

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



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Specifications Overview:

- **USB2.0 High-Speed and USB1.1 Full-Speed Compatible Interface**
- **Capacity**
 - 16 GB
- **Performance***
 - Sequential read: Up to 43 MB/sec
 - Sequential write: Up to 40 MB/sec
 - Random read (4K): Up to 1,400 IOPS
 - Random write (4K): Up to 6 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
- **S.M.A.R.T. Support**
- **NAND Flash Type:** MLC
- **Firmware Version:** SLC-lite
- **MTBF:** >1,000,000 hours
- **Endurance (in Terabytes Written: TBW)**
 - 16 GB: 292 TBW
- **Temperature Range**
 - Operating: -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 Consumption***
 - Operating voltage: 5V (with a certain percentage of tolerance)
 - Active mode: 110 mA
 - Idle mode: 50 mA
- **Connector**
 - 10-pin (2x5) female header in 2.54mm
- **Support Non-Removable Setting**
- **RoHS Recast Compliant (2011/65/EU)**

*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 Descriptions

Apacer's USB-Disk Module (UDM) 2A-SL is a high performance, highly reliable, high endurance USB2.0 flash disk module in a small form factor designed for embedded applications or the system as a boot drive. As an embedded flash storage, it is compliant with USB2.0 and backward compatible with USB1.1, and connects to the host system via a 10-pin connector.

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 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. When host performs program/erase command on a block, bad block may appear in Status Register. 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.

1.1.3 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 (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.

1.1.4 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.

1.1.5 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.

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.

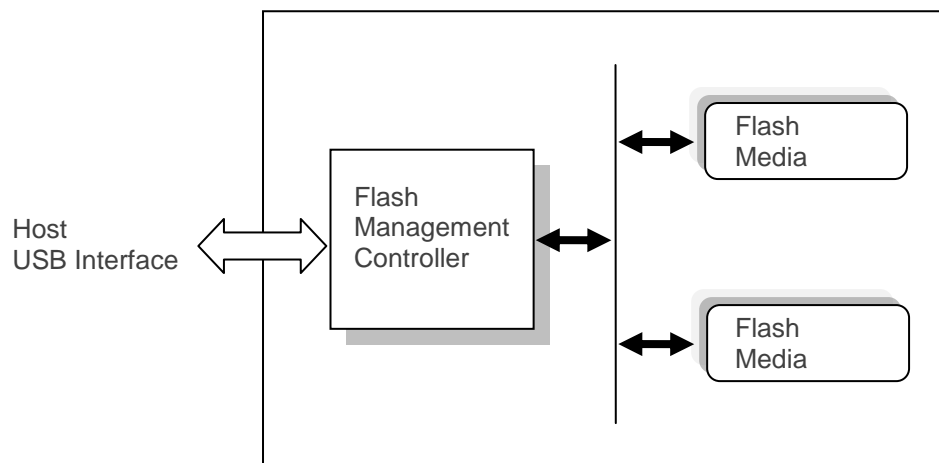


Figure 2-1 Functional Block Diagram

3. Pin Assignments

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

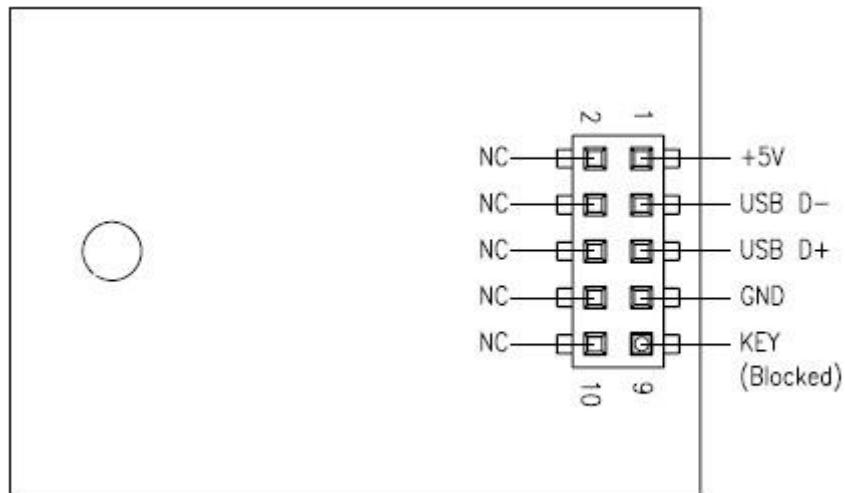


Table 3-1 Pin Assignment of the 10-Pin Configuration

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

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
16GB	16,022,257,664

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	16 GB
Sequential Read* (MB/s)		43
Sequential Write* (MB/s)		40
Random Read IOPS** (4K)		1,400
Random Write IOPS** (4K)		6

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	-40°C to 85°C
	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 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
16 GB	292

Note:

- This estimation complies with sequential 128K workload pattern.
- Flash vendor guaranteed SLC-lite P/E cycle: 20K
- WAF may vary from capacity, flash configurations and writing behavior on each platform.
- 1 Terabyte = 1,024 GB.

