Product Manual

# Momentus®5400 FDE

**ST9120826A**

**ST9100826A**

**ST980821A**

**ST960814A**

**ST940811A**

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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 drives:

- ST9120826A
- ST9100826A
- ST980821A
- ST960814A
- ST940811A

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 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 250 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).

## 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 disc drives

The Momentus 5400 FDE contains drive trust technology providing Full-Disc Encryption (FDE) using proven Triple DES (TDES) data encryption and decryption.

**Feature list**

- Automatically encrypts (and decrypts) all data on the drive
- Operations are performed with no measured 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 ATA interface speed.

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

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.

The Momentus 5400 FDE contains 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 (FDE) 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.

The Momentus 5400 FDE drive may be integrated into the computer system in the same way you would integrate a non-FDE Momentus 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. The drive will encrypt data without a user id.

# 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 ST9120826A, ST9100826A, ST980821A, ST960814A, and ST940811A 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 | ST9120826A | ST9100826A | ST980821A | ST960814A | ST940811A |
|---|---|---|---|---|---|
| Formatted Gbytes (512 bytes/sector)* | 120 | 100 | 80 | 60 | 40 |
| Guaranteed sectors | 234,441,648 | 195,371,568 | 156,301,488 | 117,210,240 | 78,140,160 |
| Bytes per sector | 512 | | | | |
| Physical read/write heads | 4 | 4 | 3 | 2 | 2 |
| Discs | 2 | 2 | 2 | 1 | 1 |
| Cache (Mbytes) | 8 | | | | |
| Recording density, BPI (bits/inch typical) | 778,000 | | | | |
| Track density. TPI (tracks/inch typical) | 126,000 | | | | |
| Areal density (Gbits/inch$^2$ max) | 98.2 | | | | |
| Spindle speed (RPM) | 5,400 | | | | |
| Internal data transfer rate OD (Mbytes/sec max) | 42 | | | | |
| I/O data-transfer rate (Mbytes/sec max) | 100 | | | | |
| ATA data-transfer modes supported | PIO modes 0–4<br>Ultra DMA modes 0–5 | | | | |
| Height | 9.5 +/-0.2 mm (0.374 +/-.008 inches) | | | | |
| Width | 69.85 +/-0.25 mm (2.750 +/-0.010 inches) | | | | |
| Length | 100.2 +/-0.25 mm (3.945 +/-0.010 inches) | | | | |
| Weight (typical) | 100 grams (0.22 lb) | | | | |
| Average latency (msec) | 5.6 | | | | |
| Power-on to ready (sec typical) | 3.5 | | | | |
| Standby to ready (sec typical) | 3.0 | | | | |
| Startup current 5V (typical) | 1.0 amps | | | | |
| Track-to-track seek time (msec typical) | 1.0 (read), 1.5 (write) | | | | |
| Average seek time (msec typical) | 12.5 | | | | |
| Average seek, read (msec typical) | 12.5 | | | | |

**Table 1: Specifications**

| Drive specification | ST9120826A | ST9100826A | ST980821A | ST960814A | ST940811A |
|---|---|---|---|---|---|
| Average seek, write (msec typical) | 14.5 | | | | |
| Full-stroke seek (msec) | 22 (typical); 24 (max) | | | | |
| Seek power (typical) | 2.0 watts | | | | |
| Read/write power (typical) | Read: 2.50 watts; Write: 2.50 watts | | | | |
| Idle mode (typical, low power) | 1.40 watts | | | | |
| Standby mode | 0.96 watts (typical)*** | | | | |
| Sleep mode | 0.96 watts (typical)*** | | | | |
| Voltage tolerance (including noise) | 5V ± 5% | | | | |
| Ambient temperature | 5° to 55°C (operating), –40° to 70°C (nonoperating) | | | | |
| Temperature gradient (°C per hour max, noncondensing) | 20°C (operating)<br>30°C (nonoperating) | | | | |
| Relative humidity (noncondensing) | 5% to 90% (operating)<br>5% to 95% (nonoperating) | | | | |
| Relative humidity gradient | 30% per hour max | | | | |
| Wet bulb temperature (°C max) | 30°C (operating)<br>40°C (nonoperating) | | | | |
| Altitude, operating | –304.8 m to 3,048 m (–1000 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) | 250 | | | | |
| 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 (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, 10–500 Hz) | | | | |
| Drive acoustics, sound power (bels), 2 disc | | | | | |
| Idle** | 2.4 (typical)<br>2.6 (max) | | | | |
| Performance seek | 2.9 (typical)<br>3.1 (max) | | | | |
| Nonrecoverable read errors | 1 per $10^{14}$ bits read | | | | |
| Annualized Failure Rate (AFR) | 0.73% | | | | |
| Load/Unload (U/UL) cycles | | | | | |
| 25°C, 50% relative humidity | 600,000 software-controlled power on/off cycles<br>20,000 hard power on/off cycles | | | | |
| 32°C, 80% relative humidity<br>5°C, 80% relative humidity<br>5°C, 10% relative humidity<br>55°C, 16% relative humidity | 600,000 software-controlled power on/off cycles<br>20,000 hard power on/off cycles | | | | |

