M.2 2280 SATA SSD 840V-D Datasheet

(SQF-SM8xx-xxxGDVCx)

CONTENTS

Revision History

Rev.	Date	History
1.0	2023/8/11	1. Preliminary
1.1	2023/8/15	1. Update Part Numbers
1.2	2023/9/30	1. Update product description
1.3	2024/6/19	1. Revise SLC cache on
1.4	2024/7/10	1. Update product description

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 840V-D power failure protective M.2 2280 SATA-SSD (SQF-SM8 840V-D) delivers all the advantages of Flash Disk technology with the Serial ATA III (6.0Gb) interface, fully compliant with standard Next Generation Form Factor (NGFF) M.2 2280 (B+M Key) form factor. The SATA SSD is designed to operate at a maximum operating frequency of 300MHz with 30MHz external crystal. Moreover, it can reach and sustain up to 550MB/s read and 530MB/s write performance with DRAM cache based on Kioxia 3D TLC Flash. The complete firmware, hardware capacitor power loss protection and the wide temperature original pack Flash choice make this product series the best and sound for edge rugged applications.

2. Features

- **Standard SATA interface**
  - Support SATA 1.5/3.0/6.0 Gbps interface
  - SATA Revision 3.2 compliant
- **Operating Voltage：3.3V**
- **Support LDPC with RAID ECC**
- **TRIM、AHCI、AES256 and OPAL supported**
- **Voltage Stabilizer and Hardware Power Loss Protection supported**
- **Temperature Ranges**
  - Commercial Temperature
    - 0℃ to 70℃ for operating[1]
    - -40℃ to 85℃ for storage
  - Industrial Temperature
    - -40℃ to 85℃ for operating[1]
    - -40℃ to 85℃ for storage

  *Note 1: Based on SMART Attribute C2h measured by thermal sensor.
- **Mechanical Specification**
  - Shock：1,500G / 0.5ms
  - Vibration：20G / 80~2,000Hz
- **Humidty**
  - Humidity：Up to 95% under 40℃
- **Acquired RoHS、WHQL、CE、FCC Certificate**
- **Acoustic：0 dB**
- **Dimension：80.8 mm x 22.0 mm x 3.8 mm**

3. Specification Table

■ Performance

Capacity		Sequential Performance (MB/sec)		Random Performance (IOPS @4K)	
		Read	Write	Read	Write
3D TLC (BiCS5)	240 GB	550	150	47K	37K
	480 GB	550	330	92K	84K
	960 GB	550	530	98K	88K

* All performance above are tested with AHCI mode

■ POR/SPOR Standby Ready Time (Unit: ms)

Capacity	POR ready time (ms)		SPOR ready time (ms)	
	Typ	Max.	Typ.	Max.
240GB	600	800	1700	2500
480GB	900	950	1500	2600
960GB	1200	1400	2400	3800

1. **POR/SPOR stands for following:**

   POR: Power On Ready. (The ready time variation depends on data recover size.)

   SPOR: Power On Ready after Sudden Power Off. (The ready time variation depends on data recover size.)

2. **POR/SPOR ready time stands for following:**

   Power on Time: From Power On to SSD response after drive ready.

■ 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 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 New JEDEC 219 Client Workload and verified with following workload conditions,**
  - PreCond%full = 100%
  - Trim commands enabled
  - Random data pattern.

3D TLC (BiCS5)	TBW	DWPD*
240 GB	300	1.14
480 GB	700	1.33
960 GB	1590	1.51

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

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 840V-D series 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.

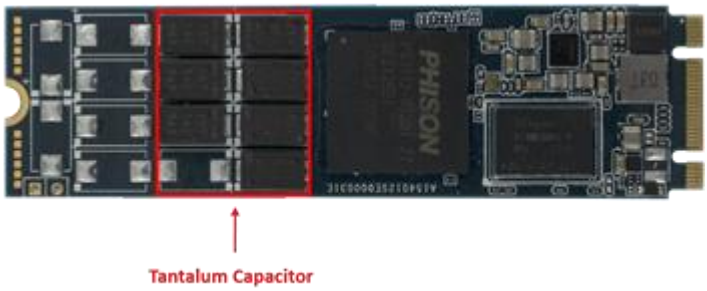
In addition, it is critical for a controller to shorten the time the in-flight data stays in the controller internal cache. Thus, SQFlash applies an algorithm to reduce the amount of data resides in the cache to provide a better performance. With Flush Manager, incoming data would only have a “pit stop” 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.

