

SLC

Industrial 2.5" Rugged Metal

PATA SSD

HERMIT-F Series



Document No. : 100-XR2IF-HFTS

Version No. : 02V0

Date : June, 2019

ISO 9001 : 2015 CERTIFIED



Product Features

■ Flash IC

- TOSHIBA NAND Flash IC.
- Single-Level Cell (SLC) management

■ Compatibility

- ATA/ATAPI-7 standard compatible in True-IDE mode.

■ Additional Capabilities

- S.M.A.R.T. *¹ (Self-Monitoring, Analysis and Reporting. Technology) feature set support.
- Supports the following data transfer rate:
 - PIO mode 2, 3, 4, 5, 6
 - DMA mode 0, 1, 2, 3, 4
 - Ultra DMA mode 0, 1, 2, 3, 4, 5, 6.
- 4K Mapping units
- Customize C.H.S./Total LBAs capacity.
- Static, Dynamic, and Global wear leveling algorithm
- Flexible 96-Bit/1KB BCH ECC engine.
- Support bad Block Management.

■ Mechanical

- Standard 44-Pin PATA (IDE) male connector
- Dimension: 100.0mm x 70.1mm x 8.8mm.
- Weight: 62.0 g / 2.18 oz.

■ Power Operating Voltage 5.0V(+/-) 5%

- Read Mode: 154.9 mA (max.)
- Write Mode: 141.7 mA (max.)
- Standby Mode: 10.5 mA (max.)

■ Performance (Maximum value) *²

- Sequential Read: 62.2 MB/sec. (max.)
- Sequential Write: 57.4 MB/sec. (max.)
- 4K Random Read: 10.0 MB/sec.
- 4K Random Write: 8.5 MB/sec.

■ Capacity

- 128MB, 256MB, 512MB, 1GB, 2GB, 4GB, 8GB, 16GB, 32GB and 64GB.

■ Reliability

- **TBW:** Up to 451.7 TBW at 64GB Capacity.
- (Client workload by JESD-219A)
- **ECC:** Flexible 96-Bit/1KB BCH ECC engine.
- **MTBF:** >3,000,000 hours
- **Temperature:** (Operating)
 - Standard Grade: 0°C ~ +70°C
 - Industrial Grade: -40°C ~ +85°C
- **Vibration:** 70 Hz to 2K Hz, 15G, 3 axes.
- **Shock:** 0.5ms, 1500 G, 3 axes
- **Erase counts:** 60K

■ 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 Industrial SLC 2.5" Rugged Metal PATA SSD HERMIT-F Series

| Product Picture | Grade | Standard grade (0°C ~ 70°C) | Industrial Grade (-40°C ~ +85°C) |
|---|-------|-----------------------------|----------------------------------|
|  | 128MB | SR2IF128M-HFCTC-U | WR2IF128M-HFITI-U |
| | 256MB | SR2IF256M-HFCTC-U | WR2IF256M-HFITI-U |
| | 512MB | SR2IF512M-HFCTC-U | WR2IF512M-HFITI-U |
| | 1GB | SR2IF001G-HFCTC-U | WR2IF001G-HFITI-U |
| | 2GB | SR2IF002G-HFCTC-U | WR2IF002G-HFITI-U |
| | 4GB | SR2IF004G-HFCTC-U | WR2IF004G-HFITI-U |
| | 8GB | SR2IF008G-HFCTC-U | WR2IF008G-HFITI-U |
| | 16GB | SR2IF016G-HFCTC-U | WR2IF016G-HFITI-U |
| | 32GB | SR2IF032G-HFCTC-U | WR2IF032G-HFITI-U |
| | 64GB | SR2IF064G-HFCTC-U | WR2IF064G-HFITI-U |

II. Part Number Decoder:

X1 X2 X3 X4 X5 X6 X7 X8 X9 — **X11 X12 X13 X14 X15** — **X17 X18**

X1 : Grade

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

W: Ind. Temp Grade - operating temp. -40° C ~ +85 ° C

X2 : The material of case

R : Rugged Metal

X3 X4 X5 : Product category

2IF : 2.5" PATA SSD

X6 X7 X8 X9 : Capacity

| | | | |
|--------------|-------|--------------|------|
| 128M: | 128MB | 004G: | 4GB |
| 256M: | 256MB | 008G: | 8GB |
| 512M: | 512MB | 016G: | 16GB |
| 001G: | 1GB | 032G: | 32GB |
| 002G: | 2GB | 064G: | 64GB |

X11 : Controller

H : HERMIT Series

X12 : Controller version

A, B, C.....

