PE3 series

Enterprise-grade PCIe SSD

Specifications

Capacity
- PE3 Streaming
  - U.2: 480–7,680 GB
  - M.2: 240–3,840 GB
- PE3 Pro
  - U.2: 480–3,840 GB
  - M.2: 480–1,920 GB
- PE3 Boot
  - M.2: 240–480 GB
- PE3 Max
  - U.2: 480–1,920 GB
  - M.2: 240–960 GB

Components
- Controller: Marvell 88SS1092
- Flash: 3D TLC
- DRAM: DDR4

Compliance
- PCIe Gen3 x4, NVMe 1.2
- NVMe TRIM-support
- Up to 16 I/O queues
- Surprise insertion/surprise removal (SISR) and hot-plug-capable (U.2 form factor only)

Performance (up to)[1]
- Sequential read: 3,200 MB/s
- Sequential write: 2,000 MB/s
- Random 4K read: 310,000 IOPS
- Random 4K write: 200,000 IOPS
- Random 4K write full drive: 70,000 IOPS

Power management
- Auto idle
- PCIe 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, IEEE 1667 and Bitlocker
- Data sanitization with crypto erase, fast erase, normal erase
- Cryptographic firmware image signing

Latency (QD1)
- Read: 110 µs
- Write: 25 µs

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]
- PE3 Streaming: 0.6 DWPD, 2 DWPD @ 5 years
- PE3 Pro: 1.5 DWPD, 5 DWPD @ 5 years
- PE3 Boot: 1.0 DWPD, 3 DWPD @ 5 years
- PE3 Max: 5 DWPD, 10 DWPD @ 5 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
- U.2: 100.5 mm x 69.85 mm x 7 mm
- M.2: 80 mm x 22 mm x 3.6 mm

Power consumption (TYP)
- Active: <9.0 W
- Idle: <1.5 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)

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/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.

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Product datasheet

1. Order information

The following table lists the standard part numbers for Exascend PE3 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.com.

Table 1: PE3 series SSD product list

PART NUMBER	CONFIGURATION	CAPACITY*	FLASH TYPE	FORM FACTOR
EXPE3M240GB	Streaming	240 GB	3D TLC	M.2 2280
EXPE3M480GB	Streaming	480 GB	3D TLC	M.2 2280
EXPE3M960GB	Streaming	960 GB	3D TLC	M.2 2280
EXPE3M1920GB	Streaming	1,920 GB	3D TLC	M.2 2280
EXPE3M3840GB	Streaming	3,840 GB	3D TLC	M.2 2280
EXPE3M240GB-WP	Streaming	240 GB	3D TLC	M.2 2280 w/PLP
EXPE3M480GB-WP	Streaming	480 GB	3D TLC	M.2 2280 w/PLP
EXPE3M240GB-P	Pro	480 GB	3D TLC	M.2 2280
EXPE3M480GB-P	Pro	960 GB	3D TLC	M.2 2280
EXPE3M960GB-P	Pro	1,920 GB	3D TLC	M.2 2280
EXPE3M240GB-X	Max	240 GB	3D TLC	M.2 2280
EXPE3M480GB-X	Max	480 GB	3D TLC	M.2 2280
EXPE3M960GB-X	Max	960 GB	3D TLC	M.2 2280
EXPE3M240GB-XWP	Max	240 GB	3D TLC	M.2 2280 w/PLP
EXPE3M480GB-XWP	Max	480 GB	3D TLC	M.2 2280 w/PLP
EXPE3M240GB-T	Boot	240 GB	3D TLC	M.2 2280
EXPE3M480GB-T	Boot	480 GB	3D TLC	M.2 2280
EXPE3U480GB	Streaming	480 GB	3D TLC	U.2
EXPE3U960GB	Streaming	960 GB	3D TLC	U.2
EXPE3U1920GB	Streaming	1,920 GB	3D TLC	U.2
EXPE3U3840GB	Streaming	3,840 GB	3D TLC	U.2
EXPE3U7680GB	Streaming	7,680 GB	3D TLC	U.2
EXPE3U480GB-P	Pro	480 GB	3D TLC	U.2
EXPE3U960GB-P	Pro	960 GB	3D TLC	U.2
EXPE3U1920GB-P	Pro	1,920 GB	3D TLC	U.2
EXPE3U3840GB-P	Pro	3,840 GB	3D TLC	U.2
EXPE3U480GB-X	Max	480 GB	3D TLC	U.2
EXPE3U960GB-X	Max	960 GB	3D TLC	U.2
EXPE3U1920GB-X	Max	1,920 GB	3D TLC	U.2

