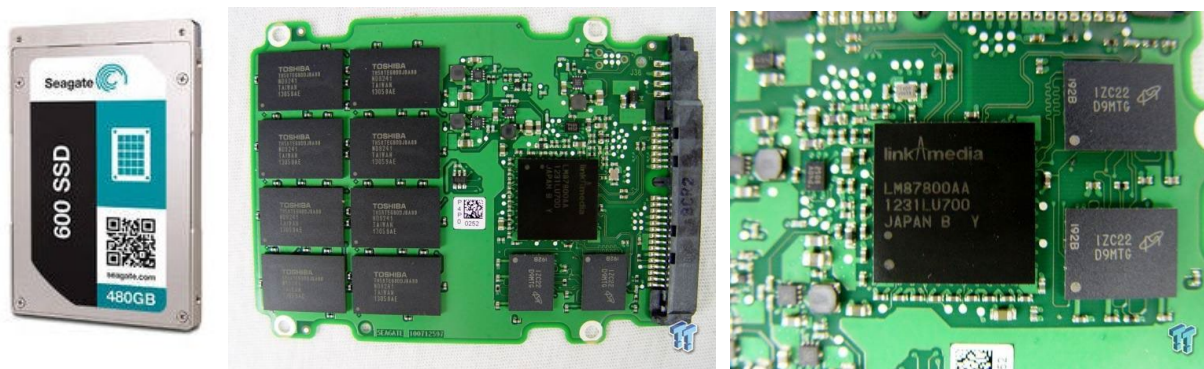# Actividades sobre discos de estado sólido

Parámetros básicos del disco de estado sólido Seagate 600 SSD ST480HM000

En la figura de la derecha se puede ver el controlador del dispositivo (chip cuadrado) y los dos chips DDR2 SDRAM de 256 MB (chips rectangulares) que actúan como buffers.

14. Geometría física y parámetros básicos del dispositivo de estado sólido

a) Indique el factor de forma (*form factor*) y la capacidad de la unidad.

> 2,5" pulgadas   480 GB → 6 10^9

b) ¿Qué tipo de celda de memoria se ha empleado en su fabricación?

> 2 bits

c) ¿Cuántos sectores en total, y de qué capacidad, garantiza el fabricante?

> 1000 millones sectores | 937.703.088 sectores   de 512 bytes = 480 GB

15. Rendimiento del dispositivo

a) ¿Cuál es la interfaz externa del dispositivo? ¿Cuál es su ancho de banda máxima?

> Interfaz SATA   6 Gbps   8b/10b → 600MB/s

b) ¿Con qué programa de prueba (*benchmark*) y qué versión se han obtenido las velocidades de transferencia publicadas por el fabricante?

> IOMeter

c) Según el fabricante, la velocidad de transferencia sostenida de la unidad en lecturas es de 530 MB/s. ¿En qué condiciones se ha obtenido este valor?

> 128KB en 4 bloques consecutivos

d) El fabricante también aporta un índice de rendimiento expresado en KIOPs. ¿Qué diferencia hay entre este índice y el anterior?

> Secuencial → 530 MB/s
>
> Random → 328 MB/s

e) Indica cuál es el consumo energético típico de la unidad en operaciones secuenciales de lectura y de escritura. ¿Hay diferencia entre los dos valores? En caso afirmativo, ¿cuál puede ser la razón?

> Read:
> Secuencial: 2,30 W
> Random: 1,67W
>
> Write:
> Secuencial: 2,64W
> Random: 2,54W

16.   Confiabilidad del dispositivo

a) ¿En qué términos exactos se expresa la garantía del dispositivo?

En años → 3

MAX TB escritura → 73TB

b) ¿Cuál es la cantidad máxima de datos que se pueden escribir en el dispositivo al día?

40 GB

c) ¿Qué número de veces se puede conectar / desconectar la unidad de la alimentación eléctrica?

25.000 ciclos encendido y apagado

d) Si el dispositivo es nuevo o ha tenido muy poco uso y se deja guardado en un cajón, ¿cuánto tiempo permanecerá la información registrada? ¿Y si el dispositivo ya se ha utilizado?

12 meses y nuevo 10 años

e) ¿Cómo afecta la temperatura la capacidad de retención del dispositivo si no hay conexión eléctrica?

Los celdas se degradan a altas temperaturas (40°C). Disminuyen la capacidad de retención

f) Indica en qué condiciones se han estimado las especificaciones de los índices AFR y MTBF.

8760 power on hours per year
250 average power cycles per year
Operations at nominal voltages (5V)
Adequate cooling

g) Un servidor dispone de un sistema de almacenamiento integrado por un total de 50 dispositivos ST480HM000. ¿Qué número medio de errores irrecuperables se producirán si hay que leerlos todos?

Errores: $1\ error/10^{16}\ bits$

$$\frac{50 \times 480 \times 10^9 \times 8\ bits}{10^{16}\ bits} = 0,0192\ errores$$

h) Considera el diseño de un sistema de almacenamiento formado por 250 dispositivos ST480HM000. Haz una estimación del número de unidades que fallarán durante el primer año de operación.

AFR = 0,58%.

tasa de fallos

$250 \times 0,58\% = 1,45\ unidades$

→ 2 unidades

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DEPARTAMENT D'INFORMÀTICA DE SISTEMES I COMPUTADORS

600 SSD

Data Sheet

Speed up your laptop with SSD performance and ruggedness.

- Upgrades existing laptops by replacing client 2.5-inch HDDs with fast, rugged client SSDs
- Delivers nearly 4× faster boot times and more than 2× faster application load times when compared to typical laptop HDDs
- Significantly reduces the amount of time end-users must wait before using their devices
- Allows end-users to access data faster and to take advantage of superior laptop responsiveness
- The ultimate upgrade drive for road warriors, power users, executives and gamers—work and play faster
- No mechanical, moving parts helps ensure data stays safe even if laptop is dropped or bumped while operating
- Installs like a typical HDD and works with any standard laptop and OS
- Supports SATA 6Gb/s interface
- Provides up to 480GB capacity
- First client SSD available in both 7mm and 5mm z-heights for space-constrained laptops
- Over 30 years of compatibility and reliability HDD testing expertise optimized for SSDs

Best-Fit Applications

- Performance upgrade for existing laptops with 2.5-inch hard drives
- Improved ruggedness upgrade for existing laptops that may be dropped while operating

600 SSD

Seagate ®

Comprehensive Storage Device Portfolio

The Seagate® 600 SSD broadens the Seagate portfolio by providing channel partners a one-stop shop for all their SSD, SSHD and HDD storage needs.

With supply chain expertise, deep ecosystem relationships and manufacturing excellence, all combined with global inventory hubs and volume ramp flexibility, Seagate enables product availability to accommodate the most dynamic forecast requirements.

