

***RoHS Compliant***

# **Serial ATA Flash Drive**

***mSATA H1-M Product Specifications (Toshiba 15nm)***

**October 27, 2015**

**Version 1.0**



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## Features:

- **Compliance with SATA Revision 3.1**
  - SATA 6.0 Gbps interface
  - Backward compatible with SATA 1.5/3.0 Gbps interfaces
  - ATA command set
- **Capacities**
  - 8, 16, 32, 64, 128, 256 GB
- **Performance\***
  - Interface burst read/write: 600 MB/sec
  - Sustained read: up to 430 MB/sec
  - Sustained write: up to 170 MB/sec
- **Flash Management**
  - Built-in hardware ECC
  - Wear leveling
  - 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**
  - 3.3 V  $\pm$  5%
- **Power Consumption (typical)\***
  - Active mode: 475 mA
  - Idle mode: 105 mA
- **Form Factor**
  - JEDEC MO-300
  - Dimensions (50.80 x 29.85 x 1.00, unit: mm)
- **Connector**
  - 52-pin mSATA signal connector
- **RoHS Compliant**
- **Device Sleep (optional)**

\*Varies from capacities. The values addressed here are typical and may vary depending on host system settings.

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# 1. Product Description

## 1.1 Introduction

Apacer mSATA H1-M delivers all the advantages of flash disk technology with the Serial ATA 6.0 Gbps interface and is fully compliant with the standard mSATA form factor, known as JEDEC MO-300 standard. The module is designed to operate at optimal efficiency and reliability. Its performance can reach up to 520 MB/s read and up to 185MB/s write. Meanwhile, the power consumption of the mSATA module is much lower than traditional hard drives.

## 1.2 Capacity Specification

**Table 1-1** Capacity specification

| 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.

LBA count addressed in the table above indicates total user storage capacity and will remain the same throughout the lifespan of the device. However, the total usable capacity of the SSD is most likely to be less than the total physical capacity because a small portion of the capacity is reserved for device maintenance usages.

## 1.3 Performance

Performance of mSATA H1-M is shown in Table 1-2.

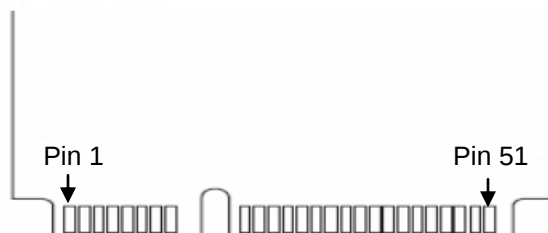
**Table 1-2** Performance specification

| Capacity<br>Performance       | 8 GB | 16 GB | 32 GB | 64 GB | 128 GB | 256 GB |
|-------------------------------|------|-------|-------|-------|--------|--------|
| <b>Sustained Read (MB/s)</b>  | 120  | 215   | 405   | 415   | 410    | 430    |
| <b>Sustained Write (MB/s)</b> | 85   | 150   | 170   | 155   | 160    | 160    |

Note: Performance varies from flash configurations or host system settings.

## 1.4 Pin Assignments

Pin assignment of the mSATA H1-M is shown in Figure 1-2 and described in Table 1-3.



