

# SLC

## micro SATA III Flash Module

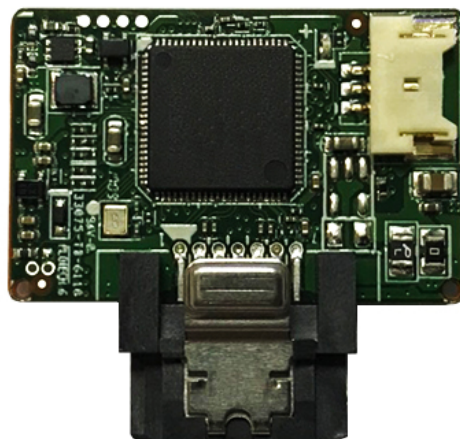
### HERMES-J Series

#### APRO Industrial micro SATA-III Flash Module (MSF)

**Document No. :** 100-xBMSF-JJCTS

**Version No. :** 01V0

**Date :** December 2017



ISO 9001 : 2015 CERTIFIED



### Product Features

#### ■ Flash IC

- TOSHIBA NAND Flash IC.
- Single-Level Cell (SLC) management

#### ■ Compatibility

- SATA Revision 3.1
- SATA 1.5Gb/s; SATA 3Gb/s & SATA 6Gb/s data transfer rate.

#### ■ 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.
- Native Command Queuing (NCQ) support.
- TRIM maintenance command support.
- Static wear-leveling algorithm

#### ■ Mechanical

- Standard 7 pins SATA female connector
- Optional built-in power pin as the 7th pin of 7pin header (w/fuse) or power input power cable (w/o fuse)
- Dimension:  
Vertical Standard (VS)=18.0mm x 38.5mm /20.0g  
Vertical Low Profile (VL)=30.1 mm x 28.7mm /20.0g  
Horizontal Standard (HS)=18.0mm x 30.3mm /20.0g  
Horizontal Low Profile (HL)=30.0mm x 20.0mm /20.0g  
Horizontal Low Profile w/mounting hole (HO)=  
30.0 mm x 28.8mm /20.0g

#### ■ Power

- Operating Voltage +5V(+/-) 5%
- Read Mode: 55mA (max.)
- Write Mode: 70mA (max.)
- Idle Mode: 20mA (max.)
- If design in Pin7 VCC on motherboard, 5V with 1A power supply is requested.

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

- Sequential Read (1GB Data): 220 MB/sec. <sup>\*3</sup>
- Sequential Write (1GB Data): 110 MB/sec. <sup>\*3</sup>
- 4KB Random Read (QD32): 10.2K IOPS <sup>\*2</sup>.
- 4KB Random Write (QD32): 16.8K. IOPS<sup>\*2</sup>.

#### ■ Capacity

- 4GB, 8GB, 16GB and 32GB

#### ■ Reliability

- **TBW:** Up to 187.5 TBW at 32GB Capacity.  
(Based on JESD-218)
- **MTBF:** > 3,000,000 hours.
- **ECC:** 40bits per 1024bytes in an ECC block.
- **Temperature:** (Operating)  
Standard Grade: 0°C ~ +70°C  
Wide Temp. Grade: -40°C ~ +85°C
- **Vibration:** 20G (IEC 68-2-6).
- **Shock:** 1500G (IEC 68-2-27)

#### ■ Certifications and Declarations

- **Certifications:** CE & FCC
- **Declarations:** RoHS2 & 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


### Order Information

#### A. Part Number List


##### ◆ APRO Industrial micro SATA III Flash Module – Vertical Standard Form Factor

Product Picture	Grade	Standard grade (0°C ~ 70°C)	Industrial Grade ( -40°C ~ +85°C )
	4GB	SBMSF004G-JJCTC-VS(/F)	WBMSF004G-JJITI-VS(/F)
	8GB	SBMSF008G-JJCTC-VS(/F)	WBMSF008G-JJITI-VS(/F)
	16GB	SBMSF016G-JJCTC-VS(/F)	WBMSF016G-JJITI-VS(/F)
	32GB	SBMSF032G-JJCTC-VS(/F)	WBMSF032G-JJITI-VS(/F)


