APRO Co., Ltd.

aSLC

CompactFlash® Card

HERMIT-F Series

Document No. : 100-xxCFC-HFCTMAS

Version No. : 02V1

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ISO 9001 : 2015 CERTIFIED

Product Features

- **Flash IC**
  - TOSHIBA 15nm NAND Flash IC.
  - Multi-Level Cell (MLC) management by enhance endurance technology (aSLC).

- **Compatibility**
  - CF 6.1 standard compatible.
  - PC-Card 8.0 (PC-Card ATA) standard compatible.
  - PCMCIA specification version 2.1 compatible.
  - ATA-7 standard compatible in True-IDE mode.

- **Additional Capabilities**
  - Fast ATA host-to-buffer transfer rates supporting PIO mode 6, MDMA mode 4, UDMA mode 6 in True-IDE mode
  - 4K Mapping units
  - S.M.A.R.T.[*1] (Self-Monitoring, Analysis and Reporting Technology) feature set support.
  - TRIM maintenance command support.
  - Static, Dynamic, and Global wear leveling algorithm
  - Flexible 96-Bit/1KB BCH ECC engine.
  - Support bad Block Management

- **Mechanical**
  - Standard 50-pin connector consisting of two rows of 25 female contacts.
  - Dimension: 42.8 mm x 36.4 mm x 3.3 mm.
  - Weight:
    Plastic frame-kit: 12g / 0.42 oz.
    Metal frame-kit: 14g / 0.49 oz.

- **Power: Operating Voltage @ 5V(+/-) 10%**
  - Read Mode: 123.0 mA (max.)
  - Write Mode: 118.0 mA (max.)
  - Idle Mode: 3.0.0 mA (max.)

- **Performance (Maximum value) *[2]**
  - Sequential Read: 116.8 MB/sec. (max.)
  - Sequential Write: 90.9 MB/sec. (max.)
  - 4K Random Read: 13.7 MB/sec. (max.)
  - 4K Random Write: 11.0 MB/sec. (max.)

- **Capacity**
  - 4GB, 8GB, 16GB, 32GB, 64GB and 128GB

- **Reliability**
  - **TBW:** Up to 251.4 TBW at 128GB Capacity. (Client workload by JESD-219A)
  - **ECC:** Flexible 96-Bit/1KB BCH ECC engine.
  - **Temperature:** (Operating)
    Standard Grade: 0ºC ~ +70ºC
    Wide Temp. Grade: -40ºC ~ +85ºC
  - **Vibration:** 70 Hz to 2K Hz, 15G, 3 axes.
  - **Shock:** 0.5ms, 1500 G, 3 axes

- **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 aSLC CompactFlash® Card HERMIT-F Series with plastic frame kit**

Product Picture	Grade	Standard grade (0°C ~ 70°C)	Wide Temp Grade (-40°C ~ +85°C)
	4GB	SPCFC004G-HFCTMASUF	WPCFC004G-HFCTMASUFC
	8GB	SPCFC008G-HFCTMASUF	WPCFC008G-HFCTMASUFC
	16GB	SPCFC016G-HFCTMASUF	WPCFC016G-HFCTMASUFC
	32GB	SPCFC032G-HFCTMASUF	WPCFC032G-HFCTMASUFC
	64GB	SPCFC064G-HFCTMASUF	WPCFC064G-HFCTMASUFC
	128GB	SPCFC128G-HFCTMASUF	WPCFC128G-HFCTMASUFC

◆ **APRO aSLC CompactFlash® Card HERMIT-F Series with rugged metal frame kit**

Product Picture	Grade	Standard grade (0°C ~ 70°C)	Wide Temp Grade (-40°C ~ +85°C)
	4GB	SRCFC004G-HFCTMASUF	WRCFC004G-HFCTMASUFC
	8GB	SRCFC008G-HFCTMASUF	WRCFC008G-HFCTMASUFC
	16GB	SRCFC016G-HFCTMASUF	WRCFC016G-HFCTMASUFC
	32GB	SRCFC032G-HFCTMASUF	WRCFC032G-HFCTMASUFC
	64GB	SRCFC064G-HFCTMASUF	WRCFC064G-HFCTMASUFC
	128GB	SRCFC128G-HFCTMASUF	WRCFC128G-HFCTMASUFC

Notes:

C : *Special conformal coating treated on whole PCBA which may support industrial grade operating temperature -40°C ~ +85°C*

