# UD info Corp.

## Industrial M.2 2280 PCIe SSD
## FIPS 140-2
## M2P-80DA Series
## Product DataSheet

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# Revision History

| Revision | Draft Date | History | Author |
|---|---|---|---|
| 1.0 | 2021/7/8 | New release | Golden Lee |
| 1.1 | 2021/10/22 | Update Product picture | Golden Lee |
| 1.2 | 2024/6/12 | Adde BiCS5 NAND support for Wide temperature | Golden Lee |

# Product Overview

- **Capacity**
  - 256GB up to 2TB
- **Form Factor**
  - E12 M.2 2280-D2-M
- **PCIe Interface**
  - NVMe PCIe Gen3 x4
- **Compliance**
  - NVMe 1.3
  - PCI Express Base 3.1
- **Flash Interface**
  - Up to 4pcs of BGA132 flash
- **Performance**Note1
  - Read up to 3,400 MB/s
  - Write up to 3,100 MB/s
- **Power Consumption**Note2
  - Idle < 2,000 mW
  - L2 < 5 mW
- **Power Management**
  - Support APST
  - Support ASPM
  - Support L1.2
- **Reliability**
  - MTBF more than 2,000,000 hours
  - Uncorrectable Bit Error Rate (UBER) < 1 sector per $10^{16}$ bits read
- **Advanced Flash Management**
  - Advanced Wear Leveling
  - Bad Block Management
  - TRIM
  - SMART
  - Over-Provision
- **Temperature Range**
  - Operation:
    - Standard: 0°C ~ 70°C
    - Wide: -40°C ~ 85°C
  - Storage: -40°C ~ 85°C
  - Operation airflow: 800LFM at 35°C ambient
- **Compliant**
  - RoHS
- **Features Support List**
  - End to end data path protection
  - Thermal throttling
  - SmartECC™
  - SmartRefresh™
  - TCG OPAL
  - FIPS 140-2 lv2 certified: Certificate number #3940

**Notes:**

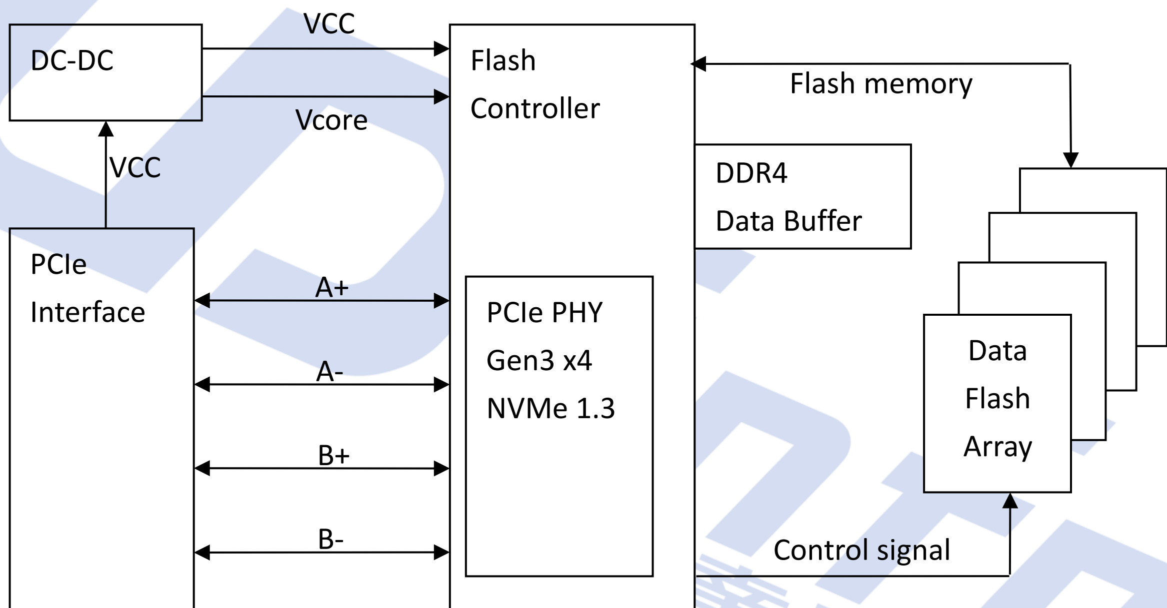
1. Refer to Chapter 2 for more details.
2. Refer to Chapter 4, section 4.2 power consumption for more details.

# 1. INTRODUCTION

## 1.1. General Description

UDinfo's M.2 2280 FIPS PCIe solid state Drive delivers all the advantages of flash disk technology with PCIe Gen3 x4 interface and is fully compliant with the standard Next Generation Form Factor (NGFF) called M.2 Card Format. The M.2 2280 could provide a wide range capacity up to 2TB and its performance can reach up to 3,400MB/s read and 3,100MB/s write based on 3D TLC NAND flash with the choice of 512MB/1GB/2GB DDR4. Moreover, the power consumption of the M.2 2280 is much lower than traditional hard drives, making it the best embedded solution for new platforms.

## 1.2. Block Diagram




**M.2 2280 PCIe SSD Block Diagram**

# 2. PRODUCT SPECIFICATIONS

## 2.1. Product Specifications

- **Capacity**
  - 256GB up to 2TB
- **Electrical/Physical Interface**
  - PCI Express Base Ver 3.1
  - Compliant with NVMe 1.3
  - PCIe Gen3 x 4 lane & backward compatible to PCIe Gen2 and Gen1
  - 8 IO queues supported(1 admin queue and 8 IO queue). Each IO queue support 256 entries.
  - Support power management
- **Supported NAND Flash**
  - Support Kioxia 3D TLC
  - Support up to 4pcs of BGA132 flash (M.2 2280-D2)
  - Support OFNI 4.0 & Toggle 3.0 interface
- **ECC Scheme**
  - Applies LDPC of ECC algorithm
- **Sector Size Support**
  - 512Bytes
  - 4KB
- **GPIO**
- **Support SMART and TRIM commands**
- **Certification & Compliance**
  - RoHS
  - WHQL
  - PCI Express Base 3.1
  - UNH-IOL NVM Express Logo
- **Security features**
  - FIPS 140-2 lv2 certified: when used in FIPS approved mode (When installed, initialized and configured as specified in the Security Rules Section of the UDinfo FIPS 140-2 non-

proprietary Security Policy)

- Full disk AES-XTS 256bit hardware encryption to protect user data storage
- RSA-2048 Digital Signature Verification for secure boot and secure firmware update
- On-chip Deterministic Random Number Generator used for key generation
- Tamper-Evidence Protection
- Support of TCG OPAL SSC 2.0

- **LBA Range**
  - IDEMA standard

| Capacity | Total Sectors (LBA) | User Data Size |
| --- | --- | --- |
| 256GB | 500,118,192 | Depended on file management |
| 512GB | 1,000,215,216 | |
| 1TB | 2,000,409,264 | |
| 2TB | 4,000,797,360 | |

- **TBW (Terabytes Written)**

| Temperature Grade | Capacity | TBW |
| --- | --- | --- |
| Standard Temp. 0°C ~ 70°C | 256GB | 320 |
| | 512GB | 720 |
| | 1TB | 1,620 |
| | 2TB | 3,140 |
| Wide Temp. -40°C ~ 85°C | 256GB | 260 |
| | 512GB | 640 |
| | 1TB | 1,410 |
| | 2TB | 3,050 |

**Notes:**

1. Samples were built using Kioxia 3D TLC NAND flash.
2. The test followed JEDEC219A client endurance workload.
3. TBW may differ according to flash configuration and platform.
4. The endurance of SSD could be estimated based on user behavior, NAND endurance cycles, and write amplification factor. It is not guaranteed by flash vendor.

