# PM4 series (RM2/4)

## Enterprise-grade PCIe SSD

## Specifications(Customized)

### Capacity
- Pro Edition
  - M.2 2280: 240~480 / 960~7680 GB

### omponents
- Controller: Marvell 88SS1321
- Flash: 3D TLC
- DRAM: DDR4

### Compliance
- PCIe Gen4x4/ Gen4x2/ Gen3x4
- Surprise insertion / surprise removal (SISR) and hot-plug capable (U.2/E1.S support)

### Performance (up to)[1]
- Sequential read: 3200 MB/s
- Sequential write: 3010 MB/s
- Random 4K read: 371,000 IOPS
- Random 4K write: 61,000 IOPS

### Power management
- Auto idle
- PCIe link power management
- Temperature monitoring and throttling

### Security
- NVM Format
- Support SED (TCG Opal 2.01/AES-256)

### Reliability
- Advanced LDPC error correction
- Global static and dynamic wear leveling
- UBER: <1 sector per $10^{17}$ bits read
- MTBF: 2.0 million hours

### Physical insertion cycles
- 5000 Cycles

### Endurance[2] (JESD219 Enterprise / Client) @ 5 years
- Streaming(Standard) Edition: 0.6 DWPD / 1.5 DWPD
- Pro Edition: 1 DWPD / 2 DWPD
- Max Edition: 25 DWPD / 40 DWPD

### Data retention
- JESD218A-compliant

### Compatibility
- Windows 11/10/8.1/7
- Windows Server 2012/2016/2019/2022
- CentOS, Fedora, FreeBSD, openSUSE, Red Hat, Ubuntu, VMware ESXi, Citrix, KVM

### Mechanical form factor
- M.2 2280: 80 mm x 22 mm x 4.0 mm

### Power consumption (TYP)
- Idle: < 1.1 W
- Active: < 8.8 W

### Environment
- Operating temperature: 0–70 °C
- Storage temperature: -40–85 °C

### Shock & vibration
- Operating: 50 G
  (11 ms duration, half sine wave)
- Non-operating: 1500 G
  (0.5 ms duration, half sine wave)
- Vibration: 10 G
  (peak,10–2000 Hz)

### Technology
- HW power loss protection (<4TB)
- Conformal Coating (upon request)
- Underfill (upon request)

### Warranty
- 5-year limited warranty[3]

**Specification notes:**
1. Performance claims
   a. Actual performance may vary based on the hardware, software, and overall system configuration.
   b. Sequential performance is measured with 128 KB transfer size, QD 32 and 4 KB alignment with Iometer.
   c. Random performance is sustained performance measured with 4K transfer size, QD 32 and 4 KB alignment with Iometer.
   d. Performance test platform: CPU: Intel Core i9-13900K; motherboard: ASUS Prime Z790-P; OS: Windows 11 Pro x64 21H2.
2. Endurance claims
   a. DWPD stands for Drive Writes Per Day. TBW = DWPD * capacity * warranty * 365 / 1024.
   b. Access patterns used for random workload during endurance testing is compliant with the JESD219 standard.
3. Limited warranty details: please refer to limited warranty policy and warranty terms.


Products and specifications are subject to change by Exascend without notice.
Customized solutions available upon request. Contact us at https://exascend.com/inquiry/.

# Table of Contents

**Specifications** ..... **1**
**Product Datasheet** ..... **3**
1. Order information ..... 3
2. Part number decoder ..... 4
3. Product overview ..... 5
3.1 PM4 series ..... 5
3.2 Customization and tuning services ..... 6
4. Detailed specifications ..... 7
4.1 Capacity ..... 7
4.2 Performance ..... 8
4.3 Environment specification ..... 9
4.4 Power consumption ..... 10
4.5 Reliability ..... 10
5. Physical dimension diagram ..... 11
5.1 PCIe M.2 2280 ..... 11
6. Pin Assignment ..... 12
6.1 PCIe M.2 connector ..... 12
7. Compliance ..... 14
8. Supported NVMe commands ..... 14
9. S.M.A.R.T. support ..... 15
9.1 Overview of S.M.A.R.T. support ..... 15
9.2 S.M.A.R.T. health information ..... 15
**Legal information** ..... **17**
Limited Warranty Policy ..... 17
Warranty Terms ..... 17
Disclaimer of liability ..... 17
Copyright notice ..... 17
Contact information ..... 18
**Revision** ..... **19**

# Product Datasheet

## 1. Order information

The following table lists the standard part numbers for Exascend PM4 series SSDs. For customization and design service inquiries, including – but not limited to – custom operating temperature, capacity, over-provisioning, endurance, performance, and power, please contact your Exascend account manager or send us an email at sales@exascend.us.

