Product Manual

SV35 Series SATA

ST3500641SV
ST3250824SV
ST3160812SV

100415208
Rev. B
August 2007

Publication number: 100415208, Rev. B
August 2007

Contents

List of Figures

1.0 Introduction

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 surveilance 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 Queueing 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.

2.0 Drive specifications

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^2 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	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	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^{14} 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: www.seagate.com/support/service/ 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^2 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

Drive specification	ST3250824SV
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^{14} 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: www.seagate.com/support/service/ 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

Drive specification	ST3160212SCE
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^2 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	2 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

Drive specification	ST3160212SCE
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^{14} 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: www.seagate.com/support/service/ 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^2 max)	
ST3500641SV and ST3250824SV	97.69
ST3160812SV	119.0
Spindle speed (RPM) (± 0.2%)	7,200
Internal data-transfer rate (Mbits/sec max)	
ST3500641SV and ST3250824SV	815.2
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

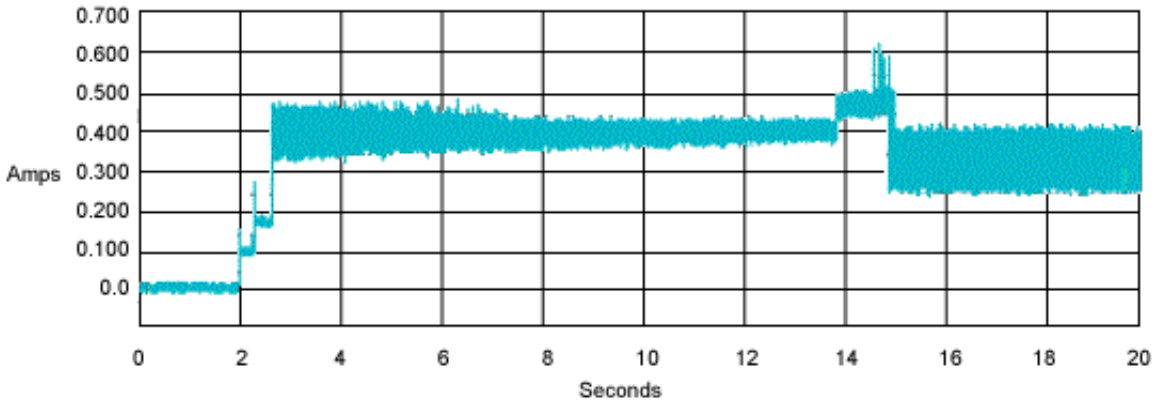

Figure 1 Typical 5V startup and operation current profile

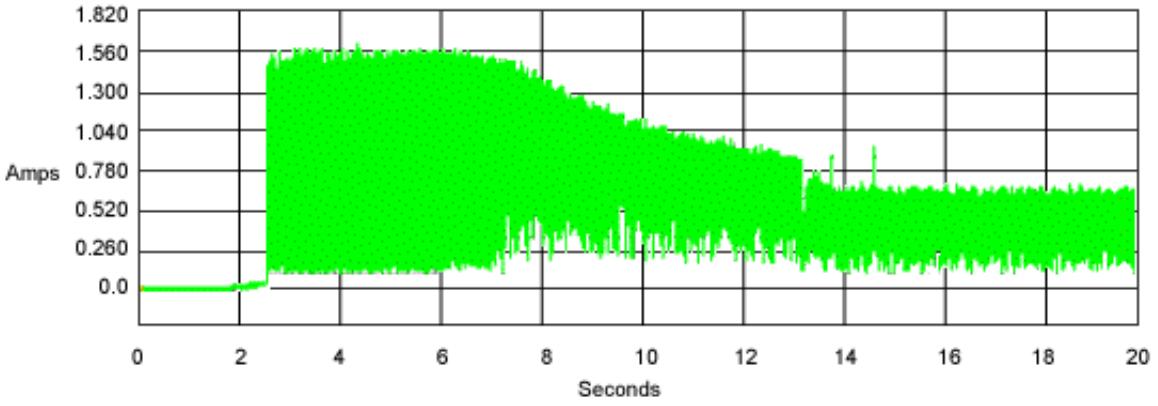

Figure 2 Typical 12V startup and operation current profile

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 ± 5%
12V ± 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:

