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User manual MAXTOR ST32000644NS
User guide MAXTOR ST32000644NS
Operating instructions MAXTOR ST32000644NS
Instructions for use MAXTOR ST32000644NS
Instruction manual MAXTOR ST32000644NS



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Manual abstract:

B Rev. C Rev. D Rev. E Rev. F Rev. @@3-4, 6 and 13. 4, 13, 16 and 20. 1, 5, 9-11,14-15 & 17-18. 5 & 17-18. 6 & 31.
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one terabyte, or TB, equals one trillion bytes. Your computer's operating system may use a different standard of measurement and report a lower capacity.
In addition, some of the listed capacity is used for formatting and other functions, and thus will not be available for data storage. Seagate reserves the right to
change, without notice, product offerings or specifications. Contents 1.0 2.0 3.0 Seagate Technology support services

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· Full-track multiple-sector transfer capability without local processor intervention.

· SeaTools™ diagnostic software performs a drive self-test that eliminates unnecessary drive returns. · Support for S.M.A.R.

T. drive monitoring and reporting. · Supports latching SATA cables and connectors. · Worldwide Name (WWN) capability uniquely identifies the drive. 2 Constellation ES Serial ATA Product Manual, Rev. G 2.1 About the Serial ATA interface The Serial ATA interface provides several advantages over the traditional (parallel) ATA interface. The primary advantages include: · Easy installation and configuration with true plug-and-play connectivity. It is not necessary to set any jumpers or other configuration options. · Thinner and more flexible cabling for improved enclosure airflow and ease of installation.

· Scalability to higher performance levels. In addition, Serial ATA makes the transition from parallel ATA easy by providing legacy software support. Serial ATA was designed to allow you to install a Serial ATA host adapter and Serial ATA disc drive in your current system and expect all of your existing applications to work as normal. The Serial ATA interface connects each disc drive in a point-to-point configuration with the Serial ATA host adapter. There is no master/slave relationship with Serial ATA devices like there is with parallel ATA. If two drives are attached on one Serial ATA host adapter, the host operating system views the two devices as if they were both "masters" on two separate ports. This essentially means both drives behave as if they are Device 0 (master) devices. Note. The host adapter may, optionally, emulate a master/slave environment to host software where two devices on separate Serial ATA ports are represented to host software as a Device 0 (master) and Device 1 (slave) accessed at the same set of host bus addresses. A host adapter that emulates a master/slave environment manages two sets of shadow registers.

This is not a typical Serial ATA environment. The Serial ATA host adapter and drive share the function of emulating parallel ATA device behavior to provide backward compatibility with existing host systems and software. The Command and Control Block registers, PIO and DMA data transfers, resets, and interrupts are all emulated. The Serial ATA host adapter contains a set of registers that shadow the contents of the traditional device registers, referred to as the Shadow Register Block. All Serial ATA devices behave like Device 0 devices.

For additional information about how Serial ATA emulates parallel ATA, refer to the "Serial ATA: High Speed Serialized AT Attachment" specification. The specification can be downloaded from www.serialata.org. Constellation ES Serial ATA Product Manual, Rev.

G 3 3.0 Drive specifications 8 976,773,168 512 Bytes per sector ST32000644NS ST31000524NS ST3500514NS *One GB equals one billion bytes when referring to hard drive capacity. Accessible capacity may vary depending on operating environment and formatting. 3.2.1 LBA mode When addressing these drives in LBA mode, all blocks (sectors) are consecutively numbered from 0 to n1, 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 48bit addressing support of drives with capacities over 137GB. 3.

3 Cylinders 16,383 Default logical geometry Read/write heads 16 Sectors per track 63 LBA mode When addressing these drives in LBA mode, all blocks (sectors) are consecutively numbered from 0 to n1, where n is the number of guaranteed sectors as defined above. 3.4 Interface Recording and interface technology Serial ATA (SATA) Perpendicular 1421 240 347 7200 1300 140 300 (Ultra DMA mode 5) Recording method Recording density, KBPI (Kb/in max) Track density, KTIPI (ktracks/in avg) Areal density (Gb/in² avg) Spindle speed (RPM) (\pm 0.2%) Internal data transfer rate (Mb/s max) Sustained data transfer rate (MB/s max) I/O data-transfer rate (MB/s max) 6 Constellation ES Serial ATA Product Manual, Rev. G 3.5 Physical characteristics weight: (maximum) ST32000644NS ST31000524NS ST3500514NS Cache buffer ST32000644NS ST31000524NS and ST3500514NS 64MB (64,768KB) 32MB (32,768KB) 710g (1.565 lb) 640g (1.411 lb) 610g (1.345 lb) 3.6 Seek time Seek measurements are taken with nominal power at 25°C ambient temperature.

All times are measured using drive diagnostics. The specifications in the table below are defined as follows: · Track-to-track seek time is an average of all possible single-track seeks in both directions. · Average seek time is a true statistical random average of at least 5000 measurements of seeks between random tracks, less overhead. *Typical seek times (ms) Track-to-track Average latency: Read 0.5 <8.

