RoHS Compliant

CFast 2H

CFast 2H Product Specifications

July 6, 2015

Version 1.2

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

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: 540 mA
  - Idle mode: 85 mA
- **Performance***
  - Sustained read: Up to 515 MB/sec
  - Sustained write: Up to 145 MB/sec
- **Capacity**
  - 2, 4, 8, 16, 32, 64 GB
- **NAND Flash Type:** SLC
- **MTBF:** >2,000,000 hours
- **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**

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

Table of Contents

1. General Description

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 6.0 Gbps 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 6.0 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.

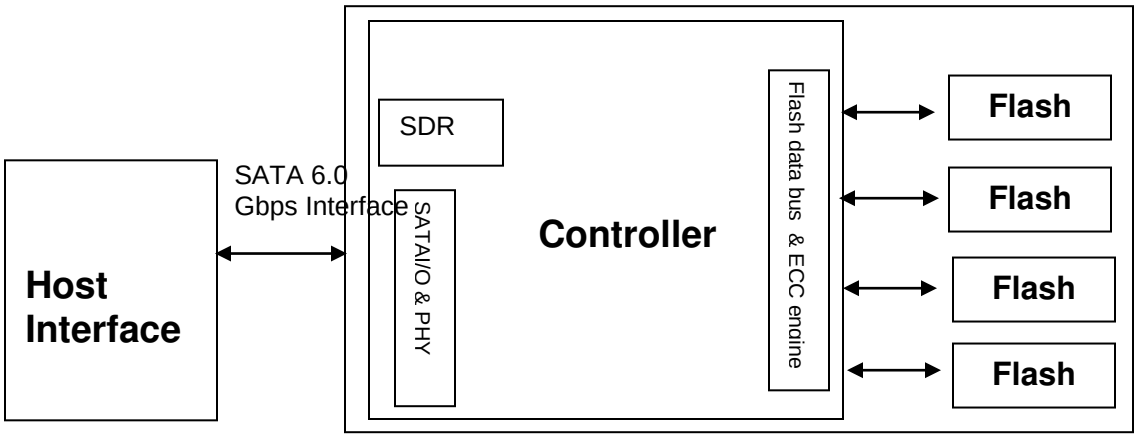


Figure 2-1 Apacer CFast block diagram

3. Pin Assignments

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

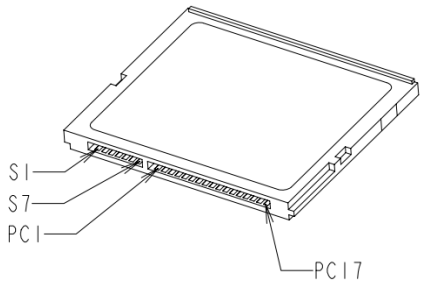


Figure 3-1 Pin Assignment

Table 3-1 Signal Segment

Pin	Type	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

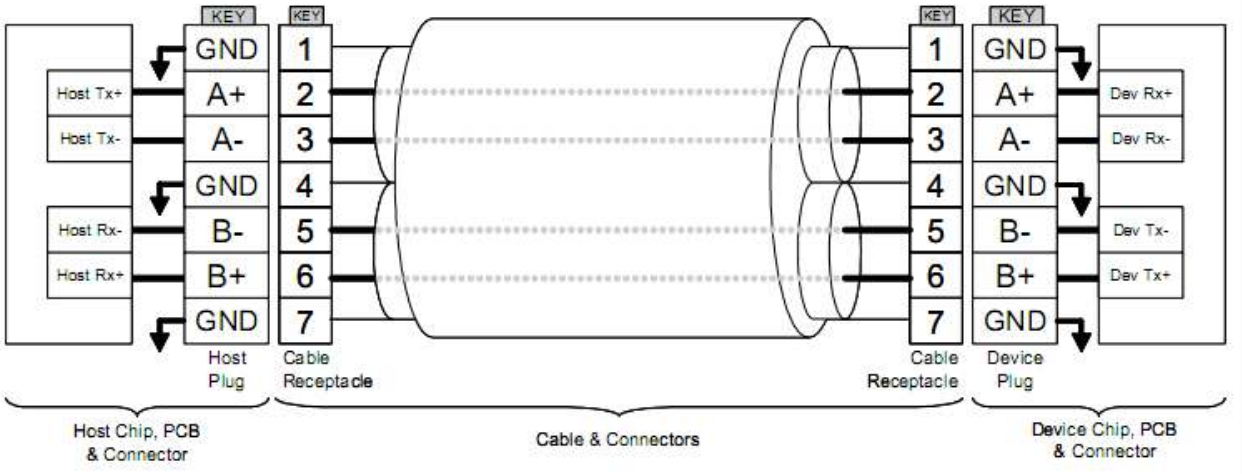


Figure 3-2 SATA Cable / Connector Connection Diagram

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 Specification

4.1 Capacity

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

Table 4-2: Performance table

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

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

4.3 Environmental Specifications

Environmental specification of the CFast 2H 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)		≧20N, hold 1min/5times
Torque (non-operating)		0.5N-m or ±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. Serving as statistical reference, the prediction result for CFast 2H is more than 2,000,000 hours.

