U.2 PCIe SSD EU-2 DWPD 1 Datasheet

(SQF-CU2xxDxxxxDU2C)

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Revision History

Rev.	Date	History
0.1	2024/6/11	1. Preliminary release
0.2	2024/9/13	1. Update block diagram
0.3	2024/10/17	1. Correct description

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Safety Instructions

1. Read these safety instructions carefully.
2. Keep this User Manual for later reference.
3. Disconnect this equipment from any AC outlet before cleaning. Use a damp cloth. Do not use liquid or spray detergents for cleaning.
4. For plug-in equipment, the power outlet socket must be located near the equipment and must be easily accessible.
5. Keep this equipment away from humidity.
6. Put this equipment on a reliable surface during installation. Dropping it or letting it fall may cause damage.
7. The openings on the enclosure are for air convection. Protect the equipment from overheating. DO NOT COVER THE OPENINGS.
8. Make sure the voltage of the power source is correct before connecting the equipment to the power outlet.
9. Position the power cord so that people cannot step on it. Do not place anything over the power cord.
10. All cautions and warnings on the equipment should be noted.
11. If the equipment is not used for a long time, disconnect it from the power source to avoid damage by transient overvoltage.
12. Never pour any liquid into an opening. This may cause fire or electrical shock.
13. Never open the equipment. For safety reasons, the equipment should be opened only by qualified service personnel.
14. If one of the following situations arises, get the equipment checked by service personnel:
    - The power cord or plug is damaged.
    - Liquid has penetrated the equipment.
    - The equipment has been exposed to moisture.
    - The equipment does not work well, or you cannot get it to work according to the user's manual.
    - The equipment has been dropped and damaged.
    - The equipment has obvious signs of breakage.
15. DO NOT LEAVE THIS EQUIPMENT IN AN ENVIRONMENT WHERE THE STORAGE TEMPERATURE MAY GO BELOW -20° C (-4° F) OR ABOVE 60° C (140° F). THIS COULD DAMAGE THE EQUIPMENT. THE EQUIPMENT SHOULD BE IN A CONTROLLED ENVIRONMENT.
16. CAUTION: DANGER OF EXPLOSION IF BATTERY IS INCORRECTLY REPLACED. REPLACE ONLY WITH THE SAME OR EQUIVALENT TYPE RECOMMENDED BY THE MANUFACTURER, DISCARD USED BATTERIES ACCORDING TO THE MANUFACTURER'S INSTRUCTIONS.

Consignes de sécurité

1. Lisez attentivement ces instructions de sécurité.
2. Conservez ce manuel pour référence ultérieure.
3. Débranchez cet appareil de toute prise secteur avant le nettoyage. Utilisez un chiffon humide. Ne pas utiliser de détergents liquides ou en aérosol pour le nettoyage
4. Pour les équipements enfichables, la prise de courant doit être située près de l'équipement et doit être facilement accessible.
5. Gardez cet équipement à l’abri de l’humidité.
6. Placez cet équipement sur une surface fiable lors de l'installation. Le laisser tomber ou le laisser tomber peut causer des dommages.
7. Les ouvertures sur l'enceinte sont destinées à la convection de l'air. Protégez l'équipement de la surchauffe. NE COUVREZ PAS LES OUVERTURES.
8. Assurez-vous que la tension de la source d'alimentation est correcte avant de connecter l'équipement à la prise de courant.
9. Positionnez le cordon d’alimentation de sorte que personne ne puisse marcher dessus. Ne placez rien sur le cordon d'alimentation.
10. Toutes les mises en garde et avertissements sur l'équipement doivent être notés..
11. Si l’appareil n’est pas utilisé pendant une longue période, débranchez-le de la source d’alimentation pour éviter tout dommage dû à une surtension transitoire.
12. Ne jamais verser de liquide dans une ouverture. Cela pourrait provoquer un incendie ou un choc électrique.
13. N'ouvrez jamais l'équipement. Pour des raisons de sécurité, l’équipement ne doit être ouvert que par du personnel qualifié.
14. Si l’une des situations suivantes se produit, faites vérifier l’équipement par le personnel de service:l:
    - Le cordon d'alimentation ou la fiche est endommagé Liquid has penetrated the equipment.
    - L'équipement a été exposé à l'humidité.
    - L'équipement ne fonctionne pas bien ou vous ne pouvez pas le faire fonctionner conformément au manuel d'utilisation..
    - L'équipement est tombé et endommagé..
    - L'équipement présente des signes évidents de rupture.
15. NE PAS LAISSER CET APPAREIL DANS UN ENVIRONNEMENT O LA TEMPÉRATURE DE STOCKAGE PEUT ÊTRE INFÉRIEURE À -20 ° C (-4 ° F) OU SUPÉRIEURE À 60 ° C (140 ° F). CELA POURRAIT ENDOMMAGER L'ÉQUIPEMENT. L’ÉQUIPEMENT DOIT ÊTRE DANS UN ENVIRONNEMENT CONTRÔLÉ.
16. ATTENTION: DANGER D'EXPLOSION EN CAS DE REMPLACEMENT INCORRECT DE LA PILE. REMPLACEZ UNIQUEMENT AVEC LE MÊME TYPE OU LE TYPE ÉQUIVALENT RECOMMANDÉ PAR LE FABRICANT, DÉJETTEZ LES PILES UTILISÉES SELON LES INSTRUCTIONS DU FABRICANT.

