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

EE25 Series

ST940813AM

ST940814AM

ST930813AM

ST930814AM

ST920813AM

ST920814AM

100384290

Rev. E

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. Quantitative usage examples for various applications are for illustrative purposes. Actual quantities will vary based on various factors, including file size, file format, features and application software. Seagate reserves the right to change, without notice, product offerings or specifications.

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1.0 Introduction

This manual describes the functional, mechanical and interface specifications for the following Seagate® EE25 Series drives:

ST940813AM	OEM	40 GBytes
ST940814AM	Aftermarket	40 GBytes
ST930813AM	OEM	30 Gbytes
ST930814AM	Aftermarket	30 Gbytes
ST920813AM	OEM	20 Gbytes
ST920814AM	Aftermarket	20 Gbytes

These drives provide the following key features:

- Extreme operating environment capabilities:
 - OEM temperature range: -30°C to 85°C
 - Aftermarket temperature range: -20°C to 75°C
- 5,400-RPM spindle speed and 8-Mbyte buffer combine for superior performance.
- Quiet operation. Fluid Dynamic Bearing (FDB) motor.
- 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.
- 800 Gs nonoperating shock and 200 Gs operating shock.
- 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.
- 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).

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 ST940813AM, ST940814AM, ST930813AM, ST930814AM, ST920813AM, and ST920814AM model drives.

2.1 Specification summary

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

Table 1: Specifications for 40 and 30 Gbyte models

Drive specification	ST940813AM (OEM)	ST940814AM (Aftermarket)	ST930813AM (OEM)	ST930814AM (Aftermarket)
Formatted (512 bytes/sector)*	40 Gbytes		30 Gbytes	
Guaranteed sectors	78,140,160		58,605,120	
Bytes per sector	512			
Physical read/write heads	2			
Discs	1			
Cache	8 Mbytes			
Recording density, BPI	540.1k bits/inch at ID			
Track density, TPI	119k tracks/inch at ID			
Areal density	64.3 Gbits/inch ² at ID			
Spindle speed	5,400 RPM			
Internal data transfer rate	321.1 Mbits/sec max			
I/O data transfer rate	100 Mbytes/sec			
ATA data-transfer modes supported	PIO modes 0–4; Multiword DMA modes 0–2; Ultra DMA modes 0–5			
Height	9.5 +/-0.2 mm (0.374 +/- .008 inches)			
Width	69.85 +/-0.25 mm (2.750 +/-0.010 inches)			
Length	100.2 +/-0.25 mm (3.945 +/-0.010 inches)			
Weight	100 grams (0.22 lb) (typical)			
Average latency	5.6 msec			
Power-on to ready -20 to 85°C -30 to -20°C 3 sigma maximum at extreme temperature	3.0 seconds (typical) 15 seconds (typical) 30 seconds			
Standby to ready -20 to 85°C -30 to -20°C 3 sigma maximum at extreme temperature	3.0 seconds (typical) 15 seconds (typical) 30 seconds			
Track-to-track seek time	1.0 ms (read, typical), 1.5 ms (write, typical)			
Average seek time	12.5 msec (typical)			
Average seek, read	12.5 msec (typical)			
Average seek, write	14.5 msec (typical)			
Full-stroke seek	22 msec (typical); 24 msec (max)			
Startup current 5V	1.1 amps (typical)			
Seek power	1.90 watts / 0.38 amps (typical)			
Read power	1.90 watts / 0.38 amps (typical)			
Write power	1.70 watts / 0.34 amps (typical)			
Idle mode	0.99 watts / 0.20 amps (typical)			
Standby mode	0.26 watts / 0.05 amps (typical)***			
Sleep mode	0.26 watts / 0.05 amps (typical)***			
Voltage tolerance (including noise)	5V ± 5%			
Ambient temperature Operating Nonoperating	-30° to 85°C (OEM); -20° to 75°C (aftermarket); -40° to 95°C (OEM and aftermarket)			
Temperature gradient (°C per minute, max, noncondensing)	3°C (operating) 3°C (nonoperating)			
Relative humidity (noncondensing)	5% to 90% (operating) 5% to 95% (nonoperating)			
Relative humidity gradient	30% per hour max			

