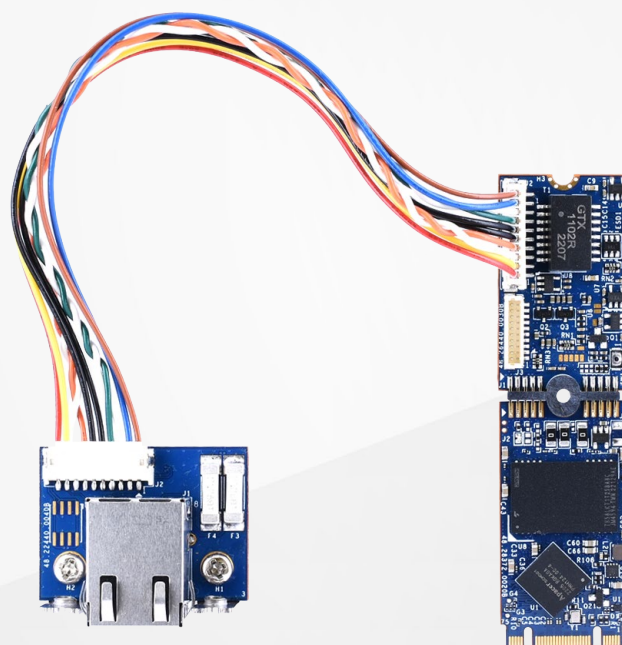


RoHS Recast Compliant

M.2 2280 Transformed Solid State Drive

SV25T-M280 with OOB Module BiCS5 Product Specifications



July 14, 2023

Version 1.3



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Specifications Overview:

- **Compliance with SATA Revision 3.2**
 - SATA 6 Gb/s interface
 - ATA-8 command set
 - Backward compatible with SATA 1.5/3 Gb/s interfaces
- **Capacity**
 - 60, 120, 240, 480, 960 GB
- **Performance¹**
 - Burst read/write: 600 MB/sec
 - Sequential read: Up to 550 MB/sec
 - Sequential write: Up to 485 MB/sec
 - 4K Random read: Up to 50,000 IOPS
 - 4K Random write: Up to 65,000 IOPS
- **Flash Management**
 - Low-Density Parity-Check (LDPC) Code
 - Global Wear Leveling
 - Flash bad-block management
 - Flash Translation Layer: Page Mapping
 - S.M.A.R.T.
 - DataDefender™
 - Device Sleep
 - ATA Secure Erase
 - TRIM
 - Hyper Cache Technology
 - Over-provisioning
 - SMART Read Refresh™
- **NAND Flash Type: 3D TLC (BiCS5)**
- **MTBF: >3,000,000 hours**
- **Endurance (in drive writes per day: DWPD)**
 - Without CoreSnapshot
 - 120 GB: 1.90 DWPD
 - 240 GB: 1.69 DWPD
 - 480 GB: 1.83 DWPD
 - 960 GB: 1.48 DWPD
 - With CoreSnapshot
 - 60 GB: 1.90 DWPD
 - 120 GB: 1.69 DWPD
 - 240 GB: 1.83 DWPD
 - 480 GB: 1.48 DWPD
- **Temperature Range**
 - Operating:
 - Standard: 0°C to 70°C
 - Wide: -40°C to 85°C
 - Storage: -55°C to 100°C
- **Supply Voltage**
 - 3.3V ± 5%
- **Power Consumption¹**
 - Active mode (Max.): 400 mA
 - Idle mode: 65 mA
- **SATA Power Management Modes**
- **Security and Reliability**
 - AES 256-bit hardware encryption
 - Thermal Sensor
 - End-to-End Data Protection
- **Value-added Features**
 - Double-barreled Solution: Cloud Edition
 - Out-Of-Band (OOB) Management
 - CoreSnapshot 2 (optional)
- **OOB Features**
 - Supports PWR and Recover signal
 - Supports 3.3V~5V power input
 - Built-in ± 15KV ESD protection for Ethernet Port (Air Discharge)
 - Built-in ± 2KV ESD protection for I/O Pin (Contact Discharge)
 - Complies with EN61000-4-2 (ESD) Air-15kV, Contact-8kV
- **Connector Type**
 - 75-pin SATA-based M.2 module pinout
 - 10-pin OOB connector
- **Form Factor**
 - Double-sided: M.2 2280-D5-B-M
 - Dimensions (unit: mm):
 - SSD: 22.00 x 80.00 x 7.75_(max.)
 - RJ45: 35.30 x 29.50 x 19.10
- **LED Indicators for Drive Behavior**
- **RoHS Recast Compliant (Complies with 2011/65/EU Standard)**

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 Description

Apacer's SV25T-M280 with OOB Module, designed as M.2 2280 mechanical dimensions, is a Transformed Solid State Drive (SSD) composed of a M.2 2242 SSD and Out-Of-Band (OOB) module with a specially-designed rugged connector. Utilizing 3D NAND for higher capacity up to 960GB and providing more power efficiency than 2D NAND, SV25T-M280 with OOB Module provides full compliance with the latest SATA Revision 3.2 interface specifications and delivers exceptional read/write speed, making it the leading add-in storage solution for future host computing systems.

SV25T-M280 with OOB Module is built with a powerful SATA controller that supports on-the-module ECC as well as efficient wear leveling scheme and implemented with LDPC (Low Density Parity Check) ECC engine to extend SSD endurance and increase data reliability. Furthermore, SV25T-M280 with OOB Module is equipped with a built-in thermal sensor to monitor the temperature of the SSD via S.M.A.R.T commands to prevent overheating. Operating under 6 Gb/s interface, SV25T-M280 with OOB Module is provided with Apacer latest S.M.A.R.T. primarily oriented for the latest SATA interface SSD, for drive lifetime monitoring and analysis. For highly-intensive applications, End-to-End Data Protection ensures that data integrity can be assured at multiple points in the path to enable reliable delivery of data transfers. Security-wise, Advanced Encryption Standard (AES) ensures data security and provides users with peace of mind knowing their data is safeguarded at all times.

On top of that, SV25T-M280 with OOB Module features CoreSnapshot 2 and Double-barreled Solution to optimize the stability of system operation and management. CoreSnapshot 2 ensures that SV25T-M280 with OOB Module can function normally and return to normal operation in the event of unexpected system failures to reduce downtime and maximum output, while Double-barreled Solution extends the practical operating lifespan and integrates seamlessly with alternated RDM platforms, makes monitoring of a complex system much easier and more efficient through the Cloud.