Specifications	2.5-Inch, 7mm z-Height			2.5-Inch, 5mm z-Height		
	480GB[1]	240GB[1]	120GB[1]	480GB[1]	240GB[1]	120GB[1]
Model Number	ST480HM000	ST240HM000	ST120HM000	ST480HM001	ST240HM001	ST120HM001
Interface Options	SATA 6Gb/s	SATA 6Gb/s	SATA 6Gb/s	SATA 6Gb/s	SATA 6Gb/s	SATA 6Gb/s
NAND Flash Type	MLC	MLC	MLC	MLC	MLC	MLC
Performance						
Sustained Sequential Read/Write Command Rate (MB/s), 128KB	>500/>400	>500/>400	>500/>300	>500/>400	>500/>400	>500/>300
Random Read/Write Command Rate (IOPS) Peak, 4KB	Up to 80K/70K	Up to 80K/70K	Up to 80K/60K	Up to 80K/70K	Up to 80K/70K	Up to 80K/60K
Configuration/Reliability						
Nonrecoverable Read Errors per Bits Read, Max	1 per 10E16	1 per 10E16	1 per 10E16	1 per 10E16	1 per 10E16	1 per 10E16
Annualized Failure Rate (AFR)	0.58%	0.58%	0.58%	0.58%	0.58%	0.58%
Limited Warranty With Media Usage (years)[3]	3	3	3	3	3	3
Maximum Data Written to Device per Day (GB)	40	40	20	40	40	20
Max Amount of Data Written to Device During Warranty Period (TB)[3]	73	73	36.5	73	73	36.5
Power Management						
+5V Max Start Current (mA)	950	950	950	950	950	950
Average Sleep Power (W)	0.6	0.6	0.6	0.6	0.6	0.6
Average Standby Power (W)	0.6	0.6	0.6	0.6	0.6	0.6
Average Idle Power (W)	1.1	1.1	1.1	1.1	1.1	1.1
Average Operating Power (W)	0.75	0.75	0.75	0.75	0.75	0.75
Environmental						
Internal Operating Temperature (°C)	0 to 70	0 to 70	0 to 70	0 to 70	0 to 70	0 to 70
Nonoperating Temperature (°C)	−40 to 75	−40 to 75	−40 to 75	−40 to 75	−40 to 75	−40 to 75
Temperature Change Rate/Hr, Max (°C)	20	20	20	20	20	20
Relative Humidity, Noncondensing (%)	5 to 95	5 to 95	5 to 95	5 to 95	5 to 95	5 to 95
Shock, 0.5ms (Gs)	1500	1500	1500	1500	1500	1500
Vibration, 20Hz to 2000Hz (Grms)	11.08	11.08	11.08	11.08	11.08	11.08
Physical						
Height (mm/in)[2]	7.0/0.276	7.0/0.276	7.0/0.276	5.0/0.197	5.0/0.197	5.0/0.197
Width (mm/in)[2]	69.85/2.75	69.85/2.75	69.85/2.75	69.85/2.75	69.85/2.75	69.85/2.75
Depth (mm/in)[2]	100.45/3.955	100.45/3.955	100.45/3.955	100.45/3.955	100.45/3.955	100.45/3.955
Weight (g/lb)	77/0.17	77/0.17	77/0.17	67/0.15	67/0.15	67/0.15
Carton Unit Quantity	20	20	20	20	20	20
Cartons per Pallet	45	45	45	45	45	45
Cartons per Layer	9	9	9	9	9	9

1 One gigabyte, or GB, equals one billion bytes when referring to drive capacity.
2 The drive physical dimensions conform to the Small Form Factor Standard (SFF-8201) found at www.sffcommittee.org. For connector-related dimensions, see SFF-8223.
3 Limited Warranty With Media Usage period is either 3 years or when the device reaches the maximum TB total written during the warranty period, whichever comes first.

www.seagate.com

Product Manual

Seagate® 600 SSD

Standard 2.5" 7mm
Limited Warranty With
Media Usage models

ST480HM000
ST240HM000
ST120HM000

Standard 2.5" 5mm
Limited Warranty With
Media Usage models

ST480HM001
ST240HM001
ST120HM001

Document Revision History

Revision	Date	Description of changes
Rev. A	04/11/2013	Initial release.
Rev. B	05/13/2013	1, 3, 4 and 13.

Contents

FIGURES

Seagate Technology Support Services

For information regarding online support and services, visit http://www.seagate.com/about/contact-us/technical-support/

Available services include:

- Presales & Technical support
- Global Support Services telephone numbers & business hours
- Authorized Service Centers

Warranty terms will vary based on type of warranty chosen: "Managed Life" or "Limited Warranty With Media Usage". Consult your Seagate sales representative for warranty terms and conditions.

For information regarding data recovery services, visit http://www.seagate.com/services-software/data-recovery-services/

For Seagate OEM and Distribution partner portal, visit: http://www.seagate.com/partners/

For Seagate reseller portal, visit: http://www.seagate.com/partners/my-spp-dashboard/

1.0 INTRODUCTION

This manual describes the functional, mechanical and interface specifications for the following Seagate® 600 SSD model drives:

2.5" Limited Warranty With Media, 7mm Model	2.5" Limited Warranty With Media, 5mm Model
ST480HM000	ST480HM001
ST240HM000	ST240HM001
ST120HM000	ST120HM001

These drives provide the following key features:
• Multi-Level Cell (19nm MLC) NAND Flash storage.
• Serial ATA 3.1 Host Interface (SATA 6Gb/s).
• High instantaneous (burst) data-transfer rates (up to 530MB/s).
• Parallel flash access channels.
• State-of-the-art on-the-fly error-correction algorithms.
• Native Command Queueing with command ordering to increase performance in demanding applications.
• Highly integrated hardware functions.
• Data Set Management with Trim Support.
• Silent operation.
• SeaTools diagnostic software performs a drive self-test that eliminates unnecessary drive returns.
• Support for S.M.A.R.T. drive monitoring and reporting.
• Supports latching SATA cables and connectors.
• Worldwide Name (WWN) capability uniquely identifies the drive.

1.1 ABOUT THE SERIAL ATA INTERFACE

The Serial ATA interface provides several advantages:
• 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.

The Serial ATA interface connects each drive in a point-to-point configuration with the Serial ATA host adapter. 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.

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.

2.0 DRIVE SPECIFICATIONS

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

2.5" Limited Warranty With Media Usage	Capacity					
	480GB		240GB		120GB	
	ST480HM000	ST480HM001	ST240HM000	ST240HM001	ST120HM000	ST120HM001

Product data communicated in this manual is specific only to the model numbers listed in this manual. The data listed in this manual may not be predictive of future generation specificatio ns or requirements. If you are designing a system which will use one of the models listed or future generation products and need further assistance, please contact your Customer Technical Support Engineer or our global support services group as shown in See "Seagate Technology Support Services" on page 1.

2.1 SPECIFICATION SUMMARY TABLES

The specifications listed in the following table is for quick re ference. For details on specification measurement or definition , see the appropriate section of this manual.

Table 1 Drive specifications summary for 2.5" - 480, 240 and 120 GB models

Drive specification	ST480HM000	ST480HM001	ST240HM000	ST240HM001	ST120HM000	ST120HM001
Formatted GB (512 bytes/sector)*	480		240		120	
Guaranteed logical block addresses (LBAs)	937,703,088		468,862,128		234,441,648	
Emulated Bytes per LBA	512					
Sustained 128KB sequential read/write data transfer rate (MB/s max)	530/440					
Peak 4KB Random read/write command rate (KIOPs)	80/70					
Flash Memory Type	NAND MLC					
I/O data-transfer rate (MB/s max)	600					
Height (mm max)	7.0mm (0.276 in)	5.0mm (0.197 in)	7.0mm (0.276 in)	5.0mm (0.197 in)	7.0mm (0.276 in)	5.0mm (0.197 in)
Width (mm max)	70.10 mm (2.760 in)					
Length (mm max)	100.45 mm (3.955 in)					
Weight (max)	77 g (0.170 lb)	67 g (0.148lbs)	77 g (0.170 lb)	67 g (0.148 lbs)	77 g (0.170 lb)	67 g (0.148 lbs)
Power-on to ready (typ)	<1 sec					
Standby to ready (max)	3 sec					
Data Retention (typical minimum at 30°C)	12 months					
Startup current 5V (max)	950 mA					
Voltage tolerance (including noise)	5V ± 5%					
Temperature	0° to 70°C (operating as reported by SMART attribute 194) −40° to 75°C (nonoperating)					
Temperature gradient (°C per hour max)	20°C (operating) 20°C (nonoperating)					
Relative humidity	5% to 95% (operating) 5% to 95% (nonoperating)					
Relative humidity gradient	20% per hour max					
Wet bulb temperature (°C max)	29					
Altitude, operating	−61 m to 3048 m (−200 ft. to 10,000+ ft.)					
Altitude, nonoperating (below mean sea level, max)	−61 m to 12,192 m (−200 ft to 40,000+ ft)					
Operational Shock (max at 0.5ms)	1500 Gs					
Non-Operational Shock (max at 0.5ms)	1500 Gs					
Vibration, random operating	20–2000 Hz: 11.08 Grms					

Drive specification	ST480HM000	ST480HM001	ST240HM000	ST240HM001	ST120HM000	ST120HM001
Vibration, random nonoperating	20–2000 Hz: 11.08 Grms					
Nonrecoverable read errors, max	1 LBA per 10^{16} bits read					
Annualized Failure Rate (AFR)	0.58%					
Warranty	3-Year Limited Warranty With Media Usage					
Lifetime Power cycles	25,000					
Supports Hotplug operation per Serial ATA Revision 3.0 specification	Yes					

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

**Warranty terms are "Limited Warranty With Media Usage", see Warranty information in   Section 2.10.2 or consult your Seagate sales representative for warranty terms and conditions.

