RoHS Compliant

Serial ATA Flash Drive

Specifications for SAFD25M3

August 10th, 2011

Version 1.4

Apacer Technology Inc.
4th Fl., 75 Hsin Tai Wu Rd., Sec.1, Hsichih, New Taipei City, Taiwan 221
Tel: +886-2-2698-2888   Fax: +886-2-2698-2889
www.apacer.com

Features:

- **Standard Serial ATA 2.5 (Gen. 2)**
  - Serial ATA 2.5 (Gen. 2)
  - SATAⅡ, 3.0 Gbps
  - ATA-compatible command set

- **Capacities**
  - 4, 8, 16 GB

- **Performance***
  - Burst read/write: 300 MB/sec
  - Sustained read: up to 115 MB/sec
  - Sustained write: up to 90 MB/sec

- **Intelligent endurance design**
  - Built-in hardware ECC, enabling up to 14/28 bit correction per 1K bytes
  - Static wear-leveling scheme together with dynamical block allocation to significantly increase the lifetime of a flash device and optimize the disk performance
  - Flash bad-block management
  - S.M.A.R.T.
  - Power Failure Management
  - ATA Secure Erase
  - Write Protect
  - Destroy
  - TRIM

- **NAND Flash Type:** SLC

*Varies from capacities.

- **Data integrity under power-cycling**
  - No battery required for data storage

- **Temperature**
  - Operation:
    Standard: 0°C to 70°C
    Extended Temperature: -40°C to 85°C
  - Storage: -40°C to 100°C

- **Supply voltage**
  - 5.0 V ± 5%

- **Low power consumption***
  - Active mode: 360 mA@5.0 V
  - Idle mode: 90 mA@5.0 V

- **Form factor**
  - 2.5 inch

- **Connector**
  - 7-pin SATA male connector
  - 15-pin SATA power connector

- **RoHS compliant**

Rev. 1.4

Table of Contents

Rev. 1.4

1. Product Description

1.1   Introduction

Apacer's Serial ATA Flash Drive (SAFD25M3) is a solid-state disk (SSD) drive that contains a controller, embedded firmware, and flash media along with a male connector. Using NAND flash memory devices, SAFD25M3 drive interfaces with the host allowing data to be seamlessly transferred between the host and the flash devices.

SAFD25M3 drive is designed with a single-chip controller, offering capacities of up to 16 gigabytes and providing full support for the SATAⅡ high-speed interface standard. It can operate at sustained access rates of up to 100 megabytes per second, which is much faster than any other solid-state or traditional SATA drive currently available on the market.

In addition to buffer management through dynamical allocation, SAFD25M3 adopts the static wear-leveling scheme to allow uniform use of all storage blocks, ensuring that the lifetime of a flash media can be significantly increased and the disk performance is optimized as well. SAFD25M3 provides the S.M.A.R.T. feature complies to the SATA Rev.2.6, ATA/ATAPI-7 specifications and uses the standard SMART command B0h to read data from the drive. This feature protects the user from unscheduled downtime by monitoring and storing critical drive performance.