1. Overview

Advantech SQFlash EU-2 series U.2 PCIe SSD (Solid State Drive) delivers all the advantages of flash disk technology with PCIe Gen.5 x4 interface, including being fully compliant with standard U.2 form factor, providing low power consumption compared to traditional hard drive and hot-swapping when removing/replacing/upgrading flash disks. EU-2 series U.2 offers a wide range of capacities up to 30.7TB and its performance can reach up to 14000 MB/s (for sequential read) and 8500 MB/s (for sequential write) based on TLC NAND flash with the DDR4. Moreover, the power consumption of EU-2 series U.2 15mm SSD is much lower than traditional hard drives, making it the best embedded solution for new platforms.

2. Features

- **PCIe Interface**
  - PCIe Express Base 5.0
  - NVMe Express 2.0
  - PCIe Gen.5 x4 lanes & backward compatible to PCIe Gen 4, Gen 3, Gen 2 and Gen 1 Device Capacity
  - PCIe Express SFF-8639 Module Specification Revision 4.0, Version1.0
- **Operating Voltage：12.0V**
- **Support fourth LDPC generation of ECC algorithm**
- **AES256、TCG-OPAL、TRIM supported**
- **Temperature Ranges[1]**
  - Commercial Temperature
    - 0℃ to 70℃ for operating
    - -40℃ to 85℃ for storage

  *Note : 1. Based on SMART Attribute (Byte index [2 :1] of PCIe-SIG standard, which measured by thermal sensor
- **Mechanical Specification (Operating)**
  - Shock：500G / 2ms ; 1000G / 0.5ms
  - Vibration：2.17G / 7~800Hz
- **Humidty**
  - Humidity：up to 95% on 40℃
- **MTBF : 2.5 million hours**
- **Acquired RoHS、WHQL、CE、FCC Certificate**
- **Acoustic：0 dB**
- **Dimension (w/ heatsink)：100.0 mm x 70 mm x 15 mm**

3. Specification Table

■ Sustained Performance

		Sequential 128KB (QD=32, Workers=1) (MB/sec)		4K Sustained Random (QD=64, Workers=8) (IOPS)	
		Read	Write	Read	Write
3D TLC (V7)	1920 GB	14,000	4,200	2,200K	155K
	3840 GB	14,000	8,500	3,050K	350K
	7680 GB	14,000	8,500	3,050K	400K
	15360 GB	14,000	8,400	2,750K	440K
	30720 GB	14,000	7,500	2,300K	283K

NOTES:

1. Performance was estimated based on TLC NAND flash.
2. Performance may differ according to flash configuration and platform.
3. The tables are for reference only. Any criteria for accepting goods shall be further discussed based on different flash configurations.

■ Latency

		4K Sustained Random (QD=1, Workers=1)		4K Sustained Random (QD=4, Workers=8)		4K Sustained Random (QD=64, Workers=8)	
		Read (us)	Write (us)	Read (us)	Write (us)	Read (us)	Write (us)
3D TLC (V7)	1920 GB	60	10	85	250	260	4000
	3840 GB	60	10	85	160	190	2000
	7680 GB	60	10	85	160	190	1500
	15360 GB	60	10	85	100	220	1200
	30720 GB	65	10	85	130	250	2000

NOTES:

1. Performance was estimated based on TLC NAND flash.
2. Performance may differ according to flash configuration and platform.
3. The tables are for reference only. Any criteria for accepting goods shall be further discussed based on different flash configurations.

■ Quality of Service (High Performance, QoS=99%, 4KB sustained)

		QD=1, Workers=1		QD=4, Workers=8		QD=64, Workers=8	
		Read (4KB)	Write (4KB)	Read (4KB)	Write (4KB)	Read (4KB)	Write (4KB)
3D TLC (V7)	1920 GB	80	12	140	250	1000	4000
	3840 GB	80	12	130	160	650	1250
	7680 GB	80	12	120	160	650	1500
	15360 GB	80	12	120	100	900	1200
	30720 GB	80	12	120	130	1200	2000

Endurance

JEDEC defined an endurance rating TBW (TeraByte Written), following by the equation below, for indicating the number of terabytes a SSD can be written which is a measurement of SSDs' expected lifespan, represents the amount of data written to the device.

