SEAGATE

IRONWOLF
NAS

Seagate® IronWolf® 510 SSD

Product Manual

User Capacity	Standard M.2 2280-S2-M	Standard M.2 2280-D2-M
240 GB	ZP240NM30001	
480 GB	ZP480NM30001	
960 GB		ZP960NM30001
1920 GB		ZP1920NM30001

Revision History

Version and Date	Description of Changes
Rev B, August 2020	Formatting updates throughout
Rev A, October 2019	First document release.

Contents

Seagate Technology Support Services

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

For Firmware Download and Tools Download for Secure Erase, visit: https://www.seagate.com/support/downloads/

For information regarding online support and services, visit: http://www.seagate.com/contacts/

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

For information regarding data recovery services, visit:
http://www.seagate.com/services-software/seagate-recovery-services/recover/

For Seagate OEM and Distribution partner and Seagate reseller portal, visit: http://www.seagate.com/partners

1. Introduction

The Seagate® IronWolf® 510 SSD is designed for everything business NAS, with 24×7 performance to handle multi-user environments across a wide range of capacities. The Seagate IronWolf 510 SSD offers PCIe Gen 3 x4 interface with NVMe protocol support in an ultra-small M.2 form factor.

Table 1   The IronWolf 510 SSD Features

Feature	Description	
Capacity (User)	■ 240 GB, 480 GB, 960 GB, 1920 GB	
Certifications, Eco-Compliance	■ CE, UL, FCC, BSMI, KCC, Microsoft WHQL, VCCI, CB ■ RoHS	
Data Retention	■ 12 months power-off retention at 30°C per JEDEC client standard	
Dimensions	■ M.2 2280-S2 (240 GB, 480 GB): 80 mm (±0.15) x 22 mm (±0.15) x 2.15 mm (±0.15) ■ M.2280-D2 (960 GB, 1920 GB): 80 mm (+ - 0.15) x 22 mm (+ - 0.15) x 3.5 mm (+ - 0.08)	
Endurance	■ 1 Drive Write Per Day (DWPD)	Endurance rating valid for SSD Life Remaining > 1% (SMART E7h>1). See Section 2.8, *Reliability and Endurance*.
Form Factor	■ M.2 2280-S2-M (240 GB, 480 GB) ■ M.2 2280-D2-M (960 GB, 1920 GB)	
Interface Compliance	■ PCIe Gen3 x4, backwards compatible with PCIe Gen2 and Gen1 ■ NVMe 1.3 compliant ■ 8 IO queues supported (1 admin queue and 8 IO queue). Each IO queue support 256 entries	
Logical Block Size	■ 512 bytes (default) ■ 4KB	
NAND	■ 3D TLC	
Operating Systems	■ Windows® 8.1 (64 bit), and Windows 10 (64 bit), Windows Enterprise 10, Windows Server 2016, 2019 ■ Ubuntu 16.04,18.04 ■ CentOS 6 and 7 ■ RHEL 7	
Performance Random	■ Read: Up to 380,000 IOPS ■ Write: Up to 29,000 IOPS	Actual performance might vary depending on use conditions and environment. See Section 2.2, *Performance*.
Performance Sequential	■ Read: Up to 3150MB/s ■ Write: Up to 1000MB/s	Actual performance might vary depending on the capacity, use conditions and environment. See Section 2.2, *Performance*.
Power Consumption	■ Active mode: < 6000 mW ■ Idle mode: < 2000 mW	Results vary with capacity and mode. See Section 2.6, *Power Consumption*.
Power Management	■ Supports Active State Power Management (ASPM)	
Reliability	■ End-to-end data path protection ■ MTBF: 1.8 million hours ■ UBER: 1 error in 10^{16} bits read	
Security	■ TCG Pyrite supported on standard models	

Table 1   The IronWolf 510 SSD Features *(continued)*

Feature	Description	
Shock and Vibration	Shock ■ Non-Operating: 1,500 G, at 0.5 ms	**See Section 2.7, *Environmental Conditions*.**
	Vibration ■ Non-Operating: 1.52 G$_{RMS}$, (20 to 800 Hz, Frequency)	
Temperature Range (Operating)	■ 0°C to 70°C ■ Temperature Sensor (SMART Attribute ID C2h)	
Voltage	■ Min = 3.14V ■ Max = 3.47 V	
Warranty	Five years, or when the device reaches Host TBW, whichever happens first. Endurance rating valid for SSD Life Remaining > 1% (SMART E7h>1).	
Weight	■ 6.5 to 8.3g ±5%	

