



# MLC

## Mini SATA III Flash Module (mSATA Module)

PHANES-HR Series

### **Product Specification**

APRO MLC mini SATA III flash module

Supports DDR-III SDRAM Cache

Version 01V0

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#### Revision History

Revision	Description	Date
1.0	Initial release	2016/04/20

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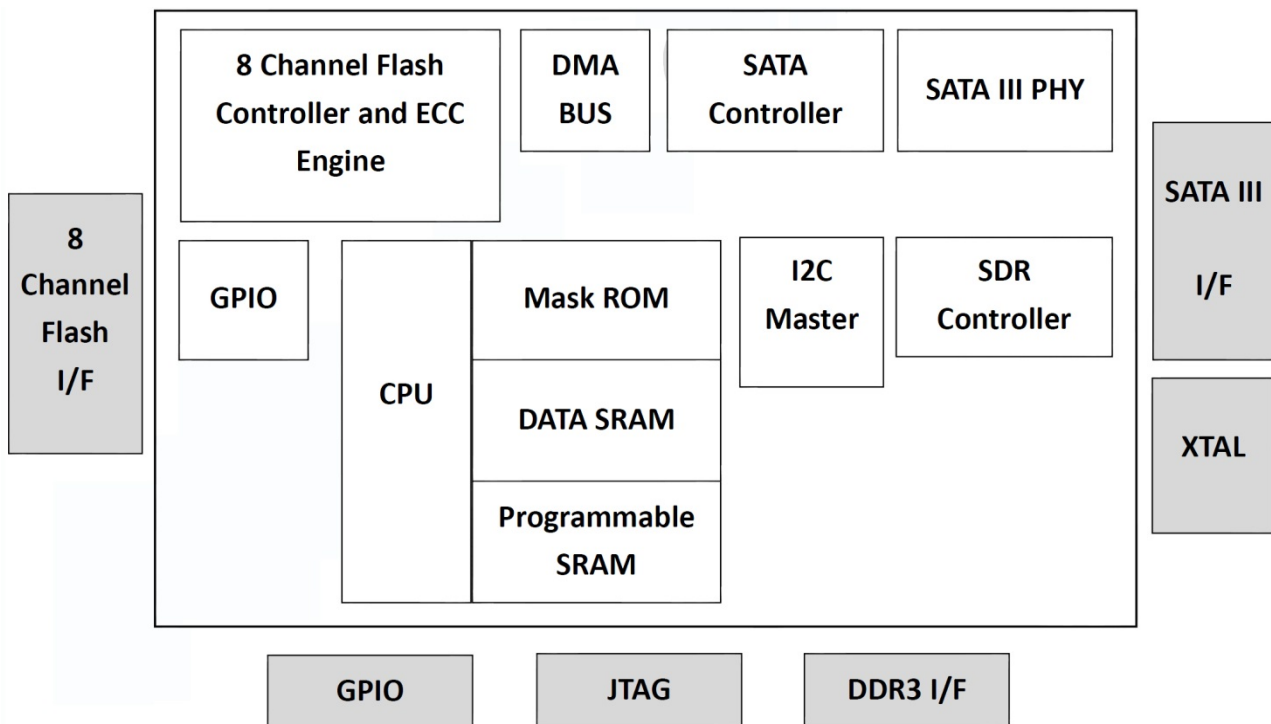
**1. Introduction**

APRO MLC mini SATA III flash module – PHANES-HR Series provides high capacity flash memory Solid State Drive (SSD) that electrically complies with Serial ATA 3.0 (SATA) standard. APRO MLC mini SATA III flash module – PHANES-HR Series support SATA Gen-III (6.0 GB/s) with high performance. The main used flash memories are MLC-NAND type flash memory chips. The available disk capacities are 128GB, 256GB, 512GB and 1TB.

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. The data transfer performance by sequential read is up to 540 MB/sec, and sequential write is up to 520 MB/sec.

