# Seagate® SkyHawk AI™ SATA

## Product Manual

**512E* Standard Models**

ST32000VE000

ST20000VE004

ST16000VE005

210547400, Rev A
September 2025

## Revision History

| Version and Date | Description of Changes |
|---|---|
| Rev A, September 2025 | Initial release of the document. |

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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.

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# 1. Introduction

This manual describes the functional, mechanical, and interface specifications for the following: Seagate® SkyHawk AI™ Xz SATA drive models.

**Table 1 - 512E Models**

| 512E Models Standard |
|---|
| ST32000VE000 |
| ST20000VE004 |
| ST16000VE005 |

These drives provide the following key features:

- 7200 RPM spindle speed
- Fluid Dynamic Bearing motor
- Tri Stage Actuator
- 512MB Cache buffer
- Full-track multiple-sector transfer without local processor intervention
- High instantaneous (burst) data-transfer rates (up to 600MB per second)
- Native Command Queuing with command ordering to increase performance in demanding applications
- PowerChoice™ for selectable power savings
- SeaTools™ diagnostic software performs a drive self-test that eliminates unnecessary drive returns
- SkyHawk Health Management (SHM)
- State-of-the-art cache and on-the-fly error-correction algorithms
- Support for SMART drive monitoring and reporting
- Supports latching SATA cables and connectors
- Top Cover Attached motor for excellent vibration tolerance
- Worldwide Name (WWN) capability uniquely identifies the drive

**NOTE** Seagate recommends validating the configuration with the selected HBA/RAID controller manufacturer to ensure use of full capacity is supported.

# 2. 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 Seagate SkyHawk AI SATA drive models.

## 2.1 Specification summary tables

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

**Table 2 - Drive specification**

| Drive specification | ST32000VE000 | ST20000VE004 | ST16000VE005 |
|---|---|---|---|
| Formatted (512 bytes/sector)* | 32TB | 20TB | 16TB |
| Guaranteed sectors | See Section 2.2 *Formatted capacity* | | |
| Heads | 20 | | |
| Disk | 10 | | |
| Bytes per logical sector | 512 | | |
| Bytes per physical sector | 4096 | | |
| Recording density, KBPI (Kb/in max) | 2470 | 2339 | |
| Track density, KTPI (ktracks/in avg) | 738 | | |
| Areal density, (Gb/in$^2$ avg) | 1841 | 1726 | |
| Spindle speed (RPM) | 7200 | | |
| Internal data transfer rate (Mb/s max) | 2951 | | |
| Max sustained transfer rate (MB/s) (measured at outer diameter) | 285 | 240 | |
| I/O data-transfer rate (MB/s max) | 600 | | |
| ATA data-transfer modes supported | PIO modes 0–4<br>Multiword DMA modes 0–2<br>Ultra DMA modes 0–6 | | |
| Cache buffer (MB) | 512 | | |
| Weight: (maximum) | 695 g (1.53 lb) | | |
| Average latency (ms) | 4.16 | | |
| Power-on to ready (sec) (typ/max) | 30 / 60 | | |
| Standby to ready (sec) (typ/max) | 30 / 60 | | |
| Startup current (typical) 12V (peak) | 2.0A | | |
| Voltage tolerance (including noise) | 5V ± 5%<br>12V ± 10% | | |
| Operating temperature | 10°C to 60°C (Drive Reported Temperature) | | |
| Non-operating temperature | –40°C to 70°C (ambient temperature, see Section 2.6.1 *Temperature* and Section 2.13 *Product warranty*) | | |
| Temperature gradient (°C per hour max) | 20°C (operating)<br>20°C (non-operating) | | |

**Table 2 - Drive specification**

| Drive specification | ST32000VE000 | ST20000VE004 | ST16000VE005 |
|---|---|---|---|
| Relative humidity* | 5% to 95% (operating)<br>5% to 95% (non-operating) | | |
| Relative humidity gradient | 20% per hour max | | |
| Altitude, operating | –304.8 m to 3,048 m<br>(–1000 ft to 10,000 ft) | | |
| Altitude, non-operating<br>(below mean sea level, max) | –304.8 m to 12,192 m<br>(–1000 ft to 40,000 ft) | | |
| Operational shock (2 ms) | 30 g | | |
| Nonoperational shock (2 ms) | 200 g | | |
| Linear random operating vibration | 5–500 Hz: 0.70 grms | | |
| Random rotary operating vibration | 20–1500Hz: 12.5 rads/s$^2$ | | |
| Linear random non-operating vibration | 2–500 Hz: 2.27 grms | | |
| Drive acoustics, sound power (bels) | | | |
| Idle | 2.8 (typical)<br>3.0 (max)<br>During periods of drive idle, some offline activity may occur according to the SMART specification, which may increase acoustic and power to operational levels. | | |
| Performance seek | 3.2 (typical)<br>3.4 (max) | | |
| Nonrecoverable read errors | 1 sector per $10^{15}$ bits read | | |
| Annualized failure rate (AFR)* | 0.35% based on 8760 POH | | |
| Maximum rated workload* | Maximum rate of <550TB/year<br>Workloads exceeding the annualized rate may degrade the drive MTBF and impact product reliability. The Annualized Workload Rate is in units of TB per year, or TB per 8760 power on hours. Workload Rate = TB transferred * (8760 / recorded power on hours). | | |
| Warranty | For warranty assistance, visit www.seagate.com/warranty. Enter the drive serial number and country of purchase. The system will display the warranty information for the drive. | | |
| Load-unload cycles | 600,000 | | |
| Supports Hotplug operation per Serial ATA Revision 3.3 specification | Yes | | |

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

** See Section 2.9 *Reliability* for rated MTBF device operating condition requirements.

## 2.2 Formatted capacity

**Table 3 - Formatted capacity**

| ST models | Formatted capacity * | Guaranteed sectors | Bytes per logical sector |
|---|---|---|---|
| ST32000VE000 | 32TB | 62,501,421,056 | 512E (Default) |
| ST20000VE004 | 20TB | 39,063,650,304 | |
| ST16000VE005 | 16TB | 31,251,759,104 | |

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

**NOTE** LBA Counts for drive capacities greater than 8TB are calculated based upon the SFF-8447 standard publication.

See www.snia.org/technology-communities/sff/specifications.

### 2.2.1 Logical block addressing (LBA) mode

When addressing these drives in LBA mode, all blocks (sectors) are consecutively numbered from 0 to *n*–1, where *n* is the number of guaranteed sectors as defined above.

See Section 4.3.1 *IDENTIFY DEVICE command* (words 60-61 and 100-103) for additional information about 48-bit addressing support of drives with capacities over 137GB.

## 2.3 Recording and interface technology

**Table 4 - Recording and interface technology**

| Interface | Serial ATA (SATA) |
|---|---|
| Recording method | CMR |
| Recording density, KBPI (Kb/in max) | |
| 32TB | 2470 |
| 20TB | 2339 |
| 16TB | |
| Track density, KTPI (ktracks/in avg) | |
| All models | 738 |
| Areal density (Gb/in$^2$ avg) | |
| 32TB | 1841 |
| 20TB | 1726 |
| 16TB | |
| Spindle speed (RPM) (± 0.2%) | |
| All models | 7200 |
| Internal data transfer rate (Mb/s max) | |
| All models | 2951 |
| Max sustained data transfer rate (MB/s) | |
| 32TB | 285 |
| 20TB | 240 |
| 16TB | |
| I/O data-transfer rate (MB/s max) | 600 |

## 2.4 Start/stop times

Power-on to Ready time is based on typical operating conditions, default full current spin-up profile, and clean shutdown prior to measurement. To ensure a clean shutdown, a Flush Cache, Standby, or Standby Immediate command must be completed before removal of interface power.

**Table 5 - Start/stop times**

| Interface | Time |
|---|---|
| Power-on to Ready (sec) | 30 (typ) / 60 (max) |
| Standby to Ready (sec) | 30 (typ) / 60 (max) |
| Ready to Spindle Stop (sec) | 20 (max) |

**NOTE** An unexpected power loss event and/or spin up at cold or hot temperature extremes may cause the drive to exceed the typical time to ready by 5-20 seconds. Extended time to ready is dependent on cache state and environmental conditions prior to the unexpected power loss and during the subsequent power-on.

## 2.5 Power specifications

The drive receives DC power (+5V or +12V) through a native SATA power connector. See Figure 3, *Attaching SATA cabling*, on page 22.

### 2.5.1 Power consumption

Power requirements for the drives are listed in Table 6, *DC power requirements (32/20/16TB models)*. Typical power measurements are based on an average of drives tested, under nominal conditions, using 5.0V and 12.0V input voltage at 35°C ambient temperature.

**Table 6 - DC power requirements (32/20/16TB models)**

| Workload Mode 6.0Gb (24/20TB) | Avg (25C) W | Avg 5V typ (A) | Avg 12V typ (A) |
|---|---|---|---|
| Spinup (Max) | | | 2.0 |
| Idle[1] | 6.703 | 0.311 | 0.429 |
| Operation* | 8.217 | 0.455 | 0.484 |
| Standby | 1.189 | 0.209 | 0.012 |
| Sleep | 1.189 | 0.209 | 0.012 |

* Based on IDEMA 3 Stream workload

**NOTE** During periods of drive idle, some offline activity may occur according to the SMART specification which may increase acoustic and power to operational levels.

