Seagate® Nytro® 1361 SSD
Product Manual

Nytro 1361 - Read Intensive Models

Standard	SED - TCG Opal
XA480LE10006	XA480LE10016
XA960LE10006	XA960LE10016
XA1920LE10006	XA1920LE10016
XA3840LE10006	XA3840LE10016

203864400, Rev A

July 2022

Revision History

Version and Date	Description of Changes
Rev A, July 2022	First release of the document.

Contents

Seagate Technology Support Services

For Internal SSD Support, visit: https://www.seagate.com/support/products/

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1. Introduction

The Seagate® Nytro® 1361 is a next-generation enterprise SATA SSD that delivers enterprise class features in a 2.5-inch × 7 mm form factor.

Table 1   Features

Feature	Description	
Capacity	■ 480, 960, 1920, or 3840 GB	
Certifications, Eco-Compliance	■ CE, UL, cUL, RCM, BSMI, KCC, TUV, Microsoft WHQL, VCCI, CB ■ RoHS, WEEE, ■ Secure Data Deletion See Section 10., *Safety and Compliance Standards*	
Dimension	■ Width: 69.85±0.25 mm ■ Length: 100.10±0.25 mm ■ Height: 7 mm +0.10/-0.30	
Endurance	1 DWPD Total Bytes Written ■ 480 GB 865 TB ■ 960 GB 1829 TB ■ 1920 GB 3806 TB ■ 3840 GB 6924 TB	
Logical Block Size	■ 512 bytes	
Form Factor	■ 2.5 inch × 7 mm Standard SSD	
Interface Compliance	■ Fully compliant with ATA-8/ACS4 Standard ■ Compliant with SATA Revision 3.1 and 3.2 ■ Supported protocol AHCI and ASC3 command set ■ Compatible with SATA 1.5 Gbps, 3 Gbps, and 6Gbps interfaces ■ PIO, DMA, UDMA supported ■ Native Command Queuing (NCQ): up to 32 commands ■ Data Set Management Command Trim support	
NAND	■ BiCS5 cTLC	
Performance	■ Sequential Read: up to 530 MB/s ■ Sequential Write: up to 500 MB/s ■ Random Read: up to 94,000 IOPS ■ Random Write: up to 72,000 IOPS	Actual performance might vary depending on use conditions and environment. See Section 2.2, *Performance*.
Power Consumption	■ Active mode: < 5.8 W ■ Idle mode: < 2.0 W	See Section 2.3, *Power*
Power Loss Data Protection	■ In-process writes to the NAND are completed in the event of an unexpected power loss	
Power Management	■ OS-aware hot-plug/hot-swap support	
Power On Ready	■ See Section 2.3, *Power, on page 10*.	

Table 1   Features (Continued)

Feature	Description
Reliability	■ SMART thermal monitoring ■ MTBF: 2 million hours ■ UBER: 1 read error per 10^{17}bits read with End-to-End data-path protection
Security	■ AES-256 and TCG Opal 2.0, IEEE1667 supported on SED models
Shock	■ Non-Operating: 1500G, duration 0.5ms
Vibration	■ Non-Operating: Random, 20 Grms, 80-2000 Hz
Voltage	■ 5 V ±5%
Data Retention	■ 3 months power-off retention at 40°C once the drive reaches the rated write endurance (EOL)
Temperature Range	■ Operating: 0°C to 70°C ■ Non-operating: -40°C to 85°C
Warranty	■ Five years limited Warranty with Media Usage, based on the shorter of term or endurance usage of the drive.
Weight	■ Max 66.7g, 2.4 ounces ±5%

1.1   Reference Documents

In case of conflict between this document and the following reference document, this document takes precedence.

■ SATA Specifications
— Serial ATA Revision 3.2
— SATA-IO Commands for ATA-8
■ Trusted Computing Group (TCG) Documents
— Storage Work Group Security Subsystem Class: Opal, Version 2.00
■ Solid State Drive Requirements and Endurance Test Methods
— JESD218
— JESD219
■ Seagate Documentation
— SeaTools® User Guide - Publication Number: 100869623
— Seagate Compliance, Safety, and Disposal Guide - Publication Number: 100860164

2. Specifications

2.1   Models and Capacity

Table 2   Nytro 1361 SSD - Read Intensive - 1 DWPD Models

Capacity (GB)	Standard	SED - TCG Opal (no WHQL certification)	User-Addressable Sector	Bytes per Sector
480	XA480LE10006	XA480LE10016	937,703,088	512 Bytes
960	XA960LE10006	XA960LE10016	1,875,385,008	
1920	XA1920LE10006	XA1920LE10016	3,750,748,848	
3840	XA3840LE10006	XA3840LE10016	7,501,476,528	

