Halogen-free

CompactFlash Series 5

Specifications for Industrial CompactFlash Card

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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:

- **CompactFlash Association Specification Revision 4.1 Standard Interface**
  - 512 bytes per sector
  - ATA command set compatible
  - ATA transfer mode supports:
    PIO Mode 6
    Multiword DMA Mode 4
    Ultra DMA Mode 5
    PCMCIA UDMA Mode 5
- **Capacities**
  - 128, 256, 512 MB
    1, 2, 4, 8, 16, 32, 64 GB
- **Performance**
  - Sustained read: Up to 55 MB/sec
  - Sustained write: Up to 42 MB/sec
- **Intelligent ATA/IDE module**
  - Wear-leveling algorithms to substantially increase longevity of flash media
  - Built-in BCH ECC capable of correcting up to 24 bits in 1,024 byte data
  - Flash block management
  - Power failure management
  - Supports S.M.A.R.T commands
- **NAND Flash Type: SLC**
- **Temperature ranges**
  - 0℃ to 70℃ for operation (Standard)
  - -40℃ to 85℃ for operation (Extended)
  - -40℃ to 100℃ for storage
- **Operating voltage**
  - 3.3 V
  - 5.0 V
- **Power consumption (typical)****
  - Active mode: 175 mA
  - Standby mode: 3 mA
- **Connector Type**
  - 50 pins female
- **Physical Dimensions**
  - 36.4mm x 42.8mm x 3.3mm
- **Endurance (TBW: Terabytes Written)**
  - 128 MB: 0.5 TBW
  - 256 MB: 1.1 TBW
  - 512 MB: 2.3 TBW
  - 1 GB: 4.5 TBW
  - 2 GB: 9.1 TBW
  - 4 GB: 18.2 TBW
  - 8 GB: 36.5 TBW
  - 16 GB: 73.0 TBW
  - 32 GB: 146.0 TBW
  - 64 GB: 292.1 TBW
- **Halogen free**

*Performance and power consumption may vary depending on host system configurations.

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1. General Description

Apacer's value-added Industrial CompactFlash Card offers high performance, high reliability and power-efficient storage. Regarding standard compliance, this CompactFlash Card complies with CompactFlash specification revision 4.1, supporting transfer modes up to Programmed Input Output (PIO) Mode 6, Multi-word Direct Memory Access (DMA) Mode 4, Ultra DMA Mode 5, and PCMCIA Ultra DMA Mode 5.

Apacer's value-added CFC provides complete PCMCIA – ATA functionality and compatibility. Apacer 's CompactFlash technology is designed for applications in Point of Sale (POS) terminals, telecom, IP-STB, medical instruments, surveillance systems, industrial PCs and handheld applications such as the new generation of Digital Single Lens Reflex (DSLR) cameras.

1.1 Intelligent CompactFlash Module

1.1.1 Wear-leveling algorithms

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. On the other hand, NAND flash storage adopts flash as their primary media. 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 earlier. Wear leveling is an important mechanism that level out the wearing of blocks so that the wearing-down of blocks can be almost evenly distributed. This will increase the lifespan of SSDs. Commonly used wear leveling types are Static and Dynamic.

1.1.2 S.M.A.R.T. Technology

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 SMART feature adopts the standard SMART command B0h to read data from the drive. When the Apacer SMART Utility running on the host, it analyzes and reports the disk status to the host before the device is in critical condition.

1.1.3 Built-in Hardware ECC

This CompactFlash card employs BCH Error Correction Code (ECC) algorithms. This on-chip hardware BCH-ECC engines is 13/24 bit programmed that can correct up to 24-bit errors per 1,024 byte data. This built-in hardware ECC performs parity generation and error detection/correction for data integrity.

1.1.4 Flash Block Management

Contemporary process technology is unable to guarantee total reliability of NAND flash memory array. When a flash memory device leaves factory, it comes with a highly minimal number of initial bad block during production or out-of-factory as there is no currently known technology that produce flash chips free of bad blocks. On the other hand, 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, block 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.

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1.1.5 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

2. Functional Block

The CompactFlash Card (CFC) includes a controller and flash media, as well as the CompactFlash standard interface. Figure 2-1 shows the functional block diagram.

