Seagate® Exos® M SATA

Product Manual

512E* Models Instant Secure Erase

ST32000NM004K

ST30000NM004K

ST28000NM003K

ST24000NM001K

* Default configuration is 512E

See Section 2.2.1 *Fast Format - logical sectors size conversion* for Fast Formatting between 4KN and 512E configurations

210048100, Rev C
March 2025

Revision History

Version and Date	Description of Changes
Rev A, December 2024	Initial release of the document.
Rev B, January 2025	MTBF corrected to 2,500,000.
Rev C, March 2025	ST32000NM004K added. Operating shock corrected to 30 g. SET SECTOR CONFIGURATION SUPPORTED bit set to 1. DEPOPULATION TIME field set to unique.

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1. Introduction

This manual describes the functional, mechanical, and interface specifications for the following: Seagate® Exos® M SATA drive models.

Table 1 - 512E ISE Models

512E ISE Models
ISE
ST32000NM004K
ST30000NM004K
ST28000NM003K
ST24000NM001K

These drives provide the following key features:

- 7200 RPM spindle speed.
- 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.
- Heat Assisted Magnetic Recording (HAMR).
- SeaTools™ diagnostic software performs a drive self-test that eliminates unnecessary drive returns.
- 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.
- T13 Fast Format conversion (see Section 2.2.1 *Fast Format - logical sectors size conversion*).
- 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.

The Self-Encrypting Drive models indicated on the cover of this product manual have provisions for "Security of Data at Rest" based on the standards defined by the Trusted Computing Group (see www.trustedcomputinggroup.org).

2. Drive specifications

Unless otherwise noted, all specifications are measured under ambient conditions and nominal power. For convenience, the phrases the drive and this drive are used throughout this manual to indicate the Seagate Exos M 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 specifications summary

Drive specification	ST32000NM004K	ST30000NM004K	ST28000NM003K	ST24000NM001K
Formatted (512 bytes/sector) *	32TB	30TB	28TB	24TB
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			
Track density, KTPI (ktracks/in avg)	738			
Areal density, (Gb/in^2 avg)	1841			
Spindle speed (RPM)	7200			
Internal data transfer rate (Mb/s max)	2852			
Sustained transfer rate OD (MB/s)	285	275	270	240
I/O data-transfer rate (MB/s max)	600			
ATA data-transfer modes supported	PIO modes 0–4 Multiword DMA modes 0–2 Ultra DMA modes 0–6			
Cache buffer	512MB			
Weight: (maximum)	695g (1.532 lb)			
Average latency	4.16ms			
Power-on to ready (sec) (typ/max)	30/60			
Standby to ready (sec) (typ/max)	30/60			
Startup current (typical) 12V (peak)	2.6A 2.0A (optional configuration through SMART Command Transport)			
Voltage tolerance (including noise)	5V ± 5% 12V ± 10%			
Operating temperature	10 to 60°C (Drive Reported Temperature)			
Non-Operating temperature	–40° 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) 20°C (non-operating)			
Relative humidity **	5% to 95% (operating) 5% to 95% (non-operating)			

Table 2 - Drive specifications summary *(continued)*

Drive specification	ST32000NM004K	ST30000NM004K	ST28000NM003K	ST24000NM001K
Relative humidity gradient	20% per hour max			
Altitude, operating	–304.8 m to 3,048 m (–1000 ft to 10,000+ ft)			
Altitude, nonoperating (below mean sea level, max)	–304.8 m to 12,192 m (–1000 ft to 40,000+ ft)			
Operational Shock (2 ms)	30 *g*			
Non-Operational 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) 3.0 (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.			
Performance seek	3.2 (typical) 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 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 https://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	Bytes per physical sector
ST32000NM004K	32TB	62,501,421,056	512 (Default)	4096 (see Section 2.2.1)
ST30000NM004K	30TB	58,594,426,880		
ST28000NM003K	28TB	54,689,529,856		
ST24000NM001K	24TB	46,875,541,504		

* 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.

2.2.1 Fast Format - logical sectors size conversion

- Drive supports either 512E or 4KN logical sector size formats
- SET SECTOR CONFIGURATION EXT (B2h) command (ACS-4 Standard) quickly converts between 512 and 4096 byte logical sector size formats
- The selected sector size change occurs immediately upon command completion
- Default shipping format is 512E

Table 4 - SET SECTOR CONFIGURATION EXT command inputs

Field	Description
FEATURE	COMMAND CHECK field
COUNT	Bit Description
	15 : 3 Reserved
	2:0 SECTOR CONFIGURATION DESCRIPTOR INDEX field
LBA	Reserved
DEVICE	Bit Description 7 Obsolete 6 N/A 5 Obsolete 4 Transport Dependent 3:0 Reserved
COMMAND	7:0 B2h

- COMMAND CHECK field value is taken from the DESCRIPTOR CHECK field in the descriptor specified by the SECTOR CONFIGURATION DESCRIPTOR INDEX field
- SECTOR CONFIGURATION DESCRIPTOR INDEX field specifies the Sector Configuration descriptor in the Set Sector Configuration log page

2.2.1.1 Sector Configuration log (Log Address 2Fh)

The Sector Configuration log contains Sector Configuration descriptors. The Sector Configuration descriptors describe sector configurations. The sector configuration is specified using the SET SECTOR CONFIGURATION EXT command.

