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**STT2401A, STT3401A**

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**Travan 40 tape drive**

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**Product Manual**  
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Part Number 100249522

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- 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.

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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 Canada.

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# Introduction

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# 1

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## Drive overview

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The Seagate® STT3401A and STT2401A extend the Seagate family of one-inch high Travan drives that feature high performance, high reliability, and quiet operation. The drives transfer data at up to 120 megabytes per minute (Mbytes/min) without compression.

With optimal system resources and compressible data structures, nominal transfer rates of up to 240 Mbytes per minute can be obtained using software data compression (assuming a 2:1 compression ratio). The compression ratio is dependent on the specific system and the nature of the files being compressed.

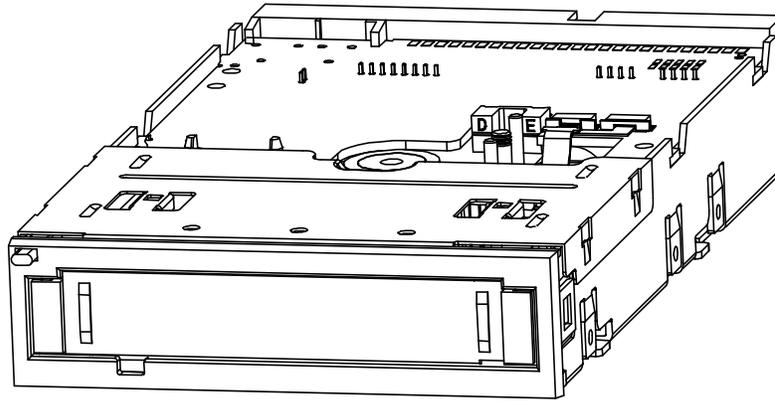
These drives are internal devices, providing affordable storage in either 3.5-inch (STT3401A) or half-high 5.25-inch (STT2401A) form factors, for easy installation in today's computers.

### Key features

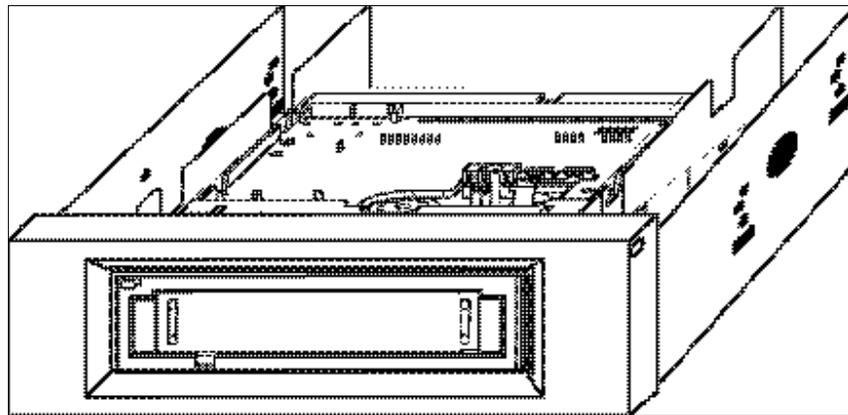
- Automated cartridge loading: When a cartridge is inserted into the drive, it is automatically drawn into the drive mechanism. The cartridge is fully loaded within the drive and does not extend beyond the front of the bezel during operation. Pressing the Eject button causes the drive to unload the cartridge until it extends out about one inch beyond the bezel.
- Backward read-compatible with Industry Standard QIC-3220-MC Travan 5 Data Format
- Selectable sustained data transfer rate of 2.0 Mbytes per second (compressed) or 1.22 Mbytes per second (native), to support various host systems
- Auto-Throttle™ tape speed adjusts to sustain streaming operation with the Host transfer rates.
- ATAPI interface
- Servo-burst-controlled high-resolution head positioning system
- Available in either 3.5-inch, 1-inch high or 5.25-inch half-height form factors
- Data integrity of less than 1 hard read error in  $10^{17}$  bits, with automatic retry algorithm
- 8-Mbyte data buffer
- High-speed, 110 inch-per-second tape rewind
- EEPROM containing non-volatile option settings and diagnostic results

With the availability of greater capacity disc drives and the growth of small networks, the need for cost-effective, high-capacity storage has grown. The STT3401A is ideal for standalone computers, workstations, and small networks.

Figure 1 shows the STT3401A 3.5-inch internal drive. Figure 2 shows the STT2401A, which comes with brackets for mounting in 5.25-inch drive bays.



**Figure 1**  
**STT3401A 3.5-inch internal drive**

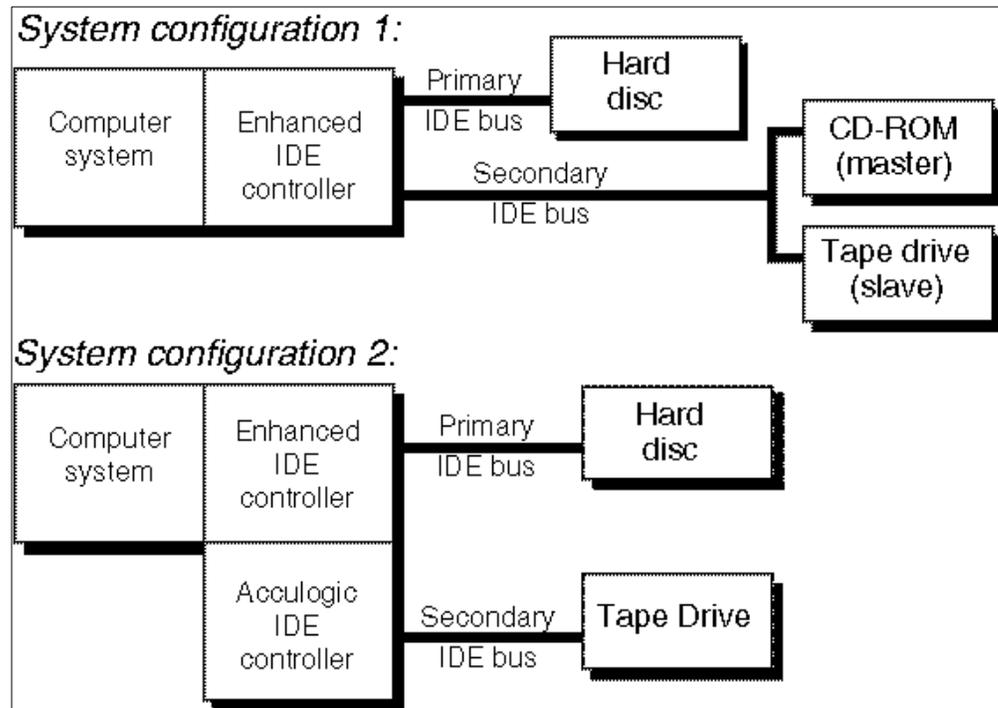


**Figure 2**  
**STT2401A 5.25-inch internal drives**

## **Typical system configurations**

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The Enhanced IDE standard supports up to four ATAPI peripherals: two devices on the primary port and two devices on the secondary port. Of the two devices on each port, one must be designated master and the other must be designated slave. Figure 3 on the following page shows sample configurations for two ATAPI systems.



**Figure 3**  
**Sample ATAPI configurations**

## Minicartridge technology overview

Having evolved from the original mass-storage medium—reel-to-reel, one-half-inch tape storage—the minicartridge technology of today offers fast, efficient, high-capacity storage in a compact, easily-removable hard-shell package. In little more than a decade, storage capacities have increased from some 60 megabytes (Mbytes) on 9 tracks (QIC-24, 1982) to the 40-Gbyte (compressed) capacity achievable with a single Travan 40 cartridge.

The streaming-tape intelligence in the Travan drive provides a continuous tape motion with an uninterrupted, precisely coordinated flow of data to and from the minicartridge. This "streaming" motion combined with the "serpentine" recording method is one element that contributes to the increased storage capacities, efficiency, and speed of today's minicartridge technology.

Use of the "serpentine" recording method exploits the bi-directional capabilities of the cartridge. With this method, the tape is not rewound at the end of a track. Instead, the write-read heads are logically or mechanically switched to a different position on the tape and another track is written or read in the reverse direction. That is, the drive first records track 1 in one direction and when the end of the tape is reached, the head is moved and the direction of tape motion is reversed to record track 2. This serpentine process continues until the entire tape is recorded. The individual tracks are sequential to minimize the amount of head motion as the heads change position for each track.

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## Flash EEPROM

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The Seagate Travan drives incorporate leading-edge technology in the flash EEPROM, which is useful should the drive's firmware need to be upgraded. With the permanently installed, electrically upgradeable, flash EEPROM memory, revised firmware for the drive can be loaded using a Seagate OEM firmware cartridge or through the host IDE bus.

This feature enables qualified OEMs needing to revise the drive firmware to do so rapidly and at a reduced cost. Flash EEPROM should also prolong the life cycle of a drive because many new techniques—such as increasing the capacity of the drive through support for longer tapes—may require only a firmware upgrade.

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## References

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The following standards documents describe some of the technology incorporated in the drives referenced in this manual.

- **QIC-170**—Preformatted magnetic minicartridge
- **QIC-157**—ATAPI command set for streaming tape
- **QIC-3220-MC**—Serial recorded magnetic tape minicartridge (TR-5)
- **Travan 640** —Serial recorded magnetic tape minicartridge (Travan 40 or 40GB)
- **Tape Alert Specification 3.0**

For more information about a particular QIC standard, contact Quarter-Inch Cartridge Standards, Inc., c/o Freeman Associates, 311 East Carrillo Street, Santa Barbara, California 93101.

# Specifications

# 2

## Performance specifications

The following table lists the performance specifications for the Seagate STT2401A and STT3401A tape drives.

<i>Feature</i>	<i>Specification</i>
<b>Capacity</b>	20.0 Gbytes—Travan 40 cartridge (native) (40.0 Gbytes, assuming 2:1 compression)
<b>Sustained backup rate</b>	up to 120 Mbytes per minute native; up to 240 Mbytes per minute with 2:1 compression
<b>Tape speed</b>	
<b>Read/Write</b>	92 inches per second (56 inches per second throttle-down speed)
<b>Fast Forward/Rewind</b>	110 inches per second
<b>Load time</b>	< 2 seconds (mechanical load) <18 seconds to READY (from Beginning of Tape)
<b>Unload time</b>	< 2 seconds (mechanical unload) <10 seconds (plus rewind time to Beginning of Tape)

## Recording Specifications

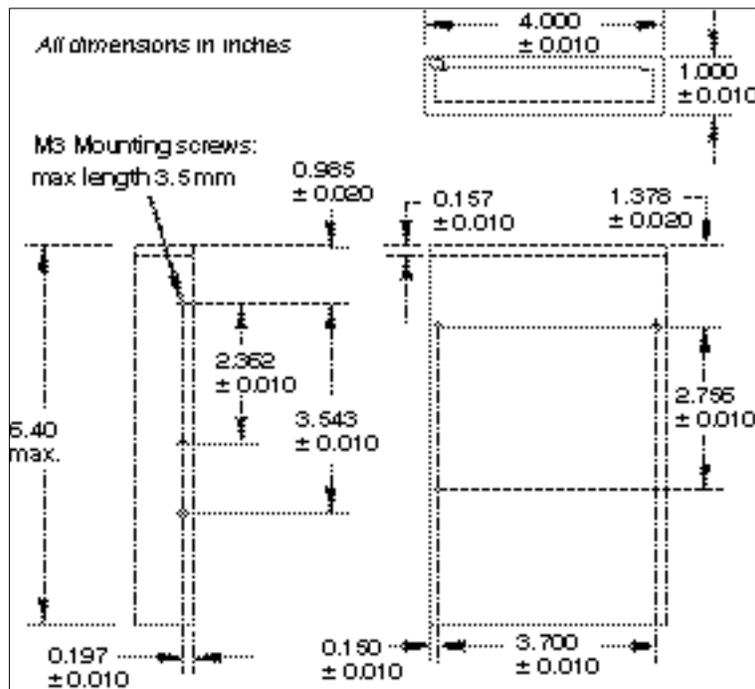
<b>Recording method</b>	Serpentine
<b>Recording format</b>	Travan 640
<b>Recording code</b>	VRR
<b>Head configuration</b>	Wide write/narrow read
<b>Recording media</b>	1650-Oe 750' Travan 40 or 40 Gbytes (20 Gbytes native)
<b>Cartridge size</b>	3.2 in. x 2.4 in. x 0.4 in. (81 mm x 61 mm)
<b>Data density</b>	192,000 bits per inch
<b>Tracks</b>	108 data tracks, one (1) directory track

## Physical specifications

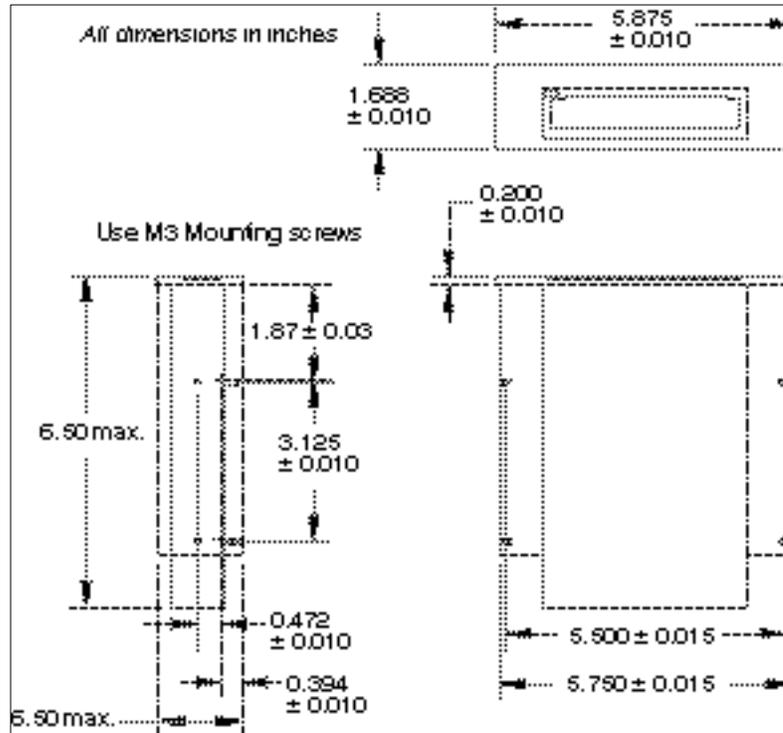
The physical specifications of the STT3401A and STT2401A are listed in the following table.

Specification	Drive for 3.5-inch mount	Drive for 5.25-inch mount
Height	1.0 in / 25.4 mm	1.625 in (max) / 41.3 mm including bezel
Width	4.0 in / 101.6 mm	5.875 in / 149.2 mm including bezel
Length	6.4 in (max) / 161.5 mm	6.5 in (max) / 165.1 mm including bezel
Weight	1.0 lbs / 0.45 kg	1.6 lbs / 0.72 kg

Figures 4 and 5 show the general dimensions of the 3.5-inch STT3401A (without mounting brackets) and the 5.25-inch STT2401A (with mounting brackets).



**Figure 4**  
STT3401A (3.5-inch mount) general dimensions



**Figure 5**  
STT2401A (5.25-inch mount) general dimensions

## Power supply specifications

The following table lists the power supply requirements for the Travan 40 drives. Power specifications are measured at the tape drive power connector and are nominal values.

### Current and power requirements

Specification	Power supply requirement	
	+12V DC supply	+5V DC supply
Voltage tolerance	±10%	±5%
Current requirements		
Seek	0.8 amps rms	0.8 amps rms
Load/unload	0.8 amps rms	0.6 amps rms
Capstan startup	2.0 amps rms (<200 ms)	1.0 amps rms
Standby	0.03 amps rms	0.5 amps rms
Ripple (peak to peak)	≤200 mV max	≤200 mV max

<b>Power use</b>		
<b>Seek</b>	9.6 watts	4.0 watts
<b>Load/unload</b>	9.6 watts	3.0 watts
<b>Capstan startup</b>	38 watts	6.0 watts
<b>Standby</b>	0.4 watts	2.3 watts

### **Power connector**

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

<b>Pin</b>	<b>Assignment</b>
1	+12V DC
2	+12 return
3	+5 return
4	+5V DC

### **Environmental requirements**

The following table lists the environmental specifications for the Seagate STT2401A and STT3401A. All specifications apply to the drive mechanism unless otherwise noted.

<b>Specification</b>	<b>Operational</b>	<b>Non-operational</b>
<b>Temperature</b>	+41° to +104°F (+5° to +40°C)	–40° to +149°F (–40° to +65°C)
<b>Drive</b>		
<b>Cartridge at baseplate</b>	+41° to +134°F (+5° to +57°C)	
<b>Thermal gradient</b>		5°C per hour (18° F per hour)
<b>Relative humidity</b>	20% to 80% non-condensing	5% to 95% non-condensing
<b>Maximum wet bulb temperature</b>	78.8°F (26°C)	No condensation
<b>Altitude</b>	–1,000 to +15,000 feet (–305 to 4,572 meters)	–1,000 to +50,000 feet (–305 to 15,240 meters)
<b>Vibration:</b>		
<b>Peak to peak displacement</b>	0.005 in. max. (5 to 54 Hz)	0.1 in. max. (5 to 17 Hz)
<b>Peak Acceleration</b>	0.75 G rms (54 to 500 Hz)	1.5 G rms (17 to 500 Hz)

<b>Shock (1/2 sine wave)</b>	7Gs peak, 11 msec (retries may be occur)	50 Gs peak, 11 msec
<b>Acoustic level operational (A-wt sum)</b>	55 dBA maximum (measured at operator position, per ISO 7779)	—
<b>Shock (1/2 sine wave)</b>	2.5 Gs peak, 11 msec	100 Gs peak, 11 msec

## Reliability

The STT3401A is designed for maximum reliability and data integrity. The following table summarizes the reliability specifications.

<b>Feature</b>	<b>Specification</b>
Non-recoverable (hard) error rate	< 1 in $10^{17}$ bits
Correctable (soft) error rate	< 1 in $10^7$ bits
Error recovery and control methods	Write Equalization; Data Randomization; Retry on read; Reed-Solomon Error Correction Code
Mean-Time-Between-Failures (MTBF)	More than 200,000 hours (20% duty rate)
Mean-Time-To-Repair (MTTR)	Less than 0.5 hour

### Mean-Time-Between-Failures

The Mean-Time-Between-Failures (MTBF) is greater than 250,000 hours. This specification includes all power-on and operational time but excludes maintenance periods. Operational time is assumed to be 20% of the power-on time. Operational time is the time the tape is loaded.

**Note:** Seagate does not warrant the stated MTBF as representative of any particular unit installed for customer use. The failure rate quoted here 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 install a replacement drive. The MTTR for the drive is less than 0.5 hour (30 minutes).

Seagate Travan drives are field-replaceable. If a problem occurs with a subassembly or component in the drive, the entire unit should be replaced. The faulty drive should

be returned to the factory in its original packaging. Contact your distributor, dealer, your computer system company, or your Seagate sales representative to arrange the return.

## Tape compatibility

The table below summarizes the types of tape cartridges that can be used with the Seagate Travan 40 drives. All other tape formats are incompatible. The Travan 40 drives can read any NS20 or Travan 5 cartridge written per the QIC-3220-MC standard. Travan 40 cartridges used by the drive must be preformatted in accordance with the QIC-180 standard.

**Note.** If Travan tapes are magnetically erased, they cannot be reformatted and become unusable.

<i>Cartridge format</i>	<i>Capacity* (Gbytes)</i>	<i>Length (feet)</i>	<i>Seagate part number</i>
Travan 40	40	750	STTM40
Travan NS20	20	740	STTM20
Travan 5 (QIC-3220-MC)	20	740	STTM20

**\*Note.** The capacities shown above are based on 2:1 data compression. Uncompressed values are one half as high. Capacities, backup speeds and transfer rates will vary with file type and system configuration.

## Regulatory compliance

The Seagate Travan 40 drive complies with the regulations listed in the following table.

<i>Agency</i>	<i>Regulation</i>
CSA	C22.2, No. 950-M89
TUV & IEC-RHEINLAND	EN 60 950/IEC 950
UL	1950
Canadian Dept. of Communications	Class B
EN55022 (CISPR-22) with additional CE-Mark test requirements	Class B
FCC	Class B, Part 15

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 (+5V DC and +12V DC) based on the regulation applied—Extra Low Voltage (SEC) for UL and CSA and Safety Extra Low Voltage for BSI and VDE (if applicable).

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## Installation

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# 3

This chapter explains how to install the Seagate STT3401A and STT2401A drives. It also describes how to set the master/slave jumpers and presents details of the drive's power and ATAPI interface connectors.

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### Before you begin

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#### Handling guidelines

Because the drive's electronic components can be damaged by electrostatic discharge, use an electrostatic grounding strap when handling the drive. This strap prevents an electrostatic discharge from damaging the electronic components on or in the drive unit.

If you do not have an electrostatic grounding strap, perform the installation at a static-safe workstation. If one is not available, follow these guidelines as you install the drive unit:

- Work in an uncarpeted area.
- To protect the drive from static electricity, DO NOT remove the drive from its anti-static bag until you are ready to install it.
- Before you remove the drive from the anti-static bag, touch a metal or grounded surface to discharge any static electricity buildup from your body.

<b>Caution:</b> If you touch static-sensitive parts of the drive (such as the printed circuit board) electronic components may be damaged.
--

- Hold the drive by the edges only. Avoid direct contact with any printed circuit board.
- Lay the drive only on top of its anti-static bag or return the drive to its bag when you need to lay the drive down.

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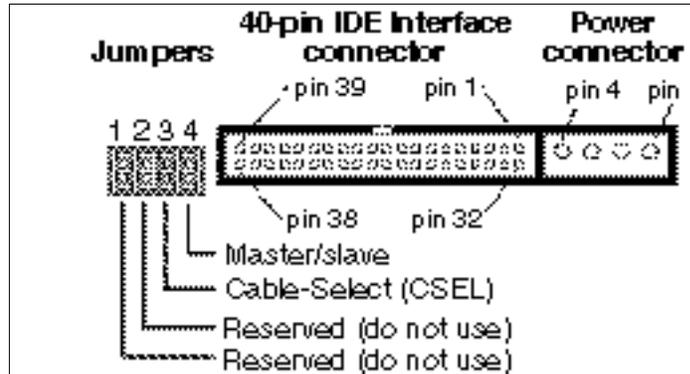
### Setting jumpers

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In ATAPI systems, where two devices attached to a single interface cable, one of the drives must be configured as "master" and the other must be configured as "slave." In some cases, the assignment of master and slave can be made using a special cable, as long as the devices provide a "cable select" setting.

Before installing the Seagate Travan 40 drive make sure that the jumpers are properly configured for your system. Figure 6 shows the location of the jumper block, as well as master/slave jumper settings for various configurations.

**Note:** Record your jumper settings prior to installation. The jumpers are not visible after the drive has been installed.



**Figure 6**  
**Jumper block settings for STT3401A and ST2401A**

These jumper settings are explained in further detail below.

- **Jumpers 1 and 2** are reserved for factory use. Do not install a jumper on these pins.
- **Cable Select:** When the CSEL jumper is off, the device address (Master or Slave) is determined by the setting of the "Master" jumper. When the CSEL jumper is on, the Master jumper is ignored and the device address is defined by the CSEL signal in the Host cable. If CSEL is tied to ground, the device address is Device 0 (Master). If the signal is tied high (or open), the device address is Device 1 (Slave).
- **Master/Slave:** When this jumper is on, drive will act as Master on the ATA port. An ATAPI device cannot be a Master to an ATA device, only other ATAPI devices. If there is no jumper on the Master or CSEL jumper blocks, the drive is configured as a slave. See table below:

"CSEL" jumper block	"Master" jumper block	Drive's master/slave setting
Off	On	Device is Master (Device 0)
Off	Off	Device is Slave (Device 1)
On	On or Off	Device is Master or Slave depending on CSEL signal level

## Installing the drive

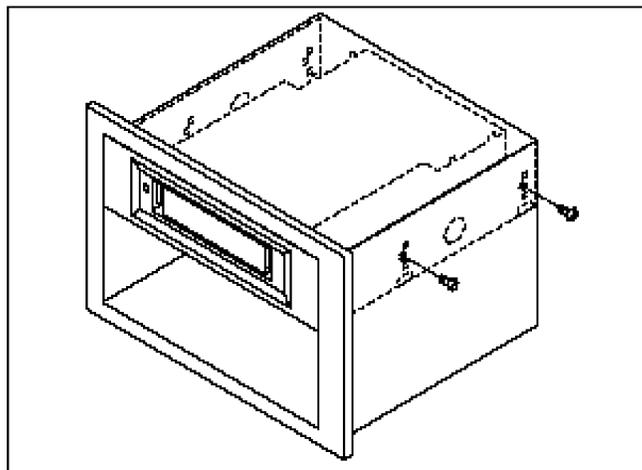
The STT3401A can be installed in a one-half-inch high by 3.5-inch form factor drive bay or in a one-inch high by 5.25-inch form factor (with mounting brackets). The drive can be installed in three different orientations: horizontally (LED to the left) and vertically (on either side).

The following section provides directions for mounting the drive in either a 3.5-inch enclosure or in a 5.25-inch enclosure.

1. Before you install the drive, write down the serial number and model number shown on the drive and store this information in a safe place. You need this information if you ever call for service.
2. With the computer cover removed, remove the faceplate from the drive bay in which you plan to install the drive. Refer to the manual that you received with your computer for instructions about removing the computer's faceplate.

**Note:** If devices are installed in any drive bays adjacent to the one you are using for the internal drive, partially removing those devices might give you more working space.

3. Attach any special mounting hardware to the drive that your system might require. Refer to the manual that you received with your computer for requirements.
4. Locate the mounting screw holes in the drive brackets. Each side contains two sets of holes. Use the set that aligns the drive properly within the drive bay.
5. Slide the tape drive into the computer so that the drive bezel and the computer faceplate are flush. Figure 7 shows the screws used to mount the STT2401A in a 5.25-inch drive bay.



