

RoHS Compliant

Industrial SD Card Series 2
Datasheet for Industrial SD2-M Devices

October 1, 2021

Revision 2.1

***This Specification Describes the Features and
Capabilities of the Standard and Industrial
Temperature
Industrial SD Cards***

***Please Contact Fortasa Memory Systems Sales for
any Custom Features Required For Your Specific
Application***



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Features:

- **Fully compatible with SD Card standard specification**
 - Part 1, Physical Layer Specification, Version 3.01
 - Part 2, File System Specification, Version 3.00
 - Part 3, Security Specification, Version 3.00
- **Low power consumption (typical)**
 - Supply voltage: 2.7 – 3.6V
 - Active mode: 145 mA
 - Stand-by mode: 235 μ A
- **Performance**
 - Sustained Read: up to 43 MB/sec
 - Sustained write: up to 30 MB/sec
- **BUS Speed Mode**
 - Support Class 10 with UHS-I
- **Capacity**
 - 8, 16, 32, 64, 128GB
- **NAND flash type: Industrial MLC**
- **Temperature ranges**
 - Operation:
 - Standard Temperature: -25°C to +70°C
 - Industrial Temperature: -40°C to +85°C
 - Storage: -40°C to +85°C
- **Intelligent endurance design**
 - Built-in hardware ECC, enabling up to 72 bit correction per 1024 bytes
 - Global wear-leveling scheme together with dynamical block allocation to significantly increase the lifetime of a flash device and optimize the disk performance
 - Flash bad-block management
 - Power Failure Management
 - Read Disturb Management
 - S.M.A.R.T. utility supported
- **Physical Dimensions**
 - 32mm (L) x 24mm (W) x 2.1mm (H)
- **Endurance in Terabytes Written (TBW)**
 - 8 GB: 4 TBW
 - 16 GB: 9 TBW
 - 32 GB: 18 TBW
 - 64 GB: 37 TBW
 - 128 GB: 75 TBW
- **RoHS Recast compliant**



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1 Product Description

1.1 General Description

Fortasa's Industrial SD2-M card is a high reliability solid state storage solution designed specifically to address the rigorous requirements of Industrial/OEM customers. **Manufactured using Industrial Temperature rated MLC NAND-flash, this Flash card can work in highly demanding environment and withstand wide range of operating temperature from -40°C to +85°C.**

1.2 Functional Block

The Industrial SD card includes a single-chip SD Interface Flash Controller and flash media. The controller integrates the flash management unit to support multi-channel, multi-bank flash arrays. Figure 1-1 shows the functional block diagram of the Industrial SD card.

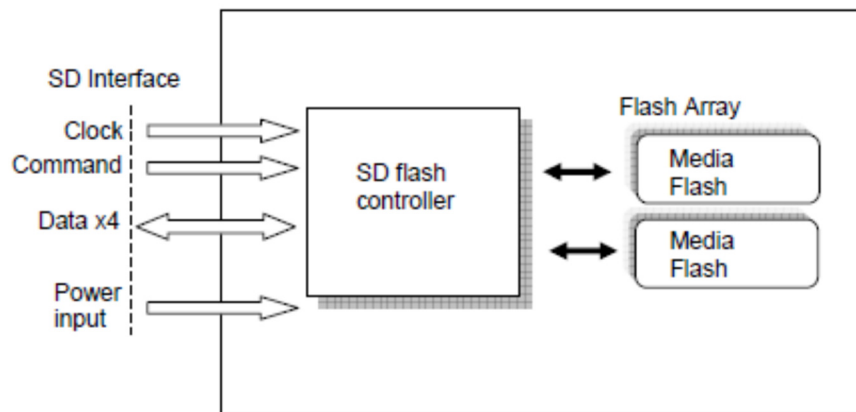


Figure 1-1: Functional block diagram

1.3 Functional Description

The Industrial SD card contains an integrated logical subsystem that provides multiple management capabilities including:

- Powerful Error Correction Algorithm
- Global Wear Leveling Algorithm
- Critical Power Management for low power operation

1.3.1 Flash Management

The Industrial SD Flash controller contains logic/physical flash block mapping and bad block management system. It manages all flash blocks including user data space, spare block space and system overhead blocks.