1.1   Reference Documents

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

■ PCIe Specifications
— PCIe - PCI Express Electromechanical specification, revision 4.0
— NVMe - Non Volatile Memory Express specification 1.3
— PCIe CEM - PCI Express Card Electromechanical specification, revision 1.1
— PCI Express M.2 Specification, revision 1.1
■ 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™ SSD GUI User Guide - Publication Number: 100837824
— SeaChest for SSD User Guide - Publication Number: 100847684

2. Specifications

2.1 Models and Capacity

Table 2 Models and Capacity

Model Names	User Capacity	NAND
ZP240NM30001	240 GB	3D TLC
ZP480NM30001	480 GB	3D TLC
ZP960NM30001	960 GB	3D TLC
ZP1920NM3001	1920 GB	3D TLC

NOTE   About capacity:

- Sector Size: 512 Bytes (default), and 4000 Bytes

- User-addressable LBA count = (97696368) + (1953504 x (Desired Capacity in Gb-50.0)) From International Disk Drive Equipment and Materials Association (IDEMA) (*LBA1-03_standard.doc*)

2.2 Performance

Table 3 Random and Sequential Read and Write Performance

Parameter	240 GB	480 GB	960 GB	1920 GB
Sequential Read (MB/s)	2,450	2,650	3,150	3,150
Sequential Write (MB/s)	290	600	1,000	850
Random Read (IOPS) (QD32T4)	100,000	193,000	345,000	270,000
Random Write (IOPS) (QD32T4)	12,000	20,000	28,000	25,000
Random Read (IOPS) (QD32T8)	100,000	199,000	380,000	290,000
Random Write (IOPS) (QD32T8)	13,000	21,000	29,000	27,000

NOTE   About performance:

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

- Performance is measured with the following conditions

  (a) Sustained Sequential: FIO, full-range, 128K data size, QD=32

  (b) Sustained Random: FIO, full-range, 4K data size, QD=32, 4/8 workers

2.3   Latency

Table 4   QD1 4KB Random Average Latency

Capacity	Read (4KB)	Write (4KB)
240 GB	110	70
480 GB	110	40
960 GB	110	30
1920 GB	140	30

NOTE   About latency:

- Performance can differ according to flash configuration and platform.

- The latency table is for reference only. Units are in microseconds.

2.4   Quality of Service (QoS)

Table 5   Quality of Service (QoS)

Capacity	QoS (99.99%)			
	Read (4KB QD=1)	**Write (4KB QD=1)**	**Read (4KB QD=32)**	**Write (4KB QD=32)**
	Unit: ms			
240 GB	0.34	0.13	1.67	2.53
480 GB	0.32	0.10	0.99	1.64
960 GB	0.34	0.11	0.62	1.51
1920 GB	0.44	0.10	0.83	1.63

NOTE   About QoS:

- QoS is measured with the following conditions

  FIO test: 4KB transfer size, QD=1 or 32 on 4KB random read and write workload on whole LBA range of SSD when the performance performs on steady state and all background operations run normally.

- According to random 4KB QD=1 and 32 workloads, the result of QoS is the maximum round-trip time which is taken for 99.99% of commands to host.

- QoS can differ according to flash configuration and platform.

2.5 Supply Voltage

Table 6 Supply Voltage

Parameter	Rating
Operating Voltage	Min = 3.14V Max = 3.47 V
Rise Time (Max/Min)	100 ms / 0.1 ms
Fall Time (Max/Min)	5 s /1 ms
Minimum Off Time	1 s

NOTE Minimum Off Time is the time between power being removed from the SSD (Vcc<100 mW) and power being re-applied to the SSD.

2.6 Power Consumption

Table 7 Power Consumption

	240 GB	480 GB	960 GB	1920 GB
Max Average Active (mW)	5,300	6,000	6,000	6,000
Peak Active (mW)	5,500	6,200	6,200	6,500
Idle (mW)	1,750	1,830	1,950	2,000

NOTE About power consumption:

- The measured power voltage is 3.3 V.

- Power consumption is measured during the sequential/random read and write performed by FIO 3.7.

- Power Consumption can differ according to flash configuration and platform.

2.7   Environmental Conditions

Table 8   Temperature, Humidity, Shock

Specification	Value

Temperature
       Operational temperature
       (with airflow: 800 LFM at 35℃)
       Non-operating
	0℃ to 70℃
	
	-40℃ to 85℃

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

Shock Non-operating	1,500 G, duration 0.5 ms
Vibration Non-operating	1.52 $G_{RMS,}$ (20Hz to 80Hz, Frequency)

NOTE   **Temperature** is measured without condensation.

Operating mode temperature is measured by temperature sensor, SMART Attribute C2h.

Airflow is suggested. Airflow allows the device to be operated at the appropriate temperature for each component during heavy workloads environments.

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.

