

RoHS Recast Compliant **USB-Disk Module 2A** Product Specifications



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Version 1.5



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Specifications Overview:

- **USB2.0 High-Speed and USB1.1 Full-Speed Compatible Interface**
- **Capacity**
 - 256, 512 MB
 - 1, 2, 4, 8, 16, 32 GB
- **Performance***
 - Sequential read: Up to 44 MB/sec
 - Sequential write: Up to 41 MB/sec
 - Random read (4K): Up to 2,400 IOPS
 - Random write (4K): Up to 105 IOPS
- **Flash Management**
 - Flash bad-block management
 - Global Wear Leveling
 - BCH (72 bit) Error Detection Code/Error Correction Code (EDC/ECC)
 - S.M.A.R.T.
 - Power Failure Management
- **Supports Non-Removable Setting**
- **NAND Flash Type: SLC**
- **MTBF: >2,000,000 hours**
- **Endurance (in Terabytes Written: TBW)**
 - 256 MB: 13 TBW
 - 512 MB: 26 TBW
 - 1 GB: 54 TBW
 - 2 GB: 108 TBW
 - 4 GB: 219 TBW
 - 8 GB: 438 TBW
 - 16 GB: 884 TBW
 - 32 GB: 1,752 TBW
- **Temperature Range**
 - Operating:
 - Standard: 0°C to 70°C
 - Wide: -40°C to 85°C
 - Storage: -40°C to 100°C
- **Supports Boot-up Function for OS**
 - Windows: WinXP/7 or later
 - Mac: 10.2.8 or later
 - Linux: 2.4.10 or later
- **Power Consumption***
 - Operating voltage: 5V (with a certain percentage of tolerance)
 - Active mode: 110 mA
 - Idle mode: 45 mA
- **Connector**
 - 10-pin (2x5) female header in 2.54mm
- **Write Protect Switch (optional)**
- **RoHS Recast Compliant (2011/65/EU)**

*Varies from capacities. The values for performances and power consumptions presented are typical and may vary depending on flash configurations or platform settings.

Table of Contents

| | |
|--|-----------|
| 1. General Descriptions | 4 |
| 1.1 Performance-optimized Controller | 4 |
| 1.1.1 Error Correction Code (ECC)..... | 4 |
| 1.1.2 Global Wear Leveling | 4 |
| 1.1.3 Write Protection Mode (optional) | 4 |
| 1.1.4 Power Failure Management..... | 4 |
| 2. Functional Block | 5 |
| 3. Pin Assignments..... | 6 |
| 3.1 Type A, Type B, and Type C | 6 |
| 3.2 Type D (STD) | 7 |
| 4. Product & Reliability Specifications | 8 |
| 4.1 Capacity Specifications | 8 |
| 4.2 Performance Specifications | 8 |
| 4.3 Environmental Specifications | 9 |
| 4.4 Mean Time Between Failures (MTBF)..... | 9 |
| 4.5 Certification and Compliance..... | 9 |
| 4.6 Endurance | 10 |
| 5. Electrical Specifications..... | 10 |
| 5.1 Operating Conditions | 11 |
| 5.2 Absolute Maximum Rating | 11 |
| 5.3 Power Consumption..... | 11 |
| 5.4 AC Characteristics | 12 |
| 6. Physical Dimensions | 13 |
| 6.1 Horizontal Design | 13 |
| 6.1.1 Type A (STD 90D) | 13 |
| 6.1.2 Type B (STD 90D-MH) | 14 |
| 6.1.3 Type C (STD 90D-MS) | 15 |
| 6.2 Vertical Design..... | 16 |
| 6.2.1 Type D (STD 180D) | 16 |
| 6.3 Write Protect Switch (optional) | 17 |
| 7. Product Ordering Information..... | 18 |

| | |
|---|-----------|
| 7.1 Product Code Designations | 18 |
| 7.2 Valid Combinations | 19 |
| 7.2.1 Type A (STD 90D) Standard 90 Degree..... | 19 |
| 7.2.2 Type B (STD 90D-MH) Standard 90 Degree Mounting Header | 19 |
| 7.2.3 Type C (STD 90D-MS) Standard 90 Degree Mounting Screw | 19 |
| 7.2.4 Type D (STD 180D) Standard 180 Degree | 20 |
| 7.2.5 Type A (STD 90D) NR Standard 90 Degree | 20 |
| 7.2.6 Type B (STD 90D-MH) NR Standard 90 Degree Mounting Header | 20 |
| 7.2.7 Type C (STD 90D-MS) NR Standard 90 Degree Mounting Screw..... | 21 |
| 7.2.8 Type D (STD 180D) Standard 180 Degree | 21 |

1. General Descriptions

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.

1.1 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.

1.1.1 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.

1.1.2 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 (UDM) 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.

1.1.3 Write Protection Mode (optional)

When the device is configured to the Write-Protection mode, it enhances the data security and protection. This feature prevents the stored data from inadvertent system writes or erases, and viruses.

1.1.4 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.

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.

