

A decorative graphic on the left side of the page, featuring a large dashed circle, a solid blue circle, and several overlapping curved lines in light blue and grey.

Product Manual

# Barracuda ES.2 Serial ATA

**ST3100340NS**  
**ST3750330NS**

**ST3500320NS**  
**ST3250310NS**

100468393  
Rev. A  
August 2007

## Revision history

Revision	Date	Sheets affected or comments
Rev. A	08/10/07	Initial release

Copyright © 2007 Seagate Technology LLC. All rights reserved. Printed in U.S.A.

Publication number: 100468393, Rev. A August 2007

Seagate, Seagate Technology and the Wave logo are registered trademarks of Seagate Technology LLC in the United States and/or other countries. Barracuda, SeaTools and SeaTDD are either trademarks or registered trademarks of Seagate Technology LLC or one of its affiliated companies in the United States and/or other countries. All other trademarks or registered trademarks are the property of their respective owners.

One gigabyte, or GB, equals one billion bytes when referring to hard drive capacity. Accessible capacity may vary depending on operating environment and formatting. Seagate reserves the right to change, without notice, product offerings or specifications.

# Contents

<b>1.0</b>	<b>Introduction</b> . . . . .	<b>1</b>
1.1	About the Serial ATA interface . . . . .	2
<b>2.0</b>	<b>Drive specifications</b> . . . . .	<b>3</b>
2.1	Specification summary tables . . . . .	3
2.2	Formatted capacity . . . . .	8
2.2.1	LBA mode . . . . .	8
2.3	Default logical geometry . . . . .	8
2.4	Recording and interface technology . . . . .	9
2.5	Physical characteristics . . . . .	9
2.6	Seek time . . . . .	10
2.7	Start/stop times . . . . .	10
2.8	Power specifications . . . . .	11
2.8.1	Power consumption . . . . .	11
2.8.2	Conducted noise . . . . .	13
2.8.3	Voltage tolerance . . . . .	13
2.8.4	Power-management modes . . . . .	14
2.9	Environmental specifications . . . . .	15
2.9.1	Ambient temperature . . . . .	15
2.9.2	Temperature gradient . . . . .	15
2.9.3	Humidity . . . . .	15
2.9.4	Altitude . . . . .	15
2.9.5	Shock . . . . .	15
2.9.6	Vibration . . . . .	16
2.10	Acoustics . . . . .	17
2.11	Electromagnetic immunity . . . . .	17
2.12	Reliability . . . . .	18
2.12.1	Annualized Failure Rate (AFR) and Mean Time Between Failures (MTBF) . . . . .	18
2.13	Agency certification . . . . .	18
2.13.1	Safety certification . . . . .	18
2.13.2	Electromagnetic compatibility . . . . .	18
2.13.3	FCC verification . . . . .	19
2.14	Environmental protection . . . . .	20
2.14.1	European Union Restriction of Hazardous Substances (RoHS) Directive . . . . .	20
2.14.2	China Restriction of Hazardous Substances (RoHS) Directive . . . . .	20
2.15	Corrosive environment . . . . .	20
<b>3.0</b>	<b>Configuring and mounting the drive</b> . . . . .	<b>23</b>
3.1	Handling and static-discharge precautions . . . . .	23
3.2	Configuring the drive . . . . .	24
3.3	Serial ATA cables and connectors . . . . .	24
3.4	Drive mounting . . . . .	25
<b>4.0</b>	<b>Serial ATA (SATA) interface</b> . . . . .	<b>27</b>
4.1	Hot-Plug compatibility . . . . .	27
4.2	Serial ATA device plug connector pin definitions . . . . .	28
4.3	Supported ATA commands . . . . .	29
4.3.1	Identify Device command . . . . .	31
4.3.2	Set Features command . . . . .	35
4.3.3	S.M.A.R.T. commands . . . . .	36
<b>5.0</b>	<b>Seagate Technology support services</b> . . . . .	<b>37</b>



## List of Figures

Figure 1.	Typical 5V startup and operation current profile . . . . .	12
Figure 2.	Typical 12V startup and operation current profile . . . . .	13
Figure 3.	Serial ATA connectors . . . . .	24
Figure 4.	Attaching SATA cabling . . . . .	24
Figure 5.	Mounting dimensions—top, side and end view . . . . .	25



## 1.0 Introduction

---

This manual describes the functional, mechanical and interface specifications for the following Seagate Barracuda® ES.2 Serial ATA model drives:

ST31000340NS      ST3750330NS      ST3500320NS      ST3250310NS

These drives provide the following key features:

- 7,200 RPM spindle speed.
- High instantaneous (burst) data-transfer rates (up to 300 Mbytes per second).
- Perpendicular recording technology provides the drives with increased areal density.
- State-of-the-art cache and on-the-fly error-correction algorithms.
- Native Command Queueing with command ordering to increase performance in demanding applications.
- Full-track multiple-sector transfer capability without local processor intervention.
- Quiet 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.

## 1.1 About the Serial ATA interface

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

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

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

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

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

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

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



## 2.0 Drive specifications

---

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

ST31000340NS      ST3750330NS      ST3500320NS      ST3250310NS

### 2.1 Specification summary tables

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

**Table 1: Drive specifications summary for 1000 GB (1 Tbyte) and 750 GB models**

Drive specification	ST31000340NS	ST3750330NS
Formatted Gbytes (512 bytes/sector)*	1000	750
Guaranteed sectors	1,953,525,168	1,465,149,168
Heads	8	6
Discs	4	3
Bytes per sector	512	
Default sectors per track	63	
Default read/write heads	16	
Default cylinders	16,383	
Recording density, KBPI (kbits/in max)	1,090	
Track density, KTPI (ktracks/in avg.)	150	
Areal density, (Gbits/in <sup>2</sup> avg)	164	
Spindle speed (RPM)	7,200	
Internal data transfer rate (Mbits/sec max)	1287	
Sustained data transfer rate OD (Mbytes/sec max)	105	
I/O data-transfer rate (Mbytes/sec max)	300	
ATA data-transfer modes supported	PIO modes 0–4 Multiword DMA modes 0–2 Ultra DMA modes 0–6	
Cache buffer	32 Mbytes	
Height (mm max)	26.1 mm (1.028 inches)	
Width (mm max)	101.6 mm (4.000 inches) +/- 0.010 inches	
Length (mm max)	146.99 mm (5.787 inches)	
Weight (max)	665 grams (1.466 lbs)	630 grams (1.389 lbs)
Average latency	4.16 msec	
Power-on to ready (sec max)	20 sec	
Standby to ready (sec max)	10 sec	9 sec
Track-to-track seek time (msec typical)	0.8 read; 1.0 write	
Average seek, read (msec typical)	8.5	
Average seek, write (msec typical)	9.5	
Startup current (typical) 12V (peak)	2.8 amps	
Voltage tolerance (including noise)	5V + 10% / -7.5% 12V + 10% / -7.5%	
Ambient temperature	5° to 55°C (operating) –40° to 70°C (nonoperating)	
Temperature gradient (°C per hour max)	20°C (operating) 30°C (nonoperating)	
Relative humidity	5% to 95% (operating) 5% to 95% (nonoperating)	
Relative humidity gradient	30% per hour max	
Wet bulb temperature (°C max)	37.7 (operating) 40.0 (nonoperating)	
Altitude, operating	–60.96 m to 3,048 m (–200 ft. to 10,000+ ft.)	
Altitude, nonoperating (below mean sea level, max)	–60.96 m to 12,192 m (–200 ft. to 40,000+ ft.)	
Operational Shock (max at 2 msec)	70 Gs	
Non-Operational Shock (max at 2 msec)	300 Gs	

