Product Manual

# Momentus® Thin Series SATA

**ST92503010AS**
**ST91603010AS**

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# Revision history

| Revision | Date | Sheets affected or comments |
|---|---|---|
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| Rev. B | 03/02/10 | 3-4, 10 & 35. |



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One gigabyte, or GB, equals one billion bytes and one terabyte, or TB, equals one trillion bytes. Your computer's operating system may use a different standard of measurement and report a lower capacity. In addition, some of the listed capacity is used for formatting and other functions, and thus will not be available for data storage. Seagate reserves the right to change, without notice, product offerings or specifications.

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# 1.0 Introduction

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

- ST92503010AS
- ST91603010AS

These drives provide the following key features:

- 5400-RPM spindle speed.
- 8-MB buffer.
- Quiet operation. Fluid Dynamic Bearing (FDB) motor.
- High instantaneous (burst) data-transfer rates (up to 3Gb/s).
- Perpendicular recording technology.
- State-of-the-art cache and on-the-fly error-correction algorithms.
- Native Command Queuing (NCQ) with command ordering.
- Full-track multiple-sector transfer capability without local processor intervention.
- 1000 Gs nonoperating shock and 350 Gs of operating shock.
- SeaTools diagnostic software performs a drive self-test that eliminates unnecessary drive returns.
- The 3D Defense System™, which includes Drive Defense, Data Defense and Diagnostic Defense, offers the industry's most comprehensive protection for disk drives.
- Support for S.M.A.R.T. drive monitoring and reporting.
- Support for Read Multiple and Write Multiple commands.

## 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 normally 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 disk drive in your current system and expect all of your existing applications to work as normal.

The Serial ATA interface connects each disk 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 http://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 ST92503010AS and ST91603010AS models.

## 2.1 Specification summary table

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

**Table 1: Drive specifications**

| Drive specification | ST92503010AS | ST91603010AS |
|---|---|---|
| Formatted GB (512 bytes/sector)* | 250 | 160 |
| Guaranteed sectors | 488,397,168 | 312,581,808 |
| Bytes per sector | 512 | |
| Physical read/write heads | 2 | |
| Discs | 1 | |
| Cache (MB) | 8 | |
| Recording density in BPI (bits/in avg) | 1434k | |
| Track density TPI (tracks/in avg) | 265k | |
| Areal density (Gb/in$^2$ avg) | 380 | |
| Spindle speed (RPM) | 5400 | |
| Average latency (ms) | 5.6 | |
| Internal transfer rate (Mb/s max) | 1175 | |
| I/O data transfer rate (MB/s max) | 300 | |
| ATA data-transfer modes supported | SATA 1.0, Serial ATA Revision 2.6<br>PIO modes 0–4<br>Multiword DMA modes 0–2<br>Ultra DMA modes 0–6 | |
| Height (max) | 7.0 mm (0.276 in) | |
| Width (max) | 70.10 mm (2.76 in) | |
| Length (max) | 100.55 mm (3.959 in) | |
| Weight (max) | <92.0 g (<0.203 lb) | |
| Power-on to ready (sec typical) | 3.4 | |
| Standby to ready (sec typical) | 1.8 | |
| Track-to-track seek time, read (ms typical) | 1 | |
| Average seek, read (ms typical) | 14 | |
| Full-stroke seek, read (ms) | 30 (max) | |
| Startup current, +5V (max) | 1.0A | |
| Read/write power (typical) | Read: 1.4W; Write: 1.78W | |

