

SA4 series

Automotive-grade SATA3 SSD

Specifications

Capacity

- SA4 Standard
 - 2.5-inch: 240–7680 GB
 - mSATA: 240–960 GB
 - M.2 2280: 240–7680 GB
- SA4 Max
 - 2.5-inch: 240–960 GB
 - mSATA: 240–240 GB
 - M.2 2280: 240–960 GB

Components

- Controller: Marvell 88SS1074/88SS1079/88SS1080
- Flash: 3D TLC
- DRAM: DDR3

Compliance

- SATA 3.2 compatible with 6/3/1.5 Gb/s rates
- ATA/ATAPI ACS3 command set compliant
- NCQ: Up to 32 Queue Depth
- Enhance SMART ATA feature set
- Data set management TRIM command
- OS aware host hot plug / removal

Performance (up to)¹

- Sequential read: 550 MB/s
- Sequential write: 535 MB/s
- Random 4K read: 98,000 IOPS
- Random 4K write: 24,000 IOPS

Power management

- DIPM / HIPM
- Auto idle
- SATA link power management
- Temperature monitoring and proprietary thermal management algorithm

Security (Optional)

- AES-256 encryption
- Full disk encryption (FDE) as self-encrypting drive (SED) with TCG Opal 2.0
- Security erase
- Cryptographic firmware image signing

Latency (QD1)

- Read: 100 μ s
- Write: 40 μ s

Reliability

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

Endurance (JESD219 enterprise, client)²

- SA4 Standard: 0.6 DWPD, 2 DWPD @ 3 years
- SA4 Max: 5 DWPD, 10 DWPD @ 3 years

Data retention

- JESD218A-compliant

Compatibility

- Windows 10/8.1/7
- Windows Server 2016/2012 R2/2012
- CentOS, Fedora, FreeBSD, openSUSE, Red Hat, Ubuntu, VMware ESXi, Citrix, KVM

Mechanical form factor

- 2.5-inch: 100.5 mm x 69.85 mm x 7 mm
- mSATA: 50.8mm x 29.85mm x 3.4mm
- M.2 2280: 80 mm x 22 mm x 3.5 mm

Power consumption (TYP)

- Active: <4 W
- Idle: <0.5 W

Environment

- Operating temperature: -40–85 °C
- Storage temperature: -50–95°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)

Warranty

- 3-year limited warranty³

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/8K transfer size, QD 32 and 4 KB alignment with Iometer.
 - d. Performance test platform: CPU: Intel Core i7 4770K; motherboard: ASUS Z87-DELUXE; chipset: Intel Z87 Express; OS: Windows 8.1 Pro x64.
2. Endurance claims
 - a. DWPD stands for Drive Writes Per Day. $TBW = DWPD * capacity * warranty * 365 / 1000$.
 - 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.

Table of Contents

| | |
|--|-----------|
| Specifications | 1 |
| Product datasheet | 4 |
| 1. Order information | 4 |
| 2. Part number decoder | 5 |
| 3. Product overview | 6 |
| 4. Detailed specifications | 8 |
| 4.1 Capacity | 8 |
| 4.2 Performance | 8 |
| 4.3 Latency | 9 |
| 4.4 Quality of Service | 10 |
| 4.5 Environment specification | 10 |
| 4.6 Power consumption | 11 |
| 4.7 Reliability | 11 |
| 5. Physical dimension diagram | 12 |
| 5.1 SATA 2.5 Inch board | 12 |
| 5.2 mSATA | 13 |
| 5.3 M.2 2280 PCB | 14 |
| 6. Pin Assignment | 15 |
| 6.1 SATA 2.5 Inch connector | 15 |
| 6.2 mSATA connector | 16 |
| 6.3 M.2 connector | 18 |
| 7. Compliance | 20 |
| 8. Supported ATA commands | 20 |
| 9. S.M.A.R.T. support | 21 |
| 9.1 Overview of S.M.A.R.T. support | 21 |
| 9.2 S.M.A.R.T. health information | 21 |
| 9.3 S.M.A.R.T. Sub command | 22 |
| Legal information | 23 |
| Limited Warranty Policy | 23 |
| Warranty Terms | 23 |
| Disclaimer of liability | 23 |
| Copyright notice | 24 |
| Contact information | 24 |
| Revision history | 25 |

Product datasheet

1. Order information

The following table lists the standard part number for Exascend SA4 series SSD, for design service inquiries on operating temperature, capacity, over-provisioning, endurance, performance, and power, please contact Exascend sales support, or email us at: sales@exascend.com.

