

# **MLC**

## **SATA III CFast™ Card**

### **MUSE-D Series**

**Document No. :** 100-xxCFA-VDCTM

**Version No. :** 02V0

**Date :** May, 2019

ISO 9001 : 2015 CERTIFIED



### Product Features

#### ■ Flash IC

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

#### ■ Compatibility

- Compliant with SATA Revision 3.1
- Compliant with CFast™ specification V2.0
- SATA 1.5Gbps/3.0Gbps/6.0Gbps data transfer rate.
- ATA-8 command set

#### ■ Additional Capabilities

- S.M.A.R.T.\*<sup>1</sup> (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:
- Plastic frame-kit: 10g / 0.35 oz.
- Metal frame-kit: 13g / 0.46 oz..

#### ■ Power Operating Voltage 3.3V(+/-) 5%

- Read Mode: 115.0 mA (max.)
- Write Mode: 260.0 mA (max.)
- Idle Mode: 100.0 mA (max.)

#### ■ Performance (Maximum value) \*<sup>2</sup>, \*<sup>3</sup>

- Sequential Read: 530.0 MB/sec. (max.)
- Sequential Write: 210.0 MB/sec. (max.)
- 4KB Random Read (QD32): 32.0 K IOPS. (max.)
- 4KB Random Write (QD32): 26.0 K. IOPS. (max.)

#### ■ Capacity

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

#### ■ Reliability

- **TBW:** Up to 416 TBW at 256GB Capacity.  
(Client workload by JESD-219A)
- **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:** 70 Hz to 2K Hz, 20G, 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
3. Typical I/O performance numbers as measured fresh-out-of-the-box (FOB) using IOMeter with a queue depth of 32


### Order Information

#### I. 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-(T)	WPCFA008G-VDCTMC-(T)C
	16GB	SPCFA016G-VDCTM-(T)	WPCFA016G-VDCTMC-(T)C
	32GB	SPCFA032G-VDCTM-(T)	WPCFA032G-VDCTMC-(T)C
	64GB	SPCFA064G-VDCTM-(T)	WPCFA064G-VDCTMC-(T)C
	128GB	SPCFA128G-VDCTM-(T)	WPCFA128G-VDCTMC-(T)C
	256GB	SPCFA256G-VDCTM-(T)	WPCFA256G-VDCTMC-(T)C

##### ◆ 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-(T)	WRCFA008G-VDCTMC-(T)C
	16GB	SRCFA016G-VDCTM-(T)	WRCFA016G-VDCTMC-(T)C
	32GB	SRCFA032G-VDCTM-(T)	WRCFA032G-VDCTMC-(T)C
	64GB	SRCFA064G-VDCTM-(T)	WRCFA064G-VDCTMC-(T)C
	128GB	SRCFA128G-VDCTM-(T)	WRCFA128G-VDCTMC-(T)C
	256GB	SRCFA256G-VDCTM-(T)	WRCFA256G-VDCTMC-(T)C

#### 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**—**X17**

#### **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

<b>008G:</b>	8GB	<b>064G:</b>	64GB
<b>016GB:</b>	16GB	<b>128GB:</b>	128GB
<b>032G:</b>	32GB	<b>256GB:</b>	256GB

#### **X11** : Controller

**V** : MUSE 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** : 15nm MLC -NAND Flash IC

#### **X17** : Reserved for specific requirement

**Blank** : Standard product w/o thermal sensor and conformal-coating

**T** : Thermal Sensor (optional)

**C** : Conformal coating (optional)

### **Revision History**

Revision	Description	Date
1.0	Initial release.	2017/12/11
1.1	Add the option for thermal sensor	2018/11/02
1.2	Updated Version	2018/11/28
2.0	Updated document form	2019/05/23

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### 1. Introduction

APRO MLC SATA III CFast™ Card MUSE-D Series compliant to the CFast™ Specification 2.0 issued by CompactFlash Association (CFA), it breakthroughs the speed performance under traditional ATA-8 specification. Integrating the CompactFlash card form factor and support SATA 1.5Gbps/3.0Gbps/6.0Gbps data transfer rate with high performance, the transfer speed is much higher than traditional CF Card while it keeps small form factor and rigid case as CF Card. APRO MLC SATA III CFast™ Card MUSE-D Series also supports Metal Frame Kit as an optional product which may endure various harsh operating environments. The main used Flash memory is MLC-NAND Type Flash memory chips for 8GB, 16GB, 32GB, 64GB, 128GB and 256GB capacities.

APRO MLC SATA III CFast™ Card MUSE-D Series features with great portability and resistance against vibration. The sequential read speed is 530.0 MB/sec and sequential write speed is 210.0 MB/sec, the data transfer performance by 4K random read is 32,000 IOPS and 4K random write is up to 26,000 IOPS for Multiple Level Cell (MLC) solution.

Furthermore, APRO also provide 1.8" SATA to CFast™ card Adapter (P/N: **AD-CA128SATA200AR**) to increase the application flexibility.