2.2   Performance

Table 3 Nytro 1361 SSD Performance

Operation	Units	480 GB	960 GB	1920 GB	3840 GB
128KB Sequential Read (QD32)	MB/s	530	530	530	530
128KB Sequential Write (QD32)	MB/s	450	500	500	500
4KB Random Read (QD32)	KIOPS	94	94	94	94
4KB Random Write (QD32)	KIOPS	37	62	72	68
Latency 4KB Random Read (QD1)	μsec	130	130	120	130
Latency 4KB Random Write (QD1)	μsec	40	50	30	40
QoS 99% 4KB Random Read (QD32)	μsec	570	820	360	360
QoS 99% 4KB Random Write (QD32)	μsec	870	750	930	750
QoS 99.99% 4KB Random Read (QD32)	μsec	810	1260	510	520
QoS 99.99% 4KB Random Write (QD32)	μsec	980	1450	2750	2770

NOTE   Performance is measured with the following conditions

- Performance measured with FIO v3.7 on Ubuntu 16.04.3 host.

- 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 3x drive capacity 128 KB sequential write IOs, prior to sequential testing, followed by 3x drive capacity of 4K random write IOs, at queue depth 4, prior to random testing.

- Results obtained with a direct SATA port connection to host as a secondary device and may vary with capacity, endurance and system configuration. The HBA used could also affect measured results.

- Performance may vary based on the SSD's firmware version, system hardware, and configuration.

2.3 Power

The drive uses 5 V DC power.

Table 4   Power Consumption

Capacity	Power Consumption (W)		
	Maximum Average Active	Peak Active	Maximum Average Idle
480 GB	3.5	3.7	1.5
960 GB	4.5	4.8	1.6
1920 GB	5.1	5.3	1.8
3840 GB	5.8	6.0	2.0

NOTE   About power consumption:

- The measured power voltage is 5 V.

- The average value of power consumption is achieved based on 100% conversion efficiency.

- Power Consumption can differ according to system hardware, and configuration.

- Idle power is measured with DIPM off

2.4   Environmental Conditions

Table 5   Temperature, Humidity, Shock

Specification	Value
Temperature Operating (case temperature at specific airflow)	0°C to 70°C -40°C to 85°C

Humidity
        Operating
        Non-operating (storage)
	90%
	93%

Shock Non-operating	1,500 G, duration 0.5 ms
Vibration Non-operating	20 $G_{RMS,}$ (80Hz to 2000Hz, Frequency)

NOTE   **Temperature** is measured without condensation. Operating mode temperature is measured by temperature sensor, SMART Attribute C2h.

NOTE   **Shock and vibration** results assume that the SSD is mounted securely with the input vibration applied to the SSD mounting. These specifications do not cover connection issues that may result from testing at this level. The measured specification is in root mean square (RMS) form.

■   **Non-operating Shock.** The limits of non-operating shock applies to all conditions of handling and transportation. This includes both isolated SSD and integrated SSDs. Shock 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 SSD and integrated SSDs. Vibration may be applied in the X, Y, or Z-axis.

2.5   Reliability and Endurance

Table 6   Reliability

Specification	Values	Endurance
Mean time between failures (MTBF)	2 million hours @ 55°C	1 DWPD
Uncorrectable Bit Error Rate	<1 error in 10^{17} bits read	Total Bytes Written
		▪ 480 GB 865 TB
		▪ 960 GB 1829 TB
		▪ 1920 GB 3806 TB
		▪ 3840 GB 6924 TB

NOTES

- ▪ 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 temperature sensor, SMART Attribute ID C2h.

- ▪ Endurance rating valid for SSD Life Remaining > 1% (SMART E7h>1).

