Seagate® BarraCuda® SATA

Product Manual

Standard Models

ST24000DM001

ST20000DM001

ST16000DM001

ST12000DM003

210203200, Rev B
February 2026

Revision History

Version and Date	Description of Changes
Rev A, March 2025	Initial release of the document.
Rev B, February 2026	Added 12TB model ST12000DM003

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1. Introduction

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

Table 1 - Standard Models

Standard Models
ST24000DM001
ST20000DM001
ST16000DM001
ST12000DM003

These drives provide the following key features:

- Compliant with RoHS requirements in China and Europe
- High instantaneous (burst) data-transfer rates (up to 600MB per second)
- Native Command Queuing with command ordering to increase performance in demanding applications
- Quiet operation
- 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
- Supports SMART drive monitoring and reporting
- Supports latching SATA cables and connectors
- Worldwide Name (WWN) capability uniquely identifies the drive

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 BarraCuda 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 for 24TB, 20TB, 16TB, and 12TB models

Drive Specification*	ST24000DM001	ST20000DM001	ST16000DM001	ST12000DM003
Formatted capacity (512 bytes/sector)**	24TB	20TB	16TB	12TB
Guaranteed sectors	See Section 2.2 *Formatted capacity*.			
Heads	20			
Disks	10			
Bytes per logical sector	512			
Bytes per physical sector	4096			
SATA interface transfer rate	600 MB/s			
Maximum data transfer rate	190 MB/s			
ATA data-transfer modes supported	PIO modes: 0 to 4 Multiword DMA modes: 0 to 2 Ultra DMA modes 0 to 6			
Cache buffer	512MB			
Height (max)	26.11 mm / 1.028 in			
Width (max)	101.85 mm / 4.010 in			
Length (max)	147 mm / 5.787 in			
Weight (typ)	695 g / 1.532 lb			
Average latency	4.16ms			
Power-on to Ready (typ/max)	30s / 60s			
Standby to Ready (typ/max)	30s / 60s			
Startup current (typical) 12V	2.0 A			
Voltage tolerance (including noise)	5 V ±5% 12 V ±10%			
Non-operating temperature (ambient)	–40°C to 70°C			
Operating temperature	10°C to 60°C (drive reported temperature)			
Temperature gradient	20°C per hour max (operating) 20°C per hour max (non-operating)			
Relative humidity	5% to 95% (operating) 5% to 95% (non-operating)			
Relative humidity gradient (max)	20% per hour			
Altitude, operating	–304 m to 3048 m (–1000 ft to 10,000 ft)			

Table 2 - Drive specifications summary for 24TB, 20TB, 16TB, and 12TB models *(continued)*

Drive Specification*	ST24000DM001	ST20000DM001	ST16000DM001	ST12000DM003
Altitude, non-operating (below mean sea level, max)	–304 m to12,192 m (–1000 ft to 40,000 ft)			
Operational shock (2ms)	30 *g*			
Non-operational shock (2ms)	200 *g*			
Random rotary operating vibration	20–1500Hz: 12.5 rads/s^2			
Linear random operating vibration	5–500 Hz: 0.70 GRMS			
Linear random non-operating vibration	2–500 Hz: 2.27 GRMS			
Drive acoustics, sound power				
Idle***	2.8 bels (typ) 3.0 bels (max)			
Seek	3.2 bels (typ) 3.4 bels (max)			
Non-recoverable read errors	1 per 10^{14} bits read			
Rated workload	Average annualized workload rating: <120 TB/year. The specifications for the product assumes the I/O workload does not exceed the average annualized workload rate limit of 120TB/year. Workloads exceeding the annualized rate may degrade and impact reliability as experienced by the particular application. The average annualized workload rate limit is in units of TB per calendar year.			
Warranty	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 hot-plug operation per the Serial ATA Revision 3.2 specification	Yes			

* All specifications above are based on native configurations.

**One GB equals one billion bytes and 1TB equals one trillion bytes when referring to hard drive capacity. Accessible capacity may vary depending on operating environment and formatting.

