

RoHS Recast Compliant

M.2 2242 Flash Drive

SM220-M242 Product Specifications

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Version 1.4



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Features:

- **Compliance with SATA Interface**
 - Serial ATA Revision 3.1
 - SATA 6.0 Gbps
 - ATA-8 command set
 - Backward compatible with SATA 1.5/3.0 Gbps
- **Capacity**
 - 8, 16, 32, 64, 128 GB
- **Performance***
 - Interface burst read/write: 600 MB/sec
 - Standard Speed:
 - Sustained read: up to 270 MB/sec
 - Sustained write: up to 70 MB/sec
 - High-Speed:
 - Sustained read: up to 510 MB/sec
 - Sustained write: up to 120 MB/sec
- **Flash Management**
 - Built-in hardware ECC
 - Static/dynamic wear-leveling
 - Flash bad-block management
 - S.M.A.R.T.
 - Power Failure Management
 - ATA Secure Erase
 - TRIM
- **SATA Power Management**
- **NAND Flash Type:** MLC
- **MTBF:** >1,000,000 hours
- **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 ± 5%
- **Power Consumption***
 - Standard Speed:
 - Active mode: 305 mA
 - Idle mode: 80 mA
 - High-Speed:
 - Active mode: 430 mA
 - Idle mode: 75 mA
- **Connector Type**
 - 75-pin SATA-based M.2 module pinout
- **Form Factor**
 - M.2 2242 form factor
 - Dimensions: 42.00 x 22.00 x 3.60, unit: mm
- **Shock & Vibration****
 - Shock: 1,500 G
 - Vibration: 15 G
- **Device Sleep (optional)**
- **RoHS Recast Compliant (Complies with 2011/65/EU Standard)**

*Varies from capacities. The values for performances and power consumptions presented are typical and may vary depending on flash configurations or platform settings. The term idle refers to the standby state of the device.

**Non-operating

Table of Contents

| | |
|---|-----------|
| 1. General Description | 3 |
| 2. Pin Assignments..... | 3 |
| 3. Product Specifications..... | 6 |
| 3.1 Capacity..... | 6 |
| 3.2 Performance | 6 |
| 3.3 Environmental Specifications | 7 |
| 3.4 Mean Time Between Failures (MTBF) | 7 |
| 3.5 Certification and Compliance | 7 |
| 4. Flash Management | 8 |
| 4.1 Error Correction/Detection..... | 8 |
| 4.2 Bad Block Management | 8 |
| 4.3 Wear Leveling..... | 8 |
| 4.4 Power Failure Management | 8 |
| 4.5 ATA Secure Erase..... | 8 |
| 4.6 TRIM..... | 9 |
| 4.7 SATA Power Management..... | 9 |
| 5. Software Interface | 10 |
| 5.1 Command Set..... | 10 |
| 5.2 S.M.A.R.T. | 10 |
| 6. Electrical Specifications | 12 |
| 7. Mechanical Specifications | 13 |
| 7.1 Dimensions..... | 13 |
| 8. Product Ordering Information..... | 15 |
| 8.1 Product Code Designations..... | 15 |
| 8.2 Valid Combinations..... | 16 |

1. General Description

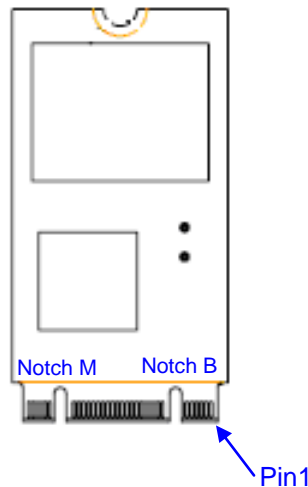
Apacer's SM220-M242 (M.2 2242) is the next generation modularized Solid State Drive (SSD) with the shape of all new M.2 form factor, with the aim to be more suitable for mobile and compact computers with standard width at only 22.00 mm. SM220-M242 appears in M.2 2242 mechanical dimensions and is believed to be the leading add-in storage solution for future host computing systems.

The M.2 SSD is designed with SATA-based connector pinouts, providing full compliance with the latest SATA Revision 3.1 interface specifications. Aside from SATA compliance, SM220-M242 delivers exceptional performance and power efficiency. On the other hand, the extreme thin and light form factor makes SM220-M242 the ideal choice for mobile computing systems, which appears to be the trend in near future.

