

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 blue and grey.

Product Manual

## **DB35 Series 7200.2**

**ST3500841ACE**

**ST3400833ACE**

**ST3300822ACE**

**ST3250824ACE**

**ST3200827ACE**

**ST3160212ACE**

**ST3120213ACE**

**ST3802110ACE**

100389999  
Rev. D  
August 2007

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Publication number: 100389999, Rev. D

August 2007

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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.

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## 1.0 Introduction

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This manual describes the functional, mechanical and interface specifications for the following Seagate® DB35 Series 7200.2 model drives:

- ST3500841ACE
- ST3400833ACE
- ST3300822ACE
- ST3250824ACE
- ST3200827ACE
- ST3160212ACE
- ST3120213ACE
- ST3802110ACE

These drives provide the following key features:

- Minimal acoustics for consumer storage usage profile.
- Bedroom quiet performance.
- Optimized power for consumer storage devices.
- Spinup current limited to a maximum of 2 amps.
- 7,200-RPM spindle speed
- 8-Mbyte buffer: ST3500841ACE, ST3400833ACE, ST3300822ACE, ST3250824ACE, and ST3200827ACE.
- 2-Mbyte buffer: ST3160212ACE, ST3120213ACE, and ST3802110ACE.
- High instantaneous (burst) data transfer rates (up to 100 Mbytes per second) using Ultra DMA mode 5.
- Tunneling Magnetoresistive (TMR) recording heads.
- State-of-the-art cache and on-the-fly error-correction algorithms.
- Full-track multiple-sector transfer capability without local processor intervention.
- 350 Gs nonoperating shock.
- Support for S.M.A.R.T. drive monitoring and reporting.
- Support for Read Multiple and Write Multiple commands.
- Support for autodetection of master/slave drives that use cable select (CSEL).
- SeaTools diagnostic software performs a drive self-test that eliminates unnecessary drive returns.
- The 3D Defense System™, which includes Drive Defense, Data Defense, and Diagnostic Defense, offers the industry's most comprehensive protection for disc drives.





## 2.0 Drive specifications

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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 models:

ST3500841ACE	ST3250824ACE	ST3120213ACE
ST3400833ACE	ST3200827ACE	ST3802110ACE
ST3300822ACE	ST3160212ACE	

### 2.1 Specification summary table

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

**Table 1: Drive specifications for 500 and 400 Gbyte models**

Drive specification	ST3500841ACE	ST3400833ACE
Formatted Gbytes (512 bytes/sector)*	500	400
Guaranteed sectors	976,773,168	781,422,768
Bytes per sector	512	
Default sectors per track	63	
Default read/write heads	16	
Default cylinders	16,383	
Recording density, KBPI (kbits/in max)	790.1	
Track density, KTPI (ktracks/in max)	124.5	
Areal density, (Gbits/in <sup>2</sup> max)	97.96	
Spindle speed (RPM)	7,200	
Internal data transfer rate (Mbits/sec max)	815.2	
Sustained data transfer rate (Mbytes/sec max)	65.0	
I/O data-transfer rate (Mbytes/sec max)	100	
ATA data-transfer modes supported	PIO modes 0–4 Multiword DMA modes 0–2 Ultra DMA modes 0–5	
Cache buffer	8 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 (typical)	710 grams (1.57 lb.)	
Average latency (msec)	4.16	
Power-on to ready (sec max)	16 sec	
Standby to ready (sec max)	16 sec	
Track-to-track seek time (msec typical)	<0.8 (read), <1.0 (write)	
Average seek (msec typical)	18 (read), 20 (write)	
Startup current (typical) 12V (peak)	2.0 amps	
Seek power (typical)	12.60 watts	
Operating (Consumer Storage Profile)	9.20 watts	
Operating (PVR Storage Profile)	4.88 watts	
Idle mode (typical)	8.00 watts	
Standby mode (typical)	0.80 watts	
Sleep mode (typical)	0.80 watts	
Voltage tolerance (including noise)	5V ± 5% 12V ± 10%	
Ambient temperature	0° to 60°C (operating) –40° to 70°C (nonoperating)	
Temperature gradient (°C per hour max)	20°C (operating) 30°C (nonoperating)	
Relative humidity	5% to 90% (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.)	

Drive specification	ST3500841ACE	ST3400833ACE
Operational Shock (max at 2 msec)	63 Gs	
Non-Operational Shock (max at 2 msec)	300 Gs	
Vibration, operating	5-22 Hz: +/-0.25", Displacement limited 22-350 Hz: 0.5 Gs 350-500 Hz: 0.25 Gs	
Vibration, nonoperating	5-22 Hz: +/-0.25", Displacement limited 22-350 Hz: 5.0 Gs 350-500 Hz: 1.0 Gs	
Drive acoustics, sound power		
Idle** (bels)	2.79 (typical) 2.96 (max)	2.59 (typical) 2.75 (max)
Operational, CE seeks (bels)	2.82 (typical) 2.97 (max)	2.75 (typical) 2.90 (max)
Operational, PVR seeks (bels)	2.71 (typical) 2.88 (max)	2.61 (typical) 2.75 (max)
Nonrecoverable read errors	1 per 10 <sup>14</sup> bits read	
Annualized Failure Rate (AFR)	0.70%	
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	