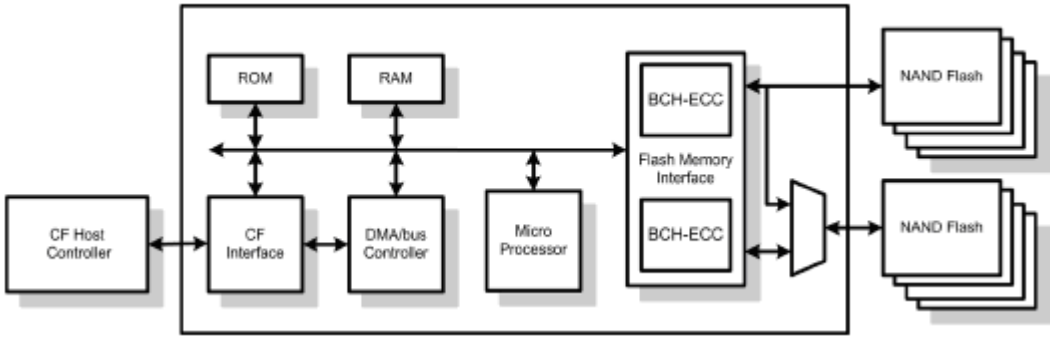


Figure 2-1: Functional block diagram

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3. Pin Assignments

Table 3-1 lists the pin assignments with respective signal names for the 50-pin configuration. A "#" suffix indicates the active low signal. The pin type can be input, output or input/output.

Table 3-1: Pin assignments (1 of 2)

Pin No.	Memory card mode		I/O card mode		True IDE mode	
	Signal name	Pin I/O type	Signal name	Pin I/O type	Signal name	Pin I/O type
1	GND	-	GND	-	GND	-
2	D3	I/O	D3	I/O	D3	I/O
3	D4	I/O	D4	I/O	D4	I/O
4	D5	I/O	D5	I/O	D5	I/O
5	D6	I/O	D6	I/O	D6	I/O
6	D7	I/O	D7	I/O	D7	I/O
7	#CE1	I	#CE1	I	#CS0	I
8	A10	I	A10	I	A10[1]	I
9	#OE	I	#OE	I	#ATA SEL	I
10	A9	I	A9	I	A9[1]	I
11	A8	I	A8	I	A8[1]	I
12	A7	I	A7	I	A7[1]	I
13	VCC	-	VCC	-	VCC	-
14	A6	I	A6	I	A6[1]	I
15	A5	I	A5	I	A5[1]	I
16	A4	I	A4	I	A4[1]	I
17	A3	I	A3	I	A3[1]	I
18	A2	I	A2	I	A2	I
19	A1	I	A1	I	A1	I
20	A0	I	A0	I	A0	I
21	D0	I/O	D0	I/O	D0	I/O
22	D1	I/O	D1	I/O	D1	I/O
23	D2	I/O	D2	I/O	D2	I/O
24	WP	O	#IOIS16	O	#IOCS16	O
25	#CD2	O	#CD2	O	#CD2	O
26	#CD1	O	#CD1	O	#CD1	O
27	D11	I/O	D11	I/O	D11	I/O
28	D12	I/O	D12	I/O	D12	I/O
29	D13	I/O	D13	I/O	D13	I/O
30	D14	I/O	D14	I/O	D14	I/O
31	D15	I/O	D15	I/O	D15	I/O
32	#CE2	I	#CE2	I	#CS1	I
33	#VS1	O	#VS1	O	#VS1	O
34	#IORD	I	#IORD	I	#IORD	I
35	#IOWR	I	#IOWR	I	#IOWR	I
36	#WE	I	#WE	I	#WE	I
37	RDY/-BSY	O	#IREQ	O	INTRQ	O
38	VCC	-	VCC	-	VCC	-
39	#CSEL	I	#CSEL	I	#CSEL	I
40	#VS2	O	#VS2	O	#VS2	O
41	RESET	I	RESET	I	#RESET	I

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Table 3-1: Pin assignments (2 of 2)

Pin No.	Memory card mode		I/O card mode		True IDE mode	
	Signal name	Pin I/O type	Signal name	Pin I/O type	Signal name	Pin I/O type
42	#WAIT	O	#WAIT	O	IORDY	O
43	#INPACK	O	#INPACK	O	DMARQ[2]	O
44	#REG	I	#REG	I	DMACK[2]	I
45	BVD2	O	#SPKR	O	#DASP	I/O
46	BVD1	O	#STSCHG	O	#PDIAG	I/O
47	D8	I/O	D8	I/O	D8	I/O
48	D9	I/O	D9	I/O	D9	I/O
49	D10	I/O	D10	I/O	D10	I/O
50	GND	-	GND	-	GND	-