Drive specification	ST31000340NS	ST3750330NS
Vibration, operating	5–22 Hz: 0.25 Gs, Limited displacement 22–350 Hz: 0.50 Gs 350–500 Hz: 0.25 Gs	
Vibration, nonoperating	5–22 Hz: 2.0 Gs, Limited displacement 22–350 Hz: 5.0 Gs 350–500 Hz: 2.0 Gs	
Drive acoustics, sound power (bels)		
Active	3.25 (typical) 3.4 (max)	
Idle**	2.7 (typical) 2.9 (max)	
Performance seek	3.05 (typical) 3.2 (max)	
Quiet seek	2.95 (typical) 3.1 (max)	
Nonrecoverable read errors	1 sector per 10 <sup>15</sup> bits read	
Annualized Failure Rate (AFR)	0.73%	
Warranty	5 years on distribution units. To determine the warranty for a specific drive, use a web browser to access the following web page: <a href="http://www.seagate.com/support/service/">www.seagate.com/support/service/</a> From this page, click on the "Verify Your Warranty" link. You will be asked to provide the drive serial number, model number (or part number) and country of purchase. The system will display the warranty information for your drive.	
Contact start-stop cycles (25°C, 50% rel. humidity)	50,000	
Supports Hotplug operation per Serial ATA Revision 2.5 specification	Yes	

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

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

**Table 2: Drive specifications summary for 500 GB and 250 GB models**

Drive specification	ST3500320NS	ST3250310NS
Formatted Gbytes (512 bytes/sector)*	500	250
Guaranteed sectors	976,773,168	488,397,168
Heads	4	2
Discs	2	1
Bytes per sector	512	
Default sectors per track	63	
Default read/write heads	16	
Default cylinders	16,383	
Recording density, KBPI (kbits/in max)	1,090	
Track density, KTPI (ktracks/in avg.)	150	
Areal density, (Gbits/in <sup>2</sup> avg)	164	
Spindle speed (RPM)	7,200	
Internal data transfer rate (Mbits/sec max)	1287	
Sustained data transfer rate OD (Mbytes/sec max)	105	
I/O data-transfer rate (Mbytes/sec max)	300	
ATA data-transfer modes supported	PIO modes 0–4 Multiword DMA modes 0–2 Ultra DMA modes 0–6	
Cache buffer	32 Mbytes	
Height (mm max)	26.1 mm (1.028 inches)	
Width (mm max)	101.6 mm (4.000 inches) +/- 0.010 inches	
Length (mm max)	146.99 mm (5.787 inches)	
Weight (max)	530 grams (1.168 lbs)	495 grams (1.091 lbs)
Average latency	4.16 msec	
Power-on to ready (sec max)	20 sec	
Standby to ready (sec max)	8 sec	
Track-to-track seek time (msec typical)	0.8 read; 1.0 write	
Average seek, read (msec typical)	8.5	
Average seek, write (msec typical)	9.5	
Startup current (typical) 12V (peak)	2.8 amps	
Voltage tolerance (including noise)	5V + 10% / -7.5% 12V + 10% / -7.5%	
Ambient temperature	5° to 55°C (operating) –40° to 70°C (nonoperating)	
Temperature gradient (°C per hour max)	20°C (operating) 30°C (nonoperating)	
Relative humidity	5% to 95% (operating) 5% to 95% (nonoperating)	
Relative humidity gradient	30% per hour max	
Wet bulb temperature (°C max)	37.7 (operating) 40.0 (nonoperating)	
Altitude, operating	–60.96 m to 3,048 m (–200 ft. to 10,000+ ft.)	
Altitude, nonoperating (below mean sea level, max)	–60.96 m to 12,192 m (–200 ft. to 40,000+ ft.)	
Operational Shock (max at 2 msec)	70 Gs	
Non-Operational Shock (max at 2 msec)	300 Gs	

Drive specification	ST3500320NS	ST3250310NS
Vibration, operating	5–22 Hz: 0.25 Gs, Limited displacement 22–350 Hz: 0.50 Gs 350–500 Hz: 0.25 Gs	
Vibration, nonoperating	5–22 Hz: 2.0 Gs, Limited displacement 22–350 Hz: 5.0 Gs 350–500 Hz: 2.0 Gs	
Drive acoustics, sound power (bels)		
Active	3.25 (typical) 3.4 (max)	
Idle**	2.5 (typical) 2.7 (max)	
Performance seek	2.85 (typical) 3.0 (max)	
Quiet seek	2.75 (typical) 2.9 (max)	
Nonrecoverable read errors	1 sector per 10 <sup>15</sup> bits read	
Annualized Failure Rate (AFR)	0.73%	
Warranty	5 years on distribution units. To determine the warranty for a specific drive, use a web browser to access the following web page: <a href="http://www.seagate.com/support/service/">www.seagate.com/support/service/</a> From this page, click on the “Verify Your Warranty” link. You will be asked to provide the drive serial number, model number (or part number) and country of purchase. The system will display the warranty information for your drive.	
Contact start-stop cycles (25°C, 50% rel. humidity)	50,000	
Supports Hotplug operation per Serial ATA Revision 2.5 specification	Yes	

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

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

## 2.2 Formatted capacity

Model	Formatted capacity*	Guaranteed sectors	Bytes per sector
ST31000340NS	1000 Gbytes	1,953,525,168	512
ST3750330NS	750 Gbytes	1,465,149,168	
ST3500320NS	500 Gbytes	976,773,168	
ST3250310NS	250 Gbytes	488,397,168	

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

### 2.2.1 LBA mode

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

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

## 2.3 Default logical geometry

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

### LBA mode

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

## 2.4 Recording and interface technology

	1000GB	750GB	500GB	250GB
Interface	Serial ATA (SATA)			
Recording method	Perpendicular			
Recording density, KBPI (kbits/inch max)	1,090			
Track density, KTPI (ktracks/inch avg)	150			
Areal density (Gbits/inch <sup>2</sup> avg)	164			
Spindle speed (RPM) (± 0.2%)	7,200			
Internal data transfer rate (Mbits/sec max)	1287			
Sustained data transfer rate (Mbytes/sec max)	105			
I/O data-transfer rate (Mbytes/sec max)	300 (Ultra DMA mode 5)			

## 2.5 Physical characteristics

Maximum height	26.1 mm (1.028 inches)
Maximum width	101.6 mm (4.000 +/- 0.010 inches)
Maximum length	146.99 mm (5.787 inches)
Max weight	
ST31000340NS	665 grams (1.466 lbs)
ST3750330NS	630 grams (1.389 lbs)
ST3500320NS	530 grams (1.168 lbs)
ST3250310NS	495 grams (1.091 lbs)
Cache buffer	32 Mbytes (16,384 kbytes)

## 2.6 Seek time

Seek measurements are taken with nominal power at 25°C ambient temperature. All times are measured using drive diagnostics. The specifications in the table below are defined as follows:

- Track-to-track seek time is an average of all possible single-track seeks in both directions.
- Average seek time is a true statistical random average of at least 5,000 measurements of seeks between random tracks, less overhead.

*Typical seek times (msec)	Read	Write
Track-to-track	0.8	1.0
Average	8.5	9.5
Average latency:	4.16	

\*Measured in performance mode.

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

## 2.7 Start/stop times

	ST31000340NS	ST3750330NS	ST3500320NS, ST3250310NS
Power-on to Ready (sec)	20 (max)		
Standby to Ready (sec)	10 (max)	9 (max)	8 (max)
Ready to spindle stop (sec)	20 (max)		



## 2.8 Power specifications

The drive receives DC power (+5V or +12V) through a native SATA power connector. See Figure 4 on page 24.

### 2.8.1 Power consumption

Power requirements for the drives are listed in the table on page 9. Typical power measurements are based on an average of drives tested, under nominal conditions, using 5.0V and 12.0V input voltage at 25°C ambient temperature.

- **Spinup power**

Spinup power is measured from the time of power-on to the time that the drive spindle reaches operating speed.

- **Seek mode**

During seek mode, the read/write actuator arm moves toward a specific position on the disc surface and does not execute a read or write operation. Servo electronics are active. Seek mode power represents the worst-case power consumption, using only random seeks with read or write latency time. This mode is not typical and is provided for worst-case information.

- **Read/write power and current**

Read/write power is measured with the heads on track, based on a 16-sector write followed by a 32-msec delay, then a 16-sector read followed by a 32-msec delay.