\*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 for 300, 250, and 200 Gbyte models**

Drive specification	ST3300822ACE	ST3250824ACE	ST3200827ACE
Formatted Gbytes (512 bytes/sector)*	300	250	200
Guaranteed sectors	586,072,368	488,397,168	390,721,968
Bytes per sector	512		
Default sectors per track	63		
Default read/write heads	16		
Default cylinders	16,383		
Recording density, KBPI (kbits/in max)	790.1		
Track density, KTPI (ktracks/in max)	124.5		
Areal density, (Gbits/in <sup>2</sup> max)	97.69		
Spindle speed (RPM)	7,200		
Internal data transfer rate (Mbits/sec max)	867.2		
Sustained data transfer rate (Mbytes/sec max)	76.6		
I/O data-transfer rate (Mbytes/sec max)	100		
ATA data-transfer modes supported	PIO modes 0–4 Multiword DMA modes 0–2 Ultra DMA modes 0–5		
Cache buffer	8 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 (typical)	655 grams (1.44 lb.)	580 grams (1.28 lb.)	
Average latency (msec)	4.16		
Power-on to ready (sec max)	16 sec		
Standby to ready (sec max)	16 sec		
Track-to-track seek time (msec typical)	<0.8 (read), <1.0 (write)		
Average seek (msec typical)	18 (read), 20 (write)		
Startup current (typical) 12V (peak)	2.0 amps		
Seek power (typical)	12.40 watts		
Operating (Consumer Storage Profile)	9.25 watts		
Operating (PVR Storage Profile)	4.88 watts		
Idle mode (typical)	8.00 watts		
Standby mode (typical)	0.80 watts		
Sleep mode (typical)	0.80 watts		
Voltage tolerance (including noise)	5V ± 5% 12V ± 10%		
Ambient temperature	0° to 60°C (operating) –40° to 70°C (nonoperating)		
Temperature gradient (°C per hour max)	20°C (operating) 30°C (nonoperating)		
Relative humidity	5% to 90% (operating) 5% to 95% (nonoperating)		
Relative humidity gradient	30% per hour max		
Wet bulb temperature (°C max)	37.7 (operating) 40 (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.)		

Drive specification	ST3300822ACE	ST3250824ACE	ST3200827ACE
Operational Shock (max at 2 msec)	63 Gs		
Non-Operational Shock (max at 2 msec)	350 Gs		
Vibration, operating	5-22 Hz: 0.25 Gs, Limited displacement 22-350 Hz: 0.5 Gs 350-500 Hz: 0.25 Gs		
Vibration, nonoperating	5-22 Hz: 0.25 Gs, Limited displacement 22-350 Hz: 5.0 Gs 350-500 Hz: 1.0 Gs		
Drive acoustics, sound power			
Idle* (bels)	2.67 (typical) 2.82 (max)		
Operational, CE seeks (bels)	2.80 (typical) 2.90 (max)		
Operational, PVR seeks (bels)	2.68 (typical) 2.80 (max)		
Nonrecoverable read errors	1 per 10 <sup>14</sup> bits read		
Annualized Failure Rate (AFR)	0.70%		
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		

\*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 3: Drive specifications for 160, 120, and 80 Gbyte models**

Drive specification	ST3160212ACE	ST3120213ACE	ST3802110ACE
Formatted Gbytes (512 bytes/sector)*	160	120	80
Guaranteed sectors	312,581,808	234,441,648	156,301,488
Bytes per sector	512		
Default sectors per track	63		
Default read/write heads	16		
Default cylinders	16,383		
Recording density, KBPI (kbits/in max)	840.0		
Track density, KTPI (ktracks/in max)	141.5		
Areal density, (Gbits/in <sup>2</sup> max)	119.0		
Spindle speed (RPM)	7,200		
Internal data transfer rate (Mbits/sec max)	867.2		
Sustained data transfer rate (Mbytes/sec max)	83.0		
I/O data-transfer rate (Mbytes/sec max)	100		
ATA data-transfer modes supported	PIO modes 0–4 Multiword DMA modes 0–2 Ultra DMA modes 0–5		
Cache buffer	2 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 (typical)	580 grams (1.28 lb.)		
Average latency (msec)	4.16		
Power-on to ready (sec max)	16 sec		
Standby to ready (sec max)	16 sec		
Track-to-track seek time (msec typical)	<0.8 (read), <1.0 (write)		
Average seek (msec typical)	18 (read), 20 (write)		
Startup current (typical) 12V (peak)	2.0 amps		
Seek power (typical)	12.40 watts		
Operating (Consumer Storage Profile)	9.25 watts		
Operating (PVR Storage Profile)	4.91 watts		
Idle mode (typical)	8.00 watts		
Standby mode (typical)	0.80 watts		
Sleep mode (typical)	0.80 watts		
Voltage tolerance (including noise)	5V ± 5% 12V ± 10%		
Ambient temperature	0° to 60°C (operating) –40° to 70°C (nonoperating)		
Temperature gradient (°C per hour max)	20°C (operating) 30°C (nonoperating)		
Relative humidity	5% to 90% (operating) 5% to 95% (nonoperating)		
Relative humidity gradient	30% per hour max		
Wet bulb temperature (°C max)	37.7 (operating) 40 (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.)		

