

RoHS Compliant

ATA CF

Specification

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Version 1.3



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Features:

- **Standard ATA/IDE bus interface bus interface**
 - ATA command set compatible
 - ATA mode support for up to:
 - PIO Mode-4
 - Multiword DMA Mode-2
 - Ultra DMA Mode-4
- **Connector Type**
 - 50 pins female
- **Low power consumption (typical)**
 - Supply voltage: 3.3V & 5V
 - Active mode: 80 mA/95 mA (3.3V/5.0V)
 - Sleep mode: 500 μ A/600 μ A (3.3V/5.0V)
- **Performance**
 - Sustained read: up to 35 MB/sec
 - Sustained write:
 - Standard: up to 15 MB/sec
 - High Speed: up to 25 MB/sec
- **Capacity**
 - Standard:
 - 128, 256, 512 MB
 - 1, 2, 16 GB
 - High Speed:
 - 256, 512 MB
 - 1, 2, 4, 8 GB
- **NAND Flash Type: SLC**
- **Temperature ranges**
 - Operation:
 - Standard: 0°C to 70°C
 - ET*: -40°C to 85°C
 - Storage: -40°C to 100°C
- **Flash management**
 - Intelligent endurance design
 - Advanced wear-leveling algorithms*
 - S.M.A.R.T. technology*
 - Built-in hardware ECC*
 - Enhanced data integrity*
 - Intelligent power failure recovery
 - Enhanced security level
 - Secure protection zone*
 - Quick erase*
- **RoHS compliant**

*Extended Temperature

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1. General Description

Apacer's ATA CF offers the most reliable and high performance storage which is compatible with CF Type I and Type II device. Unlike the ordinary cards, Apacer ATA CF provides solid traceability to ensure all perspectives qualified especially for use in Point of Sale (POS) terminals, telecom, IP-STB, medical instruments, surveillance systems, industrial PCs and handheld applications

Featuring technologies as Advanced Wear-leveling algorithms, S.M.A.R.T, Enhanced Data Integrity, Built-in Hardware ECC, Intelligent Power Failure Recovery, Secure Protection Zone, and Quick Erase, Apacer's ATA CF assures users of a versatile device on data storage.

1.1 Performance-Optimized Controller

The ATA CF 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 ATA CF Controller. It reduces the power consumption of the ATA CF Controller by putting circuitry not in operation into sleep mode. The PMU has zero wake-up latency.

1.1.2 SRAM Buffer

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

2. Functional Block

The ATA CF includes a controller and flash media, as well as the ATA CF standard interface. Figure 2-1 shows the functional block diagram.

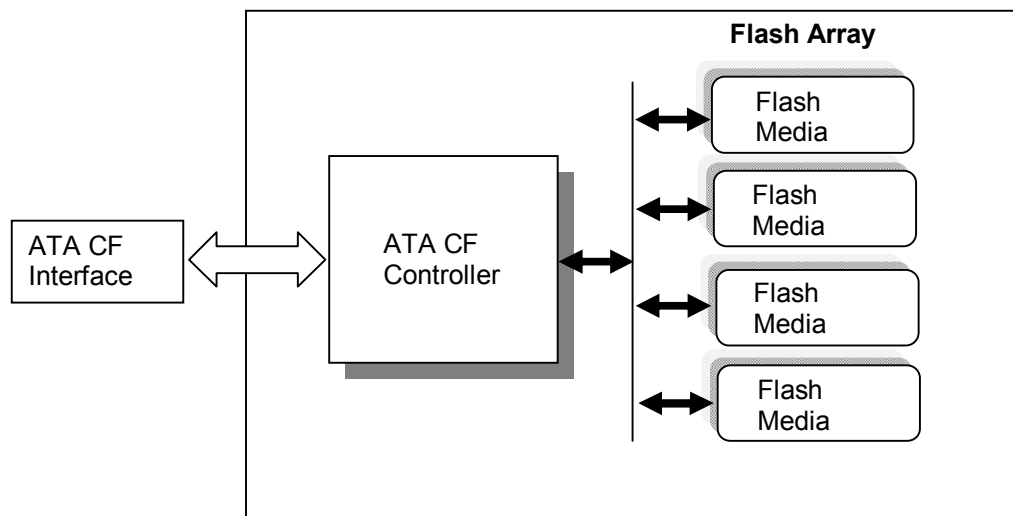


Figure 2-1: Functional block diagram

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

Pin No.	True IDE mode		Pin No.	True IDE mode	
	Signal name	Pin I/O type		Signal name	Pin I/O type
1	GND	-	26	#CD1	O
2	D3	I/O	27	D11	I/O
3	D4	I/O	28	D12	I/O
4	D5	I/O	29	D13	I/O
5	D6	I/O	30	D14	I/O
6	D7	I/O	31	D15	I/O
7	#CE1	I	32	#CE2	I
8	GND	-	33	#VS1	O
9	GND	-	34	#IORD	I
10	GND	-	35	#IOWR	I
11	GND	-	36	VCC	-
12	GND	-	37	INTRQ	O
13	VCC	-	38	VCC	-
14	GND	-	39	#CSEL	I
15	GND	-	40	#WP_PD*	I
16	GND	-	41	RESET	I
17	GND	-	42	IORDY	O
18	A2	I	43	DMARQ**	O
19	A1	I	44	DMACK**	I
20	A0	I	45	#DASP	I/O
21	D0	I/O	46	#PDIAG	I/O
22	D1	I/O	47	D8	I/O
23	D2	I/O	48	D9	I/O
24	#IOCS16	O	49	D10	I/O
25	#CD2	O	50	GND	-

*Write-Protect enabled when pin 40 assigned to GND.

