PRODUCT MANUAL

ST1.3 Series

ST612712DEG

ST612712DE

ST610712DEG

ST610712DE

ST680712DEG

ST680712DE

ST660712DEG

ST660712DE

Rev. C
February 2007

Revision status summary sheet

Revision	Date	Sheets Affected
Rev. A	07/13/2006	All.
Rev. B	09/14/2006	1, 3, 5-7, 17, 20 and 26.
Rev. C	02/27/2007	Front cover and 18 .

Publication number: 100409345, Rev. C February 2007

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1.0 Introduction

This manual describes the functional, mechanical and interface specifications for the following Seagate® ST1.3 Series drives:

- ST612712DE-12GB, ST610712DE-10GB, ST680712DE-8GB and ST660712DE-6GB disc drives with a ZIF (zero insertion force) connector using an IDE interface.
- ST612712DEG-12GB, ST610712DEG-10GB, ST680712DEG-8GB and ST660712DEG-6GB disc drives with a ZIF (zero insertion force) connector using an IDE interface. These models incorporate an additional free-fall sensor for robust drop performance.

These drives provide the following key features.

- 3,600-RPM spindle speed and a 2-Mbyte buffer combined for superior read/write performance.
- Quiet operation. Fluid Dynamic Bearing (FDB) motor.
- Giant magnetoresistive (GMR) 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.
- 2.0K Gs nonoperating shock, and 300 Gs operating shock.
- SeaTools™ diagnostic software performs a drive self-test that eliminates unnecessary drive returns.

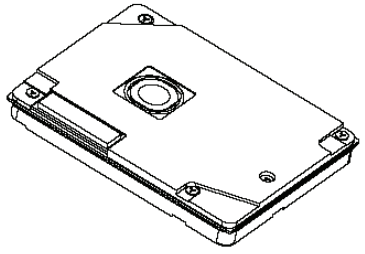


Figure 1. ST1.3 Series IDE interface (ZIF connector) disc drive

1.1 Disclaimer

Seagate Technology LLC makes no warranties whatsoever, including any warranty of merchantability, non-infringement, fitness for any particular purpose, or any warranty otherwise arising out of any proposal, specification or sample. Seagate may not be held liable for any direct, indirect, incidental, special, exemplary, or consequential damages (including, but not limited to, loss of use, data, or profits; procurement of substitute goods or services; or business interruptions) however caused and on any theory of liability, whether in contract, strict liability, or tort (including negligence or otherwise) arising in any way from the use of this kit, even if advised of the possibility of such damage.

1.2 Drive care

Do not use the ST1.3 Series disc drives outside of the ranges of environmental conditions found in Section 2.8, "Environmental specifications." Doing so may void the warranty of the ST1.3 Series disc drive.

1.3 Handling precautions

- Do not cover or seal the breather hole! Covering or sealing the breather hole may result in loss of data.

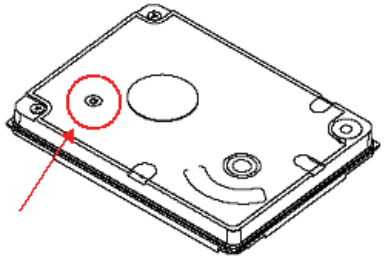


Figure 2. ST1.3 Series breather hole location

- Do not apply any force to the drive during handling or installation.
- When handling the drive, wear an wrist strap that is properly grounded to prevent damage from electrostatic discharge (ESD).
- Handle the drive carefully by the edges. Do not touch any exposed printed circuit board or the top cover.
- The drive is fragile—handle it with care. Do not press down on the top cover or attempt to use a pen to write on the drive's label. Do not apply more than 0.2 kg of force to the top cover.

Figure 3. ST1.3 Series improper handling example

- Do not drop the drive.
- Do not expose the drive to wet conditions.
- Do not place the drive near a strong magnetic field.
- Do not expose the drive to extreme temperatures.
- The drive may become hot during operation. Be careful when removing the drive from the host device immediately after operation.

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 ST612712DE, ST612712DEG, ST610712DE, ST610712DEG, ST680712DE, ST680712DEG, ST660712DE and ST660712DEG model drives.