- ▪ Endurance is characterized while running JEDEC Enterprise 219A workload

3. Mechanical Information

3.1   Dimensions in product mechanical drawing

Figure 1 Dimensions
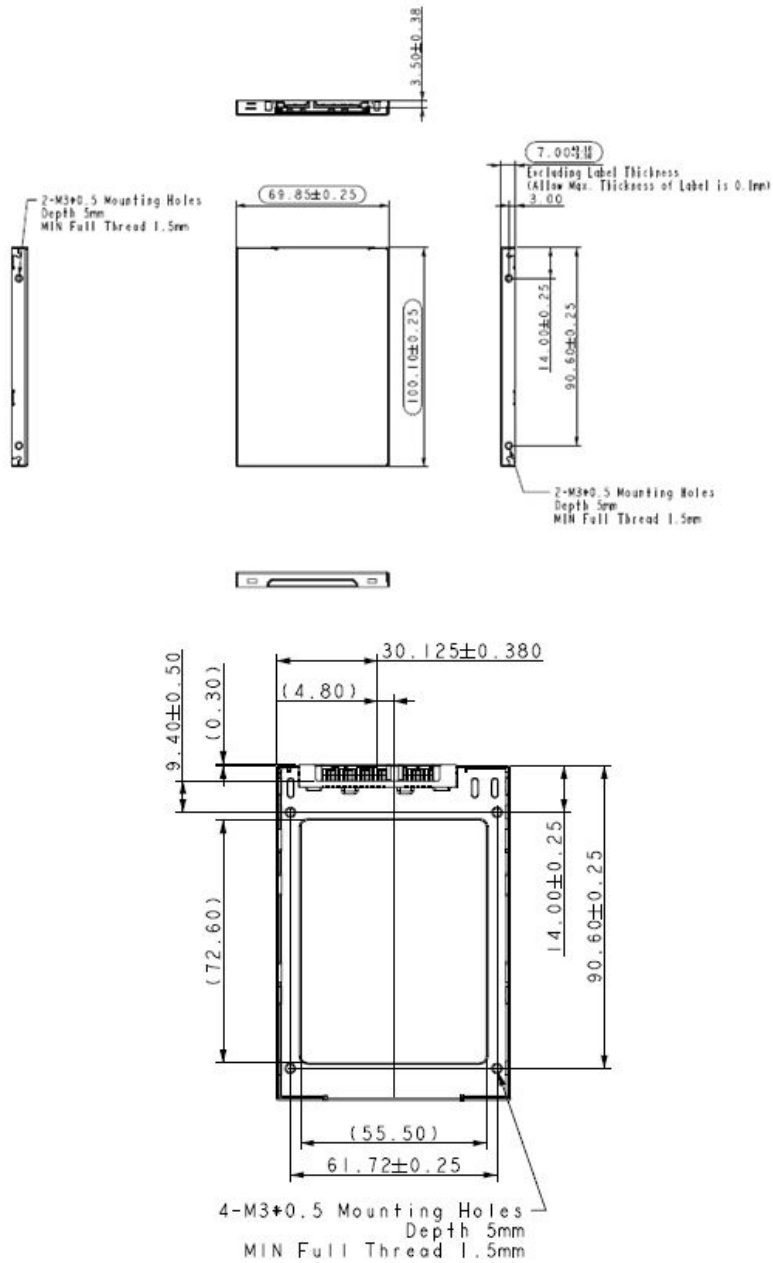
3.1.1   Product Dimensions and Weights by Capacity

See below for units of dimension and weights by product capacity.

Table 7 Dimensions and Weights

Dimensions	Units
Width	69.85±0.25 mm
Length	100.10±0.25 mm
Height	7 mm +0.10/-0.30

Capacity	Weights
480 GB	57.4g
960 GB	58.3g
1920 GB	60.7g
3840 GB	66.7g

4. Pin and Signal Descriptions

4.1   Serial ATA Interface Connector

4.2   Connector Pin Signal Definitions

Table 8   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-	Differential signal pair A+ and A-
S4	Ground	Ground
S5	B-	Differential signal pair B+ and B-
S6	B+	Differential signal pair B+ and B-
S7	Ground	Ground

NOTE   Key and spacing separate the signal and power segments.

4.3   Power Pin Signal Definitions

Table 9   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	DEVSLP	SATA PHY Power Control
P4	GND	Ground
P5	GND	Ground
P6	GND	Ground
P7	V5	5 V Power Precharge
P8	V5	5 V Power
P9	V5	5 V Power
P10	GND	Ground
P11	Reserved	Reserved
P12	GND	Ground
P13	V12	12 V Power (not used)
P14	V12	12 V Power (not used)
P15	V12	12 V Power (not used)

NOTE   Key and spacing separate the signal and power segments.

5. Supported ATA Command List

The Nytro 1361 SSD complies with ATA-8. See Section 1.1, *Reference Documents*. All mandatory and many optional commands and features are supported.

5.1   ATA Feature Set

The following table summarizes the ATA feature set and commands that the Nytro 1361 SSD supports.

Table 10 ATA Feature Set

Feature	Supported
48-Bit Address feature set	Yes
General feature set	Yes
Native Command Queuing (NCQ) feature set	Yes
Power Management feature set	Yes
Security feature set	Yes
SMART feature set	Yes

5.2   ATA Command Description

The following table shows the ATA commands supported.

Table Legend:

> **Y** means **Support**.
>
> **O** means **Option**, default is **No support**.
>
> **-** means **No support.**

Table 11 ATA Command Description

Op Code	Support	Description	Op Code		Support	Description
00h	Y	NOP	B6h	12h	-	NV Cache: QUERY NV CACHE PINNED SET DMA EXT
03h	-	CFA REQUEST EXTENDED ERROR	B6h	13h	-	NV Cache: QUERY NV CACHE MISSES DMA EXT
06h	Y	DATA SET MANAGEMENT	B6h	14h	-	NV Cache: FLUSH NV CACHE
08h	-	DEVICE RESET	C4h		Y	READ MULTIPLE
0Bh	-	REQUEST SENSE DATA EXT	C5h		Y	WRITE MULTIPLE
10h	Y	RECALIBRATE	C6h		Y	SET MULTIPLE MODE
11h-1Fh	-	RECALIBRATE	C7h		-	READ DMA QUEUED
20h	Y	READ SECTOR(S)	C8h		Y	READ DMA
21h	Y	READ SECTOR(S) WITHOUT RETRY	C9h		Y	READ DMA WITHOUT RETRY

Table 11 ATA Command Description (Continued)