II. Part Number Decoder:

X1 X2 X3 X4 X5 X6 X7 X8 X9 — X11 X12 X13 X14 X15 X16 X17 X18 X19 X20

X1 : **Grade**

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

W: Wide Temp Grade- operating temp. -40º C ~ +85 º C

X2 : **The material of case**

P : Plastic frame kit

R : Rugged Metal frame kit

X3 X4 X5 : **Product category**

CFC : CompactFlash® Card

X6 X7 X8 X9 : **Capacity**

004G:	04GB	**032G:**	32GB
008G:	08GB	**064G:**	64GB
016G:	16GB		

X11 : **Controller**

H : HERMIT Series

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 : **aSLC Technology**

AS : aSLC Technology extends MLC product's lifespan

X18 X19 : **Data Transfer Rate**

PF : PIO-6 mode / fixed disk type

PR : PIO-6 mode / removable disk type

UF : Defaulted as UDMA-6 mode / fixed disk type

UR : UDMA-6 mode / removable disk type

AA : PIO/UDMA & fixed/removable disk type auto-detected

X20 : **Reserved for specific requirement**

C : Conformal coating (optional)

Revision History

Revision	Description	Date
1.0	Initial release	2017/12/29
1.1	Add aSLC Technology	2018/07/06
1.2	Updated version	2018/11/28
2.0	Updated power consumption & performance	2019/04/01
2.1	Updated document form	2019/06/10

Contents

1. Introduction

APRO aSLC CompactFlash® Card HERMIT-F Series provides ULTRA HIGH RANDOM SPEED performance that electrically complies with ATA/ATAPI 7 standard. APRO aSLC CompactFlash® Card HERMIT-F Series support UDMA-6 with high random write (4K data size) performance.

The main used flash memories are aSLC-NAND type flash memory chips. The available disk capacities are 4GB, 8GB, 16GB, 32GB, 64GB and 128GB.

The operating temperature grade is optional for standard grade 0°C ~ 70°C and wide temp. grade -40°C ~ +85°C. The data transfer performance by sequential read is up to 116.8 MB/sec, and sequential write is up to 90.9 MB/sec; 4k data random read is up to 13.7MB/sec, and 4k data random write is up to 11.1MB/sec.

APRO aSLC CompactFlash® Card HERMIT-F Series products provide a high level interface to the host computer. This interface allows a host computer to issue commands to the aSLC CompactFlash® Card to read or write blocks of memory. Each sector is protected by a flexible 96-Bit/1KB BCH ECC engine. APRO aSLC CompactFlash® Card 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 aSLC CompactFlash® Card HERMIT-F Series.