- **Operating power and current**

Operating power is measured using 40 percent random seeks, 40 percent read/write mode (1 write for each 10 reads) and 20 percent drive idle mode.

- **Idle mode power**

Idle mode power is measured with the drive up to speed, with servo electronics active and with the heads in a random track location.

- **Standby mode**

During Standby mode, the drive accepts commands, but the drive is not spinning, and the servo and read/write electronics are in power-down mode.

**Table 3: DC power requirements**

Power dissipation (4-disc values shown)	Avg (watts 25° C)	Avg 5V typ amps	Avg 12V typ amps
Spinup	—	—	2.80 (peak)
Idle*	7.96	0.320	0.530
Idle* (with offline activity)	9.29	0.610	0.520
Operating (40% r/w, 40% seek, 20% inop.)	11.16	0.600	0.680
Seeking (random, 20% idle)	10.42	0.500	0.660
Standby	0.99	0.150	0.020
Sleep	0.99	0.150	0.020

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

### 2.8.1.1 Typical current profiles

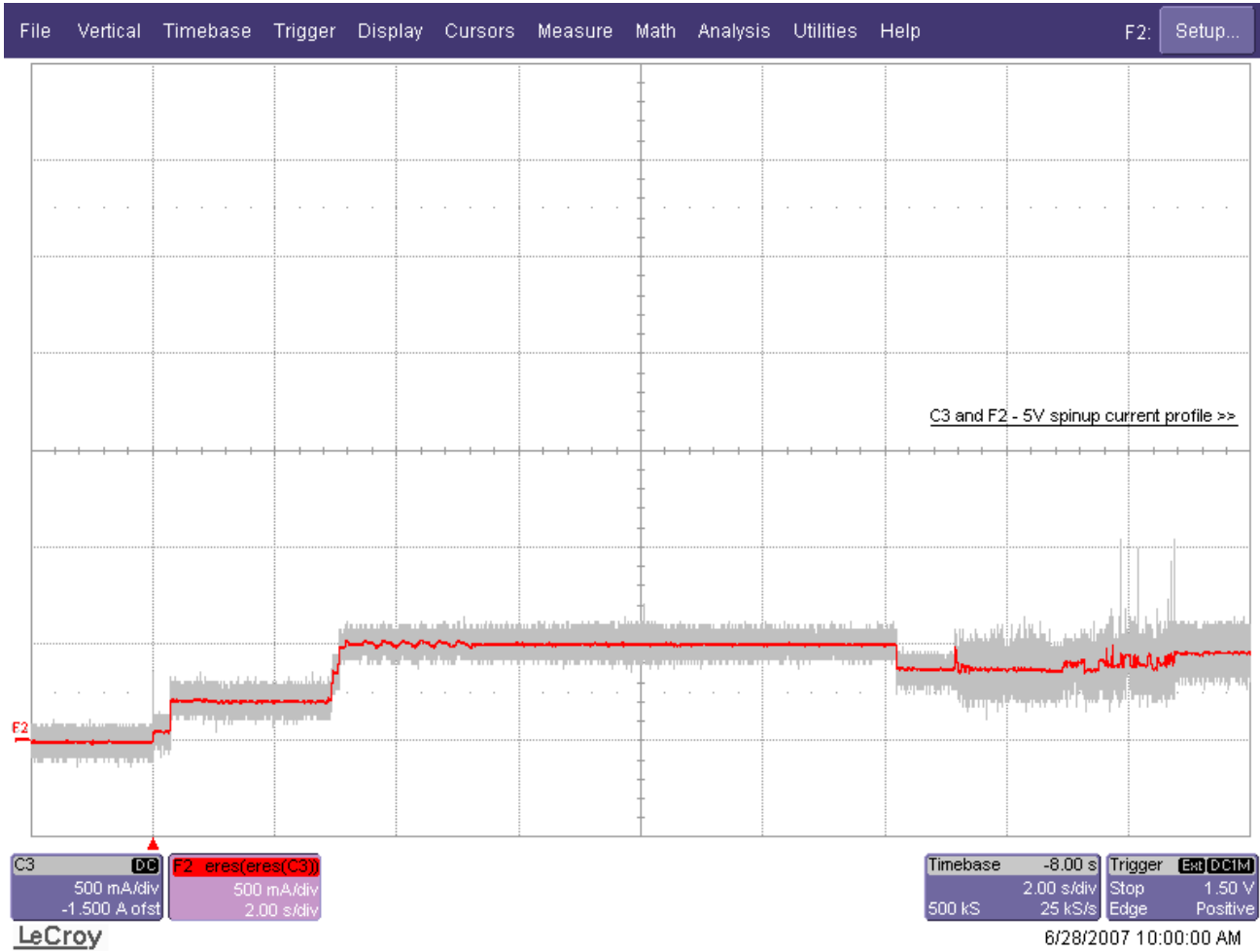


Figure 1. Typical 5V startup and operation current profile

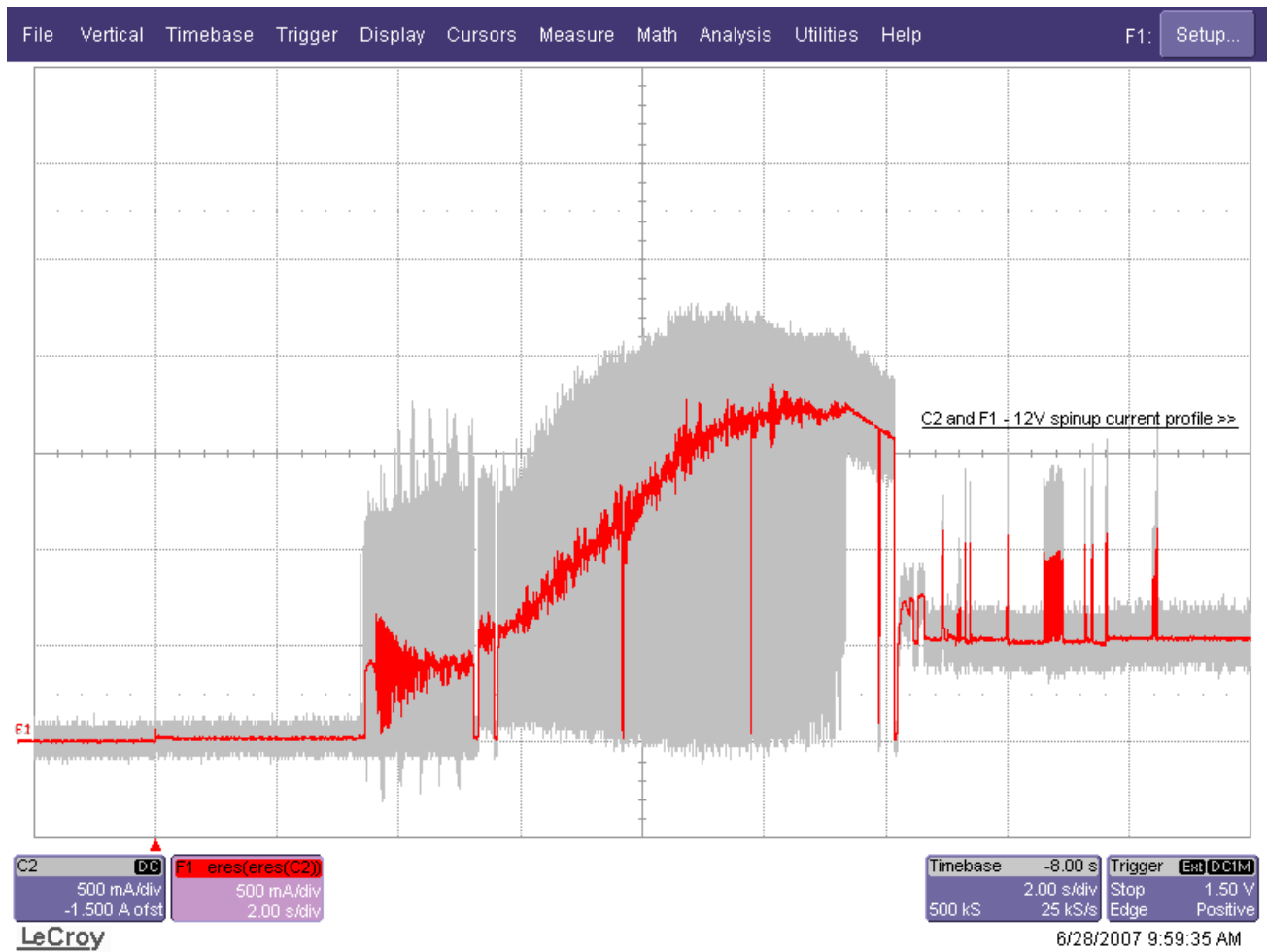


Figure 2. Typical 12V startup and operation current profile

### 2.8.2 Conducted noise

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

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

**Note.** Equivalent resistance is calculated by dividing the nominal voltage by the typical RMS read/write current.

### 2.8.3 Voltage tolerance

Voltage tolerance (including noise):

