



# Seagate® Nytro® 1351, 1551 SSD

## Product Manual

**Nytro 1351 - Read Intensive Models    Nytro 1551 - Mixed Workload Models**

**SED - TCG Enterprise**

XA240LE10023  
XA480LE10083  
XA960LE10083  
XA1920LE10083  
XA3840LE10083

**SED - TCG Opal**

XA240LE10043  
XA480LE10103  
XA960LE10103  
XA1920LE10103  
XA3840LE10103

**Standard**

XA240LE10003  
XA480LE10063  
XA960LE10063  
XA1920LE10063  
XA3840LE10063

**SED - TCG Enterprise**

XA240ME10023  
XA480ME10083  
XA960ME10083  
XA1920ME10083  
XA3840ME10083

**SED - TCG Opal**

XA240ME10043  
XA480ME10103  
XA960ME10103  
XA1920ME10103  
XA3840ME10103

**Standard**

XA240ME10003  
XA480ME10063  
XA960ME10063  
XA1920ME10063  
XA3840ME10063

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## Revision History

Version and Date	Description of Changes
Rev D, July 2019	Updated <a href="#">Section 6.2, SMART Attributes</a>
Rev C, June 2019	Updated: <ul style="list-style-type: none"><li>■ <a href="#">Section 2.1, Models and Capacity.</a></li><li>■ <a href="#">Section 2.2, Performance.</a></li><li>■ <a href="#">Section 3.1, Dimensions and Weight.</a></li></ul>
Rev B, November 2018	Updated: <ul style="list-style-type: none"><li>■ <a href="#">Table 4 Performance - Capacity Optimized (7% OP - Default as Shipped).</a></li><li>■ <a href="#">Table 5 Performance - Performance Optimized (28% OP - Available with Tunable Capacity).</a></li><li>■ <a href="#">Section 2.7, Endurance.</a></li><li>■ Thermal non-operating note in <a href="#">Table 7 Temperature, Humidity, Shock.</a></li></ul>
Rev A, July 2018	First release of the document.

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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](http://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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## Seagate Technology Support Services

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For information regarding Warranty Support, visit: <http://www.seagate.com/support/warranty-and-replacements/>

For information regarding data recovery services, visit:

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# 1. Introduction

The Seagate® Nytro® 1351 and Nytro 1551 next generation enterprise SATA SSDs deliver enterprise class features in a 2.5-inch × 7 mm form factor.

**Table 1 Features**

Feature	Description
<b>Capacity</b>	<ul style="list-style-type: none"> <li>■ 240, 480, 960, 1920, or 3840 GB</li> </ul>
<b>Certifications, Eco-Compliance</b>	<ul style="list-style-type: none"> <li>■ CE, UL, cUL, RCM, BSMI, KCC, TUV, Microsoft WHCK, Microsoft WHQL, SATA-IO</li> <li>■ RoHS, WEEE</li> </ul>
<b>Dimension</b>	<ul style="list-style-type: none"> <li>■ Width: 69.85±0.25 millimeters</li> <li>■ Length: 100±0.25 millimeters</li> <li>■ Height: Maximum 7 millimeters</li> </ul>
<b>Endurance</b>	<ul style="list-style-type: none"> <li>■ Lifetime Endurance: Nytro 1551 3 DWPD Class; Nytro 1351 1 DWPD Class</li> </ul>
<b>Logical Block Size</b>	<ul style="list-style-type: none"> <li>■ 512 bytes</li> </ul>
<b>Form Factor</b>	<ul style="list-style-type: none"> <li>■ 2.5 inch × 7 mm Standard SSD</li> </ul>
<b>Interface Compliance</b>	<ul style="list-style-type: none"> <li>■ Fully compliant with SATA revision 3.2 and 3.3, compatible with SATA 6.0Gb/s and 3.0Gb/s interface rates.</li> <li>■ Fully compliant with ATA/ATAPI Command Set – 4 and supports all mandatory ATA commands defined in the ATA8-ACS specification. <ul style="list-style-type: none"> <li>— ATA General Feature Command Set</li> <li>— Power Management Command Set</li> <li>— Security Mode Feature Set</li> <li>— SMART Command Set</li> <li>— Device Statistics</li> <li>— SMART Command Transport</li> <li>— Dataset Management Command Set</li> <li>— Host Protected Area Command Set</li> <li>— 48-bit Address Command Set</li> <li>— General Purpose Log Command Set</li> <li>— Native Command Queuing</li> <li>— Software Settings Prevention</li> <li>— ATA Sanitize Command Set</li> <li>— Identify Device Command Set</li> <li>— Log Addresses Requirement</li> </ul> </li> <li>■ PIO, DMA, UDMA (up to 6, dependent on host) supported.</li> <li>■ SATA 6.0Gb/s Native Command Queuing (NCQ): up to 32 commands.</li> <li>■ SMART command transport (SCT) technology.</li> <li>■ SEND FPDMA QUEUED (NCQ-Trim)</li> </ul>
<b>NAND</b>	<ul style="list-style-type: none"> <li>■ 3D TLC</li> </ul>
<b>Flash Controller</b>	<ul style="list-style-type: none"> <li>■ Seagate proprietary Flash Controller</li> <li>■ Seagate DuraWrite™ Technology for improved performance</li> </ul>
<b>Performance</b>	<ul style="list-style-type: none"> <li>■ See <a href="#">Section 2.1, Models and Capacity, on page 8.</a></li> </ul>
<b>Power Consumption</b>	<ul style="list-style-type: none"> <li>■ See <a href="#">Section 2.3, Power, on page 11.</a></li> </ul>

