Western Digital.

PRODUCT MANUAL

PC SN810 NVMe™ SSD

For Generic OEM

02-05-WW-04-00308

Revision History

Revision	Date	Description	Reference
1.0	April 21, 2021	Initial release.	

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1.0 PREFACE

1.1 Typographical Conventions

This document uses the typographical conventions listed and shown in Table 1-1.

Table 1-1. Typographical Conventions

Convention	Usage	Examples
Note:	Important additional information or further explanation of a topic.	*Note*: A weekly backup is recommended.
Bold	A command or system input that you type, or text or a button displayed on a screen.	Click **HELP** for details on disaster recovery.
Italics	Italic font indicates any of the following: ■ ***A term with a specific meaning*** in the context of this document. ■ *Emphasis* on specific information. ■ *Reference* to another document.	Detailed information on ***disaster recovery*** methods is available in *Administrator Guide*.
Blue Text	References hyperlinks.	For more details, visit www.wdc.com.

1.2 Glossary of Abbreviations and Acronyms

This section shows the glossary of abbreviations and acronyms used in this document.

Table 1-2. Glossary of Abbreviations and Acronyms

Abbreviation/Acronyms	Definition
AES	Advanced Encryption Standard
APST	Autonomous Power State Transitions
ASPM	Active State Power Management
ECC	Error Correction Code
EDC	Error Detection Code
ESD	Electrostatic Discharge
FFU	Field Firmware Update
FW	Firmware
HCTM	Host Control Thermal Management
LBA	Logical Block Addressing
LDPC	Low-Density Parity Check
MLC	Multi Level Cell
MTTF	Mean Time to Failure
NVMe	Non-Volatile Memory Express
PCIe	Peripheral Component Interconnect Express
RTD3	Runtime D3
SSC	Security Subsystem Class
SD	Storage Device
SED	Self-Encrypting Drive
SLC	Single Level Cell
SSD	Solid State Drive
TBW	Terabytes Written
TCG	Trusted Computing Group
TLC	Triple Level Cell

2.0 INTRODUCTION

This data sheet describes the functional, mechanical, and interface specifications of the Western Digital® PC SN810 NVMe™ SSD specifically for Generic OEM.

2.1 General Description

The Western Digital PC SN810 NVMe SSD was designed to deliver high PCIe Gen4 performance in NVMe platforms, leveraging the proven Western Digital in-house architecture.

The proven Western Digital in-house architecture is optimized for the client SSD, both corporate and commercial, platforms needs. Among other features, the PC SN810 NVME SSD supports the nCache™ 4.0 for SLC management, the power optimized 3 Gear LDPC Hardware Engine, BICS4 multi-pages XOR protection and a full ECC data-path protection.

The nCache 4.0 is the latest Western Digital's Caching architecture, introducing both Reads and Writes speed enhancements through Dynamic SLC management.

The PC SN810 NVME SSD also features an NVMe Low-Power state of 5mW, NVMe Power Management, NVMe HCTM (Host Control Thermal Management), NVMe APST (Autonomous Power State Transitions) and NVMe ASPM (Active State Power Management). In addition, PC SN810 NVME SSD includes a self- thermal throttling mechanism as the last level of thermal protection

The PC SN810 NVME SSD is available in M.2 2280 single sided form factor, with capacities of 256, 512, 1024, and 2048 gigabytes (GB)[1].

[1] 1 gigabyte (GB) = 1 billion bytes. Some of the drive capacity is used for formatting and other functions and is not available for data storage.

2.2 Key Features and Specification

Table 2-1. Key Features and Specifications for PC SN810 NVMe SSD

Memory Supported	Western Digital BiCS4 256Gb 2P X3, and BiCS4 512Gb 2P X3
Unformatted Capacities[1]	256GB, 512GB, 1024GB, 2048GB
Form Factors	M.2 2280 S3-M
Host Interface	PCIe Gen4 x4
Host Protocol	NVM Express 1.4
Security Protocol	▪ non-SED SKUs:TCG Pyrite 2.01 and ATA Password ▪ SED SKUs: TCG Opal 2.01 and ATA Password
Performance[2]	▪ Sequential Read: Up to 6,600 MB/s ▪ Sequential Write: Up to 5,000 MB/s ▪ Random Read 4K: Up to 760K IOPS ▪ Random Write 4K: Up to 650K IOPS
Average Power[3]	200mW
Low Power[4]	5mW
Flush Management	LDPC Engine + multi page XOR protection
Data Path Protection	Full ECC Data Path
Code Protection	Secure Boot
SLC Cache	nCache 4.0
Thermal Throttling	▪ NVMe Host Control Thermal Management (HCTM) ▪ Self-Throttling
Power Management	▪ NVMe Power Management ▪ NVMe Autonomous Power State Transitions (APST) ▪ Active State Power Management (ASPM)
Mean time to failure (MTTF)	1.75M hours
Uncorrectable bit error rate (UBER)	1 bit per 10^{16} bits read
Operating temperature[5]	0°C to 80°C
Non-operating temperature and storage[6]	-55°C to +85°C
Operating and non-operating shock	1,500G, 0.5ms half sine
Operating vibration	$5G_{RMS}$, 10 to 2,000Hz, 15min/axis on 3 axes
Non-operating vibration	$4.9G_{RMS}$, 7 to 800Hz, 15min/axis on 3 axes

[1] Logical capacity of the drive conforms to the IDEMA HDD Specification. See www.idema.org for details. A portion of the drive capacity is not available for data storage. 1 gigabyte (GB) = 1 billion bytes.

[2] Performance is measured by CrystalDiskMark 7.0.0f using 1GB LBA range. Windows 10 using Microsoft driver build 18362.116, Primary drive FOB. ASUS ROG Crosshair VIII Hero X570 platform with AMD® Ryzen 9 3950X 16-Core, HyperX Fury 32GB 3200Mhz DDR4 CL 16 DIMM. C-State On.

[3] Average Power as measured using MobileMark™ 2014 on AMD Ryzen 5 3500 6-core, 16GB DRAM, NVIDIA GeFORCE GT 710, C-State on, Windows 10 Pro, primary drive. Average 5s.

[4] Low Power referring to NVMe PS4 at 25°C.

[5] Operational temperature is defined as temperature reported by the drive. Note that drive temperature readings are expected to be higher than ambient temperature when the SSD is placed inside a system.

[6] Non-operating storage temperature does not guarantee data retention beyond endurance and data retention specifications.

2.3 Functional Description

The Western Digital PC SN810 NVMe SSD supports the following features:

- NVM Express 1.4 compliance
- In-house 3 gears LDPC engine with advanced DSP capabilities in hardware
- NAND XOR protection for multi-page recovery
- Dynamic and static wear-leveling to extend the life of the SSD
- Secure Boot including RSA Authentication
- Secure FFU

2.4 Advanced Flash Management

2.4.1 Defect and Error Management

The PC SN810 NVME SSD contains an enhanced defect and error management system. If necessary, the device will rewrite data from a defective block to a good block. This action is completely transparent to the host and does not consume any user data space.

2.4.2 Wear Leveling

NAND based SSDs use dynamic and static wear leveling and automatic block management to ensure an even distribution of write/erase cycles throughout the entire device. These processes guarantee high data reliability and maximize flash life expectancy. Wear leveling is done between all TLC blocks and separately between all SLC blocks.

2.4.3 Bad Block Management

Bad blocks are occasionally created during the life cycle of a flash component. These bad blocks must be marked and replaced dynamically in order to prevent read/write failures. When a bad block is detected, the embedded Bad Block Mapping algorithm removes the block from future use.

2.4.4 Background Garbage Collection

The flash management firmware will perform internal house-keeping activities, such consolidating and flushing the SLC blocks to the TLC storage or reorganizing the data in the TLC array or SLC array. These activities are performed in the background and are transparent to the host, thus improving performance while providing a seamless user experience.

