Archive HDD

v2 SATA Product Manual

ST8000AS0002
ST6000AS0002

100757960, Rev. J
Gen 2 - November 2017

Document Revision History

Revision	Date	Pages affected
Rev. A	07/17/2014	Initial release.
Rev. B	11/18/2014	5, 8-10, 12-14, 16-17, 20, 25
Rev. C	01/07/2015	front & back covers, 9, 12-13 & 16
Rev. D	04/23/2015	front cover, 6, 8, 10, 16 & 30.
Rev. E	10/14/2015	front cover, 4 6-10, 18, 22 & 28-30:.
Rev. F	11/02/2015	front cover, 5, 7, 9 & 28
Rev. G	01/26/2016	6-8, 15-18 & 21.
Rev. H	03/02/2016	13.
Rev. J	11/16/2017	15: Added Figure 2: Location of the HDA temperature check point 18-21: Updated Safety, EMC, FCC & RoHS sections, per Compliance Council

Publication number: 100757960, Rev. J November 2017

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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 Archive HDD model drives:

Standard model

ST8000AS0002

ST6000AS0002

These drives provide the following key features:

- High instantaneous (burst) data-transfer rates (up to 600MB per second).
- TGMR recording technology provides the drives with increased areal density.
- 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.

1.1 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 users to install a SATA host adapter and SATA disk drive in the current system and expect all of the 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.

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 3.2". The specification can be downloaded from www.sata-io.org.

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.

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 model

ST8000AS0002

ST6000AS0002

2.1 Specification summary tables

The specifications listed in **Table 1** are for quick reference. For details on specification measurement or definition, refer to the appropriate section of this manual.

Table 1 Drive specifications summary

Drive Specification*	ST8000AS0002	ST6000AS0002
Formatted capacity (512 bytes/sector)**	8000GB (8TB)	6000GB (6TB)
Guaranteed sectors	15,628,053,168	11,721,045,168
Heads	12	
Disks	6	
Bytes per sector	512	
Recording density (max)	1950 KFCI	
Track density (avg)	435 KTPI	
Areal density (avg)	848 Gb/in^2	
Internal data transfer rate (max)	1900 Mb/s	
Average data rate, read/write (MB/s)	150 MB/s	
Maximum sustained data rate, OD read (MB/s)	190 MB/s	
ATA data-transfer modes supported	PIO modes: 0 to 4 Multiword DMA modes: 0 to 2 Ultra DMA modes 0 to 6	
I/O data-transfer rate (max)	600MB/s	
Cache buffer	128MB	
Height (max)	26.1mm / 1.028 in	
Width (max)	101.6mm/4.0 in (± 0.010 in)	
Length (max)	146.99mm / 5.787 in	
Weight (typical)	780g / 1.72 lb	
Average latency	5.5ms	
Power-on to ready (max)	30.0s	
Standby to ready (max)	25.0s	
Average seek, read (typical) Average seek, write (typical)	<12.0ms typical <12.0ms typical	
Startup current (typical) 12V	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	20°C per hour max (operating) 30°C per hour max (nonoperating)	
Relative humidity	5% to 90% (operating) 5% to 95% (nonoperating)	
Relative humidity gradient (max)	30% per hour	
Wet bulb temperature (max)	26°C max (operating) 29°C max (nonoperating)	

Table 1 Drive specifications summary

Drive Specification*	ST8000AS0002	ST6000AS0002
Altitude, operating	-304.8m to 3048m (-1000 ft to 10,000 ft)	
Altitude, non-operating (below mean sea level, max)	-304.8m to12,192m (-1000ft to 40,000+ ft)	
Operational shock (max)	70 Gs (read) and 40 Gs (write) at 2ms	
Non-operational shock (max)	250 Gs at 2ms	
Vibration, operating	10Hz to 22Hz: 0.25 Gs, Limited displacement 22Hz to 350Hz: 0.50 Gs 350Hz to 500Hz: 0.25 Gs	
Vibration, non-operating	5Hz to 500Hz: 3.0 Gs	
Drive acoustics, sound power		
Idle***	2.7 bels (typical) 2.8 bels (max)	
Seek	2.8 bels (typical) 2.9 bels (max)	
Non-recoverable read errors	1 per 10^{14} bits read	
Rated workload	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 limit = 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: http://www.seagate.com/support/warranty-and-replacements/ From this page, click on "Is my Drive under Warranty". 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.	
Load/unload cycles (25°C, 50% rel. humidity)	300,000 at 25°C, 50% rel. humidity	
Supports hotplug operation per the 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.