1.2   Functional Block Diagram

SAFD25M3 drive includes a single-chip SATAⅡ Controller and the flash media, as well as the SATA standard interface. The controller integrates the flash management unit with the controller itself to support multi-channel, multi-bank flash arrays. Figure 1-1 shows the functional block diagram.
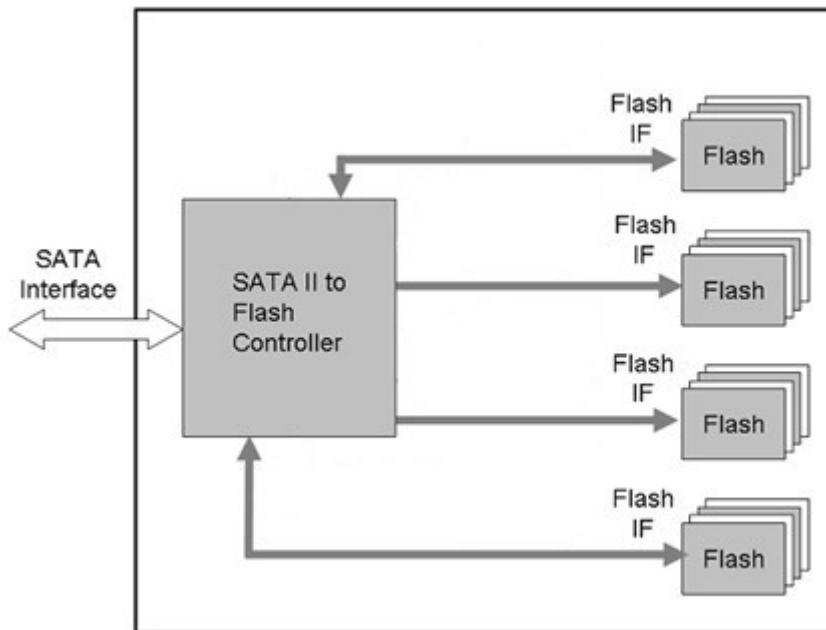

Figure 1-1 Apacer SAFD25M3 block diagram

Rev. 1.4

1.3 ATA Mode Support

SAFD25M3 provides ATA mode support as follows:

- Up to PIO mode-4
- Up to Multiword DMA mode-2
- Up to UDMA mode-5

1.4 Capacity Specification

Capacity specification of the SAFD product family is available as shown in Table 1-1. It lists the specific capacity, the default numbers of logical cylinders and heads, and the number of logical sectors per track for each product line.

Table 1-1 Capacity specification

Capacity	Total Bytes*	Cylinders	Heads	Sectors	Max LBA**
4 GB	3,952,263,168	7,658	16	63	7,719,264
8 GB	7,913,816,064	15,334	16	63	15,456,672
16 GB	15,842,017,280	16,383	16	63	30,941,440

*Display of total bytes varies from file systems.
**Cylinders, heads or sectors are not applicable for these capacities. Only LBA addressing applies.

1.5 Performance

Performance of SAFD25M3 is shown in Table 1-2.

Table 1-2 Performance specification

Capacity / Performance	4 GB	8 GB	16 GB
Sustained read (MB/s)	110	115	115
Sustained write (MB/s)	47	90	90

Note: Performance varies from flash configurations.

Rev. 1.4

Serial ATA Flash Drive
AP-SAFD25MAAxxxxS-XXT

1.6 Pin Assignments

Figure 1-2 illustrates pin assignments of Apacer SAFD25M3 pins, and Table1-3 and Table 1-4 describe its signal segment and power segment, respectively.
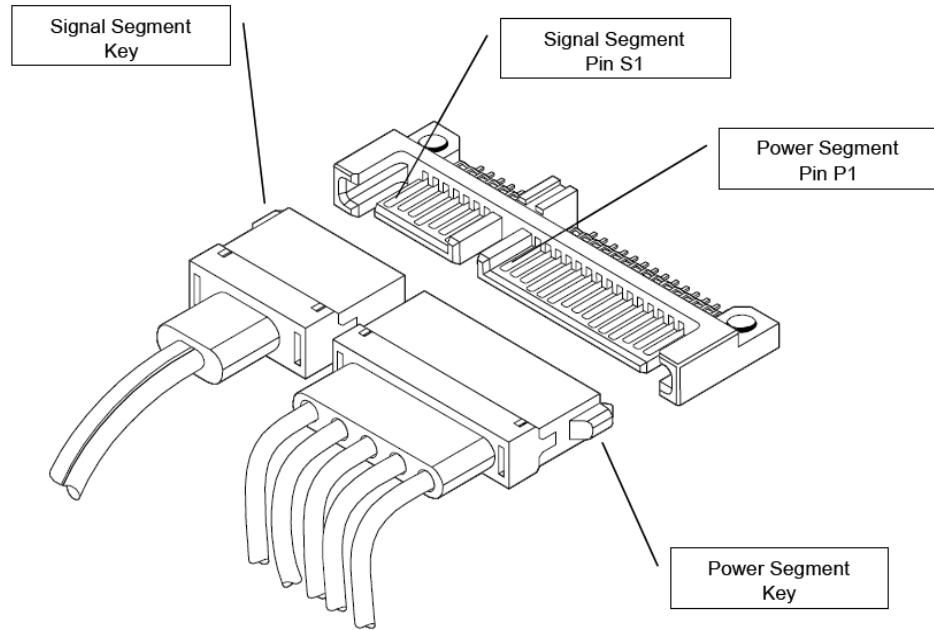