2.1 Power, access times and acoustics

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: Specifications

Drive specification	ST612712DEG ST612712DE	ST610712DEG ST610712DE	ST680712DEG ST680712DE	ST660712DEG ST660712DE
Formatted Gbytes	12.0	10.0	8.0	6.0
Guaranteed sectors	23,438,016	19,533,024	15,625,008	11,719,008
Physical heads	2/1			
Physical discs	1			
Bytes per sector (logical)	512			
Cache (Mbytes)	2			
Recording density, BPI (bits/inch max)	933,000			
Track density. TPI (tracks/inch max)	140,000			
Areal density (Gbits/inch^2 max)	130.6			
Spindle speed (RPM)	3,600			
Internal data transfer rate OD (Mbits/sec max)	130.0			
Sustained data transfer rate OD (Mbytes/sec)	10.2			
I/O data-transfer rate (Mbytes/sec max)	66.7 (UDMA 4)			
ATA data-transfer modes supported	PIO modes 0–4; Multiword DMA modes 0-2; Ultra DMA modes 0–4			
Height (max)	5.1 mm (0.2009 inches)			
Width	40.0 +/-0.2 mm (1.5748 +/-0.008 inches)			
Length	30.0 +/-0.2 mm (1.1811 +/-0.008 inches)			
Weight	13.6 gm - 0.3000 lb. (typ)			
Average latency (msec)	8.3			
Power-on to ready (sec typical / max) (without retry)	1.0 / 2.5			
Standby to ready (sec typical / max) (without retry)	1.0 / 2.5			
Startup current 3.3v (peak) (maximum RMS in 10ms window)	330 mA			
Seek power (typical 3.3V)	154 mA			

Table 1: Specifications

Drive specification	ST612712DEG ST612712DE	ST610712DEG ST610712DE	ST680712DEG ST680712DE	ST660712DEG ST660712DE
Read/write power (typical 3.3V)	230/240 mA			
Performance idle mode (typical 3.3V)	140 mA			
Low power idle mode (typical 3.3V)	77 mA			
Standby/Sleep mode (typical 3.3V)	13 mA			
Voltage tolerance (including noise)	3.3V ± 5%			
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 (noncondensing)	5% to 90% (operating) 5% to 95% (nonoperating)			
Relative humidity gradient	30% per hour max			
Wet bulb temperature (°C max)	33°C (operating) 40°C (nonoperating)			
Altitude, operating	–60.98 m to 3,048 m (–200 ft to 10,000+ ft)			
Altitude, nonoperating (below mean sea level, max)	–60.98 m to 12,192 m (–200 ft to 40,000+ ft)			
Shock, operating (Gs max at 1 msec)	300			
Shock, nonoperating (Gs max at 1 msec)	2000			
Vibration, operating (max displacement may apply below 10 hz)	1.0 Gs (0 to peak, 10–500 Hz) @ 2 oct/min sweep rate			
Vibration, nonoperating (max displacement may apply below 22 hz)	5.0 Gs (0 to peak, 10–500 Hz) @ 0.5 oct/min sweep rate			
Drive acoustics, sound power (bels)				
Idle (typical / max)	1.6/ 1.9			
Operational (typical / max)	1.7 / 2.0			
Nonrecoverable read errors	1 per 10^{14} bits read			
Load/Unload (LUL) cycles (25°C)	300,000 software-controlled power on/off cycles 20,000 hard power on/off cycles			
Warranty	Per agreement			

2.2 Formatted capacity

Model	Formatted capacity	Guaranteed sectors	Bytes per sector
ST612712DEG ST612712DE	12.0 Gbytes	23,438,016	512
ST610712DEG ST610712DE	10.0 Gbytes	19,533,924	512
ST680712DEG ST680712DE	8.0 Gbytes	15,625,008	512
ST660712DEG ST660712DE	6.0 Gbytes	11,719,008	512

2.3 Default logical geometry

Model	Cylinders	Read/write heads	Sectors per track
ST612712DEG ST612712DE ST610712DEG ST610712DE ST680712DEG ST680712DE ST660712DEG ST660712DE	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

Technology	Specification
Interface	Seagate (ZIF) Flex Connector (35-way)
Recording method	Perpendicular Magnetic Recording
Recording density BPI (bits/inch max)	933,000
Track density TPI (tracks/inch max)	140,000
Areal density (Gbits/inch^2 max)	130.6
Spindle speed (RPM) (± 0.2%)	3,600
Internal data-transfer rate OD (Mbits/sec max)	130.0
Sustained data transfer rate OD (Mbytes/sec max)	10.2
I/O data-transfer rate (Mbytes/sec max)	66.7 (UDMA 4)
Interleave	1:1
Cache buffer All models	 2 Mbytes (2,048 Kbytes)

2.5 Physical characteristics

Height	(mm) (inches)	5.1 (max) 0.2007 (max)
Width	(mm) (inches)	40.0 +/-0.2 1.5748 +/-0.008
Length	(mm) (inches)	30.0 +/-0.2 1.1811 +/-0.008
Typical weight	(grams) (pounds)	13.6 (typ) 0.030 (typ)
Interface Connector		Seagate (ZIF) Flex Connector (35-way)

2.6 Time to ready

Time to ready	Typical	Max (without retry)
Power-On to Ready (sec)	1.0	2.5
Standby to Ready (sec)	1.0	2.5

2.7 Power specifications

The drive receives DC power (+3.3V) through the ZIF (IDE interface) connector for ST612712DE, ST612712DEG, ST610712DE, ST610712DEG, ST680712DEG, ST680712DE, ST660712DEG and ST660712DE models.