With regard to flash management, the drive adopts the latest page mapping file translation layer and comes with various implementations including powerful hardware ECC engine, power saving modes, wear leveling, flash block management, S.M.A.R.T., TRIM, Hyper Cache technology, over-provisioning, DataDefender™ and SMART Read Refresh™.

With exceptional performance, trustable reliability and enhanced data protection, SV25T-M280 with OOB Module 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 SV25T-M280 with OOB Module consists of two units: a solid-state drive and an OOB module. As indicated in Figure 2-1, the SSD contains flash media and a single-chip controller which integrates the flash management unit to support multi-channel, multi-bank flash arrays. The SSD interfaces with the OOB module using the external I/O signal port. The external I/O signal port forms a bidirectional serial interface that implements the industry standard Serial ATA (SATA) protocol.

As for the OOB module, it includes a microcontroller unit (MCU), NOR Flash, Ethernet PHY and RJ45 connector. Being the management unit, the MCU is designed to not only activate the OOB module along with the NOR Flash, but also connect to the Internet via Ethernet PHY and the RJ45 connector using the Ethernet protocol.

Note: The actual number of NAND Flash used on Apacer SV25T-M280 with OOB Module varies from capacities. The illustration is for reference only.

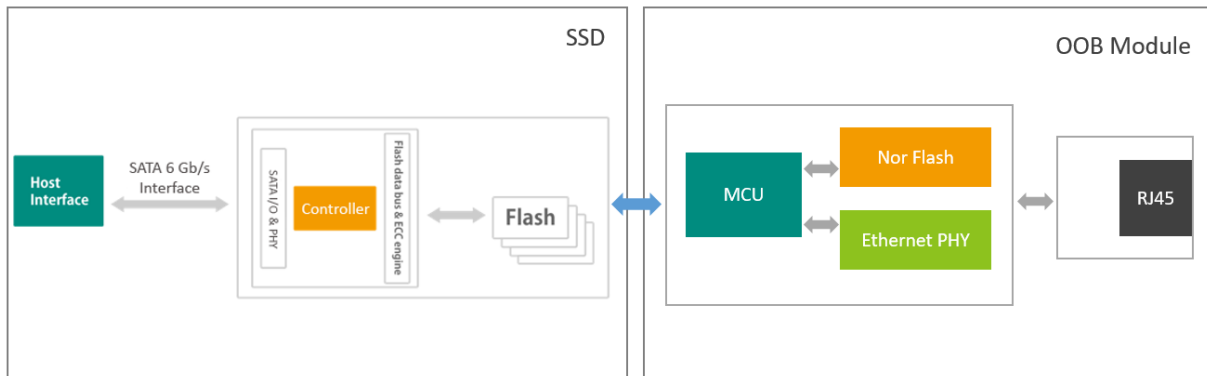


Figure 2-1 Functional Block Diagram

3. Pin Assignments

3.1 SATA Connectors

This connector does not support hot plug capability. There are a total of 75 pins. 12 pin locations are used for mechanical key locations; this allows such a module to plug into both Key B and Key M connectors.

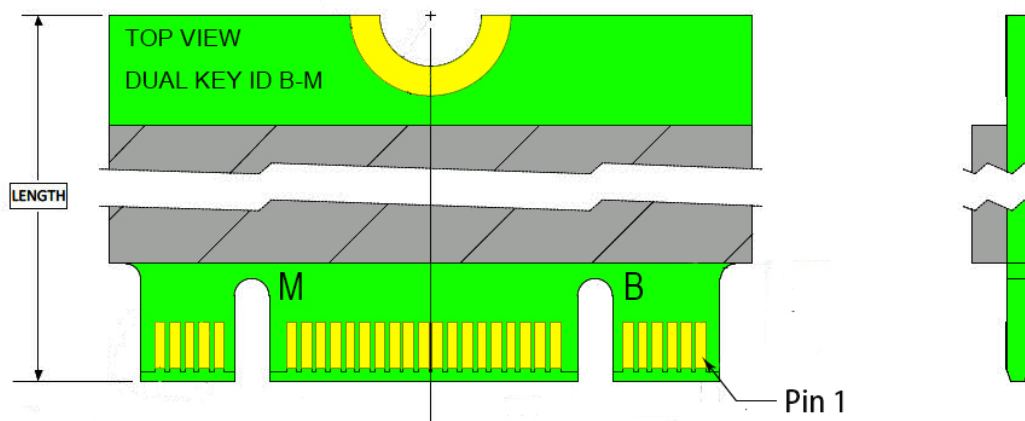


Figure 3-1 SATA Connectors

Table 3-1 Pin Assignments

| Pin No. | Type | Description |
|---------|-------------------|--|
| 1 | CONFIG_3 | Ground (according to M.2 configurations for SSD-SATA definition) |
| 2 | 3.3V | Supply Pin, 3.3V |
| 3 | GND | Ground |
| 4 | 3.3V | Supply pin, 3.3V |
| 5 | No connect | No connect |
| 6 | Not available | No connect |
| 7 | Not available | No connect |
| 8 | Not available | Reserved for Apacer use only ¹ |
| 9 | No connect | No connect |
| 10 | DAS/DSS | Device Activity Signal/Disable Staggered Spin-up |
| 11 | No connect | No connect |
| 12 | (removed for key) | Mechanical notch B |
| 13 | (removed for key) | Mechanical notch B |
| 14 | (removed for key) | Mechanical notch B |
| 15 | (removed for key) | Mechanical notch B |
| 16 | (removed for key) | Mechanical notch B |
| 17 | (removed for key) | Mechanical notch B |
| 18 | (removed for key) | Mechanical notch B |
| 19 | (removed for key) | Mechanical notch B |

