

# 3D-NAND Flash

( KIOXIA BiCS3 )

## 1.8" Slim Lite SATA III SSD

**MUSE-ER Series**

**Supports DRAM Cache**

**(JEDEC MO-297A)**



**Document No. :** 100-xB8RJ-VECT3

**Version No. :** 01V0

**Date :** December, 2019

ISO 9001 : 2015 CERTIFIED



### Product Features

#### ■ Flash IC

- TOSHIBA **BiCS FLASH™**.<sup>\*4</sup>
- **BiCS3** 3D TLC NAND Flash

#### ■ Compatibility

- Compliant with SATA Revision 3.2
- SATA 1.5Gb/s; SATA 3Gb/s & SATA 6Gb/s Interface compatible.
- ATA-8 ACS4 command set

#### ■ Additional Capabilities

- S.M.A.R.T.<sup>\*1</sup> (Self-Monitoring, Analysis and Reporting Technology) feature set support.
- Native Command Queuing (NCQ) support.
- TRIM maintenance command support.
- Support Static wear-leveling algorithm
- Hardware Low Density Parity Check Code, LDPC support.
- Support bad Block Management
- Support DRAM buffer which is support high transfer rate as a data buffer for the SSD

#### ■ Mechanical

- 1.8" form factor compatible with JEDEC Standard MO-297A physical specification
- SATA 7-pin (data) + 15-pin (power connector) SATA Interface
- Dimension: 39.0 mm x 54.0 mm.
- Weight: 15.0 g / 0.53 oz.

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

- Read Mode: 419.0 mA (RMS.)
- Write Mode: 543.0 mA (RMS.)
- Idle Mode: 181.0 mA (max.)

#### ■ Performance (Maximum value) <sup>\*2\*3</sup>

- Sequential Read: 560.0 MB/sec. (512GB.)
- Sequential Write: 520.0 MB/sec. (512GB.)
- 4KB Random Read (QD32): 73.0K IOPS
- 4KB Random Write (QD32): 65.0K IOPS

#### ■ Capacity

- 128GB, 256GB and 512GB

#### ■ Reliability

- **TBW:** Up to 600 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  
Industrial. Grade: -40°C ~ +85°C
- **Vibration:** 70 Hz to 2K 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. Typical I/O performance numbers as measured fresh-out-of-the-box (FOB) using IOMeter with a queue depth of 32
3. Sequential performance is based on CrystalDiskMark 5.1.2 with file size 1000MB
4. **BiCS** means Bit Cost Scalable Technology.

**BiCS FLASH** is a trademark of Toshiba Corporation.

### Order Information

#### I. Part Number List

##### ◆ APRO SLC Slim Lite SATA III SSD MUSE-ER Series

Product Picture	Capacity	Standard grade (0°C ~ 70°C)	Industrial Grade ( -40°C ~ +85°C )
	128GB	SB8RJ128G-VECT3(T)	WB8RJ128G-VEIT3(T)C
	256GB	SB8RJ256G-VECT3(T)	WB8RJ256G-VEIT3(T)C
	512GB	SB8RJ512G-VECT3(T)	WB8RJ512G-VEIT3(T)C