2.7.1 Power consumption

Power requirements for the drives are listed in the table on page 8. Typical power measurements are based on an average of drives tested, under nominal conditions, using +3.3V 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, at the moment while the head is writing/reading from/to disc. It is performed with 100 percent duty cycle of write/read operation.

- **Low power idle mode**

  Spindle motor is working normally with actuator unloaded to the parked position.

- **Standby mode / Sleep 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 2: DC power

ST1.3 Series Power Consumption (W) Max current the average of the peak value in 10ms window	Average 3.3V (mA)	Max 3.3V (mA)
Current	270	330
Spinup	180	300
Load/Unload current	190	200
Write	240	300
Read	230	300
Seek	154	161
Performance idle	140	147
Low power idle	77	86
Standby/Sleep	13	18

*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.

2.7.1.1 Typical current profile

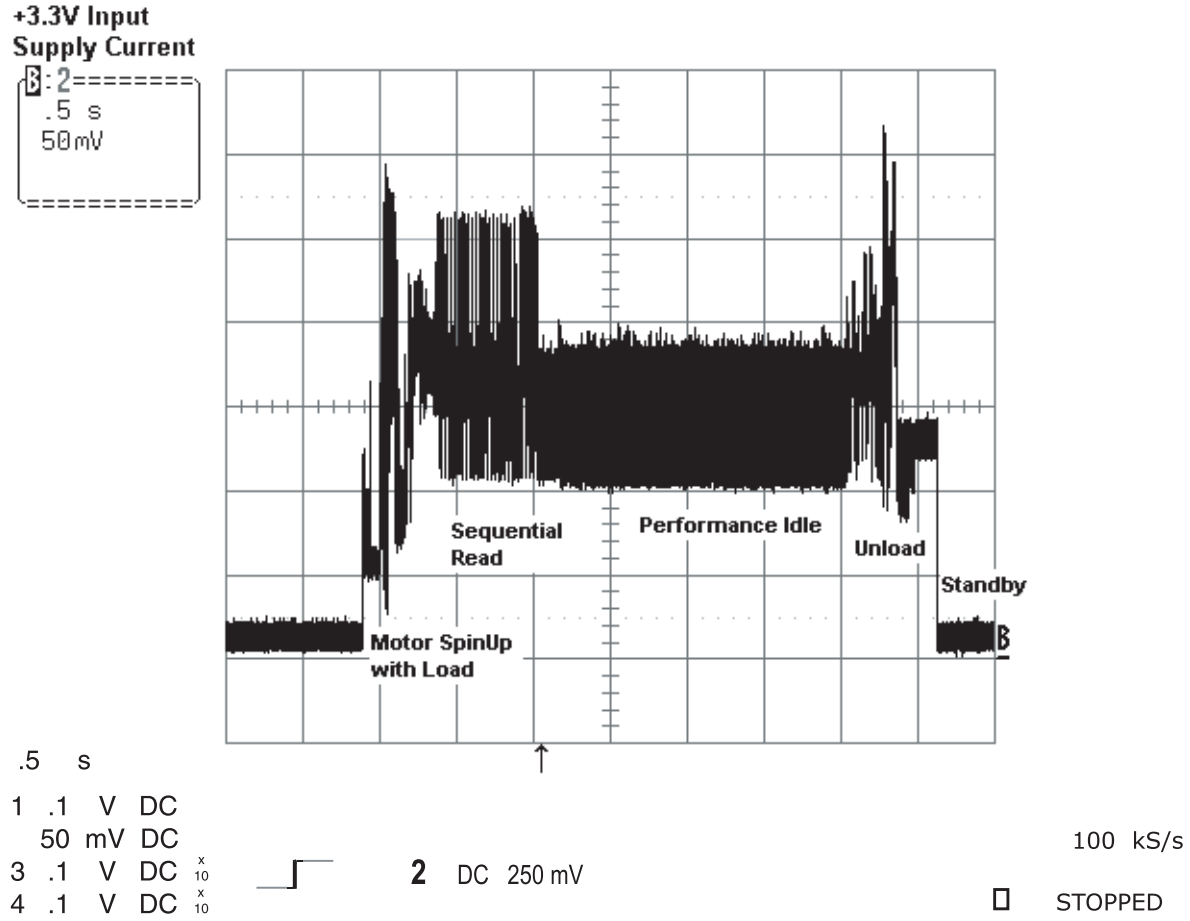


Figure 4. Typical 3.3V startup and operation current profile

2.7.2 Conducted noise

Input noise ripple is measured at the host system power supply across an equivalent 15-ohm resistive load on the +3.3 volt line.