5 4.16 Write 0.8 <9.5 *Measured in performance mode. Note.

These drives are designed to consistently meet the seek times represented in this manual. Physical seeks, regardless of mode (such as track-to-track and average), are expected to meet the noted values. However, due to the manner in which these drives are formatted, benchmark tests that include command overhead or measure logical seeks may produce results that vary from these specifications. 3.7 Start/stop times 2TB models 1TB models 10 (max) 10 (max) 500GB models 7 (max) 7 (max) Power-on to Ready (sec) Standby to Ready (sec) Ready to spindle stop (sec) 15 (max) 15 (max) 20 (max) Constellation ES Serial ATA Product Manual, Rev. G 7 3.8 Power specifications The drive receives DC power (+5V or +12V) through a native SATA power connector. See Figure 4 on page 26. 3.8.

1 Power consumption Power requirements for the drives are listed in the table on page 9. Typical power measurements are based on an average of drives tested, under nominal conditions, using 5.0V and 12.0V input voltage at 25°C ambient temperature. · Spinup power Spinup power is measured from the time of power-on to the time that the drive spindle reaches operating speed. · Seek mode During seek mode, the read/write actuator arm moves toward a specific position on the disc surface and does not execute a read or write operation. Servo electronics are active. Seek mode power represents the worst-case power consumption, using only random seeks with read or write latency time. This mode is not typical and is provided for worst-case information. · Read/write power and current Read/write power is measured with the heads on track, based on a 16-sector write followed by a 32-ms delay, then a 16-sector read followed by a 32ms delay.

· Operating power and current Operating power is measured using 40 percent random seeks, 40 percent read/write mode (1 write for each 10 reads) and 20 percent drive idle mode. · Idle mode power Idle mode power is measured with the drive up to speed, with servo electronics active and with the heads in a random track location.



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· Standby mode During Standby mode, the drive accepts commands, but the drive is not spinning, and the servo and read/write electronics are in power-down mode. 8 Constellation ES Serial ATA Product Manual, Rev. G Table 2: 2000GB Drive DC power requirements I.

5Gb mode 3.0Gb mode Power (Watts) 6.38 4.83 5.01 3.
26 0.51 24.22 24.47 33.71 35.71 0.52 26.13 34.91 0.55 9.

02 9.21 27.78 7.78 7.90 29.32 8.56 8.78 16.16 8.52 8.

66 18.00 +5V ±5% 0.27 0.14 0.14 0.

14 0.09 0.98 0.74 0.78 0.

82 0.09 0.36 0.61 0.09 0.30 0.31 1.06 0.31 0.31 1.

44 0.65 0.67 1.08 0.65 0.66 1.44 +12V ±5% 0.42 0.42 0.36 0.

22 0.01 0.90 1.64 2.50 2.

64 0.01 2.03 2.64 0.01 0.

63 0.64 1.88 0.52 0.53 1.84 0.44 0.44 0.88 0.44 0.

44 0.88 Power (Watts) 6.39 5.70 5.00 3.27 0.53 15.70 23.42 33.95 35.

83 0.55 26.24 34.77 0.57 9.

03 9.22 27.86 7.80 7.95 29.

28 8.54 8.67 15.96 8.52 8.65 17.76 Voltage Regulation Avg Idle Current * Advanced Idle Current * Idle_A Idle_B Idle_C Standby Transition Current * Idle_A (Active) Idle_B (Active) Idle_C (Active) Standby (Active) Average Sleep Current Maximum Start Current DC (peak DC) AC (Peak DC) Delayed Motor Start (DC max) Peak operating current (random read): Typical DC Maximum DC Maximum DC(peak) Peak operating current (random write) Typical DC Maximum DC Maximum DC(peak) Peak operating current (sequential read) Typical DC Maximum DC Maximum DC(peak) Peak operating current (sequential write) Typical DC Maximum DC Maximum DC(peak) +5V ±5% 0.26 0.13 0.13 0.

13 0.09 0.86 0.76 0.78 0.80 0.09 0.35 0.59 0.09 0.

30 0.30 1.04 0.30 0.31 1.

40 0.65 0.67 1.12 0.64 0.

66 1.44 +12V ±5% 0.42 0.35 0.36 0.22 0.01 1.66 1.72 2.48 2.

64 0.01 2.03 2.66 0.01 0.63 0.64 1.88 0.52 0.53 1.

86 0.44 0.45 0.88 0.44 0.

45 0.90 Constellation ES Serial ATA Product Manual, Rev. G 9 Table 3: 1000GB Drive DC power requirements 1.5Gb mode 3.0Gb mode Power (Watts) 4.

59 3.86 3.53 1.70 0.54 16.06 19.90 36.98 39.73 0.57 26.

44 38.76 0.66 7.41 7.52 23.28 6.20 6.30 25.46 6.64 6.

75 12.44 6.79 6.92 15.18 +5V ±5% 0.

27 0.15 0.15 0.15 0.10 0.

86 0.76 0.82 0.78 0.10 0.38 0.69 0.11 0.31 0.32 0.

