

***RoHS Compliant***

**CFast**

***Product Specifications***

**May 29<sup>th</sup>, 2012**

**Version 1.1**

**Apacer**  
*Access the best*

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## Features:

- **Standard Serial ATA 2.6 (Gen. 2)**
  - SATA II, 3.0 Gbps
  - ATA-compatible command set
  - ATA modes support
- **Connector type**
  - 7 + 17 pin female connector
- **Power consumption (typical)\*\***
  - Supply voltage: 3.3V
  - Active mode: 360 mA
  - Idle mode: 85 mA
- **Performance\*\***
  - Sustained read: Up to 160 MB/sec
  - Sustained write: Up to 140 MB/sec
- **Capacity**
  - 4, 8, 16, 32, 64 GB
- **NAND Flash Type:** SLC
- **MTBF:** >2,000,000
- **Temperature ranges**
  - Operation:
    - Standard: 0 °C to 70 °C
    - ET\*: -40 °C to 85 °C
  - Storage: -40 °C to 100 °C
- **Intelligent endurance design**
  - Built-in hardware ECC, enabling up to 16/24 bit correction per 1K bytes
  - Dynamic/Static wear-leveling scheme together with dynamical block allocation to significantly increase the lifetime of a flash device and optimize the disk performance
  - Flash bad-block management
  - S.M.A.R.T.
  - Power Failure Management
  - ATA Secure Erase
  - TRIM
- **RoHS Compliant**

\*Extended Temperature

\*\*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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## 1. General Description

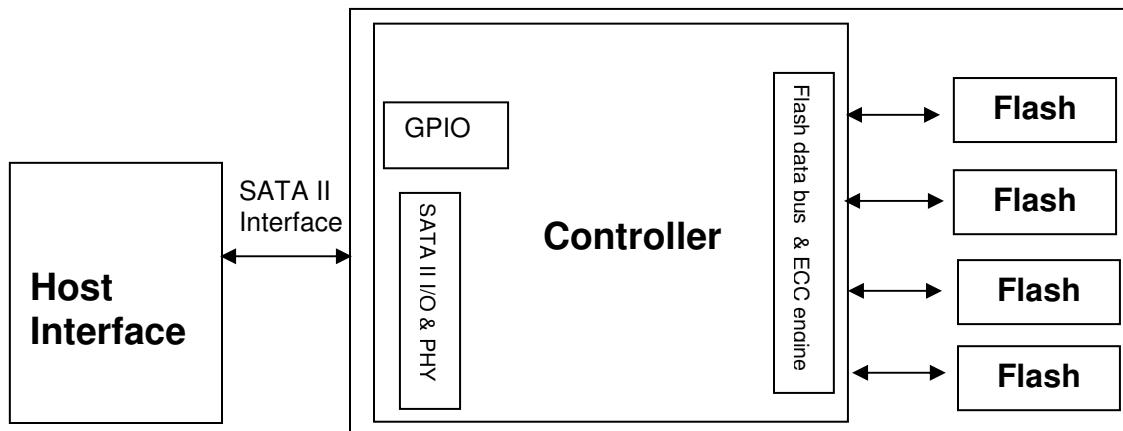
CFast emerges as the evolution of the CompactFlash card, by adopting SATA transfer bus rather than PATA, which delivers a much higher data transfer rate required in industrial and enterprise storage usages. Although not backward compatible with its former CF form factor, CFast proves to be a more advanced embedded solution for cache, storage acceleration, communication and networking applications that require small physical fit.

Apacer CFast is designed with a powerful controller that easily breaks the performance limit for CompactFlash by delivering the transfer rate up to 160 MB/s while maintaining the reliability and power efficiency inherited from its former. Leveraging from CompactFlash form factor and SATA interface, CFast can be integrated into host computing system without excessive BIOS configurations and driver installations.

In addition to its performance, Apacer CFast is designed with reliability and data integrity. The CFast card adopts static wear-leveling to average the use of all flash blocks to prolong the lifetime and improve block efficiency of flash media. A built-in powerful ECC engine operates at hardware level for error correction and detection. With its well-organized architecture, CFast is an ideal storage device for industrial, enterprise and mobile applications.