2.2 Formatted capacity

Model	Formatted capacity*	Guaranteed sectors	Bytes per sector
ST8000AS0002	8000GB	15,628,053,168	512
ST6000AS0002	6000GB	11,721,045,168	

*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.

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 Default logical geometry

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

LBA mode

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

2.4 Recording and interface technology

Interface	SATA
Recording method	TGMR
Recording density (KFCI)	1950
Track density (Ktracks/inch avg)	435
Areal density (Gb/in^2)	848
Internal data transfer rate (Mb/s max)	1900
Maximum sustained data transfer rate, OD read (MB/s)	190
Average data rate, read/write (MB/s)	150
I/O data-transfer rate (MB/s max)	600

2.5 Physical characteristics

Maximum height	26.11mm / 1.028 in
Maximum width	101.6mm / 4.0 in (± 0.010 in)
Maximum length	146.99mm / 5.787 in
Typical weight	780g / 1.72 lb
Cache buffer	128MB

2.6 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	5.5	

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

2.7 Start/stop times

The start/stop times are listed below.

Power-on to ready (in seconds)	24 (typical) 30 (max)
Standby to ready (in seconds)	20 (typical) 25 (max)
Ready to spindle stop (in seconds)	15 (typical) 20 (max)

Time-to-ready may be longer than normal if the drive power is removed without going through normal OS powerdown procedures.

2.8 Power specifications

The drive receives DC power (+5V or +12V) through a native SATA power connector. Refer to Figure 1 on page 12.

2.8.1 Power consumption

Power requirements for the drives are listed in Table 2. Typical power measurements are based on an average of drives tested, under nominal conditions, using 5.0V and 12.0V input voltage at 35°C ambient temperature.

Table 2 DC power requirements

		6.0Gb mode	
Voltage		**+5V**	**+12V**
Regulation		**±5%**	**±5%**
Avg Idle Current *		0.18	0.33
Advanced Idle Current *			
	Idle_A	0.14	0.34
	Idle_B	0.13	0.29
	Idle_C	0.14	0.14
	Standby	0.12	0.01
Maximum Start Current			
	DC (peak DC)	0.33	1.42
	AC (peak DC)	0.49	2.11
Peak operating current (random read):			
	Typical DC	0.22	0.61
	Maximum DC	0.22	0.63
Peak operating current (random write)			
	Typical DC	0.49	0.32
	Maximum DC	0.49	0.40
Peak operating current (sequential read)			
	Typical DC	0.46	0.39
	Maximum DC	0.47	0.40
Peak operating current (sequential write)			
	Typical DC	0.37	0.40
	Maximum DC	0.37	0.41

* 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.