**Figure 7**  
**Mounting the STT2401A in a 5.25-inch drive bay**

6. Secure the drive using the mounting screws. The threaded mounting brackets are designed for M3.0 metric screws. If you are mounting the drive in a 3.5-inch bay, use the screw supplied with the drive. Do not substitute other screws. Using longer screws may damage the drive. If slide rails are needed, use the plastic slide rails (supplied with the drive in some configurations).
7. Connect an available power cable to the power connector on the drive. Figure 6 on page 12 shows the location of the power connector. The recommended power mating connector should have an AMP 1-48024-0 housing with AMP 60617-1 pins or equivalent.

**Note:** Turn off all power before attaching power or interface connectors.

8. Connect the interface cable with the connector on the rear of the unit. When you make the connection, be sure pin 1 of the connector aligns with pin 1 on the cable connector. See Figure 6 on page 12 for the location of the connector and the Pin 1 location.

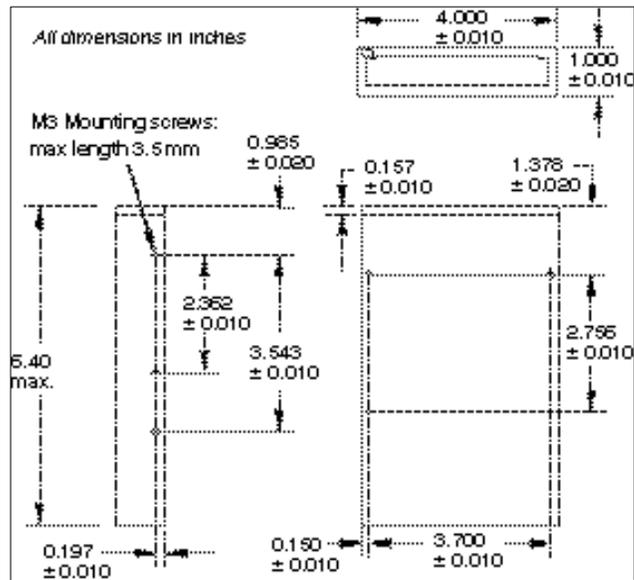
**Note:** Pin 1 on the connector on the rear of the drive is to your right as you look at the back of the drive (right side up). (See Figure 5.) Your cable should have Pin 1 highlighted by a color or dark strip. Be sure to mate Pin 1 on the cable to Pin 1 on the drive. Failure to do so could make the drive inoperative. Also, the cable is keyed to prevent incorrect installation. Make sure that the blocked pin in the cable connector coincides with the missing pin on the connector on the rear of the drive. (See Figure 6.)

9. Replace the computer cover. Be sure to reconnect any peripherals that you disconnected during the installation.
10. Plug the computer and any peripherals into an AC power outlet.
11. Start the computer and install your tape backup software.

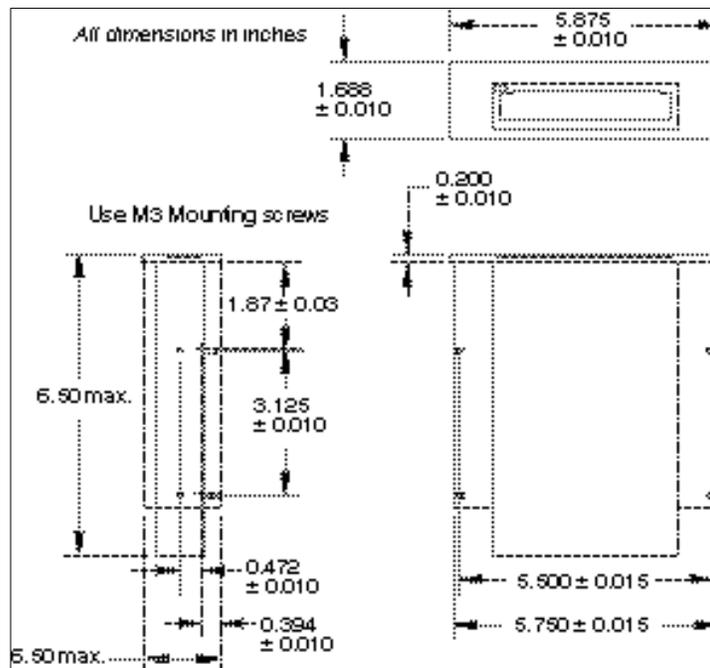
## ***Mounting dimensions***

---

Figures 8 and 9, respectively, show the location of the mounting holes for the STT3401A and STT2401A.



**Figure 8**  
**Mounting holes on STT3401A (without mounting brackets)**



**Figure 9**  
**Mounting holes on STT2401A (with mounting bracket)**

## Drive operation and maintenance

# 4

### Introduction

This chapter describes important operational procedures for the STT3401A and STT2401A. It covers the following topics:

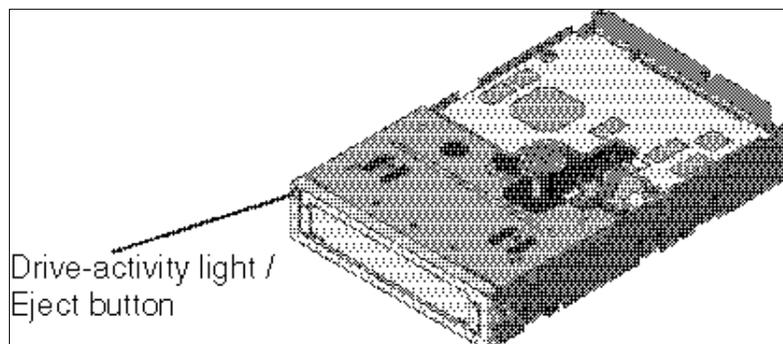
- The front panel LED (Drive Activity Light/Eject Button)
- Using Travan 40 cartridges
- Drive maintenance and troubleshooting instructions.
- Loading revised firmware (updating flash EEPROM)

### Front panel LED

As shown in Figure 10, the front panel of the Travan 40 drive contains the cartridge opening and one light-emitting diode (LED), which doubles as an eject button.

The LED on the front of the drive may blink to indicate various drive conditions. The basic blink patterns are shown below. See page 21 for a listing of diagnostic blink patterns that may occur during drive startup.

LED blink pattern	Drive status
On continuously	Drive is ready; cartridge is loaded and initialized
Slow blinking	Drive is active OR a cartridge is being initialized
Fast blinking	A drive fault has occurred OR drive firmware is being downloaded or updated



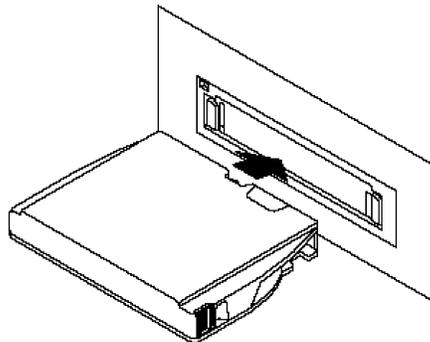
**Figure 10**  
**Front Panel LED on the STT3401A (STT2401A is similar)**

## Using Travan cartridges

The minicartridges recommended for use with the Travan 40 drive are listed in Chapter 2. This section describes some operations using the cartridges.

### Loading cartridges

Your tape drive has a flip-up door that covers the cartridge opening when a tape cartridge is not installed in the drive. The cartridge must be inserted into the drive with the metal base plate down and the write-protect switch on the left. Inserting a cartridge activates the drive's motorized "soft-load" mechanism, which draws the cartridge all the way into the drive. Figure 11 shows the proper orientation of a cartridge during loading.



**Figure 11**  
**Loading a Travan cartridge**

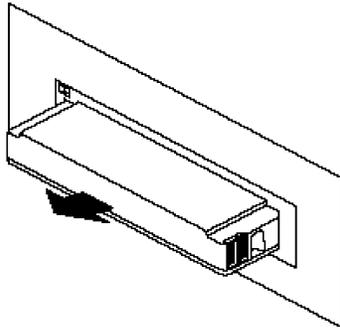
### Unloading cartridges

**To unload** a cartridge, wait until the drive activity LED is OFF and then press the Drive-activity Light/Eject button. The drive automatically unloads and ejects a cartridge when the Eject button is pressed or when the drive receives an Unload command from the Host. The cartridge is unloaded until it extends about 22 mm beyond the bezel. At this point, you can pull the cartridge straight out, as shown in Figure 12.

Alternatively, use the eject command from the backup software to eject the tape if the drive LED does not turn off after the backup. Refer to your software documentation to find the eject command for your particular software.

**Note.** The drive may retain the cartridge for up to 2 minutes after the Eject button is pressed in order to complete the current operation, rewind, and update the cartridge directory track.

**Caution:** Under normal circumstances, you should never attempt to remove the cartridge manually or while the drive is active.



**Figure 12**  
**Unloading a Tape cartridge**

After removing the cartridge from the drive, place the cartridge in its protective case and store it in a cool, dry location.

## **Emergency cartridge removal**

### **Forcing cartridge ejection**

If the drive will not eject a cartridge during normal operation, but you still have power to the drive, try the following steps to force the drive to eject the cartridge:

1. Remove power from the drive.
2. Press and hold the eject button.
3. Power up the drive, while holding down the Eject button. The cartridge will be ejected (unloaded).

As soon as the cartridge is unloaded, grasp the cartridge and pull it from the drive.

### **Manual ejection**

If the power fails with a cartridge in the drive, and the procedure above does not work, you may be able to remove the cartridge manually. However, there is a risk of damaging the drive or the cartridge.

**Note.** Do not attempt to remove the cartridge while the drive is powered-on and tape is in motion. This may result in an incomplete tape operation.

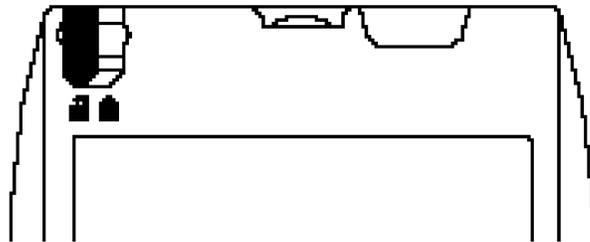
Take a small straight screwdriver and insert it into the notch in the lower left side of the bezel below the cartridge. Make sure that the screwdriver is inserted straight into the drive. The screwdriver will hit a stop. Push on the stop with a firm force. As the stop is gradually pushed into the drive, the cartridge will come out of the drive. Continue to push with the screwdriver until the edges of the cartridge can be grasped. Then grasp the cartridge and pull it firmly from the drive.

**Caution.** After using the emergency ejection procedure to remove a cartridge, you must restart the drive before inserting a new cartridge. Power must be reapplied to the drive before it will move the loading mechanism into position for inserting a new cartridge.

### ***Setting the write-protect switch***

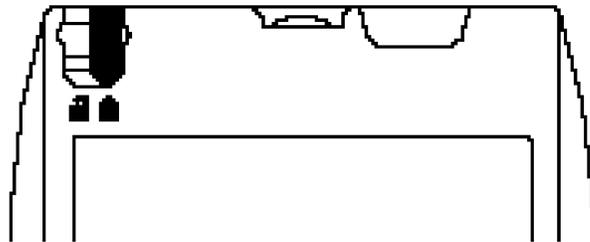
Travan minicartridges feature a sliding write protect tab located in the upper left corner of the cartridge. You can set the tab to keep data from being written on the tape. Use this switch when you want to make sure that important data on the tape will not be overwritten.

Figure 13 shows the cartridge with the switch in the non-protected (read/write) or unlocked position.



***Figure 13***  
***Travan cartridge write-protect switch—unlocked position***

Figure 14 shows the tab in the protected (read only) or locked position.



***Figure 14***  
***Travan cartridge write-protect switch—locked position***

To return a cartridge to the "writeable" state, push the switch toward the end of the cartridge or to the unlocked position.

## ***Drive maintenance***

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Minimal maintenance is needed to ensure that your Travan 40 drive operates at peak condition. This section explains how to care for tape cartridges, how to clean the drive head, and what to do if you experience problems with the drive.

### ***Caring for tape cartridges***

Although Travan tape cartridges are ruggedly built, they must be handled with care to preserve the data they contain. The following points are guidelines for storing and using minicartridges.

- Do not open the tape access door of the cartridge or touch the tape itself. One fingerprint can prevent the drive from reading the tape.
- Keep the cartridge away from sources of electromagnetic fields, such as telephones, dictation equipment, mechanical or printing calculators, motors, and bulk erasers. Do not lay cartridges on the computer monitor or on the base unit of the computer.
- Keep the cartridge away from direct sunlight and heat sources, such as radiators or warm air ducts.
- Keep the cartridge free of moisture. Do not wet or submerge a cartridge in any liquid.
- Do not expose the cartridge to temperature extremes. Allow the cartridge to assume room temperature slowly.
- Retensioning the tape cartridge is always recommended for optimal performance, particularly after exposure of the cartridge to temperature changes or shock. Retensioning restores the proper tape tension to the media.

### ***Cleaning the drive read/write head***

<p><b>Caution.</b> Never clean the read/write head of the drive with anything other than a Seagate-approved dry-process cleaning cartridge.</p>
---

To properly maintain the tape drive, you should periodically clean the read/write head. No other periodic maintenance is required.

Follow these guidelines to help ensure that your drive provides long, reliable service:

- Operate the drive in a clean, dust-free environment.
- Never apply a lubricant to the drive.
- Generally Travan drives are highly reliable and require little user maintenance. For normal operations cleaning once per month is quite adequate.
- For new cartridges, clean the head after two hours of tape movement. Thereafter the drive can be cleaned as per normal operations.

Generally, the more severe the operating conditions (the greater the amount of dust or moisture in the air), the more often the drive should be cleaned. Be sure to clean

the drive immediately if you observe an increase in the number of errors while running your backup software, or if a TapeAlert cleaning message is displayed.

With the newer generation of Travan tape drive heads used in these drives, only the dry-process cleaning cartridge method is recommended. This method does not involve any flammable materials and provides a clean recording surface by wiping away debris as the cleaning material passes across the recording head. Residents of the U.S. can purchase Travan cleaning cartridges (model number STTMCL) directly from Seagate on the web at: <http://buytape.seagate.com>.

## Troubleshooting

If you experience problems after you install the drive, read through this section, and try the remedies suggested here. If problems persist, contact your tape drive supplier or Seagate technical support, as described below:

US and Canada	1-800-SEAGATE (1-800-732-4283)
Outside US and Canada	1-405-936-1234
Seagate web site	<a href="http://www.seagate.com">http://www.seagate.com</a>

Before you call technical support, be sure that you have the documentation for your computer and for all installed peripheral devices.

### Initial checks

Prior to performing detailed troubleshooting, check the drive and associated system components for any obvious problems:

- Check that all connections are secure.
- Check the drive to be sure the jumper settings are correct.

The following paragraphs describe some possible drive problems and the recommended procedure for addressing each problem.

### **No drive response, front panel LED does not light**

Verify that +5V DC and/or +12V DC is applied to the drive. Insure that the power supply connector is installed properly.

### **Front panel LED blinks rapidly following power-up self-test**

If a drive failure is detected during the power-up self-test, the front panel LED blinks rapidly a specific number of times, followed by a pause. This pattern is repeated until power is removed from the drive. The number of blinks indicates the type of problem with the drive, as shown in the table below. If you experience this problem, return the drive to an authorized Seagate repair center.

Number of LED blinks	Drive status
----------------------	--------------

1	DRAM Write Mismatch
2	DRAM Write Timed Out
3	DRAM Read Timed Out
4	DMA Timed Out
5	ATAPI Interface Failed
6	SRAM Self Test Failed
7	DRAM/SRAM Self Test Failed
8	Serial ASIC Failed
9	Buffer Manager ASIC Failed
11	Stepper Motor Test Failed
12	Transport Motor Test Failed
15	Attempt to install incompatible firmware
16	Transfer timeout
17	Load operation failed

### ***Drive does not come ready***

- Insure the cartridge is properly oriented and fully inserted.
- Insure the cartridge is not broken and the tape appears in good condition.

### ***Motor starts to drive cartridge but stops immediately***

Check the cartridge for tape run-off, or excessive torque. Replace cartridge if required.

### ***Drive will not write but will read previously written tapes***

- Make sure the cartridge is not write-protected.
- Make sure the cartridge is a Travan 40 cartridge, not a Travan 5 or older Travan cartridge.
- Verify proper cable attachment to the host PC.
- If this does not correct the problem, contact Seagate Technical Support (see page 21).

### ***Tape does not stream***

Host data handshake may be too slow. Check BIOS setting for ATAPI interface mode; the interface chipset may not be capable of high speed PIO mode. Some backup application software is capable of higher transfer rates than others. Other Host activity could restrict backup operation transfer rate.

If a power interruption occurs during a backup or restore operation, start over when the power is restored.

### ***Drive not seen during boot-up***

- Ensure that 5/12 volt power is plugged into tape drive. Insert tape:
  - If soft load receives tape and tape movement back and forth occurs—power is OK.
  - If no tape movement occurs—power down system and use power plug from other device such as CD-ROM. If soft load receives tape and tape movement back and forth occurs—power plug is bad. If no tape movement occurs (soft load does not receive and load tape)—return drive for repair.
- Check Master/Slave jumper settings; refer to Seagate Travan 40 User Guide for installation possibilities.
- Check system BIOS settings and ensure that ATAPI is set for the Travan 40 channel.
- Check that Transfer Mode in BIOS is set for PIO Mode.

### ***Drive not seen by OS after boot-up***

- Ensure that correct drivers are installed for Windows operating systems. Refer to Seagate PowerPoint presentation for loading Windows drivers.
- For Windows 2000/XP look for tape drive in Device Manager. If shown as Unknown Device, use procedures to cause drive to be seen as a tape drive. Add device driver as necessary.

### ***Tape won't load***

- Ensure that 5/12 volt power is plugged into tape drive. Insert tape:
  - If soft load receives tape and tape movement back and forth occurs—power is OK.
  - If no tape movement occurs—power down system and use power plug from other device such as CD-ROM. If soft load receives tape and tape movement back and forth occurs—power plug is bad.
- Remove ATAPI bus cable and insert tape:
  - If no tape movement occurs (soft load does not receive and load tape)—return drive for repair.
  - If tape movement back and forth occurs—check Master/Slave jumper settings; refer to Seagate Travan 40 User Guide.

### ***Back-up program “freezes” or “locks up”***

- Check that the system meets the hardware requirements for both the tape drive and backup software.
- Check for any changes to the computer that may have caused IRQ, DMA, or Address conflicts.
- Check that the system is not set to Boot from CD-ROM with tape as a master.
- Check available hard drive space on the drive where the software is installed. The backup software may need to temporarily use hard drive space to function correctly.

- Hard disc problems can also cause system lock up. Run a hard disc diagnostic utility such as CHKDSK or SCANDISK and repair any error it might find.
- Not enough system resources or a misbehaving memory resident program may cause erratic system behavior. In some instances, files in some third party Recycle Bins have caused the backup software to lock up. Try emptying the Recycle Bin before attempting a backup.
- Disable anti-virus programs and Advanced Power Management (especially for laptops).

### ***“Bad blocks,” media errors, etc.***

- Retensioning tape before every backup is recommended.
- Check for automatic retension capability in backup software.
- Use Seagate Stdiag tool to perform write/read test. Retension the tape with Stdiag program. Stdiag write/read test will overwrite data on the tape. Set “Test Size” to minimum of 100MB.
  - If test write/read fails—replace tape with new tape and retry Stdiag test.
  - If test write/read passes—retry backup. If backup fails, replace the tape.

### ***Slow backups***

- Check installation configuration per Seagate Travan 40 User Guide. Tape drive and hard drive should never be on the same IDE connector.
- Check that system has enough memory available for backup software to operate.
- Is backup from local hard drives or over a network? Backups over a network connection can often be slower than local hard drives. Attempt backup over local hard drive and see if backup is faster.
- Disable memory resident programs such as fax software, Internet connections, anti-virus programs, screen savers, and others that are not essential to system operation.
- Run tests with software compression on and off. Use the setting that will obtain the best backup throughput.

### ***Tape won’t eject***

- Ensure unit is powered on.
- Ensure tape is allowed to eject. Backup software often issues commands to prevent tape from being ejected via pushbutton. Issue the command from the backup software to allow tape removal, if necessary.

### ***“Incompatible format,” “Won’t write on this tape”***

- Ensure that tape is a Travan 40 cartridge.
- Ensure that the tape is not write protected.

- Use Stdiag to perform a write/read test. Retension the tape with Stdiag program. The Stdiag write/read test will overwrite data on the tape. Set “Test Size” to minimum of 100MB.
  - If test write/read fails—replace tape with new tape and retry backup.
  - If test write/read passes—retry backup. If backup fails, replace the tape.
- Sometimes not being able to write to a specific tape is due to backup software configuration, especially with Media Pools setup. Read the software documentation carefully.

## ***Loading revised firmware via Seagate firmware cartridge***

---

The Travan 40 drive uses flash EEPROM. Flash EEPROM enables you to download new firmware when revisions to firmware are released. Firmware revisions are released on specially encoded cartridges that are automatically recognized by these drives. These firmware revisions are available for qualified OEMs only from Seagate Removable Storage Solutions®.

To load a firmware upgrade tape, follow these steps.

1. Power on the host system and the Travan drive. Allow the system boot up process to reach the point where there is no ATAPI bus activity.
2. Place the firmware upgrade cartridge record switch to the non-record position. Insert the firmware upgrade cartridge in the drive and observe the green LED light on the front of the drive.
3. Once the upgrade cartridge is inserted, tape motion begins. The drive LED flashes on and off. Approximately 15 seconds later, tape motion stops and the LED continues to flash.
4. The LED flashes on and off at a steady rate as the firmware upgrade continues. Approximately 45 seconds later, the drive resets internally, and the tape moves back and forth, then stops.
5. The LED light will go off and remain off. Double check that the LED remains off. Make sure that there is no further tape motion. Remove the upgrade cartridge.
6. The firmware is now upgraded to the new revision. The drive is operational and the new firmware is active. Turning power off at this time does not affect the firmware revision level.

**Note:** Once the firmware upgrade cartridge is inserted in the drive, it is important that no power interruption occurs while the firmware is loading. **DO NOT POWER OFF THE DRIVE AT THIS TIME.** If a power interruption occurs, the firmware may not be loaded correctly, and the drive may not operate properly.

If a problem occurs during the firmware loading process, the LED on the front panel goes out. In that case, the firmware upgrade cartridge may be defective, or the drive may not be operating correctly.

If after a repeat loading of the firmware cartridge the same condition is observed, contact your Seagate sales representative.

Firmware upgrade cartridges are available to qualified Seagate OEM customers. Contact your Seagate sales representative for information.

# ATAPI interface

# 5

## Introduction

The Seagate Travan 40 drives come with an ATA Packet Interface (ATAPI) controller for communications between the host computer and the drive. The drive supports the QIC-157 standard interface.

**Note:** Refer to the **QIC-157 Standard** for detailed information about this interface.

This chapter clarifies the use of several ATA-2 signals and ATAPI commands that are either vague or optional in the QIC-157 specification.

## ATA-2 Interface pin assignments

The Seagate Travan drives provide a standard ATA-2 connector. The pin assignments for this connector are listed in the following table for your reference.

Pin	Assignment	Description	Source
1	RESET	Reset	Host
2	Gnd	Ground	N/A
3	DD7	Data Bus bit 7	Host/Device
4	DD8	Data Bus bit 8	Host/Device
5	DD6	Data Bus bit 6	Host/Device
6	DD9	Data Bus bit 9	Host/Device
7	DD5	Data Bus bit 5	Host/Device
8	DD10	Data Bus bit 10	Host/Device
9	DD4	Data Bus bit 4	Host/Device
10	DD11	Data Bus bit 11	Host/Device
11	DD3	Data Bus bit 3	Host/Device
12	DD12	Data Bus bit 12	Host/Device
13	DD2	Data Bus bit 2	Host/Device
14	DD13	Data Bus bit 13	Host/Device
15	DD1	Data Bus bit 1	Host/Device
16	DD14	Data Bus bit 14	Host/Device
17	DD0	Data Bus bit 0	Host/Device
18	DD15	Data Bus bit 15	Host/Device
19	GND	Ground	N/A
20	—	Key pin	N/A

Pin	Assignment	Description	Source
21	DMARQ	DMA Request	Device
22	GND	Ground	N/A
23	DLOW-	I/O Write	Host
24	-REQ	Ground	N/A
25	-I/O	I/O Read	Host
26	GND	Ground	N/A
27	IORDY	I/O Ready	Device
28	CSEL	Cable Select	Device
29	DMACK	DMA Acknowledge	Host
30	GND	Ground	N/A
31	INTRQ	Interrupt Request	Device
32	10CS16-	16-Bit I/O	Device
33	DA1	Device Address Bit 1	Host
34	PDIAG	Passed Diagnostics	Device
35	DA0	Device Address Bit 0	Host
36	DA2	Device Address Bit 2	Host
37	CS0-	Chip Select 0	Host
38	CD1-	Chip Select 1	Host
39	DASP-	Device Active or Slave Present	Device
40	Ground	Ground	N/A

## ATAPI commands

This section describes the ATAPI commands as implemented by the STT2401A and ST3401A. The table below lists the commands in the order of their Operation Code, and identifies the page number where the command is described in this manual.

Op Code (Hex)	Command	See Page
00	TEST UNIT READY	84
01	REWIND	80
03	REQUEST SENSE	73
08	READ	67
0A	WRITE	86
10	WRITE FILEMARK	89
11	SPACE	82
12	INQUIRY	31
13	VERIFY	85

Op Code (Hex)	Command	See Page
15	MODE SELECT	51
17	RELEASE UNIT	72
19	ERASE	29
1A	MODE SENSE	61
1B	LOAD / UNLOAD	33
1D	SEND DIAGNOSTIC	81
1E	PREVENT/ALLOW MEDIA REMOVAL	66
2B	LOCATE	35
34	READ POSITION	71
3B	WRITE BUFFER	87
3C	READ BUFFER	69
4C	LOG SELECT	36
4D	LOG SENSE	37

### ***Specification compliance***

---

The STT3401A complies with the following specifications. Where conflicts occur, the first listed document takes priority.

