



aSLC

2.5" SATA III SSD

PHANES-HR Series

Product Specification

APRO aSLC RUGGED METAL 2.5" SATA III SSD

Supports DDR-III SDRAM Cache

Version 01V0

Document No. 100-XR7SR-PHCTMBAS

April 2016

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Revision History

| Revision | Description | Date |
|----------|-----------------|------------|
| 1.0 | Initial release | 2016/04/29 |
| | | |

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1. Introduction

APRO aSLC Rugged Metal 2.5" SATA III SSD – PHANES-HR Series provides high capacity flash memory Solid State Drive (SSD) that electrically complies with Serial ATA 3.0 (SATA) standard. APRO aSLC Rugged Metal 2.5" SATA III SSD – PHANES-HR Series support SATA Gen-III (6.0 GB/s) with high performance. The available disk capacities are 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. The data transfer performance by sequential read is up to 550 MB/sec, and sequential write is up to 530 MB/sec. which is based on Toshiba's 15nm Toggle MLC flash (with 256MB/512MB/1024/2048 MB DDR3 cache enabled).

APRO aSLC Rugged Metal 2.5" SATA III SSD products provide a high level interface to the host computer. This interface allows a host computer to issue commands to the APRO aSLC Rugged Metal 2.5" SATA III SSD – PHANES-HR Series to read or write blocks of memory. Each sector is protected by a powerful 120 bits per 2K bytes error correction (ECC). APRO aSLC Rugged Metal 2.5" SATA III SSD 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.

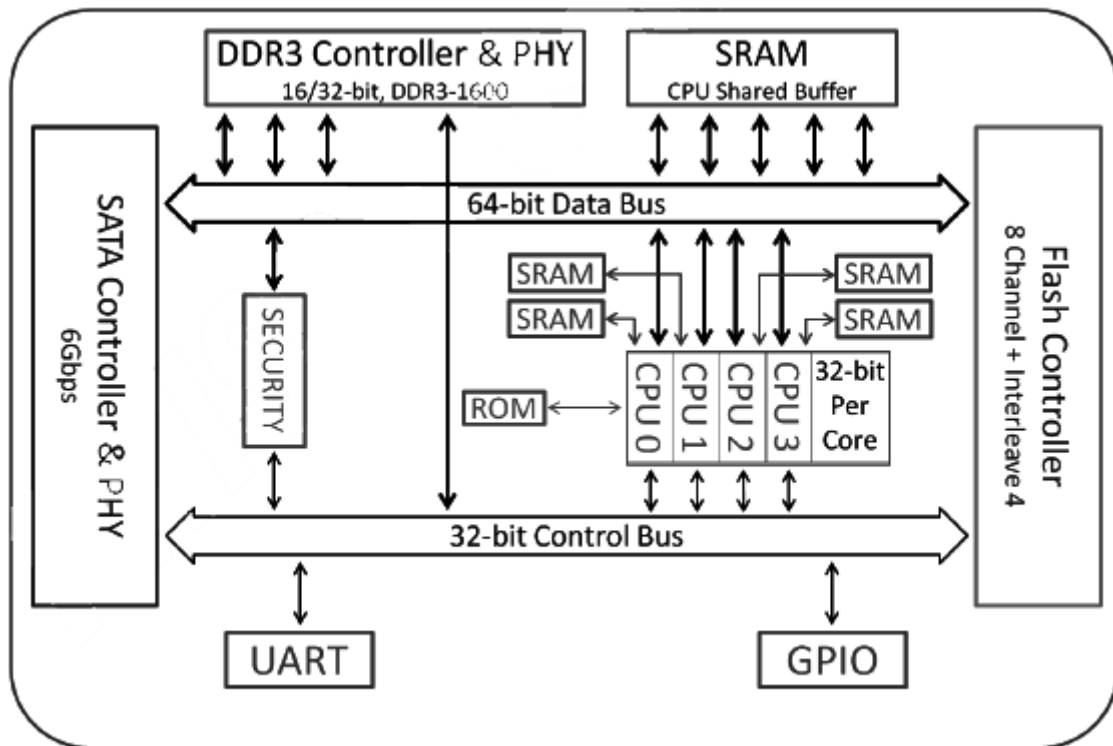


Figure 1: APRO aSLC Rugged Metal 2.5" SATA III SSD PHANES-HR Series controller block diagram