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

- **NAND Endurance**: Program / Erase cycle of a NAND flash.
  - 3D TLC (V7): 10,000 cycles
- **SSD Capacity**: SSD physical capacity in total of a SSD.
- **WAF**: Write Amplification Factor (WAF), as the equation shown below, is a numerical value representing the ratio between the amount of data that a SSD controller needs to write and the amount of data that the host's flash controller writes. A better WAF, which is near to 1, guarantees better endurance and lower frequency of data written to flash memory.

WAF = (Lifetime write to flash) / (Lifetime write to host)

- **Endurance measurement is based on JESD218 Test method and JESD219A Workload, tested by ULINK**

3D TLC (V7)	Enterprise workload	DWPD
1920 GB	3,504	1
3840 GB	7,008	1
7680 GB	14,016	1
15360 GB	28,032	1
30720 GB	56,064	1

Note.

1. Sequential: Mainly sequential write are estimated by PassMark Burnin Test v8.1 pro.

2. Client: Follow JESD218 Test method and JESD219A Workload, tested by ULINK. (The capacity lower than 64GB client workload is not specified in JEDEC219A, the values are estimated.)

3. Based on out-of-box performance.

4. Current TBW Values are for reference only. Actual figures will be released after MP.

Mean Time Between Failures

Mean Time Between Failures (MTBF) is demonstrated through a 2,000-hour Reliability Demonstration Test.

Description	Value
Mean Time Between Failures	2.5 milion hours

4. General Description

Error Detection and Correction

Flash memory cells will deteriorate with use, which might generate random bit errors in the stored data. Thus, SQF-CU2 PCIe SSD applies the 500bit/4KB LDPC (Low Density Parity Check) of ECC algorithm, which can detect and correct errors occur during read process, ensure data been read correctly, as well as protect data from corruption

Wear Leveling

NAND flash devices can only undergo a limited number of program/erase cycles, and in most cases, the flash media are not used evenly. If some areas get updated more frequently than others, the lifetime of the device would be reduced significantly. Thus, Wear Leveling is applied to extend the lifespan of NAND Flash by evenly distributing write and erase cycles across the media.

SQFlash provides advanced Wear Leveling algorithm, which can efficiently spread out the flash usage through the whole flash media area. Moreover, by implementing both dynamic and static Wear Leveling algorithms, the life expectancy of the NAND flash is greatly improved.

Bad Block Management

Bad blocks are blocks that include one or more invalid bits, and their reliability is not guaranteed. Blocks that are identified and marked as bad by the manufacturer are referred to as “Initial Bad Blocks”. Bad blocks that are developed during the lifespan of the flash are named “Later Bad Blocks”. SQFlash implements an efficient bad block management algorithm to detect the factory-produced bad blocks and manages any bad blocks that appear with use. This practice further prevents data being stored into bad blocks and improves the data reliability.

Garbage Collection / TRIM

Garbage collection and TRIM technology is used to maintain data consistency and perform continual data cleansing on SSDs. It runs as a background process, freeing up valuable controller resources while sorting good data into available blocks, and deleting bad blocks. It also significantly reduces write operations to the drive, thereby increasing the SSD’s speed and lifespan.

SMART

SMART, an acronym for Self-Monitoring, Analysis and Reporting Technology, is an open standard that allows a hard disk drive to automatically detect its health and report potential failures. When a failure is recorded by SMART, users can choose to replace the drive to prevent unexpected outage or data loss. Moreover, SMART can inform users of impending failures while there is still time to perform proactive actions, such as copy data to another device.

