

MLC

SATA-III CFast™ Card

MUSE-D Series

APRO MLC SATA-III CFast™ Card



Document No. : 100-xxCFA-VDCTM

Version No. : 01V0

Date : December. 2017

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.
- Static wear-leveling algorithm
- Hardware Low Density Parity Check Code, LDPC support.

■ Mechanical

- 7-pin (data) + 17-pin (power) CFast™ Card connector
- Dimension: 42.8 mm x 36.4 mm x 3.5 mm.
- Weight: 10.0 g / 0.4 o.z.

■ Power

- Operating Voltage 3.3V(+/-) 5%
- Read Mode: 150mA (max.)
- Write Mode: 260mA (max.)
- Idle Mode: 100mA (max.)

■ Performance (Maximum value)^{2,3}

- Sequential Read (1GB Data): 530 MB/sec. ^{*3}
- Sequential Write (1GB Data): 210 MB/sec. ^{*3}
- 4KB Random Read (QD32): 32K IOPS ^{*2}.
- 4KB Random Write (QD32): 26K. IOPS^{*2}.

■ Capacity

- 8GB, 16GB, 32GB, 64GB, 128GB and 256GB

■ Reliability

- **TBW:** Up to 416 TBW at 256GB Capacity.
(Client workload by JESD-218/219A)
- **MTBF:** > 3,000,000 hours.
- **ECC:** Designed with hardware LDPC ECC engine with hard-decision and soft-decision decoding.
- **Temperature:** (Operating)
Standard Grade: 0°C ~ +70°C
Wide Temp. Grade: -40°C ~ +85°C
- **Vibration:** 20G (IEC 68-2-6).
- **Shock:** 1500G (IEC 68-2-27)

■ 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. Sequential performance is based on CrystalDiskMark 5.1.2 with file size 1000MB


Order Information

1. Part Number List

◆ APRO MLC SATA III CFast™ Card – MUSE-D Series with plastic frame kit

Product Picture	Grade	Standard grade (0°C ~ 70°C)	Wide Temp Grade (-40°C ~ +85°C)
	8GB	SPCFA008G-VDCTM	WPCFA008G-VDCTMC
	16GB	SPCFA016G-VDCTM	WPCFA016G-VDCTMC
	32GB	SPCFA032G-VDCTM	WPCFA032G-VDCTMC
	64GB	SPCFA064G-VDCTM	WPCFA064G-VDCTMC
	128GB	SPCFA128G-VDCTM	WPCFA128G-VDCTMC
	256GB	SPCFA256G-VDCTM	WPCFA256G-VDCTMC

◆ APRO MLC SATA III CFast™ Card – MUSE-D Series with rugged metal frame kit

Product Picture	Grade	Standard grade (0°C ~ 70°C)	Wide Temp Grade (-40°C ~ +85°C)
	8GB	SRCFA008G-VDCTM	WRCFA008G-VDCTMC
	16GB	SRCFA016G-VDCTM	WRCFA016G-VDCTMC
	32GB	SRCFA032G-VDCTM	WRCFA032G-VDCTMC
	64GB	SRCFA064G-VDCTM	WRCFA064G-VDCTMC
	128GB	SRCFA128G-VDCTM	WRCFA128G-VDCTMC
	256GB	SRCFA256G-VDCTM	WRCFA256G-VDCTMC

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 / 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

P : Plastic frame kit

R : Rugged Metal frame kit

X3 X4 X5 : Product category

CFA : CFast™ Card

X6 X7 X8 X9 : Capacity

008G:	8GB	064G:	64GB
016GB:	16GB	128GB:	128GB
032G:	32GB	256GB:	256GB

X11 : Controller

V : MUSE 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 : 15nm MLC -NAND Flash IC

C : Reserved for specific requirement

C : Conformal-coating

Revision History

Revision	Description	Date
1.0	Initial release.	2017/12/11

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1. Introduction

APRO MLC CFast™ Card – MUSE-D Series provides high capacity flash memory Solid State Drive (SSD) that electrically complies with SATA Revision 3.1 standard. APRO MLC CFast™ Card – MUSE-D Series support SATA 1.5Gb/s; SATA 3Gb/s & SATA 6Gb/s data transfer rate with high performance.

