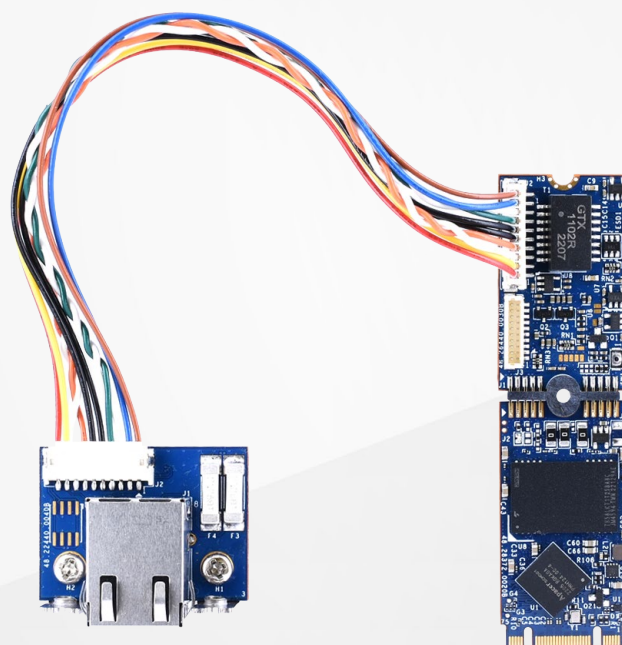


RoHS Recast Compliant

M.2 2280 Transformed Solid State Drive

SV25T-M280 with OOB Module BiCS5 Product Specifications



March 10, 2023

Version 1.1



Apacer Technology Inc.

1F, No.32, Zhongcheng Rd., Tucheng Dist., New Taipei City, Taiwan, R.O.C

Tel: +886-2-2267-8000 Fax: +886-2-2267-2261

www.apacer.com

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 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™
- **Security and Reliability**
 - AES 256-bit hardware encryption
 - Thermal Sensor
 - End-to-End Data Protection
- **SATA Power Management Modes**
- **NAND Flash Type: 3D TLC (BiCS5)**
- **MTBF: >3,000,000 hours**
- **Endurance (in drive writes per day: DWPD)**
 - 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**
 - 3.3 V ± 5%
- **Power Consumption¹**
 - Active mode (Max.): 400 mA
 - Idle mode: 65 mA
- **Value-added Features**
 - Double-barreled Solution: Cloud Edition
 - Out-Of-Band (OOB) Management
 - CoreSnapshot (CoreSnapshot 2)
- **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.

Table of Contents

1. General Description	4
2. Functional Block	5
3. Pin Assignments.....	6
3.1 SATA Connectors.....	6
3.2 OOB Module Connectors	9
4. Product Specifications.....	12
4.1 Capacity.....	12
4.2 Performance	12
4.3 Environmental Specifications	13
4.4 Mean Time Between Failures (MTBF)	13
4.5 Certification and Compliance.....	13
4.6 Endurance	14
4.7 LED Indicator Behavior.....	14
5. Flash Management.....	15
5.1 Error Correction/Detection.....	15
5.2 Bad Block Management	15
5.3 Global Wear Leveling	15
5.4 DataDefender™.....	15
5.5 ATA Secure Erase.....	15
5.6 TRIM.....	16
5.7 Flash Translation Layer – Page Mapping.....	16
5.8 Device Sleep (DevSleep or DEVSLP) Mode.....	16
5.9 Hyper Cache Technology.....	16
5.10 Over-provisioning	17
5.11 SATA Power Management.....	17
5.12 SMART Read Refresh™	17
6. Security and Reliability Features	18
6.1 Advanced Encryption Standard.....	18
6.2 End-to-End Data Protection.....	18
6.3 Thermal Sensor	18
7. Value-added Features	19

7.1 Double-barreled Solution: Cloud Edition	19
7.2 Out-Of-Band Management	19
7.3 CoreSnapshot.....	19
8. Software Interface	20
8.1 Command Set.....	20
8.2 S.M.A.R.T.	21
9. Electrical Specifications.....	22
9.1 SSD	22
9.1.1 Operating Voltage	22
9.1.2 Power Consumption	22
9.2 OOB Module	22
9.2.1 Ethernet Communication	22
9.2.2 Power	23
10. Mechanical Specifications	24
10.1 SSD	24
10.2 RJ45	25
11. Product Ordering Information.....	26
11.1 Product Code Designations.....	26
11.2 Valid Combinations.....	27
Appendix 1. Cable Specifications.....	28
1.1 I/O Board Cable.....	28
1.2 Power Management Cable	29

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 robust connector. Utilizing 3D NAND for higher capacity up to 480GB 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 and Double-barreled Solution to optimize the stability of system operation and management. CoreSnapshot 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.

