SEAGATE ST5000AS0001 Self Encryption Drive Instruction Manual

Contents

SEAGATE ST5000AS0001 Self Encryption Drive

Product Information

Specifications

- Standard Model: ST5000AS0011
- Self-Encryption Drive Model: ST5000AS0001
- Document Revision: 100743737 Rev. C
- Release Date: October 2014

Introduction
The product manual provides information and instructions for the Seagate Archive HDD. The standard model is ST5000AS0011, and the self-encrypting drive model is ST5000AS0001. The self-encrypting drive models have provisions for data security at rest based on the standards defined by the Trusted Computing Group.

About the SATA Interface
The Serial ATA (SATA) interface offers several advantages over the traditional ATA interface. These advantages include:

- Higher data transfer rates
- Improved system performance
- Hot-swapping support
- Thinner cables for better airflow
- Backward compatibility with legacy software

The SATA interface allows for easy transition from parallel ATA by providing legacy software support. It enables users to install a SATA host adapter and SATA disk drive in their current system while expecting all existing applications to function normally. In a SATA configuration, each disk drive is connected to the SATA host adapter in a point-to-point setup. Unlike parallel ATA, there is no master/slave relationship with SATA devices. If two drives are attached to one SATA host adapter, the host operating system treats them as separate devices and does not assign a master/slave designation. Both drives are recognized as Device 0 (master) devices by the system. Note

that some host adapters may emulate a master/slave environment for host software. In this scenario, two devices on separate SATA ports are represented as Device 0 (master) and Device 1 (slave) accessed at the same set of host bus addresses. However, this is not a typical SATA environment.

Product Usage Instructions

Setup and Installation

To set up the Seagate Archive HDD, follow these steps:

1. Ensure that your system meets the minimum requirements for the drive.
2. Choose an appropriate mounting location for the drive, considering factors such as ventilation and accessibility.
3. Attach the SATA cables to the drive and the SATA host adapter. Refer to Figure 3 for guidance on attaching SATA cabling.
4. If necessary, connect the power cable to the drive.
5. Mount the drive securely using appropriate screws or brackets. Refer to Figure 4 for mounting dimensions.
6. Power on your system and allow it to detect the new drive.
7. Initialize and format the drive according to your operating system's instructions.

Data Management

To manage your data on the Seagate Archive HDD:

- Organize your files into folders and directories for easy access.
- Regularly back up your important data to prevent loss in case of drive failure.
- Use reliable data management software to ensure data integrity and security.

Troubleshooting

If you encounter any issues with the Seagate Archive HDD, follow these troubleshooting steps:

1. Check all cable connections to ensure they are secure.
2. Ensure that the drive is receiving power by checking the power cable connection.
3. Update the firmware of the drive to the latest version, if available.
4. Check the Seagate website for any known issues or firmware updates specific to your drive model.
5. If the issue persists, contact Seagate technical support for further assistance.

FAQ

1. **Q: Where can I find online support and services for the Seagate Archive HDD?**
   A: You can visit the Seagate website at **http://www.seagate.com/about/contact-us/technical-support/** for online support and services.
2. **Q: Which Seagate HDD models are recommended for NAS and Surveillance applications?**
   A: For NAS and Surveillance applications, it is suggested to use Seagate NAS HDD and Surveillance HDD for better performance and reliability.

Document Revision History

Revision	Date	Pages affected
Rev. A	01/14/2014	Initial release.
Rev. B	01/21/2014	4 & 8.
Rev. C	10/16/2014	2-10, 12, 14 & 21-27.

Publication number: 100743737, Rev. C October 2014

When referring to drive capacity, one gigabyte, or GB, equals one billion bytes and one terabyte, or TB, equals one trillion bytes. Your computer's operating system may use a different standard of measurement and report a lower capacity. In addition, some of the listed capacity is used for formatting and other functions, and thus will not be available for data storage. Actual quantities will vary based on various factors, including file size, file format, features and application software. Actual data rates may vary depending on operating environment and other factors. The export or re-export of hardware or software containing encryption may be regulated by the U.S. Department of Commerce, Bureau of Industry and Security (for more information, visit **www.bis.doc.gov**), and controlled for import and use outside of the U.S. Seagate reserves the right to change, without notice, product offerings or specifications.

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For information regarding Warranty Support, visit: **http://www.seagate.com/support/warranty-and-replacements/** For information regarding data recovery services, visit: **http://www.seagate.com/services-software/data-recovery-services/**For Seagate OEM and Distribution partner portal, visit: **http://www.seagate.com/partners/** For Seagate reseller portal, visit: **http://www.seagate.com/partners/my-spp-dashboard/**

Introduction

This manual describes the functional, mechanical and interface specifications for the following: Seagate® Archive HDD model drives:.

Standard models	Self-Encrypting (SED) models
ST5000AS0011	ST5000AS0001

Note
The Self-Encrypting Drive models indicated on the cover of this product manual have provisions for "Security of Data at Rest" based on the standards defined by the Trusted Computing Group (see

www.trustedcomputinggroup.org).

These drives provide the following key features:

- 5900 RPM spindle speed.
- TGMR recording technology provides the drive with increased areal density.
- High instantaneous (burst) data-transfer rates (up to 600MB per second).
- State-of-the-art cache and on-the-fly error-correction algorithms.
- Native Command Queuing with command ordering to increase performance in demanding applications.
- Full-track multiple-sector transfer capability without local processor intervention.
- Seagate AcuTrac™ servo technology delivers dependable performance even with hard drive track widths of only 75 nanometers.
- Seagate SmartAlign™ technology provides a simple, transparent migration to Advanced Format 4K sectors
- Quiet operation.
- Compliant with RoHS requirements in China and Europe
- SeaTools™ diagnostic software performs a drive self-test that eliminates unnecessary drive returns.
- Support for S.M.A.R.T. drive monitoring and reporting.
- Supports latching SATA cables and connectors.
- Worldwide Name (WWN) capability uniquely identifies the drive.
- Archive HDDs are not intended for surveillance or NAS applications and may experience lower performance in these environments. For NAS and Surveillance applications, Seagate NAS HDD and Surveillance HDD are suggested for better performance and reliability

About the SATA interface
The Serial ATA (SATA) interface provides several advantages over the traditional (parallel) ATA interface.

The primary advantages include:

- Easy installation and configuration with true plug-and-play connectivity. It is not necessary to set any jumpers or other configuration options.
- Thinner and more flexible cabling for improved enclosure airflow and ease of installation.
- Scalability to higher performance levels.

In addition, SATA makes the transition from parallel ATA easy by providing legacy software support. SATA was designed to allow the user to install a SATA host adapter and SATA disk drive in the current system and expect all existing applications to work as normal. The SATA interface connects each disk drive in a point-to-point configuration with the SATA host adapter. There is no master/slave relationship with SATA devices like there is with parallel ATA. If two drives are attached on one SATA host adapter, the host operating system views the two devices as if they were both “masters” on two separate ports. This essentially means both drives behave as if they are Device 0 (master) devices.

Note
The host adapter may, optionally, emulate a master/slave environment to host software where two devices on separate SATA ports are represented to host software as a Device 0 (master) and Device 1 (slave) accessed at the same set of host bus addresses. A host adapter that emulates a master/slave environment manages two sets of shadow registers. This is not a typical SATA environment.
The SATA host adapter and drive share the function of emulating parallel ATA device behavior to provide backward compatibility with existing host systems and software. The Command and Control Block registers, PIO and DMA

data transfers, resets, and interrupts are all emulated. The SATA host adapter contains a set of registers that shadow the contents of the traditional device registers, referred to as the Shadow Register Block. All SATA devices behave like Device 0 devices. For additional information about how SATA emulates parallel ATA, refer to the “Serial ATA International Organization: Serial ATA Revision 3.0”. The specification can be downloaded from **www.sata-io.org**.