#### II. Part Number Decoder:

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

##### **X1** : Grade

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

**W**: Industrial Grade – operating temp. -40° C ~ +85 ° C

##### **X2** : The material of case

**B** : Bare

##### **X3 X4 X5** : Product category

**8RJ** : 1.8" Slim Lite SATA SSD w/ SDRAM Cache

##### **X6 X7 X8 X9** : Capacity

**128G:** 128GB      **512G:** 512GB

**256G:** 256GB

##### **X11** : Controller

**V** : MUSE Series

##### **X12** : Controller version

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

##### **X13** : Controller Grade

**C** : Commercial grade

**I** : Industrial grade

##### **X14** : Flash IC

**T** : Toshiba NAND Flash IC

##### **X15** : Flash IC grade / Type

**3** : KIOXIA BiCS3 TLC NAND FLASH IC.

##### **X17 X18**: 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	2019/12/02

### Contents

Product Features .....	- 2 -
Order Information .....	- 3 -
<b>I. Part Number List</b> .....	- 3 -
<b>II. Part Number Decoder:</b> .....	- 3 -
Revision History .....	- 4 -
Contents .....	- 5 -
<b>1. Introduction</b> .....	- 6 -
<b>1.1. Scope</b> .....	- 7 -
<b>1.2. Flash Management Technology - Static Wear Leveling</b> .....	- 7 -
<b>1.3. Bad Block Management</b> .....	- 7 -
<b>1.4. DRAM Buffer</b> .....	- 7 -
<b>1.5. Power Interrupt Data Protection</b> .....	- 8 -
<b>2. Product Specifications</b> .....	- 9 -
<b>2.1. System Environmental Specifications</b> .....	- 9 -
<b>2.2. System Power Requirements</b> .....	- 9 -
<b>2.3. System Performance</b> .....	- 9 -
<b>2.4. System Reliability</b> .....	- 10 -
<b>2.5. Physical Specifications</b> .....	- 11 -
<b>2.6. Conformal coating</b> .....	- 12 -
<b>3. Interface Description</b> .....	- 12 -
<b>5.1. 1.8" Slim Lite SATA III SSD MUSE-ER Series interface</b> .....	- 12 -
<b>5.2. Pin Assignments</b> .....	- 13 -
<b>Appendix A: Limited Warranty</b> .....	- 14 -

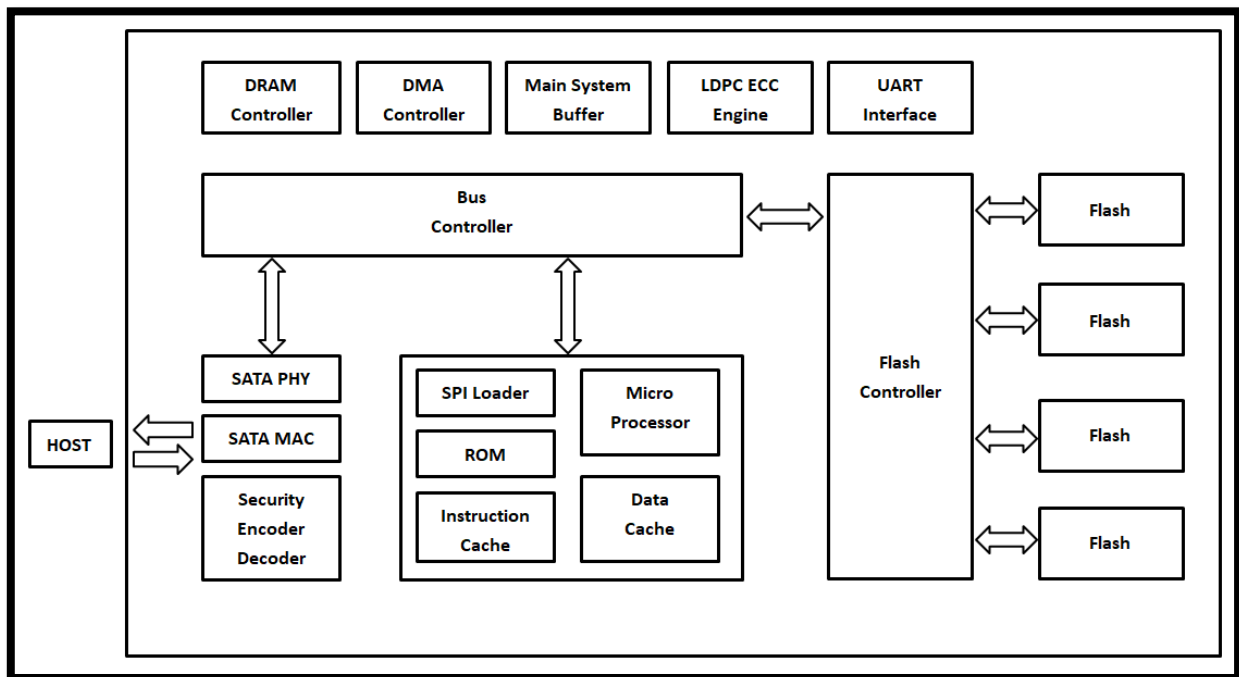
### 1. Introduction

APRO 1.8" Slim Lite SATA III SSD (BiCS3 3D TLC NAND FLASH) MUSE-ER Series provides high capacity flash memory Solid State Drive (SSD) that electrically complies with Serial ATA 3.2 (SATA) standard and ATA-8 command set compatible. APRO 1.8" Slim Lite SATA III SSD (BiCS3 3D TLC NAND FLASH) MUSE-ER Series support SATA 1.5Gbps/3.0Gbps/6.0Gbps data transfer rate with high performance and designed with a DRAM which is support data buffer for the SSD. The main used flash memories are BiCS 3D-NAND Flash memory chips. The available disk capacities are 128GB, 256GB and 512GB.

