Apacer

RoHS Compliant

USB-Disk Module 3.0 1U

Product Specifications

December 22, 2022

Version 1.4

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Specifications Overview:

- **USB3.0 High-Speed interface and backward compatible with USB2.0 and 1.1**
- **Capacity**
  - SLC: 128, 256, 512 MB
    1, 2, 4, 8, 16 GB
  - MLC: 8, 16, 32 GB
- **Performance**[1]

  SLC
  - Sequential read: Up to 40 MB/sec
  - Sequential write: Up to 35 MB/sec

  MLC
  - Sequential read: Up to 90 MB/sec
  - Sequential write: Up to 48 MB/sec
- **Flash Management**
  - Built-in hardware ECC
  - Global Wear Leveling
  - Power Failure Management
- **NAND Flash Type:** SLC/MLC
- **MTBF**
  - SLC: >2,000,000 hours
  - MLC: >1,000,000 hours
- **Temperature Range**
  - Operating:
    Standard: 0°C to 70°C
    Wide: -40°C to 85°C
  - Storage: -40°C to 85°C
- **Supply Voltage**
  - 5.0 V ± 5%
- **Power Consumption**[1]

  SLC
  - Active mode (Max.): 150 mA
  - Idle mode: 70 mA

  MLC
  - Active mode (Max.): 190 mA
  - Idle mode: 75 mA
- **Connector Type**
  - 20-pin (2x10) female header
- **RoHS Compliant**

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 USB-Disk Module (UDM) is a high performance, embedded solid state drive (SSD) designed to replace a conventional IDE hard disk drive. UDM SSD can be plugged into a standard Embedded USB connector commonly found in desktops, portable PC systems and industrial PC systems. 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

The USB-Disk Module (UDM) contains a controller, embedded firmware, and Flash Media with a female connector. The UDM interfaces with the host system allowing data to be written to and read from the Flash Media.

