

PHISON



X100

U.2/U.3

Version 1.8

Phison Electronics Corporation

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

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

Phison may make changes to specifications, components and product description at any time without notice.

PHISON and the Phison logo are trademarks of Phison Electronics Corporation, registered in the United States and other countries. Products and specifications discussed herein are for reference purposes only. Copies of documents which include information of part number or ordering number, or other materials may be obtained by emailing us at sales@phisonenterprise.com or support@phisonenterprise.com.

©2024 Phison Electronics Corp. All Rights Reserved.

PHISON Confidential

REVISION HISTORY

Revision	Draft Date	History
1.0	2023-10-30	1 st release
1.1	2024-02-23	Modify Drive Security Type Modify Power Consumption Methodologies
1.2	2024-03-22	Add LBAF
1.3	2024-05-15	Replace to PASCARI format Update warrenty policy information
1.4	2024-06-27	Add 960GB and 800GB Information
1.5	2024-09-02	Modify Table 3-2 Shock Update warrenty policy information
1.6	2024-09-30	Modify 6 SUPPORTED COMMANDS
1.7	2025-02-27	Reformatting and updating perfotmance data Remove 960GB and 800GB
1.8	2025-06-11	Add note of U.3

PRODUCT OVERVIEW

Capacity

- OP=7%: 1920GB, 3840GB, 7680GB, 15360GB, 30720GB
- OP=28%: 1600GB, 3200GB, 6400GB, 12800GB, 25600GB

Form Factor

- U.2 / U.3¹

PCIe Interface

- PCIe Gen4x4
- Single Port x4 lanes / Dual Port x2 lanes
- PCIe AER (Advanced Error Reporting)

Compliance

- PCI Express® Base Specification Rev. 4.0
- NVM Express™ Base Specification Rev. 1.4
- NVM Express® Management Interface Rev 1.1
- PCI Express SFF-8639 Module Specification Revision 4.0, Version1.0, SFF-TA-1001 r1.1

Performance

- Sequential Read: up to 7,400MB/s
- Sequential Write: up to 7,000MB/s
- Random Read: up to 1,750K IOPS
- Random Write: up to 490K IOPS

Power Consumption²

- Active Read (Avg. RMS): 19W
- Active Write (Avg. RMS): 21W
- Max. Idle Power: 8.6W

Endurance/Reliability

- MTBF³: 2.5 million hours
- UBER: < 1 sector per 10¹⁸ bits read
- DWPD: 1 / 3
- TBW⁴:
1600GB SSD – 8760TB
1920GB SSD – 3504TB
3200GB SSD – 17520TB

3840GB SSD – 7008TB

6400GB SSD – 35040TB

7680GB SSD – 14016TB

12800GB SSD – 70080TB

15360GB SSD – 28032TB

25600GB SSD – 140160TB

30720GB SSD – 56064TB

Environmental Specifications

- Temperature Range
Operating: 0°C - 70°C with specified airflow
Non-operating: -40°C - 85°C
- Shock:
Operating: 500G, 2ms
Non-operating: 1000G, 0.5ms
- Vibration:
Operating: 2.17 Grms (200 - 2000Hz)
Non-operating: 16.3 Grms (10 - 2000 Hz)
- Drop: 80cm height
- Bending: 50N

Certifications and Declarations

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

Product Ecological Compliance

- RoHS compliant

Feature Support

- LBAF: 512 / 512+8 / 4K / 4K+8 / 4K+64 Bytes
- 64 Namespaces
- Single Port / Dual Port
- Reservation
- Metadata Protection
- Thermal throttling
- Power Loss Protection
- Hardware AES-XTS 256-bit Encryption
- SMBus

Physical Dimension

- U.2 / U.3 100(L)x70(W)x15(H) mm

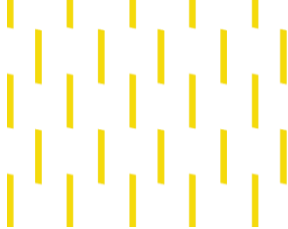
NOTES:

1. U.3 form factor support is available through custom configurations for qualified OEM customers upon request.
2. Please see “4.2 Power Consumption” for details.
3. MTBF is a prediction simulation based on Telcordia SR-332 model.
4. Please see “2.4.1. TBW (TeraBytes Written) and DWPD (Drive Write Per Day)” for details.

TABLE OF CONTENTS

REVISION HISTORY	2
PRODUCT OVERVIEW	3
TABLE OF CONTENTS	4
LIST OF FIGURES	6
LIST OF TABLES	7
1. INTRODUCTION.....	9
1.1. General Description	9
1.2. SSD List.....	9
2. PRODUCT SPECIFICATIONS.....	11
2.1. Electrical/Physical Interface.....	11
2.2. Device Capacity.....	11
2.3. Performance	12
2.3.1. Sequential Read/Write Performance	12
2.3.2. Random Read/Write Performance	12
2.3.3. IOPS Consistency.....	13
2.3.4. Latency.....	13
2.3.5. Quality of Service (QoS).....	14
2.4. Reliability	15
2.4.1. TBW (TeraBytes Written) and DWPD (Drive Write Per Day)	15
2.4.2. UBER	15
2.4.3. MTBF.....	16
3. ENVIRONMENTAL SPECIFICATIONS.....	17
3.1. Temperature and Humidity.....	17
3.2. Thermal Throttling.....	17
3.3. Airflow Profile	18
3.4. Mechanical (Shock/Vibration/Drop/Bending)	19
3.5. Altitude	19
3.6. Electrostatic Discharge (ESD)	19
3.7. EMI Compliance.....	19

4.	ELECTRICAL SPECIFICATIONS	20
4.1.	Supply Voltage	20
4.2.	Power Consumption	20
4.3.	Inrush Current.....	21
5.	PHYSICAL DIMENSION	22
5.1.	Physical Information	22
6.	INTERFACE	24
6.1.	PCIe U.3 and U.2 Pin Assignment and Descriptions	24
7.	SUPPORTED COMMANDS.....	26
7.1.	NVMe Command List.....	26
7.2.	Identify Device Data	28
7.3.	SMART Attributes	35
8.	VITAL PRODUCT DATA.....	37
9.	PRODUCT COMPLIANCE	38
10.	PRODUCT WARRANTY POLICY	39
11.	REFERENCE	41



LIST OF FIGURES

Figure 3-1 Thermal Throttling Mechanism 18

Figure 3-2 X100 U.3 Airflow Curve 18

Figure 5-1 U.2 / U.3 2.5-inch 15mm Mechanical information 22

Figure 5-2 U.2 / U.3 pro 2.5-inch 15mm Mechanical information 23

Figure 6-1 X100 U.3 PCIe SSD Pin Assignment..... 24

Figure 6-2 X100 U.2 PCIe SSD Pin Assignment..... 24

Figure 8-1 X100 U.3 PCIe SSD Controller Block Diagram 37

PHISON Confidential

LIST OF TABLES

Table 1-1 Single Port SSD List.....	9
Table 1-2 Dual Port SSD List.....	10
Table 2-1 User Capacity and Addressable Sectors.....	11
Table 2-2 Sequential Read / Write Performance	12
Table 2-3 Random Read / Write Performance.....	12
Table 2-4 IOPS Consistency.....	13
Table 2-5 Latency.....	13
Table 2-6 QoS (99%).....	14
Table 2-7 QoS (99.99%).....	14
Table 2-8 TBW & DWPD.....	15
Table 2-9 UBER.....	15
Table 2-10 MTBF	16
Table 3-1 Temperature and Humidity Specification	17
Table 3-2 Thermal Throttling Mechanism	17
Table 3-3 Mechanical Test Condition.....	19
Table 3-4 Altitude	19
Table 3-5 Electrostatic Discharge (ESD)	19
Table 3-6 EMI Compliance	19
Table 4-1 Supply Voltage.....	20
Table 4-2 X100P Power Consumption	20
Table 4-3 X100E Power Consumption.....	20
Table 4-4 Inrush Current.....	21
Table 5-1 Physical Dimensions and Weight	22
Table 6-1 Pin Assignment and Descriptions.....	24
Table 7-1 Admin Command List.....	26
Table 7-2 I/O Commands	26
Table 7-3 Set Feature Commands.....	26
Table 7-4 Get Log Page Commands	27
Table 7-5 NVMe Management Interface Commands	27

