APRO Co., Ltd.

3D NAND Flash

(TOSHIBA **BiCS FLASH™**)

SATA III 1.8" Flash SSD

PHANES-K Series

Document No. : 100-xP8SF-PKCT3

Version No. : 01V0

Date : September, 2020

ISO 9001 : 2015 CERTIFIED

Product Features

- **Flash IC**
  - TOSHIBA **BiCS FLASH™.**[*3]
  - 3D NAND Flash

- **Compatibility**
  - Compliant with 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.*1 (Self-Monitoring, Analysis and Reporting Technology) feature set support.
  - Native Command Queuing (NCQ) support.
  - TRIM maintenance command support.
  - Both Static & Dynamic wear-leveling algorithm
  - Hardware Low Density Parity Check Code, LDPC support.
  - Support bad Block Management
  - Support DIPM/HIPM Mode for power saving

- **Mechanical**
  - micro SATA 7 pins (data) + 9 pins (power connector) host Interface
  - 1.8" form-factor (shorter than PCMCIA Type II form-factor)
  - Dimension: 54.0 mm x 78.5 mm x 5.0 mm.
  - Weight: 25g /0.88oz.

- **Power Operating Voltage 3.3V(+/-) 5%**
  - Read Mode: 1,900.0 mW (max.)
  - Write Mode: 1,900.0 mW (max.)
  - Idle Mode: 310.0 mW (max.)

- **Performance (Maximum value) *[2]**
  - Sequential Read: 530.0 MB/sec. (max.) *[2]
  - Sequential Write: 470.0 MB/sec. (max.) *[2]

- **Capacity**
  - 64GB, 128GB, 256GB, 512GB and 1TB

- **Reliability**
  - **TBW:** Up to 835 TBW at 1TB Capacity. (Client workload by JESD-219A)
  - **ECC:** Designed with hardware LDPC ECC engine with hard-decision and soft-decision decoding.
  - **Temperature:** (Operating)
    Standard Grade: 0ºC ~ +70ºC
    Wide Temp. Grade: -40ºC ~ +85ºC
  - **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 micro SATA III SSD (3D NAND FLASH) PHANES-K Series**

Product Picture	Grade	Standard grade (0ºC ~ 70ºC)	Wide Temp. Grade (-40ºC ~ +85ºC)
	64GB	SP8SF064G-PKCT3	WP8SF064G-PKCT3-C
	128GB	SP8SF128G-PKCT3	WP8SF128G-PKCT3-C
	256GB	SP8SF256G-PKCT3	WP8SF256G-PKCT3-C
	512GB	SP8SF512G-PKCT3	WP8SF512G-PKCT3-C
	1TB	SP8SF001T-PKCT3	WP8SF001T-PKCT3-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 - C

X1 : **Grade**

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

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

X2 : **The material of case**

P : Plastic frame kit

X3 X4 X5 : **Product category**

8SF : 1.8" micro SATA III SSD

X6 X7 X8 X9 : **Capacity**

064G:	64GB	**512G:**	512GB
128G:	128GB	**001T:**	1TB
256G:	256GB		

X11 : **Controller**

P : PHANES Solution

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**

3 : BiCS 3D-NAND Flash IC.

C : **Reserved for specific requirement**

C : Conformal-coating

Revision History

Revision	Description	Date
1.0	Initial release.	2020/9/17

Contents

1. Introduction

APRO micro SATA III SSD (3D NAND FLASH) PHANES-K Series provides high capacity flash memory Solid State Drive (SSD) that electrically complies with SATA Revision 3.2 standard; APRO micro SATA III SSD (3D NAND FLASH) PHANES-K Series support SATA 1.5Gb/s; SATA 3Gb/s & SATA 6Gb/s data transfer rate with high performance.

The available disk capacities are from 64GB up to 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.

APRO micro SATA III SSD (3D NAND FLASH) PHANES-K Series is suitable to handheld device embedded system, inventory recorder and particularly for serious environment monitor recorder system. The sequential read speed is 530 MB/sec and sequential write speed is 470 MB/se which were testing based on 1TB capacity

APRO micro SATA III SSD (3D NAND FLASH) PHANES-K Series provides a high level interface to the host computer. This interface allows a host computer to issue commands to the APRO micro SATA III SSD (3D NAND FLASH) 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 micro SATA III SSD (3D NAND FLASH) 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 shows a block diagram of the used high tech micro SATA III SSD controller.

