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RoHS Compliant

mSATA Flash Drive

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

March 25, 2016

Version 1.2



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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
- **Capacity**
 - 8, 16, 32, 64, 128 GB
- **Performance***
 - Interface burst read/write: 600 MB/sec
 - Sustained read: up to 230 MB/sec
 - Sustained write: up to 160 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
- **Temperature Range**
 - Operating:
 - Standard: 0°C to 70°C
 - Extended: -40°C to 85°C
 - Storage: -40°C to 85°C
- **Supply Voltage**
 - 3.3 V ± 5%
- **Power Consumption***
 - Active mode: 520 mA
 - Idle mode: 85 mA
- **Form Factor**
 - mSATA mini, JEDEC MO-300B
 - Dimensions (29.85 x 26.80 x 1.00**, unit: mm)
- **Connector**
 - 52-pin mSATA signal connector
- **Device Sleep (optional)*****
- **RoHS Compliant**

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

**Only the height of the PCB

***Not available in 64GB and 128GB models

Table of Contents

| | |
|--|-----------|
| 1. Product Description | 3 |
| 1.1 Introduction | 3 |
| 1.2 Capacity Specifications | 3 |
| 1.3 Performance | 3 |
| 1.4 Pin Assignments | 4 |
| 2. Software Interface | 6 |
| 2.1 Command Set | 6 |
| 2.2 S.M.A.R.T. | 7 |
| 3. Flash Management | 8 |
| 3.1 Error Correction/Detection | 8 |
| 3.2 Bad Block Management | 8 |
| 3.3 Wear Leveling | 8 |
| 3.4 Power Failure Management | 8 |
| 3.5 TRIM | 8 |
| 3.6 Secure Erase | 8 |
| 3.7 SATA Power Management | 9 |
| 4. Environment Specifications | 10 |
| 4.1 Environmental | 10 |
| 4.2 Mean Time Between Failures (MTBF) | 10 |
| 4.3 Certification and Compliance | 10 |
| 4.4 Endurance | 11 |
| 5. Electrical Characteristics | 12 |
| 5.1 Operating Voltage | 12 |
| 5.2 Power Consumption | 12 |
| 6. Mechanical Specifications | 13 |
| 6.1 Dimensions | 13 |
| 7. Product Ordering Information | 15 |
| 7.1 Product Code Designation | 15 |
| 7.2 Valid Combinations | 16 |

1. Product Description

1.1 Introduction

Apacer's mSATA mini 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 mini form factor, known as JEDEC MO-300B standard. The module is designed to operate at optimal efficiency and reliability while maintained in super compact form factor. Meanwhile, the power consumption of the mSATA mini module remains at minimal level.

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 |

*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 mini H1-M is shown in Table 1-2.

Table 1-2 Performance Specifications

| Capacity Performance | 8 GB | 16 GB | 32 GB | 64 GB | 128 GB |
|-------------------------------|------|-------|-------|-------|--------|
| Sustained Read (MB/s) | 120 | 215 | 230 | 230 | 220 |
| Sustained Write (MB/s) | 85 | 150 | 130 | 160 | 125 |

