Apacer

RoHS Recast Compliant

SATA Flash Drive

SS130-25 2.5” Product Specifications

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Version 1.1

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Apacer

Specifications Overview:

- **Serial ATA Revision 3.2 Compliance**
  - SATA 6.0 Gbps interface
  - Backward compatible with SATA 3.0/1.5 Gbps interface
  - ATA Command set
- **Capacity**
  - 32, 64, 128, 256, 512 GB
- **Performance***
  - Burst read/write: 600 MB/sec
  - Sequential read: up to 520 MB/sec
  - Sequential write: up to 540 MB/sec
  - Random read (4K): up to 82,000 IOPS
  - Random write (4K): up to 90,000 IOPS
- **Flash Management**
  - Built-in hardware ECC
  - Global Wear Leveling
  - Flash bad-block management
  - S.M.A.R.T.
  - Power Failure Management
  - Device Sleep
  - TRIM
- **DRAM Cache for Enhanced Random Performance**
- **NAND Flash Type:** SLC
- **MTBF:** >2,000,000 hours
- **Endurance**
  - 32 GB: 1,136 TBW
  - 64 GB: 2,314 TBW
  - 128 GB: 4,629 TBW
  - 256 GB: 9,202TBW
  - 512 GB: 10,033 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***
  - Active mode: 1,160 mA
  - Idle mode: 85 mA
- **Form Factor**
  - 2.5 inch
  - Dimensions: 100.00 x 69.85 x 6.90, unit: mm
  - Net Weight: 70.8 g
- **Connector Type**
  - 7-pin SATA male connector
  - 15-pin SATA power connector
- **Reliability**
  - Thermal Sensor
  - Thermal Management Technique (optional)**
- **Security (optional)**
  - Instant Keychange
  - AES 256-bit hardware encryption
- **Shock & Vibration*****
  - Shock: 1,500 G
  - Vibration: 15 G
- **RoHS Compliant (Complies with 2011/65/EU Standard)**

*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.
**Built-in feature for 512GB model, optional for 32-256GB model
***Non-operating

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1. General Descriptions

1.1 Introduction

Apacer SS130-25 (2.5 inch) Embedded Solid State Drive is a speedy and reliable companion for industrial PC and laptops. Designed in SATA 6.0 Gb/s interface, the drive can deliver outstanding performance up to 520 MB/s sustained transfer rate, highly suitable to serve as operating system boot drive or storage media of important data. With its compliance with the latest SATA specification, this cutting edge device supports power management, which greatly saves in power consumption, making it more environmental and economical than traditional hard disk drives.

Regarding data reliability, the controller unit of SS130-25 is built with a powerful ECC engine in the device correcting up to 120bit per 2KB data. For better I/O performance, the controller unit comes with an external DDR3 cache to strengthen the IOPS (Input Output Per Second) of the device, proving to be the ideal companion for PC and laptop users.

1.2 Capacity Specifications

Table 1-1 Capacity Specifications

Capacity	Total bytes*	Cylinders	Heads	Sectors	Max 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
256 GB	256,060,514,304	16,383	16	63	500,118,192
512 GB	512,110,190,592	16383	16	63	1,000,215,216

*Display of total bytes varies from file systems, which means not all of the bytes can be used for storage.
**Notes: 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 SS130-25 is listed below in Table 1-2.

Table 1-2 Performance Specifications

Performance \ Capacity	32 GB	64 GB	128 GB	256 GB	512 GB
Sequential Read* (MB/s)	505	505	495	515	520
Sequential Write* (MB/s)	320	530	540	540	515
Random Read IOPS (4K)**	82,000	82,000	80,000	80,000	71,000
Random Write IOPS (4K)**	55,000	90,000	90,000	89,000	87,000

