A decorative graphic on the left side of the page. It features a solid blue circle at the top, a dashed circle below it, and several overlapping circles and arcs in light blue and grey. A horizontal dashed line runs across the page, passing through the middle of the graphic.

Product Manual

# **SV35 Series SATA**

**ST3500641SV**

**ST3250824SV**

**ST3160812SV**

100415208  
Rev. C  
October 2007

## Revision history

Revision	Date	Sheets affected or comments
Rev. A	04/25/06	Initial release.
Rev. B	08/23/07	1.
Rev. C	10/01/07	4, 8, 11 and 18.

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One gigabyte, or GB, equals one billion bytes when referring to hard drive capacity. Accessible capacity may vary depending on operating environment and formatting. Seagate reserves the right to change, without notice, product offerings or specifications.

# Contents

<b>1.0</b>	<b>Introduction</b> . . . . .	<b>1</b>
1.1	About the Serial ATA interface . . . . .	2
<b>2.0</b>	<b>Drive specifications</b> . . . . .	<b>3</b>
2.1	Specification summaries . . . . .	3
2.2	Formatted capacity . . . . .	10
2.2.1	LBA mode . . . . .	10
2.3	Default logical geometry . . . . .	10
2.4	Recording and interface technology . . . . .	11
2.5	Physical characteristics . . . . .	12
2.6	Seek time . . . . .	12
2.7	Start/stop times . . . . .	13
2.8	Power specifications . . . . .	13
2.8.1	Power consumption . . . . .	13
2.8.2	Conducted noise . . . . .	15
2.8.3	Voltage tolerance . . . . .	15
2.8.4	Power-management modes . . . . .	15
2.9	Environmental specifications . . . . .	16
2.9.1	Ambient temperature . . . . .	16
2.9.2	Temperature gradient . . . . .	16
2.9.3	Humidity . . . . .	16
2.9.4	Altitude . . . . .	16
2.9.5	Shock . . . . .	17
2.9.6	Vibration . . . . .	17
2.10	Acoustics . . . . .	18
2.11	Electromagnetic immunity . . . . .	18
2.12	Reliability . . . . .	19
2.13	Agency certification . . . . .	19
2.13.1	Safety certification . . . . .	19
2.13.2	Electromagnetic compatibility . . . . .	19
2.13.3	FCC verification . . . . .	20
2.14	Environmental protection . . . . .	21
2.14.1	European Union Restriction of Hazardous Substances (RoHS) . . . . .	21
2.15	Corrosive environment . . . . .	21
<b>3.0</b>	<b>Configuring and mounting the drive</b> . . . . .	<b>23</b>
3.1	Handling and static-discharge precautions . . . . .	23
3.2	Breather filter hole precautions . . . . .	24
3.3	Configuring the drive . . . . .	25
3.4	Serial ATA cables and connectors . . . . .	25
3.5	Drive mounting . . . . .	26
<b>4.0</b>	<b>Serial ATA (SATA) interface</b> . . . . .	<b>27</b>
4.1	Hot-Plug compatibility . . . . .	27
4.2	Serial ATA device plug connector pin definitions . . . . .	28
4.3	Supported ATA commands . . . . .	30
4.3.1	Identify Device command . . . . .	33
4.3.2	Set Features command . . . . .	37
4.3.3	S.M.A.R.T. commands . . . . .	38
4.3.4	Streaming feature set support . . . . .	39
<b>5.0</b>	<b>Seagate Technology support services</b> . . . . .	<b>49</b>



## List of Figures

Figure 1.	Typical 5V startup and operation current profile . . . . .	14
Figure 2.	Typical 12V startup and operation current profile . . . . .	14
Figure 3.	Breather filter hole location . . . . .	24
Figure 4.	Serial ATA jumper block and connectors . . . . .	25
Figure 5.	Attaching SATA cabling . . . . .	25
Figure 6.	Mounting dimensions—top, side and end view . . . . .	26



## 1.0 Introduction

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This manual describes the functional, mechanical and interface specifications for the following Seagate SV35 Series SATA model drives:

- ST3500641SV
- ST3250824SV
- ST3160812SV

These drives provide the following key features:

- Specifically designed for surveillance DVRs.
- Optimized power for surveillance systems--spinup limited to a maximum to 2.0 amps.
- Seek profile optimized for surveillance performance and power consumption.
- 7,200 RPM spindle speed.
- 16 Mbyte buffer: ST3500641SV.
- 8 Mbyte buffer: ST3250824SV and ST3160812SV
- High instantaneous (burst) data-transfer rates (up to 300 Mbytes per second).
- Tunneling Magnetoresistive (TMR) recording heads.
- Native Command Queuing with command ordering to increase performance in demanding applications.
- State-of-the-art cache and on-the-fly error-correction algorithms.
- Full-track multiple-sector transfer capability without local processor intervention.
- 350 Gs nonoperating shock.
- Support for S.M.A.R.T. drive monitoring and reporting.
- Support for Read Multiple and Write Multiple commands.
- SeaTools diagnostic software performs a drive self-test that eliminates unnecessary drive returns.
- Supports latching SATA cables and connectors.
- The 3D Defense System™, which includes Drive Defense, Data Defense, and Diagnostic Defense, offers the industry's most comprehensive protection for disc drives.

## 1.1 About the Serial ATA interface

The Serial ATA interface provides several advantages over the traditional (parallel) ATA interface. The primary advantages include:

- Easy installation and configuration with true plug-and-play connectivity. It is not necessary to set any jumpers or other configuration options.
- Thinner and more flexible cabling for improved enclosure airflow and ease of installation.
- Scalability to higher performance levels.

In addition, Serial ATA makes the transition from parallel ATA easy by providing legacy software support. Serial ATA was designed to allow you to install a Serial ATA host adapter and Serial ATA disc drive in your current system and expect all of your existing applications to work as normal.

The Serial ATA interface connects each disc drive in a point-to-point configuration with the Serial ATA host adapter. There is no master/slave relationship with Serial ATA devices like there is with parallel ATA. If two drives are attached on one Serial ATA host adapter, the host operating system views the two devices as if they were both “masters” on two separate ports. This essentially means both drives behave as if they are Device 0 (master) devices.

**Note.** The host adapter may, optionally, emulate a master/slave environment to host software where two devices on separate Serial ATA ports are represented to host software as a Device 0 (master) and Device 1 (slave) accessed at the same set of host bus addresses. A host adapter that emulates a master/slave environment manages two sets of shadow registers. This is not a typical Serial ATA environment.

The Serial ATA host adapter and drive share the function of emulating parallel ATA device behavior to provide backward compatibility with existing host systems and software. The Command and Control Block registers, PIO and DMA data transfers, resets, and interrupts are all emulated.

The Serial ATA host adapter contains a set of registers that shadow the contents of the traditional device registers, referred to as the Shadow Register Block. All Serial ATA devices behave like Device 0 devices. For additional information about how Serial ATA emulates parallel ATA, refer to the “Serial ATA: High Speed Serialized AT Attachment” specification. The specification can be downloaded from [www.serialata.org](http://www.serialata.org).



## **2.0 Drive specifications**

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Unless otherwise noted, all specifications are measured under ambient conditions, at 25°C, and nominal power. For convenience, the phrases *the drive* and *this drive* are used throughout this manual to indicate the following models:

ST3500641SV

ST3250824SV

ST3160812SV

### **2.1 Specification summaries**

The specifications listed in tables 1 and 2 are for quick reference. For details on specification measurement or definition, see the appropriate section of this manual.

**Table 1: Drive specifications for 500 Gbyte models**

Drive specification	ST3500641SV
Formatted Gbytes (512 bytes/sector)*	500
Guaranteed sectors	976,773,168
Bytes per sector	512
Default sectors per track	63
Default read/write heads	16
Default cylinders	16,383
Recording density in BPI (kbits/inch max)	790.1
Track density TPI (ktracks/inch avg)	124.5
Areal density (Gbits/inch <sup>2</sup> avg)	97.96
Spindle speed (RPM)	7,200
Internal data transfer rate (Mbits/sec max)	815.2
Sustained transfer rate (Mbytes/sec max)	65
I/O data transfer rate (Mbytes/sec max)	300
ATA data-transfer modes supported	PIO modes 0–4 Multiword DMA modes 0–2 Ultra DMA modes 0–6
SATA data-transfer modes supported	3.0 Gbits/sec 1.5 Gbits/sec
Cache buffer	16 Mbytes
Height (max)	26.1 mm (1.028 inches)
Width (max)	101.6 mm (4.000 inches) +/-0.010 inches
Length (max)	146.99 mm (5.787 inches)
Weight (max) grams	710 grams
Average latency (msec)	4.16
Power-on to ready (max)	16 sec
Standby to ready (max)	16 sec
Track-to-track seek time (msec typical)	<0.8 (read), <1.0 (write)
Average seek (msec typical)	18 (read), 20 (write)
Startup current (typical) 12V (peak)	2.0 amps
Seek power (typical)	8.6 watts
DVR Operating (typical)	8.45 watts
Idle mode (typical)	8.00 watts
Standby mode (typical)	0.80 watts
Sleep mode (typical)	0.80 watts
Voltage tolerance (including noise)	5V ± 5% 12V ± 10%
Ambient temperature	0° to 60°C (operating) –40° to 70°C (nonoperating)
Temperature gradient (°C per hour max)	20°C (operating) 30°C (nonoperating)
Relative humidity	5% to 90% (operating) 5% to 95% (nonoperating)
Relative humidity gradient	30% per hour max
Wet bulb temperature (°C max)	37.7 (operating) 40.0 (nonoperating)
Altitude, operating	–60.96 m to 3,048 m (–200 ft to 10,000+ ft)

**Table 1: Drive specifications for 500 Gbyte models**

Drive specification	ST3500641SV
Altitude, nonoperating (meters below mean sea level, max)	-60.96 m to 12,192 m (-200 ft to 40,000+ ft)
Shock, operating (max at 2 msec)	63 Gs
Shock, nonoperating (max at 2 msec)	300 Gs
Vibration, operating	5-22 Hz: +/-0.25", Displacement limited 22-350 Hz: 0.5 Gs 350-500 Hz: 0.25 Gs
Vibration, nonoperating	5-22 Hz: +/-0.25", Displacement limited 23-350 Hz: 5.0 Gs 351-500 Hz: 1.0 Gs
Drive acoustics, sound power	
Idle** (bels)	2.79 (typical) 2.96 (max)
Operational, DVR seeks (bels)	2.71 (typical) 2.88 (max)
Nonrecoverable read errors	1 per 10 <sup>14</sup> bits read
Annualized Failure Rate (AFR)	<1%
Warranty	5 years on distribution units. To determine the warranty for a specific drive, use a web browser to access the following web page: <a href="http://www.seagate.com/support/service/">www.seagate.com/support/service/</a> From this page, click on the "Verify Your Warranty" link. You will be asked to provide the drive serial number, model number (or part number) and country of purchase. The system will display the warranty information for your drive.
Contact start-stop cycles (25°C, 50% relative humidity)	50,000
Supports Hotplug operation per SATA II specification	Yes

\*One Gbyte equals one billion bytes when referring to hard drive capacity. Accessible capacity may vary depending on operating environment and formatting.

\*\*During periods of drive idle, some offline activity may occur according to the S.M.A.R.T. specification, which may increase acoustic and power to operational levels..

