RoHS Compliant

Serial ATA Flash Drive

SFD25A -M Product Specifications

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Version 1.5

Apacer Access the best

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Features:

- **Compliance with SATA Revision 3.1**
  - Serial ATA Revision 3.1
  - SATA 6.0 Gbps interface
  - Backward compatible with SATA 1.5 and 3.0 Gbps interfaces
  - ATA-8 command set
- **Capacities**
  - Standard type: 16, 32, 64, 128, 256 GB
  - High-speed type: 32, 64, 128, 256 GB
- **Performance***
  - Burst read/write: 600 MB/sec

  Standard type:
  - Sustained read: up to 385 MB/sec
  - Sustained write: up to 170 MB/sec

  High-speed type:
  - Sustained read: up to 525 MB/sec
  - Sustained write: up to 455 MB/sec
  - Random read (4K): up to 86,000 IOPS
  - Random write (4K): up to 79,000 IOPS
- **Flash Management**
  - Built-in hardware ECC, enabling up to 40 bit correction per 1K bytes
  - Static/dynamic wear leveling
  - Flash bad-block management
  - S.M.A.R.T.
  - Power Failure Management
  - ATA Secure Erase
  - TRIM
- **NAND Flash Type:** MLC
- **Endurance (in Terabytes Written: TBW)**
  - 16GB: 34 TBW
  - 32GB: 68 TBW
  - 64GB: 136 TBW
  - 128GB: 272 TBW
  - 256 GB: 545 TBW
- **Temperature ranges**
  - Operating:

    Standard: 0℃ to 70℃

    Enhanced: -25℃ to 85℃
  - Storage: -40℃ to 100℃
- **Supply voltage**
  - 5.0 V ± 5%
- **Power consumption (typical)***

  Standard type:
  - Active mode: 385 mA
  - Idle mode: 105 mA

  High-speed type:
  - Active mode: 680 mA
  - Idle mode: 50 mA
- **Form factor**
  - 2.5”
  - Dimensions with 7mm enclosure: 100.00 x 69.85 x 6.90, unit: mm
  - Dimensions with 9.5mm enclosure: 100.00 x 69.84 x 9.30, unit: mm
- **Connector**
  - 7-pin SATA signal connector
  - 15-pin SATA power connector
- **Shock & Vibration****
  - Shock: 1500 G
  - Vibration: 15 G
- **DRAM cache for enhanced random performance (for high-speed type only)**
- **SATA power management modes**
- **Device Sleep mode (optional)**
- **RoHS compliant**

*The values addressed here are typical and may vary depending on settings and platforms.
**Non-operating

Table of Contents

1. Product Description

1.1 Introduction

Apacer's SFD25A-M is a well-balanced solid-state disk (SSD) drive with standard form factor and great performance. Designed in SATA 6.0 Gbps interface, the SSD is able to deliver exceptional read/write speed, making it the ideal companion for heavy-loading industrial or server operations.

For data efficiency, the internal controlling unit of the SSD is engineered with DRAM for enhanced random performance (for high-speed type only). In regard of reliability, the drive comes with various implementations including powerful hardware ECC engine, power saving modes, wear leveling, flash block management, S.M.A.R.T., TRIM, and power failure management.

1.2 Capacity Specification

Table 1-1 Capacity specification

Capacity	Total Bytes*	Cylinders	Heads	Sectors	Max LBA*
16 GB	16,013,942,784	16,383	16	63	31,277,232
32 GB	32,017,047,552	16,383	16	63	62,533,296
64 GB	64,023,257,088	16,383	16	63	125,045,424
128 GB	128,035,676,160	16,383	16	63	250,069,680
256 GB	256,060,514,304	16383	16	63	500,118,192

*Display of total bytes varies from file systems.

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

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.

1.3 Performance

Table 1-2 Performance (standard type)

Capacity / Performance	16 GB	32 GB	64 GB	128 GB	256 GB
Sustained Read (MB/s)	200	370	350	385	385
Sustained Write (MB/s)	22	42	80	170	170

Note: Performance varies from flash configurations or host system settings.

