RoHS Compliant

ATA Flash Drive Ⅲ

Specification for AFDⅢ 253

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Features:

- **Standard ATA/IDE Bus Interface**
  - 512 bytes per sector
  - ATA command set compatible
  - Support up to PIO Mode-4
  - Support up to Multi-word DMA Mode-2
  - Support up to Ultra DMA Mode-4
- **Capacity**
  - 256, 512 MB
  - 1, 2, 4, 8, 16, 32 GB
- **Fast sustained read performance**
  - Support up to 35 MB/sec
- **Fast sustained write performance**
  - Support up to 25 MB/sec
- **Intelligent ATA/IDE module**
  - Embedded Flash File System (FFS)
  - Dynamic wear-leveling algorithms to substantially increase longevity of flash media
  - Built-in BCH ECC support for correcting up to 8 random single-bit errors per 512-byte sector
- **Power Management Unit**
  - Immediate disabling of unused circuitry without host intervention
  - Zero wake-up latency
- **Temperature ranges**
  - 0°C to 70°C for operation (Standard)
  - -40°C to 85°C for operation (ET[1])
  - -40°C to 100°C for storage
- **Supply voltage**
  - 5 V
- **Low power consumption**
  - Active mode: 138 mA
  - Sleep mode: 2000 µA
- **Connector type**
  - 44 pin male
- **RoHS Compliant**

1. Extended Temperature

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. AFD also offers users selectable Master/Slave operation through an external jumper setting. Apacer AFD Series is the best drop-in 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. This means the AFD does not require any additional or proprietary host software such as the Flash File System (FFS) and Memory Technology Driver (MTD) software. 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-4 interfaces, and use a standard ATA driver that fits to all major operating systems such as Windows 9x/ME/2000/NT/XP/CE, Mac OS, and Unix etc.

1.1 Performance-Optimized Controller

The heart of an ATA-Flash Driver is the ATA controller, which translates standard ATA signals into the data and controls of the flash media. This proprietary ATA controller is specifically designed to attain high data throughput from the host to the flash.

1.1.1 Power Management Unit (PMU)

The power management unit (PMU) controls the power consumption of the ATA-Flash Drive controller. It can dramatically extend product battery life by leaving the idle part of the circuitry into sleep mode. The PMU has zero wake-up latency.

1.1.2 SRAM Buffer

The SRAM buffer is a key contributor to the ATA controller performance. It optimizes data writes to the flash.

1.1.3 Embedded Flash File System

The embedded Flash File System (FFS) is an integral part of the ATA 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 ATA-Flash Drive 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 achieved through hardware-based error detection and correction.

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.