Table 5 - Sector Configuration descriptors page format (log page 00h)

Offset	Type	Description
0...15	Bytes	Sector Configuration descriptor 0
16...31	Bytes	Sector Configuration descriptor 1
... ...		
112...127	Bytes	Sector Configuration descriptor 7
128...511	Bytes	Reserved

Table 6 - Sector Configuration descriptors format

Offset	Type	Description
0	Byte	Sector Configuration descriptor flags
		Bit Description 7 DESCRIPTOR VALID bit 6:0 Reserved
1	Byte	LOGICAL TO PHYSICAL SECTOR RELATIONSHIP SETTING field
2...3	Word	DESCRIPTOR CHECK field
4...7	DWord	LOGICAL SECTOR SIZE SETTING field
8...15	Bytes	Reserved

2.2.2 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 5.3.1 *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 7 - Recording and interface technology

Interface	Serial ATA (SATA)
Recording method	CMR
Recording density, KBPI (Kb/in max)	2470
Track density, KTPI (ktracks/in avg)	738
Areal density (Gb/in2 avg)	1841
Spindle speed (RPM) (± 0.2%)	7200
Internal data transfer rate (Mb/s max)	2852
Sustained data transfer rate (MB/s max)	
32TB	285
30TB	275
28TB	270
24TB	240
I/O data-transfer rate (MB/s max)	600 (Ultra DMA mode 5)

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 8 - Start/stop times

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

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 23.

2.5.1 Power consumption

Power requirements for the drives are listed in the tables below. 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.

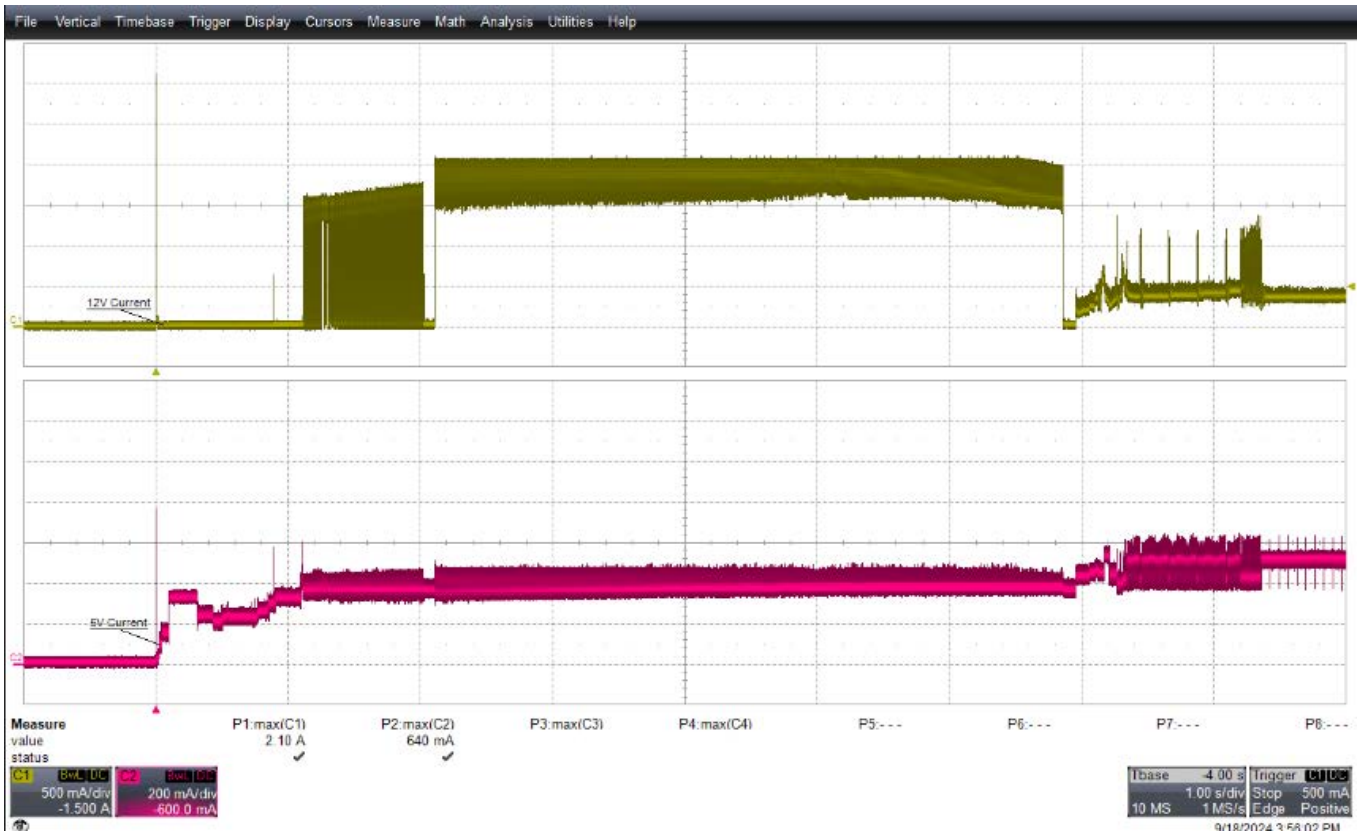
Table 9 - DC power requirements (32/30/28/24TB models)