Table 7-6 SMBus / I2C Elements Supported	27
Table 7-7 Identify Controller Data Structure	28
Table 7-8 NVM Command Set Attributes	29
Table 7-9 IO Command Set Attributes	29
Table 7-10 IO Vendor Specific	33
Table 7-11 Identify Namespace Data Structure & NVM Command Set Specific	33
Table 7-12 List of Identify Namespace Data Structure for Each Capacity	34
Table 7-13 SMART Attributes (Log Identifier 02h)	35
Table 7-14 SMART Attributes (Log Identifier C0h)	35
Table 9-1 Product Regulatory Compliance and Certifications	38
Table 11-1 List of References	41

1. INTRODUCTION

1.1. General Description

Phison's U.2 / U.3 Solid State Disk (SSD) delivers all the advantages of flash disk technology with PCIe Gen4x4 interface, including being fully compliant with standard U.2/U.3 form factor, providing low power consumption compared to traditional hard drive and hot-swapping when removing/replacing/upgrading flash disks. X100 series offers a wide range of capacities up to 30,720GB and its performance can reach up to 7400MB/s (for sequential read) and 7000MB/s (for sequential write) based on 3D TLC NAND flash with the DDR4. Moreover, the power consumption of X100 U.2/U.3 SSD is much lower than traditional hard drives, making it the best embedded solution for new platforms.

1.2. SSD List

Table 1-1 Single Port SSD List

Model Name	Form Factor	DWPD	Capacity	Security	Part Number
X100E	U.2/U.3 ¹	3	1600GB	SED	XP106H011T60E222T0400
				Non-SED	XP106H011T60E022T0400
			3200GB	SED	XP106H013T20E224T0900
				Non-SED	XP106H013T20E024T0900
			6400GB	SED	XP106H016T40E228T1900
				Non-SED	XP106H016T40E028T1900
			12800GB	SED	XP106H0112T8E2116T300
				Non-SED	XP106H0112T8E0116T300
X100P	U.2/U.3 ¹	1	1920GB	SED	XP106H011T92P222T0400
				Non-SED	XP106H011T92P022T0400
			3840GB	SED	XP106H013T84P224T0900
				Non-SED	XP106H013T84P024T0900
			7680GB	SED	XP106H017T68P228T1900
				Non-SED	XP106H017T68P028T1900
			15360GB	SED	XP106H0115T3P2116T300
				Non-SED	XP106H0115T3P0116T300
			30720GB	SED	XP106H0130T7P2132T700
				Non-SED	XP106H0130T7P0132T700

NOTE:

1. U.3 form factor support is available through custom configurations for qualified OEM customers upon request.

Table 1-2 Dual Port SSD List

Model Name	Form Factor	DWPD	Capacity	Security	Part Number
X100E	U.2/U.3 ¹	3	1600GB	SED	XX106H011T60E222T0400
				Non-SED	XX106H011T60E022T0400
			3200GB	SED	XX106H013T20E224T0900
				Non-SED	XX106H013T20E024T0900
			6400GB	SED	XX106H016T40E228T1900
				Non-SED	XX106H016T40E028T1900
			12800GB	SED	XX106H0112T8E2116T300
				Non-SED	XX106H0112T8E0116T300
X100P	U.2/U.3 ¹	1	1920GB	SED	XX106H011T92P222T0400
				Non-SED	XX106H011T92P022T0400
			3840GB	SED	XX106H013T84P224T0900
				Non-SED	XX106H013T84P024T0900
			7680GB	SED	XX106H017T68P228T1900
				Non-SED	XX106H017T68P028T1900
			15360GB	SED	XX106H0115T3P2116T300
				Non-SED	XX106H0115T3P0116T300
			30720GB	SED	XX106H0130T7P2132T700
				Non-SED	XX106H0130T7P0132T700

NOTE:

- U.3 form factor support is available through custom configurations for qualified OEM customers upon request.

2. PRODUCT SPECIFICATIONS

2.1. Electrical/Physical Interface

- PCI Express® Base Specification Rev. 4.0
- NVMe Express™ Base Specification Rev. 1.4
- PCIe Gen 4 x 4 lanes & backward compatible to PCIe Gen 3, Gen 2 and Gen 1
- PCI Express SFF-8639 Module Specification Revision 4.0, Version 1.0, SFF-TA-1001 r1.1
- 8 IO queues supported (1 admin queue and 8 IO queue). Each IO queue support 256 entries.

2.2. Device Capacity

Table 2-1 User Capacity and Addressable Sectors

Model Name	Capacity	User Addressable Sectors	Bytes per Sector
X100P	1920GB	3,750,748,848	512 Byte
	3840GB	7,501,476,528	
	7680GB	15,002,931,888	
	15360GB	30,005,842,608	
	30720GB	60,011,664,048	
X100E	1600GB	3,125,627,568	512 Byte
	3200GB	6,251,233,968	
	6400GB	12,502,446,768	
	12800GB	25,004,872,368	
	25600GB	50,009,723,568	

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.
3. The count of User Addressable Sectors is calculated by the formula of IDEMA.

2.3. Performance

2.3.1. Sequential Read/Write Performance

Table 2-2 Sequential Read / Write Performance

Model Name	Capacity	Flash Type	Sequential 512KB (QD=32, Job=1)	
			Read (MB/s)	Write (MB/s)
X100P	1920GB	3D TLC	7,400	3,600
	3840GB	3D TLC	7,400	6,900
	7680GB	3D TLC	7,400	7,000
	15360GB	3D TLC	7,400	7,000
	30720GB	3D TLC	7,400	6,000
X100E	1600GB	3D TLC	7,400	3,600
	3200GB	3D TLC	7,400	6,900
	6400GB	3D TLC	7,400	7,000
	12800GB	3D TLC	7,400	7,000
	25600GB	3D TLC	7,400	6,000

NOTES:

- Performance is measured with the following conditions
 - FIO on Linux: 512KB sequential read/write with QD32 and 1 job for full drive.
 - SSD is unformatted drive.
- Performance platform:
 - Operating System: Ubuntu 20.04.2 LTS
 - CPU: AMD Ryzen 7 3700X 8-Core Processor
 - Motherboard: Gigabyte Technology Co., Ltd. X570 AORUS MASTER
 - DRAM: DDR4 3200MHz 16GB
- 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.

2.3.2. Random Read/Write Performance

Table 2-3 Random Read / Write Performance

Model Name	Capacity	Flash Type	Random 4KB (QD=128, Jobs=8)	
			Read (IOPS)	Write (IOPS)
X100P	1920GB	3D TLC	1,750K	126K
	3840GB	3D TLC	1,750K	195K
	7680GB	3D TLC	1,750K	190K
	15360GB	3D TLC	1,750K	210K
	30720GB	3D TLC	1,750K	210K
X100E	1600GB	3D TLC	1,750K	300K
	3200GB	3D TLC	1,750K	460K
	6400GB	3D TLC	1,750K	460K
	12800GB	3D TLC	1,750K	490K
	25600GB	3D TLC	1,750K	470K

NOTES:

- Performance is measured with the following conditions
 - FIO on Linux: 4KB random read/write with QD128 and 8 jobs for full drive.
 - SSD is unformatted drive.
- Performance platform:

- (a) Operating System: Ubuntu 20.04.2 LTS
 - (b) CPU: AMD Ryzen 7 3700X 8-Core Processor
 - (c) Motherboard: Gigabyte Technology Co., Ltd. X570 AORUS MASTER
 - (d) DRAM: DDR4 3200MHz 16GB
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.