Drive Specifications

Unless otherwise noted, all specifications are measured under ambient conditions, at 25°C, and nominal power. For convenience, the phrases the drive and this drive are used throughout this manual to indicate the following drive models:

Standard models	**Self-Encrypting (SED) models**
ST5000AS0011	ST5000AS0001

Specification summary tables
The specifications listed in Table 1.
For details on specification measurement or definition, refer to the appropriate section of this manual.

Drive specifications summary for 5TB model

Drive Specification*	**ST5000AS0011 and ST5000AS0001**
Formatted capacity (512 bytes/sector)*	5000GB (5TB)
Guaranteed sectors	9,767,541,168
Heads	8
Disks	4
Bytes per sector (4K physical emulated at 512-byte sectors)	4096
Recording density, KFCI (max)	1807
Track density, KTPI (ktracks/in avg.)	455
Areal density, (Gb/in2 avg)	826
Spindle speed (RPM)	5900
Internal data transfer rate (Mb/s max)	1813
Average data rate, read/write (MB/s)	146
Sustained data transfer rate OD (MB/s max)	180
I/O data-transfer rate MB/s max)	600
ATA data-transfer modes supported	PIO modes 0–4 Multiword DMA modes 0–2 Ultra DMA modes 0–6
Cache buffer	128MB
Height (max)	26.1mm / 1.028 in

Width (max)	101.85mm /4.010 in
Length (max)	147.00mm / 5.787 in
Weight (typical)	655g (1.44 lb)
Average latency	5.1ms
Power-on to ready (sec max)	30.0
Standby to ready (sec max)	17.0
Average seek, read (ms typical) Average seek, write (ms typical)	<12.0 <12.0
Startup current (typical) 12V (peak)	2.0A
Voltage tolerance (including noise)	5V: ± 5% 12V: ±10%
Ambient Temperature	0 to 60°C (operating) -40 to 70°C (non-operating)
Temperature gradient (°C per hour max)	20°C (operating) 30°C (non-operating)
Relative humidity	5% to 90% (operating) 5% to 95% (non-operating)
Relative humidity gradient (per hour max)	30%

Wet bulb temperature (max)	30.0°C max (operating) 40.0°C max (nonoperating)
Altitude, operating	–61 m to 3048 m (–200 ft to 10,000+ ft)
Altitude, non-operating (below mean sea level, max)	–61 m to 12,192 m (–200 ft to 40,000+ ft)
Operational Shock (max @ 2 ms)	80 Gs
Non-Operational Shock (max @ 2 m s))	300 Gs
Vibration, operating	2–22 Hz: 0.25 Gs, Limited displacement 22–350 Hz: 0.50 Gs 350–500 Hz: 0.25 Gs
Vibration, non-operating	5Hz to 22Hz: 3.0 Gs 22Hz to 350Hz: 3.0 Gs 350Hz to 500Hz: 3.0 Gs
Drive acoustics, sound power (bels)	
Idle**	2.3 (typical) 2.5 (max)
Performance seek	2.8 (typical) 3.0 (max)
Non-recoverable read errors	1 per 1014 bits read
Workload Rate Limit	Average rate of <180TB/year The AFR specification for the drive assum es the I/O workload does not exceed the Average Annualized Workload Rate Limit of <180TB/year. Workloads exceeding the annualized rate m ay degrade the drive AFR and impact product reliability. The Average An nualized Workload Rate Limit is in units of TB per year, or TB per 8760 p ower on hours. Workload Rate = TB transferred x (8760 / recorded power on hours).
Warranty	To determine the warranty for a specific drive, use a web browser to acc ess the following web page: **http://www.seagate.com/support/warrant y-and-replacements/** From this page, click on the “Check to see if the drive is under Warranty” link. Users will be asked to provide the drive serial number, model numb er (or part number) and country of purchase. The system will display the warranty information for the drive.
Load/Unload cycles (25°C, 50% rel. humidity)	300,000
Supports Hot plug operation per the Serial ATA Rev. 3.2 specification	Yes

- One GB equals one billion bytes and 1TB equals one trillion 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.

Formatted capacity

Model	Formatted capacity*	Guaranteed sectors	Bytes per sector
ST5000AS0011 and ST5000AS0001	5TB	9,767,541,168	4096 (512 byte emulation)

- One GB equals one billion bytes and 1TB equals one trillion bytes when referring to hard drive capacity.

  Accessible capacity may vary depending on operating environment and formatting.

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 5.3.1, “Identify Device command” (words 60-61 and 100-103) for additional information about 48-bit addressing support of drives with capacities over 137GB.

Recording and interface technology

Interface	Serial ATA (SATA)
Recording method	Perpendicular
Recording density, KFCI (max)	1807
Track density, KTPI (ktracks/in avg)	455
Areal density (Gb/in^2 avg)	826
Spindle speed (RPM) (± 0.2%)	5900
Internal data transfer rate (Mb/s max)	1813
Sustained data transfer rate, OD read (MB/s max)	180
Average data rate, read/write (MB/s)	146
I/O data-transfer rate (MB/s max)	600 (Ultra DMA mode 5)

Physical characteristics

Height (max)	26.11mm / 1.028 in
Width (max)	101.85mm / 4.010 in
Length (max)	147.00mm / 5.787 in
Weight: (maximum)	655g (1.44 lb)
Cache buffer	128MB (129,536KB)

Seek time
Seek measurements are taken with nominal power at 25°C ambient temperature. All times are measured using drive diagnostics.

The specifications in the table below are defined as follows:

- Track-to-track seek time is an average of all possible single-track seeks in both directions.
- Average seek time is a true statistical random average of at least 5000 measurements of seeks between

random tracks, less overhead.

Typical seek times (ms)	Read	Write
Track-to-track	1.0	1.2
Average	<12.0	<12.0
Average latency	5.1	

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.

Start/stop times

Power-on to ready (sec)	25 (typical) 30 (max)
Standby to ready (sec)	15 (typical) 17 (max)
Ready to spindle stop (sec)	10 (typical) 11 (max)

Power specifications

The drive receives DC power (+5V or +12V) through a native SATA power connector. Refer to Figure 3 on page 15.

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, using 5.0V and 12.0V input voltage at 25°C ambient temperature.

- **Spin up power**
  Spin up power is measured from the time of power-on to the time that the drive spindle reaches operating speed.
- **Seek mode**
  During seek mode, the read/write actuator arm moves toward a specific position on the disc surface and does not execute a read or write operation. Servo electronics are active. Seek mode power represents the worst-case power consumption, using only random seeks with read or write latency time. This mode is not typical and is provided for worst-case information.
- **Read/write power and current**
  Read/write power is measured with the heads on track, based on a 16-sector write followed by a 32-ms delay, then a 16-sector read followed by a 32-ms delay.
- **Operating power and current**
  Operating power is measured using 40 percent random seeks, 40 percent read/write mode (1 write for each 10 reads) and 20 percent drive idle mode.

