

**RoHS Compliant**

## **Serial ATA Flash Drive**

SS21P-25 Product Specifications

CorePower Series

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**Version 1.3**



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## Specifications Overview:

- **Compliance with SATA Revision 3.1**
  - Serial ATA Revision 3.1
  - SATA 6 Gb/s interface
  - Backward compatible with SATA 1.5 and 3 Gb/s interfaces
  - ATA-8 command set
- **Capacity**
  - 32, 64, 128, 240 GB
- **Performance<sup>1</sup>**
  - Burst read/write: 600 MB/sec
  - Sequential read: Up to 550 MB/sec
  - Sequential write: Up to 430 MB/sec
  - Random read (4K): Up to 82,000 IOPS
  - Random write (4K): Up to 76,000 IOPS
- **Flash Management**
  - Built-in hardware ECC
  - Global Wear Leveling
  - Flash bad-block management
  - S.M.A.R.T.
  - DataDefender™
  - ATA Secure Erase
  - TRIM
- **NAND Flash Type: SLC**
- **MTBF: >2,000,000 hours**
- **Endurance (in Terabytes Written: TBW)**
  - 32 GB: 1,261 TBW
  - 64 GB: 2,636 TBW
  - 128 GB: 5,610 TBW
  - 240 GB: 105 TBW
- **Temperature Range**
  - Operating:
    - Standard: 0°C to 70°C
    - Wide: -40°C to 85°C
  - Storage: -40°C to 100°C
- **Supply Voltage**
  - 5.0 V ± 5%
- **Power Consumption<sup>1</sup>**
  - Active mode: 620 mA
  - Idle mode: 165 mA
- **SATA Power Management Mode**
- **Connector Type**
  - 7-pin SATA signal connector
  - 15-pin SATA power connector
- **Form Factor**
  - 2.5"
  - Dimensions: 100.00 x 69.84 x 9.30, unit: mm
- **RoHS Compliant**
- **Apacer CorePower** – Implementation of Tantalum Capacitors to serve as backup power supply, capable of withstanding extended ambient temperature

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.

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# 1. General Descriptions

## 1.1 Introduction

Apacer's SS21P-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 is able to deliver exceptional read/write speed, making it the ideal companion for heavy-loading industrial or server operations. 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 DataDefender.

## 1.2 Capacity

Capacity specifications of SS21P-25 are available as shown in Table 1-1. It lists the specific capacity and the default numbers of heads, sectors and cylinders for each product line.

**Table 1-1 Capacity Specifications**

Capacity	Total bytes	Cylinders	Heads	Sectors	Total LBA
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
240 GB	240,057,409,536	16,383	16	63	468,862,128

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.

## 1.3 Performance

Performance of SS21P-25 is listed below in Table 1-2.

**Table 1-2 Performance Specifications**

Performance	Capacity	32 GB	64 GB	128 GB	240 GB
	<b>Sequential Read (MB/s)</b>		550	550	550
<b>Sequential Write (MB/s)</b>		255	420	430	420
<b>Random Read IOPS (4K)</b>		81,000	82,000	82,000	56,000
<b>Random Write IOPS (4K)</b>		62,000	73,000	76,000	75,000

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.

## 1.4 Pin Assignments

Table 1-3 describes the SFD signal segment, and Table 1-4, power segment.