The operating temperature grade is optional for Standard grade 0°C ~ 70°C and Industrial grade supports -40°C ~ +85°C. The data transfer performance by sequential read is up to 560.0 MB/sec, and sequential write is up to 520.0 MB/sec.

APRO 1.8" Slim Lite SATA III SSD (BiCS3 3D TLC NAND FLASH) MUSE-ER Series with built-in DRAM provides a high level interface to the host computer. This interface allows a host computer to issue commands to the APRO 1.8" Slim Lite SATA III SSD (BiCS3 3D TLC NAND FLASH) MUSE-ER 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 1.8" Slim Lite SATA III SSD (BiCS3 3D TLC NAND FLASH) MUSE-ER Series intelligent controller manages interface protocols, data storage and retrieval as well as ECC, defect handling and diagnostics, power management and clock control.

Figure 1 shows a block diagram of the used high tech APRO 1.8" Slim Lite SATA III SSD (BiCS3 3D TLC NAND FLASH) MUSE-ER Series.



**Figure 1: APRO 1.8" Slim Lite SATA III SSD (BiCS3 3D TLC NAND FLASH) MUSE-ER Series block diagram**

### 1.1. Scope

This document describes features, specifications and installation guide of APRO 1.8" Slim Lite SATA III SSD (BiCS3 3D TLC NAND FLASH) MUSE-ER Series. In the appendix, there provides order information, warranty policy, RMA/DOA procedure for the most convenient reference.

### 1.2. Flash Management Technology - Static Wear Leveling

In order to gain the best management for flash memory, APRO 1.8" Slim Lite SATA III SSD (BiCS3 3D TLC NAND FLASH) MUSE-ER Series supports Static Wear-leveling technology to manage the Flash system. The life of flash memory is limited; the management is to increase the life of the flash product.

A static wear-leveling algorithm evenly distributes data over an entire Flash cell array and searches for the least used physical blocks. The identified low cycled sectors are used to write the data to those locations. If blocks are empty, the write occurs normally. If blocks contain static data, it moves that data to a more heavily used location before it moves the newly written data. The static wear leveling maximizes effective endurance Flash array compared to no wear leveling or dynamic wear leveling.

### 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 1.8" Slim Lite SATA III SSD (BiCS3 3D TLC NAND FLASH) MUSE-ER 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.

### 1.4. DRAM Buffer

SSDs designed with a DRAM buffer which is support high transfer rate as a data buffer for the SSD; SSD with DRAM buffer is able to deliver excellent random data transfer speed.

- 128GB, 256GB Supports 2GBits DRAM Cache
- 512GB Supports 4GBits DRAM Cache

### **1.5. Power Interrupt Data Protection**

Industrial market these days, often faces system failures due to power supply conditions. Over half of all fields encounter failures with data loss and corruption in applications due to power interruption. Data protection against sudden power interruption requires a unique feature in storage devices. Possibilities of this issue may occur on several conditions, such as disconnecting the device while operating, or unstable power supplies.

In order to mitigate the damage power interruption can cause to the storage device, APRO 1.8" Slim Lite SATA III SSD (BiCS3 3D TLC NAND FLASH) MUSE-ER Series has designed a special technology to detect and eliminate the damage that power interruption generates and ensures data integrity. Flash will become write-protected to prevent data from being written into the wrong sector. Built-in voltage detect function alerts the host system of any unstable power supply and prevents the transmission of commands until power levels are once again stabilized. Storage devices can be damaged and data corrupted, product will need to be reformatted when this issue occurs, sometimes even have to reinstall O.S., or send back to supplier for repairmen. This shows direct influence on company's reputation, reliability of product itself, and most importantly, customer's faith. For most applications, storage devices normally work under power supplies lower than it should receive. Due to inefficient power levels, data corruption and damage of device can seriously influence ongoing business or deals, this may result in project loss due to the return and repair period of products.

