Industrial USB 3.1 Gen1

USB Flash Disk P-Series

(MLC Type)

データシート

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Revision History

Revision	Description	Date
V1.0	New release	June 2020

Table of Contents

1. Product Description

1.1. Product Overview

ADTEC Industrial USB Flash Disk (Below, UFD) P-Series, is specified as USB 3.1 Gen1 (Super Speed 5Gbps) Device, Mass Storage Class; USB-IF (USB Implementers Forum), WHQL (Window Hardware Quality Labs).
In addition to being as a removable storage device, USB Flash Disk can also be configured as a bootable disk for system recovery.
Also, its random-access performance exceeds the minimum requirement of Windows / Linux / VxWorks / QNX Embedded operating system, in which randomly access blocks of information are saved into UFD P-Series for boosting up the average performance.
They are available in 8GB, 16GB, 32GB, 64GB, 128GB, 256GB and 512GB capacities by KIOXIA (Toshiba) 15nm MLC Flash IC.
The operating temperature grade is optional for standard grade 0°C ~ 70°C and industrial grade -40°C ~ +85°C. The data transfer performance by sequential read is up to 97.0 MB/sec, and sequential write is up to 60.2 MB/sec; 4k data random read is up to 11.3 MB/sec, and 4k data random write is up to 6.4 MB/sec.

ADTEC UFD P-Series also offers unique customization for OEM customers by laser carvings.

1.2. Product Features

- Compliant with USB 3.1 standard (backward compatible to USB 2.0 and USB 1.1).
- Implements USB 3.1 Gen1 (SuperSpeed 5Gbps).
- Supports Full Speed, High Speed and Super Speed transmission.
- USB mass storage device class (MSC).
- USB Attached SCSI (UASP) support.
- "hyMap® Flash Translation Layer" offering class-leading random write performance, minimal write amplification, and highest endurance for random usage profiles.
- S.M.A.R.T.*1 (Self-Monitoring, Analysis and Reporting Technology) feature set support.
- AES-128 and AES-256 support with CBC and XTS modes, high performance on-the-fly encryption / decryption.
- Configurable Early-Acknowledge to avoid any data loss during power fail.
- Silent, low-power operation. Resistant to shock and vibration.
- Memory Capacities
  MLC: 8GB / 16GB / 32GB / 64GB / 128GB / 256GB / 512GB
- Supports Bad Block Management.
- Fully Compliant with RoHS directive.
- CE and FCC Compatibility.

*1 Support official S.M.A.R.T. Utility.

1.3. Specifications

Interface	USB3.1 Gen1 compatible
NAND Flash Type	MLC
Controller	Hyperstone U9
Connector Type	USB Type-A (Male 9 pin)
Capacity	8GB / 16GB / 32GB / 64GB / 128GB / 256GB / 512GB
Power Consumption (512GB)	Active: < 0.95W / Idle: <0.21W
Operating Temperature	Normal Temperature: 0°C ~ +70°C Wide Temperature: -40°C ~ +85°C
Storage Temperature	Normal Temperature: -20°C ~ +80°C Wide Temperature: -50°C ~ +95°C
Humidity	85°C / 95% RH, non-operating *non-condensing
S.M.A.R.T (Health Monitor)	Yes
Dimension (L x W x H)	62.1 x 17.6 x 8.4mm
Weight	15.0 g

Table 1: UFD P-Series Specifications

1.4. Performance

Capacity	8GB	16GB	32GB	64GB	128GB	256GB	512GB
Sequential Read (MB/s)	**64.7**	**54.8**	**61.7**	**97.4**	**96.2**	**97.0**	**94.0**
Sequential Write (MB/s)	**23.2**	**21.1**	**21.3**	**59.8**	**57.3**	**60.2**	**61.2**
4KB Random Read (MB/s)	**10.5**	**10.3**	**10.0**	**11.3**	**11.2**	**11.3**	**11.2**
4KB Random Write (MB/s)	**5.9**	**5.4**	**5.4**	**6.5**	**6.5**	**6.4**	**6.9**

*Performance may vary based on USB Flash Disk capacity, hardware test platform, test software, operating system and other system variables.

