BARRACUDA PRO

SATA Product Manual

Standard 512E model

ST14000DM001

ST12000DM001

ST10000DM001

100835983, Rev. A

Gen 2 - June 2018

Document Revision History

Revision	Date	Pages affected and Description of changes
Rev. A	06/19/2018	Initial release.

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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/

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1.1   Introduction

This manual describes the functional, mechanical and interface specifications for the following:
Seagate® BarraCuda® Pro Serial ATA drive models.

Table 1:   Models

Standard 512E models
ST14000DM001
ST12000DM001
ST10000DM001

These drives provide the following key features:

- 256 MB data buffer.
- 7200 RPM spindle speed.
- 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.
- PowerChoice™ for selectable power savings
- Perpendicular recording technology provides the drives with increased areal density.
- 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.
- T13 Fast Format conversion (see Section 1.2.2.1)
- Top Cover Attached motor for excellent vibration tolerance
- Worldwide Name (WWN) capability uniquely identifies the drive.

> **NOTE**   Seagate recommends validating the configuration with the selected HBA/RAID
> controller manufacturer to ensure use of full capacity is supported.

1.1.1   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 the current system and expect all of the 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.

> **NOTE**   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.

1.2   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 BarraCuda Pro Serial ATA drive models.

1.2.1   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 2   Drive specifications summary

Drive specification	ST14000DM001	ST12000DM001	ST10000DM001
Formatted (512 bytes/sector)*	14TB	12TB	10TB
Guaranteed sectors	(see *Section 1.2.2*)		
Heads	16	15	13
Discs	8		
Bytes per logical sector	512		
Bytes per physical sector	4096		
Recording density, KBPI (Kb/in max)	2426		
Track density, KTPI (ktracks/in avg.)	436		
Areal density, (Gb/in^2 avg)	1058		
Spindle speed (RPM)	7200		
Internal data transfer rate (Mb/s max)	2833		
Sustained data transfer rate OD (MiB/s max)	238 (250 MB/s max)		
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	256MB (262,144KB)		
Weight: (maximum)	690g (1.521 lb)		
Average latency	4.16ms		
Power-on to ready (sec) (typ/max)	23/30		
Standby to ready (sec) (typ/max)	23/30		
Startup current (typical) 12V (peak)	2.0A		
Voltage tolerance (including noise)	5V ± 5% 12V ± 10%		
Operating drive temperature*	0° to 60°C (Drive Reported Temperature)		
Non-Operating temperature	–40° to 70°C (Ambient Temperature, see sections 1.2.6.0.1 and 1.2.15)		

Drive specification	ST14000DM001	ST12000DM001	ST10000DM001
Temperature gradient (°C per hour max)	20°C (operating) 30°C (nonoperating)		
Relative humidity*	5% to 95% (operating) 5% to 95% (nonoperating)		
Relative humidity gradient	30% per hour max		
Altitude, operating	–304.8 m to 3,048 m (–1000 ft to 10,000+ ft)		
Altitude, nonoperating (below mean sea level, max)	–304.8 m to 12,192 m (–1000 ft to 40,000+ ft)		
Operational Shock (max at 2 ms - typical)	Read 70 Gs / Write 40 Gs		
Non-Operational Shock (max at 2 ms - typical)	250 Gs		
Vibration, operating	5–22 Hz: 0.25 Gs, Limited displacement 22–350 Hz: 0.50 Gs 350–500 Hz: 0.25 Gs		
Operation Rotational vibration	20–1500Hz: 12.5 rads/s^2		
Vibration, nonoperating	2–500 Hz: 2.27 Grms ref		
Drive acoustics, sound power (bels)			
Idle	1.8 (typical) 2.0 (max) During periods of drive idle, some offline activity may occur according to the SMART specification, which may increase acoustic and power to operational levels.		
Performance seek	2.6 (typical) 2.8 (max)		
Nonrecoverable read errors	1 sector per 10^{15} bits read		
Annualized Failure Rate (AFR)*	1% based on 8760 POH		
Maximum Rated Workload*	Maximum rate of <300TB/year Workloads exceeding the annualized rate may degrade the drive MTBF and impact product reliability. The 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: http://www.seagate.com/support/warranty-and-replacements/. 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	300,000		
Supports Hotplug operation per Serial ATA Revision 3.3 specification	Yes		

*See **Section 1.2.10, "Reliability"** for rated MTBF device operating condition requirements.

1.2.2   Formatted capacity

ST models	Formatted capacity*	Guaranteed sectors	Bytes per logical sector
ST14000DM001	14TB	27,344,764,928	
ST12000DM001	12TB	23,437,770,752	512E
ST10000DM001	10TB	19,532,873,728	

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

> **NOTE**   LBA Counts for drive capacities greater than 8TB are calculated based upon the
> SFF-8447 standard publication. ftp://ftp.seagate.com/sff/SFF-8447.PDF

1.2.2.1   Fast Format - logical sector size conversion

- Drive supports either 512E or 4KN logical sector size formats
- SET SECTOR CONFIGURATION EXT (B2h) command (ACS-4 Standard) quickly converts between 512 and 4096 byte logical sector size formats
- The selected sector size change occurs immediately upon command completion
- Default shipping format is 512E

Table 3   SET SECTOR CONFIGURATION EXT command inputs

Field	Description
FEATURE	COMMAND CHECK field
COUNT	Bit Description
	15 : 3 Reserved
	2:0 SECTOR CONFIGURATION DESCRIPTOR INDEX field
LBA	Reserved
DEVICE	Bit Description
	7 Obsolete
	6 N/A
	5 Obsolete
	4 Transport Dependent
	3:0 Reserved
COMMAND	7:0 B2h

- COMMAND CHECK field value is taken from the DESCRIPTOR CHECK field in the descriptor specified by the SECTOR CONFIGURATION DESCRIPTOR INDEX field
- SECTOR CONFIGURATION DESCRIPTOR INDEX field specifies the Sector Configuration descriptor in the Set Sector Configuration log page

Sector Configuration log (Log Address 2Fh)

The Sector Configuration log contains Sector Configuration descriptors. The Sector Configuration descriptors describe sector configurations. The sector configuration is specified using the SET SECTOR CONFIGURATION EXT command.

Table 4   **Sector Configuration descriptors page format (log page 00h)**

Offset	Type	Description
0...15	Bytes	Sector Configuration descriptor 0
16...31	Bytes	Sector Configuration descriptor 1
... ...		
112...127	Bytes	Sector Configuration descriptor 7
128...511	Bytes	Reserved

Table 5   **Sector Configuration descriptors format**

Offset	Type	Description
0	Byte	Sector Configuration descriptor flags
		Bit Description
		7 DESCRIPTOR VALID bit
		6:0 Reserved
1	Byte	LOGICAL TO PHYSICAL SECTOR RELATIONSHIP SETTING field
2...3	Word	DESCRIPTOR CHECK field
4...7	DWord	LOGICAL SECTOR SIZE SETTING field
8...15	Bytes	Reserved

1.2.2.2   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 1.4.3.1, "Identify Device command"** (words 60-61 and 100-103) for additional information about 48-bit addressing support of drives with capacities over 137GB.

