Seagate

Viper® 200 LTO Tape Drive

STU42001LW, STU42001WD

STU62001LW, STU62001WD

Product Manual

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FCC notice

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

- Reorient the receiving antenna.

- Relocate the computer with respect to the receiver.

- Move the computer into a different outlet so that the computer and receiver are on different branch circuits.

If necessary, you should consult the dealer or an experienced radio/television technician for additional suggestions. You may find the booklet, *How to Identify and Resolve Radio-TV Interference Problems,* prepared by the Federal Communications Commission, helpful. This booklet (Stock No. 004-000-00345-4) is available from the U.S. Government Printing Office, Washington, DC 20402.

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

Further, this equipment complies with the limits for a Class B digital apparatus in accordance with Canadian Radio Interference Regulations ICES-003.

Cet appareil numérique de la classe B est conforme a la norme NMB-003 du Canda.

The external device drive described in this manual requires shielded interface cables to comply with FCC emission limits.

Additional Warnings:

- To prevent fire or electrical shock hazard, do not expose the unit to rain or moisture.

- To avoid electrical shock, do not open the cabinet.

- Refer servicing to qualified personnel.

About this manual

Seagate provides this manual "as is," without warranty of any kind, either expressed or implied, including, but not limited to, the implied warranties of merchantability and fitness for a particular purpose. Seagate reserves the right to change, without notification, the specifications contained in this manual.

Seagate assumes no responsibility for the accuracy, completeness, sufficiency, or usefulness of this manual, nor for any problem that may arise from the use of the information in this manual.

This manual includes the following sections:

Introduction   The introduction provides an overview of LTO and Ultrium technology, and summarizes the drive's key features, technical specifications and Management/Diagnostic Software.

Specifications   This section contains detailed drive and cartridge specifications, as well as a summary of regulatory approvals and compatibility with various hardware and software.

Installation   The installation section includes handling precautions, unpacking tips, and installation instructions for the internal and external drives, as well as a summary of cabling and connector specifications.

Operation and maintenance   This section explains the use and operation of the drive and describes maintenance procedures, including drive "parking" and emergency cartridge removal.

Theory of operation   This section summarizes the technology used in various drive components.

SCSI interface   This section provides general information about the drive's SCSI interface.

Ultrium tape format   This section summarizes the features and technical characteristics of the LTO tape format.

Customer support services   This section lists service and support programs to ensure customer satisfaction, including Internet web addresses, telephone numbers and fax numbers.

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Introduction *1*

About the Ultrium tape format

The Viper 200 complies with the LTO Ultrium 8-channel format specification U-18. The Ultrium tape format is specifically designed for maximum data storage capacity. The Ultrium format achieves this high capacity by using long (600-meter) and wide (1/2-inch) tape media. Data is recorded in 384 tracks, grouped in four bands, each bounded by two servo tracks, for extreme reliability.

The Ultrium tape cassette uses just one tape reel, instead of two. This maximizes the amount of tape that can fit in a single cartridge, since space within the cartridge is taken up by the tape, not by tape reels. Despite its ultra-high capacity, the Ultrium cartridge is thinner than other existing single-reel cartridges. It measures about 4 inches square and is a little more than 3/4 of an inch thick. For more information, see "Ultrium Tape Format" on page 45.

Open format, open opportunities

One of the missions of LTO technology was to provide an open-format specification where multiple manufacturers could obtain a license, providing the foundation for new, improved Ultrium products. This goal has been reached, with more than 25 licensees supporting the Ultrium format.

The key advantages of a dynamic open format include the following

- Multiple independent technology sources

- Extensive industry support from manufacturers, OEMs and automation suppliers

- Shorter technology-development cycles

- Greater competition, increasing innovation and value.

Four generations of storage solutions

The Ultrium format of LTO technology defines a four-generation technology roadmap, which provides aggressive, attainable specifications based on the current technologies in use today.

	Generation 1	Generation 2	Generation 2	Generation 4
Capacity	200 Gbytes	400 Gbytes	800 Gbytes	1,600 Gbytes
Speed	Up to 40 Mbytes/sec	Up to 80 Mbytes/sec	Up to 160 Mbytes/sec	To 320 Mbytes/sec
Media	MP	MP	MP	Thin Film
Encoding	RLL 1,7	PRML	PRML	PRML

Note 1. Capacity and speed based on 2:1 data compression

Note 2. The LTO partners reserve the right to change the information in this migration path without notice.

About the Viper 200

The Viper 200 is a high-performance eight-channel LTO tape drive that uses ½-inch Ultrium tape cartridges with a native capacity of up to 100 Gbytes (for a 609m tape). It supports Read While Write (RWW) and intelligent hardware data compression as well as cartridge soft load. The drive's native sustained user data transfer rate is 16 Mbytes per second. The tape capacity and transfer rate are maximized through the use of intelligent data compression. The Viper 200 design is well suited for mid-range to high-end servers, mainframe systems, and tape library automation systems.

The Viper 200 comes with an ULTRA SCSI LVD or HVD interface, as well as a serial library interface. For more information on these interfaces, see "Interface, cabling and connectors" on page 23 of this manual. The internal Viper 200 drives (STU42001LW and STU42001WD) are designed to fit in a 5¼-inch full-height drive bay. The external drives (STU62001LW and STU62001WD) are standalone subsystems with built-in power supplies. The table below shows the model numbers for the different drive configurations.

Model	STU42001LW	STU42001WD	STU62001LW	STU62001WD
Mounting	Internal	Internal	External	External
Interface	LVD	HVD	LVD	HVD

Features and benefits

The following table summarizes the features and benefits of the Viper 200 drives.

Features	Benefits
Performance	
32 Mbyte-per-second compressed transfer rate	Highest announced rate, over 115 Gbytes per hour compressed
FastSense™	Optimization of data transfers resulting in shorter backup times and increased reliability due to fewer

Features	Benefits
	stops and starts
Intelligent Data Compression	Maximizes performance and capacity by analyzing compressibility prior to recording
Multiple interface options: LVD, HVD, Fibre Channel	Provides maximum flexibility to system integrators allowing optimization of the Viper 200 drive and their system
Fast Search	Tape search speeds between 6 and 9 meters per second, equating to average time to file between 32 and 48 seconds
Cartridge Memory	Enables fast loading of cartridges; stores pertinent information regarding the media
64-Mbyte data buffer	Extra fast backups on high-performance systems
Reliability	
Tape Alert drive performance monitoring and reporting	Remote monitoring of device performance
3rd generation read channel	Increased maturity and data integrity
Patented head positioner	Increased data integrity
Shock dampened isolated chassis	Increased shock tolerance and reliability
Managed airflow dynamics with isolated HTI chamber	Increased data integrity and reliability through decreasing contaminants
Hard error rate of 1 in 10^{17} bits	Built-in reliability
Two levels of ECC	Extra data safety and protection from errors
Reliable tape picking implementation	Increased reliability and proof of strong engineering
Electrical	
Very low RF emissions	Ease of agency certifications
Low power consumption	Typically only 23 to 34 watts operating range
Low heat rating	Increased reliability
Controlled tape path during power interruption	Disaster avoidance technology; saves data during unplanned power outages and prevents unnecessary field service
Software / Firmware / Interface	
Custom designed LSI circuitry	Seagate-designed and tested for fast, efficient data processing
RISC processors	Fast, efficient data processing
Second generation LVD firmware	Mature SCSI firmware decreases the number of revisions, increasing the ease of ongoing qualifications
Supports native firmware of a wide variety of UNIX platforms	Reduced set-up and configuration time
Support for Ultra SCSI-2, Low Voltage Differential, High Voltage Differential, and Single-ended interfaces	Compatible with the today's and tomorrow's high-performance interfaces
Remote diagnostics	Increases data safety through monitoring and

Features	Benefits
	testing capabilities; Individual feature set or private label capabilities for each system OEM and automation manufacturer
Support for SCSI-2 and some SCSI-3 instructions	Extra control of drive from the host system

Specification summary

Specification	Value	
Tape Format	LTO (Ultrium)	
Capacity	100 Gbytes (native)	609m cartridge
	50 Gbytes (native)	319m cartridge
	30 Gbytes (native)	203m cartridge
	10 Gbytes (native)	87m cartridge
Performance	16 Mbytes per second (native) with FastSense™ Dynamically adjustable to: 14, 12, 10, 8 Mbytes /second	
Models	Internal - LVD: STU42001LW; HVD: STU42001WD External - LVD: STU62001LW; HVD: STU62001WD	
Form Factor	5.25" Full-Height (internal drive)	
Interfaces	LVD HVD RS-422 Serial Port	
Tape Speed	4 meters per second at 16 Mbytes per second	
Search Speed	4 meters per second	
Recording	Heads:	8 channel
	Recording Density:	93K fci
	Data Density:	124K bpi
	Data Tracks:	384
	Data Track Density:	768 tracks per inch
	Servo Tracks:	5
Error Rate	Less than one error in 10^{17} bits read (w/error correction) *(Error rate before ECC: 6 errors in 10^7 bits read)*	
Power Consumption (typical)	Idle (tape loaded):	14 watts
	Streaming RWW:	25 watts
	Ramp up (peak):	35 watts (0.8 sec)
	Ramp down (peak):	27 watts (0.8 sec)
	Load/Unload (peak):	15 watts (0.2 sec)
	Thread/Unthread (peak):	23 watts (0.2 sec)
Reliability	MTBF:	250K hours @ 100% Duty cycle
	Loads/Unloads:	300K cycles
	Threads/Unthreads:	100K cycles
	Head Life:	30K hours
	Cartridge Loads/Unloads:	5K cycles

Management/diagnostic software

The Viper 200 includes *SeaTools Tape Diagnostic Utility* software. This software includes the following capabilities:

Drive settings

- Set maximum drive speed
- Select Power-On Self-Test mode (on/off)
- Select data compression mode
- Select cartridge autoload mode
- Select cartridge auto-unload mode

Drive commands

- Retension tape
- Download firmware
- Show remaining cartridge capacity

Diagnostics

- Read-Write test, with user-selectable data lengths
- Media interchange test
- Drive electronics test
- Advanced drive diagnostics

Specifications   *2*

This chapter provides technical specifications for the internal and external SCSI drives. This information covers the following specifications and requirements:

- Physical specifications

- Power requirements

- Drive performance specifications

- Environmental requirements

- Reliability

- Ultrium cartridge specifications

- Regulatory compliance

- Hardware and software compatibility

Physical specifications

The physical specifications of the Viper 200 drives are listed in the following table:

Specification	Internal drive without bezel	Internal drive with bezel	External drive
Height	3.25 inches (82.6 mm) max	3.32 inches (84.26 mm)	6.8 inches[1] (172.7 mm)
Width	5.75 inches (146.05 ± 0.25 mm)	5.82 inches (147.75 mm)	7.61 inches (193.3 mm)
Length	8.06 inches (205 mm) max	8.62 inches (219 mm) max	12.17 inches[2] (309.1 mm)
Weight	6.2 lb. (2.82 kg)	6.5 lb. (2.95 kg)	14.5 lb (6.58 kg)

Notes: [1] Includes rubber feet (case alone is 6.44 inches high)
          [2] Includes front bezel and fan grill (case alone is 11.9 inches long)

Figure 1 on the following page shows the dimensions of the internal Viper 200 drive.

