

SONY®

PRODUCT DESCRIPTION MANUAL

DDS-3 Tape Drive

Model : SDT-9000

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1. INTRODUCTION

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1. INTRODUCTION

This manual provides information about the Sony SDT-9000 Digital Data Storage (DDS) Tape Drives which is necessary to integrate the drives into OEM products.

This manual describes the specifications, SCSI Interface, diagnostics, operation and installation of Sony DDS Tape Drives. This drive is:

- SDT-9000 12 to 24 GB capacity,^{*1} 1.2 to 2.4 MBytes/Second Transfer Rate,^{*2} Single-Ended, 3.5"FH

*1, *2 This is assuming 2:1 Compression ratio.

The degree of data compression attained while recording data varies according to system environment and data type.

Note: The SDT-9000 drive uses data compression to achieve high capacity and high transfer rates. Actual capacity and transfer rate depends on the source file type.

Note: The capacity ratings listed above are based on a 125 meter DDS-3 tape cassette.

The Sony SDT-9000 drive is a high capacity data storage device using 4 mm DAT (Digital Audio Tape) technology. The SDT-9000 drive achieves high data reliability through read-after-write, an additional level of Error Correction Code, and other features.

The Sony SDT-9000 drive stores data on tape using a standard format called DDS (Digital Data Storage), DDS-DC, DDS-2 and DDS-3. This format is used by numerous other DDS tape drive manufacturers, providing a broad range of compatible tape drives.

The Sony SDT-9000 is fully READ and WRITE compatible with the DDS-3, DDS-2, DDS and DDS-DC format tapes.

1.1 FEATURES OF THE DRIVE

Major features of the Sony SDT-9000 include:

- 12.0 GB capacity
(12GB to 24 GB with Data Compression) *1
 - Sustained transfer rate - 1,180 KB/sec
(approximately 1.2 MB/s to 2.4 MB/s with Data Compression) *2
- *1, *2 This is assuming 2:1 Compression ratio.
The degree of data compression attained while recording data varies according to system environment and data type.
- Supported Format: DDS-3, DDS-2, DDS , DDS-DC and DCLZ
 - Fully READ and WRITE compatible with the DDS-3, DDS-2, DDS and DDS-DC format tapes
 - Burst transfer rate
 - 5 MB/sec Asynchronous
 - 10 MB/sec Synchronous
 - Large 2 MB Buffer
 - 3 1/2 inch form factor
 - Embedded SCSI interface
 - Supports Variable or Fixed record length
 - Supports SCSI Disconnection/Arbitration
 - Read After Write (RAW)
 - Frame rewrite function
 - Three levels of Error Correction Code (ECC)
 - High Speed search (200 times normal Read/Write speed)
 - Random read
 - N-Group write option
 - Dual Partition option

1.2 REFERENCE

Please refer to the following documents for additional information:

- 8th Draft Helical-Scan Digital Computer Tape Cartridge
Digital Data Storage (DDS) Recorded Format
ANSI ASC TC X3B5 Document 90-231A²
- Proposed Final Test Unrecorded Helical-Scan Digital Computer Tape Cartridge
ANSI ASC TC X3B5 Document 92-251
- 3,81 mm Wide Magnetic Tape Cartridge For Information Interchange
Helical Scan Recording, DDS Format, June 1990
European Computer Manufacturers Association (ECMA-139)¹
- 3,81 mm Wide Magnetic Tape Cartridge For Information Interchange
Helical Scan Recording, DDS-DC Format, June 1991
European Computer Manufacturers Association (ECMA-150)¹
- Data Compression For Information Interchange
Adaptive Coding with Embedded Dictionary, DCLZ Algorithm, June 1991
European Computer Manufacturers Association (ECMA-151)¹
- 3.81mm Wide Magnetic Tape Cartridge For Information Interchange
Helical Scan Recording, DDS-2 Format Using 120m Length Tapes,
December 1993
European Computer Manufacturers Association (ECMA-198)¹
- 3.81mm Wide Magnetic Tape Cartridge For Information Interchange
Helical Scan Recording, DDS-3 Format Using 125m Length Tapes
European Computer Manufacturers Association (ECMA XXX)¹
- Designing a Data Storage Format for Digital Audio Tape (DAT)
DDS Manufacturers Group
- Small Computer System Interface (SCSI-1), ANSI X3.131-1986
The ANSI authorized standard for SCSI implementation, available through ANSI²
- Enhanced Small Computer Systems Interface (SCSI-2)
ANSI X3T9.2/86-109 (Revision 10H, or above), available through ANSI²

Note 1: Also available from: European Computer Manufacturers Association
114 Rue du Rhone - CH-1204 Geneva (Switzerland)
TEL: (41) 22-735-36-34
FAX: (41) 22-786-52-31

Note 2: Also available from: Global Engineering Documents
2805 McGaw Avenue
Irvine, CA 92714
(800) 854-7179
(714) 261-1455

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2. SPECIFICATIONS

Physical, environmental and performance specifications for the SDT-9000

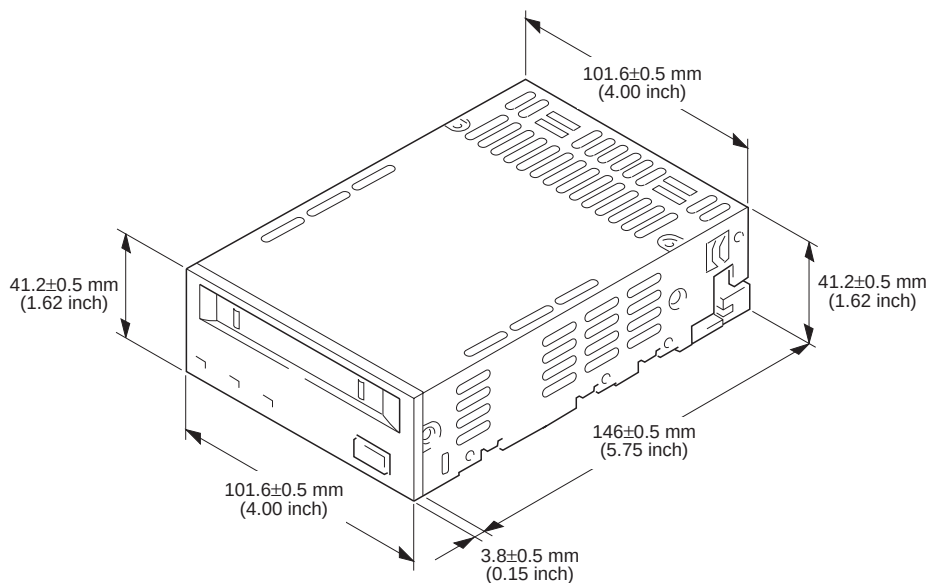
2.1 PHYSICAL SPECIFICATIONS

2.1.1 Dimensions

The SDT-9000 conforms to the 3.5 inch standard height form factor.

	SDT-9000
Height	41.2 mm (1.62 in) $\pm$ 0.5 mm (0.02 in)
Width	101.6 mm (4.0 in) $\pm$ 0.5 mm (0.02 in)
Depth	146.0 mm (5.75 in) $\pm$ 0.5 mm (0.02 in)

Note: The above dimensions do not include the front panel thickness, eject button and some projecting.

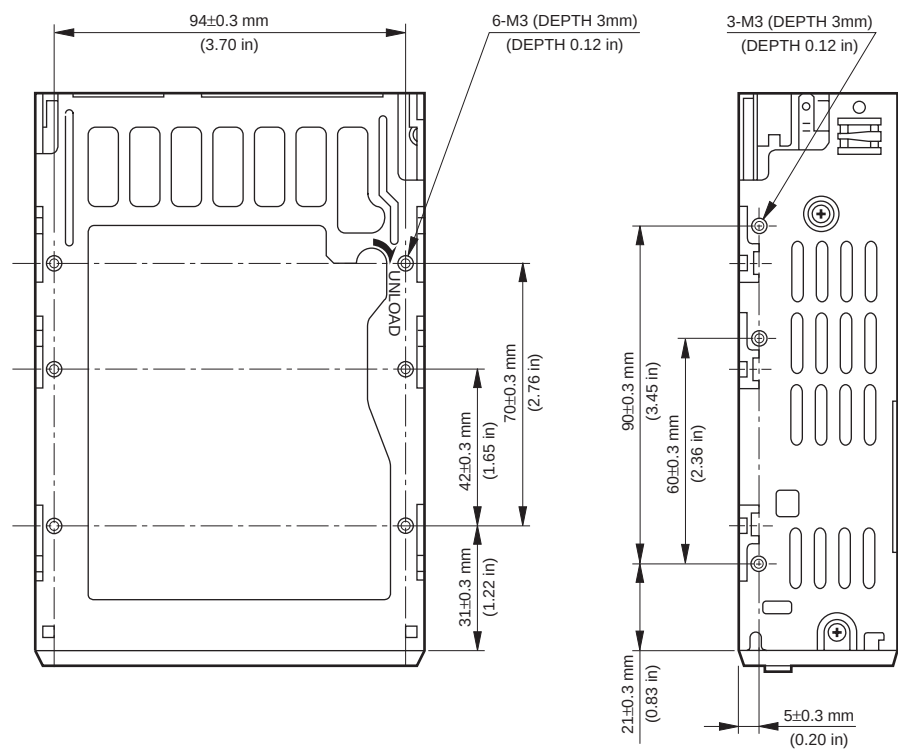


SDT-9000

Figure 2-1 Dimensions

2. 1. 1. 1 Mounting Holes

Figure 2-2 gives details of the mounting holes for the drive.



SDT-9000
Figure 2-2 Mounting Holes

Note: Mounting Screw Thread Length 2.5 mm. If the mounting screw thread length is exceeded, damage to the drive may occur.

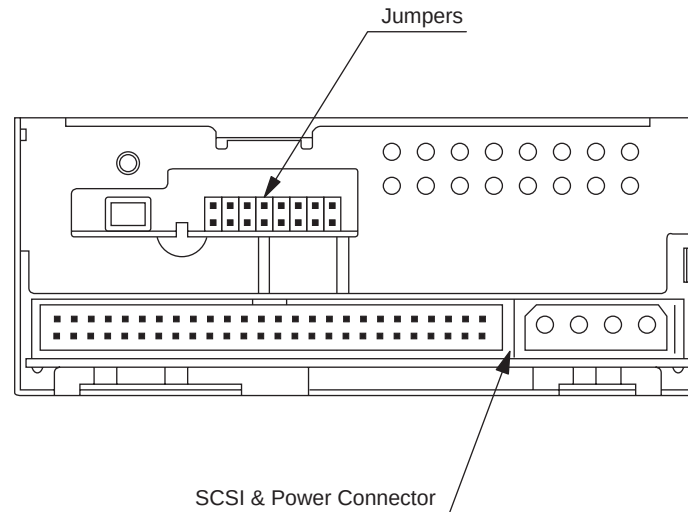
2. SPECIFICATION

2.1.2 Weight

- SDT-9000 - 620 grams (1 lb 6 oz), without a cassette

2.1.3 Connectors

The SDT-9000 has a SCSI connector with a power connector at the positions shown in Figure 2-3. All other connectors are for use by Sony's manufacturing and service facilities only.



SDT-9000

Figure 2-3 Connector Positions

2.1.3.1 SCSI Cables and Terminators

The Single-Ended SCSI configuration is supported. The hardware and termination specifications of this interface can be found in Section 4, Physical Characteristics, of the ANSI X3T9.2/86-109 Revision 10d (SCSI) Standard.

Only unshielded connectors are supported. Active (or switchable) internal termination is provided.

Possible cable and connector sources are listed below.

This does not imply that these are the only sources for SCSI accessories.

SCSI Single-Ended Unshielded:

Cable: 28 AWG Ribbon

Spectra Strip 132-2899-887 style 2697 (or equivalent)

Connector: AMP 1-746094-0 (or equivalent)

Note: When using high-speed data transfer with the SDT-9000, it is recommended that total length of the SCSI cable not exceed 3m.

2.2 ENVIRONMENTAL SPECIFICATIONS

Note: The specifications which apply when a medium is present may be different than these.

2.2.1 Temperature and Humidity Range

Temperature	
Operating:	5°C to 40°C ($\Delta T < 10^{\circ}\text{C/h}$)
Non-operating(mech):	-40°C to 70°C ($\Delta T < 20^{\circ}\text{C/h}$)
Non-operating(tape):	-40°C to 45°C ($\Delta T < 20^{\circ}\text{C/h}$)
Humidity	
Operating:	20 to 80% RH, non-condensing Maximum wet bulb temperature=26°C
Non-operating(mech):	5 to 95% RH ($\Delta \text{RH} < 30\%/h$)
Non-operating(tape):	20 to 80% RH ($\Delta \text{RH} < 30\%/h$)

2.2.2 Altitude

Operating:	0 to 2133 m (0 to 7000 feet)
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2.2.3 Dust

Operating:	Less than 150 microgram/m ³ Based Sampling period 24 hours
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2.2.4 Vibration

Operating:	Swept Sine 5 to 500 Hz @ 0.25 G Peak 1 Octave/min. 3 axis, 3 directions
Non-operating:	Swept Sine 5 to 500 Hz @ 0.5 G Peak 1 Octave/min. 3 axis, 3 directions

2.2.5 Shock

Operating:	No Data Loss Half Sine 5 G Peak 3 ms 3 axes, 3 directions Interval 10 seconds
Non-operating:	No Device Damage Half Sine 90 G Peak 3 ms (30 G Peak 11 ms) 3 axes, 3 directions

2. SPECIFICATION

2. 2. 6 Acoustic Noise

The ambient noise level is no greater than 25db (A). The sound-meter on (A) scale is located 1m in front of the center of the unit front panel.

Streaming Write/Read	35 db (A)
Insert/Eject	60 db (A)

(A): A curve weight

2. 2. 7 EMC

Radiated:	FTZ/FCC class B, VCCI-2 (Equivalent)
Conducted:	FTZ/FCC class B, VCCI-2 (Equivalent)
ESD:	Discharge Voltage Less than 15kV: No operation failure Less than 20kV: No drive damage

2. 2. 8 Orientation

The SDT-9000 can be installed in three different mounting positions as shown in the figure below. Each position has a maximum tolerance of ± 10 degrees.

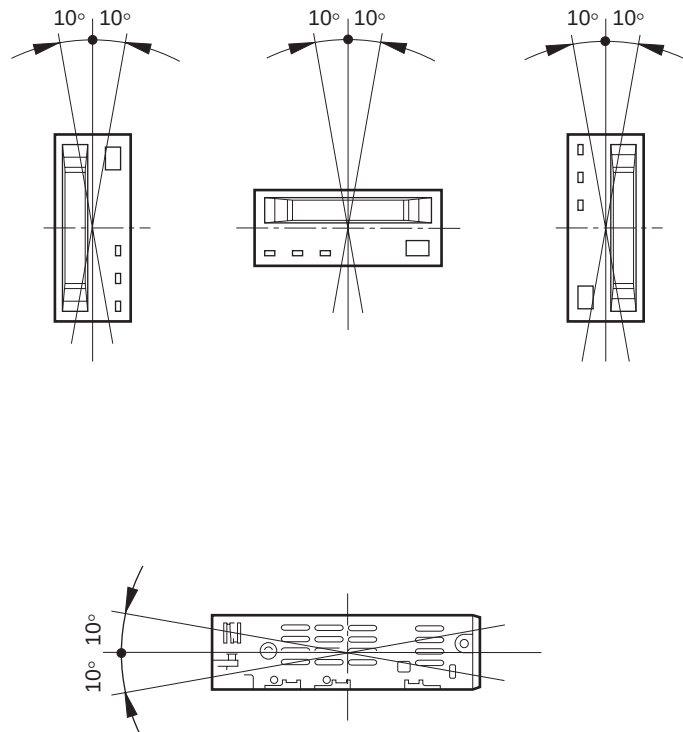


Figure 2-4 Mounting Attitude and Tolerance

2. 3 PERFORMANCE SPECIFICATION

The data capacity, data transfer rate and data reliability specifications in this chapter require the media to conform to the DDS-3 Media Specification and also require the drive and media to remain within their respective operating and non-operating environmental specifications. The specifications below also assume that the C3 ECC frame is generated on writing and used as necessary on reading, and further assumes that read-after-write rewrites are used as necessary on writing.

2. 3. 1 Data Capacity

The native (uncompressed) capacities of different length cartridges are as follows. Note that 60 m and 90 m cartridges are automatically written in DDS-1 format, only 120 m cartridges are written in DDS-2 format, and only 125 m cartridges are written in DDS-3 format.

Length	Format	Native Capacity
60 m	DDS-1	1.3 GB typical
90 m	DDS-1	2.0 GB typical
120 m	DDS-2	4.0 GB typical
125 m	DDS-3	12.0 GB typical

The SDT-9000 includes a data compression capability. When data compression is enabled that the drive capacity can increase typically twice. The efficiency of the data compression depends on the actual data that is being compressed and cannot be predicted precisely prior to compression.

2. 3. 2 Data Transfer Rate

2. 3. 2. 1 Sustained Data Transfer Rate To and From Tape

The sustained transfer rate to and from the tape is 1180 KB per second (70 megabytes per minute). For this sustained rate to be achieved, the drive must be streaming. There may be some dependency on the host for this to be achieved. When data compression is enabled the drive can achieve a transfer rate from 1.2 MBytes/s to 2.4 MBytes/s *1.

*Assuming 2:1 compression. Actual capacity and transfer rate may vary since compression is depending upon data type.

*1 This is assuming 2:1 Compression ratio.

The degree of data compression attained while recording data varies according to system environment and data type.

2. 3. 2. 2 Burst Data Transfer Rate To and From the SCSI Bus

The SDT-9000 will transmit and receive data bursts to and from the SCSI bus at a maximum burst rate of 5 megabytes per second, using SCSI asynchronous transfers and 10 megabytes per second, using SCSI synchronous transfers.

2. 3. 3 Initialize Time

Initialize Time means the period from the time the drive is powered on to the time when the drive is ready and waiting for a SCSI command such as INQUIRY or TEST UNIT READY.

Initialize Time is less than 3 seconds.

Note: The drive will respond with BUSY status until the completion of the Initialize Time.

Note: The Initialize Time does not include the time necessary for drive diagnostics to complete and the drive to become ready for tape insertion.

2. 3. 4 Load Time

2. SPECIFICATION

Load Time means the period from the time when the operator inserts a cassette into the drive to the time when the drive is ready.

Load Time is less than 24 seconds (for a single partition tape).

2.3.5 Rewind Time

Rewind Time means the period from the beginning to the end of rewinding sequence. This value depends on the tape length and the position of the head along the tape.

Rewind Time is less than 80 seconds, when a 125 meter tape is loaded.

2.3.6 Search Time

Search Time means the period for the drive to find the position that is required by a command. This time also depends on the tape length and the position of the head along the tape.

Search Time is less than 45 seconds, when a 125 meter tape is loaded.

2.3.7 Unload Time

Unload Time means the period from the beginning of the unload sequence caused by Unload Command or Eject button to the time when a cassette is ejected from the slot.

Unload Time does not include Rewind time.

Unload Time is less than 20 seconds (for a single partition tape).

2.3.8 Error Rate

The uncorrectable bit error rate is expected to be less than 10^{-15} . For further details, refer to “Designing a Data Storage Format for Digital Audio Tape (DAT)”, produced by the DDS Manufacturers Group.

2.3.9 Retry Limits on Rewrites

For Read-After-Write error correction, each frame can be rewritten up to a maximum of 127 times giving 128 writes of the frame. With N-Group writing, where every group is written a fixed number of times, the upper limit is 8.

N-Group writing is not supported by DDS-3.

2.3.10 Definition of Failure

A failure is defined as any permanent malfunction of the drive that prevents the user from retrieving data from tape. This includes failure to power up, failure to unload or eject a cassette, or failure to write and read data to and from the tape, providing that both the drive and tape are being used within specification.

Faults are not considered failures when they are related to operator error, mishandling and abuse, system-related faults (cabling problems, unsupported systems, operating software, and so on), no trouble found, and transportation damage.

2.3.11 Mean Time Between Failures

The Mean Time Between Failures (MTBF) for the SDT-9000 is 200,000 power-on hours, assuming a duty cycle of 20%, where:

$$\text{Duty cycle} = \frac{\text{Tape Motion Time}}{\text{Power-on Time}} \times 100$$

12.5% is assumed as a typical usage level.

2.3.12 Mean Time To Repair

The Mean Time To Repair (MTTR) of the SDT-9000 is 30 minutes. Since at the field level the entire drive is considered a Field Replaceable Unit (FRU) the time to replace the drive with a new one is less than 30 minutes.

2.3.13 Component Life

2. SPECIFICATION

The specified life of the SDT-9000 is 8 years average.
The usage model for this specification is as follows.
3 hours tape pulling time per day
6 days usage per week
The SDT-9000 is equivalent to 7,500 hours tape-pulling life.

2. 3. 14 Durability

The durability of the components in the SDT-9000 will exceed the number of operations listed on the following table:

Start/Stop	400,000 times
Reposition	3,000,000 times
Thread/Unthread	10,000 times
Load/Eject	10,000 times
2. 4 SAFETY	

- The SDT-9000 conforms to the following safety standards:
- Underwriters Laboratory, Inc.
UL 1950 Information Processing and Business Equipment (Fifth Edition)
 - Canadian Standards Association
CSA No 950 Information Processing and Business Equipment
 - TUV
EN 60950 Safety of Information Technology Equipment including Electrical
Business Equipment (First Edition)
 - CE Mark

2. 4. 1 Conditions of Acceptability

The SDT-9000 is for use only in equipment where the suitability of the combination has been determined by an appropriate certification organization (for example, Underwriters Laboratories, Inc. or the Canadian Standards Association in North America, and the British Standards Institution or Verband Deutscher Elektrotechniker in Europe).
Other considerations include the following:

1. An enclosure must be supplied to limit the operator’s access to live parts, to provide system stability, and to furnish the drive with the necessary grounding integrity.
2. The necessary voltage supplies must be provided. These supplies are Extra Low Voltage SEC for UL and CSA, or Safety Extra Low Voltage for BSI, VDE, and so on, of +5V and +12V DC.

2. 5 INSTALLATION REQUIREMENTS

2. SPECIFICATION

2.5.1 Power Requirements

SDT-9000

Voltage	Max Ripple	Current	
		Maximum	Typical (Write/Read)
5V +/-5%	100 mV p-p	2.0 A	1.0 A
12V +/-10%	100 mV p-p	0.7 A	0.21 A

Note: 12V +/-5% when updating the firmware

3. INSTALLATION

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3 INSTALLATION

3.1 INSTALLATION GUIDE

This section describes how to install the SDT-9000 into the host system. For the connector descriptions, see Chapter 2.1.3. Figure 3-1 shows the individual jumper positions.

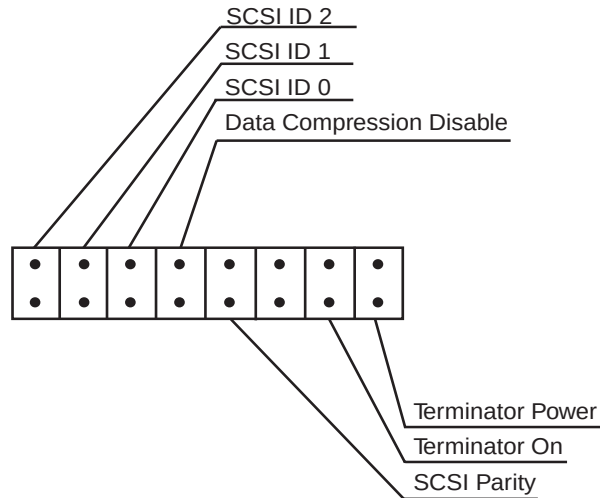


Figure 3-1: Jumper positions

3.1.1 SCSI ID Number Jumper

The SCSI ID number of the SDT-9000 is selected by the SCSI ID number jumpers. The figure below shows the jumper configuration for each of the possible SCSI IDs.

SCSI ID	2	1	0	D	P	-	R	T
0	:	:	:	*	*	*	*	*
1	:	:		*	*	*	*	*
2	:		:	*	*	*	*	*
3	:			*	*	*	*	*
4		:	:	*	*	*	*	*
5		:		*	*	*	*	*
6			:	*	*	*	*	*
7				*	*	*	*	*

: = OPEN Jumper not installed

| = CLOSED Jumper installed

Note: The factory jumper setting is for SCSI ID 0.

3.1.2 Termination Power Jumper

T jumper is used to set whether SDT-9000 provides the termination power to pin 26 on SCSI bus, or not.

Term Power	2	1	0	D	P	—	R	T
Provide Term Power	*	*	*	*	*	*	*	
Term Power Not Provided	*	*	*	*	*	*	*	:

Note: The factory jumper setting is to provide TERMPWR from the drive.

3.1.3 Termination Resistors Setting

To provide a reliable transmission line for SCSI signals, the SCSI bus needs the termination resistors at both ends. When the SDT-9000 is not connected to the end of the bus, all termination resistors must be disabled by removing a jumper.

Terminators	2	1	0	D	P	—	R	T
Terminators Enabled	*	*	*	*	*	*		*
Terminators Disabled	*	*	*	*	*	*	:	*

Note: The factory setting is for the drive to be connected to the end of the SCSI bus (Terminator Resistors are enabled)

Note: Terminator resistors are not removable. Attempting to remove the terminators may result in damage to the drive that is not covered by warranty.

3.1.4 Parity Jumper

Parity function can be selected by this Parity jumper.

SCSI Parity	2	1	0	D	P	—	R	T
Parity Enabled	*	*	*	*		*	*	*
Parity Disabled	*	*	*	*	:	*	*	*

Note: The factory setting is for parity enabled.

3. Installation

3.1.5 Data Compression Disable

After power-on reset with this jumper set, both data compression and data decompression are disabled. (DCE bit and DDE bit of MODE SENSE/SELECT Data Compression Control Page are set to 0).

D jumper is used to disable data compression of SDT-9000.

DC Disable	2	1	0	D	P	-	R	T
DC Disabled	*	*	*		*	*	*	*
DC Enabled	*	*	*	:	*	*	*	*

Note: The factory setting is for data compression enabled (SDT-9000).

Note: DCE/DDE bit can be reset and overridden by MODE SELECT command regardless of this jumper setting.

3.1.6 SCSI 50 pin Connector



Figure 3-1 Non-shielded SCSI Device Connector

Table 3-1 shows the assignments for the pins of the connector. These assignments are as defined in Table 4-1 of the SCSI specification.

For the Single Ended SCSI Interface, all odd pins, except pin 25, are connected to GROUND. Pin 25 is not connected. Pin 26 is for the power supply for the two termination resistors when they are enabled.

Signal Name	Cable Conductor Number		Signal Name
GROUND	1	2	-DB(0)
GROUND	3	4	-DB(1)
GROUND	5	6	-DB(2)
GROUND	7	8	-DB(3)
GROUND	9	10	-DB(4)
GROUND	11	12	-DB(5)
GROUND	13	14	-DB(6)
GROUND	15	16	-DB(7)
GROUND	17	18	-DB(P)
GROUND	19	20	GROUND
GROUND	21	22	GROUND
RESERVED	23	24	RESERVED
OPEN	25	26	TERMPWR
RESERVED	27	28	RESERVED
GROUND	29	30	GROUND
GROUND	31	32	-ATN
GROUND	33	34	GROUND
GROUND	35	36	-BSY
GROUND	37	38	-ACK
GROUND	39	40	-RST
GROUND	41	42	-MSG
GROUND	43	44	-SEL
GROUND	45	46	-C/D
GROUND	47	48	-REQ
GROUND	49	50	-I/O

Table 3-1: Single-Ended SCSI

3. 1. 7 Power Connector

For the power requirements, see Chapter 2.