- This product description manual
- QIC-157 revision D

## **ERASE (Group 0, Op. Code 19)**

The ERASE command will erase the entire tape if the tape is positioned at BOT. Both the Directory and the Data Partitions will be erased. If the drive is in the Directory Partition when the ERASE command is received, the drive will remain in the Directory Partition after the operation is completed. The drive performs a Logical Erase by rewriting the directory information; the data on the tape is not physically erased or overwritten.

If the ERASE command is issued when the drive is not at BOT, no erase operation will be performed and the drive will return an *Illegal Request* Sense Key.

This command is used to erase previously written data.

### **Command Descriptor Block for ERASE Command**

Byte	Data Bits								Hex
	7	6	5	4	3	2	1	0	
0	0	0	0	1	1	0	0	1	19
1	0	0	0	0	0	0	IMM	LONG	0X
2	0	0	0	0	0	0	0	0	00
3	0	0	0	0	0	0	0	0	00
4	0	0	0	0	0	0	0	0	00
5	0	0	0	0	0	0	0	0	00

**NOTE:** The ATAPI interface does not have an IMM bit or functional equivalent. The DSC and BUSY bits in the Host taskfile status register indicate bus and command status.

**LONG:** Use of the LONG bit is optional. Drive operation is the same whether LONG = 0 or LONG = 1.

## INQUIRY (Group 0, Op. Code 12)

The INQUIRY command allows the Host to determine the configuration of the tape drive connected to the bus.

### CDB for INQUIRY Command

Byte	Data Bits								Hex
	7	6	5	4	3	2	1	0	
0	0	0	0	1	0	0	1	0	12
1	0	0	0	0	0	0	0	0	00
2	0	0	0	0	0	0	0	0	00
3	0	0	0	0	0	0	0	0	00
4	Allocation Length								XX
5	0	0	0	0	0	0	0	0	00

**Allocation Length:** This field may specify up to 54 bytes (36h) of data to be sent to the Host. Any value greater than 36h sends 36h (54d) bytes. A 0 indicates no data is to be sent and is not considered an error.

### INQUIRY Data Block Format

Byte	Data Bits								Hex
	7	6	5	4	3	2	1	0	
0	Peripheral Qualifier			SCSI Device Type					01
1	RMB	Reserved							80
2	ISO Version		ECMA Version			ANSI Version			0X
3	0	TrmIOP	0	0	Response Data Format			42	
4	Additional Length								31
5	Reserved								00
6	Reserved								00
7	0	0	0	Sync	0	0	0	0	10
8-0F	Vendor Name in ASCII								ASCII
10-1F	Product Name in ASCII								ASCII
20-23	Firmware Revision Level in ASCII								ASCII
24-2D	Reserved								ASCII
2E-35	Reserved								ASCII

### SCSI-2 Format—INQUIRY Data Block

**Peripheral Qualifier:** This field is set to 000b, unless an illegal LUN is specified, in which case it is set to 011b.

**SCSI Device Type:** The Device Type 01h represents a sequential access device.

**RMB:** The Removable Media Bit is always set indicating that removable media is used by the device.

**ISO Version:** This field is 00b, indicating that the drive does not comply with ISO version ISO DP 9316.

**ECMA Version:** This field is 000b, indicating that the drive does not comply with ECMA version ECMA-111.

**ANSI Version:** This field indicates the ANSI compliance level. A value of 001b indicates compliance with SCSI Standard X3.131-1986. A value of 010b indicates compliance with QIC-121 (SCSI-2).

**TrmIOP:** Terminate I/O message is supported. The Term I/O bit shall be set to 1.

**Response Data Format:** This field will have a value of 2h to indicate compliance with the QIC-121 (SCSI-2) inquiry data format, or a value of 1h to indicate the SCSI-1 option has been selected.

**Additional Length:** This field indicates that there are 31 (1Fh) bytes following this byte.

**Sync:** The Sync bit is always set to 1, indicating the drive supports synchronous data transfer.

**Vendor Name:** Bytes 8-0Fh are set to the ASCII values for the Vendor Name per the table below.

**Product Name:** Bytes 10-1Fh are set to ASCII values for the Product Name. See the table below.

Vendor name ( _ = space)	Product name	Drive description
"Seagate_"	"STT3401A"	Travan 40 drive

**Firmware Revision Level:** Bytes 20h-23h contain Firmware Revision.

## ***LOAD/UNLOAD (Group 0, Op. Code 1B)***

This command has three functions.

- To position (LOAD) a tape cartridge to BOT
- To eject (UNLOAD) a cartridge
- To retension the installed cartridge in conjunction with a Load/Unload operation

**Note.** The Imation Travan Mini Cartridge specification requires cartridge conditioning under specified conditions. Conditioning is achieved by running the tape three complete end-to-end passes, and retensioning a cartridge when loading is recommended.

While loading or unloading, the LED blinks slowly.

When an UNLOAD command is received, if the previous WRITE command terminated with a *Check Condition*, any buffered data that cannot be written to tape will be lost. All media access commands will be terminated with a *Check Condition* and the Sense Key will be set to 2h (*Not Ready*) after successful execution of an UNLOAD command.

### ***CDB for LOAD/UNLOAD Command***

Byte	Data Bits								Hex
	7	6	5	4	3	2	1	0	
0	0	0	0	1	1	0	1	1	1B
1	0	0	0	0	0	0	0	IMM	0X
2	0	0	0	0	0	0	0	0	00
3	0	0	0	0	0	0	0	0	00
4	0	0	0	0	0	0	RET	LOA	0X
5	0	0	0	0	0	0	0	0	00

**NOTE:** The ATAPI interface does not have an IMM bit or functional equivalent. The DSC and BUSY bits in the Host taskfile status register indicate bus and command status. See the ATAPI note on page 80.

**RET:** The retension bit determines whether a retension operation is to be performed as a part of the LOAD/UNLOAD command or not. A Retension operation is performed by running the tape to EOT, then back to BOT. It is recommended to retension the tape before every read/write of the tape. When set to 0, no retension takes place. When set to 1, a tape retension is performed.

**LOA:** The LOA bit determines whether it is a LOAD or UNLOAD command. When set to 0, an UNLOAD command is designated. When set to 1, a LOAD command is designated.

**LOAD/UNLOAD Command (EOT, RET and LOA Bits)**

Initial State	EOT	RET	LOA	Action	Final State
Loaded, Ready	0	0	0	Position to BOT and set Unload status	Unloaded, Not Ready
Loaded, Ready	0	0	1	Position to BOT	Ready
Loaded, Ready	0	1	0	Retension, Position to BOT and set Unload status	Unloaded, Not Ready
Loaded, Ready	0	1	1	Retension and Position to BOT	Ready
Loaded, Ready	1	0	0	Set Unload status	Unloaded, Not Ready
X	1	X	1	<i>Check Condition</i> , Illegal Request	Same as Initial
Loaded, Ready	1	1	0	Retension and set Unload status	Unloaded, Not Ready
Unloaded, NR	X	X	0	<i>Check Condition</i> , Not Ready	Unloaded, Not Ready
Unloaded, NR	0	0	1	Load cartridge and Position to BOT	Ready
Unloaded, NR	0	1	1	Load cartridge, Retension and Position to BOT	Ready

**Additional Sense Bits:** CNI—Cartridge Not in Place, WP—Cartridge Write Protected, EOM—End-of-Media, BOM—Beginning-Of-Media.

NOTE: Log Select page 32h (byte 17h bit 4) defines the action of the UNLOAD command. If the bit is 1, the Unload command will eject the cartridge. If the bit is 0, the Eject button must be pushed to eject the cartridge.

NOTE: If a cartridge has been ejected but not removed from the drive, a LOAD command will draw the cartridge into the drive.

## LOCATE (Group 1, Op. Code 2B)

The LOCATE command causes the target to position the logical unit to the specified block address in a specified partition. Upon completion, the logical position will be before the specified location so that the specified block will be the next to be read, or will be the append point if it follows an “Appendable Point” (see WRITE command). Prior to performing the locate operation, the target shall ensure that all buffered data and filemarks have been transferred to the media.

If the specified block is not found in the current partition, then a *Check Condition* status is returned, the Sense Key is set to *Blank Check* (8h), the BNL bit is set in byte 12h of the Sense Data, and the tape will be positioned at EOD.

### CDB for LOCATE Command

Byte	Data Bits								Hex
	7	6	5	4	3	2	1	0	
0	0	0	1	0	1	0	1	1	2B
1	0	0	0	0	0	0	CP	0	0X
2	0	0	0	0	0	0	0	0	00
3	MSB								XX
4	Block Address								XX
5									XX
6	LSB								XX
7	0	0	0	0	0	0	0	0	00
8	Partition								XX
9	0	0	0	0	0	0	0	0	00

**CP:** The Change Partition bit determines if a partition change is required before positioning to the requested block. When set to 1, the partition specified in the Partition field is selected. If necessary, the drive will change partitions before positioning to the requested block. This is only allowed if the FDP bit in the Media Partition Page (MODE SENSE Page 11h) has been set to 1. A CP bit of 0 indicates no partition change required. The partition field is ignored.

**Block Address:** The Block Address field specifies the logical block address at which the target shall be located.

**Partition:** The Partition field specifies which partition to select (if the CP bit is 1). When set to 0, the Data Partition is selected. When set to 1, the Directory Partition is selected.

#### Application Notes:

The CP field is one of two methods to change the active partition between the Data and Directory Partitions. The second method is to use the Device Configuration Page of the MODE SELECT command.

The Travan 40 format specifies that there will always be two partitions physically on the tape.

## LOG SELECT (Group 2, Code 4C)

The LOG SELECT command provides a means for the Initiator to manage statistical information maintained by the tape drive about itself.

### CDB for LOG SELECT Command

Byte	Data Bits								Hex
	7	6	5	4	3	2	1	0	
0	0	1	0	0	1	1	0	0	4C
1	0	0	0	0	0	0	PCR	SP	0X
2	PC		0	0	0	0	0	0	X0
3	0	0	0	0	0	0	0	0	00
4	0	0	0	0	0	0	0	0	00
5	0	0	0	0	0	0	0	0	00
6	0	0	0	0	0	0	0	0	00
7	MSB Parameter List Length								XX
8	LSB								XX
9	0	0	0	0	0	0	0	0	00

**PCR:** The Parameter Code Reset (PCR) bit shall be set to 1 with the parameter list length equal to 0 to reset CERTAIN FIELDS OF Log Sense Page 03h (see their respective definitions). If PCR bit is 1, and the parameter list length is greater than 0, the command will terminate with *Check Condition* status. The Sense Key will be set to *Illegal Request* and the additional Sense Code will be set to *Invalid Field in CDB*.

**SP:** The Save Parameters (SP) bit must be set to 0.

**PC:** The Page Control (PC) field must be set to 01b. This field defines the type of parameter values to be selected. The Cumulative Values parameter is the only one supported.

**Parameter Length:** This field must be set to 0 when the PCR bit is set to 1 to cause the parameters to be reset. This field must be set to the appropriate size when using page 32 to modify the configuration and the PCR bit must be 0 when sending parameters.

## LOG SENSE (Group 2, Op. Code 4D)

The LOG SENSE command provides a means for the Initiator to retrieve statistical information maintained by the tape drive about the tape drive.

### CDB for LOG SENSE Command

Byte	Data Bits								Hex
	7	6	5	4	3	2	1	0	
0	0	1	0	0	1	1	0	1	4D
1	0	0	0	0	0	0	PPC	SP	0X
2	PC		Page Code						XX
3	0	0	0	0	0	0	0	0	00
4	0	0	0	0	0	0	0	0	00
5	MSB Parameter Pointer								XX
6	LSB								XX
7	MSB Parameter List Length								XX
8	LSB								XX
9	0	0	0	0	0	0	0	0	00

**PPC:** The Parameter Pointer Control (PPC) bit shall be set to 0 with the Parameter Pointer field 0. This will cause all available log parameters for the specified log page to be returned to the Initiator subject to the specified allocation length. If the PPC bit is set to 1 or if the PPC is set to 0 with the Parameter Pointer field other than 0, the command is terminated with *Check Condition* status. The Sense Key will be set to *Illegal Request* and the additional Sense Code will be set to *Invalid Field in CDB*.

**SP:** The Save Parameters bit must be set to 0.

**PC:** The Page Control field must be set to 01b. This field defines the type of parameter values to be selected. The Cumulative Values parameter is the only one supported.

**Page Code:** The Page Code field indicates which page of log data is being requested. The supported Page Codes are:

Code	Page Description	Ref Page
00h	Supported Log Pages	38
03h	Error Counter For Read	38
2Eh	TapeAlert if enabled via Log Select page 32, byte 17, bit 7)	40
31h	Tape Capacity, Special Information)	45
3Eh	Firmware Checksum	49

**Parameter Pointer:** Shall be set to 0. See PPC.

**Parameter List Length:** Specifies the number of bytes allocated for Log data. The number of bytes returned in the Data-In Phase will be the lesser of the Parameter List Length or the data available in the specified page.

**Page 00h—Supported Log Page**

Byte	Data Bits								Hex
	7	6	5	4	3	2	1	0	
0	0	0	Page Code						00
1	0	0	0	0	0	0	0	0	00
2	MSB Additional Page Length								00
3	LSB								09
4	Supported Page List								03
5									2E
6									31
7									33
8									3E
9									
10									
11									

**Supported Log Page:** The Supported Log Page provides a list of supported log pages other than itself. Bytes 4-9 are coded as shown, indicating the valid page codes.

Code	Page Description
00h	Supported Log Pages
03h	Error Counter For Read
2Eh	TapeAlert if enabled via Log Select page 32, byte 17, bit 7
31h	Tape Capacity, Special Information
33h	Special Information
3Eh	Firmware Checksum

**Page 03h—Error Counter for READ (ATAPI)**

Byte	Data Bits								Hex
	7	6	5	4	3	2	1	0	
0	0	0	Page Code						03
1	0	0	0	0	0	0	0	0	00
2	MSB Additional Page Length								00
3	LSB								10
4	MSB Parameter Code								00
5	LSB								00
6	DU	DS	TSD	ETC	TMC		0	LP	40
7	Parameter Length								04
8	MSB								XX
9	Total Blocks Recovered by ECC								XX
A	LSB								XX
B									XX
C	MSB								00

D	Parameter Code LSB							01
E	DU	DS	TSD	ETC	TMC	0	LP	40
F	Parameter Length							04
10	MSB							XX
11	Total Errors Corrected							XX
12	LSB							XX
13								XX

NOTE: (Total Blocks Recovered by ECC) + Total Errors Corrected = Total Blocks Read

**Page 03—Error Counter for READ definitions**

Byte		
<b>00</b>	<b>Page Code</b>	Set to 03h.
<b>01</b>	<b>Reserved</b>	Set to 00h.
<b>02-03</b>	<b>Additional Page Length</b>	Set to 1Ch.
<b>04-05</b>	<b>Parameter Code</b>	0000h—# of block recovered by ECC alone 0001h—# of blocks recovered without using ECC 0002h—total # of rereads 0003h—total errors corrected 0004h—# of frames corrected by ECC alone 0005h—total # of bytes processed 8004h—total # of bytes corrected by ECC
<b>06</b>	<b>DU</b>	The Disable Update bit is always set to 0, indicating the drive updates parameter values for all events.
	<b>DS</b>	The Disable Save bit is always set to 1, indicating the drive does not save parameter values.
	<b>TSD</b>	The Target Save Disable bit is always set to 0 indicating the drive defines a method for saving log parameters.
	<b>ETC</b>	The Enable Threshold Comparison bit is always set to 0, indicating comparison to the threshold value is not performed whenever the cumulative value is updated.
	<b>TMC</b>	The Threshold Met Criteria bits are used with the ETC bit and are always set to 0.
	<b>LP</b>	The List Parameters bit is always set to 0, indicating all parameters are data counters.
<b>07</b>	<b>Parameter Length</b>	Set to 02h, indicating 2 bytes in the counter.
<b>08-09</b>	<b>Total Re-Reads (*)</b>	Total number of uncorrectable frames. An uncorrectable frame will generate a Re-Read recovery sequence.
...		
<b>0E-10</b>	<b>Total Errors Corrected (*)</b>	Total number of frames corrected is the sum of the number of frames corrected by ECC plus the number of frames corrected by the Re-Read recovery procedure.
...		
<b>15-16</b>	<b>Frames Corrected By ECC Alone (*)</b>	The total number of frames containing one or more blocks that failed the CRC check. For the total number of blocks, see REQUEST SENSE.
...		
<b>1B-1F</b>	<b>Total Bytes Processed (*)</b>	The transfer length of all Fixed Block Mode READ commands times the block length specified in Mode Data plus the total transfer length of all Variable Block Mode READ commands.
...		
<b>1B-1F</b>	<b>Total Bytes Corrected by ECC (*)</b>	The total number of bytes corrected by ECC during all READ commands.

Note: Fields marked with (\*) will reset on power cycle, SCSI reset, cartridge insertion, rewind, or PCR.

### Page 2Eh—TapeAlert Diagnostic

Data Bits									Hex	
Byte	7	6	5	4	3	2	1	0		
0	0	0	Page Code							2E
1	Reserved								00	
2	MSB								00	
3	Page Length									
	LSB								140	
TapeAlert Flags										
5n-1	MSB								nn	
	Parameter Code									
5n	LSB								nn	
5n+1	DU	DS	TSD	ETC	TMC		Res	LP	80	
5n+2	Parameter Length								01	
5n+3	Value of Flag (set when bit 0 = 1)								01	

**TapeAlert Diagnostic** page conforms to TapeAlert Specification 2.0. This page is supported when LOG SELECT page 32, byte 17, bit 7 is set to enable TapeAlert Diagnostic reporting.

TapeAlert is a tape drive status monitoring and messaging standard that detects problems that could have an impact on backup quality. TapeAlert provides easy-to-understand warnings of errors as they arise, and suggests a course of action to remedy the problem. The TapeAlert standard has been designed to allow easy integration into backup applications from any software vendor.

To take advantage of TapeAlert, you need TapeAlert-compatible tape drives and TapeAlert-compatible backup software.

TapeAlert firmware constantly monitors the drive hardware and the media, checking for errors and potential difficulties. Any problems identified are flagged on the TapeAlert Diagnostic page, where 64 bytes have been reserved for use by TapeAlert.

After a backup has been completed, the TapeAlert-compatible backup application will automatically read the drive's TapeAlert log page to check for any problems. If an error is flagged, the backup software displays a clear warning message on the user's screen, and adds the TapeAlert messages to its logs. These messages are standard across all applications that support TapeAlert, and are designed to give clear explanation of the problem and suggested resolution. For example, a user attempting to backup onto an expired tape would encounter the message:

WARNING:	The tape cartridge has reached the end of its useful life: 1.Copy any data you need to another tape 2.Discard the old tape
----------	--

TapeAlert currently checks for errors occurring in the following main categories:

- Drive recoverable and unrecoverable read problems
- Drive recoverable and unrecoverable write problems

- Drive hardware defects
- Worn out media or wrong media
- Expired cleaning tapes
- Abnormal error conditions

The TapeAlert information is accessed via a Log Sense page, and configuration is via a MODE SELECT page. The Mode Sense/Select configuration of the TapeAlert interface is compatible with the SMART diagnostic standard for disc drives. The Host software should first check the tape drive/library to determine whether it supports the TapeAlert Log Sense page 0x2e. By default the Host software access to the TapeAlert Log Sense page is via polling.

The TapeAlert Log Sense page is read from a tape drive/autoloader device at the following times as a minimum:

- At the beginning of a write/read job, even if media is not loaded
- Immediately after a fatal error during the write/read job
- At the end of each tape when the write/read job spans multiple tapes. If the tape is to be ejected then the Log Sense page must be read BEFORE this.
- At the end of a write/read job

Each time the Host software reads the TapeAlert Log page, it should check all 64 flags to discover which are set (there may be more than one). The definitions of the 64 flags are device type specific, so that there is one definition for tape drive/autoloader devices, and a different definition for stand-alone changer devices (in libraries). For each set flag, the Host software should communicate the defined error message and severity for that flag to the user, and also log it. If multiple flags are set simultaneously, they will be displayed together in ascending order of severity. At the beginning of each set of TapeAlert error messages, the tape device/library that initiated them must be identified. For the tape drive media-related flags (flags 4, 7 and 14) the software label of the media should be included in the TapeAlert error messages so that the user is aware what piece of media the error refers to. Such information could also be displayed with the messages for other flags as well, if required. The information read in the TapeAlert flags should not in itself cause the software to stop a current backup/restore job.

Each flag will be cleared to 0 in the following circumstances:

- At drive power on
- When the TapeAlert Log page is read
- When specified corrective action has been taken (such as using a cleaning cartridge)
- On ATAPI bus reset
- On Log Select reset

NOTE: When a flag is cleared by reading the TapeAlert Log page, a flag cannot be set again until the error condition is removed (e.g., the specified corrective action has been taken). So, for example, if the cartridge in the drive is not data grade, once flag 8 has been cleared by the Host software reading the Log page it cannot be set again until the cartridge has been removed. All other methods of clearing allow the flag to be set again.

There are three types of flags, listed below in order of increasing severity:

Severity	Urgent User Intervention	Risk of Data Loss	Explanations
Critical	X	X	
Warning		X	X
Information			X

The definitions of the 64 alert flags in the Log page vary depending on the device type. The following table details ONLY those TapeAlert error flags supported by the Seagate STT3401A drive.

The tape drive/autoloader flag definitions are grouped as follows:

- Flags 1 to 19: For tape drive write/read management
- Flags 20 to 25: For cleaning management
- Flags 26 to 39: For tape drive hardware errors
- Flags 40 to 64: For tape autoloader errors

### TapeAlert Flags

No.	Flag	Type	Required Host Message	Cause
1	Read Warning	W	The tape drive is having problems reading data. No data has been lost, but there has been a reduction in the performance of the tape.	The drive is having severe trouble reading.
2	Write Warning	W	The tape drive is having problems writing data. No data has been lost, but there has been a reduction in the capacity of the tape.	The drive is having severe trouble writing.
3	Hard Error	W	The operation has stopped because an error has occurred while reading or writing data that the drive cannot correct.	The drive had a hard read or write error.
4	Media	C	Your data is at risk: 1. Copy any data you require from this tape. 2. Do not use this tape again. 3. Restart the operation with a different tape.	Media can no longer be written/read, or performance is severely degraded.
5	Read Failure	C	The tape is damaged or the drive is faulty. Call the tape drive supplier helpline.	The drive can no longer read data from the tape.
6	Write Failure	C	The tape is from a faulty batch or the tape drive is faulty: 1. Use a good tape to test the drive. 2. If the problem persists, call the tape drive	The drive can no longer write data to the tape.

No.	Flag	Type	Required Host Message	Cause
			supplier helpline.	
7	Media Life	W	The tape cartridge has reached the end of its calculated useful life: 1. Copy any data you need to another tape 2. Discard the old tape.	The media has exceeded its specified life.
9	Write Protect	C	You are trying to write to a write-protected cartridge.  Remove the write-protection or use another tape.	WRITE command is attempted to a write-protected tape.
10	No Removal	I	You cannot eject the cartridge because the tape is in use. Wait until the operation is complete before ejecting the cartridge.	Manual unload attempted when prevent media removal is on.
11	Cleaning Media	I	The tape in the drive is a cleaning cartridge.  If you want to back up or restore, insert a data-grade tape.	Cleaning tape encountered during backup or restore.
12	Unsupported Format	I	You have tried to load a cartridge of a type that is not supported by this drive.	e.g., TR3 cartridge is not supported
13	Recoverable Snapped Tape	C	The operation has failed because the tape in the drive has snapped: 1. Discard the old tape. 2. Restart the operation with a different tape.	Tape snapped/cut in the drive where media can be ejected
16	Forced Eject	C	The operation has failed because the tape cartridge was manually ejected while the tape drive was actively writing or reading.	Manual or forced eject while drive actively writing or reading
17	Read Only Format	W	You have loaded a cartridge of a type that is read-only in this drive. The cartridge will appear as write protected.	e.g., NS8 cartridge is read only
18	Tape Directory Corrupted	W	The directory on the tape cartridge has been corrupted.  File search performance will be degraded.	Directory data stored on tape has been corrupted.
19	Expired Media	W	The tape cartridge is nearing the end of calculated life. It is recommended that: 1. Another cartridge be used for storing data 2. This cartridge be stored for archival recovery	Media exceeded number of recommended passes.
21	Clean Periodic	W	The tape drive is due for routine cleaning: 1. Wait for the current operation to finish. 2. Then use a cleaning cartridge.  The drive must be cleaning using a cleaning cartridge to clear this flag.	The drive is ready for a periodic clean
29	Drive Maintenance	W	Preventive maintenance of the drive is required. Check the tape drive users manual for device specific preventive maintenance tasks or call the tape drive supplier help line.	The drive requires preventive maintenance (not cleaning)
30	Hardware A	C	The tape drive has a hardware fault: 1. Eject the tape cartridge. 2. Reset the drive.	The drive has a hardware fault that requires reset to recover.

No.	Flag	Type	Required Host Message	Cause
			3. Restart the operation.	
31	Hardware B	C	<p>The tape drive has a hardware fault:</p> <ol style="list-style-type: none"> <li>1. Turn the tape drive off and on again.</li> <li>2. Restart the operation.</li> <li>3. If the problem persists, call the tape drive supplier helpline. Check the tape drive users manual for device-specific instructions on turning the device power on and off.</li> </ol>	The drive has a hardware fault that is not read/write related or requires a power cycle to recover.
32	Interface	W	<p>The tape drive has a problem with the Host interface:</p> <ol style="list-style-type: none"> <li>1. Check the cables and cable connections.</li> <li>2. Restart the operation.</li> </ol>	The drive has identified an interfacing fault.
33	Eject Media	C	<p>The operation has failed:</p> <ol style="list-style-type: none"> <li>1. Eject the tape.</li> <li>2. Insert the tape again.</li> <li>3. Restart the operation.</li> </ol>	Error recovery action
34	Download Fail	W	The firmware download has failed because you have tried to use the incorrect firmware for this tape drive. Obtain the correct firmware and try again.	Firmware download failed.