##### ◆ APRO Industrial micro SATA III Flash Module – Vertical Low Profile Form Factor

Product Picture	Grade	Standard grade (0°C ~ 70°C)	Industrial Grade ( -40°C ~ +85°C )
	4GB	SBMSF004G-JJCTC-VL(/F)	WBMSF004G-JJITI-VL(/F)
	8GB	SBMSF008G-JJCTC-VL(/F)	WBMSF008G-JJITI-VL(/F)
	16GB	SBMSF016G-JJCTC-VL(/F)	WBMSF016G-JJITI-VL(/F)
	32GB	SBMSF032G-JJCTC-VL(/F)	WBMSF032G-JJITI-VL(/F)


##### ◆ APRO Industrial micro SATA III Flash Module – Horizontal Standard Form Factor

Product Picture	Grade	Standard grade (0°C ~ 70°C)	Industrial Grade ( -40°C ~ +85°C )
	4GB	SBMSF004G-JJCTC-HS(/F)	WBMSF004G-JJITI-HS(/F)
	8GB	SBMSF008G-JJCTC-HS(/F)	WBMSF008G-JJITI-HS(/F)
	16GB	SBMSF016G-JJCTC-HS(/F)	WBMSF016G-JJITI-HS(/F)
	32GB	SBMSF032G-JJCTC-HS(/F)	WBMSF032G-JJITI-HS(/F)

##### ◆ APRO Industrial micro SATA III Flash Module – Horizontal Low Profile Form Factor

Product Picture	Grade	Standard grade (0°C ~ 70°C)	Wide Temp Grade ( -40°C ~ +85°C )
	4GB	SBMSF004G-JJCTC-HL(/F)	WBMSF004G-JJITI-HL(/F)
	8GB	SBMSF008G-JJCTC-HL(/F)	WBMSF008G-JJITI-HL(/F)
	16GB	SBMSF016G-JJCTC-HL(/F)	WBMSF016G-JJITI-HL(/F)
	32GB	SBMSF032G-JJCTC-HL(/F)	WBMSF032G-JJITI-HL(/F)

##### ◆ APRO Industrial micro SATA III Flash Module – Horizontal Low Profile w/mounting hole Form Factor

Product Picture	Grade	Standard grade (0°C ~ 70°C)	Wide Temp Grade ( -40°C ~ +85°C )
	4GB	SBMSF004G-JJCTC-HO(/F)	WBMSF004G-JJITI-HO(/F)
	8GB	SBMSF008G-JJCTC-HO(/F)	WBMSF008G-JJITI-HO(/F)
	16GB	SBMSF016G-JJCTC-HO(/F)	WBMSF016G-JJITI-HO(/F)
	32GB	SBMSF032G-JJCTC-HO(/F)	WBMSF032G-JJITI-HO(/F)

