

RoHS Recast Compliant

USB Flash Drive

Industrial AH322-M WORM Drive Product Specifications



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Version 1.3



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Specifications Overview:

- **Capacity**
 - 8, 16, 32 GB
- **Performance¹**
 - Sequential read: Up to 38 MB/sec
 - Sequential write: Up to 19 MB/sec
- **Flash Management**
 - Built-in advanced ECC algorithm
 - Global Wear Leveling
 - Flash bad-block management
 - Power Failure Management
 - S.M.A.R.T.
 - SMART Read Refresh™
- **NAND Flash Type:** MLC
- **MTBF:** >3,000,000 hours
- **Product Compatibility**
 - Compatible with USB 2.0 and 1.1 specifications
 - High speed: up to 480Mbps/sec for USB 2.0
 - Full speed: up to 12Mbps/sec for USB 1.1
 - OS support
 - Windows 7/10/11
 - Linux Fedora v23 / Ubuntu v16.04
 - Android v7.1 (PC)
 - File system support: FAT32 only
- **Temperature Range**
 - Operating: -40°C to 85°C
 - Storage: -50°C to 95°C
- **Supply Voltage**
 - 5V ± 10%
- **Power Consumption¹**
 - Active mode (Max.): 200 mA
 - Idle mode: 60 mA
- **Inherent Characteristics**
 - When writing files, it must adhere to the “one by one” principle. This means that a file must be completely written before starting another one.
 - The "Data Clusters" of the file must be written sequentially.
- **Dimensions**
 - 55.29 x 18.00 x 8.50, unit: mm
- **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.

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1. General Description

Apacer industrial AH322-M WORM (Write Once Read Many) Drive is a solid-state Flash memory product that provides data storage protection by allowing data to be written once, preventing it from being erased, modified, or overwritten. This write protection function ensures that the data cannot be tampered with once it is written to the device.

Apacer AH322-M WORM Drive is compatible with USB 2.0 standard and designed to plug in directly to USB-A receptacles. With flash management including bad block management, built-in ECC, wear leveling, S.M.A.R.T., power failure management, and SMART Read Refresh, Apacer AH322-M WORM Drive serves as an ideal portable storage solution for rugged and embedded applications ranging from industrial, computing to enterprise markets.

2. Functional Block

With embedded firmware, Apacer AH322-M WORM Drive 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.

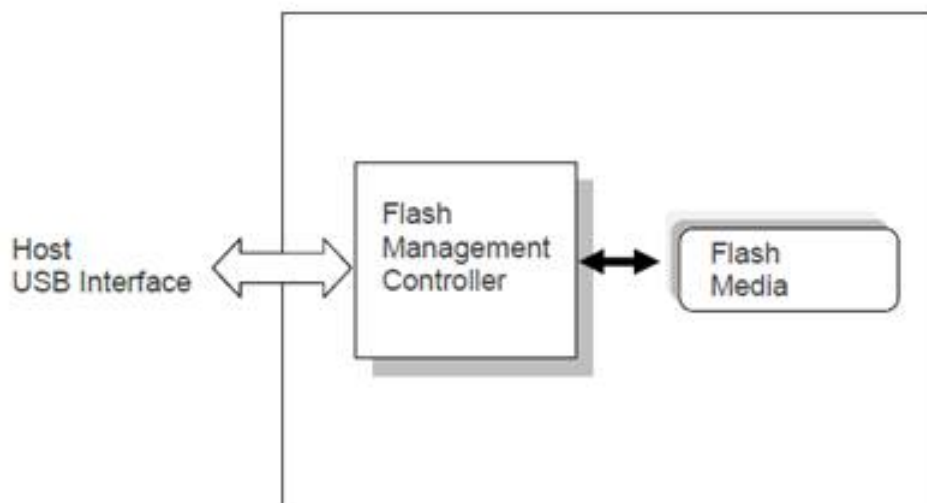


Figure 2-1 Functional Block Diagram

3. Pin Assignments

Table 3-1 Pin Assignments

Pin No.	Pin Name	Function
1	VCC	USB power input
2	USB D-	USB differential signal
3	USB D+	The pair are used to transmit Data/Address/Command
4	VSS	Ground

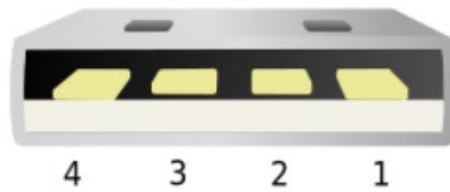


Figure 3-1 Pin Assignments

4. Product Specifications

4.1 Capacity

Capacity specifications of AH322-M WORM Drive is shown in Table 4-1.

Table 4-1 Capacity Specifications

Capacity	Total bytes	Total LBA
8 GB	7,742,685,184	15,122,432
16 GB	15,476,981,760	30,228,480
32 GB	30,953,963,520	60,456,960

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.

4.2 Performance

Performance of AH322-M WORM Drive is listed below in Table 4-2.

