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Product Specification

MEMXPRO M.2 2280 PM31 Series

Revision V3.0

Form Factor

- M.2 SATA (2280)

NAND Flash Type

- MLC

Capacities

- 128GB, 256GB, 512GB

Performance

- Sequential Read (max): 545 MB/sec
- Sequential write (max): 453 MB/sec
- Random Read (max): 72500 IOPS
- Random write (max): 71250 IOPS

Supply Voltage

- 3.3V±5%

Power Consumption

- Idle mode: 0.264W (3.3Vx80mA)
- Active mode(max): 3.96W (3.3Vx1200mA)

Temperature Ranges

Operating:

- Standard: 0°C~+70°C
- Extended: -25°C~+85°C
- Industrial: -40°C~+85°C

Storage:

- -55°C to 95°C

Shock & Vibration

- Shock: 1500G@0.5ms
- Vibration: 20G (7~2KHz)

Mean Time Between Failures (MTBF)

- > 3,000,000 hours

Hardware Function Switch (Optional)

- Write Protect
- Quick Erase

Compatibility

- Serial ATA Revision 3.1 specifications
- SATA3 (6Gb/s) interface
- Backward compatible with SATA1 (1.5Gb/s) and SATA2 (3Gb/s) interface
- ATA/ATAPI-8 and ACS-2 command set
- Data set management command (TRIM)
- Native Command Queuing (NCQ) command set
- SATA Device Sleep (DEVSLP)(Optional)
- Self-Monitoring, Analysis, and Reporting Technology (S.M.A.R.T)

Data Protection and Reliability

- Built-in hardware ECC, enabling up to 66-bit correction per 1KB
- Supports ATA8 security feature set
- Internal data shaping technique increases data endurance
- Global wear leveling algorithm

Certificates and Declarations

- FCC
- CE
- RoHS
- REACH

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Revision History

| Version	Description	Date
1.0	Internal release	2015/10/12
1.1	Part Number Recode	2015/10/25
1.2	Official release	2016/01/11
1.3	Add Toshiba solution	2016/07/22
2.0	Update TBW	2016/11/28
2.5	Add certificates	2017/01/09
2.8	Update RoHS declaration of conformity & PN naming guide	2018/01/11
3.0	Update	2019/09/23

V3.0   2019/09/26

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Contents

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1   Overview

1.1   Introduction

MEMXPRO M.2 2280 SATA PM31 is a compact SSD with M.2 (NGFF) industrial standard and SATA 3 (6.0Gb/s) interface. M.2 SSD products can be configured as boot drives or data storage devices, providing better performance and efficiency with faster read/write speeds, while reducing startup, file transfer, and software application load times.