96 0.33 0.34 1.30 0.65 0.67 1.02 0.68 0.70 1.28 +12V ±5% 0.

27 0.27 0.23 0.08 0.01 1.

06 1.27 2.81 3.01 0.01 2.

05 2.99 0.01 0.49 0.50 1.54 0.38 0.39 1.58 0.28 0.

28 0.62 0.28 0.28 0.60 Power (Watts) 4.61 3.99 3.56 1.73 0.57 17.

02 19.02 37.78 39.98 0.59 26.

45 39.29 0.64 7.42 7.56 23.

28 6.21 6.34 25.46 6.63 6.74 12.54 6.78 6.90 13.60 Voltage Regulation Avg Idle Current * Advanced Idle Current * Idle_A Idle_B Idle_C Standby Transition Current * Idle_A (Active) Idle_B (Active) Idle_C (Active) Standby (Active) Average Sleep Current Maximum Start Current DC (peak DC) AC (Peak DC) Delayed Motor Start (DC max) Peak operating current (random read): Typical DC Maximum DC Maximum DC(peak) Peak operating current (random write) Typical DC Maximum DC Maximum DC(peak) Peak operating current (sequential read) Typical DC Maximum DC Maximum DC(peak) Peak operating current (sequential write) Typical DC Maximum DC Maximum DC(peak) +5V ±5% 0.

27 0.14 0.14 0.14 0.09 0.86 0.80 0.76 0.78 0.09 0.

38 0.59 0.11 0.30 0.31 0.

96 0.32 0.33 1.30 0.65 0.

66 1.00 0.68 0.70 1.26 +12V ±5% 0.27 0.27 0.23 0.08 0.01 0.

98 1.32 2.76 2.99 0.01 2.05 2.98 0.01 0.49 0.50 1.

54 0.38 0.39 1.58 0.28 0.

29 0.62 0.28 0.29 0.74 10 Constellation ES Serial ATA Product Manual, Rev.

G Table 4: 500GB Drive DC power requirements 1.5Gb mode 3.0Gb mode Power (Watts) 3.71 3.13 2.82 1.50 0.53 10.44 16.81 32.

91 35.08 0.54 26.14 33.83 0.55 6.45 6.56 27.56 5.32 5.

48 22.80 5.63 5.72 10.62 5.

84 5.92 12.22 +5V ±5% 0.28 0.14 0.

14 0.14 0.09 0.84 0.80 0.72 0.84 0.09 0.36 0.63 0.

09 0.29 0.30 1.00 0.31 0.31 1.20 0.62 0.63 1.02 0.
66 0.67 1.30 +12V ±5% 0.20 0.21 0.
18 0.07 0.01 0.54 1.13 2.
43 2.59 0.01 2.03 2.59 0.01 0.42 0.42 1.38 0.31 0.

32 1.38 0.21 0.21 0.46 0.21 0.21 0.48 Power (Watts) 3.74 3.17 2.
85 1.52 0.55 10.68 17.56 32.
77 35.28 0.56 26.14 34.24 0.
59 6.47 6.54 21.32 5.31 5.45 22.56 5.62 5.72 10.62 5.

82 5.89 12.26 Voltage Regulation Avg Idle Current * Advanced Idle Current * Idle_A Idle_B Idle_C Standby Transition Current * Idle_A (Active) Idle_B (Active) Idle_C (Active) Standby (Active) Average Sleep Current Maximum Start Current DC (peak DC) AC (Peak DC) Delayed Motor Start (DC max) Peak operating current (random read): Typical DC Maximum DC Maximum DC(peak) Peak operating current (random write) Typical DC Maximum DC Maximum DC(peak) Peak operating current (sequential read) Typical DC Maximum DC Maximum DC(peak) Peak operating current (sequential write) Typical DC Maximum DC Maximum DC(peak) +5V ±5% 0.26 0.13 0.13 0.13 0.09 0.84 0.70 0.

70 0.80 0.09 0.36 0.55 0.
09 0.29 0.30 1.00 0.31 0.
31 1.20 0.62 0.63 1.02 0.66 0.67 1.34 +12V ±5% 0.20 0.21 0.

18 0.07 0.01 0.52 1.11 2.45 2.59 0.01 2.03 2.59 0.
01 0.42 0.42 1.38 0.32 0.
33 1.40 0.21 0.21 0.46 0.

21 0.21 0.46 *During periods of drive idle, some offline activity may occur according to the S.M.A.R.T. @@G 11 3.8.1.

1 Typical current profiles 12 Constellation ES Serial ATA Product Manual, Rev. G Figure 1. Typical 5V startup and operation current profile Figure 2. Typical 12V startup and operation current profile 3.8.2 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 +5V line. · Using 12V power, the drive is expected to operate with a maximum of 120mV peak-to-peak square-wave injected noise at up to 10MHz. · Using 5V power, the drive is expected to operate with a maximum of 100mV peak-to-peak square-wave injected noise at up to 10MHz. Note. Equivalent resistance is calculated by dividing the nominal voltage by the typical RMS read/write current.

