



BARRACUDA

COMPUTE

SATA 2.5" Product Manual

Standard models

ST5000LM000

ST4000LM024

ST3000LM024

100804767, Rev. E

February 2017

Document Revision History

| Revision | Date | Pages affected and Description of change |
|----------|------------|--|
| Rev. A | 07/19/2016 | Initial release. |
| Rev. B | 09/06/2016 | 6 & 8: Changed Weight (typical) to Weight (max) 13: Removed '2004/108/EC (Until 19th April, 2016) and' & '(From 20th April, 2016)' 13: Modified EMC Standard from EN55022 to EN55032 13: Added Korean text for Class B device warning |
| Rev. C | 10/10/2016 | fc: Applied BarraCuda logo and Added model numbers 10: Added bullets to Section 2.8.1 Power consumption 10: Updated Table 4 DC Power Requirements 13: Updated to MSIP Korean text for Class B device warning |
| Rev. D | 11/17/2016 | 5: Revised bullet list 6 & 8: Revised Data transfer rate = 140MB/s 6 & 10: Start-up current = 1.2A 10: Updated Section 2.8.1 11: Added Section 2.8.4 |
| Rev. E | 02/21/2017 | 7: Added Power-off/Flush Command note after Table 1 7 & 14: Revised Rated Workload statements 14: Added Section 2.12.1 Data loss under power interruption with write cache enabled |

© 2017 Seagate Technology LLC. All rights reserved.

Publication number: 100804767, Rev. E February 2017

Seagate, Seagate Technology, BarraCuda and the Spiral logo are registered trademarks of Seagate Technology LLC in the United States and/or other countries. MTC Technology and SeaTools are either trademarks or registered trademarks of Seagate Technology LLC or one of its affiliated companies in the United States and/or other countries. The FIPS logo is a certification mark of NIST, which does not imply product endorsement by NIST, the U.S., or Canadian governments. All other trademarks or registered trademarks are the property of their respective owners.

No part of this publication may be reproduced in any form without written permission of Seagate Technology LLC.
Call 877-PUB-TEK1 (877-782-8351) to request permission.

When referring to drive capacity, one gigabyte, or GB, equals one billion bytes and one terabyte, or TB, equals one trillion bytes. Your computer's operating system may use a different standard of measurement and report a lower capacity. In addition, some of the listed capacity is used for formatting and other functions, and thus will not be available for data storage. Actual quantities will vary based on various factors, including file size, file format, features and application software. Actual data rates may vary depending on operating environment and other factors. The export or re-export of hardware or software containing encryption may be regulated by the U.S. Department of Commerce, Bureau of Industry and Security (for more information, visit www.bis.doc.gov), and controlled for import and use outside of the U.S. Seagate reserves the right to change, without notice, product offerings or specifications.

Contents

| | |
|--|-----------|
| Seagate® Technology Support Services | 4 |
| 1. Introduction | 5 |
| 1.1 About the Serial ATA Interface | 5 |
| 2. Specifications | 6 |
| 2.1 Specification Summary | 6 |
| 2.2 Formatted Capacity | 7 |
| 2.2.1 LBA mode | 8 |
| 2.3 Physical organization | 8 |
| 2.4 Recording and Interface Technology | 8 |
| 2.5 Physical Characteristics | 8 |
| 2.6 Seek time | 9 |
| 2.7 Start/stop times | 9 |
| 2.8 Power Specifications | 10 |
| 2.8.1 Power consumption | 10 |
| 2.8.2 Conducted noise | 10 |
| 2.8.3 Supply Voltage | 10 |
| 2.8.4 Power-management modes | 11 |
| 2.9 Environmental Specifications | 12 |
| 2.9.1 Shock | 12 |
| 2.9.2 Vibration | 12 |
| 2.10 Acoustics | 13 |
| 2.10.1 Test for prominent discrete tones (PDTs) | 13 |
| 2.11 Electromagnetic Immunity | 13 |
| 2.12 Reliability | 14 |
| 2.12.1 Data loss under power interruption with write cache enabled | 14 |
| 2.13 Agency Certification | 14 |
| 2.13.1 Safety certification | 14 |
| 2.13.2 Electromagnetic Compatibility (EMC) | 14 |
| 2.13.3 FCC verification | 15 |
| 2.14 Environmental Protection | 15 |
| 2.14.1 European Union Restriction of Hazardous Substances (RoHS) Directive | 15 |
| 2.14.2 China Requirements — China RoHS 2 | 16 |
| 2.15 Corrosive Environment | 16 |
| 3. Unpacking, Configuring and Mounting the Drive | 17 |
| 3.1 Handling and Static-Discharge Precautions | 17 |
| 3.2 Configuring the Drive | 17 |
| 3.2.1 Serial ATA Cables and Connectors | 17 |
| 3.3 Drive Mounting | 18 |
| 4. Serial ATA (SATA) Interface | 19 |
| 4.1 Hot-Plug Compatibility | 19 |
| 4.2 Serial ATA Device Plug Connector Pin Definitions | 19 |
| 4.3 Supported ATA Commands | 20 |
| 4.3.1 Identify Device command | 23 |
| 4.3.2 Set Features command | 27 |
| 4.3.3 S.M.A.R.T. commands | 28 |

| | | |
|-----------|---|----|
| Figure 1. | Attaching SATA Cabling | 17 |
| Figure 2. | Mounting Dimensions (for 1-disk models) | 18 |

Seagate® Technology Support Services

For information regarding online support and services, visit: <http://www.seagate.com/contacts/>

For information regarding Warranty Support, visit: <http://www.seagate.com/support/warranty-and-replacements/>

For information regarding data recovery services, visit: <http://www.seagate.com/services-software/seagate-recovery-services/recover/>

For Seagate OEM, Distribution partner and reseller portals, visit: <http://www.seagate.com/partners/>

1. Introduction

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

| Standard models | | |
|-----------------|-------------|-------------|
| ST5000LM000 | ST4000LM024 | ST3000LM024 |

These drives provide the following key features:

- 128MB buffer.
- 5400-RPM spindle speed.
- 650 Gs non-operating shock and 300 Gs of operating shock.
- Full-track multiple-sector transfer capability without local processor intervention.
- High instantaneous (burst) data-transfer rates (up to 6Gb/s).
- MTC Technology™, proprietary data flow management.
- Native Command Queuing (NCQ) with command ordering.
- Quiet operation with Fluid Dynamic Bearing (FDB) motor.
- SeaTools™ diagnostic software performs a drive self-test that eliminates unnecessary drive returns.
- Shingled magnetic recording with perpendicular magnetic recording heads/media.
- State-of-the-art cache and on-the-fly error-correction algorithms.
- Support for Read Multiple and Write Multiple commands.
- Support for S.M.A.R.T. drive monitoring and reporting.
- Worldwide Name (WWN) capability uniquely identifies the drive.

