RoHS Compliant

Value Added CompactFlash Series 5

Specification for Industrial CompactFlash Card

September 27th, 2011

Version 1.0

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 6
    PCMCIA UDMA Mode 6

- **Capacities**
  – Standard:
    128, 256, 512 MB
    1, 2, 4 GB
  – High Speed:
    256, 512 MB
    1, 2, 4, 8, 16 GB

- **Standard read/write performance**
  – Sustained read: Up to 29 MB/sec
  – Sustained write: Up to 20 MB/sec

- **High-speed read/write performance**
  – Sustained read: Up to 50 MB/sec
  – Sustained Write: Up to 30 MB/sec

- **Intelligent ATA/IDE module**
  – Embedded Flash File System (FFS)
  – 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
  – Supports S.M.A.R.T commands

- **NAND Flash Type: SLC**

- **Power Management Unit**
  – Immediate disabling of unused circuitry without host intervention
  – Zero wake-up latency

- **Power Smart Design**
  – Automatic sleep and wake-up mechanism to save power
  – Built-in 1.8V Power-On-Reset
  – Built-in 2.6V Voltage detector for power fail protection
  – Supports on-chip and external voltage regulator

- **Temperature ranges**
  – 0°C to 70°C for operation (Standard)
  – -40°C to 85°C for operation (ET*)
  – -40°C to 100°C for storage

- **Operating voltage for read and write**
  – 3.3 V
  – 5.0 V

- **Power consumption (typical)****
  – Active mode: 180 mA
  – Sleep mode: 6 mA

- **Connector Type**
  – 50 pins female

- **Write Protect by Hardware Switch**
  – Write protect activated/deactivated by a mechanical switch

- **Physical Dimensions**
  – 36.4mm x 42.8mm x 3.3mm

- **RoHS compliant**

*Extended Temperature
**Power consumption may vary depending on capacities and the flash configuration.

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Table of Contents

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 6, and PCMCIA Ultra DMA Mode 6.

For power efficiency, this industrial CompactFlash card supports some power smart design mechanisms such as Power-On-Reset, voltage regulator for output voltage adjustments and power failure protection, as well as the automatic sleep and wake-up feature. In terms of security, it comes with a hardware write protect switch.

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 Performance-Optimized Controller

The CompactFlash Card Controller translates standard CF signals into flash media data and control signals.

1.1.1 Power Management Unit (PMU)

The power management unit (PMU) controls the power consumption of the CompactFlash card controller. It reduces the power consumption of the CompactFlash Card Controller by putting circuitry not in operation into sleep mode. The PMU has zero wake-up latency.

1.1.2 SRAM Buffer

The CompactFlash Card Controller performs as an SRAM buffer to optimize the host's data transfer to and from the flash media.

1.1.3 Embedded Flash File System

The embedded Flash File System (FFS) is an integral part of the CompactFlash controller. It contains the MCU firmware to perform the following tasks:

1. Translate host side signals into flash media writes and reads
2. Provide dynamic data flash media wear leveling to spread the flash writes across all unused memory address space to increase the longevity of flash media
3. Keep track of data file structures

1.1.4 Error Correction Code (ECC)

The CompactFlash card is programmed with BCH Error Detection Code (EDC) and Error Correction Code (ECC) algorithms capable of correcting up to 24 random bits in 1,024 bytes data.

High performance is achieved through hardware-based error detection and correction.

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.
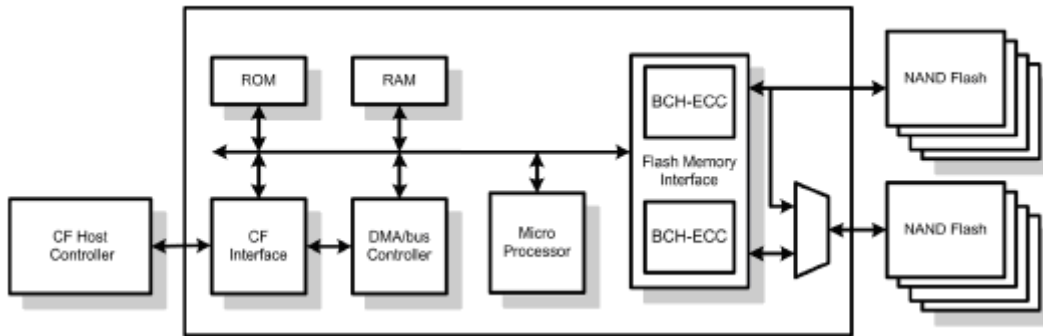
Figure 2-1: Functional block diagram

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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. Capacity Specification

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[2]	16	63	32,014,336

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

4.1 Performance Specification

Performances of the Standard and High Speed ATA-Flash Disk are listed in Table 4-2 and Table 4-3.

