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Product Manual

Momentum® 5400 FDE.2 SATA

ST9160824AS

ST9120827AS

ST980816AS

100443773
Rev. B
August 2007

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Publication number: 100443773, 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.

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1.0 Introduction

This manual describes the functional, mechanical and interface specifications for the following Seagate Momentus® 5400 FDE.2 SATA model drives:

ST9160824AS

ST9120827AS

ST980816AS

These drives provide the following key features:

- Trusted Drive technology including:
 - Hardware Full Disc Encryption (FDE)
 - Drive Trust security interface and ATA security interface
 - Pre-boot authentication and initialization using the drive's secure partition and Drive Trust API
 - Encryption key escrow. Consult with your ISV.
- 5,400-RPM spindle speed and 8-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 6.
- 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.
- 900 Gs nonoperating shock and 350 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.

1.1 System requirements

The following hardware and software is required to use these drives.

Host system requirements:

- Windows XP with Service Pack 2 (or later) when utilizing the Windows Drive Trust API.
- System/BIOS that supports ATA Security commands.

1.2 About Momentus 5400 FDE.2 SATA disc drives

The Momentus® 5400 FDE.2 SATA drives contain drive trust technology providing Full-Disc Encryption (FDE) using proven Advanced Encryption Standard (AES) data encryption and decryption.

Feature list

- Automatically encrypts (and decrypts) all data on the drive
- Operations are performed with no measurable performance loss
- All user data is encrypted on write operations and decrypted on read operations

Benefits

- Drive-level protection of data
- Drives that are stolen, taken out of service, or re-purposed remain fully protected
- Near instantaneous disposal and re-purposing of the drive (ensures that data from previous user is not accessible by the new drive owner)
- Able to be deployed within a trusted computing environment

The drive encrypts every write operation and decrypts every read operation without user intervention. The encryption and decryption is done on the drive itself, so there is a near-zero performance impact when the drive writes and reads data. The performance-optimized encryption and decryption engine performs at the SATA interface speed.

The purpose of full-disc encryption on the drive is to protect the data stored on the drive in the event that the host system is lost or stolen. This data at rest protection assures the system owner that if their system is lost or stolen, their data will not be accessible without the correct credentials.

Note. To ensure that the system reauthenticates the user, turn the laptop power off (shut down) rather than putting it in sleep mode. The system will authenticate the user at powerup.

Having the encryption/decryption on the drive also provides the highest level of security for data because all data, including the boot sector bytes, operating system, temp and even the swap files are encrypted at the drive level.

Momentum 5400 FDE.2 SATA drives contain two security interfaces:

1. The ATA Security Interface

This interface is provided for compatibility with the existing ATA Security Command Set. The ATA Security Interface is active upon shipment and ready for use.

2. The Drive Trust Security Interface

This interface is provided to enable a robust enterprise-level security and management policy. Use of the Drive Trust Security Interface requires additional software to manage the Drive Trust interface. Please contact your system or software provider for more details.

1.2.1 Drive state upon shipment

Upon shipment from the Seagate factory, the ATA Security Interface is enabled and functioning. The following is the detailed state of the drive upon shipment.

- Full Disc Encryption is active and functioning. All user data is encrypted on write and decrypted on read.
- The user interface to the drive is active and all read and write commands are allowed.
- The ATA user password is null (no value).
- The ATA master password is set to the Security ID (SID).
- ATA Security is set to the unlocked state. No password is required to access the drive.

Momentum 5400 FDE.2 SATA drives may be integrated into the computer system in the same way you would integrate a non-FDE Momentum drive.

The encryption key is enabled and operational when the drive leaves the Seagate factory. No user id is required to access the drive, so the data on the drive is accessible to anyone possessing the 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 the ST9160824AS, ST9120827AS and ST980816AS 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	ST9160824AS	ST9120827AS	ST980816AS
Formatted Gbytes (512 bytes/sector)*	160	120	80
Guaranteed sectors	312,581,808	234,441,648	156,301,488
Bytes per sector	512		
Physical read/write heads	4	3	2
Discs	2	2	1
Cache (Mbytes)	8		
Recording density in BPI (bits/inch max)	870k		
Track density TPI (tracks/inch max)	150k		
Areal density (Gbits/inch ² max)	132		
Spindle speed (RPM)	5,400		
Internal transfer rate (Mbits/sec max)	352		
I/O data transfer rate (Mbytes/sec max)	150		
ATA data-transfer modes supported	SATA 1.0, Serial ATA Revision 2.5 PIO modes 0–4 Multiword DMA modes 0–2 Ultra DMA modes 0–6		
Height (max)	9.5 +/- 0.2 mm (0.374 +/- .0078 inches)		
Width (max)	69.85 mm (2.75 +/- 0.0098 inches)		
Length (max)	100.50 +/- 0.25 mm (3.957 +/- 0.010 inches)		
Weight (typical)	100 grams (0.22 lb)		96 grams (0.21 lb)
Average latency (msec)	5.6		
Power-on to ready (sec typical)	3.0		
Standby to ready (sec typical)	3.0		
Track-to-track seek time (msec typical)	1.0 (read), 1.5 (write)		
Average seek, read (msec typical)	12.5		
Average seek, write (msec typical)	14.5		
Full-stroke seek (msec)	22 (typical); 24 (max)		

Table 1: Drive specifications

Drive specification	ST9160824AS	ST9120827AS	ST980816AS
Startup current, +5V (typical)	1.0 amps		
Seek power (typical)	2.0 watts		
Read/write power (typical)	Read: 1.9 watts; Write: 1.8 watts		
Idle mode, low power (typical)	0.85 watts		
Standby mode	0.46 watts (typical)***		
Sleep mode	0.46 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	5% to 90% (operating) 5% to 95% (nonoperating)		
Relative humidity gradient	30% per hour max		
Wet bulb temperature (°C max)	30 (operating) 40 (nonoperating)		
Altitude, operating	-304.8 m to 3,048 m (-1000 ft to 10,000+ ft)		
Altitude, nonoperating (meters below mean sea level, max)	-304.8 m to 12,192 m (-1000 ft to 40,000+ ft)		
Shock, operating (Gs max at 2 msec)	350		
Shock, nonoperating (Gs max at 2 msec)	800		
Shock, nonoperating (Gs max at 1 msec)	900		
Shock, nonoperating (Gs max at 0.5 msec)	400		
Vibration, operating	1.0 G (0 to peak, 5–500 Hz)		
Vibration, nonoperating	5 Gs (0 to peak, 5–500 Hz)		
Drive acoustics, sound power (bels)			
Idle**	2.4 (typical) 2.6 (max)		
Performance seek	3.0 (typical) 3.2 (max)		
Nonrecoverable read errors	1 per 10 ¹⁴ bits read		
Annualized Failure Rate (AFR)	<0.60%		
Load/Unload (U/UL) cycles			
25°C, 50% relative humidity	600,000 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	600,000 software-controlled power on/off cycles 20,000 hard power on/off cycles		
Warranty	5 years on distribution units. To determine the warranty for a specific drive, use a web browser to access the following web page: www.seagate.com/support/service/ From this page, click on the "Verify Your Warranty" link. You will be asked to provide the drive serial number, model number (or part number) and country of purchase. The system will display the warranty information for your drive.		
Supports Hotplug operation per Serial ATA Revision 2.5 specification	Yes (requires COMPRESET from host after a hotplug event)		