1.3.2 Powerful ECC Algorithm

The Industrial SD also contains a sophisticated defect and error management system. In case that a bit is found to be defective, the Flash Controller on-the-fly ECC engine mathematically recalculates the missing bit to provide the requested with outmost integrity. This operation is completely transparent to the host and does not consume any user data space. The built-in BCH-ECC automatically corrects of upto 72 bits of data per 1024 byte sector.

1.3.3 Power Management

A power saving feature of the Industrial SD is an automatic entrance and exit from sleep mode. Upon completion of an operation, the SD will enter sleep mode to conserve power if no additional commands are received within a set number of seconds. The host does not have to take any action for this to occur. The SD card is always in the sleep mode except when the host is accessing it, thus conserving power.

Any command issued by the host to the Industrial SD will cause it to exit sleep mode and response to the host.

1.3.4 SMART Utility Supported

S.M.A.R.T. (SMART), an acronym stands for Self-Monitoring, Analysis and Reporting Technology, is an open standard allowing storage device to automatically monitor its own health and report potential problems in order to prevent data loss. This failure warning technology provides predictions from unscheduled downtime by observing and storing critical drive performance and usage parameters. Ideally, SMART Command monitoring enables user to take proactive actions to avoid potential drive failure. Please contact Fortasa for vendor specific SMART Command definition.

1.3.5 Global Wear Leveling

NAND Flash components inherently have a limited number of program/erase cycles, and in typical cases, the utilization of the flash media is not even. As an example, a drive where an OS image resides, would not write/erase to the address space where the image is stored causing greater endurance stress to the remaining area. Thus the more frequent writes to a reduced address space would wear out the Flash storage capability and significantly reduce the lifetime of the drive. Global Wear Leveling algorithm of Flash Controller is utilized to extend the lifespan of NAND Flash by evenly distributing writes and erase cycles across the full address space of the Flash media.

1.3.6 Read Disturb Management

During the Flash Drive data read the sensing circuitry disturbs the electrons in the flash cells which occasionally can provide a faulty reading. ECC engine typically corrects these faulty readings so that drive information is recovered. However, when there are many read cycles to the same data address, these errors can accumulate to beyond ECC's capability to recover and the data would no longer be recovered. , Fortasa's Auto-Read Refresh algorithm will spontaneously refresh the data stored when the error count reaches a threshold and data is in danger of being lost.

1.3.7 Power Failure Management

Fortasa Industrial SD cards provide full data protection mechanism for every abnormal power shutdown situation, such as power failure or brown-out condition during user data programming, updating system tables, erasing blocks, etc. Fortasa Power-Loss Protection mechanism includes:

- Maintaining data integrity and increasing the reliability of the data stored in the NAND Flash memory.
- Protecting F/W table and the user data written to flash from data loss in the event of power glitch or loss.

1.4 Capacity Specification

Standard capacity specification of the Industrial SD product is shown in Table 1-1. The table lists the specific number of bytes of storage for each card capacity.

Table 1-1: Capacity specifications

Capacity	Total Bytes
8GB	7,960,788,992
16GB	15,997,075,456
32GB	32,082,231,296
64GB	64,156,073,984
128GB	128,278,593,536

Please contact factory for any non-listed SD capacity or custom requirement.

1.5 Performance Specification

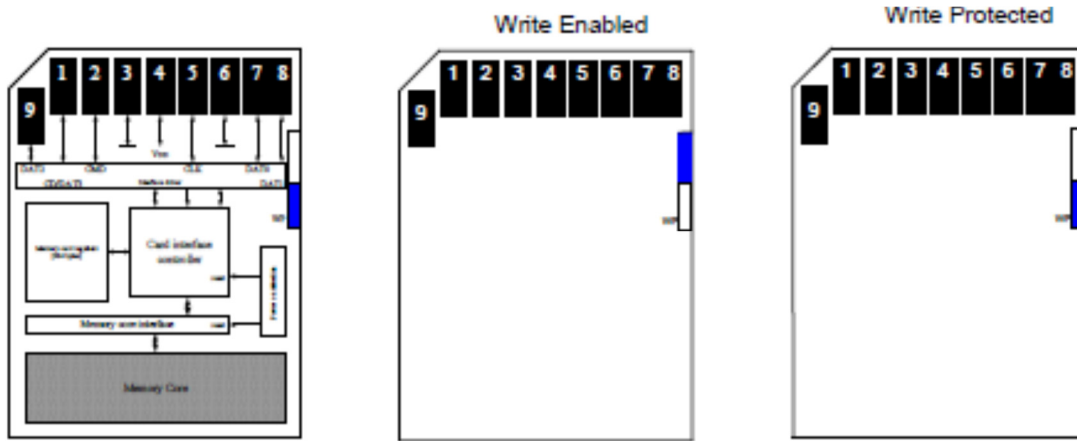
Performances of the Industrial SD card are listed in Table 1-2.