2.3.3. IOPS Consistency

Table 2-4 IOPS Consistency

Model Name	Capacity	Flash Type	Random 4KB (QD=8, Jobs=4)	
			Read	Write
X100P	1920GB	3D TLC	99%	99%
	3840GB	3D TLC	99%	95%
	7680GB	3D TLC	99%	99%
	15360GB	3D TLC	99%	98%
	30720GB	3D TLC	99%	95%
X100E	1600GB	3D TLC	99%	99%
	3200GB	3D TLC	99%	97%
	6400GB	3D TLC	99%	96%
	12800GB	3D TLC	99%	95%
	25600GB	3D TLC	99%	96%

NOTES:

1. Performance is measured with the following conditions
 - (a) FIO on Linux: 4KB random Read/write with QD8 and 4 jobs.
 - (b) SSD is unformatted drive.
2. Performance Platform
 - (a) Operating System: Ubuntu 20.04.2 LTS
 - (b) CPU: AMD Ryzen 7 3700X 8-Core Processor
 - (c) Motherboard: Gigabyte Technology Co., Ltd. X570 AORUS MASTER
 - (d) DRAM: DDR4 3200MHz 16GB
3. $IOPS\ Consistency\ (\%) = (99.9\% \text{ IOPS}) / (\text{Average IOPS}) \times 100$
4. Performance 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.

2.3.4. Latency

Table 2-5 Latency

Model Name	Capacity	Flash Type	Random 4KB (QD=1, Job=1)	
			Read (us)	Write (us)
X100P	1920GB	3D TLC	70	7
	3840GB	3D TLC	70	7
	7680GB	3D TLC	70	7
	15360GB	3D TLC	70	7
	30720GB	3D TLC	70	7
X100E	1600GB	3D TLC	70	7
	3200GB	3D TLC	70	7
	6400GB	3D TLC	70	7
	12800GB	3D TLC	70	7

Model Name	Capacity	Flash Type	Random 4KB (QD=1, Job=1)	
			Read (us)	Write (us)
	25600GB	3D TLC	70	7

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
 - CPU: AMD Ryzen 7 3700X 8-Core Processor
 - Motherboard: Gigabyte Technology Co., Ltd. X570 AORUS MASTER
 - DRAM: DDR4 3200MHz 16GB
- 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=8, Jobs=4)	
			Read (us)	Write (us)	Read (us)	Write (us)
X100P	1920GB	3D TLC	80	10	150	260
	3840GB	3D TLC	80	10	140	180
	7680GB	3D TLC	80	10	130	170
	15360GB	3D TLC	80	10	120	160
	30720GB	3D TLC	80	10	120	150
X100E	1600GB	3D TLC	80	10	150	120
	3200GB	3D TLC	80	10	140	80
	6400GB	3D TLC	80	10	130	80
	12800GB	3D TLC	80	10	120	80
	25600GB	3D TLC	80	10	120	80

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=8, Jobs=4)	
			Read (us)	Write (us)	Read (us)	Write (us)
X100P	1920GB	3D TLC	90	12	250	330
	3840GB	3D TLC	90	12	220	330
	7680GB	3D TLC	90	12	210	330
	15360GB	3D TLC	90	12	210	320
	30720GB	3D TLC	90	12	170	1000
X100E	1600GB	3D TLC	90	12	250	330
	3200GB	3D TLC	90	12	200	900
	6400GB	3D TLC	90	12	180	900
	12800GB	3D TLC	90	12	170	900
	25600GB	3D TLC	90	12	160	900

NOTES:

- QoS is measured with the following conditions
 - FIO test: 4KB transfer size, QD=1, 8 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.

2. Performance platform:
 - (a) Operating System: Ubuntu 20.04.2 LTS
 - (b) CPU: AMD Ryzen 7 3700X 8-Core Processor
 - (c) Motherboard: Gigabyte Technology Co., Ltd. X570 AORUS MASTER
 - (d) DRAM: DDR4 3200MHz 16GB
3. According to random 4KB QD=1 and 8 workloads, the result of QoS is the maximum round-trip time which is taken for 99%, 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
X100P	1920GB	3504	1
	3840GB	7008	1
	7680GB	14016	1
	15360GB	28032	1
	30720GB	56064	1
X100E	1600GB	8760	3
	3200GB	17520	3
	6400GB	35040	3
	12800GB	70080	3
	25600GB	140160	3

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
1920GB	< 1 sector per 10^{18} bits read
3840GB	
7680GB	
15360GB	
30720GB	
1600GB	
3200GB	
6400GB	
12800GB	
25600GB	

NOTE:

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

2.4.3. MTBF

Table 2-10 MTBF

Capacity	MTBF
1920GB	2.5 million hours
3840GB	
7680GB	
15360GB	
30720GB	
1600GB	
3200GB	
6400GB	
12800GB	
25600GB	

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
	Non-operating	-40°C to 85°C
Relative Humidity	Operating	5% to 95%
	Non-operating	5% to 95%

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 Mechanism

Item	Description
Stage 1 No TMT	To monitor temperature every 1 secs, until flash temperature is over 77 °C. Clock frequency mode 0
Stage 2 TMT1	When flash temp reaches TMT1 (flash 77 °C), the drive will speed down to TMT1 performance (< 2000MB/s).
Stage 3 TMT2	When flash temp reaches TMT2 (flash 81 °C), the drive will speed down to TMT2 performance (< 450MB/s).
Stage 4 TT Stable	Enter TT Dynamic Mechanism (keep TMT1 state 60 sec or TMT2 state 15 sec) Once CTRL (+/- 2) or FLH (+/- 1) temp change: 3% increase or decline of full performance in TMT1 to TMT2 temp range (75~81°C) 3% increase or 9% decline of full performance in TMT2 to Protect temp range (81~85°C)
TMT Protect	When the controller is over 110°C or flash is over 85°C , the drive will be forced to perform at the lowest performance (< 50 MB/s)
TMT Fatal	Perform thermal shutdown process when controller T _J is 120°C.
Resume No TMT	While flash is cooled down to 75°C or below, the performance will be back to full speed.

NOTES:

1. The temperature for TMT is based on T_{case}. (T_{case}: temperate value of on SSD thermal sensor)
2. TMT levels maybe varying by different workloads.

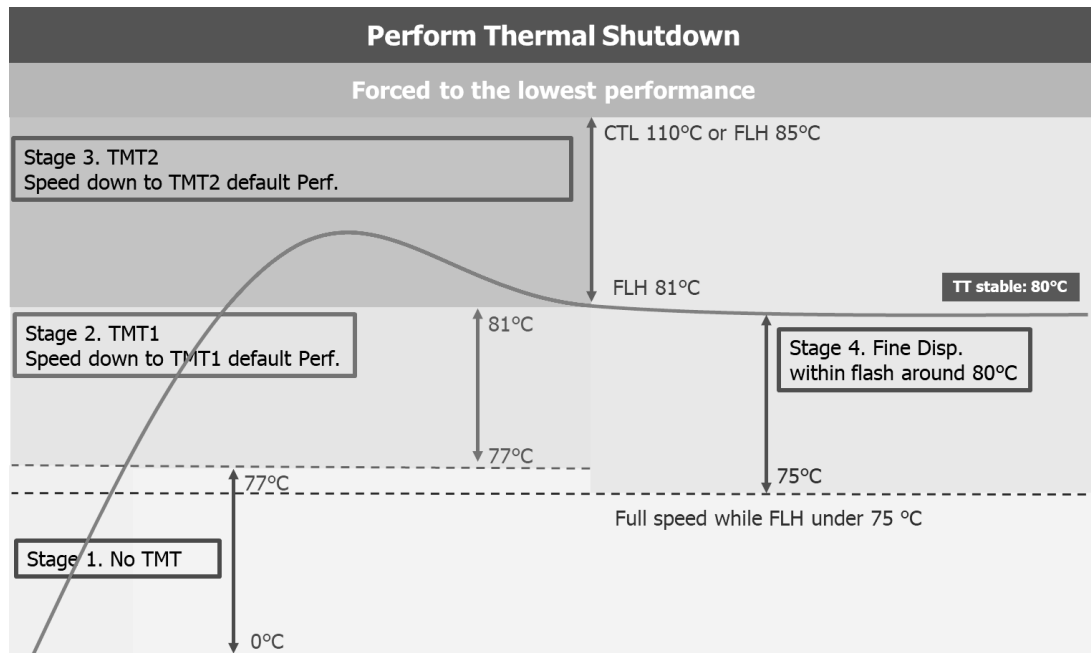


Figure 3-1 Thermal Throttling Mechanism

3.3. Airflow Profile

Figure 3-2 depicts the minimum airflow a X100 U.3 (8TB) SSD needs to operate without triggering thermal throttling at ambient temperatures varied from 35°C to 65°C.

