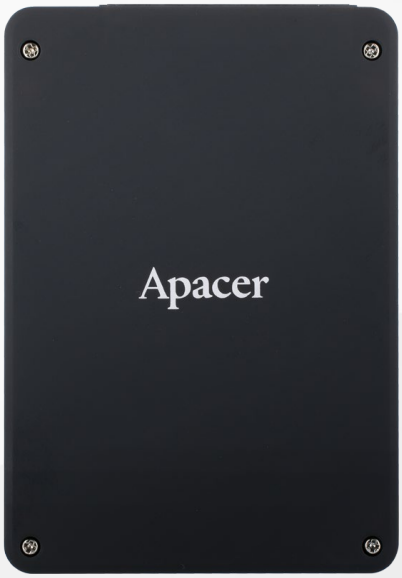
Apacer

RoHS Compliant

Serial ATA Flash Drive

Industrial SM210-25 Product Specifications



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Specifications Overview:

- **Compliance with SATA Revision 3.1**
  - SATA 6 Gb/s interface
  - Backward compatible with SATA 1.5 and 3 Gb/s interfaces
  - ATA-8 command set
- **Capacity**
  - 16, 32, 64, 128, 256, 512 GB
- **Performance**[1]
  - Burst read/write: 600 MB/sec
  - Sequential read: Up to 510 MB/sec
  - Sequential write: Up to 470 MB/sec
  - Random read (4K): Up to 83,000 IOPS
  - Random write (4K): Up to 79,000 IOPS
- **DRAM Cache for Enhanced Random Performance**
- **Flash Management**
  - Built-in hardware ECC
  - Global Wear Leveling
  - Flash bad-block management
  - S.M.A.R.T.
  - Power Failure Management
  - Device Sleep
  - ATA Secure Erase
  - TRIM
- **NAND Flash Type:** MLC
- **MTBF:** >3,000,000 hours
- **Endurance (in Terabytes Written: TBW)**
  - 16 GB: 35 TBW
  - 32 GB: 71 TBW
  - 64 GB: 142 TBW
  - 128 GB: 285 TBW
  - 256 GB: 571 TBW
  - 512 GB: 1,142 TBW
- **Temperature Range**
  - Operating:
    - Standard: 0°C to 70°C
    - Wide: -40°C to 85°C
  - Storage: -55°C to 100°C
- **Supply Voltage**
  - 5V ± 5%
- **Power Consumption**[1]
  - Active mode (Max.): 710 mA
  - Idle mode: 75 mA
- **SATA Power Management Modes**
- **Connector Type**
  - 7-pin SATA signal connector
  - 15-pin SATA power connector
- **Reliability**
  - Thermal Sensor
- **Physical Characteristics**
  - 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
- **RoHS Compliant**

Note:
1. Varies from capacities. The values for performances and power consumptions presented are typical and may vary depending on flash configurations or platform settings. The term idle refers to the standby state of the device.

Table of Contents

1. General Description

Apacer's SM210-25 is a well-balanced solid-state disk (SSD) drive with standard form factor and great performance. Designed in SATA 6 Gb/s interface, the SSD provides full compliance with the SATA Revision 3.1 interface specifications and delivers exceptional read/write speed, making it the ideal companion for heavy-loading industrial or server operations.

SM210-25 is built with a powerful SATA controller that supports on-the-module ECC for error correction as well as efficient wear leveling scheme for extended lifespan. Moreover, SM210-25 is equipped with not only a built-in thermal sensor to monitor the temperature of the SSD via S.M.A.R.T health monitoring to prevent overheating. Operating under 6 Gb/s interface, SM210-25 is provided with Apacer latest S.M.A.R.T. that is primarily oriented for the latest SATA interface SSD, for drive lifetime monitoring and analysis. The drive also comes with various implementations including flash block management, ATA secure erase, power failure management, TRIM, Device Sleep, and power saving modes.

With exceptional performance and enhanced reliability, SM210-25 is definitely the ideal storage or cache solution for a variety of applications ranging from industrial, imaging, computing to enterprise markets.

2. Functional Block

Apacer SM210-25 includes a single-chip controller designed with a DRAM and flash media. The controller integrates the flash management unit to support multi-channel, multi-bank flash arrays. Figure 2-1 shows the functional block diagram.

