RoHS Compliant

Mini PCIe Disk Module Plus

mPDM+ Product Specifications

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Version 1.1

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Features:

- **Standard PCI Express bus interface**
  - PCI Express Specification Rev.2.0*
  - PCI Express Card Electromechanical Rev. 2.0
  - Supports ECRC (end-to-end CRC) and advanced error reporting
  - Supports Spread Spectrum Clocking (SSC)
- **Capacity**
  - 8, 16, 32, 64, 128 GB
- **Performance****
  - Sustain Read Speed up to 390 MB/s
  - Sustain Write Speed up to 320 MB/s
- **Flash Management**
  - Supports ECC up to 72 bit correction per 1K Byte data
  - Wear leveling
  - Flash bad-block management
  - S.M.A.R.T.
  - Power Failure Management
  - ATA Secure Erase
- **NAND Flash: MLC**
- **Temperature ranges**
  - 0 to 70°C for ambient temperature
  - -40°C to 85°C for storage temperature
- **Supply voltage**
  - 3.3 V +/- 5%
- **Power consumption****
  - Active mode: 1,110 mA
  - Idle mode: 440 mA
- **Form Factor**
  - PCI Express Full-Mini Card Type
  - Dimensions: 50.80 x 29.85 x 4.20, unit: mm
- **Connector type**
  - One lane mini PCI Express
- **RoHS compliant**
- **Supports NCQ (Native Command Queue) commands**
- **Supports AHCI 1.3**

*The mPDM+ is not backward compatible. Operational instability or inefficiency will occur if this device is applied on a PCIe 1.0 socket.
**The performance and power consumption values addressed here are typical and may vary from platforms.

Table of Contents

1. General Description

Apacer's mPDM+ (mini PCIe Disk Module Plus) SSD offers a breakthrough in non-volatile memory storage. Formed as a mini PCI-Express card, this mPDM+ can fit in various types of embedded platforms, such as workstation, thin computing devices and high-end heavy duty servers where spaces are concerned. Regarding data transfer rate, mPDM+ delivers ideal data read/write performance.

Apacer mPDM+ provides one-lane PCI-Express 2.0 host interface, and is compatible with 5.0 Gbps maximum transfer rate. Compatibility wise, this mini PCIe SSD is not only fully compliant with PCI Express Specification Rev.2.0 and Electromechanical Rev.2.0, but also supports NCQ commands and IDE/AHCI operational modes.

1.1 Error Correction/Detection

The ECC engine in this device can detect and correct up to 72 bits error in 1K bytes.

1.2 Flash 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". Thus, this device 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.

1.3 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, Wear Leveling technique is applied to extend the lifespan of NAND Flash by evenly distributing write and erase cycles across the media. Apacer provides advanced Wear Leveling algorithm, which can efficiently spread out the flash usage through the whole flash media area. Moreover, by implementing both dynamic and static Wear Leveling algorithms, the life expectancy of the NAND Flash is greatly improved.

1.4 Power Failure Management

Power Loss Protection is a mechanism to prevent data loss during unexpected power failure. DRAM is a volatile memory and frequently used as temporary cache or buffer between the controller and the NAND flash to improve the SSD performance. However, one major concern of the DRAM is that it is not able to keep data during power failure. Accordingly, the module applies the flushing mechanism which requests the controller to transfer data to the cache. For this flash module, SDR performs as a cache, and its sizes include 8MB or 32MB. Only when the data is fully committed to the NAND flash will the controller send acknowledgement to the host. Such implementation can prevent false-positive performance and the risk of power cycling issues.

Additionally, it is critical for a controller to shorten the time the in-flight data stays in the cache. Thus, the module applies an algorithm to reduce the amount of data resides in the cache to provide a better

performance by allowing incoming data to only have a “pit stop” in the cache and then move to the NAND flash at once. If the flash is jammed due to particular file sizes (random 4K), the cache will be treated as an “organizer”, consolidating incoming data into groups before written into the flash to improve write amplification.

In sum, with this power failure management, this module proves to provide the reliability required by consumer, industrial, and enterprise-level application.