## Table 1: Drive specifications

| Drive specification | ST92503010AS | ST91603010AS |
|---|---|---|
| Idle mode, low power (typical) | 0.58W | |
| Standby mode | 0.20W (typical)*** | |
| Sleep mode | 0.20W (typical)*** | |
| Voltage tolerance (including noise) | +5V ± 10% | |
| Ambient temperature | 0° to 60°C (operating), –40° to 70°C (nonoperating) | |
| Temperature gradient<br>(°C per hour max) | 20°C (operating)<br>35°C (nonoperating) | |
| Relative humidity | 5% to 95% (operating)<br>5% to 95% (nonoperating) | |
| Relative humidity gradient | 30% per hour max | |
| Wet bulb temperature<br>(°C max) | 37.7 (operating)<br>40 (nonoperating) | |
| Altitude, operating | –304.8 m to 3,048 m (–1000 ft. to 10,000+ ft.) | |
| Altitude, nonoperating<br>(meters below mean sea level, max) | –304.8 m to 12,192 m (–1000 ft. to 40,000+ ft.) | |
| Shock, operating (Gs max at 2ms) | 350 | |
| Shock, nonoperating (Gs max at 2ms) | 800 | |
| Shock, nonoperating (Gs max at 1ms) | 1000 | |
| Shock, nonoperating (Gs max at 0.5ms) | 600 | |
| Vibration, operating (Swept Sine) | 1.0 Gs (0 to peak, 5–500 Hz) | |
| Vibration, nonoperating | 5.0 Gs (0 to peak, 5–500 Hz) | |
| Drive acoustics, sound power (bels) | | |
| Idle** | 2.0 (typical)<br>2.2 (max) | |
| Performance seek | 2.4 (typical)<br>2.5 (max) | |
| Nonrecoverable read errors | 1 per $10^{14}$ bits read | |
| Annualized Failure Rate (AFR) | 0.48% | |
| Load/Unload (U/UL) cycles | | |
| 25°C, 50% relative humidity | 600,000 software-controlled power on/off cycles<br>20,000 hard power on/off cycles | |
| 32°C, 80% relative humidity<br>5°C, 80% relative humidity<br>5°C, 10% relative humidity<br>55°C, 16% relative humidity | 600,000 software-controlled power on/off cycles<br>20,000 hard power on/off cycles | |
| Warranty | To determine the warranty for a specific drive, use a web browser to access the following web page: support.seagate.com/customer/warranty_validation.jsp<br>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. | |
| Supports Hotplug operation per Serial ATA Revision 2.6 specification | Yes (requires COMPRESET from host after a hotplug event) | |

*One GB 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.

***Typical notebooks will pull power to the drive when entering S3 and S4; while in the S3 and S4 states, drive sleep and drive standby modes will not contribute to battery power consumption.

## 2.2 Formatted capacity

| Model | Formatted capacity* | Guaranteed sectors | Bytes per sector |
|---|---|---|---|
| ST92503010AS | 250 GB | 488,397,168 | 512 |
| ST91603010AS | 160 GB | 312,581,808 | |

*One GB 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 GB.

## 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 Physical organization

| Drive model | Read/write heads | Number of discs |
|---|---|---|
| ST92503010AS | 2 | 1 |
| ST91603010AS | | |

## 2.5 Recording and interface technology

| | |
|---|---|
| Interface | Serial ATA (SATA) |
| Recording method | Perpendicular |
| Recording density BPI (bits/in avg) | 1434k |
| Track density TPI (tracks/in avg) | 265k |
| Areal density (Gb/in$^2$ avg) | 380 |
| Spindle speed (RPM) (±0.2%) | 5400 |
| Maximum Internal transfer rate (Mb/s) | 1175 |
| I/O data-transfer rate (MB/s max) | 300 |
| Interleave | 1:1 |
| Cache buffer | 8 MB (8,192 KB) |

## 2.6 Physical characteristics

| Drive specification | | |
|---|---|---|
| Height | (mm)<br>(in) | 6.8 +/-0.2<br>0.268 +/-0.0079 |
| Width | (mm)<br>(in) | 69.85 +/-0.25<br>2.75 +/-0.0098 |
| Length | (mm)<br>(in) | 100.35 +0.20/-0.25<br>3.951 +0.008/-0.010 |
| Weight (max)<br>ST92503010AS and ST91603010AS | | 92.0 g<br>0.203 lb |

## 2.7 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 5000 measurements of seeks between random tracks, less overhead.

**Table 2: Typical seek times**

| Typical seek times (ms) | Read |
|---|---|
| Track-to-track | 1 |
| Average | 14 |
| Full-stroke | 30 (max) |
| Average latency | 5.56 |

**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 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.

## 2.8 Start/stop times

| Time to ready | Typical | Max @ 25°C |
|---|---|---|
| Power-on to Ready (sec) | 3.4 | 3.6 |
| Standby to Ready (sec) | 1.8 | 2.0 |

## 2.9 Power specifications

The drive receives DC power (+5V) through a native SATA power connector.

### 2.9.1 Power consumption

Power requirements for the drives are listed in the table on page 7. Typical power measurements are based on an average of drives tested, under nominal conditions, 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 disk surface and does not execute a read or write operation. Servo electronics are active. Seek mode power is measured based on three random seek operations every 100ms. This mode is not typical.

- **Read/write power and current**

  Read/write power is measured with the heads on track, based on three 63 sector read or write operations every 100ms.

- **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 model

**Table 3: DC power**

| Power dissipation | +5V input average (25° C) |
|---|---|
| Spinup (max) | 1.00A |
| Seek | 1.54W |
| Read | 1.40W |
| Write | 1.78W |
| Idle, performance* | 1.30W |
| Idle, active* | 0.70W |
| Idle, low power mode* | 0.58W |
| Standby** | 0.20W |
| Sleep | 0.20W |

*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.