Figure 1. Internal Viper Drive—dimensions

Side View

82.6 mm (max)

21.80 ± 0.20 mm

M3 X 5.0
4X Near side
4X Far side

84.26 mm (max)

79.24 ± 0.20 mm

48.9 ± 0.20 mm

9.90 ± 0.20 mm

210.41 mm

219.00 mm max

Bottom View

4X M3 X 5.0

139.70 mm ± 0.20 mm

146.05 ± 0.25 mm

147.75 mm

79.24 ± 0.20 mm

48.9 ± 0.20 mm

205 mm (max, without bezel)
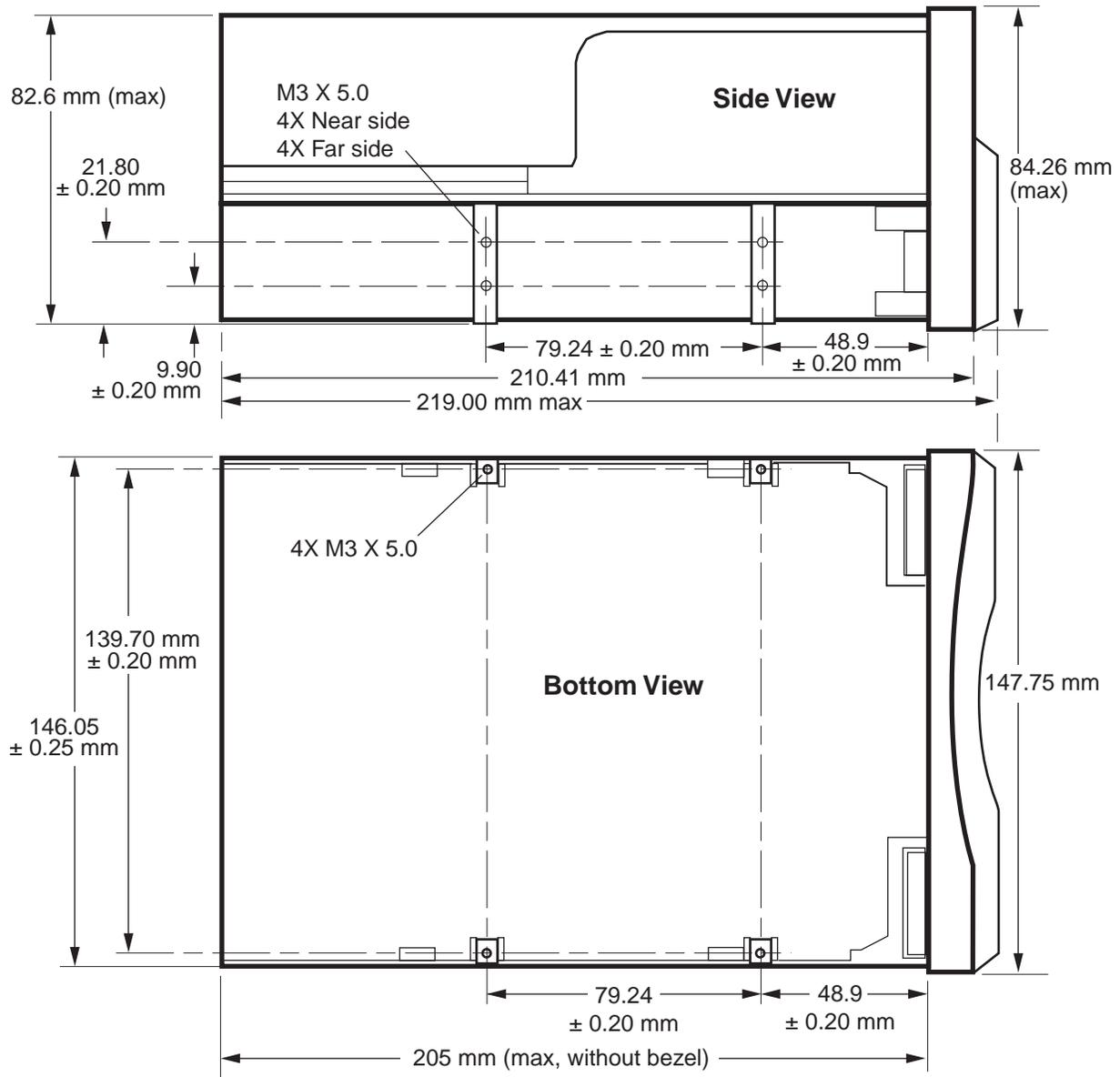
Power specifications

The external Viper 200 drives (STU62001LW and STU62001WD) come with a built-in 90-260VAC (47-63 Hz) automatic switching power supply.

Maximum voltage and power specifications for the internal Viper 200 drives (STU42001LW and STU42001WD) are listed in the tables below.

Voltage and current

	+12 VDC	**+5 VDC**
DC Voltage Tolerance	+ or – 10%	+ or – 5 %
Non-operating max voltage	14 Volts peak	7 Volts peak
Max Operating current		
Continuous:	1.0 amps RMS	3.5 amps max RMS*
Peak:	3.0 amps (1 sec max)	NA
Standby current (max)	0.5 amps RMS	2.0 amps RMS*
Ripple (peak-to-peak)	≤ 100 mV	≤ 100 mV

Power dissipation

Max Standby Power	14 watts RMS*
Max Continuous Operating Power	30 watts RMS*
Max Peak Operating Power	48.5 watts (1 sec max)

* RMS parameters measured at the power connector using a true RMS digital meter.

Power connector

The following table lists pin assignments of the power connector for the internal Viper drive.

Pin	**Assignment**
1	+12 VDC power
2	+12 VDC return
3	+5 VDC return
4	+5 VDC power

Drive performance specifications

The following table lists the performance specifications for the Viper 200 drive.

Specification	Value
Capacity	
Ultrium type A (609 m)	100 Gbytes (native)
Ultrium type B (319 m)	50 Gbytes (native)
Ultrium type C (203 m)	30 Gbytes (native)
Ultrium type D (87 m)	10 Gbytes (native)
Recording density	3,660 RLL-encoded ONEs per mm
Flux density	3,660 flux transitions per mm
Track density	3 tracks per mm
Error recovery	Read-after-write Reed Solomon ECC (2 levels)
Recording unrecoverable errors	< 1 in 10^{17} data bits
Recording undetectable errors	< 1 in 10^{27} data bits
Tape drive type	LTO (Ultrium)
Head configuration	16 thin-film write heads 16 MR read heads 8 MR servo heads During operation 8 write heads, 8 read heads and 2 servo heads are active at the same time.
Recording format	Ultrium 8-channel (U-18)
Recording method	(1,7) RLL
Transfer rate (sustained)	16.137 Mbytes/second (max, native)
Synchronous transfer rate (burst)	80 Mbytes per sec max
Asynchronous transfer rate (burst)	40 Mbytes per sec max
Cartridge load and tape thread time	<10 seconds
Cartridge unload time	3 seconds
Average rewind time (609-m tape)	< 76 seconds
Maximum rewind time (609-m tape)	152 seconds
Average data access time (609-m tape)	< 76 seconds
Maximum data access time (609-m tape)	152 seconds
Average rewind time (609-m tape)	< 76 seconds
Maximum rewind time (609-m tape)	152 seconds
Tape speed	up to 4 meters per second

Environmental requirements

The following table lists the environmental specifications for the Viper drive mechanism.

Specification	Operational	Non-operational
Temperature	+50° to +104°F (+ 10° to + 40°C)	–40° to +149°F (–40° to + 66°C)
Airflow requirements	Internal: 9 CFM (front to back)	
Thermal gradient	11°C per hour (10-40°C)	11°C per hour (10-40°C)
Relative humidity	20% to 80% non-condensing	10% to 95% non-condensing
Humidity gradient	10% per hour	10% per hour
Maximum wet bulb temp.	78.8°F (26°C)	No condensation
Altitude	max 10,000 feet MSL (at 25°C)	40,000 feet (power off)
Shock (1/2 sine wave)	2 Gs peak, 10 msec	10 Gs peak, 10 msec
Vibration (Sweep Test)	0.01 inches DA (5-22 Hz) 0.50 G peak (22–500 Hz) sweep rate 5-500Hz ; 1 octave per minute)	1.0 G (5-500Hz; sweep rate 0.5 octave per minute)
Acoustic level idling (A-wt sum)	38 dBA maximum 5.0 LwA Bels	—
Acoustic level operational (A-wt sum)	41 dBA maximum 5.5 LwA Bels	—

Injected noise

The internal drive will operate without degradation of error rates with 100 mV of noise injected between the chassis and 0 V at the power connector at any frequency between 45 Hz and 10 MHz.

Reliability

The Viper drive is designed for maximum reliability and data integrity. The following table summarizes the reliability specifications.

Specification	Description
Non-recoverable error rate	< 1 in 10^{17} bits
Error recovery and control	- Error-correction code techniques (C1 and C2 ECC) - Read-after-write (RAW) - Error monitoring and reporting (error log) - Retry on read
Mean time between failures (MTBF)	250,000 hours MTBF at 100% duty cycle: power applied and tape moving continuously (External drive; 50,000 hours at full load and 25°C)
Cartridge load/unload	300,000 cartridge load/unload cycles (no thread)
Mean time to repair (MTTR)	Less than 0.5 hour

Mean time between failures

The mean time between failures (MTBF) for the internal drive is specified at 250,000 hours minimum. This specification includes all power-on and operational time but excludes maintenance periods. Operational time is assumed to be 100 percent of the power-on time. Operational time is the time the tape is loaded.

The MTBF for the external drive power supply is 50,000 hours with the unit operated at full load and 25°C.

Note. The MTBF rating does not represent any particular drive, but is derived from a large database of test samples. Actual rates may vary from unit to unit.

Mean time to repair

The mean time to repair (MTTR) is the average time required by a qualified service technician to diagnose a defective drive and to install a replacement drive. The MTTR for LTO products is less than 0.5 hour (30 minutes).

The Seagate LTO drives are field-replaceable units. If a problem occurs with a subassembly or component in the drive, you should replace the entire unit. Return the drive to the factory in its original packaging. Contact your distributor, dealer, your computer system company or your Seagate sales representative to arrange the return.

LTO cartridge specifications

Environmental considerations

Specification	Value
Operating temperature	10°C to 45°C
Relative Humidity	10% to 80%
Wet Bulb Temperature	26° C max
Max Localized Temperature-permanent tape damage	> 52°C

If during storage and/or transportation a cartridge has been exposed to conditions outside the above values, it must be conditioned before use in the operating environment. The conditioning shall be exposure to the operating environment for a time equal to, or greater than, the time away from the operating environment, up to a maximum of 24 hours. There shall be no deposit of moisture anywhere on or in the cartridge.

The stray magnetic field at any point on the tape shall not exceed 4000 A/m.
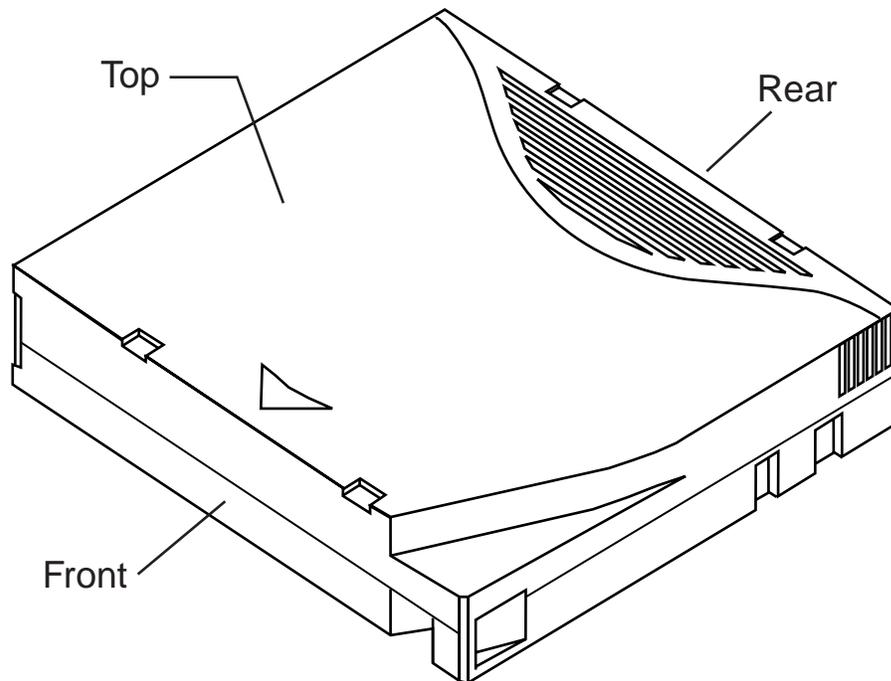
Figure 2. Ultrium cartridge

Cartridge memory

Each Ultrium 1 cartridge has 4 Kbytes of nonvolatile memory: 3 Kbytes are used to store tape-directory and hardware specific information. 1 Kbyte is available for application and OEM use. The cartridge memory is powered, read, and written to via a radio-frequency link.

Cartridge reliability

Recommended cartridge use: After 5,000 load/unload cycles, replace the cartridge to insure data integrity.

See the Ultrium Tape Format section of this manual for additional cartridge information and illustrations.

Regulatory compliance

These drives comply with the safety and EMC regulations listed in the following tables.

Safety compliance

Country	Regulatory Organization	Compliant to:
United States	Underwriters Laboratories (UL)	UL 1950 – 3ª edition
Canada	Canadian Standards Association (CSA)	CSA 22.2 950-95
Germany	Technischer Überwachungs-Verein (TUV) Rheinland	IEC 950 / EN60950, (including amendments A1, A2, A3, A4, A11)
Mexico	Normas Oficiales Mexicanas (NOM), similar to UL	NOM standards
Singapore	Productivity and Standards Board (PSB)	PSB safety certification
South Korea	JEON	JEON safety certification
Argentina	Instituto Argentino de Racionalization de Materiales (IRAM)	IRAM safety certification
China	Chinese Commodity Import Bureau (CCIB)	CCIB safety certification
EU member nations	Comité Europèen de Normalisation Electrotechnique – the European Committee for Electrotechnical Standardization (CENELEC)	IEC 950 / EN60950 (including amendments A1, A2, A3, A4, A11)
Member Nations of the IECEE*	International Electrotechnical Commission on Electrical Equipment (IECEE) for Mutual Recognition of Test Certificates for Electrical Equipment "CB Scheme"	CB Scheme per IEC 950 / EN60950 with details and exceptions for each member country
Hungary	MEEI Budapest	CB Scheme
Czech Republic	EZU Praha	CB Scheme
Poland	PCBC BBJ-SEP	CB Scheme
Russia	GOSSTANDART (GOST)	CB Scheme
Bulgaria	CSM	CB Scheme
Malaysia	JBE SIRIM	CB Scheme
Thailand	TISI	CB Scheme
India	STQC BIS	
South Africa	SABS	CB Scheme
Israel	SII	

* Member nations of the IECEE include Austria, Australia, Belgium, Canada, China (PR), Czech Republic, Denmark, Finland, France, Germany, Hungary, India, Ireland, Israel, Italy, Japan, (South) Korea, Netherlands, Norway, Poland, Russian Federation, Singapore, Slovakia, Slovenia, South Africa, Spain, Switzerland, United Kingdom, USA, Yugoslavia.