2.8 Reliability and Endurance

Table 9 Reliability and Endurance

Specification	Value
Mean time between failures (MTBF)	1.8 million hours
Bit Error Rate	1 error in 10^{16} bits read
Endurance	240 GB: 1 DWPD 480 GB: 1 DWPD 960 GB: 1 DWPD 1,920 GB: 1 DWPD

NOTE   About endurance:

- 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 Client JESD219A workload (per JESD218A specification).

3. Mechanical Information

3.1 Dimensions and Weight (M.2 2280-S2)

Weight: 6.5 g (240 GB), 6.9 g (480 GB)

Height: 2.15 mm±008 mm

Width: 22 mm±0.15 mm

Length: 80 mm±-0.15 mm

Figure 1 Top View
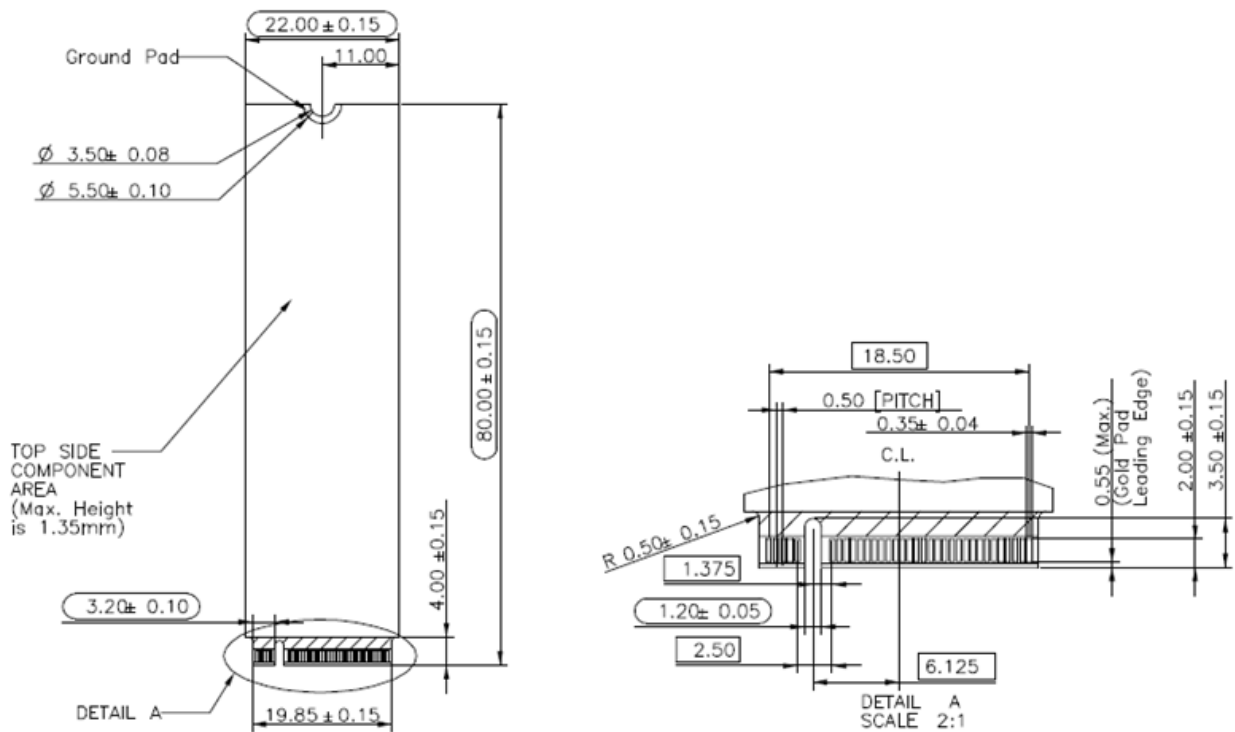
Notes :
1. ▨ = Max Component Height
2. ▨ = No Component
3. ▨ = No Component / Signal Vias / Signal Copper / Printing
4. General Tolerance ±0.15mm
5. ⬭ are critical dimensions

Figure 2 Bottom View

Ø 6.00± 0.10

Ground Pad

Don't allow any
component on
the bottom side

DETAIL B

18.00

9.00

0.55 (Max.)
(Gold Pad Leading Edge)

2.50 ±0.15

C.L.
1.125

2.50

1.50

DETAIL   B
SCALE   2:1

Figure 3 Side View

1.35 MAX.

4.00 [MIN.]

