RoHS Recast Compliant

USB Flash Drive

UV110-UFD5 BiCS5 Product Specifications

November 4, 2022

Version 1.1

Specifications Overview:

- **USB 3.2 Gen1 Super Speed compatible, and backward compatible with USB 2.0 & USB 1.1 interfaces**

  – USB 3.2 Gen1 max. transfer rate: 5 Gb/s

  – Backward compatible with 480Mb/s for USB 2.0 & 12 Mb/s for USB 1.1

- **Capacity**

  – 128, 256 GB

- **Performance[1]**

  – Sequential read: Up to 270 MB/sec

  – Sequential write: Up to 185 MB/sec

  – Random read (4K): Up to 2,900 IOPS

  – Random write (4K): Up to 900 IOPS

- **Flash Management**

  – Built-in hardware Low Density Parity-Check (LDPC) ECC

  – Global Wear Leveling

  – Flash bad-block management

  – Flash Translation Layer: Page Mapping

  – Power Failure Management

  – S.M.A.R.T.

  – Hyper Cache Technology

  – SMART Read Refresh™

- **NAND Flash Type:** 3D TLC (BiCS5)

- **MTBF:** >3,000,000 hours

- **Endurance (in drive writes per day: DWPD)**

  – 128 GB: 2.74 DWPD

  – 256 GB: 2.74 DWPD

- **Temperature Range**

  – Operating:

     Standard: 0°C to 70°C

     Wide: -40°C to 85°C

  – Storage: -40°C to 100°C

- **Supply Voltage**

  – 5.0 V ± 5%

- **Power Consumption[1]**

  – Active mode (Max.): 220 mA

  – Idle mode: 85 mA

- **Supports Non-Removable Setting**

- **Supports Toggle 2.0 mode/ONFI 3.0**

- **OS Support**

  – Windows: Win7/8/10 later

  – Mac: 10.2.8/10.8 or later

  – Linux: 2.4.0/2.4.10 or later

- **Dimensions**

  – 56.05 x 18.00 x 8.50, unit: mm

  – Net weight: 7.37g ± 5%

- **LED Indicators for Drive Behavior**

- **RoHS Recast Compliant**

  – Complies with 2011/65/EU Standard

Note:
1. Varies from capacities. The values for performances and power consumptions presented are typical and may vary depending on flash configurations or platform settings. The term idle refers to the standby state of the device.

Table of Contents

1. General Description

Apacer's UV110-UFD5 is a high performance, new generation USB flash drive compatible with the latest USB specification – USB 3.2 Gen1 Super Speed, with a maximum transfer rate of 5 Gb/s designed to replace a conventional IDE hard disk drive. The connector is backward compatible with USB 2.0 and USB 1.1 interfaces. With compliance with USB 3.2 specification, this USB drive can deliver up to 270 MB/s outstanding performance and operate at minimal power consumption.

Utilizing 3D NAND for capacity up to 256GB and providing more power efficiency than 2D NAND, UV110-UFD5 is designed to replace a conventional IDE hard disk drive. The USB can be plugged into a standard Embedded USB connector commonly found in desktops, portable PC systems and industrial PC systems. Regarding reliability, UV110-UFD5 is implemented with LDPC (Low Density Parity Check) ECC engine to extend SSD endurance and increase data reliability. With ESD prevention on mechanism and electronic circuit design, the product prevents mechanical interference and enhances environment and ESD protection.

In terms of flash management, UV110-UFD5 adopts the latest page mapping file translation layer and comes with various implementations including powerful hardware ECC engine, wear leveling, flash block management, S.M.A.R.T., power failure management, Hyper Cache technology and SMART Read Refresh™. This product is well suited for embedded flash storage applications offering new and expanded functionality as well as more cost-effective designs, better performance and increased reliability.

