



Seagate® BarraCuda® SSD

Product Manual

ZA250CM10002

ZA500CM10002

ZA1000CM10002

ZA2000CM10002

100835666, Rev. A
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Revision History

Version and Date	Description of Changes
Rev A, June 2018	First document release.

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

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Seagate Technology Support Services

For Internal SSD Support, visit: <https://www.seagate.com/support/products/>

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/seagate-recovery-services/recover/>

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1. Introduction

The Seagate® BarraCuda® SSD is a fast, dependable storage solution for everyday compute applications. The Seagate BarraCuda SSD offers SATA interface, fully compatible with SATA 3.2 6.0Gbps.

Table 1 The BarraCuda SSD Features

Feature	Description	
Capacity (User)	<ul style="list-style-type: none"> 250 GB, 500 GB, 1000 GB, 2000 GB 	
Certifications, Eco-Compliance	<ul style="list-style-type: none"> CE, UL, FCC, BSMI, KCC, Microsoft WHQL, VCCI, CB RoHS 	
Dimensions	<ul style="list-style-type: none"> (69.85±0.25) x (100±0.25) x (Max. 7) mm 	SSD outer case can support suitable Z-height for various host situations.
Endurance	<ul style="list-style-type: none"> 250 GB 120 Terabyte Writes (TBW) 500 GB 249 TBW 1000 GB 485 TBW 2000 GB 1067 TBW 	Endurance rating valid for SSD Life Remaining > 1% (SMART E7h>1). See Section 2.5, Reliability/Endurance .
Form	<ul style="list-style-type: none"> 2.5-inch Standard SSD 	
Interface Compliance	<ul style="list-style-type: none"> Fully compliant with ATA-8/ACS-3 Standard Compliant with SATA Revision 3.2 Supported protocol AHCI and ASC2 command set Compatible with SATA 1.5 Gbps, 3 Gbps, and 6Gbps interfaces PIO, DMA, UDMA (up to 6 modes, dependent on host) supported Native Command Queuing (NCQ): up to 32 commands Data Set Management Command Trim support 	
NAND	<ul style="list-style-type: none"> Triple-level cell (TLC), BiCS3 3D 	
Operating Systems	<ul style="list-style-type: none"> Windows® 7 (64 bit), 8 (64 bit), 8.1 (64 bit), and Windows 10 (64 bit) Ubuntu 16.10 	
Performance Random	<ul style="list-style-type: none"> Read: Up to 90,000 IOPS Write: Up to 90,000 IOPS 	Actual performance might vary depending on use conditions and environment. See Section 2.2, Performance .
Performance Sequential	<ul style="list-style-type: none"> Read: Up to 560 MB/s Write: Up to 540 MB/s 	Actual performance might vary depending on the capacity, use conditions and environment. See Section 2.2, Performance .
Power Consumption	<ul style="list-style-type: none"> Active mode: < 3,100 mW Idle mode: < 225 mW DEVSLP: 5 mW 	Results vary with capacity and mode. See Section 2.3, Power Consumption .
Power Loss Data Protection	<ul style="list-style-type: none"> To protect your data, you must send a Standby Immediate command (0x1h) before you remove power. The BarraCuda SSD does not provide data protection for a sudden power loss. 	
Power Management	<ul style="list-style-type: none"> 2.5 inch: 5 V SATA Supply Host-initiated power management Device-initiated power management HIPM/DEVSLP Mode 	
Reliability	<ul style="list-style-type: none"> End-to-end data path protection MTBF: 1.8 million hours UBER: 1 error in 10¹⁶ bits read 	

Table 1 The BarraCuda SSD Features (continued)

Feature	Description	
Shock and Vibration	Shock <ul style="list-style-type: none"> ■ Non-Operating: 1,500 G, at 0.5 ms 	See Section 2.4, Environmental Conditions.
	Vibration <ul style="list-style-type: none"> ■ Non-Operating: 1.52 G_{RMS}, (20 to 800 Hz, Frequency) 	
Temperature Range (Operating)	<ul style="list-style-type: none"> ■ 0°C to 70°C ■ Temperature Sensor (SMART Attribute ID C2h) 	
Voltage	<ul style="list-style-type: none"> ■ 5V±5% 	
Warranty	Five years, or when the device reaches Host TBW, whichever happens first. Endurance rating valid for SSD Life Remaining > 1% (SMART E7h>1).	
Weight	<ul style="list-style-type: none"> ■ 50 g, 1.76 Oz ±5% 	