Note: The actual number of NAND flash used on Apacer SM210-25 varies from capacities. The illustration is for reference only.

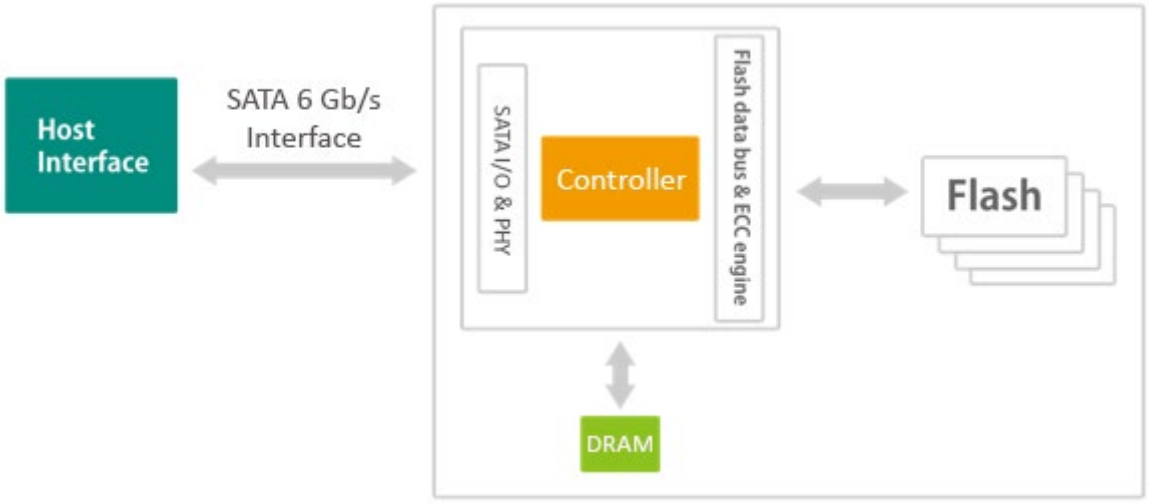


Figure 2-1 Functional Block Diagram

3. Pin Assignments

Table 3-1 describes the signal segment, and Table 3-2, power segment.

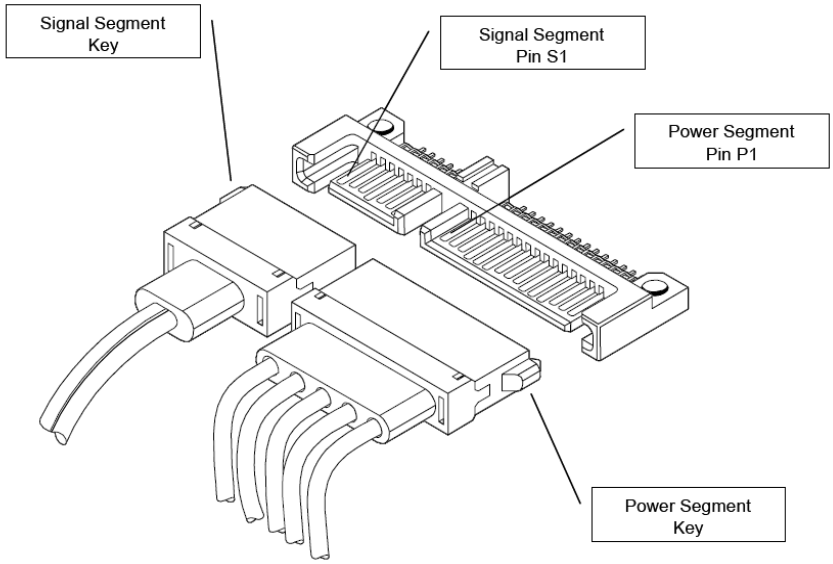


Figure 3-1 SATA Connectors

Table 3-1 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 3-2 Power Segment

Pin	Signal/Description
P1	Unused (3.3V)
P2	Unused (3.3V)
P3	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)