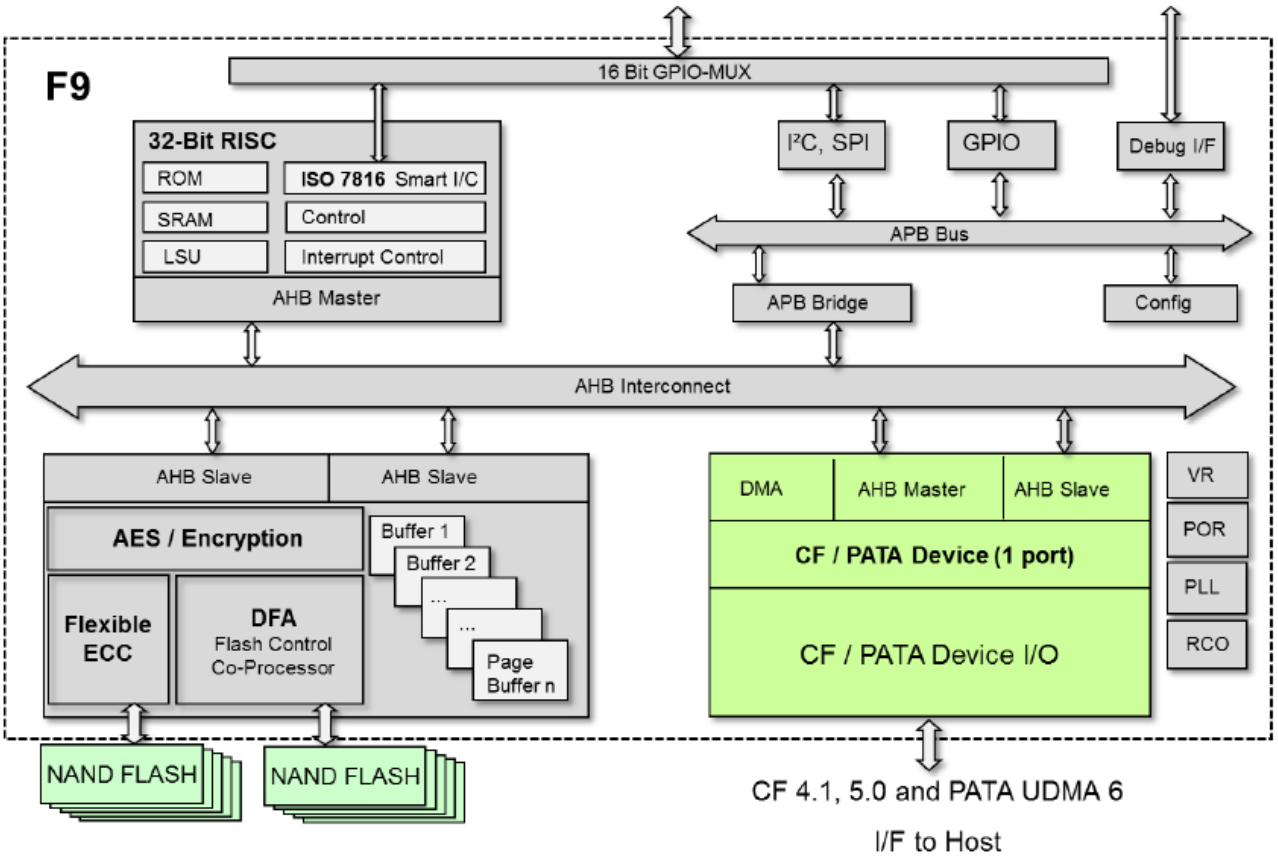

Figure 1: APRO aSLC CompactFlash® Card HERMIT-F Series block diagram

1.1. *Scope*

This document describes features, specifications and installation guide of APRO aSLC CompactFlash® Card 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. *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
  - aSLC-aware Power Fail Management
  - Option: Reliable Write of user data
- **Rigorous Testing to ensure functionality**
  - Power Cycling Test
  - Stress Test
  - Regression Test

1.4. *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 aSLC CompactFlash® Card 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.

1.5. *aSLC Technology*

The aSLC can be considered as an extended version of the MLC. While MLC contains both fast and slow pages, aSLC only utilizes fast pages for programming. The concept of aSLC is demonstrated in the Figure 2 below. The first and second bits of a memory cell represent a fast and slow page respectively, as shown in the left table. Since only fast pages are programmed when applying aSLC, the bits highlighted in red are used, as shown in the right table. As a result, aSLC provides better performance and endurance than MLC does. Moreover, the aSLC performs similarly to the SLC, yet more cost effective.

MLC Flash	
1st bit (fast)	2nd bit (slow)
1	1
1	0
0	1
0	0

aSLC Flash	
1st bit (fast)	2nd bit (slow)
1	1
1	0
0	1
0	0

Figure 2: The concept of APRO aSLC CompactFlash® Card HERMIT-F Series

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 aSLC CompactFlash® Card HERMIT-F Series		Standard Grade	Wide Temp. Grade
		SxCFCxxxG-HFCTMAS-U	WxCFCxxxG-HFCTMAS-U
Temperature	Operating:	0ºC ~ +70ºC	-40ºC ~ +85ºC
	Non-operating:	-20ºC ~ +80ºC	-50ºC ~ +95ºC
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 aSLC CompactFlash® Card HERMIT-F Series	
DC Input Voltage (VCC) +5V ± 10% or +3.3V ± 10%	Operating @ +5V ± 10%
Reading Mode :	123.0 mA (max.)
Writing Mode :	118.0 mA (max.)
Idle Mode :	3.0 mA (max.)

2.3. System Performance

Table 3: System Performances

Data Transfer Mode	PIO 2~6, MWDMA 0~4, UDMA 0~6 supported					
Access Time	0.962 ms (64GB)					
Capacity	4GB	8GB	16GB	32GB	64GB	128GB
Sequential Read (MB/s)	116.5	116.1	116.5	117.0	116.8	116.3
Sequential Write(MB/s)	58.5	53.3	86.4	99.4	90.9	90.3
4K Random Read (MB/s)	13.8	12.6	13.8	13.7	13.7	13.5
4K Random Write(MB/s)	10.6	10.0	10.6	11.0	11.1	10.9

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

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 MLC Flash w/aSLC Technology : 20K P/E Cycles
Capacity	**TBW(TB)**
4GB	7.7
8GB	15.5
16GB	31.3
32GB	62.7
64GB	125.6
128GB	251.4

Note:

- *Samples were built using Toshiba 15nm Toggle MLC NAND flash.*
- *Client workload by JESD-219A.*
- *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 3 for APRO aSLC CompactFlash® Card HERMIT-F Series physical specifications and dimensions.