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

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

***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
ST9160824AS	160 Gbytes	312,581,808	512
ST9120827AS	120 Gbytes	234,441,648	512
ST980816AS	80 Gbytes	156,301,488	512

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

2.2.1 LBA mode

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

See Section 4.2.5, "Identify Device command" (words 60-61 and 100-103) for additional information about 48-bit addressing support of drives with capacities over 137 Gbytes.

2.3 Default logical geometry

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

LBA mode

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

2.4 Physical organization

Drive model	Read/write heads	Number of discs
ST9160824AS	4	2
ST9120827AS	3	2
ST980816AS	2	1

2.5 Recording and interface technology

Interface	Serial ATA (SATA)
Recording method	Perpendicular
Recording density BPI (bits/inch max)	870k
Track density TPI (tracks/inch max)	150k
Areal density (Gbits/inch ² max)	132
Spindle speed (RPM) ($\pm 0.2\%$)	5,400
Maximum Internal transfer rate (Mbits/sec)	352
I/O data-transfer rate (Mbytes/sec max)	150
Interleave	1:1
Cache buffer	8 Mbytes (8,192 kbytes)

2.6 Physical characteristics

Drive specification	
Height	(mm) 9.5 +/-0.2 (inches) 0.374 +/-0.0078
Width	(mm) 69.85 +/-0.25 (inches) 2.75 +/-0.0098
Length	(mm) 100.50 +/-0.25 (inches) 3.957 +/-0.010
Typical weight	
ST9160824AS	100 grams
ST9120827AS	0.22 pounds
ST980816AS	96 grams 0.21 pounds

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 5,000 measurements of seeks between random tracks, less overhead.

Typical seek times (msec)	Read	Write
Track-to-track	1.0	1.5
Average	12.5	14.5
Full-stroke	22.0	24.0
Average latency	5.56	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)	3.0	8.0
Standby to Ready (sec)	3.0	8.0

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 table 2. 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 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 msec. 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 msec.

- **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 2: DC power

Power dissipation	+5V input average (25° C)
Spinup (typical)	1.0 amps
Seek	2.0 watts
Read	1.9 watts
Write	1.8 watts
Idle, performance*	1.5 watts
Idle, active*	0.9 watts
Idle, low power mode*	0.85 watts
Standby	0.46 watts
Sleep	0.46 watts

*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

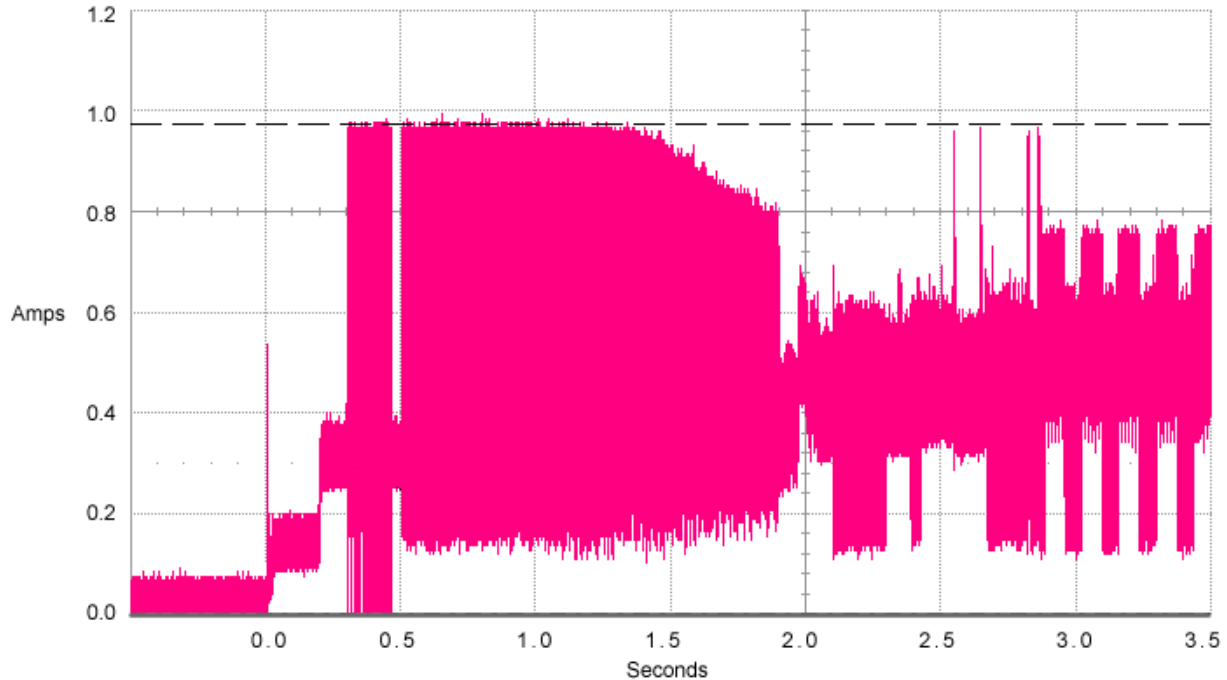


Figure 1. Typical +5V only startup and operation current profile

2.9.2 Deferred spinup

Momentum 5400 FDE.2 SATA drives do not support the deferred spinup option. If you require this option, refer to the Momentum 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 \pm 5%

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 3: 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 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 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 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 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 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 65°C (149°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), without condensation

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	30°C (86°F max)
Nonoperating	40°C (104°F max)

2.10.4 Altitude

Operating	-304.8 m to 3,048 m (-1,000 ft to 10,000+ ft)
Nonoperating	-304.8 m 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 350 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 900 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 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 10 Hz.
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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 22 Hz.
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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:

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

Models		Idle*	Performance seek
2 discs	ST9160824AS	2.4 bels (typ)	3.0 bels (typ)
	ST9120827AS	2.6 bels (max)	3.2 bels (max)
1 disc	ST980816AS	2.2 bels (typ)	2.9 bels (typ)
		2.4 bels (max)	3.1 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:

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 2,000 MHz, 10 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
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 >95% Reduction for 250 cycles >95%, 0.5 cycles	C C 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)	<0.60%
Load/Unload (U/UL) 25°C, 50% relative humidity 32°C, 80% relative humidity 5°C, 80% relative humidity 5°C, 10% relative humidity 55°C, 16% relative humidity	 600,000 software-controlled power on/off cycles 20,000 hard power on/off cycles 600,000 software-controlled power on/off cycles 20,000 hard power on/off cycles
Warranty	5 years on distribution units. Important: When returning a drive for warranty support, if possible, you should provide the valid ATA Master password, or return the drive in the Security Erased state with the User Data Area accessible. If these recommendations are not followed, Seagate cannot access the drive to perform failure analysis to verify your warranty claim. To determine the warranty for a specific drive, use a web browser to access the following web page: www.seagate.com/support/service/ From this page, click on the “Verify Your Warranty” link. You will be asked to provide the drive serial number, model number (or part number) and country of purchase. The system will display the warranty information for your drive.