Figure 1-1 SATA Connectors

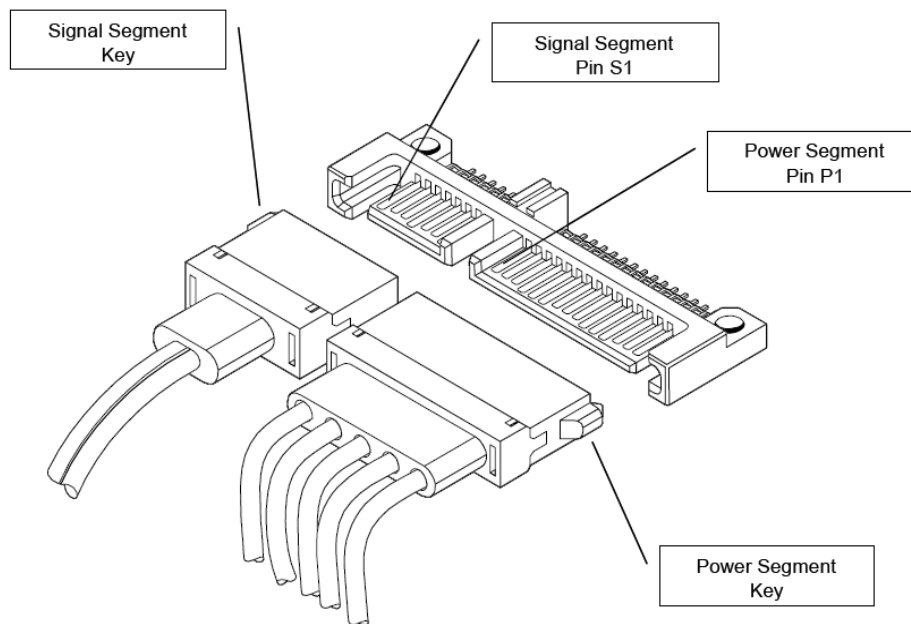


Table 1-3 Signal Segment

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

Table 1-4 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)

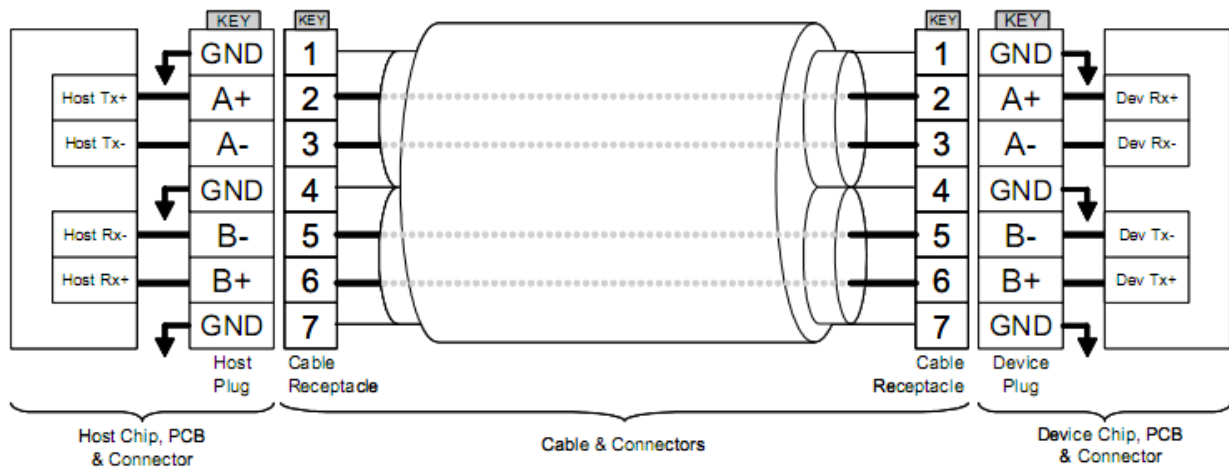


Figure 1-2 SATA Cable/Connector Connection Diagram

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.

## 2. Software Interface

### 2.1 Command Set

Table 2-1 summarizes the ATA commands supported by SS21P-25.

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.

**Table 2-2 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 2-3 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 2-4 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
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

## 3. Flash Management

### 3.1 Error Correction/Detection

SS21P-25 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. 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 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.

### 3.4 DataDefender™

Apacer's DataDefender is an advanced technology of power failure management which combines both firmware and hardware mechanisms to ensure data integrity. When power disruption occurs, the low voltage detector will be triggered. When this happens, the SSD's protection mechanism is activated and cuts off data transmission from the host. Once the power supply is resumed, the firmware protection mechanism will ensure the integrity of the firmware as well as the data already written into the NAND flash media.

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 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.

## 3.7 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  $\mu$ s (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.

Note: The behaviors of power management features would depend on host/device settings.

## 4. Reliability Specifications

### 4.1 Environmental

Environmental specifications of SS21P-25 product are shown in Table 4-1.

**Table 4-1 Environmental Specifications**

Environment	Specifications
Temperature	0°C to 70°C (Standard); -40°C to 85°C (Wide)
	-40°C to 100°C (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 SS21P-25. The prediction result for SS21P-25 is more than 2,000,000 hours.

