

RoHS Compliant

ATA Flash Drive 257

Product Specifications

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Version 1.3



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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**
 - 44-pin male
- **Power consumption (typical)***
 - Supply voltage: 5V
 - Active mode: 295 mA
 - Idle mode: 35 mA
- **Performance***
 - Sustained read: Up to 100 MB/sec
 - Sustained write: Up to 95 MB/sec
- **Capacity**
 - 8, 16, 32, 64, 128 GB
- **NAND flash type: SLC**
- **Temperature ranges**
 - Operating: 0°C to 70°C
 - Extended: -40°C to 85°C
 - Storage: -40°C to 100°C
- **Flash management**
 - Advanced wear-leveling algorithms
 - S.M.A.R.T.
 - Built-in Hardware ECC: 72bit/1KB
 - Flash Block Management
 - Power failure management
- **RoHS compliant**
- **ATA secure erase**
- **Master/Slave jumper setting**

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

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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 industrial PCs. AFD also offers users selectable Master/Slave operation through an external jumper setting. 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 5 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, Flash Block Management, 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.

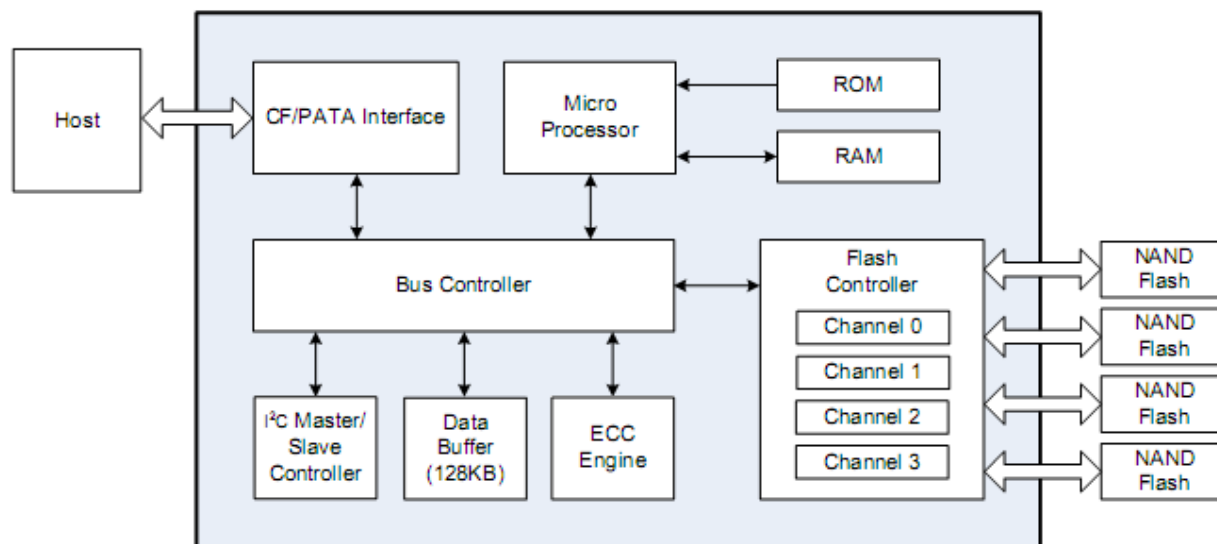


Figure 2-1: ATA-Flash Drive functional block diagram

3. Pin Assignments

3.1 Pin Definitions

Table 3-1 lists the pin assignments with respective signal names for the 44-pin configuration. A “#” suffix indicates the active low signal. The pin type can be input, output or input/output.