1.1 About the Serial ATA Interface

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

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

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

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

Note

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

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

The Serial ATA host adapter contains a set of registers that shadow the contents of the traditional device registers, referred to as the Shadow Register Block. All Serial ATA devices behave like Device 0 devices. For additional information about how Serial ATA emulates parallel ATA, refer to the *Serial ATA International Organization: Serial ATA* (Revision 2.6). The specification can be downloaded from www.serialata.org.

2. Specifications

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

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

2.1 Specification Summary

Table 1 Drive Specifications Summary

| Drive Specification | ST5000LM000 | ST4000LM024 | ST3000LM024 |
|-------------------------------------|--|---------------|---------------|
| Formatted capacity ¹ | 5000GB | 4000GB | 3000GB |
| Guaranteed sectors | 9,767,541,168 | 7,814,037,168 | 5,860,533,168 |
| Heads | 10 | 10 / 8 | 8 |
| Disks | 5 | 5 / 4 | 4 |
| Bytes per sector | 512 (logical) / 4096 (physical) | | |
| Recording density | 2254 Kb/in | | |
| Track density | 580 Ktracks/in avg | | |
| Areal density | 1307 Gb/in ² avg | | |
| Spindle speed | 5400 RPM | | |
| Data transfer rate (up to) | 140 MB/s | | |
| Interface | SATA 6Gb/s | | |
| ATA data-transfer modes supported | PIO modes 0–4 Multiword DMA modes 0–2 Ultra DMA modes 0–6 | | |
| Cache buffer | 128 MB | | |
| Height | 15.0 +0.5/- 0.25 mm (0.59 +0.002/-0.010 in) | | |
| Width | 69.85 +/- 0.25 mm (2.750 +/- 0.010 in) | | |
| Length | 100.35 +0.20 / -0.25 mm (3.951 +0.008 / -0.010 in) | | |
| Weight (max) | 190 g (0.42lb) | | |
| Average latency | 5.6 ms | | |
| Startup current, Max (+5V) | 1.2A | | |
| Voltage tolerance (including noise) | 5V ± 5% | | |
| Operating temperature | 0° to 60°C | | |
| Non-operating temperature (Ambient) | -40° to 70°C | | |
| Temperature gradient (max) | 20°C per hour max (operating) 35°C per hour max (non-operating) | | |

Table 1 Drive Specifications Summary (continued)

| Drive Specification | ST5000LM000 | ST4000LM024 | ST3000LM024 |
|--|--|-------------|-------------|
| Relative humidity | 5% to 95% (operating) 5% to 95% (non-operating) | | |
| Relative humidity gradient | 20°C per hour max (operating) 30°C per hour max (non-operating) | | |
| Wet bulb temperature (max) | 37.7°C max (operating) 40.0°C max (non-operating) | | |
| Altitude, operating | -304.8 m to 3048 m (-1000 ft to 10,000+ ft) | | |
| Altitude, non-operating (below mean sea level, max) | -304.8 m to 12,192 m (-1000 ft to 40,000+ ft) | | |
| Operational Shock | 300 Gs at 2 ms max | | |
| Non-Operational Shock | 650 Gs at 1 ms max | | |
| Vibration, operating | 5–500 Hz: 0.7 Grms | | |
| Vibration, non-operating | 5–500 Hz: 3.52 Grms | | |
| Nonrecoverable read errors | 1 per 10 ¹⁴ bits read | | |
| Rated workload | Average annualized workload rating: <55 TB/year. The specifications for the product assumes the I/O workload does not exceed the average annualized workload rate limit of 55 TB/year. Workloads exceeding the annualized rate may degrade and impact reliability as experienced by the particular application. The average annualized workload rate limit is in units of TB per calendar year. | | |
| Warranty | To determine the warranty for a specific drive, use a web browser to access the following web page: http://www.seagate.com/support/warranty-and-replacements/ . From this page, click on the “Is my Drive under Warranty” link. The following are required to be provided: the drive serial number, model number (or part number) and country of purchase. The system will display the warranty information for the drive. | | |
| Load-unload cycles | 600,000 at 25°C, 50% rel. humidity | | |
| Supports Hotplug operation per the Serial ATA Revision 3.2 specification | Yes | | |

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

| | |
|-------------|--|
| Note | If the drive is powered-off before issuing flush cache command, in some instances, the end user data in the DRAM cache might not be committed to the disk. |
|-------------|--|

2.2 Formatted Capacity

| Model | Formatted Capacity ¹ | Guaranteed Sectors | Bytes per Sector |
|------------|---------------------------------|--------------------|---------------------------------|
| 5TB models | 5000 GB | 9,767,541,168 | 512 (logical) / 4096 (physical) |
| 4TB models | 4000 GB | 7,814,037,168 | |
| 3TB models | 3000 GB | 5,860,533,168 | |

- One GB 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.

Refer to [Unpacking, Configuring and Mounting the Drive](#) on page 17 (words 60-61 and 100-103) for additional information about 48-bit addressing support of drives with capacities over 137 GB.