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

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

2.2 Formatted capacity

Table 3 - Formatted capacity

ST models	Formatted capacity *	Guaranteed sectors	Bytes per sector
ST24000DM001	24TB	46,875,541,504	512 (see Section 2.2.1 *Logical Block Addressing (LBA) mode*)
ST20000DM001	20TB	39,063,650,304	
ST16000DM001	16TB	31,251,759,104	
ST12000DM003	12TB	23,437,770,752	

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

2.2.1 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
Data transfer rate (MB/s max)	Up to 190

2.4 Physical characteristics

Table 5 - Dimensions and weight

Dimensions	
Maximum height	26.11 mm / 1.028 in
Maximum width	101.85 mm / 4.010 in
Maximum length	147 mm / 5.787 in
Typical weight	
24/20/16/12TB	695 g / 1.532 lb
Cache buffer	
Cache buffer	512MB

2.5 Start/stop times

Table 6 - Start/stop times

Standard models	ST24000DM001	ST20000DM001	ST16000DM001	ST12000DM003
Power-on to Ready (typ/max)	30s / 60s			
Standby to Ready (typ/max)	30s / 60s			
Ready to Spindle Stop (typ/max)	20s / 20s			

NOTE Time-to-ready may be longer than normal if the drive power is removed without going through normal OS power-down procedures.

2.6 Power specifications

The drive receives DC power (+5 V or +12 V) through a native SATA power connector. Refer to Figure 2, *Attaching SATA cabling*, on page 16.

2.6.1 Power consumption

Power requirements for the drives are listed in Table 7, *DC power requirements*. Typical power measurements are based on an average of drives tested, under nominal conditions, using 5.0 V and 12.0 V input voltage at 25°C ambient temperature. These power measurements are done with DIPM enabled.

- Spin-up current is measured from power-on to the time that the drive spindle reaches operating speed.
- Read/Write current is measured with the heads on track, based on three 64-sector read or write operations every 100 ms.
- The drive supports three idle modes: Performance Idle, Active Idle, and Low Power Idle. Refer to Section 2.6.4 *Power-management modes* for power-management modes.

Table 7 - DC power requirements

Power dissipation	Avg (watts, 25° C)	Avg 5 V (amps, typ)	Avg 12 V (amps, typ)
Spin up		0.895	2.000
Idle, Low Power	6.18	0.288	0.395
Read/Write	8.958	0.578	0.506
Standby	1.220	0.208	0.015
Sleep	1.220	0.208	0.015

2.6.2 Conducted noise

Input noise ripple is measured at the host system power supply across an equivalent 80-ohm resistive load on the +12 V line or an equivalent 15-ohm resistive load on the +5 V line.

- Using 12 V power, the drive is expected to operate with a maximum of 120 mV peak-to-peak sine-wave injected noise at up to 10MHz.
- Using 5 V power, the drive is expected to operate with a maximum of 100 mV peak-to-peak sine-wave injected noise at up to 10MHz.

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

2.6.3 Voltage tolerance

Voltage tolerance (including noise):

+5 V = ± 5%
+12 V = ± 10%

2.6.4 Power-management modes

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

Table 8 - Power management modes

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

Active mode

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

Idle mode

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

Standby mode

The drive enters Standby mode immediately when the host sends a Standby Immediate command. If the host has set the standby timer, the drive enters Standby mode automatically after the drive has been inactive for a specifiable length of time. The standby timer delay is established using a Standby or Idle command. In Standby mode, the electronics are in low power mode, the heads are parked, and the spindle is at rest. The drive accepts all commands and returns to Active mode when disk access is necessary.

Sleep mode

The drive enters Sleep mode after receiving a Sleep command from the host. In Sleep mode, the electronics are in low power mode, the heads are parked, and the spindle is at rest. The drive leaves Sleep mode after it receives a Hard Reset or Soft Reset from the host. After receiving a reset, the drive exits Sleep mode and enters Standby mode.

Idle and Standby timers

Each time the drive performs an Active function (read, write or seek), the standby timer is reinitialized and begins counting down from its specified delay times to zero. If the standby timer reaches zero before drive activity is required, the drive makes a transition to Standby mode. In both Idle and Standby mode, the drive accepts all commands and returns to Active mode when disk access is necessary.

2.7 Environmental specifications

This section provides the temperature, humidity, shock, and vibration specifications for Seagate BarraCuda SATA drives. Ambient temperature is defined as the temperature of the environment immediately surrounding the drive. Above 1000 ft (305 m), the maximum temperature is derated linearly by 1°C every 1000 ft. Refer to Section 3.3 *Drive mounting* for base plate measurement location.

2.7.1 Temperature

Table 9 - 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. 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°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 the drive.

2.7.2 Humidity

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

Table 10 - 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.

