

PHISON



D100P

M.2 22110

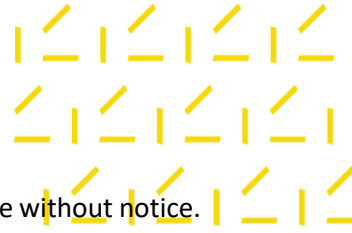
Version 3.0

Phison Electronics Corporation

Tel: +886-37-586-896 Fax: +886-37-587-868

E-mail: sales@phisonenterprise.com / support@phisonenterprise.com



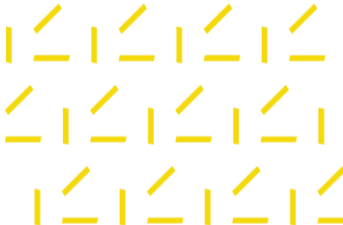


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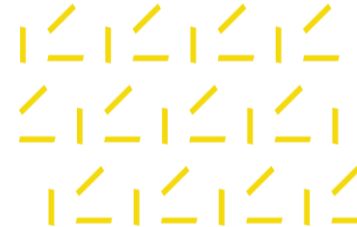
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REVISION HISTORY

Revision	Draft Date	History
1.0	2024/3/13	First release
1.1	2024/4/16	Modify TBW
2.0	2024/5/21	1. Replace with PASCARI format 2. Warranty policy update
2.1	2024/5/23	Modify document name
3.0	2025/7/1	Modify format

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PRODUCT OVERVIEW

Capacity

- 480GB, 960GB, 1920GB, 3840GB

Form Factor

- M.2 22110

PCIe Interface

- PCIe Gen4 x 4

Compliance

- PCI Express® Base Specification Rev. 4.0
- NVMe Express™ Base Specification Rev. 1.4
- NVMe Express™ Management Interface Rev 1.1

Performance¹

- Sequential Read: up to 6000 MB/s
- Sequential Write: up to 1800 MB/s
- Random Read: up to 800K IOPS
- Random Write: up to 60K IOPS

Power Consumption³

- Active Read (Avg. RMS): 10.3 W
- Active Write (Avg. RMS): 7.9 W
- Idle: 4.2 W

Endurance/Reliability

- MTBF : 2.0 million hrs
- UBER : < 1 sector per 10¹⁷ bits read
- DWPD: 1
- TBW:
480GB SSD - 850TB
960GB SSD - 1800TB
1920GB SSD - 3700TB
3840GB SSD - 7500TB

Environmental Specifications

- Temperature Range²
Operating: 0°C - 70°C²
Non-operating: -40°C - 85°C
- Shock:
Operating: 1000G, 0.5ms
Non-operating: 1500G, 0.5ms
- Vibration:
Operating 3.08Grms (7 - 200Hz)
Non-operating 20G (20 - 2000Hz)
- Drop: 80cm height
- Bending: ≥20N force

Certifications and Declarations

- CE, FCC, BSMI, VCCI, UKCA, RCM, ICES, KCC, CB, UL

Product Ecological Compliance

- RoHS compliant

Feature Support

- 64 Namespaces
- Hardware Based Power Loss Data Protection
- Reservation
- Thermal throttling
- Hardware AES-XTS 256-bit Encryption
- SMBus
- End-to-End Data Path Protection
- TCG Opal 2.0⁴
- Sanitize⁴
- SECDED

Physical Dimension:

- M.2 22110, 110(L)x22(W)x4.08(H) mm

NOTES:

1. Refer to Chapter 2 for more details.
2. Operation temperature is measured by device temperature sensor. Airflow is suggested and it will allow device to be operated at appropriate temperature for each component during heavy workloads environment.
3. Refer to Chapter 4, Section 4.2 Power Consumption for more details.
4. Supported by a separate firmware setting. Further information available upon request.

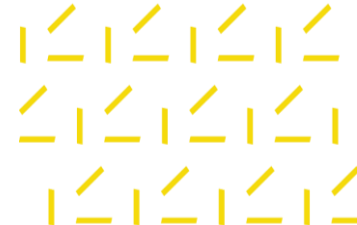
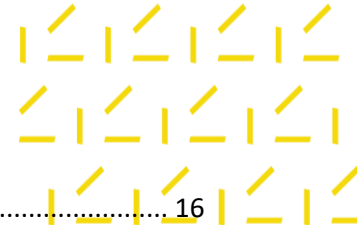


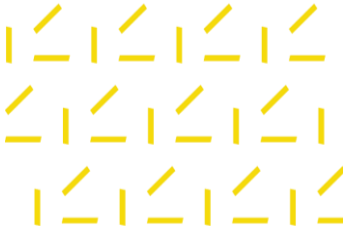
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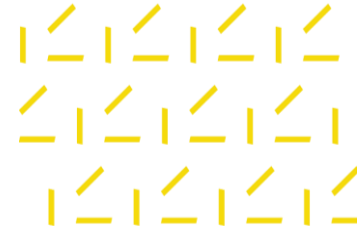
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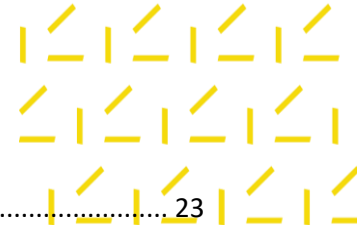
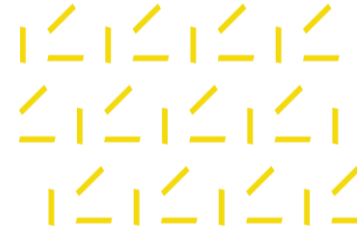


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1. INTRODUCTION

1.1. General Description

This document describes the specifications of Phison Enterprise PCIe Gen4x4 Solid State Drive. Applying to NVMe (Non-Volatile Memory express) high-speed interface, Phison SSD are ideal storage solution for outstanding performance, low latency and Quality of Service.

For enterprise-class, the form factor is M.2 22110 and the capacities are 480GB, 960GB, 1920GB and 3840GB.

1.2. SSD List

Model Name	Form Factor	DWPD	Capacity	Security	Part Number
D100P	M.2 22110	1	480GB	Non-SED	D180AK02480GP01512G00
				SED	D180AK02480GP21512G00
			960GB	Non-SED	D180AK02960GP011T0200
				SED	D180AK02960GP211T0200
			1920GB	Non-SED	D180AK021T92P012T0400
				SED	D180AK021T92P212T0400
			3840GB	Non-SED	D180AK023T84P014T0900
				SED	D180AK023T84P214T0900



2. PRODUCT SPECIFICATIONS

2.1. Electrical/Physical Interface

- PCI Express® Base Specification Rev. 4.0
- NVMe Express™ Base Specification Rev. 1.4
- NVMe Express™ Management Interface Rev 1.1
- PCIe Gen 4 x 4 lane & backward compatible to PCIe Gen 3, Gen 2 and Gen 1
- 129 queues supported (1 admin queue and 128 IO queue). Each IO queue support 16K entries.