#### 2.5.1.1 Typical current profiles

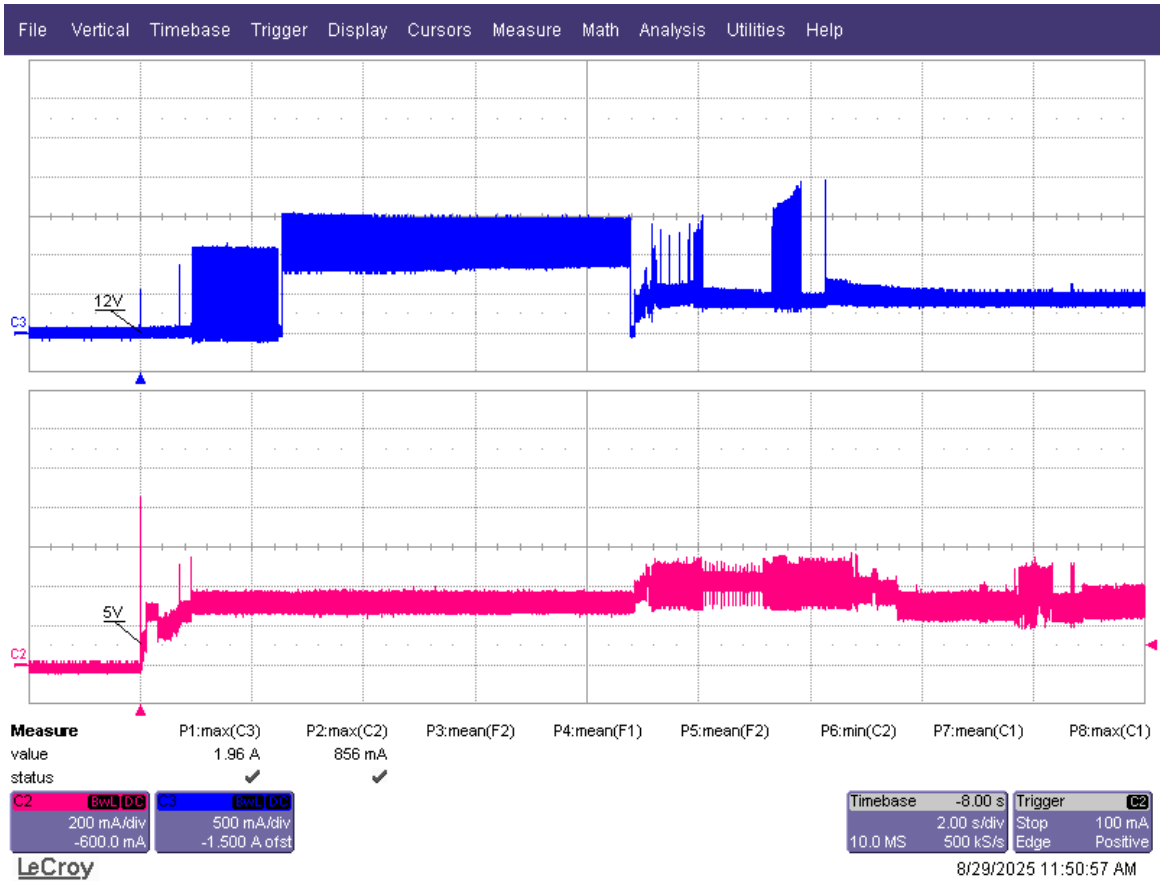



**Figure 1. Typical 5V and 12V startup and operation current profiles**

### 2.5.2 Conducted noise

Noise is specified as a periodic and random distribution of frequencies covering a band from DC to 10 MHz. Maximum allowed noise values given below are peak-to-peak measurements and apply at the drive power connector.

| | | |
|---|---|---|
| +5V | = | 250 mV pp from 100 Hz to 20 MHz |
| +12V | = | 800 mV pp from 100 Hz to 8 KHz<br>450 mV pp from 8 KHz to 20 KHz<br>250 mV pp from 20 KHz to 5 MHz |

### 2.5.3 Voltage tolerance

Voltage tolerance (including noise):

| | | |
|---|---|---|
| +5V | = | ± 5% |
| +12V | = | ± 10% |

### 2.5.4 Extended Power Conditions - PowerChoice™

Utilizing the load/unload architecture a programmable power management interface is provided to tailor systems for reduced power consumption and performance requirements.

The table below lists the supported power conditions available in PowerChoice. Power conditions are ordered from highest power consumption (and shortest recovery time) to lowest power consumption (and longest recovery time) as follows: Idle_a power >= Idle_b power >= Idle_c power >= Standby_z power. The further users go down the table, the greater thepower savings achieved. For example, Idle_b results in greater power savings than the Idle_a power condition. Standby results in the greatest power savings.

**Table 7 - Extended power conditions - PowerChoice**

| Power Condition Name | Power Condition ID | Description |
|---|---|---|
| Idle_a | 81H | Reduced electronics. |
| Idle_b | 82H | Heads unloaded. Disks spinning at full RPM. |
| Idle_c | 83H | Heads unloaded. Disks spinning at reduced RPM. |
| Standby_z | 00H | Heads unloaded. Motor stopped (disks not spinning). |

Each power condition has a set of current, saved, and default settings. Default settings are not modifiable. Default and saved settings persist across power-on resets. The current settings do not persist across power-on resets. At the time of manufacture, the default, saved and current settings are in the Power Conditions log match.

**PowerChoice is invoked using one of two methods:**

- Automatic power transitions which are triggered by expiration of individual power condition timers. These timer values may be customized and enabled using the Extended Power Conditions (EPC) feature set using the standardized SET FEATURES command interface.
- Immediate host commanded power transitions may be initiated using an EPC SET FEATURES "Go to Power Condition" subcommand to enter any supported power condition. Legacy power commands STANDBY IMMEDIATE and IDLE IMMEDIATE also provide a method to directly transition the drive into supported power conditions.

**PowerChoice exits power saving states under the following conditions:**

- Any command which requires the drive to enter the PM0: Active state (media access)
- Power on reset

**PowerChoice provides the following reporting methods for tracking purposes:**

*CHECK POWER MODE command*

- Reports the current power state of the drive

*IDENTIFY DEVICE command*

- EPC Feature set supported flag
- EPC Feature enabled flag is set if at least one Idle power condition timer is enabled

**Power Condition Log reports the following for each power condition:**

- Nominal recovery time from the power condition to active
- If the power condition is Supported, Changeable, and Savable
- Default enabled state and timer value
- Saved enabled state and timer value
- Current enabled state and timer value

### SMART Read Data Reports

- Attribute 192 - Emergency Retract Count
- Attribute 193 - Load/Unload Cycle Count

### PowerChoice manufacturer default power condition timer values

Default power condition timer values have been established to assure product reliability and data integrity. A minimum timer value threshold of two minutes ensures the appropriate amount of background drive maintenance activities occur. Attempting to set a timer values less than the specified minimum timer value threshold will result in an aborted EPC "Set Power Condition Timer" subcommand.

**Table 8 - PowerChoice default timer values**

| Power Condition Name | Default Timer Values |
|---|---|
| Idle_a | 100 ms |
| Idle_b | 10 min |
| Idle_c | 10 min |
| Standby_z | 15 min |

Setting power condition timer values less than the manufacturer specified defaults or issuing the EPC "Go to Power Condition" subcommand at a rate exceeding the default timers may limit product reliability and data integrity.

### PowerChoice supported extended power condition feature subcommands

**Table 9 - PowerChoice supported extended condition feature subcommands**

| EPC Subcommand | Description |
|---|---|
| 00H | Restore Power Condition Settings |
| 01H | Go to Power Condition |
| 02H | Set Power Condition Timer |
| 03H | Set Power Condition State |
| 04H | Enable EPC Feature Set |
| 05H | Disable EPC Feature Set |

### PowerChoice supported extended power condition identifiers

**Table 10 - PowerChoice supported extended power condition identifiers**

| Power Condition Identifiers | Power Condition Name |
|---|---|
| 00H | Standby_z |
| 01 - 80H | Reserved |
| 81H | Idle_a |
| 82H | Idle_b |
| 83H | Idle_c |
| 84 - FEH | Reserved |
| FFH | All EPC Power Conditions |

## 2.6 Environmental limits

Temperature and humidity values experienced by the drive must be such that condensation does not occur on any drive part. Altitude and atmospheric pressure specifications are referenced to a standard day at 58.7°F (14.8°C).

**NOTE** To maintain optimal performance, drives should be run at nominal drive temperatures and humidity. See Section 2.9 *Reliability* for rated MTBF device operating condition requirements.

### 2.6.1 Temperature

**Table 11 - Temperature ranges (operating/non-operating)**

| | |
|---|---|
| **Operating** | 50°F to 140°F (10°C to 60°C drive reported) temperature range with a maximum temperature gradient of 36°F (20°C) per hour as reported by the drive.<br>The maximum allowable drive reported temperature is 149°F (65°C).<br>Airflow may be required to achieve consistent nominal drive temperature values (see Section 3.3 *Drive mounting*). To confirm that the required cooling is provided for the electronics and HDA, place the drive in its final mechanical configuration and perform random write/read operations. After the temperatures stabilize, monitor the current drive temperature using the SMART temperature attribute 194 or Device Statistics log 04h page 5. |
| **Non-operating** | –40°F to 158°F (–40°C to 70°C) package ambient with a maximum gradient of 36°F (20°C) per hour. This specification assumes that the drive is packaged in the shipping container designed by Seagate for use with drive. |

### 2.6.2 Humidity

The values below assume that no condensation on the drive occurs. Maximum wet bulb temperature is 84.2°F (29°C).

**Table 12 - Relative humidity (operating/non-operating)**

| | |
|---|---|
| **Operating** | 5% to 95% non-condensing relative humidity with a maximum gradient of 20% per hour. |
| **Non-operating** | 5% to 95% non-condensing relative humidity with a maximum gradient of 20% per hour. |

### 2.6.3 Effective Altitude

**Table 13 - Effective altitude (sea level)**

| | |
|---|---|
| **Operating** | –304.8 m to 3048 m (–1000 ft to 10,000 ft) |
| **Non-operating** | –304.8 m to 12,192 m (–1000 ft to 40,000 ft) |

### 2.6.4 Shock and Vibration

Shock and vibration measurements specified in this document are made directly on the drive itself and applied in the X, Y, and Z axis at the drive mounting point locations.

### 2.6.4.1 Shock

**Table 14 - Shock**

| | |
|---|---|
| **Operating** | The drive operates without error while subjected to intermittent shock pulses not exceeding 30 g typical at a 2ms duration limited by Z-axis, shown in Figure 2, *Drive orientation*. |
| **Non-operating** | The drive will operate without non-recoverable errors after being subjected to shock pulses not exceeding 200 g at a duration of 2ms. |

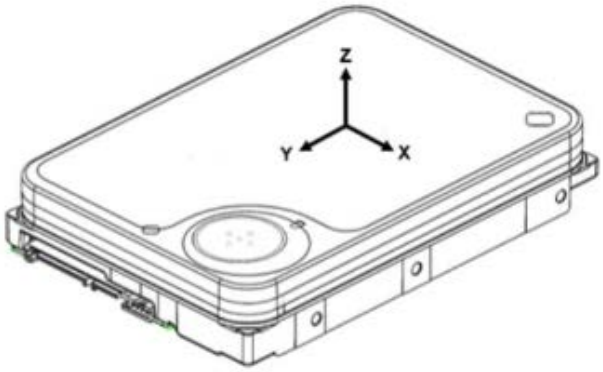



**Figure 2 Drive orientation**

### 2.6.4.2 Vibration

#### Linear random operating vibration

The drive will operate without non-recoverable errors while being subjected to the random power spectral density noise specified below.

**Table 15 - Linear random operating vibration**

| PSD OF 5-500 Hz random noise at 0.70 g rms | | | | | |
|---|---|---|---|---|---|
| Frequency (Hz) | 5 | 20 | 200 | 250 | 500 |
| PSD ($G^2$/Hz) | 0.00025 | 0.00210 | 0.00210 | 0.00020 | 0.00020 |

#### Random rotary operating vibration

The drive will exhibit greater than 90% throughput for sequential and random write operations while subjected to the shaped random power spectral density noise specified below.