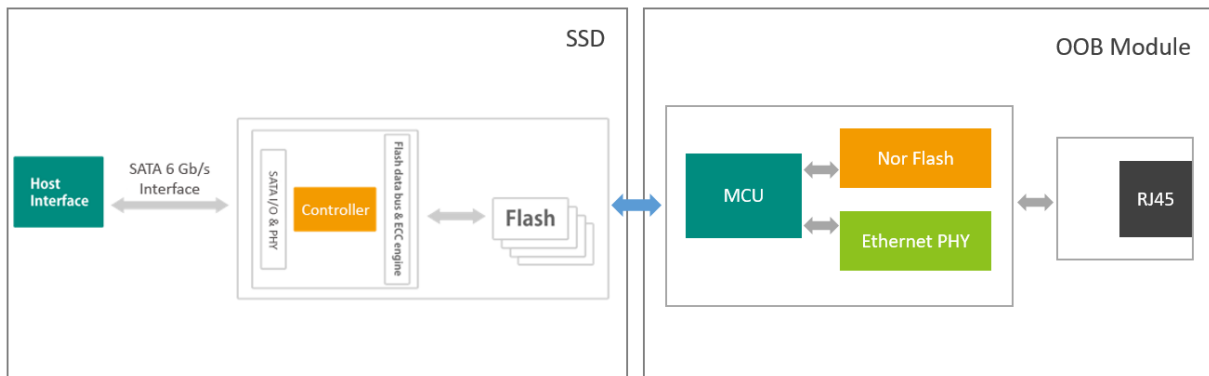


Figure 2-1 Functional Block Diagram

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.

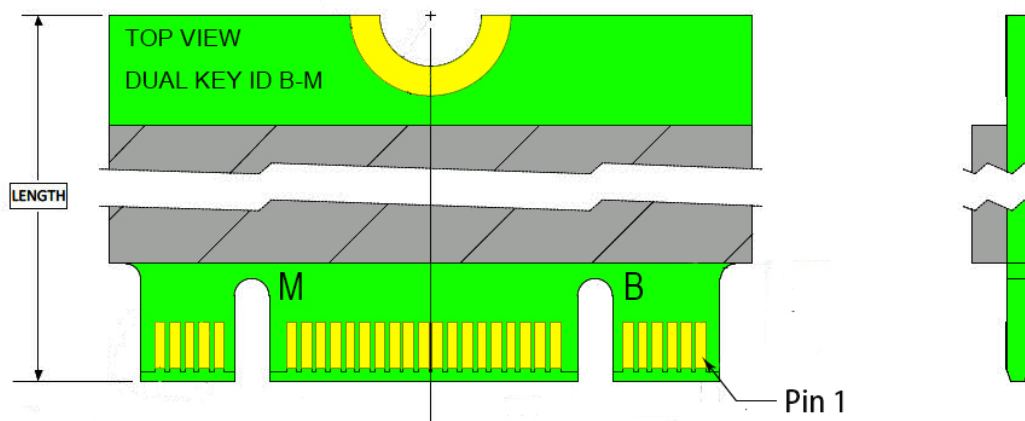


Figure 3-1 SATA Connectors

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.