Drive specification	ST940813AM (OEM)	ST940814AM (Aftermarket)	ST930813AM (OEM)	ST930814AM (Aftermarket)
Wet bulb temperature	40°C (operating, max) 40°C (nonoperating, max)			
Altitude, operating (at 25°C)	-304.8 m to 4,419.6 m (-1000 ft to 14,500 ft) For higher temperature capabilities, See "Temperature vs. altitude capability" on page 15.			
Altitude, nonoperating (below mean sea level, max)	-304.8 m to 12,192 m (-1,000 ft to 40,000 ft)			
Shock, operating at 2 msec at 11 msec	200 Gs max 110 Gs max			
Shock, nonoperating at 2 msec at 1 msec at 0.5 msec	800 Gs max 800 Gs max 400 Gs max			
Vibration, operating (swept sine) (max displacement may apply below 10 Hz)	2.0 G (10 - 200 Hz) 1.0 G (200 - 500 Hz)			
Vibration, nonoperating (max displacement may apply below 22 Hz)	5.0 Gs (0 to peak, 5-500 Hz); (X, Y, Z axis 0, 22, 45° angles)			
Drive acoustics, sound power				
Idle**	2.3 Bels (typical) 2.5 Bels (max)			
Normal seek	2.5 Bels (typical) 2.7 Bels (max)			
Performance seek	2.8 Bels (typical) 3.0 Bels (max)			
Nonrecoverable read errors	1 per 10 ¹⁴ bits read			
Mean Time Before Failure (MTBF)	550,000 power-on hours At 8,760 POH (Power On Hours) per year Max case temperature: 70°C at the case measurement location shown in Figure 3.			
Load/Unload (U/UL) cycles				
25°C, 50% relative humidity	600,000 software-controlled power on/off cycles 30,000 hard power on/off cycles			
32°C, 80% relative humidity 5°C, 80% relative humidity 5°C, 10% relative humidity 60°C, 20% relative humidity	600,000 software-controlled power on/off cycles 30,000 hard power on/off cycles			
Service life	10 years (form, fit, and function replacement)			
Warranty	1 year standard (up to 5 years max with additional warranty purchase). To determine the warranty for a specific drive, use a web browser to access the following web page: www.seagate.com/support/service/ 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.			

*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.

***Typical host systems will pull power to the drive when entering S3 and S4; while in the S3 and S4 states, drive sleep and drive standby modes will not contribute to battery power consumption.

Table 2: Specifications for 20 Gbyte models

Drive specification	ST920813AM (OEM)	ST920814AM (Aftermarket)
Formatted (512 bytes/sector)*	20 Gbytes	
Guaranteed sectors	39,070,080	
Bytes per sector	512	
Physical read/write heads	1	
Discs	1	
Cache	8 Mbytes	
Recording density, BPI	540.1k bits/inch at ID	
Track density, TPI	119k tracks/inch at ID	
Areal density	64.3 Gbits/inch ² at ID	
Spindle speed	5,400 RPM	
Internal data transfer rate	321.1 Mbits/sec max	
I/O data transfer rate	100 Mbytes/sec	
ATA data-transfer modes supported	PIO modes 0–4; Multiword DMA modes 0–2; Ultra DMA modes 0–5	
Height	9.5 +/-0.2 mm (0.374 +/-0.008 inches)	
Width	69.85 +/-0.25 mm (2.750 +/-0.010 inches)	
Length	100.2 +/-0.25 mm (3.945 +/-0.010 inches)	
Weight	100 grams (0.22 lb) (typical)	
Average latency	5.6 msec	
Power-on to ready -20 to 85°C -30 to -20°C 3 sigma maximum at extreme temperature	3.0 seconds (typical) 15 seconds (typical) 30 seconds	
Standby to ready -20 to 85°C -30 to -20°C 3 sigma maximum at extreme temperature	3.0 seconds (typical) 15 seconds (typical) 30 seconds	
Track-to-track seek time	1.0 msec (read, typical), 1.5 msec (write, typical)	
Average seek time	12.5 msec (typical)	
Average seek, read	12.5 msec (typical)	
Average seek, write	14.5 msec (typical)	
Full-stroke seek	22 msec (typical); 24 msec (max)	
Startup current 5V	1.1 amps (typical)	
Seek power	1.90 watts / 0.38 amps (typical)	
Read power	1.90 watts / 0.38 amps (typical)	
Write power	1.70 watts / 0.34 amps (typical)	
Idle mode	0.99 watts / 0.20 amps (typical)	
Standby mode	0.26 watts / 0.05 amps (typical)***	
Sleep mode	0.26 watts / 0.05 amps (typical)***	
Voltage tolerance (including noise)	5V ± 5%	
Ambient temperature Operating Nonoperating	-30° to 85°C (OEM); -20° to 75°C (aftermarket); -40° to 95°C (OEM and aftermarket)	
Temperature gradient	3°C per minute, noncondensing (operating) 3°C per minutes, max, noncondensing (nonoperating)	
Relative humidity (noncondensing)	5% to 90% (operating) 5% to 95% (nonoperating)	
Relative humidity gradient	30% per hour max	