Electromagnetic compatibility (EMC)

Country	Regulatory Organization	Compliant to:
United States	Federal Communications Commission (FCC)	Title 47: Code of Federal Regulations, Part 15, Subpart B, Class B: Digital Device (47CFR15B)
Canada	Industry Canada Digital Apparaus - Interference-Causing Equipment Standard (ICES-003)	ICES-003 Class B: Digital Apparatus
EU member nations	CE	Emissions per CISPR 22:1997 - EN55022:1998 and Immunity per CISPR 24:1997 - EN55024:1998
Australia & New Zealand	Standards Australia Spectrum Management "C-Tick"	AS/NZS 3548-1995 (same as CISPR 22)
Japan	Voluntary Control Council for Interface (VCCI)	This is a voluntary compliance standard; the drives meet it via CE compliance
South Korea	Radio Research Lab of Korea (RRL)	RRL EMC certification
Taiwan	Bureau of Commodity Inspection and Quarantine (BSMI)	BSMI EMC certification
China	Chinese Commodity Import Bureau (CCIB)	CCIB EMC certification
Poland	PREDOM-OBR	CISPR-22, Class B
Russia	GOSSTANDART (GOST)	CISPR-22, Class B
Bulgaria	CSM	CISPR-22, Class B
Israel	SII	CISPR-22, Class B

Note: Use these drives only in equipment where the combination has been determined to be suitable by an appropriate certification organization (for example, Underwriters Laboratories Inc. or the Canadian Standards Association in North America).

You should also consider the following safety points:

- Install the drive in an enclosure that limits the user's access to live parts, gives adequate system stability and provides the necessary grounding for the drive.

- Provide the correct voltages (+5 VDC and +12 VDC) based on the regulation applied—Extra Low Voltage (SEC) for UL and CSA, and Safety Extra Low Voltage for BSI and VDE (if applicable).

Hardware and software compatibility

Compatible operating systems

The Viper 200 is compatible with the following operating systems running on an Intel-based system.

- Microsoft Windows NT (Windows 2000)
- Novell NetWare 5.0 and 5.1
- Red Hat Linux 6.2
- SCO OSR 5.0.5, 5.0.6
- SCO Unixware 7.1

Compatible native backup software

The Viper 200 is compatible with the native backup software provided with the following operating systems:

Compaq Tru64	Microsoft NT 4.0/Win2000	SCO UnixWare 7.1
DEC VMS, UNIX, Ultrix, OSF1	Novell NetWare 5.0 and 5.1	SGI Irix 6.6 and later
HP/UX 11.2 and later	Red Hat Linux 6.2	SunOS 4.3 and later
IBM AIX 4.3 and later (including Monterey)	SCO Unix 5.0.5	Sun Solaris 2.6 and later

Compatible network backup software

The Viper 200 is compatible with the following network backup utility software (ISV certifications).

ADSM Backup	HP Omniback	SCH Technologies Robot
Bakbone NetVault	IBM Tivoli	Sunsoft Solstice (Legato)
BEI UltraBAc	Legato Celestra	Syncsoft Backup Express
CA ArcServe	Legato Networker	Veritas Backup
CA Sterling	Linux EST BRU2000	Veritas NetBackup
Cristie PCBax	OTG Software Inc. Xtender	Yosemite TapeWare
Dantz Retrospect	SCH Technologies RBU	
EMC Symmetrix	SCH Technologies RLB	

Installation   *3*

Introduction

This chapter explains how to install the Viper 200 internal and external drives. It includes the following sections

- **Unpacking and inspection:** contains general information that you should read before installation.

- **Installing an internal Viper drive:** describes installing the internal drive in a 5.25-inch drive bay.

- **Installing an external Viper drive:** describes installing an external drive.

- **Interface, cabling and connectors:** gives specific cabling requirements and connector pinouts for the drive.

Unpacking and inspection

Although drives are inspected and carefully packaged at the factory, damage may occur during shipping. Follow these steps for unpacking the drive.

1. Visually inspect the shipping containers and notify your carrier immediately of any damage.

2. Place shipping containers on a flat, clean, stable surface; then carefully remove and verify the contents against the packing list. If parts are missing or the equipment is damaged, notify your Seagate representative.

3. Always save the containers and packing materials for any future reshipment.

Installing an internal Viper drive

The Viper 200 internal drives (STU42001LW and STU42001WD) are intended to be mounted within a host system. Internal drive installation involves three main steps:

1. Configuring the drive

2. Mounting the drive

3. Connecting the power and interface cables

Guidelines and cautions

The following guidelines and cautions apply to handling and installing internal tape drives. Keep them in mind as you install the drive.

- Handle the drive by the sides rather than by the top cover to reduce the risk of dropping the drive or damaging it during installation.

- Internal drives contain some exposed components that are sensitive to static electricity. To reduce the possibility of damage from static discharge, the drives are shipped in a protective antistatic bag. Do not remove the drive from the antistatic bag until you are ready to install it.

- Before you remove the drive from the antistatic bag, touch a metal or grounded surface to discharge any static electricity buildup from your body.

- Always lay the drive either on top of the antistatic bag or place it inside of the bag to reduce the chance of damage from static discharge.

- Install an HVD drive only in an HVD environment and an LVD drive only in an LVD environment. Do not mix HVD and LVD devices. Look at the label above the drive's SCSI connector to determine if the drive is an HVD or an LVD model (see examples at right):

    SCSI LVD/SE   SCSI DIFF

    LVD label   HVD label

- Due to the speed of the Viper 200 drive, it is recommended that a maximum of two Viper drives be connected to one host SCSI adapter.

1. Configuring an internal Viper drive

Before you install the tape drive in your computer, you may need to configure the drive's SCSI ID and other drive features. Jumpers located on the back of the drive (near the left edge) are used to configure the SCSI ID and to enable termination power.

Default settings

The default drive settings for the Viper 200 drives are:

- SCSI ID 6

- Termination power disabled.

If these default settings are appropriate for your needs, skip ahead to "Mounting an internal Viper 200."

Jumper settings

Configuration jumpers on the back of the drive control the drive's SCSI ID and SCSI termination power. The jumpers can also be used for remote SCSI address selection. Figure 3 shows the locations of the jumper blocks for the internal Viper 200.

Drive-configuration jumper pins

Default settings:

Pins:	Function:
1-2	SCSI ID bit 0
3-4	SCSI ID bit 1
5-6	SCSI ID bit 2
7-8	SCSI ID bit 3
9-10	Reserved
11-12	Termination Power (shown disabled)

Jumper Settings:

SCSI ID=0	SCSI ID=8
SCSI ID=1	SCSI ID=9
SCSI ID=2	SCSI ID=10
SCSI ID=3	SCSI ID=11
SCSI ID=4	SCSI ID=12
SCSI ID=5	SCSI ID=13
SCSI ID=6	SCSI ID=14
SCSI ID=7	SCSI ID=15
	Termination power enabled
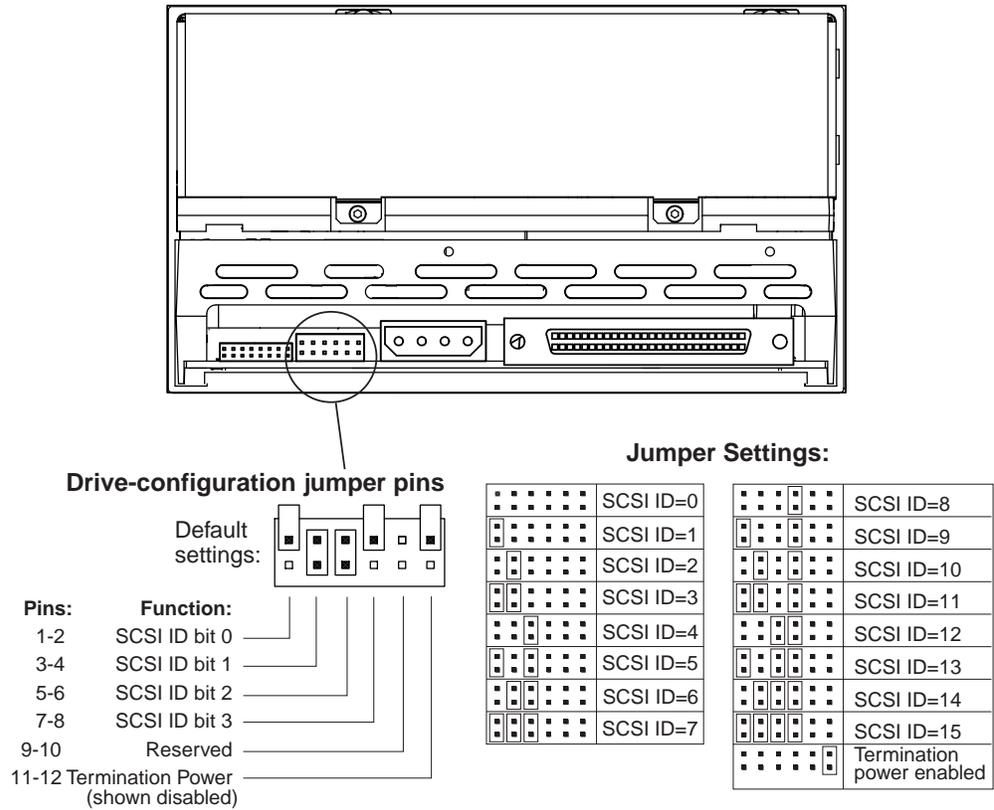
Figure 3. Back view of the Viper 200 internal drive, showing jumper settings

2. Mounting an internal Viper drive

You can mount internal drives either horizontally or vertically, with the drive's left side facing up (see Figure 4). If a drive is mounted vertically, the side of the drive should be within 5 degrees of horizontal. If a drive is mounted horizontally, the base of the drive must be within 15 degrees of horizontal and the PCB side of the drive must face down.

YES   YES   NO   NO
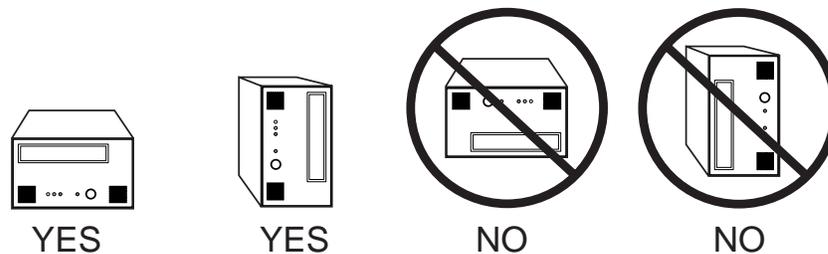
Figure 4. Acceptable mounting orientations for the internal Viper 200

Mounting the drive in a 5.25-Inch drive bay

Mount the drive in a 5.25-inch, full-height drive bay and secure it using two M3.0 X 5 metric screws on each side of the drive. Do not use screws longer than 5 mm or you may damage the drive. Figure 1 on page 7 shows the locations of the mounting-screw holes on the side and bottom of the drive, respectively.

3. Connecting the SCSI interface cable

Viper 200 drives are designed to be used with either an Ultra2 SCSI LVD or HVD interface.

Connecting the SCSI cable

First turn off all power to the drive and computer. Then attach the interface cable to the 68-pin SCSI interface connector on the back of the drive (see Figure 5). Do not mix LVD and HVD devices on the same SCSI bus.