Table 5: Physical Specifications of APRO aSLC CompactFlash® Card-HERMIT-F Series

Length:	36.40 mm
Width:	42.80 mm
Thickness:	3.3 mm
Weight:	**Plastic frame-kit:** 12g / 0.42 oz. **Metal frame-kit:** 14g / 0.49 oz.

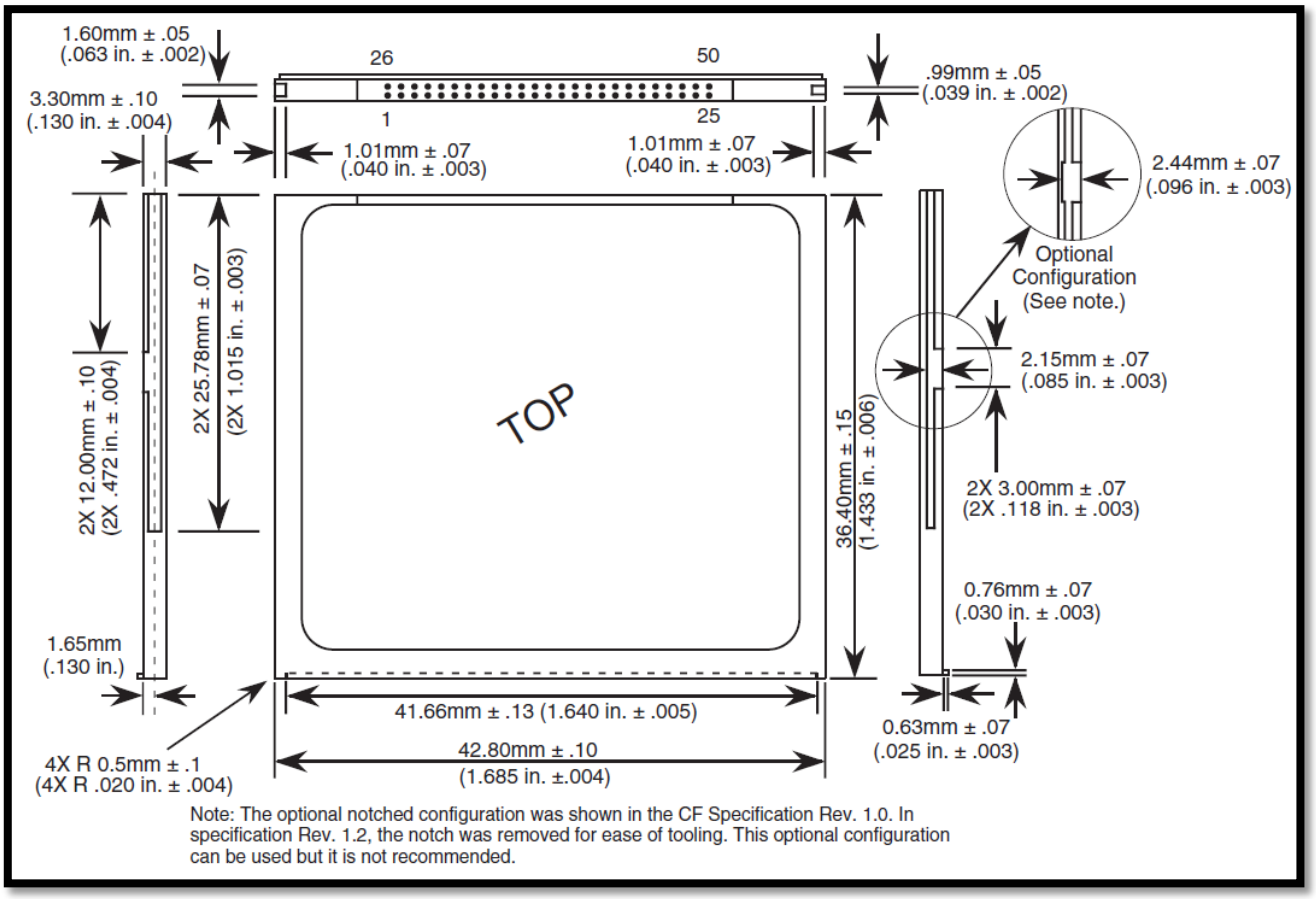

Figure 3: APRO aSLC CompactFlash® Card Dimension

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 use 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 of APRO aSLC CompactFlash® Card HERMIT-F Series

Unformatted Capacity	Cylinder	Head	Sector	LBA Total Sectors
4GB	7,773	16	63	7,835,184
8GB	15,525	16	63	15,649,200
16GB	16,383	16	63	31,277,232
32GB	16,363	16	63	62,533,296
64GB	16,383	16	63	125,045,424
128GB	16,383	15	63	250,069,680

3. Interface Description

3.1. CF Card interface (CompactFlash® Type I)

APRO aSLC CompactFlash® Card HERMIT-F Series equipped Standard 50-pin connector consisting of two rows of 25 female contacts.