Op Code	Support	Description	Op Code	Support	Description
22h	-	READ LONG	CAh	Y	WRITE DMA
23h	-	READ LONG WITHOUT RETRY	CBh	Y	WRITE DMA WITHOUT RETRY
24h	Y	READ SECTOR(S) EXT	CCh	-	WRITE DMA QUEUED
25h	Y	READ DMA EXT	CDh	-	CFA WRITE MULTIPLE WITHOUT ERASE
26h	-	READ DMA QUEUED EXT	CEh	Y	WRITE MULTIPLE FUA EXT
27h	Y	READ NATIVE MAX ADDRESS EXT	D1h	-	CHECK MEDIA CARD TYPE
29h	Y	READ MULTIPLE EXT	DAh	-	GET MEDIA STATUS
2Ah	-	READ STREAM DMA EXT	DEh	-	MEDIA LOCK
2Bh	-	READ STREAM EXT	DFh	-	MEDIA UNLOCK
2Fh	Y	READ LOG EXT	E0h	Y	STANDBY IMMEDIATE
30h	Y	WRITE SECTOR(S)	E1h	Y	IDLE IMMEDIATE
31h	Y	WRITE SECTOR(S) WITHOUT RETRY	E2h	Y	STANDBY
32h	-	WRITE LONG	E3h	Y	IDLE
33h	-	WRITE LONG WITHOUT RETRY	E4h	Y	READ BUFFER
34h	Y	WRITE SECTOR(S) EXT	E5h	Y	CHECK POWER MODE
35h	Y	WRITE DMA EXT	E6h	Y	SLEEP
36h	-	WRITE DMA QUEUED EXT	E7h	Y	FLUSH CACHE
37h	Y	SET MAX ADDRESS EXT	E8h	Y	WRITE BUFFER
38h	-	CFA WRITE SECTORS WITHOUT ERASE	E9h	Y	READ BUFFER DMA
39h	Y	WRITE MULTIPLE EXT	EAh	Y	FLUSH CACHE EXT

Table 12 ATA Command List (continued)

Op Code	Support	Description	Op Code			Support	Description
3Ah	-	WRITE STREAM DMA EXT	EBh			Y	WRITE BUFFER DMA
3Bh	-	WRITE STREAM EXT	ECh			Y	IDENTIFY DEVICE
3Ch	-	WRITE VERIFY	EDh			-	MEDIA EJECT
3Dh	Y	WRITE DMA FUA EXT	EEh			-	IDENTIFY DEVICE DMA
3Eh	-	WRITE DMA QUEUED FUA EXT	EFh	01h		-	SET FEATURES: Enable 8-bit PIO transfer mode (CFA feature set only)
3Fh	Y	WRITE LOG EXT	EFh	02h		Y	SET FEATURES: Enable write cache
40h	Y	READ VERIFY SECTOR(S)	EFh	03h		Y	SET FEATURES: Set transfer mode based on value in Count field
41h	Y	READ VERIFY SECTOR(S) WITHOUT RETRY	EFh	05h		Y	SET FEATURES: Enable advanced power management
42h	Y	READ VERIFY SECTOR(S) EXT	EFh	06h		-	SET FEATURES: Enable Power-Up In Standby feature set
44h	-	Reserved	EFh	07h		-	SET FEATURES: Power-Up In Standby feature set device spin-up
45h	O	WRITE UNCORRECTABLE EXT	EFh	0Ah		-	SET FEATURES: Enable CFA power mode 1
47h	Y	READ LOG DMA EXT	EFh	0Bh		-	SET FEATURES: Enable Write-Read-Verify feature set
50h	-	FORMAT TRACK	EFh	10h	01h	-	SET FEATURES: Enable use of Serial ATA feature
51h	-	CONFIGURE STREAM	EFh	10h	02h	Y	SET FEATURES: Enable DMA Setup FIS Auto-Activate optimization
57h	Y	WRITE LOG DMA EXT	EFh	10h	03h	Y	SET FEATURES: Enable Device-initiated interface power state (DIPM) transitions
60h	Y	READ FPDMA QUEUED	EFh	10h	04h	-	SET FEATURES: Enable use of Serial ATA feature
61h	Y	WRITE FPDMA QUEUED	EFh	10h	05h	-	SET FEATURES: Enable use of Serial ATA feature
70h	Y	SEEK	EFh	10h	06h	O	SET FEATURES: Enable Software Settings Preservation (SSP)
71-76h	-	SEEK	EFh	10h	07h	Y	SET FEATURES: Enable Device Automatic Partial to Slumber transitions
77h	Y	SET DATE AND TIME EXT	EFh	10h	09h	O	SET FEATURES: Enable Device Sleep

Table 13 ATA Command List (continued)

