

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 µs
- Write: 40 µs

Reliability

- Advanced LDPC error correction
- Global static and dynamic wear leveling
- Hardware power-off protection
- UBER: <1 sector per 10¹⁷ 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.

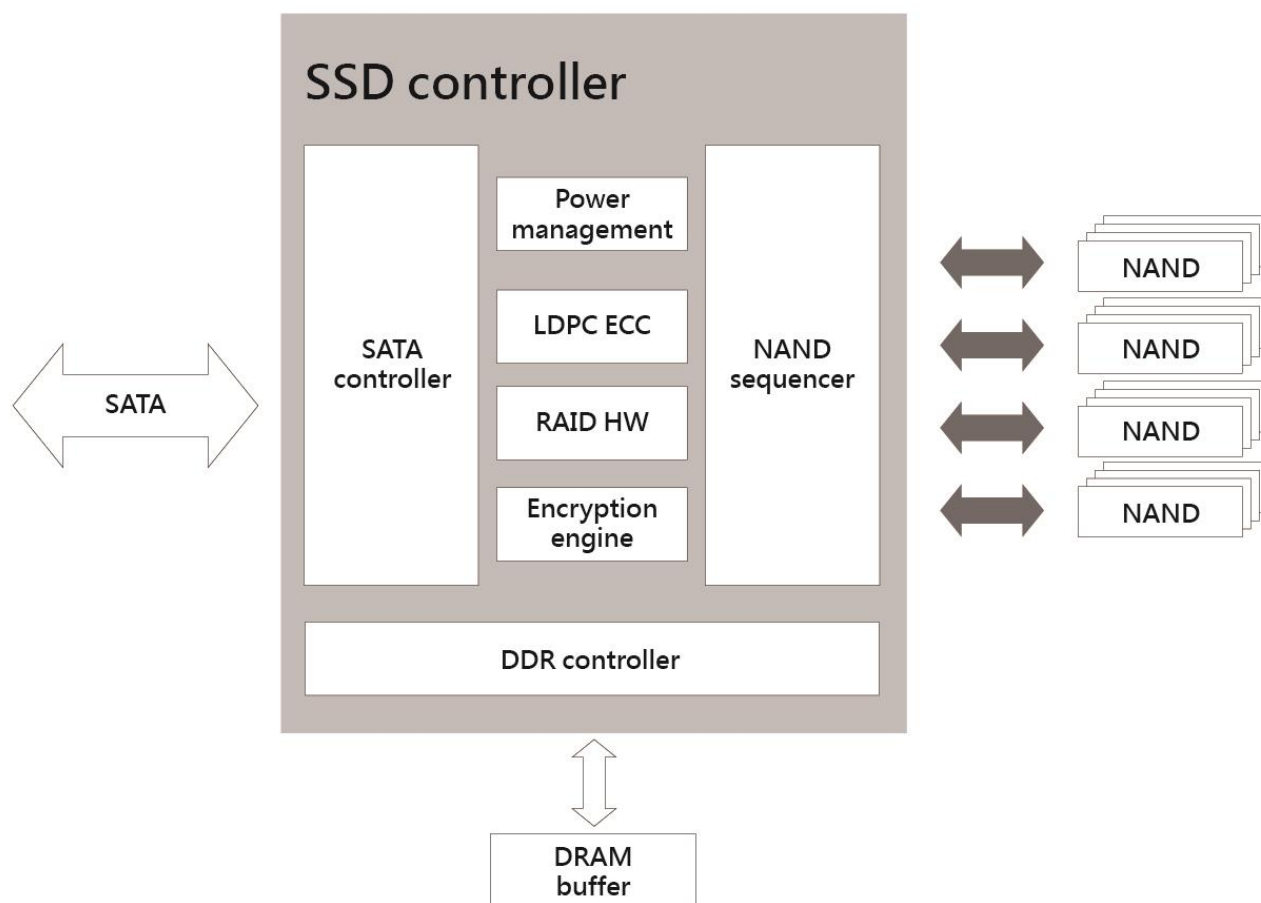
SA4 Max series:

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.