- **Performance**

  - Standard Temperature Grade Performance

| Capacity | Flash Structure | Flash Type | Sequential | | Random | |
|---|---|---|---|---|---|---|
| | | | Read (MB/s) | Write (MB/s) | Read (IOPS) | Write (IOPS) |
| 256GB | 64GB x 4 | BGA, 3D TLC, 256Gb DDP | 3,300 | 1,300 | 210K | 320K |
| 512GB | 128GB x 4 | BGA, 3D TLC, 256Gb QDP | 3,400 | 2,500 | 420K | 635K |
| 1TB | 256GB x 4 | BGA, 3D TLC, 256Gb ODP | 3,400 | 3,100 | 700K | 690K |
| 2TB | 512GB x 4 | BGA, 3D TLC, 512Gb ODP | 3,400 | 3,000 | 700K | 680K |

  - Wide Temperature Grade Performance

| Capacity | Flash Structure | Flash Type | Sequential | | Random | |
|---|---|---|---|---|---|---|
| | | | Read (MB/s) | Write (MB/s) | Read (IOPS) | Write (IOPS) |
| 256GB | 128GB x 2 | BGA, 3D TLC, 512Gb DDP | 1,400 | 140 | 54K | 35K |
| 512GB | 128GB x 4 | BGA, 3D TLC, 512Gb DDP | 3,300 | 330 | 120K | 80K |
| 1TB | 256GB x 4 | BGA, 3D TLC, 512Gb QDP | 3,300 | 730 | 260K | 170K |
| 2TB | 512GB x 4 | BGA, 3D TLC, 512Gb ODP | 3,300 | 900 | 340K | 230K |

**Notes:**

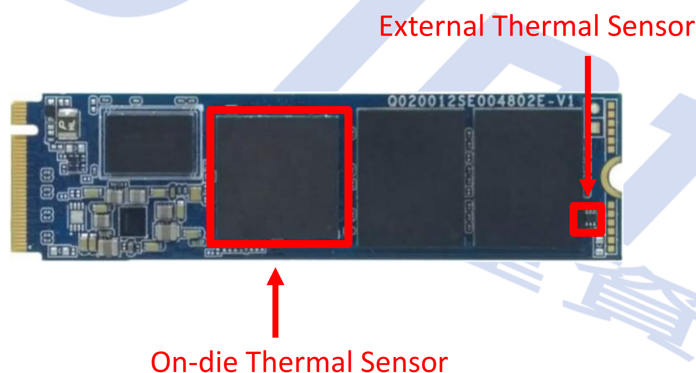
1. The performance was estimated based on Kioxia 3D TLC NAND flash.
2. Performance may differ according to flash configuration and platform.
3. The table above is for reference only. Any criteria for accepting goods shall be discussed based on different flash configurations.
4. Performance is measured with the follow conditions
   (a) CrystalDiskMark 6.0.0, 1GB range, QD=32, Thread=1
   (b) IOMeter, 1GB range, 4K data size, QD=32

## 2.2. Thermal Throttling

The purpose of thermal throttling is to prevent any components in a SSD from over-heating during read and write operations. The controller is designed with an on-die thermal sensor and with its accuracy, firmware can apply different levels of throttling to achieve the purpose of protection efficiently and proactively via S.M.A.R.T. reading.

- **Purpose of Thermal Throttling:**
  - In order to keep the optimal performance in the safe range of the temperature.

- **Thermal sensors:**
  - We have external thermal sensor & on-die thermal sensor (internal controller) to detect temperature. There is 1pcs external thermal sensor on PCB, the position depends on different form factor (The thermal sensor is shown below. The picture is for reference only).
  - External thermal sensor would detect flash temperature; On-die thermal sensor detect controller temperature.



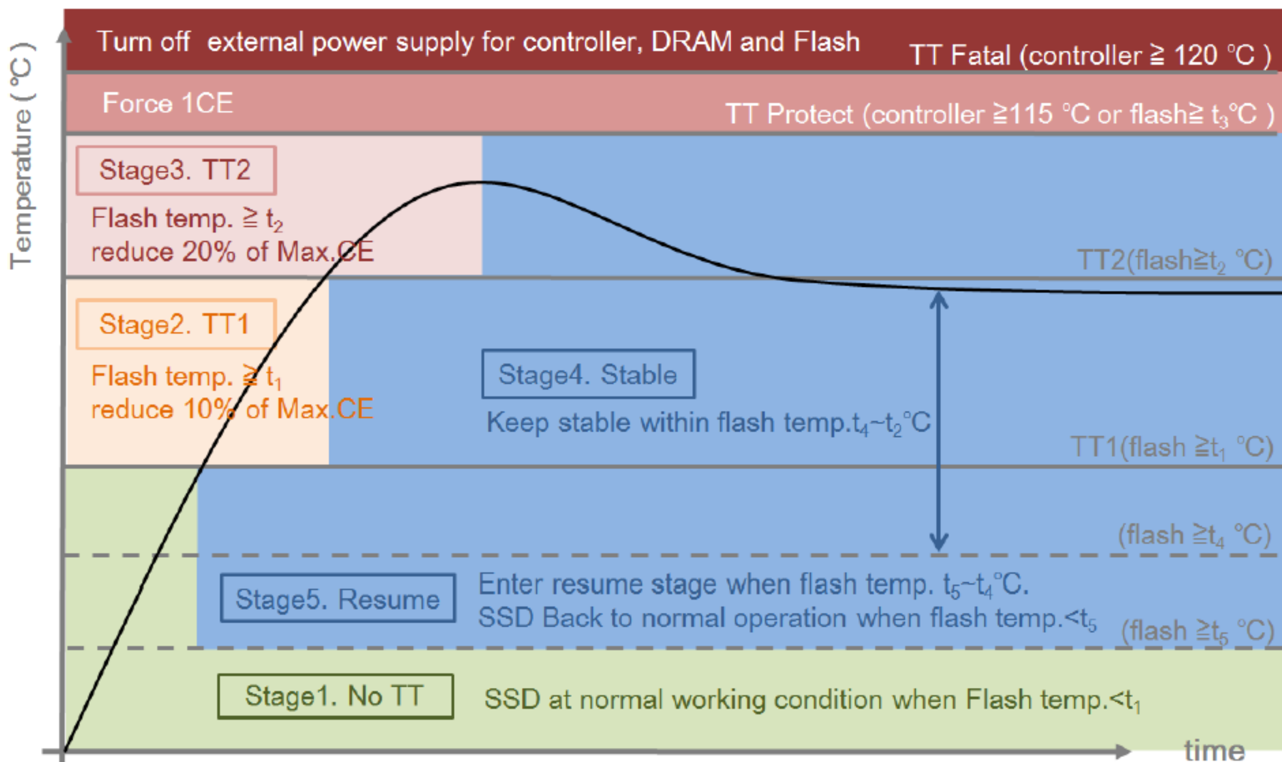



**Figure 2-1 Thermal Throttling Schematic**

| | Operation temp. of Normal-temp. grade: 0-70°C | Operation temp. of Wide-temp. grade: -40-85°C |
|---|---|---|
| **$t_1$** | 68°C | 82°C |
| **$t_2$** | 70°C | 85°C |
| **$t_3$** | 80°C | 95°C |
| **$t_4$** | 64°C | 78°C |
| **$t_5$** | 60°C | 74°C |