Table 1-3 Performance specification (high-speed type)

Capacity Performance	32 GB	64 GB	128 GB	256 GB
Sustained Read (MB/s)	380	515	520	525
Sustained Write (MB/s)	85	145	300	455
Random Read IOPS (4K)	46,000	79,000	85,000	86,000
Random Write IOPS (4K)	19,000	35,000	71,000	79,000

Note: Performance varies from flash configurations or host system settings.
IOPS: measured on 8GB span (16777216 sectors Disk Size), 32 Outstanding I/Os (QD=32), Full Random Data pattern, 4KB Align I/Os and test durations 15minutes.

1.4 Pin Assignments

Table 1-4 describes the SFD signal segment, and Table1-5, power segment.

Figure 1-1 SATA Connectors

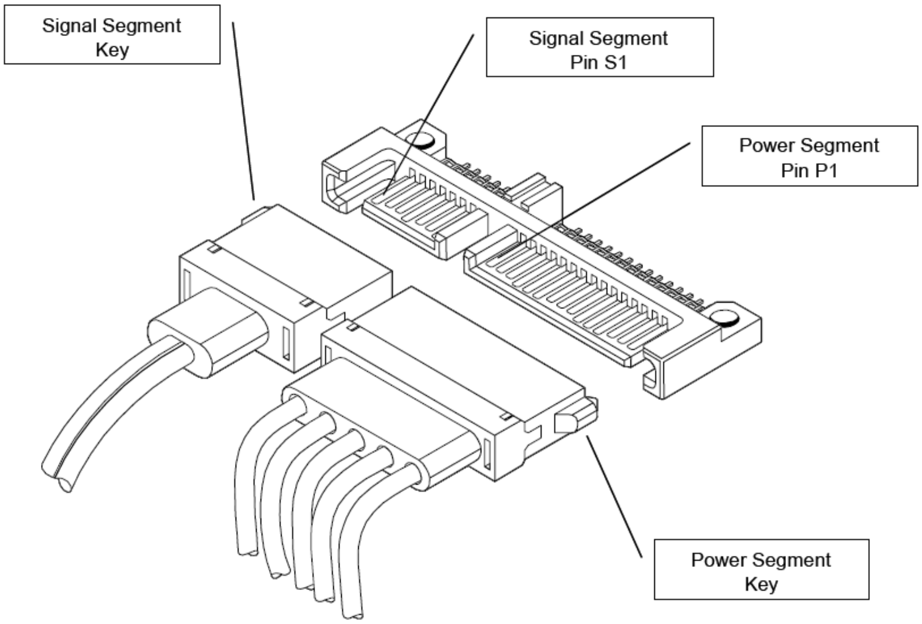

Table 1-4: Signal segment

Pin	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 1-5: Power segment

Pin	Signal/Description
P1	Unused (3.3V)
P2	Unused (3.3V)
P3	Unused or Device Sleep*
P4	Ground
P5	Ground
P6	Ground
P7	5V
P8	5V
P9	5V
P10	Ground
P11	DAS
P12	Ground
P13	Unused (12V)
P14	Unused (12V)
P15	Unused (12V)