**Standby power is measured at steady state (after 200ms from transition)

### 2.9.1.1 Typical current profile

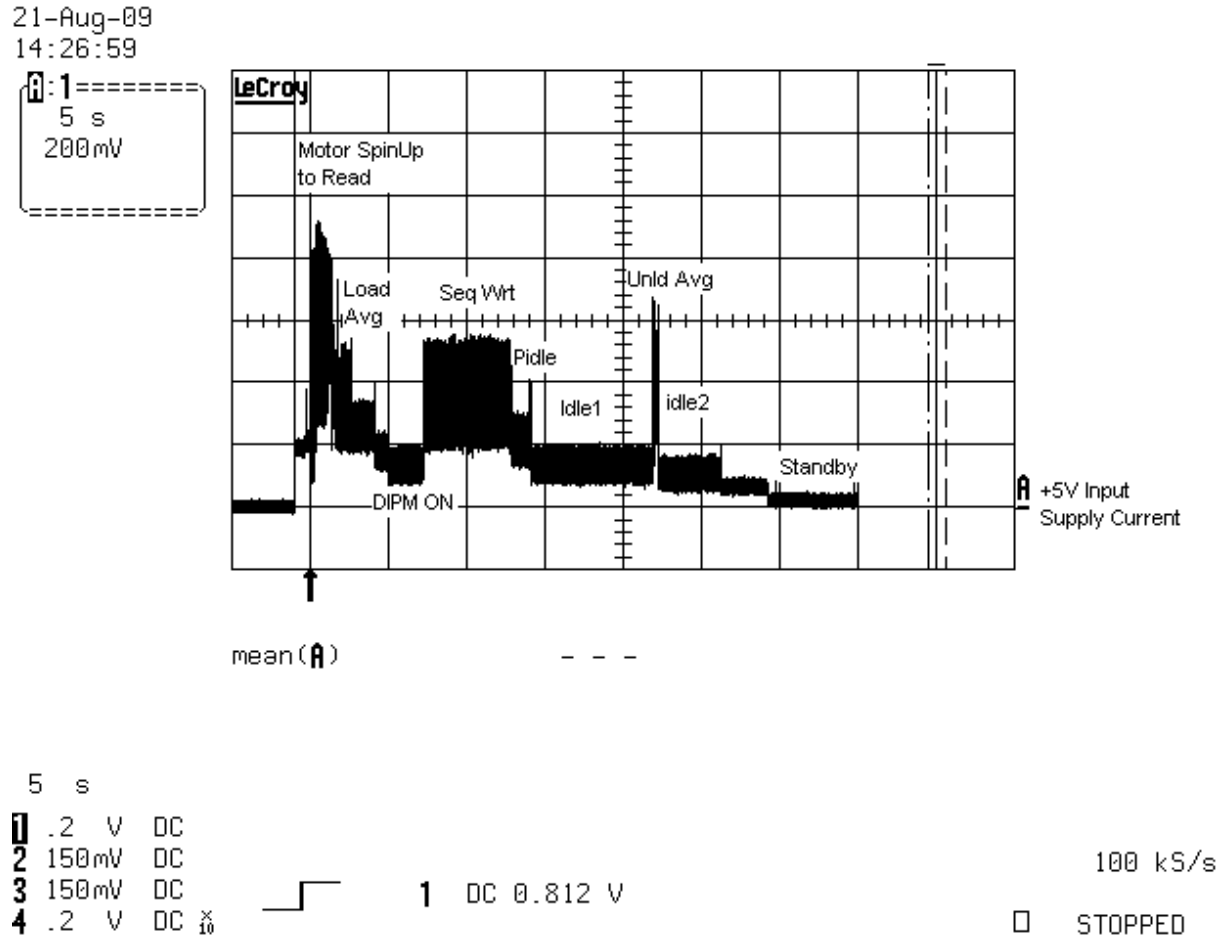


**Figure 1. Typical +5V only startup and operation current profile**

### 2.9.2 Deferred spinup

Momentus Thin Series SATA drives do not support the deferred spinup option. If you require this option, refer to the Momentus 5400.3 SATA Blade Server family of drives.

### 2.9.3 Conducted noise

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

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.