– Voltage Stabilizer

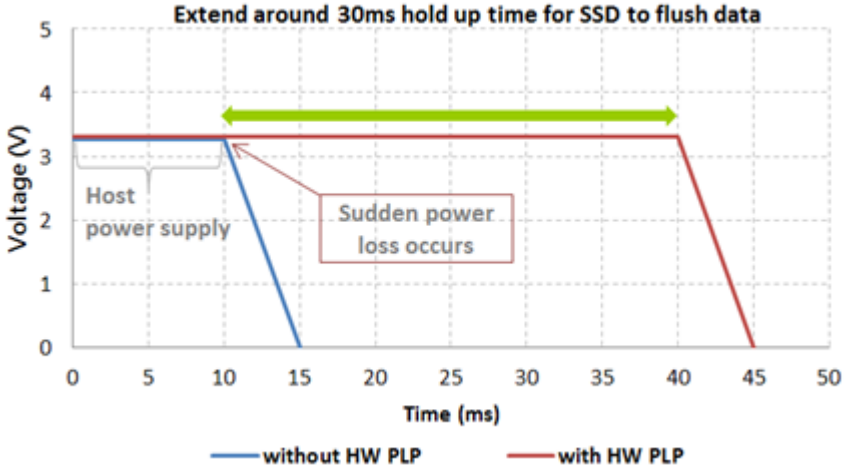
While the built-in voltage detector detects an unstable power input (< 3.135 V or > 3.465 V), the controller will issue a power failure interrupt and force a Flush CMD first. At the same time, the whole internal power supply will be switched to Voltage Stabilizer immediately to ensure stable power is supplied throughout the whole drive. This ensures the Flash IC and DDR IC will not operate with unstable power which could lead to data errors or bad data integrity.

– **Hardware Power Loss Data Protection (HW PLP)**

To prevent data loss or corruption from unexpected power loss event, SQFlash 840V added hardware power loss data protection (HW PLP) circuit with capacitor components on the board design. These capacitors act like a UPS (Uninterruptible Power Supply) for the SSDs, the capacitors will be charged upon powering up and be prepared for emergency cases. When unexpected power loss happens, the capacitors can provide additional power up time for the controller to manage and flush all the critical information (Cached user data and physical- to-logical table) in the DRAM to NAND to ensure data integrity and prevent data loss.



▲ **Capacitor Position Diagram**



▲ **Capacitor Hold Up Time**

[Notes]

1. The hold-up time is measured by using a 960GB SSD.
2. The hold-up time and the number of capacitors are different by each capacity.

■ 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.

Advanced Device Security Features

- **Advanced Encryption Standard (AES)**

  An AES 256-bit encryption key is generated in the drive's security controller before the data gets 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 support**

  SQFlash 840V-D series supports standard OPAL 2.0 function for advance Self-Encryption Drive (SED) feature sets. Advantech provides also user friendly interface for setting disk / system bonding to prevent SSD be used in non-authorized platforms, which is called Flash Lock function.

  - AES 256-bitHardware Self Encryption
  - Deploy Storage Device & Take Ownership: The Storage Device is integrated into its target system and ownership transferred by setting or changing the Storage Device's owner credential.
  - Activate or Enroll Storage Device: LBA ranges are configured and data encryption and access control credentials (re)generated and/or set on the Storage Device. Access control is configured for LBA range unlocking.
  - Lock & Unlock Storage Device: unlocking of one or more LBA ranges by the host and locking of those ranges under host control via either an explicit lock or implicit lock triggered by a reset event. MBR shadowing provides a mechanism to boot into a secure pre-boot authentication environment to handle device unlocking.
  - Repurpose & End-of-Life: erasure of data within one or more.

- **Secure Erase Function (SATA Command)**

  SQFlash 840V-D series supports standard SATA command for secure erase function; when the SSD controller receive the secure erase command, the erase process will reset all blocks and erase all of the user data in the SSD.

- **Sanitize Function (SATA Command)**

  SQFlash 840V-D series implements Sanitize command sets by default and supports Block Erase, Crypto Scramble, Overwrite and other related commands. With internal AES encryption support, Crypto Scramble starts with resetting AES key. In this way, the existing data will be scrambled within 10ms and can no longer be recovered. Also, the erase flag is set when the erase function is triggered, which will ensure the entire erase process can be 100% completed. Even if there's power outage, the erase operation will resume as soon as power is restored.
  (Note) Crypto Scramble needs to be done with the TCG OPAL 2.0 setting enabled.

- **Write Protect Function**

  SQFlash 840V-D series default support Write Protect function, when the write protect function enabled, all of the write command will carried to a buffer area without real programming to the Flash IC. Therefore, the data won't be saved in this mode and will be totally discarded upon power shutting down.
  (Note) If the SSD is OS drive, SSD might bump into issue at startup after write protection executed, because some OS need to write data at startup.

