Apacer

RoHS Compliant

Mini PCIe Disk Module

PV170-mPCIe Product Specifications

September 5, 2018

Version 1.0

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

Apacer

Specifications Overview:

- **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**
  - 30, 60, 120 GB
- **Performance****
  - Sequential read: Up to 395 MB/sec
  - Sequential write: Up to 380 MB/sec
  - Random read (4K): Up to 60,000 IOPS
  - Random write (4K): Up to 62,000 IOPS
- **Flash Management**
  - Low-Density Parity-Check (LDPC) Code
  - Global Wear Leveling
  - Flash bad-block management
  - Flash Translation Layer: Page Mapping
  - S.M.A.R.T.
  - Power Failure Management
  - ATA Secure Erase
  - TRIM
  - Over-Provisioning
  - Hyper Cache Technology
- **Security**
  - End-to-End Data Protection
- **NAND Flash Type:** 3D TLC
- **Temperature Range**
  - Operating: 0°C to 70°C
  - Storage: -40°C to 100°C
- **Supply Voltage**
  - 3.3 V ± 5%
- **Power Consumption****
  - Active mode: 610 mA
  - Idle mode: 360 mA
- **Connector Type**
  - One lane mini PCI Express
- **Form Factor**
  - PCI Express Full-Mini Card Type
  - Dimensions: 50.80 x 29.85 x 4.20, unit: mm
  - Net Weight: 5.8 g
- **Shock & Vibration*****
  - Shock: 1,500 G
  - Vibration: 15 G
- **Supports AHCI 1.3**
- **Supports NCQ (Native Command Queue) Commands**
- **RoHS Compliant**

*The mPDM is not backward compatible. Operational instability or inefficiency will occur if this device is applied on a PCIe 1.0 socket.
**Varies from capacities. The values for performances and power consumptions presented are typical and may vary depending on flash configurations or platform settings.
***Non-operating

Table of Contents

1. General Descriptions

Apacer's PV170-mPCIe is a mini PCIe Disk Module with standard mini PCI-Express interface. Compliant with full-size mini PCIe form factor, PV170-mPCIe can fit in various types of embedded platforms. The SSD 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.

With Over-Provisioning designed as inbuilt feature for 3D NAND, PV170-mPCIe delivers exceptional random read/write performance, power efficiency, and offers greatly extended lifespan. Performance is even tremendously optimized due to the implementation of Page Mapping firmware technology. The incorporation of Over-Provisioning and Page Mapping makes PV170-mPCIe the ideal choice for networking system, thin computing devices and high-end heavy duty servers.

2. Functional Block

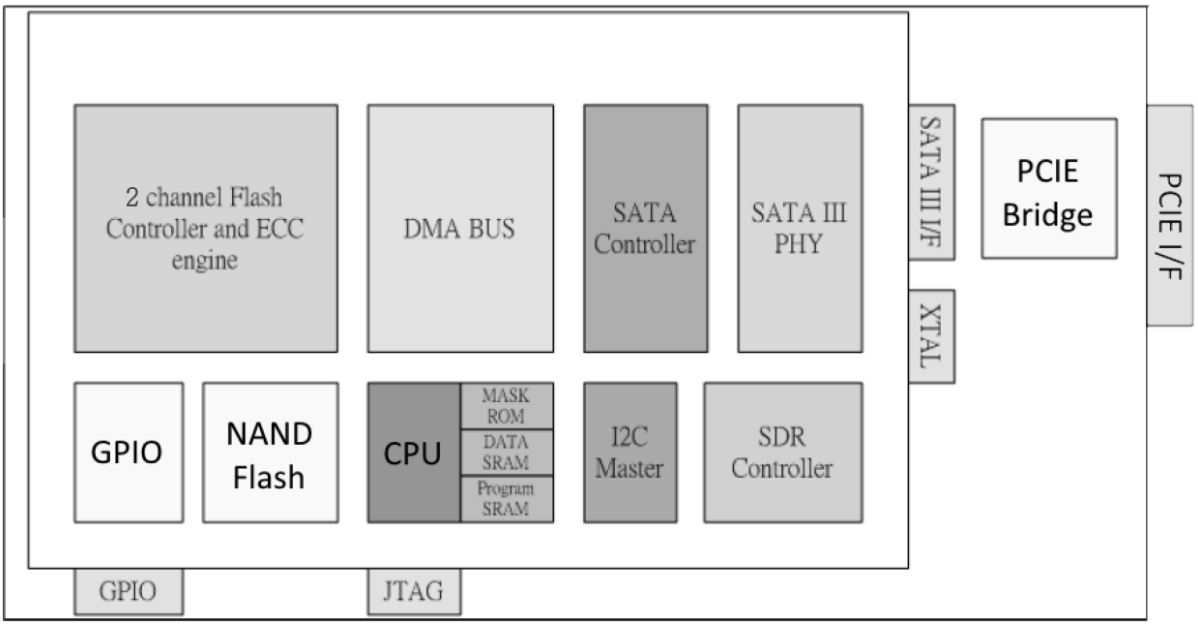
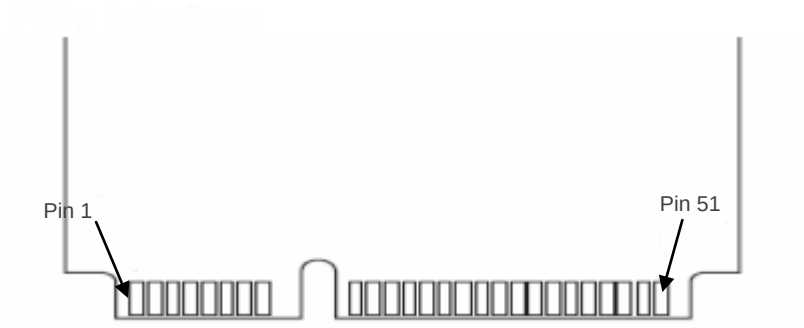