Table 3-1 Pin Assignments

| Pin No. | Type | Description |
|---------|-------------------|--|
| 20 | Not available | No connect |
| 21 | CONFIG_0 | Ground (according to M.2 configurations for SSD-SATA definition) |
| 22 | Not available | No connect |
| 23 | Not available | No connect |
| 24 | Not available | No connect |
| 25 | Not available | No connect |
| 26 | Not available | No connect |
| 27 | GND | Ground |
| 28 | Not available | No connect |
| 29 | PERn1 | No connect |
| 30 | Not available | No connect |
| 31 | PERp1 | No connect |
| 32 | Not available | No connect |
| 33 | GND | Ground |
| 34 | Not available | No connect |
| 35 | PETn1 | No connect |
| 36 | Not available | No connect |
| 37 | PETp1 | No connect |
| 38 | DEVSLP | Device Sleep, input. If driven high the host is informing the SSD to enter a low power state |
| 39 | GND | Ground |
| 40 | Not available | No connect |
| 41 | SATA-Rx+ | Host receiver differential signal pair |
| 42 | Not available | No connect |
| 43 | SATA-Rx- | Host receiver differential signal pair |
| 44 | Not available | No connect |
| 45 | GND | Ground |
| 46 | Not available | No connect |
| 47 | SATA-Tx- | Host transmitter differential pair |
| 48 | Not available | No connect |
| 49 | SATA-Tx+ | Host transmitter differential pair |
| 50 | PERST# | No connect |
| 51 | GND | Ground |
| 52 | CLKREQ# | No connect |
| 53 | REFCLKN | No connect |
| 54 | PEWAKE# | No connect |
| 55 | REFCLKP | No connect |
| 56 | MFG1 | Reserved for Apacer use only ¹ |
| 57 | GND | Ground |
| 58 | MFG2 | Reserved for Apacer use only ¹ |
| 59 | (removed for key) | Mechanical notch M |

Table 3-1 Pin Assignments

| Pin No. | Type | Description |
|---------|-------------------|--------------------|
| 60 | (removed for key) | Mechanical notch M |
| 61 | (removed for key) | Mechanical notch M |
| 62 | (removed for key) | Mechanical notch M |
| 63 | (removed for key) | Mechanical notch M |
| 64 | (removed for key) | Mechanical notch M |
| 65 | (removed for key) | Mechanical notch M |
| 66 | (removed for key) | Mechanical notch M |
| 67 | Not available | No connect |
| 68 | SUSCLK | No connect |
| 69 | CONFIG_1 | Ground |
| 70 | 3.3V | Supply pin, 3.3V |
| 71 | GND | Ground |
| 72 | 3.3V | Supply pin, 3.3V |
| 73 | GND | Ground |
| 74 | 3.3V | Supply pin, 3.3V |
| 75 | CONFIG_2 | Ground |

Note:

1. Reserved by Apacer, please do not connect to a host.

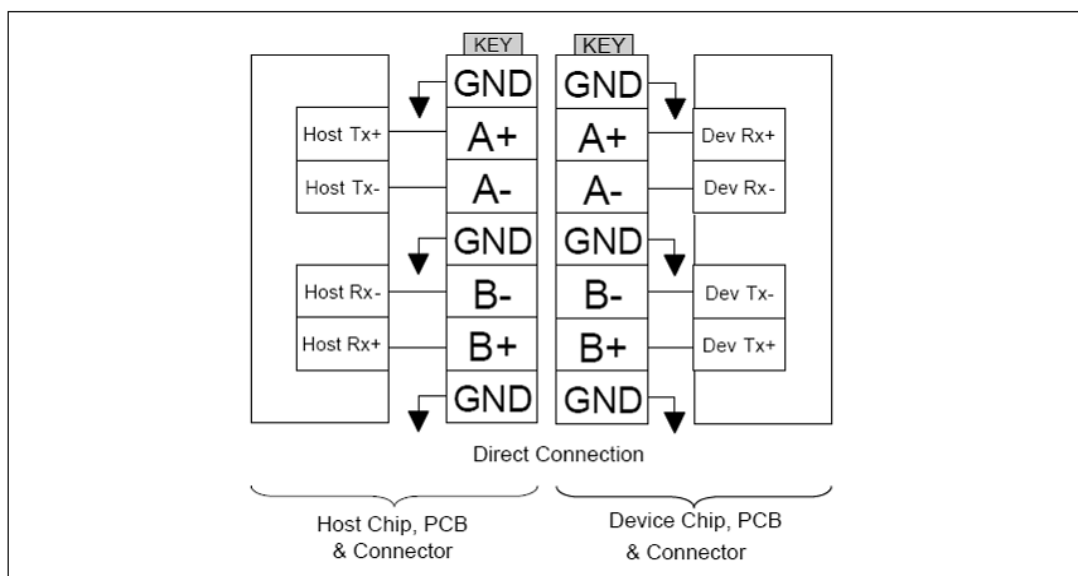


Figure 3-2 Direct Connection between the Host and Device

3.2 OOB Module Connectors

Table 3-2 and 3-3 describe the pins for OOB module.

Top View

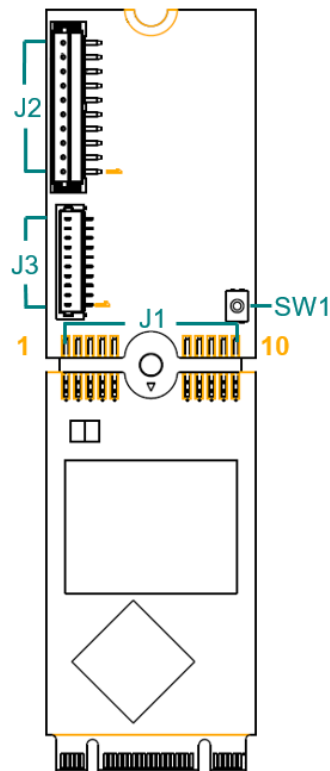


Figure 3-3 Top View: OOB Module Connectors

Table 3-2 Top View: OOB Module Pin Assignments

| J2: Ethernet Signal | | |
|---------------------|--------|---------------------------------|
| Pin No. | Type | Description |
| 1 | LED+ | Output: Ethernet ACT (blinking) |
| 2 | LED- | |
| 3 | RX- | Receive Input Pair |
| 4 | RX+ | |
| 5 | GND | Ground |
| 6 | GND | Ground |
| 7 | TX- | Transmit Output Pair |
| 8 | TX+ | |
| 9 | LED+ | Output: 100M Link |
| 10 | EX_VCC | External Power Input |

| J3: External I/O Signal | | |
|--|--------------------|---------------------------------------|
| Pin No. | Type | Description |
| 1 | Reserved by Apacer | Debug: Boot Select |
| 2 | Reserved by Apacer | Debug USB Signal |
| 3 | Reserved by Apacer | |
| 4 | Reserved by Apacer | |
| 5 | Reserved by Apacer | Debug UART Signal |
| 6 | Reserved by Apacer | Output Signal (OD) |
| 7 | GND | Ground |
| 8 | MB_POWER | OUTPUT: Motherboard Power Signal (OD) |
| 9 | GND | Ground |
| 10 | EX_VCC | External Power Input |
| J1: External I/O Signal | | |
| Pin No. | Type | Description |
| 1 | GPIO8 | INPUT: Power Status |
| 2 | GPIO17 | INPUT: Recovery Status |
| 3 | GPIO23 | OUTPUT: Recovery Signal |
| 4 | SCL | I2C Signal |
| 5 | SDA | |
| 6 | NA | No definition |
| 7 | NA | No definition |
| 8 | NC | No contact |
| 9 | NC | No contact |
| 10 | GND | Ground |
| SW1: Reset Button | | |
| Description | | |
| Used for system reboot without turning off the system power. | | |