*P3 can be configured as Device Sleep trigger by option

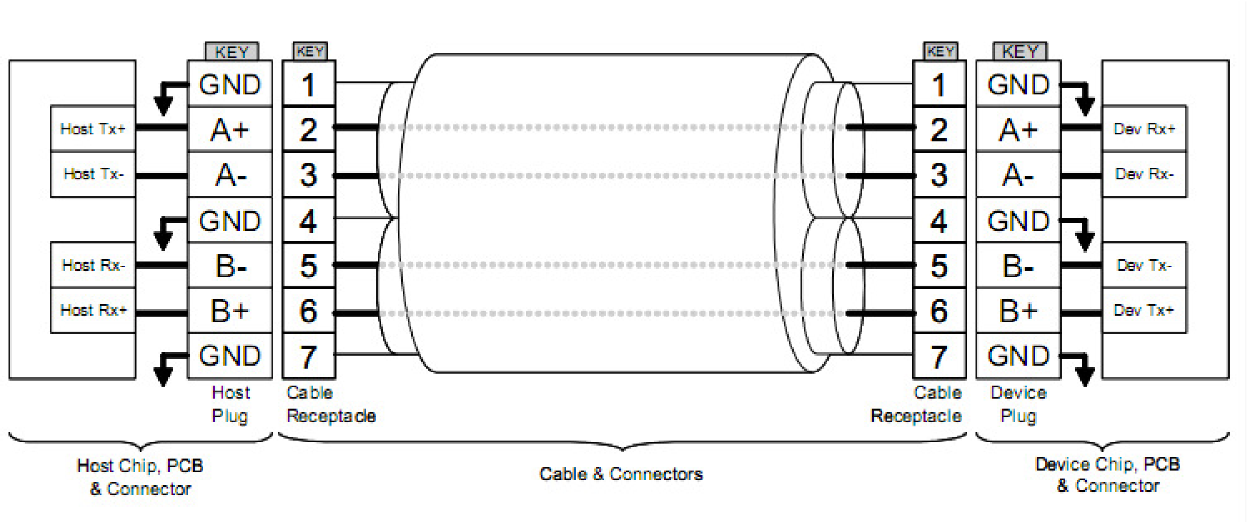

Figure 1-3 SATA Cable/Connector Connection Diagram

The connector on the left represents the Host with TX/RX differential pairs connected to a cable. 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.

2. Software Interface

2.1 Command Set

Table 2-1 summarizes the ATA commands supported by SFD25A-M.

Table 2-1: Command set

Code	Command	Code	Command
E5h	Check Power Mode	F6h	Security Disable Password
90h	Execute Diagnostics	F3h	Security Erase Prepare
E7h	Flush Cache	F4h	Security Erase Unit
ECh	Identify Device	F5h	Security Freeze Lock
E3h	Idle	F1h	Security Set Password
E1h	Idle Immediate	F2h	Security Unlock
91h	Initialize Device Parameters	7xh	Seek
C8h	Read DMA	Efh	Set Features
25h	Read DMA EXT	C6h	Set Multiple Mode
60h	Read FPDMA Queued	E6h	Sleep
47h	Read Log DMA EXT	B0h	S.M.A.R.T.
2Fh	Read Log EXT	E2h	Standby
C4h	Read Multiple	E0h	Standby Immediate
20 or 21h	Read Sector(s)	Cah	Write DMA
40 or 41h	Read Verify Sector(s)	35h	Write DMA EXT
10h	Recalibrate	61h	Write FPDMA Queued
57h	Write Log DMA EXT	3Fh	Write Log EXT
C5h	Write Multiple	30h or 31h	Write Sector(s)

2.2 S.M.A.R.T.

S.M.A.R.T. is an abbreviation for Self-Monitoring, Analysis and Reporting Technology, a self-monitoring system that provides indicators of drive health as well as potential disk problems. It serves as a warning for users from unscheduled downtime by monitoring and displaying critical drive information. Ideally, this should allow taking proactive actions to prevent drive failure and make use of S.M.A.R.T. information for future product development reference.

Apacer devices use the standard SMART command B0h to read data out from the drive to activate our S.M.A.R.T. feature that complies with the ATA/ATAPI specifications. S.M.A.R.T. Attribute IDs shall include initial bad block count, total later bad block count, maximum erase count, average erase count, power on hours and power cycle. When the S.M.A.R.T. Utility running on the host, it analyzes and reports the disk status to the host before the device reaches in critical condition.

Note: attribute IDs may vary from product models due to various solution design and supporting capabilities.

Apacer memory products come with S.M.A.R.T. commands and subcommands for users to obtain information of drive status and to predict potential drive failures. Users can take advantage of the following commands/subcommands to monitor the health of the drive.

Code	SMART Subcommand
D0h	READ DATA
D1h	READ ATTRIBUTE THRESHOLDS
D2h	Enable/Disable Attribute Autosave
D4h	Execute Off-line Immediate
D5h	Read Log (optional)
D6h	Write Log (optional)
D8h	Enable Operations
D9h	Disable operations
Dah	Return Status

General SMART attribute structure

Byte	Description
0	ID (Hex)
1 – 2	Status flag
3	Value
4	Worst
5*-11	Raw Data

*Byte 5: LSB

SMART attribute ID list

ID (Hex)	Attribute Name
9 (0x09)	Power-on hours
12 (0x0C)	Power cycle count
163 (0xA3)	Max. erase count
164 (0xA4)	Avg. erase count
166 (0xA6)	Total later bad block count
167 (0xA7)	SSD Protect Mode (vendor specific)
168 (0xA8)	SATA PHY Error Count
175 (0xAF)	Bad Cluster Table Count
192 (0xC0)	Unexpected Power Loss Count
194 (0xC2)	Temperature
241 (0xF1)	Total sectors of write

3. Flash Management

3.1 Error Correction/Detection

SFD25A-M implements a hardware ECC scheme, based on the BCH algorithm. It can detect and correct up to 40 bits error in 1K bytes.