**Standard Product and SKU list**

| P/N | Form Factor | Edition | Capacity | Flash Type |
|---|---|---|---|---|
| EXPM4M0240GBRM2-0P0GWP | M.2 2280 | Pro | 240 GB | 3D TLC |
| EXPM4M0480GBRM2-0P0GWP | M.2 2280 | Pro | 480 GB | 3D TLC |
| EXPM4M0960GBRM4-0P0GWP | M.2 2280 | Pro | 960 GB | 3D TLC |
| EXPM4M1920GBRM4-0P0GWP | M.2 2280 | Pro | 1,920 GB | 3D TLC |
| EXPM4M3840GBRM4-0P0GWP | M.2 2280 | Pro | 3,840 GB | 3D TLC |
| EXPM4M7680GBRM4-0P0GWP | M.2 2280 | Pro | 7,680 GB | 3D TLC |

## 2. Part number decoder

**[ P/N Decoder For Standard Product and SKU ]**

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| **EX** | **PM4** | **M** | **7680GB** | **RM4** | **-** | **(Blank)** |

| String | Code | Definition | Description |
|---|---|---|---|
| 1 | Code 1~2 | Prefix | Exascend |
| 2 | Code 3~5 | Product Line | SI3 / SE4 / SI4 / SV4 / SA4 / SR4<br>PI3 / PE4 / PI4 / PA4 / PD5 / PB2/ PM4 |
| 3 | Code 6 | Form Factor | A = 2.5”<br>B = mSATA<br>E = E1.S<br>G = BGA SSD<br>M = M.2 2280<br>P = M.2 2260<br>Q = M.2 2242<br>R = M.2 2230<br>U = U.2 |
| 4 | Code 7~12 | Capacity | Capacity & Unit |
| 5 | Code 13~15 | Sub-Series | (Blank) = Default<br>RM* = Internal Code |
| 6 | Code 16 | Hyphen | - |
| 7 | Code 17~ | Product Edition | (Blank) = Streaming Edition (Standard)<br>0P = Pro Edition (High DWPD)<br>0X = Max Edition (pSLC)<br>0G =TCG Opal<br>WP = HW PLP |

**[ P/N Decoder For Customization Product and SKU ]**

Exascend offers professional services for customization for additional feature options and fixed BOM services. Please contact your sales representative for details. For the customization and fixed BOM decoder, Please contact your sales representative.

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|
| **EX** | **PM4** | **M** | **0240GB** | **RM2** | **-** | ******<br>**(The character length depends on the additional feature by request.)** | **-** | **********<br>**(Customer identification by request)** |


Products and specifications are subject to change by Exascend without notice.
Customized solutions available upon request. Contact us at https://exascend.com/inquiry/.

# 3. Product overview

## 3.1 PM4 series

The PM4 series is available in the M.2 , U.2 and E1.S form factors, features the high-speed PCIe Gen 4 x4 interface with 3D TLC NAND flash memory technology. The PM4 series is available in the *Streaming*, *Pro*, and *Max Edition* to meet specific application demands for write amplification factor (WAF), write endurance (DWPD and TBW), and over-provisioning (OP).

**PM4 Streaming series:**
Designed for read-intensive enterprise-class workloads, supporting up to 0.6 DWPD under JESD219 enterprise workloads – or 1.5 DWPD under JESD219 client workloads for 5 years.

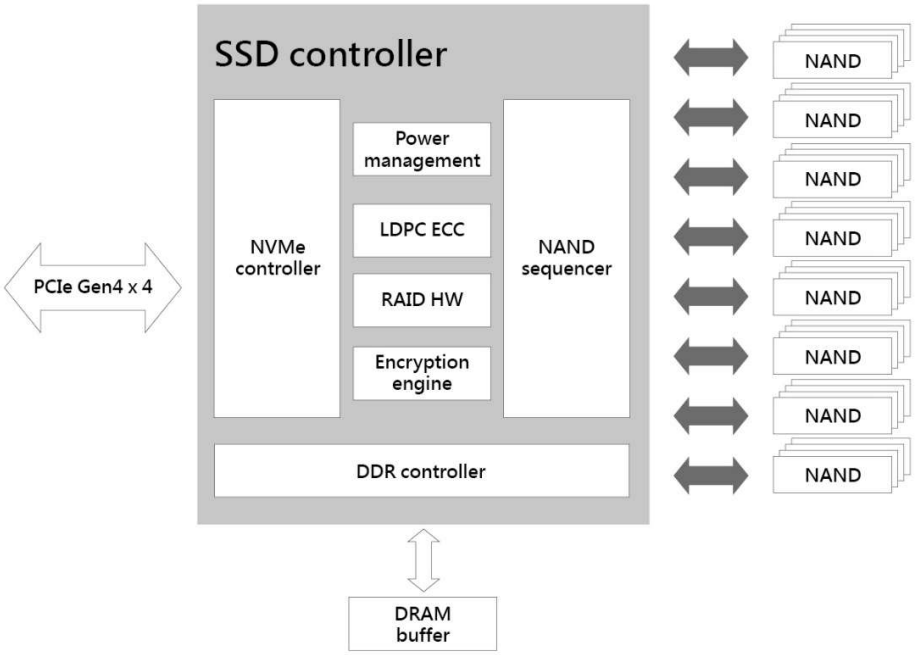
**PM4 Pro series:**
Optimized for mixed read and write-intensive enterprise-class workloads, supporting up to 1 DWPD under JESD219 enterprise workloads – or 2 DWPD under JESD219 client workloads for 5 years.

