



Seagate[®] XF1440

PCIe[®] Gen 3 x4 - NVMe SSD



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Document Revision History

Revision	Date	Pages affected and description of change
Rev. A	10/06/2015	Initial release.
Rev. B	10/06/2015	12: Revised Section 4.4 text.
Rev. C	10/11/2015	5: Added Note #3: 10: Section 3.2.1 & Fig. 2 corrected to reflect "8639" connector

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When referring to drive capacity, one gigabyte, or GB, equals one billion bytes and one terabyte, or TB, equals one trillion bytes. Your computer's operating system may use a different standard of measurement and report a lower capacity. In addition, some of the listed capacity is used for formatting and other functions, and thus will not be available for data storage. Actual quantities will vary based on various factors, including file size, file format, features and application software. Actual data rates may vary depending on operating environment and other factors. The export or re-export of hardware or software containing encryption may be regulated by the U.S. Department of Commerce, Bureau of Industry and Security (for more information, visit www.bis.doc.gov), and controlled for import and use outside of the U.S. Seagate reserves the right to change, without notice, product offerings or specifications.

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1.0 Scope

Seagate XF1440 SSD is a PCIe Gen 3 SSD architected with the NVMe (Non-Volatile Memory express) interface that delivers leading performance, low latency, and world class reliability and endurance.

- **Interface:**
 - PCIe Gen 3 x4 - NVMe SSD
- **Capacities:**
 - 400GB, 480GB, 800GB, 960GB, 1.6TB, 1.8TB
- **Components:**
 - eMLC NAND Flash Memory
- **Form Factor:**
 - Industry standard SFF 2.5 inch, 7mm dimensions
- **Power**
 - Lower power than current Enterprise class products (<12.5W)
 - Power Loss Data Protection (PLDP)
 - Hot Plug capable
- **Shock**
 - Op/Non Op: 1500G @ 0.5ms
- **Vibration**
 - Op/Non Op: 3.08 Grms (7-800hz)
 - Op/Non Op: 16.3 Grms (20-2000hz)
- **Certifications**
 - CE, BSMI, KCC, C-Tick, FCC, IC, UL, TUV, CB
- **Reliability:**
 - Mean Time Between Failure (MTBF): 2 Million hours
 - Data Retention: 3 months @ 40C
 - Sector Size: 4096 bytes
- **Endurance**
 - Certain models support up to 3 Drive Writes/day
 - Certain models support up to 0.3 Drive Writes/day
- **Temperature**
 - Operating: 0 to 70C case temperature at specific airflow
 - Non Operating: -40 to 85C
- **Airflow**
 - Varies by capacity point. Refer to page 7 for details.
- **Performance**
 - Values vary by capacity and endurance. Refer to page 6 for details.
- **Security**
 - Self encryptions available
- **Product Compliance**
 - RoHS

2.0 Product Specifications

2.1 Models and Capacity

High Endurance with PLDP	High Capacity with PLDP
2.5" Models	2.5" Models
ST1600HM0011	ST1800HM0001
ST800HM0021	ST960HM0001
ST400HM0021	ST480HM0001

Table 1 Formatted Capacity at 4096 Block Size

XF1440 Series	Formatted Capacity
400GB	97,778,846
480GB	117,212,886
800GB	195,353,046
960GB	234,423,126
1600GB	390,703,446
1800GB	439,541,046

2.2 Performance

Table 2 Performance

Specification	400GB	480GB	800GB	960GB	1600GB	1800GB
Sequential Read (Mb/s) 128k, QD=32	2400	2400	2400	2400	2400	2400
Sequential Write (Mb/s) 128k, QD=32	600	600	800	800	800	800
Random Read (kIOPS) 4k, QD=64	200	200	200	200	200	200
Random Write (kIOPS) 4k, QD=64	34	6	34	7	34	3
80/20 Mixed Workload Random Read/Write (kIOPS) 4k, QD=64	116	26	116	30	116	20

Notes:

- [1] Performance results based on IOMeter.
IOMeter is available at <http://www.iometer.org/> or <http://sourceforge.net/projects/iometer/>.
IOMeter is licensed under the Intel Open Source License and the GNU General Public License.
- [2] Typical response times are measured under nominal conditions of temperature and voltage as measured on a representative sample of drives.
- [3] Measurements are performed on the drive once the workload has reached steady state, including all background activities required for normal operations.

