Product Manual

DB35 Series 7200.2

ST3500841ACE

ST3400833ACE

ST3300822ACE

ST3250824ACE

ST3200827ACE

ST3160212ACE

ST3120213ACE

ST3802110ACE

Seagate

Revision status summary sheet

Revision	Date	Notes
Rev. A	05/02/06	Initial release.
Rev. B	05/17/06	Revise AFR specification.
Rev. C	11/10/06	Revise DC power requirements Table 4.

Contents

List of Figures

DB35 Series 7200.2 Product Manual, Rev. C

1.0 Introduction

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 Giant magnetoresistive (TGMR) recording heads and EPRML technology, which provide the drives with increased areal density.
- 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

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^2 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^{14} 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: 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.	
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^2 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.)		

DB35 Series 7200.2 Product Manual, Rev. C

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^{14} 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: 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.		
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^2 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^{14} 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: 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.		
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^2 max)	

ST3500841ACE, ST3400833ACE, ST3300822ACE, ST3250824ACE, ST3200827ACE	97.69
ST3160212ACE, ST3120213ACE, ST3802110ACE	119.0
Spindle speed (RPM) (± 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

Drive specification	

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
 	
    ST3300822ACE
 	
    ST3250824ACE
    ST3200827ACE
    ST3160212ACE
    ST3120213ACE
    ST3802110ACE
	710 grams (1.57 lbs)
	
	655 grams (1.44 lbs)
	
	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
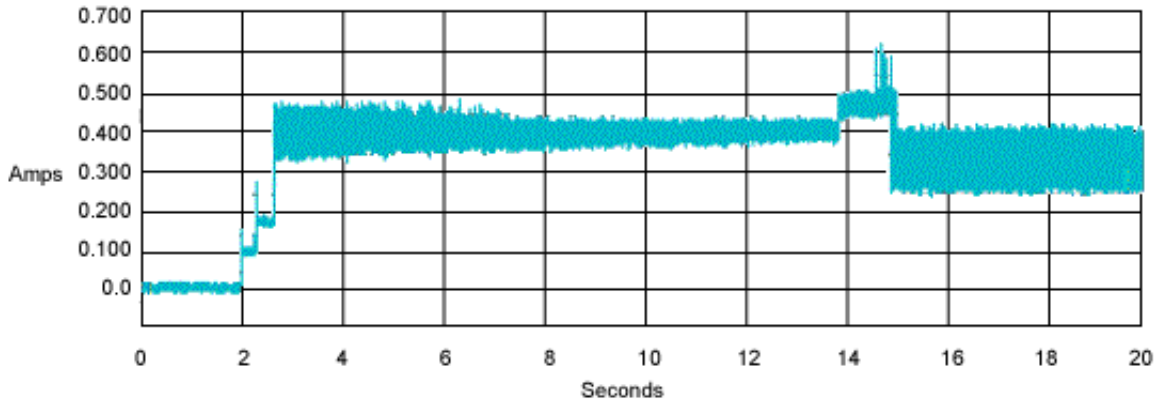
Figure 1   **Typical 5V startup and operation current profile**
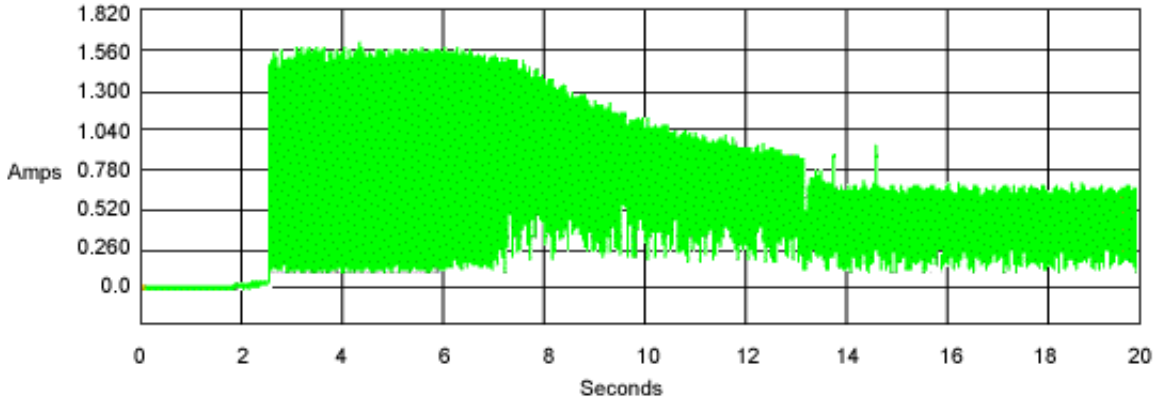
Figure 2   **Typical 12V startup and operation current profile**