**Notes:**

1. TT shown on Figure 2-1 means “Thermal Throttling”.
2. CE = Chip Enable.
3. temp. = temperature

## 2.3. TCG Opal 2.0

The Opal specification is a set of specifications for self-encrypting drives published by the Trusted Computing Group (TCG), a non-profit organization that develops, defines, and promotes standards and specifications for secure computing. The Opal Security Subsystem Class(SSC) 2.0 defines the details of data management in storage devices and the classes authority for data access, and secures data from theft and tampering by unauthorized persons who are able to gain access to the storage device or host system.

**TCG Opal 2.0 Main Features:**

- AES 256-bit Hardware Self Encryption
- Deploy Storage Device & Take Ownership:
  The Storage Device is integrated into its target system and ownership transferred by setting or changing the Storage Device's owner credential.
- Activate or Enroll Storage Device:
  LBA ranges are configured and data encryption and access control credentials (re)generated and/or set on the Storage Device. Access control is configured for LBA range unlocking.
- Lock & Unlock Storage Device:
  Unlocking of one or more LBA ranges by the host and locking of those ranges under host control via either an explicit lock or implicit lock triggered by a reset event. MBR shadowing provides a mechanism to boot into a secure pre-boot authentication environment to handle device unlocking.
- Repurpose & End-of-Life:
  Erasure of data within one or more.
- Physical Presence SID (PSID):
  PSID is defined by TCG OPAL as a 32-character string and the purpose is to revert SSD back to its manufacturing setting when the drive is still OPAL-activated. PSID code can be printed on a SSD label when an OPAL-activated SSD supports PSID revert feature.

# 3. ENVIRONMENTAL SPECIFICATIONS

## 3.1. Environmental Conditions

### 3.1.1. Temperature and Humidity

- Temperature:
  - Storage: -40°C to 85°C
  - Operational (Standard): 0°C to 70°C
  - Operational (Wide): -40°C to 85°C

■ **High Temperature Test Condition**

| | Temperature | Humidity |
|---|---|---|
| **Operation (Standard/Wide)** | 70°C/85°C | 0% RH |
| **Storage** | 85°C | 0% RH |

■ **Low Temperature Test Condition**

| | Temperature | Humidity |
|---|---|---|
| **Operation (Standard/Wide)** | 0°C/-40°C | 0% RH |
| **Storage** | -40°C | 0% RH |

■ **High Humidity Test Condition**

| | Temperature | Humidity |
|---|---|---|
| **Operation** | 40°C | 90% RH |
| **Storage** | 40°C | 93% RH |

■ **Temperature Cycle Test**

| | Temperature |
|---|---|
| **Operation (Standard/Wide)** | 0°C/-40°C |
| | 70°C/85°C Note1 |
| **Storage** | -40°C |
| | 85°C |

**Notes:**

1. Operation temperature is measured by device temperature sensor. Airflow is suggested and it will allow device to be operated at appropriate temperature for each component during heavy workloads environment.

### 3.1.2. Shock

■ **Shock Specification**

| | Acceleration Force |
|---|---|
| **Non-Operational** | 1500G |

### 3.1.3. Vibration

■ **Vibration Specification**

| | Condition | |
|---|---|---|
| | Frequency/Displacement | Frequency/Acceleration |
| **Non-Operational** | 20Hz~80Hz/1.52mm | 80Hz~2000Hz/20G |

### 3.1.4. Drop

■ **Drop Specification**

| | Height of Drop | Number of Drop |
|---|---|---|
| **Non-operational** | 80cm free fall | 6 face of each unit |

### 3.1.5. Bending

■ **Bending Specification**

| | Force | Action |
|---|---|---|
| **Non-operational** | ≥ 20N | Hold 1min/5times |

### 3.1.6. Durability

■ **Durability**

| | Condition |
|---|---|
| **Operational** | 1000 mating cycles |

### 3.1.7. Electrostatic Discharge (ESD)

■ **Contact ESD Specification**

| Device | Temperature | Relative Humidity | +/- 4KV |
|---|---|---|---|
| M.2 2280 | 25.0°C | 50% (RH) | Device functions are affected, but EUT will be back to its normal or operational state automatically. |

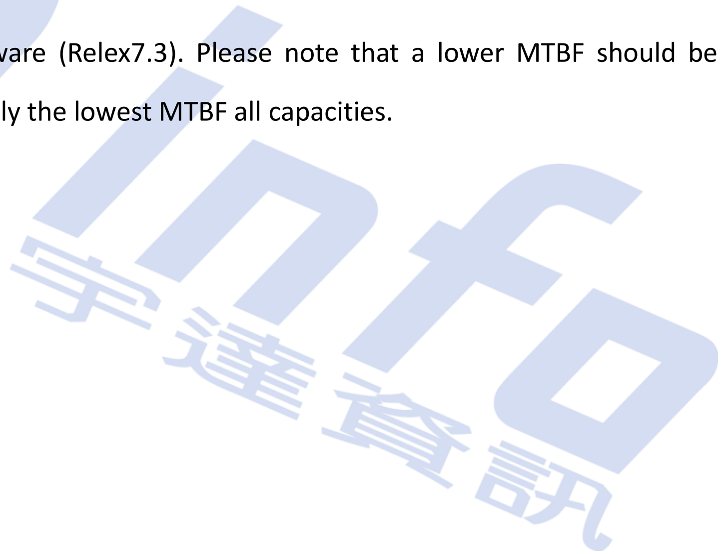
### 3.1.8. EMI Compliance

| Specification |
|---|
| EN 55032, CISPR 32 (CE) |
| AS/NZS CISPR 32 (CE) |
| ANSI C63.4 (FCC) |
| VCCI-CISPR 32 (VCCI) |
| CNS 13438 (BSMI) |

## 3.2. MTBF

MTBF, Mean Time Between Failures, is a measure of reliability a device. Its value represents the average time between a repair and the next failure. The unit of MTBF is in hours. The higher the MTBF value, the higher the reliability of the device.

Our MTBF result is based on simulation software (Relex7.3). Please note that a lower MTBF should be expected for higher capacity drives, and we apply the lowest MTBF all capacities.