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

1.4 Pin Assignments

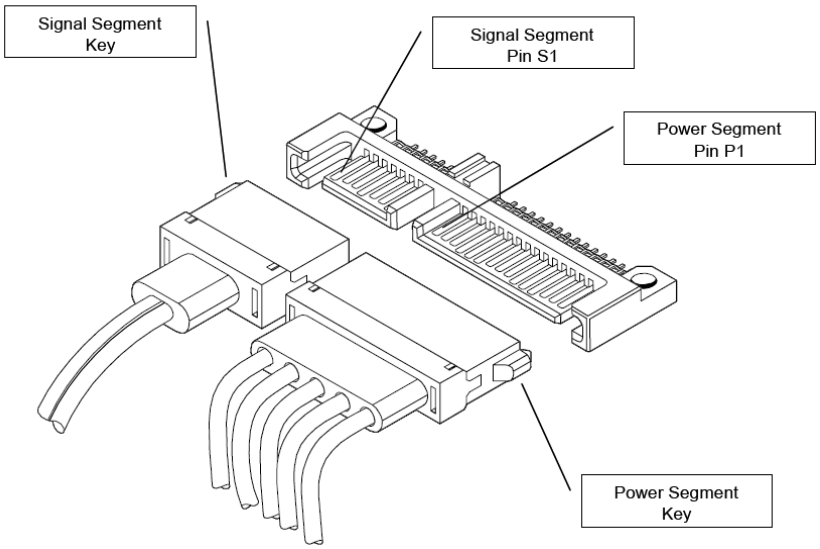


Table 1-3 Signal Segment

Pin	Type	Description
S1	GND	
S2	RxP	Serial Data Receiver Signal Pair
S3	RxN	
S4	GND	
S5	TxN	Serial Data Transmitter Signal Pair
S6	TxP	
S7	GND	

Table 1-4 Power Segment

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

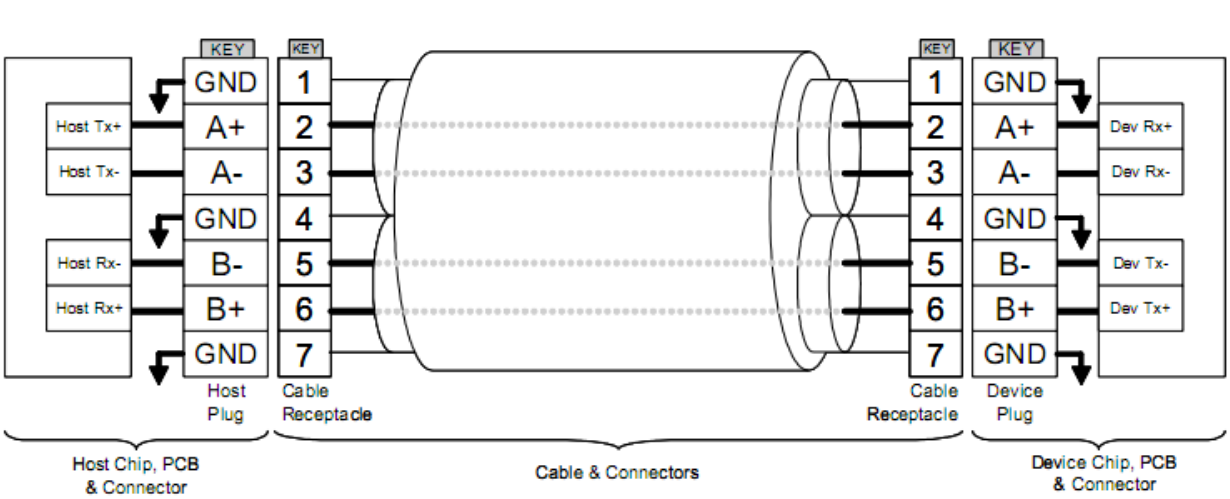


Figure 1-1 SATA Cable / Connector Connection Diagram

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.