Figure 1-2 Apacer SAFD25M3 pin assignments

Table 1-3 Signal segment

Name	Type	Description
S1	GND	
S2	RxP	+ Differential Receive Signal
S3	RxN	- Differential Receive Signal
S4	GND	
S5	TxN	- Differential Transmit Signal
S6	TxP	+Differential Transmit Signal
S7	GND	

Table 1-4 Power segment

| Pin	Signal/Description
P1	Not used (3.3V)
P2	Not used (3.3V)
P3	Not used (3.3V)
P4	Ground
P5	Ground
P6	Ground
P7	5V
P8	5V
P9	5V
P10	Ground
P11	Ground
P12	Ground
P13	Not used (12V)
P14	Not used (12V)
P15	Not used (12V)

Rev. 1.4
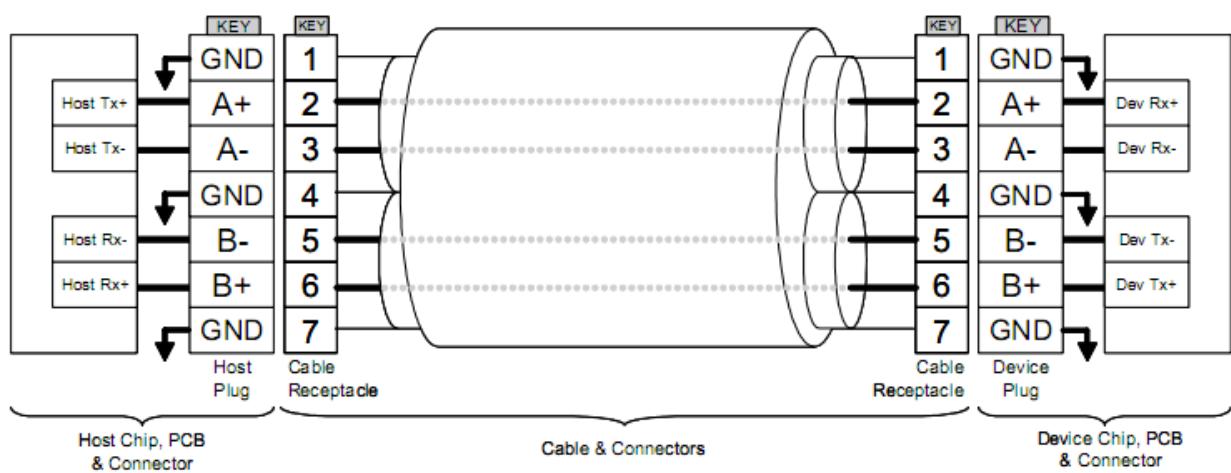
Figure 1-3 SATA Cable / Connector Connection Diagram

The connector on the left represents the Host with TX/RX differential pairs connected to a cable while the connector on the right shows the Device with TX/RX differential pairs also connected to the cable. Notice also the ground path connecting the shielding of the cable to the Cable Receptacle.

Rev. 1.4

2. Software Interface

2.1 Command Set

Table 2-1 summarizes the ATA commands supported by SAFD25M3.

