

MLC

Rugged-Metal USB 2.0

Generation 4SB

HERCULES-PD Series

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ISO 9001 : 2015 CERTIFIED



Product Features

■ Flash IC

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

■ Compatibility

- Complete USB specification ver.2.0 and backward compatible ver.1.1
- High Speed and Full Speed transfer support.
- USB Mass Storage Class Specification Rev. 1.0

■ Additional Capabilities

- Support Static Wear Leveling algorithm.
- Supports Windows Series O.S., Mac OS 10.x, and Linux kernel 2.4 operating systems.
- Supports Windows 8, Windows 7 and Windows Vista ReadyBoost function.

■ Mechanical

- USB 2.0 Type-A Connector
- IP-54 & IP-68 Waterproof (Non-operation)
- Dimension: 54.82 mm x 15.95 mm x 15.95 mm
- Weight: 22.0 g / 0.77 oz.

■ Power Operating Voltage 5V(+/-) 10%

- Read Mode: 95.5 mA (max.)
- Write Mode: 99.0 mA (max.)
- Idle Mode: 62.8 mA (max.)

■ Performance (Maximum value) *1.

- Sequential Read: 26.0 MB/sec. (max.)
- Sequential Write: 14.9 MB/sec. (max.)

■ Capacity

- 4GB, 8GB, 16GB and 32GB.

■ Reliability

- **TBW:** Up to 7.7 TBW at 32GB Capacity.
(Client workload by JESD-219A)
- **ECC:** up to 72 bits error correction in 1K Byte data
- **Temperature:** (Operating)
Standard Grade: 0°C ~ +70°C
Wide Temp. Grade: -40°C ~ +85°C
- **Vibration:** 70Hz ~ 2K Hz, 15G / 3 axes.
- **Shock:** 0.5ms, 1500 G, 3 axis.

■ Certifications and Declarations

- **Certifications:** CE & FCC
- **Declarations:** RoHS & REACH


Remarks:

1. Sequential performance is based on CrystalDiskMark 5.1.2 with file size 500MB.

Order Information

I. Part Number List

◆ APRO MLC Rugged-Metal USB Flash Disk Generation-4SB HERCULES-PD Series

Product Picture	Grade	Standard grade (0°C ~ 70°C)	Wide Temp Grade (-40°C ~ +85°C)
	4GB	SRUFD004G-MPDTM-4SB	WRUFD004G-MPDTM-4SBC
	8GB	SRUFD008G-MPDTM-4SB	WRUFD008G-MPDTM-4SBC
	16GB	SRUFD016G-MPDTM-4SB	WRUFD016G-MPDTM-4SBC
	32GB	SRUFD032G-MPDTM-4SB	WRUFD032G-MPDTM-4SBC

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 X18 X19 X20**

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

R : Rugged Metal

X3 X4 X5 : Product category

UFD : USB Flash Disk

X6 X7 X8 X9 : Capacity

004G: 4GB 032G: 32GB

008G: 8GB

016G: 16GB

X11 : Controller

M : HERCULES Series

X12 X13 : Controller version

A, B, C.....

X14 : Flash IC

T : Toshiba NAND Flash IC

X15 : Flash IC grade / Type

M : 15nm MLC -NAND Flash IC

X17 X18 X19 : Housing Generation

4SB : Generation 4 housing , Screw Thread Black

X20 : Reserved for specific requirement

C : Conformal-coating (optional)

Revision History

Revision	Description	Date
1.0	Initial release	2019/08/15

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1. Introduction

APRO MLC Rugged-Metal USB Flash Disk Generation-4SB HERCULES-PD Series, is specified as 2.0 High Speed Device, Mass Storage Class; USB-IF (USB Implementers Forum), WHQL (Window Hardware Quality Labs). In addition to being as a removable storage device, APRO MLC Rugged-Metal USB Flash Disk Generation-4SB HERCULES-PD Series can also be configured as a bootable disk for system recovery. Also, its supports the Windows Series O.S., Mac OS 10.x, and Linux kernel 2.4 operating systems, and supports Windows 8, Windows 7 and Windows Vista ReadyBoost function. They are available in 4GB, 8GB, 16GB and 32GB capacities by Toshiba MLC Flash IC.