Bottom View

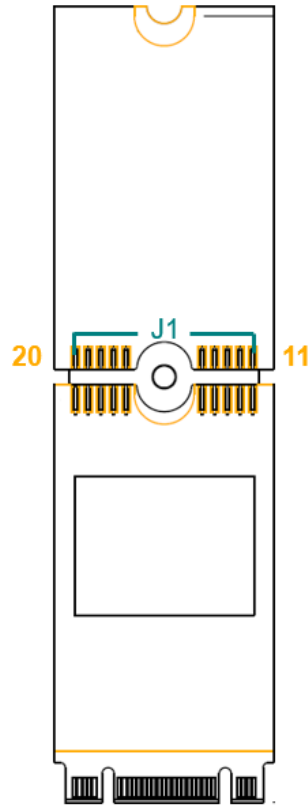


Figure 3-4 Bottom View: OOB Module Connectors

Table 3-3 Bottom View: OOB Module Pin Assignments

| J1: External I/O Signal | | |
|-------------------------|--------|-------------------------|
| Pin No. | Type | Description |
| 11 | GND | Ground |
| 12 | NC | No contact |
| 13 | NC | No contact |
| 14 | NA | No definition |
| 15 | NA | No definition |
| 16 | SDA | I2C Signal |
| 17 | SCL | |
| 18 | GPIO23 | OUTPUT: Recovery Signal |
| 19 | GPIO17 | INPUT: Recovery Status |
| 20 | GPIO8 | INPUT: Power Status |

4. Product Specifications

4.1 Capacity

Capacity specifications of SV25T-M280 with OOB Module are available as shown in Table 4-1 and 4-2. They list the specific capacity and the default numbers of heads, sectors and cylinders for each product line.

Table 4-1 Without CoreSnapshot 2: Capacity Specifications

| Capacity | Total bytes | Cylinders | Heads | Sectors | Total LBA |
|----------|-----------------|-----------|-------|---------|---------------|
| 120 GB | 120,034,123,776 | 16,383 | 16 | 63 | 234,441,648 |
| 240 GB | 240,057,409,536 | 16,383 | 16 | 63 | 468,862,128 |
| 480 GB | 480,103,981,056 | 16,383 | 16 | 63 | 937,703,088 |
| 960 GB | 960,197,124,096 | 16,383 | 16 | 63 | 1,875,385,008 |

Table 4-2 With CoreSnapshot 2: Capacity Specifications (optional)

| Capacity | Total bytes | Cylinders | Heads | Sectors | Total LBA |
|----------|-----------------|-----------|-------|---------|-------------|
| 60 GB | 59,022,286,848 | 16,383 | 16 | 63 | 115,277,904 |
| 120 GB | 119,033,929,728 | 16,383 | 16 | 63 | 232,488,144 |
| 240 GB | 239,057,215,488 | 16,383 | 16 | 63 | 466,908,624 |
| 480 GB | 479,103,787,008 | 16,383 | 16 | 63 | 935,749,584 |

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 SV25T-M280 with OOB Module is listed below in Table 4-3 and 4-4.

Table 4-3 Without CoreSnapshot 2: Performance Specifications

| Performance | Capacity | 120 GB | 240 GB | 480 GB | 960 GB |
|--------------------------------|-------------------------------|--------|--------|--------|--------|
| | Sequential Read (MB/s) | | 550 | 550 | 550 |
| Sequential Write (MB/s) | | 465 | 485 | 485 | 485 |
| 4K Random Read (IOPS) | | 16,000 | 35,000 | 50,000 | 46,000 |
| 4K Random Write (IOPS) | | 65,000 | 65,000 | 65,000 | 60,000 |

Table 4-4 With CoreSnapshot 2: Performance Specifications (optional)

| Capacity | 60 GB | 120 GB | 240 GB | 480 GB |
|--------------------------------|--------|--------|--------|--------|
| Performance | | | | |
| Sequential Read (MB/s) | 550 | 550 | 550 | 550 |
| Sequential Write (MB/s) | 465 | 485 | 485 | 485 |
| 4K Random Read (IOPS) | 16,000 | 35,000 | 50,000 | 46,000 |
| 4K Random Write (IOPS) | 65,000 | 65,000 | 65,000 | 60,000 |

Notes:

- The table shows the operating performance after completing the backup and recovery processes, and the performance results may differ from various flash configurations or host system setting. Write performance may be affected during the backup process, but will recover to the maximum performance level once the backup task is completed.
- Sequential read/write is based on CrystalDiskMark 8.0.4 with file size 1,000MB.
- Random read/write is measured using IOMeter with Queue Depth 32.

4.3 Environmental Specifications

Environmental specifications of SV25T-M280 with OOB Module product are shown in Table 4-5.

Table 4-5 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 SV25T-M280 with OOB Module. The prediction result for SV25T-M280 with OOB Module 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

SV25T-M280 with OOB Module complies with the following standards:

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

4.6 Endurance

The endurance of a storage device is predicted by Drive Writes Per Day 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 4-6 Without CoreSnapshot 2: Endurance Specifications

| Capacity | Drive Writes Per Day |
|----------|----------------------|
| 120 GB | 1.90 |
| 240 GB | 1.69 |
| 480 GB | 1.83 |
| 960 GB | 1.48 |

Table 4-7 With CoreSnapshot 2: Endurance Specifications (optional)

| Capacity | Drive Writes Per Day |
|----------|----------------------|
| 60 GB | 1.90 |
| 120 GB | 1.69 |
| 240 GB | 1.83 |
| 480 GB | 1.48 |

Notes:

- This estimation complies with JEDEC JESD-219, Enterprise endurance workload of random data with payload size distribution.
- Flash vendor guaranteed 3D NAND TLC P/E cycle: 3K
- WAF may vary from capacity, flash configurations and writing behavior on each platform.
- 1 Terabyte = 1,024GB
- DWPD (Drive Writes Per Day) is calculated based on the number of times that user overwrites the entire capacity of an SSD per day of its lifetime during the warranty period. (3D NAND TLC warranty: 3 years)

4.7 LED Indicator Behavior

The behavior of the SV25T-M280 with OOB Module LED indicators is described in Table 4-8 and 4-9.

