

***RoHS Compliant***  
**Industrial SD Card R1 Series**  
***Datasheet for Industrial SD Card***

**April 11, 2017**

**Revision 1.5**

***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**
  - SD Memory Card Specifications, Part 1, Physical Layer Specification, Version 3.00
  - SD Memory Card Specifications, Part 2, File System Specification, Version 3.00
  - SD Memory Card Specifications, Part 3, Security Specification, Version 3.00
- **Low power consumption (typical)**
  - Supply voltage: 3.3V±5%
  - Active mode: 120 mA
  - Standby mode: 260 µA
- **Performance**
  - Sustained Read: up to 43 MB/sec
  - Sustained write: up to 41 MB/sec
- **Capacity**
  - Standard: 512MB, 1, 2 GB
  - SDHC: 4, 8, 16 GB
- **NAND flash type: SLC**
- **Temperature ranges**
  - Operation:  
Industrial Temperature: -40°C to 85°C
  - Storage: -40°C to 100°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**
  - 24mm x 32mm x 2.1 mm
- **RoHS compliant**
- **MTBF:** >2,000,000 hours

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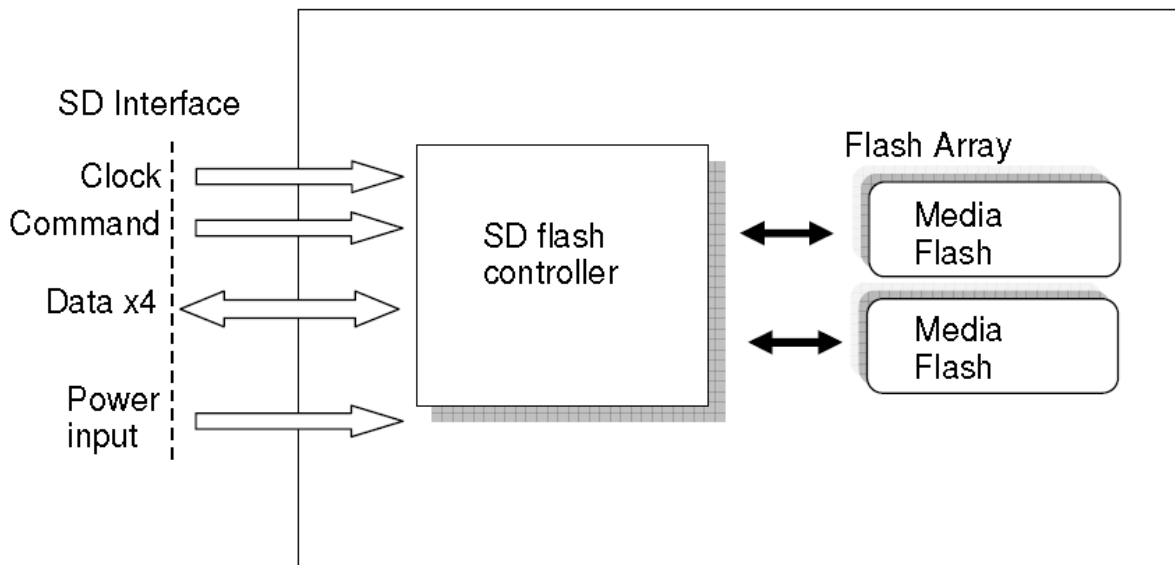
## 1 Product Description

### 1.1 General Description

Fortasa's Industrial SD card is a high reliability solid state storage solution designed specifically to address the rigorous requirements of OEM customers. The SLC-NAND based Industrial SD cards offer the highest endurance, reliability and environmental agility.

### 1.2 Functional Block

The Industrial SD card includes a single-chip SD Interface Flash Controller and the 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.

**Table 1-1:** Capacity specifications

Capacity	Total Bytes
512MB	495,190,016
1GB	969,605,120
2GB	1,938,489,344
4GB	3,875,504,128
8GB	7,751,073,792
16GB	15,510,503,424

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

### 1.5 Performance Specification

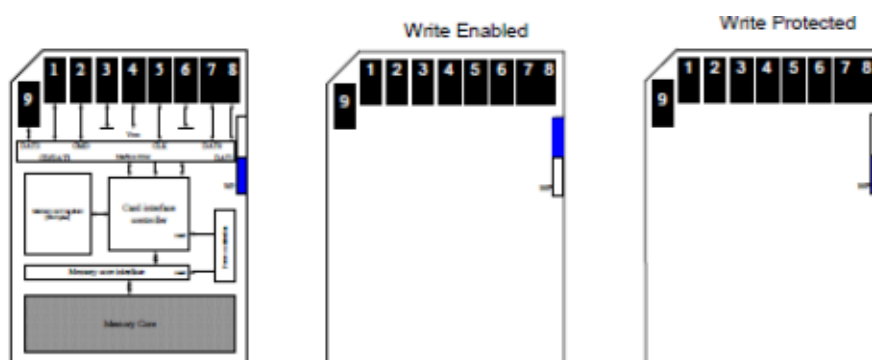
Performances of the Industrial SD card are listed in Table 1-2.