Drive specification	ST920813AM (OEM)	ST920814AM (Aftermarket)
Wet bulb temperature	40°C (operating, max) 40°C (nonoperating, max)	
Altitude, operating (at 25°C)	–304.8 m to 4,419.6 m (–1000 ft to 14,500 ft) For higher temperature capabilities, See “Temperature vs. altitude capability” on page 15.	
Altitude, nonoperating (below mean sea level, max)	–304.8 m to 12,192 m (–1,000 ft to 40,000 ft)	
Shock, operating at 2 msec at 11 msec	200 Gs max 110 Gs max	
Shock, nonoperating at 2 msec at 1 msec at 0.5 msec	800 Gs max 800 Gs max 400 Gs max	
Vibration, operating (max displacement may apply below 10 Hz)	2.0 G (10 - 200 Hz) 1.0 G (200 - 500 Hz)	
Vibration, nonoperating (max displacement may apply below 22 Hz)	5.0 Gs (0 to peak, 5–500 Hz)	
Drive acoustics, sound power		
Idle**	2.3 Bels (typical) 2.5 Bels (max)	
Normal seek	2.5 Bels (typical) 2.7 Bels (max)	
Performance seek	2.8 Bels (typical) 3.0 Bels (max)	
Nonrecoverable read errors	1 per 10 ¹⁴ bits read	
Mean Time Before Failure (MTBF)	550,000 power-on hours At 8,760 POH (Power On Hours) per year Max case temperature: 70°C at the case measurement location shown in Figure 3.	
Load/Unload (U/UL) cycles		
25°C, 50% relative humidity	600,000 software-controlled power on/off cycles 30,000 hard power on/off cycles	
32°C, 80% relative humidity 5°C, 80% relative humidity 5°C, 10% relative humidity 60°C, 20% relative humidity	600,000 software-controlled power on/off cycles 30,000 hard power on/off cycles	
Service life	10 years (form, fit, and function replacement)	
Warranty	1 year standard (up to 5 years max with additional warranty purchase). To determine the warranty for a specific drive, use a web browser to access the following web page: www.seagate.com/support/service/ 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.	

*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.

***Typical host systems will pull power to the drive when entering S3 and S4; while in the S3 and S4 states, drive sleep and drive standby modes will not contribute to battery power consumption.

2.2 Formatted capacity

Model	Formatted capacity*	Guaranteed sectors	Bytes per sector
ST940813AM	40 Gbytes	78,140,160	512
ST940814AM	40 Gbytes	78,140,160	512
ST930813AM	30 Gbytes	58,605,120	512
ST930814AM	30 Gbytes	58,605,120	512
ST920813AM	20 Gbytes	39,070,080	512
ST920814AM	20 Gbytes	39,070,080	512

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

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 Physical organization

Model	Read/write heads	Number of discs
ST940813AM	2	1
ST940814AM	2	1
ST930813AM	2	1
ST930814AM	2	1
ST920813AM	1	1
ST920814AM	1	1

2.5 Recording and interface technology

Technology	Specification
Interface	Parallel ATA
Recording density BPI	540.1k bits/inch typical
Track density TPI	119k tracks/inch typical
Areal density	64.3 Gbits/inch ² max
Spindle speed	5,400 RPM (\pm 0.2%)
Internal data-transfer rate	321.1 Mbits/sec max
I/O data transfer rate	100 Mbytes/sec max
Interleave	1:1
Cache buffer	8 Mbytes (8,192 kbytes)

2.6 Physical characteristics

Height	(mm) (inches)	9.5 \pm 0.2 0.374 \pm 0.008
Width	(mm) (inches)	69.85 \pm 0.25 2.750 \pm 0.010
Length	(mm) (inches)	100.2 \pm 0.25 3.945 \pm 0.010
Typical weight	(grams) (pounds)	100 0.22

2.7 Seek time

Seek measurements are taken with nominal power. All times are measured using drive diagnostics. The specifications 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.

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.

Read seek times vs temperature								
	85°C		25°C		-20°C		-30°C	
	msec		msec		msec		msec	
	Typical	Max	Typical	Max	Typical	Max	Typical	Max
Track-to-track	1	1	0.5	1	0.5	6	1	6
Average	11	15	11	13	11	14	11	17
Full-stroke	22	28	22	24	22	28	23	29
Average latency	5.6		5.6		5.6		5.6	

Write seek times vs temperature								
	85°C		25°C		-20°C		-30°C	
	msec		msec		msec		msec	
	Typical	Max	Typical	Max	Typical	Max	Typical	Max
Track-to-track	1	2	1	2	1	7	1	7
Average	14	19	14	15	14	16	15	19
Full-stroke	23	30	25	27	25	30	25	30
Average latency	5.6		5.6		5.6		5.6	

2.8 Start/stop times

	Typical	Max
Power-on to Ready -20 to 85°C -30 to -20°C 3 sigma at extreme temperature	3.0 seconds 15 seconds -	8.0 seconds - 30 seconds
Standby to Ready -20 to 85°C -30 to -20°C 3 sigma at extreme temperature	3.0 seconds 15 seconds -	8.0 seconds - 30 seconds
Spin down (secs typical at 1 to 85°C)	5.0	8.0
Spin down (secs typical at -30 to 0°C)	15	20

2.9 Power specifications

The drive receives DC power (+5V) through the interface connector.