#### Notes:

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

### B. Part Number Decoder:

**X1 X2 X3 X4 X5 X6 X7 X8 X9 – X11 X12 X13 X14 X15 – Y1 Y2 – C C**

**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

**MSF** :Micro SATA Flash Module

**X6 X7 X8 X9** : Capacity

**004G:** 4GB **016G:** 16GB

**008G:** 8GB **032G:** 32GB

**X11** : Controller

**J** : HERMES Series

**X12** : Controller version

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

**X13** : Controller Grade

**C** : Commercial grade

**I** : Industrial grade

**X14** : Flash IC

**T** : Toshiba SLC-NAND Flash IC

**X15** : Flash IC grade / Type

**C** : Commercial grade

**I** : Industrial grade

**Y1 Y2** : MSF Orient Only

**VS** : Vertical Standard Form Factor

**VL** : Vertical Low Profile Form Factor

**HS** : Horizontal Standard Form Factor

**HL** : Horizontal Low Profile Form Factor

**HO** : Horizontal Low Profile w/mounting hole Form Factor

**C** : Reserved for specific requirement

**F** : Power Pin-7 with fuse

**C** : Conformal-coating

### **Revision History**

Revision	Description	Date
1.0	Initial release.	2017/12/21

### Contents

Product Features .....	2
Order Information.....	3
1. <b>Part Number List</b> .....	3
2. <b>Part Number Decoder:</b> .....	4
Revision History .....	4
Contents .....	5
1. <b>Introduction</b> .....	- 6 -
1.1. <b>Scope</b> .....	- 7 -
1.2. <b>Flash Management Technology - Static Wear Leveling</b> .....	- 7 -
1.3. <b>Bad Block Management</b> .....	- 7 -
2. <b>Product Specifications</b> .....	- 8 -
2.1. <b>System Environmental Specifications</b> .....	- 8 -
2.2. <b>System Power Requirements</b> .....	- 8 -
2.3. <b>System Performance</b> .....	- 9 -
2.4. <b>System Reliability</b> .....	- 9 -
2.5. <b>Physical Specifications</b> .....	- 10 -
2.5.1. <b>Conformal coating</b> .....	- 13 -
3. <b>Interface Description</b> .....	- 14 -
3.1. <b>APRO Industrial micro SATA III Flash Modules interface</b> .....	- 14 -
3.2. <b>Pin Assignments</b> .....	- 15 -
Appendix A: <b>Limited Warranty</b> .....	- 16 -

### 1. Introduction

APRO Industrial micro SATA III Flash Module – HERMES-J Series provides high capacity flash memory Solid State Drive (SSD) that electrically complies with Serial ATA 3.0 (SATA) standard. APRO Industrial micro SATA III Flash Module – HERMES-J Series support SATA Gen-III (6.0 GB/s) with high performance. The main used flash memories are SLC-NAND type flash memory chips. The available disk capacities are 4GB, 8GB, 16GB and 32GB.

The operating temperature grade is optional for Standard grade 0°C ~ 70°C and wide temp grade supports -40°C ~ +85°C. The data transfer performance by sequential read is up to 220 MB/sec, and sequential write is up to 110 MB/sec.

APRO Industrial micro SATA III Flash Module provides a high level interface to the host computer. This interface allows a host computer to issue commands to the Industrial micro SATA III Flash Module to read or write blocks of memory. Each sector is protected by a powerful 40 bits per 1024 bytes error correction (ECC). APRO Industrial micro SATA III Flash Module HERMES-J Series intelligent controller manages interface protocols, data storage and retrieval as well as ECC, defect handling and diagnostics, power management and clock control.

With the great flexibility to meet different SATA interface locations in systems, APRO Industrial micro SATA III Flash Module comes with optional form-factor in vertical type and horizontal type. And the power operating voltage supports 5V. Particularly it is built-in power pin as the 7th pin of 7pin header (w/fuse) or power input power cable (w/o fuse).

Figure 1 shows a block diagram of the used high tech industrial micro SATA III Flash Module controller.