3.8.3 Voltage tolerance Voltage tolerance (including noise): 5V ± 5% 12V ±10% Constellation ES Serial ATA Product Manual, Rev. G 13 3.8.

4 Power-management modes The drive provides programmable power management to provide greater energy efficiency. In most systems, you can control power management through the system setup program. The drive features the following power-management modes: Power modes Active Idle_a Idle_b Idle_c Standby Sleep Heads Tracking ID Biased Parked Parked Parked Parked Spindle Rotating Rotating Rotating Rotating at lower RPM Stopped Stopped Buffer Enabled Enabled Enabled Enabled Enabled Disabled · Active mode The drive is in Active mode during the read/write and seek operations. · Idle mode The buffer remains enabled, and the drive accepts all commands and returns to Active mode any time disc access is necessary. · Standby mode The drive enters Standby mode when the host sends a Standby Immediate command.

If the host has set the standby timer, the drive can also enter Standby mode automatically after the drive has been inactive for a specifiable length of time. The standby timer delay is established using a Standby or Idle command. In Standby mode, the drive buffer is enabled, the heads are parked and the spindle is at rest. The drive accepts all commands and returns to Active mode any time disc access is necessary. · Sleep mode The drive enters Sleep mode after receiving a Sleep command from the host. In Sleep mode, the drive buffer is disabled, 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.



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After receiving a reset, the drive exits Sleep mode and enters Standby mode with all current translation parameters intact. · 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 any drive activity is required, the drive makes a transition to Standby mode.

In both Idle and Standby mode, the drive accepts all commands and returns to Active mode when disc access is necessary. 14 Constellation ES Serial ATA Product Manual, Rev. G 3.8.4.1 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 you 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. Power Condition Name Idle_a Idle_b Idle_c Standby_z Power Condition ID 81H 82H 83H 00H Description Reduced electronics Heads unloaded. Disks spinning at full RPM Heads unloaded. Disks spinning at reduced RPM 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 Constellation ES Serial ATA Product Manual, Rev. G 15 S.M.A.R.T. Read Data Reports · Attribute 192 - Emergency Retract Count · Attribute 193 - Load/Unload Cycle Count PowerChoice Manufacture Default Power Condition Timer Values Default power condition timer values have been established to assure product reliability and data integrity.

A minimum timer value threshold of two minutes ensures the appropriate amount of background drive maintenance activities occur. Attempting to set a timer values less than the specified minimum timer value threshold will result in an aborted EPC "Set Power Condition Timer" subcommand. Power Condition Name Idle_a Idle_b Idle_c Standby_z Manufacturer Default Timer Values 2 min 4 min 10 min 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 EPC Subcommand 00H 01H 02H 03H Description Restore Power Condition Settings Go to Power Condition Set Power Condition Timer Set Power Condition State PowerChoice Supported Extended Power Condition Identifiers Power Condition Identifiers 00H 01 - 80H 81H 82H 83H 84 - FEH FFH Power Condition Name Standby_z Reserved Idle_a Idle_b Idle_c Reserved All EPC Power Conditions 16 Constellation ES Serial ATA Product Manual, Rev. G 3.9 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). Maximum wet bulb temperature is 82°F (28°C).

3.9.1 Temperature a. Operating The drive meets the operating specifications over a 41°F to 140°F (5°C to 60°C) drive case temperature range with a maximum temperature gradient of 36°F (20°C) per hour. The maximum allowable drive case temperature is 60°C.

See Figure 3 for HDA case temperature measurement location The MTBF specification for the drive assumes the operating environment is designed to maintain nominal case temperature. The rated MTBF is based upon a sustained case temperature of 104°F (40°C). Occasional excursions in operating temperature between the rated MTBF temperature and the maximum drive operating case temperature may occur without impact to the rated MTBF temperature. However, continual or sustained operation at case temperatures beyond the rated MTBF temperature will degrade the drive MTBF and reduce product reliability. Air flow may be required to achieve consistent nominal case temperature values (see Section 4.

4). 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, measure the case temperature of the drive. b. 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. HDA Temp. Check Point Figure 3. HDA temperature checkpoint Note. Image is for reference only, may not represent actual drive.

Constellation ES Serial ATA Product Manual, Rev. G 17 3.9.2 3.9.2.1 Operating: Humidity Relative humidity 5% to 90% noncondensing (30% per hour max) 5% to 95% noncondensing (30% per hour max) Nonoperating: 3.



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9.3 Operating: Altitude 60.96 m to 3,048 m (200 ft.

to 10,000+ ft.) 60.96 m to 12,192 m (200 ft. @ Shock may be applied in the X, Y or Z axis. @ Shocks should not be repeated more than two times per second.

@@@@ Vibration may be applied in the X, Y or Z axis. @ All measurements are consistent with ISO document 7779. @ 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.

@@@@@ Operations at nominal voltages. @ Normal I/O duty cycle for enterprise nearline applications.