X13 : Controller Grade

C : Commercial grade

I : Industrial grade

X14 : Flash IC

T : Toshiba NAND Flash IC

X15 : Flash IC grade / Type

C : Commercial grade

I : Industrial grade

X17 : Data transfer rate and disk type

U: Defaulted as UDMA-6 mode / Fixed disk type

P: PIO-4 mode / Fixed disk type

A: Auto detect data transfer mode / Fixed disk type

X18 : Reserved for specific requirement

C : Conformal-coating (optional)

Revision History

| Revision | Description | Date |
|----------|--------------------------------|------------|
| 1.0 | Initial release | 2017/11/17 |
| 1.1 | Add capacity 16GB, 32GB & 64GB | 2018/06/11 |
| 1.2 | Updated Version | 2018/11/28 |
| 2.0 | Updated Document form | 2019/06/10 |

Contents

| | |
|--|------|
| Product Features | 2 - |
| Order Information | 3 - |
| I. Part Number List | 3 - |
| II. Part Number Decoder: | 3 - |
| Revision History | 4 - |
| Contents | 5 - |
| 1. Introduction | 6 - |
| 1.1. Scope | 7 - |
| 1.2. Flash Management Technology - Static, Dynamic, and Global Wear leveling .. | 7 - |
| 1.3. Bad Block Management | 7 - |
| 1.4. Protected against data corruption and failing devices | 7 - |
| 1.5. Mean Time Between Failure (MTBF) | 8 - |
| 1.5.1. Definition | 8 - |
| 1.5.2. Obtaining MTBF | 8 - |
| 1.5.3. Definitions | 9 - |
| 2. Product Specifications | 11 - |
| 2.1. System Environmental Specifications | 11 - |
| 2.2. System Power Requirements | 11 - |
| 2.3. System Performance | 11 - |
| 2.4. System Reliability | 12 - |
| 2.5. Physical Specifications | 12 - |
| 2.6. Conformal coating | 14 - |
| 2.7. Device Parameter | 14 - |
| 3. Interface Description | 15 - |
| 3.1. PATA SSD HERMIT-F Series interface | 15 - |
| 3.2. Pin Assignments | 16 - |
| Appendix A: Limited Warranty | 17 - |

1. Introduction

APRO Industrial SLC 2.5" Rugged Metal PATA SSD HERMIT-F Series provides **ULTRA HIGH RANDOM SPEED** Solid State Drive (SSD) that electrically complies with ATA/ATAPI 7 standard. APRO Industrial SLC 2.5" Rugged Metal PATA SSD HERMIT-F Series support UDMA-6 with high random write (4K data size) performance. The main used flash memories are SLC-NAND type flash memory chips. The available disk capacities are 128MB, 256MB, 512MB, 1GB, 2GB, 4GB, 8GB, 16GB, 32GB and 64GB.

The operating temperature grade is optional for Standard grade 0°C ~ 70°C and industrial grade -40°C ~ +85°C. The data transfer performance by sequential read is up to 62.2 MB/sec, and sequential write is up to 57.4 MB/sec; 4k data random read is up to 10.0 MB/sec, and 4k data random write is up to 8.5 MB/sec.

APRO Industrial SLC 2.5" Rugged Metal PATA SSD HERMIT-F Series products provide a high level interface to the host computer. This interface allows a host computer to issue commands to the APRO Industrial SLC 2.5" Rugged Metal PATA SSD HERMIT-F Series to read or write blocks of memory. Each sector is protected by a flexible 96-Bit/1KB BCH ECC engine. APRO Industrial SLC 2.5" Rugged Metal PATA SSD HERMIT-F 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 APRO Industrial SLC 2.5" Rugged Metal PATA SSD HERMIT-F Series.