3.2 Bad Block Management

Current production technology is unable to guarantee total reliability of NAND flash memory array. When a flash memory device leaves factory, it comes with a minimal number of initial bad blocks during production or out-of-factory as there is no currently known technology that produce flash chips free of bad blocks. In addition, 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.

3.3 Wear Leveling

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. 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 sooner. 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.

3.4 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.

Note: The controller unit of this product model is designed with a DRAM as a write cache for improved performance and data efficiency. Though unlikely to happen in most cases, the data cached in the volatile DRAM might be potentially affected if a sudden power loss takes place before the cached data is flushed into non-volatile NAND flash memory.

3.5 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.

3.6 TRIM

TRIM is a SATA command that helps improve the read/write performance and efficiency of solid-state drives (SSD). The command enables the host operating system to inform SSD controller whick blocks contain invalid data, mostly because of the erase commands from host. The invalid will be discarded permanently and the SSD will retain more space for itself.

3.7 SATA Power Management

By complying with SATA 6.0 Gb/s specifications, the SSD supports the following SATA power saving modes:

- ACTIVE: PHY ready, full power, Tx & Rx operational
- PARTIAL: Reduces power, resumes in under 10 µs (microseconds)
- SLUMBER: Reduces power, resumes in under 10 ms (milliseconds)
- HIPM: Host-Initiated Power Management
- DIPM: Device-Initiated Power Management
- AUTO-SLUMBER: Automatic transition from partial to slumber.
- Device Sleep (DevSleep or DEVSLP): PHY powered down; power consumption ≦ 5 mW; host assertion time ≦ 10 ms; exit timeout from this state ≦ 20 ms (unless specified otherwise in SATA Identify Device Log).

Note:
1. The behaviors of power management features would depend on host/device settings.
2. Device Sleep mode is optional, depending on product ordering selections.

4. Reliability Specifications

4.1 Environmental

SFD25A-M environmental specifications follow MIL-STD-810F, as indicated in the following table.

Table 4-1 SFD25A-M environmental specifications

Environment	Specification
Temperature	0℃ to 70℃ (standard) / -25℃ to 85℃ (enhanced)
	-40℃ to 100℃ (Non-operating)
Vibration	Non-operating : Sine wave, 15(G), 10~2000(Hz), Operating : Random, 7.69(Grms), 20~2000(Hz)
Shock	Non-operating: Acceleration, 1,500 G, 0.5 ms Operating: Peak acceleration, 50 G, 11 ms

4.2 Mean Time Between Failures (MTBF)

Mean Time Between Failures (MTBF) is predicted based on reliability data for the individual components in SFD drive. The prediction result for the SFD25A-M is more than 1,000,000 hours.

Notes about the MTBF:

The MTBF is predicated and calculated based on “Telcordia Technologies Special Report, SR-332, Issue 2” method.

4.3 Certification and Compliance

SFD25A-M complies with the following standards:

- CE
- FCC
- RoHS
- MIL-STD-810F

4.4 Endurance

The endurance of a storage device is predicted by TeraBytes Written based on several factors related to usage, such as the amount of data written into the drive, block management conditions, and daily workload for the drive. Thus, key factors, such as Write Amplifications and the number of P/E cycles, can influence the lifespan of the drive.

Capacity	TeraBytes Written
16 GB	34
32 GB	68
64 GB	136
128 GB	272
256 GB	545

Notes:

- The measurement assumes the data written to the SSD for test is under a typical and constant rate.
- The measurement follows the standard metric: 1 TB (Terabyte) = 1000 GB.

5. Electrical Characteristics

5.1 Operating Voltage

Table 5-1 lists the supply voltage for SFD25A-M.

