



# Product Specification

MEMXPRO 2.5" SSD PM31 Series

Revision V3.2



**Form Factor**

- 2.5" SSD (SFF-8201)

**NAND Flash Type**

- MLC

**Capacities**

- 64GB, 128GB, 256GB, 512GB

**Performance**

- Sequential Read (max): 545 MB/sec
- Sequential write (max): 453 MB/sec
- Random Read (max): 72500 IOPS
- Random write (max): 71200 IOPS

**Supply Voltage**

- 5V±5%

**Power Consumption**

- Idle mode: 0.4W (5Vx80mA)
- Active mode(max): 6W (5Vx1.2A)

**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

**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)
- 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**

- CE
- FCC
- RoHS
- REACH

## Revision History

Version	Description	Date
1.0	Internal release	2015/10/12
1.1	Part Number Recode	2015/10/25
1.2	Initial release	2016/01/11
1.3	Add Toshiba solution	2016/07/22
2.0	Update TBW	2016/11/29
2.5	Add certificates	2016/12/27
2.6	Add 64GB Toshiba solution	2017/11/15
2.8	Update RoHS declaration of conformity & PN naming guide	2018/01/12
3.0	Update model names & PNs; add flash management	2018/09/20
3.2	Update capacity information	2019/04/19

## Contents

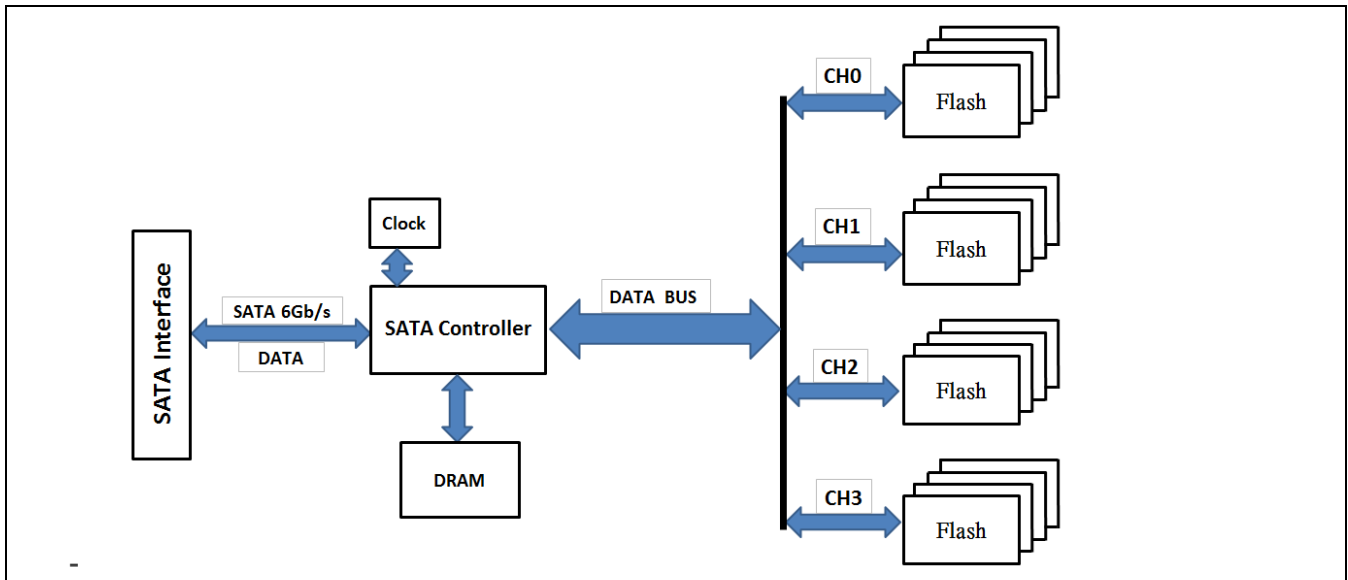
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# 1 Overview

## 1.1 Introduction

MEMXPRO 2.5" SSD PM31 series is a performance-enhanced MLC solid state drives compliant with the standard SFF-8201 specification. Supporting larger capacities, faster read/write speeds, along with robust aluminum pressure die casting enclosure, 2.5" SSD PM31 series offers supreme performance and extreme reliability to operate in harsh environments with wide temperature ranges and high levels of shock and vibration for embedded and industrial applications.