Figure 2-1 Functional Block Diagram

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	3.3V
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 Specifications

4.1 Capacity

Capacity specifications of PV170-mPCIe are available as shown in Table 4-1. It lists the specific capacity and the default numbers of heads, sectors and cylinders for each product line.

Table 4-1 Capacity Specifications

Capacity	Total bytes*	Cylinders	Heads	Sectors	Max LBA
30GB	30,016,536,576	16,383	16	63	58,626,288
60GB	60,021,538,816	16,383	16	63	117,231,408
120GB	120,033,640,448	16,383	16	63	234,441,648

*Display of total bytes varies from file systems, which means not all of the bytes can be used for storage.
**Notes: 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 PV170-mPCIe is listed below in Table 4-2.

Table 4-2 Performance Specifications

Capacity / Performance	30 GB	60 GB	120 GB
Sequential Read* (MB/s)	295	395	395
Sequential Write* (MB/s)	125	255	380
Random Read IOPS (4K)**	20,000	39,000	60,000
Random Write IOPS (4K)**	29,000	56,000	62,000

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 specifications of PV170-mPCIe product are shown in Table 4-3.

Table 4-3 Environmental Specifications

Environment	Specifications
Temperature	0°C to 70°C (Operating)
	-40°C to 100°C (Non-operating)
Vibration	Non-operating: Sine wave, 15(G), 10~2000(Hz), Operating: Random, 7.69(GRMS), 20~2000(Hz)
Shock	Non-operating: Acceleration, 1,500 G, 0.5 ms Operating: Peak acceleration, 50 G, 11 ms

4.4 Certification and Compliance

PV170-mPCIe complies with the following standards:

- CE
- FCC
- RoHS
- MIL-STD-810F

5. Flash Management

5.1 Error Correction/Detection

PV170-mPCIe implements a hardware ECC scheme, based on the Low Density Parity Check (LDPC). LDPC is a class of linear block error correcting code which has apparent coding gain over BCH code because LDPC code includes both hard decoding and soft decoding algorithms. With the error rate decreasing, LDPC can extend SSD endurance and increase data reliability while reading raw data inside a flash chip.

5.2 Bad 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, page mapping technique and S.M.A.R.T 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.

5.3 Global Wear Leveling

Flash memory devices differ from Hard Disk Drives (HDDs) in terms of how blocks are utilized. For HDDs, when a change is made to stored data, like erase or update, the controller mechanism on HDDs will perform overwrites on blocks. Unlike HDDs, flash blocks cannot be overwritten and each P/E cycle wears down the lifespan of blocks gradually. Repeatedly program/erase cycles performed on the same memory cells will eventually cause some blocks to age faster than others. This would bring flash storages to their end of service term sooner. Global wear leveling is an important mechanism that levels out the wearing of all blocks so that the wearing-down of all blocks can be almost evenly distributed. This will increase the lifespan of SSDs.