Table 1-2: Industrial SD Card Performance specifications

Capacity	4GB	8GB	16GB	32GB	64GB	128GB
Parameter						
Sustained read (MB/s)	43	43	43	43	43	43
Sustained write (MB/s)	14	26	23	30	22	22

Note: Performances vary from flash configurations or host system settings

1.6 Card Architecture



1.7 Pin Assignments

Pin	SD Mode		SPI Mode	
	Name	Description	Name	Description
1	CD/DAT3	Card Detect/Data line[Bit 3]	CS	Chip Select
2	CMD	Command/Response	DI	Data In
3	VSS1	Supply Voltage GND	VSS	Supply Voltage GND
4	VDD	Supply Voltage	VDD	Supply Voltage
5	CLK	Clock	SCLK	Clock
6	VSS2	Supply Voltage GND	VSS2	Supply Voltage GND
7	DAT0	Data Line [Bit 0]	DO	Data out
8	DAT1	Data Line [Bit 1]	Reserved	
9	DAT2	Data Line [Bit 2]	Reserved	

2. Environmental Specifications

2.1 Environments

Environmental specification of the Industrial SD2-M series follows the MIL-STD-810F standard as shown in Table 2-1.

Table 2-1: Environmental specifications

Environment		Specification
Temperature	Operation	-25°C to +70°C (Standard); -40°C to +85°C (Industrial)
	Storage	-40°C to +85°C
Humidity	Operation	RH 95% Under 55°C
	Storage	RH 95% Under 55°C
Shock	Non -Operating	1500G, 0.5ms
Vibration	Non -Operating	20Hz~80Hz/1.52mm (frequency/displacement) 80Hz~2000Hz/20G (frequency/displacement) X, Y, Z axis/60mins each
Salt Spray	Non -Operating	Concentration: 3% NaCl at 35°C (storage for 24 hours)
Waterproof	Non -Operating	JIS IPX7 compliance, Water temperature 25°C Water depth: the lowest point of unit is locating 1000mm below surface(storage for 30 mins)
Bending	Non -Operating	≥10N, hold 1min/5times
Torque	Non -Operating	0.15N-m or 2.5deg, hold 30 seconds/ 5 times
Drop	Non -Operating	1.5 m free fall, 6 surfaces of each
X-ray Exposure		0.1 Gy of medium-energy radiation (70 KeV to 140 KeV, cumulative dose per year) to both sides of the card (storage for 30 mins)
Minimum Moving Force of WP switch		Moving Force: 40gf (Ensures that the WP switch will not slide while it is inserted inside a connector)
WP Switch Cycles		0.4~0.5N, 1000 times

2.2 System Reliability

Durability	10,000 Mating Cycles
ESD	Contact: +/-4KV each item 25 times Air: +/-8KV 10 times

3. Electrical Specification

3.1 Operating Voltage

Caution: Absolute Maximum Stress Ratings – Applied conditions greater than those listed under “Absolute Maximum Stress Ratings” may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these conditions or conditions greater than those defined in the operational sections of this data sheet is not implied. Exposure to absolute maximum stress rating conditions may affect device reliability.

Table 3-1: Operating range

Range	Ambient Temperature	Conditions
Standard	-25°C to +70°C	2.7-3.6 V
Industrial	-40°C to +85°C	

3.2 Power Consumption

Table 3-2 lists the Industrial SD2-M typical power consumption.