2. Part number decoder

EX	PE3	M	1920GB	-X

1. Exascend
2. Product series (SC1/SC3/PC3/PC4/SE1/SE3/PE3/PE4/SI2/SI3/PI3/PE4/PI4)
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

3.1 PE3 series

Exascend's PE3 series is an enterprise-class lineup of PCIe NVMe SSDs featuring high IOPS and extreme quality of service (QoS) suitable for the most demanding enterprise workloads.

The PE3 series is specifically designed for high-reliability server, enterprise data center, and cloud computing applications. The PE3 series supports full-drive encryption (FDE) as a self-encrypting drive (SED), featuring a hardware AES-256 hardware encryption engine for military-grade encryption with no impact on system performance. The PE3 series supports the TCG Opal 2.0, IEEE 1667 and Bitlocker specifications for self-encrypting drives.

The PE3 series is available in the U.2 and M.2 form factors, features the high-speed PCIe Gen 3 x4 interface with 3D TLC NAND flash memory technology, and delivers capacities up to 7.68 TB. The PE3 series is available in the *Streaming*, *Pro*, *Max*, and *Boot* subseries to meet specific application demands for write amplification factor (WAF), write endurance (DWPD and TBW), and over-provisioning (OP).

Exascend's PE3 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 5 years.

PE3 Streaming 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 5 years.

PE3 Pro series:
Optimized for mixed read and write-intensive enterprise-class workloads, supporting up to 1.5 DWPD under JESD219 enterprise workloads – or 5 DWPD under JESD219 client workloads – for 5 years.