1.2.3   Recording and interface technology

Interface	Serial ATA (SATA)
Recording method	Perpendicular
Recording density, KBPI (Kb/in max)	2426
Track density, KTPI (ktracks/in avg)	436
Areal density (Gb/in^2 avg)	1058
Spindle speed (RPM) (± 0.2%)	7200
Internal data transfer rate (Mb/s max)	2833
Sustained data transfer rate (MiB/s max)	238
I/O data-transfer rate (MB/s max)	600 (Ultra DMA mode 5)

1.2.4   Start/stop times

Power-on to Ready (sec) (typ/max)	23/30
Standby to Ready (sec) (typ/max)	23/30
Ready to spindle stop (sec) (max)	20

1.2.5   Power specifications

The drive receives DC power (+5V or +12V) through a native SATA power connector. **See Figure 2 on page 25** .

1.2.5.1   Power consumption

Power requirements for the drives are listed in **Table 6**. 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 6   DC power requirements

		6.0Gb mode		
Voltage		+5V	+12V	Watts
Regulation		± 5%	± 10%	Total
Avg Idle Current *		0.297	0.299	5.07
Advanced Idle Current *				
	Idle_A	0.267	0.295	4.88
	Idle_B	0.203	0.185	3.24
	Idle_C	0.200	0.127	2.52
	Standby	0.193	0.017	1.17
	Sleep	0.226	0.018	1.35
Maximum Start Current				
	DC (peak DC)	1.078	1.672	
	AC (Peak DC)	1.128	2.06	
	Delayed motor start (max) DC			
Operating current (random read 4K16Q):				
	Typical DC	0.454	0.405	7.14
	Maximum DC	0.472	0.415	7.33
	Maximum DC (peak)	1.32	2.305	
Operating current (random write 4K16Q)				
	Typical DC	0.317	0.385	6.20
	Maximum DC	0.326	0.388	6.28
	Maximum DC (peak)	0.791	1.425	
Operating current (sequential read 64K16Q)				
	Typical DC	0.90	0.319	8.33
	Maximum DC	0.919	0.324	8.49
	Maximum DC (peak)	1.183	0.601	
Operating current (sequential write 64K16Q)				
	Typical DC	0.752	0.319	7.59
	Maximum DC	0.756	0.324	7.67
	Maximum DC (peak)	0.89	1.824	

*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

1.2.5.1.1 Typical current profiles
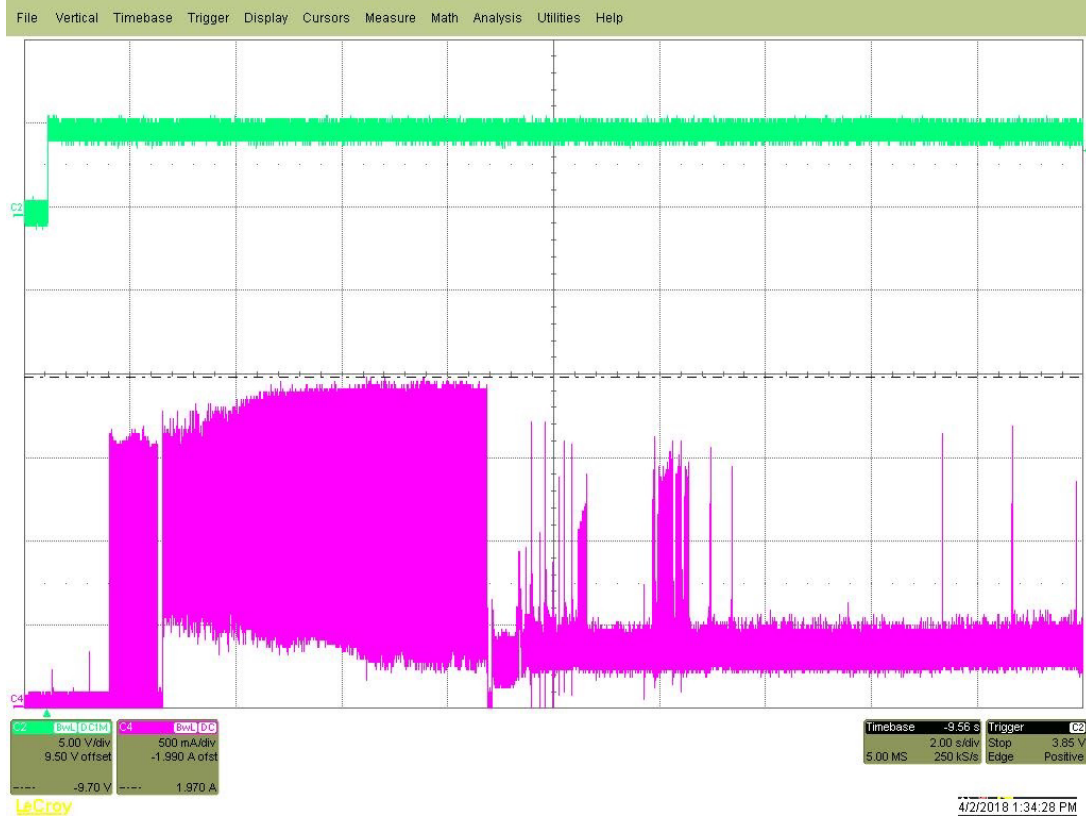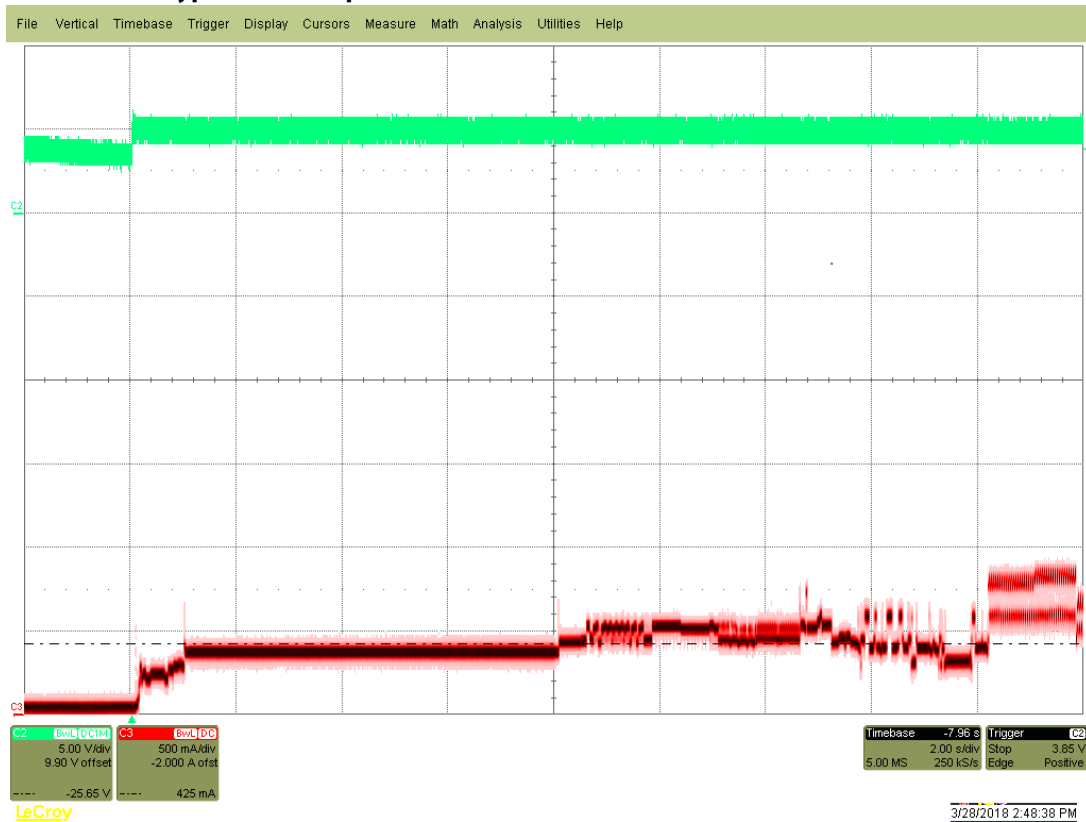
Figure 1.   Typical 5V and 12V startup and operation current profiles

