

# SI4 series

## Industrial-grade SATA3 SSD

### Specifications

#### Capacity

- SI4 Standard
  - 2.5-inch: 120–7680 GB
  - mSATA: 120–960 GB
  - M.2 2280: 120–7680 GB
- SI4 Max
  - 2.5-inch: 120–960 GB
  - mSATA: 120–240 GB
  - M.2 2280: 120–960 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)<sup>1</sup>

- Sequential read: 550 MB/s
- Sequential write: 535 MB/s
- Random 4K read: 98,000 IOPS
- Random 4K write: 90,000 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  $\mu$ s
- Write: 40  $\mu$ 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)<sup>2</sup>

- SI4 Standard: 0.6 DWPD, 2 DWPD @ 3 years
- SI4 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 warranty<sup>3</sup>

**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 number for Exascend SI4 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](mailto:sales@exascend.com).

**Table 1: SI4 series SSD product list**

PART NUMBER	CONFIGURATION	CAPACITY*	FLASH TYPE	FORM FACTOR
EXSI4A240GB	Standard	240GB	Industrial 3D TLC	2.5"
EXSI4A480GB	Standard	480GB	Industrial 3D TLC	2.5"
EXSI4A960GB	Standard	960GB	Industrial 3D TLC	2.5"
EXSI4A1920GB	Standard	1920GB	Industrial 3D TLC	2.5"
EXSI4A3840GB	Standard	3840GB	Industrial 3D TLC	2.5"
EXSI4A7680GB	Standard	7680GB	Industrial 3D TLC	2.5"
EXSI4A120GB-X	Max	120GB	Industrial 3D TLC	2.5"
EXSI4A240GB-X	Max	240GB	Industrial 3D TLC	2.5"
EXSI4A480GB-X	Max	480GB	Industrial 3D TLC	2.5"
EXSI4A960GB-X	Max	960GB	Industrial 3D TLC	2.5"
EXSI4B120GB	Standard	120GB	Industrial 3D TLC	mSATA
EXSI4B240GB	Standard	240GB	Industrial 3D TLC	mSATA
EXSI4B480GB	Standard	480GB	Industrial 3D TLC	mSATA
EXSI4B960GB	Standard	960GB	Industrial 3D TLC	mSATA
EXSI4B120GB-X	Max	120GB	Industrial 3D TLC	mSATA
EXSI4B240GB-X	Max	240GB	Industrial 3D TLC	mSATA
EXSI4M240GB	Standard	240GB	Industrial 3D TLC	M.2 2280
EXSI4M480GB	Standard	480GB	Industrial 3D TLC	M.2 2280
EXSI4M960GB	Standard	960GB	Industrial 3D TLC	M.2 2280
EXSI4M1920GB	Standard	1920GB	Industrial 3D TLC	M.2 2280
EXSI4M3840GB	Standard	3840GB	Industrial 3D TLC	M.2 2280
EXSI4M7680GB	Standard	7680GB	Industrial 3D TLC	M.2 2280
EXSI4M240GB-X	Max	240GB	Industrial 3D TLC	M.2 2280
EXSI4M480GB-X	Max	480GB	Industrial 3D TLC	M.2 2280
EXSI4M960GB-X	Max	960GB	Industrial 3D TLC	M.2 2280

## 2. Part number decoder

EX	SI4	M	1920GB	-X
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1. Exascend

2. Product series

(SC1/SC3/PC3/PC4/SE1/SE3/PE3/PE4/SI2/SI3/PI3/SI4/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

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](mailto:sales@exascend.com)

The S14 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 S14 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.

