

**RoHS Recast Compliant**

## **Serial ATA Flash Drive**

mSATA H1-M Product Specifications (Toshiba 15nm)

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**Version 1.5**



**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](http://www.apacer.com)

## 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
- **Capacity**
  - 8, 16, 32, 64, 128, 256 GB
- **Performance\***
  - Interface burst read/write: 600 MB/sec
  - Sequential read: up to 430 MB/sec
  - Sequential write: up to 170 MB/sec
- **Flash Management**
  - Built-in hardware ECC
  - Global 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 Range**
  - Operating:
    - Standard: 0°C to 70°C
    - Extended: -40°C to 85°C
  - Storage: -40°C to 100°C
- **Supply Voltage**
  - 3.3 V  $\pm$  5%
- **Power Consumption\***
  - Active mode: 475 mA
  - Idle mode: 105 mA
- **Form Factor**
  - JEDEC MO-300
  - Dimensions (50.80 x 29.85 x 4.85, unit: mm)
- **Connector**
  - 52-pin mSATA signal connector
- **RoHS Compliant**
- **Device Sleep (optional)**
- **Firmware Version: 928A**

\*Varies from capacities. The values for performances and power consumptions presented are typical and may vary depending on flash configurations or platform settings.

## Table of Contents

<b>1. Product Specifications.....</b>	<b>2</b>
1.1 Introduction.....	2
1.2 Capacity.....	2
1.3 Performance.....	2
1.4 Pin Assignments.....	3
<b>2. Software Interface.....</b>	<b>5</b>
2.1 Command Set.....	5
2.2 S.M.A.R.T.....	5
<b>3. Flash Management.....</b>	<b>6</b>
3.1 Error Correction/Detection.....	6
3.2 Bad Block Management.....	6
3.3 Global Wear Leveling.....	6
3.4 Power Failure Management.....	6
<b>4. Environment Specifications.....</b>	<b>8</b>
4.1 Environmental.....	8
4.2 Mean Time Between Failures (MTBF).....	8
4.3 Certification and Compliance.....	8
4.4 Endurance.....	9
<b>5. Electrical Specifications.....</b>	<b>10</b>
5.1 Operating Voltage.....	10
5.2 Power Consumption.....	10
<b>6. Physical Characteristics.....</b>	<b>11</b>
6.1 Dimensions.....	11
<b>7. Product Ordering Information.....</b>	<b>12</b>
7.1 Product Code Designations.....	12
7.2 Valid Combinations.....	13

# 1. Product Specifications

## 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 430 MB/s read and up to 170 MB/s write. Meanwhile, the power consumption of the mSATA module is much lower than traditional hard drives.

## 1.2 Capacity

Capacity specifications of mSATA H1-M are available as shown in Table 1-1. It lists the specific capacity and the default numbers of heads, sectors and cylinders for each product line.

**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, which means not all of the bytes can be used for storage.

\*\*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

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

**Table 1-2** Performance Specifications

Performance	Capacity	8 GB	16 GB	32 GB	64 GB	128 GB	256 GB
Sequential Read* (MB/s)		120	215	405	415	410	430
Sequential Write* (MB/s)		85	150	170	155	160	160

Note:

Results may differ from various flash configurations or host system setting.

\*Sequential performance is based on CrystalDiskMark 5.2.1 with file size 1,000MB.

