RoHS Compliant

ATA Flash Drive 187

Specifications

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Version 1.0

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Features:

- **Standard ATA/IDE bus interface**
  - ATA command set compatible
  - ATA operating mode supports up to:
    PIO Mode-4
    Multiword DMA Mode-2
    Ultra DMA Mode-6
- **Connector type**
  - 40-pin ZIF
- **Power consumption (typical)***
  - Supply voltage: 3.3V
  - Active mode: 375 mA
  - Idle mode: 30 mA
- **Performance***
  - Sustained read: Up to 100 MB/sec
  - Sustained write: Up to 95 MB/sec
- **Capacity**
  - 4, 8, 16, 32, 64, 128 GB
- **NAND Flash Type:** SLC
- **Temperature ranges**
  - Operation: 0℃ to 70℃
  - Extended: -40℃ to 85℃
  - Storage: -40℃ to 100℃
- **Flash management**
  - Intelligent endurance design
    Advanced wear-leveling algorithms
    S.M.A.R.T.
    Built-in Hardware ECC: 72bit/1KB
  - Power failure management
  - Enhanced security level
    ATA Secure Erase
- **Supports synchronous flash interface**
- **RoHS compliant**
- **MTBF >** 2,000,000 hours

*The values presented in Performance and Power consumption are typical and may vary depending on various settings and platforms.

Table of Contents

1. General Description

Apacer's ATA-Flash Drive (AFD) is a high-performance, solid state drive (SSD) designed to replace a conventional IDE hard disk drive. AFD supports standard ATA/IDE protocol and can be plugged into a standard IDE connector commonly found in desktop or portable PCs. It is more rugged, reliable and power-efficient compared to the mechanical hard drive and is designed for use in rugged laptops, military devices, thin clients, Point of Sale (POS) terminals, telecom, medical instruments, surveillance systems and industrials PCs. Apacer AFD Series is the best instant replacement for high-maintenance HDD where reliability is a major concern.

AFD includes a built-in microcontroller and file management firmware that communicates through with the ATA standard interfaces. AFD is designed to work at 3.3 Volts, support the standard ATA/IDE protocol up to PIO Mode-4, Multiword DMA Mode-2, and Ultra DMA Mode-6 interfaces, and use a standard ATA driver that fits to most of the mainstream operating systems.

Featuring technologies as Advanced Wear-leveling algorithms, S.M.A.R.T, Power Failure Management, and ATA Secure Erase, the AFD device assures users of security in storage applications.

2. Functional Block

The ATA-Flash Drive (AFD) includes the ATA controller and flash media, as well as the ATA standard interface. Figure 2-1 shows the functional block diagram.