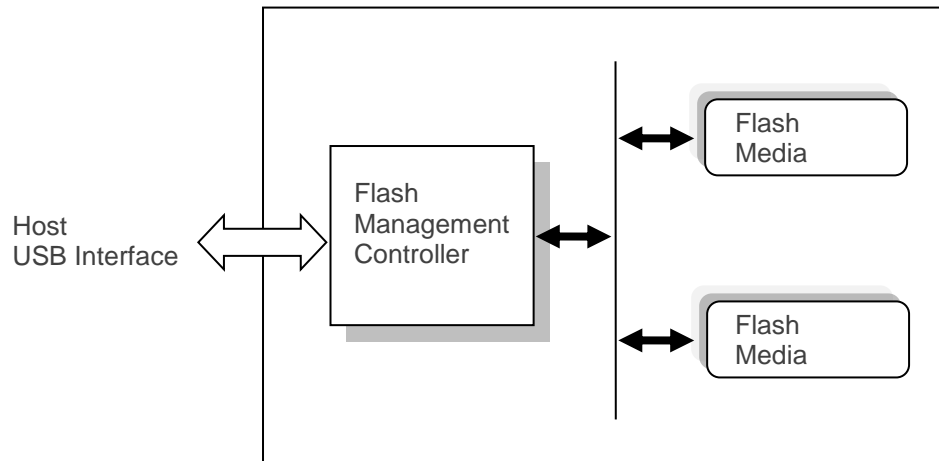


Figure 2-1 Functional Block Diagram

3. Pin Assignments

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

3.1 Type A, Type B, and Type C

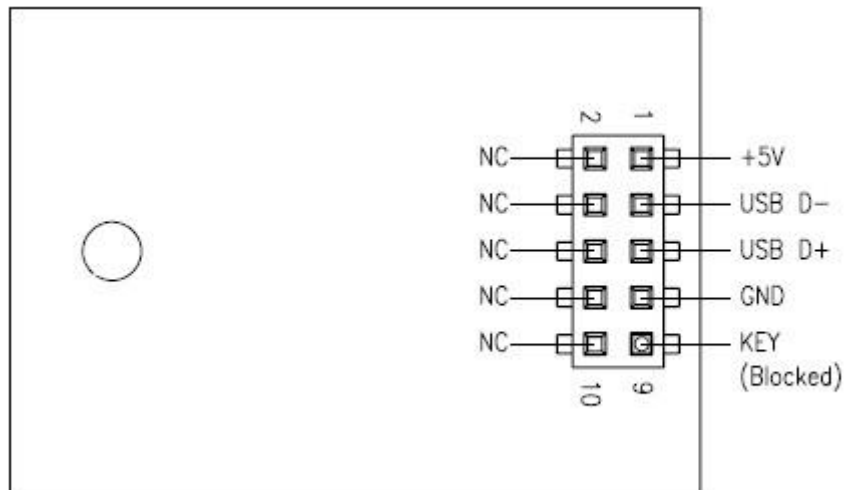


Table 3-1 Pin Assignment of the 10-Pin Configuration in Type A, Type B, and Type C

| Pin | Signal | Pin | Signal |
|-----|---------------|-----|--------|
| 1 | +5V | 2 | N.C |
| 3 | USB D- | 4 | N.C |
| 5 | USB D+ | 6 | N.C |
| 7 | GND | 8 | N.C |
| 9 | Key (Blocked) | 10 | N.C |

3.2 Type D (STD)

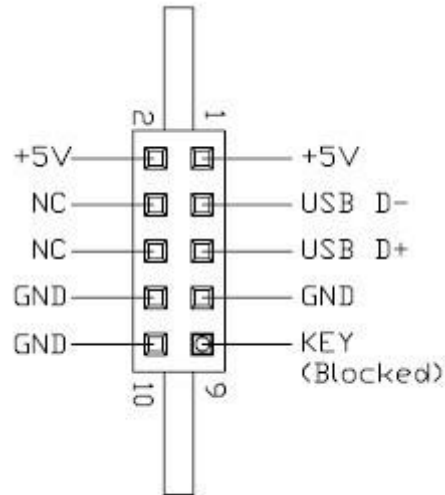


Table 3-2 Pin Assignment of the 10-Pin Configuration in Type D (STD)

| Pin | Signal | Pin | Signal |
|-----|---------------|-----|--------|
| 1 | +5V | 2 | +5V |
| 3 | USB D- | 4 | N.C |
| 5 | USB D+ | 6 | N.C |
| 7 | GND | 8 | GND |
| 9 | Key (Blocked) | 10 | GND |

4. Product & Reliability Specifications

4.1 Capacity Specifications

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

Table 4-1 Capacity Specifications

| Capacity | Total Bytes |
|----------|----------------|
| 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 |

Note: The number of total bytes may vary depending on the file system in use.

4.2 Performance Specifications

Performance of the USB-Disk Module product is listed below in Table 4-2.

Table 4-2 Performance Specifications

| Performance | Capacity | 256 MB | 512 MB | 1 GB | 2 GB | 4 GB | 8 GB | 16 GB | 32 GB |
|---------------------------------|----------|--------|--------|-------|-------|-------|-------|-------|-------|
| | | MB | MB | GB | GB | GB | GB | GB | GB |
| Sequential Read* (MB/s) | | 44 | 44 | 44 | 44 | 44 | 44 | 44 | 44 |
| Sequential Write* (MB/s) | | 10 | 20 | 35 | 36 | 38 | 40 | 41 | 41 |
| Random Read IOPS** (4K) | | 2,400 | 2,400 | 2,000 | 1,900 | 1,800 | 1,700 | 1,600 | 1,600 |
| Random Write IOPS** (4K) | | 45 | 60 | 50 | 50 | 70 | 80 | 105 | 105 |

Note:

Results may differ from various flash configurations or host system setting.

*Sequential performance is based on CrystalDiskMark 5.2.1 with file size 1,000MB.

**Random performance measured using IOMeter with Queue Depth 32.

4.3 Environmental Specifications

Environmental specification of the USB-Disk Module product family is available as shown in Table 4-3.