2.3 Physical organization

| Drive model | Read/write heads | Number of discs |
|-------------|------------------|-----------------|
| 5TB models | 10 | 5 |
| 4TB models | 10 / 8 | 5 / 4 |
| 3TB models | 8 | 4 |

2.4 Recording and Interface Technology

| Interface | Serial ATA (SATA) |
|----------------------------|-----------------------------|
| Recording method | Perpendicular |
| Recording density | 2254 Kb/in |
| Track density | 580 Ktracks/in avg |
| Areal density | 1307 Gb/in ² avg |
| Spindle speed | 5400 RPM |
| Data transfer rate (up to) | 140 MB/s |
| Interface | SATA 6Gb/s |

2.5 Physical Characteristics

| | | |
|-------------------|--------------|--|
| All models | Height | 15.0 +0.5/- 0.25 mm (0.59 +0.008/-0.010 in) |
| | Width | 69.85 +/- 0.25 mm (2.750 +/- 0.010 in) |
| | Length | 100.35 +0.20 / -0.25 mm (3.951 +0.008 / -0.010 in) |
| | Weight (max) | 190 g (0.42lb) |
| | Cache buffer | 128 MB (129,536 KB) |

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:

- Average seek time is determined by averaging the time to complete 1,000 seeks of random length.
- Average latency is the time required for the drive to rotate 1/2 of a revolution and on average is incurred after a seek completion prior to reading or writing user data.
- Startup time is the time elapsed between the supply voltages reaching operating range and the drive being ready to accept all commands.
- Actual rotational speed can be different a little.
- Performance specification is limited to the room temperature & normal voltage condition.

Table 2: Typical seek times

| Typical seek times (ms) | Read/Write |
|-------------------------|------------|
| Average | 14.0/14.0 |
| Average latency | 5.6 |

Note

Seek time is defined as the time from the receipt of a read, write or seek command until the actuator has repositioned and settled on the desired track with the drive operating at nominal DC input voltages and nominal operating temperature.

2.7 Start/stop times

Table 3: Start/stop times

| Capacity | 5TB, 4TB and 3TB models |
|-------------------------|-------------------------|
| Typical seek times (ms) | Typical |
| Power-on to ready (sec) | 7.5 |
| Standby to ready (sec) | 6.5 |

2.8 Power Specifications

The drive receives DC power (+5V) through a native SATA power connector (refer to1).

2.8.1 Power consumption

Power requirements for the drives are listed in the table in Table 4. Typical power measurements are based on an average of drives tested, under nominal conditions, at 25°C ambient temperature. These power measurements are done with DIPM enabled.

- Spinup current is measured from the time of power-on to the time that the drive spindle reaches operating speed.
- Read/Write current is measured with the heads on track, based on three 64 sector read or write operations every 100 ms.
- The drive supports two idle modes: Active Idle mode and Low Power Idle mode. Refer to Section 2.8.4 for power-management modes.

Table 4: DC Power Requirements

| Power Dissipation | 5TB, 4TB & 3TB models +5V input average (25° C) |
|----------------------|--|
| Spinup (max) | 1.2A |
| Write average | 2.10W |
| Read average | 1.90W |
| Idle, low power mode | 0.85W |
| Standby ¹ | 0.18W |
| Sleep | 0.18W |

1. Standby power is measured at steady state (after 200ms from transition)

2.8.2 Conducted noise

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

- Using 5-volt power, the drive is expected to operate with a maximum of 100 mV peak-to-peak square-wave injected noise at up to 20 MHz.

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

2.8.3 Supply Voltage

| | |
|----------------------------|--------------------------|
| Allowable voltage | 5V ± 5% |
| Allowable noise/ripple | 100 mV p-p max, 0-30 MHz |
| Allowable supply rise time | 1-100 ms |
| Allowable supply fall time | <5 s |

2.8.4 Power-management modes

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

| Power modes | Heads | Spindle | Electronics |
|-----------------|----------|----------|---------------|
| Active | Tracking | Rotating | Full Power |
| Idle, Active | Floating | Rotating | Partial Power |
| Idle, Low Power | Parked | Rotating | Partial Power |
| Standby | Parked | Stopped | Low Power |
| Sleep | Parked | Stopped | Low Power |

- **Active mode**

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

- **Idle mode**

The electronics remain powered, and the drive accepts all commands and returns to Active mode when disk access is necessary.

- **Standby mode**

The drive enters Standby mode immediately when the host sends a Standby Immediate command. If the host has set the standby timer, the drive enters 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 electronics are in low power mode, the heads are parked and the spindle is at rest. The drive accepts all commands and returns to Active mode when disk access is necessary.

- **Sleep mode**

The drive enters Sleep mode after receiving a Sleep command from the host. In Sleep mode, the electronics are in low power mode, 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.

2.9 Environmental Specifications

This section provides the temperature, humidity, shock, and vibration specifications for Seagate BarraCuda drives.

Ambient temperature is defined as the temperature of the environment immediately surrounding the drive.

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

Table 5: Environmental specifications

| Parameters | Operating | Non-Operating |
|----------------------|---|---|
| Ambient temperature | 0° to 60°C (32° to 140°F) | -40° to 70°C (-40° to 158°F) |
| Temperature gradient | 20°C per hour (68°F per hour) max, without condensation | 35°C per hour (95°F per hour) max, without condensation |
| Humidity | 5% to 95% non-condensing (30% per hour) | 5% to 95% non-condensing (30% per hour) |
| Wet bulb | 37.7°C (99.8°F) max | 40°C (104°F) max |
| Altitude | -304.8m to 3048m (-1000ft to 10,000ft) | -304.8m to 12,192m (-1000ft to 40,000ft) |

Note

The recommended storage period:

- 1 year under controlled conditions of 34°C 90%RH or less
- 90 days in uncontrolled storage conditions

2.9.1 Shock

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

2.9.1.1 Operating shock

These drives comply with the performance levels specified in this document when subjected to a maximum operating shock of 300 Gs based on half-sine shock pulses of 2 ms. Shocks should not be repeated more than one time per axis.

Shocks should not be repeated more than one time per axis. There must be a minimum delay of 3 seconds between pulses.

2.9.1.2 Non-operating shock

The non-operating shock level that the drive can experience without incurring physical damage or degradation in performance when subsequently put into operation is 650 Gs based on a non-repetitive half-sine shock pulse of 1 ms duration.

2.9.2 Vibration

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

2.9.2.1 Operating vibration

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

| | |
|----------------------|----------|
| 5-500 Hz, Sequential | 0.7 Grms |
|----------------------|----------|

2.9.2.2 Non-operating vibration

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

| | |
|------------------|-----------|
| 5-500 Hz, Random | 3.52 Grms |
|------------------|-----------|

2.10 Acoustics

Drive emission of sound is measured consistent with the ECMA-74 and its referenced standards. Testing is conducted at room temperature (approximately 25°C). Emission levels are reported as the total A-weighted sound power levels for steady state, idle, and active seeks modes of operation.