2.8.1.1 Typical current profiles

Archive HDD current profiles

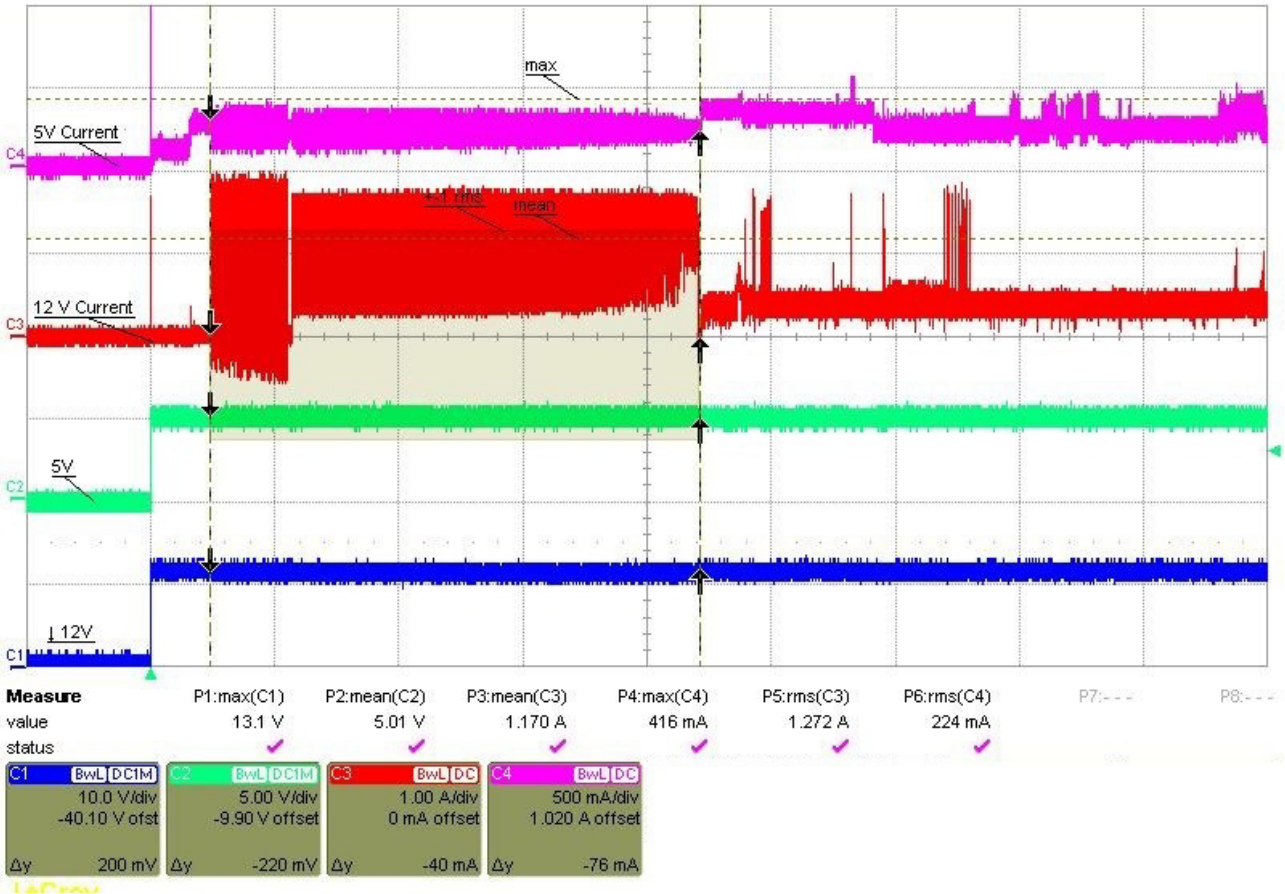


Figure 1 Typical 5V & 12V - 6Gb/s startup and operation current profiles

2.8.2 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.

2.8.3 Voltage tolerance

Voltage tolerance (including noise):

- 5V = ±5%
- 12V = ±10%

2.8.4 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_H	Reduced electronics
Idle_b	82_H	Heads unloaded. Disks spinning at full RPM
Idle_c	83_H	Heads unloaded. Disks spinning at reduced RPM
Standby_z	00_H	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 one second 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	1 sec
Idle_b	5 min
Idle_c	undefined
Standby_z	disabled

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_H	Restore Power Condition Settings
01_H	Go to Power Condition
02_H	Set Power Condition Timer
03_H	Set Power Condition State
04_H	Enable EPC Feature Set
05_H	Disable EPC Feature Set

PowerChoice Supported Extended Power Condition Identifiers

Power Condition Identifiers	Power Condition Name
00_H	Standby_z
01 - 80_H	Reserved
81_H	Idle_a
82_H	Idle_b
83_H	Idle_c
84 - FE_H	Reserved
FF_H	All EPC Power Conditions

2.9 Environmental specifications

This section provides the temperature, humidity, shock, and vibration specifications for Archive HDD. 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.

