

RoHS Compliant

CFast 2H

CFast 2H Product Specifications

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Version 1.3



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Specifications Overview:

- **Standard Serial ATA Interface**
 - SATA Revision 3.1 compliance
 - SATA 6 Gb/s interface speed
 - Backward compatible with SATA 1.5 and 3 Gb/s interfaces
 - ATA-compatible command set
- **Capacity**
 - 2, 4, 8, 16, 32, 64 GB
- **Performance***
 - Sequential read: Up to 515 MB/sec
 - Sequential write: Up to 145 MB/sec
- **Flash Management**
 - Built-in hardware ECC
 - Global Wear Leveling
 - Flash bad-block management
 - S.M.A.R.T.
 - Power Failure Management
 - Device Sleep
 - ATA Secure Erase
 - TRIM
- **NAND Flash Type: SLC**
- **MTBF: >2,000,000 hours**
- **Temperature Range**
 - Operating:
 - Standard: 0°C to 70°C
 - Wide: -40°C to 85°C
 - Storage: -40°C to 100°C
- **Supply Voltage**
 - 3.3 V \pm 5%
- **Power Consumption***
 - Active mode: 540 mA
 - Idle mode: 85 mA
- **Connector Type**
 - 7 + 17 pin female connector
- **Shock & Vibration****
 - Shock: 1,500 G
 - Vibration: 15 G
- **RoHS Compliant**

*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

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1. General Descriptions

Apacer CFast 2H is the latest enhancement of conventional CFast form factor that delivers various technological advantages. This new flash memory card comes with SATA 6 Gb/s interface for higher performance and is compliant with standard CFast specifications. CFast 2H 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 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 includes a single-chip SATA 6 Gb/s 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.