Table 1: SA4 series SSD product list

| PART NUMBER | CONFIGURATION | CAPACITY* | FLASH TYPE | FORM FACTOR |
|---------------|---------------|-----------|-------------------|-------------|
| EXSA4A240GB | Standard | 240GB | Industrial 3D TLC | 2.5" |
| EXSA4A480GB | Standard | 480GB | Industrial 3D TLC | 2.5" |
| EXSA4A960GB | Standard | 960GB | Industrial 3D TLC | 2.5" |
| EXSA4A1920GB | Standard | 1920GB | Industrial 3D TLC | 2.5" |
| EXSA4A3840GB | Standard | 3840GB | Industrial 3D TLC | 2.5" |
| EXSA4A7680GB | Standard | 7680GB | Industrial 3D TLC | 2.5" |
| EXSA4A120GB-X | Max | 120GB | Industrial 3D TLC | 2.5" |
| EXSA4A240GB-X | Max | 240GB | Industrial 3D TLC | 2.5" |
| EXSA4A480GB-X | Max | 480GB | Industrial 3D TLC | 2.5" |
| EXSA4A960GB-X | Max | 960GB | Industrial 3D TLC | 2.5" |
| EXSA4B240GB | Standard | 240GB | Industrial 3D TLC | mSATA |
| EXSA4B480GB | Standard | 480GB | Industrial 3D TLC | mSATA |
| EXSA4B960GB | Standard | 960GB | Industrial 3D TLC | mSATA |
| EXSA4B120GB-X | Max | 120GB | Industrial 3D TLC | mSATA |
| EXSA4B240GB-X | Max | 240GB | Industrial 3D TLC | mSATA |
| EXSA4M240GB | Standard | 240GB | Industrial 3D TLC | M.2 2280 |
| EXSA4M480GB | Standard | 480GB | Industrial 3D TLC | M.2 2280 |
| EXSA4M960GB | Standard | 960GB | Industrial 3D TLC | M.2 2280 |
| EXSA4M1920GB | Standard | 1920GB | Industrial 3D TLC | M.2 2280 |
| EXSA4M3840GB | Standard | 3840GB | Industrial 3D TLC | M.2 2280 |
| EXSA4M7680GB | Standard | 7680GB | Industrial 3D TLC | M.2 2280 |
| EXSA4M240GB-X | Max | 240GB | Industrial 3D TLC | M.2 2280 |
| EXSA4M480GB-X | Max | 480GB | Industrial 3D TLC | M.2 2280 |
| EXSA4M960GB-X | Max | 960GB | Industrial 3D TLC | M.2 2280 |

2. Part number decoder

| | | | | |
|----|-----|---|--------|----|
| EX | SA4 | M | 1920GB | -X |
|----|-----|---|--------|----|

1. Exascend
2. Product series
(SC1/SC3/PC3/PC4/SE1/SE3/PE3/PE4/SI2/SI3/SI4/SA4/PI3/PE4/PI4/PA3/PA4)
3. Form factor
(A=2.5"; B=mSATA; M=M.2 2280; N=M.2 2260; Q=M.2 2242; U=U.2; E=E1.S)
4. Capacity
5. Identifier
 - H= extended temp
 - X= Max
 - P= Pro
 - T= Boot
 - R=RED approved
 - WP= with PLP

3. Product overview

Exascend provides customizable hardware and firmware design service of cutting-edge SSD products for advanced storage systems. Our products are designed specifically for high reliability commercial, enterprise data center, and cloud computing applications. Combining world class design R&D, and engineering support capabilities, Exascend strives to provide customers with the best-in-class product and service, enabling enhanced boot times, faster application loading, reduced power consumption and extended reliability. To explore more about our extended engineering support services, i.e., tailored capacity, over-provisioning, operating temperature range, endurance, performance, power, and longevity, please contact Exascend sales representative, or email us at: sales@exascend.com

The SA4 series support full-disk self-encryption (SED), featuring FIPS-certified AES-256 hardware encryption engine to provide hardware-based secure data encryption without sacrificing SSD performance. The SED supports TCG Opal 2.0 for trusted computing. When TCG Opal is not enabled, system BIOS can alternatively enable and manage full drive data encryption (FDE) via ATA security command set. Please note, TCG Opal and ATA security function set cannot be activated simultaneously.

Exascend's SA4 series is designed for demanding enterprise-level workloads. It supports up to 5 drive writes per day (DWPD) under JESD219 enterprise workloads – or 10 DWPD under JESD219 client workloads – for 3 years.

SA4 Standard series:

Designed for read-intensive enterprise-class workloads, supporting up to 0.6 DWPD under JESD219 enterprise workloads – or 2 DWPD under JESD219 client workloads – for 3 years.

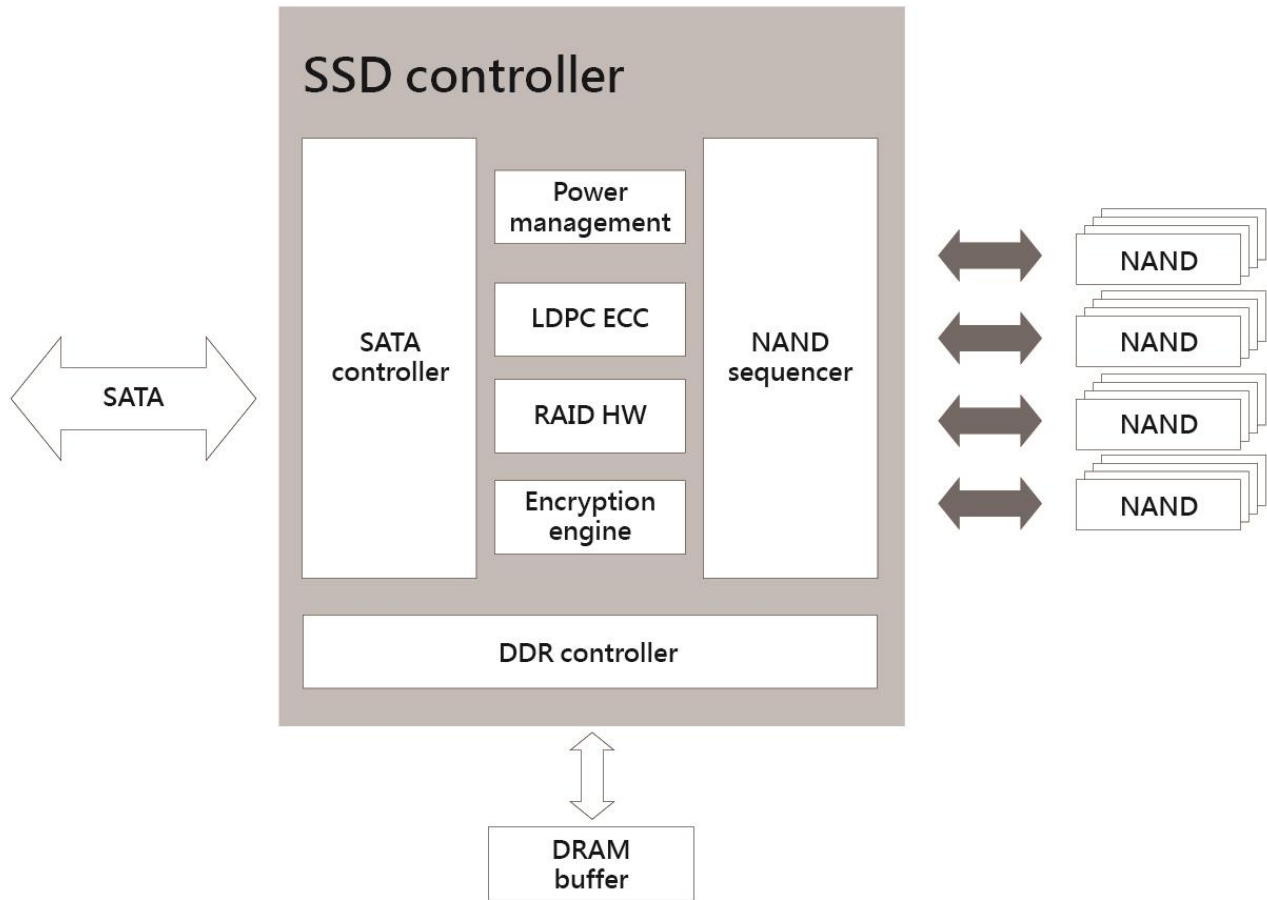
SA4 Max series:

Ideal for extreme, intensive workloads, supporting up to 5 DWPD under JESD219 enterprise workloads – or up to 10 DWPD under JESD219 client workloads – for 3 years.

SA4 series product highlights:

- High I/O performance and throughput bandwidth
- Consistent I/O latency and QoS for enterprise workloads
- Advanced flash management and global wear leveling algorithm that extend drive life
- Data path protection
- Full disk encryption (FDE) as self-encrypting drive (SED) with TCG Opal 2.0
- RAID ECC for exceptional reliability and stability
- Self-Monitoring, Analysis and Reporting Technology (S.M.A.R.T.)
- Proprietary thermal management ensuring consistent performance
- Hardware and firmware-based power loss protection reducing risk of data corruption and device failure
- *Optional customization and tuning services*

Figure 1: SSD functional logic diagram



4. Detailed specifications

The Exascend SA4 series provides extreme performance and ultra-high reliability, delivering speeds up to 550 MB/s sequential read, 535 MB/s sequential write, 98,000 IOPS random read, and 24,000 IOPS for full drive 4k random write. Available in a wide variety of form factors, configurations and storage capacities, the SA4 series is ideal for enterprise applications that demand storage devices that can handle extreme workloads and offer steadfast reliability.

4.1 Capacity

Table 2: SA4 logical block address configuration

| SA4 SERIES | UNFORMATTED CAPACITY (TOTAL USER ADDRESSABLE SECTORS IN LBA MODE) |
|------------|--|
| 240GB | 468,862,128 |
| 480GB | 937,703,088 |
| 960GB | 1,875,385,008 |
| 1920GB | 3,750,748,848 |
| 3840GB | 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 3: Drive performance – SA4 series

| | UNIT | SA4 STANDARD SERIES | | | | | |
|--------------------------|------|--|--------|--------|--------|--------|--------|
| Capacity | GB | 240GB | 480GB | 960GB | 1.92TB | 3.84TB | 7.68TB |
| Sequential read (128KB) | MB/s | 550 | 550 | 550 | 550 | 550 | 535 |
| Sequential write (128KB) | MB/s | 300 | 535 | 535 | 535 | 535 | 535 |
| Random read (4KB) | IOPS | 85,000 | 98,000 | 98,000 | 98,000 | 98,000 | 75,000 |
| Random write (4KB) | IOPS | 10,000 | 18,000 | 20,000 | 20,000 | 20,000 | 10,000 |
| TBW (JESD219 enterprise) | TBW | 150 | 300 | 600 | 1,200 | 2,400 | 8,000 |
| TBW (JESD219 client) | TBW | 370 | 750 | 1,500 | 3,000 | 6,000 | 20,000 |
| DWPD (3 years) | | 0.6 @ JESD219 enterprise 2 @ JESD219 client | | | | | |
| Form factor | | M.2 & 2.5 Inch | | | | | |

Table 3: Drive performance – SA4 series

| | UNIT | SA4 MAX SERIES | | | | |
|--------------------------|---|----------------|--------|--------|----------|--------|
| Capacity | GB | 120GB | 240GB | 480GB | 960GB | 1.92TB |
| Sequential read (128KB) | MB/s | 540 | 550 | 550 | 550 | 550 |
| Sequential write (128KB) | MB/s | 400 | 535 | 535 | 535 | 535 |
| Random read (4KB) | IOPS | 75,000 | 85,000 | 98,000 | 98,000 | 98,000 |
| Random write (4KB) | IOPS | 30,000 | 60,000 | 60,000 | 72,000 | 70,000 |
| TBW (JESD219 enterprise) | TBW | 1,100 | 2,200 | 4,400 | 8,500 | 17,000 |
| TBW (JESD219 client) | TBW | 3,500 | 7,000 | 14,000 | 27,500 | 55,000 |
| DWPD (3 years) | 5 @ JESD219 enterprise 10 @ JESD219 client | | | | | |
| Form factor | | M.2 & 2.5 Inch | | | 2.5 Inch | |

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/8K transfer size, QD 32 and 4 KB alignment with Iometer.
- Performance test platform: CPU: Intel Core i7 4770K; motherboard: ASUS Z87-DELUXE; chipset: Intel Z87 Express; OS: Windows 8.1 Pro x64.