5.4 Flash Translation Layer – Page Mapping

Page mapping is an advanced flash management technology whose essence lies in the ability to gather data, distribute the data into flash pages automatically, and then schedule the data to be evenly written. Page-level mapping uses one page as the unit of mapping. The most important characteristic is that each logical page can be mapped to any physical page on the flash memory device. This mapping algorithm allows different sizes of data to be written to a block as if the data is written to a data pool and it does not need to take extra operations to process a write command. Thus, page mapping is adopted to increase random access speed and improve SSD lifespan, reduce block erase frequency, and achieve optimized performance and lifespan.

5.5 ATA Secure Erase

ATA 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.

5.6 Power Failure Management

Power Failure Management plays a crucial role when experiencing unstable power supply. Power disruption may occur when users are storing data into the SSD. In this urgent situation, the controller would run multiple write-to-flash cycles to store the metadata for later block rebuilding. This urgent operation requires about several milliseconds to get it done. At the next power up, the firmware will perform a status tracking to retrieve the mapping table and resume previously programmed NAND blocks to check if there is any incompleteness of transmission.

5.7 TRIM

TRIM is a SATA command that helps improve the read/write performance and efficiency of solid-state drives (SSD). The command enables the host operating system to inform SSD controller which blocks contain invalid data, mostly because of the erase commands from host. The invalid will be discarded permanently and the SSD will retain more space for itself.

5.8 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.

5.9 Over-Provisioning

Over-Provisioning (OP) is a certain portion of the SSD capacity exclusively for increasing Garbage Collection (GC) efficiency, especially when the SSD is filled to full capacity or performs a heavy mixed-random workload. OP has the advantages of providing extended life expectancy, reliable data integrity, and high sustained write performance.

5.10 Hyper Cache Technology

Apacer proprietary Hyper Cache technology uses a portion of the available capacity as SLC (1bit-per-cell) NAND flash memory, called Hyper cache mode. When data is written to SSD, the firmware will direct the data to Hyper Cache mode, providing excellent performance to handle various scenarios in industrial use.

6. Security Features

6.1 End-to-End Data Protection

End-to-End Data Protection is a feature implemented in Apacer SSD products that extends error control to cover the entire path from the host computer to the drive and back, and ensure data integrity at multiple points in the path to enable reliable delivery of data transfers. Unlike ECC which does not exhibit the ability to determine the occurrence of errors throughout the process of data transmission, End-to-End Data Protection allows SSD controller to identify an error created anywhere in the path and report the error to the host computer before it is written to the drive. This error-checking and error-reporting mechanism therefore guarantees the trustworthiness and reliability of the SSD.

7. Electrical Specifications

7.1 Operating Voltage

Table 7-1 lists the supply voltage for PV170-mPCIe.

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 7-1 Operating Range

Parameter	Min.	Typical	Max.	Units
Power supply	3.13	3.3	3.46	V

7.2 Power Consumption

Table 7-2 lists the power consumption for PV170-mPCIe.

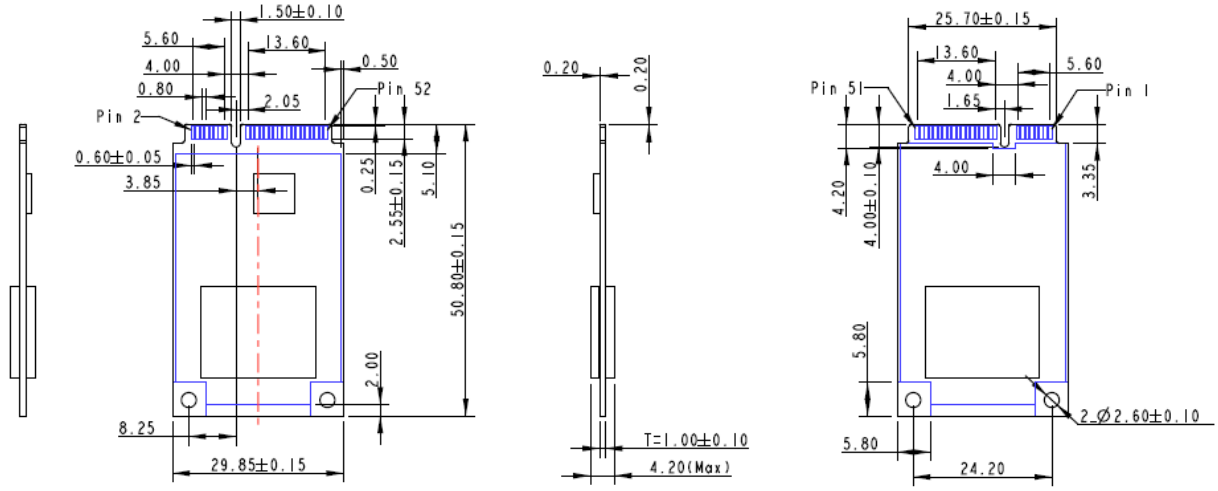
Table 7-2 Power Consumption

Capacity / Mode	30 GB	60 GB	120 GB
Active (mA)	530	580	610
Idle (mA)	360	360	360

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.

