



MLC

2.5" SATA III SSD

TERMINATOR-I Series

APRO RUGGED METAL 2.5" SATA-III

Self-destructible/ AES256 SSD



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ISO 9001 : 2015 CERTIFIED



Product Features

■ Flash IC

- TOSHIBA 15nm NAND Flash IC.
- Multi-Level Cell (MLC) management

■ Compatibility

- SATA Revision 3.1
- SATA 1.5Gb/s; SATA 3Gb/s & SATA 6Gb/s data transfer rate.
- ATA-8 ACS2 command set

■ Additional Capabilities

- S.M.A.R.T.¹ (Self-Monitoring, Analysis and Reporting Technology) feature set support.
- Thermal Monitor for SSD's temperature.
- Native Command Queuing (NCQ) support.
- TRIM maintenance command support.
- Global Wear Leveling
- Power loss protection by tantalum capacitors
- Hardware based AES256bit encryption
- Fast Erase function
- Device Self-destructable function by hardware jumper or via ATA command (see also topic 5.3)
- Write Protection function via jumper

■ Mechanical

- Standard 2.5" SATA Flash Disk form-factor
- SATA 7-pin (data) + 15-pin (power connector) SATA Interface
- Dimension: 100.0 x 70.0 x 9.2 (+/- 0.1mm).
- Weight: 115.00 g / 3.7 o.z.

■ Power

- Operating Voltage 5V(+/-) 5%
- Read Mode: 900mA (max.)
- Write Mode: 1.2A (max.)
- Idle Mode: 120mA (max.)

■ Performance (Maximum value)^{2, 3, 4}

- Sequential Read (1GB Data): 560 MB/sec.
- Sequential Write (1GB Data): 450 MB/sec.
- 4KB Random Read (QD32): 320 MB/sec.
- 4KB Random Write (QD32): 300 MB/sec.
- 4KB Random Read latency time: 0.11 ms.
- 4KB Random Read latency time: 0.04 ms.

■ Capacity

- 128GB, 256GB, 512GB,

■ Reliability

- **TBW:** Up to 900TBW at 512GB Capacity. (JESD-218/219A)
- **MTBF:** ≥ 2,000,000 hours.
- **ECC Scheme:** up to 66 bits error correction in 1K Byte data
- **Temperature:** (Operating)
Standard Grade: 0°C ~ +70°C
Wide Temp. Grade: -40°C ~ +85°C
- **Vibration:** 20G (80Hz~2000Hz).
- **Shock:** 1500G (1ms)

■ Certifications and Declarations

- **Certifications:** CE & FCC
- **Declarations:** RoHS2 & REACH


Remarks:

1. Support official S.M.A.R.T. Utility.
2. Typical I/O performance numbers as measured fresh-out-of-the-box (FOB) using IOMeter with a queue depth of 32
3. Performance values vary by capacity

Order Information

1. Part Number List

◆ APRO MLC Rugged Metal 2.5" SATA III SSD – TERMINATOR-I Series

Product Picture	Grade	Standard grade (0°C ~ 70°C)	Wide Temp Grade (-40°C ~ +85°C)
	128GB	SR2SR128G-MSCTMB	WR2SR128G-MSCTMB/C
	256GB	SR2SR256G-MSCTMB	WR2SR256G-MSCTMB/C
	512GB	SR2SR512G-MSCTMB	WR2SR512G-MSCTMB/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

X2 : The material of case

R : 2.5" Rugged Metal Casing

X3 X4 X5 : Product category

2SR : 2.5" SATA SSD with SDRAM Cache

X6 X7 X8 X9 : Capacity

128G: 128GB

256GB: 256GB

512G: 512GB

X11 : Controller

M : SMI 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

M : MLC-NAND Flash IC

X16 X17 X18 : Flash IC

B : 15 nm

C : Reserved for specific requirement

C : Conformal-coating

Revision History

Revision	Description	Date
1.0	Initial release.	2017/03/29
1.1	Wording correction	2017/03/31

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1. Introduction

APRO MLC Rugged Metal 2.5" SATA III SSD – TERMINATOR-I Series provides high capacity flash memory Solid State Drive (SSD) that electrically complies with SATA Revision 3.1 standard. APRO MLC Rugged Metal 2.5" SATA III SSD – TERMINATOR-I Series support SATA 1.5Gb/s; SATA 3Gb/s & SATA 6Gb/s data transfer rate with high performance. The available disk capacities are 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.