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 ± 5%
12V ± 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, ad 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:

(Number of seeks per second = 0.4 / (average latency + 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: ± 4 kV; Air: ± 8 kV	B	EN 61000-4-2: 95
Radiated RF immunity	80 to 1,000 MHz, 3 V/m, 80% AM with 1 kHz sine 900 MHz, 3 V/m, 50% pulse modulation @ 200 Hz	A	EN 61000-4-3: 96 ENV 50204: 95
Electrical fast transient	± 1 kV on AC mains, ± 0.5 kV on external I/O	B	EN 61000-4-4: 95
Surge immunity	± 1 kV differential, ± 2 kV common, AC mains	B	EN 61000-4-5: 95
Conducted RF immunity	150 kHz to 80 MHz, 3 Vrms, 80% AM with 1 kHz sine	A	EN 61000-4-6: 97
Voltage dips, interrupts	0% open, 5 seconds 0% short, 5 seconds 40%, 0.10 seconds 70%, 0.01 seconds	C C C B	EN 61000-4-11: 94

2.12 Reliability

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. Although amendments to the Euro-pean Union's Restriction of Hazardous Substances (RoHS) Directive have not been finalized, to the best of our knowledge the disc drives documented in this publication will comply with the final RoHS Directive require-ments.

A number of parts and materials in Seagate products are procured from external suppliers. We rely on the rep-resentations 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 operat-ing procedures that ensure that restricted substances are not utilized in our manufacturing operations, labora-tory 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

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.

Breather hole
Do not cover or seal this hole.
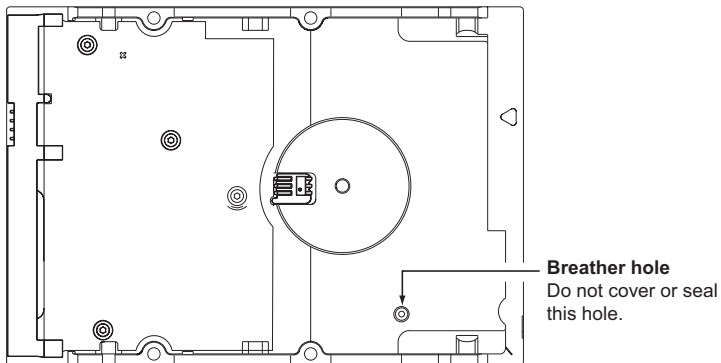
Figure 3   Breather filter hole location

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.
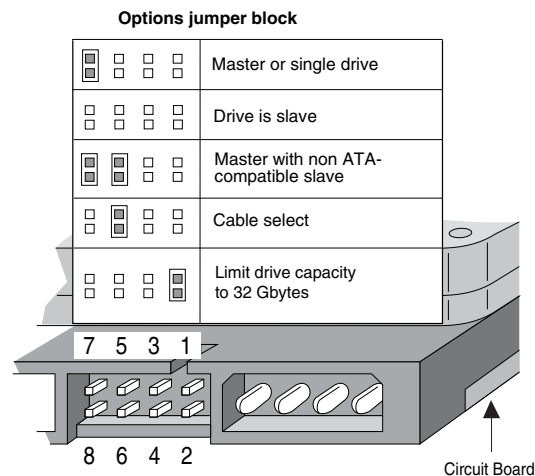
Figure 4   Master/slave jumper settings

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$_H$ 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.