**Page 31h—Tape Capacity Page**

Byte	Data Bits								Hex	
	7	6	5	4	3	2	1	0		
0	0	0	Page Code							31
1	0	0	0	0	0	0	0	0	00	
2	MSB Additional Page Length								00	
3	LSB								20	
4	MSB Parameter Code								00	
5	LSB								01	
6	DU	DS	TSD	ETC	TMC		0	LP	40	
7	Parameter Length								04	
8	MSB Remaining Capacity Data Partition								XX	
9									XX	
A									XX	
B	LSB								XX	
C	MSB Parameter Code								00	
D	LSB								02	
E	DU	DS	TSD	ETC	TMC		0	LP	40	
F	Parameter Length								04	
10	MSB Remaining Capacity Directory Partition								XX	
11									XX	
12									XX	
13	LSB								XX	
14	MSB Parameter Code								00	
15	LSB								03	
16	DU	DS	TSD	ETC	TMC		0	LP	40	
17	Parameter Length								04	
18	MSB Maximum Capacity Data Partition								XX	
19									XX	
1A									XX	
1B	LSB								XX	
1C	MSB Parameter Code								00	
1D	LSB								04	
1E	DU	DS	TSD	ETC	TMC		0	LP	40	
1F	Parameter Length								04	
20	MSB Maximum Capacity Directory Partition								XX	
21									XX	
22									XX	
23	LSB								XX	

**Page 31h—Special Information**

Byte	Data Bits								Hex	
	7	6	5	4	3	2	1	0		
0	0	0	Page Code							31
1	0	0	0	0	0	0	0	0	00	
2	MSB Additional Page Length								00	
3	LSB								1F	
4	MSB Parameter Code								00	
5	LSB								00	
6	DU	DS	TSD	ETC	TMC		0	LP	E1	
7	Parameter Length								06	
8	MSB Unit Serial Number								XX	
D	LSB								XX	

**Page 31h—Special Information Definitions**

Byte		
00	Page Code	Set to 31h.
01	Reserved	Set to 00h
02-03	Additional Page Length	Set to 1Eh.
04-05	Parameter Code	Set to 00 00h, indicating the first parameter follows.
06	DU	The Disable Update bit is always set to 1.
	DS	The Disable Save bit is always set to 1, indicating the drive does not save parameter values.
	TSD	The Target Save Disable bit is always set to 1, indicating the drive does not provide a target defined method for saving log parameters.
	ETC	The Enable Threshold Comparison bit is always set to 0, indicating comparison to the threshold value is not performed whenever the cumulative value is updated.
	TMC	The Threshold Met Criteria bits are used with the ETC bit and are always set to 0.
	LP	The List Parameters bit is always set to 1, indicating the parameter is a list parameter.
07	Parameter Length	Set to 0Ch, indicating 12 bytes in the counter.
08-13	Unit Serial Number	Set to the ASCII value of the drives ten-digit serial number.

**Page 33h—Special Information in STT31401A mode**

Byte	Data Bits								Hex	
	7	6	5	4	3	2	1	0		
0	0	0	Page Code							33
1	0	0	0	0	0	0	0	0	00	
2	MSB Additional Page Length								00	
3	LSB								140	
4	MSB Parameter Code								00	
5	LSB								00	
6	DU	DS	TSD	ETC	TMC		0	LP	40	
7	Parameter Length								0C	
8	MSB Unit Serial Number								XX	
13	LSB								XX	
14	MSB Parameter Code								00	
15	LSB								01	
16	DU	DS	TSD	ETC	TMC		0	LP	40	
17	Parameter Length								03	
18	MSB Cartridge Insertions								XX	
1A	LSB								XX	
1B	MSB Parameter Code								00	
1C	LSB								02	
1D	DU	DS	TSD	ETC	TMC		0	LP	40	
1E	Parameter Length								04	
1F	MSB Tape Moved								XX	
22	LSB								XX	
23	MSB Parameter Code								00	
24	LSB								03	
25	DU	DS	TSD	ETC	TMC		0	LP	40	
26	Parameter Length								02	
27	MSB Number of Cleanings								XX	
28	LSB								XX	
29	MSB Parameter Code								00	
2A	LSB								04	
2B	DU	DS	TSD	ETC	TMC		0	LP	40	
2C	Parameter Length								04	
2D	MSB Time Since Last Cleaning (in Minutes)								XX	
30	LSB								XX	
31	MSB Parameter Code								00	
32	LSB								05	
33	DU	DS	TSD	ETC	TMC		0	LP	40	

Byte	Data Bits								Hex
	7	6	5	4	3	2	1	0	
34	Parameter Length								04
35	MSB Longest Time Between Cleanings (in Minutes)								XX
38	LSB								XX
39	MSB Parameter Code								00
3A	LSB								06
3B	DU	DS	TSD	ETC	TMC		0	LP	40
3C	Parameter Length								02
3D	MSB Cleaning Interval (in Minutes)								XX
3E	LSB								XX

## Page 33h—Special Information Definitions

Byte		
00	Page Code	Set to 31h.
01	Reserved	Set to 00h
02-03	Additional Page Length	Set to 1Eh.
04-05	Parameter Code	Set to 00 00h, indicating the first parameter follows.
06	DU	The Disable Update bit must be set to 0, indicating the drive updates parameter values for all events.
	DS	The Disable Save bit is always set to 1, indicating the drive does not save parameter values.
	TSD	The Target Save Disable bit is always set to 0 indicating the drive defines a method for saving log parameters.
	ETC	The Enable Threshold Comparison bit is always set to 0, indicating comparison to the threshold value is not performed whenever the cumulative value is updated.
	TMC	The Threshold Met Criteria bits are used with the ETC bit and are always set to 0.
	LP	The List Parameters bit is always set to 1, indicating the parameter is a list parameter.
07	Parameter Length	Set to 0Ch, indicating 12 bytes in the counter.
08-13	Unit Serial Number	Set to the ASCII value of the drive's ten-digit serial number. The ten-digit value is interpreted as follows: PPSYWWNNNN. Where: PP is the product code, i.e., TG is NS20 SCSI. S is the manufacture location, i.e., T is Thailand. Y is the last digit of the calendar year, i.e., 8 is 1998. WW is the calendar week. NNNN is the alphanumeric serial number. (The serial number markings are detailed in document 44872.)
...		
18-1A	Cartridge Insertions	The number of physical loads of any cartridge type during the life of the drive. The number of cartridge loads includes cleaning cartridge loads and failed load attempts. The field is never reset.
...		

1F-22	<b>Tape Moved</b>	The length of tape (estimated in feet) passed over the head since the last head cleaning. The field is incremented by 740 feet at EOT and BOT when tape motion is reversed. It is only incremented when the full length of the tape has been traversed and the direction of tape motion is reversed. The field is reset if a cleaning operation is performed successfully.
...		
27-28	<b>Number of Cleanings</b>	The number of successful cleanings performed during the life of the drive. If a cleaning cartridge is inserted and does not complete the cleaning cycle, this field will not increment. The field is never reset.
...		
2D-30	<b>Time Since Last Cleaning</b>	The calculated time in minutes (1.5 minutes per full track) since the last cleaning was performed. The field is reset if a cleaning operation is performed successfully.
...		
35-38	<b>Longest Time Between Cleanings</b>	The longest calculated time interval in minutes between cleaning cycles. It is compared to the "Time Since Last Cleaning" value after every successful cleaning cycle and the greatest value is retained. The field is never reset.
...		
3C-3E	<b>Cleaning Interval</b>	The interval in minutes (3000 minutes = 50 hours) for setting the TapeAlert cleaning flag. This field is only changeable at the factory. In the field the value will remain the same.

Note: Fields on page 33h are not reset on power cycle.

**Page 3Eh—Report Check-Sum of FLASH-RAM (LOG SENSE only)**

Byte	Data Bits								Hex
	7	6	5	4	3	2	1	0	
00	Page Code								3E
01	0	0	0	0	0	0	0	0	00
02	MSB Additional Page Length								00
03	LSB								08
04	MSB Parameter Code								00
05	LSB								00
06	DU	DS	TSD	ETC	TMC		0	LP	40
07	Parameter Length								04
08	MSB Existing Check-Sum								XX
09	LSB								XX
0A	MSB Calculated Check-Sum								XX
0B	LSB								XX

**Page 3Eh—Report Check-Sum Definitions**

Byte		
0	<b>Page Code</b>	The Report Check Sum of Flash-RAM (core firmware for TRAVAN 6/7) Page Code is set to 3E.
1	<b>Reserved</b>	Set to 00h.
2-3	<b>Additional Page Length</b>	Set to 08h.
4-5	<b>Parameter Code</b>	Set to 00 00h, to indicate the first (and only) parameter

		follows.
<b>6</b>	<b>DU</b>	The Disable Update bit must be set to 0, indicating the drive updates parameter values for all events.
	<b>DS</b>	The Disable Save bit is always set to 1, indicating the drive does not save parameter values.
	<b>TSD</b>	The Target Save Disable bit is always set to 0 indicating the drive defines a method for saving log parameters.
	<b>ETC</b>	The Enable Threshold Comparison bit is always set to 0, indicating comparison to the threshold value is not performed whenever the cumulative value is updated.
	<b>TMC</b>	The Threshold Met Criteria bits are used with the ETC bit and are always set to 00b.
	<b>LP</b>	The List Parameters bit is always set to 1.
<b>7</b>	<b>Parameter Length</b>	Set to 04h, indicating 04 bytes of parameter data.
<b>8-9</b>	<b>Existing Check-Sum</b>	2-byte check-sum value that is hard coded in the firmware and stored in the EEPROM.
<b>0A-0B</b>	<b>Calculated Check-Sum</b>	2-byte check-sum value that is calculated when this Log Sense page is requested.

NOTE: When the existing and calculated check sums are equal, the firmware load was successful.

NOTE: The existing check sum is saved into EEPROM.

## MODE SELECT (Group 0, Op. Code 15)

The Host issues the MODE SELECT command to establish certain drive parameters. These parameters are sent to the drive as data. The parameters established by this command are not unique to the Initiator issuing the command. If a second Initiator changes the parameters at any time, these new parameters are used for all Hosts communicating with the drive. After accepting the MODE SELECT parameters from the Initiator, the drive sets Unit Attention condition for all other Initiators. The unit will accept this command when positioned anywhere on tape.

### CDB for MODE SELECT Command

Byte	Data Bits								Hex
	7	6	5	4	3	2	1	0	
0	0	0	0	1	0	1	0	1	15
1	0	0	0	PF	0	0	0	0	X0
2	0	0	0	0	0	0	0	0	00
3	Parameter List Length								XX
4									XX
5	0	0	0	0	0	0	0	0	00

**PF (Page Format):** A PF bit of 1 indicates that MODE SELECT Parameters following header and block descriptor are structured as pages of related parameters. Only the following pages are valid: Page 01h (Error Recovery and Reporting Parameter), Page 02h (Disconnect/Reconnect Control Parameters), Page 10h (Device Configuration Parameters), Page 11h (Media Partition Parameters), Page 0Fh (Data Compression Parameters), and Page 20h (Forced Streaming Parameters).

**Parameter List Length (PLL):** This field specifies the number of bytes for the Parameter List to be transferred from the Host. When 0, no bytes are transferred and this is not considered an error. When greater than 12h and PF is set to 1, the data following the Block Descriptor is in Page Format.

NOTE: This field is 2 bytes in length.

**Parameter List:** The first four bytes of the Parameter List comprise the Header, while the remaining bytes comprise the Block Descriptor.

Byte	Header Data Bits								Hex
	7	6	5	4	3	2	1	0	
0	0	0	0	0	0	0	0	0	00
1	0	0	0	0	0	0	0	0	00
2	0	0	0	BUFM	Speed Code				XX
3	Block Descriptor Length								08

**BUFM:** The BUFM enables the Buffered Mode for WRITE commands. If BUFM is set to 0, Buffered Mode is disabled for all WRITE commands, which do not terminate and send a Good Sense until the last data block has been written onto the tape by the drive. If BUFM is set to 1, Buffered Mode is enabled. WRITE commands terminate and return a Good Status as soon as the Host places the last data block in the buffer. If an error occurs while writing data after the command terminates, the drive returns a *Check Condition* Status on the next command received from the Host. The Host must then issue a REQUEST SENSE command to determine the

cause of the error. While writing, the drive will revert to Unbuffered Mode when Logical Early Warning (LEW) is reached. A REWIND issued at this point will cause the drive to rewind to BOT and return to Buffered Mode.

**Speed Code:** The values of speed codes are given in the table below. The Speed Code may be set explicitly by MODE SELECT command, or implicitly when AVC (Auto-Throttle) is set to 1 (bit 4, byte 8 of page code 10h). If AVC is set to 1, MODE SENSE will report the actual speed selected to optimize data throughput.

Code	Meaning	Tape Speed	Transfer Rate
0h	Use default speed.	92 ips	2.0 MBps
1h	Use lowest tape speed.	56 ips	1.2 MBps
2h-Fh	Use highest tape speed.	92 ips	2.0 MBps

**Block Descriptor Length:** Specifies the number of bytes in the Block Descriptor. This value is 08.

### Block Descriptor

Byte	Data Bits								Hex
	7	6	5	4	3	2	1	0	
0	Density Code								45h
1	MSB								00
2	Number of Blocks								00
3	LSB								00
4	0	0	0	0	0	0	0	0	00
5	MSB								XX
6	Block Length								XX
7	LSB								XX

**Density Code:** This byte identifies the bit density and format of the media used by the drive. The value returned by this field is determined by the last MODE SELECT command, or is the default value based on the cartridge type and/or previously recorded density following a power-up reset. See MODE SELECT for a table of valid Density Codes.

**Number of Blocks:** This field must be 0.

**Block Length:** This field specifies the block length and mode. If this field is 00h, the drive operates in variable length block mode. If this field is non-0, the drive operates in fixed length block mode and the logical block length is equal to the value of this field. The STT3401A default block length is 512 bytes.

**Page Code 01h** is used to specify target Error Recovery and Reporting parameters.

**Page Code 01h—Error Recovery and Reporting Parameters**

Byte	Data Bits								Hex
	7	6	5	4	3	2	1	0	
0	0	0	Page Code						01
1	Additional Page Length								0A
2	0	0	TB	0	EER	PER	DTE	DCR	X8
3	Read Retry Count								10
4	0	0	0	0	0	0	0	0	00
5	0	0	0	0	0	0	0	0	00
6	0	0	0	0	0	0	0	0	00
7	0	0	0	0	0	0	0	0	00
8	Write Retry Count								10
9	0	0	0	0	0	0	0	0	00
0A	0	0	0	0	0	0	0	0	00
0B	0	0	0	0	0	0	0	0	00

**TB:** A Transfer Block bit of 1 indicates that a data block not recovered in a READ operation within the recovery limits specified shall be transferred to the Initiator. A TB bit of 0 indicates that the failing data block shall not be transferred to the Initiator. The default value on power-up / reset condition is zero. This value is changeable by the Host.

**EER:** An Enable Error Recovery bit of 1 instructs the drive to apply ECC before attempting read retries. A 0 instructs the drive to exhaust the read retry count first then apply ECC. The power-up default is 1 and may not be changed by the Host.

**PER:** A Post Error Reporting bit of 1 instructs the drive to report *Check Condition* status on a recovered error. A 0 instructs the drive not to report *Check Condition* status on a recovered error. The power-up default is 0. The value may be changed, but the drive always operates as though the value is 0.

**DTE:** The Disable Transfer on Error bit is valid only if PER is set to 1. A 1 instructs the drive not to transfer recovered data. A 0 instructs the drive to transfer recovered data. The power-up default is 0. The value may be changed, but the drive always operates as though the value is 0.

**DCR:** The Disable Correction bit is valid only if EER is 0. A 1 instructs the drive not to apply ECC on a block in error; the drive will do a retry instead. A 0 instructs the drive to apply ECC on a block in error. The power-up default is 0. The value may be changed, but the drive always operates as though the value is 0.

**Read Retry Count:** Specifies the number of times that the target should attempt its read recovery algorithm. The Read Retry Count depends upon the format being written. Its value is not changeable by the Host.

**Write Retry Count:** This count is ignored and is not used by the drive.

**Page Code 10h—Device Configuration Parameters**

Byte	Data Bits								Hex	
	7	6	5	4	3	2	1	0		
0	0	0	Page Code (10h)							10
1	Additional Page Length								0E	
2	0	CAP	CAF	Active Format						X0
3	Active Partition								XX	
4	Write Buffer Full Ratio								XX	
5	Read Buffer Empty Ratio								XX	
6	MSB Write Delay Time								00	
7	LSB								00	
8	DBR	BIS	RSMK	AVC	SOCF		RBO	REW	XX	
9	Gap Size								00	
0A	EOD Defined			EEG	SEW	0	0	0	XX	
0B	MSB								00	
0C	Buffer Size At Early Warning								00	
0D	LSB								00	
0E	0	0	0	0	0	0	0	0	00	
0F	0	0	0	0	0	0	0	0	00	

**Additional Page Length:** Set to 0Eh to specify the length of the Device Configuration page.

**CAP:** Change Active Partition bit, set to 1, will set the logical partition to the one specified by the active partition field. This is only allowed if the FDP bit in the Media Partition Page (MODE SELECT/Sense Page 11h) has been set to 1. A CAP bit set to 0 indicates no partition change is specified. The default value is 0. This value is changeable by the Host.

**CAF:** The Change Active Format field shall always be set to 0, which specifies no change to format. The Density Code in the Block Descriptor is used to specify the format.

**Active Format:** The field specifies the format to be used when the tape is positioned at BOT and CAF is set to 1. Refer to Density Code field for valid format values. The power-up default is 00h. This value is not changeable by the Host.

**Active Partition:** The field contains the partition number, which will become active when the CAP bit is set to 1. The drive supports 2 partitions: When set to 0, the Data Partition is selected. When set to 1, the Directory Partition is selected. To set the Active Partition to one, FDP must also be set in Page 11h.

**Write Buffer Full Ratio:** On WRITE commands, this field indicates to the target how full the buffer shall be before writing data to the media. This field is not changeable and is ignored. The drive buffer will hold up to 28 frames of user data. When writing, the drive will start tape motion when 10 frames have assembled in the buffer.

**Read Buffer Empty Ratio:** On READ commands, this field indicates to the target how empty the buffer shall be before retrieving additional data from the media. This field is not changeable and is ignored. The drive buffer will hold up to 28 frames of user data. When reading, the drive will start tape movement when the buffer has free space for a minimum of 16 frames.

**Write Delay Time:** This field indicates the maximum time, in 100 millisecond increments, that the drive shall retain buffered data without subsequent write or synchronizing commands before forcing it to the media. Filler blocks containing invalid filler data required to fill out ECC frames will accompany data forced to tape. A value of 00 00h indicates data will never be forced to tape. Valid values are 00 00h and up to 10 00h (27.3 minutes). Invalid values will be rounded up. The default value is 00 00h and this field is changeable.

**Data Buffer Recovery** is set to 0 and the RECOVER BUFFERED DATA command is not supported and will not be accepted.

**BIS:** A Block Identifiers Supported (BIS) bit is reported as 1 in MODE SENSE. This field is non-changeable.

**RSMK:** The Report Setmark (RSMK) bit, if set to 1, instructs the drive to report Setmarks by the same rules applying to Filemarks. If set to 0, Setmarks will be ignored when reading, and commands to write Setmarks will not be accepted. This value is 0 by default and is not changeable. Setmarks are not supported

**AVC:** The Automatic Velocity Control (AVC) bit enables the Auto-Throttle feature. When set to 0, the tape speed is set by the speed code in the device specific parameter byte. When set to 1, the drive uses Auto-Throttle to reduce tape speed from the Speed Code setting to minimize repositioning of the tape. The adjusted tape speed will be reported in MODE SENSE.

**NOTE:** If Speed Code 0h is used with AVC on, the drive will default to 92 ips (2.0 Mbytes/Sec native transfer rate). If the system is unable to sustain streaming at that rate, the drive will Auto-Throttle to the lower speed (56 ips). At the beginning of each track, the drive will increase speed to 92 ips in an attempt to increase throughput.

**SOCF:** Stop On Consecutive Filemarks bit is not a supported function and must be set to 00b.

**BRO:** Recover Buffered Order bit determines the order in which data will be returned to the Host for a RECOVER BUFFERED DATA command. When set to 1, the data blocks will be returned to in LIFO order. When set to 0, FIFO order will be utilized. Only a value of 0 is supported. This field is non-changeable.

**REW:** A Report Early-Warning bit of 1 indicates the target shall return *Check Condition* status with the EOM bit set to 1 when the logical early-warning position is encountered during Read and Write operations. A REW bit of 0 indicates the target shall not report this condition for read operations (but it shall report the early warning for write operations). The default value is 0b. This field is not changeable.

**NOTE:** Early Warning is reported only on WRITE commands.

**Gap Size** field value determines the size of the inter-block gap while writing data and must be set to 0. This field is non-changeable.

**End-of-Data (EOD) Defined:** This field indicates which format type the logical unit shall use to detect and generate the EOD area. The only type supported is 000b, indicating a device default EOD definition per QIC format standard. Values 001b to 111b are reserved. This field is non-changeable.

**EEG:** Enable EOD Generation—When set to 1, this bit indicates that the logical unit shall generate the appropriate EOD area, as determined by the EOD Defined field. A value of 0 indicates that EOD generation is disabled. 1 is the value supported. This field is non-changeable.

**SEW:** Synchronize at Early Warning (SEW)—When set to 1, and Logical Early Warning is encountered during a WRITE operation, the tape drive will truncate the current command, write any buffered data to the tape, and return a *Check Condition* with EOM set in the Sense Data. 1 is the value supported. This field is non-changeable.

NOTE: When Logical Early Warning is detected, the drive will not interrupt the current DMA, which will be 64Kbytes or less. Notification will be given when the current command completes, or if the data left to be written is too large notification will be given on the maximum burst DMA boundary.

**Buffer Size at Early Warning** is always 0, indicating the buffer size is device specific.

#### Page Code 11h—Media Partition Page

Byte	Data Bits								Hex	
	7	6	5	4	3	2	1	0		
0	0	0	Page Code							11
1	Additional Page Length								06	
2	Maximum Additional Partitions								00	
3	Additional Partitions Defined								00	
4	FDP	SDP	IDP	PSUM		0	0	0	XX	
5	Media Format Recognition								03	
6	0	0	0	0	0	0	0	0	00	
7	0	0	0	0	0	0	0	0	00	

Additional Page Length shall be set to 6.

**Maximum Additional Partitions** field indicates the maximum number of additional partitions supported by the drive. The value of this field is returned during a MODE SENSE command. It will always be set to 0, indicating the drive supports one data partition consistent with QIC-157D, table 5-44. This parameter is not changeable.

**Additional Partitions Defined** field specifies the number of additional partitions to be defined for a volume when SCP or IDP is set to 1. This field must be set to 0, and is not changeable.

**FDP:** Fixed Data Partition bit may be changed by a MODE SELECT command only when the drive is positioned to BOT. When set to 0, the drive considers the entire media as a single partition. When FDP is set to 1 the drive is in dual partition mode. FDP does not cause the selected partition to change. CAP in page 10h is used for that function. The FDP bit default value is 1 and it is not changeable in STT3401A mode.

**Select Data Partition (SDP), Initiator-Defined Partitions (IDP), and Partitions Size Unit of Measure (PSUM)** fields shall be set to 0, indicating that the STT3401A drive assigns partitions based on its pre-defined definition of the data and directory partitions. These values are not changeable by the Host.

**Media Format Recognition** field is intended for use by the MODE SENSE command, in which it is set to 03h, indicating that the drive is capable of recognizing the format and partition of the tape automatically. This is per QIC-157D, table 5-45. This field is ignored in MODE SELECT commands.

**Page Code 1Ch** is used for TapeAlert Diagnostics.

**Page Code 1Ch—TapeAlert Diagnostics**

Byte	Data Bits								Hex
	7	6	5	4	3	2	1	0	
0	0	0	Page Code						1C
1	Page Length								0A
2	Perf	Reserved			Dexcpt	Test	Resrvd	LgErr	XX
3	Reserved				MRIE				XX
4	Interval Timer								XX
5									
6									
7									
8	Report Count / Test Flag Number								XX
9									
10									
11									

The Page Code is set to 1Ch. The purpose of the TapeAlert Mode page is similar to the SMART disc diagnostic interface. The TapeAlert Mode page will return to the default settings when a bus reset is received. The following fields are in the Mode page:

**Dexcpt (Default set to 1):** When this bit is set to 0 the reporting method indicated by the MRIE field is used. When this bit is set to 1 this indicates that the target shall disable all information exception operations, ignoring the MRIE field (in this mode the software must poll the TapeAlert Log page). Thus to enable “*Check Condition*” mode, set the bit to 0.

**LogErr (Default set to 0):** When this bit is set to 0, this indicates that the logging of informational exception conditions within a target is vendor specific. When this bit is set to 1, the target shall log informational exception conditions.

**Perf (Default set to 0):** When this bit is set to 0, this indicates that informational exception operations that can cause delays are acceptable. When this bit is set to 1, the target shall not cause delays while doing informational exception operations (may cause the target to disable some or all of the informational exception operations).

**Test (Default set to 0):** When this bit is set to 0, this indicates that the target shall not generate any false/test informational exception conditions.

When this bit is set to one and Test Flag Number is set to 0, the target will generate a false informational exception condition based on the MRIE field (the Interval Timer field is ignored and the Report Count field is used as the Test Flag Number). When a false information exception condition is posted, the TapeAlert flags in the Log page are not modified. However, real informational exception conditions have priority over false informational exception conditions. The Test bit will be automatically cleared when the false information exception condition is posted on the first command (excluding Inquiry and Request Sense) that is received with no real information exception condition pending. The false informational exception condition will then be

reported in the method specified by the MRIE value, except with the additional Sense Code set to 0x5DFF. If both the Test and Dexcpt bits are set to 1 and Test Flag Number set to 0, then the MODE SELECT command will return *Check Condition*, with Sense Key set to *Illegal Request* and extended sense set to *Invalid Field in Parameter List*.

