

SLC

Industrial SD/SDHC Card 3.0

PHANES-F Series

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ISO 9001 : 2015 CERTIFIED



Product Features

■ Flash IC

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

■ Compatibility

- SD Memory Card Specifications, Part 1 Physical Layer Specification, version 3.1 Final
- SD Memory Card Specifications, Part 3, Security Specification, Version 3.0 Final

■ Additional Capabilities

- S.M.A.R.T.*¹ (Self-Monitoring, Analysis and Reporting Technology) feature set support.
- Supports SD command Class 2/4/6/10
- Supports SD mode and SPI mode
- Supports CPRM
- Supports Embedded Mode
- Support bad Block Management
- Support both Static and Dynamic Wear Leveling
- **Bus speed mode:**
128MB~2GB: non-UHS
4GB~32GB: UHS-I

■ Mechanical

- 9 exposed contact pins on one side.
- Dimension: 32.0mm x 24.0mm x 2.1mm.
- Weight: 2.5 g / 0.09 oz.

■ Power Operating Voltage 3.3V(+/-) 10%

- Read Mode: 400 mA (UHS-I Mode max.)
- Write Mode: 400 mA (UHS-I Mode max.)
- Idle Mode: 1000 uA (max.)

■ Performance (Maximum value) *²

- SD card performance

- Sequential Read: 21.9 MB/sec. (512MB) *²
- Sequential Write: 20.0 MB/sec. (512MB) *²

- SDHC card performance

- Sequential Read: 65.0 MB/sec. (32GB) *²
- Sequential Write: 55.0 MB/sec. (32GB) *²

■ Capacity

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

■ Reliability

- **ECC:** Designed with BCH ECC Algorithm.
- **MTBF:** > 3,000,000 hours
- **Temperature:** (Operating)
Standard Grade: 0°C ~ +70°C
Industrial Grade: -40°C ~ +85°C
- **Vibration:** 80Hz~2000Hz/20G.
- **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

Order Information

I. Part Number List

◆ APRO SLC Industrial Secure Digital Memory Card PHANES-F Series

| Product Picture | Grade | Industrial Grade (-40°C ~ +85°C) |
|---|-------|------------------------------------|
|  | 128MB | WPSDC128M-PFITI |
| | 256MB | WPSDC256M-PFITI |
| | 512MB | WPSDC512M-PFITI |
| | 1GB | WPSDC001G-PFITI |
| | 2GB | WPSDC002G-PFITI |
| | 4GB | WPSDH004G-PFITI |
| | 8GB | WPSDH008G-PFITI |
| | 16GB | WPSDH016G-PFITI |
| | 32GB | WPSDH032G-PFITI |

II. Part Number Decoder:

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

X1 : Grade

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

X12 : Controller version

A, B, C.....

X2 : The material of case

P : Plastic casing

X13 : Controller Grade

I : Industrial grade

X3 X4 X5 : Product category

SD : Secure Digital (SD) memory card

SDH : Secure Digital High Capacity (SDHC)

memory card

X14 : Flash IC

T : Toshiba NAND Flash IC

X15 : Flash IC grade / Type

I : Industrial grade

X6 X7 X8 X9 : Capacity

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

X11 : Controller

P : PHANES Series

Revision History

| Revision | Description | Date |
|----------|-----------------------|------------|
| 1.0 | Initial release | 2016/04/08 |
| 2.0 | Updated Document form | 2019/06/17 |

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 | - 6 - |
| 1.2. Flash Management Technology – Static & Dynamic Wear Leveling | - 6 - |
| 1.3. Bad Block Management | - 6 - |
| 1.4. Embedded Mode | - 6 - |
| 2. Product Specifications | - 7 - |
| 2.1. System Environmental Specifications | - 7 - |
| 2.2. System Power Requirements | - 7 - |
| 2.3. System Performance | - 7 - |
| 2.4. System Reliability | - 8 - |
| 2.5. Physical Specifications | - 9 - |
| 3. Interface Description | - 11 - |
| 3.1. APRO SLC Secure Digital Memory Card interface | - 11 - |
| 3.2. Pin Assignments | - 12 - |
| Appendix A: Limited Warranty | - 13 - |

1. Introduction

APRO SLC Industrial Secure Digital Memory Card PHANES-F Series is specifically designed to meet the security, performance and environmental requirements of some significant applications such like networking, telecommunications and data-communications, mobile & embedded computing, medical instruments and industrial computing applications.

The main used Flash memory is SLC-NAND Type Flash memory chips are 128MB, 256MB, 512MB, 1GB, 2GB, 4GB, 8GB, 16GB and 32GB. APRO SLC Industrial Secure Digital Memory Card PHANES-F Series include a copyright protection that complies with the security of the SDMI standard, and the physical form-factor, pin assignment.

1.1. Scope

This document describes the key features and specifications of APRO SLC Industrial Secure Digital Memory Card PHANES-F Series.

