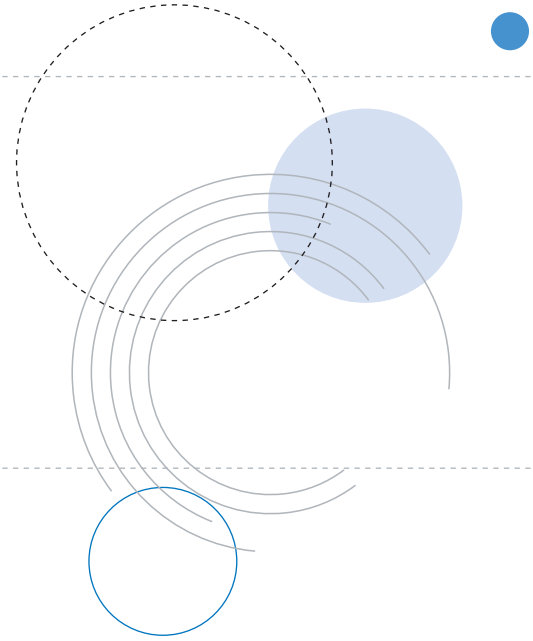

Product Manual

Momentus 5400.1 Cruise

ST93012A-AM

100354610
Rev. B
August 2007

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One gigabyte, or GB, equals one billion bytes and one terabyte, or TB, equals one trillion bytes when referring to hard drive capacity. Accessible capacity may vary depending on operating environment and formatting. Quantitative usage examples for various applications are for illustrative purposes. Actual quantities will vary based on various factors, including file size, file format, features and application software. Seagate reserves the right to change, without notice, product offerings or specifications.

Contents

List of Figures

1.0 Introduction

This manual describes the functional, mechanical and interface specifications for the following Seagate® Momentus™ 5400.1 drive:

- ST93012A-AM

This drive provides the following key features:

- 5,400-RPM spindle speed and 2-Mbyte buffer combine for superior performance.
- Quiet operation. Fluid Dynamic Bearing (FDB) motor.
- High instantaneous (burst) data transfer rates (up to 100 Mbytes per second) using Ultra DMA mode 5.
- Tunneling Magnetoresistive (TMR) recording heads.
- State-of-the-art cache and on-the-fly error-correction algorithms.
- Full-track multiple-sector transfer capability without local processor intervention.
- 800 Gs nonoperating shock, and 225 Gs 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 disc drives.
- Support for S.M.A.R.T. drive monitoring and reporting.
- Support for Read Multiple and Write Multiple commands.
- Support for autodetection of master/slave drives that use cable select (CSEL).

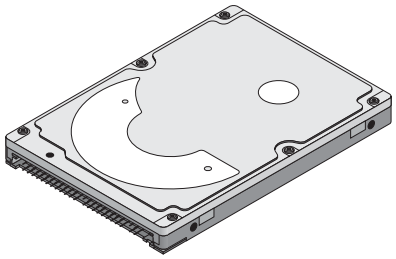

Figure 1. Momentus 5400.1 Cruise disc drive

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 ST93012A-AM model drives.

2.1 Specification summary

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: Specifications

Drive specification	**ST93012A-AM**
Formatted Gbytes (512 bytes/sector)	30
Guaranteed sectors	58,605,120
Bytes per sector	512
Physical read/write heads	2
Discs	1
Cache (Mbytes)	2
Recording density, BPI (bits/inch max)	577,000
Track density. TPI (tracks/inch max)	100,780
Areal density (Mbits/inch^2 max)	58
Spindle speed (RPM)	5,400
Internal data transfer rate OD (Mbytes/sec max)	46.05
Sustained data transfer rate OD (Mbytes/sec)	33.0
I/O data-transfer rate (Mbytes/sec max)	100
ATA data-transfer modes supported	PIO modes 0–4; Multiword DMA modes 0–2; Ultra DMA modes 0–5
Height	9.5 +/-0.2 mm (0.374 +/-.0078 inches)
Width	69.85 +/-0.25 mm (2.75 +/-0.0098 inches)
Length	100.2 +/-0.25 mm (3.945 +/-0.0098 inches)
Weight (typical)	99 grams (0.218 lb.)
Average latency (msec)	5.6
Power-on to ready (sec typical)	3.9
Standby to ready (sec typical)	2.6 sec
Startup current 5V (peak)	1.2 amps
Track-to-track seek time (msec typical)	1.5 (read), 2.0 (write)
Average seek time (msec typical)	14.0
Average seek, read (msec typical)	14.0
Average seek, write (msec typical)	16.0