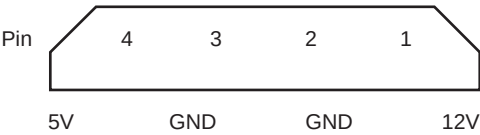


Figure 3-2 Power Connector

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4 OPERATION

4.1 SUMMARY OF LED INDICATIONS

The SDT-9000 LEDs have five (5) different methods of reporting the current status/operation of the drive:

LED function	Meaning
Off	Not active
On	Activity
Flashing-1	Drive Activity
Flashing-2	Warning
Flash code 1, 2	Failure

Table 4-1: Possible LED indication meanings

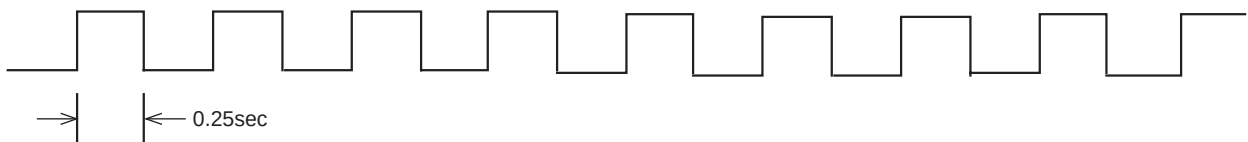
The following table shows the meaning of each of the possible combinations of LED indications:

LED	Busy	Tape	Status
Off	Not Busy	Unloaded	
On	SCSI active	Loaded	Write Protected
Flashing-1	Drive active	Loading/Unloading	Cleaning Tape at EOM
Flashing-2		Error Rate Warning	Cleaning Request
Flash code 1	Waiting for Reset	Waiting for Eject	
Flash code 2		Illegal FW Tape	Selftest Failure

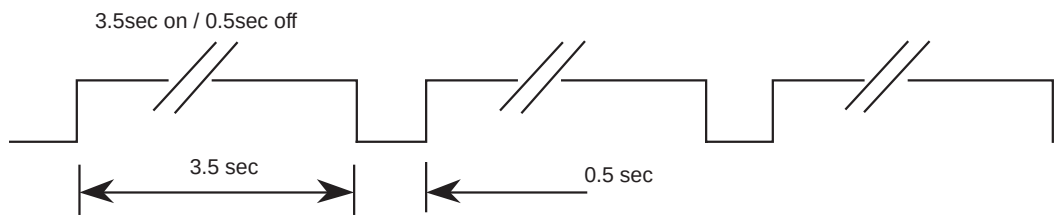
Table 4-2: Meaning of each LED indications

Flashing-1

0.25sec on / 0.25sec off



Flashing-2

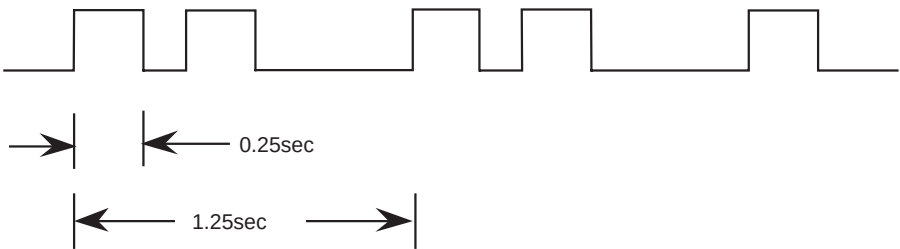


Flash Code LED Indication:

Flash code 1 (one pulse)



Flash code 2 (two pulses)



The following table shows the LED indication for each drive status/condition:

STATE			LED		
Activity	Cartridge	Other	Busy	Tape	Status
None	None	None	off	off	off
SCSI	None	None	on	off	off
Drive	Loading/Unloading	None	Flashing-1	Flashing-1	off
Drive	Loading/Unloading	Write Protected	Flashing-1	Flashing-1	on
None	Loaded	Cleaning Tape at EOM	off	on	Flashing-1
None	Loaded	None	off	on	off
SCSI	Loaded	None	on	on	off
SCSI/Drive	Loaded	None	Flashing-1	on	off
*	Loaded	Write Protected	*	on	on
*	Loaded	Error Rate Warning	*	Flashing-2	
*	*	Cleaning Request	*	*	Flashing-2
*	*	Selftest Failure	*	*	Flash code 2
*	*	Waiting for Reset	Flash code 1	*	*
*	*	Waiting for Eject	*	Flash code 1	*
		Illegal FW Tape	*	Flash code 2	*
		Front Panel Test		See 4.3.5.1	

Table 4-3: LEDs indications for each state

4.2 OPERATOR ACTION

4.2.1 Powering up the SDT-9000

After the initial installation of the SDT-9000 has been verified, power can be applied to the unit. The +12V and +5V power must be applied simultaneously. The SDT-9000 will execute a power-up diagnostic and then comes ready. Once the tape has been loaded the SDT-9000 sends a CHECK CONDITION response on receipt of the next SCSI command from the host. The UNIT ATTENTION key is set in the returned REQUEST SENSE data to indicate that the tape may have been changed. (Sense Key/ASC/ASCQ = 06/28/00)

4.2.2 Inserting Cassettes

The operator inserts a cassette into the slot on the front panel with the arrow on the cassette pointing towards the drive. As the cassette is inserted, the drive takes it and automatically loads it into the drive mechanism. The SDT-9000 performs a tape load sequence as described in section 4.3.1.

4.2.3 Removing Cassettes

The cassette can be removed from the SDT-9000 either in response to a SCSI UNLOAD command, or by pressing the Eject button.

The operator uses the Eject button to initiate the unload sequence (see section 4.3.2). The mechanism winds the tape to Beginning of Media (BOM), unthreads it, and ejects the cassette from the slot.

Note: Operation of the Eject button is disabled if the host has previously sent a SCSI PREVENT ALLOW MEDIA REMOVAL command with prevent bit set to one. In this case, pressing the Eject button has no effect, and does not initiate an Unload sequence. The Eject button returns to normal operation following receipt of a PREVENT ALLOW MEDIA REMOVAL command with prevent bit clear.

4.2.4 Write-Protecting Cassettes

Cassettes can be write-protected by sliding the tab on the back of the cassette open. In this state, data can be read from the tape but not written to it.

When a Write Protected tape is loaded in the drive the Tape and Status LEDs will be lit. The Busy LED will indicate any activity on the SCSI bus or mechanical motions in the drive itself.

Caution: The Tape Log, which contains a history of usage of the tape, will not be updated when the cassette is write-protected. It follows that the Tape Log becomes inaccurate if a cassette is used write-protected, and the media warning cannot be relied on to indicate that the cassette needs to be copied and replaced.

4.3 INTERNAL FUNCTION

4.3.1 The Load Sequence

During load sequence, the following occurs:

1. The drive mechanism accepts the cassette, threads the tape and rewinds to Beginning-of-Media (BOM). The tape is then moved to Beginning-of-Tape (BOT) and the Reference area is checked to find the tape format (DDS-3, DDS-2, DDS and DDS-DC, blank, audio, and so on). If the format is not DDS-3, DDS-2, DDS and DDS-DC, the drive rewinds the tape to BOT and awaits either a WRITE, Partitioning MODE SELECT or an UNLOAD command.
2. The System area is then accessed and the System log read into the drive.
3. Finally the drive goes online.

In the case of two partition tape the drive detects that the tape has been formatted as a two partition tape when the Reference Area is read. The drive will then automatically position to the beginning of partition 0 before coming on-line. Partition 0 is the partition that begins the furthest from BOM.

4.3.2 The Unload Sequence

The drive will always write any buffered data out to tape followed by an EOD prior to initiating the Unload sequence. During this sequence the tape is rewound to BOT and, if the tape is write-enabled, the copy of the tape log held in RAM is written back to tape. The tape is then rewound to BOM and the tape unthreaded from the mechanism. At this stage the tape is either retained in the drive or ejected, depending on media removal is enabled by the PREVENT ALLOW MEDIA REMOVAL command.

In the case of two partition tape the drive detects that the tape has been formatted as a two partition tape when the Reference Area is read during the load sequence. When the Unload operation begins the drive will then automatically update the Tape Log for each partition before unloading the tape.

4.3.3 Power-Fail Handling

If there is a power-fail, the SDT-9000 performs the following actions, and reverts to its default configuration:

1. The drive remains positioned at the point where the power-fail or SCSI Reset occurred.
2. It executes the Power-Up sequence of self-tests. (When power is restored.)
3. If a tape is in the drive, the SDT-9000 starts a load sequence.
The drive rewinds the tape to BOT and remains on-line.
4. The drive returns CHECK CONDITION status for the first command after the power-fail or Reset. The next command from the initiator should be a REQUEST SENSE. The drive will return sense data including a sense key that will indicate that the drive has been reset. (Sense Key / ASC / ASCQ = 06/29/00)

4.3.4 Diagnostic and Normal Status Displays

This chapter describes LED displays while the SDT-9000 is starting up. When power is turned on, the SDT-9000 will go through its diagnostics to reach normal status. When a failure is detected during diagnostics, the LEDs show that the SDT-9000 is out of order and needs to be repaired.

4.3.4.1 Diagnostic Status Display

The SDT-9000 starts with its Diagnostic function. This is made up of the Front Panel Test and the Kernel Test.

4. OPERATION

4.3.4.1.1 Front Panel Test

LED display sequence:

	<u>Busy</u>	<u>Tape</u>	<u>Status</u>	
0.25 sec	on	on	on	Front Panel Test
0.25 sec	-	-	-	
0.25 sec	on	on	on	
0.25 sec	-	-	-	
0.25 sec	on	-	-	
0.25 sec	-	on	-	
0.25 sec	-	-	on	repeat until end of Power On Diagnostic
0.25 sec	on	-	-	
0.25 sec	-	on	-	
0.25 sec	-	-	on	
0.25 sec	on	-	-	
0.25 sec	-	on	-	
0.25 sec	-	-	on	

Note: This function is for checking BUSY, STATUS and TAPE LEDs and the related circuits. No errors can be generated as this test is only for operator verification of indicator operation.

4.3.4.1.2 Kernel Test

After the Front Panel Test, the SDT-9000 checks its internal units.

Note: If a failure is detected, the SDT-9000 displays the Failed Unit. Refer to section 4.3.4.

When a Diagnostic error occurs, the SDT-9000 must be powered off. The SDT-9000 will not work and should be checked or repaired immediately.

Note: The purpose of the diagnostic firmware is to test the SDT-9000 electronics for functionality. If the diagnostic request comes from the host through SCSI, then the results are reported through SCSI.

If the electronics are not functioning, the diagnostic firmware tries to isolate the non-functional area to a specific Failed Unit. Given a failure, the firmware decides on an hierarchical basis which Unit to designate as the Most Suspect Failed Unit (MSFU). The confidence in this decision is intended to be 95%. The MSFU is identified and displayed on the front panel as shown above section 4.3.4. For the details of Diagnostics, see section 7.

4. OPERATION

4.3.4.2 Normal Status Display

After the Diagnostic Display, when no failures are detected, the SDT-9000 is in the Normal Status. The LEDs show various Normal Status (No Error) indications as shown in the table below:

STATE			LED		
Activity	Cartridge	Other	Busy	Tape	Status
None	None	None	off	off	off
SCSI	None	None	on	off	off
Drive	Loading/Unloading	None	Flashing-1	Flashing-1	off
Drive	Loading/Unloading	Write Protected	Flashing-1	Flashing-1	on
None	Loaded	Cleaning Tape at EOM	off	on	Flashing-1
None	Loaded	None	off	on	off
SCSI	Loaded	None	on	on	off
SCSI/Drive	Loaded	None	Flashing-1	on	off
*	Loaded	Write Protected	*	on	on

Table 4-4: Normal LED indications

4.3.4.3 Media Warning

When a Media Warning threshold is exceeded the drive will indicate that the tape is bad by flashing the Tape LED. The indicator will be on for 3.5 seconds, off for 0.5 seconds. The Busy and Status LEDs will operate normally.

If this occurs, the data on the cassette should be copied onto a new one and the old cassette discarded.

This status is cleared by unloading the cassette.

The Media Warning is displayed if any of the following conditions are met:

- More than 1 RAW rewrite per 4 groups written
- More than 1 read retry per 512 groups read
- More than 1 ECC C3 error correction per 128 groups read

Note: Media warning is calculated as an average value of 1024 groups of data (either Read or Write) 1024 Groups of data is approximately 390 MB.

4.4 TAPE FORMAT

The SDT-9000 is an implementation of the Digital Data Storage (DDS) format, a standard developed by Sony and Hewlett-Packard for 4mm data storage drives. It incorporates the error correction techniques used in DAT audio drives with additional techniques specifically designed to provide the optimum level of data integrity. These extra methods of error detection and correction are:

- C3 ECC, third level Error Correction Code, providing correction across frames within groups
- Read-After-Write, where data is verified immediately after it is written and re-written if there is any error.
- N-Group Writing, where every group is repeated a set number of times.
- Randomizer, to reduce inter-symbol interference.
- Track checksums, to detect and locate helical errors, thereby improving the performance of C3 ECC.

4.4.1 Tape Partitions

Tapes can be formatted as a single data space or as two partitions. With two partitions, each has the same structure and can be written independently. So, for example, the partition further from BOM (Partition 0) can contain data files, and the partition closer to BOM (Partition 1) could contain a directory of these files, written later.

With the exception of the Device area on the tape, each partition of a 2-partition tape is identical to a single data space tape in structure. This means each partition has its own Tape Log area; this is necessary because the patterns of usage may be very different for each partition. Similarly, each has its own Vendor Group, because the partitions might be written by different drives.

4.4.1.1 Formatting Partitions

The SCSI MODE SELECT command is used to create partitions on a tape. The command can perform the following operations:

- Set up two partitions on a blank tape.
- Convert a single data space tape to a 2-partition tape.
- Convert a 2-partition tape to a single data space tape.
- Change the size of both partitions on a 2-partition tape.
- Resize the partitions of a 2-partition.

Note: Formatting is not needed for single partition operation.

The MODE SELECT, Medium Partitions Parameters Page (11h) is used to Format the tape.

MODE SELECT, Device Configuration Page (10h) is used to change from one partition to another, see the MODE SELECT Command description in the SCSI command section of this manual. The LOCATE Command also has the capability to select a partition prior to positioning.

Any data on the tape before the format pass becomes inaccessible, even if the format pass is intended only to change the size of the two partitions. The Tape Logs are also destroyed and new logs created.

If you do not format a new tape, it will be organized as a single data space tape. After data has been written to it, whether it was first initialized or not, a format pass is necessary to alter its characteristics and hence how it is handled by the tape drive system.

Note: The format operation can be very time consuming depending on the requested size of the first partition on the tape. The amount of time required can be approximated by use of the following formula:

- Number of Megabytes in Partition 1 x 0.02 = number of minutes required
- Add 22 additional seconds for processing overhead

4.5 MAINTENANCE, TROUBLESHOOTING AND SERVICE

4.5.1 Head Cleaning

The SDT-9000 has a built-in head cleaner designed to last for the life of the drive. In addition, a cleaning tape should be used periodically to clean the entire tape path.

The drive will automatically request that the user perform a cleaning operation (described below). The need for a cleaning is determined by the length of time that the drum has been rotating since the last cleaning was performed. The drive will request a cleaning cycle after every 24 hours of drum rotation.

The Cleaning Request is indicated by the Status LED flashing:

- on for 3.5 seconds
- off for 0.5 seconds

4.5.2 Troubleshooting Guide

Problems encountered while operating the Sony SDT-9000 tape drive fall into two categories: Operational problems and Read/Write problems.

Operational problems include any conditions that prevent the tape drive from operating. Operational problems usually are discovered the first time the drive is installed on a system or when the system configuration is changed or physically moved.

Read/Write problems include conditions that effect the transfer of data to and from the tape drive. Commands such as REWIND, REQUEST SENSE and UNLOAD perform normally but data transfers fail.

The following sections describe the recommended procedures for solving operational and read/write problems.

4.5.2.1 Operational Problems

1. The tape drive will not accept a tape cartridge.

Withdraw the tape cassette and turn the power to drive off, wait 5 seconds, then back on. Observe the drive for a normal power up sequence (See Section 4.3.4).

If the LEDs do not light, check the power supply and power cable connection. If the drive completes the power on sequence normally but still won't accept the tape cassette, the drive may be defective.

A tape may already be in the drive. Tape LED is on. Press EJECT to remove the first tape.

The power has been removed from the drive with a tape loaded. When the power is restored to the drive, it will detect the tape and rewind the tape to BOT. Press EJECT to remove the cassette.

2. A tape is in the drive and will not eject.

If the SCSI command PREVENT ALLOW MEDIA REMOVAL (with Prevent bit set to one) has been sent to the drive, the cartridge will be retained in the drive even after an UNLOAD command. The EJECT button is also disabled. Send an PREVENT ALLOW MEDIA REMOVAL (with prevent bit clear) command, issue a SCSI bus reset, or power the drive off and back on to override this condition.

4. OPERATION

If Tape is still in the drive after following the above procedure.

The drive has a serious problem and should be returned to Sony for repair with the tape in place.

Note: If it is absolutely mandatory that the tape cassette be removed prior to returning the drive for repair the following Emergency Cassette Removal procedure should be followed.

Caution: This procedure should only be attempted by a mechanically qualified person and will probably result in the tape being unusable. Do not proceed if further damage to the tape drive would be done.

Emergency Cassette Removal Procedure

1. Remove the drive from the chassis or enclosure to allow access to the bottom and left side of the drive.
2. Remove the drive's top cover.
3. Locate the small opening in the bottom of the drive and insert the tip of a small screwdriver so that the Loading/Threading motor shaft can be rotated.
4. Rotate the motor shaft clockwise to bring the threading mechanism back to the initial position.
5. Before continuing the manual eject procedure, tape slack must be removed in order to prevent tape damage. Repeatedly press the ratchet mechanism located on the left side of the drive to tighten the tape.
6. After the tape slack has been removed, continue to turn the motor shaft clockwise until the tape is lifted out of the drive mechanism and is ejected.
7. Return the drive to Sony for repair.

The following figure shows the drive access points for the Emergency Cassette Removal Procedure:

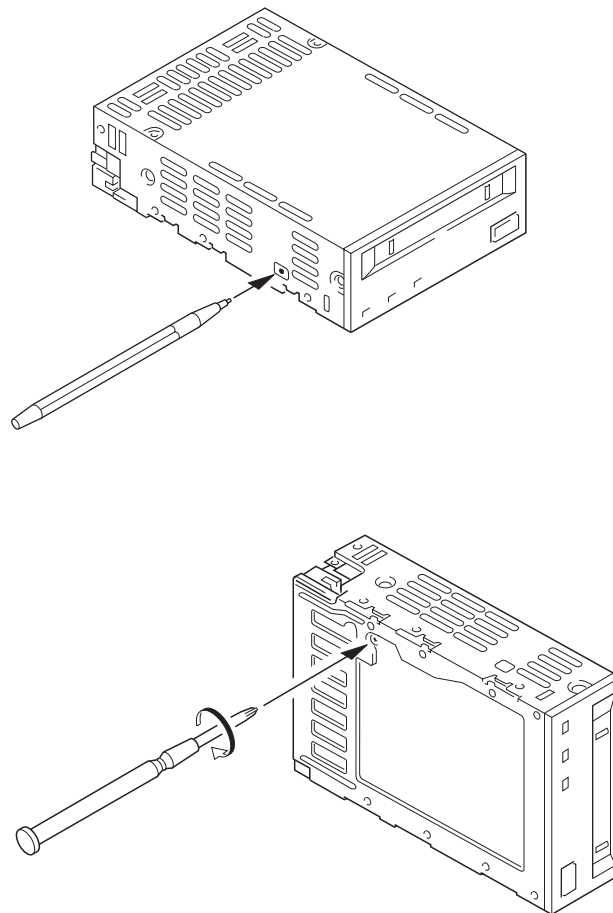


Figure 4-1: Emergency Tape Removal Procedure

3. The drive powers up properly and loads and unloads tapes but will not respond to any SCSI commands.
 - A. If SCSI bus reset does not cause the drive to reset (same as power-on self test):
 - Check the SCSI cable connectors
 - Check SCSI cable pin one is aligned with the SCSI connector pin one
 - Check for a broken cable or defective connector
 - Try another known good SCSI device in the same location.
 - B. If SCSI bus reset causes the drive to reset then the problem is with the SCSI bus addressing or termination.
 - Check that the SCSI bus ID jumper is set for the proper address
(See Section 3.1.1.)
 - Check SCSI bus termination
The two SCSI devices at the ends of the bus should be terminated
No other units should have terminators installed
- Note:** The strength of the SCSI bus signals can be affected if too many terminators are installed (Signal drivers can be damaged as well)

4. 5. 2. 2 Read/Write Problems

To prevent read/write errors, follow the cleaning recommendation in section 4.5.

If a read/write error occurs, a combination of the following steps should correct the problem.

- Remove the tape.
- Clean the drive with the DDS cleaning cartridge.
- Load a new tape in the drive.
- Retry the operation.

Note: If these steps do not correct the problem the drive may be defective and should be returned to Sony for service.

4. 5. 3 Clearance for Service

All servicing is performed only after removal of the SDT-9000 from its mounting.

It is recommended that in mounting the drive into a chassis provisions should be made to allow easy access to the mounting screws (see Figure 2-2).

4. 5. 4 Packaging for Return to Sony

The drive should be returned in its original packaging.

Sony will not take responsibility for shipping damage caused to an improperly packaged drive.

4.6 DATA COMPRESSION

The tape capacity is increased by compressing data prior to writing it to the tape. Data compression is a well established technology for reducing the number of bits used to represent data in order to improve data transfer rate as well as reduce the amount of storage space consumed by the data.

The SDT-9000 uses the AHA 3210 Data Compression IC from Advanced Hardware Architectures. This chip provides a powerful data compression algorithm in a very small package. The data compression used by the chip is the DCLZ algorithm. DCLZ has been standardized (or is in the process of standardization) with the ANSI, ECMA and ISO standards organizations. The DDS Manufacturers Group (made up of representatives from active DDS Format Licensees) has agreed upon the DCLZ algorithm as the standard data compression algorithm for data interchange between DDS format drives.

The DC control page allows the host computer to enable data compression and also configure the way in which the drive responds to compressed/uncompressed data boundaries on the tape.

Note: The DDS format allows both compressed and uncompressed data to reside on the same tape.

SDT-9000 has a jumper plug to disable the Data Compression.

After power-on reset with this jumper set, data compression is disabled. However, a MODE SELECT command can override the setting of this jumper.

After power-on reset without this jumper set, both data compression and data decompression are enabled. (See 3.1.5)

The more random the data is, the less compression is possible. This is due to the fact that data compression operates on the principle of reducing the redundancy in the data string and random data has very little redundancy.

Data compression is a very powerful and reliable method increasing data capacity and transfer rate without compromising data reliability.

5. SCSI INTERFACE

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5. SCSI INTERFACE

5.1 INTRODUCTION

The SDT-9000 uses the SCSI interface to connect to the host system.

The Small Computer System Interface (SCSI) is an industry standard interface, approved by the American National Standards Institute (ANSI). It is recommended that this document be used along with the ANSI standard document. The ANSI specification defines the interface in general while this document describes the specific implementation for this unit.

The SCSI documents, listed in detail in section 1.2, offer the information required to integrate this unit with SCSI-compatible computer systems.

This section is divided into four sub-sections:

- Introduction
- SCSI Bus Operation
- SCSI Messages
- SCSI Status

Note: The details of each SCSI Command are covered in section 6.

The Introduction provides general, high-level information. For the hardware description and the installation requirements, see section 2.

The SCSI protocol supported by the unit are covered in the Bus Operation, Message, and Status sections.

5.1.1 Overview of the SCSI Interface

The SCSI implementation provides the unit with a standard set of features and functions. These include:

- Asynchronous and Synchronous communication modes
- Single-ended / Differential Configurations
- Full implementation of Mandatory commands
- Implementation of most sequential non-Mandatory commands
- Internal active termination resistors

Note: These terminators do not have to be removed from the drive in order to be disabled. A jumper position is used for this function. Terminator power can be supplied by the drive.

5.1.2 Supported Messages

The following messages are supported: (alphabetic order)

- * Abort
- * Bus Device Reset
- * Command Complete
- * Disconnect
- * Extended Message - Synchronous Data Transfer Request
- * Identify (w/ & w/o disconnect)
- * Initiator Detected Error
- * Message Parity Error
- * Message Reject
- * No Operation
- * Restore Pointers
- * Save Data Pointer

For implementation details on these messages, see the Message Specification section.

5. 1. 3 Supported and Unsupported Commands

The following commands are supported. They include all Mandatory and Extended commands, most Optional commands.

Command Name	Operation Code
ERASE	19h
INQUIRY	12h
LOAD/UNLOAD	1Bh
LOCATE	2Bh
LOG SELECT	4Ch
LOG SENSE	4Dh
MODE SELECT(6)	15h
MODE SENSE(6)	1Ah
PREVENT ALLOW MEDIUM REMOVAL	1Eh
READ	08h
READ BLOCK LIMITS	05h
READ BUFFER	3Ch
READ POSITION	34h
RECEIVE DIAGNOSTIC RESULTS	1Ch
RELEASE UNIT	17h
REQUEST BLOCK ADDRESS	02h
REQUEST SENSE	03h
RESERVE UNIT	16h
REWIND	01h
SEEK BLOCK	0Ch
SEND DIAGNOSTIC	1Dh
SPACE	11h
TEST UNIT READY	00h
VERIFY	13h
WRITE	0Ah
WRITE BUFFER	3Bh
WRITE FILEMARKS	10h

Table 5-1: Supported SCSI Commands

For implementation details on these commands, see the Command section.

The following Optional commands are NOT supported.

- CHANGE DEFINITION
- COMPARE
- COPY AND VERIFY
- 10 byte MODE SENSE & MODE SELECT
- READ REVERSE
- TRACK SELECT (SCSI-1 optional command, not applicable to the SDT-9000)

5.2 SCSI BUS OPERATION

5.2.1 Typical SCSI Operation

This example describes the typical SCSI bus sequence between the host and the drive.

1. After waiting for the bus clear time the Host arbitrates for the SCSI bus. It does this by asserting BSY and the data line corresponding to its bus ID. If any other devices wish to compete for the bus, they also assert BSY and the appropriate data line. Each arbitrating device then inspects the data bus. The device with the highest ID wins the bus. All the other devices must release BSY and their data lines.
2. The Host attempts to select the target by asserting SEL and releasing BSY. The Host maintains its ID and asserts the target's ID on the data bus. Each target then checks the data lines. If the target's ID matches that on the data bus, it accepts selection by asserting BSY. Once the Host has detected BSY being asserted, it asserts ATN to indicate that it wants the target to go to the MESSAGE OUT phase. The Host releases SEL.
3. The target now has control of the SCSI bus and it is the target which switches between phases. The target responds to the ATTENTION condition and initiates the MESSAGE OUT phase. The Host sends an IDENTIFY message which tells the target which logical unit the Host wishes to talk to. The fact that the target responds to the ATN indicates to the Host that the target can accommodate more than just a COMMAND COMPLETE message.
4. The target initiates the COMMAND phase and transfers the Command Descriptor Block from the Host. In the COMMAND phase, the target decodes the command and either executes the command (TEST UNIT READY) or sets itself up for a data transfer to the Host (READ, WRITE, INQUIRY etc.). The target then either switches to the STATUS phase, if the command is complete, or if it is ready to transfer data, the DATA phase.
5. The data transfer length is set by the Host in the Command Descriptor Block. The target will remain in the DATA phase until all the data is transferred.
6. The target then initiates a STATUS phase and transfers one byte to the Host to indicate whether the target has successfully completed the command. If the target has detected an error, the next command that the Host is expected to send is REQUEST SENSE. This allows the target to return further status information to the Host.
7. The target completes the SCSI sequence by going to the MESSAGE IN phase and transferring a COMMAND COMPLETE message to the Host. The target then releases BSY allowing the bus to go to the BUS FREE state.

5.2.2 Disconnect

In order to improve bus usage and performance, the unit is capable of temporarily disconnecting from the bus, consequently allowing other initiator-target communications to take place. To do so, however, the Host needs to support Disconnect/Reselect. The mechanism for performing the Disconnect/Reselect procedure is implemented as follows:

1. The Host arbitrates for the SCSI bus and upon winning the bus it proceeds to select target device. Prior to releasing SEL and completing the selection phase, the Host asserts the ATN line. The Host then releases SEL and BSY to allow the target to assume control of the SCSI bus. By asserting ATN, the host indicates that the target should go to a MESSAGE OUT phase.
2. At this point, the target responds to the Host ATTENTION condition by initiating a MESSAGE OUT phase and receiving a message from the Host which tells it whether or not the Host allows Disconnects for the desired logical unit on the target.
3. If the Host does not send an Identify message, the target assumes that Disconnects are not permitted.
4. The I/O activity from this point is controlled entirely by the target. The target initiates the COMMAND phase and reads in the Command Descriptor Block (CDB) from the Host. If the Host has sent an Identify message with the Disconnect permission bit set, then the target will immediately disconnect from the bus after the entire CDB has been received.
5. The Disconnect process occurs when the target initiates a MESSAGE IN phase and sends a DISCONNECT message back to the Host. This message may be preceded by a SAVE DATA POINTERS message byte if the Disconnect is performed in the middle of the DATA phase. Following the MESSAGE IN phase, the target frees the bus by releasing the BSY.

6. The host now waits for the target to perform Reselection. When ready, the target reselects the Host and sends an Identify message via a MESSAGE IN phase, indicating the specific logical unit with which the subsequent communications are to take place. Usually, the target will proceed from the MESSAGE IN phase to either a DATA or a STATUS phase. If the Host had been previously told to SAVE DATA POINTERS, then the target's Identify message implies that the Host restores its data pointers upon reselection; in other words, it is not necessary for the target to send a specific RESTORE DATA POINTERS to the Host in such context.
7. When doing a large data transfer, the target may choose to divide the entire transfer into several smaller transfers. This allows the target to free the SCSI bus whenever it needs to perform its own system tasks not immediately related to the actual data transfer over the SCSI bus. The target will not lock the bus into the DATA phase if it is not presently ready to efficiently execute the transfer.
After the data transfer is completed, the target enters a STATUS phase and sends a single status byte to the Host. It then proceeds to a MESSAGE IN phase, during which the target sends a COMMAND COMPLETE message. Finally, the target frees the bus and the current command is considered completed.
8. The Host may change Disconnect permission at any time after the SELECTION phase by asserting ATN and sending an Identify message via a MESSAGE OUT phase. If the Host, however, performs this action during a DATA phase, it is possible that the target will not notice the change in Disconnect permission status until past the end of the current bus phase.

5.3 MESSAGE SPECIFICATION

This section includes all SCSI messages. Both supported and non-supported messages are listed. Elements of this section come from section 5, Logical Characteristics, of the SCSI standard.

The message system allows communication between an initiator and a target for the purpose of physical path management. The table below lists the Messages supported by the SDT-9000.

Code	Description	Direction	
		In	Out
00	COMMAND COMPLETE	*	
01	EXTENDED MESSAGE (Note 1)	*	*
02	SAVE DATA POINTER	*	
03	RESTORE POINTERS	*	
04	DISCONNECT	*	
05	INITIATOR DETECTED ERROR		*
06	ABORT		*
07	MESSAGE REJECT	*	*
08	NO OPERATION		*
09	MESSAGE PARITY ERROR		*
0C	BUS DEVICE RESET		*
80- FF	IDENTIFY	*	*

Table 5-2: Message Descriptions

Note: The SDT-9000 supports the Synchronous Data Transfer Request Extended Message.

5.3.1 COMMAND COMPLETE (00h)

This message is sent from a target to an initiator to indicate that the execution of a command has completed and valid status has been sent to the initiator. After successfully sending this message, the target goes to the BUS FREE phase by releasing BSY.

When received as a target, it will be handled as an illegal message, the unit will return MESSAGE REJECT and will continue.

5.3.2 EXTENDED MESSAGE (01h)

This is sent by either the initiator or the target as the first byte of a multiple-byte message.

The unit will not initiate any Extended Messages.

No Vendor Unique codes are implemented and only the Synchronous Data Transfer Request code is supported. Any other message code is handled as an illegal message; the unit will return MESSAGE REJECT and will continue.