Table 2: UFD P-Series Performance

1.5. TBW (Tera Bytes Written)

Capacity	8GB	16GB	32GB	64GB	128GB	256GB	512GB
TBW(TB)	**1.9**	**3.9**	**7.8**	**15.6**	**31.2**	**62.5**	**125.0**

*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.
*Client workload by JESD-219A

Table 3: UFD P-Series TBW

1.6. System Requirement

The Host system which is connected to USB Flash Disk should meet system requirements at minimum.

1.6.1. Power Requirement

Item	Symbol	Rating	Unit
Input voltage	VIN	5.0DC ± 10% 900mA (max.)	V

Table 4: UFD P-Series Power Requirement

1.6.2. Operating System

- Windows family.
- Linux family.
- VxWorks family.
- QNX family.
- DOS or embedded system.

2. Detailed Specification

2.1. Physical Specifications

2.1.1. Dimension

The Dimensions of ADTEC UFD P-Series are illustrated in Figure 1 and described in Table 5.

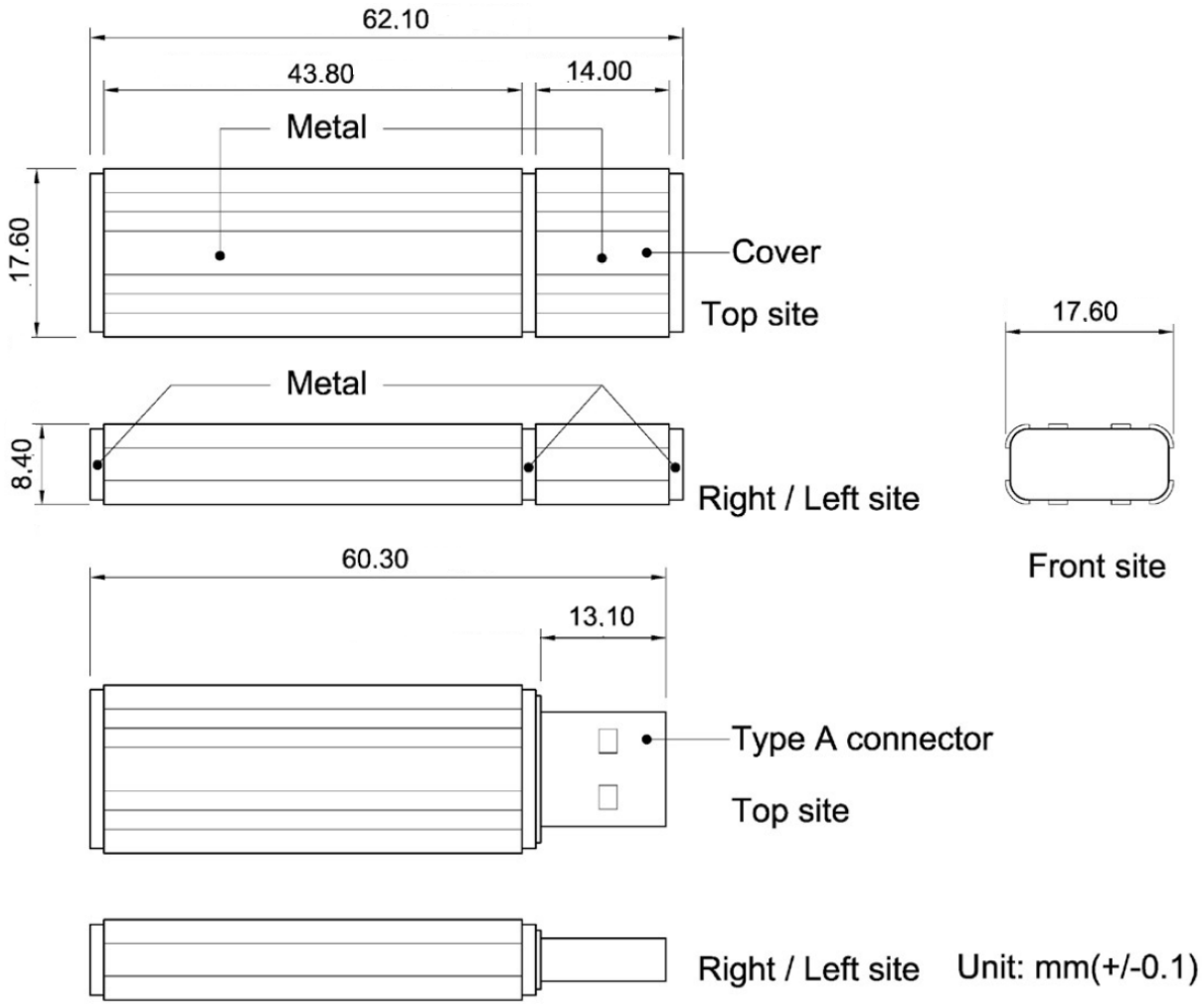

Figure 1: UFD P-Series Dimensions

Parameter	Specifications
Width	17.6mm ± 0.1mm
Length	62.1mm ± 0.1mm
Thickness	8.4mm ± 0.1mm

Table 5: UFD P-Series Physical Dimension

2.2. Electronic Specifications

2.2.1. Product Definition

ADTEC UFD P-Series is designed to operate and work as Data or Code Storage device by NAND Flash Memory and its Controller through Universal Serial Bus Interface to Host Systems.