DETAIL C

0.80 ±0.08

0.30 ±0.25 −2X

20.0°±5.0° −2X

0.58 (0.20Min)

DETAIL   C
SCALE   2:1
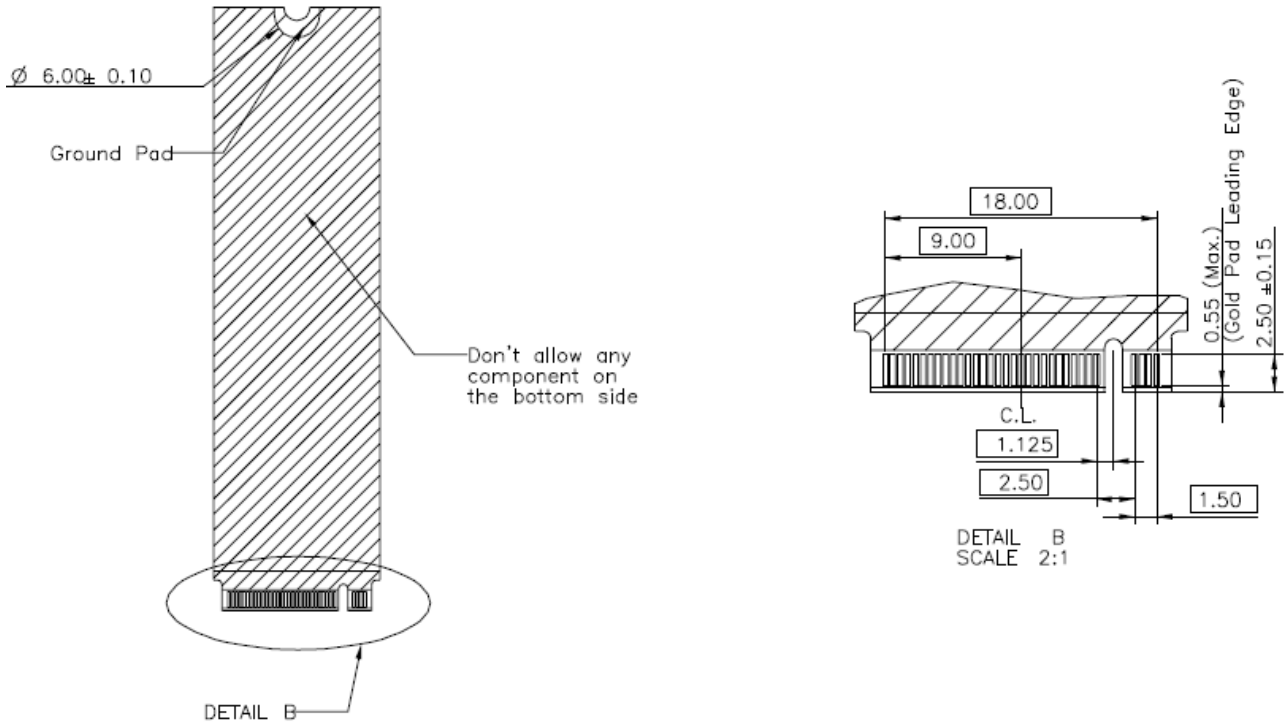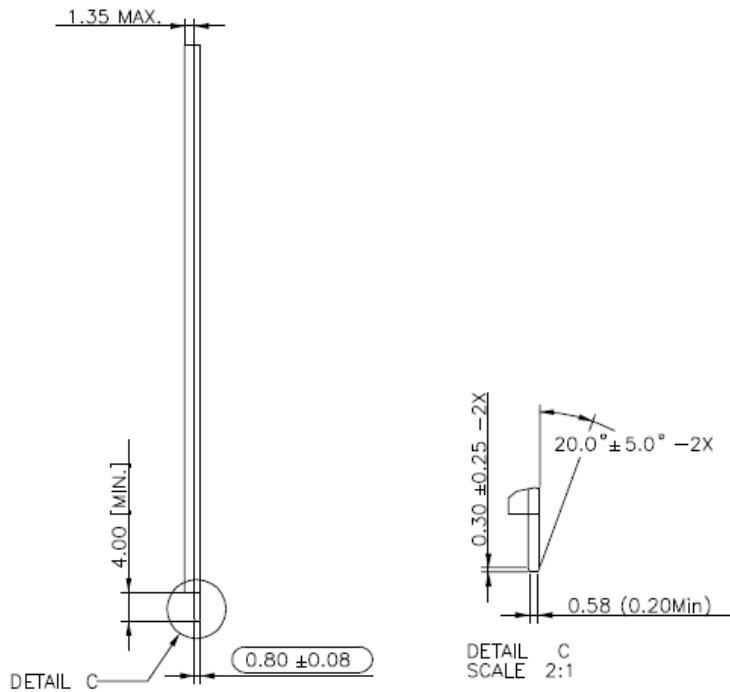
3.2 Dimensions and Weight (M.2 2280-D2)

Weight: 8.1 g (960 GB), 8.3 g (1920 GB)

Height: 3.5 mm±0.08 mm

Width: 22 mm±0.15 mm

Length: 80 mm±0.15 mm

Figure 4 Top View

Figure 5 Bottom View

Ø 6.00± 0.10

Ground Pad

1.00± 0.10

Bottom Side
Component
Area
(Max. Height
is 1.35mm)

5.20 [MIN.]