2.2. Device Capacity

Table 2-1 User Capacity and Addressable Sectors

Model Name	Capacity	User Addressable Sectors	Bytes per Sector
D100P	480GB	937,703,088	512 Bytes
	960GB	1,875,385,008	
	1920GB	3,750,748,848	
	3840GB	7,501,476,528	

NOTES:

1. 1 Gigabyte (GB) is equal to 1,000,000,000 bytes; 1 sector is equal to 512 bytes.
2. The total actual usable capacity of the SSD may be less than the total physical capacity because internal NAND management, SSD format, SSD partition, operating system and so on.

2.3. Performance

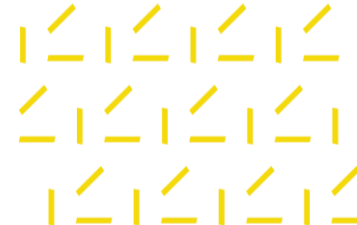
2.3.1. Sequential Read/Write Performance

Table 2-2 Sequential Read / Write Performance

Model Name	Capacity	Flash Type	Sequential 128KB (QD=32, Job=1)	
			Read (MB/s)	Write (MB/s)
D100P	480GB	3D TLC	6000	700
	960GB	3D TLC	6000	1400
	1920GB	3D TLC	6000	1800
	3840GB	3D TLC	3700	1700

NOTES:

1. Performance is measured with the following conditions
 - (a) FIO on Linux: 128KB sequential read/write with QD32 and 1 job for full drive.
 - (b) SSD is unformatted drive.
2. Performance platform:
 - (a) Operating System: Ubuntu 20.04.2 LTS
 - (b) Kernel: Linux version 5.10.32-ryder-20211006
 - (c) CPU: AMD EPYC 7543P 32-Core Processor
 - (d) Motherboard: Gigabyte Technology Co., Ltd. MZ32-AR0
 - (e) RAM: 131772576 kB
3. Performance may differ according to flash configuration and platform.
4. The tables are for reference only. Any criteria for accepting goods shall be further discussed based on different flash configurations.



2.3.2. Random Read/Write Performance

Table 2-3 Random Read / Write Performance

Model Name	Capacity	Flash Type	Random 4KB (QD=32, Jobs=8)	
			Read (IOPS)	Write (IOPS)
D100P	480GB	3D TLC	450K	25K
	960GB	3D TLC	750K	50K
	1920GB	3D TLC	800K	60K
	3840GB	3D TLC	400K	40K

NOTES:

- Performance is measured with the following conditions
 - FIO on Linux: 4KB random read/write with QD256 (QD32, 8 jobs) for full drive.
 - SSD is unformatted drive.
- Performance platform:
 - Operating System: Ubuntu 20.04.2 LTS
 - Kernel: Linux version 5.10.32-ryder-20211006
 - CPU: AMD EPYC 7543P 32-Core Processor
 - Motherboard: Gigabyte Technology Co., Ltd. MZ32-AR0
 - RAM: 131772576 kB
- Performance may differ according to flash configuration and platform.
- The tables are for reference only. Any criteria for accepting goods shall be further discussed based on different flash configurations.

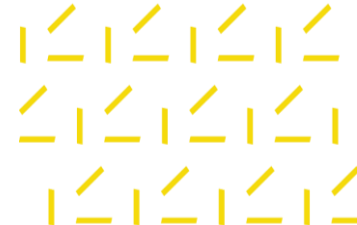
2.3.3. IOPS Consistency

Table 2-4 IOPS Consistency

Model Name	Capacity	Flash Type	Random 4KB (QD=32, Jobs=8)	
			Read	Write
D100P	480GB	3D TLC	98%	99%
	960GB	3D TLC	97%	99%
	1920GB	3D TLC	97%	89%
	3840GB	3D TLC	99%	99%

NOTES:

- Performance is measured with the following conditions
 - FIO on Linux: 4KB random read/write with QD256 (QD32, 8 jobs)
 - SSD is unformatted drive.
- Performance Platform
 - Operating System: Ubuntu 20.04.2 LTS
 - Kernel: Linux version 5.10.32-ryder-20211006
 - CPU: AMD EPYC 7543P 32-Core Processor
 - Motherboard: Gigabyte Technology Co., Ltd. MZ32-AR0
 - RAM: 131772576 kB
- $IOPS \text{ Consistency (\%)} = (99.9\% \text{ IOPS}) / (\text{Average IOPS}) \times 100$
- Performance may differ according to flash configuration and platform.
- The tables are for reference only. Any criteria for accepting goods shall be further discussed based on different flash configurations.



2.3.4. Latency

Table 2-5 Latency

Model Name	Capacity	Flash Type	Random 4KB (QD=1, Job=1)	
			Read (us)	Write (us)
D100P	480GB	3D TLC	75	40
	960GB	3D TLC	75	35
	1920GB	3D TLC	75	35
	3840GB	3D TLC	80	25

NOTES:

- Performance is measured with the following conditions
 - FIO on Linux: 4KB random read/write with QD1 and 1 job for full drive.
 - SSD is unformatted drive.
- Performance platform:
 - Operating System: Ubuntu 20.04.2 LTS
 - Kernel: Linux version 5.10.32-ryder-20211006
 - CPU: AMD EPYC 7543P 32-Core Processor
 - Motherboard: Gigabyte Technology Co., Ltd. MZ32-AR0
 - RAM: 131772576 kB
- Performance may differ according to flash configuration and platform.
- The tables are for reference only. Any criteria for accepting goods shall be further discussed based on different flash configurations.