## 2. Functional Block

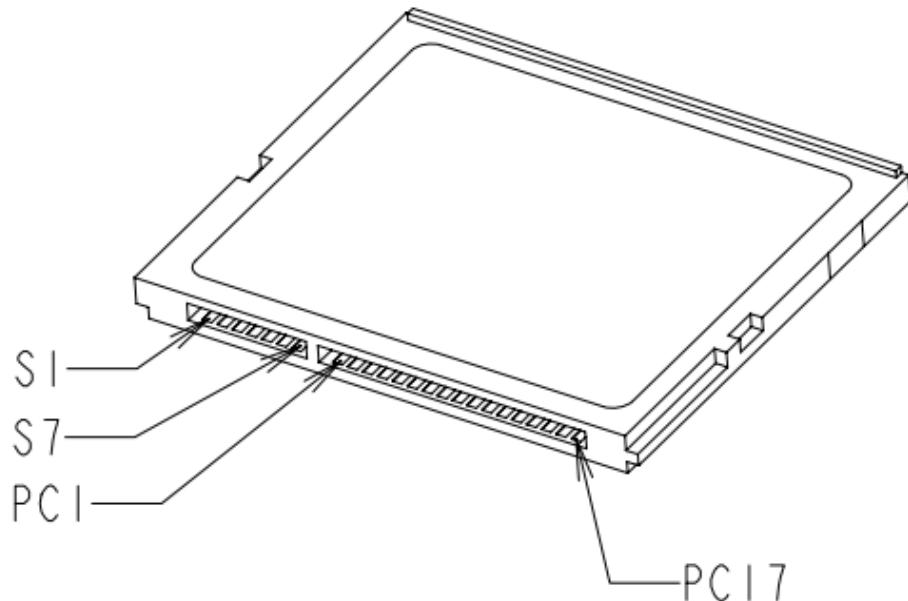
Apacer CFast includes a single-chip SATA II Controller and the flash media. The controller integrates the flash management unit to support multi-channel, multi-bank flash arrays. Figure 2-1 shows the functional block diagram.



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

### 3. Pin Assignments

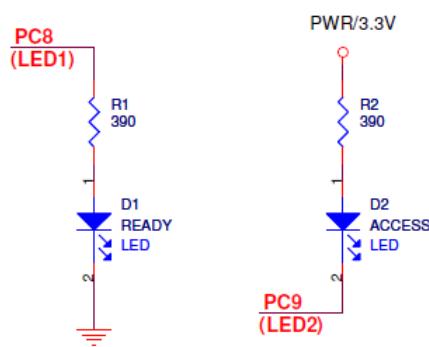
Table 3-1 describes CFast signal segment, and Table 3-2, its power segment.