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

1.4 Pin Assignments

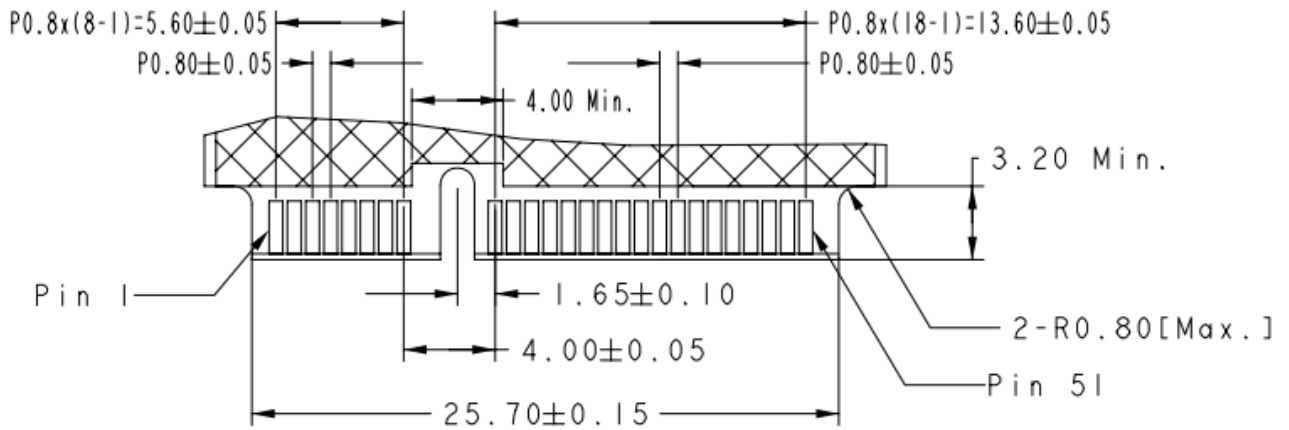


Figure 1-1 Pin Assignment

Table 1-3 Pin Assignment Description

| Pin # | mSATA Pin | Description |
|-------|-----------|-------------|
| 1 | NC | No Connect |
| 2 | +3.3V | 3.3V Source |
| 3 | NC | No Connect |
| 4 | DGND | Digital GND |
| 5 | NC | No Connect |
| 6 | NC | No Connect |
| 7 | NC | No Connect |
| 8 | NC | No Connect |
| 9 | DGND | Digital GND |
| 10 | NC | No Connect |
| 11 | NC | No Connect |
| 12 | NC | No Connect |
| 13 | NC | No Connect |
| 14 | NC | No Connect |
| 15 | DGND | Digital GND |
| 16 | NC | No Connect |
| 17 | NC | No Connect |
| 18 | DGND | Digital GND |
| 19 | NC | No Connect |
| 20 | NC | No Connect |

mSATA Flash Drive

APSDMxxxGN1HN-XTM1X

| Pin # | mSATA Pin | Description |
|-------|-----------|---|
| 21 | SATA GND | SATA Ground Return Pin |
| 22 | NC | No Connect |
| 23 | +B | Host Receiver Differential Signal Pair |
| 24 | +3.3V | 3.3V Source |
| 25 | -B | Host Receiver Differential Signal Pair |
| 26 | SATA GND | SATA Ground Return Pin |
| 27 | SATA GND | SATA Ground Return Pin |
| 28 | NC | No Connect |
| 29 | SATA GND | SATA Ground Return Pin |
| 30 | NC | No Connect |
| 31 | -A | Host Transmitter Differential Signal Pair |
| 32 | NC | No Connect |
| 33 | +A | Host Transmitter Differential Signal Pair |
| 34 | DGND | Digital GND |
| 35 | SATA GND | SATA Ground Return Pin |
| 36 | NC | No Connect |
| 37 | SATA GND | SATA Ground Return Pin |
| 38 | NC | No Connect |
| 39 | +3.3V | 3.3V Source |
| 40 | DGND | Digital GND |
| 41 | +3.3V | 3.3V Source |
| 42 | NC | No Connect |
| 43 | NC | No Connect |
| 44 | NC | No Connect or Device Sleep* |
| 45 | Vendor | Vendor specific |
| 46 | NC | No Connect |
| 47 | Vendor | Vendor specific |
| 48 | NC | No Connect |
| 49 | DAS | Device activity signal |
| 50 | DGND | Digital GND |
| 51 | GND | Default connect to GND |
| 52 | +3.3V | 3.3V Source |

*Device Sleep is optional

2. Software Interface

2.1 Command Set

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

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 | 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 |

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 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.

3.7 SATA Power Management

By complying with SATA 6.0 Gb/s specifications, the mSATA SSD supports Device Sleep power state:

- Device Sleep (DevSleep or DEVSLP): PHY powered down; power consumption ≤ 5 mW; host assertion time ≤ 10 ms; exit timeout from this state ≤ 20 ms (unless specified otherwise in SATA Identify Device Log).

Note: Device Sleep mode is optional, depending on product ordering selections.

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) |
| 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 | ≥ 50N, 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 mini 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 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 |
|----------|-------------------|
| 8 GB | 7 |
| 16 GB | 14 |
| 32 GB | 28 |
| 64 GB | 57 |
| 128 GB | 114 |

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.
- The estimated values are based on JEDEC Enterprise endurance workload comprised of random data with the payload size distribution with sequential write behavior.