2.9.1 Power consumption

Power requirements for the drives are listed in the table on page 11. Typical power measurements are based on an average of drives tested, under nominal conditions, using 5.0V 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 is measured based on three random seek operations every 100 msecs. This mode is not typical.

- **Read/write power and current**

Read/write power is measured with the heads on track, based on three 63 sector read or write operations every 100 msecs.

- **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 model

Power dissipation	+5V average							
	85C		25C		-20C		-30C	
	Watts	Amps	Watts	Amps	Watts	Amps	Watts	Amps
Spinup, typical	4.5	0.9	5	1.0	5	1.0	6.5	1.3
Spinup, maximum	5	1.0	5.5	1.1	5.5	1.1	7.5	1.5
Idle, performance mode*	1.35	0.27	1.72	0.34	2.18	0.43	2.76	0.55
Idle, active*	0.96	0.19	0.99	0.2	2.05	0.41	2.69	0.53
Idle, low power mode*	0.82	0.16	0.88	0.17	1.95	0.39	2.67	0.53
Seeking	1.57	0.31	1.90	0.38	2.38	0.47	2.97	0.59
Read	1.57	0.31	1.90	0.38	2.40	0.48	2.97	0.59
Write	1.38	0.27	1.70	0.34	2.45	0.49	3.00	0.60
Standby	0.30	0.06	0.26	0.05	0.22	0.04	0.22	0.04
Sleep	0.30	0.06	0.26	0.05	0.22	0.04	0.22	0.04

*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.

2.9.1.1 Typical current profile

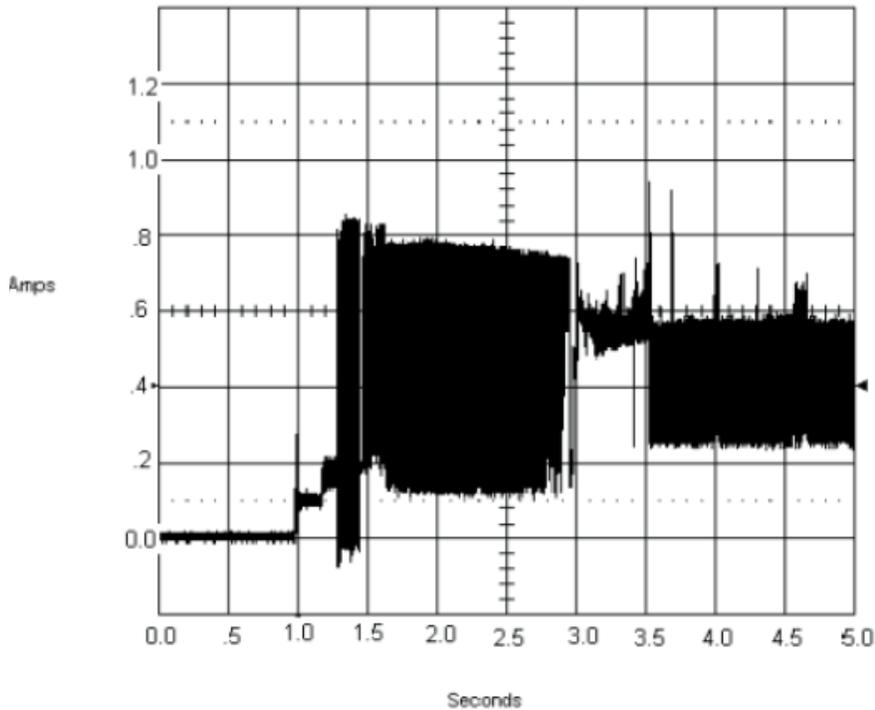


Figure 1. Typical 5V startup and operation current profile

2.9.2 Conducted noise

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

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.

2.9.3 Voltage tolerance

Voltage tolerance (including noise):

5V \pm 5%

2.9.4 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 (operating)	Tracking	Rotating	Enabled
Idle, performance	Tracking	Rotating	Enabled
Idle, active	Floating	Rotating	Disabled
Idle, low power	Parked	Rotating	Disabled
Standby	Parked	Stopped	Disabled
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.

2.10 Environmental specifications

2.10.1 Ambient temperature

Ambient temperature is defined as the temperature of the environment immediately surrounding the drive. Actual drive case temperature, measured on baseplate, should not exceed 90°C (194°F) within the operating ambient conditions.