**PM4 Max series:**
Ideal for extreme, intensive workloads, supporting up to 25 DWPD under JESD219 enterprise workloads – or up to 40 DWPD under JESD219 client workloads for 5 years.

Key product highlights include:

- High I/O and throughput performance
- Next generation LDPC technology secures NAND endurance
- Advanced Flash management and global wear leveling algorithm extending drive life
- High stability and reliability
- Temperature monitoring and intelligent management

**Figure: SSD functional logic diagram**





Products and specifications are subject to change by Exascend without notice.
Customized solutions available upon request. Contact us at https://exascend.com/inquiry/.

### 3.2 Customization and tuning services

Exascend provides customized hardware and firmware design services, tailoring cutting-edge SSD products for advanced storage systems. Combining world-class R&D and engineering support capabilities, Exascend provides customers with best-in-class products and services, enabling enhanced boot times, faster-loading applications, reduced power consumption, and extended reliability. To learn more about our extended engineering support services, e.g., tailored capacity, over-provisioning, extended operating temperature range, endurance, performance, power, and longevity, please contact your Exascend account manager or send us an email at sales@exascend.us.

# 4. Detailed specifications

Exascend PM4 series SSD consists solely of semiconductor devices, it does not contain any mechanical part such as platter (disk), motor and suspension as traditional hard disk drive. Thus, it exhibits superior performance, capacity, reliability, ruggedness, low power, and small form factor profiles that qualified to be the best storage solution for enterprise application with extreme workloads and increased MTBF requirements.

Exascend PM4 SSD uses a single-chip Flash controller to manage multiple NAND Flash memory modules. The controller works with a host system to allow data to be written to and read from the Flash memory modules through a PCIe interface.

## 4.1 Capacity

**Table : PM4 logical block address configuration**

| Capacity | UNFORMATTED CAPACITY (TOTAL USER ADDRESSABLE SECTORS IN LBA MODE) |
|---|---|
| 240 GB | 468,862,128 |
| 480 GB | 937,703,088 |
| 960 GB | 1,875,385,008 |
| 1,920 GB | 3,750,748,848 |
| 3,840 GB | 7,501,476,528 |
| 7,680 GB | 15,002,931,888 |
| | |

**Notes:**

- The LBA count shown represents total user-accessible storage capacity and will remain the same throughout the drive's lifetime.
- The total usable capacity of the SSD may be less than the total physical capacity because a small portion of the capacity is used for NAND flash management and maintenance purposes.

## 4.2 Performance

**Table : Drive performance – PM4 series**

| Standard(Streaming) Edition | M.2 2280 | |
|---|---|---|
| Parameter | UNIT | 240 GB |
| Sequential (Sustained) Read (128KB) | MB/s | 2,060 MB/s |
| Sequential (Sustained) write (128KB) | MB/s | 485 MB/s |
| Random read (4KB) | IOPS | 121,000 IOPS |
| Random write (4KB) | IOPS | 17,000 IOPS |
| Latency (Read)(QoS 99% @ QD=1) | µs | 90 µs |
| Latency (Write)(QoS 99% @ QD=1) | µs | 175 µs |
| Latency (Read)(QoS 99.9% @ QD=1) | µs | 140 µs |
| Latency (Write)(QoS 99.9% @ QD=1) | µs | 10,810 µs |
| Latency (Read)(QoS 99.99% @ QD=1) | µs | 1,335 µs |
| Latency (Write)(QoS 99.99% @ QD=1) | µs | 21,890 µs |
| Remark | | |
| Endurance (JESD219 enterprise) | DWPD | 1 @ 5Yrs |
| Endurance (JESD219 client) | DWPD | 2 @ 5Yrs |

| Standard(Streaming) Edition | M.2 2280 | |
|---|---|---|
| Parameter | UNIT | 480 GB |
| Sequential (Sustained) Read (128KB) | MB/s | 3,265 MB/s |
| Sequential (Sustained) write (128KB) | MB/s | 760 MB/s |
| Random read (4KB) | IOPS | 261,000 IOPS |
| Random write (4KB) | IOPS | 16,000 IOPS |
| Latency (Read)(QoS 99% @ QD=1) | µs | 80 µs |
| Latency (Write)(QoS 99% @ QD=1) | µs | 40 µs |
| Latency (Read)(QoS 99.9% @ QD=1) | µs | 145 µs |
| Latency (Write)(QoS 99.9% @ QD=1) | µs | 15,005 µs |
| Latency (Read)(QoS 99.99% @ QD=1) | µs | 2,180 µs |
| Latency (Write)(QoS 99.99% @ QD=1) | µs | 30,540 µs |
| Remark | | |
| Endurance (JESD219 enterprise) | DWPD | 1 @ 5Yrs |
| Endurance (JESD219 client) | DWPD | 2 @ 5Yrs |