2. Specifications

2.1 Models and Capacity

Table 2 Models and Capacity

Model Names	User Capacity
ZA250CM10002	250 GB
ZA500CM10002	500 GB
ZA1000CM10002	1000 GB
ZA2000CM10002	2000 GB

NOTE About capacity:

- Sector Size: 512 Bytes
- User-addressable LBA count = (97696368) + (1953504 x (Desired Capacity in Gb-50.0)) From International Disk Drive Equipment and Materials Association (IDEMA) (*LBA1-03_standard.doc*)

2.2 Performance

Table 3 Random and Sequential Read and Write Performance

Parameter	250GB	500 GB	1000 GB	2000 GB
Sequential Read MB/s	560	560	560	560
Sequential Write MB/s	530	535	540	540
Random Read (IOPS)	90,000	90,000	90,000	90,000
Random Write (IOPS)	90,000	90,000	90,000	90,000

NOTE About performance:

- Fresh out of box (FOB) performance obtained on newly formatted drive. Performance may vary based on the SSD's firmware version, system hardware, and configuration.
- Performance is based on CrystalDiskMark v.5.2.1 x64 on Windows 10 host.

2.3 Power Consumption

Table 4 Power Consumption

	250 GB	500 GB	1000 GB	2000 GB
Read (mW)	2,250	2,250	2,450	2,600
Write (mW)	2,600	2,600	2,800	3,100
Idle (mW)	185	192	221	225
Slumber (mW)	75	78	109	115
DEVSLP (mW)	5	5	5	5

NOTE

About power consumption:

- The average value of power consumption is based on 100% conversion efficiency.
- The measured power voltage is 5 V.
- Samples used BiCS3 3D Toggle TLC NAND flash and were measured under ambient temperature.
- Sequential Read/Write is measured while testing 4000 MB five times by CrystalDiskMark.
- Power Consumption can differ according to flash configuration and platform.

2.4 Environmental Conditions

Table 5 Temperature, Humidity, Shock

Specification	Value
Temperature	
Operating (case temperature at specific airflow)	0°C to 70°C
Non-operating	-40°C to 85°C
Humidity	
Operating	90%
Non-operating (storage)	93%
Shock	
Non-operating	1,500 G, duration 0.5 ms
Vibration	
Non-operating	1.52 G _{RMS} , (20Hz to 80Hz, Frequency)

NOTE

Temperature is measured without condensation. Operating mode temperature is measured by temperature sensor, SMART Attribute C2h.

NOTE

Shock and vibration results assume that the SSD is mounted securely with the input vibration applied to the SSD mounting. These specifications do not cover connection issues that may result from testing at this level. The measured specification is in root mean square (RMS) form.

- **Non-operating Shock.** The limits of non-operating shock applies to all conditions of handling and transportation. This includes both isolated SSD and integrated SSDs. Shock may be applied in the X, Y, or Z-axis.
- **Non-Operating Vibration.** The limits of non-operating vibration shall apply to all conditions of handling and transportation. This includes both isolated SSD and integrated SSDs. Vibration may be applied in the X, Y, or Z-axis.

2.5 Reliability/Endurance

Table 6 Reliability/Endurance

Specification	Value
Mean time between failures (MTBF)	1.8 million hours
Bit Error Rate	1 error in 10 ¹⁶ bits read
Endurance	<ul style="list-style-type: none"> ■ 250 GB: 120 TBW ■ 500 GB: 249 TBW ■ 1000 GB: 485 TBW ■ 2000 GB 1,067 TBW

NOTE

About endurance:

- The SSD achieves the specified MTBF in an operational environment that complies with the operational temperature range specified in this manual. Operating temperatures are measured by temperature sensor, SMART Attribute ID C2h.
- Endurance rating valid for SSD Life Remaining > 1% (SMART E7h>1).
- Endurance is characterized while running Client JESD219A workload (per JESD218A specification).

