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***RoHS Compliant***

# **SATA Flash Drive**

***SFD18SH-M Product Specifications***

**November 13, 2015**

***Version 2.0***



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## 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**
  - 8, 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 Management**
  - Built-in hardware ECC
  - Wear-leveling
  - Flash bad block management
  - S.M.A.R.T.
  - Power Failure Management
  - TRIM
- **NAND Flash Type: MLC**
- **Endurance**
  - 8 GB: 7 TBW
  - 16 GB: 14 TBW
  - 32 GB: 28 TBW
  - 64 GB: 57 TBW
  - 128 GB: 114 TBW
  - 256 GB: 228 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 ± 5%
- **Power Consumption (typical)\***
  - Active mode: 392 mA
  - Idle mode: 57 mA
- **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 256 GB. Moreover, it can reach up to 510 MB/s read as well as 190 MB/s write high performance.

## 1.2 Capacity Specifications

**Table 1-1 Capacity Specifications**

| Capacity | Total Bytes*    | Cylinders | Heads | Sectors | Max LBA**   |
|----------|-----------------|-----------|-------|---------|-------------|
| 8 GB     | 8,012,390,400   | 15,525    | 16    | 63      | 15,649,200  |
| 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

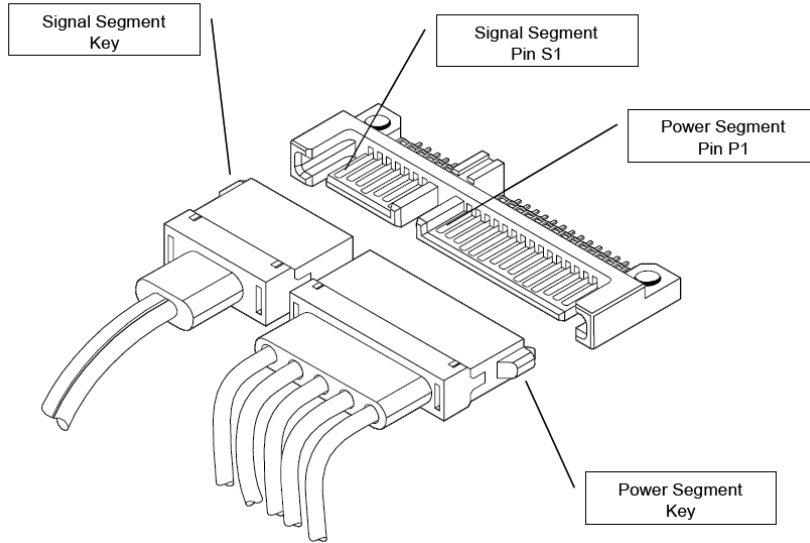
**Table 1-2 Performance Specifications**

| Capacity \ Performance        | 8 GB | 16 GB | 32 GB | 64 GB | 128 GB | 256 GB |
|-------------------------------|------|-------|-------|-------|--------|--------|
| <b>Sustained Read (MB/s)</b>  | 155  | 480   | 480   | 480   | 480    | 510    |
| <b>Sustained Write (MB/s)</b> | 85   | 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.