APRO MLC mini SATA III flash module products provide a high level interface to the host computer. This interface allows a host computer to issue commands to the mSATA module to read or write blocks of memory. Each sector is protected by a powerful 120 bits per 2K bytes error correction (ECC). APRO MLC mini SATA III flash module PHANES-HR 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 MLC mini SATA III flash module controller.



**Figure 1: APRO MLC mini SATA III flash module PHANES-HR Series controller block diagram**

## 1.1. Scope

This document describes features, specifications and installation guide of APRO MLC mini SATA III flash module – PHANES-HR Series. In the appendix, there provides order information, warranty policy, RMA/DOA procedure for the most convenient reference.

## 1.2. System Features

- MLC-NAND type flash technology
- Standard mSATA form-factor, compliant with JEDEC MO-300A
- Mini PCI-e connector with 52 pins SATA pin out
- SATA 1.0a, SATA 2.6 and SATA 3.0 specification compliance
- S.M.A.R.T. (Self-Monitoring, Analysis and Reporting Technology) function supported.
- Non-volatile memory and no moving parts
- MLC Flash SSD standard grade capacities are 128GB, 256GB, 512GB and 1TB.
- Sequential read performance up to 540 MB/sec
- Sequential write performance up to 520 MB/sec
- Automatic 120 bits per 2K bytes error correction (ECC) and retry capabilities
- +5 V  $\pm 5\%$  operation
- Shock : 0.5ms, 1500 G, 3 axes
- Vibration : 80 Hz to 2K Hz, 20G, 3 axes
- Very high performance, very low power consumption
- Low weight, Noiseless
- Standard grade supports operating temperature 0°C to +70°C, and Industrial Grade, -40°C to +85°C with special conformal coating treatment on PCBA

## 1.3. Flash Management Technology - Static 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 mini SATA III flash module PHANES-HR 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.

### 1.4. Power Loss Protection: Flushing Mechanism

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, APRO’s MLC SSD applies the Guaranteed Flush technology, which requests the controller to transfer data to the cache. 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.

Additionally, it is critical for a controller to shorten the time the in-flight data stays in the cache. Thus, APRO’s mSATA module applies an algorithm to reduce the amount of data resides in the cache to provide a better performance. This SmartCacheFlush technology allows incoming data to only have a “pit stop” in the cache and then move to the NAND flash at once. If the flash is jammed due to particular file sizes (such as random 4KB data), the cache will be treated as an “organizer”, consolidating incoming data into groups before written into the flash to improve write amplification.

## 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 mini SATA III flash module		Standard Grade	Wide Temp Grade
PHANES-HR Series		SBMSRxxxG-PHCTMB	WBMSRxxxG-PHCTMB/C
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	Operating & Non-operating:	80 Hz to 2K Hz, 20G, 3 axes	
Shock	Operating & Non-operating:	0.5ms, 1500 G, 3 axes	

### 2.2. System Power Requirements

Table 2: Power Requirement

APRO MLC mini SATA III flash module		
PHANES-HR Series		
DC Input Voltage (VCC) 100mV max. ripple(p-p)		5V±5%
+5V Current (Maximum average value)	Reading Mode :	2,380mW (max.)
	Writing Mode :	3,600mW (max.)
	Idle Mode :	< 615mW (max.)

### 2.3. System Performance

**Table 3: System Performances**

Data Transfer Mode supporting		Serial ATA Gen-III (6.0Gb/s = 768MB/s)			
Average Access Time		0.1 ms (estimated)			
Maximum Performance	Capacity	128GB	256GB	512GB	1TB
	Sequential Read (MB/s)	540	540	540	540
	Sequential Write(MB/s)	200	400	520	510
	4KB Random Read IOPS (QD32)	92K	90.6K	89.8K	90.0K
	4KB Random Write IOPS (QD32)	49.9K	89.6K	90.5K	91.5K

Note:

- (1). All values quoted are typically at 25 °C and nominal supply voltage.
- (2). Testing of the MLC mini SATA III flash module maximum performance was performed under the following platform:
  - Computer with AMD 3.0GHz processor with Windows 7 Professional operating system

### 2.4. System Reliability

**Table 4: System Reliability**

Wear-leveling Algorithms	Static and Dynamic Wear-leveling	
Bad Blocks Management	Supportive	
ECC Technology	120 bits per 2K bytes	
Capacity	TBW(TB)	DWPD & Lifespan
128GB	257	DWPD=2.81 DWPD ( Drive Written Per Day ) Lifespan = 2 Years
256GB	514	
512GB	1,028	
1TB	2,057	

### 2.5. Physical Specifications

Refer to Table 5 and see Figure 2 for MLC mini SATA III flash module PHANES-HR Series physical specifications and dimensions.