**Table 1 Features (Continued)**

Feature	Description
<b>Power Loss Data Protection</b>	<ul style="list-style-type: none"> <li>■ In-process writes to the NAND are completed in the event of an unexpected power loss</li> </ul>
<b>Power Management</b>	<ul style="list-style-type: none"> <li>■ OS-aware hot-plug/hot-swap support</li> </ul>
<b>Power On Ready</b>	<ul style="list-style-type: none"> <li>■ See <a href="#">Section 2.3, Power, on page 11</a>.</li> </ul>
<b>Reliability</b>	<ul style="list-style-type: none"> <li>■ Power-loss data protection</li> <li>■ SMART thermal monitoring</li> <li>■ MTBF: 2 million hours @ 55°C</li> <li>■ UBER: 1 read error per 10<sup>17</sup>bits read</li> <li>■ End-to-End data-path protection</li> <li>■ Seagate SHIELD – Advanced ECC for improved reliability with minimal impact on performance <ul style="list-style-type: none"> <li>— Adaptive Code Rates</li> <li>— Intelligent Noise handling</li> <li>— Adaptive Read Voltage calibration</li> <li>— Multi-Level Error Correction - Best-in-class LDPC implementation</li> </ul> </li> <li>■ Seagate RAISE (Redundant Array of Independent Silicon Elements) <ul style="list-style-type: none"> <li>— Protects user data from various flash silicon failures</li> <li>— RAID-like data protection and recovery from flash memory failures</li> <li>— Operates within a single drive without impacting performance</li> <li>— Corrects a single page, single block or single die failure within one RAISE stripe on capacities 480GB and higher. For 240GB, corrects a single page, single block or single plane failure within one RAISE stripe.</li> </ul> </li> </ul>
<b>Security</b>	<ul style="list-style-type: none"> <li>■ Seagate Secure™</li> <li>■ Secure Supply Chain <ul style="list-style-type: none"> <li>— O-TTPS (Open Trusted Technology Provider Standard) compliant</li> </ul> </li> <li>■ SD&amp;D (Secure Download &amp; Diagnostics) <ul style="list-style-type: none"> <li>— Cryptographic FW signing, RSA 2048 key</li> <li>— Secure Boot</li> <li>— Locked Diagnostic Port</li> <li>— FW Authenticity and Integrity Verification, SHA 256</li> </ul> </li> <li>■ Instant Secure Erase/TCG Enterprise Protocol, AES-256 Encryption models</li> <li>■ TCG Opal Protocol, AES-256 Encryption models</li> </ul> <p><b>NOTE</b> Windows Hardware Quality Labs (WHQL) certification for Opal configurations is not available at this time.</p>
<b>Shock</b>	<ul style="list-style-type: none"> <li>■ Operating: 1000G, duration 0.5ms</li> <li>■ Non-Operating: 1000G, duration 0.5ms</li> </ul>
<b>Vibration</b>	<ul style="list-style-type: none"> <li>■ Operating: Random, 3.8 Grms, 10-3000Hz, Uniform PSD:0.005 G<sup>2</sup>/Hz</li> <li>■ Non-Operating: Random, 7 Grms, 10-500Hz, Uniform PSD:0.01 G<sup>2</sup>/Hz</li> </ul>
<b>Voltage</b>	<ul style="list-style-type: none"> <li>■ 5 V (240GB, 480GB)</li> <li>■ 5 V and 12 V (960GB, 1920GB, 3840GB)</li> </ul>
<b>Data Retention</b>	<ul style="list-style-type: none"> <li>■ 3 months power-off retention at 40°C once the drive reaches the rated write endurance (EOL)</li> </ul>
<b>Temperature Range</b>	<ul style="list-style-type: none"> <li>■ Operating: 0°C to 70°C</li> <li>■ Non-operating: -40°C to 85°C</li> </ul>

**Table 1 Features (Continued)**

Feature	Description
<b>Thermal gradient</b>	<ul style="list-style-type: none"><li>■ Operating: 20°C/hour</li><li>■ Non-operating: 30°C/hour</li></ul>
<b>Tunable Capacity</b>	<ul style="list-style-type: none"><li>■ Set to Capacity Optimized or Performance Optimized</li></ul>
<b>Warranty</b>	<ul style="list-style-type: none"><li>■ Five years limited Warranty with Media Usage, based on the shorter of term or endurance usage of the drive. See <a href="#">Section 2.7, Endurance, on page 14</a>.</li></ul>
<b>Weight</b>	<ul style="list-style-type: none"><li>■ up to 77g ±5%</li></ul>

## 2. Specifications

### 2.1 Models and Capacity

**Table 2 Nytro 1351 - Read Intensive - 1 DWPD Models**

Capacity (GB)	LBA Count	SED - TCG Enterprise	SED - TCG Opal (no WHQL certification)	Standard
240	468,862,128	XA240LE10023	XA240LE10043	XA240LE10003
480	937,703,088	XA480LE10083	XA480LE10103	XA480LE10063
960	1,875,385,008	XA960LE10083	XA960LE10103	XA960LE10063
1920	3,750,748,848	XA1920LE10083	XA1920LE10103	XA1920LE10063
3840	7,501,476,528	XA3840LE10083	XA3840LE10103	XA3840LE10063

**Table 3 Nytro1551 - Mixed Workload - 3 DWPD Models**

Capacity (GB)	LBA Count	SED - TCG Enterprise	SED - TCG Opal (no WHQL certification)	Standard
240	468,862,128	XA240ME10023	XA240ME10043	XA240ME10003
480	937,703,088	XA480ME10083	XA480ME10103	XA480ME10063
960	1,875,385,008	XA960ME10083	XA960ME10103	XA960ME10063
1920	3,750,748,848	XA1920ME10083	XA1920ME10103	XA1920ME10063
3840	7,501,476,528	XA3840ME10083	XA3840ME10103	XA3840ME10063



## 2.2 Performance

**Table 4 Performance - Capacity Optimized (7% OP - Default as Shipped)**

Capacity	Units	240 GB		480 GB		960 GB		1920 GB		3840 GB	
		0%	20%	0%	20%	0%	20%	0%	20%	0%	20%
128K SR QD32	MB/s	564	564	564	564	564	564	564	564	564	564
128K SW QD32	MB/s	232	333	488	536	536	537	536	537	536	536
4K RR QD32	KIOPs	55	57	80	82	93	93	94	94	90	92
4K R70R QD32	KIOPs	18	32	29	45	40	57	47	66	46	61
4K RW QD32	KIOPs	8	30	16	48	22	59	23	48	22	41
8K RR QD32	KIOPs	43	49	56	57	57	57	57	57	57	57
8K R70R QD32	KIOPs	11	24	16	34	22	40	31	44	32	45
8K RW QD32	KIOPs	4	17	9	34	14	40	15	40	13	37
4K RR Latency QD1	usec	154	150	154	148	153	148	154	150	172	162
4K RW Latency QD1	usec	124	37	65	38	58	38	58	38	58	38
4K RR QD32 99% CI	usec	1800	1800	800	800	600	600	600	600	700	700
4K R70R QD32 99% CI	usec	7300	4700	5000	3700	3900	3000	3700	2800	3600	2700
4K RW QD32 99% CI	usec	6700	3000	3400	1600	3000	800	2900	1900	3000	2000
4K RR QD32 99.99% CI	usec	2000	2000	1600	1200	800	1000	800	900	1800	1800
4K R70R QD32 99.99% CI	usec	14000	8400	9400	6400	7200	6000	6300	5500	6300	5600
4K RW QD32 99.99% CI	usec	9200	5200	5600	3400	4400	2100	4200	2000	3900	2300