2. Software Interface

2.1 Command Set

Table 2-1 Command Set

Command	Code	Command	Code
CHECK Power Mode	E5h	Security Erase Prepare	F3h
Data Set Management	06h	Security Erase Unit	F4h
Download Microcode PIO	92h	Security Freeze Lock	F5h
Execute Drive Diagnostic	90h	Security Set Password	F1h
Flush Cache	E7h	Security Unlock	F2h
Flush Cache Ext	EAh	Seek	70h
Identify Device	ECh	Set Features	EFh
Idle	E3h	Set Max Address	F9h
Idle Immediate	E1h	Set Max Address Ext	37h
Initialize Drive Parameters	91h	Set Multiple Mode	C6h
Read Buffer	E4h	Sleep	E6h
Read DMA (W/O retry)	C9h	SMART	B0h
Read DMA (W/ retry)	C8h	Standby	E2h
Read DMA Ext	25h	Standby Immediate	E0h
Read FPDMA Queued	60h	Write Buffer	E8h
Read Log Ext	2Fh	Write DMA (W/O retry)	CBh
Read Multiple	C4h	Write DMA (W/ retry)	CAh
Read Multiple Ext	29h	Write DMA Ext	35h
Read Native Max Address	F8h	Write DMA FUA Ext	3Dh
Read Native Max Ext	27h	Write FPDMA Queued	61h
Read Sector(s) (W/O retry)	21h	Write Log Ext	3Fh
Read Sector(s) (W/ retry)	20h	Write Multiple	C5h
Read Sector(s) Ext	24h	Write Multiple Ext	39h
Read Verify Ext	42h	Write Multiple FUA Ext	CEh
Read Verify Sector(s) (W/O retry)	41h	Write Sector(s) (W/O retry)	31h
Read Verify sector(s) (W/ retry)	40h	Write Sector(s) (W/ retry)	30h
Recalibrate	10h	Write Sector(s) Ext	34h
Security Disable Password	F6h		

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
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

This device implements hardware ECC scheme based on the BCH algorithm which can detect and correct up to 120 bits error in 2K Bytes.

3.2 Flash 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 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 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.

3.5 ATA Secure Erase

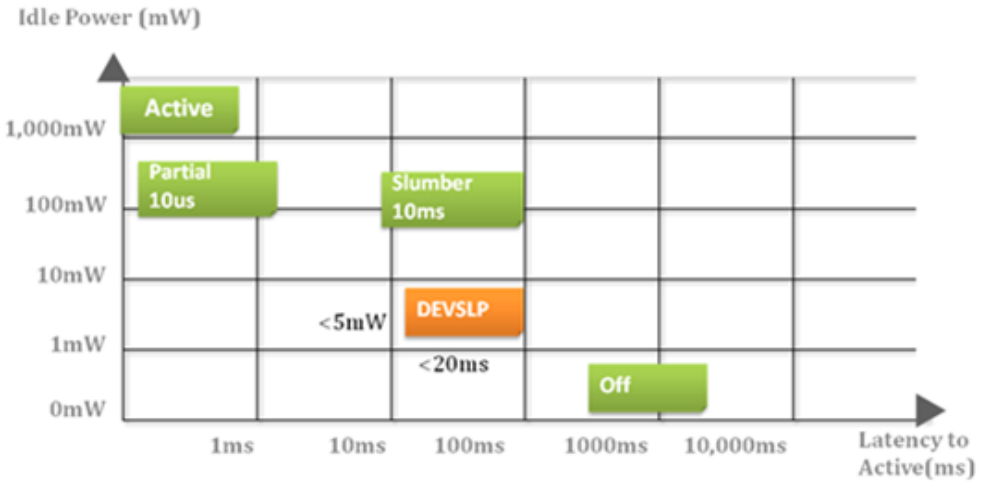
ATA Secure Erase is an ATA disk purging command currently embedded in most of the storage drives. Defined in ATA specifications, (ATA) Secure Erase is part of Security Feature Set that allows storage drives to erase all user data areas. The erase process usually runs on the firmware level as most of 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 DEVSLP (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.



4. Security & Reliability Features

4.1 Thermal Sensor

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

4.2 Thermal Management Technique (optional)

Thermal management technique can monitor the temperature of the SSD equipped with a built-in thermal sensor via S.M.A.R.T. commands. This method can ensure the temperature of the device stays within temperature limits by drive throttling, i.e. reducing the speed of the drive when the device temperature reaches the threshold level, so as to prevent overheating, guarantee data reliability, and prolong product lifespan. When the temperature exceeds the maximum threshold level, thermal throttling will be triggered to reduce performance step by step to prevent hardware components from being damaged. Performance is only permitted to drop to the extent necessary for recovering a stable temperature to cool down the device's temperature. Once the temperature decreases to the minimum threshold value, transfer speeds will rise back to its optimum performance level.

