RoHS Compliant

SATA Disk Module 5 Series
Datasheet for SDM5-M - 7 Pin / 180 Degree Medium Profile Module

August 6, 2014

Revision 1.0

This Specification Describes the Features and Capabilities of Industrial and Standard Temperature SATA Disk Modules

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

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Features:

- **Standard Serial SATA 3.1 (6Gbit/sec)**
    - Serial ATA 3.1 Revision compliance
    - Serial SATA 6.0Gbps interface
    - ATA-8 Command Set
- **Connector Type**
    - 7-pin signal connector
    - 2-pin power connector
- **Capacity**
    - 8, 16, 32, 64 GB
- **Low power consumption (typical) ***
    - Active mode: 240 mA
    - Idle mode: 90 mA
- **Performance**
    - Burst transfer rate: 600 MB/sec
    - Sustained read: up to 200 MB/sec
    - Sustained write: up to 90 MB/sec
- **NAND flash type: MLC**
- **Superior Reliability Through Built-in Hardware ECC**
    - Built-in hardware BCH ECC, correcting 40-bit error per 1024-byte data sector
- **Form Factor**
    - SATA Disk Module Medium Profile
    - Dimensions: 67.90x24.00x8.95 mm
- **Temperature ranges**
    - Operation:
        - Standard Temperature: 0°C to 70°C
        - Industrial Temperature: -40°C to 85°C ***
    - Storage: -40°C to 100°C
- **Flash management**
    - Intelligent endurance design
        - *Advanced wear-leveling algorithms*
        - *S.M.A.R.T. Technology*
        - *ATA Secure Erase*
        - *Trim*
    - Intelligent power failure recovery
- **MTBF:** >1,000,000 hours
- **RoHS compliant**

Table of Contents

1. General Description

Fortasa's SATA-Disk Module (SDM) is a high-performance, SATA interface, solid state drive (SSD) designed to replace a conventional SATA hard disk drive. SDM supports standard SATA protocol and can be plugged into a standard SATA connector commonly found in rugged laptops, military devices, thin clients, Point of Sale (POS) terminals, telecom, medical instruments, surveillance systems and industrial PCs. Fortasa SDM Series is the best drop-in replacement for high-maintenance HDD where reliability is of a major importance.

SATA Disk Module includes a built-in microcontroller and file management firmware that communicates through the SATA standard interface. This means the SDM does not require any additional or proprietary host software such as the Flash File System (FFS) and Memory Technology Driver (MTD) software. SDM is designed to work at 5 Volts and uses a standard SATA driver that fits to all major operating systems such as Microsoft's Windows series, MAC OS, and UNIX variants.

SDM offers capacities of up to 64 gigabytes, providing full support for the SATA 6.0 Gb/s high-speed interface standard. It can operate at sustained access rates of up to 200 megabytes per second, which is much faster than other solid-state or traditional HDD SATA drives currently available on the market. **Manufactured using Industrial Temperature rated MLC NAND-flash, this SSD can work in highly demanding environment and withstand wide range of operating temperature from -40°C to +85°C (for certain capacities only).**

SDM offers high reliability global data wear-leveling scheme to allow uniform use of all storage blocks, increasing the lifetime of Flash media and optimizing drive performance. It also offers Self-Monitoring Analysis and Reporting Technology (S.M.A.R.T.) to monitor drive accesses and provide the host with vital information about drive condition to schedule maintenance and service times.