APRO TERMINATOR-I Series SSD provide the ultra-high random speed for heavy-loading embedded or server operations with space constraints for host computing systems; the data transfer performance by 4K random read is up to 300MB/sec and 4K random write is up to 290MB/sec; the sequential read is up to 560 MB/sec, and sequential write is up to 340 MB/sec. which is based on Toshiba's 15nm Toggle MLC flash.

A self-destroyable function is capable of physically destroying to the SSD's controller which supports AES 256bits encryption function; it is the best solution for some certain highly sensitive and confidential data systems. Once the AES controller was destroyed, the data stored in the flash memory will not be recoverable.

APRO MLC 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 MLC Rugged Metal 2.5" SATA III SSD – TERMINATOR-I Series to read or write blocks of memory. Each sector is protected by a powerful 66 bits per 1K bytes error correction (ECC). APRO MLC Rugged Metal 2.5" SATA III SSD TERMINATOR-I Series intelligent controller manages interface protocols, data storage and retrieval as well as ECC, bad block management and diagnostics, power management and clock control.

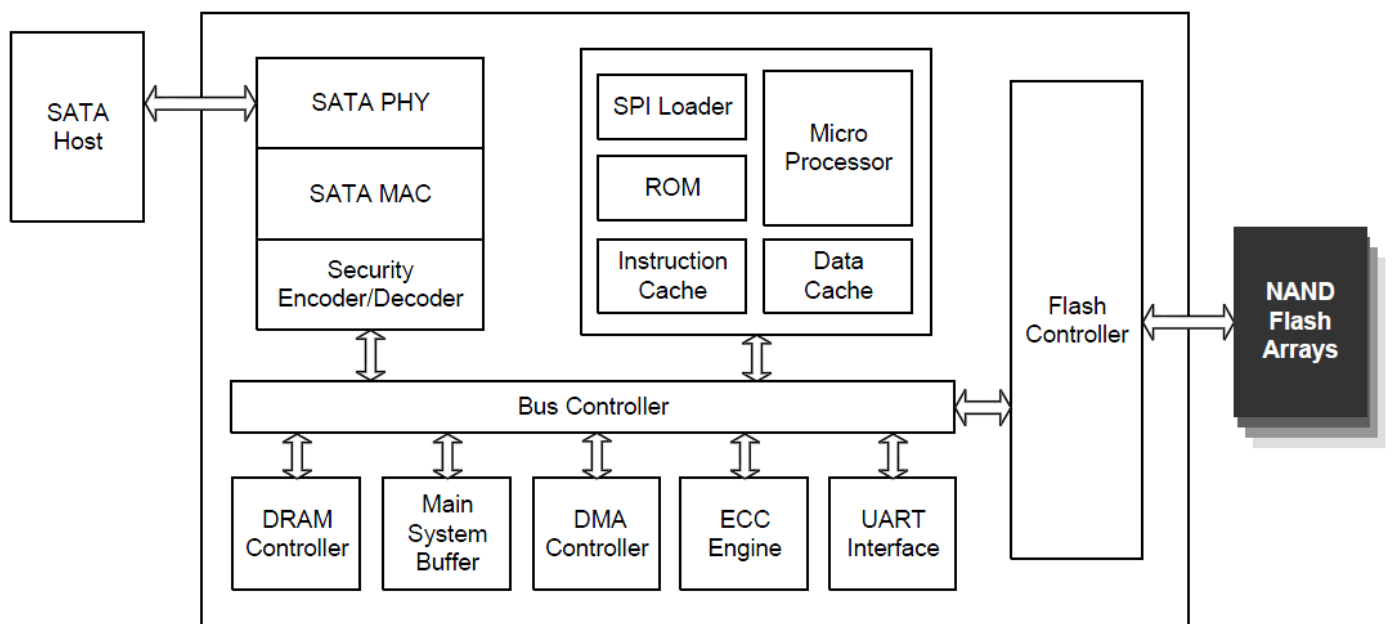


Figure 1: APRO MLC Rugged Metal 2.5" SATA III SSD TERMINATOR-I Series controller block diagram