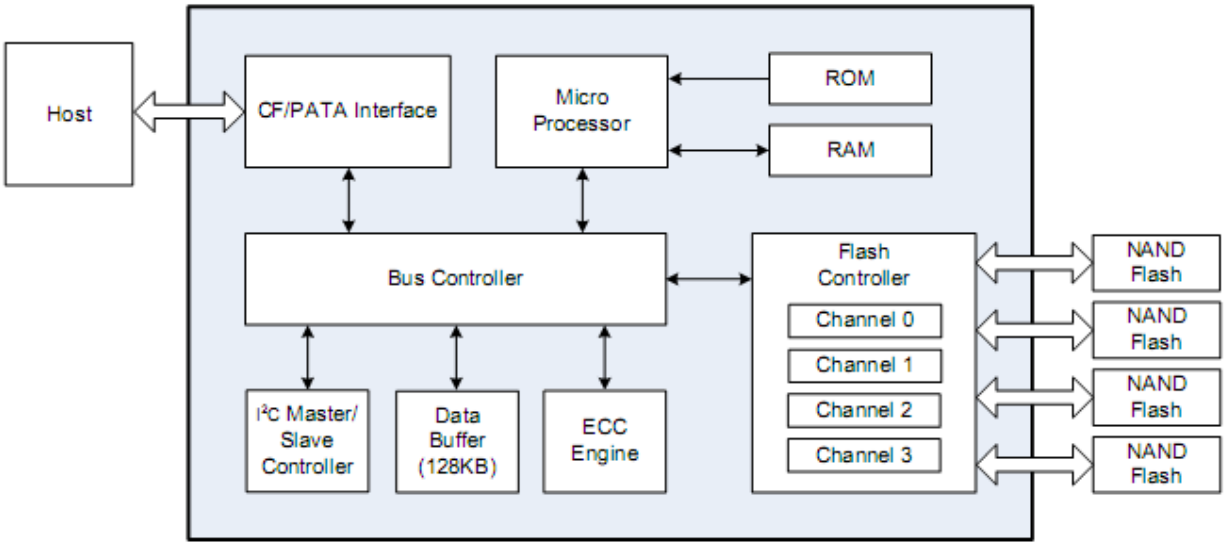


Figure 2-1: ATA-Flash Drive functional block diagram

3. Pin Assignments

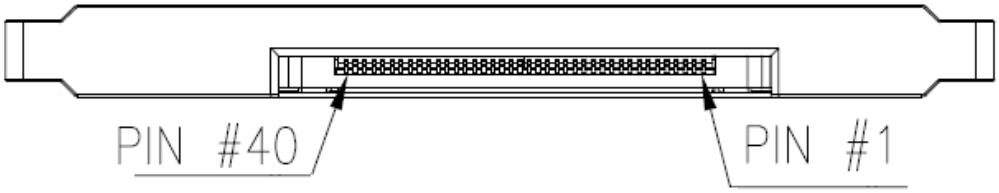


Table 3-1: Pin assignments

Pin #	SIGNALS	Pin #	SIGNALS
1	Reserved	21	GROUND
2	Reserved	22	DMARQ
3	RESET#	23	GROUND
4	GROUND	24	DIOW#
5	DD 7	25	DIOR#
6	DD 8	26	GROUND
7	DD 6	27	IORDY
8	DD 9	28	GROUND
9	DD 5	29	DMACK#
10	DD 10	30	INTRQ
11	DD 4	31	A1
12	DD 11	32	PDIAG#
13	DD 3	33	A0
14	DD 12	34	A2
15	DD 2	35	CS0#
16	DD 13	36	CS1#
17	DD 1	37	DASP#
18	DD 14	38	3.3V
19	DD 0	39	3.3V
20	DD 15	40*	CSEL

*The pin is set as “Master”.

4. Product Specification

4.1 Capacity

Capacity specification of the ATA-Flash Drive (AFD) lists out unformatted, out-of-box capacity information.

Table 4-1: AFD capacity specifications

Capacity	Total bytes*	Cylinders**	Heads	Sectors	Max LBA
4GB	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
128 GB	128,035,676,160	16383	16	63	250,069,680

*Display of total bytes varies from file systems.
**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 Specifications

Performance of the ATA-Flash Drive is listed in Table 4-2.

Table 4-2: Performance specifications

Performance \ Capacity	4 GB	8 GB	16 GB	32 GB	64 GB	128 GB
Sustained read (MB/s)	100	100	100	100	100	100
Sustained write (MB/s)	45	85	90	95	95	95

Note: Performance varies from flash configurations or host system configurations

4.3 Environmental Specifications

Environmental specification of the ATA-Flash Drive follows the standards of MIL-STD-810F.

Table 4-3: ATA-Flash Drive environmental specifications

Item	Criteria
Non-Operating Temperature	-40~100 (℃)
Operating Temperature	0℃ to 70℃ (Standard); -40℃ to 85℃ (Extended)
Vibration*	Sine wave: 15(G), 10~2000(Hz); X, Y, Z axis
Shock*	1500(G), 0.5(ms), ±X, ±Y, ±Z axis

*Non-operating

5. Flash Management

5.1 Intelligent Endurance Design

5.1.1 Advanced 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 adopt 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.

5.1.2 S.M.A.R.T.

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 attributes 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, SMART Attribute IDs shall include Initial bad block count, Bad block count, Spare block count, Maximum erase count, Average erase count and Power cycle. When the SMART Utility running on the host, it analyzes and reports the disk status to the host before the device reaches in critical condition.

5.1.3 Built-in Hardware ECC

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. This ATA-Flash Drive is programmed with a hardware ECC engine which correct up to 72 bits per 1KB.

5.1.4 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.