**Table 1-2: Performance specifications**

Capacity \ Performance	512MB	1GB	2GB	4GB	8GB	16GB
<b>Sustained read (MB/s)</b>	23	23	23	43	43	43
<b>Sustained write (MB/s)</b>	15	15	18	35	39	41

Note: Performances vary from flash configurations or host device 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 SD series follows the MIL-STD-810 standard as shown in Table 2-1.

**Table 2-1:** Environmental specifications

Environment		Specification
Temperature	Operation	0°C to 70°C (standard); -40°C to 85°C (industrial)
	Storage	-40°C to 100°C
Humidity	Operation	25°C - 95% RH (Non-condensing)
	Storage	40°C - 93% RH (Non-condensing)
Salt Spray	Non -Operating	5%wt NaCl Solution Temperature:35°C 24hr
Bending	Non -Operating	10N
Torque	Non -Operating	0.15N.m or angle = ± 2.5 deg.(Max)
Drop	Non -Operating	1.5 m free fall
X-ray Exposure		0.1 Gy of medium-energy radiation (70 keV to 140keV, cumulative dose per year) to both sides of the card, according to ISO 7816-1.
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		Minimum 1,000 Cycles (@ Slideforce: 0.4N-5N)

### 2.2 System Reliability

<b>Durability</b>	10,000 Mating Cycles
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### 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
Industrial	-40°C to 85°C	3.3 V ±10% ( 2.7-3.3 V)

#### 3.2 Power Consumption

Table 3-2 lists the Industrial SD power consumption.

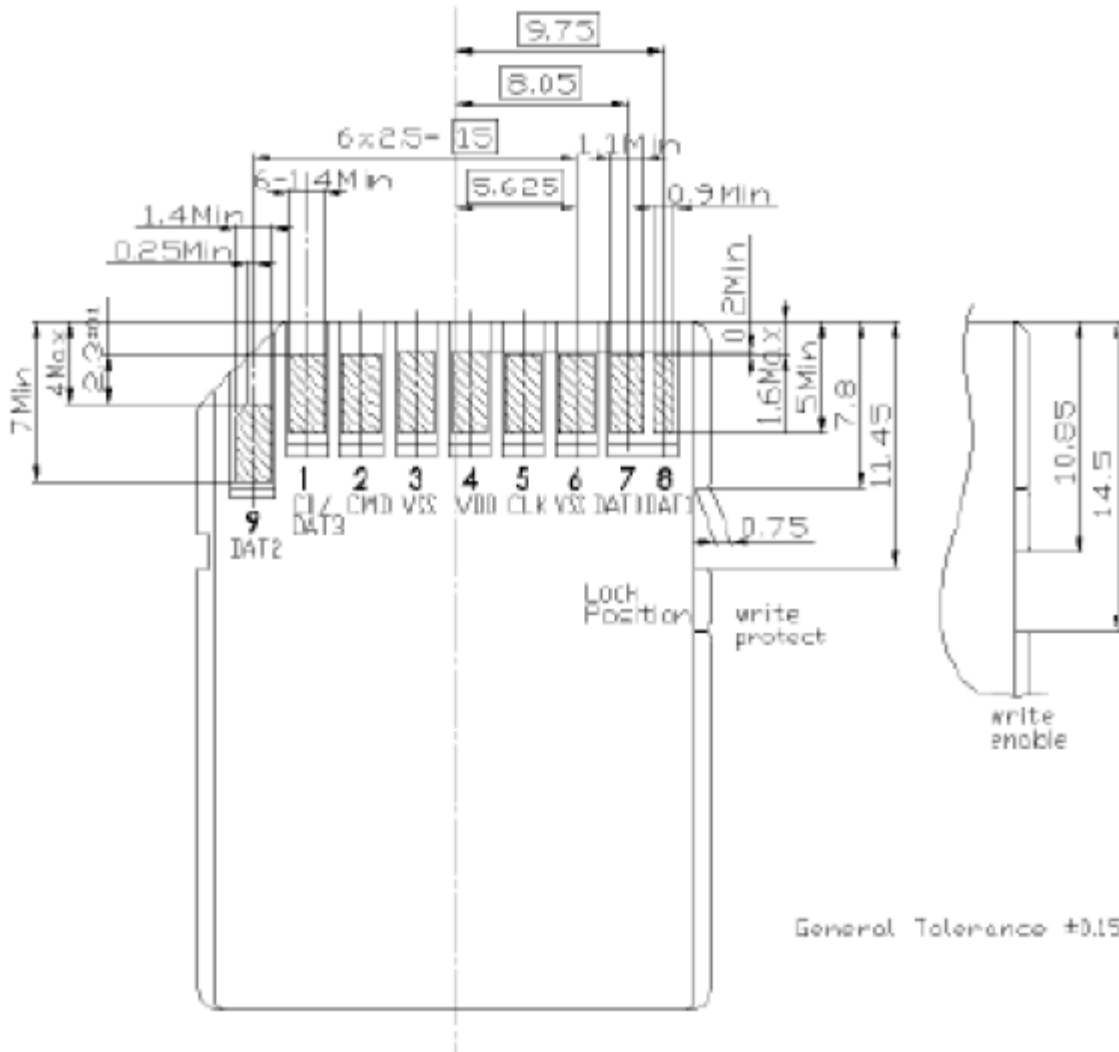
**Table 3-2** Industrial SD power consumption