1.1. *Scope*

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

1.2. *Flash Management Technology - Global Wear Leveling*

The Global wear leveling to prevent stagnation in the constantly updated data is dynamically balanced wear ignore static area (data not updated very often), in order to achieve uniform application of wear leveling in all blocks. Static data including the operating system files, lookup tables, run the file and so on. Global wear leveling program / erase count is evenly distributed over all the blocks, the user can set the execution time of wear leveling region, i.e., wear leveling frequency. Each erase block, the flash memory controller will increase the count of a wear leveling. If the counter reaches a specified frequency wear leveling, the controller checks the display of the start block erase count is less than the average erase count, in order to perform the block exchange. If less than the average erase count, indicating that the block is not frequently used, may be exchanged with a spare block in the block list, because a higher frequency of spare blocks. If the check erase count block is higher than average, the controller will then check the next block, until it finds another block is not frequently used. Thus, each block will have the same erase count in all areas.

1.3. *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.

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.

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 Wide Temp. 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.

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 Rugged Metal 2.5" SATA III SSD TERMINATOR-I Series		Standard Grade SR2SRxxxG-MSCTMB	Wide Temp Grade WR2SRxxxG-MSCTMB/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	Frequency/Displacement:	20Hz ~ 80 Hz, 1.52mm / X, Y, Z axis/60 min for each	
	Frequency/Acceleration:	80Hz ~ 2000 Hz, 20G / X, Y, Z axis/60 min for each	
Shock	Operating & Non-operating:	0.5ms, 1500 G, 3 axes	
Electrostatic Discharge (ESD)	Temperature:	24°C	
	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 MLC Rugged Metal 2.5" SATA III SSD TERMINATOR-I Series		
DC Input Voltage (VCC)		5V±5%
+5V Current (Maximum average value)	Reading Mode :	900mA (max.)
	Writing Mode :	1.2A (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)		
Maximum Performance	Capacity	128GB	256GB	512GB
	Sequential Read (MB/s)	530	560	560
	Sequential Write (MB/s)	180	340	450
	4KB Random Read (MB/s) (QD32)	250	300	320
	4KB Random Write (MB/s) (QD32)	110	290	300

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

2.4. System Reliability

Table 4: System Reliability

Wear-leveling Algorithms	Global Wear-leveling	
Bad Block Management	Supportive	
ECC Technology	66 bits per 1K bytes	
TBW (Tera Bytes Written)		
Capacity	128GB	230
	256GB	450
	512GB	900

Note:

- TBW value calculation is based on JEDEC JESD218A & 219A standards.
- 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 Rugged Metal 2.5" SATA III MLC SSD TERMINATOR-I Series physical specifications and dimensions.

Table 5: Physical Specifications of APRO MLC Rugged Metal 2.5" SATA III SSD-TERMINATOR-I Series

Length:	100.0 mm / 3.94 in.
Width:	70.0 mm / 2.75 in.
Thickness:	9.2 mm / 0.36 in.
Weight:	115.00 g / 3.7 o.z.