Table 4-3 Environmental Specifications

| Item | Specifications | |
|-------------|----------------|--|
| Temperature | Operation | 0°C to 70°C (Standard); -40°C to 85°C (Wide) |
| | Storage | -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-202G) |
| 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 | FCC, CE | |

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 USB is more than 2,000,000 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 (UDM) complies with the following standards:

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

4.6 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 4-4 Endurance Specifications

| Capacity | TeraBytes Written |
|----------|-------------------|
| 256 MB | 13 |
| 512 MB | 26 |
| 1 GB | 54 |
| 2 GB | 108 |
| 4 GB | 219 |
| 8 GB | 438 |
| 16 GB | 884 |
| 32 GB | 1,752 |

Note:

- The estimated values are based on sequential write behavior.
(Apacer EDTestTool, test mode – sequential data pattern –100.00% of disk space with 128K)
- Flash vendor guaranteed SLCP/E cycle: 60K
- WAF may vary from capacity, flash configurations and writing behavior on each platform.
- 1 Terabyte = 1024GB

5. Electrical Specifications

5.1 Operating Conditions

Table 5-1 lists the absolute stress rating 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 5-1 Operating Range

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

5.2 Absolute Maximum Rating

Table 5-2 lists the absolute maximum power ratings for the USB-Disk Module.

Table 5-2 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 |

5.3 Power Consumption

Table 5-3 lists the power consumption for the USB-Disk Module.

Table 5-3 Power Consumption

| Capacity Mode | 216 MB | 512 MB | 1 GB | 2GB | 4 GB | 8 GB | 16 GB | 32 GB |
|---------------------|--------------------|--------|------|-----|------|------|-------|-------|
| | Active (mA) | 85 | 85 | 95 | 105 | 100 | 95 | 95 |
| Standby (mA) | 40 | 40 | 40 | 45 | 40 | 40 | 40 | 45 |

Note:

*All values are typical and may vary depending on flash configurations or host system settings.

**Active power is an average power measurement performed using CrystalDiskMark with 128KB sequential read/write transfers.

5.4 AC Characteristics

Table 5-4 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 5-5 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 |

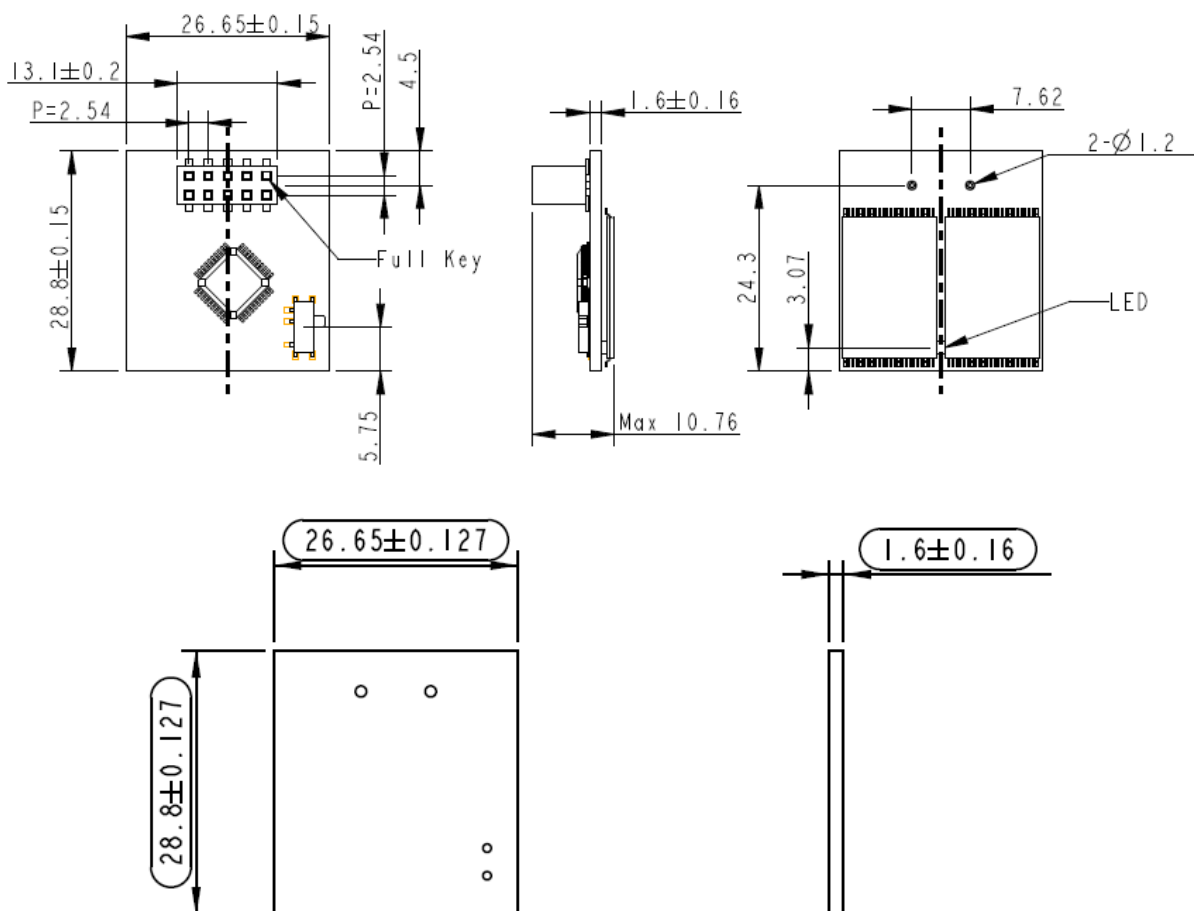
6. Physical Dimensions

6.1 Horizontal Design

6.1.1 Type A (STD 90D)

Standard 90 Degree

| Length | Width | Height (Max) |
|---------|----------|--------------|
| 28.8 mm | 26.65 mm | 10.76 mm |

