

# MLC

## M.2 SATA III Module

### PHANES-K Series

( 2242 & 2280 Form factor )

Document No. : 100-xBMDS-PKCTMB

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ISO 9001 : 2015 CERTIFIED



### Product Features

#### ■ Flash IC

- TOSHIBA 15nm NAND Flash IC.
- Multi-Level Cell (MLC) management

#### ■ Compatibility

- SATA Revision 3.2
- SATA 1.5Gbps/3.0Gbps/6.0Gbps data transfer rate.
- ATA-8 ACS4 command set

#### ■ Additional Capabilities

- S.M.A.R.T.\*<sup>1</sup> (Self-Monitoring, Analysis and Reporting Technology) feature set support.
- Thermal Monitor for SSD's temperature. (Optional)
- Native Command Queuing (NCQ) support.
- TRIM maintenance command support.
- Both Static & Dynamic wear-leveling algorithm
- Hardware Low Density Parity Check Code, LDPC support.

#### ■ Mechanical

- Interface compatible with PCI Express™ M.2
- M.2 2242-D3-B-M form-factor
- M.2 2280-D5-B-M form-factor
- **Dimension:**
- **2242:** 42 mm x 22 mm.
- **2280:** 80 mm x 22 mm.
- **Weight:**
- **2242:** 5.0 g / 0.17 oz.
- **2280:** 8.0 g / 0.28 oz.

#### ■ Power Operating Voltage 3.3V(+/-) 5%

- Read Mode: 1,500.0 mW (max.)
- Write Mode: 2,650.0 mW (max.)
- Idle Mode: 280.0 mW (max.)

#### ■ Performance (Maximum value)<sup>2</sup>

- Sequential Read: 550.0 MB/sec. (max.)
- Sequential Write: 490.0 MB/sec. (max.)

#### ■ Capacity

- **2242:** 8GB, 16GB, 32GB, 64GB, 128GB and 256GB
- **2280:** 8GB, 16GB, 32GB, 64GB, 128GB, 256GB and 512GB

#### ■ Reliability

- **TBW:** Up to 540 TBW at 512GB Capacity. (Client workload by JESD-219A)
- **ECC:** Designed with hardware LDPC ECC engine with hard-decision and soft-decision decoding.
- **Temperature:** (Operating)  
Standard Grade: 0°C ~ +70°C  
Wide Temp. Grade: -40°C ~ +85°C
- **Vibration:** 80 Hz to 2000 Hz, 20G, 3 axes
- **Shock:** 0.5ms, 1500 G, 3 axes

#### ■ Certifications and Declarations

- **Certifications:** CE & FCC
- **Declarations:** RoHS & REACH


#### Remarks:

1. Support official S.M.A.R.T. Utility.
2. Sequential performance is based on CrystalDiskMark 5.1.2 with file size 1000MB


### Order Information

#### I. Part Number List

##### ◆ APRO MLC M.2-2242 Form-factor SATA III Module PHANES-K Series

Product Picture	Grade	Standard grade (0°C ~ 70°C)	Wide Temp Grade ( -40°C ~ +85°C )
	8GB	SBMDS008G-PKCTM4BM(T)	WBMDS008G-PKCTM4BM(T)C
	16GB	SBMDS016G-PKCTM4BM(T)	WBMDS016G-PKCTM4BM(T)C
	32GB	SBMDS032G-PKCTM4BM(T)	WBMDS032G-PKCTM4BM(T)C
	64GB	SBMDS064G-PKCTM4BM(T)	WBMDS064G-PKCTM4BM(T)C
	128GB	SBMDS128G-PKCTM4BM(T)	WBMDS128G-PKCTM4BM(T)C
	256GB	SBMDS256G-PKCTM4BM(T)	WBMDS256G-PKCTM4BM(T)C