Regarding reliability, SM220-M242 is built with a powerful SATA controller that supports on-the-module ECC as well as efficient wear leveling scheme. Since it is operating under SATA 6.0 Gbps interface, SM220-M242 is provided with Apacer latest S.M.A.R.T. that are primarily oriented for the latest SATA interface SSD, for drive lifetime monitoring and analyzing.

2. Pin Assignments

This connector does not support hot plug capability. There are a total of 75 pins. 12 pin locations are used for mechanical key locations; this allows such a module to plug into both Key B and Key M connectors.



| Pin | Type | Description |
|-----|---------------|--|
| 1 | CONFIG_3 | Ground (according to M.2 configurations for SSD-SATA definition) |
| 2 | 3.3V | Supply Pin, 3.3V |
| 3 | GND | Ground |
| 4 | 3.3V | Supply pin, 3.3V |
| 5 | No connect | No connect |
| 6 | Not available | No connect (used for other purposes) |
| 7 | Not available | No connect (used for other purposes) |

M.2 2242 Flash Drive APM2T42SM22xxxGAN-3XTMXX



| Pin | Type | Description |
|-----|-------------------|--|
| 8 | Not available | No connect (used for other purposes) |
| 9 | No connect | No connect |
| 10 | DAS/DSS | Device Activity Signal/Disable Staggered Spin-up |
| 11 | No connect | No connect (used for other purposes) |
| 12 | (removed for key) | Mechanical notch B |
| 13 | (removed for key) | Mechanical notch B |
| 14 | (removed for key) | Mechanical notch B |
| 15 | (removed for key) | Mechanical notch B |
| 16 | (removed for key) | Mechanical notch B |
| 17 | (removed for key) | Mechanical notch B |
| 18 | (removed for key) | Mechanical notch B |
| 19 | (removed for key) | Mechanical notch B |
| 20 | Not available | No connect (used for other purposes) |
| 21 | CONFIG_0 | Ground (according to M.2 configurations for SSD-SATA definition) |
| 22 | Not available | No connect (used for other purposes) |
| 23 | Not available | No connect (used for other purposes) |
| 24 | Not available | No connect (used for other purposes) |
| 25 | Not available | No connect (used for other purposes) |
| 26 | Not available | No connect (used for other purposes) |
| 27 | GND | Ground |
| 28 | Not available | No connect (used for other purposes) |
| 29 | PERn1 | Not used |
| 30 | Not available | No connect (used for other purposes) |
| 31 | PERp1 | Not used |
| 32 | Not available | No connect (used for other purposes) |
| 33 | GND | Ground |
| 34 | Not available | No connect (used for other purposes) |
| 35 | PETn1 | Not used |
| 36 | Not available | No connect (used for other purposes) |
| 37 | PETp1 | Not used |
| 38 | DEVSLP | Device Sleep, input. If driven high the host is informing the SSD to enter a low power state |
| 39 | GND | Ground |
| 40 | Not available | No connect (used for other purposes) |
| 41 | SATA-Rx+ | Host receiver differential signal pair |
| 42 | Not available | No connect (used for other purposes) |