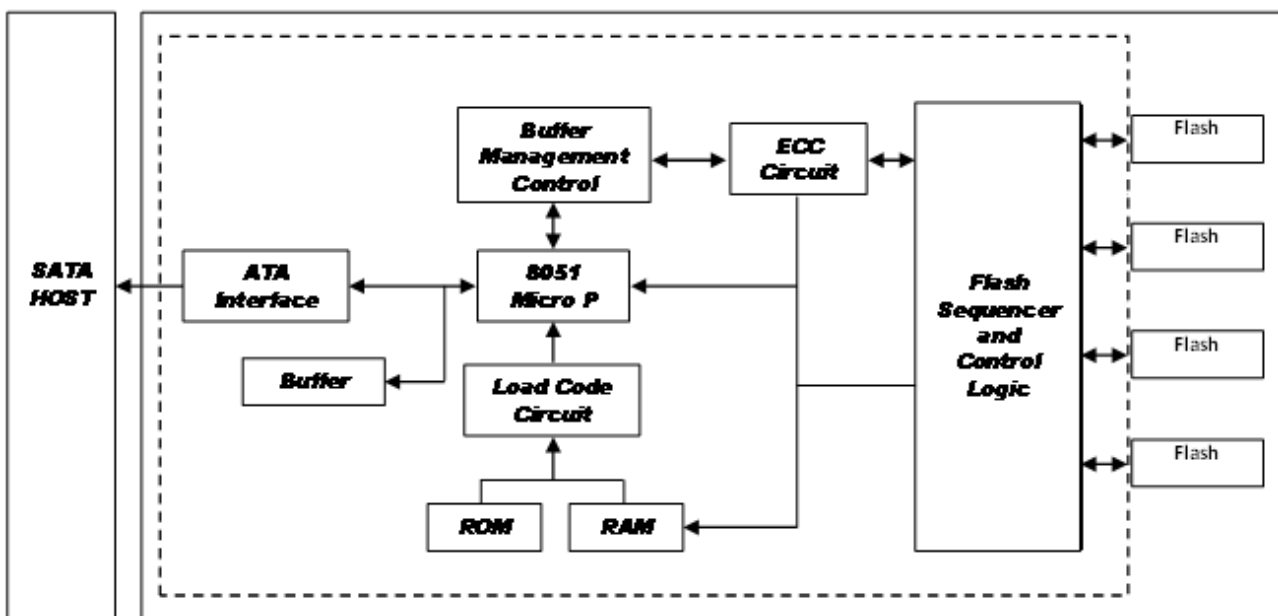


Figure 1: APRO Industrial micro SATA III Flash Module HERMES-J Series controller block diagram

### **1.1. Scope**

This document describes features, specifications and installation guide of APRO Industrial micro SATA III Flash Module - HERMES-J 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 Industrial micro SATA III Flash Module - HERMES-J 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**

Bad blocks of NAND flash may accumulate up to 2% of entire number of blocks during its manufacturing process and during the flash operational usage.

A system must be able to recognize bad block(s) based on the original bad block information and create a bad block table to keep track of blocks that fail during use. The first block of NAND Flash (block 0) is guaranteed to be good. The bad block information is stored in the reservoir area that is located in the highest address region of the NAND flash. Once the bad blocks have been located, and the bad blocks be no longer accessed.

To locate the bad blocks on a brand new device, read out each block. Any block that is not all FFFFh in 1st sector of 1st or 2nd page in a spare area is a bad block. Although random bit errors may occur during use, this does not necessarily mean that a block is bad. Generally, a block should be marked as bad only when there is a problem or erase failure. This can be determined by doing a status read after erase/program operation. The flash memory is initialized by formatting the flash memory into a reserved area and user area.

In order to detect the initial bad blocks to handle run time bad blocks, APRO Industrial micro SATA III Flash Module - HERMES-J 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 Industrial micro SATA III Flash Module HERMES-J Series		Standard Grade SBMSFxxxG-JJCTC	Wide Temp Grade WBMSFxxxG-JJITI
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:	7 Hz to 2K Hz, 20G, 3 axes (IEC 68-2-6)	
Shock	Operating & Non-operating:	0.5ms, 1500 G, 3 axes (IEC 68-2-27)	
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 Industrial micro SATA III Flash Module HERMES-J Series	
DC Input Voltage (VCC)	5V±5%
Reading Mode :	55mA (max.)
Writing Mode :	70mA (max.)
Idle Mode :	20mA (max.)

Note: If design in Pin7/8 VCC on motherboard, 5V with 1A power supply is requested.