### NOTE

Information on performance:

- 0% refers to data that cannot be compressed and 20% refers to data for which the size can be losslessly compressed by 20%. Performance values shown is based on data compressibility values of 0% and 20% as set with VDBench.
- The scripts that were used to arrive at these measurements are available on request.
- MB is 10<sup>6</sup> bytes. MB/s = 10<sup>6</sup> bytes/sec.
- 4 KB = 4,096 bytes, 8 KB = 8,192 bytes.
- All workloads set to 4 KB alignment.
- All metrics represent sustained values, across full LBA range.
- Drive write cache is active and protected by Power Loss Data Protection (PLDP) feature.
- Performance test precondition: The drive is preconditioned with 2x drive capacity 128 KB sequential write IOs, prior to sequential testing, followed by 9 hours per 1 TB drive capacity of 4K random write IOs, at queue depth 32, prior to random testing.
- Results obtained with a direct SATA port connection to host and may vary with capacity, endurance and system configuration. The HBA used could also affect measured results.

**Table 5 Performance - Performance Optimized (28% OP - Available with Tunable Capacity)**

Capacity	Units	200 GB		400 GB		800 GB		1600 GB		3200 GB	
		0%	20%	0%	20%	0%	20%	0%	20%	0%	20%
128K SR QD32	MB/s	564	564	564	564	564	564	564	564	564	564
128K SW QD32	MB/s	234	337	490	537	536	537	537	537	536	537
4K RR QD32	KIOPs	58	60	82	85	93	93	94	94	92	93
4K R70R QD32	KIOPs	27	36	40	50	50	60	60	70	60	71
4K RW QD32	KIOPs	18	39	36	67	48	69	48	68	48	68
8K RR QD32	KIOPs	47	52	57	57	57	57	57	57	57	57
8K R70R QD32	KIOPs	19	27	28	37	35	43	41	48	41	48
8K RW QD32	KIOPs	10	22	20	45	33	45	33	45	31	45
4K RR Latency QD1	usec	148	144	145	138	140	134	142	137	152	144
4K RW Latency QD1	usec	55	37	44	40	43	40	43	40	46	39
4K RR QD32 99% CI	usec	1700	1500	700	700	600	600	500	500	700	600
4K R70R QD32 99% CI	usec	5300	4200	4000	3400	3500	2900	3100	2500	2800	2000
4K RW QD32 99% CI	usec	4000	2900	2600	800	1400	700	1100	700	1600	800
4K RR QD32 99.99% CI	usec	2000	2000	1100	1000	800	900	800	800	1100	1000
4K R70R QD32 99.99% CI	usec	9800	8000	8000	6000	6600	5600	6000	5000	5400	5000
4K RW QD32 99.99% CI	usec	6300	5000	5600	3400	3200	1800	3000	1800	3000	2300

**NOTE**

Information on performance:

- 0% refers to data that cannot be compressed and 20% refers to data for which the size can be losslessly compressed by 20%. Performance values shown is based on data compressibility values of 0% and 20% as set with VDBench.
- The scripts that were used to arrive at these measurements are available on request.
- MB is 10<sup>6</sup> bytes. MB/s = 10<sup>6</sup> bytes/sec.
- 4 KB = 4,096 bytes, 8 KB = 8,192 bytes.
- All workloads set to 4 KB alignment.
- All metrics represent sustained values, across full LBA range.
- Drive write cache is active and protected by Power Loss Data Protection (PLDP) feature.
- Performance test precondition: The drive is preconditioned with 2x drive capacity 128 KB sequential write IOs, prior to sequential testing, followed by 9 hours per 1 TB drive capacity of 4K random write IOs, at queue depth 32, prior to random testing.
- Results obtained with a direct SATA port connection to host and may vary with capacity, endurance and system configuration. The HBA used could also affect measured results.

## 2.3 Power

The drive uses either 5 V or it uses 5 and 12 V DC power.

**Table 6 Power**

	240 GB	480 GB	960 GB	1920 GB	3840 GB
<b>Power</b>					
Voltage (V)	5	5	5 / 12	5 / 12	5 / 12
<b>Power Consumption</b>					
Overall average active power (W)	2.3	2.7	3.2	3.4	3.5
Maximum average active power (W)	2.6	3.2	4.5	5.1	5.0
Peak (25uS sample) burst active power (W) 5V limited to 6W	4.9	5.4	7.8	8.8	8.6
Idle (W)	1.1	1.1	1.2	1.2	1.2

**NOTE** 5V power limited to 6 W beyond which power will be drawn from 12 V.

## 2.4 Environmental Conditions

**Table 7 Temperature, Humidity, Shock**

Specification	Values
Temperature	<ul style="list-style-type: none"> <li>■ Operating: 0°C to 70°C</li> <li>■ Non-operating: -40°C to 85°C</li> </ul>
Humidity	<ul style="list-style-type: none"> <li>■ Operating and Non-Operating: 5% - 95%</li> </ul>
Shock	<ul style="list-style-type: none"> <li>■ Operating: 1000G, duration 0.5ms</li> <li>■ Non-Operating: 1000G, duration 0.5ms</li> </ul>
Thermal gradient	<ul style="list-style-type: none"> <li>■ Operating: 20°C/hour</li> <li>■ Non-operating: 30°C/hour</li> </ul>

**NOTE**

Operating, as measured by temperature sensor, SMART Attribute ID 194.