Serial Interface connector (pins on 2-mm centers)   Drive-configuration jumper pins   5 / 12 Volt power connector   68-pin SCSI connector
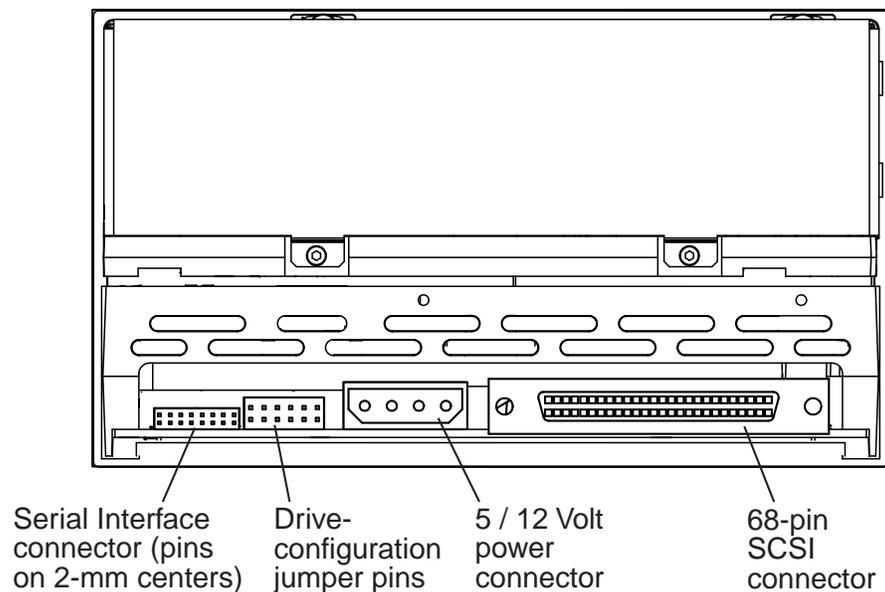
Figure 5. Back view of the Viper 200 internal drive, showing connectors

SCSI termination

The Viper 200 internal drive does *not* provide SCSI termination. Therefore, you must place a SCSI bus terminator or a SCSI device with termination enabled at the end of the SCSI chain. Two examples of SCSI termination are shown in Figure 6 on the following page. The Viper 200 does provide terminator power if a jumper is placed on the termination power jumper, as shown in Figure 3 on the previous page.
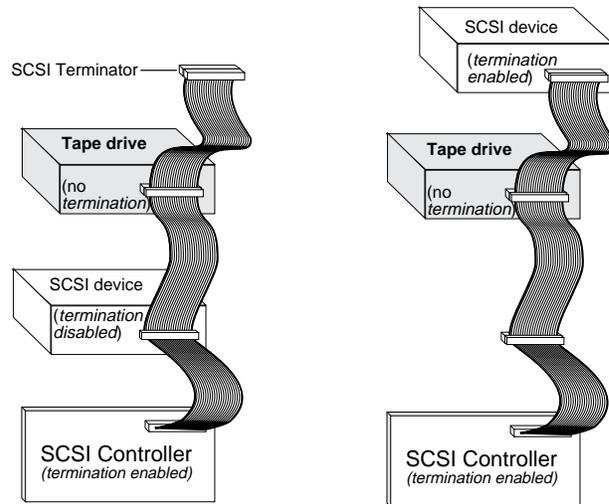
Figure 6. Two SCSI termination examples for internal Viper drive

Connecting a serial interface cable (for tape libraries)

The drive includes an RS-422 serial interface for tape libraries. The RS-422 serial interface connector is on the lower left side of the back of the drive, as shown in Figure 5 on the previous page.

The pin descriptions for the Serial Interface connector are shown in the table below. The pins on this connector are set on 2-millimeter centers.

Pin numbers	Description
1 through 8	Reserved (do not use)
9	Lib RXD-P input to drive
10	GND
11	Lib RXD-N input to drive
12	GND
13	Lib TXD-P output from drive
14	GND
15	Lib TXD-N output from drive
16	GND

Connecting a power cable

Attach a four-pin power cable to the power connector on the back of the drive. Figure 5 on the previous page shows the location of the power connector.

The recommended 4-pin power connector for the internal Viper 200 is an AMP 1-48024-0 housing with AMP 60617-1 pins or equivalent.

Installing an external Viper drive

The external Viper 200 drives (STU62001LW and STU62001WD) are compact subsystems that connect to the host computer through an external SCSI port. Installing an external drive involves the three simple steps shown below:

1. Configuring an external drive

Setting the SCSI ID

Make sure that the drive is turned off. Then set the SCSI ID for the drive using the push-button switch on the back of the external drive, as shown in Figure 7. The change will take effect when you turn the drive back on.
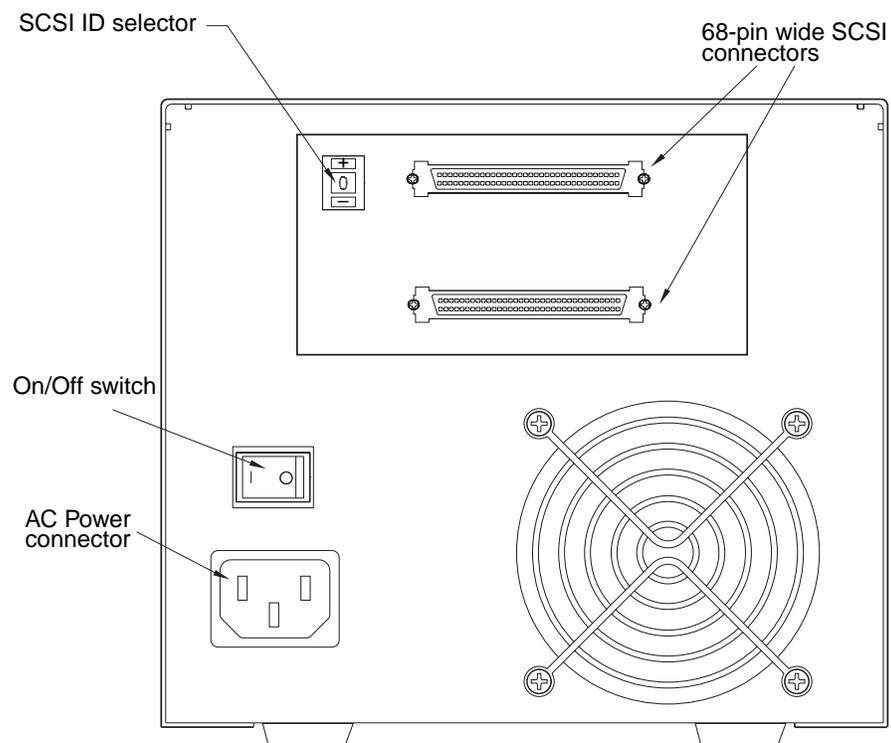
Figure 7. Back of external Viper 200 showing switches and connectors

2. Connecting the SCSI interface cable

The external Viper 200 provides two 68-pin, shielded connectors on the rear panel of the enclosure (see Figure 7). Either connector can be used as a SCSI IN or SCSI OUT connection, so you can use either connector to attach the drive to a host computer or to another SCSI device.

Note: Turn off all power before connecting or disconnecting SCSI cables.

SCSI termination

If the Viper drive is the last device or the only device in a SCSI chain, you must install a terminating plug on the unused SCSI connector. See Figure 8 below for two SCSI termination examples. You can purchase appropriate terminating plugs on the Internet at http://buytape.seagate.com.

Note.   Termination power is enabled as a default for the external Viper 200 drive.
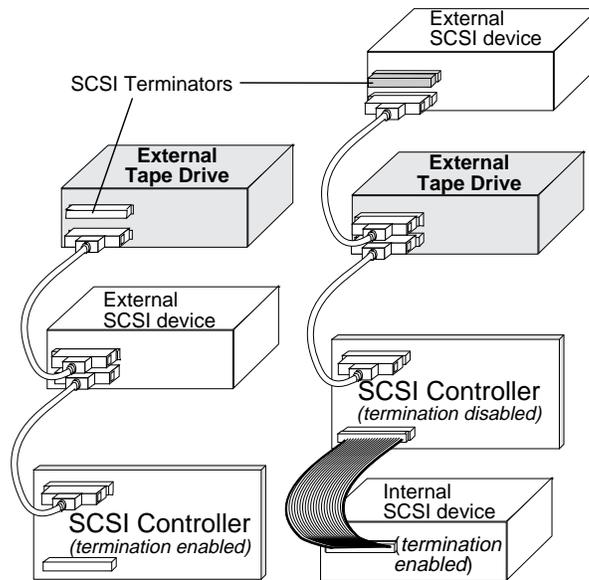
Example 1: SCSI termination in a system that has only external SCSI devices.

Example 2: SCSI termination in a system that has both internal and external SCSI devices.

Figure 8. SCSI termination examples for external tape drives

3. Connecting the power cord

Attach the power cord securely to the power connector on the back of the drive (see Figure 7 on the previous page).

Interface, cabling and connectors

The Viper 200 drives are available with LVD or HVD single-ended SCSI interfaces. ANSI SCSI standards specify the technical requirements for correctly cabling and connecting single-ended devices. This section provides some basic information about SCSI cabling and connectors for the drives.

Notes:

- HVD cannot be mixed with LVD or single ended devices.

- The best performance can be attained in a system where all devices are optimized for LVD SCSI, including drives, host and terminators.

- The next best performance can be attained in single-ended mode with an LVD host and terminator. If there is a single-ended device in the SCSI chain, the drives will switch to the single-ended mode.

Interface summary

Viper drives conform to the ANSI SPI-2 (T10/1142D) standard. Compliance to this standard is sometimes referred as Ultra2 SCSI. The LVD/SE Viper drives (STU62001LW and STU42001LW) support single-ended (SE) and low voltage differential (LVD). The HVD Viper drives (STU62001WD and STU42001WD) support high voltage differential (HVD) with 8- and 16-bit wide transfers.

LVD and HVD drives can be identified by the following labels, located above the SCSI connector:

LVD label   HVD label

The drives typically operate on a daisy-chain interface in which other SCSI devices are also operating. Devices on the daisy chain must all operate in the same mode, either SE, LVD, or HVD but not a mixture of these. The LVD/SE model is LVD/SE multimode compliant in that it automatically switches to LVD or SE as determined by the level of the SCSI DIFFSENS line. Therefore any SE device on the daisy chain forces the entire chain to SE mode. On the interface daisy chain, all signals are common between all devices on the chain, or SCSI bus.

Caution:	An HVD drive should never be plugged into a SCSI bus that contains LVD or SE devices.

The daisy chain of SCSI devices must be terminated at both ends with terminators of the proper impedance, in order to operate correctly. Intermediate SCSI devices shall not be terminated. Internal Viper drives do not have onboard termination circuits. Some type of external termination circuits must be provided for these drives by the end user or designers of the equipment into which the drives will be integrated.

Data transfer methods and rates

Interface Mode	Asyn-chronous	Fast-5	Fast-10	Ultra/Fast-20	Ultra2/Fast-40
SE	Yes	Yes	Yes	Yes	No
LVD	Yes	Yes	Yes	Yes	Yes
HVD	Yes	Yes	Yes	Yes	No
8-bit transfer rate (Mbytes/second)	-	5	10	20	40
16-bit transfer rate (Mbytes/second)	-	10	20	40	80

Cabling and connectors

Internal drive

Cabling

Use a 68-pin, flat cable with a maximum length of 6 meters (19 feet) to connect the drives to the SCSI host adapter. If twisted-pair cabling is used, connect the twisted pairs to physically opposing contacts on the connector.

A SCSI standard stub no greater than 0.1 meter should be used off the mainline connection within any connected equipment. The cable's characteristic impedance should be between 90 ohms and 140 ohms. A cable with characteristic impedance of greater than 100 ohms is recommended. To minimize noise and ensure even distribution of terminator power, the minimum recommended conductor size is 28 AWG (0.08042 mm^2).

Connectors

Viper drives use a 68 pin, non-shielded connector, alternative 3.

Interface voltages

VTERM : 4.25 to 5.25 Volts DC
CURRENT : 1.5A minimum, 2.0A maximum

External drive

The external drive provides two 68-pin, shielded connectors (ANSI Alternative 2) on the rear panel of the drive. These connectors consist of two rows of ribbon contacts spaced 2.16 mm (0.085 in) apart.

These two connectors facilitate adding the drive to a daisy-chain configuration. Either connector is a SCSI IN connection; the other is a SCSI OUT connection. When the drive is the last device in the chain (or the only device), an external terminator is plugged in the SCSI OUT connector.

Operation and maintenance *4*

This section describes important operational procedures for the Viper 200 drive. It covers the following topics:

- Understanding the front panel display

- How to use LTO cartridges

- Cleaning the tape drive

- "Parking" the drive for shipping, resetting the drive, and emergency cartridge removal

Front panel display

Multiple front panels are available for the Viper 200. Different panels are available for different customers, as well as for different operating environments (including automated systems). A generalized view of the Viper 200 front-panel display is shown in Figure 9.