2.3.5. Quality of Service (QoS)

Table 2-6 QoS (99%)

Model Name	Capacity	Flash Type	4KB Random Read/Write Quality of Service (QoS=99%)			
			(QD=1, Job=1)		(QD=32, Job=1)	
			Read (us)	Write (us)	Read (us)	Write (us)
D100P	480GB	3D TLC	180	90	385	1210
	960GB	3D TLC	155	60	330	730
	1920GB	3D TLC	125	65	275	895
	3840GB	3D TLC	130	65	450	820

Table 2-7 QoS (99.99%)

Model Name	Capacity	Flash Type	4KB Random Read/Write Quality of Service (QoS=99.99%)			
			(QD=1, Job=1)		(QD=32, Job=1)	
			Read (us)	Write (us)	Read (us)	Write (us)
D100P	480GB	3D TLC	230	180	445	1275
	960GB	3D TLC	210	165	380	785
	1920GB	3D TLC	205	145	325	950
	3840GB	3D TLC	195	145	615	860

NOTES:

- QoS is measured with the following conditions
 - FIO test: 4KB transfer size, QD=1, 32 on 4KB random read and write workload on whole LBA range of drive once the performance performs on steady state and all background operations run normally.
- Performance platform:
 - Operating System: Ubuntu 20.04.2 LTS
 - Kernel: Linux version 5.10.32-ryder-20211006
 - CPU: AMD EPYC 7543P 32-Core Processor
 - Motherboard: Gigabyte Technology Co., Ltd. MZ32-AR0

(e) RAM: 131772576 kB

3. According to random 4KB QD=1 and 32 workloads, the result of QoS is the maximum round-trip time which is taken for 99% and 99.99% of commands to host.
4. QoS may differ according to flash configuration and platform.
5. The tables are for reference only. Any criteria for accepting goods shall be further discussed based on different flash configurations.

2.4. Reliability

2.4.1. TBW (TeraBytes Written) and DWPD (Drive Write Per Day)

Table 2-8 TBW & DWPD

Model Name	Capacity	TBW	DWPD
D100P	480GB	850	1
	960GB	1800	1
	1920GB	3700	1
	3840GB	7500	1

NOTES:

1. The JEDEC Enterprise 219A workload.
2. Warranty is 5 years.
3. $DWPD = TBW / (365 \times 5 \text{ years} \times \text{User capacity})$

2.4.2. UBER

Table 2-9 UBER

Capacity	UBER
480GB	< 1 sector per 10^{17} bits read
960GB	
1920GB	
3840GB	

NOTES:

1. UBER (Uncorrectable Bit Error Rates) means the uncorrectable error per bits read.

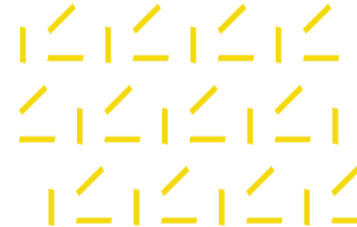
2.4.3. MTBF

Table 2-10 MTBF

Capacity	MTBF
480GB	2.0 million hours
960GB	
1920GB	
3840GB	

NOTES:

1. MTBF (Mean Time Between Failures) represents the average operational time between failures of the drive



3. ENVIRONMENTAL SPECIFICATIONS

3.1. Temperature and Humidity

Table 3-1 Temperature and Humidity Specification

Temperature	Operating	0°C to 70°C ¹
	Non-operating	-40°C to 85°C
Temperature Cycle Test	Operating	0°C to 70°C ¹
	Non-operating	-40°C to 85°C
Relative Humidity	Operating	0% to 90%
	Non-operating	0% to 93%

NOTES:

1. Operating temperature is measured by device temperature sensor. Airflow is suggested and it will allow device to be operated at appropriate temperature for each component during heavy workloads environment.

3.2. Thermal Throttling

Table 3-2 Thermal Throttling Table

Thermal Threshold Thermal Management Temperature(TMT)	480GB, 960GB, 1920GB,3840GB	Throttled Performance
TMT1	FLH 81°C ¹ or CTL 113°C ²	<50%
TMT2	FLH 83°C ¹ or CTL 118°C ²	<25%
TMT Protect	FLH 85°C ¹ or CTL 121°C ²	R/W = 40/40 MB/s
TMT Fatal	FLH 88°C ¹ or CTL 125°C ²	NA

NOTES:

1. Temperature based on the composite temperature(Tc)
2. Temperature based on the junction temperature(Tj)
3. Recovering to the previous stage as the temperature falls out its threshold except TMT fatal.
4. Shutdown and be recovered after power cycle only.

3.3. Airflow Profile

Figure 3-1 depicts the minimum airflow a D100P M.2 22110 (3840GB) SSD needs to operate without triggering thermal throttling at different ambient temperatures.

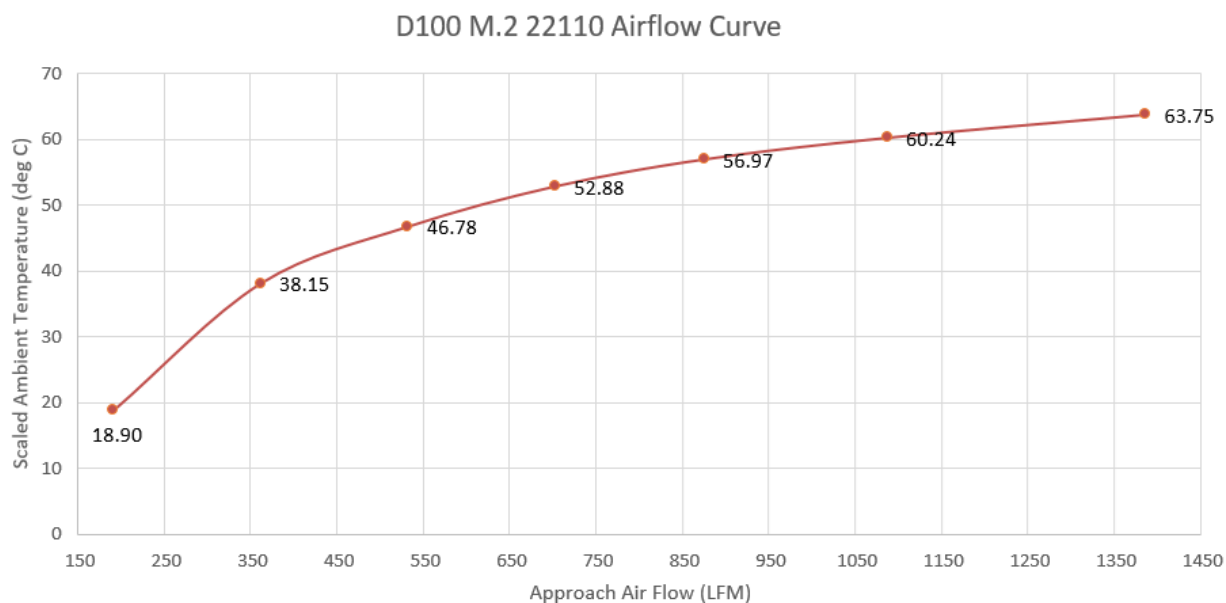
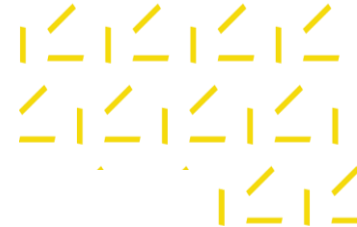