APRO 1.8" Slim Lite SATA III SSD (BiCS3 3D TLC NAND FLASH) MUSE-ER Series is designed to meet the highly standard of customer's requirements in industrial, military and medical markets, which included performances, reliability and longer lifetime.



### 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 1.8" Slim Lite SATA III SSD (BiCS3 3D TLC NAND FLASH) MUSE-ER Series		Standard Grade	Industrial Grade
		SB8RJxxxG-VECT3	WB8RJxxxG-VECT3C
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:	70 Hz to 2K 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 1.8" Slim Lite SATA III SSD (BiCS3 3D TLC NAND FLASH) MUSE-ER Series		
DC Input Voltage (VCC)	+5V±5%	
Maximum average value	Reading Mode (RMS.) :	Read Mode: 419.0 mA
	Writing Mode (RMS.) :	Write Mode: 543.0 mA
	Idle Mode :	Idle Mode: 181.0 mA

#### 2.3. System Performance

**Table 3: System Performances**

Data Transfer Mode supporting		Serial ATA Gen-III (6.0Gb/s = 768MB/s)			
Maximum Performance	Capacity	128GB	256GB	512GB	
	Sequential Read (MB/s)	560.0	550.0	560.0	
	Sequential Write(MB/s)	130.0	280.0	520.0	
	4KB Random Read IOPS (QD32)	39.0K	71.0K	73.0K	
	4KB Random Write IOPS (QD32)	33.0K	54.0K	65.0K	

Note: The performance was measured using CrystalDiskMark by file size 1000MB (QD32).

### 2.4. System Reliability

**Table 4: System Reliability**

<b>Wear-leveling Algorithms</b>	Static wear-leveling algorithms
<b>Bad Blocks Management</b>	Supportive
<b>ECC Technology</b>	Hardware design LDPC (Low Density Parity Check)
<b>Erase counts</b>	TOSHIBA <b>BiCS FLASH™</b> 3D NAND Flash: 3K P/E Cycles
<b>Capacity</b>	<b>TBW(TB)</b>
<b>128GB</b>	150
<b>256GB</b>	300
<b>512GB</b>	600

