APRO Co., Ltd.

# 2.5” SATA III SLC SSD

## HERCULES-T Series

**Product Specification**

INDUSTRIAL

APRO RUGGED METAL 2.5” SATA III SLC SSD

Version 01V0

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Revision History

| Revision | Description | Date |
|---|---|---|
| 1.0 | Initial release | 2017/05/26 |
| | | |

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## 1. Introduction

APRO industrial rugged metal 2.5” SATA III SLC SSD – HERCULES-T 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 SLC SSD – HERCULES-T 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 8GB, 16GB, 32GB, 64GB, 128GB and 256GB.

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 173.4 MB/sec, and sequential write is up to 165.8 MB/sec.

APRO Rugged Metal 2.5” SATA III SLC SSD built-in DDRIII SDRAM 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 SLC SSD to read or write blocks of memory. Hardware BCH ECC capable of correcting errors up to 66-bit/1KB (ECC). APRO Rugged Metal 2.5” SATA III SLC SSD HERCULES-T 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 SLC SSD controller.

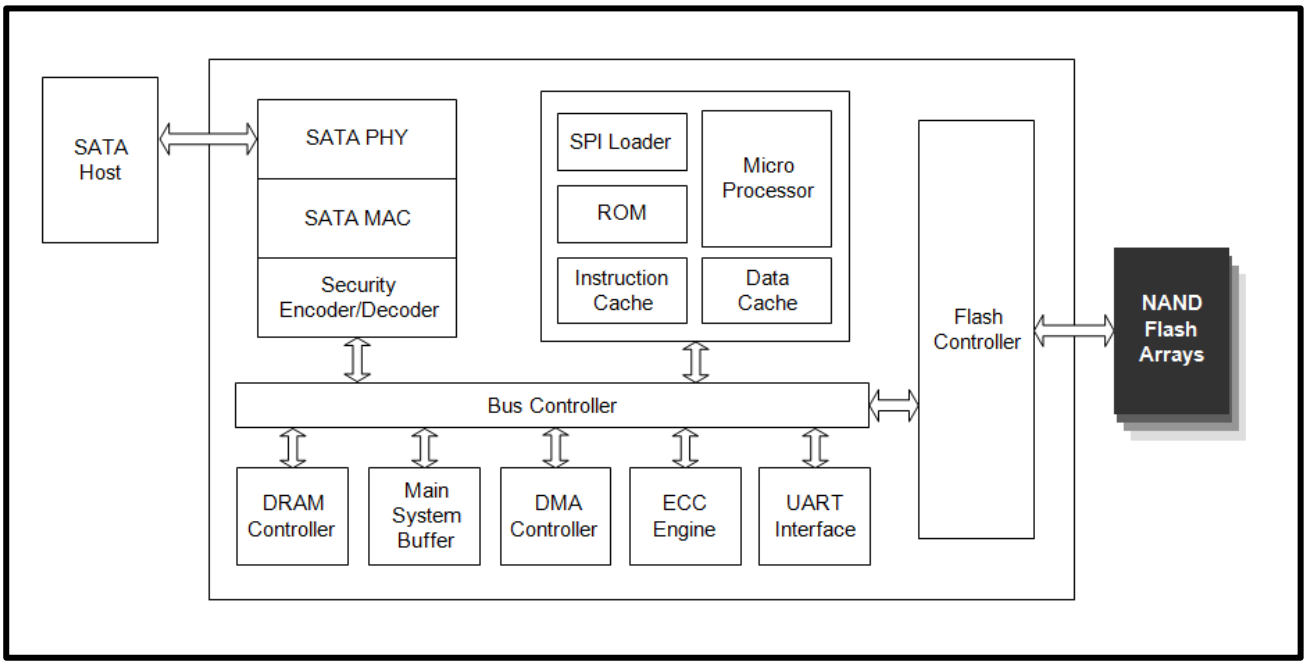


***Figure 1: APRO Rugged Metal 2.5” SATA III SLC SSD HERCULES-T Series controller block diagram***


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## *1.1. Scope*

This document describes features, specifications and installation guide of APRO's Rugged Metal 2.5" SATA III SLC SSDs HERCULES-T Series. In the appendix, there provides order information, warranty policy, RMA/DOA procedure for the most convenient reference.