When the Test bit is set to 1 and the Test Flag Number is set to valid non-0 value, the target will generate/clear a test informational exception condition. The value of the Test bit returned by a Mode Sense command will remain at 0. The test action is based on the Test Flag Number value:

**1 to 64:** This will set in the Log page the TapeAlert flag indicated by the Test Flag Number. Once the TapeAlert flag is set it is processed normally based on the Dexcpt, MRIE, Interval Count and Report Count values.

**-1 to -64:** This will clear the TapeAlert flag indicated by the absolute value of the Test Flag Number. Clearing the flag in this way is equivalent to performing the specified corrective action for that flag, thus allowing a real information exception condition to be set if the real error condition occurs for that flag.

**32767 (0x7FFF):** This will set all of the TapeAlert flags in the Log Page that are supported by the target. Once the supported TapeAlert flags are set they are processed normally based on the Dexcpt, MRIE, Interval Count and Report Count values.

**Interval Timer (Default set to 0):** When this field is set to 0, this indicates that the target shall only report the informational exception condition one time. When this field is set to non-0, the value indicates the period in 100 millisecond increments for reporting that an informational exception condition has occurred. The target shall not report informational exception conditions more frequently than the specified timer interval and as soon as possible after the timer interval has elapsed. A value of 0xFFFFFFFF in the field indicates the timer interval is vendor specific.

**Report Count/Test Flag Number (Default set to 0):** This field has a dual purpose. When the Test bit is set to 0, then the value of this field in the MODE SELECT data represents the Report Count, which is what is always returned in response to a Mode Sense command. When the Report Count field is set to 0, this indicates that there is no limit on the number of times the target shall report the informational exception condition (assuming that Interval Timer is set to non-0). When the Report Count field is set to non-0 this indicates the number of times to report an informational exception condition. If multiple TapeAlert flags are set simultaneously, these are reported as a single informational exception condition. The report count is controlled by the most recent flag set.

When a MODE SELECT command is sent with the Test bit is set to 1, then the value of this field in the MODE SELECT data represents the Test Flag Number, which is never returned in response to a Mode Sense command. Valid vales of the Test Flag Number are -64 to 64 and 32677 (0x7FFF). Negative numbers are represented using the 2's complement method. If the Test Flag Number is set to an invalid value, then the MODE SELECT command will return *Check Condition*, with Sense Key set to *Illegal Request* and extended sense set to *Invalid Field in Parameter List*. If the device does not support Test Flag Number, then when the Test bit is set to 1 and the Test Flag Number is set to non-0, the MODE SELECT command will return *Check Condition*. The Sense Key is set to *Illegal Request* and extended sense set to *Invalid Field in Parameter List*.

**MRIE (Default set to 0x3):** This field indicates the method used by the target to report informational exception conditions (note that this is standard SCSI terminology and is not related in any way to the “Information” severity level for the flags). The priority of reporting informational exception conditions is vendor specific. If the informational exception condition was generated by an event that caused a real *Check Condition* to occur, then this real *Check Condition* will over-ride (i.e. be used instead of) the *Check Condition* defined in MRIE modes 0x1 to 0x5. The values defined for this field are:

**0x0: No reporting of informational exception conditions.** This method instructs the device server to not report information exception conditions

**0x1: Asynchronous Event Reporting.** This method instructs the device server to report information exception conditions by using the rules for asynchronous event reporting as described in the SCSI-3 Architecture Model and the relevant protocol standard. The Sense Key shall be set to RECOVERED ERROR and the additional Sense Code shall indicate the cause of the information exception condition (which is 5D00 for a TapeAlert event).

**0x2: Generate Unit Attention.** This method instructs the device server to report information exception conditions by returning a *Check Condition* status on the next SCSI command (excluding Inquiry and Request Sense) after an informational exception condition was detected. The Sense Key shall be set to *Unit Attention* and the additional Sense Code shall indicate the cause of the information exception condition (which is 5D00 for a TapeAlert event). The command that has the *Check Condition* shall NOT be executed before the informational exception condition is reported (and thus needs to be repeated).

**0x3: Conditionally generate Recovered Error.** This method instructs the device server to report information exception conditions, if reporting of recovered errors is allowed, by returning a *Check Condition* status on the next SCSI command (excluding Inquiry and Request Sense) after an informational exception condition was detected. The Sense Key shall be set to RECOVERED ERROR and the additional Sense Code shall indicate the cause of the information exception condition (which is 5D00 for a TapeAlert event). The command that has the *Check Condition* shall complete without error before any exception condition may be reported (and thus does NOT need to be repeated).

**0x4: Unconditionally generate Recovered Error.** This method instructs the device server to report information exception conditions, regardless of the value of the per bit of the error recovery parameters mode page, by returning a *Check Condition* status on the next SCSI command (excluding *Inquiry* and *Request Sense*) after an informational exception condition was detected. The Sense Key shall be set to *Recovered Error* and the additional Sense Code shall indicate the cause of the information exception condition (which is 5D00 for a TapeAlert event). The command that has the *Check Condition* shall complete without error before any exception condition may be reported (and thus does NOT need to be repeated).

**0x5: Generate No Sense.** This method instructs the device server to report information exception conditions by returning a *Check Condition* status on the next SCSI command (excluding Inquiry and Request Sense) after an informational exception condition was detected. The Sense Key shall be set to *No Sense* and the additional Sense Code shall indicate the cause of the information exception condition (which is 5D00 for a TapeAlert event). The command that has the *Check Condition* shall complete without error before any exception condition may be reported (and thus does NOT need to be repeated).

0x6: **Only report informational exception condition on request.** This method instructs the device server to preserve information exception(s) information. To find out about information exception conditions the application client polls the device server by issuing an unsolicited REQUEST SENSE command. The Sense Key shall be set to *No Sense* and the additional Sense Code shall indicate the cause of the informational exception condition (which is 5D00 for a TapeAlert event).

With MRIE modes 0x1 to 0x6, the additional Sense Code of 5D00 indicates that a TapeAlert event has occurred on the device, and detailed information about this event is stored in the TapeAlert Log page. Note that the MRIE modes do not affect the logging of events in the TapeAlert Log page.

## MODE SENSE (Group 0, Op. Code 1A)

The MODE SENSE command provides the Host with information pertaining to the configuration of the drive. The drive does not disconnect from the Initiator while executing this command.

### CDB for MODE SENSE Command

Byte	Data Bits								Hex
	7	6	5	4	3	2	1	0	
0	0	0	0	1	1	0	1	0	1A
1	0	0	0	0	DBD	0	0	0	0X
2	PC		Page Code						XX
3	0	0	0	0	0	0	0	0	00
4	Allocation Length								XX
5		0	0	0	0	0	0	0	00

**DBD—Disable Block Descriptor:** A DBD bit of 0 will enable transfer of the block descriptor. A DBD bit of 1 will disable transfer of block descriptor parameters.

**PC—Page Control:** PC field as described below defines the type of values to be returned for Parameter Page.

Bit 7	Bit 6	Type of Parameter Values to be Returned
0	0	Current Values
0	1	Changeable Values <sup>2</sup>
1	0	Default Values <sup>2</sup>
1	1	Saved Values <sup>1,2</sup>

Note: 1) This is not supported by the drive. If PC=11b, the command will result in an *Illegal Request* (Sense Key 5).

2) With the ATAPI interface drive, PC must equal 00b. Other values will return an *Illegal Request* (Sense Key 5)

**Page Code:** The Page Code field specifies which Parameter Page(s) is (are) to be returned. Any Page Code value other than listed below will result in an *Illegal Request*.

Page Code	Description
01h	Error Recovery and Reporting Parameter Page will Be Returned
02h	Disconnect / Reconnect Control Parameter Page Will Be Returned
10h	Device Configuration Parameter Page Will Be Returned
11h	Media Partition Page Will Be Returned
1C	TapeAlert Diagnostics Page Will Be Returned

Page Code	Description
20h	Forced Streaming Page Will Be Returned
2Ah	Capabilities and Mechanical Status Page
3Fh	All Pages (01h through 3Fh) Will Be Returned

Refer to MODE SELECT command for a description of the Parameter Pages.

**Allocation Length:** This field specifies the number of bytes requested from the Parameter List. A maximum of 12 (0Ch) may be returned. When set to 0, no bytes are transferred and this is not considered an error.

**Parameter List:** The first four bytes of the Parameter List comprise the Header, while the remaining bytes comprise the Block Descriptor.

Byte	Header Data Bits								Hex
	7	6	5	4	3	2	1	0	
0	Sense Data Length								XX
1	Media Type								XX
2	WP	0	0	BUFM	Speed Code				XX
3	Block Descriptor Length								08

**Sense Data Length:** The Sense Data Length of 11 (0Bh) includes the four-byte Header and eight-byte Block Descriptor.

**Media Type:** This byte identifies the cartridge type installed in the drive. 00h indicates no cartridge or unknown cartridge. See table below for valid cartridge codes.

Code	Cartridge Type
00h	No cartridge, cleaning cartridge, or type unknown
85h	Travan 5
95h	Travan 7

**WP:** When this bit is 1, the cartridge installed in the drive is Write Protected.

**BUFM:** The BUFM bit indicates the Buffered Mode is enabled for WRITE commands. If set to 0, Buffered Mode is disabled for the WRITE command. The command does not terminate and send a Good Sense until the last data block has been written onto the tape by the drive. If BUFM is set to 1, the Buffered Mode is enabled. The WRITE command terminates and returns a Good Status as soon as the Host places the last data block in the buffer. If an error occurs while writing data after the command terminates, the drive returns a *Check Condition* Status on the next command received from the Host. The Host must then issue a REQUEST SENSE command to determine the cause of the error. While writing, the drive will revert to Unbuffered Mode when Logical Early Warning (LEW) is reached. A REWIND issued at this point will cause the drive to rewind the BOT and return to Buffered Mode.

**Speed Code:** Speed code values are listed in the table below. The Speed Code may be set explicitly by MODE SELECT command, or implicitly when AVC ( Auto-Throttle) is set to 1 (bit 4, byte 8 of page code 10h). If AVC is set to 1, MODE SENSE will report the actual speed selected to optimize data throughput.

Code	Meaning
0h	Use default speed.
1h	Use lowest tape speed.
2h-Fh	Use highest tape speed

**Block Descriptor Length:** Specifies the number of bytes in the Block Descriptor. This value is 08.

**Block Descriptor**

Byte	Data Bits								Hex
	7	6	5	4	3	2	1	0	
0	Density Code								XXh
1	MSB								00
2	Number Of Blocks								00
3	LSB								00
4	0	0	0	0	0	0	0	0	00
5	MSB								XX
6	Block Length								XX
7	LSB								XX

**Density Code:** This byte identifies the bit density and format of the media used by the drive. The value returned by this field is determined by the last MODE SELECT command, or is the default value based on cartridge type and/or previously recorded density following a power-up reset.

Density Code	QIC Reference	Read	Write
46	Travan 5, QIC-3220-MC	Yes	No
***	Travan 40	Yes	Yes

**Number of Blocks:** This field must be 0.

**Block Length:** This field indicates the selected block length and mode. The STT3401A default block length is 512 bytes. The maximum fixed block length is 1024 bytes.

**Parameters:** MODE Sense Data pages are as specified in the MODE SELECT commands. See Section 0 for page, field, and bit specifications.

**Page Code 2A Capabilities and Mechanical Status Page**

Byte	Data Bits								Hex	
	7	6	5	4	3	2	1	0		
0	0	0	Page Code (2A)							2A
1	Page Length (12h)								12	
2	Reserved								XX	
3	Reserved								XX	
4	Rsvd	Rsvd	Rsvd	SPREV	Rsvd	Rsvd	Rsvd	RO <sup>1</sup>	20 or 21	
5	Rsvd	Rsvd	QFA	Rsvd	EFMT	Rsvd	Rsvd	Rsvd	28	
6	CMPRS	ECC	Rsvd	DIS-CONNECT	EJECT <sup>1</sup>	PREVENT	LOCKED <sup>1</sup>	LOCK	XX	
7	Rsvd	Rsvd	Rsvd	Rsvd	Rsvd	BLK1024	BLK512	Rsvd	06	
8	MSB Maximum Speed Supported (in KBps)								07	
9	LSB								D0	
0A	MSB Reserved								XX	
0B	LSB								XX	
0C	MSB Continuous Transfer Limit (in blocks)								00	
0D	LSB								00	
0E	MSB Current Speed Selected (in KBps)								07	
0F	LSB								D0	
10	MSB Buffer Size (in 512 byte units)								10	
11	LSB								00	
12	MSB Reserved								XX	
13	LSB								XX	

NOTE: 1) These values may change depending on cartridge type and drive status.

**SPREV:** If the SPREV bit is set, the device supports SPACE in the reverse direction.

**RO:** If the RO bit is set, the device is operating in read-only mode. This bit does not reflect the state of the write protect flag on the cartridge which is indicated by the WP bit in the Mode Page Header.

**QFA:** If the QFA bit is set, the device supports a two-partition format, which may be used for quick file access.

**EFMT:** If the EFMT bit is set, the device supports ERASE command initiated formatting.

**CMPRS:** If the CMPRS bit is set, the device supports data compression.

**ECC:** If the ECC bit is set, the device performs error correction.

**DISCONNECT:** If the DISCONNECT bit is set, the device can break up data transfers without the need to restrict transfer lengths to the Continuous Transfer Limit.

**EJECT:** If the Eject bit is set, the device can mechanically unload the cartridge with the LOAD / UNLOAD command.

**PREVENT:** If the PREVENT bit is set, the device defaults to the Prevent state after power-up.

**LOCKED:** If the LOCKED bit is set, the volume is locked.

**LOCK:** If the LOCK bit is set, the device supports locking the volume using the PREVENT/ALLOW MEDIA REMOVAL command.

**BLK1024:** If the BLK1024 bit is set, the device is capable of using a 1024-byte block size.

**BLK512:** If the BLK512 bit is set, the device is capable of using a 512-byte block size.

**Maximum Speed Supported:** This field indicates the maximum data rate the device supports. This value is the maximum sustained native data transfer rate of the device returned in 1000 byte per second units.

**Continuous Transfer Limit:** This field indicates the number of blocks (of the current block size) that can be transferred without delay due to a buffer limitation. When DISCONNECT is set to 0, transfers restricted to the Continuous Transfer Limit will result in efficient use of the bus. When DISCONNECT is set to 1, this field is ignored.

**Current Speed Selected:** This field indicates the actual data rate the device is currently using. This value is returned in 1000 byte per second units.

**Buffer Size:** This field is an estimate of the read and write buffer size in 512-byte units.

## ***PREVENT/ALLOW MEDIA REMOVAL (Group 0, Op. Code 1E)***

This command is used to prevent or allow the removal of the tape cartridge.

### ***CDB for PREVENT/ALLOW MEDIA REMOVAL Command***

Byte	Data Bits								Hex
	7	6	5	4	3	2	1	0	
0	0	0	0	1	1	1	1	0	1E
1	0	0	0	0	0	0	0	0	00
0	0	0	0	0	0	0	0	0	00
3	0	0	0	0	0	0	0	0	00
0	0	0	0	0	0	0	0	PRE	0X
5	0	0	0	0	0	0	0	0	00

**PRE:** When set to 0, an ALLOW command is indicated. Following this command, cartridge unloading via the front panel Eject button or the UNLOAD command is allowed.

When set to 1, a PREVENT command is indicated. Following this command, an UNLOAD command or an Eject button push will be rejected. An UNLOAD command will be terminated with *Check Condition* Status. The Sense Key will be set to 5h (*Illegal Request*), and the ASC and ASCQ codes will be set to 53/02h (*Media Removal Prevented*). This command is canceled by a hard reset or a PREVENT/ALLOW command with the PRE bit set to 0. The drive does not disconnect from the Initiator while executing this command. A PREVENT command can be cleared by an ALLOW command only if sent by the same Initiator.

## READ (Group 0, Op. Code 08)

The READ command transfers the specified amount of data from the tape drive to the Initiator. The command terminates when one of the following conditions occurs:

- The Transfer length specified in the CDB has been satisfied.
- A Filemark or Setmark has been read.
- Logical Early Warning or physical End-of-Media has been reached.
- An unrecoverable read error has occurred (i.e., a command was issued to Read data that could not be recovered by ECC or rereading).
- An *Illegal Length* indication occurred (unless the SILI bit is set and the Illegal Length is an under length condition).
- End of Recorded Data is encountered.

When the command terminates for a reason other than the first, the residue can be obtained with a REQUEST SENSE command.

### CDB for READ Command

Byte	Data Bits								Hex
	7	6	5	4	3	2	1	0	
0	0	0	0	0	1	0	0	0	08
1	0	0	0	0	0	0	SILI	FBM	0X
2	MSB								XX
3	Transfer Length								XX
4	LSB								XX
5	0	0	0	0	0	0	0	0	00

**SILI:** Suppress Illegal Length Indicator (SILI) applies only to the variable block length mode, which is not supported by ATAPI-interface tape drives. The combination of the SILI bit and the FBM bit both set to 1 causes *Illegal Request* (Sense Key 5h).

**NOTE:** If ILI condition exists for a Fixed Block Transfer, the Illegal Length block will not be transferred.

**FBM:** Fixed Block Mode (FBM) is associated with the Transfer Length field. When set to 1, the transfer length is given in blocks as specified in the MODE SELECT data.

**NOTE:** If the block length on tape is different than the block length specified in MODE SELECT data, an Illegal Length error is declared.

**Transfer Length:** If FBM is set to 1, this field specifies the number of blocks to be transferred to the Initiator.

When Reading, the STT3401A keeps track of “soft” read errors (corrected blocks) and data overruns. These error counters are available by means of the REQUEST SENSE command.

**Data Error Counter:** This counter is incremented each time a block must be corrected using ECC. It is cleared when any command is issued that terminates the

READ process (e.g., REWIND). See REQUEST SENSE, bytes 14-15 and LOG SENSE, Page 3.

**Data Under-Run Counter:** This counter is incremented each time a buffer overrun causes the tape to reposition. The counter is cleared when the READ process is terminated. See REQUEST SENSE, bytes 16-17.

## READ BUFFER (Group 1, Op. Code 3C)

The READ BUFFER command will cause the contents of the drive's data buffer to be returned to the Host and is intended to be used in conjunction with the WRITE BUFFER command as a Diagnostic tool. Using Buffer I.D. and Buffer Offset, the data transfer may be started from any location in the buffer. This command tests the ATAPI Bus and the drive's Data Buffer. The tape is not affected.

### CDB for READ BUFFER Command

Byte	Data Bits								Hex
	7	6	5	4	3	2	1	0	
0	0	0	1	1	1	1	0	0	3C
1	0	0	0	0	0	Mode			0X
2	Buffer I.D.								XX
3	MSB								XX
4	Buffer Offset								XX
5	LSB								XX
6	MSB								XX
7	Transfer Length								XX
8	LSB								XX
9	0	0	0	0	0	0	0	0	00

**MODE:** The Mode field determines the format of the data that is returned to the Host.

Mode	Type	Description
0-1h	Reserved	
2h	Data Only Mode	The drive will send the data only, and no header.
3-7h	Reserved	

**Buffer I.D.:** The data buffer is divided into 256 equal segments of 2048 bytes each. The number of each segment is specified by the Buffer I.D. To perform a read buffer at the first segment (or beginning) of the buffer, a Buffer I.D. of 00h must be specified. To perform a read buffer at the 128<sup>th</sup> segment, a Buffer I.D. of 7Fh must be specified (etc.).

**Buffer Offset:** This field specifies the byte location in the specified buffer in which the first data byte to be transferred to the Host will be found. Offset values greater than 7FFh will cause *Check Condition, Illegal Request*.

**Transfer Length:** This field specifies the number of bytes to be read from the Buffer by the Host. The value includes the four-byte Header.

NOTE: The STT3401A has an 8 MB buffer. Each segment, as defined by Buffer I.D., will be 2K bytes in size and the maximum offset will be 7ffh.

**READ BUFFER Header (Mode 00h)**

Byte	Data Bits								Hex
	7	6	5	4	3	2	1	0	
0	0	0	0	0	0	0	0	0	00
1	MSB								XX
2	Buffer Capacity								XX
3	LSB								XX

**Buffer Capacity:** This field specifies the total number of bytes in the drive's buffer.

## **READ POSITION (Group 1, Op. Code 34)**

The READ POSITION command reports the current position of the logical unit and any data blocks in the buffer. No tape movement shall occur as a result of the command. The drive may disconnect during this command.

### **CDB for READ POSITION Command**

Byte	Data Bits								Hex
	7	6	5	4	3	2	1	0	
0	0	0	1	1	0	1	0	0	34
1	0	0	0	0	0	0	0	BT	0X
2	0	0	0	0	0	0	0	0	00
3	0	0	0	0	0	0	0	0	00
4	0	0	0	0	0	0	0	0	00
5	0	0	0	0	0	0	0	0	00
6	0	0	0	0	0	0	0	0	00
7	0	0	0	0	0	0	0	0	00
8	0	0	0	0	0	0	0	0	00
9	0	0	0	0	0	0	0	0	00

**BT:** The Block Address Type bit determines the reporting method of the block location field. If 0, the logical addresses are returned for current block and the last block in the data buffer. If set to 1, the physical block address is returned for the first block location and the last block in the data buffer. Information is returned to the host in the format shown below.

### **READ POSITION Data Format**

Byte	Data Bits								Hex
	7	6	5	4	3	2	1	0	
0	BOP	EOP	0	0	0	BPU	0	0	XX
1	Partition Number								XX
2	0	0	0	0	0	0	0	0	00
3	0	0	0	0	0	0	0	0	00
4	MSB								XX
5	First Block Location								XX
6	LSB								XX
7	LSB								XX
8	MSB								XX
9	Last Block Location								XX
0A	LSB								XX
0B	LSB								XX
0C	0	0	0	0	0	0	0	0	00
0D	MSB								XX
0E	Number of Blocks in Buffer								XX
0F	LSB								XX
10	MSB								XX
11	Number of Bytes in Buffer								XX
12	LSB								XX
13	LSB								XX

**BOP:** The Beginning Of Partition bit, if set to 1, indicates that the logical unit is at the beginning-of-partition in the current partition.

**EOP:** The End Of Partition bit, if set to 1, indicates that the logical unit is at the end-of-partition in the current partition.

**BPU:** A Block Position Unknown bit of 1 indicates that the first and last block locations are not known or cannot be obtained.

**Partition Number:** The Partition Number reports the current partition position. 00h indicates the Data partition, 01h indicates the Directory Partition.

**First Block Location:** The First Block Location reports the current tape block address (i.e., the next to be read to the Host for READ command).

**Last Block Location:** The Last Block Location reports the last tape block address to be written to tape from the buffer for the WRITE command. This field is 0 if the previous command was READ, VERIFY, SEEK, SPACE, or LOCATE.

## REQUEST SENSE (Group 0, Op. Code 03)

Information pertinent to the completion of a command is obtained by the REQUEST SENSE command. Although a REQUEST SENSE command may be issued at any time, it is typically issued immediately following a command that has resulted in a *Check Condition* (Status 02h). Sense Data remains valid until reset by a subsequent command issued by the same Initiator selecting the same LUN as the one that resulted in the *Check Condition*. In the case of the single Initiator option, the drive will assume that the REQUEST SENSE command is from the same Initiator. A REQUEST SENSE command also resets the Sense Data and Sense information (byte 0 to 11h). All other sense information is preserved, or in the case of Data Error and Under-run Counters, updates may occur.

### CDB for REQUEST SENSE Command

Byte	Data Bits								Hex
	7	6	5	4	3	2	1	0	
0	0	0	0	0	0	0	1	1	03
1	0	0	0	0	0	0	0	0	00
2	0	0	0	0	0	0	0	0	00
3	0	0	0	0	0	0	0	0	00
4	Transfer Length								XX
5	0	0	0	0	0	0	0	0	00

The REQUEST SENSE command returns a *Check Condition* status only upon a catastrophic failure in reporting the Sense Data. For example, a 1 bit in a reserved field of the CDB or repeated bus parity errors. Under these conditions it is likely that the Sense Data returned is not valid.

**Transfer Length:** Specifies the number of sense bytes requested by the Host. The command terminates when either the number of bytes requested or all available bytes are transferred whichever is less.

The following figure represents the Sense Byte Format.

### Sense Data Format (for all Sense Keys except 0Ah—Copy Aborted)

Byte	Data Bits								Hex
	7	6	5	4	3	2	1	0	
00	AVF	Error Code (70h or 71h)							XX
01	0	0	0	0	0	0	0	0	00
02	FM	EOM	ILI	0	Sense Key				XX
03	MSB								XX
–	Sense Information								XX
06	LSB								XX
07	Additional Sense Length (56 bytes)								38
08	MSB								XX
–	Command Specific Information								XX
0B	LSB								XX
0C	Additional Sense Code								XX
0D	Additional Sense Code Qualifier								XX
0E	Field Replaceable Unit Code								XX
0F	SKSV	C/D	0	0	BPV	Bit Pointer			XX
10	MSB								XX

Byte	Data Bits								Hex
	7	6	5	4	3	2	1	0	
11	Field Pointer LSB								XX
12	0	CNI	0	WP	PEO M	UDE	BNL	FIL	XX
13	0	0	NDT	0	BOM	BPE	0	0	XX
14	MSB Data Error Counter								XX
15	LSB								XX
16	MSB Data Overrun/Under-run Counter								XX
17	LSB								XX
18	Track Number								XX
19	Cartridge Type								XX
1A	MSB Filemark Count								XX
1B	LSB								XX
1C	MSB Physical Block Number								XX
1D	Physical Block Number								XX
1E	LSB								XX
1F	Tape Module Error Code (High Byte)								XX
20	Tape Module Error Code (Low Byte)								XX
21	Reserved								XX
22	Least Last 10 Commands								XX
2B	Most								XX
2C	Reserved								0X
–									–
3F									0X

**AVF:** Address Valid Flag. When the AVF is 1, the Sense Information (bytes 3-6) contains valid information.

**FM:** When the Filemark bit is set to 1, a Filemark has been encountered during a read operation.

**EOM:** The End-of-Media bit, when set to 1, indicates the tape has reached the Logical Early Warning Point.

**ILI:** The Illegal Length Indicator, when set to 1, indicates that the length of the block read from the media does not match the block length specified by the READ or COPY command, or the length specified by MODE SELECT.