**Table 1: Specifications**

| Drive specification | ST9120826A | ST9100826A | ST980821A | ST960814A | ST940811A |
|---|---|---|---|---|---|
| Warranty | 5 years on distribution units.<br>To determine the warranty for a specific drive, use a web browser to access the following web page:<br>www.seagate.com/support/service/<br>From this page, click on the “Verify Your Warranty” link. You will be asked to provide the drive serial number, model number (or part number) and country of purchase. The system will display the warranty information for your drive. | | | | |

*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 |
|---|---|---|---|
| ST9120826A | 120 Gbytes | 234,441,648 | 512 |
| ST9100826A | 100 Gbytes | 195,371,568 | 512 |
| ST980821A | 80 Gbytes | 156,301,488 | 512 |
| ST960814A | 60 Gbytes | 117,210,240 | 512 |
| ST940811A | 40 Gbytes | 78,140,160 | 512 |

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

## 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 |
|---|---|---|
| ST9120826A | 4 | 2 |
| ST9100826A | 3 | 2 |
| ST980821A | 3 | 2 |
| ST960814A | 2 | 1 |
| ST940811A | 2 | 1 |

## 2.5 Recording and interface technology

| Technology | Specification |
|---|---|
| Interface | Parallel ATA |
| Recording method | RLL 0,11 |
| Recording density BPI (bits/inch typical) | 778,000 |
| Track density TPI (tracks/inch typical) | 126,000 |
| Areal density (Gbits/inch$^2$ max) | 98.2 |
| Spindle speed (RPM) (± 0.2%) | 5,400 |
| Internal data-transfer rate OD (Mbytes/sec max) | 42 |
| I/O data-transfer rate (Mbytes/sec max) | 100 (Ultra DMA mode 5) |
| Interleave | 1:1 |
| Cache buffer | 8 Mbytes (8,192 kbytes) |

## 2.6 Physical characteristics

| | | |
|---|---|---|
| Height | (mm)<br>(inches) | 9.5 +/–0.2<br>0.374 +/–0.008 |
| Width | (mm)<br>(inches) | 69.85 +/–0.25<br>2.750 +/–0.010 |
| Length | (mm)<br>(inches) | 100.2 +/–0.25<br>3.945 +/–0.010 |
| Typical weight | (grams)<br>(pounds) | 100<br>0.22 |

## 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 | 1.0 | 1.5 |
| Average | 12.5 | 14.5 |
| Full-stroke | 22.0 | 24.0 |
| Average latency | 5.56 | 5.56 |

*Measured in performance mode

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

## 2.8 Time to ready

| Time to ready | Typical | Max @ 25°C |
|---|---|---|
| Power-on to Ready (sec) | 3.5 | 8.0 |
| Standby to Ready (sec) | 3.0 | 8.0 |

## 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 10. 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 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.

- **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 average (25° C) |
|---|---|
| Spinup (typical) | 1.0 amps |
| Seek | 2.00 watts |
| Read | 2.50 watts |
| Write | 2.50 watts |
| Idle, performance mode* | 1.90 watts |
| Idle, active* | 1.70 watts |
| Idle, low power mode* | 1.40 watts |
| Standby | 0.96 watts |
| Sleep | 0.96 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

