Cheetah 15K.5 SCSI

ST3300655LW
ST3300655LC
ST3146855LW
ST3146855LC
ST373455LW
ST373455LC

Seagate

Manual abstract:

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. . . . . .I Interface Manual, part number 100293069, and the SCSI Commands Reference Manual, part number 100293068. The Cheetah 15K.5 SCSI disc drive is a UL recognized component per UL1950, CSA certified to CSA C22.2 No.
950-95, and VDE certified to VDE 0805 and EN60950. 2.1.1 Electromagnetic compatibility The drive, as delivered, is designed for system integration and installation into a suitable enclosure prior to use. As such the drive is supplied as a subassembly and is not subject to Subpart B of Part 15 of the FCC Rules and Regulations nor the Radio Interference Regulations of the Canadian Department of Communications.
The design characteristics of the drive serve to minimize radiation when installed in an enclosure that provides reasonable shielding. As such, the drive is capable of meeting the Class B limits of the FCC Rules and Regulations of the Canadian Department of Communications when properly packaged. However, it is the user's responsibility to assure that the drive meets the appropriate EMI requirements in their system. Shielded I/O cables may be required if the enclosure does not provide adequate shielding. If the I/O cables are external to the enclosure, shielded cables should be used, with the shields grounded to the enclosure and to the host controller.
2.1.2 Electromagnetic susceptibility As a component assembly, the drive is not required to meet any susceptibility performance requirements. It is the responsibility of those integrating the drive within their systems to perform those tests required and design their system to ensure that equipment operating in the same system as the drive or external to the system does not adversely affect the performance of the drive. See Table 3, DC power requirements. Cheetah 15K.5 SCSI Product Manual, Rev. C 3 2.2 Electromagnetic compliance Seagate uses an independent laboratory to confirm compliance to the directives/standard(s) for CE Marking and C-Tick Marking. The drive was tested in a representative system for typical applications.

The selected system represents the most popular characteristics for test platforms. The system configurations include: · Typical current use microprocessor · 3.5-inch floppy disc drive · Keyboard · Monitor/display · Printer · External modem · Mouse Although the test system with this Seagate model complies to the directives/standard(s), we cannot guarantee that all systems will comply. The computer manufacturer or system integrator shall confirm EMC compliance and provide CE Marking and C-Tick Marking for their product. Electromagnetic compliance for the European Union If this model has the CE Marking it complies with the European Union requirements of the Electromagnetic Compatibility Directive 89/336/EEC of 03 May 1989 as amended by Directive 92/31/EEC of 28 April 1992 and Directive 93/68/EEC of 22 July 1993. Australian C-Tick If this model has the C-Tick Marking it complies with the Australia/New Zealand Standard AS/NZS3548 1995 and meets the Electromagnetic Compatibility (EMC) Framework requirements of Australia's Spectrum Management Agency (SMA). Korean MIC If this model has the Korean Ministry of Information and Communication (MIC) logo, it complies with paragraph 1 of Article 11 of the Electromagnetic Compatibility (EMC) Control Regulation and meets the Electromagnetic Compatibility Framework requirements of the Radio Research Laboratory (RRL) Ministry of Information and Communication Republic of Korea. This drive has been tested and complies with the Electromagnetic Interference/Electromagnetic Susceptibility (EMI/EMS) for Class B products. Taiwanese BSMI If this model has the Chinese National Standard (CNS) 13438 marking, it complies with Chinese National Standard (CNS) 13438 and meets the Electromagnetic Compatibility (EMC) Framework requirements of the Taiwanese Bureau of Standards, Metrology, and Inspection (BSMI). 4 Cheetah 15K.
5 SCSI Product Manual, Rev. C 2.3 Reference documents Seagate P/N 100384777 Seagate P/N 75789512 Seagate P/N 100293068 Seagate P/N 100293069 Cheetah 15K.5 SCSI Installation Guide Safety and Regulatory Agency Specifications SCSI Commands Reference Manual Parallel SCSI Interface Product Manual Applicable ANSI small computer system interface (SCSI) document numbers: T10/1143D T10/1416D T10/1417D T10/1157D T10/1365D SFF-8451 Package Test Specification Package Test Specification Specification, Acoustic Test Requirements, and Procedures Enhanced SCSI Parallel Interface (EPI) Primary Commands-3 (SPC-3) SCSI Block Commands (SBC-2) SCSI Architectural Model-2 (SAM-2) SPI-4 (SCSI Parallel Interface version 4) Specification for SCA-2 Unshielded Connections Seagate P/N 30190-001 (under 100 lb.) Seagate P/N 30191-001 (over 100 lb.
) Seagate P/N 30553-001 In case of conflict between this document and any referenced document, this document takes precedence. Cheetah 15K.5 SCSI Product Manual, Rev. C 5 6 Cheetah 15K.5 SCSI Product Manual, Rev.
C 3.0 General description Cheetah 15K.5 SCSI drives combine giant magnetoresistive (GMR) heads, partial response/maximum likelihood (PRML) read channel electronics, embedded servo technology, and a wide Ultra320 SCSI interface to provide high performance, high capacity data storage for a variety of systems including engineering workstations, network servers, mainframes, and supercomputers. Ultra320 SCSI use negotiated transfer rates. These transfer rates will occur only if your host adapter supports these data transfer rates and is compatible with the required hardware requirements of the I/O circuit type. This drive also operates at SCSI-1 and SCSI-2 data transfer rates for backward compatibility with non-Ultra/Ultra2/ Ultra160/Ultra320 SCSI host adapters. Table 1 lists the features that differentiate the Cheetah 15K.5 SCSI models. Table 1: Drive model number vs. differentiating features Number of active heads I/O circuit type [1] Number of I/O connector pins Model number ST3300655LW ST3146855LW ST373455LW ST3300655LC ST3146855LC ST373455LC [1] 8 4 2 8 4 2 Single-ended (SE) and low voltage differential (LVD) Single-ended (SE) and low voltage differential (LVD) 68 80 See Section 9.