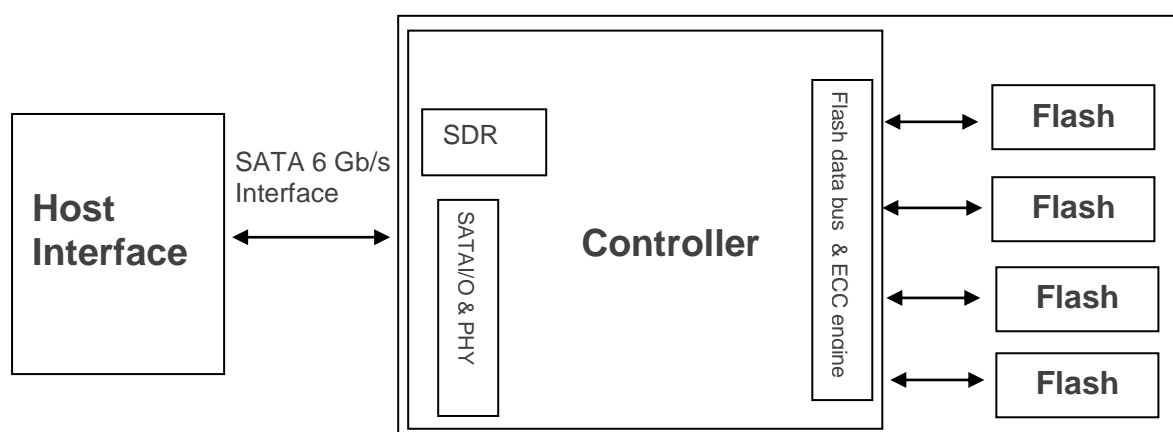


Figure 2-1 Functional Block Diagram

3. Pin Assignments

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

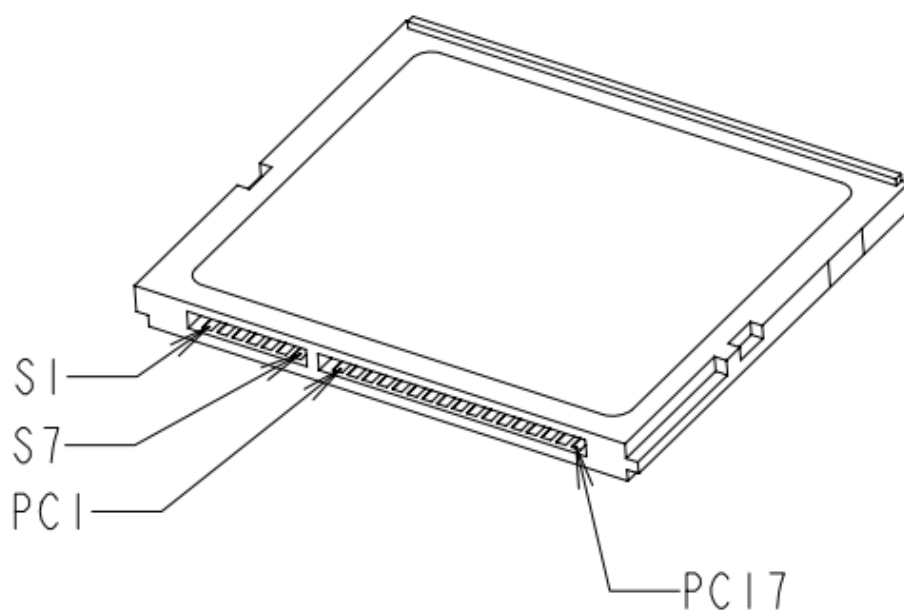


Figure 3-1 Pin Assignment

Table 3-1 Signal Segment

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

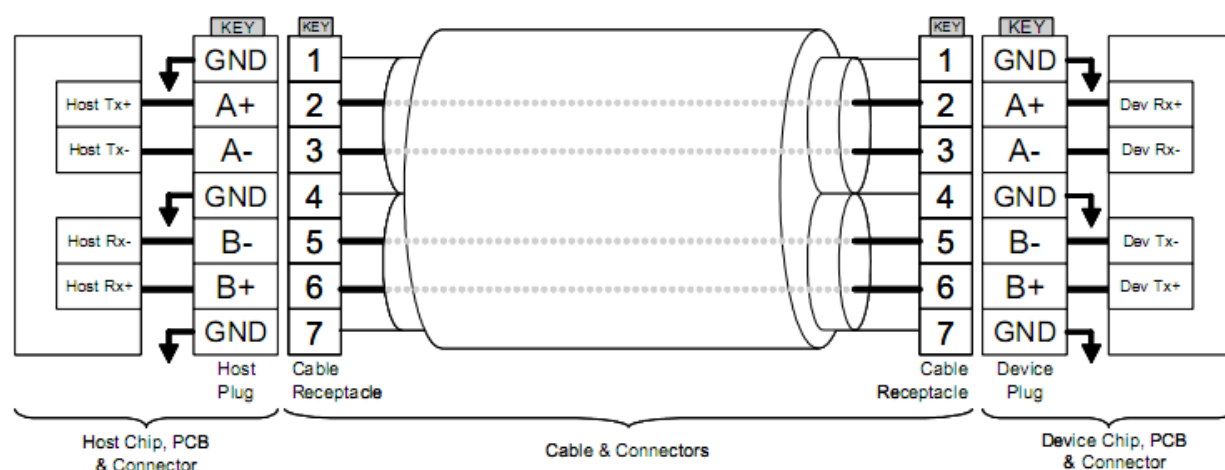


Figure 3-2 SATA Cable / Connector Connection Diagram

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.

4. Product Specifications

4.1 Capacity

Capacity specifications of CFast 2H 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
2 GB	2,011,226,112	3,897	16	63	3,928,176
4 GB	4,011,614,208	7,773	16	63	7,835,184
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

*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 CFast 2H is listed below in Table 4-2.

Table 4-2 Performance Specifications

Capacity	2 GB	4 GB	8 GB	16 GB	32 GB	64 GB
Performance						
Sequential Read* (MB/s)	65	65	280	510	495	515
Sequential Write* (MB/s)	35	50	80	140	140	145

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.

4.3 Environmental Specifications

Environmental specifications of CFast 2H product are shown in Table 4-3.

Table 4-3 Environmental Specifications

Item	Specifications
Operating temp.	0°C to 70°C (Standard); -40°C to 85°C (Wide)
Non-operating temp.	-40°C to 100°C
Operating vibration	7.69 GRMS, 20~2000 Hz/random (compliant with MIL-STD-810G)
Non-operating vibration	4.02 GRMS, 15~2000 Hz/random (compliant with MIL-STD-810G)
Operating shock	50G, 11ms
Non-operating shock	1500G, 0.5ms (compliant with MIL-STD-883K)

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. The prediction result for CFast 2H is more than 2,000,000 hours.

Note: The MTBF is predicated and calculated based on “Telcordia Technologies Special Report, SR-332, Issue 2” method.

4.5 Certification and Compliance

CFast 2H complies with the following standards:

- CE
- FCC
- BSMI
- RoHS
- MIL-STD-810G

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

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 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.

