



# Enterprise Capacity 3.5 HDD

v5.1 SATA Product Manual

**Standard 512n  
models**

ST2000NM0008  
ST1000NM0008

**Instant Secure Erase  
512n models**

ST2000NM0018  
ST1000NM0018

100805922, Rev. D  
February 2018

## Document Revision History

Revision	Date	Pages affected and Description of changes
Rev. A	10/26/2016	Initial release.
Rev. B	06/01/2017	9: Updated Advanced Idle Current (Idle_A, B & C)
Rev. C	09/22/2017	13: Updated Figure 2: Location of the HDA temperature check point 16-19: Updated Sections 2.12 through 2.14.3
Rev. D	02/12/2018	19: Updated Table 6: Taiwan - Restricted Substances - Unit row headers = HDD & PCBA 21-22: Updated fastener penetration depth to 0.14" in text & mechanical drawing

**© 2018 Seagate Technology LLC. All rights reserved.**

Publication number: 100805922, Rev. D February 2018

Seagate, Seagate Technology and the Spiral logo are registered trademarks of Seagate Technology LLC in the United States and/or other countries. PowerChoice and SeaTools are either trademarks or registered trademarks of Seagate Technology LLC or one of its affiliated companies in the United States and/or other countries. The FIPS logo is a certification mark of NIST, which does not imply product endorsement by NIST, the U.S., or Canadian governments. All other trademarks or registered trademarks are the property of their respective owners.

No part of this publication may be reproduced in any form without written permission of Seagate Technology LLC.

Call 877-PUB-TEK1 (877-782-8351) to request permission.

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](http://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.

# Contents

<b>Seagate® Technology Support Services</b> .....	<b>4</b>
<hr/>	
<b>1.0 Introduction</b> .....	<b>5</b>
1.1 About the Serial ATA interface .....	5
<hr/>	
<b>2.0 Drive specifications</b> .....	<b>6</b>
2.1 Specification summary tables .....	6
2.2 Formatted capacity .....	8
2.2.1 LBA mode .....	8
2.3 Recording and interface technology .....	8
2.4 Start/stop times .....	8
2.5 Power specifications .....	9
2.5.1 Power consumption .....	9
2.5.2 Conducted noise .....	10
2.5.3 Voltage tolerance .....	10
2.5.4 Extended Power Conditions - PowerChoice™ .....	11
2.6 Environmental specifications .....	13
2.6.1 Ambient Temperature .....	13
2.7 Temperature gradient .....	13
2.7.1 Humidity .....	13
2.7.2 Altitude .....	13
2.7.3 Shock .....	14
2.7.4 Vibration .....	14
2.8 Acoustics .....	15
2.9 Test for Prominent Discrete Tones (PDTs) .....	15
2.10 Electromagnetic immunity .....	15
2.11 Reliability .....	16
2.11.1 Annualized Failure Rate (AFR) and Mean Time Between Failures (MTBF) .....	16
2.12 Agency and Safety Certifications .....	16
2.13 Safety certification .....	16
2.13.1 European Union (EU) CE Marking Requirements .....	16
2.13.2 Australian RCM Compliance Mark .....	17
2.13.3 Canada ICES-003 .....	17
2.13.4 South Korean KC Certification Mark .....	17
2.13.5 Morocco Commodity Mark .....	17
2.13.6 Taiwanese BSMI .....	17
2.13.7 FCC verification .....	17
2.14 Environmental protection .....	18
2.14.1 European Union Restriction of Hazardous Substance Law .....	18
2.14.2 China Requirements —China RoHS 2 .....	19
2.14.3 Taiwan Requirements — Taiwan RoHS .....	19
2.15 Reference documents .....	20
2.16 Corrosive environment .....	20
2.17 Product warranty .....	20

---

<b>3.0</b>	<b>Configuring and mounting the drive</b> .....	<b>21</b>
3.1	Handling and static-discharge precautions .....	21
3.2	Configuring the drive .....	21
3.3	Serial ATA cables and connectors .....	21
3.4	Drive mounting .....	21
3.4.1	Mechanical specifications .....	22

---

<b>4.0</b>	<b>Serial ATA (SATA) interface</b> .....	<b>23</b>
4.1	Hot-Plug compatibility .....	23
4.2	Serial ATA device plug connector pin definitions .....	23
4.3	Supported ATA commands .....	24
4.3.1	Identify Device command .....	26
4.3.2	Set Features command .....	30
4.3.3	S.M.A.R.T. commands .....	31

# Seagate® Technology Support Services

For information regarding online support and services, visit: <http://www.seagate.com/contacts/>

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/recover/>

For Seagate OEM, Distribution partner and reseller portals, visit: <http://www.seagate.com/partners/>

# 1.0 Introduction

This manual describes the functional, mechanical and interface specifications for the following: Seagate® Enterprise Capacity 3.5 HDD v5.1 model drives:.

Standard 512n models		Instant Secure Erase models	
ST2000NM0008	ST1000NM0008	ST2000NM0018	ST1000NM0018

These drives provide the following key features:

- 7200 RPM spindle speed.
- Compliant with RoHS requirements in China and Europe.
- Full-track multiple-sector transfer capability without local processor intervention.
- High instantaneous (burst) data-transfer rates (up to 600MB per second).
- Native Command Queuing with command ordering to increase performance in demanding applications.
- Perpendicular recording technology provides the drives with increased areal density.
- PowerChoice™ for selectable power savings
- SeaTools™ diagnostic software performs a drive self-test that eliminates unnecessary drive returns.
- State-of-the-art cache and on-the-fly error-correction algorithms.
- Support for S.M.A.R.T. drive monitoring and reporting.
- Supports latching SATA cables and connectors.
- Tarnish-resistant components to help protect drive from environmental elements, increasing field reliability
- Worldwide Name (WWN) capability uniquely identifies the drive.

## 1.1 About the Serial ATA interface

The Serial ATA interface provides several advantages over the traditional (parallel) ATA interface. The primary advantages include:

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

In addition, Serial ATA makes the transition from parallel ATA easy by providing legacy software support. Serial ATA was designed to allow users to install a Serial ATA host adapter and Serial ATA disk drive in current systems and expect all existing applications to work as normal.

The Serial ATA interface connects each disk drive in a point-to-point configuration with the Serial ATA host adapter. There is no master/slave relationship with Serial ATA devices like there is with parallel ATA. If two drives are attached on one Serial ATA host adapter, the host operating system views the two devices as if they were both “masters” on two separate ports. This essentially means both drives behave as if they are Device 0 (master) devices.

<b>Note</b>	The host adapter may, optionally, emulate a master/slave environment to host software where two devices on separate Serial ATA ports are represented to host software as a Device 0 (master) and Device 1 (slave) accessed at the same set of host bus addresses. A host adapter that emulates a master/slave environment manages two sets of shadow registers. This is not a typical Serial ATA environment.
-------------	---

The Serial ATA host adapter and drive share the function of emulating parallel ATA device behavior to provide backward compatibility with existing host systems and software. The Command and Control Block registers, PIO and DMA data transfers, resets, and interrupts are all emulated.

The Serial ATA host adapter contains a set of registers that shadow the contents of the traditional device registers, referred to as the Shadow Register Block. All Serial ATA devices behave like Device 0 devices. For additional information about how Serial ATA emulates parallel ATA, refer to the “Serial ATA: High Speed Serialized AT Attachment” specification. The specification can be downloaded from [www.serialata.org](http://www.serialata.org).