2.4.5 SLC Cache - nCache 4.0

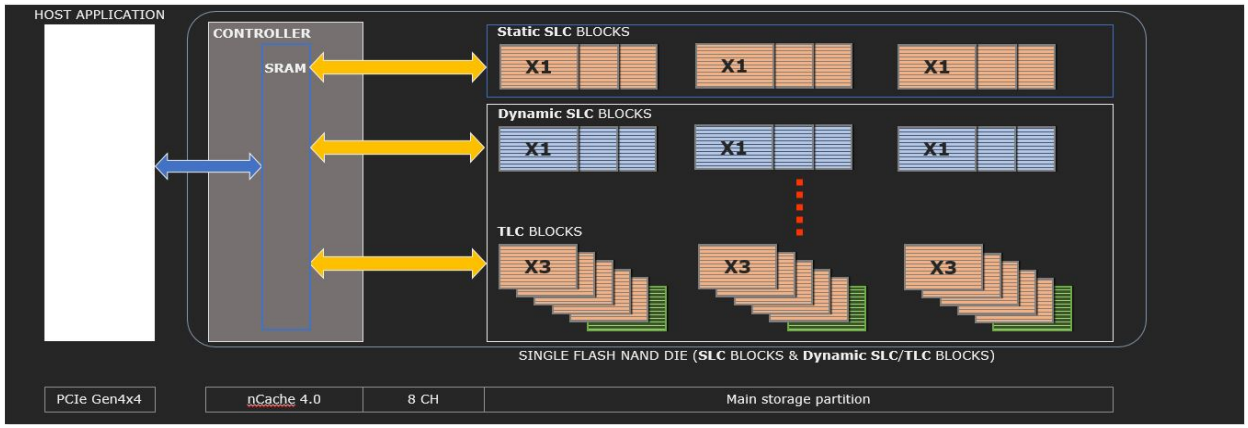
The nCache 4.0 is a pool of X1 (SLC) blocks for sequential and random host operations. These X1 blocks are used as write cache to accumulate and consolidate all writes at high speed.

The PC SN810 NVME SSD utilize the nCache 4.0 tiered caching which further improves performance and power efficiently by introducing several enhancements as:

- nCache 4.0 uses an SLC cache (pool of blocks) to achieve higher performance in burst operations, while taking advantage of BICS direct programming when working outside of the cache

- Static SLC cache is always available
  - The Static SLC cache sizes are 3GB for 256GB, 6GB for 512GB, 12GB for 1024GB, 24GB for 2048GB
- When possible, TLC blocks can also be used as SLC cache (dynamic) to increase performance in additional workloads
  - Dynamic SLC pool size is adjusted during operation based on drive fullness, endurance usage, and workload
- Static/dynamic SLC blocks are evicted to TLC at idle times to free cache space for future burst operations

Figure 2-1. PC SN810 NVMe SSD Tiered Caching Technology



2.4.6 Error Correction Layers

The PC SN810 NVME SSD advanced Error Correction and Data recovery mechanism constructed from multi layers of protection:

- **Multi Gear LDPC Engine** - The PC SN810 NVME SSD LDPC use Multi-Gear Hardware LDPC Engine tailored for Western Digital 3D NAND. The ultra-low power and high speed - Gear1 Mode, help reduce the overall power consumed by the LDPC during reads and writes.
- **Hardware DSP and Soft Decode** - Hardware accelerators used for enhanced Error Correction; at high BER rates.
- **XOR Recovery** - The XOR Recovery is an extreme and rare protection layer. It is a RAID-Like protection and is able to recovery multi-pages at need.

3.0 General Product Specifications

3.1 Interface

The PC SN810 NVME SSD is a PCI Express Gen4 x4 SSD. Complies with:

- PCI Express 4.0 up to four lanes, and backward compatible with PCI Express 3.0
- Configurable Lane width: x1, x2 and x4
- NVM Express Rev 1.4

3.2 Hardware Configuration

Table 3-1 provides the basic hardware configuration values for the PC SN810 NVME SSD.

Table 3-1. PC SN810 NVMe SSD Hardware Configuration

SSD Capacity	Form Factor	NAND Technology	Memory	DRAM
256GB	M.2 2280-S3-M	BiCS4 256Gb 2P X3	2 x 4D BGA	DDR4 4Gb
512GB	M.2 2280-S3-M	BiCS4 256Gb 2P X3	2 x 8D BGA	DDR4 4Gb
1024GB	M.2 2280-S3-M	BiCS4 256Gb 2P X3	2 x 16D BGA	DDR4 4Gb
2048GB	M.2 2280-S3-M	BiCS4 512Gb 2P X3	2 x 16D BGA	DDR4 8Gb

3.3 Capacity

Table 3-2. PC SN810 NVMe SSD Capacity Specification

Unformatted Capacity[1]	Sectors in LBA Mode[2]	Available Form Factors
256GB	500,118,192	M.2 2280-S3-M
512GB	1,000,215,216	M.2 2280-S3-M
1024GB	2,000,409,264	M.2 2280-S3-M
2048GB	4,000,797,360	M.2 2280-S3-M

[1] 1 gigabyte (GB) = 1 billion bytes. Some of the listed capacity is used for formatting and other functions, and thus is not available for data storage.
[2] 1 Sector = 512 bytes. LBA count based on IDEMA standard.

4.0 PERFORMANCE

Table 4-1 includes the PC SN810 NVMe SSD performance in a system that supports PCI Express Gen4 x4, FOB in CDM.

Table 4-1. PC SN810 NVMe SSD M.2 2280 Performance

Parameter	Queue Depth / Threads	256GB	512GB	1024GB	2048GB
Sequential Read 128KB MB/s[1]	QD=8, T = 1	5,700	6,000	6,600	6,600
Sequential Write 128KB MB/s[1]	QD=8, T = 1	1,900	4,000	5,000	5,000
Random Read 4KB (32QD) IOPS[1]	QD=32, T = 16	400,000	750,000	760,000	760,000
Random Write 4KB (32QD) IOPS[1]	QD=32, T = 16	490,000	630,000	650,000	650,000

[1] Test Conditions: Performance is measured by CrystalDiskMark 7.0.0f using 1GB LBA range. Windows 10 using Microsoft driver build 18362.116, Primary drive FOB. ASUS ROG Crosshair VIII Hero X570 platform with AMD® Ryzen 9 3950X 16-Core, HyperX Fury 32GB 3200Mhz DDR4 CL 16 DIMM. C-State On.

5.0 Power Characteristics

5.1 Supply Voltage

Table 5-1. PC SN810 NVMe SSD Supply Voltage

Parameter	Specification
Input Voltage M.2 2280	3.3V ± 5%
Maximum Ripple	100mV (peak to peak), 100Hz to 6MHz
Maximum Supply Rise Time	100ms

5.2 Average Active-Power Consumption[1]

The *average active-power consumption* is defined as the blended read/write/idle power used by the drive while in operation with a commonly used operating system. It is measured using the MobileMark™ benchmark, average 5 seconds. During this test Microsoft StorNVMe driver triggers non-operative low power state.

This benchmark simulates the typical usage of user applications in a Windows environment, providing a reproducible test for measuring average active-power consumption.

Table 5-2. PC SN810 NVMe SSD Average Active-Power Consumption

Form Factor	Input Voltage	Test Suite	Unit	256GB, 512GB, 1024GB, 2048GB
M.2 2280	3.3V ± 5%	Productivity	mW	200

5.3 Operating Power Consumption – Average Maximum[2]

Average maximum operating power consumption is measured while the PC SN810 NVME SSD is continuously processing sequential read and write commands (tested separately) for at least 1 minute, with a transfer size of 256 sectors per command (128KB), queue depth of 32 and 1 thread. The sampling interval is 125 milliseconds. This benchmark is designed to test the worst-case scenario, when continuous power is required by the PC SN810 NVME SSD during long read or write command sequences.