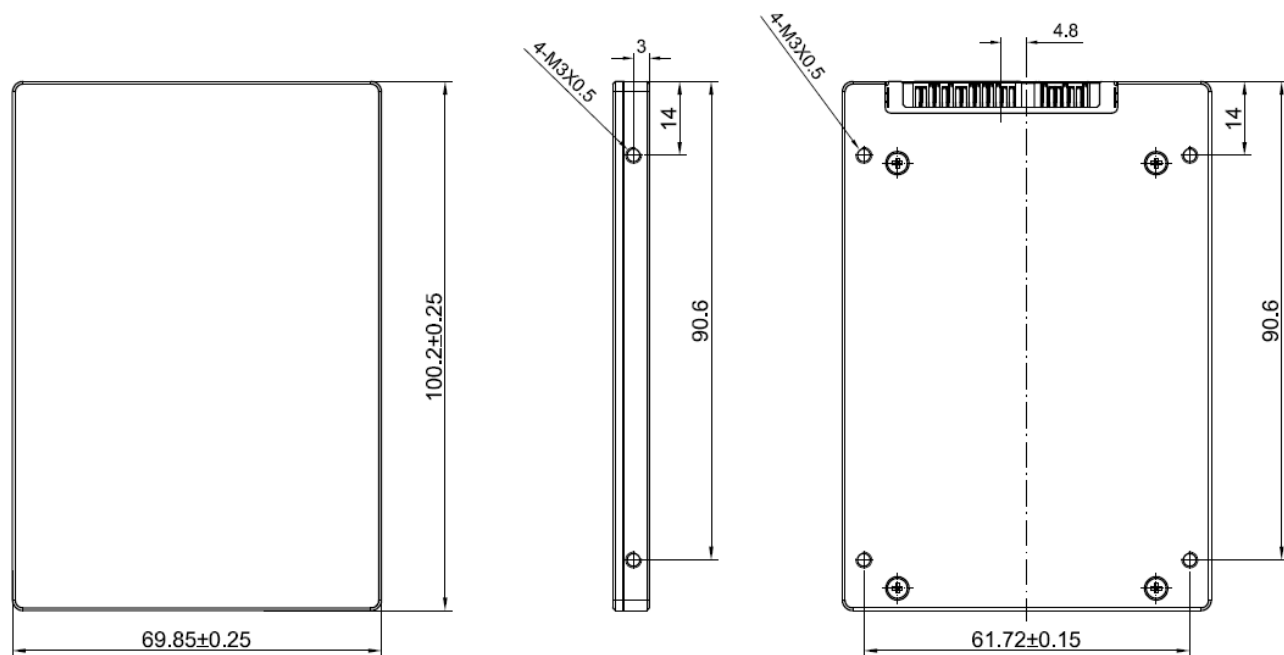
Table 9: Reliability table

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 $\pm 0.15\text{mm}$

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

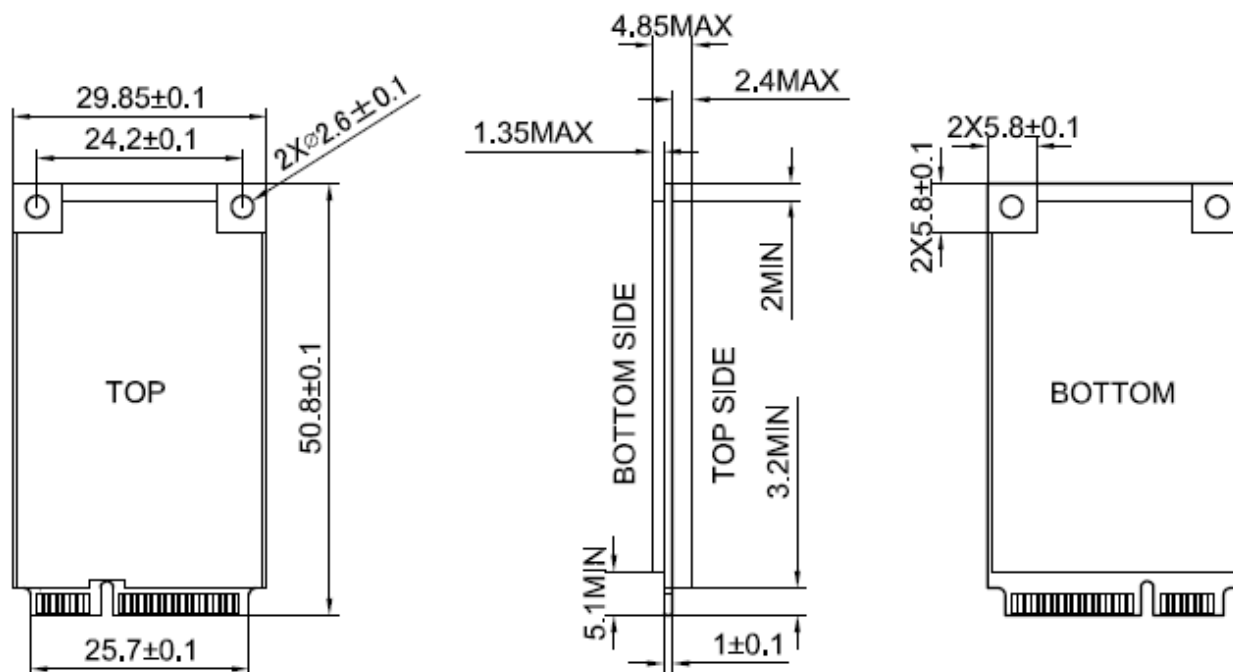


Table 11: Physical dimensions for mSATA

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

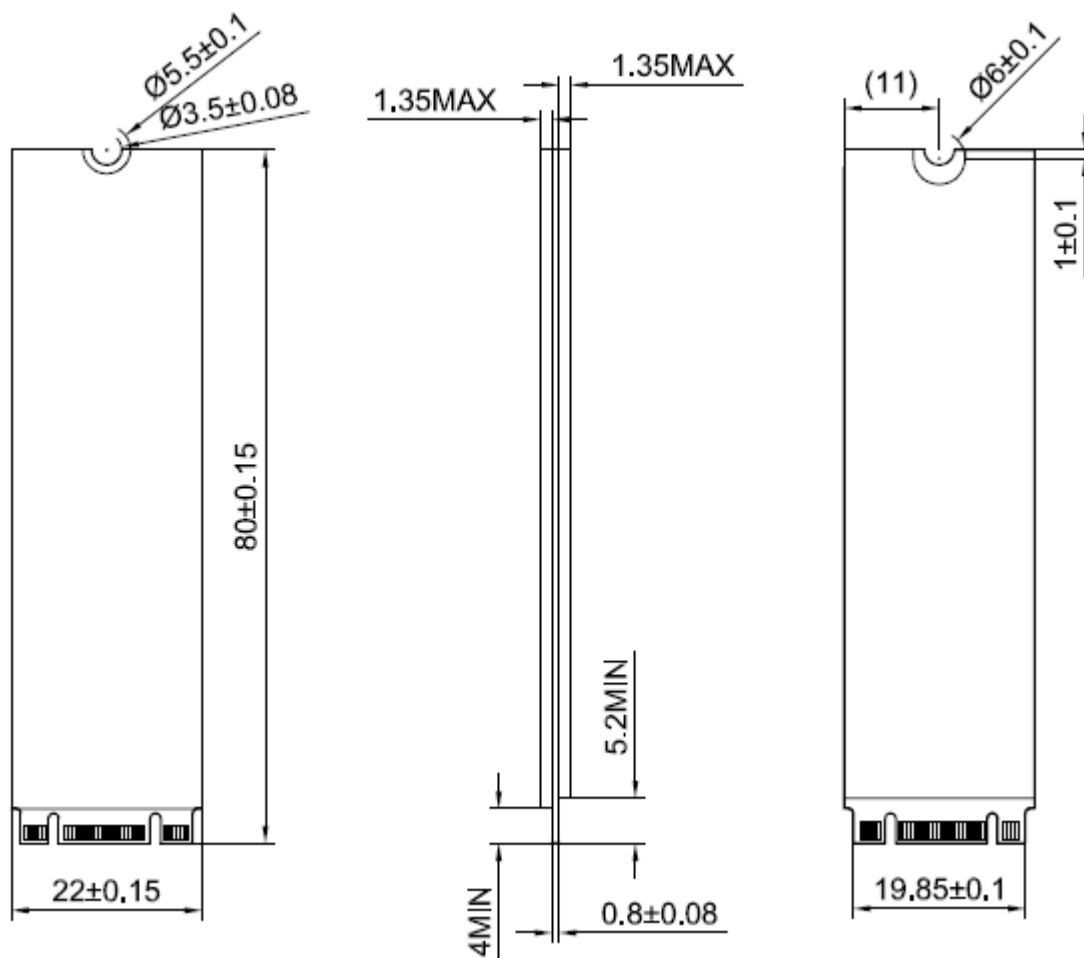


Table 12: Physical dimensions for M.2 2280

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	AEnh	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

Revision history

Table 22: SA4 datasheet revision history

REVISION	DESCRIPTION	DATE
001	First released	November, 2021
002	Update dimension diagram	January, 2022
003	Add SMBus Signal	March, 2022
004	Modify performance	July, 2022
005	Modify performance	October, 2022
006	Add 7680GB	December, 2022
007	Modify format	February, 2023