1.1. Scope

This document describes features, specifications and installation guide of APRO aSLC Rugged Metal 2.5" SATA III SSD – PHANES-HR Series. In the appendix, there provides order information, warranty policy, RMA/DOA procedure for the most convenient reference.

1.2. System Features

- aSLC-NAND type flash technology
- Standard 2.5" SATA Flash Disk form-factor (7mm height)
- SATA 7-pin (data) + 15-pin (power connector) SATA Interface
- Extremely Rugged Metal casing to endure harsh environments
- 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.
- TRIM Commands supported.
- aSLC Flash SSD standard grade capacities are 64GB, 128GB, 256GB and 512GB.
- Sequential read performance up to 550 MB/sec; Sequential write performance up to 530 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. aSLC Technology

The aSLC can be considered as an extended version of the MLC. While MLC contains both fast and slow pages, aSLC only utilizes fast pages for programming. The concept of aSLC is demonstrated in the **Figure 2** below. The first and second bits of a memory cell represent a fast and slow page respectively, as shown in the left table. Since only fast pages are programmed when applying aSLC, the bits highlighted in red are used, as shown in the right table. As a result, aSLC provides better performance and endurance than MLC does. Moreover, the aSLC performs similarly to the SLC, yet more cost effective.

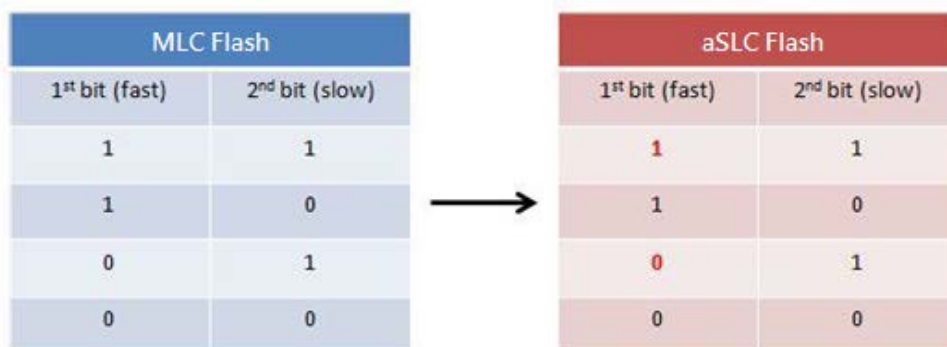


Figure 2: The concept of APRO aSLC Rugged Metal 2.5" SATA III SSD – PHANES-HR Series

1.4. Flash Management Technology - Dynamic and 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 aSLC Rugged Metal 2.5” SATA III SSD – 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.

1.5. 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 aSLC 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 aSLC Rugged Metal 2.5” SATA III SSD – PHANES-HR Series 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 aSLC Rugged Metal 2.5” SATA III SSD | | Standard Grade | Wide Temp Grade |
|--|----------------------------|-----------------------------|----------------------|
| PHANES-HR Series | | SR7SRxxxG-PHCTMBAS | WR7SRxxxG-PHCTMBAS/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 aSLC Rugged Metal 2.5" SATA III SSD | | |
|--|----------------|----------------------|
| PHANES-HR Series | | |
| DC Input Voltage (VCC) | | 5V±5% |
| +5V Current (Maximum average value) | Reading Mode : | 2,520mW (512GB max.) |
| | Writing Mode : | 4,450mW (512GB max.) |
| | Idle Mode : | 400mW (512GB 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 | 64GB | 128GB | 256GB | 512GB |
| | Sequential Read (MB/s) | 550 | 550 | 550 | 550 |
| | Sequential Write(MB/s) | 495 | 510 | 530 | 530 |
| | 4KB Random Read IOPS (QD32) | 72K | 72K | 72K | 72K |
| | 4KB Random Write IOPS (QD32) | 90K | 90K | 90K | 90K |

Note:

The performance was measured using CrystalDiskMark with SATA 6Gbps host.