Table 5-3. PC SN810 NVMe SSD Average Max Power Consumption

Form Factor	Input Voltage	Test	Unit	256GB	512GB	1024GB	2048GB
M.2 2280	3.3V ± 5%	Read	mW	7,000	8,000	8,000	8,250
			A	2.1	2.4	2.4	2.5
		Write	mW	4,000	5,200	6,300	7,200
			A	1.2	1.6	1.9	2.2

1 Average Power as measured using MobileMark™ 2014 on AMD Ryzen 5 3500 6-core, 16GB DRAM, NVIDIA GeFORCE GT 710, C-State on, Windows 10 Pro, primary drive. Average 5s.

2 Measured at 25°C. Power consumption can vary due to input voltage and ambient temperature variation.

5.4 Peak Power and In-Rush Current

Peak power consumption is the maximum instantaneous power consumption measured while the PC SN810 NVME SSD is continuously processing sequential read and write commands (tested separately) for at least 1 minute, with a transfer size of 256 sectors per command (128KB), queue depth of 32 and 1 threads. The sampling interval is 10µs. This benchmark is designed to test the worst-case scenario, when continuous power is required by the PC SN810 NVME SSD during long read or write command sequences.

Maximum in-rush current refers to the maximum instantaneous power consumption of the PC SN810 NVME SSD drive after a power cycle until all voltage rails required for operation are stabilized to their nominal values on the drive. The sampling interval is 10µs.

Table 5-4. PC SN810 NVMe SSD Peak Power and In-Rush Current

Form Factor	Input Voltage	Test	Unit	256GB, 512GB, 1024GB, 2048GB
M.2 2280	3.3V ± 5%	Peak Power (10us)	mW	10,560
			A	3.2
		Max In-Rush	mW	6,930
			A	2.1

5.5 NVMe Power Management

The PC SN810 NVME SSD supports NVMe power management. Product Identify reports 5 NVMe power modes as detailed below.

L1.2 mode enabled and asynchronously controlled by the PCI Express layer.

Table details the power consumption and performance per power state. Power consumption and performance are measured during sustained sequential write or sustained sequential read as defined in *Section 4.0 on page 13*.

Table 5-5. PC SN810 NVMe SSD Power Consumption and Performance Per NVMe Power State

Power Mode	Device State	Sustained Sequential Read/ Write up to [MB/s]	Avg Power	Latency (ENLAT+EXLAT)
PS0	Full Performance	256GB: 5,700 MB/s Read 1,900 MB/s Write 512GB: 6,000 MB/s Read 4,000 MB/s Write 1024GB: 6,600 MB/s Read 5,000 MB/s Write 2048GB: 6,600 MB/s Read 5,000 MB/s Write	256GB: 7W Read 4W Write 512GB: 8W Read 5.2W Write 1024GB: 8W Read 6.3W Write 2048GB: 8.25W Read 7.2W Write	—
PS1	Light Throttling	1,700 MB/s Read 1,200 MB/s Write	3.5W	—
PS2	Heavy Throttling	700 MB/s Read 600 MB/s Write	2.6W	—
PS3	Non-Operational, Rapid recovery	—	25mW	15ms
PS4	Non-Operational, Slow Recovery	—	5mW	50ms

5.6 Graceful Power-off Requirements

On most operating systems, *Write Cache* is enabled by default. This feature is not specific to Western Digital SSD products. There may be data residing in the PC SN810 NVME SSD cache that have not been written to the flash memory. To ensure that the data is properly committed to flash memory, the PC SN810 NVME SSD requires the host to write 01b (normal shutdown) to the **Shutdown Notification (CC:SHN)** field. This command instructs the PC SN810 NVME SSD to write all of its volatile data cache to flash memory and returns a GOOD status to the host after its successful completion. This command is handled transparently by most operating systems during the shutdown sequence (for example, hibernation, shutdown, and standby.)

However, if power is lost without warning - leading to an ungraceful shutdown - data loss may occur. This may also lead to a longer power-on time for the subsequent power-up.

6.0 THERMAL THROTTLING

6.1 Self-Thermal Throttling

In order to protect the integrity of the data and prevent excessive heat dissipation, the PC SN810 NVME SSD utilizes several component temperature sensors (junction temperature) to monitor the SSD critical components temperatures. If a sensor temperature rises above the allowable limit, system performance is lowered until the temperature decreases to an acceptable level. The device returns to full performance when the temperature returns to a normal range.

Table 6-1 describes the performance results, while thermal throttling is activated.

Table 6-1. PC SN810 NVMe SSD Performance Under Thermal Throttling

PC SN810 NVMe SSD Self-Throttling Mode	Sequential Read	Sequential Write
Entry Temp [°C]	T_{Nand}>85°C or $T_{controller}$>105°C	
Exit Temp [°C]	T_{Nand}<82°C and $T_{controller}$<100°C	
Power [W]	1.2W	1.2W
Performance[1] [MB/s]	180 MB/s	90 MB/s

[1] *While during self-throttling mode PC SN810 NVME SSD is keeping the power value flat; performance may be varied between devices due to process variation.*

6.2 Denial of Service

To avoid data corruption, and as a last protection measure, if **T_{Nand}>95°C or $T_{controller}$>117°C** the device will enter a denial of service state. A recovery to functional mode is only by a full power cycle.

7.0 ENDURANCE

The endurance of the PC SN810 NVME SSD is calculated using JEDEC client workload (JESD219), unconnected to power.

Endurance is a direct function of user workload and access pattern. It is defined in terms of Terabytes Written (TBW). Refer to Table 7-1 below.

Table 7-1. PC SN810 NVMe SSD Endurance

Parameter	256GB	512GB	1024GB	2048GB
Drive Endurance Data Retention I Year @ 30°C	200 TBW	300 TBW	400 TBW	500 TBW

8.0 SECURITY

There are two types of Western Digital® PC SN810 NVMe SSD SKUs:

- Non-Encrypted Drives (Non-SED). They support two security protocols:
  - TCG Pyrite 2.01
  - ATA Security passthrough over NVMe
- Self-Encrypting Drives (SED). They support two security protocols:
  - TCG Opal 2.01
  - ATA Security passthrough over NVMe

8.1 Support of TCG Pyrite 2.01

The non-SED version of the Western Digital® PC SN810 NVMe SSD supports password locking of user data conforming to the standard: "TCG Storage Security Subsystem Class: Pyrite. Specification Version 2.01." It includes the following capabilities and characteristics:

- Provides a mechanism that locks access to the entire user media by NVMe read and write commands. When configured, access is locked automatically upon device power cycle
- Requires password authentication for one of the configured host authorities in order to unlock the device
- Supports up to 5 authentication attempts with the wrong password. After that, it requires a power cycle before accepting a new authentication
- Protects unlock password received from the host using a cryptographic digest. No plaintext password is stored inside the device
- Supports the following TCG features:
  - TCG Block SID Authentication
  - TCG PSID Revert conforming to the standard: "TCG Storage Opal SSC Feature Set: PSID". NAND Block Erase for all user data received from host is implemented as a Data Removal Mechanism for TCG Pyrite
- All devices are shipped with TCG security disabled. Host can take ownership of the device security using default credentials of SID authority

TCG Pyrite device relies on the host BIOS to implement the security protocol for password locking:

- Host shall issue TCG Block SID Authentication command for devices with disabled security to prevent malicious host applications from taking control over device security using the default password
- Host may sets user password to enable device locking
- Host shall submit user password to unlock locked device during system boot to get access to protected user data

8.2 Support of ATA Security passthrough over NVMe (ATA Security)

Both Non-SED and SED versions of Western Digital® PC SN810 NVMe SSD support ATA Security passthrough over NVMe (ATA Security) conforming to the definition of security protocol "ATA Device Server Password" in SPC-5 (SCSI Primary Commands 5 (SPC-5), T10/INCITS).