2.2 FORMATTED CAPACITY

Formatted capacity*	Guaranteed LBAs	Emulated LBA Size (Bytes)
480GB	937,703,088	
240GB	468,862,128	512
120GB	234,441,648	

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

2.2.1 LBA mode

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

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

2.3 DEFAULT LOGICAL GEOMETRY FOR ATA BASED SYSTEMS

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

2.4 PERFORMANCE, RECORDING AND INTERFACE TECHNOLOGY

2.4.1 Interface technology

	480GB models	240GB models	120GB models
Interface	Serial ATA (SATA-II)		
Interface Speeds Supported	6Gb/s, 3Gb/s, 1.5Gb/s		
Maximum Burst Transfer Rate	600MB/s		
Hot Plug Support	Yes		
Native Command Queuing Support	Yes		
Trim Support	Yes		

2.4.2 Recording technology

Flash Memory Type	NAND MLC
Emulated LBA Size (Bytes)	512
Default transfer alignment offset	0
Typical Data Retention with Power removed (at 30°C)	12 months

2.4.3 Performance

	Notes	480GB	240GB	120GB
Sustained sequential 128KB read/write data transfer rate (MB/s)	[1]	530/440		
Peak 4KB random read/write command rate (KIOPs)	[2]	80/70		

→ 328MB/s

[1]   Testing performed at Queue Depth = 32, Sequentially Preconditioned drive, using IOMeter 2006.7.27.
[2]   Testing performed at Queue Depth = 32, Randomly Preconditioned drive, using IOMeter 2006.7.27.

Note.   IOMeter is available at http://www.iometer.org/ or http://sourceforge.net/projects/iometer/.
IOMeter is licensed under the Intel Open Source License and the GNU General Public License. Intel does not endorse any IOMeter results.

Peak performance is defined as the typical best case performance that the product will be able to achieve when the product is preconditioned as mentioned and host commands are aligned on 4KB boundaries.

Sustained performance is defined as the typical worst case pe rformance that the product will be able to achieve when the product is preconditioned as mentioned and host commands are aligned on 4KB boundaries.

Due to the nature of Flash memory technologies there are many factors that can result in values different than those stated in this specification. Some discrepancies can be caused by bandwidth limitations in the host adapter, operating system, or driver limitations. It is not the intent of this manual to cover all possible causes of performance discrepancies.

When evaluating performance of SSD devices, it is recommended to measure performance of the device in a method that resembles the targeted application using real world data and workloads. Test time should also be adequately large to ensure that sustainable metrics and measures are obtained.

2.5   PHYSICAL CHARACTERISTICS

	ST480HM000, ST240HM000 & ST120HM000	ST480HM001, ST240HM001 & ST120HM001
Maximum height	7.00 mm (0.276 in)	5.00 mm (0.197 in)
Maximum width	70.10 mm (2.760 in)	
Maximum length	100.45 mm (3.955 in)	
Max weight	77 g (0.170lb)	67 g (0.148 lb)

2.6   TIME TO READY

	480GB	240GB	120GB
Power-on to Ready (sec)	<1 (typ)		

2.7 POWER SPECIFICATIONS

The drive receives DC power (+5V) through a native SATA power connector. See 2 on page 16.

2.7.1 Power consumption

Power requirements for the drives are listed in the table on page 9. Typical power measurements are based on an average of drives tested, under nominal conditions, at 35°C ambient temperature.

- **Startup power**

  Startup power is measured from the time of power-on to the time that the drive reaches operating condition and can process media access commands.

- **Peak operating mode**

  During peak operating mode, the drive is tested in various read and write access patterns to simulate the worst-case power consumption.

- **Idle mode power**

  Idle mode power is measured with the drive powered up and ready for media access commands, with no media access commands having been received from the host.

- **Standby mode**

  During Standby mode, the drive accepts commands, but not be able to immediately access the media because the drive electronics are in a partial power-down mode.

2.7.2 DC power requirements

Table 2   480GB DC power requirements

Parameter	ST480HM000, ST480HM001 (6.0Gb)	
Voltage	**+5V**	**Power**
Regulation	**+/- 5%**	**(watts)**
Average Idle Current	0.22	1.10
Average Sleep Current	0.10	0.50
Maximum Start Current	0.95	
DC (Peak DC)	0.54	
AC (Peak AC)	0.40	
Peak Operating Current (random read):		
Typical DC	0.32	1.59
Maximum DC	0.33	1.63
Maximum DC (peak)	0.90	4.50
Peak Operating Current (random write):		
Typical DC	0.40	2.02
Maximum DC	0.46	2.31
Maximum DC (peak)	1.44	7.20
Peak Operating Current (sequential read):		
Typical DC	0.44	2.18
Maximum DC	0.45	2.20
Maximum DC (peak)	1.02	5.10
Peak Operating Current (sequential write):		
Typical DC	0.52	2.61
Maximum DC	0.60	2.99
Maximum DC (peak)	1.50	7.50

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

Table 3   240GB DC power requirements

Parameter	ST240HM000, ST240HM001	(6.0Gb)
Voltage	**+5V**	**Power**
Regulation	**+/- 5%**	**(watts)**
Average Idle Current	0.22	1.10
Average Sleep Current	0.10	0.50
Maximum Start Current	0.95	
DC (Peak DC)	0.52	
AC (Peak AC)	0.38	
Peak Operating Current (random read):		
Typical DC	0.32	1.57
Maximum DC	0.34	1.68
Maximum DC (peak)	0.78	3.90
Peak Operating Current (random write):		
Typical DC	0.41	2.03
Maximum DC	0.46	2.27
Maximum DC (peak)	1.22	6.10
Peak Operating Current (sequential read):		
Typical DC	0.43	2.06
Maximum DC	0.44	2.309
Maximum DC (peak)	0.92	4.20
Peak Operating Current (sequential write):		
Typical DC	0.53	2.64
Maximum DC	0.56	2.82
Maximum DC (peak)	1.28	6.40

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

Table 4   120GB DC power requirements

Parameter	ST120HM000, ST120HM001	(6.0Gb)
Voltage	**+5V**	**Power**
Regulation	**+/- 5%**	**(watts)**
Average Idle Current	0.22	1.10
Average Sleep Current	0.10	0.50
Maximum Start Current	0.95	
DC (Peak DC)	0.54	
AC (Peak AC)	0.70	
Peak Operating Current (random read):		
Typical DC	0.34	1.67
Maximum DC	0.35	1.72
Maximum DC (peak)	0.82	4.10
Peak Operating Current (random write):		
Typical DC	0.51	2.54
Maximum DC	0.56	2.18
Maximum DC (peak)	1.42	7.10
Peak Operating Current (sequential read):		
Typical DC	0.43	2.30
Maximum DC	0.44	2.34
Maximum DC (peak)	0.92	4.40
Peak Operating Current (sequential write):		
Typical DC	0.53	2.64
Maximum DC	0.56	2.90
Maximum DC (peak)	1.28	6.40