Table 3: Power Connector

Pin No.	Connector	
Pin 1	Vcc 5V	
Pin 2	GND	

### 2.3. System Performance

Table 4: System Performances

Data Transfer Mode supporting		Serial ATA Gen-III (6.0Gb/s = 768MB/s)			
Maximum Performance	Capacity	4GB	8GB	16GB	32GB
	Sequential Read (MB/s)	180	180	220	220
	Sequential Write (MB/s)	60	60	110	110
	4KB Random Read IOPS (QD32)	9,000	9,000	10,200	10,200
	4KB Random Write IOPS (QD32)	9,600	9,600	16,800	16,800

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

### 2.4. System Reliability

Table 5: System Reliability

Wear-leveling Algorithms		Static Wear-leveling
Bad Block Management		Supportive
ECC Technology		40bits per 1024bytes in an ECC block
Erase counts		NAND SLC Flash Cell Level : 60K P/E Cycles
TBW (Tera Bytes Written)		
Capacity	4GB	23.4
	8GB	46.8
	16GB	93.7
	32GB	187.5

Note:

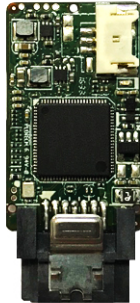




TBW value calculation is based on JEDEC JESD218 standards. (Solid-State Drive Requirements and Endurance Test Method)

- 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 Industrial micro SATA III Flash Module - HERMES-J Series physical specifications and dimensions.

**Table 6: Form Factors**

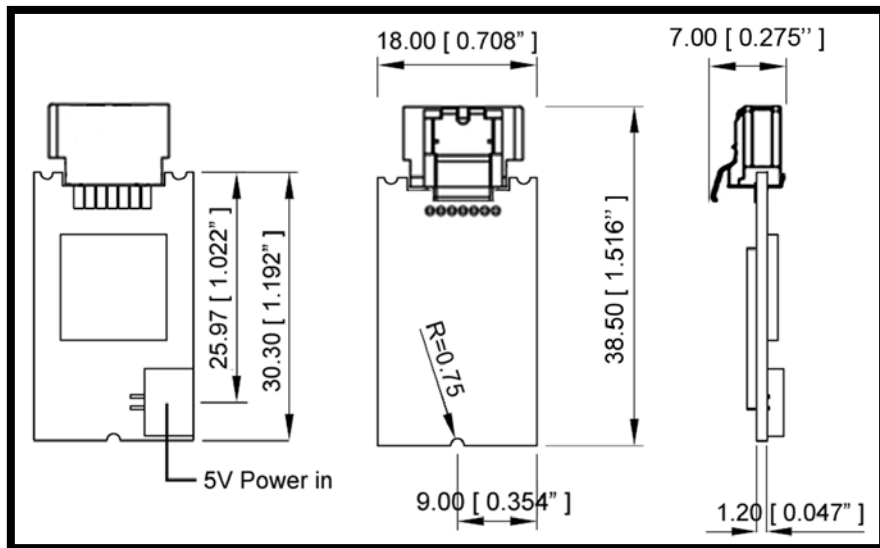
Vertical Type Standard Form Factor (VS)	Vertical Type Low Profile Form Factor (VL)	
		
Horizontal Type Standard Form Factor (HS)	Horizontal Type Low Profile Form Factor (HL)	Horizontal Type Low Profile Form Factor w/mounting hole (HO)
		

Refer to Table 6 & 7 for micro SATA III Flash Module HERMES-J Series physical specifications and dimensions.

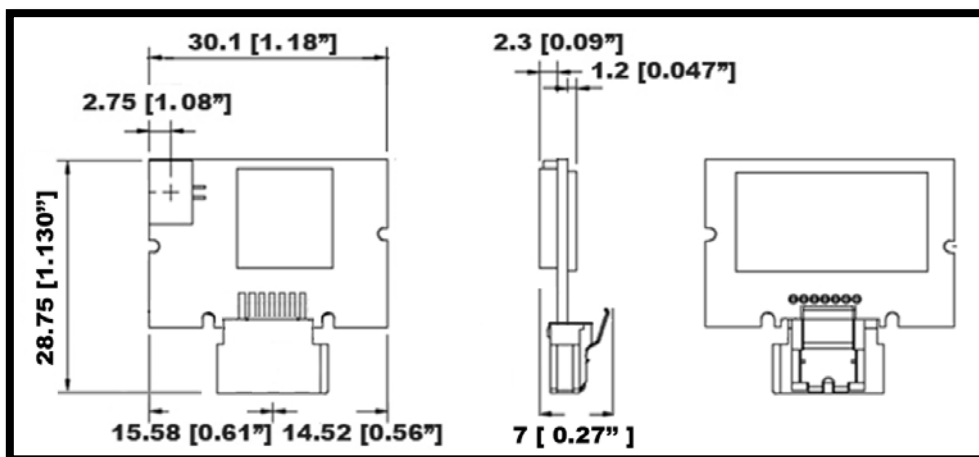
**Table 7: Physical Specifications of APRO Industrial micro SATA III Flash Module-HERMES-J Series**