## 1.2 Block Diagram



## 2 Product Specification

### 2.1 Capacity

Raw Capacity	Cylinder	Head	Sector	User Capacity	LBA*
64GB	16383	16	63	59.63GB	125045424
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	64GB	324	89	49.25K	22.5K
	128GB	531	178	72K	44.7K
	256GB	530	350	73.5K	68.7K
	512GB	545	453	72.5K	71.2K

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	5V±5%
Power Consumption	Specification (W)
Idle (max.)	0.4W (5Vx80mA)
Active (max.)	6W (5Vx1.2A)

## 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.

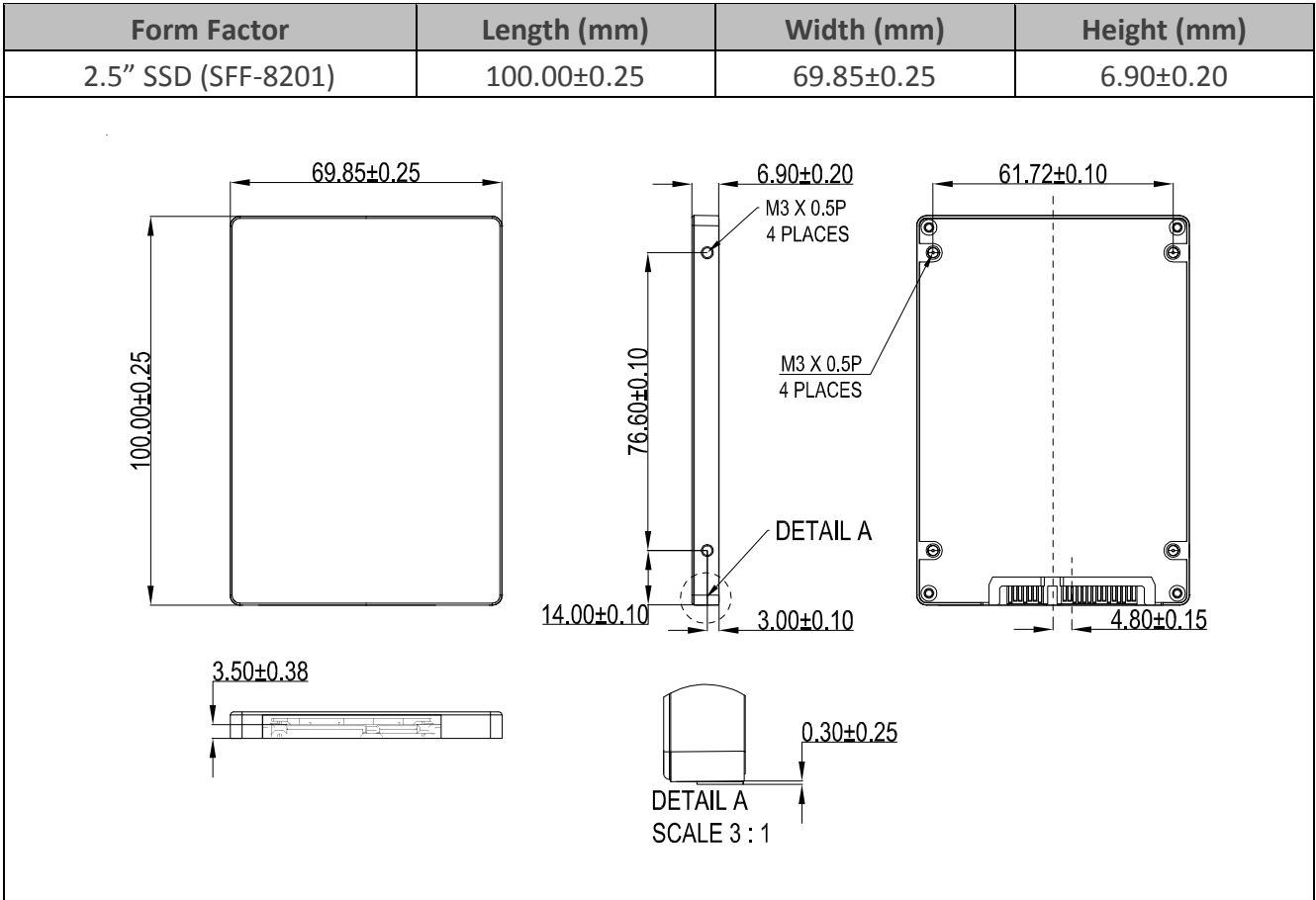
## 2.5 Total Bytes Written

Capacity	Endurance - TBW*
64GB	117TB
128GB	235TB
256GB	471TB
512GB	943TB

Note:\* TBW calculation is tested upon JEDEC JESD218A & 219A standards.

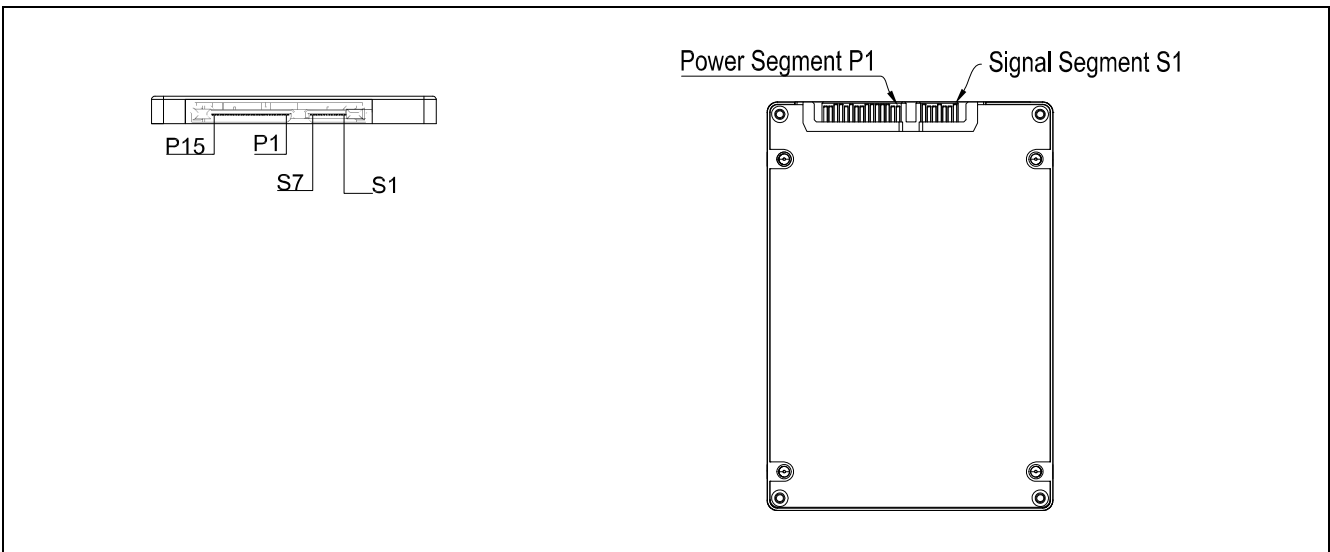
### 3 Mechanical Information

#### 3.1 Dimensions



Notes: All dimensions are in millimeters

#### 3.2 Connector Pin Signal Location





### 3.3 Connector Pin Signal Definitions

PIN #	Function
S1	Ground
S2	Host side A+ (TXP) / Device side B+(RXP)
S3	Host side A- (TXN) / Device side B-(RXN)
S4	Ground
S5	Host side B- (RXN) / Device side A-(TXN)
S6	Host side B+ (RXP) / Device side A+(TXP)
S7	Ground

P1	NC
P2	NC
P3	DEVSLP
P4	Ground
P5	Ground
P6	Ground
P7	5V
P8	5V
P9	5V
P10	Ground
P11	DAS/ DSS
P12	Ground
P13	NC
P14	NC
P15	NC

## 4 Flash Management

### 4.1 Error Detection and Correction

2.5" SSD 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.

#### 4.5 Current and Voltage Overload Protection

With built-in Over Current Protection (OCP) and Over Voltage Protection (OVP) ICs, 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): PHY powered down; power consumption  $\leq 5\text{mW}$ ; host assertion time  $\leq 10\text{ms}$ ; exit timeout from this state  $\leq 20\text{ms}$  (unless specified otherwise in SATA Identify Device Log).