**Sense Key:** Defines the type of failure associated with the current *Check Condition* (02h Status). The Sense Keys are defined in the following table.

**Sense Information:** When the AVF bit is 1, the Sense Information bytes represent the difference between the Transfer Length requested by the command and the actual number of blocks or bytes transferred (i.e., the residue).

**Additional Sense Length:** The Additional Sense Length specifies the number of bytes to follow this byte. For all commands except the COPY command, this field is 38h.

**Command Specific Information:** This field contains information that depends on the command that was last executed. Further meaning for this field is defined within the command description.

**Additional Sense Code & Qualifier:** Specifies detailed information related to the additional Sense Code. If the error or exception condition is reportable by the device the value returned will be as specified. If the condition is not reportable by the device, a value of 00h is used.

**Field Replaceable Unit:** The value of this field will be 0, indicating that no specific mechanism or unit has been identified to fail or that the data is not available. There are no FRUs in the drive.

**SKSV:** The Sense Key Specific Valid bit of 1 indicates that the Sense Key Specific fields (bytes 0Fh, 10h & 11h) are valid. This bit is 0, not supported.

The following fields are not cleared by a REQUEST SENSE command.

**CNI:** Cartridge Not In Place.

**WP:** Cartridge Write Protected.

**PEOM:** Physical-End-of-Media—Indicates the position is past the Physical Early Warning hole on the tape. (Note that the EOM bit in byte 02h denotes the Logical Early Warning Point).

**UDE:** Unrecoverable Data Error.

**BNL:** Block Not Located. (Cleared by a successful MEDIA ACCESS command.)

**FIL:** Filemark Detected (Same as FM). (Cleared by a successful MEDIA ACCESS command.)

**NDT:** No Data Detected. Same as Sense Key 8h. (Cleared by a successful MEDIA ACCESS command.)

**BOM:** Physical Beginning-Of-Media (Beginning of Partition).

**BPE:** Not applicable

**Data Error Counter:** For write operations, this is the number of blocks since the start of the current write operation re-written because they were detected to be in error by the READ-WHILE-WRITE check. For read operations, this is the number of blocks recovered by ECC or read-retry since the tape was last at BOT.

**Buffer Overrun / Under-run Counter:** For write operations, this is the number of times that the under-run logic was forced to rewrite a data block in and under-run condition. (An under-run can occur without tape reposition.) For read operations, this is the number of times a reposition cycle was required due to buffer overrun.

**Track Number:** The track number that the read/write head is currently positioned to.

**Cartridge Type:** The allowable cartridge types are listed below.

#### **Cartridge Type Codes**

Code	Travan 7 Compatibility	Cartridge Type
00h	N/A	No cartridge, cleaning cartridge, or type unknown
85h	Read / Write	Travan 5, NS20
95h	N/A	Travan 7

**Filemark Count:** This is the number of Filemarks encountered since the tape was last at BOM. This counter is not reset by a REQUEST SENSE command, but is reset when tape is positioned back to BOM.

**Physical Block Number:** The number of the next physical block to be read/written by the Host.

**Tape Module Error Code (TMC):** Vendor unique error codes provided for firmware and drive-related diagnostic purposes.

**Last 10 Commands:** This field shows the last 10 CDBs received by the drive from the host.

### Request Sense Keys

Sense Key (hex value)	Type	Meaning
0	No Sense	Indicates that there is no specific Sense Key information to be reported. This would be the case for a successful command or a command that received <i>Check Condition</i> or command Terminated status because one of the Filemark, EOM, or ILI bits is set to 1.
1	Recovered Data	Indicates that the last command completed successfully with some recovery action performed by the target. Details may be determined by examining the additional sense bytes and the information bytes. When multiple recovered errors occur during one command, the choice of which error to report (first, last, most severe, etc.) is device specific.
2	Not Ready	The tape drive cannot be accessed. Operator intervention may be required.
3	Media Error	An unrecoverable error occurred that was caused by either a flaw in the media, or an error in the recorded data.
4	Hardware Error	The drive detected an unrecoverable hardware failure during the performance of a command or internal diagnostics.
5	Illegal Request	There was an illegal parameter in the command Description block or associated additional parameters or an inappropriate sequence of commands was issued.
6	Unit Attention	The tape cartridge may have been changed or the drive Reset since the last command was issued. This error is reported by the first command following this condition and the function of this condition is not performed. The Unit Attention is reported to all Initiators that subsequently issue commands to the drive.
7	Data Protect	A write or erase operation was attempted on a device with the cartridge in the Safe state.
8	Blank Check	The drive encountered the End-of-Recorded Media. This is

Sense Key (hex value)	Type	Meaning
		not the same as the physical EOM.
9	Vendor Unique	This Sense Key is available for reporting vendor unique conditions (Not Used).
A	Copy Aborted	A COPY command was aborted due to an error on the source or destination device (Not Supported).
B	Aborted Command	The drive aborted the command either at the request of the Initiator or due to a hardware failure, such as the removal of a cartridge during a read or write operation. The Initiator may recover by trying the command again.
C	Reserved	(Not Used)
D	Volume Overflow	The physical End-of-Media has been reached. The data remaining in the buffer may be read with a Recover Buffer Data command.
E	Miscompare	Indicates that the source data did not match the data read from the media.
F	Reserved	Reserved

**Sense Code (ASC) and ASC Qualifier Assignments**

Sense Key	ASC	ASCQ	Meaning
00	00	00	Normal
00	00	00	Illegal length
00	00	00	Busy
00	00	00	Command failed because of reservation conflict
00	00	01	Filemark found
00	00	02	Early EOM detected
00	00	04	Blank check (EOD reached)
00	00	06	SCSI terminated I/O message response
00	5D	00	Tape Alert - no sense
01	5D	00	Tape Alert- triggered by previous command
02	04	01	Not ready, but is coming ready
02	30	02	Unknown cartridge type or cartridge type is incompatible (ex. compressed data on tape, but compression hardware option not installed)
02	3A	00	No media in drive
02	3A	00	Media is present, but is not ready
03	0C	00	Media error on write command
03	11	00	Media error on read command
03	30	00	Write denied due to incompatible cartridge type
04	02	00	Seek error, failed to reach target track
04	3F	02	Bad checksum detected while attempting to update flash
04	40	00	Power On Self Test failed

Sense Key	ASC	ASCQ	Meaning
04	44	00	Hardware error occurred
04	44	81	Fan error
04	47	00	SCSI parity error non-command state
04	47	00	SCSI parity error in command state
05	00	00	Attempted to erase tape when not at BOT
05	20	00	Invalid CDB opcode
05	21	00	Invalid LBA
05	22	00	Invalid function requested
05	24	00	Invalid data byte in CDB
05	25	00	Invalid LUN
05	26	00	Invalid parameter in data
05	2C	00	Log select failed
05	3D	00	SCSI bad id
05	3D	00	SCSI parity error in identify message
05	49	00	SCSI LUN is non-zero (in msg)
05	50	00	Attempted to write when not at either BOT or EOD
05	53	02	Command not allowed because of previous Prevent/Allow CDB command
06	28	00	Media just came ready, normal status after cartridge insertion
06	29	00	Drive was just initialized, normal status after power-on
06	2A	00	Mode select parameters changed
06	2A	02	Log select parameters changed
06	5D	00	Tape alert- unit attention
06	5D	FF	Tape alert- bad mode
07	27	00	Attempted to write on a write-protected cartridge
08	00	05	Read or located into EOD: blank check
0B	00	00	Host aborted the command
0B	00	00	Command was aborted
0B	00	00	ATA 'nop' command
0B	3A	00	Cartridge was removed before a medium operation was completed
0B	48	00	SCSI error - extended message
0B	49	00	SCSI error - bad message (not in command state)
0B	49	00	Fatal drive firmware error occurred
0B	49	00	SCSI error (received bad message while in command state)
0B	4E	00	Command was aborted because of attempted command overlap condition

Sense Key	ASC	ASCQ	Meaning
0D	00	00	Physical end of medium detected

## **REWIND (Group 0, Op Code 01)**

When operating in single partition mode, the REWIND command causes the drive to rewind the tape to the physical Beginning-Of-Partition (BOP) or load point.

### **CDB for REWIND command**

Byte	Data Bits								Hex
	7	6	5	4	3	2	1	0	
0	0	0	0	0	0	0	0	1	01
1	0	0	0	0	0	0	0	IMM	0X
2	0	0	0	0	0	0	0	0	00
3	0	0	0	0	0	0	0	0	00
4	0	0	0	0	0	0	0	0	00
5	0	0	0	0	0	0	0	0	00

**IMM—Immediate:** Not applicable for ATAPI drives

**Application Note:** When Writing in Buffered Mode, the target shall discard any buffered data after a REWIND command is validated if the previous command was terminated with a *Check Condition* status, and the drive is unable to write the data to tape (as when a “hard” write error occurred).

## ***SEND DIAGNOSTIC (Group 0, Code 1D)***

The SEND DIAGNOSTIC command requests the target to perform diagnostic tests on it. Except when the Self-Test bit is one, this command is usually followed by a Receive Diagnostic Results command.

### ***CDB for SEND DIAGNOSTIC command***

Byte	Data Bits								Hex
	7	6	5	4	3	2	1	0	
0	0	0	0	1	1	1	0	1	1D
1	0	1	0	0	0	0	0	0	40
2	0	0	0	0	0	0	0	0	00
3	MSB Parameter List Length								00
4	LSB								00
5	0	0	0	0	0	0	0	0	00

**Parameter List Length:** The Parameter List must be set to 0.

## SPACE (Group 0, Op. Code 11)

The SPACE command provides a means of positioning the tape forward or reverse of the current position. The command can space over data blocks, filemarks, sequential filemarks, or to the End-of-Data.

### CDB for SPACE command

Byte	Data Bits								Hex
	7	6	5	4	3	2	1	0	
0	0	0	0	1	0	0	0	1	11
0	0	0	0	0	0	0	DFE		0X
2	MSB Count LSB								XX
3									XX
4									XX
5	0	0	0	0	0	0	0	0	00

**DFE—Data, Filemarks, End-of-Data:** The DFE field determines the type of blocks to be spaced over.

Bit 1	Bit 0	Description
0	0	Data (Logical) Blocks
0	1	Filemarks
1	0	Consecutive Filemarks
1	1	End of Recorded Data

**Count:** The Count Field specifies the number of data blocks, filemarks or consecutive filemarks to be spaced over. A value of 0 results in no tape movement and is not considered an error. A negative value -N (2's complement notation) results in a logical reverse space over N blocks or filemarks ending on the BOM side of the last block or filemark.

**Spacing Over Data Blocks:** The number of logical (not physical) data blocks to be spaced over is determined by the Count Field. If a Filemark or EOD is encountered while spacing over data blocks, tape movement is stopped and the command terminates with a *Check Condition* (Status 02h). The number of data blocks remaining to be spaced over is located in the Sense Information bytes. If termination was caused by a Filemark, the tape is positioned following the Filemark, the Sense Key is set to 0h (No Sense) and the FM flag bit is set. If termination was caused by EOD (End of Recorded Data), the Sense Key will be set to Blank Check (8h). If Logical Early Warning is encountered, the command will complete normally, but *Check Condition* Status will be reported. The Sense Key will be set to *No Sense* (0h) and the EOM flag bit will be set. Bad data blocks will not be reported.

**Spacing Over Filemark Blocks:** In Space Over Filemark mode, data blocks are ignored. When the command terminates normally, the tape is positioned following the last Filemark read. If EOD is encountered, the command terminates with a *Check Condition* (Status 02h) and the number of Filemarks remaining to be spaced over is located in the Sense Information bytes returned by a REQUEST SENSE command.

If *Logical Early Warning* is encountered, the command continues to normal completion, then reports *Check Condition* with *No Sense* and EOM set in the Sense Data.

NOTE: If RSMK is set in Mode Data Page 10h, Byte 8, Bit 5, Set Marks will be treated as Filemarks when spacing over data.

**Spacing Over Consecutive Filemark Blocks:** The number of consecutive filemarks to be spaced over is specified in the Count Field. The tape is positioned following the last Filemark in the sequence. If a data block is encountered, the count is restored to its original value and the space operation continues, following the data block. If Logical Early Warning is encountered, the command continues to normal completion, then reports *Check Condition* with *No Sense* and EOM set in the Sense Data.

**Spacing to the End-of-Data:** When spacing to the End-of-Data, the Count Field is ignored. The drive will take the most direct route available to position the tape at EOD.

When Logical Early Warning is encountered during the SPACE EOD operation, the drive will complete the command normally, except that it will send back a *Check Condition*, *No Sense*, and the EOM bit set in the Sense Key byte.

NOTE: The drive may accept a non-media command while DSC is 0 and if BUSY is 0.

## ***TEST UNIT READY (Group 0, Op Code 00)***

This command performs a test to ensure that the tape drive is ready and a tape cartridge is installed. TEST UNIT READY does not initiate the internal diagnostic self-test. The drive does not disconnect during execution of this command.

### ***CDB for TEST UNIT READY command***

Byte	Data Bits								Hex
	7	6	5	4	3	2	1	0	
0	0	0	0	0	0	0	0	0	00
1	0	0	0	0	0	0	0	0	00
2	0	0	0	0	0	0	0	0	00
3	0	0	0	0	0	0	0	0	00
4	0	0	0	0	0	0	0	0	00
5	0	0	0	0	0	0	0	0	00

## VERIFY (Group 0, Op. Code 13)

The VERIFY command performs a Verification Check on a specified number of data blocks on the tape without involving the Host. Verification starts at the present position of the tape and continues for the specified number of blocks. If a data block cannot be verified by CRC recovery then ECC and read retries will be employed in an attempt to recover the data. The command terminates as a result of one of the following conditions:

- The specified number of blocks has been verified.
- A Filemark or Setmark has been detected.
- The End-of-Data has been reached.
- A Verification failure occurred.

Upon termination, the tape is positioned to read the block following the last data block or Filemark read correctly.

### CDB for VERIFY command

Byte	Data Bits								Hex
	7	6	5	4	3	2	1	0	
0	0	0	0	1	0	0	1	1	13
1	0	0	0	0	0	IMM	BytCmp	FBM	0X
2	MSB								XX
3	Length Of Verification								XX
4	LSB								XX
5	0	0	0	0	0	0	0	0	00

**IMM:** When the IMMEDIATE bit is set to 0, status will be returned to the Host when the VERIFY operation is completed. When set to 1, the status will be returned to the Host as soon as the VERIFY operation is initiated.

**NOTE:** The ATAPI interface does not have an IMM bit or functional equivalent. The DSC and BUSY bits in the Host taskfile status register indicate bus and command status.

**BytCmp:** When the Byte Compare bit is set to 0, the drive will perform a media data recoverability verification only. A Byte Compare bit set to 1 indicates the drive will perform a byte-by-byte compare between data read from the media and data sent from the Host. BytCmp=1 is not supported.

**FBM:** The Fixed Block Mode bit (FMB) set to 1 indicates fixed block mode operation.

## **WRITE (Group 0, Op. Code 0A)**

The WRITE command transfers the specified amount of data from the Initiator to the tape drive. A rewind or other Write process terminating command (e.g., WRITE FILEMARK with length set to 0) must be issued after the last write command to allow the drive to finish writing all buffered data.

NOTE: The Imation Travan Cartridge specification requires cartridge conditioning under specified conditions. Conditioning is achieved by running the tape one complete end-to-end pass, and retensioning a cartridge when loading is recommended.

The command terminates when one of the following conditions occurs.

- The Transfer length field in the CDB has been satisfied and the data has been transferred to the tape drive's buffer (Buffered Mode).
- The drive failed to find the append point.
- An unrecoverable write error occurred. (Failed after 16 attempts to write the block correctly.)
- The physical or logical End-of-Media has been reached.

When the command terminates for a reason other than the first, the residue can be obtained with a REQUEST SENSE command.

### **CDB for WRITE command**

Byte	Data Bits								Hex
	7	6	5	4	3	2	1	0	
0	0	0	0	0	1	0	1	0	0A
1	0	0	0	0	0	0	0	FMB	0X
2	MSB								XX
3	Transfer Length								XX
4	LSB								XX
5	0	0	0	0	0	0	0	0	00

**Fixed Block Mode:** The Fixed Block Mode (FBM) bit is associated with the Transfer length field, as indicated below.

**Transfer Length:** If FBM is set to 1, this number specifies the number of blocks to be transferred from the Initiator.

NOTE: The drive writes a "frame-oriented" recording format to tape. Data which does not fill a frame will be retained in the buffer until:

- 1) enough additional data to fill a frame is received,
- 2) a terminating command to the WRITE process is received, or
- 3) Write Buffer Delay Time expires (see MODE SELECT).

Terminating commands are WRITE FILEMARK with IMM set to 0, REWIND, SPACE, LOCATE, or Load/Unload.

The STT3401A drive will only accept WRITE commands at the Beginning-of-Tape (BOT), Beginning-of-Partition (BOP) and End-of-Recorded-Data (EOD).

## WRITE BUFFER (Group 1, Op. Code 3B)

The WRITE BUFFER command is used in conjunction with the READ BUFFER command as a diagnostic tool or for downloading firmware. This command tests the ATAPI Bus and the drive's Data Buffer. The tape is not affected. Using Buffer ID and Buffer Offset, data can be placed in any location in the buffer.

### CDB for WRITE BUFFER command

Byte	Data Bits								Hex
	7	6	5	4	3	2	1	0	
0	0	0	1	1	1	0	1	1	3B
1	0	0	0	0	0	Mode			0X
2	Buffer I.D.								XX
3	MSB								00
4	Buffer Offset								00
5	LSB								XX
6	MSB								XX
7	Transfer Length								XX
8	LSB								XX
9	0	0	0	0	0	0	0	0	00

**MODE:** The Mode Bits determine the operation and format as indicated in the table below.

Mode Bits			Description
2	1	0	
0	0	0	Reserved
0	0	1	Reserved
0	1	0	Data only is written, no header.
1	0	0	Download firmware segments 1 through (N-1). Firmware is not saved in EEPROM.
1	0	1	Download firmware segment N (last segment). Firmware is saved ("flashed") into EEPROM.
1	1	0	Reserved
1	1	1	Reserved

**Buffer I.D.:** The Data Buffer is divided into 256 equal segments. (If the buffer size is 512KB, each segment is 2K). The Buffer ID specifies the segment into which the first byte of data transferred by the Host is to be placed.

**NOTE:** If the buffer size is 2048KB, each segment will be 8K bytes in size and the maximum offset will be 09ffh.

**Buffer Offset:** This field specifies where the first data byte received from the Host is to be placed in the Buffer specified by the Buffer ID field. Values greater than 07FFh will give *Check Condition, Illegal Request*.

**Transfer Length:** This field specifies the number of bytes to be written into the Buffer by the Host. The value includes the four-byte Header.

**WRITE BUFFER Header (Mode 000b)**

Byte	Data Bits								Hex
	7	6	5	4	3	2	1	0	
0	0	0	0	0	0	0	0	0	00
1	MSB								00
2	Buffer Capacity								00
3	LSB								00

**Buffer Capacity:** All bytes of this field must be set to 00h or the command will terminate with an Illegal Request (Sense Key 5).

When Firmware is downloaded and saved to “Flash” EPROM, it is possible to verify the check-sum stored in the firmware against the check-sum calculated as the firmware was loaded. See LOG SENSE command page 3E.

## **WRITE FILEMARK (Group 0, Op. Code 10)**

This command writes a specified number of Filemark blocks to the tape.

### **CDB for WRITE FILEMARK command**

Byte	Data Bits								Hex
	7	6	5	4	3	2	1	0	
0	0	0	0	1	0	0	0	0	10
1	0	0	0	0	0	0	WSMK	IMM	00
2	MSB								XX
3	Transfer Length								XX
4	LSB								XX
5	0	0	0	0	0	0	0	0	00

**WSMK—Write Setmarks:** This bit must be set to 0. Writing Setmarks is not supported. If RSMK is set to 0 in Mode Data page 10h, Byte 8, Bit 5, Illegal Request will result when this bit is set in the CDB. Reading Setmarks is supported and Setmarks are treated as Filemarks, but Setmarks are counted separately.

**IMM—Immediate:** When IMM is set to 1, the drive returns status upon verification of the CDB. When IMM is set to 0, the drive writes all buffered data to the tape including the specified number of filemarks, prior to sending command Complete with “Good” status. Filemarks written in Immediate mode do not interrupt streaming.

**NOTE:** The ATAPI interface does not have an IMM bit or functional equivalent. IMM is assumed to be set (1).

**Transfer Length:** Specifies the number of Filemark blocks to be written. When this value is 0 (and IMM = 0), the drive writes all data in the Data Buffer to tape and no Filemarks are written, but an EOD frame will be written. If it is successful, the drive issues a Good Status. If not, it issues a *Check Condition* (Status 02). The Sense Information Bytes returned by the REQUEST SENSE command reflect the number of blocks remaining in the Data Buffer.

**NOTE:** The STT3401A maintains the total number of filemarks written in a session. The counter may be read by means of the REQUEST SENSE command. If the Immediate bit is set to 0, streaming will be interrupted when the last block is written and the data buffer is flushed.

The locations of the filemarks are recorded in the media header. If the tape is not rewind after the last WRITE command or WRITE FILEMARK command, the media header will not be updated and it will not be accurate. If the Eject button is pressed, the cartridge will be rewind and the media header will be updated. If AutoPark is enabled, the drive will rewind the cartridge and update the media header after the drive is idle for several minutes.

If AutoPark is not enabled and the cartridge is not ejected, the cartridge in the drive is vulnerable to a power shutdown or a power failure causing the drive to leave the cartridge with an old version of the media header. The cartridge will be useable, but the lack of an accurate header will cause substantial delays during a SPACE or LOCATE command. This problem can

be avoided by simply insuring the cartridge is removed from the drive following any WRITE or WRITE FILEMARK operations

## ***ATA Command Descriptions***

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The following ATA commands are supported.

### General Feature Set

- EXECUTE DEVICE DIAGNOSTIC
- IDENTIFY DEVICE
- NOP
- SET FEATURES

### ATAPI Feature Set

- ATAPI 'DEVICE' RESET
- IDENTIFY PACKET DEVICE
- PACKET

### Power Management Feature Set

- CHECK POWER MODE
- IDLE
- IDLE IMMEDIATE
- SLEEP
- STANDBY
- STANDBY IMMEDIATE

Much of this section is taken directly from the ATA-4 specification. Information that is not relevant to this device has been omitted.

<b>Opcode (Hex)</b>	<b>Command</b>	<b>Ref. page</b>
00	NOP	107
08	DEVICE RESET	94
90	EXECUTE DEVICE DIAGNOSTIC	95
A0	PACKET	108
A1	IDENTIFY PACKET DEVICE	98
E0	STANDBY IMMEDIATE	113
E1	IDLE IMMEDIATE	106
E2	STANDBY	112

<b>Opcode (Hex)</b>	<b>Command</b>	<b>Ref. page</b>
E3	IDLE	105
E5	CHECK POWER MODE	93
E6	SLEEP	111
EC	IDENTIFY DEVICE	97
EF	SET FEATURES	109

## CHECK POWER MODE (ATA Command E5)

The CHECK POWER MODE command allows the Host to determine the power mode of the selected device. The device does not disconnect from the bus while executing this command.

### Host Taskfile Registers—Inputs

Host Taskfile Register	Data Bits								HEX
	7	6	5	4	3	2	1	0	
Features	N/A								N/A
Sector Count	N/A								N/A
Sector Number	N/A								N/A
Byte Count High	N/A								N/A
Byte Count Low	N/A								N/A
Device/Head	rsvd	LBA	rsvd	DEV	SAM LUN (not used)				
Command	command								E5

### Host Taskfile Registers—Normal Outputs

Host Taskfile Register	Data Bits								HEX
	7	6	5	4	3	2	1	0	
Error	rsvd	tag type (not supported)			MCH	ABRT	EOM	ILI	00
Sector Count	N/A								N/A
Sector Number	result value 00h device is in Standby mode 80h device is in Idle mode FFh device is in Active or Idle mode								N/A
Byte Count High	N/A								N/A
Byte Count Low	N/A								N/A
Device/Head	rsvd	LBA	rsvd	DEV	SAM LUN (not used)				
Status	BSY	RDY	rsvd	DSC	DRQ	Corr	rsvd	CHK	50

## DEVICE RESET (ATA Command 08)

The Device Reset command enables the Host to reset an individual device without affecting the other device on the same IDE cable. This command shall be accepted when BSY or DRQ is set to one, DRDY is cleared to 0, or DMARQ is asserted. This command shall be accepted when in Sleep mode. The command will never end in an error condition.

### Host Taskfile Registers—Inputs

Host Taskfile Register	Data Bits								HEX
	7	6	5	4	3	2	1	0	
Features	N/A								N/A
Sector Count	N/A								N/A
Sector Number	N/A								N/A
Byte Count High	N/A								N/A
Byte Count Low	N/A								N/A
Device/Head	rsvd	LBA	rsvd	DEV	SAM LUN (not used)				
Command	command								08

### Host Taskfile Registers—Outputs

Host Taskfile Register	Data Bits								HEX
	7	6	5	4	3	2	1	0	
Error	rsvd	tag type (not supported)			MCH	ABRT	EOM	ILI	01
Sector Count	ATAPI 'signature'								01
Sector Number	ATAPI 'signature'								01
Byte Count High	ATAPI 'signature'								EB
Byte Count Low	ATAPI 'signature'								14
Device/Head	rsvd	LBA	rsvd	DEV	SAM LUN (not used)				
Status	BSY	RDY	rsvd	DSC	DRQ	Corr	rsvd	CHK	00

## **EXECUTE DEVICE DIAGNOSTIC (ATA Command 90)**

This command shall perform the internal diagnostic tests implemented by the device. The DEV bit in the Device/Head register is ignored. Both devices, if present, shall execute this command regardless of which device is selected.