**Table 16 - Random rotary operating vibration**

| PSD OF 20-1500 Hz at 12.5 rad/sec$^2$ | | | | |
|---|---|---|---|---|
| Frequency (Hz) | 20 | 200 | 800 | 1500 |
| PSD ((rad/sec$^2$)$^2$/Hz) | 5.53E-02 | 5.53E-02 | 3.49E-01 | 6.14E-04 |

**Linear random non-operating vibration**

The drive will not incur physical damage or have non-recoverable errors after being subjected to the power spectral density noise specified below.

**Table 17 - Linear random non-operating vibration**

| PSD Profile 2-500 Hz at 2.27 g rms | | | | |
|---|---|---|---|---|
| Frequency (Hz) | 2 | 4 | 100 | 500 |
| $G^2$/Hz | 0.001 | 0.030 | 0.030 | 0.001 |

## 2.7 Acoustics

Drive acoustics are measured as overall A-weighted acoustic sound power levels (no pure tones). All measurements are consistent with ISO document 7779. Sound power measurements are taken under essentially free-field conditions over a reflecting plane. For all tests, the drive is oriented with the cover facing upward.

**NOTE** For seek mode tests, the drive is placed in seek mode only. The number of seeks per second is defined by the following equation:

(Number of seeks per second = 0.4 / (average latency + average access time))

**Table 18 - Fluid Dynamic Bearing (FDB) motor acoustics**

| | Idle* | Performance seek |
|---|---|---|
| All models | 2.8 bels (typ)<br>3.0 bels (max) | 3.2 bels (typ)<br>3.4 bels (max) |

* During periods of drive idle, some offline activity may occur according to the SMART specification, which may increase acoustic and power to operational levels.

### 2.7.1 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 this threshold curve (originated in ISO 389-7) 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.

## 2.8 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 19 - Radio frequency environments**

| Test | Description | Performance level | Reference standard |
|---|---|---|---|
| Electrostatic discharge | Contact, HCP, VCP: ± 4 kV; Air: ± 8 kV | B | EN 61000-4-2: 95 |
| Radiated RF immunity | 80 to 1000 MHz, 3 V/m,<br>80% AM with 1 kHz sine<br>900 MHz, 3 V/m, 50% pulse modulation @ 200 Hz | A | EN 61000-4-3: 96<br>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<br>0% short, 5 seconds<br>40%, 0.10 seconds<br>70%, 0.01 seconds | C<br>C<br>C<br>B | EN 61000-4-11: 94 |

## 2.9 Reliability

### 2.9.1 Annualized Failure Rate (AFR) and Mean Time Between Failures (MTBF)

The production disk drive achieves an annualized failure-rate of 0.35% (MTBF of 2,500,000 hours) over a 5 year service life when used in Enterprise Storage field conditions as limited by the following:

- 8760 power-on hours per year
- HDA temperature as reported by the drive >= 10°C and <= 30°C
- Ambient wet bulb temp <= 26°C
- Typical workload
- The AFR (MTBF) is a population statistic not relevant to individual units
- ANSI/ISA S71.04-2013 G2 classification levels and dust contamination to ISO 14644-1 Class 8 standards (as measured at the device)

The MTBF specification for the drive assumes the operating environment is designed to maintain nominal drive temperature and humidity. Occasional excursions in operating conditions between the rated MTBF conditions and the maximum drive operating conditions may occur without significant impact to the rated MTBF. However, continual or sustained operation beyond the rated MTBF conditions will degrade the drive MTBF and reduce product reliability.

| | |
|---|---|
| **Non-recoverable read errors** | 1 per $10^{15}$ bits read, max |
| **Load unload cycles** | 600,000 cycles |

| | |
|---|---|
| **Maximum Rated Workload** | Maximum rate of <550TB/year<br>Workloads exceeding the annualized rate may degrade the drive MTBF and impact product reliability. The Annualized Workload Rate is in units of TB per year, or TB per 8760 power on hours. Workload Rate = TB transferred * (8760 / recorded power on hours). |
| **Warranty** | For warranty assistance, visit www.seagate.com/warranty. Enter the drive serial number and country of purchase. The system will display the warranty information for the drive. |
| **Preventive maintenance** | None required. |

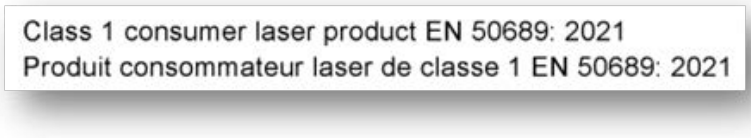
## 2.10 HDD and SSD Regulatory Compliance and Safety

For the latest regulatory and compliance information, go to www.seagate.com/support. Scroll down the page and select the Compliance, Safety and Disposal Guide link.

### 2.10.1 Safety certification

The drives are recognized in accordance with:
UL/cUL 62368 -1, EN 62368 -1, IEC 60825.1:2014/A11:2021, and 21 CFR 1010.2/1040.10




### 2.10.2 Regulatory Models

The following regulatory model number represents all features and configurations within the series:

Regulatory Model Number: STL026

## 2.11 Corrosive environment

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 hard disk drives are especially sensitive to the presence of sulfide, chloride, and nitrate contaminants. Sulfur is found to be the most damaging. 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.

Seagate recommends that data centers be kept clean by monitoring and controlling the dust and gaseous contamination. Gaseous contamination should be within ANSI/ISA S71.04-2013 G2 classification levels (as measured on copper and silver coupons), and dust contamination to ISO 14644-1 Class 8 standards, and MTBF rated conditions as defined in the Annualized Failure Rate (AFR) and Mean Time Between Failure (MTBF) section.

## 2.12 Reference documents

**Supported Standards**

Serial ATA Revision 3.3 specification

**ANSI Documents**

ISO/IEC 17760-105 ATA Command Set - 5 (ACS-5)

**Specification for Acoustic Test Requirement and Procedures**

Seagate part number: 30553-001

In case of conflict between this document and any referenced document, this document takes precedence.

## 2.13 Product warranty

Beginning on the date of shipment to the customer and continuing for the period specified in the purchase contract, Seagate warrants that each product (including components and subassemblies) that fails to function properly under normal use due to defect in materials or workmanship or due to nonconformance to the applicable specifications will be repaired or replaced, at Seagate's option and at no charge to the customer, if returned by customer at customer's expense to Seagate's designated facility in accordance with Seagate's warranty procedure. Seagate will pay for transporting the repair or replacement item to the customer. For more detailed warranty information, refer to the standard terms and conditions of purchase for Seagate products on the purchase documentation.

For warranty assistance, visit www.seagate.com/warranty. Enter the drive serial number and country of purchase. The system will display the warranty information for the drive.

### 2.13.1 Shipping

When transporting or shipping a drive, use only a Seagate-approved container. Keep the original box. Seagate approved containers are easily identified by the Seagate Approved Package label. Shipping a drive in a non-approved container voids the drive warranty.

Seagate repair centers may refuse receipt of components improperly packaged or obviously damaged in transit. Contact the authorized Seagate distributor to purchase additional boxes. Seagate recommends shipping by an air-ride carrier experienced in handling computer equipment.

### 2.13.2 Storage

Maximum storage periods are 180 days within original unopened Seagate shipping package or 60 days unpackaged within the defined non-operating limits (refer to environmental section in this manual). Storage can be extended to one year packaged or unpackaged under optimal environmental conditions (25°C, <40% relative humidity non-condensing, and non-corrosive environment). During any storage period, the drive non-operational temperature, humidity, wet bulb, atmospheric conditions, shock, vibration, magnetic, and electrical field specifications should be followed.

### 2.13.3 Product repair and return information

Seagate customer service centers are the only facilities authorized to service Seagate drives. Seagate does not sanction any third-party repair facilities. Any unauthorized repair or tampering with the factory seal voids the warranty.

## 2.14 Seagate Rescue™ Data Recovery Service

Data recovery is the process of salvaging data from corrupted or damaged storage media devices. This corruption could stem from physical damage to the hardware itself or logical damage to the internal filing system. In all scenarios, the objective is to copy all files stored within the damaged device to a new device or restore the original device to working order.

To initiate a claim or check your warranty for questions about your service availability, go to www.seagate.com/rescue.

# 3. 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** | • Before handling the drive, put on a grounded wrist strap. Wear a grounded wrist strap throughout the entire installation procedure.<br>• Handle the drive by its edges or frame only.<br>• The drive is extremely fragile—handle it with care. Do not press down on the top cover.<br>• Always rest the drive on a padded, antistatic surface until mounting it in the computer.<br>• Do not touch the connector pins or the printed circuit board.<br>• 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 Serial ATA cables and connectors

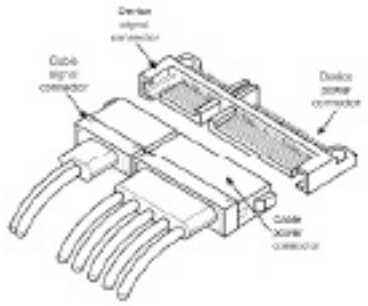
The Serial ATA interface cable consists of four conductors in two differential pairs, plus three ground connections. The cable size may be 30 to 26 AWG with a maximum length of one meter (39.37 in).

See Table 21, *Serial ATA connector pin definitions* 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 illustrated in Figure 3, *Attaching SATA cabling*.

**Figure 3 Attaching SATA cabling**



Each cable is keyed to ensure correct orientation. Seagate SkyHawk AI SATA 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. See Figure 4, *Mounting configuration dimensions* for drive mounting dimensions. Follow these important mounting precautions when mounting the drive:

- Allow a minimum clearance of 0.030 in (0.76mm) around the entire perimeter of the drive for cooling.
- Use only 6-32 UNC mounting screws.
- The screws should be inserted no more than 0.140 in (3.56mm) into the bottom or side mounting holes.
- Do not overtighten the mounting screws (maximum torque: 6 in-lb).

### 3.3.1 Mechanical specifications

Refer to Figure 4, *Mounting configuration dimensions* for detailed mounting configuration dimensions.

**NOTE** These dimensions conform to the Small Form Factor Standard documented in SFF-8301 and SFF-8323, found at www.snia.org/technology-communities/sff/specifications.