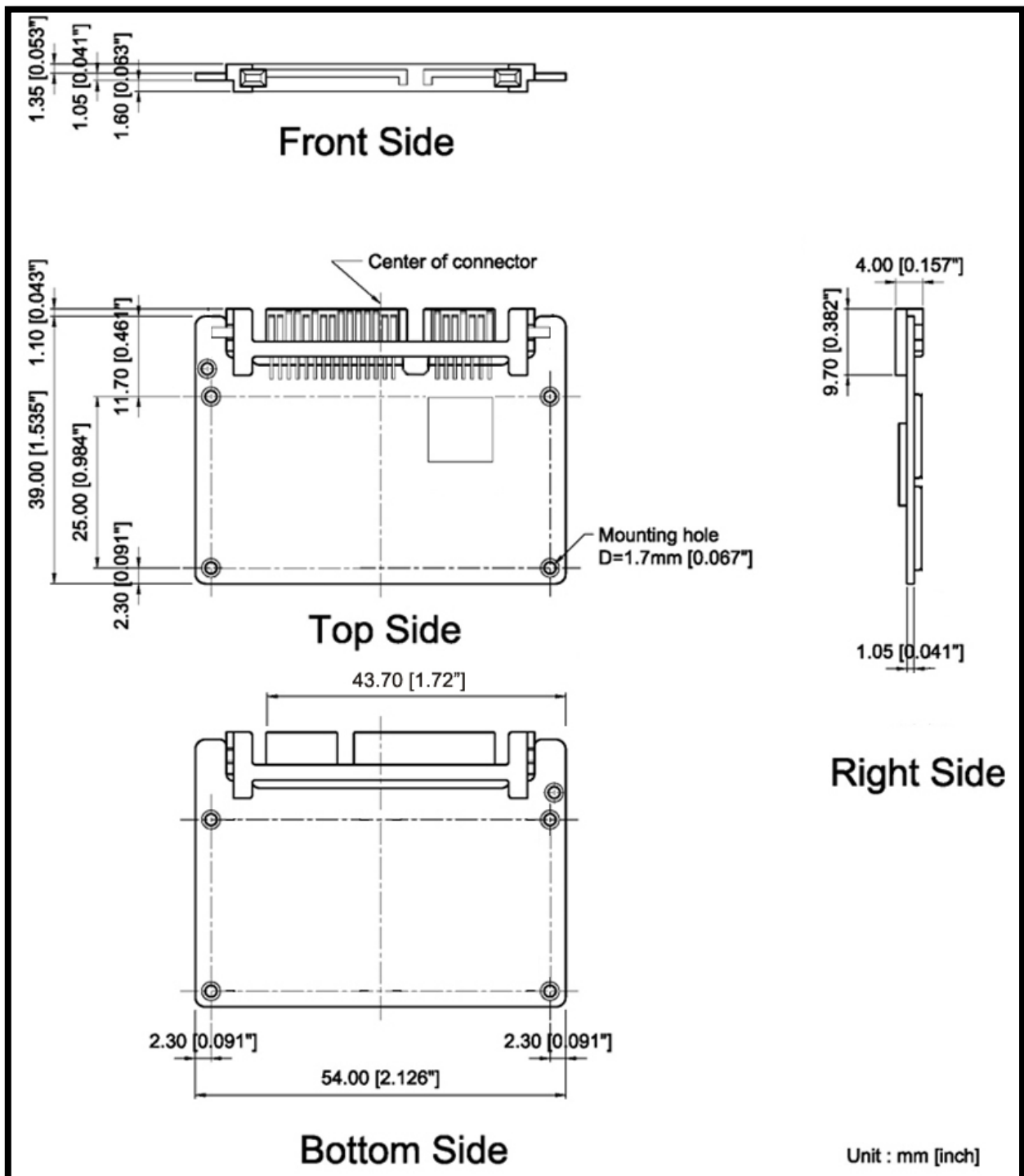
- Client workload by JESD-219A.
- The endurance of SSD could be varying based on user behavior, NAND endurance cycles, and write amplification factor. It is not guaranteed by flash vendor.

### 2.5. Physical Specifications

Refer to Table 5 and see Figure 2 for APRO 1.8" Slim Lite SATA III SSD (BiCS3 3D TLC NAND FLASH) MUSE-ER Series physical specifications and dimensions.

**Table 5: Physical Specifications of APRO 1.8" Slim Lite SATA III SSD (BiCS3 3D TLC NAND FLASH) MUSE-ER Series**

<b>Length:</b>	39.00 mm
<b>Width:</b>	54.00 mm
<b>Weight:</b>	15.0 g / 0.53 oz.



**Figure 2: APRO 1.8" Slim Lite SATA III SSD (BiCS3 3D TLC NAND FLASH) MUSE-ER Series 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.

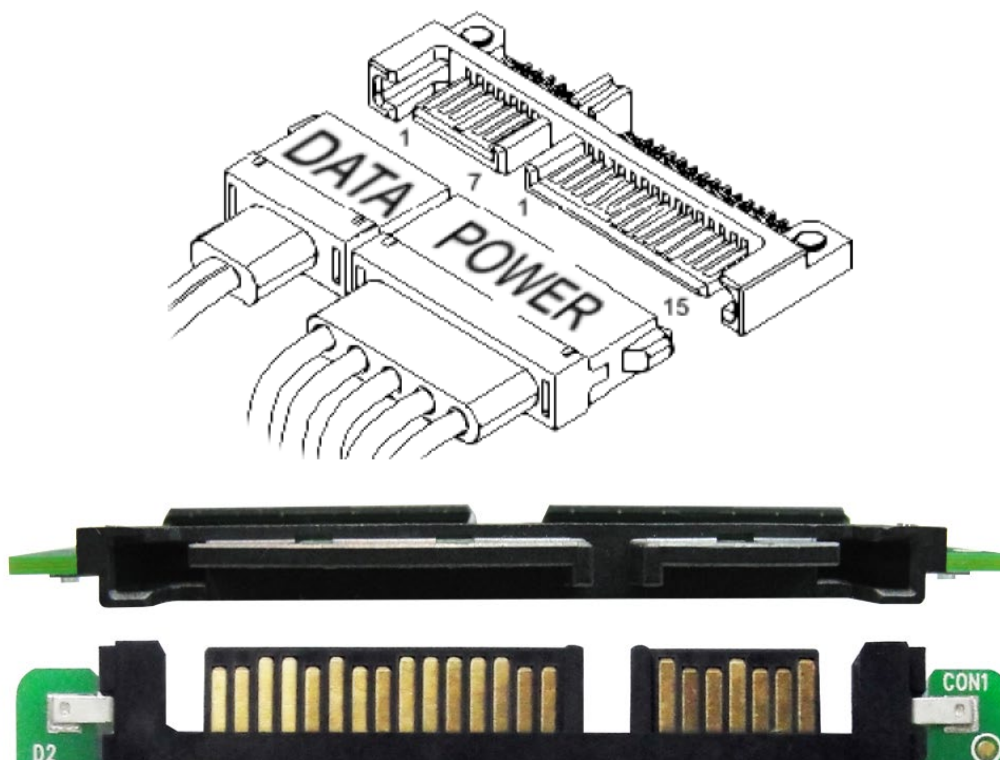
Conformal coating offers protection of circuitry from moisture, fungus, dust and corrosion caused by extreme environments. It also prevents damage from those Flash storages handling during construction, installation and use, and reduces mechanical stress on components and protects from thermal shock. 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