Table 2-1 Command set

Code	Command	Code	Command
E5h	Check Power Mode	F3h	Security Erase Prepare
06h	Data Set Management	F4h	Security Erase Unit
90h	Execute Device Diagnostic	F5h	Security Freeze Lock
E7h	Flush Cache	F1h	Security Set Password
EAh	Flush Cache EXT	F2h	Security Unlock
Ech	Identify Device	70h	Seek
E3h	Idle	Efh	Set Features
E1h	Idle Immediate	C6h	Set Multiple Mode
91h	Initialize Device Parameters	E6h	Sleep
C8h	Read DMA	B0h	SMART
25h	Read DMA EXT	E2h	Standby
C4h	Read Multiple	E0h	Standby Immediate
29h	Read Multiple EXT	Cah	Write DMA
20h	Read Sector	35h	Write DMA EXT
24h	Read Sector EXT	C5h	Write Multiple
40h	Read Verify Sectors	39h	Write Multiple EXT
42h	Read Verify Sectors EXT	30h	Write Sector
10h	Recalibrate	34h	Write Sector EXT
F6h	Security Disable Password		

Rev. 1.4

3. Flash Management

3.1 Error Correction/Detection

SAFD25M3 implements a hardware ECC scheme, based on the BCH algorithm. It can detect and correct up to 14 bits or 28 bits error per 1K bytes.

3.2 Bad Block Management

Although bad blocks on the flash media are already identified by the flash manufacturer, they can also be accumulated over time during operation. SAFD25M3's controller maintains a table that lists those normal blocks with disk data, the free blocks for wear leveling, and bad blocks with errors. When a normal block is detected broken, it is replaced with a free block and listed as a bad block. When a free block is detected broken, it is then removed from the free block list and marked as a bad block.

During device operation, this ensures that newly accumulated bad blocks are transparent to the host. The device will stop file write service once there are only two free blocks left such that the read function is still available for copying the files from the disk into another.

3.3 Wear Leveling

The NAND flash devices are limited by a certain number of write cycles. When using a FAT-based file system, frequent FAT table updates are required. If some area on the flash wears out faster than others, it would significantly reduce the lifetime of the whole SSD, 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. This scheme is called wear leveling.

Apacer's wear-leveling scheme is achieved both via buffer management and Apacer-specific static wear leveling. They both ensure that the lifetime of the flash media can be increased, and the disk access performance is optimized as well.

3.4 Power Failure Management

The Low Power Detection on the controller initiates crucial data saving before the power supplied to the device is too low. This feature prevents the device from crash and ensures data integrity during an unexpected power-off.

3.5 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.

Rev. 1.4

3.6 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 calibration parameters. Ideally, this should allow taking proactive actions to prevent impending drive failure.

Apacer SAFD 25M3 uses the standard SMART command B0h to read data from the drive for SMART feature as the SATA Rev.2.6 ATA/ATAPI-7 specifications. Based on the SFF-8035i Rev. 2.0 specifications, Apacer SMART defines vendor-specified SMART Attribute IDs (A0h, A1h, A2h, A3h, A4h-A5h) in SAFD25M3. They represent initial bad block count, bad block count, spare block count, maximum erase count, and average erase counts respectively. When the Apacer SMART Utility running on the host, it analyzes and reports the disk status to the host before SAFD25M3 is in critical condition.

3.7 TRIM

Made of millions of NAND flash cells, SSD can be written into groups called pages in 4K size generally, but can only be erased in larger groups called blocks of 128 pages or 512KB. These stipulations are partially the source of many performance issues. Until an address gets used again, the SSD has to keep track of every last bit of data that's written on it. The ATA-TRIM instruction tilts the balance in favor of the SSD. TRIM addresses a major part of the performance degradation issue over time that plagues all SSDs. A TRIM enabled drive running an OS with TRIM support will stay closer to its peak performance over time.

Rev. 1.4

4. Environmental Specifications

4.1 Environments

SAFD25M3 environmental specifications are listed as below.