1.2   Block Diagram
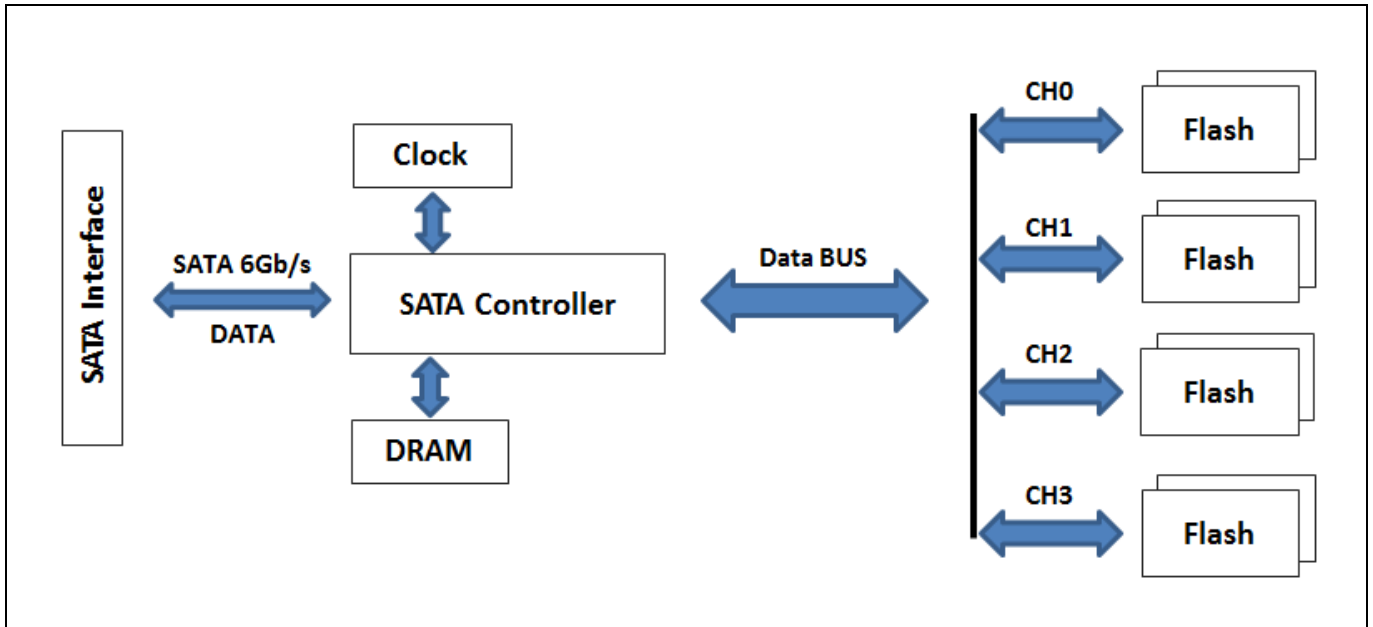
2   Product Specification

2.1   Capacity

Raw Capacity	Cylinder	Head	Sector	User Capacity	LBA*
128GB	16383	16	63	119.24GB	250069680
256GB	16383	16	63	238.47GB	500118192
512GB	16383	16	63	476.94GB	1000215216

Note: *One LBA = 512 Bytes.

2.2   Performance

Brand	Raw Capacity	Sequential Read MB/sec (Max.)	Sequential Write MB/sec (Max.)	Random Read IOPS (4KB QD32)	Random Write IOPS (4KB QD32)
Toshiba	128GB	531	178	72K	44.75K
	256GB	530	350	73.5K	68.75K
	512GB	545	453	72.5K	71.25K

Note: Test tool: CrystalDiskMark 3.03
   * Sequential performance is measured by file size 1000MB.
   **Random performance is measured by 4KB Queue Depth 32.

2.3   Power Characteristics

Supply Voltage	Parameter Specification
Input Voltage	3.3V±5%
Power Consumption	**Specification (W)**
Idle (max.)	0.264W (3.3Vx80mA)
Active (max.)	3.96W (3.3Vx1200mA)

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2.4   Environmental Conditions

Environment	Specification
Storage Temperature	-55°C~+95°C
Operating Temperature	0°C+70°C (Standard) ; -25°C~+85°C (Extended); -40°C~+85°C (Industrial)
Vibration*	20G (7~2K Hz)
Shock**	1500G@0.5ms
Humidity	Relative Humidity: 10-95%, non-condensing
MTBF***	>3,000,000 hours

Note:*Vibration reference to IEC 60068-2-6 testing standard.
　　**Shock reference to IEC 60068-2-27 testing standard.
　　***MTBF prediction is based on Telcordia SR-332.

2.5   Total Bytes Written

Capacity	Endurance - TBW*
128GB	219TB
256GB	438TB
512GB	877TB

Note:* TBW calculation is tested upon JEDEC JESD218 & 219A standards.