- Measured without condensation.
- The non-operating environmental range beyond the operating environmental range is limited to 180 days in original packaging or 60 days otherwise.
- The Shock specification assumes that the SSD is mounted securely with the input vibration applied to the drive mounting. Stimulus may be applied in the X, Y or Z axis.
- Operating Shock: The drive, as installed for normal operation, operates error-free while subjected to intermittent shock not exceeding specification. Shock may be applied in the X, Y, or Z-axis. Shock must not be repeated more than once every 2 seconds.
- Non-Operating Shock: The limits of non-operating shock applies to all conditions of handling and transportation. This includes isolated and integrated drives. Shock may be applied in the X, Y, or Z-axis.

**Table 8 Vibration**

Specification	Values
Maximum Vibrations	<ul style="list-style-type: none"> <li>■ Operating: Random, 3.8 Grms, 10-3000Hz, Uniform PSD:0.005 G<sup>2</sup>/Hz</li> <li>■ Non-Operating: Random, 7 Grms, 10-500Hz, Uniform PSD:0.01 G<sup>2</sup>/Hz</li> </ul>

**NOTE**

The Vibration specification assumes that the SSD is mounted securely with the input Vibration applied to the drive mounting screws. Stimulus may be applied in the X, Y or Z axis.

- 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.
- 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.

## 2.5 Reliability

**Table 9 Reliability**

Specification	Values
Mean time between failures (MTBF)	2 million hours @ 55°C
Uncorrectable Bit Error Rate	<1 error in 10 <sup>17</sup> bits read

**NOTE** The SSD achieves the specified MTBF in an operational environment that complies with the operational temperature range specified in this manual. Operating temperatures are measured by the temperature sensor, SMART Attribute ID, Primary Temperature, provided in Table 20, "SMART Attributes," on page 27.

## 2.6 Tunable Capacity

You can set the SSD to Capacity Optimized or Performance Optimized states. When shipped, the SSD is in the Capacity Optimized state. Use the Seagate utility, SeaTools™ SSD to set the states. Seagate recommends to set the required state at deployment, prior to installing a file system. Changing states does not change the rated TBW specification for endurance.

## 2.7 Endurance

### 2.7.1 Expected DWPD

DuraWrite can enhance endurance depending on the characteristics of the write workload. Realized Host DWPD can be gaged from the table below based on the actual Write Amplification (WA) measurements. To capture the WA value:

1. Read the Lifetime Writes from Host.
2. Read the Lifetime Writes to Flash.
3. Run the application workload of interest for several hours.
4. Read the two SMART attributes again to find both the host writes and flash writes accumulated over the time the workload was running.
5. The WA value is accumulated flash writes divided by host writes.
6. Use this WA value to find an approximate Host DWPD value in the following table.
7. Related workload characteristics are given in the table as a reference.

### 2.7.1.1 Nytro 1351 Workload WA to DWPD Reference - 7% OP

Table 10 Workload WA to DWPD Reference - 7% OP

User Capacity		240	480	960	1920	3840	Reference Workload
Measured WA	Host DWPD	Host TBW					
0.8	2.2	960	1920	3840	7680	15400	Highly sequential and compressible
1	1.8	768	1540	3070	6140	12300	Highly sequential and somewhat compressible
1.1	1.6	698	1400	2790	5590	11200	Fully sequential and not compressible
1.75	1	439	878	1760	3510	7020	Moderately compressible and predominantly random
2	0.9	384	768	1540	3070	6140	Moderately compressible and highly random
3	0.6	256	512	1020	2050	4100	Slightly compressible and completely random
4	0.4	192	384	768	1540	3070	Highly incompressible and random

### 2.7.1.2 Nytro 1351 Workload WA to DWPD Reference - 28% OP

Table 11 Workload WA to DWPD Reference - 28% OP

User Capacity		200	400	800	1600	3200	Reference Workload
Measured WA	Host DWPD	Host TBW					
0.8	2.6	960	1920	3840	7680	15400	Highly sequential and compressible
1	2.1	768	1540	3070	6140	12300	Highly sequential and somewhat compressible
1.1	1.9	698	1400	2790	5590	11200	Fully sequential and not compressible
1.35	1.6	569	1140	2280	4550	9100	Moderately compressible and highly random
2	1.1	384	768	1540	3070	6140	Slightly compressible and completely random
3	0.7	256	512	1020	2050	4100	Highly incompressible and random

#### NOTE

Information on endurance:

- DWPD is drive write per day.
- DWPD values based on as shipped, 7%, or 28% capacity points.
- Lifetime Writes to Flash are available from the corresponding SMART attribute, See, [Table 20, SMART Attributes, on page 27](#).
- Lifetime Writes from Host are available from the corresponding SMART attribute, see [Table 20, SMART Attributes, on page 27](#).
- Write Amplification (WA) is calculated as the cumulative writes to flash divided by the cumulative writes from the host SMART attribute values over the same time interval.

### 2.7.1.3 Nytro 1551 Workload WA to DWPD Reference - 7% OP

Table 12 Workload WA to DWPD Reference - 7% OP

User Capacity		240	480	960	1920	3840	Reference Workload
Measured WA	Host DWPD	Host TBW					
0.8	5.1	2240	4480	8960	17900	35800	Highly sequential and compressible
1	4.1	1790	3580	7170	14300	28700	Highly sequential and somewhat compressible
1.1	3.7	1630	3260	6520	13000	26100	Fully sequential and not compressible
1.35	3	1330	2650	5310	10600	21200	Moderately compressible and predominantly random
2	2	896	1790	3580	7170	14300	Moderately compressible and highly random
3	1.4	597	1190	2390	4780	9560	Slightly compressible and completely random
4	1	448	896	1790	3580	7170	Highly incompressible and random

### 2.7.1.4 Nytro 1551 Workload WA to DWPD Reference - 28% OP

Table 13 Workload WA to DWPD Reference - 28% OP

User Capacity		200	400	800	1600	3200	Reference Workload
Measured WA	Host DWPD	Host TBW					
0.8	6.1	2240	4480	8960	17900	35800	Highly sequential and compressible
1	4.9	1790	3580	7170	14300	28700	Highly sequential and somewhat compressible
1.1	4.5	1630	3260	6520	13000	26100	Fully sequential and not compressible
1.35	3.6	1330	2650	5310	10600	21200	Moderately compressible and highly random
2	2.5	896	1790	3580	7170	14300	Slightly compressible and completely random
3	1.6	597	1190	2390	4780	9560	Highly incompressible and random

#### NOTE

Information on endurance:

- DWPD is drive write per day.
- DWPD values based on as shipped, 7%, or 28% capacity points.
- Lifetime Writes to Flash are available from the corresponding SMART attribute, See, [Table 20, SMART Attributes, on page 27](#).
- Lifetime Writes from Host are available from the corresponding SMART attribute, see [Table 20, SMART Attributes, on page 27](#).
- Write Amplification (WA) is calculated as the cumulative writes to flash divided by the cumulative writes from the host SMART attribute values over the same time interval.