Figure 3-1 D100 M.2 22110 Airflow Curve

3.4. Mechanical (Shock/Vibration/Drop/Bending)

Table 3-3 Mechanical Test Condition

Shock	Operating	1000G, 0.5ms
	Non-operating	1500G, 0.5ms
Vibration	Operating	3.08Grms (7 - 800Hz)
	Non-operating	20G (20 - 2000Hz)
Drop	Non-operating	80cm
Bending	Non-operating	20N

3.5. Electrostatic Discharge (ESD)

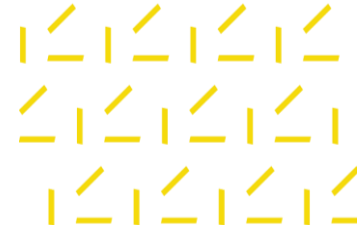
Table 3-4 Electrostatic Discharge (ESD)

Specification	+/- 4KV
EN 55024, CISPR 24 EN 61000-4-2 and IEC 61000-4-2	Device functions are affected, but EUT will be back to its normal or operational state automatically.

3.6. EMI Compliance

Table 3-5 EMI Compliance

Specification
EN 55032, CISPR 32(CE) AS/NZS CISPR 32(CE) ANSI C63.4 (FCC) CNS 15936 (BSMI) VCCI-CISPR 32 (VCCI)



4. ELECTRICAL SPECIFICATIONS

4.1. Supply Voltage

Table 4-1 Supply Voltage

3.3V Operating Voltage	3.3V, + / - 5%
3.3V Rise Time (Max/Min)	100 ms / 0.1 ms
3.3V Fall Time (Max/Min)	1 s / 10 ms
Min. Off Time ¹ (under 0.1 V)	1 s

NOTE:

1. Minimum time between power removed from SSD ($V_{cc} < 100$ mW) and power re-applied to the drive.

4.2. Power Consumption

Table 4-2 Power Consumption

Model Name	D100P			
Capacity	480GB	960GB	1920GB	3840GB
128K Sequential READ (Average RMS, W)	8.1	8.9	7.9	7.2
128K Sequential WRITE (Average RMS, W)	4.8	7.0	7.4	7.9
4KB Random READ (Average RMS, W)	5.4	8.1	10.3	8.7
4KB Random WRITE (Average RMS, W)	4.7	6.3	7.5	7.6
4KB 70/30 Random READ/WRITE (Average RMS, W)	4.9	6.0	7.0	7.0
Idle (Average RMS, W)	4	4	4.2	4.2

NOTES:

1. FIO with QD32 and 1 job for 128KB sequential read/write 1min & QD32 and 8 jobs for 4KB random read/write 1min test to measure the power of active read/write.
2. The power of idle is measured with LPM off.
3. The power of idle is measured with LPM off.
4. Power Consumption may differ according to flash configuration and platform.
5. The average value of power consumption is achieved based on 100% conversion efficiency.
6. The measured power voltage of M.2 22110 SSD is 3.3V.

4.3. Inrush Current

Table 4-3 Inrush Current

Inrush current	480GB	960GB	1920GB	3840GB
3.3V	3.5A			

5. PHYSICAL DIMENSION

5.1. Physical Information

Table 5-1 Physical Dimensions and Weight (PCB)

Parameter	Unit	480GB	960GB	1920GB	3840GB
Length	mm	110.00 ± 0.15			
Width	mm	22.00 ± 0.15			
Height	mm	4.00 ± 0.08			
Weight	g	12.3	12.4	12.4	15

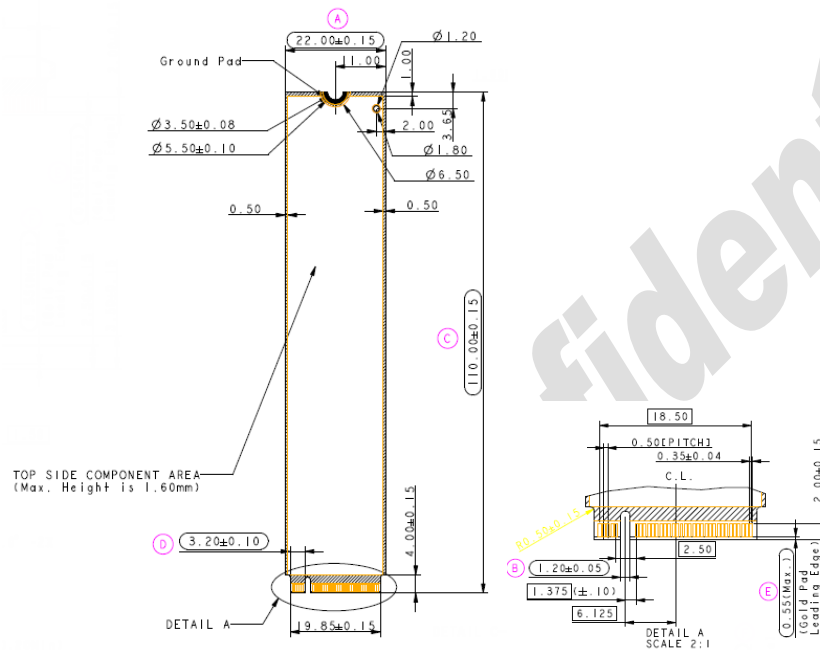


Figure 5-1 M.2 22110 Mechanical Diagram (Top View)

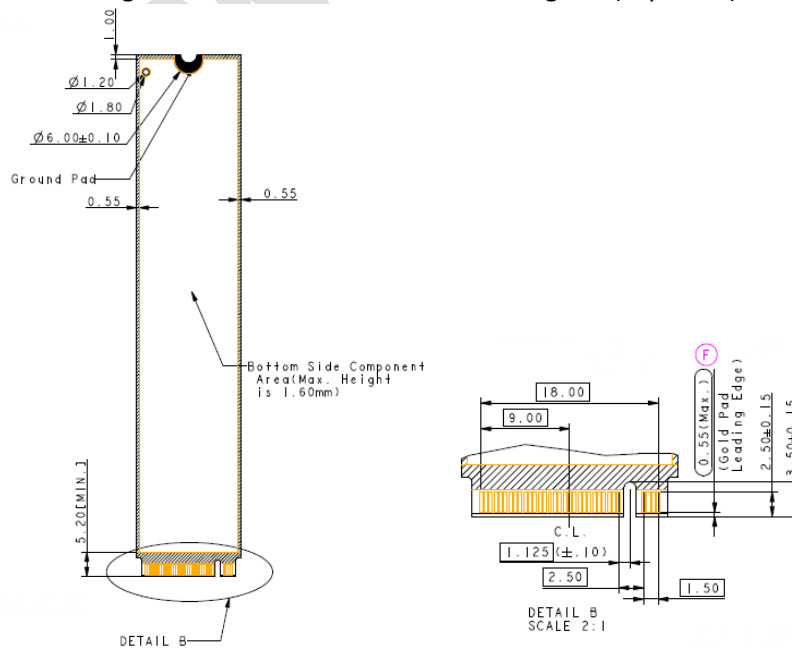


Figure 5-2 M.2 22110 Mechanical Diagram (Bottom View)

