

RoHS Recast Compliant

USB Flash Drive

UH110-UFD4 BiCS3 Product Specifications



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Version 1.5



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Specifications Overview:

- **USB 3.1 Gen1 Super Speed compatible, and backward compatible with USB 2.0 & USB 1.1 interfaces**
 - USB 3.1 Gen1 max. transfer rate: 5 Gb/s
 - Backward compatible with 480Mb/s for USB 2.0 & 12 Mb/s for USB 1.1
- **Capacity**
 - 4, 8 GB
- **Performance¹**
 - Sequential read: Up to 265 MB/sec
 - Sequential write: Up to 50 MB/sec
 - Random read (4K): Up to 3,300 IOPS
 - Random write (4K): Up to 1,100 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.
 - SMART Read Refresh™
 - SLC-liteX
- **NAND Flash Type:** 3D TLC (BiCS3)
- **MTBF:** >3,000,000 hours
- **Endurance (in drive writes per day: DWPD)**
 - 4 GB: 21.69 DWPD
 - 8 GB: 21.9 DWPD
- **Temperature Range**
 - Operating:
 - Standard: 0°C to 70°C
 - Wide: -40°C to 85°C
 - Storage: -55°C to 100°C
- **Supply Voltage**
 - 5.0 V ± 5%
- **Power Consumption¹**
 - Active mode (Max.): 185 mA
 - Idle mode: 75 mA
- **Supports Non-Removable Setting**
- **Supports Toggle 2.0 mode/ONFI 3.0**
- **OS Support**
 - Windows: Win7/8/10 later
 - Linux: 2.4.0/2.4.10 or later
- **Dimensions**
 - 51.15 x 17.20 x 7.70, unit: mm
- **LED Indicators for Drive Behavior**
- **Write Protect Switch**
- **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 UH110-UFD4 is a new generation USB flash drive compatible with the latest USB specification – USB 3.1 Gen1 Super Speed, with a maximum transfer rate of 5 Gb/s. The connector is backward compatible with USB 2.0 and USB 1.1 interfaces. With compliance with USB 3.1 specification, this USB drive can deliver up to 265 MB/s outstanding performance and operate at minimal power consumption.

Utilizing 3D NAND for higher capacity up to 8GB and providing more power efficiency than 2D NAND, UH110-UFD4 is designed to replace a conventional IDE hard disk drive. The USB is not only implemented with LDPC (Low Density Parity Check) ECC engine to extend SSD endurance and increase data reliability, but also equipped with Apacer's SLC-liteX technology to perform with higher number of P/E cycles up to 30,000 times. In addition, it is designed with a physical switch to activate write protection. In terms of flash management, the USB 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 and SMART Read Refresh™.

With exquisite size and robust metal housing, UH110-UFD4 prevents mechanical interference and enhances environment and ESD protection, and is well suited for portable flash storage applications.

2. Functional Block

With embedded firmware, Apacer's UH110-UFD4 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.

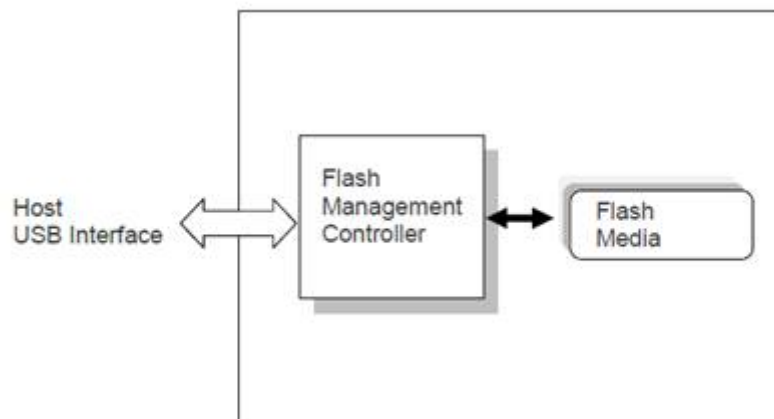


Figure 2-1 Functional Block Diagram

3. Product Specifications

3.1 Capacity

Capacity specifications of UH110-UFD4 are available as shown in Table 3-1.

Table 3-1 Capacity Specifications

Capacity	Total bytes	Total LBA
4 GB	3,885,465,600	7,588,800
8 GB	7,745,863,680	15,128,640

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 UH110-UFD4 is listed below in Table 3-2.

Table 3-2 Performance Specifications

Capacity	4 GB	8 GB
Performance		
Sequential Read (MB/s)	265	265
Sequential Write (MB/s)	50	50
Random Read IOPS (4K)	3,300	3,300
Random Write IOPS (4K)	1,000	1,100

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 5.2.1 with file size 1,000MB.
- Random read/write is measured using IOMeter with Queue Depth 32.

3.3 Environmental Specifications

Environmental specifications of UH110-UFD4 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.	-55°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)

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 UH110-UFD4 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

UH110-UFD4 complies with the following standards:

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

3.6 Endurance

The endurance of a storage device is predicted by TeraBytes Written 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	TeraBytes Written
4 GB	21.69
8 GB	21.9

Notes:

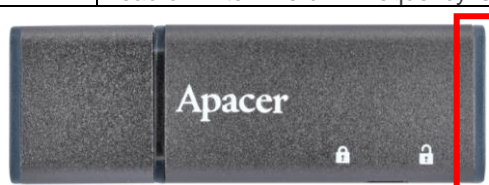
- This estimation values are based on sequential write behavior. (Apacer EDTestTool, test mode –sequential data pattern -100.00% of disk space with 128K)
- Flash vendor guaranteed SLC-liteX P/E cycle: 30K
- WAF may vary from capacity, flash configurations and writing behavior on each platform.
- 1 Terabyte = 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. (SLC liteX warranty: 5 years)

3.7 LED Indicator Behavior

The behavior of the UH110-UFD4 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 UH110-UFD4 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)

UH110-UFD4 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 UH110-UFD4 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 SLC-liteX

SLC-liteX is based on 3D NAND technology. The firmware is carefully tweaked by our engineering team so as to offer the greatest number of P/E cycles in this format – 30,000, which is 10 times more than MLC or industrial 3D TLC. The longest lifespans are therefore available at reasonable cost.