1.2.5.2   Conducted noise

Noise is specified as a periodic and random distribution of frequencies covering a band from DC to 10 MHz. Maximum allowed noise values given below are peak-to-peak measurements and apply at the drive power connector.

+5v   =   250 mV pp from 100 Hz to 20 MHz.

+12v   =   800 mV pp from 100 Hz to 8 KHz.
                    450 mV pp from 8 KHz to 20 KHz.
                    250 mV pp from 20 KHz to 5 MHz.

1.2.5.3   Voltage tolerance

Voltage tolerance (including noise):

5V $\pm$ 5%   12V $\pm$ 10%

1.2.5.4   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_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 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	4 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_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

1.2.6   Environmental limits

Temperature and humidity values experienced by the drive must be such that condensation does not occur on any drive part. Altitude and atmospheric pressure specifications are referenced to a standard day at 58.7°F (14.8°C).

NOTE   To maintain optimal performance drives should be run at nominal drive temperatures and humidity.

See **Section 1.2.10, "Reliability"** for rated MTBF device operating condition requirements.

1.2.6.0.1   Temperature

a. Operating

32°F to 140°F (0°C to 60°C) temperature range with a maximum temperature gradient of 36°F (20°C) per hour as reported by the drive.

The maximum allowable drive reported temperature is 140°F (60°C).

Air flow may be required to achieve consistent nominal drive temperature values (see **Section 1.3.4**). To confirm that the required cooling is provided for the electronics and HDA, place the drive in its final mechanical configuration, and perform random write/read operations. After the temperatures stabilize, monitor the current drive temperature using the SMART temperature attribute 194 or Device Statistics log 04h page 5.

b. Non-operating

−40° to 158°F (−40° to 70°C) package ambient with a maximum gradient of 36°F (20°C) per hour. This specification assumes that the drive is packaged in the shipping container designed by Seagate for use with drive.

1.2.6.1   Humidity

The values below assume that no condensation on the drive occurs. Maximum wet bulb temperature is 84.2°F (29°C).

1.2.6.1.1   Relative humidity

Operating:	5% to 95% non-condensing relative humidity with a maximum gradient of 20% per hour.
Nonoperating:	5% to 95% non-condensing relative humidity with a maximum gradient of 20% per hour.

1.2.6.1.2   Effective Altitude (sea level)

Operating:	−304.8 m to 3048 m (−1000 ft. to 10,000+ ft.)
Nonoperating:	−304.8 m to 12,192 m (−1000 ft. to 40,000+ ft.)

1.2.6.2   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.

1.2.6.2.1   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.

1.2.6.2.2   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 250 Gs based on a nonrepetitive half-sine shock pulse of 2ms duration.

1.2.6.3   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.

1.2.6.3.1   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^2 w/RVFF

* Rotary Random Operating Vibration

1.2.6.3.2   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 Linear Random	2.27 Grms ref

Freq (Hz)	2	4	100	500
G^2/Hz	.001	.03	.03	.001

1.2.7   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 7   Fluid Dynamic Bearing (FDB) motor acoustics

	Idle*	Performance seek
All models	1.8 bels (typ) 2.0 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.

1.2.8   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.

1.2.9   Electromagnetic immunity

When properly installed in a representative host system, the drive operates without errors or degradation in performance when subjected to the radio frequency (RF) environments defined in the following table:

Table 8   Radio frequency environments

Test	Description	Performance level	Reference standard
Electrostatic discharge	Contact, HCP, VCP: ± 4 kV; Air: ± 8 kV	B	EN 61000-4-2: 95
Radiated RF immunity	80 to 1000 MHz, 3 V/m, 80% AM with 1 kHz sine 900 MHz, 3 V/m, 50% pulse modulation @ 200 Hz	A	EN 61000-4-3: 96 ENV 50204: 95
Electrical fast transient	± 1 kV on AC mains, ± 0.5 kV on external I/O	B	EN 61000-4-4: 95
Surge immunity	± 1 kV differential, ± 2 kV common, AC mains	B	EN 61000-4-5: 95
Conducted RF immunity	150 kHz to 80 MHz, 3 Vrms, 80% AM with 1 kHz sine	A	EN 61000-4-6: 97
Voltage dips, interrupts	0% open, 5 seconds 0% short, 5 seconds 40%, 0.10 seconds 70%, 0.01 seconds	C C C B	EN 61000-4-11: 94

1.2.10   Reliability

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

The production disk drive shall achieve an annualized failure-rate of 1% (MTBF of 1,000,000 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 <= 30°C
- Ambient wet bulb temp <= 26°C
- Typical workload
- 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. 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
Load unload cycles	300,000 cycles
Maximum Rated Workload	Maximum rate of <300TB/year
	Workloads exceeding the annualized rate may degrade the drive MTBF and impact product reliability. The 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: http://www.seagate.com/support/warranty-and-replacements/.
	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.
Preventive maintenance	None required.

1.2.11   Agency and Safety Certifications

Each Hard Drive and Solid State Drive ("devices") 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.

1.2.11.1   Safety certification

The drives are recognized in accordance with UL/cUL 62368 -1 and EN 62368 -1.

1.2.11.2   Regulatory Models

The following regulatory model number represent all features and configurations within the series:

Regulatory Model Numbers: STL006

1.2.11.3 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 "European Union Restriction of Hazardous Substance Law" on page 22.

1.2.11.4 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).

1.2.11.5 Canada ICES-003

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

1.2.11.6 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
B급 기기 (가정용 방송통신기자재)	이 기기는 가정용(B급) 전자파적합기기로서 주로 가정에서 사용하는 것을 목적으로 하며, 모든 지역에서 사용할 수 있습니다.

1.2.11.7 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.