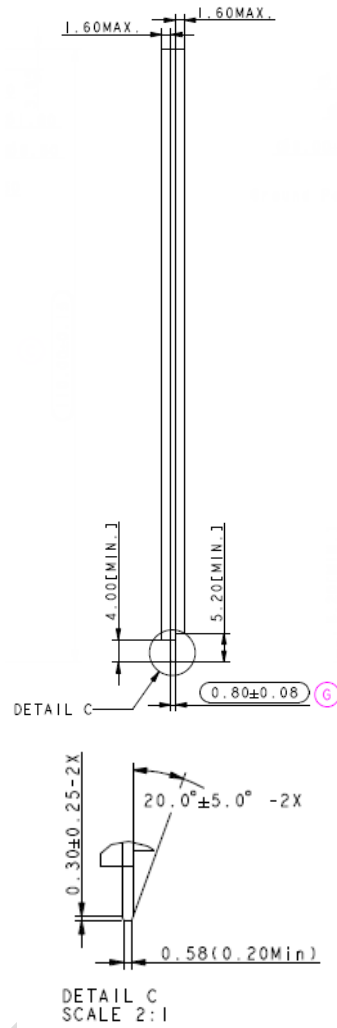
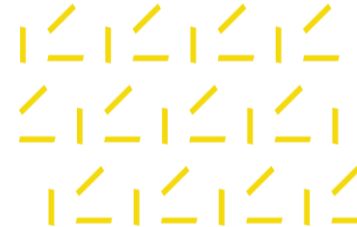


Figure 5-3 M.2 22110 Mechanical Diagram (Side View)



6. INTERFACE

6.1. PCIe M.2 Pin Assignment and Descriptions

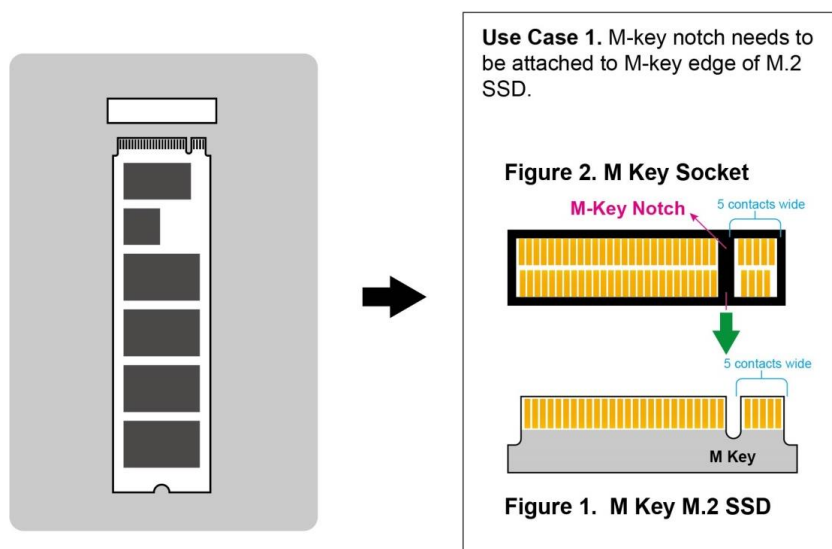


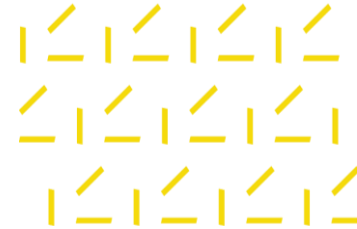
Figure 6-1 D100P M Key M.2 PCIe SSD Pin Assignment

Table 6-1 Pin Assignment and Descriptions of M.2 22110-D

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	PLN# (I)(0/3.3V)	Power Loss Notification Open drain with a pull-up on Adapters.
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

Pin No.	PCIe Pin	Description
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	PLA_S3# (O)(0/3.3V)	Power Loss Acknowledge Open drain with pull-up on Platforms.
31	PETp1	PCIe TX Differential signal defined by the PCI Express M.2 spec
32	GND	Ground
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	GND	Ground
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	N/C	No connect
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. Pins should be left N/C in 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.
59	Module Key M	Module Key
60	Module Key M	
61	Module Key M	

Pin No.	PCIe Pin	Description
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	N/C	No connect
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	GND	Ground



7. SUPPORTED COMMANDS

7.1. NVMe Command List

Table 7-1 Admin Commands

Identifier	O/M	Command Description
00h	M	Delete I/O Submission Queue
01h	M	Create I/O Submission Queue
02h	M	Get Log Page
04h	M	Delete I/O Completion Queue
05h	M	Create I/O Completion Queue
06h	M	Identify
08h	M	Abort
09h	M	Set Feature
0Ah	M	Get Feature
0Ch	M	Asynchronous Event Request
0Dh	O	Namespace Management
10h	O	Firmware Commit
11h	O	Firmware Image Download
14h	O	Device Self-test
15h	O	Namespace Attachment
1Dh	O	NVMe-MI Send
1Eh	O	NVMe-MI Receive
80h	O	Format NVM
81h	O	Security Send
82h	O	Security Receive
84h	O	Sanitize

Table 7-2 I/O Commands

Identifier	O/M	Command Description
00h	O	Flush
01h	O	Write
02h	O	Read
05h	O	Compare
08h	O	Write Zeroes
09h	O	Dataset Management

Table 7-3 Set Feature Commands

Identifier	O/M	Command Description
00h		Reserved
01h	M	Arbitration
02h	M	Power Management
04h	M	Temperature Threshold
05h	M	Error Recovery
07h	M	Number Of Queues
08h	M	Interrupt Coalescing
09h	M	Interrupt Vector Configuration
0Ah	M	Write Atomicity Normal
0Bh	M	Asynchronous Event Configuration
0Eh	O	Timestamp

Identifier	O/M	Command Description
10h	O	Host Controlled Thermal Management
11h	O	Non-Operational Power State Config
0Eh - 7Dh		Reserved
80h	O	Software Progress Marker