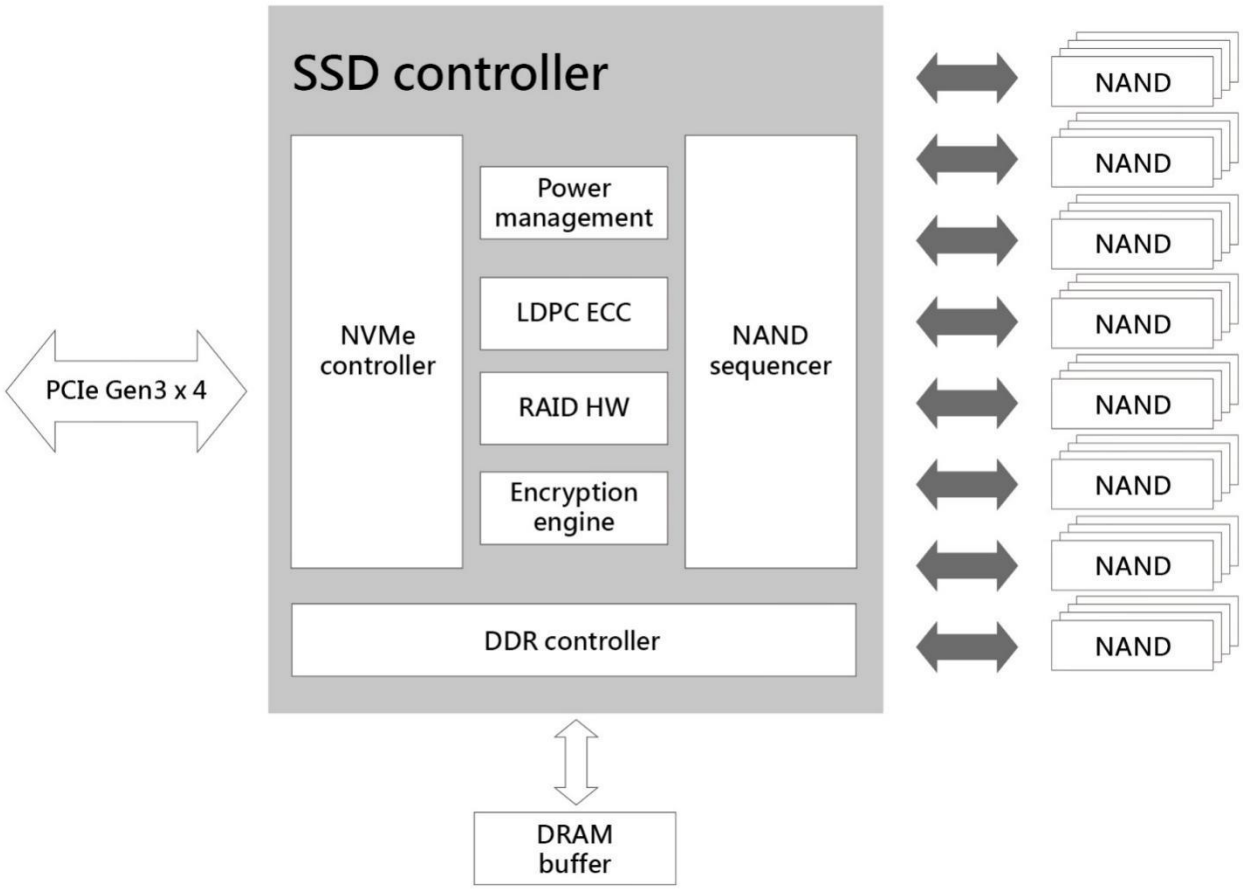
PE3 Max series:
Ideal for extreme, intensive workloads, supporting up to 5 DWPD under JESD219 enterprise workloads – or up to 10 DWPD under JESD219 client workloads – for 5 years.

PE3 Boot series:
Engineered for enterprise-class system boot applications and journaling workloads, supporting up to 1 DWPD under JESD219 enterprise workloads – or 3 DWPD under JESD219 client workloads – for 5 years.

PE3 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, IEEE 1667 and Bitlocker
- 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



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.com.

4. Detailed specifications

The Exascend PE3 series provides extreme performance and ultra-high reliability, delivering speeds up to 3,100 MB/s sequential read, 2,000 MB/s sequential write, 310,000 IOPS random read, and 70,000 IOPS steady-state random write. Available in a wide variety of form factors, configurations and storage capacities, the PE3 series is ideal for enterprise applications that demand storage devices that can handle extreme workloads and offer steadfast reliability.

4.1 Capacity

Table 2: PE3 logical block address configuration

PE3 SERIES	UNFORMATTED CAPACITY (TOTAL USER ADDRESSABLE SECTORS IN LBA MODE)
240 GB	468,851,544
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 3: Drive performance – PE3 series

	UNIT	PE3 BOOT SERIES		PE3 STREAMING SERIES					
Capacity	GB	**240 GB**	**480 GB**	**240 GB**	**480 GB**	**960 GB**	**1,920 GB**	**3,840 GB**	**7,680 GB**
Sequential read	MB/s	3,100	3,100	1600	3,100	3,100	3,100	3,100	3,100
Sequential write	MB/s	350	600	300	500	1,100	1,600	1600	1,600
Sustained read (4KB)	IOPS	150K	200K	110K	180K	300K	310K	310K	310K
Sustained write (4KB)	IOPS	10K	18K	10K	18K	23K	30K	30K	30K
TBW (JESD219 enterprise)	TBW	433	866	260	520	1,000	2,000	4,000	8,000
TBW (JESD219 client)	TBW	1,300	2,600	650	1,300	2,600	5,200	10,000	20,000
DWPD (5 years)	1 @ JESD219 enterprise 3 @ JESD219 client			0.6 @ JESD219 enterprise 1.5 @ JESD219 client					
Form factor		M.2		M.2	M.2 & U.2				U.2