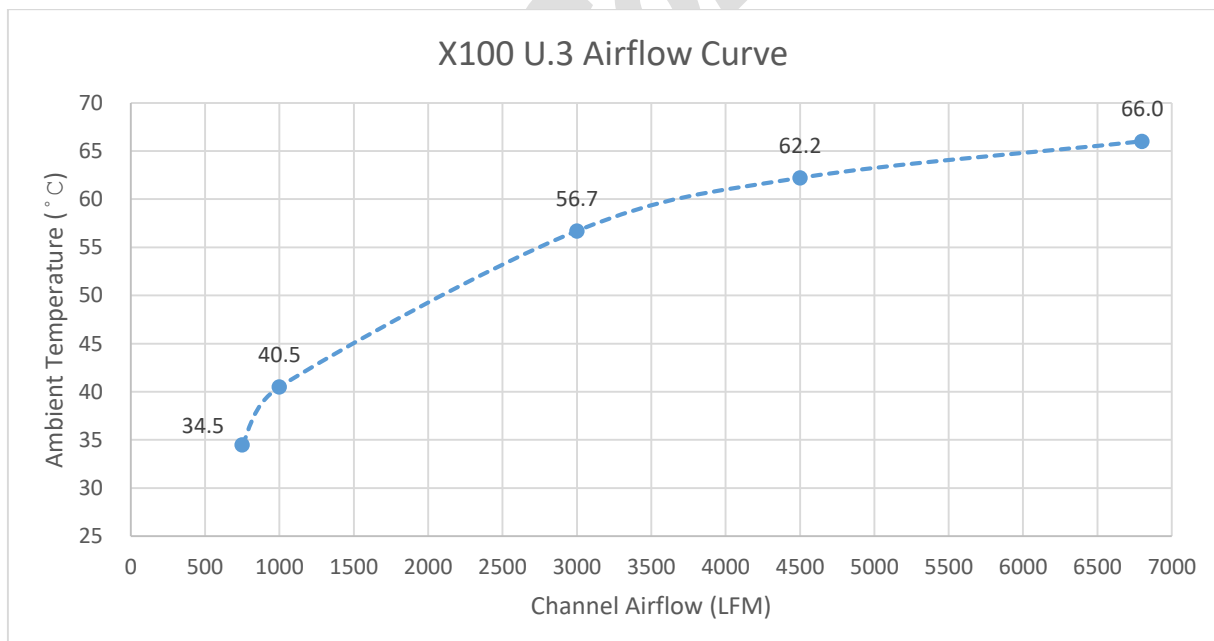


Figure 3-2 X100 U.3 Airflow Curve

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

Table 3-3 Mechanical Test Condition

Shock	Operating	500G, 2ms
		1000G, 0.5ms
	Non-operating	500G, 2ms
		1000G, 0.5ms
Vibration	Operating	2.17 Grms (200 - 2000Hz)
	Non-operating	16.3 Grms (10 - 2000 Hz)
Drop	Non-operating	80cm
Bending	Non-operating	50N

3.5. Altitude

Table 3-4 Altitude

Altitude	Operating	0 to 18,000 feet
	Non-operating	0 to 40,000 feet

3.6. Electrostatic Discharge (ESD)

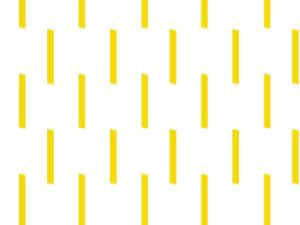
Table 3-5 Electrostatic Discharge (ESD)

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.

3.7. EMI Compliance

Table 3-6 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

12V Operating Voltage	12V, + / - 10%
12V Rise Time (Max/Min)	2ms / 100ms
12V Fall Time (Max/Min)	0.1ms / 5s
12V Noise Level	240mVp-p, 0-20MHz
Min. Off Time ¹ (under 0.1 V)	500ms
3.3Vaux Operating Voltage	3V, + / - 15%
3.3Vaux Rise Time (Max/Min)	2ms / 100ms
3.3Vaux Fall Time (Max/Min)	0.1ms / 5s
3.3Vaux Noise Level	66mVp-p, 0-20MHz

NOTE:

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

4.2. Power Consumption

Table 4-2 X100P Power Consumption

Model Name	X100P				
Capacity	1920GB	3840GB	7680GB	15360GB	30720GB
128K Sequential READ (Average RMS, W)	10	11	12	12	14
128K Sequential WRITE (Average RMS, W)	13	18	19	20	21
4KB Random READ (Average RMS, W)	12	13	15	16	19
4KB Random WRITE (Average RMS, W)	12	15	17	20	21
4KB 70/30 Random READ/WRITE (Average RMS, W)	12	15	17	17	19
Idle (Average RMS, W)	5.4	5.6	5.8	7.3	8.6

Table 4-3 X100E Power Consumption

Model Name	X100E				
Capacity	1600GB	3200GB	6400GB	12800GB	25600GB
128K Sequential READ (Average RMS, W)	10	11	12	13	13
128K Sequential WRITE (Average RMS, W)	13	18	19	21	20
4KB Random READ (Average RMS, W)	13	14	16	16	18
4KB Random WRITE (Average RMS, W)	12	16	18	20	20
4KB 70/30 Random READ/WRITE (Average RMS, W)	12	15	17	17	18
Idle (Average RMS, W)	5.5	5.8	5.9	7.4	8.0

NOTES:

1. Power consumption is measured in average RMS on full speed mode.
2. Performance is measured with the following conditions
 - (a) Power Consumption: 128KB seq. read/write & 4K random read/write for full drive.
 - (b) SSD is unformatted drive.
3. Performance platform:
 - (a) Mother board: MPG Z690
 - (b) CPU: Intel i9-13900
 - (c) DRAM: 32G
 - (d) OS version: Ubuntu 20.04.2 LTS
4. Performance 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.
6. Power consumption is measured in average RMS on full speed mode.
7. Data collection procedure – Average RMS (500ms resolution)
 - (a) Run entire test script one time.
 - (b) Run every condition in this script
 - (c) Calculate average value for every condition then choose Average RMS
 - (d) Note value for every condition
 - (e) 3pcs sample for every capacity.

4.3. Inrush Current

Table 4-4 Inrush Current

Inrush current	1600GB /1920GB	3200GB /3840GB	6400GB /7680GB	12800GB /15360GB	25600GB /30720GB
12V	1.5A				

5. PHYSICAL DIMENSION

5.1. Physical Information

Table 5-1 Physical Dimensions and Weight

Parameter	Unit	1600GB /1920GB	3200GB /3840GB	6400GB /7680GB	12800GB /15360GB	25600GB /30720GB
Length	mm	100.10 ± 0.30		100.10 ± 0.30		
Width	mm	69.85 ± 0.25		69.85 ± 0.25		
Height	mm	14.65 ± 0.25		14.7 ± 0.20		
Weight	g	198	200	203	205	208