2. Functional Block

The SATA Disk Module includes a controller and flash media, as well as the SATA standard interface. Figure 2-1 shows the functional block diagram.
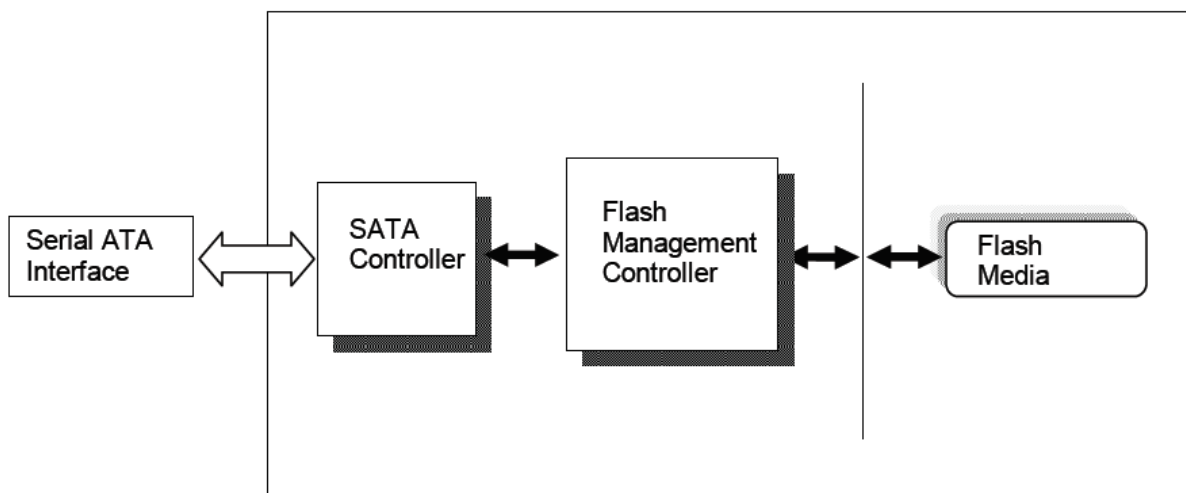
Figure 2-1: Functional block diagram

3. Pin Assignments
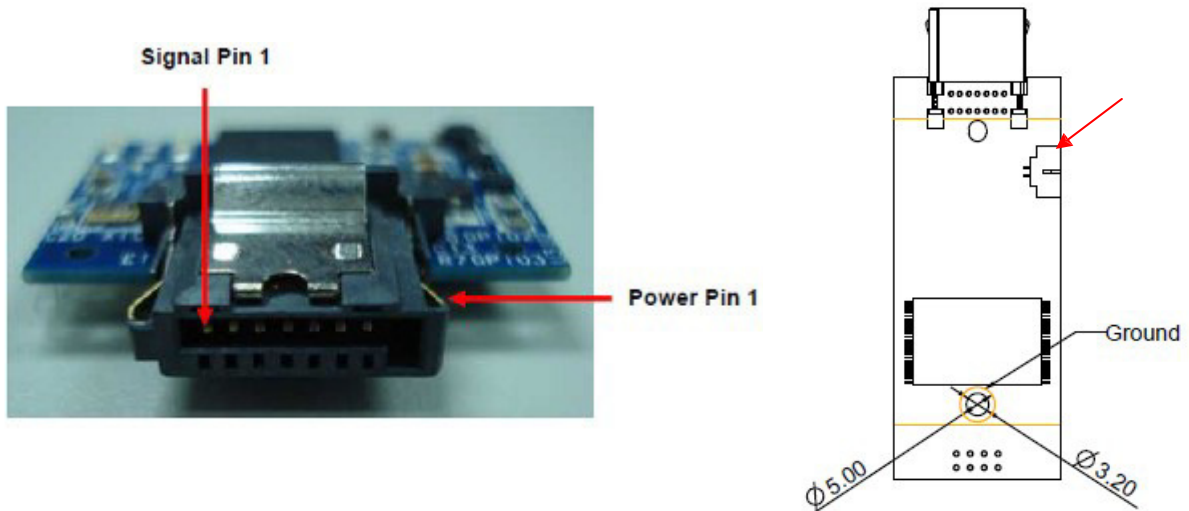
Table 3-1: Signal Segment

Pin	Signal	Description
S1		Ground
S2	RxP	Serial Data Receiver
S3	RxN	
S4		Ground
S5	TxN	Serial Data Transmitter
S6	TxP	
S7		Ground

Table 3-2: Power Segment

Pin	Signal
P1	Vcc (5V)
P2	GND

4. Product Specification

4.1 Functional Specification

4.1.1 Capacity Specifications

Standard capacity specification of the SATA Disk Module product is shown in Table 4-1. The table lists the specific capacity and the default numbers of heads, sectors and cylinders (CHS) for each product line.