##### ◆ APRO MLC M.2-2280 Form-factor SATA III Module PHANES-K Series

Product Picture	Grade	Standard grade (0°C ~ 70°C)	Wide Temp Grade ( -40°C ~ +85°C )
	8GB	SBMDS008G-PKCTM8BM(T)	WBMDS008G-PKCTM8BM(T)C
	16GB	SBMDS016G-PKCTM8BM(T)	WBMDS016G-PKCTM8BM(T)C
	32GB	SBMDS032G-PKCTM8BM(T)	WBMDS032G-PKCTM8BM(T)C
	64GB	SBMDS064G-PKCTM8BM(T)	WBMDS064G-PKCTM8BM(T)C
	128GB	SBMDS128G-PKCTM8BM(T)	WBMDS128G-PKCTM8BM(T)C
	256GB	SBMDS256G-PKCTM8BM(T)	WBMDS256G-PKCTM8BM(T)C
	512GB	SBMDS512G-PKCTM8BM(T)	WBMDS512G-PKCTM8BM(T)C

#### Notes:

**C** : Special conformal coating treated on whole PCBA which may support industrial grade operating temperature -40°C ~ +85°C

### II. Part Number Decoder:

**X1 X2 X3 X4 X5 X6 X7 X8 X9** — **X11 X12 X13 X14 X15 X16 X17 X18 X19 X20**

**X1** : Grade

**S**: Standard Grade – operating temp. 0° C ~ 70 ° C

**W**: Wide Temp Grade- operating temp. -40° C ~ +85 ° C

**X2** : The material of case

**B** : Bare PCBA w/o Casing

**X3 X4 X5** : Product category

**MDS** : M.2 SATA SSD

**X6 X7 X8 X9** : Capacity

<b>008G:</b>	8GB	<b>128GB:</b>	128GB
<b>016GB:</b>	16GB	<b>256GB:</b>	256GB
<b>032G:</b>	32GB	<b>512GB:</b>	512GB
<b>064G:</b>	64GB		

**X11** : Controller

**P** : PHANES Series

**X12** : Controller version

**A, B, C.....**

**X13** : Controller Grade

**C** : Commercial grade

**X14** : Flash IC

**T** : Toshiba NAND Flash IC

**X15** : Flash IC grade / Type

**M** : MLC-NAND Flash IC

**X16 X17 X18** : Form-Factor

**4**: 2242 form-factor

**8**: 2280 form-factor

**BM**: B + M Key.

**X19 X20** : Reserved for specific requirement

**Blank** : Standard product w/o thermal sensor and conformal-coating

**T** : Thermal Sensor (optional)

**C** : Conformal coating (optional)

### Revision History

Revision	Description	Date
1.0	Initial release.	2018/07/05
1.1	Add the option for thermal sensor	2018/11/02
1.2	Updated Version	2018/11/28
1.3	Corrected decryptions.	2019/03/20
2.0	Updated document form	2019/06/13

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### 1. Introduction

APRO MLC M.2 SATA III Module PHANES-K Series provides high capacity flash memory Solid State Drive (SSD) that electrically complies with SATA Revision 3.2 standard. APRO MLC M.2 SATA III Module PHANES-K Series support SATA 1.5Gbps/ 3.0Gbps/ 6.0Gbps data transfer rate with high performance. The available disk capacities are 8GB, 16GB, 32GB, 64GB, 128GB, 256GB and 512GB. The operating temperature grade is optional for Standard grade 0°C ~ 70°C and wide temp grade with conformal coating supports -40°C ~ +85°C.

APRO MLC M.2 SATA III Module PHANES-K Series provide the ultra-high speed for embedded or server operations with space constraints for host computing systems; the data transfer performance by sequential read is up to 550.0 MB/sec, and sequential write is up to 490.0 MB/sec. which is based on Toshiba’s 15nm Toggle MLC flash.

APRO PHANES-K Series M.2 SSD PCB design with two notches in B and M positions use up to two PCI Express lanes and provide broader compatibility at the same time for M/B socket mounting, while the M.2 modules with only one notch in the M position use up to four PCI Express lanes; both examples we provide APRO MLC M.2 SATA III Module PHANES-K Series to be a SATA storage devices.