(Number of seeks per second = 0.4 / (average latency + average access time)

Drive acoustics, sound power	
Idle	**Operational, DVR (Digital Video Recorder) seeks**
2.46 bels (typ) 2.65 bels (max)	2.8 bels (typ) 2.9 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: ± 4 kV; Air: ± 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	± 1 kV on AC mains, ± 0.5 kV on external I/O	B	EN 61000-4-4: 95
Surge immunity	± 1 kV differential, ± 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^{14} 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 rep-resentations 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 operat-ing procedures that ensure that restricted substances are not utilized in our manufacturing operations, labora-tory 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 corro-sive chemicals as electronic drive component reliability can be affected by the installation environment. The sil-ver, 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 vulca-nized 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

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.

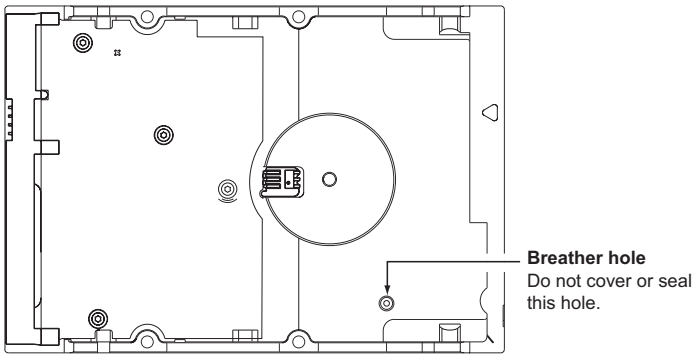

Figure 3 Breather filter hole location

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.

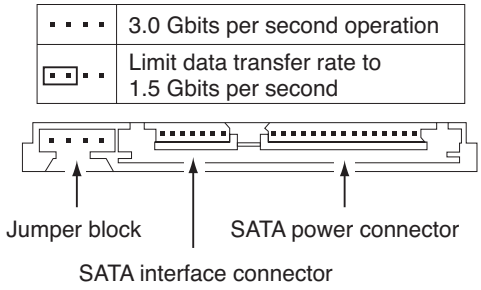

Figure 4 Serial ATA jumper block and connectors

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.

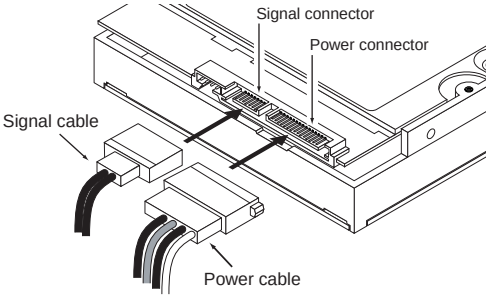

Figure 5 Attaching SATA cabling

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).