A Synchronous Data Transfer Request message has the following format:

Byte	Value	Description
0	01h	Extended message
1	03h	Extended message length
2	01h	SYNCHRONOUS DATA TRANSFER REQUEST code
3	m	Transfer period (m times 4 nanoseconds)
4	x	REQ/ACK offset

Table 5-3: Synchronous Data Transfer Request

A SYNCHRONOUS DATA TRANSFER REQUEST (SDTR) message exchange shall be initiated by an SCSI device whenever a previously-arranged data transfer agreement may have become invalid. The agreement becomes invalid after any condition which may leave the data transfer agreement in an indeterminate state such as:

- (1) after a hard reset condition
- (2) after a BUS DEVICE RESET message and
- (3) after a power cycle.

In addition, an SCSI device may initiate an SDTR message exchange whenever it is appropriate to negotiate a new data transfer agreement (either synchronous or asynchronous). SCSI devices that are capable of synchronous data transfers shall not respond to an SDTR message with a MESSAGE REJECT message.

The SDTR message exchange establishes the permissible transfer periods and the REQ/ACK offsets for all logical units and target routines on the two devices. This agreement only applies to data phases.

Transfer period: is the minimum time allowed between leading edges of successive REQ pulses and of successive ACK pulses. The SDT-9000 supports the following transfer periods:

Transfer Period	100	200	250	300	350	400	450	500
Transfer Rate (MB/sec)	10.00	5.00	4.00	3.33	2.86	2.50	2.22	2.00

Table 5-4: Synchronous Data Transfer Rates

REQ/ACK offset: is the maximum number of REQ pulses allowed to be outstanding before the leading edge of its corresponding ACK pulse is received at the target. A REQ/ACK offset value of zero shall indicate asynchronous data transfer mode. The SDT-9000 supports synchronous data transfer REQ/ACK offset values from 1 to 15.

The originating device (the device that sends the first of the pair of SDTR messages) sets its values according to the rules above to permit it to receive data successfully. If the responding device can also receive data successfully with these values (or smaller transfer periods or larger REQ/ACK offsets or both), it returns the same values in its SDTR message. If it requires a larger transfer period, a smaller REQ/ACK offset, or both in order to receive data successfully, it substitutes values in its SDTR message as required, returning unchanged any value not required to be changed. Each device when transmitting data shall respect the limits set by the other's SDTR message, but it is permitted to transfer data with larger transfer periods, smaller REQ/ACK offsets, or both than specified in the other's SDTR message. The successful completion of an exchange of SDTR messages implies an agreement as follows:

Responding Device SDTR response Implied Agreement

- | | |
|----------------------------------|---|
| (1) Non-zero REQ/ACK offset | Each device transmits data with a transfer period equal to or greater than and a REQ/ACK offset equal to or less than the values received in the other device's SDTR message. |
| (2) REQ/ACK offset equal to zero | Asynchronous transfer |
| (3) MESSAGE REJECT message | Asynchronous transfer |

If the initiator recognizes that negotiation is required, it asserts the ATN signal and sends a SDTR message to begin the negotiating process. After successfully completing the MESSAGE OUT phase, the target shall respond with the proper SDTR message. If an abnormal condition prevents the target from returning an appropriate response, both devices shall go to asynchronous data transfer mode for data transfers between the two devices.

Following target response (1) above, the implied agreement for synchronous operation shall be considered to be negated by both the initiator and the target if the initiator asserts the ATN signal and the first message out is either MESSAGE PARITY ERROR or MESSAGE REJECT. In this case, both devices shall go to asynchronous data transfer mode for data transfers between the two devices. For the MESSAGE PARITY ERROR case, the implied agreement shall be reinstated if a re-transmittal of the second of the pair of messages is successfully accomplished. After two retry attempts, if the target receives a MESSAGE PARITY ERROR message, it shall terminate the retry activity. This may be done either by changing to any other information transfer phase and transferring at least one byte of information or by going to the BUS FREE phase. The initiator shall accept such action as aborting the negotiation, and both devices shall go to asynchronous data transfer mode for data transfer between the two devices.

The implied synchronous agreement shall remain in effect until a BUS DEVICE RESET message is received, until a hard reset condition occurs, or until one of the two SCSI devices elects to modify the agreement. The default data transfer mode is asynchronous data transfer mode. The default data transfer mode is entered at power on, after a BUS DEVICE RESET message, or after a hard reset condition.

5.3.3 SAVE DATA POINTER (02h)

This message is sent from a target to the initiator at the end of a Data Phase to request that the initiator save a copy of the present active data pointer for the currently attached logical unit.

As a target, it will send this message prior to a disconnect.

When received as a target, it will be handled as an illegal message, the unit will return MESSAGE REJECT and will continue.

5.3.4 RESTORE POINTERS (03h)

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

The unit sends a RESTORE POINTERS message before resending a previously unsuccessful status or data transfer. It doesn't send a RESTORE POINTERS for re-selection but relies on the implicit restore pointers in a re-selection.

When received as a target, it will be handled as an illegal message; the unit will return MESSAGE REJECT and will continue.

5.3.5 DISCONNECT (04h)

This message is sent from a target to inform an initiator that the present physical path is going to be broken (the target plans to disconnect by releasing BSY). Later, reselection will be required in order to complete the current operation.

Note: The initiator detects a catastrophic error condition when the BUS FREE phase occurs (other than as result of a RESET condition) without first receiving a DISCONNECT or COMMAND COMPLETE message. If the target intentionally creates this condition, the target clears the current command. This message does not cause the initiator to save the data pointer.

As a target, the unit supports this message and will disconnect if allowed by the initiator.

When received as a target, it will be handled as an illegal message; the unit will return MESSAGE REJECT and will continue.

5.3.6 INITIATOR DETECTED ERROR (05h)

This message is sent from an initiator to inform a target that an error (e.g.: parity error) has occurred that does not prevent the target from re-trying the operation. At this point, present pointer integrity is not assured. A RESTORE POINTERS message or a disconnect followed by a reselection, will cause the pointers to be restored to their previously defined state. When received as a target the unit will attempt to retry the phase and if unsuccessful then enter the status phase reporting CHECK CONDITION with the sense key set to COMMAND ABORTED.

5.3.7 ABORT (06h)

This message is sent from the initiator to the target to clear the present operation. All pending data and status from the affected logical unit is cleared, and the target goes to the BUS FREE phase. This message can be sent to a logical unit that is not currently performing an operation for the initiator.

A transaction which has not yet been acknowledged with a good Status byte will cause the transaction to be aborted. If a transaction has already been acknowledged, the abort will force a Write of any pending data. The device will proceed directly to BUS FREE state.

5.3.8 MESSAGE REJECT (07h)

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

In order to indicate its intentions of sending this message, the initiator asserts the ATN signal prior to its release of ACK for the REQ ACK handshake of the message that is to be rejected. Message Reject is issued in response to any messages which the unit considers to be illegal or not supported. The illegal message will cause the current command to be aborted and the unit will enter the status phase reporting CHECK CONDITION with the sense key set to COMMAND ABORTED.

When received as a target, if the unit was previously in Message In phase (i.e.: sending messages to the host) then MESSAGE REJECT will cause the unit to go straight to the Status phase with a CHECK CONDITION status and a sense key of COMMAND ABORTED. If the unit was not previously in Message In phase then MESSAGE REJECT will be handled as an illegal message.

If the initiator sends MESSAGE REJECT message in response to the unit DISCONNECT message, the unit will disable disconnects for the rest of the nexus and continue.

5.3.9 NO OPERATION (08h)

This message is sent by an initiator in response to a target's request for a message when the initiator does not currently have any other valid message to send. This message is accepted when the drive is acting as a target. When a NO-OP is received during any phase, the unit will continue as though nothing had happened.

5.3.10 MESSAGE PARITY ERROR (09h)

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

To indicate its intentions of sending this message, the initiator will send the ATN signal prior to its release of ACK for the REQ/ACK handshake of the message that has the parity error. This provides an interlock so that the target can determine which message has the parity error.

This message will not be sent by the drive. When received as a target, the unit will return MESSAGE REJECT and will continue.

5.3.11 BUS DEVICE RESET (0Ch)

This message is sent from an initiator to direct a target to clear all current commands. Upon recognizing this message, the currently executing command will be aborted and the drive will proceed to the BUS FREE state. The drive will then execute a hard reset which will leave the drive in a state as if it had been power-cycled. All data in the buffer will be written to tape before the reset is performed.

A BUS DEVICE RESET message should be used to reset the drive, rather than a hard reset, as this will only reset the drive rather than all the devices on the bus.

Due to the catastrophic nature of this command, it should be used cautiously in a multi-initiator system.

5.3.12 IDENTIFY (80h-FFh)

These messages are sent by either the initiator or the target to establish the physical connection path between an initiator and target for a particular logical unit. This message byte can have the following bits set:

Bit 7: This bit is always set to one to distinguish these messages from other messages.

Bit 6: This bit is only set to one by the initiator. When set to one, it indicates that the initiator has the ability to disconnect and reconnect.

Bit 5: LUNTAR: This bit is always zero to indicate that the LUNTRN field below is valid.

Bits 4-3: Reserved.

Bits 2-0: LUNTRN: These bits specify a logical unit number in a target, and must always be set to zero as the unit is a single target, single logical unit device on the SCSI bus. The Logical Unit Number for the drive is fixed and is set to zero. Any other value will cause the unit to enter the status phase reporting CHECK CONDITION with the sense key set to COMMAND ABORTED.

Therefore, only the values 80h and C0h are supported.

When sent from a target to an initiator during reconnection, an implied RESTORE POINTERS message will be performed by the initiator prior to completion of this message, since at no time will a RESTORE POINTERS be sent.

5.4 STATUS SPECIFICATION

A Status byte is sent from the drive to the Host during the STATUS phase at the termination of each command as specified in the SCSI specification, unless the command has been cleared by an ABORT message, by a BUS DEVICE RESET message, or by a hard RESET.

The Status bytes that will be return are:

- 00h** GOOD: This status indicates that the drive has successfully completed the command.
- 02h** CHECK CONDITION: Any error, exception, or abnormal condition that causes sense data to be set returns CHECK CONDITION. The REQUEST SENSE command should be sent following this status to determine the nature of the error.
- 08h** BUSY: The drive is busy. This status is returned whenever the drive is unable to accept a command from an otherwise acceptable initiator.

The BUSY status will be returned by the unit, if, while it is DISCONNECTED from the SCSI bus, it receives a command from a different initiator. The unit does not stack commands and therefore will not accept the next command until the current one has completed. Note that if an initiator sends overlapped commands to the unit (i.e.: it sends a new command while the previous one is still executing and the unit is disconnected) then the first command will be aborted and a CHECK CONDITION will be returned to the initiator to indicate that the command was aborted. The second command will NOT be executed.

The BUSY status returned by the drive must not be confused with DRIVE NOT READY. DRIVE NOT READY will be returned as part of the Sense data following a REQUEST SENSE command and indicates that the drive is offline and no media is loaded in the drive.

The drive is deemed offline if the tape is currently unloaded and, normally, ejected from the drive. However, the drive will still be offline if the tape has been retained within the drive following a Host issued PREVENT MEDIA REMOVAL command prior to the unload.

In the offline state, the Host cannot perform any operation which would cause tape motion. These commands will return a CHECK CONDITION status with a DRIVE NOT READY sense key set. The command types which are not allowed are write, read, verify or space commands. The Host may load the tape when the unit is offline so long as the tape has been prevented from being ejected via the PREVENT/ALLOW MEDIA REMOVAL command.

While the drive is “Busy” the Host may issue any commands, including diagnostic commands, which do not access the tape and a GOOD status shall be returned. These commands are:

INQUIRY
LOG SELECT
LOG SENSE
MODE SELECT
MODE SENSE
PREVENT ALLOW MEDIUM REMOVAL
READ BLOCK LIMITS
READ BUFFER
RECEIVE DIAGNOSTIC RESULTS
RELEASE UNIT
REQUEST SENSE
RESERVE UNIT
SEND DIAGNOSTIC
WRITE BUFFER

The TEST UNIT READY command is used to determine the online/offline state of the drive and will, therefore, return a CHECK CONDITION status with a DRIVE NOT READY sense key set if no media is currently loaded.

- 18h** RESERVATION CONFLICT: This status is returned by the drive whenever the host or another SCSI device attempts to access the drive if it has been reserved via the RESERVE UNIT command.

6. COMMAND SPECIFICATION

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6. COMMAND SPECIFICATION

This section includes all supported and unsupported SCSI commands. Elements of this section come from sections 7, 8 and 9 of the ANSI X3T9.2, SCSI interface specification.

There are different types of SCSI commands, each with a specific, required length (in bytes.) The majority of the commands are 6 byte Group 0 commands. Group 1 & 2 commands are 10 bytes long. Note that the drive will wait until the required number of bytes are transferred. At the termination of each command, the target sends a status byte to the initiator. See the section on Status for more details. All SDT-9000 SONY unique commands are in Group 7.

Group 7 commands are 6 bytes long.

The following is a list of the supported SCSI Commands and page index:

PARA	SCSI COMMAND	OP CODE	PAGE
6.01	ERASE	19h	6-3
6.02	INQUIRY	12h	6-4
6.03	LOAD UNLOAD	1Bh	6-7
6.04	LOCATE	2Bh	6-9
6.05	LOG SELECT	4Ch	6-10
6.06	LOG SENSE	4Dh	6-13
6.07	MODE SELECT (6)	15h	6-30
6.08	MODE SENSE (6)	1Ah	6-47
6.09	PREVENT ALLOW MEDIUM REMOVAL	1Eh	6-51
6.10	READ	08h	6-52
6.11	READ BLOCK LIMITS	05h	6-55
6.12	READ BUFFER	3Ch	6-56
6.13	READ POSITION	34h	6-58
6.14	RECEIVE DIAGNOSTIC RESULTS	1Ch	6-61
6.15	RELEASE UNIT	17h	6-64
6.16	REQUEST BLOCK ADDRESS	02h	6-65
6.17	REQUEST SENSE	03h	6-66
6.18	RESERVE UNIT	16h	6-77
6.19	REWIND	01h	6-78
6.20	SEEK BLOCK	0Ch	6-79
6.21	SEND DIAGNOSTIC	1Dh	6-80
6.22	SPACE	11h	6-83
6.23	TEST UNIT READY	00h	6-86
6.24	VERIFY	13h	6-87
6.25	WRITE	0Ah	6-89
6.26	WRITE BUFFER	3Bh	6-91
6.27	WRITE FILEMARKS	10h	6-93

Table 6-1: SCSI Commands and Page Index

Note: In compliance with the SCSI specification, the unit will terminate the command with a CHECK CONDITION status and the sense key will be set to ILLEGAL REQUEST when a reserved bit, byte, field or code is not zero.

The unit has an embedded SCSI controller interface and therefore is a single target, single logical unit device when on the SCSI bus. The Logical Unit Number for the drive is fixed and is set to zero. In order to be SCSI-2 compatible, the following scheme is used to check the LUN:

SCSI-2 states that the LUN addressed by the host should appear in the IDENTIFY message sent to the target on selection. If SDT-9000 receives an IDENTIFY message with a LUNTRN field of zero, then it will not check the LUN field in the CDB (ANSI have reserved the right to reclaim the LUN field in the CDB in the next release of SCSI and has recommended that this field not be used in SCSI-2 compatible devices). However, SCSI-1 and SCSI-2 devices are allowed to coexist on the same bus, and SCSI-1 hosts will not send an IDENTIFY message. If SDT-9000 does NOT receive an IDENTIFY message on selection then it WILL check the LUN field in the CDB and expect it to be zero. If it isn't the unit will return a CHECK CONDITION status with an ILLEGAL REQUEST sense key set.

6.01 ERASE 19h

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (19h)							
1	Logical Unit Number			Reserved			Immed	Long
2	Reserved							
3	Reserved							
4	Reserved							
5	Unused (00b)		Reserved					

ERASE causes part or all of the remaining data within a partition be erased beginning at the current logical position. Any write data that is currently held in the buffer is written to tape before the ERASE is executed.

Immed:

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

Long:

The Long bit controls the distance to be erased.

If the bit is set to 1, the drive will write EOD from the current logical position till the end of current partition.

If the bit is set to 0, the drive will write only 300 frames (for DDS1) or 450 frames (for DDS2, DDS3) of EOD from the current logical position.

6.02 INQUIRY 12h

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (12h)							
1	Logical Unit Number			Reserved				EVPD(0)
2	Page Code (00h)							
3	Reserved							
4	Allocation Length (24h)							
5	Unused (00b)		Reserved					

INQUIRY tells the drive to send information regarding the drive parameters to the initiator.

EVPD:

The drive does not support the Vital Product Data option. Therefore, the Enable Vital Product Data bit must be set to zero otherwise the drive returns a CHECK CONDITION status with an ILLEGAL REQUEST Sense Key.

Page Code:

This field is not supported and must be set to zero otherwise the drive returns a CHECK CONDITION status with an ILLEGAL REQUEST Sense Key.

Allocation Length:

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

INQUIRY will return a CHECK CONDITION status only when the target cannot return the requested Inquiry data. If an INQUIRY is received from an initiator with a pending UNIT ATTENTION condition (before the drive reports CHECK CONDITION status), the target will perform the INQUIRY and will not clear the UNIT ATTENTION condition.

The drive returns the standard INQUIRY data as described below.

Bit Byte	7	6	5	4	3	2	1	0
0	Peripheral Qualifier			Peripheral Device Type (01h)				
1	RMB (1)	Device-Type Modifier (0)						
2	ISO Version (0)		ECMA Version (0)			ANSI-Approved Version (2)		
3	AENC (0)	TrmIOP	Reserved (0)		Response Data Format (2)			
4	Allocation Length (1Fh)							
5	Reserved							
6	Reserved							
7	RelAdr (0)	WB32 (0)	WB16 (0)	Sync (1)	Linked (0)	Reserved	CmdQ (0)	SftRe (0)
8	(MSB) Vendor Identification							
15	(SONY) (LSB)							
16	(MSB) Product Identification							
31	(SDT-9000) (LSB)							
32	(MSB) Product Revision Level							
35	(LSB)							

Table 6-2: INQUIRY Data

Peripheral Qualifier and Peripheral Device Type:

These fields identify the device that is currently connected to the logical unit. The drive is a single target, single logical unit device. The logical unit number is set to zero. Therefore, the drive normally returns Peripheral Qualifier set to 000b the specified peripheral device type is currently connected to this logical unit and Peripheral Device Type set to 01h sequential-access device. However, if the initiator requests a logical unit number greater than zero, the drive returns Peripheral Qualifier set to 011b the target is not capable of supporting a physical device on this logical unit and Peripheral Device Type set to 1Fh unknown device type.

RMB:

The Removable Medium bit is one, indicating that the tape can be removed.

Device-Type Modifier:

This is a seven-bit user defined code, set to 00h.

ISO Version:

This field is zero, indicating that the drive does not necessarily comply with the ISO version of SCSI.

ECMA Version:

This field is zero, indicating that the drive does not necessarily comply with the ECMA version of SCSI.

ANSI Approved Version:

This field is 2, indicating that the drive complies with the ANSI version of SCSI-2.

AENC:

The drive does not support asynchronous event notification, so this field is zero.

TrmIOP:

The drive does not support the Terminate I/O Process message so this field is zero.

Response Data Format:

This field is 2 indicating that the INQUIRY DATA format complies with the ANSI version of SCSI-2.

Additional Length:

The additional length field specifies the length in bytes of the parameters, in this case, 31 bytes.

RelAdr:

The drive does not support the Relative Addressing mode so this bit is never set.

WBus32:

The drive does not support 32-bit wide data transfers, so this bit is never set.

WBus16:

The drive does not support 16-bit wide data transfers, so this bit is never set.

Sync:

The drive supports synchronous data transfers, so this bit is set.

Linked:

The drive does not support linked commands, so this bit is never set.

CmdQue:

The drive does not support tagged command queuing, so this bit is never set.

SftRe:

The drive responds to the RESET condition with a HARD reset, so this bit is never set.

Vendor Identification:

This field contains eight bytes of ASCII data identifying the vendor of the product as "SONY". This and the next two fields are left-aligned with the unused bytes at the end of the fields and filled with space characters (20h).

Product Identification:

This field contains sixteen bytes of ASCII data identifying the product as "SDT-9000".

Product Revision Level:

This field contains four bytes of ASCII data, which define the SCSI Interface Revision Level.

6.03 LOAD/UNLOAD 1Bh

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (1Bh)							
1	Logical Unit Number			Reserved				Immed
2	Reserved							
3	Reserved							
4	Reserved					EOT	Re-Ten	Load
5	Unused (00b)		Reserved					

LOAD/UNLOAD allows the host to tell the drive to enable or disable the media for further operations.

Load:

When this bit is set, the drive loads the tape and positions it at the beginning of Partition 0. The load command is used when the tape has been retained in the drive by the command sequence, PREVENT ALLOW MEDIA REMOVAL (with prevent bit set), UNLOAD. The drive will automatically perform a Load operation when a tape is inserted, a SCSI Reset is received, or when power is restored with a tape in the drive.

If the bit is not set (UNLOAD), the drive writes any buffered data to the tape, writes the EOD, then rewinds the tape to BOM and ejects it.

Immed:

If this bit is set, status is returned as soon as the load or unload operation is initiated. Otherwise, the status is returned after the operation has completed.

Re-Ten:

If this bit is set, the drive winds to EOM then rewinds to BOM before starting a normal loading sequence.

EOT:

An end-of-tape (EOT) bit of one and a Load bit of zero indicates that the medium shall be positioned at end-of-medium for removal from the peripheral device. Prior to performing the unload operation, any buffered data that is to be written shall be transferred to the medium.

An EOT bit of zero and Load bit of zero indicates that the medium shall be positioned at beginning-of-medium for removal etc.

An EOT bit of one and a Load bit of one shall cause the target to return CHECK CONDITION status. The sense key shall be set to ILLEGAL REQUEST and the additional sense code shall be set to ILLEGAL FIELD IN CDB.

If the drive has received an UNLOAD command with the Immediate bit set and then receives either another command which would involve tape motion or TEST UNIT READY, the drive will return a CHECK CONDITION status with a NOT READY sense key set.

When the drive receives the UNLOAD, it updates the System area of whichever partition on the tape is currently active. The tape is then rewound to BOM and ejected. The operator must reload the drive manually. If, however, the drive has previously received a PREVENT MEDIA REMOVAL (with prevent bit set) command, the tape is retained in the drive. A subsequent LOAD command will load and position the tape at BOP zero. If an UNLOAD were sent instead, the drive would return NOT READY and the tape would remain within the drive. In this case, the drive requires a PREVENT ALLOW MEDIA REMOVAL (with prevent bit clear) command before an UNLOAD will eject the tape.

Note: While the PREVENT MEDIA REMOVAL is in effect, the Front Panel EJECT button is completely disabled.

If the cassette is unloaded but has not been ejected from the drive because of moisture detection, then a subsequent UNLOAD will cause the tape to be ejected from the drive. All commands except INQUIRY, REQUEST SENSE and READ BLOCK LIMITS will return a CHECK CONDITION status with a HARDWARE ERROR sense key set. The tape may also be ejected via the Front Panel EJECT button.

If no cassette is in drive, both LOAD and UNLOAD will return a CHECK CONDITION status with NOT READY sense key set.

6.04 LOCATE 2Bh

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (2Bh)							
1	Logical Unit Number			Reserved		BT (0)	CP	Immed
2	Reserved							
3	(MSB)							
4	Block Address							
5								
6	(LSB)							
7	Reserved							
8	Reserved							
9	Unused (00b)		Reserved					

LOCATE command causes the target to position the logical unit to the specified block address in a specified partition. Upon completion, the logical position shall be before the specified location. Prior to performing the locate operation, the target shall ensure that all buffered data, filemarks, and setmarks have been transferred to the medium.

BT: A block address type (BT) bit=1 is not supported and shall be set to zero otherwise a CHECK CONDITION with an ILLEGAL REQUEST sense key will be returned.

CP: A change partition (CP) bit of one indicates that a change to the partition specified in the partition field is to occur prior to positioning to the block specified in the block address field. A CP bit of zero indicates no partition change is to be made and the partition field is to be ignored.

Immed:

An immediate (Immed) bit of zero indicates that the target shall not return status until the locate operation has completed. An Immed bit of one indicates that the target shall return status as soon as all buffered commands have completed execution and the command descriptor block of the LOCATE command has been validated. If CHECK CONDITION status is returned for a LOCATE command with an Immed bit of one, the locate operation shall not be performed.

Block Address:

The Block Address field specifies the block address to which the target shall position the medium based on the current setting of the BT bit.

Partition:

The Partition field specifies which partition to select if the CP bit is one. Refer to the MODE SELECT command, Medium Partition page for additional information about partitioning.

6.05 LOG SELECT 4Ch

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (4Ch)							
1	Logical Unit Number			Reserved			PCR	SP (0)
2	PC		Reserved					
3	Reserved							
4	Reserved							
5	Reserved							
6	Reserved							
7	(MSB) Parameter List Length							
8	(LSB)							
9	Unused (00b)		Reserved					

The LOG SELECT command provides a means for the Host to manage statistical information maintained by the device about its own hardware or the installed media. This description should be read in conjunction with the description of the LOG SENSE command which follows it, to provide the reader with information about log page format, parameters and supported pages.

PCR:

A Parameter Code Reset bit of one and a Parameter List Length of zero will cause ALL log pages which can be cleared, to be cleared. If this field is set and the Parameter List Length field is non-zero then the command will be terminated with a CHECK CONDITION status with the sense key set to ILLEGAL REQUEST, and an additional sense code of INVALID FIELD IN CDB.

SP: The device does not have non-volatile RAM into which it may save parameters. Therefore, the Save Page bit is not supported by this device and shall always be set to zero. If the SP bits is set, the command will be terminated with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST, and an additional sense code of INVALID FIELD IN CDB.

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

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

Table 6-3: Page Control field values

If this field is set to 00b, 10b or 11b and the Parameter List Length field is non-0 then the command will be terminated with a CHECK CONDITION status with the sense key set to ILLEGAL REQUEST, and an additional sense code of INVALID FIELD IN CDB. This is because no modification of these log pages are permitted.

For a description of command action if this field is set to 01b then see the description of the Parameter List Length field below.

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

If this field is set to 11b and the Parameter List Length field is 0 then all Current Cumulative Values will be reset to the Default Cumulative Values.

This is equivalent to all log pages which can be cleared.

Parameter List Length:

This field specifies the length in bytes of the LOG SELECT parameter list that shall be transferred from the initiator to the target during the DATA OUT phase. A parameter list length of zero indicates that no data shall be transferred. This condition shall not be considered as an error (see description of Parameter Code Reset and Page Control fields above). If this field is non-0 the Page Control field must be 01b.

The purpose of the LOG SELECT command is to allow the initiator to modify and initialize parameters within the logs supported by the device. However in this case, access to individual parameters within log pages is not supported and so initiator is restricted to resetting complete log pages only.

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

Page Code	Description
02h	Write Error Counter Page
03h	Read Error Counter Page
07h	Last n Error Events Page

Table 6-4: Page Codes

Note: Due to the way in which logs are stored and updated, clearing log page 2 will result in log page 3 also being cleared and vice versa.

Because of this method of clearing the log pages, the Parameter List Length field must be an integer multiple of the Log Page Header length (i.e. 4). Otherwise the command will be terminated with a CHECK CONDITION status with the sense key set to ILLEGAL REQUEST and an additional sense code of INVALID FIELD IN CDB.

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

6.06 LOG SENSE 4Dh

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (4Dh)							
1	Logical Unit Number			Reserved			PPC (0)	SP (0)
2	PC		Page Code					
3	Reserved							
4	Reserved							
5	(MSB) _____							
6	Parameter Pointer _____ (LSB)							
7	(MSB) _____							
8	Allocation Length _____ (LSB)							
9	Unused (00b)		Reserved					

LOG SENSE provides a means for the Host to retrieve statistical information maintained by the device about its own hardware or the installed media. It is a complementary command to the LOG SELECT command.

SP: The device does not have non-volatile RAM into which it may save parameters. Therefore, the Save Page bit is not supported by this device and shall always be sent to zero. If the SP bit is set, the command will be terminated with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST, and an additional sense code of INVALID FIELD IN CDB.

PPC:

The Parameter Pointer Control bit shall always be set to zero. This indicates that the parameter data requested from the device will start with the parameter code specified in the Parameter Pointer field and return the number of bytes specified in the Allocation Length field in ascending order of parameter codes from the specified log page. A PPC bit of zero and a Parameter Pointer field of zero cause all available parameter data for that page code to be returned to the initiator.

If the PPC bit is set or the Parameter Pointer is larger than the highest numbered parameter on the page, then the target shall terminate the command with CHECK CONDITION status. The sense key shall be set to ILLEGAL REQUEST and the additional sense code shall be set to INVALID FIELD IN CDB.

If the drive does not support a parameter code within this page then it shall not return any data associated with this parameter.

PC: The Page Control field defines the type of parameter values to be selected. The page control field is defined below:

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

Table 6-5: Page Control field values

The Current Threshold Values and the Default Threshold Values are non-changeable and will both return the same values - i.e. the maximum values that each parameter can attain. Note that for some parameters the term threshold value has no meaning. See the description of individual pages/parameters below for more details.

The Current Cumulative Values are the values computed since the last reset of the device (either by power-cycling, BUS DEVICE RESET or SCSI RESET). Note that for some parameters these values cannot be reset by any method. See description of individual pages/parameters below for more details.

The Default Cumulative Values are the values to which each parameter gets initialized on a reset condition as described above. See description of individual pages/parameters below for more details.

Page Code:

The Page Code field identifies which log page is being requested by the initiator.

If the page is not supported then the command will terminate with a CHECK CONDITION status with the sense key set to ILLEGAL REQUEST and an additional sense code of INVALID FIELD IN CDB. Supported pages are:

Page Code	Description	Allocation Length
00h	Supported Log Pages	0Ch
02h	Write Error Counter Page	20h
03h	Read Error Counter Page	20h
07h	Last n Error Events Page	1A8h (max)
30h	Tape Log Page (Sony Unique)	5Ch
		5Eh(DDS-3)
31h	Tape Capacity Log Page	24h
33h	Drive Usage Page (Sony Unique)	8Ch
39h	Data Compression Transfer Log Page	5Ch

Table 6-6: Supported Log Pages

Parameter Pointer:

The Parameter Pointer field allows the host to specify at which parameter within a log page the requested data should begin.