In order to sustain various harsh and tough operating environments, APRO design special rugged metal casing, and passed the IP-54 & IP-68 Waterproof environmental testing.

APRO MLC Rugged-Metal USB Flash Disk Generation-4SB HERCULES-PD Series also offers unique customization for OEM customers by laser carvings.

Figure 1 shows a block diagram of APRO MLC Rugged-Metal USB Flash Disk Generation-4SB HERCULES-PD Series

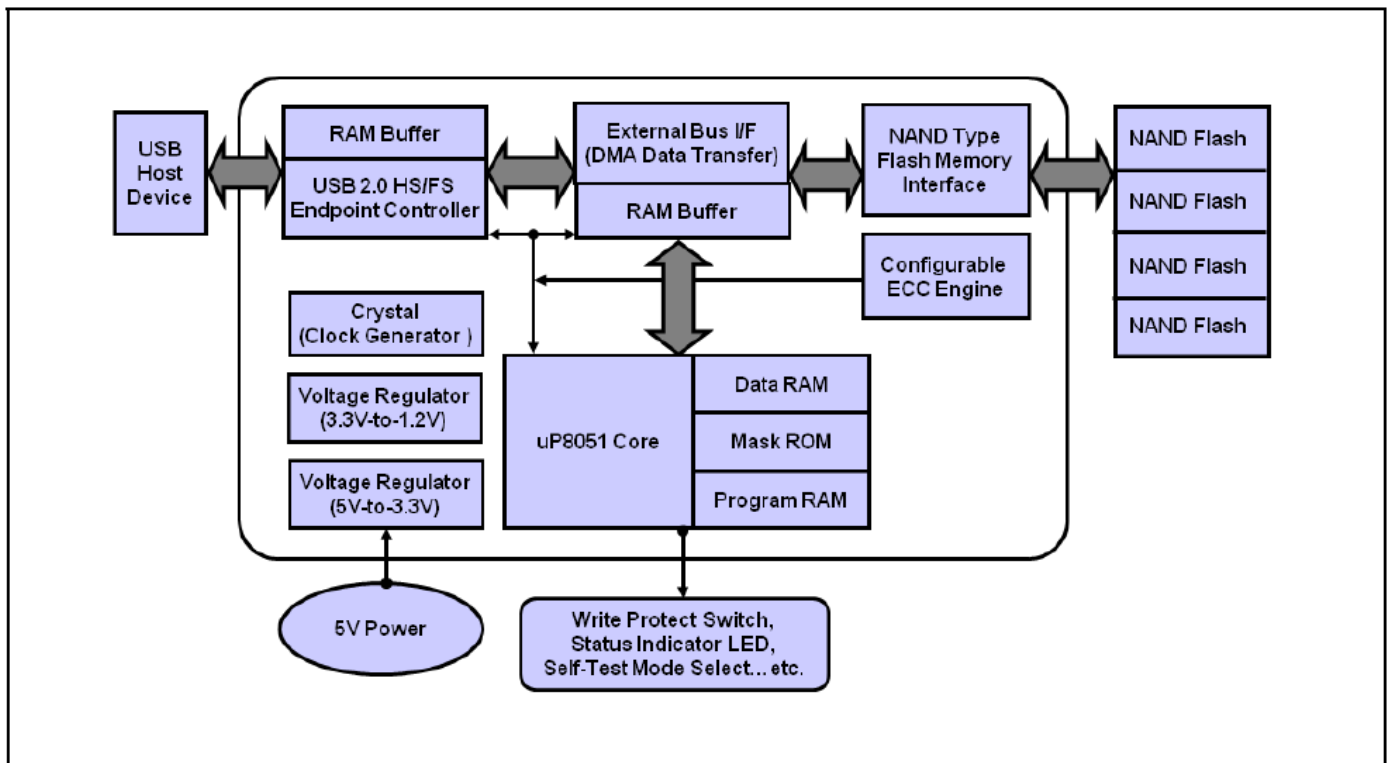


Figure 1: APRO MLC Rugged-Metal USB Flash Disk Generation-4SB HERCULES-PD Series block diagram

1.1. *Scope*

This document describes the key features and specifications of APRO MLC Rugged-Metal USB Flash Disk Generation-4SB HERCULES-PD Series.