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 with conformal coating supports -40°C ~ +85°C.

APRO MLC CFast™ Card – MUSE-D Series 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 32,000 IOPS and 4K random write is up to 29,000 IOPS; the sequential read is up to 535 MB/sec, and sequential write is up to 210 MB/sec. which is based on Toshiba's 15nm Toggle MLC flash.

APRO MLC CFast™ Card provide a high level interface to the host computer. This interface allows a host computer to issue commands to the APRO MLC CFast™ Card – MUSE-D Series to read or write blocks of memory. A powerful hardware design is architecture multiplied LDPC (Low Density Parity Check) for Error Correcting Coding (ECC). APRO MLC CFast™ Card MUSE-D Series intelligent controller manages interface protocols, data storage and retrieval as well as ECC, bad block management and diagnostics, power management and clock control.

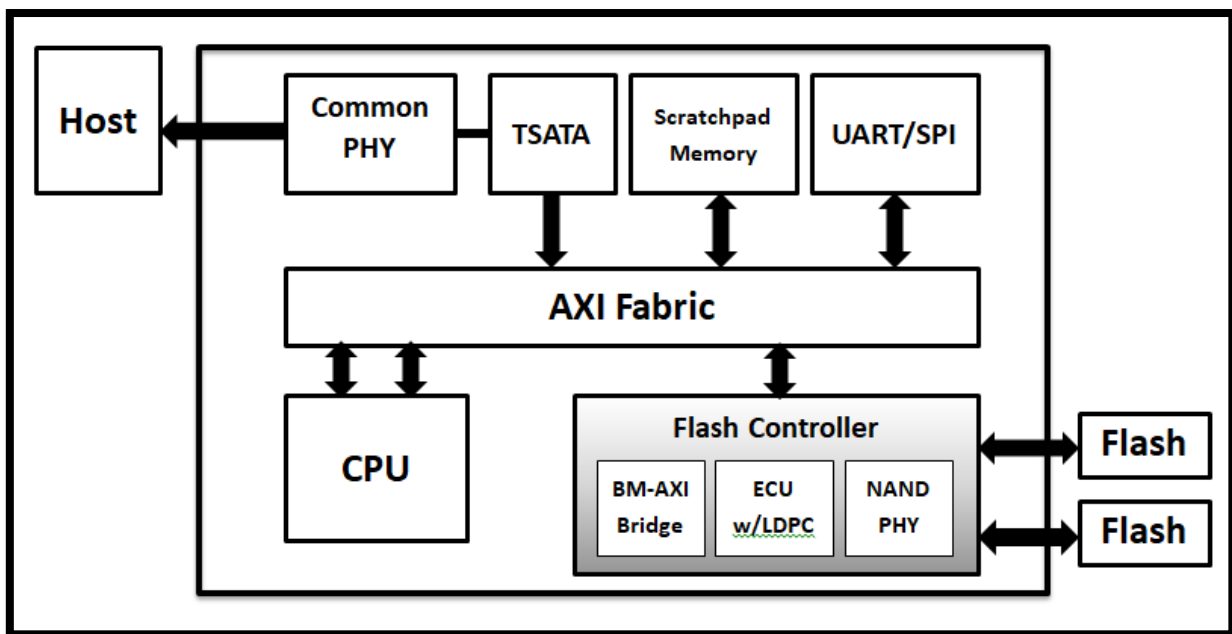


Figure 1: APRO MLC CFast™ Card MUSE-D Series controller block diagram

1.1. Scope

This document describes features, specifications and installation guide of APRO MLC CFast™ Card – MUSE-D Series. In the appendix, there provides order information, warranty policy, RMA/DOA procedure for the most convenient reference.

1.2. Flash Management Technology - Static Wear Leveling

In order to gain the best management for flash memory, APRO MLC CFast™ Card – MUSE-D Series supports Static 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.