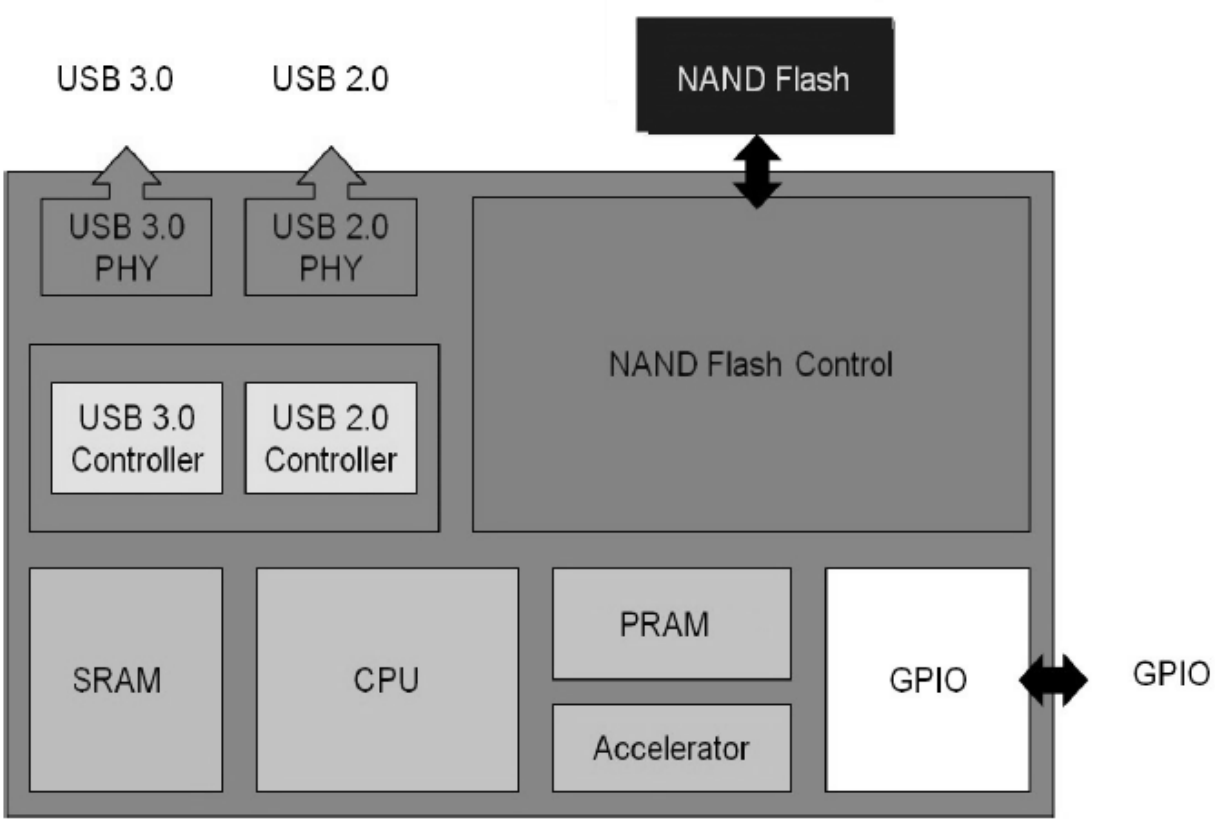

Figure 2-1 Functional Block Diagram

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3. Pin Assignments

This chapter provides the information on the pin assignments and signal descriptions.

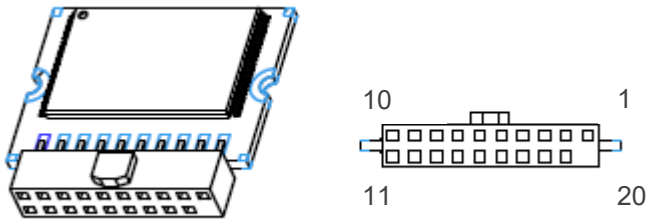

Figure 3-1 Pin Assignments

Table 3-1 Pin Assignment of the 20-pin configuration

Pin	Signal	Pin	Signal
1	+5V	11	N.C
2	TX-	12	N.C
3	TX+	13	N.C
4	GND	14	N.C
5	RX-	15	N.C
6	RX+	16	N.C
7	GND	17	N.C
8	D-	18	N.C
9	D+	19	N.C
10	N.C	20	-

Note: Pin#11~Pin#19 are not used.

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4. Product Specifications

4.1 Capacity

The USB-Disk Module product family is available as shown in Table 4-1.

Table 4-1 Capacity Specifications

Density	Total Bytes
128 MB	124,485,632
256 MB	250,314,752
512 MB	500,924,416
1 GB	998,998,016
2 GB	2,001,502,208
4 GB	4,001,382,400
8 GB	8,002,748,416
16 GB	16,022,257,664
32 GB	32,010,944,512

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 the USB-Disk Module is listed below in Table 4-2 and 4-3.

4.2.1 SLC

Table 4-2 Performance Specifications

Capacity / Performance	128 MB	256 MB	512 MB	1 GB	2 GB	4 GB	8 GB	16 GB
Sequential Read (MB/s)	30	30	30	30	30	40	40	40
Sequential Write (MB/s)	5	10	20	20	25	30	35	35

Notes:
- Results may differ from various flash configurations or host system setting.
- Sequential read/write is based on CrystalDiskMark 5.2.1 with file size 1,000MB.

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4.2.2 MLC

Table 4-3 Performance Specifications

Performance \ Capacity	8 GB	16 GB	32 GB
Sequential Read (MB/s)	95	95	90
Sequential Write (MB/s)	28	24	48

Notes:
- Results may differ from various flash configurations or host system setting.
- Sequential read/write is based on CrystalDiskMark 5.2.1 with file size 1,000MB.

4.3 Environmental Specifications

Environmental specifications of the USB-Disk Module are shown in Table 4-4.

Table 4-4 Environmental Specifications

Item	Specifications
Temperature	Operating: 0°C to 70°C (Standard); -40°C to 85°C (Wide)
	Non-operating: -40°C to 100°C
Shock	Operating: 50(G)/11(ms)/half sine (compliant with MIL-STD-202G)
	Non-operating: 1,500(G)/0.5(ms)/half sine (compliant with MIL-STD-883K)
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)
EMC	CE, FCC

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 the USB-Disk Module. Following is the prediction result for the USB-Disk Module depending on flash type:

- SLC: More than 2,000,000 hours
- MLC: More than 1,000,000 hours

Note: The MTBF is predicated and calculated based on “Telcordia Technologies Special Report, SR-332, Issue 2” method.