- **Idle mode power**
  Idle mode power is measured with the drive up to speed, with servo electronics active and with the heads in a random track location.
- **Standby mode**
  During Standby mode, the drive accepts commands, but the drive is not spinning, and the servo and read/write electronics are in power-down mode.

5TB Drive DC power requirements

			6.0Gb mode	
Voltage			**+5V**	**+12V**
Regulation			**±5%**	**±5%**
Avg Idle Current *			0.12	0.21
Advanced Idle Current *				
	Idle_A		0.11	0.21
	Idle_B		0.12	0.21
	Idle_C		0.12	0.21
	Standby		0.11	0.005
Average Sleep Current			0.104	0.006
Maximum Start Current				
	DC (peak DC)	3s	0.3	1.21
	AC (peak DC)	3s	0.49	2.01
Peak operating current (random read):				
	Typical DC		0.21	0.38
	Maximum DC	3s	0.21	0.39
Peak operating current (random write)				
	Typical DC		0.44	0.28
	Maximum DC	3s	0.45	0.29
Peak operating current (sequential read)				
	Typical DC		0.38	0.29
	Maximum DC	3s	0.44	0.31
Peak operating current (sequential write)				
	Typical DC		0.34	0.30
	Maximum DC	3s	0.35	0.31

- 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.

- **Spinup power**

  Spinup power is measured from the time of power-on to the time that the drive spindle reaches operating speed.

- **Operating Read/Write power and current**

  Sequential read/write – 128 block transfer, QD=16, minimum 10 data points

  Random read/write – 8 block transfer, QD=16, minimum 10 data points

  Typical DC – average of average operating currents

  Maximum DC – average of max operating currents

- **Average Idle Current**

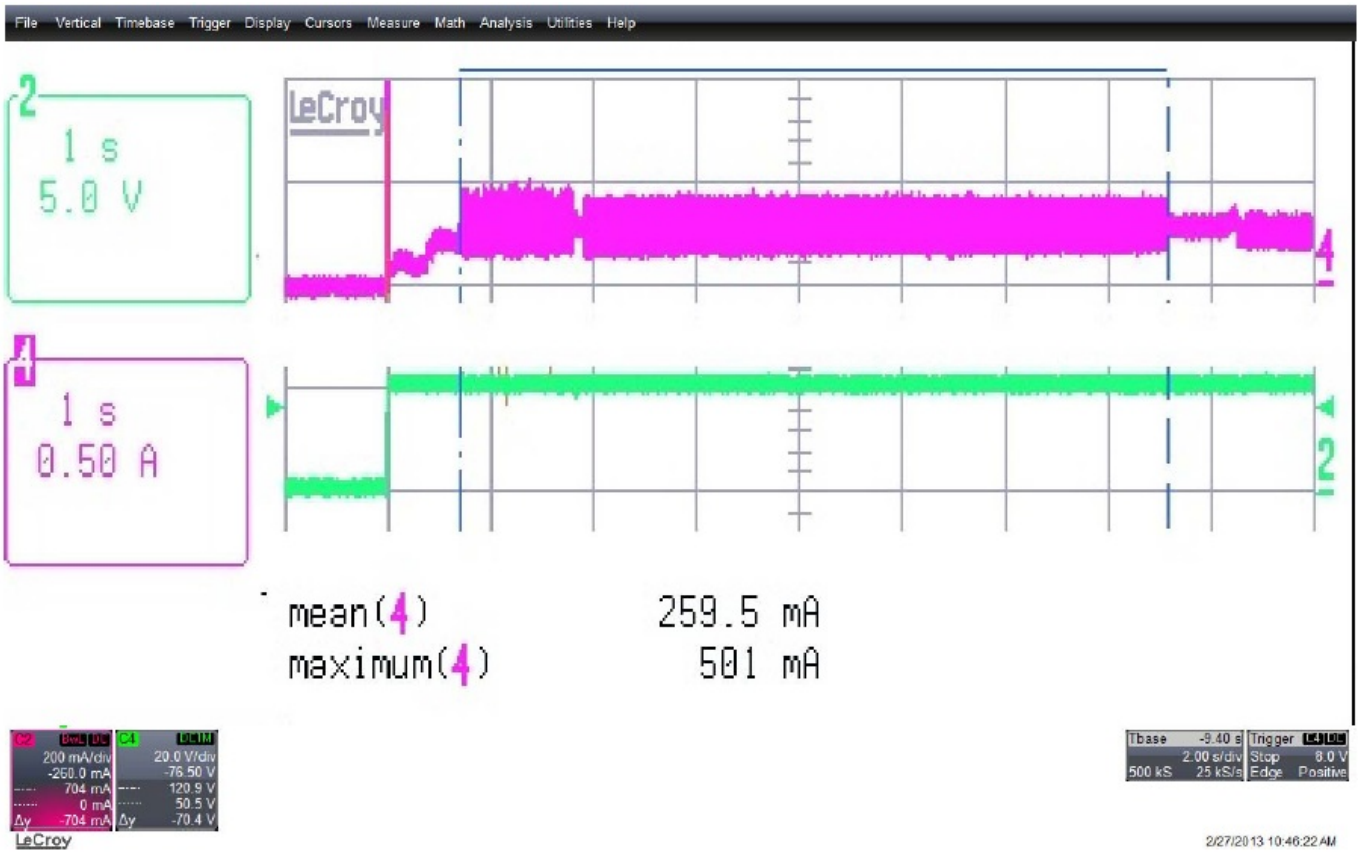
  Idle mode power is measured with the drive up to speed, with servo electronics active and with the heads in a random track location.

- **EPC Idle/Standby/Sleep mode**

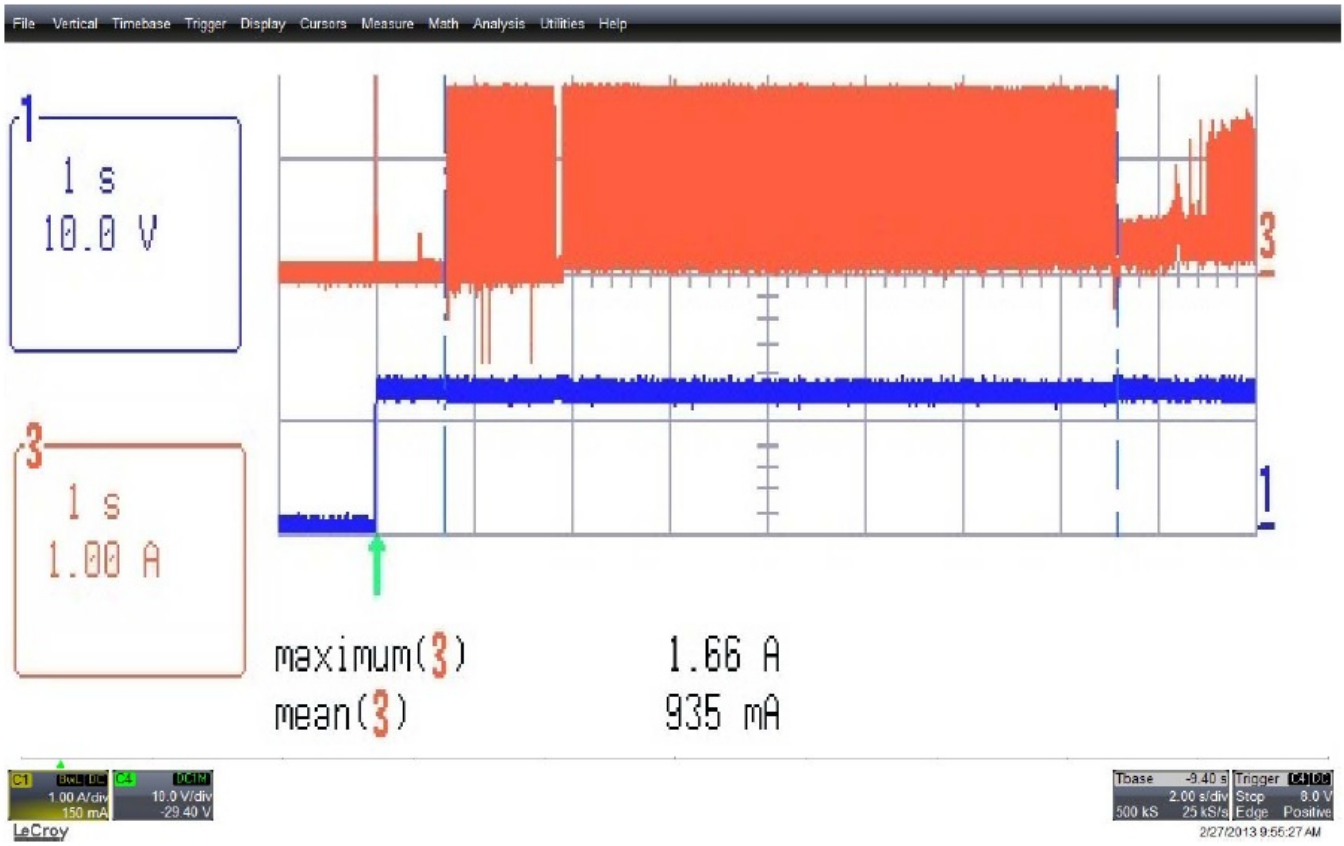
  The current is measured in the desired EPC idle/standby state.