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

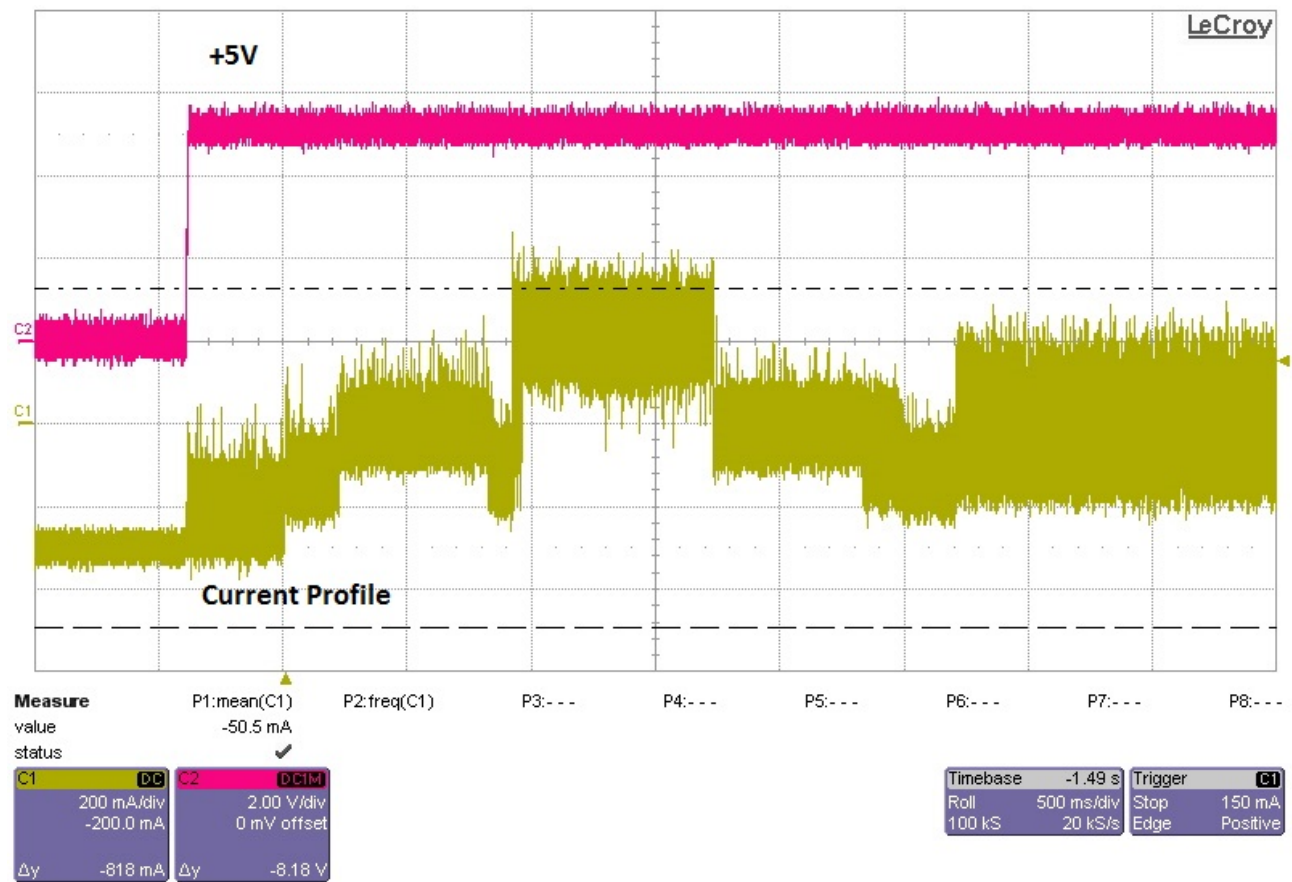### 2.7.2.1 Typical current profiles

Figure 1. *Typical 5V Startup and Operation Current Profile*

2.8   ENVIRONMENTAL SPECIFICATIONS

2.8.1   Temperature

Temperature is defined as the drive's internal temperature as reported by SMART attribute 194 for operation or the drive case temperature for non-operating.

Above 1000 feet (305 meters), the maximum temperature is derated linearly to 112°F (44°C) at 10,000 feet (3048 meters).

Operating:	0° to 70°C (32° to 158°F)
Nonoperating:	–40° to 75°C (–40° to 167°F)

2.8.2   Temperature gradient

Operating:	20°C per hour (30°F per hour max), without condensation
Nonoperating:	20°C per hour (30°F per hour max)

2.8.3   Humidity

2.8.3.1   Relative humidity

Operating:	5% to 95% noncondensing (20% per hour max)
Nonoperating:	5% to 95% noncondensing (20% per hour max)

2.8.3.2   Wet bulb temperature

Operating:	29°C (84°F max)
Nonoperating:	29°C (84°F max)

2.8.4   Altitude

** Operating:	–61 m to 3048 m (–200 ft. to 10,000+ ft.)
** Nonoperating:	–61 m to 12,192 m (–200 ft. to 40,000+ ft.)

** Applies to atmospheric pressure only.

2.8.5   Shock

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

2.8.5.1   Operating shock

These drives comply with the performance levels specified in this document when subjected to a maximum operating shock of 1500 Gs based on half-sine shock pulse s of 0.5ms. This specification does not cover connection issues that may result from testing at this level.

2.8.5.2   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 1500 Gs based on a half-sine shock pulse of 0.5ms duration.

2.8.6   Vibration

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

2.8.6.1 Operating vibration

The maximum random vibration levels that the drive may experience while meeting the performance standards specified in this document are specified below. This sp ecification does not cover connection issues that may result from testing at this level.

20–2000 Hz	11.08 Grms

2.8.6.2 Nonoperating vibration

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

20–2000 Hz	11.08 Grms

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 5   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

2.10 RELIABILITY

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

The product shall achieve an Annualized Failure Rate - AFR - of 0.58%. AFR and MTBF are population statistics that are not relevant to individual units.

AFR and MTBF specifications are based on the following assumptions:

- 8760 power-on-hours per year.
- 250 average power cycles per year.
- Operations at nominal voltages.
- Systems will provide adequate cooling to ensure the case temperatures do not exceed specification.

2.10.2 Reliability specifications

Unrecoverable read error rate during	1 LBA per 10^{16} bits read, max
Annualized Failure Rate (AFR)	0.58%
Power cycles	25,000 cycles (at nominal voltage and temperature, with 60 cycles per hour and a 50% duty cycle)
Warranty	Warranty terms are "Limited Warranty With Media Usage" [2] Consult your Seagate sales representative for warranty terms and conditions.
Preventive maintenance	None required.
Typical Data Retention with Power removed (at 40°C)	12 months [1]
Endurance	40GBs (max capacity) host writes per day

[1] As NAND Flash devices age with use, the capability of the media to retain a programmed value begins to deteriorate. This deterioration is affected by the number of times a particular memory cell is programmed and subsequently erased. When a device is new, it has a powered off data retention capability of up to ten years. With use the retention capability of the device is reduced. Temperature also has an effect on how long a Flash component can retain its programmed value with power removed. At high temperature the retention capabilities of the device are reduced. Data retention is not an issue with power applied to the SSD. The SSD drive contains firmware and hardware features that can monitor and refresh memory cells when power is applied.

[2] Limited Warranty With Media Usage: This warranty is based on the shorter of term and endurance usage of the drive: 36 months or 73 (max capacity) TBW whichever comes first.

2.11 AGENCY CERTIFICATION

2.11.1 Safety certification

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

2.11.2 Electromagnetic compatibility

Drives that display the CE mark comply with the European Union (EU) requirements specified in the Electromagnetic Compatibility Directive (2004/108/EC) as put into place 20 July 2007. Testing is performed to the levels specified by the product standards for Information Technology Equipment (ITE). Emission levels are defined by EN 55022, Class B and the immunity levels are defined by EN 55024.

Seagate uses an independent laboratory to confirm compliance wit h the EC directives specified in the previous paragraph. Drives are tested in representative end-user systems. Although CE-marked Seagate drives comply with the directives when used in the test systems, we cannot guarantee that all systems will comply with the directives. The drive is designed for operation inside a properly designed enclosure, with properly shielded I/O cable (if necessary) and terminators on all unused I/O ports. Computer manufacturers and system integrators should confirm EMC compliance and provide CE marking for their products.

Korean KCC

If these drives have the Korean Communications Commission (KCC) logo, they comply with KN22 and KN61000.

Australian C-Tick (N176)

If these models have the C-Tick marking, they comply with the Australia/New Zealand Standard AS/NZ CISPR22 and meet the Electromagnetic Compatibility (EMC) Framework requirements of the Australian Communication Authority (ACA).

2.11.3 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 Technology LLC has tested this device in enclosures as described above to ensure that the total assembly (enclosure, 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, you 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, you should consult your dealer or an experienced radio/television technician for additional suggestions. You may find helpful the following booklet prepared by the Federal Communications Commission: *How to Identify and Resolve Radio-Television Interference Problems*. This booklet is available from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402. Refer to publication number 004-000-00345-4.