4.3 Latency

Table 4: Drive latency – SA4 series

| PARAMETER | UNIT | SA4 SERIES | | | | | | |
|-------------|------|------------|--------|--------|--------|---------|---------|--------|
| | | 120 GB | 240 GB | 480 GB | 960 GB | 1.92 TB | 3.84 TB | 7.68TB |
| Read (TYP) | µs | 100 | 100 | 100 | 100 | 110 | 110 | 110 |
| Write (TYP) | µs | 40 | 40 | 40 | 40 | 40 | 40 | 40 |

Notes:

- Measured with device connected as secondary drive.
- Actual performance may vary based on the hardware, software, and overall system configuration.
- Latency is measured through FIO with QD1 random read/write workload when the drive has entered steady state.
- Performance test platform: CPU: Intel Core i7 4770K; motherboard: ASUS Z87-DELUXE; chipset: Intel Z87 Express; OS: Windows 8.1 Pro x64.

4.4 Quality of Service

Table 5: QoS – SA4 Standard Series

| Specification | Unit | Queue Depth = 1 | | | | | |
|------------------------------------|------|-----------------|-------|-------|--------|--------|--------|
| | | 240GB | 480GB | 960GB | 1920GB | 3840GB | 7680GB |
| Quality of Service (99%) | | | | | | | |
| Reads | µs | 150 | 150 | 150 | 150 | 150 | 150 |
| Writes | µs | 120 | 120 | 120 | 120 | 120 | 250 |
| Quality of Service (99.9%) | | | | | | | |
| Reads | µs | 200 | 200 | 200 | 200 | 200 | 200 |
| Writes | µs | 350 | 350 | 350 | 350 | 350 | 750 |
| Quality of Service (99.99%) | | | | | | | |
| Reads | µs | 350 | 350 | 350 | 350 | 350 | 350 |
| Writes | µs | 1500 | 1500 | 1500 | 1500 | 1500 | 1500 |

Table 6: QoS – SA4 Max Series

| Specification | Unit | Queue Depth = 1 | | | | | |
|------------------------------------|------|-----------------|-------|-------|-------|--------|--------|
| | | 120 GB | 240GB | 480GB | 960GB | 1920GB | 3840GB |
| Quality of Service (99%) | | | | | | | |
| Reads | µs | 150 | 150 | 150 | 150 | 150 | 150 |
| Writes | µs | 120 | 120 | 120 | 120 | 120 | 120 |
| Quality of Service (99.9%) | | | | | | | |
| Reads | µs | 200 | 200 | 200 | 200 | 200 | 200 |
| Writes | µs | 300 | 300 | 300 | 300 | 300 | 300 |
| Quality of Service (99.99%) | | | | | | | |
| Reads | µs | 325 | 350 | 350 | 350 | 350 | 350 |
| Writes | µs | 750 | 800 | 800 | 800 | 800 | 800 |

4.5 Environment specification

Table 7: Environmental specification table

| PARAMETER | VALUE |
|----------------------------|---|
| Operating temperature | -40–85 °C |
| Storage temperature | -50–95 °C |
| Power supply voltage range | 2.5": 5.0 V ± 10% M.2: 3.3 V ± 5% mSATA: 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) |

4.6 Power consumption

Table 8: SA4 series power consumption table

| PARAMETER | UNIT | 120 GB | 240GB | 480GB | 960GB | 1920GB | 3840GB | 7680GB |
|----------------------|------|--------|-------|-------|-------|--------|--------|--------|
| Active Write-Average | W | <1.2 | <2.4 | <3.15 | <3.45 | <3.51 | <3.55 | <3.55 |
| Active Write-Burst | W | <1.6 | <3.2 | <4.3 | <4.45 | <4.50 | <4.55 | <4.55 |
| Active Read-Average | W | <1.525 | <1.6 | <1.55 | <1.55 | <1.5 | <1.8 | <1.8 |
| Active Read-Burst | W | <2.3 | <2.25 | <2.3 | <2.25 | <2.22 | <2.4 | <2.4 |
| Idle | W | <0.5 | <0.5 | <0.5 | <0.5 | <0.875 | <0.875 | <0.875 |

4.7 Reliability

Products in the Exascend SA4 series meet or exceed SSD endurance and data retention requirements as specified in the JESD218 standard. Reliability specifications are listed in the following table.