APRO MLC M.2 SATA III Module PHANES-K Series provides a high level interface to the host computer. This interface allows a host computer to issue commands to the APRO MLC M.2 SATA III Module PHANES-K Series to read or write blocks of memory. A powerful hardware design is architecture multiplied LDPC (Low Density Parity Check) for Error Correcting Coding (ECC). APRO MLC M.2 SATA III Module PHANES-K Series intelligent controller manages interface protocols, data storage and retrieval as well as ECC, bad block management and diagnostics, power management and clock control.

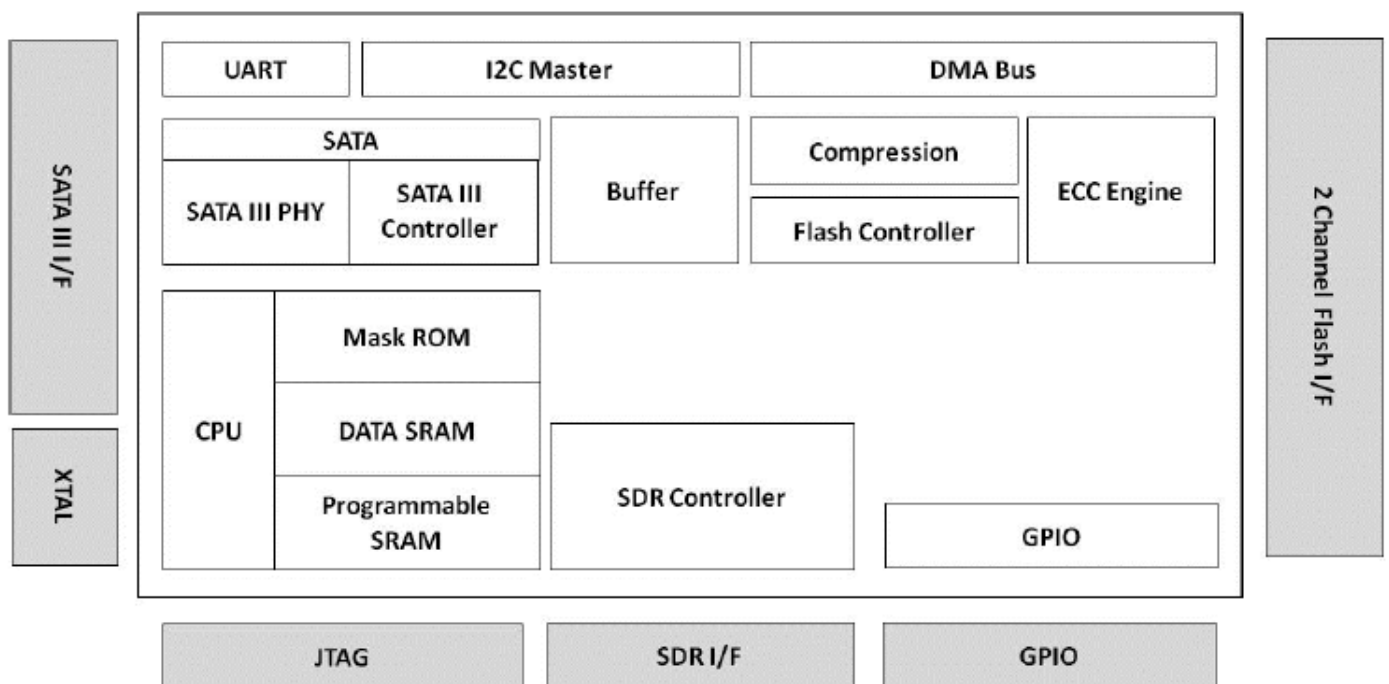


Figure 1: APRO MLC M.2 SATA III Module PHANES-K Series block diagram

### 1.1. *Scope*

This document describes features, specifications and installation guide of APRO MLC M.2 SATA III Module PHANES-K Series. In the appendix, there provides order information, warranty policy, RMA/DOA procedure for the most convenient reference.