The device supports complete list of ATA Security commands:

- Security Set Password
- Security Unlock
- Security Disable Password
- Security Freeze Lock
- Security Erase Prepare
- Security Erase Unit

The SED version of Western Digital® PC SN810 NVMe SSD uses an internally generated data encryption key to protect data at rest. The password received from the host is used to wrap this key cryptographically prior to saving it to an internal security storage. User password is required to unwrap this key and decrypt the stored user data.

8.3 Support of TCG Opal 2.01

The SED version of Western Digital® PC SN810 NVMe SSD supports password locking and hardware-accelerated full disk encryption of user data at rest conforming to the standard: "TCG Storage Security Subsystem Class: Opal. Specification Version 2.01". It includes the following capabilities and characteristics:

- Superset of password locking commands from TCG Pyrite 2.0 (see section 8.1)
- AES-XTS 256-bit hardware encryption for user data. One global and up to 8 non-global LBA ranges are encrypted with separate keys
- User data encryption keys are generated using internal HW TRNG and wrapped with credentials of authorities that have access to the corresponding LBA ranges
- Support of the following TCG features:
  - TCG Single User Mode
  - TCG Block SID Authentication
  - TCG PSID Revert
  - TCG Additional DataStore
  - MBR Shadowing with MBR size 128MB
- TCG Opal implementation was tested for compatibility with WinMagic SecureDoc and McAfee Endpoint Encryption security management software.

8.4 Co-existence of TCG and ATA Security protocols

ATA Security and TCG security protocols can not be activated together. Only one of the protocols can be active at any given time. If the ATA Password is set, interactions with TCG commands are implemented as specified in TCG SIIS standard v1.08 for interaction of these protocols.

When the device is in TCG Manufactured-Inactive state the host command ATA Freeze Lock also enables TCG BlockSID state.

8.5 Secure Erase Commands

Western Digital® PC SN810 NVMe SSD supports sanitization of user data using several NVMe commands and using standard commands of the supported security protocols. They implement combination of the following sanitization operations:

1. FTL Cleanup implements logical erase of user data by manipulation and clean-up of the Flash Translation Layer (FTL) tables. It makes any subsequent read request return uninitialized data. Previously written user data is not physically erased from

the media but is inaccessible for NVMe commands.

2. Block Erase implements physical erase of user data using NAND Block Erase operations. The scope of erasure includes all user LBAs including any spare and re-allocated blocks.
3. Crypto Erase erases the user data encryption key from security storage making it impossible to decrypt the data at rest. This mode is supported only on SED devices.

Table 8-1 below summarizes operations implemented by different commands and methods together with their results.

Table 8-1. PC SN810 NVMe SSD Data Erase Command and Results

Command	Mode	PC SN810 Non-SED, Pyrite 2.01			PC SN810 SED, Opal 2.01		
		Operations	Data at Rest	Read Result	Operations	Data at Rest	Read Result
Format NVM	No Secure Erase (SES = 000b)	FTL Cleanup	Untouched	Zeroes	FTL Cleanup	Untouched	Zeroes
	User Data Erase (SES = 001b)	FTL Cleanup Block Erase	NAND Erase	Zeroes	FTL Cleanup Block Erase	NAND Erase	Zeroes
	Crypto Erase (SES = 010b)	N/A			FTL Cleanup, Crypto Erase	Untouched, Decryption key erased	Zeroes
Sanitize[1]	Block Erase (SANACT = 010b)	FTL Cleanup Block Erase	NAND Erase	Zeroes	FTL Cleanup Block Erase	NAND Erase	Zeroes
	Crypto Erase (SANACT = 100b)	N/A			FTL Cleanup, Crypto Erase	Untouched, Decryption key erased	Zeroes
TCG Revert[2], Revert SP	KeepGobalLocking RangeKey/ KeepData = FALSE	FTL Cleanup Block Erase	NAND Erase	Zeroes	FTL Cleanup, Crypto Erase	Untouched, Decryption key erased	Zeroes
ATA Security	Normal	FTL Cleanup Block Erase	NAND Erase	Zeroes	FTL Cleanup Block Erase	NAND Erase	Zeroes
	Enhanced	FTL Cleanup Block Erase	NAND Erase	Zeroes	FTL Cleanup, Crypto Erase	Untouched, Decryption key erased	Zeroes

[1]The Sanitize command doesn't support parameter NDAS and Overwrite operation.
[2]TCG Revert does not erase user data if TCG protocol is not activated.

8.6 Security of Read-Only Mode

The Western Digital PC SN810 NVMe SSD enters read-only mode upon reaching end-of-life conditions for user media. In this mode, it stops accepting commands that might write user or system data.

Format NVM in the User Data Erase mode is supported when device turns read-only mode. It provides a secure option to erase all user data before disposal of the device or before returning it for failure analysis. Successful status returned for the command is an indication of complete sanitization of user data. If device fails to complete the process, data sanitization should be addressed by physical destroy methods, e.g. shredding.

Device preserves TCG locking settings as configured before transition to read-only mode. Host application shall be ready that the Format NVM command is aborted when device is write-locked. Host shall unlock device with valid user password before applying the command.

8.7 Secure Field Firmware Update (FFU)

The genuine Western Digital® firmware update image is encrypted and signed. The RSA digital signature algorithm with 2048-bit key is used for signing of the file, while AES-CBC-256 algorithm is used for encryption.

The device automatically verifies the signature of a firmware update image during FFU and rejects images that fail the procedure. A root certificate for the verification is provisioned to permanent eFuse storage in the SSD controller during device manufacturing. The firmware signing process in Western Digital relies on HSM-based signing servers for the storage of private keys to guarantee protection against key leakage and enable auditability of firmware releases.

The Western Digital PC SN810 NVMe SSD implements no interface to update device firmware that bypasses regular FFU commands or to disable digital signature verification.

8.8 Secure Boot

The Western Digital PC SN810 NVMe SSD verifies digital signatures of firmware images loaded from NAND Flash storage before running them. Signatures cover all parts of the stored firmware images including the boot loader. The boot loader itself is verified by ROM, then it verifies other parts. If the verification fails, the SSD enters failure mode where it does not handle user data commands except Identify Controller.

Secure Boot uses an RSA digital signature algorithm with 2048-bit keys. The firmware signing process in Western Digital relies on HSM-based signing servers for storage of private keys. The SSD controller includes hardware acceleration for RSA calculations to ensure that signature verification does not cause significant delays for the Western Digital PC SN810 NVMe SSD initialization. The RSA Public key for verification is provisioned to the device during manufacturing and rooted to the SSD controller one-time programmable eFuse.

8.9 Secure RMA

All Western Digital® PC SN810 NVME SSD devices implement hardware "locks" for debug access to the SSD controller and for any vendor-specific diagnostic commands. Removing of these "locks" is limited only to authorized engineers in WD facilities. Devices in RMA-unlocked mode are not locked again and are not returned to customers.

The unlock procedure requires authentication on Western Digital® HSM-based Signing Server with an RSA challenge-request protocol that generates a device-specific unlock token. The public key for verification of the procedure is provisioned to device during manufacturing and rooted to the controller eFuse. User data is destroyed before entering RMA-unlocked mode.