### 5.1. 1.8" Slim Lite SATA III SSD (BiCS3 3D TLC NAND FLASH) MUSE-ER Series interface

APRO 1.8" Slim Lite SATA III SSD (BiCS3 3D TLC NAND FLASH) MUSE-ER Series is equipped with standard 7 pins + 15 pins Serial ATA connector.



**Figure 3: The connectors of APRO 1.8" Slim Lite SATA III SSD (BiCS3 3D TLC NAND FLASH) MUSE-ER Series**

### 5.2. Pin Assignments

APRO 1.8" Slim Lite SATA III SSD (BiCS3 3D TLC NAND FLASH) MUSE-ER Series operates with standard SATA pin-out.

The pin assignments are listed in below table 6.

Name	Type	Description
<b>S1</b>	GND	NA
<b>S2</b>	A+	Differential Signal Pair A
<b>S3</b>	A-	
<b>S4</b>	GND	NA
<b>S5</b>	B-	Differential Signal Pair B
<b>S6</b>	B+	
<b>S7</b>	GND	NA
<b>Key and Spacing separate signal and power segments</b>		
<b>P1</b>	NC	NA
<b>P2</b>	NC	NA
<b>P3</b>	NC	NA
<b>P4</b>	GND	NA
<b>P5</b>	GND	NA
<b>P6</b>	GND	NA
<b>P7</b>	V5	5V Power, Pre-Charge
<b>P8</b>	V5	5V Power
<b>P9</b>	V5	5V Power
<b>P10</b>	GND	NA
<b>P11</b>	DAS/DSS	Device Activity Signal / Disable Staggered Spin up
<b>P12</b>	GND	NA
<b>P13</b>	Not Used (12V pre-charge)	NA
<b>P14</b>	Not Used (12V)	NA
<b>P15</b>	Not Used (12V)	NA

**Table 6 - Pin Assignments**

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

APRO warrants your 1.8" Slim Lite SATA III SSD (BiCS3 3D TLC NAND FLASH) MUSE-ER 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:**

- **3D-NAND Flash (Standard grade / Industrial grade): 2 years / Within 3K Erasing Counts**

This document is for information use only and is **subject to change without prior notice**. APRO Co., Ltd. assumes no responsibility for any errors that may appear in this document, nor for incidental or consequential damages resulting from the furnishing, performance or use of this material. No part of this document may be reproduced, transmitted, transcribed, stored in a retrievable manner or translated into any language or computer language, in any form or by any means, electronic, mechanical, magnetic, optical, chemical, manual or otherwise, without the prior written consent of an officer of APRO Co., Ltd.

All parts of the APRO documentation are protected by copyright law and all rights are reserved.

APRO and the APRO logo are registered trademarks of APRO Co., Ltd.

Product names mentioned herein are for identification purposes only and may be trademarks and/or registered trademarks of their respective companies.

© 2023 APRO Corporation. All rights reserved