Note. If you are using a 40-pin, 80-conductor cable, attach the blue connector to the motherboard, the black connector to the master drive, and the gray connector to the slave.
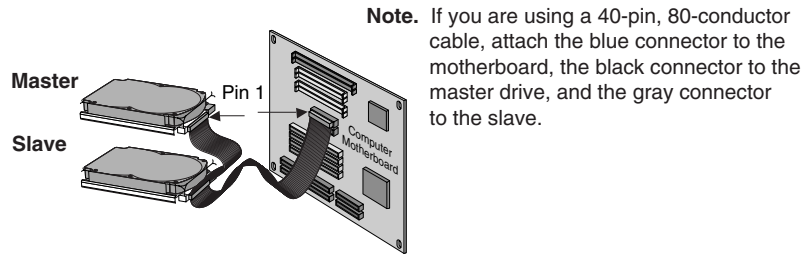
Figure 5   Ultra ATA cable connectors

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.

1.028 max
(26.11) 2

3 x 0.25 ± 0.010
(6.35 ± 0.037)
both sides

1.122   0.02
(28.5 ± 0.51) 2

1.638 ± 0.01
(41.61 ± 0.25)

5.787 max
(146.99)

4.0 ± 0.01
(101.60 ± 0.25) 2

2

Recommended
case temperature
measurement location

3 x 6-32 UNC-2B
0.150 (3.81) max. fastener
penetration both sides. 3 threads
minimum engagement.

0.228
(5.79)

2.23
(56.56)

2.83
(71.80)

3.71
(94.35)

0.178
(4.27)

1.625 ± 0.020
(41.28 ± 0.51) 2

1.75 ± 0.01
(44.45 ± 0.25) 2

4 x 6-32 UNC-2B
0.150 (3.81) max. fastener
penetration. 3 threads
minimum engagement.

0.1240 ± 0.01
(3.18 ± 0.25) 2

3.750 ± 0.01
(95.25 ± 0.25) 2

4.0 ± 0.01
(101.60 ± 0.25) 2

Recommended
case temperature
measurement location

Figure 6   Mounting dimensions—top, side and end view

4.0 ATA interface

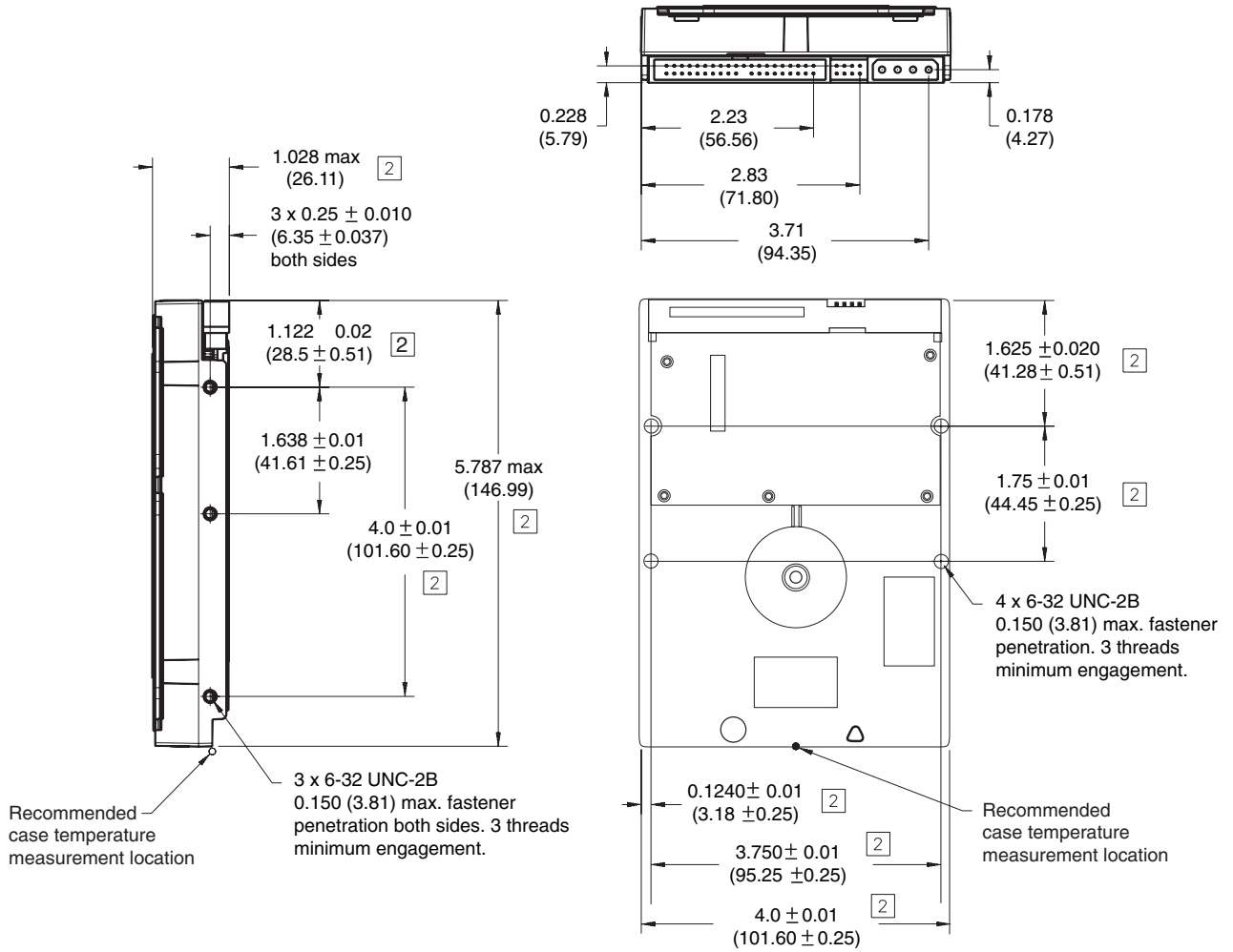These drives use the industry-standard ATA task file interface that supports 16-bit data transfers. It supports ATA programmed input/output (PIO) modes 0–4; multiword DMA modes 0–2, and Ultra DMA modes 0–5. The drive also supports the use of the IORDY signal to provide reliable high-speed data transfers.