DETAIL B

18.00

9.00

0.55 (Max.)
(Gold Pad Leading Edge)

2.50 ±0.15

C.L.

1.125

2.50

1.50

DETAIL   B
SCALE   2:1
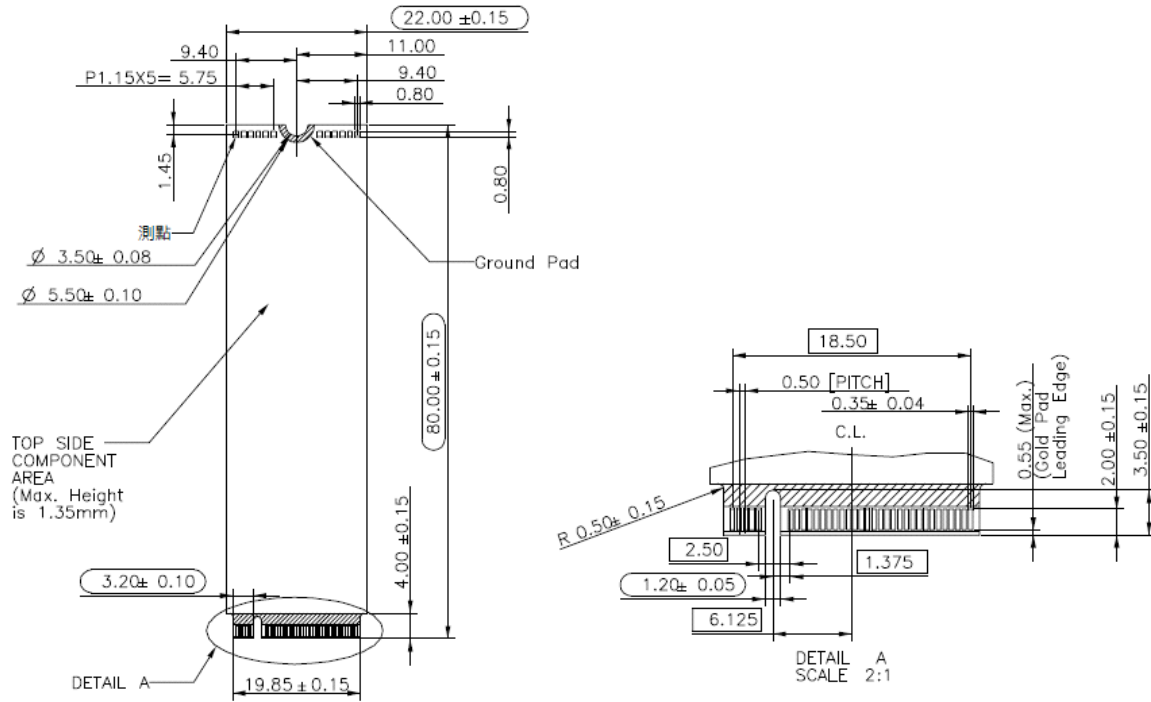