M.2 2280 PCIe SSD 920F Datasheet

(SQFFCM8xx-xxxxDECC)

CONTENTS

Revision History

Rev.	Date	History
1.0	2024/8/23	1. Preliminary release

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 920F series M.2 2280 PCIe SSD (Solid State Drive) delivers all the advantages of flash disk technology with PCIe Gen3 x4 interface and is fully compliant with the standard Next Generation Form Factor (NGFF) called M.2 Card Format. SQF 920F M.2 2280 offers a wide range capacity up to 2048GB and its performance can reach up to 3400 MB/s (for read) and 3100 MB/s (for write) based on 32CE NAND flash with 512MB/1GB/2GB DDR4. Moreover, the power consumption of SQF 920F M.2 2280 is much lower than traditional hard drives, making it the best embedded solution for new platforms.

2. Features

- **PCIe Interface**
  - Compliant with NVMe1.3
  - PCIe Express Base Ver 3.1
  - PCIe Gen 3 x 4 lane & backward compatible to PCIe Gen 2 and Gen 1
  - IO queues supported (1 admin queue and 8 IO queue). Each IO queue support 256 entries.
  - Support power management
- **Operating Voltage：3.3V**
- **Support LDPC with RAID ECC**
- **AES256、TCG-OPAL、TRIM、AHCI 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**
  - Shock：1,500G / 0.5ms
  - Vibration：20G / 80~2,000Hz
- **Humidty**
  - Humidity：Up to 95% under 55℃
- **Physical Anti temper**
  - Coating on PCBA
- **Acquired RoHS、WHQL、CE、FCC Certificate**
- **Acoustic：0 dB**
- **Dimension：80.0 mm x 22.0 mm x 3.8 mm**

3. Specification Table

Performance

		Sequential (MB/sec)		Random (IOPS @4K)	
		Read	**Write**	**Read**	**Write**
3D TLC	256 GB	1,900	1,100	100K	280K
	512 GB	3,300	2,300	200K	550K
	1 TB	3,300	3,100	400K	600K
	2 TB	3,300	3,000	700K	630K

1. Performance was estimated based on Kioxia TLC.
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.
4. Performance is and measured with the following conditions
    (a) CrystalDiskMark 6.0.0, 1GB range, QD=32, Thread=1
    (b) IOMeter, 1GB range, 4K data size, QD=32

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 (BiCS5): 3,000 cycles
- **SSD Capacit**y: 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 New JEDEC 219 Client Workload and verified with following workload conditions,**
    - PreCond%full = 100%
    - Trim commands enabled
    - Random data pattern.

3D TLC	TBW	DWPD*
256 GB	270	0.96
512 GB	650	1.15
1 TB	1420	1.26
2 TB	3040	1.35

* Endurance of 1 drive writes per day (DWPD) for 3 years

4. General Description

Error Correction Code (ECC)

Flash memory cells will deteriorate with use, which might generate random bit errors in the stored data. Thus, SQFlash 920F series PCIe SSD applies the LDPC with RAID 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.

Power Loss Protection

– Flush Manager

Power Loss Protection is a mechanism to prevent data loss during unexpected power failure. DRAM is a volatile memory and frequently used as temporary cache or buffer between the controller and the NAND flash to improve the SSD performance. However, one major concern of the DRAM is that it is not able to keep data during power failure. Accordingly, SQFlash SSD applies the Flush Manager technology, only when the data is fully committed to the NAND flash will the controller send acknowledgement (ACK) to the host. Such implementation can prevent false-positive performance and the risk of power cycling issues.

In addition, it is critical for a controller to shorten the time the in-flight data stays in the controller internal cache. Thus, SQFlash applies an algorithm to reduce the amount of data resides in the cache to provide a better performance. With Flush Manager, incoming data would only have a “pit stop” in the cache and then move to NAND flash directly. Also, the onboard DDR will be treated as an “organizer” to consolidate incoming data into groups before written into the flash to improve write amplification.

TRIM

TRIM is a feature which helps improve the read/write performance and speed of solid-state drives (SSD). Unlike hard disk drives (HDD), SSDs are not able to overwrite existing data, so the available space gradually becomes smaller with each use. With the TRIM command, the operating system can inform the SSD which blocks of data are no longer in use and can be removed permanently. Thus, the SSD will perform the erase action, which prevents unused data from occupying blocks all the time.

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.