Tape Cartridge Slot

Power
LED
(Green)

Tape
Load/Unload
Button

Status
LED
(Amber)

Error
LED
(Orange)
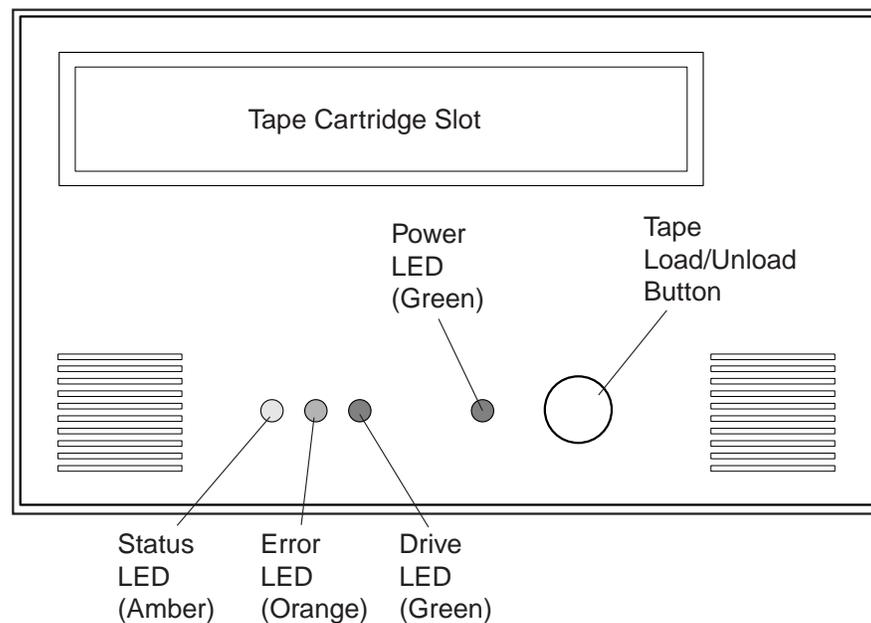
Drive
LED
(Green)

Figure 9. Generic front panel display for Viper 200

All drives have four LEDs on the front panel. The functions and colors of the LEDs are summarized in the following paragraphs.

- **Power LED** (green) – The Power LED blinks during drive power-up and Power-on Self Test (POST). If there is an error during the POST, the Power LED

remains on (not blinking), along with the Status light. During normal operation, the Power light remains on (not blinking).

- **Status LED** (amber) – If the Status LED stays on continuously, the drive needs to be cleaned. Other changes in drive or cartridge status are indicated by various blinking patterns, which are described in the table below.

- **Error LED** (orange) – The Error light blinks if the drive experienced a non-recoverable error.

- **Drive LED** (green) – The Drive LED is lit whenever a tape is loaded and ready for use. The Drive LED light blinks whenever a tape is loaded and moving.

The following table summarizes all the "blink codes" used by the Viper 200.

Drive Condition	Status LED (Amber)	Error LED (Orange)	Drive LED (Green)
Cleaning Request	ON		
Write Protected	1/4 sec ON 1/4 sec OFF		
Prevent Media Removal Mode Active	1/2 sec ON 1/8 sec OFF		
Hardware or Firmware Error		1/8 sec ON 1/8 sec OFF	
Positioning – Loading, Unloading, Rewinding, Spacing or Locating			ON continuously
Tape Active – Writing, Reading or Verifying			1/2 sec ON 1/8 sec OFF
SCSI Active			1/4 sec ON 1/8 sec OFF
Manual Intervention Required	1/8 sec ON 1/8 sec OFF	1/8 sec ON 1/8 sec OFF	
Power On Self Test (POST) Failure	ON	1/2 sec ON 1/2 sec OFF	
Excessive Rewrites or Read C2 errors		1/4 sec ON 1/4 sec OFF	1/8 sec ON 1/8 sec OFF
Cleaning Cartridge Present	ON		ON
Cleaning Cartridge at EOT	1/8 sec ON 1/8 sec OFF		ON
SCSI bus reset	1/4 sec ON 1/8 sec OFF		1/4 sec ON 1/8 sec OFF
Servo Initialization	1/2 sec ON 1/2 sec OFF		1/2 sec ON 1/2 sec OFF
Power On Self Test (POST) In Progress	1/4 sec ON 1/4 sec OFF	1/4 sec ON 1/4 sec OFF	1/4 sec ON 1/4 sec OFF
Cleaning Failure	1/8 sec ON 1/8 sec OFF	1/8 sec ON 1/8 sec OFF	ON
Microcode Download	1/8 sec ON 1/8 sec OFF	1/4 sec ON 1/4 sec OFF	1/8 sec ON 1/8 sec OFF
Microcode Download Error	1/8 sec ON 1/8 sec OFF	1/8 sec ON 1/8 sec OFF	1/8 sec ON 1/8 sec OFF

Using LTO cartridges

Loading a cartridge

To load an Ultrium cartridge into the Viper 200, place the cartridge in the slot and then push it to the detent. Then:

- Continue to push the cartridge the rest of the way into the drive; or,

- Press the load/unload button on the front of the drive to seat the cartridge; or,

- Use a library or host command to finish loading the tape.

Unloading a cartridge

To unload an Ultrium cartridge from the Viper 200, either:

- Use a library or host command to unload the tape, or

- Push the load/unload button on the front of the drive.

Caution.	Several seconds may elapse between the time you press the load/unload button and the time the cartridge is ejected. Do not power down the tape drive or the host computer until the Viper 200 has completely ejected the cartridge.

Write-protecting a cartridge

Ultrium cartridges have a sliding write-protect switch near the back right corner of the cartridge, as shown in Figure 10. If you slide the switch to the position farthest from the corner of the cartridge, data can be read from the cartridge but not written to it. If you slide the switch all the way toward the corner (as shown in Figure 10 bel0w), data can be both read from and written to the cartridge.

Note. LTO cartridges have prewritten servo patterns and should not be bulk erased.
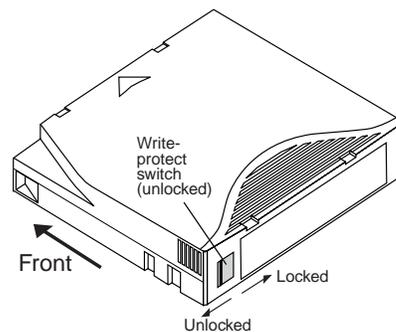

Figure 10. Ultrium cartridge showing write-protect switch

Cartridge care and maintenance

To protect the data on your Ultrium data cartridges, observe the following precautions:

- Always remove the cartridge from the drive when not in use and store it in its protective case.

- Do not expose cartridges to dirt, dust or moisture.

- Do not touch the tape media within a cartridge.

- Do not use data cartridges outside the specified operating conditions: 10°C to 45° C, 10% to 80% relative humidity.

  If a data cartridge has been exposed to temperature or humidity changes within the limits listed above, allow the tape cartridge to acclimate to its surroundings for at least one hour before use. Then retension the tape (as descrbed below) to allow the tape pack to become stable, for better performance.

  If, during storage and/or transportation, a data cartridge has been exposed to conditions outside the above range, it must be conditioned before use in the operating environment. The conditioning process requires exposure to the operating environment for a time equal to, or greater than, the time away from the operating environment, up to a maximum of 24 hours. The data cartridge should then be retensioned (as described below).

- Keep the cartridge away from direct sunlight and heat sources, such as radiators, heaters or warm air ducts.

- Keep the cartridge away from sources of electromagnetic fields, such as telephones, computer monitors, dictation equipment, mechanical or printing calculators, motors, magnetic tools, and bulk erasers.

- Avoid dropping the cartridges. This can damage components inside the cartridge, possibly rendering the tape unusable. If a tape is dropped it is advisable to open the cartridge door and make sure that the leader pin is in the correct position. A dropped cartridge should be retensioned before use.

- Do not bulk erase Ultrium cartridges. Bulk-erased cartridges cannot be reformatted by the tape drive and will be rendered unusable.

Tape Retensioning:

Ultrium data cartridges require periodic retensioning to operate properly. Retensioning reduces pack shift and stabilizes the tape pack. See your backup software manual for instructions on how to retensioning a tape cartridge. You should retension a tape cartridge under the following circumstances:

- If the cartridge is being used for the first time.

- If the tape cartridge has not been used for over a month.

- If the tape cartridge has been exposed to changes in temperature (first allow the media to acclimate to its surroundings).

- If the tape is "shoe shining" back and forth and backups are proceeding slowly.

Drive maintenance

The Ultrium drive requires little or no maintenance. However, on rare occasions, the drive mechanism may need to be cleaned.

Cleaning the tape drive

Excessive tape debris or other material may accumulate on the tape heads if the drive is used with nonapproved media or operated in a hot, dusty environment. In this case, the drive may experience excessive errors while reading or writing, and the amber Status LED will remain on continuously during operation. This means that the drive heads need to be cleaned.

The LTO cleaning cartridge has the same dimensions as the data cartridge and contains an LTO-CM (Cartridge Memory), but is loaded with cleaning media instead of recording media. Always keep the cleaning cartridge in its protective case when not in use.

To clean the drive, insert a Seagate-approved cleaning cartridge. During the cleaning process, both the Status and Drive LEDs will remain lit. After the cleaning process is completed, the cartridge may be ejected automatically, or you may need to press the load/unload button to remove the cartridge. Each time you use the cleaning cartridge, write the date on the label for future reference.

Note: If the Status LED comes on continuously within 24 hours after a cleaning cycle, perform the cleaning cycle again. If, after three cleaning cycles in a 72-hour period, the Status LED lights up again, contact Seagate Technical Support.

Each time the drive is cleaned, the tape advances to a new, unused section of media. After approximately 50 cleanings, all of the media will be used up and you should discard the cleaning cartridge. When a cleaning cartridge is used up, the amber Status LED flashes while the green Drive LED remains on. Do not attempt to reuse a spent cleaning cartridge

Note: The cleaning procedure will not run and the cleaning cartridge will be ejected in the following circumstances:

- The drive does not recognize the cartridge as an LTO cleaning cartridge.

- The cleaning cartridge has been used too recently. (The drive tries to prevent excessive cleaning, which can cause wear on the heads.)

- All of the tape on the cleaning cartridge has been used up (at EOT). In this case, the Status LED will flash rapidly while the Drive LED remains on.

Parking the drive for shipping

Seagate recommends that you "park" the Viper 200 before shipping it or placing it in an environment where it may be subject to physical shock. Parking the drive moves the tape mechanism to the configuration that is resilient to shock. You can park the Viper 200 using the Load/Unload button on the front of the drive, or by running special software on your host system. In either case, the drive must be powered up in order to enter park mode.

Parking the drive using the load/unload button

To park a drive manually, press and hold the load/unload button for 15 seconds or more. After you release the load/unload button, the green Drive LED lights up and the parking process begins. During the parking process, the picker arm moves into the take-up reel and the cartridge carrier moves to the load (down) position. After the process is complete, the Drive LED goes off, indicating that the drive has been successfully parked.

After parking the drive, you can turn the drive off and pack it for shipping. When you turn the drive on again, it will automatically return to normal operating mode.

If you need to unpark the drive without cycling power, press and hold the load/unload button for more that 5 seconds but less than 15 seconds.

Parking the drive using software

You can also park a Viper 200 using special software that communicates with the drive through it's SCSI interface. This utility program, called Command-Line Tape Diagnostics (CLDIAG), is available from the technical support section of the Seagate web site, at www.seagate.com/support. This utility software supports many commands, one of which can be used to park the Viper 200.

After loading the software on your system, you can park the Viper 200 by issuing the following command:

cldiag park

To return the drive to normal operational mode, you can either turn the drive off and then turn it on again, or issue the following command:

cldiag unpark

Note.   This command syntax applies to systems which contain a single Seagate Viper drive. If multiple Viper drives or other Seagate SCSI tape drives are attached to your system, you will need to specify the SCSI I.D. of the drive you wish to park, as described in the CLDIAG documentation.

Emergency reset and emergency cartridge eject

If the Viper 200 ever stops communicating with the host computer, use the following procedure to reset the drive and eject a cartridge (if necessary).

Caution.	When you perform an emergency cartridge eject, any data currently in the drive or host's buffers will *not* be written to the tape and the tape record may not be correctly terminated with an End of Data mark. If the End of Data mark is not written to the tape, it will be impossible to append any data to that tape, unless you overwrite the existing data on the tape.

To perform an emergency reset, hold down the load/unload button for five seconds, then release it. If there is no tape in the drive, the drive firmware reboots the drive and begins the power-on self-test sequence.

If there is a tape in the drive when you perform an emergency reset, the drive ignores all outstanding SCSI commands and ejects the tape. The drive then reboots and begins the power-on self-test sequence.

If the procedures above do not cause the cartridge to be ejected from the drive, it may be necessary to remove the cartridge manually, as described below.

Manual cartridge removal

The remainder of this section provides instructions for manually removing a data cartridge from an internal Viper drive. This should *only* be done if the cartridge cannot be removed by pushing the buttons on the front of the drive or by issuing commands from a host device. This should only be necessary if you must remove a data cartridge prior to returning the drive to Seagate.

Caution:	After following these procedures, you *must* return the drive to Seagate for repair. Do *not* attempt to use the drive until after it has been serviced.