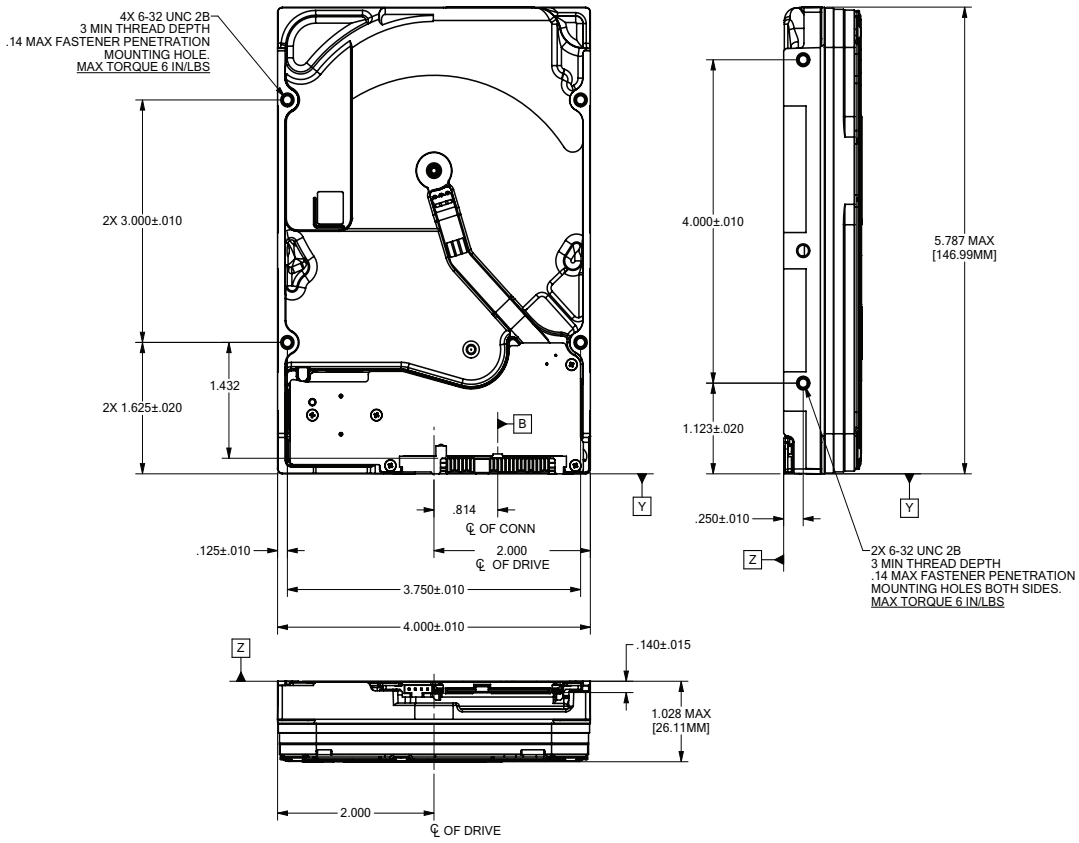



**Figure 4 Mounting configuration dimensions**

**NOTE** The image is for mechanical dimension reference only and may not represent the actual drive.

**Table 20 - Weight**

| Capacity | Weight (lb/g) |
|---|---|
| 32TB | 1.53/695 |
| 20TB | |
| 16TB | |

# 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.

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

## 4.1 Hot-Plug compatibility

Seagate SkyHawk AI SATA drives incorporate connectors which enable users to hot plug these drives in accordance with the Serial ATA Revision 3.3 specification. This specification can be downloaded from www.serialata.org.

| Caution | The drive motor must come to a complete stop (Ready to Spindle Stop time indicated in Section 2.4 *Start/stop times*) prior to changing the plane of operation. This time is required to ensure data integrity. |
|---|---|

## 4.2 Serial ATA device plug connector pin definitions

Table 21, *Serial ATA connector pin definitions* summarizes the signals on the Serial ATA interface and power connectors.

**Table 21 - 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 | | | |

**Table 21 - Serial ATA connector pin definitions**

| Segment | Pin | Function | Definition |
|---|---|---|---|
| Power | P1 | V33 | Not Used (P1 and P2 tied internally) |
| | P2 | V33 | Not Used (P1 and P2 tied internally) |
| | P3 | PWRDIS | Enter/Exit Power Disable (option) |
| | 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 1.27mm (0.050”) 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 blindmate backplane configuration.
4. All used voltage pins ($V_x$) must be terminated.

## 4.3 Supported ATA commands

The following table lists Serial ATA standard commands that the drive supports. For a detailed description of the ATA commands, refer to the Serial ATA: High Speed Serialized AT Attachment specification. See Section 4.3.5 *SMART commands* for details and subcommands used in the SMART implementation.

**Table 22 -**

| Command name | Command code (in hex) |
|---|---|
| ACCESSIBLE MAX ADDRESS CONFIGURATION | |
| GET NATIVE MAX ADDRESS EXT | 78H / 0000H |
| SET ACCESSIBLE MAX ADDRESS EXT | 78H / 0001H |
| FREEZE ACCESSIBLE MAX ADDRESS EXT | 78H / 0002H |
| CHECK POWER MODE | E5H |
| CONFIGURE STREAM | 51H |

**Table 22 -**

| Command name | Command code (in hex) |
|---|---|
| DOWNLOAD MICROCODE | 92H |
| EXECUTE DEVICE DIAGNOSTICS | 90H |
| FLUSH CACHE | E7H |
| FLUSH CACHE EXTENDED | EAH |
| GET PHYSICAL ELEMENT STATUS | 12H |
| IDENTIFY DEVICE | ECH |
| IDLE | E3H |
| IDLE IMMEDIATE | E1H |
| READ BUFFER | E4H |
| READ DMA | C8H |
| READ DMA EXTENDED | 25H |
| READ FPDMA QUEUED | 60H |
| READ LOG DMA EXT | 47H |
| READ LOG EXT | 2FH |
| READ MULTIPLE | C4H |
| READ MULTIPLE EXTENDED | 29H |
| READ SECTORS | 20H |
| READ SECTORS EXTENDED | 24H |
| READ STREAM DMA EXT | 2AH |
| READ VERIFY SECTORS | 40H |
| READ VERIFY SECTORS EXTENDED | 42H |
| RECEIVE FPDMA QUEUED | 65H |
| REQUEST SENSE DATA EXT | 0BH |
| REMOVE ELEMENT AND TRUNCATE | 7CH |
| RESTORE ELEMENTS AND REBUILD | 7DH |
| SANITIZE DEVICE - CRYPTO SCRAMBLE | B4H / 0011H (SED and ISE drives only) |
| SANITIZE DEVICE - OVERWRITE EXT | B4H / 0014H |
| SANITIZE DEVICE - FREEZE LOCK EXT | B4H / 0020H |
| SANITIZE DEVICE - STATUS EXT | B4H / 0000H |
| SECURITY DISABLE PASSWORD | F6H |
| SECURITY ERASE PREPARE | F3H |
| SECURITY ERASE UNIT | F4H |
| SECURITY FREEZE | F5H |
| SECURITY SET PASSWORD | F1H |
| SECURITY UNLOCK | F2H |
| SEND FPDMA QUEUED | 64H |
| SET DATE & TIME EXT | 77H |
| SET FEATURES | EFH |
| SET MULTIPLE MODE | C6H |
| SET SECTOR CONFIGURATION EXT | B2H |

**Table 22 -**

| Command name | Command code (in hex) |
|---|---|
| SLEEP | E6H |
| SMART DISABLE OPERATIONS | B0H / D9H |
| SMART ENABLE/DISABLE AUTOSAVE | B0H / D2H |
| SMART ENABLE OPERATIONS | B0H / D8H |
| SMART EXECUTE OFFLINE | B0H / D4H |
| SMART READ ATTRIBUTE THRESHOLDS | B0H / D1H |
| SMART READ DATA | B0H / D0H |
| SMART READ LOG SECTOR | B0H / D5H |
| SMART RETURN STATUS | B0H / DAH |
| SMART SAVE ATTRIBUTE VALUES | B0H / D3H |
| SMART WRITE LOG SECTOR | B0H / D6H |
| STANDBY | E2H |
| STANDBY IMMEDIATE | E0H |
| TRUSTED SEND | 5EH (SED drives only) |
| TRUSTED SEND DMA | 5FH (SED drives only) |
| TRUSTED RECEIVE | 5CH (SED drives only) |
| TRUSTED RECEIVE DMA | 5DH (SED drives only) |
| WRITE BUFFER | E8H |
| WRITE DMA | CAH |
| WRITE DMA EXTENDED | 35H |
| WRITE DMA FUA EXTENDED | 3DH |
| WRITE FPDMA QUEUED | 61H |
| WRITE LOG DMA EXT | 57H |
| WRITE LOG EXTENDED | 3FH |
| WRITE MULTIPLE | C5H |
| WRITE MULTIPLE EXTENDED | 39H |
| WRITE MULTIPLE FUA EXTENDED | CEH |
| WRITE SECTORS | 30H |
| WRITE SECTORS EXTENDED | 34H |
| WRITE STREAM DMA EXT | 3AH |
| WRITE UNCORRECTABLE EXTENDED | 45H |

### 4.3.1 IDENTIFY DEVICE command

The IDENTIFY DEVICE command (command code ECH) 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 2, *Drive specification*. 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. *Drive specifications* for default parameter settings.

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

**Table 23Identify Device command**

| Word | Description | Value |
|---|---|---|
| 0 | Configuration information:<br>• Bit 15: 0 = ATA; 1 = ATAPI<br>• Bit 7: removable media<br>• Bit 6: removable controller<br>• Bit 0: reserved | 0C5AH |
| 1 | Obsolete | 16,383 |
| 2 | ATA-reserved | C837H |
| 3 | Obsolete | 16 |
| 4 | Retired | 0000H |
| 5 | Retired | 0000H |
| 6 | Obsolete | 003FH |
| 7–9 | Retired | 0000H |
| 10–19 | Serial number: (20 ASCII characters, 0000H = none) | ASCII |
| 20-21 | Retired | 0000H |
| 22 | Obsolete | 0000H |
| 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) | ST32000VE000<br>ST20000VE004<br>ST16000VE005 |
| 47 | (Bits 7–0) Maximum sectors per interrupt on Read multiple and Write multiple (16) | 8010H (512e) / 8002H (4KN) |
| 48 | Trusted computing feature set supported bit 0 (SED only) | 4000H |
| 49 | Standard Standby timer, IORDY supported and may be disabled | 2F00H |
| 50 | Capabilities | 4000H |
| 51-52 | Obsolete | xxxxH |
| 53 | Misc | 0007H |
| 54–58 | Obsolete | xxxxH |
| 59 | (Bit 15: 0) Block Erase Ext Not Supported - N<br>(Bit 14: 1) Overwrite Ext Supported - Y<br>(Bit 13: X) Crypto Scramble Ext Supported (SED Only) - N<br>(Bit 12: 1) Sanitize feature set supported - Y<br>(Bit 11: 1) Commands allowed during sanitize op as specified in ACS-3 - Y<br>(Bit 10: 1) Sanitize Antifreeze Lock Ext command supported - Y | 5D10H (512E) / 5D02H (4KN) |
| 60–61 | Total number of user-addressable LBA sectors available<br>(see Section for related information)<br>*Note: The maximum value allowed in this field is: 0FFFFFFFh (268,435,455 sectors, 137GB). Drives with capacities over 137GB will have 0FFFFFFFh in this field and the actual number of user-addressable LBAs specified in words 100-103. This is required for drives that support the 48-bit addressing feature. | 0FFFFFFFh* |
| 62 | Obsolete | 0000H |
| 63 | Multiword DMA active and modes supported (see note following this table) | xx07H |
| 64 | Advanced PIO modes supported (modes 3 and 4 supported) | 0003H |