## 2.7.2 Endurance Warranty

The endurance warranty is based on total writes to the flash media.

**Table 14 Total Bytes Written to Flash**

As Shipped Capacity	240 GB	480 GB	960 GB	1920 GB	3840 GB
Nytro 1351	768 TB	1540 TB	3070 TB	6140 TB	12300 TB
Nytro 1551	1790 TB	3580 TB	7170 TB	14300 TB	28700 TB

### NOTE

Information on endurance:

- TB=10<sup>12</sup> bytes
- Limited Warranty with Media Usage provides coverage for the warranty period or the endurance usage of the drive, which ever comes first.
- SSD endurance is based on lifetime writes to the flash media.
- Lifetime Writes to Flash are available from the corresponding SMART attribute, See, Table 20, "SMART Attributes," on page 27.

## 3. Mechanical Information

### 3.1 Dimensions and Weight

**Weight by capacity:**

**240 GB:** 75 g

**480 GB:** 75 g

**960 GB:** 77 g

**1920 GB:** 77 g

**3840 GB:** 82 g

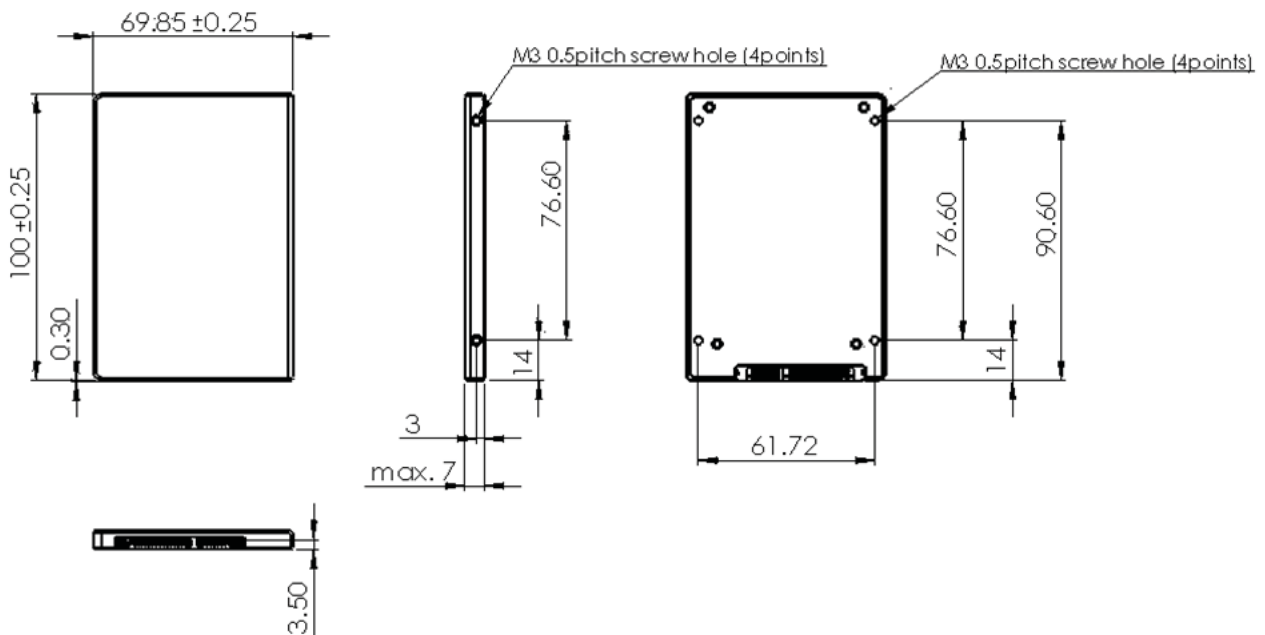
**Height:** Maximum 7 mm

**Width:**  $69.85 \pm 0.25$

**Length:**  $100 \pm 0.25$

**NOTE** All dimensions are in millimeters.

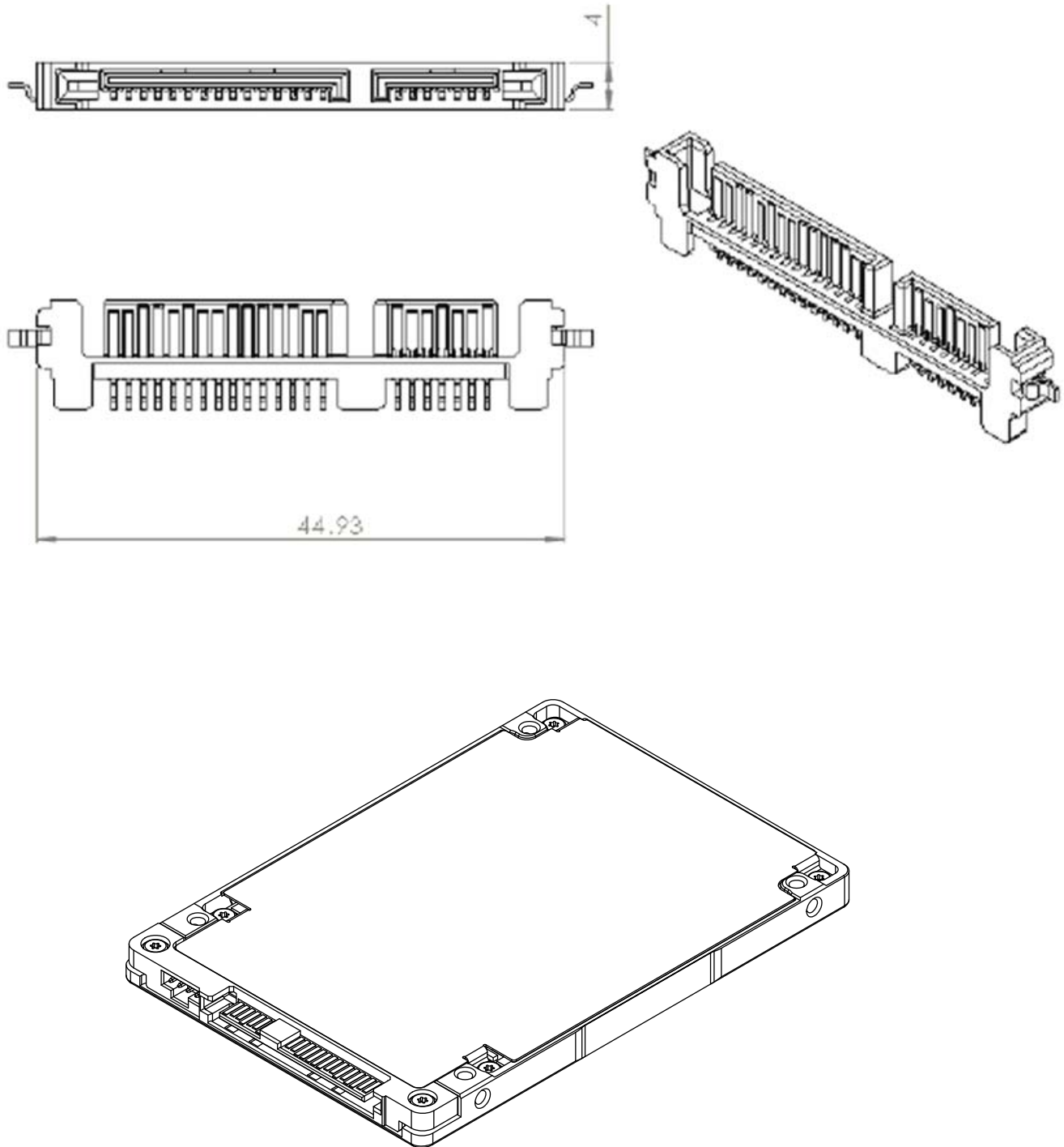
**Figure 1 Dimensions**



## 4. Pin and Signal Descriptions

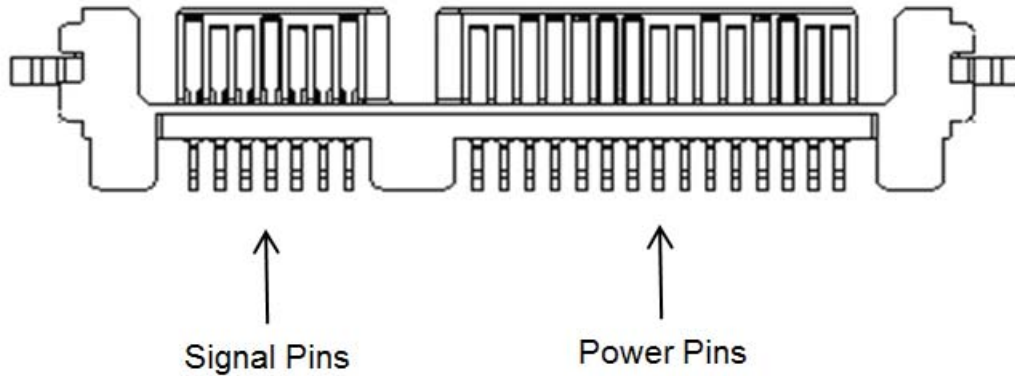
### 4.1 Serial ATA Interface Connector

Figure 2 Connector Physical Dimension and Connector Assembly



## 4.2 Pin Locations

Figure 3 Layout of 2.5-inch Signal and Power Segment Pins