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

### 4.3 Certification and Compliance

SS21P-25 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.

**Table 4-2 Endurance Specifications**

Capacity	TeraBytes Written
32 GB	1,261
64 GB	2,636
128 GB	5,610
240 GB	105

Notes:

- This estimation complies with JEDEC JESD-219, enterprise endurance workload of random data with payload size distribution.
- Flash vendor guaranteed SLC P/E cycle: 60K
- WAF may vary from capacity, flash configurations and writing behavior on each platform.
- 1 Terabyte = 1,024 GB.

## 5. Electrical Specifications

### 5.1 Operating Voltage

Table 5-1 lists the supply voltage for SS21P-25.

**Table 5-1 Operating Range**

Item	Range
Supply Voltage	5V $\pm$ 5% (4.75-5.25V)

### 5.2 Power Consumption

Table 5-2 lists the power consumption for SS21P-25.

**Table 5-2 Power Consumption**

Mode \ Capacity	32 GB	64 GB	128 GB	240 GB
Active (mA)	355	535	620	510
Idle (mA)	120	120	120	165

Notes:

- All values are typical and may vary depending on flash configurations or host system settings.
- Active power is an average power measurement performed using CrystalDiskMark with 128KB sequential read/write transfers.

### 5.3 Apacer CorePower

If the voltage supply is cut, for instance, accidental power off or sudden blackout, the data would be shortly lost. To protect SSD data integrity from this disastrous scenario, Apacer has developed the hardware-based technology named Apacer CorePower. The CorePower equips SSDs with electrolytic capacitors that can deliver urgent power current so that the flash controller can take this extended moment to flush cached data and essential metadata into NAND Flash blocks.

In addition to electrolytic capacitors which guarantee SSD data integrity, an inbuilt IC detector also serves the same purpose as well as ensures the stability of data transmission. The detector is designed to take proactive measures for the aforementioned disastrous scenario. When supply voltage drops below a minimum threshold, the detector will send out signals to the flash controller notifying it to stop operating to prevent poor performance or erratic operation. In the meanwhile, signals will also be sent to DRAM to have cached data flushed into NAND Flash blocks so as to avoid data loss, similar to the function performed by electrolytic capacitors.