## *1.2. System Features*

- SLC-NAND type flash technology.
- Standard 2.5" SATA Flash Disk form-factor (9.2mm height).
- SATA 7-pin (data) + 15-pin (power connector) SATA Interface.
- Extremely Rugged Metal casing to endure harsh environments.
- Power interrupts data protection technology by Tantalum Capacitors.
- SATA 1.0a, SATA 2.6 and SATA 3.0 specification compliance.
- SMART (Self-Monitoring, Analysis and Reporting Technology) function supported.
- Supports Window-7 TRIM Command.
- Non-volatile memory and no moving parts.
- SLC Flash SSD standard grade capacity from 8GB up to 256GB.
- Supports 4GBits DDRIII SDRAM Cache
- Sequential read performance up to 173.4 MB/sec.
- Sequential write performance up to 165.8 MB/sec.
- Hardware BCH ECC capable of correcting errors up to 66-bit/1KB (ECC).
- +5 V ±5% operation.
- Shock: 0.5ms, 1500 G, 3 axes.
- Vibration: 7 Hz to 2K Hz, 20G, 3 axes.
- Very high performance, very low power consumption.

## *1.3. Flash Management Technology - Global Wear Leveling*

In order to gain the best management for flash memory, APRO's Rugged Metal 2.5" SATA III SLC SSDs HERCULES-T Series applies Global 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. The objective of global wear leveling is to prevent any frequently updated data from staying at the static area so that wear leveling could be evenly applied to all blocks. Static areas contain any data that does not change, and are ignored by dynamic wear leveling. Such static data may include operating system files, table look-ups, executable files, and etc. Global wear leveling frequently replaces blocks in this area with block in the hot area, and thus each block in all areas has the same probability to be used.

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 data, it moves that data to a more heavily used location before it moves the newly written data. Wear leveling maximizes effective endurance Flash array compared to no wear leveling products.


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### *1.4. DRAM Buffer*

SSDs designed with a DDRIII SDRAM buffer which is support high transfer rate as a data buffer for the SSD; SSD with SDRAM buffer is able to deliver excellent random data transfer speed.

### *1.5. Power Interrupt Data Protection Technology*

In the event of an unstable power supply, SSD loses power before it can finish programming process from host to flash, this may cause data being written to the incorrect block and further leads to data corruption.

Power Interrupt Data Protection Technology is applied with several tantalum capacitors to provide power buffering after host power interruption. The Data Protection Technology provides enough time for the SSD controller can write all DRAM buffer data to flash, all data will be protected and without data loss.

The ability of Power Interrupt Data Protection Technology is able to write 1.28MB of data within 60ms.
This ensures all data in the DRAM buffer can be successfully written into flash.

Traditionally, super capacitors were applied in most SSD products, the advantages of tantalum capacitors over super capacitors are:

- **Tantalum capacitors are electrolyte free.**
  It is able to maintain its designed capacitance for several years when used within design limits.
- **Wide operating temperature range.**
  Tantalum capacitors can operate from temperature range of -55C to +125C, which is very suitable for industrial and military usage.
- **Tantalum capacitors have an ultimate high volumetric efficiency (CV/cc).**
  For example, a 50-microfarad tantalum capacitor can be equal and to properly replace a 500-microfarad aluminum capacitor.


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## 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 SLC SSD HERCULES-T Series | | Standard Grade | Industrial Grade |
|---|---|---|---|
| | | SR2SRxxxG-MTCTC | WR2SRxxxG-MTITI |
| Temperature | Operating:<br>Non-operating: | 0ºC ~ +70ºC<br>-20ºC ~ +80ºC | -40ºC ~ +85ºC<br>-50ºC ~ +95ºC |
| Humidity | Operating & Non-operating: | 10% ~ 95% non-condensing | |
| Vibration | Operating & Non-operating: | 7 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 SLC SSD HERCULES-T Series | | |
|---|---|---|
| DC Input Voltage (VCC) | | 5V±5% |
| +5V Current (Maximum average value) | Reading Mode : | 350mA. (max.) |
| | Writing Mode : | 420mA. (max.) |
| | During FE/SE : | 330mA. (max.) |
| | Idle Mode : | 120mA. (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 | 8GB | 16GB | 32GB | 64GB | 128GB | 256GB |
| | Sequential Read (MB/s) | 100 | 159.1 | 173.3 | 173.2 | 173.4 | 173.4 |
| | Sequential Write(MB/s) | 50 | 82.1 | 161.3 | 162.0 | 165.9 | 165.8 |