Op Code		Support	Description	Op Code			Support	Description
78h		Y	ACCESSIBLE MAX ADDRESS CONFIGURATION	EFh	42h		-	SET FEATURES: Enable Automatic Acoustic Management feature set
79-7Fh		-	SEEK	EFh	43h		-	SET FEATURES: Set Maximum Host Interface Sector Times
87h		-	CFA TRANSLATE SECTOR	EFh	44h		-	SET FEATURES: Vendor Specific ECC byte
90h		Y	EXECUTE DEVICE DIAGNOSTIC	EFh	55h		Y	SET FEATURES: Disable read look-ahead feature
91h		Y	INITIALIZE DEVICE PARAMETERS	EFh	5Dh		-	SET FEATURES: Enable release interrupt
92h		Y	DOWNLOAD MICROCODE	EFh	5Eh		-	SET FEATURES: Enable service interrupt
93h		Y	DOWNLOAD MICROCODE DMA	EFh	5Fh		-	SET FEATURES: Enable NDRQ Feature
94h		-	STANDBY IMMEDIATE	EFh	66h		Y	SET FEATURES: Disable reverting to power-on defaults
95h		-	IDLE IMMEDIATE	EFh	81h		-	SET FEATURES: Disable 8-bit PIO transfer mode (CFA feature set only)
96h		-	STANDBY	EFh	82h		Y	SET FEATURES: Disable write cache
97h		-	IDLE	EFh	85h		Y	SET FEATURES: Disable advanced power management
98h		-	CHECK POWER MODE	EFh	86h		-	SET FEATURES: Disable Power-Up In Standby feature set
99h		-	SLEEP	EFh	8Ah		-	SET FEATURES: Disable CFA power mode
A0h		-	PACKET	EFh	8Bh		-	SET FEATURES: Disable Write-Read-Verify feature set
A1h		-	IDENTIFY PACKET DEVICE	EFh	90h	01h	-	SET FEATURES: Disable use of Serial ATA feature
A2h		-	SERVICE	EFh	90h	02h	Y	SET FEATURES: Disable DMA Setup FIS Auto-Activate optimization
B0h	D0h	Y	SMART: READ DATA	EFh	90h	03h	Y	SET FEATURES: Disable Device-initiated interface power state (DIPM) transitions
B0h	D1h	Y	SMART: READ ATTRIBUTE THRESHOLDS	EFh	90h	04h	-	SET FEATURES: Disable use of Serial ATA feature

Table 12 ATA Command List (continued)

Op Code		Support	Description	Op Code			Support	Description
B0h	D2h	Y	SMART: ENABLE/DISABLE AUTOSAVE	EFh	90h	05h	-	SET FEATURES: Disable use of Serial ATA feature
B0h	D3h	Y	SMART: SAVE ATTRIBUTE VALUES	EFh	90h	06h	Y	SET FEATURES: Disable Software Settings Preservation (SSP)
B0h	D4h	Y	SMART: EXECUTE OFF-LINE IMMEDIATE *note2	EFh	90h	07h	Y	SET FEATURES: Disable Device Automatic Partial to Slumber transitions
B0h	D5h	Y	SMART: READ LOG	EFh	90h	09h	O	SET FEATURES: Disable Device Sleep
B0h	D6h	Y	SMART: WRITE LOG	EFh	AAh		Y	SET FEATURES: Enable read look-ahead feature
B0h	D8h	Y	SMART: ENABLE OPERATIONS	EFh	BBh		-	SET FEATURES: Default ECC byte
B0h	D9h	Y	SMART: DISABLE OPERATIONS	EFh	C2h		-	SET FEATURES: Disable Automatic Acoustic Management feature set
B0h	DAh	Y	SMART: RETURN STATUS	EFh	C3h		-	SET FEATURES: Enable/Disable the Sense Data Reporting feature set
B0h	DBh	Y	SMART: ENABLE/DISABLE AUTOMATIC OFF-LINE	EFh	CCh		Y	SET FEATURES: Enable reverting to power-on defaults
B0h	E0h	-	SMART: Vendor specific	EFh	DDh		-	SET FEATURES: Disable release interrupt
B1h	C0h	Y	DEVICE CONFIGURATION: RESTORE	EFh	DEh		-	SET FEATURES: Disable SERVICE interrupt
B1h	C1h	Y	DEVICE CONFIGURATION: FREEZE LOCK	EFh	DFh		-	SET FEATURES: Disable NDRQ Feature
B1h	C2h	Y	DEVICE CONFIGURATION: IDENTIFY	F1h			Y	SECURITY SET PASSWORD
B1h	C3h	Y	DEVICE CONFIGURATION: SET	F2h			Y	SECURITY UNLOCK
B1h	C4h	Y	DEVICE CONFIGURATION: IDENTIFY DMA	F3h			Y	SECURITY ERASE PREPARE
B1h	C5h	Y	DEVICE CONFIGURATION: SET DMA	F4h			Y	SECURITY ERASE UNIT
B4h	0000h	O	SANITIZE DEVICE: SANITIZE STATUS EXT	F5h			Y	SECURITY FREEZE LOCK
B4h	0011h	O	SANITIZE DEVICE: CRYPTO SCRAMBLE EXT	F6h			Y	SECURITY DISABLE PASSWORD
B4h	0012h	O	SANITIZE DEVICE: BLOCK ERASE EXT	F8h			Y	READ NATIVE MAX ADDRESS
B4h	0014h	O	SANITIZE DEVICE: OVERWRITE EXT	F9h	00h		Y	SET MAX: SET MAX ADDRESS