Table 5-1 SFD25A-M operating voltage

Parameter	Conditions
Supply voltage	5V ±5% (4.75-5.25 V)

5.2 Power Consumption

Table 5-2 Power consumption (standard type)

Capacity Mode	16 GB	32 GB	64 GB	128 GB	256 GB
Active (mA)	255	255	255	385	385
Idle (mA)	105	105	105	105	105

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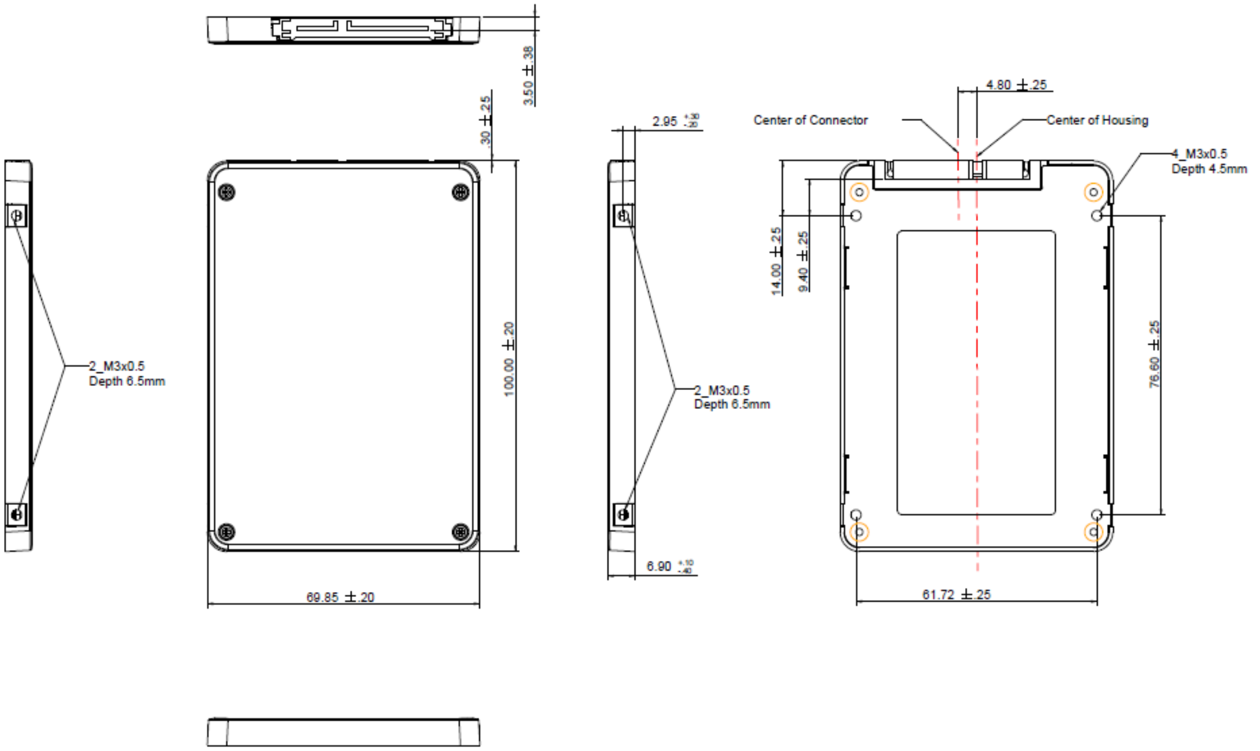
Table 5-3 Power consumption (high-speed type)

Capacity Mode	32 GB	64 GB	128 GB	256 GB
Active (mA)	240	300	470	680
Idle (mA)	50	50	50	50

Note: Power consumptions may vary depending on settings and platforms.