Table 6: Drive A-weighted Sound Power Levels (SWL, BA)

| | Idle ¹ | Performance Seek |
|----------------------------------|-------------------|------------------|
| 5TB, 4TB & 3TB models | 2.6 bels (typ) | 2.7 bels (typ) |

1. 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.

2.10.1 Test for prominent discrete tones (PDTs)

Seagate follows the ECMA-74 standards for measurement and identification of PDTs. An exception to this process is the use of the absolute threshold of hearing. Seagate uses the lower limit for the threshold curve* to discern tone audibility and to compensate for the inaudible components of sound prior to computation of tone ratios according to Annex D of the ECMA-74 standards.

*Defined as the median curve given by ISO 389-7 (Tf curve) minus 10dB at all frequencies.

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) environment as defined in Table 7.

Table 7 Radio Frequency Environments

| Test | Description | Performance Criteria | Reference Standard |
|----------------------------------|---|----------------------|-----------------------------------|
| Electrostatic discharge | Contact, HCP, VCP: ± 4 kV; Air: ± 8 kV | B | EN 61000-4-2: 95 |
| Radiated RF immunity | 80 to 1GHz, 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 |
| Power Frequency H-field immunity | 1 A/m, 50Hz/60Hz, 3 axes | A | EN 61000-4-8: 97 |
| Voltage dips, interrupts | 30% Reduction for 25 cycles >95% Reduction for 250 cycles >95%, 0.5 cycles | C C B | EN 61000-4-11: 94 |

2.12 Reliability

| | |
|---|--|
| Nonrecoverable read errors | 1 per 10 ¹⁴ bits read, max |
| Load/Unload (U/UL) 25°C, 50% relative humidity | 600,000 software-controlled power on/off cycles 20,000 hard power on/off cycles |
| Rated workload | Average annualized workload rating: <55 TB/year. The specifications for the product assumes the I/O workload does not exceed the average annualized workload rate limit of 55 TB/year. Workloads exceeding the annualized rate may degrade and impact reliability as experienced by the particular application. The average annualized workload rate limit is in units of TB per calendar year. |
| Warranty | To determine the warranty for a specific drive, use a web browser to access the following web page: http://www.seagate.com/support/warranty-and-replacements/ . From this page, click on the "Is my Drive under Warranty" link. The following are required to be provided: the drive serial number, model number (or part number) and country of purchase. The system will display the warranty information for the drive. |

2.12.1 Data loss under power interruption with write cache enabled

Drive preserves its data during all operations except in cases where power to the drive is interrupted during write operations. This could result in either an uncorrected data error being reported, or the entire sector/track becoming unreadable. This can be permanently recovered by rewriting to the same location on the drive. Additionally any data present in the DRAM buffer will not be written to the disk media, additionally, the drive will not be able to return the original data.

In order to prevent this data loss, the host should issue a standby immediate or flush cache command before a controlled power off operation to the drive.

2.13 Agency Certification

2.13.1 Safety certification

These products are certified to meet the requirements of UL60950-1, CSA60950-1 and EN60950 and so marked as to the certify agency.

2.13.2 Electromagnetic Compatibility (EMC)

Hard drives that display the CE mark comply with the European Union (EU) requirements specified in the Electromagnetic Compatibility (EMC) Directive 2014/30/EU. Testing is performed to the levels specified by the product standards for Information Technology Equipment (ITE). Emission levels are defined by EN 55032, Class B and the immunity levels are defined by EN 55024.

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.

Australian RCM Compliance Mark

Models displayed with the RCM compliance mark, comply with the mandatory standards as per the Australian Communications and Media Authority (ACMA) Electromagnetic Compatibility (EMC) regulatory arrangement.

Canada ICES-003

These drives have been tested and comply with "ICES-003 Issue 5, Class B" for sale in CANADA.

Korean RRA

If these drives have the Korean Communications Commission (KCC) 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 National Radio Research Agency (RRA) Communications Commission, 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..

| 기종별 | 사용자안내문 |
|------------------------|--|
| B급 기기 (가정용 방송통신기자재) | 이 기기는 가정용(B급) 전자파적합기기로서 주로 가정에서 사용하는 것을 목적으로 하며, 모든 지역에서 사용할 수 있습니다. |

Taiwan BSMI

These drives have been tested and comply with "CNS 13438 (Complete 2006 version), Class B" for sale in Taiwan.

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 has tested this device in enclosures as described above to ensure that the total assembly (enclosure, disk 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, users 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, users should consult the dealer or an experienced radio/television technician for additional suggestions. Users may find helpful the following booklet prepared by the Federal Communications Commission: *How to Identify and Resolve Radio-Television Interference Problems*. This booklet is available from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402. Refer to publication number 004-000-00345-4.

2.14 Environmental Protection

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

2.14.1 European Union Restriction of Hazardous Substances (RoHS) Directive

The European Union Restriction of Hazardous Substances (RoHS) Directive, restricts the presence of chemical substances, including Lead, Cadmium, Mercury, Hexavalent Chromium, PBB and PBDE, in electronic products, effective July 2006. This drive is manufactured with components and materials that comply with the RoHS Directive.

2.14.2 China Requirements — China RoHS 2

China RoHS 2 refers to the Ministry of Industry and Information Technology Order No. 32, effective July 1, 2016, titled Management Methods for the Restriction of the Use of Hazardous Substances in Electrical and Electronic Products. To comply with China RoHS 2, we determined this product's Environmental Protection Use Period (EPUP) to be 20 years in accordance with the *Marking for the Restricted Use of Hazardous Substances in Electronic and Electrical Products*, SJ/T 11364-2014.

中国电器电子产品有害物质限制使用管理办法

(Management Methods for the Restriction of the Use of Hazardous Substances in Electrical and Electronic Products _ China RoHS)

产品中有害物质的名称及含量

(Name and Content of the Hazardous Substances in Product)



Table 8 Hazardous Substances

| 部件名称 Part Name | 有害物质 Hazardous Substances | | | | | |
|-------------------|------------------------------|----------------------|----------------------|--|---|--|
| | 铅 Lead (Pb) | 汞 Mercury (Hg) | 镉 Cadmium (Cd) | 六价铬 Hexavalent Chromium (CF (VI)) | 多溴联苯 Polybrominated biphenyls (PBB) | 多溴二苯醚 Polybrominated diphenyl ethers (PBDE) |
| 印刷电路板组装 PCBA | X | O | O | O | O | O |
| 机壳 Chassis | X | O | O | O | O | O |

本表格依据 SJ/T 11364 的规定编制。
This table is prepared in accordance with the provisions of SJ/T 11364-2014

O: 表示该有害物质在该部件所有均质材料中的含量均在 GB/T 26572 规定的限量要求以下。
O: Indicates that the hazardous substance contained in all of the homogeneous materials for this part is below the limit requirement of GB/T26572.