# 4. ELECTRICAL SPECIFICATIONS

## 4.1. Supply Voltage

| Parameter | Rating |
|---|---|
| Operating Voltage | Min = 3.14V<br>Max = 3.47V |
| Rise Time (Max/Min) | 100ms / 0.1ms |
| Fall Time (Max/Min) | 5s / 1ms |
| Min. off Time[Note1] | 1s |

Note:

1. Minimum time between power removed from SSD (Vcc < 100mV) and power re-applied to the drive.

## 4.2. Power Consumption

- Standard Temperature Grade Power Consumption

| Capacity | Flash Configuration | CE# | Read | | Write | |
|---|---|---|---|---|---|---|
| | | | Max. | Avg. | Max. | Avg. |
| 256GB | BGA, 3D TLC, 256Gb DDP | 8 | 5.0 | 4.7 | 3.1 | 3.0 |
| 512GB | BGA, 3D TLC, 256Gb QDP | 16 | 5.1 | 4.9 | 4.5 | 4.4 |
| 1TB | BGA, 3D TLC, 256Gb ODP | 32 | 5.3 | 5.3 | 5.2 | 5.1 |
| 2TB | BGA, 3D TLC, 512Gb ODP | 32 | 5.3 | 5.0 | 5.7 | 5.6 |

Unit: W

- Wide Temperature Grade Power Consumption

| Capacity | Flash Configuration | CE# | Read (Max.) | Write (Max.) | Idle (Max.) |
|---|---|---|---|---|---|
| 256GB | BGA, 3D TLC, 512Gb DDP | 4 | 3.3 | 2.7 | 2 |
| 512GB | BGA, 3D TLC, 512Gb DDP | 8 | 5.4 | 3.5 | 2 |
| 1TB | BGA, 3D TLC, 512Gb QDP | 16 | 5.4 | 4.7 | 2 |
| 2TB | BGA, 3D TLC, 512Gb ODP | 16 | 5.7 | 5.8 | 2 |

Unit: W

**Notes**

1. Based on ECPU1xxx-series under ambient temperature.
2. Use CrystalDiskMark 6.0.0 with the setting of 1000MB. Sequentially read and write the disk for 5 times, and measure power consumption during sequential Read [1/5]~[5/5] or sequential Write [1/5]~[5/5]
3. Power Consumption may differ according to flash configuration and platform.

4. The measured power voltage is 3.3V.

- Standard Temperature Grade Power Consumption for power states

| Capacity | Flash Configuration | CE# | Active | | | PS3 | PS4 |
|---|---|---|---|---|---|---|---|
| | | | PS0 | PS1 | PS2 | | |
| 256GB | BGA, 3D TLC, 256Gb DDP | 8 | 5,000 | 1,700 | 1,700 | 16 | 2 |
| 512GB | BGA, 3D TLC, 256Gb QDP | 16 | 5,100 | 1,800 | 1,700 | 16 | 2 |
| 1TB | BGA, 3D TLC, 256Gb ODP | 32 | 5,300 | 1,900 | 1,700 | 21 | 2 |
| 2TB | BGA, 3D TLC, 512Gb ODP | 32 | 5,700 | 1,900 | 1,800 | 22 | 2 |

Unit: mW

**Note**

1. Based on ECPU1xxx-series under ambient temperature.
2. The average value of power consumption is achieved based on 100% conversion efficiency.
3. The measured power voltage is 3.3V.
4. The temperature of a storage device in PS1 should remain constant or should slightly decrease for all workloads so the actual power in PS1 should be lower than PS0.
5. The temperature of a storage device in PS2 should decrease sharply for all workloads so the actual power in PS2 should be lower than PS1.

- Mobile Mark 2014 Average Power consumption

| Capacity | Flash Configuration | Primary |
|---|---|---|
| 256GB | BGA, 3D TLC, 256Gb DDP | TBA |
| 512GB | BGA, 3D TLC, 256Gb QDP | TBA |
| 1TB | BGA, 3D TLC, 256Gb ODP | TBA |
| 2TB | BGA, 3D TLC, 512Gb ODP | TBA |

Unit: mW

**Notes**

1. Based on ECPU1xxx-series under ambient temperature.
2. The measured power voltage is 3.3V.
3. The average value of power consumption is achieved based on 100% conversion efficiency.

# 5. INTERFACE

## 5.1. Pin Assignment and Descriptions

The follow table defines the signal assignment of the internal NGFF connector for SSD usage, described in the PCI Express M.2 Specification version 1.1 of the PCI-SIG.

| Pin # | SATA Pin | Description |
|---|---|---|
| 1 | GND | Ground |
| 2 | 3.3V | 3.3V source |
| 3 | GND | Ground |
| 4 | 3.3V | 3.3V source |
| 5 | PETn3 | PCIe TX Differential signal defined by the PCI Express M.2 spec |
| 6 | N/C | No connect |
| 7 | PETp3 | PCIe TX Differential signal defined by the PCI Express M.2 spec |
| 8 | N/C | No connect |
| 9 | GND | Ground |
| 10 | LED1# | Open drain, active low signal. These signals are used to allow the add-in card to provide status indicators via LED devices that will be provided by the system. |
| 11 | PERn3 | PCIe RX Differential signal defined by the PCI Express M.2 spec |
| 12 | 3.3V | 3.3V source |
| 13 | PERp3 | PCIe RX Differential signal defined by the PCI Express M.2 spec |
| 14 | 3.3V | 3.3V source |
| 15 | GND | Ground |
| 16 | 3.3V | 3.3V source |
| 17 | PETn2 | PCIe RX Differential signal defined by the PCI Express M.2 spec |
| 18 | 3.3V | 3.3V source |
| 19 | PETp2 | PCIe RX Differential signal defined by the PCI Express M.2 spec |
| 20 | N/C | No connect |
| 21 | GND | Ground |
| 22 | N/C | No connect |
| 23 | PERn2 | PCIe RX Differential signal defined by the PCI Express M.2 spec |
| 24 | N/C | No connect |
| 25 | PERp2 | PCIe RX Differential signal defined by the PCI Express M.2 spec |
| 26 | N/C | No connect |
| 27 | GND | Ground |
| 28 | N/C | No connect |

