RoHS Compliant

SATA Flash Drive

SFD18SH-M Product Specifications

November 25th, 2014

Version 1.4

Features:

- **Serial ATA Revision 3.1 Compliance**
  - SATA 6.0 Gbps interface
  - Backward compatible with SATA 3.0/1.5 Gbps interface
  - ATA Command set

- **Capacities**
  - 16, 32, 64, 128, 256 GB

- **Performance***
  - Interface burst read/write: 600 MB/sec
  - Sustained read: up to 510 MB/sec
  - Sustained write: up to 190 MB/sec

- **Flash endurance design**
  - Built-in hardware ECC
  - Wear-leveling
  - Flash bad block management
  - S.M.A.R.T.
  - Power Failure Management
  - TRIM

- **NAND Flash Type:** MLC

- **Endurance**
  - 16GB : 27 TBW
  - 32GB : 54 TBW
  - 64GB : 108 TBW
  - 128GB : 217 TBW
  - 256GB : 434 TBW

- **Temperature ranges**
  - Operating:
    Standard: 0°C to 70°C
    Extended: -40°C to 85°C
  - Storage: -40°C to 85°C

- **Supply voltage**
  - 5 V $\pm$ 5%

- **Power consumption (typical)***
  - Active mode : 1,960 mW
  - Idle mode : 285 mW

- **Form factor**
  - JEDEC MO-297
  - Dimensions (54.0 x 39.8 x 4.0, unit: mm)

- **Connector**
  - 7-pin SATA male connector
  - 15-pin SATA power connector

- **RoHS compliant**

- **Device Sleep mode (optional)**

*The values presented for Performances and Power Consumption are typical and may vary depending on different configurations and platforms.

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1. Product Description

1.1 Introduction

Apacer SFD18SH-M half-slim MO-297 SSD (Solid State Drive) delivers multiple technological advantages of flash memory storage. With SATA 6.0 Gbps interface, SFD18SH-M offers exceptional data transfer performance. Form factor wise, this model is fully compliant with JEDEC MO-297 standard, which is designed with standard interface consisting of SATA 7-pin signal segment and 15-pin power segment, while in compact size. This module provides low power consumption compared to traditional hard drive and hot-swapping when removing/ replacing/ upgrading flash disks. Its capacity could provide a wide range up to 256GB. Moreover, it can reach up to 510MB/s read as well as 190MB/s write high performance.

1.2 Capacity Specification

Table 1-1 Capacity specification

Capacity	Total Bytes*	Cylinders	Heads	Sectors	Max LBA**
16 GB	16,013,942,784	16,383	16	63	31,277,232
32 GB	32,017,047,552	16,383	16	63	62,533,296
64 GB	64,023,257,088	16,383	16	63	125,045,424
128 GB	128,035,676,160	16,383	16	63	250,069,680
256 GB	256,060,514,304	16,383	16	63	500,118,192

*Display of total bytes varies from file systems.
 **Cylinders, heads or sectors are not applicable for these capacities. Only LBA addressing applies.
 ***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

Table 1-2 Performance specifications

Performance \ Capacity	16 GB	32 GB	64 GB	128 GB	256 GB
Sustained Read (MB/s)	315	480	480	480	510
Sustained Write (MB/s)	150	150	180	180	190