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.

- Model name: Momentus 5400.3
- Certificate number: STX-L253 (B)

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.

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 (Pb), in electronic products effective July 2006.

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

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

2.16 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.

Momentum® 5400 FDE.2 SATA drives can be connected to a computer system using a standard SATA interface. The host system must support the ATA pass-through facility to successfully use these drives. Additionally, in the Windows environment, users not having administrator rights on their user account will be required to load a Seagate-supplied driver.

The following operating systems support the required pass-through facilities:

- Windows XP, Service Pack 2 (and later)
- Windows 2003 Server, Service Pack 1 (and later). This OS has not been tested by Seagate.

Momentum® 5400 FDE.2 SATA drives may be used as boot drives when used with these operating systems.

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 with no jumpers, terminators, or other settings. It is not necessary to set any jumpers on this drive for proper operation. The jumper block adjacent to the signal connector is for factory use only.

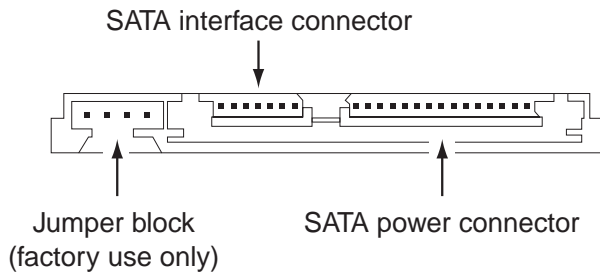


Figure 2. Serial ATA connectors

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 4 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.

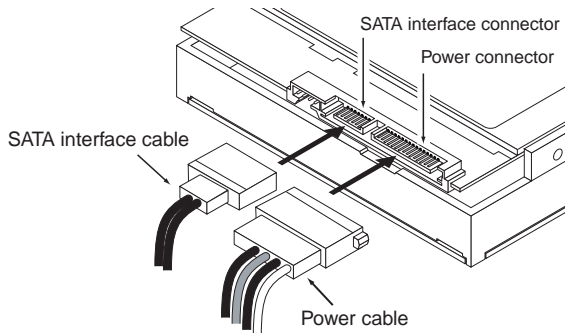


Figure 3. Attaching SATA cabling

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

Measurements shown in Figure 4 are in inches.

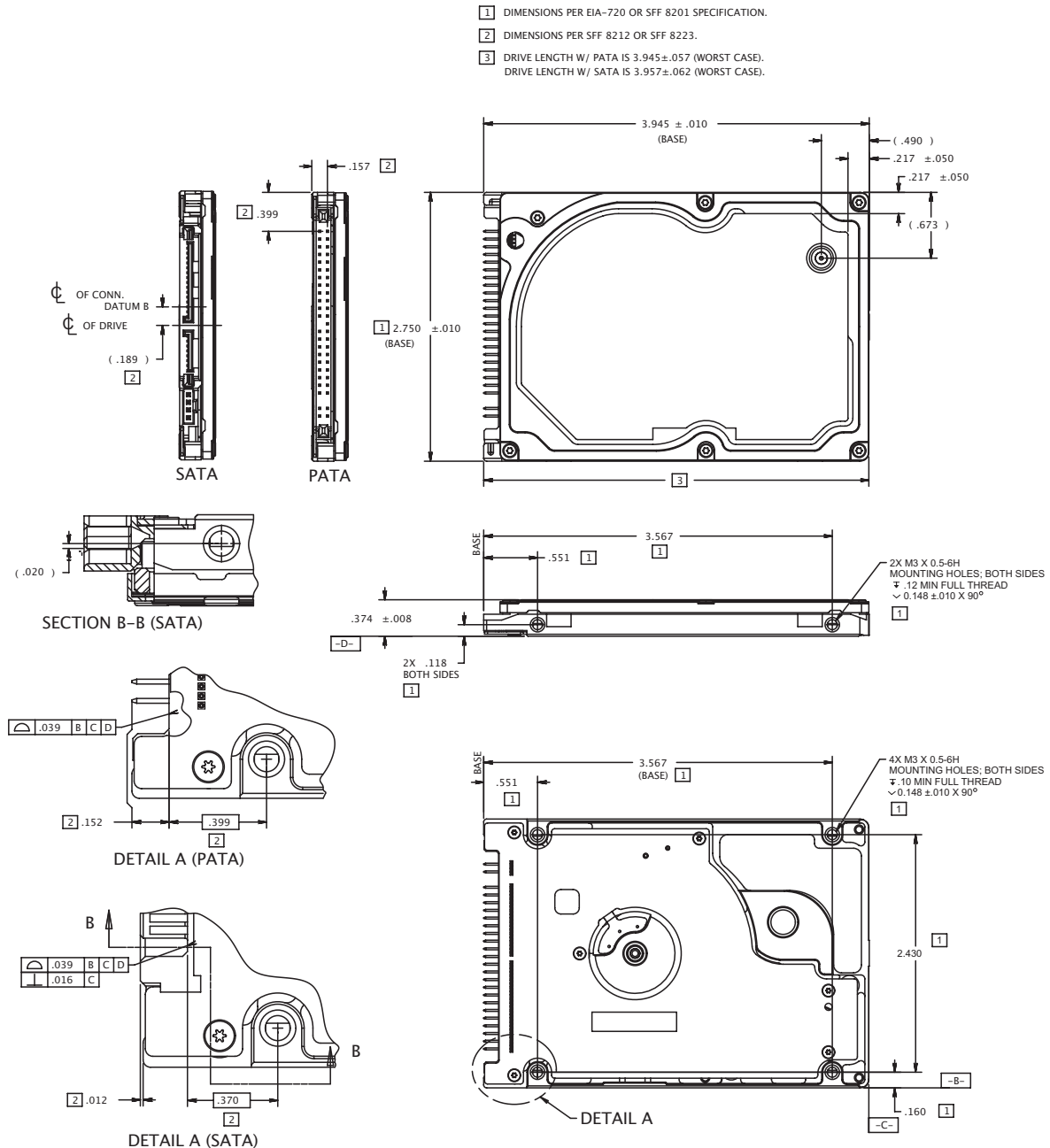


Figure 4. Mounting dimensions

3.5 Drive integration

Momentum 5400 FDE.2 SATA drives may be installed in the target computer system in exactly the same way as a non-FDE Momentum drive.