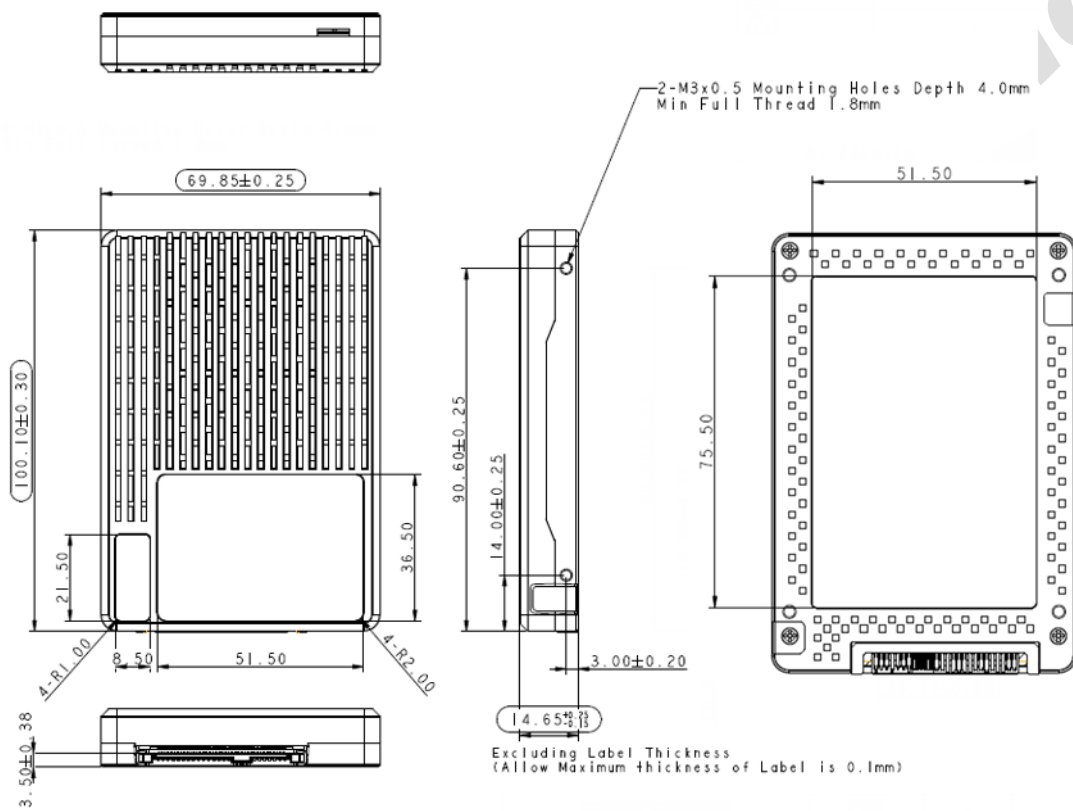


Figure 5-1 U.2 / U.3 2.5-inch 15mm Mechanical information

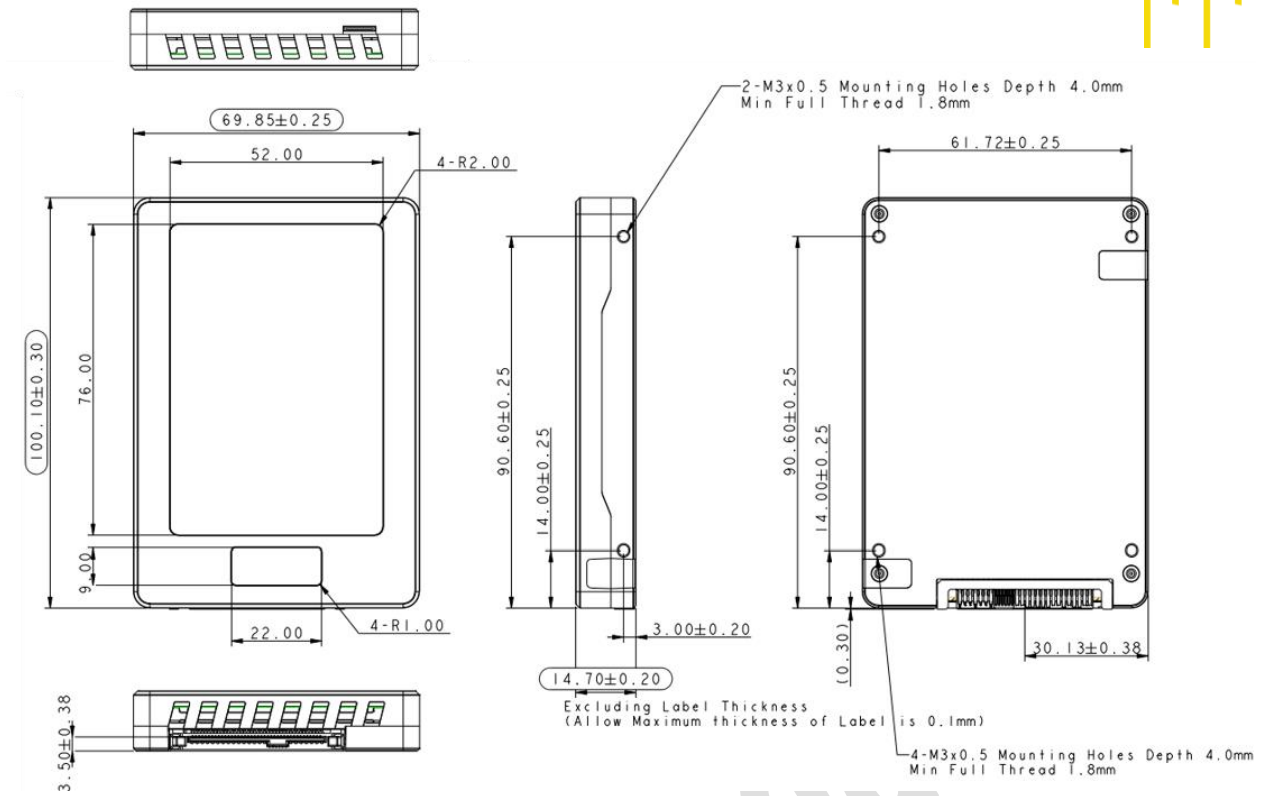


Figure 5-2 U.2 / U.3 pro 2.5-inch 15mm Mechanical information

6. INTERFACE

6.1. PCIe U.3 and U.2 Pin Assignment and Descriptions

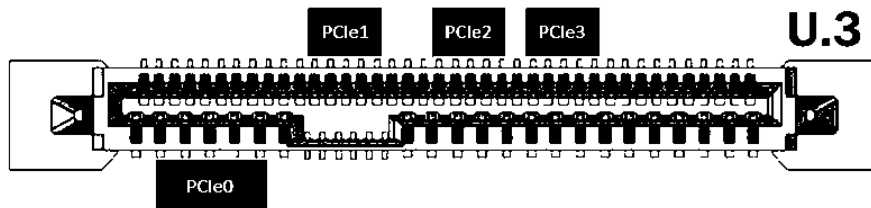


Figure 6-1 X100 U.3 PCIe SSD Pin Assignment

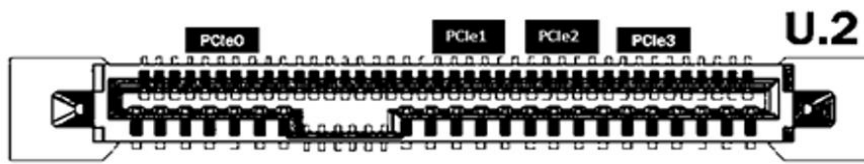


Figure 6-2 X100 U.2 PCIe SSD Pin Assignment

Table 6-1 Pin Assignment and Descriptions

Pin No.	Name	Description
P1	WAKE#	Reserved
P2	Reserved	Reserved
P3	PWRDIS	Power disable
P4	IfDet#	Interface Type Detect
P5	Ground	Ground
P6	Ground	Ground
P7	+5V	Reserved
P8	+5V	Reserved
P9	+5V	Reserved
P10	PRSNT#	Presence detect
P11	Activity#	Activity indicator
P12	Ground	Ground
P13	+12V Precharge	+12V Precharge power
P14	+12V	+12V power
P15	+12V	+12V power
SG1	Ground	Ground
SG2	Ground	Ground
S1	Ground	Ground
S2	U.3 TX p0	Transmitter differential pair, U.3 Lane 0
S3	U.3 TX n0	Transmitter differential pair, U.3 Lane 0
S4	Ground	Ground
S5	U.3 RX n0	Receiver differential pair, U.3 Lane 0
S6	U.3 RX p0	Receiver differential pair, U.3 Lane 0
S7	Ground	Ground
S8	Ground	Ground
S9	U.3 TX p1	Transmitter differential pair, U.3 Lane 1