Table 1: Specifications

Drive specification	ST93012A-AM
Full-stroke seek (msec)	22 (typical); 26 (max)
Seek power (typical)	2.4 watts
Read/write power (typical)	2.4 watts
Idle mode (typical)	1.2 watts
Standby mode	0.36 watts (typical)**
Sleep mode	0.36 watts (typical)**
Voltage tolerance (including noise)	5V ± 5%
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 (noncondensing)	5% to 90% (operating) 5% to 95% (nonoperating)
Relative humidity gradient	30% per hour max
Wet bulb temperature (°C max)	33°C (operating) 40°C (nonoperating)
Altitude, operating	–192.12 m to 3,048 m (–650 ft to 10,000+ ft)
Altitude, nonoperating (below mean sea level, max)	–304.8 m to 12,192 m (–1,000 ft to 40,000+ ft)
Shock, operating (Gs max at 2 msec)	225
Shock, nonoperating (Gs max at 2 msec)	800
Shock, nonoperating (Gs max at 1 msec)	800
Shock, nonoperating (Gs max at 0.5 msec)	400
Vibration, operating (max displacement may apply below 10 hz)	1.0 Gs (0 to peak, 5–500 Hz)
Vibration, nonoperating (max displacement may apply below 22 hz)	5.0 Gs (0 to peak, 5–500 Hz)
Drive acoustics, sound power (bels)	
Idle*	2.3 (typical) 2.5 (max)
Quiet seek	2.5 (typical) 2.7 (max)
Nonrecoverable read errors	1 per 10^{14} bits read
Mean time between failures (power-on hours)	330,000 at 25°C Max case temperature: 60°C
Load/Unload (U/UL) cycles	
25°C, 50% relative humidity	300,000 software-controlled power on/off cycles 20,000 hard power on/off cycles
32°C, 80% relative humidity 5°C, 80% relative humidity 5°C, 10% relative humidity 55°C, 16% relative humidity	100,000 software-controlled power on/off cycles 20,000 hard power on/off cycles
Service life	5 Years
Warranty	1 Year

*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
ST93012A-AM	30 Gbytes	58,605,120	512

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

Model	Read/write heads	Number of discs
ST93012A-AM	2	1

2.5 Recording and interface technology

Technology	Specification
Interface	Parallel ATA
Recording method	RLL 0,11
Recording density BPI (bits/inch max)	577,000
Track density TPI (tracks/inch max)	100,780
Areal density (Mbits/inch^2 max)	58
Spindle speed (RPM) (± 0.2%)	5,400
Internal data-transfer rate OD (Mbytes/sec max)	46.05
Sustained data transfer rate OD (Mbytes/sec max)	33.0
I/O data-transfer rate (Mbytes/sec max)	100 (Ultra DMA mode 5)
Interleave	1:1
Cache buffer	2 Mbytes (2,048 kbytes)

2.6 Physical characteristics

Height	(mm) (inches)	9.5 +/-0.2 0.374 +/-0.0078
Width	(mm) (inches)	69.85 +/-0.25 2.75 +/-0.0098
Length	(mm) (inches)	100.2 +/-0.25 3.945 +/-0.0098
Typical weight	(grams) (pounds)	99 0.218

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 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	1.5	2.0
Average	14.0	16.0
Full-stroke	24.0	26.0
Average latency	5.6	5.6

*Measured in quiet mode

Note. This drives is designed to consistently meet the seek times represented in this manual. Physical seeks, (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.

2.8 Time to ready

Time to ready	Typical	Max
Power-on to Ready (sec)	3.9	8
Standby to Ready (sec)	2.6	8

2.9 Power specifications

The drive receives DC power (+5V) through the interface connector.

2.9.1 Power consumption

Power requirements for the drives are listed in the table on page 8. Typical power measurements are based on an average of drives tested, under nominal conditions, using 5.0V 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 is measured based on three random seek operations every 100 msecs. 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 100 msecs.