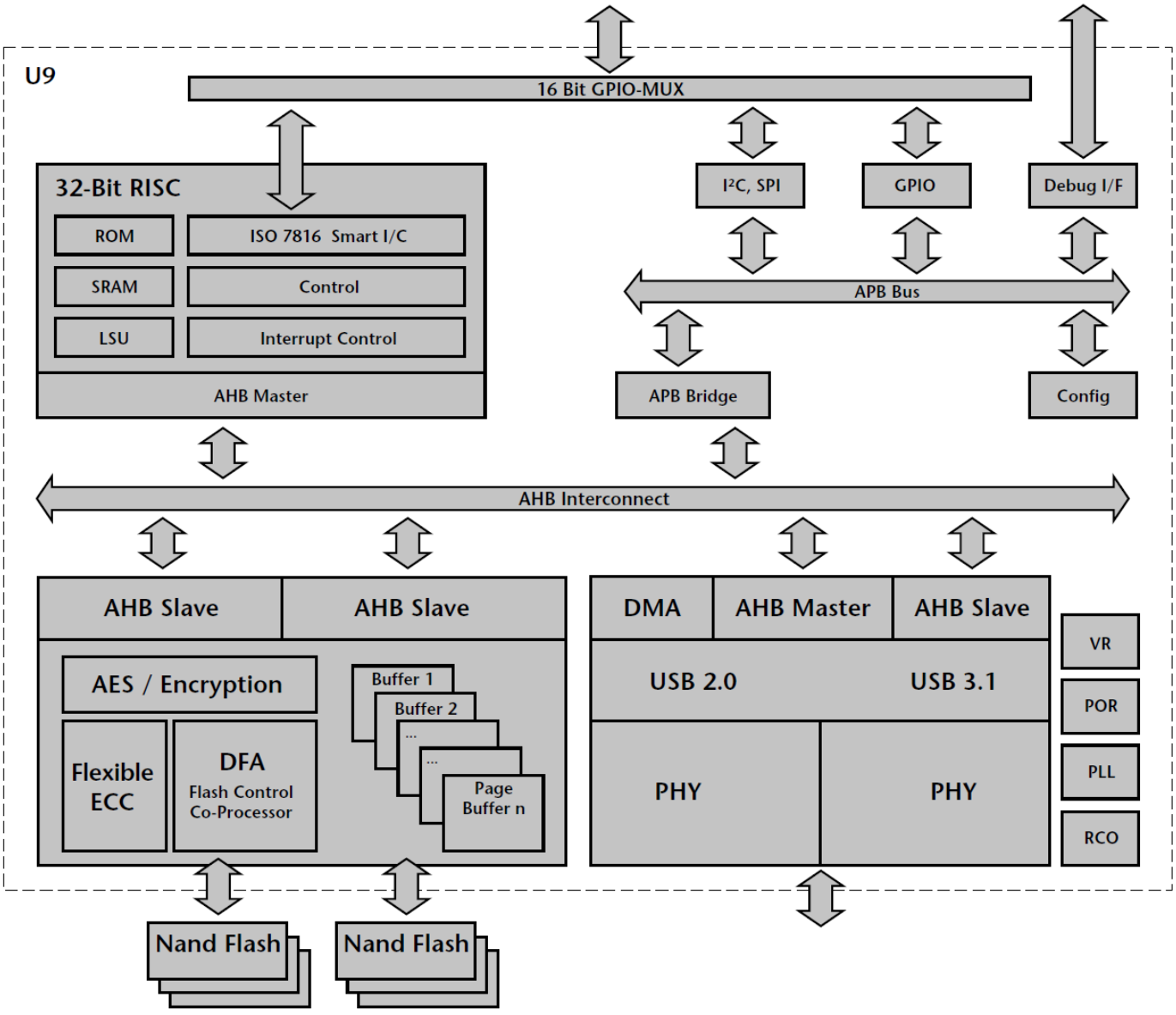

Figure 2: UFD P-Series Block Diagram

2.2.2. Pin Signal Assignment

ADTEC UFD P-Series is equipped with standard 9 pins USB 3.1 Type A male connector. There are total of 9 pins in the signal segment. The pin assignments are listed in below table in Table 6.

PIN#	Function	Description
1	V BUS	Power
2	D-	USB2.0 Differential Pair
3	D+	
4	GND	Ground for power return
5	Std A_SSRX-	Super-speed transmitter differential pair
6	Std A_SSRX+	
7	GND_DRAIN	Ground for signal return
8	Std A_SSTX-	Super-speed receiver differential pair
9	Std A_SSTX+	