1.2.11.8   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 "Taiwan Requirements — Taiwan RoHS" on page 23.

1.2.11.9   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.

1.2.12 Environmental protection

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

1.2.12.1 European Union Restriction of Hazardous Substance Law

1.2.12.1.1 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).

1.2.12.1.2 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.

1.2.12.2 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 9 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.						

1.2.12.3   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 10 Taiwan - Restricted Substances

設備名稱：硬碟設備，型號： Equipment Name: Hard Disk Device, Type Designation:						
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)
頂蓋 Top Cover	—	O	O	O	O	O
磁碟 Magnetic disk	—	O	O	O	O	O
電機底座組件 Motor Base Assembly	—	O	O	O	O	O
印刷電路板组装 PCB Assembly	—	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.						

1.2.13   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.

1.2.14   Reference documents

Supported Standards

Serial ATA Revision 3.3 specification

ANSI Documents

INCITS 522-2014ATA/ATAPI Command Set - 3 (ACS-3)

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.

1.2.15   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). 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 the 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.

1.3   Configuring and mounting the drive

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

1.3.1   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.

1.3.2   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.

1.3.3   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).
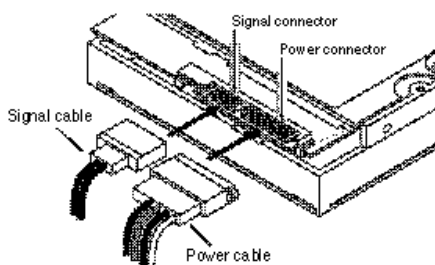
See **Table 11** for connector pin definitions. Either end of the SATA signal cable can be attached to the drive or host.

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 2**.

Figure 2.   Attaching SATA cabling

Each cable is keyed to ensure correct orientation. BarraCuda Pro Serial ATA drives support latching SATA connectors.

1.3.4   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 3** 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).

1.3.4.1   Mechanical specifications

Refer to **Figure 3** for detailed mounting configuration dimensions. See **Section 1.3.4**, "Drive mounting."

Weight:	1.521 lb	690 g

NOTE   These dimensions conform to the Small Form Factor Standard documented in SFF-8301 and SFF-8323, found at www.snia.org/technology-communities/sff/specifications.
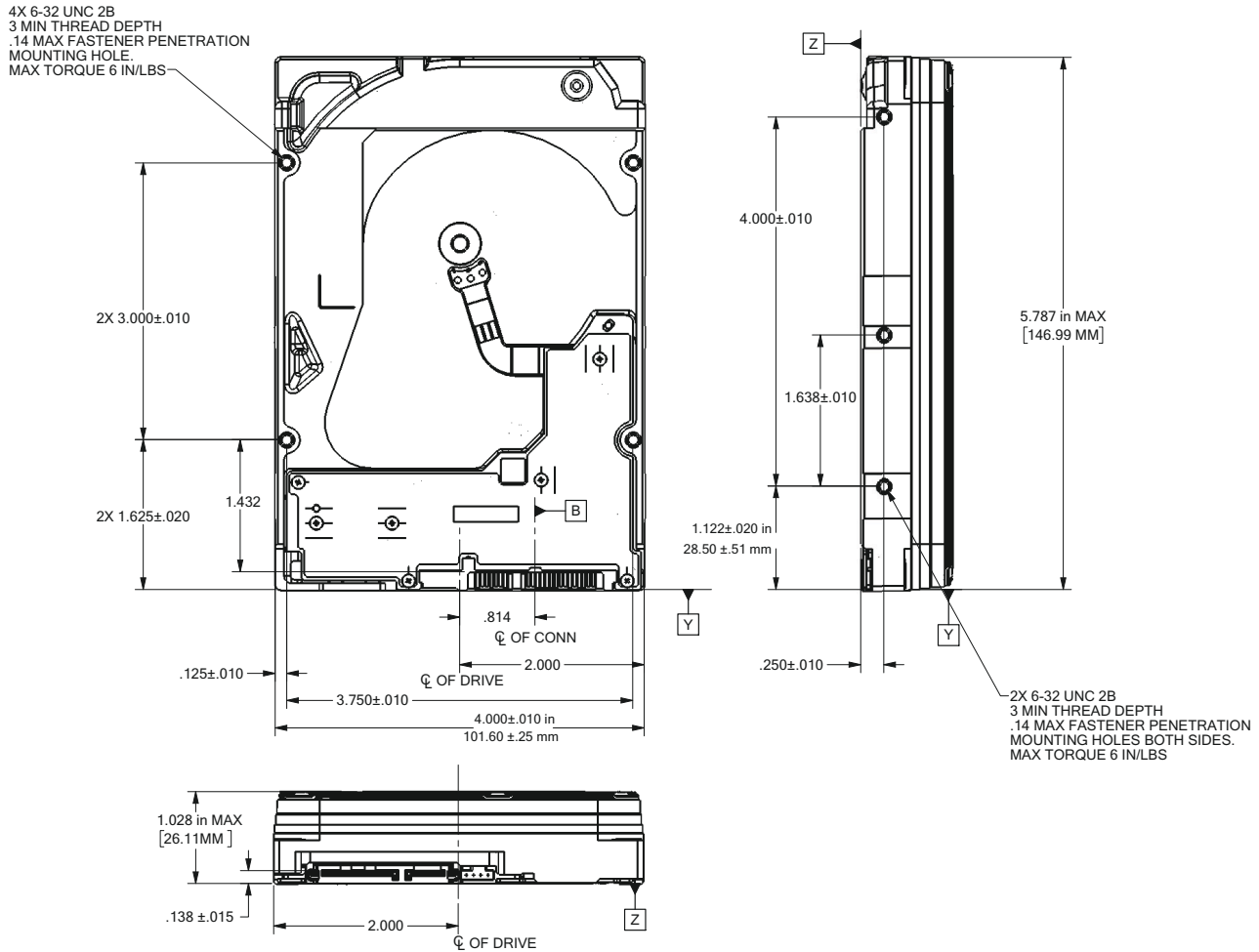
Figure 3.   Mounting configuration dimensions

NOTE   The image is for mechanical dimension reference only and may not represent the actual drive.

1.4 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.

1.4.1 Hot-Plug compatibility

BarraCuda Pro Serial ATA drives incorporate connectors which enable users to hot plug these drives in accordance with the Serial ATA Revision 3.3 specification. This specification can be downloaded from www.serialata.org.

Caution:

The drive motor must come to a complete stop **(Ready to spindle stop time indicated in Section 1.2.4)** prior to changing the plane of operation. This time is required to insure data integrity.

1.4.2 Serial ATA device plug connector pin definitions

Table 11 summarizes the signals on the Serial ATA interface and power connectors.