*Note:*

*(1). All values quoted are typically at 25℃ and nominal supply voltage.*

*(2). Testing base on CrystalDiskMark 3.01 with file size 1000MB*


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## 2.4. System Reliability

***Table 4: System Reliability***

| | |
|---|---|
| **Wear-leveling Algorithms** | Global wear leveling algorithm evens program/erase count and maximizes SSD lifespan |
| **Bad Blocks Management** | Supportive |
| **ECC Technology** | Hardware BCH ECC capable of correcting errors up to 66-bit/1KB (ECC). |
| **Endurance** | Un-limited Read Cycles<br>Endurance Management enables five years minimal useful life |

***Table 5: TBW (TeraBytes Written)***

| **TBW (Tera Bytes Written)** | | |
|---|---|---|
| **Capacity** | **TBW(TB)** | **DWPD & Lifespan** |
| **8GB** | 56.1 | 8,192MB Total written per day<br>Lifespan = 5 Years |
| **16GB** | 122.6 | |
| **32GB** | 225.6 | |
| **64GB** | 456.3 | |
| **128GB** | 903.7 | |
| **256GB** | 1,807.4 | |

*Note:*

*(1). Total bytes written are based on JEDEC 218. (Solid-State Drive Requirements and Endurance Test Method)*

*(2). Lifespan is calculated by device written per day.*

## 2.5. Physical Specifications

Refer to Table 5 and see Figure 2 for Rugged Metal 2.5" SATA III SLC SSD HERCULES-T Series physical specifications and dimensions.

***Table 5: Physical Specifications***

| | |
|---|---|
| **Length:** | 100.0 mm / 3.93 in |
| **Width:** | 70.00 mm / 2.75 in |
| **Thickness:** | 9.20 mm / 0.36 in |
| **Net Weight:** | 95.00 g / 3.35 oz |


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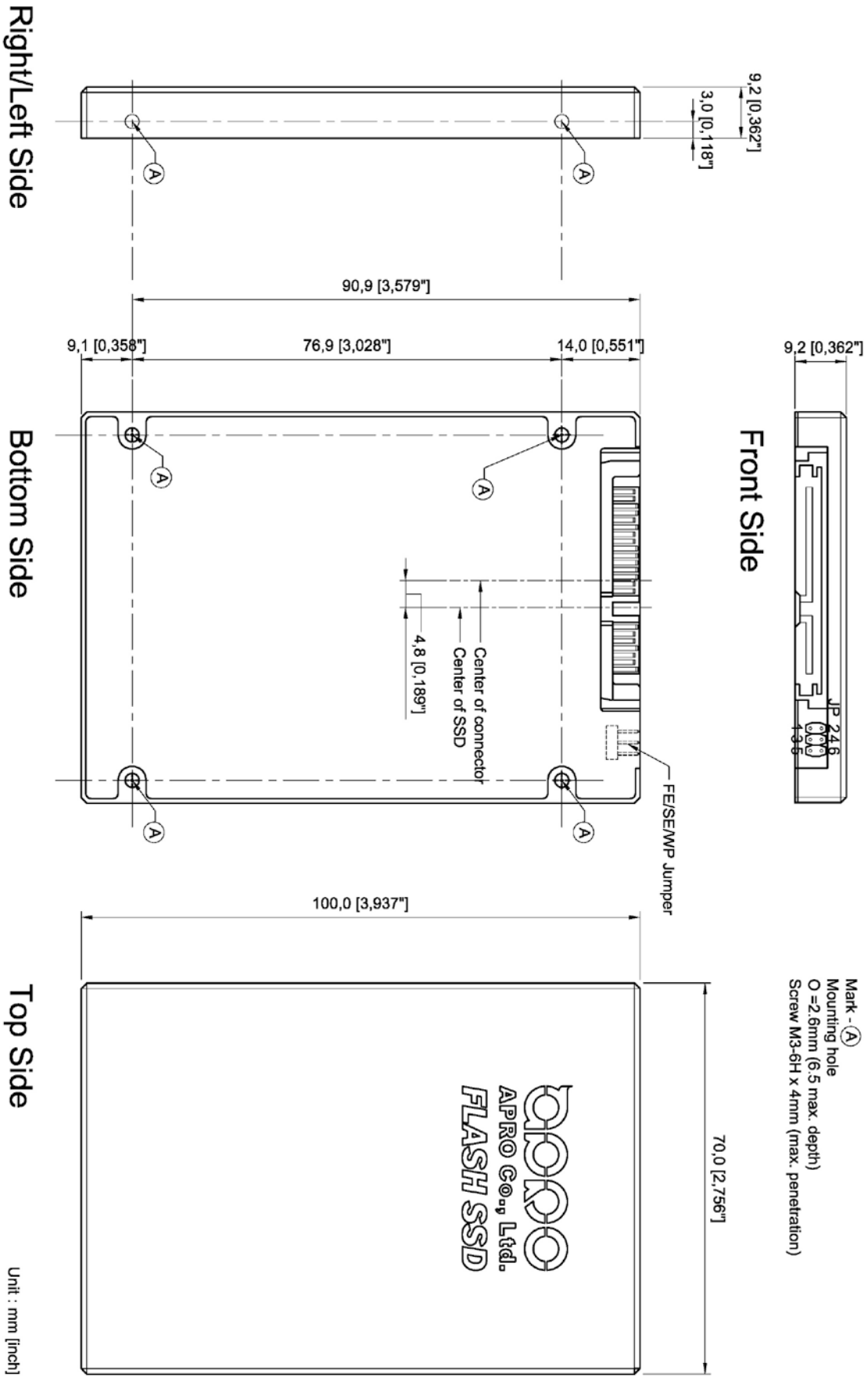