6 for details and definitions. The drive records and recovers data on approximately 70 mm non-removable discs.

The drive supports the Small Computer System Interface (SCSI) as described in the ANSI SCSI interface specifications to the extent described in this manual (volume 1), which defines the product performance characteristics of the Cheetah 15K.5 SCSI family of drives, the Parallel SCSI Interface Manual, part number 100293069, and the SCSI Commands Reference Manual, part number 100293068, which describe the general interface characteristics of this and other families of Seagate SCSI drives. The drive's interface supports multiple initiators, disconnect/reconnect, self-configuring host software, and logical block addressing. The head and disc assembly (HDA) is sealed at the factory. Air circulates within the HDA through a nonreplaceable filter to maintain a contamination-free HDA environment. Never disassemble the HDA and do not attempt to service items in the sealed enclosure (heads, media, actuator, etc.) as this requires special facilities. The drive contains no replaceable parts.

Opening the HDA voids your warranty. Cheetah 15K.5 SCSI Product Manual, Rev. C 7 Cheetah 15K.5 SCSI drives use a dedicated landing zone at the innermost radius of the media to eliminate the possibility of destroying or degrading data by landing in the data zone.

The drive automatically goes to the landing zone when power is removed. An automatic shipping lock prevents potential damage to the heads and discs that results from movement during shipping and handling. The shipping lock automatically disengages when power is applied to the drive and the head load process begins. A high-performance actuator assembly with a low-inertia, balanced, patented, straight-arm design provides excellent performance with minimal power dissipation. 3.

1 Standard features The Cheetah 15K.5 SCSI family has the following standard features: · Perpendicular recording technology. · Integrated Ultra320 SCSI interface. · Multimode SCSI drivers and receivers--single-ended (SE) and low voltage differential (LVD) · 16 bit I/O data bus · Asynchronous and synchronous data transfer protocol · Firmware downloadable via SCSI interface · Selectable even byte sector sizes from 512 to 528 bytes/sector · Programmable sector reallocation scheme · Flawed sector reallocation at format time · Programmable auto write and read reallocation · Reallocation of defects on command (post format) · ECC burst correction length of up to 400. · Sealed head and disc assembly · No preventative maintenance or adjustment required · Dedicated head landing zone · Embedded servo design · Self diagnostics performed when power is applied to the drive · Zoned bit recording (ZBR) · Vertical, horizontal, or top down mounting · Dynamic spindle brake · 16,384 kbytes data buffer · Hot plug compatibility (Section 9.6.4.2 lists proper host connector needed) for LC model drives · Drive Self Test (DST) · Supports SCSI bus fairness 3.2 Media characteristics The media used on the drive has an aluminum substrate coated with a thin film magnetic material, overcoated with a proprietary protective layer for improved durability and environmental protection. 8 Cheetah 15K.

5 SCSI Product Manual, Rev. C 3.3 Performance · Supports industry standard Ultra320 SCSI interface · Programmable multi-segmentable cache buffer (see Section 4.5) · 15k RPM spindle. Average latency = 2.0 msec · Command queuing of up to 64 commands · Background processing of queue · Supports start and stop commands (spindle stops spinning) 3.4 Reliability · Annualized Failure Rate (AFR) of 0.62% · Increased LSI circuitry integration · Incorporates industry-standard Self-Monitoring, Analysis and Reporting Technology (S.M.A.

R.T.) · 5-year warranty 3.5 Formatted capacities Standard OEM models are formatted to 512 bytes per block. The sector size is selectable at format time. Users having the necessary equipment may modify the data block size before issuing a format command and obtain different formatted capacities than those listed. To provide a stable target capacity environment and at the same time provide users with flexibility if they choose, Seagate recommends product planning in one of two modes: 1. Seagate designs specify capacity points at certain sector sizes that Seagate guarantees current and future products will meet. We recommend customers use this capacity in their project planning, as it ensures a stable operating point with backward and forward compatibility from generation to generation. The current guaranteed operating points for this product are: ST3300655LW ST3300655LC Sector Size 512 514 520 522 524 528 Decimal 585,937,500 574,712,644 573,653,847 570,053,000 566,007,800 557,874,778 Hex 22ECB25C 22416B44 22314357 21FA5188 21BC97F8 21407E5A ST3146855LW ST3146855LW Decimal 286,749,488 282,050,768 280,790,184 279,041,740 275,154,368 272,662,935 Hex 11177330 10CFC0D0 10BC84A8 10A1D6CC 106685C0 10408197h ST373455LW ST373455LC Decimal 143,374,744 141,025,384 140,395,092 139,463,602 137,577,184 136,331,467 Hex 88BB998 867E068 85E4254 8500BB2 83342E0 82040CBh 2.

Seagate drives also may be used at the maximum available capacity at a given sector size, but the excess capacity above the guaranteed level will vary between 10K and 15K families and from generation to generation, depending on how each sector size actually formats out for zone frequencies and splits over servo bursts. This added capacity potential may range from 0.1 to 1.3 percent above the guaranteed capacities listed above. Using the drives in this manner gives the absolute maximum capacity potential, but the user must determine if the extra capacity potential is useful, or whether their assurance of backward and forward compatibility takes precedence. Cheetah 15K.5 SCSI Product Manual, Rev. C 9 3.5.1 Programmable drive capacity Using the Mode Select command, the drive can change its capacity to something less than maximum.

See the Mode Select Parameter List table in the SCSI Interface Manual. Refer to the Parameter list block descriptor number of blocks field. A value of zero in the number of blocks field indicates that the drive shall not change the capacity it is currently formatted to have. A number in the number of blocks field that is less than the maximum number of LBAs changes the total drive capacity to the value in the block descriptor number of blocks field. A value greater than the maximum number of LBAs is rounded down to the maximum capacity. 3.6 Factory installed accessories OEM Standard drives are shipped with the Cheetah 15K.5 Installation Guide, part number 100384777, and the Safety and Regulatory Agency Specifications, part number 75789512 (unless otherwise specified). The factory also ships with the drive a small bag of jumper plugs used for the J5 and J6 option select jumper headers (on LW models only).