X: 表示该有害物质至少在该部件的某一均质材料中的含量超出 GB/T 26572 规定的限量要求。
X: Indicates that the hazardous substance contained in at least one of the homogeneous materials used for this part is above the limit requirement of GB/T26572.

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. Unpacking, Configuring and Mounting the Drive

This chapter describes how to unpack, mount, configure and connect a BarraCuda. It also describes how to install the drive in systems.

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 | <ul style="list-style-type: none">• Keep the drive in the electrostatic discharge (ESD) bag until ready for installation to limit the drive's exposure to ESD.• Before handling the drive, put on a grounded wrist strap, or ground yourself frequently by touching the metal chassis of a computer that is plugged into a grounded outlet. Wear a grounded wrist strap throughout the entire installation procedure.• Handle the drive by its edges or frame <i>only</i>.• 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 mounting it in the computer.• Do not touch the connector pins or the printed circuit board.• Do not remove the factory-installed labels from the drive or cover them with additional labels. Removal voids the warranty. Some factory-installed labels contain information needed to service the drive. Other labels are used to seal out dirt and contamination. |
|----------------|--|

3.2 Configuring the Drive

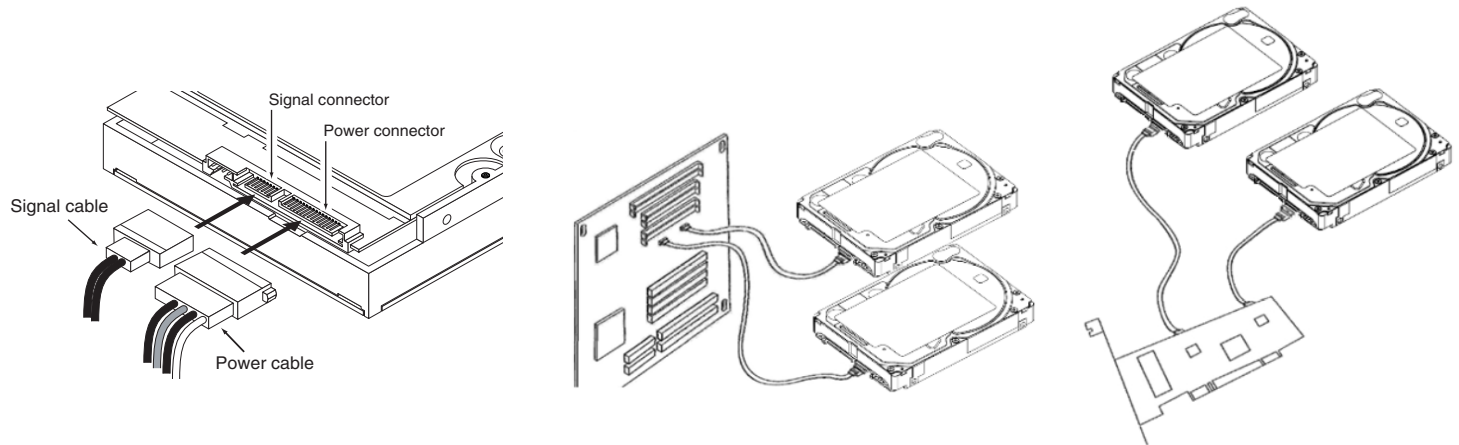
Each drive on the Serial ATA interface connects in a point-to-point configuration with the Serial ATA host adapter. There is no master/slave relationship because each drive is considered a master in a point-to-point relationships. If two drives are attached on one Serial ATA host adapter, the host operating system views the two devices as if they were both “masters” on two separate ports. Both drives behave as if they are Device 0 (master) devices.

3.2.1 Serial ATA Cables and Connectors

The Serial ATA interface cable consists of four conductors in two differential pairs, plus three ground connections. The cable size may be 30 to 26 AWG with a maximum length of one meter (39.37 in). Refer to Table 9 for connector pin definitions. Either end of the SATA signal cable can be attached to the drive or host.

For direct backplane connection, the drive connectors are inserted directly into the host receptacle. The drive and the host receptacle incorporate features that enable the direct connection to be hot pluggable and blind mateable. For installations which require cables, users can connect the drive as shown in 1.

Figure 1 Attaching SATA Cabling



Each cable is keyed to ensure correct orientation. BarraCuda drives support latching SATA connectors.