Table 3: Drive performance – PE3 series (continue)

	UNIT	PE3 MAX SERIES				PE3 PRO SERIES			
Capacity	GB	**240 GB**	**480 GB**	**960 GB**	**1,920 GB**	**480 GB**	**960 GB**	**1,920 GB**	**3,840 GB**
Sequential read	MB/s	3,200	3,200	3,200	3,200	3,100	3,100	3,100	3,100
Sequential write	MB/s	2,000	2,000	2,000	2,000	700	1,300	1,600	2,000
Sustained read (4KB)	IOPS	320K	320K	340K	340K	200K	340K	340K	340K
Sustained write (4KB)	IOPS	50K	60K	70K	65K	40K	45K	50K	50K
TBW (JESD219 enterprise)	TBW	2,200	4,400	8,500	17,000	1,300	2,600	5,200	10,000
TBW (JESD219 client)	TBW	4,500	9,000	18,000	36,000	2,500	5,200	10,000	20,000
DWPD (5 years)		5 @ JESD219 enterprise 10 @ JESD219 client				1.5 @ JESD219 enterprise 3 @ JESD219 client			
Form factor		M.2 & U.2			U.2	M.2 & U.2			U.2

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 – PE3 series

PARAMETER	UNIT	PE3 SERIES					
		240 GB	480 GB	960 GB	1.92 TB	3.84 TB	7.68 TB
Read (TYP)	µs	110	110	110	120	120	120
Write (TYP)	µs	25	25	25	30	30	30

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 Environment specification

Table 5: Environmental specification table

PARAMETER	VALUE
Operating temperature	0–70 °C
Storage temperature	-40–85 °C
Power supply voltage range	U.2: 12.0 V ±10% M.2: 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)

4.5 Power consumption

Table 6: PE3 series power consumption table

PARAMETER	VALUE	UNIT
Active power (average)	<9	W
Idle mode power (average)	<1.5	W

4.6 Reliability

Products in the Exascend PE3 series meet or exceed SSD endurance and data retention requirements as specified in the JESD218 standard. Reliability specifications are listed in the following table.