| Pro Edition | M.2 2280 | | | | | |
|---|---|---|---|---|---|---|
| Parameter | UNIT | 960 GB | 1,920 GB | 3,840 GB | 7,680 GB | |
| Sequential (Sustained) Read (128KB) | MB/s | 3,075 MB/s | 3,185 MB/s | 3,200 MB/s | 3,000 MB/s | |
| Sequential (Sustained) write (128KB) | MB/s | 1,815 MB/s | 3,000 MB/s | 3,010 MB/s | 3,010 MB/s | |
| Random read (4KB) | IOPS | 371,000 IOPS | 276,000 IOPS | 346,000 IOPS | 351,000 IOPS | |
| Random write (4KB) | IOPS | 31,000 IOPS | 41,000 IOPS | 61,000 IOPS | 52,000 IOPS | |
| Latency (Read)(QoS 99% @ QD=1) | µs | 95 µs | 75 µs | 85 µs | 80 µs | |
| Latency (Write)(QoS 99% @ QD=1) | µs | 20 µs | 130 µs | 125 µs | 160 µs | |
| Latency (Read)(QoS 99.9% @ QD=1) | µs | 285 µs | 265 µs | 210 µs | 400 µs | |
| Latency (Write)(QoS 99.9% @ QD=1) | µs | 4,945 µs | 275 µs | 285 µs | 420 µs | |
| Latency (Read)(QoS 99.99% @ QD=1) | µs | 2,180 µs | 795 µs | 465 µs | 600 µs | |
| Latency (Write)(QoS 99.99% @ QD=1) | µs | 13,960 µs | 435 µs | 370 µs | 490 µs | |
| Remark | | | | | | |
| Endurance (JESD219 enterprise) | DWPD | 1 @ 5Yrs | | | | |
| Endurance (JESD219 client) | DWPD | 2 @ 5Yrs | | | | |

**Notes:**
- Measured with device connected as secondary drive.
- Actual performance may vary based on the hardware, software, and overall system configuration.
- Sequential performance is measured with 128 KB transfer size, QD 32 and 4 KB alignment with Iometer.
- Random performance is sustained performance measured with 4K transfer size, QD 32 and 4 KB alignment with Iometer.
- Performance test platform: CPU: Intel Core i9-13900K; motherboard: ASUS Prime Z790-P; OS: Windows 11 Pro x64 21H2

## 4.3 Environment specification

**Table : Environmental specification table**

| Parameter | Value |
|---|---|
| Operating temperature | 0–70 °C |
| Storage temperature | -40–85 °C |
| Power supply voltage range | M.2 2280 : 3.3 V ± 5% |
| Humidity (non-condensing) | 5–95% (Operating) |
| Vibration | 10 G (peak, 10–2000 Hz) |
| Shock (operating) | 50 G (11 ms duration, half sine wave) |
| Shock (non-operating) | 1500 G (0.5 ms duration, half sine wave) |

## 4.4 Power consumption

**Table : PM4 series power consumption table**

| Pro Edition | M.2 2280 | | |
|---|---|---|---|
| Parameter | Status | UNIT | 240 GB |
| Idle Mode | Avg. | Watt | < 1.2 W |
| Active Mode | Avg. | Watt | < 3.3 W |
| | Max. | Watt | < 4.1 W |
| Remark | | | |

| Pro Edition | M.2 2280 | | |
|---|---|---|---|
| Parameter | Status | UNIT | 480 GB |
| Idle Mode | Avg. | Watt | < 1.1 W |
| Active Mode | Avg. | Watt | < 3.5 W |
| | Max. | Watt | < 5.3 W |
| Remark | | | |

| Pro Edition | M.2 2280 | | | | | | |
|---|---|---|---|---|---|---|---|
| Parameter | Status | UNIT | 960 GB | 1,920 GB | 3,840 GB | 7,680 GB | |
| Idle Mode | Avg. | Watt | < 1.1 W | < 1.4 W | < 1.4 W | < 1.4 W | |
| Active Mode | Avg. | Watt | < 4.6 W | < 5.9 W | < 5.9 W | < 5.9 W | |
| | Max. | Watt | < 6.9 W | < 8.8 W | < 8.8 W | < 8.2 W | |
| Remark | | | | | | | |

## 4.5 Reliability

Products in the Exascend PM4 series meet or exceed SSD endurance and data retention requirements as specified in the JESD218 standard. Reliability specifications are listed in the following table.

| Reliability | |
|---|---|
| Mean Time Between Failures (MTBF)* | 2,000,000 hours |
| Uncorrectable Bit Error Rate (UBER)** | <1 sector per $10^{17}$ |

*Mean Time Between Failures is a measure of how reliable a hardware product or a component is. The value describes the expected time between two failures. **A metric for the rate of occurrence of data errors, equal to the number of data errors per bits read.