Drive specification	ST3160212ACE	ST3120213ACE	ST3802110ACE
Operational Shock (max at 2 msec)	63 Gs		
Non-Operational Shock (max at 2 msec)	350 Gs		
Vibration, operating	5-22 Hz: +/-0.25", Displacement limited 22-350 Hz: 0.5 Gs 350-500 Hz: 0.25 Gs		
Vibration, nonoperating	5-22 Hz: +/-0.25", Displacement limited 22-350 Hz: 5.0 Gs 350-500 Hz: 1.0 Gs		
Drive acoustics, sound power			
Idle** (bels)	2.48 (typical) 2.64 (max)	2.46 (typical) 2.65 (max)	2.43 (typical) 2.51 (max)
Operational, CE seeks (bels)	2.65 (typical) 2.95 (max)	2.57 (typical) 2.64 (max)	2.61 (typical) 2.63 (max)
Operational, PVR seeks (bels)	2.53 (typical) 2.62 (max)	2.50 (typical) 2.57 (max)	2.45 (typical) 2.51 (max)
Nonrecoverable read errors	1 per 10 <sup>14</sup> bits read		
Annualized Failure Rate (AFR)	0.70%		
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		

\*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
ST3500841ACE	500 Gbytes	976,773,168	512
ST3400833ACE	400 Gbytes	781,422,768	512
ST3300822ACE	300 Gbytes	586,072,368	512
ST3250824ACE	250 Gbytes	488,397,168	512
ST3200827ACE	200 Gbytes	390,721,968	512
ST3160212ACE	160 Gbytes	312,581,808	512
ST3120213ACE	120 Gbytes	234,441,648	512
ST3802110ACE	80 Gbytes	156,301,488	512

\*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 4.1.2, "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

Interface	ATA
Recording method	16/17 EPRML
Recording density KBPI (kbits/inch max)	
ST3500841ACE, ST3400833ACE, ST3300822ACE, ST3250824ACE, ST3200827ACE	790.1
ST3160212ACE, ST3120213ACE, ST3802110ACE	840.0
Track density KTPI (ktracks/inch max)	
ST3500841ACE, ST3400833ACE, ST3300822ACE, ST3250824ACE, ST3200827ACE	124.5
ST3160212ACE, ST3120213ACE, ST3802110ACE	141.5
Areal density (Gbits/inch <sup>2</sup> max)	



ST3500841ACE, ST3400833ACE, ST3300822ACE, ST3250824ACE, ST3200827ACE	97.69
ST3160212ACE, ST3120213ACE, ST3802110ACE	119.0
Spindle speed (RPM) ( $\pm$ 0.2%)	7,200
Internal data-transfer rate (Mbits/sec max)	
ST3500841ACE, ST3400833ACE	815.2
ST3300822ACE, ST3250824ACE, ST3200827ACE, ST3160212ACE, ST3120213ACE, ST3802110ACE	867.2
Sustained data transfer rate (Mbytes/sec max)	
ST3500841ACE, ST3400833ACE	65.0
ST3300822ACE, ST3250824ACE, ST3200827ACE	76.6
ST3160212ACE, ST3120213ACE, ST3802110ACE	83.0
I/O data-transfer rate (Mbytes/sec max)	100 (Ultra DMA mode 5)
Cache buffer	
ST3500841ACE, ST3400833ACE, ST3300822ACE, ST3250824ACE, ST3200827ACE	8 Mbytes (8,192 kbytes)
ST3160212ACE, ST3120213ACE, ST3802110ACE	2 Mbytes (2,048 kbytes)

## 2.5 Physical characteristics

<b>Drive specification</b>		
Maximum height	(mm) (inches)	26.1 1.028
Maximum width	(mm) (inches)	101.6 4.000 ± 0.010
Maximum length	(mm) (inches)	146.99 5.787
Typical weight		
ST3500841ACE ST3400833ACE		710 grams (1.57 lbs)
ST3300822ACE		655 grams (1.44 lbs)
ST3250824ACE ST3200827ACE ST3160212ACE ST3120213ACE ST3802110ACE		580 grams (1.28 lbs)

## 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	18	20
Average latency:	4.16	4.16

**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 or exceed 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

Power-on to Ready (sec)	16
Standby to Ready (sec)	16 (max)
Ready to spindle stop (sec)	10 (max)

## 2.8 Power specifications

The drive receives DC power (+5V and +12V) through a four-pin standard drive power connector.

### 2.8.1 Power consumption

Power requirements for the drives are listed in the table on page 13. 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.

- **Operating power and current**

Operating power is measured using a standard Consumer Storage Profile.