2.7.3 Effective Altitude

Table 11 - 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 to 40,000+ ft)

2.7.4 Shock and Vibration

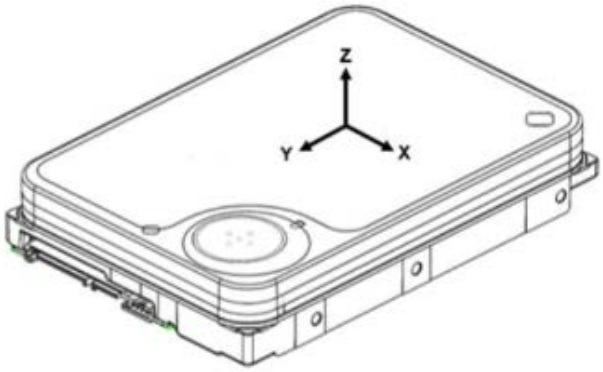
Shock and vibration measurements specified in this document are made directly on the drive itself and applied in the X, Y, and Z axes at the drive mounting point locations.

2.7.4.1 Shock

Table 12 - 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 1, *Drive orientation*.
Non-operating	The drive operates without non-recoverable errors after being subjected to shock pulses not exceeding 200 *g* at a duration of 2ms.

Figure 1 Drive orientation



2.7.4.2 Vibration

Linear random operating vibration

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

Table 13 - Linear random operating vibration

PSD OF 5-500 Hz random noise at 0.70 GRMS					
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 exhibits greater than 90% throughput for sequential and random write operations while subjected to the shaped random power spectral density noise specified below.

Table 14 - 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 does not incur physical damage or have non-recoverable errors after being subjected to the power spectral density noise specified below.

Table 15 - Linear random non-operating vibration

PSD Profile 2-500 Hz at 2.27 GRMS				
Frequency (Hz)	2	4	100	500
PSD (g^2/Hz)	0.001	0.030	0.030	0.001

2.8 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 16 - Fluid Dynamic Bearing (FDB) motor acoustics

Models	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.

2.8.1 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.

2.9 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 Table 17, *Radio frequency environments*.

Table 17 - Radio frequency environments

Test	Description	Performance level	Reference standard
Electrostatic discharge	Contact, HCP, VCP: ± 4 kV; Air: ± 8 kV	B	EN61000-4-2: 95
Radiated RF immunity	80MHz to 1,000MHz, 3 V/m, 80% AM with 1kHz sine	A	EN61000-4-3: 96
Electrical fast transient	± 1 kV on AC mains, ± 0.5 kV on external I/O	B	EN61000-4-4: 95
Surge immunity	± 1 kV differential, ± 2 kV common, AC mains	B	EN61000-4-5: 95
Conducted RF immunity	150kHz to 80MHz, 3 Vrms, 80% AM with 1kHz sine	A	EN61000-4-6: 97
Voltage dips, interrupts	0% open, 5 seconds 0% short, 5 seconds 40%, 0.10 seconds 70%, 0.01 seconds	C C C B	EN61000-4-11: 94

2.10 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.

2.10.1 Data loss under power interruption with write cache enabled

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

In order to prevent this data loss, the host should issue a Standby Immediate or Flush Cache command before a controlled power-off operation to the drive.

2.10.2 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.

2.11 HDD and SSD Regulatory Compliance and Safety

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

2.11.1 Regulatory models

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

STL026

2.11.2 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





2.12 Corrosive environment

Seagate electronic drive components pass accelerated corrosion testing equivalent to 10 years exposure to light industrial environments containing sulfurous gases, chlorine, and nitric oxide, classes G and H per ASTM B845. However, this accelerated testing cannot duplicate every potential application environment. Users should use caution exposing any electronic components to uncontrolled chemical pollutants and corrosive chemicals as electronic drive component reliability can be affected by the installation environment. The silver, copper, nickel, and gold films used in Seagate products are especially sensitive to the presence of sulfide, chloride, and nitrate contaminants. Sulfur is found to be the most damaging. In addition, electronic components should never be exposed to condensing water on the surface of the printed circuit board assembly (PCBA) or exposed to an ambient relative humidity greater than 95%. Materials used in cabinet fabrication, such as vulcanized rubber that can outgas corrosive compounds, should be minimized or eliminated. The useful life of any electronic equipment may be extended by replacing materials near circuitry with sulfide-free alternatives.