**NOTE** The 2.5-inch connector supports built in latching capability.

## 4.3 Connector Pin Signal Definitions

Table 15 Serial ATA Connector Pin Signal Definitions—2.5-inch Form Factors

Pin	Name	Definition
S1	Ground	Ground
S2	A+	Differential signal pair +A and A-
S3	A-	
S4	Ground	Ground
S5	B-	Differential signal pair +B and B-
S6	B+	
S7	Ground	Ground

**NOTE** Key and spacing separate the signal and power segments.

## 4.4 Power Pin Signal Definitions

**Table 16 Serial ATA Power Pin Signal Definitions—2.5-inch Form Factors**

Pin	Function	Definition
P1	V33	3.3 V Power; not used
P2	V33	3.3 V Power; not used
P3	V33	DevSlp; do not connect 3.3 V
P4	GND	Ground
P5	GND	Ground
P6	GND	Ground
P7	V5	5 V Power
P8	V5	5 V Power
P9	V5	5 V Power
P10	GND	Ground
P11	DAS	Device Activity Signal
P12	GND	Ground
P13	V12	12 V Power
P14	V12	12 V Power
P15	V12	12 V Power

### NOTE

Key and spacing separate the signal and power segments.

- Uses 12 V and 5 V power only. The 240 GB and 480 GB models use 5 V supply only.
- Ground pins are P4, P5, P6, P10, and P12.
- P7, P8, and P9 are 5V power pins and are connected internally on the drive.
- P13, P14, and P15 are 12V power pins and are connected internally on the drive.

## 4.5 SSD Activity LED Indicator (Optional)

The SSD can support DAS Control function from the SSD module to indicate LED activity of host side.