Table 12 ATA Command List (continued)

Op Code		Support	Description	Op Code		Support	Description
B4h	0020h	O	SANITIZE DEVICE: SANITIZE FREEZE LOCK EXT	F9h	01h	Y	SET MAX: SET MAX PASSWORD
B4h	0040h	O	SANITIZE DEVICE: SANITIZE ANTIFREEZE LOCK EXT	F9h	02h	Y	SET MAX: SET MAX LOCK
B6h	00h	-	NV Cache: SET NV CACHE POWER MODE EXT	F9h	03h	Y	SET MAX: SET MAX UNLOCK
B6h	01h	-	NV Cache: RETURN FROM NV CACHE POWER MODE EXT	F9h	04h	Y	SET MAX: SET MAX FREEZE LOCK
B6h	10h	-	NV Cache: ADD LBA(S) TO NV CACHE PINNED SET DMA EXT	F9h	05h	Y	SET MAX: SET MAX SET PASSWORD DMA
B6h	11h	-	NV Cache: REMOVE LBA(S) FROM NV CACHE PINNED SET DMA EXT	F9h	06h	Y	SET MAX: SET MAX UNLOCK DMA

NOTE   The following apply:

- Value 00h: Execute SMART off-line routine in off-line mode (30 secs)

- Value 01h: Execute SMART short self-test routine in off-line mode (1 min)

- Value 02h: Execute SMART extended self-test routine in off-line mode (2 mins)

- Value 03h: Execute SMART conveyance self-test routine in off-line mode (3 mins)

6. SMART Support

The Nytro 1361 SSD supports the SMART command set.

6.1   SMART IDs

Table 14 SMART IDs, Bytes, Byte Index, and Descriptions

Bytes	0	1	2	3	4	5	6	7	8	9	10	11	?
Description	**Byte Index**												
	ID	Flag 0	Flag 1	Value	Worst	DATA							Threshold
Number of Accumulation of Uncorrectable Errors	01h	0Bh	00h	64h	64h	Host UNC Error Count		0	0	0	0	0	32h
Power-On hours Count	09h	12h	00h	64h	64h	Power on hours		0	0	0	0	0	00h
Drive Power Cycle Count	0Ch	12h	00h	64h	64h	Power on/off cycles			0	0	0	0	00h
Spare Blocks Available	10h	12h	00h	64h	64h	Spare Blocks Available by drive		0	0	0	0	0	00h
Remaining Spare Blocks	11h	12h	00h	64h	64h	Remaining Spare Blocks by drive		0	0	0	0	0	00h
SATA PHY Error Count	A8h	12h	00h	64h	64h	SATA PHY error count (Continue count)			0	0	0	0	00h
Bad Block Count(Early / Later)	Aah	03h	00h	Note1*		Total Early Bad Block Count		0	0	Total Later Bad Block Count		0	0Ah
Erase count (average, max, erase count)	Adh	12h	00h	64h	64h	Max Erase Count		Avg Erase Count		Min Erase Count		0	00h
Unexpected Power Loss count	Aeh	12h	00h	64h	64h	Unexpected Power Loss Count			0	0	0	0	00h

Table 15 SMART IDs, Bytes, Byte Index, and Descriptions--continued

Bytes	0	1	2	3	4	5	6	7	8	9	10	11	?
Description	**Byte Index**												
	ID	Flag 0	Flag 1	Value	Worst	DATA							Threshold
Wear Range delta	B1h	00h	00h	64h	64h	Wear Range delta Note2*	0	0	0	0	0	0	00h
Unexpected Power Loss Count	C0h	12h	00h	64h	64h	Unexpected Power Loss Count						0	00h
Temperature (only Toshiba or thermo sensor embedded)	C2h	23h	00h	127 - Current Temperature	127 - Highest Temperature	Current temperature			Lowest temperature		Highest temperature	0	00h
Number of accumulation CRC error (read/write data FIS CRC error)	Dah	0Bh	00h	64h	64h	SATA PHY error count						0	32h
SSD life remaining	E7h	13h	00h	64h	64h	Note3 *	0	0	0	0	Throttling level	0	00h
Read Failure Block Count	E8h	13h	00h	64h	64h	Flash Read Fail Count			Raw Read Error Rate	?		0	00h
Lifetime Writes to Flash (G Unit)	E9h	0Bh	00h	64h	64h	Lifetime Writes to Flash by GiB						0	00h
NAND read (Sectors)	Eah	0Bh	00h	64h	64h	NAND read (Sectors)						0	00h
Lifetime Writes to Flash (Sector Unit)	Ebh	0Bh	00h	64h	64h	Lifetime Writes to Flash by Sector						0	00h
Host Writes (G Unit)	F1h	12h	00h	64h	64h	Lifetime Writes from Host by GiB						0	00h
Host Reads (G Unit)	F2h	12h	00h	64h	64h	Lifetime Reads from Host by GiB						0	00h
Write Protect Detail	F6h	03h	00h	253 - Write Protect Value	253 - Write Protect Value	Write Protect Detail Note4*						0	FDh
Health Check Timer	F7h	02h	00h	64h	64h	Health Check Timer (min)						0	00h