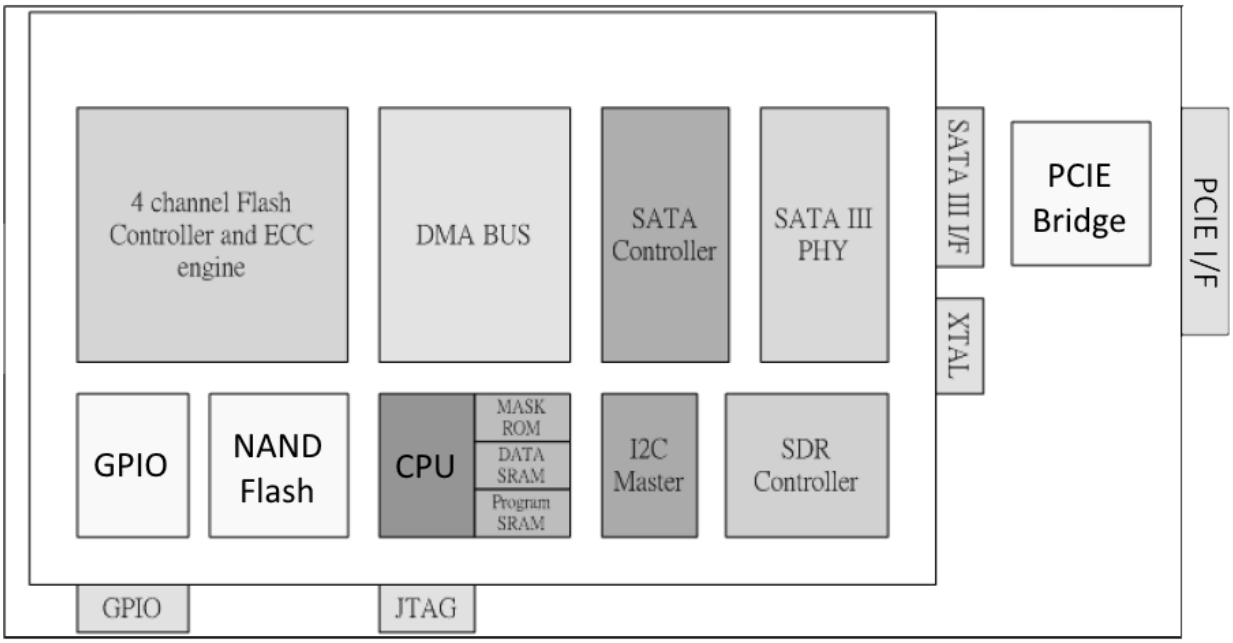
1.5 ATA Secure Erase

AATA Secure Erase is an ATA disk purging command currently embedded in most of the storage drives. Defined in ATA specifications, (ATA) Secure Erase is part of Security Feature Set that allows storage drives to erase all user data areas. The erase process usually runs on the firmware level as most of the ATA-based storage media currently in the market are built-in with this command. ATA Secure Erase can securely wipe out the user data in the drive and protects it from malicious attack.

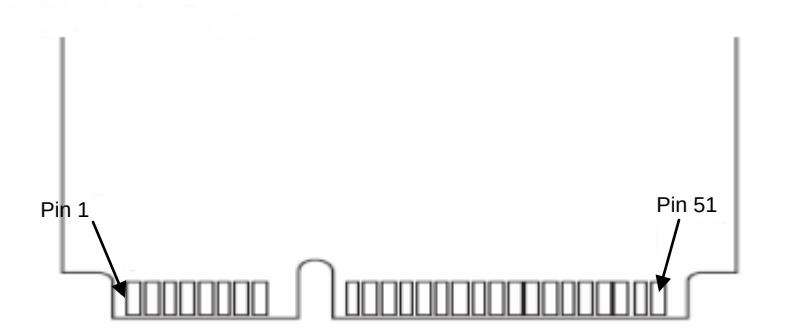
1.6 S.M.A.R.T.

SMART, an acronym for Self-Monitoring, Analysis and Reporting Technology, is an open standard that allows a hard disk drive to automatically detect its health and report potential failures. When a failure is recorded by SMART, users can choose to replace the drive to prevent unexpected outage or data loss. Moreover, SMART can inform users of impending failures while there is still time to perform proactive actions, such as copy data to another device.