## 1.4 Pin Assignments



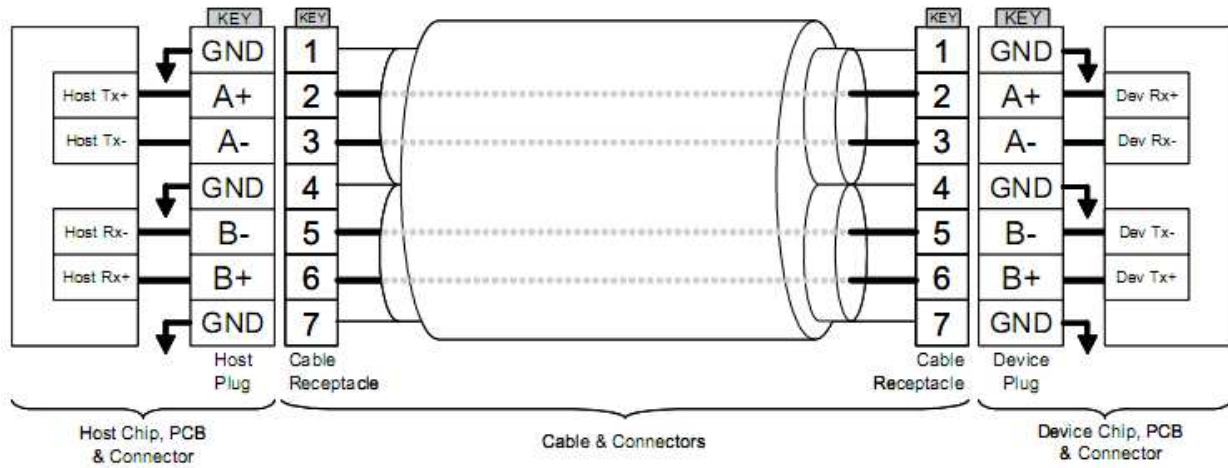
**Table 1-3** Signal Segment

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

**Table 1-4** Power Segment

| Pin | Signal/Description       |
|-----|--------------------------|
| P1  | Not used (3.3V)          |
| P2  | Not used (3.3V)          |
| P3  | 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)           |

Note: P3 can be configured as trigger pin for Device Sleep.



**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.

## 2. Software Interface

### 2.1 Command Set

Table 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           | EC h |
| 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.**

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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

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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

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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

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Table 4-1 Environmental specifications

| Environment |           | Specification   |
|-------------|-----------|---|
| Temperature | Operating | 0°C to 70°C (Standard); -40°C to 85°C (Extended)  |
|             | Storage   | -40°C to 85°C   |
| Shock       |           | 1,500G, 0.5ms   |