NOTE   The following apply:

1. "Bad Block Count (Early / Later) ID 170 (AAh)" Value = 100 * [1 - (Total later bad block count per drive / Total acceptable bad block count per drive)]. This formula calculates the percentage of spare block. Value will range from 100 to 0.

2. "Wear Range Delta ID 177 (B1h)" (max erase count - least erase count) / (P-E Cycle) * 100 (percentage).

3. "SSD life remaining ID 231 (E7h)"
   SSD life remaining = 100-{(average erase count/Rated PE Cycle) * (100)}

4. "Write Protect Detail ID 246 (F6h)"
   Write Protect Type
   bit 4 FTL_ERR_WP
   bit 5 FTL_ERR_ASSERT_WP
   bit 7 FTL_ERR_NAND
   bit 9 FTL_ERR_PCAP_WP
   bit 10 FTL_ERR_PFAIL_UNFINISH_WP

7. Advanced Device Security Features

7.1 Secure Erase

Secure Erase is a standard ATA command which writes all "0xFF" to fully wipe all the data on hard drives and SSDs. When this command is issued, SSD controller erases its storage blocks and returns to its factory default settings.

7.2 Physical Presence SID (PSID)

Physical Presence SID (PSID) is defined by TCG as a 32-character string and this command reverts the SSD back to its manufacturing setting. The PSID code is printed on an SSD label.

7.3 Crypto Erase

The Crypto Erase (TCG) command erases all data from an OPAL-activated SSD drive by resetting the cryptographic key of the disk. Because the key is modified, the previously encrypted data becomes useless, maintaining data security.

7.4 TCG OPAL

Trusted Computing Group (TCG) provides a scalable infrastructure for managing encryption of user data in a Storage Device, as well as extensibility to enable features. For example, one set of capabilities defined in the Core Spec includes ways to access control of user data on the Storage Device. This includes controlling media encryption, Key Management, and Read/Write Lock State.

7.5   Sanitize Operation

The table below lists the types of Sanitize Operation supported.

Table 16 Sanitize Operation

Drive Security Type	Sanitize Operation			TCG Commands		IEEE 1667
	Overwrite	Block Erase	Crypto Erase	PSID Revert Process	Instant Secure Erase	Windows eDrive
SED (TCG Opal)	Yes	Yes	Yes	Yes	Yes	Yes
Non-SED	Yes	Yes	No	No	No	No

NOTES

- ■ Crypto Erase erases of AES encrypted data structure by resetting the cryptographic key of the drive. The previously encrypted data becomes irretrievable.

- ■ The Instant Secure Erase command erases all the data of the SED drive with the Opal-activated encrypted data structure by resetting the SSD with the PSID. Because the key is reset, the previously encrypted data cannot be accessed.

- ■ IEEE 1667 is supported but needs to be activated by SeaChest_Security tool when required to prevent unintended eDrive implementation and the following requirement of reverting by PSID before being able to re-install the Operation System.

8. Feature Details

8.1 Flash Management

8.1.1 Error Correction Code (ECC)

Flash memory cells deteriorate with use. This can generate random bit errors in the stored data. The Nytro 1361 SSD applies the LDPC ECC algorithm to detect and correct 340bits/2K Byte errors occur during read process, to make sure the SSD reads correctly, and to protect data from corruption.

8.1.2 Wear Leveling

NAND flash devices can undergo only a limited number of program/erase cycles. Commonly, the SSD does not use areas of the flash media evenly. If the SSD updates some areas more frequently than others, this reduces the lifetime of the device. Wear Leveling extends the life of the NAND Flash by evenly distributing write and erase cycles across the media.

Seagate's advanced Wear Leveling algorithm spreads the flash usage throughout the whole flash media area. Implementing dynamic and static Wear Leveling algorithms improves the life expectancy of the NAND flash.

8.1.3 Bad Block Management

Bad blocks do not function properly and they can contain more invalid bits. This can make stored data unstable and bad block reliability is not guaranteed. Blocks identified and marked as bad by the manufacturer are called "Early Bad Blocks". Bad blocks that develop during the lifespan of the Flash are called "Later Bad Blocks". Seagate's bad block management algorithm detects the factory-produced bad blocks and manages bad blocks that appear with use. This practice prevents the drive from storing data in bad blocks and improves data reliability

8.1.4 TRIM

The TRIM feature improves the read/write performance and speed of SSDs. SSDs cannot overwrite existing data, so the available space becomes smaller with each data block use. The TRIM command tells the SSD [through the operating system] which data blocks can be removed permanently because they are no longer in use. The SSD erases these unused data blocks.

