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RoHS Recast Compliant

Serial ATA Flash Drive

M.2 2242 P100-M Product Specifications (Toshiba 15nm)

October 22, 2015

Version 1.0



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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
- **Capacities**
 - 8, 16, 32, 64, 128, 256 GB
- **Performance***
 - Interface burst read/write: 600 MB/sec
 - Sustained read: up to 450 MB/sec
 - Sustained write: up to 165 MB/sec
- **Flash Management**
 - Built-in hardware ECC
 - Wear-leveling
 - Flash bad-block management
 - S.M.A.R.T.
 - Power Failure Management
 - ATA Secure Erase
 - 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 100°C
- **Supply Voltage**
 - 3.3 V \pm 5%
- **Power Consumption (typical)***
 - Active mode: 455 mA
 - Idle mode: 95 mA
- **Connector Type**
 - 75-pin SATA-based M.2 module pinout
- **Form Factor**
 - M.2 2242 form factor
 - Dimensions:
 - 42mm(L)x22mm(W)x3.65mm(H)
- **Shock & Vibration****
 - Shock:1,500 G
 - Vibration: 15 G
- **MTBF: >2,000,000 hours**
- **RoHS Recast Compliant**
- **Device Sleep Mode (optional)**

*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 |
| 4.8 ENDURANCE | 10 |
| 5. SOFTWARE INTERFACE | 11 |
| 5.1 COMMAND SET | 11 |
| 5.2 S.M.A.R.T..... | 12 |
| 6. ELECTRICAL SPECIFICATION | 13 |
| 7. MECHANICAL SPECIFICATIONS | 14 |
| 8. PRODUCT ORDERING INFORMATION | 15 |
| 8.1 PRODUCT CODE DESIGNATIONS | 15 |
| 8.2 VALID COMBINATIONS | 16 |

1. General Description

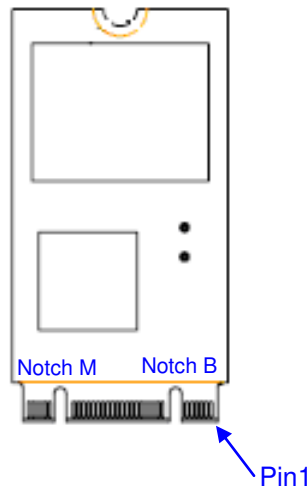
Apacer P100-M is the next generation modularized Solid State Drive (SSD) with the shape of all new M.2 form factor, with the aim to be the more suitable for mobile and compact computers with standard width at only 22.00 mm. P100-M appears in M.2 2242 mechanical dimensions and is believed to be the leading 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 3.2 interface specifications. Aside from SATA compliance, P100-M delivers exceptional performance and power efficiency. On the other hand, the extreme thin and light form factor makes P100-M the ideal choice for mobile computing systems, which appears to be the trend in near future.

Regarding reliability, P100-M 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, P100-M 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) |
| 8 | Not available | No connect (used for other purposes) |

M.2 2242 Flash Drive
APM2T42P100xxxxAN-XTM1X



| | | |
|----|-------------------|--|
| 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) |
| 43 | SATA-Rx- | Host receiver differential signal pair |
| 44 | Not available | No connect (used for other purposes) |

M.2 2242 Flash Drive
APM2T42P100xxxxAN-XTM1X



| | | |
|----|-------------------|--|
| 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 M |
| 60 | (removed for key) | Mechanical notch M |
| 61 | (removed for key) | Mechanical notch M |
| 62 | (removed for key) | Mechanical notch M |
| 63 | (removed for key) | Mechanical notch M |
| 64 | (removed for key) | Mechanical notch M |
| 65 | (removed for key) | Mechanical notch M |
| 66 | (removed for key) | Mechanical notch M |
| 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 specification of P100-M is 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 |
| 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.

3.2 Performance

Performances of P100-M are listed below in table 3-2.

Table 3-2: Performance

| Capacity Performance | 8 GB | 16 GB | 32 GB | 64 GB | 128 GB | 256 GB |
|-------------------------------|------|-------|-------|-------|--------|--------|
| Sustained read (MB/s) | 120 | 215 | 230 | 405 | 450 | 440 |
| Sustained write (MB/s) | 85 | 150 | 130 | 160 | 165 | 160 |

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

3.3 Environmental Specifications

Environmental specification of P100-M series follows MIL-STD-810, as shown in Table 3-3.

Table 3-3 P100-M environmental specifications

| Item | 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 (Operating) RH 95% under 55°C (Extended) |
| Shock | 1500G, 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 | 24°C, RH 49% |

3.4 Mean Time Between Failures (MTBF)

Mean Time Between Failures (MTBF) is predicted based on reliability data for the individual components in P100-M. The prediction result for P100-M is more than 2,000,000 hours.

Notes about the MTBF:

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

3.5 Certification and Compliance

P100-M complies with the following standards:

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

4. Flash Management

4.1 Error Correction/Detection

P100-M implements a hardware ECC scheme, based on the BCH algorithm. It can detect and correct up to 72 bits error in 1K bytes.

4.2 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.

4.3 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 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.

