

RoHS Recast Compliant

USB Flash Drive

Industrial UV110-UFD1 BiCS5 Product Specifications



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Version 1.4



Apacer Technology Inc.

1F, No.32, Zhongcheng Rd., Tucheng Dist., New Taipei City, Taiwan, R.O.C

Tel: +886-2-2267-8000 Fax: +886-2-2267-2261

www.apacer.com

Specifications Overview:

- **USB 3.2 Gen 1 Super Speed compatible, and backward compatible with USB 2.0 & USB 1.1 interfaces**
 - USB 3.2 Gen 1 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, 512 GB
- **Performance¹**
 - Sequential read: Up to 275 MB/sec
 - Sequential write: Up to 190 MB/sec
 - Random read (4K): Up to 3,000 IOPS
 - Random write (4K): Up to 1,000 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
 - 512 GB: 2.74 DWPD
- **Temperature Range**
 - Operating:
 - Standard: 0°C to 70°C
 - Wide: -40°C to 85°C
 - Storage: -55°C to 100°C
- **Supply Voltage**
 - 5V ± 5%
- **Power Consumption¹**
 - Active mode (Max.): 230 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
- **Physical Characteristics**
 - Dimensions: 46.85 x 17.20 x 7.70, unit: mm
 - Net weight: 8.5g ± 5%
- **LED Indicator 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.

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1. General Description

Apacer's UV110-UFD1 is a next-generation, high-performance USB flash drive designed to meet the latest USB 3.2 Gen 1 SuperSpeed specifications, providing transfer rates up to 5 Gb/s, making it an ideal replacement for conventional IDE hard drives. The connector is also backward compatible with USB 2.0 and USB 1.1 interfaces, ensuring broad usability. Compliant with USB 3.2, UV110-UFD1 achieves impressive performance of up to 275 MB/s while maintaining low power consumption.

Utilizing 3D NAND technology for capacities up to 256GB, UV110-UFD1 offers improved power efficiency than 2D NAND. It is designed to interface with standard Embedded USB connectors commonly found in desktops, portable PCs, and industrial systems. For enhanced reliability, the drive incorporates an LDPC (Low Density Parity Check) ECC engine, extending its endurance and enhancing data integrity. UV110-UFD1 also features a compact size and robust metal housing, which protects against mechanical interference and provides enhanced environmental and ESD protection.

In terms of flash management, UV110-UFD1 incorporates the latest page mapping file translation layer and includes a suite of advanced technologies such as a robust hardware ECC engine, wear leveling, flash block management, S.M.A.R.T., power failure management, Hyper Cache technology, and SMART Read Refresh. This makes it an excellent choice for embedded flash storage applications, providing enhanced functionality, cost-effectiveness, superior performance, and increased reliability.

2. Functional Block

With embedded firmware, Apacer's UV110-UFD1 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.

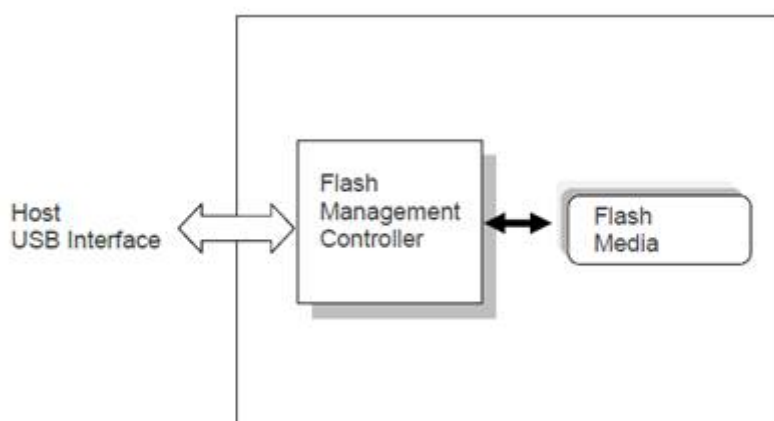


Figure 2-1 Functional Block Diagram

3. Product Specifications

3.1 Capacity

Capacity specifications of UV110-UFD1 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
512 GB	495,263,711,232	967,311,936

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-UFD1 is listed below in Table 3-2.

Table 3-2 Performance Specifications

Capacity	128 GB	256 GB	512 GB
Performance			
Sequential Read (MB/s)	270	275	275
Sequential Write (MB/s)	145	190	190
4K Random Read (IOPS)	3,000	3,000	3,000
4K Random Write (IOPS)	800	1,000	1,000

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-UFD1 product are shown in Table 3-3.