1. The signal should be grounded by the host.
2. Connection required when UDMA is in use.

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4. Product Specification

4.1 Capacity

Capacity specification of the Compact Flash Card series (CFC) 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[1]	Cylinders	Heads	Sectors	Max LBA
128 MB	128,450,560	980	8	32	250,880
256 MB	256,901,120	980	16	32	501,760
512 MB	512,483,328	993	16	63	1,000,944
1GB	1,024,966,656	1,986	16	63	2,001,888
2GB	2,048,901,120	3,970	16	63	4,001,760
4GB	4,110,188,544	7,964	16	63	8,027,712
8GB	8,195,604,480	15,880	16	63	16,007,040
16GB	16,391,340,032	16,383	16	63	32,014,336
32GB	32,019,316,736	16,383	16	63	62,537,728
64 GB	64,030,244,864	16,383	16	83	125,059,072

Notes:
Display of total bytes varies from operating systems.
Cylinders, heads or sectors are not applicable for these capacities. Only LBA addressing applies
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

Performances of the CF cards are listed in Table 4-2

Table 4-2: Performance specifications

Capacity / Performance	128 MB	256 MB	512 MB	1 GB	2 GB	4 GB	8 GB	16 GB	32 GB	64 GB
Sustained read (MB/s)	21	24	47	45	55	55	55	48	57	50
Sustained write (MB/s)	6	6	22	19	25	35	42	38	27	26

Notes: performance may vary depending on flash configurations or host system settings.

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4.3 Environmental Specifications

Environmental specification of the Compact Flash Card series (CFC) which follows the MIL-STD-810F standards is available as shown in Table 4-3.

Table 4-3: Environmental specifications

Environment		Specification
Temperature	Operation	0℃ to 70℃; -40℃ to 85℃ (Extended Temperature)
	Storage	-40℃ to 100℃
Vibration (Non-Operation)		Sine wave : 10~2000Hz, 15G (X, Y, Z axes)
Shock (Non-Operation)		Half sine wave 1,500G (X, Y, Z ; All 6 axes)

4.4 Certification & Compliance

The CompactFlash card complies with the following global standards:

- CE
- FCC
- Halogen-free
- CompactFlash Association Specification Revision 4.1
- EMC

4.5 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
128 MB	0.5
256 MB	1.1
512 MB	2.3
1 GB	4.5
2 GB	9.1
4 GB	18.2
8 GB	36.5
16 GB	73.0
32 GB	146.0
64 GB	292.1

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.

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5. Software Interface

5.1 CF-ATA Command Set

Table 5-1: CFC-ATA command set

Command	Code
Check-Power-Mode	E5H or 98H
Execute-Drive-Diagnostic	90H
Erase-Sector(s)	C0H
Flush-Cache	E7H
Format-Track	50H
Identify-Drive	ECH
Idle	E3H or 97H
Idle-Immediate	E1H or 95H
Initialize-Drive-Parameters	91H
NOP	00H
Read-Buffer	E4H
Read-Multiple	C4H
Read-Sector(s)	20H or 21H
Read-Verify-Sector(s)	40H or 41H
Recalibrate	1XH
Request-Sense	03H
Seek	7XH
Set-Features	EFH
Set-Multiple-mode	C6H
Set-Sleep-Mode	E6H or 99H
Standby	E2H or 96H
Standby-Immediate	E0H or 94H
Translate-Sector	87H
Write-Buffer	E8H
Write-Multiple	C5H
Write-Multiple-Without-Erase	CDH
Write-Sector(s)	30H or 31H
Write-Sector(s)-Without-Erase	38H
Write-Verify	3CH

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6. 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.

Table 6-1: Operating range

Standard Operating Temperature	0℃ to +70℃
Extended Operating Temperature	-40℃ to +85℃
Supply voltage	5V± 5% (4.75-5.25V)
	3.3V ± 5% (3.135-3.465V)

Table 6-2: Absolute maximum power pin stress ratings

Parameter	Symbol	Conditions
Input Power	V_{DD}	-0.3V min. to 6.5V max.
Voltage on any pin except V_{DD} with respect to GND	V	-0.5V min. to VDD + 0.5V max.