For example if a page supported parameters 0 through 5, and the Parameter Pointer field contained 3 then only parameters 3, 4 and 5 would be returned to the initiator. Similarly, if a page supported parameters 1, 3 and 6, and the Parameter Pointer field contained 2, then only parameters 3 and 6 would be returned to the initiator.

Note that parameters within a page are always returned in ascending order according to parameter code. If an invalid parameter pointer is sent the drive will return CHECK CONDITION with the sense key set to ILLEGAL REQUEST and an additional sense code of INVALID FIELD IN CDB.

Allocation Length:

The Allocation Length field is used to inform the target how much space the initiator has allocated for data. There must be sufficient space allocated for all the requested data. If there isn't then the command will terminate with a CHECK CONDITION status with the sense key set to ILLEGAL REQUEST and an additional sense code of INVALID FIELD IN CDB. Note however that if this field is 0 then this is not considered an error and the device will just return a GOOD status.

6. 06. 1 The Log Page Descriptor

The format of the log pages consists of zero or more variable-length parameter structures. Each page begins with a 4-byte page header followed by zero or more variable-length parameter structures defined for that page. The Log Select command supports the ability to send zero or more log pages. The LOG SENSE command returns a single log page as specified in the Page Code field of the CDB.

Bit Byte	7	6	5	4	3	2	1	0
0	Reserved		Page Code					
1	Reserved							
2	(MSB)							
3	Page Length (n-3)							
	(LSB)							
	Log Parameters (s)							
4- x+3	Log Parameter (First) (Length x)							
	⋮							
n-y n	Log Parameter (Last) (Length y)							

Table 6-7: Log Page Format

Page code:
Identifies which page of data is being transferred. If the Page Code field value is reserved or not implemented by the target, the target shall terminate the command with a CHECK CONDITION status. The sense key shall be set to ILLEGAL REQUEST, and the additional sense code shall be set to INVALID FIELD IN PARAMETER LIST.

Page Length:
Defines the length, in bytes, of the following log parameters. This length does not include bytes zero through three. A Page Length value that results in the truncation of any parameter shall cause the target to terminate the command with CHECK CONDITION status. The sense key shall be set to ILLEGAL REQUEST and the additional sense code shall be set to INVALID FIELD IN PARAMETER LIST.

6.06.2 The Log Parameter Descriptor

Most log pages contain one or more special data structures called log parameters. These may be data counters which record the occurrence of certain events, or they may be more complex structures which describe activities or other events which occur within the device. Each parameter structure begins with a 4-byte parameter header followed by one or more bytes of parameter structure data. The 4-byte header is shown below:

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

Table 6-8: Log Parameter

Parameter Code:

Identifies which parameter of data is being transferred. If the parameter code value is reserved or not implemented by the target, then the target shall terminate the command with CHECK CONDITION status. The sense key shall be set to ILLEGAL REQUEST and the additional sense code shall be set to INVALID FIELD IN PARAMETER LIST.

The DU, DS, TSD, ET, TMC, and LP fields are collectively referred to as the control byte.

DU: The DU bit (Disable Update) is not defined for threshold values (indicated by the PC field of the LOG SENSE command descriptor block). The target shall ignore the value of any DU bits in a LOG SELECT command.

DS: The DS bit-field informs the initiator that savable parameters are disabled (i. e. not supported), and should always be 1. If it is 0 the command will terminate with CHECK CONDITION status with sense key set to ILLEGAL REQUEST and additional sense code of ILLEGAL FIELD IN PARAMETER LIST.

TSD:

A target save disable (TSD) bit of zero indicates a target-defined method for saving log parameters. This implicit saving operation shall be done frequently enough to insure that the cumulative parameter values retain statistical significance (i.e. across power cycles). A TSD bit of one indicates that either the target does not provide a target-defined method for saving log parameters or the target-defined method has been disabled by the initiator. If the initiator sets both the DS and the TSD bits set to one, the target shall terminate the command with CHECK CONDITION status . The sense key shall be set to ILLEGAL REQUEST with the additional sense code set to INVALID FIELD IN PARAMETER LIST.

ETC:

This bit is not supported by this device.

An enable threshold comparison (ETC) bit of one indicates that when the cumulative parameter value is updated, it shall be compared to the threshold parameter value and the action specified by the TMC field shall be taken. An (ET) bit of zero disables this comparison. The ET bit is the same for both the cumulative and threshold log parameter. Thus when the ET bit is set to a value by the initiator, this value is returned for both the cumulative and threshold values of the log parameter.

TMC:

This bit is not supported by this device.

The threshold met criteria (TMC) field defines the binary relationship between the cumulative and threshold log parameter values under which the threshold is met. If the ET bit is one and the threshold condition is met, a Unit Attention condition shall be posted to all initiators. When reporting the unit attention condition, the target shall set the sense key to UNIT ATTENTION, the additional sense code to LOG EXCEPTION, and the additional sense code qualifier to THRESHOLD CONDITION MET.

TMC	Threshold Met Criteria
00b	Any update of the parameter
01b	Cumulative = Threshold
10b	Cumulative < > Threshold
11b	Cumulative > Threshold

Table 6-9: Threshold Met criteria

The TMC field is the same for both the cumulative and threshold parameter. Thus when the TMC field is set to a value by the initiator, this value is returned for both cumulative and threshold values of the log parameter.

LP: The LP bit field defines whether the parameter is a data counter or a list parameter. An LP bit of one indicates that the parameter is a list Parameter. An LP bit of Zero indicates that the parameter is a data counter. See the description of each supported page below for information on the setting of this field.

Note: If any of the other bit-fields in the control byte are set then the command will terminate with a CHECK CONDITION status with a sense key of ILLEGAL REQUEST and an additional sense code of INVALID FIELD IN PARAMETER LIST.

6.06.3 Supported Log Pages

The following log pages are supported:

Page Code	Description	Allocation Length
00h	Supported Log Pages	0Ch
02h	Write Error Counter Page	20h
03h	Read Error Counter Page	20h
07h	Last n Error Events Page	1A8h (max)
30h	Tape Log Page (Sony Unique)	5Ch
		5Eh(DDS-3)
31h	Tape Capacity Log Page	24h
33h	Drive Usage Page (Sony Unique)	8Ch
39h	Data Compression Transfer Log Page	5Ch

Table 6-10: Supported Log pages

A description of each supported log page is given below.

6.06.3.1 Summary List of Supported Pages

The summary list of supported log pages returns the list of page codes supported by the target. This page is only valid for the Log Sense command and if sent to the host during a Log Select command will cause termination with CHECK CONDITION status with sense key set to ILLEGAL REQUEST and additional sense code of INVALID FIELD IN PARAMETER LIST.

Bit Byte	7	6	5	4	3	2	1	0
0	Page Code (00h)							
1	Reserved							
2	(MSB)							
3	Page Length (00 08h)							
	(LSB)							
4	Supported Page List							
B	(00 02 03 07 30 31 33 39h)							

Table 6-11: Supported Log Pages

This page returns the summary list of supported log pages for the specified logical unit to the requesting initiator.

IMPLEMENTORS NOTE:
Typically, an initiator should first request page zero to determine the list of pages supported by the device.
The page code parameters are a list containing the page codes of the supported pages for the logical unit in ascending order.
Note that neither Threshold nor Cumulative values have any meaning for this page.

6. 06. 4 Write and Read Error Counters Pages

The Error Counters Pages (Write and Read) are used to report statistical information about Write and Read soft and hard errors and retries. Each parameter is a counter which is updated by the target every time the corresponding event occurs. The format of the Error Counters Pages is given below:

Bit Byte	7	6	5	4	3	2	1	0
0	Page Code (02h or 03h)							
1	Reserved							
2	(MSB)Page Length (n)							
3	(LSB)							
4	(MSB)Parameter Code							
5	(LSB)							
6	DU (0)	DS (1)	TSD (0)	ETC (0)	TMC (00)	Reserved	LP (0)	
7	Parameter Length (n-3)							
8	(MSB)Parameter Value							
n	(LSB)							

Table 6-12: Write/Read Error counters page

The Page Code is one of the following:

Page Code	Description
02h	Write Error Counter Page
03h	Read Error Counter Page

Table 6-13: Page Code

The following parameter codes are supported for each Error Counters Page:

Parameter Code	Description	Parameter Length (Bytes)	Default Cumulative	Default Threshold
0003h	Total Errors Corrected (Soft Errors)	2	0	FFFFh
0004h	Total Times Correction Algorithm Processed	4	0	FFFFFFFFh
0005h	Total Groups Processed	4	0	FFFFFFFFh
0006h	Total Errors Uncorrected (Hard Errors)	2	0	FFFFh

Table 6-14: Error Counter parameter codes

6. 06. 5 Last N Error Events List

This page is used to report information on soft and hard errors encountered by the device during normal operation. Each parameter corresponds to an encountered error and is a report of what type of error occurred and when it occurred. The format of the page is given below:

Bit Byte	7	6	5	4	3	2	1	0
0	Page Code (07h)							
1	Reserved							
2	(MSB)Page Length (n*14)							
3	(LSB)							
4	(MSB)Parameter Code							
5	(LSB)							
6	DU (0)	DS (1)	TSD (0)	ETC (0)	TMC (00)	Reserved	LP (1)	
7	Parameter Length (0Ah)							
8	Parameter Value							
17								

Table 6-15: Last N Error Events Page

The Parameter Codes supported are 1 through 30 where 30 is the maximum number of entries in the log page.

If there are no entries, the command will return the Page Header with the Page Length field set to 0.

Each error event record contains diagnostic information for a single error encountered by the device. The parameter codes associated with the error-event records indicate the order in which the errors occurred. A higher parameter code indicates that the error event occurred later in time.

Each parameter entry is 10 bytes long and has the following format:

Byte Offset	Meaning
0 - 4	Result Message (see Diagnostic Section)
5	Unused
6 - 9	Timestamp (number of 50 ms increments since power-on)

Table 6-16: Error Event format

When the log page becomes full, no more entries will be added until the log is cleared (using one of the methods described previously) or a reset occurs. The current cumulative values will be returned regardless of the page control field in the LOG SENSE CDB.

6.06.6 Tape Log Page (Sony Unique)

This page is a Sony unique page which provides information on the tape currently being used. This log cannot be cleared and has the following format:

Bit Byte	7	6	5	4	3	2	1	0
0	Page Code (30h)							
1	Reserved							
2	(MSB) Page Length (58h)							
3	Page Length (5Ah) (DDS-3) (LSB)							
4	(MSB) Parameter Code							
5	(LSB)							
6	DU (0)	DS (1)	TSD (0)	ETC (0)	TMC (00)	Reserved	LP (0)	
7	Parameter Length (m)							
8	Parameter Value							
3+m								

Table 6-17: Tape Log Page

This page is used to return Tape Log information to the host in a format which conforms to the LOG SENSE command page format.

Supported Parameter Codes in this page are listed below along their meanings:

Parameter Code	Description	Length
001h	Current number of Groups Written	3
002h	Current number of RAW Retries	2
003h	Current number of Groups Read	3
004h	Current number of ECC-3 Retries	2
005h	Previous number of Groups Written	3 4 (DDS-3)
006h	Previous number of RAW Retries	2
007h	Previous number of Groups Read	3 4 (DDS-3)
008h	Previous number of ECC-3 Retries	2
009h	Total number of Groups Written	4
00Ah	Total number of RAW Retries	3
00Bh	Total number of Groups Read	4
00Ch	Total number of ECC-3 Retries	3
00Dh	Load Count	2

Table 6-18: Tape Log parameter codes

This information is contained within RAM in the Drive Controller. When a cassette is loaded, the contents of the System Area are copied into this log. The log is updated as the tape is used and is copied back onto the System Area when the cassette is unloaded (if the tape is Write enabled).

Note: The System Area only contains 'previous' and 'total' information - (when the cassette is unloaded, the 'current' values become the System Area 'previous' values).

The term 'current' refers to information generated during the current load of the tape; 'previous' refers to information generated during the last tape load; 'total' refers to information generated during the life of the tape since it was first initialized including the current load.

Use: An estimate of reading and writing performance can be made by the ratios of 'RAW retries' to 'groups written' and 'ECC-3 retries' to 'groups read'. An indication of tape degradation can be gained by comparing these ratios for 'current', 'previous' and 'total' entries.

Any attempt to change this page using LOG SELECT will result in a CHECK CONDITION with a Sense Key of ILLEGAL REQUEST. The current cumulative values will be returned regardless of the Page Control field in the LOG SENSE CDB.

6.06.7 Tape Capacity Log Page

The Tape Capacity Log Page is used to indicate the approximate capacity of the tape currently being used. The PC field of the LOG SENSE command is ignored for this field.

The 36 bytes of the log page have the following format:

Bit Byte	7	6	5	4	3	2	1	0
0	Page Code (31h)							
1	Reserved							
2	(MSB) Page Length (20h)							
3	(LSB)							
4	(MSB) Parameter Code							
5	(LSB)							
6	DU (0)	DS (1)	TSD (0)	ETC (0)	TMC (11)	Reserved	LP (0)	
7	Parameter Length (04Ah)							
8	(MSB) Parameter Value							
11	(LSB)							

Table 6-19: Tape Capacity Log Page

Tape Capacity Log Page Parameters:

Code	Value
------	-------

0001	Remaining capacity, partition 0 (kilobytes)
0002	Remaining capacity, partition 1 (kilobytes). For a single partition tape, it will be zero.
0003	Maximum capacity, partition 0 (kilobytes)
0004	Maximum capacity, partition 1 (kilobytes). For a single partition tape, it will be zero.

6. 06. 8 Drive Usage Log Page (Sony Unique)

This page is a SONY unique page which provides information on the drive currently being used. This log cannot be cleared and has the following format:

Bit Byte	7	6	5	4	3	2	1	0
0	Page Code (33h)							
1	Reserved							
2	(MSB)Page Length (88h)							
3	(LSB)							
4	(MSB)Parameter Code							
5	(LSB)							
6	DU (0)	DS (1)	TSD (0)	ETC (0)	TMC (00)	Reserved	LP (0)	
7	Parameter Length (m)							
8	Parameter Value							
7+m								

Table 6-20: Drive Usage Log Page

This page is used to return the vendor unique Drive Usage Log information to the host in a format which conforms to the Log Sense command page format.

Supported Parameter Codes in this page are listed below with their meaning:

Parameter Code		Length (bytes)
0001h	Drum revolution minute	3
0002h	Load count	2
0003h	Thread count	2
0004h	Mechanism motion count (rotary encoder)	3
0005h	Cleaning interval (minute)	3
0006h	EEPROM written count	3
0007h	MD serial number	4
0008h	PCB serial number	4
0009h	Drive serial number	4
0011h - 0018h	Last 8 Mechanism Error Events List	5 x 8

Table 6-21: Supported Parameter Codes

Each Mechanism Error Event is 5 bytes long and has following format:

Byte offset	Meaning
0	Error code
1	Executing Mechanism Commands when error was detected
2 - 4	Timestamp (minute)

Table 6-22: Mechanism Error Event Format

Executing Mechanism Commands

FWD ATF ON	0x01
FF	0x07
PAUSE	0x0e
THREAD	0x0f
TENSION OFF	0x10
RVS	0x11
REW	0x17
UNTHREAD	0x20
STOP	0x21
EJECT	0x22
MD INITIALIZE	0x2A

FWD	0x30
LOAD	0x31
RE TENSION	0x32
RESTART	0x33
STOP FF	0x34
STOP REW	0x35
ASSERT	0x36
RELEASE	0x37
RE ASSERT	0x38
STOP FWD	0x39
STOP RVS	0x3A

6.06.9 Data Compression Transfer Log Page

The page allows the host to monitor the performance of the DCLZ compression. The PC field in LOG SENSE determines whether current cumulative, default cumulative, or current/default threshold values are returned. The page has the following format:

Bit Byte	7	6	5	4	3	2	1	0
0	Page Code (39h)							
1	Reserved							
2	(MSB)Page Length (58h)							
3	(LSB)							
4	(MSB)Parameter Code (n)							
5	(LSB)							
6	DU (0)	DS (1)	TSD (0)	ETC (0)	TMC (00)	Reserved	LP (0)	
7	Parameter Length (04Ah)							
8	(MSB)Parameter Value							
11	(LSB)							

Table 6-23: Data Compression Transfer Log Page

Data Compression Log Page Fields:

Supported Parameter Codes in this page and their meanings are as follows:

Code	Description
0001h	Number of entities written
0002h	Number of entities read
0003h	Number of records written
0004h	Number of records read
0005h	Kilobytes to data compression
0006h	Kilobytes from data compression
0007h	Kilobytes to tape
0008h	Kilobytes from tape
0009h	Logical entity size
000Ah	Physical entity size
000Bh	Uncompressed entities

Entities Written/Read:

The total number of complete entities written to or read from the tape since the last power-on or Cleaner Log operation.

Records Written/Read:

The total number of records (both compressed and uncompressed) written to or read from the tape since the last power-on or Clear Log operation.

Kilobytes to/from Data Compression:

The total number of kilobytes written to or read from the tape since the last power-on or Clear Log operation. For Kilobytes from Data Compression, this number may be greater than the number of kilobytes transferred to the host due to readahead.

Logical Entity Size:

The logical size of the last entity written to or read from the tape:
size = number of records in entity × record size in bytes

Physical Entity Size:

The physical size of the last entity written to or read from the tape:
size = entity header length + uncompressed data length

Uncompressed Entities:

The total number of times non-DCLZ entities have been encountered on the tape during read operations since the last power-on or Clear Log operation.

LOG SENSE Commands

From these figures, the host can calculate the average compression ratio achieved by the drive since the last power-on or Clear Log operation as follows:

$$\text{average compression ratio} = \frac{\text{kilobytes to data compression}}{\text{kilobytes to tape}}$$

Similarly, the host can calculate instantaneous compression ratio achieved by the drive for a particular read or write command:

$$\text{instantaneous compression ratio} = \frac{\text{logical entity size}}{\text{physical entity size}}$$

6.07 MODE SELECT 15h

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (15h)							
1	Logical Unit Number			PF	Reserved			SP (0)
2	Reserved							
3	Reserved							
4	Parameter List Length							
5	Unused (00b)		Reserved					

MODE SELECT enables the Host to configure the drive. Similarly MODE SENSE enables the Host to identify which configuration parameters the drive supports and what its current configuration actually is.

Implementing MODE SELECT and MODE SENSE requires a certain amount of “handshaking” between the Host and the drive. Before configuring the drive, the Host should issue a MODE SENSE. This allows the drive to return its current configuration and indicate what parameters are configurable. The Host interprets this information and may then issue a MODE SELECT command to set up the drive to the Host’s preferred configuration.

Note: In the MODE SELECT and MODE SENSE (opcode 1Ah) descriptions much of the information overlaps and therefore the two descriptions should be read in conjunction.

MODE SELECT allows the initiator to specify configuration parameters to the drive.

The drive always powers-up with its default configurations set. This is also true if the drive receives a BUS DEVICE RESET message or a hard reset through the RST line on the SCSI bus.

PF: The Page Format bit indicates that the data sent by the Host after the MODE SELECT header and block descriptors complies with the definition of pages as set out in SCSI-2. The drive expects this bit to be set, otherwise it returns a CHECK CONDITION status with the sense key set to ILLEGAL REQUEST.

However, if the Parameter List Length is set to 12 bytes, i.e. the host only wishes to transfer the Parameter List Header and a single Block Descriptor, the PF bit need not be set and the drive will return a GOOD status.

SP: The Save Parameters bit instructs the drive to save all savable pages. This bit is not supported and the drive will return a CHECK CONDITION status with an ILLEGAL REQUEST sense key set if it is set.

Parameter List Length:

This specifies the length, in bytes, of the MODE SELECT parameter list that is transferred during the DATA OUT phase. A zero parameter list length indicates that no data is transferred. The Parameter List length must be a value which coincides with header, block descriptor or page boundaries. If this does not occur then the drive will return a CHECK CONDITION status with an ILLEGAL REQUEST sense key set.

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

Bit Byte	7	6	5	4	3	2	1	0
0	Reserved							
1	Reserved							
2	Reserved	Buffered Mode			Speed (00h)			
3	Block Descriptor Length (08h)							
4	Density Code (13h)							
5	(MSB)							
6	Number of Blocks (00 00 00h)							
7	(LSB)							
8	Reserved							
9	(MSB)							
10	Block Length							
11	(LSB)							

Table 6-24: MODE SELECT parameter list

Buffered Mode:

Buffered Mode is the mechanism by which the drive implements Immediate Reporting on WRITE commands.

If the field is zero, then the drive does not report a GOOD status on WRITE commands until the data blocks are actually written to tape.

If the Buffered Mode field is one, then the drive reports GOOD status on WRITE commands as soon as the data block has been transferred to the buffer. This is the default configuration for the drive.

If Buffered Mode is not used, the drive will suffer a significant degradation in performance with respect to capacity as each record will be written as a partial group. Partial groups are not appended to automatically, but are left on the tape.

Speed:

The drive only supports one speed, the default speed. Because of this, this field must be set to zero. Any other value will cause a CHECK CONDITION status with an ILLEGAL REQUEST sense key is returned.

Block Descriptor Length:

This specifies the length in bytes of all the block descriptors. Since the drive only allows one block descriptor, this value must be eight. Any other value will cause a CHECK CONDITION status with an ILLEGAL REQUEST sense key to be returned.

Note: The block descriptor specifies the media characteristics for the DDS drive. The block descriptor contains the density code, number of blocks and block length fields.

Density Code:

The supported values for the density code field are defined in the following table.

Code Value	Density
00h	Default Format
13h	Sony/Hewlett Packard DDS Format
7Fh	No change from previous density (No-Op)

Table 6-25: Sequential-Access Density Codes

Note: 00h - Default: The use of the word “Default” is SCSI specific. It instructs the drive to use its default or only density. Therefore the drive uses its only density of 13h. 13h is the value that has been allocated for use by DDS devices by the ANSI SCSI Committee (X3T9.2).

Number of Blocks:

A MODE SENSE field which will be returned as zero, indicating that all of the remaining logical blocks on the media will have the medium characteristics specified by the block descriptor, or until a subsequent MODE SELECT command changes those parameters. This field must be set to zero on a MODE SELECT otherwise a CHECK CONDITION status will be returned with an ILLEGAL REQUEST sense key.

Block length:

The Block Length field specifies the length in bytes of each logical block transferred over the SCSI bus. A block length of zero indicates that the length is variable. Any other value indicates the number of bytes per block that the drive must handshake over the bus. This establishes block length such that the transfer length for read, write and verify type commands will be a block count not a byte count.

Note: It is value of this field together with the Fixed Bit Field in the READ, or WRITE commands that determines whether the drive is in Fixed or Variable block mode.

Mode	Fixed Bit in Read, Write, Verify & Recover Buffered Data	Block Length in Mode Select/Sense
Fixed Block	1	Block Size
Variable Block	0	0

The default fixed block size is 512 bytes however, the drive will accept a variable Write command (fixed bit of zero) without reporting an error.

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

Bit Byte	7	6	5	4	3	2	1	0
0	PS	Reserved	Page Code					
1	Additional Page Length							

Table 6-26: MODE SELECT Page Header

PS: when the Page Savable bit is set, this indicates that the page contains saved parameters. This bit will never be set as there is no non-volatile RAM on the drive into which parameter data may be saved.

The page codes that are supported are:

Page Code	Description	Parameter List Length
00h	Standard Sense	0Ch
02h	Disconnect-Reconnect Page	0Ch+10h=1Ch
0Fh	Data Compression Control Page	0Ch+10h=1Ch
10h	Device Configuration Page	0Ch+10h=1Ch
11h	Medium Partitions Parameter Page	0Ch+0Ch=18h
3Fh	Return All Pages	0Ch+10h+10h+10h+0Ch=48h

Table 6-27: Supported MODE SELECT Page Codes

Additional Page Length:

Indicates the number of bytes in that page. The value does not, however, include bytes 0 and 1. The length is returned on MODE SENSE and must subsequently be set to the same value when performing MODE SELECT.

If the page length does not match that expected by the drive a CHECK CONDITION status is returned with the sense key to set to ILLEGAL REQUEST.

The drive also returns a CHECK CONDITION status with an ILLEGAL REQUEST sense key if the Host sends an unsupported Page Code, a page field with values that are not supported or are not changeable. In this case, no parameters will have been changed by the command.

6.07.1 Disconnect-Reconnect Page

The drive supports the Disconnect-Reconnect Page which has the following format:

Bit Byte	7	6	5	4	3	2	1	0
0	PS (0)	Reserved	Page Code (02h)					
1	Page Length (0Eh)							
2	Buffer Full Ratio (00h)							
3	Buffer Empty Ratio (00h)							
4	(MSB)	Bus Inactivity Limit (00h)						
5								(LSB)
6	(MSB)	Disconnect Time Limit						
7								(LSB)
8	(MSB)	Connect Time Limit (00h)						
9								(LSB)
10	(MSB)	Maximum Burst size						
11								(LSB)
12	Reserved						DTDC	
13	Reserved							
14	Reserved							
15	Reserved							

Table 6-28: Disconnect-Reconnect Page

Buffer Full Ratio, Buffer Empty Ratio, Bus Inactivity Limit and Connect Time Limit fields are not supported by the drive if set to non-zero values a CHECK CONDITION status is returned with ILLEGAL REQUEST sense key set.

Disconnect Time Limit:

This field indicates the minimum time in 100 microsecond increments that the drive shall wait after releasing the SCSI bus before attempting reselection.

Maximum Burst Size:

This field defines the maximum amount of data that the drive shall transfer during a data phase before disconnecting. This value is expressed in increments of 512 bytes. Default value= 494 (01EEh).

Note: $512 * 494 = 252,928$ bytes which means that the Maximum Burst Size is approximately equal to two DDS Format Groups of user data.

DTDC:

This field defines further restrictions on when a disconnect is permitted.

DTDC	Description
00b	Data transfer disconnect control is not used. Disconnect is controlled by the other field in this page.
01b	A target shall not attempt to disconnect once the data transfer of a command has started until all data the command is to transfer has been transferred. The connect time limit and bus inactivity limit are ignored during the data transfer.
10b	Reserved
11b	A target shall not attempt to disconnect once the data transfer of a command has started until the command is complete. The connect time limit and bus inactivity limit are ignored once data transfer has started.

If DTDC is nonzero and the maximum burst size is nonzero the target shall return CHECK CONDITION status. The sense key shall be set to ILLEGAL REQUEST and the additional sense code set to ILLEGAL FIELD IN PARAMETER LIST.

6.07.2 Data Compression Control Page

The drive supports the Data Compression Control Page which has the following format:

Bit Byte	7	6	5	4	3	2	1	0
0	PS (0)	Reserved	Page Code (0Fh)					
1	Page Length (0Eh)							
2	DCE	DCC	Reserved					
3	DDE	RED		Reserved				
4	(MSB) Compression Algorithm (LSB)							
7								
8	(MSB) Decompression Algorithm (LSB)							
11								
12	Reserved							
13	Reserved							
14	Reserved							
15	Reserved							

Table 6-29: Data Compression Control Page

This page specifies the parameters for the control of the data compression capability of the drive.

DCE:

A data compression enable (DCE) bit of one indicates that data compression is enabled. When this bit is set, data sent to the device by the initiator shall be processed using the selected compression algorithm before being written to the medium. A DCE bit of zero indicates that data compression is disabled.

DCC:

A data compression capable (DCC) bit of one indicates that the drive supports data compression and shall process data sent to it for transfer to the medium using the selected compression algorithm when the DCE bit is one. A DCC bit of zero indicates that the device does not support data compression. This shall be a non-changeable field. The SDT-9000 has the capability to decompress data and will set this bit to a one.

DDE:

A data decompression enable (DDE) bit of one indicates that data decompression is enabled. Data Compression capability can not be turned off on SDT-9000.

RED:

The report exception on decompression (RED) field indicates the device's response to a boundary condition caused by a change in the format of recorded data from:

uncompressed to compressed

or

compressed to uncompressed

This field only has an effect during reading not during writing.

RED=00b When the RED field = 00b, the drive will report a CHECK CONDITION status (MEDIUM ERROR) whenever data is encountered on the media that the drive cannot decompress.

The SDT-9000 will not report CHECK CONDITION at a boundary condition as long as the data is uncompressed or DCLZ compressed.

RED=01b A RED field of 01b is undefined and the drive will issue a CHECK CONDITION status with the sense key set to ILLEGAL REQUEST.

RED=10b When the RED field = 10b, the drive shall return a CHECK CONDITION status whenever a boundary condition is encountered on the medium. The boundary conditions are:

from uncompressed to compressed

or

from compressed to uncompressed

CHECK CONDITION will be reported on the boundary condition even if the drive supports hardware decompression.

For any of the boundary conditions which result in a CHECK CONDITION status, the additional sense code shall be set to either DECOMPRESSION EXCEPTION, ALGORITHM ID OF NN. The drive will set the decompression algorithm field to the algorithm identifier of the compression algorithm used to process the encountered data. The device shall be positioned on the EOP side of the encountered data, and the command-specific information field in the sense data shall contain a count of the number of data blocks contained within the encountered data.

Note: When compressed data is encountered on the medium which the device cannot decompress, the device should treat the data as a single variable-length record. In the sense data, the valid bit, the ILI bit and the information field should be set accordingly.

RED=11b A RED field of 11b is undefined and the drive will issue a CHECK CONDITION status with the sense key set to ILLEGAL REQUEST.

Compression Algorithm:

The compression algorithm field indicates the compression algorithm the drive will use to process data sent to it by the initiator (if the DCE bit is one).

The SDT-9000 supports the DCLZ data compression algorithm which is identified by the value: 00 00 00 20h in the compression algorithm field. A value of zero shall indicate that no compression algorithm is currently selected. Any other values in this field will cause the drive to return a CHECK CONDITION status the sense key shall be set to ILLEGAL REQUEST.

Decompression Algorithm:

For MODE SELECT the decompression algorithm field indicates the decompression algorithm selected by the initiator for use in subsequent decompression of data encountered on the medium.