2.12 ENVIRONMENTAL PROTECTION

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

2.12.1 European Union Restriction of Hazardous Substances (RoHS) Directive

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

2.12.2 China Restriction of Hazardous Substances (RoHS) Directive 中国限制危险物品的指令

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

该产品具有20年的环境保护使用周期 （EPUP）。 下表包含了中国 "电子产品所导致的污染的控制的记号要求" 所指定的信息。

Name of Parts 部件名称	Toxic or Hazardous Substances or Elements 有毒有害物质或元素					
	Lead 铅（Pb）	Mercury 汞（Hg）	Cadmium 镉（Cd）	Hexavalent Chromium 六价铬（Cr6+）	Polybrominated Diphenyl 多溴联苯（PBB）	Polybrominated Diphenyl Ether 多溴二苯醚（PBDE）
PCBA	X	O	O	O	O	O
CHASSIS	X	O	O	O	O	O

"O" indicates the hazardous and toxic substance content of the part (at the homogenous material level) is lower than the threshold defined by the China RoHS MCV Standard.

"O"表示该部件（于同类物品程度上）所含的危险和有毒物质低于中国RoHS MCV标准所定义的门槛值。

"X" indicates the hazardous and toxic substance content of the part (at the homogenous material level) is over the threshold defined by the China RoHS MCV Standard.

"X"表示该部件（于同类物品程度上）所含的危险和有毒物质超出中国RoHS MCV标准所定义的门槛值。

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 Seagate products are especially sensitive to the presence of sulfide, chloride, and nitrate contaminants. Sulfur is found to be the most damaging. In addition, electronic components should never be exposed to condensing water on the surface of the printed circuit board assembly (PCBA) or exposed to an ambient relative humidity greater than 95%. Materials used in cabinet fabrication, such as vulcanized rubber, that can outgas corrosive compounds should be minimized or eliminated. The useful life of any electronic equipment may be extended by replacing materials near circuitry with sulfide-free alternatives.

3.0   CONFIGURING AND MOUNTING THE DRIVE

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

3.1   HANDLING AND STATIC-DISCHARGE PRECAUTIONS

After unpacking, and before installation, th e drive may be exposed t o 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 yourself 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.
• The drive is fragile—handle it with care.
• Always rest the drive on an antistatic surface until you mount 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.

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.

Serial ATA drives are designed for easy inst allation. If you connect the drive and rec eive a "drive not detected" error, your SATA equipped motherboard or host adapter may use a chipset that does not support SATA 6.0Gb speed autonegotiation. You will need to install a SATA host adapter that supports autonegotiation.

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 mete r (39.37 inches). See Table 6 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, you can connect the drive as illustrated in 2.
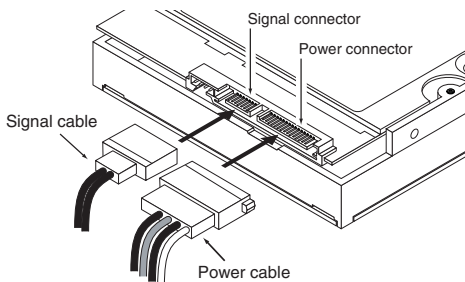
Figure 2.   Attaching SATA cabling

Each cable is keyed to ensure correct orientation. Seagate 600 SSD drives support latching SATA connectors.

3.4 DRIVE MOUNTING

You can mount the drive in any orientation using four screws in the side-mounting holes or four screws in the bottom-mounting holes. Follow these important mounting precautions when mounting the drive:

• Allow a minimum clearance of 0.030 in (0.76 mm) around the entire perimeter of the drive for cooling as a guideline. Please refer to Section 3.5 for final cooling requirements.

• Use only M3 x 0.5 metric mounting screws.

• Four (4) threads (0.080 in) minimum screw engagement recommended. Also ensure maximum screw length does not bottom out in mounting holes.

• Do not overtighten the mounting screws (maximum torque: 4.5 in-lb, ± 0.45 in-lb).

Refer to 4 for detailed mounting configuration dimensions.
See Section 3.4, "Drive mounting."

Weight:	7mm models	0.170 pounds	77 grams
	5mm models	0.148 pounds	67 grams

Note. These dimensions conform to the Small Form Factor Standard documented in SFF-8201 and SFF-8223 found at www.sffcommittee.org.
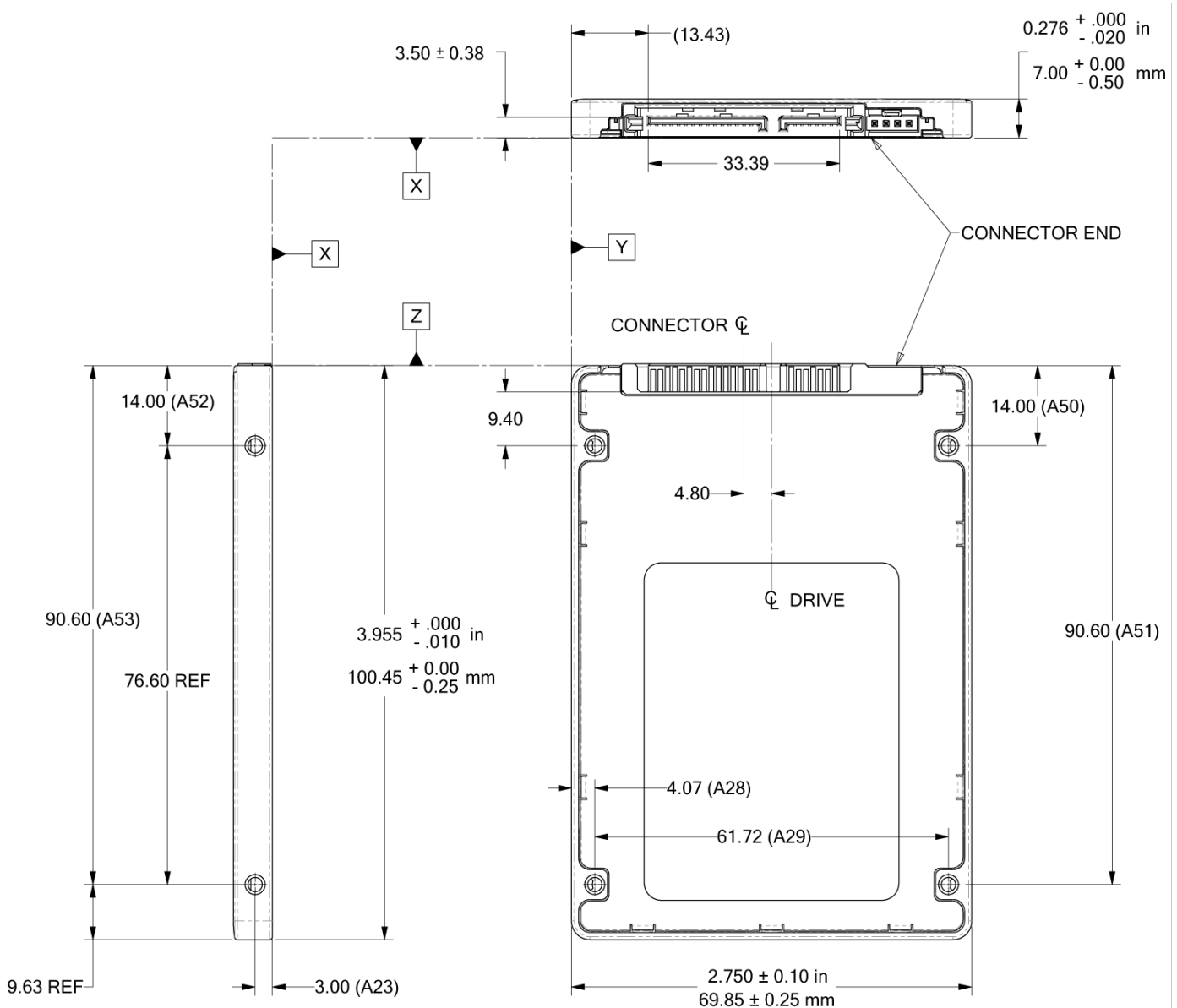
Figure 3. Mounting configuration dimensions (7mm models)