2.9.1 Ambient Temperature

Operating	0° to 60°C (37.4° to 140°F)
Non-operating	-40° to 70°C (-40° to 158°F)

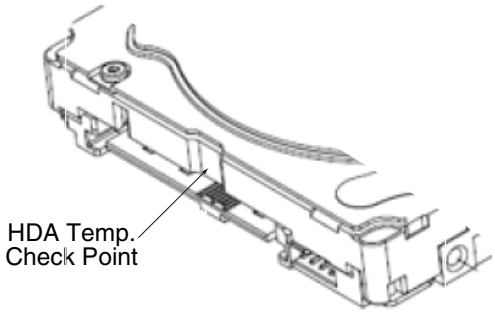


Figure 2 Location of the HDA temperature check point

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

2.9.2 Temperature gradient

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

2.9.3 Humidity

2.9.3.1 Relative humidity

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

2.9.3.2 Wet bulb temperature

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

2.9.4 Altitude

Operating	-304.8m to 3048m (-1000 ft. to 10,000 ft.)
Non-operating	-304.8m to 12,192m (-1000 ft. to 40,000+ ft.)

2.9.5 Shock

All shock specifications assume that the drive is mounted securely with the input shock applied at the drive mounting screws. Shock may be applied in the X, Y or Z axis.

2.9.5.1 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 during read operations. Shocks should not be repeated more than two times per second.

2.9.5.2 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 250 Gs based on a non-repetitive half-sine shock pulse of 2ms duration.

2.9.6 Operating vibration

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

10Hz to 22Hz	0.25 Gs (Limited displacement)
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.

2.9.7 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 500Hz	3.0 Gs

2.10 Acoustics

Drive acoustics are measured as overall A-weighted acoustic sound power levels (no pure tones). All measurements are consistent with ISO document 7779. Sound power measurements are taken under essentially free-field conditions over a reflecting plane. For all tests, the drive is oriented with the cover facing upward.

Note	For seek mode tests, the drive is placed in seek mode only. The number of seeks per second is defined by the following equation: (Number of seeks per second = 0.4 / (average latency + average access time

Table 3 Fluid Dynamic Bearing (FDB) motor acoustics

	Idle*	Seek
All models	2.7 bels (typical) 2.8 bels (max)	2.8 bels (typical) 2.9 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.

2.10.1 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.

2.11 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**.

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

2.12 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 on "Is my Drive under Warranty". 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.

2.12.1 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.

2.13 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.

2.13.1 Safety certification

The drives are recognized in accordance with UL/cUL 60950-1 and EN 60950-1.

2.13.2 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 20 .

2.13.3 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).

2.13.4 Canada ICES-003

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

2.13.5 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.

기 종 별	사 용 자 안 내 문
B 급 기기 (가정용 방송통신기자재)	이 기기는 가정용(B 급) 전자파적합기기로서 주로 가정에서 사용하는 것을 목적으로 하며, 모든 지역에서 사용할 수 있습니다.

2.13.6 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.

2.13.7 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 21 .

2.13.8 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^{+6})	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：僅適用于內部使用 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^{+6})	多溴聯苯 (PBB)	多溴二苯醚 (PBDE)
硬盤驅動器 HDD	—	O	O	O	O	O
印刷電路板组装 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 Corrosive environment

Seagate electronic drive components pass accelerated corrosion testing equivalent to 10 years exposure to light industrial environments containing sulfurous gases, chlorine and nitric oxide, classes G and H per ASTM B845. However, this accelerated testing cannot duplicate every potential application environment. Users should use caution exposing any electronic components to uncontrolled chemical pollutants and corrosive chemicals as electronic drive component reliability can be affected by the installation environment. The silver, copper, nickel and gold films used in Seagate products are especially sensitive to the presence of sulfide, chloride, and nitrate contaminants. Sulfur is found to be the most damaging. In addition, electronic components should never be exposed to condensing water on the surface of the printed circuit board assembly (PCBA) or exposed to an ambient relative humidity greater than 95%. Materials used in cabinet fabrication, such as vulcanized rubber, that can outgas corrosive compounds should be minimized or eliminated. The useful life of any electronic equipment may be extended by replacing materials near circuitry with sulfide-free alternatives.