Table 4-8 Top View: LED Behavior

| Location | LED | Description |
|----------|-------|---|
| LED A | HDDA1 | LED blinks when the drive is being accessed |

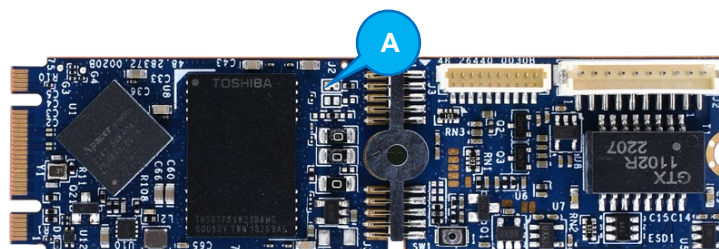
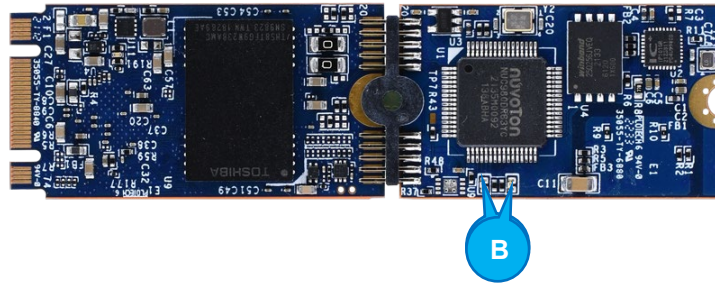


Table 4-9 Bottom View: LED Behavior

| Location | Description |
|----------|---|
| LED B | LED blinks when the OOB module is ready |



5. Flash Management

5.1 Error Correction/Detection

SV25T-M280 with OOB Module implements a hardware ECC scheme, based on the Low Density Parity Check (LDPC). LDPC is a class of linear block error correcting code which has apparent coding gain over BCH code because LDPC code includes both hard decoding and soft decoding algorithms. With the error rate decreasing, LDPC can extend SSD endurance and increase data reliability while reading raw data inside a flash chip.

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 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.

5.5 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.

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 Flash Translation Layer – Page Mapping

Page mapping is an advanced flash management technology whose essence lies in the ability to gather data, distribute the data into flash pages automatically, and then schedule the data to be evenly written. Page-level mapping uses one page as the unit of mapping. The most important characteristic is that each logical page can be mapped to any physical page on the flash memory device. This mapping algorithm allows different sizes of data to be written to a block as if the data is written to a data pool and it does not need to take extra operations to process a write command. Thus, page mapping is adopted to increase random access speed and improve SSD lifespan, reduce block erase frequency, and achieve optimized performance and lifespan.

5.8 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

5.9 Hyper Cache Technology

Apacer proprietary Hyper Cache technology uses a portion of the available capacity as SLC (1bit-per-cell) NAND flash memory, called Hyper cache mode. When data is written to SSD, the firmware will direct the data to Hyper Cache mode, providing excellent performance to handle various scenarios in industrial use.

5.10 Over-provisioning

Over-provisioning (OP) is a certain portion of the SSD capacity exclusively for increasing Garbage Collection (GC) efficiency, especially when the SSD is filled to full capacity or performs a heavy mixed-random workload. OP has the advantages of providing extended life expectancy, reliable data integrity, and high sustained write performance.

5.11 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 μ 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.
- Device Sleep (DevSleep or DEVSLP): PHY powered down; power consumption \leq 5 mW; host assertion time \leq 10 ms; exit timeout from this state \leq 20 ms (unless specified otherwise in SATA Identify Device Log).

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

5.12 SMART Read Refresh™

Apacer's SMART Read Refresh plays a proactive role in avoiding read disturb errors from occurring to ensure health status of all blocks of NAND flash. Developed for read-intensive applications in particular, SMART Read Refresh is employed to make sure that during read operations, when the read operation threshold is reached, the data is refreshed by re-writing it to a different block for subsequent use.

6. Security and Reliability Features

6.1 Advanced Encryption Standard

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.

6.2 End-to-End Data Protection

End-to-End Data Protection is a feature implemented in Apacer SSD products that extends error control to cover the entire path from the host computer to the drive and back, and ensure data integrity at multiple points in the path to enable reliable delivery of data transfers. Unlike ECC which does not exhibit the ability to determine the occurrence of errors throughout the process of data transmission, End-to-End Data Protection allows SSD controller to identify an error created anywhere in the path and report the error to the host computer before it is written to the drive. This error-checking and error-reporting mechanism therefore guarantees the trustworthiness and reliability of the SSD.

6.3 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. Value-added Features

7.1 Double-barreled Solution: Cloud Edition

Apacer's Double-barreled Solution: Cloud Edition (or DBS: Cloud Edition) is a plug-in edition comprised of CoreAnalyzer2 and SSDWidget2.0 that can integrate seamlessly with alternated remote-device management (RDM) platforms. CoreAnalyzer2 helps determine which SSD and firmware are most suitable for a customer, and SSDWidget2.0 lets customers remotely monitor SSD status in real-time. The DBS Cloud Edition offers customers greater choice in deploying RDM system and adds flexibility while retaining seamless integration. This makes monitoring of a complex system much easier and more efficient through the Cloud.

7.2 Out-Of-Band Management

Out-of-band (OOB) management is based on a hardware module that provides a separate channel or communication path used for transmitting data outside the main data channel. It can be used for various purposes such as monitoring, troubleshooting, or emergency recovery. Apacer's OOB Module offers an alternate method of device control during the case of a system disaster.