4.5 Certification and Compliance

CFast 2H complies with the following standards

- CE
- FCC
- BSMI
- RoHS

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 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 2H 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 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.

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	READ LOG (OPTIONAL)
D6H	WRITE LOG (OPTIONAL)
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
175 (0xAF)	BAD CLUSTER TABLE COUNT
192 (0xC0)	UNEXPECTED POWER LOSS COUNT
194 (0xC2)	TEMPERATURE
241 (0xF1)	TOTAL SECTORS OF WRITE

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.

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 2H

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 2H

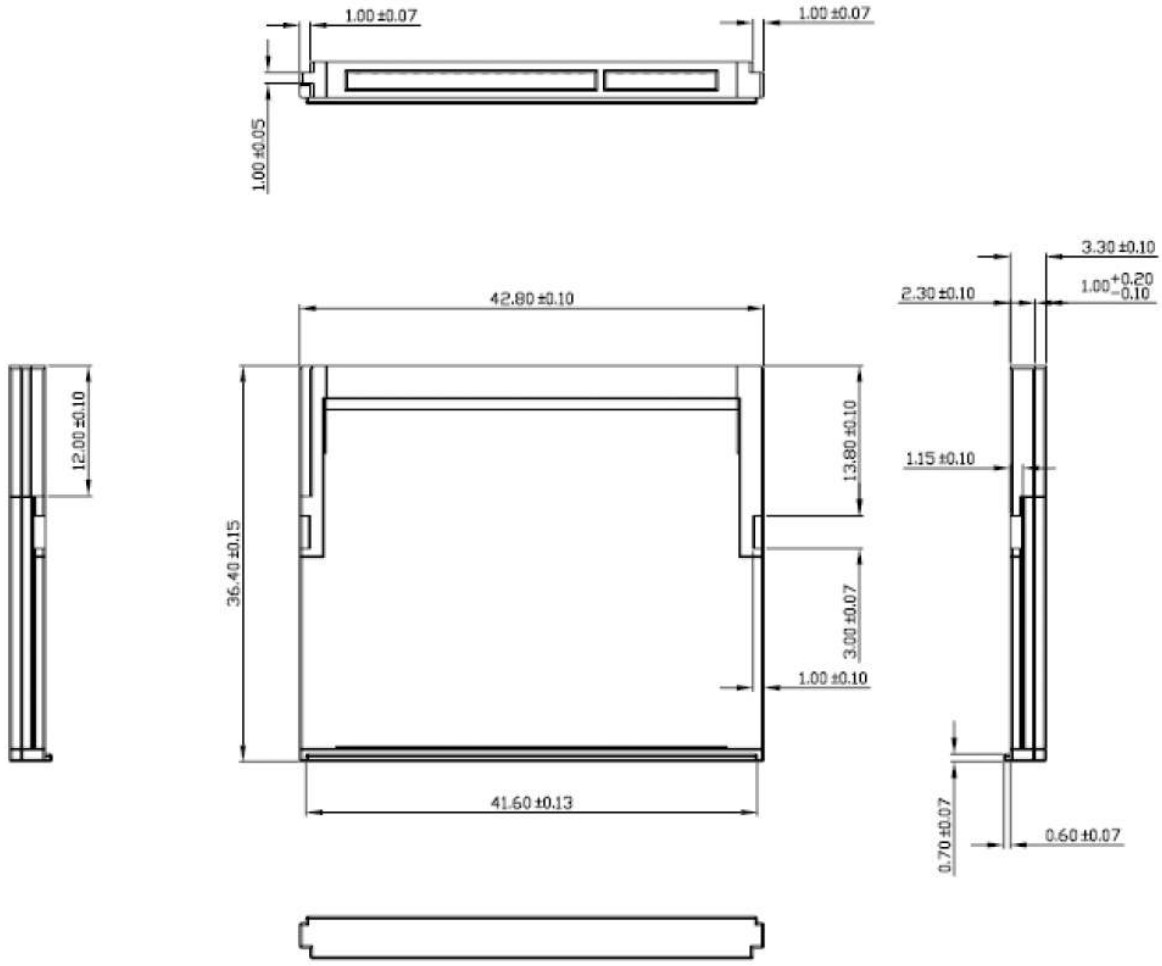
Table 7-2 Power consumption (typical)