## 1.4 Pin Assignments

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

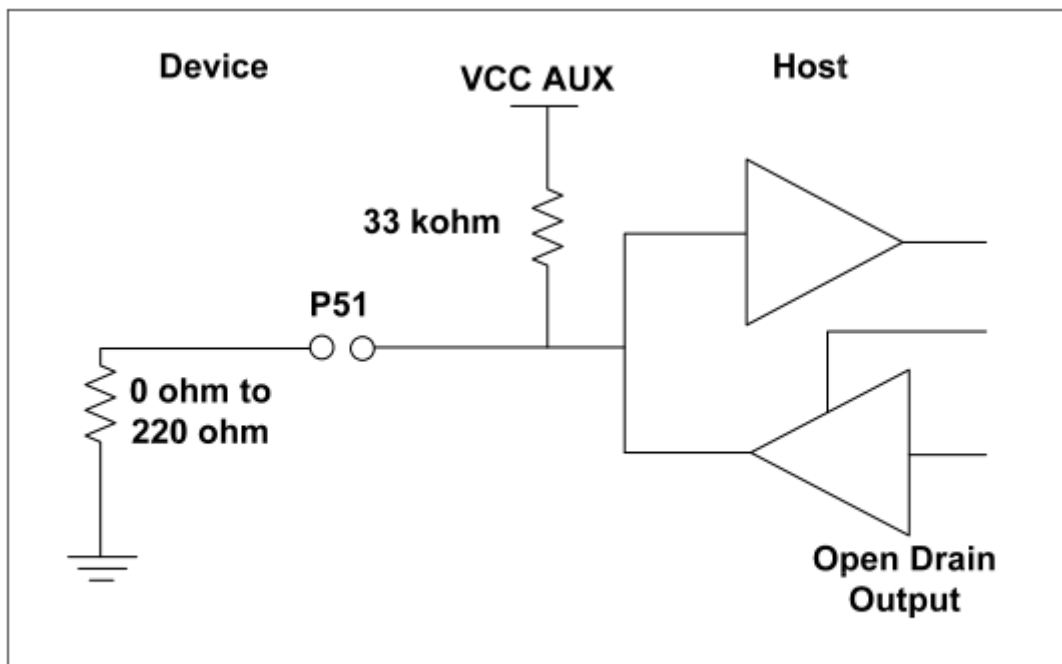


**Figure 1-1** Pin Assignment

**Table 1-3** Pin Assignment Description

Pin	Type	Description	Pin	Type	Description
1	Reserved	No Connect	27	GND	Ground
2	+3.3V	3.3V source	28	Reserved	No Connect
3	Reserved	No Connect	29	GND	Ground
4	GND	Ground	30	Reserved	No Connect
5	Reserved	No Connect	31	-A	Host Transmitter Differential Signal Pair
6	Reserved	No Connect	32	Reserved	No Connect
7	Reserved	No Connect	33	+A	Host Transmitter Differential Signal Pair
8	Reserved	No Connect	34	GND	Ground
9	GND	Ground	35	GND	Ground
10	Reserved	No Connect	36	Reserved	No Connect
11	Reserved	No Connect	37	GND	Ground
12	Reserved	No Connect	38	Reserved	No Connect
13	Reserved	No Connect	39	+3.3V	3.3V source
14	Reserved	No Connect	40	GND	Ground
15	GND	Ground	41	+3.3V	3.3V source
16	Reserved	No Connect	42	Reserved	No Connect
17	Reserved	No Connect	43	Device Type	No Connect
18	GND	Ground	44	DEVS LP	Device Sleep, input. If driven high the host will inform the SSD to enter a low power state.
19	Reserved	No Connect	45	Reserved	No Connect
20	Reserved	No Connect	46	Reserved	No Connect
21	GND	Ground	47	Reserved	No Connect
22	Reserved	No Connect	48	Reserved	No Connect
23	+B	Host Receiver Differential Signal Pair	49	DAS/DSS	Device Activity Signal/Disable Staggered Spin-up
24	+3.3V	3.3V Source	50	GND	Ground
25	-B	Host Receiver Differential Signal Pair	51*	Detect	0 ohm
26	GND	Ground	52	+3.3V	3.3V source

\*Note about Pin51: It is a presence detection pin that shall be connected to GND by a 0 ohm to 220 ohm Resistor on device. Please see the diagram below.



**BI-directional host-side Implementation of P51 for compatibility with non-mSATA devices (Informative)**

## 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.

## 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 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.

### 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** Environmental Specifications

Environment	Specifications
Temperature	0°C to 70°C (Operating)
	-40°C to 85°C (Extended)
	-40°C to 85°C (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

## 4.4 Endurance

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

Note:

- 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.