4.3 Instant Keychange (optional)

AES 256-bit encryption is a popular way of securing drives, since it's extremely resilient to brute-force attacks. All the data stored on a drive protected by AES encryption needs to be decrypted by a matching AES key before it can be read. The real advantage of AES encryption is that the key is automatically generated during production and provides an instant protection mechanism.

This is the Instant Keychange function. When an Instant Keychange command is issued, a new key will be generated to replace the original key stored in the flash memory less than a second. Since the new key does not match the old one, when the host is attempting to access the data present in the flash memory, the data will be irretrievable due to AES key authentication failure. The data has not been erased in the conventional sense of all the bits being rewritten as ones or zeros, but it is functionally unreadable and therefore completely protected.

4.4 Advanced Encryption Standard (optional)

Advanced Encryption Standard (AES) is a specification for the encryption of electronic data. AES has been adopted by the U.S. government since 2001 to protect classified information and is now widely implemented in embedded computing applications. The AES algorithm used in software and hardware is symmetric so that encrypting/decrypting requires the same encryption key. Without the key, the encrypted data is inaccessible to ensure information security.

Notably in flash memory applications, AES 256-bit hardware encryption is the mainstream to protect sensitive or confidential data. The hardware encryption provides better performance, reliability, and security than software encryption. It uses a dedicated processor, which is built inside the controller, to process the encryption and decryption. This enormously shortens the processing time and makes it efficient.

5. Reliability Specifications

5.1 Environmental Specifications

Environmental specifications of SS130-25 product follow MIL-STD-810G standards as shown in Table 5-1.

Table 5-1 Environmental Specifications

Environment	Specifications
Temperature	0°C to 70°C (Standard); -40°C to 85°C (Wide)
	-40°C to 100°C (Storage)
Vibration	Operation: 7.69 (Grms), 20~2000(Hz)/random (compliant with MIL-STD-810G) Non-operation: 4.02 (Grms), 15~2000(Hz)/random (compliant with MIL-STD-810G)
Shock	Operation: Acceleration, 50(G)/11(ms)/half sine (compliant with MIL-STD-202G) Non-operation: Acceleration,1,500(G)/0.5(ms)/half sine (compliant with MIL-STD-883K)

5.2 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 SS130-25 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.

5.3 Certification and Compliance

SS130-25 complies with the following standards:

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

5.4 Endurance

The endurance of a storage device is predicted by Tera Bytes 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	Tera Bytes Written
32 GB	1,136
64 GB	2,314
128 GB	4,629
256 GB	9,202
512 GB	10,033

Note:

- 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 = 1,024GB

6. Electrical Specifications

6.1 Operating Voltage

Table 6-1 lists the supply voltage for SS130-25.

Table 6-1 Operating Voltage

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

6.2 Power Consumption

Table 6-2 lists the power consumption SS130-25.

Table 6-2 Power Consumption

Capacity / Mode	32 GB	64 GB	128 GB	256 GB	512 GB
Active (mA)	510	715	730	775	1,160
Idle (mA)	47	47	47	48	85

Note:
*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.