- **Operating power and current**

  Operating power is measured using 40 percent random seeks, 40 percent read/write mode (1 write for each 10 reads) and 20 percent drive idle mode.

- **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 2: DC power

Power dissipation (watts)	Average (watts, 25° C)	5V typ amps
Spinup	—	1.2
Idle, performance mode	2.00	0.4
Idle, active	1.20	0.24
Idle, low power mode	0.97	0.19
Operating 40% r/w. 40% seek, 20% inop.	2.87	0.72
Seeking	2.4	0.48
Read	2.4	0.48
Write	2.4	0.48
Standby	0.36	0.07
Sleep	0.36	0.07

*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.

2.9.1.1 Typical current profile

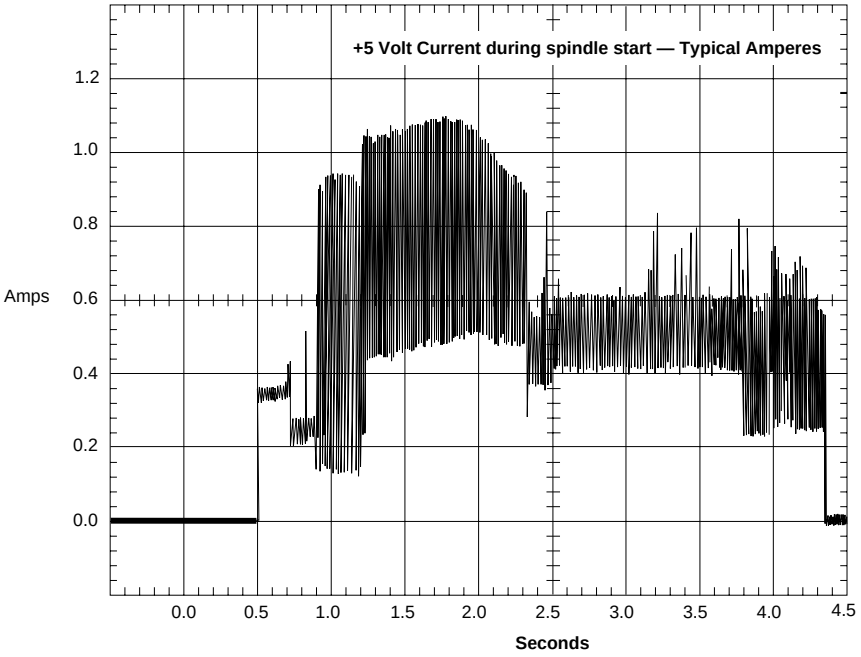

Figure 2. Typical 5V startup and operation current profile

2.9.2 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.

2.9.3 Voltage tolerance

Voltage tolerance (including noise):

5V ± 5%

2.9.4 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:

Table 3: Power management modes

Power modes	Heads	Spindle	Buffer
Active (operating)	Tracking	Rotating	Enabled
Idle, performance	Tracking	Rotating	Enabled
Idle, active	Floating	Rotating	Disabled
Idle, low power	Parked	Rotating	Disabled
Standby	Parked	Stopped	Disabled
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.

2.10 Environmental specifications

2.10.1 Ambient temperature

Ambient temperature is defined as the temperature of the environment immediately surrounding the drive. Actual drive case temperature should not exceed 60°C (140°F) within the operating ambient conditions.

Above 1,000 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	30°C per hour (86°F per hour max)

2.10.3 Humidity

2.10.3.1 Relative humidity

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

2.10.3.2 Wet bulb temperature

Operating	33°C (91.4°F max)
Nonoperating	40°C (104°F max)

2.10.4 Altitude

Operating	–198.12 m to 3,048 m (–650 ft to 10,000+ ft)
Nonoperating	–304.8 to 12,192 m (–1,000 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 225 Gs based on half-sine shock pulses of 2 msec. 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 2 msec duration.

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 1 msec duration.

The nonoperating shock level that the drive can experience without incurring physical damage or degradation in performance when subsequently put into operation is 400 Gs based on a nonrepetitive half-sine shock pulse of 0.5 msec 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 following table lists the maximum vibration levels that the drive may experience while meeting the performance standards specified in this document.