@@@@@ 3.14.2 Electromagnetic compatibility Hard drives that display the CE mark comply with the European Union (EU) requirements specified in the Electromagnetic Compatibility Directive (2004/108/EC) as put into place 20 July 2007. Testing is performed to the levels specified by the product standards for Information Technology Equipment (ITE). Emission levels are defined by EN 55022, Class B and the immunity levels are defined by EN 55024. Drives are tested in representative end-user systems. Although CE-marked Seagate drives comply with the directives when used in the test systems, we cannot guarantee that all systems will comply with the directives. The drive is designed for operation inside a properly designed enclosure, with properly shielded I/O cable (if necessary) and terminators on all unused I/O ports.

Computer manufacturers and system integrators should confirm EMC compliance and provide CE marking for their products. Korean RRL If these drives have the Korean Communications Commission (KCC) logo, they comply with paragraph 1 of Article 11 of the Electromagnetic Compatibility control Regulation and meet the Electromagnetic Compatibility (EMC) Framework requirements of the Radio Research Laboratory (RRL) Communications Commission, Republic of Korea. These drives have been tested and comply with the Electromagnetic Interference/Electromagnetic Susceptibility (EMI/EMS) for Class B products. Drives are tested in a representative, end-user system by a Korean-recognized lab. · Family name: Constellation ES · Certificate number: STX-Constell-ES (B) Australian C-Tick (N176) If these models have the C-Tick marking, they comply with the Australia/New Zealand Standard AS/NZ CISPR22 and meet the Electromagnetic Compatibility (EMC) Framework requirements of the Australian Communication Authority (ACA). 3.14.3 FCC verification These drives are intended to be contained solely within a personal computer or similar enclosure (not attached as an external device). As such, each drive is considered to be a subassembly even when it is individually marketed to the customer. As a subassembly, no Federal Communications Commission verification or certification of the device is required.

Seagate has tested this device in enclosures as described above to ensure that the total assembly (enclosure, disc drive, motherboard, power supply, etc.) does comply with the limits for a Class B computing device, pursuant to Subpart J, Part 15 of the FCC rules. Operation with noncertified assemblies is likely to result in interference to radio and television reception. Radio and television interference. This equipment generates and uses radio frequency energy and if not installed and used in strict accordance with the manufacturer's instructions, may cause interference to radio and television reception.

This equipment is designed to provide reasonable protection against such interference in a residential installation. However, there is no guarantee that interference will not occur in a particular installation. If this 22 Constellation ES Serial ATA Product Manual, Rev. G equipment does cause interference to radio or television, which can be determined by turning the equipment on and off, you are encouraged to try one or more of the following corrective measures: · Reorient the receiving antenna. · Move the device to one side or the other of the radio or TV.

· Move the device farther away from the radio or TV. · Plug the computer into a different outlet so that the receiver and computer are on different branch outlets. If necessary, you should consult your dealer or an experienced radio/television technician for additional suggestions. You may find helpful the following booklet prepared by the Federal Communications Commission: How to Identify and Resolve Radio-Television Interference Problems. This booklet is available from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402. Refer to publication number 004-000-00345-4.

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

3.15.1 European Union Restriction of Hazardous Substances (RoHS) Directive Seagate designs its products to meet environmental protection requirements worldwide, including regulations restricting certain chemical substances. A new law, the European Union Restriction of Hazardous Substances (RoHS) Directive, restricts the presence of chemical substances, including Lead, Cadmium, Mercury, Hexavalent Chromium, PBB and PBDE, in electronic products, effective July 2006. This drive is manufactured with components and materials that comply with the RoHS Directive. 3.15.2 China Restriction of Hazardous Substances (RoHS) Directive This product has an Environmental Protection Use Period (EPU) of 20 years. The following table contains information mandated by China's "Marking Requirements for Control of Pollution Caused by Electronic Information Products" Standard. "O" indicates the hazardous and toxic substance content of the part (at the homogenous material level) is lower than the threshold defined by the China RoHS MCV Standard.

O"RoHS MCV "X" indicates the hazardous and toxic substance content of the part (at the homogenous material level) is over the threshold defined by the China RoHS MCV Standard. X "RoHS MCV Constellation ES Serial ATA Product Manual, Rev. G 23 3.16 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%.



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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. 24 Constellation ES Serial ATA Product Manual, Rev. G 4.0 Configuring and mounting the drive This section contains the specifications and instructions for configuring and mounting the drive. 4.1 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, or ground yourself frequently by touching the metal chassis of a computer that is plugged into a grounded outlet. Wear a grounded wrist strap throughout the entire installation procedure. · Handle the drive by its edges or frame only. · The drive is extremely fragile--handle it with care.

Do not press down on the drive top cover. · Always rest the drive on a padded, antistatic surface until you mount 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.

Constellation ES Serial ATA Product Manual, Rev. G 25 4.2 Configuring the drive Each drive on the Serial ATA interface connects point-to-point with the Serial ATA host adapter.