3.

7 Options (factory installed) All customer requested options are incorporated during production or packaged at the manufacturing facility before shipping. Some of the options available are (not an exhaustive list of possible options): · Other capacities can be ordered depending on sparing scheme and sector size requested. · Single unit shipping pack. The drive is normally shipped in bulk packaging to provide maximum protection against transit damage. Units shipped individually require additional protection as provided by the single unit shipping pack.

Users planning single unit distribution should specify this option. · The Cheetah 15K.5 Installation Guide, part number 100384777, usually ships with each standard OEM drive. Extra copies may be ordered. · The Safety and Regulatory Agency Specifications, part number 75789512, usually ships with each standard OEM drive.

Extra copies may be ordered. 3.8 Accessories The following accessories are available. All accessories may be installed in the field. · Single unit shipping pack. 10 Cheetah 15K.5 SCSI Product Manual, Rev. C 4.0 4.1 Performance characteristics Internal drive characteristics (transparent to user) ST3300655LW ST3300655LC ST3146855LW ST3146855LC ST373455LW ST373455LC Drive capacity Read/write heads Tracks/surface (total) Tracks/inch Peak bits/inch Areal Density Internal data rate Disc rotational speed Average rotational latency 300.

0 8 74,340 125,000 890k 110 960 to 1607 15k 2.0 146.8 4 74,340 125,000 890k 110 960 to 1607 15k 2.0 73.4 2 74,340 125,000 890k 110 960 to 1607 15k 2.0 GBytes (formatted),** Tracks (user accessible) TPI BPI Gbits/inch2 Mbits/sec (variable with zone) rpm msec * One Gbyte equals one billion bytes when referring to hard drive capacity. Accessible capacity may vary depending on operating environment and formatting. ** Rounded off value. 4.2 SCSI performance characteristics (visible to user) The values given in Section 4.*

2.1 apply to all models of the Cheetah 15K.5 SCSI family unless otherwise specified. Refer to the Parallel SCSI Interface Manual for additional timing details. Cheetah 15K.

5 SCSI Product Manual, Rev. C 11 4.2.1 Seek time Not including controller overhead (msec)1,2 Read Write Average Single Track Full Stroke 1. 2. Typical Typical Typical 3.5 0.2 6.8 4.0 0.4 7.5 Typical access times are measured under nominal conditions of temperature, voltage, and horizontal orientation as measured on a representative sample of drives. Access to data = access time + latency time. 4.2.

2 Format command execution time (minutes) [1] ST3300655LW ST3300655LC ST3146855LW ST3146855LC ST373455LW ST373455LC Maximum (with verify) Maximum (no verify) 4.2.3 120 60 90 45 60 30 Generalized performance characteristics Sustainable disc transfer rate: Minimum [3] Maximum [3] 73 125 Mbytes/sec Mbytes/sec SCSI interface data transfer rate (asynchronous): Maximum instantaneous one byte wide Maximum instantaneous two bytes wide Synchronous transfer rate In low voltage differential (LVD) interface mode Sector Sizes: Default Variable 512 byte user data blocks 512 to 528 bytes per sector in even number of bytes per sector. If n (number of bytes per sector) is odd, then n-1 will be used. Yes Negligible 2.00 msec 5.0 to 320 MBytes/sec 5.0 10.0 MBytes/sec [3] MBytes/sec [3] Read/write consecutive sectors on a track Flaw reallocation performance impact (for flaws reallocated at format time using the spare sectors per sparing zone reallocation scheme) Average rotational latency Notes for Section 4.2.

[1] [2] [3] Execution time measured from receipt of the last byte of the Command Descriptor Block (CDB) to the request for a Status Byte Transfer to the Initiator (excluding connect/disconnect). Assumes no errors and no sector has been relocated. Assumes system ability to support the rates listed and no cable loss. 12 Cheetah 15K.5 SCSI Product Manual, Rev.

C 4.3 Start/stop time After DC power at nominal voltage has been applied, the drive becomes ready within 20 seconds if the Motor Start Option is disabled (i.e., the motor starts as soon as the power has been applied). If a recoverable error condition is detected during the start sequence, the drive executes a recovery procedure which may cause the time to become ready to exceed 20 seconds.

During spin up to ready time the drive responds to some commands over the SCSI interface in less than 3 seconds after application of power. Stop time is 30 seconds from removal of DC power. If the Motor Start Option is enabled, the internal controller accepts the commands listed in the SCSI Interface Product Manual less than 3 seconds after DC power has been applied. After the Motor Start Command has been received the drive becomes ready for normal operations within 20 seconds typically (excluding an error recovery procedure). The Motor Start Command can also be used to command the drive to stop the spindle (see the SCSI Commands Reference Manual). There is no power control switch on the drive. 4.4 Prefetch/multi-segmented cache control The drive provides prefetch (read look-ahead) and multi-segmented cache control algorithms that in many cases can enhance system performance. "Cache" as used herein refers to the drive buffer storage space when it is used in cache operations. To select prefetch and cache features the host sends the Mode Select command with the proper values in the applicable bytes in Mode Page 08h (see the SCSI Interface Product Manual).

Prefetch and cache operation are independent features from the standpoint that each is enabled and disabled independently via the Mode Select command. However, in actual operation the prefetch feature overlaps cache operation somewhat as is noted in Section 4.5.1 and Section 4.5.2. All default cache and prefetch Mode parameter values (Mode Page 08h) for standard OEM versions of this drive family are given in Table 10. 4.5 Note. Cache operation Refer to the SCSI Interface Manual for more detail concerning the cache bits.

Of the 16 Mbytes physical buffer space in the drive, approximately 13,000 kbytes can be used as a cache. The buffer is divided into logical segments from which data is read and to which data is written. The drive keeps track of the logical block addresses of the data stored in each segment of the buffer. If the cache is enabled (see RCD bit in the SCSI Interface Manual), data requested by the host with a read command is retrieved from the buffer, if possible, before any disc access is initiated. If cache operation is not enabled, the buffer is still used, but only as circular buffer segments during disc medium read operations (disregarding Prefetch operation for the moment).