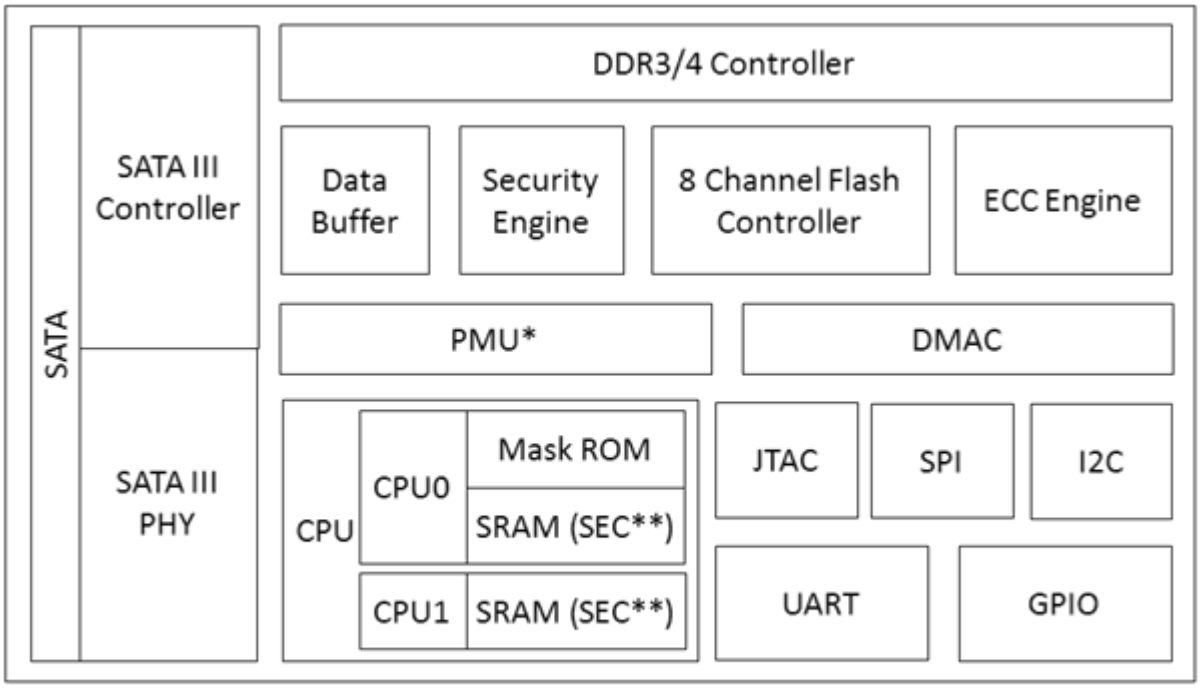
- **Crypto Erase**

  SQFlash Crypto Erase is a security function based on vendor command which can be triggered by sending ATA Command. When Crypto Erase is activated, it will trim logical to physical table, fill data in it, and then reset the AES key. With this Crypto Erase function, we can ensure original data in SSD inaccessible through the NAND flash.

- **Military Secure Erase**

  SQFlash Military Secure Erase is a series of security function based on vendor command which can be triggered by sending ATA Command. Please check Military Secure Erase Whitepaper for detail of each functions: AFSSI 5020, DoD 5220.22-M, USA NAVY NAVSO P-5239-26, NSA Manual 130-2, USA-ARMY 380-19, NISPOMUP Chap 8, Sect.8-501, NSA/CSS 9-12, AFSSI 8580.

■ Block Diagram



*PMU: Power Management Unit
**SEC: Single bit Error Correct

■ LBA value

Density	LBA
240 GB	468,862,128
480 GB	937,703,088
960 GB	1,875,385,008

5. Pin Assignment and Description

Pin #	SATA Pin	Description
1	CONFIG_3 = GND	Ground
2	3.3V	Supply pin
3	GND	Ground
4	3.3V	Supply pin
5	N/C	No Connect
6	N/C	No Connect
7	N/C	No Connect
8	N/C	No Connect
9	N/C or GND Note	No Connect or Ground
10	DAS/DSS# (O) (OD)	Status indicators via LED devices that will be provided by the system Active Low. A pulled-up LED with series current limiting resistor should allow for 9mA when On.
11	N/C	No Connect
12	Module Key	
13	Module Key	
14	Module Key	
15	Module Key	
16	Module Key	
17	Module Key	
18	Module Key	
19	Module Key	
20	N/C	No Connect
21	CONFIG_0 = GND	Ground
22	N/C	No Connect
23	N/C	No Connect
24	N/C	No Connect
25	N/C	No Connect
26	N/C	No Connect
27	GND	Ground
28	N/C	No Connect
29	N/C	No Connect
30	N/C	No Connect
31	N/C	No Connect
32	N/C	No Connect
33	GND	Ground
34	N/C	No Connect
35	N/C	No Connect
36	N/C	No Connect
37	N/C	No Connect
38	DEVSLP (I) (0/3.3V)	Device Sleep, Input.

