

UD info Corp.

Industrial M.2 2280 SATA Drive M2S-80DC Series Product DataSheet



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Revision History

Revision	Draft Date	History	Author
1.0	2019/5/2	New release	Golden Lee
1.1	2019/10/7	Update Performance / TBW / Power Consumption	Golden Lee
1.2	2020/4/8	Add wide temperature support for 2TB	Golden Lee
1.3	2020/9/2	Add Quick Erase function	Golden Lee
1.4	2021/7/20	Add BiCS4 support	Golden Lee
1.5	2022/5/12	Add BiCS5 support	Golden Lee
1.6	2022/10/20	Add BiCS5 wide temperature support	Golden Lee
1.7	2023/3/29	Removed safety certification	Golden Lee

Product Overview

- **Capacity**
 - 120GB up to 1920GB
- **Form Factor**
 - M.2 2280-D2-B-M
- **SATA Interface**
 - SATA Revision 3.1
 - SATA 1.5Gbps, 3Gbps, and 6Gbps interface
- **Flash Interface**
 - Flash Type: 3D TLC
 - Up to 4pcs of BGA132/152 flash
 - Up to 2pcs of BGA272 flash^{Note4}
- **Performance**
 - Read up to 550 MB/s
 - Write up to 530 MB/s
- **Power Consumption^{Note1}**
 - Active mode: < 3,000 mW
 - Idle mode: < 1,200 mW
- **Reliability**
 - MTBF: 2,000,000 hours
 - UBER^{Note2} < 1 sector per 10¹⁶ bits read
- **ECC**
 - LDPC / RAID ECC
 - Low density parity check code (>120bit/KBytes)
- **Temperature Range^{Note3}**
 - Operation Temperature:
 - Standard: 0°C ~ 70°C
 - Wide: -40°C ~ 85°C
 - Storage Temperature: -40°C ~ 85°C
- **RoHS Compliant**
- **EMI Compliant**
 - EN55032, CISPR 32 (CE)
 - AS/NZS CISPR 32 (CE)
 - ANSI C63.4 (FCC)
 - CNS 13438 (BSMI)
 - VCCI-CISPR 32 (VCCI)
- **Features Support List:**
 - End to end data path protection
 - Thermal throttling
 - Support of AES/TCG OPAL^{Note4}
- **Hardware Power Loss Protection Support^{Note5}**

Notes:

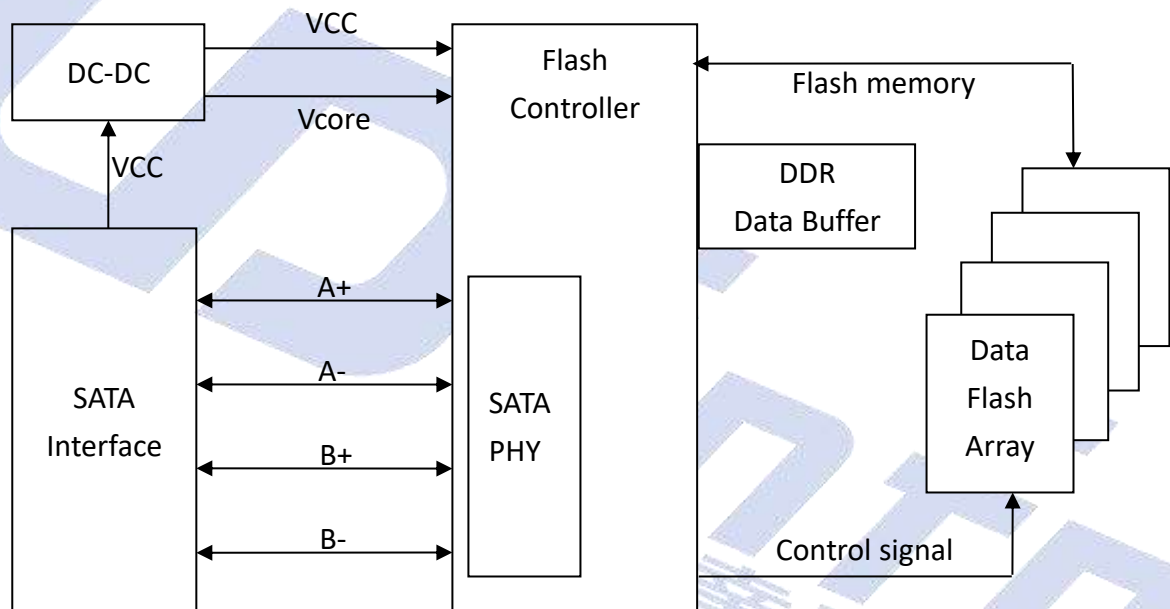
1. Please see "Power Consumption" for details.
2. Uncorrectable Bit Error Rate (UBER)
3. The operation temperature means the case temperature, in which can be detected via the SMART.
4. Supported by separate firmware version. Further information available upon request.
5. For Power Loss Protection PCBA and only support 120GB~960GB

1. INTRODUCTION

1.1. General Description

UDinfo's M.2 2280 SATA Drive delivers all the advantages of Flash Disk technology with the Serial ATA I/II/III interface and is fully compliant with the standard *Next Generation Form Factor* (NGFF) called M.2 Card Format, which is generated by Intel. The M.2 2280 SATA Drive is designed to operate at a maximum operating frequency of 400MHz with 25MHz external crystal. Its capacity could provide a wide range up to 2TB. Moreover, it can reach up to 550MB/s read as well as 530MB/s write high performance based on Kioxia 3D TLC NAND flash.

1.2. Block Diagram



M.2 2280 SSD Block Diagram

2. PRODUCT SPECIFICATIONS

2.1. Product Specifications

- **Capacity**
 - 120GB up to 1920GB
- **Electrical/Physical Interface**
 - SATA Interface
 - Compliant with SATA Revision 3.1
 - Compatible with SATA 1.5Gbps, 3Gbps and 6Gbps interface
 - Not Support LPM for Industrial grade product.
 - Support expanded register for SATA protocol 48 bits addressing mode
- **Support Hardware Quick Erase function (Optional)**
- **Support Hardware Power Loss Protection (Optional)**
 - Protect data loss, even the last data, during write process when power sudden off.
 - Add-on Polymer Tantalum Capacitors hold-up several milliseconds to keep DRAM data write to NAND Flash.

2.2. Device Capacity

Capacity	IDEMA Standard		User Data Size
	512Bytes/Sector	4KBytes/Sector	
	Total Sectors (LBA)	Total Sectors (LBA)	
120GB	234,441,648	29,305,206	Depended on file management
240GB	468,862,128	58,607,766	
480GB	937,703,088	117,212,886	
960GB	1,875,385,008	234,423,126	
1920GB	3,750,748,848	468,843,606	

Notes:

1. 1 Gigabyte (GB) is equal to 1,000,000,000 Bytes; 1 sector is equal to 512 Bytes.
2. The calculation is following IDEMA Standard.
3. The total actual user data size of the SSD may be less than device capacity due to SSD format,

SSD partition, operating system.

EX: OS shows 223.57GB (NTFS) with 240GB SSD.