M.2 2242 Flash Drive APM2T42SM22xxxGAN-3XTMXX



| Pin | Type | Description |
|-----|-------------------|--|
| 43 | SATA-Rx- | Host receiver differential signal pair |
| 44 | Not available | No connect (used for other purposes) |
| 45 | GND | Ground |
| 46 | Not available | No connect (used for other purposes) |
| 47 | SATA-Tx- | Host transmitter differential pair |
| 48 | Not available | No connect (used for other purposes) |
| 49 | SATA-Tx+ | Host transmitter differential pair |
| 50 | PERST# | Not used |
| 51 | GND | Ground |
| 52 | CLKREQ# | Not used |
| 53 | REFCLKN | Not used |
| 54 | PEWAKE# | Not used |
| 55 | REFCLKP | Not used |
| 56 | MFG1 | Manufacturing pin. Use determined by vendor (no connect on a host) |
| 57 | GND | Ground |
| 58 | MFG2 | Manufacturing pin. Use determined by vendor (no connect on a host) |
| 59 | (removed for key) | Mechanical notch B |
| 60 | (removed for key) | Mechanical notch B |
| 61 | (removed for key) | Mechanical notch B |
| 62 | (removed for key) | Mechanical notch B |
| 63 | (removed for key) | Mechanical notch B |
| 64 | (removed for key) | Mechanical notch B |
| 65 | (removed for key) | Mechanical notch B |
| 66 | (removed for key) | Mechanical notch B |
| 67 | Not available | No connect (used for other purposes) |
| 68 | SUSCLK | Not used |
| 69 | CONFIG_1 | Ground |
| 70 | 3.3V | Supply pin, 3.3V |
| 71 | GND | Ground |
| 72 | 3.3V | Supply pin, 3.3V |
| 73 | GND | Ground |
| 74 | 3.3V | Supply pin, 3.3V |
| 75 | CONFIG_2 | Ground |

3. Product Specifications

3.1 Capacity

Capacity specifications of SM220-M242 are available as shown in Table 3-1. It lists the specific capacity and the default numbers of heads, sectors and cylinders for each product line.

Table 3-1 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, 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.

3.2 Performance

Performance of SM220-M242 is listed below in Table 3-2 and Table 3-3.

Table 3-2 Performance Specifications (Standard Speed)

| Capacity | 8 GB | 16 GB | 32 GB | 64 GB |
|-------------------------------|------|-------|-------|-------|
| Performance | | | | |
| Sustained Read (MB/s) | 115 | 215 | 210 | 270 |
| Sustained Write (MB/s) | 25 | 48 | 42 | 70 |

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

Table 3-3 Performance Specifications (High-Speed)

| Capacity | 64 GB | 128 GB |
|-------------------------------|-------|--------|
| Performance | | |
| Sustained Read (MB/s) | 395 | 510 |
| Sustained Write (MB/s) | 80 | 120 |

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

3.3 Environmental Specifications

Environmental specifications of SM220-M242 series follow MIL-STD-810, as shown in Table 3-4.

Table 3-4 Environmental Specifications

| Item | Specifications |
|-------------------------|---|
| Operating temp. | 0°C to 70°C (Standard); -40°C to 85°C (Extended) |
| Non-operating temp. | -40°C to 100°C |
| Operating vibration | 20~2000(Hz), 7.69 (Grms), random wave, X, Y, Z axis |
| Non-operating vibration | 10~2000(Hz), 15(G), sine wave, X, Y, Z axis |
| Operating shock | 50(G), 11(ms), half-sine wave |
| Non-operating shock | 1,500(G), 0.5(ms), half-sine wave |

3.4 Mean Time Between Failures (MTBF)

Mean Time Between Failures (MTBF) is predicted based on reliability data for the individual components in SM220-M242. The prediction result for SM220-M242 is more than 1,000,000 hours.

Note: The MTBF is predicated and calculated based on “Telcordia Technologies Special Report, SR-332, Issue 2” method.

3.5 Certification and Compliance

SM220-M242 complies with the following standards:

- CE
- FCC
- RoHS Recast
- MIL-STD-810

4. Flash Management

4.1 Error Correction/Detection

SM220-M242 implements a hardware ECC scheme, based on the BCH algorithm. It can detect and correct up to 40 bits error in 1K bytes.

4.2 Bad Block Management

Current production technology is unable to guarantee total reliability of NAND flash memory array. When a flash memory device leaves factory, it comes with a minimal number of initial bad blocks during production or out-of-factory as there is no currently known technology that produce flash chips free of bad blocks. In addition, bad blocks may develop during program/erase cycles. When host performs program/erase command on a block, bad block may appear in Status Register. Since bad blocks are inevitable, the solution is to keep them in control. Apacer flash devices are programmed with ECC, block mapping technique and S.M.A.R.T to reduce invalidity or error. Once bad blocks are detected, data in those blocks will be transferred to free blocks and error will be corrected by designated algorithms.

4.3 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. Wear leveling is an important mechanism that level out the wearing of blocks so that the wearing-down of blocks can be almost evenly distributed. This will increase the lifespan of SSDs. Commonly used wear leveling types are Static and Dynamic.