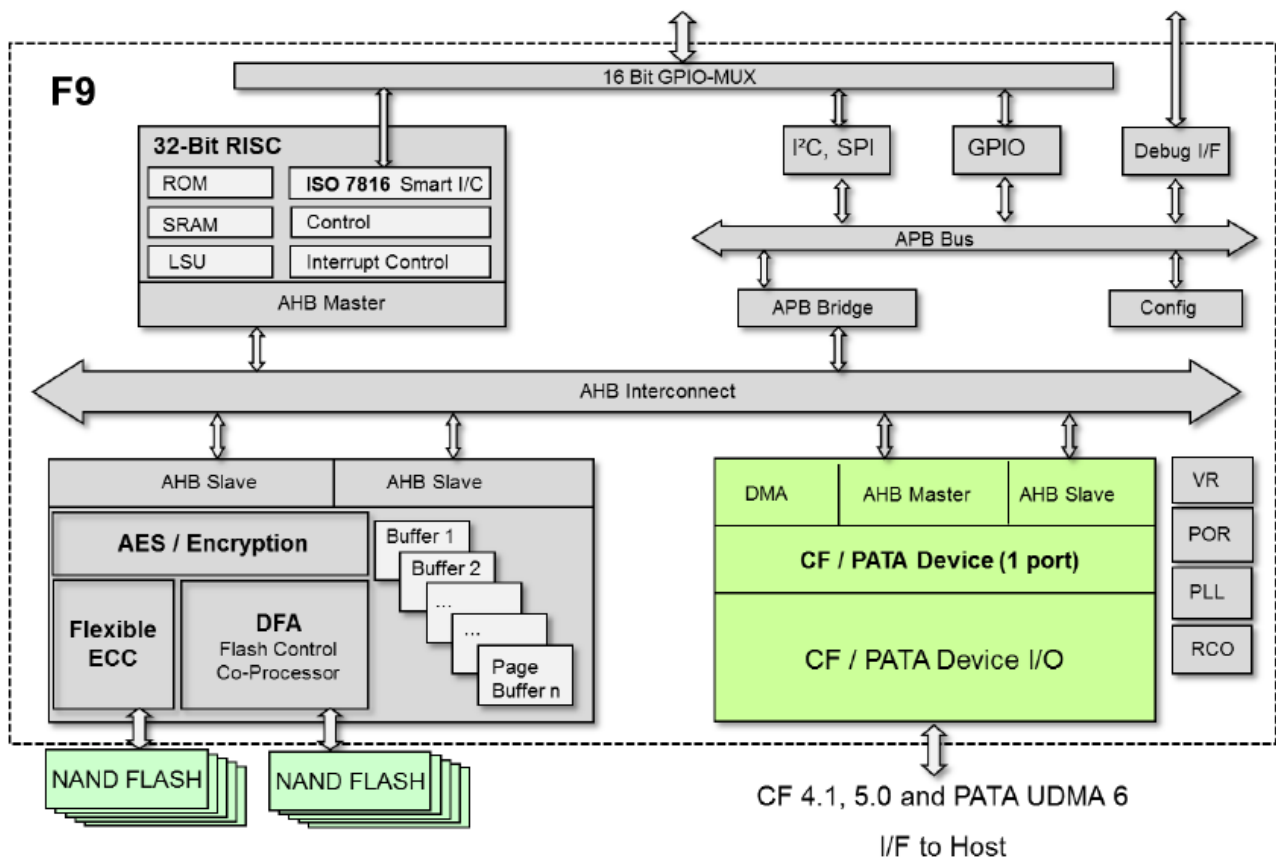


Figure 1: APRO Industrial SLC 2.5" Rugged Metal PATA SSD HERMIT-F Series block diagram

1.1. *Scope*

This document describes features, specifications and installation guide of APRO Industrial SLC 2.5" Rugged Metal PATA SSD HERMIT-F Series. The appendix provides order information, warranty policy, RMA/DOA procedure for the most convenient reference.