**Table 2: Drive specifications for 250 Gbyte models**

Drive specification	ST3250824SV
Formatted Gbytes (512 bytes/sector)*	250
Guaranteed sectors	488,397,168
Bytes per sector	512
Default sectors per track	63
Default read/write heads	16
Default cylinders	16,383
Recording density in BPI (kbits/inch max)	790.1
Track density TPI (ktracks/inch avg)	124.5
Areal density (Gbits/inch <sup>2</sup> avg)	97.69
Spindle speed (RPM)	7,200
Internal data transfer rate (Mbits/sec max)	867.2
Sustained transfer rate (Mbytes/sec max)	76.6
I/O data transfer rate (Mbytes/sec max)	300
ATA data-transfer modes supported	PIO modes 0–4 Multiword DMA modes 0–2 Ultra DMA modes 0–6
SATA data-transfer modes supported	3.0 Gbits/sec 1.5 Gbits/sec
Cache buffer	8 Mbytes
Height (max)	26.1 mm (1.028 inches)
Width (max)	101.6 mm (4.000 inches) +/-0.010 inches
Length (max)	146.99 mm (5.787 inches)
Weight (max) grams	580 grams (1.28 lb.)
Average latency (msec)	4.16
Power-on to ready (typical)	16 sec
Standby to ready (typical)	16 sec
Track-to-track seek time (msec typical)	<0.8 (read), <1.0 (write)
Average seek (msec typical)	18 (read), 20 (write)
Startup current (typical) 12V (peak)	2.0 amps
Seek power (typical)	8.6 watts
DVR Operating (typical)	6.49 watts
Idle mode (typical)	8.00 watts
Standby mode (typical)	0.80 watts
Sleep mode (typical)	0.80 watts
Voltage tolerance (including noise)	5V ± 5% 12V ± 10%
Ambient temperature	0° to 60°C (operating) –40° to 70°C (nonoperating)
Temperature gradient (°C per hour max)	20°C (operating) 30°C (nonoperating)
Relative humidity	5% to 90% (operating) 5% to 95% (nonoperating)
Relative humidity gradient	30% per hour max
Wet bulb temperature (°C max)	37.7 (operating) 40 (nonoperating)
Altitude, operating	–60.96 m to 3,048 m (–200 ft to 10,000+ ft)

**Table 2: Drive specifications for 250 Gbyte models**

<b>Drive specification</b>	<b>ST3250824SV</b>
Altitude, nonoperating (meters below mean sea level, max)	-60.96 m to 12,192 m (-200 ft to 40,000+ ft)
Shock, operating (max at 2 msec)	63 Gs
Shock, nonoperating (max at 2 msec)	350 Gs
Vibration, operating	5-22 Hz: +/-0.25", Displacement limited 22-350 Hz: 0.5 Gs 350-500 Hz: 0.25 Gs
Vibration, nonoperating	5-22 Hz: +/-0.25", Displacement limited 22-350 Hz: 5.0 Gs 350-500 Hz: 1.0 Gs
Drive acoustics, sound power (bels)	
Idle** (bels)	2.67 (typical) 2.82 (max)
Operational, DVR seeks (bels)	2.8 (typical) 2.9 (max)
Nonrecoverable read errors	1 per 10 <sup>14</sup> bits read
Annualized Failure Rate (AFR)	<1%
Warranty	5 years on distribution units. To determine the warranty for a specific drive, use a web browser to access the following web page: <a href="http://www.seagate.com/support/service/">www.seagate.com/support/service/</a> From this page, click on the "Verify Your Warranty" link. You will be asked to provide the drive serial number, model number (or part number) and country of purchase. The system will display the warranty information for your drive.
Contact start-stop cycles (25°C, 50% relative humidity)	50,000
Supports Hotplug operation per SATA II specification	Yes

\*One Gbyte equals one billion bytes when referring to hard drive capacity. Accessible capacity may vary depending on operating environment and formatting.

\*\*During periods of drive idle, some offline activity may occur according to the S.M.A.R.T. specification, which may increase acoustic and power to operational levels.

**Table 3: Drive specifications for 160 Gbyte models**

<b>Drive specification</b>	<b>ST3160812SV</b>
Formatted Gbytes (512 bytes/sector)*	160
Guaranteed sectors	312,581,808
Bytes per sector	512
Default sectors per track	63
Default read/write heads	16
Default cylinders	16,383
Recording density in BPI (kbits/inch max)	840.0
Track density TPI (ktracks/inch avg)	141.5
Areal density (Gbits/inch <sup>2</sup> avg)	119.0
Spindle speed (RPM)	7,200
Internal data transfer rate (Mbits/sec max)	867.2
Sustained transfer rate (Mbytes/sec max)	83.0
I/O data transfer rate (Mbytes/sec max)	300
ATA data-transfer modes supported	PIO modes 0–4 Multiword DMA modes 0–2 Ultra DMA modes 0–6
SATA data-transfer modes supported	1.5 Gbits/sec 3.0 Gbits/sec
Cache buffer	8 Mbytes
Height (max)	26.1 mm (1.028 inches)
Width (max)	101.6 mm (4.000 inches) +/-0.010 inches
Length (max)	146.99 mm (5.787 inches)
Weight (typical)	580 grams (1.28 lb.)
Average latency (msec)	4.16
Power-on to ready (typical)	16 secs
Standby to ready (typical)	16 secs
Track-to-track seek time (msec typical)	<0.8 (read), <1.0 (write)
Average seek (msec typical)	18 (read), 20 (write)
Startup current (typical) 12V (peak)	2.0 amps
Seek power (typical)	8.6 watts
DVR Operating (typical)	5.71 watts
Idle mode (typical)	8.00 watts
Standby mode (typical)	0.80 watts
Sleep mode (typical)	0.80 watts
Voltage tolerance (including noise)	5V ± 5% 12V ± 10%
Ambient temperature	0° to 60°C (operating) –40° to 70°C (nonoperating)
Temperature gradient (°C per hour max)	20°C (operating) 30°C (nonoperating)
Relative humidity	5% to 90% (operating) 5% to 95% (nonoperating)
Relative humidity gradient	30% per hour max
Wet bulb temperature (°C max)	37.7 (operating) 40 (nonoperating)
Altitude, operating	–60.96 m to 3,048 m (–200 ft to 10,000+ ft)

**Table 3: Drive specifications for 160 Gbyte models**

<b>Drive specification</b>	<b>ST3160812SV</b>
Altitude, nonoperating (meters below mean sea level, max)	-60.96 m to 12,192 m (-200 ft to 40,000+ ft)
Shock, operating (max at 2 msec)	63 Gs
Shock, nonoperating (max at 2 msec)	350 Gs
Vibration, operating	5-22 Hz: 0.25 Gs, Limited displacement 22-350 Hz: 0.5 Gs 350-500 Hz: 0.25 Gs
Vibration, nonoperating	5-22 Hz: 0.25 Gs, Limited displacement 23-350 Hz: 5.0 Gs 351-500 Hz: 1.0 Gs
Drive acoustics, sound power (bels)	
Idle** (bels)	2.48 (typical) 2.64 (max)
Operational, DVR seeks (bels)	2.53 (typical) 2.62 (max)
Nonrecoverable read errors	1 per 10 <sup>14</sup> bits read
Annualized Failure Rate (AFR)	<1%
Warranty	5 years on distribution units. To determine the warranty for a specific drive, use a web browser to access the following web page: <a href="http://www.seagate.com/support/service/">www.seagate.com/support/service/</a> From this page, click on the "Verify Your Warranty" link. You will be asked to provide the drive serial number, model number (or part number) and country of purchase. The system will display the warranty information for your drive.
Contact start-stop cycles (25°C, 50% relative humidity)	50,000
Supports Hotplug operation per SATA II specification	Yes

\*One Gbyte equals one billion bytes when referring to hard drive capacity. Accessible capacity may vary depending on operating environment and formatting.

\*\*During periods of drive idle, some offline activity may occur according to the S.M.A.R.T. specification, which may increase acoustic and power to operational levels.

## 2.2 Formatted capacity

Model	Formatted capacity*	Guaranteed sectors	Bytes per sector
ST3500641SV	500 Gbytes	976,773,168	512
ST3250824SV	250 Gbytes	488,397,168	512
ST3160812SV	160 Gbytes	312,581,808	512

\*One Gbyte equals one billion bytes when referring to hard drive capacity. Accessible capacity may vary depending on operating environment and formatting.

### 2.2.1 LBA mode

When addressing these drives in LBA mode, all blocks (sectors) are consecutively numbered from 0 to  $n-1$ , where  $n$  is the number of guaranteed sectors as defined above.

See Section 4.3.1, "Identify Device command" (words 60-61 and 100-103) for additional information about 48-bit addressing support of drives with capacities over 137 Gbytes.

## 2.3 Default logical geometry

Cylinders	Read/write heads	Sectors per track
16,383	16	63

### LBA mode

When addressing these drives in LBA mode, all blocks (sectors) are consecutively numbered from 0 to  $n-1$ , where  $n$  is the number of guaranteed sectors as defined above.



## 2.4 Recording and interface technology

Interface	ATA
Recording method	16/17 EPRML
Recording density KBPI (kbits/inch max)	
ST3500641SV and ST3250824SV	790.1
ST3160812SV	840.0
Track density KTPI (ktracks/inch max)	
ST3500641SV and ST3250824SV	124.5
ST3160812SV	141.5
Areal density (Gbits/inch <sup>2</sup> max)	
ST3500641SV and ST3250824SV	97.69
ST3160812SV	119.0
Spindle speed (RPM) (± 0.2%)	7,200
Internal data-transfer rate (Mbits/sec max)	
ST3500641SV	815.2
ST3250824SV and ST3160812SV	867.2
Sustained data transfer rate (Mbytes/sec max)	
ST3500641SV	65.0
ST3250824SV	76.6
ST3160812SV	83.0
I/O data-transfer rate (Mbytes/sec max)	300
Cache buffer	
ST3500641SV	16 Mbytes (16,385 kbytes)
ST3250824SV and ST3160812SV	8 Mbytes (8,192 kbytes)

## 2.5 Physical characteristics

Drive specification	
Maximum height (mm) (inches)	26.1 1.028
Maximum width (mm) (inches)	101.6 4.000 +/- 0.010
Maximum length (mm) (inches)	146.99 5.787
Maximum weight ST3500641SV ST3250824SV ST3160812SV	710 grams (1.57 lbs) 580 grams (1.28 lbs)

## 2.6 Seek time

Seek measurements are taken with nominal power at 25°C ambient temperature. All times are measured using drive diagnostics. The specifications in the table below are defined as follows:

- Track-to-track seek time is an average of all possible single-track seeks in both directions.
- Average seek time is a true statistical random average of at least 5,000 measurements of seeks between random tracks, less overhead.

Typical seek times (msec)	Read	Write
Track-to-track	0.8	1.0
Average	18	20
Average latency:	4.16	4.16

**Note.** These drives are designed to consistently meet the seek times represented in this manual. Physical seeks, regardless of mode (such as track-to-track and average), are expected to meet or exceed the noted values. However, due to the manner in which these drives are formatted, benchmark tests that include command overhead or measure logical seeks may produce results that vary from these specifications.

## 2.7 Start/stop times

Power-on to Ready (sec)	16
Standby to Ready (sec)	16 (max)
Ready to spindle stop (sec)	10 (max)

## 2.8 Power specifications

The drive receives DC power (+5V and +12V) through a native SATA power connector. See Figure 5 on page 25.

### 2.8.1 Power consumption

Power requirements for the drives are listed in the table on page 9. Typical power measurements are based on an average of drives tested, under nominal conditions, using 5.0V and 12.0V input voltage at 25°C ambient temperature.

- **Spinup power**

Spinup power is measured from the time of power-on to the time that the drive spindle reaches operating speed.

- **Seek mode**

During seek mode, the read/write actuator arm moves toward a specific position on the disc surface and does not execute a read or write operation. Servo electronics are active. Seek mode power represents the worst-case power consumption, using only random seeks with read or write latency time. This mode is not typical and is provided for worst-case information.

- **Operating power and current**

Operating power is measured using a standard Surveillance Storage Profile.

- **Idle mode power**

Idle mode power is measured with the drive up to speed, with servo electronics active and with the heads in a random track location.

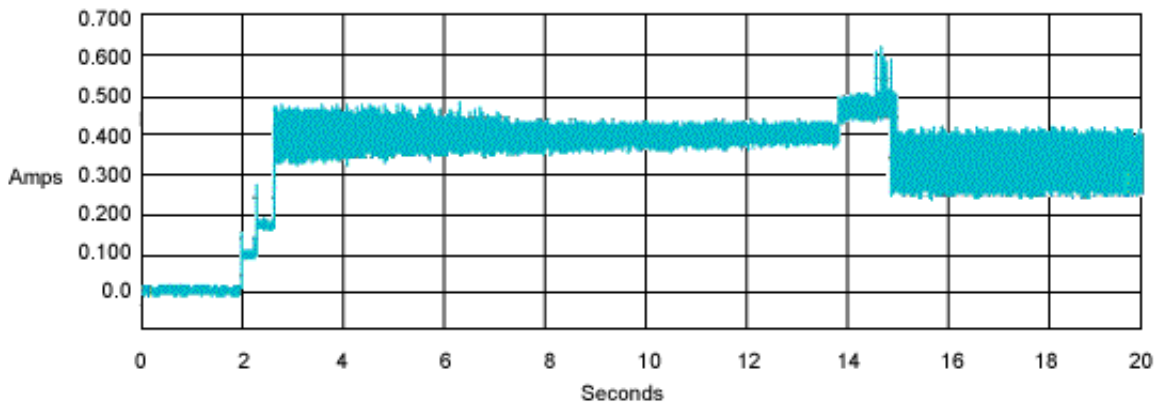
- **Standby mode**

During Standby mode, the drive accepts commands, but the drive is not spinning, and the servo and read/write electronics are in power-down mode.