That is, the drive does not check in the buffer segments for the requested read data, but goes directly to the medium to retrieve it. The retrieved data merely passes through some buffer segment on the way to the host. All data transfers to the host are in accordance with buffer-full ratio rules.

See the explanation provided with the information about Mode Page 02h (disconnect/reconnect control) in the SCSI Interface Manual. The following is a simplified description of the prefetch/cache operation: Case A--read command is received and all of the requested logical blocks are already in the cache: 1. Drive transfers the requested logical blocks to the initiator. Case B--A Read command requests data, and at least one requested logical block is not in any segment of the cache: 1. The drive fetches the requested logical blocks from the disc and transfers them into a segment, and then from there to the host in accordance with the Mode Select Disconnect/Reconnect parameters, page 02h. 2. If the prefetch feature is enabled, refer to section 4.5.2 for operation from this point. Cheetah 15K.5 SCSI Product Manual, Rev. C 13 Each cache segment is actually a self-contained circular buffer whose length is an integer number of logical blocks.

The drive dynamically creates and removes segments based on the workload. The wrap-around capability of the individual segments greatly enhances the cache's overall performance. Note. The size of each segment is not reported by Mode Sense command page 08h, bytes 14 and 15. The value 0XFFFF is always reported regardless of the actual size of the segment. Sending a size specification using the Mode Select command (bytes 14 and 15) does not set up a new segment size. If the STRICT bit in Mode page 00h (byte 2, bit 1) is set to one, the drive responds as it does for any attempt to change an unchangeable parameter. Caching write data 4.5.1 Write caching is a write operation by the drive that makes use of a drive buffer storage area where the data to be written to the medium is stored while the drive performs the Write command.

If read caching is enabled (RCD=0), then data written to the medium is retained in the cache to be made available for future read cache hits. The same buffer space and segmentation is used as set up for read functions. The buffer segmentation scheme is set up or changed independently, having nothing to do with the state of RCD. When a write command is issued, if RCD=0, the cache is first checked to see if any logical blocks that are to be written are already stored in the cache from a previous read or write command. If there are, the respective cache segments are cleared.

The new data is cached for subsequent Read commands. If the number of write data logical blocks exceed the size of the segment being written into, when the end of the segment is reached, the data is written into the beginning of the same cache segment, overwriting the data that was written there at the beginning of the operation; however, the drive does not overwrite data that has not yet been written to the medium. If write caching is enabled (WCE=1), then the drive may return Good status on a write command after the data has been transferred into the cache, but before the data has been written to the medium. If an error occurs while writing the data to the medium, and Good status has already been returned, a deferred error will be generated. The Synchronize Cache command may be used to force the drive to write all cached write data to the medium.

Upon completion of a Synchronize Cache command, all data received from previous write commands will have been written to the medium. Tables 10, 11 and 12 show the mode default settings for the drive. 4.5.2 Prefetch operation If the Prefetch feature is enabled, data in contiguous logical blocks on the disc immediately beyond that which was requested by a Read command are retrieved and stored in the buffer for immediate transfer from the buffer to the host on subsequent Read commands that request those logical blocks (this is true even if cache operation is disabled). Though the prefetch operation uses the buffer as a cache, finding the requested data in the buffer is a prefetch hit, not a cache operation hit. To enable Prefetch, use Mode Select page 08h, byte 12, bit 5 (Disable Read Ahead - DRA bit). DRA bit = 0 enables prefetch. The drive does not use the Max Prefetch field (bytes 8 and 9) or the Prefetch Ceiling field (bytes 10 and 11). When prefetch (read look-ahead) is enabled (enabled by DRA = 0), the drive enables prefetch of contiguous blocks from the disc when it senses that a prefetch hit will likely occur.

The drive disables prefetch when it decides that a prefetch hit is not likely to occur. 14 Cheetah 15K.5 SCSI Product Manual, Rev. C 5.0 Reliability specifications The following reliability specifications assume correct host/drive operational interface, including all interface timings, power supply voltages, environmental requirements and drive mounting constraints (see Section 8.4). Seek Errors Read Error Rates [1] Recovered Data Unrecovered Data Miscorrected Data Annualized Failure Rate (AFR) Preventive Maintenance Note. [1] Error rate specified with automatic retries and data correction with ECC enabled and all flaws reallocated. Less than 10 in 108 seeks Less than 10 errors in 1012 bits transferred (OEM default settings) Less than 1 sector in 1016 bits transferred (OEM default settings) Less than 1 sector in 1021 bits transferred 0.62% None required 5.

1 Error rates The error rates stated in this specification assume the following: · The drive is operated per this specification using DC power as defined in this manual (see Section 6.2). · Errors caused by host system failures are excluded from error rate computations. · Assume random data. · Default OEM error recovery settings are applied.

This includes AWRE, ARRE, full read retries, full write retries and full retry time. 5.1.1 Recoverable Errors Recoverable errors are those detected and corrected by the drive, and do not require user intervention. Recoverable Data errors will use correction, although ECC on-the-fly is not considered for purposes of recovered error specifications.

Recovered Data error rate is determined using read bits transferred for recoverable errors occurring during a read, and using write bits transferred for recoverable errors occurring during a write. 5.1.2 Unrecoverable Error Unrecoverable Data Errors (Sense Key = 03h) are specified at less than 1 sector in error per 1016 bits transferred. Unrecoverable Data Errors resulting from the same cause are treated as 1 error for that block. Cheetah 15K.5 SCSI Product Manual, Rev. C 15 5.1.3 Seek errors A seek error is defined as a failure of the drive to position the heads to the addressed track.

After detecting an initial seek error, the drive automatically performs an error recovery process. If the error recovery process fails, a seek positioning error (Error code = 15h or 02h) will be reported with a Hardware error (04h) in the Sense Key. Recoverable seek errors are specified at Less than 10 errors in 108 seeks. Unrecoverable seek errors (Sense Key = 04h) are classified as drive failures. 5.2 Reliability and service You can enhance the reliability of Cheetah 15K.

