*RoHS Compliant*

# CFast 2H

*CFast 2H-M Product Specifications*

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*Version 1.1*

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# Features:

- **Standard Serial ATA Interface**
  – SATA Revision 3.1 compliance
  – SATA 6.0 Gbps interface speed
  – Backward compatible with SATA 1.5 and 3.0 Gbps interfaces
  – ATA-compatible command set

- **Connector type**
  – 7 + 17 pin female connector

- **Power consumption (typical)\***
  – Supply voltage: 3.3V
  – Active mode: 480 mA
  – Idle mode: 100 mA

- **Performance\***
  – Sustained read: Up to 520 MB/sec
  – Sustained write: Up to 175 MB/sec

- **Capacity**
  – 8, 16, 32, 64, 128 GB

- **NAND Flash Type:** MLC

- **MTBF:** >1,000,000 hours

- **Endurance**
  – 8GB: 7 TBW
  – 16GB: 14 TBW
  – 32GB: 28 TBW
  – 64GB: 57 TBW
  – 128GB: 114 TBW

- **Temperature ranges**
  – Operating:
    Standard: 0°C to 70°C
    Wide: -40°C to 85°C
  – Storage: -40°C to 85°C

- **Flash Management**
  – Built-in hardware ECC
  – Static/dynamic wear-leveling
  – Flash bad-block management
  – S.M.A.R.T.
  – Power Failure Management
  – ATA Secure Erase
  – TRIM

- **RoHS Compliant**

- **DEVSLP Supported**

*Vary from capacities. The values presented in Power consumption and Performances are typical, and may vary depending on different settings and platforms.

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# Table of Contents

# 1. General Description

Apacer CFast 2H-M is the latest enhancement of conventional CFast form factor that delivers various technological advantages. This new flash memory card comes with SATA 6.0 Gbps interface for higher performance and is compliant with standard CFast specifications. CFast 2H-M consists of SATA-based 7-pin signal segment and 17-pin for power and control purposes. It can offer moderate capacity and decent data transfer performance. For power efficiency, this new flash memory card leverages the technological benefits of SATA Revision 3.0 specifications. For data integrity, the CFast card is built with ECC engine correcting up to 72-bit. Together with its small form factor nature, Apacer CFast 2H-M is definitely the ideal solution to replace conventional PATA-based CompactFlash for applications in industrial computing systems, mobile computers and video processing instruments.

# 2. Functional Block

Apacer CFast 2H-M includes a single-chip SATA 6.0 Gbbps  and the flash media. The controller integrates the flash management unit to support multi-channel, multi-bank flash arrays. Figure 2-1 shows the functional block diagram.
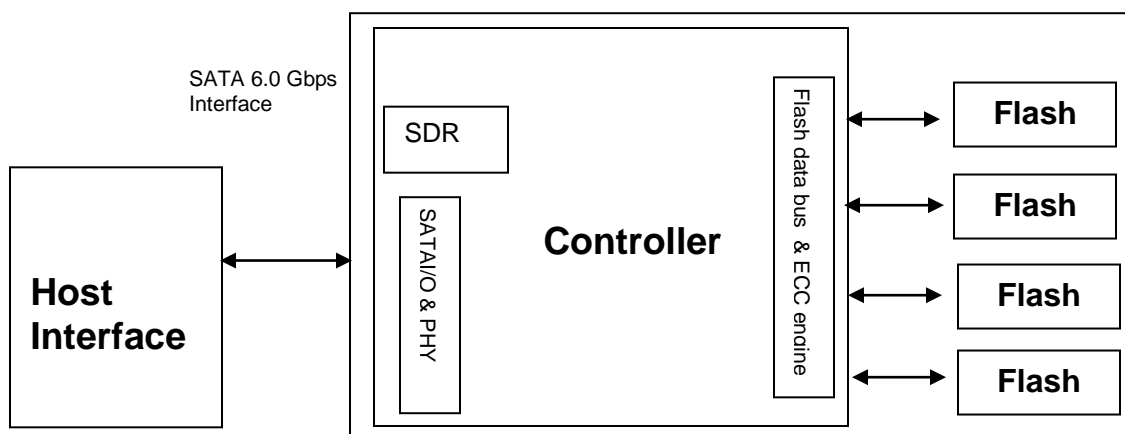