Table 4-1 SAFD25M3 environmental specifications

Item	Specification
operating temp.	-40~85(℃)
non-operating temp.	-40~100(℃)
humidity	5~95(%) R.H, non-condensing
Sine vibration	10~2000(Hz), 15(G), non-operating
Random vibration	20~2000(Hz), 7.7 (Grms), operating
operating shock	hals-sine 50(G)/11(ms)
non-operating shock	half-sine 1500(G)/0.5(ms)

4.2 Mean Time Between Failures (MTBF)

Mean Time Between Failures (MTBF) is predicted based on reliability data for the individual components in SAFD25M3. Although many component MTBFs are given in databases and often these values are not really accurate, the prediction result for SAFD 25M3 is more than 2,000,000 hours.

4.3 Certification and Compliance

SAFD25M3 complies with the following standards:

- CE – EN55022/55024
- FCC 47CFR Part15 Class B
- RoHS
- SATA II (SATA Rev. 2.6)
- Up to ATA/ATAPI-7 (including S.M.A.R.T.)

Rev. 1.4

⌐'────5. 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 5-1 Operating voltage

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

Table 5-2 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.

Rev. 1.4

6. Physical Characteristics

6.1   Dimension

Power Segment Pin 1   Signal Segment Pin 1

3.00

14.30

20.93

2-M3

4-M3

61.73

Unit: ㎜
Tolerance: ±0.2㎜

Rev. 1.4

Apacer
Access the best

70.00±.10

48.66±.20

47.41

55.73

9.25±.10

Unit: ㎜
Tolerance: ±0.2 ㎜

© 2011 Apacer Technology Inc.