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	DIOW– STOP	23 Device I/O Write: Stop Ultra DMA Burst
24	Ground	24 Ground
25	DIOR– HDMARDY– HSTROBE	25 Device I/O Read: Host Ultra DMA Ready: Host Ultra DMA Data Strobe
26	Ground	26 Ground
27	IORDY DDMARDY– DSTROBE	27 I/O Channel Ready Device Ultra DMA Ready Device Ulta 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– CBLID–	34 Passed Diagnostics Cable Assembly Type Identifier
35	DA0	35 Device Address (2:0)
36	DA2	36 Device Address (2:0)
37	CS0–	37 Chip Select (1:0)
38	CS1–	38 Chip Select (1:0)
39	DASP–	39 Drive Active/Slave Present
40	Ground	40 Ground

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

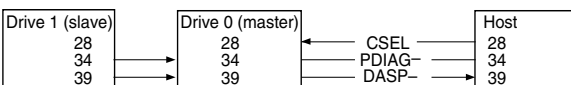| Drive 1 (slave)	Drive 0 (master)		Host
28	28	CSEL	28
34	34	PDIAG–	34
39	39	DASP–	39

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_H or $E5_H$
Device Configuration Freeze Lock	$B1_H$ / $C1_H$
Device Configuration Identify	$B1_H$ / $C2_H$
Device Configuration Restore	$B1_H$ / $C0_H$
Device Configuration Set	$B1_H$ / $C3_H$
Device Reset	08_H
Download Microcode	92_H
Execute Device Diagnostics	90_H
Flush Cache	$E7_H$
Flush Cache Extended	EA_H
Format Track	50_H
Identify Device	EC_H
Idle	97_H or $E3_H$
Idle Immediate	95_H or $E1_H$
Initialize Device Parameters	91_H
Read Buffer	$E4_H$
Read DMA	$C8_H$
Read DMA Extended	25_H
Read DMA Without Retries	$C9_H$
Read Log Ext	$2F_H$
Read Multiple	$C4_H$
Read Multiple Extended	29_H
Read Native Max Address	$F8_H$
Read Native Max Address Extended	27_H
Read Sectors	20_H
Read Sectors Extended	24_H
Read Sectors Without Retries	21_H
Read Verify Sectors	40_H
Read Verify Sectors Extended	42_H
Read Verify Sectors Without Retries	41_H
Recalibrate	10_H