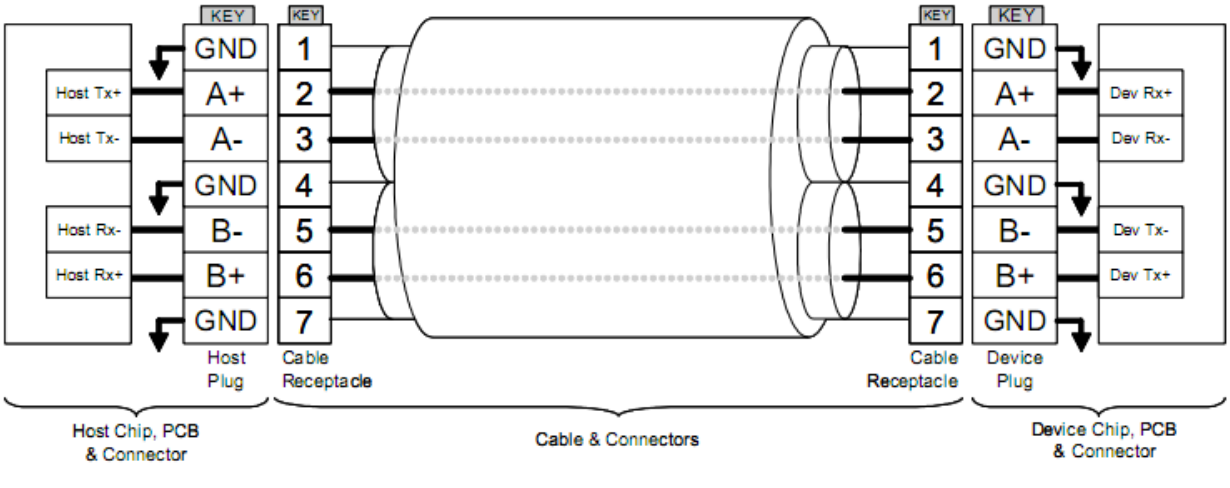


Figure 3-2 SATA Cable/Connector Connection Diagram

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.

4. Product Specifications

4.1 Capacity

Capacity specifications of SM210-25 are 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 Capacity Specifications

Capacity	Total bytes	Cylinders	Heads	Sectors	Total 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	16,383	16	63	500,118,192
512 GB	512,110,190,592	16,383	16	63	1,000,215,216

Notes:
- Display of total bytes varies from operating systems.
- 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

Performance of SM210-25 is listed below in Table 4-2.

Table 4-2 Performance Specifications

Capacity / Performance	16 GB	32 GB	64 GB	128 GB	256 GB	512 GB
Sequential Read (MB/s)	215	380	510	510	510	490
Sequential Write (MB/s)	47	100	205	380	350	470
4K Random Read (IOPS)	26,000	48,000	78,000	81,000	83,000	56,000
4K Random Write (IOPS)	8,000	24,000	49,000	79,000	79,000	29,000

Notes:
- Results may differ from various flash configurations or host system setting.
- Sequential read/write is based on CrystalDiskMark 5.2.1 with file size 1,000MB.
- Random read/write is measured using IOMeter with Queue Depth 32.

4.3 Environmental

Environmental specifications of SM210-25 product are shown in Table 4-3.

Table 4-3 Environmental Specifications

Parameter	Type	Specifications
Temperature	Operating	0°C to 70°C (Standard); -40°C to 85°C (Wide)
	Non-operating	-55°C to 100°C
Vibration	Operating	7.69 GRMS, 20~2000 Hz/random (compliant with MIL-STD-810G)
	Non-operating	4.02 GRMS, 15~2000 Hz/random (compliant with MIL-STD-810G)
Shock	Operating	Acceleration, 50(G)/11(ms)/half sine (compliant with MIL-STD-202G)
	Non-operating	Acceleration, 1500(G)/0.5(ms)/half sine (compliant with MIL-STD-883K)

Note: This Environmental Specification table indicates the conditions for testing the device. Real world usages may affect the results.

4.4 Mean Time Between Failures (MTBF)

Mean Time Between Failures (MTBF) is predicted based on reliability data for the individual components in SM210-25. The prediction result for SM210-25 is more than 3,000,000 hours.

Note: The MTBF is predicated and calculated based on “Telcordia Technologies Special Report, SR-332, Issue 3” method.

4.5 Certification and Compliance

SM210-25 complies with the following standards:

- CE
- UKCA
- FCC
- RoHS
- MIL-STD-810G

4.6 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.