Rev. 1.4
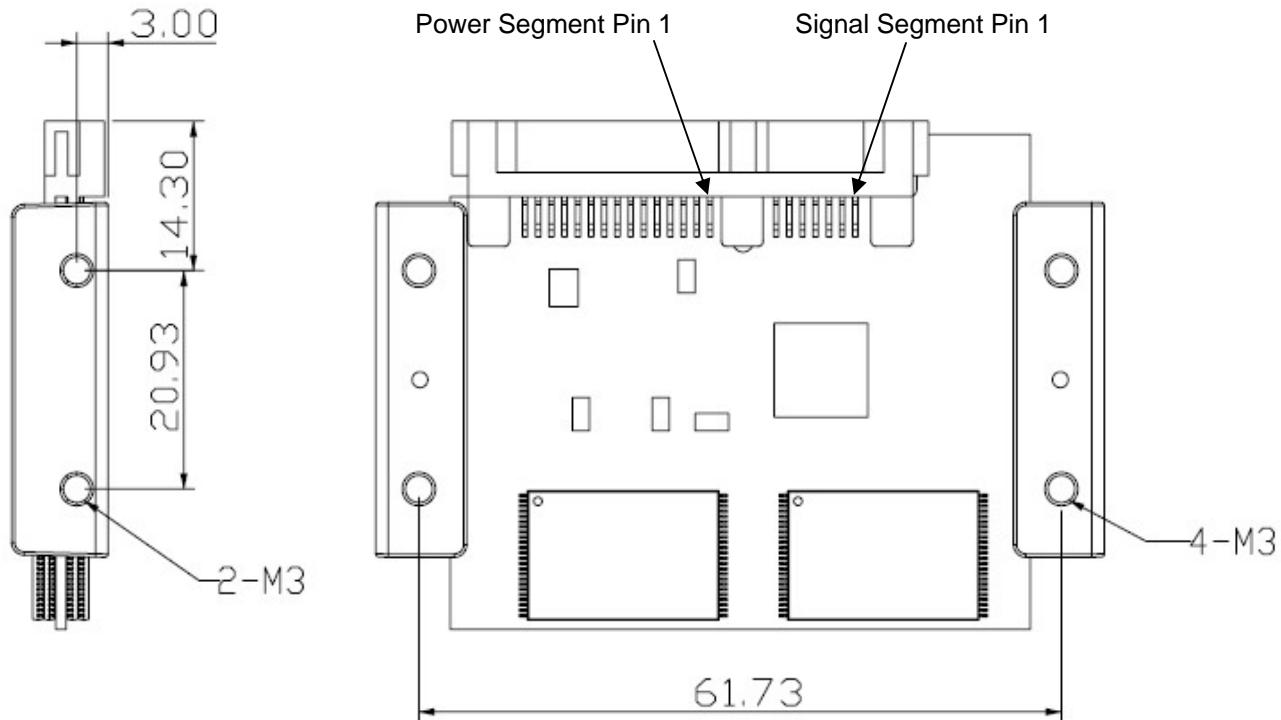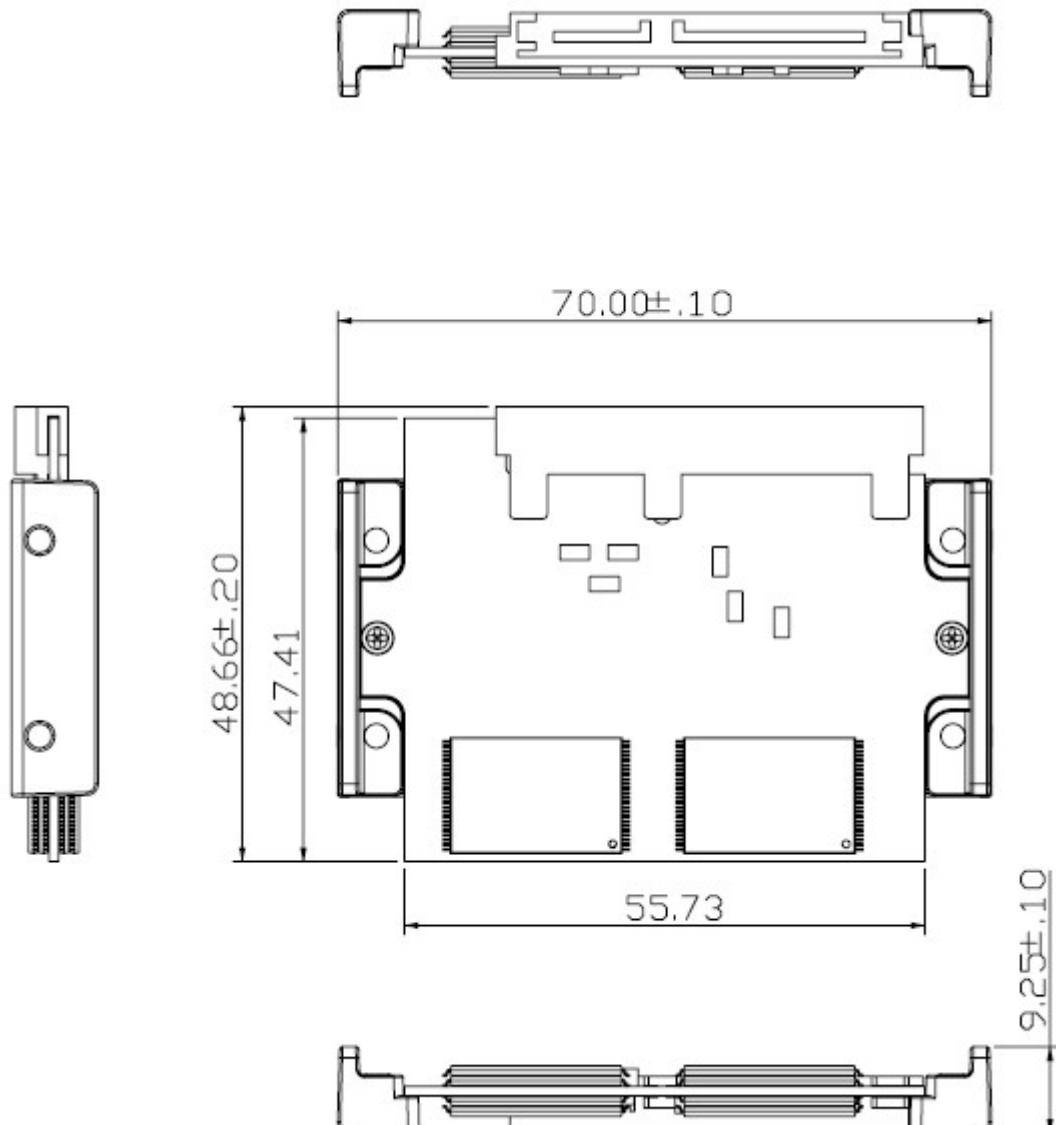
7. Product Ordering Information