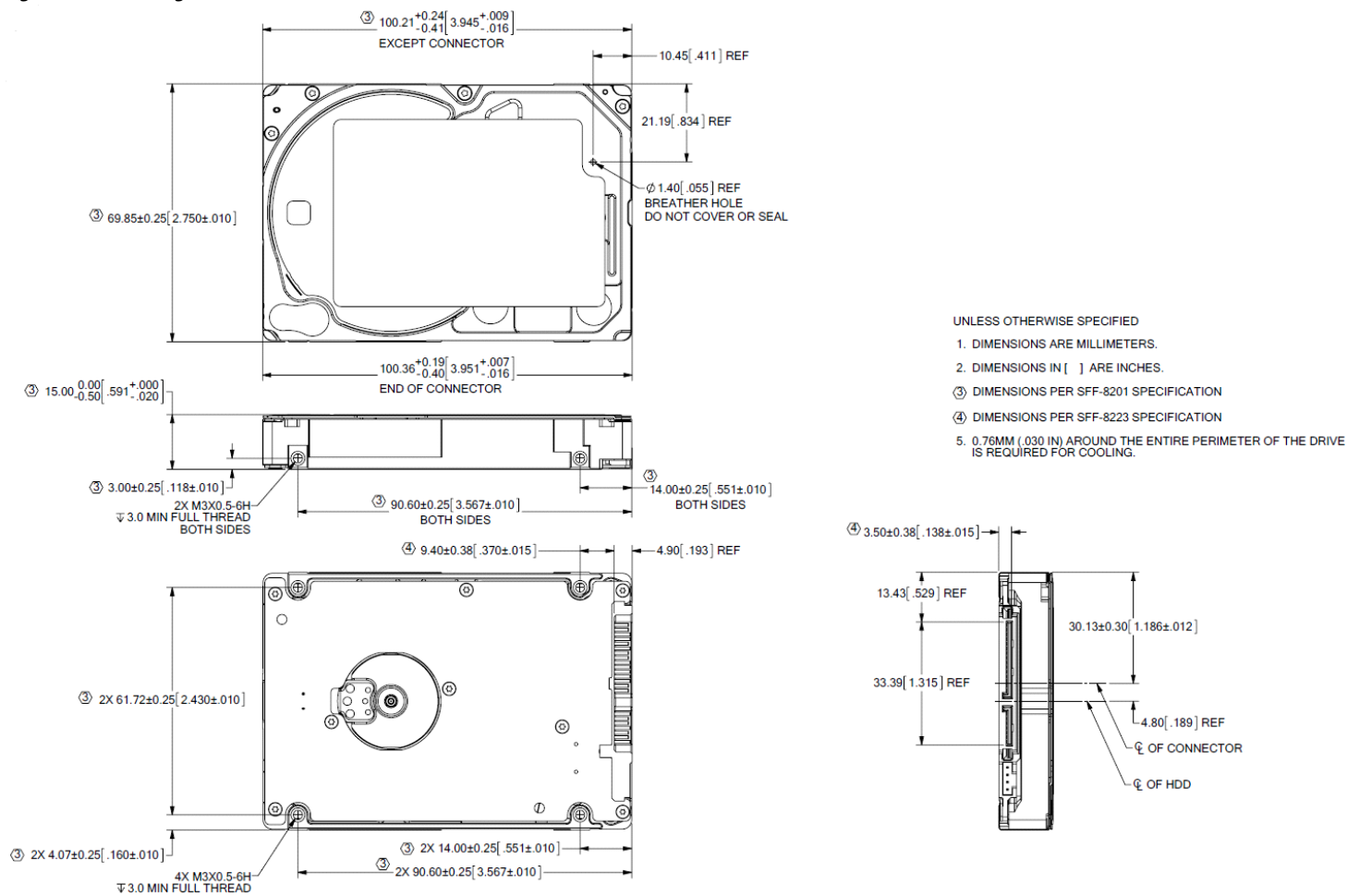
3.3 Drive Mounting

Users can mount the drive in any orientation using four screws in the side-mounting holes or four screws in the bottom-mounting holes. Refer to 2 and **Figure 2** for drive mounting dimensions. Follow these important mounting precautions when mounting the drive:

- Allow a minimum clearance of 0.030 in (0.76 mm) around the entire perimeter of the drive for cooling.
- Use only M3 x 0.5 mounting screws.
- Do not overtighten the mounting screws. Maximum torque: 4.0 in-lb (0.4519 N-m).
- Four (4) threads (0.080 in, 2.032 mm) minimum screw engagement recommended.
- Avoid excessive drive distortion when mounting. Refer to the following specifications for stiffness/deflection information:

| Top cover stiffness/deflection | |
|---|---|
| Operating: no performance degradation, emitted noise, mechanical damage, or hard errors | 10 mm probe: 2.0kgf (typical) |
| Non-operating: no hard errors | 10 mm probe: maximum 2.0kgf (instantaneous) |

Figure 2 Mounting Dimensions (for 1-disk models)



4. Serial ATA (SATA) Interface

These drives use the industry-standard Serial ATA interface that supports FIS data transfers. It supports ATA programmed input/output (PIO) modes 0–4; multiword DMA modes 0–2, and Ultra DMA modes 0–6. The drive also supports the use of the IORDY signal to provide reliable high-speed data transfers.

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

4.1 Hot-Plug Compatibility

BarraCuda drives incorporate connectors which enable users to hot plug these drives in accordance with the Serial ATA: High Speed Serialized AT Attachment specification revision 2.0. This specification can be downloaded from www.serialata.org. This device requires a COMRESET from the host after a hotplug event.

4.2 Serial ATA Device Plug Connector Pin Definitions

Table 9 summarizes the signals on the Serial ATA interface and power connectors. Refer to the *Table Notes* below.

Table 9 Serial ATA Connector Pin Definitions

| Segment | Pin | Function | Definition |
|---|-----|----------------------|---|
| Signal | S1 | Ground | 2nd mate |
| | S2 | A+ | Differential signal pair A from Phy |
| | S3 | A- | |
| | S4 | Ground | 2nd mate |
| | S5 | B- | Differential signal pair B from Phy |
| | S6 | B+ | |
| | S7 | Ground | 2nd mate |
| Key and spacing separate signal and power segments | | | |
| Power | P1 | V33 | 3.3V power |
| | P2 | V33 | 3.3V power |
| | P3 | V33 | 3.3V power, pre-charge, 2nd mate |
| | P4 | Ground | 1st mate |
| | P5 | Ground | 2nd mate |
| | P6 | Ground | 2nd mate |
| | P7 | V5 | 5V power, pre-charge, 2nd mate |
| | P8 | V5 | 5V power |
| | P9 | V5 | 5V power |
| | P10 | Ground | 2nd mate |
| | P11 | Ground or LED signal | If grounded, drive does not use deferred spin |
| | P12 | Ground | 1st mate |
| | P13 | V12 | 12V power, pre-charge, 2nd mate |
| | P14 | V12 | 12V power |
| | P15 | V12 | 12V power |

Notes

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

4.3 Supported ATA Commands

Table 10 lists Serial ATA standard commands that the drive supports. For a detailed description of the ATA commands, refer to the *Serial ATA International Organization: Serial ATA* (Revision 2.6). Refer to www.sata-io.org.

Refer to **S.M.A.R.T. commands** on page 28 for details and subcommands used in the S.M.A.R.T. implementation.