8. Physical Characteristics

8.1 Dimensions



Unit: mm
Tolerance: ± 0.25

8.2 Net Weight

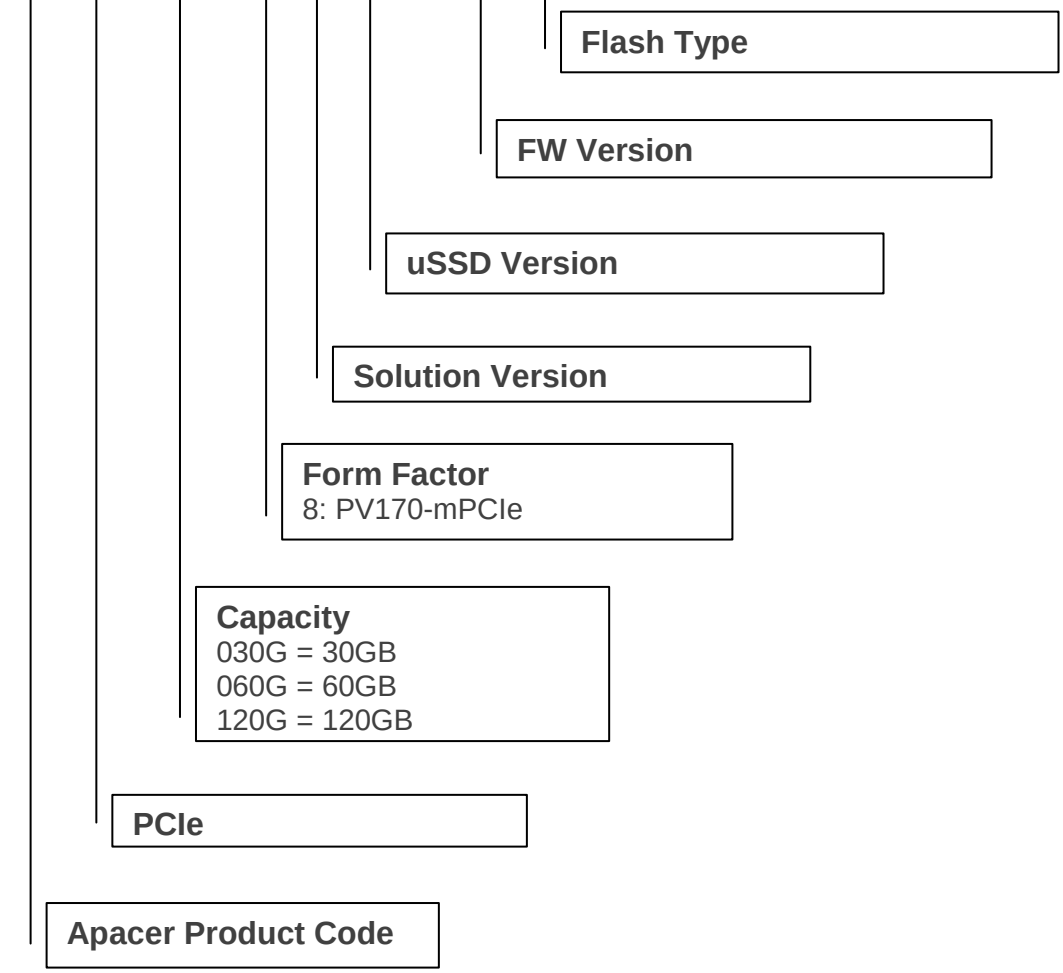
Table 8-1 Net Weight

Capacity	Net Weight (g)
30GB	5.8
60GB	5.8
120GB	5.8

9. Product Ordering Information

9.1 Product Code Designations

AP P xxxG 8 J C – A TV



9.2 Valid Combinations

Capacity	Part Number
30GB	APP030G8JC-ATV
60GB	APP060G8JC-ATV
120GB	APP120G8JC-ATV

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	9/5/2018

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