MX500 2.5-inch and M.2 SATA NAND Flash SSD

CT250MX500SSD1, CT500MX500SSD1, CT1000MX500SSD1, CT2000MX500SSD1, CT250MX500SSD4, CT500MX500SSD4, CT1000MX500SSD4

Features

- Micron® 3D TLC NAND Flash
- RoHS-compliant package
- SATA 6 Gb/s interface
- TCG/Opal 2.0-compliant self-encrypting drive (SED)
- Compatible with Microsoft eDrive®
- Hardware-based AES-256 encryption engine
- ATA modes supported
  - PIO mode 3, 4
  - Multiword DMA mode 0, 1, 2
  - Ultra DMA mode 0, 1, 2, 3, 4, 5, 6
- Industry-standard, 512-byte sector size support
- Hot-plug/hot-remove capable (2.5")
- Device sleep (DEVSLP), extreme low-power mode
- Native command queuing support with 32-command support
- ATA-8 ACS-3 revision 5 command set compliant
- ATA security feature command set and password login support
- SECURE ERASE (data page) command set: fast and secure erase
- SANITIZE BLOCK ERASE and SANITIZE CRYPTO SCRAMBLE support
- Self-monitoring, analysis, and reporting technology (SMART) command set
- Performance[1,2]
  - Sequential 128KB READ: Up to 560 MB/s
  - Sequential 128KB WRITE: Up to 510 MB/s
  - Random 4KB READ: Up to 95,000 IOPS
  - Random 4KB WRITE: Up to 90,000 IOPS
- Reliability
  - MTTF: 1.8 million device hours[2]
  - Static and dynamic wear leveling
  - NAND-integrated power loss immunity, to protect data at rest
- Low power consumption
  - Device Sleep: <3mW
  - DIPM: 110mW TYP[4]
- Endurance – total bytes written (TBW)
  - Up to 360TB
- Capacity (unformatted): 250GB, 500GB, 1000GB, 2000GB
- Mechanical:
  - 2.5 inch x 7mm z-height
  - M.2 Type 2280 (22mm x 80mm)
- Secure field-upgradeable firmware
- Power consumption: 250GB: <3.5W; 500GB: <4.5W; 1000GB/2000GB: <5.0W
- Operating temperature
  - Commercial (0°C to 70°C)[5]

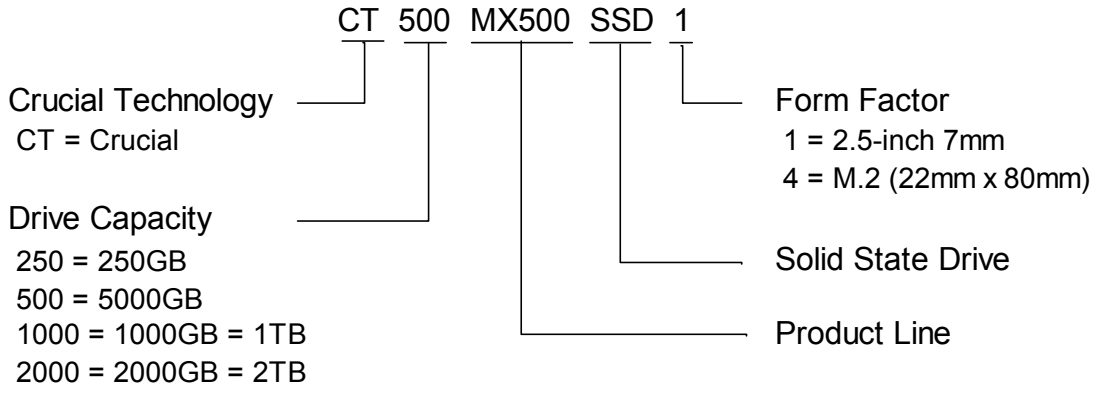
Notes: 1. Typical I/O performance numbers as measured fresh-out-of-the-box (FOB) using CrystalDiskMark with a queue depth of 32 and write cache enabled
2. 4 KB transfers used for READ/WRITE latency values.
3. The product achieves a mean time to failure (MTTF) based on population statistics not relevant to individual units.
4. Active average power measured during execution of MobileMark® with DIPM (device initiated power management) enabled.
5. Temperature measured by SMART attribute 194.

Warranty: Contact your sales representative for further information regarding the product, including product warranties.

