

RoHS Recast Compliant

USB-Disk Module 2A-M

Low-Profile (Housing) 180D Product Specifications



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Version 1.6



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:

- **USB2.0 High-Speed and USB1.1 Full-Speed Compatible Interface**
- **Capacity**
 - 8, 16, 32, 64, 128 GB
- **Performance¹**
 - Sequential read: Up to 44 MB/sec
 - Sequential write: Up to 43 MB/sec
 - Random read (4K): Up to 2,300 IOPS
 - Random write (4K): Up to 190 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: MLC**
- **MTBF: >1,000,000 hours**
- **Endurance (in Terabytes Written: TBW)**
 - 8 GB: 7 TBW
 - 16 GB: 18 TBW
 - 32 GB: 38 TBW
 - 64 GB: 51 TBW
 - 128 GB: 117 TBW
- **Temperature Range**
 - Operating:
 - Standard: 0°C to 70°C
 - Wide: -40°C to 85°C
 - Storage: -40°C to 100°C
- **Support Boot-up Function for OS**
 - Windows: WinXP/7 or later
 - Mac: 10.2.8 or later
 - Linux: 2.4.10 or later
- **Power Consumption¹**
 - Operating voltage: 5V (with a certain percentage of tolerance)
 - Active mode (Max.): 125 mA
 - Idle mode: 50 mA
- **Connector**
 - 10-pin (2x5) female header in 2.54mm
- **Write Protect Switch (optional)**
- **RoHS Recast Compliant (2011/65/EU)**

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) 2A-M LP(H) 180D coming with both with and without housing can be plugged into a standard Embedded USB connector commonly found in desktops, portable PC systems and industrial PC systems. As an embedded flash storage, it is compliant with USB2.0 and backward compliant with USB1.1.

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.

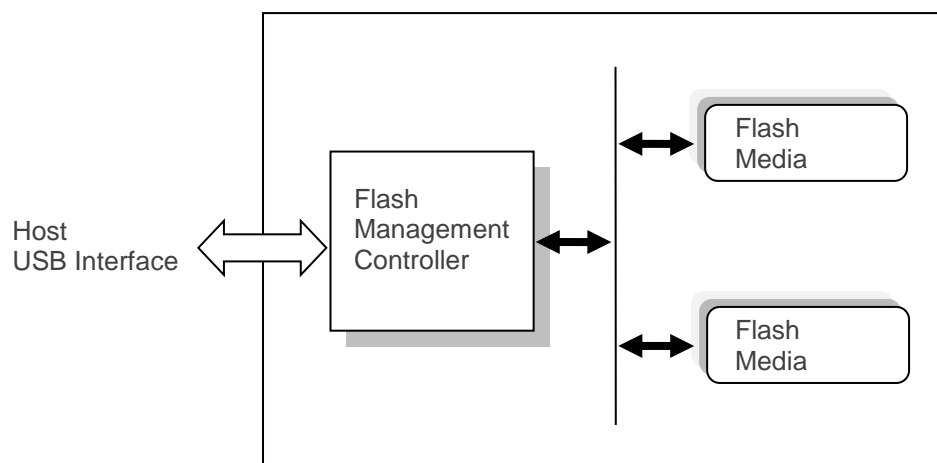


Figure 2-1 Functional Block Diagram

3. Pin Assignments

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

3.1 Without Housing

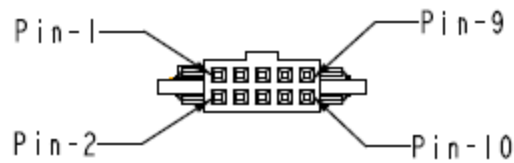


Table 3-1 Pin Assignment of the 10-Pin Configuration in Type D (LP)

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	N.C.	10	N.C.

3.2 With Housing



Table 3-2 Pin Assignment of the 10-Pin Configuration (LPH)

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	N.C.	10	N.C.

4. Product and 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
8GB	8,002,748,416
16GB	16,022,257,664
32GB	32,010,944,512
64GB	64,021,889,024
128GB	128,043,745,280

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	8 GB	16 GB	32 GB	64 GB	128 GB
	Sequential Read (MB/s)		44	44	44	44
Sequential Write (MB/s)		26	42	42	42	43
Random Read IOPS (4K)		1,900	1,800	1,800	1,700	2,300
Random Write IOPS (4K)		100	115	95	190	35

Notes:

- 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	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-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	

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 USB is 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 (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
8 GB	7
16 GB	18
32 GB	38
64 GB	51
128 GB	117

Notes:

- The estimated values are based on sequential write behavior. (Apacer EDTest Tool, test mode – sequential data pattern – 100.00% of disk space)
- Flash vendor guaranteed MLC P/E cycle: Toshiba - 3K.
- The WLE/WAF values may vary with the real application on user platform.
- 1 Terabyte = 1,000 GB.