Table 4-4 Endurance Specifications

Capacity	TeraBytes Written
16 GB	35
32 GB	71
64 GB	142
128 GB	285
256 GB	571
512 GB	1,142

Notes:

- This estimation complies with JEDEC JESD-219, enterprise endurance workload of random data with payload size distribution.
- Flash vendor guaranteed MLC P/E cycle: 3K
- WAF may vary from capacity, flash configurations and writing behavior on each platform.
- 1 Terabyte = 1,024GB

5. Flash Management

5.1 Error Correction/Detection

SM210-25 implements a hardware ECC scheme, based on the BCH algorithm. It can detect and correct up to 72 bits error in 1K bytes.

5.2 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. Since bad blocks are inevitable, the solution is to keep them in control. Apacer flash devices are programmed with ECC, page 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.

5.3 Global 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. Global wear leveling is an important mechanism that levels out the wearing of all blocks so that the wearing-down of all blocks can be almost evenly distributed. This will increase the lifespan of SSDs.

5.4 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.

5.5 Power Failure Management

Power Failure Management plays a crucial role when power supply becomes unstable. Power disruption may occur when users are storing data into the SSD, leading to instability in the drive. However, with Power Failure Management, a firmware protection mechanism will be activated to scan pages and blocks once power is resumed. Valid data will be transferred to new blocks for merging and the mapping table will be rebuilt. Therefore, data reliability can be reinforced, preventing damage to data stored in the NAND Flash.

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.

5.6 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 which 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.

5.7 Device Sleep (DevSleep or DEVSLP) Mode

Device Sleep is a feature that allows SATA devices to enter a low power mode by designating a particular pin as DEVSLP signal with an aim to reducing power consumption.

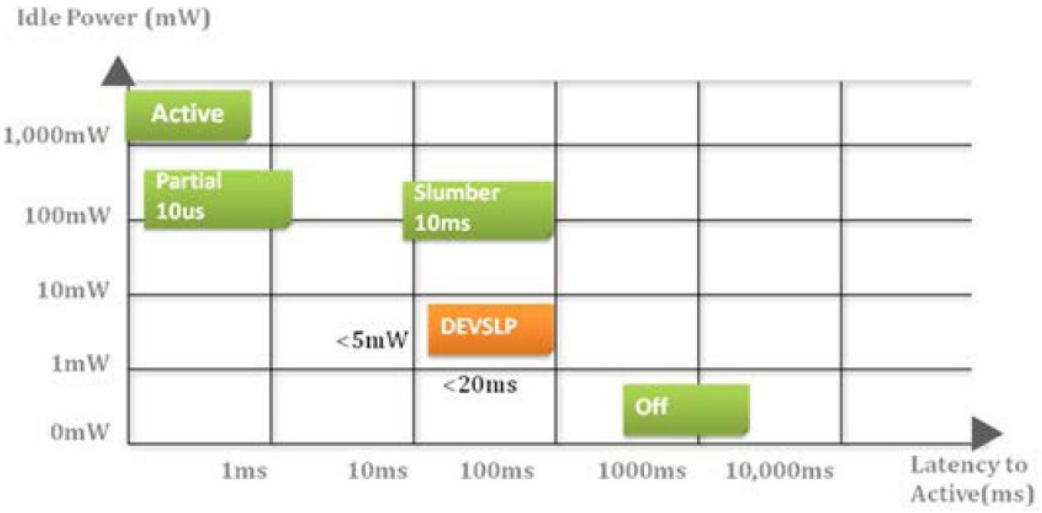


Figure 5-1 Device Sleep

5.8 SATA Power Management

By complying with SATA 6 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: The behaviors of power management features would depend on host/device settings.

6. Reliability Features

6.1 Thermal Sensor

Apacer Thermal Sensor is a digital temperature sensor with serial interface. By using a designated pin for transmission, storage device owners are able to read temperature data.

7. Software Interface

7.1 Command Set

This section defines the software requirements and the format of the commands the host sends to SM210-25. Commands are issued to SM210-25 by loading the required registers in the command block with the supplied parameters, and then writing the command code to the Command register.