Table 3-2 Industrial SD2-M power consumption

Measurement \ Capacity	4Gb	8GB	16GB	32GB	64GB	128GB
	Active Mode (mA)	65	75	75	75	135
Standby Mode (µA)	170	200	185	185	195	235

Note:

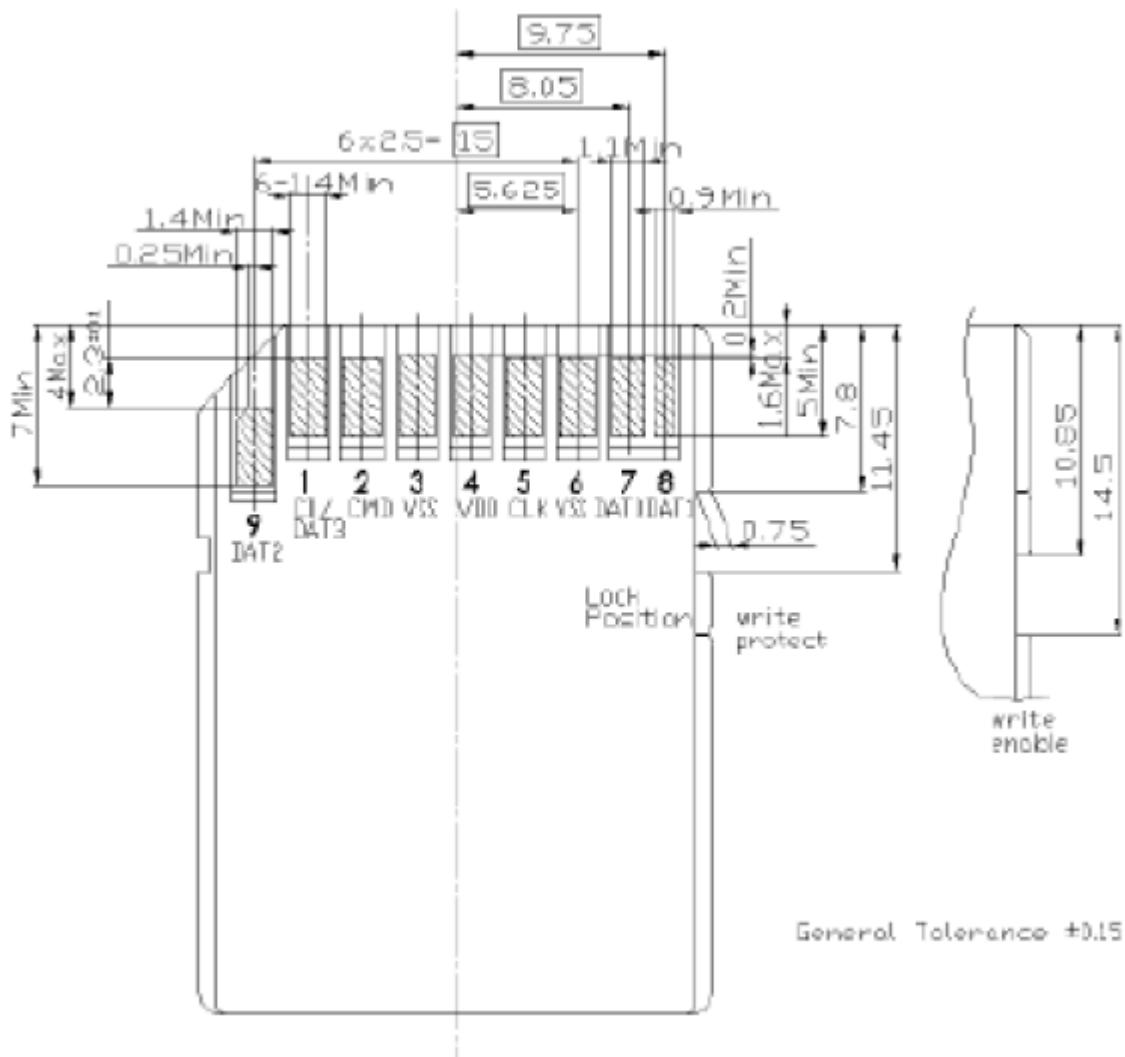
*All values are typical and may vary depending on flash configurations or host system settings.

**Active power is an average power measurement performed using CrystalDiskMark with 128KB sequential read/write transfers.