Note. These dimensions conform to the Small Form Factor Standard documented in SFF-8120 and SFF-8146 found at www.sffcommittee.org.
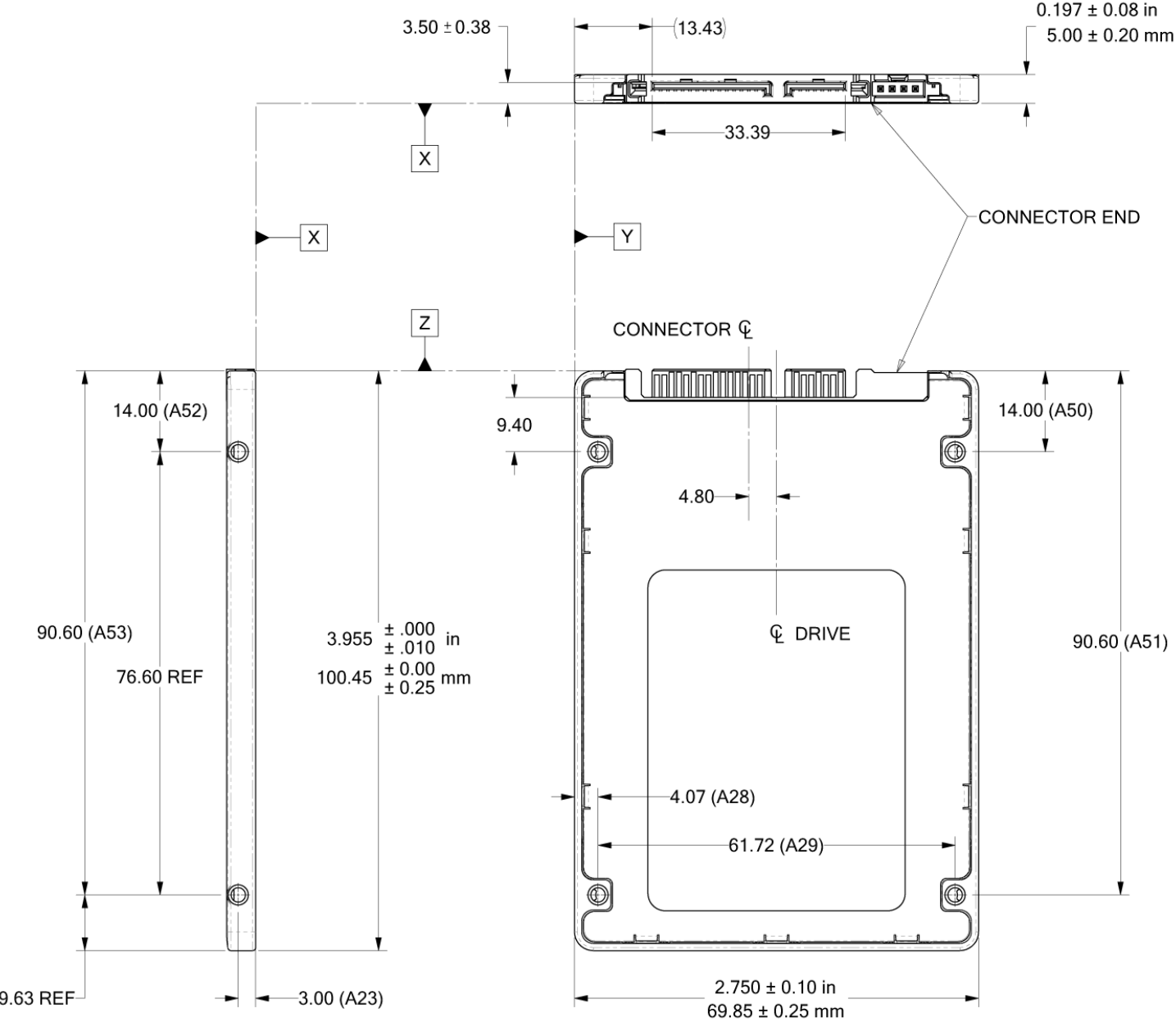
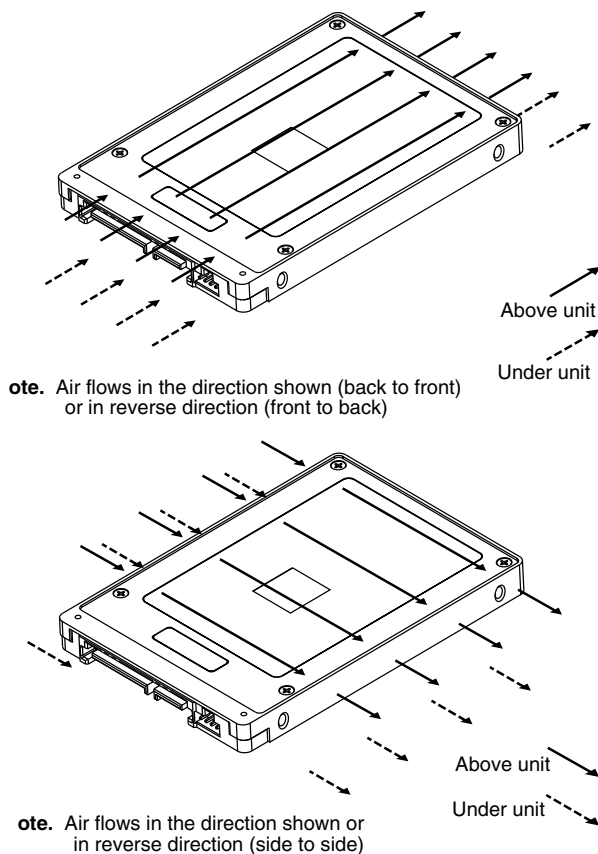**Figure 4.** Mounting configuration dimensions (5mm models)

3.5 COOLING

Cabinet cooling must be designed by the customer so that the ambient temperature immediately surrounding the drive will not exceed temperature conditions specified in Section 2.8.1, "Temperature."

The rack, cabinet, or drawer environment for the drive must provide heat removal. You should confirm that adequate heat removal is provided using the temperature measurement guidelines described in Section 2.8.1.

Forced air flow may be required to keep temperatures at or below the temperatures specified in Section 2.8.1 in which case the drive should be oriented, or air flow directed, so that the least amount of air flow resistance is created while providing air flow to the drive. Also, the shortest possible path between the air inlet and exit should be chosen to minimize the travel length of air heated by the drive and other heat sources within the rack, cabinet, or drawer environment.

If forced air is determined to be necessary, possible air-flow patterns are shown in figure 5. The air-flow patterns are created by one or more fans, either forcing or drawing air as shown in the illustrations. Conduction, convection, or other forced air-flow patterns are acceptable as long as the temperature measurement guidelines of Section 2.8.1 are met.

Above unit

Under unit

ote. Air flows in the direction shown (back to front) or in reverse direction (front to back)

Above unit

Under unit

ote. Air flows in the direction shown or in reverse direction (side to side)

Figure 5. Air flow

Image may not represent actual product, for reference only.

4.0 SERIAL ATA (SATA) INTERFACE

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

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

4.1 HOT-PLUG COMPATIBILITY

Seagate 600 SSD drives incorporate connectors which enable you to hot plug these drives in accordance with the Serial ATA II: Extension to Serial ATA 1.0a specification. This specification can be downloaded from www.serialata.org.

4.2 SERIAL ATA DEVICE PLUG CONNECTOR PIN DEFINITIONS

Table 6 summarizes the 2.5" drive Signal and Power SATA Plug.

Table 6   2.5" SATA Connector Plug Pinout

Segment	Pin	Function	Definition
Signal	S1	GND	Ground
	S2	A+	Differential Signal Pair (Host to Drive)
	S3	A-	
	S4	GND	Ground
	S5	B-	Differential Signal Pair (Drive to Host)
	S6	B+	
	S7	GND	Ground
	Key and spacing separate signal and power segments		
Power	P1	V_{33}	Unused [2]
	P2	V_{33}	
	P3	V_{33}	
	P4	GND	Ground [1]
	P5	GND	
	P6	GND	
	P7	V_5	5V power to Drive
	P8	V_5	
	P9	V_5	
	P10	Ground	Ground
	P11	LED Signal	Activity LED: Driven low to light
	P12	Ground	Ground [1]
	P13	V_{12}	Unused [3]
	P14	V_{12}	
	P15	V_{12}	

Notes:

[1]   Ground pins 4 and 12 mate first on SATA backplane connectors.
[2]   The three V_{33} pins are unused but connected together on the drive. They can be used for a drive-in-place detection.
[3]   The three V_{12} pins are unused but connected together on the drive. They can be used for a drive-in-place detection.