1.2. Flash Management Technology – Static & Dynamic 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 SLC Industrial Secure Digital Memory Card PHANES-F 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.

1.3. 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 SLC Industrial Secure Digital Memory Card PHANES-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. Embedded Mode

Embedded mode is a function specially designed for operating systems that do not utilize FAT. Often under non Windows OS, for example Linux or customized host, wear leveling mechanism of APRO SLC MicroSD cards will be affected or even disabled in some cases. With embedded mode activated, SLC MicroSD cards ensure that under any circumstances, wear leveling mechanism can operate normally to keep the usage of blocks even throughout the MicroSD card's life cycle. This is especially a great add-on for security cameras or drive recorders.

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 SLC Industrial Secure Digital Memory Card PHANES-F Series | | Environmental Specification |
|---|----------------------------|-----------------------------|
| Temperature | Operating: | -40°C ~ +85°C |
| | Non-operating: | -50°C ~ +95°C |
| Humidity | Operating & Non-operating: | 10% ~ 95% non-condensing |
| Vibration | Operating & Non-operating: | 80Hz~2000Hz/20G. |
| Shock | Operating & Non-operating: | 0.5ms, 1500 G, 3 axes |

2.2. System Power Requirements

Table 2: Power Requirement

| APRO SLC Industrial Secure Digital Memory Card PHANES-F Series | | DC Input Voltage (VCC): 3.3V(+/-) 10% | |
|---|----------------|---------------------------------------|--------------|
| Capacity | | 128MB ~ 4GB | 8GB ~ 32GB |
| Maximum average value | Reading Mode : | 100 mA (max.) | < 400mA max. |
| | Writing Mode : | 100 mA (max.) | < 400mA max. |
| | Idle Mode : | 150 uA (max.) | < 1000uA max |

2.3. System Performance

Table 3: System Performances

| | | | | | | | | | | |
|-------------------------------|-------------------------|---------------------------|-------|-------|------|------|------|------|------|------|
| Data Transfer Mode supporting | | SDA Specification Ver 3.0 | | | | | | | | |
| Average Access Time | | 1 ms (estimated) | | | | | | | | |
| Maximum Performance | Capacity | 128MB | 256MB | 512MB | 1GB | 2GB | 4GB | 8GB | 16GB | 32GB |
| | Sequential Read (MB/s) | 20.0 | 20.5 | 21.9 | 20.0 | 20.0 | 30.0 | 65.0 | 65.0 | 65.0 |
| | Sequential Write (MB/s) | 4.5 | 9.0 | 20.0 | 20.0 | 20.0 | 25.0 | 50.0 | 50.0 | 55.0 |

Note:

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

2.4. System Reliability

Table 4: System Reliability

| | |
|--------------------------------------|---|
| Wear-leveling Algorithms | Static and Dynamic wear-leveling algorithms |
| Bad Blocks Management | Supportive |
| ECC Technology | BCH ECC |
| Endurance | NAND SLC Flash : 60K Erase counts |
| Durability | 10,000 inserting cycles |
| Bending | > 10N |
| Torque | 0.1N +/- 2.5 deg. |
| Drop Test | 1.5M free fall |
| Salt Spray | Concentration: 3% NaCl/35°C |
| Waterproof | 1000mm submerge for 30 minutes, IPx7 compliance |
| Electrostatic Discharge (ESD) | Contact: +/- 4KV each item 25 times Air: +/- 8KV 10 times |
| X-Ray Exposure Test | 0.1 Gy of medium energy radiation (70 keV to 140keV, cumulative does per year) to both sides of the card. |

Note:

- 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 1 for APRO SLC Industrial Secure Digital Memory Card PHANES-F Series physical specifications and dimensions.

Table 5: Physical Specifications of APRO SLC Industrial Secure Digital Memory Card PHANES-F Series

| | |
|-------------------|-----------------|
| Length: | 32.00 mm |
| Width: | 24.00 mm |
| Thickness: | 2.10 mm |
| Weight: | 2.5 g / 0.09 oz |

Figure 1: APRO SLC Secure Digital Memory -F Series Dimension

3. Interface Description

3.1. Secure Digital Memory Card interface

APRO SLC Industrial Secure Digital Memory Card PHANES-F Series has 9 exposed contacts on one side.