**Table : Reliability table**

| Endurance Rating (TBW)<br>(TBW stands for total bytes written whose access pattern is compliant with JESD218 standard) | | | |
|---|---|---|---|
| 5Yrs @ JESD219 Workload | Capacity | Enterprise | Client |
| Pro Edition | **240 GB** | 430 TB | 860 TB |
| | **480 GB** | 860 TB | 1,720 TB |
| | **960 GB** | 1,720 TB | 3,440 TB |
| | **1,920 GB** | 3,440 TB | 6,880 TB |
| | **3,840 GB** | 6,880 TB | 13,760 TB |
| | **7,680 GB** | 13,760 TB | 27,520 TB |

# 5. Physical dimension diagram

## 5.1 PCIe M.2 2280

**Figure : M.2 2280 physical dimension diagram**

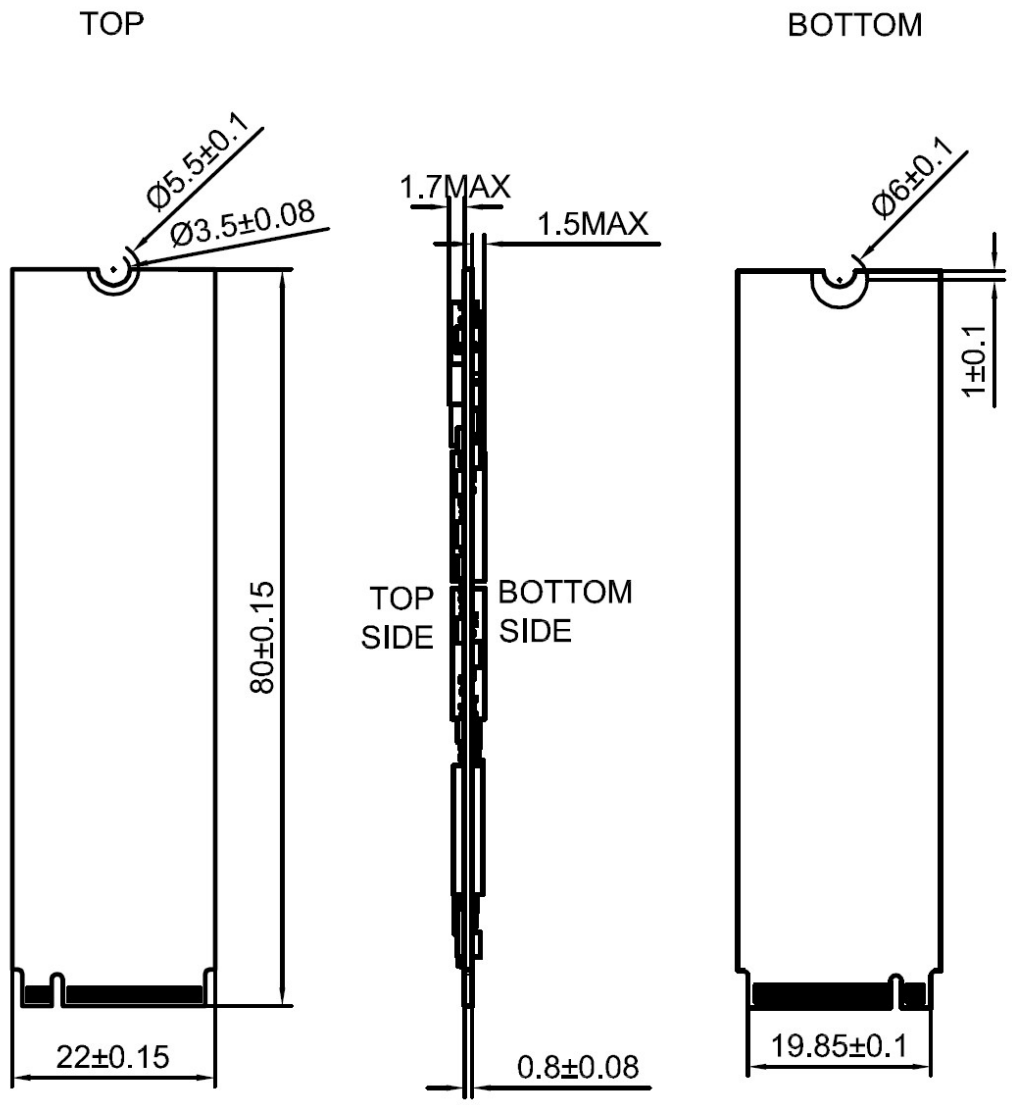



**Table : Physical dimensions for M.2 2280**

| PHYSICAL DIMENSIONS | VALUE | UNIT |
|---|---|---|
| **Length** | 80 | mm |
| **Width** | 22 | mm |
| **Thickness** | 4.0 | mm |