3. 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

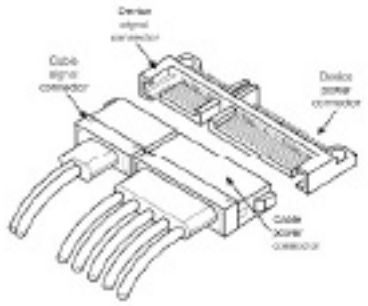
The Serial ATA interface cable consists of four conductors in two differential pairs, plus three ground connections. The cable size may be 30 to 26 AWG with a maximum length of one meter (39.37 in).

See Table 18, *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 2, *Attaching SATA cabling*.

Figure 2 Attaching SATA cabling



Each cable is keyed to ensure correct orientation. Seagate BarraCuda 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 3, *Mounting configuration dimensions* for drive mounting dimensions. Follow these important mounting precautions when mounting the drive:

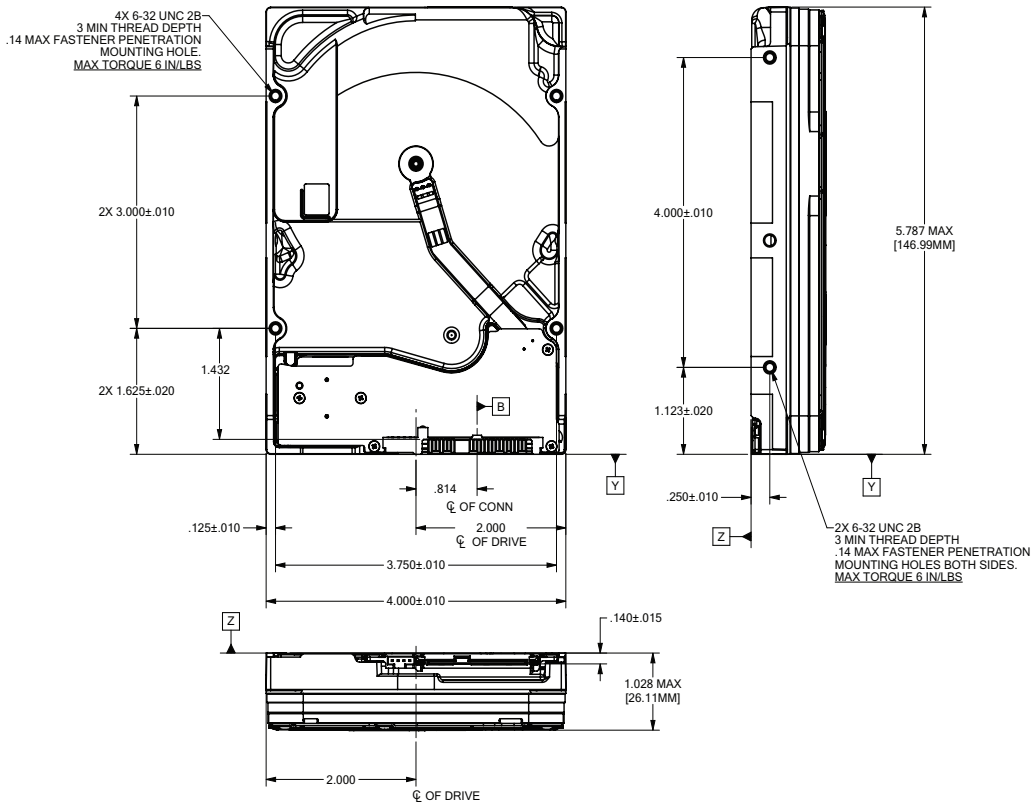
- Allow a minimum clearance of 0.030 in (0.76 mm) around the entire perimeter of the drive for cooling.
- Use only 6-32 UNC mounting screws.
- The screws should be inserted no more than 0.140 in (3.56 mm) into the bottom or side mounting holes.
- Do not overtighten the mounting screws (maximum torque: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

3.3.1 Mechanical specifications

Refer to Figure 3, *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 3 Mounting configuration dimensions



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

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 BarraCuda SATA drives incorporate connectors which enable users to hot-plug these drives in accordance with the Serial ATA Revision 3.2 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 2.5 *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 18, *Serial ATA connector pin definitions* summarizes the signals on the Serial ATA interface and power connectors.