3.0 Configuring and Mounting the Drive

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

3.1 Handling and static-discharge precautions

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

Caution

- 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 mounting it in the computer.
- Do not touch the connector pins or the printed circuit board.
- Do not remove the factory-installed labels from the drive or cover them with additional labels. Removal voids the warranty. Some factory-installed labels contain information needed to service the drive. Other labels are used to seal out dirt and contamination.

3.2 Configuring the drive

Each drive on the 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 drives are designed for easy installation. It is usually not necessary to set any jumpers on the drive for proper operation; however, if users connect the drive and receive a "drive not detected" error, the SATA-equipped motherboard or host adapter may use a chipset that does not support SATA speed auto-negotiation.

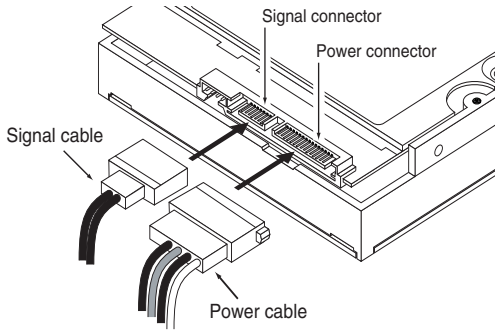
3.3 SATA cables and connectors

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 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**



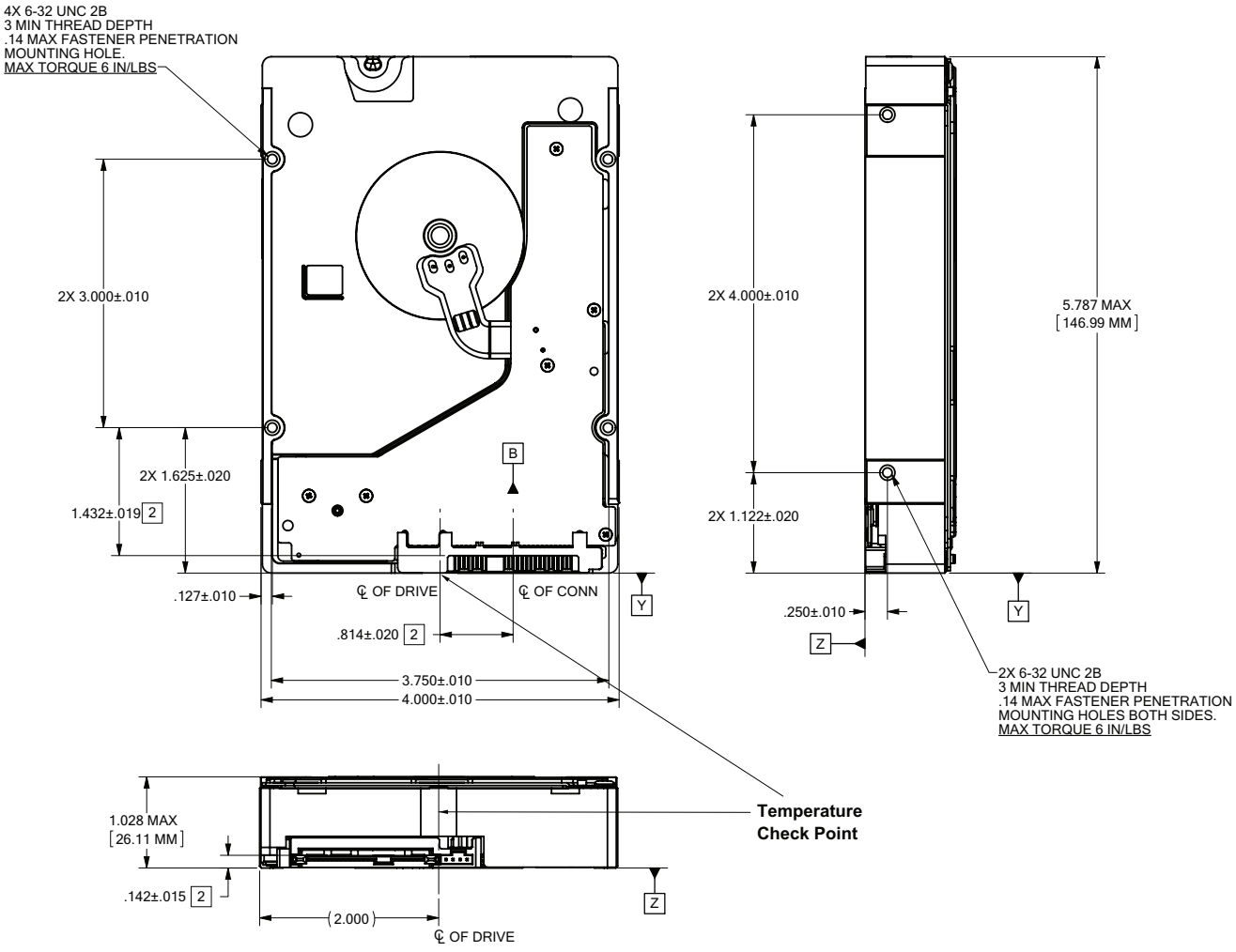
Each cable is keyed to ensure correct orientation. Archive HDD drives support latching SATA connectors.