## 5. Electrical Specifications

### 5.1 Operating Voltage

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

**Table 5-1** Operating Range

Item	Range
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

Capacity Mode	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

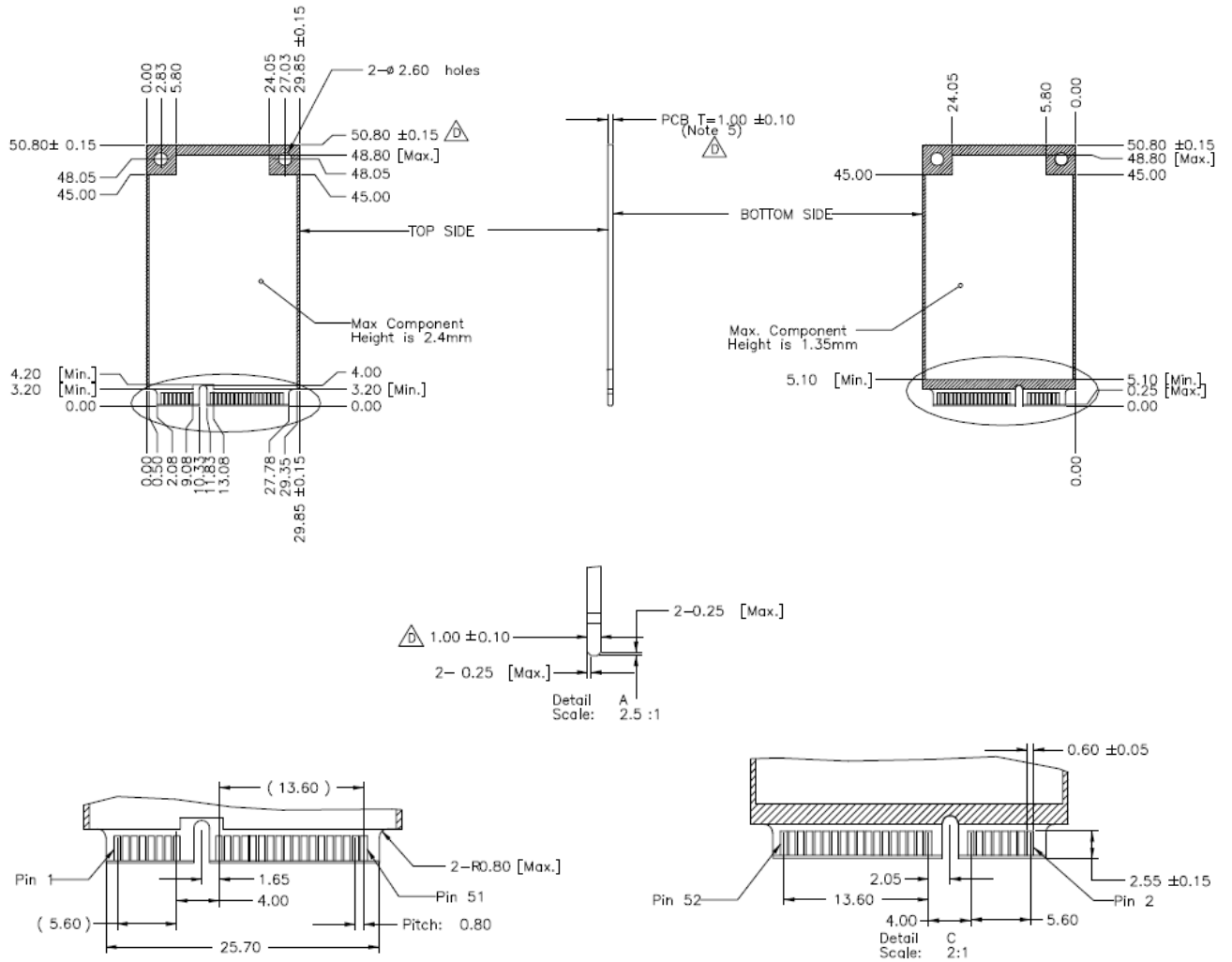
Note:

\*All values are typical and may vary depending on flash configurations or host system settings.

\*\*Active power is an average power measurement performed using CrystalDiskMark with 128KB sequential read/write transfers.