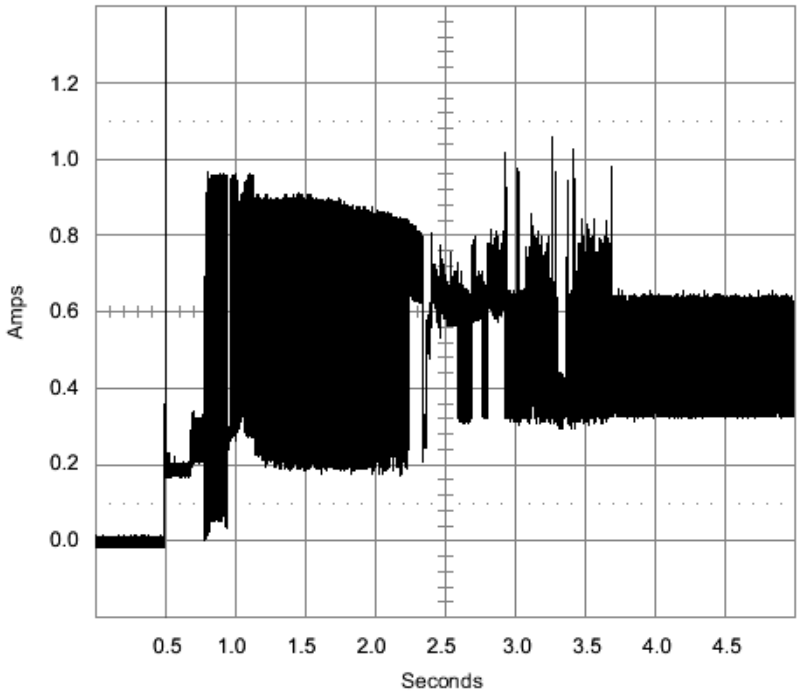


**Figure 5. Typical 5V startup and operation current profile**

### 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 | 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 in performance mode, 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 | 5° to 55°C (41° to 131°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 250 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 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**

| Idle* | Performance Seek |
|---|---|
| 2.4 bels (typ)<br>2.6 bels (max) | 2.9 bels (typ)<br>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:

**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 2,000 MHz, 10 V/m,<br>80% AM with 1 kHz sine<br>900 MHz, 3 V/m, 50% pulse modulation @ 200 Hz | A | EN 61000-4-3: 96<br><br>ENV 50204: 95 |
| Electrical fast transient | ± 1 kV on AC mains, ± 0.5 kV on external I/O | B | EN 61000-4-4: 95 |
| Surge immunity | ± 1 kV differential, ± 2 kV common, AC mains | B | EN 61000-4-5: 95 |
| Conducted RF immunity | 150 kHz to 80 MHz, 3 Vrms, 80% AM with 1 kHz sine | A | EN 61000-4-6: 97 |
| Power Frequency H-field immunity | 1 A/m, 50Hz/60Hz, 3 axes | A | EN 61000-4-8: 97 |
| Voltage dips, interrupts | 30% Reduction for 25 cycles<br>>95% Reduction for 250 cycles<br>>95%, 0.5 cycles | C<br>C<br>B | EN 61000-4-11: 94 |

A - 1) No upset or degradation in performance beyond manufacturer's specified limits.
2) No data loss.

B - 1) Unit self recovers without user intervention.
2) No data loss.

C - 1) Upset OK provided that unit will function after user intervention.

## 2.13 Reliability

| Measurement type | Specification |
|---|---|
| Nonrecoverable read errors | 1 per $10^{14}$ bits read, max. |
| Annualized Failure Rate (AFR) | 0.73% |
| Load/Unload (U/UL) | |
| 25°C, 50% relative humidity | 600,000 software-controlled power on/off cycles<br>20,000 hard power on/off cycles |
| 32°C, 80% relative humidity<br>5°C, 80% relative humidity<br>5°C, 10% relative humidity<br>55°C, 16% relative humidity | 600,000 software-controlled power on/off cycles<br>20,000 hard power on/off cycles |
| Warranty | 5 years on distribution units.<br>**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.<br>If these recommendations are not followed, Seagate cannot access the drive to perform failure analysis to verify your warranty claim.<br>To determine the warranty for a specific drive, use a web browser to access the following web page:<br>www.seagate.com/support/service/<br>From this page, click on the “Verify Your Warranty” link. You will be asked to provide the drive serial number, model number (or part number) and country of purchase. The system will display the warranty information for your drive. |

## 2.14 Agency certification

### 2.14.1 Safety certification

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.

- Family name: Momentus 5400.2
- Certificate numbers: E-D011-05-2395 (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.

**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.

Momentus®5400 FDE drives can be connected to a computer system using a standard IDE interface cable and power connector. 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.

Momentus®5400 FDE 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.
  The sole exception to this statement is for the Momentus®5400 FDE perforated label which you should remove and attach to the exterior of the computer system.

## 3.2 Jumper settings

### 3.2.1 Master/slave configuration

Use the options jumper block shown in Figure 6 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.