	(Optional)	When driven high the host is informing the SSD to enter alow power state
39	GND	Ground
40	N/C	No Connect
41	SATA-B+	SATA differential signals in the SATA specification
42	N/C	No Connect
43	SATA-B-	SATA differential signals in the SATA specification
44	N/C	No Connect
45	GND	Ground
46	N/C	No Connect
47	SATA-A-	SATA differential signals in the SATA specification
48	N/C	No Connect
49	SATA-A+	SATA differential signals in the SATA specification
50	N/C	No Connect
51	GND	Ground
52	N/C	No Connect
53	N/C	No Connect
54	N/C	No Connect
55	N/C	No Connect
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 inplatform Socket
59	Module Key	
60	Module Key	
61	Module Key	
62	Module Key	
63	Module Key	
64	Module Key	
65	Module Key	
66	Module Key	
67	N/C	No Connect
68	SUSCLK (I) (0/3.3V)	No Connect
69	CONFIG_1 = GND	Defines module type
70	3.3V	Supply pin
71	GND	Ground
72	3.3V	Supply pin
73	GND	Ground
74	3.3V	Supply pin
75	CONFIG_2 = GND	Ground

NOTE: (1) N/C for Socket 2, and GND for Socket 3. (2) No support low power mode.

6. Identify Device Data

The Identity Device Data enables Host to receive parameter information from the device. The parameter words in the buffer have the arrangement and meanings defined in below table. All reserve bits or words are zero

Word	Type[1]	Default Value	Description
0	F	0040h	General configuration bit-significant information
1	X	*1	Obsolete
2	F	C837h	Specific configuration
3	X	0010h	Obsolete
4-5	X	0000h	Retired
6	X	003Fh	Obsolete
7-8	X	0000h	Reserved for assignment by the Compact Flash Association
9	X	0000h	Retired
10-19	V	Varies	Serial number (ATA string)
20-21	X	0000h	Retired
22	X	0000h	Obsolete
23-26	V	Varies	Firmware revision (ATA string)
27-46	V	Varies	Model number (ATA string)
47	F	8010h	7:0- Maximum number of logical sectors that shall be transferred per DRQ data block on READ/WRITE MULTIPLE commands
48	V	TCG OPAL disabled: 4000h TCG OPAL enable: 4001h	Trusted Computing feature set options
49	F	2F00h	Capabilities
50	F	4000h	Capabilities
51-52	X	0000h	Obsolete
53	F	0007h	Capabilities
54	X	*1	Obsolete
55	X	0010h	Obsolete
56	X	003Fh	Obsolete
57-58	X	*2	Obsolete
59	V	TCG OPAL disabled:0110h TCG OPAL enable: FD10h	Current setting for number of logical sectors that shall be transferred per DRQ data block on READ/WRITE Multiple commands
60-61	V	*3	Maximum number of sector (28bit LBA mode)
62	X	0000h	Obsolete
63	F	0407h	Multi-word DMA modes supported/selected

Word	Type[1]	Default Value	Description
64	F	0003h	PIO mode 3 and mode 4 supported
65	F	0078h	Minimum Multiword DMA transfer cycle time per word
66	F	0078h	Manufacturer's recommended Multiword DMA transfer cycle time
67	F	0078h	Minimum PIO transfer cycle time without flow control
68	F	0078h	Minimum PIO transfer cycle time with IORDY flow control
69	V	TCG OPAL disabled: 5F20h TCG opal enable: 5F30h	Device configuration identify and device configuration set DMA are supported
70	X	0000h	Reserved
71-74	X	0000h	Reserved for the IDENTIFY PACKET DEVICE command
75	F	001Fh	Queue depth
76	F	E50Eh	Serial SATA capabilities
77	F	0006h	Serial ATA Additional Capabilities
78	F	004Ch	Serial ATA features supported
79	F	0040h	Serial ATA features enabled
80	F	07F8h	Major Version Number
81	F	0000h	Minor Version Number
82	F	746Bh	Command and feature sets supported
83	F	7D09h	Command and feature sets supported
84	F	4063h	Command and feature sets supported
85	F	7469h	Command set/feature enabled
86	F	BC09h	Command set/feature enabled
87	F	4063h	Command set/feature default
88	F	007Fh	Ultra DMA Modes
89	F	0002h	Time required for security erase unit completion
90	F	0002h	Time required for Enhanced security erase completion
91	F	00FEh	Current advanced power management value
92	F	FFFEh	Master Password Revision Code
93	F	0000h	Hardware reset result. For SATA devices, word 93 shall be set to the value 0000h.
94	X	0000h	Current AAM value
95	F	0000h	Stream Minimum Request Size
96	F	0000h	Streaming Transfer Time – DMA
97	F	0000h	Streaming Access Latency – DMA and PIO
98-99	F	0000h	Streaming Performance Granularity
100-103	V	*4	Maximum user LBA for 48 bit Address feature set
104	F	0000h	Streaming Transfer Time – PIO