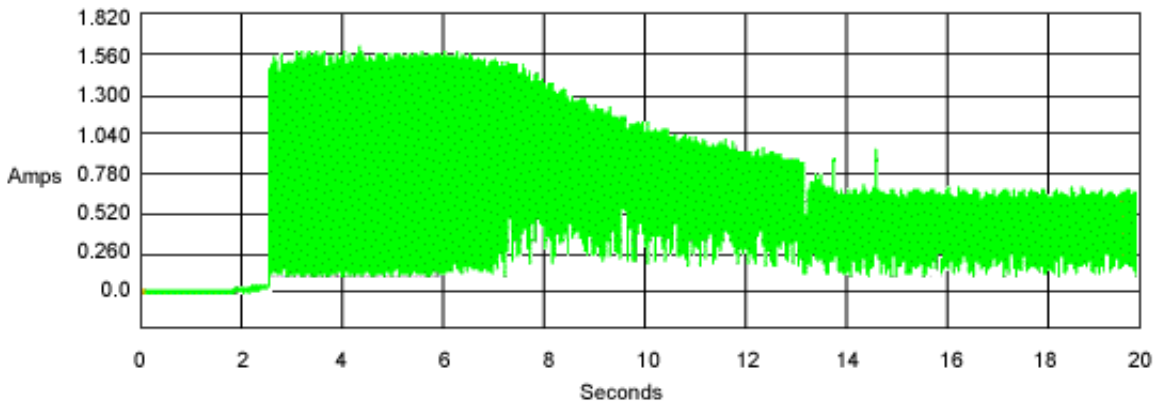
**Table 4: DC power requirements**

Power dissipation (typical) Example: ST3500641SV	Average (watts, 25° C)	5V typ amps	12V typ amps
Spinup	—	—	2.0 (peak)
Idle	6.9	0.353	0.519
Operating (DVR Storage Profile)	8.44	0.478	0.50
Seeking	12.60	0.613	0.795
Standby	0.80	0.106	0.023
Sleep	0.80	0.106	0.023

**2.8.1.1 Typical current profiles**



**Figure 1 Typical 5V startup and operation current profile**



**Figure 2 Typical 12V startup and operation current profile**

## 2.8.2 Conducted noise

Input noise ripple is measured at the host system power supply across an equivalent 80-ohm resistive load on the +12 volt line or an equivalent 15-ohm resistive load on the +5 volt line.

- Using 12-volt power, the drive is expected to operate with a maximum of 120 mV peak-to-peak square-wave injected noise at up to 10 MHz.
- Using 5-volt power, the drive is expected to operate with a maximum of 100 mV peak-to-peak square-wave injected noise at up to 10 MHz.

**Note.** Equivalent resistance is calculated by dividing the nominal voltage by the typical RMS read/write current.

## 2.8.3 Voltage tolerance

Voltage tolerance (including noise):

5V  $\pm$  5%

12V  $\pm$  10%

## 2.8.4 Power-management modes

The drive provides programmable power management to provide greater energy efficiency. In most systems, you can control power management through the system setup program. The drive features the following power-management modes:

Power modes	Heads	Spindle	Buffer
Active	Tracking	Rotating	Enabled
Idle	Tracking	Rotating	Enabled
Standby	Parked	Stopped	Enabled
Sleep	Parked	Stopped	Disabled

- **Active mode**

The drive is in Active mode during the read/write and seek operations.

- **Idle mode**

The buffer remains enabled, and the drive accepts all commands and returns to Active mode any time disc access is necessary.

- **Standby mode**

The drive enters Standby mode when the host sends a Standby Immediate command. If the host has set the standby timer, the drive can also enter Standby mode automatically after the drive has been inactive for a specifiable length of time. The standby timer delay is established using a Standby or Idle command. In Standby mode, the drive buffer is enabled, the heads are parked and the spindle is at rest. The drive accepts all commands and returns to Active mode any time disc access is necessary.

- **Sleep mode**

The drive enters Sleep mode after receiving a Sleep command from the host. In Sleep mode, the drive buffer is disabled, the heads are parked and the spindle is at rest. The drive leaves Sleep mode after it receives a Hard Reset or Soft Reset from the host. After receiving a reset, the drive exits Sleep mode and enters Standby mode with all current translation parameters intact.

- **Idle and Standby timers**

Each time the drive performs an Active function (read, write or seek), the standby timer is reinitialized and begins counting down from its specified delay times to zero. If the standby timer reaches zero before any drive activity is required, the drive makes a transition to Standby mode. In both Idle and Standby mode, the drive accepts all commands and returns to Active mode when disc access is necessary.

## 2.9 Environmental specifications

### 2.9.1 Ambient temperature

Ambient temperature is defined as the temperature of the environment immediately surrounding the drive. Actual drive case temperature should not exceed 69°C (156°F) within the operating ambient conditions. Recommended measurement locations are shown in Figure 6.

Above 1,000 feet (305 meters), the maximum temperature is derated linearly to 44°C (112°F) at 10,000 feet (3,048 meters).

Operating:	0° to 60°C (32° to 140°F)
Nonoperating:	-40° to 70°C (-40° to 158°F)

### 2.9.2 Temperature gradient

Operating:	20°C per hour (68°F per hour max), without condensation
Nonoperating:	30°C per hour (86°F per hour max)

### 2.9.3 Humidity

#### 2.9.3.1 Relative humidity

Operating:	5% to 90% noncondensing (30% per hour max)
Nonoperating:	5% to 95% noncondensing (30% per hour max)

#### 2.9.3.2 Wet bulb temperature

Operating:	37.7°C (99.9°F max)
Nonoperating:	40°C (104°F max)

### 2.9.4 Altitude

Operating:	-60.96 m to 3,048 m (-200 ft. to 10,000+ ft.)
Nonoperating:	-60.96 m to 12,192 m (-200 ft. to 40,000+ ft.)

## 2.9.5 Shock

All shock specifications assume that the drive is mounted securely with the input shock applied at the drive mounting screws. Shock may be applied in the X, Y or Z axis.

### 2.9.5.1 Operating shock

These drives comply with the performance levels specified in this document when subjected to a maximum operating shock of 63 Gs based on half-sine shock pulses of 2 msec. Shocks should not be repeated more than two times per second.

### 2.9.5.2 Nonoperating shock

The nonoperating shock level that the drive can experience without incurring physical damage or degradation in performance when subsequently put into operation is 300 Gs for 500 GB drives and 350 Gs for 250 and 160 GB drives, based on a nonrepetitive half-sine shock pulse of 2 msec duration.

## 2.9.6 Vibration

All vibration specifications assume that the drive is mounted securely with the input vibration applied at the drive mounting screws. Vibration may be applied in the X, Y or Z axis.

### 2.9.6.1 Operating vibration

The maximum vibration levels that the drive may experience while meeting the performance standards specified in this document are specified below.

5–22 Hz	+/-0.25", Displacement limited
22–350 Hz	0.50 Gs
350–500 Hz	0.25 Gs

### 2.9.6.2 Nonoperating vibration

The following table lists the maximum nonoperating vibration that the drive may experience without incurring physical damage or degradation in performance when subsequently put into operation.

5–22 Hz	0.25 G (Limited displacement)
22–350 Hz	5.0 Gs
350–500 Hz	1.0 Gs

## 2.10 Acoustics

Drive acoustics are measured as overall A-weighted acoustic sound power levels (no pure tones). All measurements are consistent with ISO document 7779. Sound power measurements are taken under essentially free-field conditions over a reflecting plane. For all tests, the drive is oriented with the cover facing upward.

**Note.** For seek mode tests, the drive is placed in seek mode only. The number of seeks per second is defined by the following equation:

$$(\text{Number of seeks per second} = 0.4 / (\text{average latency} + \text{average access time}))$$

Drive acoustics, sound power		
Model	Idle	Operational, DVR (Digital Video Recorder) seeks
ST3500641SV	2.79 bels (typ) 2.96 bels (max)	2.71 bels (typ) 2.88 bels (max)
ST3250824SV	2.67 bels (typ) 2.82 bels (max)	2.80 bels (typ) 2.90 bels (max)
ST3160812SV	2.48 bels (typ) 2.64 bels (max)	2.53 bels (typ) 2.62 bels (max)

## 2.11 Electromagnetic immunity

When properly installed in a representative host system, the drive operates without errors or degradation in performance when subjected to the radio frequency (RF) environments defined in the following table:

**Table 5: Radio frequency environments**

Test	Description	Performance level	Reference standard
Electrostatic discharge	Contact, HCP, VCP: $\pm 4$ kV; Air: $\pm 8$ kV	B	EN 61000-4-2: 95
Radiated RF immunity	80 to 1,000 MHz, 3 V/m, 80% AM with 1 kHz sine 900 MHz, 3 V/m, 50% pulse modulation @ 200 Hz	A	EN 61000-4-3: 96 ENV 50204: 95
Electrical fast transient	$\pm 1$ kV on AC mains, $\pm 0.5$ kV on external I/O	B	EN 61000-4-4: 95
Surge immunity	$\pm 1$ kV differential, $\pm 2$ kV common, AC mains	B	EN 61000-4-5: 95
Conducted RF immunity	150 kHz to 80 MHz, 3 Vrms, 80% AM with 1 kHz sine	A	EN 61000-4-6: 97
Voltage dips, interrupts	0% open, 5 seconds 0% short, 5 seconds 40%, 0.10 seconds 70%, 0.01 seconds	C C C B	EN 61000-4-11: 94



## 2.12 Reliability

Nonrecoverable read errors	1 per 10 <sup>14</sup> bits read, max
Annualized Failure Rate (AFR)	<1% (nominal power, 8760 power on hours, 25°C ambient temperature)
Contact start-stop cycles	50,000 cycles (at nominal voltage and temperature, with 60 cycles per hour and a 50% duty cycle)
Preventive maintenance	None required

## 2.13 Agency certification

### 2.13.1 Safety certification

The drives are recognized in accordance with UL 1950 and CSA C22.2 (950) and meet all applicable sections of IEC950 and EN 60950 as tested by TUV North America.

### 2.13.2 Electromagnetic compatibility

Hard drives that display the CE mark comply with the European Union (EU) requirements specified in the Electromagnetic Compatibility Directive (89/336/EEC). Testing is performed to the levels specified by the product standards for Information Technology Equipment (ITE). Emission levels are defined by EN 55022, Class B and the immunity levels are defined by EN 55024.

Seagate uses an independent laboratory to confirm compliance with the EC directives specified in the previous paragraph. Drives are tested in representative end-user systems. Although CE-marked Seagate drives comply with the directives when used in the test systems, we cannot guarantee that all systems will comply with the directives. The drive is designed for operation inside a properly designed enclosure, with properly shielded I/O cable (if necessary) and terminators on all unused I/O ports. Computer manufacturers and system integrators should confirm EMC compliance and provide CE marking for their products.

### Korean RRL

If these drives have the Korea Ministry of Information and Communication (MIC) logo, they comply with paragraph 1 of Article 11 of the Electromagnetic Compatibility control Regulation and meet the Electromagnetic Compatibility (EMC) Framework requirements of the Radio Research Laboratory (RRL) Ministry of Information and Communication Republic of Korea.

These drives have been tested and comply with the Electromagnetic Interference/Electromagnetic Susceptibility (EMI/EMS) for Class B products. Drives are tested in a representative, end-user system by a Korean-recognized lab.

- EUT name (model numbers): ST3500641SV, ST3250824SV, and ST3160812SV.
- Certificate numbers: E-H011-05-3453 (B)
- Trade name or applicant: Seagate Technology
- Manufacturing date: March 2006
- Manufacturer/nationality: Singapore and China

## Australian C-Tick (N176)

If these models have the C-Tick marking, they comply with the Australia/New Zealand Standard AS/NZS3548 1995 and meet the Electromagnetic Compatibility (EMC) Framework requirements of the Australian Communication Authority (ACA).

### 2.13.3 FCC verification

These drives are intended to be contained solely within a personal computer or similar enclosure (not attached as an external device). As such, each drive is considered to be a subassembly even when it is individually marketed to the customer. As a subassembly, no Federal Communications Commission verification or certification of the device is required.

Seagate Technology LLC has tested this device in enclosures as described above to ensure that the total assembly (enclosure, disc drive, motherboard, power supply, etc.) does comply with the limits for a Class B computing device, pursuant to Subpart J, Part 15 of the FCC rules. Operation with noncertified assemblies is likely to result in interference to radio and television reception.