2. Functional Block

With embedded firmware, Apacer's UV110-UFD5 contains a controller and flash media with a female connector. It interfaces with the host system allowing data to be written to and read from the flash media.
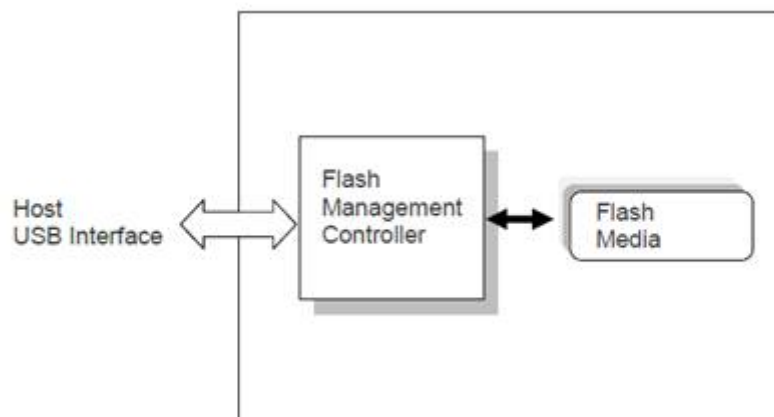

Figure 2-1 Functional Block Diagram

3. Product Specifications

3.1 Capacity

Capacity specifications of UV110-UFD5 are available as shown in Table 3-1.

Table 3-1 Capacity Specifications

Capacity	Total bytes	Total LBA
128 GB	123,924,905,984	242,040,832
256 GB	247,895,949,312	484,171,776

Notes:
- Display of total bytes varies from operating systems.
- 1 GB = 1,000,000,000 bytes; 1 sector = 512 bytes.
- LBA count addressed in the table above indicates total user storage capacity and will remain the same throughout the lifespan of the device. However, the total usable capacity of the SSD is most likely to be less than the total physical capacity because a small portion of the capacity is reserved for device maintenance usages.

3.2 Performance

Performance of UV110-UFD5 is listed below in Table 3-2.

Table 3-2 Performance Specifications

Capacity \ Performance	128 GB	256 GB
Sequential Read (MB/s)	270	270
Sequential Write (MB/s)	180	185
Random Read IOPS (4K)	2,800	2,900
Random Write IOPS (4K)	900	900

Notes:
- Results may differ from various flash configurations or host system setting, and the above test results are based on the default file structure with FAT 32 file system.
- Sequential read/write is based on CrystalDiskMark 8.0.4 with file size 1,000MB.
- Random read/write is measured using IOMeter with Queue Depth 32.

3.3 Environmental Specifications

Environmental specifications of UV110-UFD5 product are shown in Table 3-3.

Table 3-3 Environmental Specifications

Item	Specifications
Operating temp.	0°C to 70°C (Standard); -40°C to 85°C (Wide)
Non-operating temp.	-40°C to 100°C
Operating vibration	7.69 GRMS, 20~2000 Hz/random (compliant with MIL-STD-810G)
Non-operating vibration	4.02 GRMS, 15~2000 Hz/sine (compliant with MIL-STD-810G)
Operating shock	50G, 11ms/half sine (compliant with MIL-STD-202G)
Non-operating shock	1500G, 0.5ms/half sine (compliant with MIL-STD-883K)
ESD prevention	Air discharge ±15KV; contact discharge ±8KV (IEC 61000-4-2 / EN 55035)

Note: This Environmental Specification table indicates the conditions for testing the device. Real world usages may affect the results.

3.4 Mean Time Between Failures (MTBF)

Mean Time Between Failures (MTBF) is predicted based on reliability data for the individual components in Apacer's USB flash drive. Serving as statistical reference, the prediction result for Apacer's UV110-UFD5 is more than 3,000,000 hours.

Note: The MTBF is predicated and calculated based on "Telcordia Technologies Special Report, SR-332, Issue 3" method.

3.5 Certification and Compliance

UV110-UFD5 complies with the following standards:

- CE
- FCC
- RoHS Recast Compliant
- MIL-STD-810

3.6 Endurance

The endurance of a storage device is predicted by Drive Writes Per Day based on several factors related to usage, such as the amount of data written into the drive, block management conditions, and daily workload for the drive. Thus, key factors, such as Write Amplifications and the number of P/E cycles, can influence the lifespan of the drive.