- **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 4: DC power requirements**

Power dissipation (watts)	Models	Average (watts, 25° C)	5V typ amps	12V typ amps
Spinup	All	—	—	2.0 (peak)
Idle	All	8.00	0.353	0.519
Operating (Consumer Storage Profile)	500GB, 400GB	9.20	0.587	0.520
	300GB, 250GB, 200GB, 160GB, 120GB and 80GB	9.25		
Operating (PVR Storage Profile)	500GB, 400GB, 300GB, 250GB and 200GB	4.88	0.39	0.41
	160GB, 120GB and 80GB	4.91		
Seeking	500GB, 400GB	12.60	0.613	0.795
	300GB, 250GB, 200GB, 160GB, 120GB and 80GB	12.40		
Standby	All	0.80	0.106	0.023
Sleep	All	0.80	0.106	0.023

### 2.8.1.1 Typical current profile

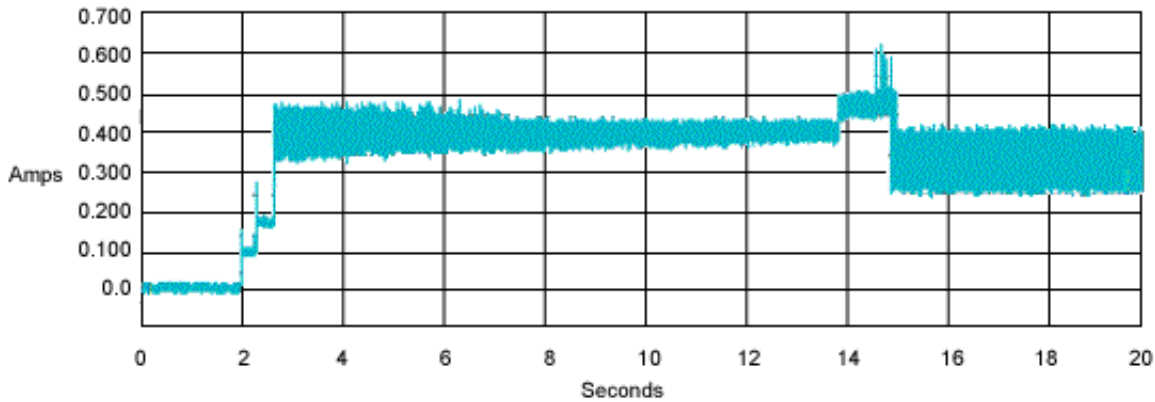


Figure 1 Typical 5V startup and operation current profile

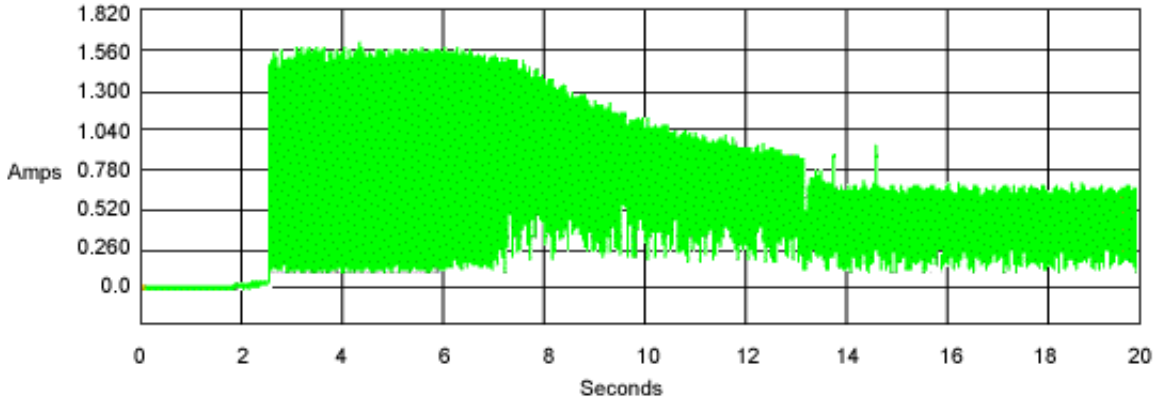


Figure 2 Typical 12V startup and operation current profile

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

## 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 mode	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 69°C (156°F) within the operating ambient conditions for standard models. Recommended measurement locations are shown in See Figure 6 on page 27.

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

Operating:	0° to 60°C (32° to 140°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 90% 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°C (104°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 63 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 for 500, 400, and 300 GB drives and 350 Gs for 250, 200, 160, and 80 GB drives, 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 following table lists the maximum vibration levels that the drive may experience while meeting the performance standards specified in this document.

5–22 Hz	+/-0.25", Displacement limited
22–350 Hz	0.50 Gs
350–500 Hz	0.25 Gs

#### 2.9.6.2 Nonoperating vibration

The following table lists the maximum nonoperating vibration that the drive may experience without incurring physical damage or degradation in performance when subsequently put into operation.