**Connection required when UDMA is in use.

4. Capacity Specification

Capacity specification of the ATA CF series 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
128 MB	128,057,344	977	8	32	250,112
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	1986	16	63	2,001,888
2GB	2,048,385,024	3969	16	63	4,000,752
4GB	4,096,253,952	7937	16	63	8,000,496
8GB	8,001,552,384	15504	16	63	15,628,032
16GB	16,001,040,384	16383*	16	63	31,252,032

*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 CF are listed in Table 4-2 and Table 4-3, respectively.

Table 4-2: Standard Performance specifications

Capacity	128 MB / 256 MB	2 GB	16 GB
Performance	512 MB / 1 GB		
Sustained read (MB/s)	19	35	22
Sustained write (MB/s)	7	15	15

Table 4-3: High Speed Performance specifications

Capacity	256 MB / 512 MB	1GB / 2 GB / 4 GB / 8 GB
Performance		
Sustained read (MB/s)	30	35
Sustained write (MB/s)	13	22~25

4.2 Environmental Specifications

Environmental specification of the ATA CF 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)

5. Flash Management

5.1 Intelligent endurance design

5.1.1 Advanced wear-leveling algorithms

The NAND flash devices are limited by a certain number of write cycles. When using a file system, frequent file table updates is mandatory. If some area on the flash wears out faster than others, it would significantly reduce the lifetime of the whole device, 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. The scheme is achieved both via buffer management and Apacer-specific advanced wear leveling to ensure that the lifetime of the flash media can be increased, and the disk access performance is optimized as well.

5.1.2 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.

5.1.3 Built-in hardware ECC

The ATA CF uses BCH Error Detection Code (EDC) and Error Correction Code (ECC) algorithms which correct up to eight random single-bit errors for each 512-byte block of data. High performance is fulfilled through hardware-based error detection and correction.

5.1.4 Enhanced data integrity

The properties of NAND flash memory make it ideal for applications that require high integrity while operating in challenging environments. The integrity of data to NAND flash memory is generally maintained through ECC algorithms and bad block management. Flash controllers can support up to 8 bits ECC capability for accuracy of data transactions, and bad block management is a preventive mechanism from loss of data by retiring unusable media blocks and relocating the data to the other blocks, along with the integration of advanced wear leveling algorithms, so that the lifespan of device can be expanded.

5.2 Intelligent power failure recovery

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 crash and ensures data integrity during an unexpected blackout. Once power was failure before cached data writing back into flash, data in the cache will lost. The next time the power is on, the controller will check these fragmented data segment, and, if necessary, replace them with old data kept in flash until programmed successfully.

5.3 Enhanced security level

5.3.1 Secure protection zone

Partitioning with static commands to logically secure data, protection zones are the solid frameworks of file vaults. 3 different types of zones, unprotected, read-only, and restricted, are offered for effortless administration. When the product is shipped out of Apacer, all sectors are in the unprotected zone, which means there is no control on any data transaction. For further management control, the read-only zone can be set to be accessed exclusively for grantees, and the restricted zone, to be as the maximum security stockade with full administration privilege required. A maximum of 4 zones can be configured as either restricted or read-only zone presenting concurrently. The space outside these zones is automatically in the unprotected zone if available. After the zone has been configured, the protection zone can be de-activated or re-activated by either software methods or hardware components. Protection zone configuration is non-volatile and it will be in effect until the next set of configuration overwrites it.

5.3.2 Quick erase

Accomplished by the Secure Erase (SE) command, which added to the open ANSI standards that control disk drives, "Quick Erase" is built into the disk drive itself and thus far less susceptible to malicious software attacks than external software utilities. It is a positive 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 while encountering power failure, and will be continued when power is back on.