Table 7-4 Get Log Page Commands

Identifier	O/M	Command Description
00h		Reserved
01h	M	Error Information
02h	M	SMART / Health Information
03h	M	Firmware Slot Information
04h	O	Changed Namespace List
06h	O	Device Self-test
07h	O	Telemetry Host-Initiated
08h	O	Telemetry Controlled-Initiated
09h - 7Fh		Reserved
81h	O	Sanitize Status
82h - FFh		Reserved

Table 7-5 NVMe Management Interface Commands

Identifier	O/M	Command Description
00h	M	Read NVMe-MI Data Structure
01h	M	NVM Subsystem Health Status Poll
02h	M	Controller Health Status Poll
03h	M	Configuration Set
04h	M	Configuration Get
05h	M	VPD Read
06h	M	VPD Write
07h	M	Reset

Table 7-6 SMBus / I2C Elements Supported

SMBus/I2C Element	SMBus/I2C Address(8bit)	
	Hex Format	Binary format
SMBus/I2C Management Endpoint	3Ah	0011_101xb
Basic Management Command	D4h	1101_010xb

7.2. Identify Device Command

The following table details the sector data returned by the IDENTIFY DEVICE command.

Table 7-7 Identify Controller Data Structure

Bytes	O/M	Description	Default Value
01:00	M	PCI Vendor ID (VID)	0x1987
03:02	M	PCI Subsystem Vendor ID (SSVID)	0x1987
23:04	M	Serial Number (SN)	TBD
63:24	M	Model Number (MN)	PASCARI D100P
71:64	M	Firmware Revision (FR)	TBD
72	M	Recommended Arbitration Burst (RAB)	0x01
75:73	M	IEEE OUI Identifier (IEEE)	0x6479A7

Bytes	O/M	Description	Default Value
76	O	Controller Multi-Path I/O and Namespace Sharing Capabilities (CMIC)	0x00
77	M	Maximum Data Transfer Size (MDTS)	0x09
79:78	M	Controller ID (CNTLID)	0x0001
83:80	M	Version (VER)	0x00010400
87:84	M	RTD3 Resume Latency (RTD3R)	0x00989680
91:88	M	RTD3 Entry Latency (RTD3E)	0x00989680
95:92	M	Optional Asynchronous Events Supported (OAES)	0x00000300
99:96	M	Controller Attributes (CTRATT)	0x0002
100:101	O	Read Recovery Level support bitmap (rrls)	0x00
110:102	-	Reserved	0x00
111	M	Controller Type, if support NVMe 1.4 shall be set to other than 0 (cntrltype)	0x01
127:112	O	FRU Globally Unique Identifier (fguid[16])	0x00
129:128	O	Command Retry Delay Time 1 (crdt1)	0x00
131:130	O	Command Retry Delay Time 2 (crdt2)	0x00
133:132	O	Command Retry Delay Time 3 (crdt3)	0x00
255:134	-	Reserved	0x00
257:256	M	Optional Admin Command Support (OACS)	0x005F
258	M	Abort Command Limit (ACL)	0x03
259	M	Asynchronous Event Request Limit (AERL)	0x03
260	M	Firmware Updates (FRMW)	0x18
261	M	Log Page Attributes (LPA)	0x08
262	M	Error Log Page Entries (ELPE)	0x3E
263	M	Number of Power States Support (NPSS)	0x00
264	M	Admin Vendor Specific Command Configuration (AVSCC)	0x01
265	O	Autonomous Power State Transition Attributes (APSTA)	0x00
267:266	M	Warning Composite Temperature Threshold (WCTEMP)	0x0167
269:268	M	Critical Composite Temperature Threshold (CCTEMP)	0x0168
271:270	O	Maximum Time for Firmware Activation (MTFA)	0x0064
275:272	O	Host Memory Buffer Preferred Size (HMPRE)	0x00000000
279:276	O	Host Memory Buffer Minimum Size (HMMIN)	0x00000000
295:280	O	Total NVM Capacity (TNVMCAP)	480GB: 0x6FC86D60 960GB: 0xDF903560 1920GB: 0x01BF1FC560 3840GB: 0x037E3EE560
311:296	O	Unallocated NVM Capacity (UNVMCAP)	0x00
315:312	O	Replay Protected Memory Block Support (RPMBS)	0x00
317:316	O	Extended Device Self-test Time (edstt)	0x000A
318	O	Device Self-test Options (dsto)	0x00
319	M	Firmware Update Granularity (fwug)	0x01
321:320	M	Keep Alive Support (kas)	0x0000
323:322	O	Host Controlled Thermal Management Attributes (hctma)	0x0001
325:324	O	Minimum Thermal Management Temperature (mntmt)	0x0139
327:326	O	Maximum Thermal Management Temperature (mxtmt)	0x0164
331:328	O	Sanitize Capabilities (sanicap)	0xA0000003

Bytes	O/M	Description	Default Value
335:332	O	Host Memory Buffer Min. Descriptor Entry Size (hmminds)	0x00
337:336	O	Host Memory Maximum Descriptor Entries (hmmaxd)	0x00
339:338	O	NVM Set ID Maximum (nsetidmax)	0x00
341:340	O	Endurance Group ID Maximum (endgidmax)	0x00
342	O	ANA Maximum Transition Time (anatt)	0x00
343	O	Asymmetric Namespace Access Capabilities (anacap)	0x00
347:344	O	ANA Group ID Maximum (anagrpxmax)	0x00
351:348	O	Number of ANA Group IDs (nanagrpids)	0x00
355:352	O	Persistent Event Log Size (pels)	0x00
511:356	-	Reserved	0x00

Table 7-8 NVM Command Set Attributes

Bytes	O/M	Description	Default Value
512	M	Submission Queue Entry Size (SQES)	0x66
513	M	Completion Queue Entry Size (CQES)	0x44
515:514	M	Maximum Outstanding Commands (maxcmd)	0x0200
519:516	M	Number of Namespaces (NN)	0x00000040
521:520	M	Optional NVM Command Support (ONCS)	0x005D
523:522	M	Fused Operation Support (FUSES)	0x0000
524	M	Format NVM Attributes (FNA)	0x04
525	M	Volatile Write Cache (VWC)	0x06
527:526	M	Atomic Write Unit Normal (AWUN)	0x00FF
529:528	M	Atomic Write Unit Power Fail (AWUPF)	0x0000
530	M	NVM Vendor Specific Command Configuration (NVSCC)	0x01
531	M	Namespace Write Protection Capabilities (nwpc)	0x00
533:532	O	Atomic Compare & Write Unit (ACWU)	0x0000
535:534	M	Reserved	0x0000
539:536	O	SGL Support (SGLS)	0x00000000
543:540	O	Maximum Number of Allowed Namespace, if supports ANA Reporting shall not be 0 and less than NN (mnan)	0x00
767:544	-	Reserved	0x00