Figure 3-1: ATA-Flash Drive 44-pin Connector

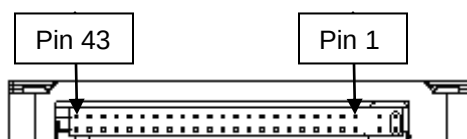
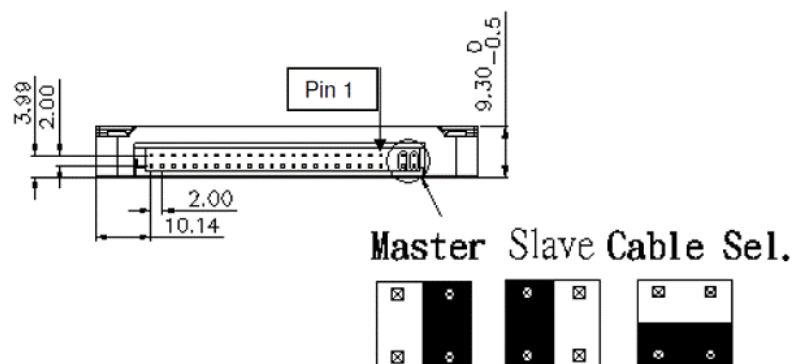


Table 3-1: Pin assignments for the 44-pin configuration

Pin No.	Signal Name	Pin Type	Pin No.	Signal Name	Pin Type
1	RESET#	I	2	GND	-
3	D7	I/O	4	D8	I/O
5	D6	I/O	6	D9	I/O
7	D5	I/O	8	D10	I/O
9	D4	I/O	10	D11	I/O
11	D3	I/O	12	D12	I/O
13	D2	I/O	14	D13	I/O
15	D1	I/O	16	D14	I/O
17	D0	I/O	18	D15	I/O
19	GND	-	20	NC	-
21	DMARQ	O	22	GND	-
23	IOWR#	I	24	GND	-
25	IORD# HDMARDY# HSTROBE#	I	26	GND	-
27	IORDY DDMARDY# DSTROBE	O	28	CSEL	I
29	DMACK#	I	30	GND	-
31	INTRQ	O	32	IOCS16#	O
33	A1	I	34	PDIAG#	I/O
35	A0	I	36	A2	I
37	CS1FX#	I	38	CS3FX#	I
39	DASP#	I/O	40	GND	-
41	VDD	-	42	VDD	-
43	GND	-	44	NC	-

3.2 Jumper Setting



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
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

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

Note: Performance varies from flash 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 (°C)
Operating Temperature	0°C to 70°C (Standard); -40°C to 85°C (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 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 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 levels 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.

5.2 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 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.

5.3 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 corrects up to 72 bits per 1KB.

5.4 Flash Block Management

Current 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 blocks during production or out-of-factory as there is no currently known technology that produces 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.

5.5 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.

6. Software Interface

6.1 Command Set

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.

6.2 ATA Secure Erase

ATA Secure Erase is an ATA disk purging command currently embedded in most of the storage drives. Defined in ATA specifications, (ATA) Secure Erase is part of Security Feature Set that allows storage drives to erase all user data areas. The erase process usually runs on the firmware level as most of the ATA-based storage media currently in the market are built-in with this command. ATA Secure Erase can securely wipe out the user data in the drive and protects it from malicious attack.