# 6. Pin Assignment

## 6.1 PCIe M.2 connector

**Table : M.2 connector signal name, power pin assignment, and description**
**(The naming and description of the PINs are based on the SSD module side.)**

| PIN NAME | SIGNAL NAME | DESCRIPTION | PIN NAME | SIGNAL NAME | DESCRIPTION |
|---|---|---|---|---|---|
| **1** | GND | Ground | 2 | 3.3V | 3.3V Power |
| 3 | GND | Ground | 4 | 3.3V | 3.3V Power |
| 5 | PCIe 3 TXn | PCIe Lane 3 TX- | 6 | Reserved | Reserved |
| 7 | PCIe 3 TXp | PCIe Lane 3 TX+ | 8 | Reserved | Reserved |
| 9 | GND | Ground | 10 | DAS | Device Activity Signal |
| 11 | PCIe 3 RXn | PCIe Lane 3 RX- | 12 | 3.3V | 3.3V Power |
| 13 | PCIe 3 RXp | PCIe Lane 3 RX+ | 14 | 3.3V | 3.3V Power |
| 15 | GND | Ground | 16 | 3.3V | 3.3V Power |
| 17 | PCIe 2 TXn | PCIe Lane 2 TX- | 18 | 3.3V | 3.3V Power |
| 19 | PCIe 2 TXp | PCIe Lane 2 TX+ | 20 | NC | No Connection |
| 21 | GND | Ground | 22 | NC | No Connection |
| 23 | PCIe 2 RXn | PCIe Lane 2 RX- | 24 | NC | No Connection |
| 25 | PCIe 2 RXp | PCIe Lane 2 RX+ | 26 | NC | No Connection |
| 27 | GND | Ground | 28 | NC | No Connection |
| 29 | PCIe 1 TXn | PCIe Lane 1 TX- | 30 | Reserved | Reserved |
| 31 | PCIe 1 TXp | PCIe Lane 1 TX+ | 32 | GND | Ground |
| 33 | GND | Ground | 34 | NC | No Connection |
| 35 | PCIe 1 RXn | PCIe Lane 1 RX- | 36 | NC | No Connection |
| 37 | PCIe 1 RXp | PCIe Lane 1 RX+ | 38 | GND | Ground |
| 39 | GND | Ground | 40 | SCL | SMBus_SCL |
| 41 | PCIe 0 TXn | PCIe Lane 0 TX- | 42 | SDA | SMBus_SDA |
| 43 | PCIe 0 TXp | PCIe Lane 0 TX+ | 44 | Reserved | Reserved |
| 45 | GND | Ground | 46 | NC | No Connection |
| 47 | PCIe 0 RXn | PCIe Lane 0 RX- | 48 | NC | No Connection |
| 49 | PCIe 0 RXp | PCIe Lane 0 RX+ | 50 | PERST | PCIe Reset |
| 51 | GND | Ground | 52 | CLKREQ | PCIe Clock Request |
| 53 | Ref CLKN | PCIe Reference clk- | 54 | NC | No Connection |
| 55 | Ref CLKP | PCIe Reference clk+ | 56 | UART RX | Manufacturing Use |
| 57 | GND | Ground | 58 | UART TX | Manufacturing Use |
| 59 | PCIe Module Key | PCIe Module Key | 60 | PCIe Module Key | PCIe Module Key |
| 61 | PCIe Module Key | PCIe Module Key | 62 | PCIe Module Key | PCIe Module Key |

| | | | | | |
|---|---|---|---|---|---|
| 63 | PCIe Module Key | PCIe Module Key | 64 | PCIe Module Key | PCIe Module Key |
| 65 | PCIe Module Key | PCIe Module Key | 66 | PCIe Module Key | PCIe Module Key |
| 67 | NC | No Connection | 68 | NC | No Connection |
| 69 | NC | No Connection | 70 | 3.3V | 3.3V Power |
| 71 | GND | Ground | 72 | 3.3V | 3.3V Power |
| 73 | GND | Ground | 74 | 3.3V | 3.3V Power |
| 75 | GND | Ground | | | |

# 7. Compliance

Exascend PM4 series SSD complies with the following specifications:

- FCC
- CE
- RoHS
- UKCA

# 8. Supported NVMe commands

Exascend PM4 series SSDs support the NVMe commands that are shown in the following table. For details about the NVMe commands, please refer to the NVMe 1.4 command set specifications.

**Table 22: Admin commands**

| COMMAND NAME | CODE (HEX) | COMMAND NAME | CODE (HEX) |
|---|---|---|---|
| **Delete I/O submission queue** | 00h | Abort | 08h |
| **Create I/O completion queue** | 01h | Set features | 09h |
| **Get log page** | 02h | Get features | 0Ah |
| **Delete I/O submission queue** | 04h | Asynchronous event request | 0Ch |
| **Create I/O completion queue** | 05h | Firmware commit | 10h |
| **Identify** | 06h | Firmware image download | 11h |

**Table 23: I/O commands**

| COMMAND NAME | CODE (HEX) | COMMAND NAME | CODE (HEX) |
|---|---|---|---|
| **Flush** | 00h | Compare | 05h |
| **Write** | 01h | Dataset management | 09h |
| **Read** | 02h | Write zeroes | 08h |
| **Write uncorrectable error** | 04h | | |