## 2.0 Drive specifications

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

Standard 512n models		Instant Secure Erase models	
ST2000NM0008	ST1000NM0008	ST2000NM0018	ST1000NM0018

### 2.1 Specification summary tables

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

**Table 1 Drive specifications summary**

Drive specification*	ST2000NM0008 and ST2000NM0018	ST1000NM0008 and ST1000NM0018
Formatted (512N bytes/sector)**	2000GB (2TB)	1000GB (1TB)
Guaranteed sectors	3,907,029,168	1,953,525,168
Heads	4	2
Discs	2	
Bytes per logical sector	512	
Recording density, KBPI (Kb/in max)	1936	
Track density, KTPI (ktracks/in avg.)	330	
Areal density, (GFC/in <sup>2</sup> avg)	651	
Spindle speed (RPM)	7200	
Internal data transfer rate (Mb/s max)	2585	
Sustained data transfer rate OD (max)	185MiB/s	
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	
Weight: (maximum)	550g (1.213 lb)	
Average latency	4.16ms	
Power-on to ready (sec)	17 (max)	
Standby to ready (sec)	17 (max)	
Startup current (typical) 12V (peak)	2.8A	
Voltage tolerance (including noise)	5V ±5% 12V ±10%	
Non-Operating (Ambient °C)	-40° to 70°	
Operating ambient temperature (min °C)	5°	
Operating temperature (drive case max °C)	60° †	
Temperature gradient (°C per hour max)	20°C (operating) 30°C (non-operating)	
Relative humidity	5% to 95% (operating) 5% to 95% (non-operating)	
Relative humidity gradient	20% per hour max (operating & non-operating)	
Altitude, operating	-304.8 m to 3,048 m (-1000 ft to 10,000+ ft)	
Altitude, non-operating (below mean sea level, max)	-304.8 m to 12,192 m (-1000 ft to 40,000+ ft)	
Operational Shock (max at 2 ms)	Read 70 Gs Write 40 Gs	
Non-Operational Shock (max at 2 ms)	300 Gs	
Vibration, operating	5–22 Hz: 0.25 Gs, Limited displacement 22–350 Hz: 0.50 Gs 350–500 Hz: 0.25 Gs	

Drive specification*	ST2000NM0008 and ST2000NM0018	ST1000NM0008 and ST1000NM0018
Operation Rotational vibration	20–1500Hz: 12.5 rads/s <sup>2</sup>	
Vibration, non-operating (Random psd)	2–500 Hz: 2Hz/.001g <sup>2</sup> /Hz 4Hz/.03g <sup>2</sup> /Hz 100Hz/.03g <sup>2</sup> /Hz 500Hz/.001g <sup>2</sup> /Hz	
Drive acoustics, sound power (bels)		
Idle***	2.2 bels (typ) 2.4 bels (max)	
Performance seek	2.6 bels (typ) 2.8 bels (max)	
Non-recoverable read errors	1 sector per 10 <sup>15</sup> bits read	
Annualized Failure Rate (AFR)	0.44% based on 8760 POH @ 40C case temp	
Rated Workload	Average rate of <550TB/year The MTBF specification for the drive assumes the I/O workload does not exceed the Average Annualized Workload Rate of <550TB/year. Workloads exceeding the annualized rate may degrade the drive MTBF and impact product reliability. The Average Annualized Workload Rate is in units of TB per year, or TB per 8760 power on hours. Workload Rate = TB transferred * (8760 / recorded power on hours).	
Warranty	To determine the warranty for a specific drive, use a web browser to access the following web page: <a href="http://www.seagate.com/support/warranty-and-replacements/">http://www.seagate.com/support/warranty-and-replacements/</a> . From this page, click on the “Is my Drive under Warranty” link. The following are required to be provided: the drive serial number, model number (or part number) and country of purchase. The system will display the warranty information for the drive.	
Load-unload cycles	600,000	
Supports Hotplug operation per Serial ATA Revision 3.2 specification	Yes	

\* All specifications above are based on native configurations.

\*\* 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.

† Seagate does not recommend operating at sustained case temperatures above 60°C. Operating at higher temperatures will reduce useful life of the product.



## 2.2 Formatted capacity

Formatted capacity*	Guaranteed sectors	Bytes per logical sector
2TB	3,907,029,168	512
1TB	1,953,525,168	

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

### 2.2.1 LBA mode

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

See Section 4.3.1, "Identify Device command" (words 60-61 and 100-103) for additional information about 48-bit addressing support of drives with capacities over 137GB.

## 2.3 Recording and interface technology

Interface	Serial ATA (SATA)
Recording method	Perpendicular
Recording density, KBPI (Kb/in max)	1936
Track density, KTPI (ktracks/in avg)	330
Areal density (GFC/in <sup>2</sup> avg)	651
Spindle speed (RPM) ( $\pm 0.2\%$ )	7200
Internal data transfer rate (Mb/s max)	2585
Sustained data transfer rate (max)	185 MiB/s (193 MB/s)
I/O data-transfer rate (MB/s max)	600 (Ultra DMA mode 5)

## 2.4 Start/stop times

Power-on to Ready (sec)	17 (max)
Standby to Ready (sec)	17 (max)
Ready to spindle stop (sec)	12 (max)

## 2.5 Power specifications

The drive receives DC power (+5V or +12V) through a native SATA power connector. See Figure 3 on page 21.

### 2.5.1 Power consumption

Power requirements for the drives are listed in the table on page 9. 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.

**Table 2 DC power requirements (2TB and 1TB)**

		6.0Gb mode		
Voltage		+5V	+12V	Watts
Regulation		± 5%		Total
<b>Avg Idle Current *</b>		0.288	0.267	4.64
<b>Advanced Idle Current *</b>				
	Idle_A	0.279	0.279	4.74
	Idle_B	0.156	0.253	3.80
	Idle_C	0.164	0.159	2.73
	Standby	0.162	0.000	0.82
<b>Maximum Start Current</b>				
	DC (peak DC)	0.568	2.026	27.152
	AC (Peak DC)	1.008	2.76	
<b>Peak operating current (random read):</b>				
	Typical DC	0.311	0.562	8.30
	Maximum DC	0.317	0.569	8.41
<b>Peak operating current (random write)</b>				
	Typical DC	0.320	0.557	8.29
	Maximum DC	0.326	0.567	8.43
<b>Peak operating current (sequential read)</b>				
	Typical DC	0.579	0.270	6.14
	Maximum DC	0.590	0.278	6.29
<b>Peak operating current (sequential write)</b>				
	Typical DC	0.514	0.294	6.10
	Maximum DC	0.523	0.302	6.24

\*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.