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 Flash 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 and block mapping technique 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.

5.4 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.

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 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
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

5.7 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.

6. Electrical Specifications

6.1 Operating Conditions

Table 6-1 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 6-1 Operating Range

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

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

Table 6-3 lists the power consumption for the USB-Disk Module.

Table 6-3 Power Consumption (Unit: mA)

Mode \ Capacity	Capacity				
	8 GB	16 GB	32 GB	64 GB	128 GB
Active (Max.)	85	110	110	120	125
Idle	47	49	49	50	50

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 6-4 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 6-5 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

7. Mechanical Specifications

7.1 Without Housing

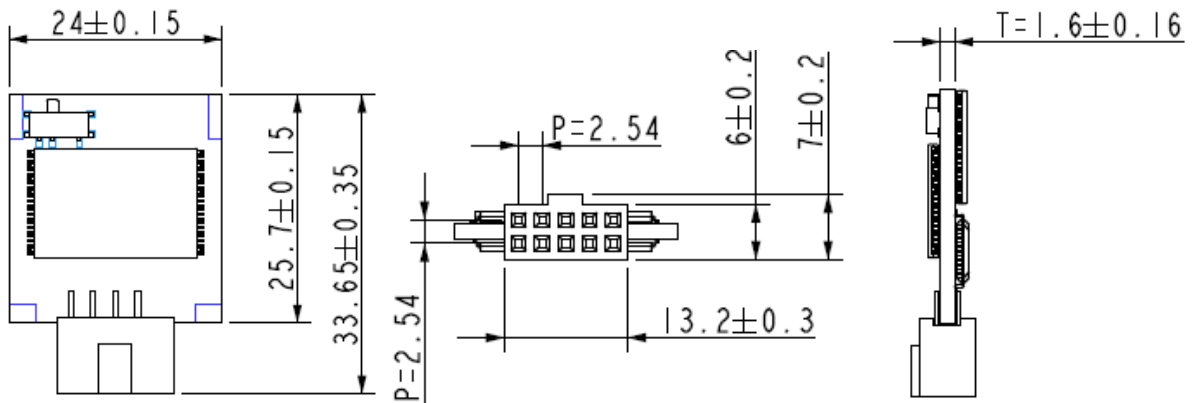


Figure 7-1 Dimensions – Without Housing

Note: Write Protect switch is optional.