1.2. *Flash Management Technology - Static, Dynamic, and Global Wear leveling*

➤ **Dynamic**

Blocks with lowest erase count selected for writing from free block list.

➤ **Static**

When a block is added to the free list, its erase count is compared to the overall lowest erase count; if the distance is higher than the WL-threshold, data content is swapped (GC) and the block with low erase count moves to the free blocks.

➤ **Global**

Both dynamic and static WL is global within ILV channel, done in background, interruptible by host commands.

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 Later 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 Industrial SLC 2.5" Rugged Metal PATA SSD HERMIT-F 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.

1.4. *Protected against data corruption and failing devices*

Sudden Power Fail (SPF) Event

- Reset of controller and immediate write protection of flash
- If the last data written is corrupt, controller recovers latest valid entry
- If a write operation is active at power loss this data might be lost

Transaction-oriented logging of mapping changes

- All mapping information is kept in non-volatile storage
- MLC-aware Power Fail Management
- Option: Reliable Write of user data

Rigorous Testing to ensure functionality

- Power Cycling Test
- Stress Test
- Regression Test

1.5. Mean Time Between Failure (MTBF)

1.5.1. Definition

MTBF (Mean time between failures) is defined as failure or maintenance required for the average time including failure detection and maintenance for the device. For a simple and maintainable unit, $MTBF = MTTF + MTTR$.

MTTF (mean time to failure) is defined as the expectation of random variables for time to failure.

MTTR (mean time to restoration) is the expectation of random variables of time required for restoration which includes the time required for confirmation that a failure occurred, as well as the time required for maintenance.

1.5.2. Obtaining MTBF

There are two methods for obtaining MTBF:

A. MTBF software estimation method: by calculating all the MTBF data of all the components included in the bill of material, and the data of the completed products including actual parameters of voltage and electrical current using analysis software, the MTBF of the completed product is estimated.

B. MTBF sample test method: by determining a certain number of samples and a fixed time for testing, using a Arrhenius Model and Coffin-Manson Model to obtain parameters, and then using the formula with the parameters, the longevity and in so the reliability is proved.

Arrhenius Model: $Af = e\{ (1/k \times Ea (1/273+Tmax - 1/273+Ttest))\}$

Coffin-Manson Model: $Af = (\Delta Ttest/\Delta Tuse)m$

➤ APRO uses the A method to Estimate MTBF

MTBF is actually obtained by calculation which is just an estimation of future occurrences. The main reason to use the first method is that the data contains the analysis by all the parameters of components and actual parameters of voltage and electrical current of finished products, which is considered adequate and objective.

➤ Interpretation of MTBF Analysis

APRO estimates MTBF using a prediction methodology based on reliability data for the individual components in APRO products. The predicted MTBF based on Parts stress analysis Method of Telcordia Special Report SR-332, for components failure rates. Component data comes from several sources: device life tests, failure analysis of earlier equipment, device physics, and field returns.

The Telcordia model is based on the Telcordia document, Reliability Prediction Procedure for Electronic Equipment, Technical Reference SR-332. This standard basically modified the component models in MIL-HDBK-217 to better reflect the failure rates that AT&T Bell Lab equipment was experiencing in the field and was originally developed by AT&T Bell Lab as the Bellcore model.

This model supports different failure rate calculation methods in order to support the taking into account of stress, burn-in, laboratory, or field data. A Parts Count or Parts Stress analysis is included in Telcordia performance. Relx supports Telcordia Issues 1 and 2 and also Bellcore Issues 4, 5, and 6. Telcordia Issue 2, released in September 2006, are supported by Relx and Telcordia Issue 1, released in May 2001, is replaced with Relx. Refer to Telcordia Issue 2 Fields for information about the fields in Relx Reliability Studio specific to Telcordia Issue 2.