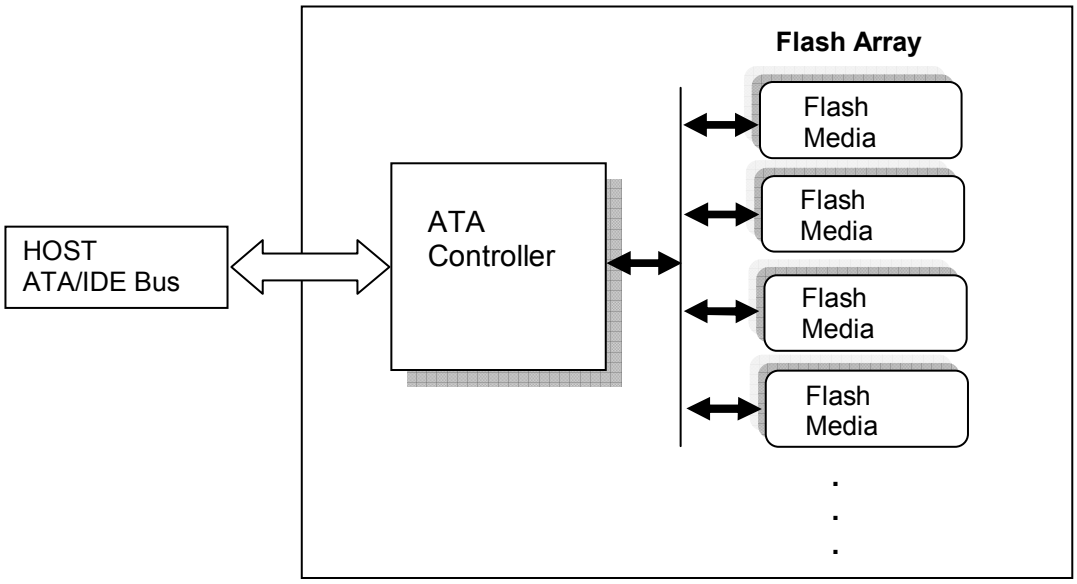


Figure 2-1: ATA-Flash Drive functional block diagram

3. Pin Assignments

Table 3-1 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

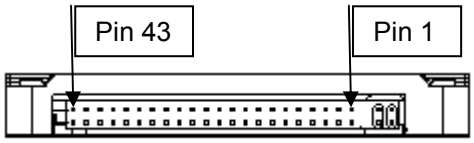


Table 3-1: Pin assignments for the 44-pin configuration

Pin No.	Signal Name	Pin Type	I/O Type	Pin No.	Signal Name	Pin Type	I/O Type
1	RESET#	I	I2U	**2**	GND	-	Ground
3	D7	I/O	I1Z, O2	**4**	D8	I/O	I1Z, O2
5	D6	I/O	I1Z, O2	**6**	D9	I/O	I1Z, O2
7	D5	I/O	I1Z, O2	**8**	D10	I/O	I1Z, O2
9	D4	I/O	I1Z, O2	**10**	D11	I/O	I1Z, O2
11	D3	I/O	I1Z, O2	**12**	D12	I/O	I1Z, O2
13	D2	I/O	I1Z, O2	**14**	D13	I/O	I1Z, O2
15	D1	I/O	I1Z, O2	**16**	D14	I/O	I1Z, O2
17	D0	I/O	I1Z, O2	**18**	D15	I/O	I1Z, O2
19	GND	-	Ground	**20**	NC	-	-
21	DMARQ	O	O1	**22**	GND		Ground
23	IOWR#	I	I2Z	**24**	GND	-	Ground
25	IORD#	I	I2Z	**26**	GND	-	Ground
27	NC	-	-	**28**	CSEL	I	I1U
29	DMACK#	I	I2U-	**30**	GND	-	-
31	INTRQ	O	O1	**32**	IOCS16#	O	O2
33	A1	I	I1Z	**34**	PDIAG#	I/O	I1U, O1
35	A0	I	I1Z	**36**	A2	I	I1Z
37	CS1FX#	I	I2Z	**38**	CS3FX#	I	I2Z
39	DASP#	I/O	I1U, O6	**40**	GND	-	Ground
41	VDD	-	Power	**42**	VDD	-	Power
43	GND	-	Ground	**44**	NC	-	-

4. Capacity Specification

Capacity specification of the ATA-Flash Drive (AFD) product family 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: AFD capacity specifications

Capacity	Total bytes	Cylinders	Heads	Sectors	Max LBA
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
16 GB	16,001,040,384	16383[1]	16	63	31,252,032
32 GB	32,001,048,576	16383[1]	16	63	62,502,048

1. Cylinders, heads or sectors are not applicable for these capacities. Only LBA addressing applies.

4.1 Performance Specification

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

Table 4-2: Performance specifications

Capacity / Performance	256 MB / 512 MB	1GB / 2GB	4 GB / 8 GB / 16 GB / 32 GB
Sustained read (MB/s)	30	35	35
Sustained write (MB/s)	13	20	25

4.2 Environmental Specifications

Environmental specification of the ATA-Flash Drive which follows the MIL-STD-810F standards is available as shown in Table 4-3.

Table 4-3: ATA-Flash Drive environmental specifications

Environment		Specification
Temperature	Operation	0°C to 70°C; -40°C to 85°C (ET[1])
	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)

1. Extended Temperature

5. Software Interface

5.1 ATA-Flash Drive Command Set

This section defines the software requirements and the format of the commands the host sends to the ATA-Flash Drive. Commands are issued to the ATA-Flash Drive 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 5-1: ATA-Flash Drive 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	-
Seek	7XH	-	-	Y	Y	Y	Y
Set-Features	EFH	Y[7]	-	-	-	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

Table 5-1: Command set (2 of 2)

Command	Code	FR[1]	SC[2]	SN[3]	CY[4]	DH[5]	LBA[6]
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-Flash Drive and Head parameters are used
D means only the ATA-Flash Drive parameter is valid and not the Head parameter

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: ATA-Flash Drive operating voltage

Range	Ambient Temperature	5V
Standard	0°C to 70°C	4.5-5.5V
Extended Temperature	-40°C to 85°C	4.5-5.5V