Workload Mode		6.0Gb mode		
Voltage		+5V	+12V	Watts
Regulation		± 5%	± 10%	Total
Avg Idle Current *		0.331	0.434	6.763
Advanced Idle Current *				
	Idle_A	0.312	0.428	6.696
	Idle_B	0.249	0.240	4.125
	Idle_C	0.248	0.158	3.136
	Standby	0.208	0.013	1.196
Maximum Start Current				
	DC (peak DC)	0.852	2.180	
	AC (Peak DC)	0.960	2.400	
	Delayed motor start (max) DC	0.454	0.812	
Operating current (random read 4K16Q):				
	Typical DC	0.337	0.632	9.269
	Maximum DC	0.340	0.637	
	Maximum DC (peak)	0.865	2.429	
Operating current (random write 4K16Q)				
	Typical DC	0.451	0.506	8.327
	Maximum DC	0.454	0.514	
	Maximum DC (peak)	0.991	2.360	
Operating current (sequential read 64K16Q)				
	Typical DC	0.632	0.405	8.020
	Maximum DC	0.638	0.412	
	Maximum DC (peak)	1.015	2.386	
Operating current (sequential write 64K16Q)				
	Typical DC	0.821	0.402	8.929
	Maximum DC	0.827	0.408	
	Maximum DC (peak)	1.041	0.550	

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
450 mV pp from 8 KHz to 20 KHz
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 in the table, the more power savings is actualized. For example, Idle_b results in greater power savings than the Idle_a power condition. Standby results in the greatest power savings.

Table 10 - 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 value less than the specified minimum timer value threshold will result in an aborted EPC "Set Power Condition Timer" subcommand.

Table 11 - PowerChoice default timer values

Power Condition Name	Default Timer Values
Idle_a	100 ms
Idle_b	2 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 this products reliability and data integrity.

PowerChoice supported extended power condition feature subcommands

Table 12 - 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 13 - 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 14 - Temperature ranges (operating/non-operating)

Operating	50 to 140°F (10 to 60°C drive reported) temperature range with a maximum temperature gradient of 36°F (20°C) per hour as reported by the drive. The maximum allowable drive reported temperature is 140°F (60°C). 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° to 158°F (–40° 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 15 - 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 16 - Effective altitude (sea level)

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

2.6.4 Shock and Vibration

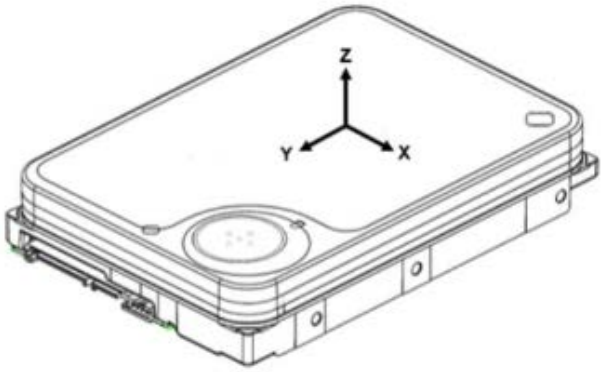
Shock and vibration measurements specified in this document are made directly on the drive itself and applied in the X, Y, and Z axis at the drive mounting point locations.

2.6.4.1 Shock

Table 17 - Shock

Operating	The drive will operate 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 18 - Linear random operating vibration

PSD OF 5-500 Hz random noise at 0.70 g rms					
Frequency (Hz)	5	20	200	250	500
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 19 - Random rotary operating vibration

PSD OF 20-1500 Hz at 12.5 rad/sec^2				
Frequency (Hz)	20	200	800	1500
(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 20 - Linear random non-operating vibration

PSD Profile 2-500 Hz at 2.27 Grms				
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 21 - Fluid Dynamic Bearing (FDB) motor acoustics