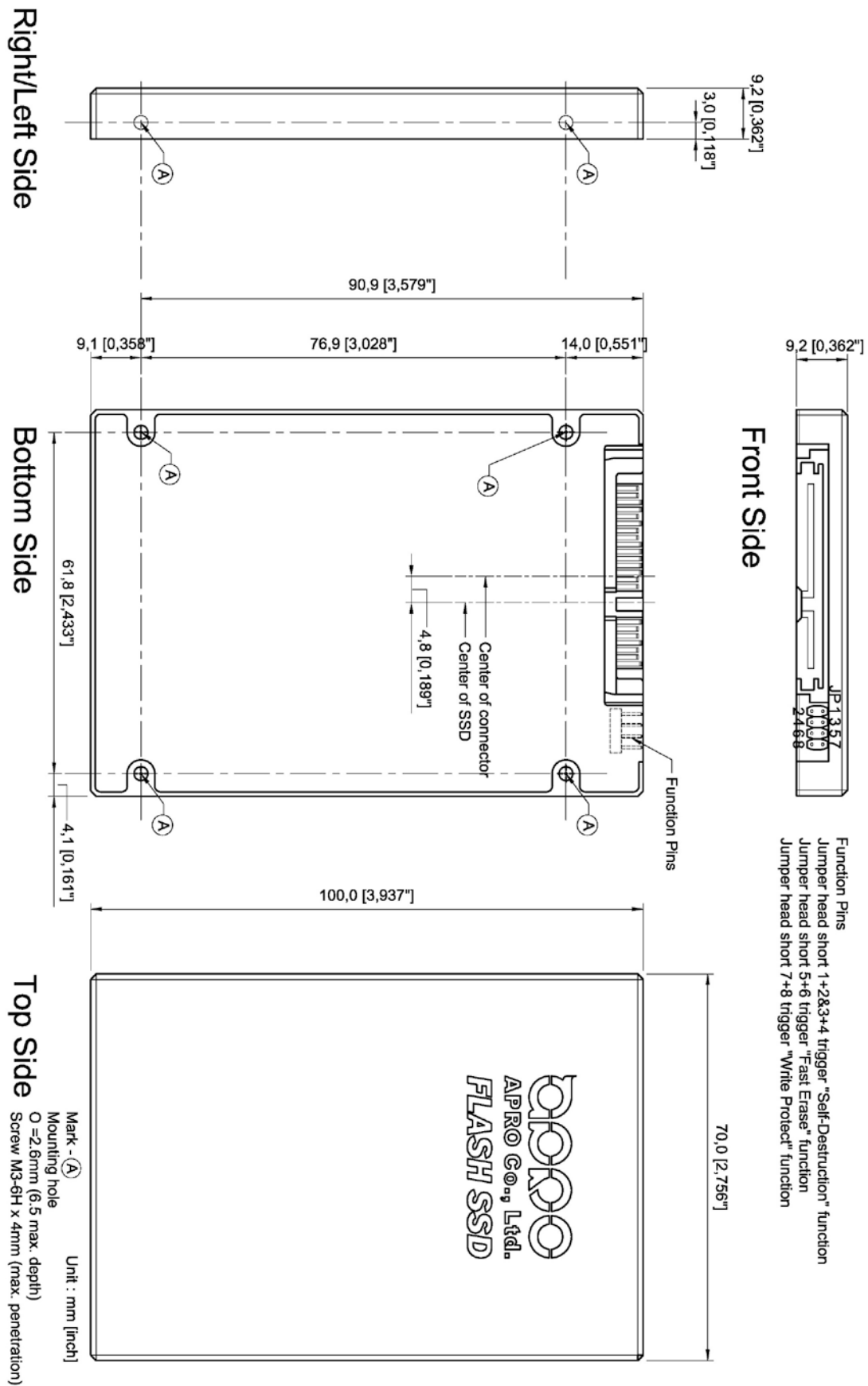


Figure 2: APRO MLC Rugged Metal 2.5" SATA III SSD Dimension

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 storage 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 Rugged Metal 2.5" SATA III SSD interface