**Figure 2-1** Apacer CFast block diagram

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# 3. Pin Assignments

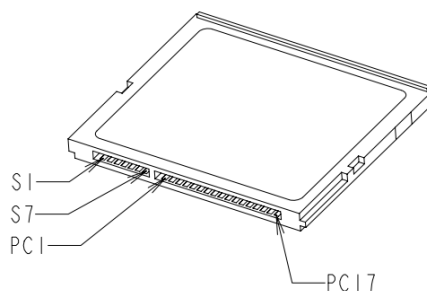Table 3-1 describes CFast 2H-M signal segment, and Table 3-2, its power segment.



**Figure 3-1** Pin Assignment

Table 3-1 Signal Segment

| Pin | Type | Description |
|-----|------|-------------|
| S1 | GND | Ground |
| S2 | A+ | SATA Differential |
| S3 | A- | Signal Pair A |
| S4 | GND | Ground |
| S5 | B- | SATA Differential |
| S6 | B+ | Signal Pair B |
| S7 | GND | Ground |

Table 3-2 Power Segment

| Pin | Definition | Type | Description |
|-----|-----------|------|-------------|
| PC1 | CDI | Input | Card Detect In |
| PC2 | PGND | Device GND | Device GND |
| PC3 | | | Reserved |
| PC4 | | | Reserved |
| PC5 | | | Reserved |
| PC6 | | | Reserved |
| PC7 | PGND | Device GND | Device GND |
| PC8 | LED1 | LED Output | LED Output |
| PC9 | LED2 | LED Output | LED Output |
| PC10 | | | Reserved |
| PC11 | | | Reserved |
| PC12 | IFDet | GND | Card output, connect to PGND on card |
| PC13 | PWR | 3.3V | Device power (3.3V) |
| PC14 | PWR | 3.3V | Device power (3.3V) |
| PC15 | PGND | Device GND | Device GND |
| PC16 | PGND | Device GND | Device GND |
| PC17 | CDO | Output | Card Detect Out |

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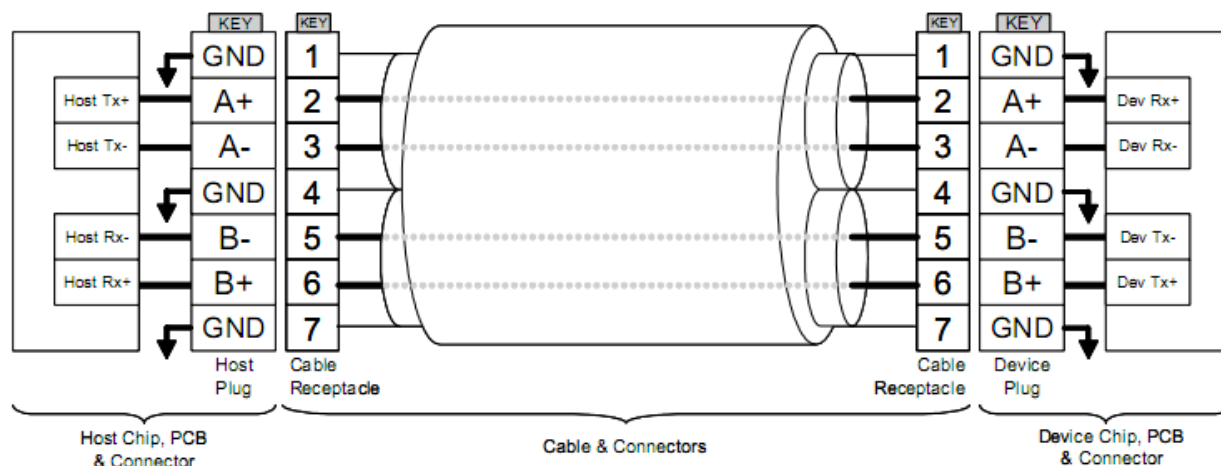
**Figure 3-2** SATA Cable / Connector Connection Diagram

The connector on the left represents the Host with TX/RX differential pairs connected to a cable while the connector on the right shows the Device with TX/RX differential pairs also connected to the cable. Notice also the ground path connecting the shielding of the cable to the Cable Receptacle.