7.1 Product Code Designations

A P – SAFD 25M A A x x x x S – XX T

Flash type

Temperature Range
Blank: Standard
ET: Extended Temperature

Environmental Specification

Capacities:
004G = 4GB
008G = 8GB
016G = 16GB

Apacer Brand

Solution version

2.5 inch Form Factor

Serial ATA Flash Drive

Apacer Product Code

Rev. 1.4
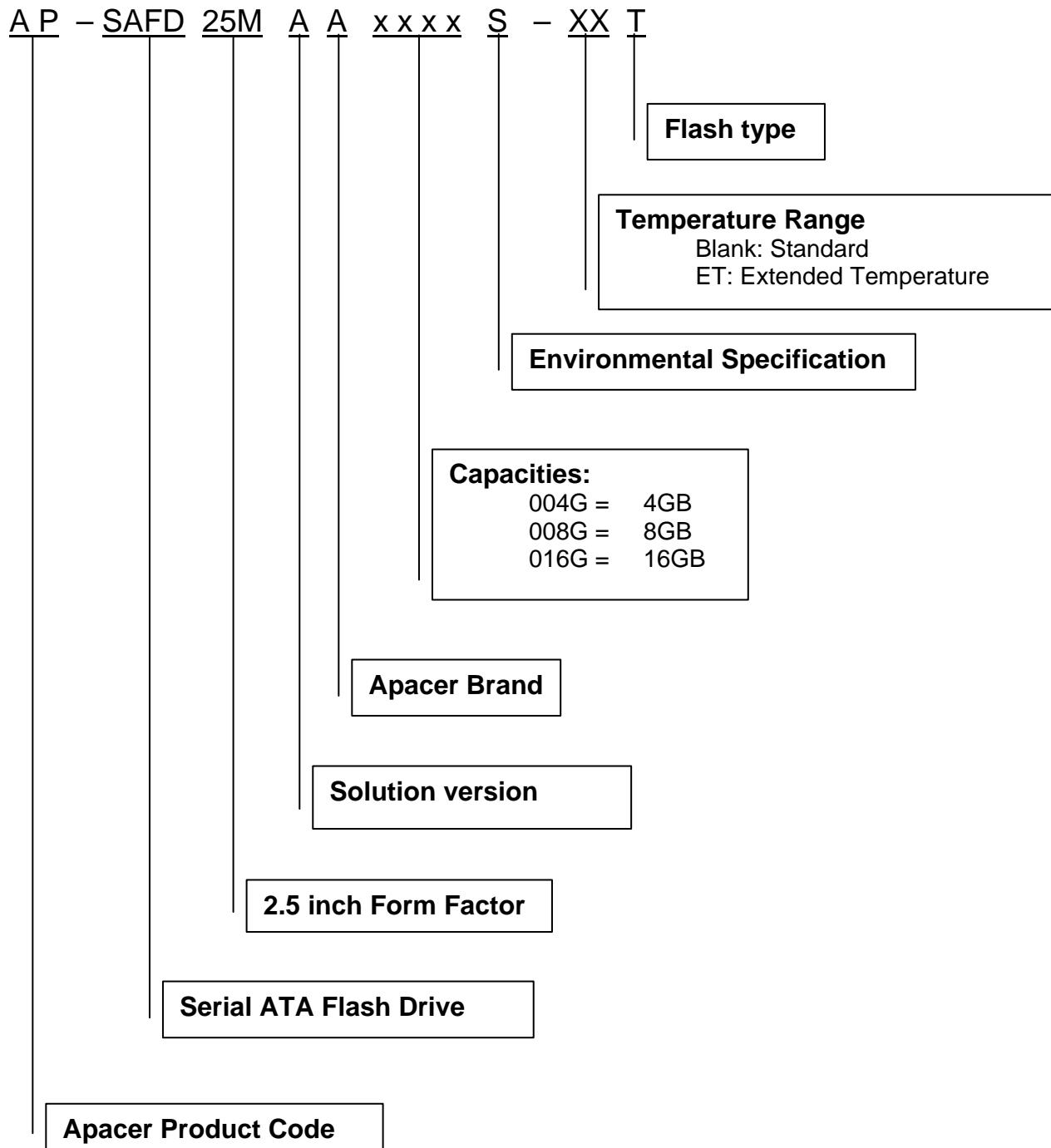
7.2   Valid Combinations

Capacity	Standard	Extended Temperature
4GB	AP-SAFD25MAA004GS-T	AP-SAFD25MAA004GS-ETT
8GB	AP-SAFD25MAA008GS-T	AP-SAFD25MAA008GS-ETT
16GB	AP-SAFD25MAA016GS-T	AP-SAFD25MAA016GS-ETT

Note: Valid combinations are those products in mass production or will be in mass production. Consult your Apacer sales representative to confirm availability of valid combinations and to determine availability of new combinations.

Rev. 1.4

Revision History

Revision	Date	Description	Remark
0.1	12/17/2010	Preliminary release	
1.0	02/25/2011	Formal release	
1.1	04/01/2011	Updated Performance Specifications	
1.2	04/14/2011	Updated Environmental Specifications	
1.3	07/18/2011	Updated Power Consumption – Active mode: 353 mA -> 360mA – Idle mode: 120 mA -> 90mA	
1.4	08/10/2011	Updated ECC - Built in hardware ECC, enabling up to 14/28 bit correction per 1K bytes	

Rev. 1.4