7. Physical Characteristics

7.1 Dimensions

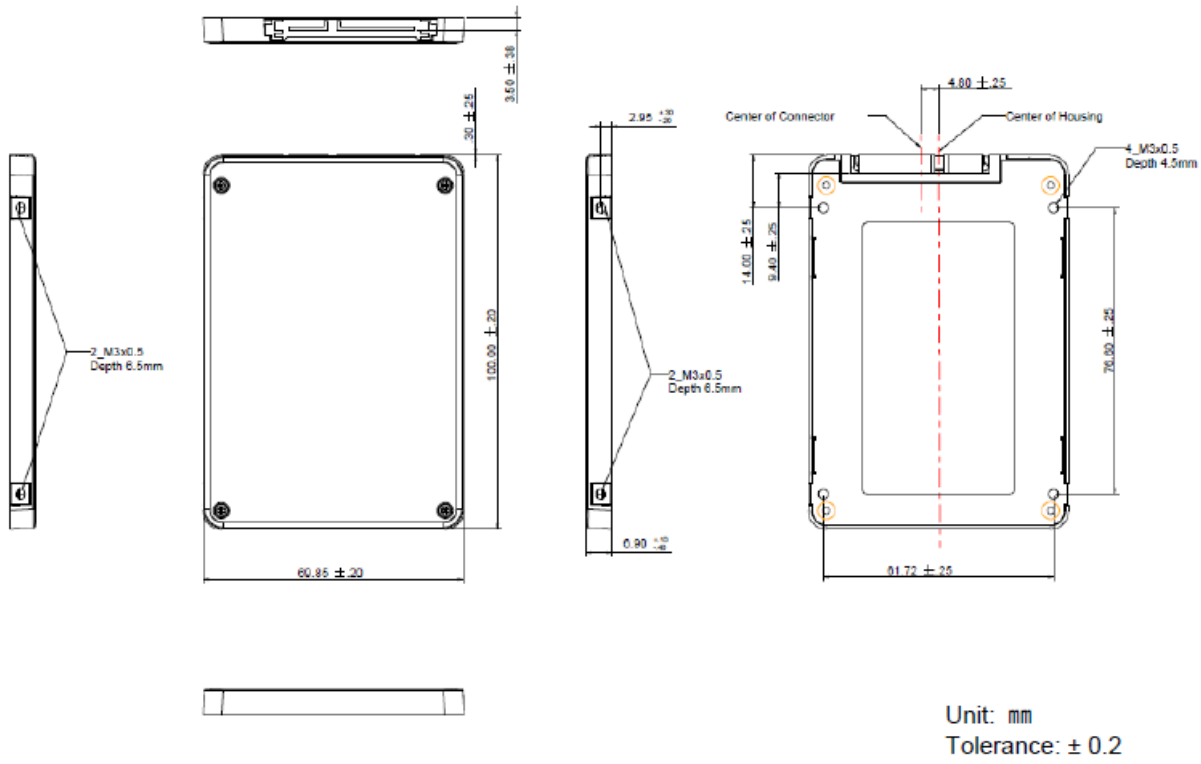


Figure 7-1 Physical Dimensions

7.2 Net Weight

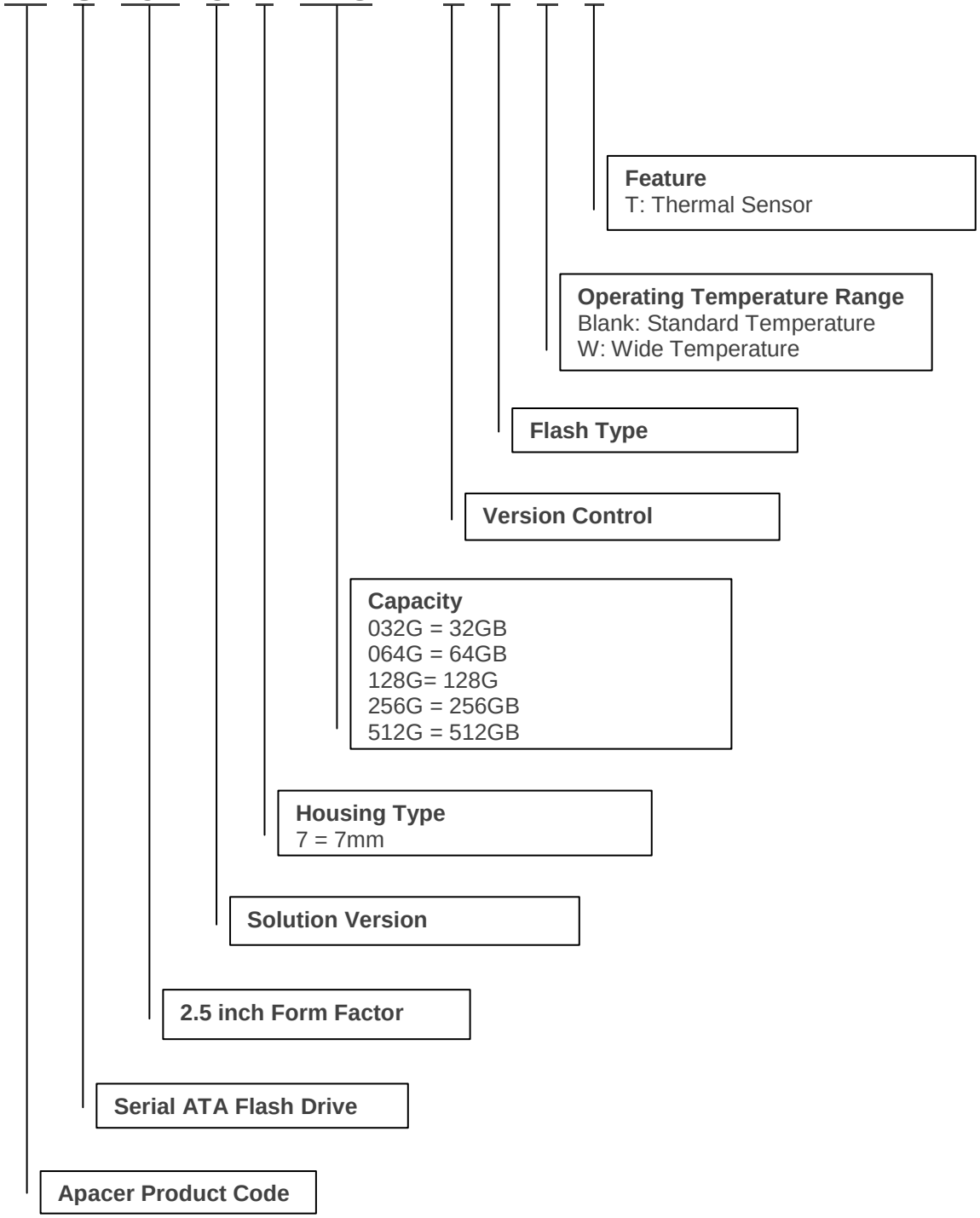
Table 7-1 Net Weight

Capacity	Net Weight (g)
32GB	68.6
64GB	68.6
128GB	70.8
256GB	70.8
512GB	70.8

8. Product Ordering Information

8.1 Product Code Designations

AP S 25H U 7 xxxG – X T X F



8.2 Valid Combinations

8.2.1 Standard

Capacity	Standard Temperature	Wide Temperature
32GB	APS25HU7032G-KTF	APS25HU7032G-KTWF
64GB	APS25HU7064G-KTF	APS25HU7064G-KTWF
128GB	APS25HU7128G-KTF	APS25HU7128G-KTWF
256GB	APS25HU7256G-KTF	APS25HU7256G-KTWF
512GB	APS25HU7512G-HTF	APS25HU7512G-HTWF

8.2.2 AES (optional)

Capacity	Standard Temperature	Wide Temperature
32GB	APS25HU7032G-VTF	APS25HU7032G-VTWF
64GB	APS25HU7064G-VTF	APS25HU7064G-VTWF
128GB	APS25HU7128G-VTF	APS25HU7128G-VTWF
256GB	APS25HU7256G-VTF	APS25HU7256G-VTWF
512GB	APS25HU7512G-WTF	APS25HU7512G-WTWF

8.2.3 Instant Keychange (optional)

Capacity	Standard Temperature	Wide Temperature
32GB	APS25HU7032G-YTF	APS25HU7032G-YTWF
64GB	APS25HU7064G-YTF	APS25HU7064G-YTWF
128GB	APS25HU7128G-YTF	APS25HU7128G-YTWF
256GB	APS25HU7256G-YTF	APS25HU7256G-YTWF
512GB	APS25HU7512G-ZTF	APS25HU7512G-ZTWF

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.

Revision History

Revision	Description	Date
0.1	Preliminary release	6/3/2019
1.0	- Completed endurance rating for 512GB at Endurance on Specifications Overview page and 5.4 Endurance - Updated 2.2 S.M.A.R.T. - Updated shock and vibration specs at 5.1 Environmental Specifications	6/28/2019
1.1	- Added Thermal Management Technique to Reliability on Specifications Overview page - Added Security section to Specifications Overview page - Updated technology description for 3.4 Power Failure Management - Added 4.2 Thermal Management Technique, 4.3 Instant Keychange and 4.4 Advanced Encryption Standard - Updated 8. Product Ordering Information by adding 8.2.2 and 8.2.3 sections	8/19/2019

Global Presence

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