7. Electrical Specification

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

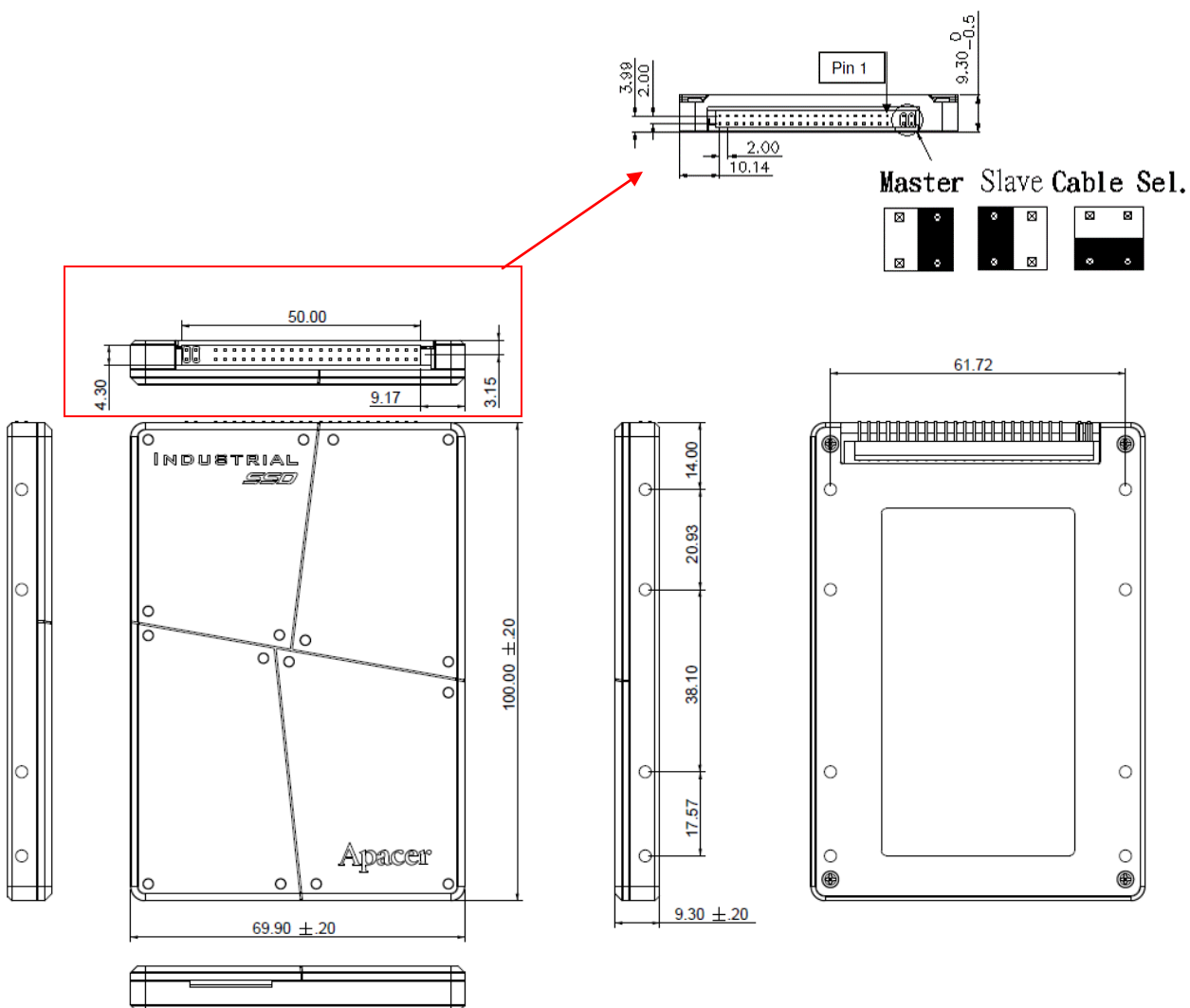
Ambient Temperature	Power supply
0°C to 70°C (standard) -40°C to 85°C (extended)	4.75-5.25V

Table 7-2: Power consumption

Capacity	8 GB	16 GB	32 GB	64 GB	128 GB
Modes					
Active (mA)	220	240	265	290	295
Idle (mA)	30	30	30	35	35