| Vibration   |           | 20Hz~80Hz/1.52mm (frequency/displacement)<br>80Hz~2000Hz/20G (frequency/displacement)<br>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)

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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

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- RoHS
- SATA Revision 3.1
- ATA/ATAPI
- FCC
- CE
- BSMI
- MIL-STD-810G

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## 4.4 Endurance

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

| Capacity | Tera Bytes Written |
|----------|--------------------|
| 8 GB     | 7                  |
| 16 GB    | 14                 |
| 32 GB    | 28                 |
| 64 GB    | 57                 |
| 128 GB   | 114                |
| 256 GB   | 228                |

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) = 1,000 GB.
- This estimation complies with JEDEC JESD-219, enterprise endurance workload of random data with payload size distribution.

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## 5. Electrical Characteristics

### 5.1 Operating Voltage

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

**Table 5-1** Operating Voltage

| Parameter      | Conditions  |
|----------------|-------------|
| Supply voltage | 5V $\pm$ 5% |

### 5.2 Power Consumption

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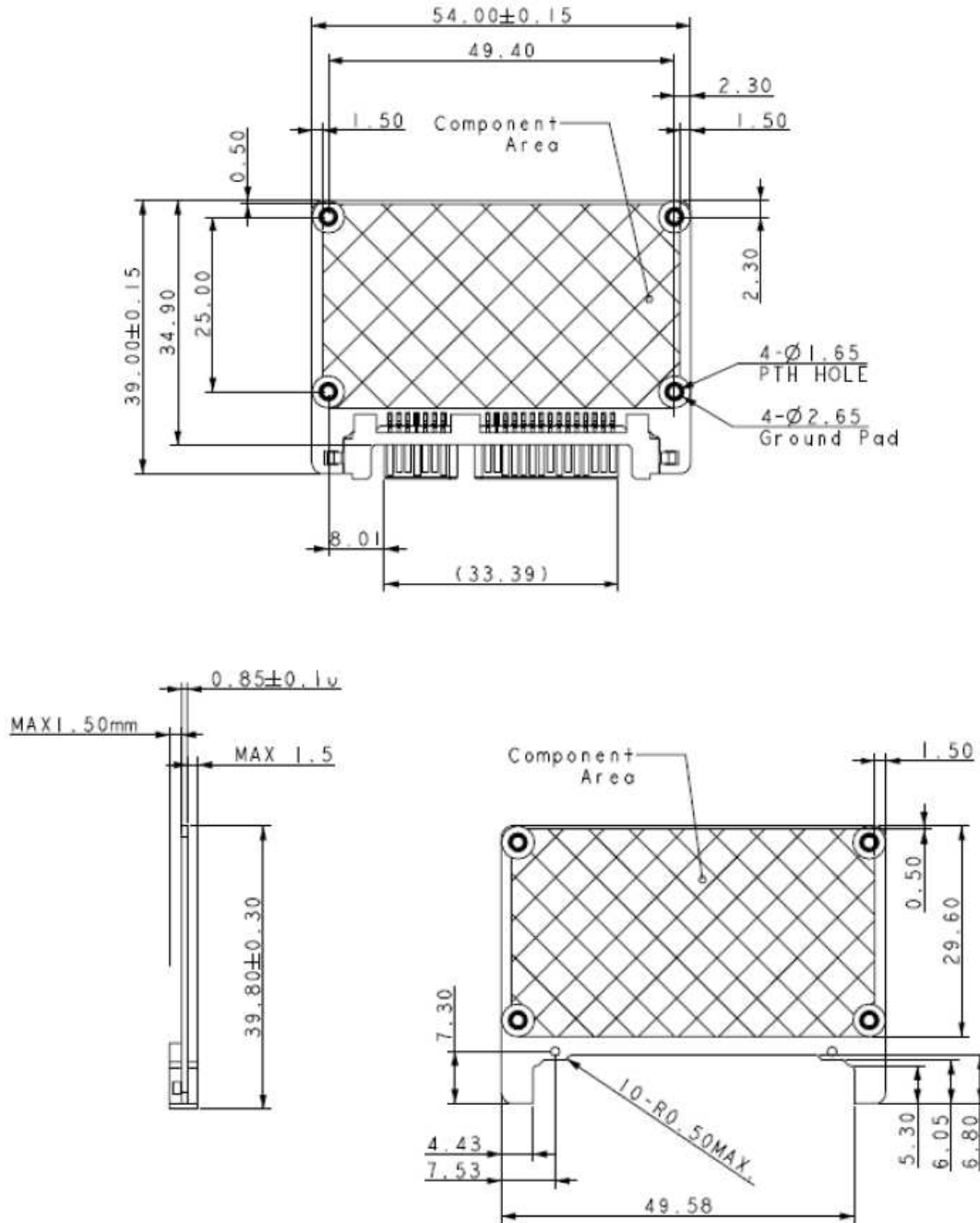
Table 5-2 lists SFD18SH-M power consumption.