Part Numbering Information

The SSD is available under Micron's Crucial brand in different configurations and densities. The chart below is a comprehensive list of options for the MX500 series devices; not all options listed can be combined to define an offered product.

Figure 1: Part Number Chart



General Description

Micron's solid state drive (SSD) uses a single-chip controller with a SATA interface on the system side and 4-channels of Micron NAND Flash internally. Packaged in an 2.5-inch HDD replacement enclosure, or in the ultra-portable M.2 configuration, the SSD integrates easily in existing storage infrastructures.

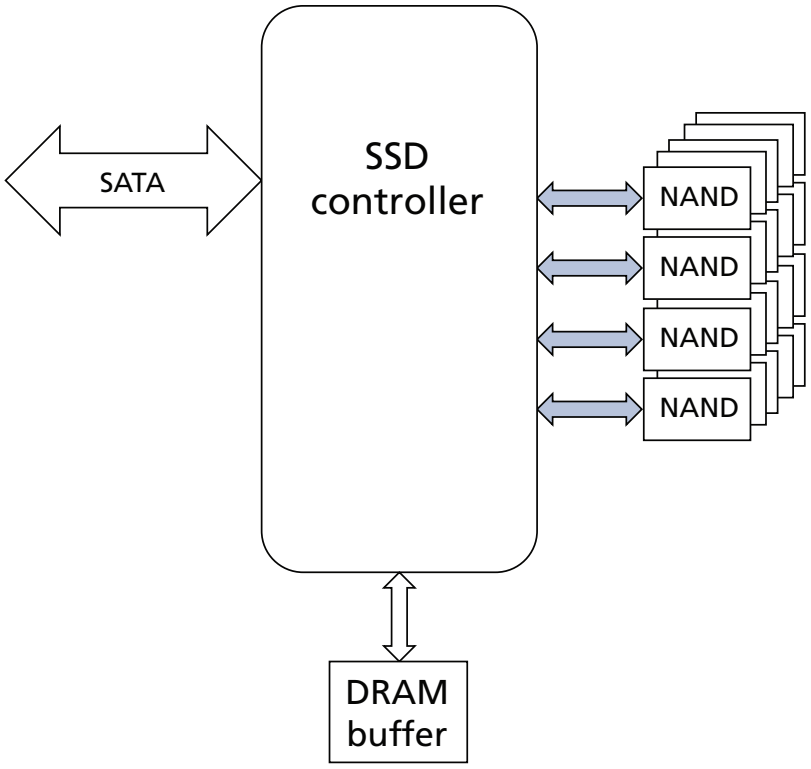
The SSD is designed to use the SATA interface efficiently during both READs and WRITEs while delivering bandwidth-focused performance. SSD technology enables enhanced boot times, faster application load times, reduced power consumption, and extended reliability.

The self-encrypting drive (SED) features an AES-256 encryption engine, providing hardware-based, secure data encryption, with no loss of SSD performance. This SED follows the TCG/Opal specification for trusted peripherals.

When TCG/Opal features are not enabled, the device can also perform data encrytion by invoking the ATA Security command set encryption features, to provide full drive encryption (FDE) managed by the host system BIOS. TCG/Opal and ATA Security feature sets cannot be enabled simultaneously.

The data encryption is always running; however, encryption keys are not managed and the data is not secure until either TCG/Opal or ATA Security feature sets are enabled.

Figure 2: Functional Block Diagram



Performance

Measured performance can vary for a number of reasons. The major factors affecting drive performance are the capacity of the drive and the interface of the host. Additinally, overall system performance can affect the measured drive performance. When comparing drives, it is recommended that all system variables are held unchanged, and only the drive being tested varies.

For SSDs designed for the client computing market, Micron specifies performance in fresh-out-of-box (FOB) state. Data throughput measured in steady state may be lower than FOB state, depending on the nature of the data workload.

For a description of these performance states and of Micron's best practices for performance measurement, refer to Micron's technical marketing brief, Best Practices or SSD Performance Measurement.