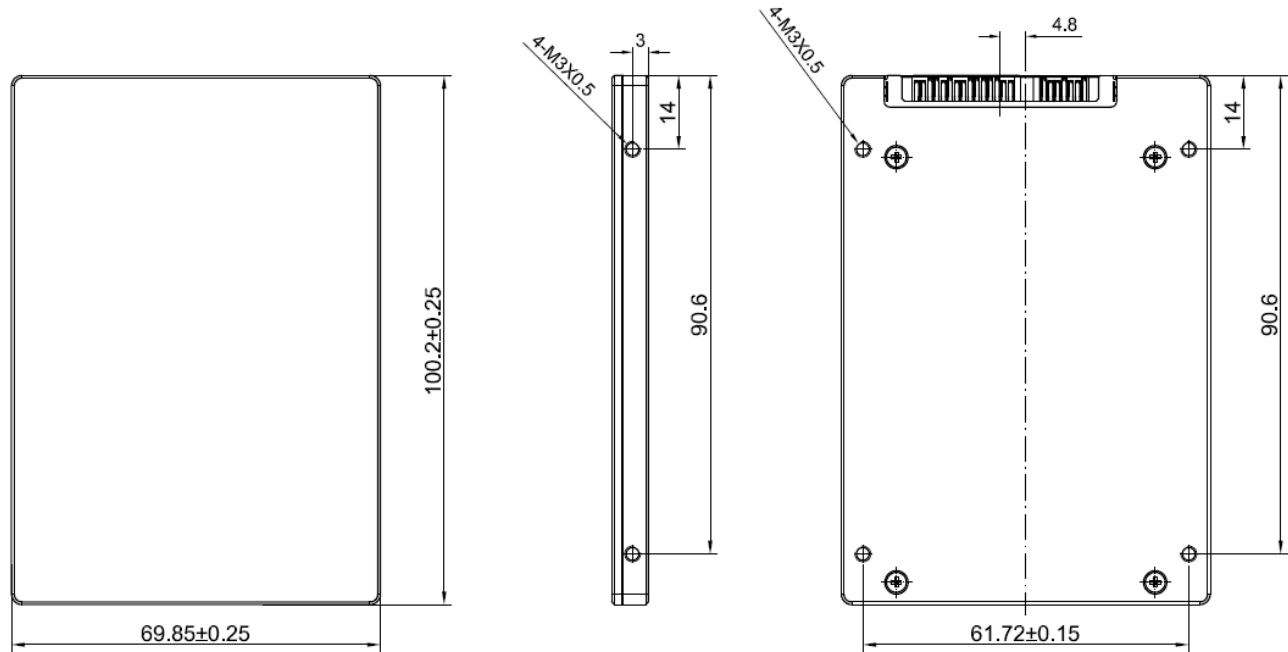
Table 9: Reliability table

| PARAMETER | VALUE |
|---|--------------------------------|
| Mean Time Between Failures (MTBF) 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. | 2,000,000 hours |
| Uncorrectable Bit Error Rate (UBER) A metric for the rate of occurrence of data errors, equal to the number of data errors per bits read. | <1 sector per 10 ¹⁷ |

5. Physical dimension diagram

5.1 SATA 2.5 Inch board

Figure 2: 2.5 Inch physical dimension diagram



GENERAL TOLERANCE IS ± 0.15 mm

DIMENSION UNIT: mm

Table 10: Physical dimensions for SATA 2.5 Inch

| PHYSICAL DIMENSIONS | VALUE | UNIT |
|---------------------|-------|------|
| Length | 100 | mm |
| Width | 69.85 | mm |
| Thickness | 7 | mm |

5.2 mSATA

Figure 3: mSATA physical dimension diagram

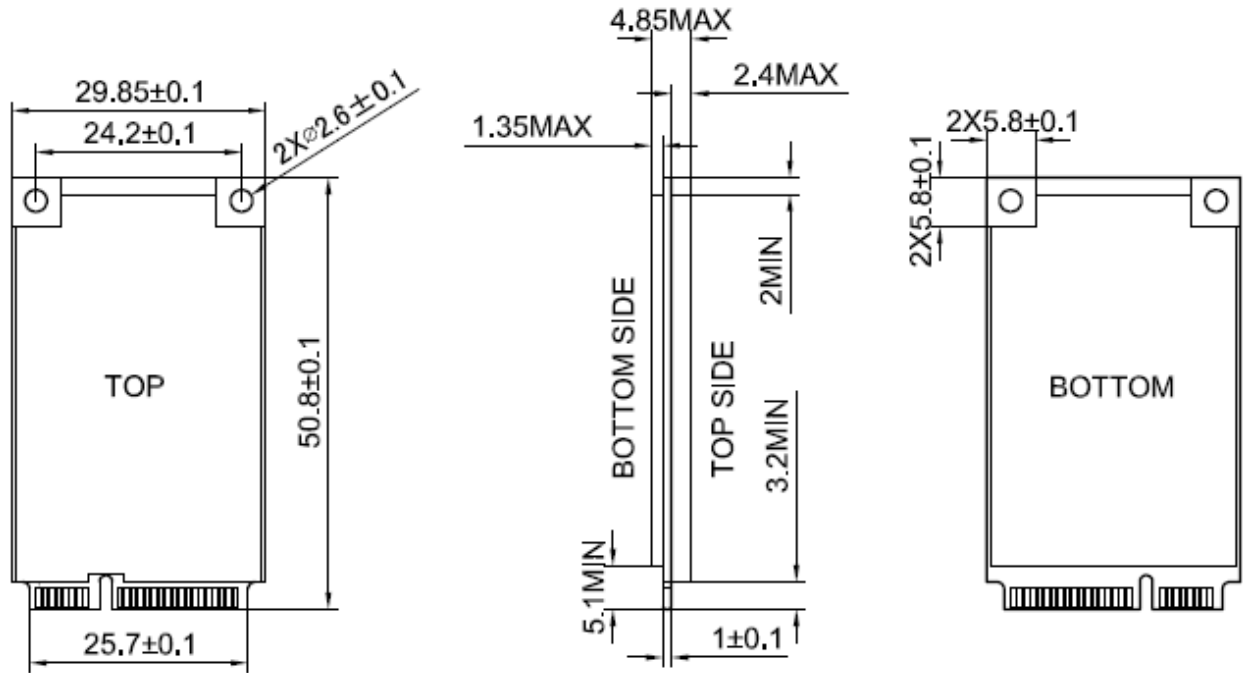


Table 11: Physical dimensions for mSATA

| PHYSICAL DIMENSIONS | VALUE | UNIT |
|---------------------|-------|------|
| Length | 50.8 | mm |
| Width | 29.85 | mm |
| Thickness | 3.4 | mm |