Form-factor	Width	Length	Weight
Vertical Type – Standard (VS)	18.00 mm	38.50 mm	20.00g
Vertical Type – Low Profile (VL)	30.10 mm	28.75 mm	20.00g
Horizontal Type – Standard (HS)	18.00 mm	30.30 mm	20.00g
Horizontal Type –Low Profile (HL)	30.00 mm	20.08 mm	20.00g
Horizontal Type –Low Profile w/mounting hole (HO)	30.00 mm	28.8 mm	20.00g

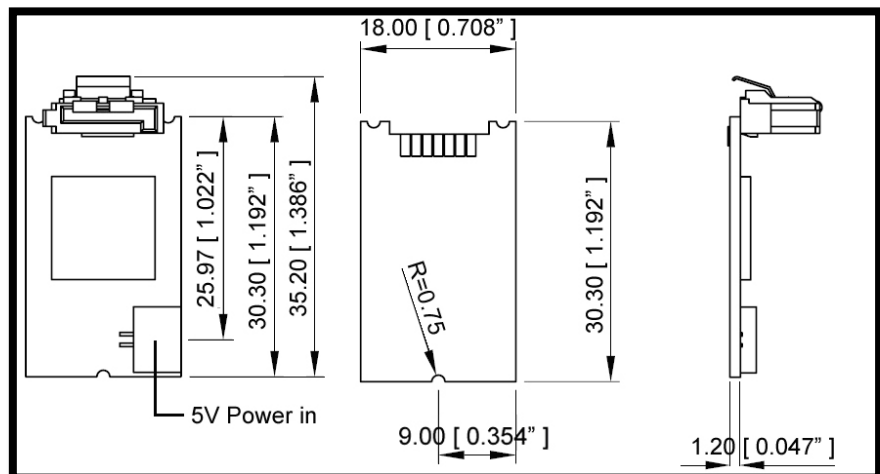
Vertical Type - Standard Form-factor (VS)