### 1.2. *Flash Management Technology - Static & Dynamic 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.

APRO MLC M.2 SATA III Module PHANES-K Series 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.

### 1.3. *Bad Block Management*

#### ➤ **Early Bad Block**

The fault block generated during the manufacturing process of NAND Flash is called Early Bad Block.

#### ➤ **Later Bad Block**

In the process of use, as the number of operations of writing and erasing increases, a fault block is gradually generated, which is called a Later Bad Block.

**Bad block management** is a management mechanism for a bad block to be detected by the control IC and mark bad blocks in the NAND Flash and improve the reliability of data access. The bad block management mechanism of the control IC will establish a **Bad Block Table** when the NAND Flash is started for the first time, and will also record the errors found in the process of use in the bad block table, and data is ported to new valid blocks to avoid data loss.

In order to detect the initial bad blocks to handle run time bad blocks, APRO MLC M.2 SATA III Module PHANES-K Series provides the **Bad Block Management** scheme. It remaps a bad block to one of the reserved blocks so that the data contained in one bad block is not lost and new data writes on a bad block is avoided.



## 2. Product Specifications

For all the following specifications, values are defined at ambient temperature and nominal supply voltage unless otherwise stated.

### 2.1. System Environmental Specifications

Table 1: Environmental Specification

APRO MLC M.2 2242/2280 SATA III Module		Standard Grade	Wide Temp Grade
PHANES-K Series		SBMDSxxxG-PKCTMBxBM	WBMDSxxxG-PKCTMBxBMC
Temperature	Operating:	0°C ~ +70°C	-40°C ~ +85°C
	Non-operating:	-20°C ~ +80°C	-50°C ~ +95°C
Humidity	Operating & Non-operating:	10% ~ 95% non-condensing	
Vibration	Frequency/Acceleration:	80 Hz to 2000 Hz, 20G, 3 axes	
Shock	Operating & Non-operating:	0.5ms, 1500 G, 3 axes	
Electrostatic Discharge (ESD)	Temperature:	24°C	
	Relative Humidity:	49% (RH)	
	+/-4KV:	Device functions are affected, but EUT will be back to its normal or operational state automatically.	

### 2.2. System Power Requirements

Table 2: Power Requirement

APRO MLC M.2 2242/2280 SATA III Module PHANES-K Series		
DC Input Voltage (VCC)		3.3V±5%
(Maximum average value)	Reading Mode :	1,165mW (2242/256GB max.) 1,500mW (2280/512GB max.)
	Writing Mode :	1,535mW (2242/256GB max.) 2,650mW (2280/512GB max.)
	Idle Mode :	260mW (2242/256GB max.) 280mW (2280/512GB max.)

### 2.3. System Performance

Table 3: System Performances

Data Transfer Mode supporting		Serial ATA Gen-III (6.0Gb/s = 768MB/s)						
Maximum Performance	Capacity	8GB	16GB	32GB	64GB	128GB	256GB	512GB
	Sequential Read (MB/s)	320.0	320.0	550.0	550.0	550.0	550.0	550.0
	Sequential Write (MB/s)	105.0	85.0	175.0	335.0	465.0	490.0	490.0

Note:

1. The performance was measured using CrystalDiskMarkv5.0x64 with SATA 6Gbps host.
2. Samples were built using Toshiba 15nm MLC
3. Performance may differ according to flash configuration and platform.