### 2.5.1.1 Typical current profiles (2TB and 1TB models)

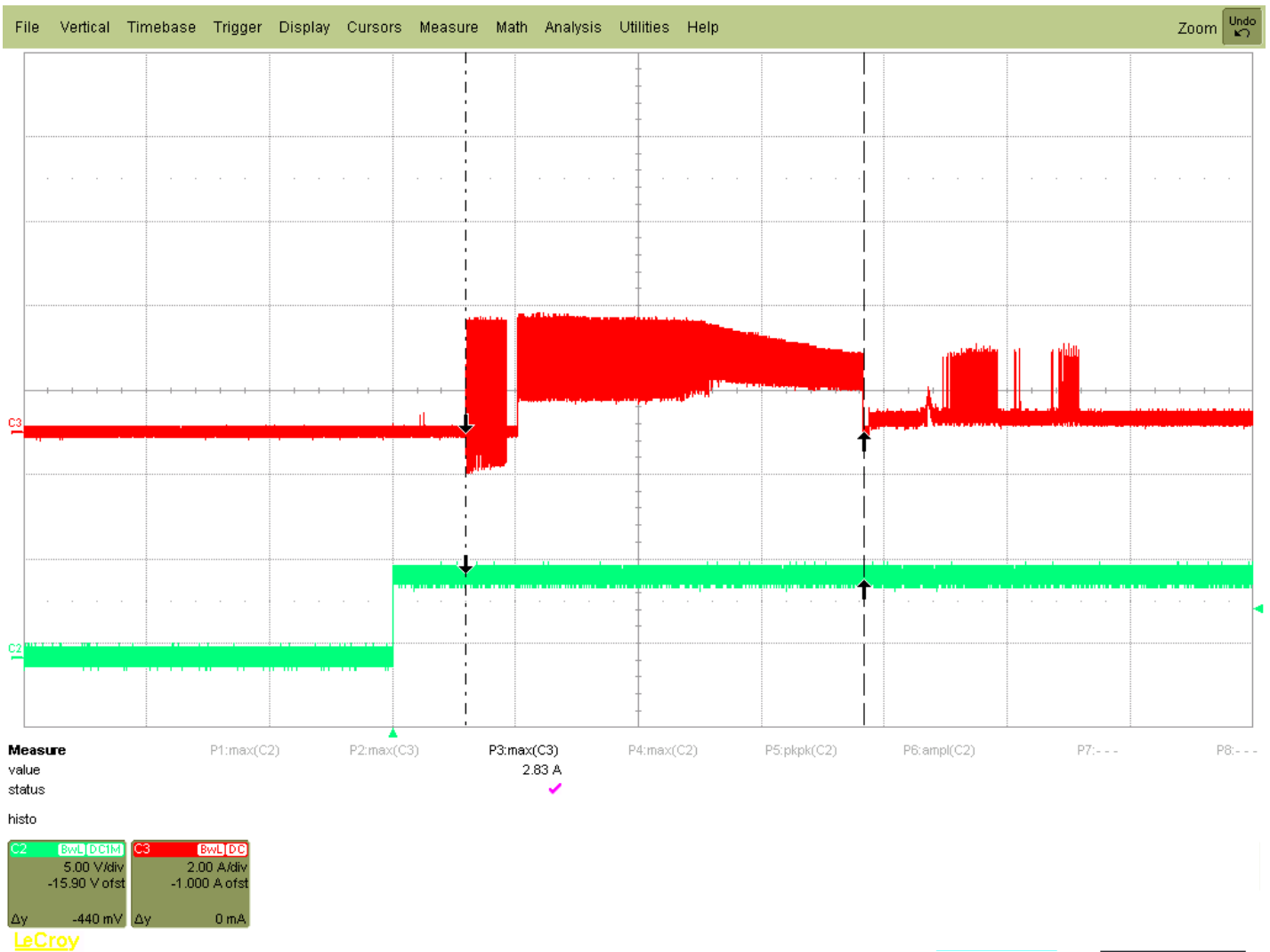


Figure 1. Typical 5V & 12V startup and operation current profile (2TB and 1TB models)

### 2.5.2 Conducted noise

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

- Using 12V power, the drive is expected to operate with a maximum of 120mV peak-to-peak square-wave injected noise at up to 10MHz.
- Using 5V power, the drive is expected to operate with a maximum of 100mV 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.

### 2.5.3 Voltage tolerance

Voltage tolerance (including noise):

- 5V ± 5%
- 12V ± 10%

## 2.5.4 Extended Power Conditions - PowerChoice™

Utilizing the load/unload architecture a programmable power management interface is provided to tailor systems for reduced power consumption and performance requirements.

The table below lists the supported power conditions available in PowerChoice. Power conditions are ordered from highest power consumption (and shortest recovery time) to lowest power consumption (and longest recovery time) as follows: Idle\_a power >= Idle\_b power >= Idle\_c power >= Standby\_z power. The further users go down in the table, the more power savings is actualized. For example, Idle\_b results in greater power savings than the Idle\_a power condition. Standby results in the greatest power savings.

Power Condition Name	Power Condition ID	Description
Idle_a	81 <sub>H</sub>	Reduced electronics
Idle_b	82 <sub>H</sub>	Heads unloaded. Disks spinning at full RPM
Idle_c	83 <sub>H</sub>	Heads unloaded. Disks spinning at reduced RPM
Standby_z	00 <sub>H</sub>	Heads unloaded. Motor stopped (disks not spinning)

Each power condition has a set of current, saved and default settings. Default settings are not modifiable. Default and saved settings persist across power-on resets. The current settings do not persist across power-on resets. At the time of manufacture, the default, saved and current settings are in the Power Conditions log match.

### PowerChoice is invoked using one of two methods

- Automatic power transitions which are triggered by expiration of individual power condition timers. These timer values may be customized and enabled using the Extended Power Conditions (EPC) feature set using the standardized Set Features command interface.
- Immediate host commanded power transitions may be initiated using an EPC Set Features "Go to Power Condition" subcommand to enter any supported power condition. Legacy power commands Standby Immediate and Idle Immediate also provide a method to directly transition the drive into supported power conditions.

### PowerChoice exits power saving states under the following conditions

- Any command which requires the drive to enter the PM0: Active state (media access)
- Power on reset

### PowerChoice provides the following reporting methods for tracking purposes

Check Power Mode Command

- Reports the current power state of the drive

Identify Device Command

- EPC Feature set supported flag
- EPC Feature enabled flag is set if at least one Idle power condition timer is enabled

Power Condition Log reports the following for each power condition

- Nominal recovery time from the power condition to active
- If the power condition is Supported, Changeable, and Savable
- Default enabled state, and timer value
- Saved enabled state, and timer value
- Current enabled state, and timer value

S.M.A.R.T. Read Data Reports

- Attribute 192 - Emergency Retract Count
- Attribute 193 - Load/Unload Cycle Count

### PowerChoice Manufacture Default Power Condition Timer Values

Default power condition timer values have been established to assure product reliability and data integrity. A minimum timer value threshold of two minutes ensures the appropriate amount of background drive maintenance activities occur. Attempting to set a timer values less than the specified minimum timer value threshold will result in an aborted EPC "Set Power Condition Timer" subcommand.

Power Condition Name	Manufacturer Default Timer Values
Idle_a	100 ms
Idle_b	2 min
Idle_c	10 min
Standby_z	15 min

Setting power condition timer values less than the manufacturer specified defaults or issuing the EPC "Go to Power Condition" subcommand at a rate exceeding the default timers may limit this products reliability and data integrity.

### PowerChoice Supported Extended Power Condition Feature Subcommands

EPC Subcommand	Description
00 <sub>H</sub>	Restore Power Condition Settings
01 <sub>H</sub>	Go to Power Condition
02 <sub>H</sub>	Set Power Condition Timer
03 <sub>H</sub>	Set Power Condition State
04 <sub>H</sub>	Enable EPC Feature Set
05 <sub>H</sub>	Disable EPC Feature Set

### PowerChoice Supported Extended Power Condition Identifiers

Power Condition Identifiers	Power Condition Name
00 <sub>H</sub>	Standby_z
01 - 80 <sub>H</sub>	Reserved
81 <sub>H</sub>	Idle_a
82 <sub>H</sub>	Idle_b
83 <sub>H</sub>	Idle_c
84 - FE <sub>H</sub>	Reserved
FF <sub>H</sub>	All EPC Power Conditions

## 2.6 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 [Figure 2](#) for base plate measurement location.

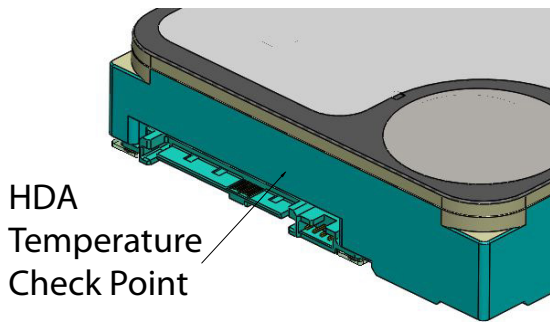
### 2.6.1 Ambient Temperature

<b>Non-operating (Ambient)</b>	-40° to 60°C (-40° to 140°F)
<b>Operating ambient (min °C)</b>	5° (41°F)
<b>Operating (Drive case max °C)</b>	60° (140°F) †

† Seagate does not recommend operating at sustained case temperatures above 60°C. Operating at higher temperatures will reduce useful life of the product.

### 2.7 Temperature gradient

<b>Operating</b>	20°C per hour (36°F per hour max), without condensation
<b>Non-operating</b>	30°C per hour (54°F per hour max)



**Figure 2.** Location of the HDA temperature check point

**Note** Image is for reference only, may not represent actual drive

### 2.7.1 Humidity

#### 2.7.1.1 Relative humidity

<b>Operating</b>	5% to 90% non-condensing (20% per hour max)
<b>non-operating</b>	5% to 95% non-condensing (20% per hour max)

#### 2.7.1.2 Wet bulb temperature

<b>Operating</b>	26°C / 78.8°F (rated)
<b>Non-operating</b>	29°C / 84.2°F (rated)

### 2.7.2 Altitude

<b>Operating</b>	-304m to 3048m (-1000 ft. to 10,000 ft.)
<b>Non-operating</b>	-304m to 12,192m (-1000 ft. to 40,000+ ft.)