Note:
1. Results may vary depending on host system configurations.
2. Sustained Read/Write: The read/write performances are measured by CrystalDiskMark under Windows 7 operating system.
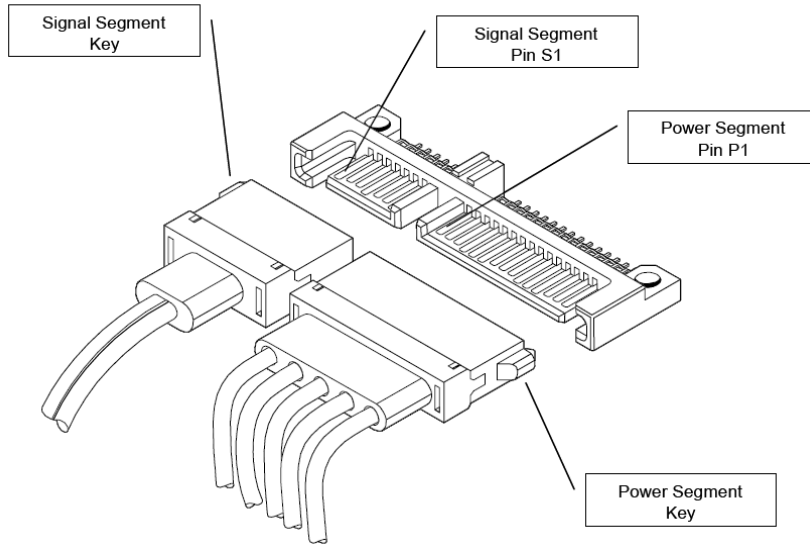
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1.4 Pin Assignments

Table 1-4: 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 1-5: Power segment

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

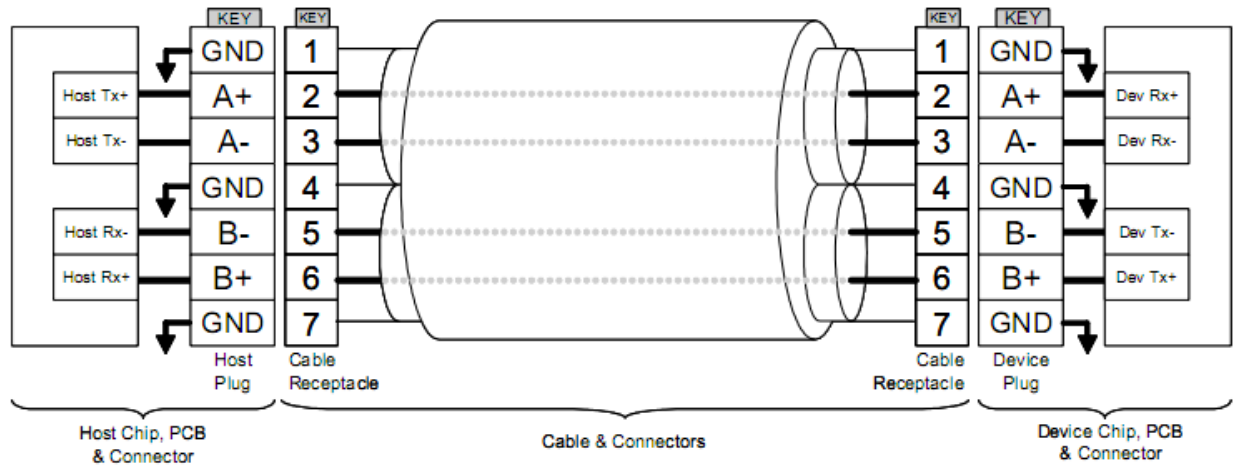P3 can be configured as trigger pin for Device Sleep

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Figure 1-3 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.