Table 7-1 Command Set

Code	Command	Code	Command
E5h	CHECK POWER MODE	F4h	SECURITY ERASE UNIT
06h	DATA SET MANAGEMENT	F5h	SECURITY FREEZE LOCK
92h	DOWNLOAD MICROCODE	F1h	SECURITY SET PASSWORD
90h	EXECUTE DEVICE DIAGNOSTIC	F2h	SECURITY UNLOCK
E7h	FLUSH CACHE	70h	SEEK
EAh	FLUSH CACHE EXT	EFh	SET FEATURES
ECh	IDENTIFY DEVICE	C6h	SET MULTIPLE MODE
E3h	IDLE	E6h	SLEEP
E1h	IDLE IMMEDIATE	B0h	SMART
91h	INITIALIZE DEVICE PARAMETERS	E2h	STANDBY
E4h	READ BUFFER	E0h	STANDBY IMMEDIATE
C8h	READ DMA	E8h	WRITE BUFFER
25h	READ DMA EXT	CAh	WRITE DMA
60h	READ FPDMA QUEUED	35h	WRITE DMA EXT
C4h	READ MULTIPLE	3Dh	WRITE DMA FUA EXT
29h	READ MULTIPLE EXT	61h	WRITE FPDMA QUEUED
2Fh	READ LOG EXT	3Fh	WRITE LOG EXT
47h	READ LOG DMA EXT	57h	WRITE LOG DMA EXT
20h	READ SECTOR	C5h	WRITE MULTIPLE
24h	READ SECTOR EXT	39h	WRITE MULTIPLE EXT
40h	READ VERIFY SECTORS	CEh	WRITE MULTIPLE FUA EXT
42h	READ VERIFY SECTORS EXT	30h	WRITE SECTOR
10h	RECALIBRATE	34h	WRITE SECTOR EXT
F6h	SECURITY DISABLE PASSWORD	45h	WRITE UNCORRECTABLE EXT
F3h	SECURITY ERASE PREPARE		

7.2 S.M.A.R.T.

SMART, an acronym for Self-Monitoring, Analysis and Reporting Technology, is an open standard that allows a hard disk drive to automatically detect its health and report potential failures. When a failure is recorded by SMART, users can choose to replace the drive to prevent unexpected outage or data loss. Moreover, SMART can inform users of impending failures while there is still time to perform proactive actions, such as copy data to another device.

Table 7-2 SMART Subcommand Set

Code	SMART Subcommand
D0h	READ DATA
D1h	READ ATTRIBUTE THRESHOLDS
D2h	ENABLE/DISABLE ATTRIBUTE AUTOSAVE
D4h	EXECUTE OFF-LINE IMMEDIATE
D5h	SMART READ LOG
D6h	SMART WRITE LOG
D8h	ENABLE OPERATIONS
D9h	DISABLE OPERATIONS
DAh	RETURN STATUS

Table 7-3 General SMART Attribute Structure

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

*Byte 5: LSB

Table 7-4 SMART Attribute ID List

ID (Hex)	Attribute Name
9 (0x09)	Power-on Hours
12 (0x0C)	Power Cycle Count
163 (0xA3)	Maximum Erase Count
164 (0xA4)	Average Erase Count
166 (0xA6)	Total Later Bad Block Count
167 (0xA7)	SSD Protect Mode (Vendor Specific)
168 (0xA8)	SATA PHY Error Count
171 (0xAB)	Program Fail Count
172 (0xAC)	Erase Fail Count
175 (0xAF)	Bad Cluster Table Count
192 (0xC0)	Unexpected Power Loss Count
194 (0xC2)	Temperature
231 (0xE7)	Lifetime Left
241 (0xF1)	Total Sectors of Write

8. Electrical Specifications

8.1 Operating Voltage

Table 8-1 lists the supply voltage for SM210-25.

Table 8-1 Operating Range

Item	Range
Supply Voltage	5V ± 5% (4.75-5.25V)

8.2 Power Consumption

Table 8-2 lists the power consumption for SM210-25.

Table 8-2 Power Consumption

Capacity / Mode	Unit	16 GB	32 GB	64 GB	128 GB	256 GB	512 GB
Active (Max.)	mA	215	240	310	480	530	710
Idle		75	70	75	75	70	75

Notes:
- All values are typical and may vary depending on flash configurations or host system settings.
- Power consumption is measured using CrystalDiskMark 5.2.1 with file size 1,000MB.