The SDT-9000 can decompress data recorded with the DCLZ algorithm therefore this field can be set to 00 00 00 20h. However, the SDT-9000 is capable of automatic recognition of the compression algorithm used to process the data encountered on the medium. Therefore, the drive will override the value in the decompression field (if is set to zero) for a subsequent read operation when DCLZ compressed data is detected on the media.

Note: A CHECK CONDITION will occur on the transition from uncompress to compressed if RED = 10b.

For the MODE SENSE command, the decompression algorithm field reflects either the algorithm selected by the initiator or compression algorithm which was used to process the data most recently encountered on the medium, during a read operation.

A value of zero shall indicate that the data encountered on the medium during the most recent read operation was uncompressed.

6. 07. 3 Device Configuration Page

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

Bit Byte	7	6	5	4	3	2	1	0
0	PS (0)	Reserved	Page Code (10h)					
1	Page Length (0Eh)							
2	Reserved	CAP	CAF	Active Format				
3	Active Partition							
4	Write Buffer Full Ratio (00h)							
5	Read Buffer Empty Ratio (00h)							
6	(MSB) Write Delay Time							
7	(LSB)							
8	DBR (0)	BIS (1)	RSmk	AVC (0)	SOCF (00b)		RBO (0)	REW
9	Gap Size (00h)							
10	EOD Defined (000b)			EEG (1)	SEW (1)	Reserved		
11	(MSB)							
12	Buffer Size at Early Warning (00 00 00h)							
13	(LSB)							
14	Select Data Compression Algorithm							
15	Reserved							

Table 6-30: Device Configuration Page

CAP:

The Change Active Partition bit, then set to one, indicates that the logical partition is changed to the one specified by the Active Partition Field. This is a feature supported by the drive and is discussed below.

CAF:

The Change Active Format bit, set to one, indicates that the active format is to be changed to that set in the Active Format Field.

Active Format:

The definition of this field is DAT specific. This field is used to enable DDS format options and is described below:

4	3	2	1	0
Disable RAW	ECC-3	N-Group		

Table 6-31: Active Format

Disable RAW:

This bit is used to enable or disable the use of Read-After-Write error detection. If this bit is NOT set, RAW is enabled. This is the drive's default configuration.

ECC-3:

This bit is used to enable or disable the use of Third Level Error Correction (ECC-3). If this bit is set, ECC-3 is enabled. This is the drive's default configuration.

N-Group:

The value of this field indicates the number of times a group will repeatedly be written to tape. The default is zero repetitions. This feature may be used to performance match the drive with the Host. A decode of the field is shown below:

This field will not be used on DDS-3.

2	1	0	Number of Repetitions
0	0	0	0 (Default)
0	0	1	1
0	1	0	2
0	1	1	3
1	0	0	4
1	0	1	5
1	1	0	6
1	1	1	7

Table 6-32: N-Group field values

Active Partition:

Indicates the current logical partition number in use on the medium.

The partition number may be either partition 0 or 1. Setting this field to any other values will be rejected by the drive with a CHECK CONDITION status and the ILLEGAL REQUEST sense key set.

The drive will default to Partition 0 if the drive has been power-cycled, has received a BUS DEVICE RESET message, a Hard RESET or a tape is loaded. This is irrespective of whether the tape has been partitioned or not. If the media is to be used in the two partition format, the media must first be initialized using MODE SELECT Medium Partitions Parameter Page.

If the currently loaded tape has not been formatted to be a two partition tape and the Host requests the Active Partition to be changed via the CAP and Active Partition fields, then the drive will return a CHECK CONDITION status with a MEDIUM ERROR sense key set.

Write Buffer Full Ratio and Read Buffer Empty Ratio:

These fields are not supported by the drive. Setting these fields to anything other than zero will cause the drive to return a CHECK CONDITION status and an ILLEGAL REQUEST sense key.

The drive implements an algorithm which automatically adjusts these ratios so as to maximize streaming to the Host.

Write Delay Time:

This field indicates the maximum time, in 100 millisecond increments, that the drive shall wait with a partially full buffer before forcing the data to tape. The drive defaults to a 5 second delay since the last SCSI bus activity before the data is flushed from the buffer to the tape. If Write Delay Time is set to zero the drive will wait indefinitely for the data group to be filled.

DBR: This field is not supported and should be always set to 0.

BIS: Block Identifiers Supported is set to one to indicate that the media has recorded information about the logical block ID relative to the partition.

The DBR and BIS bit are only valid on a MODE SENSE command where they are used to report drive capabilities. These bits are ignored by the drive on a MODE SELECT command. The drive will not return a CHECK CONDITION.

RSmk:

The Report Set Mark bit, when set to one, indicates that Save Set Marks will be reported to the drive. When zero, Save Set Marks are NOT reported. The default is one, Save Set Marks reported.

AVC:

Automatic Velocity Control function is not supported by the drive and if this bit is set a CHECK CONDITION status is returned with an ILLEGAL REQUEST sense key.

SOCF:

Stop on Consecutive Filemarks function is not supported by the drive and if this bit is set a CHECK CONDITION status is returned with an ILLEGAL REQUEST sense key.

RBO:

This field is not supported. If this bit is set a CHECK CONDITION status is returned with an ILLEGAL REQUEST sense key.

REW:

The drive returns Report Early-Warning End-of-Media bit not set. This indicates that the drive will not report the early-warning condition on reads but will report early-warning on writes at a distance of 1500 mm (:DDS2/3, 500 mm: DDS-1) before the physical End-Of-Partition

Gap Size:

This field is not used by the DDS format and shall be set to zero otherwise a CHECK CONDITION with an ILLEGAL REQUEST sense key will be returned.

EOD Defined:

This field shall always be set to zero so that the drive will use its default EOD definition to detect and generate EOD. Any other value will cause the drive to return a CHECK CONDITION status with an ILLEGAL REQUEST sense key set.

EEG:

The Enable EOD Generation bit shall always be set to indicate that drive will generate an EOD. The drive generates an EOD mark prior to any change of direction, if that change follows a write-type operation. This bit is only valid on the MODE SENSE command where it is used to report drive capabilities. This bit is ignored by the drive on a MODE SELECT command. The drive will not return a CHECK CONDITION.

SEW:

The Synchronize at Early Warning bit is always set to indicate that data written to the device at or after Early-Warning End-of-Media will be written to the medium as normal. Any other value will cause the drive to return a CHECK CONDITION status with an ILLEGAL REQUEST sense key set.

Buffer Size at Early Warning:

This field is not supported by the drive and if set a CHECK CONDITION status is returned with an ILLEGAL REQUEST sense key set.

Select Data Compression Algorithm:

The SDT-9000 supports the Data Compression Page and that page should be used instead of this field to control Data Compression. This field is not supported by the drive and if set a CHECK CONDITION status is returned with an ILLEGAL REQUEST sense key set.

6.07.4 Medium Partitions Parameter Page

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

Bit Byte	7	6	5	4	3	2	1	0
0	PS (0)	Reserved	Page Code (11h)					
1	Page Length (0Ah)							
2	Maximum Additional Partitions (01h)							
3	Additional Partitions Defined (00h or 01h)							
4	FDP (0)	SDP (0)	IDP	PSUM (10b)		Reserved		
5	Medium format Recognition (03h)							
6	Reserved							
7	Reserved							
8	Partition Size (Partition 0)							
9								
10	Partition Size (Partition 1)							
11								

Table 6-33: Medium Partitions Parameter Page

Warning: This page is used to format a tape to one or two partitions. Extreme care must be used with this parameter page to avoid accidental reformatting of a tape.

Maximum Additional Partitions:

This field is only valid on MODE SENSE where it is used report the maximum number of additional partitions that are supported by the drive, which is one.

Additional Partitions Defined:

This field specifies the number of additional partitions to be defined for the tape based on the IDP bit. The maximum allowed is the value returned in the Maximum Additional Partitions field, which for the drive is one. Therefore, the supported values are zero or one.

If the Mode Sense command is issued with the Parameter List Length set to 16h, the Page Length that is returned will be 8 bytes, and the value for Partition 1 will be returned in bytes 8, 9. The value for Partition 0 is not returned in this case.

For issuing Mode Select with Additional Partition Defined = 0, the command will function properly even when the Parameter List Length of the CDB is set to 14h. In this case, it is necessary to set the Parameter Length to 6h.

FDP:

The Fixed Data Partitions bit is not supported by the drive and if set, a CHECK CONDITION status is returned with an ILLEGAL REQUEST Sense Key set.

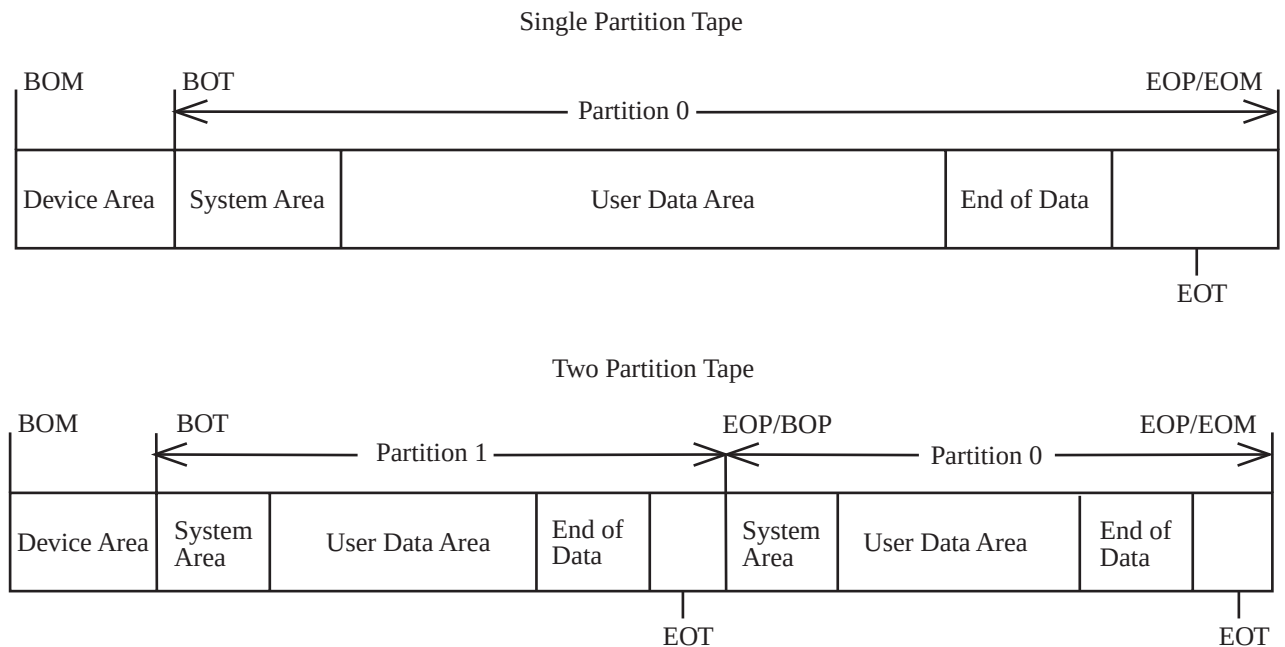
SDP:

The Select Data Partitions bit is not supported by the drive and if set, a CHECK CONDITION status is returned with an ILLEGAL REQUEST Sense Key set.

IDP:

The Initiator Defined Partitions bit is supported and, when set to one, indicates that the tape shall be partitioned based on the Additional Partitions Defined field, PSUM and Partition Size field. Setting of this bit is only valid at BOM, otherwise the drive will return a CHECK CONDITION status with an ILLEGAL REQUEST Sense Key set.

The DDS format allows the tape to be split into two entirely separate and independent partitions. Each partition will have its own Reference, System and Vendor Group area. Each partition will have a minimum size of 2541 frames. The maximum size of a partition will be the whole tape. The partitions may exist together or the entire tape may be treated as a single partition. This is illustrated below:



BOM = Beginning-of-Media (Physical)

BOT = Beginning-of-Tape (Logical)

EOM = End-of-Media (Physical)

EOP = End-of-Partition (Logical)

EOT = End-of-Tape (Logical)

Note: The System area consists of three sub-sections:

Reference Area

System Area

Vendor Group

Figure 6-1: Tape Partition Layout

The Host may, therefore, partition a tape into one partition which spans the whole physical length of the tape or into two partitions, each of which will behave as completely separate and independent tapes.

A tape does not require partitioning prior to use. If a Host only wishes to use a single partition tape, then there is no need to send this page. On the first WRITE to a blank tape, the device will create the System, Reference and Vendor areas on tape before proceeding with the write. To reformat from a two to a single, or from a single to a two partition tape, the Host is required to use the Medium Partitions Parameter page.

PSUM:

The Partition Size Unit of Measured field defines the units in which the Partition Size value selects the partition size, which in the case of this drive is Megabytes. Therefore, the drive returns 10b for a MODE SENSE and will only accept this value for a MODE SELECT, otherwise a CHECK CONDITION status is returned with an ILLEGAL REQUEST Sense Key set.

Medium Format Recognition:

This field is only valid on a MODE SENSE and is set to 03h to indicate that the drive is capable of format and partition recognition.

Partition Sizes:

This field allows the initiator to allocate the capacity of the second partition, Partition 1. It will also allow the initiator to reallocate the capacity of previously partitioned tapes.

The Partition Size specifies the capacity of Partition 1 in Megabytes. The drive rounds the Partition Size to the next whole group value and then applies an algorithm which allows for the writing of ECC-3 frames and for RAW error recovery so as to reserve sufficient physical space on the media for the specified capacity. The minimum space allocated shall be 2541 frames.

If the Additional Partitions Defined and Partition Size fields are set to zero the drive will initialize the tape as Partition 0, spanning the whole length of the tape.

Partition 0 size is only valid during MODE SENSE and is ignored during MODE SELECT Remaining Capacity goes to P.0.

6.08 MODE SENSE 1Ah

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (1Ah)							
1	Logical Unit Number			Reserved	DBD	Reserved		
2	PCF		Page Code					
3	Reserved							
4	Allocation Length							
5	Unused (00b)		Reserved					

MODE SENSE provides a means for the drive to report its media, current and changeable configuration parameters to the host. It is a complementary command to MODE SELECT.

DBD:

A disable block descriptors (DBD) bit of zero indicates that the target may return zero or more block descriptors in the returned MODE SENSE data at the target's discretion. A DBD bit of one specifies that the target shall not return any block descriptors in the returned MODE SENSE data.

PCF:

The Page Control Field indicates the type of page parameter values to be returned to the Host as shown below.

Bit 7	Bit 6	Parameter Values	Description
0	0	Current Values	This is the normal default situation where the drive returns to the host its current configuration. Page fields not supported are set to zero by the drive.
0	1	Changeable Values	These are any values which a host may alter in a subsequent MODE SELECT command. Any field that the drive allows to be changed is set to one. Otherwise the field is set to zero.
1	0	Default Values	The drive returns the default values of the mode parameters. Page field not supported are set to zero by the drive.
1	1	Saved Values	Not supported by the drive

Table 6-34: Page Control field values

The addition page length field of each page returned by the drive indicates the number of bytes supported for that page. Fields not supported by the drive are set to zero.

Page Code:

This allows the Host to select any specific or all pages supported by the drive.

The page codes that are supported are:

Page Code	Description	Parameter List Length
00h	Standard Sense	0Ch
02h	Disconnect-Reconnect Page	0Ch+10h=1Ch
0Fh	Data Compression Control Page	0Ch+10h=1Ch
10h	Device Configuration Page	0Ch+10h=1Ch
11h	Medium Partitions Parameter Page	0Ch+0Ch=18h
3Fh	Return All Pages	0Ch+10h+10h+10h+0Ch=48h

Table 6-35: Supported MODE SENSE Page Codes

If the Host selects any other values, the drive will terminate the command with a CHECK CONDITION status and an ILLEGAL REQUEST sense key set.

Note: If the Page Code is zero, the drive will only return the four-byte header and the one eight-byte block descriptor and terminate the command with GOOD status.

Allocation Length:

The Allocation Length specifies the number of bytes that the HOST has allocated for returned MODE SENSE data. An Allocation Length of zero means that the drive will return no MODE SENSE data. This is not considered an error and GOOD status will be returned. Any other value indicates the maximum number of bytes that can be transferred. The drive terminates the DATA IN phase when the Allocation Length bytes have been transferred or when all available MODE SENSE data has been transferred to the initiator, whichever is less. The Allocation Length must fall on header or block descriptor boundaries. If the Allocation Length does not fall on these boundaries then the drive returns CHECK CONDITION status with the ILLEGAL REQUEST sense key set, unless the value is greater than that required for the specified page.

If the Page Code is zero, the Host requires MODE SENSE to only return the four-byte header the one eight-byte block descriptor, therefore the Allocation Length must be set to 0Ch. The value of the Page Control Field is then not checked by the drive and may be set to any value.

The MODE SENSE data contains a four-byte header, followed by one eight-byte block descriptor, followed by zero or more variable length pages, depending on the Page Code and the Allocation Length.

Bit Byte	7	6	5	4	3	2	1	0
0	Mode Data Length							
1	Medium Type (00h)							
2	WP	Buffered Mode			Speed (00h)			
3	Block Descriptor Length (08h)							
4	Density Code (13h)							
5	(MSB)	Number of Blocks (00 00 00h)						
6								
7								(LSB)
8	Reserved							
9	(MSB)	Block Length						
10								
11								(LSB)

Table 6-36: MODE SENSE data

Mode Data Length:

The mode data length specifies the length in bytes of the following mode sense data that is available to be transferred during the DATA IN phase. The mode data length does not include itself but does include the total length of all requested MODE SENSE pages.

Media Type:

The media value will be zero as only one media type is supported.

WP:

A Write Protected bit of zero indicates that the tape is write enabled. A Write Protected bit of one indicates that the tape is write protected.

Buffered Mode:

if this bit is set to zero, the drive will not report a GOOD status on WRITE commands until the data blocks are actually written on the tape. If set, the drive is in buffered mode and may report a GOOD status on WRITE commands as soon as the data block has been transferred to the drive's buffer. One or more blocks may be buffered prior to writing to the tape.

Speed Field:

will return zero as the drive only supports one speed.

Block Descriptor Length:

returns a value of 8, which specifies the length in bytes of the following Block Descriptor. The drive only returns a single Block Descriptor.

When the DBD is one, the Block Descriptor Length in the parameter header is set to 0.

Destiny Code:

The drive returns 13h in the Density Code field. (Assigned by ANSI SCSI Committee X3T9.2)

Number of Blocks:

The Number of Blocks field is zero, indicating that an unspecified (or unknown) number of the remaining logical blocks on the tape may have the media characteristics specified by the Block Descriptor.

Block Length:

The Block Length field specifies the length in bytes of each logical block transferred over the SCSI bus. A Block Length of zero indicates that the length is variable. Any other value indicates the number of bytes per block that the drive must handshake over the bus. This establishes Block Length such that the Transfer Length for read, write and verify type commands will be a block count not a byte count.

Note: It is value of this field together with the Fixed Bit Field in the READ, or WRITE commands that determines whether the drive is in Fixed or Variable block mode.

Page Descriptor:

The supported pages are fully documented in the MODE SELECT section of this Chapter.

PS: when the Page Savable bit is set, this indicates that the page contains saved parameters. This bit will never be set as there is no non-volatile RAM on the drive into which parameter data may be saved.

All fields not supported by the drive are set to zero.

6.09 PREVENT ALLOW MEDIUM REMOVAL 1Eh

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (1Eh)							
1	Logical Unit Number			Reserved				
2	Reserved							
3	Reserved							
4	Reserved							Prevent
5	Unused (00b)		Reserved					

The PREVENT ALLOW MEDIUM REMOVAL command requests that the target enable or disable the removal of the medium in the drive. This mechanism is independent of device reservations and the drive shall not allow medium removal if any initiator currently has medium removal prevented.

The prevention of medium removal shall begin when any initiator issues a PREVENT ALLOW MEDIUM REMOVAL command with a prevent bit of one (medium removal prevented). The prevention of medium removal for the logical unit shall terminate:

1. Upon a hard RESET condition.
2. Upon the receipt of a BUS DEVICE RESET message from any initiator
3. After all initiators that have medium removal prevented issue PREVENT ALLOW MEDIUM REMOVAL commands with a prevent bit of zero, and the target has successfully performed a synchronize cache operation.

While a prevention of medium removal condition is in effect the target shall inhibit mechanisms that normally allow removal of the medium by an operator.

Prevent:

When this bit is set, the drive will not eject the tape following an UNLOAD. When it receives the UNLOAD, the drive writes any buffered data to tape, rewinds and updates the system logs, then unthreads the tape from the mechanism. The drive does not eject the tape. Setting this bit also completely disables the Eject button on the front panel. This situation remains until the Prevent bit is set to zero.

When this bit is set to zero, the drive ejects the cassette following completion of an UNLOAD. The Eject button is also re-enabled.

6.10 READ 08h

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (08h)							
1	Logical Unit Number			Reserved			SILI	Fixed
2	(MSB)							
3	Transfer Length							
4	(LSB)							
5	Unused (00b)		Reserved					

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

Fixed: This bit specifies the meaning of the Transfer Length field and whether fixed-length or variable-length blocks are to be transferred.

If the Fixed bit is set to zero, Variable Block mode is requested. A single block is transferred with the Transfer Length specifying the maximum number of bytes the Host has allocated for the returned data.

If the Fixed bit is set to one, the Transfer Length specifies the number of blocks to be transferred to the Host. This is valid only if the logical unit is currently operating in Fixed Block mode, in other words, when it has been instructed to use fixed-length blocks with MODE SELECT command. If the Fixed bit is set and the drive is in Variable Block mode, the READ is rejected with a CHECK CONDITION status and an ILLEGAL REQUEST sense key set.

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

A successful READ command with the Fixed bit set transfers (current Block Length) X (Transfer Length) bytes of data to the Host. Upon termination of the READ command, the media will be logically positioned after the last block transferred (EOM side).

SILI: A Suppress Incorrect Length Indicator bit of one indicates that the device will not return CHECK CONDITION status if the only error is that the Transfer Length is not equal to the actual Block Length recorded on the media. Note, however, that if the SILI bit is one and the Fixed bit is zero, then the device WILL report CHECK CONDITION if the requested Transfer Length is less than the actual record size recorded on the medium (overlength condition) AND the device is configured to be in Fixed Block mode (i.e. the Block Length field in the MODE SELECT/SENSE block descriptor is non-zero).

If the SILI bit is one and the Fixed bit is one, the drive will terminate the command with a CHECK CONDITION status with the sense key set to ILLEGAL REQUEST and the additional sense code to ILLEGAL FIELD IN CDB. If the SILI bit is not set and the actual Block Length is different from the specified transfer length, a CHECK CONDITION status is returned. Within the Sense data, the Incorrect Length Indicator (ILI) bit and Valid bit will be set to one, the Sense Key field is set to NO SENSE and the Information Bytes are to set the difference (residue) between the requested Transfer Length and the actual Block Length, or in Fixed Block mode, the difference (residue) between the requested number of blocks and the actual number of blocks read. No more than Transfer Length bytes are transferred to the initiator and the tape is logically positioned after the last block transferred (EOM side).

If the drive reads a Filemark, the drive will return a CHECK CONDITION status. Within the Sense data, the Filemark and Valid bits are set and the Sense Key field is set to NO SENSE. The information fields contain the residue count. The Additional Sense Code and Additional Sense Code Qualifier fields are set to Filemark Detected. Upon termination, the media will be logically positioned after the Filemark (EOM side).

If, however, the drive encounters a Save-Set Mark during a READ, nothing is reported unless the drive has been configured through MODE SELECT to Report Save-Set Marks. The drive will ignore the Setmark and continue the READ. If the Report Save-Set Marks configuration is enabled then the Filemark and Valid bits are set and the Sense Key field is set to NO SENSE. The information fields contain the residue count and the Additional Sense Code and Additional Sense Code Qualifier fields are set to Setmark Detected. The tape is logically positioned after the Save-Set Mark (EOM side).

If the drive detects EOD during the READ, the drive will return a CHECK CONDITION status. Within the Sense data, the Valid bit is set and the Sense Key field is set to BLANK CHECK. The information fields contain the residue count. The Additional Sense Code and Additional Sense Code Qualifier fields are set to EOD DETECTED. Upon termination, the media will be physically positioned before EOD and after the last block on tape.

The meaning of EOM is different for READ than for a WRITE type of command. EOM is only reported when the physical EOM/P is encountered. The drive returns a CHECK CONDITION status. The EOM and Valid bits are set and the Information fields contain the residue count. If EOD is not written after the physical EOM/P, the Sense Key is set to MEDIUM ERROR and the Additional Sense Code and Additional Sense Code Qualifier fields are set to EOM/P Detected. If EOD is written, the Sense Key is set to BLANK CHECK and the Additional Sense Code and Additional Sense Code Qualifier fields are set to END-OF-DATA DETECTED. The tape is physically positioned at EOM/P.

For a Filemark, a (reported) Save-Set Mark, EOD or EOM detected, if the Fixed bit is set, the Information field in the REQUEST SENSE Data will be set to the difference (residue) between the requested Transfer Length and the actual number of blocks read (not including the Filemark or Save-Set Mark). If the Fixed bit is set to zero, the information bytes will be set the requested Transfer Length because Filemarks and Save-Set Marks are considered to have a byte count of zero, (though this does not cause the ILI bit to be set).

READ may return the following sense keys on a CHECK CONDITION:

NO SENSE :

If the actual Block Length is different from the specified Transfer Length and the SILI bit is zero, the ILI (Incorrect Length Indicator) bit and Valid bit are set to one. The Information bytes in extended sense are set to the difference (residue) between the requested Transfer Length and the actual Block Length, or in blocked mode, the difference (residue) between the requested number of blocks and the actual number of blocks read (not including the incorrect length block). No more than Transfer Length bytes are transferred to the initiator and the tape is logically positioned after the block (EOM side).

If the drive reads a Filemark during this command, it sets the Filemark bit in the REQUEST SENSE data. Upon termination, the tape is logically positioned after the Filemark (EOM side). If, however, the drive encounters a Save-Set Mark during this command, nothing is reported unless the SDT-9000 has been configured through MODE SELECT to Report Save Set Marks. If the Report Save Set Marks configuration is enabled then the Valid bit and the Additional Sense Key flags are set in the REQUEST SENSE data to indicate that a Save-Set Mark has been encountered. The tape is also logically positioned after the Save-Set Mark (EOM side).

For both a Filemark and a reported Save-Set Mark, if the Fixed bit is one, the Information bytes in the REQUEST SENSE data are set to the difference residue between the requested Transfer Length and the actual number of blocks read (not including the Filemark or Save-Set Mark).

If the Fixed bit is set to zero, the Information bytes are set to the difference (residue) between the requested Transfer Length and the actual number of bytes read. Filemarks and Save-Set Marks are considered to have a byte count of zero, though this does not cause the ILI bit to be set.

MEDIUM ERROR :

The current record being read or a previously acknowledged WRITE type of operation experienced an error probably related to the condition of the tape, or the cleanliness of the head.

HARDWARE ERROR :

Either a previously acknowledged WRITE type of operation had a major non-media related failure or the read itself experienced the failure. The Valid bit is set, and the Information field contains the appropriate residue. The meaning of EOM is different in a READ command from that in a WRITE type of command. EOM is only reported on physical end-of-media. However, this condition is indistinguishable from other fatal servo errors and so is reported as a HARDWARE ERROR.

BLANK CHECK:

If EOD (End-of-Data) was encountered during a read, the sense key is BLANK CHECK, the Valid bit is set and the Information bytes contain the residue count.

6.11 READ BLOCK LIMITS 05h

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (05h)							
1	Logical Unit Number			Reserved				
2	Reserved							
3	Reserved							
4	Reserved							
5	Unused (00b)		Reserved					

The READ BLOCK LIMITS command tells the drive to return its limits for Block Length. The READ BLOCK LIMITS data shown below will be sent during the DATA IN phase of the command. The command does not reflect the currently selected block size, only the available limits. MODE SENSE returns the current block size.

One (1) byte is the minimum and 16 Megabytes - 1 byte is the maximum block size which the unit can support.

Bit Byte	7	6	5	4	3	2	1	0
0	Reserved							
1	(MSB)							
2	Minimum Block Length Limit (FF FF FFh)							
3								
4	(MSB)							
5	Minimum Block Length Limit (00 01h)							

Table 6-37: READ BLOCK LIMITS Data

6.12 READ BUFFER 3Ch

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (3Ch)							
1	Logical Unit Number			Reserved		Mode		
2	Buffer ID (00h)							
3	(MSB)							
4	Buffer Offset							
5	(LSB)							
6	(MSB)							
7	Allocation Length							
8	(LSB)							
9	Unused (00b)		Reserved					

READ BUFFER is used in conjunction with WRITE BUFFER as a diagnostic function for testing the 1MB data buffer and the SCSI bus integrity of the drive. A REWIND command should be sent to the drive after WRITE/READ BUFFER diagnostic testing to return to normal operation.

Note: This command was not intended to be used to recover data that is buffered within the drive. Data returned is not guaranteed to be valid, as the drive writes any buffered data to tape prior to accepting either a READ BUFFER or WRITE BUFFER for the first time.

Mode:

The drive supports the following values within this field. If any other value is set, the drive will terminate the command with a CHECK CONDITION status and an ILLEGAL REQUEST sense key set.

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

Table 6-38: READ BUFFER Mode values

Combined Header and Data Mode - in this mode, the drive returns a four-byte header followed by the data bytes.

The drive terminates the DATA IN phase when Allocation Length bytes of header plus data have been transferred or when the header and all available data have been transferred to the initiator, whichever is less.

The four-byte READ BUFFER header is followed by data bytes from the drive’s data buffer.

Bit Byte	7	6	5	4	3	2	1	0
0	Reserved							
1	(MSB)							
2	Available Length (10 00 00h)							
3	(LSB)							

Table 6-39: READ BUFFER Header

Available Length:

specifies the total number of data bytes that are available in the target's data buffer. This number is not reduced to reflect the Allocation Length nor is it reduced to reflect the actual number of bytes written using the WRITE BUFFER command. Following the READ BUFFER header, the target will transfer data from its data buffer.