2.3. Performance

■ Bics3 Sequential Read/Write Performance

Capacity	Flash Structure	Flash Type	Sequential (MB/s)	
			Read	Write
120GB	128GB x 1	Bics3, BGA272 ^{Note5}	550	170
240GB	64GB x 4	Bics3, BGA152	550	320
	128GB x 2	Bics3, BGA272 ^{Note5}	550	340
480GB	128GB x 4	Bics3, BGA152	550	500
	256GB x 2	Bics3, BGA272 ^{Note5}	550	500
960GB	256GB x 4	Bics3, BGA152	550	520
	512GB x 2	Bics3, BGA272 ^{Note5}	550	500
1920GB	512GB x 4	Bics3, BGA152	550	520

■ Bics4 Sequential Read/Write Performance

Capacity	Flash Structure	Flash Type	Sequential (MB/s)	
			Read	Write
240GB	64GB x 4	BGA, Bics4, DDP	550	370
480GB	128GB x 4	BGA, Bics4, QDP	550	500
960GB	256GB x 4	BGA, Bics4, QDP	550	530
1920GB	512GB x 4	BGA, Bics4, ODP	550	530

■ Bics5 Sequential Read/Write Performance

Capacity	Flash Structure	Flash Type	Sequential (MB/s)	
			Read	Write
240GB	128GB x 2	BGA, Bics5, DDP	550	150
480GB	128GB x 4	BGA, Bics5, DDP	550	340
960GB	256GB x 4	BGA, Bics5, QDP	550	530
1920GB	512GB x 4	BGA, Bics5, ODP	550	530

Notes:

1. The performance was measured CrystalDiskMark5.0x64 with SATA 6Gbps host and test data size is 1GB

2. The performance was estimated based on Kioxia BiCS TLC NAND flash.
3. Performance may differ according to flash configuration and platform.
4. Performance specification is under that Thermal Throttling has not worked yet.
5. For Power Loss Protection (PLP) function.

■ **Bics3 Random Read/Write Performance**

Capacity	Flash Structure	Flash Type	4KB Random (IOPS)	
			Read	Write
120GB	64GB x 2	Bics3, BGA, DDP	50,000	45,000
240GB	64GB x 4	Bics3, BGA, DDP	98,000	70,000
480GB	128GB x 4	Bics3, BGA, QDP	98,000	82,000
960GB	256GB x 4	Bics3, BGA, ODP	98,000	82,000
1920GB	512GB x 4	Bics3, BGA, ODP	98,000	88,000

■ **Bics4 Random Read/Write Performance**

Capacity	Flash Structure	Flash Type	4KB Random (IOPS)	
			Read	Write
240GB	64GB x 4	BGA, Bics4, DDP	91,000	84,000
480GB	128GB x 4	BGA, Bics4, QDP	98,000	85,000
960GB	256GB x 4	BGA, Bics4, QDP	98,000	89,000
1920GB	512GB x 4	BGA, Bics4, ODP	98,000	89,000

■ **Bics5 Random Read/Write Performance**

Capacity	Flash Structure	Flash Type	4KB Random (IOPS)	
			Read	Write
240GB	128GB x 2	BGA, Bics5, DDP	47,000	38,000
480GB	128GB x 4	BGA, Bics5, DDP	92,000	85,000
960GB	256GB x 4	BGA, Bics5, QDP	98,000	88,000
1920GB	512GB x 4	BGA, Bics5, ODP	98,000	88,000

Notes:

1. The performance was measured IOMeter v1.1.0 with QD32 for 4KB random read/write test. (Total test file is 8GB)
2. The performance was estimated based on Kioxia BiCS TLC NAND flash.
3. Performance may differ according to flash configuration and platform.
4. Performance specification is under that Thermal Throttling has not worked yet.

2.4. POR/SPOR Standby Ready Time

- Bics3 POR/SPOR Ready Time

Capacity	POR ready time		SPOR ready time	
	Typ.	Max.	Typ.	Max.
240GB	240	300	3,200	8,400
480GB	260	300	3,900	8,400
960GB	260	400	5,100	8,400
1920GB	300	400	6,100	13,000

Unit: ms

- Bics3 POR/SPOR Ready Time (Power Loss Protection enable)

Capacity	POR ready time		SPOR ready time	
	Typ.	Max.	Typ.	Max.
120GB	2,500	3,500	4,500	6,400
240GB	2,500	3,500	4,500	6,400
480GB	2,500	3,500	4,500	6,400
960GB	2,500	3,500	4,500	6,400

Unit: ms

- Bics4 POR/SPOR Ready Time

Capacity	POR ready time		SPOR ready time	
	Typ.	Max.	Typ.	Max.
240GB	240	260	1,780	2,640
480GB	260	290	2,250	5,380
960GB	240	290	2,060	4,120
1920GB	260	280	5,310	11,060

Unit: ms

- Bics5 POR/SPOR Ready Time

Capacity	POR ready time		SPOR ready time	
	Typ.	Max.	Typ.	Max.
240GB	300	310	1,700	2,700
480GB	300	310	2,000	3,000
960GB	300	310	2,500	4,000
1920GB	350	400	4,600	8,600

Unit: ms

Notes:

1. POR/SPOR stands for following:

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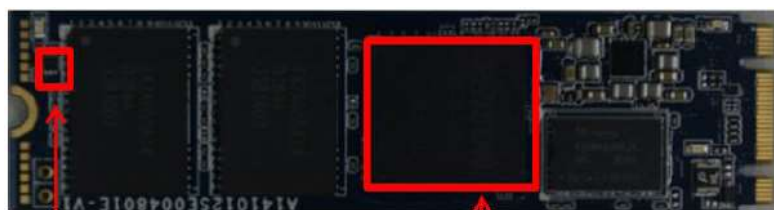
- (a.) POR: Power On Ready. (The ready time variation depends on data recover size.)
 - (b.) SPOR: Power On Ready after Sudden Power Off. (The ready time variation depends on data recover size.)
2. POR/SPOR ready time stands for following:
Power on Time: From Power On to SSD response after drive ready.
3. All the POR/SPOR data are testing by internal Pattern System. These data will be affected by different platforms and conditions.



2.5. Thermal Throttling

The purpose of thermal throttling is to prevent any components in a SSD from over-heating during read and write operations. The controller is designed with an on-die thermal sensor and with its accuracy, firmware can apply different levels of throttling to achieve the purpose of protection efficiently and proactively via S.M.A.R.T. reading.

- **SSD Configuration:**
 - Example 480GB SSD: (BiCS3 512Gb x 2CE) x 4pcs BGA132/152, total 8CE
 - CE = Chip Enable pins, max CE = All 8CE enabled. Total CE numbers depends on SSD configuration
- **Purpose of Thermal Throttling:**
 - In order to keep the optimal performance in the safe range of the temperature.
- **Thermal sensors:**
 - We have external thermal sensor & on-die thermal sensor (internal controller) to detect temperature. There is 1pcs external thermal sensor on PCB, the position depends on different form factor (The thermal sensor is shown below. The picture is for reference only).
 - External thermal sensor would detect flash temperature; On-die thermal sensor detect controller temperature.