**Figure 3-1** Pin Assignment

**Table 3-1:** Signal segment

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

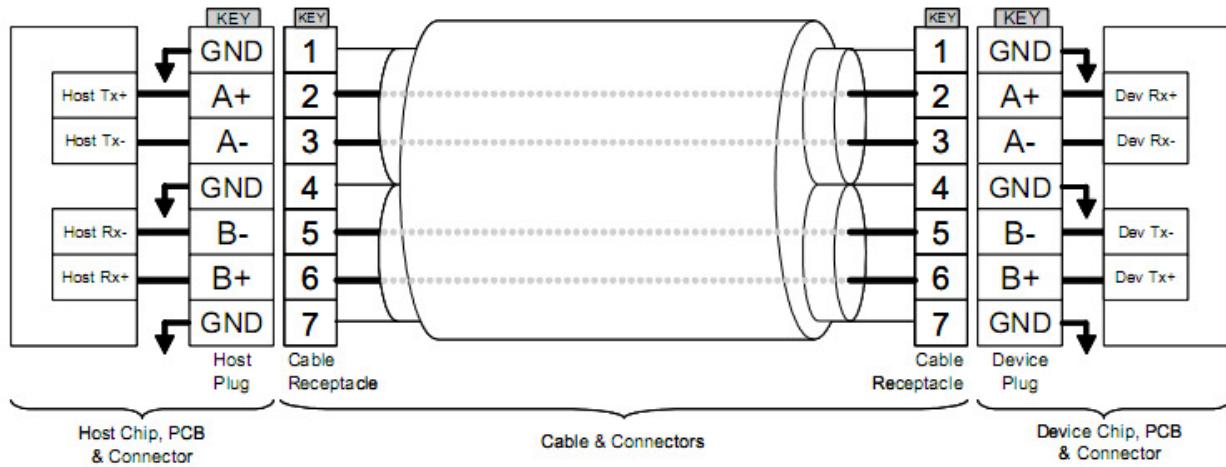


\*Refer above for LED output design guide

**Table 3-2:** Power segment

| Pin  | Name | Type        | Description         |
|------|------|-------------|---------------------|
| PC1  | CDI  | CMOS Input  | Card Detect In      |
| PC2  | GND  | Device GND  |                     |
| PC3  | TBD  | TBD         |                     |
| PC4  | TBD  | TBD         |                     |
| PC5  | TBD  | TBD         |                     |
| PC6  | TBD  | TBD         |                     |
| PC7  | GND  | Device GND  |                     |
| PC8* | LED1 | LED Output  | Ready               |
| PC9* | LED2 | LED Output  | Access              |
| PC10 | IO1  | CMOS I/O    | Reserved I/O        |
| PC11 | IO2  | CMOS I/O    | Write Protect**     |
| PC12 | IO3  | CMOS I/O    | Reserved I/O        |
| 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  | CMOS Output | Card Detect Out     |

\*\*Enabled by adjusting the pin "PC11" from high to low active



**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. Capacity Specification

Capacity specification of the CFast 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     |
|----------|----------------|-----------|-------|---------|-------------|
| 4 GB     | 4,011,614,208  | 7773      | 16    | 63      | 7,835,184   |
| 8 GB     | 8,012,390,400  | 15525     | 16    | 63      | 15,649,200  |
| 16 GB    | 16,013,942,784 | 16383     | 16    | 63      | 31,277,232  |
| 32 GB    | 32,017,047,552 | 16383     | 16    | 63      | 62,533,296  |
| 64 GB    | 64,023,257,088 | 16383     | 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

### 4.1 Performance

Performance of CFast product family is available as shown in Table 4-2.

**Table 4-2:** Performance table

| Capacity<br>Performance | 4 GB | 8 GB | 16 GB | 32 GB | 64 GB |
|-------------------------|------|------|-------|-------|-------|
| Sustained Read (MB/s)   | 140  | 150  | 150   | 160   | 160   |
| Sustained Write (MB/s)  | 55   | 100  | 100   | 140   | 140   |

Note: Performances results are measured by CrystalDiskMark under Windows XP SP3 and may vary from host system configurations.

## 4.2 Environmental Specifications

Environmental specification of the CFast 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 (Standard); -40 °C to 85 °C (Extended Temperature) |
|                           | Storage   | -40 °C to 100 °C   |
| Humidity                  |           | 5% to 95% RH (Non-condensing)                                    |
| Vibration (Non-Operating) |           | Sine wave : 10~2000Hz, 15G (X, Y, Z axis)                        |
| Shock (Non-Operating)     |           | Half sine wave, 1500 G (X, Y, Z ; All 6 axis)                    |

Note: this Environmental Specification table indicates the conditions for testing the device. Real world usages may affect the results.

## 4.3 Mean Time Between Failures (MTBF)

Mean Time Between Failures (MTBF) is predicted based on reliability data for the individual components in CFast. Serving as statistical reference, the prediction result for CFast is more than 2,000,000 hours.

Notes about the MTBF:

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

## 4.4 Certification and Compliance

CFast complies with the following standards

- CE
- FCC
- RoHS
- MIL-STD
- SATA II (SATA Rev. 2.6)
- Up to ATA/ATAPI-7 ( including S.M.A.R.T.)

## 5. Flash Management

### 5.1 Error Correction/Detection

CFast implements a hardware ECC which is based on the BCH algorithm. It can detect and correct up to 16 bits or 24 bits error in 1K bytes depending on the NAND flash configuration used.