Table 11 Serial ATA connector pin definitions

Segment	Pin	Function	Definition
Signal	S1	Ground	2nd mate
	S2	A+	Differential signal pair A from Phy
	S3	A-	
	S4	Ground	2nd mate
	S5	B-	Differential signal pair B from Phy
	S6	B+	
	S7	Ground	2nd mate
Key and spacing separate signal and power segments			
Power	P1	V33	3.3V power
	P2	V33	3.3V power
	P3	V33	3.3V power, pre-charge, 2nd mate
	P4	Ground	1st mate
	P5	Ground	2nd mate
	P6	Ground	2nd mate
	P7	V5	5V power, pre-charge, 2nd mate
	P8	V5	5V power
	P9	V5	5V power
	P10	Ground	2nd mate
	P11	Ground or LED signal	If grounded, drive does not use deferred spin
	P12	Ground	1st mate.
	P13	V12	12V power, pre-charge, 2nd mate
	P14	V12	12V power
	P15	V12	12V power

Notes:

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

1.4.3 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 51** for details and subcommands used in the S.M.A.R.T. implementation.

Table 12 Supported ATA commands

Command name	Command code (in hex)
Accessible Max Address Configuration	
Get Native Max Address Ext	78_H / 0000_H
Set Accessible Max Address Ext	78_H / 0001_H
Freeze Accessible Max Address Ext	78_H / 0002_H
Check Power Mode	$E5_H$
Configure Stream	51_H
Download Microcode	92_H
Execute Device Diagnostics	90_H
Flush Cache	$E7_H$
Flush Cache Extended	EA_H
Get Physical Element Status	12_H
Identify Device	EC_H
Idle	$E3_H$
Idle Immediate	$E1_H$
Read Buffer	$E4_H$
Read DMA	$C8_H$
Read DMA Extended	25_H
Read FPDMA Queued	60_H
Read Log DMA Ext	47_H
Read Log Ext	$2F_H$
Read Multiple	$C4_H$

Command name	Command code (in hex)
Read Multiple Extended	29_H
Read Sectors	20_H
Read Sectors Extended	24_H
Read Stream DMA Extended	$2A_H$
Read Verify Sectors	40_H
Read Verify Sectors Extended	42_H
Receive FPDMA Queued	65_H
Request Sense Data Ext	$0B_H$
Remove Element And Truncate	$7C_H$
Sanitize Device - Crypto Scramble	$B4_H$ / 0011_H (SED and ISE drives only)
Sanitize Device - Overwrite Ext	$B4_H$ / 0014_H
Sanitize Device - Freeze Lock Ext	$B4_H$ / 0020_H
Sanitize Device - Status Ext	$B4_H$ / 0000_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
Send FPDMA Queued	64_H
Set Date & Time Ext	77_H
Set Features	EF_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	$E2_H$

Command name	Command code (in hex)
Standby Immediate	E0$_H$
Trusted Send	5E$_H$ (SED drives only)
Trusted Send DMA	5F$_H$ (SED drives only)
Trusted Receive	5C$_H$ (SED drives only)
Trusted Receive DMA	5D$_H$ (SED drives only)
Write Buffer	E8$_H$
Write DMA	CA$_H$
Write DMA Extended	35$_H$
Write DMA FUA Extended	3D$_H$
Write FPDMA Queued	61$_H$
Write Log DMA Ext	57$_H$
Write Log Extended	3F$_H$
Write Multiple	C5$_H$
Write Multiple Extended	39$_H$
Write Multiple FUA Extended	CE$_H$
Write Sectors	30$_H$
Write Sectors Extended	34$_H$
Write Stream DMA Extended	3A$_H$
Write Uncorrectable Extended	45$_H$

1.4.3.1   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 **Table 12** on **page 28**. 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 1.2 on page 7**for default parameter settings.

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

Table 13   Identify Device command

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	Obsolete	16,383
2	ATA-reserved	C837$_H$
3	Obsolete	16
4	Retired	0000$_H$
5	Retired	0000$_H$
6	Obsolete	003F$_H$
7–9	Retired	0000$_H$
10–19	Serial number: (20 ASCII characters, 0000$_H$ = none)	ASCII
20-21	Retired	0000$_H$
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)	ST14000DM001 ST12000DM001 ST10000DM001
47	(Bits 7–0) Maximum sectors per interrupt on Read multiple and Write multiple (16)	8010$_H$ (512e) / 8002$_H$ (4KN)
48	Trusted computing feature set supported bit 0 (SED only)	4000$_H$
49	Standard Standby timer, IORDY supported and may be disabled	2F00$_H$
50	Capabilities	4000$_H$
51-52	Obsolete	xxxx$_H$
53-56	Words 54–58, 64–70 and 88 are valid	xxxx$_H$
57–58	Obsolete	xxxx$_H$
59	(Bit 15: 0) Block Erase Ext Not Supported - N (Bit 14: 1) Overwrite Ext Supported - Y (Bit 13: X) Crypto Scramble Ext Supported (SED Only) - N (Bit 12: 1) Sanitize feature set supported - Y (Bit 11: 1) Commands allowed during sanitize op as specified in ACS-3 - Y (Bit 10: 1) Sanitize Antifreeze Lock Ext command supported - Y	5D10$_H$ (512E) / 5D02$_H$ (4KN)

Table 13   Identify Device command

Word	Description	Value
60–61	Total number of user-addressable LBA sectors available (see **Section 1.2.2** 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	Obsolete	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 ns)	0078_H
66	Recommended multiword DMA transfer cycle time per word (120 ns)	0078_H
67	Minimum PIO cycle time without IORDY flow control (240 ns)	0078_H
68	Minimum PIO cycle time with IORDY flow control (120 ns)	0078_H
69	Additional supported	0008_H
70–74	ATA-reserved	0000_H
75	Queue depth	$001F_H$
76	Serial ATA capabilities	$8D0E_H$
77	(Bit 6:1) Send/Receive FPDMA Queued Commands Supported	$xx4x_H$
78	Serial ATA features supported	$80CC_H$
79	Serial ATA features enabled	$xxxx_H$
80	Major version number	$0FE0_H$
81	Minor version number	$005E_H$
82	Command sets supported	$306B_H$
83	Command sets supported	7561_H
84	Command sets support extension (see note following this table)	6173_H
85	Command sets enabled	3069_H
86	Command sets enabled	$B441_H$
87	Command sets enable extension	6173_H
88	Ultra DMA support and current mode (see note following this table)	$xx7F_H$
89	Security erase time	$xxxx_H$
90	Enhanced security erase time	$xxxx_H$
92	Master password revision code	$FFFE_H$
93	Hardware reset value	$xxxx_H$
95–99	ATA-reserved	0000_H
100–103	Total number of user-addressable LBA sectors available (see **Section 1.2.2** for related information). These words are required for drives that support the 48-bit addressing feature. Maximum value: 0000FFFFFFFFFFFFh.	ST14000DM001 = 27,344,764,928 ST12000DM001 = 23,437,770,752 ST10000DM001 = 19,532,873,728
104–105	ATA-reserved	0000_H

Table 13   Identify Device command

Word	Description	Value
106	Physical/Logical sector size	6003_H (512E) / 5000_H (4KN)
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.
112–118	ATA-reserved	0000_H
119	Commands and feature sets supported	$43DE_H$
120	Commands and feature sets supported or enabled	$409C_H$
121-127	ATA-reserved	0000_H
128	Security status	0029_H
129–159	Seagate-reserved	$xxxx_H$
160–167	ATA-reserved	0000_H
168	Device Nominal Form Factor	3.5"
169–205	ATA-reserved	0000_H
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.	$xxBD_H$
207-216	ATA-reserved	0000_H
217	Nominal media rotation rate	7200
218-221	ATA-reserved	0000_H
222	Transport Major Version	$11FF_H$
223	Transport Minor Version	0000_H
224-229	ATA-reserved	0000_H
230-233	Extended Number of User Accessible Sectors	65DE00000 - (512E) CBBC0000 - (4KN)
234-254	ATA-reserved	0000_H
255	Integrity word	$xxA5_H$

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 logging is supported.
	1	SMART self-test is supported.
	2	Media serial number is not supported.
	3	Media Card Pass Through Command feature set is not supported.
	4	Streaming feature set is not 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 not 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.