**Figure 1-2** Apacer mSATA H1-M pin assignment

**Table 1-3** Pin Assignment Description

| Pin # | mSATA Pin | Description                            | Pin # | mSATA Pin | Description                               |
|-------|-----------|----------------------------------------|-------|-----------|-------------------------------------------|
| 1     | NC        | No Connect                             | 27    | SATA GND  | SATA Ground Return Pin                    |
| 2     | +3.3V     | 3.3V Source                            | 28    | NC        | No Connect                                |
| 3     | NC        | No Connect                             | 29    | SATA GND  | SATA Ground Return Pin                    |
| 4     | DGND      | Digital GND                            | 30    | NC        | No Connect                                |
| 5     | NC        | No Connect                             | 31    | -A        | Host Transmitter Differential Signal Pair |
| 6     | NC        | No Connect                             | 32    | NC        | No Connect                                |
| 7     | NC        | No Connect                             | 33    | +A        | Host Transmitter Differential Signal Pair |
| 8     | NC        | No Connect                             | 34    | DGND      | Digital GND                               |
| 9     | DGND      | Digital GND                            | 35    | SATA GND  | SATA Ground Return Pin                    |
| 10    | NC        | No Connect                             | 36    | NC        | No Connect                                |
| 11    | NC        | No Connect                             | 37    | SATA GND  | SATA Ground Return Pin                    |
| 12    | NC        | No Connect                             | 38    | NC        | No Connect                                |
| 13    | NC        | No Connect                             | 39    | +3.3V     | 3.3V Source                               |
| 14    | NC        | No Connect                             | 40    | DGND      | Digital GND                               |
| 15    | DGND      | Digital GND                            | 41    | +3.3V     | 3.3V Source                               |
| 16    | NC        | No Connect                             | 42    | NC        | No Connect                                |
| 17    | NC        | No Connect                             | 43    | NC        | No Connect                                |
| 18    | DGND      | Digital GND                            | 44    | NC        | No Connect                                |
| 19    | NC        | No Connect                             | 45    | Vendor    | Vendor specific                           |
| 20    | NC        | No Connect                             | 46    | NC        | No Connect                                |
| 21    | SATA GND  | SATA Ground Return Pin                 | 47    | Vendor    | Vendor specific                           |
| 22    | NC        | No Connect                             | 48    | NC        | No Connect                                |
| 23    | +B        | Host Receiver Differential Signal Pair | 49    | DA/DSS    | Device activity signal                    |
| 24    | +3.3V     | 3.3V Source                            | 50    | DGND      | Digital GND                               |
| 25    | -B        | Host Receiver Differential Signal Pair | 51    | GND       | Default connect to GND                    |
| 26    | SATA GND  | SATA Ground Return Pin                 | 52    | +3.3V     | 3.3V Source                               |

## 2. Software Interface

### 2.1 Command Set

Table 2-1 summarizes the ATA commands supported by mSATA H1-M.

**Table 2-1:** Command set

| Code | Command                           | Code | Command                     |
|------|-----------------------------------|------|-----------------------------|
| E5h  | Check power mode                  | F6h  | Security Disable Password   |
| 06h  | Data Set management               | F3h  | Security Erase Prepare      |
| B1H  | DCO                               | F4h  | Security Erase Unit         |
| 92h  | Download Microcode PIO            | F5h  | Security Freeze Lock        |
| 93h  | Download Microcode DMA            | F1h  | Security Set Password       |
| 90h  | Execute drive diagnostic          | F2h  | Security Unlock             |
| E7h  | Flush cache                       | 70h  | Seek                        |
| EAh  | Flush cache Ext                   | EFh  | Set features                |
| ECh  | Identify device                   | F9h  | Set Max Address             |
| E3h  | Idle                              | 37h  | Set Max Address Ext         |
| E1h  | Idle immediate                    | C6h  | Set multiple mode           |
| 91h  | Initialize drive parameters       | E6h  | Sleep                       |
| E4h  | Read buffer                       | B0h  | Smart                       |
| C9h  | Read DMA (w/o retry)              | E2h  | Standby                     |
| C8h  | Read DMA (w/retry)                | E0h  | Standby immediate           |
| 25h  | Read DMA Ext                      | E8h  | Write buffer                |
| 60h  | Read FPDMA QUEUED                 | CBh  | Write DMA (w/o retry)       |
| 2Fh  | Read Log Ext                      | CAh  | Write DMA (w/retry)         |
| C4h  | Read multiple                     | 35h  | Write DMA Ext               |
| 29h  | Read multiple Ext                 | 3Dh  | Write DMA FUA Ext           |
| F8h  | Read native max address           | 61h  | Write FPDMA QUEUED          |
| 27h  | Read native max Ext               | 3Fh  | Write Log Ext               |
| 21h  | Read sector(s) (w/o retry)        | C5h  | Write multiple              |
| 20h  | Read sector(s) (w/retry)          | 39h  | Write multiple Ext          |
| 24h  | Read sector(s) Ext                | CEh  | Write multiple FUA Ext      |
| 42h  | Read Verify Ext                   | 31h  | Write sector(s) (w/o retry) |
| 41h  | Read verify sector(s) (w/o retry) | 30h  | Write sector(s) (w/retry)   |
| 40h  | Read verify sector(s) (w/retry)   | 34h  | Write sector(s) Ext         |
| 10h  | Recalibrate                       | 45h  | Write uncorrectable         |