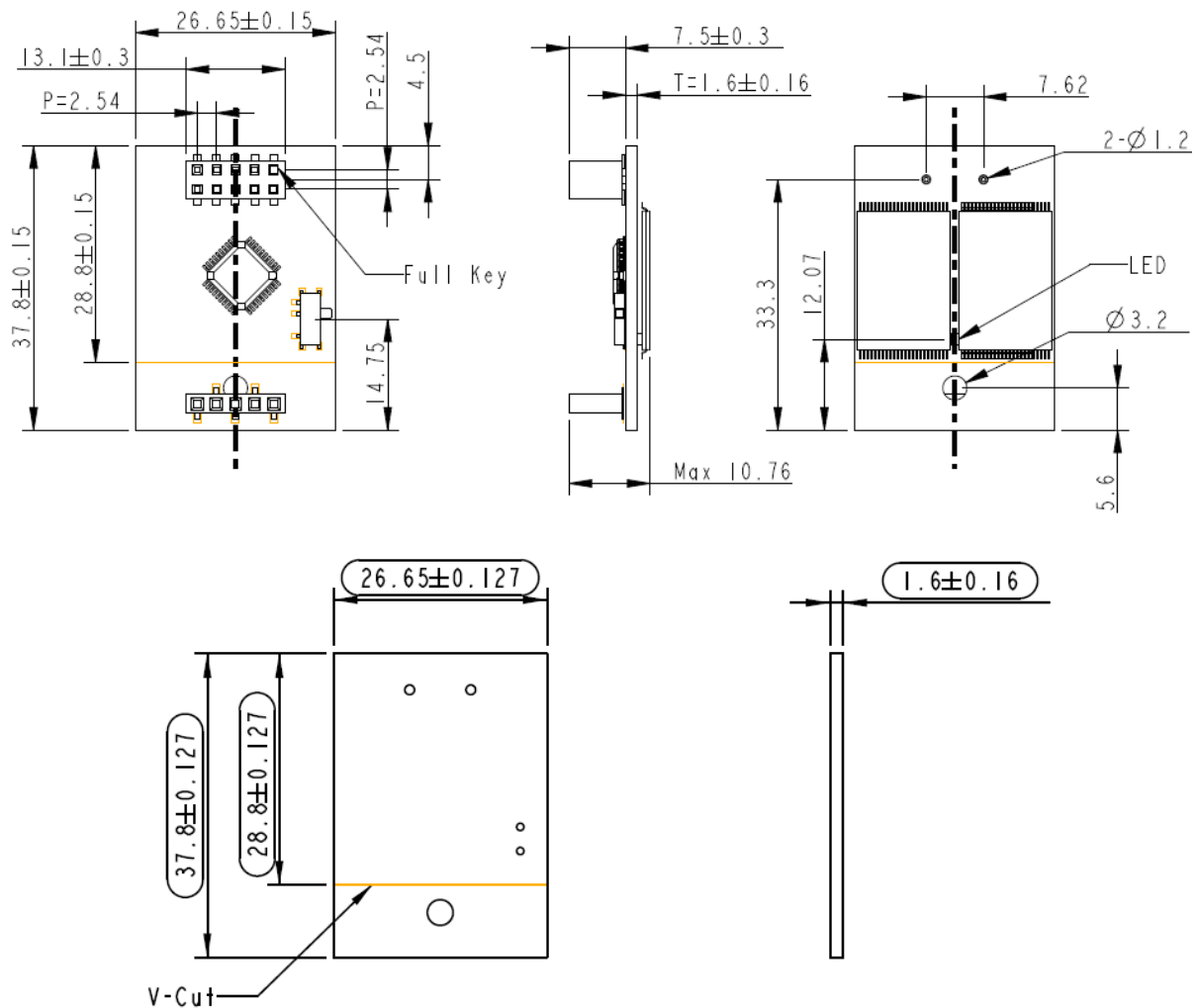


Unit: mm
Tolerance: ± 0.2

6.1.2 Type B (STD 90D-MH)

Standard 90 Degree Mounting Header

| Length | Width | Height (Max) |
|---------|----------|--------------|
| 37.8 mm | 26.65 mm | 10.76 mm |