### 5.2 Bad Block Management

Although bad blocks on the flash media are already identified by the flash manufacturer, they can also be accumulated over time during operation. CFast's controller maintains a table that lists those normal blocks with disk data, the free blocks for wear leveling, and bad blocks with errors. When a normal block is detected with error, it is replaced with a free block and listed as a bad block. When a free block is detected with error, it is then removed from the free block list and marked as a bad block.

During device operation, this ensures that newly accumulated bad blocks are transparent to the host. The device will stop file write service once there are only two free blocks left; such that the read function is still available for copying the files from the disk into another.

### 5.3 Wear Leveling

The NAND flash devices are limited by a certain number of write cycles. When using a FAT-based file system, frequent FAT table updates are required. If some area on the flash wears out faster than others, it would significantly reduce the lifetime of the whole SSD; even if the erase counts of others are far from the write cycle limit. Thus, if the write cycles can be distributed evenly across the media, the lifetime of the media can be prolonged significantly. This algorithm is called wear leveling.

Apacer's wear-leveling scheme is achieved both via buffer management and Apacer-specific dynamic/static global wear leveling to ensure the lifetime of the flash media can be increased and the disk access performance is optimized as well.

### 5.4 Power Failure Management

The Low Power Detection on the controller initiates cached data saving before the power supply to the device is too low. This feature prevents the device from malfunctioning and ensures data integrity during an unexpected blackout. Once power failure happens before cached data completes writing back into flash, data in the cache will be lost. Once power resumes, the controller will check these fragmented data segment, and, if necessary, replace them with old data kept in flash until programmed successfully.

### 5.5 ATA Secure Erase

Accomplished by the Secure Erase (SE) command, which is added to the open ANSI standards that control disk drives, "ATA Secure Erase" is built into the disk drive itself and thus far less susceptible to malicious software attacks than external software utilities. It is an easy-to-use data destroy command, amounting to electronic data shredding. Executing the command causes a drive to internally completely erase all possible user data. This command is carried out within disk drives, so no additional software is required. Once executed, neither data nor the erase counter on the device would be recoverable, which blurs the accuracy of device lifespan. The process to erase will not be stopped until finished even if power failure is encountered, and will be continued when power resumes.

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## **5.6 S.M.A.R.T.**

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S.M.A.R.T. is an acronym for Self-Monitoring, Analysis and Reporting Technology, an open standard allowing disk drives to automatically monitor their own health and report potential problems. It protects the user from unscheduled downtime by monitoring and storing critical drive performance and calibration parameters. Ideally, this should allow taking proactive actions to prevent impending drive failure.

Apacer devices use the standard SMART command B0h to read data out from the drive to activate our SMART feature that complies with the ATA/ATAPI-7 specifications. Based on the SFF-8035i Rev. 2.0 specifications, Apacer SMART defines vendor-specified SMART Attribute IDs (A0 ~ A5, and 0C). They represent Initial bad block count, Bad block count, Spare block count, Maximum erase count, Average erase count and Power cycle. When the Apacer SMART Utility running on the host, it analyzes and reports the disk status to the host before the device reaches in critical condition.

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## **5.7 TRIM**

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Made of millions of NAND flash cells, SSD can be written into groups called pages in 4K size generally, but can only be erased in larger groups called blocks of 128 pages or 512KB. These stipulations are partially the source of many performance issues. Until an address is used again, the SSD keeps track of every last bit of data that's written on it. The ATA-TRIM instruction tilts the balance in favor of the SSD. TRIM addresses a major part of the performance degradation issue over time that plagues all SSDs. A TRIM enabled drive running an OS with TRIM supported will stay closer to its peak performance over time.

## 6. Software Interface

### 6.1 ATA Command Set

Table 6-1 summarizes the ATA command set with the paragraphs that follow describing the individual commands and the task file for each.