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

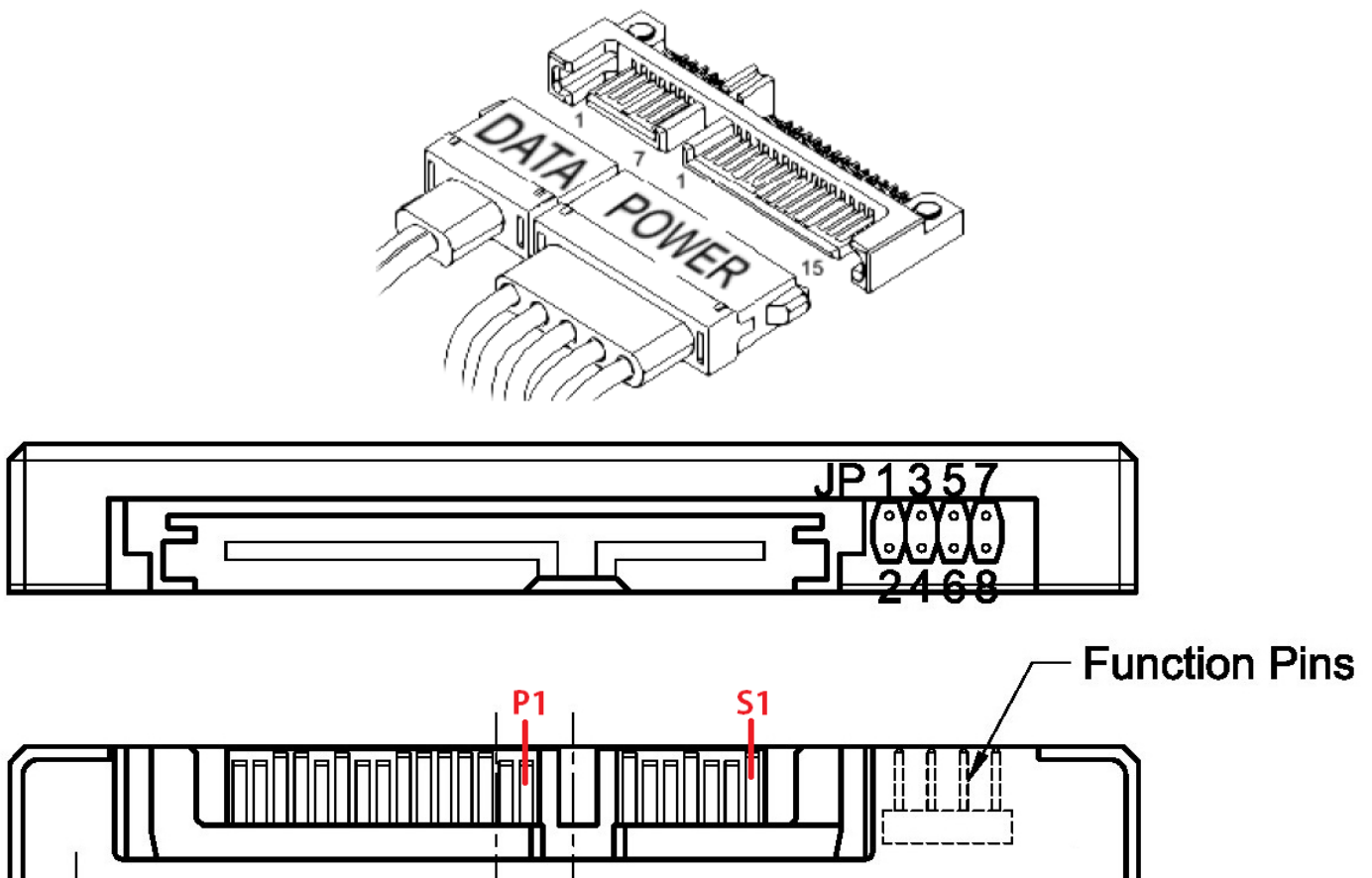


Figure 3: The connectors of APRO MLC Rugged Metal 2.5" SATA III SSD

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	Host side A+ (TXP) / Device side B+ (RXP)	Differential Signal Pair A
S3	Host side A- (TXN) / Device side B- (RXN)	
S4	GND	NA
S5	Host side B- (RXN) / Device side A- (TXN)	Differential Signal Pair B
S6	Host side B+ (RXP) / Device side A+ (TXP)	
S7	GND	NA
Key and Spacing separate signal and power segments		
P1	NC	NA
P2	NC	NA
P3	DEVSLP	NA
P4	GND	NA
P5	GND	NA
P6	GND	NA
P7	5V	5V Power
P8	5V	5V Power
P9	5V	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:

- All pins are in a signal row with a 1.27 mm (0.050" pitch).

