



2.5" SATA III MLC SSD

PHANES-HR Series

Product Specification

APRO RUGGED METAL 2.5" SATA III MLC SSD

Supports DDR-III SDRAM Cache

Version 01V1

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Revision History

Revision	Description	Date
1.0	Initial release	2016/04/20
1.1	Add. 2TB Power consumption	2017/07/18

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1. Introduction

APRO Rugged Metal 2.5" SATA III MLC SSD – PHANES-HR Series provides high capacity flash memory Solid State Drive (SSD) that electrically complies with Serial ATA 3.0 (SATA) standard. APRO Rugged Metal 2.5" SATA III MLC SSD – 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 64GB, 128GB, 256GB, 512GB, 1TB and 2TB.

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.

APRO Rugged Metal 2.5" SATA III MLC SSD products provide a high level interface to the host computer. This interface allows a host computer to issue commands to the Rugged Metal 2.5" SATA III MLC SSD to read or write blocks of memory. Each sector is protected by a powerful 120 bits per 2K bytes error correction (ECC). APRO Rugged Metal 2.5" SATA III MLC 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 shows a block diagram of the used high tech Rugged Metal 2.5" SATA III MLC SSD controller.

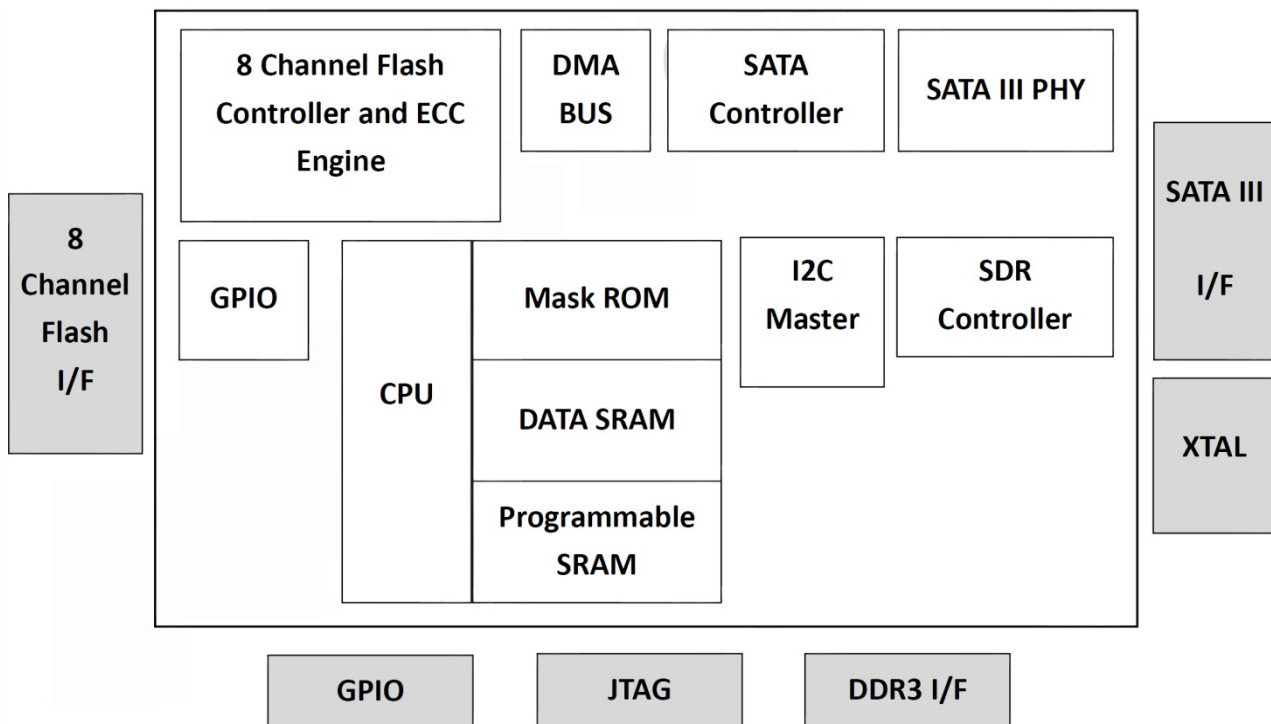


Figure 1: APRO Rugged Metal 2.5" SATA III MLC SSD PHANES-HR Series controller block diagram

1.1. *Scope*

This document describes features, specifications and installation guide of APRO's Rugged Metal 2.5" SATA III MLC SSDs – 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 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.
- Non-volatile memory and no moving parts
- MLC Flash SSD standard grade capacities are 64GB, 128GB, 256GB, 512GB, 1TB and 2TB.
- 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. *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 2.5" SATA III MLC 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.