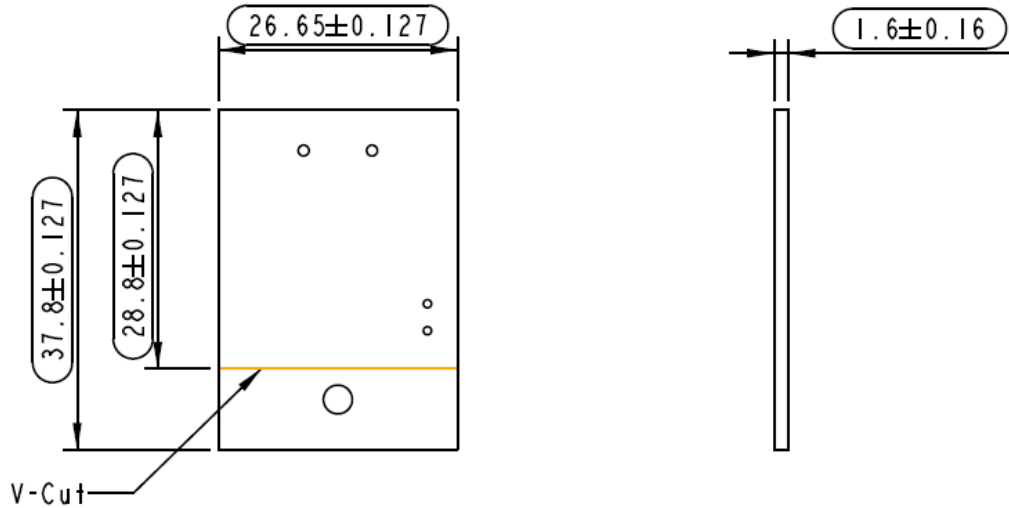
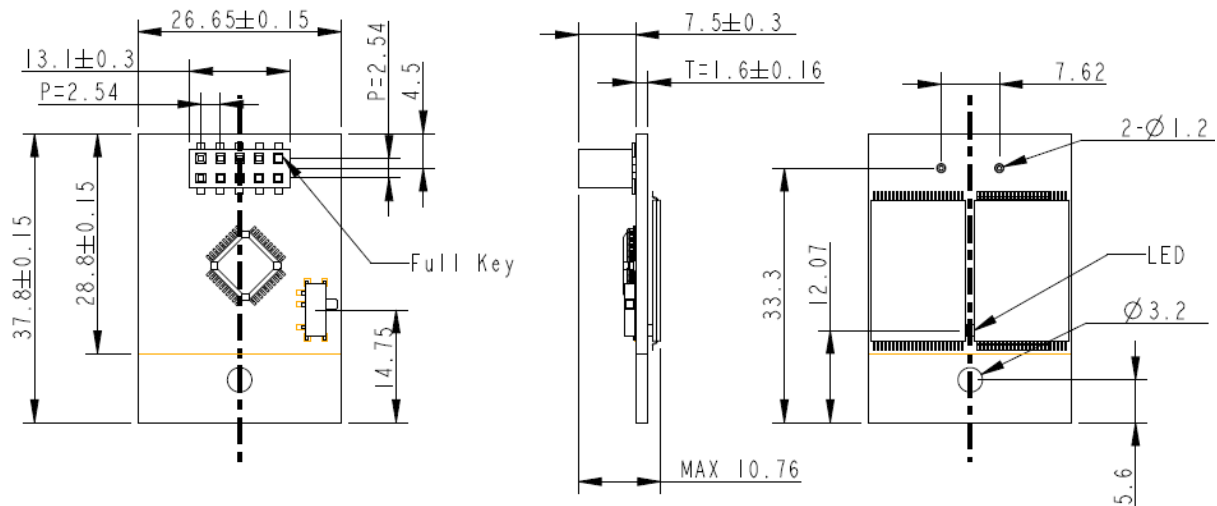


Unit: mm
Tolerance: ±0.2

6.1.3 Type C (STD 90D-MS)

Standard 90 Degree Mounting Screw

| Length | Width | Height (Max) |
|---------|----------|--------------|
| 37.8 mm | 26.65 mm | 10.76 mm |