### 2.4. System Reliability

**Table 4: System Reliability**

<b>Wear-leveling Algorithms</b>		Static and Dynamic wear-leveling algorithms
<b>Bad Block Management</b>		Supportive
<b>ECC Technology</b>		Hardware design LDPC (Low Density Parity Check)
<b>Erase counts</b>		NAND MLC Flash Cell Level : 3K P/E Cycles
<b>TBW (Tera Bytes Written)</b>		
<b>Capacity</b>	<b>8GB</b>	3.0
	<b>16GB</b>	6.0
	<b>32GB</b>	13.0
	<b>64GB</b>	30.0
	<b>128GB</b>	87.0
	<b>256GB</b>	198.0
	<b>512GB</b>	540.0

Note:

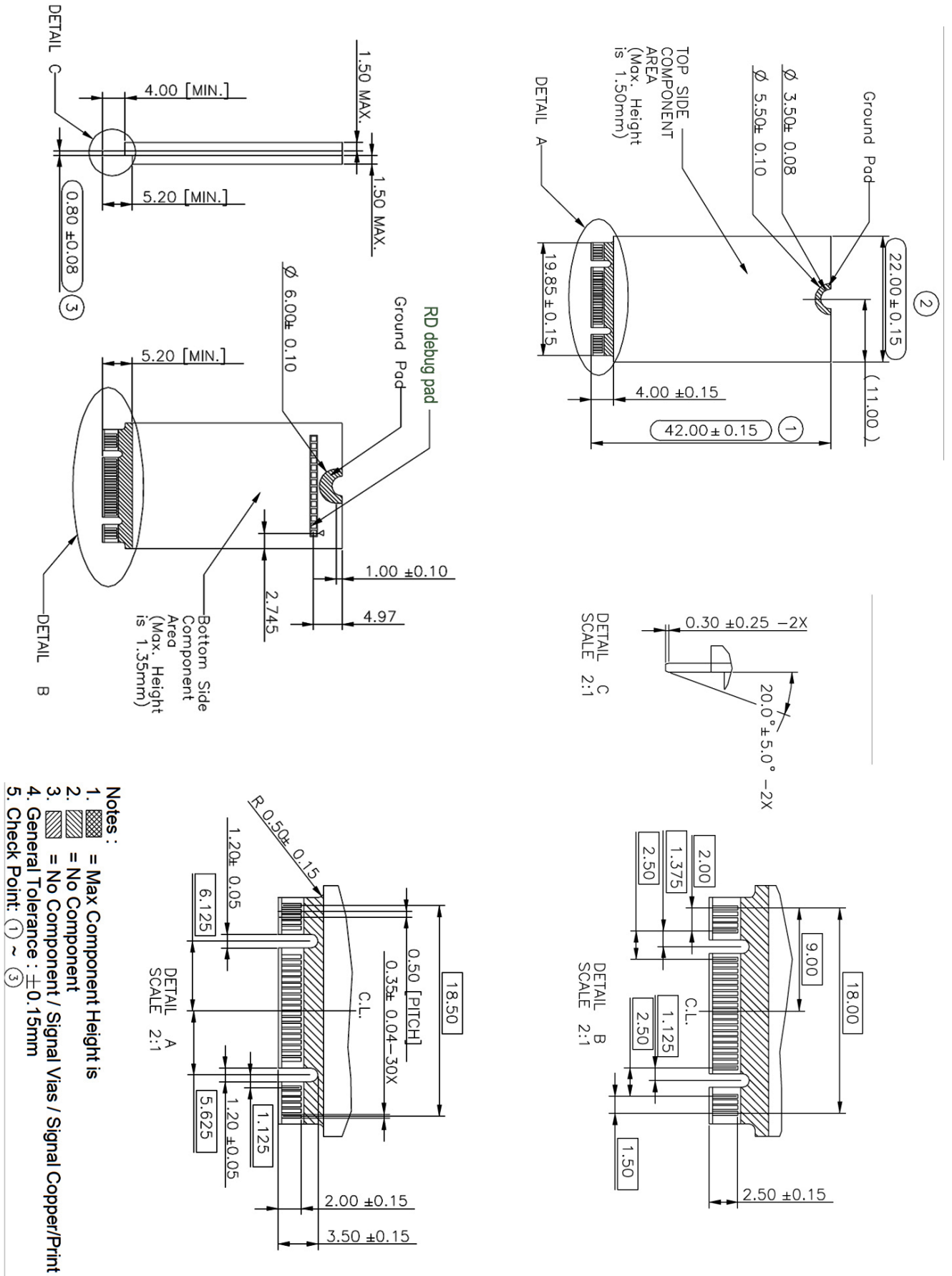
- Samples were built using Toshiba 15nm Toggle MLC NAND flash.
- Client workload by JESD-219A.
- The endurance of SSD could be estimated based on user behavior, NAND endurance cycles, and write amplification factor. It is not guaranteed by flash vendor.