5.5 Power Failure Management

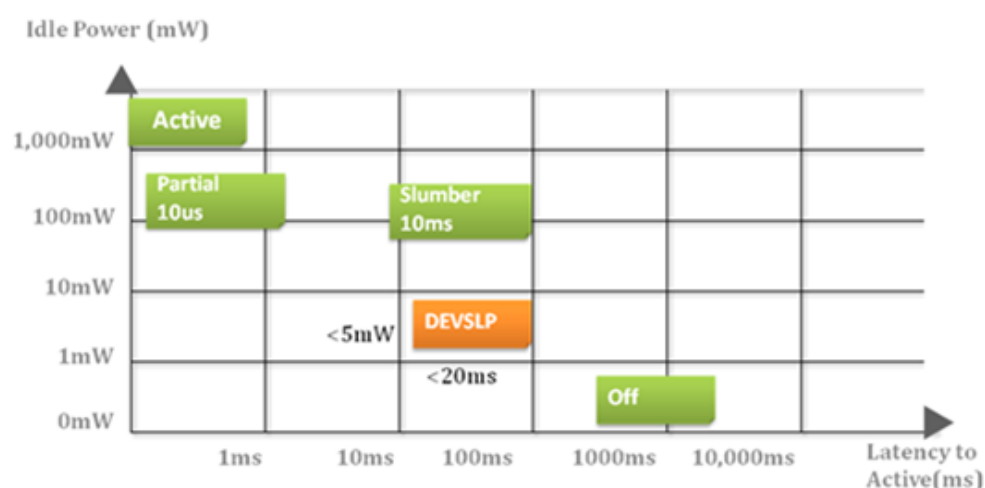
Power Failure Management plays a crucial role when experiencing unstable power supply. Power disruption may occur when users are storing data into the SSD. In this urgent situation, the controller would run multiple write-to-flash cycles to store the metadata for later block rebuilding. This urgent operation 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.

5.6 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.

5.7 DEVSLP (DevSleep or DEVSLP) Mode

Device Sleep is a feature that allows SATA devices to enter a low power mode by designating a particular pin as DEVSLP signal with an aim to reducing power consumption.



Parameter	Description & Conditions	SATA, mSATA, M.2	
		Min	Max
V_{DIn}	Tolerated input voltage.	-0.5 V	3.6 V
$V_{HAssert}$	Voltage presented to host if signal not driven low. Value specified for all allowable $I_{HAssert}$.	-	2.4 V
$I_{HNegate}$	Device current delivered to host if host driving signal low. Value specified at $V_{HNegate}$ voltage of 0 V.	-	100 μ A

6. Software Interface

6.1 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	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	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		

6.2 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.

Apacer devices use the standard SMART command B0h to read data out from the drive to activate our S.M.A.R.T. feature that complies with the ATA/ATAPI specifications. S.M.A.R.T. Attribute IDs shall include initial bad block count, total later bad block count, maximum erase count, average erase count, power on hours and power cycle. When the S.M.A.R.T. Utility running on the host, it analyzes and reports the disk status to the host before the device reaches in critical condition.

Note: Attribute IDs may vary from product models due to various solution design and supporting capabilities.

Apacer memory products come with S.M.A.R.T. commands and subcommands for users to obtain information of drive status and to predict potential drive failures. Users can take advantage of the following commands/subcommands to monitor the health of the drive.

Code	SMART Subcommand
D0h	READ DATA
D1h	READ ATTRIBUTE THRESHOLDS
D2h	ENABLE/DISABLE ATTRIBUTE AUTOSAVE
D4h	EXECUTE OFF-LINE IMMEDIATE
D5h	SMART READ LOG
D6h	SMART WRITE LOG
D8h	ENABLE OPERATIONS
D9h	DISABLE OPERATIONS
DAh	RETURN STATUS

General SMART attribute structure

Byte	Description
0	ID (Hex)
1 – 2	Status Flag
3	Value
4	Worst
5*-11	Raw Data

*Byte 5: LSB

SMART attribute ID list

ID (Hex)	Attribute Name
9 (0x09)	Power-on Hours
12 (0x0C)	Power Cycle Count
163 (0xA3)	Max. Erase Count
164 (0xA4)	Avg. Erase Count
166 (0xA6)	Total Later Bad Block Count
167 (0xA7)	SSD Protect Mode (Vendor Specific)
168 (0xA8)	SATA PHY Error Count
171 (0xAB)	Program Fail Count
172 (0xAC)	Erase Fail Count
175 (0xAF)	Bad Cluster Table Count
192 (0xC0)	Unexpected Power Loss Count
194 (0xC2)	Temperature
231 (0xE7)	Lifetime Left
241 (0xF1)	Total Sectors of Write

7. Electrical Specifications

7.1 Operating Voltage

Table 7-1 lists the supply voltage for CFast 2H.