Table 4-1: Capacity specifications

Capacity	Total Bytes	Cylinders	Heads	Sectors	Max LBA
8GB	8,012,390,400	15,525	16	63	15,649,200
16GB	16,013,942,784	16,383[1]	16	63	31,277,232
32GB	32,017,047,552	16,383[1]	16	63	62,533,296
64GB	64,023,257,088	16,383[1]	16	63	125,045,424

1.   Cylinders, heads or sectors are not applicable for these capacities. Only LBA addressing applies.

Please contact factory for any non-listed SATA Disk Module capacity or custom CHS requirement.

4.2 Performance Specification

Performances of the SATA Disk Module are listed in Table 4-2.

Table 4-2: Performance specifications

Performance \ Capacity	8GB	16GB	32GB	64GB
Sustained read (MB/s)	100	190	195	200
Sustained write (MB/s)	11	24	42	90

4.3 Environmental Specification

Environmental specification of the SATA Disk Module series follows the MIL-STD-202 standard as shown in Table 4-3.

Table 4-3: Environmental specifications

Environment		Specification
Temperature	Operating	0°C to 70°C (Standard temperature); -40°C to 85°C (Industrial temperature)
	Storage	-40°C to 100°C
Vibration	Operating	20~2000(Hz), 7.69 (Grms), random wave, X, Y, Z axis
	Non-operating	10~2000(Hz), 15(G), sine wave, X, Y, Z axis
Shock		Acceleration: 1,500 G, 0.5 ms, half-sine wave Peak acceleration: 50 G, 11 ms, half-sine wave
Humidity		5% to 95% RH (Non-condensing)

4.4 Mean Time Between Failures (MTBF)

Mean Time Between Failures (MTBF) is predicted based on reliability data for the individual components in the SDM drive. Based on provided component data, SATA Disk Module is rated at more than 1,000,000 hours.

4.5 Certification and Compliance

The SDM complies with the following standards:

- CE – EN55022/55024
- FCC 47CFR Part15 Class B
- RoHS
- MIL-STD-202 and MIL-STD-810F

5. Flash Management

The most critical attribute of an Industrial grade SATA Disk Module is its inherent high level of reliability. This characteristic is achieved through unique technical features of Flash Controller and specific component selection that offer higher degree of reliability compared to the consumer grade components.

5.1 Intelligent Flash Controller Features

5.1.1 Advanced wear-leveling algorithms

All NAND flash devices are limited by a finite number of write cycles. Under a standard file system, frequent file table updates are mandatory. As a painful side effect of OS file overhead, some areas of flash address space wear out faster than others. As these certain sections get a substantially higher write occurrence the whole SATA Disk Module can wear out very quickly. This uneven wear would significantly reduce the lifetime of the whole device, even if majority of the Flash sectors are far from the write cycle limit. Fortasa's SATA Disk Module products offer advanced data wear leveling which distributes Flash writes evenly across the SATA Disk Module memory space. By utilizing this advanced wear leveling feature, the lifetime of the media can be significantly extended.

5.1.2 S.M.A.R.T. technology

S.M.A.R.T. is an acronym for Self-Monitoring, Analysis and Reporting Technology, an open standard allowing disk drives to automatically monitor their own health and report potential problems. It protects the user from unscheduled downtime by monitoring and storing critical drive performance and calibration parameters. Ideally, this feature allows the host to take proactive actions to prevent impending drive failure.