5–22 Hz	0.25 Gs (Limited displacement)
22–350 Hz	5.0 Gs
350–500 Hz	1.0 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:

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

#### Drive acoustics, sound power

Idle	Operational, CE seeks	Operational, PVR (Personal Video Recorder) seeks
2.46 bels (typ) 2.65 bels (max)	2.57 bels (typ) 2.64 bels (max)	2.50 bels (typ) 2.57 bels (max)

## 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: $\pm 4$ kV; Air: $\pm 8$ 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	$\pm 1$ kV on AC mains, $\pm 0.5$ kV on external I/O	B	EN 61000-4-4: 95
Surge immunity	$\pm 1$ kV differential, $\pm 2$ 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

Nonrecoverable read errors	1 per $10^{14}$ bits read, max.
Annualized Failure Rate (AFR)	0.70% (nominal power, 25°C ambient temperature)
Contact start-stop cycles	50,000 cycles (at nominal voltage and temperature, with 60 cycles per hour and a 50% duty cycle)
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.

- EUT name (model numbers): See table below.
- Certificate numbers:

Model	Certificate Number
ST3500841ACE	E-H011-05-3453 (B)
ST3400833ACE	E-H011-05-3453 (B)
ST3300822ACE	E-H011-05-3453 (B)
ST3250824ACE	E-H011-05-3453 (B)
ST3200827ACE	E-H011-05-3453 (B)
ST3160212ACE	E-H011-05-3453 (B)
ST3120213ACE	E-H011-05-3453 (B)
ST3802110ACE	E-H011-05-3453 (B)

- Trade name or applicant: Seagate Technology
- Manufacturing date: January 2006
- Manufacturer/nationality: Singapore and China

#### 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)

The European Union Restriction of Hazardous Substances (RoHS) Directive restricts the presence of chemical substances, including Lead (Pb), in electronic products effective July 2006.

A number of parts and materials in Seagate products are procured from external suppliers. We rely on the representations of our suppliers regarding the presence of RoHS substances in these parts and materials. Our supplier contracts require compliance with our chemical substance restrictions, and our suppliers document their compliance with our requirements by providing material content declarations for all parts and materials for the disc drives documented in this publication. Current supplier declarations include disclosure of the inclusion of any RoHS-regulated substance in such parts or materials.

Seagate also has internal systems in place to ensure ongoing compliance with the RoHS Directive and all laws and regulations which restrict chemical content in electronic products. These systems include standard operating procedures that ensure that restricted substances are not utilized in our manufacturing operations, laboratory analytical validation testing, and an internal auditing process to ensure that all standard operating procedures are complied with.

## 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

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

### 3.1 Handling and static discharge precautions

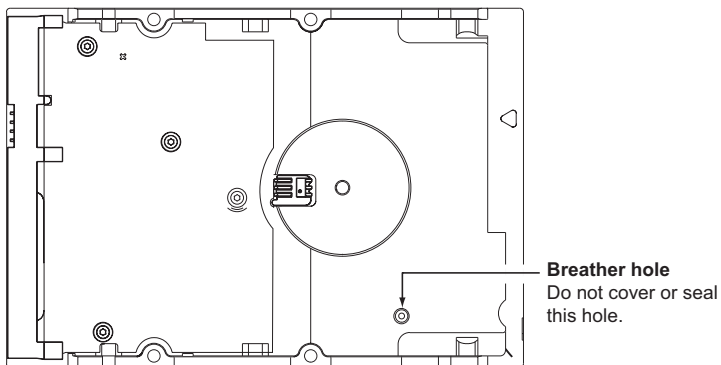
After unpacking, and before installation, the drive may be exposed to potential handling and electrostatic discharge (ESD) hazards. Observe the following standard handling and static-discharge precautions:

**Caution:**

- Keep the drive in the electrostatic discharge (ESD) bag until you are ready for installation.
- 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 Breather filter hole precautions

This section contains information regarding the precautions which should be taken regarding the breather filter hole in Seagate hard disc drives. Proper precautions should be taken to ensure full functionality and prevent possible damage to the drive.



**Figure 3 Breather filter hole location**

**Caution: Do not cover, seal, or insert any object into this hole.**

This hole has two purposes:

- To allow condensation inside the hard disc to escape
- To allow air pressure inside the hard disc to equalize with ambient pressure

**Note.** If this hole is covered, sealed, or penetrated by any object, drive reliability may be compromised and could lead to permanent damage—doing so voids the warranty.

### 3.3 Jumper settings

#### 3.3.1 Master/slave configuration

The options jumper block shown in Figure 4 is used to configure the drive for operation. It is the 8-pin dual header between the interface connector and the power connector. Use the following settings to configure the drive as a master or a slave.

**Master or single drive.** The drive is configured at the factory for a master or single-drive operation with a jumper set on pins 7 and 8.

**Drive as slave.** Remove all jumpers.

**Drive as master with a non-ATA-compatible slave.**

Use this jumper setting *only* if the drive does not work as a master with no jumpers installed.