3. Mechanical Information

3.1 Dimensions and Weight

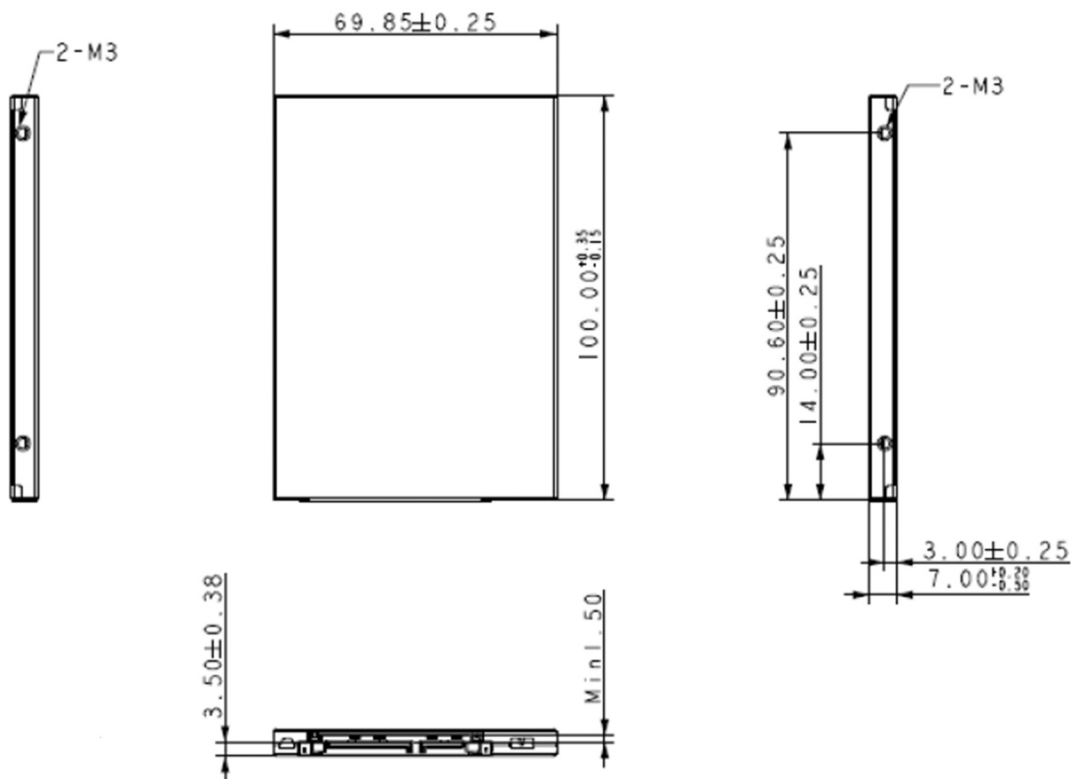
Weight: 50 g, 1.76 Oz +/- 5%

Height: Maximum, 7 mm

Width: 69.85 mm±0.25 mm

Length: 100 mm+0.35/-0.15 mm

Figure 1 BarraCuda SSD Enclosure



4. Pin and Signal Descriptions

4.1 Signal Pin Definitions

Table 7 Serial ATA Connector Pin Signal Definitions

Pin	Name	Definition
S1	Ground	Ground
S2	A+	Differential signal pair A+ and A-
S3	A-	
S4	Ground	Ground
S5	B-	Differential signal pair B- and B+
S6	B+	
S7	Ground	Ground

NOTE Key and spacing separate the signal and power segments.

4.2 Power Pin Definitions

Table 8 Power Pin Definitions

Pin	Function	Definition
P1	not used	Not Used (3.3 V)
P2	V33	Not Used (3.3 V)
P3	DEVSLP	SATA PHY Power Control
P4	GND	Ground
P5	GND	Ground
P6	GND	Ground
P7	V5	5 V Power, Precharge
P8	V5	5 V Power
P9	V5	5 V Power
P10	GND	Ground
P11	DAS	GPIO for debug
P12	Reserved	Reserved
P13	not used	Not Used (12 V pre-charge)
P14	V12	Not Used (12 V)
P15	V12	Not Used (12 V)

NOTE About Power Pin Signal Definitions:

- Key and spacing separate the signal and power segments.
- Uses 5 V power only; 3.3 V (P1-P2) and 12 V (P13-P15) power are not used.