	Idle*	Performance seek
All models	2.8 bels (typ) 3.0 bels (max)	3.2 bels (typ) 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 22 - 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, 80% AM with 1 kHz sine 900 MHz, 3 V/m, 50% pulse modulation @ 200 Hz	A	EN 61000-4-3: 96 ENV 50204: 95
Electrical fast transient	± 1 kV on AC mains, ± 0.5 kV on external I/O	B	EN 61000-4-4: 95
Surge immunity	± 1 kV differential, ± 2 kV common, AC mains	B	EN 61000-4-5: 95
Conducted RF immunity	150 kHz to 80 MHz, 3 Vrms, 80% AM with 1 kHz sine	A	EN 61000-4-6: 97
Voltage dips, interrupts	0% open, 5 seconds 0% short, 5 seconds 40%, 0.10 seconds 70%, 0.01 seconds	C C C B	EN 61000-4-11: 94

2.9 Reliability

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

The production disk drive shall achieve 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 to <= 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 drive MTBF and reduce product reliability.

Non-recoverable read errors	1 per 1015 bits read, max
Load unload cycles	600,000 cycles

Maximum Rated Workload	Maximum rate of <550TB/year Workloads exceeding the annualized rate may degrade 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 https://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, see www.seagate.com/support. Scroll down the page and click 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 Numbers: 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 https://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.

2.13.4 Immersion Cooling Environments

Seagate hard disk drive (HDD) is designed to operate within specified environmental conditions to ensure optimal performance and reliability. While the product has been rigorously tested and validated under various scenarios, it is essential to note that immersion cooling environments are not currently supported on Seagate Exos M series drives.

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. • Handle the drive by its edges or frame only. • The drive is extremely fragile—handle it with care. Do not press down on the 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 Serial ATA cables and connectors

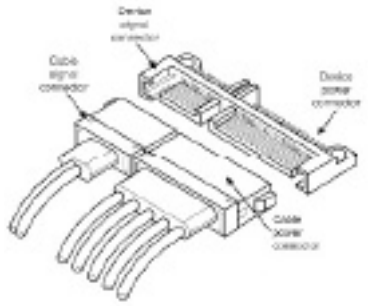
The Serial ATA interface cable consists of four conductors in two differential pairs, plus three ground connections. The cable size may be 30 to 26 AWG with a maximum length of one meter (39.37 in).

See Table 24, *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 Exos M 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*, on page 25 for drive mounting dimensions. Follow these important mounting precautions when mounting the drive:

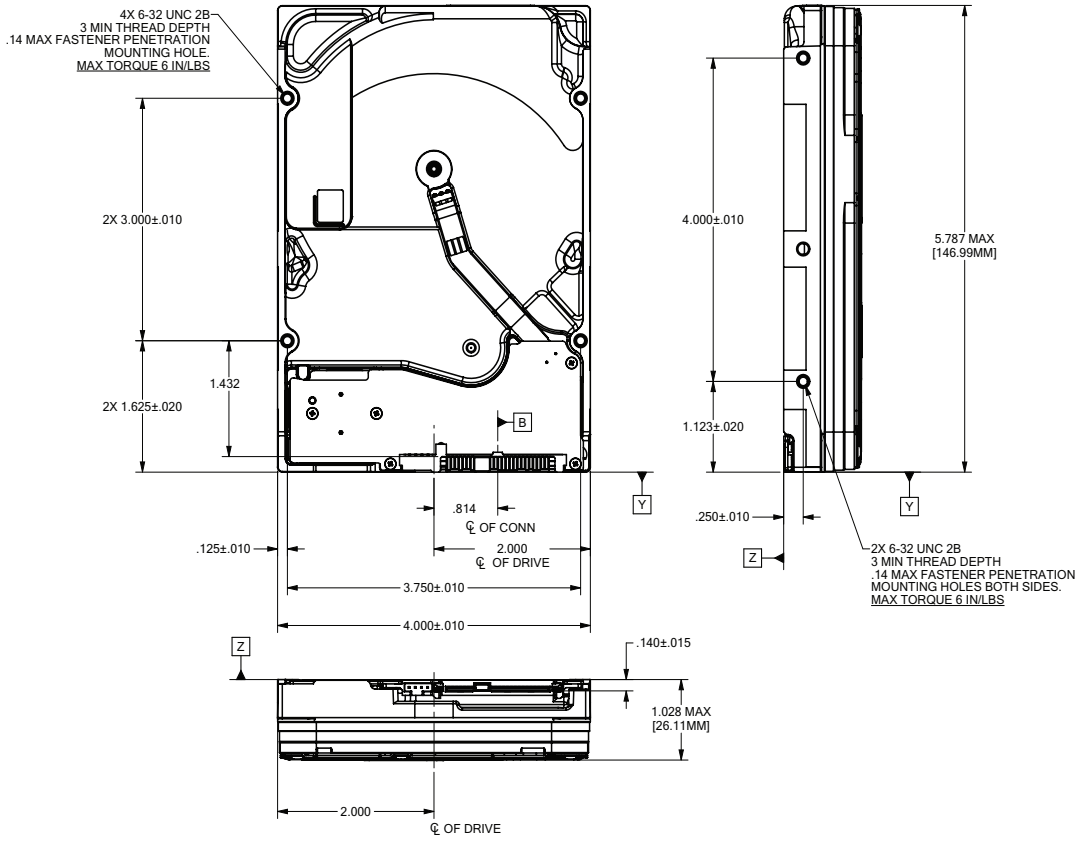
- Allow a minimum clearance of 0.030 in (0.76mm) around the entire perimeter of the drive for cooling.
- Use only 6-32 UNC mounting screws.
- The screws should be inserted no more than 0.140 in (3.56mm) into the bottom or side mounting holes.
- Do not overtighten the mounting screws (maximum torque: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