#### **S14 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.

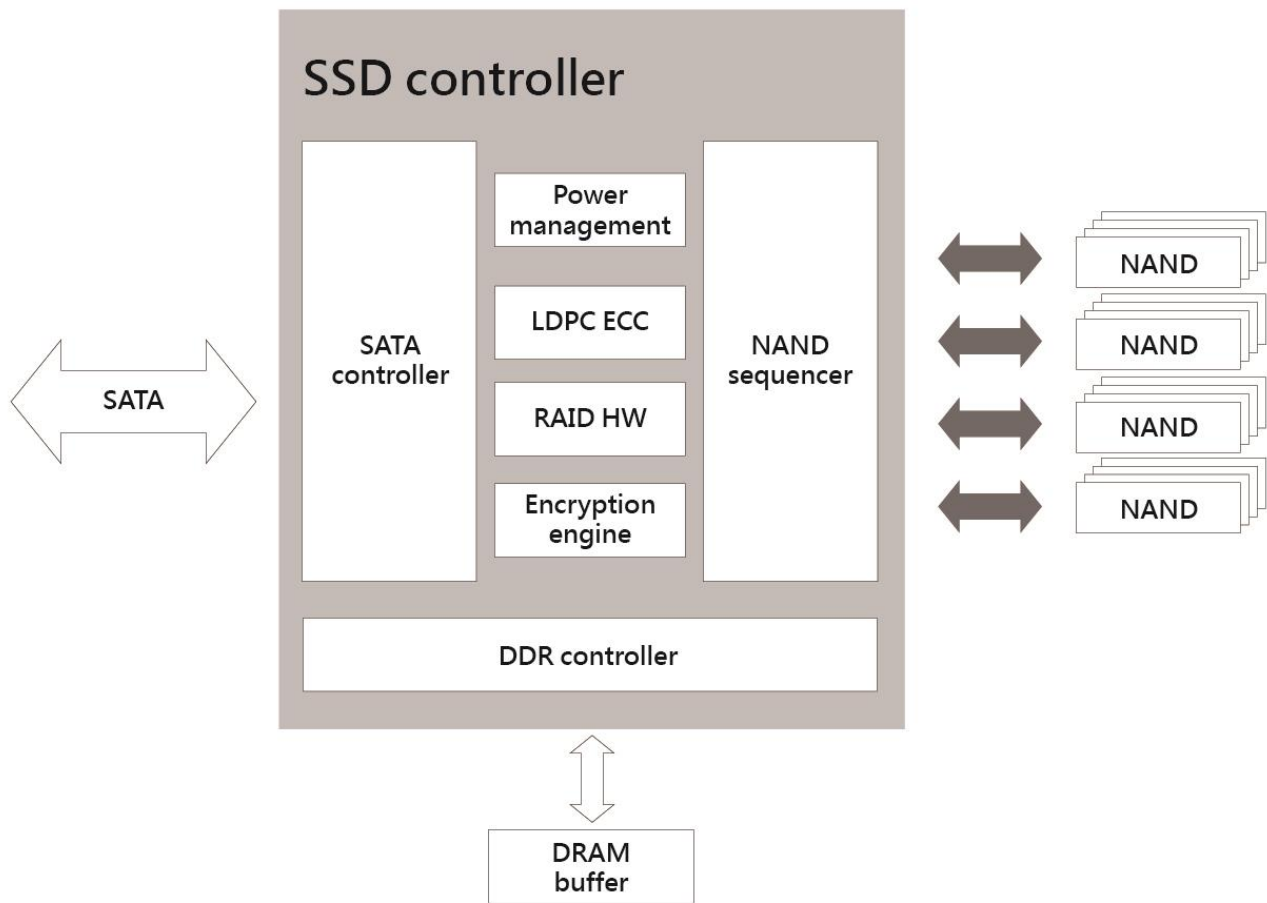
#### **S14 Max series:**

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.

#### **S14 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 SI4 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 90,000 IOPS for full drive 4k random write. Available in a wide variety of form factors, configurations and storage capacities, the SI4 series is ideal for enterprise applications that demand storage devices that can handle extreme workloads and offer steadfast reliability.

### 4.1 Capacity

**Table 2: SI4 logical block address configuration**

SE3 SERIES	UNFORMATTED CAPACITY (TOTAL USER ADDRESSABLE SECTORS IN LBA MODE)
120GB	234,441,648
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 – SI4 series**

Capacity	UNIT	SI4 STANDARD SERIES						
		120GB	240GB	480GB	960GB	1.92TB	3.84TB	7.68TB
Sequential read (128KB)	MB/s	540	550	550	550	550	550	535
Sequential write (128KB)	MB/s	140	300	535	535	535	535	535
Random read (4KB)	IOPS	45,000	85,000	98,000	98,000	98,000	98,000	75,000
Random write (4KB)	IOPS	5,000	10,000	18,000	20,000	20,000	20,000	10,000
TBW (JESD219 enterprise)	TBW	75	150	300	600	1,200	2,400	8,000
TBW (JESD219 client)	TBW	185	370	750	1,500	3,000	6,000	20,000
DWPD (3 years)		0.6 @ JESD219 enterprise 1.5 @ JESD219 client						
Form factor		M.2 & 2.5 Inch						