Word	Type[1]	Default Value	Description
105	F	0008h	Maximum number of 512-byte blocks per DATA SET MANAGEMENT command
106	F	4000h	Physical sector size/Logical sector size
107	F	0000h	Inter-seek delay for ISO-7779 acoustic testing
108-111	V	Varies	World Wide Name
112-115	X	0000h	Reserved
116	X	0000h	Reserved for TLC
117-118	F	0000h	Logical sector size (DWord)
119	F	4019h	Supported settings
120	F	4019h	Commands and feature sets supported or enabled
121-126	X	0000h	Reserved for expanded supported and enabled settings
127	X	0000h	Obsolete
128	V	Varies	Security status
129-140	V	Varies	Vendor specific
141	V	Varies	Vendor specific
142-159	V	Varies	Vendor specific
160	X	0000h	Reserved for CFA
161-167	X	0000h	Reserved for CFA
168	V	Varies	CFA power mode
169	F	0001h	DATA SET MANAGEMENT command is supported
170-173	F	0000h	Additional Product Identifier
174-175	X	0000h	Reserved
176-205	F	0000h	Current media serial number
206	F	0000h	SCT Command Transport
207-208	X	0000h	Reserved
209	F	4000h	Alignment of logical blocks within a physical block
210-211	F	0000h	Write-Read-Verify Sector Count Mode 3 (not support)
212-213	F	0000h	Write-Read-Verify Sector Count Mode 2 (not support)
214-216	X	0000h	Obsolete
217	F	0001h	Nominal media rotation rate
218	X	0000h	Reserved
219	X	0000h	NV Cache relate (not support)
220	V	0000h	Write read verify feature set current mode
221	X	0000h	Reserved
222	F	107Fh	Transport major version number
223	F	0000h	Transport minor version number

Word	Type[1]	Default Value	Description
224-229	X	0000h	Reserved
230-233	F	0000h	Extend number of user addressable sectors
234	F	0001h	Minimum number of 512-byte data blocks per Download Microcode operation
235	F	0400h	Maximum number of 512-byte data blocks per Download Microcode operation
236-254	X	0000h	Reserved
255	V	XXA5h XX is variable	Integrity word (Checksum and Signature) Bit[15:8] Checksum

Capacity (GB)	*1 (Word 1/Word 54)	*2 (Word 57 – 58)	*3 (Word 60 – 61)	*4 (Word 100 – 103)
240	3FFFh	FBFC10h	FFFFFFFh	1BF244B0h
480	3FFFh	FBFC10h	FFFFFFFh	37E436B0h
960	3FFFh	FBFC10h	FFFFFFFh	6FC81AB0h

7. ATA Command Set

[Command Set List]

Op Code	Support	Command	Op Code		Support	Command
00h	Y	NOP	C6h		Y	SET MULTIPLE
06h	Y	DATA SET MANAGEMENT	C8h		Y	READ DMA
07h	-	DATA SET MANAGEMENT XL	C9h		Y	READ DMA WITHOUT RETRY
0Bh	-	REQUEST SENSE DATA EXT	CAh		Y	WRITE DMA
10h	Y	RECALIBRATE	CBh		Y	WRITE DMA WITHOUT RETRY
11h-1Fh	-	RECALIBRATE	CEh		Y	WRITE MULTIPLE FUA EXT
20h	Y	READ SECTOR(S)	E0h		Y	STANDBY IMMEDIATE
21h	Y	READ SECTOR(S)S WITHOUT RETRY	E1h		Y	IDLE IMMEDIATE
24h	Y	READ SECTOR(S) EXT	E2h		Y	STANDBY
25h	Y	READ DMA EXT	E3h		Y	IDLE
27h	Y	READ NATIVE MAX ADDRESS EXT	E4h		Y	READ BUFFER
29h	Y	READ MULTIPLE EXT	E5h		Y	CHECK POWER MODE
2Ah	-	READ STREAM DMA EXT	E6h		Y	SLEEP
2Bh	-	READ STREAM EXT	E7h		Y	FLUSH CACHE
2Fh	Y	READ LOG EXT	E8h		Y	WRITE BUFFER
30h	Y	WRITE SECTOR(S)	E9h		Y	READ BUFFER DMA
31h	Y	WRITE SECTOR(S)S(S) WITHOUT RETRY	EAh		Y	FLUSH CACHE EXT
34h	Y	WRITE SECTOR(S) EXT	EBh		Y	WRITE BUFFER DMA
35h	Y	WRITE DMA EXT	ECh		Y	IDENTIFY DEVICE
37h	Y	SET MAX: ADDRESS EXT	EFh	02h	Y	SET FEATURES: Enable volatile write cache
38h	-	WRITE SECTORS WITHOUT ERASE	EFh	03h	Y	SET FEATURES: Set transfer mode
39h	Y	WRITE MULTIPLE EXT	EFh	05h	Y	SET FEATURES: Enable the APM feature set
3Ah	-	WRITE STREAM DMA EXT	EFh	06h	-	SET FEATURES: Enable the PUIS feature set
3Bh	-	WRITE STREAM EXT	EFh	07h	-	SET FEATURES: PUIS feature set device spin-up
3Dh	Y	WRITE DMA FUA EXT	EFh	0Bh	-	SET FEATURES: Enable Write-Read-Verify feature set