4.5 Certification and Compliance

The USB-Disk Module complies with the following standards:

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

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5. Flash Management

5.1 Performance-optimized Controller

The heart of an UDM 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.

5.2 Error Correction Code (ECC)

The UDM uses BCH Error Detection Code (EDC) and Error Correction Code (ECC) algorithms which correct up to 72bit random single-bit errors for each 1024-byte block of data depending on spare area of flash memory. High performance is achieved through hardware-based error detection and correction.

5.3 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 USB-Disk Module 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.

5.4 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.

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6. Electrical Specifications

6.1 Operating Voltage

Table 6-1 lists the supply voltage for the USB-Disk Module.

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 Operating Range

Range	Ambient Temperature	Voltage
Standard	0°C to 70°C	4.5-5.5V
Wide Temperature	-40°C to 85°C	

6.2 Absolute Maximum Rating

Table 6-2 lists the absolute maximum power ratings for the USB-Disk Module.

Table 6-2 Absolute maximum power pin stress ratings

Parameter	Symbol	Min	Max	Unit
Power Supply Input	VDD- VSS	-0.3	5.5	V
Voltage on any pin except VDD with respect to GND	VIN	–ss – 0.3	VDD +0.3	V

6.3 Power Consumption

Tables 6-3 and 6-4 list the power consumption for the USB-Disk Module.

6.3.1 SLC

Table 6-3 Power Consumption (Unit: mA)

Capacity / Mode	128 MB	256 MB	512 MB	1 GB	2GB	4 GB	8 GB	16 GB
Active (Max.)	125	140	140	140	145	145	145	150
Idle	65	70	70	70	70	70	70	70

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.

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6.3.2 MLC

Table 6-4 Power Consumption (Unit: mA)

Capacity / Mode	8 GB	16 GB	32 GB
Active (Max.)	165	170	190
Idle	75	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.

6.4 AC Characteristics

Table 6-5 AC Characteristics Full Speed

Parameter	Symbol	Min	Typ	Max	Unit
Rise Time	T_{FR}	4	—	20	ns
Fall Time	T_{FF}	4	—	20	ns
Differential Rise and Fall Time Matching	T_{FRFM}	90		111.11	%
Driver Output Resistance	Z_{DRV}	28	—	44	Ω

Table 6-6 AC Characteristics High Speed

Parameter	Symbol	Min	Typ	Max	Unit
Rise Time (10%~90%)	T_{HSR}	500	—	—	ps
Fall Time (10%~90%)	T_{HSF}	500	—	—	ps
Driver Output Resistance	Z_{HSDRV}	40.5	—	49.5	Ω

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7. Mechanical Specifications

Table 7-1 Dimensions

Parameter	Unit	128 MB	256 MB	512 MB	1GB	2GB	4GB	8GB	16GB	32GB
Length	mm	24.00 ± 0.15								
Width		22.40 ± 0.2								
Height		5.00								