Table 6: UFD P-Series connector pin definition

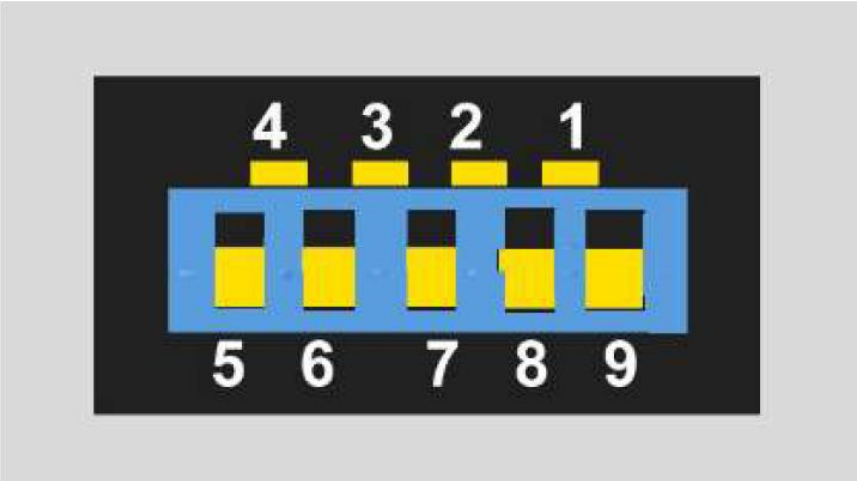

Figure 3: UFD P-Series Connector Pin Assignment

2.3. Shock & Vibration

Reliability	Test Conditions	Reference Standards
Vibration	70Hz to 2KHz, 15G, 3 axes	IEC 60068-2-6
Mechanical Shock	Duration: 0.5ms, 1500G, 3 axes	IEC 60068-2-27

Table 7: Shock/Vibration Testing for UFD P-Series

2.4. Error Detection and Correction

The hardware Error Correction Coding (ECC) engine executes parity generation and error detection/correction features and enhances decoding throughput and data reliability.