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 UH110-UFD4.

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 UH110-UFD4.

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 UH110-UFD4.

Table 5-3 Power Consumption (Unit: mA)

Mode	Capacity	4 GB	8 GB
	Active (Max.)		185
Idle		75	75

Notes:

- All values are typical and may vary depending on flash configurations or host system settings.
- Power consumption is measured using CrystalDiskMark 5.2.1.

6. Mechanical Specifications

6.1 Dimensions

Table 6-1 Dimensions

Length	Width	Height
51.15mm	17.2mm	7.7mm

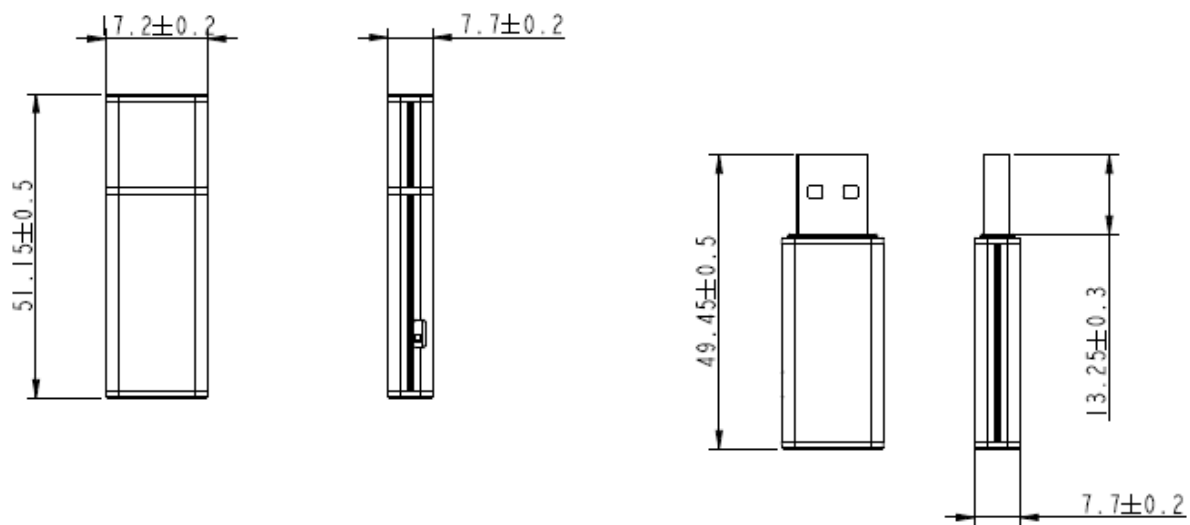


Figure 6-1 Physical Dimensions

6.2 Write Protect Switch

Apacer implements the Virtual Write scheme that allows write commands to go through the flash controller and data temporarily stored, but no data has been actually written into the flash. Once the system is reset and rebooted, the temporarily stored data will be lost and nowhere to be found in the system. Since the Virtual Write scheme runs at device level, it requires no software or driver installation and is independent from the host OS.

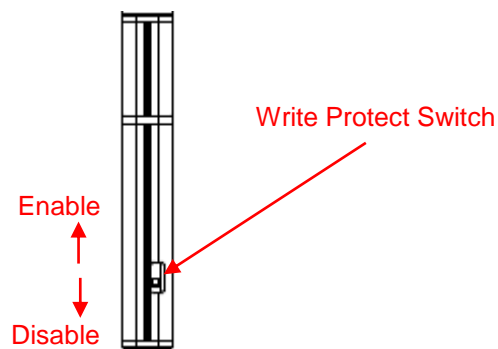


Figure 6-2 Write Protect Switch

7. Product Ordering Information

7.1 Product Code Designations

Apacer's UH110-UFD4 USB is available in different configurations and densities. See the chart below for a comprehensive list of options for the UH110-UFD4 series devices.

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

Code 1-3 (Product Line & Form Factor)	USB+UFD4
Code 5-6 (Model/Solution)	UH110-UFD4
Code 7-8 (Product Capacity)	8E: 4GB 8F: 8GB
Code 9 (Flash Type & Product Temp)	L: 3D SLC-liteX Standard temperature M: 3D SLC-liteX Wide temperature
Code 10 (Product Spec)	UH110-UFD4 silver-gray housing (with Write Protect)
Code 12-14 (Version Number)	Random numbers generated by system
Code 15-16 (Firmware Version)	UFPA4BAA

7.2 Valid Combinations

The following table lists the available models of the UH110-UFD4 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
4GB	AN2.118ELR.00116	N/A
8GB	AN2.118FLR.00116	AN2.118FMR.00116

Revision History

Revision	Description	Date
1.0	Initial release	7/21/2020
1.1	Modified the wrong model name at 4.5 Global Wear Leveling	8/27/2020
1.2	Updated 7.1 Product Code Designations by changing the description of code 5-6 to UH110-UFD4	3/19/2021
1.3	Removed Hyper Cache Technology support	9/29/2021
1.4	Updated Endurance on Specifications Overview page and Table 3-4	12/30/2021
1.5	Added Table 4-1 to 4.6 S.M.A.R.T.	11/4/2022

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