Table 4-2 Performance Specifications

Performance	Capacity	8 GB	16 GB	32 GB
	Sequential Read (MB/s)		38	38
Sequential Write (MB/s)		14	15	19

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 H2testw 1.4 with file size 1,000MB.

4.3 Environmental Specifications

Environmental specifications of AH322-M WORM Drive product are shown in Table 4-3.

Table 4-3 Environmental Specifications

Parameter	Type	Specifications
Temperature	Operating	-40°C to 85°C
	Non-operating	-50°C to 95°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.

4.4 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 AH322-M WORM Drive 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.

4.5 Certification and Compliance

AH322-M WORM Drive complies with the following standards:

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

4.6 LED Indicator Behavior

The behavior of the AH322-M WORM Drive LED indicator is described in Table 4-4.

Table 4-4 LED Behavior

Location	LED Color	Description
As indicated by the red marker below	Yellow green	LED blinks when the drive is being accessed such as power on, read or write. The blink frequency is 65.536ms switch H to L and loop.



5. Flash Management

5.1 Bad Block Management

Bad blocks are blocks that include one or more invalid bits, and their reliability is not guaranteed. Blocks that are identified and marked as bad by the manufacturer are referred to as “Initial Bad Blocks”. Bad blocks that are developed during the lifespan of the flash are named “Later Bad Blocks”. Apacer implements an efficient bad block management algorithm to detect the factory-produced bad blocks and manages any bad blocks that appear with use. This practice further prevents data being stored into bad blocks and improves the data reliability.

5.2 Powerful ECC Algorithms

Flash memory cells will deteriorate with use, which might generate random bit errors in the stored data. Thus, the WORM drive applies the BCH ECC Algorithm, which can detect and correct errors occur during read process, ensure data been read correctly, as well as protect data from corruption. The device can detect and correct up to 43 bits error in 1K bytes.

5.3 Global Wear Leveling

NAND Flash devices can only undergo a limited number of program/erase cycles, and in most cases, the flash media are not used evenly. If some area get updated more frequently than others, the lifetime of the device would be reduced significantly. Thus, Global Wear Leveling technique is applied to extend the lifespan of NAND Flash by evenly distributing writes and erase cycles across the media.

Apacer provides Global Wear Leveling algorithm, which can efficiently spread out the flash usage through the whole flash media area. Moreover, by implementing Global Wear Leveling algorithm, the life expectancy of the NAND Flash is greatly improved.

5.4 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 5-1 SMART Attribute ID List

ID (Hex)	Attribute Name
12 (0x0C)	Power Cycle Count
162 (0xA2)	Spare Block Count
163 (0xA3)	Maximum Erase Count
164 (0xA4)	Average Erase Count
165 (0xA5)	Initial Bad Block Count
166 (0xA6)	Later Bad Block Count
192 (0xC0)	Abnormal Shutdown Count

5.5 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.

5.6 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.

6. Electrical Specifications

6.1 Absolute Stress Rating

Table 6-1 lists the absolute stress rating for AH322-M WORM Drive.

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 6-1 Absolute Stress Rating

Parameter	Rating
V _{CC} with respect to GND	-0.5V to +5.5V
Operating Temperature	-40°C to 85°C

6.2 DC Characteristics

Table 6-2 lists the DC characteristics for AH322-M WORM Drive.

Table 6-2 DC characteristics

Symbol	Parameter	Min	Typ	Max	Unit
V _{DD}	Supply Voltage	4.5	5	5.5	V
V _{IH}	Input Voltage High	2			V
V _{IL}	Input Voltage Low			0.8	V
V _{OH}	Output Voltage High	85%*V _{DD}			V
V _{OL}	Output Voltage Low			0.4	V

6.3 Power Consumption

Table 6-3 lists the power consumption for AH322-M WORM Drive.

Table 6-3 Power Consumption

Mode	Capacity		8 GB	16 GB	32 GB
	Unit				
Active (Max.)	mA		195	195	200
Idle			60	60	60

Notes:

- All values are typical and may vary depending on flash configurations or host system settings.
- Power consumption is measured using H2testw 1.4 with file size 1,000MB.

7. Mechanical Specifications

Table 7-1 Physical Information

Parameter	Unit	8 GB	16 GB	32 GB
Length	mm	55.29 ± 0.30		
Width		18.00 ± 0.20		
Height		8.50 ± 0.20		

Mechanical Illustration				

Actual Photo	
Front	Back

8. Product Ordering Information

The following table lists the available models of the AH322-M WORM Drive 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	Valid Combination
8GB	APHA008GELAEG-2DM
16GB	APHA016GELAEG-2DM
32GB	APHA032GELAEG-2DM

Revision History

Revision	Description	Date
1.0	Initial release	11/7/2023
1.1	Revised Product Limitations on Specifications Overview page by breaking it down into OS Support and Inherent Characteristics	12/27/2023
1.2	Changes to Specifications Overview include the following: - Removed "Write performance is 50% lower compared to a standard USB" from Inherent Characteristics - Consolidated compatible specifications and support items to a new section Product Compatibility	1/5/2024
1.3	- Added 4.6 LED Indicator Behavior - Added product photos to 7. Mechanical Specifications	4/12/2024

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