| Pin # | SATA Pin | Description |
|---|---|---|
| 29 | PETn1 | PCIe TX Differential signal defined by the PCI Express M.2 spec |
| 30 | N/C | No connect |
| 31 | PETp1 | PCIe TX Differential signal defined by the PCI Express M.2 spec |
| 32 | N/C | No connect |
| 33 | GND | Ground |
| 34 | N/C | No connect |
| 35 | PERn1 | PCIe RX Differential signal defined by the PCI Express M.2 spec |
| 36 | N/C | No connect |
| 37 | PERp1 | PCIe RX Differential signal defined by the PCI Express M.2 spec |
| 38 | N/C | No connect |
| 39 | GND | Ground |
| 40 | SMB_CLK (I/O)(0/1.8V) | SMBus Clock; Open Drain with pull-up on platform. |
| 41 | PETn0 | PCIe TX Differential signal defined by the PCI Express M.2 spec |
| 42 | SMB_DATA (I/O)(0/1.8V) | SMBus Data; Open Drain with pull-up on platform. |
| 43 | PETp0 | PCIe TX Differential signal defined by the PCI Express M.2 spec |
| 44 | ALERT#(O)(0/1.8V) | Alert notification to master; Open Drain with pull-up on platform; Active low. |
| 45 | GND | Ground |
| 46 | N/C | No connect |
| 47 | PERn0 | PCIe RX Differential signal defined by the PCI Express M.2 spec |
| 48 | N/C | No connect |
| 49 | PERp0 | PCIe RX Differential signal defined by the PCI Express M.2 spec |
| 50 | PERST#(I)(0/3.3V) | PE-Reset is a functional reset to the card as defined by the PCIe Mini CEM specification. |
| 51 | GND | Ground |
| 52 | CLKREQ#(I/O)(0/3.3V) | Clock Request is a reference clock request signal as defined by the PCIe Mini CEM specification; Also used by L1 PM Sub-states. |
| 53 | REFCLKn | PCIe Reference Clock signals (100 MHz) defined by the PCI Express M.2 spec. |
| 54 | PEWAKE#(I/O)(0/3.3V) | PCIe PME Wake.<br>Open Drain with pull up on platform; Active Low. |
| 55 | REFCLKp | PCIe Reference Clock signals (100 MHz) defined by the PCI Express M.2 spec. |
| 56 | Reserved for MFG DATA | Manufacturing Data line. Used for SSD manufacturing only.<br>Not used in normal operation.<br>Pins should be left N/C in platform Socket. |

| Pin # | SATA Pin | Description |
|---|---|---|
| 57 | GND | Ground |
| 58 | Reserved for MFG CLOCK | Manufacturing Clock line. Used for SSD manufacturing only.<br>Not used in normal operation.<br>Pins should be left N/C in platform Socket. |
| 59 | Module Key M | Module Key |
| 60 | Module Key M | |
| 61 | Module Key M | |
| 62 | Module Key M | |
| 63 | Module Key M | |
| 64 | Module Key M | |
| 65 | Module Key M | |
| 66 | Module Key M | |
| 67 | N/C | No Connect |
| 68 | SUSCLK(32KHz)<br>(I)(0/3.3V) | 32.768 kHz clock supply input that is provided by the platform<br>chipset to reduce power and cost for the module. |
| 69 | N/C | PEDET (NC-PCIe).<br>No Connect for PCIe. |
| 70 | 3.3V | 3.3V source |
| 71 | GND | Ground |
| 72 | 3.3V | 3.3V source |
| 73 | GND | Ground |
| 74 | 3.3V | 3.3V source |
| 75 | GND | Ground |

# 6. SUPPORTED COMMANDS

## 6.1. NVMe Command List

Table 6-1 Admin Commands

| Op-Code | O/M | Command Description |
|---|---|---|
| 00h | M | Delete I/O Submission Queue |
| 01h | M | Create I/O Submission Queue |
| 02h | M | Get Log Page |
| 04h | M | Delete I/O Completion Queue |
| 05h | M | Create I/O Completion Queue |
| 06h | M | Identify |
| 08h | M | Abort |
| 09h | M | Set Features |
| 0Ah | M | Get Features |
| 0Ch | M | Asynchronous Event Request |
| 10h | O | Firmware Activate |
| 11h | O | Firmware Image Download |
| 14h | O | Device Self-test |
| 80h | O | Format NVM (disabled when in FIPS approved mode) |
| 81h | O | Security Send |
| 82h | O | Security Receive |
| 84h | O | Sanitize (disabled) |

Table 6-2 I/O Commands

| Op-Code | O/M | Command Description |
|---|---|---|
| 00h | O | Flush |
| 01h | O | Write |
| 02h | O | Read |
| 04h | O | Write Uncorrectable (disabled when in FIPS approved mode) |
| 05h | O | Compare (disabled when in FIPS approved mode) |
| 08h | O | Write Zeroes (disabled when in FIPS approved mode) |
| 09h | O | Dataset Management (disabled when in FIPS approved mode) |

**Table 6-3 Set Feature Commands**

| Op-Code | O/M | Command Description |
| --- | --- | --- |
| 00h | | Reserved |
| 01h | M | Arbitration |
| 02h | M | Power Management |
| 03h | O | LBA Range Type |
| 04h | M | Temperature Threshold |
| 05h | M | Error Recovery |
| 06h | O | Volatile Write Cache |
| 07h | M | Number of Queues |
| 08h | M | Interrupt Coalescing |
| 09h | M | Interrupt Vector Configuration |
| 0Ah | M | Write Atomicity Normal |
| 0Bh | M | Asynchronous Event Configuration |
| 0Ch | O | Autonomous Power State Transition |
| 0Dh | O | Host Memory Buffer |
| 0Eh | O | Timestamp |
| 10h | O | Host Controlled Thermal Management |
| 11h | O | Non-Operational Power State Config |
| 0Eh – 7Dh | | Reserved |
| 80h | O | Software Progress Marker |

**Table 6-4 Get Log Page Commands**

| Op-Code | O/M | Command Description |
| --- | --- | --- |
| 00h | | Reserved |
| 01h | M | Error Information |
| 02h | M | SMART / Health Information |
| 03h | M | Firmware Slot Information |
| 04h | O | Changed Namespace List |
| 06h | O | Device Self-test |
| 09h – 7Fh | | Reserved |
| 81h | - | Sanitize Status (not supported) |
| 82h - FFh | | Reserved |

## 6.2. Identify Device Data

The following table details the sector data returned by the IDENTIFY DEVICE command.

- **Identify Controller Data Structure**

| Bytes | O/M | Default Value | Description |
|---|---|---|---|
| 01:00 | M | 0x1987 | PCI Vendor ID (VID) |
| 03:02 | M | 0x1987 | PCI Subsystem Vendor ID (SSVID) |
| 23:04 | M | TBD | Serial Number (SN) |
| 63:24 | M | TBD | Model Number (MN) |
| 71:64 | M | TBD | Firmware Revision (FR) |
| 72 | M | 0x01 | Recommended Arbitration Burst (RAB) |
| 75:73 | M | TBD * | IEEE OUI Identifier (IEEE) |
| 76 | O | 0x00 | Controller Multi-Path I/O and Namespace Sharing Capabilities (CMIC) |
| 77 | M | 0x09 | Maximum Data Transfer Size (MDTS) |
| 79:78 | M | 0x0001 | Controller ID (CNTLID) |
| 83:80 | M | 0x00010300 | Version (VER) |
| 87:84 | M | 0x001E8480(2sec) | RTD3 Resume Latency (RTD3R) |
| 91:88 | M | 0x00989680(10sec) | RTD3 Entry Latency (RTD3E) |
| 95:92 | M | 0x00000300 | Optional Asynchronous Events Supported (OAES) |
| 99:96 | M | 0x0002 | Controller Attributes (CTRATT) |
| 239:100 | - | 0x00 | Reserved |
| 255:240 | - | 0x00 | Refer to the NVMe Management Interface Specification for definition |
| 257:256 | M | 0x0017 | Optional Admin Command Support (OACS) |
| 258 | M | 0x03 | Abort Command Limit (ACL) |
| 259 | M | 0x03 | Asynchronous Event Request Limit (AERL) |
| 260 | M | 0x1F | Firmware Updates (FRMW) |
| 261 | M | 0x0C | Log Page Attributes (LPA) |
| 262 | M | 0x3E | Error Log Page Entries (ELPE) |
| 263 | M | 4 | Number of Power States Support (NPSS) |
| 264 | M | 0x01 | Admin Vendor Specific Command Configuration (AVSCC) |
| 265 | O | 0x01 | Autonomous Power State Transition Attributes (APSTA) |
| 267:266 | M | 0x0157 (70C) | Warning Composite Temperature Threshold (WCTEMP) |
| 269:268 | M | 0x0161 (80C) | Critical Composite Temperature Threshold (CCTEMP) |
| 271:270 | O | 0x0000 (No report) | Maximum Time for Firmware Activation (MTFA) |
| 275:272 | O | 0x00000000 | Host Memory Buffer Preferred Size (HMPRE) |
| 279:276 | O | 0x00000000 | Host Memory Buffer Minimum Size (HMMIN) |