External Thermal Sensor
On-die Thermal Sensor

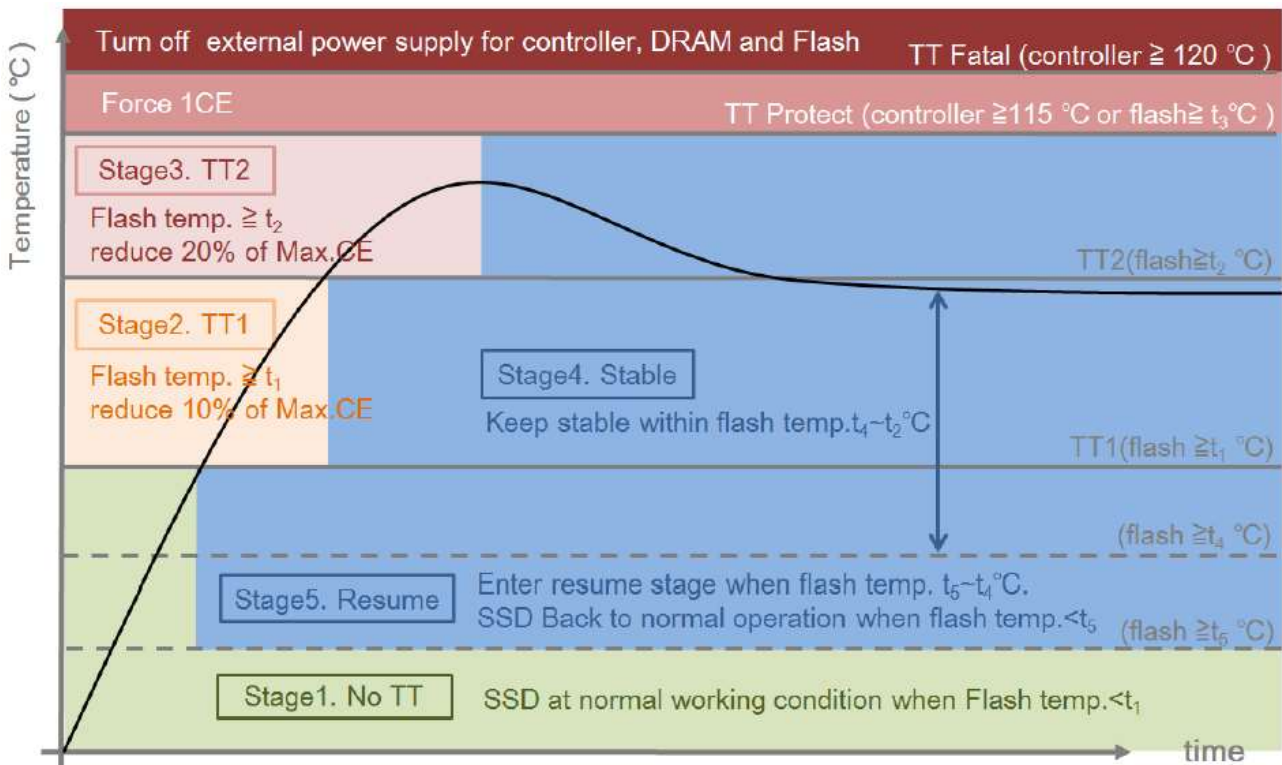


Figure 2-1 Thermal Throttling Schematic

	Operation temp. of Normal-temp. grade: 0-70°C	Operation temp. of Wide-temp. grade: -40-85°C
t₁	68°C	82°C
t₂	70°C	85°C
t₃	80°C	95°C
t₄	64°C	78°C
t₅	60°C	74°C

Notes:

1. TT shown on Figure 2-1 means “Thermal Throttling”.
2. CE = Chip Enable.
3. temp. = temperature

2.6. TCG Opal 2.0 (Optional)

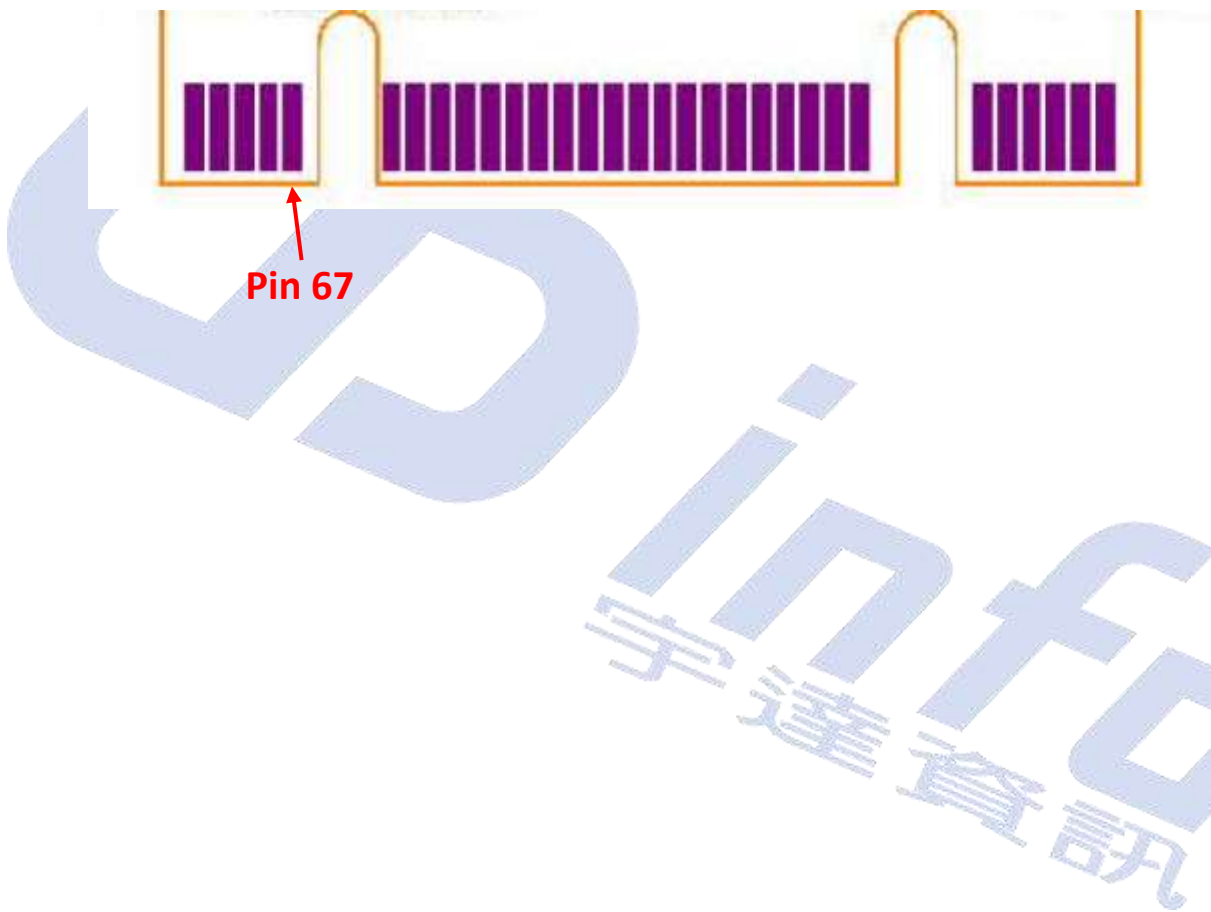
The Opal specification is a set of specifications for self-encrypting drives published by the Trusted Computing Group (TCG), a non-profit organization that develops, defines, and promotes standards and specifications for secure computing. The Opal Security Subsystem Class(SSC) 2.0 defines the details of data management in storage devices and the classes authority for data access, and secures data from theft and tampering by unauthorized persons who are able to gain access to the storage device or host system.

TCG Opal 2.0 Main Features:

- AES 256-bit Hardware 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.

2.7. Quick Erase Function (Optional)

The Quick Erase is a special feature to allow users to erase user data which used on finger pin67. When this feature is triggered (**Low Trigger**), the SSD controller will write all “0x00” to wipe all the data except firmware area, and the SSD will return to its factory default setting. This feature is particularly useful for emergent circumstances to quickly erase user data.



3. ENVIRONMENTAL SPECIFICATIONS

3.1. Environmental Conditions

3.1.1. Temperature Specification

	Mode	Min.	Max.	Unit
Temperature Ranges	Operation (Standard)	0	70	°C
	Operation (Wide)	-40	85	°C
	Storage	-40	85	°C
Humidity	Operation	5	95	%
	Storage	5	95	%
Temperature Cycle Test	Operation (Standard)	0	70	°C
	Operation (Wide)	-40	85	°C
	Storage	-40	85	°C

Notes:

- The operation temperature means the case temperature, in which can be detected via the S.M.A.R.T. Airflow is suggested and it will allow device to be operated at appropriate temperature for each component during heavy workloads environment.