Unit: mm Tolerance: ± 0.2

7.2 With Housing

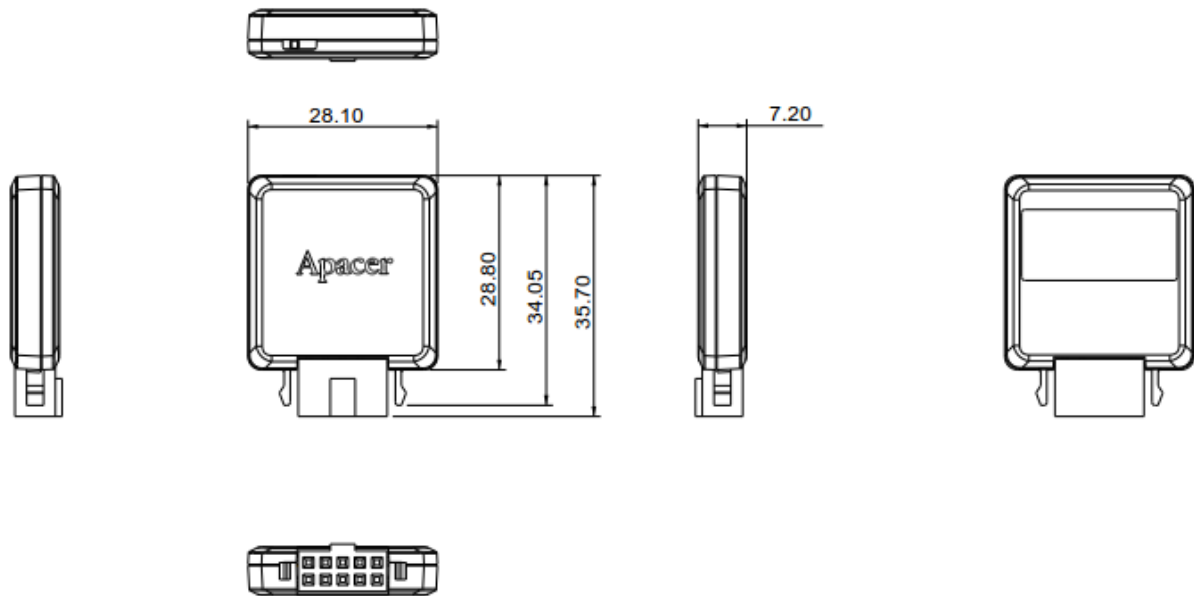


Figure 7-2 Dimensions – With Housing

Note: Write Protect switch is optional.

Unit: mm
Tolerance: ± 0.2

7.3 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.

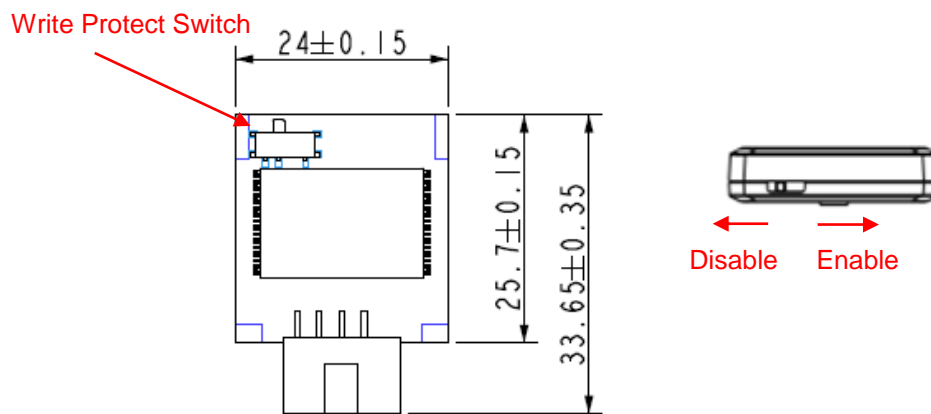


Figure 7-3 Write Protect Switch

7.4 Installation Requirements

Apacer USB-Disk Module comes with two options in mechanical design: with and without housing. Depending on the physical design, requirements of motherboard on which for installing the USB module differ. Before installation, make sure your motherboard has the identical socket design as illustrated below.

7.4.1 Without Housing

The UDM without housing can be inserted into the socket with **either** three holes (two on the sides and one at the front) **or** only one hole at the front.

Table 7-1 Socket Design for the UDM without Housing

UDM Design \ Socket Design	Socket with three holes: two on the sides, one at the front	Socket with only one hole at the front
		