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

2.10.6.2 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.

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

2.11 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)

Table 4: Drive level acoustics

Acoustic mode	
Idle*	**Quiet Seek**
2.3 bels (typ) 2.5 bels (max)	2.5 bels (typ) 2.7 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.

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 5: Electromagnetic immunity

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

2.13 Reliability

Measurement type	Specification
Nonrecoverable read errors	1 per 10^{14} bits read, max.
Mean time between failures	330,000 power-on hours At nominal power, 25°C ambient temperature. Max case temperature: 60°C at the case measurement location shown in Figure 4.
Load/Unload (U/UL)	
25°C, 50% relative humidity	300,000 software-controlled power on/off cycles 20,000 hard power on/off cycles
32°C, 80% relative humidity 5°C, 80% relative humidity 5°C, 10% relative humidity 55°C, 16% relative humidity	100,000 software-controlled power on/off cycles 20,000 hard power on/off cycles
Service Life	5 Years
Warranty	1 Year

2.14 Agency certification

2.14.1 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.

2.14.2 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): ST93012A-AM
- Certificate numbers:
  ST93012A-AM E-H011-03-1191(B)
- Trade name or applicant: Seagate Technology
- Manufacturing date: April 2003
- 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/NZS3548 1995 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, 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.

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 Jumper settings

3.2.1 Master/slave configuration

Use the options jumper block shown in Figure 3 to configure the drive for operation. This jumper block is the 4-pin header adjacent to pins 1 and 2 of the I/O signal pins. For additional information about using the Cable select option, see section 3.2.2.

The "Master or single drive" option is the factory default setting.

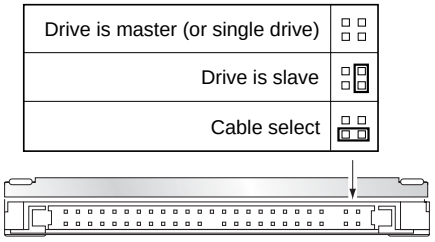

Figure 3. Jumper settings

3.2.2 Cable-select option

Computers that use cable select determine the master and slave drives by selecting or deselecting pin 28, CSEL, on the interface bus. Master and slave drives are determined by their physical position on the cable. To enable cable select, set a jumper as shown in Figure 3. Refer to your computer manual to determine whether your computer supports this option.

3.3 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 inch-lb).
- Four (4) threads (0.080 inches) minimum screw engagement recommended.