Typical current profiles

5TB model current profile



Typical 5TB model 5V – 6Gb/s startup and operation current profile



Typical 5TB model 12V – 6Gb/s startup and operation current profile

Conducted noise
Input noise ripple is measured at the host system power supply across an equivalent 80-ohm resistive load on the+12 volt line or an equivalent 15-ohm resistive load on the +5 volt line.

- Using 12-volt power, the drive is expected to operate with a maximum of 120 mV peak-to-peak square-wave injected noise at up to 10MHz.
- 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 10MHz.

Note
Equivalent resistance is calculated by dividing the nominal voltage by the typical RMS read/write current.

Voltage tolerance
Voltage tolerance (including noise):

- 5V ± 5%
- 12V +10% / -7.5%

Environmental specifications

This section provides the temperature, humidity, shock, and vibration specifications for Desktop HDDs. Ambient temperature is defined as the temperature of the environment immediately surrounding the drive. Above 1000ft. (305 meters), the maximum temperature is derated linearly by 1°C every 1000 ft. Refer to Section 3.4 Drive mounting for base plate measurement location.

Ambient Temperature

Operating	0° to 60°C (32° to 140°F)
Non-operating	–40° to 70°C (–40° to 158°F)

Temperature gradient

Operating	20°C per hour (68°F per hour max), without condensation
Non-operating	30°C per hour (86°F per hour max)

Humidity
Relative humidity

Operating	5% to 90% non-condensing (30% per hour max)
Nonoperating	5% to 95% non-condensing (30% per hour max)

Wet bulb temperature

Operating	30°C (86°F max)
Non-operating	40°C (104°F max)

Altitude

Operating	–61 m to 3048 m (–200 ft. to 10,000+ ft.)
Non-operating	–61 m to 12,192 m (–200 ft. to 40,000+ ft.)

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.

Operating shock
These drives comply with the performance levels specified in this document when subjected to a maximum operating shock of 80 Gs based on half-sine shock pulses of 2 ms during read operations. Shocks should not be repeated more than two times per second.

Non-operating shock
The non-operating shock level that the drive can experience without incurring physical damage or degradation in performance when subsequently put into operation is 300 Gs based on a non-repetitive half-sine shock pulse of 2 ms duration.

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.

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

2Hz to 22Hz	0.25 Gs
22Hz to 350Hz	0.50 Gs
350Hz to 500Hz	0.25 Gs

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. Throughput may vary if improperly mounted.

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

5Hz to 22Hz	3.0 Gs (Limited displacement)
22Hz to 350Hz	3.0 Gs
350Hz to 500Hz	3.0 Gs

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

Fluid Dynamic Bearing (FDB) motor acoustics

	Idle*	**Performance Seek**
4 Disks	2.3 bels (typical) 2.5 bels (max)	2.8 bels (typical) 3.0 bels (max)

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

Test for Prominent Discrete Tones (PDTs)
Seagate follows the ECMA-74 standards for measurement and identification of PDTs. An exception to this process is the use of the absolute threshold of hearing. Seagate uses this threshold curve (originated in ISO 389-7) to discern tone audibility and to compensate for the inaudible components of sound prior to computation of tone ratios according to Annex D of the ECMA-74 standards.

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 Table 4.

Radio frequency environments

Test	Description	Performance level	Reference standard
Electrostatic discharge	Contact, HCP, VCP: ± 4 kV; Air: ± 8 kV	B	EN61000-4-2: 95
Radiated RF immunity	80MHz to 1,000MHz, 3 V/m, 80% AM with 1kHz sine 900MHz, 3 V/m, 50% pulse modulation @ 200Hz	A	EN61000-4-3: 96 ENV50204: 95
Electrical fast transient	± 1 kV on AC mains, ± 0.5 kV on external I/O	B	EN61000-4-4: 95
Surge immunity	± 1 kV differential, ± 2 kV common, AC mains	B	EN61000-4-5: 95
Conducted RF immunity	150kHz to 80MHz, 3 Vrms, 80% AM with 1kHz sine	A	EN61000-4-6: 97
Voltage dips, interrupts	0% open, 5 seconds 0% short, 5 seconds 40%, 0.10 seconds 70%, 0.01 seconds	C C C B	EN61000-4-11: 94

Reliability

Annualized Failure Rate (AFR) and Mean Time Between Failure (MTBF)
The product shall achieve an Annualized Failure Rate (AFR) of <1% (MTBF of 800K hours) when operated at an nominal power and typical case temperatures of 40°C. Operation at temperatures outside the specifications in Section 2.8 Environmental specifications may increase the product AFR (decrease MTBF). AFR and MTBF are population statistics that are not relevant to individual units.

AFR and MTBF specifications are based on the following assumptions for business critical storage system environments:

- 8760 power-on-hours per year.
- Operations at nominal voltages.
- Temperatures outside the specifications in Section 2.8 Environmental specifications may reduce the product reliability.
- A workload rate below the average annualized specified limits. Operation at excessive I/O duty cycle may degrade product reliability.

The enterprise application nearline environment of power-on-hours, temperature, and I/O duty cycle affect the product AFR and MTBF.

Nonrecoverable read errors	1 per 1014 bits read, max
Annualized Failure Rate (AFR)	<1% (nominal power, 25°C air temperature)
Load unload cycles	300,000 cycles
Workload rate limit	Average rate of <180TB/year The AFR specification for the drive assumes the I/O workload does not exceed the Average Annualized Workload Rate Limit of <180TB/year. Workloads exceeding the annualized rate may degrade the drive AFR and impact product reliability. The Average Annualized Workload Rate Limit is in units of TB per year, or TB per 8760 power on hours. Workload Rate = TB transferred x (8760 / recorded power on hours).
Warranty	To determine the warranty for a specific drive, use a web browser to access the following web page: **http://www.seagate.com/support/warranty-and-replacements/** From this page, click the “Check to see if the drive is under Warranty” link. Users 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 the drive.
Preventive maintenance	None required.