➤ Purpose of the analyses

The purpose of these analyses is to obtain early estimation of device reliability during engineering and customer validation stages. The prediction results will expose the reliability of whole assembly, viewed as a set of serially connected electronic components. Rating of the assembly electronic components will show the ratio between actual critical elements parameters and their specification limits. The purpose of component rating is to improve a product's inherent design reliability, increase its number of operating times, and to reduce warranty costs and to achieve a more robust design.

1.5.3. Definitions

| Term | Definition |
|-----------------------------------|---|
| Failure | The event, or inoperable state, in which any item or part of an item does not, or would not, perform as previously specified. |
| Failure rate | The total number of failures within an item population, divided by the total number of life units expended by that population, during a particular measurement interval under stated condition. |
| FIT | Failures In Time: the number of failures in 1 billion hours. |
| PPM | Part per million: the number of failures in 1 million hours. |
| Mean Time Between Failures (MTBF) | A basic measure of reliability for repairable items: The mean number of life units during which all parts of the item perform within their specified limits, during a particular measurement interval under stated conditions. |
| GB | Ground, Fixed, Controlled: Nearly zero environmental stress with optimum engineering operation and maintenance. Typical applications are central office, environmentally controlled vaults, environmentally controlled remote shelters, and environmentally controlled customer premise area. |
| GF | Ground, Fixed, Uncontrolled: Some environmental stress with limited maintenance. Typical applications are manholes, poles, remote terminals, and customer premise areas subject to shock, vibration, temperature, or atmospheric variations. |

➤ Software & Database

Analysis Software & Analysis Method

Software Name : Relex Reliability Studio 2008

Software Version : Relex Studio 2008

➤ Analysis Method

The prediction method used was Telcordia SR-332, Issue 2,

Parts Count

Failure rate (λ) = 10^9 hours (FITs)

MTBF = $1/\lambda$

$\lambda_{SSi} = \lambda_{Gi} \cdot TT_{Qi} \cdot TT_{Si} \cdot TT_{Ti}$

Where λ_{Gi} : Generic steady-state failure rate for device i

TT_{Qi} : Quality factor for device i

TT_{Si} : Stress factor for device i

TT_{Ti} : Temperature factor for device i

➤ **Calculation Parameter**

Operation Temperature : 25°C

Environment : Ground Benign, Controlled

Operation Stress : 50% (Voltage, Current, Power)

Method : Method I, Case 3

Products are advertised with MTBF up to 1 million hours in the market. Take one million hours as an example, the product's estimated life is 114 years. However, the current rapid progress of technology, advancement of flash storage device's manufacturing process research and development, and the supply period of former flash IC manufacturing processes are crucial to the actual life expectancy of flash products. In short, the MTBF of flash storage is for reference only. Good customer service and technical support provided by manufacturers is the most significant issue regarding to the life-span of products.

Remark:

All the details of testing and data are for reference only and do not imply any products performance as a result. MTBF is only an estimated date and is depends on both hardware and software. User shall not assume that all the products have the same MTBF as APRO estimates.

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 Industrial SLC 2.5" Rugged Metal PATA SSD HERMIT-F Series | | Standard Grade SR2IFxxxG-HFCTC-U | Industrial Grade WR2IFxxxG-HFITI-U |
|---|----------------------------|-------------------------------------|---------------------------------------|
| 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: | 70 Hz to 2K Hz, 15G, 3 axes | |
| Shock | Operating & Non-operating: | 0.5ms, 1500 G, 3 axes | |

2.2. System Power Requirements

Table 2: Power Requirement

| APRO Industrial SLC 2.5" Rugged Metal PATA SSD HERMIT-F Series | | |
|--|----------------|------------------|
| DC Input Voltage (VCC) | | +5V ± 5% |
| Maximum average value | Reading Mode : | 154.9 mA (64GB.) |
| | Writing Mode : | 141.7mA (64GB.) |
| | Idle Mode : | 10.5 mA (64GB.) |