**Table 6-1:** Command set

| <b>Code</b> | <b>Command</b>               | <b>Code</b> | <b>Command</b>         |
|-------------|------------------------------|-------------|------------------------|
| E5h         | Check Power Mode             | F3h         | Security Erase Prepare |
| 06h         | Data Set Management          | F4h         | Security Erase Unit    |
| 90h         | Execute Device Diagnostic    | F5h         | Security Freeze Lock   |
| E7h         | Flush Cache                  | F1h         | Security Set Password  |
| Eah         | Flush Cache EXT              | F2h         | Security Unlock        |
| Ech         | Identify Device              | 70h         | Seek                   |
| E3h         | Idle                         | Efh         | Set Features           |
| E1h         | Idle Immediate               | C6h         | Set Multiple Mode      |
| 91h         | Initialize Device Parameters | E6h         | Sleep                  |
| C8h         | Read DMA                     | B0h         | SMART                  |
| 25h         | Read DMA EXT                 | E2h         | Standby                |
| C4h         | Read Multiple                | E0h         | Standby Immediate      |
| 29h         | Read Multiple EXT            | Cah         | Write DMA              |
| 20h         | Read Sector                  | 35h         | Write DMA EXT          |
| 24h         | Read Sector EXT              | C5h         | Write Multiple         |
| 40h         | Read Verify Sectors          | 39h         | Write Multiple EXT     |
| 42h         | Read Verify Sectors EXT      | 30h         | Write Sector           |
| 10h         | Recalibrate                  | 34h         | Write Sector EXT       |
| F6h         | Security Disable Password    |             |                        |

## 7. 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.

### 7.1 Absolute Maximum Rating

Table 7-1 lists Absolute Maximum Rating of Cfast.

**Table 7-1: Absolute Maximum Rating**

| Parameter           | Symbol | Min  | Max     | Units |
|---------------------|--------|------|---------|-------|
| Power Supply        | Vcc    | -0.3 | 3.6     | V     |
| Input Voltage       | Vin    | -0.3 | Vcc+0.3 | V     |
| Output Voltage      | Vout   | -0.3 | Vcc+0.3 | V     |
| Storage Temperature | Ts     | -40  | 100     | °C    |

### 7.2 Recommended Operation Conditions

Table 7-2 lists Cfast recommended operation conditions.

**Table 7-2: Recommended Operations Conditions**

| Parameter     | Symbol | Min | Typ | Max | Units |
|---------------|--------|-----|-----|-----|-------|
| Power Supply  | Vcc    | 3.0 | 3.3 | 3.6 | V     |
| Input Voltage | Vin    | 0   | -   | Vcc | V     |

### 7.3 Power Consumption

**Table 7-3 Power consumption (typical)**

| Mode \ Capacity | 4 GB | 8 GB | 16 GB | 32 GB | 64 GB |
|-----------------|------|------|-------|-------|-------|
| Active (mA)     | 250  | 320  | 345   | 325   | 360   |
| Standby (mA)    | 85   | 85   | 85    | 85    | 85    |