3.3.1 Mechanical specifications

Refer to Figure 4, *Mounting configuration dimensions*, on page 25 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 23 - Weight

Capacity	Weight (lb/g)
32TB	1.532/695
30TB	
28TB	
24TB	

4. About self-encrypting drives

Self-encrypting drives (SEDs) offer encryption and security services for the protection of stored data, commonly known as “protection of data at rest.” These drives are compliant with the Trusted Computing Group (TCG) Enterprise Storage Specifications as detailed in Section 2.12.

The Trusted Computing Group (TCG) is an organization sponsored and operated by companies in the computer, storage and digital communications industry. Seagate’s SED models comply with the standards published by the TCG.

To use the security features in the drive, the host must be capable of constructing and issuing the following two ATA commands:

- Trusted Send
- Trusted Receive

These commands are used to convey the TCG protocol to and from the drive in their command payloads.

4.1 Data encryption

Encrypting drives use one inline encryption engine for each port, employing AES-256 bit data encryption keys with AES-XTS mode to encrypt all data prior to being written on the media and to decrypt all data as it is read from the media. The encryption engines are always in operation and cannot be disabled.

The 32-byte Data Encryption Key (DEK) is a random number which is generated by the drive, never leaves the drive, and is inaccessible to the host system. The DEK is itself encrypted when it is stored on the media and when it is in volatile temporary storage (DRAM) external to the encryption engine. A unique data encryption key is used for each of the drive's possible 32 data bands (see Section 4.5 *Data bands*).

4.2 Controlled access

The drive has two security providers (SPs) called the "Admin SP" and the "Locking SP." These act as gatekeepers to the drive security services. Security-related commands will not be accepted unless they also supply the correct credentials to prove the requester is authorized to perform the command.

4.2.1 Admin SP

The Admin SP allows the drive's owner to enable or disable firmware download operations (see Section 4.4 *Drive locking*). Access to the Admin SP is available using the SID (Secure ID) password or the MSID (Manufacturers Secure ID) password.

4.2.2 Locking SP

The Locking SP controls read/write access to the media and the cryptographic erase feature. Access to the Locking SP is available using the BandMasterX or EraseMaster passwords. Since the drive owner can define up to 16 data bands on the drive, each data band has its own password called BandMasterX where X is the number of the data band (0 through 15).

4.2.3 Default password

When the drive is shipped from the factory, all passwords are set to the value of MSID. This 32-byte random value can only be read by the host electronically over the interface. After receipt of the drive, it is the responsibility of the owner to use the default MSID password as the authority to change all other passwords to unique owner-specified values.

4.3 Random number generator (RNG)

The drive has a 32-byte hardware RNG that it is uses to derive encryption keys or, if requested to do so, to provide random numbers to the host for system use, including using these numbers as Authentication Keys (passwords) for the drive's Admin and Locking SPs.

4.4 Drive locking

In addition to changing the passwords, as described in Section 4.2.3 *Default password*, the owner should also set the data access controls for the individual bands.

The variable "LockOnReset" should be set to "PowerCycle" to ensure that the data bands will be locked if power is lost. In addition "ReadLockEnabled" and "WriteLockEnabled" must be set to true in the locking table in order for the bands "LockOnReset" setting of "PowerCycle" to actually lock access to the band when a "PowerCycle" event occurs. This scenario occurs if the drive is removed from its cabinet. The drive will not honor any data read or write requests until the bands have been unlocked. This prevents the user data from being accessed without the appropriate credentials when the drive has been removed from its cabinet and installed in another system.

When the drive is shipped from the factory, the firmware download port is unlocked.

4.5 Data bands

When shipped from the factory, the drive is configured with a single data band called Band 0 (also known as the Global Data Band) which comprises LBA 0 through LBA max. The host may allocate Band1 by specifying a start LBA and an LBA range. The real estate for this band is taken from the Global Band. An additional 30 Data Bands may be defined in a similar way (Band2 through Band31), but before these bands can be allocated LBA space, they must first be individually enabled using the EraseMaster password.