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. 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 0.140 inch (3.56mm) into the bottom or side mounting holes.
- Do not overtighten the mounting screws (maximum torque: 6 inch-lb).

Figure 4 Mounting dimensions



4.0 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.

4.1 Hot-Plug compatibility

Archive HDD drives incorporate connectors which enable users to hot plug these drives in accordance with the SATA Revision 3.2 specification. This specification can be downloaded from www.serialata.org.

A Standby Immediate command should be issued and allowed to complete, and no more commands issued, prior to removing power from a drive. Consequences of not completing a Standby Immediate command and subjecting the drive to an unexpected power loss include the following:

- potentially longer time to ready on the subsequent power up; and
- if the drive was actively writing there may be unrecoverable sectors.

The existence of unrecoverable sectors may result in long command completion times for subsequent reads and writes in the vicinity of the LBAs that were actively being written when power was unexpectedly lost.

4.2 SATA device plug connector pin definitions

Table 7 summarizes the signals on the SATA interface and power connectors.

Table 7 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	V_{33}	3.3V power
	P2	V_{33}	3.3V power
	P3	V_{33}	3.3V power, pre-charge, 2nd mate
	P4	Ground	1st mate
	P5	Ground	2nd mate
	P6	Ground	2nd mate
	P7	V_5	5V power, pre-charge, 2nd mate
	P8	V_5	5V power
	P9	V_5	5V power
	P10	Ground	2nd mate
	P11	Ground or LED signal	If grounded, drive does not use deferred spin
	P12	Ground	1st mate.
	P13	V_{12}	12V power, pre-charge, 2nd mate
	P14	V_{12}	12V power
	P15	V_{12}	12V power

Notes

1. All pins are in a single row, with a 1.27 mm (0.050 in) 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 (V_x) must be terminated.

4.3 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 3.2 (http://www.sata-io.org).

See "S.M.A.R.T. commands" on page 32 for details and subcommands used in the S.M.A.R.T. implementation.

Table 8 SATA standard commands

Command name	Command code (in hex)
Check Power Mode	$E5_H$
Device Configuration Freeze Lock	$B1_H$ / $C1_H$
Device Configuration Identify	$B1_H$ / $C2_H$
Device Configuration Restore	$B1_H$ / $C0_H$
Device Configuration Set	$B1_H$ / $C3_H$
Device Reset	08_H
Download Microcode	92_H
Execute Device Diagnostics	90_H
Flush Cache	$E7_H$
Flush Cache Extended	EA_H
Format Track	50_H
Identify Device	EC_H
Idle	$E3_H$
Idle Immediate	$E1_H$
Initialize Device Parameters	91_H
Read Buffer	$E4_H$
Read DMA	$C8_H$
Read DMA Extended	25_H
Read DMA Without Retries	$C9_H$
Read Log Ext	$2F_H$
Read Multiple	$C4_H$
Read Multiple Extended	29_H
Read Native Max Address	$F8_H$
Read Native Max Address Extended	27_H
Read Sectors	20_H
Read Sectors Extended	24_H
Read Sectors Without Retries	21_H
Read Verify Sectors	40_H