There is no master/slave relationship because each drive is considered a master in a point-to-point relationship. If two drives are attached on one Serial ATA host adapter, the host operating system views the two devices as if they were both "masters" on two separate ports. Both drives behave as if they are Device 0 (master) devices. 4.3 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 7 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, you can connect the drive as illustrated in Figure 4. Signal connector Power connector Signal cable Power cable Figure 4. Attaching SATA cabling Each cable is keyed to ensure correct orientation. Constellation ES Serial ATA drives support latching SATA connectors. 26 Constellation ES Serial ATA Product Manual, Rev. G 4.4 Drive mounting You 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 5 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 0.150 in (3.81mm) into the bottom or side mounting holes. · Do not overtighten the mounting screws (maximum torque: 6 in-lb). Note. These dimensions conform to the Small Form Factor Standards documented in SFF-8301 and SFF-8323, found at www.sffcommittee.org

org in mm in mm Breather Hole in mm Figure 5. Mounting dimensions--top, side and end view Constellation ES Serial ATA Product Manual, Rev. G 27 5.0 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 04; multiword DMA modes 02, and Ultra DMA modes 06.

For detailed information about the Serial ATA interface, refer to the "Serial ATA: High Speed Serialized AT Attachment" specification. 5.1 Hot-Plug compatibility Constellation ES Serial ATA drives incorporate connectors which enable you to hot plug these drives in accordance with the Serial ATA Revision 2.6 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 3.7) prior to changing the plane of operation. This time is required to insure data integrity. 28 Constellation ES Serial ATA Product Manual, Rev. G 5.2 Serial ATA device plug connector pin definitions Table 7 summarizes the signals on the Serial ATA interface and power connectors. Table 7: Segment Serial ATA connector pin definitions Pin S1 S2 S3 S4 S5 S6 Function Ground A+ AGround BB+ Ground 2nd mate Key and spacing separate signal and power segments P1 P2 P3 P4 P5 P6 P7 V33 V33 V33 Ground Ground Ground V5 V5 V5 Ground Ground or LED signal Ground V12 V12 V12 3.3V power 3.

3V power 3.3V power, pre-charge, 2nd mate 1st mate 2nd mate 2nd mate 5V power, pre-charge, 2nd mate 5V power 5V power 2nd mate If grounded, drive does not use deferred spin 1st mate. 12V power, pre-charge, 2nd mate 12V power 12V power 2nd mate Differential signal pair B from Phy Definition 2nd mate Differential signal pair A from Phy Signal S7 Power P8 P9 P10 P11 P12 P13 P14 P15 Notes: 1. All pins are in a single row, with a 1.27mm (0.050") pitch. 2. The comments on the mating sequence apply to the case of backplane blindmate connector only. In this case, the mating sequences are: · the ground pins P4 and P12. · the pre-charge power pins and the other ground pins.

· the signal pins and the rest of the power pins. 3. There are three power pins for each voltage. One pin from each voltage is used for pre-charge when installed in a blind-mate backplane configuration. 4.

All used voltage pins (Vx) must be terminated. Constellation ES Serial ATA Product Manual, Rev. G 29 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 "S.M.A.R.T. commands" on page 37 for details and subcommands used in the S.M.A.R.

T. implementation. Table 8: Supported ATA commands Command code (in hex) E5H B1H / C1H B1H / C2H B1H / C0H B1H / C3H 08H 92H 90H E7H EAH 50H ECH E3H E1H 91H E4H C8H 25H C9H 2FH C4H 29H F8H 27H 20H 24H 21H 40H 42H 41H 10H F6H F3H F4H Command name Check Power Mode Device Configuration Freeze Lock Device Configuration Identify Device Configuration Restore Device Configuration Set Device Reset Download Microcode Execute Device Diagnostics Flush Cache Flush Cache Extended Format Track Identify Device Idle Idle Immediate Initialize Device Parameters Read Buffer Read DMA Read DMA Extended Read DMA Without Retries Read Log Ext Read Multiple Read Multiple Extended Read Native Max Address Read Native Max Address Extended Read Sectors Read Sectors Extended Read Sectors Without Retries Read Verify Sectors Read Verify Sectors Extended Read Verify Sectors Without Retries Recalibrate Security Disable Password Security Erase Prepare Security Erase Unit 30 Constellation ES Serial ATA Product Manual, Rev.



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G Command name Security Freeze Security Set Password Security Unlock Seek Set Features Set Max Address Note: Individual Set Max Address commands are identified by the value placed in the Set Max Features register as defined to the right. Set Max Address Extended Set Multiple Mode Sleep S.M.A.R.T. Disable Operations S.
M.A.R.T. Enable/Disable Autosave S.
M.A.R.T. Enable Operations S.
M.A.R.T. Execute Offline S.M.A.R.T. Read Attribute Thresholds S.

M.A.R.T. Read Data S.M.A.R.T. Read Log Sector S.
M.A.R.T. Return Status S.
M.A.R.T. Save Attribute Values S.