## 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
01	MSB	00	00	00	00	00	00	Read error rate
05	LSB	MSB	00	00	00	00	00	Reallocated sectors count
09	LSB			MSB	00	00	00	Power-on hours
0C	LSB			MSB	00	00	00	Power cycle count
A0	LSB			MSB	00	00	00	Uncorrectable sector count when read/write
A1	LSB	MSB	00	00	00	00	00	Number of valid spare block
A3	LSB	MSB	00	00	00	00	00	Number of initial invalid block
A4	LSB			MSB	00	00	00	Total erase count
A5	LSB			MSB	00	00	00	Maximum erase count
A6	LSB			MSB	00	00	00	Minimum erase count
A7	LSB			MSB	00	00	00	Average erase count
A8	LSB			MSB	00	00	00	Max erase count of spec
A9	LSB			MSB	00	00	00	Remain Life (percentage)
AF	LSB			MSB	00	00	00	Program fail count in worst die
B0	LSB	MSB	00	00	00	00	00	Erase fail count in worst die
B1	LSB			MSB	00	00	00	Total wear level count
B2	LSB	MSB	00	00	00	00	00	Runtime invalid block count
B5	LSB			MSB	00	00	00	Total Program Fail Count
B6	LSB	MSB	00	00	00	00	00	Total Erase Fail Count
BB	LSB			MSB	00	00	00	Uncorrectable Error Count
C0	LSB	MSB	00	00	00	00	00	Power-off Retract Count
C2	MSB	00	00	00	00	00	00	Controlled Temperature
C3	LSB			MSB	00	00	00	Hardware ECC Recovered
C4	LSB			MSB	00	00	00	Reallocation Event Count
C6	LSB			MSB	00	00	00	Uncorrectable Error Count Off-line
C7	LSB	MSB	00	00	00	00	00	Ultra DMA CRC Error Count
E1	LSB						MSB	Total LBAs Written (each write unit = 32MB)
E8	LSB	MSB	00	00	00	00	00	Available Reserved Space
F1	LSB						MSB	Total LBAs Written (each write unit = 32MB)
F2	LSB						MSB	Total LBAs Read (each read unit = 32MB)

## 6 Certificates & Declarations

### 6.1 Device Certifications & Declarations

Certifications	Description
CE Compliant	In accordance with the provisions of the Electromagnetic Compatibility (EMC) Directive 2004/108/EC of the European Parliament and of the Council of 15 December 2004.
FCC Compliant	In accordance with FCC Regulations under Part 15 Subpart B Class B following the ANSI C63.4 procedure.
RoHS Compliant	Restriction of hazardous substance directive
REACH Compliant	Regulation of the European Union for hazard assessment of substances

## 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	S	2	5	-	x	x	x	x	M	S	4	6	x	x	x	xx

<b>1.</b>	Product Code F: Flash	<b>10.</b>	Flash Vendor M: Micron T: Toshiba	<b>16.</b>	Operating Temperature C: Standard 0°C to 70°C E: Extended -25°C to 85°C W: Industrial -40°C to 85°C
<b>2.</b>	Product Series P: Performance	<b>11.</b>	Flash Type M: MLC, 3D MLC	<b>17.</b>	PCB Version
<b>3-5</b>	Form Factor S25: SATA 2.5" SSD	<b>12-14</b>	Controller S46: SM2246EN	<b>18.</b>	Special Function
<b>7-9</b>	Flash Capacity 64G: 64GB A2G: 128GB B5G: 256GB E1G: 512GB	<b>15.</b>	Channel Numbers 1:1 2:2 4:4	<b>19-22</b>	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)
64GB	FPS25-64GTMS462C2	FPS25-64GTMS462E2	FPS25-64GTMS462W2
128GB	FPS25-A2GTMS464C2	FPS25-A2GTMS464E2	FPS25-A2GTMS464W2
256GB	FPS25-B5GTMS464C2	FPS25-B5GTMS464E2	FPS25-B5GTMS464W2
512GB	FPS25-E1GTMS464C2	FPS25-E1GTMS464E2	FPS25-E1GTMS464W2