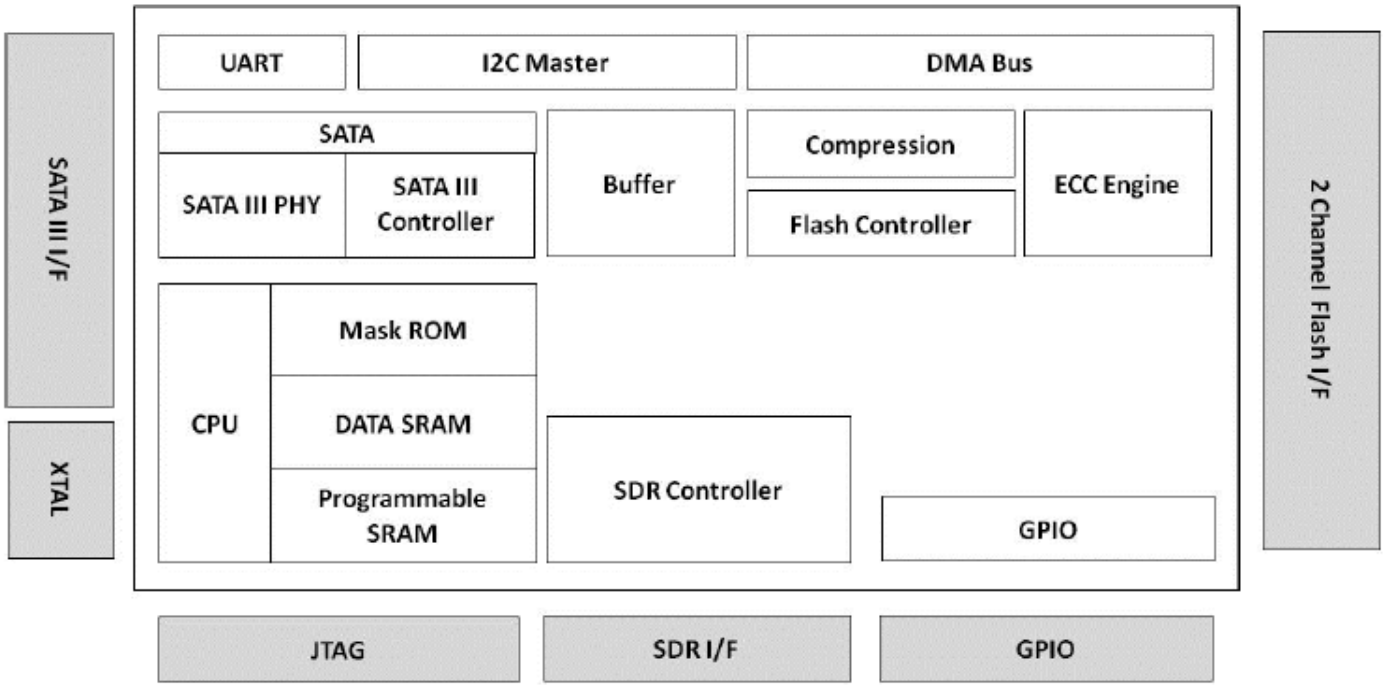

Figure 1: APRO micro SATA III SSD (3D NAND FLASH) PHANES-K Series block diagram

1.1. *Scope*

This document describes features, specifications and installation guide of APRO micro SATA III SSD (3D NAND FLASH) 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 micro SATA III SSD (3D NAND FLASH) 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 Latter 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 micro SATA III SSD (3D NAND FLASH) 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 micro SATA III SSD (3D NAND FLASH) PHANES-K Series		Standard Grade	Wide Temp. Grade
		SP8SFxxxG-PKCT3	WP8SFxxxG-PKCT3-C
Temperature	Operating:	0ºC ~ +70ºC	-40ºC ~ +85ºC
	Non-operating:	-20ºC ~ +80ºC	-50ºC ~ +95ºC
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:	24ºC	
	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 micro SATA III SSD (3D NAND FLASH) PHANES-K Series	
DC Input Voltage (VCC)	3.3V +/- 5% (Default) 5V +/- 5% (Option)
Reading Mode :	1,900.0 mW (max.)
Writing Mode :	1,900.0 mW (max.)
Idle Mode :	310.0 mW (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	64GB	128GB	256GB	512GB	1TB
	Sequential Read (MB/s)	320.0	550.0	550.0	520.0	530.0
	Sequential Write (MB/s)	220.0	450.0	460.0	470.0	470.0