2. Block Diagram



3. Pin Assignments



Pin	Signal	Pin	Signal
51	Reserved	52	+3.3V
49	Reserved	50	GND
47	Reserved	48	Reserved
45	Reserved	46	Reserved
43	GND	44	Reserved
41	3.3V	42	Reserved
39	3.3V	40	Reserved
37	GND	38	NC
35	GND	36	NC
33	PETp0	34	GND
31	PETn0	32	Reserved
29	GND	30	Reserved
27	GND	28	NC
25	PERp0	26	GND
23	PERn0	24	+3.3Vaux
21	GND	22	PERST#
19	Reserved	20	Reserved
17	Reserved	18	GND
15	GND	16	NC
13	REFCLK+	14	NC
11	REFCLK-	12	NC
9	GND	10	NC
7	CLKREQ#	8	NC
5	NC	6	NC
3	NC	4	GND
1	Reserved	2	3.3V

4. Product Specification

4.1 Capacity

Table 4-1: Capacity specifications

Capacity	Total bytes*	Cylinders	Heads	Sectors	Max LBA
8 GB	8,012,390,400	15,525	16	63	15,649,200
16 GB	16,013,942,784	16,383	16	63	31,277,232
32 GB	32,017,047,552	16,383	16	63	62,533,296
64 GB	64,023,257,088	16,383	16	63	125,045,424
128 GB	128,035,676,160	16,383	16	63	250,069,680

*Display of total bytes varies from file systems.
**Cylinders, heads or sectors are not applicable for these capacities. Only LBA addressing applies.
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 mPDM+ 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

Performances and random read/write specifications of the mPDM+ are listed in following tables.

Table 4-2: Performance

Capacity / Performance	8 GB	16 GB	32 GB	64 GB	128 GB
Sustained read (MB/s)	160	315	390	390	390
Sustained write (MB/s)	80	155	175	185	320

Note: Results may differ from various flash configurations or host system settings.

4.3 Environmental Specification

Environmental specification of mPDM+ product family follows the MIL-STD-810F standard.

Table 4-3: Environmental specifications

Environment		Specification
Temperature	Operation	0 to 70°C
	Storage	-40°C to 85°C
Humidity		5% to 95% RH (Non-condensing)
Vibration (Non-Operating)		Sine wave : 10~2000Hz, 15G (X, Y, Z axes)
Shock (Non-Operating)		Half sine wave, 1500 G (X, Y, Z ; All 6 axes)

5. Electrical Specification

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: Absolute maximum stress ratings

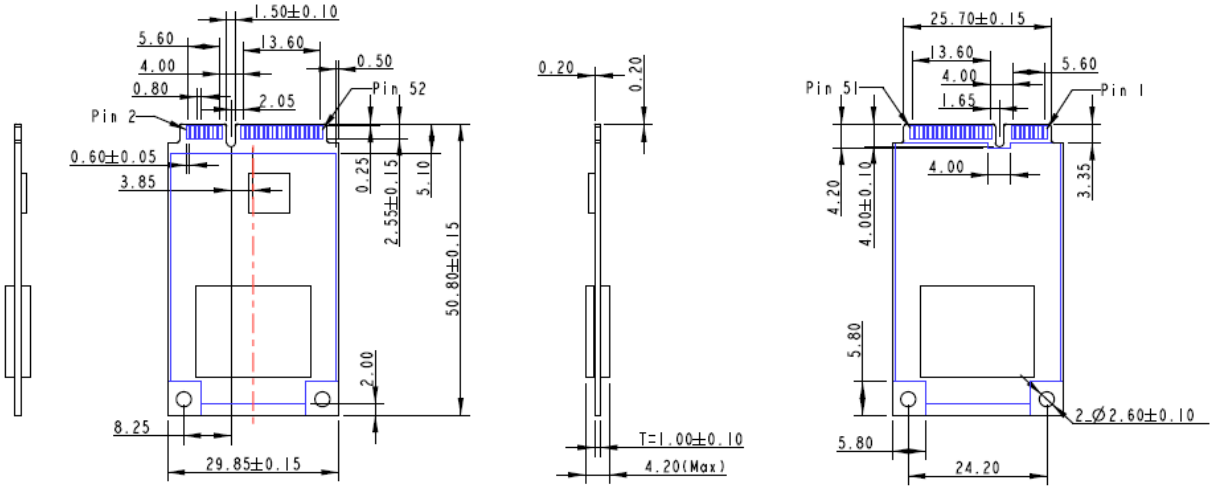
Parameter	Min.	Typical	Max.	Units
Power supply	3.13	3.3	3.46	V
Operating temperature	0		70	°C
Storage temperature	-40		85	°C

Table 5-2: Power consumption (typical)

Capacity / State	8 GB	16 GB	32 GB	64 GB	128 GB
Active (mA)	515	600	630	700	1,110
Idle (mA)	340	340	340	345	440

*Results may differ from various flash configurations and platforms.