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 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.

4.6 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.

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.

4.8 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 |

Notes:

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

5. Software Interface

5.1 Command Set

This section defines the software requirements and the format of the commands the host sends to P100-M. Commands are issued to P100-M 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

| Command | Code | Command | Code |
|-----------------------------------|---------|-------------------------|------|
| NOP | 00h | Idle | 97h |
| Data Set Management | 06h | Check Power Mode | 98h |
| Recalibrate | 10h-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 |

M.2 2242 Flash Drive
APM2T42P100xxxxAN-XTM1X



| | | | |
|------------------------|-----|---------------------------|-----|
| 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 |

5.2 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.

6. Electrical Specification

Table 6-1: Operating range

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

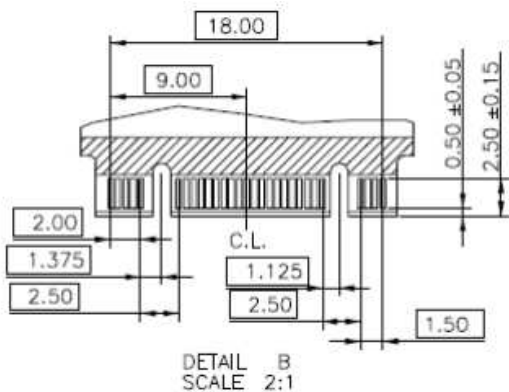
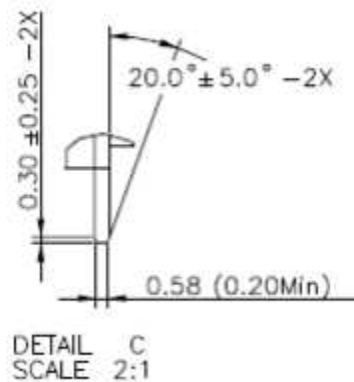
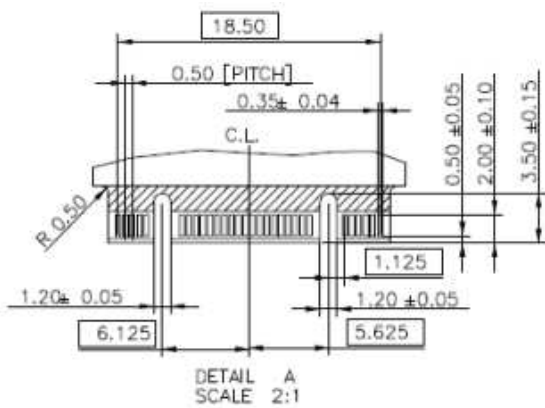
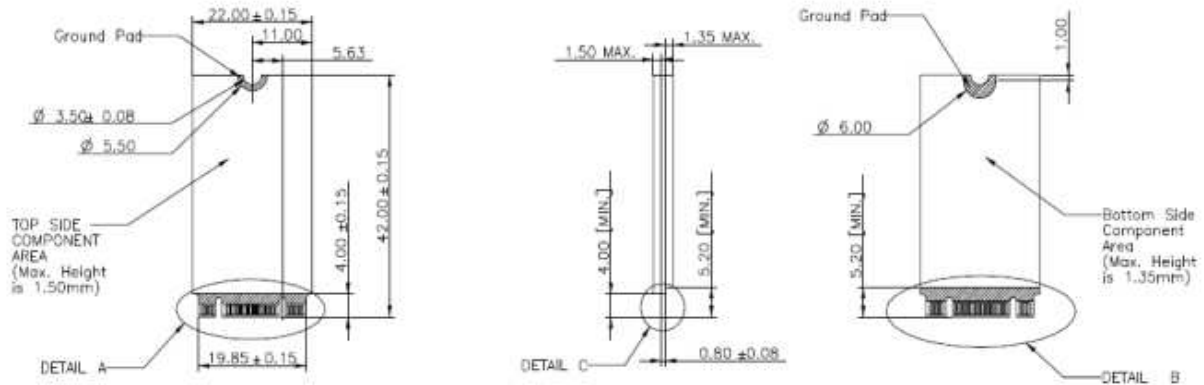
Table 6-2: Power consumption (typical)

| Capacity \ Modes | 8 GB | 16 GB | 32 GB | 64 GB | 128 GB | 256 GB |
|------------------|------|-------|-------|-------|--------|--------|
| Active (mA) | 300 | 300 | 315 | 360 | 455 | 450 |
| Idle (mA) | 85 | 85 | 85 | 95 | 95 | 95 |