**Table 23Identify Device command**

| Word | Description | Value |
|---|---|---|
| 65 | Minimum multiword DMA transfer cycle time per word (120 ns) | 0078H |
| 66 | Recommended multiword DMA transfer cycle time per word (120 ns) | 0078H |
| 67 | Minimum PIO cycle time without IORDY flow control (240 ns) | 0078H |
| 68 | Minimum PIO cycle time with IORDY flow control (120 ns) | 0078H |
| 69 | Additional supported | 000CH |
| 70–74 | ATA-reserved | 0000H |
| 75 | Queue depth | 001FH |
| 76 | Serial ATA capabilities | 8D0EH |
| 77 | (Bit 6:1) Send/Receive FPDMA Queued Commands Supported | 0046H |
| 78 | Serial ATA features supported | xxC4H |
| 79 | Serial ATA features enabled | 0044H |
| 80 | Major version number | 1FE0H (ACS-5) |
| 81 | Minor version number | FFFFH |
| 82 | Command sets supported | 306BH |
| 83 | Command sets supported | 7561H |
| 84 | Command sets support extension (see note following this table) | 6173H |
| 85 | Command sets enabled | 3069H |
| 86 | Command sets enabled | B441H |
| 87 | Command sets enable extension | 6173H |
| 88 | Ultra DMA support and current mode (see note following this table) | 007FH |
| 89 | Security erase time | xxxxH |
| 90 | Enhanced security erase time | xxxxH |
| 92 | Master password revision code | FFFEH |
| 93 | Hardware reset value | xxxxH |
| 95–99 | ATA-reserved | 0000H |
| 100–103 | Total number of user-addressable LBA sectors available.<br>These words are required for drives that support the 48-bit addressing feature.<br>Maximum value: 0000FFFFFFFFFFFFh. | See Section 2.2.1 *Logical block addressing (LBA) mode* |
| 104 | Streaming Transfer Time | 0000H |
| 106 | Physical/Logical sector size | 6003H (512E) / 5000H (4KN) |
| 107 | ATA-reserved | 0000H |
| 108–111 | The mandatory value of the world wide name (WWN) for the drive.<br>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 | 0000H |
| 119 | Commands and feature sets supported | 43DEH |
| 120 | Commands and feature sets supported or enabled | 40DCH |
| 121-127 | ATA-reserved | 0000H |
| 128 | Security status | 0021H |
| 129–159 | Seagate-reserved | xxxxH |
| 160–167 | ATA-reserved, CF Assoc | 0000H |

**Table 23Identify Device command**

| Word | Description | Value |
|---|---|---|
| 168 | Device Nominal Form Factor | 3.5“ |
| 169–205 | ATA-reserved | 0000H |
| 206 | SCT Command Transport command set.<br>If bit 0 is set to one, then the device supports SCT Command Transport.<br>Bits 7:2 indicate individual SCT feature support. | xxBDH |
| 207-208 | ATA-reserved | 0000H |
| 209 | Alignment of Logical Blocks in Physical Block | 4000 |
| 210-211 | Write-Read-Verify Mode 3 Count | 0000 |
| 212-213 | Write-Read-Verify Mode 2 Count | 0000 |
| 214-216 | Obsolete | |
| 217 | Nominal media rotation rate | 7200 |
| 218-219 | ATA-reserved | 0000H |
| 222 | Transport Major Version | 11FFH (SATA 3.3) |
| 223 | Transport Minor Version | 0000H |
| 224-229 | ATA-reserved | 0000H |
| 230-233 | Extended Number of User Accessible Sectors | (see Section ) |
| 234-254 | ATA-reserved | 0000H |
| 255 | Integrity word | xxA5H |

**NOTE** See the bit descriptions below for words 63, 84, and 88 of the Identify Drive data.

**Table 24 - Bit descriptions for words 63, 84, 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 84 |
| 0 | SMART error logging is supported. |
| 1 | SMART self-test is supported. |
| 2 | Media serial number is not supported. |
| 3 | Media Card Pass Through Command feature set is not supported. |
| 4 | Streaming feature set is not supported. |
| 5 | GPL feature set is supported. |
| 6 | WRITE DMA FUA EXT and WRITE MULTIPLE FUA EXT commands are supported. |
| 7 | WRITE DMA QUEUED FUA EXT command is not supported. |
| 8 | 64-bit World Wide Name is supported. |
| 9-10 | Obsolete. |

**Table 24 - Bit descriptions for words 63, 84, and 88 of the Identify Drive data *(continued)***

| Description (if bit is set to 1) | |
|---|---|
| 11-12 | Reserved for TLC. |
| 13 | IDLE IMMEDIATE command with IUNLOAD feature is supported. |
| 14 | Shall be set to one |
| 15 | Shall be cleared to zero |
| 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. |

## 4.3.2 IDENTIFY DEVICE Data log

The IDENTIFY DEVICE Data log (log 30H) transfers information about the drive. The data is organized as a set of 512-byte blocks of data, whose contents are shown in Table 25, *IDENTIFY DEVICE Data log*. 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.

The following may contain drive-specific features that may are included in the Serial ATA specification.

**Table 25 - IDENTIFY DEVICE Data log**

| Page (hex) | QWord Offset (dec) | Bits | Description | Value (hex) |
|---|---|---|---|---|
| 00 | List of supported pages | | | |
| | 0..7 | 63:24 | Reserved | |
| | | 23:16 | Page number | 00 |
| | | 15:0 | Revision number | 0001 |
| | 8 | | Number of entries in the following list | 09 |
| | 9 | | Page number of the 1st supported ID data log page | 00 |
| | 10 | | Page number of the 2nd supported ID data log page | 01 |
| | 11 | | Page number of the next supported ID data log page | 02 |
| | 12 | | Page number of the next supported ID data log page | 03 |
| | 13 | | Page number of the next supported ID data log page | 04 |

**Table 25 - IDENTIFY DEVICE Data log *(continued)***

| Page (hex) | QWord Offset (dec) | Bits | Description | Value (hex) |
|---|---|---|---|---|
| | 14 | | Page number of the next supported ID data log page | 05 |
| | 15 | | Page number of the next supported ID data log page | 06 |
| | 16 | | Page number of the next supported ID data log page | 00 |
| | 17 | | Page number of the last supported ID data log page | 08 |
| | 18..511 | | Reserved | |
| | | | | |
| 01 | Copy of IDENTIFY DEVICE data | | | |
| | 0..511 | | Copy of IDENTIFY DEVICE command data | |
| | | | | |
| 02 | Capacity | | | |
| | 0..7 | Capacity page information header (QWord) | | |
| | | 63 | Shall be set to one | 1 |
| | | 62:24 | Reserved | |
| | | 23:16 | Page number | 02 |
| | | 15:0 | Revision number | 0001 |
| | 8..15 | Device Capacity (QWord) | | |
| | | 63 | Shall be set to one | 1 |
| | | 62:48 | Reserved | 0 |
| | | 47:0 | Accessible capacity | (see Section 2.2 *Formatted capacity*) |
| | 16..23 | Physical/Logical Sector Size (QWord) | | |
| | | 63 | Contents of the QWord are valid | 1 |
| | | 62 | LOGICAL TO PHYSICAL SECTOR RELATIONSHIP SUPPORTED bit | 1 (512E) / 0 (4KN) |
| | | 61 | LOGICAL SECTOR SIZE SUPPORTED bit | 1 (4KN) / 0 (512E) |
| | | 60:22 | Reserved | 0 |
| | | 19:16 | Logical to physical sector relationship | 0 (4KN) / 3 (512E) |
| | | 15:0 | Logical sector offset | 4000H |
| | 24..31 | Logical Sector Size (QWord) | | |
| | | 63 | Contents of the QWord are valid | 0 |
| | | 62:32 | Reserved | 0 |
| | | 31:0 | Logical sector size | 0 |
| | 32..39 | Nominal Buffer Size (QWord) | | |
| | | 63 | Contents of the QWord are valid | 1 |
| | | 62:0 | Buffer size | 512 |
| | 40..511 | | Reserved | 0 |
| | | | | |
| 03 | Supported Capabilities | | | |

**Table 25 - IDENTIFY DEVICE Data log *(continued)***

| Page (hex) | QWord Offset (dec) | Bits | Description | Value (hex) |
|---|---|---|---|---|
| | 0..7 | Supported Capabilities page information header (QWord) | | |
| | | 63 | Shall be set to one | 1 |
| | | 62:24 | Reserved | |
| | | 23:16 | Page number | 03 |
| | 8..15 | Supported Capabilities (QWord) | | |
| | | 63 | Shall be set to one | 1 |
| | | 62:55 | Reserved | 0 |
| | | 54 | ADVANCED BACKGROUND OPERATION SUPPORTED bit | 0 |
| | | 53 | PERSISTENT SENSE DATA REPORTING bit | 0 |
| | | 52 | SFF-8447 REPORTING bit | 1 |
| | | 51 | DEFINITIVE ENDING PATTERN SUPPORTED bit | 1 |
| | | 50 | DATA SET MANAGEMENT XL SUPPORTED bit | 0 |
| | | 49 | SET SECTOR CONFIGURATION SUPPORTED bit | 1 |
| | | 48 | ZERO EXT SUPPORTED bit | 0 |
| | | 47 | SUCCESSFUL NCQ COMMAND SENSE DATA SUPPORTED bit | 1 |
| | | 46 | DLC SUPPORTED bit | 0 |
| | | 45 | REQUEST SENSE DEVICE FAULT SUPPORTED bit | 1 |
| | | 44 | DSN SUPPORTED bit | 1 |
| | | 43 | LOW POWER STANDBY SUPPORTED bit | 0 |
| | | 42 | SET EPC POWER SOURCE SUPPORTED bit | 0 |
| | | 41 | AMAX ADDR SUPPORTED bit | 1 |
| | | 40 | Reserved for CFA | 0 |
| | | 39 | DRAT SUPPORTED bit | 0 |
| | | 38 | LPS MISALIGNMENT REPORTING SUPPORTED bit | 0 |
| | | 37 | Reserved | 0 |
| | | 36 | READ BUFFER DMA SUPPORTED bit | 0 |
| | | 35 | WRITE BUFFER DMA SUPPORTED bit | 0 |
| | | 34 | Reserved | 0 |
| | | 33 | DOWNLOAD MICROCODE DMA SUPPORTED bit | 0 |
| | | 32 | 28-BIT SUPPORTED bit | 0 |
| | | 31 | RZAT SUPPORTED bit | 0 |
| | | 30 | Reserved | 0 |
| | | 29 | NOP SUPPORTED bit | 0 |
| | | 28 | READ BUFFER SUPPORTED bit | 1 |
| | | 27 | WRITE BUFFER SUPPORTED bit | 1 |
| | | 26 | Reserved | 0 |