Command name	Command code (in hex)
Security Disable Password	$F6_H$
Security Erase Prepare	$F3_H$
Security Erase Unit	$F4_H$
Security Freeze	$F5_H$
Security Set Password	$F1_H$
Security Unlock	$F2_H$
Seek	70_H
Set Features	EF_H
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.	$F9_H$ Address: 00_H Password: 01_H Lock: 02_H Unlock: 03_H Freeze Lock: 04_H
Set Max Address Extended	37_H
Set Multiple Mode	$C6_H$
Sleep	99_H or $E6_H$
S.M.A.R.T. Disable Operations	$B0_H$ / $D9_H$
S.M.A.R.T. Enable/Disable Autosave	$B0_H$ / $D2_H$
S.M.A.R.T. Enable Operations	$B0_H$ / $D8_H$
S.M.A.R.T. Execute Offline	$B0_H$ / $D4_H$
S.M.A.R.T. Read Attribute Thresholds	$B0_H$ / $D1_H$
S.M.A.R.T. Read Data	$B0_H$ / $D0_H$
S.M.A.R.T. Read Log Sector	$B0_H$ / $D5_H$
S.M.A.R.T. Return Status	$B0_H$ / DA_H
S.M.A.R.T. Save Attribute Values	$B0_H$ / $D3_H$
S.M.A.R.T. Write Log Sector	$B0_H$ / $D6_H$
Standby	96_H or $E2_H$
Standby Immediate	94_H or $E0_H$
Write Buffer	$E8_H$
Write DMA	CA_H
Write DMA Extended	35_H
Write DMA Without Retries	CB_H
Write Log Extended	$3F_H$
Write Multiple	$C5_H$
Write Multiple Extended	39_H
Write Sectors	30_H

Command name	Command code (in hex)
Write Sectors Without Retries	31$_H$
Write Sectors Extended	34$_H$

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 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: • 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)	ST3500841ACE ST3400833ACE ST3300822ACE ST3250824ACE ST3200827ACE ST3160212ACE ST3120213ACE ST3802110ACE
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*$_H$

Word	Description	Value
56	Number of current logical sectors per logical track	$xxxx_H$
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) *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_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	SATA-reserved	$xxxx_H$
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
92	Master password revision code	$FFFE_H$
93	Hardware reset value (see description following this table)	$xxxx_H$
95–99	ATA-reserved	0000_H

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: 0000FFFFFFFFFFFFh.	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_H
128	Security status	0001_H
129–159	Seagate-reserved	$xxxx_H$
160–254	ATA-reserved	0000_H
255	Integrity word	$xxA5_H$

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_{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 *(default).*	
03_H	Set transfer mode (based on value in Sector Count register).	
	Sector Count register values:	
	00_H	Set PIO mode to default (PIO mode 2).
	01_H	Set PIO mode to default and disable IORDY (PIO mode 2).
	08_H	PIO mode 0
	09_H	PIO mode 1
	$0A_H$	PIO mode 2
	$0B_H$	PIO mode 3
	$0C_H$	PIO mode 4 *(default)*
	20_H	Multiword DMA mode 0
	21_H	Multiword DMA mode 1
	22_H	Multiword DMA mode 2
	40_H	Ultra DMA mode 0
	41_H	Ultra DMA mode 1
	42_H	Ultra DMA mode 2
	43_H	Ultra DMA mode 3
	44_H	Ultra DMA mode 4
	45_H	Ultra DMA mode 5
55_H	Disable read look-ahead (read cache) feature.	
82_H	Disable write cache.	
AA_H	Enable read look-ahead (read cache) feature *(default).*	
$F1_H$	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.

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 $D4_H$) 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
$D0_H$	S.M.A.R.T. Read Data
$D1_H$	Vendor-specific
$D2_H$	S.M.A.R.T. Enable/Disable Attribute Autosave
$D3_H$	S.M.A.R.T. Save Attribute Values
$D4_H$	S.M.A.R.T. Execute Off-line Immediate (runs DST)
$D5_H$	S.M.A.R.T. Read Log Sector
$D6_H$	S.M.A.R.T. Write Log Sector
$D7_H$	Vendor-specific
$D8_H$	S.M.A.R.T. Enable Operations
$D9_H$	S.M.A.R.T. Disable Operations
DA_H	S.M.A.R.T. Return Status

Note. If an appropriate code is not written to the Features Register, the command is aborted and $0x04$ (abort) is written to the Error register.