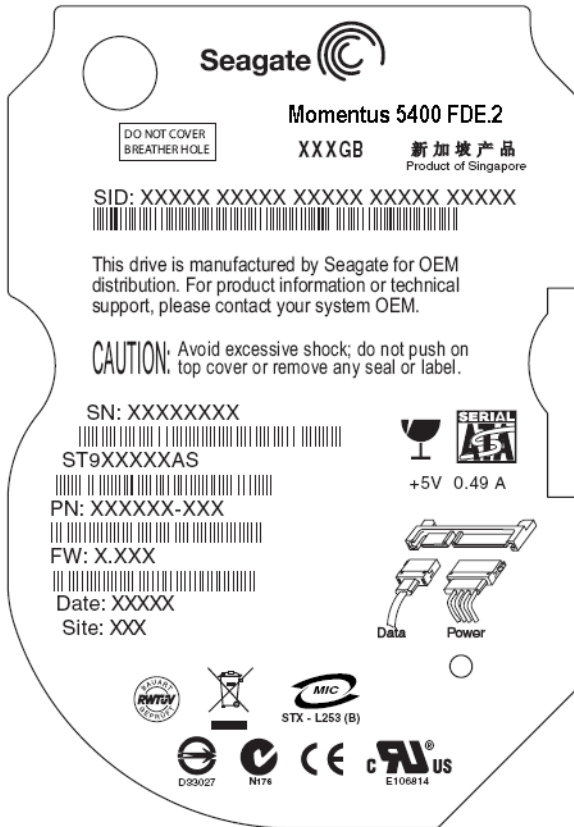


Figure 5. Momentum 5400 FDE.2 SATA drive label example

To install the drive in the system:

1. Remove the drive from the packaging material.
2. Install the drive in the computer system.
3. Load any desired images and operating system to the drive.
4. Install other components and options.
5. Set the original Master Password to a new value (see Section 1.2.1 for information about setting the SID) utilizing System/BIOS or third party software (optional).

No password is required to change the Master password when the drive is in the unlocked state.

The drive remains in the unlocked state until a User password is set.

After the installation procedure is complete, the computer is ready to be shipped to the customer.

Note. The manufacturer of the computer system (system integrator) does not have to enter any password. The installation procedure for the Momentum 5400 FDE.2 SATA is exactly the same as the Momentum 5400.3.

3.5.1 Drive installation

Upon receipt by the consumer, the drive's user interface is identical to a Momentus 5400.3 drive. The normal ATA security commands are functioning and available for initialization of the password as follows:

Per normal ATA Security Commands specifications, the drive is unlocked and all ATA security commands and all normal ATA commands may be issued.

1. Consumer accesses the computer manufacturer's BIOS set-up screen.
2. Consumer selects option to set User Password.
After setting the User password, the drive is now under access control (locked) and will require a password for future accesses.
3. Optional: Consumer selects the option to set the Master password from the BIOS choices.
4. Consumer exits the BIOS settings menu and continues with the boot process.
5. The BIOS enters the Security Freeze Command (F5) prior to exiting the boot sequence.

3.5.2 Consumer usage

After initialization, the consumer will just need to enter their User password each time the computer is booted according to the following description:

1. The computer system is turned on or the hardware is reset.
2. The drive reports to the BIOS that it is in the locked state per standard ATA Security Command reporting.
3. The BIOS queries the user for the password.
4. The BIOS supplies the password to the drive using the Security Unlock Command (F2).
5. The drive is unlocked and the BIOS may continue the booting process.
6. The BIOS enters the Security Freeze Lock Command (F5) prior to exiting the boot sequence.

Note. To ensure that the system reauthenticates the user, turn the laptop power off (shut down) rather than putting it in sleep mode. The system will authenticate the user at powerup.

3.6 Security Erase--ATA security commands

The Momentus 5400 FDE.2 SATA provides powerful features for cryptographically erasing the drive for disposal or repurposing. The drive uses the ATA Security Erase Prepare (F3) and ATA Security Erase (F4) commands to perform the cryptographic erase.

3.6.1 Security Erase procedure

Using the Security Erase commands, the drive may be cryptographically erased according to the following procedure:

1. Consumer boots up the computer normally according to the Consumer Usage section above.
2. Consumer invokes software or BIOS option for Erase.
3. The software or BIOS queries the user for either the User or Master password.
4. The software or BIOS issues the Security Erase Prepare (F3) command.
5. The software or BIOS issues the Security Erase Unit (F4) command.
Select the Enhanced erase for cryptographic erase that completes in less than one second.

3.6.2 Drive State after security erase

Upon completion of the erase sequence, all data is cryptographically erased and the drive has been returned to the manufactured state as follows:

- The old encryption key is deleted.
- A new random encryption key has been created on the drive.
- Encryption function is active and functioning.
The new key is used to encrypt all user data on write and decrypt on read.
- The user interface to the drive is active and all read and write commands are allowed.
- The ATA User password is reset to null (no value).
- The ATA Master password is not modified
The ATA Master password is the same value as it was before the erase.
- The ATA Security is set to the Unlocked state.
No password is required to access the drive.

The drive may now be disposed of safely, or the drive may be returned to service for another consumer following the initialization procedure defined above. Drives returned to Seagate for warranty purposes have special requirements. See the warranty information in Section 2.13 for additional details.

4.0 Serial ATA interface

These drives use the industry-standard Serial ATA (SATA) 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

Momentum 5400 FDE.2 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 4 summarizes the signals on the Serial ATA interface and power connectors..

Table 4: Serial ATA connector pin definitions

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

Key and spacing separate signal and power segments

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:

- All pins are in a single row, with a 1.27 mm (0.050") pitch.
- 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.
- 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.
- All used voltage pins (V_x) must be terminated.

4.2.1 ATA Security policy exceptions

In the ATA Security Interface mode, the drive conforms to the ATA Security Policy, except the following desirable exceptions to implement the desired Momentus 5400 FDE.2 SATA behavior:

Upon execution of the Secure Erase Sequence, the drive will have the following behavior:

- All modes of Secure Erase will instantaneously delete the encryption key rendering all user data unintelligible.
- A new encryption key will be generated inside the drive replacing the previous encryption key.
- The new encryption/decryption key will be applied to the data for all subsequent writes/reads prior to the next Secure Erase sequence.
- The User password will be cleared to a null value.
- The Master password will retain the current value per the ATA specification.