| Bytes | O/M | Default Value | Description |
|---|---|---|---|
| 295:280 | O | ** | Total NVM Capacity (TNVMCAP) |
| 311:296 | O | ** | Unallocated NVM Capacity (UNVMCAP) |
| 315:312 | O | 0x00000000 | Replay Protected Memory Block Support (RPMBS) |
| 511:316 | - | Non-zero | Reserved |
| **NVM Command Set Attributes** | | | |
| 512 | M | 0x66 | Submission Queue Entry Size (SQES) |
| 513 | M | 0x44 | Completion Queue Entry Size (CQES) |
| 515:514 | - | 0x0000 | Reserved |
| 519:516 | M | 0x00000001 | Number of Namespaces (NN) |
| 521:520 | M | 0x001F | Optional NVM Command Support (ONCS) |
| 523:522 | M | 0x0000 | Fused Operation Support (FUSES) |
| 524 | M | 0x00 | Format NVM Attributes (FNA) |
| 525 | M | 0x01 | Volatile Write Cache (VWC) |
| 527:526 | M | TBD | Atomic Write Unit Normal (AWUN) |
| 529:528 | M | TBD | Atomic Write Unit Power Fail (AWUPF) |
| 530 | M | 0x01 | NVM Vendor Specific Command Configuration (NVSCC) |
| 531 | - | 0x00 | Reserved |
| 533:532 | O | 0x0000 | Atomic Compare & Write Unit (ACWU) |
| 535:534 | - | 0x0000 | Reserved |
| 539:536 | O | 0x00000000 | SGL Support (SGLS) |
| 703:540 | - | 0x00 | Reserved |
| **IO Command Set Attributes** | | | |
| 2047:704 | - | 0x00 | Reserved |
| 2079:2048 | M | TBD | Power State 0 Descriptor (PSD0) |
| 2111:2080 | O | 0x00 | Power State 1 Descriptor (PSD1) |
| 2143:2112 | O | 0x00 | Power State 2 Descriptor (PSD2) |
| 2175:2144 | O | 0x00 | Power State 3 Descriptor (PSD3) |
| 2207:2176 | O | 0x00 | Power State 4 Descriptor (PSD4) |
| 2239:2208 | O | 0x00 | Power State 5 Descriptor (PSD5) |
| 2271:2240 | O | 0x00 | Power State 6 Descriptor (PSD6) |
| 2303:2272 | O | 0x00 | Power State 7 Descriptor (PSD7) |
| 2335:2304 | O | 0x00 | Power State 8 Descriptor (PSD8) |
| 2367:2336 | O | 0x00 | Power State 9 Descriptor (PSD9) |
| 2399:2368 | O | 0x00 | Power State 10 Descriptor (PSD10) |
| 2431:2400 | O | 0x00 | Power State 11 Descriptor (PSD11) |

| Bytes | O/M | Default Value | Description |
|---|---|---|---|
| 2463:2432 | O | 0x00 | Power State 12 Descriptor (PSD12) |
| 2495:2464 | O | 0x00 | Power State 13 Descriptor (PSD13) |
| 2527:2496 | O | 0x00 | Power State 14 Descriptor (PSD14) |
| 2559:2528 | O | 0x00 | Power State 15 Descriptor (PSD15) |
| 2591:2560 | O | 0x00 | Power State 16 Descriptor (PSD16) |
| 2623:2592 | O | 0x00 | Power State 17 Descriptor (PSD17) |
| 2655:2624 | O | 0x00 | Power State 18 Descriptor (PSD18) |
| 2687:2656 | O | 0x00 | Power State 19 Descriptor (PSD19) |
| 2719:2688 | O | 0x00 | Power State 20 Descriptor (PSD20) |
| 2751:2720 | O | 0x00 | Power State 21 Descriptor (PSD21) |
| 2783:2752 | O | 0x00 | Power State 22 Descriptor (PSD22) |
| 2815:2784 | O | 0x00 | Power State 23 Descriptor (PSD23) |
| 2847:2816 | O | 0x00 | Power State 24 Descriptor (PSD24) |
| 2879:2848 | O | 0x00 | Power State 25 Descriptor (PSD25) |
| 2911:2880 | O | 0x00 | Power State26 Descriptor (PSD26) |
| 2943:2912 | O | 0x00 | Power State 27 Descriptor (PSD27) |
| 2975:2944 | O | 0x00 | Power State 28 Descriptor (PSD28) |
| 3007:2976 | O | 0x00 | Power State 29 Descriptor (PSD29) |
| 3039:3008 | O | 0x00 | Power State 30 Descriptor (PSD30) |
| 3071:3040 | O | 0x00 | Power State 31 Descriptor (PSD31) |
| **Vendor Specific** | | | |
| 4095:3072 | O | Vendor Reserved | Vendor Specific (VS) |

***** The OUI shall be a valid IEEE/RAC assigned identifier that may be registered at
http://standards.ieee.org/develop/regauth/oui/public.html.