**Radio and television interference.** This equipment generates and uses radio frequency energy and if not installed and used in strict accordance with the manufacturer's instructions, may cause interference to radio and television reception.

This equipment is designed to provide reasonable protection against such interference in a residential installation. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause interference to radio or television, which can be determined by turning the equipment on and off, you are encouraged to try one or more of the following corrective measures:

- Reorient the receiving antenna.
- Move the device to one side or the other of the radio or TV.
- Move the device farther away from the radio or TV.
- Plug the computer into a different outlet so that the receiver and computer are on different branch outlets.

If necessary, you should consult your dealer or an experienced radio/television technician for additional suggestions. You may find helpful the following booklet prepared by the Federal Communications Commission: *How to Identify and Resolve Radio-Television Interference Problems*. This booklet is available from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402. Refer to publication number 004-000-00345-4.

## **2.14 Environmental protection**

Seagate designs its products to meet environmental protection requirements worldwide, including regulations restricting certain chemical substances.

### **2.14.1 European Union Restriction of Hazardous Substances (RoHS)**

The European Union Restriction of Hazardous Substances (RoHS) Directive restricts the presence of chemical substances, including Lead (Pb), in electronic products effective July 2006.

A number of parts and materials in Seagate products are procured from external suppliers. We rely on the representations of our suppliers regarding the presence of RoHS substances in these parts and materials. Our supplier contracts require compliance with our chemical substance restrictions, and our suppliers document their compliance with our requirements by providing material content declarations for all parts and materials for the disc drives documented in this publication. Current supplier declarations include disclosure of the inclusion of any RoHS-regulated substance in such parts or materials.

Seagate also has internal systems in place to ensure ongoing compliance with the RoHS Directive and all laws and regulations which restrict chemical content in electronic products. These systems include standard operating procedures that ensure that restricted substances are not utilized in our manufacturing operations, laboratory analytical validation testing, and an internal auditing process to ensure that all standard operating procedures are complied with.

## **2.15 Corrosive environment**

Seagate electronic drive components pass accelerated corrosion testing equivalent to 10 years exposure to light industrial environments containing sulfurous gases, chlorine and nitric oxide, classes G and H per ASTM B845. However, this accelerated testing cannot duplicate every potential application environment.

Users should use caution exposing any electronic components to uncontrolled chemical pollutants and corrosive chemicals as electronic drive component reliability can be affected by the installation environment. The silver, copper, nickel and gold films used in Seagate products are especially sensitive to the presence of sulfide, chloride, and nitrate contaminants. Sulfur is found to be the most damaging. In addition, electronic components should never be exposed to condensing water on the surface of the printed circuit board assembly (PCBA) or exposed to an ambient relative humidity greater than 95%. Materials used in cabinet fabrication, such as vulcanized rubber, that can outgas corrosive compounds should be minimized or eliminated. The useful life of any electronic equipment may be extended by replacing materials near circuitry with sulfide-free alternatives.



## 3.0 Configuring and mounting the drive

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This section contains the specifications and instructions for configuring and mounting the drive.

### 3.1 Handling and static-discharge precautions

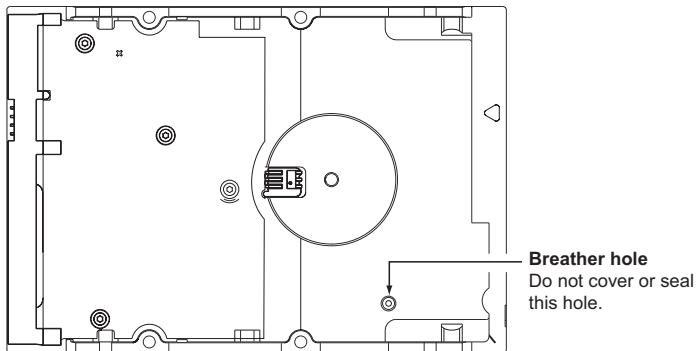
After unpacking, and before installation, the drive may be exposed to potential handling and electrostatic discharge (ESD) hazards. Observe the following standard handling and static-discharge precautions:

**Caution:**

- Keep the drive in the electrostatic discharge (ESG) bag until you are ready for installation.
- Before handling the drive, put on a grounded wrist strap, or ground yourself frequently by touching the metal chassis of a computer that is plugged into a grounded outlet. Wear a grounded wrist strap throughout the entire installation procedure.
- Handle the drive by its edges or frame *only*.
- The drive is extremely fragile—handle it with care. Do not press down on the drive top cover.
- Always rest the drive on a padded, antistatic surface until you mount it in the computer.
- Do not touch the connector pins or the printed circuit board.
- Do not remove the factory-installed labels from the drive or cover them with additional labels. Removal voids the warranty. Some factory-installed labels contain information needed to service the drive. Other labels are used to seal out dirt and contamination.

### 3.2 Breather filter hole precautions

This section contains information regarding the precautions to take with the breather filter hole in Seagate hard disc drives. Take the proper precautions to ensure full functionality and to prevent possible damage to the drive.



**Figure 3 Breather filter hole location**

**Caution: Do not cover, seal, or insert any object into this hole.**

This hole has two purposes:

- To allow condensation inside the hard disc to escape
- To allow air pressure inside the hard disc to equalize with ambient pressure

**Note.** If this hole is covered, sealed, or penetrated by any object, drive reliability may be compromised and could lead to permanent damage--doing so voids the warranty.

### 3.3 Configuring the drive

Each drive on the Serial ATA interface connects in a point-to-point configuration with the Serial ATA host adapter. There is no master/slave relationship because each drive is considered a master in a point-to-point relationships. If two drives are attached on one Serial ATA host adapter, the host operating system views the two devices as if they were both “masters” on two separate ports. This means both drives behave as if they are Device 0 (master) devices.

Serial ATA drives are designed for easy installation. It is usually not necessary to set any jumpers on the drive for proper operation; however, if you connect the drive and receive a “drive not detected” error, your SATA-equipped motherboard or host adapter may use a chipset that does not support SATA speed autonegotiation. If you have a motherboard or host adapter that does not support autonegotiation:

- Configure the jumper block with a jumper as shown in Figure 4 below to limit the data transfer rate to 1.5 Gbits per second (and leave the drive connected to the SATA-equipped motherboard or host adapter that doesn't support autonegotiation) or
- Install a SATA host adapter that supports autonegotiation, set the drive jumper block set to “3 Gbits per second operation” (see Figure 4 below), and connect the drive to that adapter. This option has the benefit of not limiting the drive to a 1.5 Gbits/sec transfer rate.

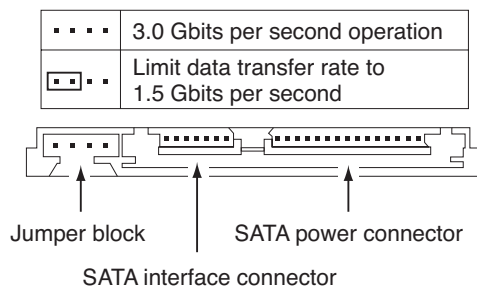


Figure 4 Serial ATA jumper block and connectors

### 3.4 Serial ATA cables and connectors

The Serial ATA interface cable consists of four conductors in two differential pairs, plus three ground connections. The cable size may be 30 to 26 AWG with a maximum length of one meter (39.37 inches). See Table 6 for connector pin definitions. Either end of the SATA signal cable can be attached to the drive or host.

For direct backplane connection, the drive connectors are inserted directly into the host receptacle. The drive and the host receptacle incorporate features that enable the direct connection to be hot pluggable and blind mateable.

For installations which require cables, you can connect the drive as illustrated in Figure 5.

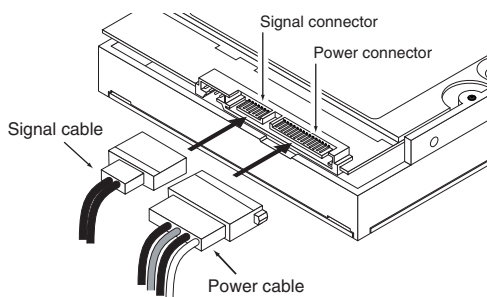


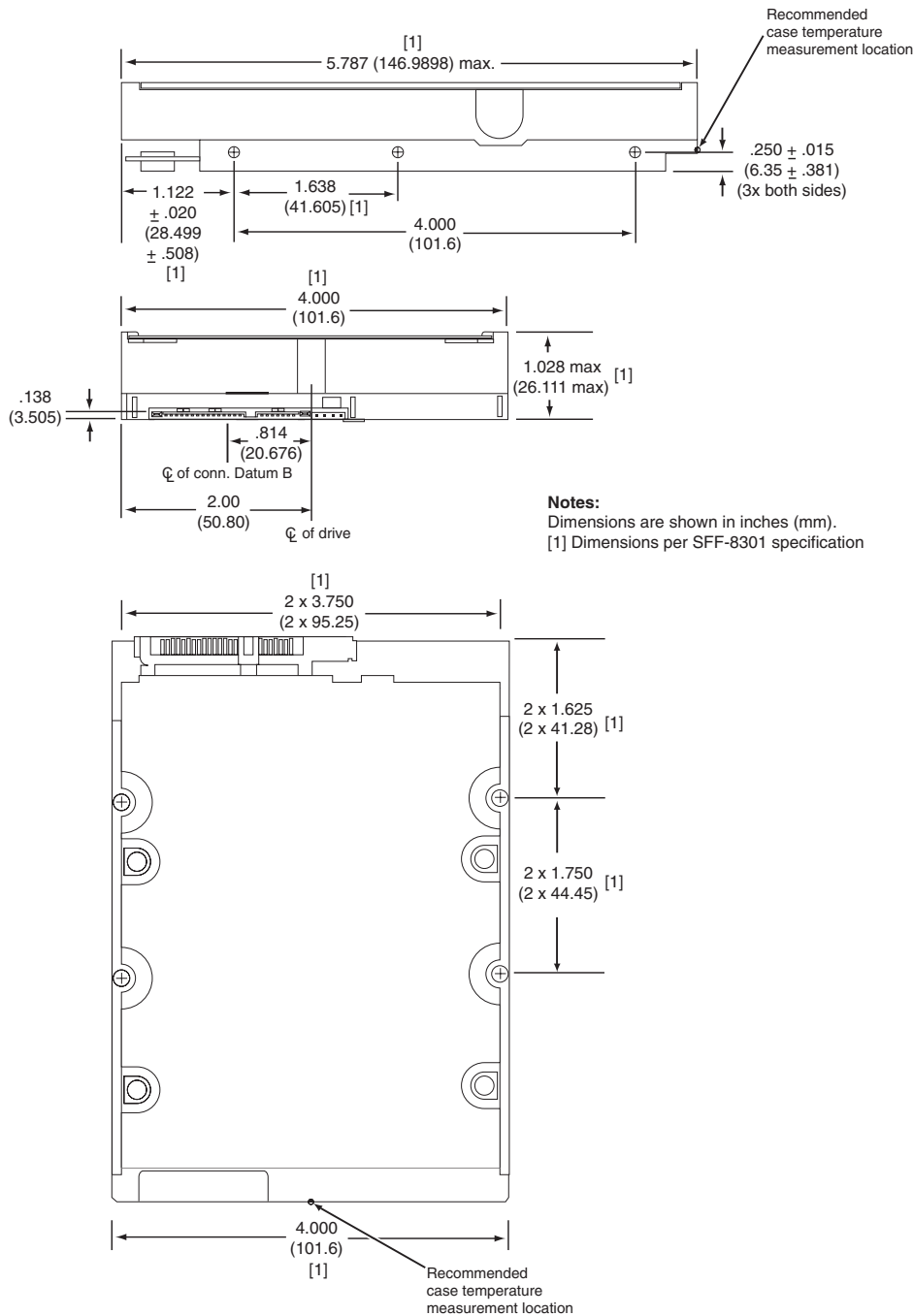
Figure 5 Attaching SATA cabling

Each cable is keyed to ensure correct orientation. SV35 Series SATA drives support latching SATA connectors.

### 3.5 Drive mounting

You can mount the drive in any orientation using four screws in the side-mounting holes or four screws in the bottom-mounting holes. See Figure 6 on page 26 for drive mounting dimensions. Follow these important mounting precautions when mounting the drive:

- Allow a minimum clearance of 0.030 inches (0.76 mm) around the entire perimeter of the drive for cooling.
- Use only 6-32 UNC mounting screws.
- The screws should be inserted no more than 0.150 inch (3.81 mm) into the bottom or side mounting holes.
- Do not overtighten the mounting screws (maximum torque: 6 inch-lb).