4. Function Pins configuration of TERMINATOR-I Series 2.5" SATA III SSD

4.1. Self-Destruction function

To execute Self-Destruction function, jumper must be set on Pin-1, Pin-2, Pin-3 and Pin-4.

A self-destroyable function is capable of physically destroying to the SSD's controller which supports AES 256bits encryption function; it is the best solution for some certain highly sensitive and confidential data systems. Once the AES controller was destroyed, the data stored in the flash memory will not be recoverable.

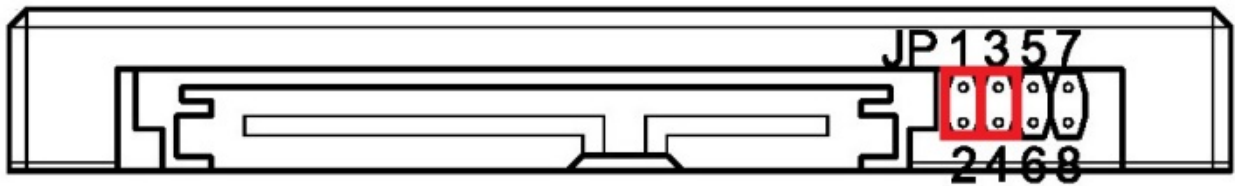


Figure 4: The jumper configuration of Self-Destruction function

4.2. Fast Erase

Fast Erase Procedure is one of the default sanitizing procedure in APRO Secure Erase SSD Series, it is trigger by placing jumper head on Pin-5 and Pin-6, SSD will be then become fully erased and filled with 0x00.

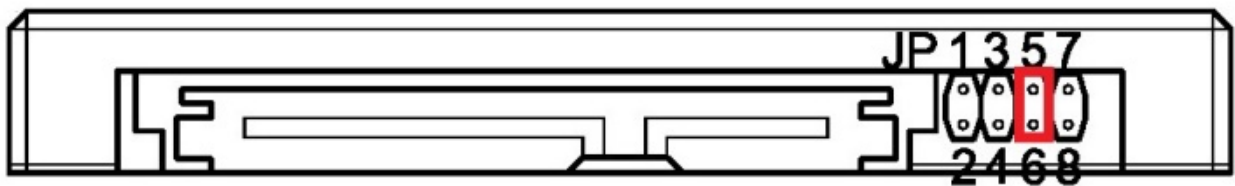


Figure 5: The jumper configuration of Fast Erase function

4.3. Write Protect Function

Write-Protect function can be enabled by setting the jumper head on Pin-7 and Pin-8, once it's enabled, it will abort any writing commands sent to the SSD. At this stage, SSD will become Read-Only and user will not be able to write or delete any data on the SSD.