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

2.4. *System Reliability*

Table 4: System Reliability

Wear-leveling Algorithms		Static & Dynamic Wear-leveling
Bad Block Management		Supportive
ECC Technology		Hardware design LDPC (Low Density Parity Check)
Erase counts		TOSHIBA **BiCS FLASH™** NAND TLC Flash Cell Level : 3K P/E Cycles
TBW (Tera Bytes Written)		
Capacity	**64GB**	42
	128GB	75
	256GB	180
	512GB	425
	1TB	835

Note:

- 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 micro SATA III SSD (3D NAND FLASH) PHANES-K Series physical specifications and dimensions.

Table 5: Physical Specifications of APRO micro SATA III SSD (3D NAND FLASH) PHANES-K Series

Length:	54.0 mm
Width:	78.5 mm
Thickness:	5.0 mm
Weight:	25g / 0.88 oz.

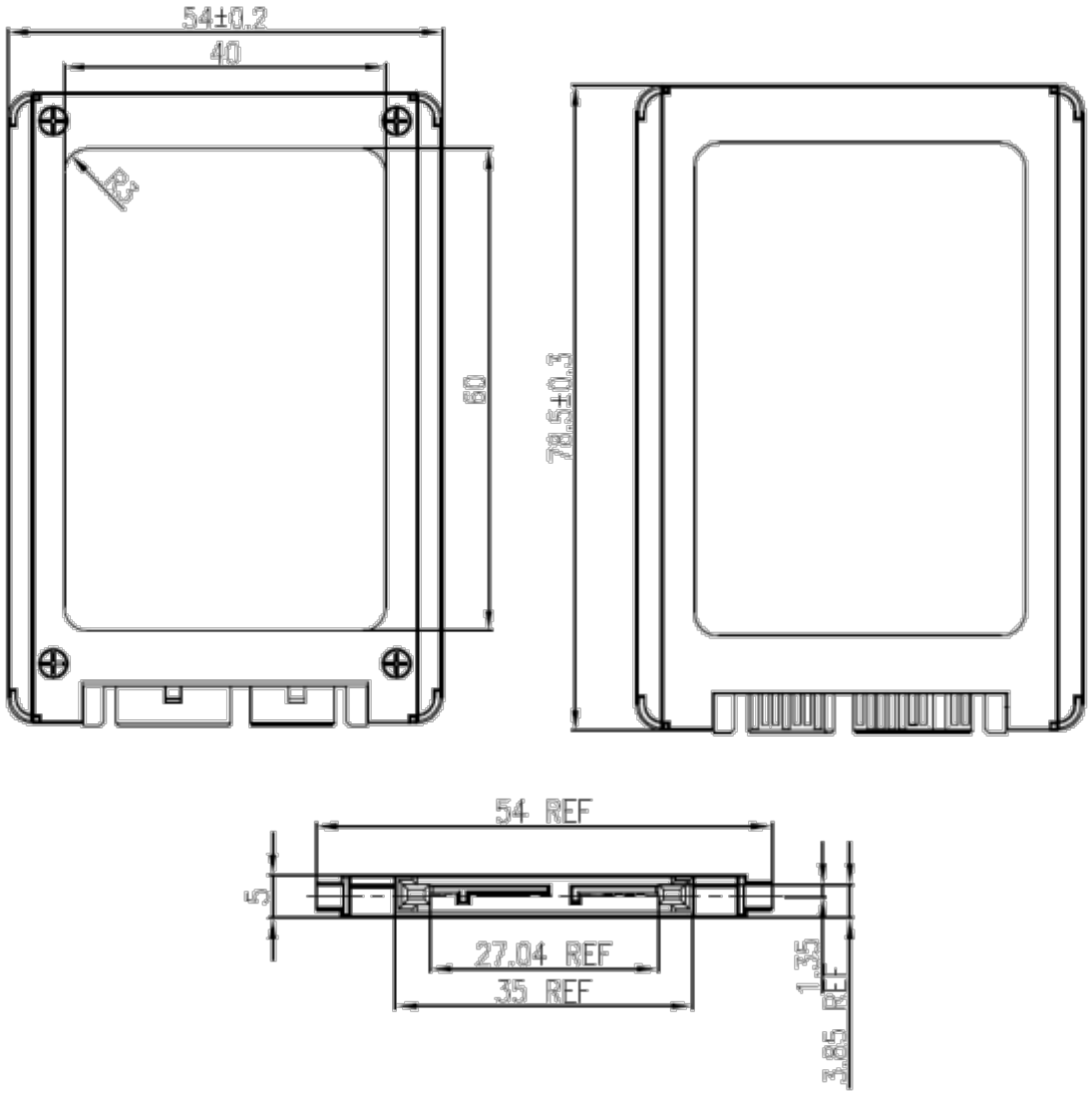

Figure 2: APRO SLC micro SATA III SSD Dimension

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 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 use MIL-I-46058C silicon conformal coating

3. Interface Description

3.1. micro SATA III SSD interface

Refer to Table 6 and see Figure 3 for APRO micro SATA III SSD (3D NAND FLASH) PHANES-K Series pin assignments.