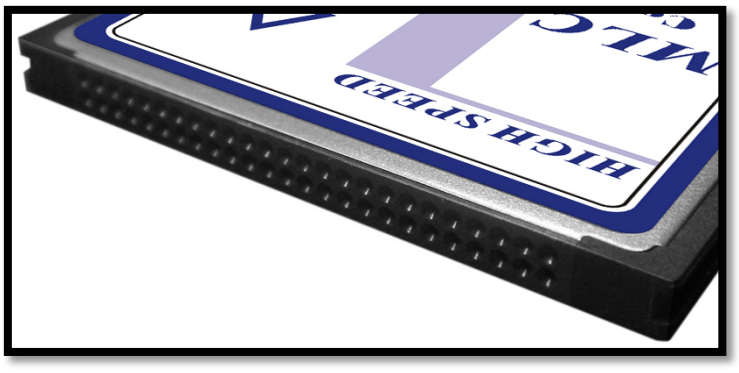

Figure 3: 50-pin CompactFlash® Type I Connector

3.2. Pin Assignments

Signals whose source is the host is designated as inputs while signals that the CompactFlash® (CF) Card sources are outputs. The pin assignments are listed in below table 7. The signal/pin assignments are listed in below Table 7. Low active signals have a "-" prefix. Pin types are Input, Output or Input/Output.

Table 7 - Pin Assignments of APRO aSLC CompactFlash® Card-HERMIT-F Series

True IDE Mode[4]			
Pin Num.	**Signal Name**	**Pin Type**	**In, Out Type**
1	GND		Ground
2	D03	I/O	11Z,OZ3
3	D04	I/O	11Z,OZ3
4	D05	I/O	11Z,OZ3
5	D06	I/O	11Z,OZ3
6	D07	I/O	11Z,OZ3
7	-CS0	I	13Z
8	A10[2]	GND	Ground
9	-ATA SEL	GND	Ground
10	A09[2]	GND	Ground
11	A08[2]	GND	Ground
12	A07[2]	GND	Ground
13	VCC		Power
14	A06[2]	GND	Ground
15	A05[2]	GND	Ground
16	A04[2]	GND	Ground
17	A03[2]	GND	Ground
18	A02	I	11Z
19	A01	I	11Z
20	A00	I	11Z
21	D00	I/O	11Z,OZ3
22	D01	I/O	11Z,OZ3
23	D02	I/O	11Z,OZ3
24	-IOCS16	NC	ON3
25	-CD2	GND	Ground
26	-CD1	GND	Ground
27	D11[1]	I/O	11Z,OZ3
28	D12[1]	I/O	11Z,OZ3
29	D13[1]	I/O	11Z,OZ3
30	D14[1]	I/O	11Z,OZ3
31	D15[1]	I/O	11Z,OZ3

True IDE Mode[4]			
Pin Num.	**Signal Name**	**Pin Type**	**In, Out Type**
32	-CS1[1]	I	13Z
33	-VS1	GND	Ground
34	-IORD[7]	I	13Z
	HSTROBE[8]		
	-HDMARDY[9]		
35	-IOWR[7]	I	13Z
	STOP[8.9]		
36	-WE[3]	I	13U
37	INTRQ	O	OZ1
38	VCC		Power
39	-CSEL	I	12U
40	-VS2	NC	OPEN
41	-RESET	I	12Z
42	IORDY[7]	O	ON1
43	DMARQ	O	OZ1
44	-DMACK[6]	I	13U
45	-DASP	I/O	11U,ON1
46	-PDIAG	I/O	11U.ON1
47	D08[1]	I/O	11Z,OZ3
48	D09[1]	I/O	11Z,OZ3
49	D10[1]	I/O	11Z,OZ3
50	GND		Ground

Appendix A: Limited Warranty

APRO warrants your aSLC CompactFlash® Card 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:

- **aSLC (Standard grade / Wide temp. grade) 2 years / Within 20K Erasing Counts**