5. Electrical Characteristics

5.1 Operating Voltage

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

Table 5-1 Operating Voltage

| Parameter | Conditions |
|----------------|------------|
| Supply Voltage | 3.3V ± 5% |

5.2 Power Consumption

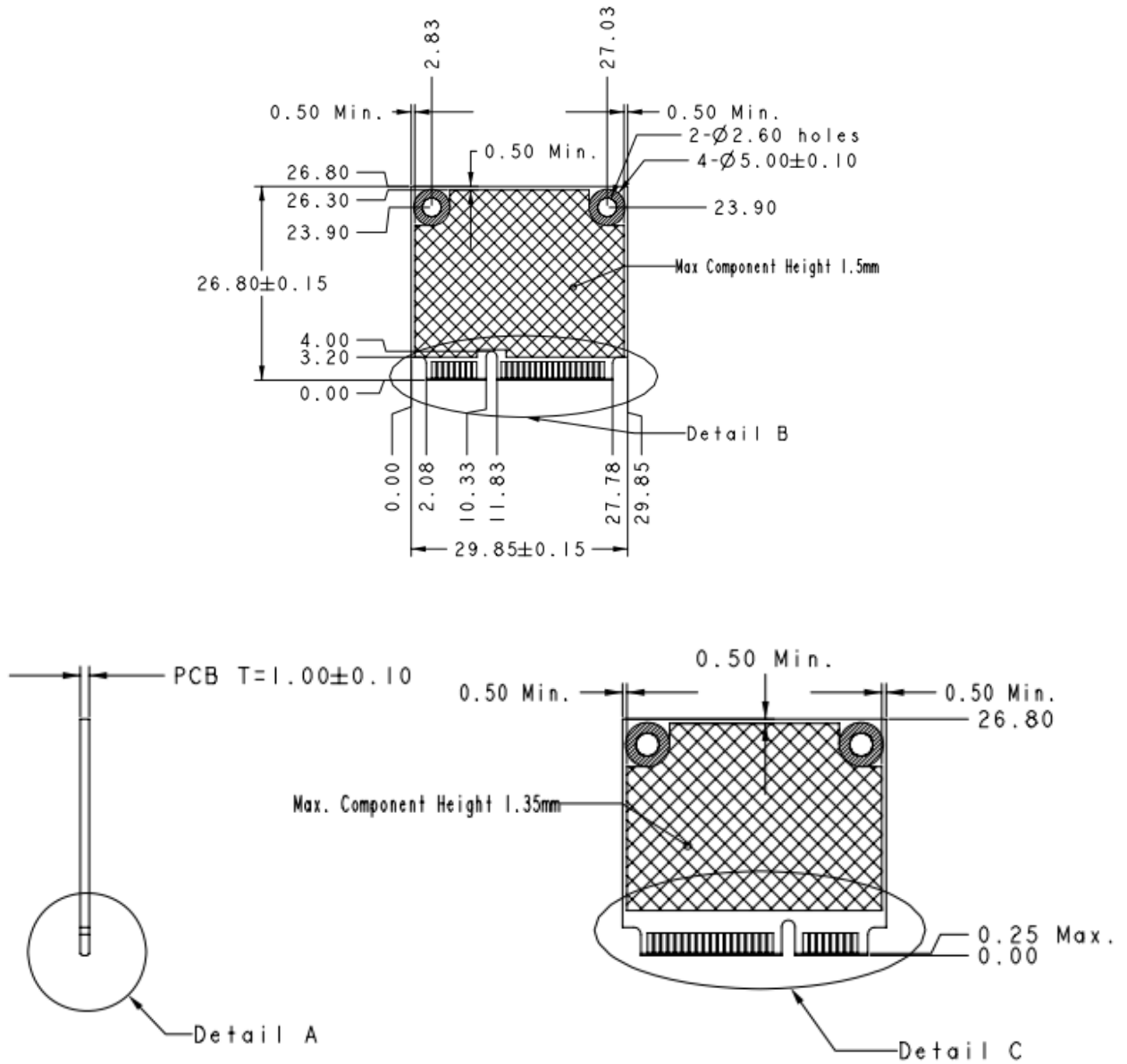
Table 5-2 Power Consumption (typical)

| Mode \ Capacity | 8 GB | 16 GB | 32 GB | 64 GB | 128 GB |
|-----------------|------|-------|-------|-------|--------|
| Active (mA) | 350 | 330 | 330 | 520 | 515 |
| Idle (mA) | 85 | 80 | 80 | 80 | 80 |