5V +10% / -7.5%  
 12V +10% / -7.5%

## 2.8.4 Power-management modes

The drive provides programmable power management to provide greater energy efficiency. In most systems, you can control power management through the system setup program. The drive features the following power-management modes:

Power modes	Heads	Spindle	Buffer
Active	Tracking	Rotating	Enabled
Idle	Tracking	Rotating	Enabled
Standby	Parked	Stopped	Enabled
Sleep	Parked	Stopped	Disabled

- **Active mode**

The drive is in Active mode during the read/write and seek operations.

- **Idle mode**

The buffer remains enabled, and the drive accepts all commands and returns to Active mode any time disc access is necessary.

- **Standby mode**

The drive enters Standby mode when the host sends a Standby Immediate command. If the host has set the standby timer, the drive can also enter Standby mode automatically after the drive has been inactive for a specifiable length of time. The standby timer delay is established using a Standby or Idle command. In Standby mode, the drive buffer is enabled, the heads are parked and the spindle is at rest. The drive accepts all commands and returns to Active mode any time disc access is necessary.

- **Sleep mode**

The drive enters Sleep mode after receiving a Sleep command from the host. In Sleep mode, the drive buffer is disabled, the heads are parked and the spindle is at rest. The drive leaves Sleep mode after it receives a Hard Reset or Soft Reset from the host. After receiving a reset, the drive exits Sleep mode and enters Standby mode with all current translation parameters intact.

- **Idle and Standby timers**

Each time the drive performs an Active function (read, write or seek), the standby timer is reinitialized and begins counting down from its specified delay times to zero. If the standby timer reaches zero before any drive activity is required, the drive makes a transition to Standby mode. In both Idle and Standby mode, the drive accepts all commands and returns to Active mode when disc access is necessary.

## 2.9 Environmental specifications

### 2.9.1 Ambient temperature

Ambient temperature is defined as the temperature of the environment immediately surrounding the drive. Actual drive case temperature should not exceed 60°C (140°F) within the operating ambient conditions.

Above 1,000 feet (305 meters), the maximum temperature is derated linearly to 112°F (44°C) at 10,000 feet (3,048 meters).

Operating:	5° to 55°C (41° to 131°F)
Nonoperating:	-40° to 70°C (-40° to 158°F)

### 2.9.2 Temperature gradient

Operating:	20°C per hour (68°F per hour max), without condensation
Nonoperating:	30°C per hour (86°F per hour max)

### 2.9.3 Humidity

#### 2.9.3.1 Relative humidity

Operating:	5% to 95% noncondensing (30% per hour max)
Nonoperating:	5% to 95% noncondensing (30% per hour max)

#### 2.9.3.2 Wet bulb temperature

Operating:	37.7°C (99.9°F max)
Nonoperating:	40.0°C (104.0°F max)

### 2.9.4 Altitude

Operating:	-60.96 m to 3,048 m (-200 ft. to 10,000+ ft.)
Nonoperating:	-60.96 m to 12,192 m (-200 ft. to 40,000+ ft.)

### 2.9.5 Shock

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

#### 2.9.5.1 Operating shock

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

#### 2.9.5.2 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 300 Gs based on a nonrepetitive half-sine shock pulse of 2 msec duration.

## 2.9.6 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.

### 2.9.6.1 Operating vibration

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

5–22 Hz	0.25 Gs (Limited displacement)
22–350 Hz	0.50 Gs
350–500 Hz	0.25 Gs

### 2.9.6.2 Nonoperating vibration

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

5–22 Hz	2.0 Gs (limited displacement)
22–350 Hz	5.0 Gs
350–500 Hz	2.0 Gs

## 2.10 Acoustics

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

**Note.** For seek mode tests, the drive is placed in seek mode only. The number of seeks per second is defined by the following equation:

$$(\text{Number of seeks per second} = 0.4 / (\text{average latency} + \text{average access time}))$$

**Table 4: Fluid Dynamic Bearing (FDB) motor acoustics**

	Active	Idle*	Performance seek	Quiet Seek
ST31000340NS	3.25 bels (typ) 3.4 bels (max)	2.7 bels (typ) 2.9 bels (max)	3.05 bels (typ) 3.2 bels (max)	2.95 bels (typ) 3.1 bels (max)
ST3750330NS				
ST3500320NS				
ST3250310NS		2.5 bels (typ) 2.7 bels (max)	2.85 bels (typ) 3.0 bels (max)	2.75 bels (typ) 2.9 bels (max)

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

## 2.11 Electromagnetic immunity

When properly installed in a representative host system, the drive operates without errors or degradation in performance when subjected to the radio frequency (RF) environments defined in 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 1,000 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

## 2.12 Reliability

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

The product shall achieve an Annualized Failure Rate - AFR - of 0.73% (Mean Time Between Failures - MTBF - of 1.2 Million hrs) when operated in an environment that ensures the HDA case temperatures do not exceed 50°C. Operation at case temperatures outside the specifications in Section 2.9 may increase the product Annualized Failure Rate (decrease MTBF). AFR and MTBF are population statistics that are not relevant to individual units.

AFR and MTBF specifications are based on the following assumptions for business critical storage system environments:

- 8,760 power-on-hours per year.
- 250 average motor start/stop cycles per year.
- Operations at nominal voltages.
- Systems will provide adequate cooling to ensure the case temperatures do not exceed 50°C. Temperatures outside the specifications in Section 2.9 will increase the product AFR and decrease MTBF.

Nonrecoverable read errors	1 per 10 <sup>15</sup> bits read, max
Annualized Failure Rate (AFR)	0.73% (nominal power, 50°C case temperature)
Contact start-stop cycles	50,000 cycles (at nominal voltage and temperature, with 60 cycles per hour and a 50% duty cycle)
Warranty	5 years on distribution units. To determine the warranty for a specific drive, use a web browser to access the following web page: <a href="http://www.seagate.com/support/service/">www.seagate.com/support/service/</a> From this page, click on the “Verify Your Warranty” link. You will be asked to provide the drive serial number, model number (or part number) and country of purchase. The system will display the warranty information for your drive.
Preventive maintenance	None required.

## 2.13 Agency certification

### 2.13.1 Safety certification

The drives are recognized in accordance with UL 1950 and CSA C22.2 (950) and meet all applicable sections of IEC950 and EN 60950 as tested by TUV North America.

### 2.13.2 Electromagnetic compatibility

Hard drives that display the CE mark comply with the European Union (EU) requirements specified in the Electromagnetic Compatibility Directive (89/336/EEC). 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 with 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 RRL

If these drives have the Korea Ministry of Information and Communication (MIC) logo, they comply with paragraph 1 of Article 11 of the Electromagnetic Compatibility control Regulation and meet the Electromagnetic Compatibility (EMC) Framework requirements of the Radio Research Laboratory (RRL) Ministry of Information and Communication Republic of Korea.

These drives have been tested and comply with the Electromagnetic Interference/Electromagnetic Susceptibility (EMI/EMS) for Class B products. Drives are tested in a representative, end-user system by a Korean-recognized lab.