Global Presence

Taiwan (Headquarters)

Apacer Technology Inc.
4th Fl., 75 Hsin Tai Wu Rd., Sec.1
Hsichih, New Taipei City
Taiwan 221
R.O.C.
Tel: +886-2-2698-2888
Fax: +886-2-2698-2889
amtsales@apacer.com

U.S.A.

Apacer Memory America, Inc.
386 Fairview Way, Suite102,
Milpitas, CA 95035
Tel: 1-408-518-8699
Fax: 1-408-935-9611
sa@apacerus.com

Japan

Apacer Technology Corp.
5F, Matsura Bldg., Shiba, Minato-Ku
Tokyo, 105-0014, Japan
Tel: 81-3-5419-2668
Fax: 81-3-5419-0018
jpservices@apacer.com

Europe

Apacer Technology B.V.
Aziëlaan 22,
5232 BA 's-Hertogenbosch,
The Netherlands
Tel: 31-73-645-9620
Fax: 31-73-645-9629
sales@apacer.nl

China

Apacer Electronic (Shanghai) Co., Ltd
1301, No.251,Xiaomuqiao Road, Shanghai,
200032, China
Tel: 86-21-5529-0222
Fax: 86-21-5206-6939
sales@apacer.com.cn

India

Apacer Technologies Pvt Ltd,
#1064, 1st Floor, 7th 'A' Main,
3rd Block Koramangala, Bangalore – 560 034
Tel: +91 80 4152 9061/62/63
Fax: +91 80 4170 0215
sales_india@apacer.com

Mouser Electronics

Authorized Distributor

Click to View Pricing, Inventory, Delivery & Lifecycle Information:

[Apacer]():
 AP-SAFD25MAA004GS-ETT   AP-SAFD25MAA004GS-T   AP-SAFD25MAA008GS-ETT   AP-SAFD25MAA008GS-T
AP-SAFD25MAA016GS-ETT   AP-SAFD25MAA016GS-T