Table 1: Drive Performance - 1 2.5”

Capacity	250GB	500GB	1000GB	2000GB	
Interface Speed	**6 Gb/s**				**Unit**
Sequential read (128KB transfer)	560	560	560	560	MB/s
Sequential write (128KB transfer)	510	510	510	510	MB/s
Random read (4KB transfer)	95,000	95,000	95,000	95,000	IOPS
Random write (4KB transfer)	90,000	90,000	90,000	90,000	IOPS

Notes:
1. Performance numbers are maximum values, except as noted.
2. I/O performance numbers as measured using CrystalDiskMark with a queue depth of 32 and write cache enabled. Fresh-out-of-box (FOB) state is assumed. For performance measurement purposes, the SSD may be restored to FOB state using the secure erase command
3. Iometer measurements are performed on an 20GB span of logical block addresses (LBAs).
4. System variations will affect measured results.

Logical Block Address Configuration

The drive is set to report the number of logical block addresses (LBA) that will ensure sufficient storage space for the specified capacity. Standard LBA settings, based on the IDEMA standard (LBA1-03), are shown below.

Table 2: Standard LBA Settings

Capacity	Total LBA		Max LBA		User Available Bytes
	Decimal	Hexadecimal	Decimal	Hexadecimal	(Unformatted)
250GB	488,397,168	1D1C5970	488,397,167	1D1C596F	250,059,350,016
500GB	976,773,168	3A386030	976,773,167	3A38602F	500,107,862,016
1000GB	1,953,525,168	74706DB0	1,953,525,167	74706DAF	1,000,204,886,016
2000GB	3,907,029,168	E8E088B0	3,907,029,167	E8E088AF	2,000,398,934,016

Reliability

Micron's SSDs incorporate advanced technology for defect and error management. They use various combinations of hardware-based error correction algorithms, data parity protection, firmware-based static and dynamic wear-leveling algorithms.

Mean Time To Failure

Mean time to failure (MTTF) for the SSD can be predicted based on the component reliability data using the methods referenced in the Telcordia SR-332 reliability prediction procedures for electronic equipment, and is validated in Reliability Demonstration Test (RDT).

Table 3: MTTF

Capacity	MTTF (Operating Hours)[1]
All capacities	1.8 million

Notes: **1.** Mean Time to Failure (MTTF) is a statistic which estimates the performance of a large population of devices, and is not predictive of the lifetime of individual units.

Endurance

Endurance for the SSD can be predicted based on the usage conditions applied to the device, the internal NAND component cycles, the write amplification factor, and the wear-leveling efficiency of the drive. The tables below show the drive lifetime for each SSD capacity by client computing and sequential input and based on predefined usage conditions.

Table 4: Drive Lifetime – Client Computing

Capacity	Drive Lifetime (Total Bytes Written)
250GB	100TB
500GB	180TB
1000GB	360TB
2000GB	700TB

Notes:
1. Total bytes written calculated with the drive 90% full.
2. SSD write cache is enabled.
3. Access patterns used during reliability testing are 25% sequential and 75% random and consist of the following: 1% are 512B; 44% are 4 KiB; 35% are 64 KiB; and 20% are 128 KiB. (Note: Disabling write cache is not recommended.)
4. Host workload parameters, including write cache settings, I/O alignment, transfer sizes, randomness, and percent full, that are substantially different than the described notes may result in varied endurance results.
5. GB/day can be calculated by dividing the total bytes written value by the number of days in the interval of interest (365 days × number of years). For example: 100 TB/3 years/365 days = 91 GB/day for 3 years.

Electrical Characteristics

Environmental conditions beyond those listed may cause permanent damage to the device. This is a stress rating only, and functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.

Table 5: SATA Power Consumption

Capacity	Device Sleep Typical	Idle Average	Active Average	Active Maximum (128KB transfer)	Unit
250GB	2	55	70	3000	mW
500GB				4000	
1000GB	2	65	75	5000	mW
2000GB	2	110	150	6000	

Notes:
1. TData taken at 25°C using a 6 Gb/s SATA interface.
2. Active average power measured while running MobileMark Productivity Suite.
3. Host and device initiated power management (DIPM) enabled. DIPM slumber and DEVSLP enabled.
4. Active maximum power is an average power measurement performed using Iometer with 128KB sequential write transfers..

Table 6: Maximum Ratings

Parameter/Condition	Symbol	Min	Max	Unit	Notes
Voltage input	V5	4.5	5.5	V	–
Voltage input, M.2	3V3	3.14	3.46	V	–
Operating temperature	T_C	0	70	°C	1
Non-operating temperature	–	–40	85	°C	–
Rate of temperature change	–	–	20	°C/hour	–
Relative humidity (non-condensing)	–	5	95	%	–

Notes:
1. Operating temperature is best measured by reading the SSD's on-board temperature sensor, which is recorded in SMART attribute 194 (or 0xC2).