8.1.5 SMART

SMART, stands for Self-Monitoring, Analysis, and Reporting Technology. SMART is an open standard that allows an SSD to automatically detect its health and report potential failures. When SMART records a failure, users can replace the SSD to prevent unexpected outage or data loss. SMART can also inform users of impending failures while there is still time to copy data to another device.

8.1.6   Over Provisioning

Over Provisioning (OP) preserves an additional area beyond user capacity in an SSD, which is not visible to users and cannot be used by them. OP improves performance and IOPS (Input/Output Operations per Second) by providing the controller additional space to manage P/E cycles. OP enhances the reliability and endurance as well. Moreover, the write amplification of the SSD becomes lower when the controller writes data to the flash.

8.1.7   Firmware Upgrade

Firmware provides a set of instructions on how the device communicates with the host. Firmware upgrades are typically available with added features, fixed compatibility issues, and improved read/write performance.

8.1.8   Thermal Throttling

Thermal throttling prevents components in an SSD from over-heating during read and write operations. The Nytro 1361 SSD design provides an on-die and onboard thermal sensor. With this accuracy, firmware can apply different levels of throttling to protect efficiently and proactively through the SMART reading.

Table 17 Thermal Throttling

Item	Content
tmt1 threshold	68°C per Smart reported
tmt2 threshold	70°C per Smart reported
Protect threshold	80°C per Smart reported or 115°C on-die thermal sensor (controller)
Fatal threshold	120°C from on-die thermal sensor (controller)
Resume performance threshold	60°C per Smart reported
Temperature polling frequency	Every 1 sec
TMT1_state impact	±10% CE
TMT2_state impact	-20% CE

8.1.9   Garbage Collection

Garbage collection allocates and releases memory to accelerate the read/write processing and improve performance. When there is less available space, the SSD slows down the read/write processing and implements garbage collection to release memory.

8.2   SSD Lifetime Management Terms

Here's an explanation of common terms that describe SSD Lifetime Management.

■ **Total Bytes Written (TBW)** measures the lifespan of the SSD. This measurement represents the amount of data written to the device. To calculate the TBW of an SSD, use the following equation:

TBW = [(NAND Endurance) x (SSD Capacity)] / [WAF]

■ **NAND Endurance.** NAND endurance refers to the P/E (Program/Erase) cycle of a NAND flash.

■ **SSD Capacity.** The SSD capacity is the specific capacity in total of an SSD.

- **WAF.** Write Amplification Factor (WAF) is a numerical value. This value represents the ratio between the amount of data that an SSD controller needs to write and the amount of data that the host's flash controller writes. A WAF, near 1, guarantees better endurance and lower frequency of data written to flash memory.

TBW in this document is based on the JEDEC 218/219 workload.

8.2.1 Media Wear Indicator

Actual life indicator reported by SMART Attribute 231 (E7h) Life Remaining by percentage. This indicator recommends User to replace drive when reaching to 0%.

8.2.2 Read Only Mode (End of Life)

When the SSD is aged by program/erase cycles, media wear-out may cause increasing numbers of bad blocks. When the number of usable good blocks falls outside a defined usable range, the drive notifies the host through AER event and Critical Warning to enter Read Only Mode to prevent further data corruption. When this happens, the user should replace the SSD with another one immediately

8.3 Adaptive Approach to Performance Tuning

8.3.1 Predict and Fetch

When the Host tries to read data from the SSD, the SSD performs only one read action after receiving one command. However, the Nytro 1361 SSD applies Predict and Fetch to improve the read speed. When the host issues sequential read commands to the SSD, the SSD expects that the following are also read commands. Therefore, before receiving the next command, flash has prepared the data. This accelerates data processing time, and the host needs less wait time to receive data.

8.3.2 Throughput

Based on the available space of the SSD, the Nytro 1361 SSD regulates the read/write speed and manages the performance of throughput. When the SSD has more space, the firmware continuously performs read/write actions. There is no need yet to implement garbage collection to allocate and release memory to accelerate the read/write processing and improve performance. When the SSD has less available space, it slows down the read/write processing and implements garbage collection to release memory.

9. SeaTools Drive Management

SeaTools® is a free drive management software from Seagate. SeaTools monitors health, and tests and analyzes drives. It is data safe and simple to install on your system. SeaTools provides the following resources:

- Health Monitoring
- Drive Test and Maintenance
- Drive Status
- Test
- Disc Wizard
- Firmware Update
- Erase Commands

To download SeaTools and get more information, visit here:

https://www.seagate.com/in/en/support/downloads/seatools

10. Safety and Compliance Standards

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

You can find up to date information on safety certifications, and component compliance requirements for Seagate devices on the Seagate Support page, here: https://www.seagate.com/support/

Scroll down to the Compliance section to access all compliance resources.

10.1   Regulatory Model Numbers

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

- STA023

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