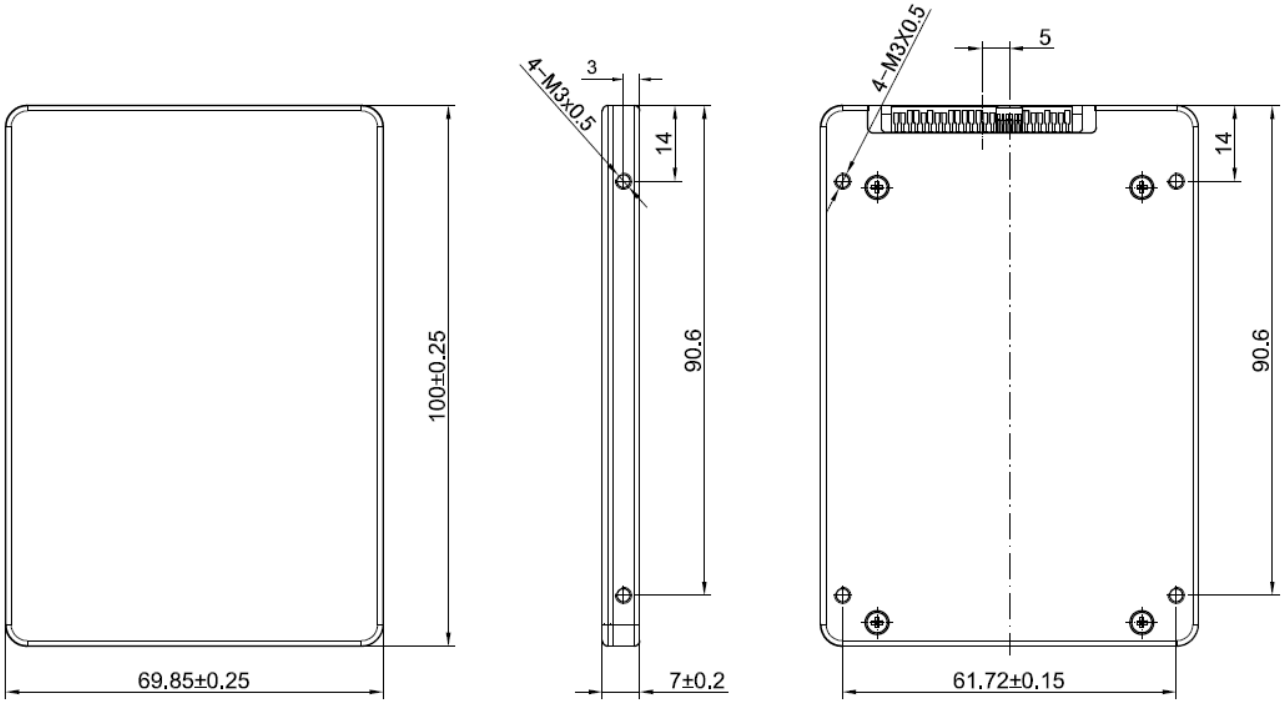
Table 7: Reliability table

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 U.2 board

Figure 2: U.2 physical dimension diagram



GENERAL TOLERANCE IS ±0.15mm
DIMENSION UNIT: mm

Table 8: Physical dimensions for U.2

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

5.2 PCIe M.2 2280

Figure 3: M.2 2280 physical dimension diagram

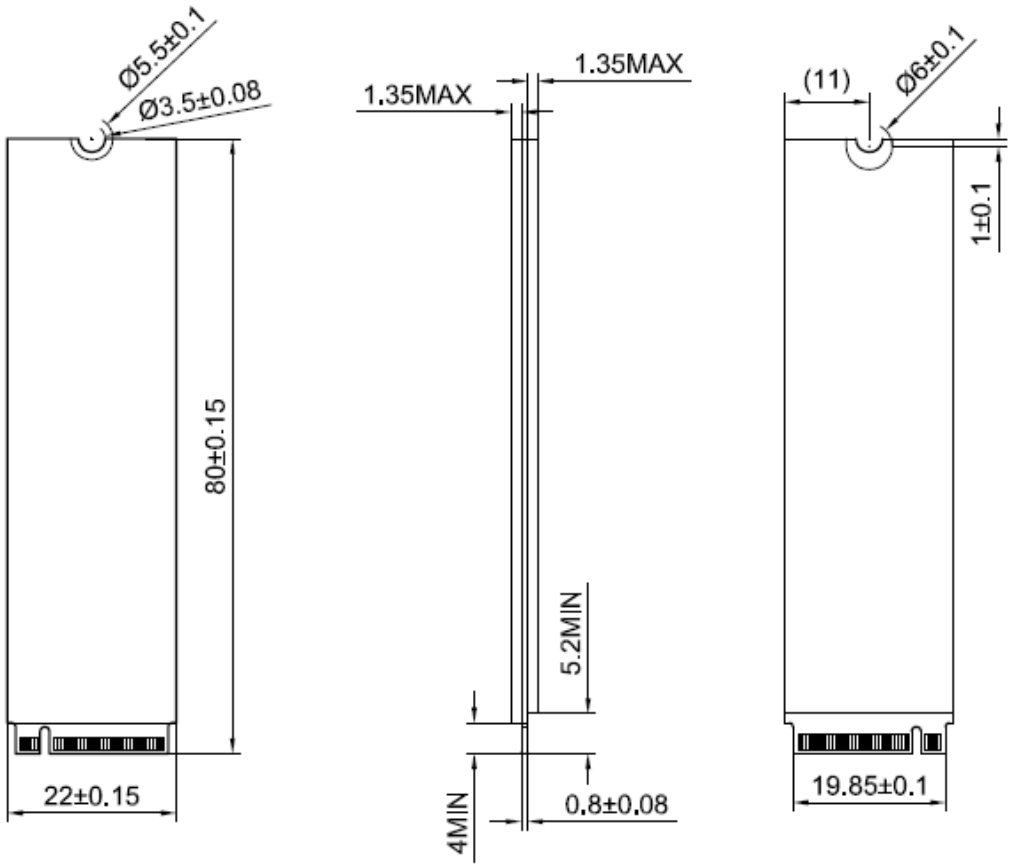


Table 9: Physical dimensions for M.2 2280

PHYSICAL DIMENSIONS	VALUE	UNIT
Length	80	mm
Width	22	mm
Thickness	3.6	mm

Figure 4: M.2 P3M2N physical dimension diagram

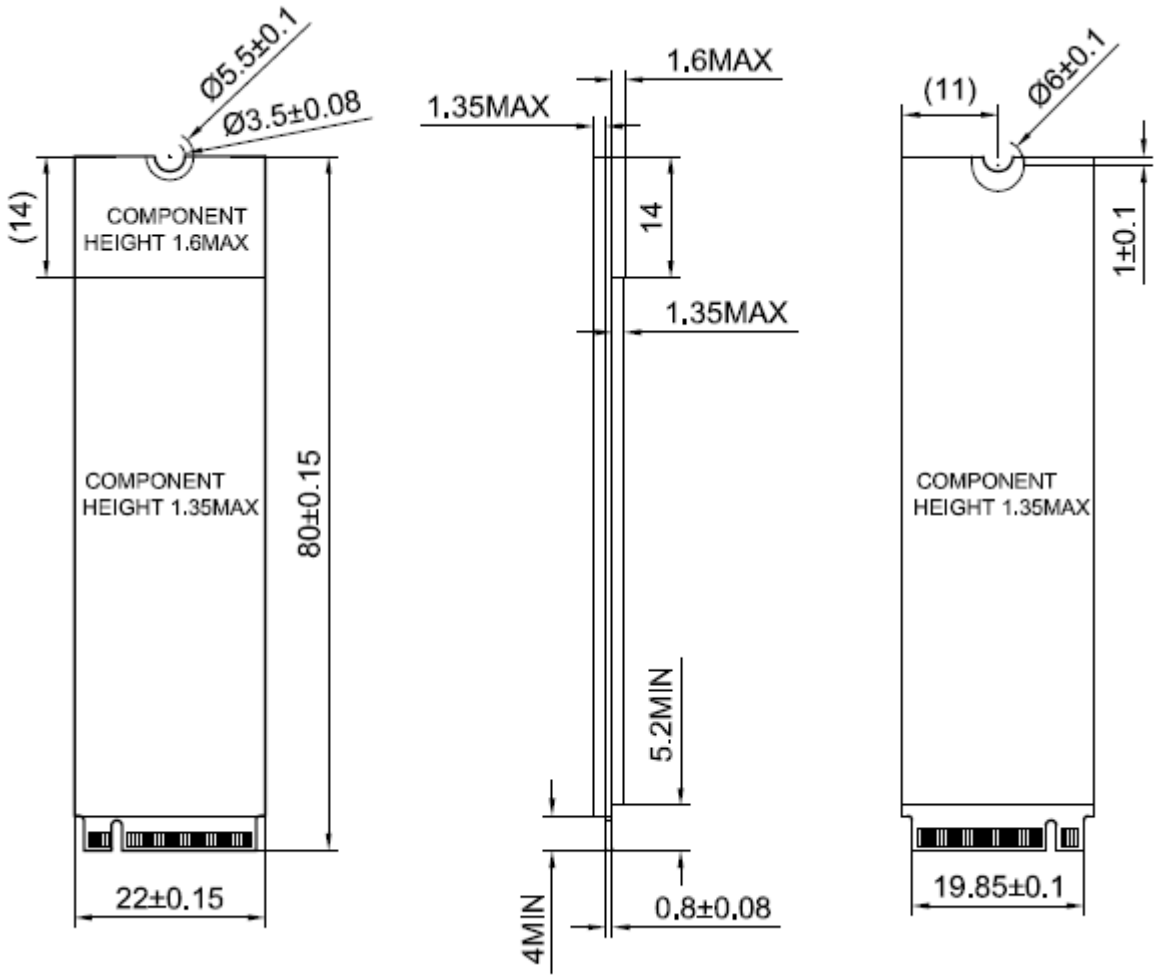


Table 10: Physical dimensions for M.2 P3M2N

PHYSICAL DIMENSIONS	VALUE	UNIT
Length	80	mm
Width	22	mm
Thickness	3.6	mm

6. Pin Assignment

6.1 U.2 connector

Table 11: U.2 connector signal name, power pin assignment, and description

PIN NAME	SIGNAL NAME	DESCRIPTION
S1	GND	Ground
S2		Not used
S3		Not used
S4	GND	Ground
S5		Not used
S6		Not used
S7	GND	Ground
E1		
E2		
E3	3.3Vaux	3.3 V Power
E4		
E5	PERST0#	Fundamental reset port 0
E6	Reserved	Reserved
P1		Not used (SATA/SAS)
P2		Not used (SATA/SAS)
P3	CLKREQ	CLKREQ
P4	IfDet_N	Interface detection (drive type)
P5	GND	Ground
P6	GND	Ground
P7		Not used (SATA/SAS)