M.A.R.T. Write Log Sector Standby Standby Immediate Write Buffer Write DMA Write DMA Extended Write DMA FUA Extended Write DMA Without Retries Write Log Extended Write Multiple Write Multiple Extended Write Multiple FUA Extended Write Sectors Write Sectors Without Retries Write Sectors Extended Write Uncorrectable Command code (in hex) F5H F1H F2H 70H EFH F9H Address: Password: Lock: Unlock: Freeze Lock: 37H C6H E6H B0H / D9H B0H / D2H B0H / D8H B0H / D4H B0H / D1H B0H / D0H B0H / D5H B0H / DAH B0H / D3H B0H / D6H E2H E0H E8H CAH 35H 3DH CBH 3FH C5H 39H CEH 30H 31H 34H 45H 00H 01H 02H 03H 04H Constellation ES Serial ATA Product Manual, Rev. G 31 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 8 on page 30. 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 3.0 on page 4 for default parameter settings. The following commands contain drive-specific features that may not be included in the Serial ATA specification. Word Description Configuration information: · Bit 15: 0 = ATA; 1 = ATAPI · Bit 7: removable media · Bit 6: removable controller · Bit 0: reserved Number of logical cylinders ATA-reserved Number of logical heads Retired Retired Number of logical sectors per logical track: 63 Retired Serial number: (20 ASCII characters, 0000H = none) Retired Retired Obsolete Firmware revision (8 ASCII character string, padded with blanks to end of string) Drive model number: (40 ASCII characters, padded with blanks to end of string) (Bits 70) Maximum sectors per interrupt on Read multiple and Write multiple (16) Reserved Standard Standby timer, IORDY supported and may be disabled ATA-reserved PIO data-transfer cycle timing mode Retired Words 5458, 6470 and 88 are valid Number of current logical cylinders Number of current logical heads Number of current logical sectors per logical track Current capacity in sectors Number of sectors transferred during a Read Multiple or Write Multiple command 8010H 0000H 2F00H 0000H 0200H 0200H 0007H xxxxH xxxxH xxxxH xxxxH Value 0 0C5AH 1 2 3 4 5 6 79 1019 20 21 22 2326 2746 47 48 49 50 51 52 53 54 55 56 5758 59 16,383 0000H 16 0000H 0000H 003FH 0000H ASCII 0000H 0400H 0000H x.xx 32 Constellation ES Serial ATA Product Manual, Rev. G Word Description Total number of user-addressable LBA sectors available (see Section 3.2 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. Retired Multiword DMA active and modes supported (see note following this table) Advanced PIO modes supported (modes 3 and 4 supported) Minimum multiword DMA transfer cycle time per word (120 ns) Recommended multiword DMA transfer cycle time per word (120 ns) Minimum PIO cycle time without IORDY flow control (240 ns) Minimum PIO cycle time with IORDY flow control (120 ns) ATA-reserved Queue depth Serial ATA capabilities Reserved for future Serial ATA definition Serial ATA features supported Serial ATA features enabled Major version number Minor version number Command sets supported Command sets supported Command sets support extension (see note following this table) Command sets enabled Command sets enabled Command sets enable extension Ultra DMA support and current mode (see note following this table) Security erase time Enhanced security erase time Master password revision code Hardware reset value ATA-reserved Total number of user-addressable LBA sectors available (see Section 3.2 for related information). These words are required for drives that support the 48-bit addressing feature. Maximum value: 0000FFFFFFFFFh. ATA-reserved Value 6061 0FFFFFFFh 62 63 64 65 66 67 68 6974 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 92 93 9599 100103 104107 0000H xx07H 0003H 0078H 0078H 00F0H 0078H 0000H 001FH xxxxH xxxxH xxxxH xxxxH 003EH 0028H 364BH 7C03H 4003H See Word 108-111 note. (4003H = 0100000000000011 binary) 30xxH 0001H 4000H xx3FH 0000H 0000H FFEH xxxxH 0000H ST32000644NS = 3,907,029,168 ST31000524NS = 1,953,525,168 ST3500514NS = 976,773,168 0000H Constellation ES Serial ATA Product Manual, Rev. G 33 Word 108111 Description 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. @@@@Multiword DMA mode 1 is supported. Multiword DMA mode 2 is supported.

Multiword DMA mode 0 is currently active. Multiword DMA mode 1 is currently active. Multiword DMA mode 2 is currently active. Word 84 SMART error logging is supported. SMART self-test is supported. Media serial number is supported. Media Card Pass Through Command feature set is supported. Streaming feature set is supported. GPL feature set is supported. WRITE DMA FUA EXT and WRITE MULTIPLE FUA EXT commands are supported.

WRITE DMA QUEUED FUA EXT command is supported. 64-bit World Wide Name is supported. Obsolete. Reserved for TLC. IDLE IMMEDIATE command with IUNLOAD feature is supported. Shall be set to 1. @@@@Ultra DMA mode 1 is supported. Ultra DMA mode 2 is supported. Ultra DMA mode 3 is supported. Ultra DMA mode 4 is supported.

Ultra DMA mode 5 is supported. Ultra DMA mode 6 is supported. Ultra DMA mode 0 is currently active. Ultra DMA mode 1 is currently active. Ultra DMA mode 2 is currently active.

Ultra DMA mode 3 is currently active. Ultra DMA mode 4 is currently active. Ultra DMA mode 5 is currently active. Ultra DMA mode 6 is currently active. Constellation ES Serial ATA Product Manual, Rev.