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 | |
| Endurance | TBW (Tera Bytes Written) ; Based on Sequential Write Test. | |
| Capacity | TBW(TB) | DWPD & Lifespan |
| 64GB | 1284 | DWPD=18.76 DWPD (Drive Written Per Day) Lifespan = 3 Years |
| 128GB | 2568 | |
| 256GB | 5136 | |
| 512GB | 10,271 | |

NOTES:

(1). Samples were built using Toshiba 15nm Toggle MLC NAND flash.

(2). TBW may differ according to flash configuration and platform.

(3) 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 3 for Rugged Metal 2.5" SATA III aSLC SSD PHANES-HR Series physical specifications and dimensions.

Table 5: Physical Specifications of APRO aSLC Rugged Metal 2.5" SATA III SSD-PHANES-HR Series

| | |
|------------|---------------------|
| Length: | 100.0 mm / 3.94 in |
| Width: | 69.90 mm / 2.75 in |
| Thickness: | 7.0 mm / 0.28 in |
| Weight: | 115.00 g / 3.7 o.z. |

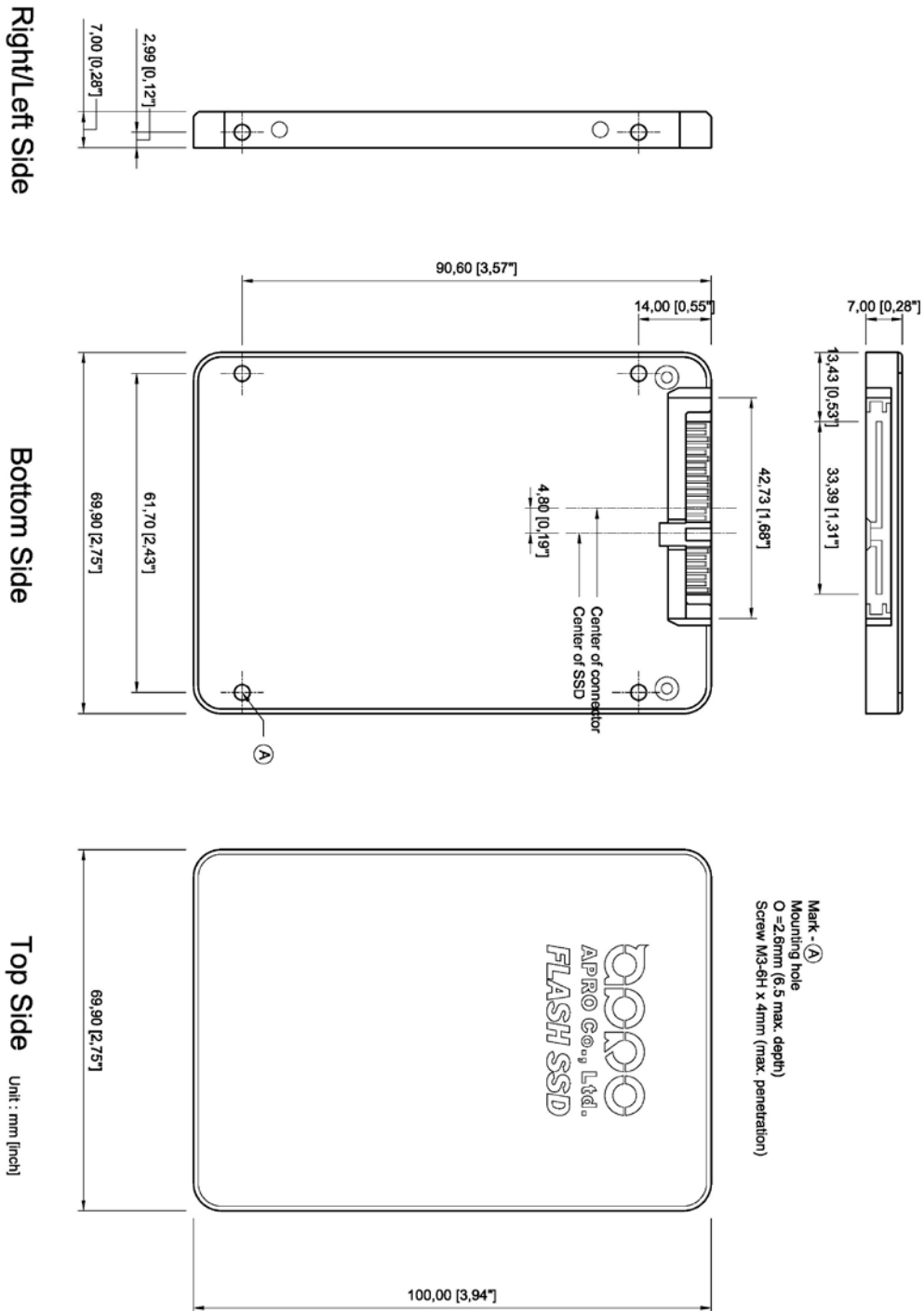


Figure 3: APRO aSLC Rugged Metal 2.5" SATA III SSD Dimension

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 uses MIL-I-46058C silicon conformal coating

3. Interface Description

3.1. APRO aSLC Rugged Metal 2.5" SATA III SSD interface

APRO aSLC Rugged Metal 2.5" SATA III SSD is equipped with standard 7 pins + 15 pins Serial ATA connector.