**Figure 6** Mounting dimensions—top, side and end view



## **4.0 Serial ATA (SATA) interface**

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These drives use the industry-standard Serial ATA interface that supports FIS data transfers. It supports ATA programmed input/output (PIO) modes 0–4; multiword DMA modes 0–2, and Ultra DMA modes 0–6.

For detailed information about the Serial ATA interface, refer to the “Serial ATA: High Speed Serialized AT Attachment” specification.

### **4.1 Hot-Plug compatibility**

SV35 Series SATA drives incorporate connectors which enable you to hot plug these drives in accordance with the Serial ATA II: Extension to Serial ATA 1.0a specification. This specification can be downloaded from [www.serialata.org](http://www.serialata.org).

## 4.2 Serial ATA device plug connector pin definitions

Table 6 summarizes the signals on the Serial ATA interface and power connectors..

**Table 6: Serial ATA connector pin definitions**

Segment	Pin	Function	Definition
<b>Signal</b>	S1	Ground	2nd mate
	S2	A+	Differential signal pair A from Phy
	S3	A-	
	S4	Ground	2nd mate
	S5	B-	Differential signal pair B from Phy
	S6	B+	
	S7	Ground	2nd mate

Key and spacing separate signal and power segments

<b>Power</b>	P1	V <sub>33</sub>	3.3V power
	P2	V <sub>33</sub>	3.3V power
	P3	V <sub>33</sub>	3.3V power, pre-charge, 2nd mate
	P4	Ground	1st mate
	P5	Ground	2nd mate
	P6	Ground	2nd mate
	P7	V <sub>5</sub>	5V power, pre-charge, 2nd mate
	P8	V <sub>5</sub>	5V power
	P9	V <sub>5</sub>	5V power
	P10	Ground	2nd mate
	P11	Ground or LED signal	If grounded, drive does not use deferred spin
	P12	Ground	1st mate.
	P13	V <sub>12</sub>	12V power, pre-charge, 2nd mate
	P14	V <sub>12</sub>	12V power
	P15	V <sub>12</sub>	12V power

### Notes:

1. All pins are in a single row, with a 1.27 mm (0.050") pitch.
2. The comments on the mating sequence apply to the case of backplane blindmate connector only. In this

case, the mating sequences are:

- the ground pins P4 and P12.
  - the pre-charge power pins and the other ground pins.
  - the signal pins and the rest of the power pins.
3. There are three power pins for each voltage. One pin from each voltage is used for pre-charge when installed in a blind-mate backplane configuration.
  4. All used voltage pins ( $V_x$ ) must be terminated.

### 4.3 Supported ATA commands

The following table lists Serial ATA standard commands that the drive supports. For a detailed description of the ATA commands, refer to the Serial ATA: High Speed Serialized AT Attachment specification. See “S.M.A.R.T. commands” on page 38 for details and subcommands used in the S.M.A.R.T. implementation.

**Table 7: Supported ATA commands**

Command name	Command code (in hex)
Check Power Mode	98 <sub>H</sub> or E5 <sub>H</sub>
Device Configuration Freeze Lock	B1 <sub>H</sub> / C1 <sub>H</sub>
Device Configuration Identify	B1 <sub>H</sub> / C2 <sub>H</sub>
Device Configuration Restore	B1 <sub>H</sub> / C0 <sub>H</sub>
Device Configuration Set	B1 <sub>H</sub> / C3 <sub>H</sub>
Device Reset	08 <sub>H</sub>
Download Microcode	92 <sub>H</sub>
Execute Device Diagnostics	90 <sub>H</sub>
Flush Cache	E7 <sub>H</sub>
Flush Cache Extended	EA <sub>H</sub>
Format Track	50 <sub>H</sub>
Identify Device	EC <sub>H</sub>
Idle	97 <sub>H</sub> or E3 <sub>H</sub>
Idle Immediate	95 <sub>H</sub> or E1 <sub>H</sub>
Initialize Device Parameters	91 <sub>H</sub>
Read Buffer	E4 <sub>H</sub>
Read DMA	C8 <sub>H</sub>
Read DMA Extended	25 <sub>H</sub>
Read DMA Without Retries	C9 <sub>H</sub>
Read Log Ext	2F <sub>H</sub>
Read Multiple	C4 <sub>H</sub>
Read Multiple Extended	29 <sub>H</sub>
Read Native Max Address	F8 <sub>H</sub>
Read Native Max Address Extended	27 <sub>H</sub>

<b>Command name</b>	<b>Command code (in hex)</b>
Read Sectors	20 <sub>H</sub>
Read Sectors Extended	24 <sub>H</sub>
Read Sectors Without Retries	21 <sub>H</sub>
Read Verify Sectors	40 <sub>H</sub>
Read Verify Sectors Extended	42 <sub>H</sub>
Read Verify Sectors Without Retries	41 <sub>H</sub>
Recalibrate	10 <sub>H</sub>
Security Disable Password	F6 <sub>H</sub>
Security Erase Prepare	F3 <sub>H</sub>
Security Erase Unit	F4 <sub>H</sub>
Security Freeze	F5 <sub>H</sub>
Security Set Password	F1 <sub>H</sub>
Security Unlock	F2 <sub>H</sub>
Seek	70 <sub>H</sub>
Set Features	EF <sub>H</sub>
Set Max Address  Note: Individual Set Max Address commands are identified by the value placed in the Set Max Features register as defined to the right.	F9 <sub>H</sub>  Address: 00 <sub>H</sub> Password: 01 <sub>H</sub> Lock: 02 <sub>H</sub> Unlock: 03 <sub>H</sub> Freeze Lock: 04 <sub>H</sub>
Set Max Address Extended	37 <sub>H</sub>
Set Multiple Mode	C6 <sub>H</sub>
Sleep	99 <sub>H</sub> or E6 <sub>H</sub>
S.M.A.R.T. Disable Operations	B0 <sub>H</sub> / D9 <sub>H</sub>
S.M.A.R.T. Enable/Disable Autosave	B0 <sub>H</sub> / D2 <sub>H</sub>
S.M.A.R.T. Enable Operations	B0 <sub>H</sub> / D8 <sub>H</sub>
S.M.A.R.T. Execute Offline	B0 <sub>H</sub> / D4 <sub>H</sub>
S.M.A.R.T. Read Attribute Thresholds	B0 <sub>H</sub> / D1 <sub>H</sub>
S.M.A.R.T. Read Data	B0 <sub>H</sub> / D0 <sub>H</sub>

<b>Command name</b>	<b>Command code (in hex)</b>
S.M.A.R.T. Read Log Sector	B0 <sub>H</sub> / D5 <sub>H</sub>
S.M.A.R.T. Return Status	B0 <sub>H</sub> / DA <sub>H</sub>
S.M.A.R.T. Save Attribute Values	B0 <sub>H</sub> / D3 <sub>H</sub>
S.M.A.R.T. Write Log Sector	B0 <sub>H</sub> / D6 <sub>H</sub>
Standby	96 <sub>H</sub> or E2 <sub>H</sub>
Standby Immediate	94 <sub>H</sub> or E0 <sub>H</sub>
Write Buffer	E8 <sub>H</sub>
Write DMA	CA <sub>H</sub>
Write DMA Extended	35 <sub>H</sub>
Write DMA FUA Extended	CD <sub>H</sub>
Write DMA Without Retries	CB <sub>H</sub>
Write Log Extended	3F <sub>H</sub>
Write Multiple	C5 <sub>H</sub>
Write Multiple Extended	39 <sub>H</sub>
Write Multiple FUA Extended	CE <sub>H</sub>
Write Sectors	30 <sub>H</sub>
Write Sectors Without Retries	31 <sub>H</sub>
Write Sectors Extended	34 <sub>H</sub>

### 4.3.1 Identify Device command

The Identify Device command (command code EC<sub>H</sub>) transfers information about the drive to the host following power up. The data is organized as a single 512-byte block of data, whose contents are shown in Table 7 on page 30. All reserved bits or words should be set to zero. Parameters listed with an “x” are drive-specific or vary with the state of the drive. See Section 2.0 on page 3 for default parameter settings.

The following commands contain drive-specific features that may not be included in the Serial ATA specification.

Word	Description	Value
0	Configuration information: <ul style="list-style-type: none"> <li>• Bit 15: 0 = ATA; 1 = ATAPI</li> <li>• Bit 7: removable media</li> <li>• Bit 6: removable controller</li> <li>• Bit 0: reserved</li> </ul>	0C5A <sub>H</sub>
1	Number of logical cylinders	16,383
2	ATA-reserved	0000 <sub>H</sub>
3	Number of logical heads	16
4	Retired	0000 <sub>H</sub>
5	Retired	0000 <sub>H</sub>
6	Number of logical sectors per logical track: 63	003F <sub>H</sub>
7–9	Retired	0000 <sub>H</sub>
10–19	Serial number: (20 ASCII characters, 0000 <sub>H</sub> = none)	ASCII
20	Retired	0000 <sub>H</sub>
21	Retired	0400 <sub>H</sub>
22	Obsolete	0000 <sub>H</sub>
23–26	Firmware revision (8 ASCII character string, padded with blanks to end of string)	x.xx
27–46	Drive model number: (40 ASCII characters, padded with blanks to end of string)	ST3500641SV ST3250824SV ST3160812SV
47	(Bits 7–0) Maximum sectors per interrupt on Read multiple and Write multiple (16)	8010 <sub>H</sub>
48	Reserved	0000 <sub>H</sub>
49	Standard Standby timer, IORDY supported and may be disabled	2F00 <sub>H</sub>
50	ATA-reserved	0000 <sub>H</sub>
51	PIO data-transfer cycle timing mode	0200 <sub>H</sub>
52	Retired	0200 <sub>H</sub>

Word	Description	Value
53	Words 54–58, 64–70 and 88 are valid	0007 <sub>H</sub>
54	Number of current logical cylinders	xxxx <sub>H</sub>
55	Number of current logical heads	xxxx <sub>H</sub>
56	Number of current logical sectors per logical track	xxxx <sub>H</sub>
57–58	Current capacity in sectors	xxxx <sub>H</sub>
59	Number of sectors transferred during a Read Multiple or Write Multiple command	xxxx <sub>H</sub>
60–61	Total number of user-addressable LBA sectors available (see Section 2.2 for related information) *Note: The maximum value allowed in this field is: 0FFFFFFFh (268,435,455 sectors, 137 Gbytes). Drives with capacities over 137 Gbytes will have 0FFFFFFFh in this field and the actual number of user-addressable LBAs specified in words 100-103. This is required for drives that support the 48-bit addressing feature.	0FFFFFFFh*
62	Retired	0000 <sub>H</sub>
63	Multiword DMA active and modes supported (see note following this table)	xx07 <sub>H</sub>
64	Advanced PIO modes supported (modes 3 and 4 supported)	0003 <sub>H</sub>
65	Minimum multiword DMA transfer cycle time per word (120 nsec)	0078 <sub>H</sub>
66	Recommended multiword DMA transfer cycle time per word (120 nsec)	0078 <sub>H</sub>
67	Minimum PIO cycle time without IORDY flow control (240 nsec)	00F0 <sub>H</sub>
68	Minimum PIO cycle time with IORDY flow control (120 nsec)	0078 <sub>H</sub>
69–74	ATA-reserved	0000 <sub>H</sub>
75	Queue depth	0000 <sub>H</sub>
76	Serial ATA capabilities	xxxx <sub>H</sub>
77	Reserved for future Serial ATA definition	xxxx <sub>H</sub>
78	Serial ATA features supported	xxxx <sub>H</sub>
79	Serial ATA features enabled	xxxx <sub>H</sub>
80	Major version number	003E <sub>H</sub>
81	Minor version number	0000 <sub>H</sub>
82	Command sets supported	364B <sub>H</sub>



Word	Description	Value
83	Command sets supported	7C03 <sub>H</sub>
84	Command sets support extension	4003 <sub>H</sub>
85	Command sets enabled	30xx <sub>H</sub>
86	Command sets enabled	0001 <sub>H</sub>
87	Command sets enable extension	4000 <sub>H</sub>
88	Ultra DMA support and current mode (see note following this table)	xx3F <sub>H</sub>
89	Security erase time	0000 <sub>H</sub>
90	Enhanced security erase time	0000 <sub>H</sub>
92	Master password revision code	FFFE <sub>H</sub>
93	Hardware reset value (see description following this table)	xxxx <sub>H</sub>
95–99	ATA-reserved	0000 <sub>H</sub>
100–103	Total number of user-addressable LBA sectors available (see Section 2.2 for related information). These words are required for drives that support the 48-bit addressing feature. Maximum value: 0000FFFFFFFF <sub>H</sub> .	ST3500641SV = 976,773,168 ST3250824SV = 488,397,168 ST3160812SV = 312,581,808
104–127	ATA-reserved	0000 <sub>H</sub>
128	Security status	0001 <sub>H</sub>
129–159	Seagate-reserved	xxxx <sub>H</sub>
160–254	ATA-reserved	0000 <sub>H</sub>
255	Integrity word	xxA5 <sub>H</sub>

**Note.** Advanced Power Management (APM) and Automatic Acoustic Management (AAM) features are not supported

**Note.** See the bit descriptions below for words 63, 88, and 93 of the Identify Drive data.

Description (if bit is set to 1)		
Bit	Word 63	
0	Multiword DMA mode 0 is supported.	
1	Multiword DMA mode 1 is supported.	
2	Multiword DMA mode 2 is supported.	
8	Multiword DMA mode 0 is currently active.	
9	Multiword DMA mode 1 is currently active.	