9. Mechanical Specifications

9.1 7mm Type Dimensions

Table 9-1 Physical Dimensions

Parameter	Unit	16 GB	32 GB	64 GB	128 GB	256 GB	512 GB
Length	mm	100.00 ± 0.20					
Width		69.85 ± 0.20					
Height		6.90 + 0.10/-0.40					

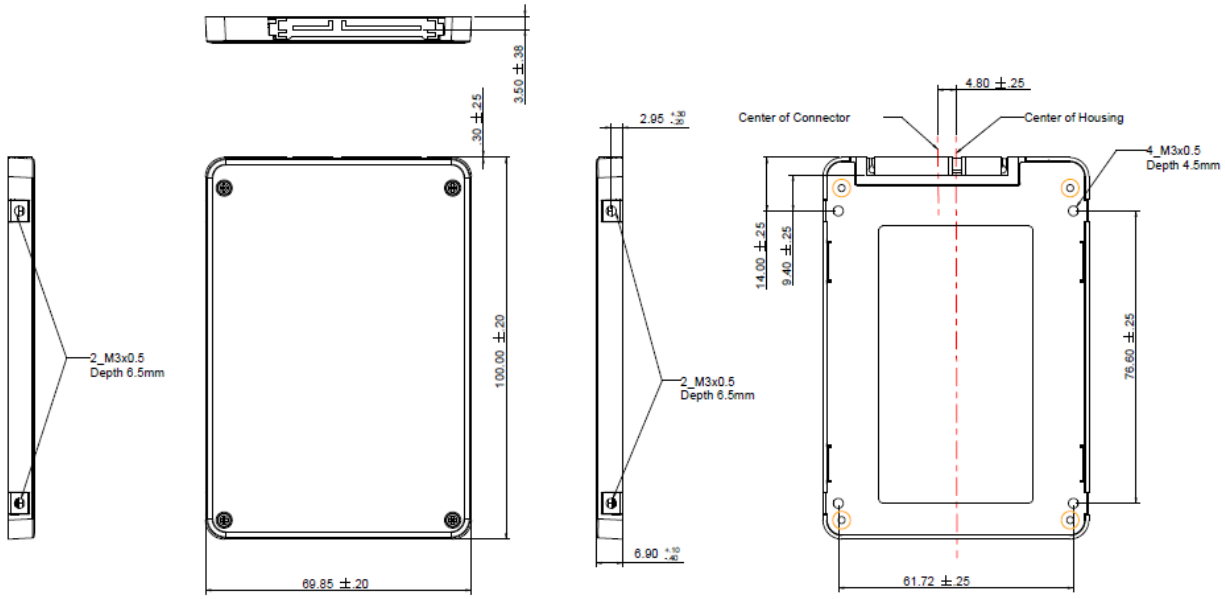


Figure 9-1 7mm Housing Physical Dimensions

9.2 9.5mm Type Dimensions

Table 9-2 Physical Dimensions

Parameter	Unit	16 GB	32 GB	64 GB	128 GB	256 GB	512 GB
Length	mm	100.00 ± 0.20					
Width		69.84 ± 0.20					
Height		9.30 ± 0.20					