Agency certification

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

Electromagnetic compatibility
Hard drives that display the CE mark comply with the European Union (EU) requirements specified in the Electromagnetic Compatibility Directive (2004/108/EC) as put into place 20 July 2007. Testing is performed to the levels specified by the product standards for Information Technology Equipment (ITE). Emission levels are defined by EN 55022, Class B and the immunity levels are defined by EN 55024.
Drives are tested in representative end-user systems. Although CE-marked Seagate drives comply with the directives when used in the test systems, we cannot guarantee that all systems will comply with the directives. The drive is designed for operation inside a properly designed enclosure, with properly shielded I/O cable (if necessary) and terminators on all unused I/O ports. Computer manufacturers and system integrators should confirm EMC compliance and provide CE marking for their products.

Korean RRL
If these drives have the Korean Communications Commission (KCC) logo, they comply with paragraph 1 of Article 11 of the Electromagnetic Compatibility control Regulation and meet the Electromagnetic Compatibility (EMC) Framework requirements of the Radio Research Laboratory (RRL) Communications Commission, Republic of Korea. These drives have been tested and comply with the Electromagnetic Interference/Electromagnetic Susceptibility (EMI/EMS) for Class B products. Drives are tested in a representative, end-user system by a Korean-recognized lab.

- Family name: Seagate Archive HDD
- Certificate number: MSIP-REM-STX-ArchiveHDD
- Date of certification: 2014-Feb-04

Australian C-Tick (N176)
If these models have the C-Tick marking, they comply with the Australia/New Zealand Standard AS/NZ CISPR22

and meet the Electromagnetic Compatibility (EMC) Framework requirements of the Australian Communication Authority (ACA).

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 has tested this device in enclosures as described above to ensure that the total assembly (enclosure, disk drive, motherboard, power supply, etc.) does comply with the limits for a Class B computing device, pursuant to Subpart J, Part 15 of the FCC rules. Operation with non-certified 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, users 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, consult the dealer or an experienced radio/television technician for additional suggestions. Users 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.

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) Directive

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

China Restriction of Hazardous Substances (RoHS) Directive

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

Name of Parts	Toxic or Hazardous Substances or Elements					
	Lead (Pb)	Mercury (Hg)	Cadmium (Cd)	Hexavalent Chromium (Cr6+)	Polybrominated Diphenyl (PBB)	Polybrominated Diphenyl Ether (PBDE)
PCBA	X	O	O	O	O	O
HDA	X	O	O	O	O	O

- “O” indicates the hazardous and toxic substance content of the part (at the homogeneous material level) is lower than the threshold defined by the China RoHS MCV Standard.
- “X” indicates the hazardous and toxic substance content of the part (at the homogeneous material level) is over the threshold defined by the China RoHS MCV Standard.

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.

Configuring and Mounting the Drive

This section contains the specifications and instructions for configuring and mounting the drive.

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:

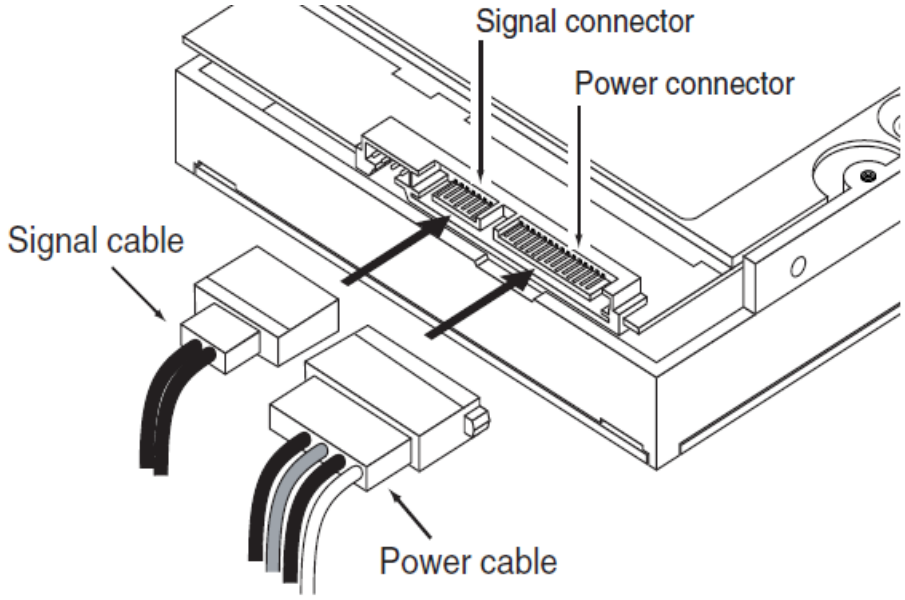
Caution

- Before handling the drive, put on a grounded wrist strap, or ground oneself frequently by touching the metal chassis of a computer that is plugged into a grounded outlet. Wear a grounded wrist strap throughout the entire installation procedure.
- Handle the drive by its edges or frame only.
- The drive is extremely fragile—handle it with care. Do not press down on the drive top cover.
- Always rest the drive on a padded, antistatic surface until it is mounted 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.

Configuring the drive
Each drive on the SATA interface connects point-to-point with the SATA host adapter. There is no master/slave relationship because each drive is considered a master in a point-to-point relationship. If two drives are attached on one SATA host adapter, the host operating system views the two devices as if they were both “masters” on two separate ports. Both drives behave as if they are Device 0 (master) devices.

SATA cables and connectors
The SATA 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 5 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