5.3 M.2 2280 PCB

Figure 4: M.2 2280 physical dimension diagram

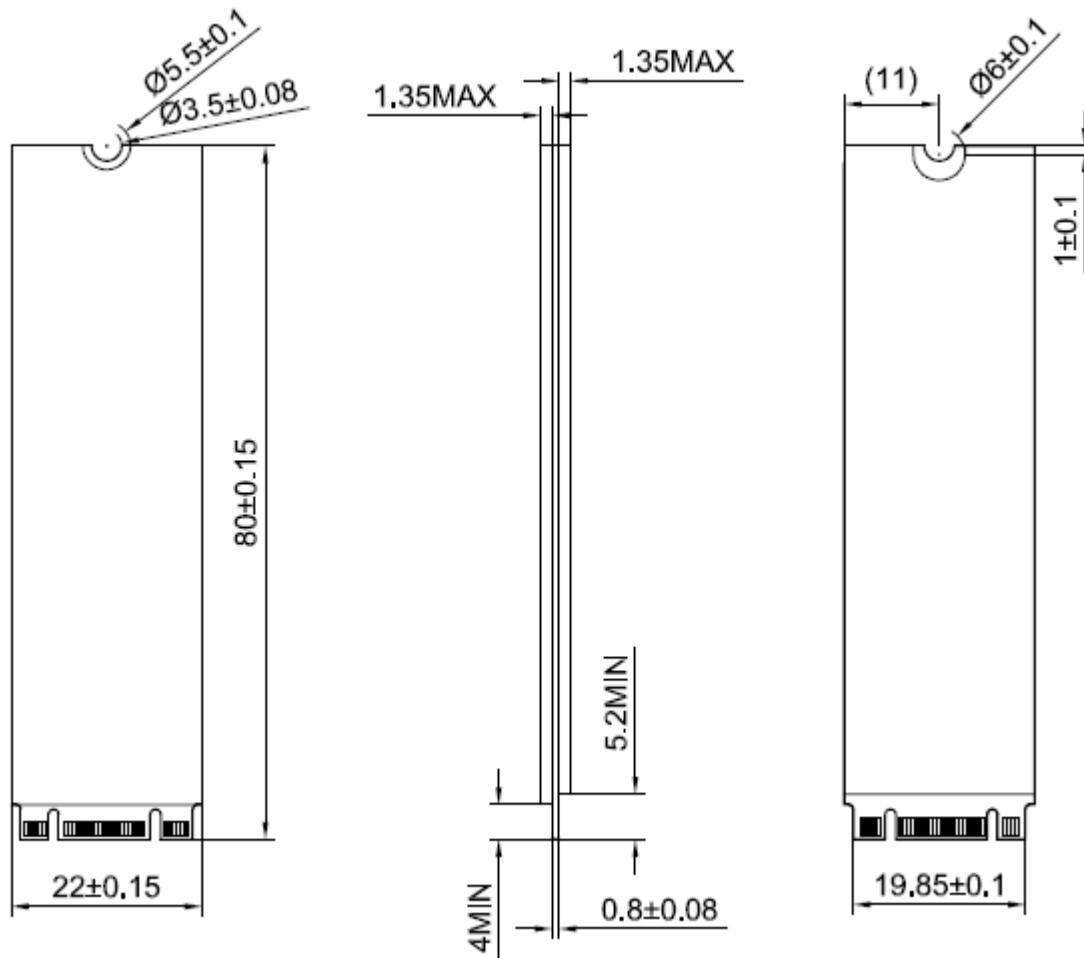


Table 12: Physical dimensions for M.2 2280

| PHYSICAL DIMENSIONS | VALUE | UNIT |
|---------------------|-------|------|
| Length | 80 | mm |
| Width | 22 | mm |
| Thickness | 3.5 | mm |

6. Pin Assignment

6.1 SATA 2.5 Inch connector

Table 15: 2.5 inch connector signal name, power pin assignment, and description

| PIN NAME | SIGNAL NAME | DESCRIPTION |
|----------|----------------------|--------------------------------|
| S1 | GND | Ground |
| S2 | R+ | + Differential Receive Signal |
| S3 | R- | - Differential Receive Signal |
| S4 | GND | Ground |
| S5 | T- | - Differential Transmit Signal |
| S6 | T+ | + Differential Transmit Signal |
| S7 | GND | Ground |
| P1 | NC | NO Connect |
| P2 | HW_Trigger_IN | hardware erase input(3V~10V) |
| P3 | DevsIp | Enter/Exit DevSleep |
| P4 | HW_Trigger_IN_Return | Hardware erase return |
| P5 | GND | Ground |
| P6 | GND | Ground |
| P7 | V5 | 5V Power,Pre-charge |
| P8 | V5 | 5V Power |
| P9 | V5 | 5V Power |
| P10 | GND | Ground |
| P11 | DAS | Device Activity Signal |
| P12 | GND | Ground |
| P13 | V12 | 12V Power (Not Used) |
| P14 | V12 | 12V Power (Not Used) |
| P15 | V12 | 12V Power (Not Used) |