4.4 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 write-to-flash 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.

4.5 ATA Secure Erase

ATA Secure Erase is an ATA disk purging command currently embedded in most of the storage drives. Defined in ATA specifications, (ATA) Secure Erase is part of Security Feature Set that allows storage drives to erase all user data areas. The erase process usually runs on the firmware level as most of the ATA-based storage media currently in the market are built-in with this command. ATA Secure Erase can securely wipe out the user data in the drive and protects it from malicious attack.

4.6 TRIM

TRIM is a SATA command that helps improve the read/write performance and efficiency of solid-state drives (SSD). The command enables the host operating system to inform SSD controller which blocks contain invalid data, mostly because of the erase commands from host. The invalid will be discarded permanently and the SSD will retain more space for itself.

4.7 SATA Power Management

By complying with SATA 6.0 Gb/s specifications, the SSD supports the following SATA power saving modes:

- ACTIVE: PHY ready, full power, Tx & Rx operational
- PARTIAL: Reduces power, resumes in under 10 μ s (microseconds)
- SLUMBER: Reduces power, resumes in under 10 ms (milliseconds)
- HIPM: Host-Initiated Power Management
- DIPM: Device-Initiated Power Management
- AUTO-SLUMBER: Automatic transition from partial to slumber.
- Device Sleep (DevSleep or DEVSLP): PHY powered down; power consumption \leq 5 mW; host assertion time \leq 10 ms; exit timeout from this state \leq 20 ms (unless specified otherwise in SATA Identify Device Log).

Note:

1. The behaviors of power management features would depend on host/device settings.
2. Device Sleep mode is optional, depending on product ordering selections.

5. Software Interface

5.1 Command Set

This section defines the software requirements and the format of the commands the host sends to SM220-M242. Commands are issued to SM220-M242 by loading the required registers in the command block with the supplied parameters, and then writing the command code to the Command register.

Table 5-1 Command Set

| Code | Command | Code | Command |
|------|------------------------------|------|------------------------|
| E5h | Check Power Mode | F3h | Security Erase Prepare |
| 06h | Data Set Management | F4h | Security Erase Unit |
| 90h | Execute Device Diagnostic | F5h | Security Freeze Lock |
| E7h | Flush Cache | F1h | Security Set Password |
| EAh | Flush Cache EXT | F2h | Security Unlock |
| ECh | Identify Device | 70h | Seek |
| E3h | Idle | EFh | Set Features |
| E1h | Idle Immediate | C6h | Set Multiple Mode |
| 91h | Initialize Device Parameters | E6h | Sleep |
| C8h | Read DMA | B0h | SMART |
| 25h | Read DMA EXT | E2h | Standby |
| C4h | Read Multiple | E0h | Standby Immediate |
| 29h | Read Multiple EXT | CAh | Write DMA |
| 20h | Read Sector | 35h | Write DMA EXT |
| 24h | Read Sector EXT | C5h | Write Multiple |
| 40h | Read Verify Sectors | 39h | Write Multiple EXT |
| 42h | Read Verify Sectors EXT | 30h | Write Sector |
| 10h | Recalibrate | 34h | Write Sector EXT |
| F6h | Security Disable Password | | |

5.2 S.M.A.R.T.

S.M.A.R.T. is an abbreviation for Self-Monitoring, Analysis and Reporting Technology, a self-monitoring system that provides indicators of drive health as well as potential disk problems. It serves as a warning for users from unscheduled downtime by monitoring and displaying critical drive information. Ideally, this should allow taking proactive actions to prevent drive failure and make use of S.M.A.R.T. information for future product development reference.

Apacer devices use the standard SMART command B0h to read data out from the drive to activate our S.M.A.R.T. feature that complies with the ATA/ATAPI specifications. S.M.A.R.T. Attribute IDs shall include initial bad block count, total later bad block count, maximum erase count, average erase count, power on hours and power cycle. When the S.M.A.R.T. Utility running on the host, it analyzes and reports the disk status to the host before the device reaches in critical condition.

M.2 2242 Flash Drive APM2T42SM22xxxGAN-3XTMXX

Note: Attribute IDs may vary from product models due to various solution design and supporting capabilities.