With multi-mode correction capability up to 96 bits, the powerful ECC engine is able to support the latest generation NAND.

2.5. Wear-Leveling

Wear Levelling (WL) is used to systematically utilize all Flash blocks of the system equally in terms of consuming their individual write-erase-cycle endurance budget. hyMap® supports dynamic, static, and global Wear levelling. Dynamic WL requires no copy-overhead but alone would be limited to blocks not containing data. Static WL includes also those blocks containing data. Static data is relocated if needed. This WL activity is triggered at predefined threshold levels. Also, these routines are executed in the background and interrupted in case of higher priority host commands.

Global WL refers to the procedure of involving all blocks (user blocks, management blocks, free blocks) of a device and is not limited to flash chips for instance. Generally, the WL algorithm selects a block with the lowest erase count from a pool of unused blocks to be written to (dynamic WL). At some point formerly used blocks enter the pool of unused blocks again as a result of the garbage collection. When a block enters the pool of unused blocks, its erase counter value is compared with the lowest erase counter value of all used blocks (global WL). If the difference exceeds a configurable threshold, the data of a used block with lowest erase count is moved into the block that just became unused and the used block with lowest erase count enters the pool of unused blocks instead (static WL).

The threshold is configurable and defines the granularity and the spread between the block(s) with the “lowest erase counts” and the “highest erase counts”. Within hyMap® this is called Adaptive Wear Levelling.

2.6. Bad Blocks Management

Bad Blocks are blocks that contain one or more invalid bits whose reliability are not guaranteed.

The Bad Blocks may be presented while the USB Flash Disk is shipped or may generate during the lifetime of the USB Flash Disk. When the Bad Blocks is detected, it will be flagged, and not be used anymore. The USB Flash Disk implement Bad Blocks management and replacement, Error Correct Code to avoid data error occurred. The functions will be enabled automatically to transfer data from Bad Blocks to spare blocks, and correct error bit. After the reserved block less than threshold of each channel, the USB Flash Disk will be locked, and cannot be read and written anymore.

2.7. Power Fail Robustness

Generally, ADTEC UFD P-Series proved voltage sensing capability and as soon as a power down is recognized, the controller is reset, and the flash is write-protected. A log of all recent flash transactions is kept. Should the latest data be corrupt, the controller will recover the latest valid entry before that last failed write.

2.8. No external DRAM no capacitor

All mapping information is reliably stored on the flash. No external DRAM is used to store vital mapping information in volatile memory and no external capacitor is needed to make sure that DRAM content is stored in the Flash in case of a power fail situation.

Hence, there is no additional reliability risk and endurance impact related to implementing these additional components.

2.9. Reliable Write

hyMap® is targeted to making MLC Flash as reliable as possible. Since two logical MLC Flash pages are physically correlated, it is possible to destroy data of an older page by writing another new one within the same block (paired pages).

hyMap® applies Reliable Write to cope with this occurrence and in order to make MLC power-fail safe.

2.10. Mean Time between Failures (MTBF)

Failure Rate: The total number of failures within an item population, divided by the total number of life units expended by that population, during a particular measurement interval under stated condition.

Mean Time between Failures (MTBF): A basic measure of reliability for repairable items: The mean number of life units during which all parts of the item perform within their specified limits, during a particular measurement interval under stated conditions.

Product	Condition	MTBF (Hours)
ADTEC UFD P-Series (MLC)	Telcordia SR-332 GB, 25°C	>2,000,000

Table 8: UFD P-Series MTBF

2.11. Endurance

- Flash Endurance: MLC: 3,000 P/E Cycle
- Wear-Leveling Algorithm: Dynamic, Static, and Global Wear-Levelling
- Bad Blocks Management: Support
- Error Correct Code: Up to 96bit / 1KB

2.12. Speed Mode

- ADTEC UFD P-Series support following speed mode:
  - Full Speed: 12Mbps
  - High Speed: 480Mbps
  - Super Speed: 5Gbps