5.0 Seagate Technology support services

Online services

Internet
www.seagate.com for information about Seagate products and services. Worldwide support is available 24 hours daily by e-mail for your questions.

Presales Support: www.seagate.com/support/email/email_presales.html *or* Presales@Seagate.com
Technical Support: www.seagate.com/support/email/email_disc_support.html *or* DiscSupport@Seagate.com

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

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

Seagate Service Centers

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

Technical Support
Seagate technical support is available to assist you online at support.seagate.com 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 drives. 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 one of the Seagate CSO warranty centers for assistance. Have your drive's "ST" model number and serial 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 in North America. To speak with a case management representative, call 1-800-475-0143. Additional information, including an online request form and data loss prevention resources, is available at www.datarecovery.seagate.com.

Authorized Service Centers

In some locations outside the US, you can contact an Authorized Service Center for service.

USA/Canada/Latin America support services

Seagate Service Centers

Presales Support

Call center	Toll-free	Direct dial	FAX
Americas	1-877-271-3285[1]	+1-405-324-4730[1]	+1-405-324-4704

Technical Support

Call center	Toll-free	Direct dial	FAX
Americas	1-800-SEAGATE[2]	+1-405-324-4700[2]	+1-405-324-3339

Customer Service Operations

Warranty Service

Call center	Toll-free	Direct dial	FAX / E-mail
USA, Canada, Mexico and Latin America	1-800-468-3472[3]	—	+1-956-664-4725
Brazil *Jabil Industrial Do Brasil LTDA*[4]	—	+55-11-4191-4761	+55-11-4191-5084 SeagateRMA.br@jabil.com

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

---

[1]Hours of operation are 8:00 A.M. to 7:00 P.M., Monday through Friday (Central time).
[2]Hours of operation are 8:00 A.M. to 8:00 P.M., Monday through Friday (Central time).
[3]Hours of operation are 8:00 A.M. to 5:00 P.M., Monday through Friday (Central time).
[4]Authorized Service Center
[5]Hours of operation are 8:00 A.M. to 8:00 P.M., Monday through Friday, and 9:00 A.M. to 5:00 P.M., Saturday (Eastern time).

European support services

For presales and technical support in Europe, dial the Seagate Service Center toll-free number for your specific location. If your location is not listed here, dial our presales and technical support call center at +1-405-324-4714 from 8:00 A.M. to 11:45 A.M. and 1:00 P.M. to 5:00 P.M. (Central Europe time) Monday through Friday. The presales and technical support call center is located in Oklahoma City, USA.

For European warranty service, dial the toll-free number for your specific location. If your location is not listed here, dial our European CSO warranty center at +31-20-316-7222 from 8:30 A.M. to 5:00 P.M. (Central Europe time) Monday through Friday. The CSO warranty center is located in Amsterdam, The Netherlands.

Seagate Service Centers

Toll-free support numbers

Call center	Presales and Technical Support	Warranty Service
Austria	—	00 800-47324289
Belgium	00 800-47324283 (00 800-4SEAGATE)	00 800-47324289
Denmark	00 800-47324283	00 800-47324289
France	00 800-47324283	00 800-47324289
Germany	00 800-47324283	00 800-47324289
Ireland	00 800-47324283	00 800-47324289
Italy	00 800-47324283	00 800-47324289
Netherlands	00 800-47324283	00 800-47324289
Norway	00 800-47324283	00 800-47324289
Poland	00 800-311 12 38	00 800-311 12 38
Spain	00 800-47324283	00 800-47324289
Sweden	00 800-47324283	00 800-47324289
Switzerland	00 800-47324283	00 800-47324289
Turkey	00 800-31 92 91 40	00 800-31 92 91 40
United Kingdom	00 800-47324283	00 800-47324289

FAX services—All Europe (toll call)

Technical Support	+1-405-324-3339
Warranty Service	+31-20-653-3513

Africa/Middle East support services

For presales and technical support in Africa and the Middle East, dial our presales and technical support call center at +1-405-324-4714 from 8:00 A.M. to 11:45 A.M. and 1:00 P.M. to 5:00 P.M. (Central Europe time) Monday through Friday. The presales and technical support call center is located in Oklahoma City, USA.