**Table 25 - IDENTIFY DEVICE Data log *(continued)***

| Page (hex) | QWord Offset (dec) | Bits | Description | Value (hex) |
|---|---|---|---|---|
| | 8..15 (cont.) | 25 | READ LOOK-AHEAD SUPPORTED bit | 1 |
| | | 24 | VOLATILE WRITE CACHE SUPPORTED bit | 1 |
| | | 23 | SMART bit | 1 |
| | | 22 | FLUSH CACHE EXT SUPPORTED bit | 1 |
| | | 21 | Reserved | 0 |
| | | 20 | 48-BIT SUPPORTED bit | 1 |
| | | 19 | Reserved | 0 |
| | | 18 | SPIN-UP SUPPORTED bit | 1 |
| | | 17 | PUIS SUPPORTED bit | 1 |
| | | 16 | APM SUPPORTED bit | 0 |
| | | 15 | Reserved for CFA | 0 |
| | | 14 | DOWNLOAD MICROCODE SUPPORTED bit | 1 |
| | | 13 | UNLOAD SUPPORTED bit | 1 |
| | | 12 | WRITE FUA EXT SUPPORTED bit | 1 |
| | | 11 | GPL SUPPORTED bit | 1 |
| | | 10 | STREAMING SUPPORTED bit | 1 |
| | | 9 | Reserved | 0 |
| | | 8 | SMART SELF-TEST SUPPORTED bit | 1 |
| | | 7 | SMART ERROR LOGGING SUPPORTED bit | 1 |
| | | 6 | EPC SUPPORTED bit | 1 |
| | | 5 | SENSE DATA SUPPORTED bit | 1 |
| | | 4 | FREE-FALL SUPPORTED bit | 0 |
| | | 3 | DM MODE 3 SUPPORTED bit | 1 |
| | | 2 | GPL DMA SUPPORTED bit | 1 |
| | | 1 | WRITE UNCORRECTABLE SUPPORTED bit | 1 |
| | | 0 | WRV SUPPORTED bit | 1 |
| | 16..23 | DOWNLOAD MICROCODE Capabilities (QWord) | | |
| | | 63 | Contents of the QWord are valid | 1 |
| | | 62:36 | Reserved | 0 |
| | | 35 | DM CLEARS NONACTIVATED DEFERRED DATA bit | 0 |
| | | 34 | DM OFFSETS DEFERRED SUPPORTED bit | 1 |
| | | 33 | DM IMMEDIATE SUPPORTED bit | 1 |
| | | 32 | DM OFFSETS IMMEDIATE SUPPORTED bit | 1 |
| | | 31:16 | DM MAXIMUM TRANSFER SIZE field | 0000H |
| | | 15:0 | DM MINIMUM TRANSFER SIZE field | 0000H |

**Table 25 - IDENTIFY DEVICE Data log *(continued)***

| Page (hex) | QWord Offset (dec) | Bits | Description | Value (hex) |
|---|---|---|---|---|
| | 24..31 | Nominal Media Rotation Rate (QWord) | | |
| | | 63 | Shall be set to one | 1 |
| | | 62:16 | Reserved | 0 |
| | | 15:0 | NOMINAL MEDIA ROTATION RATE field | 7200 |
| | 32..39 | Form Factor (QWord) | | |
| | | 63 | Contents of the QWord are valid | 1 |
| | | 62:4 | Reserved | 0 |
| | | 3:0 | NOMINAL FORM FACTOR field | 3.5” |
| | 40..47 | Write-Read-Verify Sector Count Mode 3 (QWord) | | |
| | | 63 | Contents of the QWord are valid | 1 |
| | | 62:32 | Reserved | 0 |
| | | 31:0 | WRV MODE 3 COUNT field | 0 |
| | 48..55 | Write-Read-Verify Sector Count Mode 2 (QWord) | | |
| | | 63 | Contents of the QWord are valid | 1 |
| | | 62:32 | Reserved | 0 |
| | | 31:0 | WRV MODE 2 COUNT field | 0 |
| | 56..71 | World wide name (DQWord) | | |
| | | 127 | Shall be set to one | 1 |
| | | 126:64 | Reserved | 0 |
| | | 63:0 | WORLD WIDE NAME field | unique |
| | 72..79 | DATA SET MANAGEMENT (QWord) | | |
| | | 63 | Shall be set to one | 1 |
| | | 62:32 | Reserved | 0 |
| | | 31:16 | MAX PAGES PER DSM COMMAND field | 0 |
| | | 15:8 | LOGICAL BLOCK MARKUPS SUPPORTED field | 0 |
| | | 7:1 | Reserved | 0 |
| | | 0 | TRIM SUPPORTED bit | 0 |

**Table 25 - IDENTIFY DEVICE Data log *(continued)***

| Page (hex) | QWord Offset (dec) | Bits | Description | Value (hex) |
|---|---|---|---|---|
| | 80..95 | Utilization Per Unit Time (QWord) | | |
| | | 127 | Shall be set to one | 1 |
| | | 126:120 | Reserved | 0 |
| | | 119:112 | UTILIZATION TYPE field | Combined Writes and Reads |
| | | 111:104 | UTILIZATION UNITS field | TB |
| | | 103:96 | UTILIZATION INTERVAL field | Per Year |
| | | 95:34 | Reserved | 0 |
| | | 63:32 | UTILIZATION B field | |
| | | 31:0 | UTILIZATION A field | 550 |
| | 96..103 | Utilization Usage Rate Support (QWord) | | |
| | | 63 | Contents of the QWord are valid | 0 |
| | | 62:24 | Reserved | 0 |
| | | 23 | SETTING RATE BASIS SUPPORTED bit | 0 |
| | | 22:9 | Reserved | 0 |
| | | 8 | SINCE POWER ON RATE BASIS SUPPORTED bit | 0 |
| | | 7:5 | Reserved | 0 |
| | | 4 | POWER ON HOURS RATE BASIS SUPPORTED bit | 0 |
| | | 3:1 | Reserved | 0 |
| | | 0 | DATE/TIME RATE BASIS SUPPORTED bit | 0 |
| | 104..111 | Zoned Capabilities (QWord) | | |
| | | 63 | Contents of the QWord are valid | 0 |
| | | 62:2 | Reserved | 0 |
| | | 1:0 | Zoned | 0 |
| | 112..119 | Supported ZAC Capabilities (QWord) | | |
| | | 63 | Contents of the QWord are valid | 0 |
| | | 62:5 | Reserved | 0 |
| | | 4 | NON-DATA RESET WRITE POINTERS EXT SUPPORTED bit | 0 |
| | | 3 | NON-DATA FINISH ZONE EXT SUPPORTED bit | 0 |
| | | 2 | NON-DATA CLOSE ZONE EXT SUPPORTED bit | 0 |
| | | 1 | NON-DATA OPEN ZONE EXT SUPPORTED bit | 0 |
| | | 0 | REPORT ZONES EXT SUPPORTED bit | 0 |

**Table 25 - IDENTIFY DEVICE Data log *(continued)***

| Page (hex) | QWord Offset (dec) | Bits | Description | Value (hex) |
|---|---|---|---|---|
| | 120..127 | Advanced Background Operations Capabilities (QWord) | | |
| | | 63 | Contents of the QWord are valid | 0 |
| | | 62 | ABO FOREGROUND MODE SUPPORTED bit | 0 |
| | | 61 | ABO IR MODE SUPPORTED bit | 0 |
| | | 60:48 | Reserved | 0 |
| | | 47:16 | ABO MINIMUM FRACTION field | 0 |
| | | 15:0 | ABO MINIMUM SUPPORTED TIMELIMIT field | 0 |
| | 128..135 | Advanced Background Operations Recommendations (QWord) | | |
| | | 63 | Contents of the QWord are valid | 0 |
| | | 62:32 | Reserved | 0 |
| | | 31:16 | DEVICE MAINTENANCE POLLING TIME field | 0 |
| | | 15:0 | ABO RECOMMENDED ABO START INTERVAL field | 0 |
| | 136..143 | Queue Depth (QWord) | | |
| | | 63 | Contents of the QWord are valid | 0 |
| | | 62:5 | Reserved | 0 |
| | | 4:0 | QUEUE DEPTH field | 32 |
| | 144..151 | Supported SCT Capabilities (QWord) | | |
| | | 63 | Contents of the QWord are valid | 1 |
| | | 62:27 | Reserved | 0 |
| | | 26 | SCT WRITE SAME FUNCTION 103 SUPPORTED bit | 1 |
| | | 25 | SCT WRITE SAME FUNCTION 102 SUPPORTED bit | 1 |
| | | 24 | SCT WRITE SAME FUNCTION 101 SUPPORTED bit | 1 |
| | | 23:19 | Reserved | 0 |
| | | 18 | SCT WRITE SAME FUNCTION 3 SUPPORTED bit | 1 |
| | | 17 | SCT WRITE SAME FUNCTION 2 SUPPORTED bit | 1 |
| | | 16 | SCT WRITE SAME FUNCTION 1 SUPPORTED bit | 1 |
| | | 15:6 | Reserved | 0 |
| | | 5 | SCT DATA TABLES SUPPORTED bit | 1 |
| | | 4 | SCT FEATURE CONTROL SUPPORTED bit | 1 |
| | | 3 | SCT ERROR RECOVERY CONTROL SUPPORTED bit | 1 |
| | | 2 | SCT WRITE SAME SUPPORTED bit | 1 |
| | | 1 | Reserved | 0 |
| | | 0 | SCT SUPPORTED bit | 1 |