5. Supported ATA Command List

The BarraCuda SSD complies with ATA-8/ACS-3. All mandatory and many optional commands and features are supported.

5.1 ATA Feature Set

The following table summarizes the ATA feature set and commands that the BarraCuda SSD supports.

Table 9 ATA Feature Set

Feature	Supported
48-Bit Address feature set	Yes
General feature set	Yes
Native Command Queuing (NCQ) feature set	Yes
Power Management feature set	Yes
Security feature set	Yes
SMART feature set	Yes

5.2 ATA Command Description

The following table shows the ATA commands supported.

Table 10 ATA Command Description

Op-Code	Command Description	Op-Code	Command Description			
00h	—	NOP	60h	—	—	Read FPDMA Queued
06h	—	Data Set Management	61h	—	—	Write FPDMA Queued
10h	—	Recalibrate	70h	—	—	Seek
20h	—	Read Sectors	90h	—	—	Execute Device Diagnostic
21h	—	Read Sectors without Retry	91h	—	—	Initialize Device Parameters
24h	—	Read Sectors EXT	92h	—	—	Download Microcode
25h	—	Read DMA EXT	93h	—	—	Download Microcode DMA
27h	—	Read Native Max Address EXT	B0h	—	—	SMART
29h	—	Read Multiple EXT	B0h	D0h	—	SMART READ DATA
2Fh	—	Read Log EXT	B0h	D1h	—	SMART READ DATA ATTRIBUTE THRESHOLD
30h	—	Write Sectors	B0h	D2h	—	SMART ENABLE/DISABLE ATTRIBUTE AUTOSAVE
31h	—	Write Sectors without Retry	B0h	D3h	—	SMART SAVE ATTRIBUTE VALUES

Table 10 ATA Command Description (continued)

Op-Code		Command Description	Op-Code			Command Description
34h	—	Write Sectors EXT	B0h	D4h	—	SMART EXECUTE OFF-LINE IMMEDIATE
35h	—	Write DMA EXT	B0h	D5h	—	SMART READ LOG
37h	—	Set Native Max Address EXT	B0h	D6h	—	SMART WRITE LOG
39h	—	Write Multiple EXT	B0h	D8h	—	SMART ENABLE OPERATIONS
3Dh	—	Write DMA FUA EXT	B0h	D9h	—	SMART DISABLE OPERATIONS
3Fh	—	Write Long EXT	B0h	DAh	—	SMART RETURN STATUS
40h	—	Read Verify Sectors	B0h	DBh	—	SMART ENABLE/DISABLE AUTOMATIC OFF-LINE
41h	—	Read Verify Sectors without Retry	B1h		—	DEVICE CONFIGURATION OVERLAY
42h	—	Read Verify Sectors EXT	B1h	C0h	—	DEVICE CONFIGURATION RESTORE
45h	—	Write Uncorrectable EXT	B1h	C1h	—	DEVICE CONFIGURATION FREEZE LOCK
47h	—	Read Log DMA EXT	B1h	C2h	—	DEVICE CONFIGURATION IDENTIFY
57h	—	Write Log DMA EXT	B1h	C3h	—	DEVICE CONFIGURATION SET
B1h	C4h	DEVICE CONFIGURATION IDENTIFY DMA	ECh	—	—	Identify Device
B1h	C5h	DEVICE CONFIGURATION SET DMA	EFh	—	—	Set Features
C4h	—	Read Multiple	EFh	02h	—	Enable 8-bit PIO transfer mode
C5h	—	Write Multiple	EFh	03h	—	Set transfer mode based on value in Count field
C6h	—	Set Multiple Mode	EFh	05h	—	Enable advanced power management
C8h	—	Read DMA	EFh	10h	—	Enable use of Serial ATA feature
C9h	—	Read DMA without Retry	EFh	10h	02h	Enable DMA Setup FIS Auto-Activate optimization
CAh	—	Write DMA	EFh	10h	03h	Enable Device-initiated interface power state (DIPM) transitions
CBh	—	Write DMA without Retry	EFh	10h	06h	Enable Software Settings Preservation (SSP)

Table 10 ATA Command Description (continued)