7.3 CoreSnapshot 2 (optional)

Apacer CoreSnapshot 2 is an advanced firmware-based backup and recovery technology compared with CoreSnapshot Lite. With the implementation of incremental backup, CoreSnapshot 2 allows users to easily perform backups once data and OS recovery is completed, thereby solving unexpected data loss or OS crash immediately. It can not only help avoid the expensive RMA (Return/Reject Material Authorization) and related costs of onsite service support for clients, but also offer various methods of recovery, including In-band software recovery, hardware pin trigger and Out-of-Band (OOB). When an error occurs in an application, clients can trigger the In-Band recovery command on the host or through cloud service. And, when a device has encountered a BSoD (Blue Screen of Death), clients can utilize an external hardware pin trigger or OOB module to recover the system immediately just in one second.

8. Software Interface

8.1 Command Set

This section defines the software requirements and the format of the commands the host sends to SV25T-M280 with OOB Module. Commands are issued to SV25T-M280 with OOB Module by loading the required registers in the command block with the supplied parameters, and then writing the command code to the Command register.

Table 8-1 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 | | |

Note: For more information about CoreSnapshot 2 command set, please contact Apacer's Sales representatives.

8.2 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 8-2 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 8-3 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 8-4 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 |
| 242 (0xF2) | Total Sectors of Read |

9. Electrical Specifications

9.1 SSD

9.1.1 Operating Voltage

Table 9-1 lists the supply voltage for SV25T-M280 with OOB Module.

Table 9-1 Operating Range

| Item | Range |
|----------------|------------------------------|
| Supply Voltage | 3.3V \pm 5% (3.135-3.465V) |

9.1.2 Power Consumption

Table 9-2 and 9-3 list the power consumption for SV25T-M280 with OOB Module.

Table 9-2 Without CoreSnapshot 2: Power Consumption

| Mode \ Capacity | 120 GB | 240 GB | 480 GB | 960 GB |
|--------------------------|--------|--------|--------|--------|
| Active (mA)(Max.) | 375 | 400 | 400 | 400 |
| Idle (mA) | 65 | 65 | 65 | 65 |

Table 9-3 With CoreSnapshot 2: Power Consumption (optional)

| Mode \ Capacity | 60 GB | 120 GB | 240 GB | 480 GB |
|--------------------------|-------|--------|--------|--------|
| Active (mA)(Max.) | 375 | 400 | 400 | 400 |
| Idle (mA) | 65 | 65 | 65 | 65 |

Notes:

- All values are typical and may vary depending on flash configurations or host system settings.
- Power consumption is measured using CrystalDiskMark 8.0.4.

9.2 OOB Module

9.2.1 Ethernet Communication

Table 9-4 describes the specifications of Ethernet for OOB module.

Table 9-4 Ethernet Specifications

| Parameter | Specifications |
|--------------------|-------------------------------------|
| Ethernet Standard | IEEE 802.3, IEEE 802.3u (100Base-T) |
| Connector Type | RJ-45 |
| Transmission Speed | 10/100 Mbps |
| Port Number | 1 |
| Protection | 15 KV ESD protection |

9.2.2 Power

Table 9-5 lists the power specifications for OOB module.

Table 9-5 Power Specifications

| Parameter | Specifications |
|-------------------|----------------|
| Power Source | +3.3~5 VDC |
| Power Consumption | 1W @ 3.3 VDC |
| Connector Type | BOX header |

10. Mechanical Specifications

10.1 SSD

Table 10-1 Physical Dimensions

| Parameter | Unit | 60 GB | 120 GB | 240 GB | 480 GB | 960 GB |
|---------------|------|--------------|--------|--------|--------|--------|
| Length | mm | 80.00 ± 0.30 | | | | |
| Width | | 22.00 ± 0.15 | | | | |
| Height (Max.) | | 7.75 | | | | |

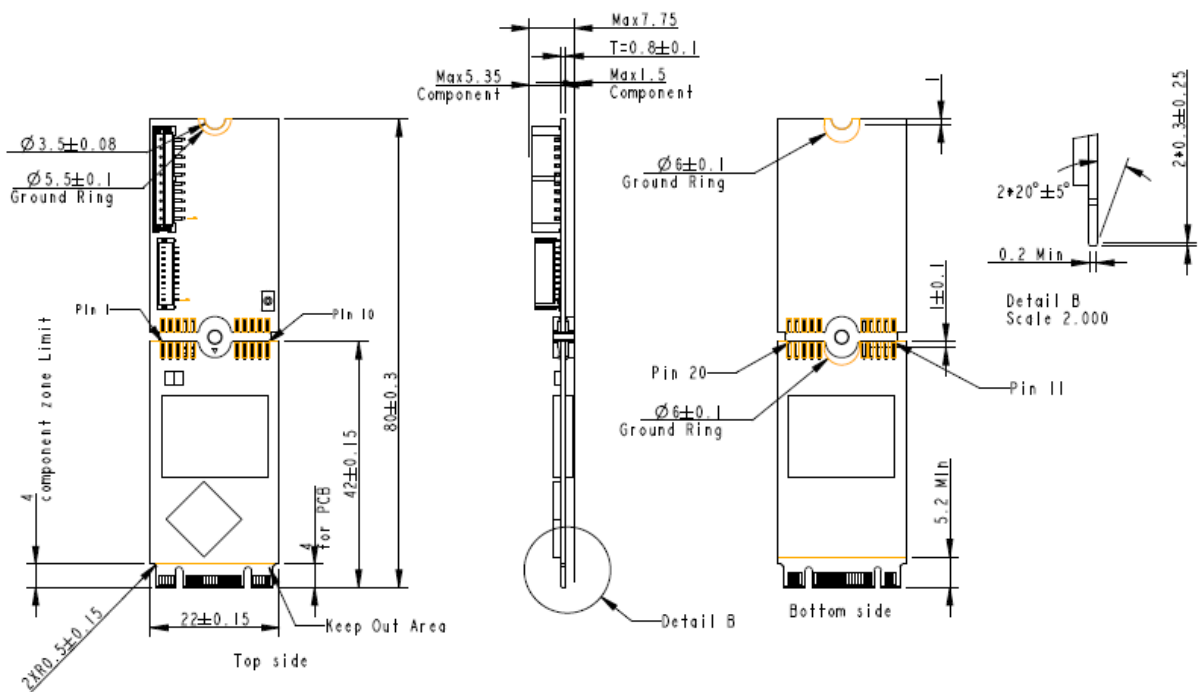


Figure 10-1 Physical Dimensions

10.2 RJ45

Table 10-2 Physical Dimensions

| Parameter | Unit | 60 GB | 120 GB | 240 GB | 480 GB | 960 GB |
|-----------|------|--------------|--------|--------|--------|--------|
| Length | mm | 35.30 ± 0.30 | | | | |
| Width | | 29.50 | | | | |
| Height | | 19.10 | | | | |