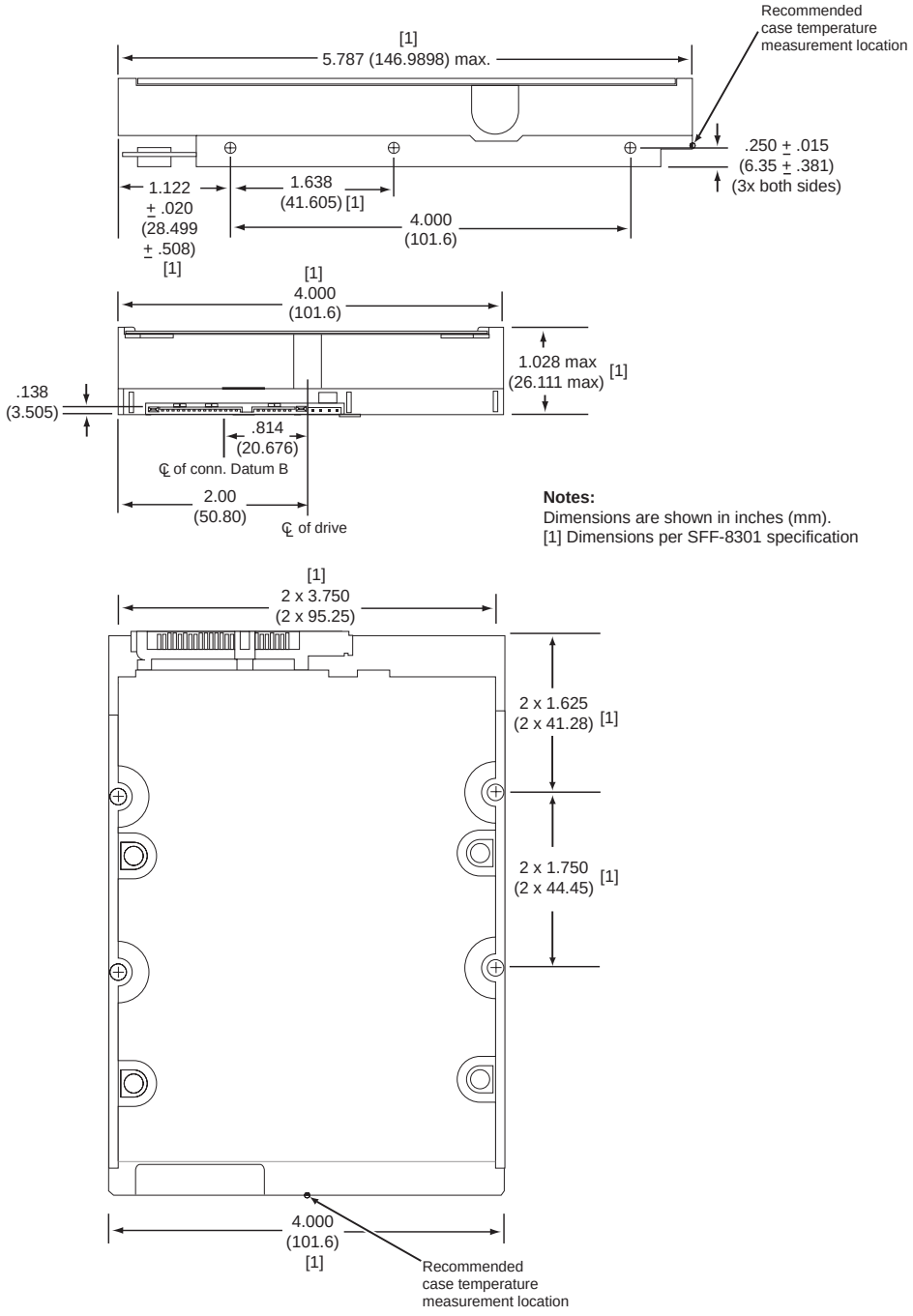

Figure 6 Mounting dimensions—top, side and end view

4.0 Serial ATA (SATA) interface

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.

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
	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+	
Signal	S7	Ground	2nd mate
Key and spacing separate signal and power segments			
	P1	V_{33}	3.3V power
	P2	V_{33}	3.3V power
	P3	V_{33}	3.3V power, pre-charge, 2nd mate
	P4	Ground	1st mate
	P5	Ground	2nd mate
	P6	Ground	2nd mate
	P7	V_5	5V power, pre-charge, 2nd mate
Power	P8	V_5	5V power
	P9	V_5	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_{12}	12V power, pre-charge, 2nd mate
	P14	V_{12}	12V power
	P15	V_{12}	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_H or $E5_H$
Device Configuration Freeze Lock	$B1_H$ / $C1_H$
Device Configuration Identify	$B1_H$ / $C2_H$
Device Configuration Restore	$B1_H$ / $C0_H$
Device Configuration Set	$B1_H$ / $C3_H$
Device Reset	08_H
Download Microcode	92_H
Execute Device Diagnostics	90_H
Flush Cache	$E7_H$
Flush Cache Extended	EA_H
Format Track	50_H
Identify Device	EC_H
Idle	97_H or $E3_H$
Idle Immediate	95_H or $E1_H$
Initialize Device Parameters	91_H
Read Buffer	$E4_H$
Read DMA	$C8_H$
Read DMA Extended	25_H
Read DMA Without Retries	$C9_H$
Read Log Ext	$2F_H$
Read Multiple	$C4_H$
Read Multiple Extended	29_H
Read Native Max Address	$F8_H$
Read Native Max Address Extended	27_H