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2. Software Interface

2.1 Command Set

Command	Code	Command	Code
NOP	00h	Idle	97h
Data Set Management	06h	Check Power Mode	98h
Recalibrate	10f-1Fh	Sleep	99h
Read Sectors	20h	SMART	B0h
Read Sectors without Retry	21h	Device Configuration	B1h
Read Sectors EXT	24h	Read Multiple	C4h
Read DMA EXT	25h	Write Multiple	C5h
Read Native Max Address EXT	27h	Set Multiple Mode	C6h
Read Multiple EXT	29h	Read DMA	C8h
Read Log EXT	2Fh	Read DMA without Retry	C9h
Write Sectors	30h	Write DMA	CAh
Write Sectors Without Retry	31h	Write DMA without Retry	CBh
Write Sectors EXT	34h	Write Multiple FUA EXT	Ceh
Write DMA EXT	35h	Standby Immediate	E0h
Set Native Max Address EXT	37h	Idle Immediate	E1h
CFA Write Sectors without erase	38h	Standby	E2h
Write Multiple EXT	39h	Idle	E3h
Write DMA FUA EXT	3Dh	Read Buffer	E4h
Write Long EXT	3Fh	Check Power Mode	E5h
Read Verify Sectors	40h	Sleep	E6h
Read Verify Sectors without Retry	41h	Flush Cache	E7h
Read Verify Sectors EXT	42h	Write Buffer	E8h
Write Uncorrectable EXT	45h	Flush Cache EXT	Eah
Read FPDMA Queued	60h	Identify Device	Ech
Write FPDMA Queued	61h	Set Features	Efh
Seek	70h-7Fh	Security Set Password	F1h
Execute Device Diagnostic	90h	Security Unlock	F2h
Initialize Device Parameters	91h	Security Erase Prepare	F3h
Download Microcode	92h	Security Erase Unit	F4h
Download Microcode DMA	93h	Security Freeze Lock	F5h
Standby Immediate	94h	Security Disable Password	F6h
Idle Immediate	95h	Read Native Max Address	F8h
Standby	96h	Set Max Address	F9h

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2.2   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.

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3. Flash Management

3.1   Error Correction/Detection

Flash memory cells will deteriorate with use, which might generate random bit errors in the stored data. Thus, this SSD applies the BCH ECC Algorithm, which can detect and correct errors occur during Read process, ensure data been read correctly, as well as protect data from corruption. This ECC supports up to 72bit/1K data.

3.2   Bad Block Management

Bad blocks are blocks that include one or more invalid bits, and their reliability is not guaranteed. Blocks that are identified and marked as bad by the manufacturer are referred to as "Initial Bad Blocks". Bad blocks that are developed during the lifespan of the flash are named "Later Bad Blocks". Apacer implements an efficient bad block management algorithm to detect the factory-produced bad blocks and manages any bad blocks that appear with use. This practice further prevents data being stored into bad blocks and improves the data reliability.

3.3   Wear Leveling

NAND Flash devices can only undergo a limited number of program/erase cycles, and in most cases, the flash media are not used evenly. If some areas get updated more frequently than others, the lifetime of the device would be reduced significantly. Thus, Wear Leveling technique is applied to extend the lifespan of NAND Flash by evenly distributing write and erase cycles across the media.

Apacer provides advanced Wear Leveling algorithm, which can efficiently spread out the flash usage through the whole flash media area. Moreover, by implementing both dynamic and static Wear Leveling algorithms, the life expectancy of the NAND Flash is greatly improved.

3.4   Power Failure Management

Power Failure Management plays a crucial role when experiencing unstable power supply. Power disruption may occur when users are storing data into the SSD. In this urgent situation, the controller would run multiple flush cycles to store the metadata for later block rebuilding. This urgent operation requires about several milliseconds to get it done. At the next power up, the firmware will perform a status tracking to retrieve the mapping table and resume previously programmed NAND blocks to check if there is any incompleteness of transmission.

3.5   TRIM

TRIM is a feature which helps improve the read/write performance and speed of solid-state drives (SSD). Unlike hard disk drives (HDD), SSDs are not able to overwrite existing data, so the available space gradually becomes smaller with each use. With the TRIM command, the operating system can inform the SSD which blocks of data are no longer in use and can be removed permanently. Thus, the SSD will perform the erase action, which prevents unused data from occupying blocks all the time.

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3.6 Secure Erase

Secure Erase is a standard ATA command and will write all "0xFF" to fully wipe all the data on hard drives and SSDs. When this command is issued, the SSD controller will empty its storage blocks and return to its factory default settings.

Note. Secure erase command belongs to ATA security command.