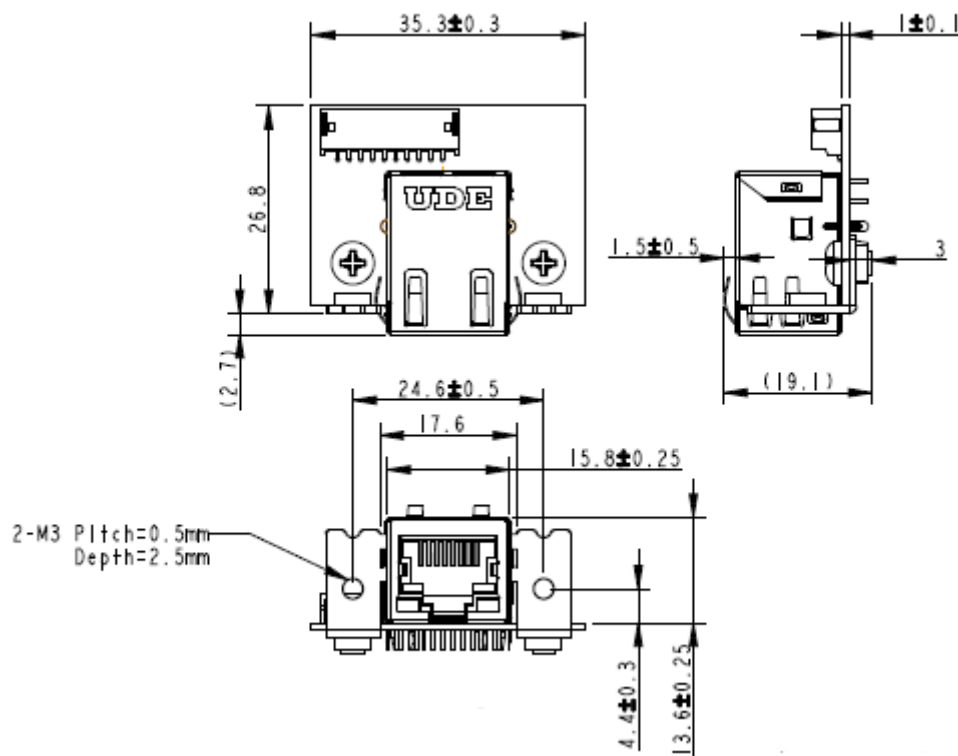


Figure 10-2 Physical Dimensions

11. Product Ordering Information

11.1 Product Code Designations

Apacer's SV25T-M280 with OOB Module SSD is available in different configurations and densities. See the chart below for a comprehensive list of options for the SV25T-M280 with OOB Module series devices.

| Code | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |
|------|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|
| | A | 5 | 2 | . | F | 1 | X | X | X | B | . | 0 | 0 | 1 | X | X |

| | | |
|--|---|--|
| Code 1-3 (Product Line & Form Factor) | SATA M.2 2280 | |
| Code 5-6 (Model/Solution) | SV25T | |
| Code 7-8 (Product Capacity) | Standard | 5H: 120GB 5J: 240GB 5K: 480GB 5L: 960GB |
| | With CoreSnapshot 2 | DH: 60GB DJ: 120GB DK: 240GB DL: 480GB |
| Code 9 (Flash Type & Product Temp) | V: 3D TLC Standard temperature W: 3D TLC Wide temperature | |
| Code 10 (Product Spec) | Double-sided B+M key | |
| Code 12-14 (Version Number) | Random numbers generated by system | |
| Code 15-16 (Firmware Version) | 02: Thermal sensor with DEVSLP CoreSnapshot 2 OP for Cloud version 04: Thermal sensor with DEVSLP OP for Cloud version | |

11.2 Valid Combinations

The following tables list the available models of the SV25T-M280 with OOB Module series featuring CoreSnapshot 2 technology 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.

11.2.1 Standard

| Capacity | Standard Temperature | Wide Temperature |
|----------|----------------------|------------------|
| 120GB | A52.F15HGB.00104 | A52.F15HHB.00104 |
| 240GB | A52.F15JGB.00104 | A52.F15JHB.00104 |
| 480GB | A52.F15KGB.00104 | A52.F15KHB.00104 |
| 960GB | A52.F15LGB.00104 | A52.F15LHB.00104 |

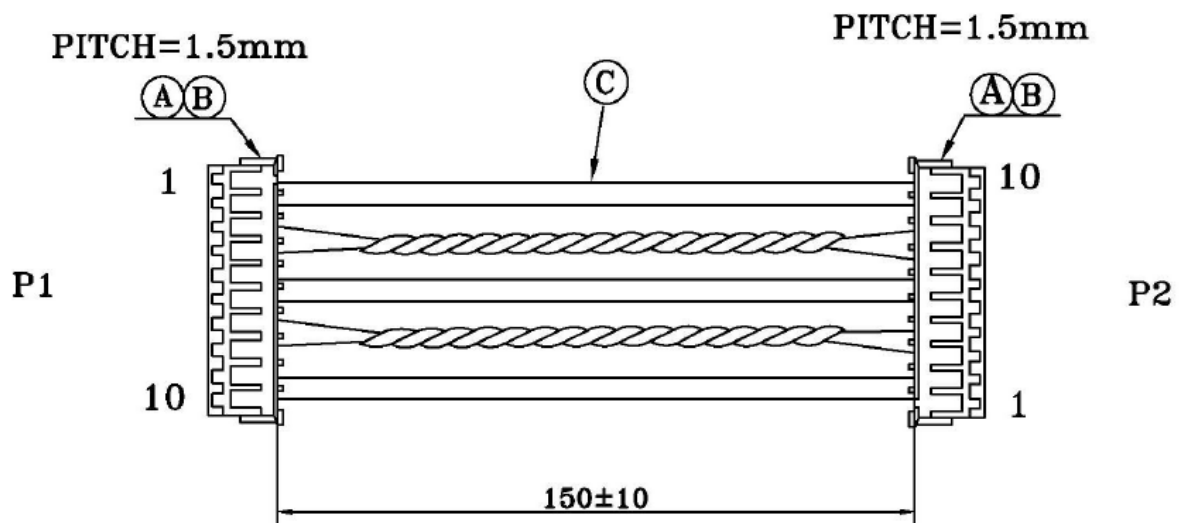
11.2.2 With CoreSnapshot 2 (optional)

| Capacity | Standard Temperature | Wide Temperature |
|----------|----------------------|------------------|
| 60GB | A52.F1DHVB.00102 | A52.F1DHWB.00102 |
| 120GB | A52.F1DJVB.00102 | A52.F1DJWB.00102 |
| 240GB | A52.F1DKVB.00102 | A52.F1DKWB.00102 |
| 480GB | A52.F1DLVB.00102 | A52.F1DLWB.00102 |