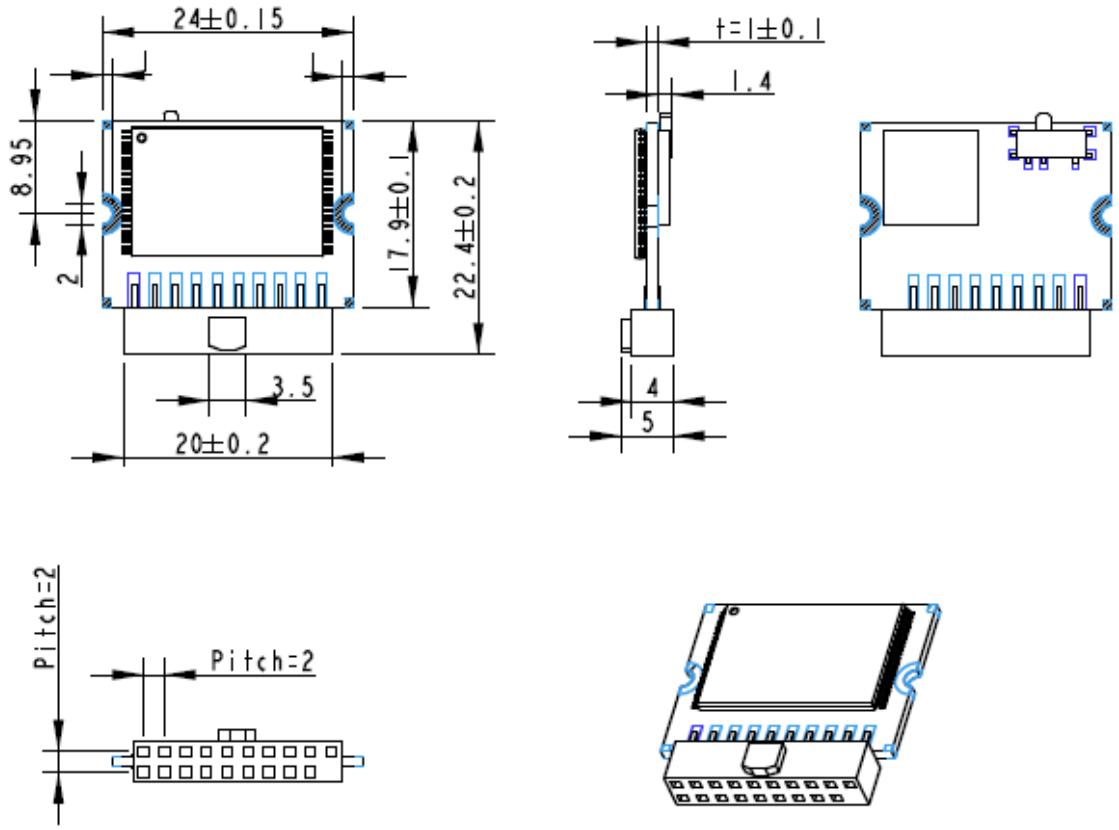

Figure 7-1 Physical Dimensions

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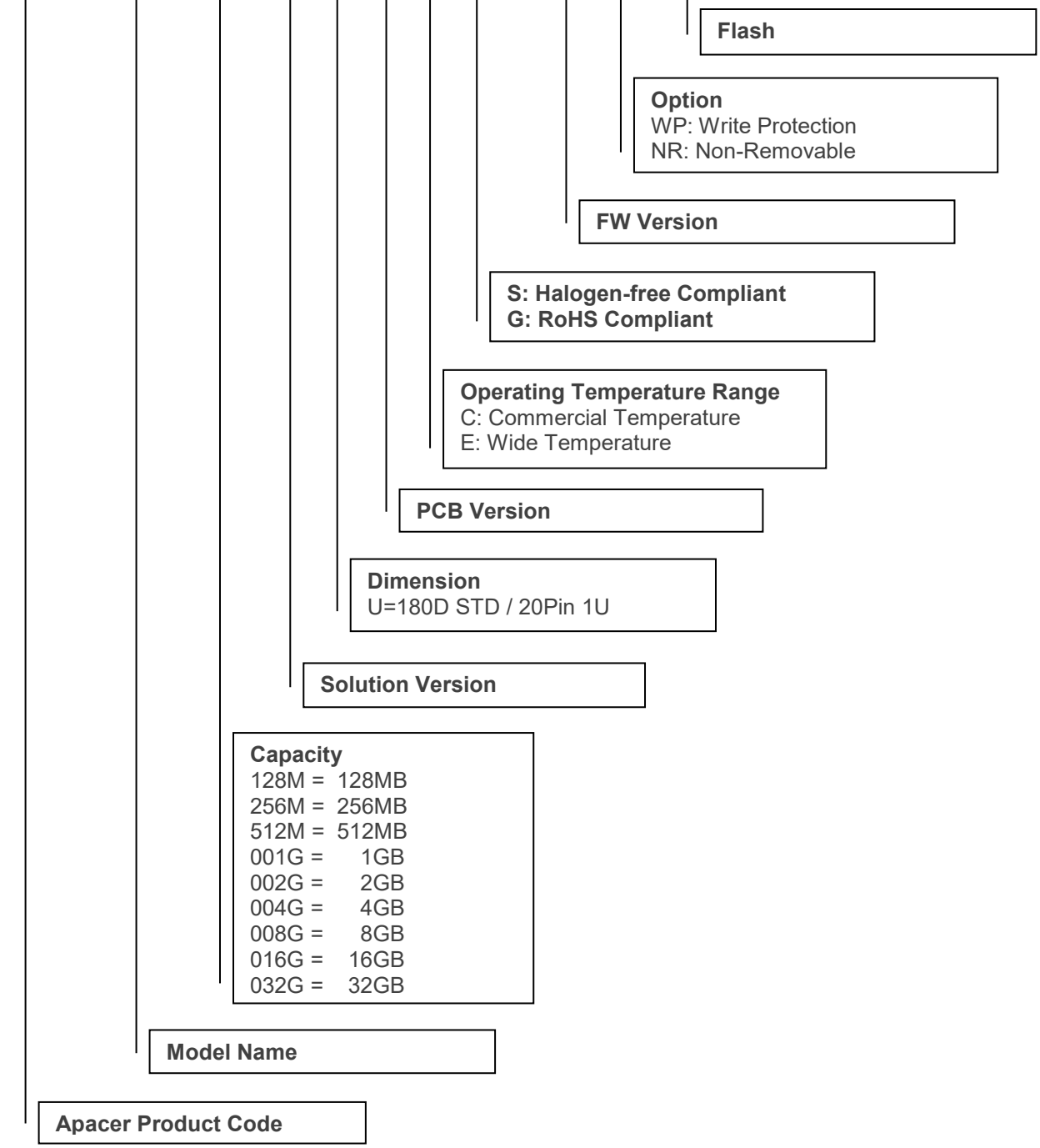
8. Product Ordering Information

8.1 Product Code Designations

AP – UM xxxX A U 0 X X – 4 XX TX



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8.2 Valid Combinations

The following tables list the available models of the USB-Disk Module 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.

8.2.1 180D STD / 20Pin 1U SLC

Capacity	Standard Temperature	Wide Temperature
128MB	AP-UM128MAU0CS-4T	AP-UM128MAU0ES-4T
256MB	AP-UM256MAU0CS-4T	AP-UM256MAU0ES-4T
512MB	AP-UM512MAU0CS-4T	AP-UM512MAU0ES-4T
1GB	AP-UM001GAU0CS-4T	AP-UM001GAU0ES-4T
2GB	AP-UM002GAU0CS-4T	AP-UM002GAU0ES-4T
4GB	AP-UM004GAU0CS-4T	AP-UM004GAU0ES-4T
8GB	AP-UM008GAU0CS-4T	AP-UM008GAU0ES-4T
16GB	AP-UM016GAU0CS-4T	AP-UM016GAU0ES-4T

8.2.2 180D STD / 20Pin 1U MLC

Capacity	Standard Temperature	Wide Temperature
8GB	AP-UM008GAU0CS-4TM	AP-UM008GAU0ES-4TM
16GB	AP-UM016GAU0CS-4TM	AP-UM016GAU0ES-4TM
32GB	AP-UM032GAU0CS-4TM	AP-UM032GAU0ES-4TM

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Revision History

Revision	Description	Date
1.0	Initial release	4/3/2018
1.1	- Renamed extended temperature to wide temperature - Updated Table 4-3 by changing non-operating temperature to -40°C to 85°C	7/9/2020
1.2	Updated Table 4-3 Environmental Specifications	8/6/2020
1.3	- Added Power Failure Management to Flash Management on Specifications Overview page - Added 1.1.3 Power Failure Management	11/6/2020
1.4	Updated Table 4-4 by changing compliance standard for non-operating shock specification and adding EMC compliance standards	12/22/2022

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