APRO MLC SATA III CFast™ Card MUSE-D Series supports optional standard grade operating temperature 0°C ~ 70°C and wide temperature -40°C ~ +85°C.

APRO MLC SATA III CFast™ Card MUSE-D Series provides a high level interface to the host computer. This interface allows a host computer to issue commands to the APRO MLC SATA III 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 SATA III 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.

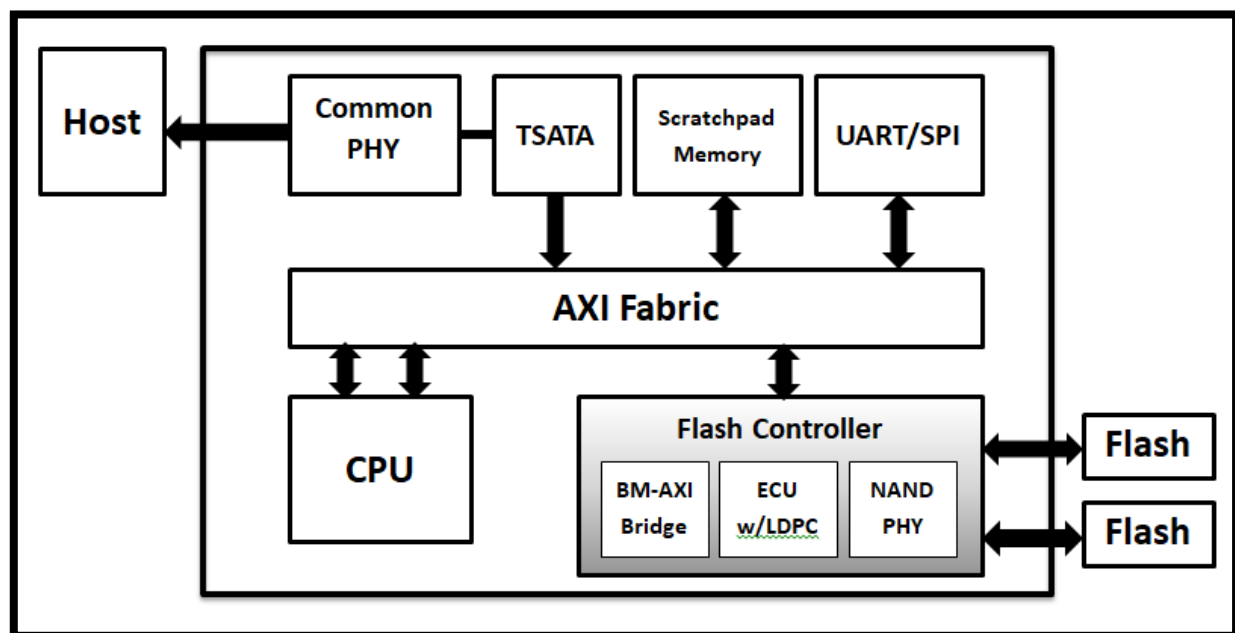


Figure 1: APRO MLC SATA III CFast™ Card MUSE-D Series block diagram

### 1.1. *Scope*

This document describes features, specifications and installation guide of APRO MLC SATA III 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 SATA III 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*

#### ➤ **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 MLC SATA III 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 SATA III 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:	70 Hz to 2K Hz, 20G, 3 axes	
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 SATA III CFast™ Card MUSE-D Series		
DC Input Voltage (VCC)		3.3V±5%
Maximum average value	Reading Mode :	115.0 mA (max.)
	Writing Mode :	260.0 mA (max.)
	Idle Mode :	100.0 mA (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)	140.0	220.0	450.0	530.0	530.0	530.0
	Sequential Write (MB/s)	25.0	25.0	50.0	100.0	190.0	210.0
	4KB Random Read IOPS (QD32)	8.7K	10.0K	17.0K	27.0K	32.0K	32.0K
	4KB Random Write IOPS (QD32)	6.9K	6.1K	12.0K	25.0K	31.0K	26.0K

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

### 2.4. System Reliability

**Table 4: System Reliability**

<b>Wear-leveling Algorithms</b>		Static wear-leveling algorithms
<b>Bad Block Management</b>		Supportive
<b>Erase counts</b>		NAND MLC Flash Cell Level : 3K P/E Cycles
<b>ECC Technology</b>		Hardware design LDPC (Low Density Parity Check)
<b>TBW (Tera Bytes Written)</b>		
<b>Capacity</b>	<b>8GB</b>	15.5
	<b>16GB</b>	31.0
	<b>32GB</b>	62.0
	<b>64GB</b>	124.0
	<b>128GB</b>	210.5
	<b>256GB</b>	416.0

Note:

- Client workload by JESD-219A.
- 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 SATA III CFast™ Card MUSE-D Series physical specifications and dimensions.

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

<b>Length:</b>	36.4 mm
<b>Width:</b>	42.8 mm
<b>Thickness:</b>	3.5 mm
<b>Weight:</b>	Plastic frame-kit: 10g / 0.35 oz.
	Metal frame-kit: 13g / 0.46 oz.