Note. On completion of this sequence, the user is assured that all sectors on the drive are unintelligible and the drive is returned to the default factory state. It is then immediately ready for disposal or repurposing.

The ATA Security Erase Unit Command provides for normal and enhanced erase modes as follows:

Table 5: ATA Security Erase Unit bits

Word	Content		
0	Control word		
	Bit 0	Identifier	0 = Compare User password
			1 = Compare Master password
	Bit 1	Erase mode	0 = Normal Erase
			1 = Enhanced Erase
	Bit (15:2)	Reserved	
1 - 16	Password (32 bytes)		
17 - 255	Reserved		

Choosing the Enhanced Erase mode will simply perform the Cryptographic Erase described above, and return status almost immediately. This is the recommended option.

To maintain consistency with the ATA Security specification, Momentus 5400 FDE.2 SATA drives provide an option to perform the Normal Erase mode.

Choosing normal erase will result in the drive overwriting the entire drive, with data encrypted with the newly generated encryption key, in addition to the Cryptographic Erase.

4.2.2 Drive Trust Mode supported

Identify Page - Word 150 decimal (0x96h)- Bit 12 Identifies Drive Trust Support.

Value = 1 = Drive Trust is supported (this is a trusted drive)

Table 6: Drive Trust Identify Page

Ident Value	BIT set	Bit	Description
5	0	15	Vendor specific
	1	14	Vendor specific
	0	13	Vendor specific
	1	12	Drive Trust Enabled
0	0	11	Vendor specific
	0	10	Vendor specific
	0	9	Vendor specific
	0	8	Vendor specific
9	1	7	Vendor specific
	0	6	Vendor specific
	0	5	Vendor specific
	1	4	Drive Trust Supported
8	1	3	Vendor specific
	0	2	Vendor specific
	0	1	Vendor specific
	0	0	Vendor specific

4.2.3 Full Disc Encryption support

Identify Page--Word 243 decimal (0xF3h)--bit 14 indicates Full Disc Encryption capability.

1 = Full Disc Encryption supported.

Table 7: Full-disc Encryption Identify Page

Ident Value	BIT set	Bit	Description
4	0	15	Vendor specific
	1	14	Full-disc Encryption
	0	13	Vendor specific
	0	12	Vendor specific
0	0	11	Vendor specific
	0	10	Vendor specific
	0	9	Vendor specific
	0	8	Vendor specific
0	0	7	Vendor specific
	0	6	Vendor specific
	0	5	Vendor specific
	0	4	Vendor specific
0	0	3	Vendor specific
	0	2	Vendor specific
	0	1	Vendor specific
	0	0	Vendor specific

4.2.4 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-7 Standard*.

Table 8: Supported commands

Op Code	Command	ATA Security API			Drive Trust Security API	
		Locked	Unlocked	Frozen	Secure State	Authenticated State
Special Commands						
5C	TRUSTED RECEIVE (PIO)	Executable	Executable	Executable	Executable	Executable
5E	TRUSTED SEND (PIO)	Executable	Executable	Executable	Executable	Executable
Normal Commands						
E5	CHECK POWER MODE	Executable	Executable	Executable	Executable	Executable
98	CHECK POWER MODE	Executable	Executable	Executable	Executable	Executable
51	CONFIGURE STREAM	Aborted	Executable	Executable	Aborted	Executable
B1	DEVICE CONFIGURATION	Aborted	Executable	Executable	Aborted	Executable
08	DEVICE RESET	Executable	Executable	Executable	Executable	Executable
92	DOWNLOAD MICROCODE	Aborted	Aborted	Aborted	Aborted	Aborted
90	EXECUTE DEVICE DIAGNOSTIC	Executable	Executable	Executable	Executable	Executable
E7	FLUSH CACHE	Aborted	Executable	Executable	Aborted	Executable
EA	FLUSH CACHE EXT	Aborted	Executable	Executable	Aborted	Executable
EC	IDENTIFY DEVICE	Executable	Executable	Executable	Executable	Executable
A1	IDENTIFY PACKET DEVICE	Executable	Executable	Executable	Executable	Executable
E3	IDLE	Executable	Executable	Executable	Executable	Executable
97	IDLE	Executable	Executable	Executable	Executable	Executable
E1	IDLE IMMEDIATE	Executable	Executable	Executable	Executable	Executable
95	IDLE IMMEDIATE	Executable	Executable	Executable	Executable	Executable
00	NOP	Executable	Executable	Executable	Executable	Executable
E4	READ BUFFER	Aborted	Executable	Executable	Aborted	Executable
C8	READ DMA	Aborted	Executable	Executable	Aborted	Executable
C9	READ DMA	Aborted	Executable	Executable	Aborted	Executable
25	READ DMA EXT	Aborted	Executable	Executable	Aborted	Executable
2F	READ LOG EXT	Aborted	Executable	Executable	Aborted	Executable
C4	READ MULTIPLE	Aborted	Executable	Executable	Aborted	Executable
29	READ MULTIPLE EXT	Aborted	Executable	Executable	Aborted	Executable

Table 8: Supported commands

Op Code	Command	ATA Security API			Drive Trust Security API	
		Locked	Unlocked	Frozen	Secure State	Authenticated State
F8	READ NATIVE MAX ADDRESS	Executable	Executable	Executable	Executable	Executable
27	READ NATIVE MAX ADDRESS EXT	Executable	Executable	Executable	Executable	Executable
20	READ SECTOR(S)	Aborted	Executable	Executable	Aborted	Executable
21	READ SECTOR(S)	Aborted	Executable	Executable	Aborted	Executable
24	READ SECTOR(S) EXT	Aborted	Executable	Executable	Aborted	Executable
2A	READ STREAM DMA EXT	Aborted	Executable	Executable	Aborted	Executable
2B	READ STREAM EXT	Aborted	Executable	Executable	Aborted	Executable
40	READ VERIFY SECTOR(S)	Aborted	Executable	Executable	Aborted	Executable
41	READ VERIFY SECTOR(S)	Aborted	Executable	Executable	Aborted	Executable
42	READ VERIFY SECTOR(S) EXT	Aborted	Executable	Executable	Aborted	Executable
10	RECALIBRATE	Executable	Executable	Executable	Executable	Executable
F6	SECURITY DISABLE PASSWORD	Aborted	Executable	Aborted	Aborted	Aborted
F3	SECURITY ERASE PREPARE	Executable	Executable	Aborted	Aborted	Aborted
F4	SECURITY ERASE UNIT	Executable	Executable	Aborted	Aborted	Aborted
F5	SECURITY FREEZE LOCK	Aborted	Executable	Executable	Aborted	Aborted
F1	SECURITY SET PASSWORD	Aborted	Executable	Aborted	Aborted	Aborted
F2	SECURITY UNLOCK	Executable	Executable	Aborted	Aborted	Aborted
70	SEEK	Executable	Executable	Executable	Executable	Executable
91	SET DRIVE PARAMETERS	Executable	Executable	Executable	Executable	Executable
EF	SET FEATURES	Executable	Executable	Executable	Executable	Executable
F9 _H	SET MAX ADDRESS	Aborted	Executable	Executable	Aborted	Executable
F9 _H / 00 _H	SET MAX ADDRESS EXT	Aborted	Executable	Executable	Aborted	Executable
F9 _H / 01 _H	SET MAX SET PASSWORD	Aborted	Executable	Executable	Aborted	Executable
F9 _H / 02 _H	SET MAX LOCK	Aborted	Executable	Executable	Aborted	Executable
F9 _H / 04 _H	SET MAX FREEZE LOCK	Aborted	Executable	Executable	Aborted	Executable
F9 _H / 03 _H	SET MAX UNLOCK	Aborted	Executable	Executable	Aborted	Executable
C6	SET MULTIPLE MODE	Executable	Executable	Executable	Executable	Executable