### 2.5. Physical Specifications

Refer to Table 5 and see Figure 2 for APRO MLC M.2 SATA III Module PHANES-K Series physical specifications and dimensions.

**Table 5: Physical Specifications of APRO MLC M.2 SATA III Module PHANES-K Series**

<b>Form-Factor</b>	<b>Length:</b>	<b>Width:</b>	<b>Weight:</b>
2242	42.0 mm	22.0 mm	5.0 g / 0.17 oz.
2280	80.0 mm	22.0 mm	8.0 g / 0.28 oz.



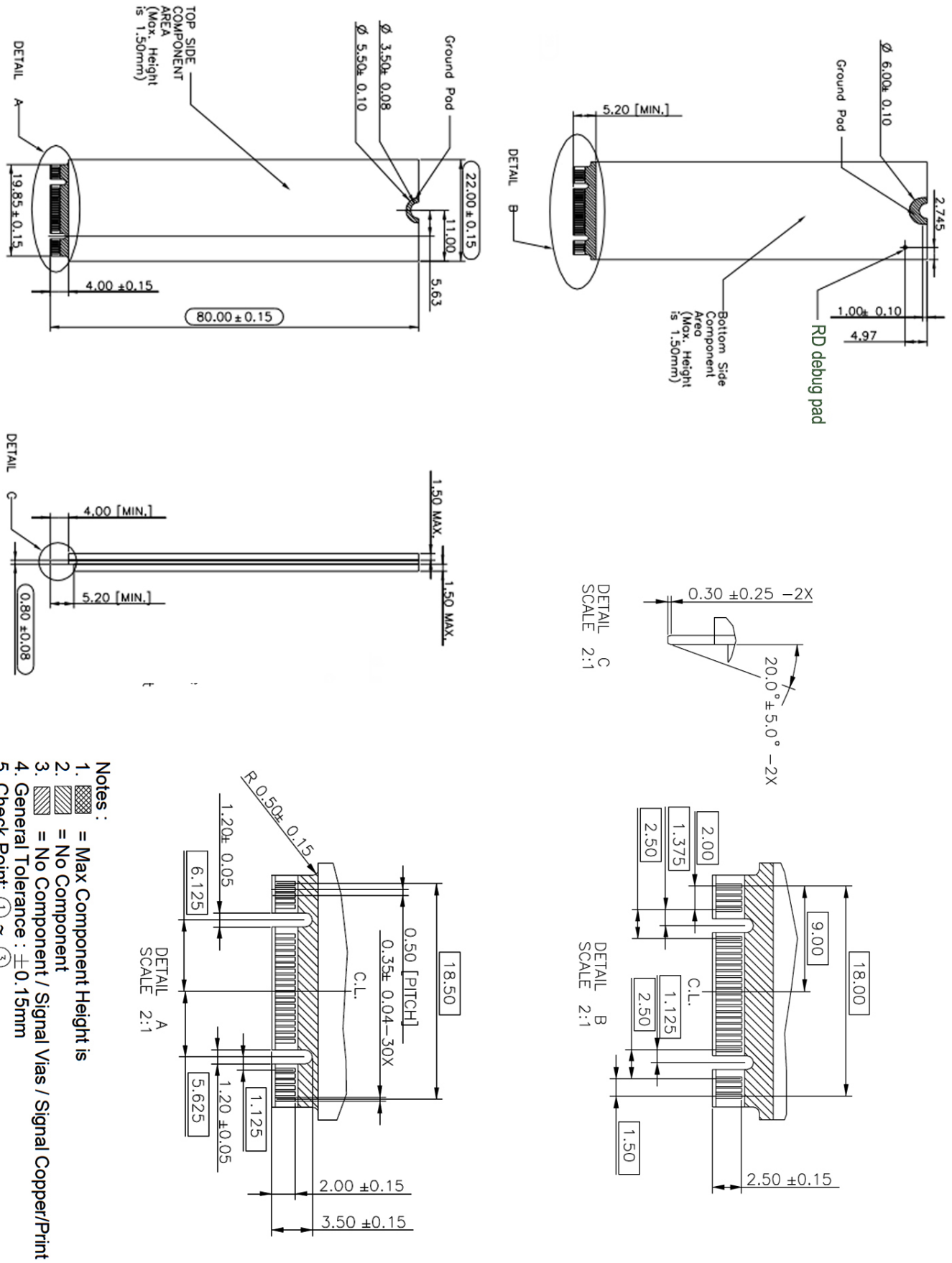


Figure 3: APRO MLC M.2-2280 Form-factor SATA III Module Dimension

### 2.6. Conformal coating

Conformal coating is a protective, dielectric coating designed to conform to the surface of an assembled printed circuit board. Commonly used conformal coatings include silicone, acrylic, urethane and epoxy. APRO applies only silicone on APRO storage products upon requested especially by customers. The type of silicone coating features good thermal shock resistance due to flexibility. It is also easy to apply and repair.

Conformal coating offers protection of circuitry from moisture, fungus, dust and corrosion caused by extreme environments. It also prevents damage from those Flash storages handling during construction, installation and use, and reduces mechanical stress on components and protects from thermal shock. The greatest advantage of conformal coating is to allow greater component density due to increased dielectric strength between conductors.