6. Mechanical Specifications

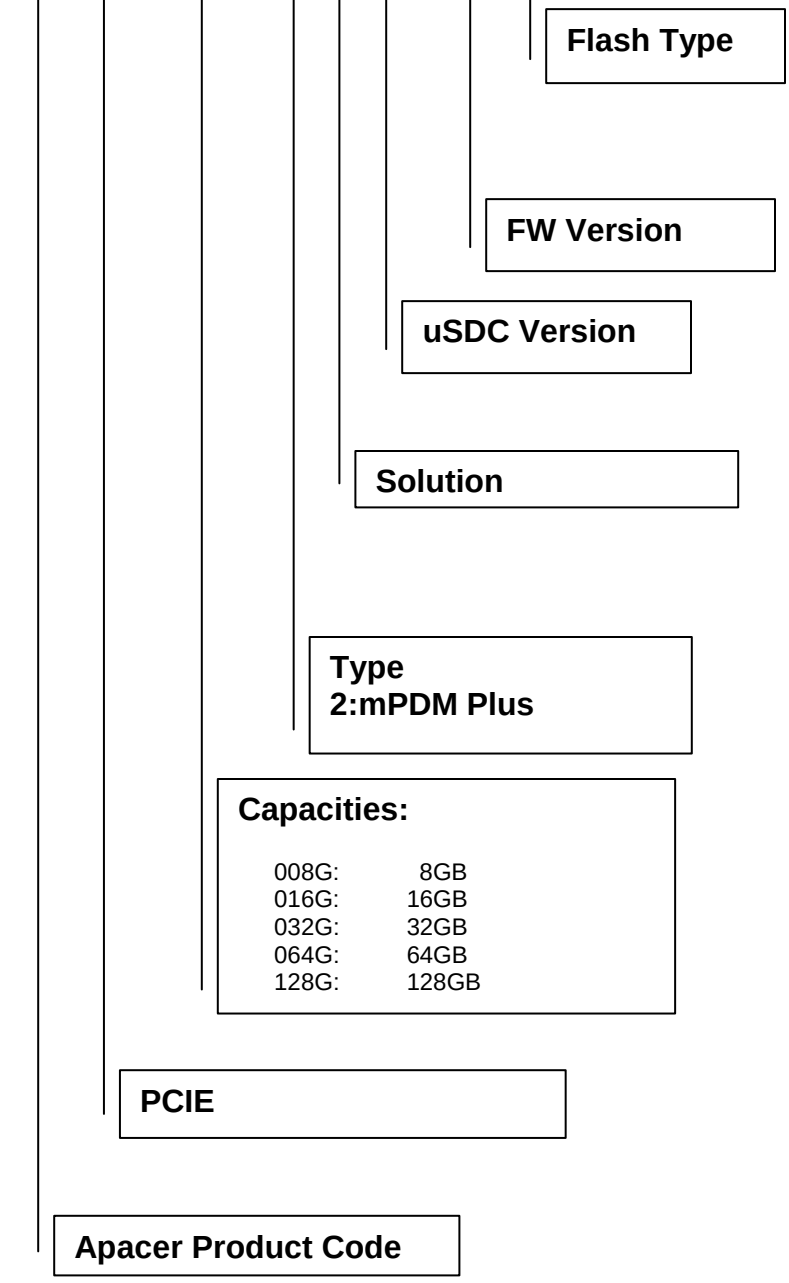


Unit: mm
Tolerance: ± 0.25

7. Product Ordering Information

7.1 Product Code Designations

A P P XXXX X X A – A XX



7.2 Valid Combinations

Capacity	Standard
8GB	APP008G2DA-ATM
16GB	APP016G2DA-ATM
32GB	APP032G2DA-ATM
64GB	APP064G2DA-ATM
128GB	APP128G2EA-ATM

For availabilities, please consult with Apacer sales representatives

Revision History

Revision	Date	Description	Remark
1.0	10/24/2014	Official release	
1.1	06/09/2015	Added block diagram	

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