2.3 Power Consumption

The 2.5" drive receives DC power (+12V) through the standard PCIe 8639 interface.

Table 3 DC Requirements

Supply Voltage	XF1440 Series
Voltage Tolerances - nominal (%)	12V ± 10%
DC Ripple/Noise	450mv max: 50 – 150K hz 150mmv max: 10M – 80M hz
Rise Time (Max*/Min) *10% ~ 90% Nominal Voltage	100ms* /0s (hot-pluggable)
Fall Time (Min)	100µs @ 1A max discharge
Minimum Off Time	150ms
Inrush Current (Typical Peak)	2A for <2ms

Table 4 Power

Specification	XF1440 Series
Max Operating Power (W)	12.5
Average Read/Write Power (W)	9.0
Power State 1 (W)	8.25
Power State 2 (W)	6.0

Notes:

- [1] NVMe Autonomous Power States are not supported
- [2] Typical power measurements are based on an average of drives tested under nominal conditions

2.4 Power Loss Data Protection

If power is interrupted, at any time while data is being programmed into the NAND, it is possible that data loss may occur. This can cause drive errors to be reported to the host. To prevent these errors from occurring, XF 1440 implements an energy storage solution called Power Loss Data Protection. This is a circuit that maintains power to the NAND while it is being programmed, even if power to the system is interrupted. By supporting Power Loss Data Protection, the drive assures data integrity in the drive is preserved, preventing the loss of data and the reporting of drive errors to the host.

2.5 Environmental Conditions

Table 5 Temperature

Specification	XF1440 Series
Temperature (degrees C) Operating (case temperature at specific airflow) Non-Operating	0 to 70 -40 to 85
Temperature Gradient Maximum (C per hour) Operating Non-Operating	20C/hr 20C/hr

Table 6 Shock

Specification	XF1440 Series
Shock - Maximum Operating [2] / Non Operating [3]	1500 G's at 0.5 ms

Notes:

- [1] Specification does not cover connection issues that may result from testing at this level
- [2] Operating shock - The drive, as installed for normal operation, shall operate error free while subjected to intermittent shock not exceeding specification. Shock may be applied in the X, Y, or Z-axis. Shock is not to be repeated more than once every 2 seconds
- [3] Non-Operating shock - The limits of non-operating shock shall apply to all conditions of handling and transportation. This includes both isolated drive and integrated drives. Shock may be applied in the X, Y, or Z-axis.

Table 7 Vibration

Specification	XF1440 Series
Vibration - Maximum Operating [1] / Non Operating [2]	3.08 Grms (7-800 Hz) 16.3 Grms (20-2000 Hz)

Notes:

- [1] Operating vibration - The drive, as installed for normal operation, shall operate error free while subjected to specified vibration not exceeding specification. Vibration may be applied in the X, Y, or Z-axis.
- [2] Non-Operating vibration - The limits of non-operating vibration shall apply to all conditions of handling and transportation. This includes both isolated drive and integrated drives. Vibration may be applied in the X, Y, or Z-axis.

Table 8 Airflow Requirements for SFF

Airflow Definition	Unit	Ambient Temperature	400GB/480GB	800GB/960GB	1600GB/1800GB
Airflow Along Drive [1]	LMF	35C	110	412	412

Notes:

[1] It is recommended that airflow for 2.5-inch form factor should be towards the server, from the non-connector side to the connector side. Airflow is specified across the surface of the drive. Spacing all sides was assumed to be 3mm.

2.6 Reliability**Table 9 Reliability**

Specification	XF1440 Series
Mean Time Between Failures (MTBF) [1] [2]	2,000,000 Hours
Data Retention [3]	3 months @ 40C

Notes:

[1] The MTBF specification is based on the following assumptions for Enterprise Storage System environments: 8760 power on hours per year, 250 power on/off cycles per year, and nominal voltages.

[2] The production drive shall achieve specified MTBF when operated in an environment that ensures the case temperatures do not exceed the temperature specifications.