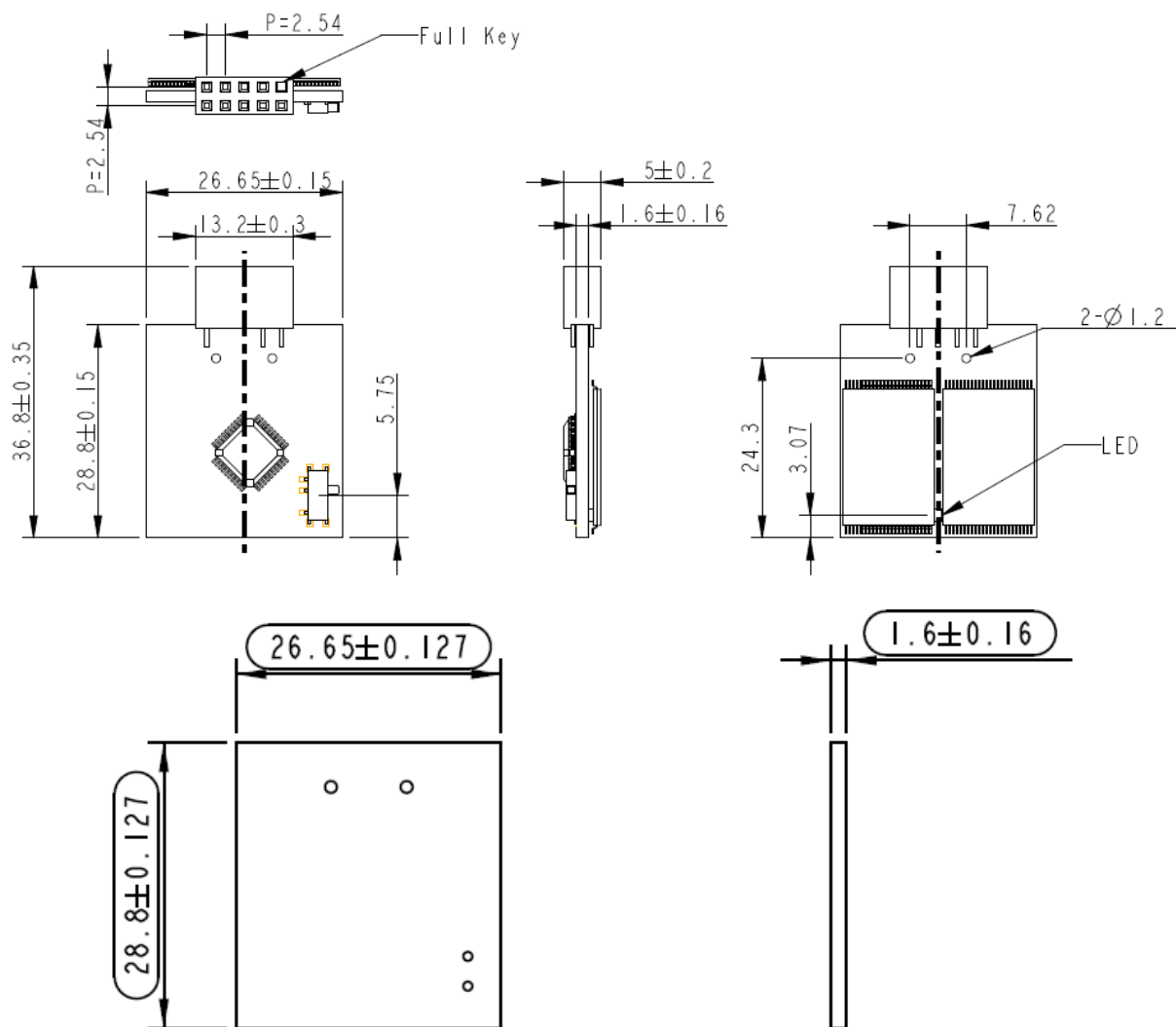
Unit: mm
Tolerance: ± 0.2

6.2 Vertical Design

6.2.1 Type D (STD 180D)

Standard 180 Degree

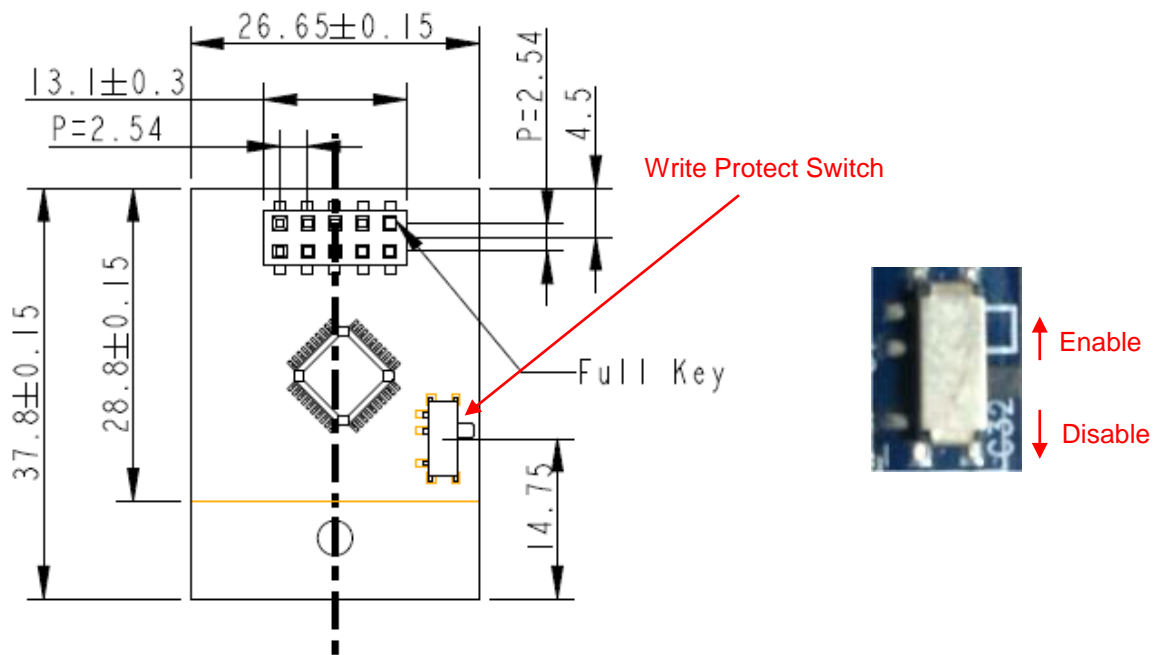
| Length | Width | Height (Max) |
|---------|----------|--------------|
| 36.8 mm | 26.65 mm | 5 mm |