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# 4. Product Specification

## 4.1 Capacity

Capacity specification of the CFast 2H-M is 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 |
|---|---|---|---|---|---|
| 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 CFast-M 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 CFast 2H-M product family is available as shown in Table 4-2.

**Table 4-2:** Performance table

| Capacity / Performance | 8 GB | 16 GB | 32 GB | 64 GB | 128 GB |
|---|---|---|---|---|---|
| Sustained Read (MB/s) | 155 | 305 | 325 | 520 | 520 |
| Sustained Write (MB/s) | 80 | 150 | 175 | 145 | 150 |

Note: Performances results are measured by CrystalDiskMark under Windows 7 and may vary from host system configurations.

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## 4.3 Environmental Specifications

Environmental specification of the CFast 2H-M follows the MIL-STD-810F testing standards, shown in Table 4-3.

**Table 4-3** Environmental specification

| Environment | | Specification |
|---|---|---|
| Temperature | Operation | 0°C to 70°C / -40°C to 85°C |
| | Storage | -40°C to 85°C |
| Humidity | Operation | 40°C 93%RH |
| | Storage | 40°C 95%RH |
| Vibration (Non-Operating) | | 80~2000Hz/20G (acceleration) ; 20~80Hz/1.52mn (displacement), X,Y, Z axis/30 min for each |
| Shock (Non-Operating) | | Half sine wave, 1500 G  (X, Y, Z ; All 6 axis) |
| Drop (non-operating) | | 110cm free fall, 6-face each unit |
| Bending (non-operating) | | $\geqq$20N, hold 1min/5times |
| Torque (non-operating) | | 0.5N-m or $\pm$2.5 degree, hold 5min/5times |

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 CFast 2H-M. Serving as statistical reference, the prediction result for CFast 2H-M is more than 1,000,000 hours.

## 4.5 Certification and Compliance

CFast 2H-M complies with the following standards

- CE
- FCC
- BSMI
- RoHS

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# 5. Flash Management

## 5.1 Error Correction/Detection

Flash memory cells will deteriorate with use, which might generate random bit errors in the stored data. Thus, the CFast-M applies the BCH ECC Algorithm, which can detect and correct errors up to 72-bit in 1K byte data  during Read process, ensure data been read correctly, as well as protect data from corruption.

## 5.2 Bad 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". Apacer 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.

## 5.3 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 areas 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.

## 5.4 Power Failure Management

Power Failure Management is a mechanism to prevent data loss during unexpected power failure. When power outage occurs, the data that has not been written into NAND Flash is in risk.  Thus, the purpose of this mechanism is to request the controller to transfer data to the cache. In this CFast-M 2.0 structure, SDR performs as a cache, and its sizes is 32MB. Only when the data is fully committed to the NAND flash will the controller send acknowledgement (ACK) 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, this CFast 2H-M memory card applies an algorithm to reduce the amount of data resides in the cache to provide a better performance. This allows 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.

## 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 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.

## 5.7 TRIM

TRIM is a feature which helps improve the read/write performance and speed of Solid-State Drives (SSD). Unlike Hard Disk Drives (HDD), SSDs are not able to overwrite existing data, so the available space gradually becomes smaller with each use. With the TRIM command, the operating system can inform the SSD which blocks of data are no longer in use and can be removed permanently. Thus, the SSD will perform the erase action, which prevents unused data from occupying blocks all the time.

## 5.8 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.

| Capacity | TeraBytes Written |
|---|---|
| 8 GB | 7 |
| 16 GB | 14 |
| 32 GB | 28 |
| 64 GB | 57 |
| 128 GB | 114 |

Notes:
- The measurement assumes the data written to the SSD for test is under a typical and constant rate.
- The measurement follows the standard metric: 1 TB (Terabyte) = 1000 GB.
- This estimation complies with JEDEC JESD-219, enterprise endurance workload of random data with payload size distribution.