**Table 25 - IDENTIFY DEVICE Data log *(continued)***

| Page (hex) | QWord Offset (dec) | Bits | Description | Value (hex) |
|---|---|---|---|---|
| | 152..159 | Depopulation Capabilities (QWord) | | |
| | | 63 | Contents of the QWord are valid | 1 |
| | | 62:3 | Reserved | 0 |
| | | 2 | RESTORE ELEMENTS AND REBUILD SUPPORTED bit | 1 |
| | | 1 | GET PHYSICAL ELEMENT STATUS SUPPORTED bit | 1 |
| | | 0 | REMOVE ELEMENT AND TRUNCATE SUPPORTED bit | 1 |
| | 160..167 | Depopulation Execution Time (QWord) | | |
| | | 63 | Contents of the QWord are valid | 0 |
| | | 62:0 | DEPOPULATION TIME field (see 9.10.5.19) | Unique per drive |
| | 168..175 | Command Duration Limit Supported bits (QWord) | | |
| | | 63 | Contents of QWord are valid | 1 |
| | | 62:3 | Reserved | 0 |
| | | 2 | HIGH PRIORITY ENHANCEMENT SUPPORTED bit | 0 |
| | | 1 | COMMAND DURATION GUIDELINES SUPPORTED bit | 0 |
| | | 0 | COMMAND DURATION LIMITS SUPPORTED bit | 1 |
| | 176..183 | Command Duration Limit Minimum Time Limit (QWord) | | |
| | | 63 | Contents of QWord are valid | 1 |
| | | 62:32 | Reserved | 0 |
| | | 31:0 | CDL MINIMUM TIME LIMIT field | 2710H, 10,000 us |
| | 184..191 | Command Duration Limit Maximum Time Limit (QWord) | | |
| | | 63 | Contents of QWord are valid | 1 |
| | | 62:32 | Reserved | 0 |
| | | 31:0 | CDL MAXIMUM TIME LIMIT field | 7FFFFFFFH, 2,147,483,647 us |
| | 192..503 | Reserved | | |
| | 504..511 | Vendor Specific Supported Capabilities (QWord) | | |
| | | 63 | Contents of the QWord are valid | 1 |
| | | 62:0 | Vendor specific | |
| 04 | Current Settings | | | |

**Table 25 - IDENTIFY DEVICE Data log *(continued)***

| Page (hex) | QWord Offset (dec) | Bits | Description | Value (hex) |
|---|---|---|---|---|
| | 0..7 | Current Settings page information header (QWord) | | |
| | | 63 | Shall be set to one | 1 |
| | | 62:24 | Reserved | 0 |
| | | 23:16 | Page number | 04 |
| | 8..15 | Current Settings (QWord) | | |
| | | 63 | Shall be set to one | 1 |
| | | 62:19 | Reserved | 0 |
| | | 18 | SUCCESSFUL NCQ COMMAND SENSE DATA ENABLED bit | 0 |
| | | 17 | DLC ENABLED bit | 0 |
| | | 16 | DSN ENABLED bit | 0 |
| | | 15 | EPC ENABLED bit | 1 |
| | | 14 | Reserved | 0 |
| | | 13 | VOLATILE WRITE CACHE ENABLED bit | 1 |
| | | 12 | Reserved | 0 |
| | | 11 | REVERTING TO DEFAULTS ENABLED bit | 0 |
| | | 10 | SENSE DATA ENABLED bit | 1 |
| | | 9 | Reserved | 0 |
| | | 8 | NON-VOLATILE WRITE CACHE bit | 1 |
| | | 7 | READ LOOK-AHEAD ENABLED bit | 1 |
| | | 6 | SMART ENABLED bit | 1 |
| | | 5 | Reserved | 0 |
| | | 4 | Reserved | 0 |
| | | 3 | PUIS ENABLED bit | 0 |
| | | 2 | APM ENABLED bit | 0 |
| | | 1 | FREE-FALL ENABLED bit | 0 |
| | | 0 | WRV ENABLED bit | 0 |
| | 16..23 | Feature Settings (QWord) | | |
| | | 63 | Contents of the QWord are valid | 1 |
| | | 62:18 | Reserved | 0 |
| | | 17:16 | POWER SOURCE field | 0 |
| | | 15:8 | APM LEVEL field | 0 |
| | | 7:0 | WRV MODE field | 0 |
| | 24..31 | DMA Host Interface Sector Times (QWord) | | |
| | | 63 | Contents of the QWord are valid | 1 |
| | | 62:16 | Reserved | 0 |
| | | 15:0 | DMA SECTOR TIME field | 0 |

**Table 25 - IDENTIFY DEVICE Data log *(continued)***

| Page (hex) | QWord Offset (dec) | Bits | Description | Value (hex) |
|---|---|---|---|---|
| | 32..39 | PIO Host Interface Sector Times (QWord) | | |
| | | 63 | Contents of the QWord are valid | 1 |
| | | 62:16 | Reserved | 0 |
| | | 15:0 | PIO SECTOR TIME field | 0 |
| | 40..47 | Streaming Minimum Request Size (QWord) | | |
| | | 63 | Contents of the QWord are valid | 1 |
| | | 62:16 | Reserved | 0 |
| | | 15:0 | STREAM MIN REQUEST SIZE field | 1000H |
| | 48..55 | Streaming Access Latency (QWord) | | |
| | | 63 | Contents of the QWord are valid | 1 |
| | | 62:16 | Reserved | 0 |
| | | 15:0 | STREAM ACCESS LATENCY field | 0 |
| | 56..63 | Streaming Performance Granularity (QWord) | | |
| | | 63 | Contents of the QWord are valid | 1 |
| | | 62:16 | Reserved | 0 |
| | | 15:0 | STREAM GRANULARITY field | 2710H |
| | 64..71 | Free-fall Control Sensitivity (QWord) | | |
| | | 63 | Contents of the QWord are valid | 1 |
| | | 62:16 | Reserved | 0 |
| | | 15:0 | FREE-FALL SENSITIVITY field | 0 |
| | 72..79 | Device Maintenance Schedule (QWord) | | |
| | | 63 | Contents of the QWord are valid | 0 |
| | | 62:58 | Reserved | 0 |
| | | 57:48 | MINIMUM INACTIVE TIME IN MILLISECONDS field | 0 |
| | | 47:32 | TIME SCHEDULED FOR DEVICE MAINTENANCE field | 0 |
| | | 31:16 | TIME TO PERFORMANCE DEGRADATION field | 0 |
| | | 15:0 | MINIMUM INACTIVE TIME field | 0 |
| | 80..87 | Advanced Background Operations Settings (QWord) | | |
| | | 63 | Contents of the QWord are valid | 0 |
| | | 62:8 | Reserved | 0 |
| | | 7:0 | ABO STATUS field | 0 |
| | 88..511 | Reserved | | |
| | | | | |
| 05 | Strings | | | |

**Table 25 - IDENTIFY DEVICE Data log *(continued)***

| Page (hex) | QWord Offset (dec) | Bits | Description | Value (hex) |
|---|---|---|---|---|
| | 0..7 | Supported Capabilities page information header (QWord) | | |
| | | 63 | Shall be set to one | 1 |
| | | 62:24 | Reserved | |
| | | 23:16 | PAGE NUMBER field | 05 |
| | 8..27 | SERIAL NUMBER field (ATA String) | | XXXXXXXXH |
| | 28..31 | Reserved | | |
| | 32..39 | FIRMWARE REVISION field (ATA String) | | XXXXH |
| | 40..47 | Reserved | | |
| | 48..87 | MODEL NUMBER field (ATA String) | | ST32000VE000<br>ST20000VE004<br>ST16000VE005 |
| | 88..95 | Reserved | | |
| | 96..103 | ADDITIONAL PRODUCT IDENTIFIER field (ATA String) | | 0 |
| | 104..511 | Reserved | | |
| | | | | |
| 06 | Security | | | |
| | 0..7 | Security page information header (QWord) | | |
| | | 63 | Shall be set to one | 1 |
| | | 62:24 | Reserved | |
| | | 23:16 | PAGE NUMBER field | 06 |
| | 8..15 | Master password identifier (QWord) | | |
| | | 63 | Contents of the QWord are valid | 1 |
| | | 62:16 | Reserved | 0 |
| | | 15:0 | MASTER PASSWORD IDENTIFIER field | FFFEH |
| | 16..23 | Security Status (QWord) | | |
| | | 63 | Contents of the QWord are valid | 1 |
| | | 62:7 | Reserved | 0 |
| | | 6 | SECURITY SUPPORTED bit | 1 |
| | | 5 | MASTER PASSWORD CAPABILITY bit | 0 |
| | | 4 | ENHANCED SECURITY ERASE SUPPORTED bit | 1 |
| | | 3 | SECURITY COUNT EXPIRED bit | 0 |
| | | 2 | SECURITY FROZEN bit | 0 |
| | | 1 | SECURITY LOCKED bit | 0 |
| | | 0 | SECURITY ENABLED bit | 0 |

**Table 25 - IDENTIFY DEVICE Data log *(continued)***

| Page (hex) | QWord Offset (dec) | Bits | Description | Value (hex) |
|---|---|---|---|---|
| | 24..31 | Time required for an Enhanced Erase mode SECURITY ERASE UNIT command (QWord) | | |
| | | 63 | Contents of the QWord are valid | 1 |
| | | 62:16 | Reserved | 0 |
| | | 15 | ENHANCED SECURITY ERASE TIME FORMAT bit | 1 |
| | | 14:0 | ENHANCED SECURITY ERASE TIME field | Unique per drive |
| | 32..39 | Time required for an Normal Erase mode SECURITY ERASE UNIT command (QWord) | | |
| | | 63 | Contents of the QWord are valid | 1 |
| | | 62:16 | Reserved | 0 |
| | | 15 | NORMAL SECURITY ERASE TIME FORMAT bit | 1 |
| | | 14:0 | NORMAL SECURITY ERASE TIME field | Unique per drive |
| | 40..47 | Trusted Computing Feature Set (QWord) | | |
| | | 63 | Contents of the QWord are valid | 1 |
| | | 62:1 | Reserved | 0 |
| | | 0 | TRUSTED COMPUTING SUPPORTED bit | 0<br>(1, SED drives only) |
| | 48..55 | Security Capabilities (QWord) | | |
| | | 63 | Contents of the QWord are valid | 1 |
| | | 62:7 | Reserved | 0 |
| | | 6 | COMMANDS ALLOWED BY SANITIZE bit | 1 |
| | | 5 | SANITIZE ANTIFREEZE LOCK SUPPORTED bit | 1 |
| | | 4 | BLOCK ERASE SUPPORTED bit | 0 |
| | | 3 | OVERWRITE SUPPORTED bit | 1 |
| | | 2 | CRYPTO SCRAMBLE SUPPORTED bit | 0 |
| | | 1 | SANITIZE SUPPORTED bit | 1 |
| | | 0 | ENCRYPT ALL SUPPORTED bit | 0 |
| | 56..511 | Reserved | | |
| | | | | |
| 07 | Parallel ATA | | | |
| | 000..511 | | (Not supported for SATA drives) | All zeros |
| | | | | |
| 08 | Serial ATA | | | |