3.1.2. Mechanical Specification

Items			Condition
Shock	Non-operational	Acceleration Force	1500G 0-p with half sine wave (0.5ms)
Vibration	Non-operational	Frequency/Displacement	20Hz~80Hz/1.52mm
		Frequency/Acceleration	80Hz~2000Hz/20G p-p with sine wave
Bending	Non-operational	≥ 20N	Hold 1min/5times
Drop	Non-operational	Height of Drop	80cm free fall
		Number of Drop	6 face of each unit
		Conflicting Material	Concrete floor

3.1.3. 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.

3.1.4. EMI Compliance

EMI Compliance
EN 55032, CISPR 32 (CE)
AS/NZS CISPR 32 (CE)
ANSI C63.4 (FCC)
VCCI-CISPR 32 (VCCI)
CNS 13438 (BSMI)
UL

3.2. TBW (Terabytes Written)

Capacity	Flash Type	TBW
120GB	Bics3	188
240GB	Bics3	378
480GB	Bics3	794
960GB	Bics3	1580
1920GB	Bics3	3118
240GB	Bics4	355
480GB	Bics4	825
960GB	Bics4	1697
1920GB	Bics4	3413
240GB	Bics5	285
480GB	Bics5	700
960GB	Bics5	1600
1920GB	Bics5	3260

Notes:

1. TBW is measured by JEDEC Client 219A workload and calculated with PE count = 3000.
2. TBW may differ according to flash configuration and platform.
3. The SSD supports trim function. If Operation System does not support trim command, performance and TBW will be affected. (Like certain Windows OS, Linux kernel version before 2.6.33, other OS please reference each own user manual)
4. The endurance of SSD could be estimated based on user behavior, NAND endurance cycles, and write amplification factor.

3.3. UBER

Capacity	UBER
120GB ~ 1920GB	< 1 sector per 10 ¹⁶ bits read

Notes:

1. UBER (Uncorrectable Bit Error Rates) means the uncorrectable error per bits read.
2. UBER = FER (fail rate) / Data Size (user data bit).
3. FER = uncorrectable ECC frame number / total ECC frame number.
4. The LDPC for Kioxia BiCS TLC ECC capability > 120bit/KB.

3.4. MTBF

MTBF, an acronym for Mean Time between Failures, is a measure of reliability of a device. Its value represents the average time between a repair and the next failure. The unit of MTBF is in hours. The higher the MTBF value, the higher the reliability of the device.

Our MTBF result is based on simulation software (Relax 7.3). Please note that a lower MTBF should be expected for higher capacity drives, and we apply the lowest MTBF for all capacities.

Capacity	MTBF
120GB ~ 1920GB	2 million hours

4. ELECTRICAL SPECIFICATIONS



4.1. Supply Voltage

Parameter	Rating
Operating Voltage	3.3V ± 5%
Rise Time (Max/Min)	100ms / 0.1ms
Fall Time (Max/Min)	5s / 10ms
Min. off Time	1s

Notes:

1. Minimum time between power removed from SSD ($V_{cc} < 100$ mV) and power re-applied to the drive.
2. Ensure the voltage of each power domain in SSD has enough time to discharge less than 0.1V.
3. Rise Time during from 10% to 90% of 3.3V.
4. Fall Time during from 90% to 10% of 3.3V.

4.2. Power Consumption

Capacity	Flash Structure	Flash Type	Read	Write	Idle
120GB	128GB x 1	Bics3, BGA272 ^{Note6}	2000	2000	800
240GB	64GB x 4	Bics3, BGA152	1400	1500	800
	128GB x 2	Bics3, BGA272 ^{Note6}	2000	2000	1000
480GB	128GB x 4	Bics3, BGA152	1500	1800	800
	256GB x 2	Bics3, BGA272 ^{Note6}	2000	2200	1000
960GB	256GB x 4	Bics3, BGA152	1500	2000	900
	512GB x 2	Bics3, BGA272 ^{Note6}	2000	2200	1000
1920GB	512GB x 4	Bics3, BGA152	1600	2100	900
240GB	64GB x 4	BGA, Bics4, DDP	1850	2200	1100
480GB	128GB x 4	BGA, Bics4, QDP	1850	2400	1100
960GB	256GB x 4	BGA, Bics4, QDP	2100	2800	1200
1920GB	512GB x 4	BGA, Bics4, ODP	2100	2800	1200
240GB	128GB x 2	BGA, Bics5, DDP	1900	2000	1200
480GB	128GB x 4	BGA, Bics5, DDP	1900	2500	1200
960GB	256GB x 4	BGA, Bics5, QDP	1900	2800	1200
1920GB	512GB x 4	BGA, Bics5, ODP	2000	3000	1200

Unit: mW

Notes:

1. The average value of power consumption is achieved based on 100% conversion efficiency.
2. The measured power voltage is 3.3V.
3. Samples were built using Kioxia BiCS TLC NAND flash and measured under normal temperature.
4. Sequential R/W is measured while testing 1GB sequential R/W 5 times by CrystalDiskMark.
5. Power Consumption may differ according to flash configuration and platform.
6. For Power Loss Protection (PLP) function.



5. INTERFACE



5.1. Pin Assignment and Descriptions

The follow table defines the signal assignment of the internal NGFF connector for SSD usage, described in the PCI Express M.2 Specification version 1.0 of the PCI-SIG.

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

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Pin #	SATA Pin	Description
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. When driven high the host is informing the SSD to enter a low 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 in platform Socket

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Pin #	SATA Pin	Description
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 Reserved for Quick Erase function (Low Active)
68	SUSCLK (I) (0/3.3V)	No Connect
69	CONFIG_1 = GND	Ground
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: N/C for Socket 2, and GND for Socket 3.



6. SUPPORTED COMMANDS



6.1. ATA Command List

Op Code	Support	Description	Op Code	Support	Description	
00h	Y	NOP	B6h	12h	-	NV Cache: QUERY NV CACHE PINNED SET DMA EXT
03h	-	CFA REQUEST EXTENDED ERROR	B6h	13h	-	NV Cache: QUERY NV CACHE MISSES DMA EXT
06h	Y	DATA SET MANAGEMENT	B6h	14h	-	NV Cache: FLUSH NV CACHE
08h	-	DEVICE RESET	C4h	Y	Y	READ MULTIPLE
0Bh	-	REQUEST SENSE DATA EXT	C5h	Y	Y	WRITE MULTIPLE
10h	Y	RECALIBRATE	C6h	Y	Y	SET MULTIPLE MODE
11h-1Fh	-	RECALIBRATE	C7h	-	-	READ DMA QUEUED
20h	Y	READ SECTOR(S)	C8h	Y	Y	READ DMA
21h	Y	READ SECTOR(S) WITHOUT RETRY	C9h	Y	Y	READ DMA WITHOUT RETRY
22h	-	READ LONG	CAh	Y	Y	WRITE DMA
23h	-	READ LONG WITHOUT RETRY	CBh	Y	Y	WRITE DMA WITHOUT RETRY
24h	Y	READ SECTOR(S) EXT	CCh	-	-	WRITE DMA QUEUED
25h	Y	READ DMA EXT	CDh	-	-	CFA WRITE MULTIPLE WITHOUT ERASE
26h	-	READ DMA QUEUED EXT	CEh	Y	Y	WRITE MULTIPLE FUA EXT
27h	Y	READ NATIVE MAX ADDRESS EXT	D1h	-	-	CHECK MEDIA CARD TYPE
29h	Y	READ MULTIPLE EXT	DAh	-	-	GET MEDIA STATUS
2Ah	-	READ STREAM DMA EXT	DEh	-	-	MEDIA LOCK
2Bh	-	READ STREAM EXT	DFh	-	-	MEDIA UNLOCK
2Fh	Y	READ LOG EXT	E0h	Y	Y	STANDBY IMMEDIATE
30h	Y	WRITE SECTOR(S)	E1h	Y	Y	IDLE IMMEDIATE
31h	Y	WRITE SECTOR(S) WITHOUT RETRY	E2h	Y	Y	STANDBY
32h	-	WRITE LONG	E3h	Y	Y	IDLE
33h	-	WRITE LONG WITHOUT RETRY	E4h	Y	Y	READ BUFFER
34h	Y	WRITE SECTOR(S) EXT	E5h	Y	Y	CHECK POWER MODE
35h	Y	WRITE DMA EXT	E6h	Y	Y	SLEEP
36h	-	WRITE DMA QUEUED EXT	E7h	Y	Y	FLUSH CACHE
37h	Y	SET MAX ADDRESS EXT	E8h	Y	Y	WRITE BUFFER