***Figure 2: APRO Rugged Metal 2.5" SATA III SLC SSD Dimension***

### *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 Rugged Metal 2.5” SATA III SLC SSD interface*

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

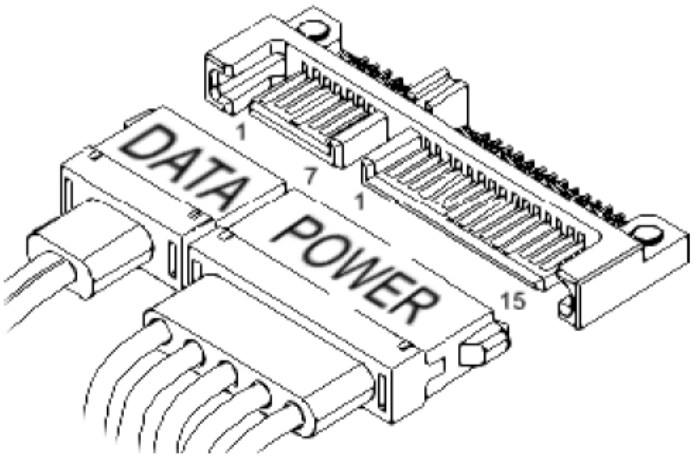


***Figure 3 : The connectors of 2.5” SATA III SLC SSD***


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### *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.*


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## *Appendix A: Ordering Information*

### *1. Part Number List*

◆ **APRO Rugged Metal 2.5" SATA III SLC SSD – HERCULES-T Series**

| *Product Picture* | *Grade* | *Standard grade (0ºC ~ 70ºC)* | *Industrial Grade ( -40ºC ~ +85ºC )* |
|---|---|---|---|
|  | *8GB* | SR2SR008G-MTCTC (/C) | WR2SR008G-MTITI (/C) |
| | *16GB* | SR2SR016G-MTCTC (/C) | WR2SR016G-MTITI (/C) |
| | *32GB* | SR2SR032G-MTCTC (/C) | WR2SR032G-MTITI (/C) |
| | *64GB* | SR2SR064G-MTCTC (/C) | WR2SR064G-MTITI (/C) |
| | *128GB* | SR2SR128G-MTCTC (/C) | WR2SR128G-MTITI (/C) |
| | *256GB* | SR2SR256G-MTCTC (/C) | WR2SR256G-MTITI (/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. 0º C ~ 70 º C

**W:** Industrial Grade- operating temp. -40º C ~ +85 º C

**X2** : **The material of case**

**R :** 2.5" Rugged Metal Casing

**X3 X4 X5** : **Product category**

**2SR :** 2.5" SATA SSD w/SDRAM cache

**X6 X7 X8 X9** : **Capacity**

| | | | |
|---|---|---|---|
| **008G:** | 08GB | **064G:** | 64GB |
| **016G:** | 16GB | **128G:** | 128GB |
| **016G:** | 16GB | **256G:** | 256GB |

**X11** : **Controller**

**M :** HERCULES-T 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

**C** : **Reserved for specific requirement**

**C :** Conformal-coating


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## *Appendix B: Limited Warranty*

APRO warrants your Rugged Metal 2.5" SATA III SLC 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:***

- **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.***