**Table 24 Get log commands**

| COMMAND NAME | CODE (HEX) | COMMAND NAME | CODE (HEX) |
|---|---|---|---|
| **Reserved** | 00h | S.M.A.R.T. / health information | 02h |
| **Error information** | 01h | Firmware information | 03h |

# 9. S.M.A.R.T. support

## 9.1 Overview of S.M.A.R.T. support

Data storage drives capture a variety of information during operation that may be used to analyze drive "health." Drive manufacturers have adopted S.M.A.R.T. (Self-Monitoring, Analysis, and Reporting Technology) to help warn system software, a system administrator, or a user of impending drive failure, when time still remains to take preventive action. The S.M.A.R.T. standard defines the protocols for reporting errors and for invoking self-tests to collect and analyze data on demand. The specification is flexible and provides for individual manufacturers to define their own unique vendor-specific information. This section describes the baseline S.M.A.R.T. commands and attributes supported by products in the Exascend PM4 series. Further, it is recommended to consult the list of public S.M.A.R.T. attributes.

## 9.2 S.M.A.R.T. health information

**Table 24: S.M.A.R.T. health information**

| BYTE | DESCRIPTION |
|---|---|
| 00 | **Critical warning:** This field indicates critical warnings for the state of the controller. Each bit corresponds to a critical warning type; multiple bits may be set. If a bit is cleared to '0', then that critical warning does not apply. Critical warnings may result in an asynchronous event notification to the host. Bits in this field represent the current associated state and are not persistent. |
| 2:1 | **Composite temperature:** Contains a value corresponding to a temperature in degrees Kelvin that represents the current composite temperature of the controller and namespace(s) associated with that controller. The manner this value is computed is implementation-specific and may not represent the actual temperature of any physical point in the NVM subsystem. The value of this field may be used to trigger an asynchronous event. Warning and critical overheating composite temperature threshold values are reported by the WCTEMP and CCTEMP fields in the Identify Controller data structure. |
| 3 | **Available spare:** Contains a normalized percentage (0 to 100%) of the remaining spare capacity available. |
| 4 | **Available spare threshold:** When the *available spare* falls below the threshold indicated in this field, an asynchronous event completion may occur. The value is indicated as a normalized percentage (0 to 100%). |
| 5 | **Percentage used:** Contains a vendor-specific estimate of the percentage of NVM subsystem life used based on the actual usage and the manufacturer's prediction of NVM life. A value of 100 indicates that the estimated endurance of the NVM in the NVM subsystem has been consumed but may not indicate an NVM subsystem failure. The value allowed to exceed 100. Percentages greater than 254 shall be represented as 255. This value shall be updated once per power-on hour (when the controller is not in a sleep state). |
| 47:32 | **Sectors read:** Contains the number of 512-byte user data units read from the controller; This value is reported in thousands (i.e., a value of 1 corresponds to 1000 units of 512 bytes read) and is rounded up. When the LBA size is a value other than 512 bytes, the controller shall convert the amount of data read to 512-byte units. |
| 63:48 | **Sectors written:** Contains the number of 512-byte user data units written to the controller. This value is reported in thousands (i.e., a value of 1 corresponds to 1000 units of 512 bytes written) and is rounded up. When the LBA size is a value other than 512 bytes, the controller shall convert the amount of data written to 512-byte units. For the NVM* command set, logical blocks written as part of write operations shall be included in this value. |
| 79:64 | **Host read commands:** Indicates the number of read commands completed by the controller. For the NVM command set, this is the number of *compare* and *read* commands |
| 95:80 | **Host write commands:** Indicates the number of write commands completed by the controller. For the NVM command set, this is the number of *write* commands. |
| 111:96 | **Controller busy time:** Contains the amount of time the controller is busy with I/O commands. The controller is busy when there is a command outstanding to an I/O queue (specifically, a command was issued via an I/O submission queue tail doorbell write and the corresponding completion queue entry has not been posted yet to the associated I/O completion queue). This value is reported in minutes. |

| | |
|---|---|
| **127:112** | **Power cycles:** Contains the number of power cycles. |
| **143:128** | **Power-on hours:** Indicates the number of actively power-on hours. This does not include time the controller was powered and in a lower state condition. |
| **159:144** | **Number of unsafe shutdowns:** Indicates the number of unsafe shutdowns. This count is incremented when a shutdown notification (CC.SHN) is not received prior to loss of power |
| **175:160** | **Number of media errors:** Indicates the number of occurrences where the controller detected an unrecovered data integrity error. Errors such as uncorrectable ECC, CRC checksum failure, or LBA tag mismatch are included in this field. |
| **195:192** | **Warning composite temperature time:** Indicates the amount of time in minutes that the controller is operational and the Composite Temperature is greater than or equal to the Warning Composite Temperature Threshold (WCTEMP) field and less than the Critical Composite Temperature Threshold (CCTEMP) field in the Identify Controller data structure. If the value of the WCTEMP or CCTEMP field is 0h, then this field is always cleared to 0h regardless of the Composite Temperature value. |
| **199:196** | **Critical composite temperature time:** Contains the amount of time in minutes that the controller is operational, and the Composite Temperature is greater the Critical Composite Temperature Threshold (CCTEMP) field in the Identify Controller data structure. If the value of the CCTEMP field is 0h, then this field is always cleared to 0h regardless of the Composite Temperature value. |
| **201:200** | **Temperature sensor 1:** Contains the current temperature reported by temperature sensor 1 in degrees Kelvin. |