- Barracuda ES.2
- Certificate number:
  - 1 TB- STX- ST31000340NS (B)
  - 750 GB- STX- ST31000340NS (B)
  - 500 GB- STX- ST3500320NS (B)
  - 250 GB- STX- ST3500320NS (B)

## Australian C-Tick (N176)

If these models have the C-Tick marking, they comply with the Australia/New Zealand Standard AS/NZS3548 1995 and meet the Electromagnetic Compatibility (EMC) Framework requirements of the Australian Communication Authority (ACA).

### 2.13.3 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, disc 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.

## 2.14 Environmental protection

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

### 2.14.1 European Union Restriction of Hazardous Substances (RoHS) Directive

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

### 2.14.2 China Restriction of Hazardous Substances (RoHS) Directive

#### 2.14.2 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 Biphenyl 多溴联苯 (PBB)	Polybrominated Diphenyl Ether 多溴二苯醚 (PBDE)
PCBA	X	O	O	O	O	O
HDA	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。

## 2.15 Corrosive environment

Seagate electronic drive components pass accelerated corrosion testing equivalent to 10 years exposure to light industrial environments containing sulfurous gases, chlorine and nitric oxide, classes G and H per ASTM B845. However, this accelerated testing cannot duplicate every potential application environment. Users should use caution exposing any electronic components to uncontrolled chemical pollutants and corrosive chemicals as electronic drive component reliability can be affected by the installation environment. The silver, copper, nickel and gold films used in Seagate products are especially sensitive to the presence of sulfide, chloride, and nitrate contaminants. Sulfur is found to be the most damaging. In addition, electronic components should never be exposed to condensing water on the surface of the printed circuit board assembly (PCBA) or

exposed to an ambient relative humidity greater than 95%. Materials used in cabinet fabrication, such as vulcanized rubber, that can outgas corrosive compounds should be minimized or eliminated. The useful life of any electronic equipment may be extended by replacing materials near circuitry with sulfide-free alternatives.



## 3.0 Configuring and mounting the drive

---

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

### 3.1 Handling and static-discharge precautions

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

**Caution:**

- Before handling the drive, put on a grounded wrist strap, or ground 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.
- Handle the drive by its edges or frame *only*.
- The drive is extremely fragile—handle it with care. Do not press down on the drive top cover.
- Always rest the drive on a padded, antistatic surface until 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. Other labels are used to seal out dirt and contamination.

## 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 installation. It is usually not necessary to set any jumpers on the drive for proper operation; however, if you connect the drive and receive a “drive not detected” error, your SATA-equipped motherboard or host adapter may use a chipset that does not support SATA speed autonegotiation. If you have a motherboard or host adapter that does not support autonegotiation:

- Install a jumper as shown in Figure 3 below to limit the data transfer rate to 1.5 Gbits per second (and leave the drive connected to the SATA-equipped motherboard or host adapter that doesn't support autonegotiation) or
- Install a SATA host adapter that supports autonegotiation, leave the drive jumper block set to “Normal operation” (see Figure 3 below), and connect the drive to that adapter. This option has the benefit of not limiting the drive to a 1.5 Gbits/sec transfer rate.

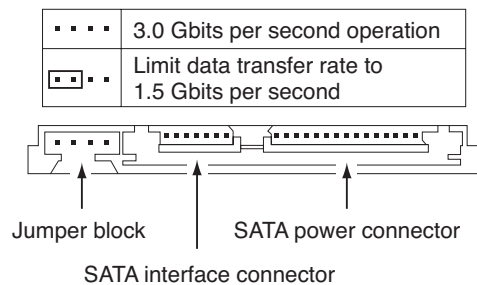


Figure 3. Serial ATA connectors

## 3.3 Serial ATA cables and connectors

The Serial ATA interface cable consists of four conductors in two differential pairs, plus three ground connections. The cable size may be 30 to 26 AWG with a maximum length of one meter (39.37 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 Figure 4.

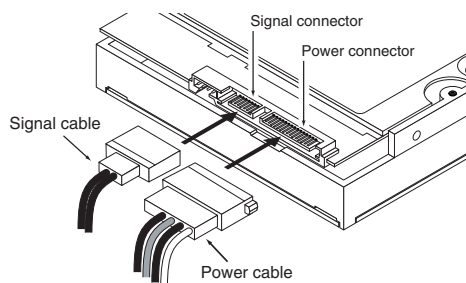


Figure 4. Attaching SATA cabling

Each cable is keyed to ensure correct orientation. Barracuda ES.2 Serial ATA 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. See Figure 5 for drive mounting dimensions. Follow these important mounting precautions when mounting the drive:

- Allow a minimum clearance of 0.030 inches (0.76 mm) around the entire perimeter of the drive for cooling.
- Use only 6-32 UNC mounting screws.
- The screws should be inserted no more than 0.150 inch (3.81 mm) into the bottom or side mounting holes.
- Do not overtighten the mounting screws (maximum torque: 6 inch-lb).

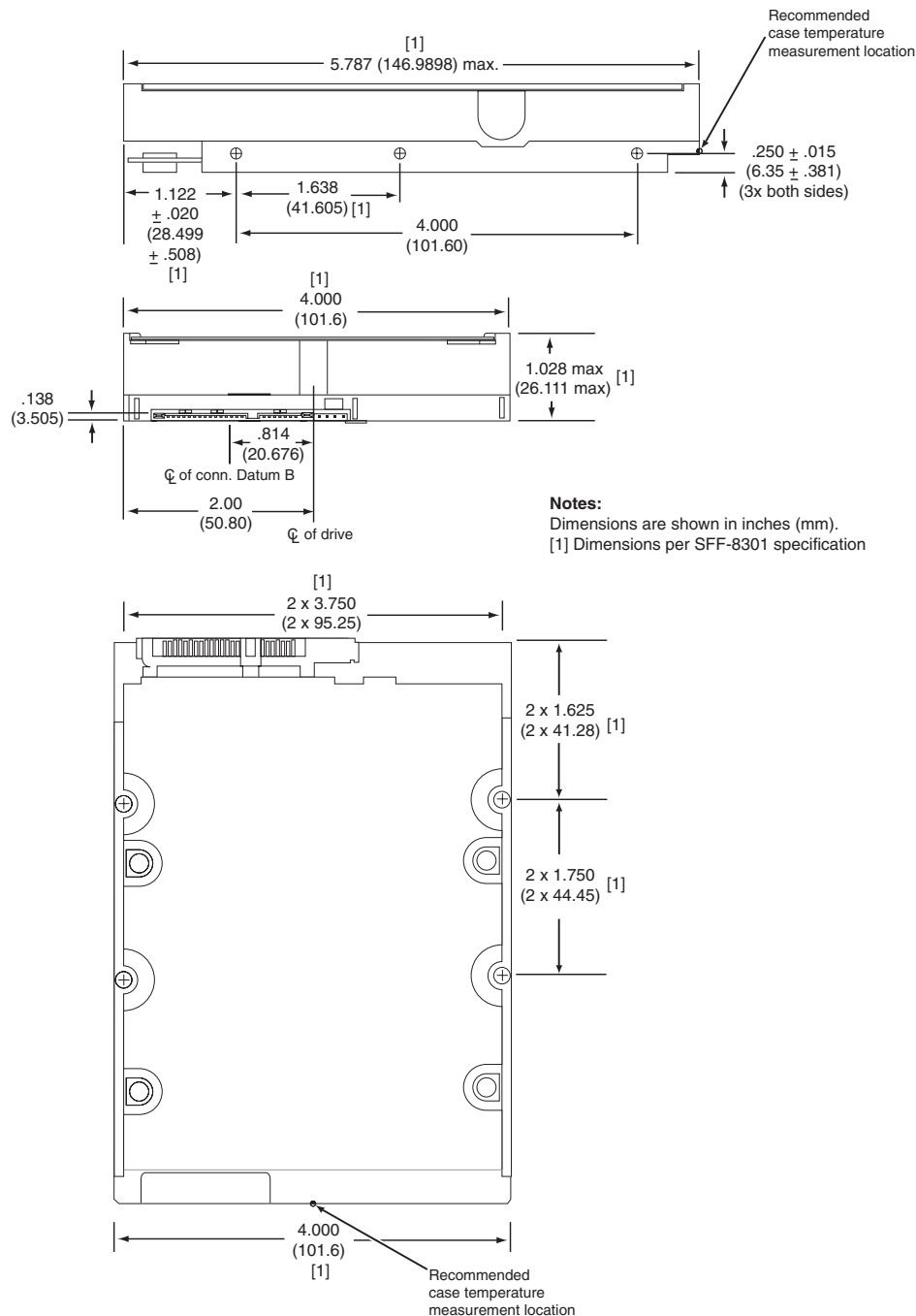


Figure 5. Mounting dimensions—top, side and end view





## **4.0 Serial ATA (SATA) interface**

---

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

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

### **4.1 Hot-Plug compatibility**

Barracuda ES.2 Serial ATA 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](http://www.serialata.org).