Table 8: Supported commands

Op Code	Command	ATA Security API			Drive Trust Security API	
		Locked	Unlocked	Frozen	Secure State	Authenticated State
E6	SLEEP	Executable	Executable	Executable	Executable	Executable
99	SLEEP	Executable	Executable	Executable	Executable	Executable
B0 _H / D9 _H	SMART DISABLE OPERATIONS	Executable	Executable	Executable	Executable	Executable
B0 _H / D2 _H	SMART ENABLE/DISABLE AUTOSAVE	Executable	Executable	Executable	Executable	Executable
B0 _H / D8 _H	SMART ENABLE OPERATIONS	Executable	Executable	Executable	Executable	Executable
B0 _H / D4 _H	SMART EXECUTE OFF-LINE IMMEDIATE	Executable	Executable	Executable	Executable	Executable
B0 _H / 08 _H	SMART READ DATA	Executable	Executable	Executable	Executable	Executable
B0 _H / D5 _H	SMART READ LOG	Executable	Executable	Executable	Executable	Executable
B0 _H / DA _H	SMART RETURN STATUS	Executable	Executable	Executable	Executable	Executable
B0 _H / D6 _H	SMART WRITE LOG	Executable	Executable	Executable	Executable	Executable
E2	STANDBY	Executable	Executable	Executable	Executable	Executable
96	STANDBY	Executable	Executable	Executable	Executable	Executable
E0	STANDBY IMMEDIATE	Executable	Executable	Executable	Executable	Executable
94	STANDBY IMMEDIATE	Executable	Executable	Executable	Executable	Executable
E8	WRITE BUFFER	Aborted	Executable	Executable	Aborted	Executable
CA	WRITE DMA	Aborted	Executable	Executable	Aborted	Executable
CB	WRITE DMA	Aborted	Executable	Executable	Aborted	Executable
35	WRITE DMA EXT	Aborted	Executable	Executable	Aborted	Executable
3D	WRITE DMA FUA EXT	Aborted	Executable	Executable	Aborted	Executable
3F	WRITE LOG EXT	Aborted	Executable	Executable	Aborted	Executable
C5	WRITE MULTIPLE	Aborted	Executable	Executable	Aborted	Executable
39	WRITE MULTIPLE EXT	Aborted	Executable	Executable	Aborted	Executable
30	WRITE SECTOR(S)	Aborted	Executable	Executable	Aborted	Executable
31	WRITE SECTOR(S)	Aborted	Executable	Executable	Aborted	Executable
34	WRITE SECTOR(S) EXT	Aborted	Executable	Executable	Aborted	Executable
3A	WRITE STREAM DMA EXT	Aborted	Executable	Executable	Aborted	Executable
3B	WRITE STREAM EXT	Aborted	Executable	Executable	Aborted	Executable

4.2.5 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 Serial ATA specification.

Word	Description	Value
0	Configuration information: • Bit 15: 0 = ATA; 1 = ATAPI • Bit 7: removable media • Bit 6: removable controller • Bit 0: reserved	0C5A _H
1	Number of logical cylinders	16,383
2	ATA-reserved	0000 _H
3	Number of logical heads	16
4	Retired	0000 _H
5	Retired	0000 _H
6	Number of logical sectors per logical track: 63	003F _H
7–9	Retired	0000 _H
10–19	Serial number: (20 ASCII characters, 0000 _H = none)	ASCII
20	Retired	0000 _H
21	Retired	0400 _H
22	Obsolete	0000 _H
23–26	Firmware revision (8 ASCII character string, padded with blanks to end of string)	x.xx
27–46	Drive model number: (40 ASCII characters, padded with blanks to end of string)	ST9160824AS ST9120827AS ST980816AS
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

Word	Description	Value
57–58	Current capacity in sectors	xxxx _H
59	Number of sectors transferred during a Read Multiple or Write Multiple command	xxxx _H
60–61	Total number of user-addressable LBA sectors available (see Section 2.2 for related information)	ST9160824AS = 312,581,808 ST9120827AS = 234,441,648 ST980816AS = 156,301,488
62	Retired	0000 _H
63	Multiword DMA active and modes supported (see note following this table)	xx07 _H
64	Advanced PIO modes supported (modes 3 and 4 supported)	0003 _H
65	Minimum multiword DMA transfer cycle time per word (120 nsec)	0078 _H
66	Recommended multiword DMA transfer cycle time per word (120 nsec)	0078 _H
67	Minimum PIO cycle time without IORDY flow control (240 nsec)	00F0 _H
68	Minimum PIO cycle time with IORDY flow control (120 nsec)	0078 _H
69–74	ATA-reserved	0000 _H
75	Queue depth	0000 _H
76	Serial ATA capabilities	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	0000 _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 (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 (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) These words are required for drives that support the 48-bit addressing feature. Maximum value: 0000FFFFFFFF _H .	ST9160824AS = 312,581,808 ST9120827AS = 234,441,648 ST980816AS = 156,301,488
104–127	ATA-reserved	0000 _H
128	Security status	0001 _H
129–159	Seagate-reserved	xxxx _H
160–254	ATA-reserved	0000 _H
255	Integrity word	xxA5 _H

Note. 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}

4.2.6 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 9: Set Features command values

02 _H	Enable write cache (<i>default</i>).
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 (<i>default</i>)
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
55 _H	Disable read look-ahead (read cache) feature.
82 _H	Disable write cache
AA _H	Enable read look-ahead (read cache) feature (<i>default</i>).
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.