Table 18 - 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 18 - Serial ATA connector pin definitions *(continued)*

Segment	Pin	Function	Definition
Power	P1	V33	3.3 V power
	P2	V33	3.3 V power
	P3	V33	3.3 V power, pre-charge, 2nd mate
	P4	Ground	1st mate
	P5	Ground	2nd mate
	P6	Ground	2nd mate
	P7	V5	5 V power, pre-charge, 2nd mate
	P8	V5	5 V power
	P9	V5	5 V power
	P10	Ground	2nd mate
	P11	Ground or LED signal	If grounded, drive does not use deferred spin
	P12	Ground	1st mate
	P13	V12	12 V power, pre-charge, 2nd mate
	P14	V12	12 V power
	P15	V12	12 V power

Notes:

1. All pins are in a single row, with a 1.27 mm (0.050 in) pitch.
2. The comments on the mating sequence apply to the case of backplane blindmate connector only. In this case, the mating sequences are:
   - The ground pins P4 and P12
   - The pre-charge power pins and the other ground pins
   - The signal pins and the rest of the power pins
3. There are three power pins for each voltage. One pin from each voltage is used for pre-charge when installed in a 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 International Organization: Serial ATA Revision 3.0 (www.sata-io.org). See Section 4.3.3 *SMART commands* for details and subcommands used in the SMART implementation.

Table 19 - SATA standard commands

Command name	Command code (in hex)
Accessible Max Address Configuration	
Get Native Max Address Ext	78_H / 0000_H
Set Accessible Max Address Ext	78_H / 0001_H
Freeze Accessible Max Address Ext	78_H / 0002_H
Check Power Mode	$E5_H$
Configure Stream	51_H

Table 19 - SATA standard commands *(continued)*

Command name	Command code (in hex)
Download Microcode	92_H
Execute Device Diagnostics	90_H
Flush Cache	$E7_H$
Flush Cache Extended	EA_H
Get Physical Element Status	12_H
Identify Device	EC_H
Idle	$E3_H$
Idle Immediate	$E1_H$
Read Buffer	$E4_H$
Read FPDMA Queued	60_H
Read DMA	$C8_H$
Read DMA Extended	25_H
Read Log DMA Ext	47_H
Read Log Ext	$2F_H$
Read Multiple	$C4_H$
Read Multiple Extended	29_H
Read Native Max Address	$F8_H$
Read Sectors	20_H
Read Sectors Extended	24_H
Read Stream DMA Ext	24_H
Read Verify Sectors	40_A
Read Verify Sectors Extended	42_H
Receive FPDMA Queued	65_H
Remove Element And Truncate	$7C_H$
Restore Elements And Rebuild	$7D_H$
Request Sense Data Ext	$0B_H$
Sanitize Device - Crypto Scramble	$B4_H$ / 0011_H (SED and ISE drives only)
Sanitize Device - Freeze Lock Ext	$B4_H$ / 0020_H
Sanitize Device - Overwrite Ext	$B4_H$ / 0014_H
Sanitize Device - Status Ext	$B4_H$ / 0000_H
Security Disable Password	$F6_H$
Security Erase Prepare	$F3_H$
Security Erase Unit	$F4_H$
Security Freeze	$F5_H$
Security Set Password	$F1_H$
Security Unlock	$F2_H$
Send FPDMA Queued	64_H
Set Date & Time Ext	77_H
Set Features	EF_H
Set Multiple Mode	$C6_H$

Table 19 - SATA standard commands *(continued)*

Command name	Command code (in hex)
Sleep	$E6_H$
SMART Disable Operations	$B0_H$ / $D9_H$
SMART Enable/Disable Autosave	$B0_H$ / $D2_H$
SMART Enable Operations	$B0_H$ / $D8_H$
SMART Execute Offline	$B0_H$ / $D4_H$
SMART Read Attribute Thresholds	$B0_H$ / $D1_H$
SMART Read Data	$B0_H$ / $D0_H$
SMART Read Log Sector	$B0_H$ / $D5_H$
SMART Return Status	$B0_H$ / DA_H
SMART Save Attribute Values	$B0_H$ / $D3_H$
SMART Write Log Sector	$B0_H$ / $D6_H$
Standby	$E2_H$
Standby Immediate	$E0_H$
Write Buffer	$E8_H$
Write DMA	CA_H
Write DMA Extended	35_H
Write DMA FUA Extended	$3D_H$
Write FPDMA Queued	61_H
Write Log DMA Ext	57_H
Write Log Extended	$3F_H$
Write Multiple	$C5_H$
Write Multiple Extended	39_H
Write Multiple FUA Extended	CE_H
Write Sectors	30_H
Write Sectors Extended	34_H
Write Stream DMA Ext	$3A_H$
Write Uncorrectable	45_H

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, whose contents are shown in Section 4.3 *Supported ATA commands*, on page 19. 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 commands contain drive-specific features that may not be included in the SATA specification.