## 6. Physical Characteristics

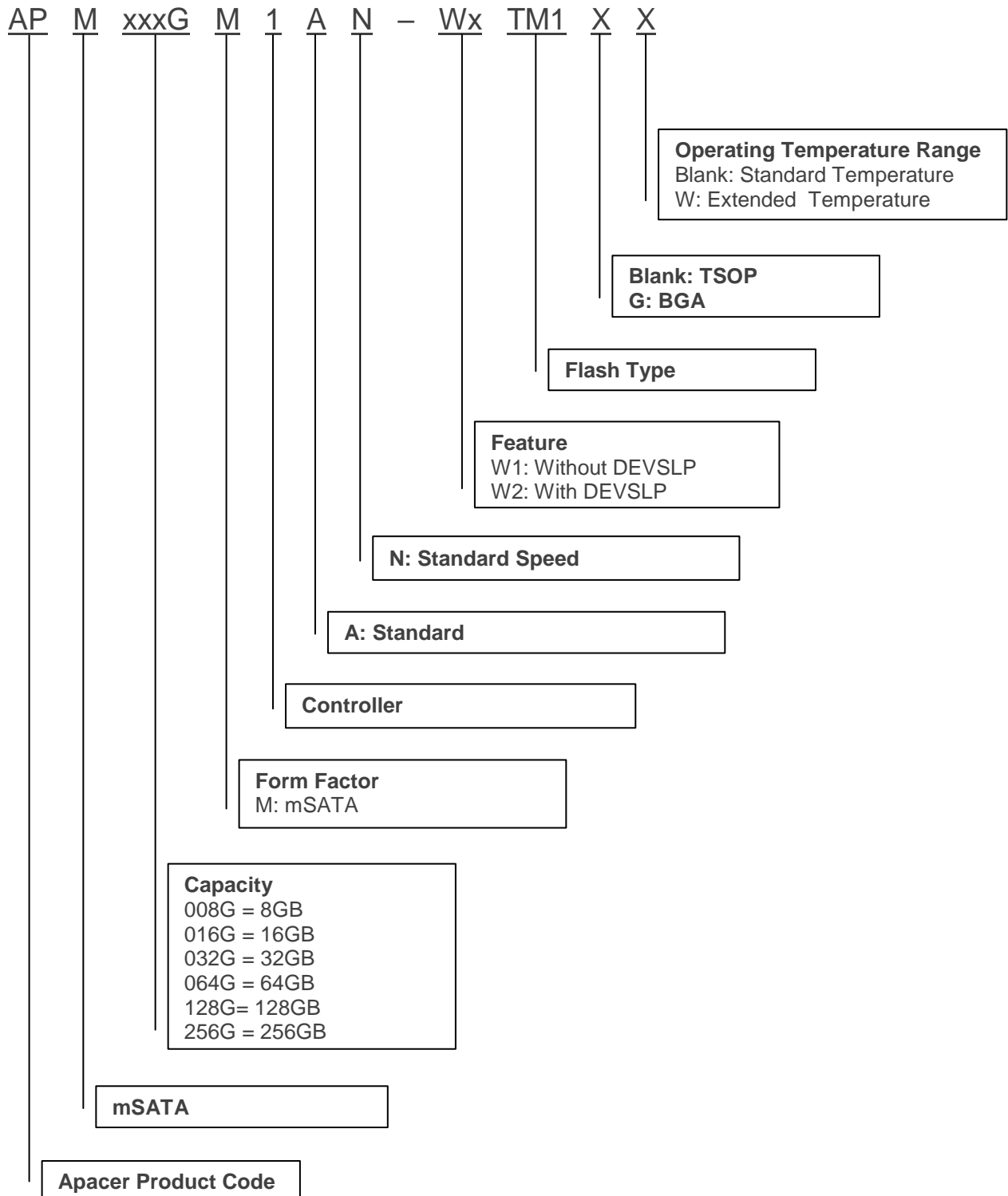
### 6.1 Dimensions



Unit: mm  
Tolerance:  $\pm 0.2$

## 7. Product Ordering Information

### 7.1 Product Code Designations



## 7.2 Valid Combinations

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

Capacity	No DEVSLP	DEVSLP
8GB	APM008GM1AN-W1TM1	APM008GM1AN-W2TM1
16GB	APM016GM1AN-W1TM1	APM016GM1AN-W2TM1
32GB	APM032GM1AN-W1TM1	APM032GM1AN-W2TM1
64GB	APM064GM1AN-W1TM1	APM064GM1AN-W2TM1
128GB	APM128GM1AN-W1TM1G	APM128GM1AN-W2TM1G
256GB	APM256GM1AN-W1TM1G	APM256GM1AN-W2TM1G

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

Capacity	No DEVSLP	DEVSLP
8GB	APM008GM1AN-W1TM1W	APM008GM1AN-W2TM1W
16GB	APM016GM1AN-W1TM1W	APM016GM1AN-W2TM1W
32GB	APM032GM1AN-W1TM1W	APM032GM1AN-W2TM1W
64GB	APM064GM1AN-W1TM1W	APM064GM1AN-W2TM1W
128GB	APM128GM1AN-W1TM1GW	APM128GM1AN-W2TM1GW
256GB	APM256GM1AN-W1TM1GW	APM256GM1AN-W2TM1GW

**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.

## Revision History

Revision	Description	Date
1.0	Official release	10/27/2015
1.1	Revised the height shown on Features page	6/16/2016
1.2	Revised pin assignments	8/3/2016
1.3	- Added Firmware Version on Features page - Updated product ordering information	5/11/2017
1.4	Updated product ordering information	8/1/2017
1.5	- Revised form factor at 7.1 from mSATA mini to mSATA - Updated 64GB product ordering information (No DEVSLP) - Added valid combinations for 64-256GB (DEVSLP)	10/12/2017

## 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](mailto: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](mailto:sa@apacerus.com)

### Japan

#### Apacer Technology Corp.

5F, Matsura Bldg., Shiba, Minato-Ku  
Tokyo, 105-0014, Japan  
Tel: 81-3-5419-2668  
Fax: 81-3-5419-0018  
[jpservices@apacer.com](mailto: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](mailto: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](mailto:sales@apacer.com.cn)

### India

#### Apacer Technologies Pvt Ltd,

Unit No.201, "Brigade Corner", 7<sup>th</sup> Block  
Jayanagar,  
Yediyur Circle, Bangalore – 560082, India  
Tel: 91-80-4152-9061  
Fax: 91-80-4170-0215  
[sales\\_india@apacer.com](mailto:sales_india@apacer.com)