Note. Security command will only be workable when device runs in non-OPAL compliant mode.

### 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 mSATA SSD module 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 device can correct 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.

### 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.

## 4. Environment Specifications

### 4.1 Environmental

Table 4-1 mSATA H1-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 90% under 40°C                         |
| Shock       | 1,500G, 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 5deg, hold 5min/5times          |
| ESD         | Pass                                      |

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

### 4.2 Mean Time Between Failures (MTBF)

MTBF, an acronym for Mean Time Between Failures, is a measure of a device's reliability. Its value represents the average time between a repair and the next failure. The measure is typically in units of hours. The higher the MTBF value, the higher the reliability of the device. The predicted result of this mSATA device is higher than 1,000,000 hours.

### 4.3 Certification and Compliance

mSATA H1-M complies with the following standards:

- SATA Revision 3.1
- RoHS
- 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) = 1000 GB.
- This estimation complies with JEDEC JESD-219, enterprise endurance workload of random data with payload size distribution.

## 5. Electrical Characteristics

### 5.1 Operating Voltage

Table 5-1 lists the supply voltage for mSATA H1-M.

**Table 5-1** mSATA H1-M operating voltage

| Parameter      | Conditions    |
|----------------|---------------|
| Supply Voltage | 3.3V $\pm$ 5% |

### 5.2 Power Consumption

Table 5-2 lists the power consumption for mSATA H1-M.