9.0 PHYSICAL SPECIFICATIONS

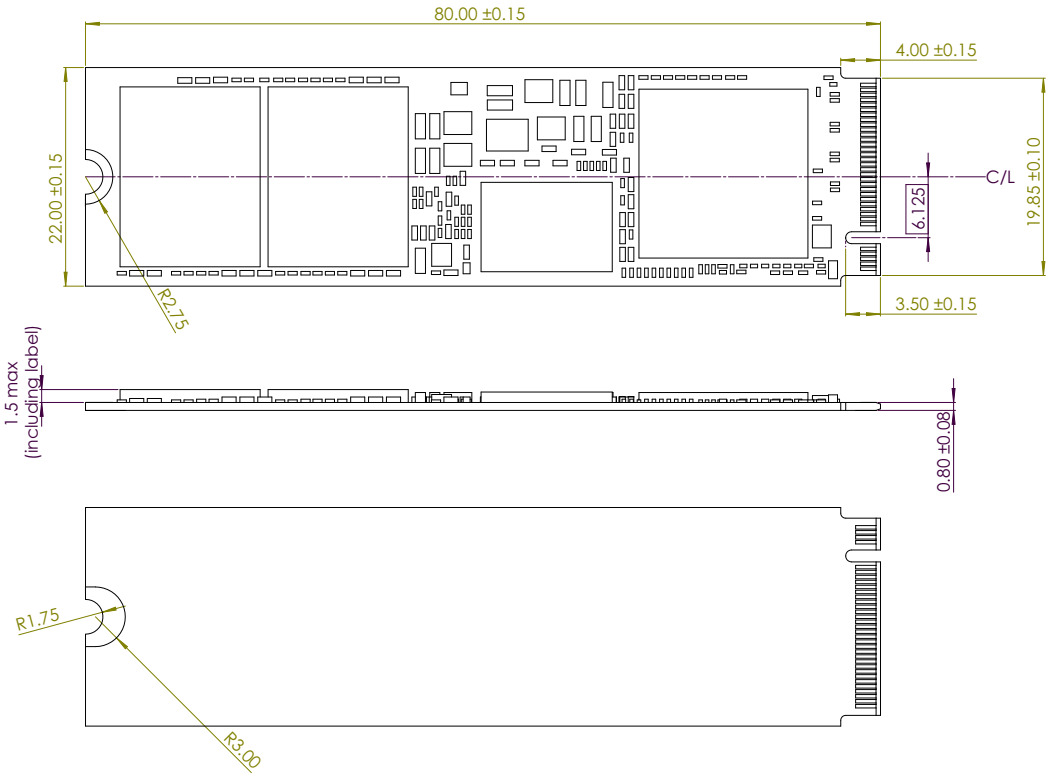
9.1 M.2 2280 Form Factor

The M.2 2280 form factor complies with *PCI Express M.2 (NGFF) Electromechanical Specification, rev. 1.1.*

Table 9-1. PC SN810 NVMe SSD M.2 2280 Form Factor Mechanical Specifications

Parameter	Specification
Type	256GB: M.2 2280 S3-M 512GB: M.2 2280 S3-M 1024GB: M.2 2280 S3-M 2048GB: M.2 2280 S3-M
Width	22 ± 0.15mm
Length	80 ± 0.15mm
PCB Thickness	0.80 ± 0.08mm
Component Height	1.5mm
Thickness (max)	256GB: 2.23mm 512GB: 2.23mm 1024GB: 2.38mm 2048GB: 2.38mm
Typical Weight	7.2±0.5gr

Figure 9-1. Top and side view of the PC SN810 NVME SSD



10.0 Environmental Specifications

10.1 Temperature

Table 10-1. PC SN810 NVMe SSD Temperature Specification

Parameter	Specifications
Operational[1]	0°C to 80°C
Non-operational[2]	-55°C to 85°C

[1] Operational temperature is defined as temperature reported by the drive. Note that drive temperature readings are expected to be higher than ambient temperature when the SSD is placed inside a system.
[2] Non-operational storage temperature does not guarantee data retention.

10.2 Humidity

Table 10-2. PC SN810 NVMe SSD Humidity Specification

Parameter		Specifications
Operational	Humidity (Non-condensation)	5% to 95%
	Maximum Wet Bulb	30°C
Non-Operational	Humidity (Non-condensation)	5% to 95%
	Maximum Wet Bulb	40°C

10.3 Vibration

Table 10-3. PC SN810 NVMe SSD Vibration Specification

Parameter	Specifications
Non-Operation Vibration	$4.9G_{RMS}$, 7 to 800Hz, 15min/axis on 3 axes
Operating Vibration	$5G_{RMS}$, 10 to 2,000Hz, 15min/axis on 3 axes

10.4 Shock

Table 10-4. PC SN810 NVMe SSD Shock Specification

Parameter	Acceleration Force
Operating and Non-Operational Shock	1500G,0.5ms, half sine, 3 pulses x 6 surfaces

10.5 Altitude

Table 10-5. PC SN810 NVMe SSD Altitude Specification

Parameter	Specifications
Operational/Non-operational	-1500ft (-457m) to 40,000ft (12,192m)

10.6 Electrostatic Discharge (ESD)[1]

Table 10-6. PC SN810 NVMe SSD ESD Specification

Parameter	Voltage
Contact	±4kV
Air	8kV

10.7 Acoustics

The PC SN810 NVMe SSD does not generate any acoustic noise (0dB).

10.8 Chemical Restrictions

The Western Digital PC SN810 NVMe SSD complies with the European Union's Restriction on Use of Hazardous Substances in Electrical and Electronic Equipment (EU RoHS) Directive 2011/65/EC and European Union's Registration, Evaluation, Authorization and Restriction of Chemicals (REACH), Regulation (EC) 1907/2006.

Western Digital PC SN810 complies with the European Community Directive 2012/19/EU on Waste Electrical and Electronic Equipment (WEEE).

It also complies with China's management methods for controlling pollution by electronic information products (China RoHS).

[1] Tested per IEC 61000-4-2 Standard

10.9 Regulatory Agency Approvals and Declarations

PC SN810 meets the standards of the following regulatory agencies:

- **Federal Communication Commission:** Verified to comply with FCC Rules for Radiated and Conducted Emission, Part 15, Subpart B, for Class B Equipment.

  This equipment has been tested and found to comply with the limits for a class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

  - Reorient or relocate the receiving antenna.
  - Increase the separation between the equipment and receiver.
  - Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
  - Consult the dealer or an experienced radio/TV technician for help.
- **Canada EMI Compliance:** Per ICES-003 Issue 5, Class B
- **CE Compliance for Europe Countries and Morocco:** Verified to comply with
- EN55032:2015 for RF Emissions and EN55024:1998, A1:2001 + A2:2003, EN61000-3-2:2000, EN61000-3-3:1995 + A1:2001 for Generic Immunity as applicable.

  Verified to meet or exceed Directive of Electromagnetic Compatibility 2014/30/EU and Safety Low Voltage Directive 2014/35/EU
- **RCM Compliance for Australia and New Zealand:** Verified to comply with AS/NZ3548 for RF Emissions as required by the Australian Communications Authority.
- **Korean KC Mark:** Registered as a Class-B product with the South Korean Ministry of Information and Communication.
- **Taiwan BSMI ROHS Compliance:** Certified as a Class-B product with the Bureau of Standards Metrology and Inspection (BSMI ROHS).
- **Voluntary Control Council for Interference (VCCI):** Verified to comply with VCCI V-2 (V-3 Technical Requirements), the Voluntary Control Council for Interference by Information Technology Equipment.

  この装置は、クラスB機器です。この装置は、住宅環境で使用することを目的としていますが、この装置がラジオやテレビジョン受信機に近接して使用されると、受信障害を引き起こすことがあります。
  取扱説明書に従って正しい取り扱いをして下さい。 VCCI－B

- **CB-Scheme Safety Standard**: Verified safety compliance per IEC 60590-1 (IEC System for Mutual Recognition of Test Certificates for Electrical Equipment (IECEE)).
- **Underwriters Laboratories for USA and Canada product safety**: Bi-National UL Standard CAN/CSA-C22.2 No. 60950/UL 60950-1 Standard for Safety of Information Technology Equipment, including Electrical Business Equipment.

- **EU Safety Compliance**: IEC 60950-1 per EN 60950-1, Standard for Safety of Information Technology Equipment, including Electrical Business Equipment.

11.0 Reliability Characteristics

11.1 Error Rate

The non-recoverable error rate is 1 error per 10^{16} bits read.