Table 7-9 IO Command Set Attributes

Bytes	O/M	Description	Default Value
1023:768	M	NVM Subsystem NVMe Qualified Name (subnqn)	0x00
1791:1024	-	Reserved	0x00
2047:1792	-	Refer to the NVMe over Fabrics specification	0x00
2079:2048	M	Power State 0 Descriptor (PSD0)	0x0370
2111:2080	O	Power State 1 Descriptor (PSD1)	0x00
2143:2112	O	Power State 2 Descriptor (PSD2)	0x00
2175:2144	O	Power State 3 Descriptor (PSD3)	0x00
2207:2176	O	Power State 4 Descriptor (PSD4)	0x00
2239:2208	O	Power State 5 Descriptor (PSD5)	0x00
2271:2240	O	Power State 6 Descriptor (PSD6)	0x00
2303:2272	O	Power State 7 Descriptor (PSD7)	0x00
2335:2304	O	Power State 8 Descriptor (PSD8)	0x00
2367:2336	O	Power State 9 Descriptor (PSD9)	0x00
2399:2368	O	Power State 10 Descriptor (PSD10)	0x00
2431:2400	O	Power State 11 Descriptor (PSD11)	0x00
2463:2432	O	Power State 12 Descriptor (PSD12)	0x00

Bytes	O/M	Description	Default Value
2495:2464	O	Power State 13 Descriptor (PSD13)	0x00
2527:2496	O	Power State 14 Descriptor (PSD14)	0x00
2559:2528	O	Power State 15 Descriptor (PSD15)	0x00
2591:2560	O	Power State 16 Descriptor (PSD16)	0x00
2623:2592	O	Power State 17 Descriptor (PSD17)	0x00
2655:2624	O	Power State 18 Descriptor (PSD18)	0x00
2687:2656	O	Power State 19 Descriptor (PSD19)	0x00
2719:2688	O	Power State 20 Descriptor (PSD20)	0x00
2751:2720	O	Power State 21 Descriptor (PSD21)	0x00
2783:2752	O	Power State 22 Descriptor (PSD22)	0x00
2815:2784	O	Power State 23 Descriptor (PSD23)	0x00
2847:2816	O	Power State 24 Descriptor (PSD24)	0x00
2879:2848	O	Power State 25 Descriptor (PSD25)	0x00
2911:2880	O	Power State 26 Descriptor (PSD26)	0x00
2943:2912	O	Power State 27 Descriptor (PSD27)	0x00
2975:2944	O	Power State 28 Descriptor (PSD28)	0x00
3007:2976	O	Power State 29 Descriptor (PSD29)	0x00
3039:3008	O	Power State 30 Descriptor (PSD30)	0x00
3071:3040	O	Power State 31 Descriptor (PSD31)	0x00

Table 7-10 IO Vendor Specific

Bytes	O/M	Description	Default Value
4095:3072	O	Vendor Specific (VS)	Phison Reserved

NOTES:

- * The OUI shall be a valid IEEE/RAC assigned identifier that may be registered at <http://standards.ieee.org/develop/regauth/oui/public.html>.
- ** depends on the using of capacity

Table 7-11 Identify Namespace Data Structure & NVM Command Set Specific

Bytes	O/M	Description	Default Value
7:0	M	Namespace Size (NSZE)	480GB: 0x37E436B0 960GB: 0x6FC81AB0 1920GB: 0xDF8FE2B0 3840GB: 0x1BF1F72B0
15:8	M	Namespace Capacity (NCAP)	480GB: 0x37E436B0 960GB: 0x6FC81AB0 1920GB: 0xDF8FE2B0 3840GB: 0x1BF1F72B0
23:16	M	Namespace Utilization (NUSE)	480GB: 0x37E436B0 960GB: 0x6FC81AB0 1920GB: 0xDF8FE2B0 3840GB: 0x1BF1F72B0
24	M	Namespace Features (NSFEAT)	0x00
25	M	Number of LBA Formats (NLBAF)	0x01
26	M	Formatted LBA Size (FLBAS)	0x00
27	M	Metadata Capabilities (MC)	0x00
28	M	End-to-end Data Protection Capabilities (DPC)	0x00
29	M	End-to-end Data Protection Type Settings (DPS)	0x00
30	O	Namespace Multi-path I/O and Namespace Sharing Capabilities (NMIC)	0x00

Bytes	O/M	Description	Default Value
31	O	Reservation Capabilities (RESCAP)	0x00
32	O	Format Progress Indicator (FPI)	0x00
33	O	Deallocate Logical Block Features (dlfeat)	0x09
35:34	O	Namespace Atomic Write Unit Normal (NAWUN)	0x0000
37:36	O	Namespace Atomic Write Unit Power Fail (NAWUPF)	0x0000
39:38	O	Namespace Atomic Compare & Write Unit (NACWU)	0x0000
41:40	O	Namespace Atomic Boundary Size Normal (NABSN)	0x0000
43:42	O	Namespace Atomic Boundary Offset (NABO)	0x0000
45:44	O	Namespace Atomic Boundary Size Power Fail (NABSPF)	0x0000
47:46		Namespace Optimal IO Boundary (noiob)	0x0000
64:48	O	NVM Capacity (NVMCAP)	480GB: 0x6FC86D60 960GB: 0xDF903560 1920GB: 0x01BF1FC560 3840GB: 0x037E3EE560
65:64	O	Namespace Preferred Write Granularity (npwg)	0x00
67:66	O	Namespace Preferred Write Alignment (npwa)	0x00
69:68	O	Namespace Preferred Deallocation(Trim) Granularity (npdg)	0x00
71:70	O	Namespace Preferred Deallocation(Trim) Alignment (npda)	0x00
73:72	O	Namespace Optimal Write Size (nows)	0x00
91:74	-	Reserved	0x00
95:92	O	ANA Groput Identifier (anagrpId)	0x00
98:96	-	Reserved	0x00
99	O	Namespace Attributes (nsattr)	0x00
101:100	O	NVM Set Identifier (nvmsetid)	0x00
103:102	O	Endurance Group Identifier // NVMe 1.4 add (endgid)	0x00
119:104	O	Namespace Globally Unique Identifier (NGUID)	0x00
127:120	O	IEEE Extended Unique Identifier (EUI64)	TBD**
131:128	M	LBA Format 0 Support (LBAF0)	0x02090000
135:132	O	LBA Format 1 Support (LBAF1)	0x010C0000
139:136	O	LBA Format 2 Support (LBAF2)	0x00000000
143:140	O	LBA Format 3 Support (LBAF3)	0x00000000
147:144	O	LBA Format 4 Support (LBAF4)	0x00000000
151:148	O	LBA Format 5 Support (LBAF5)	0x00000000
155:152	O	LBA Format 6 Support (LBAF6)	0x00000000
159:156	O	LBA Format 7 Support (LBAF7)	0x00000000
163:160	O	LBA Format 8 Support (LBAF8)	0x00000000
167:164	O	LBA Format 9 Support (LBAF9)	0x00000000
171:168	O	LBA Format 10 Support (LBAF10)	0x00000000
175:172	O	LBA Format 11 Support (LBAF11)	0x00000000
179:176	O	LBA Format 12 Support (LBAF12)	0x00000000
183:180	O	LBA Format 13 Support (LBAF13)	0x00000000
187:184	O	LBA Format 14 Support (LBAF14)	0x00000000
191:188	O	LBA Format 15 Support (LBAF15)	0x00000000