Op Code	Support	Command	Op Code			Support	Command
3Fh	Y	WRITE LOG EXT	EFh	0Ch		-	SET FEATURES: Enable device life control
40h	Y	READ VERIFY SECTOR(S)	EFh	10h	01h	-	SET FEATURES: Enable Non-zero Buffer Offsets
41h	Y	READ VERIFY SECTOR(S) WITHOUT RETRY	EFh	10h	02h	-	SET FEATURES: Enable DMA Setup FIS Auto-Activate optimization
42h	Y	READ VERIFY SECTOR(S) EXT	EFh	10h	03h	Y	SET FEATURES: Enable Device-initiated interface power state transitions
44h	-	Reserved	EFh	10h	04h	-	SET FEATURES: Enable Guaranteed In-Order Data Delivery
45h	Y	WRITE UNCORRECTABLE EXT	EFh	10h	06h	Y	SET FEATURES: Enable Software Settings Preservation
47h	Y	READ LOG DMA EXT	EFh	10h	07h	Y	SET FEATURES: Enable Device Automatic Partial to Slumber transitions
51h	-	CONFIGURE STREAM	EFh	10h	08h	-	SET FEATURES: Enable Hardware Feature Control
57h	Y	WRITE LOG DMA EXT	EFh	10h	09h	-	SET FEATURES: Enable Device Sleep
5Bh	Y	TRUSTED NON-DATA	EFh	41h		-	SET FEATURES: Enable the Free-fall Control feature set
5Ch	Y	TRUSTED RECEIVE	EFh	45h		-	SET FEATURES: Set rate basis
5Dh	Y	TRUSTED RECEIVE DMA	EFh	4Ah		-	SET FEATURES: Extended Power Condition feature
5Eh	Y	TRUSTED SEND	EFh	55h		Y	SET FEATURES: Disable read look-ahead feature
5Fh	Y	TRUSTED SEND DMA	EFh	62h	00h	-	SET FEATURES: Disable Long Physical Sector Alignment Error Reporting Control feature

60h	Y	READ FPDMA QUEUED	EFh	62h	01h	-	SET FEATURES: Enable Long Physical Sector Alignment Error Reporting Control feature

Op Code		Support	Command	Op Code			Support	Command
61h		Y	WRITE FPDMA QUEUED	EFh	63h	01h	-	SET FEATURES: Enable DSN feature
70h		Y	SEEK	EFh	63h	02h	-	SET FEATURES: Disable DSN feature
71-76h		-	SEEK	EFh	66h		-	SET FEATURES: Disable reverting to power-on defaults
77h		Y	SET DATE & TIME EXT	EFh	82h		Y	SET FEATURES: Disable volatile write cache
78h	00h	-	GET NATIVE MAX ADDRESS EXT	EFh	85h		Y	SET FEATURES: Disable the APM feature set
78h	01h	-	SET ACCESSIBLE MAX ADDRESS EXT	EFh	86h		Y	SET FEATURES: Disable the PUIS feature set
78h	02h	-	FREEZE ACCESSIBLE MAX ADDRESS EXT	EFh	8Bh		-	SET FEATURES: Disable Write-Read-Verify feature set
79-7Fh		-	SEEK	EFh	8Ch		-	SET FEATURES: Disable device life control
90h		Y	EXECUTE DEVICE DIAGNOSTIC	EFh	90h	01h	-	SET FEATURES: Disable Non-zero Buffer Offsets
91h		Y	INITIALIZE DEVICE PARAMETERS	EFh	90h	02h	Y	SET FEATURES: Disable DMA Setup FIS Auto-Activateoptimization
92h		Y	DOWNLOAD MICROCODE PIO	EFh	90h	03h	Y	SET FEATURES: Disable Device-initiated interface power state transitions
93h		Y	DOWNLOAD MICROCODE DMA	EFh	90h	04h	-	SET FEATURES: Disable Guaranteed In-Order Data Delivery
94h		-	STANDBY IMMEDIATE	EFh	90h	06h	Y	SET FEATURES: Disable Software Settings Preservation
95h		-	IDLE IMMEDIATE	EFh	90h	07h	Y	SET FEATURES: Disable Device Automatic Partial to Slumber transitions
96h		-	STANDBY	EFh	90h	09h	-	SET FEATURES: Disable Device Sleep