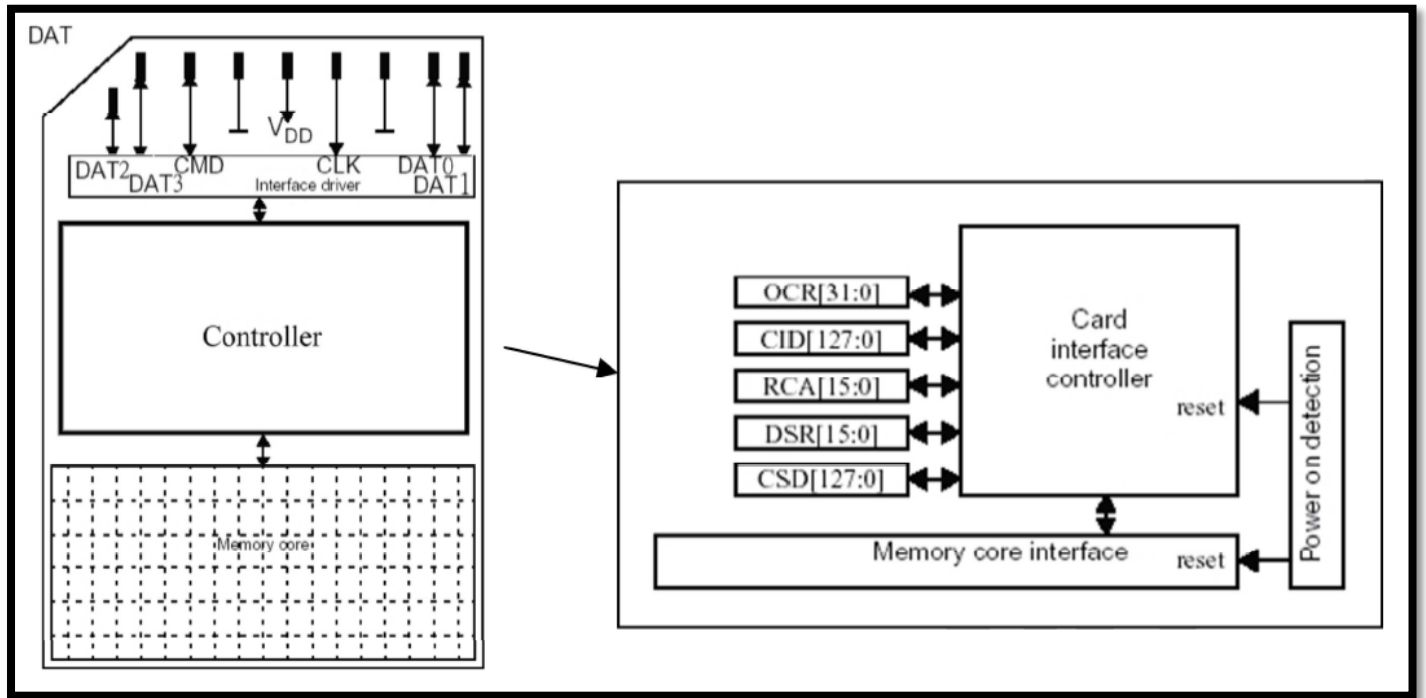


Figure 2: 9 Pins Connector

3.2. Pin Assignments

There are total of 9 pins in the Micro SD Connector. The pin assignments are listed in below table 6.

Table 6 - Pin Assignments

| Pin Number | SD Mode | | | SPI Mode | | |
|------------|------------------------|---------------------|--------------------------------|------------------|----------------|-----------------------|
| | Pin Name | Type ¹ | Description | Pin Name | Type | Description |
| Pin 1 | CD / DAT3 ² | I/O/PP ³ | Card Detect / Data Line [bit3] | CS | I ³ | Chip Select |
| Pin 2 | CMD | PP | Command / Response | DI | I | Data in |
| Pin 3 | V _{SS1} | S | Supply voltage ground | V _{SS} | S | Supply voltage ground |
| Pin 4 | V _{DD} | S | Supply voltage | V _{DD} | S | Supply voltage |
| Pin 5 | CLK | I | Clock | SCLK | I | Clock |
| Pin 6 | V _{SS2} | S | Supply voltage ground | V _{SS2} | S | Supply voltage ground |
| Pin 7 | DAT0 | I/O/PP | Data Line [bit0] | DO | O/PP | Data Out |
| Pin 8 | DAT1 | I/O/PP | Data Line [bit1] | RSV | | |
| Pin 9 | DAT2 | I/O/PP | Data Line [bit2] | RSV | | |

- S: power supply, I:input; O:output using push-pull drivers; PP:I/O using push-pull drivers.
- The extended DAT lines (DAT1-DAT3) are input on power up. They start to operate as DAT lines after SET_BUS_WIDTH command. The Host shall keep its own DAT1-DAT3 lines in input mode, as well, while they are not used. It is defined so, in order to keep compatibility to Multi-Media Cards.
- At power up this line has a 50KOhm pull up enabled in the card. This resistor serves two functions Card detection and Mode Selection. For Mode Selection, the host can drive the line high or let it be pulled high to select SD mode. If the host wants to select SPI mode it should drive the line low. For Card detection, the host detects that the line is pulled high. This pull-up should be disconnected by the user during regular data transfer period, with SET_CLR_CARD_DETECT(ACMD42) command.

Appendix A: Limited Warranty

APRO warrants your SLC Secure Digital Memory Card PHANES-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 IND. Grade 5 years / Within 60K Erasing Counts**

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