Op-Code		Command Description	Op-Code			Command Description
CEh	—	Write Multiple FUA EXT	EFh	10h	07h	Enable Device Automatic Partial to Slumber transitions
E0h	—	Standby Immediate	EFh	10h	09h	Enable Device Sleep
E1h	—	Idle Immediate	EFh	55h	—	Disable read look-ahead feature
E2h	—	Standby	EFh	66h	—	Disable reverting to power-on defaults
E3h	—	Idle	EFh	82h	—	Disable write cache
E4h	—	Read Buffer	EFh	85h	—	Disable advanced power management
E5h	—	Check Power Mode	EFh	90h	—	Disable use of Serial ATA feature set
E6h	—	Sleep	EFh	90h	02h	Disable DMA Setup FIS Auto-Activate optimization
E7h	—	Flush Cache	EFh	90h	03h	Disable Device-initiated interface power state (DIPM) transitions
E8h	—	Write Buffer	EFh	90h	06h	Disable Software Settings Preservation (SSP)
E9h	—	Read Buffer DMA	EFh	90h	07h	Disable Device Automatic Partial to Slumber transitions
EAh	—	Flush Cache EXT	EFh	90h	09h	Disable Device Sleep
EBh	—	Write Buffer DMA	EFh	AAh	—	Enable read look-ahead feature
EFh	CCh	Enable reverting to power-on defaults	F4h	—	—	Security Erase Unit
F1h	—	Security Set Password	F5h	—	—	Security Freeze Lock
F2h	—	Security Unlock	F6h	—	—	Security Disable Password
F3h	—	Security Erase Prepare	F8h	—	—	Read Native Max Address

6. SMART Support

The BarraCuda SSD supports the SMART command set.

6.1 SMART ID

The following table lists SMART IDs and Descriptions.

Table 11 SMART Attribute IDs and Descriptions

Description	0	1	2	3	4	5	6	7	8	9	10	11	Threshold
	ID	Flag		Value	Worse	DATA							
Number of Accumulation of Uncorrectable Error	01h	0Bh	00h	64h	64h	UECC error count from Host	0	0	0	0	0	0	32h
Power-On hours Count	09h	12h	00h	64h	64h	Power on hour	0	0	0	0	0	0	00h
Drive Power Cycle Count	0Ch	12h	00h	64h	64h	Power on/off cycles				0	0	0	00h
Spare Blocks Available	10h	12h	00h	64h	64h	Spare Blocks Available by plane	0	0	0	0	0	0	00h
Remaining Spare Blocks	11h	12h	00h	64h	64h	Remaining Spare Blocks by plane	0	0	0	0	0	0	00h
SATA PHY Error Count	A8h	12h	00h	64h	64h	SATA PHY error count				0	0	0	00h
Bad Block Count (Early / Later)	AAh	03h	00h	Note ^a		Early Bad Block count by all plane	0	0	Later Bad Block count by all plane		0	0Ah	
Erase count (average, max, erase count)	ADh	12h	00h	64h	64h	Max Erase Count	Average Erase Count		Least Erase Count		0	00h	
Unexpected Power Loss count	AEh	12h	00h	64h	64h	Number of accidental power loss count				0	0	0	00h
Wear Range delta	B1h	00h	00h	00h	00h	Note ^b	0	0	0	0	0	0	00h
Unexpected Power Loss Count	C0h	12h	00h	64h	64h	number of accidental power loss count				0	0	0	00h
Temperature (only Toshiba or thermo sensor embedded)	C2h	23h	00h	128-Current Temp	128-Highest value	Current Temp	Lowest Temp		Highest Temp		0	39h	

Table 11 SMART Attribute IDs and Descriptions (continued)