	10	Multiword DMA mode 2 is currently active.
	<b>Bit</b>	<b>Word 88</b>
	0	Ultra DMA mode 0 is supported.
	1	Ultra DMA mode 1 is supported.
	2	Ultra DMA mode 2 is supported.
	3	Ultra DMA mode 3 is supported.
	4	Ultra DMA mode 4 is supported.
	5	Ultra DMA mode 5 is supported.
	6	Ultra DMA mode 6 is supported.
	8	Ultra DMA mode 0 is currently active.
	9	Ultra DMA mode 1 is currently active.
	10	Ultra DMA mode 2 is currently active.
	11	Ultra DMA mode 3 is currently active.
	12	Ultra DMA mode 4 is currently active.
	13	Ultra DMA mode 5 is currently active.
	14	Ultra DMA mode 6 is currently active.

### 4.3.2 Set Features command

This command controls the implementation of various features that the drive supports. When the drive receives this command, it sets BSY, checks the contents of the Features register, clears BSY and generates an interrupt. If the value in the register does not represent a feature that the drive supports, the command is aborted. Power-on default has the read look-ahead and write caching features enabled. The acceptable values for the Features register are defined as follows:

**Table 8: Set Features command values**

02 <sub>H</sub>	Enable write cache ( <i>default</i> ).
03 <sub>H</sub>	Set transfer mode (based on value in Sector Count register). Sector Count register values:
00 <sub>H</sub>	Set PIO mode to default (PIO mode 2).
01 <sub>H</sub>	Set PIO mode to default and disable IORDY (PIO mode 2).
08 <sub>H</sub>	PIO mode 0
09 <sub>H</sub>	PIO mode 1
0A <sub>H</sub>	PIO mode 2
0B <sub>H</sub>	PIO mode 3
0C <sub>H</sub>	PIO mode 4 ( <i>default</i> )
20 <sub>H</sub>	Multiword DMA mode 0
21 <sub>H</sub>	Multiword DMA mode 1
22 <sub>H</sub>	Multiword DMA mode 2
40 <sub>H</sub>	Ultra DMA mode 0
41 <sub>H</sub>	Ultra DMA mode 1
42 <sub>H</sub>	Ultra DMA mode 2
43 <sub>H</sub>	Ultra DMA mode 3
44 <sub>H</sub>	Ultra DMA mode 4
45 <sub>H</sub>	Ultra DMA mode 5
46 <sub>H</sub>	Ultra DMA mode 6
10 <sub>H</sub>	Enable use of SATA features
55 <sub>H</sub>	Disable read look-ahead (read cache) feature.
82 <sub>H</sub>	Disable write cache
90 <sub>H</sub>	Disable use of SATA features
AA <sub>H</sub>	Enable read look-ahead (read cache) feature ( <i>default</i> ).

**Table 8: Set Features command values**

F1<sub>H</sub> Report full capacity available

**Note.** At power-on, or after a hardware or software reset, the default values of the features are as indicated above.

**4.3.3 S.M.A.R.T. commands**

S.M.A.R.T. provides near-term failure prediction for disc drives. When S.M.A.R.T. is enabled, the drive monitors predetermined drive attributes that are susceptible to degradation over time. If self-monitoring determines that a failure is likely, S.M.A.R.T. makes a status report available to the host. Not all failures are predictable. S.M.A.R.T. predictability is limited to the attributes the drive can monitor. For more information on S.M.A.R.T. commands and implementation, see the *Draft ATA-5 Standard*.

SeaTools diagnostic software activates a built-in drive self-test (DST S.M.A.R.T. command for D4<sub>H</sub>) that eliminates unnecessary drive returns. The diagnostic software ships with all new drives and is also available at: <http://seatools.seagate.com>.

This drive is shipped with S.M.A.R.T. features disabled. You must have a recent BIOS or software package that supports S.M.A.R.T. to enable this feature. The table below shows the S.M.A.R.T. command codes that the drive uses.

**Table 9: S.M.A.R.T. commands**

Code in features register	S.M.A.R.T. command
D0 <sub>H</sub>	S.M.A.R.T. Read Data
D2 <sub>H</sub>	S.M.A.R.T. Enable/Disable Attribute Autosave
D3 <sub>H</sub>	S.M.A.R.T. Save Attribute Values
D4 <sub>H</sub>	S.M.A.R.T. Execute Off-line Immediate (runs DST)
D5 <sub>H</sub>	S.M.A.R.T. Read Log Sector
D6 <sub>H</sub>	S.M.A.R.T. Write Log Sector
D8 <sub>H</sub>	S.M.A.R.T. Enable Operations
D9 <sub>H</sub>	S.M.A.R.T. Disable Operations
DA <sub>H</sub>	S.M.A.R.T. Return Status

**Note.** If an appropriate code is not written to the Features Register, the command is aborted and 0x04 (abort) is written to the Error register.

#### 4.3.4 Streaming feature set support

The Streaming feature set is an optional feature set that allows a host to request delivery of data from a contiguous logical block address range within an allotted time. This places a higher priority on time to access the data than the integrity of the data. Streaming feature set commands only support 48-bit, LBA-mode-only addressing.

Seagate implements the following Streaming commands:

- CONFIGURE STREAM
- READ STREAM DMA EXT
- WRITE STREAM DMA EXT

Command Completion Time Out (CCTO) errors are not deferrable on DMA operations, as they require some DMA engine clean up on the host side. Therefore, Seagate does not anticipate supporting any configurations where a CCTO needs to hide from reporting as an error, and simply show up in a Stream Error log. Since the Stream Error logs were intended to be used to report deferred errors such as this, Seagate has not implemented them.

##### 4.3.4.1 Identify Device command

These drives will set word 84 bit 4 (Streaming Feature Set Supported) and word 87 bit 4 (Configure Stream command was issued) when a non-zero default time limit has been set for either reading or writing. If the host reconfigures both defaults to 0, the bit will clear.

##### Word 95 (Stream Minimum Request Size)

Word 95 contains the number of sectors that provide optimum performance in a streaming environment. This number shall be a power of two, with a minimum of eight sectors (4096 bytes). The starting LBA value for each streaming command should be evenly divisible by this request size.

##### Words 96, 97, and 104

Unsupported.

##### Words 99:98

These words define the fixed unit of time that is used only in the Command Completion Time Limit (CCTL) that is passed in streaming commands. The unit of time for this parameter is microseconds. For example, a value of 50000 indicates 50 ms.

##### 4.3.4.2 Streaming commands

Streaming commands are defined to be time-critical data transfers rather than the standard data-integrity-critical commands. Each command shall be completed within the time specified in the CONFIGURE STREAM command or in the streaming command itself to ensure the stream requirements of the AV-type application. The drive may execute background tasks as long as the READ STREAM and WRITE STREAM command execution time limits are still met.

The host may use the CONFIGURE STREAM command to define the default Command Completion Time Limit (CCTL) for reads and writes independently--this assists the device in setting up its caching for best performance. If the host does not use a CONFIGURE STREAM command, the device shall use the CCTL specified in each streaming command, and the time limit is effective for one time only. If the CCTL is not set by a CONFIGURE STREAM command, the operation of a streaming command with a zero CCTL is device vendor specific. "Stream ID" as noted in the ATA specification is not used by the Seagate implementation.

The streaming commands may access any user LBA on a device. These commands may be interspersed with non-streaming commands, but there may be an impact on performance due to the unknown time required to complete the non-streaming commands.

The streaming commands should be issued using a specified minimum number of sectors transferred per command, as specified in word 95 of the IDENTIFY DEVICE response. The transfer length of a request should be a multiple of the minimum number of sectors per transfer, as should the starting LBA of any streaming command.

### **Urgent bit**

The Urgent bit in the READ STREAM and WRITE STREAM commands is ignored. Therefore, bits 9 and 10 of IDENTIFY DEVICE data words 84 and 87 shall remain clear.

### **Flush to Disk bit**

The Flush to Disk bit in the WRITE STREAM command specifies that all data for the specified stream shall be flushed to the media before posting command completion. If a host requests flushes at times other than the end of each Allocation Unit, streaming performance may be degraded. Using the SET FEATURES command to enable/disable caching may not affect caching for streaming commands.

### **Not Sequential bit**

The Not Sequential bit specifies that the next LBA(s) after those requested in the current READ STREAM command are not anticipated to be used in a subsequent READ STREAM command. This information may help the device with pre-fetching decisions.

### **Read Continuous bit**

If the Read Continuous bit is set to 1 for the command, the device shall attempt to transfer the requested amount of data to the host within the Command Completion Time Limit even if an error occurs. The data sent to the host by the device in an error condition is vendor specific.

### **Write Continuous bit**

If the Write Continuous bit is set to 1 for the command and an error is encountered, the device shall still attempt to complete the transfer within the requested time. If an error occurs and cannot be resolved within the Command Completion Time Limit, the erroneous section on the media may be unchanged or may contain undefined data. A future read of this area may not report an error, even though the data is erroneous. If the Flush Bit is set to 1 on the STREAM WRITE command and the data cannot successfully be written to the media, then the drive will report a Stream Error on the command.

### **Handle Streaming Error bit**

The Handle Streaming Error bit specifies to the drive that this command starts at the LBA of a recently reported error section, so the device may attempt to continue its corresponding error recovery sequence where it left off earlier. This mechanism allows the host to schedule error recovery and defect management for content critical data.

#### 4.3.4.2.1 Configure Stream (51h)

The Configure Stream command specifies the default CCTL (Command Completion Time Limit) for streaming commands, and informs the drive of the Allocation Unit size and alignment.

Protocol: non-data

Register		7	6	5	4	3	2	1	0
Features	Current	Ignored	R/W	Reserved			Ignored		
	Previous	Default CCTL (7:0)							
Sector Count	Current	AU Size In Sectors (7:0)							
	Previous	AU Size In Sectors (15:8)							
LBA Low, Mid, High	Current	Reserved							
	Previous	Reserved							
Device		obs	Ignored	obs	DEV	Reserved			
Command		51h							

Note: The value indicated as Current is the value most recently written to the register. The value indicated as Previous is the value that was in the register before the most recent write to the register.

#### FEATURES REGISTER FIELD DESCRIPTIONS

##### R/W

- 0 Read stream
- 1 Write stream

##### Default CCTL (Default Command Completion Time Limit)

This value is calculated as follows (with the unit of measure being microseconds):

$$\text{Default CCTL} = ((\text{content of the Features register}) * (\text{IDENTIFY DEVICE words (99:98)}))$$

This time shall be used by the drive when an individual streaming command with a CCTL of 0 is issued. The time is measured from the write of the command register to the final INTRQ for command completion.

#### SECTOR COUNT REGISTER FIELD DESCRIPTIONS

##### Current

The size of an Allocation Unit in sectors (bits 7:0).

##### Previous

The size of an Allocation Unit in sectors (bits 15:8)

#### DEVICE REGISTER FIELD DESCRIPTIONS

##### Dev

The selected device.

### 4.3.4.2.2 Read Stream DMA (2Ah)

Protocol: DMA In

This command reads from 1 to 65536 sectors as specified in the Sector Count register. A value of 0000h in the Sector Count register requests 65536 sectors.

The RC bit indicates that the drive operate in a continuous read mode for the READ STREAM command. When RC is set to 0, the drive shall operate in normal streaming read mode.