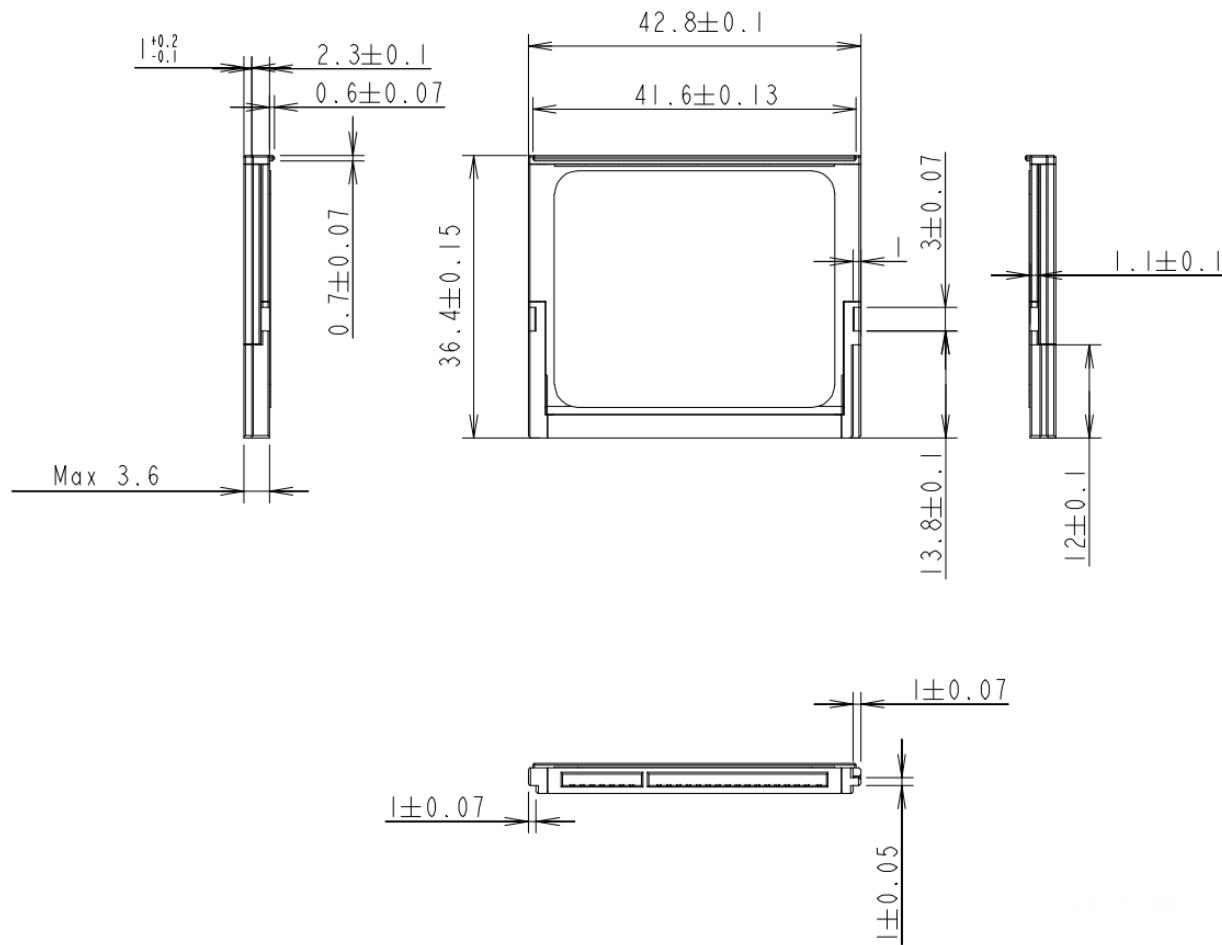
Note: Power consumption may vary from flash configurations and/or platform settings.

## 8. Physical Characteristics

### 8.1 Dimensions

**TABLE 8-1: CFast physical specification**

|  |                     |
|--|---------------------|
| <b>Length:</b>                           | $36.40 \pm 0.15$ mm |
| <b>Width:</b>                            | $42.80 \pm 0.10$ mm |
| <b>Thickness (Including Label Area):</b> | 3.6 mm (Max)        |