11.2 Mean Time to Failure (MTTF)[1]

Mean Time to Failure (MTTF) is the reliability figure most often used for electronic equipment. The Western Digital PC SN810 NVMe SSD has an estimated MTTF using a prediction methodology based in accordance with the Telcordia Special Report SR-332. The prediction is based on a Parts Stress Analysis.

Quality levels were defined as industrial grade (I) for all of the components. The detailed prediction for the system was performed at a temperature of 25°C in a GB (ground, benign) environment.

Table 11-1 summarizes the estimated MTTF results for each capacity.

Table 11-1. PC SN810 NVMe SSD MTTF

Capacity	Condition	MTTF (Hours)
256GB, 512GB, 1024GB, 2048GB	Telcordia SR-332, GB, 25°C	1,752,000

[1] Based on internal testing using Telcordia stress part testing.

12.0 Windows Device Certifications

12.1 HCK Certification

The PC SN810 NVMe SSD certified with Windows HCK (Hardware Certification Kit) for Windows 7.

- Category: Device
- Product Type: Hard Drive

12.2 HLK Certification

The PC SN810 NVMe SSD certified with Windows HLK (Hardware Lab Kit) for Windows 10.

- Category: Device
- Product Type: Hard Drive

13.0 Interface

13.1 Supported Standards

The PC SN810 NVMe SSD complies with the following standards:

- PCI Express® Base Specification Revision 4.0

13.2 Pin Assignments - M.2 2280, M Key

Table 13-1. M.2 Pin Assignments

Pin #	Function	Pin #	Function
1	GND	2	3.3V
3	GND	4	3.3V
5	PETn3	6	NC
7	PETp3	8	PLN
9	GND	10	LED/DAS
11	PERn3	12	3.3V
13	PERp3	14	3.3V
15	GND	16	3.3V
17	PETn2	18	3.3V
19	PETp2	20	NC
21	GND	22	NC
23	PERn2	24	NC
25	PERp2	26	NC
27	GND	28	NC
29	PETn1	30	NC
31	PETp1	32	NC
33	GND	34	NC
35	PERn1	36	NC
37	PERp1	38	NC
39	GND	40	NC
41	PETn0	42	NC
43	PETp0	44	NC
45	GND	46	NC
47	PERn0	48	NC
49	PERp0	50	PERST#
51	GND	52	CLKREQ#
53	REFCLKn	54	NC
55	REFCLKp	56	NC
57	GND	58	NC
59	M key	60	M key
61		62	
63		64	
65		66	
67	NC	68	NC
69	NC	70	3.3V
71	GND	72	3.3V
73	NC	74	3.3V
75	GND		

14.0 Supported NVMe Commands and Features

14.1 NVMe Command Set

- PC SN810 NVMe SSD support NVMe 1.4 standard command set and the following configurations:
- 1 Namespace
- 64 Queues
- 8 Async. Events Notifications

Table 14-1. Admin Commands

Command Name	Opcode	Comment
Delete I/O Submission Queue	00h	
Create I/O Submission Queue	01h	
Get Log Page	02h	
Delete I/O Completion Queue	04h	
Create I/O Completion Queue	05h	
Identify	06h	
Abort	08h	
Set Features	09h	
Get Features	0Ah	
Asynchronous Event Request	0Ch	Maximum of 8.
Firmware Commit	10h	
Firmware Image Download	11h	
Device Self-Test	14h	
Format NVM (User Data Erase)	80h	
Security Send	81h	
Security Receive	82h	
Sanitize	84h	

Table 14-2. NVM Commands

Command Name	Opcode	Comment
Flush	00h	
Write	01h	
Read	02h	
Write Uncorrectable	04h	
Compare	05h	
Write Zeros	08h	
Dataset Management	09h	

Table 14-3. Set Features/Get Features

Opcode	Command Name	Comment
01h	Arbitration	
02h	Power Management	
03h	LBA Range Type	
04h	Temperature Threshold	
05h	Error Recovery	
06h	Volatile Write Cache	
07h	Number of Queues	
08h	Interrupt Coalescing	
09h	Interrupt Vector Configuration	
0Ah	Write Atomicity	
0Bh	Asynchronous Event Configuration	
0Ch	Autonomous Power State Transition	
10h	Host Controlled Thermal Management	
11h	Non-Operational Power State Configuration	
17h	Sanitize Operations	

14.2 Identify Controller Response

Table 14-4 defines the specifics of the Identify Controller returned by the PC SN810 NVMe SSD.

Table 14-4. Controller Capabilities and Features

Bytes	Field	Values	Comments
01:00	PCI Vendor ID (VID)	15B7h	
03:02	PCI Subsystem Vendor ID (SSVID)	15B7h	
23:04	Serial Number (SN)	Variable	Unique serial number in ASCII
63:24	Model Number (MN)	"WD PC SN810" and SKU	
71:64	Firmware Revision (FR)	Variable	Format: 8 numeric digits
72	Recommended Arbitration Burst (RAB)	4h	
75:73	IEEE OUI Identifier (IEEE)	001B44h	
76	Controller Multi-Path I/O and Namespace Sharing Capabilities (CMIC)	0h	7-3 Reserved 2 0 = PCI Function 1 0 = Single Controller 0 0 = Single PCIe Port

Table 14-4. Controller Capabilities and Features (Continued)

Bytes	Field	Values	Comments
77	Maximum Data Transfer Size (MDTS)	7h	512KB
79:78	Controller ID (CNTLID)	2020h	
83:80	Version (VER)	10400h	
87:84	RTD3 Resume Latency (RTD3R)	222E0h	140,000us
91:88	RTD3 Entry Latency (RTD3E)	3A98h	15,000us
95:92	Optional Asynchronous Events Supported (OAES)	200h	9 1 =Controller send Firmware Activation Notices Supported
99:96	Controller Attributes (CTRATT)	3h	2 1=NVM Sets 1 1=Non-Operational Power State Permissive Mode supported
101:100	Read Recovery Levels (RRLS)	0h	
110:102	Reserved	0h	
111	Controller Type (CNTRL TYPE)	1h	
127:112	FRU Globally Unique Identifier (FGUID)	0h	
129:128	Command Retry Delay Time 1 (CRDT1)	0h	
131:130	Command Retry Delay Time 2 (CRDT2)	0h	
133:132	Command Retry Delay Time 3 (CRDT3)	0h	
139:134	Reserved	0h	
255:240	NVMe Management Interface	0h	

Table 14-5. Admin Command Set Attributes and Optional Controller Capabilities

Bytes	Field	Values	Comments
257:256	Optional Admin Command Support (OACS)	17h	Supported commands: Security Send and Security Receive Format NVM Firmware Commit and Firmware Image Download Device Self-Test 15-9 Reserved 8-5 0=not supported 4 1 = Device Self-test command is supported 3 0 = no support for the Namespace Management and Namespace Attach- ment commands 2 1 = Firmware Commit and Firmware Image Down- load commands are supported 1 1 = Format NVMe com- mand is supported 0 1 = Security Send and Security Receive commands are supported
258	Abort Command Limit (ACL)	4h	5 Abort commands supported
259	Asynchronous Event Request Limit (AERL)	7h	8 AERs supported
260	Firmware Updates (FRMW)	14h	7-5 Reserved 4 1 = firmware activation without a reset is sup- ported 3-1 010 = 2 firmware slots are supported 0 1=Slot 1 is read only 0 = slot 1 is read/write 0 0=Slot 1 is read/ write

Table 14-5. Admin Command Set Attributes and Optional Controller Capabilities (Continued)