Pin No.	Name	Description
S10	U.3 TX n1	Transmitter differential pair, U.3 Lane 1
S11	Ground	Ground
S12	U.3 RX n1	Receiver differential pair, U.3 Lane 1
S13	U.3 RX p1	Receiver differential pair, U.3 Lane 1
S14	Ground	Ground
S15	HPT0	Host port type
S16	Ground	Ground
S17	U.3 TX p2/ U.2 TX p1	Transmitter differential pair, U.3 Lane 2, or U.2 Lane 1
S18	U.3 TX n2/ U.2 TX n1	Transmitter differential pair, U.3 Lane 2, or U.2 Lane 1
S19	Ground	Ground
S20	U.3 RX n2/ U.2 RX n1	Receiver differential pair, U.3 Lane 2, or U.2 Lane 1
S21	U.3 RX p2/ U.2 RX p1	Receiver differential pair, U.3 Lane 2, or U.2 Lane 1
S22	Ground	Ground
S23	U.3 TX p3/ U.2 TX p2	Transmitter differential pair, U.3 Lane 3, or U.2 Lane 2
S24	U.3 TX n3/ U.2 TX n2	Transmitter differential pair, U.3 Lane 3, or U.2 Lane 2
S25	Ground	Ground
S26	U.3 RX n3/ U.2 RX n2	Receiver differential pair, U.3 Lane 3, or U.2 Lane 2
S27	U.3 RX p3/ U.2 RX p2	Receiver differential pair, U.3 Lane 3, or U.2 Lane 2
S28	Ground	Ground
E1	REFCLKB+	Reference clock (differential pair) for second X2 port
E2	REFCLKB-	Reference clock (differential pair) for second X2 port
E3	+3.3 Vaux	3.3 V auxiliary power
E4	CLKREQ#/PERSTB#	Clock request/Fundamental reset for second x2 port
E5	PERST#	Fundamental reset (if Dual port mode enabled, first x2 port)
E6	IFDet2#	Interface Type Detect
E7	REFCLK+	Reference clock (if dual-port enabled, first X2 port)
E8	REFCLK-	Reference clock (if dual-port enabled, first X2 port)
E9	Ground	Ground
E10	U.2 TX p0	Transmitter differential pair, U.2 Lane 0
E11	U.2 TX n0	Transmitter differential pair, U.2 Lane 0
E12	Ground	Ground
E13	U.2 RX n0	Receiver differential pair, U.2 Lane 0
E14	U.2 RX p0	Receiver differential pair, U.2 Lane 0
E15	Ground	Ground
E16	HPT1	Host port type
E17	U.2 TX p3	Transmitter differential pair, U.2 Lane 3
E18	U.2 TX n3	Transmitter differential pair, U.2 Lane 3
E19	Ground	Ground
E20	U.2 RX n3	Receiver differential pair, U.2 Lane 3
E21	U.2 RX p3	Receiver differential pair, U.2 Lane 3
E22	Ground	Ground
E23	SMCLK	SMBus (System Management Bus) clock
E24	SMDAT	SMBus (System Management Bus) data
E25	DualPortEn#	Dual-port Enable

7. SUPPORTED COMMANDS

7.1. NVMe Command List

Table 7-1 Admin Command List

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	M	Flush
01h	M	Write
02h	M	Read
04h	O	Write Uncorrectable
05h	O	Compare
08h	O	Write Zeroes
09h	O	Dataset Management (Trim only)
0Ch	O	Verify
0Dh	O	Reservation Register
0Eh	O	Reservation Report
11h	O	Reservation Acquire
15h	O	Reservation Release

Table 7-3 Set Feature Commands

Identifier	O/M	Command Description
01h	M	Arbitration
02h	M	Power Management
04h	M	Temperature Threshold
05h	M	Error Recovery

Identifier	O/M	Command Description
06h	O	Volatile Write Cache
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
0Fh	O	Keep Alive Timer
17h	O	Sanitize Config
7Eh	M	Controller Metadata (NVMe MI)
7Fh	M	Namespace Metadata (NVMe MI)
81h	O	Host Identifier
82h	O	Reservation Notification Mask
83h	O	Reservation Persistence

Table 7-4 Get Log Page Commands

Identifier	O/M	Command Description
01h	M	Error Information
02h	M	SMART / Health Information
03h	M	Firmware Slot Information
04h	O	Changed Namespace List
05h	O	Commands Supported and Effects
06h	O	Device Self-test
07h	O	Telemetry Host-Initiated
08h	O	Telemetry Controller-Initiated
0Dh	O	Persistent Event Log
80h	O	Reservation Notification
81h	O	Sanitize Status

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
FRU Information Device (for NVMe Storage Device)	A6h	1010_011xb
SMBus/I2C Management Endpoint	3Ah	0011_101xb
Basic Management Command	D4h	1101_010xb

7.2. Identify Device Data

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)	TBD
71:64	M	Firmware Revision (FR)	TBD
72	M	Recommended Arbitration Burst (RAB)	0x01
75:73	M	IEEE OUI Identifier (IEEE)	TBD*
76	O	Controller Multi-Path I/O and Namespace Sharing Capabilities (CMIC)	0x03
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)	0x001E8480 (2 Sec)
91:88	M	RTD3 Entry Latency (RTD3E)	0x00989680
95:92	M	Optional Asynchronous Events Supported (OAES)	0x00000300
99:96	M	Controller Attributes (CTRATT)	0x00000000
101:100	O	Read Recovery Levels Supported (RRLS):	0x0000
110:102	-	Reserved	0x00
111	M	Controller Type (CNTRLTYPE)	0x01
127:112	O	FRU Globally Unique Identifier (FGUID):	TBD
129:128	O	Command Retry Delay Time 1 (CRDT1):	0x0000
131:130	O	Command Retry Delay Time 2 (CRDT2):	0x0000
133:132	O	Command Retry Delay Time 3 (CRDT3):	0x0000
239:134		Reserved	
255:240	-	Refer to the NVMe Management Interface Specification for definition	0x00
257:256	M	Optional Admin Command Support (OACS)	0x005F
258	M	Abort Command Limit (ACL)	0x07
259	M	Asynchronous Event Request Limit (AERL)	0x0E
260	M	Firmware Updates (FRMW)	0x1C
261	M	Log Page Attributes (LPA)	0x1E
262	M	Error Log Page Entries (ELPE)	0x3E
263	M	Number of Power States Support (NPSS)	3
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)	0x0157 (70C)
269:268	M	Critical Composite Temperature Threshold (CCTEMP)	0x0161 (80C)
271:270	O	Maximum Time for Firmware Activation (MTFA)	0x0032
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)	**
311:296	O	Unallocated NVM Capacity (UNVMCAP)	**
315:312	O	Replay Protected Memory Block Support (RPMBS)	0x00000000

Bytes	O/M	Description	Default Value
317:316	O	Extended Device Self-test Time (EDSTT)	0x0002
318	O	Device Self-test Options (DSTO)	0x01
319	O	Firmware Update Granularity (FWUG)	0x01
321:320	O	Keep Alive Support (KAS)	0x0000
323:322	O	Host Controlled Thermal Management Attributes (HCTMA)	0x0001
325:324	O	Minimum Thermal Management Temperature (MNTMT)	0x0111
327:326	O	Maximum Thermal Management Temperature (MXTMT)	0x0157
331:328	O	Sanitize Capabilities (SANICAP)	0x60000003
335:332	O	Host Memory Buffer Minimum Descriptor Entry Size (HMMINDS):	0x00000000
337:336	O	Host Memory Maximum Descriptors Entries (HMMAXD):	0x0000
339:338	O	NVM Set Identifier Maximum (NSETIDMAX):	0x0000
341:340	O	Endurance Group Identifier Maximum (ENDGIDMAX):	0x0000
342	O	ANA Transition Time (ANATT):	0x00
343	O	Asymmetric Namespace Access Capabilities (ANACAP):	0x00
347:344	O	ANA Group Identifier Maximum (ANAGRPMAX):	0x00000000
351:348	O	Number of ANA Group Identifiers (NANAGRPID):	0x00000000
355:352	O	Persistent Event Log Size (PELS):	0x63
511:356		Reserved	0x0