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3　Mechanical Information

3.1　Dimensions

Form Factor	Length (mm)	Width (mm)	Height (mm)
M.2 SATA D2	80±0.15	22±0.15	3.5(max)
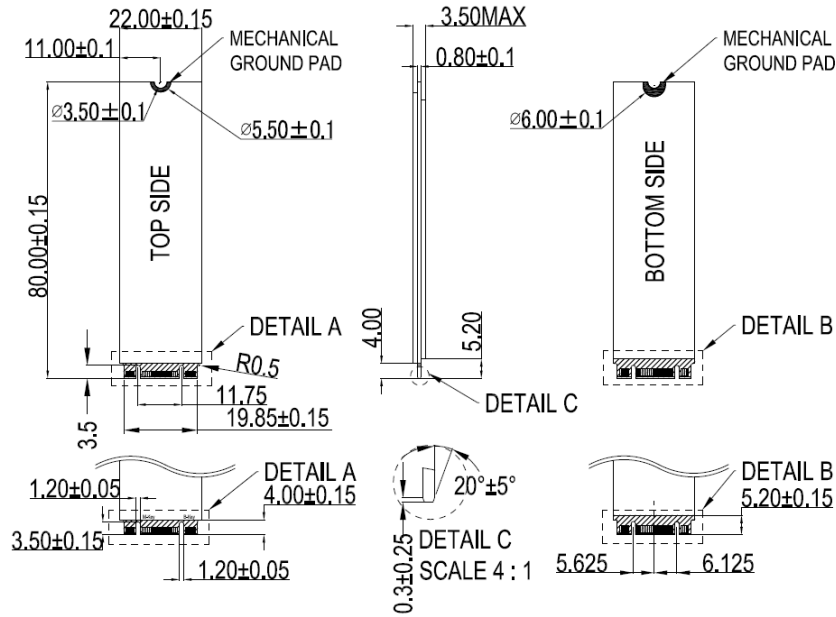
Form Factor	Length (mm)	Width (mm)	Height (mm)
M.2 SATA D5	80±0.15	22±0.15	3.8(max)
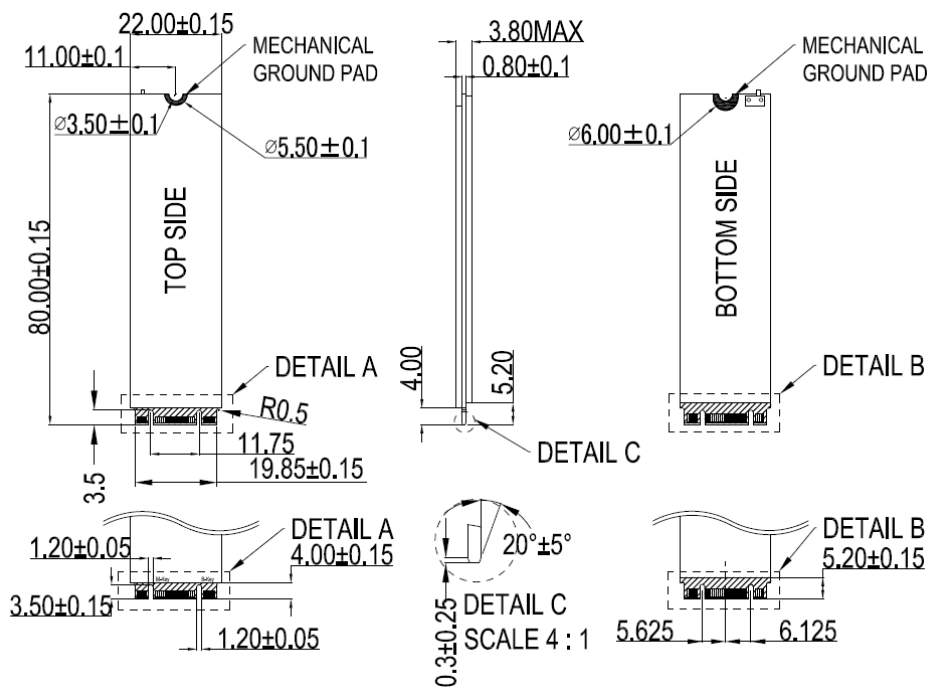
Notes: All dimensions are in millimeters