Apacer memory products come with S.M.A.R.T. commands and subcommands for users to obtain information of drive status and to predict potential drive failures. Users can take advantage of the following commands/subcommands to monitor the health of the drive.

| Code | SMART Subcommand |
|------|-----------------------------------|
| D0h | READ DATA |
| D1h | READ ATTRIBUTE THRESHOLDS |
| D2h | Enable/Disable Attribute Autosave |
| D4h | Execute Off-line Immediate |
| D5h | Read Log (optional) |
| D6h | Write Log (optional) |
| D8h | Enable Operations |
| D9h | Disable operations |
| DAh | Return Status |

General SMART attribute structure

| Byte | Description |
|-------|-------------|
| 0 | ID (Hex) |
| 1 – 2 | Status flag |
| 3 | Value |
| 4 | Worst |
| 5*-11 | Raw Data |

*Byte 5: LSB

SMART attribute ID list

| ID (Hex) | Attribute Name |
|------------|------------------------------------|
| 9 (0x09) | Power-on hours |
| 12 (0x0C) | Power cycle count |
| 163 (0xA3) | Max. erase count |
| 164 (0xA4) | Avg. erase count |
| 166 (0xA6) | Total later bad block count |
| 167 (0xA7) | SSD Protect Mode (vendor specific) |
| 168 (0xA8) | SATA PHY Error Count |
| 175 (0xAF) | Bad Cluster Table Count |
| 192 (0xC0) | Unexpected Power Loss Count |
| 194 (0xC2) | Temperature |
| 241 (0xF1) | Total sectors of write |

6. Electrical Specifications

Table 6-1 Operating Range

| Item | Range |
|----------------|--------------------------|
| Supply Voltage | 3.3V ± 5% (3.135-3.465V) |

Table 6-2 Typical Power Consumption (Standard Speed)

| Capacity | 8 GB | 16 GB | 32 GB | 64 GB |
|-------------|------|-------|-------|-------|
| Modes | | | | |
| Active (mA) | 215 | 240 | 240 | 305 |
| Idle (mA) | 80 | 80 | 80 | 80 |

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

Table 6-3 Typical Power Consumption (High-Speed)

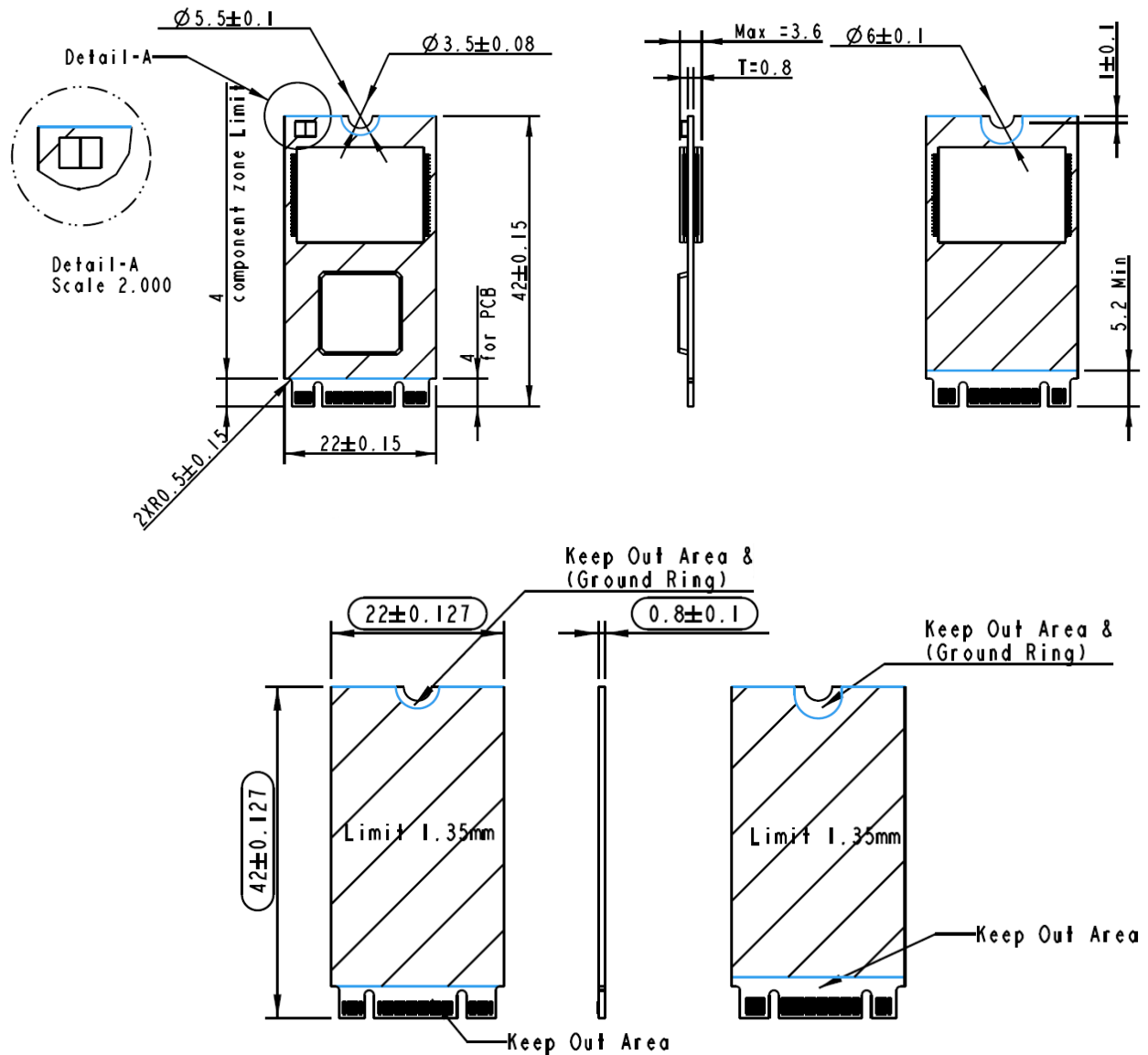
| Capacity | 64 GB | 128 GB |
|-------------|-------|--------|
| Modes | | |
| Active (mA) | 300 | 430 |
| Idle (mA) | 75 | 75 |