For warranty service in Africa and the Middle East, dial our European CSO warranty center at +31-20-316-7222 from 8:30 A.M. to 5:00 P.M. (Central Europe time) Monday through Friday, or send a FAX to +31-20-653-3513. The CSO warranty center is located in Amsterdam, The Netherlands.

Asia/Pacific support services

For Asia/Pacific presales and technical support, dial the toll-free number for your specific location. The Asia/Pacific toll-free numbers are available from 6:00 A.M. to 10:45 A.M. and 12:00 P.M. to 6:00 P.M. (Australian Eastern time) Monday through Friday, except as noted. If your location is not listed here, direct dial one of our technical support locations.

Warranty service is available from 9:00 A.M. to 5:00 P.M., Monday through Friday. Warranty service for Australia is available from 10:00 A.M. to 7:00 P.M., April through October, and from 11:00 A.M. to 8:00 P.M. November through March (Australian Eastern time) Monday through Friday.

Seagate Service Centers

Call center	Toll-free	Direct dial	FAX
Australia	1800-14-7201	—	—
China (Mandarin)[1, 4]	800-810-9668	+86-10-6225-5336	—
Hong Kong	800-90-0474	—	—
Hong Kong (Cantonese)[1, 4]	001-800-0830-1730	—	—
India[2, 4]	1-800-180-1104	—	—
Indonesia	001-803-1-003-2165	—	—
Japan[3, 4]	0034 800 400 554	—	—
Korea[3, 4]	007 98 8521 7635	—	—
Malaysia	1-800-80-2335	—	—
New Zealand	0800-443988	—	—
Singapore	800-1101-150	—	+65-6488-7525
Taiwan (Mandarin)[1, 4]	00-800-0830-1730	—	—
Thailand	001-800-11-0032165	—	—

Customer Service Operations

Warranty Service

Call center	Toll-free	Direct dial	FAX
Asia/Pacific	—	+65-6485-3595	+65-6485-4860
Australia	1800-12-9277	—	—
India[4]	—	+91-44-42015000	+91-44-42015184

---

[1]Hours of operation are 8:30 A.M. to 5:30 P.M., Monday through Friday (Australian Western time).
[2]Hours of operation are 9:00 A.M. to 6:00 P.M., Monday through Saturday.
[3]Hours of operation are 9:30 A.M. to 6:30 P.M., Monday through Friday.
[4]Authorized Service Center

Publication feedback survey

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

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

Thank you for your time and comments.

Index

Numerics

3D Defense System   1

A

acoustics   17
Active mode   15
agency certification (regulatory)   19
alternate capacity jumper   25
altitude   16
ambient conditions   3
ambient temperature   12,   16
areal density   1,   10
ATA interface   29
ATA-standard commands   30
Australian C-Tick   19
autodetection   1
average seek time   12

B

BIOS   25
BPI   10
breather filter hole precautions   24
buffer   11
burst   1

C

cable   26
cable select   1
cable-select option   25
cache   1,   11
case temperature   16
CE mark   19
certification   19
Check Power Mode   30
chemical substances   20
commands   30
compliance   19
conducted noise   14
conducted RF immunity   18
configuring the drive   23
connector pins   29
connectors   26
contact start-stop cycles   18
Corrosive environment   21
CSA C22.2 (950)   19
CSEL   25
C-Tick   19
current profile   14
cycles   18
Cylinders   10

D

Data Defense   1
data-transfer rates   1
DC power   13
Default logical geometry   10
density   10
Device Configuration Freeze Lock   30
Device Configuration Identify   30
Device Configuration Restore   30
Device Configuration Set   30
Device Reset   30
Diagnostic Defense   1
diagnostic software   1,   37
DiscWizard   25
Disk Manager   25
dissipation   13
Download Microcode   30
Drive Defense   1
drive diagnostics   12
drive monitoring   1
drive self-test   1,   37
DST   37

E

electrical fast transient   18
electromagnetic compatibility   19
Electromagnetic Compatibility Directive   19
electromagnetic immunity   18
electrostatic discharge   18
EMC compliance   19
EN 60950   19
enclosures   20
Environmental protection   20
environmental specifications   16
EPRML   1,   10
error-correction algorithms   1
errors   18
European Union   19
European Union Restriction of Hazardous Substanc-
         es   20
Execute Device Diagnostics   30