5.2 Power Failure Management

Power Failure Management ensures data transmission when experiencing unstable power supply. When power disruption takes places, NAND Flash will have to cache multiple write-to-flash cycles to securely store data. This urgent operation requires about several milliseconds to get it done. When the supplied voltage is below a certain percentage of the required, the flash controller will be signaled by a detector IC component with low power detection signal and then the firmware will communicate the controller to flush all the data into the cache of Flash storage area. This can prevent incomplete data transmission. The crucial part lies in the strength of the capacitor of the SSD. The capacitor must be able to hold up some milliseconds of remaining time before the power is totally out, for the urgent write-back-into-flash operations to complete.

5.3 Enhanced Security Level

5.3.1 ATA Secure Erase

Accomplished by the Secure Erase (SE) command, which 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 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

This section defines the software requirements and the format of the commands the host sends to the ATA-Flash Drive (AFD). Commands are issued to the AFD by loading the required registers in the command block with the supplied parameters, and then writing the command code to the command register. The manner in which a command is accepted varies.

Table 6-1: Command set

Code	Command	Code	Command
E5h	Check Power Mode	F6h	Security Disable Password
92h	Download Microcode	F3h	Security Erase Prepare
90h	Execute Device Diagnostic	F4h	Security Erase Unit
E7h	Flush Cache	F5h	Security Freeze Lock
EAh	Flush Cache EXT	F1h	Security Set Password
ECh	Identify Device	F2h	Security Unlock
A1h	Identify Packet Device	70h	Seek
E3h	Idle	EFh	Set Features
E1h	Idle Immediate	F9h	Set Max*
91h	Initialize Device Parameters	91h	Set Max Address EXT
00h	NOP	C6h	Set Multiple Mode
E4h	Read Buffer	E6h	Sleep
C8h	Read DMA	B0h	SMART
25h	Read DMA EXT	E2h	Standby
C4h	Read Multiple	E0h	Standby Immediate
29h	Read Multiple EXT	E8h	Write Buffer
F8h	Read Native Max Address	CAh	Write DMA
27h	Read Native Max Address EXT	35h	Write DMA EXT
20h	Read Sector	C5h	Write Multiple
24h	Read Sector EXT	39h	Write Multiple EXT
40h	Read Verify Sectors	30h	Write Sector
42h	Read Verify Sectors EXT	34h	Write Sector EXT
10h	Recalibrate		

*The command can be configured as “Set Max Lock”, “Set Max Address”, “Set Max Set Password”, “Set Max Unlock” and “Set Max Freeze Lock”, depending on the transfer mode in operation.