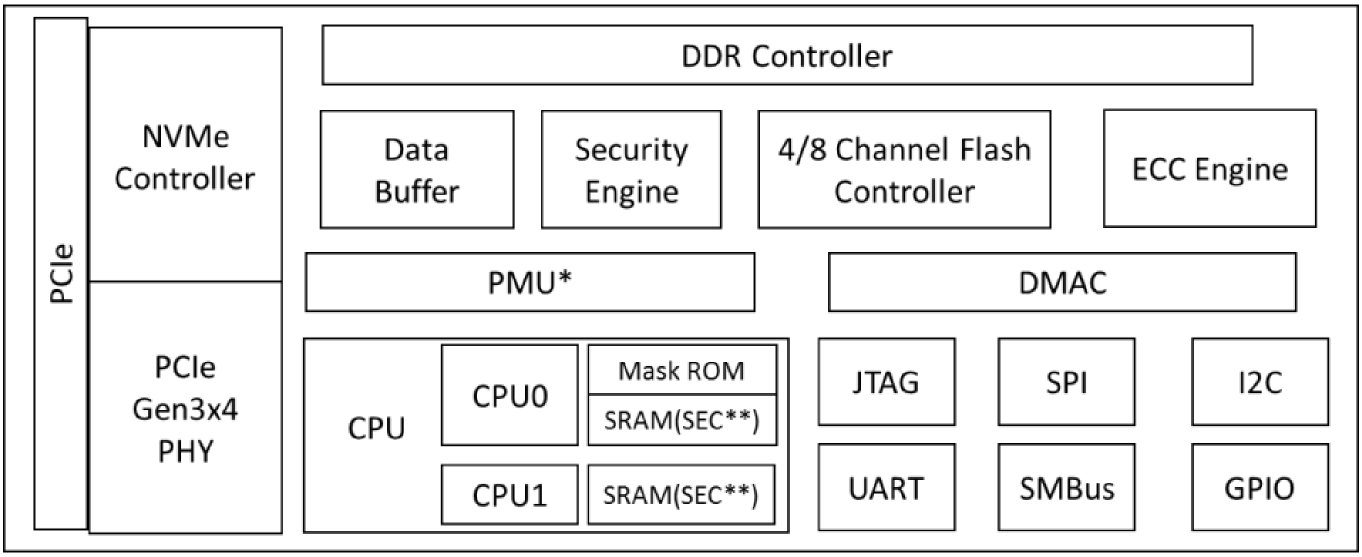
Over-Provision

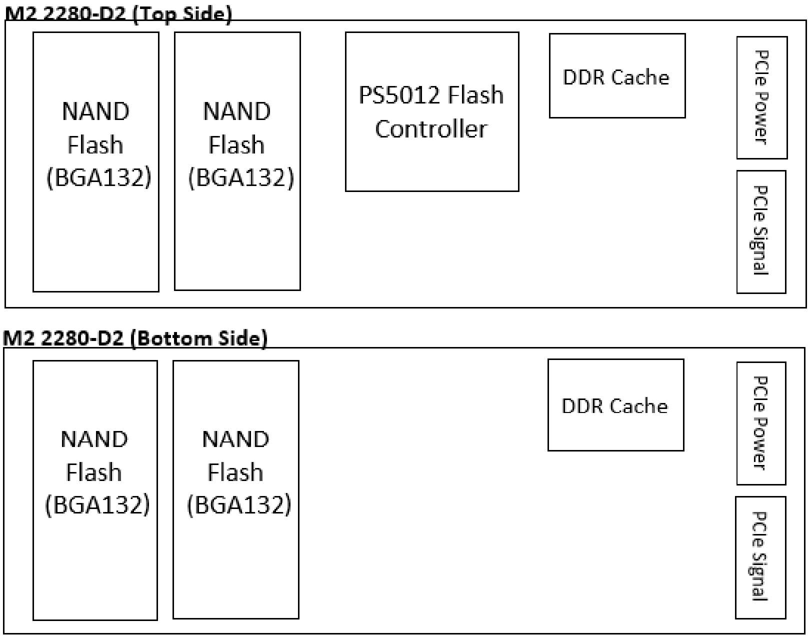
Over Provisioning refers to the inclusion of extra NAND capacity in a SSD, which is not visible and cannot be used by users. With Over Provisioning, the performance and IOPS (Input/Output Operations per Second) are improved by providing the controller additional space to manage P/E cycles, which enhances 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
256	500,118,192
512	1,000,215,216
1024	2,000,409,264
2048	4,000,797,360

5. Security Features

Advanced Encryption Standard (AES)

An AES 256-bit encryption key is generated in the drive's security controller before the data got stored on the NAND flash. When the controller or firmware fails, the data that is securely stored in the encryption key becomes inaccessible through the NAND flash.