Bytes	Field	Values	Comments
261	Log Page Attributes (LPA)	1Eh	Command Effects log page supported 7-5 Reserved 4 1 =support for Persistent Event Log 3 1 = support for Telemetry Host-Initiated and Telem- etry Controller-Initiated log pages and sending Telemetry log 2 1 = support for extended data for Get Log Page 1 1 = Command Effects Log page is supported 0 0 = no support for SMART/Health information log page on a per namespace basis
262	Error Log Page Entries (ELPE)	FFh	256 entries supported
263	Number of Power States Sup- port (NPSS)	4h	
264	Admin Vendor Specific Command Configuration (AVSCC)	1h	7-1 Reserved 0 1 = All Admin Vendor Spe- cific Commands use the format as defined by NVMe standard
265	Autonomous Power State Transition Attributes (APSTA)	1h	Autonomous power state transitions supported
267:266	Warning Composite Temperature Threshold (WCTEMP)	165h	357°K (83.85°C)
269:268	Critical Composite Temperature Threshold (CCTEMP)	169h	361°K (87.85°C)
271:270	Maximum Time for Firmware Activation (MTFA)	32h	5 seconds
275:272	Host Memory Buffer Preferred Size (HMPRE)	0h	
279:276	Host Memory Buffer Minimum Size (HMMIN)	0h	
295:280	Total NVMe Capacity (TNVM- CAP)	256GB: 3B9E656000 512GB: 773C256000 1024GB: EE77A56000 2048GB: 1DCEEA56000	
311:296	Unallocated NVM Capacity (UNVMCAP)	0h	
315:312	Replay Protected Memory Block Support (RPMBS)	0h	

Table 14-5. Admin Command Set Attributes and Optional Controller Capabilities (Continued)

Bytes	Field	Values	Comments
317:316	Extended Device Self-Test Time (EDSTT)	256GB:1Ah 512GB:34h 1024GB:68h 2048GB: D0h	
318	Device Self-test Options (DSTO)	1h	
319	Firmware Update Granularity (FWUG)	1h	
321:320	Keep Alive Support (KAS)	0h	
323:322	Host Controlled Thermal Management Attributes (HCTMA)	1h	
325:324	Minimum Thermal Management Temperature (MNTMT)	111h	
327:326	Maximum Thermal Management Temperature (MXTMT)	166h	
331:328	Sanitize Capabilities (SANICAP)	Non-SED: 60000002h SED: 60000003h	31-30 1=No-Deallocate Modifies Media After Sanitize (NODMMAS). This field indicates if media is additionally modified by the NVMe controller after a sanitize operation successfully completes that had been started a Sanitize command with the No-Deallocate After Sanitize bit set to '1'. 29 1=No-Deallocate inhibited (NDI) 1 1= Support Block Erase 0 1= Support Crypto Erase (SED only)
335:332	Host Memory Buffer Minimum Descriptor Entry Size (HMMINDS)	0h	
337:336	Host Memory Maximum Descriptors Entries (HMMAXD)	0h	
339:338	NVM Set Identifier Maximum (NSETIDMAX)	1h	
341:340	Endurance Group Identifier Maximum (ENDGIDMAX)	1h	
342	ANA Transition Time (ANATT)	0h	
343	Asymmetric Namespace Access Capabilities (ANACAP)	0h	

Table 14-5. Admin Command Set Attributes and Optional Controller Capabilities (Continued)

Bytes	Field	Values	Comments
347:344	ANA Group Identifier Maximum (ANAGRPMAX)	0h	
351:348	Number of ANA Group Identifiers (NANAGRPID)	0h	
355:352	Persistent Event Log Size (PELS)	1h	This field indicates the maximum reportable size for the Persistent Event Log in 64 KiB units. 1 64KB
511:356	Reserved	0h	

Table 14-6. NVM Command Set Attributes

Bytes	Field	Values	Comments
512	Submission Queue Entry Size (SQES)	66h	7-4 0110 = Maximum Submission Queue entry size is 6. 3-0 0110 = Required Submission Queue entry size is 6.
513	Completion Queue Entry Size (CQES)	44h	7-4 0100 = Maximum Completion Queue entry size is 4. 3-0 0100 = Required Completion Queue entry size is 4.
515:514	Maximum Outstanding Commands (MAXCMD)	0h	
519:516	Number of Namespaces (NN)	1h	Supporting one Namespace
521:520	Optional NVM Command Support (ONCS)	5Fh	15-7 Reserved 6 1 =Timestamp feature supported 5 0 = Reservations are not supported. 4 1 = Save field in the Set Features command and the Select field in the Get Features command are supported. 3 1 = Write Zero command is not supported. 2 1 = Dataset Management command is supported. 1 1 = Write Uncorrectable command is supported. 0 1 = Compare command is not supported.
523:522	Fused Operation Support (FUSES)	0h	

Table 14-6. NVM Command Set Attributes (Continued)

Bytes	Field	Values	Comments
524	Format NVM Attributes (FNA)	Non-SED: 0h SED: 4h	SED only 2 1=Cryptographic erase is supported
525	Volatile Write Cache (VWC)	7h	7-3 Reserved 2-1 011=Flush behavior 0 1 = Volatile write cache is present.
527:526	Atomic Write Unit Normal (AWUN)	0h	
529:528	Atomic Write Unit Power Fail (AWUPF)	0h	
530	NVM Vendor Specific Command Configuration (NVSCC)	1h	7-1 Reserved 0 1 = All NVM Vendor Specific Commands use the format defined in NVMe standard for Vendor Specific commands.
531	Reserved	0h	
533:532	Atomic Compare and Write Unit (ACWU)	0h	
535:534	Reserved	0h	
539:536	SGL Support (SGLS)	0h	
543:540	Maximum Number of Allowed Namespaces (MNAN)		
767:544	Reserved	0h	
1023:768	NVM Subsystem NVMe Qualified Name (SUBNQN)	--	
1791:1024	Reserved	0h	
2047:1792	NVMe over fabric identify.	0h	

Table 14-7. Power State Descriptors

Bytes	Field	Values	Comments
2079:2048	Power State 0 Descriptor (PSD0)	MP 256G: 339h MP 512GB:339h MP 1024GB:339h MP 2048GB: 339h MXPS: 0 NOPS: 0 ENLAT: 0 EXLAT: 0 RRT: 0 RRL: 0 RWT: 0 RWL: 0 IDLP: 189Ch IPS: 01b ACTP: 339h APW: 010b APS: 10b	255-184: Reserved 183-182: Active Power Scale (APS) 181-179: Reserved 178-176: Active Power Workload (APW) 175-160: Active Power (ACTP) 159-152: Reserved 151-150: Idle Power Scale (IPS) 149-144: Reserved 143-128 Idle Power (IDLP) 127-125: Reserved 124-120: Relative Write Latency (RWL) 119-117: Reserved 116-112: Relative Write Throughout 111-109: Reserved 108-104: Relative Read Latency (RRL) 103-101: Reserved 100-96: Relative Read Throughput (RRT) 95-64: Exit Latency (EXLAT) 63-32: Entry Latency (ENLAT) 31-26: Reserved 25: Non-Operational State (NOPS) 24: Max Power Scale (MXPS) 23-16: Reserved 15-00: Maximum Power (MP)

Table 14-7. Power State Descriptors (Continued)

Bytes	Field	Values	Comments
2111-2080	Power State 1 Descriptor (PSD1)	MP:15Eh MXPS: 0b NOPS: 0b ENLAT: 0h EXLAT: 0h RRT: 0000b RRL: 0000b RWT: 0000b RWL: 0000b IDLP: 189Ch IPS: 01b ACTP: 15Eh APW: 010b APS: 10b	255-184: Reserved 183-182: Active Power Scale (APS) 181-179: Reserved 178-176: Active Power Workload (APW) 175-160: Active Power (ACTP) 159-152: Reserved 151-150: Idle Power Scale (IPS) 149-144: Reserved 143-128: Idle Power (IDLP) 127-125: Reserved 124-120: Relative Write Latency (RWL) 119-117: Reserved 116-112: Relative Write Throughout 111-109: Reserved 108-104: Relative Read Latency (RRL) 103-101: Reserved 100-96: Relative Read Throughput (RRT) 95-64: Exit Latency (EXLAT) 63-32: Entry Latency (ENLAT) 31-26: Reserved 25: Non-Operational State (NOPS) 24: Max Power Scale (MXPS) 23-16: Reserved 15-00: Maximum Power (MP)