Data bands cannot overlap but they can be sequential with one band ending at LBA (x) and the next beginning at LBA (x+1).

Each data band has its own drive-generated encryption key and its own user-supplied password. The host may change the Encryption Key (see Section 4.6 *Cryptographic erase*) or the password when required. The bands should be aligned to 4K LBA boundaries.

4.6 Cryptographic erase

A significant feature of SEDs is the ability to perform a cryptographic erase. This involves the host telling the drive to change the data encryption key for a particular band. Once changed, the data is no longer recoverable since it was written with one key and will be read using a different key. Since the drive overwrites the old key with the new one, and keeps no history of key changes, the user data can never be recovered. This is tantamount to an instantaneous data erase and is very useful if the drive is to be scrapped or re-dispositioned.

4.7 Authenticated firmware download

In addition to providing a locking mechanism to prevent unwanted firmware download attempts, the drive also only accepts download files which have been cryptographically signed by the appropriate Seagate Design Center.

Three conditions must be met before the drive will allow the download operation:

1. The download must be an SED file. A standard (base) drive (non-SED) file will be rejected.
2. The download file must be signed and authenticated.
3. As with a non-SED drive, the download file must pass the acceptance criteria for the drive. For example it must be applicable to the correct drive model, and have compatible revision and customer status.

4.8 Power requirements

The standard drive models and the SED drive models have identical hardware, however the security and encryption portion of the drive controller ASIC is enabled and functional in the SED models. This represents a small additional drain on the 5V supply of about 30mA and a commensurate increase of about 150mW in power consumption. There is no additional drain on the 12V supply. See the tables in Section 2.5 *Power specifications* for power requirements on the standard (non-SED) drive models.

4.9 Supported commands

The SED models support the following two commands in addition to the commands supported by the standard (non-SED) models as listed in Table 25, *Supported ATA commands*:

- Trusted Send (5Eh) or Trusted Send DMA (5Fh)
- Trusted Receive (5Ch) or Trusted Receive DMA (5D)

4.10 RevertSP

SED models will support the RevertSP feature which erases all data in all bands on the device and returns the contents of all SPs (Security Providers) on the device to their original factory state. In order to execute the RevertSP method the unique PSID (Physical Secure ID) printed on the drive label must be provided. PSID is not electronically accessible and can only be manually read from the drive label or scanned in via the 2D barcode.

4.10.1 ATA Security Erase Unit Command on SED SATA drives

The ATA SECURITY ERASE UNIT command supports both the Normal and Enhanced erase modes with the following modifications/additions:

Normal Erase	Normal erase is accomplished by changing the media encryption key for the drive followed by an overwrite operation that repeatedly writes a single sector containing random data to the entire drive. The write operation bypasses the media encryption. On reading back the overwritten sectors, the host will receive a decrypted version, using the new encryption key, of the random data sector (the returned data will not match what was written).
Enhanced Erase	Enhanced erase shall be accomplished by changing the media encryption key for the drive.

4.10.2 Sanitize Device - CRYPTO SCRAMBLE EXT

This command cryptographically erases all user data on the drive by destroying the current data encryption key and replacing it with a new data encryption key randomly generated by the drive. Sanitize Device is a command field B4h and Feature field 0011h (CRYPTO SCRAMBLE EXT).

The drive supports the Sanitize Feature Set as defined in ANSI/INCITS ACS-2 with the exceptions and/or modifications described in this section.

Support of the SANITIZE FREEZE LOCK EXT command is determined on a customer-specific basis. OEM drives support the command.

5. 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.

5.1 Hot-Plug compatibility

Seagate Exos M 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.

5.2 Serial ATA device plug connector pin definitions

Table 24, *Serial ATA connector pin definitions* summarizes the signals on the Serial ATA interface and power connectors.

Table 24 - 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 24 - Serial ATA connector pin definitions *(continued)*

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 inch) pitch.
2. The comments on the mating sequence apply to the case of backplane blind mate 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.

5.3 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 5.3.5 *SMART commands* for details and subcommands used in the SMART implementation.

Table 25 - Supported ATA commands

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 25 - Supported ATA commands *(continued)*

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 25 - Supported ATA commands *(continued)*

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

5.3.1 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 specifications summary*. 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 26 - 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	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)	ST32000NM004K ST30000NM004K ST28000NM003K ST24000NM001K
47	(Bits 7–0) Maximum sectors per interrupt on Read multiple and Write multiple (16)	8001H (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 (Bit 14: 1) Overwrite Ext Supported - Y (Bit 13: X) Crypto Scramble Ext Supported (SED Only) - N (Bit 12: 1) Sanitize feature set supported - Y (Bit 11: 1) Commands allowed during sanitize op as specified in ACS-3 - Y (Bit 10: 1) Sanitize Antifreeze Lock Ext command supported - Y	7D01H (512E) / 5D02H (4KN)