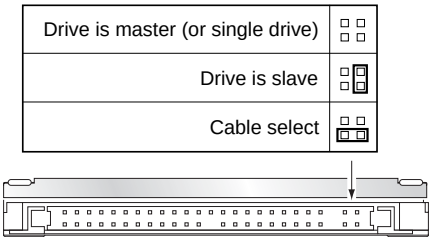


**Figure 6. Jumper settings**

### 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 6. 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 7 for drive mounting dimensions (dimensions in inches with mm in parentheses). 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 x 0.5 mounting screws.
- Do not overtighten the mounting screws (maximum torque: 4.0 inch-lb).
- Four (4) threads (0.080 inches) minimum screw engagement recommended.

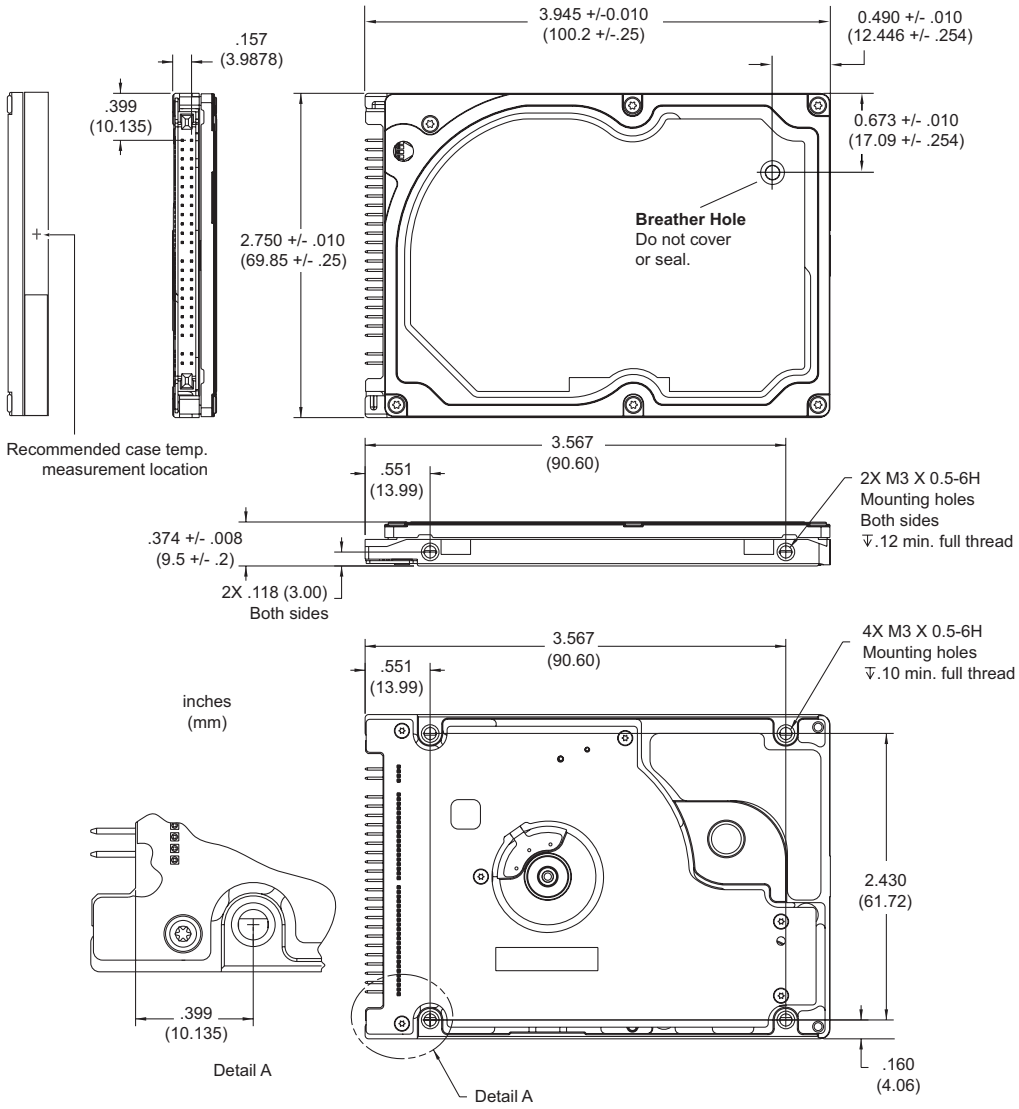


**Figure 7. Mounting dimensions—top, side and end view**

## 3.4 Drive integration

The Momentus 5400 FDE may be installed in the target computer system in exactly the same way as a non-FDE Momentus drive with one optional exception regarding the label.