1.4.3.2   Identify Device Data log

The IDENTIFY DEVICE Data log (log 30H) transfers information about the drive. The data is organized as a set of 512-byte blocks of data, whose contents are shown in **Table 2 on page 7**. 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 may contain drive-specific features that may are included in the Serial ATA specification.

Table 14 Identify Device Data log

Page (hex)	QWord Offset (dec)	Bits	Description	Value (hex)
00	List of supported pages			
	0..7	63:24	Reserved	
		23:16	Page number	00
		15:0	Revision number	0001
	8		Number of entries in the following list	09
	9		Page number of the 1st supported ID data log page	00
	10		Page number of the 2nd supported ID data log page	01
	11		Page number of the next supported ID data log page	02
	12		Page number of the next supported ID data log page	03
	13		Page number of the next supported ID data log page	04
	14		Page number of the next supported ID data log page	05
	15		Page number of the next supported ID data log page	06
	16		Page number of the next supported ID data log page	08
	17		Page number of the last supported ID data log page	00
	18..511		Reserved	
01	Copy of IDENTIFY DEVICE data			
	0..511		Copy of IDENTIFY DEVICE command data	

Table 14 Identify Device Data log (Continued)

02	Capacity			
		Capacity page information header (QWord)		
	0..7	63	Shall be set to 1	1
		62:24	Reserved	
		23:16	Page number	02
		15:0	Revision number	0001
		Device Capacity (QWord)		
	8..15	63	Shall be set to 1	1
		62:48	Reserved	0
		47:0	accessible capacity	65DE00000 - (512E) CBBC0000 - (4KN)
		Physical/Logical Sector Size (QWord)		
	16..23	63	Contents of the QWord are valid	1
		62	logical to physical sector relationship supported	1 (512E) / 0 (4KN)
		61	logical sector size supported bit	1 (4KN) / 0 (512E)
		60:22	Reserved	0
		19:16	logical to physical sector relationship	0 (4KN) / 3 (512E)
		15:0	logical sector offset	4000$_H$
		Logical Sector Size (QWord)		
	24..31	63	Contents of the QWord are valid	1
		62:32	Reserved	0
		31:0	Logical Sector Size	4096b (4KN)
		Nominal Buffer Size (QWord)		
	32..39	63	Contents of the QWord are valid	1
		62:0	buffer size	256
	40..511		Reserved	0
03	Supported Capabilities			
		Supported Capabilities page information header (QWord)		
	0..7	63	Shall be set to 1	1
		62:24	Reserved	
		23:16	Page number	03
	8..15	Supported Capabilities (QWord)		
		63	Shall be set to 1	1
		62:55	Reserved	0
		54	advanced background operation supported	0
		53	persistent sense data reporting	0

Table 14 Identify Device Data log (Continued)

		52	sff-8447 reporting	1
		51	definitive ending pattern supported	1
		50	data set management xl supported	0
		49	set sector configuration supported	1
		48	zero ext supported	0
		47	successful ncq command sense data supported	0
		46	dlc supported	0
		45	request sense device default supported	1
		44	dsn supported	1
		43	low power standby supported	0
		42	set epc power source supported	0
		41	amax addr supported	1
		40	Reserved for CFA	0
		39	drat supported	0
		38	lps misalignment reporting supported	0
		37	Reserved	0
		36	read buffer dma supported	0
		35	write buffer dma supported	0
		34	Reserved	0
		33	download microcode dma supported	0
		32	28-bit supported	0
		31	rzat supported	0
		30	Reserved	0
		29	nop supported	0
		28	read buffer supported	1
		27	write buffer supported	1
		26	Reserved	0
		25	read look-ahead supported	1
		24	volatile write cache supported	1
		23	smart supported	1
		22	flush cache ext supported	1
		21	Reserved	0
		20	48-bit supported	1
		19	Reserved	1
		18	spin-up supported	1
		17	puis supported	1
		16	apm supported	0

Table 14 Identify Device Data log (Continued)

		15	Reserved for CFA	0
		14	download microcode supported	1
		13	unload supported	1
		12	write fua ext supported	1
		11	gpl supported	1
		10	streaming supported	1
		9	Reserved	0
		8	smart self-test supported	1
		7	smart error logging supported	1
		6	epc supported	1
		5	sense data supported	1
		4	free-fall supported	0
		3	dm mode 3 supported	1
		2	gpl dma supported	1
		1	write uncorrectable supported	1
		0	wrv supported	1
	16..23	DOWNLOAD MICROCODE Capabilities (QWord)		
		63	Contents of the QWord are valid	1
		62:36	Reserved	0
		35	dm clears nonactivated deferred data	0
		34	dm offsets deferred supported	1
		33	dm immediate supported	1
		32	dm offsets immediate supported	1
		31:16	dm maximum transfer size	0000$_H$
		15:0	dm minimum transfer size	0000$_H$
	24..31	Nominal Media Rotation Rate (QWord)		
		63	Shall be set to one	1
		62:16	Reserved	0
		15:0	nominal media rotation rate	7200
	32..39	Form Factor (QWord)		
		63	Contents of the QWord are valid	1
		62:4	Reserved	0
		3:0	nominal form factor	3.5″
	40..47	Write-Read-Verify Sector Count Mode 3 (QWord)		
		63	Contents of the QWord are valid	1
		62:32	Reserved	0
		31:0	wrm mode 3 count	0

Table 14 Identify Device Data log (Continued)

	48..55	Write-Read-Verify Sector Count Mode 2 (QWord)		
		63	Contents of the QWord are valid	1
		62:32	Reserved	0
		31:0	wrm mode 2 count	0
	56..71	World wide name (DQWord)		
		127	Shall be set to one	1
		126:64	Reserved	0
		63:0	world wide name	unique
	72..79	DATA SET MANAGEMENT (QWord)		
		63	Shall be set to one	1
		62:32	Reserved	0
		31:16	max pages per dsm command	0
		15:8	logical block markups supported	0
		7:1	Reserved	0
		0	trim supported	0
	80..95	Utilization Per Unit Time (DQWord)		
		127	Shall be set to one	1
		126:120	Reserved	0
		119:112	utilization type	Combined Writes and Reads
		111:104	utilization units	TB
		103:96	utilization interval	Per Year
		95:34	Reserved	0
		63:32	utilization b	
		31:0	utilization a	550
	96..103	Utilization Usage Rate Support (QWord)		
		63	Contents of the QWord are valid	0
		62:24	Reserved	0
		23	setting rate basis supported	0
		22:9	Reserved	0
		8	since power on rate basis supported	0
		7:5	Reserved	0
		4	power on hours rate basis supported	0
		3:1	Reserved	0
		0	date/time rate basis supported	0