**Table 3: Drive performance – SI4 series**

Capacity	UNIT	SI4 MAX SERIES				
		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 – SI4 series**

PARAMETER	UNIT	SI4 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 – S14 Standard Series

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

Table 6: QoS – S14 Max Series

Specification	Unit	Queue Depth = 1					
		120 GB	240GB	480GB	960GB	1920GB	3840GB
<b>Quality of Service (99%)</b>							
Reads	µs	150	150	150	150	150	150
Writes	µs	120	120	120	120	120	120
<b>Quality of Service (99.9%)</b>							
Reads	µs	200	200	200	200	200	200
Writes	µs	300	300	300	300	300	300
<b>Quality of Service (99.99%)</b>							
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: SI4 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 SI4 series meet or exceed SSD endurance and data retention requirements as specified in the JESD218 standard. Reliability specifications are listed in the following table.

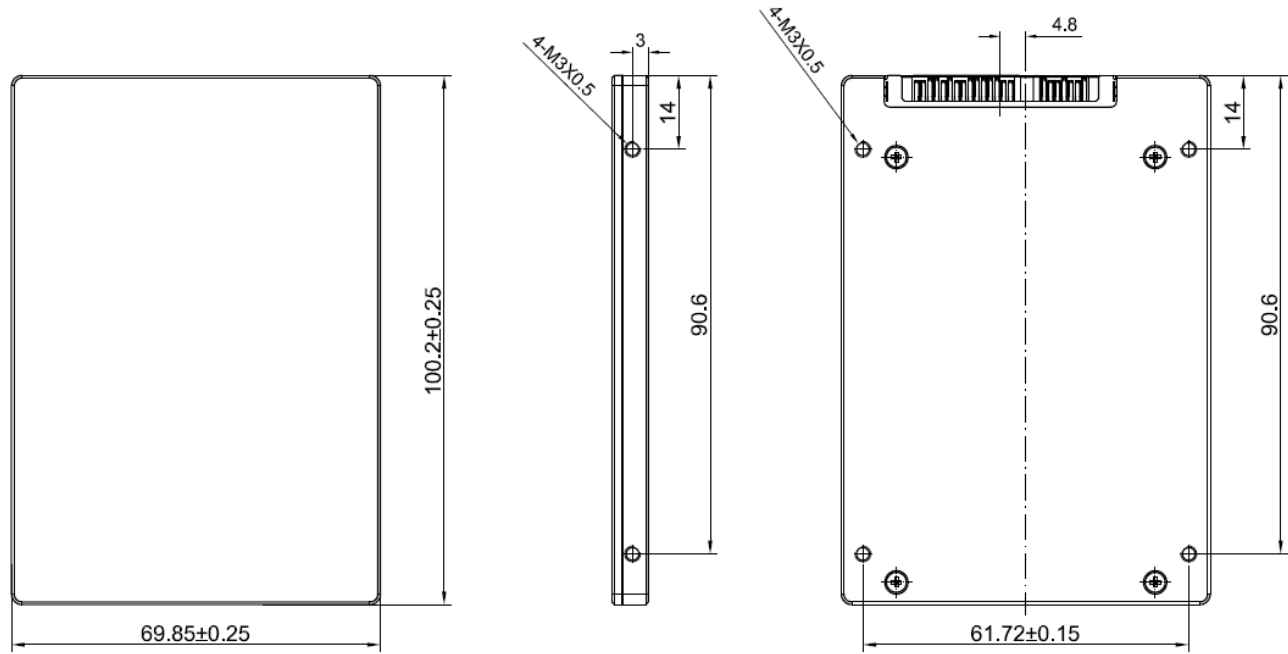
**Table 9: Reliability table**

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

## 5. Physical dimension diagram

### 5.1 SATA 2.5 Inch board

Figure 2: 2.5 Inch physical dimension diagram



GENERAL TOLERANCE IS  $\pm 0.15$ 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