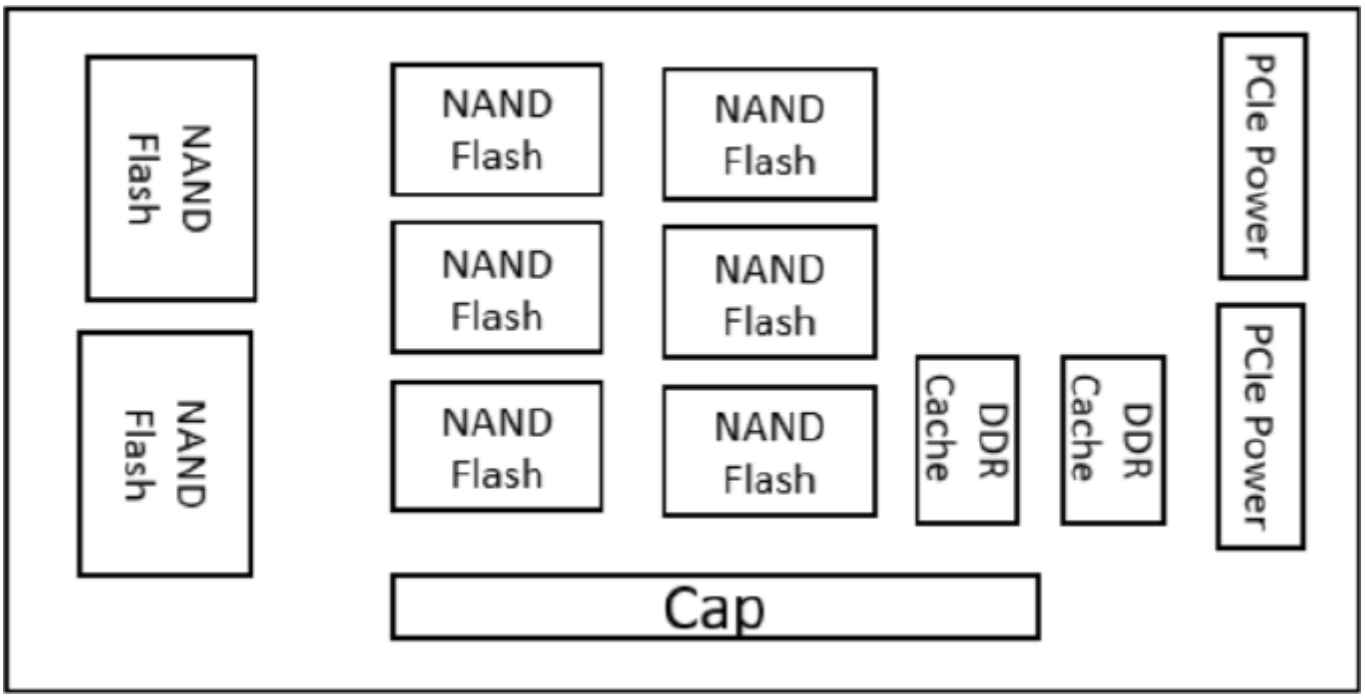
Over-Provision

Over Provisioning refers to the inclusion of extra NAND capacity in a SSD, which is not visible and cannot be used by users. With Over Provisioning, the performance and IOPS (Input/Output Operations per Second) are improved by providing the controller additional space to manage P/E cycles, which enhances the reliability and endurance as well. Moreover, the write amplification of the SSD becomes lower when the controller writes data to the flash.

Thermal Throttling

Thermal Throttling function is for protecting the drive and reducing the possibility of read / write error due to overheat. The temperature is monitored by the thermal sensor. As the operating temperature continues to increase to threshold temperature, the Thermal Throttling mechanism is activated. At this time, the performance of the drive will be significantly decreased to avoid continuous heating. When the operating temperature falls below threshold temperature, the drive can resume to normal operation.

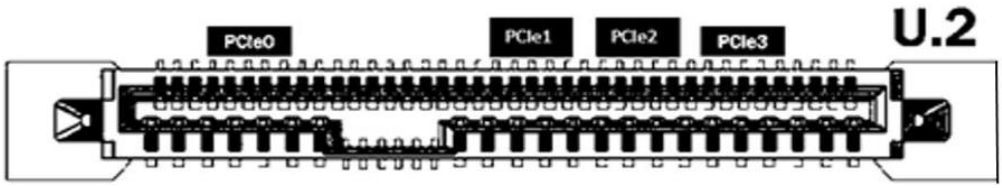
■ Block Diagram



■ LBA value

Density (GB)	LBA
1920 GB	3,750,748,848
3840 GB	7,501,476,528
7680 GB	15,002,931,888
15360 GB	30,005,842,608
30720 GB	60,011,664,048

5. PCIe U.2 Pin Assignment and Description



Pin Number	Name	Type	Description
Power Segment			
P1	WAKE#	Input	Reserved
P2	Reserved	Reserved	Reserved
P3	PWRDIS	Output	Power disable
P4	IfDet#	Input	Interface Type Detect
P5	Ground	Ground	Ground
P6	Ground	Ground	Ground
P7	+5V	Power	NC
P8	+5V	Power	NC
P9	+5V	Power	NC
P10	PRSNT#	Input	Presence detect
P11	Activity#	Input	Activity indicator
P12	Ground	Ground	Ground
P13	+12V Precharge	Power	+12V Precharge power
P14	+12V	Power	+12V for SFF-8639 power
P15	+12V	Power	+12V for SFF-8639 power
SG1	Ground	Ground	Ground
SG2	Ground	Ground	Ground
S1	Ground	Ground	Ground
S2	NC	NC	NC
S3	NC	NC	NC
S4	Ground	Ground	Ground
S5	NC	NC	NC
S6	NC	NC	NC
S7	Ground	Ground	Ground
S8	Ground	Ground	Ground
S9	NC	NC	NC
S10	NC	NC	NC
S11	Ground	Ground	Ground
S12	NC	NC	NC
S13	NC	NC	NC
S14	Ground	Ground	Ground
S15	HPT0	Output	Host port type-0
S16	Ground	Ground	Ground
S17	U.2 TX p1	Diff-Pair	Transmitter differential pair, U.2 Lane 1
S18	U.2 TX n1	Diff-Pair	Transmitter differential pair, U.2 Lane 1
S19	Ground	Ground	Ground
S20	U.2 RX n1	Diff-Pair	Receiver differential pair, U.2 Lane 1