Using 3.3-volt power, the drive is expected to operate with a maximum of 70 mV peak-to-peak square-wave injected noise at up to 20 MHz.

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

2.7.3 Voltage tolerance

Voltage tolerance (including noise):

3.3V ± 5%

2.7.4 Power-management modes

The drive provides programmable power management to provide greater energy efficiency. The drive features the following power-management modes:

Table 3: Power-management modes

Power modes	Heads	Spindle	Buffer
Active (operating)	Tracking	Rotating	Enabled
Idle, performance	Tracking	Rotating	Enabled
Idle, low power	Parked	Stopped	Disabled
Standby/Sleep	Parked	Stopped	Disabled

- **Active mode**

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

- **Low power idle mode**

  Drive enters Low Power Idle mode from Performance Idle mode when the Advanced Power Management Level is set between FDh and 80h, and the Idle timer is reached at 2 seconds (default setting is 2 seconds). Disc is not spinning and heads are parked and drive accepts all commands and returns to Active mode any time disc access is necessary.

- **Performance idle mode**

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

- **Standby/Sleep 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 disabled, 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.

- **Standby timers**

  Each time the drive performs an Active function (such as 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.

2.8 Environmental specifications

2.8.1 Ambient temperature

Ambient temperature is defined as the temperature of the environment immediately surrounding the drive. Actual drive case temperature should not exceed 70°C (158°F) within the operating ambient conditions. Case temperature of the drive operating at 60°C ambient may hit a maximum of 70°C at certain parts of the casing.

Above 1,000 feet (305 meters), the maximum temperature is derated linearly by 1°C every 1000 feet.

Operating	0° to 60°C (32° to 140°F) (70°C max case temperature)
Nonoperating	–40° to 70°C (–40° to 158°F)

2.8.2 Temperature gradient

Operating	20°C per hour (36°F per hour max), without condensation
Nonoperating	30°C per hour (54°F per hour max), without condensation

2.8.3 Humidity

2.8.3.1 Relative humidity

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

2.8.3.2 Wet bulb temperature

Operating	33°C (91.4°F max) [1]
Nonoperating	40°C (104°F max) [2]

[1] Operating: Wet bulb temperature is calculated by the operating Temperature and the Relative Humidity levels.
[2] Nonoperating: Wet bulb temperature is calculated by the nonoperating Temperature and the Relative Humidity levels.

2.8.4 Altitude

Operating	–60.98 m to 3,048 m (–200 ft to 10,000+ ft)
Nonoperating	–60.98 to 12,192 m (–200 ft to 40,000+ ft)

2.8.5 Shock

All shock measurements in this section are carried out at drive level. For all linear shock test, operating or non-operating, the input shock level shall be measured at the frame of the disk drive at the specific location indicated by the ellipse in Figure 5 below for the ZIF interface drives.

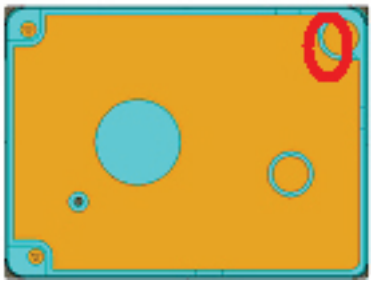


Figure 5. Location where tri-axial accelerometer will be placed on ST1.3 Series drives

All shock test will cover all the 6 directions, +/- x, y and z axes. The drive axis definition in shown in Figure 6 below.

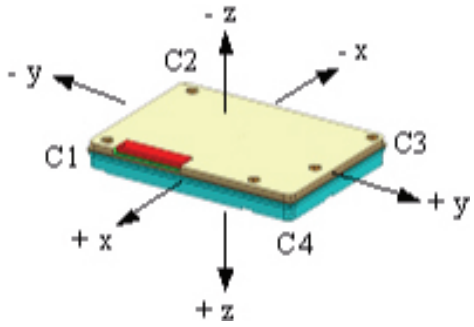


Figure 6. Drive axis definition for ST1.3 Series drives

2.8.5.1 Operating shock

The drive will be subjected to 10 shocks for each direction. During the shocks, there must be a minimum delay of 3 seconds between shock pulses. Soft errors and automatic retries are allowed during the test. No data loss or permanent damage occurs during a half sine shock pulse of:

300 Gs, 1 msec

2.8.5.2 Nonoperating shock

The nonoperating shock level that the drive can experience without incurring any physical damage when subsequently put into operation is 2000 Gs. The same applies for shock levels of 2000 Gs, 1 msec pulse duration on fresh drives for each level.

2.8.6 Vibration

All vibration specifications assume that the drive is mounted securely in a fixture that does not have fixture resonances in the frequency test range.