TCG-OPAL 2.0 Compliance

Crypto Erase is a feature that erases all data of an OPAL-activated SSD drive by resetting the cryptographic key of the disk. Since the key is modified, the previously encrypted data will become useless, achieving the purpose of data security.

Physical Presence SID (PSID) is defined by TCG OPAL as a 32-character string and the purpose is to revert SSD back to its manufacturing setting when the drive is still OPAL-activated. PSID code can be printed on a SSD label when an OPAL-activated SSD supports PSID revert feature.

6. Pin Assignment and Description

Pin No.	PCIe Pin	Description
1	GND	CONFIG_3 = GND
2	3.3V	3.3V source
3	GND	Ground
4	3.3V	3.3V source
5	PETn3	PCIe TX Differential signal defined by the PCI Express M.2 spec
6	N/C	No connect
7	PETp3	PCIe TX Differential signal defined by the PCI Express M.2 spec
8	N/C	No connect
9	GND	Ground
10	LED1#	Open drain, active low signal. These signals are used to allow the add-in card to provide status indicators via LED devices that will be provided by the system.
11	PERn3	PCIe RX Differential signal defined by the PCI Express M.2 spec
12	3.3V	3.3V source
13	PERp3	PCIe RX Differential signal defined by the PCI Express M.2 spec
14	3.3V	3.3V source
15	GND	Ground
16	3.3V	3.3V source
17	PETn2	PCIe TX Differential signal defined by the PCI Express M.2 spec
18	3.3V	3.3V source
19	PETp2	PCIe TX Differential signal defined by the PCI Express M.2 spec
20	N/C	No connect
21	GND	Ground
22	N/C	No connect
23	PERn2	PCIe RX Differential signal defined by the PCI Express M.2 spec
24	N/C	No connect
25	PERp2	PCIe RX Differential signal defined by the PCI Express M.2 spec
26	N/C	No connect
27	GND	Ground
28	N/C	No connect
29	PETn1	PCIe TX Differential signal defined by the PCI Express M.2 spec
30	N/C	No connect
31	PETp1	PCIe TX Differential signal defined by the PCI Express M.2 spec
32	N/C	No connect
33	GND	Ground
34	N/C	No connect
35	PERn1	PCIe RX Differential signal defined by the PCI Express M.2 spec
36	N/C	No connect
37	PERp1	PCIe RX Differential signal defined by the PCI Express M.2 spec
38	N/C	No connect
39	GND	Ground
40	SMB_CLK (I/O)(0/1.8V)	SMBus Clock; Open Drain with pull-up on platform
41	PETn0	PCIe TX Differential signal defined by the PCI Express M.2 spec
42	SMB_DATA (I/O)(0/1.8V)	SMBus Data; Open Drain with pull-up on platform.
43	PETp0	PCIe TX Differential signal defined by the PCI Express M.2 spec
44	ALERT#(O) (0/1.8V)	Alert notification to master; Open Drain with pull-up on platform; Active low.
45	GND	Ground
46	N/C	No connect
47	PERn0	PCIe RX Differential signal defined by the PCI Express M.2 spec

48	N/C	No connect
49	PERp0	PCIe RX Differential signal defined by the PCI Express M.2 spec
50	PERST#(I)(0/3.3V)	PE-Reset is a functional reset to the card as defined by the PCIe Mini CEM specification.
51	GND	Ground
52	CLKREQ#(I/O)(0/3.3V)	Clock Request is a reference clock request signal as defined by the PCIe Mini CEM specification; Also used by L1 PM Sub-states.
53	REFCLKn	PCIe Reference Clock signals (100 MHz) defined by the PCI Express M.2 spec.
54	PEWAKE#(I/O)(0/3.3V)	PCIe PME Wake. Open Drain with pull up on platform; Active Low.
55	REFCLKp	PCIe Reference Clock signals (100 MHz) defined by the PCI Express M.2 spec.
56	Reserved for MFG DATA	Manufacturing Data line. Used for SSD manufacturing only. Not used in normal operation. 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	
62	Module Key M	
63	Module Key M	
64	Module Key M	
65	Module Key M	
66	Module Key M	
67	N/C	No connect
68	SUSCLK(32KHz)(I)(0/3.3V)	32.768 kHz clock supply input that is provided by the platform chipset to reduce power and cost for the module.
69	N/C	PEDET (NC-PCIe)
70	3.3V	3.3V source
71	GND	Ground
72	3.3V	3.3V source
73	GND	Ground
74	3.3V	3.3V source
75	GND	Ground