[3] Data Retention is the time period for retaining data in the NAND at maximum rated endurance

2.7 Endurance**Table 10 Endurance**

2.5"	Model Type	400GB	480GB	800GB	960GB	1600GB	1800GB
Endurance Rating [1]	High Endurance	3		3		3	
	High Capacity		0.3		0.3		0.3

Notes:

[1] Endurance rating is the expected amount of host data that can be written by product when subjected to a specified work-load at a specified operating and storage temperature over the specified product life. For the specific workload to achieve this level of endurance, please reference JEDEC Specification JESD218. TBW is defined as 1x10¹² Bytes.

3.0 Mechanical Information

3.1 Mechanical Dimensions & Weight

Weight: 2.5" models 0.198 pounds 90 grams

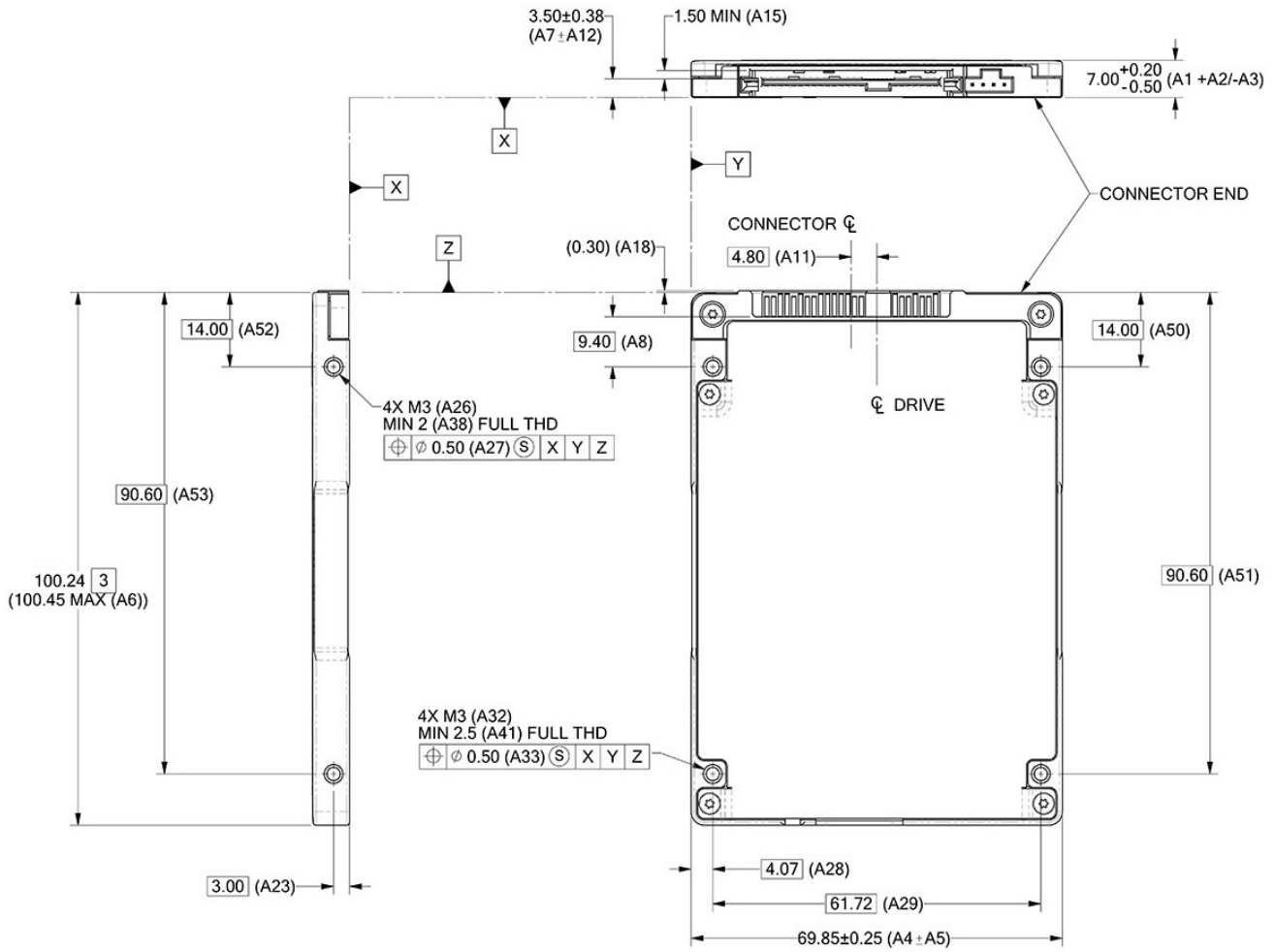


Figure 1. Configuration dimensions (2.5" models)