Table 7: Shock and Vibration

Parameter/Condition	Specification
Non-operating shock	1500G/0.5ms
Non-operating vibration	5–800Hz @ 3.1G

Dynamic Write Acceleration

Dynamic write acceleration optimizes SSD performance for typical client-computing environments, where WRITE operations tend to occur in bursts of commands with idle time between these bursts.

Capacity for accelerated performance is derived from the adaptive usage of the SSD's native NAND array, without sacrificing user-addressable storage. Recent advances in Micron NAND technology enable the SSD firmware to achieve acceleration through on the fly mode switching between SLC and TLC modes to create a high-speed SLC pool that changes in size and location with usage conditions.

During periods of idle time between write bursts, the drive may free additional capacity for accelerated write performance. The amount of accelerated capacity recovered during idle time depends on the portion of logical addresses that contain user data and other runtime parameters. In applications that do not provide sufficient idle time, the device may need to perform SLC-to-TLC data migration during host activity.

Under accelerated operation, write performance may be significantly higher than nonaccelerated operations. Power consumption per-byte written is lower during accelerated operation, which may reduce overall power consumption and heat production.

Adaptive Thermal Monitoring

The device features adaptive thermal monitoring. While most host computers exhibit operating environments that keep an SSD running in the range of 40°C to 45°C, adaptive thermal monitoring enables the SSD to operate in a wide variety of environments by slowing data throughput when the device temperature, (as indicated by SMART attribute #194), exceeds the maximum specified operating temperature of 70°C helping to prevent the host computer from running at excessive temperatures.

The device may shut down completely at a temperature point well above the specified maximum, to prevent permanent damage to the SSD and to the host computer.

TCG/Opal Support

Table 8: TCG/Opal Support Parameters

Property	Supported?	Comments
TCG Storage Specifications		
OPAL: TCG Storage Security SubSystem Class	Specification 2.00	Revision 1.00, Feb 24, 2012
TCG Core Specification	Specification 2.00	Revision 2.00, Nov 4, 2011
TCG Storage Interface Interactions Specification	TCG Reference Specification	Specification Version 1.02 Revision 1.00 30 December, 2011
OPAL SSC 1.00 (backward compatibility)	Not supported	–

Interface Connectors

The SATA signal segment interface cable has four conductors and three ground connections. As shown in Package Dimensions, the cable includes a 7-pin signal segment and a 15-pin power segment arranged in a single row with a 1.27mm (0.050in) pitch.

Figure 3: SSD Interface Connections

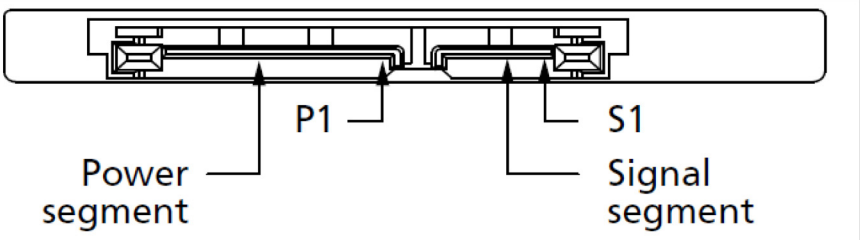


Table 9: SATA Signal Segment Pin Assignments

Signal Name	Type	Description
S1	GND	Ground
S2	A+	Differential signal pair A and A
S3	A–	
S4	GND	Ground
S5	B–	Differential signal pair B and B
S6	B+	
S7	GND	Ground

Table 10: 2.5-Inch SATA Power Segment Pin Assignments

Pin#	Signal Name	Description
P1	RETIRED	No connect
P2	RETIRED	No connect
P3	DEVSLP	Device sleep
P4	GND	Ground
P5	GND	Ground
P6	GND	Ground
P7	V5	5V power, precharge
P8	V5	5V power
P9	V5	5V power
P10	GND	Ground
P11	DAS	Device activity signal
P12	GND	Ground
P13	V12	No connect
P14	V12	No connect
P15	V12	No connect