5 SCSI disc drives by ensuring that the drive receives adequate cooling. Section 6.0 provides temperature measurements and other information that may be used to enhance the service life of the drive. Section 8.
3 provides recommended air-flow information. 5.2.1 Annualized Failure Rate (AFR) and Mean Time Between Failures (MTBF) These drives shall achieve an AFR of 0.62% (MTBF of 1,400,000 hours) when operated in an environment that ensures the HDA case temperatures do not exceed the values specified in Section 6.
4.1. Operation at case temperatures outside the specifications in Section 6.4.1 may increase the AFR (decrease the MTBF).
AFR and MTBF statistics are population statistics that are not relevant to individual units. AFR and MTBF specifications are based on the following assumptions for Enterprise Storage System environments: · 8,760 power-on hours per year · 250 average on/off cycles per year · Operating at nominal voltages · System provides adequate cooling to ensure the case temperatures specified in Section 6.4.1 are not exceeded. 5.2.2 Preventive maintenance No routine scheduled preventive maintenance shall be required. 16 Cheetah 15K.5 SCSI Product Manual, Rev. C 5.

2.3 Hot plugging Cheetah 15K.5 SCSI disc drives The ANSI SPI-4 document defines the physical requirements for removal and insertion of SCSI devices on the SCSI bus. Four cases are addressed. The cases are differentiated by the state of the SCSI bus when the removal or insertion occurs. Case 1 - All bus devices powered off during removal or insertion Case 2 - RST signal asserted continuously during removal or insertion Case 3 - Current I/O processes not allowed during insertion or removal Case 4 - Current I/O process allowed during insertion or removal, except on the device being changed Seagate Cheetah 15K.5 SCSI disc drives support all four hot plugging cases. Provision shall be made by the system such that a device being inserted makes power and ground connections prior to the connection of any device signal contact to the bus. A device being removed shall maintain power and ground connections after the disconnection of any device signal contact from the bus (see SFF-8451 Specification for SCA-2 Unshielded Connections). It is the responsibility of the systems integrator to assure that no hazards from temperature, energy, voltage, or ESD potential are presented during the hot connect/disconnect operation.
All I/O processes for the SCSI device being inserted or removed shall be quiescent. All SCSI devices on the bus shall have receivers that conform to the SPI-4 standard. If the device being hot plugged uses single-ended (SE) drivers and the bus is currently operating in low voltage differential (LVD) mode, then all I/O processes for all devices on the bus must be completed, and the bus quiesced, before attempting to hot plug. Following the insertion of the newly installed device, the SCSI host adapter must issue a Bus Reset, followed by a synchronous transfer negotiation. Failure to perform the SCSI Bus Reset could result in erroneous bus operations.
The SCSI bus termination and termination power source shall be external to the device being inserted or removed. End users should not mix devices with high voltage differential (HVD) drivers and receivers and devices with SE, LVD, or multimode drivers and receivers on the same SCSI bus since the common mode voltages in the HVD environment may not be controlled to safe levels for SE and LVD devices (see ANSI SPI-4). The disc drive spindle must come to a complete stop prior to completely removing the drive from the cabinet chassis. Use of the Stop Spindle command or partial withdrawal of the drive, enough to be disconnected from the power source, prior to removal are methods for insuring that this requirement is met. During drive insertion, care should be taken to avoid exceeding the limits stated in Section 6.
4.4, "Shock and vibration" in this manual. 5.2.4 S.M.A.R.T. S.

M.A.R.T. is an acronym for Self-Monitoring Analysis and Reporting Technology. This technology is intended to recognize conditions that indicate drive degradation and is designed to provide sufficient warning of a failure to allow data back-up before an actual failure occurs. Note. The firmware will monitor specific attributes for degradation over time but cannot predict instantaneous drive failures. Each attribute monitors a specific set of conditions in the operating performance of the drive, and the thresholds are optimized to minimize "false" predictions. Cheetah 15K.
5 SCSI Product Manual, Rev. C 17 Controlling S.M.A.R.
T. The operating mode of S.M.A.R.
T. is controlled by the DEXCPT bit and the PERF bit of the "Informational Exceptions Control Mode Page" (1Ch). The DEXCPT bit is used to enable or disable the S.M.A.R.T. process. Setting the DEXCPT bit will disable all S.M.

A.R.T. functions. When enabled, S.M.A.R.T. will collect on-line data as the drive performs normal read/write operations.
When the PERF bit is set, the drive is considered to be in "On-line Mode Only" and will not perform off-line functions. The process of measuring off-line attributes and saving data can be forced by the Rezero Unit command. Forcing S.M.A.
R.T. will reset the timer so that the next scheduled interrupt will be two hours. The drive can be interrogated by the host to determine the time remaining before the next scheduled measurement and data logging process will occur. This is accomplished by a log sense command to log page 0x3E.
The purpose is to allow the customer to control when S.M.A.R.T. interruptions occur. As described above, forcing S.M.A.R.

T by the Rezero Unit command will reset the timer. Performance impact S.M.A.R.T. attribute data will be saved to the disc for the purpose of recreating the events that caused a predictive failure. The drive will measure and save parameters once every two hours subject to an idle period on the SCSI bus. The process of measuring off-line attribute data and saving data to the disc is uninterruptable and the maximum delay is summarized below:: Maximum processing delay On-line only delay DEXCPT = 0, PERF = 1 S.M.
A.R.T. delay times Fully-enabled delay DEXCPT = 0, PERF = 0 163 milliseconds 42 milliseconds Reporting control Reporting is controlled in the Informational Exceptions Control Page (1Ch). Subject to the reporting method, the firmware will issue a 01-5D00 sense code to the host.
The error code is preserved through bus resets and power cycles. Determining rate S.M.A.R.
T. monitors the rate at which errors occur and signals a predictive failure if the rate of degraded error rate increases to an unacceptable level. To determine rate, error events are logged and compared to the number of total operations for a given attribute. The interval defines the number of operations over which to measure the rate. The counter that keeps track of the current number of operations is referred to as the Interval Counter. S.M.A.R.T.

measures error rate, hence for each attribute the occurrence of an error is recorded.