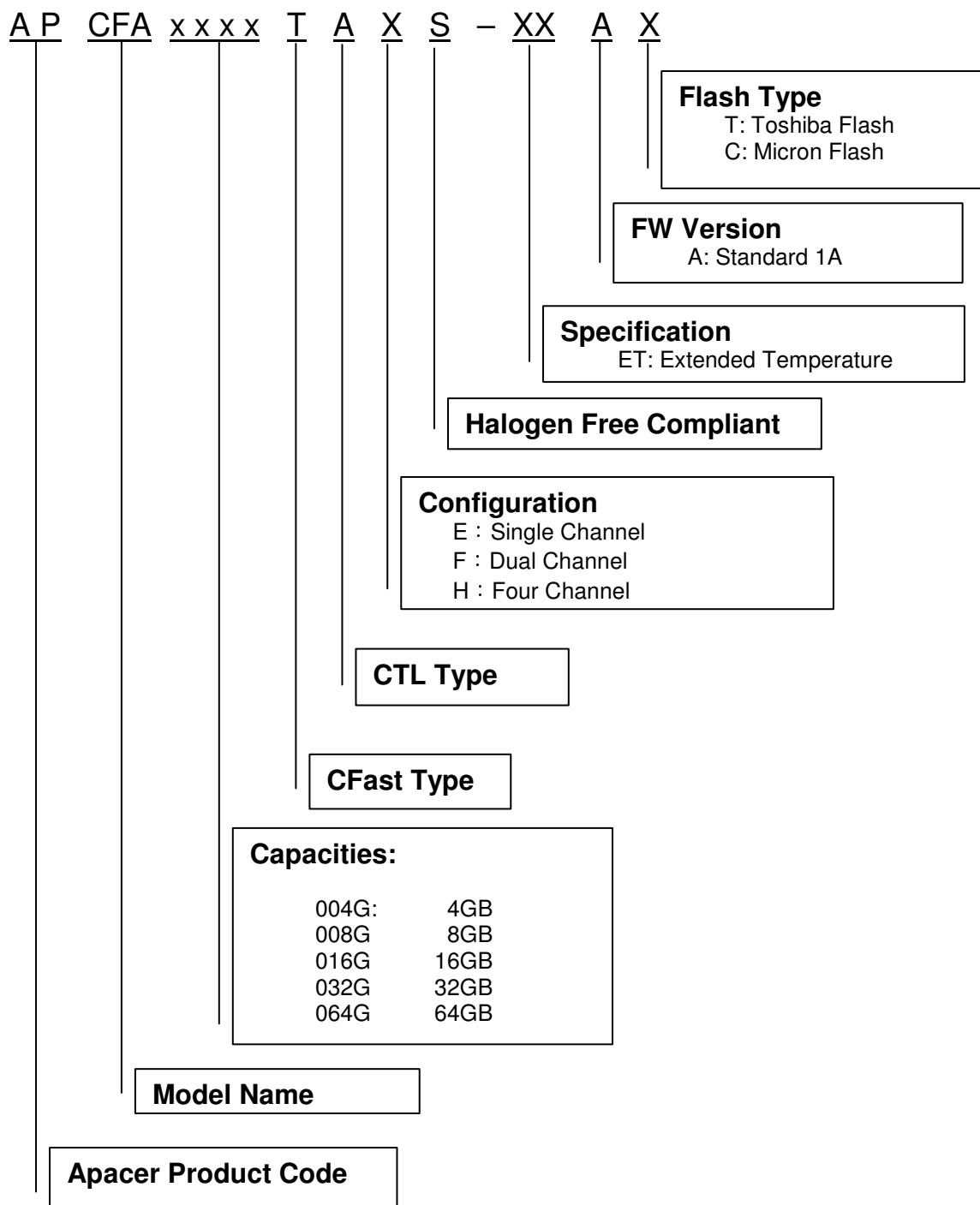


Unit: mm

**FIGURE 8-1: Physical dimension**

## 9. Product Ordering Information

### 9.1 Product Code Designations



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## 9.2 Valid Combinations

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### 9.2.1 Standard

| <b>Capacity</b> | <b>AP/N</b>      | <b>AP/N—Extended Temp.</b> |
|-----------------|------------------|----------------------------|
| 4GB             | APCFA004GTAHS-AT | APCFA004GTAHS-ETAT         |
| 8GB             | APCFA008GTAHS-AT | APCFA008GTAHS-ETAT         |
| 16GB            | APCFA016GTAHS-AT | APCFA016GTAHS-ETAT         |
| 32GB            | APCFA032GTAHS-AC | APCFA032GTAHS-ETAC         |
| 64GB            | APCFA064GTAHS-AC | APCFA064GTAHS-ETAC         |

**Note:**

- Valid combinations list out the available models for mass production.
- Products are normally shipped in unformatted capacities unless required otherwise.
- For customization request, please consult with Apacer sales representatives.

## **Revision History**

| <b>Revision</b> | <b>Date</b> | <b>Description</b>  | <b>Remark</b> |
|-----------------|-------------|---|---------------|
| 1.0             | 05/20/2012  | Official release  |               |
| 1.1             | 05/29/2012  | Added notes about hardware write protect in pin assignment<br>Revised General Description |               |

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