Fortasa SDM5-M uses the standard SMART command B0h to read data from the drive. Fortasa SMART command defines vendor-specified SMART Attribute IDs that represent initial bad block count, total later bad block count, maximum erase count, average erase count, power on hours and power cycle.

5.1.3 Built-in hardware ECC

The Fortasa Flash Controller uses superior BCH Error Detection Code (EDC) and Error Correction Code (ECC) algorithms which can detect and correct up to 40 bits of error in 1K bytes. High performance is achieved through hardware-based error detection and correction.

5.1.4 Enhanced data integrity

The properties of NAND flash memory make it ideal for applications that require high integrity while operating in challenging environments. The integrity of data to NAND flash memory is generally maintained through ECC algorithms and bad block management. Flash controllers can support up to 8 bits ECC capability for accuracy of data transactions, and bad block management is a preventive mechanism from loss of data by retiring unusable media blocks and relocating the data to the other blocks, along with the integration of advanced wear leveling algorithms, so that the lifespan of device can be expanded.

5.2 Intelligent Power Failure Recovery

The Low Power Detection on the Flash controller initiates cached data saving before the power supply to the device drops too low for operation. This feature prevents the device from system crash and ensures data integrity during an unexpected brownout. This feature makes sure that there are no catastrophic failures of the SATA Disk Module due to system power glitches.

5.3 ATA Secure Erase

Accomplished by the Secure Erase (SE) command, which is part of the ANSI standards that control disk drives, "ATA Secure Erase" is built into the disk drive itself and thus far less susceptible to malicious software attacks than external software utilities. Execution of this command amounts to electronic data shredding and causes the SSD to internally completely erase all possible user data. Aside from user data, all data erase counters and other internal controller information stored on the Flash media will be also permanently deleted. The erase process will not stop until it is completed. In case of power failure, the erase process will continue when the power is reapplied to the device.

5.4 TRIM Command Support

Over time the performance of SSD degrades as user continually writes and erases data. The ATA-TRIM command "formats" the SSD to optimize the drive performance. A TRIM enabled SSD running an OS with TRIM support will stay closer to its peak performance without much performance variance

5.5 SATA Power Management

By complying with SATA 6.0 Gb/s specifications, the SATA Disk Module supports the following SATA power saving modes:

ACTIVE: PHY ready, full power, Tx & Rx operational

PARTIAL: Reduces power, resumes in under 10 µs (microseconds)

SLUMBER: Reduces power, resumes in under 10 ms (milliseconds)

HIPM: Host-Initiated Power Management

DIPM: Device-Initiated Power Management

AUTO-SLUMBER: Automatic transition from partial to slumber.

Note: the behaviors of power management features would depend on host/device settings.

6. Software Interface

6.1 Command Set

Table 6-1 summarizes the command set with the paragraphs that follow describing the individual commands and the task file for each.

Table 6-1: Command set

Command	Code	Command	Code
Check-Power-Mode	E5H	Security-Erase-Prepare	F3H
Data Set Management	06H	Security-Erase-Unit	F4H
Execute-Drive-Diagnostic	90H	Security-Freeze-Lock	F5H
Flush-Cache	E7H	Security-Set-Password	F1H
Flush-Cache EXT	EAH	Security-Unlock	F2H
Identify-Drive	ECH	Seek	70H
Idle	E3H	Set-Features	EFH
Idle-Immediate	E1H	SMART	B0H
Initialize-Drive-Parameters	91H	Set-Multiple-Mode	C6H
Read DMA	C8H	Set-Sleep-Mode	E6H
Read DMA EXT	25H	Stand-By	E2H
Read-Multiple	C4H	Stand-By-Immediate	E0H
Read-Multiple EXT	29H	Write DMA	CAH
Read-Sector	20H	Write DMA EXT	35H
Read-Sector EXT	24H	Write-Multiple	C5H
Read-Verify-Sectors	40H	Write-Multiple EXT	39H
Read-Verify-Sectors EXT	42H	Write-Sector	30H
Recalibrate	1XH	Write-Sector EXT	34H
Security-Disable-Password	F6H		

7. Electrical Specification

7.1 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 7-1: Operating range

Range	Ambient Temperature	5V
Commercial	0°C to +70°C	4.5-5.5V
Industrial	-40°C to +85°C	

7.2 Power Consumption

Table 7-2 lists the SDM5-M power consumption.