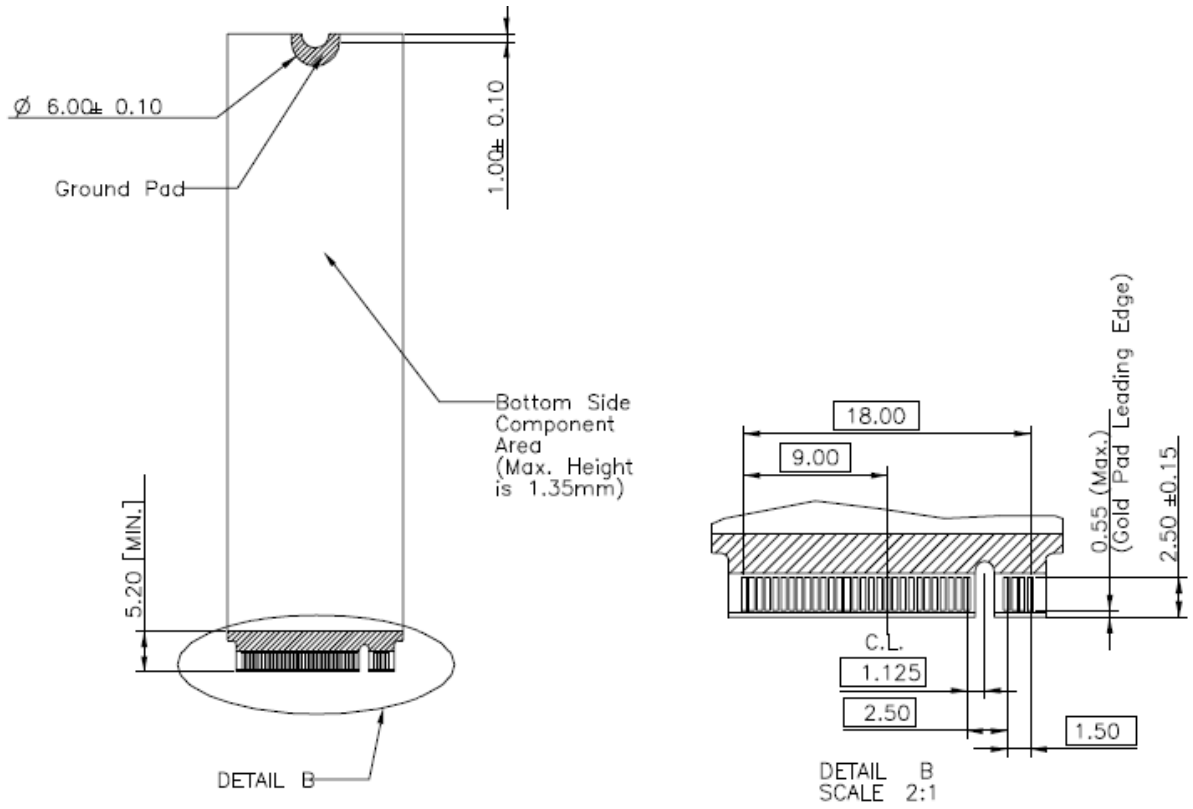
Figure 6 Side View
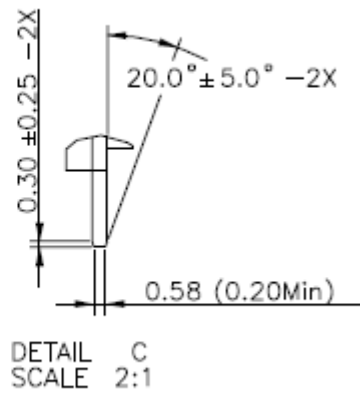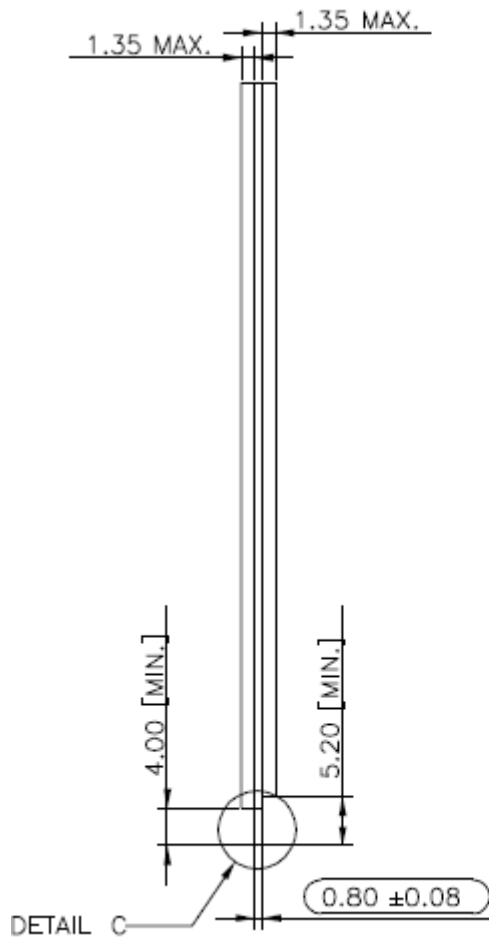
4. Pin and Signal Descriptions