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

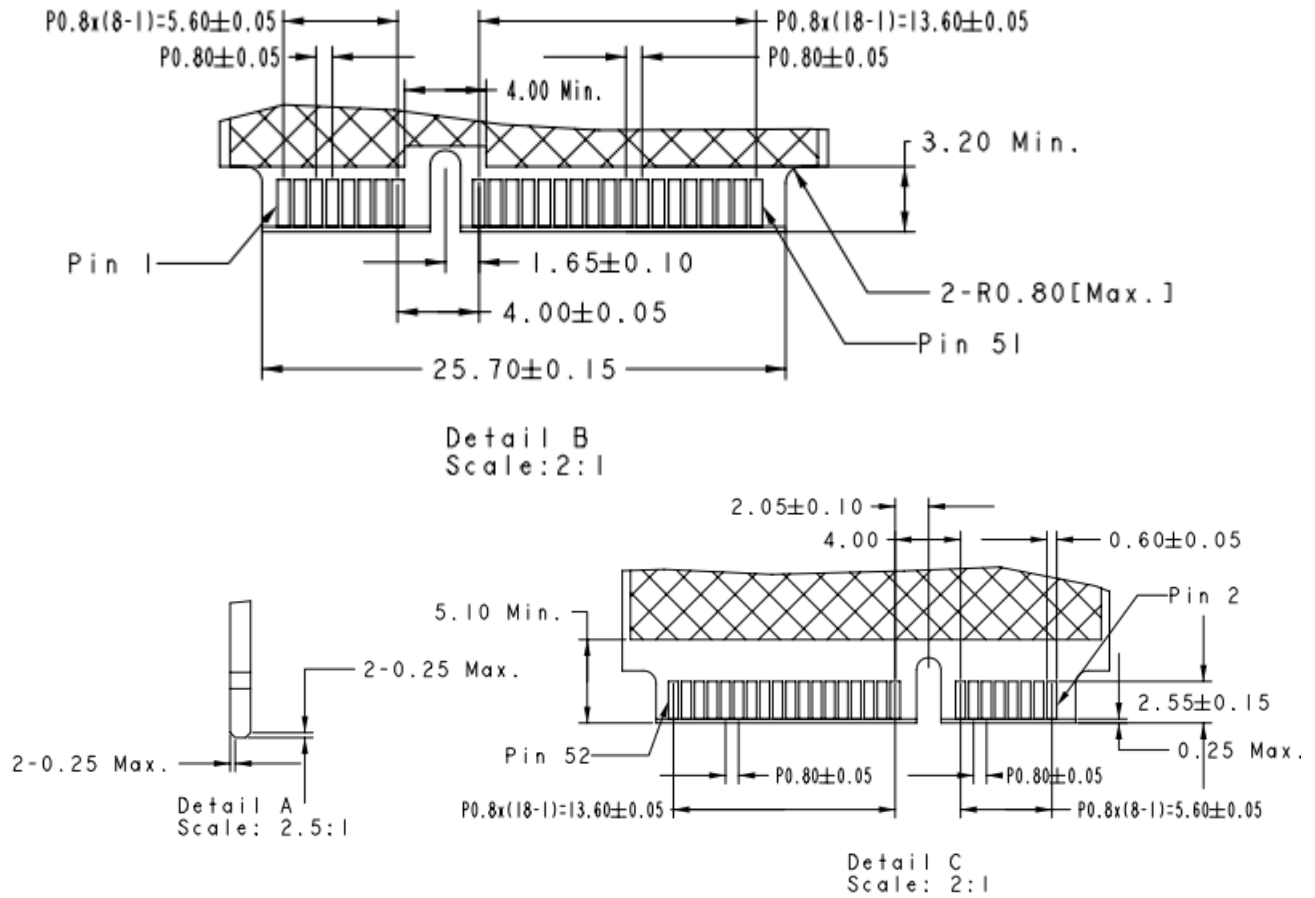
6. Mechanical Specifications

6.1 Dimensions



Unit: mm
 Tolerance: ± 0.2

mSATA Flash Drive
APSDMxxxGN1HN-XTM1X



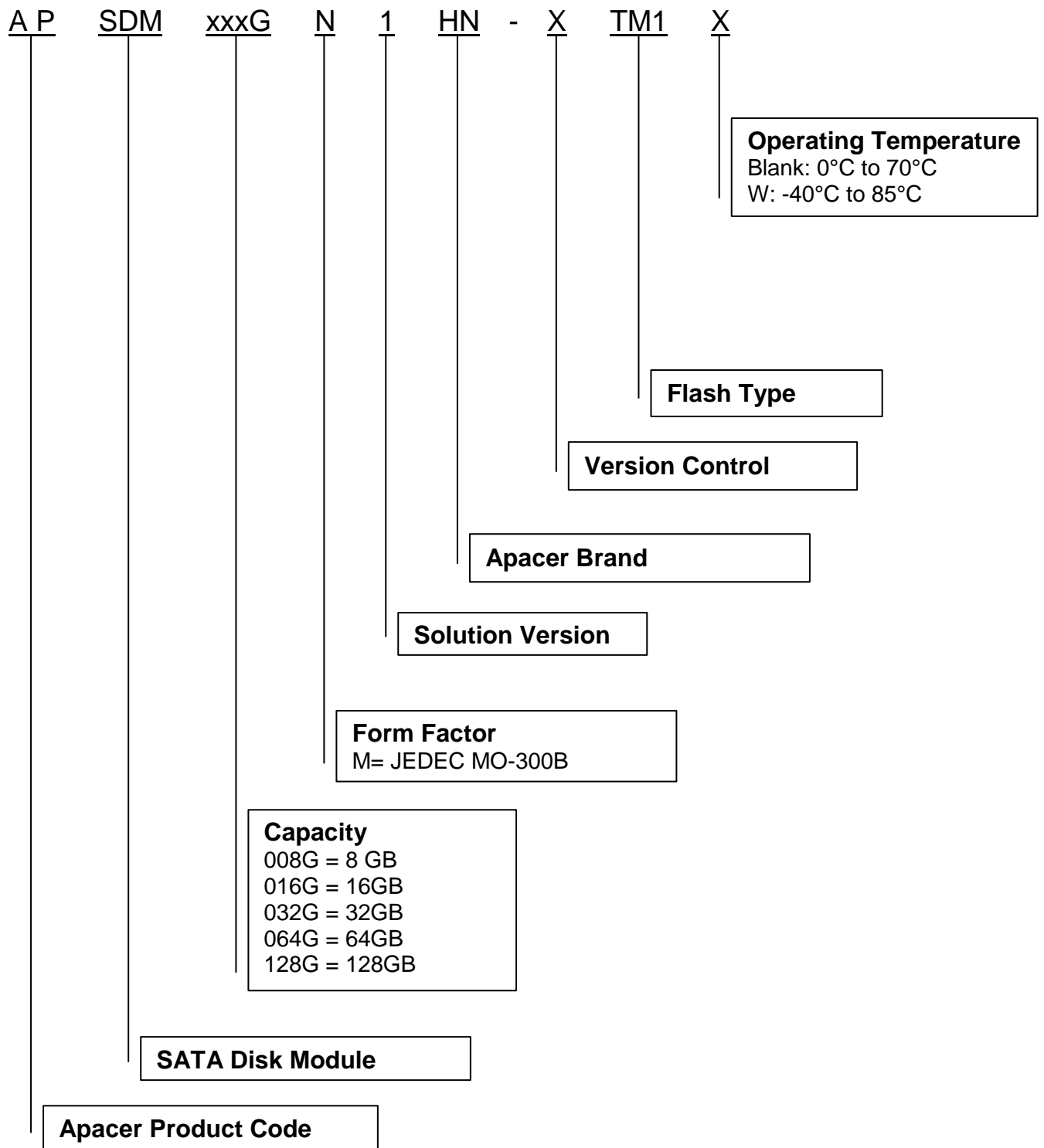
Notes :

1. = Max Component Height
2. = No Component
3. = No Component / Signal Vias / Signal Copper / Printing
4. General Tolerance ± 0.1

Unit: mm
 Tolerance: ± 0.2

7. Product Ordering Information

7.1 Product Code Designation



7.2 Valid Combinations

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

| Capacity | No DEVSLP | DEVSLP |
|----------|--------------------|--------------------|
| 8GB | APSDM008GN1HN-GTM1 | APSDM008GN1HN-HTM1 |
| 16GB | APSDM016GN1HN-GTM1 | APSDM016GN1HN-HTM1 |
| 32GB | APSDM032GN1HN-GTM1 | APSDM032GN1HN-HTM1 |
| 64GB | APSDM064GN1HN-GTM1 | - |
| 128GB | APSDM128GN1HN-GTM1 | - |

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

| Capacity | No DEVSLP | DEVSLP |
|----------|---------------------|---------------------|
| 8GB | APSDM008GN1HN-GTM1W | APSDM008GN1HN-HTM1W |
| 16GB | APSDM016GN1HN-GTM1W | APSDM016GN1HN-HTM1W |
| 32GB | APSDM032GN1HN-GTM1W | APSDM032GN1HN-HTM1W |
| 64GB | APSDM064GN1HN-GTM1W | - |
| 128GB | APSDM064GN1HN-GTM1W | - |

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 | 10/30/2015 |
| 1.1 | Remove DEVSLP support for 64GB and 128GB models | 1/26/2016 |
| 1.2 | Revised performance values for 64GB and 128GB models | 3/25/2016 |

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