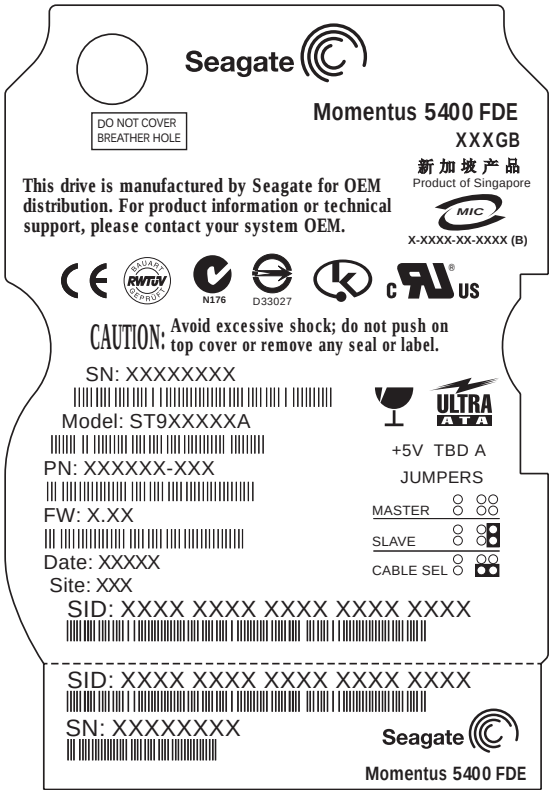


**Figure 8. Momentus 5400 FDE drive label example**

To install the drive in the system:

1. Remove the drive from the packaging material.
2. Remove the perforated sticker portion of the drive label (optional).
3. Remove the backing from the sticker (optional).
4. Apply the sticker to the outside of the computer for future reference (optional)
5. Install the drive in the computer system.
6. Load any desired images and operating system to the drive.
7. Install other components and options.
8. 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. Except for the label, the installation procedure for the Momentus 5400 FDE is exactly the same as the Momentus 5400.2.

### 3.4.1 Drive installation

Upon receipt by the consumer, the drive's user interface is identical to a Momentus 5400.2 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.

### 3.4.2 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.

## 3.5 Security Erase--ATA security commands

The Momentus 5400 FDE 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.

### 3.5.1 Security Thaw command

Most current laptop/notebook computer BIOS's issue a Freeze Lock command to the drive during the boot process. This prevents issuing the ATA Security commands. To allow for secure erase, the Momentus 5400 FDE has a new command named Security Thaw (F7). Issuing the Security Thaw command with either User or Master password supplied will remove the Freeze Lock from the drive.

### 3.5.2 Security Erase procedure

Using the Security Thaw command and 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 Thaw command (F7) to the drive supplying the given password.
5. The drive removes the Freeze Lock--Security commands may now be issued.

6. The software or BIOS issues the Security Erase Prepare (F3) command.
7. 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.

### 3.5.3 Drive State after security erase

Upon completion of the erase sequence, all data is cryptographically erase 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.
  All user data is encrypted on write and decrypted on read, with the new key
- 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 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 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-7), NCITS T13,* subsequently referred to as the *Draft ATA-7 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-7 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 ATA interface specifications

The Momentus 5400 FDE is consistent with the ATA Interface implementation of the Momentus 5400.2 products with the known exceptions listed within this section (Section 4.1.1 subordinate sections).

#### 4.1.1.1 Legacy mode -- Multi-word DMA not supported

If multi-word DMA model is selected, the drive response is indeterminate, and the ATA bus will hang. Due to this limitation, the drive will violate the DCO Set requirement in the ATA specification.

#### 4.1.1.2 Legacy mode -- Interrupts disabled mode (polling) supports limited functionality

Interrupts disabled mode is entered upon setting of the nIEN bit to 1, in the Device Control Register as shown in the ATA Specification.

**Table 7: Interrupts Disabled mode nIEN bit**

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| HOB | r | r | r | r | SRST | nIEN | 0 |

Upon entry of this mode the drive will behave normally in the absence of issuance of the following user data access commands, to the drive:

- READ/WRITE BUFFER
- READ/WRITE SECTOR
- READ/WRITE SECTOR EXT
- READ/WRITE MULTIPLE
- READ/WRITE MULTIPLE EXT
- READ/WRITE DMA
- READ/WRITE DMA EXT

If any of the identified data access commands are issued to the drive, the drive will tri-state the data bus and the retrieved data will be indeterminate. Additionally, the drive will return indeterminate values in the status register.