### 2.7.3 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.

#### 2.7.3.1 Operating shock

These drives comply with the performance levels specified in this document when subjected to a maximum operating shock of 70 Gs (read) and 40 Gs (write) based on half-sine shock pulses of 2ms. Shocks should not be repeated more than two times per second.

#### 2.7.3.2 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 300 Gs based on a nonrepetitive half-sine shock pulse of 2ms duration.

### 2.7.4 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.

#### 2.7.4.1 Operating vibration

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

5–22 Hz	0.25 Gs
22–350 Hz	0.50 Gs
350–500 Hz	0.25 Gs
20 - 1500Hz *(RROV)	12.5 rads/s <sup>2</sup> w/RVFF

\* Rotary Random Operating Vibration

#### 2.7.4.2 Nonoperating vibration

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

2–500 Hz (Random psd)	2Hz/.001g <sup>2</sup> /Hz 4Hz/.03g <sup>2</sup> /Hz 100Hz/.03g <sup>2</sup> /Hz 500Hz/.001g <sup>2</sup> /Hz
--------------------------	--

## 2.8 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.

<b>Note</b>	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 = $0.4 / (\text{average latency} + \text{average access time})$ ).
-------------	--

**Table 3 Fluid Dynamic Bearing (FDB) motor acoustics**

	Idle*	Performance seek
All models	2.2 bels (typ) 2.4 bels (max)	2.6 bels (typ) 2.8 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.

## 2.9 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.

## 2.10 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 test methods per standard EN 55024:2010.

See Table 4 below:

**Table 4 Radio frequency environments**

Specification	Test method	Test Conditions	Compliance
Electrostatic discharge	IEC/EN 61000-4-2	$\pm 4$ kV Contact / HCP, VCP / $\pm 8$ kV Air (minimum of 500 discharges applied)	Compliant
Radiated RF immunity	IEC/EN 61000-4-3	80 -1000 MHz, 3 V/m, 80% 1 kHz AM	Compliant
EFT / Burst	IEC/EN 61000-4-4	$\pm 0.5$ kV I/O, $\pm 1.0$ kV AC mains	Compliant
Surge immunity	IEC/EN 61000-4-5	AC mains: $1.2/50 \mu\text{s}$ @ $\pm 2$ kV common mode, $\pm 1$ kV differential	Compliant
Conducted RF immunity	IEC/EN 61000-4-6	150 kHz to 80 MHz, 3 Vrms, 80% 1 kHz AM, AC input, DC input and I/O	Compliant
Power Frequency H-field immunity	IEC/EN 61000-4-8	1 A/m, 50/60 Hz, 3 axes, 400 gauss	Compliant
Voltage dips and interrupts	IEC/EN 61000-4-11	>95% reduction for 0.5 cycles, 30% reduction for 25 cycles, >95% reduction for 250 cycles	Compliant

<sup>1</sup> Field in Gauss at the drive envelope. Testing per procedures 20800109-349 and 20800109-350.

<sup>2</sup> Passing Field in Gauss at the drive envelope. In practice, testing is conducted using a fixed distance from the bottom of the magnet to the top of the drive. Calibration of the field vs. distance is done with a Hall probe with no magnetic materials present.

<sup>3</sup> Testing to be done with magnet 0.375" dia. x 0.100" Ni-plated NdFeB; B, $\sim$ 11.5 kG, magnetized along its length; the magnet is oriented with the length perpendicular to the drive cover/PCBA. Drive to be properly secured during test.



## 2.11 Reliability

### 2.11.1 Annualized Failure Rate (AFR) and Mean Time Between Failures (MTBF)

The production disk drive shall achieve an annualized failure-rate of 0.44% (MTBF of 2,000,000 hours) over a 5 year service life when used in Enterprise Storage field conditions as limited by the following:

- 8760 power-on hours per year.
- HDA temperature as reported by the drive  $\leq 40^{\circ}\text{C}$
- Ambient wet bulb temp  $\leq 26^{\circ}\text{C}$
- The AFR (MTBF) is a population statistic not relevant to individual units
- ANSI/ISA S71.04-2013 G2 classification levels and dust contamination to ISO 14644-1 Class 8 standards (as measured at the device)

The MTBF specification for the drive assumes the operating environment is designed to maintain nominal drive temperature and humidity. The rated MTBF is based upon a sustained drive temperature of up to  $122^{\circ}\text{F}$  ( $40^{\circ}\text{C}$ ) and wet bulb temperature up to  $78.8^{\circ}\text{F}$  ( $26^{\circ}\text{C}$ ). Occasional excursions in operating conditions between the rated MTBF conditions and the maximum drive operating conditions may occur without significant impact to the rated MTBF. However continual or sustained operation beyond the rated MTBF conditions will degrade the drive MTBF and reduce product reliability.

Nonrecoverable read errors	1 per $10^{15}$ bits read, max
Annualized Failure Rate (AFR)	0.44% (nominal power, $40^{\circ}\text{C}$ case temperature)
Load unload cycles	600,000 cycles
Rated Workload	Average rate of $<550\text{TB}/\text{year}$ The MTBF specification for the drive assumes the I/O workload does not exceed the Average Annualized Workload Rate of $<550\text{TB}/\text{year}$ . Workloads exceeding the annualized rate may degrade the drive MTBF and impact product reliability. The Average Annualized Workload Rate is in units of TB per year, or TB per 8760 power on hours. Workload Rate = TB transferred * (8760 / recorded power on hours).
Warranty	To determine the warranty for a specific drive, use a web browser to access the following web page: <a href="http://www.seagate.com/support/warranty-and-replacements/">http://www.seagate.com/support/warranty-and-replacements/</a> . From this page, click on the "Check to see if the drive is under Warranty" link. The following are required to be provided: 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.

## 2.12 Agency and Safety Certifications

Each Hard Drive and Solid State Drive ("drives") has a product label that includes certifications that are applicable to that specific drive. The following information provides an overview of requirements that may be applicable to the drive.

### 2.13 Safety certification

These products are certified to meet the requirements of UL/cUL 60950-1, EN 60950-1, and may also include, IEC 62368, UL 62368 and EN 62368.

#### 2.13.1 European Union (EU) CE Marking Requirements

Drives that display the CE mark comply with the European Union (EU) requirements specified in the Electromagnetic Compatibility Directive (2014/30/EU) put into force on 20 April 2016. Testing is performed to the levels specified by the product standards for Information Technology Equipment (ITE). Emission levels are defined by EN 55032:2012, Class B and the immunity levels are defined by EN 55024:2010.

The drives also meet the requirements of The Low Voltage Directive (LVD) 2014/35/EU.

Seagate drives are tested in representative end-user systems. Although CE-marked Seagate drives comply with all relevant regulatory requirements and standards for the drives, Seagate cannot guarantee that all system-level products into which the drives are installed comply with all regulatory requirements and standards applicable to the system-level products. The drive is designed for operation inside a properly designed system (e.g., enclosure designed for the drive), 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 the system-level products.

For compliance with the RoHS "Recast" Directive 2011/65/EU (RoHS 2), [See Section 2.14.1 on page 18](#).

### 2.13.2 Australian RCM Compliance Mark

If these models have the RCM marking, they comply with the Australia/New Zealand Standard AS/NZ CISPR32 and meet the Electromagnetic Compatibility (EMC) Framework requirements of the Australian Communication and Media Authority (ACMA).

### 2.13.3 Canada ICES-003

If this model has the ICES-003:2016 marking it complies with requirements of ICES tested per ANSI C63.4-2014.

### 2.13.4 South Korean KC Certification Mark

The South Korean KC Certification Mark means the drives 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 Agency (RRA) 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.

기종별	사용자안내문
B급 기기 (가정용 방송통신기자재)	이 기기는 가정용(B급) 전자파적합기기로서 주로 가정에서 사용하는 것을 목적으로 하며, 모든 지역에서 사용할 수 있습니다.