97h		-	IDLE	EFh	AAh	Y	SET FEATURES: Enable read look-ahead feature
98h		-	CHECK POWER MODE	EFh	C1h	-	SET FEATURES: Disable the Free-fall Control feature set
Op Code		**Support**	**Command**	**Op Code**		**Support**	**Command**
99h		-	SLEEP	EFh	C3h 00h	-	SET FEATURES: Disable Sense Data Reporting feature set
B0h	D0h	Y	SMART: READ DATA	EFh	C3h 01h	-	SET FEATURES: Enable Sense Data Reporting feature set
B0h	D2h	Y	SMART: ENABLE/DISABLE AUTOSAVE	EFh	C4h 00h	-	SET FEATURES: Disable sense data return for successful NCQ commands
B0h	D4h	Y	SMART: EXECUTE OFF-LINE IMMEDIATE	EFh	C4h 01h	-	SET FEATURES: Enable sense data return for successful NCQ commands
B0h	D5h	Y	SMART: READ LOG	EFh	CCh	Y	SET FEATURES: Enable reverting to power-on defaults
B0h	D6h	Y	SMART: WRITE LOG	F1h		Y	SECURITY SET PASSWORD
B0h	D8h	Y	SMART: ENABLE OPERATIONS	F2h		Y	SECURITY UNLOCK
B0h	D9h	Y	SMART: DISABLE OPERATIONS	F3h		Y	SECURITY ERASE PREPARE
B0h	DAh	Y	SMART: RETURN STATUS	F3h		Y	SECURITY ERASE PREPARE
B1h	C0h	Y	DEVICE CONFIGURATION: RESTORE	F4h		Y	SECURITY ERASE UNIT
B1h	C2h	Y	DEVICE CONFIGURATION: IDENTIFY	F5h		Y	SECURITY FREEZE LOCK
B1h	C3h	Y	DEVICE CONFIGURATION: SET	F6h		Y	SECURITY DISABLE PASSWORD
B1h	C4h	Y	DEVICE CONFIGURATION: IDENTIFY DMA	F8h		Y	READ NATIVE MAX ADDRESS
B1h	C5h	Y	DEVICE CONFIGURATION: SET DMA	F9h		Y	SET MAX: ADDRESS
B6h	01h	-	NV Cache: RETURN FROM NV CACHE POWER MODE	F9h	01h	Y	SET MAX: SET PASSWORD
B6h	15h	-	NV Cache: NV CACHE ENABLE	F9h	02h	Y	SET MAX: LOCK
B6h	16h	-	NV Cache: NV CACHE DISABLE	F9h	03h	Y	SET MAX: UNLOCK
C4h		Y	READ MULTIPLE	F9h	04h	Y	SET MAX: FREEZE LOCK
C5h		Y	WRITE MULTIPLE				

Note: 1. "Y" means "Support".
2. "O" means "Option, default No support".
3. "-" means "No support".