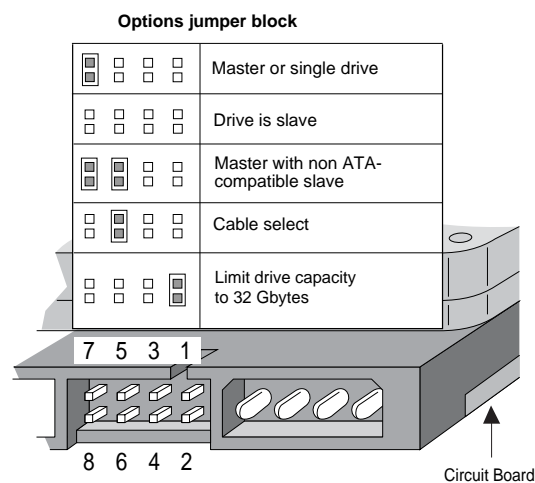


Figure 4 Master/slave jumper settings

#### 3.3.2 Cable-select option

Computers that use cable select determine the master and slave drives by selecting or deselecting pin 28, CSEL, on the interface bus. Master and slave drives are determined by their physical position on the cable. To enable cable select, set a jumper on pins 5 and 6 as shown in Figure 4. Refer to your computer manual to determine whether your computer supports this option.

#### 3.3.3 Alternate capacity jumper

Some older computers may “hang” at startup if their BIOS detects a disc drive with a capacity greater than 32 Gbytes. This limits the drive’s capacity to 32 Gbytes when the alternate capacity jumper is used. To access the full capacity of the drive, you can:

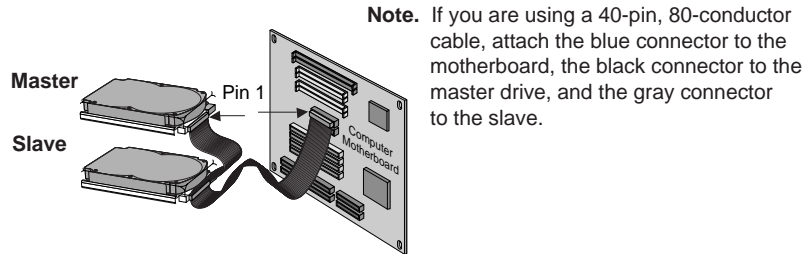
- Update the BIOS
- Use third-party software such as DiscWizard™ or Disk Manager
- Use a third-party host adapter

For drives with capacities greater than 32 Gbytes, the alternate capacity jumper changes the total available LBA sectors to 32 Gbytes to solve issues with some BIOS during power on. The ATA Set Features subcommand “F1<sub>H</sub> Report Full Capacity Available” causes Identify Data words 60 and 61 to report the full capacity. See Section 4.1.3 on page 36 for more details on the Set Features command.

Windows XP, Windows Me, Windows 98 or newer versions are needed to support drives with capacities greater than 32 Gbytes.

### 3.3.4 Ultra ATA/100 cable

An 80-conductor 40-pin cable is required to run Ultra DMA mode 3, mode 4 and mode 5. This cable uses even-numbered conductors connected to the ground pins to improve signal integrity.



**Figure 5** Ultra ATA cable connectors

**Note.** The drive supports both host and drive cable detection. The host detects the 80-conductor cable by sampling pin 34, CBLID-, on the interface bus. The drive detects the 80-conductor cable by sensing a capacitor at the host side through the CBLID- signal. The result is reported in a Fast Rise Detected bit (bit 13 of word 93 in the Identify drive parameter block).