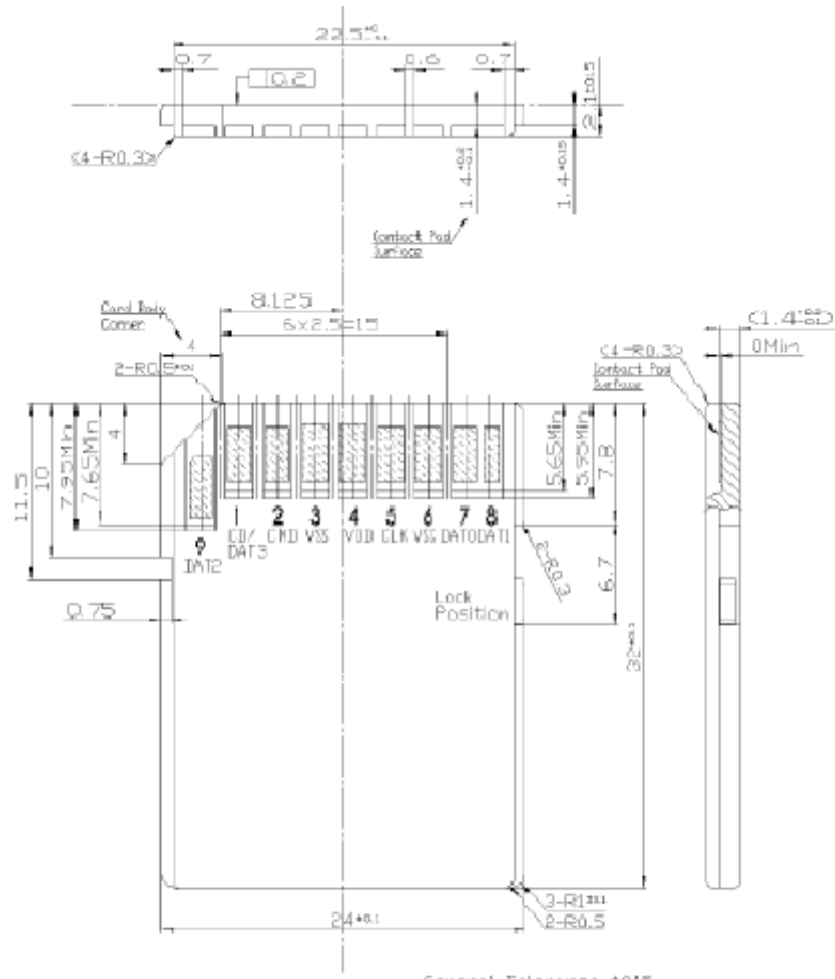
Measurement \ Capacity	Capacity					
	512MBb	1GB	2GB	4GB	8GB	16GB
<b>Active Mode (mA)</b>	80	75	80	120	115	120
<b>Standby Mode (µA)</b>	145	150	160	240	245	260