When the Read Continuous mode is enabled, the drive shall attempt to transfer data of the requested length without setting the ERR bit to 1. The SE bit shall be set to 1 if the data transferred includes errors, unless the transfer is unable to finish within the CCTL, in which case a CCTO error will be reported (see below). If an error is encountered, it may be necessary for the drive to pad the data being transferred to fulfill the host's requested transfer size. The implementation of the padding is vendor specific.

If the drive is unable to transfer the correct amount of data by the CCTL, the drive will set the ERR bit to 1 and the BSY bit to 0 in the Status Register, and the CCTO bit to 1 in the Error Register.

Register		7	6	5	4	3	2	1	0
Features	Current	Ignored	RC	NS	Ignored	r	Ignored		
	Previous	Command Completion Time Limit (7:0)							
Sector Count	Current	Sector count							
	Previous								
LBA Low, Mid, High	Current	LBA							
	Previous								
Device		obs	LBA	obs	DEV	Reserved			
Command		2Ah							

Note: The value indicated as Current is the value most recently written to the register. The value indicated as Previous is the value that was in the register before the most recent write to the register.

#### FEATURES REGISTER FIELD DESCRIPTIONS

##### RC (Read Continuous mode enabled)

Regardless of the RC setting, if it is not possible to transfer the full amount of data that the host requested before the CCTL, the drive shall provide ending status with the BSY bit cleared to 0, the SE bit set to 0, the ERR bit set, and the CCTO bit set in the Error Register.

##### NS (Not Sequential)

This bit specifies that the next LBAs after those requested in the current READ STREAM command are not anticipated to be read in a near-future read stream command.

##### Features Register Previous

The time allowed for the current command's completion. This is calculated as follows:

$$\text{CCTL} = (\text{content of the Features Register Previous}) * (\text{IDENTIFY DEVICE words (99:98)})$$



If the value is 0, the drive shall use the Default Command Completion Time Limit supplied with the most recent previous CONFIGURE STREAM command for this Stream type (Read or Write). If the Default Command Completion Time Limit is 0, or no previous Configure Stream command was defined for this Stream type, the result is vendor specific. The time is measured from the write of the command register to the final INTRQ for command completion.

## Error Outputs

If the RC bit is set to 0, the content of the registers shall be as shown below. If the RC bit is set to 1 and the drive was able to transfer the correct amount of data (even though some of it may be incorrect), the SE bit shall be set to 1, the ERR bit shall be set to 0.

Register		7	6	5	4	3	2	1	0
Error		ICRC	UNC	N/A	IDNF	N/A	ABRT	N/A	CCTO
Sector Count	HOB = 0	Length of Stream Error (7:0)							
	HOB = 1	Length of Stream Error (15:8)							
LBA Low	HOB = 0	LBA (7:0)							
	HOB = 1	LBA (31:24)							
LBA Mid	HOB = 0	LBA (15:8)							
	HOB = 1	LBA (39:32)							
LBA High	HOB = 0	LBA (23:16)							
	HOB = 1	LBA (47:40)							
Device		obs	N/A	obs	DEV	Reserved			
Status		BSY	DRDY	SE	Unused	DRQ	N/A	N/A	ERR

Note: HOB = 0 indicates the value read by the host when the HOB bit of the Device Control register is cleared to zero. HOB = 1 indicates the value read by the host when the HOB bit of the Device Control register is set to one.

## ERROR REGISTER FIELD DESCRIPTIONS

### ICRC (Interface CRC Error)

- 1 This bit shall be set to 1 if an interface CRC error has occurred during an Ultra DMA data transfer. The content of this bit is not applicable for Multiword DMA transfers.

### UNC (Uncorrectable)

- 1 This bit shall be set to 1 if data is uncorrectable. This bit should never be set on a streaming command.

### IDNF

- 1 This bit shall be set to 1 if a user-accessible address could not be found. This bit shall be set to 1 if an address outside of the range of user-accessible addresses is requested if command aborted is not returned.

### ABRT

- 1 This bit shall be set to 1 if this command is not supported. ABRT may be set to 1 if the device is not able to complete the action requested by the command. ABRT shall be set to 1 if an address outside of the range of user-accessible addresses is requested if IDNF is not set to 1.

### **CCTO (Command Completion Time Out)**

1 This bit shall be set to 1 if a Command Completion Time Out error has occurred.

### **SECTOR COUNT REGISTER FIELD DESCRIPTIONS**

#### **LBA Low/Mid/High**

The address of the first uncorrectable error.

### **DEVICE REGISTER FIELD DESCRIPTIONS**

#### **DEV**

This field indicates the selected device.

### **STATUS REGISTER FIELD DESCRIPTIONS**

#### **BSY**

0 This bit shall be set to 0 indicating command completion.

#### **DRDY**

1

#### **SE (Stream Error)**

1 This bit shall be set to one if the data contained erroneous data (even though the correct amount of data was transferred to the host). In this case, the LBA returned in the Sector Number registers shall be the address of the first sector in error, and the Sector Count registers shall contain the number of consecutive sectors that may contain errors.

#### **DRQ**

0 This bit shall be set to 0.

#### **ERR**

1 This bit shall be set to 1 if an Error register bit is set to 1.

### 4.3.4.3 Write Stream DMA (3Ah)

Protocol: DMA Out

The Write Stream DMA command allows the host to write data using the DMA data transfer protocol. This command allows for the host to specify to the device that additional actions need to be performed prior to the completion of the command if the required bits are set.

If the Write Continuous bit is set to 1, the device shall attempt to not stop execution of the command due to errors. If the WC bit is set to 1 and errors occur in the transfer or writing of the data, the device shall attempt to continue to transfer the amount of data requested and then provide ending status with the BSY bit cleared to zero, the SE bit set to 1, the ERR bit cleared to 0. If the WC bit is set to 1 and the Command Completion Time Limit expires, the device shall stop execution of the command and provide ending status with the BSY bit cleared to 0, the SE bit clear, the ERR bit set, and report the fact that the Command Completion Time Limit expired by setting the CCTO bit in the error register. In all cases, the drive shall attempt to transfer the amount of data requested within the Command Completion Time Limit even if some data transferred is in error.

Additionally, if the F bit is set for a Write Stream command, the drive shall conclude processing for the command (including flushing it to the media) before posting status.

Register		7	6	5	4	3	2	1	0
Features	Current	Ignored	WC	F	Ignored	r	Ignored		
	Previous	Command Completion Time Limit (7:0)							
Sector Count	Current	Sector count							
	Previous								
LBA Low, Mid, High	Current	LBA							
	Previous								
Device		obs	LBA	obs	DEV	Reserved			
Command		3Ah							

Note: The value indicated as Current is the value most recently written to the register. The value indicated as Previous is the value that was in the register before the most recent write to the register.

## FEATURES REGISTER FIELD DESCRIPTIONS

### WC (Write Continuous)

This bit indicates if Write Continuous mode is enabled.

- The device shall attempt to not stop execution of the command due to errors. If the WC bit is set to 1 and errors occur in the transfer or writing of data, the device shall attempt to continue to transfer the amount of data requested, and then provide ending status with the BSY bit cleared to 0, the SE bit set to 1, and the ERR bit cleared to 0. If the WC bit is set to 1 and the Command Completion Time Limit expires, the device shall stop execution of the command and provide ending status with the BSY bit cleared to 0, the SE bit clear, the ERR bit set, and report the fact that the Command Completion Time Limit expired by setting the CCTO bit in the error register to 1. In all cases, the device shall attempt to transfer the amount of data requested within the Command Completion Time Limit even if some data transferred is in error.

## F

- 1 This bit specifies that all data for the specified stream shall be flushed to the media before command complete is reported.

### CCTL (Command Completion Time Limit)

The time allowed for the current command to complete. This value is calculated as follows:

$CCTL = (\text{content of the Features register Previous}) * (\text{IDENTIFY DEVICE data words (99:98)}) \text{ microseconds}$

- 0 The device shall use the Default Command Completion Time Limit supplied with the most recent previous CONFIGURE STREAM command for this Stream type (Read or Write). If the Default Command Completion Time Limit = 0, or no previous Configure Stream command was defined for this Stream ID, the result is vendor specific. The time is measured from the write of the command register to the final INTRQ for command completion.

### Error Outputs

If the WC bit is set to 0, the content of the registers shall be as shown below. If the WC bit is set to 1 and the drive was able to transfer the correct amount of data (even though some of it may be written incorrectly to the media), the SE bit shall be set to 1 and the ERR bit shall be set to 0.

Register		7	6	5	4	3	2	1	0
Error		ICRC	N/A	N/A	IDNF	N/A	ABRT	N/A	CCTO
Sector Count	HOB = 0	Length of Stream Error (7:0)							
	HOB = 1	Length of Stream Error (15:8)							
LBA Low	HOB = 0	LBA (7:0)							
	HOB = 1	LBA (31:24)							
LBA Mid	HOB = 0	LBA (15:8)							
	HOB = 1	LBA (39:32)							
LBA High	HOB = 0	LBA (23:16)							
	HOB = 1	LBA (47:40)							
Device		obs	N/A	obs	DEV	Reserved			
Status		BSY	DRDY	SE	Unused	DRQ	N/A	N/A	ERR

Note: HOB = 0 indicates the value read by the host where the HOB bit of the Device Control register is set to 0. HOB = 1 indicates the value read by the host when the HOB bit of the Device Control register is set to 1.

### ERROR REGISTER FIELD DESCRIPTIONS

#### ICRC

- 1 This bit shall be set to 1 if an interface CRC error has occurred during an Ultra DMA data transfer. The content of this bit is not applicable for Multiword DMA transfers.

## **IDNF**

- 1 This bit shall be set to 1 if a user-accessible address could not be found. IDNF shall be set to 1 if an address outside of the range of user-accessible addresses is requested if command aborted is not returned.

## **ABRT**

- 1 This bit shall be set to 1 if this command is not supported. ABRT may be set to 1 if the device is not able to complete the action requested by the command. ABRT shall be set to 1 if an address outside of the range of user-accessible addresses is requested if IDNF is not set to 1.

## **CCTO**

- 1 This bit shall be set to 1 if a Command Completion Time Out error has occurred.

## **SECTOR COUNT REGISTER FIELD DESCRIPTIONS**

### **Current, Previous**

These bits contain the number of contiguous sectors potentially written unsuccessfully, or with bad data, beginning with the LBA of the first corrupted sector.

### **LBA (Low, Mid, High) (Current, Previous)**

These bits contain the address of the first potentially corrupted sector.

## **DEVICE REGISTER FIELD DESCRIPTIONS**

### **DEV**

This bit shall indicate the selected device.

## **STATUS REGISTER FIELD DESCRIPTIONS**

### **BSY**

- 0 This bit shall be set to 0 indicating command completion.

### **DRDY**

- 1 This bit shall be set to 1.

### **SE (Stream Error)**

- 1 This bit shall be set to 1 if an error has occurred during the execution of the command when the WC bit is set to 1 and the correct amount of data was transferred from the host. In this case, the LBA returned in the Sector Number registers shall be the address of the first sector in error, and the Sector Count registers shall contain the number of consecutive sectors that may contain errors.

### **DRQ**

- 0 This bit shall be set to 0.

### **ERR**

- 1 This bit shall be set to 1 if an Error register bit is set to 1 and the WC bit is set to 0, or if the drive was unable to transfer the correct amount of data to the host.

### **4.3.4.3.1 Time-constrained operations**

In general, time constraints have impacts not only on data transfer between the drive and the host, but also on the drive's internal motion and movement of data to and from the internal buffer (cache). If the drive moves its actuator to access some data other than what the host is (or shortly will be) accessing, there will be an unavoidable delay before the actuator can be moved to where the host needs it to be to service a command.

If write caching is allowed, the actuator could be busy servicing a cached write at virtually any time. The implication is that a timeout on a read command could actually be due to a cached write. To address this case:

- Streaming commands will not time out if there is a non-streaming cached write in progress
- all cached write data is discarded if a timeout occurs on a streaming command
- when the host issues a streaming read to the drive, internal drive activity is limited to minimize the chances that significant time will be spent on a normal write, and
- timeouts are inhibited if this case is occurring.

#### **4.3.4.3.2 Non-cached streaming writes use model**

The host can issue streaming writes. If this is done, it is recommended that the host either set the F bit or disable write caching. If the host does neither, the drive has no way to accurately report the failure location and length in the event of a write failure on a cached write. Disabling caching or using the F bit will cause some performance loss compared to the case where caching was allowed. The most straightforward way to ensure that performance is maintained in this usage model is for the host to issue large writes, so that the seek time is insignificant when compared to the amount of time that the host can allow the command to consume. If the host's time limit allows, the drive will perform internal defect management on any defective sectors encountered. If the drive runs out of time during a write of this type, any currently cached sectors in the drive's buffer will be discarded. If the error occurred in the LBA range of the current command (rather than a cached command), the portion of that write that may not have been successfully written to the media will be reported to the host in the ending status of the write command.