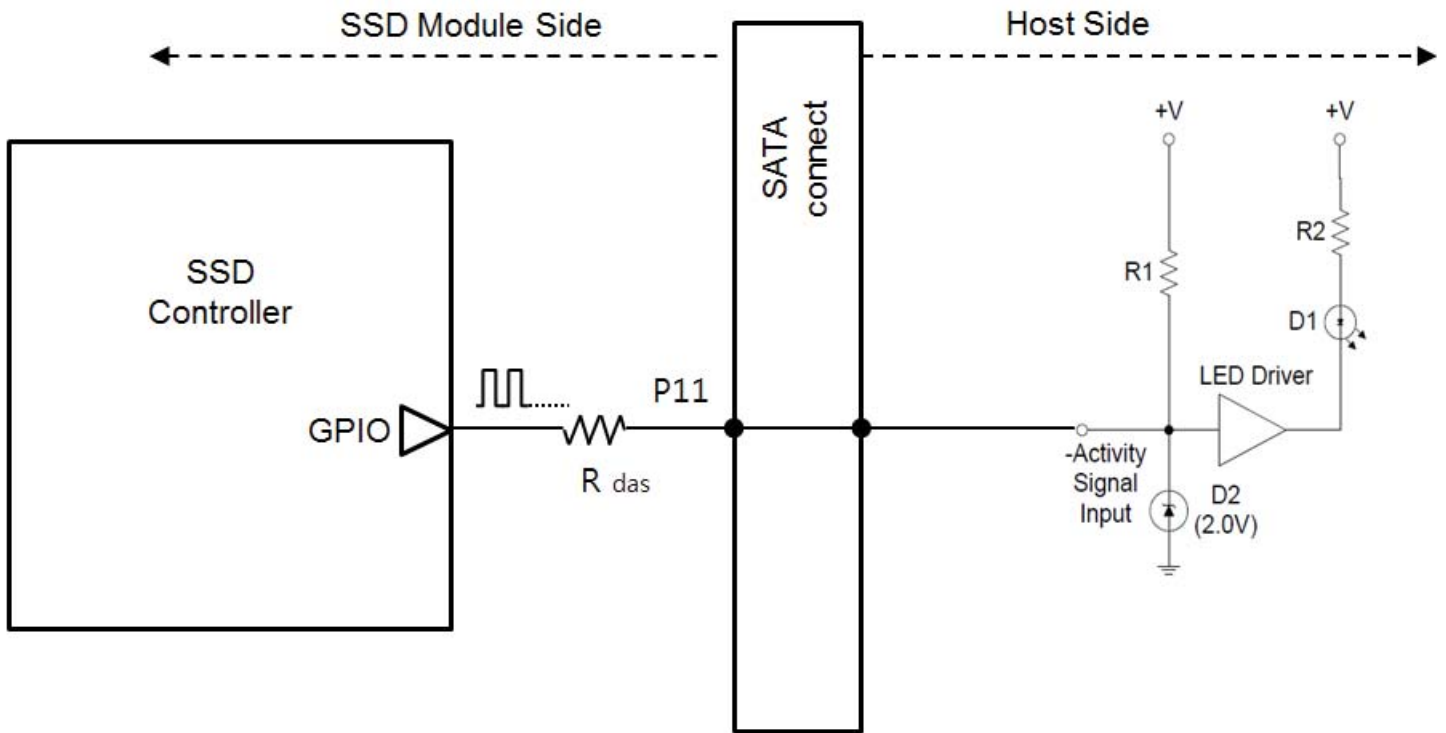
The device includes a physical pin P11 for connecting device activity LEDs.

The signal provided to indicate activity of the device is a low-voltage and low-current driver. The signal from the device is not suitable for directly driving an LED and is first buffered using a circuit external to the device before driving an LED.

The DAS function firmware feature generates a Low and High toggle Activity signal on pin 11 when the SSD is in a busy state and generates a high Activity signal input when the SSD is in idle mode (Low level: GND, High level: 2.85 V).

The DAS Firmware feature is disabled and the R das is opened when the DAS function is not in use. See [Figure 4, Circuit of SSD Activity LED indication, on page 22](#).

Figure 4 Circuit of SSD Activity LED indication



## 5. Supported ATA Command List

The SSD complies with ATA-8/ACS-4. All mandatory and many optional commands and features are supported.

### 5.1 ATA Feature Set

The following table shows the ATA feature set and commands that the SSD supports.

**Table 17 ATA Feature Set**

Feature
Power Management Command Set
Security Mode Feature Set
SMART Command Set
Device Statistics
SMART Command Transport
Dataset Management Command Set
Host Protected Area Command Set
48-bit Address Command Set
General Purpose Log Command Set
Native Command Queuing
Software Settings Prevention
ATA Sanitize Command Set
Identify Device Command Set

## 5.2 ATA Command Description

The following table shows the ATA commands supported.

**Table 18 ATA Command Description**

Command	Code (Hex)	Command	Code (Hex)
NOP	00h	EXECUTE DEVICE DIAGNOSTICS	90h
DATA SET MANAGEMENT	06h	DOWNLOAD MICROCODE	92h
REQUEST SENSE DATA EXT	08h	DOWNLOAD MICROCODE DMA	93h
READ SECTORS	20h	SMART	B0h
READ SECTORS EXT	24h	SANITIZE DEVICE	B4h
READ DMA EXT	25h	READ MULTIPLE	C4h
READ MULTIPLE EXT	29h	WRITE MULTIPLE	C5h
READ LOG EXT	2Fh	SET MULTIPLE MODE	C6h
WRITE SECTORS	30h	READ DMA	C8h
WRITE SECTORS EXT	34h	WRITE DMA	CAh
WRITE DMA EXT	35h	WRITE MULTIPLE FUA EXT	CEh
WRITE MULTIPLE EXT	39h	STANDBY IMMEDIATE	E0h
WRITE DMA FUA EXT	3Dh	IDLE IMMEDIATE	E1h
WRITE LOG EXT	3Fh	STANDBY	E2h
READ VERIFY SECTORS	40h	IDLE	E3h
READ VERIFY SECTORS EXT	42h	READ BUFFER	E4h
ZERO EXT	44h	CHECK POWER MODE	E5h
WRITE UNCORRECTABLE EXT	45h	SLEEP	E6h
READ LOG DMA EXT	47h	FLUSH CACHE	E7h
WRITE LOG DMA EXT	57h	WRITE BUFFER	E8h
TRUSTED NON-DATA	58h	READ BUFFER DMA	E9h
TRUSTED RECEIVE	5Ch	FLUSH CACHE EXT	EAh
TRUSTED RECEIVE DMA	5Dh	WRITE BUFFER DMA	EBh
TRUSTED SEND	5Eh	IDENTIFY DEVICE	ECh
TRUSTED SEND DMA	5Fh	SET FEATURES	EFh
READ FPDMA QUEUED	60h	SECURITY SET PASSWORD	F1h
WRITE FPDMA QUEUED	61h	SECURITY UNLOCK	F2h
NCQ QUEUE MANAGEMENT	63h	SECURITY ERASE PREPARE	F3h
SEND FPDMA QUEUED	64h	SECURITY ERASE UNIT	F4h
RECEIVE FPDMA QUEUED	65h	SECURITY FREEZE LOCK	F5h
SET DATE & TIME EXT	77h	SECURITY DISABLE PASSWORD	F6h
ACCESSIBLE MAX ADDRESS CONFIG	78h		



## 5.3 Security

The user/master password is supported.