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4. Reliability Specifications

4.1 Environments

Table 4-1 SFD18SH-M environmental specifications

Environment	Specification
Temperature	0°C to 70°C (Operating) / -40°C to 85°C (Extended)
	-40°C to 85°C (in storage)
Humidity	RH 93% under 40°C
Shock	1500G, 0.5ms
Vibration	20Hz~80Hz/1.52mm (frequency/displacement) 80Hz~2000Hz/20G (frequency/displacement) X, Y, Z axis/60mins each
Drop	80cm free fall, 6 face of each
Bending	≧20N, hold 1min/5times
Torque	0.5N-m or 2.5deg , hold 1min/5times
ESD	Pass

Note: Shock and Vibration specifications are subject to change without notice.

4.2 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 SFD18SH-M is more than 1,000,000 hours.

Notes about the MTBF: The MTBF is predicated and calculated based on "Telcordia Technologies Special Report, SR-332, Issue 2" method.

4.3 Certification and Compliance

- RoHS
- SATA Revision 3.0
- ATA/ATAPI
- FCC
- CE
- BSMI

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4.4 Endurance

The endurance of a storage device is predicted by TeraBytes Written based on several factors related to usage, such as the amount of data written into the drive, block management conditions, and daily workload for the drive. Thus, key factors, such as Write Amplifications and the number of P/E cycles, can influence the lifespan of the drive.

Capacity	TeraBytes Written
16 GB	27
32 GB	54
64 GB	108
128 GB	217
256 GB	434

Notes:
- The measurement assumes the data written to the SSD for test is under a typical and constant rate.
- The measurement follows the standard metric: 1 TB (Terabyte) = 1000 GB.

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5. Electrical Characteristics

5.1 Operating Voltage

Table 5-1 lists the supply voltage for SFD18SH-M.

Table 5-1 SFD18SH-M operating voltage

Parameter	Conditions
Supply voltage	5V ±5%

5.2 Power Consumption

Table 5-2 lists SFD18SH-M power consumption.

Table 5-2 SFD18SH-M power consumption

Capacity / Performance	16 GB	32 GB	64 GB	128 GB	256 GB
Active (mW)	995	1090	1465	1760	1960
Idle (mW)	280	265	275	285	285