If the Host issues an EXECUTE DEVICE DIAGNOSTIC command while a device is in or going to a power management mode except Sleep, then the device shall execute its EXECUTE DEVICE DIAGNOSTIC sequence.

Error information is returned as a diagnostic code in the Error register.

### **Host Taskfile Registers—Inputs**

Host Taskfile Register	Data Bits								HEX
	7	6	5	4	3	2	1	0	
Features	N/A								N/A
Sector Count	N/A								N/A
Sector Number	N/A								N/A
Byte Count High	N/A								N/A
Byte Count Low	N/A								N/A
Device/Head	rsvd	LBA	rsvd	DEV	SAM LUN (not used)				
Command	command								90

### **Host Taskfile Registers—Outputs**

Host Taskfile Register	Data Bits								HEX
	7	6	5	4	3	2	1	0	
Error	diagnostic code (see below)								01
Sector Count	ATAPI 'signature'								01
Sector Number	ATAPI 'signature'								01
Byte Count High	ATAPI 'signature'								EB
Byte Count Low	ATAPI 'signature'								14
Device/Head	ATAPI 'signature'								00
Status	BSY	RDY	rsvd	DSC	DRQ	Corr	rsvd	CHK	00

**Diagnostic Code:**

When this code is in the Error register of Device 0:

Code (hex)	Device 0 Meaning	Device 1 Meaning
00, 02-7F	Failed. Bits 6:1 contain an error code	Passed or is not present
01	Passed	Passed or is not present
81	Passed	Failed. See the Error register of Device 1 for details.
80, 82-FF	Failed. Bits 6:1 contain an error code	Failed. See the Error register of Device 1 for details.

When this code is in the Error register of Device 1:

Code (hex)	Device 0 Meaning	Device 1 Meaning
00, 02-7F	N/A	Failed. Bits 6:1 contain an error code
01	N/A	Passed
81	N/A	N/A
80, 82-FF	N/A	N/A

## ***IDENTIFY DEVICE (ATA Command EC)***

This command allows an ATA (not ATAPI) device to report its capabilities to the Host.

Since this device supports the PACKET feature set, this command will be aborted.

### **Host Taskfile Registers—Inputs**

Host Taskfile Register	Data Bits								HEX
	7	6	5	4	3	2	1	0	
Features	N/A								N/A
Sector Count	N/A								N/A
Sector Number	N/A								N/A
Byte Count High	N/A								N/A
Byte Count Low	N/A								N/A
Device/Head	rsvd	LBA	rsvd	DEV	SAM LUN (not used)				
Command	command								EC

### **Host Taskfile Registers—Outputs**

Host Taskfile Register	Data Bits								HEX
	7	6	5	4	3	2	1	0	
Error	Rsvd	tag type (not supported)			MCH	ABRT	EOM	ILI	04
Sector Count	ATAPI 'signature'								01
Sector Number	ATAPI 'signature'								01
Byte Count High	ATAPI 'signature'								EB
Byte Count Low	ATAPI 'signature'								14
Device/Head	rsvd	LBA	rsvd	DEV	SAM LUN (not used)				
Status	BSY	RDY	rsvd	DSC	DRQ	Corr	rsvd	CHK	01

## **IDENTIFY PACKET DEVICE (ATA Command A1)**

This command allows an ATAPI (not ATA) device to report its capabilities to the Host.

The data returned are very extensive and detailed. Please refer to the ATA-4 document for complete details. Many details that are not relevant to this device have been omitted.

The result data returned to the Host will always be 512 bytes long.

Some parameters are defined as 32-bit values (e.g., words 57 and 58). Such fields are transferred using two word transfers. The device shall first transfer the least significant bits, bits 15 through 0 of the value, on (bus) bits DD (15:0) respectively. After the least significant bits have been transferred, the most significant bits, bits 31 through 16 of the value, shall be transferred on DD (15:0) respectively.

Some parameters are defined as a string of ASCII characters. For the string "Copyright," the character "C" is the first byte; the character "o" is the 2<sup>nd</sup> byte, etc. When such fields are transferred, the order of transmission is:

1. The 1<sup>st</sup> character ("C") is on bits DD (15:8) of the first word
2. The 2<sup>nd</sup> character ("o") is on bits DD (7:0) of the first word
3. The 3<sup>rd</sup> character ("p") is on bits DD (15:8) of the second word
4. The 4<sup>th</sup> character ("y") is on bits DD (7:0) of the second word

etc.

### **Host Taskfile Registers—Inputs**

Host Taskfile Register	Data Bits								HEX
	7	6	5	4	3	2	1	0	
Features	N/A								N/A
Sector Count	N/A								N/A
Sector Number	N/A								N/A
Byte Count High	N/A								N/A
Byte Count Low	N/A								N/A
Device/Head	rsvd	LBA	rsvd	DEV	SAM LUN (not used)				
Command	command								A1

**Host Taskfile Registers—Outputs**

Host Taskfile Register	Data Bits								HEX
	7	6	5	4	3	2	1	0	
Error	rsvd	tag type (not supported)			MCH	ABRT	EOM	ILI	00
Sector Count	N/A								N/A
Sector Number	N/A								N/A
Byte Count High	residual byte count (15 : 8)								00
Byte Count Low	residual byte count (7 : 0)								00
Device/Head	rsvd	LBA	rsvd	DEV	SAM LUN (not used)				
Status	BSY	RDY	rsvd	DSC	DRQ	Corr	rsvd	CHK	40 or 50

**IDENTIFY PACKET DEVICE Data Returned to Host**

Word(s)	Starting Offset (hex)	Description of Contents	Value (hex)
0	00	General configuration bit-significant information: 15-14 10=ATAPI device 11=reserved 13 reserved 12-8 command packet set supported by the device (01h = sequential access device) 7 1=removable media device 6-5 Method device uses when ready for Host to xfer packet data 00=Microprocessor DRQ (within 3 ms of receiving a PACKET command: device shall set DRQ=1) 01=Interrupt DRQ (sometime (no limit specified) after receiving a PACKET command: device shall assert INTRQ when DRQ=1) 10=Accelerated DRQ (within 50 microsecs of receiving a Packet command: device shall set DRQ=1) 11=reserved 4-2 reserved 1-0 command packet size 00=12 byte command packet 01=16 byte command packet 1X=reserved	81C0
1-9	02	reserved	0000
10-19	14	Serial number (20 ASCII characters)	varies
20-22	28	reserved	0000
23-26	2E	Firmware revision (8 ASCII characters)	varies
27-46	36	Model number (40 ASCII characters) "Seagate STT3401A"	
47-48	5E	reserved	0000

Word(s)	Starting Offset (hex)	Description of Contents	Value (hex)
49	62	Capabilities: 15 1=interleaved DMA support 14 1=command queuing supported 13 1=overlap operation supported 12 1=ATA software reset required (obsolete) 11 1=IORDY supported (must be set if device supports PIO mode 3 or higher) 10 1=IORDY may be disabled (via the SET FEATURES command) 9 1=LBA supported 8 0=DMA supported 7-0 vendor specific	0A00
50	64	reserved	0000
51	66	15-8 PIO data transfer mode number 00h PIO mode 0 01h PIO mode 1 02h PIO mode 2 03h-FFh reserved 7-0 vendor specific	0200
52	68	reserved	0000
53	6A	Indicates which optional words are valid: 15-3 reserved 2 1=the fields reported in word 88 are valid 1 1=the fields reported in words 64-70 are valid 0 1=the fields reported in words 54-58 are valid	0002
54-62	6C	reserved for ATA devices	0000
63	7E	Only one mode may be selected at a time. If an UltraDMA mode is selected, then bits 15-8 must be 0. multiword DMA transfer MODE SELECTed 15-11 reserved 10 1=multiword DMA mode 2 is selected 9 1=multiword DMA mode 1 is selected 8 1=multiword DMA mode 0 is selected multiword DMA transfer modes supported 7-3 reserved 2 1=multiword DMA mode 2 is supported 1 1=multiword DMA mode 1 is supported 0 1=multiword DMA mode 0 is supported	0000
64	80	15-8 reserved advanced PIO transfer modes supported 7-2 reserved 1 1=PIO mode 4 is supported 0 1=PIO mode 3 is supported	0002
65	82	15-0 minimum multiword DMA transfer cycle time per word (nanosecs) multiword DMA mode 2: 120 = 0078h multiword DMA mode 1: 150 = 0096h multiword DMA mode 0: 480 = 01E0h	***01E0
66	84	15-0 manufacturer's recommended multiword DMA transfer cycle time (nanosecs)	01E0
67	86	15-0 minimum PIO transfer cycle time without IORDY flow control (nanosecs) PIO mode 4: 120 = 0078h PIO mode 3: 180 = 00B4h PIO mode 2: 240 = 00F0h PIO mode 1: 383 = 017Fh PIO mode 0: 600 = 0258h	00B4
68	88	15-0 minimum PIO transfer cycle time with IORDY flow control (nanosecs)	00B4
69-70	8A	reserved	0000

Word(s)	Starting Offset (hex)	Description of Contents	Value (hex)
71	8E	15-0 typical time (3 sigma) from receipt of Packet command to release (nanosecs) (not supported)	0000
72	90	15-0 typical time (3 sigma) from receipt of Service command to BSY cleared to 0 (nanosecs) (not supported)	0000
73-74	92	reserved	0000
75	96	Queue depth (not supported) 15-5 reserved 4-0 maximum queue depth supported	0000
76-70	98	reserved	0000
80	A0	Major version number 15-5 reserved 4 1=supports ATA/ATAPI-4 3 1=supports ATA-3 2 1=supports ATA-2 1 1=supports ATA-1 0 reserved	001E
81	A2	Minor version number 000Fh =ATA/ATAPI-4 T13 1153D revision 7	000F
82	A4	Command and feature sets supported. If words 82 and 83=0000h or FFFFh, then command set notification is not supported. 15 1=IDENTIFY DEVICE DMA command is supported 14 1=NOP command is supported 13 1=READ BUFFER command is supported 12 1=WRITE BUFFER command is supported 11 1=WRITE VERIFY command is supported 10 1=Host Protected Area feature set is supported 9 1=DEVICE RESET command is supported 8 1=SERVICE interrupt is supported 7 1=release interrupt is supported 6 1=look-ahead is supported 5 1=write cache is supported 4 1=PACKET command feature set is supported 3 1=Power management feature set is supported 2 1=Removable Media feature set is supported 1 1=Security Mode feature set is supported 0 1=SMART feature set is supported	4278
83	A6	Command sets supported. If words 82 and 83=0000h or FFFFh, then command set notification is not supported. 15 shall be cleared to 0 14 shall be set to one 13-3 reserved 2 1=Compact Flash feature set is supported 1 1=Read/Write DMA QUEUED command is supported 0 1=DOWNLOAD MICROCODE command is supported	0000
84	A8	Command set/feature supported extension. If words 82, 83, and 84 = 0000h or FFFFh, then command set notification extension is not supported. 15 shall be cleared to 0 14 shall be set to one 13-0 reserved	4000

Word(s)	Starting Offset (hex)	Description of Contents	Value (hex)
85	AA	Command and feature sets enabled. If words 82 and 83=0000h or FFFFh, then command set notification is not enabled. 15 1=IDENTIFY DEVICE DMA command is enabled 14 1=NOP command is enabled 13 1=READ BUFFER command is enabled 12 1=WRITE BUFFER command is enabled 11 1=WRITE VERIFY command is enabled 10 1=Host Protected Area feature set is enabled 9 1=DEVICE RESET command is enabled 8 1=SERVICE interrupt is enabled 7 1=release interrupt is enabled 6 1=look-ahead is enabled 5 1=write cache is enabled 4 1=PACKET command feature set is enabled 3 1=Power management feature set is enabled 2 1=Removable Media feature set is enabled 1 1=Security Mode feature set is enabled 0 1=SMART feature set is enabled	4278
86	AC	Command sets supported. If words 82 and 83=0000h or FFFFh, then command set notification is not supported. 15 shall be cleared to 0 14 shall be set to one 13-3 reserved 2 1=Compact Flash feature set is enabled 1 1=Read/Write DMA QUEUED command is enabled 0 1=DOWNLOAD MICROCODE command is enabled	0000
87	AE	Command set/feature enabled default. If words 82, 83, and 84 = 0000h or FFFFh, then command set notification extension is not supported. 15 shall be cleared to 0 14 shall be set to one 13-0 reserved	4000
88	B0	Supported and selected UltraDMA modes (not supported) 15-11 reserved 10 1=UltraDMA mode 2 is selected 9 1=UltraDMA mode 1 is selected 8 1=UltraDMA mode 0 is selected 7-3 reserved 2 1=UltraDMA mode 2 and below are supported 1 1=UltraDMA mode 1 and below are supported 0 1=UltraDMA mode 0 is supported	0000
89	B2	Time required for Security erase unit completion (not supported)	0000
90	B4	Time required for Enhanced security erase unit completion (not supported)	0000
91		Current advanced power management value	0000
92		Master Password Revision Code	0000

Word(s)	Starting Offset (hex)	Description of Contents	Value (hex)
93		<p>Hardware reset result. The contents of bits 12-0 of this word shall change only during the execution of a hardware reset.</p> <p>15 Shall be cleared to zero.                      14 Shall be set to one.                      13 1 = device detected CBLID- above ViH                      0 = device detected CBLID- below ViL                      12-8 Device 1 hardware reset result. Device 0 shall clear these bits to zero. Device 1 shall set these bits as follows:                      12 Reserved.                      11 0 = Device 1 did not assert PDIAG-.                      1 = Device 1 asserted PDIAG-.                      10-9 These bits indicate how Device 1 determined the                      Device number:                      00 = Reserved.                      01 = a jumper was used.                      10 = the CSEL signal was used.                      11 = some other method was used or the method is unknown.                      8 Shall be set to one.                      7-0 Device 0 hardware reset result. Device 1 shall clear these bits to zero. Device 0 shall set these bits as follows:                      7 Reserved.                      6 0 = Device 0 does not respond when Device 1 is selected.                      1 = Device 0 responds when Device 1 is selected.                      5 0 = Device 0 did not detect the assertion of DASP-.                      1 = Device 0 detected the assertion of DASP-.                      4 0 = Device 0 did not detect the assertion of PDIAG-.                      1 = Device 0 detected the assertion of PDIAG-.                      3 0 = Device 0 failed diagnostics.                      1 = Device 0 passed diagnostics.                      2-1 These bits indicate how Device 0 determined the device number:                      00 = Reserved.                      01 = a jumper was used.                      10 = the CSEL signal was used.                      11 = some other method was used or the method is unknown.                      0 Shall be set to one.</p>	varies
94-126		Reserved	
127		<p>Removable Media Status Notification feature set support</p> <p>15-2 Reserved                      1-0 00 = Removable Media Status Notification feature set not supported                      01 = Removable Media Status Notification feature supported                      10 = Reserved                      11 = Reserved</p>	0000
128		<p>Security status</p> <p>15-9 Reserved                      8 Security level 0 = High, 1 = Maximum                      7-6 Reserved                      5 1 = Enhanced security erase supported                      4 1 = Security count expired                      3 1 = Security frozen                      2 1 = Security locked                      1 1 = Security enabled                      0 1 = Security supported</p>	0000
129-159		vendor specific	0000

Word(s)	Starting Offset (hex)	Description of Contents	Value (hex)
160		CFA power mode 1 15 Word 160 supported 14 Reserved 13 CFA power mode 1 is required for one or more commands implemented by the device 12 CFA power mode 1 disabled 11-0 Maximum current in ma	
161-175		Reserved for assignment by the CompactFlash Association	
176-254		Reserved	
255		Integrity word 15-8 Checksum 7-0 Signature	XXXX

## ***IDLE (ATA Command E3)***

This command is accepted but performs no function. This command normally allows the Host to place the device in Idle mode using the standby timer. INTRQ is asserted even though the device may not have fully transitioned to Idle mode.

If the Sector Count register is non-0, then the Standby timer shall be enabled. The value in the Sector Count register shall be used to determine the time programmed into the Standby timer.

If the Sector Count register is 0, then the Standby timer is disabled.

### **Host Taskfile Registers—Inputs**

Host Taskfile Register	Data Bits								HEX
	7	6	5	4	3	2	1	0	
Features	N/A								N/A
Sector Count	Standby timer setting: 00h timeout disabled 01h-F0h timeout= (value * 5) secs F1h-FBh timeout= ( (value-240) * 30) min FCh timeout= 21 minutes FDh timeout= period between 8 and 12 hours FEh reserved FFh timeout= 21 min 15 sec								
Sector Number	N/A								N/A
Byte Count High	N/A								
Byte Count Low	N/A								
Device/Head	rsvd	LBA	rsvd	DEV	SAM LUN (not used)				
Command	command								E3

### **Host Taskfile Registers—Outputs**

Host Taskfile Register	Data Bits								HEX
	7	6	5	4	3	2	1	0	
Error	rsvd	tag type (not supported)			MCH	ABRT	EOM	ILI	00
Sector Count	N/A								N/A
Sector Number	N/A								N/A
Byte Count High	N/A								N/A
Byte Count Low	N/A								N/A
Device/Head	rsvd	LBA	rsvd	DEV	SAM LUN (not used)				
Status	BSY	RDY	rsvd	DSC	DRQ	Corr	rsvd	CHK	40 or 50

## ***IDLE IMMEDIATE (ATA Command E1)***

This command is accepted but performs no function. This command allows the Host to immediately place the device in Idle mode. INTRQ is asserted even though the device may not have fully transitioned to Idle mode.

### Host Taskfile Registers—Inputs

Host Taskfile Register	Data Bits								HEX
	7	6	5	4	3	2	1	0	
Features	N/A								N/A
Sector Count	N/A								N/A
Sector Number	N/A								N/A
Byte Count High	N/A								N/A
Byte Count Low	N/A								N/A
Device/Head	rsvd	LBA	rsvd	DEV	SAM LUN (not used)				
Command	command								E1

### Host Taskfile Registers—Outputs

Host Taskfile Register	Data Bits								HEX
	7	6	5	4	3	2	1	0	
Error	rsvd	tag type (not supported)			MCH	ABRT	EOM	ILI	00
Sector Count	N/A								N/A
Sector Number	N/A								N/A
Byte Count High	N/A								N/A
Byte Count Low	N/A								N/A
Device/Head	rsvd	LBA	rsvd	DEV	SAM LUN (not used)				
Status	BSY	RDY	rsvd	DSC	DRQ	Corr	rsvd	CHK	40 or 50

## ***NOP (ATA Command 00)***

This command allows a Host that only performs 16-bit register accesses, to check device status.

If this command is supported, the drive shall respond, as it does to an unrecognized command by setting the ABRT bit to 1 in the Error register, setting the Error bit in the Status Register, clearing the BSY to 0 in the Status Register, and asserting INTRQ signal.

This command is not supported. The device will abort the command.

### **Host Taskfile Registers—Inputs**

Host Taskfile Register	Data Bits								HEX
	7	6	5	4	3	2	1	0	
Features	N/A								N/A
Sector Count	N/A								N/A
Sector Number	N/A								N/A
Byte Count High	N/A								N/A
Byte Count Low	N/A								N/A
Device/Head	rsvd	LBA	rsvd	DEV	SAM LUN (not used)				
Command	command								00

### **Host Taskfile Registers—Outputs**

Host Taskfile Register	Data Bits								HEX
	7	6	5	4	3	2	1	0	
Error	rsvd	tag type (not supported)			MCH	ABRT	EOM	ILI	04
Sector Count	not changed								00
Sector Number	not changed								00
Byte Count High	not changed								00
Byte Count Low	not changed								00
Device/Head	rsvd	LBA	rsvd	DEV	SAM LUN (not used)				
Status	BSY	RDY	rsvd	DSC	DRQ	Corr	rsvd	CHK	00

## ***PACKET (ATA Command A0)***

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The PACKET command is used to transfer a device command via a command packet.

See the section ***ATAPI Packet Protocol***, above for details.

## SET FEATURES (ATA Command EF)

This command is used by the Host to establish parameters that affect the execution of certain device features.

At power on, or after a hardware reset, the default setting of the functions specified by the subcommands are vendor specific. If any subcommand input value is not supported or is invalid, the device posts an *Aborted command* error.

### Host Taskfile Registers—Inputs

Host Taskfile Register	Data Bits								HEX
	7	6	5	4	3	2	1	0	
Features	Subcommand code								
Sector Count	Subcommand specific								
Sector Number	Subcommand specific								
Byte Count High	Subcommand specific								
Byte Count Low	Subcommand specific								
Device/Head	rsvd	LBA	rsvd	DEV	SAM LUN (not used)				
Command	command								EF

### Supported Subcommands

Value	Description
03h	Set transfer mode, based on the value in the Sector Count register.
66h	Disable revert to POR values

### Set Transfer Mode Values

Mode	Bits 7:3	Bits 2:0
PIO default mode	00000b	000b
PIO default mode, disable IORDY (not supported)	00000b	001b
PIO flow control transfer mode	00001b	mode
(retired)	00010b	N/A
Multiword DMA mode	00100b	mode
Ultra DMA mode (not supported)	01000b	mode
Reserved	10000b	N/A

### Host Taskfile Registers—Outputs

Data Bits
-----------

Host Taskfile Register	7	6	5	4	3	2	1	0	HEX
Error	rsvd	tag type (not supported)			MCH	ABRT	EOM	ILI	00
Sector Count	N/A								N/A
Sector Number	N/A								N/A
Byte Count High	N/A								
Byte Count Low	N/A								
Device/Head	rsvd	LBA	rsvd	DEV	SAM LUN (not used)				
Status	BSY	RDY	rsvd	DSC	DRQ	Corr	rsvd	CHK	40 or 50

## SLEEP (ATA Command E6)

This command provides the only way for the device to enter Sleep mode.

It causes the device to set the BSY bit to one, prepare to enter Sleep mode, clear the BSY bit to 0 and assert INTRQ. The Host shall read the Status register in order to clear the interrupt and allow the device to enter Sleep mode. In Sleep mode, the interface becomes inactive without affecting the operation of the interface. The Host shall not attempt to access the Command Block registers while the device is in Sleep mode.

Because some Host systems may not read the Status register and clear the interrupt, a device may automatically de-assert INTRQ and enter Sleep mode after a vendor specific time period of not less than 2 seconds. The only way to recover from Sleep mode is with a SOFTWARE RESET (SRST), a HARDWARE RESET, or a DEVICE RESET command.

A device shall not power on in Sleep mode nor remain in Sleep mode following a reset sequence.

### Host Taskfile Registers—Inputs

Host Taskfile Register	Data Bits								HEX
	7	6	5	4	3	2	1	0	
Features	N/A								N/A
Sector Count	N/A								N/A
Sector Number	N/A								N/A
Byte Count High	N/A								N/A
Byte Count Low	N/A								N/A
Device/Head	Rsvd	LBA	rsvd	DEV	SAM LUN (not used)				
Command	command								E6

### Host Taskfile Registers—Outputs

Host Taskfile Register	Data Bits								HEX
	7	6	5	4	3	2	1	0	
Error	Rsvd	tag type (not supported)			MCH	ABRT	EOM	ILI	00
Sector Count	N/A								N/A
Sector Number	N/A								N/A
Byte Count High	N/A								
Byte Count Low	N/A								
Device/Head	Rsvd	LBA	rsvd	DEV	SAM LUN (not used)				
Status	BSY	RDY	rsvd	DSC	DRQ	Corr	rsvd	CHK	40 or 50

## STANDBY (ATA Command E2)

This command is accepted but performs no function. This command causes the device to enter the Standby mode.

If the Sector Count register is non-0, then the Standby timer shall be enabled. The value in the Sector Count register shall be used to determine the time programmed into the Standby timer.

If the Sector Count register is 0, then the Standby timer is disabled.

### Host Taskfile Registers—Inputs

Host Taskfile Register	Data Bits								HEX
	7	6	5	4	3	2	1	0	
Features	N/A								N/A
Sector Count	Standby timer setting: 00h timeout disabled 01h-F0h timeout= (value * 5) sec F1h-FBh timeout= (value-240) * 30 min FCh timeout= 21 minutes FDh timeout= period between 8 and 12 hours FEh reserved FFh timeout= 21 min 15 sec								N/A
Sector Number	N/A								N/A
Byte Count High	N/A								N/A
Byte Count Low	N/A								N/A
Device/Head	rsvd	LBA	rsvd	DEV	SAM LUN (not used)				
Command	command								E2

### Host Taskfile Registers—Outputs

Host Taskfile Register	Data Bits								HEX
	7	6	5	4	3	2	1	0	
Error	rsvd	tag type (not supported)			MCH	ABRT	EOM	ILI	00
Sector Count	N/A								N/A
Sector Number	N/A								N/A
Byte Count High	N/A								N/A
Byte Count Low	N/A								N/A
Device/Head	rsvd	LBA	rsvd	DEV	SAM LUN (not used)				
Status	BSY	RDY	rsvd	DSC	DRQ	Corr	rsvd	CHK	40 or 50

## STANDBY IMMEDIATE (ATA Command E0)

This command is accepted but performs no function. This command causes the device to immediately enter the Standby mode.

### Host Taskfile Registers—Inputs

Host Taskfile Register	Data Bits								HEX
	7	6	5	4	3	2	1	0	
Features	N/A								N/A
Sector Count	N/A								N/A
Sector Number	N/A								N/A
Byte Count High	N/A								N/A
Byte Count Low	N/A								N/A
Device/Head	rsvd	LBA	rsvd	DEV	SAM LUN (not used)				
Command	command								E0

### Host Taskfile Registers—Outputs

Host Taskfile Register	Data Bits								HEX
	7	6	5	4	3	2	1	0	
Error	rsvd	tag type (not supported)		MCH	ABRT	EOM	ILI		00
Sector Count	N/A								N/A
Sector Number	N/A								N/A
Byte Count High	N/A								
Byte Count Low	N/A								
Device/Head	rsvd	LBA	rsvd	DEV	SAM LUN (not used)				
Status	BSY	RDY	rsvd	DSC	DRQ	Corr	rsvd	CHK	40 or 50

# Travan 40 tape format

# 6

## Introduction

The Seagate Travan 40 drives conform to the Travan 640 and the QIC-3220-MC recording format standards. These formats are for streaming magnetic tape in a minicartridge that is to be used for information interchange among information processing systems, communication systems, and associated equipment.