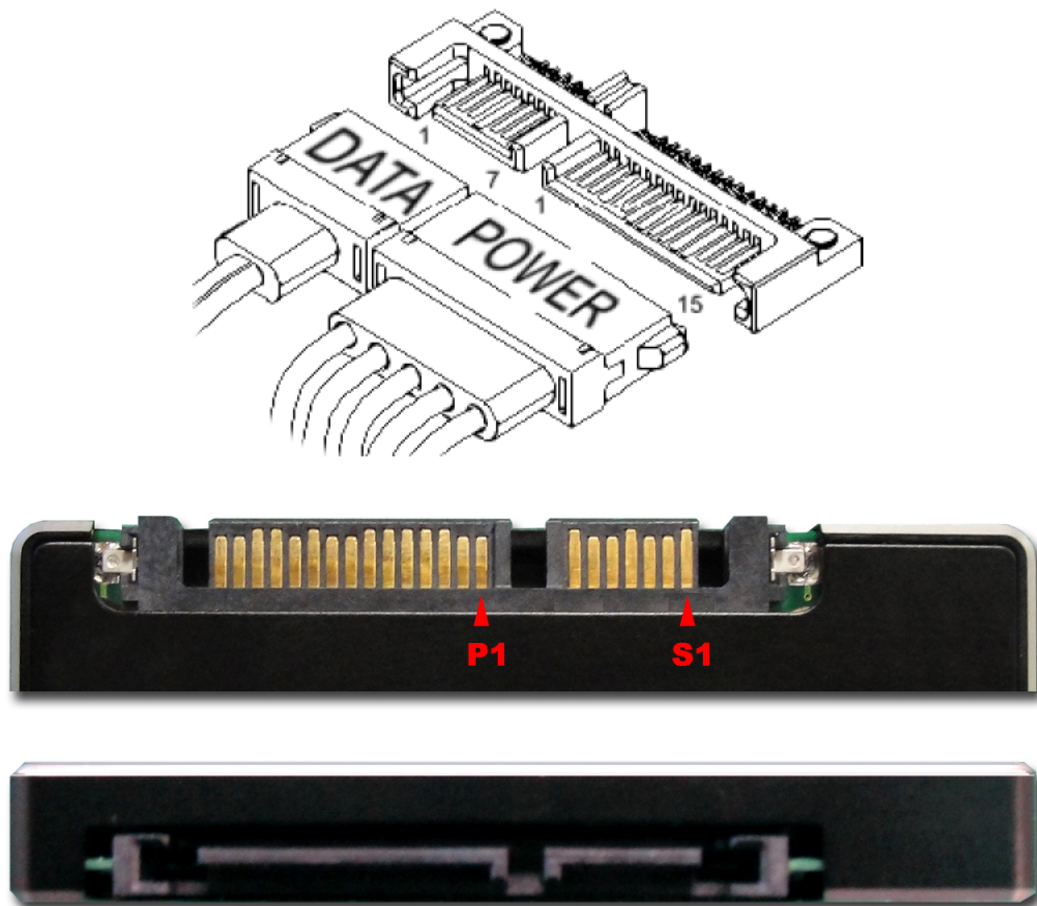


Figure 4: The connectors of APRO aSLC Rugged Metal 2.5" SATA III SSD

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

| Name | Type | Description |
|------|------|----------------------------|
| S1 | GND | NA |
| S2 | A+ | Differential Signal Pair A |
| S3 | A- | |
| S4 | GND | NA |
| S5 | B- | Differential Signal Pair B |
| S6 | B+ | |
| S7 | GND | NA |

| Key and Spacing separate signal and power segments | | |
|--|---------|--|
| P1 | NC | NA |
| P2 | NC | NA |
| P3 | NC | NA |
| P4 | GND | NA |
| P5 | GND | NA |
| P6 | GND | NA |
| P7 | V5 | 5V Power, Pre-Charge |
| P8 | V5 | 5V Power |
| P9 | V5 | 5V Power |
| P10 | GND | NA |
| P11 | DAS/DSS | Device Activity Signal / Disable Staggered Spin up |
| P12 | GND | NA |
| P13 | NC | NA |
| P14 | NC | NA |
| P15 | NC | NA |


Notes:

1. All pins are in a signal row with a 1.27 mm (0.050" pitch).
2. The commands on the mating sequence in forward table apply to the case of backplane blind mate connector only. In this case, the mating sequences are:
 - (1) The pre-charge power pins and other ground pins.
 - (2) The signal pins and the rest of the power pins.

Appendix A: Ordering Information

1. Part Number List