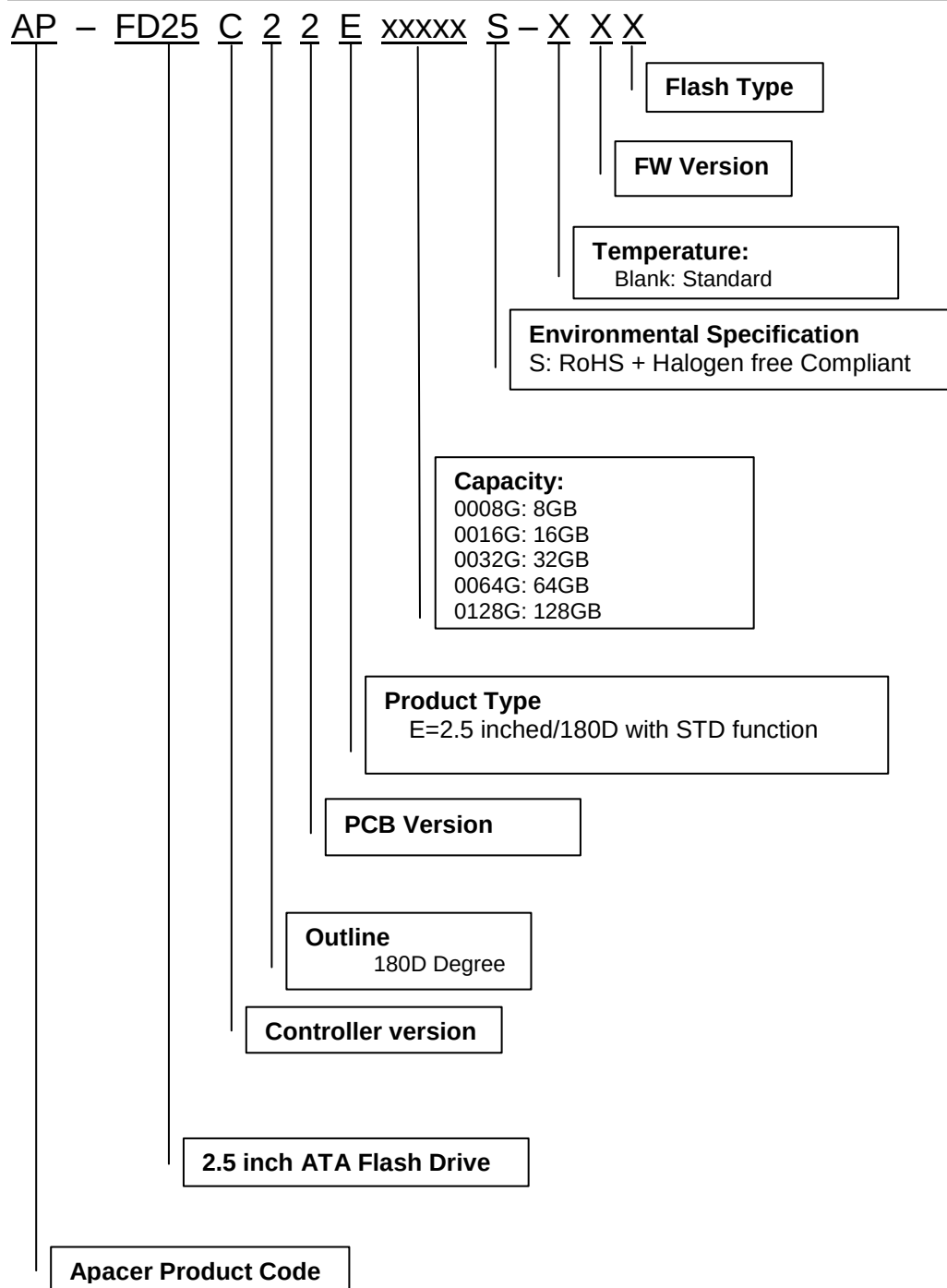
Note: Power consumption varies from flash or host system configurations

8. Physical Characteristics



9. Product Ordering Information

9.1 Product Code Designations



9.2 Valid Combinations

9.2.1 Standard Temperature

Capacity	Model Number
8GB	AP-FD25C22E0008GS-3T
16GB	AP-FD25C22E0016GS-3T
32GB	AP-FD25C22E0032GS-3T
64GB	AP-FD25C22E0064GS-3T
128GB	AP-FD25C22E0128GS-3T

9.2.2 Wide Temperature

Capacity	Model Number
8GB	AP-FD25C22E0008GS-W3T
16GB	AP-FD25C22E0016GS-W3T
32GB	AP-FD25C22E0032GS-W3T
64GB	AP-FD25C22E0064GS-W3T
128GB	AP-FD25C22E0128GS-W3T

Revision History

Revision	Date	Description	Remark
0.1	07/10/2012	Preliminary release	
1.0	08/03/2012	Official release	
1.1	10/08/2013	Added jumper setting drawing	
1.2	03/27/2015	Revised Product Ordering Information due to flash change	
1.3	09/07/2015	Revised power consumption for all models	

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