2.8.6.1 Operating sweep sine vibration

The following lists the maximum operating sweep sine vibration levels that the drive may experience while meeting the performance standards specified. It will consist of a forward and backward sweep from 10 Hz to 500 Hz to 10 Hz. The drive will operate without a hard error while being subjected to the following vibration levels.

10 Hz to 500 Hz @ 2 oct/min	1.0 Gs (0 to pk). Maximum displacement may apply below 10 Hz.

2.8.6.2 Operating random vibration

The test consists of 30 minutes of random vibration using the power spectral density (PSD) levels specified in the table below. The vibration test level is 0.67 Gs RMS. The drive will operate without a hard error while being subjected to the following vibration levels.

Table 4: Operating random vibration profile

Frequency (Hz)	G^2/Hz
17	1.1 x E-03
45	1.1 x E-03
48	8.0 x E-03
62	8.0 x E-03
65	1.0 x E-03
150	1.0 x E-03
200	5.0 x E-04
500	5.0 x E-04

2.8.6.3 Nonoperating sweep sine vibration

The following table lists the maximum nonoperating sweep sine vibration levels that the drive may experience while meeting the performance standards specified. It will consist of a forward and backward sweep from 5 Hz to 500 Hz to 5 Hz. The drive will not incur any physical damage when subsequently put into operation.

10 Hz to 500 Hz @ 0.5 oct/min	5.0 Gs (0 to pk). Maximum displacement may apply below 22 Hz.
5 Hz to 10 Hz	25.4 mm peak to peak displacement.

2.8.6.4 Nonoperating random vibration

The test consists of 15 minutes of random vibration using the power spectral density (PSD) levels specified in the table below. The vibration test level is 3.01 Gs RMS. The drive will not incur any physical damage when subsequently put into operation.

Table 5: Nonoperating random vibration profile.

Frequency (Hz)	G^2/Hz
2.5	1.0 x E-03
5	3.0 x E-02
40	1.8 x E-02
500	1.8 x E-02

2.8.6.5 Corrosive environment

Seagate electronic drive components pass accelerated corrosion testing equivalent to ten years of 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 percent. 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.

2.9 Acoustics

Drive acoustics are measured as overall A-weighted acoustic sound power levels (no pure tones). Discrete tone penalties are added to the A-weighted sound power (LW) with the following formula only when determining compliance:

LWt(spec) == LW + 0.1Pt + 0.3 < 4.0 (Bels)

where

LW = A-weighted sound power level

pt == Value of discrete tone penalty [==dLt-6.0 (dBA)]

dLt = Tone-to-noise ratio taken in accordance with ISO 7779.

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)

Table 6: Drive level acoustics

Acoustic mode	
Idle	**Operational**
1.6 bels (typ) 1.7 bels (max)	1.9 bels (typ) 2.0 bels (max)

2.10 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 7: Electromagnetic immunity

Test	Description	Performance level	Reference standard
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

2.11 Reliability

Measurement type	Specification
Nonrecoverable read errors	1 per 10^{14} bits read, max.
Load/Unload (LUL) cycles (25°C)	300,000 software-controlled power on/off cycles 20,000 hard power on/off cycles
Power On Hours (POH)	500 hours
Warranty	Per agreement

2.12 Agency certification

2.12.1 Safety certification

The drives are recognized in accordance with UL60950-1, CAN/CSA-C22.2 No.60950-1, EN60950 and IEC 60950.

2.12.2 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): ST612712DE, ST612712DEG, ST610712DE, ST610712DEG, ST680712DEG, ST680712DE, ST660712DEG and ST660712DE

  Certificate numbers:
  ST612712DEG, ST612712DE, ST610712DEG, ST610712DE
  ST680712DEG, ST680712DE, ST660712DEG and ST660712DE STX-S103 (B)

- Trade name or applicant: Seagate Technology LLC
- Manufacturing date: July 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).

2.12.3 European Union Restriction of Hazardous Substances (RoHS) Directive

Seagate designs its products to meet environmental protection requirements worldwide, including regulations restricting certain chemical substances. A new law, the European Union Restriction of Hazardous Substances (RoHS) Directive, will restrict the presence of chemical substances, including Lead (Pb), in electronic products, effective July 2006. The Directive's requirements have not been finalized. This drive is manufactured with components and materials that are expected to comply with the RoHS Directive when the Directive takes effect.

2.12.4 China Restriction of Hazardous Substances (RoHS) Directive

2.12.4 中国限制危险物品的指令

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

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

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

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

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

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

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

2.12.5 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.