Table 3-4 Endurance Specifications

Capacity	Drive Writes Per Day
128 GB	2.74
256 GB	2.74

Notes:
- This estimation values are based on sequential write behavior.
  (Apacer EDTestTool, test mode – sequential data pattern -100.00% of disk space with 128K)
- Flash vendor guaranteed 3D NAND TLC P/E cycle: 3K
- WAF may vary from capacity, flash configurations and writing behavior on each platform.
- 1 Terabyte = 1,024GB
- DWPD (Drive Write s Per Day) is calculated based on the number of times that user overwrites the entire capacity of an SSD per day of its lifetime during the warranty period. (3D NAND TLC warranty: 3 years)

3.7 LED Indicator Behavior

The behavior of the UV110-UFD5 LED indicators is described in Table 3-5.

Table 3-5 LED Behavior

Location	LED Color	Description
As indicated by the red marker below	Blue	LED blinks when the drive is being accessed such as power on, read or write. The blink frequency is 50ms switch H to L and loop.

4. Flash Management

4.1 Performance-optimized USB Controller

The heart of UV110-UFD5 is the USB controller, which translates standard USB signals into the data and controls of the flash media. This proprietary USB controller is specifically designed to attain high data throughput from host to flash.

4.2 Power Saving Implemented

The internal controller of the USB model is designed with power saving implementations, allowing the device to operate at low power consumption.

4.3 Program RAM Architect

The internal Program RAM implementation allows the host to upgrade firmware codes anytime when needed.

4.4 Error Correction/Detection (ECC)

UV110-UFD5 implements a hardware ECC scheme, based on the Low Density Parity Check (LDPC). LDPC is a class of linear block error correcting code which has apparent coding gain over BCH code because LDPC code includes both hard decoding and soft decoding algorithms. With the error rate decreasing, LDPC can extend SSD endurance and increase data reliability while reading raw data inside a flash chip.

4.5 Global Wear Leveling

Flash memory can be erased a limited number of times, This number is called the erase cycle limit, or write endurance limit, The erase cycle limit applies to each individual erase block in the flash device.

In a typical application, and especially if a file system is used, specific pages are constantly updated (e.g., the page that contains the FAT, registry, etc.). Without any special handling, these pages would wear out more rapidly than other pages, reducing the lifetime of the entire flash.

To overcome this inherent deficiency, Apacer's UV110-UFD5 uses Global Wear Leveling algorithm. This algorithm ensures that consecutive writes of a specific sector are not written physically to the same page in the flash. This spreads flash media usage evenly across all pages, thereby maximizing flash lifetime.

The Global Wear Leveling mechanism provides write/erase cycles for reliable data storage over an extended period.

4.6 S.M.A.R.T.

S.M.A.R.T. is an abbreviation for Self-Monitoring, Analysis and Reporting Technology, a self-monitoring system that provides indicators of drive health as well as potential disk problems. It serves as a warning for users from unscheduled downtime by monitoring and displaying critical drive information. Ideally, this should allow taking proactive actions to prevent drive failure and make use of S.M.A.R.T. information for future product development reference.

Table 4-1 SMART Attribute ID List

ID (Hex)	Attribute Name
162 (0xA2)	Spare Block Count
163 (0xA3)	Maximum Erase Count
164 (0xA4)	Average Erase Count
166 (0xA6)	Total Later Bad Block Count
167 (0xA7)	Protect Mode

4.7 Power Failure Management

Power Failure Management plays a crucial role when power supply becomes unstable. Power disruption may occur when users are storing data into the SSD, leading to instability in the drive. However, with Power Failure Management, a firmware protection mechanism will be activated to scan pages and blocks once power is resumed. Valid data will be transferred to new blocks for merging and the mapping table will be rebuilt. Therefore, data reliability can be reinforced, preventing damage to data stored in the NAND Flash.

4.8 Bad Block Management

Current production technology is unable to guarantee total reliability of NAND flash memory array. When a flash memory device leaves factory, it comes with a minimal number of initial bad blocks during production or out-of-factory as there is no currently known technology that produce flash chips free of bad blocks. In addition, bad blocks may develop during program/erase cycles. Since bad blocks are inevitable, the solution is to keep them in control. Apacer flash devices are programmed with ECC, page mapping technique and S.M.A.R.T to reduce invalidity or error. Once bad blocks are detected, data in those blocks will be transferred to free blocks and error will be corrected by designated algorithms.