Table 7-1 Operating Range

Parameter	Symbol	Min	Type	Max	Units
Power Supply	Vcc	3.135	3.3	3.465	V

7.2 Power Consumption

Table 7-2 lists the power consumption for CFast 2H.

Table 7-2 Power Consumption

Capacity Mode	2 GB	4 GB	8GB	16 GB	32 GB	64 GB
Active (mA)	210	225	340	500	515	540
Idle (mA)	65	65	85	85	85	85

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

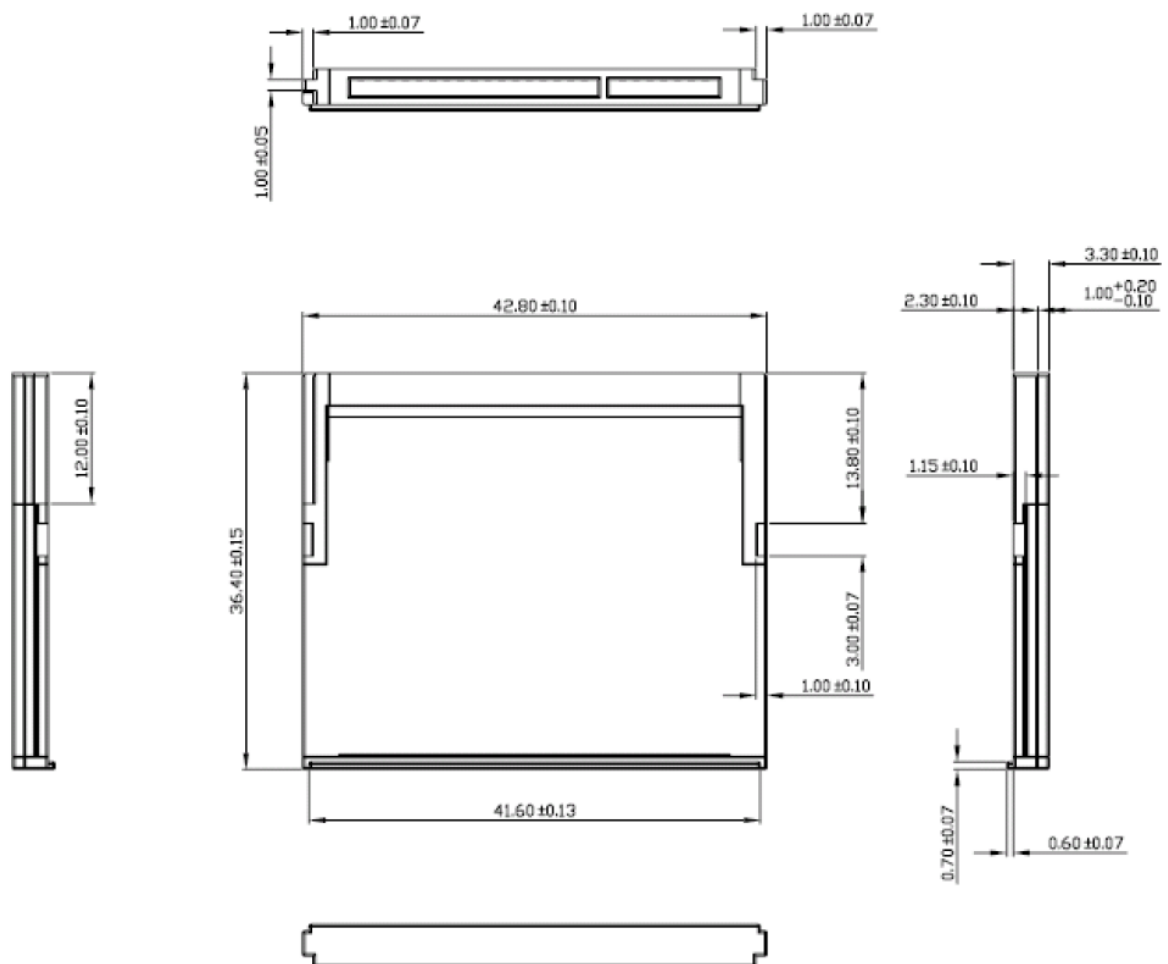
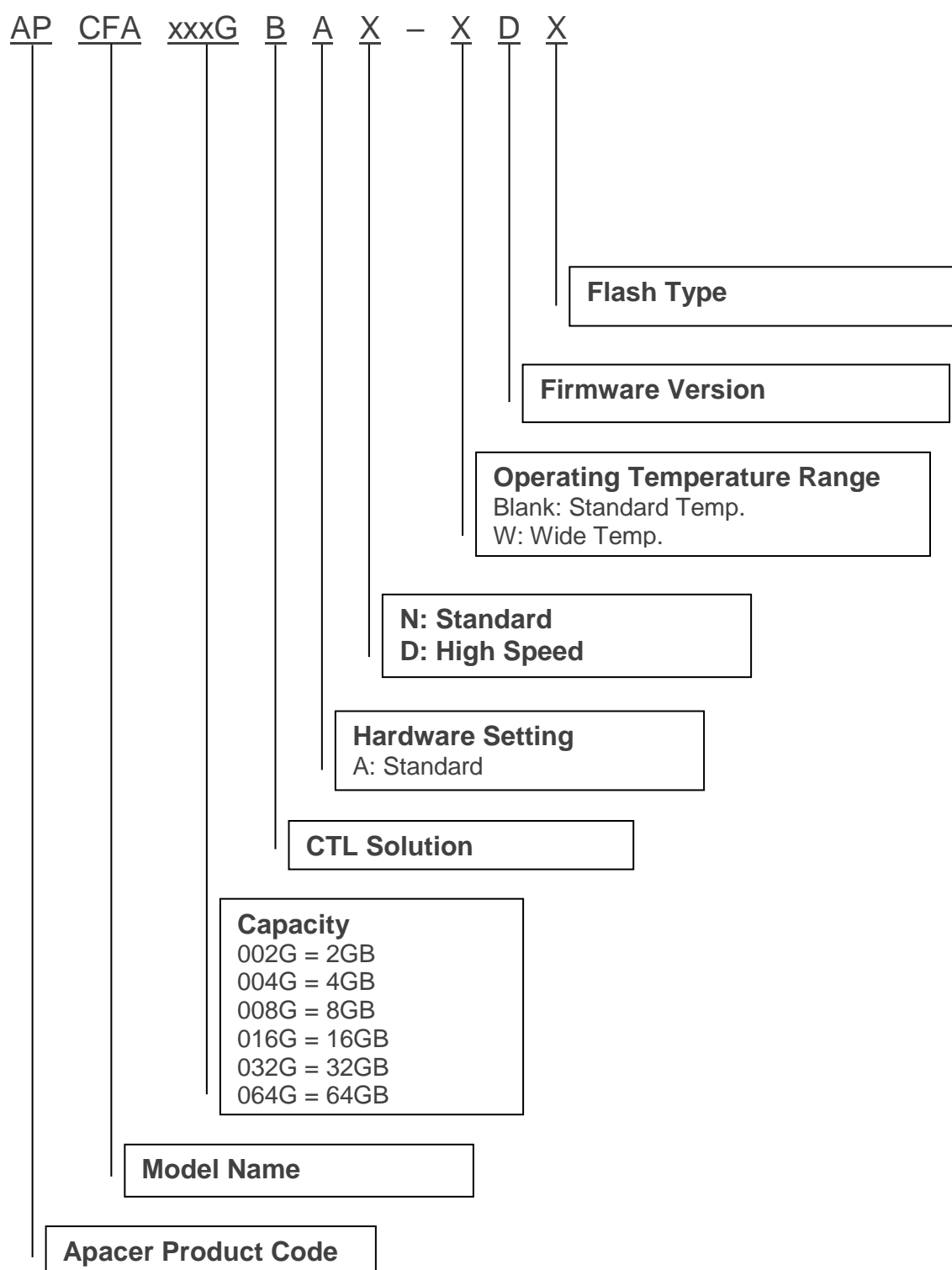


Figure 8-1 Physical Dimensions

Unit: mm

9. Product Ordering Information

9.1 Product Code Designations



9.2 Valid Combinations

Capacity	Standard Temperature	Wide Temperature
2GB	APCFA002GBAN-DT	APCFA002GBAN-WDT
4GB	APCFA004GBAN-DT	APCFA004GBAN-WDT
8GB	APCFA004GBAD-DT	APCFA004GBAD-WDT
16GB	APCFA004GBAD-DT	APCFA004GBAD-WDT
32GB	APCFA004GBAD-DT	APCFA004GBAD-WDT
64GB	APCFA004GBAD-DT	APCFA004GBAD-WDT

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	11/28/2014
1.1	Revised 5.5 SMART section	12/3/2014
1.2	Revised product ordering information	7/6/2015
1.3	<ul style="list-style-type: none"> - Changed extended temperature to wide temperature - Changed SATA 6.0 Gbps to SATA 6 Gb/s in accordance with SATA naming guidelines - Updated operating/non-operating vibration spec at Table 4-3 Environmental Specifications - Added MIL-STD-810G to 4.5 Certification and Compliance - Capitalized every letter for commands at 6.1 Command Set 	3/20/2020

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