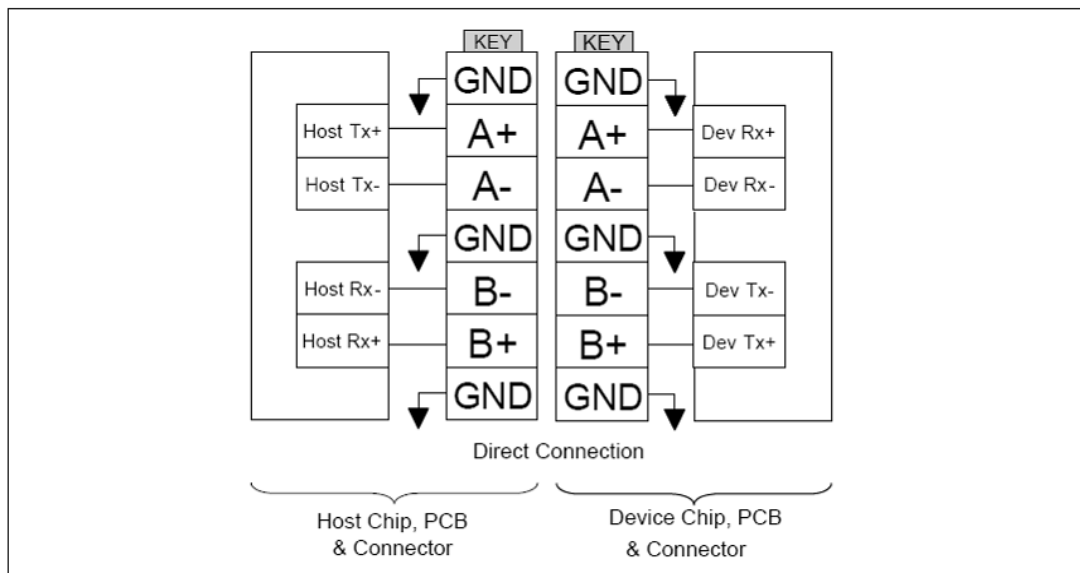


Figure 3-2 Direct Connection between the Host and Device

3.2 OOB Module Connectors

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

Top View

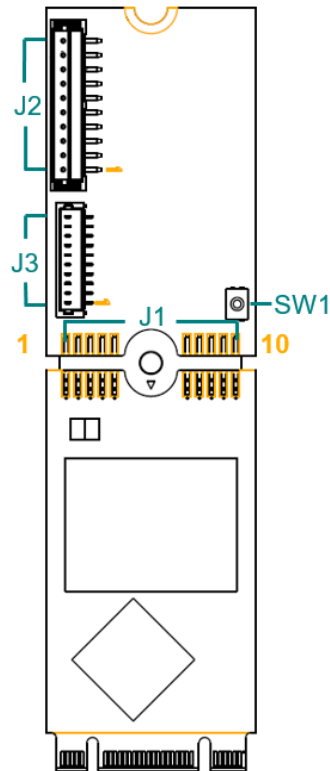


Figure 3-3 Top View: OOB Module Connectors

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

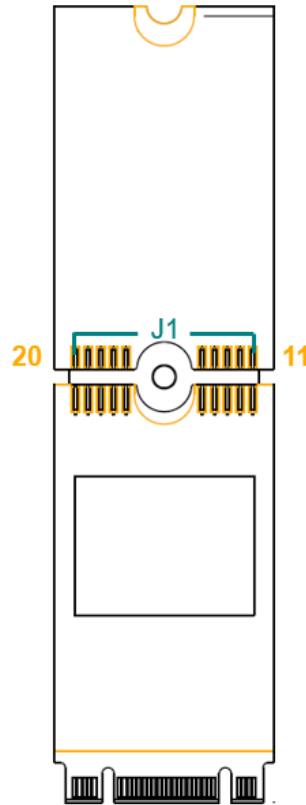


Figure 3-4 Bottom View: OOB Module Connectors

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. 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
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 4-2.

Table 4-2 Performance Specifications

Capacity	60 GB	120 GB	240 GB	480 GB
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 4-3.

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 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 4-4 Endurance Specifications

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 4-5 and 4-6.

Table 4-5 Top View – LED Behavior

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

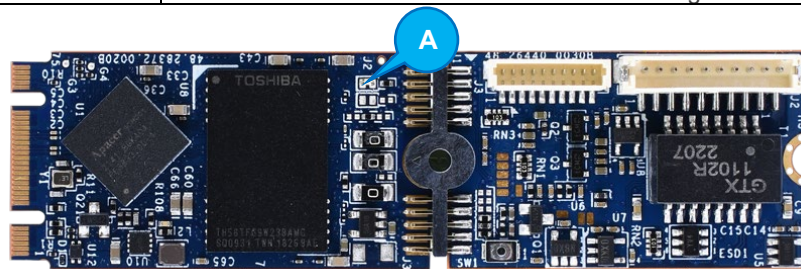
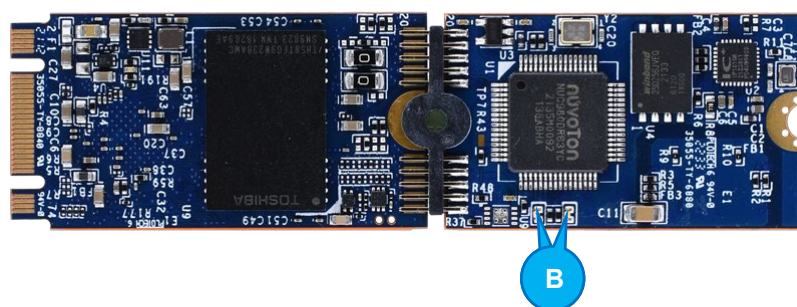