Operating	OEM: -30° to 85°C (-86° to 185°F) Aftermarket: -20° to 75°C (-68° to 167°F)
Nonoperating	-40° to 95°C (-140° to 203°F)

2.10.2 Temperature gradient

Operating	3°C per minute (37°F per minute max), without condensation
Nonoperating	3°C per minute (37°F per minute max)

2.10.3 Humidity

2.10.3.1 Relative humidity

Operating	5% to 90% noncondensing (30% per hour max)
Nonoperating	5% to 95% noncondensing (30% per hour max)

2.10.3.2 Wet bulb temperature

Operating	40°C (104°F max)
Nonoperating	40°C (104°F max)

2.11 Altitude

Operating	-304.8 m to 5,000 m (-1,000 ft to 16,400 ft) at 25°C. For higher temperature capabilities, see Figure 2 below.
Nonoperating	-304.8 m to 12,192 m (-1,000 ft to 40,000 ft)

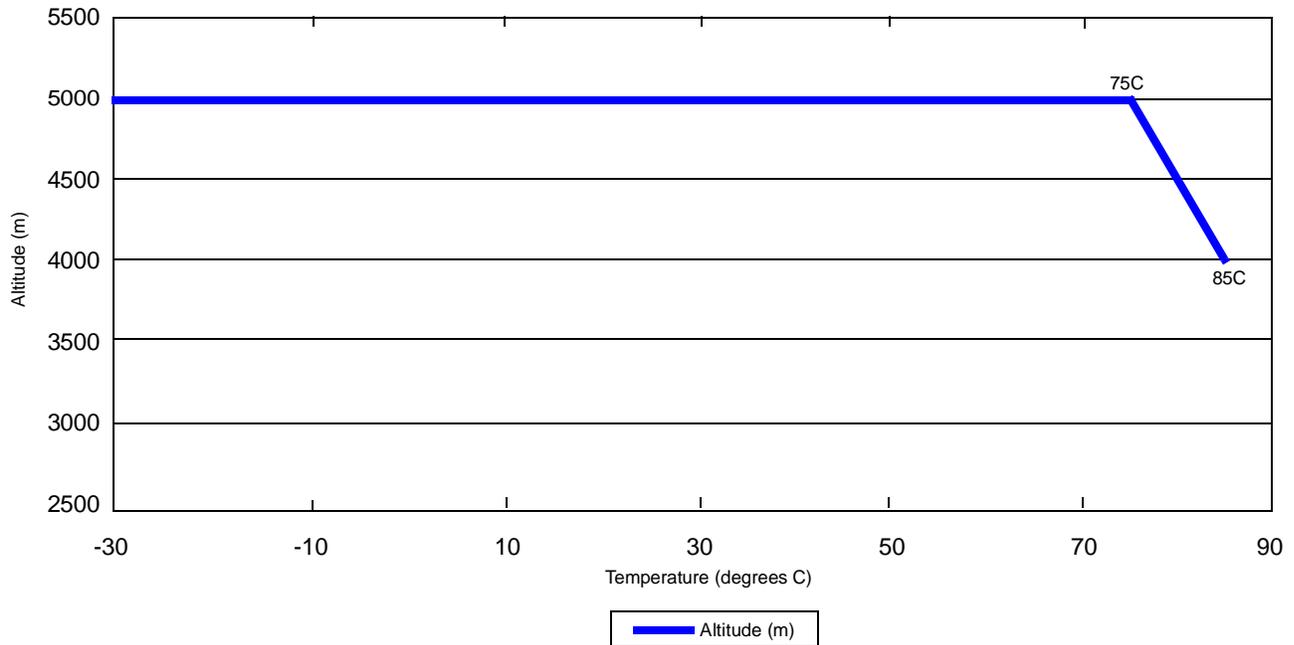


Figure 2. Temperature vs. altitude capability

2.11.1 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.

2.11.1.1 Operating shock

These drives comply with the performance levels specified in this document when subjected to a maximum operating shock of 200 Gs based on half-sine shock pulses of 2 msec. Shocks should not be repeated more than two times per second. For 11 msec shock duration, these drives will withstand operating shock up to 110 Gs.

2.11.1.2 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 800 Gs based on a nonrepetitive half-sine shock pulse of 2 msec duration.

The nonoperating shock level that the drive can experience without incurring physical damage or degradation in performance when subsequently put into operation is 800 Gs based on a nonrepetitive half-sine shock pulse of 1 msec duration.

The nonoperating shock level that the drive can experience without incurring physical damage or degradation in performance when subsequently put into operation is 400 Gs based on a nonrepetitive half-sine shock pulse of 0.5 msec duration.

2.11.2 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.

2.11.2.1 Operating vibration

The following table lists the maximum vibration levels that the drive may experience while meeting the performance standards specified in this document.

10–200 Hz	2.0 G (0 to peak)
200–500 Hz	1.0 G (0 to peak)

2.11.2.2 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.

5–500 Hz	5.0 Gs (0 to peak). Max displacement may apply below 22 Hz.
----------	---

2.12 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:

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

Acoustic mode		
Idle*	Normal Seek	Performance Seek
2.3 bels (typ) 2.5 bels (max)	2.5 bels (typ) 2.7 bels (max)	2.8 bels (typ) 3.0 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.