Note. These dimensions conform to the Small Form Factor Standard documented in SFF-8201 and SFF-8639 found at www.sffcommittee.org.

3.2 Bottom Cover Stiffness/Deflection

Operating: No uncorrectable errors	10mm probe: 1.02kgf or 5mm probe: 0.92kgf
Non-Operating: No uncorrectable errors	20mm probe: 2.0kgf on any point on bottom cover

3.2.1 8639 Connector and Pin Descriptions

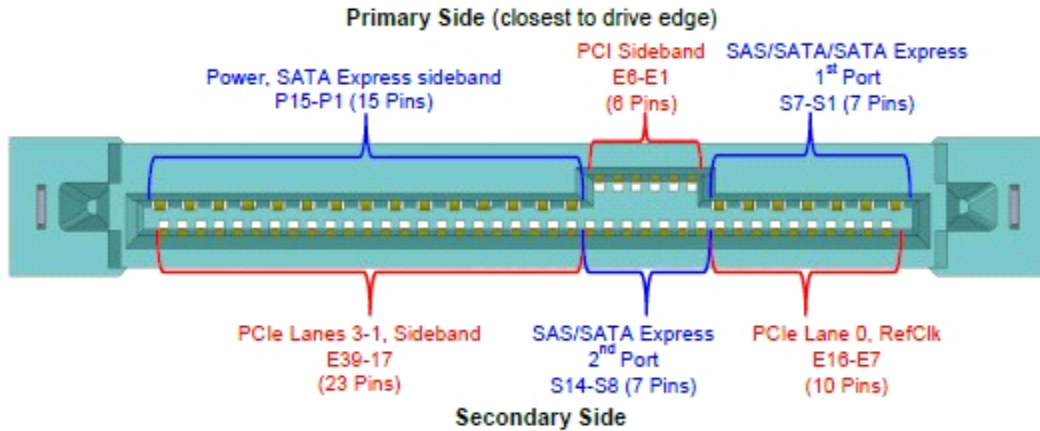


Figure 2. 8639 Connector

Note: To review the latest specification regarding the physical 8639 connector, refer to www.pcisig.com website and reference the latest PCI Express Electromechanical specification.

PCIe 8639 Pin Descriptions:

Pin	Name	Description	Pin	Name	Description
S1	GND	Ground	E7	REFCLK	Reference clock port 0
S2	NU	Not used (SATA/SAS)	E8	REFCLK	Reference clock port 0
S3	NU	Not used (SATA/SAS)	E9	GND	Ground
S4	GND	Ground	E10	PETp0	Transmitter differential pair, Lane 0
S5	NU	Not used (SATA/SAS)	E11	PETn0	Transmitter differential pair, Lane 0
S6	NU	Not used (SATA/SAS)	E12	GND	Ground
S7	GND	Ground	E13	PERn0	Receiver differential pair, Lane 0
E1	NU	(not used)	E14	PERp0	Receiver differential pair, Lane 0
E2	NU	(not used)	E15	GND	Ground
E3	NU	3.3V auxiliary power (not used)	E16	RSVD	Reserved
E4	NU	(not used)	S8	GND	Ground
E5	PERST0	Fundamental reset port 0	S9	NU	Not used (SATAe/SAS)
E6	RSVD	Reserved (Seagate Internal)	S10	NU	Not used (SATAe/SAS)
P1	NU	Not used (SATAe)	S11	GND	Ground
P2	NU	Not used (SATAe)	S12	NU	Not used (SATAe/SAS)
P3	CLKREQ	Clock Request	S13	NU	Not used (SATAe/SAS)
P4	IFDet#	Interface detect (drive type)	S14	GND	Ground
P5	GND	Ground	S15	RSVD	Reserved (Seagate internal)
P6	GND	Ground	S16	GND	Ground
P7	NU	Not used (SATA/SAS)	S17	PETp1	Transmitter differential pair, Lane 1
P8	NU	Not used (SATA/SAS)	S18	PETn1	Transmitter differential pair, Lane 1
P9	NU	Not used (SATA/SAS)	S19	GND	Ground
P10	PRSENT#	Presence detect (also used for drive type)	S20	PERn1	Receiver differential pair, Lane 1
P11	ACT	Activity signal from the drive	S21	PERp1	Receiver differential pair, Lane 1
P12	Hot-Plug GND	Ground	S22	GND	Ground
P13	+12V_pre	12V power	S23	PETp2	Transmitter differential pair, Lane 2
P14	+12V	12V power	S24	PETn2	Transmitter differential pair, Lane 2
P15	+12V	12V power	S25	GND	Ground
			S26	PERn2	Receiver differential pair, Lane 2
			S27	PERp2	Receiver differential pair, Lane 2
			S28	GND	Ground
			E17	PETp3	Transmitter differential pair, Lane 3
			E18	PETn3	Transmitter differential pair, Lane 3
			E19	GND	Ground
			E20	PERn3	Receiver differential pair, Lane 3
			E21	PERp3	Receiver differential pair, Lane 3
			E22	GND	Ground
			E23	NU	SMBus clock (not used)
			E24	NU	SMBus data (not used)
			E25	NU	Dual port enable (not used)

4.0 Interface requirements

4.1 PCIe features

This section lists the PCIe-specific features supported by Seagate XF1440 SSD drives.

4.2 Interface Commands Supported:

The Seagate XF1440 SSD supports all the mandatory NVMe Admin and I/O command-sets. In addition, several optional commands are also supported. Below is a table showing the Commands, Op-code, whether Admin or IO and mandatory or optional:

NVMe Admin Command Set

Mandatory NVMe commands:

- Delete I/O Submission Queue
- Delete I/O Completion Queue
- Create I/O Submission Queue
- Create I/O Completion Queue
- Get Log Page (log pages identified in the following pages)
- Identify
- Abort
- SET Features
- GET Features
- Asynchronous Event Notification

Optional Admin commands in NVMe revision 1.0:

- Firmware Activate
- Firmware Image Download
- Format NVM

Note: See Appendix A, "Identify Controller Data Structure" for details on commands and capabilities.

NVMe I/O Command Set

Mandatory NVMe commands set defined in NVMe 1.0 specification:

- Flush
- Write
- Read

Additionally, the following optional commands are supported:

- Write Uncorrectable
- Dataset Management (De-allocate only)

4.3 Log Page Support

XF1440 Series supports the following mandatory log pages defined in NVMe 1.0 specification:

- Error Information (Log Identifier 01h)
- SMART/ Health Information (Log Identifier 02h)
- Firmware Slot Information (Log Identifier 03h)

Note: See NVMe 1.0 version of the specification for the log page content

4.4 SMART Attributes

The following table lists the supported SMART attributes.

Table 11 SMART Attributes (Log Identifier 02h)