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

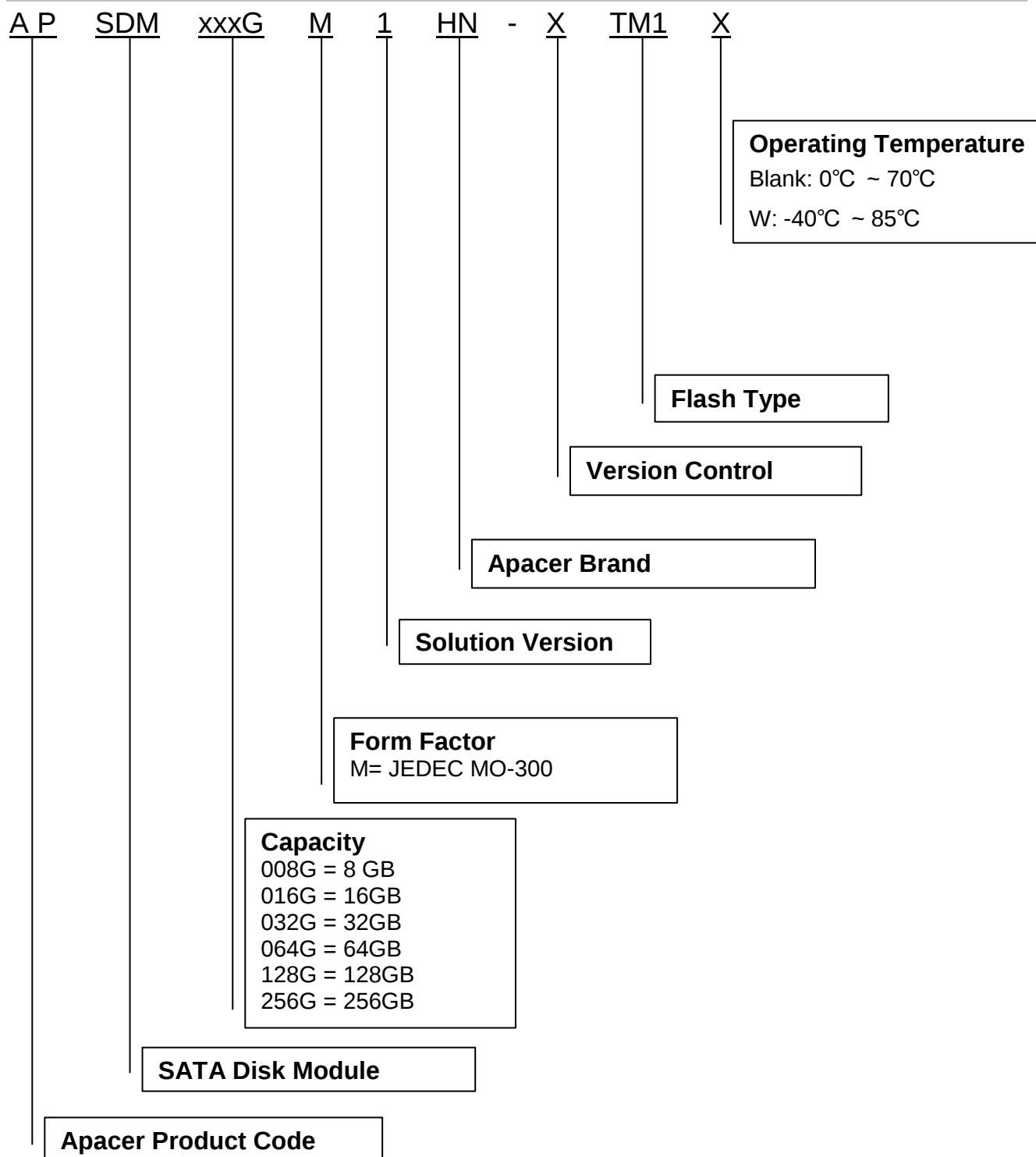
| Mode \ Capacity | 8 GB | 16 GB | 32 GB | 64 GB | 128 GB | 256 GB |
|-----------------|------|-------|-------|-------|--------|--------|
| Active (mA)     | 265  | 325   | 425   | 370   | 475    | 475    |
| Idle (mA)       | 100  | 100   | 100   | 105   | 105    | 100    |

Note: Power consumptions may vary depending on host system settings.



## 7. Product Ordering Information

### 7.1 Product Code Designation



## 7.2 Valid Combination

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

| Capacity | No DEVSLP          | DEVSLP             |
|----------|--------------------|--------------------|
| 8GB      | APSDM008GM1HN-GTM1 | APSDM008GM1HN-HTM1 |
| 16GB     | APSDM016GM1HN-GTM1 | APSDM016GM1HN-HTM1 |
| 32GB     | APSDM032GM1HN-GTM1 | APSDM032GM1HN-HTM1 |
| 64GB     | APSDM064GM1HN-GTM1 | APSDM064GM1HN-HTM1 |
| 128GB    | APSDM128GM1HN-GTM1 | APSDM128GM1HN-HTM1 |
| 256GB    | APSDM256GM1HN-GTM1 | APSDM256GM1HN-HTM1 |

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

| Capacity | No DEVSLP           | DEVSLP              |
|----------|---------------------|---------------------|
| 8GB      | APSDM008GM1HN-GTM1W | APSDM008GM1HN-HTM1W |
| 16GB     | APSDM016GM1HN-GTM1W | APSDM016GM1HN-HTM1W |
| 32GB     | APSDM032GM1HN-GTM1W | APSDM032GM1HN-HTM1W |
| 64GB     | APSDM064GM1HN-GTM1W | APSDM064GM1HN-HTM1W |
| 128GB    | APSDM128GM1HN-GTM1W | APSDM128GM1HN-HTM1W |
| 256GB    | APSDM256GM1HN-GTM1W | APSDM256GM1HN-HTM1W |

**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 | 10/27/2015 |

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