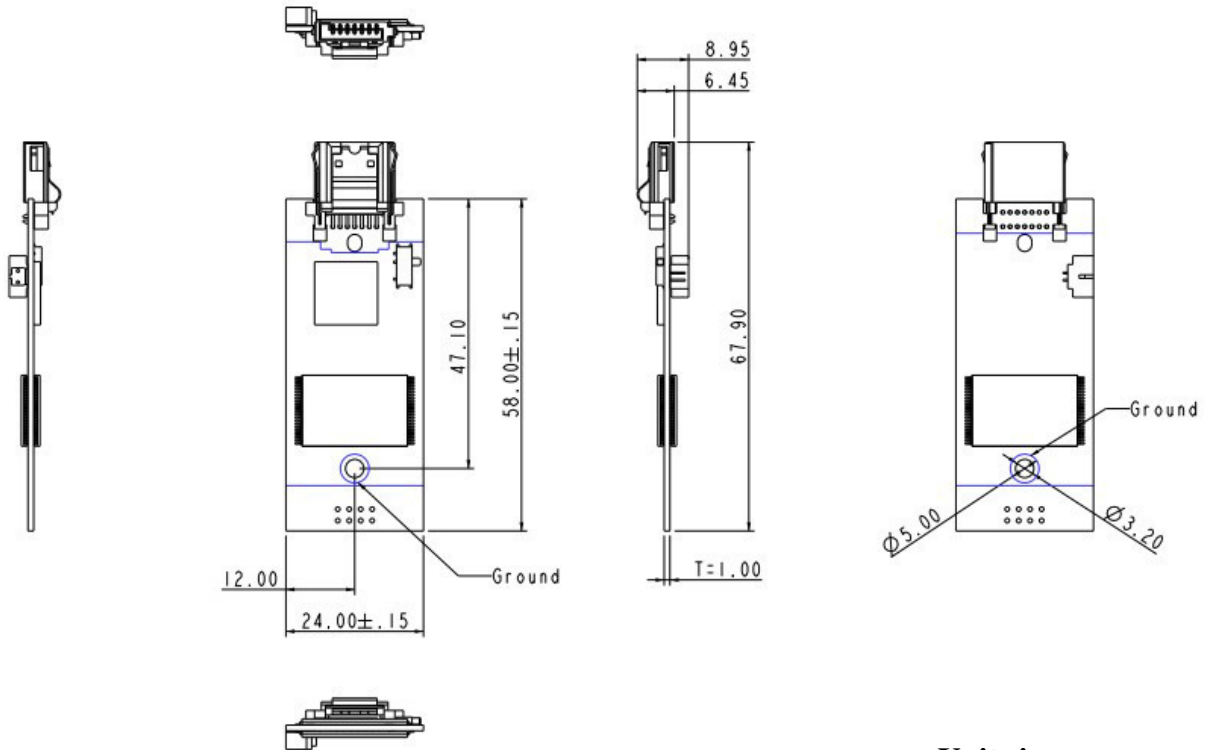**Table 7-2** SDM5-M typical power consumption

Performance \ Capacity	8GB	16GB	32GB	64GB
Active Mode (mA)	120	150	170	240
Idle Mode (mA)	90	90	90	90