5. Electrical Specifications

5.1 Operating Conditions

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
Operating Temperature	-40°C to 85°C	4.5-5.5V

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

Table 5-3 Power Consumption

Mode	Capacity	16 GB
	Active (mA)	110
Standby (mA)	50	

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.

5.2 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

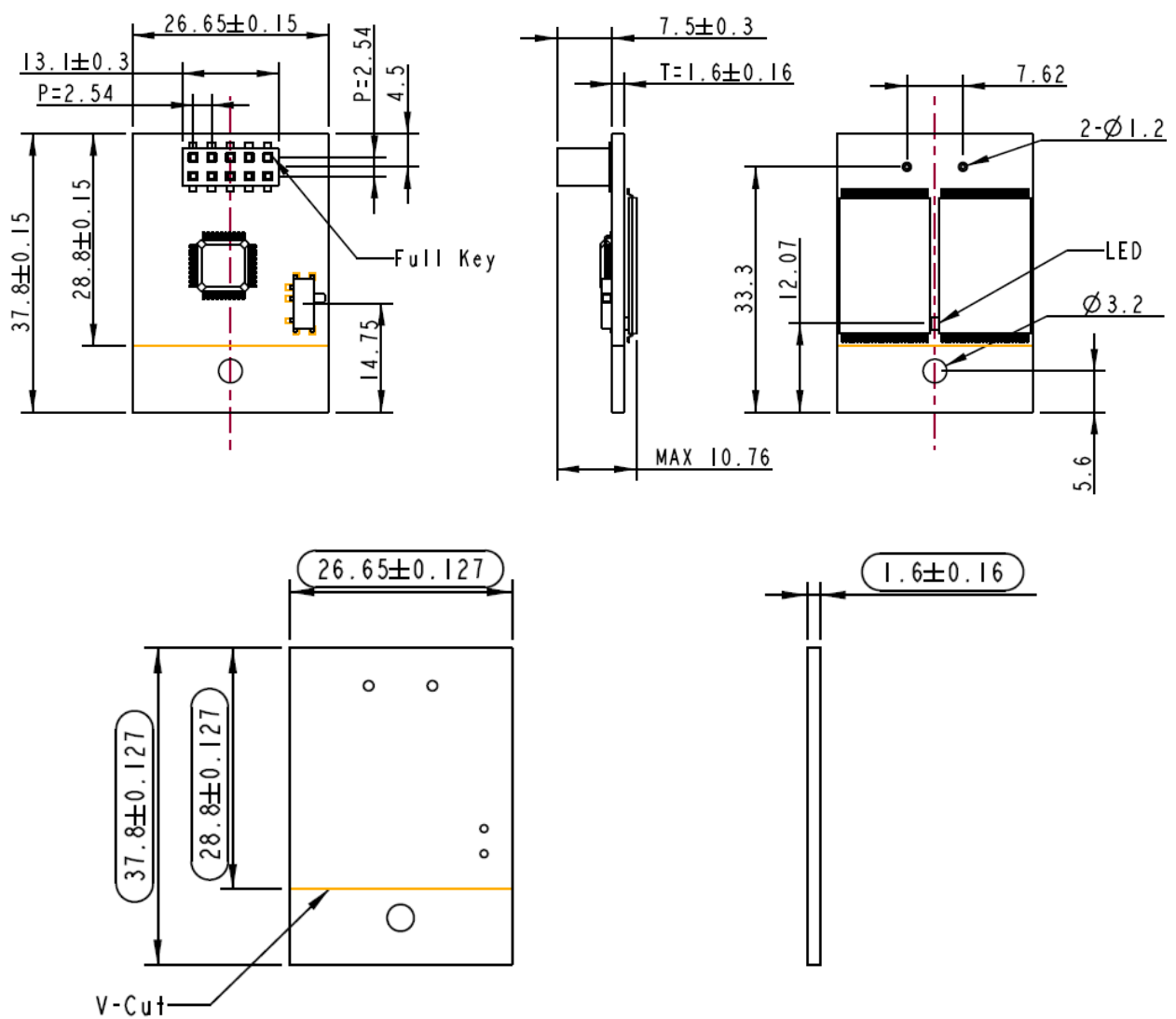
Table 5-5 AC Characteristics High Speed

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

Standard 90 Degree Mounting Screw

Length	Width	Height (Max)
37.80 mm	26.65 mm	10.76 mm



Unit: mm
Tolerance: ± 0.2

7. Product Ordering Information

Capacity	Part Number
16GB	AP-UM016GA11ES-7MSTM

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
1.0	Official release	11/27/2019

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