Table 14-7. Power State Descriptors (Continued)

Bytes	Field	Values	Comments
2143-2112	Power State 2 Descriptor (PSD2)	MP: 104h MXPS: 0b NOPS: 0b ENLAT: 0b EXLAT: 0b RRT: 0 RRL: 0 RWT: 0 RWL: 0 IDLP: 189Ch IPS: 01b ACTP: 104h APW: 010b APS: 10b	255-184: Reserved 183-182: Active Power Scale (APS) 181-179: Reserved 178-176: Active Power Workload (APW) 175-160: Active Power (ACTP) 159-152: Reserved 151-150: Idle Power Scale (IPS) 149-144: Reserved 143-128: Idle Power (IDLP) 127-125: Reserved 124-120: Relative Write Latency (RWL) 119-117: Reserved 116-112: Relative Write Throughout 111-109: Reserved 108-104: Relative Read Latency (RRL) 103-101: Reserved 100-96: Relative Read Throughput (RRT) 95-64: Exit Latency (EXLAT) 63-32: Entry Latency (ENLAT) 31-26: Reserved 25: Non-Operational State (NOPS) 24: Max Power Scale (MXPS) 23-16: Reserved 15-00: Maximum Power (MP)

Table 14-7. Power State Descriptors (Continued)

Bytes	Field	Values	Comments
2175:2144	Power State 3 Descriptor (PSD3)	MP 256GB:FAh MP 512GB:FAh MP 1024GB:FAh MP 2048GB: FAh MPS: 1b NOPS:1b ENLAT: 1388h EXLAT: 2710h RRT: 0011b RRL: 0011b RWT: 0011b RWL: 0011b IDLP: FAh IPS: 1b ACTP: 00h APW: 000b APS: 000b	255-184: Reserved 183-182: Active Power Scale (APS) 181-179: Reserved 178-176: Active Power Workload (APW) 175-160: Active Power (ACTP) 159-152: Reserved 151-150: Idle Power Scale (IPS) 149-144: Reserved 143-128: Idle Power (IDLP) 127-125: Reserved 124-120: Relative Write Latency (RWL) 119-117: Reserved 116-112 Relative Write Throughout 111-109: Reserved 108-104: Relative Read Latency (RRL) 103-101: Reserved 100-96 Relative Read Throughput (RRT) 95-64: Exit Latency (EXLAT) 63-32: Entry Latency (ENLAT) 31-26: Reserved 25: Non-Operational State (NOPS) 24: Max Power Scale (MXPS) 23-16: Reserved 15-00: Maximum Power (MP)

Table 14-7. Power State Descriptors (Continued)

Bytes	Field	Values	Comments
2207:2176	Power State 4 Descriptor (PSD4)	MP: 0032h MPS: 1b NOPS:1b ENLAT: F3Ch EXLAT: hB284h RRT: 0100b RRL: 0100b RWT: 0100b RWL: 0100b IDLP: 32h IPS: 1b ACTP: 00h APW: 000b APS: 000b	255-184: Reserved 183-182: Active Power Scale (APS) 181-179: Reserved 178-176: Active Power Workload (APW) 175-160: Active Power (ACTP) 159-152: Reserved 151-150: Idle Power Scale (IPS) 149-144: Reserved 143-128 Idle Power (IDLP) 127-125: Reserved 124-120: Relative Write Latency (RWL) 119-117: Reserved 116-112: Relative Write Throughout 111-109: Reserved 108-104: Relative Read Latency (RRL) 103-101: Reserved 100-96 Relative Read Throughput (RRT) 95-64: Exit Latency (EXLAT) 63-32: Entry Latency (ENLAT) 31-26: Reserved 25: Non-Operational State (NOPS) 24: Max Power Scale (MXPS) 23-16: Reserved 15-00: Maximum Power (MP)
3071:2208	Power State Descriptors 5-31 (PSD5 - PSD31)	0h	N/A
4095:3072	Vendor Specific (VS)	---	

Table 14-8. Vendor Specific(VS)

Bytes	Field	Values	Comments
4095:3072	Vendor Specific (VS)	---	

14.3 Log Pages

PC SN810 NVMe SSD supports the following log pages:

Table 14-9. PC SN810 NVMe SSD Log Pages

Identifier	Log Page	Reference
01h	Error Information	NVM Express specification
02h	SMART / Health Information	NVM Express specification

Table 14-9. PC SN810 NVMe SSD Log Pages (Continued)

Identifier	Log Page	Reference
03h	Firmware Slot Information	NVM Express specification
05h	Commands Supported and Effects Log	NVM Express specification
06h	Device Self-Test	NVM Express specification
07h	Telemetry Host-Initiated	NVM Express specification
08h	Telemetry Controller-Initiated	NVM Express specification
09h	Endurance Group Log Page	NVM Express specification
0Dh	Persistent Event Log	NVM Express specification
81h	Sanitize Status	NVM Express specification
CDh	Vendor Specific Program/Erase Counters	Refer to the following sections.

14.3.1 SMART/Health Information (Log Identifier 02h)

Table 14-10. PC SN810 NVMe SSD SMART/Health Information

Bytes	Attribute Name	Comment
0	Critical Warning	
2:1	Composite Temperature	Upon exiting low-power states, it may take up to one second for accurate temperature reporting.
3	Available Spare	
4	Available Spare Threshold	
5	Percentage Used	
47:32	Data Units Read	
63:48	Data Units Written	
79:64	Host Read Commands	
95:80	Host Write Commands	
111:96	Controller Busy Time	
127:112	Power Cycles	
143:128	Power On Hours	
159:144	Unsafe Shutdowns	
175:160	Media and Data Integrity Errors	
191:176	Number of Error Information Log Entries	
195:192	Warning Composite Temperature Time	
199:196	Critical Composite Temperature Time	

14.3.2 Program/Erase SMART Counters (Log Identifier CDh)

Table 14-11. Program/Erase SMART Counters (Log Identifier CDh)

Bytes	Attribute Name	Comment
3:0	Minimum Program/Erase Counter for TLC	
7:4	Maximum Program/Erase Counter for TLC	
11:8	Average Program/Erase Counter for TLC	
15:12	Minimum Program/Erase Counter for SLC	
19:16	Maximum Program/Erase Counter for SLC	
23:20	Average Program/Erase Counter for SLC	

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16.0 Ordering Information

Refer to the examples below as reference for ordering SKUs.

Table 16-1. PC SN810 NVMe SSD Ordering Information

SDG(I/F)FCT-CCCC-YYYY	
Item	**Definition**
SD	Western Digital
G	Generation: C
(I/F)	Interface and Security P- PCI Express (non-secure version) Q- PCI Express (SED)
F	Form Factor: N - M.2 2280
C	Controller: R - Triton16 8CH
T	NAND Technology: Y – BiCS4 256Gb 2P TLC Z – BiCS4 512Gb 2P TLC
CCCC	Capacity: 256G: 256GB 512G: 512GB 1T00: 1024GB 2T00: 2048GB
YYYY	Customer Code Reference: None for Generic OEM

Table 16-2. PC SN810 NVMe SSD Products SKUs for Generic OEM

SKU Number	Capacity	Form Factor	Type
SDCPNRY-256G	256GB	M.2 2280 M-S3	non-SED
SDCPNRY-512G	512GB	M.2 2280 M-S3	non-SED
SDCPNRY-1T00	1024GB	M.2 2280 M-S3	non-SED
SDCPNRZ-2T00	2048GB	M.2 2280 M-S3	non-SED
SDCQNRY-256G	256GB	M.2 2280 M-S3	SED
SDCQNRY-512G	512GB	M.2 2280 M-S3	SED
SDCQNRY-1T00	1024GB	M.2 2280 M-S3	SED
SDCQNRZ-2T00	2048GB	M.2 2280 M-S3	SED

17.0 Contact Information

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