Table 10 Pin Descriptions

| Pin No	PCIe Pin	Description
1	GND	CONFIG_3=GND
2	3.3V	3.3V source
3	GND	Ground
4	3.3V	3.3V source
5	PETn3	PCIe TX Differential signal defined by the PCI Express M.2 spec
6	N/C	No connect
7	PETp3	PCIe TX Differential signal defined by the PCI Express M.2 spec
8	N/C	No connect
9	GND	Ground
10	LED1#	Open drain, active low signal. These signals are used to allow the add-in card to provide status indicators via LED devices that will be provided by the system.
11	PERn3	PCIe RX Differential signal defined by the PCI Express M.2 spec
12	3.3V	3.3V source
13	PERp3	PCIe RX Differential signal defined by the PCI Express M.2 spec
14	3.3V	3.3V source
15	GND	Ground
16	3.3V	3.3V source
17	PETn2	PCIe TX Differential signal defined by the PCI Express M.2 spec
18	3.3V	3.3V source
19	PETp2	PCIe TX Differential signal defined by the PCI Express M.2 spec
20	N/C	No connect
21	GND	Ground
22	N/C	No connect
23	PERn2	PCIe RX Differential signal defined by the PCI Express M.2 spec
24	N/C	No connect
25	PERp2	PCIe RX Differential signal defined by the PCI Express M.2 spec
26	N/C	No connect
27	GND	Ground
28	N/C	No connect
29	PETn1	PCIe TX Differential signal defined by the PCI Express M.2 spec
30	N/C	No connect
31	PETp1	PCIe TX Differential signal defined by the PCI Express M.2 spec
32	N/C	No connect

Table 10 Pin Descriptions *(continued)*

Pin No	PCIe Pin	Description
33	GND	Ground
34	N/C	No connect
35	PERn1	PCIe RX Differential signal defined by the PCI Express M.2 spec
36	N/C	No connect
37	PERp1	PCIe RX Differential signal defined by the PCI Express M.2 spec
38	N/C	No connect
39	GND	Ground
40	SMB_CLK (I/O)(0/1.8V)	SMBus Clock; Open Drain with pull-up on platform
41	PETn0	PCIe TX Differential signal defined by the PCI Express M.2 spec
42	SMB_DATA (I/O)(0/1.8V)	SMBus Data; Open Drain with pull-up on platform.
43	PETp0	PCIe TX Differential signal defined by the PCI Express M.2 spec
44	ALERT#(O) (0/1.8V)	Alert notification to master; Open Drain with pull-up on platform; Active low.
45	GND	Ground
46	N/C	No connect
47	PERn0	PCIe RX Differential signal defined by the PCI Express M.2 spec
48	N/C	No connect
49	PERp0	PCIe RX Differential signal defined by the PCI Express M.2 spec
50	PERST#(I)(0/3.3V)	PE-Reset is a functional reset to the card as defined by the PCIe Mini CEM specification.
51	GND	Ground
52	CLKREQ#(I/O) (0/3.3V)	Clock Request is a reference clock request signal as defined by the PCIe Mini CEM specification; Also used by L1 PM Sub-states.
53	REFCLKn	PCIe Reference Clock signals (100 MHz) defined by the PCI Express M.2 spec.
54	PEWAKE#(I/O) (0/3.3V)	PCIe PME Wake. Open Drain with pull up on platform; Active Low.
55	REFCLKp	PCIe Reference Clock signals (100 MHz) defined by the PCI Express M.2 spec.
56	Reserved for MFG DATA	Manufacturing Data line. Used for SSD manufacturing only. Not used in normal operation. platform Socket.
57	GND	Ground
58	Reserved for MFG CLOCK	Manufacturing Clock line. Used for SSD manufacturing only. Not used in normal operation. Pins should be left N/C in platform Socket.

Table 10 Pin Descriptions *(continued)*

Pin No	PCIe Pin	Description
59	Module Key M	Module Key
60	Module Key M	
61	Module Key M	
62	Module Key M	
63	Module Key M	
64	Module Key M	
65	Module Key M	
66	Module Key M	
67	N/C	No connect
68	SUSCLK(32KHz) (I)(0/3.3V)	32.768 kHz clock supply input that is provided by the platform chipset to reduce power and cost for the module.
69	N/C	PEDET (NC-PCIe)
70	3.3V	3.3V source
71	GND	Ground
72	3.3V	3.3V source
73	GND	Ground
74	3.3V	3.3V source
75	GNDZD	Ground

5. SMART Support

The IronWolf 510 SSD supports the SMART command set.

5.1   SMART IDs

The following table lists SMART IDs and Descriptions.

Table 11 SMART IDs

Bytes Index	Bytes	Description
[0]	1	Critical Warning
[2:1]	2	Composite Temperature
[3]	1	Available Spare
[4]	1	Available Spare Threshold
[5]	1	Percentage Used
[31:6]	26	Reserved
[47:32]	16	Data Units Read
[63:48]	16	Data Units Written
[79:64]	16	Host Read Commands
[95:80]	16	Host Write Commands
[111:96]	16	Controller Busy Time
[127:112]	16	Power Cycles
[143:128]	16	Power On Hours
[159:144]	16	Unsafe Shutdowns
[175:160]	16	Media and Data Integrity Errors
[191:176]	16	Number of Error Information Log Entries
[195:192]	4	Warning Composite Temperature Time
[199:196]	4	Critical Composite Temperature Time

6. Feature Details

6.1　Flash Management

6.1.1　Error Correction Code (ECC)

Flash memory cells deteriorate with use. This can generate random bit errors in the stored data. The IronWolf 510 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.