Unit: mm
Tolerance: ± 0.2

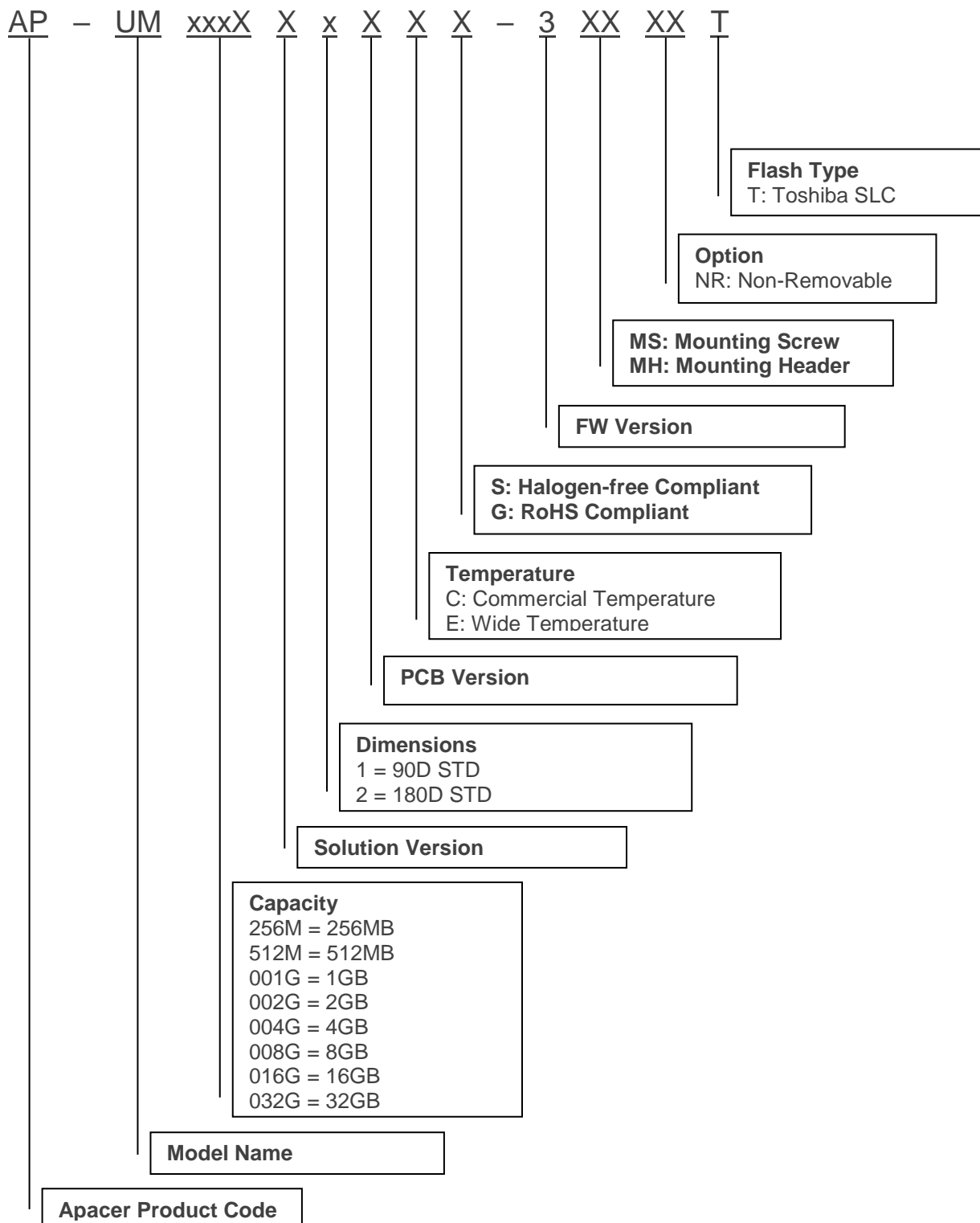
6.3 Write Protect Switch (optional)

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.



7. Product Ordering Information

7.1 Product Code Designations



7.2 Valid Combinations

7.2.1 Type A (STD 90D) Standard 90 Degree

| Capacity | Standard Temperature | Wide Temperature |
|----------|----------------------|-------------------|
| 256MB | AP-UM256MA11CS-3T | AP-UM256MA11ES-3T |
| 512MB | AP-UM512MA11CS-3T | AP-UM512MA11ES-3T |
| 1GB | AP-UM001GA11CS-3T | AP-UM001GA11ES-3T |
| 2GB | AP-UM002GA11CS-3T | AP-UM002GA11ES-3T |
| 4GB | AP-UM004GA11CS-3T | AP-UM004GA11ES-3T |
| 8GB | AP-UM008GA11CS-3T | AP-UM008GA11ES-3T |
| 16GB | AP-UM016GA11CS-3T | AP-UM016GA11ES-3T |
| 32GB | AP-UM032GA11CS-3T | AP-UM032GA11ES-3T |

7.2.2 Type B (STD 90D-MH) Standard 90 Degree Mounting Header

| Capacity | Standard Temperature | Wide Temperature |
|----------|----------------------|---------------------|
| 256MB | AP-UM256MA11CS-3MHT | AP-UM256MA11ES-3MHT |
| 512MB | AP-UM512MA11CS-3MHT | AP-UM512MA11ES-3MHT |
| 1GB | AP-UM001GA11CS-3MHT | AP-UM001GA11ES-3MHT |
| 2GB | AP-UM002GA11CS-3MHT | AP-UM002GA11ES-3MHT |
| 4GB | AP-UM004GA11CS-3MHT | AP-UM004GA11ES-3MHT |
| 8GB | AP-UM008GA11CS-3MHT | AP-UM008GA11ES-3MHT |
| 16GB | AP-UM016GA11CS-3MHT | AP-UM016GA11ES-3MHT |
| 32GB | AP-UM032GA11CS-3MHT | AP-UM032GA11ES-3MHT |

7.2.3 Type C (STD 90D-MS) Standard 90 Degree Mounting Screw

| Capacity | Standard Temperature | Wide Temperature |
|----------|----------------------|---------------------|
| 256MB | AP-UM256MA11CS-3MST | AP-UM256MA11ES-3MST |
| 512MB | AP-UM512MA11CS-3MST | AP-UM512MA11ES-3MST |
| 1GB | AP-UM001GA11CS-3MST | AP-UM001GA11ES-3MST |
| 2GB | AP-UM002GA11CS-3MST | AP-UM002GA11ES-3MST |
| 4GB | AP-UM004GA11CS-3MST | AP-UM004GA11ES-3MST |
| 8GB | AP-UM008GA11CS-3MST | AP-UM008GA11ES-3MST |
| 16GB | AP-UM016GA11CS-3MST | AP-UM016GA11ES-3MST |
| 32GB | AP-UM032GA11CS-3MST | AP-UM032GA11ES-3MST |