A static 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 static data, it moves that data to a more heavily used location before it moves the newly written data. The static wear leveling maximizes effective endurance Flash array compared to no wear leveling or dynamic wear leveling.

1.3. Bad Block Management

Bad blocks of NAND flash may accumulate up to 2% of entire number of blocks during its manufacturing process and during the flash operational usage.

A system must be able to recognize bad block(s) based on the original bad block information and create a bad block table to keep track of blocks that fail during use. The first block of NAND Flash (block 0) is guaranteed to be good. The bad block information is stored in the reservoir area that is located in the highest address region of the NAND flash. Once the bad blocks have been located, and the bad blocks be no longer accessed.

To locate the bad blocks on a brand new device, read out each block. Any block that is not all FFFFh in 1st sector of 1st or 2nd page in a spare area is a bad block. Although random bit errors may occur during use, this does not necessarily mean that a block is bad. Generally, a block should be marked as bad only when there is a problem or erase failure. This can be determined by doing a status read after erase/program operation. The flash memory is initialized by formatting the flash memory into a reserved area and user area.

In order to detect the initial bad blocks to handle run time bad blocks, APRO MLC CFast™ Card – MUSE-D 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.

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 CFast™ Card		Standard Grade	Wide Temp Grade
MUSE-D Series		SxCFAxxxG-VDCTM	WxCFAxxxG-VDCTMC
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	
	Frequency/Acceleration:	7 Hz to 2K Hz, 20G, 3 axes (IEC 68-2-6)	
Shock	Operating & Non-operating:	0.5ms, 1500 G, 3 axes (IEC 68-2-27)	
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 CFast™ Card MUSE-D Series		
DC Input Voltage (VCC)		3.3V±5%
+3.3V Current (Maximum average value)	Reading Mode :	115mA (max.)
	Writing Mode :	260mA (max.)
	Idle Mode :	100mA (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	8GB	16GB	32GB	64GB	128GB	256GB
	Sequential Read (MB/s)	140	220	450	530	530	530
	Sequential Write (MB/s)	25	25	50	100	190	210
	4KB Random Read IOPS (QD32)	8,700	10,000	17,000	27,000	32,000	32,000
	4KB Random Write IOPS (QD32)	6,900	6,100	12,000	25,000	31,000	26,000

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

2.4. System Reliability

Table 4: System Reliability

Wear-leveling Algorithms	Static Wear-leveling	
Bad Block Management	Supportive	
Flash Endurance	3,000 Erase Counts	
ECC Technology	Hardware design LDPC (Low Density Parity Check)	
TBW (Tera Bytes Written)		
Capacity	8GB	15.5
	16GB	31.0
	32GB	62.0
	64GB	124.0
	128GB	210.5
	256GB	416.0

Note:

- TBW value calculation is based on JEDEC JESD218 standards, and JESD 219A workload.
- 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 APRO MLC CFast™ Card – MUSE-D Series physical specifications and dimensions.

Table 5: Physical Specifications of APRO MLC CFast™ Card-MUSE-D Series

Length:	42.8 mm
Width:	36.4 mm
Thickness:	3.5 mm
Weight:	10.00 g / 0.4 o.z.