This chapter provides an overview of the Travan 40 tape format.

## Tape partitioning

The drive uses factory pre-written Travan 40 media. The tape is always divided into two partitions:

- Partition 1 is the directory partition and is recorded on the Directory track only.
- Partition 0 contains the data (tracks 0 through 107) and is recorded on all tracks except the Directory track.

Recording data at 192,000 bits per inch (BPI), the drive can store 20 Gbytes of data on a Travan 40 cartridge. Using software data compression, these capabilities are typically doubled.

The recording format and partitioning support Quick File Access (QFA).

## Track positions

Each track is written referenced to servo patterns written between the BOT holes and Load Point on the BOT end of the tape, and between EOT and EW on the EOT end of the Tape. The servo pattern is written across the entire width of the tape. The Directory Track has larger guard bands on both sides to allow it to be written without interfering with its adjacent tracks.

The data tracks are divided into 4 bands with 3 sub-bands each to reduce the time required to change from track to track. Tracks are grouped into bands, as shown in the following table:

Band	Starting Track	Ending Track	Direction
1	0	52	Forward
2	1	53	Reverse
3	54	106	Forward
4	55	107	Reverse

The tracks and bands are arranged to allow approximately constant distance between all sequential tracks. Band 1 is located nearest the bottom edge of tape. Band 2 is located above band 1. Continuing up sequentially is band 3 and band 4 (nearest the top edge of tape). The directory track is located between bands 2 and 3.

## Track numbering

All even numbered tracks, and the Directory Track, are recorded in the forward direction (the direction from the BOT marker to the EOT marker). All odd numbered tracks are recorded in the reverse direction (the direction from the EOT marker to the BOT marker). All even numbered tracks are located below the Directory Track; all odd numbered tracks are above it.

## Track format

Tracks are recorded sequentially beginning with track 0, then track 1, and so on. Before recording, data are grouped into blocks, and blocks are grouped into frames with 510 blocks per frame.

Two numbering methods are used for blocks: physical numbering and logical numbering. Both numbers start from 0 at the beginning of each partition.

- Physical numbering is related directly to the recorded block on the tape. Each new block is given a unique physical number, regardless of its contents.
- Logical numbering does not relate to the blocks physically recorded on the tape; rather, this type of numbering is the block numbering system used by the host computer. Often the host system operates with logical blocks that are a different size from the 512-byte blocks that are physically recorded on the tape.

The host blocks can be larger or smaller than 512-bytes and can also be fixed or variable. Fixed host blocks contain the same number of data bytes in each block. Variable host blocks may contain a different number of data bytes in each block.

The format provides both a physical block number for each block recorded on the tape and a logical block number that can span more than one physical block. These two numbers are recorded in the control field of every block.

## Frames

Every track on the tape is recorded in blocks that contain 512 data bytes. The data bytes are 8-bit bytes, which are numbered b0 to b7 with b7 being the most significant bit.

A frame is made up of 510 blocks—470 data blocks plus 40 error-correction code (ECC) blocks. Figure 16 illustrates the general track layout of sequentially recorded frames.

Frame N	Frame N+1	Frame N+2	Frame N+3	Frame N+4	
---------	-----------	-----------	-----------	-----------	--

**Figure 16**  
**General track layout**

Frames are numbered indirectly using the 26 most significant bits of the Physical Block Address. Frame operation is controlled by the drive and generally invisible to the host. Frames are used primarily as a means to control the error correction operations.

Frames can be overwritten with new data frames or an End-of-Data (EOD) frame. Append operations can only begin at EOD.

An underrun is not allowed in the middle of a frame, regardless of the frame type. Filler blocks can be used to complete a frame as long as they are not used interior to a logical block.

A frame that cannot be completed on one track is rewritten in its entirety at the beginning of the following track. Frames are not split around corner turns.

The general frame layout—470 data blocks and 40 ECC blocks—is illustrated in the table below.

Data Block 0	Data Block 1	Data Block 2	...	Data Block 470	ECC Block 0	ECC Block 1	...	ECC Block 39
--------------	--------------	--------------	-----	----------------	-------------	-------------	-----	--------------

The four types of frames are as follows:

- **Data frames** contain data and information blocks in addition to ECC blocks.
- The **Media Header frame** contains only Media Header blocks and ECC blocks. This frame is recorded as the first frame on the Directory Track.
- **Track ID frames** are recorded as part of the pre-formatting process of the cartridge. These frames are easily distinguished from other frame types because they reside entirely outside of the data region of the tape.
- An **EOD** frame is an absolute indicator of the end of the recorded data. It is recorded after the last frame containing host data upon terminating a Write process.

## Blocks

Information in the Block Control byte determines the type of block being recorded except for ECC blocks, which are recognized by their block numbers. Also, information about the number of user data bytes available in each data block is recorded in the Block Control byte of the block.

The Data Field of the blocks always contains 512 bytes. However, the number of valid data bytes in the block may be less than 512.

The seven different types of blocks are as follows:

- **Data blocks** contain user data. A full Data block contains 512 bytes; however, data block can contain from 1 through 511 valid data bytes depending on the selected logical block size of the host.
- **Media Header blocks** contain specific host, drive, and vendor information as well as the Volume Directory. The first frame on the Directory Track is the Media Header Frame. This frame contains 470 Media Header blocks (plus the normal 40 ECC blocks).
- **Information blocks**—Filemark blocks, Setmark blocks, and Cancelmark blocks—contain specific types of information. Filemark blocks are physical blocks written to tape in response to a host WRITE FILEMARKS command. Setmark blocks are physical blocks written to tape in response to a host WRITE SETMARKS command. Cancelmark blocks are physical blocks written to tape under firmware control.
- **Filler blocks** contain no valid information in the data area. These blocks are used to fill incomplete frames.
- **EOD blocks** are absolute indicators of the end of recorded data.
- **ECC blocks** contain error correction parity bytes that are used to ensure data integrity during read operations.
- **Track ID blocks** are recorded as part of the pre-formatting process of the cartridge.

## *Tape reference servo pattern*

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To increase track density, a track servo reference pattern is prerecorded on the tape at the factory. The pattern is recorded referenced to servo patterns in the region between the beginning-of-tape (BOT) hole and the load point market (LP) hole. The same pattern is recorded between the end-of-tape (EOT) hole and the early warning (EW) hole. The servo pattern is written across the entire width of the tape.

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## **Write equalization**

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The drive uses the technique of write equalization. Write equalization inserts short pulses in the write current to break up the long spacing intervals. These pulses are too short to be detected in the read process but result in significant improvement in read-back resolution.

On 1650-Oersted media, write equalization provides the benefit of compatibility with Magneto-Resistive (MR) heads. MR heads are prone to saturation by low frequency flux with high energy content. Equalization redistributes this energy to higher frequencies and eliminates the problem.

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## **Randomization**

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To reduce problems resulting from long strings of repetitive data with a bad peak shift or amplitude characteristics, a data randomizer algorithm is used on all bytes in the data and control area of each block. This randomizing takes place prior to the encoding of the data.

# Theory of operations

# 7

## Overview

The Seagate Travan 40 drives provide a low-cost, high-performance minicartridge backup system that is ideal for stand-alone users or small network computer systems. With capacities of 20.0 Gbytes to 40.0 Gbytes dependent upon media and data compression, this drive offers quick, efficient backup and restore operations. Its throttle feature automatically selects the appropriate transfer rate—1.2 Mbytes per second or 2.0 Mbytes per second—based on the speed of the operating system.

The Travan 40 drives are based on proven Seagate designs, Seagate firmware, and the latest technology. This drive uses second generation, custom LSIs for efficient circuit layout and increased reliability with low power consumption. The drives also use flash EEPROM devices for easy firmware upgrades.

This chapter describes the drive in more detail and explains implementation specific information.

## Block diagram

The electronics of the STT2401A and STT3401A are laid out on one main printed circuit board (PCB). Figure 18 shows a simplified block diagram of the drive.

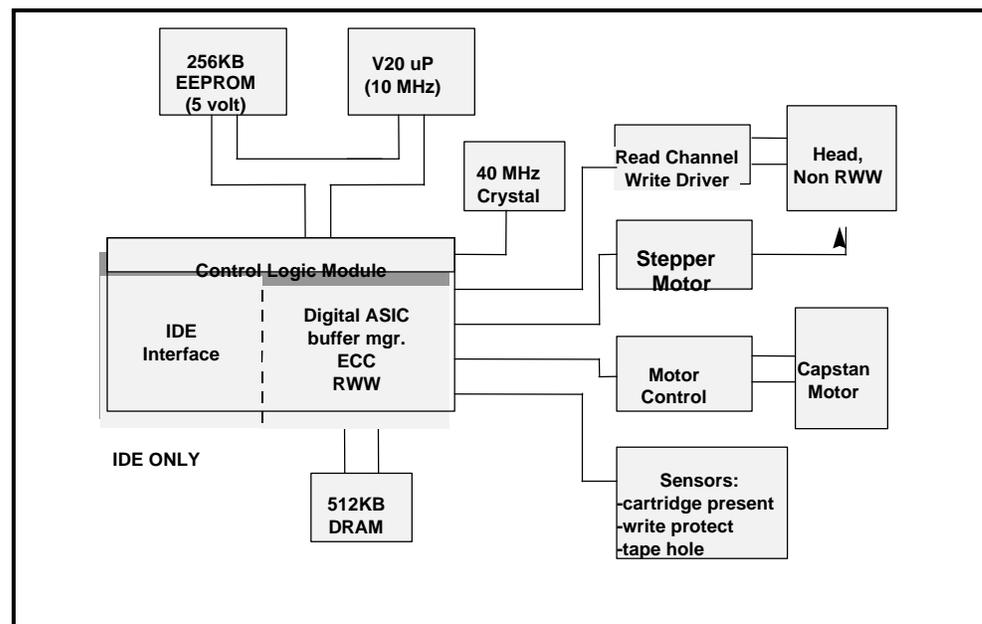


Figure 18 Simplified block diagram for STT2401A and STT3401A

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## **Drive mechanisms**

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This section generally describes the hardware design features of the Seagate Travan 40 drive. You may want to refer to the block diagrams referenced previously as you read this information.

### ***Mechanics***

The mechanical package for the Travan 40 drive was designed to provide you with all the advantages of easy cartridge loading and unloading while maintaining the positioning accuracy necessary for high-density data recording. The orientation of the cartridge is the same as the majority of Travan minicartridge drives in the field.

### ***Cartridge-load mechanism***

The cartridge is inserted in the drive by sliding it through the aperture in the bezel and into a tray mechanism. When fully inserted the back portion of the cartridge protrudes about 3/4-inch from the aperture. A switch is actuated at this point that causes a microprocessor to complete the loading operation.

When the tape is in motion, the green LED on the front panel flashes. The LED is not lit when the tape is positioned at BOT.

### ***Capstan/drive-motor assembly***

In the Travan drive, the capstan/belt motor assembly drives the cartridge, which is on a linear slide. The cartridge is loaded against the cartridge drive roller, which exerts a net radial dynamic force of 17 to 19 ounces. The motor is a brushless DC drive motor with integral capstan, which is designed to provide maximum reliability.

The motor operates from the 12V nominal supply and moves the tape at speeds from 56 to 110 inches per second (IPS).

### ***Chassis***

The drive mechanism is mounted in a molded frame that provides the mounting holes for the industry standard 3.5-inch by 1-inch form factor. A 5.25-inch mounting kit is an available option. The bezel is a simple snap-on design that is available in several standard and custom colors. The front-panel LED is green and indicates tape activity.

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## **Control circuits**

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The control logic module shown in Figure 18 includes a buffer manager to handle data movement between the controller, the buffer, and the tape formatter. This module also includes logic to perform ECC and CRC generation and testing, WRITE/READ data formatting, head stepper control, and drive motor control.

The microprocessor directs all functions performed by the control logic. The instructions are read from a flash EEPROM, which can be updated with new firmware through a specially written tape cartridge.

The 8-Mbyte DRAM data buffer allows the drive to maintain streaming when the host cannot provide data continuously at the tape-streaming rate.

The write driver receives data from the write formatter and generates write current, causing data to be written on tape by the tape head.

The read channel amplifies and conditions the signal from the tape head and passes it back to the read formatter.

The head stepper and drive motor both receive current from the control logic to control the stepping of the head from track to track and to move the tape forward and back across the tape head.

## **Head design**

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The recording/playback head is a state-of-the art, thin-film design—a thin-film inductive write head paired with an advanced magneto-resistive read head. This head design provides the drive with exceptional performance and reliability. The material composition of the head also results in exceptional wear characteristics, resulting in stable performance throughout the life of the drive.

## **Flash EEPROM**

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Because the drive uses flash EEPROM (electronically erasable, programmable read-only memory), the drive firmware can be easily upgraded when new revisions of the firmware are released. The circuitry includes 2 Mbytes of flash EEPROM.

You can load new firmware by using a specially encoded firmware upgrade cartridge. Refer to chapter 4 for information about loading new firmware using a Seagate firmware upgrade cartridge.

## **Sensors and switches**

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A number of mechanical and optical sensors and switches are integrated in the drive design. The Cartridge In switch detects when a cartridge is fully loaded and positioned against the A-plane datum of the cartridge. The Unsafe switch senses the position of the SAFE indicator on the cartridge and disables writing of write-protected (SAFE) cartridges. A temperature sensor reduces the tape speed when excessive ambient temperatures are detected.

The Head-Position Sensor is an electro-optical assembly (LED and photo-transistor) to determine the approximate head position.

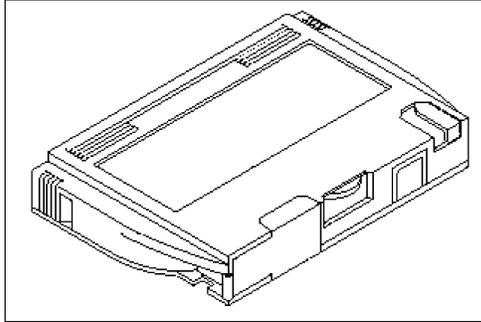
The drive has an electro-optical sensor assembly comprised of a solid-state light source (LED) and a photo-sensor (photo-transistor) that sense the beginning-of-tape (BOT), end-of-tape (EOT), load point, and early warning holes of the cartridge.

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## ***Drive media (Travan minicartridges)***

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The drive is designed to use Travan 40 cartridges. These small (approximately 2 inches by 3 inches by 0.4 inch) cartridges house 1650-Oersted Gamma Ferric Oxide magnetic tape. Figure 19 shows a Travan minicartridge.



**Figure 19**  
***Travan minicartridge***

The cartridge also provides for write protection so that existing data on the cartridge is not overwritten. A write-protected cartridge allows the existing data to be read but does not allow new data to be written to the tape. The position of the sliding write-protect tab on the cartridge determines whether or not data can be written to the tape. See chapter 4 for illustrations of the write-protect position.

# Glossary

# A

This section defines some of the acronyms and technical terms used in this manual.

ABRT	Status register bit: command has been aborted
ANSI	American National Standards Institute
ATA	AT (bus) Attachment
ATA-1	The first defined standard for ATA devices.
ATA-2	Revision 2 of ATA-1
ATA-3	Revision 3 of ATA-1
ATA-4	Revision 4 of ATA-1. This revision introduced UltraDMA
ATAPI	ATA Packet Interface—The interface providing for communications between the host computer and the drive (standard QIC-157). This is a protocol defined for devices that physically attach to the AT bus, but which store parameters in command packets instead of using the Host taskfile registers.
AZIMUTH	The angular deviation, in minutes of arc, of the mean flux transition line from the normal to the cartridge reference plane.
BEZEL	Front panel of drive
BIOS	Basic I/O Subsystem
BIT	A single digit in binary number system.
BIT CELL	A length of magnetic recording tape within which the occurrence of a flux transition signifies a “one” bit and the absence signifies a “0” bit.
BMIDE	Bus Master IDE
BLOCK	A group of 512 consecutive data bytes plus additional control bytes recorded as a unit.
BOM	Beginning of Media
BOP	Beginning of Partition. The position at the beginning of the permissible recording region of a partition.
BOT	Beginning of tape marker indicating beginning of tape.
BPI	Bits per inch
BRIDGE	An electronic device that physically connects two or more dissimilar busses, perhaps including complex behaviors or translations.

BSY	Status register bit: device is busy
BUFFER	Intermediate storage space used to hold data between two processes that proceed at different rates.
BUFFER OVERRUN	A condition developed when the Host is unable to receive data at the rate required by the tape streaming operation when reading.
BUFFER UNDERRUN	A condition developed when Host transmits or receives data at a rate less than that required by the tape streaming operation when recording.
BUS MASTERING	This is an implementation of DMA where a device other than the Host processor is in control of the DMA hardware
BYTE	A group of 8 binary (10 GCR) bits operated on as a unit.
CABLE SELECT	This is a signal within the IDE cable. It may optionally be used to determine the logical addresses of devices connected to the cable.
CANCELMARK	A "negative" Filemark or Setmark. When a Cancelmark follows as the first block in the next frame after a Filemark or Setmark, the drive when reading the tape will logically ignore the Cancelmark and the Filemark or Setmark it cancels.
CARTRIDGE	A Travan cartridge or DC2000 Minicartridge containing 8-mm wide magnetic tape wound on two co-planar hubs and driven by an internal belt which is coupled by an internal belt capstan to the external drive. The term may also refer to a cartridge enclosing a cleaning tape.
CDB	Command Descriptor Block
CHIPSET	A set of electronic devices that provide critical bus connection and protocol functions on the motherboard of a computer.
CHK	Status register bit: a <i>Check Condition</i> (error) has occurred
COD BIT	Interrupt Reason register bit: Command / Data. 1=Command. 0=Data
CRC	Cyclical Redundancy Check. A two byte code derived from information contained in the data block and block number byte and recorded after the data block and block number byte for Read and Read After Write verification.
CSA	Canadian Standard Association
CSEL	See CABLE SELECT
DATA BLOCK	A block containing user valid data in its data field
DATA COMPRESSION	The process of removing redundant data from a data stream before recording the data to tape. Compressed data requires less storage space than uncompressed data.
DENSITY	The maximum allowable flux transitions per unit length for a specific recording standard.
DEV BIT	ATAPI Drive/Head register bit: Device selector. 1=select drive 1 (slave) 0=select drive 0 (master)

	(slave). 0=select drive 0 (master)
DIRECTORY	A table of contents to the various files stored on a computer device (such as a tape or hard disc).
DIRECTORY TRACK	The track at the centerline of a tape, identified as track 254 by its Track ID frame.
DMA	Direct Memory Access. The ability to transfer data to/from main memory without the direct involvement of the Host processor.
DMA CHANNEL	An individual DMA data path. There may be several within a computer system.
DMA MODE	There are several 'styles' of DMA protocol and data rates.  See SINGLE-WORD DMA, MULTI-WORD DMA, and ULTRA DMA
DRDY	ATAPI Status register bit: Device Ready  This indicates that the device is ready to accept commands.
DRIVE	This is a short term for disc drive or tape drive.
DRQ	ATAPI Status register bit: Data ReQuest  This indicates that the device is ready to transfer data to/from the Host.
DSC	ATAPI Status register bit: Disk Seek Complete
EARLY WARNING	Early Warning marker indicates the end of the permissible recording area.
ECC	(Error Correction Code) Special drive generated information that can be used to correct bad blocks.
ECC BLOCK	A block containing drive-generated ECC data in its data field and part of control field.
ECMA	European Computer Manufacturers Association
EEPROM	Electronically Erasable, Programmable Read-Only Memory
EIDE	Extended IDE
EISA BUS	Extended ISA bus
EOT	End of Tape marker indicating the end of tape.
EOD	(End of Data) Indicates the point where the host stopped writing data to the tape.
EOM	End of Media
EOT	End of Tape
ERASE	To remove all magnetically recorded information from the tape.

FCC	(US) Federal Communications Commission
FILE MARK	An identification block written on tape in response to a command to "Write Filemarks."
FLUX TRANSITION	A point on the magnetic tape which exhibits maximum free space flux density normal to the tape surface.
FLUX TRANSITION SPACING	The distance on the magnetic tape between flux reversals.
FRAME	A group of 128 blocks forming a complete logical group.
Gbyte or GIGABYTE	A gigabyte is one billion (1,000,000,000) bytes.
GROUP CODE RECORDING—GCR	A data encoding method where a group of data bits is encoded into a group of flux transitions for recording on magnetic tape.
HOST TASKFILE REGISTERS	These are a set of addresses in the Host processor's I/O address space.  Devices may be controlled and queried by reading and writing to these locations.
IDE	Integrated Drive Electronics. When the first hard discs were introduced, much of the control mechanism was in Host software. The introduction of IDE devices moved much of that work inside the device, itself.
IDE CABLE	A physical cable connecting a Host and up to two IDE devices.  Any ATA or ATAPI device may be connected to this interface.
IDE CHANNEL	See IDE CABLE. This term refers more to the entire data path from Host to the device.
IEC	International Electrotechnical Commission
INTERLEAVING	The process of shuffling the order of data blocks before writing them to tape so the consecutive bytes are not recorded physically adjacent.
IO BIT	Interrupt Reason register bit: Input/Output Direction. 1=Input to the Host (Host read). 0=Output from the Host (Host write)
K or Kbyte	This is a unit of storage capacity equal to 1000 bytes or 1024 bytes depending on the context.
LED	Light-emitting diode
LSI	Large Scale Integration
LOAD POINT	Load point marker indicating the beginning of the permissible recording area.
MAGNETIC TAPE	An oxide or metal particle coated Mylar base tape capable of accepting and retaining magnetically recorded information.

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MASTER	Device address 0 on an IDE bus
Mbyte or MEGABYTE	A megabyte is one million (1,000,000) bytes.
MTBF	Mean Time Between Failures
MTTR	Mean Time to Repair
MULTI-WORD DMA	An ATA protocol for DMA that transfers more than one word (2-bytes) during each timing cycle.
NIBBLE	A group of four binary bits operated on as a unit.
NOISE	A disturbance of the signal caused by the read channel, write channel, head/tape interaction, or conducted or radiated sources.
OEM	Original Equipment Manufacturer
OPERATING SYSTEM	The software in the computer that controls the computer environment.
PACKET	A group of contiguous data bytes that describe input parameters for an ATAPI command.
PARAMETER	An item of information used for configuration or control.
PCB	Printed Circuit Board
PCSET	A 'CHIPSET' that provides interfaces to/from a PCI bus
PERIPHERAL	A device with which the computer communicates. The computer generally controls these devices indirectly through the means of a controller (another piece of hardware) and a program or other programs.
QIC	Quarter Inch Cartridge Drive Standards, Incorporated
PHANTOM SLAVE	When the only one device on an IDE bus is a 'master' (e.g., there is no 'slave'), the 'master' device is responsible for providing certain responses from the Host to the missing 'slave' device. The ATA-3 and ATA-4 documents specify different behaviors for this configuration. This device uses the ATA-3 definition.
PIO	Programmed I/O. This is a method of performing device I/O, where the Host processor must explicitly read or write two bytes at a time via the taskfile Data register. This is very processor-intensive. See PIO MODE
PIO MODE	There are five data rates possible with this technique: 0 through 4
POSTAMBLE	Guard information recorded after the data block.
QIC	Quarter Inch Cartridge Drive Standards, Inc.
QIC157	A QIC specification for ATAPI and SCSI streaming tape devices

RAM	Stands for Random Access Memory. It is the memory that the computer uses to hold the operating system and programs, from which all the operations are performed. Most RAMs are volatile, meaning that it is erased when the power is removed from the computer.
RANDOMIZING	A re-coding of data symbols before they are written to tape in order to provide a consistently uniform RF envelope level
RECORDED BLOCK	A group of consecutive bits comprising preamble, data block marker, data block, block number, GCR and postamble.
REFERENCE TAPE CARTRIDGE	A magnetic tape cartridge selected for a specific property to be used as a reference.
RESTORE	To copy information from the tape (or other backup device) to primary program storage.
RETENSION	An operation that restores normal tension to the tape wound on the hubs of the cartridge.
RLL	(Run Length Limited) A data encoding method where data bits are encoded so that certain constraints are met with regard to the maximum and minimum distances between flux transitions.
SCSI	Small Computer Systems Interface. This is associated with a set of standards and specifications for hardware and software.
SERPENTINE	A recording method in which tracks are laid down sequentially, and the tape is not rewound at the end of a track. This recording method exploits the bi-directional capabilities of the cartridge.
SFF	Small Form Factor Committee
SFF8020I	An SFF document which first defined the basic ATAPI protocols.  In addition, it specifies command packets for CD-ROM devices.
SINGLE-WORD DMA	An ATA protocol for DMA that transfers a single word (2-bytes) during each timing cycle.
SLAVE	Device address 1 on an IDE bus.
SRST	ATA Soft Reset. This reset will forcibly reset all devices on a single IDE cable
STREAMING	A method of recording on magnetic tape where the tape is continuously moving and data blocks are continuously recorded.
T13	The name of the ANSI committee dedicated to ATA and ATAPI standards
TRACK	A recording strip parallel to the edge of the magnetic tape containing recorded information.
TRACK ID BLOCK	A block recorded in the Load Point and Early Warning regions to designate the track number.

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UL	Underwriter's Laboratories, Inc.
UDMA	See ULTRA DMA.
ULTRA DMA	An ATA protocol for DMA transfers that can achieve data rates up to 33.3 MB/sec.
ULTRA SCSI	A SCSI protocol for high speed data transfers
ULTRA33	See ULTRA DMA.
UNCORRECTED BIT ERROR RATE	The probability of a bit being in error, without using any error correction techniques.
UNDERRUN	A condition developed when the host transmits or receives data at a rate less than required by the device for streaming operation.
VDE	Verband Deutscher Electrotechniker
VOLUME	This documentation refers to each disc, floppy or hard, as a volume. These volumes may be backed up onto tape, creating tape volumes.
X3T13	The full identifier of the T13 committee.