7. Identify Devic Command

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

Table 7-1 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)	-
63:24	M	Model Number (MN)	-
71:64	M	Firmware Revision (FR)	ECPM13.x
72	M	Recommended Arbitration Burst (RAB)	0x01
75:73	M	IEEE OUI Identifier (IEEE)	*
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)	0x01
83:80	M	Version (VER)	0x10300
87:84	M	RTD3 Resume Latency (RTD3R)	0x989680
91:88	M	RTD3 Entry Latency (RTD3E)	0x989680
95:92	M	Optional Asynchronous Events Supported (OAES)	0x200
99:96	M	Controller Attributes (CTRATT)	0x02
111:100		Reserved	0x00
127:112	O	FRU Globally Unique Identifier (FGUID)	0x00
239:128		Reserved	0x00
255:240	-	Refer to the NVMe Management Interface Specification for definition	0x00
257:256	M	Optional Admin Command Support (OACS)	0x07
258	M	Abort Command Limit (ACL)	0x03
259	M	Asynchronous Event Request Limit (AERL)	0x03
260	M	Firmware Updates (FRMW)	0x12
261	M	Log Page Attributes (LPA)	0x08
262	M	Error Log Page Entries (ELPE)	0x3E
263	M	Number of Power States Support (NPSS)	0x04
264	M	Admin Vendor Specific Command Configuration (AVSCC)	0x01
265	O	Autonomous Power State Transition Attributes (APSTA)	0x01
267:266	M	Warning Composite Temperature Threshold (WCTEMP)	0x15C
269:268	M	Critical Composite Temperature Threshold (CCTEMP)	0x161
271:270	O	Maximum Time for Firmware Activation (MTFA)	0x64
275:272	O	Host Memory Buffer Preferred Size (HMPRE)	0x00
279:276	O	Host Memory Buffer Minimum Size (HMMIN)	0x00
295:280	O	Total NVM Capacity (TNVMCAP)	256GB: 0x3B9E6560 512GB: 0x773C2560 1024GB: 0xEE77A560 2048GB: 0x01DCEEA560
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)	0x00
318	O	Device Self-test Options (DSTO)	0x00
319	M	Firmware Update Granularity (FWUG)	0x01
321:320	M	Keep Alive Support (KAS)	0x00
323:322	O	Host Controlled Thermal Management Attributes (HCTMA)	0x01

325:324	O	Minimum Thermal Management Temperature (MNTMT)	0x139
327:326	O	Maximum Thermal Management Temperature (MXTMT)	0x157
331:328	O	Sanitize Capabilities (SANICAP)	0x00
511:332		Reserved	
NVM Command Set Attributes			
512	M	Submission Queue Entry Size (SQES)	0x66
513	M	Completion Queue Entry Size (CQES)	0x44
515:514	M	Maximum Outstanding Comm	0x
519:516	M	ands (MAXCMD)	100
521:520	M	Number of Namespaces (NN)	0x01
523:522	M	Optional NVM Command Support (ONCS)	0x5D
524	M	Fused Operation Support (FUSES)	0x0
525	M	Volatile Write Cache (VWC)	0x
527:526	M	Atomic Write Unit Normal (AWUN)	0 1
529:528	M	Atomic Write Unit Power Fail (AWUPF)	0xFF
530	M	NVM Vendor Specific Command Configuration (NVSCC)	0x00
531	M	Reserved	0x01
533:532	O	Atomic Compare & Write Unit (ACWU)	0x00
535:534	M	Reserved	0x00
539:536	O	SGL Support (SGLS)	0x00
767:540		Reserved	0x00
IO Command Set Attributes			
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)	0x02A5
IO Command Set Attributes			
2111:2080	O	Power State 1 Descriptor (PSD1)	[2081:2080]0x023B [0295:0292]0x01010101
2143:2112	O	Power State 2 Descriptor (PSD2)	[2013:2012]0x0207 [2027:2024]0x02020202
2175:2144	O	Power State 3 Descriptor (PSD3)	[2147:2144]0x030001EA [2159:2156]0x03030303
2207:2176	O	Power State 4 Descriptor (PSD4)	[2179:2176]0x03000012 [2191:2188]0x04040404
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
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
Vendor Specific			
4092:3072	O	Vendor Specific (VS)	Reserved
4093	O	[Specific] Bit 0 : FIPS firmware Bit 1: FIPS mode	0x01 0x03
4096:4094	O	Vendor Specific (VS)	Reserved