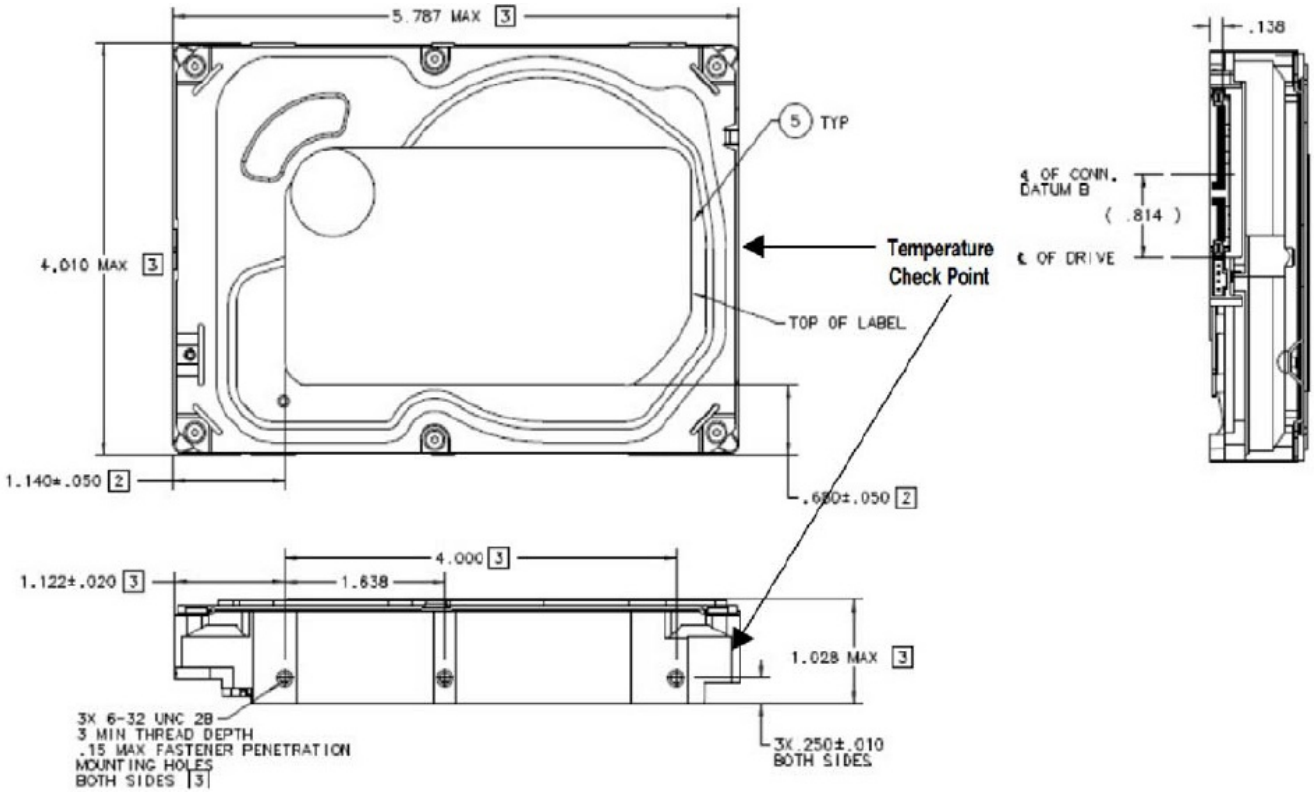
which require cables, users can connect the drive as illustrated in Figure 3.
Attaching SATA cabling



Each cable is keyed to ensure correct orientation. Seagate Archive HDD drives support latching SATA connectors.

Drive mounting

Users can mount the drive in any orientation using four screws in the side-mounting holes or four screws in the bottom-mounting holes. Refer to Figure 4 for drive mounting dimensions.



Follow these important mounting precautions when mounting the drive:

- Allow a minimum clearance of 0.030 inches (0.76mm) around the entire perimeter of the drive for cooling.
- Use only 6-32 UNC mounting screws.

- The screws should be inserted no more than 0.150 inch (3.81mm) into the bottom or side mounting holes.
- Do not overtighten the mounting screws (maximum torque: 6 inch-lb).

Weight: (maximum) 655g (1.44 lb)

Note
These dimensions conform to the Small Form Factor Standard documented in SFF-8301 and SFF-8323 found at **www.sffcommittee.org**

- This image may not be representative of the actual drive.

About (SED) Self-Encrypting Drives

Self-encrypting drives (SEDs) offer encryption and security services for the protection of stored data, commonly known as “protection of data at rest.” These drives are compliant with the Trusted Computing Group (TCG) Opal Storage Specifications as detailed in the following:
Trusted Computing Group (TCG) Documents (apply to Self-Encrypting Drive models only) TCG Storage Architecture Core Specification, Version 2.0 TCG Storage Security Subsystem Class Opal Specification, Version 2.0 (see **www.trustedcomputinggroup.org**) In case of conflict between this document and any referenced document, this document takes precedence. The Trusted Computing Group (TCG) is an organization sponsored and operated by companies in the computer, storage and digital communications industry. Seagate’s SED models comply with the standards published by the TCG.

To use the security features in the drive, the host must be capable of constructing and issuing the following two SATA commands:

- Trusted Send
- Trusted Receive

These commands are used to convey the TCG protocol to and from the drive in their command payloads.

Data Encryption
Encrypting drives use one inline encryption engine for each drive employing AES-256 data encryption in Cipher Block Chaining (CBC) mode to encrypt all data prior to being written on the media and to decrypt all data as it is read from the media. The encryption engine is always in operation and cannot be disabled. The 32-byte Data Encryption Key (DEK) is a random number which is generated by the drive, never leaves the drive, and is inaccessible to the host system. The DEK is itself encrypted when it is stored on the media and when it is in volatile temporary storage (DRAM) external to the encryption engine. A unique data encryption key is used for each of the drive’s possible16 data bands (see Section 4.5 Data Bands).

Controlled Access
The drive has two security providers (SPs) called the “Admin SP” and the “Locking SP.” These act as gatekeepers to the drive security services. Security-related commands will not be accepted unless they also supply the correct credentials to prove the requester is authorized to perform the command.

Admin SP
The Admin SP allows the drive’s owner to enable or disable firmware download operations (see Section 4.4 Drive Locking). Access to the Admin SP is available using the SID (Secure ID) password or the MSID (Manufacturers Secure ID) password.

Locking SP
The Locking SP controls read/write access to the media and the cryptographic erase feature. Access to the

Locking SP is available using the Admin or User passwords.

Default password
When the drive is shipped from the factory, all passwords are set to the value of MSID. This 32-byte random value can only be read by the host electronically over the interface. After receipt of the drive, it is the responsibility of the owner to use the default MSID password as the authority to change all other passwords to unique owner-specified values.

ATA Enhanced Security
The drive can utilize the system's BIOS through the ATA Security API for cases that do not require password management and additional security policies. Furthermore, the drive's ATA Security Erase Unit command shall support both Normal and Enhanced Erase modes with the following modifications/additions:
Normal Erase: Normal erase feature shall be performed by changing the Data Encryption Key (DEK) of the drive, followed by an overwrite operation that repeatedly writes a single sector containing random data to the entire drive. This write operation bypasses the media encryption. On reading back the overwritten sectors, the host will receive a decrypted version, using the new DEK of the random data sector (the returned data will not match what was written).
Enhanced Erase: Enhanced erase shall be performed by changing the Data Encryption Key of the drive.

Random Number Generator (RNG)
The drive has a 32-byte hardware RNG that it is uses to derive encryption keys or, if requested to do so, to provide random numbers to the host for system use, including using these numbers as Authentication Keys (passwords) for the drive's Admin and Locking SPs.

Drive Locking
In addition to changing the passwords, as described in Section 4.2.3 Default password, the owner should also set the data access controls for the individual bands. The variable "Lock On Reset" should be set to "Power Cycle" to ensure that the data bands will be locked if power is lost. In addition "Read Lock Enabled" and "Write Lock Enabled" must be set to true in the locking table in order for the bands "Lock On Reset" setting of "Power Cycle" to actually lock access to the band when a "Power Cycle" event occurs. This scenario occurs if the drive is removed from its cabinet. The drive will not honor any data read or write requests until the bands have been unlocked. This prevents the user data from being accessed without the appropriate credentials when the drive has been removed from its cabinet and installed in another system.

Data Bands
When shipped from the factory, the drive is configured with a single data band called Band 0 (also known as the Global Data Band) which comprises LBA 0 through LBA max. The host may allocate additional bands (Band1 to Band15) by specifying a start LBA and an LBA range. The real estate for this band is taken from the Global Band. Data bands cannot overlap but they can be sequential with one band ending at LBA (x) and the next beginning at LBA (x+1). Each data band has its own drive-generated encryption key. The host may change the Encryption Key (see Section 4.6 Cryptographic Erase) or the password when required. The bands should be aligned to 4K LBA boundaries.