3.0 Configuring and mounting the drive

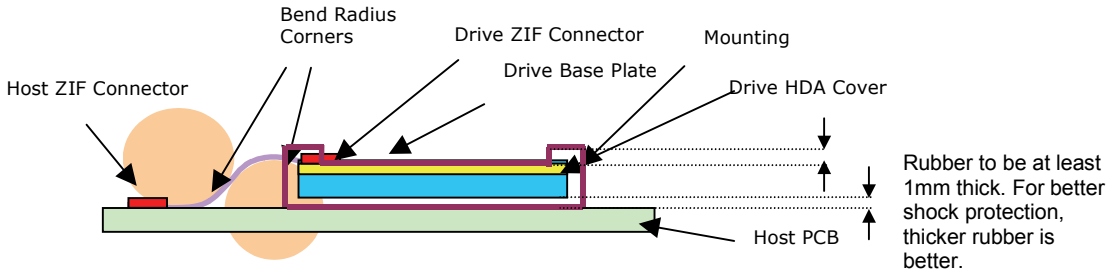
This section contains the specifications and instructions for configuring and mounting the drive.

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 drives, 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.



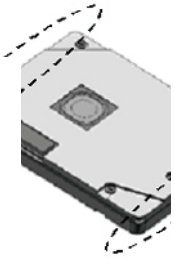
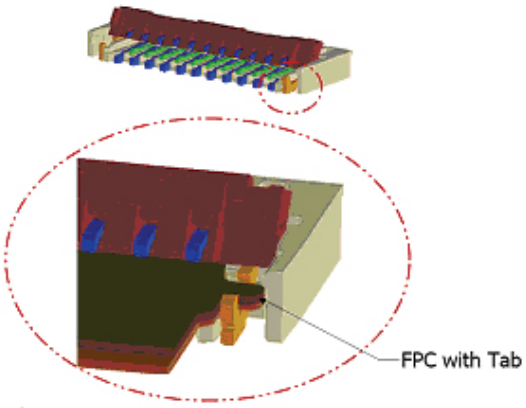


Figure 7.ST 1.3 Series proper handling example



- The drive is fragile—handle it with care. Do not press down on the drive top cover or attempt to use a pen to write on the drive's label.
- Do not apply more than 0.2 kg of force to the top cover.

Figure 8. ST1.3 Series improper handling example

- Always rest the drives on a padded, antistatic surface until you mount it in the system.
- 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.
- If provided, store drive in the protective casing when not in use.
- Turn the power off before installing or removing the drive.
- Do not cover the breather hole with any type of label, sticker, or impede the flow of air at any time.

3.2 Drive installation

See figure 9 for drive mechanical dimensions.

Follow these installation precautions when inserting the drive:

- Follow instructions for the installation of data storage devices, provided with your device's user manual.
- Do not obstruct the breather hole on the drive (see Figure 4).

• Handle the drive only by its edges or frame or designated finger grip region during mounting (see Figure 4).