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

7. Mechanical Specifications

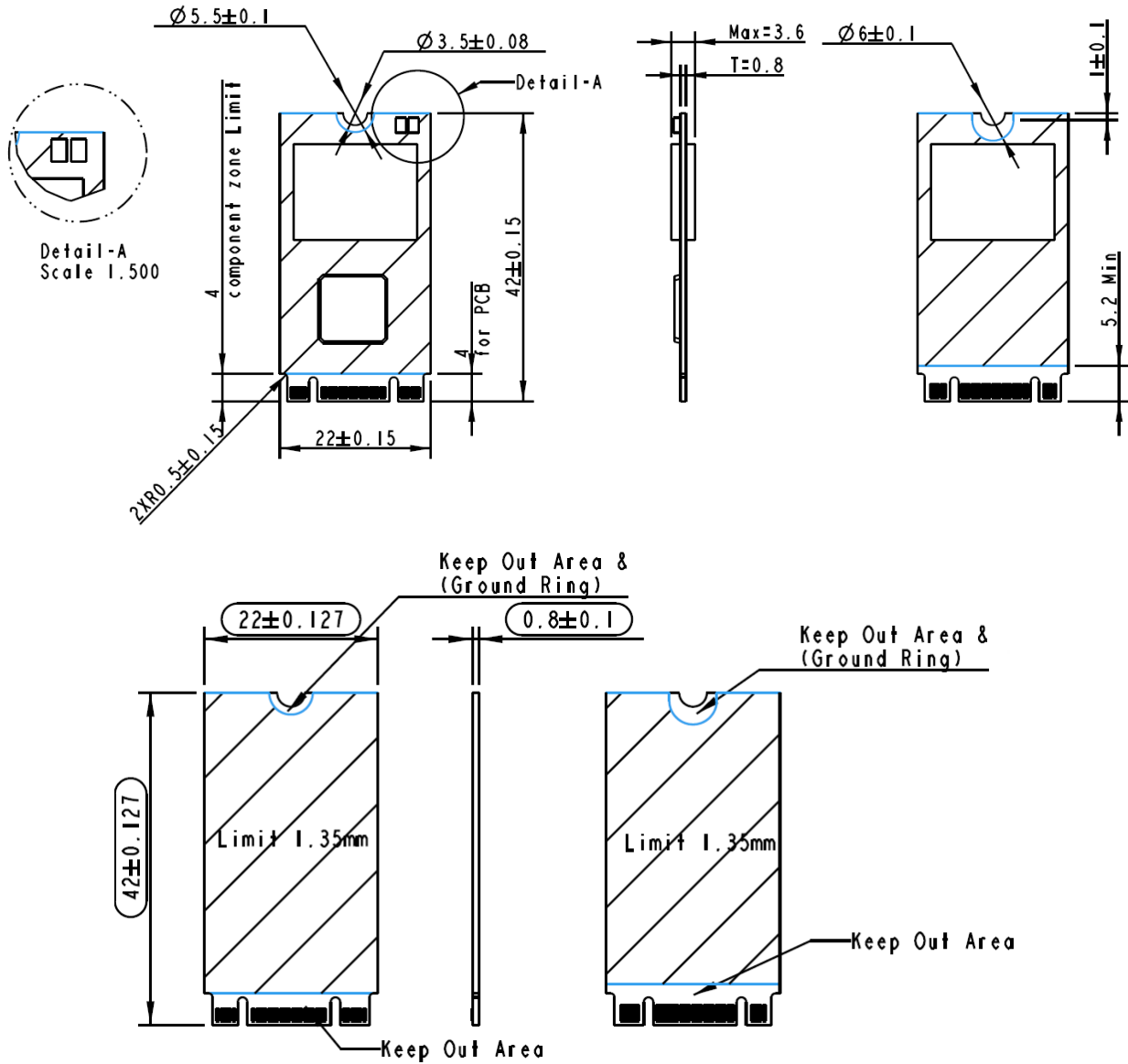