8. System Power Consumption

8.1 Supply Voltage

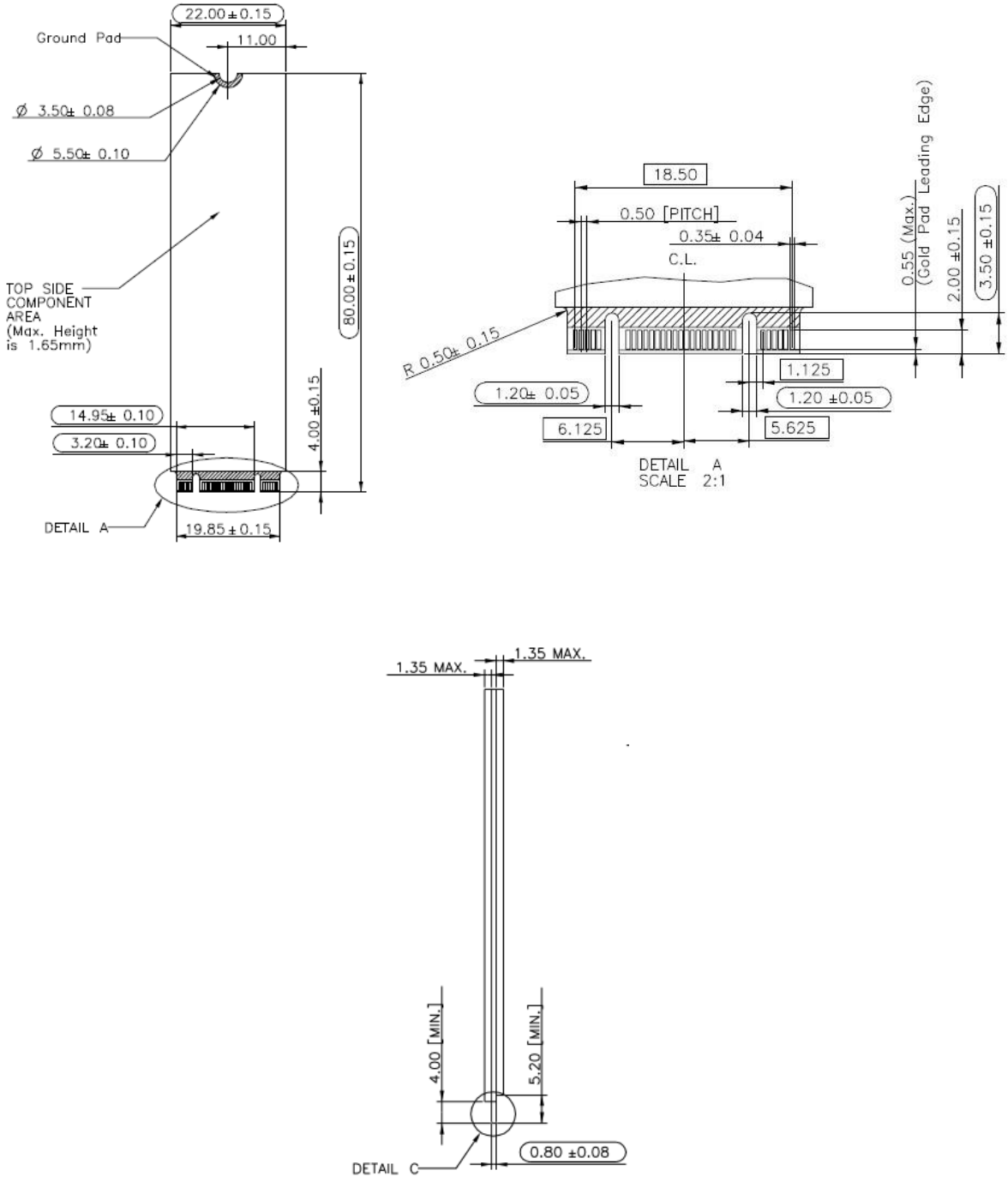
Parameter	Rating
Operating Voltage	3.3V DC, +/- 5%
Rise Time (Max/Min)	100 ms / 0.1 ms
Fall Time (Max/Min)	5 s / 10 ms
Min. Off Time1	1 s

8.2 Power Consumption

(Unit: mW)		Read	Write	Idle
3D TLC (BiCS5)	240 GB	1,900	2,000	1,200
	480 GB	1,900	2,400	1,200
	960 GB	1,900	2,900	1,200

9. Physical Dimension

M.2 2280 SATA SSD (Unit: mm)



Appendix: Part Number Table

Product	Advantech PN
SQF M.2 2280 SATA SSD 840V-D PLP (OPAL) 240G 3D TLC BiCS5 (0~70°C)	SQF-SM8V1-240GDVCC
SQF M.2 2280 SATA SSD 840V-D PLP (OPAL) 480G 3D TLC BiCS5 (0~70°C)	SQF-SM8V2-480GDVCC
SQF M.2 2280 SATA SSD 840V-D PLP (OPAL) 960G 3D TLC BiCS5 (0~70°C)	SQF-SM8V2-960GDVCC
SQF M.2 2280 SATA SSD 840V-D PLP (OPAL) 240G 3D TLC BiCS5 (-40~85°C)	SQF-SM8V1-240GDVCE
SQF M.2 2280 SATA SSD 840V-D PLP (OPAL) 480G 3D TLC BiCS5 (-40~85°C)	SQF-SM8V2-480GDVCE
SQF M.2 2280 SATA SSD 840V-D PLP (OPAL) 960G 3D TLC BiCS5 (-40~85°C)	SQF-SM8V2-960GDVCE