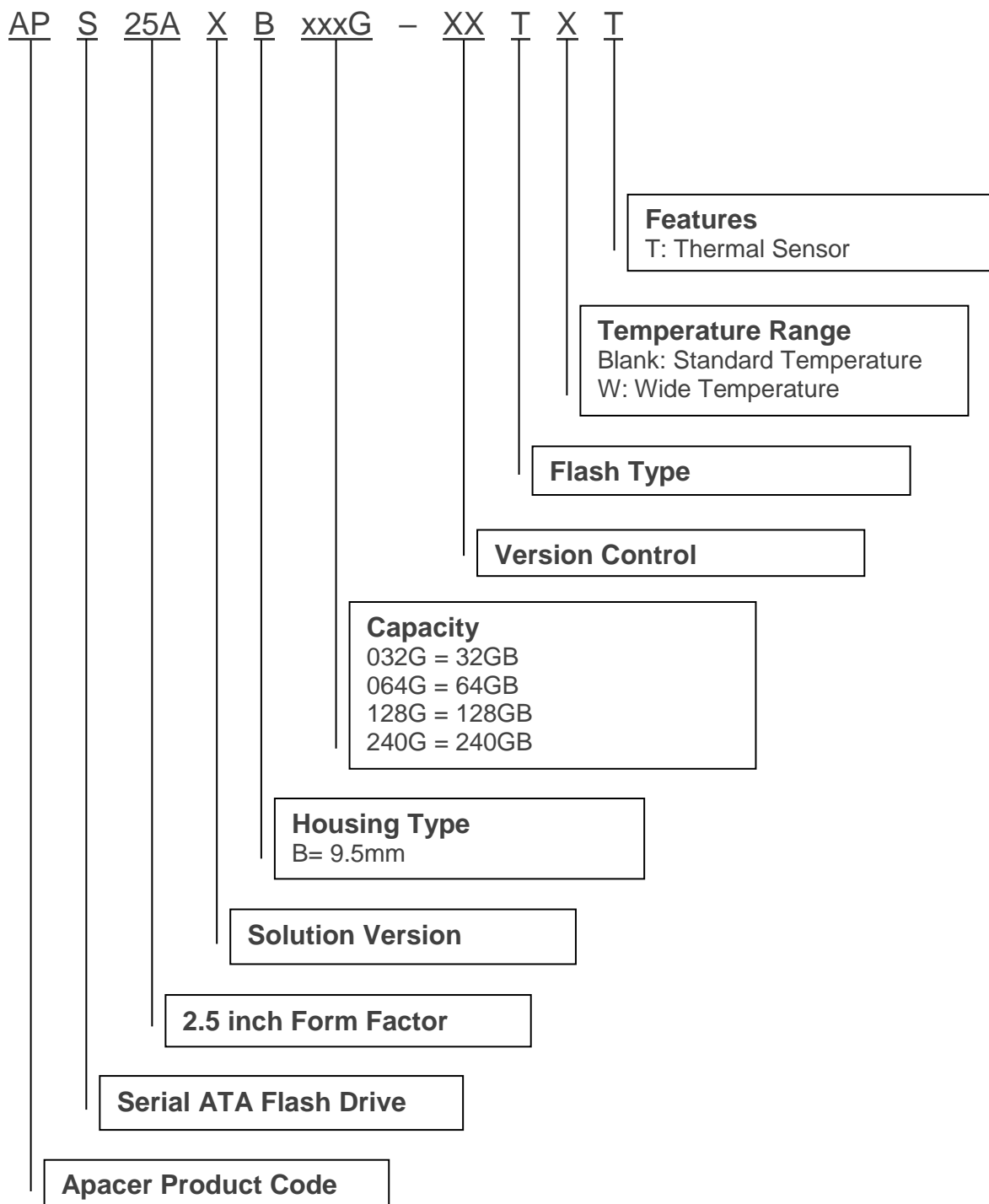
SS21P-25 is equipped with Tantalum Capacitors which have lower power leakage, higher operating temperature and higher volume-efficiency (high capacitance in small volume) than many other types of capacitors. The compact size and the high reliability are ideal for embedded computing systems.



## 7. Product Ordering Information

Apacer's SS21P-25 SSD is available in different configurations and densities. See the chart below for a comprehensive list of options for the SS21P-25 series devices.

### 7.1 Product Code Designations



## 7.2 Valid Combinations

The following tables list the available models of the SS21P-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.

Capacity	Standard Temperature	Wide Temperature
32GB	APS25AFB032G-4GTT	APS25AFB032G-4GTWT
64GB	APS25AFB064G-4GTT	APS25AFB064G-4GTWT
128GB	APS25AFB128G-4GTT	APS25AFB128G-4GTWT
240GB	APS25AFB240G-4HTT	APS25AFB240G-4HTWT

## Revision History

Revision	Description	Date
0.1	Preliminary release	7/20/2017
0.2	Removed altitude spec from 4.1 Environmental	11/7/2017
1.0	<ul style="list-style-type: none"> <li>- Renamed extended temperature to wide temperature</li> <li>- Updated performance for 240GB at 4.2 Performance</li> <li>- Updated Performance and Power Consumption on Specifications Overview page</li> <li>- Added Endurance to Specifications Overview page</li> <li>- Added 4.4 Endurance</li> <li>- Completed power consumption for 240GB at 5.2 Power Consumption</li> </ul>	4/25/2019
1.1	Changed Power Failure Management to DataDefender	11/15/2019
1.2	<ul style="list-style-type: none"> <li>- Changed SATA 6.0 Gbps to SATA 6 Gb/s in accordance with SATA naming guidelines</li> <li>- Updated Table 1-1 by changing max LBA to total LBA, total bytes and total LBA for 240GB</li> <li>- Capitalized every letter for commands at 2.1 Command Set and SMART subcommand at 2.2 S.M.A.R.T.</li> <li>- Updated the description of 3.2 Bad Block Management</li> </ul>	1/26/2021
1.3	- Removed Device Sleep support	2/17/2022

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