* The OUI shall be a valid IEEE/RAC assigned identifier that may be registered at http://standards.ieee.org/develop/regauth/oui/public.html.

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"-"depends on each sample

Table 7-2 Identify Namespace Data Structure & NVM Command Set Specific

Bytes	O/M	Description	Default Value
7:0	M	Namespace Size (NSZE)	256GB: 0x1DCF32B0 512GB: 0x3B9E12B0 1024GB: 0x773BD2B0 2048GB: 0xEE7752B0
15:8	M	Namespace Capacity (NCAP)	256GB: 0x1DCF32B0 512GB: 0x3B9E12B0 1024GB: 0x773BD2B0 2048GB: 0xEE7752B0
23:16	M	Namespace Utilization (NUSE)	256GB: 0x1DCF32B0 512GB: 0x3B9E12B0 1024GB: 0x773BD2B0 2048GB: 0xEE7752B0
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
31	O	Reservation Capabilities (RESCAP)	0x00
32	O	Format Progress Indicator (FPI)	0x00
33		Reserved	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		Reserved	0x0000
64:48	O	NVM Capacity (NVMCAP)	256GB: 0x3B9E6560 512GB: 0x773C2560 1024GB: 0xEE77A560 2048GB: 0x01DCEEA560
103:64		Reserved	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)	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

*See IDEMA SPEC

** See IEEE EUI-64 SPEC

Table 7-3 List of Identify Namespace Data Structure for Each Capacity

Capacity (GB)	Byte[7:0]: Namespace Size (NSZE)	Byte[7:0]: Namespace Size (NSZE) (Dec)
256	1DCF32B0h	500,118,192
512	3B9E12B0h	1,000,215,216
1024	773BD2B0h	2,000,409,264
2048	EE7752B0h	4,000,797,360

8. SMART Atrributes

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

9. System Power Consumption

Supply Voltage

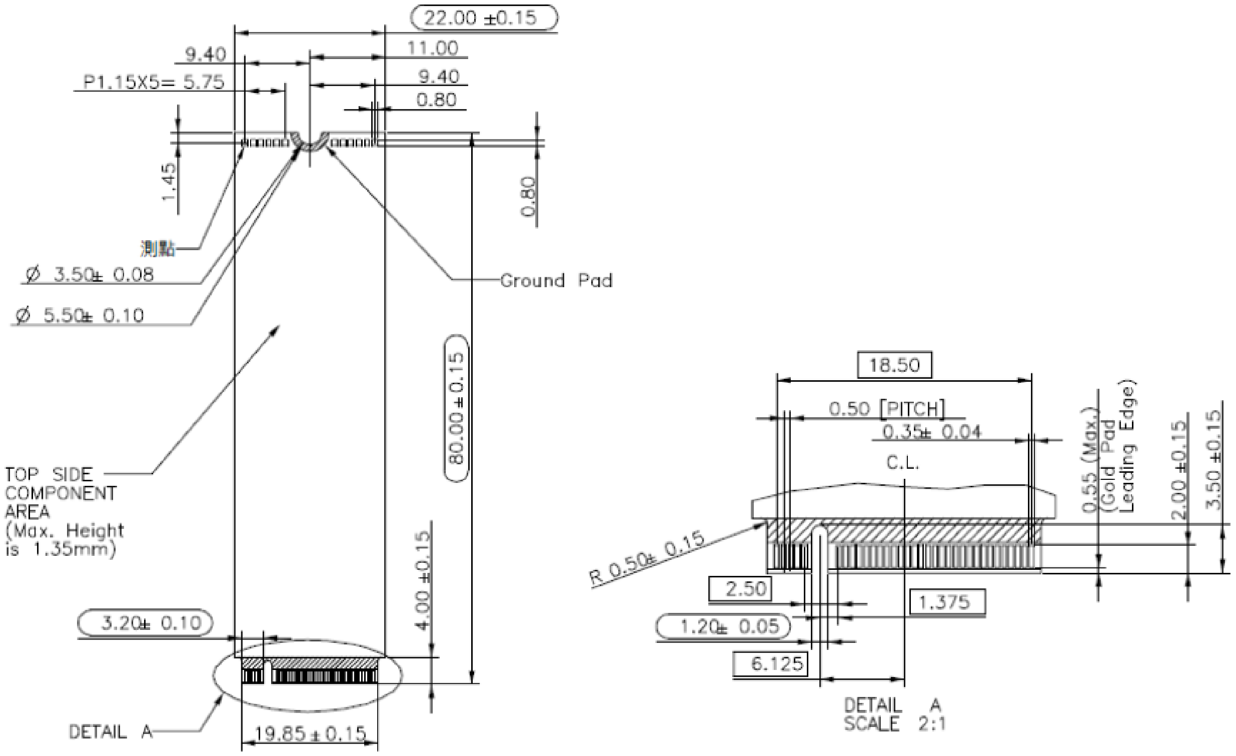
Parameter	Rating
Operating Voltage	3.3V +/- 5%
Rise Time (Max/Min)	100 ms / 0.1 ms
Fall Time (Max/Min)	5 s / 1 ms