Data Mode - in this mode, the DATA IN phase contains buffer data only.

Descriptor Mode - In this mode a maximum of four bytes of READ BUFFER descriptor information are returned. The drive returns the descriptor information for the buffer specified by the Buffer ID. Only a Buffer ID of zero will return a valid descriptor. In this mode, the drive does not reject the valid Buffer IDs with a CHECK CONDITION status but returns 10 00 00h in the READ BUFFER descriptor.

Bit Byte	7	6	5	4	3	2	1	0
0	Reserved							
1	(MSB)							
2	Buffer Capacity (10 00 00h)							
3	(LSB)							

Table 6-40: READ BUFFER Descriptor

Buffer ID:

The drive only supports a single Buffer ID field of zero. If an unsupported Buffer ID code is requested, the drive returns a CHECK CONDITION status with an ILLEGAL REQUEST sense key set.

Buffer Offset:

The buffer offset field contains the byte offset within the specified buffer from which data shall be transferred from. The initiator should conform to the offset boundary requirements returned in the READ BUFFER descriptor. If the target is unable to accept the specified buffer offset, it shall return CHECK CONDITION status, shall set the Sense Key to ILLEGAL REQUEST, and set the Additional Sense Code to ILLEGAL FIELD IN CDB.

Allocation Length:

The Allocation Length specifies the maximum number of bytes that the initiator has allocated for returned data. An Allocation Length of zero indicates that no data will be transferred. Any other value indicates the maximum number of bytes that will be transferred. The drive terminates the DATA IN phase when Allocation Length bytes of data have been transferred or when all available data has been transferred to the initiator, whichever is less. The Allocation Length must be greater than four (except in data only mode), else the drive will return a CHECK CONDITION status with an ILLEGAL REQUEST sense key set.

6.13 READ POSITION 34h

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (34h)							
1	Logical Unit Number			Reserved				BT
2	Reserved							
3	Reserved							
4	Reserved							
5	Reserved							
6	Reserved							
7	Reserved							
8	Reserved							
9	Unused (00b)		Reserved					

The READ POSITION command reports the current position of the logical unit. No medium movement shall occur as a result of the command. The position is given in two parts:

- 1. The current partition.
- 2. The offset from the start of the current partition in terms of either records (ignoring marks), or the court of all records and marks. The choice of blocks/blocks and marks is made by the host in clearing or setting the BT field.

BT: A block address type (BT) bit of one requests the target to return its current First Block Location shall include data blocks only. A BT bit of zero requests the target to return the First Block Location as a SCSI Logical Block Address (data blocks, Filemarks and Save-Set Marks are counted).

The READ POSITION data shown below shall be returned during the DATA IN phase of the command.

Bit Byte	7	6	5	4	3	2	1	0
0	BOP	EOP	Reserved			BPU	Reserved	
1	Partition Number							
2	Reserved							
3	Reserved							
4	(MSB)	First Block Location						
7							(LSB)	
8	(MSB)	Last Block Location (00 00 00 00h)						
11							(LSB)	
12	Reserved							
13	(MSB)	Number of Blocks in Buffer (00 00 00h)						
15							(LSB)	
16	(MSB)	Number of Bytes in Buffer (00 00 00h)						
19							(LSB)	

Table 6-41: READ POSITION Data Format

BOP:

A beginning of partition (BOP) bit of one indicates that the logical unit is at the beginning-of-partition in the current partition. A BOP bit of zero indicates that the current logical position is not at the beginning-of-partition.

EOP:

An end of partition (EOP) bit of one indicates that the logical unit is positioned between early-warning and end-of-partition in the current partition. An EOP bit of zero indicates that the current logical position is not between early-warning and end-of-partition. Note that this bit is mutually exclusive with the BOP bit.

BPU:

A block position unknown (BPU) bit of one indicates that the First and Last Block Locations are not known or cannot be obtained. A BPU bit of zero indicates that the First contains valid position information. Support for this option of the READ POSITION command is indicated by a BIS bit set to one in the MODE SELECT Device Configuration page.

Partition Number:

reports the current partition number for the current logical position.

First block location: indicates the Block Address associated with the current logical position. The value shall indicate the Block Address of the next data block to be transferred between the initiator and the target if a READ or WRITE command is issued. See BT field for description of Logical Block Address. Note that the Logical Block Address at BOT/P is 0.

Last block location:

This field is not supported and is always set to 0.

Number of Blocks in Buffer:

This field is not supported and is always set to 0.

Number of Bytes in Buffer:

This field is not supported and is always set to 0.

6.14 RECEIVE DIAGNOSTIC RESULTS 1Ch

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (1Ch)							
1	Logical Unit Number			Reserved				
2	Reserved							
3	(MSB) Allocation Length							
4	(LSB)							
5	Unused (00b)		Reserved					

RECEIVE DIAGNOSTIC RESULTS requests error analysis data be sent to the initiator after completion of a SEND DIAGNOSTIC command.

Allocation Length:

This field specifies the number of bytes that the initiator has allocated for returned diagnostic data. An Allocation Length of zero means that no diagnostic data will be transferred. Any other value indicates the maximum number of bytes that will be transferred.

If the SEND DIAGNOSTIC had the PF bit set, the drive returns four bytes of header data as well as five bytes of the diagnostic result. If the PF bit was not set, the drive returns only the five bytes of the diagnostic result.

The drive terminates the DATA IN phase when Allocation Length bytes have been transferred or when all the available diagnostic data (five or nine bytes depending on the PF bit) have been transferred to the initiator, whichever, is less.

If the drive returns a CHECK CONDITION status with the HARDWARE ERROR Sense Key and an Additional Sense Code of DIAGNOSTIC FAILURE set on completion of a SEND DIAGNOSTIC, then the Host should issue a RECEIVE DIAGNOSTIC RESULTS command to receive the eight bytes of data indicating the actual failure and the Most Suspect Unit (MSU).

If the Host issued a SEND DIAGNOSTIC with the PF bit set and a page Code of zero, the drive returns which pages it supports in the following format:

Bit Byte	7	6	5	4	3	2	1	0
0	Page Code (00h)							
1	Reserved							
2	(MSB)Page Length (00 02h)							
3	(LSB)							
4	Supported Page Code (00h)							
5	Supported Page Code (81h)							

Table 6-42: RECEIVE DIAGNOSTICS supported pages

If the Host issued a SEND DIAGNOSTIC with the PF bit set and a Page Code of 81h, the drive returns the following four bytes of page header, then five bytes of diagnostic results.

Bit Byte	7	6	5	4	3	2	1	0
0	Page Code (81h)							
1	Reserved							
2	(MSB)Page Length (00 05h)							
3	(LSB)							

Table 6-43: RECEIVE DIAGNOSTICS page header

The structure of the diagnostic results data is described below:

All error messages are of the same format. All fields within the error message may not be known or applicable and are cleared to zero. A diagnostic result of all zeros is returned if the diagnostic completed successfully without error.

Bit Byte	7	6	5	4	3	2	1	0
0	Reset Error	Time Re-Sync	Reserved		Error Set			
1	Error Code							
2	Result A							
3	Result B							
4	Test Number							

Table 6-44: RECEIVE DIAGNOSTICS results data

Reset error:

This bit is set when an error occurs during power-on selftest.

Time Re-Sync:

This bit indicates that the time stamp saved with the error log has no relation to that of the previous entry. It is only set by the logging routine within the data buffer as an error is logged.

Error set:

Various set of error codes exist. The definition of the error is dependent upon when set is taken from as follows:

- 0 - Runtime errors
- 1 - Drive mechanism diagnostic errors
- 2 - Drive electronics diagnostic errors

Error code:

Error codes for each error set are defined in the Diagnostics section.

Result A and B:

The content of these bytes depends on the test being run. See the Diagnostics section.

Test number:

This is the test number to which the message applies (if a test fails within a sequence, the individual test number will be returned).

6.15 RELEASE UNIT 17h

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (17h)							
1	Logical Unit Number			3rD Ptg	Third Party Dvice ID			Reserved
2	Reserved							
3	Reserved							
4	Reserved							
5	Unused (00b)		Reserved					

RELEASE UNIT releases the drive if it is currently reserved by the requesting initiator.
It is not an error to attempt to release the drive if it is not currently reserved to the requesting initiator. However, if it is reserved by another initiator, the drive is not released.

3rdPty:

The Third-Party release option for the RELEASE UNIT command allows an initiator to release a logical unit that was previously reserved using the Third-Party reservation option.
If the 3rdPty bit is zero, then the Third-Party release option is not requested. If the 3rdPty bit is one, then the drive is released, if the reservation was made using the Third-Party reservation option by the initiator that is requesting the release and for the same SCSI device as specified in the Third-Party Device ID field.

6.16 REQUEST BLOCK ADDRESS 02h

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (02h)							
1	Logical Unit Number			Reserved				
2	Reserved							
3	Reserved							
4	Allocation Length (03h)							
5	Unused (00b)		Reserved					

The REQUEST BLOCK ADDRESS command reports the current position of the logical unit. No medium movement shall occur as a result of the command. This command is used in conjunction with the SEEK BLOCK (0Ch) command.

Note: This command is similar in function to the SCSI-2 READ POSITION command and is supported by the SDT-9000 to allow backward compatibility with QIC-104 type devices.

Blocks are numbered sequentially, starting with 0 at BOT. Each SCSI Block, Filemark or Save Set Mark after BOT adds one to the count.

Allocation Length:

Indicates the number of bytes of the Block Address to transfer. A value of zero indicates that the default data Transfer Length of 3 bytes is used.

Bit Byte	7	6	5	4	3	2	1	0
0	Logical Block Address (MSB)							
1	Logical Block Address							
2	Logical Block Address (LSB)							

Table 6-46: Request Block Address Data Format

The Logical Block Address fields contain the current tape position block number.

6.17 REQUEST SENSE 03h

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (03h)							
1	Logical Unit Number			Reserved				
2	Reserved							
3	Reserved							
4	Allocation Length (1Ah)							
5	Unused (00b)		Reserved					

The REQUEST SENSE command requests that the target transfer sense data to the initiator.

The Sense Data will be valid for a CHECK CONDITION or RESERVATION CONFLICT status returned on the previous command. The Sense data will be preserved by the target until retrieved by the REQUEST SENSE command or until the receipt of any other command from the same initiator. The 26 bytes of Sense data are cleared upon receipt of any subsequent command to the logical unit, including another REQUEST SENSE.

If the drive receives an unsolicited REQUEST SENSE, then it returns Sense data with the Filemark, EOM and the appropriate values in the Additional Sense Code/Additional Sense Code Qualifier fields. These fields are only set if the drive is currently logically positioned at BOM/P, EOM, EOD, or after a Filemark or after a Setmark. The Host is required to know what the current direction of tape motion is and, therefore to know whether the logical position at a Filemark or Setmark is either on the BOT or EOT side of that mark.

The positional information provided reflects the logical position of the drive. The drive returns information based on the data still in its buffer as well as the data on tape.

The REQUEST SENSE command does not cause the drive to flush its buffered data to tape. Therefore, if the Host requires the exact physical positioning of the media, it should precede the REQUEST SENSE with a WRITE FILEMARKS command with the number of Filemarks field = 0 and with the immediate bit set to 0. This command will force the drive to flush any currently buffered data to tape. A subsequent REQUEST SENSE will return the initiator the actual physical (and logical) position of the drive.

Note: The drive will only maintain valid positional information on normal operating commands. If the SEND DIAGNOSTIC or READ/WRITE BUFFER commands are sent to the drive, valid positional information will not be returned in response to an unsolicited REQUEST SENSE.

Allocation Length:

The Allocation Length specifies the maximum number of sense bytes to be returned. The drive terminates the transfer when the Allocation Length bytes have been transferred or when all available sense data has been transferred to the Host, whichever is less.

The returned sense information has the following format:

Bit Byte	7	6	5	4	3	2	1	0
0	Valid	Error Code (70h or 71h)						
1	Segment Number							
2	Filemark	EOM	ILI	Reserved	Sense Key			
3	(MSB)	Information Bytes						
6								(LSB)
7	Additional sense Length (12h)							
8	(MSB)	Command -Specific Information						
11								(LSB)
12	Additional Sense Code							
13	Additional Sense Code Qualifier							
14	Field Replaceable Unit code							
15	SKSV	Sense-Key specific						
17								
18	Reserved							
19	(MSB)	Read/WriteData Errr Counter						
21								(LSB)
22	Reserved							
23	(MSB)	Remaining Tape						
25								(LSB)

Table 6-47: Error Codes 70h and 71h Sense Data Format

Valid:

A Valid bit of one indicates that the Information Bytes hold residual data as defined in the SCSI spec.

Error Code:

A value of 70h indicates a current error, i.e. the report is associated with the most recently received command.

A value of 71h indicates a deferred error, i.e. the report is associated with a previous command and is not as a result of the current command.

No other values will be returned.

Segment Number:

Contains the number of the current segment descriptor if the REQUEST SENSE command is in response to a COPY command. Otherwise this byte is zero.

Filemark:

This bit indicates that the current command has read a Filemark or a Setmark. Reporting of Setmarks is optional and indicated by the RSmk bit in the MODE SENSE/SELECT Device Configuration Parameter page.

EOM:

This bit indicates that an End-Of-Medium condition (End of Partition, Beginning of Partition) exists. The drive will also set the Sense Key be to NO SENSE and the Additional Sense Code Qualifier to either 04h for Beginning of Partition or 02h for End of Partition

For WRITE type operations, the drive will return a CHECK CONDITION on any operation which occurs following detection of the Early Warning End-of-Partition marker. The EOM and Additional Sense Code fields will be set.

For READ type operations, the drive will not return a CHECK CONDITION until the drive encounters the physical End-of-Partition.

Note that at PHYSICAL End-of-Partition, a WRITE FILEMARK command will cause the command to terminate with a CHECK CONDITION and a sense key of VOLUME OVERFLOW.

Note: On a DDS formatted tape, there are two indicators towards the physical end of the partition. First is EOT which occurs 1500 mm before the EOM mark (: DDS-2/3, 500 mm: DDS-1). EOM indicates the end of usable tape. The drive will NEVER write data to tape after encountering EOM. The drive uses EOT to generate the early EOP warning on writes. The host may write approximately 150 megabytes of uncompressed data to tape following the early EOM warning before encountering the physical EOM (:DDS-3, 50 megabytes: DDS-2, 10 megabytes: DDS-1).

ILI: This is the Incorrect Length Indicator bit, which indicates that the requested logical block length did not match the logical block length of the data on the medium. Only READ or VERIFY may cause this bit to be set.

Information Bytes:

The conditions of these bytes will contain the differences (residue) of the requested length minus the actual length in either bytes, blocks, Filemarks or Setmarks as determined by the command. (Negative values are indicated by two's complement notation.) These bytes will be valid for all READ, WRITE, SPACE and VERIFY commands for which a CHECK CONDITION status has been generated. These bytes will be zero for MODE SELECT/SENSE, INQUIRY, READ BLOCK LIMITS and TEST UNIT READY commands.

Additional Sense Length:

This specifies the number of additional sense bytes that are to follow. If the Allocation Length of the Command Descriptor Block is too small to transfer all of the additional sense bytes, the Additional Sense Length is not adjusted to reflect the truncation.

Command Specific Information Bytes:

Command Specific Bytes are unused, and will be zero.

Additional Sense Code and Additional Sense Code Qualifier:

These two bytes provide additional information about what caused the CHECK CONDITION status. They are used extensively by the drive. The information is presented in the Sense Key Description table on the following pages.

Field Replaceable Unit Code:

This byte is used to define a device specific mechanism or part that has failed. A value of zero indicates that no specific mechanism or unit has been identified to have failed. The units and their values are:

- 00h - Unable to identify failed unit
- 01h - Drive Mechanism
- 02h - Drive Electronics

Sense Key specific bytes:

These fields will contain data that further defines the nature of the CHECK CONDITION.

If the sense field is set to ILLEGAL REQUEST and the SKSV bit is set to one, the Sense Key specific fields will be as shown below. The fields point to illegal parameters sent by the Host.

Bit Byte	7	6	5	4	3	2	1	0
15	SKSV(1)	C/D	Reserved	Reserved	BPV	Bit Pointer		
16	(MSB) Field Pointer							
17	(LSB)							

Table 6-48: Field Pointer Bytes

C/D: When this bit is set, it indicates that the illegal parameter is in the Command Descriptor Block. A C/D of zero indicates that the illegal parameter is in the Parameter List sent by the Host during the DATA OUT phase.

BPV: When the Bit Pointer Valid bit is set, indicates that the Bit Pointer field specifies which bit of the byte designated by the Field Pointer is in error. When a multiple-bit field is in error, the Bit Pointer field points to the most significant (left most) bit of the field.

Field Pointer:

This field indicates which byte of the Command Descriptor Block or of the Parameter List data was in error. Bytes are numbered from zero. When a multiple byte field is in error, the pointer points to the most significant byte of the field.

If the SKSV bit is zero, then the Field Pointer Bytes take the SONY Unique format as shown below:

Bit Byte	7	6	5	4	3	2	1	0
15	SKSV(0)	Reserved						
16	Runtime Error Code							
17	Status Byte (00h)							

Table 6-49: Error Code and Status Bytes

Runtime Error Code:

This field is part of the internal protocol and contains the Runtime (error set 0) Error code. These internal error codes are also listed below, showing to which Sense, ASC and ASCQ fields they are mapped.

Status Byte: This field is not supported. The drive will always return 00h in this byte.

Read/Write Data Error Counter: After a read operation, this field returns “Number of read soft errors” fields of Log data. After a write operation, this field returns “Number of write soft errors” fields of Log data.

Note: This field is valid only after a READ or a WRITE command.

Note: It is direct mapping of the relevant Log data and is cleared/reset in the same way as the Log data.

Remaining Tape:

The capacity remaining of the tape in 1024 byte blocks is returned. This means the area from the current logical position to EOP.

A description of the different Sense Keys (Byte 2), Additional Sense Codes (Byte 12), and the Additional Sense Code Qualifiers (Byte 13) supported by the SDT-9000 are listed in a table beginning on the following page.

The following Table shows the REQUEST SENSE Sense Keys and the Additional Sense Key (Byte 12) and the Additional Sense Key Qualifier (Byte 13) supported by the SDT-9000:

Sense Key	Bytes 12 13	Description
0h		NO SENSE: Indicates that there is no specific sense key information to be reported for the designated logical unit. This would be the case for a successful command or a command that received CHECK CONDITION or COMMAND TERMINATED status because one of the Filemark, EOM, or ILI bits is set to one. For Filemark or Setmark detected the drive will be positioned on the EOM side of the mark if the drive direction was forward and on the BOM side of the mark if the direction was reverse.
	00 00	NO ADDITIONAL SENSE INFORMATION
	00 01	FILEMARK DETECTED
	00 02	END-OF-PARTITION/MEDIUM DETECTED
	00 03	SETMARK DETECTED
	00 04	BEGINNING-OF-PARTITION/MEDIUM DETECTED
	00 05	END-OF-DATA DETECTED
1h		RECOVERED ERROR.
2h		NOT READY. Indicates that the logical unit addressed cannot be accessed. Operator intervention may be required to correct this condition. Typically this indicates that there is no tape loaded. This status is also returned if the drive is currently rewinding following REWIND with Immed bit set and another command is received (except for INQUIRY and READ BLOCK LIMITS which return GOOD status).
	04 00	LOGICAL UNIT NOT READY - Media is present within the drive. This status is returned to any tape motion command following UNLOAD with Immed bit set or if the Eject button has been pressed by the operator. Also can be caused by the command sequence, PREVENT ALLOW MEDIA REMOVAL with Prevent bit set followed by UNLOAD. Tape motion commands such as READ, WRITE or SPACE are not allowed but Diagnostics which do not access the tape are permitted.
	04 01	LOGICAL UNIT IS IN PROCESS OF BECOMING READY - This status is returned following a LOAD command with the IMMED bit set for any tape motion command before the tape is loaded. Also during the auto load following a tape insertion.
	3A 00	MEDIUM NOT PRESENT - This status is returned for all tape motion commands when there is no media within the drive.

Table 6-50: Sense Key Descriptions (1/6)

Sense Key	Bytes 12 13	Description
3h		MEDIUM ERROR. Indicates that the current command or a previously acknowledged write-type operation terminated with a non-recovered error condition that was probably caused by a flaw in the medium, an error in the recorded data or the cleanliness of the head. This sense key may also be returned if the drive is unable to distinguish between a flaw in the medium and a specific hardware failure (sense key 4h). This condition is also marked by the Valid bit being set, indicating that the information bytes contain residue information.
	00 02	END-OF-PARTITION/MEDIUM DETECTED
	0C 00	WRITE ERROR - The Read-After-Write Retry limit was exceeded during Write. Probably caused by a flaw in the media.
	11 00	UNRECOVERED READ ERROR - C1, C2 & C3 Error Correction could not correct a Read Error. Probably caused by a flaw in the media.
	11 08	INCOMPLETE BLOCK READ - The drive could not read the DDS Format Group containing the requested block. Could be caused by head clogging or media damage.
	14 03	END-OF-DATA NOT FOUND - While Reading a DDS format tape, the drive encountered blank (unformatted) media during a Read operation. This error could be caused by serious head clogging.
	14 04	BLOCK SEQUENCE ERROR - The Group Count, which increments on sequential groups, is not continuous. Format discontinuity
	15 02	POSITIONING ERROR DETECTED BY READ OF MEDIUM - Cannot find destination Group during Space operation.
	30 00	INCOMPATIBLE MEDIUM INSTALLED - Format violation. Possible that the Sub-Area cannot be read.
	30 02	CANNOT READ MEDIUM, INCOMPATIBLE FORMAT - Format violation, non-DDS
	31 00	MEDIUM FORMAT CORRUPTED - DDS format Group GIT, BAT, or Sub-Codes do not match or are improper
	33 00	TAPE LENGTH ERROR - Attempting to select partition 1 on a single partition tape. Requested partition size in MODE SELECT - Medium Partitions Parameter page is too large (exceeds tape length) or too small (0 < requested partition size in frames < 2541).
	3B 00	SEQUENTIAL POSITIONING ERROR - Cannot format the tape because the tape position is not at BOT.
	3B 01	TAPE POSITION ERROR AT BEGINNING-OF-MEDIUM - Broken tape
	3B 08	REPOSITION ERROR - Position lost during Read, Verify, Write, Space or Select Partition operation.
	50 00	WRITE APPEND ERROR - Cannot find the last frame of the Group and therefore, cannot append.
	70 NN	DECOMPRESSION EXCEPTION SHORT ALGORITHM ID OF NN - ALGORITHM ID ≤ 255
	71 00	DECOMPRESSION EXCEPTION LONG ALGORITHM ID - ALGORITHM ID > 255

Table 6-50: Sense Key Descriptions (2/6)

Sense Key	Bytes 12 13	Description
4h		HARDWARE ERROR. Indicates that the drive detected a non-recoverable hardware failure not related to the tape (for example, controller failure, device failure, parity error, etc.) while performing the command or during a self test. If a previously acknowledged WRITE-type operation was the cause, the Valid bit is set. The Error Code in Sense Byte 16 will indicate the specific problem. Refer to the Error Code table in the Diagnostics section for more information.
	03 00	PERIPHERAL DEVICE WRITE FAULT - Drive electronics did not report successful completion to a Write operation.
	09 00	TRACK FOLLOWING ERROR - Mechanical motion timeout, Servo loopback failure, Drum or Capstan speed out of expected tolerance
	15 01	MECHANICAL POSITIONING ERROR - Cassette Compartment motion is improper.
	44 00	INTERNAL TARGET FAILURE - Any unexpected internal error conditions indicating a non-recoverable hardware failure. Refer to the Field Replaceable Unit Code field (Sense Byte 14) to determine which part of the drive is failing. Host should issue SEND DIAGNOSTICS with the Self-Test bit set to thoroughly test the drive. This Sense information could also be returned after a SEND DIAGNOSTICS command ends with a CHECK CONDITION Status. Host should issue RECEIVE DIAGNOSTICS RESULTS for more details. Possible causes: Buffer overrun/underrun, Format violation, Mechanical status timeout, internal data parity error, byte count mismatch, incorrect micro processor operation, unexpected SCSI protocol chip interrupt
	52 00	CARTRIDGE FAULT - Possible causes: Illegal media recognition switch pattern, Reel motors will not turn
	53 00	MEDIA LOAD OR EJECT FAILED - Unable to complete Load or Unload operation successfully. Possible causes: Mechanical problems or Read/Write failure in test section of the media

Table 6-50 Sense Key Descriptions (3/6)

Sense Key	Bytes 12 13	Description
5h		ILLEGAL REQUEST. Indicates that there was an illegal parameter in the Command Descriptor Block or in the additional parameters supplied as data for some commands. If the target detects an invalid parameter in the command descriptor block, then it shall terminate the command without altering the medium. If the target detects an invalid parameter in the additional parameters supplied as data, then the target may have already altered the medium. This sense key may also indicate that an invalid IDENTIFY message was received.
	1A 00	PARAMETER LIST LENGTH ERROR - Indicates that the Parameter Length error in the Command Descriptor Block. Either the value does not fall on a Header, Page or Block descriptor boundary or the Parameter List Length is unexpectedly large.
	20 00	INVALID COMMAND OPERATION CODE - Invalid or Unsupported command.
	24 00	INVALID FIELD IN CDB - Bits are set in one or more fields are not supported or are Reserved. Refer to the Field Pointer (Bytes 15-17) to identify the illegal bit or field.
	25 00	LOGICAL UNIT NOT SUPPORTED - The SDT-9000 has an embedded SCSI controller with only one Logical Unit (LUN). The error indicates that the LUNTRN field in the Identify message was not zero.
	26 00	INVALID FIELD IN PARAMETER LIST - Test Number, Configuration Number Header, or Field in the Parameter List was invalid or selected Diagnostic test is not Host assessable.
	26 01	PARAMETER NOT SUPPORTED - Unsupported page requested. Refer to the Field Pointer (Bytes 15-17) to identify the illegal bit or field.
	2C 00	COMMAND SEQUENCE ERROR - Write Buffer command when tape is inserted and not at BOT.
	3D 00	INVALID BITS IN IDENTIFY MESSAGE - Identify message was not 80h or C0h.
6h		UNIT ATTENTION. Indicates that the removable medium may have been changed or the target has been reset.
	28 00	NOT READY TO READY TRANSITION, MEDIUM MAY HAVE CHANGED
	29 00	POWER ON, RESET, OR BUS DEVICE RESET OCCURRED
	29 80	Drive Failed Power-on test or Diagnostic - (SONY Unique)
	2A 00	PARAMETERS CHANGED
	2A 01	MODE PARAMETERS CHANGED - Issued to all other initiators after one initiator changes any Mode Parameter.

Table 6-50: Sense Key Descriptions (4/6)

Sense Key	Bytes 12 13	Description
7h	27 00	DATA PROTECT. Indicates that a WRITE type of operation was attempted on a write protected tape, write operation is not performed. WRITE PROTECTED - Cassette is Write Protected
8h	00 00 00 05	BLANK CHECK. Indicates the drive encountered blank medium or end-of-data indication while reading. NO ADDITIONAL SENSE INFORMATION - Blank Tape was encountered at BOT END-OF-DATA DETECTED - During READ or SPACE command.
9h		Vendor Specific. Not supported by the SDT-9000
Ah		COPY ABORTED. Not supported by the SDT-9000
Bh	00 00 2C 00 43 00 45 00 47 00 48 00 49 00 4A 00 4B 00 4E 00	ABORTED COMMAND. Indicates that the target aborted the command. If an invalid or inappropriate message was received during the operation, or a SCSI bus protocol error was detected, the operation is terminated in an indeterminate state and ABORTED COMMAND is returned. The initiator may be able to recover by trying the command again. NO ADDITIONAL SENSE INFORMATION - Aborted Command - Host issued Abort message, Eject button pressed by an operator, or command protocol error. COMMAND SEQUENCE ERROR - Unexpected SCSI phase sequence. MESSAGE ERROR - Unexpected Message phase. SELECT OR RESELECT FAILURE - SCSI Selection/Reselection error. SCSI PARITY ERROR - SCSI Parity Error detected and drive proceeded to Status phase. INITIATOR DETECTED ERROR MESSAGE RECEIVED INVALID MESSAGE ERROR - Illegal Message received and drive proceeded to Status phase. COMMAND PHASE ERROR DATA PHASE ERROR - Possible DMA error OVERLAPPED COMMANDS ATTEMPTED - Host issued a new command to the drive while a previous command was being executed.
Ch		EQUAL. Not supported by the SDT-9000

Table 6-50: Sense Key Descriptor (5/6)

Sense Key	Bytes 12 13	Description
Dh	00 02	VOLUME OVERFLOW. Indicates that the drive has reached the physical end-of-partition and data may remain in the buffer that has not been written to the medium. END-OF-PARTITION/MEDIUM DETECTED - During Write type operation.
Eh		MISCOMPARE. Not supported by the SDT-9000
Fh		RESERVED. Not used by SDT-9000

Table 6-50: Sense Key Descriptions (6/6)

REQUEST SENSE returns the CHECK CONDITION status only to report fatal errors for the REQUEST SENSE command.

For example:

- The target receives a non zero reserved bit in the command descriptor block.
- An unrecovered parity error occurs on the Data Bus.
- A target malfunction prevents return of the sense data.
- The Allocation Length falls between block boundaries.

Following a fatal error on REQUEST SENSE, the sense data should be considered invalid. The host may attempt recovery by selecting the drive and issuing a BUS DEVICE RESET message directly following the IDENTIFY message. This forces the drive to do a hard reset. If the fault persists, the host should deny access to the drive.

6.18 RESERVE UNIT 16h

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (16h)							
1	Logical Unit Number			3rdPty	Third Party Divece ID			Reserved
2	Reserved							
3	Reserved							
4	Reserved							
5	Unused (00b)		Reserved					

RESERVE UNIT reserves the drive for exclusive use by the requesting initiator or another specified SCSI device.