6.1.2　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.

6.1.3　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

6.1.4　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.

6.1.5　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.

6.1.6 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.

6.1.7 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.

6.1.8 Thermal Throttling

Thermal throttling prevents components in an SSD from over-heating during read and write operations. The IronWolf 510 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 12 reading..

Table 12 Current version: Thermal Throttling 2.0

Item	Content
Smart reporting temperature	Flash normalized case temperature
Reference of temp. reading	On-board thermal sensor, Controller on-die thermal sensor
tmt1 threshold	68°C per Smart reported
tmt2 threshold	70°C per Smart reported
Protect threshold	80°C per Smart reported
Protect controller threshold	110°C from on-die thermal sensor
Fatal threshold	120°C from on-die thermal sensor
Resume performance threshold	60°C per Smart reported
Temperature polling frequency	Every 1 sec
TMT1_state impact	±10% CE
TMT2_state impact	-20% CE

6.1.9 Multiple Namespaces

An NVMe namespace is a quantity of non-volatile memory (NVM) You can format this namespace into logical blocks. You can use namespaces when you configure a storage virtual machine with the NVMe protocol.

You can support up to four namespaces for greater deployment flexibility.

6.1.10 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.

6.2   Advanced Device Security Features

6.2.1   Secure Erase

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

6.2.2   Physical Presence SID

The Physical Presence SID (PSID) is defined as a 32-character string. PSID reverses the SSD to its manufacturing setting when the SSD is set through TCG Pyrite (non-SED). The PSID code is printed on the SSD label. PSID erases all data when reverting the SSD to manufacturing settings.

6.2.3   Manufacturer's Secure ID

The Manufacturer's Secure ID (MSID) is defined as a 32-character string and is assigned in the manufacturing process. You cannot change this data through the host system. You can retrieve MSID electronically from the SSD across the interface. After getting the SSD, you must set a new password. If you do not set a new password, anyone who can reset the MSID can control the SSD. Such an attack on the SSD is called Denial of Service (DoS) because the rightful owner is locked out.

6.2.4   Sanitize

The Sanitize feature uses the Format NVM command to provide an alternative to the existing secure erase capabilities. This feature provides robust data security by making sure the user data from the SSD media, caches, and the Controller Memory Buffer are erased by the block erase operations, overwriting or destroying the encryption key. The following table shows the types of Sanitize Operations supported.

Table 13 Sanitize Operations

SSD Security Type	Sanitize Operation			TCG Commands	
	Overwrite	**Block Erase**	**Crypto Erase**	**PSID Revert Process**	**Instant Security Erase**
Non-SED (TCG Pyrite)	Yes	Yes	No	Yes	No

NOTE   **Sanitize Overwrite** command erases all data on the disk beyond all feasible effort to recover. Completion takes at least one hour per terabyte per pass. The number of passes is drive-selectable. The NVMe spec default is 16 passes. Contact Seagate Support for more detailed information.

6.3   SSD Lifetime Management

Drive Writes per Day (DWPD) The Terabytes Written (TBW) specification of an SSD calculates how many times you can write the user capacity of an SSD per day over the warranty period (or a different number of years), based on the JEDEC workload used to specify the TBW.

DWPD = (TBW of an SSD x 1024) / (Warranty days x SSD size in GB)

TBW (Terabytes Written) 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.

6.3.1   Media Wear Indicator

The SMART attribute byte index [5], Percentage Used, reports the Actual Life Indicator. Replace the SSD when this number reaches 100%.

6.3.2   Read Only Mode (End of Life)

When program/erase cycles age the SSD, media wear-out can cause increasing numbers of bad blocks. When the number of usable good blocks is less than the threshold (5%, SMART attribute log ID 02h Byte4), the SSD notifies the host through an AER event and Critical Warning to enter Read Only Mode to prevent further data corruption. When this happens, replace the SSD immediately.

6.4   Adaptive Approach to Performance Tuning

6.4.1   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 IronWolf 510 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.

6.4.2   Throughput

Based on the available space of the SSD, the IronWolf 510 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. When the SSD has less available space, it slows down the read/write processing and implements garbage collection to release memory.

7. Safety Certifications, and Compliance

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/

For a direct link to the Seagate HDD and SSD Regulatory Compliance and Safety document, go 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 in the Seagate IronWolf 510 SSD series:

- STA015 (M.2 2280-S2) and STA016 (M2. 2280-D2)