Byte	# of Bytes	Attribute	Description
0	1	<p>Critical Warning: These bits, if set, flag various warning sources. Bit 0: Available Spare is below Threshold Bit 1: Temperature has exceeded Threshold Bit 2: Reliability is degraded due to excessive media or internal errors Bit 3: Media is placed in Read- Only Mode Bit 4: Volatile Memory Backup System has failed (e.g., enhanced power loss capacitor test failure) Bits 5-7: Reserved</p>	Any of the critical warning can be tied to asynchronous event notification. Drive Health Indicator defined under bytes 3095-3076 of Identify Controller may still indicate "healthy" status when the critical warning flag is set.
1	2	<p>Temperature: Overall Device current temperature in Kelvin</p>	For AIC, this reports the NAND temperature, for 2.5-inch FF, this reports the case temperature,
3	1	Available Spare: Contains a normalized percentage (0 to 100%) of the remaining spare capacity available	Starts from 100 and decrements.
4	1	Available Spare Threshold	Threshold is set to 10%.
5	1	Percentage Used Estimate (Value allowed to exceed 100%)	A value of 100 indicates that the estimated endurance of the device has been consumed, but may not indicate a device failure. The value is allowed to exceed 100. Percentages greater than 254 shall be represented as 255. This value shall be updated once per power-on hour (when the controller is not in a sleep state).
32	16	Data Units Read (in LBAs)	Contains the number of 512 byte data units the host has read from the controller; this value does not include metadata. This value is reported in thousands (i.e., a value of 1 corresponds to 1000 units of 512 bytes read) and is rounded up. When the LBA size is a value other than 512 bytes, the controller shall convert the amount of data read to 512-byte units.
48	16	Data Units Write (in LBAs)	Contains the number of 512 byte data units the host has written to the controller; this value does not include metadata. This value is reported in thousands (i.e., a value of 1 corresponds to 1000 units of 512 bytes written) and is rounded up. When the LBA size is a value other than 512 bytes, the controller shall convert the amount of data written to 512-byte units. For the NVM* command set, logical blocks written as part of Write operations shall be included in this value. Write Uncorrectable commands shall not impact this value.

Table 11 SMART Attributes (Log Identifier 02h)

Byte	# of Bytes	Attribute	Description
64	16	Host Read Commands	Contains the number of read commands issued to the controller.
80	16	Host Write Commands	Contains the number of write commands issued to the controller.
96	16	Controller Busy Time (in minutes)	Contains the amount of time the controller is busy with I/O commands. The controller is busy when there is a command outstanding to an I/O Queue (specifically, a command was issued by way of an I/O Submission Queue Tail doorbell write and the corresponding completion queue entry has not been posted yet to the associated I/O Completion Queue). This value is reported in minutes.
112	16	Power Cycles	Contains the number of power cycles.
128	16	Power On Hours	Contains the number of power-on hours. This does not include time that the controller was powered and in a low power state condition.
144	16	Unsafe Shutdowns	Contains the number of unsafe shutdowns. This count is incremented when a shutdown notification (CC.SHN) is not received prior to loss of power.
160	16	Media Errors	Contains the number of occurrences where the controller detected an unrecovered data integrity error. Errors such as uncorrectable ECC, CRC checksum failure, or LBA tag mismatch are included in this field.
176	16	Number of Error Information Log Entries	Contains the number of Error Information log entries over the life of the controller.

5.0 Standards and Reference Documents

5.1 Standards

The Seagate XF1440 SSD family complies with Seagate standards as noted in the appropriate sections of this manual.

The drives are recognized in accordance with UL 60950-1 as tested by UL, CSA 60950-1 as tested by CSA, and EN60950-1 as tested by TUV.

The security features of Self-Encrypting Drive models are based on the “TCG Storage Architecture Core Specification” and the “TCG Storage Workgroup Security Subsystem Class: Enterprise_A” specification with additional vendor-unique features as noted in this product manual.

5.1.1 Electromagnetic compatibility

The drive, as delivered, is designed for system integration and installation into a suitable enclosure prior to use. 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. The drive is capable of meeting the Class A 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.

5.1.1.1 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.

5.1.2 Electromagnetic compliance

Seagate uses an independent laboratory to confirm compliance with the directives/standards for CE Marking and C-Tick Marking. The drive was tested in a representative system for typical applications and comply with the Electromagnetic Interference/Electromagnetic Susceptibility (EMI/EMS) for Class A products. The selected system represents the most popular characteristics for test platforms. The system configurations include:

- Typical current use microprocessor
- Keyboard
- Monitor/display
- Printer
- Mouse

Although the test system with this Seagate model complies with the directives/standards, we cannot guarantee that all systems will comply. The computer manufacturer or system integrator shall confirm EMC compliance and provide the appropriate 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 2004/108/EC as put into place on 20 July 2007.

Canada ICES-003

If this model has the ICES-003 Marking it complies with the Canadian Standard Association Standard CAN/CSA-CISPR 22-10, Information Technology Equipment - Radio Disturbance Characteristics - Limits and Methods of Measurement.