Before you start

1. Issue all possible commands and run diagnostics prior to using the procedures in this manual.

2. Turn off all power to the drive.

3. Unplug all connectors to the drive.

4. Remove the drive from its operating environment.

5. Place the drive on a workbench with proper ESD grounding: attach a wrist strap to the bench and the other end to your wrist.

6. Remove the top cover of the drive by removing eight screws. (You will need a 1.5-mm hex driver).

    Note. Do NOT remove the front bezel or the bottom cover from the drive.

7. Inspect the drive to determine which procedure you should follow:

•   Case 1: The cartridge is loaded and the leader pin is still in the cartridge (see Figure 11). Follow the procedure on page 32.

•   Case 2: The cartridge is loaded and seated, and the tape is threaded or partially threaded on the take-up hub. Follow the procedure on page 33.


LEADER PIN
IN CARTRIDGE
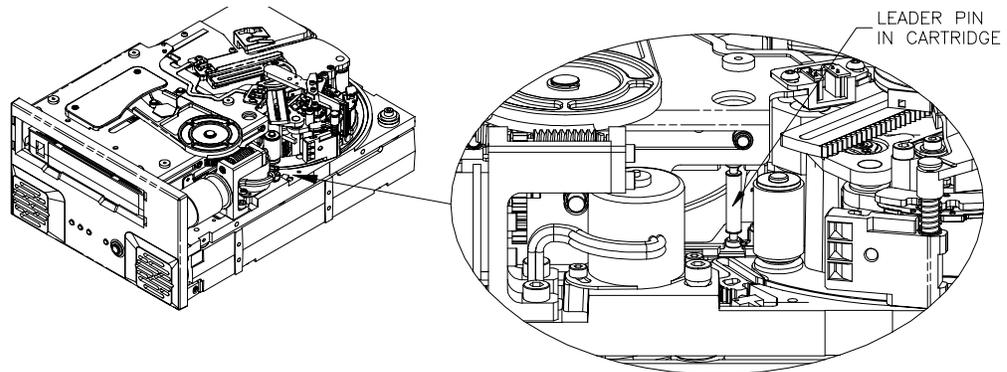
Figure 11. Diagram of Viper 200 showing leader pin inside LTO cartridge (tape *not* threaded on take-up hub)

Case 1: Cartridge Is loaded and seated

If the cartridge is loaded and seated and the leader pin is still inside the cartridge, follow these steps to remove the cartridge. To remove the cartridge you will need a small, flat-blade screw driver

1. Verify that the leader pin is still inside the cartridge as shown in Figure 11 on the previous page. If the leader pin has been pulled out of the cartridge and is still in the tape path, follow the steps in *Case 2: Cartridge Is loaded and tape is partially threaded* on the following page.

2. Use a flat-blade screwdriver to turn the worm gear counter clockwise (to the left). Figure 12 shows the location of the worm gear. This will gradually raise the cartridge elevator and cause the cartridge to slide partially out of the drive.

Note.   Do not touch any other part of the drive mechanism during this process.
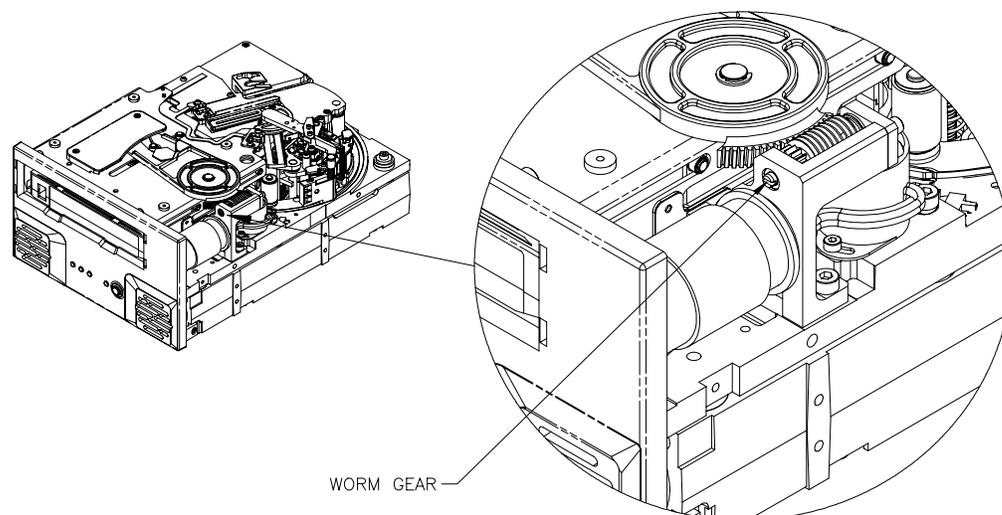
WORM GEAR

Figure 12. Diagram of Viper 200 showing worm gear

3. Continue turning the worm gear until the cartridge is sticking out of the unit approximately 17 mm (0.66"). Then carefully pull the cartridge out by hand.

4. After you have removed the cartridge, put the top cover back on the drive; then replace and tighten the screws.

5. Return the drive to Seagate.

Caution.	Do NOT use the drive after you have removed a cartridge. The drive must be returned to Seagate for servicing.

If you have any questions on this process, contact Seagate Technical Support for Tape Products (see Section 8 for contact numbers).

Case 2. Cartridge is loaded and seated and tape is threaded

Follow these steps if the cartridge is loaded and seated, and the tape is entirely or partially threaded into the drive. You will need a small, flat-blade screw driver and an 1.5-mm hex wrench. Figure 13 shows key components of the drive mechanism that are referred to in the text below.

Note.   Do not touch any part of the drive mechanism except for the components specified in the instructions. Be especially careful not to touch the tape head assembly. The MR elements in this assembly are highly susceptible to damage from static electricity.
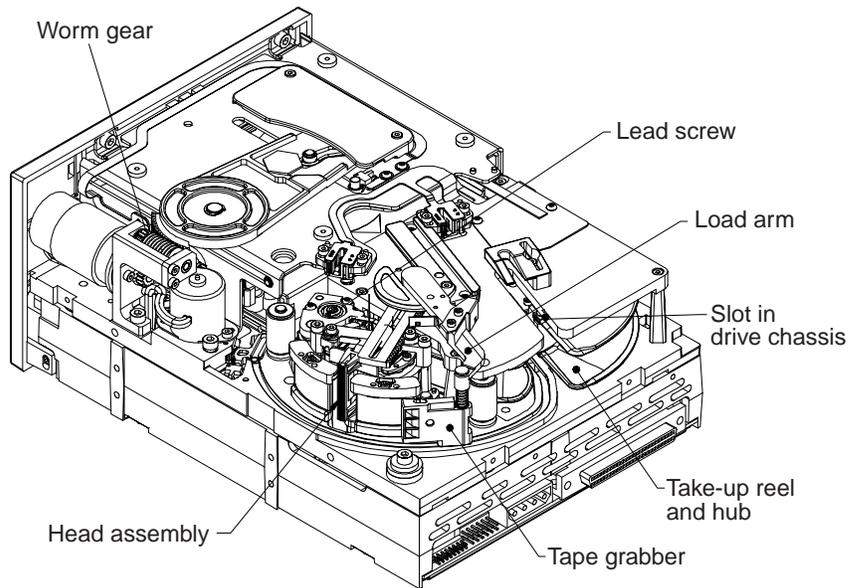
Figure 13. Diagram of Viper 200 showing key components used in manual cartridge removal (no tape cartridge in drive)

1.   Make sure the head assembly is in the lowered position by turning the lead screw (shown in Figure 14) clockwise with the flat blade screwdriver. This is necessary to allow the load arm to clear the head assembly when it is moved back toward the cartridge.
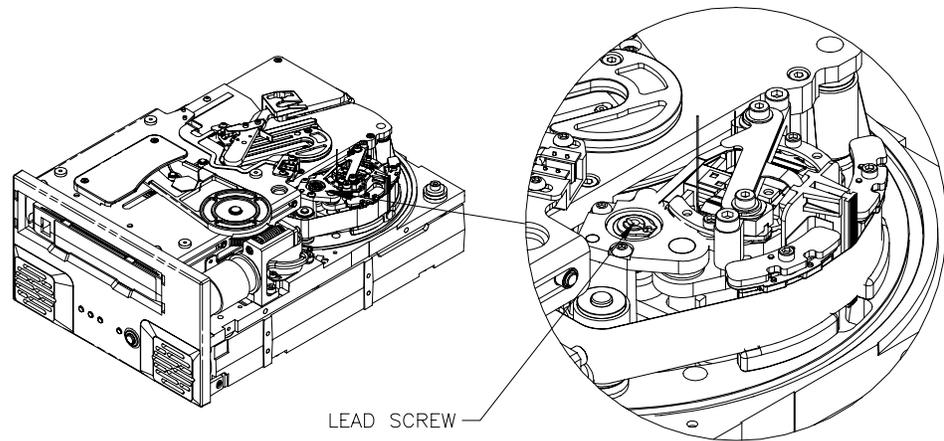
Figure 14. Diagram of Viper 200 showing lead screw (tape threaded on take-up reel)

2. Replace the drive cover to protect the gear and spooling assemblies. You do not need to replace all the screws.

3. Turn the drive upside down.

4. Insert the 1.5-mm hex wrench through the hole in the bottom plate shown in Figure 15. Turn the hex wrench clockwise slowly and smoothly to rewind the tape into the cartridge. This may take some time.

Caution:	If you turn the hex wrench quickly or unevenly, you may create a tape loop, which could cause tape contamination.
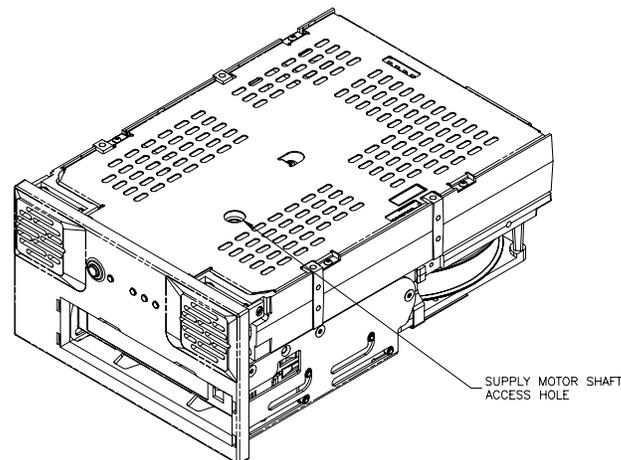
Figure 15. Diagram of underside of Viper 200 showing supply motor access hole

5. When all of the tape has been spooled off of the take-up reel, turn the drive right-side up.

6. Rotate the hub to align the slot in the hub with the slot on the drive chassis (see Figure 13).

7. Set the drive on its left side. Rotate the load arm until the tape grabber clears the hub.

> **Caution.** Be especially careful not to touch the tape head assembly. The MR elements in this assembly are highly susceptible to damage from static electricity.

8. Take up the slack tape again using the 1.5-mm hex wrench, as described in step 4 above.

9. Carefully push the grabber in toward the cartridge, as shown in Figure 16.
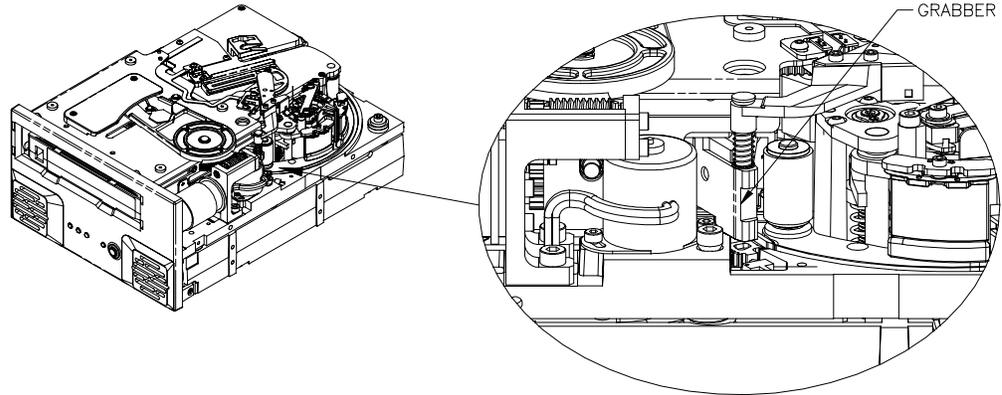
GRABBER

Figure 16. Diagram of underside of Viper 200 showing tape grabber near cartridge

10. When the leader pin and the tape grabber reach the cartridge, gently push the grabber toward the front of the cartridge. Use the grabber to push the leader pin gently into the cartridge until it seats in place (you should hear a click).