### 2.9.4 Voltage tolerance

Voltage tolerance (including noise):

5V ± 10%

### 2.9.5 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:

**Table 4: Power management modes**

| Power modes | Heads | Spindle | Buffer |
|---|---|---|---|
| Active (operating) | Tracking | Rotating | Full power |
| Idle, performance | Tracking | Rotating | Self refresh—low power |
| Idle, active | Floating | Rotating | Self refresh—low power |
| Idle, low power | Parked | Rotating | Self refresh—low power |
| Standby | Parked | Stopped | Self refresh—low power |
| Sleep | Parked | Stopped | Self refresh—low power |

- **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 disk 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 in Self Refresh Low Power mode, the heads are parked and the spindle is at rest. The drive accepts all commands and returns to Active mode any time disk 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 in Self Refresh Low Power mode, 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 disk access is necessary.

## 2.10 Environmental specifications

### 2.10.1 Ambient temperature

Ambient temperature is defined as the temperature of the environment immediately surrounding the drive.

Above 1000 feet (305 meters), the maximum temperature is derated linearly by 1°C every 1000 feet.

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

### 2.10.2 Temperature gradient

| | |
|---|---|
| Operating | 20°C per hour (68°F per hour max), without condensation |
| Nonoperating | 35°C per hour (95°F per hour max), without condensation |

### 2.10.3 Humidity

#### 2.10.3.1 Relative humidity

| | |
|---|---|
| Operating | 5% to 95% noncondensing (30% per hour max) |
| Nonoperating | 5% to 95% noncondensing (30% per hour max) |

#### 2.10.3.2 Wet bulb temperature

| | |
|---|---|
| Operating | 37.7°C (99.86°F max) |
| Nonoperating | 40°C (104°F max) |

### 2.10.4 Altitude

| | |
|---|---|
| Operating | –304.8 m to 3,048 m (–1000 ft to 10,000+ ft) |
| Nonoperating | –304.8 m to 12,192 m (–1000 ft to 40,000+ ft) |

### 2.10.5 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.

#### 2.10.5.1 Operating shock

These drives comply with the performance levels specified in this document when subjected to a maximum operating shock of 350 Gs based on half-sine shock pulses of 2ms. Shocks should not be repeated more than two times per second.

#### 2.10.5.2 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 800 Gs based on a nonrepetitive half-sine shock pulse of 2ms duration.

The nonoperating shock level that the drive can experience without incurring physical damage or degradation in performance when subsequently put into operation is 1000 Gs based on a nonrepetitive half-sine shock pulse of 1ms duration.

The nonoperating shock level that the drive can experience without incurring physical damage or degradation in performance when subsequently put into operation is 600 Gs based on a nonrepetitive half-sine shock pulse of 0.5ms duration.

### 2.10.6 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.

#### 2.10.6.1 Operating vibration

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

| | |
|---|---|
| 5–500 Hz | 1.0 Gs (0 to peak). Max displacement may apply below 10Hz. |

#### 2.10.6.2 Nonoperating vibration

The maximum nonoperating vibration levels that the drive may experience without incurring physical damage or degradation in performance when subsequently put into operation are specified below.

| | |
|---|---|
| 5–500 Hz: | 5.0 Gs (0 to peak). Max displacement may apply below 22Hz. |

## 2.11 Acoustics

Drive emission of sound is measured consistent with the ECMA-74 and its' referenced standards. Testing is conducted at room temperature (approximately 25°C). Emission levels are reported as the total A-weighted sound power levels for steady state, idle, and active seek modes of operation.

**Table 5: Drive A-weighted Sound Power Levels (SWL, BA)**

| Idle* | Performance seek |
|---|---|
| 2.0 bels (typ)<br>2.2 bels (max) | 2.4 bels (typ)<br>2.5 bels (max) |

*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.

### Test for Prominent Discrete Tones (PDTs)

Seagate follows the ECMA-74 standards for measurement and identification of PDTs. An exception to this process is the use of the absolute threshold of hearing. Seagate uses the lower limit for the threshold curve* to discern tone audibility and to compensate for the inaudible components of sound prior to computation of tone ratios according to Annex D of the ECMA-74 standards.

*Defined as the median curve given by ISO 389-7 (Tf curve) minus 10dB at all frequencies.