Description	0	1	2	3	4	5	6	7	8	9	10	11	Threshold
	ID	Flag		Value	Worse	DATA							
Number of accumulation CRC error (read/write data FIS CRC error)	DAh	0Bh	00h	64h	64h	CRC Error Count				0	0	0	32h
SSD life remaining	E7h	13h	00h	64h	64h	Note ^c	0	0	0	0	Throttling level	0	00h
Read Failure Block Count	E8h	13h	00h	64h	64h	Flash Read Fail Count				Raw Read Error Rate	0	0	00h
Lifetime Writes to Flash (G Unit)	E9h	0Bh	00h	64h	64h	Lifetime Writes to Flash by GByte					0	00h	
Lifetime Writes to Flash (Sector Unit)	EBh	0Bh	00h	64h	64h	Lifetime Writes to Flash by Sector					0	00h	
Host Writes (G Unit)	F1h	12h	00h	64h	64h	Lifetime Writes from Host by Gbyte					0	00h	
Host Reads (G Unit)	F2h	12h	00h	64h	64h	Lifetime Reads from Host by Gbyte					0	00h	

- a. Bad Block Count (Early / Later) ID170. Value = (Remaining Spare Blocks by plane)/(Spare Blocks Available by plane) *100. This formula calculates percentage of spare block. Value is between 100 and 0.
- b. Wear Range Delta ID 177. Value = (max erase count - least erase count) / (P-E Cycle) *100 (percentage).
- c. SSD Life Remaining ID 231. Value = 100 - ((average erase count / Rated PE Cycle) * 100).

7. Feature Details

7.1 Flash Management

7.1.1 Error Correction Code (ECC)

Flash memory cells deteriorate with use, which might generate random bit errors in the stored data. The BarraCuda SSD applies the BCH ECC algorithm to detect and correct 120bits/2K Byte errors occur during read process, to make sure data is read correctly, and to protect data from corruption.

7.1.2 Wear Leveling

NAND flash devices can undergo only a limited number of program/erase cycles. Commonly, areas of the flash media are not used evenly. If some areas are updated more frequently than others, this reduces the lifetime of the device. Wear Leveling extends the life of the NAND Flash by evenly distributing write and erase cycles across the media.

Seagate's advanced Wear Leveling algorithm spreads the flash usage throughout the whole flash media area. Implementing dynamic and static Wear Leveling algorithms improves the life expectancy of the NAND flash.

7.1.3 Bad Block Management

Bad blocks do not function properly and they can contain more invalid bits. This can make stored data unstable and bad block reliability is not guaranteed. Blocks identified and marked as bad by the manufacturer are called "Early Bad Blocks". Bad blocks that develop during the lifespan of the Flash are called "Later Bad Blocks". Seagate's bad block management algorithm detects the factory-produced bad blocks and manages bad blocks that appear with use. This practice prevents data from being stored in bad blocks and improves data reliability

7.1.4 TRIM

The TRIM feature improves the read/write performance and speed of SSDs. SSDs cannot overwrite existing data, so the available space becomes smaller with each data block use. The TRIM command tells the SSD (through the operating system) which data blocks can be removed permanently because they are no longer in use. The SSD erases these unused data blocks.

7.1.5 SMART

SMART, stands for Self-Monitoring, Analysis, and Reporting Technology, is an open standard that allows an SSD to automatically detect its health and report potential failures. When SMART records a failure, users can replace the drive to prevent unexpected outage or data loss. SMART can also inform users of impending failures while there is still time to copy data to another device.

7.1.6 Over Provisioning

Over Provisioning (OP) preserves an additional area beyond user capacity in a SSD, which is not visible to users and cannot be used by them. With Over Provisioning, the performance and IOPS (Input/Output Operations per Second) are improved by providing the controller additional space to manage P/E cycles, which enhances the reliability and endurance as well. Moreover, the write amplification of the SSD becomes lower when the controller writes data to the flash.

7.1.7 Firmware Upgrade

Firmware is a set of instructions on how the device communicates with the host. Firmware can be upgraded when new features are added, compatibility issues are fixed, or read/write performance gets improved.

7.1.8 Thermal Throttling

The purpose of thermal throttling is to prevent any components in a SSD from over-heating during read and write operations. BarraCudaSSD is designed with an on-board thermal sensor and with its accuracy, firmware can apply different levels of throttling to achieve the purpose of protection efficiently and proactively via SMART 12 reading.