Power Consumption

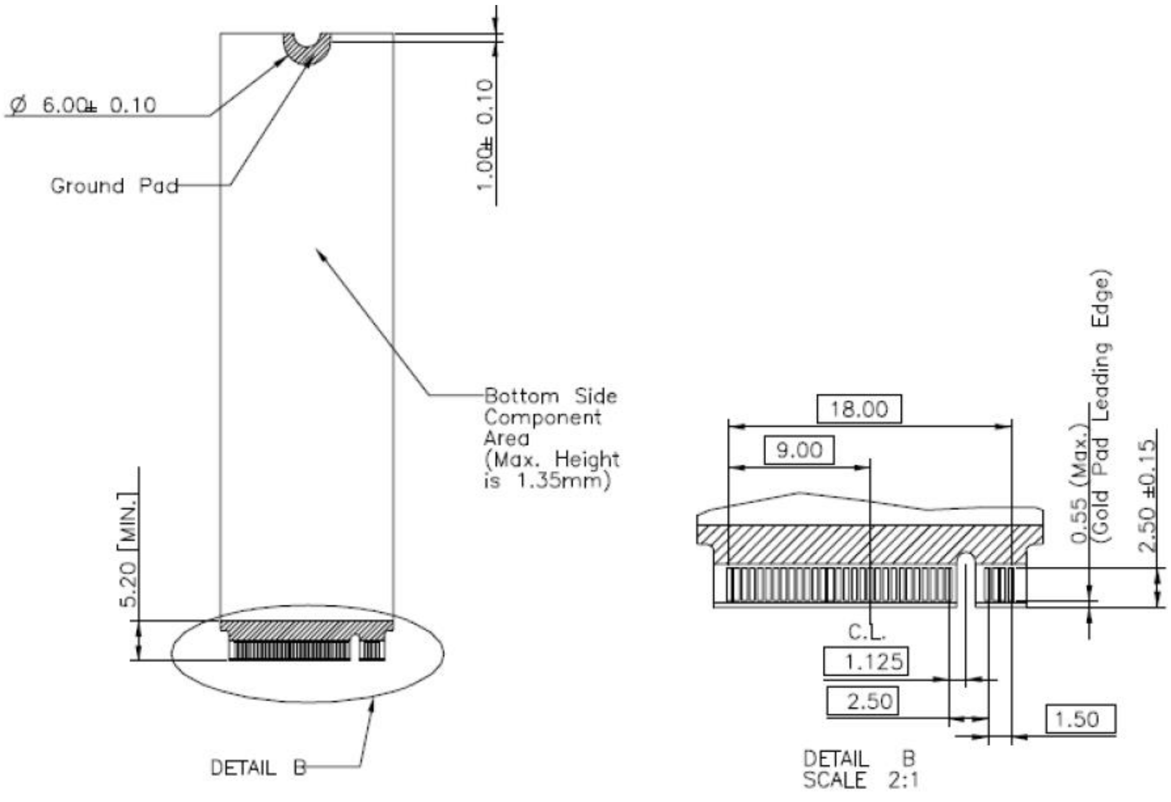
(W)		Read	Write
3D TLC	256 GB	3.7	3.3
	512 GB	5.1	4.6
	1 TB	5.3	5.5
	2 TB	5.5	5.9