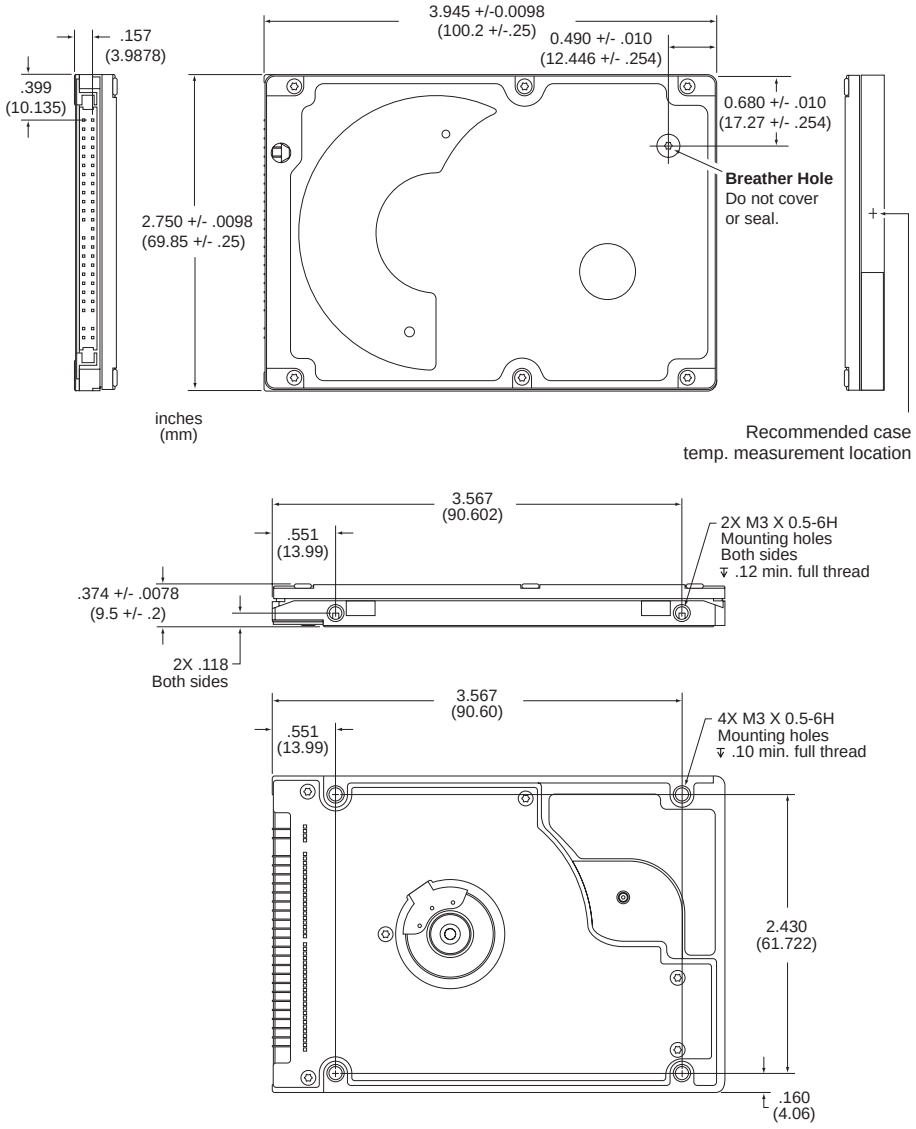

Figure 4. Mounting dimensions—top, side and end view

4.0 ATA interface

These drives use the industry-standard ATA task file interface that supports 16-bit data transfers. It supports ATA programmed input/output (PIO) modes 0–4; multiword DMA modes 0–2, and Ultra DMA modes 0–5. The drive also supports the use of the IORDY signal to provide reliable high-speed data transfers.

For detailed information about the ATA interface, refer to the draft of *AT Attachment with Packet Interface Extension (ATA/ATAPI-6), NCITS T13 1410D,* subsequently referred to as the *Draft ATA-6 Standard*.

4.1 ATA interface signals and connector pins

The following table summarizes the signals on the 44-pin ATA interface connector. For a detailed description of these signals, refer to the *Draft ATA-6 Standard.*

Table 6: Connector signals

Signal Name	Connector Contact	Cable Conductor	Cable Conductor	Connector Contact	Signal Name
RESET-	1	1	2	2	Ground
DD7	3	3	4	4	DD8
DD6	5	5	6	6	DD9
DD5	7	7	8	8	DD10
DD4	9	9	10	10	DD11
DD3	11	11	12	12	DD12
DD2	13	13	14	14	DD13
DD1	15	15	16	16	DD14
DD0	17	17	18	18	DD15
Ground	19	19	20	20	(keypin)
DMARQ	21	21	22	22	Ground
DIOW-	23	23	24	24	Ground
DIOR-	25	25	26	26	Ground
IORDY	27	27	28	28	PSYNC:CSEL
DMACK-	29	29	30	30	Ground
INTRQ	31	31	32	32	IOCS16-
DA1	33	33	34	34	PDIAG-
DA0	35	35	36	36	DA2
CS1FX-	37	37	38	38	CS3FX-
DASP-	39	39	40	40	Ground
+5 V (Logic)	41	41	42	42	+5V (Motor)
Ground (Return)	43	43	44	44	No connection

4.1.1 Supported ATA commands

The following table lists ATA-standard commands that the drive supports. For a detailed description of the ATA commands, refer to the *Draft ATA-6 Standard.* See “S.M.A.R.T. commands” on page 27. for details and sub-commands used in the S.M.A.R.T. implementation.