Table 14 Identify Device Data log (Continued)

	104..111	Zoned Capabilities (QWord)		
		63	Contents of the QWord are valid	0
		62:2	Reserved	0
		1:0	zoned	0
	112..119	Supported ZAC Capabilities (QWord)		
		63	Contents of the QWord are valid	0
		62:5	Reserved	0
		4	non-data reset write pointers ext supported	0
		3	non-data finish zone ext supported	0
		2	non-data close zone ext supported	0
		1	non-data open zone ext supported	0
		0	report zones ext supported	0
	120..127	Advanced Background Operations Capabilities (QWord)		
		63	Contents of the QWord are valid	0
		62	abo foreground mode supported	0
		61	abo ir mode supported	0
		60:48	Reserved	0
		47:16	abo minimum fraction	0
		15:0	abo minimum supported timelimit	0
	128..135	Advanced Background Operations Recommendations (QWord)		
		63	Contents of the QWord are valid	0
		62:32	Reserved	0
		31:16	device maintenance polling time	0
		15:0	abo recommended abo start interval	0
	136..143	Queue Depth (QWord)		
		63	Contents of the QWord are valid	0
		62:5	Reserved	0
		4:0	queue depth	0

Table 14 Identify Device Data log (Continued)

		Supported SCT Capabilities (QWord)			
		63	Contents of the QWord are valid		0
		62:27	Reserved		0
		26	sct write same function 103 supported		0
		25	sct write same function 102 supported		0
		24	sct write same function 101 supported		0
		23:19	Reserved		0
		18	sct write same function 3 supported		0
	144..151	17	sct write same function 2 supported		0
		16	sct write same function 1 supported		0
		15:6	Reserved		0
		5	sct data tables supported		0
		4	sct feature control supported		0
		3	sct error recovery control supported		0
		2	sct write same supported		0
		1	Reserved		0
		0	sct supported		0
		Depopulation Capabilities (QWord)			
		63	Contents of the QWord are valid		1
	152..159	62:2	Reserved		0
		1	get physical element status supported		1
		0	remove element and truncate supported		1
		35	Depopulation Execution Time (QWord)		
	160..167		Bit Description: 63 Contents of the QWord are valid		1
			62:0 DEPOPULATION TIME field (see 9.10.5.19)		E62A$_H$
	168..503	Reserved			
		Vendor Specific Supported Capabilities (QWord)			
	504..511	63	Contents of the QWord are valid		0
		62:0	Vendor specific		
04	Current Settings				
		Current Settings page information header (QWord)			
		63	Shall be set to 1		1
	0..7	62:24	Reserved		0
		23:16	Page number		04

Table 14 Identify Device Data log (Continued)

		Current Settings (QWord)		
		63	Shall be set to one	1
		62:19	Reserved	0
		18	successful ncq command sense data enabled	0
		17	dlc enabled	0
		16	dsn enabled	0
		15	epc enabled	1
		14	Reserved	0
		13	volatile write cache enabled	1
		12	Reserved	0
	8..15	11	reverting to defaults enabled	0
		10	sense data enabled	0
		9	Reserved	0
		8	non-volatile write cache	0
		7	read look-ahead	1
		6	smart enabled	1
		5	Reserved	0
		4	Reserved	0
		3	puis enabled	0
		2	apm enabled	0
		1	free-fall enabled	0
		0	wrv enabled	0
		Feature Settings (QWord)		
		63	Contents of the QWord are valid	1
		62:18	Reserved	0
	16..23	17:16	power source	0
		15:8	apm level	0
		7:0	wrv mode	0
		DMA Host Interface Sector Times (QWord)		
		63	Contents of the QWord are valid	1
	24..31	62:16	Reserved	0
		15:0	dma sector time	0
		PIO Host Interface Sector Times (QWord)		
		63	Contents of the QWord are valid	1
	32..39	62:16	Reserved	0
		15:0	pio sector time	0

Table 14 Identify Device Data log (Continued)

		Streaming Minimum Request Size (QWord)		
	40..47	63	Contents of the QWord are valid	1
		62:16	Reserved	0
		15:0	stream min request size	1000_H
		Streaming Access Latency (QWord)		
	48..55	63	Contents of the QWord are valid	1
		62:16	Reserved	0
		15:0	stream access latency	0
		Streaming Performance Granularity (QWord)		
	56..63	63	Contents of the QWord are valid	1
		62:16	Reserved	0
		15:0	stream granularity	2710_H
		Free-fall Control Sensitivity (QWord)		
	64..71	63	Contents of the QWord are valid	1
		62:16	Reserved	0
		15:0	free-fall sensitivity	0
		Device Maintenance Schedule (QWord)		
		63	Contents of the QWord are valid	0
		62:58	Reserved	0
	72..79	57:48	minimum inactive time in milliseconds	0
		47:32	time scheduled for device maintenance	0
		31:16	time to performance degradation	0
		15:0	minimum inactive time	0
		Advanced Background Operations Settings (QWord)		
	80..87	63	Contents of the QWord are valid	0
		62:8	Reserved	0
		7:0	abo_status	0
	88..511	Reserved		

Table 14 Identify Device Data log (Continued)

	Strings			
05	0..7	Supported Capabilities page information header (QWord)		
		63	Shall be set to 1	1
		62:24	Reserved	
		23:16	Page number	05
	8..27	SERIAL NUMBER (ATA String)		XXXXXXXX$_H$
	28..31	Reserved		
	32..39	FIRMWARE REVISION (ATA String)		XXXX$_H$
	40..47	Reserved		
	48..87	MODEL NUMBER (ATA String)		ST14000DM001 ST12000DM001 ST10000DM001
	88..95	Reserved		
	96..103	ADDITIONAL PRODUCT IDENTIFIER (ATA String)		0
	104..511	Reserved		
06	Security			
	0..7	Security page information header (QWord)		
		63	Shall be set to 1	1
		62:24	Reserved	
		23:16	Page number	06
	8..15	Master Password Identifier (QWord)		
		63	Contents of the QWord are valid	1
		62:16	Reserved	0
		15:0	master password identifier	FFFE$_H$
	16..23	Security Status (QWord)		
		63	Contents of the QWord are valid	1
		62:7	Reserved	0
		6	security supported	1
		5	master password capability	0
		4	enhanced security erase supported	1
		3	security count expired	0
		2	security frozen	0
		1	security locked	0
		0	security enabled	0

Table 14 Identify Device Data log (Continued)