M.2 2280 (22mm x 80mm)

Figure 4: Interface Connections – M.2

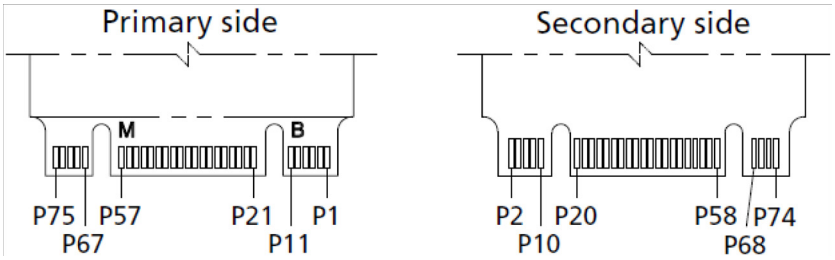


Table 11: SATA Signal Segment Pin Assignments

Primary Side			Secondary Side		
Pin #	**Signal Name**	**Description**	**Pin #**	**Signal Name**	**Description**
1	CONFIG_3	Ground	2	3V3	3.3V
3	GND	Ground	4	3V3	3.3V
5	N/C	No connect	6	N/C	No connect
7	N/C	No connect	8	N/C	No connect
9	N/C	No connect	10	DAS/DSS	Drive activity (host LED)
11	N/C	No connect	Key		
Key			20	N/C	No connect
21	CONFIG_0	Ground	22	N/C	No connect
23	N/C	No connect	24	N/C	No connect
25	N/C	No connect	26	N/C	No connect
27	GND	Ground	28	N/C	No connect
29	N/C	No connect	30	N/C	No connect
31	N/C	No connect	32	N/C	No connect
33	GND	Ground	34	N/C	No connect
35	N/C	No connect	36	N/C	No connect
37	N/C	No connect	38	DEVSLP	No connect
39	GND	Ground	40	N/C	No connect
41	SATA B+	SATA B differential pair	42	N/C	No connect
43	SATA B–		44	N/C	No connect
45	GND	Ground	46	N/C	No connect
47	SATA A–	SATA A differential pair	48	N/C	No connect
49	SATA A+		50	N/C	No connect
51	GND	Ground	52	N/C	No connect
53	N/C	No connect	54	N/C	No connect
55	N/C	No connect	56	Reserved	Vendor use
57	GND	Ground	58	Reserved	Vendor use
Key			Key		
67	N/C	No connect	68	Reserved	No connect
69	CONFIG_1	Ground	70	3V3	3.3V
71	GND	Ground	72	3V3	3.3V
73	GND	Ground	74	3V3	3.3V
75	CONFIG_2	Ground			