There are total of 7 pins in the signal segment and 9 pins in the power segment. The pin assignments are listed in below table 6.

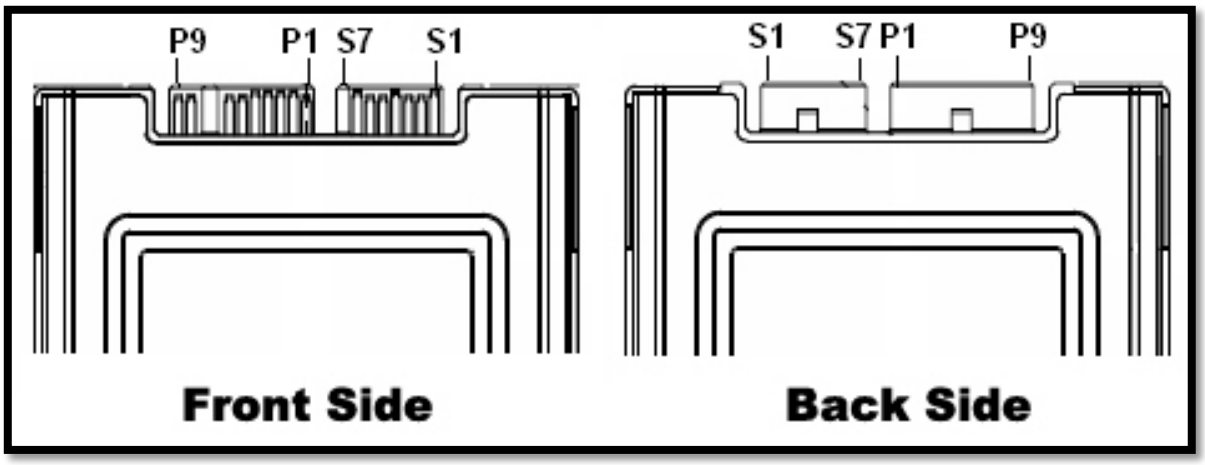

Figure 3: The connectors of SATA 7-pin (data) + 9-pin (power)

3.2. Pin Assignments

APRO micro SATA III SSD (3D NAND FLASH) PHANES-K Series operates with standard SATA pin-out.

The pin assignments are listed in below table 6.

Signal Segment Pin Assignment and Descriptions		
Pin Number	**Function**	
S1	GND	
S2	A+ (Differential Signal Pair A)	
S3	A – (Differential Signal Pair A)	
S4	GND	
S5	B – (Differential Signal Pair B)	
S6	B+ (Differential Signal Pair B)	
S7	GND	
Power Segment Pin Assignment and Description		
Pin Number	**Type**	**Function**
P1	V_{33}	3.3V Power Input
P2	V_{33}	3.3V Power Input
P3	GND	GND
P4	GND	GND
P5	V_5	Reserved for 5V Power Input (Option)
P6	V_5	Reserved for 5V Power Input (Option)
P7	Optional	Reserved for Active LED (Option)
Key	Key	N/C
P8	Optional	Erase function (Option)
P9	Optional	Reserved (Not Connected)

Table 6 - Pin Assignments

Appendix A: Limited Warranty

APRO warrants your micro SATA III SSD (3D NAND FLASH) 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:

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

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