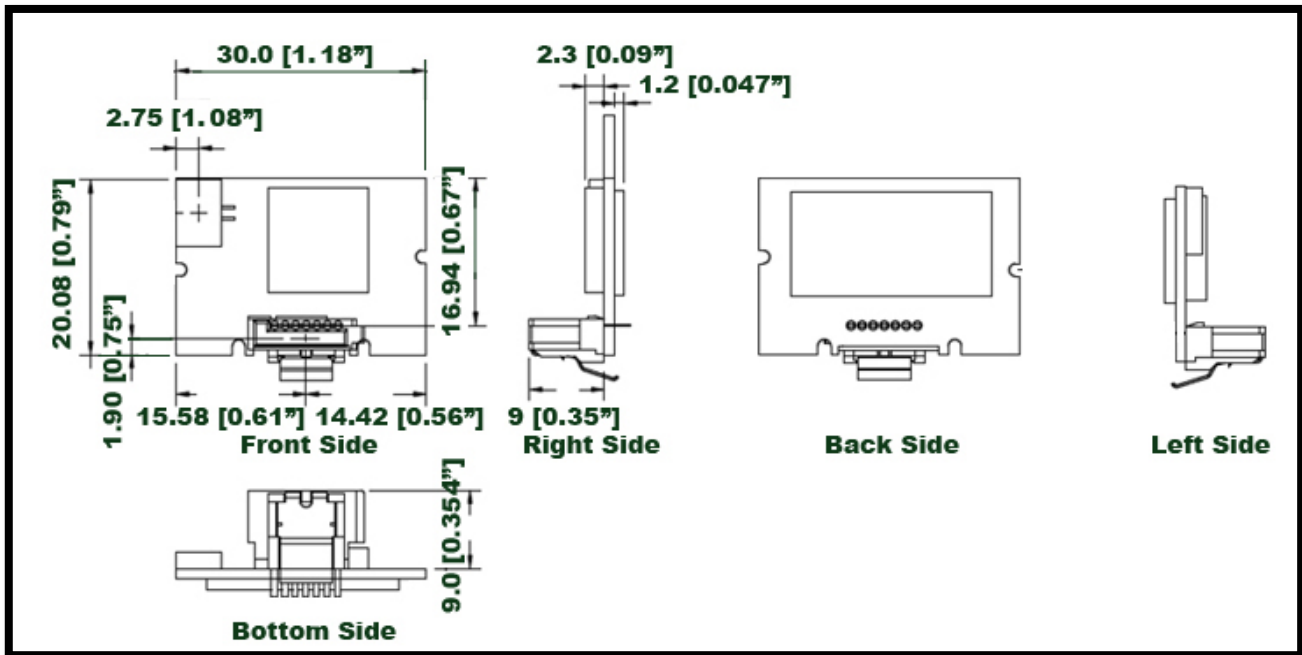
Vertical Type - Low Profile Form-factor (VL)



Horizontal Type - Standard Form-factor (HS)