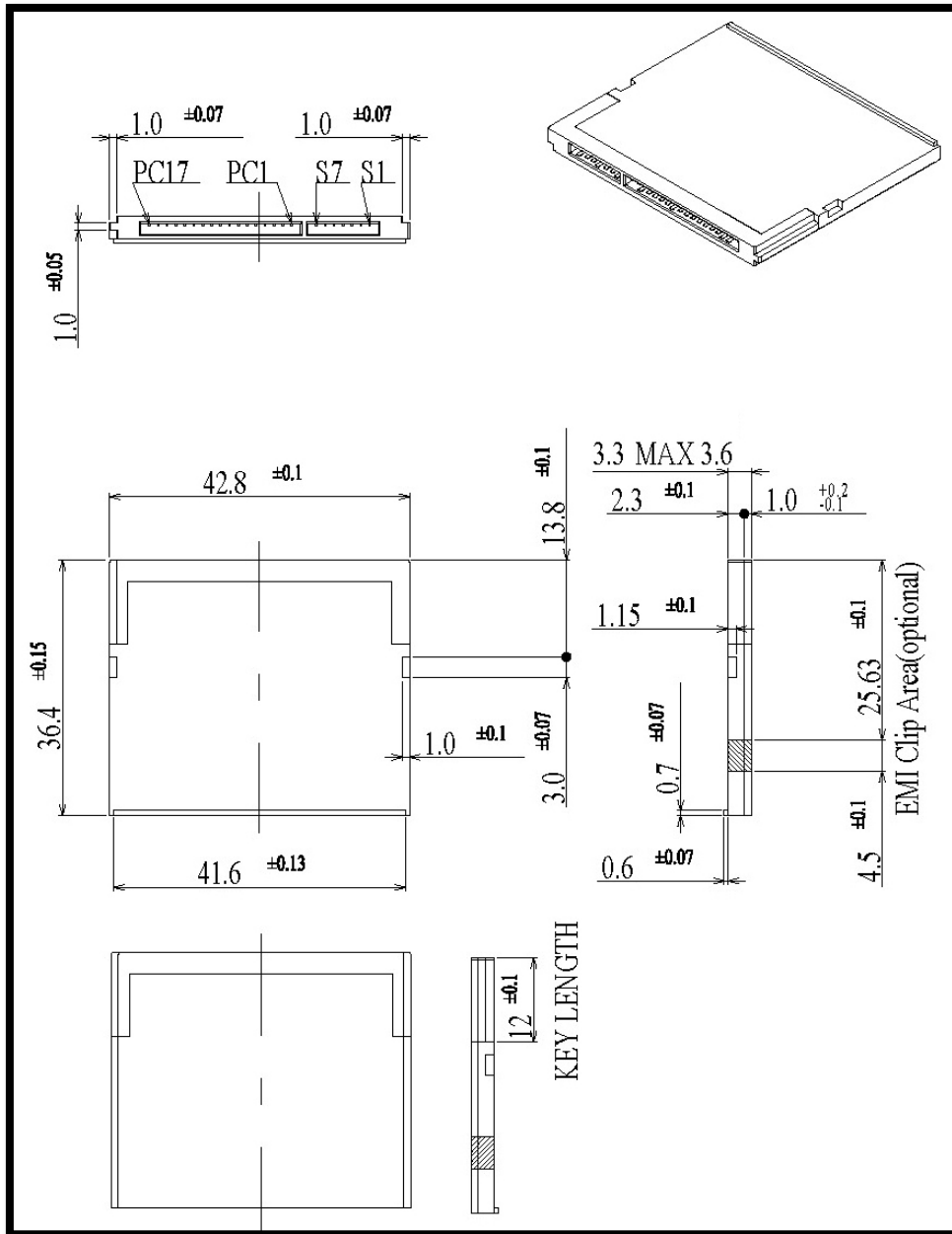


Figure 2: APRO MLC CFast™ Card Dimension

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 request 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

3. Interface Description

3.1. APRO MLC CFast™ Card interface

APRO CFast™ Card is equipped with 7 pins in the signal segment and 17 pins in the power segment.



Figure 3: The connectors of Signal Segment and Power Segment

3.2. Pin Assignments

APRO MLC CFast™ Card – MUSE-D Series operates with standard SATA pin-out.

The pin assignments are listed in below table 6.

Key and Spacing separate signal and power segments		
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

P1	CDI	Card Detect In
P2	PGND	Device Ground
P3	DEVSLP	Device Sleep
P4	NA	Reserved
P5	NA	Reserved
P6	NA	Reserved
P7	PGND	Device Ground
P8	LED1	LED Output
P9	LED2	LED Output
P10	NA	Reserved
P11	NA	Reserved
P12	IFDET	NA
P13	PWR	Device Power
P14	PWR	Device Power
P15	PGND	Device Ground
P16	PGND	Device Ground
P17	CDO	Card Detect Out

Table 6 - Pin Assignments

Appendix A: Limited Warranty

APRO warrants your MLC CFast™ Card – MUSE-D 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.

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