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		Maximum Outstanding Commands (MAXCMD)	0x0400 1 port 0x0200 2 port
519:516	M	Number of Namespaces (NN)	0x00000040
521:520	M	Optional NVM Command Support (ONCS)	0x00FF
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)	0x00FF
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)	0x000F0001
543:540	O	Maximum Number of Allowed Namespaces (MNAN):	0x00000000
767:544	M	Reserved	0x00
1023:768	M	NVM Subsystem NVMe Qualified Name (SUBNQN):	TBD

Table 7-9 IO Command Set Attributes

Bytes	O/M	Description	Default Value
2079:2048	M	Power State 0 Descriptor (PSD0)	
Bit[255:184]		Reserved	0x00
Bit[183:182]		Active Power Scale (APS)	0x0
Bit[181:179]		Reserved	0x0
Bit[178:176]		Active Power Workload (APW)	0x0

Bytes	O/M	Description	Default Value
Bit[175:160]		Active Power (ACTP)	0x0
Bit[159:152]		Reserved	0x0
Bit[151:150]		Idle Power Scale (IPS)	0x0
Bit[149:144]		Reserved	0x0
Bit[143:128]		Idle Power (IDL P)	0x0
Bit[127:125]		Reserved	0x0
Bit[124:120]		Relative Write Latency (RWL)	0x0
Bit[119:117]		Reserved	0x0
Bit[116:112]		Relative Write Throughput (RWT)	0x0
Bit[111:109]		Reserved	0x0
Bit[108:104]		Relative Read Latency (RRL)	0x0
Bit[103:101]		Reserved	0x0
Bit[100:96]		Relative Read Throughput (RRT)	0x0
Bit[95:64]		Exit Latency (EXLAT)	0x0
Bit[63:32]		Entry Latency (ENLAT)	0x0
Bit[31:26]		Reserved	0x0
Bit[25]		Non-Operational State (NOPS)	0
Bit[24]		Max Power Scale (MPS)	0
Bit[23:16]		Reserved	0x0
Bit[15:0]		Maximum Power (MP)	0x9C4*
2111:2080	O	Power State 1 Descriptor (PSD1)	
Bit[255:184]		Reserved	0x00
Bit[183:182]		Active Power Scale (APS)	0x0
Bit[181:179]		Reserved	0x0
Bit[178:176]		Active Power Workload (APW)	0x0
Bit[175:160]		Active Power (ACTP)	0x0
Bit[159:152]		Reserved	0x0
Bit[151:150]		Idle Power Scale (IPS)	0x0
Bit[149:144]		Reserved	0x0
Bit[143:128]		Idle Power (IDL P)	0x0
Bit[127:125]		Reserved	0x0
Bit[124:120]		Relative Write Latency (RWL)	0x1
Bit[119:117]		Reserved	0x0
Bit[116:112]		Relative Write Throughput (RWT)	0x1
Bit[111:109]		Reserved	0x0
Bit[108:104]		Relative Read Latency (RRL)	0x1
Bit[103:101]		Reserved	0x0
Bit[100:96]		Relative Read Throughput (RRT)	0x1
Bit[95:64]		Exit Latency (EXLAT)	0x0
Bit[63:32]		Entry Latency (ENLAT)	0x0
Bit[31:26]		Reserved	0x0
Bit[25]		Non-Operational State (NOPS)	0
Bit[24]		Max Power Scale (MPS)	0
Bit[23:16]		Reserved	0x0
Bit[15:0]		Maximum Power (MP)	0xE6

Bytes	O/M	Description	Default Value
2143:2112	O	Power State 2 Descriptor (PSD2)	
Bit[255:184]		Reserved	0x00
Bit[183:182]		Active Power Scale (APS)	0x0
Bit[181:179]		Reserved	0x0
Bit[178:176]		Active Power Workload (APW)	0x0
Bit[175:160]		Active Power (ACTP)	0x0
Bit[159:152]		Reserved	0x0
Bit[151:150]		Idle Power Scale (IPS)	0x0
Bit[149:144]		Reserved	0x0
Bit[143:128]		Idle Power (IDL P)	0x0
Bit[127:125]		Reserved	0x0
Bit[124:120]		Relative Write Latency (RWL)	0x2
Bit[119:117]		Reserved	0x0
Bit[116:112]		Relative Write Throughput (RWT)	0x2
Bit[111:109]		Reserved	0x0
Bit[108:104]		Relative Read Latency (RRL)	0x2
Bit[103:101]		Reserved	0x0
Bit[100:96]		Relative Read Throughput (RRT)	0x2
Bit[95:64]		Exit Latency (EXLAT)	0x0
Bit[63:32]		Entry Latency (ENLAT)	0x0
Bit[31:26]		Reserved	0x0
Bit[25]		Non-Operational State (NOPS)	0
Bit[24]		Max Power Scale (MPS)	0
Bit[23:16]		Reserved	0x0
Bit[15:0]		Maximum Power (MP)	0xB4
2175:2144	O	Power State 3 Descriptor (PSD3)	0x00
Bit[255:184]		Reserved	0x00
Bit[183:182]		Active Power Scale (APS)	0x0
Bit[181:179]		Reserved	0x0
Bit[178:176]		Active Power Workload (APW)	0x0
Bit[175:160]		Active Power (ACTP)	0x0
Bit[159:152]		Reserved	0x0
Bit[151:150]		Idle Power Scale (IPS)	0x0
Bit[149:144]		Reserved	0x0
Bit[143:128]		Idle Power (IDL P)	0x0
Bit[127:125]		Reserved	0x0
Bit[124:120]		Relative Write Latency (RWL)	0x3
Bit[119:117]		Reserved	0x0
Bit[116:112]		Relative Write Throughput (RWT)	0x3
Bit[111:109]		Reserved	0x0
Bit[108:104]		Relative Read Latency (RRL)	0x2
Bit[103:101]		Reserved	0x0
Bit[100:96]		Relative Read Throughput (RRT)	0x2
Bit[95:64]		Exit Latency (EXLAT)	0x0
Bit[63:32]		Entry Latency (ENLAT)	0x0

Bytes	O/M	Description	Default Value
Bit[31:26]		Reserved	0x0
Bit[25]		Non-Operational State (NOPS)	0
Bit[24]		Max Power Scale (MPS)	0
Bit[23:16]		Reserved	0x0
Bit[15:0]		Maximum Power (MP)	0xB4
2207:2176	O	Power State 4 Descriptor (PSD4)	0x00
Bit[255:184]		Reserved	0x00
Bit[183:182]		Active Power Scale (APS)	0x0
Bit[181:179]		Reserved	0x0
Bit[178:176]		Active Power Workload (APW)	0x0
Bit[175:160]		Active Power (ACTP)	0x0
Bit[159:152]		Reserved	0x0
Bit[151:150]		Idle Power Scale (IPS)	0x0
Bit[149:144]		Reserved	0x0
Bit[143:128]		Idle Power (IDL P)	0x0
Bit[127:125]		Reserved	0x0
Bit[124:120]		Relative Write Latency (RWL)	0x4
Bit[119:117]		Reserved	0x0
Bit[116:112]		Relative Write Throughput (RWT)	0x4
Bit[111:109]		Reserved	0x0
Bit[108:104]		Relative Read Latency (RRL)	0x2
Bit[103:101]		Reserved	0x0
Bit[100:96]		Relative Read Throughput (RRT)	0x2
Bit[95:64]		Exit Latency (EXLAT)	0x0
Bit[63:32]		Entry Latency (ENLAT)	0x0
Bit[31:26]		Reserved	0x0
Bit[25]		Non-Operational State (NOPS)	0
Bit[24]		Max Power Scale (MPS)	0
Bit[23:16]		Reserved	0x0
Bit[15:0]		Maximum Power (MP)	0xB4
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
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