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Op Code	Support	Description	Op Code	Support	Description		
38h	-	CFA WRITE SECTORS WITHOUT ERASE	E9h	Y	READ BUFFER DMA		
39h	Y	WRITE MULTIPLE EXT	EAh	Y	FLUSH CACHE EXT		
3Ah	-	WRITE STREAM DMA EXT	EBh	Y	WRITE BUFFER DMA		
3Bh	-	WRITE STREAM EXT	ECh	Y	IDENTIFY DEVICE		
3Ch	-	WRITE VERIFY	EDh	-	MEDIA EJECT		
3Dh	Y	WRITE DMA FUA EXT	EEh	-	IDENTIFY DEVICE DMA		
3Eh	-	WRITE DMA QUEUED FUA EXT	EFh	01h	-	SET FEATURES: Enable 8-bit PIO transfer mode (CFA feature set only)	
3Fh	Y	WRITE LOG EXT	EFh	02h	Y	SET FEATURES: Enable write cache	
40h	Y	READ VERIFY SECTOR(S)	EFh	03h	Y	SET FEATURES: Set transfer mode based on value in Count field	
41h	Y	READ VERIFY SECTOR(S) WITHOUT RETRY	EFh	05h	Y	SET FEATURES: Enable advanced power management	
42h	Y	READ VERIFY SECTOR(S) EXT	EFh	06h	-	SET FEATURES: Enable Power-Up In Standby feature set	
44h	-	Reserved	EFh	07h	-	SET FEATURES: Power-Up In Standby feature set device spin-up	
45h	O	WRITE UNCORRECTABLE EXT	EFh	0Ah	-	SET FEATURES: Enable CFA power mode 1	
47h	Y	READ LOG DMA EXT	EFh	0Bh	-	SET FEATURES: Enable Write-Read-Verify feature set	
50h	-	FORMAT TRACK	EFh	10h	01h	-	SET FEATURES: Enable use of Serial ATA feature
51h	-	CONFIGURE STREAM	EFh	10h	02h	Y	SET FEATURES: Enable DMA Setup FIS Auto-Activate optimization
57h	Y	WRITE LOG DMA EXT	EFh	10h	03h	Y	SET FEATURES: Enable Device-initiated interface power state (DIPM) transitions
60h	Y	READ FPDMA QUEUED	EFh	10h	04h	-	SET FEATURES: Enable use of Serial ATA feature
61h	Y	WRITE FPDMA QUEUED	EFh	10h	05h	-	SET FEATURES: Enable use of Serial ATA feature
70h	Y	SEEK	EFh	10h	06h	O	SET FEATURES: Enable Software Settings Preservation (SSP)

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Op Code	Support	Description	Op Code	Support	Description
71-76h	-	SEEK	EFh 10h 07h	Y	SET FEATURES: Enable Device Automatic Partial to Slumber transitions
77h	Y	SET DATE AND TIME EXT	EFh 10h 09h	O	SET FEATURES: Enable Device Sleep
78h	Y	ACCESSIBLE MAX ADDRESS CONFIGURATION	EFh 42h	-	SET FEATURES: Enable Automatic Acoustic Management feature set
79-7Fh	-	SEEK	EFh 43h	-	SET FEATURES: Set Maximum Host Interface Sector Times
87h	-	CFA TRANSLATE SECTOR	EFh 44h	-	SET FEATURES: Vendor Specific ECC byte
90h	Y	EXECUTE DEVICE DIAGNOSTIC	EFh 55h	Y	SET FEATURES: Disable read look-ahead feature
91h	Y	INITIALIZE DEVICE PARAMETERS	EFh 5Dh	-	SET FEATURES: Enable release interrupt
92h	Y	DOWNLOAD MICROCODE	EFh 5Eh	-	SET FEATURES: Enable service interrupt
93h	Y	DOWNLOAD MICROCODE DMA	EFh 5Fh	-	SET FEATURES: Enable NDRQ Feature
94h	-	STANDBY IMMEDIATE	EFh 66h	Y	SET FEATURES: Disable reverting to power-on defaults
95h	-	IDLE IMMEDIATE	EFh 81h	-	SET FEATURES: Disable 8-bit PIO transfer mode (CFA feature set only)
96h	-	STANDBY	EFh 82h	Y	SET FEATURES: Disable write cache
97h	-	IDLE	EFh 85h	Y	SET FEATURES: Disable advanced power management
98h	-	CHECK POWER MODE	EFh 86h	-	SET FEATURES: Disable Power-Up In Standby feature set
99h	-	SLEEP	EFh 8Ah	-	SET FEATURES: Disable CFA power mode
A0h	-	PACKET	EFh 8Bh	-	SET FEATURES: Disable Write-Read-Verify feature set
A1h	-	IDENTIFY PACKET DEVICE	EFh 90h 01h	-	SET FEATURES: Disable use of Serial ATA feature
A2h	-	SERVICE	EFh 90h 02h	Y	SET FEATURES: Disable DMA Setup FIS Auto-Activate optimization