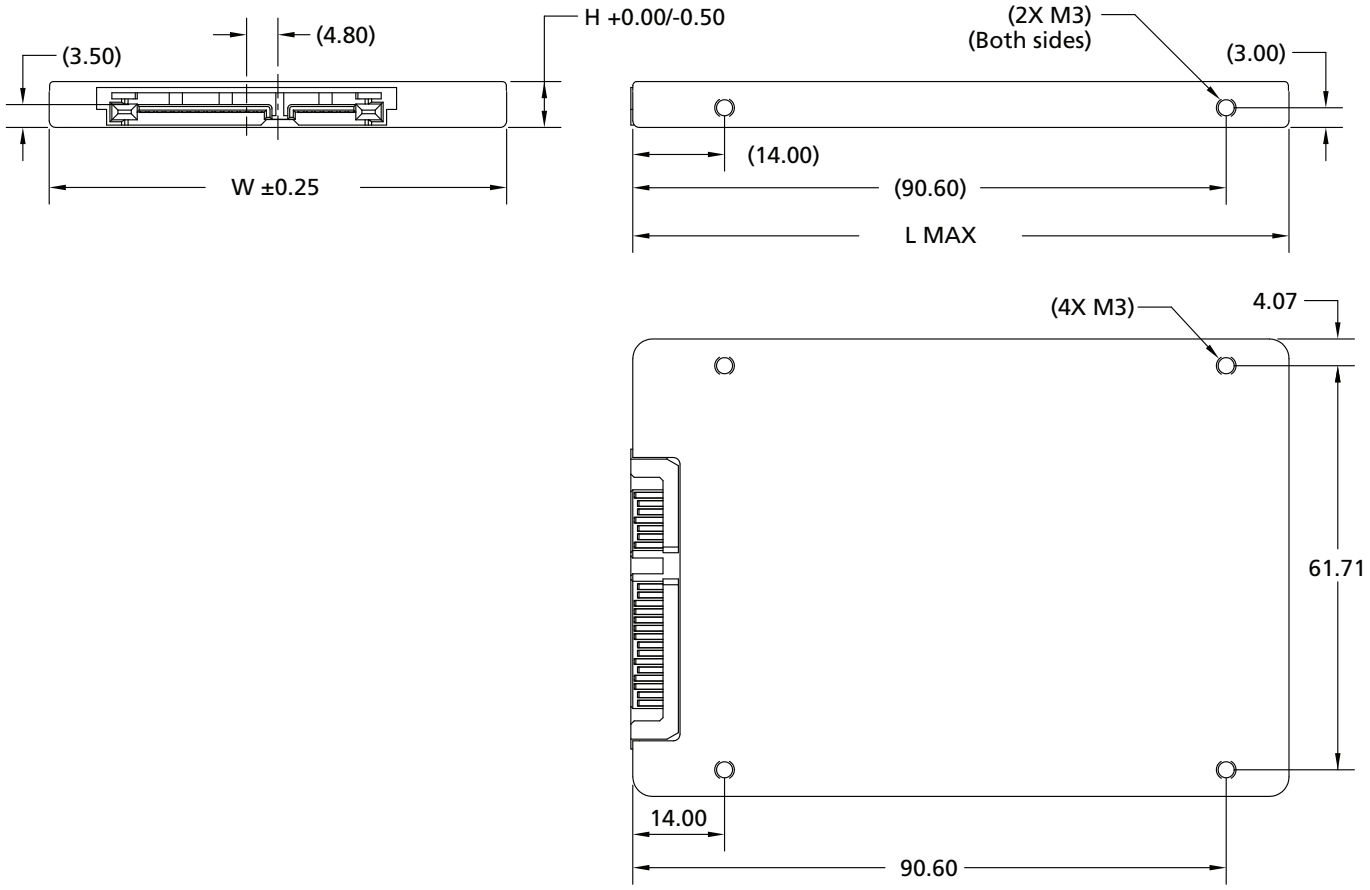
Physical Configuration

2.5-Inch 7mm

Product mass: 70 grams MAX

Physical dimensions conform to the applicable form factor specifications as listed in the figure below.

Figure 5: 2.5-Inch Package – 7mm



Notes: 1. All dimensions are in millimeters.

Table 12: 2.5-Inch Package Dimensions

Density (GB)	W	L	H	Unit
250	69.85	100.45	7.00	mm
500				
1000				
2000				

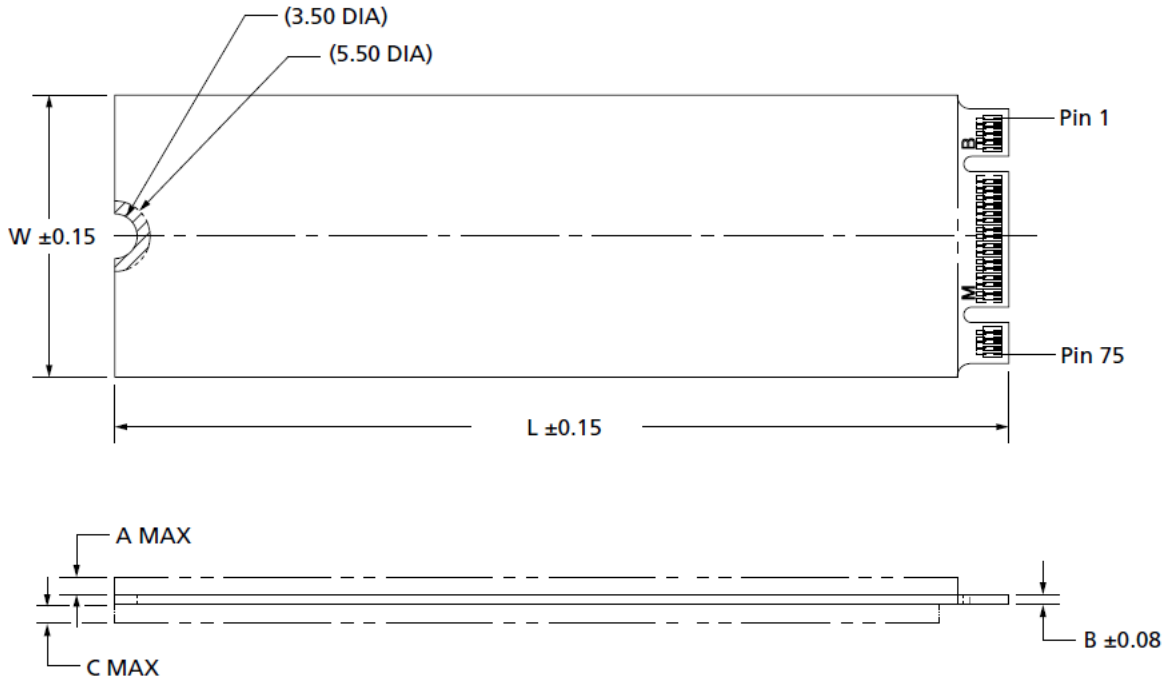
Notes: 1. Dimension values in millimeter per SFF 8201 Rev. 3.3.