4.2.7 S.M.A.R.T. commands

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

SeaTools diagnostic software activates a built-in drive self-test (DST S.M.A.R.T. command for D4_H) that eliminates unnecessary drive returns. The diagnostic software ships with all new drives and is also available at: <http://seatools.seagate.com>.

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

Table 10: 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 0x04 (abort) is written to the Error register.

5.0 Compatibility summary

5.1 Installation considerations

Many of today's mobile computers have been designed to make it possible for the end user to replace the hard drive. Refer to your system's user manual for the location of the hard drive compartment and the specific instructions regarding replacement. Refer to your system manufacturer's support website for the most up-to-date information. Read and follow all instructions regarding the proper steps to be taken when replacing the system hard drive. Some mobile systems are sealed and require specialized tools to gain access to the hard drive. Special training or tools may be needed to service some mobile computers. In some cases, opening the case may void your warranty. Consult your system documentation. Seagate recommends taking your system to an authorized service technician to replace your hard drive.

System Compatibility

Seagate Product Assurance has tested Momentus drives in the systems listed in Table 11. Testing included multiple BIOS versions and operating systems. This testing was done to demonstrate compatibility with various hardware and software configurations. Hardware and software combinations, other than those tested, may also be compatible with this drive.

Table 11: Tested systems

Model	CPU	Chipset
Acer Aspire T135	Sempron 3100+-1800	VIA K8M800
Alienware SR 10571	Opteron 254-2800	AMD K8
Compaq Presario SR1005+	Pentium 4-2800	Intel 915G/P
Compaq Presario SR1730Z	Athlon 64 3400+-2200	ATI RS480
Dell Dimension 4600	Pentium 4-2800	Intel 865
Dell Dimension 4600C	Pentium 4-2660	Intel 865
Dell Dimension 4700	Pentium 4-2800	Intel 915G/P
Dell Dimension 8300	Pentium 4-2600	Intel 875P
Dell Dimension E310	Pentium 4-2800	Intel 915G/P
Dell Dimension XPS	Pentium 4-3000	Intel 875P
Dell Dimension XPS 600	Pentium D-2800	4SLI
Dell Dimension XPS410	Pentium D-2800	Intel G/P965
Dell Power Edge SC420	Celeron-2530	Intel E7221
Dell Power Edge SC430	Celeron-2530	Intel E7230
Dell Precision 360	Pentium 4-2600	Intel 875P
E Machines T6420	Athlon 64 3400+-2200	AMD K8
Foxconn Winfast (Lab Built)	Athlon 64 3000+-1800	AMD K8
Foxconn Winfast NFPIX8AA (Lab Built)	Opteron 246-2000	AMD K8
Gateway 510	Pentium 4-3000	Intel 865

Table 11: Tested systems

Model	CPU	Chipset
Gateway E-4100	Pentium 4-2600	Intel 865
Gateway E-4100 BTS	Pentium 4-2600	Intel 865
Gateway E-4100A	Pentium 4-2200	Intel 865
Gateway E-6100	Pentium 4-2600	Intel 875P
HDNW AMD 64x2 Duel Core	Athlon 64 3200+-2010	AMD K8
HP D330	Celeron-2200	Intel 865
HP D530	Celeron-2200	Intel 865
HP Pavilion D4100E	Athlon 64 3400+-2200	ATI RS480
HP WX 3100	Pentium 4-2400	Intel 865
HP WX 4100	Pentium 4-2400	Intel 875P
HP XW4200	Pentium 4-2800	Intel 925X
IBM Tinkcentre M8148-15U	Pentium 4-2800	Intel 865
Intel Grantsdale G B1/B1 (Lab Built)	Genuine-2800	Intel 915G/P
MPC Client Pro 345E	Pentium 4-2400	Intel 865
MPC Mellennia 9201 Professional	Pentium 4-2800	Intel 875P
United Micro PCHA002	Sempron 3400+-2000	SIS 760

5.2 BIOS versions tested

The following list indicates the types of BIOS Seagate tested during the compatibility testing process. The list highlights the major BIOS manufacturers. Individual systems contain variations of these BIOS versions and were tested with regard to their implementation in the individual systems.

Table 12: Tested BIOS versions

Manufacturer	Model	BIOS Vendor	BIOS Release	BIOS Version
AMD	K8	AMI	MSIA7207NMS	V3.00
AMD	K8	AMI	V02.59	
AMD	K8	AMI	VER 02.59	VER 08.00.13
AMD	K8	AWARD	6	P6
AMD	K8	AWARD	V1.B	11/28/2005
AMD	K8	AWARD	V6.00	P0
AMD	K8	AWARD	V6.00PG	
AMD	K8	AWARD	V6.00PG	11/17/2005
AMD	K8	HP	786B9	V2.00
AMD	K8	PHOENIX	AWARD	VER 6.00PG
AMD	K8	PHOENIX	6.00P	
AMD	K8	PHOENIX	AWARD	V5.1.39
AMD	K8	PHOENIX	AWARD	V6.00PG
AMD	K8	PHOENIX	AWARD	
AMD	K8	PHOENIX	DELL	1.1.2
AMD	K8	PHOENIX	VER 2004Q3	
AMD	K8	PHOENIX		
ATI	0X5A31	INSYDE		R1.00
ATI	RS400-200	AMI	V02.59	
ATI	RS400-200	AMI	V0707	
ATI	RS480	AMERICAN MEGETRENDS	2/13/2006	
ATI	RS480	AMI	VER V3.1	
ATI	RS480	AWARD	3.13	11/15/2005
ATI	RS480	HP	VER1.09	11/22/2005
ATI	RS480	PHOENIX		V1.04
ATI	RS480	PHOENIX AWARD	V1.04	5/24/2005
INTEL	5000X	PHOENIX	DELL	A00
INTEL	865	GATEWAY	510A 15A.0027	
INTEL	865	GATEWAY	510A 15A.0043	
INTEL	865	GATEWAY	510A 15A.0045	
INTEL	865	GATEWAY	510A 15A.0066	
INTEL	865	HP	786B1	V1.14