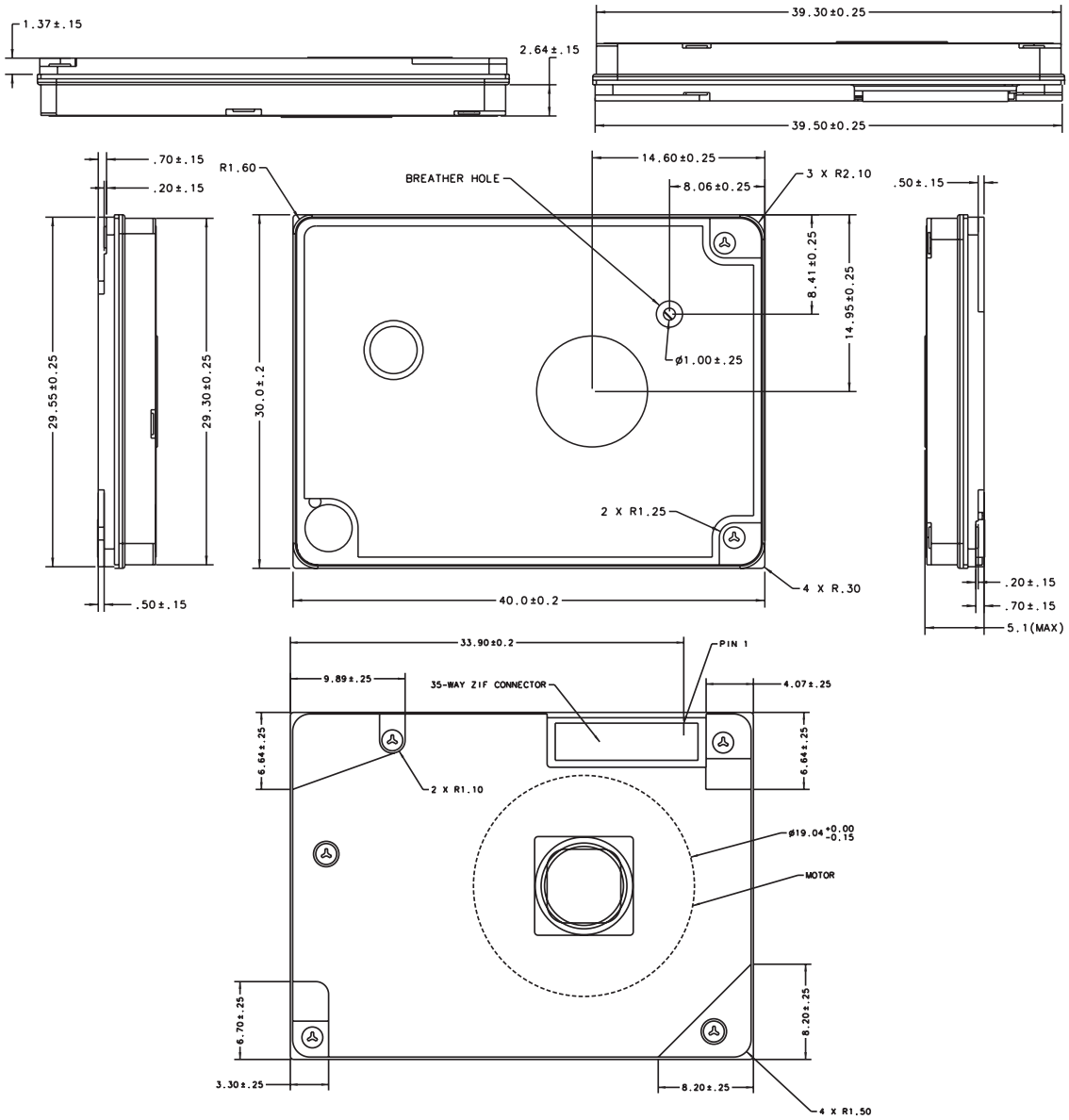


Figure 9. ST1.3 Series mechanical dimensions—top, bottom, side and end view

3.3 Mounting considerations

- Use an elastic mounting material to protect drives so as to ensure that more shock can be absorbed.
- There are no guides along the side for mounting. Instead, refer to figure on areas (refer to Figure 10, highlighted in blue) where the mounting material can rest on.
- The drive can be operated in any orientation but horizontal or vertical orientation is preferred.
- Allow a minimum clearance of 0.030 inches (0.76 mm) around the entire perimeter of the drive for cooling, with the exception of the mounting edges for better airflow.
- Our recommendation is to make as few bends on the flex cable as possible, the ideal being a flat cable. This is to prevent risk of circuit traces on FPC breaking during integration. (See Figure 11)
- The FPC may be bent in order to improve suspension of the disk. In case the system design warrants bending, care should be taken to maximize the radius.
- Mounting materials are available from many third-party vendors.
- The ZIF connector on ST1.3 has a groove for FPC with tab (refer to Figure 12), for better retention. Measurements made for horizontal retention force using FPC with tab versus FPC without tab is 17.44 N vs. 7.69 N.
- The ZIF connector has a specification of 5 insertion cycles.

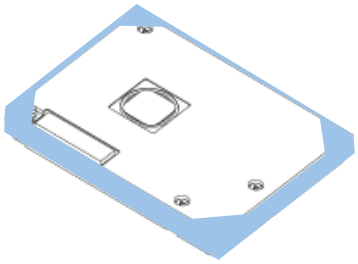


Figure 10. ST1.3 Series Area for Protective Mounting

Figure 11. ST1.3 Series Mounting Drive using FPC with Multiple Bends

Figure 12. ST1.3 Series ZIF connector with Groove for FPC with Tab

4.0 Interface description

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 0–4. The drive also supports the use of the IORDY signal to provide reliable high-speed data transfers.

For detailed information about the 35-way ZIF (IDE interface) connector, please contact your local Seagate representative.

4.1 Connector interface signals and connector pins

The following table summarizes the signals on the 35-way ZIF (zero insertion force) IDE interface connector. For a detailed description of these signals, please contact your local Seagate representative.

Table 8: 35-way ZIF (IDE interface) connector signals

Pin Num	Signal Name	In, Out Type
1	GND	Ground
2	D10	Data bus bit 10
3	D09	Data bus bit 09
4	D02	Data bus bit 02
5	D08	Data bus bit 08
6	D01	Data bus bit 01
7	Res	Reserved. Do not connect
8	D00	Data bus bit 0
9	Res	Reserved. Do not connect
10	A00	Address bus bit 0
11	DMACK-	DMA Acknowledge
12	A01	Address bus bit 1
13	DMARQ	DMA Request
14	A02	Address bus bit 2
15	IORDY	I/O Ready DMA ready during Ultra DMA data-in bursts DMA strobe during Ultra DMA data-out bursts
16	RESET-	Hard Reset
17	Res	Reserved. Do not connect
18	VCC	3.3V Voltage supply to drive
19	VCC	3.3V Voltage supply to drive
20	IRQ	Interrupt request
21	IOWR-	I/O Write Stop during DMA data bursts