Australian RCM Mark

If this model has the RCM Marking it complies with the Australia/New Zealand Standard AS/NZ CISPR22 and meets the Electromagnetic Compatibility (EMC) Framework requirements of Australia's Radiocommunications Act.

Korean KCC

If these drives have the Korean Communications Commission (KCC) logo, they comply with KN22, KN 24, and KN61000.

Taiwanese BSMI

If this model has two Chinese words meaning "EMC certification" followed by an eight digit identification number, as a 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).

5.1.3 European Union Restriction of Hazardous Substances (RoHS)

The European Union Restriction of Hazardous Substances (RoHS) Directive restricts the presence of chemical substances, including Lead (Pb), in electronic products effective July 2006.

A number of parts and materials in Seagate products are procured from external suppliers. We rely on the representations of our suppliers regarding the presence of RoHS substances in these parts and materials. Our supplier contracts require compliance with our chemical substance restrictions, and our suppliers document their compliance with our requirements by providing material content declarations for all parts and materials for the disk drives documented in this publication. Current supplier declarations include disclosure of the inclusion of any RoHS-regulated substance in such parts or materials.

Seagate also has internal systems in place to ensure ongoing compliance with the RoHS Directive and all laws and regulations which restrict chemical content in electronic products. These systems include standard operating procedures that ensure that restricted substances are not utilized in our manufacturing operations, laboratory analytical validation testing, and an internal auditing process to ensure that all standard operating procedures are complied with.

5.1.4 China Restriction of Hazardous Substances (RoHS) Directive 中国限制危险物品的指令

This product has an Environmental Protection Use Period (EPUP) of 20 years. The following table contains information mandated by China's "Marking Requirements for Control of Pollution Caused by Electronic Information Products" Standard.



该产品具有20年的环境保护使用周期（EPUP）。下表包含了中国“电子产品所导致的污染的控制的记号要求”所指定的信息。

Name of Parts 部件名称	Toxic or Hazardous Substances or Elements 有毒有害物质或元素					
	Lead 铅 (Pb)	Mercury 汞 (Hg)	Cadmium 镉 (Cd)	Hexavalent Chromium 六价铬 (Cr6+)	Polybrominated Diphenyl 多溴联苯 (PBB)	Polybrominated Diphenyl Ether 多溴二苯醚 (PBDE)
PCBA	X	0	0	0	0	0
Chassis	X	0	0	0	0	0

"0" indicates the hazardous and toxic substance content of the part (at the homogeneous material level) is lower than the threshold defined by the China RoHS MCV Standard.

“0”表示该部件（于同类物品程度上）所含的危险和有毒物质低于中国RoHS MCV标准所定义的门槛值。

"X" indicates the hazardous and toxic substance content of the part (at the homogeneous material level) is over the threshold defined by the China RoHS MCV Standard.

“X”表示该部件（于同类物品程度上）所含的危险和有毒物质超出中国RoHS MCV标准所定义的门槛值。

5.2 Reference Documents and Support

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

Title	Location
PCIe specifications: PCIe - PCI Express Electromechanical specification, revision 3.0 NVMe - Non Volatile Memory Express specification 1.1b PCIe CEM - PCI Express Card Electromechanical specification, revision 1.1	www.pcisig.com
Trusted Computing Group (TCG) Documents TCG Storage Architecture Core Specification, Rev. 1.0 TCG Storage Security Subsystem Class Enterprise Specification, Rev. 1.0	www.trustedcomputinggroup.org
Solid State Drive Requirements and Endurance Test Methods JESD218 JESD219	www.jedec.org

Seagate Support Services	Location
For information regarding online support and services, visit: Available services include: <ul style="list-style-type: none"> • Presales & Technical support • Global Support Services telephone numbers & business hours • Authorized Service Centers Warranty terms will vary based on type of warranty chosen: "Managed Life" or "Limited Warranty with Media Usage". Consult the Seagate sales representative for warranty terms and conditions. For information regarding data recovery services, visit: For Seagate OEM, Distribution partner portal, and reseller portal, visit:	http://www.seagate.com/about/contact-us/technical-support/ http://www.seagate.com/services-software/data-recovery-services/ http://www.seagate.com/partners/



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