Table 3-3 Environmental Specifications

Parameter	Type	Specifications
Temperature	Operating	0°C to 70°C (Standard); -40°C to 85°C (Wide)
	Non-operating	-55°C to 100°C
Vibration	Operating	7.69 GRMS, 20~2000 Hz/random (compliant with MIL-STD-810G)
	Non-operating	4.02 GRMS, 15~2000 Hz/random (compliant with MIL-STD-810G)
Shock	Operating	Acceleration, 50(G)/11(ms)/half sine (compliant with MIL-STD-202G)
	Non-operating	Acceleration, 1500(G)/0.5(ms)/half sine (compliant with MIL-STD-883K)

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-UFD1 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-UFD1 complies with the following standards:

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

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
512 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 cycles: 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-UFD1 LED indicator 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-UFD1 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-UFD1 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-UFD1 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™

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-UFD1.

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-UFD1.

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-UFD1.

Table 5-3 Power Consumption

Mode \ Capacity	Unit	128 GB	256 GB	512 GB
Active (Max.)	mA	200	215	230
Idle		85	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 with file size 1,000MB.

6. Mechanical Specifications

Table 6-1 Physical Information

Parameter	Unit	128 GB	256 GB	512 GB
Length	mm	46.85 ± 0.50		
Width		17.20 ± 0.20		
Height		7.70 ± 0.20		
Weight	$\text{g} \pm 5\%$	8.5	8.5	8.5

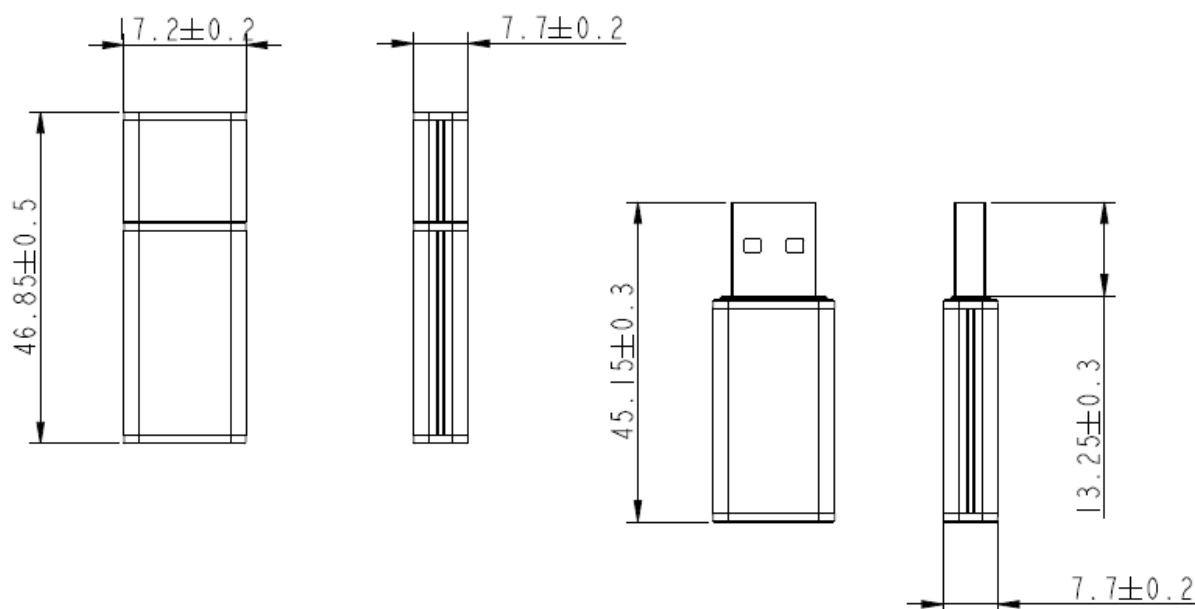


Figure 6-1 Physical Dimensions

7. Product Ordering Information

7.1 Product Code Designations

Apacer's UV110-UFD1 is available in different configurations and densities. See the chart below for a comprehensive list of options for the UV110-UFD1 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	G	.	X	X	X	3	1

Code 1-3 (Product Line & Form Factor)	USB+UFD1
Code 5-6 (Model/Solution)	UV110-UFD1
Code 7-8 (Product Capacity)	2H: 128GB (TLC) 2J: 256GB (TLC) 2K: 512GB (TLC)
Code 9 (Flash Type & Product Temp)	G: 3D TLC Standard Temperature H: 3D TLC Wide Temperature
Code 10 (Product Spec)	UV110-UFD1 silver-gray housing
Code 12-14 (Version Number)	Random numbers generated by system
Code 15-16 (Firmware Version)	UFPA3AHA

7.2 Valid Combinations

The following table lists the available models of the UV110-UFD1 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	AN2.112HGG.00331	AN2.112HHG.00231
256GB	AN2.112JGG.00431	AN2.112JHG.00231
512GB	AN2.112KGG.00131	AN2.112KHG.00131

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
1.2	- Modified non-operating vibration specification at Table 3-3 by changing sine to random - Added UKCA to 3.5 Certification and Compliance	12/26/2022
1.3	Added 512GB support	8/24/2023
1.4	- Updated Performance and Power Consumption on Specifications Overview page and Table 3-2 and 5-3 - Updated 7. Product Ordering Information due to firmware update (codes 15-16)	6/13/2024

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