S21	U.2 RX p1	Diff-Pair	Receiver differential pair, U.2 Lane 1
S22	Ground	Ground	Ground
S23	U.2 TX p2	Diff-Pair	Transmitter differential pair, or U.2 Lane 2
S24	U.2 TX n2	Diff-Pair	Transmitter differential pair, or U.2 Lane 2
S25	Ground	Ground	Ground
S26	U.2 RX n2	Diff-Pair	Receiver differential pair, U.2 Lane 2
S27	U.2 RX p2	Diff-Pair	Receiver differential pair, U.2 Lane 2
S28	Ground	Ground	Ground
E1	REFCLKB+	Diff-Pair	Reference clock (differential pair) for second X2 port
E2	REFCLKB-	Diff-Pair	Reference clock (differential pair) for second X2 port
E3	+3.3 Vaux	Power	3.3 V auxiliary power
E4	CLKREQ#/PERSTB#	Bi-dir	Clock request/Fundamental reset for second x2 port
E5	PERST#	Output	Fundamental reset (if Single Port mode enabled, first x2 port)
E6	IFDet2#	Input	Interface Type Detect
E7	REFCLK+	Diff-Pair	Reference clock (if dual-port enabled, first X2 port)
E8	REFCLK-	Diff-Pair	Reference clock (if dual-port enabled, first X2 port)
E9	Ground	Ground	Ground
E10	U.2 TX p0	Diff-Pair	Transmitter differential pair, U.2 Lane 0
E11	U.2 TX n0	Diff-Pair	Transmitter differential pair, U.2 Lane 0
E12	Ground	Diff-Pair	Ground
E13	U.2 RX n0	Diff-Pair	Receiver differential pair, U.2 Lane 0
E14	U.2 RX p0	Diff-Pair	Receiver differential pair, U.2 Lane 0
E15	Ground	Ground	Ground
E16	HPT1	Output	Host port type
E17	U.2 TX p3	Diff-Pair	Transmitter differential pair, U.2 Lane 3
E18	U.2 TX n3	Diff-Pair	Transmitter differential pair, U.2 Lane 3
E19	Ground	Ground	Ground
E20	U.2 RX n3	Diff-Pair	Receiver differential pair, U.2 Lane 3
E21	U.2 RX p3	Diff-Pair	Receiver differential pair, U.2 Lane 3
E22	Ground	Ground	Ground
E23	SMCLK	Bi-Dir	SMBus (System Management Bus) clock
E24	SMDAT	Bi-Dir	SMBus (System Management Bus) data
E25	DualPortEn#	Output	Dual-port Enable

6. NVMe Command List

Admin Commands

Identifier	O/M	Supported	Command Description
00h	M	Y	Delete I/O Submission Queue
01h	M	Y	Create I/O Submission Queue
02h	M	Y	Get Log Page
04h	M	Y	Delete I/O Completion Queue
05h	M	Y	Create I/O Completion Queue
06h	M	Y	Identify
08h	M	Y	Abort
09h	M	Y	Set Feature
0Ah	M	Y	Get Feature
0Ch	M	Y	Asynchronous Event Request
0Dh	O	Y	Namespace Management
10h	O	Y	Firmware Commit
11h	O	Y	Firmware Image Download
14h	O	Y	Device Self-test
15h	O	Y	Namespace Attachment
18h	O	-	Keep Alive
19h	O	-	Directive Send
1Ah	O	-	Directive Receive
1Ch	O	-	Virtualization Management
1Dh	O	Y	NVMe-MI Send
1Eh	O	Y	NVMe-MI Receive
7Ch	O	-	Doorbell Buffer Config
80h	O	Y	Format NVM
81h	O	Y	Security Send
82h	O	Y	Security Receive
84h	O	Y	Sanitize
86h	O	-	Get LBA Status

I/O Commands

Identifier	O/M	Supported	Command Description
00h	M	Y	Flush
01h	M	Y	Write
02h	M	Y	Read
04h	O	Y	Write Uncorrectable
05h	O	Y	Compare
08h	O	Y	Write Zeroes
09h	O	Y	Dataset Management (Trim only)
0Ch	O	Y	Verify

0Dh	O	Y	Reservation Register
0Eh	O	Y	Reservation Report
11h	O	Y	Reservation Acquire
15h	O	Y	Reservation Release