### 2.13.5 Morocco Commodity Mark

To satisfy our OEM customers, Seagate has added the Moroccan Commodity Mark to the drives provided to the OEM for the sale of Customer Kits produced by our OEM customers that are intended to be incorporated into the OEM's finished system-level product by an end user. The Customer Kits are considered 'devices' under Morocco's Order of the Minister of Industry, Trade, Investment and Digital Economy No. 2574-14 of 29 Ramadan 1436 (16 July 2015) on electromagnetic compatibility of equipment.

Seagate drives are tested for compliance and complies with the European Union (EU) Electromagnetic Compatibility (EMC) Directive 2014/30/EU and the Low Voltage Directive (LVD) 2014/35/EU. Accordingly, the drives also meets the requirements of Morocco's Order of the Minister of Industry, Trade, Investment and Digital Economy No. 2574-14 of 29 Ramadan 1436 (16 July 2015) on electromagnetic compatibility of equipment.

### 2.13.6 Taiwanese BSMI

Drives with the Taiwanese certification mark comply with Chinese National Standard, CNS13438.

For compliance with the Taiwan Bureau of Standards, Metrology and Inspection's (BSMI) requirements, [See Section 2.14.3 on page 19](#).

### 2.13.7 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 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, 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, users should consult a 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.

## **2.14 Environmental protection**

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

### **2.14.1 European Union Restriction of Hazardous Substance Law**

#### **2.14.1.1 Restriction of Hazardous Substances in Electrical and Electronic Equipment**

Seagate drives are designed to be compliant with the European Union RoHS "Recast" Directive 2011/65/EU (RoHS 2) as amended by Directive (EU) 2015/863. The RoHS2 restricts the use of certain hazardous substances such as Lead, Cadmium, Mercury, Hexavalent Chromium, Polybrominated Biphenyls (PBB) and Polybrominated Diphenyl Ether (PBDE), BisBis(2-Ethylhexyl) phthalate (DEHP), Benzyl butyl phthalate (BBP), Dibutyl phthalate (DBP), and Diisobutyl phthalate (DIBP) in electrical and electronic equipment (EEE).

#### **2.14.1.2 Substances of Very High Concern (SVHC)**

The European Union REACH (Registration, Evaluation, Authorization and Restriction of Chemicals) Regulation (EC) 1907/2006 regulates chemicals shipped into and used in Europe. 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 REACH substances in these articles and materials. Our supplier contracts require compliance with our chemical substance restrictions, and our suppliers document their compliance with our requirements by providing full-disclosure material content declarations that disclose inclusion of any REACH-regulated substance in such articles or materials. Product-specific REACH declarations are available upon request through your Seagate Sales Representative.

### 2.14.2 China Requirements — China RoHS 2



China RoHS 2 refers to the Ministry of Industry and Information Technology Order No. 32, effective July 1, 2016, titled Management Methods for the Restriction of the Use of Hazardous Substances in Electrical and Electronic Products. To comply with China RoHS 2, Seagate determines this product's Environmental Protection Use Period (EPUP) to be 20 years in accordance with the *Marking for the Restricted Use of Hazardous Substances in Electronic and Electrical Products*, SJT 11364-2014.

**Table 5 China - Hazardous Substances**

部件名称 Part Name	有害物质 Hazardous Substances					
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr <sup>+6</sup> )	多溴联苯 (PBB)	多溴二苯醚 (PBDE)
硬盘驱动器 HDD	X	O	O	O	O	O
印刷电路板组装 PCBA	X	O	O	O	O	O

本表格依据 SJ/T 11364 的规定编制。  
This table is prepared in accordance with the provisions of SJ/T 11364-2014

O: 表示该有害物质在该部件所有均质材料中的含量均在 GB/T 26572 规定的限量要求以下。  
O: Indicates that the hazardous substance contained in all of the homogeneous materials for this part is below the limit requirement of GB/T26572.

X: 表示该有害物质至少在该部件的某一均质材料中的含量超出 GB/T 26572 规定的限量要求。  
X: Indicates that the hazardous substance contained in at least one of the homogeneous materials used for this part is above the limit requirement of GB/T26572.

### 2.14.3 Taiwan Requirements — Taiwan RoHS

Taiwan RoHS refers to the Taiwan Bureau of Standards, Metrology and Inspection's (BSMI) requirements in standard CNS 15663, Guidance to reduction of the restricted chemical substances in electrical and electronic equipment. Seagate products must comply with the "Marking of presence" requirements in Section 5 of CNS 15663, effective January 1, 2018. This product is Taiwan RoHS compliant.

The following table meets the Section 5 "Marking of presence" requirements.

**Table 6 Taiwan - Restricted Substances**

設備名稱：硬盤設備，型號：僅適用於內部使用 Equipment Name: Hard Disk Device, Type Designation: Internal Use Only						
單元 Unit	限用物質及其化學符號 Restricted Substance and its chemical symbol					
	鉛 (Pb)	汞 (Hg)	鎘 (Cd)	六價鉻 (Cr <sup>+6</sup> )	多溴聯苯 (PBB)	多溴二苯醚 (PBDE)
硬盤驅動器 HDD	—	O	O	O	O	O
印刷電路板組裝 PCBA	—	O	O	O	O	O

備考 1. "O" 係指該項限用物質之百分比含量未超出百分比含量基準值。  
Note 1. "O" indicates that the percentage content of the restricted substance does not exceed the percentage of reference value of presence.

備考 2. "—" 係指該項限用物質為排除項目。  
Note 2. "—" indicates that the restricted substance corresponds to the exemption.

## 2.15 Reference documents

*Specification for Acoustic Test Requirement and Procedures*

Seagate part number: 30553-001

In case of conflict between this document and any referenced document, this document takes precedence.

## 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 hard disk drives are especially sensitive to the presence of sulfide, chloride, and nitrate contaminants. Sulfur is found to be the most damaging. 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.

Seagate recommends that data centers be kept clean by monitoring and controlling the dust and gaseous contamination. Gaseous contamination should be within ANSI/ISA S71.04-2013 G2 classification levels (as measured on copper and silver coupons), and dust contamination to ISO 14644-1 Class 8 standards, and MTBF rated conditions as defined in the Annualized Failure Rate (AFR) and Mean Time Between Failure (MTBF) section.

## 2.17 Product warranty

Beginning on the date of shipment to the customer and continuing for the period specified in the purchase contract, Seagate warrants that each product (including components and subassemblies) that fails to function properly under normal use due to defect in materials or workmanship or due to nonconformance to the applicable specifications will be repaired or replaced, at Seagate's option and at no charge to the customer, if returned by customer at customer's expense to Seagate's designated facility in accordance with Seagate's warranty procedure. Seagate will pay for transporting the repair or replacement item to the customer. For more detailed warranty information, refer to the standard terms and conditions of purchase for Seagate products on the purchase documentation.

The remaining warranty for a particular drive can be determined by calling Seagate Customer Service at 1-800-468-3472. Users can also determine remaining warranty using the Seagate web site ([www.seagate.com](http://www.seagate.com)). The drive serial number is required to determine remaining warranty information.

### Shipping

When transporting or shipping a drive, use only a Seagate-approved container. Keep the original box. Seagate approved containers are easily identified by the Seagate Approved Package label. Shipping a drive in a non-approved container voids the drive warranty.

Seagate repair centers may refuse receipt of components improperly packaged or obviously damaged in transit. Contact an authorized Seagate distributor to purchase additional boxes. Seagate recommends shipping by an air-ride carrier experienced in handling computer equipment.

### Storage

Maximum storage periods are 180 days within original unopened Seagate shipping package or 60 days unpackaged within the defined non-operating limits (refer to environmental section in this manual). Storage can be extended to 1 year packaged or unpackaged under optimal environmental conditions (25°C, <40% relative humidity non-condensing, and non-corrosive environment). During any storage period the drive non-operational temperature, humidity, wet bulb, atmospheric conditions, shock, vibration, magnetic and electrical field specifications should be followed.

### Product repair and return information

Seagate customer service centers are the only facilities authorized to service Seagate drives. Seagate does not sanction any third-party repair facilities. Any unauthorized repair or tampering with the factory seal voids the warranty.