Table 26 - Identify Device command *(continued)*

Word	Description	Value
60–61	Total number of user-addressable LBA sectors available (see Section 2.2 for related information) *Note: The maximum value allowed in this field is: 0FFFFFFFh (268,435,455 sectors, 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
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	001CH
70–74	ATA-reserved	0000H
75	Queue depth	001FH
76	Serial ATA capabilities	950EH
77	(Bit 6:1) Send/Receive FPDMA Queued Commands Supported	004xH
78	Serial ATA features supported	xxCCH
79	Serial ATA features enabled	0040H
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)	4173H
85	Command sets enabled	3069H
86	Command sets enabled	B441H
87	Command sets enable extension	4173H
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. These words are required for drives that support the 48-bit addressing feature. Maximum value: 0000FFFFFFFFFFFFh.	(see Section 2.2 *Formatted capacity*)

Table 26 - Identify Device command *(continued)*

Word	Description	Value
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. 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	47DEH
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
168	Device Nominal Form Factor	3.5“
169–205	ATA-reserved	0000H
206	SCT Command Transport command set. If bit 0 is set to one, then the device supports SCT Command Transport. 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 2.2)
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 27 - 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 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.
	11-12	Reserved for TLC.
	13	IDLE IMMEDIATE command with IUNLOAD feature is supported.
	14	Shall be set to 1.
	15	Shall be cleared to 0.
	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.

5.3.2 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 28, *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 28 - 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
	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		Page number of the last supported ID data log page	09
	19..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

Table 28 - Identify Device Data log *(continued)*

Page (hex)	QWord Offset (dec)	Bits	Description	Value (hex)
	8..15	Device Capacity (QWord)		
		63	Shall be set to one	1
		62:48	Reserved	0
		47:0	Accessible capacity	(see Section 2.2)
	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	0 (512E) / 1 (4KN)
		60:22	Reserved	0
		19:16	Logical to physical sector relationship	3 (512E) / 0 (4KN)
		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			
	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	Reserved	0
		61	TERMINIATE DEPOP ON POR field	0
		60	SETTING USER DATA INITIALIZATION SUPPORTED bit	0
		59	POWER CONSUMPTION CONTROL SUPPORTED bit	0
		58	ENABLE CHANGE IDENTIFY STRINGS SUPPORTED bit	0
		57	WRITE GATHERED EXT SUPPORTED bit	0
		56	NON-NCQ REBUILD ASSIST SUPPORTED bit	0
		55	MUTATE EXT SUPPORTED bit	0

Table 28 - Identify Device Data log *(continued)*

Page (hex)	QWord Offset (dec)	Bits	Description	Value (hex)
	8..15 (cont.)	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
		25	READ LOOK-AHEAD SUPPORTED bit	1
		24	VOLATILE WRITE CACHE SUPPORTED bit	1
		23	SMART bit	1

Table 28 - Identify Device Data log *(continued)*

Page (hex)	QWord Offset (dec)	Bits	Description	Value (hex)
	8..15 (cont.)	22	FLUSH CACHE EXT SUPPORTED bit	1
		21	Reserved	0
		20	48-BIT SUPPORTED bit	1
		19	Reserved	1
		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	0
		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 28 - 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 28 - 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	0
		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

Table 28 - Identify Device Data log *(continued)*

Page (hex)	QWord Offset (dec)	Bits	Description	Value (hex)
	112..119	Supported ZAC Capabilities (QWord)		
		63	Contents of the QWord are valid	0
		62:10	Reserved	0
		9	ZONE COUNT FOR CLOSE SUPPORTED bit	0
		8	ZONE COUNT FOR OPEN SUPPORTED bit	0
		7	ZONE COUNT FOR FINISH SUPPORTED bit	0
		6	ZONE COUNT FOR RWP SUPPORTED bit	0
		5	SEQUENTIALIZE ZONE EXT SUPPORTED bit	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
	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

Table 28 - Identify Device Data log *(continued)*

Page (hex)	QWord Offset (dec)	Bits	Description	Value (hex)
	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
	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 9.10.5.18)	unique
	168..175	Command Duration Limit Supported bits (QWord)		
		63	Contents of the 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

Table 28 - Identify Device Data log *(continued)*

Page (hex)	QWord Offset (dec)	Bits	Description	Value (hex)
	176..183	Command Duration Limit Minimum Time Limit (QWord)		
		63	Contents of the 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 the 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			
	0..7	Current Settings page information header (QWord)		
		63	Shall be set to one	1
		62:24	Reserved	0
		23:16	Page number	04

Table 28 - Identify Device Data log *(continued)*

Page (hex)	QWord Offset (dec)	Bits	Description	Value (hex)
	8..15	Current Settings (QWord)		
		63	Shall be set to one	1
		62:23	Reserved	0
		22	HIGH PRIORITY ENHANCEMENT ENABLED bit	0
		21	COMMAND DURATION LIMITS ENABLED bit	0
		20	ROUNDING BEHAVIOR bit	0
		19	FW ACTIVATION PENDING bit	0
		18	SUCCESSFUL NCQ COMMAND SENSE DATA ENABLED bit	1
		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