Table 8 SATA standard commands (continued)

Command name	Command code (in hex)	
Read Verify Sectors Extended	42_H	
Read Verify Sectors Without Retries	41_H	
Recalibrate	10_H	
Security Disable Password	$F6_H$	
Security Erase Prepare	$F3_H$	
Security Erase Unit	$F4_H$	
Security Freeze	$F5_H$	
Security Set Password	$F1_H$	
Security Unlock	$F2_H$	
Seek	70_H	
Set Features	EF_H	
Set Max Address	$F9_H$	
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:	00_H 01_H 02_H 03_H 04_H
Set Max Address Extended	37_H	
Set Multiple Mode	$C6_H$	
Sleep	$E6_H$	
S.M.A.R.T. Disable Operations	$B0_H$ / $D9_H$	
S.M.A.R.T. Enable/Disable Autosave	$B0_H$ / $D2_H$	
S.M.A.R.T. Enable Operations	$B0_H$ / $D8_H$	
S.M.A.R.T. Execute Offline	$B0_H$ / $D4_H$	
S.M.A.R.T. Read Attribute Thresholds	$B0_H$ / $D1_H$	
S.M.A.R.T. Read Data	$B0_H$ / $D0_H$	
S.M.A.R.T. Read Log Sector	$B0_H$ / $D5_H$	
S.M.A.R.T. Return Status	$B0_H$ / DA_H	
S.M.A.R.T. Save Attribute Values	$B0_H$ / $D3_H$	
S.M.A.R.T. Write Log Sector	$B0_H$ / $D6_H$	
Standby	$E2_H$	
Standby Immediate	$E0_H$	
Write Buffer	$E8_H$	
Write DMA	CA_H	
Write DMA Extended	35_H	
Write DMA FUA Extended	$3D_H$	
Write DMA Without Retries	CB_H	
Write Log Extended	$3F_H$	
Write Multiple	$C5_H$	
Write Multiple Extended	39_H	

Table 8 SATA standard commands (continued)

Command name	Command code (in hex)
Write Multiple FUA Extended	CE_H
Write Sectors	30_H
Write Sectors Without Retries	31_H
Write Sectors Extended	34_H
Write Uncorrectable	45_H

4.3.1 Identify Device command

The Identify Device command (command code EC_H) transfers information about the drive to the host following power up. The data is organized as a single 512-byte block of data, whose contents are shown in on page 25. 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.

Table 9 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	$0C5A_H$
1	Number of logical cylinders	16,383
2	ATA-reserved	0000_H
3	Number of logical heads	16
4	Retired	0000_H
5	Retired	0000_H
6	Number of logical sectors per logical track: 63	$003F_H$
7–9	Retired	0000_H
10–19	Serial number: (20 ASCII characters, 0000_H = none)	ASCII
20	Retired	0000_H
21	Retired	0400_H
22	Obsolete	0000_H
23–26	Firmware revision (8 ASCII character string, padded with blanks to end of string)	x.xx
27–46	Drive model number: (40 ASCII characters, padded with blanks to end of string)	
47	(Bits 7–0) Maximum sectors per interrupt on Read multiple and Write multiple (16)	8010_H
48	Reserved	0000_H
49	Standard Standby timer, IORDY supported and may be disabled	$2F00_H$
50	ATA-reserved	0000_H
51	PIO data-transfer cycle timing mode	0200_H
52	Retired	0200_H

Table 9 Identify Device commands (continued)