2.3. System Performance

Table 3: System Performances

| | | | | | | | | | | |
|------------------------|--|-------|-------|------|------|------|------|------|------|------|
| Data Transfer Mode | PIO 2~6, MWDMA 0~4, UDMA 0~6 supported | | | | | | | | | |
| Access Time | 0.5 ms (64GB) | | | | | | | | | |
| Capacity | 128MB | 256MB | 512MB | 1GB | 2GB | 4GB | 8GB | 16GB | 32GB | 64GB |
| Sequential Read (MB/s) | 24.9 | 29.3 | 32.4 | 61.9 | 61.5 | 64.4 | 64.5 | 64.8 | 64.6 | 62.2 |
| Sequential Write(MB/s) | 6.0 | 12.1 | 22.1 | 33.7 | 34.0 | 47.3 | 49.9 | 57.5 | 58.4 | 57.4 |
| 4K Random Read (MB/s) | 10.4 | 11.5 | 11.6 | 11.7 | 10.8 | 11.2 | 11.2 | 10.4 | 10.3 | 10.0 |
| 4K Random Write(MB/s) | 3.5 | 5.7 | 7.1 | 8.9 | 7.8 | 8.8 | 9.0 | 9.1 | 9.1 | 8.5 |

Note:

- All values quoted are typically at 25°C and nominal supply voltage.
- The performance is obtained from CrystalDiskMark Test

2.4. System Reliability

Table 4: System Reliability

| | |
|---------------------------------|---|
| Wear-leveling Algorithms | Static, Dynamic and Global wear-leveling algorithms |
| Bad Blocks Management | Supported |
| ECC Technology | Flexible 96-Bit/1KB BCH ECC engine |
| Erase counts | NAND SLC Flash Cell Level : 60K P/E Cycles |
| Capacity | TBW(TB) |
| 128MB | 1.0 |
| 256MB | 2.2 |
| 512MB | 3.9 |
| 1GB | 8.0 |
| 2GB | 16.1 |
| 4GB | 31.3 |
| 8GB | 56.1 |
| 16GB | 112.6 |
| 32GB | 225.6 |
| 64GB | 451.7 |

Note:

- Client workload by JESD-219A
- Lifespan is calculated by device written per day.

2.5. Physical Specifications

Refer to Table 5 and see Figure 3 for the APRO Industrial SLC 2.5" Rugged Metal PATA SSD HERMIT-F Series physical specifications and dimensions.

Table 5: Physical Specifications

| | |
|-------------------|-------------------|
| Length: | 100.0 mm |
| Width: | 70.10 mm |
| Thickness: | 8.80 mm |
| Weight: | 62.0 g / 2.18 oz. |