## 3.4 Drive mounting

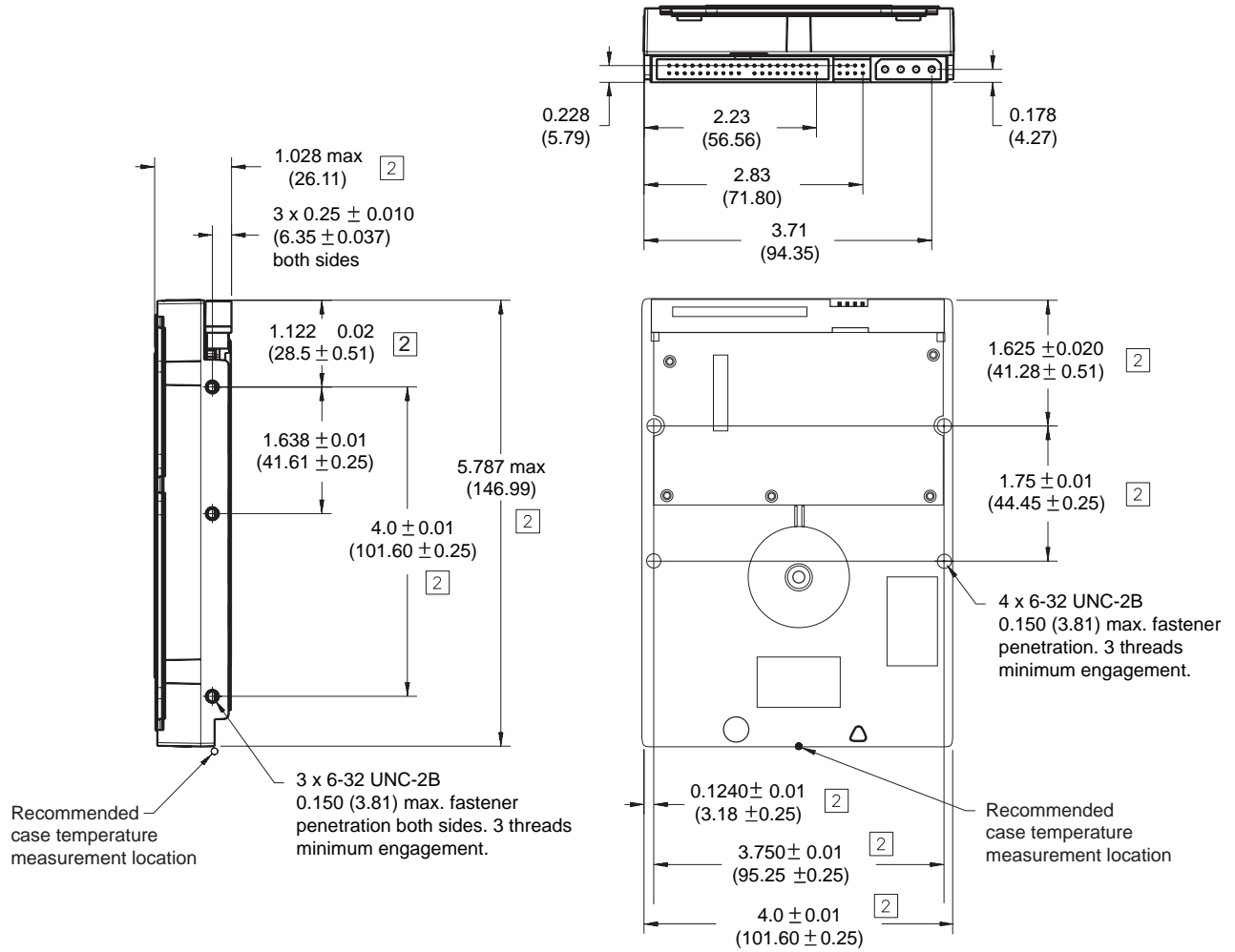
You can mount the drive in any orientation using four screws in the side-mounting holes or four screws in the bottom-mounting holes. See Figure 6 for drive mounting dimensions. Follow these important mounting precautions when mounting the drive:

- 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.
- Do not overtighten the mounting screws (maximum torque: 6 inch-lb.).
- Do not use a drive interface cable that is more than 18 inches long.



**Notes:**

- 1. Dimensions are shown in inches (mm).
- 2. Dimensions per SFF-8301 specification.



**Figure 6** Mounting dimensions—top, side and end view



## 4.0 ATA interface

These drives use the industry-standard ATA task file interface that supports 16-bit data transfers. It supports ATA programmed input/output (PIO) modes 0–4; multiword DMA modes 0–2, and Ultra DMA modes 0–5. The drive also supports the use of the IORDY signal to provide reliable high-speed data transfers.

You can use a daisy-chain cable to connect two drives to a single AT host bus. For detailed information about the ATA interface, refer to the draft of *AT Attachment with Packet Interface Extension (ATA/ATAPI-7)*, *NCITS T13 1410D*, subsequently referred to as the *Draft ATA-7 Standard*.

### 4.1 ATA interface signals and connector pins

Figure 7 summarizes the signals on the ATA interface connector that the drive supports. For a detailed description of these signals, refer to the *Draft ATA-7 Standard*.

Drive pin #	Signal name	Host pin # and signal description
1	Reset-	1 Hardware Reset
2	Ground	2 Ground
3	DD7	3 Host Data Bus Bit 7
4	DD8	4 Host Data Bus Bit 8
5	DD6	5 Host Data Bus Bit 6
6	DD9	6 Host Data Bus Bit 9
7	DD5	7 Host Data Bus Bit 5
8	DD10	8 Host Data Bus Bit 10
9	DD4	9 Host Data Bus Bit 4
10	DD11	10 Host Data Bus Bit 11
11	DD3	11 Host Data Bus Bit 3
12	DD12	12 Host Data Bus Bit 12
13	DD2	13 Host Data Bus Bit 2
14	DD13	14 Host Data Bus Bit 13
15	DD1	15 Host Data Bus Bit 1
16	DD14	16 Host Data Bus Bit 14
17	DD0	17 Host Data Bus Bit 0
18	DD15	18 Device Data (15:0)
19	Ground	19 Ground
20	(removed)	20 (No Pin)
21	DMARQ	21 DMA Request
22	Ground	22 Ground
23	D1OW-	23 Device I/O Write: Stop Ultra DMA Burst
24	STOP	24 Ground
25	D1OR-	25 Device I/O Read: Host Ultra DMA Ready: Host Ultra DMA Data Strobe
26	HDMARDY-	26 Ground
27	HSTROBE	27 I/O Channel Ready Device Ultra DMA Ready Device Ultra DMA Data Strobe
28	CSEL	28 Cable Select
29	DMACK-	29 DMA Acknowledge
30	Ground	30 Ground
31	INTRQ	31 Device Interrupt
32	IOCS16-	32 Reserved
33	DA1	33 Host Address Bus Bit 1
34	PDIAG-	34 Passed Diagnostics
35	CBLID-	35 Cable Assembly Type Identifier
36	DA0	36 Device Address (2:0)
37	DA2	37 Device Address (2:0)
38	CS0-	38 Chip Select (1:0)
39	CS1-	39 Drive Active/Slave Present
40	DASP-	40 Ground

Pins 28, 34 and 39 are used for master-slave communication (details shown below).