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7. Physical Characteristics

7.1 Dimension

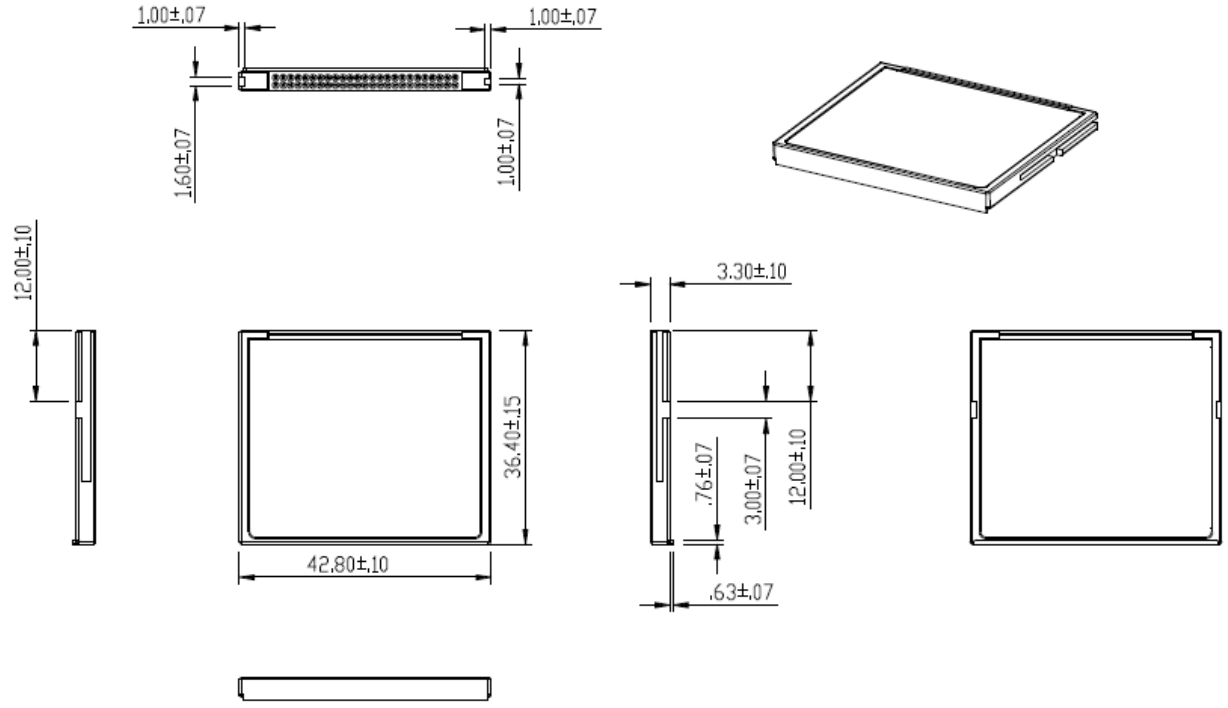


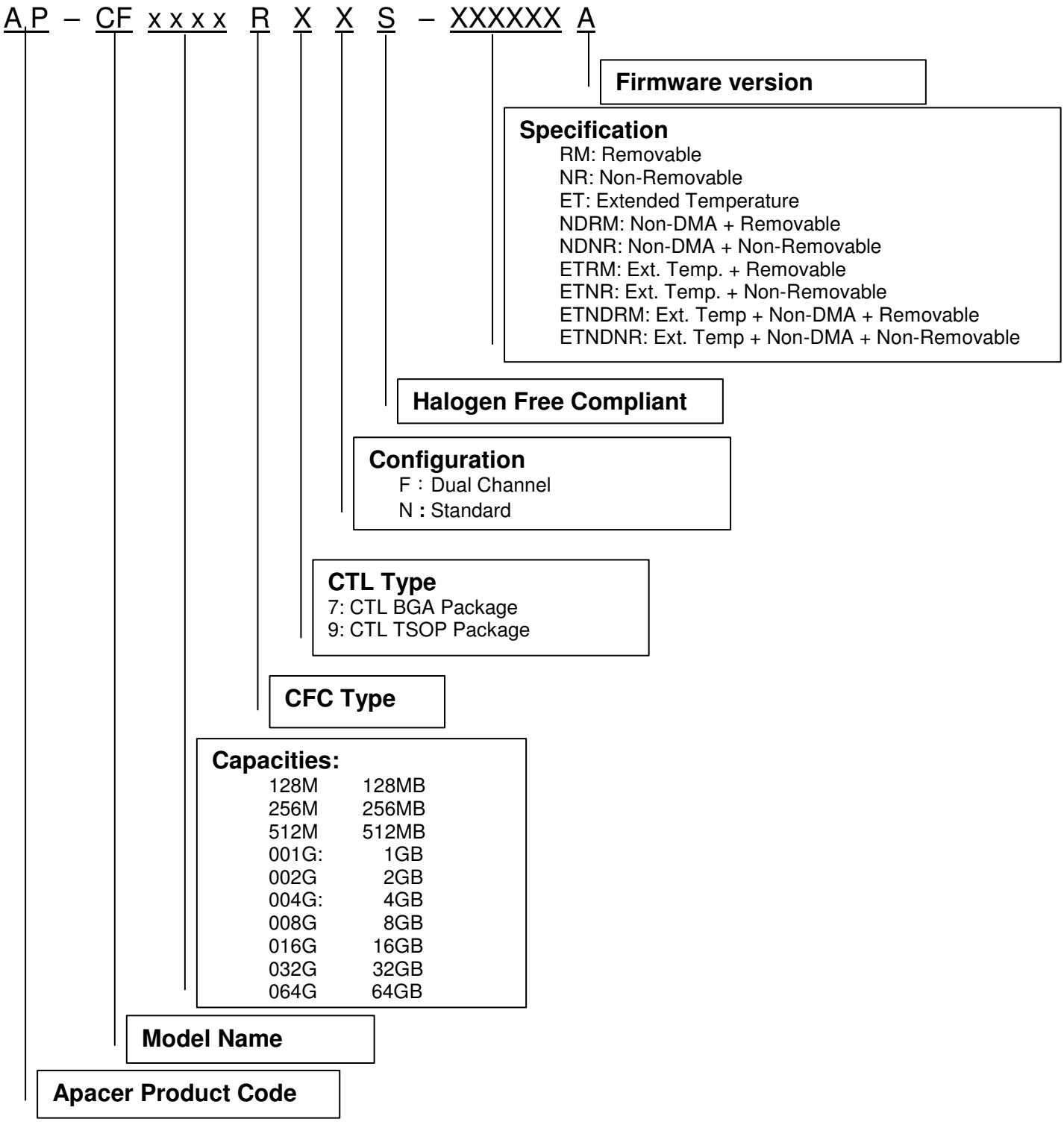
FIGURE 7-1: Physical dimension

Unit: mm

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8. Product Ordering Information

8.1 Product Code Designations



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8.2 Valid Combinations

8.2.1 Standard Temperature

8.2.1.1 Non-Removable

Capacity	*AP/N*
128MB	AP-CF128MR9NS-NRA
256MB	AP-CF256MR9NS-NRA
512MB	AP-CF512MR9NS-NRA
1GB	AP-CF001GR9NS-NRA
2GB	AP-CF002GR9NS-NRA
4GB	AP-CF004GR9NS-NRA
8GB	AP-CF008GR9NS-NRA
16GB	AP-CF016GR9FS-NR
32GB	AP-CF032GR9FS-NR
64GB	AP-CF064GR7FS-NR

8.2.1.2 Removable

Capacity	*AP/N*
128MB	AP-CF128MR9NS-RMA
256MB	AP-CF256MR9NS-RMA
512MB	AP-CF512MR9NS-RMA
1GB	AP-CF001GR9NS-RMA
2GB	AP-CF002GR9NS-RMA
4GB	AP-CF004GR9NS-RMA
8GB	AP-CF008GR9NS-RMA
16GB	AP-CF016GR9FS-RM
32GB	AP-CF032GR9FS-RM
64GB	AP-CF064GR7FS-RM