## 3.0 Configuring and mounting the drive

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

### 3.1 Handling and static-discharge precautions

After unpacking, and before installation, the drive may be exposed to potential handling and electrostatic discharge (ESD) hazards. Observe the following standard handling and static-discharge precautions:

<b>Caution</b>	<ul style="list-style-type: none"><li>• Before handling the drive, users should put on a grounded wrist strap, or ground 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.</li><li>• Handle the drive by its edges or frame <i>only</i>.</li><li>• The drive is extremely fragile—handle it with care. Do not press down on the drive top cover.</li><li>• Always rest the drive on a padded, antistatic surface until mounted in the computer.</li><li>• Do not touch the connector pins or the printed circuit board.</li><li>• 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.</li></ul>
----------------	---

### 3.2 Configuring the drive

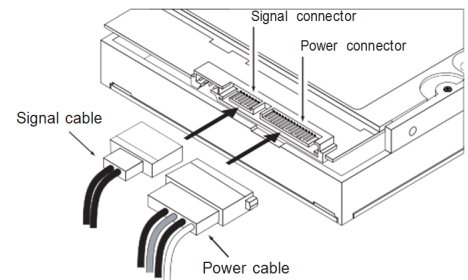
Each drive on the Serial ATA interface connects point-to-point with the Serial ATA host adapter. There is no master/slave relationship because each drive is considered a master in a point-to-point relationship. If two drives are attached on one Serial ATA host adapter, the host operating system views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

### 3.3 Serial ATA cables and connectors

The Serial ATA interface cable consists of four conductors in two differential pairs, plus three ground connections. The cable size may be 30 to 26 AWG with a maximum length of one meter (39.37 in). See Table 7 for connector pin definitions. Either end of the SATA signal cable can be attached to the drive or host.

For direct backplane connection, the drive connectors are inserted directly into the host receptacle. The drive and the host receptacle incorporate features that enable the direct connection to be hot pluggable and blind mateable.

For installations which require cables, users can connect the drive as illustrated in Figure 3.



**Figure 3. Attaching SATA cabling**

Each cable is keyed to ensure correct orientation. Seagate Enterprise Capacity 3.5 HDD v5.1 drives support latching SATA connectors.

### 3.4 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. See Figure 4 for drive mounting dimensions. Follow these important mounting precautions when mounting the drive:

- Allow a minimum clearance of 0.030 in (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 0.140 in (3.56mm) into the bottom or side mounting holes.
- Do not overtighten the mounting screws (maximum torque: 6 in-lb).

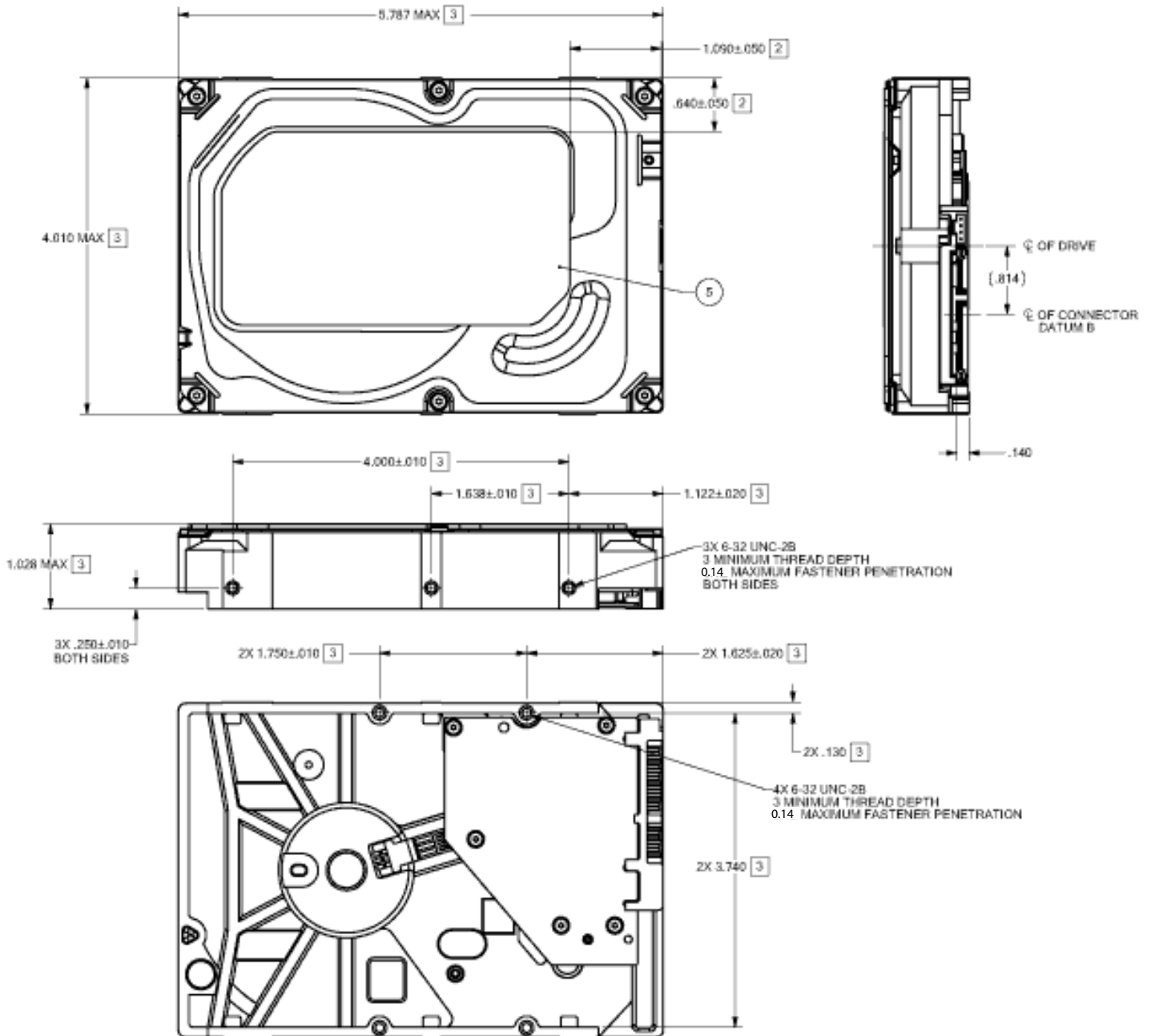
### 3.4.1 Mechanical specifications

Refer to Figure 4 for detailed mounting configuration dimensions. See Section 3.4, “Drive mounting.”

<b>Weight:</b>	2TB models	1.212 lb	550 g
	1TB models		

**Note** These dimensions conform to the Small Form Factor Standard documented in SFF-8301 and SFF-8323, found at [www.sffcommittee.org](http://www.sffcommittee.org)

**Note** The images below are for mechanical tolerance reference only and may not be a visual representation of the actual drive.



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

## 4.0 Serial ATA (SATA) interface

These drives use the industry-standard Serial ATA interface that supports FIS data transfers. It supports ATA programmed input/output (PIO) modes 0–4; multiword DMA modes 0–2, and Ultra DMA modes 0–6.

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

### 4.1 Hot-Plug compatibility

Enterprise Capacity 3.5 HDD drives incorporate connectors which enable users to hot plug these drives in accordance with the Serial ATA Revision 3.2 specification. This specification can be downloaded from [www.serialata.org](http://www.serialata.org).