Table 20 - IDENTIFY DEVICE commands

Word	Description	Value
0	Configuration information: Bit 15: 0 = ATA; 1 = ATAPI • Bit 7: removable media • Bit 6: removable controller • Bit 0: reserved	$0C5A_H$
1	Number of logical cylinders	16,383
2	Specific configuration: 37C8h Device requires SET FEATURES subcommand to spin-up after power-up and IDENTIFY DEVICE data is incomplete. 738Ch Device requires SET FEATURES subcommand to spin-up after power-up and IDENTIFY DEVICE data is complete. 8C73h Device does not require SET FEATURES subcommand to spin-up after power-up and IDENTIFY DEVICE data is incomplete. C837h Device does not require SET FEATURES subcommand to spin-up after power-up and IDENTIFY DEVICE data is complete.	$C837_H$
3	Number of logical heads	16
4	Retired	0000_H
5	Retired	0000_H
6	Number of logical sectors per logical track: 63	$003F_H$
7–9	Retired	0000_H
10–19	Serial number: (20 ASCII characters, 0000_H = none)	ASCII
20	Retired	0000_H
21	Retired	0000_H
22	Obsolete	0000_H
23–26	Firmware revision (8 ASCII character string, padded with blanks to end of string)	x.xx
27–46	Drive model number: (40 ASCII characters, padded with blanks to end of string)	
47	(Bits 7–0) Maximum sectors per interrupt on Read multiple and Write multiple (16)	8010_H
48	Trusted Computing feature set options: 15 Shall be cleared to zero 14 Shall be set to one 13:1 Reserved for the Trusted Computing Group 0 Trusted Computing feature set is supported	4000_H
49	Standard Standby timer, IORDY supported and may be disabled	$2F00_H$
50	Capabilities	4000_H
51	PIO data-transfer cycle timing mode	0200_H
52	Retired (Obsolete)	0200_H

Table 20 - IDENTIFY DEVICE commands *(continued)*

Word	Description	Value
53	15:8 Free-fall Control Sensitivity 7:3 Reserved 2 the fields reported in word 88 are valid 1 the fields reported in words (70:64) are valid 0 Obsolete	0007_H
54-58	Obsolete	$xxxx_H$
59	15 The BLOCK ERASE EXT command is supported 14 The OVERWRITE EXT command is supported 13 The CRYPTO SCRAMBLE EXT command is supported 12 The Sanitize feature set is supported 11:9 Reserved 8 Multiple logical sector setting is valid 7:0 Current setting for number of logical sectors that shall be transferred per DRQ data block on READ/WRITE Multiple commands	$5D10_H$
60–61	Total number of user-addressable LBA sectors available (see Section 2.2 *Formatted capacity* 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	0000_H
63	Multiword DMA active and modes supported (see note following this table)	$xx07_H$
64	Advanced PIO modes supported (modes 3 and 4 supported)	0003_H
65	Minimum multiword DMA transfer cycle time per word (120 nsec)	0078_H
66	Recommended multiword DMA transfer cycle time per word (120 nsec)	0078_H
67	Minimum PIO cycle time without IORDY flow control (240 nsec)	0078_H
68	Minimum PIO cycle time with IORDY flow control (120 nsec)	0078_H
69	Additional Supported	$000C_H$
70–74	ATA-reserved	0000_H
75	Queue depth	$001F_H$
76	SATA capabilities	$8D0E_H$
77	Reserved for future SATA definition	$004x_H$
78	SATA features supported	$xxCC_H$
79	SATA features enabled	0040_H
80	Major version number	$1FE0_H$
81	Minor version number	$FFFF_H$
82	Command sets supported	$306B_H$
83	Command sets supported	7561_H
84	Command sets support extension (see note following this table)	6173_H
85	Command sets enabled	3069_H
86	Command sets enabled	$B441_H$
87	Command sets enable extension	6173_H
88	Ultra DMA support and current mode (see note following this table)	$xx7F_H$
89	Security erase time	$xxxx_H$
90	Enhanced security erase time	$xxxx_H$
92	Master password revision code	$FFFE_H$