1.2. *Flash Management Technology – Static Leveling*

In order to gain the best management for flash memory, APRO MLC Rugged-Metal USB Flash Disk Generation-4SB HERCULES-PD 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 Rugged-Metal USB Flash Disk Generation-4SB HERCULES-PD 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 Rugged-Metal USB Flash Disk Generation-4SB HERCULES-PD Series		Standard Grade SRUFDxxxG-MPDTM-4SB	Wide Temp Grade WRUFDxxxG-MPDTM-4SBC
Temperature	Operating:	0°C ~ +70°C	-40°C ~ +85°C
	Non-operating:	-20°C ~ +80°C	-50°C ~ +95°C
Humidity	Operating & Non-operating:	85 °C / 95% RH Non-Operating	
Vibration	Frequency/Displacement:	20Hz ~ 70 Hz, 1.52mm / 3 axes.	
	Frequency/Acceleration:	70Hz ~ 2K Hz, 15G / 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 Rugged-Metal USB Flash Disk Generation-4SB HERCULES-PD Series		
DC Input Voltage (VCC)		5V±10%
Maximum average value	Reading Mode :	95.5 mA (max.)
	Writing Mode :	99.0 mA (max.)
	Idle Mode :	62.8 mA (max.)

2.3. System Performance

Table 3: System Performances

Data Transfer Mode supporting		USB 2.0				
Maximum Performance	Capacity	4GB	8GB	16GB	32GB	
	Sequential Read (MB/s)	26.5	26.5	26.5	26.0	
	Sequential Write (MB/s)	13.0	13.0	11.5	14.9	

Note: The performance was measured using CrystalDiskMark by file size 500MB (QD32).

2.4. System Reliability

Table 4: System Reliability

Wear-leveling Algorithms		Static Wear Leveling algorithms
Bad Block Management		Supportive
ECC Technology		72 bits per 1K bytes
Erase counts		NAND MLC Flash Cell Level : 3K P/E Cycles
Endurance		TBW (Tera Bytes Written)
Capacity	4GB	1.1
	8GB	1.9
	16GB	3.8
	32GB	7.7

Note:

- Client workload by JESD-219A.
- The endurance of disk 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 Rugged-Metal USB Flash Disk Generation-4SB HERCULES-PD Series physical specifications and dimensions.

Table 5: Physical Specifications

Generation	G4SB
Length:	54.82 mm
Width:	15.95 mm
Thickness:	15.95 mm
Weight:	22.0 g / 0.77 oz.