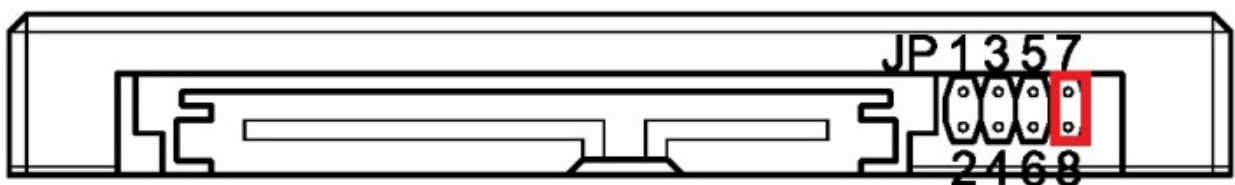


Figure 6: The jumper configuration of Write Protection function

5. Commands

5.1. Supported ATA Command Set

Table 7 – ATA Command List

Command	Code	Protocol
General Feature Set		
Execute Device Diagnostic	90h	Execute device diagnostic
Flush Cache	E7h	Non-data
Identify Device	ECh	PIO data-in
Initialize Drive Parameters	91h	Non-data
Read DMA	C8h	DMA
Read Log Ext	2Fh	PIO data-in
Read Multiple	C4h	PIO data-in
Read Sector(s)	20h	PIO data-in
Read Verify Sector(s)	40h or 41h	Non-data
Set Feature	EFh	Non-data
Set Multiple Mode	C6h	Non-data
Write DMA	CAh	DMA
Write Multiple	C5h	PIO data-out
Write Sector(s)	30h	PIO data-out
NOP	00h	Non-data
Read Buffer	E4h	PIO data-in
Write Buffer	E8h	PIO data-out
Power Management Feature Set		
Check Power Mode	E5h or 98h	Non-data
Idle	E3h or 97h	Non-data
Idle Immediate	E1h or 95h	Non-data
Sleep	E6h or 99h	Non-data
Standby	E2h or 96h	Non-data
Standby Immediate	E0h or 94h	Non-data
Security Mode Feature Set		
Security Set Password	F1h	PIO data-out
Security Unlock	F2h	PIO data-out
Security Erase Prepare	F3h	Non-data
Security Erase Unit	F4h	PIO data-out
Security Freeze Lock	F5h	Non-data
Security Disable Password	F6h	PIO data-out

Command	Code	Protocol
SMART Feature Set		
SMART Disable Operations	B0h	Non-data
SMART Enable/Disable Autosave	B0h	Non-data
SMART Enable Operations	B0h	Non-data
SMART Execute OFF-LINE Immediate	B0h	Non-data
SMART Read Log	B0h	PIO data-in
SMART Read Data	B0h	PIO data-in
SMART Read Threshold	B0h	PIO data-in
SMART Return Status	B0h	Non-data
SMART Save Attribute Values	B0h	Non-data
SMART Write Log	B0h	PIO data-out
Host Protected Area Feature Set		
Read Native Max Address	F8h	Non-data
Set Max Address	F9h	Non-data
Set Max Set Password	F9h	PIO data-out
Set Max Lock	F9h	Non-data
Set Max Freeze Lock	F9h	Non-data
Set Max Unlock	F9h	PIO data-out
48-bit Address Feature Set		
Flush Cache Ext	EAh	Non-data
Read Sector(s) Ext	24h	PIO data-in
Read DMA Ext	25h	DMA
Read Multiple Ext	29h	PIO data-in
Read Native Max Address Ext	27h	Non-data
Read Verify Sector(s) Ext	42h	Non-data
Set Max Address Ext	37h	Non-data
Write DMA Ext	35h	DMA
Write Multiple Ext	39h	PIO data-out
Write Sector(s) Ext	34h	PIO data-out
NCQ Feature Set		
Read FPDMA Queued	60h	DMA Queued
Write FPDMA Queued	61h	DMA Queued
Others		
Data Set Management	06h	DMA
Seek	70h	Non-data

5.2. Identify Device Data

Table 8 – List of Device Identification

Word	F / V	Default Value	Description
0	F	0040h	General configuration
1	X	XXXXh	Default number of cylinders
2	V	0000h	Reserved
3	X	00XXh	Default number of heads
4	X	0000h	Obsolete
5	X	0240h	Obsolete
6	F	XXXXh	Default number of sectors per track
7 - 8	V	XXXXh	Number of sectors per card (Word 7 = MSW, Word 8 = LSW)
9	X	0000h	Obsolete
10 - 19	F	XXXXh	Serial number in ASCII (Right justified)
20	X	0002h	Obsolete
21	X	0002h	Obsolete
22	X	0000h	Obsolete
23 - 26	F	XXXXh	Firmware revision in ASCII Big Endian Byte Order in Word
27 - 46	F	XXXXh	Model number in ASCII (Left justified) Big Endian Byte Order in Word
47	F	8001h	Maximum number of sectors on Read/Write Multiple command
48	F	0000h	Reserved
49	F	0F00h	Capabilities
50	F	4000h	Capabilities
51	F	0200h	PIO data transfer cycle timing mode
52	X	0000h	Obsolete
53	F	0007h	Field validity
54	X	XXXXh	Current numbers of cylinders
55	X	XXXXh	Current numbers of heads
56	X	XXXXh	Current sectors per track
57 - 58	X	XXXXh	Current capacity in sectors (LBAs) (Word 57 = LSW , Word 58 = MSW)
59	F	0101h	Multiple sector setting
60 - 61	F	XXXXh	Total number of user addressable logical sectors for 28-bit commands (DWord)