A counter keeps track of the number of errors for the current interval. This counter is referred to as the Failure Counter. Error rate is simply the number of errors per operation. The algorithm that S.M.A.R.T. uses to record rates of error is to set thresholds for the number of errors and the interval.
If the number of errors exceeds the threshold before the interval expires, then the error rate is considered to be unacceptable. If the number of errors does not exceed the threshold before the interval expires, then the error rate is considered to be acceptable. In either case, the interval and failure counters are reset and the process starts over. Predictive failures S.M.
A.R.T. signals predictive failures when the drive is performing unacceptably for a period of time. The firmware keeps a running count of the number of times the error rate for each attribute is unacceptable.
To accomplish this, a counter is incremented whenever the error rate is unacceptable and decremented (not to exceed 18 Cheetah 15K.5 SCSI Product Manual, Rev. C zero) whenever the error rate is acceptable. This counter is referred to as the Failure History Counter. There is a separate Failure History Counter for each attribute. Should the counter continually be incremented such that it reaches the predictive threshold, a predictive failure is signaled. 5.2.5 Thermal monitor Cheetah 15K.5 SCSI drives implement a temperature warning system which: 1.

Signals the host if the temperature exceeds a value which would threaten the drive. 2. Signals the host if the temperature exceeds a user-specified value. 3. Saves a S.M.A.R.T. data frame on the drive which exceed the threatening temperature value.
A temperature sensor monitors the drive temperature and issues a warning over the interface when the temperature exceeds a set threshold. The temperature is measured at power-up and then at ten-minute intervals after power-up. The thermal monitor system generates a warning code of 01-0B01 when the temperature exceeds the specified limit in compliance with the SCSI standard. The drive temperature is reported in the FRU code field of mode sense data. You can use this information to determine if the warning is due to the temperature exceeding the drive threatening temperature or the user-specified temperature.
This feature is controlled by the Enable Warning (EWasc) bit, and the reporting mechanism is controlled by the Method of Reporting Informational Exceptions field (MRIE) on the Informational Exceptions Control (IEC) mode page (1Ch). The current algorithm implements two temperature trip points. The first trip point is set at 68°C which is the maximum temperature limit according to the drive specification. The second trip point is user-selectable using the Log Select command. The reference temperature parameter in the temperature log page (see Table 2) can be used to set this trip point.
The default value for this drive is 68°C, however, you can set it to any value in the range of 0 to 68°C. If you specify a temperature greater than 68°C in this field, the temperature is rounded down to 68°C. A sense code is sent to the host to indicate the rounding of the parameter field. Table 2: Temperature Log page (0Dh) Description Primary Temperature Reference Temperature Parameter Code 0000h 0001h When the first temperature trip point is exceeded, S.M.A.R.T. data is collected and a frame is saved to the disc. 5.

2.6 Drive Self Test (DST) Drive Self Test (DST) is a technology designed to recognize drive fault conditions that qualify the drive as a failed unit. DST validates the functionality of the drive at a system level. There are two test coverage options implemented in DST: 1. Extended test 2. Short text The most thorough option is the extended test that performs various tests on the drive and scans every logical block address (LBA) of the drive. The short test is time-restricted and limited in length--it does not scan the entire media surface, but does some fundamental tests and scans portions of the media. If DST encounters an error during either of these tests, it reports a fault condition. If the drive fails the test, remove it from service and return it to Seagate for service. Cheetah 15K.
5 SCSI Product Manual, Rev. C 19 5.2.6.1 DST Failure Definition The drive will present a "diagnostic failed" condition through the self-tests results value of the diagnostic log page if a functional failure is encountered during DST.
The channel and servo parameters are not modified to test the drive more stringently, and the number of retries are not reduced. All retries and recovery processes are enabled during the test. If data is recoverable, no failure condition will be reported regardless of the number of retries required to recover the data. The following conditions are considered DST failure conditions: · Seek error after retries are exhausted · Track-follow error after retries are exhausted · Read error after retries are exhausted · Write error after retries are exhausted Recovered errors will not be reported as diagnostic failures. 5.
2.6.2 Implementation This section provides all of the information necessary to implement the DST function on this drive. 5.2.6.2.1 State of the drive prior to testing The drive must be in a ready state before issuing the Send Diagnostic command. There are multiple reasons why a drive may not be ready, some of which are valid conditions, and not errors. For example, a drive may be in process of doing a format, or another DST.

It is the responsibility of the host application to determine the "not ready" cause. While not technically part of DST, a Not Ready condition also qualifies the drive to be returned to Seagate as a failed drive. A Drive Not Ready condition is reported by the drive under the following conditions: · Motor will not spin · Motor will not lock to speed · Servo will not lock on track · Drive cannot read configuration tables from the disc In these conditions, the drive responds to a Test Unit Ready command with an 02/04/00 or 02/04/03 code. 5.2.6.2.2 Invoking DST To invoke DST, submit the Send Diagnostic command with the appropriate Function Code (001b for the short test or 010b for the extended test) in bytes 1, bits 5, 6, and 7. Refer to the SCSI Commands Reference Manual, part number 100293068, for additional information about invoking DST. 5.
2.6.2.3 Short and extended tests DST has two testing options: 1. short 2.
extended These testing options are described in the following two subsections. Each test consists of three segments: an electrical test segment, a servo test segment, and a read/verify scan segment. 20 Cheetah 15K.5 SCSI Product Manual, Rev. C Short test (Function Code: 001b) The purpose of the short test is to provide a time-limited test that tests as much of the drive as possible within 120 seconds.
The short test does not scan the entire media surface, but does some fundamental tests and scans portions of the media.

A complete read/verify scan is not performed and only factual failures will report a fault condition. This option provides a quick confidence test of the drive. Extended test (Function Code: 010b) The objective of the extended test option is to empirically test critical drive components. For example, the seek tests and on-track operations test the positioning mechanism. The read operation tests the read head element and the media surface. The write element is tested through read/write/read operations. The integrity of the media is checked through a read/verify scan of the media. Motor functionality is tested by default as a part of these tests. The anticipated length of the Extended test is reported through the Control Mode page.