Op Code		Support	Description	Op Code		Support	Description
B0h	D0h	Y	SMART: READ DATA	EFh	90h 03h	Y	SET FEATURES: Disable Device-initiated interface power state (DIPM) transitions
B0h	D1h	Y	SMART: READ ATTRIBUTE THRESHOLDS	EFh	90h 04h	-	SET FEATURES: Disable use of Serial ATA feature
B0h	D2h	Y	SMART: ENABLE/DISABLE AUTOSAVE	EFh	90h 05h	-	SET FEATURES: Disable use of Serial ATA feature
B0h	D3h	Y	SMART: SAVE ATTRIBUTE VALUES	EFh	90h 06h	Y	SET FEATURES: Disable Software Settings Preservation (SSP)
B0h	D4h	Y	SMART: EXECUTE OFF-LINE IMMEDIATE	EFh	90h 07h	Y	SET FEATURES: Disable Device Automatic Partial to Slumber transitions
B0h	D5h	Y	SMART: READ LOG	EFh	90h 09h	0	SET FEATURES: Disable Device Sleep
B0h	D6h	Y	SMART: WRITE LOG	EFh	AAh	Y	SET FEATURES: Enable read look-ahead feature
B0h	D8h	Y	SMART: ENABLE OPERATIONS	EFh	BBh	-	SET FEATURES: Default ECC byte
B0h	D9h	Y	SMART: DISABLE OPERATIONS	EFh	C2h	-	SET FEATURES: Disable Automatic Acoustic Management feature set
B0h	DAh	Y	SMART: RETURN STATUS	EFh	C3h	-	SET FEATURES: Enable/Disable the Sense Data Reporting feature set
B0h	DBh	Y	SMART: ENABLE/DISABLE AUTOMATIC OFF-LINE	EFh	CCh	Y	SET FEATURES: Enable reverting to power-on defaults
B0h	E0h	-	SMART: Vendor specific	EFh	DDh	-	SET FEATURES: Disable release interrupt
B1h	C0h	Y	DEVICE CONFIGURATION: RESTORE	EFh	DEh	-	SET FEATURES: Disable SERVICE interrupt
B1h	C1h	Y	DEVICE CONFIGURATION: FREEZE LOCK	EFh	DFh	-	SET FEATURES: Disable NDRQ Feature
B1h	C2h	Y	DEVICE CONFIGURATION: IDENTIFY	F1h		Y	SECURITY SET PASSWORD
B1h	C3h	Y	DEVICE CONFIGURATION: SET	F2h		Y	SECURITY UNLOCK
B1h	C4h	Y	DEVICE CONFIGURATION: IDENTIFY DMA	F3h		Y	SECURITY ERASE PREPARE
B1h	C5h	Y	DEVICE CONFIGURATION: SET DMA	F4h		Y	SECURITY ERASE UNIT

Op Code		Support	Description	Op Code		Support	Description
B4h	0000h	O	SANITIZE DEVICE: SANITIZE STATUS EXT	F5h		Y	SECURITY FREEZE LOCK
B4h	0011h	O	SANITIZE DEVICE: CRYPTO SCRAMBLE EXT	F6h		Y	SECURITY DISABLE PASSWORD
B4h	0012h	O	SANITIZE DEVICE: BLOCK ERASE EXT	F8h		Y	READ NATIVE MAX ADDRESS
B4h	0014h	O	SANITIZE DEVICE: OVERWRITE EXT	F9h	00h	Y	SET MAX: SET MAX ADDRESS
B4h	0020h	O	SANITIZE DEVICE: SANITIZE FREEZE LOCK EXT	F9h	01h	Y	SET MAX: SET MAX PASSWORD
B4h	0040h	O	SANITIZE DEVICE: SANITIZE ANTIFREEZE LOCK EXT	F9h	02h	Y	SET MAX: SET MAX LOCK
B6h	00h	-	NV Cache: SET NV CACHE POWER MODE EXT	F9h	03h	Y	SET MAX: SET MAX UNLOCK
B6h	01h	-	NV Cache: RETURN FROM NV CACHE POWER MODE EXT	F9h	04h	Y	SET MAX: SET MAX FREEZE LOCK
B6h	10h	-	NV Cache: ADD LBA(S) TO NV CACHE PINNED SET DMA EXT	F9h	05h	Y	SET MAX: SET MAX SET PASSWORD DMA
B6h	11h	-	NV Cache: REMOVE LBA(S) FROM NV CACHE PINNED SET DMA EXT	F9h	06h	Y	SET MAX: SET MAX UNLOCK DMA

Notes:

“Y” means “Support”.

“O” means “Option, default not support”.

“-” means “Not support”.

6.2. Identify Device Data

The following table details the sector data returned by the IDENTIFY DEVICE command of ATA8-ACS4 SPEC.

Word	F: Fixed V: Variable X: retired/obsolete /reserved	Default Value	Description
0	F	0040h	General configuration bit-significant information
1	X	*1	Obsolete – Number of logical cylinders
2	F	C837h	Specific configuration
3	X	0010h	Obsolete – Number of logical heads (16)
4-5	X	00000000h	Retired
6	X	003Fh	Obsolete – Number of logical sectors per logical track (63)
7-8	X	00000000h	Reserved for assignment by the Compact Flash Association
9	X	0000h	Retired
10-19	V	Varies	Serial number (20 ASCII characters)
20-21	X	0000h	Retired
22	X	0000h	Obsolete
23-26	V	Varies	Firmware revision (8 ASCII characters)
27-46	V	Varies	Model number (xxxxxxxx)
47	F	8010h	7:0- Maximum number of sectors transferred per interrupt on MULTIPLE commands
48	F	4000h	Reserved
49	F	2F00h	Capabilities
50	F	4000h	Capabilities
51-52	X	000000000h	Obsolete
53	F	0007h	Words 88 and 70:64 valid
54	X	*1	Obsolete – Number of logical cylinders
55	X	0010h	Obsolete – Number of logical heads (16)
56	X	003Fh	Obsolete – Number of logical sectors per track (63)
57-58	X	*2	Obsolete – Current capacity in sectors
59	F	0110h	Number of sectors transferred per interrupt on 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

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Word	F: Fixed V: Variable X: retired/obsolete /reserved	Default Value	Description
64	F	0003h	PIO modes 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	F	1F00h	Additional Supported
70	X	0000h	Reserved
71-74	X	000000000000 0000h	Reserved for the IDENTIFY PACKET DEVICE command
75	F	001Fh	Queue depth
76	F	850Eh	Serial SATA capabilities
77	F	0006h	Supported Serial ATA Phy speed
78	F	004Ch	Serial ATA features supported
79	F	0040H	Serial ATA features enabled
80	F	0FF8h	Major Version Number
81	F	0000h	Minor Version Number
82	F	746Bh	Command set supported
83	F	7D01h	Command set supported
84	F	4163h	Command set/feature supported extension
85	F	7469h	Command set/feature supported or enabled
86	F	BC01h	Command set/feature supported or enabled
87	F	4163h	Command set/feature supported or enabled
88	F	007Fh	Ultra DMA Modes
89	F	000Ah	Time required for Normal Erase mode SECURITY ERASE UNIT command
90	F	001Eh	Time required for an Enhanced Erase mode SECURITY ERASE UNIT command
91	F	0000h	Current advanced power management value
92	F	FFFEh	Master Password Revision Code
93	F	0000h	Hardware reset result. The contents of the bits (12:0) of this word can be changed only during the execution of hardware

Word	F: Fixed V: Variable X: retired/obsolete /reserved	Default Value	Description
			reset.
94	X	0000h	Vendor's recommended and actual acoustic management 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
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 in microseconds
108-111	F	Varies	Reserved
112-115	X	000000000000 0000h	Reserved
116	X	0000h	Reserved
117-118	F	00000000h	Words per logical Sector
119	F	401Ch	Supported settings
120	F	401Ch	Command set/Feature Enabled/Supported
121-126	X	0h	Reserved
127	X	0h	Obsolete
128	F	0021h	Security status
129-159	V	Varies	Vendor specific
160	X	0h	Compact Flash Association (CFA) power mode 1
161-167	X	0h	Reserved for assignment by the CFA
168	V	Varies	Device Nominal Form Factor
169	F	0001h	DATA SET MANAGEMENT command is supported
170-173	F	0h	Additional Product Identifier
174-175	X	0h	Reserve
176-205	F	0h	Current media serial number
206	F	0039h	SCT Command Transport{

Word	F: Fixed V: Variable X: retired/obsolete /reserved	Default Value	Description
207-208	X	0h	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	NV Cache relate (not support)
217	F	0001h	Non-rotating media device
218	X	0h	Reserved
219	X	0h	NV Cache relate (not support)
220	V	0h	Write read verify feature set current mode
221	X	0h	Reserved
222	F	10FFh	Transport major version number
223	F	0h	Transport minor version number
224-229	X	0h	reserved
230-233	F	0h	Extend number of user addressable sectors
234	F	0001h	Minimum number of 512-byte data blocks per DOWNLOAD MICROCODE command for mode 03h
235	F	FFFEh	Maximum number of 512-byte data blocks per DOWNLOAD MICROCODE command for mode 03h
236-242	X	0h	Reserved
243	X	0000h	Reserved
244-254	X	0h	Reserved
255	F	XXA5h XX is variable	Integrity word (Checksum and Signature)