<b>Caution</b>	The drive motor must come to a complete stop ( <b>Ready to spindle stop time indicated in Section 2.4</b> ) prior to changing the plane of operation. This time is required to insure data integrity.
----------------	---

### 4.2 Serial ATA device plug connector pin definitions

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

**Table 7 Serial ATA connector pin definitions**

Segment	Pin	Function	Definition
<b>Signal</b>	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
<b>Key and spacing separate signal and power segments</b>			
<b>Power</b>	P1	V <sub>33</sub>	3.3V power
	P2	V <sub>33</sub>	3.3V power
	P3	V <sub>33</sub>	3.3V power, pre-charge, 2nd mate
	P4	Ground	1st mate
	P5	Ground	2nd mate
	P6	Ground	2nd mate
	P7	V <sub>5</sub>	5V power, pre-charge, 2nd mate
	P8	V <sub>5</sub>	5V power
	P9	V <sub>5</sub>	5V power
	P10	Ground	2nd mate
	P11	Ground or LED signal	If grounded, drive does not use deferred spin
	P12	Ground	1st mate.
	P13	V <sub>12</sub>	12V power, pre-charge, 2nd mate
	P14	V <sub>12</sub>	12V power
	P15	V <sub>12</sub>	12V power



**Notes:**

1. All pins are in a single row, with a 1.27mm (0.050") pitch.
2. The comments on the mating sequence apply to the case of backplane blindmate connector only. In this case, the mating sequences are:
  - the ground pins P4 and P12.
  - the pre-charge power pins and the other ground pins.
  - the signal pins and the rest of the power pins.
3. There are three power pins for each voltage. One pin from each voltage is used for pre-charge when installed in a blind-mate backplane configuration.
4. All used voltage pins (V<sub>x</sub>) must be terminated.

**4.3 Supported ATA commands**

The following table lists Serial ATA standard commands that the drive supports. For a detailed description of the ATA commands, refer to the Serial ATA: High Speed Serialized AT Attachment specification. See "S.M.A.R.T. commands" on page 31 for details and subcommands used in the S.M.A.R.T. implementation.

**Table 8 Supported ATA commands**

Command name	Command code (in hex)
Accessible Max Address Configuration	
Get Native Max Address Ext	78 <sub>H</sub> / 0000 <sub>H</sub>
Set Accessible Max Address Ext	78 <sub>H</sub> / 0001 <sub>H</sub>
Freeze Accessible Max Address Ext	78 <sub>H</sub> / 0002 <sub>H</sub>
Check Power Mode	E5 <sub>H</sub>
Download Microcode	92 <sub>H</sub>
Execute Device Diagnostics	90 <sub>H</sub>
Flush Cache	E7 <sub>H</sub>
Flush Cache Extended	EA <sub>H</sub>
Identify Device	EC <sub>H</sub>
Idle	E3 <sub>H</sub>
Idle Immediate	E1 <sub>H</sub>
NoP	00 <sub>H</sub>
Read Buffer	E4 <sub>H</sub>
Read Buffer DMA	E9 <sub>H</sub>
Read DMA	C8 <sub>H</sub>
Read DMA Extended	25 <sub>H</sub>
Read FPDMA Queued	60 <sub>H</sub>
Read Log DMA Ext	47 <sub>H</sub>
Read Log Ext	2F <sub>H</sub>
Read Multiple	C4 <sub>H</sub>
Read Multiple Extended	29 <sub>H</sub>
Read Sectors	20 <sub>H</sub>
Read Sectors Extended	24 <sub>H</sub>
Read Sectors Without Retries	21 <sub>H</sub>
Read Verify Sectors	40 <sub>H</sub>
Read Verify Sectors Extended	42 <sub>H</sub>
Read Verify Sectors Without Retries	41 <sub>H</sub>
Request Sense Data Ext	0B <sub>H</sub>
Sanitize Device - Overwrite Ext	B4 <sub>H</sub> / 0014 <sub>H</sub>

**Table 8 Supported ATA commands**

<b>Command name</b>	<b>Command code (in hex)</b>
Sanitize Device - Freeze Lock Ext	B4 <sub>H</sub> / 0020 <sub>H</sub>
Sanitize Device - Status Ext	B4 <sub>H</sub> / 0000 <sub>H</sub>
Security Disable Password	F6 <sub>H</sub>
Security Erase Prepare	F3 <sub>H</sub>
Security Erase Unit	F4 <sub>H</sub>
Security Freeze	F5 <sub>H</sub>
Security Set Password	F1 <sub>H</sub>
Security Unlock	F2 <sub>H</sub>
Seek	70 <sub>H</sub>
Set Date & Time Ext	77 <sub>H</sub>
Set Features	EF <sub>H</sub>
Set Multiple Mode	C6 <sub>H</sub>
Sleep	E6 <sub>H</sub>
S.M.A.R.T. Disable Operations	B0 <sub>H</sub> / D9 <sub>H</sub>
S.M.A.R.T. Enable/Disable Autosave	B0 <sub>H</sub> / D2 <sub>H</sub>
S.M.A.R.T. Enable Operations	B0 <sub>H</sub> / D8 <sub>H</sub>
S.M.A.R.T. Execute Offline	B0 <sub>H</sub> / D4 <sub>H</sub>
S.M.A.R.T. Read Attribute Thresholds	B0 <sub>H</sub> / D1 <sub>H</sub>
S.M.A.R.T. Read Data	B0 <sub>H</sub> / D0 <sub>H</sub>
S.M.A.R.T. Read Log Sector	B0 <sub>H</sub> / D5 <sub>H</sub>
S.M.A.R.T. Return Status	B0 <sub>H</sub> / DA <sub>H</sub>
S.M.A.R.T. Save Attribute Values	B0 <sub>H</sub> / D3 <sub>H</sub>
S.M.A.R.T. Write Log Sector	B0 <sub>H</sub> / D6 <sub>H</sub>
Standby	E2 <sub>H</sub>
Standby Immediate	E0 <sub>H</sub>
Write Buffer	E8 <sub>H</sub>
Write Buffer DMA	EB <sub>H</sub>
Write DMA	CA <sub>H</sub>
Write DMA Extended	35 <sub>H</sub>
Write DMA FUA Extended	3D <sub>H</sub>
Write FPDMA Queued	61 <sub>H</sub>
Write Log DMA Ext	57 <sub>H</sub>
Write Log Extended	3F <sub>H</sub>
Write Multiple	C5 <sub>H</sub>
Write Multiple Extended	39 <sub>H</sub>
Write Multiple FUA Extended	CE <sub>H</sub>
Write Sectors	30 <sub>H</sub>
Write Sectors Without Retries	31 <sub>H</sub>
Write Sectors Extended	34 <sub>H</sub>
Write Uncorrectable	45 <sub>H</sub>

### 4.3.1 Identify Device command

The Identify Device command (command code EC<sub>H</sub>) 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 Table 8 on page 24. 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 6 for default parameter settings.

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

**Table 9 Identify Device commands**

Word	Description	Value
0	Configuration information: <ul style="list-style-type: none"> <li>• Bit 15: 0 = ATA; 1 = ATAPI</li> <li>• Bit 14-8: Retired</li> <li>• Bit 7-6: Obsolete</li> <li>• Bit 5-3: Retired</li> <li>• Bit 0: Reserved</li> </ul>	0C5A <sub>H</sub>
1	Number of logical cylinders	16,383
2	Specific Configuration	C837 <sub>H</sub>
3	Number of logical heads	16
4	Retired	0000 <sub>H</sub>
5	Retired	0000 <sub>H</sub>
6	Number of logical sectors per logical track: 63	003F <sub>H</sub>
7-9	Retired	0000 <sub>H</sub>
10-19	Serial number: (20 ASCII characters, 0000 <sub>H</sub> = none)	ASCII
20	Retired	0000 <sub>H</sub>
21	Retired	0000 <sub>H</sub>
22	Obsolete	0000 <sub>H</sub>
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 Write multiple (16)	8010 <sub>H</sub>
48	Trusted computing feature set options	4000 <sub>H</sub>
49	Standard Standby timer, IORDY supported and may be disabled	2F00 <sub>H</sub>
50	Capabilities	4000 <sub>H</sub>
51	PIO data-transfer cycle timing mode	0200 <sub>H</sub>
52	Obsolete	0200 <sub>H</sub>
53	Words 64-70 and 88 are valid	0007 <sub>H</sub>
54	Number of current logical cylinders	xxxx <sub>H</sub>
55	Number of current logical heads	xxxx <sub>H</sub>
56	Number of current logical sectors per logical track	xxxx <sub>H</sub>
57-58	Current capacity in sectors	xxxx <sub>H</sub>
59	Number of sectors transferred during a Read Multiple or Write Multiple command	0010 <sub>H</sub>
60-61	Total number of user-addressable LBA sectors available (see Section 2.2 for related information)  <b>*Note:</b> 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.	ST2000NM0008 = 0FFFFFFFh* ST2000NM0018 = 0FFFFFFFh* ST1000NM0008 = 0FFFFFFFh* ST1000NM0018 = 0FFFFFFFh*
62	Retired	0000 <sub>H</sub>