6. Mechanical Specifications

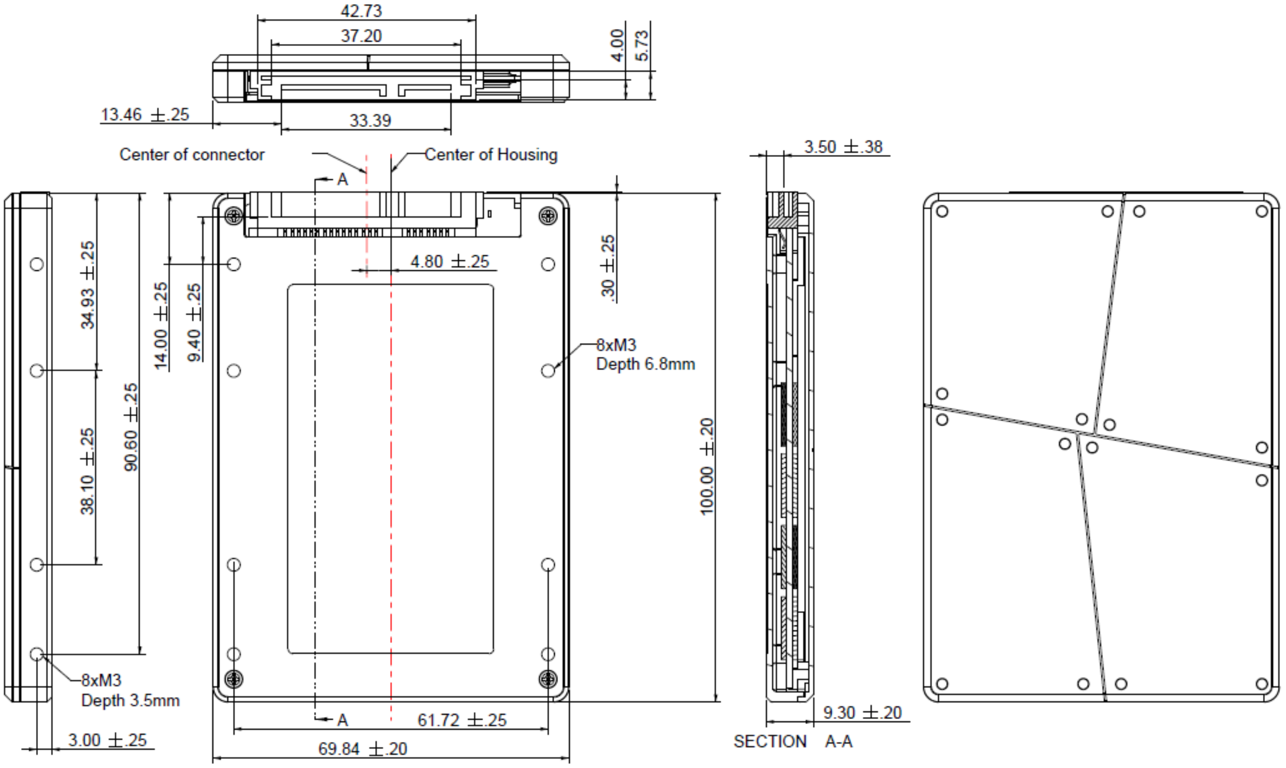
6.1 7mm Type Dimensions



Unit: mm
Tolerance: ± 0.2

Figure 6-1 SFD25A-M with 7mm Housing physical dimensions

6.2 9.5mm Type Dimensions

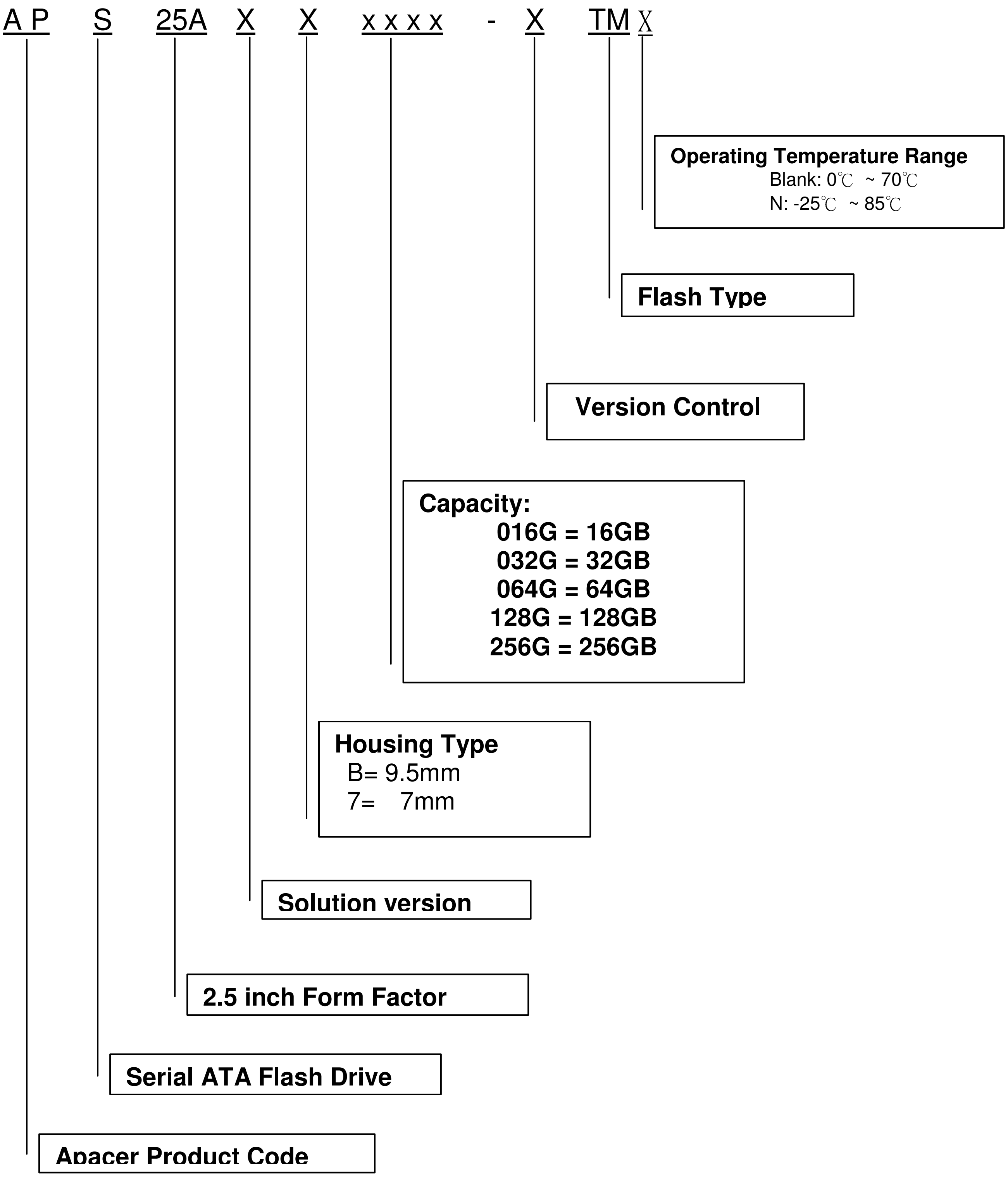


Unit: mm
Tolerance: ± 0.2

Figure 6-2 SFD25A-M with 9.5mm Housing physical dimensions

7. Product Ordering Information

7.1 Product Code Designation



A P S 25A X X x x x x - X TM X

Operating Temperature Range
Blank: 0℃ ~ 70℃
N: -25℃ ~ 85℃

Flash Type

Version Control

Capacity:
016G = 16GB
032G = 32GB
064G = 64GB
128G = 128GB
256G = 256GB

Housing Type
B= 9.5mm
7= 7mm

Solution version

2.5 inch Form Factor

Serial ATA Flash Drive

Apacer Product Code

7.2 Valid Combination

A. 9.5mm Metal Housing

7.2.1.1 9.5mm Metal Housing – Standard Speed / Operating Temperature (0℃ ~ 70℃)

Capacity	NO DEVSLP	DEVSLP
16GB	APS25ABB016G-ATM	APS25ABB016G-BTM
32GB	APS25ABB032G-ATM	APS25ABB032G-BTM
64GB	APS25ABB064G-ATM	APS25ABB064G-BTM
128GB	APS25ABB128G-ATM	APS25ABB128G-BTM
256GB	APS25ABB256G-ATM	APS25ABB256G-BTM

7.2.1.2 9.5mm Metal Housing – Standard Speed / Operating Temperature (-25℃ ~ 85℃)