Table 4-2: Standard Performance specifications

Performance \ Capacity	128 MB	256 MB	512 MB	1 GB	2 GB	4 GB
Sustained read (MB/s)	21	21	25	25	25	29
Sustained write (MB/s)	6	5	10	9	19	20

Table 4-3: High Speed Performance specifications

Performance \ Capacity	256 MB	512 MB	1GB	2 GB	4 GB	8 GB	16 GB
Sustained read (MB/s)	42	41	48	48	48	48	50
Sustained write (MB/s)	11	11	19	19	30	30	30

Notes: performance may vary depending on flash configurations.

4.2 Environmental Specifications

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

Table 4-4: Environmental specifications

Environment		Specification
Temperature	Operation	0°C to 70°C; -40°C to 85°C (Extended Temperature)
	Storage	-40°C to 100°C
Humidity		5% to 95% RH (Non-condensing)
Vibration (Non-Operation)		Sine wave: 10~2000Hz, 15G (X, Y, Z axes)
Shock (Non-Operation)		Half sine wave, Peak acceleration 50 G, 11 ms (X, Y, Z ; All 6 axes)

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5. Software Interface

5.1 CF-ATA Command Set

Table 5-1 summarizes the CF-ATA command set with the paragraphs that follow describing the individual commands and the task file for each.

Table 5-1: CFC-ATA command set

Command	Code	FR[1]	SC[2]	SN[3]	CY[4]	DH[5]	LBA[6]
Check-Power-Mode	E5H or 98H	–	–	–	–	D[8]	–
Execute-Drive-Diagnostic	90H	–	–	–	–	D	–
Erase-Sector(s)	C0H	–	Y[7]	Y	Y	Y[8]	Y
Flush-Cache	E7H	–	–	–	–	D	–
Format-Track	50H	–	Y	–	Y	Y	Y
Identify-Drive	ECH	–	–	–	–	D	–
Idle	E3H or 97H	–	Y	–	–	D	–
Idle-Immediate	E1H or 95H	–	–	–	–	D	–
Initialize-Drive-Parameters	91H	–	Y	–	–	Y	–
NOP	00H	–	–	–	–	D	–
Read-Buffer	E4H	–	–	–	–	D	–
Read-Multiple	C4H	–	Y	Y	Y	Y	Y
Read-Sector(s)	20H or 21H	–	Y	Y	Y	Y	Y
Read-Verify-Sector(s)	40H or 41H	–	Y	Y	Y	Y	Y
Recalibrate	1XH	–	–	–	–	D	–
Request-Sense	03H	–	–	–	–	D	–
Seek	7XH	–	–	Y	Y	Y	Y
Set-Features	EFH	Y	–	–	–	D	–
Set-Multiple-mode	C6H	-	Y	-	-	D	-
Set-Sleep-Mode	E6H or 99H	–	–	–	–	D	–
Standby	E2H or 96H	–	–	–	–	D	–
Standby-Immediate	E0H or 94H	–	–	–	–	D	–
Translate-Sector	87H	–	Y	Y	Y	Y	Y
Write-Buffer	E8H	–	–	–	–	D	–
Write-Multiple	C5H	–	Y[7]	Y	Y	Y	Y
Write-Multiple-Without-Erase	CDH	–	Y	Y	Y	Y	Y
Write-Sector(s)	30H or 31H	–	Y	Y	Y	Y	Y
Write-Sector(s)-Without-Erase	38H	–	Y	Y	Y	Y	Y

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Write-Verify	3CH	–	Y	Y	Y	Y	Y

1. FR - Features register
2. SC - Sector Count register
3. SN - Sector Number register
4. CY - Cylinder registers
5. DH - Drive/Head register
6. LBA - Logical Block Address mode supported
7. Y - The register contains a valid parameter for this command
8. For the Drive/Head register:
       Y means both the CompactFlash card and head parameters are used;
       D means only the CompactFlash card parameter is valid and not the head parameter

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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

Range	Ambient Temperature	3.3V	5V
Standard	0°C to +70°C	3.135-3.465V	4.75-5.25V
Extended Temperature	-40°C to +85°C		

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.