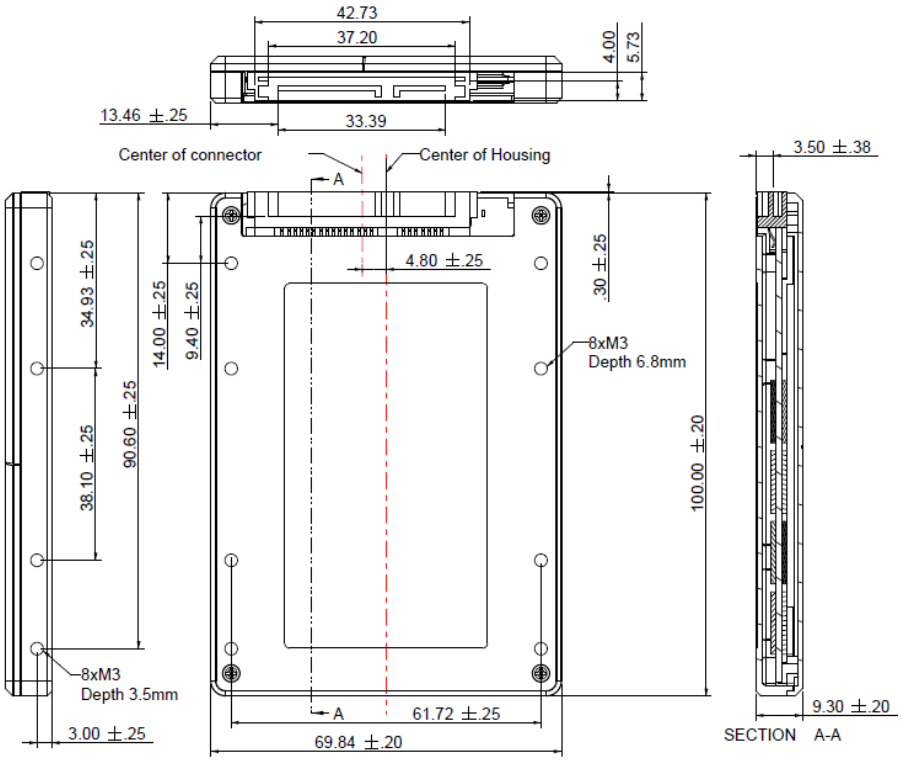
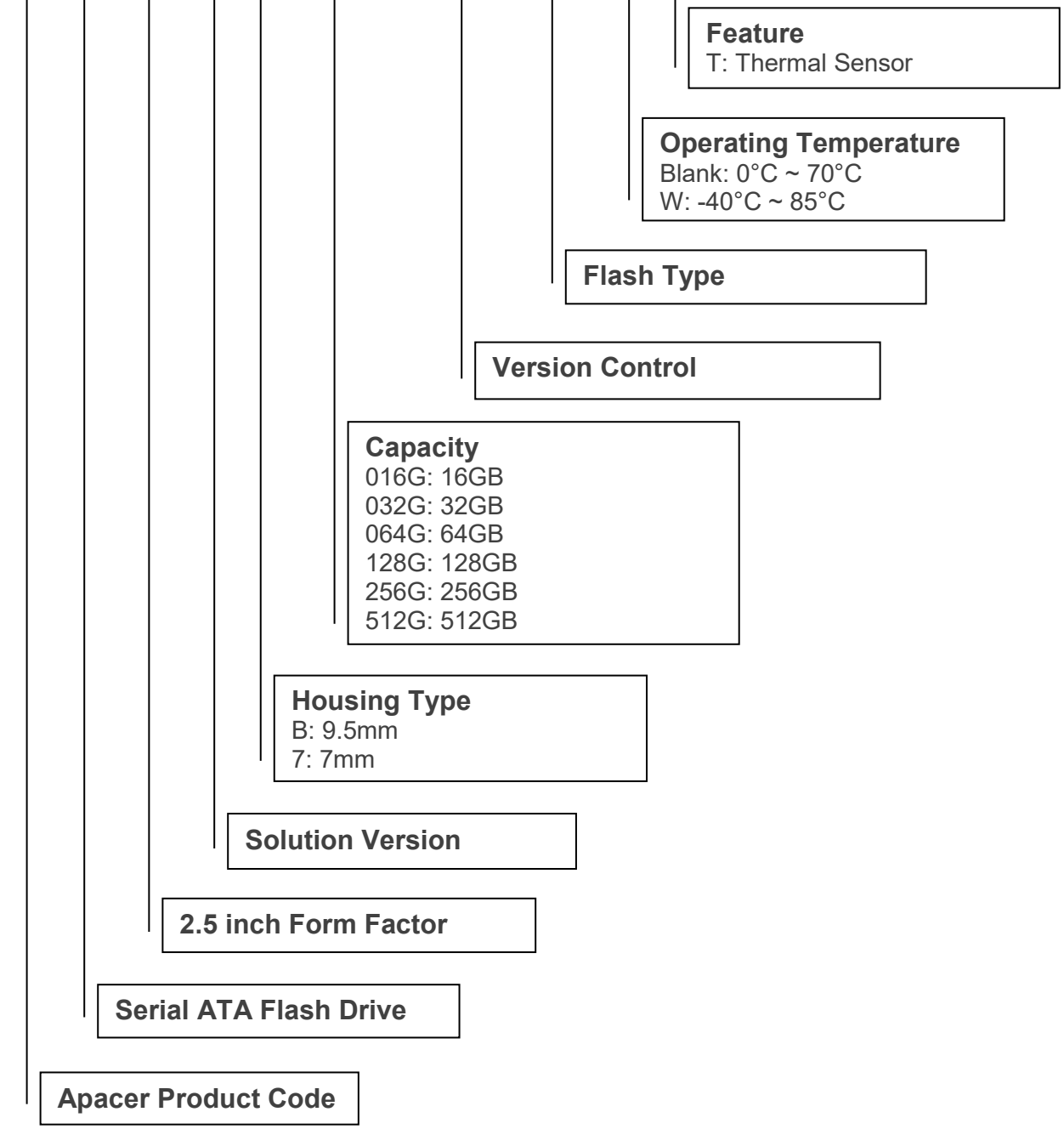