11. Using a flat-blade screwdriver, pivot the white lower track toward the drive bezel to disengage the leader pin.

11. After the grabber has released the leader pin, pull the loader arm out of the way.

12. Use a flat-blade screwdriver to turn the worm gear counter clockwise (to the left). Figure 17 shows the location of the worm gear. This will gradually raise the cartridge elevator and cause the cartridge to slide partially out of the drive.
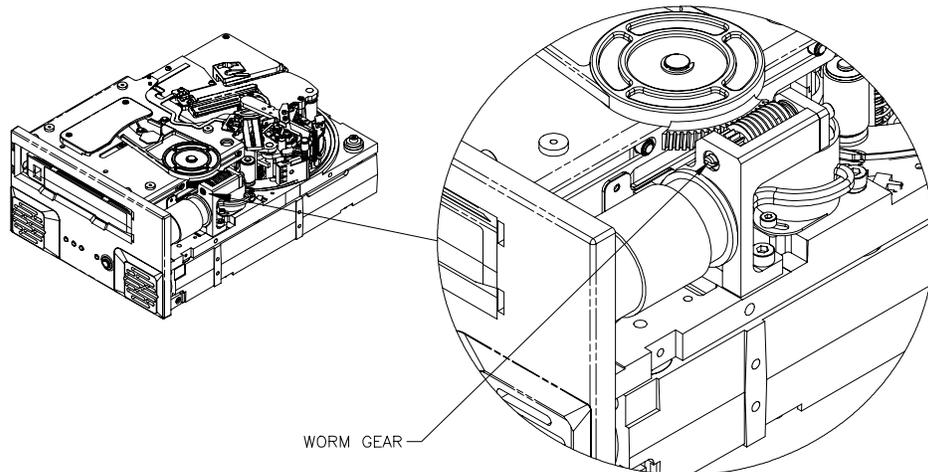
WORM GEAR

Figure 17. Diagram of Viper 200 showing worm gear

13. Continue turning the worm gear until the cartridge is sticking out of the unit approximately 17 mm (0.66"). Then carefully pull the cartridge out by hand.

14. After you have removed the cartridge, put the top cover back on the drive; then replace and tighten the screws.

15. Return the drive to Seagate.

Caution.	Do NOT use the drive after you have removed a cartridge. The drive must be returned to Seagate for servicing.

Note. Any tape cartridge removed using this procedure should be retensioned before it is used for reading or writing data.

If you have any questions on this process, contact Seagate Technical Support for Tape Products (see Section 8 for contact numbers).

Theory of operation *5*

This section describes operational theories used in the Viper 200 drive. It covers the following topics:

- Track Layout

- Recording Method

- Data Buffer

- Data Integrity

- Data Compression

Track layout

Figure 18 summarizes the layout of data on an LTO tape.
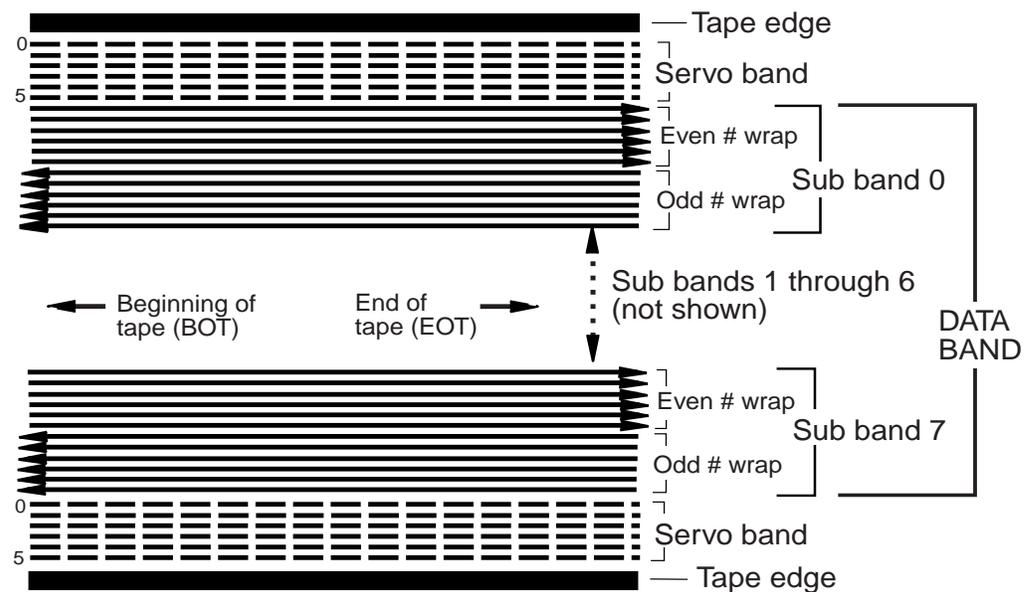
Figure 18. Layout of tracks on LTO Ultrium tape

There are 384 *data tracks* on the LTO tape, numbered 0 through 383. Data track 383 is the track closest to the bottom edge of the tape (the reference edge). The area between adjacent servo bands is a data band. There are 4 data bands, each of which includes 96 data tracks. The data bands are numbered 2,0,1,3. Data band 2 is closest to the bottom edge of the tape.

A *track group* is a set of tracks that is recorded concurrently. The sets of 12 data tracks in a data band are data sub bands. There are 8 data sub bands per data band. The data tracks are accessed in a serpentine manner.

A *wrap* is a track group recorded in the physical forward or physical reverse direction. The wraps are recorded in a serpentine fashion starting in data band 0. The tape contains 48 track groups, 24 written in the forward direction and 24 written in the reverse direction. Even-numbered wraps are recorded in the forward direction (BOT to EOT), and odd-numbered wraps are recorded in the reverse direction (EOT to BOT).

Recording method

The Viper records data using write-equalized (1,7) Run Length Limited (RLL) code. RLL (1,7) Data bits are defined as follows:

- A ONE is represented by a flux transition at the center of a bit-cell.
- A ZERO is represented by no flux transition in the bit-cell.

Data buffer

In its default configuration, the Viper has a 32-Mbyte buffer. The SDRAM controller has a burst transfer rate of 320 Mbytes/sec, and utilizes bank switching to achieve a maximum average bandwidth of nearly 240 Mbytes/sec. This is needed to support data compression in the case of compressible data being transferred from SCSI at 80 Mbytes/sec.

Data integrity

The mechanical and electrical design of the drive ensures that drive performance does not degrade over its operating life. Changes in head alignment, head wear, component drift, and other factors are minimized to ensure that data integrity and interchange capability are not compromised over the drive's operating life.

The Viper's uncorrectable error rate is less than 1 hard error in 10^{17} bits. The drive's undetectable error rate is 1 in 10^{27} bits read.

Error-correction code (ECC)

The use of Cyclic Redundancy Checking (CRC), two-level orthogonal Error Correction Coding (ECC) provides a very low probability of encountering a hard error. During the read process ECC correction is performed on-the-fly without affecting tape streaming.

There are two levels of Error Correction Coding (ECC). These two levels are orthogonal – that is, an ECC codeword at one level will intersect ECC codewords at the other level just once, which means that there will be only one common symbol between them. The two levels are called C1 and C2.

C1 ECC

As data is written to memory from the Data Processing unit, the DMA / ECC interface generates C1 ECC bytes and writes them to memory.

As data is written to tape, the C1 ECC is checked, and an interrupt generated if there is an error. The C1 ECC read from memory is the ECC that is written to tape.

When data is read from tape and stored into memory, C1 ECC is checked. If the C1 ECC is good, then that codeword pair's "Valid" bit is set. Otherwise, a pointer to the invalid Codeword Pair is passed to the C1 ECC correction engine. If it can correct the error, then the corrected bytes are written to memory, and the Valid bit is set. Otherwise, the Valid bit is left cleared. As data is read from memory to the Data Processor for decompression, the C1 ECC is again checked, and an interrupt generated if it is not correct.

C2 ECC

C2 ECC involves three distinct operations:

1. **Encoding:** Generating C2 ECC bytes from data bytes (performed by ECC co-processor hardware)

2. **Decoding:** Generating ECC syndromes from data and ECC bytes, testing for all-zeroes (performed by ECC co-processor hardware)

3. **Correction:** Generating corrected data from syndromes.

Correction is performed differently depending on the number and types of errors involved:

- For one known C1 codeword pair in error in a sub-data set (C2 codeword) the operation is performed by ECC co-processor hardware.
- For two or more known C1 codeword pairs in error, the matrix is computed by firmware and the correction is performed by hardware.
- For one or more unknown C1 codeword pairs, syndromes are generated by hardware, error location is computed by firmware, the matrix is computed by firmware, and correction performed by hardware.

Servo-tracking faults

If, while performing a write operation, the servo system detects an error that may result in adjacent data tracks being over-written; the write operation will be aborted. The write operation will not continue until the correct servo tracking is re-established.

Data compression

Background

Typical data streams of text, graphics, software code, or other forms of data contain repeated information of some sort, whether it is at the text level where you can readily recognize regular repetitions of a single word, or at the binary level where the repetitions are in bits or bytes. Although most data is unique and random, the binary

level data exhibits patterns of various sizes that repeat with varying degrees of regularity.

Storage efficiency is increased if the redundancies or repetitions in the data are removed before the data is recorded to tape. Data compression technology functions to significantly reduce or eliminate the redundancies in data before recording the information to tape. This increases the amount of data that can be stored on a finite medium and increases the overall storage efficiency of the system.

With data compression, the redundant information in a data stream is identified and then represented by codewords or symbols, which allow the same data to be recorded in a fewer number of bits. These symbols or codewords point back to the original data string, using fewer characters to represent the strings. Because these smaller symbols are substituted for the longer strings of data, more data can be stored in the same physical space.

Some important benefits result from data compression in tape drives:

- The same amount of information can be stored on a smaller length of tape.
- More data can be stored on a given length of tape.
- Performance can more closely parallel to that of high-transfer-rate computers.
- More information can be transferred in the same time interval.

Data compression considerations

In an effective data-compression method, several factors are important:

- The amount of compression (measured by the *compression ratio*, which is a ratio that compares the amount of uncompressed data to the amount of compressed data and is obtained by dividing the size of the uncompressed data by the size of the compressed data)
- The speed with which data is compressed and decompressed in relation to the host transfer rate
- The types of data to be compressed
- The data integrity of the compressed data

The amount of compression possible in a data stream depends on factors such as the data pattern, the compression algorithm, the pattern repetition length, the pattern repetition frequency, the object size (block of information to be compressed) and the starting pattern chosen.

The transfer rate depends on factors such as the compression ratio, the drive buffer size, the host computer input/output (I/O) speed, the effective disc speeds of the host computer and the record lengths that the host computer transmits.

Data compression algorithms can be tailored to provide maximum compression on specific types of data. But because varying types of data are encountered in normal day-to-day operating circumstances, an effective data compression method for a tape drive must serve various data types. Additionally, the data compression method must *adapt* to different data types, automatically providing optimum handling for all types of data.

Intelligent data compression

The tape's compressed capacity is maximized through the use of intelligent data compression. The intelligent data compression hardware determines the compressibility of each record. If the size of the record is larger after a compression attempt than the native (uncompressed) size, then the record is written in its native form.

The intelligent data compression utilizes two compression schemes:

- Scheme-1 is a LZ1 based compression scheme using a history buffer to achieve data compression.

- Scheme-2 is a pass-through compression scheme designed to pass uncompressible data through with minimal expansion.

There are three specific requirements for compliance with the LTO specification.

- First: the output data stream must be decompressible following LTO rules to create the input sequence of records and File Marks perfectly.

- Second: an LTO compressed data stream may not contain any of the eight reserved Control Symbols.

- Third: while control symbols allow switching to Scheme 2, this should never be used by operational software because this capability is only for diagnostic and testing purposes.

Software data compression should never be used because the Viper's built-in intelligent data compression is much more efficiently than software data compression systems.

The Viper 200 uses a derivative of ALDC-2 lossless data compression that includes additional control codes for intelligent data compression.

SCSI interface *6*

Introduction

This chapter summarizes the SCSI message codes, status codes and commands used by the drive. Refer to chapter 3 for SCSI cabling and connection information. Please refer to the *LTO Tape Drive SCSI Interface Manual* (part number 100109647) for detailed developer information relative to SCSI implementation.

Viper 200 drives feature a multi-mode LVD or HVD single-ended SCSI-2 interface. The drive's SCSI-2 interface allows for communication between the host computer and the tape drive. The Viper SCSI-2 interface conforms to requirements outlined in ANSI X3.131, 1994. The drive also supports some SCSI-3 command extensions.

SCSI-2 interface

The SCSI-2 interface for the Viper 200 drive conforms with the ANSI X3.131, 1994 standard. The following three tables list the message codes, status codes and commands for this interface.