When the device receives a normal SECURITY ERASE UNIT command, the device erases all data blocks including unallocated (hidden) blocks.

You can download firmware regardless of the security state.

Other security features:

- TCG- Enterprise and TCG-Opal support
- Crypto-erase sanitization
- Block-level sanitization
- Secure update of firmware

### 5.3.1 Password Loss

If you lose the user password, you can access the device using the master password. If both passwords are lost, there is no way to access the device. For TCG Opal SSDs, where the credentials are no longer known, PSID Revert can be used to regain the use of the SSD but all of the data on the drive will be erased.

## 6. SMART Support

### 6.1 SMART Command Set

The SSD supports the SMART Command Set shown in the following table.

**Table 19 SMART Commands**

Feature Field Values	Command
D0h	SMART READ DATA
D1h	SMART READ ATTRIBUTE THRESHOLDS
D2h	SMART ENABLE/DISABLE ATTRIBUTE AUTOSAVE
D3h	SAVE ATTRIBUTE VALUES
D4h	SMART EXECUTE OFF-LINE IMMEDIATE
00h*	Execute SMART Off-Line routine
01h*	Execute SMART Short Self-test routine (Off-Line)
02h*	Execute SMART Extended Self-test routine (Off-Line)
03h*	Execute SMART Conveyance self-test routine in off-line mode
04h*	Execute SMART Selective self-test routine in off-line mode
7Fh*	Abort Off-Line routine
81h*	Execute SMART Short Self-test routine (Captive)
82h*	Execute SMART Extended Self-test routine (Captive)
83h*	Execute SMART Conveyance self-test routine in captive mode
84h*	Execute SMART Selective self-test routine in captive mode
D5h	SMART READ LOG
D6h	SMART WRITE LOG
D8h	SMART ENABLE OPERATIONS
D9h	SMART DISABLE OPERATIONS
DAh	SMART RETURN STATUS
*Low LBA values	

## 6.2 SMART Attributes

The SSD supports the SMART attributes shown in the following table.

**Table 20 SMART Attributes**

Name	Default Assignment	Description	Units
Raw Read Error Rate	1	A normalized rate of moderate to severe latency causing correctable errors.	Percentage
Reallocated Sector Count	5	Count of the number of blocks that have been reallocated, excluding pending sectors.	Counter
Power-On-Hours	9	Count of the lifetime power on hours in the Active or Idle ATA state.	Hours
Power Cycle Count	12	Count of the number of complete power up cycles. Excludes power mode state changes with power continuously applied.	Counter
Flash GB Erased	100	Count in GB of the lifetime erases of flash for all purposes.	Count in Giga bytes (2 <sup>30</sup> )
Lifetime PS4 Entry Count	102	Count of the number of times the PS4 power state is entered.	Counter
Lifetime PS3 Entry Count	103	Count of the number of times the PS3 power state is entered.	Counter
Grown Bad Block Count	170	Count of the number of retired flash blocks post manufacturing.	Counter
Program Fail Count	171	Count of the number of Flash Program failures.	Counter
Erase Fail Count	172	Count of the number of Flash Erase failures.	Counter
Average Program/Erase Count	173	Count of the average number of program/erase cycles on all good blocks.	Counter
Unexpected Power Loss Count	174	Count of the number of complete power loss events not preceded by a shutdown command. Excludes power mode state changes with power continuously applied.	Counter
Wear Range Delta	177	Difference between the most and least worn blocks with regards to the maximum rated P-E cycles (most-least)/max*100.	Percentage
SATA/PCIe Interface Downshift Count	183	Count of the number of times SATA interface rate reduction is negotiated.	Counter
Uncorrectable ECC Count	187	Count of the number of unsuccessful ECC recovery attempts where higher level recovery methods also failed.	Counter
Primary Temperature	194	Current, lifetime maximum and lifetime minimum temperature.	Celsius (Signed data)
RAISE ECC Correctable Count	195	Count of the number of times RAISE successfully recovered data.	Counter
Uncorrectable Read Error Count	198	Count of the number of times an uncorrectable error is returned to the host on a read command.	Counter
SATA R-Error (CRC) Error Count	199	Count of the number of detected SATA R-Errors experienced on the SATA receiver.	Counter
Drive Life Protection Status	230	Power fail protection available.	100d, 64h protected SSD RO, 90d, 5Ah unprotected

Table 20 SMART Attributes

Name	Default Assignment	Description	Units
SSD Life Left	231	Approximate percent SSD life left, in terms of program/erase cycles or Flash blocks currently available for use.	Percentage
Available Reserved Space	232	Ratio of currently available internal reserved space to as built reserved space.	Percentage
Lifetime Writes to Flash	233	Sum in GB of the lifetime writes to flash for all purposes.	Sum in Giga bytes (2 <sup>30</sup> )
Lifetime Writes from Host	241	Sum in GB of the lifetime writes for all host write commands.	Sum in Giga bytes (2 <sup>30</sup> )
Lifetime Reads from Host	242	Sum in GB of the lifetime reads for all host read commands.	Sum in Giga bytes (2 <sup>30</sup> )
Free Space	243	Available user capacity in MB and percent of currently set user capacity.	Percentage User MB Free and percentage user space remaining

### 6.3 SMART Trip

SMART trip (threshold exceeded condition) indicates impending degradation or fault condition. The host can issue a SMART return status command (B0h/DAh) to communicate the reliability status of the drive. The threshold-exceeded condition is also checked during drive self tests.

## 7. Safety and Compliance Standards

Each Hard Drive and Solid State Drive ("device") has a product label that includes certifications that are applicable to that specific drive. The following information provides an overview of requirements that may be applicable to the drive.

The Seagate HDD and SSD Regularity Compliance and Safety document contains the latest regulations and standards that Seagate complies with. To see this document, go online here:

<https://www.seagate.com/files/www-content/forms/compliance/regulatory-compliance-and-safety-100838899-A.pdf>

### 7.1 Regulatory Model Numbers

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

- STA010



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