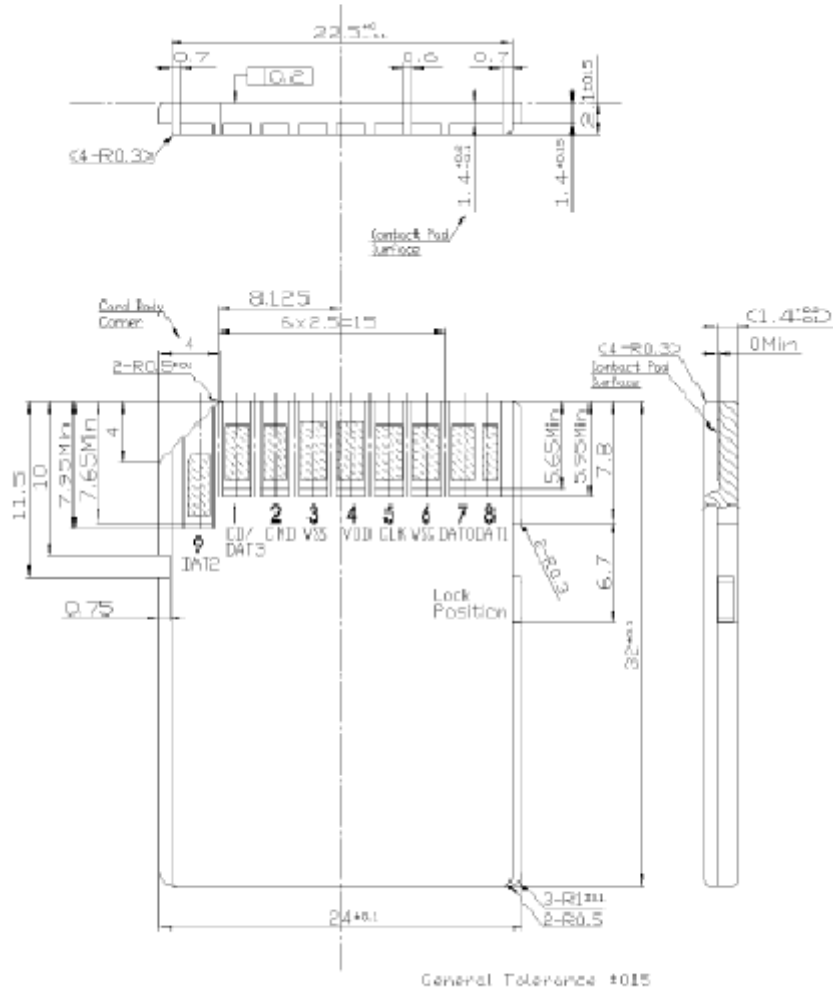
4. Physical Dimensions

Table 4-1 Industrial SD Card dimensions

Dimension	Millimeters (mm)
Length and Width	24 mm x 32 mm Min. 23.9 mm x 31.9 mm Max. 24.1 mm x 32.1 mm
Thickness	2.1 mm ± 0.15 mm
Surface	Plain (except contact areas)
Edges	Smooth Edges