7.1.9 Low Power Management

7.1.9.1 DIPM/HIPM/DEVSLP Mode

SATA interfaces contain two low power management states for power saving: Partial and Slumber modes. For Partial mode, the device has to resume to full operation within 10 microseconds, whereas the device will spend 10 milliseconds to become fully operational in the Slumber mode. SATA interfaces allow low power modes to be initiated by Host (HIPM, Host Initiated Power Management) or Device (DIPM, Device Initiated Power Management). As for HIPM, Partial or Slumber mode can be invoked directly by the software. For DIPM, the device will send requests to enter Partial or Slumber mode.

7.2 Advanced Device Security Features

7.2.1 Secure Erase

Secure Erase is a standard ATA command and it writes all of "0xFF" to fully wipe all the data on hard drives and SSDs. When this command is issued, the SSD controller erases its storage blocks and returns to its factory default settings

7.2.2 SSD Lifetime Management

Terabytes Written (TBW)

TBW (Terabytes Written) measures the lifespan of the SSD. This measurement represents the amount of data written to the device. To calculate the TBW of a SSD, use the following equation:

$$TBW = [(NAND\ Endurance) \times (SSD\ Capacity)] / [WAF]$$

NAND Endurance: NAND endurance refers to the P/E (Program/Erase) cycle of a NAND flash.

SSD Capacity: The SSD capacity is the specific capacity in total of a SSD.

WAF: Write Amplification Factor (WAF) is a numerical value representing the ratio between the amount of data that a SSD controller needs to write and the amount of data that the host's flash controller writes. A better WAF, which is near 1, guarantees better endurance and lower frequency of data written to flash memory.

TBW in this document is based on JEDEC 218/219 workload.

7.2.3 Media Wear Indicator

Actual life indicator reported by SMART Attribute 231 (E7h) Life Remaining by percentage, recommends User to replace drive before reaching 0%.

7.2.4 Read Only Mode (End of Life)

When the SSD is aged by program/erase cycles, media wear-out may cause increasing numbers of bad blocks. When the number of usable good blocks falls outside a defined usable range, the drive notifies the host through AER event and Critical Warning to enter Read Only Mode to prevent further data corruption. When this happens, the user should replace the SSD with another one immediately.

7.3 Adaptive Approach to Performance Tuning

7.3.1 Throughput

Based on the available space of the disk, the BarraCuda SSD regulates the read/write speed and manages the performance of throughput. When there is a lot of space, the firmware continuously performs read/write actions. There is no need yet to implement garbage collection to allocate and release memory to accelerate the read/write processing and improve performance. When there is less available space, the SSD slows down the read/write processing and implements garbage collection to release memory.

7.3.2 Predict and Fetch

When the Host tries to read data from the SSD, the SSD performs only one read action after receiving one command. However, the BarraCuda SSD applies Predict and Fetch to improve the read speed. When the host issues sequential read commands to the SSD, the SSD automatically expects that the following is also read commands. Therefore, before receiving the next command, flash has already prepared the data. This accelerates data processing time, and the host needs to wait less time to receive data.

7.3.3 SLC Caching

The BarraCuda SSD firmware design adopts static caching to deliver better performance, endurance and user experience.

8. Safety, Standards, and Compliance

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

8.1 Regulatory Model Numbers

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

- STA012

8.2 Agency and Safety Certifications

8.2.1 Safety Certification

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

8.2.2 Electromagnetic Compatibility

The device, as delivered, is designed for system integration and installation into a suitable enclosure prior to use. The drive is supplied as a subassembly and is not subject to Subpart B of Part 15 of the FCC Rules.

The design characteristics of the drive serve to minimize radiation when installed in an enclosure that provides reasonable shielding. The device is capable of meeting the Class B limits of the FCC Rules and Regulations of the Canadian Department of Communications when properly packaged; however, it is the user's responsibility to assure that the device meets the appropriate EMI requirements in their system.

8.2.3 Electromagnetic susceptibility

The device as delivered is tested to meet susceptibility requirements in a representative enclosure. It is the responsibility of those integrating the drive within their systems to perform those tests required and design their system to ensure that equipment operating in the same system as the drive or external to the system does not adversely affect the performance of the device.

8.2.4 Electromagnetic compliance

Seagate uses an independent laboratory to confirm compliance with the EMC directives and standards. The device was tested in a representative system for typical applications. Although the test system with this Seagate model complies with the directives/standards, we cannot guarantee that all systems will comply. The computer manufacturer or system integrator shall confirm EMC compliance and provide the appropriate marking for their product.