Bytes	O/M	Description	Default Value
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
4095:3072	O	Vendor Specific.	0x00

NOTE:

- * Maximum power of X100 production line

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)	TBD*
15:8	M	Namespace Capacity (NCAP)	TBD*
23:16	M	Namespace Utilization (NUSE)	TBD*
24	M	Namespace Features (NSFEAT)	0x1E
25	M	Number of LBA Formats (NLBAF)	0x04
26	M	Formatted LBA Size (FLBAS)	0x00
27	M	Metadata Capabilities (MC)	0x03
28	M	End-to-end Data Protection Capabilities (DPC)	0x1B
29	M	End-to-end Data Protection Type Settings (DPS)	0x00
30	O	Namespace Multi-path I/O and Namespace Sharing Capabilities (NMIC)	0x01
31	O	Reservation Capabilities (RESCAP)	0xAB
32	O	Format Progress Indicator (FPI)	0x00
33	O	Deallocate Logical Block Features (DLFEAT):	0x19
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	O	Namespace Optimal I/O Boundary (NOIOB):	0x0000
63:48	O	NVM Capacity (NVMCAP)	TBD*

Bytes	O/M	Description	Default Value
65:64	O	Namespace Preferred Write Granularity (NPWG):	0x0000
67:66	O	Namespace Preferred Write Alignment (NPWA):	0x0000
69:68	O	Namespace Preferred Deallocate Granularity (NPDG):	0x0000
71:70	O	Namespace Preferred Deallocate Alignment (NPDA):	0x0000
73:72	O	Namespace Optimal Write Size (NOWS):	0x0000
91:74	-	Reserved	0x00
95:92	O	ANA Group Identifier (ANAGRPID):	0x00000000
98:96	-	Reserved	
99	O	Namespace Attributes (NSATTR):	0x00
101:100	O	NVM Set Identifier (NVMSETID):	0x0000
103:102	O	Endurance Group Identifier (NEDGID)	0x0000
119:104	O	Namespace Globally Unique Identifier (NGUID)	TBD**
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)	0x00000000
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
383:192		Reserved	0x00
4095:384	O	Vendor Specific (VS)	0x00

NOTES:

1. *According to IDEMA SPEC
2. ** According to 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)
1600	BA4D4AB0	1,600,321,314,816
1920	DF8FE2B0	1,920,383,410,176
3200	1749A42B0	3,200,631,791,616
3840	1BF1F72B0	3,840,755,982,336
6400	5D268656000	6,401,252,745,216
7680	6FC7D256000	7,681,501,126,656
12800	BA4D0256000	12,802,494,652,416
15360	DF8F9A56000	15,362,991,415,296
25600	17499FA56000	25,604,978,466,816
30720	1BF1F2A56000	30,725,971,992,576

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)
[219:216]	4	Thermal Management Temperature 1 Transition Count
[223:220]	4	Thermal Management Temperature 2 Transition Count
[227:224]	4	Total Time For Thermal Management Temperature 1 (seconds)
[231:228]	4	Total Time For Thermal Management Temperature 2 (seconds)
[511:232]	280	Reserved

Table 7-14 SMART Attributes (Log Identifier C0h)

Bytes Index	Bytes	Description
[15:0]	16	Physical Media Units Written
[31:16]	16	Physical Media Units Read
[39:32]	8	Bad User NAND Blocks
[47:40]	8	Bad System NAND Blocks
[55:48]	8	XOR Recovery Count
[63:56]	8	Uncorrectable Read Error Count
[71:64]	8	Soft ECC Error Count
[79:72]	8	End to End Correction Counts
[80]	1	System Data % Used
[87:81]	7	Refresh Counts
[95:88]	8	User Data Erase Counts

[97:96]	2	Thermal Throttling Status and Count
[103:98]	6	DSSD Specification Version
[111:104]	8	PCIe Correctable Error Count
[115:112]	4	Incomplete Shutdowns
[119:116]	4	Reserved
[120]	1	% Free Blocks
[127:121]	7	Reserved
[129:128]	2	Capacitor Health
[135:130]	6	Reserved
[143:136]	8	Unaligned I/O
[151:144]	8	Security Version Number
[159:152]	8	Total NUSE
[175:160]	16	PLP Start Count
[191:176]	16	Endurance Estimate
[199:192]	8	PCIe Link Retraining Count
[493:200]	294	Reserved
[495:494]	2	Log Page Version
[511:496]	16	Log Page GUID

8. VITAL PRODUCT DATA

X100 U.2/U.3 devices can support Read and Write to Vital Product Data (VPD). Please refer to Figure 8-1 for details on VPD Data Structure. VPD contains:

- Basic inventory information such as type and size of Enterprise PCIe SSD, manufacture, date, revision, and GUID.
- Power management data such as power level and power modes.
- Vendor specific data.

VPD is stored in a SMBus device with a slave address of 0xA6. VPD page can be read via SMBUS through address 0x53. Writes to the VPD page uses 0x53.

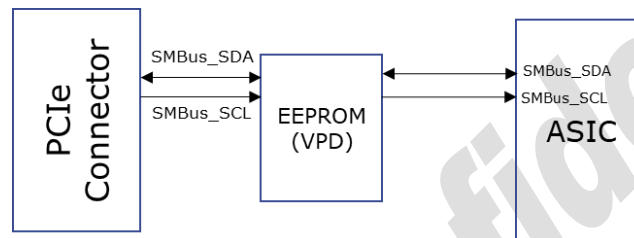
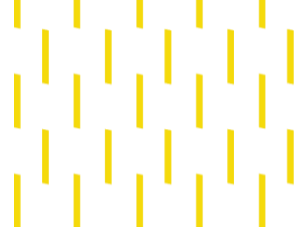


Figure 8-1 X100 U.3 PCIe SSD Controller Block Diagram



9. PRODUCT COMPLIANCE

Table 9-1 Product Regulatory Compliance and Certifications

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

PHISON Confidential

10. 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).

Disclaimer

NOTWITHSTANDING ANYTHING ELSE SET FORTH HEREIN, AND TO THE EXTENT NOT PROHIBITED BY APPLICABLE LAW, PHISON SHALL NOT BE LIABLE WITH RESPECT TO PRODUCTS UNDER ANY CONTRACT, NEGLIGENCE, STRICT LIABILITY OR OTHER LEGAL OR EQUITABLE THEORY FOR ANY LOST DATA, LOST REVENUES, LOST SAVINGS, LOST PROFITS OR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES ARISING FROM THE PURCHASE OR USE OF OR INABILITY TO USE PHISON PRODUCTS, EVEN IF PHISON HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

UNLESS OTHERWISE AGREED TO BY PHISON IN WRITING, PHISON DOES NOT RECOMMEND NOR WARRANT PRODUCTS FOR USE IN LIFE SUPPORT, NUCLEAR, MEDICAL, MILITARY, TRANSPORTATION, AUTOMOTIVE (UNLESS OTHERWISE DEFINED BY PHISON AS "AUTOMOTIVE GRADE PRODUCT"), AVIATION, AEROSPACE INDUSTRY OR OTHER APPLICATIONS WHEREIN A FAILURE OR DEFECT OF THE PHISON PRODUCT MIGHT THREATEN LIFE, INJURY, HEALTH OR LOSS OF SIGNIFICANT AMOUNT OF MONEY ("CRITICAL USE"), AND BUYER AND USER HEREBY ASSUME ALL RISK OF ANY CRITICAL USE OF PRODUCT.

11. REFERENCE

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

Table 11-1 List of References

Title	Source
PCI Express Base 4.0	https://www.pcisig.com/specifications/pciexpress/base3/
NVM Express 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
PCIe Express SFF-8639 Module Specification Revision 4.0, Version1.0, SFF-TA-1001 r1.1	https://www.snia.org/technology-communities/sff/specifications