****** Depends on the using of capacity

■ **Identify Namespace Data Structure & NVM Command Set Specific**

| Bytes | O/M | Default Value | Description |
|---|---|---|---|
| 7:0 | M | TBD* | Namespace Size (NSZE) |
| 15:8 | M | TBD* | Namespace Capacity (NCAP) |
| 23:16 | M | TBD* | Namespace Utilization (NUSE) |
| 24 | M | 0x00 | Namespace Features (NSFEAT) |
| 25 | M | 0x01 | Number of LBA Formats (NLBAF) |
| 26 | M | 0x00 | Formatted LBA Size (FLBAS) |
| 27 | M | 0x00 | Metadata Capabilities (MC) |
| 28 | M | 0x00 | End-to-end Data Protection Capabilities (DPC) |
| 29 | M | 0x00 | End-to-end Data Protection Type Settings (DPS) |
| 30 | O | 0x00 | Namespace Multi-path I/O and Namespace Sharing Capabilities (NMIC) |
| 31 | O | 0x00 | Reservation Capabilities (RESCAP) |
| 32 | O | 0x00 | Format Progress Indicator (FPI) |
| 33 | - | 0x09 | Reserved |
| 35:34 | O | 0x0000 | Namespace Atomic Write Unit Normal (NAWUN) |
| 37:36 | O | 0x0000 | Namespace Atomic Write Unit Power Fail (NAWUPF) |
| 39:38 | O | 0x0000 | Namespace Atomic Compare & Write Unit (NACWU) |
| 41:40 | O | 0x0000 | Namespace Atomic Boundary Size Normal (NABSN) |
| 43:42 | O | 0x0000 | Namespace Atomic Boundary Offset (NABO) |
| 45:44 | O | 0x0000 | Namespace Atomic Boundary Size Power Fail (NABSPF) |
| 47:46 | - | 0x0000 | Reserved |
| 63:48 | O | 0x00 | NVM Capacity (NVMCAP) |
| 103:64 | - | 0x00 | Reserved |
| 119:104 | O | TBD ** | Namespace Globally Unique Identifier (NGUID) |
| 127:120 | O | TBD ** | IEEE Extended Unique Identifier (EUI64) |
| 131:128 | M | 0x02090000 | LBA Format 0 Support (LBAF0) |
| 135:132 | O | 0x00000000 | LBA Format 1 Support (LBAF1) |
| 139:136 | O | 0x00000000 | LBA Format 2 Support (LBAF2) |
| 143:140 | O | 0x00000000 | LBA Format 3 Support (LBAF3) |
| 147:144 | O | 0x00000000 | LBA Format 4 Support (LBAF4) |
| 151:148 | O | 0x00000000 | LBA Format 5 Support (LBAF5) |
| 155:152 | O | 0x00000000 | LBA Format 6 Support (LBAF6) |
| 159:156 | O | 0x00000000 | LBA Format 7 Support (LBAF7) |
| 163:160 | O | 0x00000000 | LBA Format 8 Support (LBAF8) |
| 167:164 | O | 0x00000000 | LBA Format 9 Support (LBAF9) |

| Bytes | O/M | Default Value | Description |
|---|---|---|---|
| 171:168 | O | 0x00000000 | LBA Format 10 Support (LBAF10) |
| 175:172 | O | 0x00000000 | LBA Format 11 Support (LBAF11) |
| 179:176 | O | 0x00000000 | LBA Format 12 Support (LBAF12) |
| 183:180 | O | 0x00000000 | LBA Format 13 Support (LBAF13) |
| 187:184 | O | 0x00000000 | LBA Format 14 Support (LBAF14) |
| 191:188 | O | 0x00000000 | LBA Format 15 Support (LBAF15) |
| 383:192 | - | 0x00 | Reserved |
| 4095:384 | O | 0x00 | Vendor Specific (VS) |

***** See IDEMA SPEC

****** See IEEE EUI-64 SPEC

## ■ List of Identify Namespace Data Structure for Each Capacity

| Capacity (GB) | Byte[7:0]: Namespace Size (NSZE) |
|---|---|
| 256 | 1DCF32B0h |
| 512 | 3B9E12B0h |
| 1024 | 773BD2B0h |
| 2048 | EE7752B0h |

## 6.3. SMART Attributes

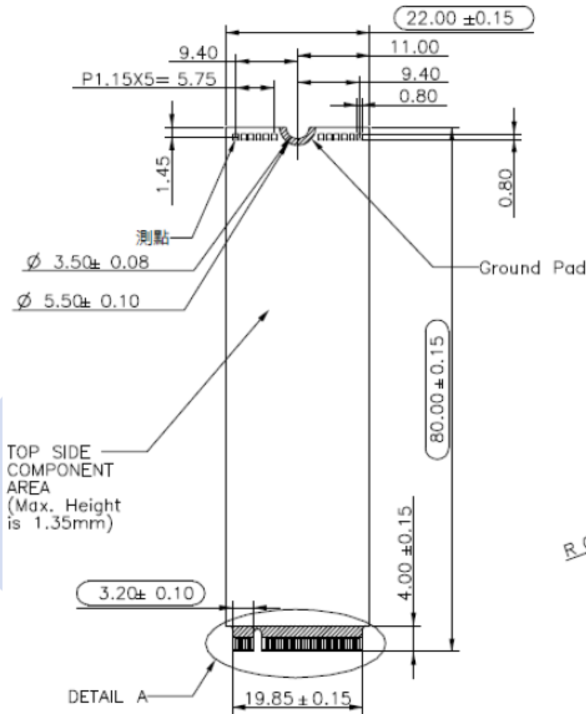
■ **SMART Attributes (Log Identifier 02h)**

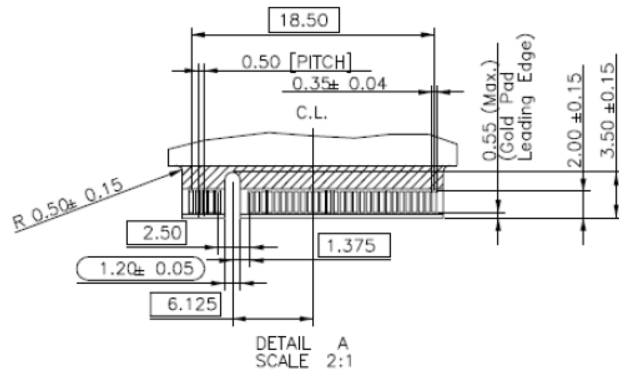
| Bytes Index | Bytes | Description |
|---|---|---|
| [0] | 1 | Critical Warning |
| [2:1] | 2 | Composite Temperature |
| [3] | 1 | Available Spare |
| [4] | 1 | Available Spare Threshold |
| [5] | 1 | Percentage Used |
| [31:6] | 26 | Reserved |
| [47:32] | 16 | Data Units Read |
| [63:48] | 16 | Data Units Written |
| [79:64] | 16 | Host Read Commands |
| [95:80] | 16 | Host Write Commands |
| [111:96] | 16 | Controller Busy Time |
| [127:112] | 16 | Power Cycles |
| [143:128] | 16 | Power On Hours |
| [159:144] | 16 | Unsafe Shutdowns |
| [175:160] | 16 | Media and Data Integrity Errors |
| [191:176] | 16 | Number of Error Information Log Entries |
| [195:192] | 4 | Warning Composite Temperature Time |
| [199:196] | 4 | Critical Composite Temperature Time |
| [201:200] | 2 | Temperature Sensor 1 (Current Temperature) |
| [203:202] | 2 | Temperature Sensor 2 (N/A) |
| [205:204] | 2 | Temperature Sensor 3 (N/A) |
| [207:206] | 2 | Temperature Sensor 4 (N/A) |
| [209:208] | 2 | Temperature Sensor 5 (N/A) |
| [211:210] | 2 | Temperature Sensor 6 (N/A) |
| [213:212] | 2 | Temperature Sensor 7 (N/A) |
| [215:214] | 2 | Temperature Sensor 8 (N/A) |
| [511:216] | 296 | Reserved |