## 4.2 Serial ATA device plug connector pin definitions

Table 6 summarizes the signals on the Serial ATA interface and power connectors.

**Table 6: Serial ATA connector pin definitions**

Segment	Pin	Function	Definition
<b>Signal</b>	S1	Ground	2nd mate
	S2	A+	Differential signal pair A from Phy
	S3	A-	
	S4	Ground	2nd mate
	S5	B-	Differential signal pair B from Phy
	S6	B+	
	S7	Ground	2nd mate

Key and spacing separate signal and power segments

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

### Notes:

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

### 4.3 Supported ATA commands

The following table lists Serial ATA standard commands that the drive supports. For a detailed description of the ATA commands, refer to the Serial ATA: High Speed Serialized AT Attachment specification. See “S.M.A.R.T. commands” on page 36 for details and subcommands used in the S.M.A.R.T. implementation.

**Table 7: Supported ATA commands**

Command name	Command code (in hex)
Check Power Mode	98 <sub>H</sub> or E5 <sub>H</sub>
Device Configuration Freeze Lock	B1 <sub>H</sub> / C1 <sub>H</sub>
Device Configuration Identify	B1 <sub>H</sub> / C2 <sub>H</sub>
Device Configuration Restore	B1 <sub>H</sub> / C0 <sub>H</sub>
Device Configuration Set	B1 <sub>H</sub> / C3 <sub>H</sub>
Device Reset	08 <sub>H</sub>
Download Microcode	92 <sub>H</sub>
Execute Device Diagnostics	90 <sub>H</sub>
Flush Cache	E7 <sub>H</sub>
Flush Cache Extended	EA <sub>H</sub>
Format Track	50 <sub>H</sub>
Identify Device	EC <sub>H</sub>
Idle	97 <sub>H</sub> or E3 <sub>H</sub>
Idle Immediate	95 <sub>H</sub> or E1 <sub>H</sub>
Initialize Device Parameters	91 <sub>H</sub>
Read Buffer	E4 <sub>H</sub>
Read DMA	C8 <sub>H</sub>
Read DMA Extended	25 <sub>H</sub>
Read DMA Without Retries	C9 <sub>H</sub>
Read Log Ext	2F <sub>H</sub>
Read Multiple	C4 <sub>H</sub>
Read Multiple Extended	29 <sub>H</sub>
Read Native Max Address	F8 <sub>H</sub>
Read Native Max Address Extended	27 <sub>H</sub>
Read Sectors	20 <sub>H</sub>
Read Sectors Extended	24 <sub>H</sub>
Read Sectors Without Retries	21 <sub>H</sub>
Read Verify Sectors	40 <sub>H</sub>
Read Verify Sectors Extended	42 <sub>H</sub>
Read Verify Sectors Without Retries	41 <sub>H</sub>
Recalibrate	10 <sub>H</sub>
Security Disable Password	F6 <sub>H</sub>
Security Erase Prepare	F3 <sub>H</sub>

Command name	Command code (in hex)
Security Erase Unit	F4 <sub>H</sub>
Security Freeze	F5 <sub>H</sub>
Security Set Password	F1 <sub>H</sub>
Security Unlock	F2 <sub>H</sub>
Seek	70 <sub>H</sub>
Set Features	EF <sub>H</sub>
Set Max Address Note: Individual Set Max Address commands are identified by the value placed in the Set Max Features register as defined to the right.	F9 <sub>H</sub> Address: 00 <sub>H</sub> Password: 01 <sub>H</sub> Lock: 02 <sub>H</sub> Unlock: 03 <sub>H</sub> Freeze Lock: 04 <sub>H</sub>
Set Max Address Extended	37 <sub>H</sub>
Set Multiple Mode	C6 <sub>H</sub>
Sleep	99 <sub>H</sub> or E6 <sub>H</sub>
S.M.A.R.T. Disable Operations	B0 <sub>H</sub> / D9 <sub>H</sub>
S.M.A.R.T. Enable/Disable Autosave	B0 <sub>H</sub> / D2 <sub>H</sub>
S.M.A.R.T. Enable Operations	B0 <sub>H</sub> / D8 <sub>H</sub>
S.M.A.R.T. Execute Offline	B0 <sub>H</sub> / D4 <sub>H</sub>
S.M.A.R.T. Read Attribute Thresholds	B0 <sub>H</sub> / D1 <sub>H</sub>
S.M.A.R.T. Read Data	B0 <sub>H</sub> / D0 <sub>H</sub>
S.M.A.R.T. Read Log Sector	B0 <sub>H</sub> / D5 <sub>H</sub>
S.M.A.R.T. Return Status	B0 <sub>H</sub> / DA <sub>H</sub>
S.M.A.R.T. Save Attribute Values	B0 <sub>H</sub> / D3 <sub>H</sub>
S.M.A.R.T. Write Log Sector	B0 <sub>H</sub> / D6 <sub>H</sub>
Standby	96 <sub>H</sub> or E2 <sub>H</sub>
Standby Immediate	94 <sub>H</sub> or E0 <sub>H</sub>
Write Buffer	E8 <sub>H</sub>
Write DMA	CA <sub>H</sub>
Write DMA Extended	35 <sub>H</sub>
Write DMA FUA Extended	CD <sub>H</sub>
Write DMA Without Retries	CB <sub>H</sub>
Write Log Extended	3F <sub>H</sub>
Write Multiple	C5 <sub>H</sub>
Write Multiple Extended	39 <sub>H</sub>
Write Multiple FUA Extended	CE <sub>H</sub>
Write Sectors	30 <sub>H</sub>
Write Sectors Without Retries	31 <sub>H</sub>
Write Sectors Extended	34 <sub>H</sub>

### 4.3.1 Identify Device command

The Identify Device command (command code EC<sub>H</sub>) transfers information about the drive to the host following power up. The data is organized as a single 512-byte block of data, whose contents are shown in Table 7 on page 29. 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	Configuration information: • Bit 15: 0 = ATA; 1 = ATAPI • Bit 7: removable media • Bit 6: removable controller • Bit 0: reserved	0C5A <sub>H</sub>
1	Number of logical cylinders	16,383
2	ATA-reserved	0000 <sub>H</sub>
3	Number of logical heads	16
4	Retired	0000 <sub>H</sub>
5	Retired	0000 <sub>H</sub>
6	Number of logical sectors per logical track: 63	003F <sub>H</sub>
7–9	Retired	0000 <sub>H</sub>
10–19	Serial number: (20 ASCII characters, 0000 <sub>H</sub> = none)	ASCII
20	Retired	0000 <sub>H</sub>
21	Retired	0400 <sub>H</sub>
22	Obsolete	0000 <sub>H</sub>
23–26	Firmware revision (8 ASCII character string, padded with blanks to end of string)	x.xx
27–46	Drive model number: (40 ASCII characters, padded with blanks to end of string)	
47	(Bits 7–0) Maximum sectors per interrupt on Read multiple and Write multiple (16)	8010 <sub>H</sub>
48	Reserved	0000 <sub>H</sub>
49	Standard Standby timer, IORDY supported and may be disabled	2F00 <sub>H</sub>
50	ATA-reserved	0000 <sub>H</sub>
51	PIO data-transfer cycle timing mode	0200 <sub>H</sub>
52	Retired	0200 <sub>H</sub>
53	Words 54–58, 64–70 and 88 are valid	0007 <sub>H</sub>
54	Number of current logical cylinders	xxxx <sub>H</sub>
55	Number of current logical heads	xxxx <sub>H</sub>
56	Number of current logical sectors per logical track	xxxx <sub>H</sub>
57–58	Current capacity in sectors	xxxx <sub>H</sub>
59	Number of sectors transferred during a Read Multiple or Write Multiple command	xxxx <sub>H</sub>