7.1 Dimensions

7.1.1 Standard Speed



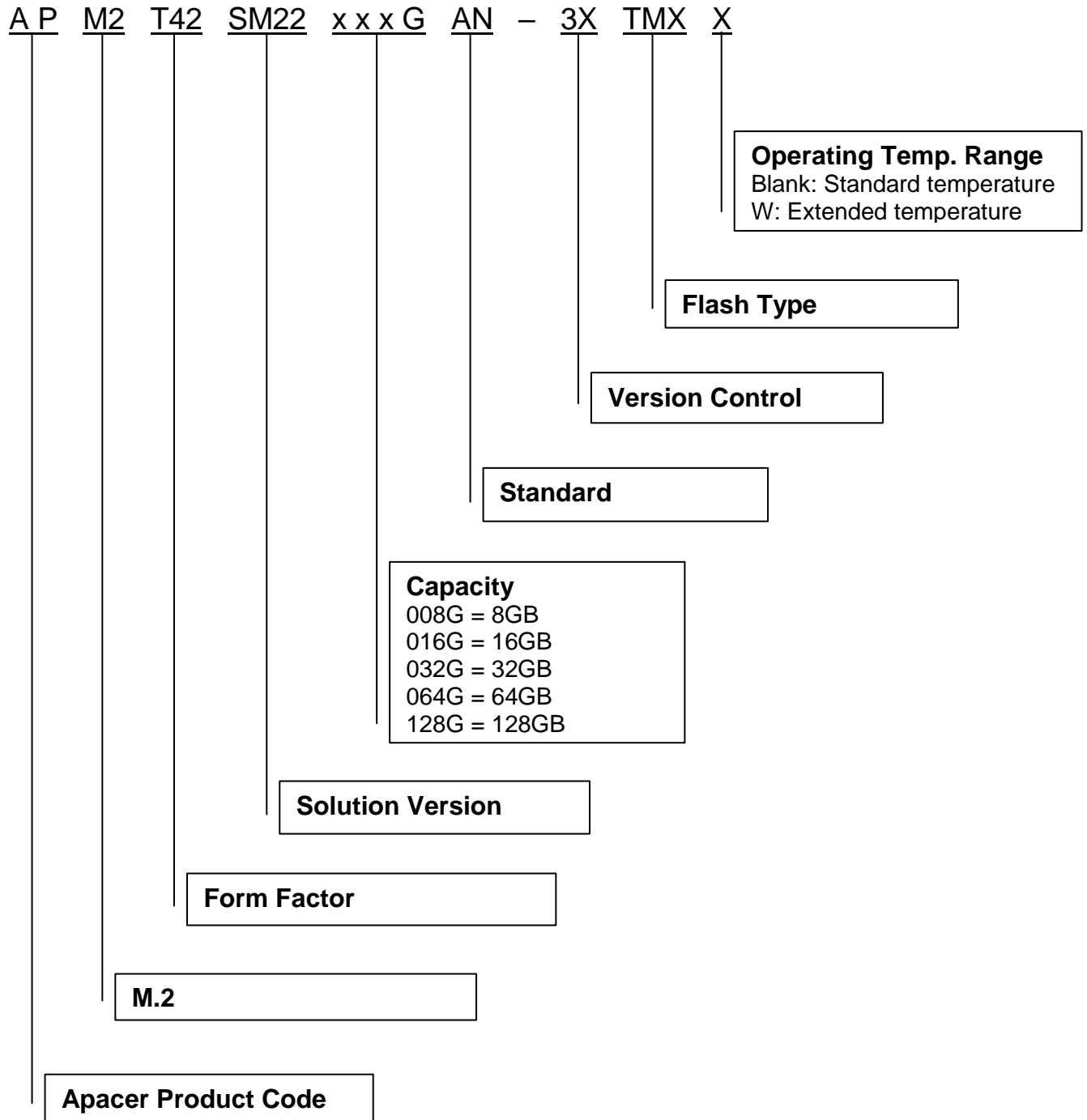
M.2 2242 Flash Drive APM2T42SM22xxxGAN-3XTMXX