# Legal information

## Limited Warranty Policy

Exascend, Inc. ("Exascend") warrants that Exascend's product, in its original sealed packaging, will be free from defects in materials and workmanship. Subject to the conditions and limitations set forth below, Exascend will either repair or replace any part of its products that prove defective by reason of improper workmanship or materials. This warranty is non-transferable and valid only for the original purchaser of the Exascend products, except where prohibited by law. The original sales receipt or invoice, or a copy thereof, is required to establish the purchase date and original purchaser.

1. This warranty supersedes all other warranties and representations, whether oral or written, between you and Exascend. Exascend makes no other warranties, including any warranty of merchantability or fitness for a particular purpose, whether expressly or implied.

2. All warranties, whether express or implied, are limited to the periods of time set forth below. Some states and jurisdictions do not allow such exclusion of implied warranties, limitations or warranty period, so above restrictions may not apply to you.

3. Exascend may acknowledge or read and save the data and information (collectively, "Information") stored in the product during after-services. Exascend hereby agrees that Exascend will not disclose any Information to any third parties, except Exascend's employees, who may need to access the Information, with or without your prior written consent.

## Warranty Terms

We offer five (5) years limited warranty for our enterprise products.

The warranty period is the SHORTER OF:

- a period of five (5) years beginning from the date of purchase; or
- the period ending when the drive reached advertised DWPD or TBW rating; or
- the period ending when the device's Lifespan indicator has reached 0% or below.

This Limited Warranty will not apply to, and Exascend will have no liability or obligation with respect to, problems or damage resulting from any of the following: (i) accident, modification, neglect, abuse, careless or incorrect handling, misuse or improper operation, disassembly, misapplication or use in unusual physical environments or under operating conditions not approved by Exascend (including, but not limited to, use of the Product with an improper voltage supply); (ii) normal wear and tear; (iii) removal of label(s) or sticker(s) provided on or with the Product (including all warranty or quality-control stickers, product serial or electronic numbers); (iv) problems relating to or residing in non-Exascend hardware, software or other items with which the Product is used; (v) use in an environment, in a manner or for a purpose for which the Product was not designed or not in accordance with Exascend's published documentation; (vi) installation, modification, alteration or repair by anyone other than Exascend or its authorized representatives; (vii) problems that do not relate to materials or workmanship or that have an insignificant impairment on the use or operation of the Product; or (viii) problems related to consumables; (ix) Product purchased "AS-IS" or "with known faults, defects or problems." Additionally, Exascend will have no liability or obligation to recover any data in the Product.

## Disclaimer of liability

Exascend, Inc. reserves the right to make changes to specifications and product descriptions such as but not limited to numbers, parameters and other technical information contained herein without notice. Please contact Exascend, Inc. to obtain the latest specifications. Exascend, Inc. grants no warranty with respect to this datasheet, explicit or implied, and is not liable for direct or indirect damages. Some states do not grant the exclusion of incidental damages and as such this statement may not be valid in such states. The provisions of the datasheet do not convey to the purchaser of the device any license under any patent right or other intellectual property right of Exascend, Inc.

**Customers must not use Exascend products in applications where a device failure or malfunction may cause personal injury or death, e.g., in life support systems or devices.**

Exascend shall not be liable for any loss, injury or damage caused by use of the products in any of the following applications:

- Medical-related devices, life support, medical measurement devices, etc.
- Control devices for trains, ships, mass transportation systems or automotive vehicles, etc.
- Specific applications including military/defense-related equipment, aerospace, nuclear facility control systems, etc.
- Safety systems for disaster prevention/crime prevention, etc.

## Copyright notice

Copyright © 2023 Exascend, Inc. All rights reserved. Information contained in this document, including but not limited to any instructions, descriptions, and product specifications, is considered proprietary and confidential to Exascend, Inc. and shall not be modified, used, copied, reproduced or disclosed in whole or in part, in any form or by any means, electronic or mechanical, for any purpose, without the written consent of Exascend, Inc.

### Contact information

Exascend Taiwan Office

Address: Room 1, 6F, No.288, Sec. 6, Civic Blvd., Xinyi Dist., Taipei City 110, Taiwan (R.O.C.)

General Support: +886-2-2726-6500

Fax: +886-2-2726-6126

Email: sales@exascend.us

# Revision

| REVISION | DESCRIPTION | DATE |
|---|---|---|
| **MRM4.Rev1.0.Preliminary** | First released - Preliminary | 2026/04/17 |
| **MRM4.Rev1.1.Preliminary** | Revise P/N | 2026/06/03 |
| | | |
| | | |
| | | |
| | | |
| | | |