	24..31	Time required for an Enhanced Erase mode SECURITY ERASE UNIT command (QWord)		
		63	Contents of the QWord are valid	1
		62:16	Reserved	0
		15	enhanced security erase time format	1
		14:0	enhanced security erase time	245$_H$
	32..39	Time required for an Normal Erase mode SECURITY ERASE UNIT command (QWord)		
		63	Contents of the QWord are valid	1
		62:16	Reserved	0
		15	normal security erase time format	1
		14:0	normal security erase time	245$_H$
	40..47	Trusted Computing Feature Set (QWord)		
		63	Contents of the QWord are valid	1
		62:1	Reserved	0
		0	trusted computing supported	0 (1, SED drives only)
	48..55	Security Capabilities (QWord)		
		63	Contents of the QWord are valid	1
		62:8	Reserved	0
		7	restricted sanitize overrides security	0
		6	acs-3 commands allowed by sanitize	1
		5	sanitize antifreeze lock supported	1
		4	block erase supported	0
		3	overwrite supported	1
		2	crypto scramble supported	0 (1, SED and ISE drives only)
		1	sanitize supported	1
		0	encrypt all supported	0
	56..511	Reserved		
07	Parallel ATA			
	000..511		(Not supported for SATA drives)	all zeros
08	Serial ATA			

Table 14 Identify Device Data log (Continued)

	0..7	Serial ATA page information header (QWord)		
		63	Shall be set to 1	1
		62:24	Reserved	
		23:16	Page number	08
	8..15	SATA Capabilities		
		63	Shall be set to one	1
		62:32	Reserved	0
		31	power disable feature always enabled	0
		30	power disable feature supported	0
		29	rebuild assist supported	0
		28	dipm ssp preservation supported	0
		27	hybrid information supported	0
		26	devsleep to reducedpwrstate capability supported	0
		25	device sleep supported	0
		24	ncq autosense supported	1
		23	software settings preservation supported	1
		22	hardware feature control supported	0
		21	in-order data delivery supported	0
		20	device initiated power management supported	1
		19	dma setup auto-activation supported	1
		18	nonzero buffer offsets supported	0
		17	send and receive queued commands supported	1
		16	ncq non-data command supported	1
		15	ncq streaming supported	0
		14	read log dma ext as equivalent to read log ext supported	1
		13	device automatic partial to slumber transitions supported	0
		12	host automatic partial to slumber transitions supported	0
		11	ncq priority information supported	0
		10	unload while ncq commands are outstanding supported	1
		9	sata phy event counters log supported	1
		8	receipt of host initiated power management requests supported	0
		7	ncq feature set supported	1
		6:3	Reserved	0
		2	sata gen3 signaling speed supported	1
		1	sata gen2 signaling speed supported	1
		0	sata gen1 signaling speed supported	1

Table 14 Identify Device Data log (Continued)

		Current SATA Settings (QWord)		
		63	Shall be set to one	1
		62:14	Reserved	0
		13	hybrid enabled	0
		12	rebuild assist enabled	0
		11	power disable feature enabled	0
		10	device sleep enabled	0
	16..23	9	automatic partial to slumber transitions enabled	0
		8	software settings preservation enabled	1
		7	hardware feature control is enabled	0
		6	in-order data delivery enabled	0
		5	device initiated power management enabled	0
		4	dma setup auto-activation enabled	1
		3	nonzero buffer offsets enabled	0
		2:0	current negotiated serial ata signal speed	(6.0, 3.0, 1.5) Gb/s
	24..39	Reserved		
	40..41	CURRENT HARDWARE FEATURE CONTROL IDENTIFIER (Word)		
	42..43	SUPPORTED HARDWARE FEATURE CONTROL IDENTIFIER (Word)		
	44..47	Reserved		
		Device Sleep Timing Variables (QWord)		
		63	devslp timing variables supported	0
	48..55	62:16	Reserved	0
		15:8	devsleep exit timeout (deto)	0
		7:5	Reserved	0
		4:0	minimum devslp assertion time (mdat)	0
	56..511	Reserved		

1.4.3.3   Device Statistics log

The Device Statistics log (log 04H) transfers information about the drive. The data is organized as a set of 512-byte blocks of data, whose contents are shown in **Table 2 on page 7**. 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 may contain drive-specific features that are included in the SATA specifications.

Table 15   Device Statistics log

Page (hex)	Statistic	Supported
00	List of supported log pages	Yes
01	General Statistics	
	Lifetime Power-on Resets	Yes
	Power-on Hours	Yes
	Logical Sectors Written	Yes
	Number of Write Commands	Yes
	Logical Sectors Read	Yes
	Number of Read Commands	Yes
	Pending Error Count	x
	Workload Utilization	No
	Utilization Usage Rate	No
	Resource Availability	x
	Random Write Resources Used	x
02	Free Fall Statistics	
	Number of Free-Fall Events Detected	No
	Overlimit Shock Events	No
03	Rotating Media Statistics	
	Spindle Motor Power-on Hours	Yes
	Head Flying Hours	Yes
	Head Loaded Events	Yes
	Number of Reallocated Logical Sectors	Yes
	Read Recovery Attempts	Yes
	Number of Mechanical Start Failures	Yes
	Number of Reallocation Candidate Logical Sectors	Yes
	Number of High Priority Unload Events	Yes
04	General Errors Statistics	
	Number of Reported Uncorrectable Errors	Yes
	Number of Resets Between Command Acceptance and Command Completion	Yes
	Physical Element Status Changed	x

Table 15   Device Statistics log

	Temperature Statistics	
05	Current Temperature	Yes
	Average Short Term Temperature	Yes
	Average Long Term Temperature	Yes
	Highest Temperature	Yes
	Lowest Temperature	Yes
	Highest Average Short Term Temperature	Yes
	Lowest Average Short Term Temperature	Yes
	Highest Average Long Term Temperature	Yes
	Lowest Average Long Term Temperature	Yes
	Time in Over-Temperature	Yes
	Specified Maximum Operating Temperature	Yes
	Time in Under-Temperature	Yes
	Specified Minimum Operating Temperature	Yes
06	Transport Statistics	
	Number of Hardware Resets	Yes
	Number of ASR Events	Yes
	Number of Interface CRC Errors	Yes
07	Solid State Device Statistics	
	Percentage Used Endurance Indicator	No
08	Zoned Device Statistics	
	Maximum Open Zones	No
	Maximum Explicitly Open Zones	No
	Maximum Implicitly Open Zones	No
	Minimum Empty Zones	No
	Maximum Non Sequential Zones	No
	Zones Emptied	No
	Suboptimal Write Commands	No
	Commands Exceeding Optimal Limit	No
	Failed Explicit Opens	No
	Read Rule Violations	No
	Write Rule Violations	No
09..FE	Reserved	
FF	Vendor Specific Statistics	
	TBD	x

1.4.3.4   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 16 Set Features command values

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

10_H Enable use of SATA features

55_H Disable read look-ahead (read cache) feature.

82_H Disable write cache

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.

1.4.3.5   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://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 17 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.

SEAGATE