7.1.2 High-Speed



8. Product Ordering Information

8.1 Product Code Designations



8.2 Valid Combinations

A. Standard Speed

8.2.1 Standard Temperature (0°C to 70°C)

| Capacity | No DEVSLP | DEVSLP |
|----------|------------------------|------------------------|
| 8GB | APM2T42SM22008GAN-3GTM | APM2T42SM22008GAN-3HTM |
| 16GB | APM2T42SM22016GAN-3GTM | APM2T42SM22016GAN-3HTM |
| 32GB | APM2T42SM22032GAN-3GTM | APM2T42SM22032GAN-3HTM |
| 64GB | APM2T42SM22064GAN-3GTM | APM2T42SM22064GAN-3HTM |

8.2.2 Extended Temperature (-40°C to 85°C)

| Capacity | No DEVSLP | DEVSLP |
|----------|-------------------------|-------------------------|
| 8GB | APM2T42SM22008GAN-3GTMW | APM2T42SM22008GAN-3HTMW |
| 16GB | APM2T42SM22016GAN-3GTMW | APM2T42SM22016GAN-3HTMW |
| 32GB | APM2T42SM22032GAN-3GTMW | APM2T42SM22032GAN-3HTMW |
| 64GB | APM2T42SM22064GAN-3GTMW | APM2T42SM22064GAN-3HTMW |

B. High-Speed

8.2.3 Standard Temperature (0°C to 70°C)

| Capacity | No DEVSLP | DEVSLP |
|----------|-------------------------|-------------------------|
| 64GB | APM2T42SM22064GAN-3GTMG | APM2T42SM22064GAN-3HTMG |
| 128GB | APM2T42SM22128GAN-3GTMG | APM2T42SM22128GAN-3HTMG |

8.2.4 Extended Temperature (-40°C to 85°C)

| Capacity | No DEVSLP | DEVSLP |
|----------|--------------------------|--------------------------|
| 64GB | APM2T42SM22064GAN-3GTMGW | APM2T42SM22064GAN-3HTMGW |
| 128GB | APM2T42SM22128GAN-3GTMGW | APM2T42SM22128GAN-3HTMGW |

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 | Date | Description | Remark |
|----------|-----------|--|--------|
| 1.0 | 12/9/2015 | Official release | |
| 1.1 | 1/26/2016 | - Added wide temperature support - Updated product ordering information | |
| 1.2 | 2/2/2016 | Added High-Speed models | |
| 1.3 | 3/18/2016 | Updated product ordering information | |
| 1.4 | 12/9/2016 | Updated product ordering information | |

Global Presence

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