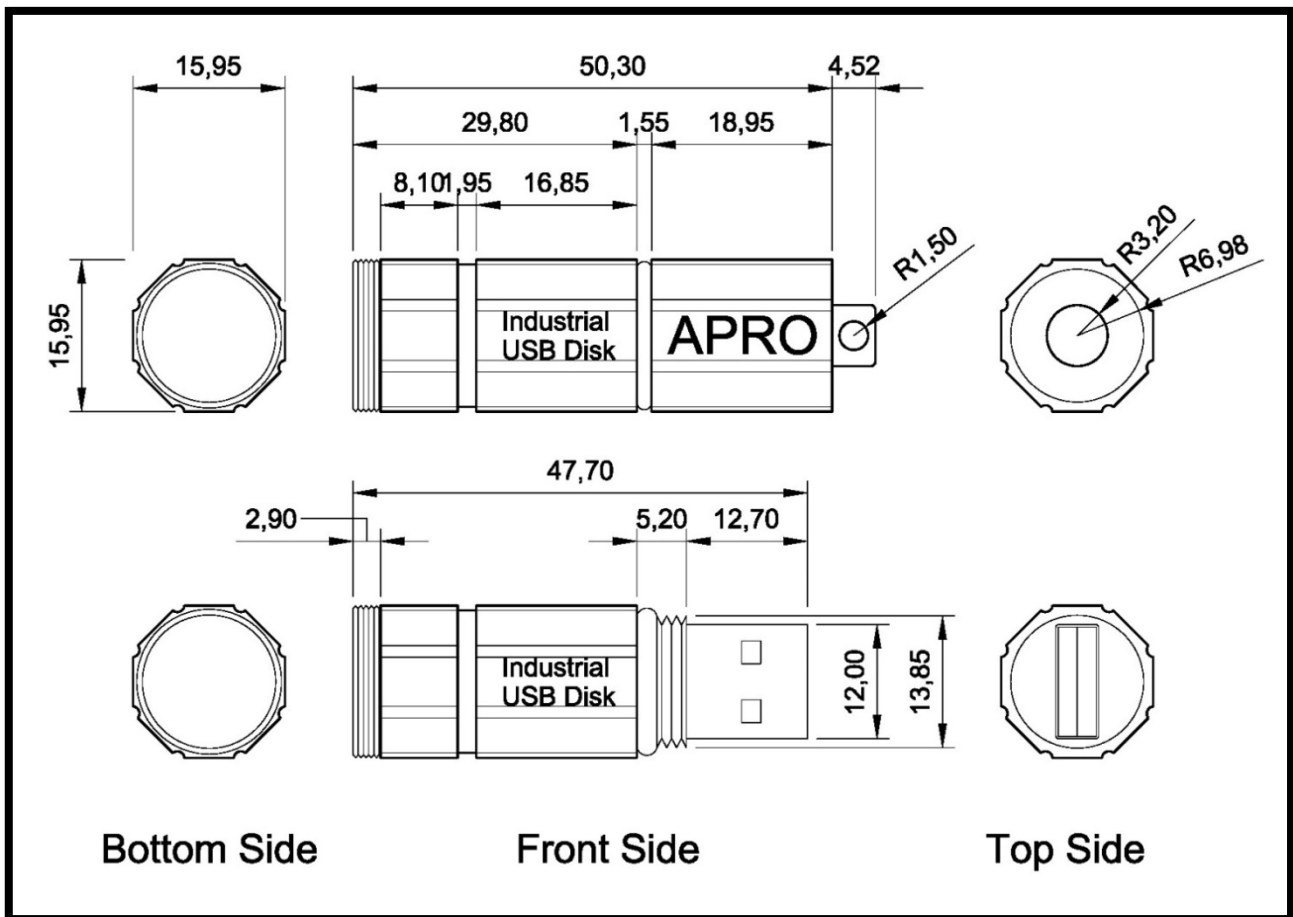


Figure 2: APRO MLC Rugged-Metal USB Flash Disk Generation-4SB HERCULES-PD Series Dimension

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

3. Interface Description

3.1. USB Flash Disk interface

APRO Rugged Metal USB Flash Disk is equipped with standard USB Type A connector.

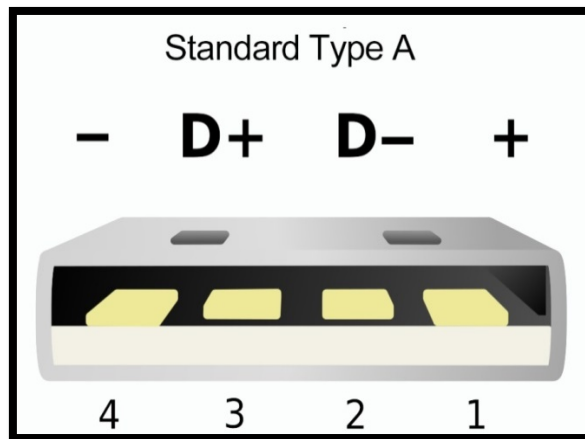


Figure 3: USB Type A Connector

3.2. Pin Assignments

There are total of 4 pins in the USB Type-A Connector. The pin assignments are listed in below table 6.

Table 6 - Pin Assignments

Pin Number	Pin Name	Function
Pin 1	Vcc	Power
Pin 2	USB -	The pairs are used to transmit Address, Data and Command.
Pin 3	USB +	
Pin 4	Vss	Ground

Appendix A: Limited Warranty

APRO warrants your APRO MLC Rugged-Metal USB Flash Disk Generation-4SB HERCULES-PD 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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