Table 6-3: Recommended system power-up timing

Symbol	Parameter	Typical	Maximum	Units
$T_{PU-READY}$[1]	Power-up to Ready Operation	200	1000	ms
$T_{PU-WRITE}$[1]	Power-up to Write Operation	200	1000	ms

1. This parameter is measured only for initial qualification and after a design or process change that could affect this parameter.

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7. Physical Characteristics

7.1 Dimension

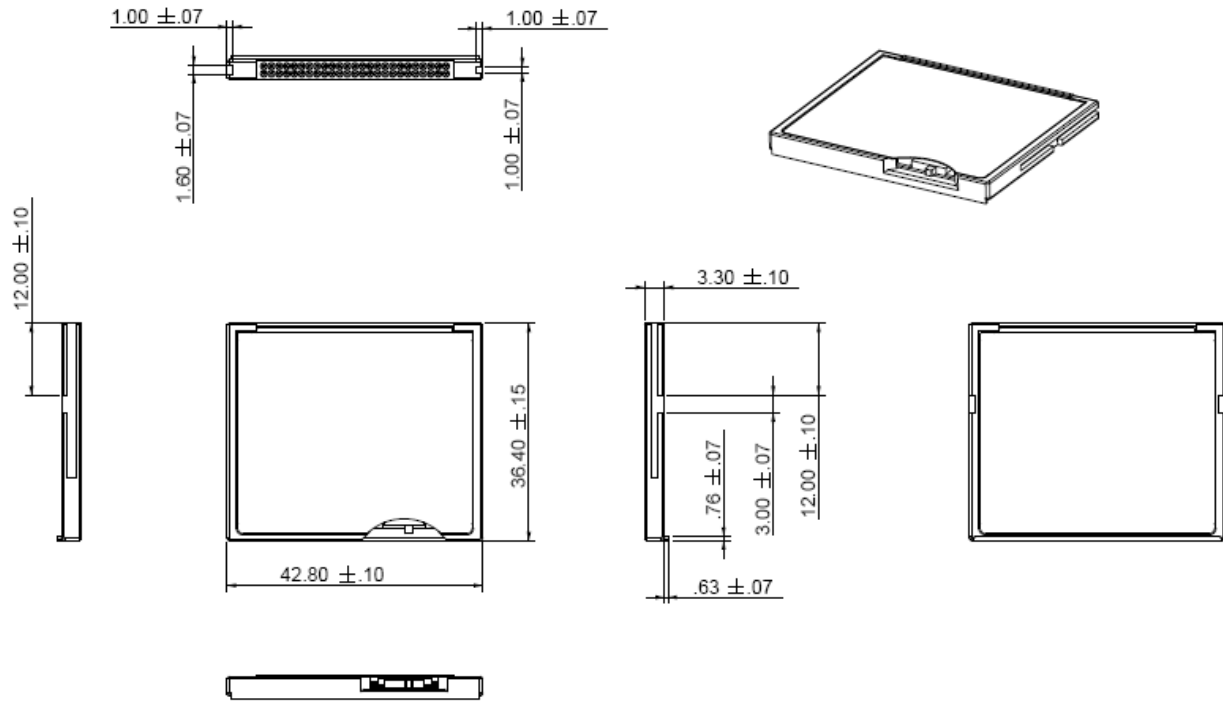| TABLE 7-1: Type I CFC physical specification	
Length:	36.40 +/- 0.15mm (1.433+/- 0.06 in.)
Width:	42.80 +/- 0.10mm (1.685+/- 0.04 in.)
Thickness (Including Label Area):	3.3mm+/-0.10mm (0.130+/-0.04in.)