## 2.12 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 6: 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 2000 MHz, 10 V/m,<br>80% AM with 1 kHz sine<br>900 MHz, 3 V/m, 50% pulse modulation @ 200 Hz | A | EN 61000-4-3: 96<br>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 |
| Power Frequency H-field immunity | 1 A/m, 50Hz/60Hz, 3 axes | A | EN 61000-4-8: 97 |
| Voltage dips, interrupts | 30% Reduction for 25 cycles<br>>95% Reduction for 250 cycles<br>>95%, 0.5 cycles | C<br>C<br>B | EN 61000-4-11: 94 |

## 2.13 Reliability

| Measurement type | Specification |
|---|---|
| Nonrecoverable read errors | 1 per $10^{14}$ bits read, max. |
| Annualized Failure Rate (AFR) | <0.48% |
| Load/Unload (U/UL) | |
| 25°C, 50% relative humidity | 600,000 software-controlled power on/off cycles<br>20,000 hard power on/off cycles |
| 32°C, 80% relative humidity<br>5°C, 80% relative humidity<br>5°C, 10% relative humidity<br>55°C, 16% relative humidity | 600,000 software-controlled power on/off cycles<br>20,000 hard power on/off cycles |
| Warranty | To determine the warranty for a specific drive, use a web browser to access the following web page: support.seagate.com/customer/warranty_validation.jsp<br>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. |

## 2.14 Agency certification

### 2.14.1 Safety certification

These products are certified to meet the requirements of UL60950-1, CSA60950-1 and EN60950 and so marked as to the certify agency.

### 2.14.2 Electromagnetic compatibility

Hard drives that display the CE mark comply with the European Union (EU) requirements specified in the Electromagnetic Compatibility Directive (2004/108/EC) as put into place 20 July 2007. 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.

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 Korean Communications Commission (KCC) 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) Communications Commission, 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.

- Certificate number: STX-MomentusThin (B)
- Trade name or applicant: Seagate Technology LLC
- Manufacturing date: September 17, 2009
- Manufacturer/nationality: USA, Singapore and China

**Australian C-Tick (N176)**

If these models have the C-Tick marking, they comply with the Australia/New Zealand Standard AS/NZ CISPR22 and meet the Electromagnetic Compatibility (EMC) Framework requirements of the Australian Communication Authority (ACA).

### 2.14.3 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, disk 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.

## 2.15 Environmental protection

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

### 2.15.1 European Union Restriction of Hazardous Substances (RoHS)

The European Union Restriction of Hazardous Substances (RoHS) Directive, restricts the presence of chemical substances, including Lead, Cadmium, Mercury, Hexavalent Chromium, PBB and PBDE, in electronic products, effective July 2006. This drive is manufactured with components and materials that comply with the RoHS Directive.

### 2.15.2 China Restriction of Hazardous Substances (RoHS) Directive 中国限制危险物品的指令

This product has an Environmental Protection Use Period (EPUP) of 20 years. The following table contains information mandated by China's "Marking Requirements for Control of Pollution Caused by Electronic Information Products" Standard.


该产品具有20年的环境保护使用周期 （EPUP）。 下表包含了中国 “电子产品所导致的污染的控制的记号要求”所指定的信息。

| Name of Parts 部件名称 | Toxic or Hazardous Substances or Elements有毒有害物质或元素 | | | | | |
|---|---|---|---|---|---|---|
| | Lead 铅 （Pb） | Mercury 汞 （Hg） | Cadmium 镉 （Cd） | Hexavalent Chromium 六价铬 （Cr6+） | Polybrominated Biphenyl 多溴联苯 （PBB） | Polybrominated Diphenyl Ether 多溴二苯醚 （PBDE） |
| PCBA | X | O | O | O | O | O |
| HDA | X | O | O | O | O | O |

"O" indicates the hazardous and toxic substance content of the part (at the homogenous material level) is lower than the threshold defined by the China RoHS MCV Standard.

“O”表示该部件（于同类物品程度上）所含的危险和有毒物质低于中国RoHS MCV标准所定义的门槛值。

"X" indicates the hazardous and toxic substance content of the part (at the homogenous material level) is over the threshold defined by the China RoHS MCV Standard.

“X”表示该部件（于同类物品程度上）所含的危险和有毒物质超出中国RoHS MCV标准所定义的门槛值。

## 2.16 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

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 (ESD) bag until you are ready for installation to limit the drive's exposure to ESD.
- 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 only by its edges or frame.
- The drive is 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 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 normally not necessary to set any jumpers on this drive for proper operation. If the host system does not support SATA 3Gb/s operation, place a jumper on pins 1 and 2 to limit the drive to 1.5Gb/s operation.