Word	Description	Value
60–61	Total number of user-addressable LBA sectors available (see Section 2.2 for related information) *Note: The maximum value allowed in this field is: 0FFFFFFFh (268,435,455 sectors, 137 Gbytes). Drives with capacities over 137 Gbytes will have 0FFFFFFFh in this field and the actual number of user-addressable LBAs specified in words 100-103. This is required for drives that support the 48-bit addressing feature.	0FFFFFFFh*
62	Retired	0000 <sub>H</sub>
63	Multiword DMA active and modes supported (see note following this table)	xx07 <sub>H</sub>
64	Advanced PIO modes supported (modes 3 and 4 supported)	0003 <sub>H</sub>
65	Minimum multiword DMA transfer cycle time per word (120 nsec)	0078 <sub>H</sub>
66	Recommended multiword DMA transfer cycle time per word (120 nsec)	0078 <sub>H</sub>
67	Minimum PIO cycle time without IORDY flow control (240 nsec)	00F0 <sub>H</sub>
68	Minimum PIO cycle time with IORDY flow control (120 nsec)	0078 <sub>H</sub>
69–74	ATA-reserved	0000 <sub>H</sub>
75	Queue depth	0000 <sub>H</sub>
76	Serial ATA capabilities	xxxx <sub>H</sub>
77	Reserved for future Serial ATA definition	xxxx <sub>H</sub>
78	Serial ATA features supported	xxxx <sub>H</sub>
79	Serial ATA features enabled	xxxx <sub>H</sub>
80	Major version number	003E <sub>H</sub>
81	Minor version number	0000 <sub>H</sub>
82	Command sets supported	364B <sub>H</sub>
83	Command sets supported	7C03 <sub>H</sub>
84	Command sets support extension	4003 <sub>H</sub>
85	Command sets enabled	30xx <sub>H</sub>
86	Command sets enabled	0001 <sub>H</sub>
87	Command sets enable extension	4000 <sub>H</sub>
88	Ultra DMA support and current mode (see note following this table)	xx3F <sub>H</sub>
89	Security erase time	0000 <sub>H</sub>
90	Enhanced security erase time	0000 <sub>H</sub>
92	Master password revision code	FFFE <sub>H</sub>
93	Hardware reset value (see description following this table)	xxxx <sub>H</sub>
95–99	ATA-reserved	0000 <sub>H</sub>
100–103	Total number of user-addressable LBA sectors available (see Section 2.2 for related information). These words are required for drives that support the 48-bit addressing feature. Maximum value: 0000FFFFFFFFFh.	1000 GB models = 1,953,525,168 750 GB models = 1,465,149,168 500 GB models = 976,773,168 250 GB models = 488,397,168
104–127	ATA-reserved	0000 <sub>H</sub>
128	Security status	0001 <sub>H</sub>

<b>Word</b>	<b>Description</b>	<b>Value</b>
129– 159	Seagate-reserved	xxxx <sub>H</sub>
160– 254	ATA-reserved	0000 <sub>H</sub>
255	Integrity word	xxA5 <sub>H</sub>

**Note.** See the bit descriptions below for words 63, 88, and 93 of the Identify Drive data.

<b>Description (if bit is set to 1)</b>		
<b>Bit</b>	<b>Word 63</b>	
0	Multiword DMA mode 0 is supported.	
1	Multiword DMA mode 1 is supported.	
2	Multiword DMA mode 2 is supported.	
8	Multiword DMA mode 0 is currently active.	
9	Multiword DMA mode 1 is currently active.	
10	Multiword DMA mode 2 is currently active.	
<b>Bit</b>	<b>Word 88</b>	
0	Ultra DMA mode 0 is supported.	
1	Ultra DMA mode 1 is supported.	
2	Ultra DMA mode 2 is supported.	
3	Ultra DMA mode 3 is supported.	
4	Ultra DMA mode 4 is supported.	
5	Ultra DMA mode 5 is supported.	
6	Ultra DMA mode 6 is supported.	
8	Ultra DMA mode 0 is currently active.	
9	Ultra DMA mode 1 is currently active.	
10	Ultra DMA mode 2 is currently active.	
11	Ultra DMA mode 3 is currently active.	
12	Ultra DMA mode 4 is currently active.	
13	Ultra DMA mode 5 is currently active.	
14	Ultra DMA mode 6 is currently active.	



### 4.3.2 Set Features command

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

**Table 8: Set Features command values**

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

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

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

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

SeaTools diagnostic software activates a built-in drive self-test (DST S.M.A.R.T. command for D4<sub>H</sub>) that eliminates unnecessary drive returns. The diagnostic software ships with all new drives and is also available at: <http://seatools.seagate.com>.

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 9: S.M.A.R.T. commands**

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

**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.

## 5.0 Seagate Technology support services

---

### Online services

#### Internet

For information regarding Seagate products and services, visit [www.seagate.com](http://www.seagate.com). Worldwide support is available 24 hours daily by email for your questions.

#### Presales Support:

Presales@Seagate.com

#### Technical Support:

DiscSupport@Seagate.com

#### Warranty Support:

<http://www.seagate.com/support/service/index.html>

#### mySeagate

my.seagate.com is the industry's first Web portal designed specifically for OEMs and distributors. It provides self-service access to critical applications, personalized content and the tools that allow our partners to manage their Seagate account functions. Submit pricing requests, orders and returns through a single, password-protected Web interface-anytime, anywhere in the world.

#### spp.seagate.com

spp.seagate.com supports Seagate resellers with product information, program benefits and sales tools. You may register for customized communications that are not available on the web. These communications contain product launch, EOL, pricing, promotions and other channel-related information. To learn more about the benefits or to register, go to spp.seagate.com, any time, from anywhere in the world.

### Seagate Service Centers

#### Presales Support

Our Presales Support staff can help you determine which Seagate products are best suited for your specific application or computer system, as well as product availability and compatibility.

#### Technical Support

Seagate technical support is available to assist you online at [support.seagate.com](http://support.seagate.com) or through one of our call centers. Have your system configuration information and your "ST" model number available.

**SeaTDD™ (+1-405-324-3655)** is a telecommunications device for the deaf (TDD). You can send questions or comments 24 hours daily and exchange messages with a technical support specialist during normal business hours for the call center in your region.

## Customer Service Operations

### Warranty Service

Seagate offers worldwide customer support for Seagate products. Seagate distributors, OEMs and other direct customers should contact their Seagate Customer Service Operations (CSO) representative for warranty-related issues. Resellers or end users of drive products should contact their place of purchase or Seagate warranty service for assistance. Have your serial number and model or part number available.

### Data Recovery Services

Seagate offers data recovery services for all formats and all brands of storage media. Our data recovery services labs are currently located throughout the world. . Additional information, including an online request form and data loss prevention resources, is available at <http://services.seagate.com/index.aspx>

### Authorized Service Centers

Seagate Service Centers are available on a global basis for the return of defective products. Contact your customer support representative for the location nearest you.

### USA/Canada/Latin America support services

For an extensive list of telephone numbers to technical support, presales and warranty service in USA/Canada/Latin America, including business hours, go to the "Contact Us" page on [www.seagate.com](http://www.seagate.com).