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8.2.1.3 Non-DMA + Removable

Capacity	*AP/N*
128MB	AP-CF128MR9NS-NDRMA
256MB	AP-CF256MR9NS-NDRMA
512MB	AP-CF512MR9NS-NDRMA
1GB	AP-CF001GR9NS-NDRMA
2GB	AP-CF002GR9NS-NDRMA
4GB	AP-CF004GR9NS-NDRMA
8GB	AP-CF008GR9NS-NDRMA
16GB	AP-CF016GR9FS-NDRM
32GB	AP-CF032GR9FS-NDRM
64GB	AP-CF064GR7FS-NDRM

8.2.1.4 Non-DMA + Non-Removable

Capacity	*AP/N*
128MB	AP-CF128MR9NS-NDNRA
256MB	AP-CF256MR9NS-NDNRA
512MB	AP-CF512MR9NS-NDNRA
1GB	AP-CF001GR9NS-NDNRA
2GB	AP-CF002GR9NS-NDNRA
4GB	AP-CF004GR9NS-NDNRA
8GB	AP-CF008GR9NS-NDNRA
16GB	AP-CF016GR9FS-NDNR
32GB	AP-CF032GR9FS-NDNR
64GB	AP-CF064GR7FS-NDNR

Note: Please consult with Apacer sales representatives for availabilities.

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8.2.2 Extended Temperature

8.2.2.1 Ext. Temp. + Non-Removable

Capacity	*AP/N*
128MB	AP-CF128MR9NS-ETNRA
256MB	AP-CF256MR9NS-ETNRA
512MB	AP-CF512MR9NS-ETNRA
1GB	AP-CF001GR9NS-ETNRA
2GB	AP-CF002GR9NS-ETNRA
4GB	AP-CF004GR9NS-ETNRA
8GB	AP-CF008GR9NS-ETNRA
16GB	AP-CF016GR9FS-ETNR
32GB	AP-CF032GR9FS-ETNR
64GB	AP-CF064GR7FS-ETNR

8.2.2.2 Ext. Temp. + Removable

Capacity	*AP/N*
128MB	AP-CF128MR9NS-ETRMA
256MB	AP-CF256MR9NS-ETRMA
512MB	AP-CF512MR9NS-ETRMA
1GB	AP-CF001GR9NS-ETRMA
2GB	AP-CF002GR9NS-ETRMA
4GB	AP-CF004GR9NS-ETRMA
8GB	AP-CF008GR9NS-ETRMA
16GB	AP-CF016GR9FS-ETRM
32GB	AP-CF032GR9FS-ETRM
64GB	AP-CF064GR7FS-ETRM

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8.2.2.3 Non-DMA + Removable

Capacity	*AP/N*
128MB	AP-CF128MR9NS-ETNDRMA
256MB	AP-CF256MR9NS-ETNDRMA
512MB	AP-CF512MR9NS-ETNDRMA
1GB	AP-CF001GR9NS-ETNDRMA
2GB	AP-CF002GR9NS-ETNDRMA
4GB	AP-CF004GR9NS-ETNDRMA
8GB	AP-CF008GR9NS-ETNDRMA
16GB	AP-CF016GR9FS-ETNDRM
32GB	AP-CF032GR9FS-ETNDRM
64GB	AP-CF064GR7FS-ETNDRM

8.2.2.4 Non-DMA + Non-Removable

Capacity	*AP/N*
128MB	AP-CF128MR9NS-ETNDNRA
256MB	AP-CF256MR9NS-ETNDNRA
512MB	AP-CF512MR9NS-ETNDNRA
1GB	AP-CF001GR9NS-ETNDNRA
2GB	AP-CF002GR9NS-ETNDNRA
4GB	AP-CF004GR9NS-ETNDNRA
8GB	AP-CF008GR9NS-ETNDNRA
16GB	AP-CF016GR9FS-ETNDNR
32GB	AP-CF032GR9FS-ETNDNR
64GB	AP-CF064GR7FS-ETNDNR

Note: Please consult with Apacer sales representatives for availabilities.

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Revision History

Revision	Date	Description	Remark
1.0	06/19/2012	Official release	
1.1	09/07/2012	Revised Product Ordering Information	
1.2	08/07/2013	Updated performance and product ordering information due to change in NAND flash use Updated the address of Taiwan headquarter Added endurance (TBW) section	

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Стандарт Электрон Связь

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Наши контакты:

Телефон: +7 812 627 14 35

Электронная почта: sales@st-electron.ru

Адрес: 198099, Санкт-Петербург, Промышленная ул, дом № 19, литера Н, помещение 100-Н Офис 331