Command name	Command code (in hex)
Read Sectors	20_H
Read Sectors Extended	24_H
Read Sectors Without Retries	21_H
Read Verify Sectors	40_H
Read Verify Sectors Extended	42_H
Read Verify Sectors Without Retries	41_H
Recalibrate	10_H
Security Disable Password	$F6_H$
Security Erase Prepare	$F3_H$
Security Erase Unit	$F4_H$
Security Freeze	$F5_H$
Security Set Password	$F1_H$
Security Unlock	$F2_H$
Seek	70_H
Set Features	EF_H
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.	$F9_H$ Address: 00_H Password: 01_H Lock: 02_H Unlock: 03_H Freeze Lock: 04_H
Set Max Address Extended	37_H
Set Multiple Mode	$C6_H$
Sleep	99_H or $E6_H$
S.M.A.R.T. Disable Operations	$B0_H$ / $D9_H$
S.M.A.R.T. Enable/Disable Autosave	$B0_H$ / $D2_H$
S.M.A.R.T. Enable Operations	$B0_H$ / $D8_H$
S.M.A.R.T. Execute Offline	$B0_H$ / $D4_H$
S.M.A.R.T. Read Attribute Thresholds	$B0_H$ / $D1_H$
S.M.A.R.T. Read Data	$B0_H$ / $D0_H$

Command name	Command code (in hex)
S.M.A.R.T. Read Log Sector	$B0_H$ / $D5_H$
S.M.A.R.T. Return Status	$B0_H$ / DA_H
S.M.A.R.T. Save Attribute Values	$B0_H$ / $D3_H$
S.M.A.R.T. Write Log Sector	$B0_H$ / $D6_H$
Standby	96_H or $E2_H$
Standby Immediate	94_H or $E0_H$
Write Buffer	$E8_H$
Write DMA	CA_H
Write DMA Extended	35_H
Write DMA FUA Extended	CD_H
Write DMA Without Retries	CB_H
Write Log Extended	$3F_H$
Write Multiple	$C5_H$
Write Multiple Extended	39_H
Write Multiple FUA Extended	CE_H
Write Sectors	30_H
Write Sectors Without Retries	31_H
Write Sectors Extended	34_H

4.3.1 Identify Device command

The Identify Device command (command code EC_H) 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: • Bit 15: 0 = ATA; 1 = ATAPI • Bit 7: removable media • Bit 6: removable controller • Bit 0: reserved	$0C5A_H$
1	Number of logical cylinders	16,383
2	ATA-reserved	0000_H
3	Number of logical heads	16
4	Retired	0000_H
5	Retired	0000_H
6	Number of logical sectors per logical track: 63	$003F_H$
7–9	Retired	0000_H
10–19	Serial number: (20 ASCII characters, 0000_H = none)	ASCII
20	Retired	0000_H
21	Retired	0400_H
22	Obsolete	0000_H
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_H
48	Reserved	0000_H
49	Standard Standby timer, IORDY supported and may be disabled	$2F00_H$
50	ATA-reserved	0000_H
51	PIO data-transfer cycle timing mode	0200_H
52	Retired	0200_H

Word	Description	Value
53	Words 54–58, 64–70 and 88 are valid	0007_H
54	Number of current logical cylinders	$xxxx_H$
55	Number of current logical heads	$xxxx_H$
56	Number of current logical sectors per logical track	$xxxx_H$
57–58	Current capacity in sectors	$xxxx_H$
59	Number of sectors transferred during a Read Multiple or Write Multiple command	$xxxx_H$
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_H
63	Multiword DMA active and modes supported (see note following this table)	$xx07_H$
64	Advanced PIO modes supported (modes 3 and 4 supported)	0003_H
65	Minimum multiword DMA transfer cycle time per word (120 nsec)	0078_H
66	Recommended multiword DMA transfer cycle time per word (120 nsec)	0078_H
67	Minimum PIO cycle time without IORDY flow control (240 nsec)	$00F0_H$
68	Minimum PIO cycle time with IORDY flow control (120 nsec)	0078_H
69–74	ATA-reserved	0000_H
75	Queue depth	0000_H
76	Serial ATA capabilities	$xxxx_H$
77	Reserved for future Serial ATA definition	$xxxx_H$
78	Serial ATA features supported	$xxxx_H$
79	Serial ATA features enabled	$xxxx_H$
80	Major version number	$003E_H$
81	Minor version number	0000_H
82	Command sets supported	$364B_H$