Table 10 Supported ATA commands

| ATA-standard commands names | Command code (in hex) |
|----------------------------------|-----------------------|
| Device Configuration Restore | B1h/C0h |
| Device Configuration Freeze Lock | B1h/C1h |
| Device Configuration Identify | B1h/C2h |
| Device Configuration Set | B1h/C3h |
| Download Microcode | 92h |
| Execute Device Diagnostics | 90h |
| Flush Cache | E7h |
| Flush Cache Extended | EAh |
| Identify Device | ECh |
| Initialize Device Parameters | 91h |
| Read Buffer | E4h |
| Read DMA | C8h |
| Read DMA Extended | 25h |
| Read DMA without Retries | C9h |
| Read Long with Retries | 22h |
| Read Long without Retries | 23h |
| Read Multiple | C4h |
| Read Multiple Extended | 29h |
| Read Native Max Address | F8h |
| Read Native Max Address Extended | 27h |
| Read Sectors | 20h |
| Read Sectors Extended | 24h |
| Read Sectors without Retries | 21h |
| Read Verify Sectors | 40h |

Table 10 Supported ATA commands

| ATA-standard commands names | Command code (in hex) | |
|--|---|---|
| Read Verify Sectors Extended | 42h | |
| Read Verify Sectors without Retries | 41h | |
| Seek | 70h | |
| Set Features | EFh | |
| Set Max Address | F9h | |
| Note: Individual Set Max commands are identified by the value placed in the Set Max Features register as defined to the right. | Address: Password: Lock: Unlock: Freeze Lock: | 00 _H 01 _H 02 _H 03 _H 04 _H |
| Set Max Address Ext | 37h | |
| Set Multiple Mode | C6h | |
| S.M.A.R.T. Disable Operations | B0h/D9h | |
| S.M.A.R.T. Enable/Disable Autosave | B0h/D2h | |
| S.M.A.R.T. Enable Operations | B0h/D8h | |
| S.M.A.R.T. Enable/Disable Auto Offline | B0h/DBh | |
| S.M.A.R.T. Enable One Attribute Modification | B0h/E0h | |
| S.M.A.R.T. Execute Offline | B0h/D4h | |
| S.M.A.R.T. Free Fall Protection Host Interface | FEh | |
| S.M.A.R.T. Read Attribute Thresholds | B0h/D1h | |
| S.M.A.R.T. Read Data | B0h/D0h | |
| S.M.A.R.T. Read Log Sector | B0h/D5h | |
| S.M.A.R.T. Return Status | B0h/DAh | |
| S.M.A.R.T. Save Attribute Values | B0h/D3h | |
| S.M.A.R.T. Write Attribute Thresholds | B0h/D7h | |
| S.M.A.R.T. Write Attribute Values | B0h/E1h | |
| S.M.A.R.T. Write Log Sector | B0h/D6h | |
| Trusted Receive | 5Ch | (SED only) |
| Trusted Receive DMA | 5Dh | (SED only) |
| Trusted Send | 5Eh | (SED only) |
| Trusted Send DMA | 5Fh | (SED only) |
| Write Buffer | E8h | |
| Write DMA | CAh | |
| Write DMA Extended | 35h | |
| Write DMA without Retries | CBh | |
| Write Long with Retries | 32h | |

Table 10 Supported ATA commands

| ATA-standard commands names | Command code (in hex) |
|---|------------------------------|
| Write Long without Retries | 33h |
| Write Multiple | C5h |
| Write Multiple Extended | 39h |
| Write Sectors | 30h, 31h |
| Write Sectors Extended | 34h |
| ATA-standard power-management commands | |
| Check Power Mode | E5h |
| Idle | E3h |
| Idle Immediate | E1h |
| Sleep | E6h |
| Standby | E2h |
| Standby Immediate | E0h |
| ATA-standard security commands | |
| Security Set Password | F1h |
| Security Unlock | F2h |
| Security Erase Prepare | F3h |
| Security Erase Unit | F4h |
| Security Freeze Lock | F5h |
| Security Disable Password | F6h |

4.3.1 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 Table 11. 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. Refer to [Drive Specifications Summary](#) on page 6 for default parameter settings.

The following commands contain drive-specific features that may not be included in the Serial ATA specification.

Table 11 Identify Device command

| 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 | Specific configuration | C837 _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 | 8000 _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) | ST5000LM000 ST4000LM024 ST3000LM024 |
| 47 | (Bits 7–0) Maximum sectors per interrupt on Read multiple and Write multiple (16) | 8010 _H |
| 48 | Trusted Computing Feature set options | 4001 _H |
| 49 | Standard Standby timer, IORDY supported and may be disabled | 2F00 _H |
| 50 | Capabilities | 4000 _H |
| 51 | PIO data-transfer cycle timing mode | 0200 _H |
| 52 | Retired | 0200 _H |
| 53 | Words 54–58, 64–70 and 88 are valid | 0007 _H |
| 54 | Number of current logical cylinders | xxxx _H |
| 55 | Number of current logical heads | xxxx _H |
| 56 | Number of current logical sectors per logical track | xxxx _H |
| 57–58 | Current capacity in sectors | xxxx _H |
| 59 | Number of sectors transferred during a Read Multiple or Write Multiple command | xxxx _H |

Table 11 Identify Device command

| Word | Description | Value |
|-------|---|---|
| 60–61 | Total number of user-addressable sectors This field contains a value that is one greater than the total number of user-addressable sectors. The maximum value that shall be placed in this field is 0FFFFFFFh. The 0FFFFFFFh value applies to all capacities over 137GB (see Section 2.2, Formatted Capacity for related information). | ST5000LM000 = 0FFFFFFFh ST4000LM024 = 0FFFFFFFh ST3000LM024 = 0FFFFFFFh |
| 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 ns) | 0078 _H |
| 66 | Recommended multiword DMA transfer cycle time per word (120 ns) | 0078 _H |
| 67 | Minimum PIO cycle time without IORDY flow control (240 ns) | 0078 _H |
| 68 | Minimum PIO cycle time with IORDY flow control (120 ns) | 0078 _H |
| 69 | Additional Supported bits Bit 4 means Device Encrypts All User Data on the device. Bit 7 means IEEE1667 protocol is supported. | xx1x _H or xx9x _H |
| 70–74 | ATA-reserved | 0000 _H |
| 75 | Queue depth | 001F _H |
| 76 | Serial ATA capabilities | 0D06 _H |
| 77 | ATA-reserved | 0000 _H |
| 78 | Serial ATA features supported | 0048 _H |
| 79 | Serial ATA features enabled | 0048 _H |
| 80 | Major version number | 01F0 _H |
| 81 | Minor version number | 0029 _H |
| 82 | Command sets supported | 746B _H |
| 83 | Command sets supported | 7D69 _H |
| 84 | Command sets support extension | 61E3 _H |
| 85 | Command sets enabled | 7469 |
| 86 | Command sets enabled | BC49 _H |
| 87 | Command sets enable extension | 61E3 _H |
| 88 | Ultra DMA support and current mode (see note following this table) | xx7F _H |
| 89 | Security erase time | xxxx _H |
| 90 | Enhanced security erase time | xxxx _H |
| 91 | Current APM values | 8080 _H |
| 92 | Master password revision code | FFFE _H |
| 93 | Hardware reset value (see description following this table) | xxxx _H |
| 94 | Auto acoustic management setting | xxxx _H |
| 95 | Stream Min. Request Size | 0000 _H |