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

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

8. Physical Characteristics

8.1 Dimensions

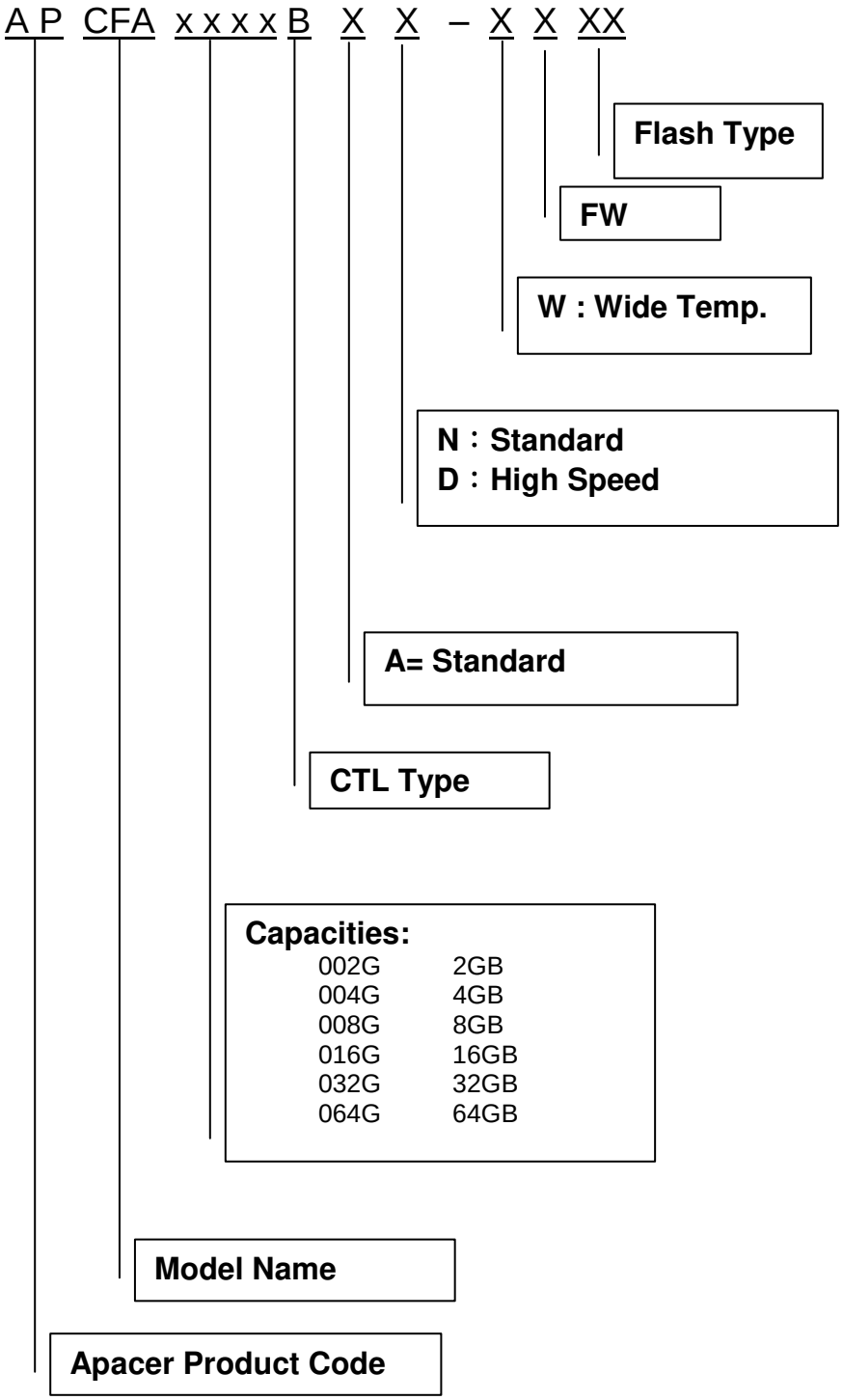


Unit: mm

FIGURE 8-1: Physical dimension

9. Product Ordering Information

9.1 Product Code Designations



9.2 Valid Combinations

9.2.1 Standard Temperature

Capacity	*AP/N*
2GB	APCFA002GBAN-DT
4GB	APCFA004GBAN-DT
8GB	APCFA008GBAD-DT
16GB	APCFA016GBAD-DT
32GB	APCFA032GBAD-DT
64GB	APCFA064GBAD-DT

9.2.2 Wide Temperature

Capacity	*AP/N*
2GB	APCFA002GBAN-WDT
4GB	APCFA004GBAN-WDT
8GB	APCFA008GBAD-WDT
16GB	APCFA016GBAD-WDT
32GB	APCFA032GBAD-WDT
64GB	APCFA064GBAD-WDT

Revision History

Revision	Date	Description	Remark
1.0	11/28/2014	Official Released	
1.1	12/03/2014	Revised 5.6 SMART section	
1.2	07/06/2015	Revised product ordering information	

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.
386 Fairview Way, Suite102,
Milpitas, CA 95035
Tel: 1-408-518-8699
Fax: 1-408-935-9611
sa@apacerus.com

Japan

Apacer Technology Corp.
5F, Matsura Bldg., Shiba, Minato-Ku
Tokyo, 105-0014, 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: 31-40-267-0000#6199
sales@apacer.nl

China

Apacer Electronic (Shanghai) Co., Ltd
1301, No.251,Xiaomuqiao Road, Shanghai,
200032, China
Tel: 86-21-5529-0222
Fax: 86-21-5206-6939
sales@apacer.com.cn

India

Apacer Technologies Pvt Ltd,
535, 1st Floor, 8th cross, JP Nagar 3rd Phase,
Bangalore – 560078, India
Tel: 91-80-4152-9061
sales_india@apacer.com