**Table 5: Physical Specifications of APRO MLC mini SATA III flash module-PHANES-HR Series**

Length:	50.80 mm
Width:	29.80 mm
Thickness:	3.20 mm
Weight:	8.0 g / 0.3 oz

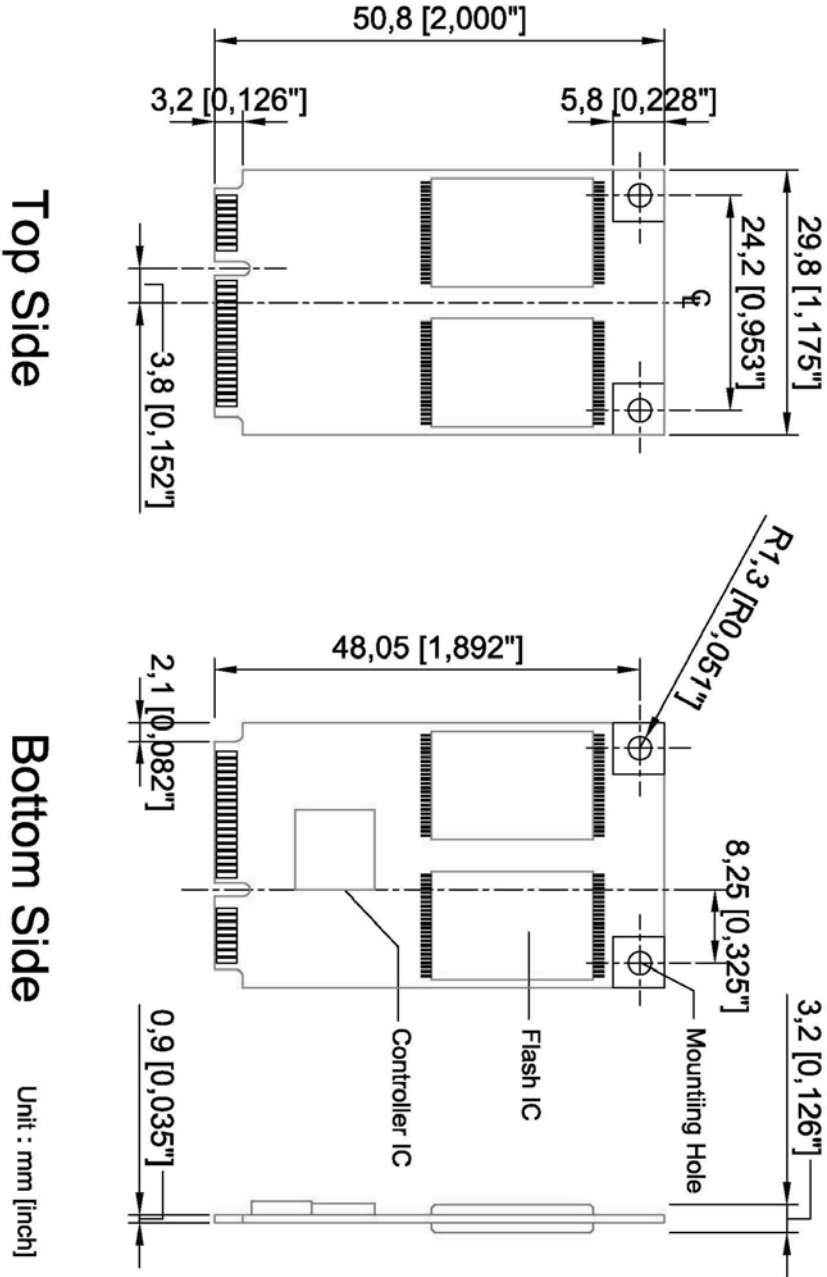


Figure 2: APRO MLC mini SATA III flash module Dimension



## 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 storages 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 uses MIL-I-46058C silicon conformal coating