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3.2   Connector Pin Signal Location
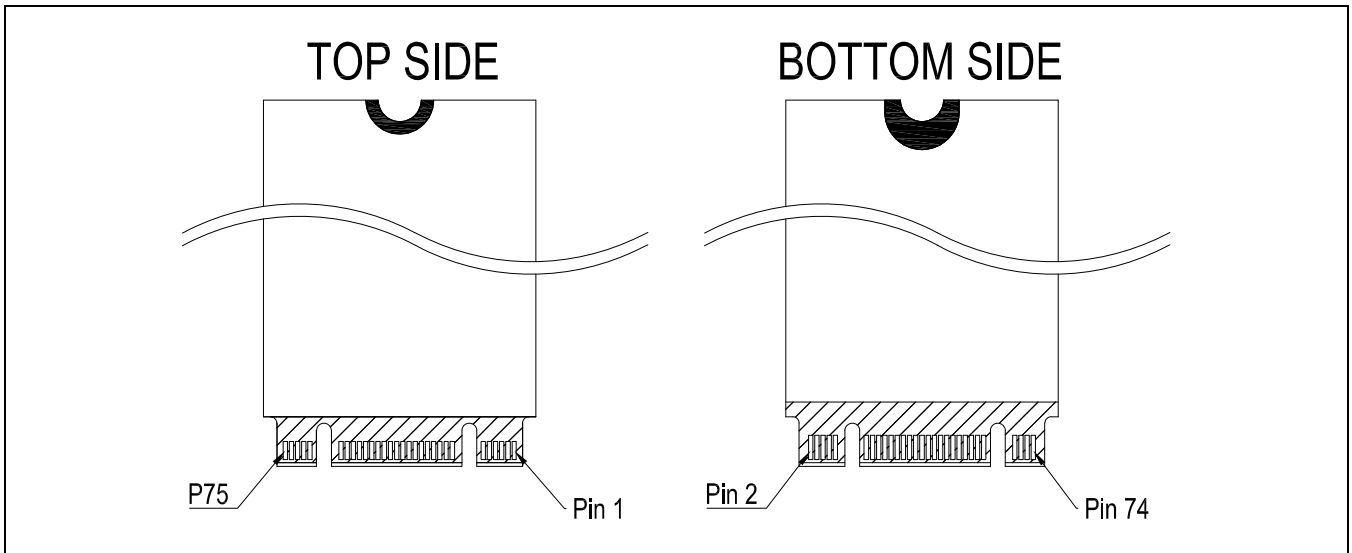
3.3 Connector Pin Signal Definitions

PIN #	Function	PIN #	Function
74	3.3V	75	CONFIG_2=GND
72	3.3V	73	GND
70	3.3V	71	GND
68	N/C	69	CONFIG_1=GND
	Module Key	67	N/C
	Module Key		Module Key
	Module Key		Module Key
	Module Key		Module Key
58	N/C		Module Key
56	N/C	57	GND
54	N/C	55	N/C
52	N/C	53	N/C
50	N/C	51	GND
48	N/C	49	SATA B+
46	N/C	47	SATA B-
44	N/C	45	GND
42	N/C	43	SATA A-
40	N/C	41	SATA A+
38	DEVSLP (I)(0/3/3V)	39	GND
36	N/C	37	N/C
34	N/C	35	N/C
32	N/C	33	GND
30	N/C	31	N/C
28	N/C	29	N/C
26	N/C	27	GND
24	N/C	25	N/C
22	N/C	23	N/C
20	N/C	21	CONFIG_0=GND
	Module Key		Module Key
	Module Key		Module Key
	Module Key		Module Key
	Module Key		Module Key
10	DAS/DSS#(I/O)	11	N/C
8	N/C	9	N/C
6	N/C	7	N/C
4	3.3V	5	N/C
2	3.3V	3	GND
		1	CONFIG_3=GND

4   Flash Management

4.1   Error Detection and Correction

M.2 2280 SATA PM31 series implements hardware BCH Error Correction Code (ECC) capable of correcting errors up to 66-bit per 1KB.

4.2   Global Wear Leveling

Wear leveling is a process that helps reduce premature wear in NAND Flash storage devices. MEMXPRO SSD and flash drives incorporate global wear leveling for greater extended life of the SSD. Global wear leveling ensures SSD endurance and stability.

4.3   Bad Block Management

Bad block management is critical to improving NAND flash drive reliability and endurance. Unlike magnetic storage media, flash can't be overwritten at the byte level; all changes must be written to a new block and the data in the original block must be marked for deletion. A bad block is an area of storage media that is no longer reliable for storing and retrieving data because it has been physically damaged or corrupted. The bad blocks may be presented while the SSD is shipped from the factory with defective blocks that originated in the manufacturing process, or may develop after a certain number of program-erase cycles. The SSD implement Error Correct Code, bad blocks management and replacement, wear-leveling, and garbage collection to avoid data error occurred.

4.4   Garbage Collection/TRIM

Garbage collection is one technique to control flash storage write amplification where the number of actual writes exceeds the number of writes requested. It involves proactively consolidating data by freeing up blocks that were written to previously. These reallocated sectors can reduce the need to erase entire blocks of data for every write operation. SSD TRIM is an Advanced Technology Attachment (ATA) command that enables an operating system to inform a NAND flash SSD which data blocks it can erase because they are no longer in use. The use of TRIM can improve the Garbage Collection process, contributing to the performance of writing data to SSDs and longer SSD life. MEMXPRO SSD drives enables TRIM to make sure that SSD performance doesn't degrade with use.