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# 6. Software Interface

## 6.1 ATA Command Set

**Table 6-1:** Command set

| Code | Command | Code | Command |
|------|---------|------|---------|
| 06h | Data Set Management | 98h | Check Power Mode |
| 10h-1Fh | Recalibrate | 99h | Sleep |
| 20h | Read Sectors | B0h | SMART |
| 21h | Read Sectors without Retry | B1h | Device Configuration |
| 24h | Read Sectors EXT | C4h | Read Multiple |
| 25h | Read DMA EXT | C5h | Write Multiple |
| 27h | Read Native Max Address EXT | C6h | Set Multiple Mode |
| 29h | Read Multiple EXT | C8h | Read DMA |
| 2Fh | Read Log EXT | C9h | Read DMA without Retry |
| 30h | Write Sectors | CAh | Write DMA |
| 31h | Write Sectors without Retry | CBh | Write DMA without Retry |
| 34h | Write Sectors EXT | CEh | Write Multiple FUA EXT |
| 35h | Write DMA EXT | E0h | Standby immediate |
| 37h | Set Native Max Address EXT | E1h | Idle Immediate |
| 38h | CFA Write Sectors without Erase | E2h | Standby |
| 39h | Write Multiple EXT | E3h | Idle |
| 3Dh | Write DMA FUA EXT | E4h | Read Buffer |
| 3Fh | Write Long EXT | E5h | Check Power Mode |
| 40h | Read Verify Sectors | E6h | Sleep |
| 41h | Read Verify Sectors without Retry | E7h | Flush Cache |
| 42h | Read Verify Sectors EXT | E8h | Write Buffer |
| 45h | Write Uncorrectable EXT | EAh | Flush Cache EXT |
| 60h | Read FPDMA Queued | ECh | Identify Device |
| 61h | Write FPDMA Queued | EFh | Set Features |
| 70h-7Fh | Seek | F1h | Security Set Password |
| 90h | Execute Device Diagonstic | F2h | Security Unlock |
| 91h | Initialize Device Parameters | F3h | Security Erase Prepare |
| 92h | Download Microcode | F4h | Security Erase Unit |
| 93h | Download Microcode DMA | F5h | Security Freeze Lock |
| 94h | Standby Immediate | F6h | Security Disable Password |
| 95h | Idle Immediate | F8h | Read Native Max Address |
| 96h | Standby | F9h | Set Max Address |
| 97h | Idle | | |

# 7. Electrical Specification

## 7.1 Operating Voltage

Table 7-1 lists operating voltage of CFast-M 2.0.

**Table 7-1:** Operating voltage

| Parameter | Symbol | Min | Typ | Max | Units |
|---|---|---|---|---|---|
| Power Supply | Vcc | 3.135 | 3.3 | 3.465 | V |

## 7.2 Power Consumption

Table 7-2 lists power consumption of CFast-M 2.0.

**Table 7-2** Power consumption (typical)

| Mode \ Capacity | 8 GB | 16 GB | 32 GB | 64 GB | 128 GB |
|---|---|---|---|---|---|
| Active (mA) | 225 | 305 | 320 | 470 | 480 |
| Standby (mA) | 80 | 80 | 80 | 100 | 100 |