2.13 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:

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 2,000 MHz, 10 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
Power Frequency H-field immunity	1 A/m, 50Hz/60Hz, 3 axes	A	EN 61000-4-8: 97
Voltage dips, interrupts	30% Reduction for 25 cycles >95% Reduction for 250 cycles >95%, 0.5 cycles	C C B	EN 61000-4-11: 94

- A - 1) No upset or degradation in performance beyond manufacturer's specified limits.
2) No data loss.
- B - 1) Unit self recovers without user intervention.
2) No data loss.
- C - 1) Upset OK provided that unit will function after user intervention.

2.14 Reliability

Measurement type	Specification
Nonrecoverable read errors	1 per 10^{14} bits read, max.
Mean time between failures (MTBF)	550,000 power-on hours At 8,760 POH (Power On Hours) per year Max case temperature: 70°C at the case measurement location shown in Figure 4.
Load/Unload (U/UL)	
25°C, 50% relative humidity	600,000 software-controlled power on/off cycles 30,000 hard power on/off cycles
32°C, 80% relative humidity 5°C, 80% relative humidity 5°C, 10% relative humidity 60°C, 20% relative humidity	600,000 software-controlled power on/off cycles 30,000 hard power on/off cycles
Service Life	10 years, form, fit, and function replacement
Warranty	1 year standard (up to 5 years with additional warranty purchase). To determine the warranty for a specific drive, use a web browser to access the following web page: www.seagate.com/support/service/ 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.

2.15 Agency certification

2.15.1 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.

2.15.2 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: EE25 Series
- Certificate numbers:STX-EE251 (B)
- Trade name or applicant: Seagate Technology International
- Manufacturing date: March 2006
- Manufacturer/nationality: Seagate Technology International

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).

2.15.3 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.

2.16 Environmental protection

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

2.16.1 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.

2.17 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:

- Keep the drive in the electrostatic discharge (ESD) bag until you are ready for installation to limit the drive's exposure to ESD.
- 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 only by its edges or frame.
- The drive is 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 Jumper settings

3.2.1 Master/slave configuration

Use the options jumper block shown in Figure 3 to configure the drive for operation. This jumper block is the 4-pin header adjacent to pins 1 and 2 of the I/O signal pins. For additional information about using the Cable select option, see Section 3.2.2.

The “Drive is master (or single drive)” option is the default setting.

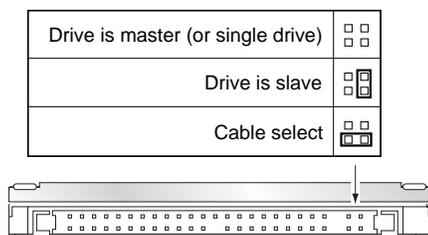


Figure 3. Jumper settings

3.2.2 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 as shown in Figure 3. Refer to your computer manual to determine whether your computer supports this option.

3.3 Drive mounting

You can mount the drive using four screws in the side-mounting holes or four screws in the bottom-mounting holes. See Figure 4 for drive mounting dimensions (dimensions in inches with mm in parentheses). 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 M3 x 0.5 mounting screws.
- Do not overtighten the mounting screws (maximum torque: 4.0 inch-lb).
- Four (4) threads (0.080 inches) minimum screw engagement recommended.