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4.5 Current and Voltage Overload Protection

With built-in Over Current Protection (OCP) and Over Voltage Protection (OVP) ICs, the MEMXPRO's SSDs are about to shut down power to protect data when encountering abnormal currents and voltages. The SSD recovers automatically when abnormal conditions are over.

4.6 SATA Power Management

SATA power saving modes:

- ACTIVE: PHY ready, full power, Tx & Rx on
- PARTIAL: Reduced power, resumes in under 10us (microseconds)
- SLUMBER: Reduces power, resumes in under 10ms (milliseconds)
- AUTO-SLUMBER: Automatic transition from partial to slumber.
- HIPM: Host-Initiated Power Management (disabled)
- DIPM: Device-Initiated Power Management
- Device Sleep (DevSleep or DEVSLP) (optional): PHY powered down; power consumption ≤ 5mW; host assertion time ≤ 10ms; exit timeout from this state ≤ 20ms (unless specified otherwise in SATA Identify Device Log).

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5   Software Information

5.1   Software Function

- ATA Security
- S.M.A.R.T
- TRIM

5.2   SMART Attributes

The following table defines the vendor specific data in byte 2 to 361 of the 512-byte SMART data.

Attribute ID	Raw Attribute Value						Attribute Name
0x01	MSB	0	0	0	0	0	Read error rate
0x05	LSB	MSB	0	0	0	0	Reallocated sectors count
0x09	LSB			MSB	0	0	Reserved
0x0C	LSB			MSB	0	0	Power cycle count
0xA0	LSB			MSB	0	0	Uncorrectable sector count when read/write
0xA1	LSB	MSB	0	0	0	0	Number of valid spare block
0xA2	LSB	MSB	0	0	0	0	Number of cache data block
0xA3	LSB	MSB	0	0	0	0	Number of initial invalid block
0xA4	LSB			MSB	0	0	Total erase count
0xA5	LSB			MSB	0	0	Maximum erase count
0xA6	LSB			MSB	0	0	Minimum erase count
0xA7	LSB			MSB	0	0	Average erase count
0xC0	LSB			MSB	0	0	Power-off retract count
0xC2	MSB	0	0	0	0	0	Controlled temperature
0xC3	LSB			MSB	0	0	Hardware ECC recovered
0xC4	LSB			MSB	0	0	Reallocation event count
0xC7	LSB	MSB	0	0	0	0	Ultra DMA CRC error count

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6 Certificates & Declarations

6.1 Device Certifications & Declarations

Certifications	Description
CE Compliance	In accordance with the provisions of the Electromagnetic Compatibility (EMC) Directive 2004/30/EC.
FCC Compliance	In accordance with FCC Regulations under Part 15 Subpart B, ICES-003 Issue 6-2016 ANSI C63.4-2014.
RoHS Compliance	Compliance with EU RoHS 2.0 Directive (2011/65/EU) requirements.
REACH Compliance	The European REACH Regulation 1907/2006 on Registration, Evaluation, Authorization, and Restriction of Chemicals (REACH) entered into force on June 1, 2007.

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7 Product Ordering Information

7.1 Part Number Naming Guide

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	xx
F	P	2	8	S	-	x	x	x	x	M	S	4	6	x	x	x	xx

1. Product Code
F: Flash

2. Product Series
P: Performance

3-5 Form Factor
28S: M.2 2280 SATA

7-9 Flash Capacity
A2G: 128GB
B5G: 256GB
E1G: 512GB

10. Flash Vendor
M: Micron
T: Toshiba

11. Flash Type
B: MLC, 3D MLC

12-14 Controller
S46: SM2246EN

15. Channel Numbers
1:1
2:2
4:4

16. Operating Temperature
C: Standard 0°C to 70°C
E: Extended -25°C to 85°C
W: Industrial -40°C to 85°C

17. PCB Version

18. Special Function

19-22 Customization Code

7.2 Ordering Information

Capacity	Commercial Grade (0°C~70°C)	Extended Grade (-25°C~85°C)	Industrial Grade (-40°C~+85°C)
128GB	FP28S-A2GTMS464C1	FP28S-A2GTMS464E1	FP28S-A2GTMS464W1
256GB	FP28S-B5GTMS464C1	FP28S-B5GTMS464E1	FP28S-B5GTMS464W1
512GB	FP28S-E1GTMS464C1	FP28S-E1GTMS464E1	FP28S-E1GTMS464W1

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