## Global Customer Support

### Presales, Technical, and Warranty Support

Call Center	Toll-free	Direct dial
USA, Canada, and Mexico	1-800-SEAGATE	+1-405-324-4700

### Data Recovery Services

Call Center	Toll-free	Direct dial	FAX
USA, Canada, and Mexico	1-800-475-01435	+1-905-474-2162	1-800-475-0158 +1-905-474-2459

## Europe, the Middle East and Africa Support Services

For an extensive list of telephone numbers to technical support, presales and warranty service in Europe, the Middle East and Africa, go to the "Contact Us" page on [www.seagate.com](http://www.seagate.com).

## Asia/Pacific Support Services

For an extensive list of telephone numbers to technical support, presales and warranty service in Asia/Pacific, go to the "Contact Us" page on [www.seagate.com](http://www.seagate.com).

## **Publication feedback survey**

We are interested in your comments and suggestions regarding this publication. Please take a few minutes to participate in our survey at the following URL:

<http://survey.seagate.com/survey/techpubs.nsf>

Thank you for your time and comments.



# Index

## A

ACA 19  
acceleration 16  
acoustics 17  
Active 14  
Active mode 14  
actuator arm 11  
Agency certification 18  
altitude 15  
Ambient temperature 15  
ambient temperature 10, 11  
Annualized Failure Rate (AFR) 18  
areal density 1, 9  
ATA commands 29  
Australia/New Zealand Standard AS/NZS3548 1995 19  
Australian Communication Authority (ACA) 19  
Australian C-Tick 19  
Average latency 10  
Average seek time 10

## B

BPI 9  
buffer 9

## C

cables and connectors 24  
cache 9  
capacity 8  
case temperature 15  
CE mark 18  
certification 18  
Check Power Mode 29  
China RoHS directive 20  
Class B computing device 19  
compatibility 18  
Conducted noise 13  
Conducted RF immunity 17  
Configuring the drive 23  
connectors 24  
Corrosive environment 20  
CSA C22.2 (950) 18  
cycles 18  
Cylinders 8

## D

data-transfer rates 1  
DC power 11  
Default logical geometry 8  
density 9

Device Configuration Freeze Lock 29  
Device Configuration Identify 29  
Device Configuration Restore 29  
Device Configuration Set 29  
Device Reset 29  
dimensions 25  
disc surface 11  
dissipation 11  
Download Microcode 29

## E

Electrical fast transient 17  
Electromagnetic compatibility 18  
Electromagnetic Compatibility (EMC) 19  
Electromagnetic Compatibility control Regulation 19  
Electromagnetic Compatibility Directive (89/336/EEC) 18  
Electromagnetic immunity 17  
Electrostatic discharge 17  
electrostatic discharge (ESD) 23  
EN 55022, Class B 18  
EN 55024 18  
EN 60950 18  
Environmental specifications 15  
error-correction algorithms 1  
errors 18  
ESD 23  
EU 18  
EU RoHS directive 20  
European Union (EU) requirements 18  
Execute Device Diagnostics 29

## F

FCC verification 19  
features 1  
Federal Communications Commission 19  
Flush Cache 29  
Flush Cache Extended 29  
Format Track 29  
Formatted capacity 8

## G

geometry 8  
Gs 16  
guaranteed sectors 8

## H

Handling precautions 23  
heads 8  
height 9  
humidity 15

## I

- I/O data-transfer rate 9
- Identify Device 29
- Identify Device command 31
- Idle 14, 29
- Idle Immediate 29
- Idle mode 11, 14
- IEC950 18
- Information Technology Equipment (ITE) 18
- Initialize Device Parameters 29
- Input noise ripple 13
- input voltage 11
- interface 9, 27
- internal data-transfer rate OD 9
- is 10
- ISO document 7779 17
- ITE 18

## K

- Korea Ministry of Information and Communication (MIC) 19
- Korean RRL 19

## L

- latency 10
- latency time 11
- LBA mode 8
- length 9
- logical geometry 8

## M

- maintenance 18
- master/slave 2
- maximum temperature 15
- MIC 19
- mounting 25
- mounting screws 15
- mounting the drive 23

## N

- noise 13
- nominal power 10
- Nonoperating shock 15
- Nonoperating vibration 16
- Nonrecoverable read errors 18

## O

- operating 11
- Operating power 11
- Operating shock 15
- Operating vibration 16

## P

- Physical characteristics 9
- point-to-point 2, 24
- Power consumption 11
- power consumption 11
- power dissipation 11
- Power modes 14
- Power specifications 11
- Power-management modes 14
- Power-on to Ready 10
- precautions 23
- printed circuit board 23
- programmable power management 14

## Q

- quick reference 3

## R

- Radiated RF immunity 17
- Radio and television interference 19
- radio frequency (RF) 17
- random seeks 11
- Read Buffer 29
- Read DMA 29
- Read DMA Extended 29
- Read DMA without Retries 29
- read errors 18
- Read Log Ext 29
- Read Multiple 29
- Read Multiple Extended 29
- Read Native Max Address 29
- Read Native Max Address Extended 29
- Read Sectors 29
- Read Sectors Extended 29
- Read Sectors Without Retries 29
- Read Verify Sectors 29
- Read Verify Sectors Extended 29
- Read Verify Sectors Without Retries 29
- read/write actuator arm 11
- Read/write heads 8
- Read/write power 11
- Recalibrate 29
- recording density 9
- recording method 9
- Recording technology 9
- relative humidity 15
- Reliability 18
- RF 17
- RMS read/write current 13
- RoHS 20
- RRL 19



## S

- S.M.A.R.T. Disable Operations 30
- S.M.A.R.T. Enable Operations 30
- S.M.A.R.T. Enable/Disable Autosave 30
- S.M.A.R.T. Execute Offline 30
- S.M.A.R.T. implementation 29
- S.M.A.R.T. Read Attribute Thresholds 30
- S.M.A.R.T. Read Data 30
- S.M.A.R.T. Read Log Sector 30
- S.M.A.R.T. Return Status 30
- S.M.A.R.T. Save Attribute Values 30
- S.M.A.R.T. Write Log sector 30
- Safety certification 18
- SATA 27
- screws 15
- sectors 8
- Sectors per track 8
- Security Disable Password 29
- Security Erase Prepare 29
- Security Erase Unit 30
- Security Freeze 30
- Security Set Password 30
- Security Unlock 30
- Seek 30
- seek mode 11
- Seek mode power 11
- Seek time 10
- Seeking 11
- Serial ATA (SATA) interface 27
- serial ATA ports 2
- Servo electronics 11
- servo electronics 11
- Set Features 30
- Set Max Address 30
- Set Max Address Extended 30
- Set Multiple Mode 30
- Shock 15
- single-track seeks 10
- Sleep 11, 14, 30
- Sleep mode 14
- sound 17
- Specification summary table 3
- spindle speed 9
- Spinup 11
- Spinup power 11
- Standby 11, 14, 30
- Standby Immediate 30
- Standby mode 11, 14
- standby timer 14
- Standby to Ready 10
- Start/stop times 10
- start-stop cycles 18
- static-discharge 23
- support services 37
- Surge immunity 17

## T

- technical support services 37
- temperature 10, 15
- temperature gradient 15
- timer 14
- timers 14
- track density 9
- Track-to-track 10
- Track-to-track seek time 10
- TUV North America 18

## U

- UL 1950 18

## V

- Vibration 16
- voltage 11
- Voltage dips, interrupts 17
- Voltage tolerance 13

## W

- weight 9
- wet bulb temperature 15
- width 9
- Write Buffer 30
- Write DMA 30
- Write DMA Extended 30
- Write DMA FUA Extended 30
- Write DMA Without Retries 30
- Write Log Extended 30
- Write Multiple 30
- Write Multiple Extended 30
- Write Multiple FUA Extended 30
- Write Sectors 30
- Write Sectors Extended 30
- Write Sectors Without Retries 30







**Seagate Technology LLC**  
**920 Disc Drive, Scotts Valley, California 95066-4544, USA**  
*Publication Number: 100468393, Rev. A, Printed in U.S.A.*