6. Software Interface

6.1 Command Set

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

Table 6-1: Command set (1 of 2)

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	Y	Y	Y	Y
Flush-Cache	E7H	-	-	-	-	D	-
Format Track	50H	-	Y ⁷	-	Y	Y ⁸	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-DMA	C8H or C9H	-	Y	Y	Y	Y	Y
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	-
Security-Disable-Password	F6H	-	-	-	-	D	-
Security-Erase-Prepare	F3H	-	-	-	-	D	-
Security-Erase-Unit	F4H	-	-	-	-	D	-
Security-Freeze-Lock	F5H	-	-	-	-	D	-
Security-Set-Password	F1H	-	-	-	-	D	-
Security-Unlock	F2H	-	-	-	-	D	-
Seek	7XH	-	-	Y	Y	Y	Y
Set-Features	EFH	Y ⁷	-	-	-	D	-

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Table 6-1: Command set (2 of 2)

Command	Code	FR ¹	SC ²	SN ³	CY ⁴	DH ⁵	LBA ⁶
SMART	B0H	Y	Y	Y	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-DMA	CAH or CBH	-	Y	Y	Y	Y	Y
Write-Multiple	C5H	-	Y	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-Without-Erase	38H	-	Y	Y	Y	Y	Y
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 (see command descriptions for use)
7. Y - The register contains a valid parameter for this command
8. For the Drive/Head register:
 Y means both the ATA CF and Head parameters are used
 D means only the ATA CF parameter is valid and not the Head parameter

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.

Table 7-1: 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 7-2: 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.

Table 7-3: Recommended system power-up timing

Symbol	Parameter	Typical	Maximum	Units
T _{PU-READY} *	Power-up to Ready Operation	200	1000	ms
T _{PU-WRITE} *	Power-up to Write Operation	200	1000	ms

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

9. Product Ordering Information

9.1 Product Code Designations

A P – C F x x x x H 4 X R – XXXXXX

Specification

NR: Non-Removable Setting
NDNR: Non-DMA + Non-Removable
ETNR: Ext. Temp. + Non-Removable
ETNDNR: Ext. Temp + Non-DMA + Non-Removable

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Configuration

E: Standard
F: High Speed

Controller Type

CFC Type

Capacity:

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

Model Name

Apacer Product Code

9.2 Valid Combinations

Non-Removable

<u>Standard</u>		<u>High Speed</u>	
Capacity	Model Number	Capacity	Model Number
128MB	AP-CF128MH4ER-NR	256MB	AP-CF256MH4FR-NR
256MB	AP-CF256MH4ER-NR	512MB	AP-CF512MH4FR-NR
512MB	AP-CF512MH4ER-NR	1GB	AP-CF001GH4FR-NR
1GB	AP-CF001GH4ER-NR	2GB	AP-CF002GH4FR-NR
2GB	AP-CF002GH4ER-NR	4GB	AP-CF004GH4FR-NR
16GB	AP-CF016GH4ER-NR	8GB	AP-CF008GH4FR-NR

Non-DMA & Non-Removable

<u>Standard</u>		<u>High Speed</u>	
Capacity	Model Number	Capacity	Model Number
128MB	AP-CF128MH4ER-NDNR	256MB	AP-CF256MH4FR-NDNR
256MB	AP-CF256MH4ER-NDNR	512MB	AP-CF512MH4FR-NDNR
512MB	AP-CF512MH4ER-NDNR	1GB	AP-CF001GH4FR-NDNR
1GB	AP-CF001GH4ER-NDNR	2GB	AP-CF002GH4FR-NDNR
2GB	AP-CF002GH4ER-NDNR	4GB	AP-CF004GH4FR-NDNR
16GB	AP-CF016GH4ER-NDNR	8GB	AP-CF008GH4FR-NDNR

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Extended Temperature

Non-Removable

<u>Standard</u>		<u>High Speed</u>	
Capacity	Model Number	Capacity	Model Number
128MB	AP-CF128MH4ER-ETNR	256MB	AP-CF256MH4FR-ETNR
256MB	AP-CF256MH4ER-ETNR	512MB	AP-CF512MH4FR-ETNR
512MB	AP-CF512MH4ER-ETNR	1GB	AP-CF001GH4FR-ETNR
1GB	AP-CF001GH4ER-ETNR	2GB	AP-CF002GH4FR-ETNR
2GB	AP-CF002GH4ER-ETNR	4GB	AP-CF004GH4FR-ETNR
16GB	AP-CF016GH4ER-ETNR	8GB	AP-CF008GH4FR-ETNR

Non-DMA & Non-Removable

<u>Standard</u>		<u>High Speed</u>	
Capacity	Model Number	Capacity	Model Number
128MB	AP-CF128MH4ER-ETNDNR	256MB	AP-CF256MH4FR-ETNDNR
256MB	AP-CF256MH4ER-ETNDNR	512MB	AP-CF512MH4FR-ETNDNR
512MB	AP-CF512MH4ER-ETNDNR	1GB	AP-CF001GH4FR-ETNDNR
1GB	AP-CF001GH4ER-ETNDNR	2GB	AP-CF002GH4FR-ETNDNR
2GB	AP-CF002GH4ER-ETNDNR	4GB	AP-CF004GH4FR-ETNDNR
16GB	AP-CF016GH4ER-ETNDNR	8GB	AP-CF008GH4FR-ETNDNR

Revision History

Revision	Date	Description	Remark
0.1	02/16/2009	Preliminary	
0.2	02/18/2009	Updated pin assignments	
1.0	02/23/2009	Official release	
1.1	03/06/2009	Product name changed	
1.2	04/01/2009	Updated feature and valid combination wording	
1.3	01/06/2010	Corrected valid combinations	

Global Presence

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