Word	Description	Value
53	Words 54–58, 64–70 and 88 are valid	0007_H
54	Number of current logical cylinders	$xxxx_H$
55	Number of current logical heads	$xxxx_H$
56	Number of current logical sectors per logical track	$xxxx_H$
57–58	Current capacity in sectors	$xxxx_H$
59	Number of sectors transferred during a Read Multiple or Write Multiple command	$xxxx_H$
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	0000_H
63	Multiword DMA active and modes supported (see note following this table)	$xx07_H$
64	Advanced PIO modes supported (modes 3 and 4 supported)	0003_H
65	Minimum multiword DMA transfer cycle time per word (120 nsec)	0078_H
66	Recommended multiword DMA transfer cycle time per word (120 nsec)	0078_H
67	Minimum PIO cycle time without IORDY flow control (240 nsec)	0078_H
68	Minimum PIO cycle time with IORDY flow control (120 nsec)	0078_H
69–74	ATA-reserved	0000_H
75	Queue depth	$001F_H$
76	SATA capabilities	$xxxx_H$
77	Reserved for future SATA definition	$xxxx_H$
78	SATA features supported	$xxxx_H$
79	SATA features enabled	$xxxx_H$
80	Major version number	$01F0_H$
81	Minor version number	0028_H
82	Command sets supported	$364B_H$
83	Command sets supported	$7F09_H$
84	Command sets support extension (see note following this table)	4163_H
85	Command sets enabled	$30xx_H$
86	Command sets enabled	$BE09_H$
87	Command sets enable extension	4163_H
88	Ultra DMA support and current mode (see note following this table)	$xx7F_H$
89	Security erase time	0039_H
90	Enhanced security erase time	0039_H
92	Master password revision code	$FFFE_H$
93	Hardware reset value	$xxxx_H$

Table 9 Identify Device commands (continued)

Word	Description	Value
94	Automatic acoustic management	8080_H
95–99	ATA-reserved	0000_H
100–103	Total number of user-addressable LBA sectors available (see Section 2.2 for related information). These words are required for drives that support the 48-bit addressing feature. Maximum value: 0000FFFFFFFFFFFFh.	ST8000AS0002 = 1,953,506,646 ST6000AS0002 = 1,465,130,646
104–107	ATA-reserved	0000_H
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	0000_H
128	Security status	0001_H
129–159	Seagate-reserved	$xxxx_H$
160–254	ATA-reserved	0000_H
255	Integrity word	$xxA5_H$

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

Note	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.

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 10 Set Features command

02_H	Enable write cache *(default)*
03_H	Set transfer mode (based on value in Sector Count register) Sector Count register values:
	00_H Set PIO mode to default (PIO mode 2)
	01_H Set PIO mode to default and disable IORDY (PIO mode 2)
	08_H PIO mode 0
	09_H PIO mode 1
	$0A_H$ PIO mode 2
	$0B_H$ PIO mode 3
	$0C_H$ PIO mode 4 *(default)*
	20_H Multiword DMA mode 0
	21_H Multiword DMA mode 1
	22_H Multiword DMA mode 2
	40_H Ultra DMA mode 0
	41_H Ultra DMA mode 1
	42_H Ultra DMA mode 2
	43_H Ultra DMA mode 3
	44_H Ultra DMA mode 4
	45_H Ultra DMA mode 5
	46_H Ultra DMA mode 6
06_H	Enable the PUIS feature set
07_H	PUIS feature set device spin-up
10_H	Enable use of SATA features
55_H	Disable read look-ahead (read cache) feature
82_H	Disable write cache
86_H	Disable the PUIS feature set
90_H	Disable use of SATA features
AA_H	Enable read look-ahead (read cache) feature *(default)*
$F1_H$	Report full capacity available

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

4.3.3 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 $D4_H$) that eliminates unnecessary drive returns. The diagnostic software ships with all new drives and is also available at: http://seatools.seagate.com.

This drive is shipped with S.M.A.R.T. features disabled. 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 11 S.M.A.R.T. commands

Code in features register	S.M.A.R.T. command
$D0_H$	S.M.A.R.T. Read Data
$D2_H$	S.M.A.R.T. Enable/Disable Attribute Autosave
$D3_H$	S.M.A.R.T. Save Attribute Values
$D4_H$	S.M.A.R.T. Execute Off-line Immediate (runs DST)
$D5_H$	S.M.A.R.T. Read Log Sector
$D6_H$	S.M.A.R.T. Write Log Sector
$D8_H$	S.M.A.R.T. Enable Operations
$D9_H$	S.M.A.R.T. Disable Operations
DA_H	S.M.A.R.T. Return Status

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

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Publication Number: 100757960, Rev. J
November 2017