8.2.5 European Union (EU) CE Marking Requirements

Devices that display the CE mark comply with the European Union (EU) requirements specified in the Electromagnetic Compatibility Directive (2014/30/EU). 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.

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

Although CE-marked Seagate devices comply with all relevant regulatory requirements and standards for the drives, Seagate cannot guarantee that all system-level products into which the devices are installed comply with all regulatory requirements and standards applicable to the system-level products. The device is designed for operation inside a properly designed system (e.g., enclosure designed for the device), 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 8.3.1, European Union Restriction of Hazardous Substance Law, on page 23](#).

8.2.6 Australian and New Zealand RCM Compliance Mark

If the device has the RCM marking, it complies with the Australia/New Zealand Standard AS/NZ CISPR32 and meets the Electromagnetic Compatibility (EMC) Framework requirements of the Australian Communications and Media Authority (ACMA).

8.2.7 Canada ICES-003

If the device has the ICES-003 Issue 6 marking, it complies with the requirements of ICES tested per ANSI C63.4-2014 or CAN/CSA-CISPR 22-10.

8.2.8 South Korean Certification Mark

If the device has the Korean Communications Commission (KCC) logo, they comply with KN32 and KN35.

8.2.9 Morocco Commodity Mark

Seagate drives are tested for compliance and comply 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 meet 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.

For devices with the Morocco Mark, Seagate has added the Moroccan Commodity Mark to the devices 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.

8.2.10 Taiwanese BSMI

Devices with the Taiwanese certification mark comply with Chinese National Standard, CNS13438 (2006.6) and CNS 15663 (2013.7).

For compliance with the Taiwan Bureau of Standards, Metrology and Inspection's (BSMI) RoHS requirements, see [Section 8.3.3, Taiwan Requirements — Taiwan RoHS, on page 25](#).

8.3 Environmental protection

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

8.3.1 European Union Restriction of Hazardous Substance Law

8.3.1.1 Restriction of Hazardous Substances in Electrical and Electronic Equipment

Seagate devices 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).

8.3.1.2 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.

8.3.2 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 12 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)
印刷电路板组装 PCBA	X	O	O	O	O	O
机壳 Chassis	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.

8.3.3 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 13 Taiwan - Restricted Substances

設備名稱：固態硬碟， Equipment Name: 2.5 inch SSDs		型號（型式） Type Designation (Type)				
單元 Unit	限用物質及其化學符號 Restricted Substance and its chemical symbol					
	鉛 Lead (Pb)	汞 Mercury (Hg)	鎘 Cadmium (Cd)	六價鉻 Hexavalent Chromium (Cr ⁺⁶)	多溴聯苯 Polybrominated biphenyls (PBB)	多溴二苯醚 Polybrominated diphenyl ethers (PBDE)
快閃記憶體 Flash Memory	○	○	○	○	○	○
連接器 Connector	○	○	○	○	○	○
外殼 Product Cover	○	○	○	○	○	○
印刷電路板總成 PCB Assembly	—	○	○	○	○	○

備考1. "超出0.1 wt %" 及 "超出0.01 wt %" 係指限用物質之百分比含量超出百分比含量基準值。
Note 1: "Exceeding 0.1 wt %" and "exceeding 0.01 wt %" indicate that the percentage content of the restricted substance exceeds the reference percentage value of presence condition.

備考2. "○" 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 2. "O" indicates that the percentage content of the restricted substance does not exceed the percentage of reference value of presence.

備考3. "—" 係指該項限用物質為排除項目。
Note 3. "—" indicates that the restricted substance corresponds to the exemption.

8.4 Reference Documents

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

Table 14 Reference Documents

Date	Title
Apr. 2007	SATA-IO Commands for ATA-8
Feb. 2011	<i>Solid-State Drive (SSD) Requirements and Endurance Test Method(JESD218A)</i>
Jul. 2011	Serial ATA Revision 3.1
Jul. 2011	IDEMA (LBA1-03_standard.doc)
Jul. 2012	SOLID-STATE DRIVE (SSD) Endurance Workload(JESD219A)
Oct. 2013	ATA/ATAPI Command Set -2 (ACS-3) Revision 5



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