Table 11 Identify Device command

| Word | Description | Value |
|---------|--|---|
| 96 | Streaming Transfer Time - DMA | 0000 _H |
| 97 | Streaming Access Latency - DMA and PIO | 0000 _H |
| 98-99 | Streaming Performance Granularity | 0000 _H |
| 100-103 | Total number of user-addressable LBA sectors available (see Section 3.2, Configuring the Drive for related information) These words are required for drives that support the 48-bit addressing feature. Maximum value: 0000FFFFFFFF _H . | ST5000LM000 = 9,767,541,168 ST4000LM024 = 3,907,029,168 ST3000LM024 = 1,953,525,168 |
| 104 | Streaming Transfer Time - PIO | 0000 _H |
| 105 | Reserved | 0000 _H |
| 106 | Physical sector size / Logical sector size | 6003 _H |
| 107 | Seagate reserved | 0000 _H |
| 108-111 | The mandatory value of the world wide name (WWN) for the drive. NOTE: This field is valid if word 84, bit 8 is set to 1 indicating 64-bit WWN support. | Each drive will have a unique value. |
| 112-118 | ATA-reserved | 0000 _H |
| 119 | Free Fall Protection support (bit 5) | 1 = Free Fall Protection supported 0 = Free Fall Protection not supported |
| 120 | Free Fall Protection enable/disable (bit 5) | 1 = Free Fall Protection feature is enabled 0 = Free Fall Protection feature is disabled |
| 121-127 | ATA-reserved | 0000 _H |
| 128 | Security status | 0021 _H |
| 129-159 | Seagate-reserved | xxxx _H |
| 160-221 | ATA-reserved | 0000 _H |
| 222 | Transport major version number | 101F _H |
| 223-254 | ATA-reserved | 0000 _H |
| 255 | Integrity word | xxA5 _H |

| | |
|-------------|---|
| Note | See the bit descriptions below for words 63, 88 and 93 of the Identify Drive data. (on next page) |
|-------------|---|

Table 12 Bit Descriptions

| 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. |
| 5 | Ultra DMA mode 5 is supported. |
| 6 | Ultra DMA mode 6 is supported. |
| 8 | Ultra DMA mode 0 is currently active. |
| 9 | Ultra DMA mode 1 is currently active. |
| 10 | Ultra DMA mode 2 is currently active. |
| 11 | Ultra DMA mode 3 is currently active. |
| 12 | Ultra DMA mode 4 is currently active. |
| 13 | Ultra DMA mode 5 is currently active. |
| 14 | Ultra DMA mode 6 is currently active. |
| Bit | Word 93 |
| 13 | 1 = 80-conductor cable detected, CBLID above VIH 0 = 40-conductor cable detected, CBLID below VIL |

4.3.2 Set Features command

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

The acceptable values for the Features register are defined as follows:

Table 13 Set Features command values

| | |
|-----------------|--|
| 02 _H | Enable write cache (<i>default</i>). |
| 03 _H | Set transfer mode (based on value in Sector Count register). Sector Count register values: 00 _H Set PIO mode to default (PIO mode 2). 01 _H Set PIO mode to default and disable IORDY (PIO mode 2). 08 _H PIO mode 0 09 _H PIO mode 1 0A _H PIO mode 2 0B _H PIO mode 3 0C _H PIO mode 4 (<i>default</i>) 20 _H Multiword DMA mode 0 21 _H Multiword DMA mode 1 22 _H Multiword DMA mode 2 40 _H Ultra DMA mode 0 41 _H Ultra DMA mode 1 42 _H Ultra DMA mode 2 43 _H Ultra DMA mode 3 44 _H Ultra DMA mode 4 45 _H Ultra DMA mode 5 46 _H Ultra DMA mode 6 |
| 55 _H | Disable read look-ahead (read cache) feature. |
| 82 _H | Disable write cache |
| AA _H | Enable read look-ahead (read cache) feature (<i>default</i>). |
| C1 _H | Disable the Free Fall Protection feature (41 _H above enables the Free Fall Protection feature) |
| 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

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

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

SeaTools diagnostic software activates a built-in drive self-test (DST S.M.A.R.T. command for D4_H) that eliminates unnecessary drive returns. The diagnostic software ships with all new drives and is also available at: <http://www.seagate.com/support/downloads/seatools/>.

This drive is shipped with S.M.A.R.T. features disabled. Users must have a recent BIOS or software package that supports S.M.A.R.T. to enable this feature. The table below shows the S.M.A.R.T. command codes that the drive uses.

Table 14 S.M.A.R.T. Commands

| Code in features register | S.M.A.R.T. command |
|---------------------------|--|
| D0 _H | S.M.A.R.T. Read Data |
| 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 |
| 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.



Seagate Technology LLC

AMERICAS Seagate Technology LLC 10200 South De Anza Boulevard, Cupertino, California 95014, United States, 408-658-1000

ASIA/PACIFIC Seagate Singapore International Headquarters Pte. Ltd. 7000 Ang Mo Kio Avenue 5, Singapore 569877, 65-6485-3888

EUROPE, MIDDLE EAST AND AFRICA Seagate Technology SAS 16-18 rue du Dôme, 92100 Boulogne-Billancourt, France, 33 1-4186 10 00

Publication Number: 100804767, Rev. E

February 2017