7.2.4 Type D (STD 180D) Standard 180 Degree

| Capacity | Standard Temperature | Wide Temperature |
|----------|----------------------|-------------------|
| 256MB | AP-UM256MA21CS-3T | AP-UM256MA21ES-3T |
| 512MB | AP-UM512MA21CS-3T | AP-UM512MA21ES-3T |
| 1GB | AP-UM001GA21CS-3T | AP-UM001GA21ES-3T |
| 2GB | AP-UM002GA21CS-3T | AP-UM002GA21ES-3T |
| 4GB | AP-UM004GA21CS-3T | AP-UM004GA21ES-3T |
| 8GB | AP-UM008GA21CS-3T | AP-UM008GA21ES-3T |
| 16GB | AP-UM016GA21CS-3T | AP-UM016GA21ES-3T |
| 32GB | AP-UM032GA21CS-3T | AP-UM032GA21ES-3T |

7.2.5 Type A (STD 90D) NR Standard 90 Degree

| Capacity | Standard Temperature | Wide Temperature |
|----------|----------------------|---------------------|
| 256MB | AP-UM256MA11CS-3NRT | AP-UM256MA11ES-3NRT |
| 512MB | AP-UM512MA11CS-3NRT | AP-UM512MA11ES-3NRT |
| 1GB | AP-UM001GA11CS-3NRT | AP-UM001GA11ES-3NRT |
| 2GB | AP-UM002GA11CS-3NRT | AP-UM002GA11ES-3NRT |
| 4GB | AP-UM004GA11CS-3NRT | AP-UM004GA11ES-3NRT |
| 8GB | AP-UM008GA11CS-3NRT | AP-UM008GA11ES-3NRT |
| 16GB | AP-UM016GA11CS-3NRT | AP-UM016GA11ES-3NRT |
| 32GB | AP-UM032GA11CS-3NRT | AP-UM032GA11ES-3NRT |

7.2.6 Type B (STD 90D-MH) NR Standard 90 Degree Mounting Header

| Capacity | Standard Temperature | Wide Temperature |
|----------|-----------------------|-----------------------|
| 256MB | AP-UM256MA11CS-3MHNRT | AP-UM256MA11ES-3MHNRT |
| 512MB | AP-UM512MA11CS-3MHNRT | AP-UM512MA11ES-3MHNRT |
| 1GB | AP-UM001GA11CS-3MHNRT | AP-UM001GA11ES-3MHNRT |
| 2GB | AP-UM002GA11CS-3MHNRT | AP-UM002GA11ES-3MHNRT |
| 4GB | AP-UM004GA11CS-3MHNRT | AP-UM004GA11ES-3MHNRT |
| 8GB | AP-UM008GA11CS-3MHNRT | AP-UM008GA11ES-3MHNRT |
| 16GB | AP-UM016GA11CS-3MHNRT | AP-UM016GA11ES-3MHNRT |
| 32GB | AP-UM032GA11CS-3MHNRT | AP-UM032GA11ES-3MHNRT |

7.2.7 Type C (STD 90D-MS) NR Standard 90 Degree Mounting Screw

| Capacity | Standard Temperature | Wide Temperature |
|----------|-----------------------|-----------------------|
| 256MB | AP-UM256MA11CS-3MSNRT | AP-UM256MA11ES-3MSNRT |
| 512MB | AP-UM512MA11CS-3MSNRT | AP-UM512MA11ES-3MSNRT |
| 1GB | AP-UM001GA11CS-3MSNRT | AP-UM001GA11ES-3MSNRT |
| 2GB | AP-UM002GA11CS-3MSNRT | AP-UM002GA11ES-3MSNRT |
| 4GB | AP-UM004GA11CS-3MSNRT | AP-UM004GA11ES-3MSNRT |
| 8GB | AP-UM008GA11CS-3MSNRT | AP-UM008GA11ES-3MSNRT |
| 16GB | AP-UM016GA11CS-3MSNRT | AP-UM016GA11ES-3MSNRT |
| 32GB | AP-UM032GA11CS-3MSNRT | AP-UM032GA11ES-3MSNRT |

7.2.8 Type D (STD 180D) Standard 180 Degree

| Capacity | Standard Temperature | Wide Temperature |
|----------|----------------------|---------------------|
| 256MB | AP-UM256MA21CS-3NRT | AP-UM256MA21ES-3NRT |
| 512MB | AP-UM512MA21CS-3NRT | AP-UM512MA21ES-3NRT |
| 1GB | AP-UM001GA21CS-3NRT | AP-UM001GA21ES-3NRT |
| 2GB | AP-UM002GA21CS-3NRT | AP-UM002GA21ES-3NRT |
| 4GB | AP-UM004GA21CS-3NRT | AP-UM004GA21ES-3NRT |
| 8GB | AP-UM008GA21CS-3NRT | AP-UM008GA21ES-3NRT |
| 16GB | AP-UM016GA21CS-3NRT | AP-UM016GA21ES-3NRT |
| 32GB | AP-UM032GA21CS-3NRT | AP-UM032GA21ES-3NRT |

Note: Valid combinations are those products 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.

Revision History

| Revision | Description | Date |
|----------|--|------------|
| 0.1 | Preliminary release | 4/6/2017 |
| 1.0 | Official release | 8/4/2017 |
| 1.1 | - Removed Extended Data Protection and added Write Protect Switch (optional) on Features page - Added 6.3 Write Protect Switch (optional) | 11/15/2017 |
| 1.2 | - Renamed extended temperature to wide temperature - Updated Table 4-3 by changing storage temperature from -40°C to 85°C to -40°C to 100°C | 8/14/2020 |
| 1.3 | Updated mechanical specs for all types of models at 6. Physical Dimensions | 10/22/2020 |
| 1.4 | - Added Power Failure Management to Flash Management on Specifications Overview page - Added 1.1.4 Power Failure Management | 11/6/2020 |
| 1.5 | - Added Endurance section to Specifications Overview page - Added 4.6 Endurance | 12/24/2020 |

Global Presence

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