Set Feature Commands

Identifier	O/M	Supported	Command Description
00h	-	-	Reserved
01h	M	Y	Arbitration
02h	M	Y	Power Management
03h	O	-	LBA Range Type
04h	M	Y	Temperature Threshold
05h	M	Y	Error Recovery
06h	O	-	Volatile Write Cache
07h	M	Y	Number Of Queues
08h	M	Y	Interrupt Coalescing
09h	M	Y	Interrupt Vector Configuration
0Ah	M	Y	Write Atomicity Normal
0Bh	M	Y	Asynchronous Event Configuration
0Ch	O	-	Autonomous Power State Transition
0Dh	O	-	Host Memory Buffer
0Eh	O	Y	Timestamp
0Fh	O	-	Keep Alive Timer
10h	O	Y	Host Controlled Thermal Management
11h	O	-	Non-Operational Power State Config
12h	O	-	Read Recovery Level Config
13h	O	-	Predictable Latency Mode Config
14h	O	-	Predictable Latency Mode Window
15h	O	-	LBA Status Information Attributes
16h	O	-	Host Behavior Support
17h	O	Y	Sanitize Config
18h	O	Y	Endurance Group Event Configuration
19h - 77h	-	-	Reserved (NVMe Reserved)
78h – 7Dh	-	-	Reserved(NVMe MI Reserved)
7Eh	M	Y	Controller Metadata (NVMe MI)
7Fh	M	Y	Namespace Metadata (NVMe MI)
80h	O	-	Software Progress Marker
81h	O	Y	Host Identifier
82h	O	Y	Reservation Notification Mask
83h	O	Y	Reservation Persistence
84h	O	-	Namespace Write Protection Config

85h - BFh	-	-	Command Set Specific (Reserved)
C0h - FFh	O	-	Vendor Specific

Get Log Page Commands

Identifier	O/M	Supported	Command Description
00h	O	Y	Supported Log Page
01h	M	Y	Error Information
02h	M	Y	SMART / Health Information
03h	M	Y	Firmware Slot Information
04h	O	Y	Changed Namespace List
05h	O	Y	Commands Supported and Effects
06h	O	Y	Device Self-test
07h	O	Y	Telemetry Host-Initiated
08h	O	Y	Telemetry Controller-Initiated
09h	O	Y	Endurance Group Information
0Ah	O	-	Predictable Latency Per NVM Set
0Bh	O	-	Predictable Latency Event Aggregate
0Ch	O	-	Asymmetric Namespace Access
0Dh	O	Y	Persistent Event Log
0Eh	O	-	LBA Status Information
0Fh	O	Y	Endurance Group Event Aggregate
10h	O	-	Media Unit Status
11h	O	-	Supported Capacity Configuration List
12h	O	Y	Feature Identifiers Supported and Effects
13h	O	Y	NVMe-MI Commands Supported and Effects
14h	O	Y	Command and Feature Lockdown
15h	O	-	Boot Partition
16h	O	-	Rotational Media Information
17h - 6Fh	-	-	Reserved
70h	O	-	Discovery
71h - 7Fh	-	-	Reserved
80h	O	Y	Reservation Notification
81h	O	Y	Sanitize Status
82h - FFh	-	-	Reserved

NVMe Management Interface Commands

Identifier	O/M	Supported	Command Description
00h	M	Y	Read NVMe-MI Data Structure
01h	M	Y	NVM Subsystem Health Status Poll
02h	M	Y	Controller Health Status Poll
03h	M	Y	Configuration Set
04h	M	Y	Configuration Get
05h	M	Y	VPD Read
06h	M	Y	VPD Write
07h	M	Y	Reset
08h	-	-	SES Receive
09h	-	-	SES Send
0Ah	O	-	Management Endpoint Buffer Read
0Bh	O	-	Management Endpoint Buffer Write
0Ch	O	-	Shutdown
0Dh - BFh	O	-	Reserved
C0h - FFh	O	-	Vendor Specific

1. “Y” means “Support”.
2. “O” means “Option, default No support”.
3. “-” means “No support”.

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. SMART Atrributes

(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

(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
[130]	1	NVMe Errata Version
[135:131]	5	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
[207:200]	8	Power State Change Count
[493:208]	28	Reserved
[495:494]	2	Log Page Version
[511:496]	16	Log Page GUID

(Log Identifier D2h)

Bytes Index	Bytes	Description
[7:0]	8	Device Capacity
[15:8]	8	User Capacity
[23:16]	8	NAND Read
[31:24]	8	NAND Write
[39:32]	8	NAND Erase Sector
[47:40]	8	SSD Life Remaining Percent D3
[55:48]	8	SSD Life Used Percent D3
[56]	1	WP Water Mark
[58:57]	2	Highest temperature
[62:59]	4	Read Fail Count
[66:63]	4	Data E3D Error
[70:67]	4	PHY Error Count
[74:71]	4	Total Bad Block Count
[78:75]	4	Total Early Bad Blcok Count
[82:79]	4	Total Later Bad Blcok Count
[86:83]	4	Read Fail Count
[90:87]	4	Program Fail Count
[94:91]	4	Erase Failure Count
[102:95]	8	System Table Copy Count
[110:103]	8	ReadMoveTableCnt
[114:111]	4	Data read retry count
[118:115]	4	RAID ECC retry count
[122:119]	4	RAID ECC failed count
[130:123]	8	Total Erase Count
[134:131]	4	D2/D3 Max Erase Cnount
[138:135]	4	D2/D3 Average Erase Count
[142:139]	4	D2/D3 Min Erase Count
[150:143]	8	Background read count (N/A)
[154:151]	4	Host Write Uncorrectable Sector Count
[158:155]	4	Wear Leveling Count
[160:159]	2	Chip internal temperature
[162:161]	2	Thermal throttling
[164:163]	2	Thermal throttling time
[172:165]	8	FW Code Update Count
[180:173]	8	Flash UNC Error Count
[184:181]	4	HB retry count
[188:185]	4	SB retry count
[190:189]	2	Previous Average Erase Count
[194:191]	4	Power CAP init error count
[198:195]	4	Flash UNC Error Count