## 3. Interface Description

### 3.1. APRO MLC mini SATA III flash module interface

APRO Mini SATA III Flash Module is equipped with mini PCI-e 52 pins SATA pin out

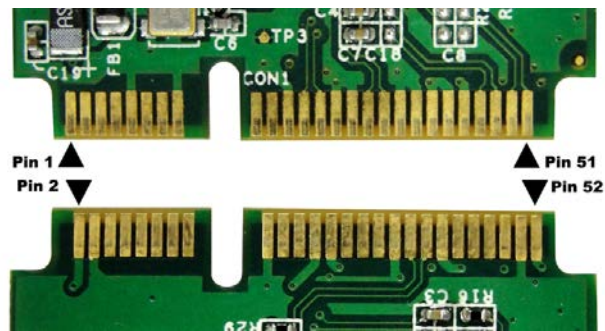


Figure 3: The connectors of mini SATA Flash Module

### 3.2. Pin Assignments

There are total of 7 pins in the signal segment and 15 pins in the power segment. The pin assignments are listed in below table 6.


**Table 6 - Pin Assignments**

Pin #	Signal Name	Pin #	Signal Name
1	NC	2	+3.3V
3	NC	4	DGND
5	NC	6	NC
7	NC	8	NC
9	DGND	10	NC
11	NC	12	NC
13	NC	14	NC
15	DGND	16	NC
17	NC	18	DGND
19	NC	20	NC
21	SATA GND	22	NC
23	TXP (out)	24	+3.3V
25	TXN (out)	26	SATA GND
27	SATA GND	28	NC
29	SATA GND	30	NC
31	RXN (in)	32	NC
33	RXP (in)	34	DGND
35	SATA GND	36	NC
37	SATA GND	38	NC
39	+3.3V	40	DGND
41	+3.3V	42	NC
43	NC	44	DEVSLP
45	NC	46	NC
47	NC	48	NC
49	DAS	50	DGND
51	GND	52	+3.3V

**Appendix A: Ordering Information**

**1. Part Number List**

◆ **APRO MLC mini SATA III flash module – PHANES-HR Series**

Product Picture	Grade	Standard grade (0°C ~ 70°C)	Wide Temp Grade ( -40°C ~ +85°C )
	128GB	SBMSR128G-PHCTMB	WBMSR128G-PHCTMB/C
	256GB	SBMSR256G-PHCTMB	WBMSR256G-PHCTMB/C
	512GB	SBMSR512G-PHCTMB	WBMSR512G-PHCTMB/C
	1TB	SBMSR001T-PHCTMB	WBMSR001T-PHCTMB/C

**Notes:**

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

**2. Part Number Decoder:**

**X1 X2 X3 X4 X5 X6 X7 X8 X9 X11 X12 X13 X14 X15 X16 / C**

**X1 : Grade**

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

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

(Standard grade with conformal coating)

**X12 : Controller version**

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

**X13 : Controller Grade**

**C :** Consumer grade

**X2 : The material of case**

**B :** Bare (without casing)

**X14 : Flash IC**

**T :** Toshiba NAND Flash IC

**X3 X4 X5 : Product category**

**MSR :** mini SATA Flash Module (mSATA) SDRAM Cache

**X15 : Flash IC grade / Type**

**M :** MLC-NAND Flash IC

**X6 X7 X8 X9 : Capacity**

**128G:** 128GB      **001T:** 1TB

**256GB:** 256GB

**512G:** 512GB

**X16 : Generation**

**B :** 15 nm

**X11 : Controller**

**P :** PHANES Series

**C : Reserved for specific requirement**

**C :** Conformal-coating

### ***Appendix B: Limited Warranty***

APRO warrants your MLC mini SATA III flash module PHANES-HR 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

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