Appendix 1. Cable Specifications

1.1 I/O Board Cable

- **Function:** Connect to the RJ-45 I/O board
- **Specifications:** 10P Wafer Pitch 1.5mm to 10P Wafer Pitch 1.5mm L=150mm

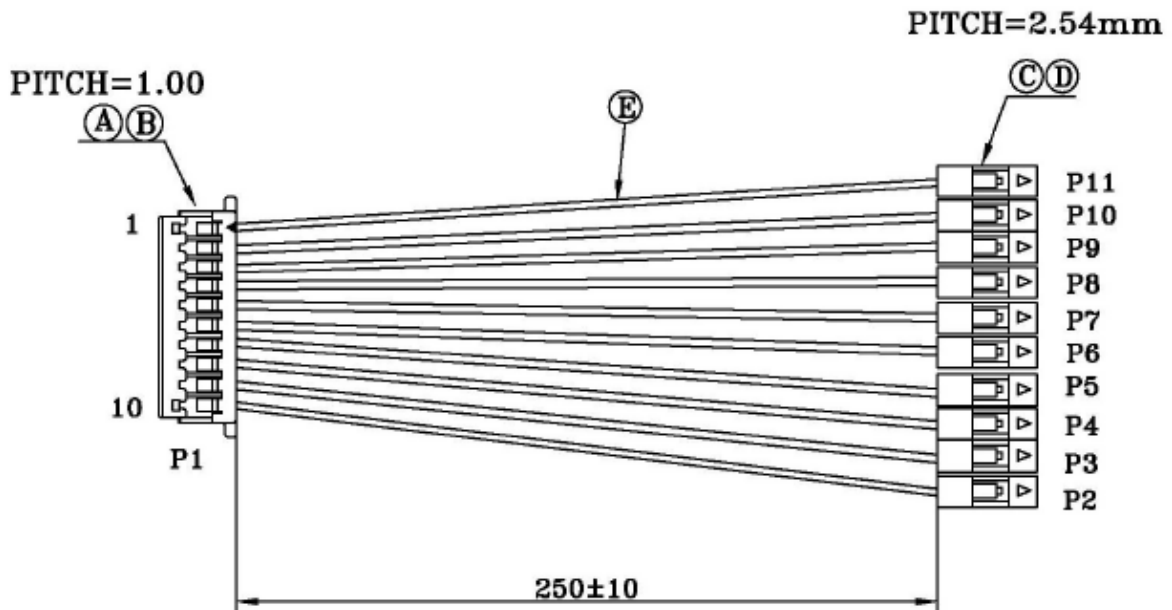


| | | | |
|----|--------|---------------------|----|
| 1 | Brown | | 10 |
| 2 | Blue | | 9 |
| 3 | White | Twisted pair cables | 8 |
| 4 | Green | | 7 |
| 5 | Black | | 6 |
| 6 | Black | | 5 |
| 7 | Orange | Twisted pair cables | 4 |
| 8 | White | | 3 |
| 9 | Yellow | | 2 |
| 10 | Red | | 1 |
| P1 | Color | | P2 |

| | | | |
|-----|----------|-----|---------------------------------------|
| C | Wire | 10 | Wire UL 1061 #24 AWG |
| B | Terminal | 20 | Terminal 1501 AMA or 1510-P ECI |
| A | Housing | 2 | Housing 1501-10Y or AMA 1510H-10P ECI |
| No. | Name | Qty | Description |

1.2 Power Management Cable

- **Function:** Connect to the motherboard
- **Specifications:** 10P Wafer Pitch 1.0mm to 10P DuPont Connector Pitch 2.54mm L=250mm



| | | | |
|-----------|--------------|--------------------|---------------|
| 1 | Red | Reserved by Apacer | P11 |
| 2 | Yellow | Reserved by Apacer | P10 |
| 3 | Black | Reserved by Apacer | P9 |
| 4 | Purple | Reserved by Apacer | P8 |
| 5 | Black | Reserved by Apacer | P7 |
| 6 | Orange | Reserved by Apacer | P6 |
| 7 | Blue | GND | P5 |
| 8 | White | MB_POWER | P4 |
| 9 | Green | GND | P3 |
| 10 | Yellow | EX_VCC | P2 |
| P1 | Color | Description | P2-P11 |

| | | | |
|------------|-------------|------------|--|
| E | Wire | 10 | Wire UL1571#28 AWG REI HSING |
| D | Terminal | 10 | Terminal 2563T-00 ECI or EQUIV |
| C | Housing | 10 | Housing 2561H-01 ECI or EQUIV |
| B | Terminal | 10 | Terminal 1010-T-T-S-D WL or 1002 AMA or E001-P ECI or EQUIV |
| A | Housing | 1 | Housing 1010-H-10 WL or 1002-10Y AMA or E001H-10P ECI or EQUIV |
| No. | Name | Qty | Description |

Revision History

| Revision | Description | Date |
|----------|--|-----------|
| 1.0 | Initial release | 2/23/2023 |
| 1.1 | <ul style="list-style-type: none"> - Modified pin assignments of J3: External I/O Signal at Table 3-2 as follows: <ul style="list-style-type: none"> - Type and description of pin 6 - Description of pin 8 - Modified the description of pin 6 at Appendix: 1.2 Power Management Cable | 3/10/2023 |
| 1.2 | <ul style="list-style-type: none"> - Added 960GB support - Changed CoreSnapshot from standard to optional feature - Added Table 4-1, 4-3, 4-6 and 9-2 - Updated 11. Product Ordering Information by adding valid combinations without CoreSnapshot support | 6/27/2023 |
| 1.3 | <ul style="list-style-type: none"> - Changed CoreSnapshot to CoreSnapshot 2 - Updated the description of 7.3 CoreSnapshot 2 - Changed the title of 11.2.1 from Without CoreSnapshot to Standard | 7/14/2023 |

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