[198:195]	8	Flash UNC Error Count
[202:199]	4	HB retry count
[206:203]	4	SB retry count
[210:207]	2	Previous Average Erase Count
[211]	4	Power CAP init error count
[215:212]	4	Data RAID ECC Recovery Success
[217:216]	4	Data RAID ECC Recovery Failed
[219:218]	4	Table RAID ECC Recovery Success
[221:220]	4	Table RAID ECC Recovery Failed
[223:222]	1	SSD Life Used Percent with Previous Average Erase Count
[231:224]	4	ddr decode 1-bit error count
[235:232]	2	error count of thermal sensor 1
[239:236]	2	error count of thermal sensor 2
[243:240]	2	error count of thermal sensor 3
[247:244]	2	error count of thermal sensor 4
[251:248]	8	raw dara of thermal sensor (raw data(2Byte)*4sensor= 8Byte)
[255:252]	4	Data Soft RAID Recovery Success
[259:256]	4	Data Soft RAID Recovery Fail
[263:260]	4	ddr corrected error count
[267:264]	4	ddr detected error count
[271:268]	4	cop1 sram corrected error count
[275:272]	4	cop1 sram detected error count
[279:276]	4	nvme sram corrected error count
[283:280]	4	nvme sram detected error count
[287:284]	4	pcie mac0 pl sram corrected error count
[291:288]	4	pcie mac0 pl sram detected error count
[295:292]	4	pcie mac0 tl sram corrected error count
[299:296]	4	pcie mac0 tl sram detected error count
[303:300]	4	pcie mac1 pl sram corrected error count
[307:304]	4	pcie mac1 pl sram detected error count
[311:308]	4	pcie mac1 tl sram corrected error count
[315:312]	4	pcie mac1 tl sram detected error count
[319:316]	4	host sram corrected error count
[323:320]	4	host sram detected error count
[327:324]	4	hdma sram corrected error count
[331:328]	4	hdma sram detected error count
[335:332]	4	ddr0 sram corrected error count
[339:336]	4	ddr0 sram detected error count
[343:340]	4	fip0 sram corrected error count
[347:344]	4	fip3 sram corrected error count
[351:348]	4	fip3 sram detected error count

[355:352]	4	aepu sram corrected error count
[359:356]	4	aepu sram detected error count
[363:360]	4	sys0 sram corrected error count
[367:364]	4	sys0 sram detected error count
[371:368]	4	smbm sram corrected error count
[375:372]	4	smbm sram detected error count
[379:376]	4	sec sram corrected error count
[383:380]	4	sec sram detected error count
[387:384]	4	dbuf sram corrected error count
[391:388]	4	dbuf sram detected error count
[395:392]	4	dmac sram corrected error count
[399:396]	4	dmac sram detected error count
[403:400]	4	corrected error count
[407:404]	4	detected error count
[415:408]	8	tlc nand read
[423:416]	8	tlc nand write
[431:424]	8	Nand_error_count
[439:432]	8	dqs_timeout_counter0
[447:440]	8	dqs_timeout_counter1
[455:448]	8	fip_dqs_timeout_flg_counter
[511:455]	56	Reserved