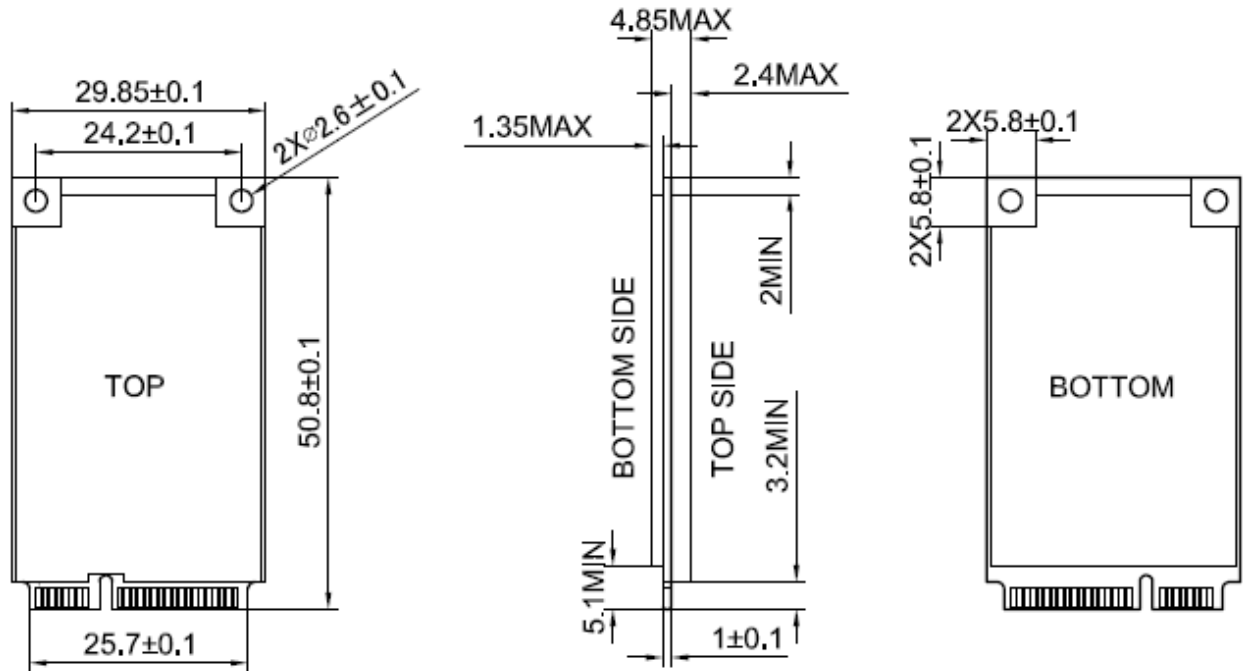


Table 11: Physical dimensions for mSATA

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

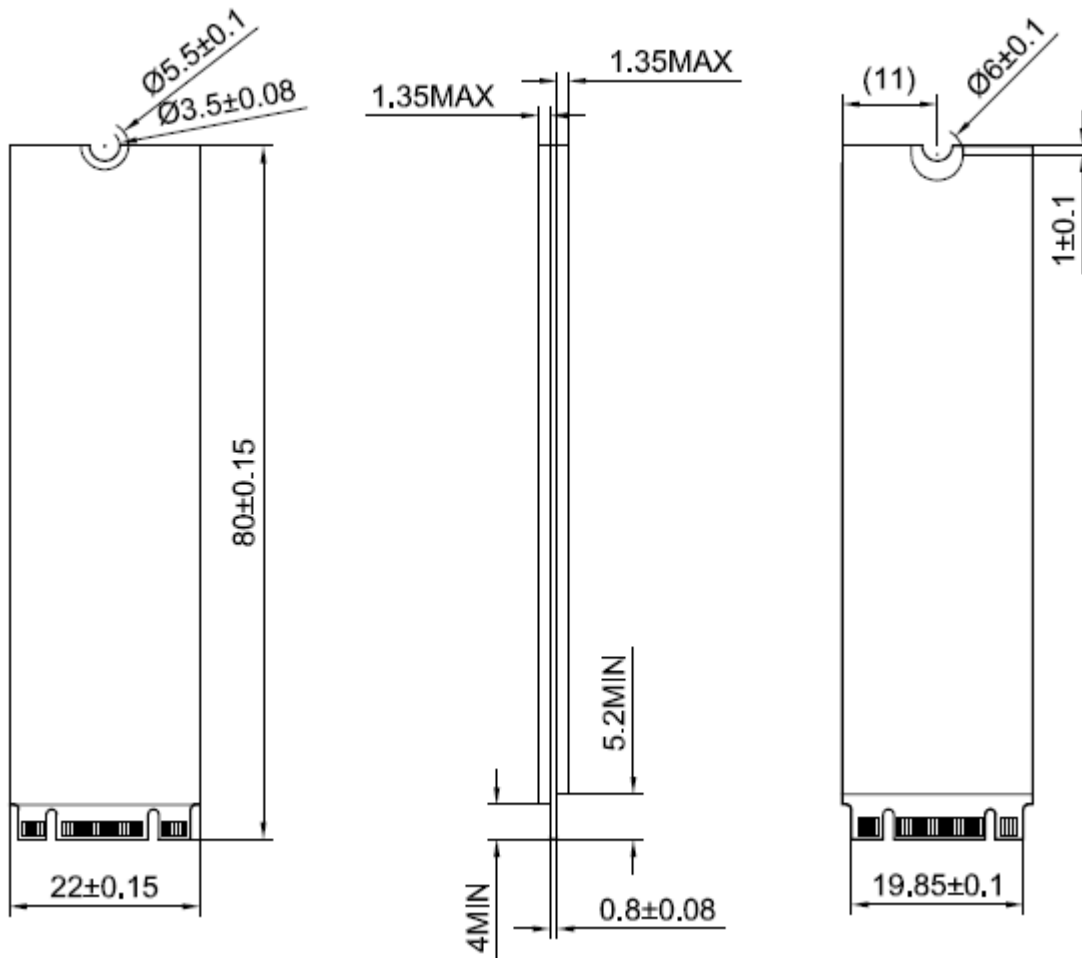


Table 12: Physical dimensions for M.2 2280

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	Devslp	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	DEVS LP	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 S14 series SSD complies with the following specifications:

- FCC
- CE
- RoHS

## 8. Supported ATA commands

Exascend S14 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)
<b>NOP</b>	00h	Read Multiple	C4h
<b>Data Set Management</b>	06h	Write Multiple	C5h
<b>Read Sectors</b>	20h	Set Multiple Mode	C6h
<b>Read Sectors EXT</b>	24h	Read DMA	C8h
<b>Read DMA EXT</b>	25h	Write DMA	CAh
<b>Read Native Max Address EXT</b>	27h	Write Multiple FUA EXT	CEh
<b>Read Multiple EXT</b>	29h	Standby Immediate	E0h
<b>Read Log EXT</b>	2Fh	IDLE Immediate	E1h
<b>Write Sectors</b>	30h	Standby	E2h
<b>Write Sectors EXT</b>	34h	IDLE	E3h
<b>Write DMA EXT</b>	35h	Read Buffer	E4h
<b>Set Max Address EXT</b>	37h	Check Power Mode	E5h
<b>Write Multiple EXT</b>	39h	Sleep	E6h
<b>Write DMA FUA EXT</b>	3Dh	Flush Cache	E7h
<b>Write Log EXT</b>	3Fh	Write Buffer	E8h
<b>Read Verify Sectors</b>	40h	Read Buffer DMA	E9h
<b>Read Verify Sectors EXT</b>	42h	Flush Cache EXT	EAh
<b>Write Uncorrectable EXT</b>	45h	Write Buffer DMA	EBh
<b>Read Log DMA EXT</b>	47h	Identify Device	ECh
<b>Write Log DMA EXT</b>	57h	Set Features	EFh
<b>Read FPDMA Queued</b>	60h	Security Set Password	0xF1
<b>Write FPDMA Queued</b>	61h	Security Unlock	0xF2
<b>Set Date &amp; Time EXT</b>	77h	Security Erase Prepare	0xF3
<b>Accessible Max Address</b>	78h	Security Erase Unit	0xF4
<b>Execute Device Diagnostic</b>	90h	Security Freeze Lock	0xF5
<b>Download Micro Code</b>	92h	Security Disable Password	0xF6
<b>Download Micro Code DMA</b>	93h	Read Native Max Address	0xF8
<b>SMART</b>	B0h	Set Max Address	0xF9
<b>Sanitize Device</b>	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 S14 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-correctable 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

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The warranty period is the SHORTER OF:

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- 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.

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