Table 12: Tested BIOS versions

Manufacturer	Model	BIOS Vendor	BIOS Release	BIOS Version
INTEL	865	HP	786B2	2.43
INTEL	865	HP	786B2	V1.11
INTEL	865	HP	786B2	V2.04
INTEL	865	HP		1.11
INTEL	865	HP		786B2 V1.10
INTEL	865	IBM	2CKT20AUS	10/26/2004
INTEL	865	INTEL	510A.86A.0053	
INTEL	865	MICRON	510A.86A.003	
INTEL	865	MICRON	510A.86A.0033	
INTEL	865	PHOENIX	DELL	A04
INTEL	865	PHOENIX	DELL	A06
INTEL	865	PHOENIX	DELL	A08
INTEL	865	PHOENIX	DELL	A10
INTEL	865	PHOENIX		6
INTEL	875P	AWARD	4/23/2003	875P-6A79BG00C
INTEL	875P	GATEWAY	510A.15A.0080	
INTEL	875P	HP	786B3	V1.09
INTEL	875P	MICRON	510A.86A.0076	
INTEL	875P	PHOENIX	DELL	A02
INTEL	875P	PHOENIX	DELL	A03
INTEL	915G/P	AMI	3.1	8.00.10 11/12/04
INTEL	915G/P	AMI	VVPGI635	5/6/2004
INTEL	915G/P	AMI	VVPGI635	
INTEL	915G/P	HP	786C1	V1.05
INTEL	915G/P	HP	786C2	V1.02
INTEL	915G/P	IBM		2/4/2005
INTEL	915G/P	MPC		EV91510A.86A.0308
INTEL	915G/P	PHOENIX	AWARD BIOS 6.00PG	R01-03
INTEL	915G/P	PHOENIX	DELL	A01
INTEL	915G/P	PHOENIX	DELL	A03
INTEL	915G/P	PHOENIX	DELL	A05
INTEL	915M	AMI		R0060F2
INTEL	915M	IBM		1.03A (77ET40WW)
INTEL	915M	PHOENIX	30/05/2005	1.05
INTEL	915M	PHOENIX	PHOENIX BIOS	1.06
INTEL	915M	PHOENIX		1.07
INTEL	915M	PHOENIX		R0071V0

Table 12: Tested BIOS versions

Manufacturer	Model	BIOS Vendor	BIOS Release	BIOS Version
INTEL	915M	PHOENIX		R0160X5
INTEL	925X	HP	786C3	V1.04
INTEL	925X	PHOENIX	DELL	A06
INTEL	945G/P	AWARD	NT94510J.86A.2487.2005.0906.1451	
INTEL	945G/P	HP	786D1	V1.03
INTEL	945G/P	PHOENIX	AWARD	V6.00PG
INTEL	945G/P	PHOENIX	DELL	A01
INTEL	945G/P	PHOENIX	DELL	A02
INTEL	945G/P	PHOENIX	DELL	A05
INTEL	945GM/PM	DELL		A02
INTEL	945GM/PM	DELL		A04
INTEL	945GM/PM	DELL		A05
INTEL	945GM/PM	DELL		A09
INTEL	945GM/PM	HP	F.05	
INTEL	945GM/PM	IBM		1.02 (79ET56WW)
INTEL	945GM/PM	IBM		1.04 (7BET44WW)
INTEL	945GM/PM	LENOVO		1.02 (7CET47WW)
INTEL	945GM/PM	LENOVO		1.10 (7FET50WW)
INTEL	945GM/PM	LENOVO		2.00 (79ETC0WW)
INTEL	945GM/PM	PHOENIX		V1.20
INTEL	955X	AMI	206	12/21/2005
INTEL	955X	HP	786D3	V1.02
INTEL	955X	PHOENIX	AWARD	W7158IMS
INTEL	955X			
INTEL	975X	AMI	206	12/21/2005
INTEL	975X	AWARD	VER F1	
INTEL	E7221	PHOENIX	DELL	A00
INTEL	G/P965	INSYDE		
INTEL	G/P965	PHOENIX	1.0.3	8/14/2006
INTEL	G/P965	PHOENIX	DELL	1.0.3
INTEL	G/P965	PHOENIX	DELL	2.1.0
NVIDIA	0X0070	PHOENIX	V6.00PG	2/7/2006
NVIDIA	NFORCE 4SLI	AMI	V310	
NVIDIA	NFORCE 4SLI	PHOENIX	DELL	A04
NVIDIA	NFORCE 4SLI	PHOENIX	V6.00PG	7/11/2005
SIS	661	AWARD	R1.00	6/13/2005

Table 12: Tested BIOS versions

Manufacturer	Model	BIOS Vendor	BIOS Release	BIOS Version
SIS	760	AMI	V2.54	
SIS	760	PHOENIX	V3.01	8/18/2004
VIA	K8M800	AMI	V0210	
VIA	K8M800	AMI	V2.54	8/30/2005
VIA	K8M800	AWARD	V6.00PG	10/17/2005

5.3 Operating system versions tested

This list indicates the types of Operating Systems Seagate tested during the compatibility testing process and highlights the major OS manufacturers. Several variations of the major operating systems have been tested.

Table 13: Operating systems tested

Manufacturer	Version/Release
Microsoft	Windows Server 2003 (Compatibility evaluated, but not tested)
Microsoft	Windows XP, XP Pro, XP Home (Service Pack 2) (multiple languages)
Microsoft	Windows Vista

5.4 Compatibility test configurations

Tests are performed to ensure functionality to the ATA/ATAPI-7 specification. Seagate design and testing are constantly evolving to match the evolution of the ATA/ATAPI specifications. Momentus 5400 FDE.2 SATA drives should be expected to be largely compliant to the emerging ATA/ATAPI-8 specification.

Exceptions to the specifications for the Momentus 5400 FDE.2 SATA drives are listed in Section 4.0.

5.5 Software utilities

The following is a brief overview of a some of the Seagate utilities used during the Seagate competitive analysis process.

The Seagate SeaTools application is an exclusive disc drive diagnostic software designed to troubleshoot most hard drive issues. Desktop edition works with most ATA, SATA, or SCSI drives in desktop systems and has a 98 percent accuracy rate.

This is a list of some of the third party utilities used in the testing process.

Vendor	Application
Intel	PCI-EXE
Microsoft	Winbench99
Symantec	Norton Utilities

5.5.1 Software support

Some customers are purchasing the Momentus 5400 FDE.2 SATA drives with software bundled from ISV partners. For those customers, the ISV software will be available to integrate with Momentus 5400 FDE.2 SATA drives.

6.0 Seagate Technology support services

Internet

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

Presales Support:

Presales@Seagate.com

Technical Support:

DiscSupport@Seagate.com

Warranty Support:

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

mySeagate

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

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Seagate Service Centers

Presales Support

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

Technical Support

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

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

Customer Service Operations

Warranty Service

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

Data Recovery Services

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

Authorized Service Centers

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

USA/Canada/Latin America support services

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

Global Customer Support

Presales, Technical, and Warranty Support

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

Data Recovery Services

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

Europe, the Middle East and Africa Support Services

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

Asia/Pacific Support Services

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

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920 Disc Drive, Scotts Valley, California 95066-4544, USA
Publication Number: 100443773, Rev. B, Printed in USA