Word	Description	Value
83	Command sets supported	$7C03_H$
84	Command sets support extension	4003_H
85	Command sets enabled	$30xx_H$
86	Command sets enabled	0001_H
87	Command sets enable extension	4000_H
88	Ultra DMA support and current mode (see note following this table)	$xx3F_H$
89	Security erase time	0000_H
90	Enhanced security erase time	0000_H
92	Master password revision code	$FFFE_H$
93	Hardware reset value (see description following this table)	$xxxx_H$
95–99	ATA-reserved	0000_H
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: 0000FFFFFFFFFFFFh.	ST3500641SV = 976,773,168 ST3250824SV = 488,397,168 ST3160812SV = 312,581,808
104–127	ATA-reserved	0000_H
128	Security status	0001_H
129–159	Seagate-reserved	$xxxx_H$
160–254	ATA-reserved	0000_H
255	Integrity word	$xxA5_H$

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.
	Bit	**Word 88**
	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_H Enable write cache *(default).*

03_H Set transfer mode (based on value in Sector Count register).
Sector Count register values:

- 00_H Set PIO mode to default (PIO mode 2).
- 01_H Set PIO mode to default and disable IORDY (PIO mode 2).
- 08_H PIO mode 0
- 09_H PIO mode 1
- $0A_H$ PIO mode 2
- $0B_H$ PIO mode 3
- $0C_H$ PIO mode 4 *(default)*
- 20_H Multiword DMA mode 0
- 21_H Multiword DMA mode 1
- 22_H Multiword DMA mode 2
- 40_H Ultra DMA mode 0
- 41_H Ultra DMA mode 1
- 42_H Ultra DMA mode 2
- 43_H Ultra DMA mode 3
- 44_H Ultra DMA mode 4
- 45_H Ultra DMA mode 5
- 46_H Ultra DMA mode 6

10_H Enable use of SATA features

55_H Disable read look-ahead (read cache) feature.

82_H Disable write cache

90_H Disable use of SATA features

AA_H Enable read look-ahead (read cache) feature *(default).*

Table 8: Set Features command values

$F1_H$	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 $D4_H$) 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
$D0_H$	S.M.A.R.T. Read Data
$D2_H$	S.M.A.R.T. Enable/Disable Attribute Autosave
$D3_H$	S.M.A.R.T. Save Attribute Values
$D4_H$	S.M.A.R.T. Execute Off-line Immediate (runs DST)
$D5_H$	S.M.A.R.T. Read Log Sector
$D6_H$	S.M.A.R.T. Write Log Sector
$D8_H$	S.M.A.R.T. Enable Operations
$D9_H$	S.M.A.R.T. Disable Operations
DA_H	S.M.A.R.T. Return Status

Note. If an appropriate code is not written to the Features Register, the command is aborted and 0*x*04 (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)

World 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):

Default CCTL = ((content of the Features register) * (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 calcuated as follows:

CCTL = (content of the Features Register Previous) * (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.

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 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, te 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 = (content of the Features register Previous) * (IDENTIFY DEVICE data words (99:98)) 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 occured 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

Internet
For information regarding Seagate products and services, visit www.seagate.com. Worldwide support is available 24 hours daily by email for your questions.

Presales Support:
Presales@Seagate.com

Technical Support:
DiscSupport@Seagate.com

Warranty Support:
http://www.seagate.com/support/service/index.html

mySeagate
my.seagate.com is the industry's first Web portal designed specifically for OEMs and distributors. It provides self-service access to critical applications, personalized content and the tools that allow our partners to manage their Seagate account functions. Submit pricing requests, orders and returns through a single, password-protected Web interface-anytime, anywhere in the world.

spp.seagate.com
spp.seagate.com supports Seagate resellers with product information, program benefits and sales tools. You may register for customized communications that are not available on the web. These communications contain product launch, EOL, pricing, promotions and other channel-related information. To learn more about the benefits or to register, go to spp.seagate.com, any time, from anywhere in the world.

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 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.

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.

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.

Index

Numerics

A

B

C

D

E

F

G

H

I

K

L

M

N

O

P

Q

R

S

T

U

V

W

Seagate Technology LLC
920 Disc Drive, Scotts Valley, California 95066-4544, USA
Publication Number: 100415208, Rev. B, Printed in USA