Upon entry into the described state, the drive will remain in this state until you power cycle the drive.

If the nIEN bit is set to 1 and none of the identified data access commands are issued, the nIEN bit may be returned to 0 and the drive will continue with normal operation in the Interrupts Enabled mode.

#### 4.1.1.3 PIO Read -- Interrupts Enabled mode

In the Interrupts Enabled mode, the drive has limited support for the host to check the status register of the drive while waiting for the data transfer interrupt.

If the host polls the status register, while waiting for interrupts and the drive has not yet posted the interrupt, the drive will tri-state the data bus. This limitation is only an issue for any host that might choose to transfer the data prior to the DRQ bit being set. For instance, any host that reads a status of 0x20 may, based on the drive Busy bit and Error bit being cleared, choose to transfer the data, even though the DRQ bit is not set. This is not recommended host behavior, and, if implemented, would result in undesirable results.

This limitation is not an issue for hosts that simply wait for the interrupt to be posted.

This is not believed to be an issue for hosts that check status but wait for the DRQ bit to be set.

#### 4.1.1.4 Device 0 only configurations

Per the ATA-ATAPI-7, Rev. 4B specification, Clause 5.16.1 (see *italicized* excerpt below), the specification expects Device 0 to return the Task File Register when Device 1 is selected as follows:

> *In a single device configuration where Device 0 is the only device and the host selects Device 1, Device 0 shall respond as follows:*
>
> *...*
>
> *If the device does not implement the PACKET Command feature set, a read of the Control Block or Command Block registers, other than the Status or Alternate Status registers, shall complete as if Device 0 was selected. A read of the Status or Alternate status register shall return the value 00h.*

Under the described conditions, and the host selecting Device 1 in a Device 0 only configuration, the Momentus 5400 FDE will not respond for the request to Slave (Device 1) and the returned value will be indeterminate.

#### 4.1.1.5 48-bit (Extended mode) Sector Count register must be written twice

Per the ATA-ATAPI-7, Rev. 4B specification, Clause 4.14:

> *In a device implementing the 48-bit Address feature set, the Feature register, the Sector Count register, the LBA Low register, the LBA Mid register, and the LBA High register are each a two-byte deep FIFO. Each time one of these registers is written, the new content written is placed into the "most recently written" location and the previous content of the register is moved to "previous content" location.*

When using the 48-bit Address feature set, the Momentus 5400 FDE assumes that the host will always write the sector count register twice, even though the address may only require one write. Failure to write the sector count register twice will result in the subsequent read likely hanging due to a mismatch in the sector count.

All registers identified above should always be written twice in when using the 48-bit Address Feature set.

### 4.1.2 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 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 Erate 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 re-purposing.

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

**Table 8: 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 drives provide an option to perform the Normal Erase mode.

**Note.** 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.

### 4.1.3 Additional technical notes

Additional notes are available on the following web site:

http://www.seagate.com/support/fde

This site shows technical notes about additional new commands for FDE drives and other FDE-related information.

### 4.1.4 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 9: 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 |

### 4.1.5 Full Disc Encryption support

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

1 = Full Disc Encryption supported.

**Table 10: 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 |

### 4.1.6 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 11: Supported commands**

| | | ATA Security API | | | Drive Trust Security API | |
|---|---|---|---|---|---|---|
| **Op Code** | **Command** | **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 |

**Table 11: Supported commands**

| | | ATA Security API | | | Drive Trust Security API | |
|---|---|---|---|---|---|---|
| **Op Code** | **Command** | **Locked** | **Unlocked** | **Frozen** | **Secure State** | **Authenticated State** |
| 29 | READ MULTIPLE EXT | Aborted | Executable | Executable | Aborted | Executable |
| 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 PASS-WORD | 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 |

**Table 11: Supported commands**

| | | ATA Security API | | | Drive Trust Security API | |
|---|---|---|---|---|---|---|
| **Op Code** | **Command** | **Locked** | **Unlocked** | **Frozen** | **Secure State** | **Authenticated State** |
| $F9_H$ / $03_H$ | SET MAX UNLOCK | Aborted | Executable | Executable | Aborted | Executable |
| C6 | SET MULTIPLE MODE | Executable | Executable | Executable | Executable | Executable |
| 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 |

**Table 11: Supported commands**

| | | ATA Security API | | | Drive Trust Security API | |
|---|---|---|---|---|---|---|
| **Op Code** | **Command** | **Locked** | **Unlocked** | **Frozen** | **Secure State** | **Authenticated State** |
| 3A | WRITE STREAM DMA EXT | Aborted | Executable | Executable | Aborted | Executable |
| 3B | WRITE STREAM EXT | Aborted | Executable | Executable | Aborted | Executable |

### 4.1.7 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. 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 5 for default parameter settings.