## 4. Physical Dimensions

**Table 4-1** Industrial SD Card dimensions

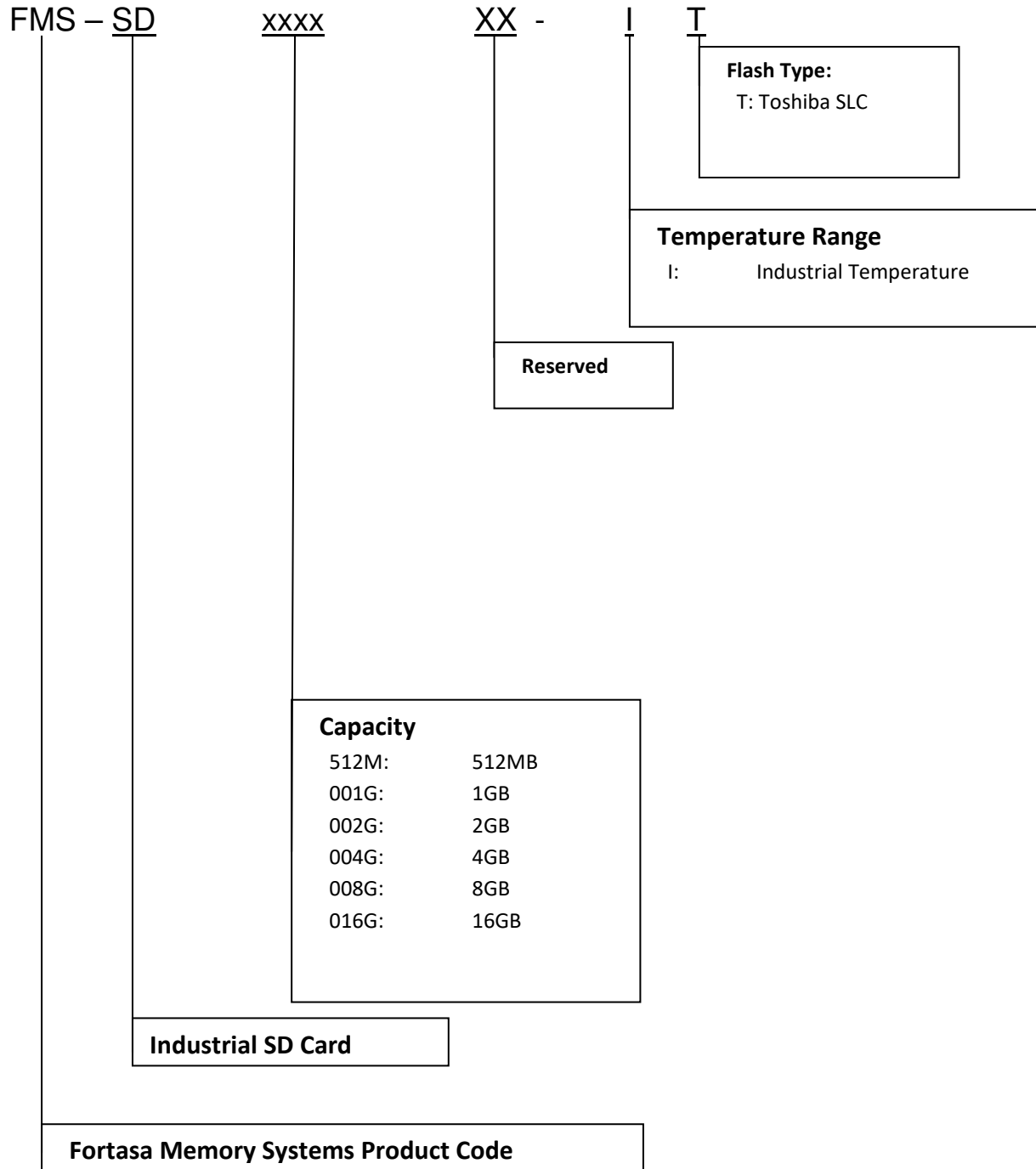
Dimension	Millimeters (mm)
Length and Width	24 mm x 32 mm Min. 23.9 mm x 31.9 mm Max. 24.1 mm x 32.1 mm
Thickness	2.1 mm ± 0.15 mm
Surface	Plain (except contact areas)
Edges	Smooth Edges





## 5. Product Ordering Information

### 5.1 Product Code Designations



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### 5.2 Valid Combinations

Capacity	Industrial Temperature Model Numbers
512MB	FMS-SD512MAA-IT
1GB	FMS-SD001GAA-IT
2GB	FMS-SD002GAA-IT
4GB	FMS-SD004GAA-IT
8GB	FMS-SD008GAA-IT
16GB	FMS-SD016GAA-IT

**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

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## 6. Revision History

Revision	Date	Description	Comments
1.0	12/22/2015	Initial Release	
1.1	1/19/2016	Added SMART Command Chapter	
1.2	2/1/2016	Removed SMART Command Chapter Revised Features to SD version 3.0 spec	
1.3	6/7/2016	Updated Product Ordering Information	
1.4	10/3/2016	Added Power Failure Management to Features and General Description	
1.5	4/11/2017	Added 512MB support	