Table 16: Pin assignment and description for 2.5-inch SATA Board (SAM1A & SAM1D)

| PIN NAME | SIGNAL NAME | DESCRIPTION |
|-----------|-------------|-------------------------------|
| S1 | Ground | Ground |
| S2 | R+ | +Differential Receive Signal |
| S3 | R- | -Differential Receive Signal |
| S4 | Ground | Ground |
| S5 | T- | -Differential Transmit Signal |
| S6 | T+ | +Differential Transmit Signal |
| S7 | Ground | Ground |
| P1, P2,P3 | V3.3 | 3.3V Power (Not used) |
| P4 | Ground | Ground |
| P5 | Ground | Ground |
| P6 | Ground | Ground |
| P7 | V5 | 5V power, pre-charge |
| P8 | V5 | 5V power |
| P9 | V5 | 5V power |
| P10 | Ground | Ground |
| P11 | DAS | Device Active Strobe |
| P12 | Ground | Ground |
| P13 | V12 | 12V Power (Not used) |
| P14 | V12 | 12V Power (Not used) |
| P15 | V12 | 12V Power (Not used) |

6.2 mSATA connector

Table 17: mSATA connector signal name, power pin assignment, and description

| PIN NAME | SIGNAL NAME | DESCRIPTION |
|----------|-------------|------------------------|
| 1 | NC | No Connection |
| 2 | 3.3V | 3.3V DC Input |
| 3 | NC | No Connection |
| 4 | GND | Ground |
| 5 | NC | No Connection |
| 6 | NC | No Connection |
| 7 | NC | No Connection |
| 8 | REV | REV(Manufacturing Use) |
| 9 | GND | Ground |
| 10 | REV | REV(Manufacturing Use) |
| 11 | NC | No Connection |
| 12 | REV | REV(Manufacturing Use) |
| 13 | NC | No Connection |
| 14 | REV | REV(Manufacturing Use) |

| | | |
|----|----------|------------------------------|
| 15 | GND | Ground |
| 16 | REV | REV(Manufacturing Use) |
| 17 | REV | REV(Manufacturing Use) |
| 18 | GND | Ground |
| 19 | NC | No Connection |
| 20 | REV | REV(Manufacturing Use) |
| 21 | GND | Ground |
| 22 | NC | No Connection |
| 23 | TXP | SATA TXP (SSD Transmits) |
| 24 | 3.3V | 3.3V DC Input |
| 25 | TXN | SATA TXN (SSD Transmits) |
| 26 | GND | Ground |
| 27 | GND | Ground |
| 28 | NC | No Connection |
| 29 | GND | Ground |
| 30 | NC | No Connection |
| 31 | RXN | SATA RXN (SSD Receives) |
| 32 | NC | No Connection |
| 33 | RXP | SATA RXP (SSD Receives) |
| 34 | GND | Ground |
| 35 | GND | Ground |
| 36 | NC | No Connection |
| 37 | GND | Ground |
| 38 | NC | No Connection |
| 39 | 3.3V | 3.3V DC Input |
| 40 | GND | Ground |
| 41 | 3.3V | 3.3V DC Input |
| 42 | NC | No Connection |
| 43 | GND | Ground |
| 44 | DEVSLP | Device Sleep Request |
| 45 | UART RXD | UART RXD (Manufacturing Use) |
| 46 | NC | No Connection |
| 47 | UART TXD | UART TXD (Manufacturing Use) |
| 48 | NC | No Connection |
| 49 | DAS | Device Activity Signal |
| 50 | GND | Ground |
| 51 | GND | Ground |
| 52 | 3.3V | 3.3V DC Input |

6.3 M.2 connector

Table 18: M.2 connector signal name, power pin assignment, and 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 | UART RX | Manufacturing Use |
| 23 | PCIe 2 RXn | PCIe Lane 2 RX- |
| 24 | NC | No Connection |
| 25 | PCIe 2 RXp | PCIe Lane 2 RX+ |
| 26 | Reserved | Reserved |
| 27 | GND | Ground |
| 28 | Reserved | Reserved |
| 29 | PCIe 1 TXn | PCIe Lane 1 TX- |
| 30 | Reserved | Reserved |
| 31 | PCIe 1 TXp | PCIe Lane 1 TX+ |
| 32 | UART TX | Manufacturing Use |
| 33 | GND | Ground |
| 34 | Reserved | Reserved |
| 35 | PCIe 1 RXn | PCIe Lane 1 RX- |

| | | |
|----|-----------------|---------------------|
| 36 | Reserved | Reserved |
| 37 | PCIe 1 RXp | PCIe Lane 1 RX+ |
| 38 | Reserved | Reserved |
| 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 | NC | No Connection |
| 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 | NC | No Connection |
| 57 | GND | Ground |
| 58 | NC | No Connection |
| 59 | PCIe Module Key | |
| 60 | PCIe Module Key | |
| 61 | PCIe Module Key | |
| 62 | PCIe Module Key | |
| 63 | PCIe Module Key | |
| 64 | PCIe Module Key | |
| 65 | PCIe Module Key | |
| 66 | 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 SA4 series SSD complies with the following specifications:

- FCC
- CE
- RoHS

8. Supported ATA commands

Exascend SA4 series SSDs support the ATA commands that are shown in the following table. For details about the ATA commands, please refer to the ATA/ATAPI ACS3 command set specifications.

