

Halogen-free

CompactFlash Series 5

Specifications for Industrial CompactFlash Card

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Version 1.2



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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°C to 70°C for operation (Standard)
 - -40°C to 85°C for operation (Extended)
 - -40°C to 100°C 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.

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.

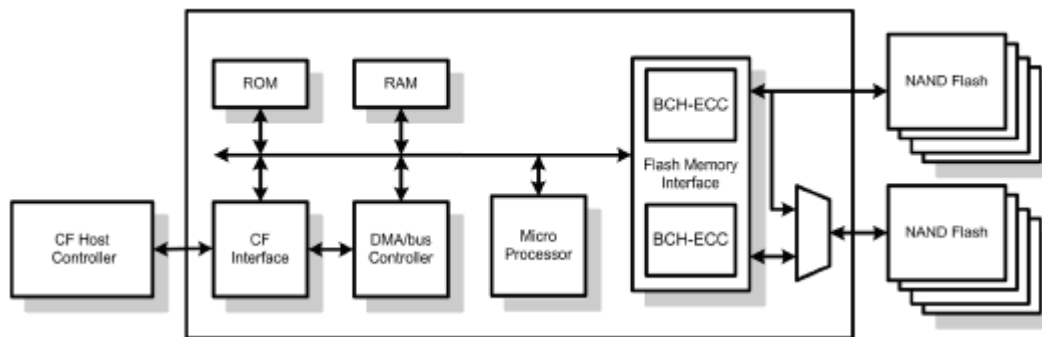


Figure 2-1: Functional block diagram

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 |

Compact Flash 5 series

AP-CFxxxxRXXS-XXXXXA



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.

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.

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°C to 70°C; -40°C to 85°C (Extended Temperature) |
| | Storage | -40°C to 100°C |
| 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.

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 |

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°C to +70°C |
| Extended Operating Temperature | -40°C to +85°C |
| 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 V _{DD} + 0.5V max. |

7. Physical Characteristics

7.1 Dimension

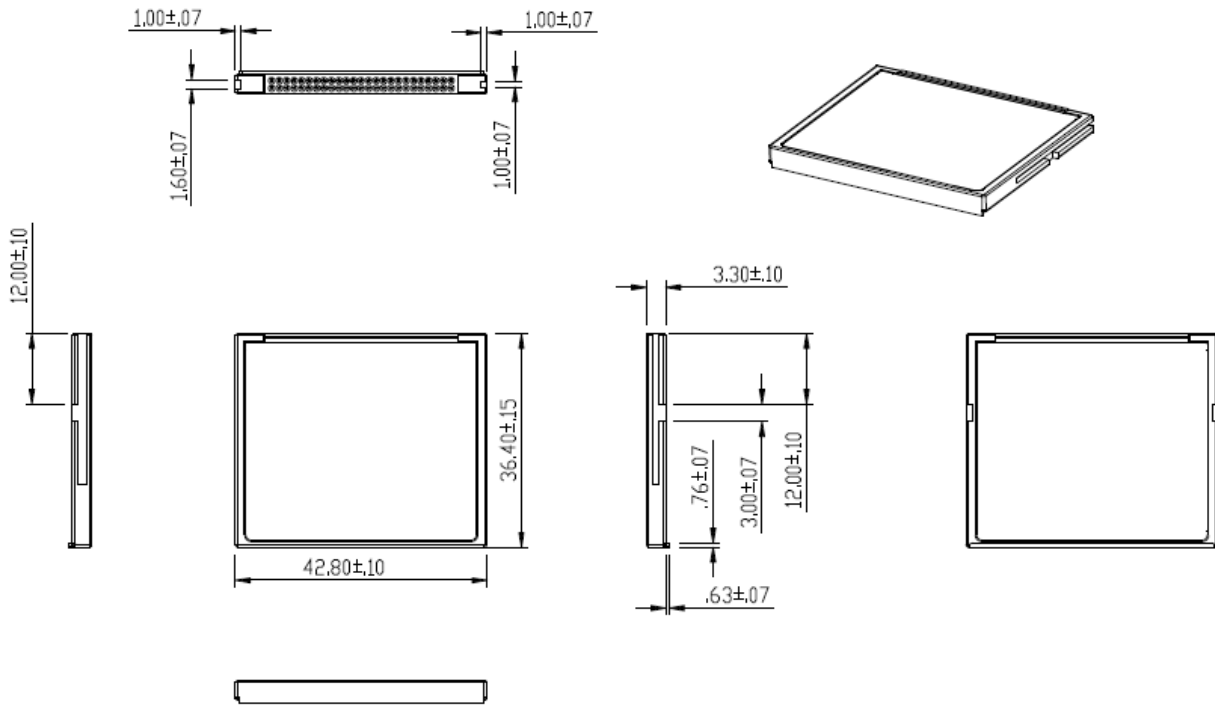


FIGURE 7-1: Physical dimension

Unit: mm

8. Product Ordering Information

8.1 Product Code Designations

A P - C F x x x x R X X S - X X X X X X A

Firmware version

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

F : Dual Channel
 N : Standard

CTL Type

7: CTL BGA Package
 9: CTL TSOP Package

CFC Type

Capacities:

| | |
|-------|-------|
| 128M | 128MB |
| 256M | 256MB |
| 512M | 512MB |
| 001G: | 1GB |
| 002G: | 2GB |
| 004G: | 4GB |
| 008G: | 8GB |
| 016G: | 16GB |
| 032G: | 32GB |
| 064G: | 64GB |

Model Name

Apacer Product Code

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 |

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.

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 |

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.

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 | |

Global Presence

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