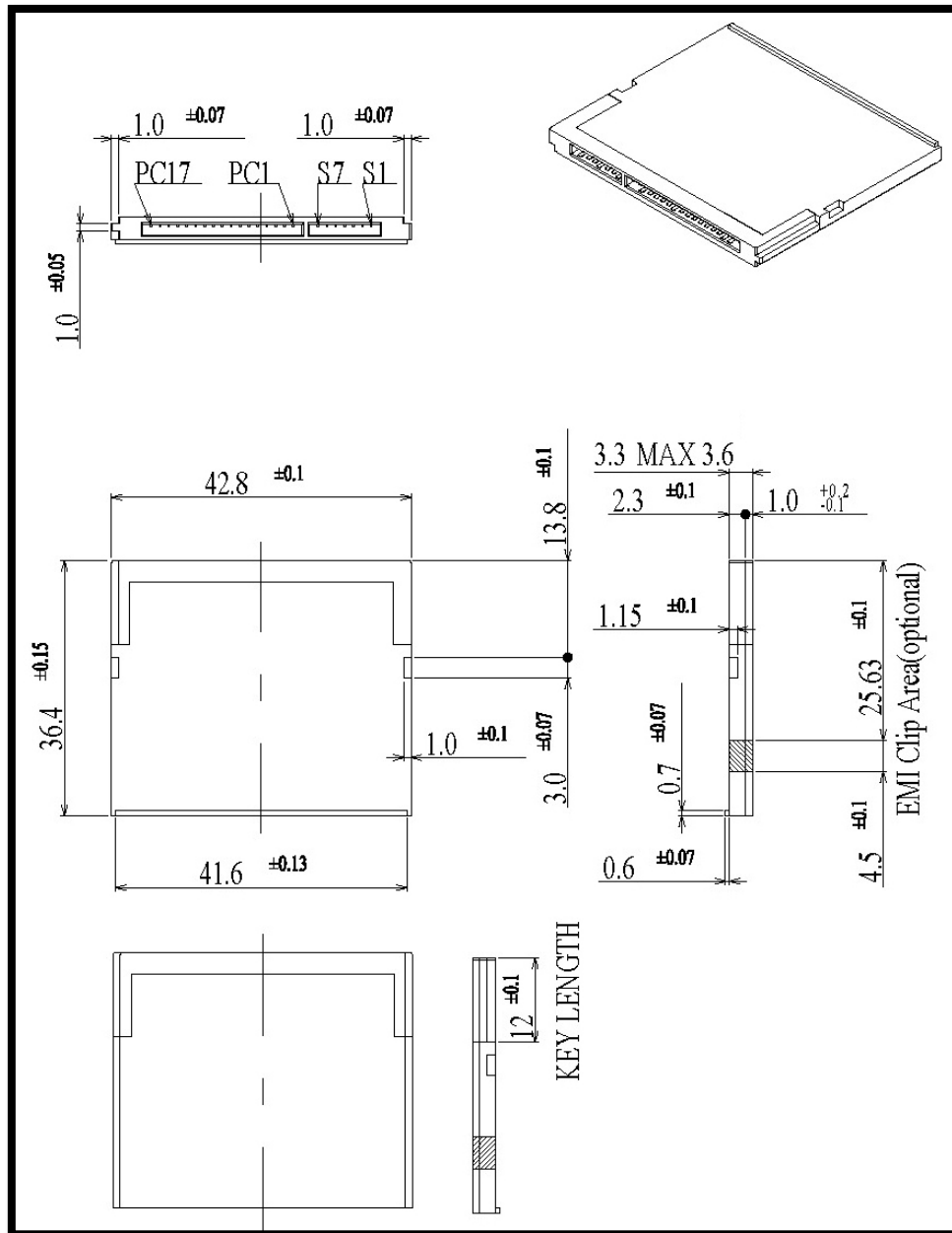


Figure 2: APRO MLC CFast™ Card Dimension

### 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 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.

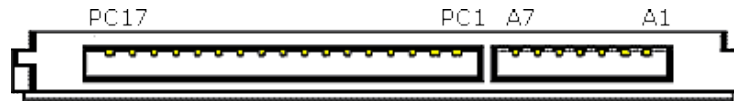
Conformal coating offers protection of circuitry from moisture, fungus, dust and corrosion caused by extreme environments. It also prevents damage from those Flash storages handling during construction, installation and use, and reduces mechanical stress on components and protects from thermal shock. The greatest advantage of conformal coating is to allow greater component density due to increased dielectric strength between conductors.

APRO use MIL-I-46058C silicon conformal coating

## 2. Interface Description

### 3.1. MLC CFast™ Card interface

APRO MLC SATA III CFast™ Card MUSE-D Series 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 SATA III 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
A1	GND	NA
A2	A+	Differential Signal Pair A
A3	A-	
A4	GND	NA
A5	B-	Differential Signal Pair B
A6	B+	
A7	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 SATA III 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**

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