Table 28 - Identify Device Data log *(continued)*

Page (hex)	QWord Offset (dec)	Bits	Description	Value (hex)
	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
	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	0001H
	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

Table 28 - Identify Device Data log *(continued)*

Page (hex)	QWord Offset (dec)	Bits	Description	Value (hex)
	88..511	Reserved		
05	Strings			
	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)		ST32000NM004K ST30000NM004K ST28000NM003K ST24000NM001K
	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

Table 28 - Identify Device Data log *(continued)*

Page (hex)	QWord Offset (dec)	Bits	Description	Value (hex)
	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
	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	0
		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 (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	1
		1	SANITIZE SUPPORTED bit	1
		0	ENCRYPT ALL SUPPORTED bit	1

Table 28 - Identify Device Data log *(continued)*

Page (hex)	QWord Offset (dec)	Bits	Description	Value (hex)
	56..511	Reserved		
07	Parallel ATA			
	000..511		(Not supported for SATA drives)	all zeros
08	Serial ATA			
	0..7	Serial ATA page information header (QWord)		
		63	Shall be set to one	0
		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	1
		19	DMA SETUP AUTO-ACTIVATION SUPPORTED bit	1
		18	NONZERO BUFFER OFFSETS SUPPORTED bit	0
		17	SEND AND RECEIVE QUEUED COMMANDS SUPPORTED bit	1

Table 28 - Identify Device Data log *(continued)*

Page (hex)	QWord Offset (dec)	Bits	Description	Value (hex)
		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	1
		10	UNLOAD WHILE NCQ COMMANDS ARE OUTSTANDING SUPPORTED bit	0
		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
		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	0
		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		

Table 28 - Identify Device Data log *(continued)*

Page (hex)	QWord Offset (dec)	Bits	Description	Value (hex)
	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		
09	Zone Device Information			
	0..7	Zoned Device Information page information header (QWord)		
		63	Shall be set to one	0
		62:24	Reserved	0
		23:16	Page number	09_H
		15:0	Revision Number	0001_H
	8..15	Zone Device Capabilities		
		63	Shall be set to one	0
		62:2	Reserved	0
		1	Remove element and modify zones supported	0
		0	URSWRZ	0
	16..23	Zone Device Settings (QWord)		
		63	Shall be set to one	0
		62:0	Reserved	0
	24..31	Optimal number of open Sequential Write Preferred zones (QWord)		
		63	Shall be set to one	0
		62:32	Reserved	0
		31:0	Optimal number of open Sequential Write Preferred zones	$0000\ 0000_H$
	32..39	Optimal number of Non-Sequentially Written Sequential Write Preferred zones (QWord)		
		63	Shall be set to one	0
		62:32	Reserved	0
		31:0	Optimal number of Non-Sequentially Written Sequential Write Preferred zones	$0000\ 0000_H$
	40..47	Maximum number of Open Sequential Write Required zones (QWord)		
		63	Shall be set to one	0
		62:32	Reserved	0
		31:0	Maximum number of Open Sequential Write Required zones	$0000\ 0000_H$

Table 28 - Identify Device Data log *(continued)*

Page (hex)	QWord Offset (dec)	Bits	Description	Value (hex)
	48..55	Version information (QWord)		
		63	Shall be set to one	0
		62:16	Reserved	0
		15:0	ZAC Minor Version	0000_H
	56..63	Zone Activation Capabilities (QWord)		
		63	Shall be set to one	0
		62:60	Reserved	0
		59:32	Maximum Activation	$0000\ 0000_H$
		31:6	Reserved	0
		5	Report Realms Command Supported	0
		4	NOZSRC Supported	0
		3	Zone Activation Control Supported	0
		2	Update URSWRZ Supported	0
		1	Zone Realms Feature Supported	0
		0	Zone Domains Feature Supported	0
	64..71	Subsequent Number of Zones (QWord)		
		63	Shall be set to one	0
		62:28	Reserved	0
		27:0	Subsequent Number of Zones	0
	72..79	Subsequent Number of Zones (QWord)		
		63	Shall be set to one	0
		62:5	Reserved	0
		4	Gap Zone Type Supported	0
		3	Sequential or Before Supported	0
		2	Sequential Write Required Supported	0
		1	Sequential Write Preferred Supported	0
		0	ConventionalSupported	0
	80..511	Reserved		

5.3.3 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 29, *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 29 - 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 29 - Device Statistics log

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	
	TBD	x

5.3.4 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 30 - Set Features command values

Value	Command	
02H	Enable write cache (default)	
03H	Set transfer mode (based on value in Sector Count register). 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.

5.3.5 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 https://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 31 - 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.

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