10. Physical Dimension

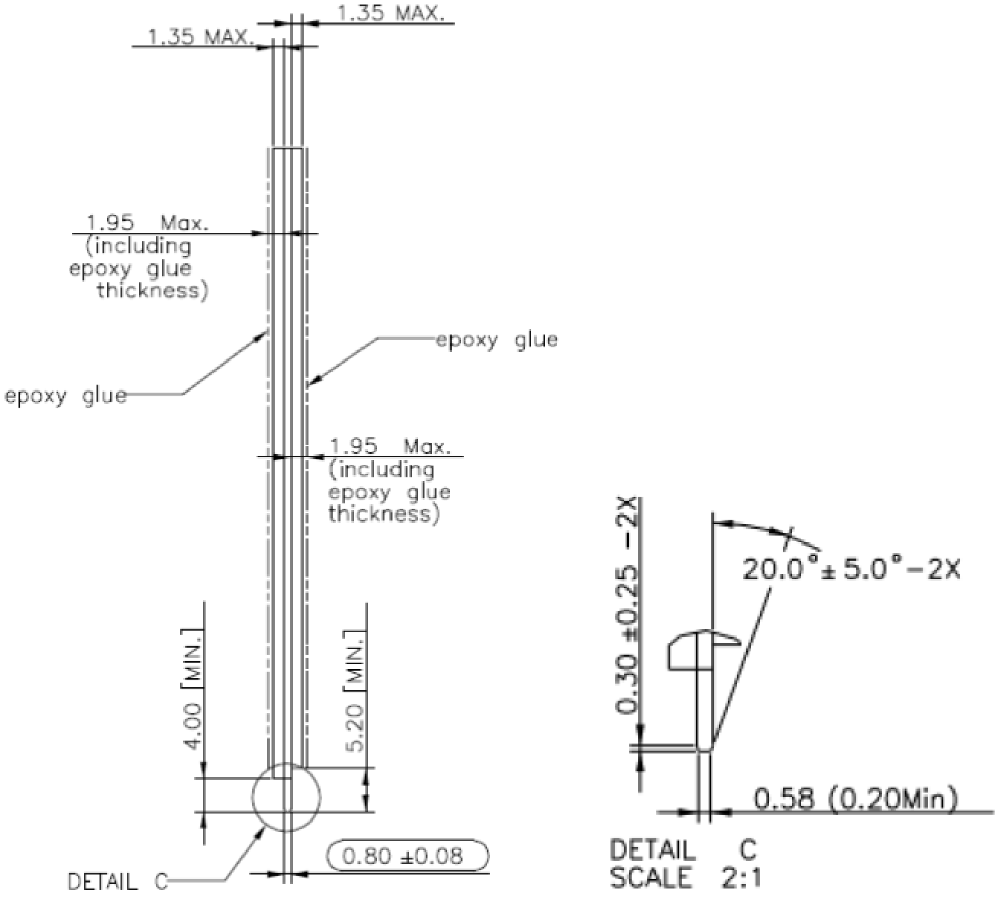
M.2 2280 PCIe SSD (Unit: mm)



Top View



Bottom View


1.35 MAX.
1.35 MAX.
1.95 Max. (including epoxy glue thickness)
epoxy glue
epoxy glue
1.95 Max. (including epoxy glue thickness)
4.00 [MIN.]
5.20 [MIN.]
0.80 ±0.08
DETAIL C
0.30 ±0.25 −2X
20.0°±5.0°−2X
0.58 (0.20Min)
DETAIL C
SCALE 2:1

Side View

Appendix: Part Number Table

Product	Advantech PN
SQF 920F M 2 2280 NVMe SSD FIPS 256GB 3D TLC BiCS5 (0~70°C)	SQFFCM8V2-256GDECC
SQF 920F M 2 2280 NVMe SSD FIPS 512GB 3D TLC BiCS5 (0~70°C)	SQFFCM8V4-512GDECC
SQF 920F M 2 2280 NVMe SSD FIPS 1TB 3D TLC BiCS5 (0~70°C)	SQFFCM8V4-1TDECC
SQF 920F M 2 2280 NVMe SSD FIPS 2TB 3D TLC BiCS5 (0~70°C)	SQFFCM8V4-2TDECC