5.2.6.2.4 Log page entries When the drive begins DST, it creates a new entry in the Self-test Results Log page. The new entry is created by inserting a new self-test parameter block at the beginning of the self-test results log parameter section of the log page. Existing data will be moved to make room for the new parameter block. The drive reports 20 parameter blocks in the log page. If there are more than 20 parameter blocks, the least recent parameter block will be deleted. The new parameter block will be initialized as follows: 1.
The Function Code field is set to the same value as sent in the DST command 2. The Self-Test Results Value field is set to Fh 3. The drive will store the log page to non-volatile memory After a self-test is complete or has been aborted, the drive updates the Self-Test Results Value field in its SelfTest Results Log page in non-volatile memory. The host may use Log Sense to read the results from up to the last 20 self-tests performed by the drive. The self-test results value is a 4-bit field that reports the results of the test.
If the field is zero, the drive passed with no errors detected by the DST. If the field is not zero, the test failed for the reason reported in the field. The drive will report the failure condition and LBA (if applicable) in the Self-test Results Log parameter. The Sense key, ASC, ASCQ, and FRU are used to report the failure condition. 5.
2.6.2.5 Abort There are several ways to abort a diagnostic. You can use a SCSI Bus Reset or a Bus Device Reset message to abort the diagnostic. You can abort a DST executing in background mode by using the abort code in the DST Function Code field. This will cause a 01 (self-test aborted by the application client) code to appear in the self-test results values log. All other abort mechanisms will be reported as a 02 (self-test routine was interrupted by a reset condition). 5.2.

7 Product warranty Beginning on the date of shipment to customer and continuing for a period of five years, Seagate warrants that each product (including components and subassemblies) or spare part that fails to function properly under normal use due to defect in materials on workmanship or due to nonconformance to the applicable specifications will be repaired or replaced, at Seagate's option and at no charge to 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 customer. For more detailed warranty information refer to the Standard terms and conditions of Purchase for Seagate products. Cheetah 15K.5 SCSI Product Manual, Rev. C 21 Shipping When transporting or shipping a drive, a Seagate approved container must be used. Keep your original box. They 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 your Authorized Seagate Distributor to purchase additional boxes. Seagate recommends shipping by an air-ride carrier experienced in handling computer equipment. 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.
22 Cheetah 15K.5 SCSI Product Manual, Rev. C 6.0 Physical/electrical specifications This section provides information relating to the physical and electrical characteristics of the Cheetah 15K.5 SCSI drive.
6.1 None. AC power requirements 6.2 DC power requirements The voltage and current requirements for a single drive are shown in the following table. Values indicated apply at the drive power connector. The tables show current values in Amperes. Table 3: ST3300655LC DC power requirements Notes LVD mode Voltage Regulation Average idle current DC Maximum starting current (peak DC) DC (peak AC) AC Delayed motor start (max) DC Peak operating current DC Maximum DC Maximum (peak) DC X 3 3 3 +5 V [5] [1][6] [3] [3] [1] [4] [1] [1] ±5% 0.70 0.76 1.07 0.

57 0.69 0.70 1.38 +12 V ±5% [2] 0.80 1.94 3.35 0.03 1.18 1.23 2.
90 X 3 3 Cheetah 15K.5 SCSI Product Manual, Rev. C 23 Table 4: ST3146855LC DC power requirements Notes LVD mode Voltage Regulation Average idle current DC Maximum starting current (peak DC) DC (peak AC) AC Delayed motor start (max) DC Peak operating current DC Maximum DC Maximum (peak) DC X 3 3 3 +5 V [5] [1][6] [3] [3] [1] [4] [1] [1] ±5% 0.71 0.74 1.
04 0.56 0.67 0.68 1.42 +12 V ±5% [2] 0.
57 1.94 3.32 0.03 0.88 0.94 2.50 X 3 3 Table 5: ST373455LC DC power requirements Notes LVD mode Voltage Regulation Average idle current DC Maximum starting current (peak DC) DC (peak AC) AC Delayed motor start (max) DC Peak operating current DC Maximum DC Maximum (peak) DC [1] X 3 3 3 +5 V [5] [1][6] [3] [3] [1] [4] [1] [1] ±5% 0.69 0.72 1.00 0.

56 0.67 0.68 1.40 +12 V ±5% [2] 0.42 1.94 3.32 0.03 0.78 0.82 2.
38 X 3 3 [2] [3] [4] [5] [6] Measured with average reading DC ammeter or equivalent sampling scope. Instantaneous current peaks will exceed these values. Power supply at nominal voltage. Number of drives tested = 6, 35 Degrees C ambient. For +12 V, a 10% tolerance is permissible during initial start of spindle, and must return to ±5% before 15,000 rpm is reached.
The ±5% must be maintained after the drive signifies that its power-up sequence has been completed and that the drive is able to accept selection by the host initiator. See +12 V current profile in Figure 19. This condition occurs when the Motor Start Option is enabled and the drive has not yet received a Start Motor command. See Section 6.2.
1 "Conducted Noise Immunity." Specified voltage tolerance is inclusive of ripple, noise, and transient response. During idle, the drive heads are relocated every 60 seconds to a random location within the band from three-quarters to maximum track. General Notes for Tables 3, 4, and 5: 1. Minimum current loading for each supply voltage is not less than 1.

2% of the maximum operating current shown. 2. The +5 and +12 volt supplies shall employ separate ground returns. 3. Where power is provided to multiple drives from a common supply, careful consideration for individual drive power requirements should be noted.