# 7. PHYSICAL DIMENSION

- **Dimension of M.2 2280-D2-M: 80mm(L) x 22mm(W) x 3.5mm(H)**

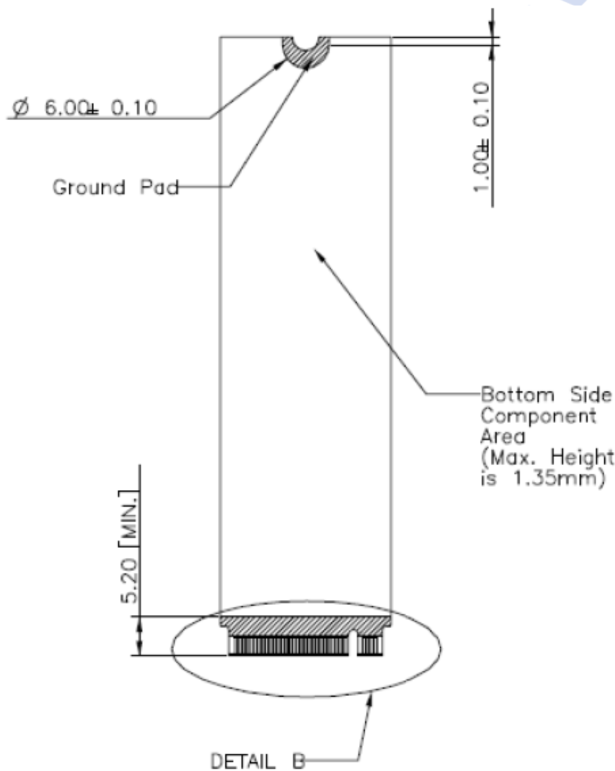
**Top View**

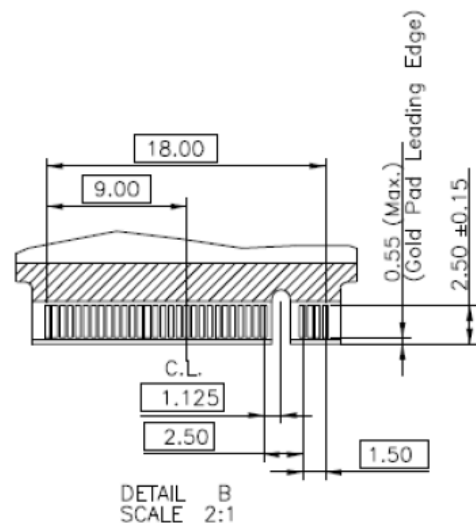


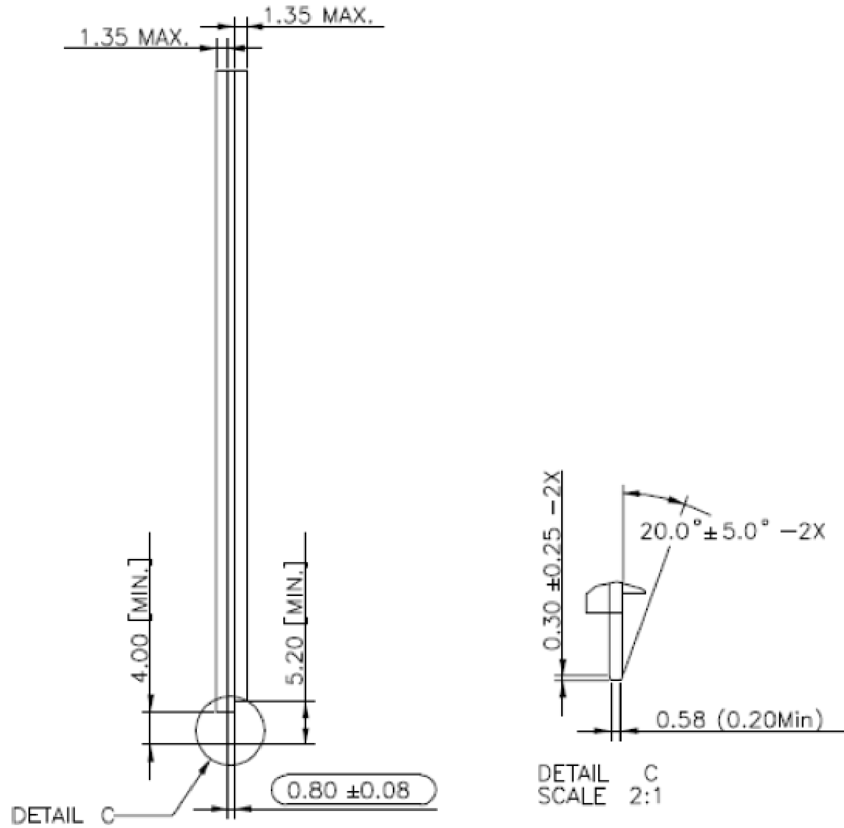

Unit : mm

**Bottom View**

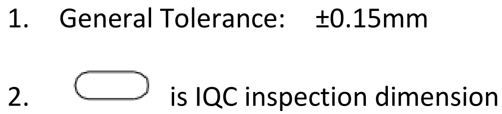


## Side View

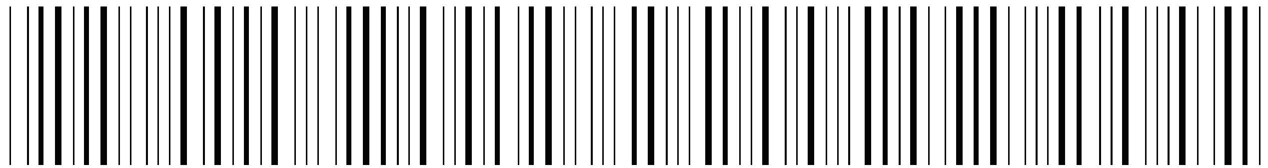


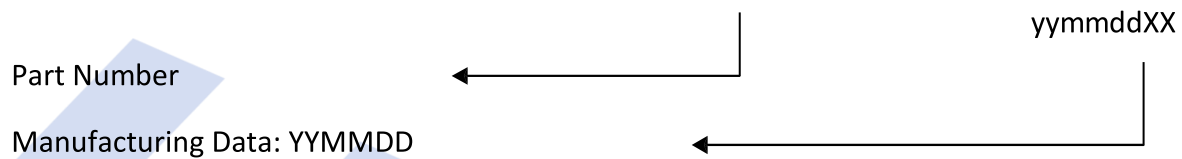
1. General Tolerance: ±0.15mm



2. ( ) is IQC inspection dimension

## 8. BARCODE DESCRIPTION




## 9. ORDERING INFORMATION

| Temperature Grade | Capacity | Part Number |
|---|---|---|
| Standard Temp.<br>0°C ~ 70°C | 256GB | M2P-80DA256GB-A8P |
| | 512GB | M2P-80DA512GB-A8P |
| | 1TB | M2P-80DA001TB-A8P |
| | 2TB | M2P-80DA002TB-A8P |
| Wide Temp.<br>-40°C ~ 85°C | 256GB | M2P-80DA256GB-BEP |
| | 512GB | M2P-80DA512GB-BEP |
| | 1TB | M2P-80DA001TB-BEP |
| | 2TB | M2P-80DA002TB-BEP |