The following commands contain drive-specific features that may not be included in the *Draft ATA-7 Standard.*

| Word | Description | Value |
|---|---|---|
| 0 | Configuration information:<br>• Bit 15: 0 = ATA; 1 = ATAPI<br>• Bit 7: removable media<br>• Bit 6: removable controller<br>• Bit 0: reserved | $0C5A_H$ |
| 1 | Number of logical cylinders | 16,383 |
| 2 | ATA-reserved | $0000_H$ |
| 3 | Number of logical heads | 16 |
| 4 | Retired | $0000_H$ |
| 5 | Retired | $0000_H$ |
| 6 | Number of logical sectors per logical track: 63 | $003F_H$ |
| 7–9 | Retired | $0000_H$ |
| 10–19 | Serial number: (20 ASCII characters, $0000_H$ = none) | ASCII |
| 20 | Retired | $0000_H$ |
| 21 | Retired | $0400_H$ |
| 22 | Obsolete | $0000_H$ |
| 23–26 | Firmware revision<br>(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) | ST9120826A<br>ST9100826A<br>ST980821A<br>ST960814A<br>ST940811A |
| 47 | (Bits 7–0) Maximum sectors per interrupt on Read multiple and Write multiple (16) | $8001_H$ |
| 48 | Reserved | $0000_H$ |
| 49 | Standard Standby timer, IORDY supported and may be disabled | $2F00_H$ |
| 50 | ATA-reserved | $4000_H$ |
| 51 | PIO data-transfer cycle timing mode | $0200_H$ |
| 52 | Retired | $0200_H$ |
| 53 | Words 54–58, 64–70 and 88 are valid | $0007_H$ |
| 54 | Number of current logical cylinders | $xxxx_H$ |
| 55 | Number of current logical heads | $xxxx_H$ |
| 56 | Number of current logical sectors per logical track | $xxxx_H$ |
| 57–58 | Current capacity in sectors | $xxxx_H$ |

| Word | Description | Value |
|---|---|---|
| 59 | Number of sectors transferred during a Read Multiple or Write Multiple command | *xxxx*$_H$ |
| 60–61 | Total number of user-addressable LBA sectors available<br>(see Section 2.2 for related information) | ST9120826A = 234,441,648<br>ST9100826A = 195,371,568<br>ST980821A = 156,301,488<br>ST960814A = 117,210,240<br>ST940811A = 78,140,160 |
| 62 | Retired | 0000$_H$ |
| 63 | Multiword DMA active and modes supported (see note following this table) | *xx*00$_H$ |
| 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 | 001B$_H$ |
| 82 | Command sets supported | 346B$_H$ |
| 83 | Command sets supported | 7D09$_H$ |
| 84 | Command sets support extension | 4003$_H$ |
| 85 | Command sets enabled | 34*xx*$_H$ |
| 86 | Command sets enabled | 3xxx$_H$ |
| 87 | Command sets enable extension | 4003$_H$ |
| 88 | Ultra DMA support and current mode<br>(see note following this table) | *xx*3F$_H$ |
| 89 | Security erase time | 0000$_H$ |
| 90 | Enhanced security erase time | 0000$_H$ |
| 91 | Advanced power management value | 8080$_H$ |
| 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$_H$ |
| 129–149 | Seagate-reserved | *xxxx*$_H$ |

| Word | Description | Value |
|---|---|---|
| 150 | Drive Trust Identify | $5098_H$ |
| 151–159 | Seagate-reserved | $xxxx_H$ |
| 160–242 | ATA-reserved | $0000_H$ |
| 243 | Disk Encryption Supported | $4000_H$ |
| 244–254 | 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 |
|---|---|---|
| | | |
| | **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 $V_{IH}$<br>0 = 40-conductor cable detected, CBLID below $V_{IL}$ |