M.2 2280 (22mm x 80mm)

Product mass: less than 10 grams

Physical dimensions conform to the applicable form factor specifications as listed in the figure below.

Figure 6: M.2 Type 2280 Package



Notes: 1. All dimensions are in millimeters.

Table 13: M.2 Type 2280 Package Dimensions

Capacity (GB)	Specification	W	L	A	B	C	Unit
250	S2	22.00	80.00	1.35	0.80	1.50	mm
500							
1000	D3						

Notes: 1. Dimension values in millimeter per SFF 8201 Rev. 3.3.

Compliance

Micron SSDs comply with the following:

- Micron Green Standard
- Built with sulfur resistant resistors
- CE (Europe): EN55032, EN55024 Class B, RoHS
- FCC: CFR Title 47, Part 15, Class B
- UL/cUL: approval to UL-60950-1, 2nd Edition, IEC 60950-1:2005 (2nd Edition); EN 60950-1 (2006) + A11:2009+ A1:2010 + A12:2011 + A2:2013
- BSMI (Taiwan): approval to CNS 13438 Class B, CNS 15663
  - http://www.crucial.com/usa/en/company-environmental
- CM (Morocco): Approval to No. 2574.14 and No. 2573.14 of 16 July 2015
- RCM (Australia, New Zealand): AS/NZS CISPR32 Class B
- KC RRL (Korea): approval to KN32 Class B, KN 35 Class B

B급 기기	이 기기는 가정용으로 전자파적합등록을한 기기로서 주거
(가정용 정보통신기기)	지역에서는 물론 모든지역에서 사용할 수 있습니다.

- W.E.E.E.: Compliance with EU WEEE directive 2012/19/EC. Additional obligations may apply to customers who place these products in the markets where WEEE is enforced.
- TUV (Germany): approval to IEC60950/EN60950
- VCCI (Japan): 2015-04 Class B

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取扱説明書に従って正しい取り扱いをして下さい。
VCCI－B

- IC (Canada): ICES-003 Class B
  - This Class B digital apparatus complies with Canadian ICES-003.
  - Cet appareil numérique de la classe B est conforme à la norme NMB-003 du Canada

FCC Rules

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and the receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

References

- Serial ATA: High-speed serialized AT attachment, Serial ATA working group, available at www.sata-io.org
- SATA 3.3 GOLD,
- ATA-8 ACS4 (T13/BSR INCITS 529, Revision 14)
- SFF 8201 Rev. 3.3: 2.5-inch form factor
- PCI Express M.2 Specification rev 1.0: For M.2 form factor
- TCG Storage Security Subsystem Class Opal; Specification 2.00 Revision 1.00, Feb 24, 2012
- TCG Core Specification; Specification 2.00 Revision 2.00, Nov 4, 2011
- TCG Storage Interface Interactions: Specification Version 1.02 Revision 1.00 30 December, 2011
- IEEE-1667: "Standard Protocol for Authentication in Host Attachments of Transient Storage Devices
- Trade Agreements Act of 1979 (19 U.S.C. 2501)

Revision History

Rev. A – 12/17

- Initial release

Rev. B – 12/17

- Table 5, revised Device Sleep to typical values.

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