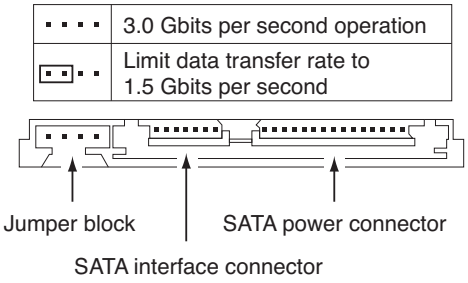


**Figure 2. Serial ATA connectors**

## 3.3 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 7 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 3.

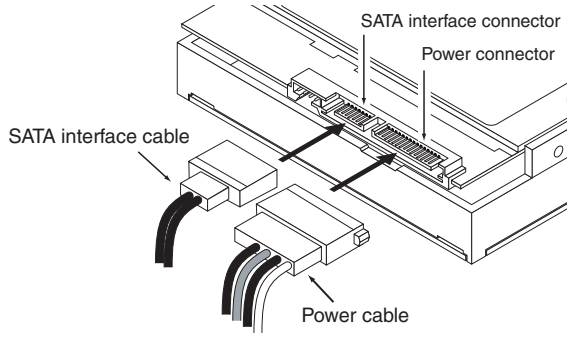


**Figure 3. Attaching SATA cabling**

Each cable is keyed to ensure correct orientation.

## 3.4 Drive mounting

You can mount the drive using four screws in the side-mounting holes or four screws in the bottom-mounting holes. See Figure 4 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 M3 UNC mounting screws.
- Do not overtighten the mounting screws. Maximum torque: 4.0 in-lb (0.4519 N-m).
- Four (4) threads (0.080 inches, 2.032 mm) minimum screw engagement recommended.
- Avoid excessive drive distortion when mounting. Refer to the following specifications for stiffness/deflection information:

| **Top cover stiffness/deflection** | |
|---|---|
| Operating with no performance degradation, emitted noise, mechanical damage, or hard errors | 10 mm probe: 1.02kgf or<br>5 mm probe: 0.92kgf |
| Non-operating with no hard errors | 20 mm probe: 2kgf at any point of top cover<br>20 mm probe: 15kgf at top cover edges only |

Measurements shown in Figure 4 are in inches.

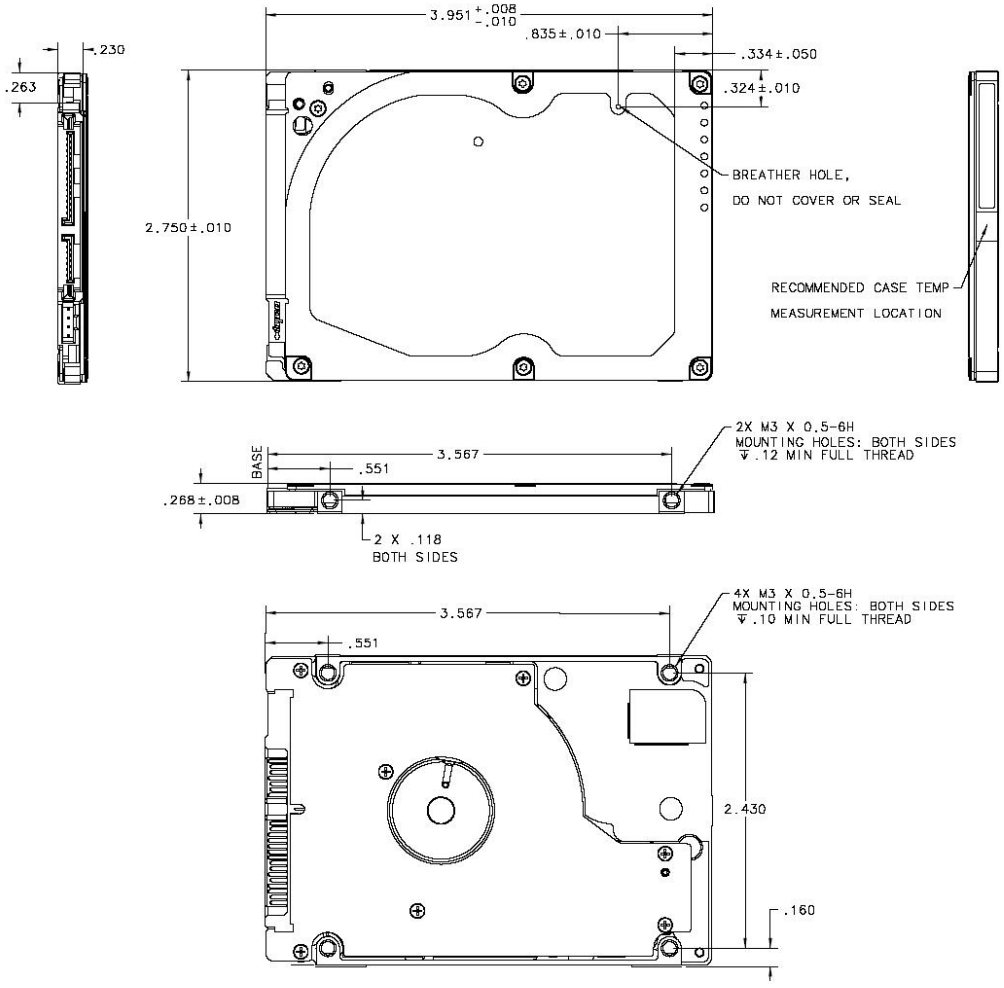


**Figure 4. Mounting dimensions—top, side and end view**

# 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. The drive also supports the use of the IORDY signal to provide reliable high-speed data transfers.