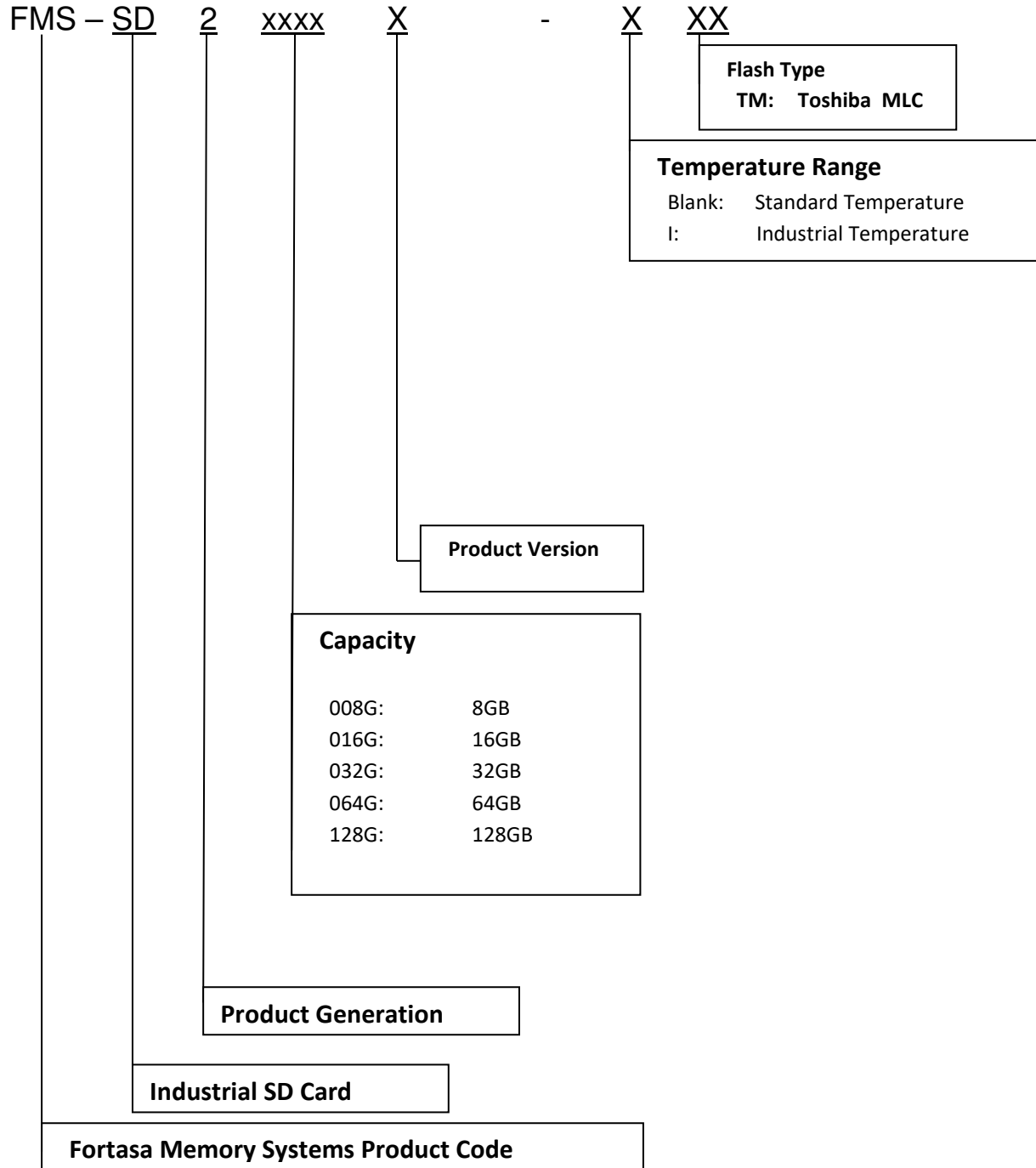


Industrial SD2-M Card FMS-SD2xxxxX-XTM



5. Product Ordering Information

5.1 Product Code Designations



Industrial SD2-M Card

FMS-SD2xxxxX-XTM



5.2 Valid Combinations

Capacity	Standard Temperature Model Numbers	Industrial Temperature Model Numbers
8GB	FMS-SD2008GB-TM	FMS-SD2008GB-ITM
16GB	FMS-SD2016GB-TM	FMS-SD2016GB-ITM
32GB	FMS-SD2032GB-TM	FMS-SD2032GB-ITM
64GB	FMS-SD2064GB-TM	FMS-SD2064GB-ITM
128GB	FMS-SD2128GB-TM	FMS-SD2128GB-ITM

Note: Valid combinations are those products in mass production or will be in mass production. Consult your Fortasa sales representative to confirm availability of valid combinations and to determine availability of new product combinations

6. Revision History

Revision	Date	Description	Comments
1.0	11/16/2015	Initial Release	
1.1	2/12/2015	Updated part number list	
1.2	12/23/2015	Updated part number list for 15nm Toshiba NAND Flash	
1.3	2/2/2016	Added performance and power consumption for 4GB capacity	
1.4	2/5/2016	Revised performance and power consumption values	
1.5	3/15/2016	Revised product ordering information	
1.6	4/19/2016	Revised capacity specification	
2.0	11/15/2017	Added Power Failure Management to Features and General Description Added Global Wear Leveling to Features and General Description Added Read Disturb Management to Flash Management Features and General Description	
2.1	10/1/2021	Added TBW Ratings to Features and General Description	

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