Where multiple units are powered on simultaneously, the peak 24 Cheetah 15K.5 SCSI Product Manual, Rev. C starting current must be available to each device. 4. Parameters, other than spindle start, are measured after a 10-minute warm up. 5. No terminator power. 6.2.1 Conducted noise immunity 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. +5 V = +12 V = 250 mV pp from 0 to 100 kHz to 20 MHz. 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.
Power sequencing 6.2.2 The drive does not require power sequencing. The drive protects against inadvertent writing during power-up and down. Daisy-chain operation requires that power be supplied to the SCSI bus terminator to ensure proper termination of the peripheral I/O cables.
To automatically delay motor start based on the target ID (SCSI ID) enable the Delay Motor Start option and disable the Enable Motor Start option on the J6 connector on LW models or on the backplane for LC models. See Section 8.1 for pin selection information. To delay the motor until the drive receives a Start Unit command, enable the Enable Remote Motor Start option on the J6 connector on LW models or on the backplane for LC models. 6.2.3 Current profile Figures 19 and 20 show +5V and +12V sample current profiles for the ST3300655LC model. All times and currents are typical. See Table 3 for maximum current requirements. Cheetah 15K.

5 SCSI Product Manual, Rev. C 25 Figure 19. Typical ST3300655LW drive +12V LVD current profile Figure 20. Typical ST3300655LW drive +5 V LVD current profile 26 Cheetah 15K.5 SCSI Product Manual, Rev. C 6.3 Power dissipation ST3300655LW/ST3300655LC For drives using low voltage differential interface circuits, typical power dissipation under idle conditions is 13.1 watts (44.70 BTUs per hour). To obtain operating power for typical random read operations, refer to the following I/O rate curve (see Figure 21).
Locate the typical I/O rate for a drive in your system on the horizontal axis and read the corresponding +5 volt current, +12 volt current, and total watts on the vertical axis. To calculate BTUs per hour, multiply watts by 3.4123.) ST3300655LC CURRENT/POWER vs THROUGHPUT (SCSI - LVD) Random 8 Block Reads 1 .800 1 .
600 1 .400 1 .200 1 8.00 1 6.00 1 4.
00 5Vo lt A 1 Vo lt A 2 Watts Power (watts) 1 2.00 1 0.00 8.00 6.00 4.00 2.00 0.00 0.0 50.0 1 00.

0 1 50.0 200.0 250.0 300.0 350.0 400.0 Amperes 1 .000 0.800 0.600 0.
400 0.200 0.000 I/Os per Second Figure 21. ST3300655LC DC current and power vs. IOPS (LVD) Cheetah 15K.
5 SCSI Product Manual, Rev. C 27 ST3146855LW/ST3146855LC For drives using low voltage differential interface circuits, typical power dissipation under idle conditions is 10.39 watts (35.45 BTUs per hour). To obtain operating power for typical random read operations, refer to the following I/O rate curve (see Figure 22).
Locate the typical I/O rate for a drive in your system on the horizontal axis and read the corresponding +5 volt current, +12 volt current, and total watts on the vertical axis. To calculate BTUs per hour, multiply watts by 3.4123. ST3146855LC CURRENT/POWER vs THROUGHPUT (SCSI - LVD) Random 8 Block Reads 1 .800 1 .600 1 .400 1 .200 1 8.00 1 6.00 1 4.

00 5Vo lt A 1 Vo lt A 2 Watts Power (watts) 1 2.00 1 0.00 8.00 6.00 4.00 2.00 0.00 0.0 50.0 1 00.
0 1 50.0 200.0 250.0 300.0 350.
0 400.0 Amperes 1 .000 0.800 0.600 0.
400 0.200 0.000 I/Os per Second Figure 22. ST3146855LC DC current and power vs. IOPS (LVD) 28 Cheetah 15K.5 SCSI Product Manual, Rev. C ST373455LW/ST373455LC For drives using low voltage differential interface circuits, typical power dissipation under idle conditions is 8.49 watts (28.97 BTUs per hour). To obtain operating power for typical random read operations, refer to the following I/O rate curve (see Figure 23).

Locate the typical I/O rate for a drive in your system on the horizontal axis and read the corresponding +5 volt current, +12 volt current, and total watts on the vertical axis. To calculate BTUs per hour, multiply watts by 3.4123. ST373455LC CURRENT/POWER vs THROUGHPUT (SCSI - LVD) Random 8 Block Reads 1 .800 1 .600 1 .400 1 .200 1 8.00 1 6.00 1 4.
00 5Vo lt A 1 Vo lt A 2 Watts Power (watts) 1 2.00 1 0.00 8.00 6.00 4.
00 2.00 0.00 0.0 50.0 1 00.
0 1 50.0 200.0 250.0 300.0 350.0 400.0 Amperes 1 .000 0.800 0.600 0.

400 0.200 0.000 I/Os per Second Figure 23. ST373455LC DC current and power vs. IOPS (LVD) Cheetah 15K.5 SCSI Product Manual, Rev. C 29 6.4 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). 6.4.1 Temperature a.
Operating The maximum allowable continuous or sustained HDA case temperature for the rated Annualized Failure Rate (AFR) is 122°F (50°C). The maximum allowable HDA case temperature is 60°C. Occasional excursions of HDA case temperatures above 122°F (50°C) or below 41°F (5°C) may occur without impact to specified AFR. Continual or sustained operation at HDA case temperatures outside these limits may degrade AFR. Provided the HDA case temperatures limits are met, the drive meets all specifications over a 41°F to 131°F (5°C to 55°C) drive ambient temperature range with a maximum temperature gradient of 36°F (20°C) per hour.
Air flow may be needed in the drive enclosure to keep within this range (see Section 8.3). Operation at HDA case temperatures outside this range may adversely affect the drives ability to meet specifications. To confirm that the required cooling for the electronics and HDA case is provided, place the drive in its final mechanical configuration, perform random write/read operations and measure the HDA case temperature after it has stabilized. 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 1.0 " .

5" Figure 24. Locations of the HDA temperature check point 6.4.2 Relative humidity The values below assume that no condensation on the drive occurs. a. Operating 5% to 95% non-condensing relative humidity with a maximum gradient of 10% per hour. b. Non-operating 5% to 95% non-condensing relative humidity with a maximum gradient of 20% per hour. 6.4.

3 Effective altitude (sea level) a.