Table 7 summarizes the 1.8" drive Signal and Power SATA Plug.

Table 7   1.8" SATA Connector Plug Pinout

Segment	Pin	Function	Definition
Signal	S1	GND	Ground
	S2	A+	Differential Signal Pair (Host to Drive)
	S3	A-	
	S4	GND	Ground
	S5	B-	Differential Signal Pair (Drive to Host)
	S6	B+	
	S7	GND	Ground
Spacing separates signal and power segments			
Power	P1	V_{33}	Unused [2]
	P2	V_{33}	
	P3	GND	Ground [1]
	P4	GND	
	P5	V_5	5V power to Drive
	P6	V_5	
	P7	LED Signal	Activity LED: Driven low to light
	Key	Key	Keyway
	P8	Optional	Reserved for Seagate use. Leave unconnected.
	P9	Optional	

Notes:

[1]   Ground pins 3 and 4 mate first on micro SATA backplane connectors
[2]   The two V_{33} pins are unused but connected together on the drive. They can be used for a drive-in-place detection.

4.3 SUPPORTED ATA COMMANDS

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

Table 8   Supported ATA commands

COMMAND NAME	COMMAND CODE (IN HEX)
Check Power Mode	$E5_H$
Data Set Management with Trim Support	06_H
Download Microcode	92_H
Flush Cache	$E7_H$
Flush Cache Extended	EA_H
Identify Device	EC_H
Idle	$E3_H$
Idle Immediate	$E1_H$
Initialize Device Parameters	91_H
NOP	00_H
Read Buffer	$E4_H$
Read DMA	$C8_H$
Read DMA Extended	25_H
Read FPDMA Queued	60_H
Read Log Ext	$2F_H$
Read Multiple	$C4_H$
Read Multiple Extended	29_H
Read Native Max Address	$F8_H$
Read Native Max Address Extended	27_H
Read Sectors	20_H
Read Sectors Extended	24_H
Read Verify Sectors	40_H
Read Verify Sectors Extended	42_H
Sanitize Block Erase	$B4_H/0012_H$
Sanitize Freeze Lock Ext	$B4_H/0020_H$
Sanitize 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	$F2_H$
Set Features	EF_H
Set Max Address	$F9_H$
Set Max Address Extended	37_H

COMMAND NAME	COMMAND CODE (IN HEX)
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 Operations	$B0_H$ / $D8_H$
S.M.A.R.T. Execute Offline	$B0_H$ / $D4_H$
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. Write Log Sector	$B0_H$ / $D6_H$
Standby	$E2_H$
Standby Immediate	$E0_H$
Write Buffer	$E8_H$
Write DMA	CA_H
Write DMA Extended	35_H
Write DMA FUA Extended	$3D_H$
Write FPDMA Queued	61_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 Uncorrectable Extended	45_H

4.3.1 Identify Device command

The Identify Device command (command code EC$_H$) transfers information about the drive to the host following power up. The data is organized as a single 512-byte block of data, whose contents are shown in Table 8 on page 22. All reserved bits or words should be set to zero. Parameters listed with an "x" are drive-specific or vary with the state of the drive. see Section 2.0 on page 3 for default parameter settings.

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

WORD	DESCRIPTION	VALUE
0	General configuration	0040$_H$
1	Number of logical cylinders (obsolete) 16,383	3FFF$_H$
2	Specific configuration	C837$_H$
3	Number of logical heads (obsolete) 16	0010$_H$
4-5	Retired	0000$_H$
6	Number of logical sectors per logical track (obsolete) 63	003F$_H$
7–8	Reserved for CompactFlash Association	0000$_H$
9	Retired	0000$_H$
10–19	Serial number: (ATA ASCII string padded with spaces (20$_H$))	ASCII
20-21	Retired	0000$_H$
22	Obsolete	0000$_H$
23–26	Firmware revision (ATA ASCII string padded with spaces (20h))	ASCII
27–46	Model number (ATA ASCII string padded with spaces (20h))	ASCII
47	(Bits 7-0) Maximum number of logical sectors that shall be transferred per DRQ data block on READ/WRITE MULTIPLE commands. 16	8010$_H$
48	Reserved for Trusted Computing feature set options	4000$_H$
49	Capabilities – Standby Timer, IORDY Support, etc	2F00$_H$
50	Capabilities Continued	4000$_H$
51	PIO data transfer cycle timing option (Obsolete)	0000$_H$
52	Retired	0000$_H$
53	Words 54–58, 64–70 and 88 are valid	0006$_H$
54	Number of current logical cylinders (Obsolete)	3FFF$_H$
55	Number of current logical heads (Obsolete)	0010$_H$
56	Number of current logical sectors per logical track (Obsolete)	003F$_H$
57–58	Current capacity in sectors (Obsolete)	FC10$_H$ 00FB$_H$
59	Number of LBAs transferred per Read Multiple or Write Multiple. Sanitize Command Support	9110$_H$
60–61	Total number of user addressable logical sectors for 28-bit commands Note: The maximum value allowed in this field is: 0FFFFFFFh. If this field contains 0FFFFFFFh and the device has user addressable LBAs greater than or 137GB, then words 100..103 contain the total number of user addressable LBAs	XXXXXXXX$_H$
62	Obsolete	0000$_H$
63	Multiword DMA active and modes supported (see note following this table)	0007$_H$
64	Advanced PIO modes supported. SATA = 0003h	0003$_H$
65	Minimum Multiword DMA transfer cycle time per word (120ns)	0078$_H$
66	Recommended Multiword DMA transfer cycle time (120ns)	0078$_H$

WORD	DESCRIPTION	VALUE
67	Minimum PIO transfer cycle time without flow control (120ns)	0078$_H$
68	Minimum PIO transfer cycle time with IORDY flow control (120ns)	0078$_H$
69	Additional Features and Commands supported. Trim Features supported, DMA commands supported	0100$_H$
70	Reserved	0000$_H$
71–74	Reserved for ATAPI	0000$_H$
75	Queue depth	001F$_H$
76	Serial ATA Capabilities Supported	870E$_H$
77	Reserved for Serial ATA	0006$_H$
78	Serial ATA features supported	0056$_H$
79	Serial ATA features enabled	0040$_H$
80	Major version number	01F0$_H$
81	Minor version number	0029$_H$
82	Commands and feature sets supported	746B$_H$
83	Commands and feature sets supported	7401$_H$
84	Commands and feature sets supported	4163$_H$
85	Commands and feature sets supported or enabled	7469$_H$
86	Commands and feature sets supported or enabled	B401$_H$
87	Commands and feature sets supported or enabled	4163$_H$
88	Ultra DMA support and current mode (see note following this table)	407F$_H$
89	Security erase time	0004$_H$
90	Enhanced security erase time	0000$_H$
91	Current APM level value	0000H
92	Master password Identifier	FFFE$_H$
93	Hardware reset result	0000$_H$
94	Reserved	0000$_H$
95–99	ATA-reserved	0000$_H$
100–103	Total Number of User Addressable Logical Blocks for 48-bit commands. These words are required for drives that support the 48-bit addressing feature. Maximum value: 0000FFFFFFFFFFFFh	480GB model = 937,703,088 240GB model = 468,862,128 120GB model = 234,441,648
104	Reserved for Streaming Command Set	0000$_H$
105	Maximum number of 512-byte blocks of LBA Range Entries (see 4.18.3.2) per DATA SET MANAGEMENT command	0001$_H$
106	Physical sector size / logical sector size	6003$_H$
107	Inter-seek delay for ISO 7779 standard acoustic testing	0000$_H$
108–111	World wide name	XXXX$_H$
112–115	Reserved	0000$_H$
116	Reserved for TLC	0000$_H$
117–118	Logical sector size (DWord)	0000$_H$
119	Commands and feature sets supported	4014$_H$
120	Commands and feature sets supported or enabled	4014$_H$
121–126	Reserved for expanded supported and enabled settings	0000$_H$