Bytes	O/M	Description	Default Value
383:192	-	Reserved	0x00
4095:384	O	Vendor Specific (VS)	0x00

NOTES:

1. *See IDEMA SPEC
2. ** See IEEE EUI-64 SPEC

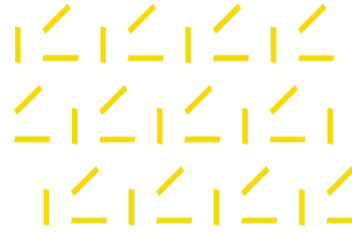
Table 7-12 List of Identify Namespace Data Structure for Each Capacity

Capacity (GB)	Byte [7:0]: Namespace Size (NSZE)(Hex)	Byte [7:0]: Namespace Size (NSZE)(Dec)
480	37E436B0h	937,703,088
960	6FC81AB0h	1,875,385,008
1920	DF8FE2B0h	3,750,748,848
3840	1BF1F72B0h	7,501,476,528

7.3. SMART Attributes

Table 7-13 SMART Attributes (Log Identifier 02h)

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
[201:200]	2	Temperature Sensor 1 (Current Temperature)
[203:202]	2	Temperature Sensor 2 (N/A)
[205:204]	2	Temperature Sensor 3 (N/A)
[207:206]	2	Temperature Sensor 4 (N/A)
[209:208]	2	Temperature Sensor 5 (N/A)
[211:210]	2	Temperature Sensor 6 (N/A)
[213:212]	2	Temperature Sensor 7 (N/A)
[215:214]	2	Temperature Sensor 8 (N/A)
[511:216]	296	Reserved

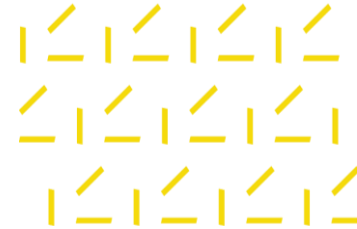


8. PRODUCT COMPLIANCE

Table 8-1 Product Regulatory Compliance and Certifications

Category	Certifications
EMC	CE
	FCC
	BSMI
	VCCI
	UKCA
	RCM
	ICES
	KCC
Safety	CB
	UL

PHISON Confidential



9. PRODUCT WARRANTY POLICY

Complete information regarding Phison's warranties to the Phison brand enterprise SSD product ("Product(s)") is listed below.

This limited warranty covers any defects in material or workmanship in the new Products accompanied by this limited warranty statement. This limited warranty does not apply to any Products on which the original identification information has been altered, obliterated or removed; that has not been handled or packaged correctly; that has been sold as secondhand; or that has been resold contrary to U.S.A. and other applicable export regulations.

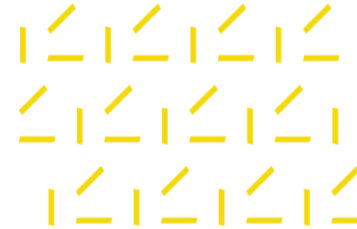
Duration of Warranty

For any other Product manufactured and supplied by Phison, Phison hereby certifies that in the event Product does not conform to the specification for (A) a period of five (5) years from the date of Phison's delivery of the Product or (B) the period ending on the date at which use of the Product exceeds Product's total terabytes written as recorded by or derived from Product's S.M.A.R.T. Attribute, including but not limited to, Product's drive life is used up in accordance with the S.M.A.R.T. Attribute, whichever occurs earlier ("Warranty Period"), and such inconformity is confirmed by Phison to be solely attributable to Phison, Phison's sole and maximum obligation shall be to repair or replace the nonconforming Product, free of charge, in Phison's sole discretion.

Exclusion of the Warranty

Notwithstanding the foregoing, the aforementioned warranty shall exclude the inconformity arising from, in relation to or associated with:

- (1) alternation, modification, improper use, misuse or excessive use of Phison Product;
- (2) failure to comply with Phison's instructions;
- (3) Phison's compliance with or use of the instructions, technologies, designs, specifications, devices, materials, components, parts, software and firmware provided, instructed or approved by Buyer (including any of its parents, subsidiaries, affiliates, suppliers, subcontractors or downstream customers);
- (4) combination of Phison Product with other materials, components, parts, goods, hardware, firmware or



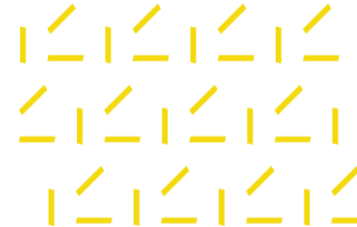
software not supplied by Phison;

- (5) any claim brought by a third party who is commonly known as intellectual property right assertion entity or patent troll;
- (6) NAND flash itself or NAND flash which is embedded into Phison Products;
- (7) Phison's compliance with general industry standards;
- (8) other error or failure not solely attributable to Phison's cause (including without limitation, normal wear or tear, manufacturing or assembly wastage, improper operation, virus, unauthorized maintenance or repair).

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10. REFERENCE

The following table is to list out the standards that have been adopted for designing the product.

Table 10-1 List of References

Title	Source
PCI Express® Base Specification Rev. 4.0	https://www.pcisig.com/specifications/pciexpress/base3/
PCI Express M.2 Specification Rev.4.0 Ver.1.0	https://www.pcisig.com/specifications/pciexpress/base3/
NVM Express™ Base Specification Rev. 1.4	http://www.nvmexpress.org/
Solid-State Drive Requirements and Endurance Test Method (JESD219A)	http://www.jedec.org/standards-documents/docs/jesd219a

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