■ List of Device Identification for Each Capacity

Capacity (GB)	*1 (Word 1/Word 54)	*2 (Word 57-58)	*3 (Word 60-61)	*4 (Word 100-103)
120	3FFFh	FBFC10h	0FFFFFFFh	DF94BB0h
240	3FFFh	FBFC10h	0FFFFFFFh	1BF244B0h
480	3FFFh	FBFC10h	0FFFFFFFh	37E436B0
960	3FFFh	FBFC10h	0FFFFFFFh	6FC81AB0h
1920	3FFFh	FBFC10h	0FFFFFFFh	DF8FE2B0h

6.3. S.M.A.R.T. Attributes

Attribute ID	Description
01h	Number of Accumulation of Uncorrectable Error.
09h	Power on Hours Count.
0Ch	Drive Power Cycle Count (number of accumulation of power on/off cycles)
A8h	SATA PHY Error Count (Only record from power on, when power off this value will clear to zero. These values include all PHY error count, ex data FIS CRC, code error, disparity error, command FIS CRC.....)
AAh	Bad Block Count (early bad count and later bad count)
ADh	Erase Count (max. erase count and average erase count)
C0h	Number of Unexpected Power Loss
C2h	Temperature
DAh	Number of Accumulation CRC Error (read/write data FIS CRC error)
E7h	SSD Life Remaining
F1h	Host Write(GB)

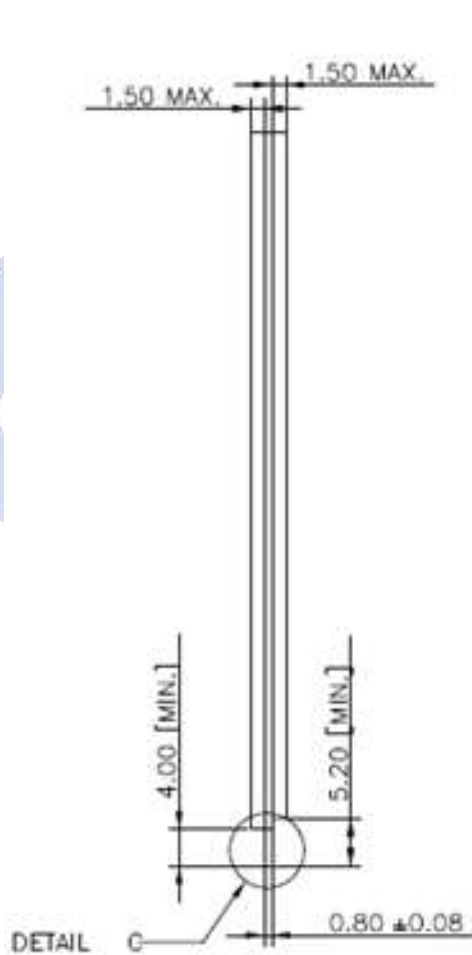


7. PHYSICAL DIMENSION

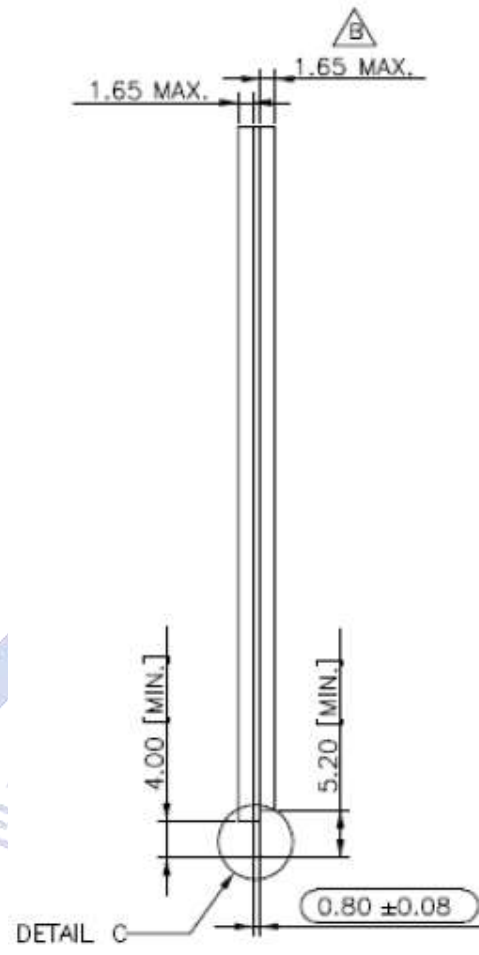


Type1. Dimension (double side): 80mm(L) x 22mm(W) x 3.8mm(H)

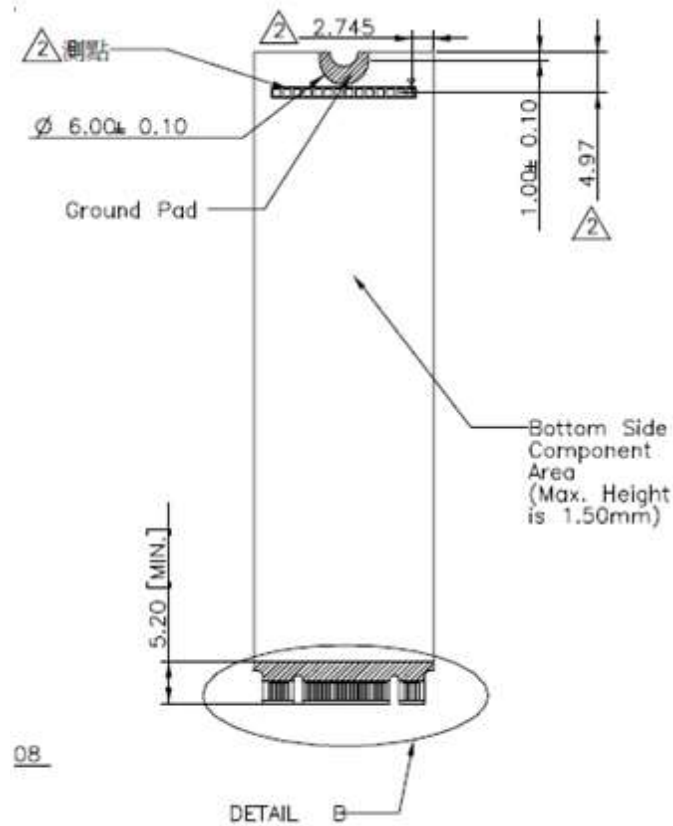
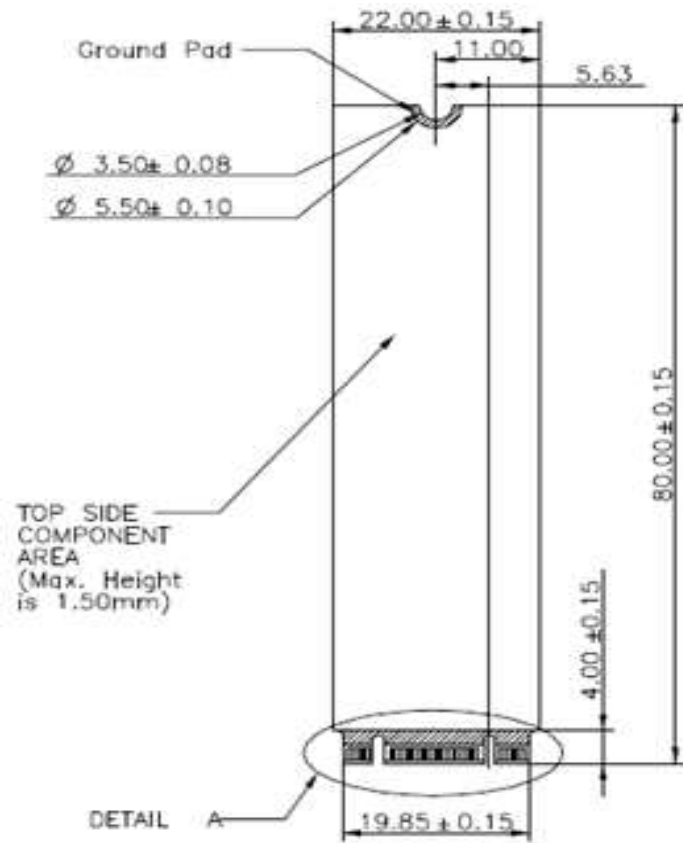
Type2. Dimension (double side): 80mm(L) x 22mm(W) x 4.1mm(H) for PLP PCBA