The reservation will remain in effect until one of the following conditions is met:

- The initiator that made the reservation sends another RESERVE UNIT command.
- The drive is released by a RELEASE UNIT command from the same initiator.
- A BUS DEVICE RESET message is received from any initiator.
- A hard RESET condition occurs.

The occurrence of the last two conditions is indicated by the drive returning a CHECK CONDITION status with a sense key of UNIT ATTENTION on the next command following the condition. It is not an error for an initiator to issue RESERVE UNIT to the drive if the drive is currently reserved by that initiator. If the drive has previously been reserved by another initiator, then the drive generates a RESERVATION CONFLICT status.

If, after honoring the reservation, any other initiator then attempts to perform any command except INQUIRY, REQUEST SENSE, or RELEASE UNIT, then the command is rejected with a RESERVATION CONFLICT status. A RELEASE UNIT command issued by another initiator will be ignored by that reserved logical unit.

3rd Pty:

The Third-Party Reservation option allows an initiator to reserve the drive for another SCSI device. This option is intended for systems that use the COPY command and is implemented by the drive.

If the Third-Party bit is zero, then the Third-Party Reservation option is not requested. If the 3rdPty bit is one, a RESERVE UNIT reserves the drive for the SCSI device specified in the Third-Party Device ID field. The drive preserves the reservation until any one of the four conditions mentioned above occurs. The drive ignores any attempt made by any other initiator to release the reservation and returns GOOD status.

An initiator that holds a current reservation may modify that reservation e.g., switch third-parties by issuing another RESERVE UNIT command to the drive.

If the logical unit has previously been reserved by another initiator, the target returns a RESERVATION CONFLICT status.

6.19 REWIND 01h

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (01h)							
1	Logical Unit Number			Reserved				Immed
2	Reserved							
3	Reserved							
4	Reserved							
5	Unused (00b)		Reserved					

REWIND tells the drive to position the media at the beginning of the currently active partition. Before rewinding, the drive writes any buffered data to tape and appends an EOD marker.

Immed:

When this bit is set, the drive writes any remaining buffered data followed by an EOD marker to tape. It then returns status to the Host before beginning the actual rewind operation. If the Immed bit is not set, status will be returned after the rewind has completed.

6.20 SEEK BLOCK (0Ch)

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (0Ch)							
1	Logical Unit Number			Reserved				Immed
2	(MSB)							
3	Logical Block Address							
4								
5	Unused (00b)		Reserved					

The SEEK BLOCK command causes the target to position the logical unit to the specified block address. Upon completion, the logical position shall be before the specified location. Prior to performing the operation, the target shall ensure that all buffered data, Filemarks, and Setmarks have been transferred to the medium. This command should be used in conjunction with the REQUEST BLOCK ADDRESS command.

Note: This command is similar in function to the SCSI-2 LOCATE command and is supported by the SDT-9000 to allow backward compatibility with QIC-104 type devices.

Immed:

If the Immed bit equals 0 then the SEEK BLOCK command will report completion status to the Initiator after the entire operation is complete. If the Immed bit is 1 then the drive will report "COMMAND COMPLETE" to the Initiator upon acceptance of the command.

Logical Block Address:

The Block Address of the desired position.

6.21 SEND DIAGNOSTIC 1DH

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (1Dh)							
1	Logical Unit Number			PF	Reserved	SelfTest	DevOf1 (0)	UnitOf1
2	Reserved							
3	(MSB) Parameter List Length							
4	(LSB)							
5	Unused (00b)			Reserved				

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

PF: The drive expects the Page Format bit to be set to indicate that the parameters transferred during the DATA OUT phase will include four bytes of header information as well as the diagnostic test bytes.

If this bit is not set the parameter bytes will only describe the diagnostic test. Note that if the SelfTest bit is set, this bit must be zero else the drive will return CHECK CONDITION with the ILLEGAL REQUEST sense key set.

SelfTest:

When this bit is set the drive executes its POWER-ON SEQUENCE. The Parameter List Length must be zero when this bit is set other-wise the drive will return a CHECK CONDITION status with an ILLEGAL REQUEST sense key set.

DevOf1:

Device Offline is not supported and shall be set to zero, otherwise the driver will return a CHECK CONDITION status with an ILLEGAL REQUEST SENSE key set.

UnitOf1:

This bit must be set for proper operation of any diagnostic test except selftest. If this bit is not set, except for selftest, the drive will return a CHECK CONDITION status with an ILLEGAL REQUEST sense key set.

Parameter List Length:

This field provides the count of the number of Parameter List bytes which will be transferred in the DATA OUT phase. These bytes describe the test that is to be run. This field must be set to zero if the SelfTest bit is set.

If the PF bit is zero, the Parameter List describes the diagnostic test to be executed. The diagnostic tests are five bytes in length. If the Parameter List Length is not set to five or zero if the SelfTest bit is set, the drive returns a CHECK CONDITION status with an ILLEGAL REQUEST sense key set.

If the PF bit is set, the Parameter List includes a four byte header as of the form:

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

Table 6-51: Diagnostic Page Format

Page Code: The drive supports two Page Codes:

00h - Return Supported pages

81h - Drive Diagnostic page

For Page Code 00h, the Page Length must be zero and the Parameter List Length must be set to four otherwise the drive returns a CHECK CONDITION status with an ILLEGAL REQUEST sense key set. This Page Code requests that the drive return a list of the supported pages in the DATA IN phase of RECEIVE DIAGNOSTIC.

For Page Code 81h, the Page Length must be five and the Parameter List Length must be set to nine otherwise the drive returns a CHECK CONDITION status with an ILLEGAL REQUEST sense key set. This page Code instructs the drive to execute the five bytes of diagnostic test that follow the four bytes of header.

The five bytes of diagnostic test information will be of the form:

Bit Byte	7	6	5	4	3	2	1	0							
0	Diagnostic Test Number														
1	Break	Loopcount													
2	Parameter A														
3	Parameter B														
4	Parameter C														

Table 6-52: Diagnostic Test information

Diagnostic Test Number: Number identifying which test to execute

Break: indicates how to terminate the loop count should an error occur.

- 0 = stop on first error
- 1 = do not stop on error

Loop Count Identifier: The number of times that the test should be repeated before status is returned.

- 0 = Continuous
- 1 = run once
- 2 = run 10 times
- 3 = run 100 times
- 4 = run 1000 times

Parameters A, B, C: Any additional parameters required to fully define the diagnostic test.

If the test completes successfully, the drive returns GOOD status. If the test failed, CHECK CONDITION status is returned with a HARDWARE ERROR Sense Key and an Additional Sense Code of DIAGNOSTIC FAILURE set. The Host should then send a REQUEST DIAGNOSTIC command which will return information as to which test failed and the nature of the failure. If the test requested is not defined, not available to the requested processor, or not executable in the current configuration, this information will be reported in the data returned by the REQUEST DIAGNOSTIC command.

Refer to section 7, Drive Diagnostics for more detailed information about the supported diagnostic tests and test operations.

6.22 SPACE 11h

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (11h)							
1	Logical Unit Number			Reserved		Code		
2	(MSB)							
3	Count							
4	(LSB)							
5	Unused (00b)		Reserved					

SPACE provides a variety of positioning functions that are determined by the Code and Count fields in the Command Descriptor Block. Both forward (toward EOM/P) and reverse (toward BOM/P) positioning are provided.

Code: The supported values are:

Code	Description
000b	Blocks
001b	Filemarks
011b	End-Of-Data
100b	Setmarks

Table 6-53: SPACE codes

Note: The drive will reject a SPACE Setmark command if it has not configured through MODE SELECT to report Setmarks. The drive will return a CHECK CONDITION status with the Sense data set to ILLEGAL REQUEST.

Note: In this command description the word “mark” is used to mean Filemark or Setmark. Only where their responses differ shall Filemark and Setmark be referred to explicitly.

Count:

When spacing over blocks or marks, the Count field is interpreted as follows:

A positive value N causes forward movement over N blocks or marks. The tape is logically positioned after the Nth block (or mark) on the EOM/P side.

A zero value causes no change in the logical position.

A negative value -N (2's complement notation) causes reverse movement over N blocks or marks. The tape is logically positioned on the BOM /P side of the Nth block (or mark).

When spacing to EOD, the Count field is ignored. Forward movement occurs until the drive encounters EOD. The position is such that a subsequent WRITE command would append data after the last entity that has been written to tape before EOD.

When executing a SPACE, the drive implements the following hierarchy:

Blocks (lowest), Filemarks, Setmarks, EOD, BOM/P or EOM/P (highest)

Therefore, SPACE N blocks will halt with GOOD status after the Nth block, or with CHECK CONDITION status on any occurrence of Filemark, Setmark, EOD, BOM/P or EOM/P. A SPACE N filemarks will halt on the Nth filemark or on any occurrence of setmark, EOD, BOM/P or EOM/P, and so on. Within the Sense data, the fields will be set as described on the following table.

Spacing	Event	Sense Data					
		Valid	Mark	EOM	Sense Key	ASC/ASCQ	Note
Blocks	Filemark	1	1	0	No Sense	Filemark Detected	a,b
	Setmark	1	1	0	No Sense	Setmark Detected	a,b,d
	EOD	1	0	0	Blank Check		b,e
	BOT	1	0	1	No Sense	BOM/P Detected	b,f
	Phy. EOT	1	0	1	Medium Error	EOM/P Detected	b,g
Filemarks	Setmark	1	1	0	No Sense	Setmark Detected	a,b,d
	EOD	1	0	0	Blank Check		b,e
	BOT	1	0	1	No Sense	BOM/P Detected	b,f
	Phy. EOT	1	0	1	Medium Error	EOM/P Detected	b,g
Setmarks	EOD	1	0	0	Blank Check		b,e
	BOT	1	0	1	No Sense	BOM/P Detected	b,f
	Phy. EOT	1	0	1	Medium Error	EOM/P Detected	b,g
EOD	BOT	0	0	1	No Sense	BOM/P Detected	c,f
	Phy. EOT	0	0	1	Medium Error	EOM/P Detected	c,g

Table 6-54: SPACE CHECK CONDITION results

Note a - The logical position is located on the EOM side of the mark if movement was in the forward direction and on the BOM side of the mark if movement was in the reverse direction.

Note b - The Information field is set to the difference (residue) between the requested count and the actual number of blocks, filemarks or setmarks spaced over.

Note c - The Information field will contain no residue count and therefore the Valid bit is not set.

Note d - The drive will only report that a Setmark has been detected while spacing over blocks or Filemarks, if it has been configured through MODE SELECT to Report Setmarks. Otherwise, the drive will continue the space operation and the presence of the Setmark will be transparent to the Host.

Note e - The tape is positioned such that a subsequent WRITE would append data after the last entity that has been written to the tape before EOD.

Note f - The tape is physically positioned at BOM/P.

Note g - EOM is only reported when the physical EOM/P is encountered. The tape is physically positioned at EOM/P. The DDS format limits the number of Filemarks or Setmarks that may be written on a tape to a maximum of 65,536 of each. If the drive is requested to space to greater than this number of Setmarks, it returns a CHECK CONDITION status with an ILLEGAL REQUEST sense key set.

The drive is able to space along tape at up to 200 times normal speed. This fast search capability is a feature of the drive which allows it to speed up longer moves on the tape. It is not intended to be used for moves that do not go across several groups. This is because searching takes the same amount of time as reading 16 groups (one group = 126600 bytes). Therefore, an algorithm has been implemented inside the buffer firmware which makes the decision of whether or not to utilize this capability.

The drive's buffer holds up to eight (8) groups worth of data (since the data buffer is 1 MBytes). Therefore, a single record (less than 1 MB in length) may be read and then backspaced over repeatedly without the tape moving since once the record is within the buffer, no further information is required from the tape.

SPACE may return the following sense keys on a CHECK CONDITION:

NO SENSE: If a Filemark occurs while spacing over blocks, the Filemark and Valid bits in extended sense are set to one. The Information bytes are set to the difference (residue) between the requested count and the actual number of blocks spaced over (not including the mark).

If a Save-Set Mark occurs while spacing over blocks or Filemarks, nothing is reported unless the SDT-9000 has been configured through MODE SELECT to Report Save Set Marks.

If the Report Save-Set Marks configuration is enabled and a Save-Set Mark occurs while spacing over blocks or Filemarks, the Valid bit and the Additional Sense keys in the Returned Sense data are set to indicate that a Save-Set Mark has been encountered. The information bytes are set to the difference (residue) in the requested count and the actual number of blocks or Save-Set Marks spaced over (not including the detected Save-Set Mark).

If End-of-Data is detected while spacing over blocks or marks, the Valid bit and the Additional Sense Keys in the Returned Sense Data are set to indicate that an EOD mark has been encountered. The Information bytes are set to the difference (residue) in the requested count and the actual number of blocks or marks spaced over.

If BOT is detected while spacing over blocks or marks in the reverse direction, the EOM bit is set in extended sense. The Valid bit is set to one and the Information bytes to the difference (residue) between the requested count and the actual number of blocks or Filemarks spaced over.

6.23 TEST UNIT READY 00h

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (00h)							
1	Logical Unit Number			Reserved				
2	Reserved							
3	Reserved							
4	Reserved							
5	Unused (00b)		Reserved					

TEST UNIT READY checks if the drive is ready. This is not a request for a self-test. If the drive has a tape loaded, this command will return a GOOD status. Otherwise, CHECK CONDITION will be reported and the sense key will be NOT READY.

Drive Status	Sense Key	ASC/ASCQ Description
Tape Loaded	00 No Sense	00 00 NO ADDITIONAL SENSE INFORMATION
No Tape Present	02 Not Ready	3A 00 MEDIUM NOT PRESENT
Tape Loading	02 Not Ready	04 01 LOGICAL UNIT IS BECOMING READY
Tape Unloading	02 Not Ready	04 00 LOGICAL UNIT NOT READY
Tape Unloaded (but retained in drive)	02 Not Ready	04 00 LOGICAL UNIT NOT READY

Table 6-55: TEST UNIT READY results

6.24 VERIFY 13h

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (13h)							
1	Logical Unit Number			Reserved		Immed (0)	BytCmp (0)	Fixed
2	(MSB)							
3	Verification Length							
4	(LSB)							
5	Unused (00b)		Reserved					

VERIFY verifies one or more blocks beginning with the next block on the tape. The verification is a media verification only. No data is transferred between the Host and the drive.

Fixed:

This bit specifies both the meaning of the Verification Length field and whether fixed-length or variable-length blocks are to be verified.

If the Fixed bit is set to zero, Variable Block mode is requested. A single block is verified with the Verification Length specifying the maximum number of bytes that are to be verified.

If the Fixed bit is set to one, the Verification Length specifies the number of blocks to be verified by the drive. This is valid only if the logical unit is currently operating in Fixed Block mode, in other words, when it has been instructed to use fixed-length blocks with MODE SELECT. The current block length is the block length defined in the MODE SELECT command. If the Fixed bit is set and the drive is in Variable Block mode, the VERIFY is rejected with a CHECK CONDITION status and an ILLEGAL REQUEST sense key set. The VERIFY is also rejected if the drive is in Fixed Block mode and the Fixed bit is not set with a CHECK CONDITION status and an ILLEGAL REQUEST sense key set.

BytCmp:

This function is not supported. If this bit is set, the command is rejected with a CHECK CONDITION status with the ILLEGAL REQUEST sense key set.

Immed:

This function is not supported. If this bit is set, the command is rejected with a CHECK CONDITION status with the ILLEGAL REQUEST sense key set.

VERIFY terminates when the Verification Length has been satisfied, when a Filemark, a Save-Set Mark (if the drive has been configured to report Setmarks), EOD or the physical EOM is encountered. The status and sense data for each of these conditions are handled in the same manner as in READ. Upon completion of VERIFY, the logical position is located after the last block from which data was verified or after the Filemark, or Setmark, if one is encountered. When the Verification Length is zero, no data is verified and the current logical position is not be changed.

If the actual block length is different from the Verification Length, a CHECK CONDITION status is returned. Within the Sense data, the Incorrect Length Indicator (ILI) bit and Valid bit will be set to one, the Sense Key field is set to NO SENSE and the Information Bytes are set to the difference (residue) between the requested Verification length and the actual block length, or in Blocked Mode, the difference (residue) between the requested number of blocks and the actual number of blocks verified.

If the drive encounters a Filemark, the drive will return a CHECK CONDITION status. Within the Sense data, the Filemark and Valid bits are set and the Sense Key field is set to NO SENSE. The Information fields contain the residue count. The Additional Sense Code and Additional Sense Code Qualifier fields are set to Filemark Detected. Upon termination, the media will be logically positioned after the Filemark (EOM side).

If, however, the drive encounters a Setmark during VERIFY, nothing is reported unless the drive has been configured through MODE SELECT to Report Setmarks. The drive will space over the Setmark and continue the VERIFY. If the Report Setmarks configuration is enabled then the Filemark and Valid bits are set and the Sense Key field is set to NO SENSE. The Information fields contain the residue count and the Additional Sense Code and Additional Sense Code Qualifier fields are set to Setmark Detected. The tape is logically positioned after the Setmark (EOM side).

If the drive detects EOD during VERIFY, the drive will return a CHECK CONDITION status. Within the Sense data, the Filemark and Valid bits are set and the Sense Key field is set to BLANK CHECK. The Information fields contain the residue count. The Additional Sense Code and Additional Sense Code Qualifier fields are not set. Upon termination, the media will be physically positioned before EOD and after the last block on tape.

The meaning of EOM is different for VERIFY than for a WRITE type of command. EOM is only reported when the physical EOM/P is encountered. The drive returns a CHECK CONDITION status. The EOM and Valid bits are set and the Sense Key is set to MEDIUM ERROR. The Information fields contain the residue count and the Additional Sense Code and Additional Sense Code Qualifier fields are set to EOM/P Detected. The tape is physically positioned at EOM/P.

For a Filemark, a (reported) Setmark, EOD or EOM detected, if the Fixed bit is set, the Information field in the Request Sense Data will be set to the difference (residue) between the requested Verification Length and the actual number of blocks verified (not including the Filemark or Setmark). If the fixed bit is set to zero, the information bytes will be set to the difference (residue) between the requested Verification Length and the actual number of bytes verified. Filemarks and Setmarks are considered to have a byte count of zero, though this does not cause the ILI bit to be set.

VERIFY may return the following sense keys on a CHECK CONDITION:

NO SENSE: If the actual block length is different from the specified Verification Length, in Variable Block mode, the Incorrect Length Indicator (ILI) bit and Valid bit are set to one. The Information bytes in extended sense are set to the difference (residue) between the requested length and the actual block length. In blocked mode, they are set to the difference (residue) between the requested number of blocks and the actual number of blocks verified.

If the drive reads a Filemark during this command, it will set the Filemark bit in the Request Sense data. Upon termination, the tape will be logically positioned after the Filemark (EOM side). If, however, the drive encounters a Setmark during this command, nothing will be reported unless the SDT-9000 has been configured through MODE SELECT to Report Setmarks.

If the Report Setmarks configuration is enabled, then the Valid bit and the Additional Sense Key flags will be set in the Request Sense data to indicate that a Setmark has been encountered. The tape will also be logically positioned after the Save-Set Mark (EOM side). For both a Filemark and a (reported) Setmark, if the Fixed bit is one, the Information bytes in the Request Sense data are set to the difference (residue) between the requested Verification Length and the actual number of blocks verified (not including the Filemark or Setmark). If the Fixed bit is set to zero, the Information blocks will be set to the difference (residue) between the requested Verification Length and the actual number of bytes verified. Filemarks and Save-Set Marks are considered to have a byte count of zero, though this will not cause the ILI bit to be set.

6.25 WRITE 0Ah

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (0Ah)							
1	Logical Unit Number			Reserved				Fixed
2	(MSB)							
3	Transfer Length							
4								
	(LSB)							
5	Unused (00b)		Reserved					

WRITE transfers one or more blocks from the Host to the tape beginning at the current logical position.

Fixed:

The Fixed Bit specifies both the meaning of the Transfer Length field and whether fixed-length or variable-length blocks are to be transferred.

If the Fixed bit is set to zero, Variable Block mode is selected. The Transfer Length specifies the maximum number of bytes that the drive handshakes out from the initiator. A single block is transferred from the initiator and is written beginning at the current logical tape position. Upon successful termination, the tape is logically positioned after this block (EOM/P side). The Transfer Length specifies the maximum number of bytes that the drive handshakes out from the initiator.

If the Fixed Bit is set to one, the Transfer Length field specifies the number of blocks to be transferred to the drive, beginning at the current logical position. This is valid only if the drive is currently operating in Fixed Block mode, in other words, when it has been instructed to use fixed-length blocks with MODE SELECT. The current block length is the block length defined in the MODE SELECT command. Upon termination, the tape is logically positioned after these blocks (EOM/P side).

If EOT is detected while writing, the drive will finish writing any buffered data. The command will terminate with CHECK CONDITION status. Within the Sense data, the EOM bit is set, the Sense Key field is set to NO SENSE and the Additional Sense Code and Additional Sense Code Qualifier fields are set to EOM/P detected. The drive will attempt to complete any subsequent writes, returning a CHECK CONDITION status in each case.

If the drive encounters the physical EOM when attempting a WRITE, a CHECK CONDITION status is returned. Within the Sense data, the EOM and Valid bits are set and the Sense Key field is set to VOLUME OVERFLOW. The Information fields contain the residue count and the Additional Sense Code and Additional Sense Code Qualifier fields are set to EOM/P Detected. The tape is physically positioned at EOM/P.

If the Transfer Length is zero, no data will be transferred and the current position on the logical unit will not be changed. When in Buffered Mode (see Mode Select), the drive will report a GOOD status on WRITE commands as soon as this data block has been transferred to the data buffer.

The drive flushes its write buffer to tape and appends an EOD marker under the following conditions:

1. Receipt of the following non-write commands:

- READ
- SPACE
- VERIFY
- READ BUFFER
- WRITE BUFFER
- REWIND
- LOAD/UNLOAD
- MODE SELECT
- LOG SENSE

The buffer can be maintained through the following media commands, assuming that no other flush condition has been met, for example, write holdoff timeout.

- WRITE
- WRITE FILEMARKS with Immediate bit set
- ERASE

2. Buffered Mode not selected. This causes the buffer to flush after every write type command. Buffered Mode can be configured through MODE SELECT and if NOT used, will cause the drive will suffer a significant degradation in performance with respect to capacity, transfer rate and, loss of streaming.
3. The write holdoff time limit is exceeded. The default value is 5 seconds.

6.26 WRITE BUFFER 3Bh

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (3Bh)							
1	Logical Unit Number			Reserved		Mode		
2	Buffer ID (00h)							
3	Buffer Offset (LSB)							
5								
6	Parameter List Length (LSB)							
8								
9	Unused (00b)		Reserved					

WRITE BUFFER is used in conjunction with the READ BUFFER command as a diagnostic function for testing the 1 MB buffer and the SCSI bus integrity of the drive. A REWIND command should be sent to the drive after WRITE/READ BUFFER diagnostic testing to allow normal operation.

WRITE BUFFER command is valid only when there is no tape inserted in the drive, or when the tape is positioned at BOT. An attempt to issue the Write Buffer command when the tape is not at BOT will result in a CHECK CONDITION status with a Request Sense Key of ILLEGAL REQUEST.

Note: The drive will write any buffered data to tape prior to executing this command. Any data that is then transferred by the WRITE BUFFER is not written to tape.

Mode:

The drive supports the following values within the Mode field. If any other value is set, the drive will terminate the command with a CHECK CONDITION status and an ILLEGAL REQUEST sense key set.

Mode	Description
000b	Write combined header and data
010b	Write data

*Table 6-56: WRITE BUFFER Mode Field***Combined Header and Data Mode**

- in this mode, the test data to be transferred must be preceded by a four-byte header. The four-byte header consists of all reserved bytes. The Parameters List Length specifies the maximum number of bytes that will be transferred during the DATA OUT phase. This number includes four bytes of header, so the data length to be stored in the buffer is transfer length minus four. The initiator should ensure that the transfer length is not greater than four plus the available length that is returned in the header of the READ BUFFER command.

Data Mode

- in this mode, the DATA OUT phase contains only buffer test data.

Buffer ID:

The drive only supports a single Buffer ID field of zero. If an unsupported Buffer ID code is requested, the drive returns a CHECK CONDITION status with an ILLEGAL REQUEST sense key set.

Buffer Offset:

The buffer offset field contains the byte offset within the specified buffer from which data shall be transferred from. The initiator should conform to the offset boundary requirements returned in the WRITE BUFFER descriptor. If the target is unable to accept the specified buffer offset, it shall return CHECK CONDITION status, shall set the Sense Key to ILLEGAL REQUEST, and set the Additional Sense Code to ILLEGAL FIELD IN CDB.

Parameter List Length:

specifies the maximum number of bytes that will be transferred during the DATA OUT phase. The initiator should attempt to ensure that the Parameter List Length does not exceed the buffer capacity. If this does occur, the drive returns a CHECK CONDITION status with an ILLEGAL REQUEST sense key set. The capacity of the buffer can be determined from the Buffer capacity field in the READ BUFFER descriptor. The Parameter List Length must be greater than four (except in data only mode), else the drive will return a CHECK CONDITION status with an ILLEGAL REQUEST sense key set.

6. 27 WRITE FILEMARKS 10h

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (10h)							
1	Logical Unit Number			Reserved			WSmk	Immed
2	(MSB)							
3	Number of Filemarks or Setmarks							
4	(LSB)							
5	Unused (00b)		Reserved					

WRITE FILEMARKS causes the specified number of Filemarks or Setmarks to be written, beginning at the current logical position on tape.

WSmk:

If this bit is set, the drive writes a Setmark to tape instead of a Filemark.

Immed:

If this bit is set, the drive returns status as soon as the Command Descriptor Block has been validated. An Immed bit of zero indicates that status will not be returned until the operation has completed. If the drive is in Unbuffered Mode and the Immed bit is set, the drive will return a CHECK CONDITION status with an ILLEGAL REQUEST sense key set.

Number of Filemarks or Setmarks:

This is the number of consecutive marks to be written to tape. A value of zero is not considered an error and GOOD status is returned.

Note: The DDS format limits the number of Filemarks or Setmarks that may be written on a tape to a maximum of 65,536. If the drive is requested to write greater than this number of Setmarks, it returns a CHECK CONDITION status with an ILLEGAL REQUEST sense key set.

This command may be used to force the drive to write any buffered data to the tape. If the drive is in Buffered Mode, and a WRITE FILEMARKS command is received without the Immed bit set, the requested mark(s) will be appended to the data and the write buffer will be flushed to tape. A zero value in the Number of Filemarks field indicates that no Filemarks are to be written to the tape but the write buffer is still flushed to tape.

If EOT is detected while writing the marks, the drive will finish writing any buffered data. The command will terminate with CHECK CONDITION status. Within the Sense data, the EOM bit is set, the Sense Key field is set to NO SENSE and the Additional Sense Code and Additional Sense Code Qualifier fields are set to EOM/P detected. The drive will attempt to complete any subsequent WRITE FILEMARKS, returning a CHECK CONDITION status in each case.

If the drive encounters the physical EOM when attempting a WRITE FILEMARKS, CHECK CONDITION status is returned. Within the Sense data, the EOM and Valid bits are set and the Sense Key field is set to VOLUME OVERFLOW. The Information fields contain the residue count and the Additional Sense Code and Additional Sense Code Qualifier fields are set to EOM/P Detected. The tape is physically positioned at EOM/P.

7. DRIVE DIAGNOSTICS

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7. DRIVE DIAGNOSTICS

This section deals with the diagnostics supported by the SDT-9000. Each diagnostic is described in detail and possible error codes are discussed.

7.1 DIAGNOSTIC TEST

This section describes the Diagnostic Test facilities of the drive. The method for executing tests and receiving test results from the Host is described and a full list of available tests and possible result messages is given.

Diagnostics can be initiated in several ways:

- Power-on Self Test
- Send Diagnostic command initiating a Self Test
- Send Diagnostic command initiating a specific test or sequence

Each type of Diagnostics will be described in detail.

7.1.1 Power-on Self Test

Each time power is applied to the drive it will automatically perform a series of diagnostics on itself to insure that the basic functions of the drive are performing properly. The power-on Self Test sequence is shown below:

Power supply voltage exceeds power-up threshold

- 60 Main Processor Microprocessor Test
- 61 Main Processor ROM checksum
- 62 Main Processor Destructive RAM Test
- 70 DDS Controller Register Test

The following 3 tests are initiated by the Mechanism Controller automatically after power-up and therefore would be executing in parallel with the tests listed above.

- 20 Mechanism Controller Microprocessor Test
- 21 Mechanism Controller ROM checksum
- 22 Mechanism Controller Destructive RAM Test

- 80 Internal Message Bus Test
- 65 EEPROM checksum Test

- 30 Front Panel Check

- 72 Data Compression Controller Register Test
- 73 Data Compression Controller SRAM Test
- 79 DMA Line Test
- 71 Buffer RAM Test
- 81 DDS Controller SRAM Test

If a failure occurs with any of the power-on diagnostic tests the drive will halt with the Status LED flashing.

If an error is detected during power-up, the drive will return CHECK CONDITION status to the host on the first command received. The host shall issue a REQUEST SENSE command to determine the cause of the CHECK CONDITION status. The Sense data returned by the drive will have a Sense Key of 6 (Unit Attention) and the ASC/ASCQ will be 29 80 (Drive failed power or test or diagnostic). The host can then issue a RECEIVE DIAGNOSTIC RESULT command to the drive in order to identify the specific diagnostic test that failed and the failure error code.

The drive should be checked by a qualified person to determine what action should be taken.

7. 1. 2 SEND DIAGNOSTIC command - Self Test

The host computer can request that the drive perform a Self Test on itself to verify that it is functioning normally. The Self Test bit in the SEND DIAGNOSTIC command is set to one, and the Parameter List Length is zero. This initiates the Self Test Diagnostic which is similar to the Power-on self test except that non-destructive RAM testing is substituted for the destructive RAM tests.

If an error is detected during this test, the drive will return CHECK CONDITION status to the host. The host shall issue a REQUEST SENSE command to determine the cause of the CHECK CONDITION status. The Sense data returned by the drive will have a Sense Key of 4 (Hardware Error) and the ASC/ASCQ will be 44 00 (Internal Target Failure). The host can then issue a RECEIVE DIAGNOSTIC RESULT command to the drive in order to identify the specific diagnostic test that failed and the failure error code.