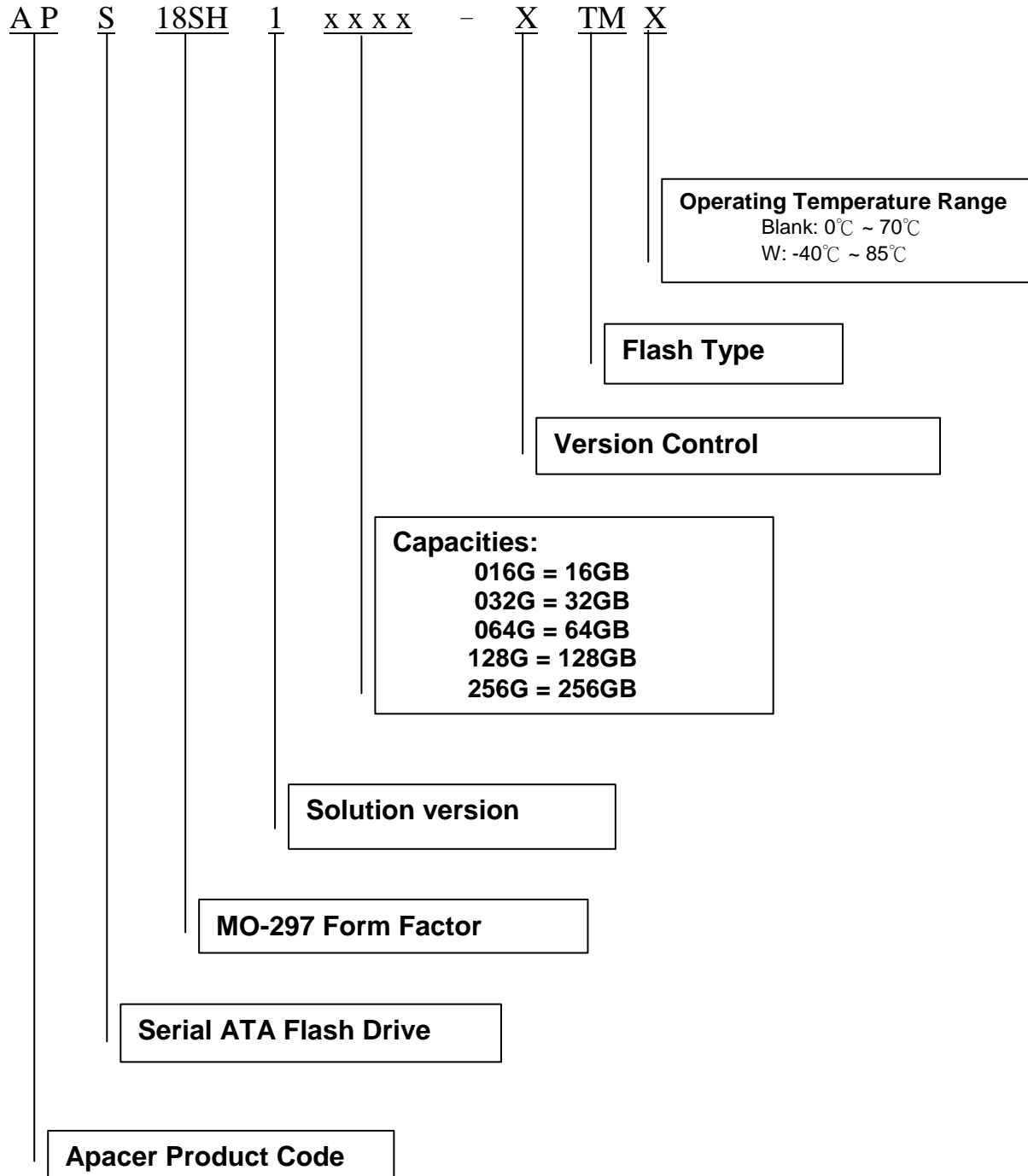Note: power consumption may vary depending on flash configurations or platforms..