### 4.1.8 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 12: Features register values**

| | | |
|---|---|---|
| $02_H$ | Enable write cache *(default).* | |
| $03_H$ | Set transfer mode (based on value in Sector Count register).<br>Sector Count register values: | |
| | $00_H$ | Set PIO mode to default (PIO mode 2). |
| | $01_H$ | Set PIO mode to default and disable IORDY (PIO mode 2). |
| | $08_H$ | PIO mode 0 |
| | $09_H$ | PIO mode 1 |
| | $0A_H$ | PIO mode 2 |
| | $0B_H$ | PIO mode 3 |
| | $0C_H$ | PIO mode 4 *(default)* |
| | $20_H$ | Abort, note supported |
| | $21_H$ | Abort, note supported |
| | $22_H$ | Abort, note supported |
| | $40_H$ | 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.

# 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 13. 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 13: Tested systems**

| | | |
|---|---|---|
| Acer Aspire 2000 | IBM R50 | Lavie LJ700/7E |
| Client Pro 345E | IBM R50P | Micron T2100 |
| Compaq NX9500 | IBM XNote | Micron T2200 |
| Compaq D315 | Imedia 7150(Discovery) | Microstar MSI-6561 |
| Compaq E -6000 | Inspiron 8100 | Microstar MSI-6566E |
| Dimension GX400 | Inspiron 1150 | Netvista |
| Dimension 4100 | Inspiron 2650 | Optiplex GX150 |
| Dimension 4100 XPSZ | Inspiron 300M | Optiplex GX260 |
| Dimension 4400 | Inspiron 5100 | Optiplex GX400 |
| Dimension 4500S | Inspiron 5150 | Pavilion 774Y |
| Dimension 4600 | Inspiron 600M | Pavilion ZD7000 |
| Dimension 8100 | Inspiron 8600 | Pavilion ZT3000 |
| Dimension 8200 | Inspiron 9100 | Pavilion ZV5000 |
| Dimension 8250 | Inspiron XPS | Pavilion ZX5000 |
| Dimension 8300 | Intel 845GBV | Performance |
| Dimension XPS | Intel SPRINGDALE-G | Performance 1400 |
| Gigabyte GA-8SIML | JIA HE H150 | Performance 1500 |
| Gigabyte GA-8SR533 | Latitude 100L | Sony PCV-RZ60 |
| HP/Compaq NX7000 | Latitude 8600 | Vaio PCG-V505/B |
| HP D330 | Latitude D400 | Vaio PCG-ZIR/P |
| HP D330 MT | Latitude D505 | Vaio PCV RX770 |
| HP D330 UT | Latitude D600 | Vaio PCV7753 |
| HP D530 | Latitude D800 | Vaio PCV-7753 |
| HP D530 CMT | Latitude X300 | |
| HP D530 SFF | | |
| HP D530 USDT | | |

## 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 14: Tested BIOS versions**

| Vendor | Release | Revision |
|---|---|---|
| ACER | | 1.01 |
| Award | Various | Various |
| Compaq | 68xxx | Various |
| Compaq | 78xxx | Various |
| Compaq | 8602 | v1.08 |
| Compaq | F.07 | |
| Dell | Various | A03 |
| HP | Various | Various |
| IBM | Various | Various |

**Table 14: Tested BIOS versions**

| Vendor | Release | Revision |
|---|---|---|
| Intel | 786B2 | v1.11 |
| NEC | Various | Various |
| Phoenix | Various | Various |

## 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 15: 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) |

## 5.4 Compatibility test configurations

The Momentus drives have been tested to demonstrate compliance in both the master drive and slave drive positions, including master and slave selection via the cable select feature. These 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 drives should be expected to be largely compliant to the emerging ATA/ATAPI-8 specification.

Notes exceptions to the specifications for the Momentus 5400 FDE are listed in the ATA Interface Section above.

## 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.

The Seagate DiscWizard™ application simplifies the installation of disc drives. This software also overcomes many system BIOS and operating system limitations that can complicate the installation of higher-capacity ATA (IDE) interface drives.

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 Third party software support

Seagate does not supply password management software. Third party software support for security features is available. For the latest list of available software, please refer to the following web site:

http://www.seagate.com/support/fde

# 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.

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

## Seagate Service Centers

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

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

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

## Customer Service Operations

### Warranty Service

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

### Data Recovery Services

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

### Authorized Service Centers

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

## USA/Canada/Latin America support services

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

## Global Customer Support

**Presales, Technical, and Warranty Support**

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

**Data Recovery Services**

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

## Europe, the Middle East and Africa Support Services

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

## Asia/Pacific Support Services

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

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