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

## 4.1 Hot-Plug compatibility

Momentus Thin Series SATA drives incorporate connectors which enable you to hot plug these drives in accordance with the Serial ATA: High Speed Serialized AT Attachment specification revision 2.0. This specification can be downloaded from http://www.serialata.org. This device requires a COMRESET from the host after a hotplug event.

## 4.2 Serial ATA device plug connector pin definitions

Table 7 summarizes the signals on the Serial ATA interface and power connectors.

**Table 7: 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 | | | |

**Table 7: Serial ATA connector pin definitions**

| Segment | Pin | Function | Definition |
|---|---|---|---|
| Power | 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 |
| | P8 | $V_5$ | 5V power |
| | P9 | $V_5$ | 5V power |
| | P10 | Ground | 2nd mate |
| | P11 | Reserved | The pin corresponding to P11 in the backplane receptacle connector is also reserved The corresponding pin to be mated with P11 in the power cable receptacle connector shall always be grounded |
| | 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 29.for details and subcommands used in the S.M.A.R.T. implementation.

| Command name | Command code (in hex) |
|---|---|
| **ATA-standard commands** | |
| Device Configuration Restore | B1h/C0h |
| Device Configuration Freeze Lock | B1h/C1h |
| Device Configuration Identify | B1h/C2h |
| Device Configuration Set | B1h/C3h |
| Download Microcode | 92h |
| Execute Device Diagnostics | 90h |
| Flush Cache | E7h |
| Flush Cache Extended | EAh |
| Identify Device | ECh |
| Initialize Device Parameters | 91h |
| Read Buffer | E4h |
| Read DMA | C8h |
| Read DMA Extended | 25h |
| Read DMA without Retries | C9h |
| Read Long with Retries | 22h |
| Read Long without Retries | 23h |
| Read Multiple | C4h |
| Read Multiple Extended | 29h |
| Read Native Max Address | F8h |
| Read Native Max Address Extended | 27h |
| Read Sectors | 20h |
| Read Sectors Extended | 24h |
| Read Sectors without Retries | 21h |
| Read Verify Sectors | 40h |
| Read Verify Sectors Extended | 42h |
| Read Verify Sectors without Retries | 41h |
| Seek | 70h |
| Set Features | EFh |
| Set Max Address | F9h |

| Command name | Command code (in hex) | |
|---|---|---|
| Note: Individual Set Max commands are identified by the value placed in the Set Max Features register as defined to the right. | Address:<br>Password:<br>Lock:<br>Unlock:<br>Freeze Lock: | $00_H$<br>$01_H$<br>$02_H$<br>$03_H$<br>$04_H$ |
| Set Multiple Mode | C6h | |
| S.M.A.R.T. Disable Operations | B0h/D9h | |
| S.M.A.R.T. Enable/Disable Autosave | B0h/D2h | |
| S.M.A.R.T. Enable Operations | B0h/D8h | |
| S.M.A.R.T. Enable/Disable Auto Offline | B0h/DBh | |
| S.M.A.R.T. Enable One Attribute Modification | B0h/E0h | |
| S.M.A.R.T. Execute Offline | B0h/D4h | |
| S.M.A.R.T. Read Attribute Thresholds | B0h/D1h | |
| S.M.A.R.T. Read Data | B0h/D0h | |
| S.M.A.R.T. Read Log Sector | B0h/D5h | |
| S.M.A.R.T. Return Status | B0h/DAh | |
| S.M.A.R.T. Save Attribute Values | B0h/D3h | |
| S.M.A.R.T. Write Attribute Thresholds | B0h/D7h | |
| S.M.A.R.T. Write Attribute Values | B0h/E1h | |
| S.M.A.R.T. Write Log Sector | B0h/D6h | |
| Write Buffer | E8h | |
| Write DMA | CAh | |
| Write DMA Extended | 35h | |
| Write DMA without Retries | CBh | |
| Write Long with Retries | 32h | |
| Write Long without Retries | 33h | |
| Write Multiple | C5h | |
| Write Multiple Extended | 39h | |
| Write Sectors | 30h, 31h | |
| Write Sectors Extended | 34h | |
| Write Uncorrectable | 45h | |
| **ATA-standard power-management commands** | | |
| Check Power Mode | E5h | |
| Idle | E3h | |
| Idle Immediate | E1h | |
| Sleep | E6h | |
| Standby | E2h | |