Cryptographic Erase
A significant feature of SEDs is the ability to perform a cryptographic erase. This involves the host telling the drive to change the data encryption key for a particular band. Once changed, the data is no longer recoverable since it was written with one key and will be read using a different key. Since the drive overwrites the old key with the new one, and keeps no history of key changes, the user data can never be recovered. This is tantamount to an instantaneous data erase and is very useful if the drive is to be scrapped or redispositioned.

Authenticated Firmware Download
In addition to providing a locking mechanism to prevent unwanted firmware download attempts, the drive also only accepts download files which have been cryptographically signed by the appropriate Seagate Design Center.

Three conditions must be met before the drive will allow the download operation:

1. The download must be an SED file. A standard (base) drive (non-SED) file will be rejected.
2. The download file must be signed and authenticated.
3. As with a non-SED drive, the download file must pass the acceptance criteria for the drive. For example it must be applicable to the correct drive model, and have compatible revision and customer status.

Power Requirements
The standard drive models and the SED drive models have identical hardware, however the security and encryption portion of the drive controller ASIC is enabled and functional in the SED models. This represents a small additional drain on the 5V supply of about 30mA and a commensurate increase of about 150mW in power consumption. There is no additional drain on the 12V supply. See the tables in section 2.7,Power specifications" for power requirements on the standard (non-SED) drive models.

Supported Commands
The SED models support the following two commands in addition to the commands supported by the standard (non-SED) models as listed in section 5.3, Supported ATA commands":

- Trusted Send
- Trusted Receive

RevertSP
SED models will support the RevertSP feature which erases all data in all bands on the device and returns the contents of all SPs (Security Providers) on the device to their original factory state. In order to execute the RevertSP method the unique PSID (Physical Secure ID) printed on the drive label must be provided. PSID is not electronically accessible and can only be manually read from the drive label or scanned in via the 2D barcode.

SATA 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 to 4; multiword DMA modes 0 to 2, and Ultra DMA modes 0 to 6. For detailed information about the SATA interface, refer to the "Serial ATA: High Speed Serialized AT Attachment" specification.

Hot-Plug compatibility
Seagate Archive HDD drives incorporate connectors which enable users to hot plug these drives in accordance with the SATA Revision 3.0 specification. This specification can be downloaded from

Caution
The drive motor must come to a complete stop (Ready to spindle stop time indicated in Section 2.6) prior to changing the plane of operation.This time is required to insure data integrity.

SATA device plug connector pin definitions
Table 5 summarizes the signals on the SATA interface and power connectors.

SATA 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	V33	3.3V power
	P2	V33	3.3V power
	P3	V33	3.3V power, pre-charge, 2nd mate
	P4	Ground	1st mate
	P5	Ground	2nd mate
	P6	Ground	2nd mate
	P7	V5	5V power, pre-charge, 2nd mate
	P8	V5	5V power
	P9	V5	5V power
	P10	Ground	2nd mate
	P11	Ground or LED signal	If grounded, drive does not use deferred spin
	P12	Ground	1st mate.
	P13	V12	12V power, pre-charge, 2nd mate
	P14	V12	12V power
	P15	V12	12V power

Notes

1. All pins are in a single row, with a 1.27 mm (0.050”) pitch.
2. The comments on the mating sequence apply to the case of backplane blindmate connector only.
   In this case, the mating sequences are:
   - the ground pins P4 and P12.
   - the pre-charge power pins and the other ground pins.
   - the signal pins and the rest of the power pins.
3. There are three power pins for each voltage.

One pin from each voltage is used for pre-charge when installed in a blind-mate backplane configuration.

- All used voltage pins (Vx) must be terminated.

Supported ATA commands

The following table lists SATA standard commands that the drive supports.

For a detailed description of the ATA commands, refer to the Serial ATA International Organization:
Serial ATA Revision 3.0 (**http://www.sata-io.org**).
See “S.M.A.R.T. commands” on page 28 for details and subcommands used in the S.M.A.R.T. implementation.

SATA standard commands

Command name	Command code (in hex)
Check Power Mode	E5H
Device Configuration Freeze Lock	B1H / C1H
Device Configuration Identify	B1H / C2H
Device Configuration Restore	B1H / C0H
Device Configuration Set	B1H / C3H
Device Reset	08H
Download Microcode	92H
Execute Device Diagnostics	90H
Flush Cache	E7H
Flush Cache Extended	EAH
Format Track	50H
Identify Device	ECH
Idle	E3H
Idle Immediate	E1H
Initialize Device Parameters	91H
Read Buffer	E4H
Read DMA	C8H
Read DMA Extended	25H
Read DMA Without Retries	C9H
Read Log Ext	2FH
Read Multiple	C4H
Read Multiple Extended	29H
Read Native Max Address	F8H
Read Native Max Address Extended	27H

Read Sectors	20H
Read Sectors Extended	24H
Read Sectors Without Retries	21H
Read Verify Sectors	40H
Read Verify Sectors Extended	42H
Read Verify Sectors Without Retries	41H
Recalibrate	10H
Security Disable Password	F6H
Security Erase Prepare	F3H
Security Erase Unit	F4H

Command name	**Command code (in hex)**	
Security Freeze	F5H	
Security Set Password	F1H	
Security Unlock	F2H	
Seek	70H	
Set Features	EFH	
Set Max Address	F9H	
Note: Individual Set Max Address commands are identified by the value placed in the Set Max Features register as defined to the right.	Address: Password: Lock: Unlock: Freeze Lock:	00H 01H 02H 03H 04H
Set Max Address Extended Set Multiple Mode	37H C6H	
Sleep	E6H	
S.M.A.R.T. Disable Operations	B0H / D9H	
S.M.A.R.T. Enable/Disable Autosave	B0H / D2H	
S.M.A.R.T. Enable Operations	B0H / D8H	
S.M.A.R.T. Execute Offline	B0H / D4H	
S.M.A.R.T. Read Attribute Thresholds	B0H / D1H	
S.M.A.R.T. Read Data	B0H / D0H	
S.M.A.R.T. Read Log Sector	B0H / D5H	
S.M.A.R.T. Return Status	B0H / DAH	
S.M.A.R.T. Save Attribute Values	B0H / D3H	

S.M.A.R.T. Write Log Sector	B0H / D6H
Standby	E2H
Standby Immediate	E0H
Write Buffer	E8H
Write DMA	CAH
Write DMA Extended	35H
Write DMA FUA Extended	3DH
Write DMA Without Retries	CBH
Write Log Extended	3FH
Write Multiple	C5H
Write Multiple Extended	39H
Write Multiple FUA Extended	CEH
Write Sectors	30H
Write Sectors Without Retries	31H
Write Sectors Extended	34H
Write Uncorrectable	45H

Identify Device command

The Identify Device command (command code ECH) 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 on page 21. All reserved bits or words should be set to zero. Parameters listed with an “x” are drive-specific or vary with the state of the drive. The following commands contain drive-specific features that may not be included in the SATA specification.