FIGURE 7-1: Physical dimension

Unit: mm

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7.2 Write Protect by Hardware Switch

This industrial CompactFlash comes with write protect function enabled by a hardware mechanical switch. Users can activate/deactivate the write protection with it. Please refer to the illustration below for locating the switch.

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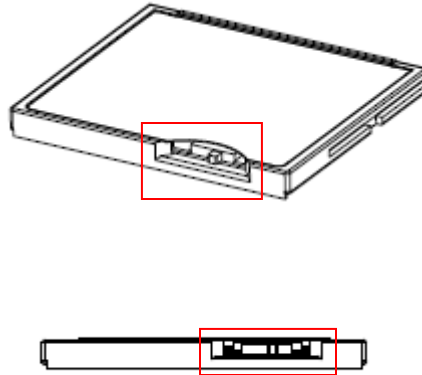
8. Product Ordering Information

8.1 Product Code Designations

A P – CF x x x x K 7 X S – XXXXXX

Specification
RM: Removable
NR: Non-Removable
ET: Extended Temperature
NDRM: Non-DMA + Removable
NDNR: Non-DMA + Non-Removable
ETRM: Ext. Temp. + Removable
ETNR: Ext. Temp. + Non-Removable
ETNDRM: Ext. Temp + Non-DMA + Removable
ETNDNR: Ext. Temp + Non-DMA + Non-Removable

Halogen Free Compliant

Configuration
E：Single Channel
F：Dual Channel

CTL Type

CFC Type

Capacities:
128M   128MB
256M   256MB
512M   512MB
001G: 1GB
002G   2GB
004G: 4GB
008G   8GB
016G   16GB

Model Name

Apacer Product Code

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8.2 Valid Combinations

8.2.1 Standard Temperature

Standard

Capacity	AP/N
128MB	AP-CF128MK7ES-NR
256MB	AP-CF256MK7ES-NR
512MB	AP-CF512MK7ES-NR
1GB	AP-CF001GK7ES-NR
2GB	AP-CF002GK7ES-NR
4GB	AP-CF004GK7ES-NR

High Speed

Capacity	AP/N
256MB	AP-CF256MK7FS-NR
512MB	AP-CF512MK7FS-NR
1GB	AP-CF001GK7FS-NR
2GB	AP-CF002GK7FS-NR
4GB	AP-CF004GK7FS-NR
8GB	AP-CF008GK7FS-NR
16GB	AP-CF016GK7FS-NR

Removable

Standard

Capacity	AP/N
128MB	AP-CF128MK7ES-RM
256MB	AP-CF256MK7ES-RM
512MB	AP-CF512MK7ES-RM
1GB	AP-CF001GK7ES-RM
2GB	AP-CF002GK7ES-RM
4GB	AP-CF004GK7ES-RM

High Speed

Capacity	AP/N
256MB	AP-CF256MK7FS-RM
512MB	AP-CF512MK7FS-RM
1GB	AP-CF001GK7FS-RM
2GB	AP-CF002GK7FS-RM
4GB	AP-CF004GK7FS-RM
8GB	AP-CF008GK7FS-RM
16GB	AP-CF016GK7FS-RM

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.

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Apacer
Access the best

Non-DMA + Removable

Standard

Capacity	AP/N
128MB	AP-CF128MK7ES-NDRM
256MB	AP-CF256MK7ES-NDRM
512MB	AP-CF512MK7ES-NDRM
1GB	AP-CF001GK7ES-NDRM
2GB	AP-CF002GK7ES-NDRM
4GB	AP-CF004GK7ES-NDRM

High Speed

Capacity	AP/N
256MB	AP-CF256MK7FS-NDRM
512MB	AP-CF512MK7FS-NDRM
1GB	AP-CF001GK7FS-NDRM
2GB	AP-CF002GK7FS-NDRM
4GB	AP-CF004GK7FS-NDRM
8GB	AP-CF008GK7FS-NDRM
16GB	AP-CF016GK7FS-NDRM

Non-DMA + Non-Removable

Standard

Capacity	AP/N
128MB	AP-CF128MK7ES-NDNR
256MB	AP-CF256MK7ES-NDNR
512MB	AP-CF512MK7ES-NDNR
1GB	AP-CF001GK7ES-NDNR
2GB	AP-CF002GK7ES-NDNR
4GB	AP-CF004GK7ES-NDNR