Table 19: Supported ATA Command Set

| COMMAND NAME | CODE (HEX) | COMMAND NAME | CODE (HEX) |
|------------------------------------|------------|---------------------------|------------|
| NOP | 00h | Read Multiple | C4h |
| Data Set Management | 06h | Write Multiple | C5h |
| Read Sectors | 20h | Set Multiple Mode | C6h |
| Read Sectors EXT | 24h | Read DMA | C8h |
| Read DMA EXT | 25h | Write DMA | CAh |
| Read Native Max Address EXT | 27h | Write Multiple FUA EXT | CEh |
| Read Multiple EXT | 29h | Standby Immediate | E0h |
| Read Log EXT | 2Fh | IDLE Immediate | E1h |
| Write Sectors | 30h | Standby | E2h |
| Write Sectors EXT | 34h | IDLE | E3h |
| Write DMA EXT | 35h | Read Buffer | E4h |
| Set Max Address EXT | 37h | Check Power Mode | E5h |
| Write Multiple EXT | 39h | Sleep | E6h |
| Write DMA FUA EXT | 3Dh | Flush Cache | E7h |
| Write Log EXT | 3Fh | Write Buffer | E8h |
| Read Verify Sectors | 40h | Read Buffer DMA | E9h |
| Read Verify Sectors EXT | 42h | Flush Cache EXT | EAh |
| Write Uncorrectable EXT | 45h | Write Buffer DMA | EBh |
| Read Log DMA EXT | 47h | Identify Device | ECh |
| Write Log DMA EXT | 57h | Set Features | EFh |
| Read FPDMA Queued | 60h | Security Set Password | 0xF1 |
| Write FPDMA Queued | 61h | Security Unlock | 0xF2 |
| Set Date & Time EXT | 77h | Security Erase Prepare | 0xF3 |
| Accessible Max Address | 78h | Security Erase Unit | 0xF4 |
| Execute Device Diagnostic | 90h | Security Freeze Lock | 0xF5 |
| Download Micro Code | 92h | Security Disable Password | 0xF6 |
| Download Micro Code DMA | 93h | Read Native Max Address | 0xF8 |
| SMART | B0h | Set Max Address | 0xF9 |
| Sanitize Device | B4h | | |

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 SA4 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 20: S.M.A.R.T. health information

| ID (Dec) | ID(Hex) | Attribute Name | Description |
|----------|---------|---|---|
| 1 | 01h | Raw Read Error Rate | Total event count for all correctable and un-correctable ecc, it would be cleared to 0 when exceeding FFFFFFFFh |
| 5 | 05h | Retired Block Count | Retired block count after leaving factory |
| 9 | 09h | Power-On Hours | Power on time, culmulative over the life of the device, integer number in hour time units |
| 12 | 0Ch | Device Power Cycle Count | Culmulative number of power cycle events over the life of the device |
| 165 | A5h | Maximum Erase Count | Maximum erase count of all the blocks in the device |
| 166 | A6h | Minimum Erase Count | Minimum erase count of all the blocks in the device |
| 167 | A7h | Average Erase Count | Average erase count of all the blocks in the device |
| 169 | A9h | Remain life/Media Wearout Indicator | Indicate the worn-out status of the device |
| 170 | AAh | Available Reserved Space | Percentage of reserved blocks remaining in op |
| 171 | ABh | Program Fail Count | Total count of program fails |
| 172 | ACh | Erase Fail Count | Total count of erase fails |
| 174 | A Eh | Unexpected Power Loss | Total count of unexpected power loss events |
| 183 | B7h | Total Sata Link Down Grade Link Count | Total count of the number of times SATA interface selected lower signaling rate due to error Byte0~1: count of failing SATA connection Byte2~3: count of SATA1 Byte4~5: count of SATA2 |
| 194 | C2h | Temperature | Byte0~1: current temperature Byte2~3: minimum temperature Byte4~5: maximum temperature |
| 198 | C6h | ECC On-the-Fly Error Count | Count of un-correcable ecc (UECCC). It is cleared at power-on reset. |
| 199 | C7h | Current Sata Interface Crc Count | Count of SATA interface CRC during this power on, it would be cleared to zero during power off |
| 241 | F1h | Lifetime Writes from Host System | Data written by host (GB=1024*1024*1024 Byte) |
| 242 | F2h | Lifetime Reads to Host System | Data read to host (GB=1024*1024*1024 Byte) |
| 249 | F9h | Total Nand Writes | Total data written to NAND (GB=1024*1024*1024 Byte) |
| 250 | FAh | Current Sata Link Down Grade Link Count | Count of the number of times SATA interface selected lower signaling rate due to error during this power on, it would be cleared to 0 during power off Byte0~1: count of failing SATA connection Byte2~3: count of SATA1 Byte4~5: count of SATA2 |
| 251 | FBh | Total Sata Interface Crc Count | Life-time SATA interface CRC count |

9.3 S.M.A.R.T. Sub command

The SMART feature set command has several separate sub-commands which are selective by host to write it to the devices' features registers before issuing the S.M.A.R.T. The sub-commands are listed below.

Table 21: S.M.A.R.T. sub command

| Command | Sub-Code |
|---|----------|
| SMART Read Data | D0 |
| SMART Read Attribute Thresholds | D1 |
| SMART Enable/Disable Attribute AutoSave | D2 |
| SMART Execute Off-Line Immediate | D4 |
| SMART Read Log | D5 |
| SMART Write Log | D6 |
| SMART Enable Operations | D8 |
| SMART Disable Operations | D9 |
| SMART Return Status | DA |

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 three (3) years limited warranty for our industrial products.

The warranty period is the SHORTER OF:

- a period of three (3) 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 © 2022 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 2, 10F, No.171, Songde Rd., Xinyi Dist., Taipei City 110, Taiwan (R.O.C.)

General Support: +886-2-2726-6500

Fax: +886-2-2726-6126

Email: sales@exascend.com