Table 4-6 Bottom View – LED Behavior

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

Apacer CoreSnapshot is a firmware-based technology that offers an instant whole disk backup and recovery mechanism for SSDs to solve 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 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 ± 5% (3.135-3.465V)

9.1.2 Power Consumption

Table 9-2 lists the power consumption for SV25T-M280 with OOB Module.

Table 9-2 Power Consumption (Unit: mA)

Mode \ Capacity	Capacity			
	60 GB	120 GB	240 GB	480 GB
Active (Max.)	375	400	400	400
Idle	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 9-3 describes the specifications of Ethernet for OOB module.

Table 9-3 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 9-4 lists the power specifications for OOB module.

Table 9-4 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
Length	mm	80.00 ± 0.30			
Width		22.00 ± 0.15			
Height (Max.)		7.75			

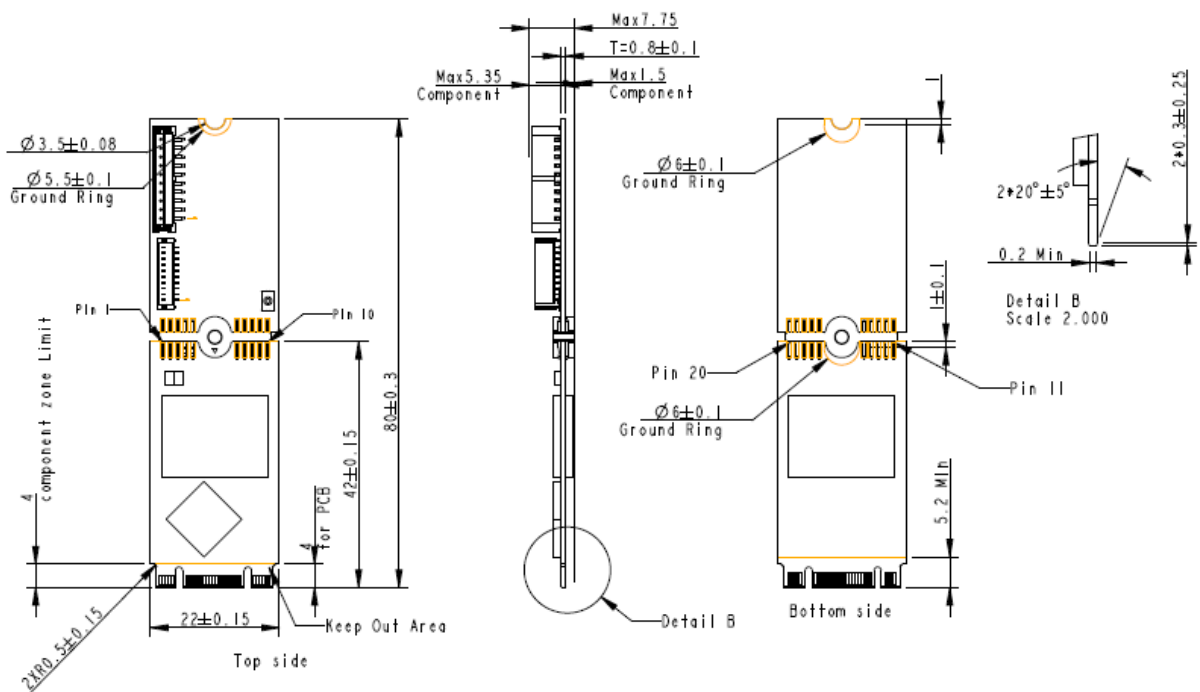


Figure 10-1 Physical Dimensions

10.2 RJ45

Table 10-2 Physical Dimensions

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

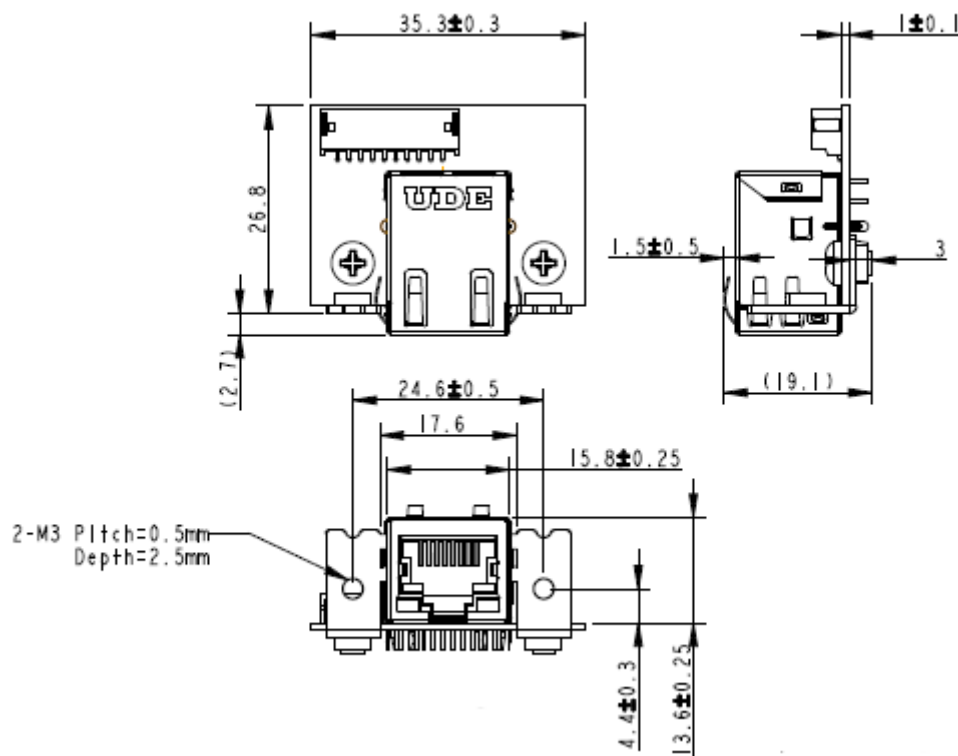


Figure 10-2 Physical Dimensions

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	D	X	X	B	.	0	0	1	0	2

Code 1-3 (Product Line & Form Factor)	SATA M.2 2280
Code 5-6 (Model/Solution)	SV25T
Code 7-8 (Product Capacity)	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)	Thermal sensor with DEVSLP + CoreSnapshot 2 OP for Cloud version

11.2 Valid Combinations

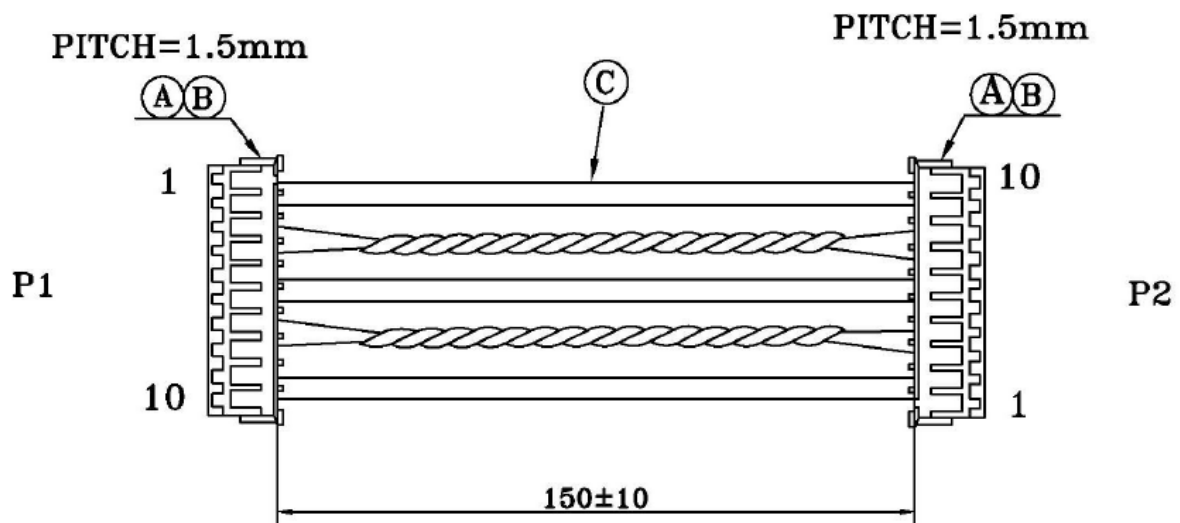
The following table lists the available models of the SV25T-M280 with OOB Module series featuring CoreSnapshot 2 technology which are in mass production or will be in mass production. Consult your Apacer sales representative to confirm availability of valid combinations and to determine availability of new combinations.