Table 6-2: Absolute maximum power pin stress ratings

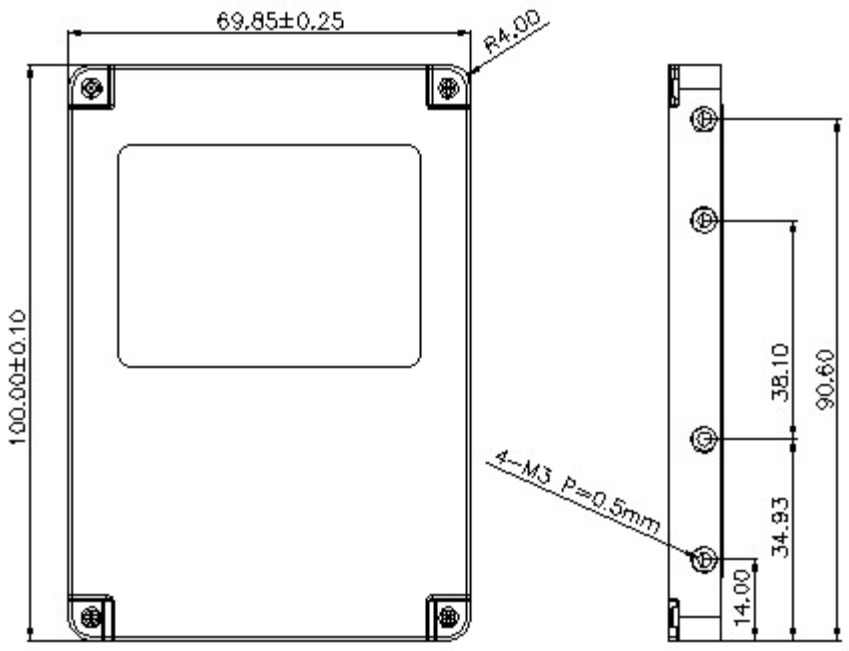
Parameter	Symbol	Conditions
Input Power	V_{DD}	-0.3V min. to 6.5V max.
Voltage on any pin except V_{DD} with respect to GND	V	-0.5V min. to VDD + 0.5V max.

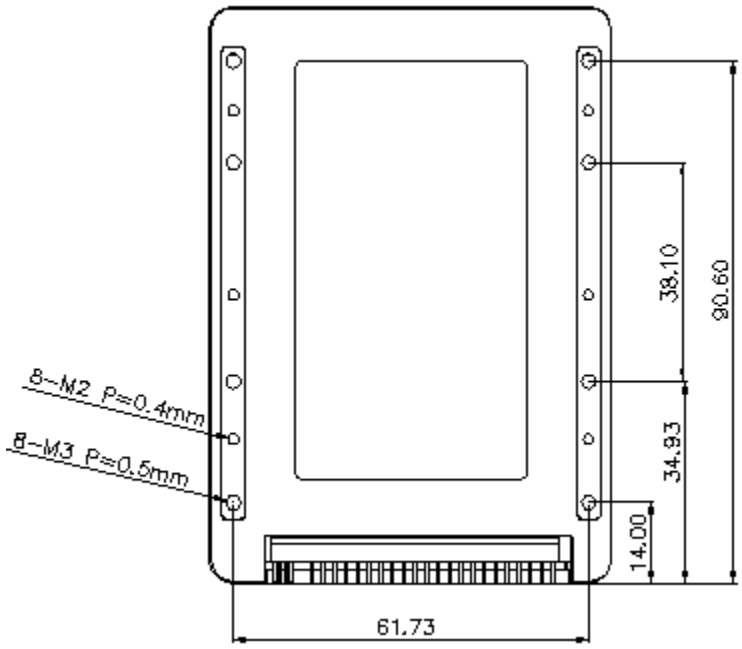
Table 6-3: Recommended system power-up timing

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

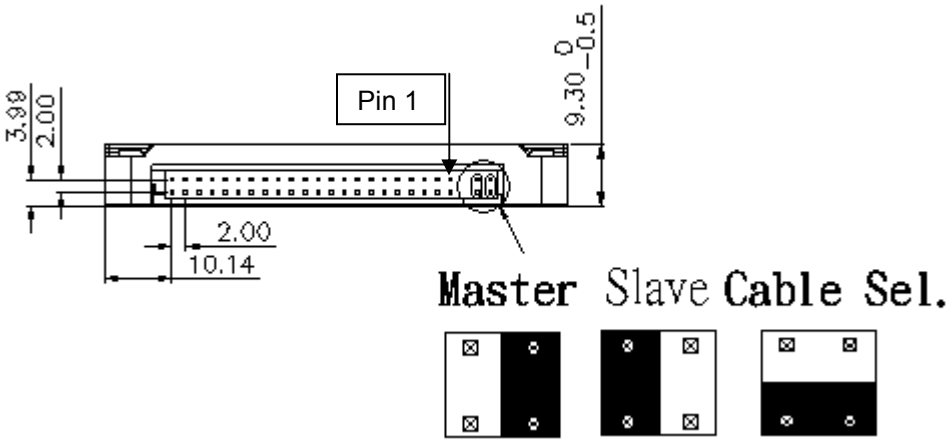
1. This parameter is measured only for initial qualification and after a design or process change that could affect this parameter.