P8		Not used (SATA/SAS)
P9		Not used (SATA/SAS)
P10	PRSNT_N	Presence detection (also used for drive type)
P11	Activity	Activity signal from the drive
P12	Hot-Plug	Ground
P13	+12V_pre	12V Power
P14	+12V	12 V Power
P15	+12V	12 V Power
E7	REFCLK0+	Reference clock port 0 +
E8	REFCLK0-	Reference clock port 0 -
E9	GND	Ground
E10	PERp0	+ Receive differential pair, channel 0
E11	PERn0	- Receive differential pair, channel 0
E12	GND	Ground
E13	PETn0	- Transmit differential pair, channel 0

E14	PETp0	+ Transmit differential pair, channel 0
E15	GND	Ground
E16	Reserved	Reserved
S8	GND	Ground
S9		Not used (SATA/SAS)
S10		Not used (SATA/SAS)
S11	GND	Ground
S12		Not used (SATA/SAS)
S13		Not used (SATA/SAS)
S14	GND	Ground
S15	Reserved	Reserved
S16	GND	Ground
S17	PERp1	+ Receive differential pair, channel 1
S18	PERn1	- Receive differential pair, channel 1
S19	GND	Ground
S20	PETn1	- Transmit differential pair, channel 1
S21	PETp1	+ Transmit differential pair, channel 1
S22	GND	Ground
S23	PERp2	+ Receive differential pair, channel 2
S24	PERn2	- Receive differential pair, channel 2
S25	GND	Ground
S26	PETn2	- Transmit differential pair, channel 1
S27	PETp2	+ Transmit differential pair, channel 1
S28	GND	Ground
E17	PERp3	+ Receive differential pair, channel 3
E18	PERn3	- Receive differential pair, channel 3
E19	GND	Ground
E20	PETn3	- Transmit differential pair, channel 3
E21	PETp3	+ Transmit differential pair, channel 3
E22	GND	Ground
E23	SMCLK	SMBus clock
E24	SMDAT	SMBus data
E25	DualPortEn N	Dual port enable

6.2 PCIe M.2 connector

Table 12: 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 PE3 series SSD complies with the following specifications:

- FCC
- CE
- RoHS

8. Supported NVMe commands

Exascend PE3 series SSDs support the NVMe commands that are shown in the following table. For details about the NVMe commands, please refer to the NVMe 1.2 command set specifications.

Table 13: 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 14: 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 15: 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 PE3 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 16: 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.

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Revision history

Table 17: PE3 datasheet revision history

REVISION	DESCRIPTION	DATE
001	First released	November, 2021
002	Update dimension diagram	January, 2022
003	Add SMbus Signal	March, 2022
004	Add sustained read/write (4KB) IOPS	November, 2022