Figure 9-2 9.5mm Housing Physical Dimensions

10. Product Ordering Information

10.1 Product Code Designations

AP S 25A F X xxxG – 7X TM1X X T



10.2 Valid Combinations

The following tables list the available model of the SM210-25 series which are 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.

10.2.1 9.5mm Metal Housing

Capacity	Standard Temperature	Wide Temperature
16GB	APS25AFB016G-7BTM1T	APS25AFB016G-7BTM1WT
32GB	APS25AFB032G-7BTM1GT	APS25AFB032G-7BTM1GWT
64GB	APS25AFB064G-7BTM1GT	APS25AFB064G-7BTM1GWT
128GB	APS25AFB128G-7BTM1GT	APS25AFB128G-7BTM1GWT
256GB	APS25AFB256G-7BTM1GT	APS25AFB256G-7BTM1GWT
512GB	APS25AFB512G-7BTM1GT	APS25AFB512G-7BTM1GWT

10.2.2 7mm Plastic Housing

Capacity	Standard Temperature	Wide Temperature
16GB	APS25AF7016G-7BTM1T	APS25AF7016G-7BTM1WT
32GB	APS25AF7032G-7BTM1GT	APS25AF7032G-7BTM1GWT
64GB	APS25AF7064G-7BTM1GT	APS25AF7064G-7BTM1GWT
128GB	APS25AF7128G-7BTM1GT	APS25AF7128G-7BTM1GWT
256GB	APS25AF7256G-7BTM1GT	APS25AF7256G-7BTM1GWT
512GB	APS25AF7512G-7BTM1GT	APS25AF7512G-7BTM1GWT

Revision History

Revision	Description	Date
1.0	Official release	6/13/2016
1.1	- Added thermal sensor support - Removed models with no DEVSLP support - Revised product ordering information	7/25/2016
1.2	- Added 32-256GB support - Revised product ordering information	9/26/2016
1.3	Revised product ordering information	10/6/2016
1.4	Updated performance values for 32-256GB	11/10/2016
1.5	Updated endurance ratings	1/24/2017
1.6	- Added 16GB support - Updated product ordering information	2/13/2017
1.7	- Updated 512GB performance - Updated product ordering information	3/24/2017
1.8	Updated performance and power consumption for 16GB	4/11/2017
1.9	Removed altitude spec from 4.1 Environmental	11/7/2017
2.0	- Updated 6.2 Power Consumption - Updated 8. Product Ordering Information due to FW change	6/26/2018
2.1	Updated 4.1 Thermal Sensor	7/9/2018
2.2	- Renamed Power Failure Management to DataDefender™ at Flash Management on Specifications Overview page and 3.4 section and updated the technology description - Revised note 3 at 5.4 Endurance - Changed the expression of extended temperature to wide temperature	11/23/2018
2.3	Updated shock and vibration specs for Table 5-1 Environmental Specifications	7/15/2019
2.4	Changed DataDefender back to Power Failure Management	11/13/2019
2.5	- Added product photo to the cover page - Updated idle power consumption for all capacities at 6.2 Power Consumption - Updated 8. Product Ordering Information due to FW change	11/18/2019
2.6	Modified flash type and P/E cycle at the notes for 5.4 Endurance	10/8/2021
2.7	- Updated MTBF to >3,000,000 hours on Specifications Overview and 4.4 Mean Time Between Failures (MTBF) - Updated storage temp to -55°C to 100°C on Specifications	3/4/2024

Revision	Description	Date
	Overview and Table 4-3 Environmental Specifications - Added UKCA to 4.5 Certification and Compliance - Updated Table 7-1 Command Set - Updated 10. Product Ordering Information due to firmware change	

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