4.9 Flash Translation Layer – Page Mapping

Page mapping is an advanced flash management technology whose essence lies in the ability to gather data, distribute the data into flash pages automatically, and then schedule the data to be evenly written. Page-level mapping uses one page as the unit of mapping. The most important characteristic is that each logical page can be mapped to any physical page on the flash memory device. This mapping algorithm allows different sizes of data to be written to a block as if the data is written to a data pool and it does not need to take extra operations to process a write command. Thus, page mapping is adopted to increase random access speed and improve SSD lifespan, reduce block erase frequency, and achieve optimized performance and lifespan.

4.10 Hyper Cache Technology

Apacer proprietary Hyper Cache technology uses a portion of the available capacity as SLC (1bit-per-cell) NAND flash memory, called Hyper cache mode. When data is written to SSD, the firmware will direct the data to Hyper Cache mode, providing excellent performance to handle various scenarios in industrial use.

4.11 SMART Read Refresh^{TM}

Apacer's SMART Read Refresh plays a proactive role in avoiding read disturb errors from occurring to ensure health status of all blocks of NAND flash. Developed for read-intensive applications in particular, SMART Read Refresh is employed to make sure that during read operations, when the read operation threshold is reached, the data is refreshed by re-writing it to a different block for subsequent use.

5. Electrical Specifications

5.1 Absolute Stress Rating

Table 5-1 lists the absolute stress rating for UV110-UFD5.

Caution: **Absolute Maximum Stress Ratings –** Applied conditions greater than those listed under "Absolute Maximum Stress Ratings" may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these conditions or conditions greater than those defined in the operational sections of this data sheet is not implied. Exposure to absolute maximum stress rating conditions may affect device reliability.

Table 5-1 Absolute Stress Rating

Item	Range
Required power supply	5V ± 5% (4.75-5.25V)

5.2 Absolute Maximum Rating

Table 5-2 lists the absolute maximum power ratings for UV110-UFD5.

Table 5-2 Absolute Maximum Power Ratings

Parameter	Min	Typ	Max	Unit
Operating Temperature (Commercial)	0	+25	+70	°C
Storage Temperature (Commercial)	-25	+25	+85	°C
Operating Temperature (Industrial)	-40	+25	+85	°C
Storage Temperature (Industrial)	-50	+25	+125	°C
1.1V Regulator Power Supply	1.04	1.12	1.20	V
1.8V Regulator Power Supply	1.76	1.86	2.0	V
3.3V Regulator Power Supply	3.15	3.3	3.45	V
5.0V Regulator Power Supply	3.0	5.0	5.5	V
2.5V Regulator Power Supply	2.35	2.5	2.7	V
1.2V Regulator Power Supply	1.13	1.2	1.3	V

5.3 Power Consumption

Table 5-3 lists the power consumption for UV110-UFD5.

Table 5-3 Power Consumption (Unit: mA)

Capacity / Mode	128 GB	256 GB
Active (Max.)	220	220
Idle	85	85

Notes:
- All values are typical and may vary depending on flash configurations or host system settings.
- Power consumption is measured using CrystalDiskMark 8.0.4.