Table 20 - IDENTIFY DEVICE commands *(continued)*

Word	Description	Value
93	Hardware reset value	$xxxx_H$
94	Obsolete	$xxxx_H$
95–99	ATA-reserved	0000_H
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*
104-105	ATA-reserved	0000_H
106	Physical sector size / logical sector size	6003_H
107	ATA-reserved	0000_H
108-111	The mandatory value of the world wide name (WWN) for the drive. **NOTE:** This field is valid if word 84, bit 8 is set to 1 indicating 64-bit WWN support.	Each drive will have a unique value.
112-118	ATA-reserved	0000_H
119	Commands and feature sets supported	$43DE_H$
120	Commands and feature sets supported or enabled	$40DC_H$
121-127	ATA-reserved	0000_H
128	Security status	0021_H
129–159	Seagate-reserved	$xxxx_H$
160–167	ATA-reserved	0000_H
168	Device Nominal Form Factor	0002_H
169-205	ATA-reserved	0000_H
206	SCT Command Transport	$50BD_H$
207-208	ATA-reserved	0000_H
209	Alignment of logical blocks within a physical block	4000_H
210-216	ATA-reserved	0000_H
217	Nominal media rotation rate	$1C20_H$
218-221	ATA-reserved	0000_H
222	Transport major version number	$11FF_H$
223-229	ATA-reserved	0000_H
230-233	Extended Number of User Addressable Sectors	See Section 2.2 *Formatted capacity*
234–254	ATA-reserved	0000_H
255	Integrity word	$xxA5_H$

NOTE Advanced Power Management (APM) and Automatic Acoustic Management (AAM) features are not supported.

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

Table 21 - Bit descriptions for words 63, 84, and 88 of the Identify Drive data

Description (if bit is set to 1)	
Bit	Word 63

Table 21 - Bit descriptions for words 63, 84, and 88 of the Identify Drive data *(continued)*

		Description (if bit is set to 1)
	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 login is supported.
	1	SMART self-test is supported.
	2	Reserved.
	3	Obsolete.
	4	Streaming feature set is supported.
	5	GPL feature set is supported.
	6	WRITE DMA FUA EXT command is supported.
	7	Obsolete.
	8	World Wide Name is supported.
	9-12	Obsolete.
	13	IDLE IMMEDIATE command with UNLOAD 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.

4.3.2 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 22 - SET FEATURES command

02_H	Enable write cache *(default)*
03_H	Set transfer mode (based on value in Sector Count register) Sector Count register values:
	00_H Set PIO mode to default (PIO mode 2)
	01_H Set PIO mode to default and disable IORDY (PIO mode 2)
	08_H PIO mode 0
	09_H PIO mode 1
	$0A_H$ PIO mode 2
	$0B_H$ PIO mode 3
	$0C_H$ PIO mode 4 *(default)*
	20_H Multiword DMA mode 0
	21_H Multiword DMA mode 1
	22_H Multiword DMA mode 2
	40_H Ultra DMA mode 0
	41_H Ultra DMA mode 1
	42_H Ultra DMA mode 2
	43_H Ultra DMA mode 3
	44_H Ultra DMA mode 4
	45_H Ultra DMA mode 5
	46_H Ultra DMA mode 6
06_H	Enable the PUIS feature set
07_H	PUIS feature set device spin-up
10_H	Enable use of SATA features
55_H	Disable read look-ahead (read cache) feature
82_H	Disable write cache
86_H	Disable the PUIS feature set
90_H	Disable use of SATA features
AA_H	Enable read look-ahead (read cache) feature *(default)*
$F1_H$	Report full capacity available

NOTE At power-on, or after a hardware or software reset, the default values of the features are as indicated above.

4.3.3 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 $D4_H$) 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 23 - SMART commands

Code in features register	SMART command
$D0_H$	SMART Read Data
$D2_H$	SMART Enable/Disable Attribute Autosave
$D3_H$	SMART Save Attribute Values
$D4_H$	SMART Execute Off-line Immediate (runs DST)
$D5_H$	SMART Read Log Sector
$D6_H$	SMART Write Log Sector
$D8_H$	SMART Enable Operations
$D9_H$	SMART Disable Operations
DA_H	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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