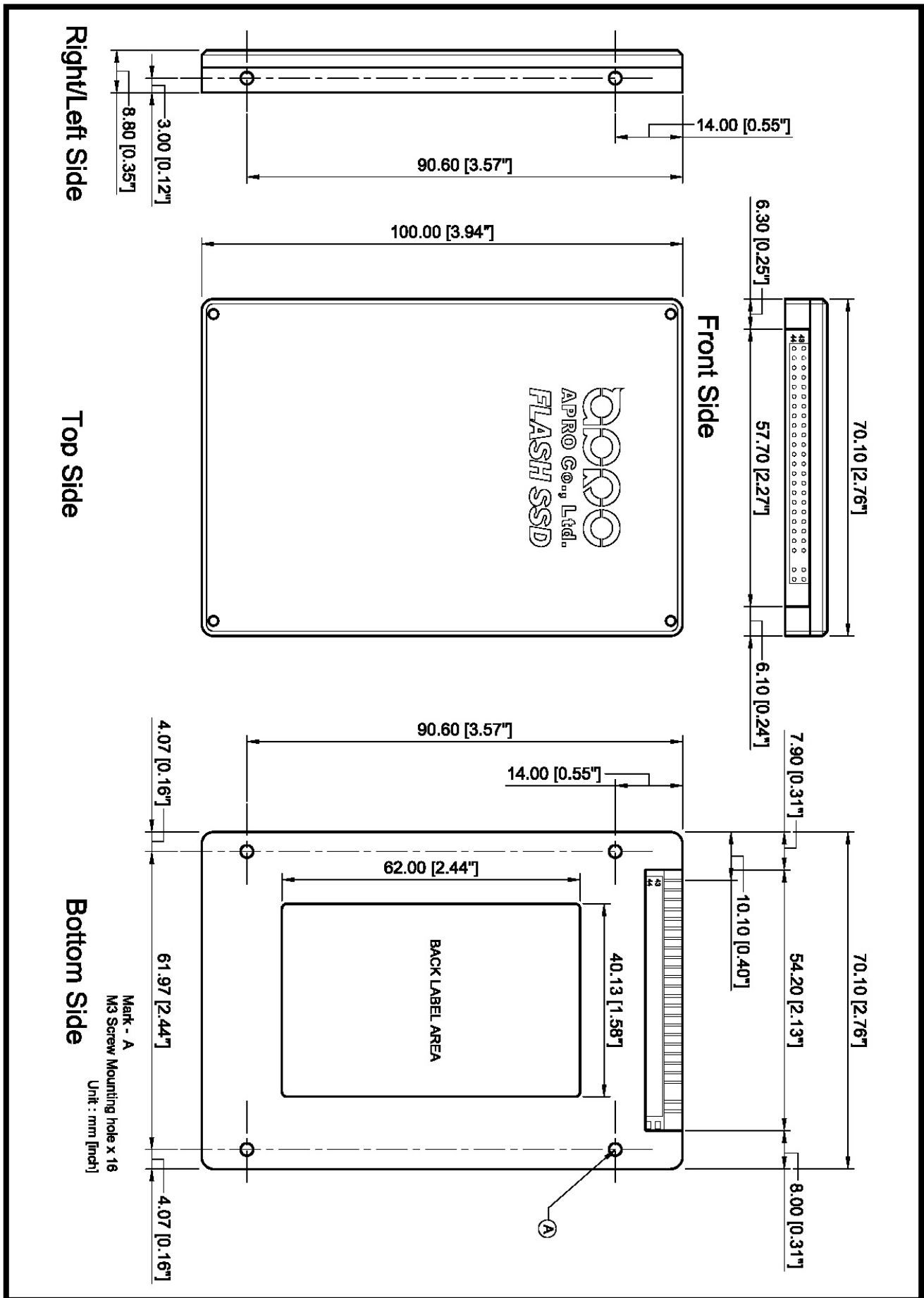


Figure 2: APRO Industrial SLC 2.5" Rugged Metal PATA SSD HERMIT-F Series Dimension

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 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

2.7. Device Parameter

The table 6 shows the specific capacity for the various models and the default number of heads, sectors/track and cylinders.

Table 6: Device Parameter

| Unformatted Capacity | Cylinder | Head | Sector | LBA Total Sectors |
|----------------------|----------|------|--------|-------------------|
| 128MB | 488 | 16 | 32 | 249,856 |
| 256MB | 958 | 16 | 32 | 490,496 |
| 512MB | 975 | 16 | 63 | 982,800 |
| 1GB | 1,950 | 16 | 63 | 1,965,600 |
| 2GB | 3,897 | 16 | 63 | 3,928,176 |
| 4GB | 7,773 | 16 | 63 | 7,835,184 |
| 8GB | 15,525 | 16 | 63 | 15,649,200 |
| 16GB | 16,383 | 15 | 63 | 31,277,232 |
| 32GB | 16,383 | 15 | 63 | 62,533,296 |
| 64GB | 16,383 | 15 | 63 | 125,045,424 |

3. Interface Description

3.1. PATA SSD HERMIT-F Series interface

Pin 1 ~ pin 44 are for IDE interface. Pin A ~ pin D is for Master/Slave selection via physical jumpers.