Identify Device commands

Word	Description	Value
0	Configuration information: • Bit 15: 0 = ATA; 1 = ATAPI • Bit 7: removable media • Bit 6: removable controller • Bit 0: reserved	0C5AH
1	Number of logical cylinders	16,383
2	ATA-reserved	0000H
3	Number of logical heads	16
4	Retired	0000H
5	Retired	0000H
6	Number of logical sectors per logical track: 63	003FH
7–9	Retired	0000H
10–19	Serial number: (20 ASCII characters, 0000H = none)	ASCII
20	Retired	0000H
21	Retired	0400H
22	Obsolete	0000H
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)	
47	(Bits 7–0) Maximum sectors per interrupt on Read multiple and W rite multiple (16)	8010H
48	Reserved	0000H
49	Standard Standby timer, IORDY supported and may be disabled	2F00H
50	ATA-reserved	0000H
51	PIO data-transfer cycle timing mode	0200H
52	Retired	0200H
53	Words 54–58, 64–70 and 88 are valid	0007H
54	Number of current logical cylinders	*xxxx*H
55	Number of current logical heads	*xxxx*H
56	Number of current logical sectors per logical track	*xxxx*H
57–58	Current capacity in sectors	*xxxx*H

59	Number of sectors transferred during a Read Multiple or Write Multiple command	*xxxx*H
60–61	Total number of user-addressable LBA sectors available (see **Section 2.2** for related information) *Note: The maximum value allowed in this field is: 0FFFFFFFh (268,435,455 sectors, 137GB). Drives with capacities over 137GB will have 0FFFFFFFh in this field and the actual number of user-addressable LBAs specified in words 100-103. This is required for drives that support the 48-bit addressing feature.	0FFFFFFFh*
62	Retired	0000H
63	Multiword DMA active and modes supported (see note following this table)	*xx*07H
64	Advanced PIO modes supported (modes 3 and 4 supported)	0003H
65	Minimum multiword DMA transfer cycle time per word (120 nsec)	0078H
66	Recommended multiword DMA transfer cycle time per word (120 nsec)	0078H
67	Minimum PIO cycle time without IORDY flow control (240 nsec)	0078H
68	Minimum PIO cycle time with IORDY flow control (120 nsec)	0078H
69–74	ATA-reserved	0000H
75	Queue depth	001FH
76	SATA capabilities	xxxxH
77	Reserved for future SATA definition	xxxxH
78	SATA features supported	xxxxH
79	SATA features enabled	xxxxH
80	Major version number	01F0H
81	Minor version number	0028H
82	Command sets supported	364BH
83	Command sets supported	7F09H
84	Command sets support extension (see note following this table)	4163H
85	Command sets enabled	30*xx*H
86	Command sets enabled	BE09H
87	Command sets enable extension	4163H
88	Ultra DMA support and current mode (see note following this table)	*xx*7FH
89	Security erase time	0039H
90	Enhanced security erase time	0039H
92	Master password revision code	FFFEH
93	Hardware reset value	*xxxx*H

94	Automatic acoustic management	8080H

95–99	ATA-reserved	0000H
100–103	Total number of user-addressable LBA sectors available (see Section 2.2 for related information). These words are required for drives that support the 48-bit addressing feature. Maximum value: 0000FFFFFFFFFFFFh.	ST5000DM000 = 9,767,541,168 ST2500DM001 = 9,767,541,168
104–107	ATA-reserved	0000H
108–111	The mandatory value of the world wide name (WWN) for the drive. NOTE: This field is valid if word 84, bit 8 is set to 1 indicating 64-bit WWN support.	Each drive will have a unique value.
112–127	ATA-reserved	0000H
128	Security status	0001H
129–159	Seagate-reserved	*xxxx*H
160–254	ATA-reserved	0000H
255	Integrity word	xxA5H

Note
Advanced Power Management (APM) and Automatic Acoustic Management (AAM) features are not supported.

- See the bit descriptions below for words 63, 84, and 88 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 84**
	0	SMART error login is supported.
	1	SMART self-test is supported.
	2	Media serial number is supported.
	3	Media Card Pass Through Command feature set is supported.
	4	Streaming feature set is supported.
	5	GPL feature set is supported.
	6	WRITE DMA FUA EXT and WRITE MULTIPLE FUA EXT commands are supported.
	7	WRITE DMA QUEUED FUA EXT command is supported.
	8	64-bit World Wide Name is supported.
	9-10	Obsolete.

	11-12	Reserved for TLC.
	13	IDLE IMMEDIATE command with IUNLOAD feature is supported.
	14	Shall be set to 1.
	15	Shall be cleared to 0.
	Bit	**Word 88**
	0	Ultra DMA mode 0 is supported.
	1	Ultra DMA mode 1 is supported.
	2	Ultra DMA mode 2 is supported.
	3	Ultra DMA mode 3 is supported.
	4	Ultra DMA mode 4 is supported.
	5	Ultra DMA mode 5 is supported.
	6	Ultra DMA mode 6 is supported.
	8	Ultra DMA mode 0 is currently active.
	9	Ultra DMA mode 1 is currently active.
	10	Ultra DMA mode 2 is currently active.
	11	Ultra DMA mode 3 is currently active.
	12	Ultra DMA mode 4 is currently active.
	13	Ultra DMA mode 5 is currently active.
	14	Ultra DMA mode 6 is currently active.

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:
Set Features command

02H	Enable write cache *(default)*
03H	Set transfer mode (based on value in Sector Count register) Sector Count register values:
	00H Set PIO mode to default (PIO mode 2)
	01H Set PIO mode to default and disable IORDY (PIO mode 2)
	08H PIO mode 0
	09H PIO mode 1
	0AH PIO mode 2
	0BH PIO mode 3
	0CH PIO mode 4 *(default)*
	20H Multiword DMA mode 0
	21H Multiword DMA mode 1
	22H Multiword DMA mode 2
	40H Ultra DMA mode 0
	41H Ultra DMA mode 1
	42H Ultra DMA mode 2
	43H Ultra DMA mode 3
	44H Ultra DMA mode 4
	45H Ultra DMA mode 5
	46H Ultra DMA mode 6
06H	Enable the PUIS feature set
07H	PUIS feature set device spin-up
10H	Enable use of SATA features
55H	Disable read look-ahead (read cache) feature
82H	Disable write cache
86H	Disable the PUIS feature set
90H	Disable use of SATA features
AAH	Enable read look-ahead (read cache) feature *(default)*
F1H	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.

S.M.A.R.T. commands

S.M.A.R.T. provides near-term failure prediction for disk drives. When S.M.A.R.T. is enabled, the drive monitors predetermined drive attributes that are susceptible to degradation over time. If self-monitoring determines that a

failure is likely, S.M.A.R.T. makes a status report available to the host. Not all failures are predictable. S.M.A.R.T. predictability is limited to the attributes the drive can monitor. For more information on S.M.A.R.T. commands and implementation, see the Draft ATA-5 Standard. SeaTools diagnostic software activates a built-in drive self-test (DST S.M.A.R.T. command for D4H) that eliminates unnecessary drive returns. The diagnostic software ships with all new drives and is also available at: **http://www.seagate.com/support/downloads/seatools/**. This drive is shipped with S.M.A.R.T. features disabled. The system 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.

Code in features register	S.M.A.R.T. command
D0H	S.M.A.R.T. Read Data
D2H	S.M.A.R.T. Enable/Disable Attribute Autosave
D3H	S.M.A.R.T. Save Attribute Values
D4H	S.M.A.R.T. Execute Off-line Immediate (runs DST)
D5H	S.M.A.R.T. Read Log Sector
D6H	S.M.A.R.T. Write Log Sector
D8H	S.M.A.R.T. Enable Operations
D9H	S.M.A.R.T. Disable Operations
DAH	S.M.A.R.T. Return Status

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

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Documents / Resources

	**SEAGATE ST5000AS0001 Self Encryption Drive** [pdf] Instruction Manual ST5000AS0001 Self Encryption Drive, ST5000AS0001, Self Encryption Drive, Encryption Drive , Drive

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