APRO use MIL-I-46058C silicon conformal coating

### 3. Interface Description

#### 3.1. M.2 2242/2280 SATA III B+M Key edge connector.

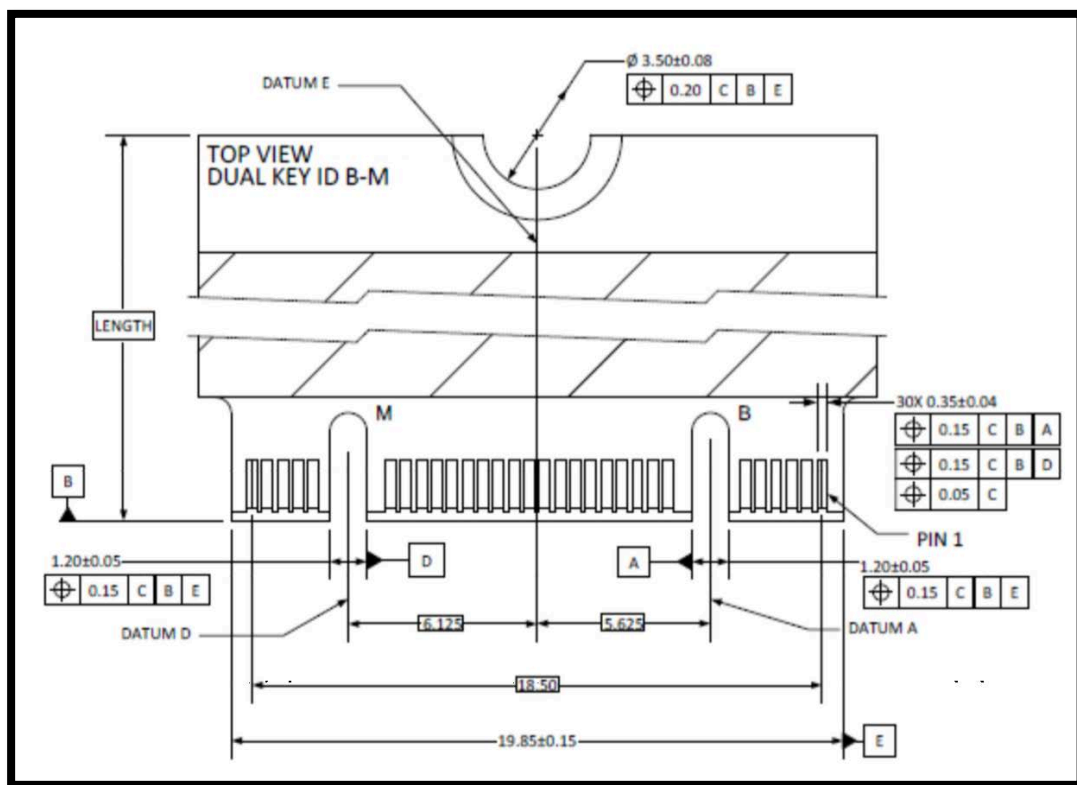


Figure 4: M.2 SATA III B+M Key edge connector

### 3.2. Pin Assignments

APRO MLC M.2 SATA III Module PHANES-K Series operates with standard SATA pin-out.

The pin assignments are listed in below table 6.

**Table 6 - Pin Assignments**

		CONFIG_2 = GND	75
74	3.3V	GND	73
72	3.3V	GND	71
70	3.3V	CONFIG_1 = GND	69
68	SUSCLK(32kHz) (I)(0/3.3V)	N/C	67
	Module Key	Module Key	
	Module Key	Module Key	
	Module Key	Module Key	
	Module Key	Module Key	
58	Reserved for MFG Clock	GND	57
56	Reserved for MFG Data	N/C	55
54	N/C	N/C	53
52	N/C	GND	51
50	N/C	SATA-A+	49
48	N/C	SATA-A-	47
46	N/C	GND	45
44	N/C	SATA-B-	43
42	N/C	SATA-B+	41
40	N/C	GND	39
38	DEVSLP (I)(0/3.3V)	N/C	37
36	N/C	N/C	35
34	N/C	GND	33
32	N/C	N/C	31
30	N/C	N/C	29
28	N/C	GND	27
26	N/C	N/C	25
24	N/C	N/C	23
22	N/C	CONFIG_0 = GND	21
20	N/C	Module Key	
	Module Key	Module Key	
	Module Key	Module Key	
	Module Key	Module Key	
	Module Key	Module Key	
10	DAS/DSS# (O)(OD)	N/C	11
8	N/C	N/C	9
6	N/C	N/C	7
4	3.3V	N/C	5
2	3.3V	GND	3
		CONFIG_3 = GND	1

### **Appendix A: Limited Warranty**

APRO warrants your MLC M.2 SATA III Module PHANES-K Series against defects in material and workmanship for the life of the drive. The warranty is void in the case of misuse, accident, alteration, improper installation, misapplication or the result of unauthorized service or repair. The implied warranties of merchantability and fitness for a particular purpose, and all other warranties, expressed or implied, except as set forth in this warranty, shall not apply to the products delivered. In no event shall APRO be liable for any lost profits, lost savings or other incidental or consequential damages arising out of the use of, or inability to use, this product.

**BEFORE RETURNING PRODUCT, A RETURN MATERIAL AUTHORIZATION (RMA) MUST BE OBTAINED FROM APRO.**

Product shall be returned to APRO with shipping prepaid. If the product fails to conform based on customers' purchasing orders, APRO will reimburse customers for the transportation charges incurred.

#### **WARRANTY PERIOD:**

- **MLC ( Standard grade / Wide temp. grade )    2 years / Within 3K Erasing Counts**

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