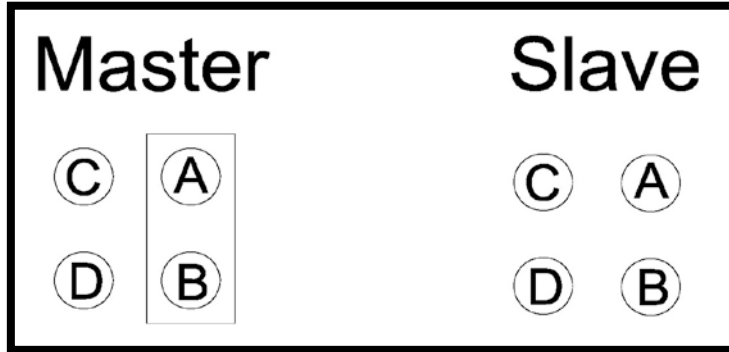


Figure 3 : The connectors of 2.5" PATA SSD

3.2. Pin Assignments

Signals whose source is the host is designated as inputs while signals that APRO Industrial SLC 2.5" Rugged Metal PATA SSD HERMIT-F Series sources are outputs.

The pin assignments are listed in below table 7.

Table 7 - Pin Assignments

| Pin | Name | Descriptions | Pin | Name | Descriptions |
|-----|------------|----------------------------|-----|----------------|--------------------------------|
| 01 | -RESET | Drive Reset | 02 | GND | Ground |
| 03 | DD7 | Drive data bus bit 7 | 04 | DD8 | Drive data bus bit 8 |
| 05 | DD6 | Drive data bus bit 6 | 06 | DD9 | Drive data bus bit 9 |
| 07 | DD5 | Drive data bus bit 5 | 08 | DD10 | Drive data bus bit 10 |
| 09 | DD4 | Drive data bus bit 4 | 10 | DD11 | Drive data bus bit 11 |
| 11 | DD3 | Drive data bus bit 3 | 12 | DD12 | Drive data bus bit 12 |
| 13 | DD2 | Drive data bus bit 2 | 14 | DD13 | Drive data bus bit 13 |
| 15 | DD1 | Drive data bus bit 1 | 16 | DD14 | Drive data bus bit 14 |
| 17 | DD0 | Drive data bus bit 0 | 18 | DD15 | Drive data bus bit 15 |
| 19 | GND | Ground | 20 | KEY | No pin |
| 21 | DMARQ | DMA request | 22 | GND | Ground |
| 23 | -DIOW:STOP | Drive I/O Write | 24 | GND | Ground |
| 25 | DIOR- | Drive I/O Read | 26 | GND | Ground |
| 27 | IORDY | I/O channel ready | 28 | CSEL | Cable select |
| 29 | -DMACK | DMA acknowledge | 30 | GND | Ground |
| 31 | INTRO | Drive interrupt | 32 | IOIS16 | Drive 16 bit I/O |
| 33 | DA1 | Drive address bus bit 1 | 34 | -PDIAG: -CBLID | Passed diagnostics |
| 35 | DA0 | Drive address bus bit 0 | 36 | DA2 | Drive address bus bit 2 |
| 37 | -CS0 | Chip select 0 | 38 | CS1 | Chip select 1 |
| 39 | -DASP | Drive active slave present | 40 | GND | Ground |
| 41 | VCC | +5V supply | 42 | VCC | +5V supply |
| 43 | GND | Ground | 44 | NC | Reserved for future definition |

Appendix A: Limited Warranty

APRO warrants your Industrial SLC 2.5" PATA SSD HERMIT-F 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:

- **SLC (Standard grade) 3 years / Within 60K Erasing Counts**
- **SLC (Industrial grade) 5 years / Within 60K Erasing Counts**

This document is for information use only and is **subject to change without prior notice**. APRO Co., Ltd. assumes no responsibility for any errors that may appear in this document, nor for incidental or consequential damages resulting from the furnishing, performance or use of this material. No part of this document may be reproduced, transmitted, transcribed, stored in a retrievable manner or translated into any language or computer language, in any form or by any means, electronic, mechanical, magnetic, optical, chemical, manual or otherwise, without the prior written consent of an officer of APRO Co., Ltd.

All parts of the APRO documentation are protected by copyright law and all rights are reserved.

APRO and the APRO logo are registered trademarks of APRO Co., Ltd.

Product names mentioned herein are for identification purposes only and may be trademarks and/or registered trademarks of their respective companies.

© 2018 APRO Corporation. All rights reserved