7. Physical Characteristics





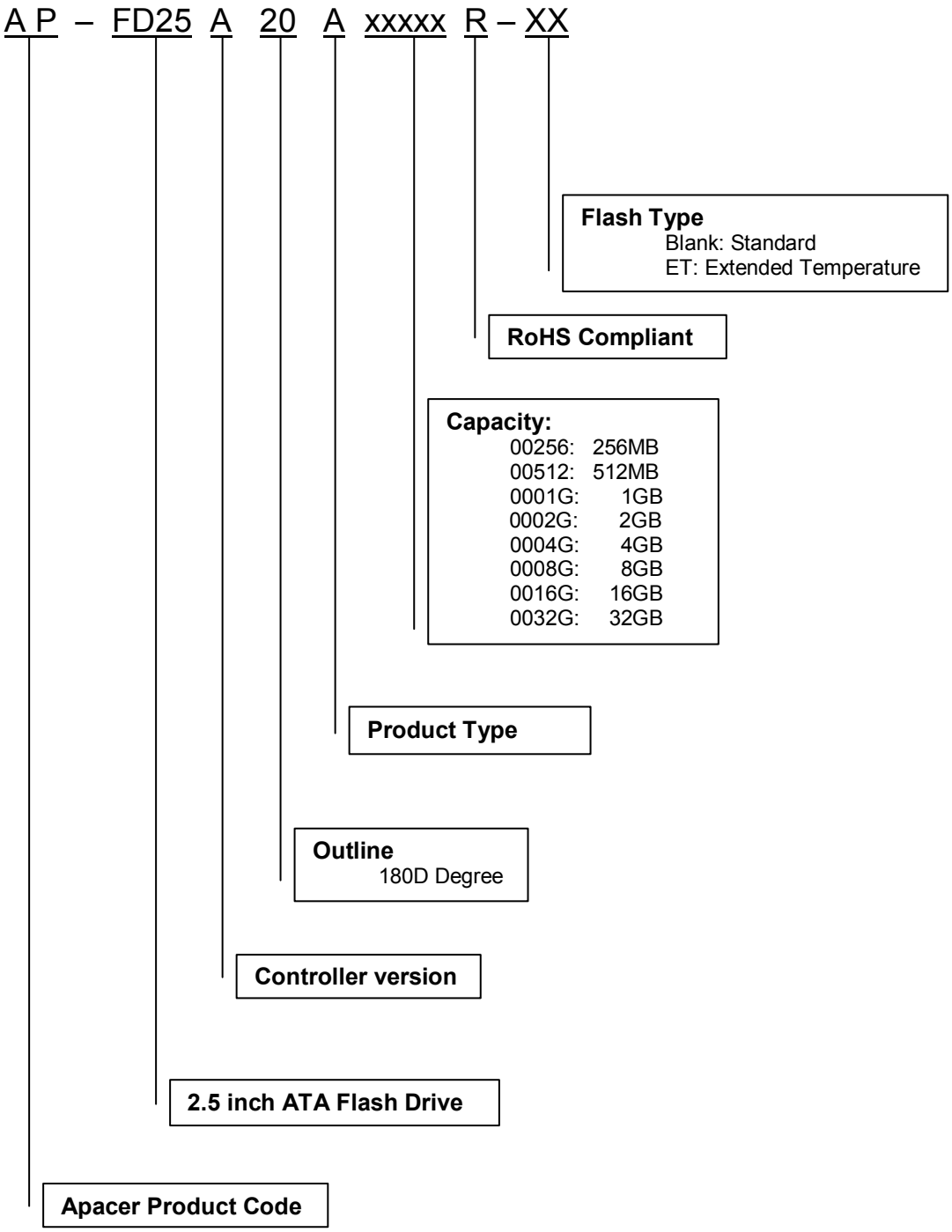
Unit: mm
Tolerance: ± 0.2



Unit: mm
Tolerance: ± 0.2

8. Product Ordering Information

8.1 Product Code Designations



8. 2 Valid Combinations

Capacity	Standard	Extended Temperature
256 MB	AP-FD25A20A00256R	AP-FD25A20A00256R-ET
512 MB	AP-FD25A20A00512R	AP-FD25A20A00512R-ET
1 GB	AP-FD25A20A0001GR	AP-FD25A20A0001GR-ET
2 GB	AP-FD25A20A0002GR	AP-FD25A20A0002GR-ET
4 GB	AP-FD25A20A0004GR	AP-FD25A20A0004GR-ET
8 GB	AP-FD25A20A0008GR	AP-FD25A20A0008GR-ET
16 GB	AP-FD25A20A0016GR	AP-FD25A20A0016GR-ET
32 GB	AP-FD25A20A0032GR	AP-FD25A20A0032GR-ET

Revision History

Revision	Date	Description	Remark
0.1	02/19/2008	Preliminary	
1.0	04/14/2008	Official release	
1.1	05/09/2008	Updated Performance Table	

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