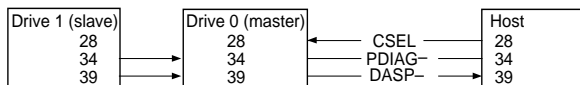


Figure 7 I/O pins and supported ATA signals

#### 4.1.1 Supported ATA commands

The following table lists ATA-standard commands that the drive supports. For a detailed description of the ATA commands, refer to the *Draft ATA-7 Standard*. See “S.M.A.R.T. commands” on page 37 for details and sub-commands used in the S.M.A.R.T. implementation.

**Table 6: 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>

Command name	Command code (in hex)
Security Disable Password	F6 <sub>H</sub>
Security Erase Prepare	F3 <sub>H</sub>
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 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 Sectors	30 <sub>H</sub>

<b>Command name</b>	<b>Command code (in hex)</b>
Write Sectors Without Retries	31 <sub>H</sub>
Write Sectors Extended	34 <sub>H</sub>

#### 4.1.2 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 the Table 6 on page 30. 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 *Draft ATA-7 Standard*.

Word	Description	Value
0	Configuration information: <ul style="list-style-type: none"> <li>• Bit 15: 0 = ATA; 1 = ATAPI</li> <li>• Bit 7: removable media</li> <li>• Bit 6: removable controller</li> <li>• Bit 0: reserved</li> </ul>	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)	ST3500841ACE ST3400833ACE ST3300822ACE ST3250824ACE ST3200827ACE ST3160212ACE ST3120213ACE ST3802110ACE
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>

Word	Description	Value
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>
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.	ST3500841ACE = 0FFFFFFFh* ST3400833ACE = 0FFFFFFFh* ST3300822ACE = 0FFFFFFFh* ST3250824ACE = 0FFFFFFFh* ST3200827ACE = 0FFFFFFFh* ST3160212ACE = 0FFFFFFFh* ST3120213ACE = DF94BB0h* ST3802110ACE = 950F8B0h*
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>
76–79	SATA-reserved	xxxx <sub>H</sub>
80	Major version number	007E <sub>H</sub>
81	Minor version number	0000 <sub>H</sub>
82	Command sets supported	346B <sub>H</sub>
83	Command sets supported	7D01 <sub>H</sub>
84	Command sets support extension	4003 <sub>H</sub>
85	Command sets enabled	34xx <sub>H</sub>
86	Command sets enabled	3xxx <sub>H</sub>
87	Command sets enable extension	4003 <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>



Word	Description	Value
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.	ST3500841ACE = 976,773,168 ST3400833ACE = 781,422,768 ST3300822ACE = 586,072,368 ST3250824ACE = 488,397,168 ST3200827ACE = 390,721,968 ST3160212ACE = 312,581,808 ST3120213ACE = 234,441,648 ST3802110ACE = 156,301,488
104–127	ATA-reserved	0000 <sub>H</sub>
128	Security status	0001 <sub>H</sub>
129–159	Seagate-reserved	xxx <sub>H</sub>
160–254	ATA-reserved	0000 <sub>H</sub>
255	Integrity word	xxA5 <sub>H</sub>

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

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

Description (if bit is set to 1)		
Bit	Word 63	
0	Multiword DMA mode 0 is supported.	
1	Multiword DMA mode 1 is supported.	
2	Multiword DMA mode 2 is supported.	
8	Multiword DMA mode 0 is currently active.	
9	Multiword DMA mode 1 is currently active.	
10	Multiword DMA mode 2 is currently active.	
Bit	Word 88	
0	Ultra DMA mode 0 is supported.	
1	Ultra DMA mode 1 is supported.	
2	Ultra DMA mode 2 is supported.	
3	Ultra DMA mode 3 is supported.	
4	Ultra DMA mode 4 is supported.	
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.	
Bit	Word 93	
13	1 = 80-conductor cable detected, CBLID above V <sub>IH</sub> 0 = 40-conductor cable detected, CBLID below V <sub>IL</sub>	

### 4.1.3 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:

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>	Multword DMA mode 0
21 <sub>H</sub>	Multword DMA mode 1
22 <sub>H</sub>	Multword 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
55 <sub>H</sub>	Disable read look-ahead (read cache) feature.
82 <sub>H</sub>	Disable write cache.
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.

#### 4.1.4 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-7 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.

Code in features register	S.M.A.R.T. command
D0 <sub>H</sub>	S.M.A.R.T. Read Data
D1 <sub>H</sub>	Vendor-specific
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
D7 <sub>H</sub>	Vendor-specific
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

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### 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.

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### Technical Support:

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

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## Seagate Service Centers

### Presales Support

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**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>

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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.

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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).

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**Seagate Technology LLC**  
**920 Disc Drive, Scotts Valley, California 95066-4544, USA**  
*Publication Number: 100389999, Rev. D, Printed in U.S.A.*