8. System Power Consumption

■ Supply Voltage

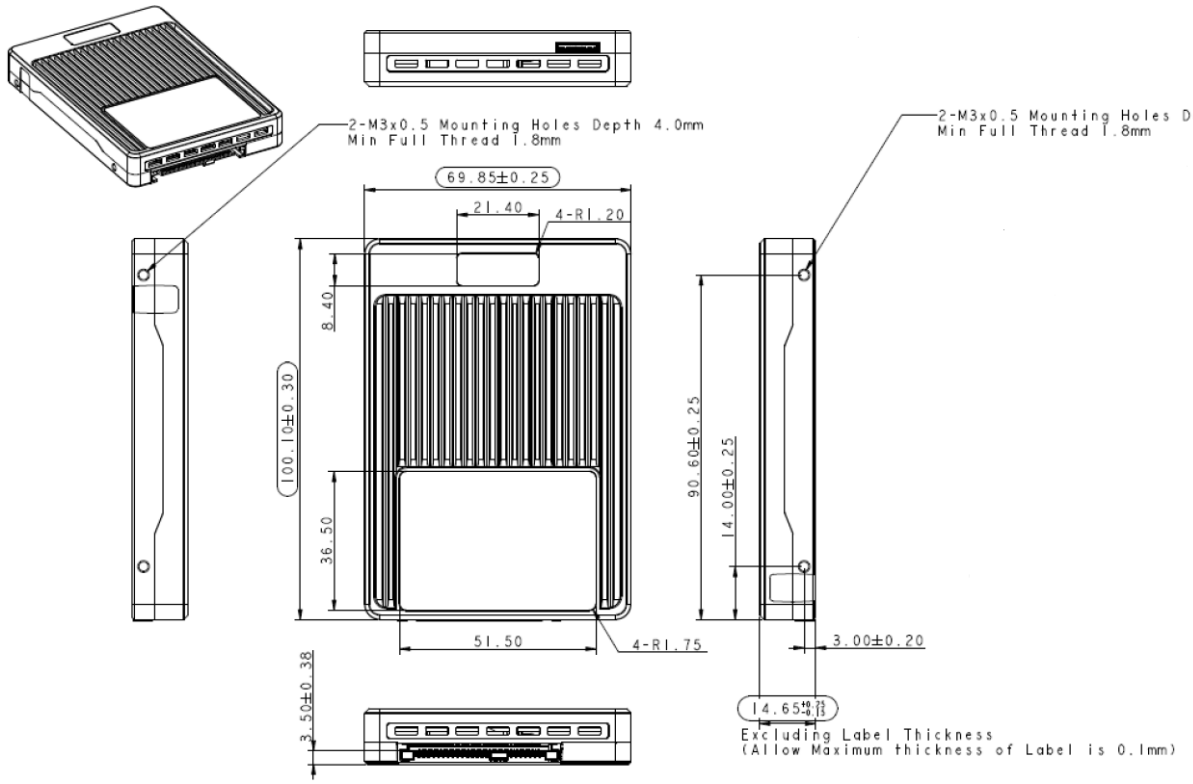
Parameter	Rating
Voltage: 12.0V	+/- 10%
Voltage: 3.3v aux	+/- 15%

■ Power Consumption

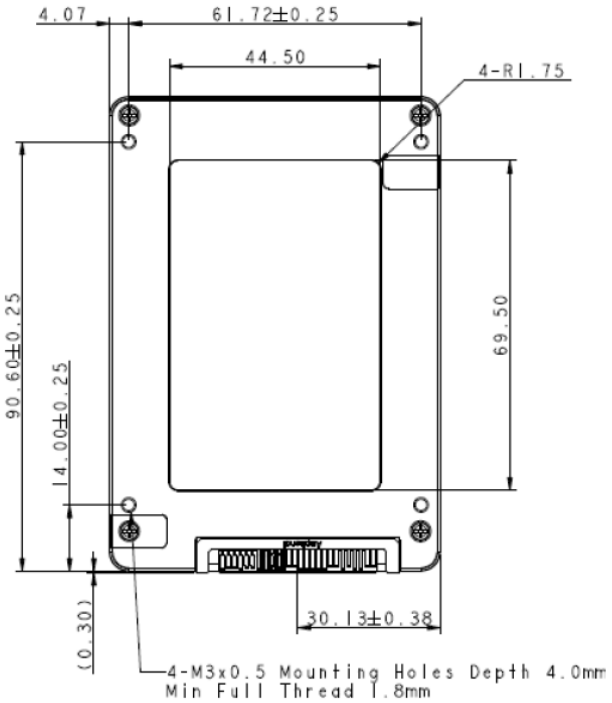
Unit (W)		Sequential		Random		Idle
		Read	Write	Read	Write	
3D TLC (V7)	1920 GB	25	25	25	25	5
	3840 GB	25	25	25	25	5
	7680 GB	25	25	25	25	5
	15360 GB	25	25	25	25	5
	30720 GB	25	25	25	25	5

9. Physical Dimension

U.2 SSD (Unit: mm)



(Top View)



(Bottom View)

Appendix: Part Number Table

Product	Advantech PN
SQF EU-2 NVMe Gen.5 U.2 SSD (OPAL) DWPD 1, 1920G 3D TLC (V7) (0~70°C)	SQF-CU2G8D1K9GDU2C
SQF EU-2 NVMe Gen.5 U.2 SSD (OPAL) DWPD 1, 3840G 3D TLC (V7) (0~70°C)	SQF-CU2GFD3K8GDU2C
SQF EU-2 NVMe Gen.5 U.2 SSD (OPAL) DWPD 1, 7680G 3D TLC (V7) (0~70°C)	SQF-CU2GFD7K6GDU2C
SQF EU-2 NVMe Gen.5 U.2 SSD (OPAL) DWPD 1, 15360G 3D TLC (V7) (0~70°C)	SQF-CU2GGD15T3DU2C
SQF EU-2 NVMe Gen.5 U.2 SSD (OPAL) DWPD 1, 30720G 3D TLC (V7) (0~70°C)	SQF-CU2GGD30T7DU2C