F

failure prediction   37
FCC verification   20
Features register   36
Flush Cache   30
Flush Cache Extended   30
Format Track   30
formatted capacity   10
frequency   18

G

geometry   10
guaranteed sectors   10

H

handling   23
heads   1,   10
height   12
humidity   16

I

I/O data-transfer rate   11
Identify Device   30
Identify Device command   33
Idle   13,   30
Idle and Standby timers   15
Idle Immediate   30
Idle mode   15
Idle mode power   13
IEC950   19
Information Technology Equipment   19
Initialize Device Parameters   30
interface   10,   29
interface signals   29
interference   20
internal data-transfer rate OD   11
ISO document 7779   17

J

jumper settings   25

K

Korean RRL   19

L

LBA mode   10
length   12
logical geometry   10

M

maintenance   18
master   25
master/slave   1
Master/slave configuration   25
maximum temperature   16
measurement locations   16
modes   29
monitoring   1
mounting the drive   23,   26

N

noise   14
nominal power   3
nonoperating shock   17
nonoperating vibration   17
nonrecoverable read errors   18

O

operating   13
operating power and current   13
operating shock   16
operating vibration   17
orientation   26

P

physical characteristics   12
pins   29
PIO   29
power consumption   13
power dissipation   13
power management   15
power specifications   13
power-management modes   15
Power-on to Ready   12
precautions   26
preventive maintenance   18
programmable power management   15

R

radiated RF immunity   18
radio and television interference   20
radio frequency   18
random track location   13
Read Buffer   30
Read DMA   30
Read DMA Extended   30
Read DMA without Retries   30
read errors   18
Read Log Ext   30
Read Multiple   1,   30
Read Multiple Extended   30
Read Native Max Address   30
Read Native Max Address Extended   30
Read Sectors   30
Read Sectors Extended   30
Read Sectors Without Retries   30
Read Verify Sectors   30
Read Verify Sectors Extended   30
Read Verify Sectors Without Retries   30
Read/write heads   10
Recalibrate   30
recording and interface technology   10
recording density   10

recording heads 1
recording method 10
register 36
relative humidity 16
reliability 18
resistance 14
resistive load 14
RF 18
RoHS 20

S

S.M.A.R.T. commands 37
S.M.A.R.T. Disable Operations 31
S.M.A.R.T. drive monitoring 1
S.M.A.R.T. Enable Operations 31
S.M.A.R.T. Enable/Disable Autosave 31
S.M.A.R.T. Execute Offline 31
S.M.A.R.T. Read Attribute Thresholds 31
S.M.A.R.T. Read Data 31
S.M.A.R.T. Read Log Sector 31
S.M.A.R.T. Return Status 31
S.M.A.R.T. Save Attribute Values 31
S.M.A.R.T. Write Log sector 31
safety certification 19
screws 26
SeaTools 1, 37
sectors 10
Sectors per track 10
Security Disable Password 31
Security Erase Prepare 31
Security Erase Unit 31
Security Freeze 31
Security Set Password 31
Security Unlock 31
Seek 31
seek mode 13
seek time 12
Seeking 13
servo electronics 13
Set Features 31
Set Features command 36
Set Max Address 31
Set Max Address Extended 31
Set Multiple Mode 31
shock 16
signals 29
single-track seeks 12
slave 25
Sleep 13, 31
Sleep mode 15
sound 17
specifications 3
spindle speed 11
Spinup 13
spinup power 13

Standby 13, 31
Standby Immediate 31
Standby mode 13, 15
Standby to Ready 12
start/stop times 12
start-stop cycles 18
static-discharge precautions 23
stop times 12
subassembly 20
support services 39
surge immunity 18

T

technical support services 39
temperature 16
temperature gradient 16
TGMR 1
timers 15
track density 10
track-to-track seek time 12
TUV North America 19

U

UL 1950 19
Ultra ATA/100 26
Ultra DMA 26

V

vibration 17
voltage 14
voltage dips, interrupts 18
voltage tolerance 14

W

weight 12
wet bulb temperature 16
width 12
Write Buffer 31
Write DMA 31
Write DMA Extended 31
Write DMA Without Retries 31
Write Log Extended 31
Write Multiple 1, 31
Write Multiple Extended 31
Write Sectors 31
Write Sectors Extended 32
Write Sectors Without Retries 32