1.4. 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 MLC SSD 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 Rugged Metal 2.5" SATA III MLC SSD		Standard Grade	Wide Temp Grade
PHANES-HR Series		SR7SRxxxG-PHCTMB	WR7SRxxxG-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 Rugged Metal 2.5" SATA III MLC SSD		Standard Grade
PHANES-HR Series		SR7SRxxxG-PHCTMB
DC Input Voltage (VCC) 100mV max. ripple(p-p)		5V±5%
+5V Current (Maximum average value)	Reading Mode :	2,520mW (1TB.) / 3,150 mW (2TB.)
	Writing Mode :	4,450mW (1TB.) / 5,500 mW (2TB.)
	Idle Mode :	400mW (1TB.) / 190 mW (2TB.)

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	1TB	2TB
	Sequential Read (MB/s)	542	563	563	563	560	550
	Sequential Write(MB/s)	101	203	402	529	528	530
	4KB Random Read IOPS (QD32)	48K	74K	73K	73K	73K	90K
	4KB Random Write IOPS (QD32)	20K	40K	66K	80K	85K	90K

Note:

(1). All values quoted are typically at 25 °C and nominal supply voltage.

(2). Testing of the Rugged Metal 2.5" SATA III MLC SSD 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
64GB	128	DWPD=2.81 DWPD (Drive Written Per Day) Lifespan = 2 Years
128GB	257	
256GB	514	
512GB	1,028	
1TB	2,057	
2TB	4,114	

2.5. Physical Specifications

Refer to Table 5 and see Figure 2 for Rugged Metal 2.5" SATA III MLC SSD PHANES-HR Series physical specifications and dimensions.

Table 5: Physical Specifications of APRO Rugged Metal 2.5" SATA III MLC 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.

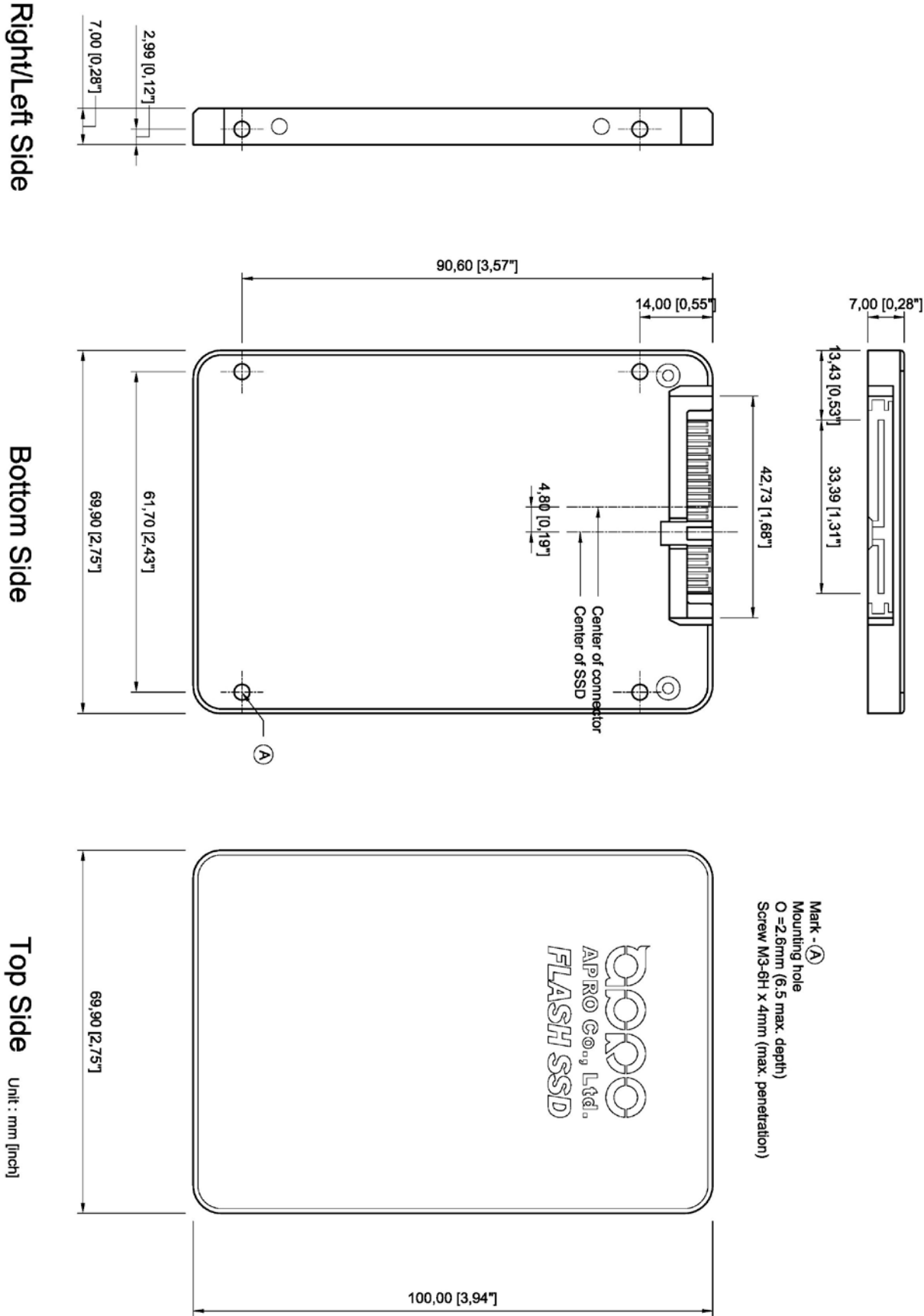


Figure 2: APRO Rugged Metal 2.5" SATA III MLC SSD Dimension

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 Rugged Metal 2.5" SATA III MLC SSD interface