◆ **APRO aSLC Rugged Metal 2.5" SATA III SSD – PHANES-HR Series**

| Product Picture | Grade | Standard grade (0°C ~ 70°C) | Wide Temp Grade (-40°C ~ +85°C) |
|---|-------|-----------------------------|-----------------------------------|
|  | 64GB | SR7SR064G-PHCTMBAS | WR7SR064G-PHCTMBAS/C |
| | 128GB | SR7SR128G-PHCTMBAS | WR7SR128G-PHCTMBAS/C |
| | 256GB | SR7SR256G-PHCTMBAS | WR7SR256G-PHCTMBAS/C |
| | 512GB | SR7SR512G-PHCTMBAS | WR7SR512G-PHCTMBAS/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 X17 X18 / 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)

X2 : The material of case

R : 2.5" Rugged Metal Casing

X3 X4 X5 : Product category

7SR : 2.5" SATA SSD with SDRAM Cache

X6 X7 X8 X9 : Capacity

064G: 64GB **512G:** 512GB

128G: 128GB

256GB: 256GB

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 : Flash IC

B : 15 nm

AS : aSLC Technology.

X11 : Controller

P : PHANES Series

C : Reserved for specific requirement

C : Conformal-coating

Appendix B: Limited Warranty

APRO warrants your aSLC Rugged Metal 2.5" SATA III SSD – 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:

- aSLC (Standard grade / Wide temp. grade) 3 years / Within 20K Erasing Counts

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