**Table 9 Identify Device commands**

Word	Description	Value
63	Multiword DMA active and modes supported (see note following this table)	x407 <sub>H</sub>
64	Advanced PIO modes supported (modes 3 and 4 supported)	0003 <sub>H</sub>
65	Minimum multiword DMA transfer cycle time per word (120 ns)	0078 <sub>H</sub>
66	Recommended multiword DMA transfer cycle time per word (120 ns)	0078 <sub>H</sub>
67	Minimum PIO cycle time without IORDY flow control (240 ns)	0078 <sub>H</sub>
68	Minimum PIO cycle time with IORDY flow control (120 ns)	0078 <sub>H</sub>
69	Additional supported	0008 <sub>H</sub>
70–74	ATA-reserved	0000 <sub>H</sub>
75	Queue depth	001F <sub>H</sub>
76	Serial ATA capabilities	850E <sub>H</sub>
77	Serial ATA Additional Capabilities	004x <sub>H</sub>
78	Serial ATA features supported	08CC <sub>H</sub>
79	Serial ATA features enabled	0040 <sub>H</sub>
80	Major version number	07F0 <sub>H</sub>
81	Minor version number	0000 <sub>H</sub>
82	Command sets supported	346B <sub>H</sub>
83	Command sets supported	7D09 <sub>H</sub>
84	Command sets support extension (see note following this table)	4163 <sub>H</sub>
85	Command sets enabled	3469 <sub>H</sub>
86	Command sets enabled	BC01 <sub>H</sub>
87	Command sets enable extension	4163 <sub>H</sub>
88	Ultra DMA support and current mode (see note following this table)	xx7F <sub>H</sub>
89	Security erase time	xx37 <sub>H</sub>
90	Enhanced security erase time	xx37 <sub>H</sub>
92	Master password revision code	FFFE <sub>H</sub>
93	Hardware reset value	xxxx <sub>H</sub>
95	ATA-reserved	1000 <sub>H</sub>
96–97	ATA-reserved	0000 <sub>H</sub>
98–99	ATA-reserved	0000-2710 <sub>H</sub>
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: 0000FFFFFFFFFh.	ST2000NM0008 = 3,907,029,168 ST2000NM0018 = 3,907,029,168 ST1000NM0008 = 1,953,525,168 ST1000NM0018 = 1,953,525,168
104–105	ATA-reserved	0000 <sub>H</sub>
106	Physical/Logical sector size	4000 <sub>H</sub>
107	ATA-reserved	0000 <sub>H</sub>
108–111	The mandatory value of the world wide name (WWN) for the drive. <b>NOTE:</b> 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.
112–118	ATA-reserved	0000 <sub>H</sub>
119	Commands and feature sets supported	405C <sub>H</sub>
120	Commands and feature sets supported or enabled	401C <sub>H</sub>

**Table 9 Identify Device commands**

<b>Word</b>	<b>Description</b>	<b>Value</b>
121-127	ATA-reserved	0000 <sub>H</sub>
128	Security status	0021 <sub>H</sub>
129-159	Seagate-reserved	xxxx <sub>H</sub>
160-205	ATA-reserved	0000 <sub>H</sub>
206	SCT Command Transport command set. If bit 0 is set to one, then the device supports SCT Command Transport. Bits 7:2 indicate individual SCT feature support.	xxBD <sub>H</sub>
207-216	ATA-reserved	0000 <sub>H</sub>
217	Nominal Media Rotation Rate	1C20 <sub>H</sub>
218-221	ATA-reserved	0000 <sub>H</sub>
222	Transport Major Version Number	107F <sub>H</sub>
223-254	ATA-reserved	0000 <sub>H</sub>
255	Integrity word	xxA5 <sub>H</sub>

<b>Note</b>	See the bit descriptions below for words 63, 84, and 88 of the Identify Drive data.
-------------	---

**Table 10 Bit descriptions for Words 63, 84 & 88**

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 logging 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.	

### 4.3.2 Set Features command

This command controls the implementation of various features that the drive supports. When the drive receives this command, it sets BSY, checks the contents of the Features register, clears BSY and generates an interrupt. If the value in the register does not represent a feature that the drive supports, the command is aborted. Power-on default has the read look-ahead and write caching features enabled. The acceptable values for the Features register are defined as follows

**Table 11 Set Features command values**

02 <sub>H</sub>	Enable write cache ( <i>default</i> ).
03 <sub>H</sub>	Set transfer mode (based on value in Sector Count register). Sector Count register values:
00 <sub>H</sub>	Set PIO mode to default (PIO mode 2).
01 <sub>H</sub>	Set PIO mode to default and disable IORDY (PIO mode 2).
08 <sub>H</sub>	PIO mode 0
09 <sub>H</sub>	PIO mode 1
0A <sub>H</sub>	PIO mode 2
0B <sub>H</sub>	PIO mode 3
0C <sub>H</sub>	PIO mode 4 ( <i>default</i> )
20 <sub>H</sub>	Multiword DMA mode 0
21 <sub>H</sub>	Multiword DMA mode 1
22 <sub>H</sub>	Multiword DMA mode 2
40 <sub>H</sub>	Ultra DMA mode 0
41 <sub>H</sub>	Ultra DMA mode 1
42 <sub>H</sub>	Ultra DMA mode 2
43 <sub>H</sub>	Ultra DMA mode 3
44 <sub>H</sub>	Ultra DMA mode 4
45 <sub>H</sub>	Ultra DMA mode 5
46 <sub>H</sub>	Ultra DMA mode 6
10 <sub>H</sub>	Enable use of SATA features
55 <sub>H</sub>	Disable read look-ahead (read cache) feature.
82 <sub>H</sub>	Disable write cache
90 <sub>H</sub>	Disable use of SATA features
AA <sub>H</sub>	Enable read look-ahead (read cache) feature ( <i>default</i> ).
F1 <sub>H</sub>	Report full capacity available

**Note** At power-on, or after a hardware or software reset, the default values of the features are as indicated above.

### 4.3.3 S.M.A.R.T. commands

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

SeaTools diagnostic software activates a built-in drive self-test (DST S.M.A.R.T. command for D4<sub>H</sub>) 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. Users must have a recent BIOS or software package that supports S.M.A.R.T. to enable this feature. The table below shows the S.M.A.R.T. command codes that the drive uses.

**Table 12 S.M.A.R.T. commands**

Code in features register	S.M.A.R.T. command
D0 <sub>H</sub>	S.M.A.R.T. Read Data
D2 <sub>H</sub>	S.M.A.R.T. Enable/Disable Attribute Autosave
D3 <sub>H</sub>	S.M.A.R.T. Save Attribute Values
D4 <sub>H</sub>	S.M.A.R.T. Execute Off-line Immediate (runs DST)
D5 <sub>H</sub>	S.M.A.R.T. Read Log Sector
D6 <sub>H</sub>	S.M.A.R.T. Write Log Sector
D8 <sub>H</sub>	S.M.A.R.T. Enable Operations
D9 <sub>H</sub>	S.M.A.R.T. Disable Operations
DA <sub>H</sub>	S.M.A.R.T. Return Status

<b>Note</b>	If an appropriate code is not written to the Features Register, the command is aborted and 0x04 (abort) is written to the Error register.
-------------	---





**Seagate Technology LLC**

*AMERICAS Seagate Technology LLC 10200 South De Anza Boulevard, Cupertino, California 95014, United States, 408-658-1000*

*ASIA/PACIFIC Seagate Singapore International Headquarters Pte. Ltd. 7000 Ang Mo Kio Avenue 5, Singapore 569877, 65-6485-3888*

*EUROPE, MIDDLE EAST AND AFRICA Seagate Technology SAS 16-18 rue du Dôme, 92100 Boulogne-Billancourt, France, 33 1-4186 10 00*

*Publication Number: 100805922, Rev. D*

*February 2018*