G 35 5.3.2 Set Features command This command controls the implementation of various features that the drive supports. When the drive receives this command, it sets BSY, checks the contents of the Features register, clears BSY and generates an interrupt. If the value in the register does not represent a feature that the drive supports, the command is aborted. Power-on default has the read look-ahead and write caching features enabled. The acceptable values for the Features register are defined as follows: Table 9: 02H 03H Set Features command values Enable write cache (default).



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Set transfer mode (based on value in Sector Count register). Sector Count register values: 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 46H Ultra DMA mode 6 10H 55H 82H 90H AAH F1H Enable use of SATA features Disable read look-ahead (read cache) feature. Disable write cache Disable use of SATA features Enable read look-ahead (read cache) feature (default). 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. 36 Constellation ES Serial ATA Product Manual, Rev. G 5.3.3 S.M.A.

R.T. commands S.M.A.

R.T. provides near-term failure prediction for disc drives. When S.M.

A.R.T. is enabled, the drive monitors predetermined drive attributes that are susceptible to degradation over time. If self-monitoring determines that a failure is likely, S.M.A.R.T. makes a status report available to the host.

Not all failures are predictable. S.M.A.R.T. predictability is limited to the attributes the drive can monitor. For more information on S.M.A. R.T. commands and implementation, see the Draft ATA-5 Standard. SeaTools diagnostic software activates a built-in drive self-test (DST S.M. A.R.T. command for D4H) that eliminates unnecessary drive returns. The diagnostic software ships with all new drives and is also available at: <http://seatools.seagate.com>. This drive is shipped with S.M.A.R.T. features disabled. You must have a recent BIOS or software package that supports S.M.

A.R.T. to enable this feature. The table below shows the S.M.A.R.T. command codes that the drive uses.

Table 10: S.M.A.R.T.

commands S.M.A.R.T.

command S.M.A.R.T. Read Data S.M.A.R.T.

Enable/Disable Attribute Autosave S.M.A.R.T. Save Attribute Values S.M.A.R.T.

Execute Off-line Immediate (runs DST) S.M.A.R.T.

Read Log Sector S.M.A.R.T.

Write Log Sector S.M.A.R.T. Enable Operations S.M.A.R.T.

Disable Operations S.M.A.R.T. Return Status Code in features register D0H D2H D3H D4H D5H D6H D8H D9H DAH Note. If an appropriate code is not written to the Features Register, the command is aborted and 0x 04 (abort) is written to the Error register. Constellation ES Serial ATA Product Manual, Rev. G 37 38 Constellation ES Serial ATA Product Manual, Rev. G Index A ACA 22 acoustics 19 Active 14 Active mode 14 actuator arm 8 Agency certification 22 altitude 18 ambient 17 ambient temperature 7, 8 Annualized Failure Rate (AFR) 21 areal density 2, 6 ATA commands 30 Australia/New Zealand Standard AS/NZ CISPR22 22 Australian Communication Authority (ACA) 22 Australian C-Tick 22 average idle current 9, 10, 11 Average latency 7 Average seek time 7 Device Reset 30 dimensions 27 disc surface 8 Download Microcode 30 E Electrical fast transient 20 Electromagnetic compatibility 22 Electromagnetic Compatibility (EMC) 22 Electromagnetic Compatibility control Regulation 22 Electromagnetic Compatibility Directive (2004/108/EC) 22 Electromagnetic immunity 20 Electrostatic discharge 20 electrostatic discharge (ESD) 25 EN 55022, Class B 22 EN 55024 22 EN60950 22 enclosures 22 environmental limits 17 error-correction algorithms 2 errors 21 ESD 25 EU 22 EU RoHS directive 23 European Union (EU) requirements 22 Execute Device Diagnostics 30 B BPI 6 buffer 7 C cables and connectors 26 cache 7 capacity 6 CE mark 22 certification 22 Check Power Mode 30 China RoHS directive 23 compatibility 22 Conducted noise 13 Conducted RF immunity 20 Configuring the drive 25 connectors 26 Corrosive environment 24 CSA60950-1 22 Cylinders 6 F FCC verification 22 features 2 Flush Cache 30 Flush Cache Extended 30 Format Track 30 Formatted capacity 6 G geometry 6 gradient 17 guaranteed sectors 6 H Handling precautions 25 heads 6 humidity 18 humidity limits 17 D data-transfer rates 2 DC power 8 Default logical geometry 6 density 6 Device Configuration Freeze Lock 30 Device Configuration Identify 30 Device Configuration Restore 30 Device Configuration Set 30 I I/O data-transfer rate 6 Identify Device 30 Identify Device command 32 Idle 14, 30 Constellation ES Serial ATA Product Manual, Rev.

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Execute Offline 31 S.M.A.R.T. implementation 30 40 Constellation ES Serial ATA Product Manual, Rev. G S.M.A.R.

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T. Read Data 31 S.M.A.R.

T. Read Log Sector 31 S.M.A.R.T. Return Status 31 S.M.A.R.

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