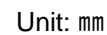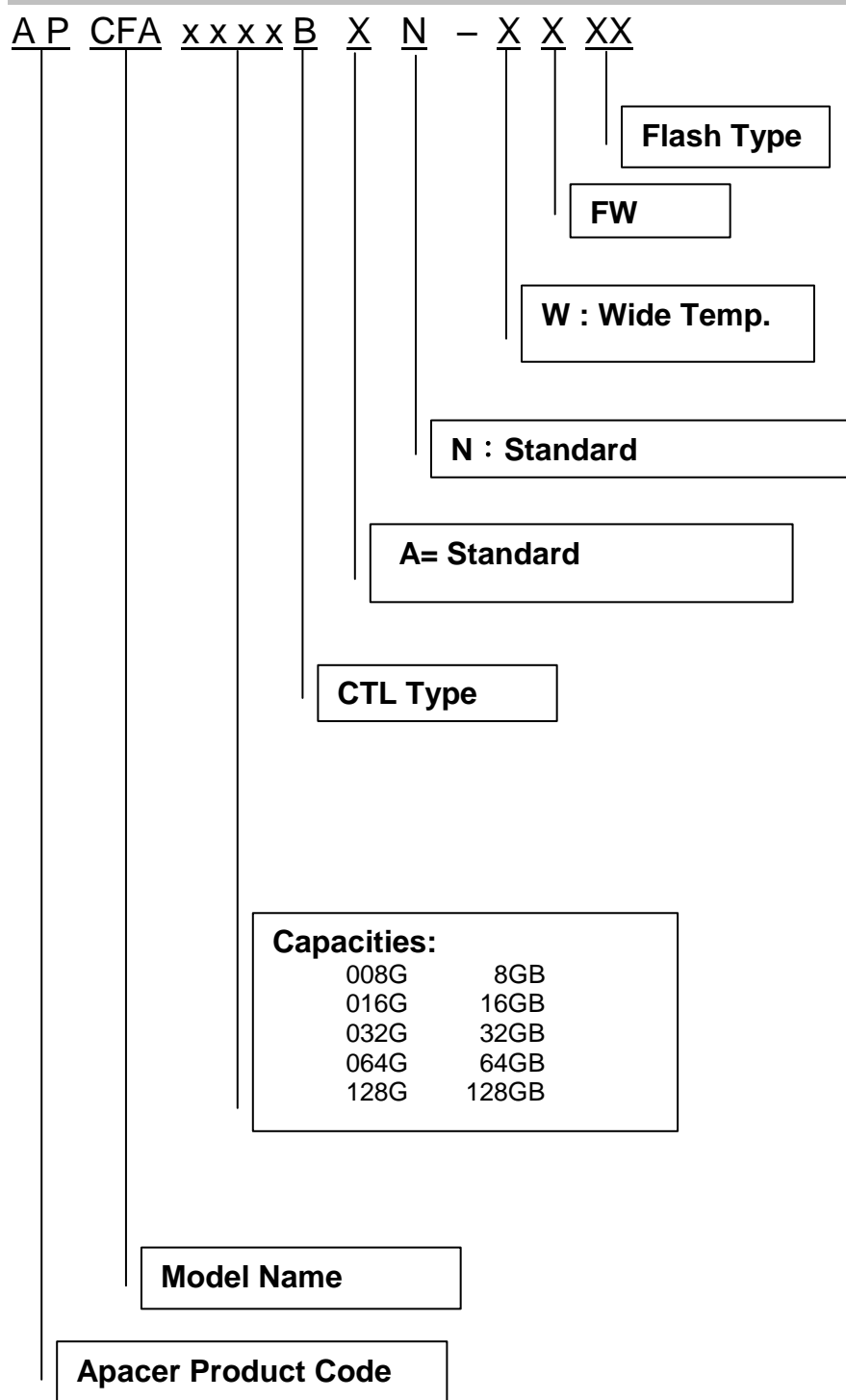Note: Power consumption may vary from flash configurations and/or platform settings.

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# 8. Physical Characteristics

## 8.1 Dimensions



Unit: ㎜

**FIGURE 8-1:** Physical dimension

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# 9. Product Ordering Information

## 9.1 Product Code Designations

A P CFA x x x x B X N – X X XX

Flash Type

FW

W : Wide Temp.

N：Standard

A= Standard

CTL Type

**Capacities:**

| | |
|---|---|
| 008G | 8GB |
| 016G | 16GB |
| 032G | 32GB |
| 064G | 64GB |
| 128G | 128GB |

**Model Name**

**Apacer Product Code**

## 9.2    Valid Combinations

### 9.2.1  Standard Temperature

| Capacity | AP/N |
|---|---|
| 8GB | APCFA008GBAN-DTM |
| 16GB | APCFA016GBAN-DTM |
| 32GB | APCFA032GBAN-DTM |
| 64GB | APCFA064GBAN-DTM |
| 128GB | APCFA128GBAN-DTM |

### 9.2.2  Wide Temperature

| Capacity | AP/N |
|---|---|
| 8GB | APCFA008GBAN-WDTM |
| 16GB | APCFA016GBAN-WDTM |
| 32GB | APCFA032GBAN-WDTM |
| 64GB | APCFA064GBAN-WDTM |
| 128GB | APCFA128GBAN-WDTM |

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# Revision History

| Revision | Date | Description | Remark |
|---|---|---|---|
| 0.1 | 09/22/2014 | Preliminary | |
| 0.2 | 10/13/2014 | Added Product Ordering Information | |
| 0.3 | 11/11/2014 | Revised Product Ordering Information | |
| 1.0 | 12/30/2014 | Official release | |
| 1.1 | 07/06/2015 | - Revised product ordering information<br>- Added endurance information | |

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