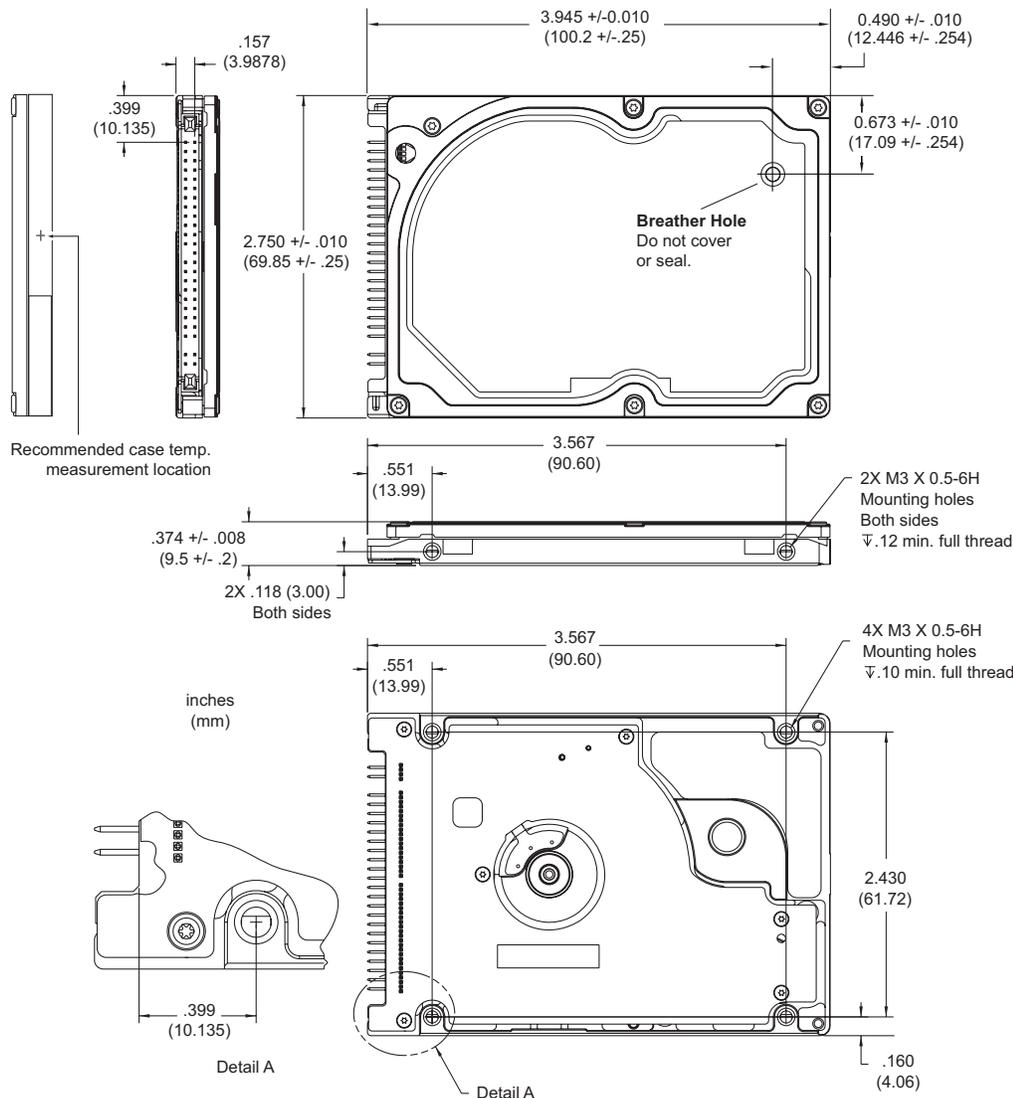


Figure 4. Mounting dimensions—top, side and end view

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.

For detailed information about the ATA interface, refer to the *AT Attachment - 6 with Packet Interface (ATA/ATAPI-6)*, *ANSI NCITS 361-200*, subsequently referred to as the *ATA-6 Standard*.

4.1 ATA interface signals and connector pins

The following table summarizes the signals on the 44-pin ATA interface connector. For a detailed description of these signals, refer to the *ATA-6 Standard*.

Signal Name	Connector Contact	Cable Conductor
RESET-	1	1
DD7	3	3
DD6	5	5
DD5	7	7
DD4	9	9
DD3	11	11
DD2	13	13
DD1	15	15
DD0	17	17
Ground	19	19
DMARQ	21	21
DIOW-	23	23
DIOR-	25	25
IORDY	27	27
DMACK-	29	29
INTRQ	31	31
DA1	33	33
DA0	35	35
CS1FX-	37	37
DASP-	39	39
+5 V (Logic)	41	41
Ground (Return)	43	43

Cable Conductor	Connector Contact	Signal Name
2	2	Ground
4	4	DD8
6	6	DD9
8	8	DD10
10	10	DD11
12	12	DD12
14	14	DD13
16	16	DD14
18	18	DD15
20	20	(keypin)
22	22	Ground
24	24	Ground
26	26	Ground
28	28	PSYNC:CSEL
30	30	Ground
32	32	IOCS16-
34	34	PDIAG-
36	36	DA2
38	38	CS3FX-
40	40	Ground
42	42	+5V (Motor)
44	44	No connection

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 *ATA-6 Standard*.

Command name	Command code (in hex)
ATA-standard commands	
ATA Device Configuration Overlay	B1 _H
ATA Service	A2 _H
Check Power Mode	98 _H , E5 _H
Download Microcode	92 _H
Execute Device Diagnostics	90 _H
Flush Cache	E7 _H
Format Track (Legacy)	50 _H
Identify Device	EC _H
Idle	97 _H , E3 _H
Idle Immediate	95 _H , E1 _H
Initialize (Set) Device Parameters	91 _H
Read Buffer	E4 _H
Read DMA	C8 _H , C9 _H
Read Log Extended	22 _H
Read Multiple	C4 _H
Read Native Max Address	F8 _H
Read Sectors	20 _H , 21 _H
Read Verify Sectors	40 _H , 41 _H
Recalibrate	10 _H
Security Disable Password	F6 _H
Security Erase Prepare	F3 _H
Security Erase Unit	F4 _H
Security Freeze Lock	F5 _H
Security Set Password	F1 _H
Security Unlock	F2 _H
Seek	70 _H
Set Drive Parameters	91 _H
Set Features	EF _H
Set Max Address	F9 _H