| Command name | Command code (in hex) |
|---|---|
| Standby Immediate | E0h |
| **ATA-standard security commands** | |
| Security Set Password | F1h |
| Security Unlock | F2h |
| Security Erase Prepare | F3h |
| Security Erase Unit | F4h |
| Security Freeze Lock | F5h |
| Security Disable Password | F6h |

### 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 the table on page 27. 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.

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

| Word | Description | Value |
|---|---|---|
| 0 | Configuration information:<br>• Bit 15: 0 = ATA; 1 = ATAPI<br>• Bit 7: removable media<br>• Bit 6: removable controller<br>• 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) | ST92503010AS<br>ST91603010AS |
| 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 | $0200_H$ |
| 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 | $xxxx_H$ |

| Word | Description | Value |
|---|---|---|
| 59 | Number of sectors transferred during a Read Multiple or Write Multiple command | $xxxx_H$ |
| 60–61 | Total number of user-addressable sectors<br>This field contains a value that is one greater than the total number of user-addressable sectors. The maximum value that shall be placed in this field is 0FFFFFFFh. The 0FFFFFFFh value applies to all capacities over 137GB (see Section 2.2 and 2.3 for related information). | ST92503010AS = 0FFFFFFFh<br>ST91603010AS = 0FFFFFFFh |
| 62 | Retired | $0000_H$ |
| 63 | Multiword DMA active and modes supported<br>(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 | $001F_H$ |
| 76 | Serial ATA capabilities | $0508_H$ |
| 77 | ATA-reserved | $0000_H$ |
| 78 | Serial ATA features supported | $0048_H$ |
| 79 | Serial ATA features enabled | $0040_H$ |
| 80 | Major version number | $003E_H$ |
| 81 | Minor version number | $0028_H$ |
| 82 | Command sets supported | $306B_H$ |
| 83 | Command sets supported | $4001_H$ |
| 84 | Command sets support extension | $4000_H$ |
| 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<br>(see note following this table) | $xx7F_H$ |
| 89 | Security erase time | $0000_H$ |
| 90 | Enhanced security erase time | $0000_H$ |
| 92 | Master password revision code | $FFFE_H$ |
| 93 | Hardware reset value<br>(see description following this table) | $xxxx_H$ |
| 94 | Auto acoustic management setting | $xxxx_H$ |

| Word | Description | Value |
|---|---|---|
| 95–99 | ATA-reserved | $0000_H$ |
| 100–103 | Total number of user-addressable LBA sectors available (see Section 2.2 for related information)<br>These words are required for drives that support the 48-bit addressing feature. Maximum value: 0000FFFFFFFFFFFFh. | ST92503010AS = 488,397,168<br>ST91603010AS = 312,581,808 |
| 104–118 | ATA-reserved | $0000_H$ |
| 119 | Free Fall Protection support (bit 5) | 1 = Free Fall Protection supported<br>0 = Free Fall Protection not supported |
| 120 | Free Fall Protection enable/disable (bit 5) | 1 = Free Fall Protection feature is enabled<br>0 = Free Fall Protection feature is disabled |
| 121–127 | 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.** 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. |
| | **Bit** | **Word 93** |
| | 13 | 1 = 80-conductor cable detected, CBLID above $V_{IH}$<br>0 = 40-conductor cable detected, CBLID below $V_{IL}$ |

### 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).<br>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 |
| $55_H$ | Disable read look-ahead (read cache) feature. |
| $82_H$ | Disable write cache |
| $AA_H$ | Enable read look-ahead (read cache) feature *(default).* |
| $C1_H$ | Disable the Free Fall Protection feature ($41_H$ above enables the Free Fall Protection feature) |
| $F1_H$ | 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 disk 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-8 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 |
| $D1_H$ | Vendor-specific |
| $D2_H$ | 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 |
| $D7_H$ | Vendor-specific |
| $D8_H$ | 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.

## 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/www/en-us/support/warranty_&_returns_assistance

**direct.seagate.com**
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## Customer Service Operations

### 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/product number available.

### 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. See www.seagate.com for the service center near 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.

**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 | 1-800-475-0143 | +1-905-474-2162 | 1-800-475-0158<br>+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.

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