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

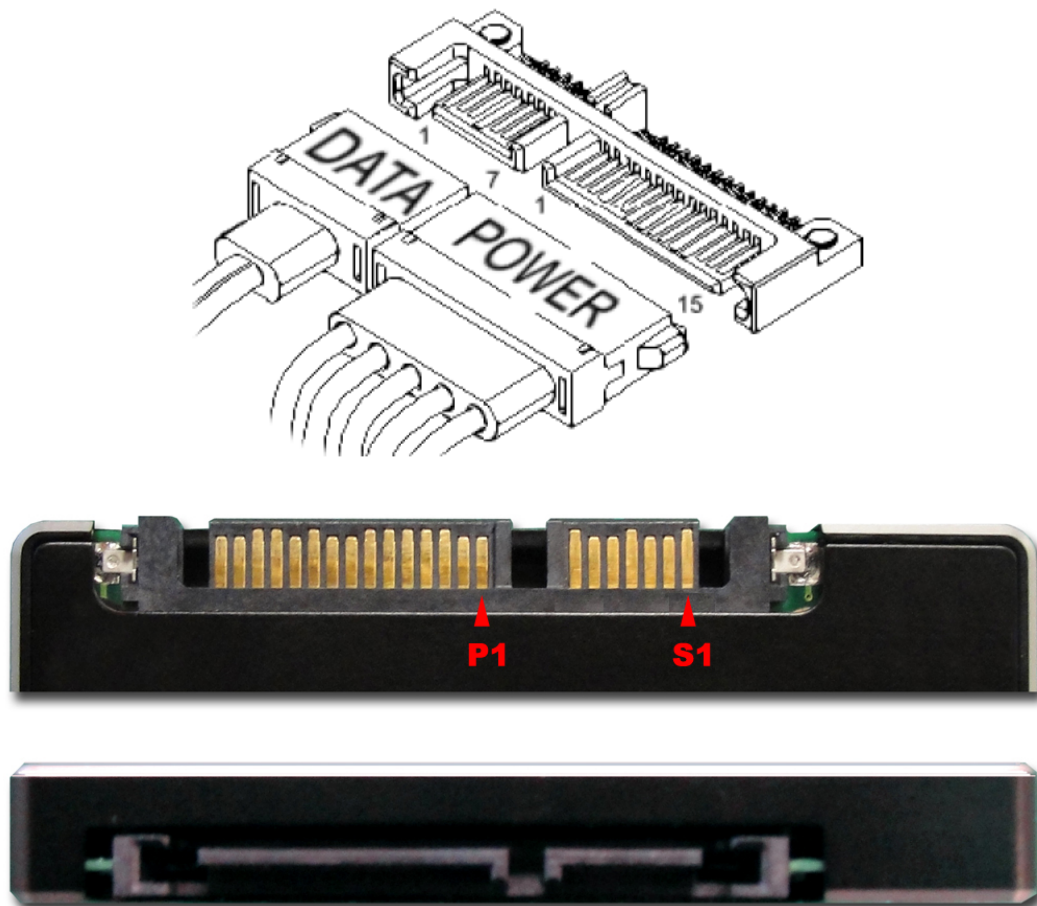


Figure 3: The connectors of 2.5" SATA III MLC SSD

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 Rugged Metal 2.5" SATA III MLC SSD – PHANES-HR Series**

Product Picture	Grade	Standard grade (0°C ~ 70°C)	Wide Temp Grade (-40°C ~ +85°C)
	64GB	SR7SR064G-PHCTMB	WR7SR064G-PHCTMB/C
	128GB	SR7SR128G-PHCTMB	WR7SR128G-PHCTMB/C
	256GB	SR7SR256G-PHCTMB	WR7SR256G-PHCTMB/C
	512GB	SR7SR512G-PHCTMB	WR7SR512G-PHCTMB/C
	1TB	SR7SR001T-PHCTMB	WR7SR001T-PHCTMB/C
	2TB	SR7SR002T-PHCTMB	WR7SR002T-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

R : 2.5" Rugged Metal Casing

X14 : Flash IC

T : Toshiba MLC-NAND Flash IC

X3 X4 X5 : Product category

7SR : 2.5" SATA SSD with SDRAM Cache

X15 : Flash IC grade / Type

M : MLC-NAND Flash IC

X6 X7 X8 X9 : Capacity

064G:	64GB	512G:	512GB
128G:	128GB	001T:	1TB
256GB:	256GB	002T:	2TB

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 Rugged Metal 2.5" SATA III MLC SSD 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.