#### **4.3.4.3.3 Non-streaming writes**

In non-streaming writes, the drive does not discard any write data, but rather protects the data as if it were in a non-timed environment altogether. The cache algorithm ensures that if a write to the media is begun, it will be finished during the write command on the ATA bus, and will not adversely affect a streaming read.

A system may use this mode during boot, and then switch over to Streaming Writes for operational mode, back again to untimed mode for maintenance, etc. This behavior can be safe as long as a Flush Cache command is issued and completed before switching between write command types.

## 5.0 Seagate Technology support services

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### Internet

For information regarding Seagate products and services, visit [www.seagate.com](http://www.seagate.com). Worldwide support is available 24 hours daily by email for your questions.

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Presales@Seagate.com

### Technical Support:

DiscSupport@Seagate.com

### Warranty Support:

<http://www.seagate.com/support/service/index.html>

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## Seagate Service Centers

### Presales Support

Our Presales Support staff can help you determine which Seagate products are best suited for your specific application or computer system, as well as product availability and compatibility.

### Technical Support

Seagate technical support is available to assist you online at [support.seagate.com](http://support.seagate.com) or through one of our call centers. Have your system configuration information and your "ST" model number available.

**SeaTDD™ (+1-405-324-3655)** is a telecommunications device for the deaf (TDD). You can send questions or comments 24 hours daily and exchange messages with a technical support specialist during normal business hours for the call center in your region.

## Customer Service Operations

### Warranty Service

Seagate offers worldwide customer support for Seagate products. Seagate distributors, OEMs and other direct customers should contact their Seagate Customer Service Operations (CSO) representative for warranty-related issues. Resellers or end users of drive products should contact their place of purchase or Seagate warranty service for assistance. Have your serial number and model or part number available.

### Data Recovery Services

Seagate offers data recovery services for all formats and all brands of storage media. Our data recovery services labs are currently located throughout the world. . Additional information, including an online request form and data loss prevention resources, is available at <http://services.seagate.com/index.aspx>

### Authorized Service Centers

Seagate Service Centers are available on a global basis for the return of defective products. Contact your customer support representative for the location nearest you.

### USA/Canada/Latin America support services

For an extensive list of telephone numbers to technical support, presales and warranty service in USA/Canada/Latin America, including business hours, go to the "Contact Us" page on [www.seagate.com](http://www.seagate.com).

## Global Customer Support

### Presales, Technical, and Warranty Support

Call Center	Toll-free	Direct dial
USA, Canada, and Mexico	1-800-SEAGATE	+1-405-324-4700

### Data Recovery Services

Call Center	Toll-free	Direct dial	FAX
USA, Canada, and Mexico	1-800-475-01435	+1-905-474-2162	1-800-475-0158 +1-905-474-2459

## Europe, the Middle East and Africa Support Services

For an extensive list of telephone numbers to technical support, presales and warranty service in Europe, the Middle East and Africa, go to the "Contact Us" page on [www.seagate.com](http://www.seagate.com).

## Asia/Pacific Support Services

For an extensive list of telephone numbers to technical support, presales and warranty service in Asia/Pacific, go to the "Contact Us" page on [www.seagate.com](http://www.seagate.com).



# Index

## Numerics

3D Defense System 1

## A

ACA 20  
acceleration 17  
acoustics 7, 9, 18  
Active 15  
Active mode 15  
actuator arm 13  
AFR 19  
Agency certification 19  
altitude 16  
Altitude, nonoperating 5, 7, 9  
Altitude, operating 4, 6, 8  
Ambient temperature 4, 6, 8, 16  
ambient temperature 12, 13  
Annualized Failure Rate (AFR) 5, 7, 9, 19  
Areal density 4, 6, 8  
areal density 11  
ATA commands 30  
ATA data-transfer modes supported 4, 6, 8  
Australia/New Zealand Standard AS/NZS3548 1995  
20  
Australian Communication Authority (ACA) 20  
Australian C-Tick 20  
Average latency 12  
Average seek time 12  
Average seek, read 4, 6, 8

## B

bels 7, 9  
BPI 4, 6, 8, 11  
buffer 4, 6, 8, 11  
Bytes per sector 4, 6, 8, 10

## C

cables and connectors 25  
Cache 4, 6, 8  
cache 11  
capacity 10  
case temperature 16  
CE mark 19  
certification 19  
Check Power Mode 30  
chemical pollutants 21  
chemical substances 21  
Class B computing device 20  
compatibility 19  
Conducted noise 15

Conducted RF immunity 18  
Configuring the drive 23  
connectors 25  
corrosive chemicals 21  
Corrosive environment 21  
CSA C22.2 (950) 19  
current 4, 6, 8  
cycles 19  
Cylinders 10  
cylinders 4, 6, 8

## D

Data Defense 1  
data-transfer rates 1  
DC power 13  
Default logical geometry 10  
Default sectors per track 4, 6, 8  
density 4, 6, 8, 11  
Device Configuration Freeze Lock 30  
Device Configuration Identify 30  
Device Configuration Restore 30  
Device Configuration Set 30  
Device Reset 30  
Diagnostic Defense 1  
dimensions 26  
disc surface 13  
displacement 17  
Download Microcode 30  
Drive Defense 1

## E

ead/write heads 4, 6, 8  
Electrical fast transient 18  
Electromagnetic compatibility 19  
Electromagnetic Compatibility (EMC) 19  
Electromagnetic Compatibility control Regulation 19  
Electromagnetic Compatibility Directive (89/336/EEC)  
19  
Electromagnetic immunity 18  
Electrostatic discharge 18  
electrostatic discharge (ESD) 23  
EN 55022, Class B 19  
EN 55024 19  
EN 60950 19  
Environmental protection 21  
Environmental specifications 16  
EPRML 11  
error-correction algorithms 1  
errors 5, 7, 9, 19  
ESD 23  
EU 19  
European Union (EU) requirements 19  
European Union Restriction of Hazardous Substances 21

Execute Device Diagnostics 30

## F

FCC verification 20  
features 1  
Federal Communications Commission 20  
Flush Cache 30  
Flush Cache Extended 30  
Format Track 30  
Formatted capacity 10  
Formatted Gbytes 4, 6, 8

## G

Gbytes 10  
geometry 10  
gradient 4, 6, 8  
Gs 17  
Guaranteed sectors 4, 6, 8, 10  
guaranteed sectors 10

## H

Handling precautions 23  
heads 4, 6, 8, 10  
Height 4, 6, 8  
height 12  
humidity 4, 6, 8, 16

## I

I/O data-transfer rate 4, 6, 8, 11  
Identify Device 30  
Identify Device command 33  
Idle 14, 15, 30  
Idle Immediate 30  
Idle mode 4, 6, 8, 13, 15  
IEC950 19  
Information Technology Equipment (ITE) 19  
Initialize Device Parameters 30  
Input noise ripple 15  
input voltage 13  
interface 11, 27  
Internal data transfer rate 4, 6, 8  
internal data-transfer rate OD 11  
is 12  
ISO document 7779 18  
ITE 19

## K

Korea Ministry of Information and Communication  
(MIC) 19  
Korean RRL 19

## L

latency 4, 6, 8, 12  
latency time 13  
LBA mode 10  
Length 4, 6, 8  
logical geometry 10

## M

maintenance 19  
master/slave 2  
maximum temperature 16  
MIC 19  
mounting 26  
mounting screws 17  
mounting the drive 23

## N

noise 15  
nominal power 12  
Nonoperating shock 17  
Nonoperating vibration 17  
Nonrecoverable read errors 5, 7, 9, 19

## O

Operating 14  
Operating power 4, 6, 8, 13  
Operating shock 17  
Operating vibration 17

## P

PCBA 21  
Physical characteristics 12  
point-to-point 2, 25  
Power consumption 13  
power consumption 13  
Power dissipation 14  
Power modes 15  
Power specifications 13  
Power-management modes 15  
Power-on to Ready 13  
Power-on to ready 4, 6, 8  
precautions 23  
printed circuit board 23  
programmable power management 15

## Q

quick reference 3

## R

Radiated RF immunity 18  
Radio and television interference 20  
radio frequency (RF) 18

- random seeks 13
- Read Buffer 30
- Read DMA 30
- Read DMA Extended 30
- Read DMA without Retries 30
- read errors 5, 7, 9, 19
- Read Log Ext 30
- Read Multiple 1, 30
- Read Multiple Extended 30
- Read Native Max Address 30
- Read Native Max Address Extended 30
- Read Sectors 31
- Read Sectors Extended 31
- Read Sectors Without Retries 31
- Read Verify Sectors 31
- Read Verify Sectors Extended 31
- Read Verify Sectors Without Retries 31
- read/write actuator arm 13
- Read/write heads 10
- Ready to spindle stop 13
- Recalibrate 31
- Recording density 4, 6, 8
- recording density 11
- recording method 11
- Recording technology 11
- Relative humidity 4, 6, 8
- relative humidity 16
- Reliability 19
- RF 18
- RMS read/write current 15
- RoHS 21
- RPM 4, 6, 8
- RRL 19

## S

- S.M.A.R.T. Disable Operations 31
- S.M.A.R.T. Enable/Disable Autosave 31
- S.M.A.R.T. Enable Operations 31
- S.M.A.R.T. Execute Offline 31
- S.M.A.R.T. implementation 30
- S.M.A.R.T. Read Attribute Thresholds 31
- S.M.A.R.T. Read Data 31
- S.M.A.R.T. Read Log Sector 32
- S.M.A.R.T. Return Status 32
- S.M.A.R.T. Save Attribute Values 32
- S.M.A.R.T. Write Log sector 32
- Safety certification 19
- SATA 27
- SATA data-transfer modes supported 4, 6, 8
- screws 17
- sector 10
- sectors 10
- Sectors per track 10
- sectors per track 4, 6, 8
- Security Disable Password 31

- Security Erase Prepare 31
- Security Erase Unit 31
- Security Freeze 31
- Security Set Password 31
- Security Unlock 31
- Seek 31
- seek mode 13
- Seek mode power 13
- Seek power 4, 6, 8
- Seek time 12
- seek time 4, 6, 8
- Seeking 14
- Serial ATA (SATA) interface 27
- serial ATA ports 2
- Servo electronics 13
- servo electronics 13
- Set Features 31
- Set Max Address 31
- Set Max Address Extended 31
- Set Multiple Mode 31
- Shock 17
- Shock, nonoperating 5, 7, 9
- Shock, operating 5, 7, 9
- single-track seeks 12
- Sleep 14, 15, 31
- Sleep mode 4, 6, 8, 15
- sound power 7, 9
- Specification summary table 3
- Spindle speed 4, 6, 8
- spindle speed 11
- spindle stop 13
- Spinup 14
- Spinup power 13
- Standby 14, 15, 32
- Standby Immediate 32
- Standby mode 4, 6, 8, 13, 15
- standby timer 15
- Standby to Ready 13
- Standby to ready 4, 6, 8
- Start/stop times 13
- start-stop cycles 5, 7, 9, 19
- Startup current 4, 6, 8
- static-discharge 23
- sulfide-free alternatives 21
- support services 49
- Surge immunity 18

## T

- technical support services 49
- temperature 4, 6, 8, 12, 16
- Temperature gradient 4, 6, 8
- temperature gradient 16
- timer 15
- timers 15
- TMR 1

TPI 4, 6, 8  
Track density 4, 6, 8  
track density 11  
Track-to-track 12  
Track-to-track seek time 4, 6, 8, 12  
Tunneling Magnetoresistive (TMR) heads 1  
TUV North America 19

## **U**

UL 1950 19

## **V**

Vibration 17  
Vibration, nonoperating 5, 7, 9  
Vibration, operating 5, 7, 9  
voltage 13  
Voltage dips, interrupts 18  
Voltage tolerance 4, 6, 8, 15

## **W**

Weight 4, 6, 8  
Wet bulb temperature 4, 6, 8  
wet bulb temperature 16  
Width 4, 6, 8  
Write Buffer 32  
Write DMA 32  
Write DMA Extended 32  
Write DMA FUA Extended 32  
Write DMA Without Retries 32  
Write Log Extended 32  
Write Multiple 1, 32  
Write Multiple Extended 32  
Write Multiple FUA Extended 32  
Write Sectors 32  
Write Sectors Extended 32  
Write Sectors Without Retries 32





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