6. Mechanical Specifications
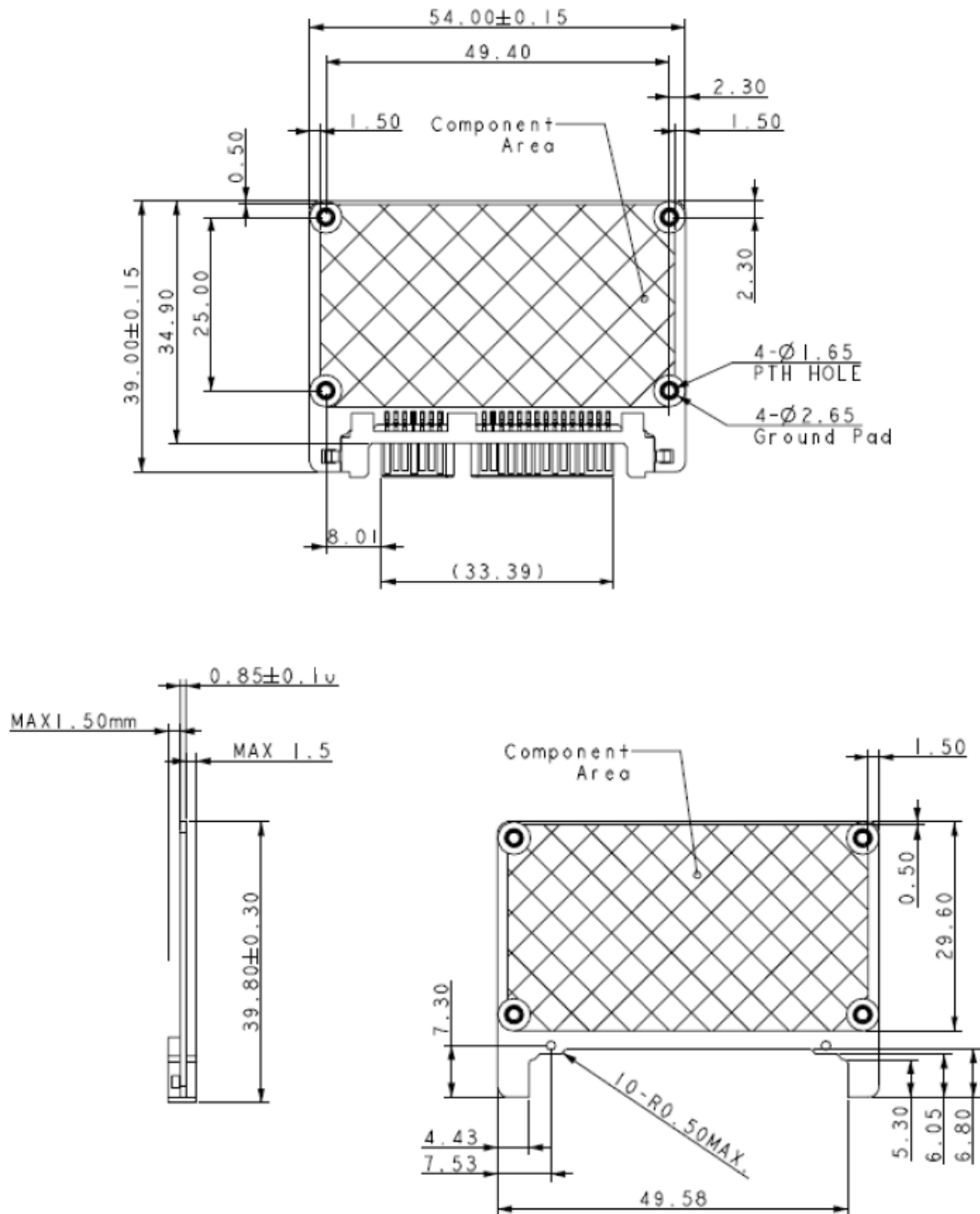
Unit: mm
Tolerance: ±0.2 mm

7. Product Ordering Information

7.1 Product Code Designations

A P　S　18SH　1　x x x x　–　X　TM　X

Operating Temperature Range
Blank: 0℃ ~ 70℃
W: -40℃ ~ 85℃

Flash Type

Version Control

Capacities:
016G = 16GB
032G = 32GB
064G = 64GB
128G = 128GB
256G = 256GB

Solution version

MO-297 Form Factor

Serial ATA Flash Drive

Apacer Product Code

7.2   Valid Combinations

7.2.1 Operating Temperature (0℃ ~ 70℃)

Capacity	No DEVSLP	DEVSLP
16 GB	APS18SH1016G-1TM	APS18SH1016G-2TM
32 GB	APS18SH1032G-1TM	APS18SH1032G-2TM
64 GB	APS18SH1064G-1TM	APS18SH1064G-2TM
128 GB	APS18SH1128G-1TM	APS18SH1128G-2TM
256 GB	APS18SH1256G-1TM	APS18SH1256G-2TM

7.2.2 Operating Temperature (-40℃ ~ 85℃)

Capacity	No DEVSLP	DEVSLP
16 GB	APS18SH1016G-1TMW	APS18SH1016G-2TMW
32 GB	APS18SH1032G-1TMW	APS18SH1032G-2TMW
64 GB	APS18SH1064G-1TMW	APS18SH1064G-2TMW
128 GB	APS18SH1128G-1TMW	APS18SH1128G-2TMW
256 GB	APS18SH1256G-1TMW	APS18SH1256G-2TMW

Note: Please consult with Apacer sales representatives for availabilities.

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Revision History

Revision	Description	Date
1.0	Official release	07/04/2014
1.1	Added 16GB model	10/14/2014
	Added Extended temperature specifications	
1.2	Revised Serial ATA spec support : 3.0 -> 3.1	11/07/2014
1.3	Added endurance information	11/20/2014
1.4	Revise 16GB performance	11/25/2014

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