**Table 25 - IDENTIFY DEVICE Data log *(continued)***

| Page (hex) | QWord Offset (dec) | Bits | Description | Value (hex) |
|---|---|---|---|---|
| | 0..7 | Serial ATA page information header (QWord) | | |
| | | 63 | Shall be set to one | 1 |
| | | 62:24 | Reserved | |
| | | 23:16 | Page number | 08 |
| | 8..15 | SATA Capabilities | | |
| | | 63 | Shall be set to one | 1 |
| | | 62:32 | Reserved | 0 |
| | | 31 | POWER DISABLE FEATURE ALWAYS ENABLED bit | 0 |
| | | 30 | POWER DISABLE FEATURE SUPPORTED bit | 0 |
| | | 29 | REBUILD ASSIST SUPPORTED bit | 0 |
| | | 28 | DIPM SSP PRESERVATION SUPPORTED bit | 0 |
| | | 27 | HYBRID INFORMATION SUPPORTED bit | 0 |
| | | 26 | DEVSLEEP TO REDUCEDPWRSTATE CAPABILITY SUPPORTED bit | 0 |
| | | 25 | DEVICE SLEEP SUPPORTED bit | 0 |
| | | 24 | NCQ AUTOSENSE SUPPORTED bit | 1 |
| | | 23 | SOFTWARE SETTINGS PRESERVATION SUPPORTED bit | 1 |
| | | 22 | HARDWARE FEATURE CONTROL SUPPORTED bit | 0 |
| | | 21 | IN-ORDER DATA DELIVERY SUPPORTED bit | 0 |
| | | 20 | DEVICE INITIATED POWER MANAGEMENT SUPPORTED bit | 0 |
| | | 19 | DMA SETUP AUTO-ACTIVATION SUPPORTED bit | 1 |
| | | 18 | NONZERO BUFFER OFFSETS SUPPORTED bit | 0 |
| | | 17 | SEND AND RECEIVE QUEUED COMMANDS SUPPORTED bit | 1 |
| | | 16 | NCQ QUEUE MANAGEMENT COMMAND SUPPORTED bit | 0 |
| | | 15 | NCQ STREAMING SUPPORTED bit | 0 |
| | | 14 | READ LOG DMA EXT AS EQUIVALENT TO READ LOG EXT SUPPORTED bit | 1 |
| | | 13 | DEVICE AUTOMATIC PARTIAL TO SLUMBER TRANSITIONS SUPPORTED bit | 0 |
| | | 12 | HOST AUTOMATIC PARTIAL TO SLUMBER TRANSITIONS SUPPORTED bit | 0 |
| | | 11 | NCQ PRIORITY INFORMATION SUPPORTED bit | 0 |
| | | 10 | UNLOAD WHILE NCQ COMMANDS ARE OUTSTANDING SUPPORTED bit | 1 |
| | | 9 | SATA PHY EVENT COUNTERS LOG SUPPORTED bit | 1 |
| | | 8 | RECEIPT OF HOST INITIATED POWER MANAGEMENT REQUESTS SUPPORTED bit | 0 |
| | | 7 | NCQ FEATURE SET SUPPORTED bit | 1 |
| | | 6:3 | Reserved | 0 |

**Table 25 - IDENTIFY DEVICE Data log *(continued)***

| Page (hex) | QWord Offset (dec) | Bits | Description | Value (hex) |
|---|---|---|---|---|
| | 8..15 (cont.) | 2 | SATA GEN3 SIGNALING SPEED SUPPORTED bit | 1 |
| | | 1 | SATA GEN2 SIGNALING SPEED SUPPORTED bit | 1 |
| | | 0 | SATA GEN1 SIGNALING SPEED SUPPORTED bit | 1 |
| | 16..23 | Current SATA Settings (QWord) | | |
| | | 63 | Shall be set to one | 1 |
| | | 62:14 | Reserved | 0 |
| | | 13 | HYBRID ENABLED bit | 0 |
| | | 12 | REBUILD ASSIST ENABLED bit | 0 |
| | | 11 | POWER DISABLE FEATURE ENABLED bit | 0 |
| | | 10 | DEVICE SLEEP ENABLED bit | 0 |
| | | 9 | AUTOMATIC PARTIAL TO SLUMBER TRANSITIONS ENABLED bit | 0 |
| | | 8 | SOFTWARE SETTINGS PRESERVATION ENABLED bit | 1 |
| | | 7 | HARDWARE FEATURE CONTROL IS ENABLED bit | 0 |
| | | 6 | IN-ORDER DATA DELIVERY ENABLED bit | 0 |
| | | 5 | DEVICE INITIATED POWER MANAGEMENT ENABLED bit | 0 |
| | | 4 | DMA SETUP AUTO-ACTIVATION ENABLED bit | 1 |
| | | 3 | NONZERO BUFFER OFFSETS ENABLED bit | 0 |
| | | 2:0 | CURRENT NEGOTIATED SERIAL ATA SIGNAL SPEED field | (6.0, 3.0, 1.5) Gb/s |
| | 24..39 | Reserved | | |
| | 40..41 | CURRENT HARDWARE FEATURE CONTROL IDENTIFIER field (Word) | | |
| | 42..43 | SUPPORTED HARDWARE FEATURE CONTROL IDENTIFIER field (Word) | | |
| | 44..47 | Reserved | | |
| | 48..55 | Device Sleep Timing Variables (QWord) | | |
| | | 63 | DEVSLP TIMING VARIABLES SUPPORTED bit | 0 |
| | | 62:16 | Reserved | 0 |
| | | 15:8 | DEVSLEEP EXIT TIMEOUT field (DETO) | 0 |
| | | 7:5 | Reserved | 0 |
| | | 4:0 | MINIMUM DEVSLP ASSERTION TIME field (MDAT) | 0 |
| | 56..511 | Reserved | | |
| | | | | |

## 4.3.3 Device Statistics log

The Device Statistics log (log 04H) transfers information about the drive. The data is organized as a set of 512-byte blocks of data, whose contents are shown in Table 26, *Device Statistics log*. 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.

The following may contain drive-specific features that are included in the SATA specifications.

**Table 26 - Device Statistics log**

| Page (hex) | Statistic | Supported |
|---|---|---|
| 00 | List of supported log pages | Yes |
| 01 | General Statistics | |
| | Lifetime Power-on Resets | Yes |
| | Power-on Hours | Yes |
| | Logical Sectors Written | Yes |
| | Number of Write Commands | Yes |
| | Logical Sectors Read | Yes |
| | Number of Read Commands | Yes |
| | Pending Error Count | Yes |
| | Workload Utilization | No |
| | Utilization Usage Rate | No |
| | Resource Availability | No |
| | Random Write Resources Used | No |
| 02 | Free Fall Statistics | |
| | Number of Free-Fall Events Detected | No |
| | Overlimit Shock Events | No |
| 03 | Rotating Media Statistics | |
| | Spindle Motor Power-on Hours | Yes |
| | Head Flying Hours | Yes |
| | Head Loaded Events | Yes |
| | Number of Reallocated Logical Sectors | Yes |
| | Read Recovery Attempts | Yes |
| | Number of Mechanical Start Failures | Yes |
| | Number of Reallocation Candidate Logical Sectors | Yes |
| | Number of High Priority Unload Events | Yes |
| 04 | General Errors Statistics | |
| | Number of Reported Uncorrectable Errors | Yes |
| | Number of Resets Between Command Acceptance and Command Completion | Yes |
| | Physical Element Status Changed | Yes |

**Table 26 - Device Statistics log *(continued)***

| Page (hex) | Statistic | Supported |
|---|---|---|
| 05 | Temperature Statistics | |
| | Current Temperature | Yes |
| | Average Short Term Temperature | Yes |
| | Average Long Term Temperature | Yes |
| | Highest Temperature | Yes |
| | Lowest Temperature | Yes |
| | Highest Average Short Term Temperature | Yes |
| | Lowest Average Short Term Temperature | Yes |
| | Highest Average Long Term Temperature | Yes |
| | Lowest Average Long Term Temperature | Yes |
| | Time in Over-Temperature | Yes |
| | Specified Maximum Operating Temperature | Yes |
| | Time in Under-Temperature | Yes |
| | Specified Minumum Operating Temperature | Yes |
| 06 | Transport Statistics | |
| | Number of Hardware Resets | Yes |
| | Number of ASR Events | Yes |
| | Number of Interface CRC Errors | Yes |
| 07 | Solid State Device Statistics | |
| | Percentage Used Endurance Indicator | No |
| 08 | Zoned Device Statistics | |
| | Maximum Open Zones | No |
| | Maximum Explicitly Open Zones | No |
| | Maximum Implicitly Open Zones | No |
| | Minimum Empty Zones | No |
| | Maximum Non Sequential Zones | No |
| | Zones Emptied | No |
| | Suboptimal Write Commands | No |
| | Commands Exceeding Optimal Limit | No |
| | Failed Explicit Opens | No |
| | Read Rule Violations | No |
| | Write Rule Violations | No |
| 09..FE | Reserved | |
| FF | Vendor Specific Statistics | |

### 4.3.4 SET FEATURES command

The SET FEATURES 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 27 - Set Features command values**

| Value | Command | |
|---|---|---|
| 02H | Enable write cache (default) | |
| 03H | Set transfer mode (based on value in Sector Count register).<br>Sector Count register values: | |
| | Value | Mode |
| | 00H | Set PIO mode to default (PIO mode 2) |
| | 01H | Set PIO mode to default and disable IORDY (PIO mode 2) |
| | 08H | PIO mode 0 |
| | 09H | PIO mode 1 |
| | 0AH | PIO mode 2 |
| | 0BH | PIO mode 3 |
| | 0CH | PIO mode 4 (default) |
| | 20H | Multiword DMA mode 0 |
| | 21H | Multiword DMA mode 1 |
| | 22H | Multiword DMA mode 2 |
| | 40H | Ultra DMA mode 0 |
| | 41H | Ultra DMA mode 1 |
| | 42H | Ultra DMA mode 2 |
| | 43H | Ultra DMA mode 3 |
| | 44H | Ultra DMA mode 4 |
| | 45H | Ultra DMA mode 5 |
| | 40H | Ultra DMA mode 6 |
| 10H | Enable use of SATA features | |
| 55H | Disable read look-ahead (read cache) feature | |
| 82H | Disable write cache | |
| 90H | Disable use of SATA features | |
| AAH | Enable read look-ahead (read cache) feature (default) | |
| F1H | 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.

### 4.3.5 SMART commands

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

SeaTools diagnostic software activates a built-in drive self-test (DST SMART command for D4H) that eliminates unnecessary drive returns. The diagnostic software ships with all new drives and is also available at www.seagate.com/support/downloads/seatools.

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

**Table 28 - SMART commands**

| Code in features register | SMART command |
|---|---|
| D0H | SMART Read Data |
| D2H | SMART Enable/Disable Attribute Autosave |
| D3H | SMART Save Attribute Values |
| D4H | SMART Execute Off-line Immediate (runs DST) |
| D5H | SMART Read Log Sector |
| D6H | SMART Write Log Sector |
| D8H | SMART Enable Operations |
| D9H | SMART Disable Operations |
| DAH | SMART 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 47488 Kato Road, Fremont, California 94538, United States, 510-661-1000*
*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 (Netherlands) B.V. Koolhovenlaan 1, 1119 NB Schiphol-Rijk, Netherlands, 31-20-316-7300*
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