WORD	DESCRIPTION	VALUE
127	Obsolete	0000$_H$
128	Security status	0001$_H$
129–159	Vendor specific	xxxx$_H$
160–167	Reserved for the CompactFlash Association	0000$_H$
168	Device Nominal Form Factor	0003$_H$
169	DATA SET MANAGEMENT features supported	0001$_H$
170–173	Additional Product Identifier (ATA String)	0000$_H$
174–175	Reserved	0000$_H$
176–197	Reserved	0000$_H$
198–199	Reserved	8000$_H$
200–205	Reserved	0000$_H$
206	SCT Command Transport	0000$_H$
207–208	Reserved for CE-ATA	0000$_H$
209	Alignment of logical blocks within a physical block	4000$_H$
210–211	Write-Read-Verify Sector Count Mode 3	0000$_H$
212–213	Write-Read-Verify Sector Count Mode 2 (DWord)	0000$_H$
214	NV Cache Capability	0000$_H$
215-216	NV Cache Size in Logical Blocks (DWord)	0000$_H$
217	Nominal media rotation rate	0001$_H$
218	Reserved	0000$_H$
219	NV Cache Options	0000$_H$
220	Write-Read-Verify feature set	0000$_H$
221	Reserved	0000$_H$
222	Transport major version number	1020$_H$
223	Transport minor version number	0000$_H$
224-233	Reserved	0000$_H$
234	Minimum number of 512-byte data blocks per DOWNLOAD MICROCODE command for mode 03h	0001$_H$
235	Maximum number of 512-byte data blocks per DOWNLOAD MICROCODE command for mode 03h	02A0$_H$
236-254	Reserved	0000$_H$
255	Integrity word (XXA5$_H$)	xxA5$_H$

Note. See the bit descriptions below for words 49, 69, 76, 78, 82-87 and 119-120 of the Identify Drive data.

Description (if bit is set to 1)	
Bit	**Word 49**
8	DMA Supported
9	Shall be set to 1
10	IORDY May be disabled
11	IORDY supported
13	Standby Timer Values supported
Bit	Word 50
14	Shall be set to 1

Bit	Word 69
5	Read zero after Trim is supported
6	Optional ATA 28-bit commands supported
8	Download Microcode DMA supported
9	Set Max Password DMA and Set Max Unlock DMA supported
10	Write Buffer DMA Supported
11	Read Buffer DMA Supported
12	DEVICE CONFIGURATION IDENTIFY DMA and DEVICE CONFIGURATION SET DMA are supported
13	Long Physical Sector Alignment Error Reporting Control is supported
14	Deterministic read after Trim is supported
Bit	**Word 76**
0	Shall be cleared to zero
1	Supports SATA Gen1 Signaling Speed (1.5Gb/s)
2	Supports SATA Gen2 Signaling Speed (3.0Gb/s)
3	Supports SATA Gen3 Signaling Speed (6.0Gb/s)
4-7	Reserved for Serial ATA
8	Supports the NCQ feature set
9	Supports receipt of host initiated power management requests
10	Supports Phy Event Counters
11	Supports Unload while NCQ commands are outstanding
12	Supports NCQ priority information
13-15	Reserved for Serial ATA
Bit	**Word 78**
0	Shall be cleared to zero
1	Device supports non-zero buffer offsets
2	Device supports DMA Setup auto-activation
3	Device supports initiating power management
4	Device supports in-order data delivery
5	Reserved for Serial ATA
6	Device supports Software Settings Preservation
7-15	Reserved for Serial ATA
Bit	**Word 82**
0	The SMART feature set is supported
1	The Security feature set is supported
2	Obsolete
3	Mandatory Power Management feature set is supported
4	PACKET feature set is supported
5	Volatile write cache is supported
6	Read look-ahead is supported
7	Release interrupt is supported
8	SERVICE interrupt is supported
9	DEVICE RESET command is supported
10	HPA feature set is supported
11	Obsolete
12	WRITE BUFFER command is supported
13	READ BUFFER command is supported
14	NOP command is supported
15	Obsolete

Bit	Word 83
0	DOWNLOAD MICROCODE command is supported
1	Obsolete
2	CFA feature set is supported
3	APM feature set is supported
4	Obsolete
5	PUIS feature set is supported
6	SET FEATURES subcommand is required to spin-up after power-up
7	Reserved
8	SET MAX security extension is supported
9	AAM feature set is supported
10	48-bit Address feature set is supported
11	DCO feature set is supported
12	Mandatory FLUSH CACHE command is supported
13	FLUSH CACHE EXT command is supported
14	Shall be set to one
15	Shall be cleared to zero
Bit	**Word 84**
0	SMART error logging is supported
1	SMART self-test is supported
2	Media serial number is supported
3	Media Card Pass Through Command feature set is supported
4	Streaming feature set is supported
5	GPL feature set is supported
6	WRITE DMA FUA EXT and WRITE MULTIPLE FUA EXT commands are supported
7	Obsolete
8	64-bit World wide name is supported
9-10	Obsolete
11-12	Reserved for TLC
13	IDLE IMMEDIATE command with UNLOAD feature is supported
14	Shall be set to one
15	Shall be cleared to zero
Bit	**Word 85**
9	DEVICE RESET command is not supported
10	HPA feature set is supported
11	Obsolete
12	WRITE BUFFER command is supported
13	READ BUFFER command is supported
14	NOP command is supported
15	Obsolete
Bit	**Word 86**
0	DOWNLOAD MICROCODE command is supported
1	Obsolete
2	CFA feature set is supported
6	SET FEATURES subcommand is required to spin-up after power-up
10	The 48-bit Address features set is supported
11	The DCO feature set is supported
12	FLUSH CACHE command supported
13	FLUSH CACHE EXT command supported
15	Words 119 ... 120 are valid

Bit	Word 87
0	SMART error logging is supported
1	SMART self-test supported
3	The Media Card Pass Through Command feature set is supported
5	The GPL feature set is supported
6	WRITE DMA FUA EXT and WRITE MULTIPLE FUA EXT commands are supported
8	The 64-bit World wide name is supported
13	The IDLE IMMEDIATE command with UNLOAD FEATURE is supported
14	Shall be set to one
15	Shall be cleared to zero
Bit	**Word 119**
0	Reserved
1	Write-Read-Verify feature set is supported
2	WRITE UNCORRECTABLE EXT command is supported
3	READ LOG DMA EXT and WRITE LOG DMA EXT commands are supported
4	DOWNLOAD MICROCODE command with mode 3 is supported
5	Free-fall Control feature set is supported
6	Extended Status Reporting feature set is supported
7	Extended Power Conditions feature set is supported
8-13	Reserved
14	Shall be set to one
15	Shall be cleared to zero
Bit	**Word 120**
2	WRITE UNCORRECTABLE EXT command is supported
3	READ LOG DMA EXT and WRITE LOG DMA EXT commands are supported
4	DOWNLOAD MICROCODE command with mode 3 is supported
14	Shall be set to one
15	Shall be cleared to zero

4.3.2 Set Features command

This command controls the implementation of various features that the drive supports. When the drive receives this command, it sets BSY, checks the contents of the Features regis ter, 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 9   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

             02_H DMA Setup FIS Auto-Activate optimization

             03_H Device-initiated interface power state transitions

             06_H Software Settings Preservation

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

66_H Disable reverting to power-on defaults

82_H Disable write cache

90_H Disable use of SATA features

             02_H DMA Setup FIS Auto-Activate optimization

             03_H Device-initiated interface power state transitions

             06_H Software Settings Preservation

AA_H Enable read look-ahead (read cache) feature *(default)*.

CC_H Enable reverting to power-on defaults

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

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

S.M.A.R.T. provides near-term failure prediction for 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-8 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. You 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 10 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
$D4_H$	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.

4.3.4 SSD Percentage Endurance Remaining Indicator

An application can interrogate the drive through the host to determine an estimate of the percentage of device life that is remaining. Seagate SeaTools diagnostic software has the capability to report the indicator value.