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

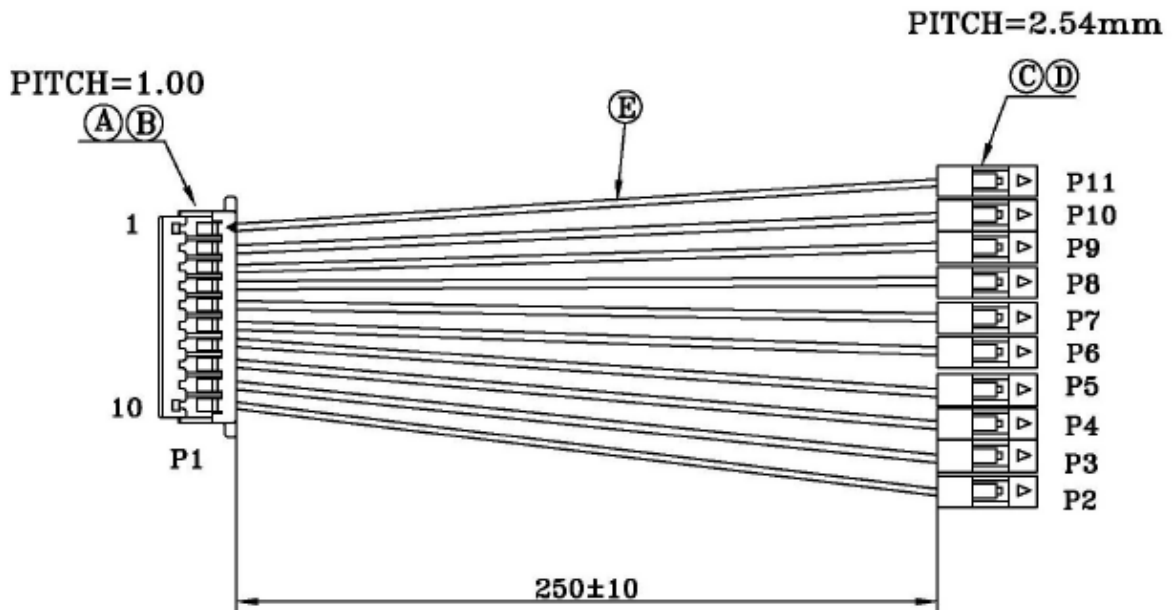


1	Brown		10
2	Blue		9
3	White	Twisted pair cables	8
4	Green		7
5	Black		6
6	Black		5
7	Orange	Twisted pair cables	4
8	White		3
9	Yellow		2
10	Red		1
P1	Color		P2

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

Global Presence

Taiwan (Headquarters)

Apacer Technology Inc.

1F., No.32, Zhongcheng Rd., Tucheng Dist.,
New Taipei City 236, Taiwan R.O.C.
Tel: 886-2-2267-8000
Fax: 886-2-2267-2261
amtsales@apacer.com

U.S.A.

Apacer Memory America, Inc.

46732 Lakeview Blvd., Fremont, CA 94538
Tel: 1-408-518-8699
Fax: 1-510-249-9551
sa@apacerus.com

Japan

Apacer Technology Corp.

6F, Daiyontamachi Bldg., 2-17-12, Shibaura, Minato-Ku,
Tokyo, 108-0023, Japan
Tel: 81-3-5419-2668
Fax: 81-3-5419-0018
jpservices@apacer.com

Europe

Apacer Technology B.V.

Science Park Eindhoven 5051 5692 EB Son,
The Netherlands
Tel: 31-40-267-0000
Fax: 31-40-290-0686
sales@apacer.nl

China

Apacer Electronic (Shanghai) Co., Ltd

Room D, 22/FL, No.2, Lane 600, JieyunPlaza,
Tianshan RD, Shanghai, 200051, China
Tel: 86-21-6228-9939
Fax: 86-21-6228-9936
sales@apacer.com.cn

India

Apacer Technologies Pvt Ltd,

1874, South End C Cross, 9th Block Jayanagar,
Bangalore-560069, India
Tel: 91-80-4152-9061/62
Fax: 91-80-4170-0215
sales_india@apacer.com