7.4.2 With Housing

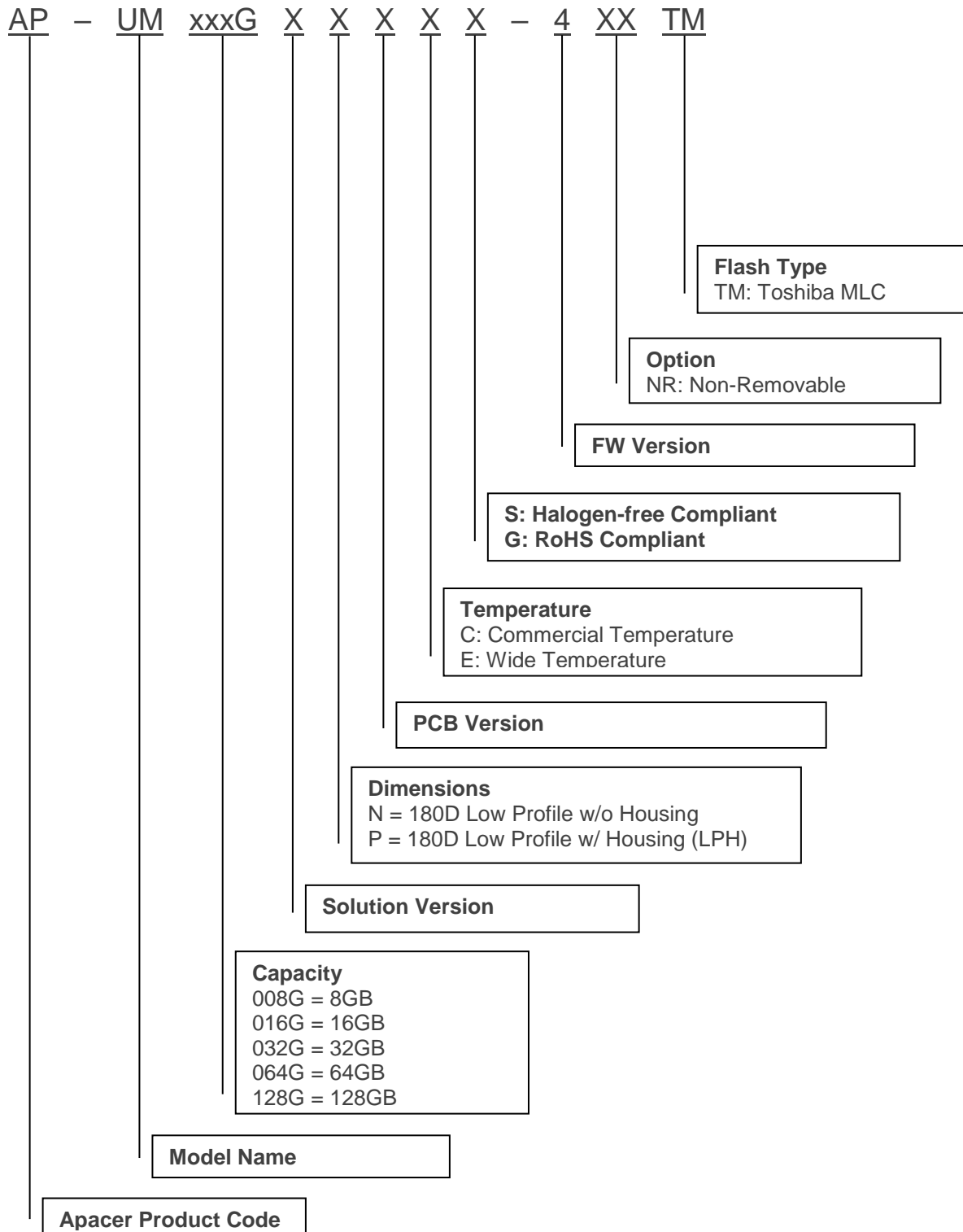
The UDM with housing can only be inserted into the socket with **three** holes, so that the hooks on the sides and the protruding part at the front of the module can snap into place to secure itself to the socket.

Table 7-2 Socket Design for the UDM with Housing

UDM Design \ Socket Design	Socket with three holes: two on the sides, one at the front	Socket with only one hole at the front
		X

8. Product Ordering Information

8.1 Product Code Designations



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 Without Housing

Capacity	Standard Temperature	Wide Temperature
8GB	AP-UM008GAN2CS-4TM	AP-UM008GAN2ES-4TM
16GB	AP-UM016GAN2CS-4TM	AP-UM016GAN2ES-4TM
32GB	AP-UM032GAN2CS-4TM	AP-UM032GAN2ES-4TM
64GB	AP-UM064GAN2CS-4TM	AP-UM064GAN2ES-4TM
128GB	AP-UM128GAN2CS-4TM	AP-UM128GAN2ES-4TM

8.2.2 With Housing

Capacity	Standard Temperature	Wide Temperature
8GB	AP-UM008GAP2CS-4TM	AP-UM008GAP2ES-4TM
16GB	AP-UM016GAP2CS-4TM	AP-UM016GAP2ES-4TM
32GB	AP-UM032GAP2CS-4TM	AP-UM032GAP2ES-4TM
64GB	AP-UM064GAP2CS-4TM	AP-UM064GAP2ES-4TM
128GB	AP-UM128GAP2CS-4TM	AP-UM128GAP2ES-4TM

Revision History

Revision	Description	Date
1.0	Official release	12/14/2017
1.1	<ul style="list-style-type: none"> - Updated 1. General Descriptions - Added 1.1.2 Flash Block Management, 1.1.4 S.M.A.R.T. and 1.1.5 Power Failure Management - Added 4.6 Endurance 	1/18/2018
1.2	Updated 3. 1 Without Housing by modifying the layout and changing signal description of pin 2, 4, 6, 8, 9, 10 to N.C.	7/31/2018
1.3	<ul style="list-style-type: none"> - Renamed extended temperature to wide temperature - Updated technology description for 1.1.5 Power Failure Management - Revised Table 3-2 	9/3/2019
1.4	Updated Table 4-3 by changing storage temperature from -40°C to 85°C to -40°C to 100°C	8/14/2020
1.5	Modified the width of female header at Connector on Specifications Overview page	9/16/2020
1.6	Added 7.4 Installation Requirements	11/16/2022

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