Command name	Command code (in hex)
Note: Individual Set Max commands are identified by the value placed in the Set Max Features register as defined to the right.	Address 00 _H Password 01 _H Lock 02 _H Unlock 03 _H Freeze Lock 04 _H
Set Multiple Mode	C6 _H
Sleep	99 _H , E6 _H
S.M.A.R.T.	B0 _H
Standby	96 _H , E2 _H
Standby Immediate	94 _H , E0 _H
Vendor Unique	9A _H , FA _H , FB _H
Write Buffer	E8 _H
Write DMA	CA _H , CB _H
Write Log Extended	32 _H
Write Multiple	C5 _H
Write Sectors	30 _H , 31 _H
ATA-standard power-management commands	
Check Power Mode	98 _H or E5 _H
Idle	97 _H or E3 _H
Idle Immediate	95 _H or E1 _H
Sleep	99 _H or E6 _H
Standby	96 _H or E2 _H
Standby Immediate	94 _H or E0 _H
ATA-standard security commands	
Security Set Password	F1 _H
Security Unlock	F2 _H
Security Erase Prepare	F3 _H
Security Erase Unit	F4 _H
Security Freeze Lock	F5 _H
Security Disable Password	F6 _H

4.1.2 Identify Device command

The Identify Device command (command code EC_H) transfers information about the drive to the host following power up. The data, shown below, is organized as a single 512-byte block of data. 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 *ATA-6 Standard*.

Word	Description	Value
0	Configuration information: <ul style="list-style-type: none"> • Bit 15: 0 = ATA; 1 = ATAPI • Bit 7: removable media • Bit 6: removable controller • Bit 0: reserved 	0C5A _H
1	Number of logical cylinders	16,383
2	ATA-reserved	0000 _H
3	Number of logical heads	16
4	Retired	0000 _H
5	Retired	0000 _H
6	Number of logical sectors per logical track: 63	003F _H
7–9	Retired	0000 _H
10–19	Serial number: (20 ASCII characters, 0000 _H = none)	ASCII
20	Retired	0000 _H
21	Retired	0400 _H
22	Obsolete	0000 _H
23–26	Firmware revision (8 ASCII character string, padded with blanks to end of string)	x.xx
27–46	Drive model number (40 ASCII characters, padded with blanks to end of string)	ST940813AM ST940814AM ST930813AM ST930814AM ST920813AM ST920814AM
47	(Bits 7–0) Maximum sectors per interrupt on Read multiple and Write multiple (16)	8010 _H
48	Reserved	0000 _H
49	Standard Standby timer, IORDY supported and may be disabled	2F00 _H
50	ATA-reserved	0000 _H
51	PIO data-transfer cycle timing mode	0200 _H
52	Retired	0200 _H
53	Words 54–58, 64–70 and 88 are valid	0007 _H
54	Number of current logical cylinders	xxxx _H
55	Number of current logical heads	xxxx _H
56	Number of current logical sectors per logical track	xxxx _H

Word	Description	Value
57–58	Current capacity in sectors	xxxx _H
59	Number of sectors transferred during a Read Multiple or Write Multiple command	xxxx _H
60–61	Total number of user-addressable LBA sectors available (see Section 2.2 for related information)	ST940813AM = 78,140,160 ST940814AM = 78,140,160 ST930813AM = 58,605,120 ST930814AM = 58,605,120 ST920813AM = 39,070,080 ST920814AM = 39,070,080
62	Retired	0000 _H
63	Multiword DMA active and modes supported (see note following this table)	xx07 _H
64	Advanced PIO modes supported (modes 3 and 4 supported)	0003 _H
65	Minimum multiword DMA transfer cycle time per word (120 nsec)	0078 _H
66	Recommended multiword DMA transfer cycle time per word (120 nsec)	0078 _H
67	Minimum PIO cycle time without IORDY flow control (240 nsec)	00F0 _H
68	Minimum PIO cycle time with IORDY flow control (120 nsec)	0078 _H
69–74	ATA-reserved	0000 _H
75	Queue depth	0000 _H
76–79	ATA-reserved	0000 _H
80	Major version number	007E _H
81	Minor version number	0000 _H
82	Command sets supported	346B _H
83	Command sets supported	7D01 _H
84	Command sets support extension	4003 _H
85	Command sets enabled	34xx _H
86	Command sets enabled	3xxx _H
87	Command sets enable extension	4003 _H
88	Ultra DMA support and current mode (see note following this table)	xx3F _H
89	Security erase time	0000 _H
90	Enhanced security erase time	0000 _H
91	Advanced power management value	0040 _H
92	Master password revision code	FFFE _H
93	Hardware reset value (see description following this table)	xxxx _H
94	Auto acoustic management setting	xxxx _H
95–127	ATA-reserved	0000 _H
128	Security status	0001 _H

Word	Description	Value
129–159	Seagate-reserved	xxxx _H
160–254	ATA-reserved	0000 _H
255	Integrity word	xxA5 _H

Note. See the bit descriptions below for words 63, 88, 93 and 94 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 _{IH} 0 = 40-conductor cable detected, CBLID below V _{IL}

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

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

5.0 Seagate Technology support services

Internet

For information regarding Seagate products and services, visit 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.

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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 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.

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.

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.

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