**Table 5-2** Power Consumption (typical)

| <b>Capacity</b><br><b>Performance</b> | <b>8 GB</b> | <b>16 GB</b> | <b>32 GB</b> | <b>64 GB</b> | <b>128 GB</b> | <b>256 GB</b> |
|---------------------------------------|-------------|--------------|--------------|--------------|---------------|---------------|
| <b>Active (mA)</b>                    | 38          | 199          | 218          | 293          | 352           | 392           |
| <b>Idle (mA)</b>                      | 17          | 56           | 53           | 55           | 57            | 57            |

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

## 6. Mechanical Specifications

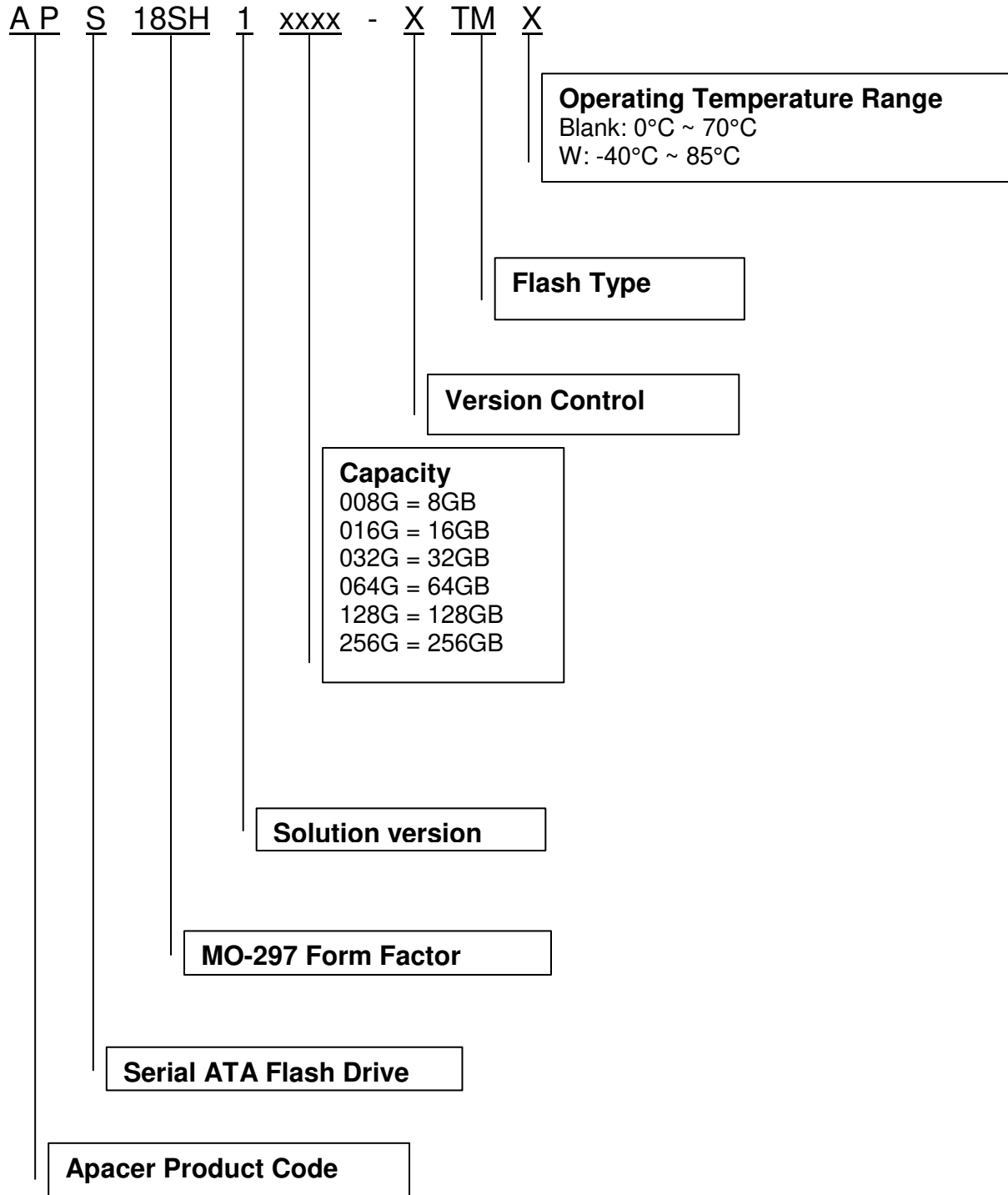


Unit: mm

Tolerance:  $\pm 0.2$  mm

## 7. Product Ordering Information

### 7.1 Product Code Designation





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## 7.2 Valid Combination

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### 7.2.1 Operating Temperature (0°C ~ 70°C)

| Capacity | no DEVSLP        | DEVSLP           |
|----------|------------------|------------------|
| 8GB      | APS18SH1008G-GTM | APS18SH1008G-HTM |
| 16GB     | APS18SH1016G-GTM | APS18SH1016G-HTM |
| 32GB     | APS18SH1032G-GTM | APS18SH1032G-HTM |
| 64GB     | APS18SH1064G-GTM | APS18SH1064G-HTM |
| 128GB    | APS18SH1128G-GTM | APS18SH1128G-HTM |
| 256GB    | APS18SH1256G-GTM | APS18SH1256G-HTM |

### 7.2.2 Extended Temperature (-40°C ~ 85°C)

| Capacity | no DEVSLP         | DEVSLP            |
|----------|-------------------|-------------------|
| 8GB      | APS18SH1008G-GTMW | APS18SH1008G-HTMW |
| 16GB     | APS18SH1016G-GTMW | APS18SH1016G-HTMW |
| 32GB     | APS18SH1032G-GTMW | APS18SH1032G-HTMW |
| 64GB     | APS18SH1064G-GTMW | APS18SH1064G-HTMW |
| 128GB    | APS18SH1128G-GTMW | APS18SH1128G-HTMW |
| 256GB    | APS18SH1256G-GTMW | APS18SH1256G-HTMW |

**Note:** Valid combinations are those products in mass production or will be in mass production. Consult your Apacer sales representative to confirm availability of valid combinations and to determine availability of new combinations.

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## Revision History

| Revision | Description   | Date       |
|----------|---|------------|
| 1.0      | Official release  | 07/04/2014 |
| 1.1      | Added 16GB model<br>Added Extended temperature specifications   | 10/14/2014 |
| 1.2      | Revised Serial ATA spec support : 3.0 -> 3.1  | 11/07/2014 |
| 1.3      | Added endurance information   | 11/20/2014 |
| 1.4      | Revised 16GB performance  | 11/25/2014 |
| 1.5      | Added 8 GB model  | 02/06/2014 |
| 1.6      | MIL-STD-810G approved, added in section 4.3 "Certification and Compliance" list                               | 03/18/2015 |
| 1.7      | - Revised product ordering information due to FW change<br>- Revised endurance value due to estimation change | 06/29/2015 |
| 1.8      | Revised performance value and product ordering information for 15nm MLC models.                               | 10/2/2015  |
| 1.9      | Revised performance value and product ordering information due to FW change                                   | 10/16/2015 |
| 2.0      | Added extended temperature and valid combinations for extended temperature                                    | 11/13/2015 |

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