Table 7: Supported commands

Command name	Command code (in hex)
ATA-standard commands	
ATA Device Configuration Overlay	$B1_H$
ATA Service	$A2_H$
Check Power Mode	$98_{H,}$ $E5_H$
Download Microcode	92_H
Execute Device Diagnostics	90_H
Flush Cache	$E7_H$
Flush Cache Extended	EA_H
Format Track (Legacy)	50_H
Identify Device	EC_H
Idle	$97_{H,}$ $E3_H$
Idle Immediate	$95_{H,}$ $E1_H$
Initialize Device Parameters	91_H
Read Buffer	$E4_H$
Read DMA	$C8_{H,}$ $C9_H$
Read DMA Extended	25_H
Read Log Extended	22_H
Read Multiple	$C4_H$
Read Multiple Extended	29_H
Read Native Max Address	$F8_H$
Read Native Max Address Extended	27_H
Read Sectors	$20_{H,}$ 21_H
Read Sectors Extended	24_H
Read Verify Sectors	$40_{H,}$ 41_H
Read Verify Sectors Extended	42_H
Recalibrate	10_H
Security Disable Password	$F6_H$
Security Erase Prepare	$F3_H$
Security Erase Unit	$F4_H$
Security Freeze Lock	$F5_H$
Security Set Password	$F1_H$

Table 7: Supported commands

Command name	Command code (in hex)
Security Unlock	$F2_H$
Seek	70_H
Set Drive Parameters	91_H
Set Features	EF_H
Set Max Address	$F9_H$
Note: Individual Set Max commands are identified by the value placed in the Set Max Features register as defined to the right.	Address: 00_H Password: 01_H Lock: 02_H Unlock: 03_H Freeze Lock: 04_H
Set Multiple Mode	$C6_H$
Sleep	99_H, $E6_H$
S.M.A.R.T.	$B0_H$
Standby	96_H, $E2_H$
Standby Immediate	94_H, $E0_H$
Vendor Unique	$9A_H$, FA_H, FB_H
Write Buffer	$E8_H$
Write DMA	CA_H, CB_H
Write DMA Extended	35_H
Write Log Extended	32_H
Write Multiple	$C5_H$
Write Multiple Extended	39_H
Write Sectors	30_H, 31_H
Write Sectors Extended	34_H
ATA-standard power-management commands	
Check Power Mode	98_H or $E5_H$
Idle	97_H or $E3_H$
Idle Immediate	95_H or $E1_H$
Sleep	99_H or $E6_H$
Standby	96_H or $E2_H$
Standby Immediate	94_H or $E0_H$
ATA-standard security commands	
Security Set Password	$F1_H$
Security Unlock	$F2_H$
Security Erase Prepare	$F3_H$
Security Erase Unit	$F4_H$

Table 7: Supported commands

Command name	Command code (in hex)
Security Freeze Lock	$F5_H$
Security Disable Password	$F6_H$

4.1.2 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. 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 *Draft ATA-6 Standard.*

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)	ST93012A-AM
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	$xxxx_H$
59	Number of sectors transferred during a Read Multiple or Write Multiple command	$xxxx_H$

Word	Description	Value
60–61	Total number of user-addressable LBA sectors available (see Section 2.2 for related information)	ST93012A-AM = 58,605,120
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
76–79	ATA-reserved	0000_H
80	Major version number	$007E_H$
81	Minor version number	0000_H
82	Command sets supported	$346B_H$
83	Command sets supported	$7D09_H$
84	Command sets support extension	4003_H
85	Command sets enabled	$34xx_H$
86	Command sets enabled	$3xxx_H$
87	Command sets enable extension	4003_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
91	Advanced power management value	0040_H
92	Master password revision code	$FFFE_H$
93	Hardware reset value (see description following this table)	$xxxx_H$
94	Auto acoustic management setting	$xxxx_H$
95–127	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, 93 and 94 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.
	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.
	Bit	**Word 93**
	13	1 = 80-conductor cable detected, CBLID above V_{IH} 0 = 40-conductor cable detected, CBLID below V_{IL}

4.1.3 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: Features register 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
05_H	Enable advanced power management	
55_H	Disable read look-ahead (read cache) feature.	
82_H	Disable write cache.	
AA_H	Enable read look-ahead (read cache) feature *(default).*	
$F1_H$	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.

4.1.4 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-6 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: Supported 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

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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:
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Warranty Support:
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Seagate Service Centers

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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

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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

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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

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Index

J

K

L

M

N

O

P

R

S

T

U

V

W

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