### Horizontal Type - Low Profile Form-factor (HL)



### Horizontal Type - Low Profile Form-factor w/mounting hole (HO)

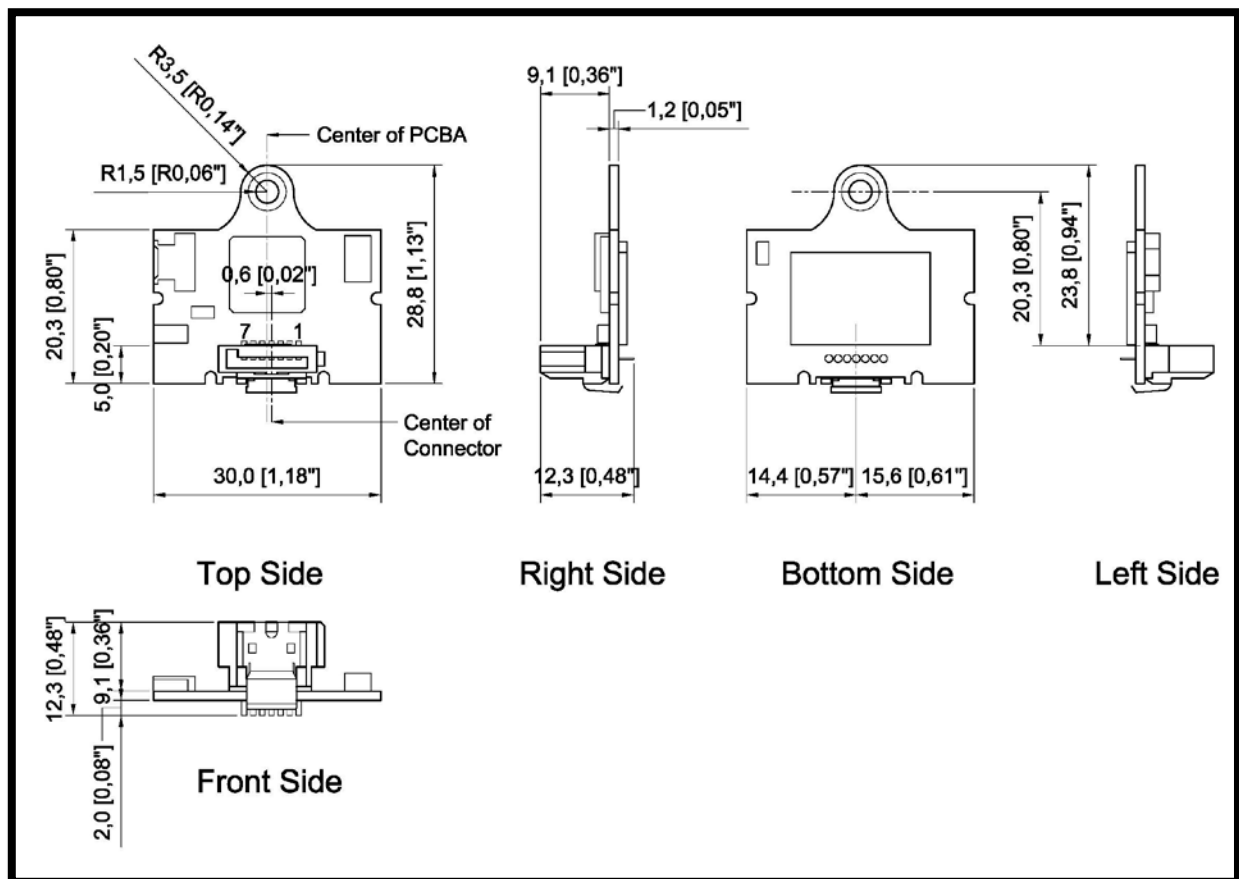


Figure 2: APRO Industrial micro SATA III Flash Modules – HERMES-J Series Dimension

### **2.5.1. *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 request 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 storage 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.

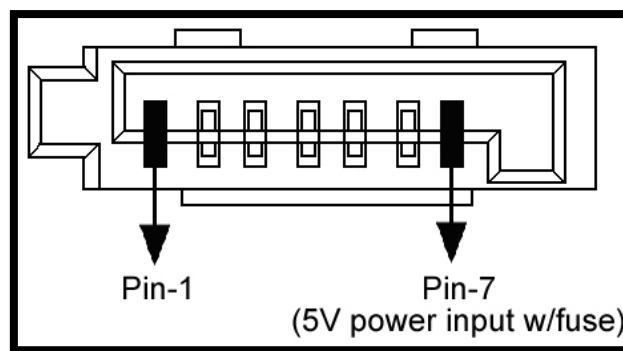
APRO uses MIL-I-46058C silicon conformal coating

### 3. Interface Description

#### 3.1. APRO Industrial micro SATA III Flash Modules interface

APRO Industrial micro SATA III Flash Modules – HERMES-J Series follow standard SATA 1.0a with 7-pin signal segment. The interface is 7-pin female connector. There are 2 solutions for customer's requirement. If customer's motherboard design in SATA interface pin-7 with 5V power output, there is a solution which has built-in power pin as the 7th pin of 7 pins header (w/fuse) , or another solution w/o fuse and for connection via cable.

Figure 4 is the aspect of the connector of micro SATA III Flash Module.



**Figure 3: The connectors of Signal Segment and Power Segment**

### 3.2. Pin Assignments

Refer to Table 9 for APRO Industrial micro SATA III Flash Module – HERMES-J Series pin assignments. There are total of 7 pins in the signal segment.

Name	Type	Description
S1	GND	Shielding
S2	A+	Differential Signal Pair A
S3	A-	
S4	GND	Shielding
S5	B-	Differential Signal Pair B
S6	B+	
S7	GND	Shielding/Power

**Table 8 - Pin Assignments**



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

APRO warrants your Industrial micro SATA III Flash Module - HERMES-J 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:***

- SLC STD. Grade    3 years / Within 60K Erasing Counts
- SLC IND. Grade    5 years / Within 60K Erasing Counts

***The warranty period is able to extend. Please contact APRO and/or Your APRO distributors for more information.***

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.

© 2017 APRO Corporation. All rights reserved