High Speed

Capacity	AP/N
256MB	AP-CF256MK7FS-NDNR
512MB	AP-CF512MK7FS-NDNR
1GB	AP-CF001GK7FS-NDNR
2GB	AP-CF002GK7FS-NDNR
4GB	AP-CF004GK7FS-NDNR
8GB	AP-CF008GK7FS-NDNR
16GB	AP-CF016GK7FS-NDNR

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8.2.2 Extended Temperature

Ext. Temp. + Non-Removable

Standard

Capacity	AP/N
128MB	AP-CF128MK7ES-ETNR
256MB	AP-CF256MK7ES-ETNR
512MB	AP-CF512MK7ES-ETNR
1GB	AP-CF001GK7ES-ETNR
2GB	AP-CF002GK7ES-ETNR
4GB	AP-CF004GK7ES-ETNR

High Speed

Capacity	AP/N
256MB	AP-CF256MK7FS-ETNR
512MB	AP-CF512MK7FS-ETNR
1GB	AP-CF001GK7FS-ETNR
2GB	AP-CF002GK7FS-ETNR
4GB	AP-CF004GK7FS-ETNR
8GB	AP-CF008GK7FS-ETNR
16GB	AP-CF016GK7FS-ETNR

Ext. Temp. + Removable

Standard

Capacity	AP/N
128MB	AP-CF128MK7ES-ETRM
256MB	AP-CF256MK7ES-ETRM
512MB	AP-CF512MK7ES-ETRM
1GB	AP-CF001GK7ES-ETRM
2GB	AP-CF002GK7ES-ETRM
4GB	AP-CF004GK7ES-ETRM

High Speed

Capacity	AP/N
256MB	AP-CF256MK7FS-ETRM
512MB	AP-CF512MK7FS-ETRM
1GB	AP-CF001GK7FS-ETRM
2GB	AP-CF002GK7FS-ETRM
4GB	AP-CF004GK7FS-ETRM
8GB	AP-CF008GK7FS-ETRM
16GB	AP-CF016GK7FS-ETRM

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.

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Non-DMA + Removable

Standard

Capacity	AP/N
128MB	AP-CF128MK7ES-ETNDRM
256MB	AP-CF256MK7ES-ETNDRM
512MB	AP-CF512MK7ES-ETNDRM
1GB	AP-CF001GK7ES-ETNDRM
2GB	AP-CF002GK7ES-ETNDRM
4GB	AP-CF004GK7ES-ETNDRM

High Speed

Capacity	AP/N
256MB	AP-CF256MK7FS-ETNDRM
512MB	AP-CF512MK7FS-ETNDRM
1GB	AP-CF001GK7FS-ETNDRM
2GB	AP-CF002GK7FS-ETNDRM
4GB	AP-CF004GK7FS-ETNDRM
8GB	AP-CF008GK7FS-ETNDRM
16GB	AP-CF016GK7FS-ETNDRM

Non-DMA + Non-Removable

Standard

Capacity	AP/N
128MB	AP-CF128MK7ES-ETNDNR
256MB	AP-CF256MK7ES-ETNDNR
512MB	AP-CF512MK7ES-ETNDNR
1GB	AP-CF001GK7ES-ETNDNR
2GB	AP-CF002GK7ES-ETNDNR
4GB	AP-CF004GK7ES-ETNDNR

High Speed

Capacity	AP/N
256MB	AP-CF256MK7FS-ETNDNR
512MB	AP-CF512MK7FS-ETNDNR
1GB	AP-CF001GK7FS-ETNDNR
2GB	AP-CF002GK7FS-ETNDNR
4GB	AP-CF004GK7FS-ETNDNR
8GB	AP-CF008GK7FS-ETNDNR
16GB	AP-CF016GK7FS-ETNDNR

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.

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Revision History

Revision	Date	Description	Remark
0.1	08/17/2011	Preliminary	
1.0	09/27/2011	Official release	

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[ETNR](#) [AP-CF016GR7FS-ETNR](#) [AP-CF008GR7FS-ETNR](#) [AP-CF002GR7FS-ETNR](#) [AP-CF128MR7ES-ETNR](#) [AP-](#)
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