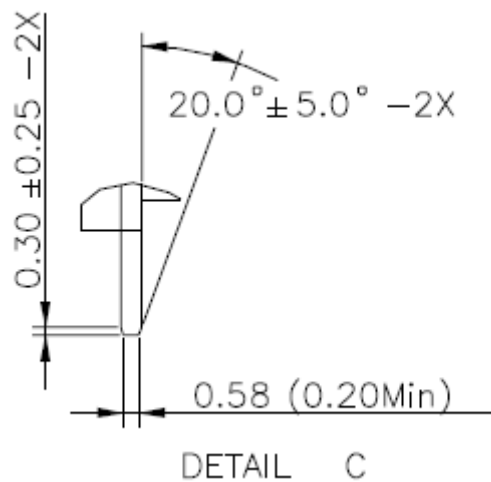
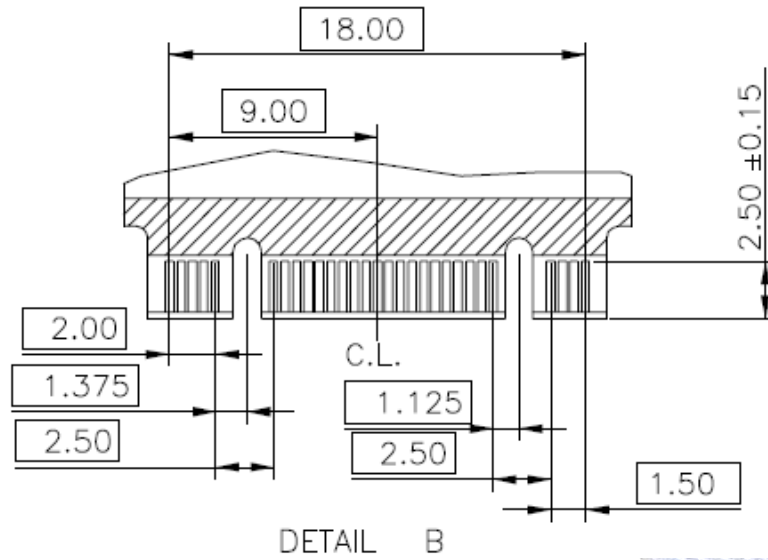
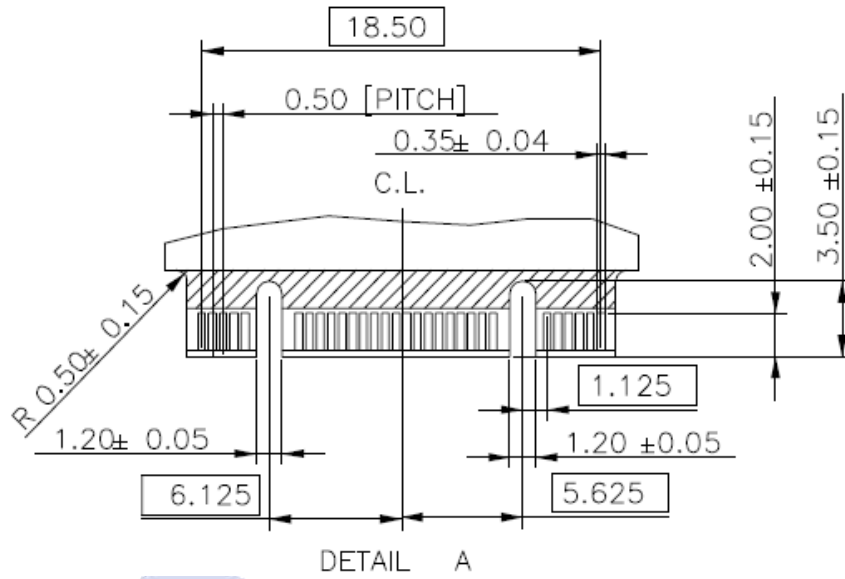


Type 1



Type 2





8. TERMINOLOGY



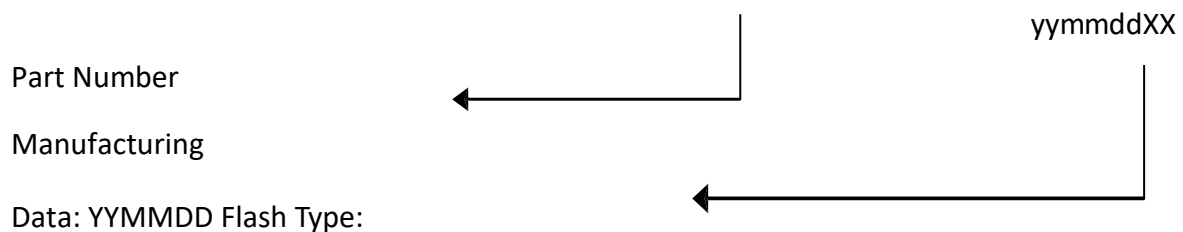
The following table is to list out the acronyms that have been applied throughout the document.

Term	Definitions
ATTO	Commercial performance benchmark application
DDR	Double data rate (SDRAM)
DIPM	Device initiated power management
HIPM	Host initiated power management
LBA	Logical block addressing
MB	Mega-byte
MTBF	Mean time between failures
NCQ	Native command queue
SATA	Serial advanced technology attachment
S.M.A.R.T.	Self-monitoring, analysis and reporting technology
SSD	Solid state disk

9. BARCODE DESCRIPTION



M 2 S 8 0 D C 9 6 0 G B A 8 P



10. PARTNUMBER DECODER



M2S-80DCX⁸X⁹X¹⁰X¹¹X¹²X¹³X¹⁴X¹⁵X¹⁶X¹⁷

X ¹ X ² X ³	X ⁴ X ⁵	X ⁶ X ⁷	X ⁸ X ⁹ X ¹⁰ X ¹¹ X ¹²	X ¹³	X ¹⁴	X ¹⁵	X ¹⁶ X ¹⁷
M2S	80	DC	120GB 240GB 480GB 960GB 1920G	A: 3D TLC Standard (0°C ~ +70°C) B: 3D TLC Industrial (-40°C ~ +85°C)	8	P	blank
X¹⁶X¹⁷ Blank: standard 06: Conformal Coating (CC) 27: Quick Erase with connector pin 31: AES + OPAL 32: PLP + AES + OPAL 39: Quick Erase with connector pin + AES + OPAL 43: AES + OPAL + CC							