The drive should be checked by a qualified person to determine what action should be taken.

7. 1. 3 SEND DIAGNOSTIC command - Individual Test

The SEND DIAGNOSTIC command also provides the capability to run each of the diagnostic tests individually. In order to identify the diagnostic test to be executed, the SEND DIAGNOSTIC command should be configured as follows:

- Self Test bit = 0
- Device Offline bit = 0
- Unit Offline bit = 1
- Parameter List Length = 5 or 9 (see below)

The SDT-9000 supports both the SCSI-1 and SCSI-2 implementations of the SEND DIAGNOSTIC command. In the SCSI-1 mode, the Page Format (PF) bit is zero and the Parameter List Length is 5, the Parameter List in this case is 5 bytes long and will be of the form:

Bit Byte	7	6	5	4	3	2	1	0
0	Diagnostic Test Number							
1	Break	Loopcount						
2	Parameter A							
3	Parameter B							
4	Parameter C							

Table 7-1: SEND DIAGNOSTIC Parameter - SCSI-1

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In the SCSI-2 mode, the Page Format (PF) bit is one, and the Parameter List Length is 9, the Parameter List in this case is 9 bytes long and will be of the form:

Bit Byte	7	6	5	4	3	2	1	0
0	Page Code (81h)							
1	Reserved							
2	(MSB) Page Length (00 05h) (LSB)							
3								
4	Diagnostic Test Number							
5	Break	Loopcount						
6	Parameter A							
7	Parameter B							
8	Parameter C							

Table 7-2: SEND DIAGNOSTIC Parameters - SCSI-2

Break: indicates how to terminate the loop count should an error occur.

- 0 = stop on first error
- 1 = do not stop on error

Loop Count Identifier: The number of times that the test should be repeated before status is returned.

- 0 = Continuous
- 1 = run once
- 2 = run 10 times
- 3 = run 100 times
- 4 = run 1000 times

Parameters A, B, C: Any additional parameters required to fully define the diagnostic test.
These parameters are unused and shall be 00h for all diagnostics.

7.1.4 Diagnostic Test Number Summary

The following is a list of the diagnostic capabilities of the SDT-9000. The Test Availability Code indicates if a particular test can be executed by the Host computer or is executed during Power-on diagnostics (or both). The drive also supports three types of diagnostics:

1. Individual Tests - Self contained modules designed to test a particular function of drive
2. Sequences - Automatic execution of a series of individual tests
3. Exercisers - Verification of a major function of the drive such as Read, Write, Search, etc.

The Diagnostic Test Number for each Test, Sequence or Exerciser is shown in the first column.

Test Availability Codes

P — Power-on Selftest

H — Host Diagnostics

PH — both

Sequence Test

00	Reset Sequence (61, 63, 65, 71-73, 77-79, 80, 81, 30)	H
02	Error Rate Test	H

Mechanism Controller Kernel Test

20	Mechanism Controller Microprocessor Test	P
21	Mechanism Controller ROM checksum	P
22	Mechanism Controller Destructive RAM Test	P

Drive Exerciser

43	Read Data Exerciser	
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Main Processor Kernel Test

60	Main Processor Microprocessor Test	P
61	Main Processor ROM checksum	P
62	Main Processor Destructive RAM Test	P
63	Main Processor Non-destructive RAM Test	

Drive Test

30	Front Panel Check	PH
65	EEPROM Checksum Test	PH
70	DDS Controller Register Test	
71	Buffer RAM Test	PH
72	Data Compression Controller Register Test	
73	Data Compression Controller SRAM Test	
77	SCSI Protocol Controller Function Test	
78	SCSI Protocol Controller Loopback Test	
79	DMA Line Test	
80	Internal Message Bus Test	PH
81	DDS Controller SRAM Test	PH

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7.1.5 RECEIVE DIAGNOSTIC RESULT command

Whenever a diagnostic test is executed, the drive automatically prepares a diagnostic test result that can be returned to the host computer when a RECEIVE DIAGNOSTIC RESULT command is issued.

If the PF bit in the SEND DIAGNOSTIC command was sent to one, the diagnostic test result will be preceded by a four byte header which will be of the form:

Bit Byte	7	6	5	4	3	2	1	0
0	Page Code (81h)							
1	Reserved							
2	(MSB) _____							
3	Page Length (00 05h) _____ (LSB)							

Table 7-3: RECEIVE DIAGNOSTIC RESULT - SCSI-2 Header

Regardless of the PF bit in the SEND DIAGNOSTIC command, the five bytes of diagnostic test result information will be of the form:

Bit Byte	7	6	5	4	3	2	1	0
0	Reset Error	Time Re-Sync	Reserved		Error Set			
1	Error Code							
2	Result A							
3	Result B							
4	Diagnostic Test Number							

Table 7-4: RECEIVE DIAGNOSTIC RESULT

Reset error: This bit is set when an error occurs during power-on selftest.

Time Re-Sync:

This bit indicates that the time stamp saved with the error log has no relation to that of the previous entry. It is only set by the logging routine within the data buffer as an error is logged.

Error set:

Two set of error codes exist. The definition of the error is dependent upon when set is taken from as follows:

0 - Runtime errors

2 - Drive diagnostic errors

Error code:

Error codes for each error set are described in section 7.1.6

Result A:

Typically this byte indicates the logical sub-assembly that failed:

1 - Drive Mechanism

2 - Drive Circuitry

Note: This byte has alternate meanings with some diagnostics. Refer to section 7.1.6.

Result B:

Typically this byte is unused however, this byte has alternate meanings with some diagnostics. Refer to section 7.2.6.

Test number:

This is the test number to which the message applies (if a test fails within a sequence, the individual test number will be returned).

Note: Diagnostic test 30 (Front Panel Check) will light each of the front panel LEDs so that the operator can verify that the LEDs are functioning. There is no error detection within the drive for this test and therefore the Error Code, Result A and Result B will always be zero.

7. Diagnostics

7.2.6 Diagnostics Results Reference

The following list of error codes are supported by the drive.

Error Sets - Error Code

Error Set 0 - Runtime Errors

00h	NO ERROR	67h	ADA FRAME OVER
01h	NO TAPE	68h	ECC FRAME OVER
02h	OFFLINE WITH TAPE	69h	DMA PARITY ERROR
04h	ILLEGAL COMMAND	6Ah	DRAM PARITY ERROR
05h	BOT ENCOUNTERED	6Bh	INTERNAL BUS COMMAND REJECT ERROR
07h	WRITE PROTECTED	6Ch	INTERNAL BUS INVALID PARAMETER ERROR
08h	PARTITION SIZE ERROR	6Dh	INTERNAL PROTOCOL ERROR
09h	PRE-RECORDED TAPE	70h	MECHANISM TIMEOUT
0Ah	INVALID FORMAT FOR READ	72h	HEAD CLOGGED
0Bh	NOT AT BOT	73h	DRUM UNLOCK
10h	INVALID TEST NUMBER	75h	DIAGNOSTIC FAILURE
11h	INVALID PARAMETER	80h	CONTROL MOTOR TIMEOUT
12h	INVALID TEST WITH CARTRIDGE	81h	T REEL TIMEOUT
13h	TEST NOT ACCESSIBLE BY HOST	82h	S REEL TIMEOUT
14h	TEST NOT ACCESSIBLE DUE TO SELFTEST ERROR	83h	CAPSTAN TIMEOUT
21h	COMMAND UNSUPPORTED	84h	DRUM TIMEOUT
22h	BLANK AT BOT	85h	COMPLEX COMMAND TIMEOUT
23h	NOT 2 PARTITION	86h	ILLEGAL ENCODER PATTERN
30h	EOD ENCOUNTERED	87h	MECH POSITION UNCERTAIN
31h	EOM ENCOUNTERED	88h	MECH POSITION NOT CHANGED
32h	BLANK ENCOUNTERED	89h	MECH POSITION CHANGED
33h	NON-DDS ENCOUNTERED	8Bh	T AND S END SENSOR ON
34h	SUBCODE UNCERTAIN	90h	FEW S REEL NG
35h	ECC UNCORRECTABLE	91h	FEW T REEL FG
36h	SYSTEM AREA UNCERTAIN	A0h	DRUM SPEED TOO SLOW
37h	EOM ENCOUNTERED	A1h	DRUM SPEED TOO FAST
3Ah	READ FRAME OVER	A2h	DRUM RAMP TOO SLOW
3Bh	SYSTEM AREA TIMEOUT	A3h	DRUM PHASE UNLOCKED
40h	MISSING TARGET	A5h	DRUM NO FG PG
43h	ILLEGAL PARTITIONING	B0h	CAPSTAN SHORT TERM SPEED SLOW
44h	APPROACH ERROR	B1h	CAPSTAN SHORT TERM SPEED FAST
50h	APPENDING ERROR	B2h	CAPSTAN LONG TERM SPEED SLOW
51h	TOO MANY READ AFTER WRITE RETRY ERROR	B3h	CAPSTAN LONG TERM SPEED FAST
52h	SYSTEM LOG FAILURE	B4h	CAPSTAN RAMP TOO SLOW
53h	FORMAT FAILURE	B5h	CAPSTAN NO FG
54h	EOM DETECTED ON WRITE	C0h	UNKNOWN BAT ENTRY
55h	APPEND TIMEOUT	C2h	FORMAT DISCONTINUITY
56h	APPEND NO AFC	C9h	NON DCLZ ENCOUNTERED
57h	APPEND OVER POSITION	CBh	TARGET NOT FOUND
58h	APPEND C2 ERROR	CCh	UNEXPECTED EOR
59h	ATF UNLOCK	CDh	ILLEGAL SKIP COUNT
5Ah	APPEND DBP NG	CEh	DCLZ ERROR
5Bh	FORMAT TIMEOUT	CFh	ILLEGAL DMA COMPLETION
60h	INTERNAL BUS PARITY ERROR	E9h	DMA ERROR

Error set 2 - Diagnostic error

01h	MAIN PROCESSOR MICROPROCESSOR REGISTER TEST FAILURE
05h	MAIN PROCESSOR ROM CHECKSUM TEST FAILURE
06h	MAIN PROCESSOR DESTRUCTIVE RAM TEST FAILURE
07h	MAIN PROCESSOR NON DESTRUCTIVE RAM TEST FAILURE
11h	EEPROM CHECKSUM TEST FAILURE
12h	BUFFER RAM TEST FAILURE
13h	DDS CONTROLLER SRAM TEST FAILURE
14h	INTERNAL MESSAGE BUS TEST FAILURE
20h	MECHANISM CONTROLLER MICROPROCESSOR TEST FAILURE
21h	MECHANISM CONTROLLER ROM CHECKSUM TEST FAILURE
22h	MECHANISM CONTROLLER DESTRUCTIVE RAM TEST FAILURE
23h	MECHANISM CONTROLLER NON DESTRUCTIVE RAM TEST FAILURE

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7.2.7 Diagnostic Tests requiring additional parameters

The diagnostic tests which require additional information in the Parameter A, B & C bytes are:

- 02 Error Rate Test
- 43 Read Data Exerciser

7.2.7.1 Error Rate Test (02) Diagnostic Parameters

This test reads or writes the number of groups defined by the Group Count. Any RAW retries, C3 ECC retries and Read/Write hard errors encountered during the test are reported in the Error Rate Log which may then be examined to determine tape performance.

Bit Byte	7	6	5	4	3	2	1	0
0	Diagnostic Test Number (02h)							
1	Loopcount							
2	Test Pattern			BOT	RND	WRT	RD	NLR
3	(MSB) Group Count							
4	(LSB)							

Table 7-5: Error Rate Test Data

The Test Pattern and RND fields are only relevant if the test includes a write pass, otherwise their values are ignored.

Test Pattern: 0 - all zeros
1 - All ones
2 - Alternating ones and zeros
3 - Rotating data bytes (0,1,2,...,255)
4 - Pseudo-random data
5 - Worst case (C6h) bytes

7. DIAGNOSTICS

BOT: 0 - Space to EOD before beginning write test
1 - Rewind to BOT before beginning read or write test

RND: 0 - Randomizer is disabled during test
1 - Randomizer is enabled during test

WRT & RD control bits: The following table shows the operation of the Error Rate Test with different combinations of the WRT & RD bits.

WRT	RD	Action
0	0	Command rejected - invalid parameters
0	1	Read Fast Search to initial position (conditional on loopcount) Repeat until loopcount = 0
1	0	Write Setmark Write test pattern Write EOD at end of first pass Fast search to initial position (conditional on loopcount) Repeat until loopcount = 0
1	1	Write Setmark Write test pattern Write EOD at end of first pass Fast search to initial position Read Fast Search to initial position (conditional on loopcount) Repeat until loopcount = 0

Table 7-6: WRT & RD control bits

At the completion of the test, the tape will be positioned after the last group written or read and before EOD.

NLR: 0 - Drive Log will be initialized before the test
1 - Drive Log will not be initialized

7. DIAGNOSTICS

Group Count: This defines the number of groups to be written to or read from the tape.

0 - Write until EOT or Read until EOD/EOM

>0 - Write until count is exhausted or EOM, Read until count is exhausted or EOD/EOM. If EOM is encountered during Write, EOD will not be written.

In all cases, encountering EOM will be recorded as a hard error.

The Diagnostic result for the Error Rate Test will be as shown in the table below.

Bit Byte	7	6	5	4	3	2	1	0
0	Reset Error	Time Re-Sync	Reserved		Error Set			
1	Error Code							
2	(MSB) _____ Actual Group Count _____							
3	(LSB)							
4	Diagnostic Test Number (02h or 03h)							

Table 7-7: Error Rate Test results

This test will result in a loss of logical tape position and therefore a load should be sent before the drive is used for any normal reads or writes.

7. DIAGNOSTICS

7.2.7.2 Read Data Exerciser (43h) Diagnostic Parameters

The purpose of this test is to read audio or DDS format data for error rate testing.

Bit Byte	7	6	5	4	3	2	1	0
0	Diagnostic Test Number (43h)							
1	Loopcount							
2	(MSB)							
3	Number of Frames							
4	(LSB)							

Table 7-8: Read Data Exerciser Parameters

Number of Frames: The drive will read the number of frames specified in this field.

Execution Time: Number of frames x loopcount x7ms (Maximum 90 minutes,120m)

Bit Byte	7	6	5	4	3	2	1	0
0	Reset Error	Time Re-Sync	Reserved		Error Set			
1	Error Code							
2	(MSB)							
3	Number of loops executed							
4	(LSB)							
4	Diagnostic Test Number (43h)							

Table 7-9: Read Data Exerciser Result

The results message will contain the number of loops executed during the test.

This test will result in a loss of logical tape position and therefore a load should be sent before the drive is used for any normal reads or writes.

APPENDIX A - ASC & ASCQ Alphabetic Order

ASC and ASCQ Assignments Alphabetic Order

BYTE

12	13	DESCRIPTION
00	04	BEGINNING-OF-PARTITION / MEDIUM DETECTED
14	04	BLOCK SEQUENCE ERROR
30	02	CANNOT READ MEDIUM INCOMPATIBLE FORMAT
52	00	CARTRIDGE FAULT
4A	00	COMMAND PHASE ERROR
2C	00	COMMAND SEQUENCE ERROR
4B	00	DATA PHASE ERROR
70	NN	DECOMPRESSION EXCEPTION SHORT ALGORITHM ID OF NN
71	00	DECOMPRESSION EXCEPTION LONG ALGORITHM ID
29	80	DRIVE FAILED POWER-ON TEST OR DIAGNOSTIC - (SONY Unique)
00	05	END-OF-DATA DETECTED
14	03	END-OF-DATA NOT FOUND
00	02	END-OF-PARTITION / MEDIUM DETECTED
00	01	FILEMARK DETECTED
30	00	INCOMPATIBLE MEDIUM INSTALLED
11	08	INCOMPLETE BLOCK READ
48	00	INITIATOR DETECTED ERROR MESSAGE RECEIVED
44	00	INTERNAL TARGET FAILURE
3D	00	INVALID BITS IN IDENTIFY MESSAGE
20	00	INVALID COMMAND OPERATION CODE
24	00	INVALID FIELD IN CDB
26	00	INVALID FIELD IN PARAMETER LIST
49	00	INVALID MESSAGE ERROR
04	01	LOGICAL UNIT IS IN PROCESS OF BECOMING READY
04	00	LOGICAL UNIT NOT READY

APPENDIX A - ASC & ASCQ Alphabetic Order

ASC and ASCQ Assignments Alphabetic Order

BYTE

12	13	Description
25	00	LOGICAL UNIT NOT SUPPORTED
15	01	MECHANICAL POSITIONING ERROR
53	00	MEDIA LOAD OR EJECT FAILED
31	00	MEDIUM FORMAT CORRUPTED
3A	00	MEDIUM NOT PRESENT
43	00	MESSAGE ERROR
2A	01	MODE PARAMETERS CHANGED
00	00	NO ADDITIONAL SENSE INFORMATION
28	00	NOT READY TO READY TRANSITION, MEDIUM MAY HAVE CHANGED
4E	00	OVERLAPPED COMMANDS ATTEMPTED
1A	00	PARAMETER LIST LENGTH ERROR
26	01	PARAMETER NOT SUPPORTED
2A	00	PARAMETERS CHANGED
03	00	PERIPHERAL DEVICE WRITE FAULT
15	02	POSITIONING ERROR DETECTED BY READ OF MEDIUM
29	00	POWER ON, RESET, OR BUS DEVICE RESET OCCURRED
3B	08	REPOSITION ERROR
47	00	SCSI PARITY ERROR
45	00	SELECT OR RESELECT FAILURE
3B	00	SEQUENTIAL POSITIONING ERROR
00	03	SETMARK DETECTED
33	00	TAPE LENGTH ERROR
3B	01	TAPE POSITION ERROR AT BEGINNING-OF-MEDIUM
09	00	TRACK FOLLOWING ERROR
11	00	UNRECOVERED READ ERROR
50	00	WRITE APPEND ERROR
0C	00	WRITE ERROR
27	00	WRITE PROTECTED

APPENDIX B - ASC & ASCQ Numerical Order

ASC and ASCQ Assignments Numerical Order

BYTE

12	13	DESCRIPTION
00	00	NO ADDITIONAL SENSE INFORMATION
00	01	FILEMARK DETECTED
00	02	END-OF-PARTITION / MEDIUM DETECTED
00	03	SETMARK DETECTED
00	04	BEGINNING-OF-PARTITION / MEDIUM DETECTED
00	05	END-OF-DATA DETECTED
03	00	PERIPHERAL DEVICE WRITE FAULT
04	00	LOGICAL UNIT NOT READY
04	01	LOGICAL UNIT IS IN PROCESS OF BECOMING READY
09	00	TRACK FOLLOWING ERROR
0C	00	WRITE ERROR
11	00	UNRECOVERED READ ERROR
11	08	INCOMPLETE BLOCK READ
14	03	END-OF-DATA NOT FOUND
14	04	BLOCK SEQUENCE ERROR
15	01	MECHANICAL POSITIONING ERROR
15	02	POSITIONING ERROR DETECTED BY READ OF MEDIUM
1A	00	PARAMETER LIST LENGTH ERROR
20	00	INVALID COMMAND OPERATION CODE
24	00	INVALID FIELD IN CDB
25	00	LOGICAL UNIT NOT SUPPORTED
26	00	INVALID FIELD IN PARAMETER LIST
26	01	PARAMETER NOT SUPPORTED
27	00	WRITE PROTECTED
28	00	NOT READY TO READY TRANSITION , MEDIUM MAY HAVE CHANGED
29	00	POWER ON, RESET, OR BUS DEVICE RESET OCCURRED
29	80	DRIVE FAILED POWER-ON TEST OR DIAGNOSTIC - (SONY Unique)
2A	00	PARAMETERS CHANGED

APPENDIX B - ASC & ASCQ Numerical Order

ASC and ASCQ Assignments Numerical Order

BYTE

12	13	Description
2A	01	MODE PARAMETERS CHANGED
2C	00	COMMAND SEQUENCE ERROR
30	00	INCOMPATIBLE MEDIUM INSTALLED
30	02	CANNOT READ MEDIUM, INCOMPATIBLE FORMAT
31	00	MEDIUM FORMAT CORRUPTED
33	00	TAPE LENGTH ERROR
3A	00	MEDIUM NOT PRESENT
3B	00	SEQUENTIAL POSITIONING ERROR
3B	01	TAPE POSITION ERROR AT BEGINNING-OF-MEDIUM
3B	08	REPOSITION ERROR
3D	00	INVALID BITS IN IDENTIFY MESSAGE
43	00	MESSAGE ERROR
44	00	INTERNAL TARGET FAILURE
45	00	SELECT OR RESELECT FAILURE
47	00	SCSI PARITY ERROR
48	00	INITIATOR DETECTED ERROR MESSAGE RECEIVED
49	00	INVALID MESSAGE ERROR
4A	00	COMMAND PHASE ERROR
4B	00	DATA PHASE ERROR
4E	00	OVERLAPPED COMMANDS ATTEMPTED
50	00	WRITE APPEND ERROR
52	00	CARTRIDGE FAULT
53	00	MEDIA LOAD OR EJECT FAILED
70	NN	DECOMPRESSION EXCEPTION SHORT ALGORITHM ID OF NN
71	00	DECOMPRESSION EXCEPTION LONG ALGORITHM ID

APPENDIX C- SCSI Commands (Op Code Order)

The following is a list of the supported SCSI Commands and page index:

PARA	SCSI COMMAND	OP CODE	PAGE
6.23	TEST UNIT READY	00h	6-86
6.19	REWIND	01h	6-78
6.16	REQUEST BLOCK ADDRESS	02h	6-65
6.17	REQUEST SENSE	03h	6-66
6.11	READ BLOCK LIMITS	05h	6-55
6.10	READ	08h	6-52
6.25	WRITE	0Ah	6-89
6.20	SEEK BLOCK	0Ch	6-79
6.27	WRITE FILEMARKS	10h	6-93
6.22	SPACE	11h	6-83
6.02	INQUIRY	12h	6-4
6.24	VERIFY	13h	6-87
6.07	MODE SELECT(6)	15h	6-30
6.18	RESERVE UNIT	16h	6-77
6.15	RELEASE UNIT	17h	6-64
6.01	ERASE	19h	6-3
6.08	MODE SENSE(6)	1Ah	6-47
6.03	LOAD UNLOAD	1Bh	6-7
6.14	RECEIVE DIAGNOSTIC RESULTS	1Ch	6-61
6.21	SEND DIAGNOSTIC	1Dh	6-80
6.09	PREVENT ALLOW MEDIUM REMOVAL	1Eh	6-51
6.04	LOCATE	2Bh	6-9
6.13	READ POSITION	34h	6-58
6.26	WRITE BUFFER	3Bh	6-91
6.12	READ BUFFER	3Ch	6-56
6.05	LOG SELECT	4Ch	6-10
6.06	LOG SENSE	4Dh	6-13

APPENDIX D - GLOSSARY

This glossary includes many terms that are useful when working with the SONY DDS tape drive. Not all terms are used within this manual.

<u>Amble</u>	A frame used to separate groups. It has a Logical Frame Number of zero. The Main Data Area contains only a valid header.
<u>ANSI</u>	American National Standards Institute, which sets standards for, amongst other things, SCSI and the safety of electrical devices.
<u>ATF</u>	Automatic Track Finding
<u>Beginning of partition(BOP)</u>	The position at the beginning of the permissible recording region of a partition. If only one partition is defined, this position is typically equivalent to the beginning-of-medium. (BOM)
<u>Beginning of medium(BOM)</u>	The extreme position along the medium in the direction away from the supply reel which can be accessed by the device.
<u>Bit error rate</u>	Number of errors / Total number of bits written or read
<u>Block error rate</u>	Number of errors / Total number of blocks written or read
<u>BOM</u>	Beginning Of Media
<u>BOT</u>	Beginning Of Tape
<u>Buffered mode</u>	A mode of data transfer in write operations which facilitates tape streaming, as reported in the Mode Select parameter.
<u>C1 ECC</u>	Level 1 error correction code is 32,28,5 Reed-Solomon code with an interleave depth of two symbols. This enables it to correct up to two symbols error or burst errors up to four symbols long. The code is stored in the same track as the data.
<u>C2 ECC</u>	Level 2 error correction code is 32,26,7 Reed-Solomon code with an interleave depth of four blocks (1 data block - 288 data bits). This enables it to correct up to three symbols error, six symbols erasure error, or 792 symbols burst error. The code is stored on the same track as the data.
<u>C3 ECC</u>	Level 3 error correction code provided by the DDS format. C3 allows any two tracks in a group to be corrected, and is used only when a raw data error is too big to be corrected by C1 and C2. C3 code is stored in an extra frame at the end of the twenty-two frames of data in each group.

APPENDIX D - GLOSSARY

DAT Digital Audio Tape

DDS Digital Data Storage, a standard format originally developed by Sony and Hewlett-Packard for 4mm tape used for data storage.

Device Area

The first area on the tape used by the drive for drum spin-up and testing.

Dropout An area of tape where the signal level of the media has fallen off to a level where data recovery is no longer possible.

Early Warning

A device computed position near but logically before the end-of-partition. See the REW bit in the Mode Select Device Configuration page.

ECC Error Correction Code (see C1, C2 & C3 ECC)

End-of-data (EOD)

End of data in a partition a special format group written after all current user data.

End of medium(EOM)

The extreme position along the medium in the direction away from the take-up reel which can be accessed by the device.

End of partition(EOP)

The position at the end of the permissible recording region of a partition. May be the same as end of media.

EOD End Of Data

EOM End Of Media

EOP End Of Partition

EOT End Of Tape

Error Rate Log

The Error Rate Log exists in RAM in the SDT-9000 and maintains a history of hard (uncorrectable) and soft (correctable by RAW or C3 ECC) errors which have occurred since the last tape load.

Fast Searching

The process of reading just the Sub Code areas to locate an item on the tape at a speed up to 200 times faster than normal read speed.

APPENDIX D - GLOSSARY

Fault Log

The Fault Log is stored in RAM in the SDT-9000 and holds a record of Self-Test failures and all problems which have been met during normal operation.

Frame

Two adjacent tracks, one A channel and one B channel.

Filemark

A mark written by the host. It does not necessarily separate files. It is up to the host to assign a meaning to the mark. Consist of a special recorded element within a partition, containing no user data, which provides a segmentation scheme.

Group

A fixed capacity set of frames written onto or read from the tape. A group contains one index and can contain several records, partial records, Filemarks and Setmarks.

Hard Error

A Hard Error is an uncorrectable data error. During writing, this is defined as being uncorrected after the RAW retry limit has been exceeded. During reading, a hard error is logged if a group is uncorrectable by C1, C2 or C3 ECC.

Head clog

Particles from the tape or from outside the drive adhere to the head gap on a read or write head and obstruct the reading or writing of data. The particles will become dislodged by the operation of the internal head cleaner and/or cleaning tape.

Index

Information stored at the end of a group which specifies the contents of the group. Every group except the Vendor Group contains an index.

Lead-in Area

The first section of the tape used for loading, BOT positioning, and tape usage logging.

Load

To insert a cassette into the drive. The drive automatically threads the tape and goes online.

LUN

Logical Unit Number, by which a device is identified on the SCSI bus. The Sony SDT-9000 has an LUN of 0 fixed in the firmware.

Noise

Any kind of magnetic or electric interference detected by the electronics.

APPENDIX D - GLOSSARY

N-group writing

Sometimes called multiple group writing, N-group writing repeats each group of data so that there are N consecutive copies of each group on the tape. This is a simple way of improving data integrity, but speed and capacity are sacrificed in writing all data several times.

Offline

The Sony SDT-9000 is offline if the tape is currently unloaded or not in the drive. The host has limited access, and cannot perform any commands which would cause tape motion. The host can, however, load a tape, if one is inserted, and can execute any diagnostic tests which do not require tape motion.

Online

The Sony SDT-9000 is online when a tape is loaded. The host has access to all command operations, including those which access the tape, set configurations and run diagnostic tests.

Overlength

The incorrect length condition that exists after executing a read command when the length of the actual block read exceeds the requested transfer length in the command descriptor block. Only the requested amount of data is returned to the host.

Partition

The entire usable region of recording and reading paths in a volume or in a portion of a volume. If there is more than one partition, they shall be numbered starting with zero (i.e., beginning of partition zero).

RAW

See Read-After-Write

Read-After-Write (RAW)

improves data integrity by reading data immediately after it is written and writing the frame again if an error is found. The Audio DAT two-head drum is replaced by a four-head drum for this purpose, the drum is configured with two read-only heads and two write-only heads. Frames are only re-written as necessary, so speed and capacity are affected minimally. RAW capability is included in the DDS format.

Reserved

Reserved for future definition and detailing and not generally available for use. Reserved bits and fields should be set to zero.

Setmark

A mark written by the host to allow fast searching to a point on the tape without having to know the number of records or filemarks that precede this point. A special recorded element within a partition, containing no user data, which provides a segmentation scheme hierarchically superior to filemarks for use in addressing or fast positioning on high capacity storage devices. (Also called Save-Set Mark)

APPENDIX D - GLOSSARY

SCSI (Small Computer System Interface)

This computer device interface has been certified as an American National Standard by ANSI. The standard contains the electrical specifications, communication protocol, and command structure necessary to connect various computer peripherals to a host computer.

Soft Error

A soft error is a data error which can be corrected by a RAW rewrite during writing, or by C1, C2 or C3 ECC, or a read-retry during reading.

Spacing

The act of positioning the medium on a sequential access device.

System Area

A section in the Lead-in Area used to store the tape usage information.

Tape Log

The Tape Log contains details of the history of a tape, the total number of groups written, of RAW retries, of groups read, of C3 ECC retries, and of loads. The log is copied into RAM when the tape is loaded into the SDT-9000, updated as the tape is used, and written back into the System area on the tape when it is unloaded. Tape Write Protect, power failure or reset will lose the log data maintained in RAM.

Underlength

The incorrect length condition that exists after executing a read command when the requested transfer length in the command descriptor block exceeds the length of the actual block read.