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

7. Mechanical Specifications

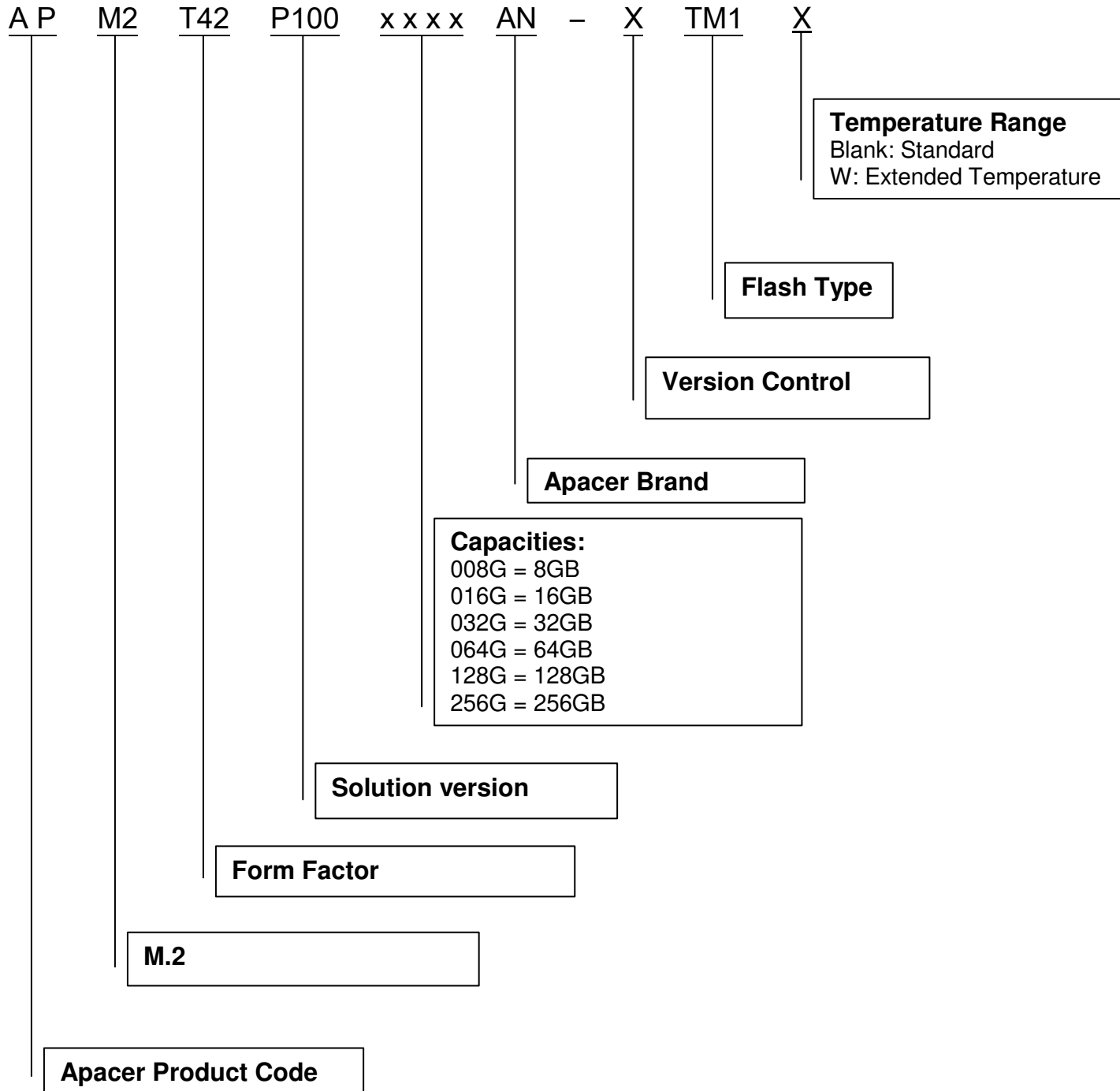
Dimension: 42mm(L) x 22mm(W) x 3.65mm(H)



Unit: mm
 Tolerance: ± 0.25

8. Product Ordering Information

8.1 Product Code Designations



8.2 Valid Combinations

8.2.1 Standard Temperature

| Capacity | No DEVSLP | DEVSLP |
|----------|------------------------|------------------------|
| 8GB | APM2T42P100008GAN-GTM1 | APM2T42P100008GAN-HTM1 |
| 16GB | APM2T42P100016GAN-GTM1 | APM2T42P100016GAN-HTM1 |
| 32GB | APM2T42P100032GAN-GTM1 | APM2T42P100032GAN-HTM1 |
| 64GB | APM2T42P100064GAN-GTM1 | APM2T42P100064GAN-HTM1 |
| 128GB | APM2T42P100128GAN-GTM1 | - |
| 256GB | APM2T42P100256GAN-GTM1 | - |

8.2.2 Extended Temperature

| Capacity | No DEVSLP | DEVSLP |
|----------|-------------------------|-------------------------|
| 8GB | APM2T42P100008GAN-GTM1W | APM2T42P100008GAN-HTM1W |
| 16GB | APM2T42P100016GAN-GTM1W | APM2T42P100016GAN-HTM1W |
| 32GB | APM2T42P100032GAN-GTM1W | APM2T42P100032GAN-HTM1W |
| 64GB | APM2T42P100064GAN-GTM1W | APM2T42P100064GAN-HTM1W |
| 128GB | APM2T42P100128GAN-GTM1W | - |
| 256GB | APM2T42P100256GAN-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 | Date | Description | Remark |
|----------|------------|------------------|--------|
| 1.0 | 10/22/2015 | Official release | |

Global Presence

| | |
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