Capacity	NO DEVSLP	DEVSLP
16GB	APS25ABB016G-ATMN	APS25ABB016G-BTMN
32GB	APS25ABB032G-ATMN	APS25ABB032G-BTMN
64GB	APS25ABB064G-ATMN	APS25ABB064G-BTMN
128GB	APS25ABB128G-ATMN	APS25ABB128G-BTMN
256GB	APS25ABB256G-ATMN	APS25ABB256G-BTMN

7.2.2.1 9.5mm Metal Housing – High Speed / Operating Temperature (0℃ ~ 70℃)

Capacity	NO DEVSLP	DEVSLP
32GB	APS25A4B032G-2ATM	APS25A4B032G-2BTM
64GB	APS25A7B064G-2ATM	APS25A7B064G-2BTM
128GB	APS25A7B128G-2ATM	APS25A7B128G-2BTM
256GB	APS25A7B256G-2ATM	APS25A7B256G-2BTM

7.2.2.2 9.5mm Metal Housing – High Speed / Operating Temperature (-25℃ ~ 85℃)

Capacity	NO DEVSLP	DEVSLP
32GB	APS25A4B032G-2ATMN	APS25A4B032G-2BTMN
64GB	APS25A7B064G-2ATMN	APS25A7B064G-2BTMN
128GB	APS25A7B128G-2ATMN	APS25A7B128G-2BTMN
256GB	APS25A7B256G-2ATMN	APS25A7B256G-2BTMN

B. 7mm Plastic Housing

7.2.3.1 7mm Plastic Housing –Standard Speed / Operating Temperature (0℃ ~ 70℃)

Capacity	NO DEVSLP	DEVSLP
16GB	APS25AB7016G-ATM	APS25AB7016G-BTM
32GB	APS25AB7032G-ATM	APS25AB7032G-BTM
64GB	APS25AB7064G-ATM	APS25AB7064G-BTM
128GB	APS25AB7128G-ATM	APS25AB7128G-BTM
256GB	APS25AB7256G-ATM	APS25AB7256G-BTM

7.2.3.2 7mm Plastic Housing –Standard Speed / Operating Temperature (-25℃ ~ 85℃)

Capacity	NO DEVSLP	DEVSLP
16GB	APS25AB7016G-ATMN	APS25AB7016G-BTMN
32GB	APS25AB7032G-ATMN	APS25AB7032G-BTMN
64GB	APS25AB7064G-ATMN	APS25AB7064G-BTMN
128GB	APS25AB7128G-ATMN	APS25AB7128G-BTMN
256GB	APS25AB7256G-ATMN	APS25AB7256G-BTMN

7.2.4.1 7mm Housing –High Speed / Operating Temperature (0℃ ~ 70℃)

Capacity	NO DEVSLP	DEVSLP
32GB	APS25A47032G-2ATM	APS25A47032G-2BTM
64GB	APS25A77064G-2ATM	APS25A77064G-2BTM
128GB	APS25A77128G-2ATM	APS25A77128G-2BTM
256GB	APS25A77256G-2ATM	APS25A77256G-2BTM

7.2.4.2 7mm Housing –High Speed / Operating Temperature (-25℃ ~ 85℃)

Capacity	NO DEVSLP	DEVSLP
32GB	APS25A47032G-2ATMN	APS25A47032G-2BTMN
64GB	APS25A77064G-2ATMN	APS25A77064G-2BTMN
128GB	APS25A77128G-2ATMN	APS25A77128G-2BTMN
256GB	APS25A77256G-2ATMN	APS25A77256G-2BTMN

Note: Please consult with Apacer sales representatives for availabilities.

Revision History

Revision	Description	Date
0.1	Preliminary release	05/17/2013
0.2	Updated mechanical drawings	08/30/2013
0.3	Added performance and power consumption information for 64, 128 and 256 GB	09/05/2013
0.4	Added IOPS Integrates categories of standard and high-speed types	10/11/2013
1.0	Official release	11/07/2013
1.1	Updated performance and power consumption due to changes in components	11/21/2013
1.2	Added Device Sleep option to power segment pin3 Updated 7mm type mechanical specifications Added Endurance (TBW) section	12/16/2013
1.3	Added Enhanced temperature grade into the specifications	04/21/2014
1.4	Updated performance and power consumption due to firmware upgrade	05/17/2014
1.5	Corrected 16GB part numbers for 9.5mm housing with standard speed models	06/26/2014

Global Presence

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