Word	F / V	Default Value	Description
62	X	0000h	Reserved
63	F	0207h	Multiword DMA transfer Supports MDMA mode 0, 1 and 2
64	F	0003h	Advanced PIO modes supported
65	F	0078h	Minimum Multiword DMA transfer cycle time per word
66	F	0078h	Recommended Multiword DMA transfer cycle time
67	F	0078h	Minimum PIO transfer cycle time without flow control
68	F	0078h	Minimum PIO transfer cycle time with IORDY flow control
69	F	4000h	Additional supported
70 - 74	F	0000h	Reserved
75	F	001Fh	Queue depth
76	F	070Eh	Serial ATA capabilities <ul style="list-style-type: none"> • Supports Serial ATA Gen3 • Supports Serial ATA Gen2 • Supports Serial ATA Gen1 • Supports Phy event counters log • Supports receipt of host initiated power management requests • Supports Native Command Queuing
77	F	0080h	Serial ATA additional capability <ul style="list-style-type: none"> • DevSleep_to_ReducedPwerState
78	F	0148h	Serial ATA features supported <ul style="list-style-type: none"> • Supports Device Sleep • Supports software settings preservation • Device supports initiating power management
79	V	0040h	Reserved
80	F	03F0h	Major version number (ACS-2)
81	F	0000h	Minor version number
82	F	742Bh	Command sets supported 0
83	F	7500h	Command sets supported 1
84	F	4023h	Command sets supported 2
85 - 87	V	XXXXh	Command set/feature enabled
88	V	007Fh	Ultra DMA mode supported and selected
89	F	0003h	Time required for a Normal Erase mode Security Erase Unit command
90	F	0001h	Time required for an Enhanced Erase mode Security Erase Unit command
91	V	0000h	Current advanced power management value
92	V	FFFEh	Master password identifier
93 - 99	V	0000h	Reserved
100 - 103	V	XXXXh	Maximum user LBA for 48-bit address feature set
104	V	0000h	Reserved
105	F	0100h	Maximum number of 512-byte blocks per Data Set Management command

Word	F / V	Default Value	Description
106 - 127	V	0000h	Reserved
128	V	0001h	Security status
129 - 159	X	XXXXh	Vendor specific
160	F	0000h	Power requirement description
161	X	0000h	Reserved
162	F	0000h	Key management schemes supported
163	F	0000h	CF Advanced True IDE Timing mode capability and setting
164 - 168	V	0000h	Reserved
169	F	0001h	Data Set Management supported
170 - 216	V	XXXXh	Reserved
217	F	0001h	Non-rotating media (SSD)
218 - 221	X	0000h	Reserved
222	F	107Fh	Transport major revision (SATA Rev 3.1)
223 - 254	X	0000h	Reserved
255	X	XXXXh	Integrity word

5.3. *Self-Destruction function software command & Utility.*

APRO MLC Rugged Metal 2.5" SATA III SSD TERMINATOR-I Series provides software command set and Utility which is based on Windows series O.S. and Linux O.S. versions. The detail information please contacts your APRO distributor.

Appendix A: Limited Warranty

APRO warrants your MLC Rugged Metal 2.5" SATA III SSD – TERMINATOR-I 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.

APRO

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