6. Mechanical Specifications

6.1 Dimensions

Table 6-1 Physical Dimensions

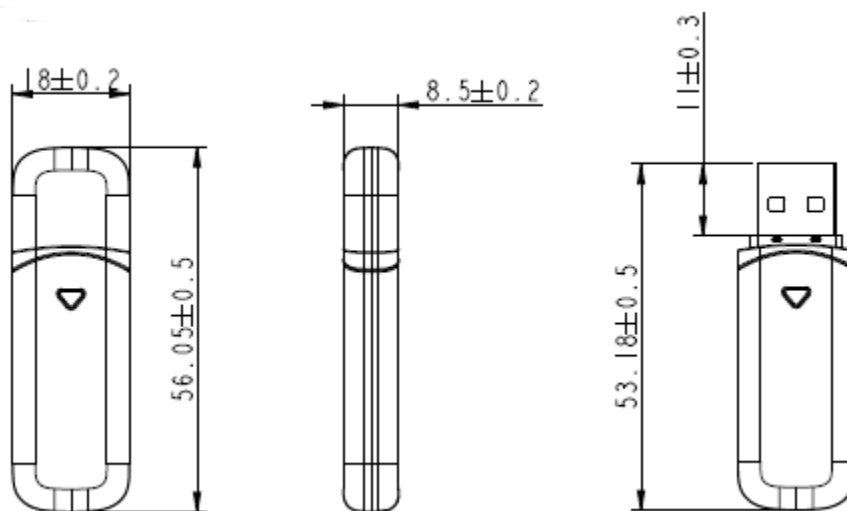| Length	Width	Height
56.05 mm	18.00 mm	8.50 mm

Figure 6-1 Physical Dimensions

6.2 Net Weight

Table 6-2 Net Weight

Capacity	Net Weight (g ± 5%)
128GB	7.37
256GB	7.37

7. Product Ordering Information

7.1 Product Code Designations

Apacer's UV110-UFD5 is available in different configurations and densities. See the chart below for a comprehensive list of options for the UV110-UFD5 series devices.

Code	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
	A	N	2	.	1	1	2	X	X	S	.	X	X	X	2	2

Code 1-3 **(Product Line & Form Factor)**	USB+UFD5
Code 5-6 **(Model/Solution)**	UV110-UFD5
Code 7-8 **(Product Capacity)**	2H: 128GB (TLC) 2J: 256GB (TLC)
Code 9 **(Flash Type & Product Temp)**	G: 3D TLC Standard temperature H: 3D TLC Wide temperature
Code 10 **(Product Spec)**	UV110-UFD5 transparent black plastic housing
Code 12-14 **(Version Number)**	Random numbers generated by system
Code 15-16 **(Firmware Version)**	UFPA3ADA

7.2 Valid Combinations

The following table lists the available models of the UV110-UFD5 series which are in mass production or will be in mass production. Consult your Apacer sales representative to confirm availability of valid combinations and to determine availability of new combinations.

Capacity	Standard Temperature	Wide Temperature
128GB	AN2.112HGS.00422	AN2.112HHS.00322
256GB	AN2.112JGS.00422	AN2.112JHS.00322

Revision History

Revision	Description	Date
1.0	Initial release	9/12/2022
1.1	Added Table 4-1 to 4.6 S.M.A.R.T.	11/4/2022

Global Presence

Taiwan (Headquarters)
Apacer Technology Inc.
1F., No.32, Zhongcheng Rd., Tucheng Dist.,
New Taipei City 236, Taiwan R.O.C.
Tel: 886-2-2267-8000
Fax: 886-2-2267-2261
amtsales@apacer.com

U.S.A.
Apacer Memory America, Inc.
46732 Lakeview Blvd., Fremont, CA 94538
Tel: 1-408-518-8699
Fax: 1-510-249-9551
sa@apacerus.com

Japan
Apacer Technology Corp.
6F, Daiyontamachi Bldg., 2-17-12, Shibaura, Minato-Ku,
Tokyo, 108-0023, Japan
Tel: 81-3-5419-2668
Fax: 81-3-5419-0018
jpservices@apacer.com

Europe
Apacer Technology B.V.
Science Park Eindhoven 5051 5692 EB Son,
The Netherlands
Tel: 31-40-267-0000
Fax: 31-40-290-0686
sales@apacer.nl

China
Apacer Electronic (Shanghai) Co., Ltd
Room D, 22/FL, No.2, Lane 600, JieyunPlaza,
Tianshan RD, Shanghai, 200051, China
Tel: 86-21-6228-9939
Fax: 86-21-6228-9936
sales@apacer.com.cn

India
Apacer Technologies Pvt Ltd,
1874, South End C Cross, 9th Block Jayanagar,
Bangalore-560069, India
Tel: 91-80-4152-9061/62
Fax: 91-80-4170-0215
sales_india@apacer.com