Table 8: 35-way ZIF (IDE interface) connector signals

22	IORD-	I/O Read DMA ready during Ultra DMA data-in bursts DMA strobe during Ultra DMA data-out bursts
23	CS1-	Chip select 1
24	CS0-	Chip select 0
25	D15	Data bus bit 15
26	D07	Data bus bit 07
27	D14	Data bus bit 14
28	D06	Data bus bit 06
29	D13	Data bus bit 13
30	D05	Data bus bit 05
31	D12	Data bus bit 12
32	D04	Data bus bit 04
33	D11	Data bus bit 11
34	D03	Data bus bit 03
35	GND	Ground

Note. For ST1.3 Series, drive is operating in master-mode only, and the DASP# (Drive Active/Slave Present) that is commonly used to drive LED light to indicate drive activity is not available.

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 ATA version 7 specification, Volume 1. (www.t13.org).

Table 9: Supported commands

Command name	Command code (in hex)	Does command cause drive to transition to active mode? [1]
ATA-standard commands		
Check Power Mode	$98_{H,}$ $E5_H$	
Download Microcode	92_H	X
Flush Cache	$E7_H$	X
Identify Device	EC_H	
Idle	$97_{H,}$ $E3_H$	X
Idle Immediate	$95_{H,}$ $E1_H$	X
Read DMA	$C8_{H,}$ $C9_H$	X
Read Multiple	$C4_H$	X
Read Sectors	$20_{H,}$ 21_H	X
Seek	$7X_H$	X
Set Features	EF_H	X
Set Multiple Mode	$C6_H$	X
Sleep	$99_{H,}$ $E6_H$	
Smart	B0h	X
Standby	$96_{H,}$ $E2_H$	X
Standby Immediate	$94_{H,}$ $E0_H$	X
Write DMA	$CA_{H,}$ CB_H	X
Write Multiple	$C5_H$	X
Write Sectors	$30_{H,}$ 31_H	X

[1] ‘X’ indicates: If the drive is in Standby mode, it will cause the drive to spin up to Active mode in order to execute the command.

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 on page 28. 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	ATA specification	Value
0	Configuration information: • Bit 15: 0 = ATA; 1 = ATAPI • Bit 7: removable media • Bit 6: removable controller • Bit 0: reserved	$848A_H$
1	Number of logical cylinders	16,383
2	ATA-reserved	0000_H
3	Number of logical heads	16
4-5	Retired	0000_H
6	Number of logical sectors per logical track	$003F_H$
7-9	Retired	0000_H
10–19	Serial number: (20 ASCII characters, 0000_H = none)	ASCII
20	Retired	0003_H
21	Retired	0100_H
22	Obsolete	0004_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)	ST612712DEG, ST612712DE, ST610712DEG, ST610712DE, ST680712DEG, ST680712DE, ST660712DEG, ST660712DE
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	$0B00_H$
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 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	$xxxx_H$
57-58	Current capacity in sectors	$xxxx_H$

Word	ATA specification	Value
59	Number of sectors transferred during a Read Multiple or Write Multiple command	0100_H
60–61	Total number of user-addressable LBA sectors available (see Section 2.2 for related information)	*capacity* $xxxx_H$
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	$00F0_H$
81	Minor version number	0000_H
82	Command sets supported	$746B_H$
83	Command sets supported	5109_H
84	Command sets supported extension	4000_H
85	Command sets enabled	7469_H
86	Command sets enabled	1009_H
87	Command sets enabled extension	4000_H
88	Ultra DMA support and current mode (see note following this table)	$xx1F_H$
89	Security erase time	0000_H
90	Enhanced security erase time	0000_H
91	Advanced power management value	4040_H
92	Master password revision code	0000_H
93	Hardware reset value	$400D_H$
94	Auto acoustic management setting	8080_H
95-99	ATA-reserved	0000_H
100-103	Total number of user-addressable LBA sectors available for 48-bit addressing feature (48-bit addressing not supported)	0000_H
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. See the bit descriptions below for words 63 and 88 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.

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:

Table 10: Features register values

Feature	Description	
02_H	Enable Write Cache.	
03_H	Used for Set transfer mode Command. 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
	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
05_H	Enable advanced power management	
55_H	Disable read look-ahead (read cache) feature.	
66_H	Disable Power On Reset (POR) establishment of defaults at Soft Reset.	
82_H	Disable write cache.	
85_H	Disable Advanced Power Management	
AA_H	Enable read look-ahead (read cache) feature.	
CC_H	Enable Power On Reset (POR) establishment of defaults at soft reset	

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

Customer Service Operations

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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.

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

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

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