SCSI message codes

Code	Description	Direction[1]
00h	Command Complete	In
02h	Save Data Pointer	In
04h	Disconnect	In
05h	Initiator Detected Error	Out
06h	Abort	Out
07h	Message Reject	In/Out
08h	No Operation	Out
0Ch	Bus Device Reset	Out
80h	Identify (No Disconnect/Reconnect)	In/Out
C0h	Identify (Disconnect/Reconnect)	In/Out
01h[2]	Extended Message	In/Out
03h	Wide Data Transfer Request	In/Out

1.   Direction is defined as follows: In = Drive to Host; Out = Host to Drive

2.   The Viper 200 drive supports only one Extended Message: Synchronous Data Transfer Request

SCSI status codes

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

SCSI-2 commands

Code	Command
00h	Test Unit Ready
01h	Rewind
03h	Request Sense
05h	Read Block Limits
08h	Read
0Ah	Write
0Bh	Set Capacity
10h	Write Filemarks
11h	Space
12h	Inquiry
13h	Verify
15h	Mode Select (6-byte version)
16h	Reserve Unit (6-byte version)
17h	Release Unit (6-byte version)
19h	Erase
1Ah	Mode Sense (6-byte version)
1Bh	Load/Unload
1Ch	Receive Diagnostic Results
1Dh	Send Diagnostic
1Eh	Prevent/Allow Medium Removal
2Bh	Locate
34h	Read Position
3Bh	Write Data Buffer
3Ch	Read Data Buffer
4Ch	Log Select
4Dh	Log Sense

SCSI-3 commands

Code	Command
0Bh	Set Capacity (proposed for SSC-2)
44h	Report Density Support
55h	Mode Select (10-byte version)
56h	Reserve Unit (10-byte version)
57h	Release Unit (10-byte version)
5Ah	Mode Sense (10-byte version)
A0h	Report LUNS

Tape Alert flags

The Viper 200 supports version 3.0 of the Tape Alert specification. The following flags are supported by the drive.

Parameter	Description	Type
3	Hard Error	Warning
4	Media	Critical
5	Read Failure	Critical
6	Write Failure	Critical
9	Write Protect	Critical
11	Cleaning Media	Information
14	Irrecoverable snapped tape	Critical
15	Memory in Cartridge Failure	Warning
16	Forced Eject	Critical
17	Read Only Format	Warning
18	Tape Directory Corrupted	Warning
20	Clean Now	Critical
21	Clean Periodic	Warning
22	Expired Cleaning Media	Critical
23	Invalid Cleaning Cartridge	Critical
30	Hardware A	Critical
31	Hardware B	Critical
32	Interface	Warning
34	Download Fault	Warning

SCSI-2 ANSI X3.131, 1994 conformance statement

General features of interface

- Disconnect/reconnect, arbitration (required in SCSI-2)
- Single-ended drivers
- Termination power supplied to cable (jumper option)
- Supports both single and multi-initiator systems
- Fixed and variable block transfer lengths
- Hard reset
- Synchronous data transfers
- Parity implemented (switch option)
- Space blocks, filemarks and EOD
- Supports third-party reservation
- Log Sense and Log Select for managing soft error reporting
- Mode Sense/Select page to control and report operation of data compression in sequential access devices and to read from and write to the configuration EEPROM

Typical system configurations

The Viper 200 supports up to 16 SCSI addresses or IDs. These IDs refer to host adapters or peripheral devices such as printers, magnetic discs or tape drives.

Any combination of a single host and up to fifteen additional SCSI devices can be chained together on a single SCSI cable.

Due to the speed of the Viper 200 drive, it is recommended that a maximum of two Vipers be connected to one host SCSI adapter.

Ultrium tape format 7

This chapter summarizes the features and benefits of the LTO tape formats, and of the Ultrium tape cartridges.

Overview of LTO tape formats

Ultrium is one of two LTO tape formats. Like DLT tapes, LTO tapes are recorded using a linear serpentine recording technique. However, the LTO specification has improved this recording technique in many ways:

Cartridge memory: All LTO tape cartridges contain a small nonvolatile-memory chip, called the LTO-CM. The LTO-CM is used to store information about the location of data on the cartridge, as well as the condition of the cartridge itself (manufacturing information, number of times the cartridge has been loaded, written, and read, the last drive to write or read the cartridge, etc.). Tape drives can read this information almost instantaneously to locate data on the tape. Tape library systems can read this information without even loading the tape into a drive mechanism, since the LTO-CM chip communicates with the LTO drive or library controller through a tiny radio-frequency interface.

More recording channels per tape: Most existing linear tape formats use 4 recording channels. First-generation LTO tapes will have 8 channels, allowing native data transfer rates of 10 to 20 Mbytes per second. Subsequent generations of tape will have 16 channels, and will be even faster.

Higher recording density: The LTO specification allows higher recording densities than any existing linear tape products. Further increases in recording density are possible in the future because the LTO tape specification is optimized for magneto-resistive (MR) tape heads.

Ultrium technology overview

The Ultrium tape format is optimized to store as much data as possible. Even the first generation Ultrium tape provides up to 100 Gbytes of uncompressed data storage--more than any other product in its class.

The Ultrium format achieves this high capacity by using long (600-meter) and wide (1/2-inch) tape media. Data is recorded in 384 tracks, grouped in four bands, each bounded by two servo tracks, for extreme reliability.

The Ultrium cartridge

The Ultrium tape cassette uses just one tape reel, instead of two. This maximizes the amount of tape that can fit in a single cartridge, since space within the cartridge is taken up by the tape, not by tape reels.

Despite its ultra-high capacity, the Ultrium cartridge is thinner than other existing single-reel cartridges. It measures about 4 inches square and is a little more than 3/4 of an inch thick.

The cartridge features a write-protect switch and built-in cartridge memory (described below).

As shown in Figure 19, there is a door near one corner of the cartridge. When the cartridge is inserted into the drive, the drive opens this door to expose the leader pin that is attached to the beginning of the tape.

Caution. Do not open the tape door manually, or you may allow dust to enter the cartridge, which could result in loss of data.
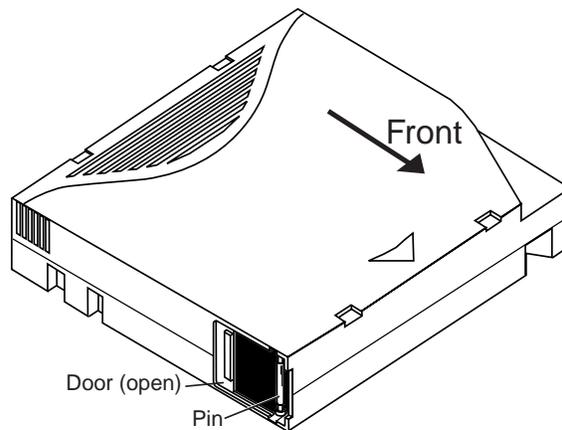
Figure 19. LTO cartridge with door open to show leader pin

Cartridge memory

To maximize data access speed and efficiency, every LTO cartridge contains a Cartridge Memory (CM) chip, which communicates with the drive via a contactless radio-frequency link. The cartridge has 4 Kbytes of memory: 3 Kbytes are used to store tape directory and hardware specific information and 1 Kbyte is available for application and OEM use.

The cartridge memory is powered, read, and written to via radio-frequency link (non-contact).

The drive will not write to a cartridge whose CM is faulty or whose CM (or manual switch) is set to write protect.

The information stored in the CM includes the following:

- Cartridge type
- Unique cartridge serial number
- Cartridge manufacturer
- Date of manufacture
- Tape length

- Information about the last drive to initialize the tape

- information about the last drive to write to the tape

- Tape Alert Flags that are set each time the cartridge is unloaded from the drive

- A count of the total number of times that the cartridge has been loaded

- A count of the total number of data sets written to this tape

- A count of the total number of write errors (recovered and unrecovered)

- A count of the total number of read errors (recovered and unrecovered)

- A count of the total number of write passes

Figure 20 shows the internal location of the Cartridge Memory and the Write-protect switch.
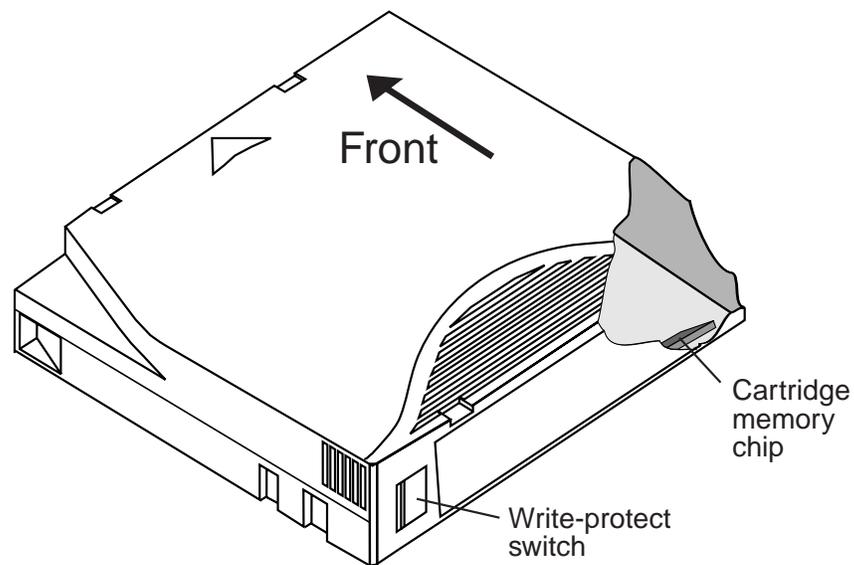
Figure 20. LTO cartridge showing cartridge memory and write-protect switch

Customer support services   *8*

Seagate offers the most extensive line of disc and tape storage products in the industry and offers comprehensive service and support programs to ensure customer satisfaction.

World-wide services:

World-wide web: A wide variety of technical support services are available on Seagate's World Wide Web site, located at **http://www.seagate.com**

Seagate E-mail Technical Support: You can e-mail questions or comments to: **tapesupport@seagate.com**

Seagate E-mail Sales Support: You can e-mail questions or comments to: **tape_sales_support@seagate.com**

Regional services

Seagate provides technical support through several regional centers worldwide. These services may include:

- **Seagate phone technical support:** For one-on-one help, you can talk to a technical support specialist during local business hours. Before calling, note your system configuration and drive model number.

- **Seagate Technical Support FAX:** You can FAX questions or comments to technical support specialists. Responses are sent during local business hours.

- **SeaFAX:** You can use a touch-tone telephone to access Seagate's automated FAX system to receive technical support information by return FAX. This service is available 24 hours daily.

Support services in the Americas

Telephone support (you will be directed to a product-specific phone or SEAFAX number)
US customers: 1-800-SEAGATE
International customers: 1-405-936-1234

Seagate Technical Support FAX (US and international):   1-405-936-1683

SeaTDD (Telephone support for the deaf; US and international): 1-405-936-1687

Pre-sales support (US customers):   1-800-626-6637
Pre-sales tape support (International customers):   1-714-641-2500

Tape Purchases: US customers can purchase Seagate data cartridges, tape supplies, accessories and select Seagate tape drive products 24 hours daily on the Internet at **http://buytape.seagate.com**.

Support services in Europe

For European customer support, dial the toll-free number for your specific country from the table below. The **Seagate Technical Support FAX** number for all European countries is 31-20-653-3513.

Country	Phone
Austria	0 800-20 12 90
Belgium	0 800-74 876
Denmark	80 88 12 66
France	0 800-90 90 52
Germany	0 800-182 6831
Ireland	1 800-55 21 22
Italy	800-790695
Netherlands	0 800-732 4283
Norway	800-113 91
Poland	00 800-311 12 38
Spain	900-98 31 24
Sweden	0 207 90 073
Switzerland	0 800-83 8411
Turkey	00 800-31 92 91 40
United Kingdom	0 800-783 5177

If your country is not listed in the table above, dial our European call center in Amsterdam at 31-20-316-7222 between 8:30 A.M. to 5:00 P.M. (European central time) Monday through Friday or send a FAX to 31-20-653-3513.

Support services for Africa and the Middle East

For support services in Africa and the Middle East, dial our European call center in Amsterdam at 31-20-316-7222 between 8:30 A.M. to 5:00 P.M. (European central time) Monday through Friday, or send a FAX to 31-20-653-3513.

Support services in Asia and the Western Pacific

For presales and technical support in Asia and the Western Pacific, dial the toll-free number for your specific country. These toll-free numbers are available Monday through Friday from 6:00 A.M. to 10:45 A.M. and 12:00 P.M. to 6:00 P.M. (Australian Eastern Time). If your country is not listed here, please use one of the direct-dial numbers.

Call Center	Toll-free number	Direct dial number	FAX number
Australia	1800-14-7201	—	—
China	—	—	+86-10-6871-4316
Hong Kong	800-90-0474	—	+852-2368 7173
Indonesia	001-803-1-003-2165	—	—
Japan	—	—	+81-3-5462-2979
Malaysia	1-800-80-2335	—	—
New Zealand	0800-443988	—	—
Singapore	800-1101-150	+65-488-7584	+65-488-7528
Taiwan	—	+886-2-2514-2237	+886-2-2715-2923
Thailand	001-800-11-0032165	—	—