7. Electrical Specification

Table 7-1: ATA-Flash Drive operating voltage & operating temperature

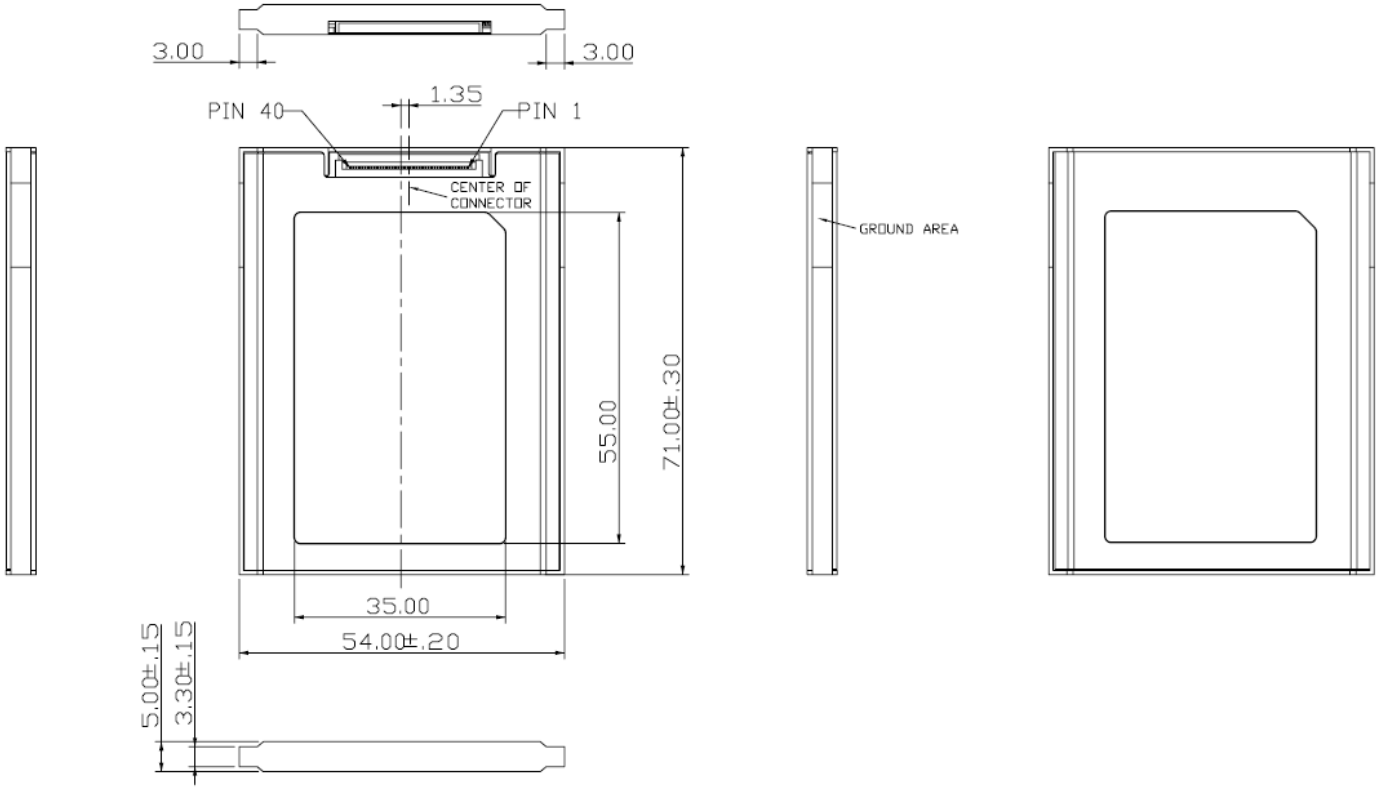
Ambient Temperature	Power supply
0℃ to 70℃ (standard) -40℃ to 85℃ (extended)	3.135 ~ 3.465V

Table 7-2: Power consumption

Capacity / Modes	4 GB	8 GB	16 GB	32 GB	64 GB	128 GB
Active (mA)	250	265	335	375	305	340
Idle (mA)	15	15	15	17	30	30

Note: Power consumption varies from flash configurations or host system configurations

8. Physical Characteristics



Unit: mm
Tolerance: ± 0.2

9. Product Ordering Information

9.1 Product Code Designations

AP – FD18 C 2 2 B xxxxx S – X X X

- **Flash Type**
- **FW Version**
- **Temperature:**
  Blank: Standard
  W: Wide Temp.
- **Environmental Specification**
  S: RoHS + Halogen free Compliant
- **Capacity:**
  0004G: 4GB
  0008G: 8GB
  0016G: 16GB
  0032G: 32GB
  0064G: 64GB
  0128G: 128GB
- **Product Type**
  B=1.8 inches/180D
- **PCB Version**
- **Outline**
  180D Degree
- **Controller version**
- **1.8 inch ATA Flash Drive**
- **Apacer Product Code**

9.2 Valid Combinations

9.2.1 STD Temp.

Capacity	Model Number
4GB	AP-FD18C22B0004GS-T
8GB	AP-FD18C22B0008GS-T
16GB	AP-FD18C22B0016GS-T
32GB	AP-FD18C22B0032GS-T
64GB	AP-FD18C22B0064GS-C
128GB	AP-FD18C22B0128GS-C

9.2.2 Extended Temp

Capacity	Model Number
4GB	AP-FD18C22B0004GS-WT
8GB	AP-FD18C22B0008GS-WT
16GB	AP-FD18C22B0016GS-WT
32GB	AP-FD18C22B0032GS-WT
64GB	AP-FD18C22B0064GS-WC
128GB	AP-FD18C22B0128GS-WC

Note: Please consult with Apacer sales representatives for availabilities.

Revision History

Revision	Date	Description	Remark
0.1	07/10/2012	Preliminary release	
1.0	09/04/2012	Official release	

Global Presence

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