8. Physical Characteristics

8.1 Dimensions

8.1.1 Standard Configuration

FIGURE 8-1: Physical dimensions

Units in mm
Tolerance: ± 0.25

8.1.2 Write Protect Switch (Optional)
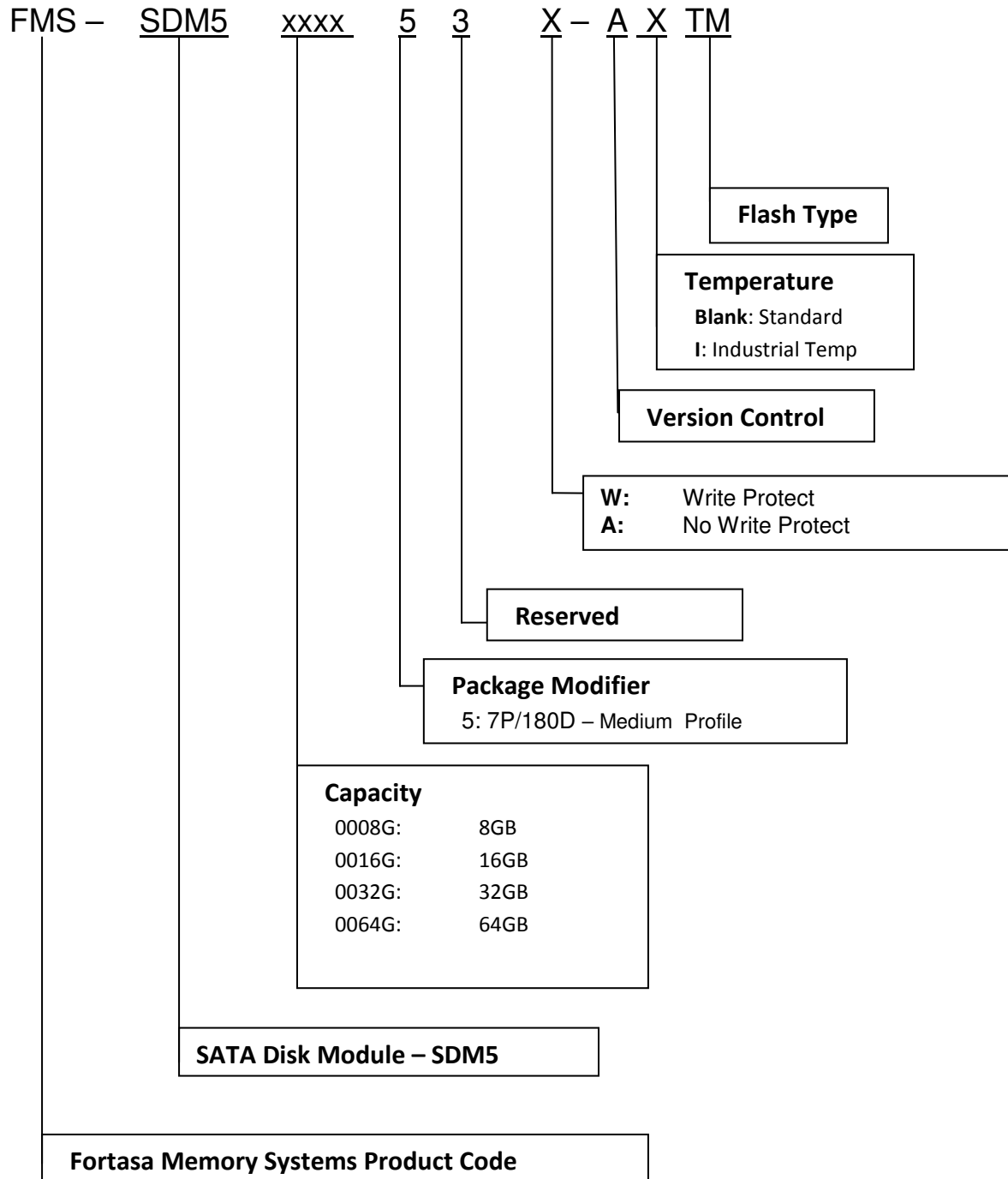

Write Protect Switch

Enable
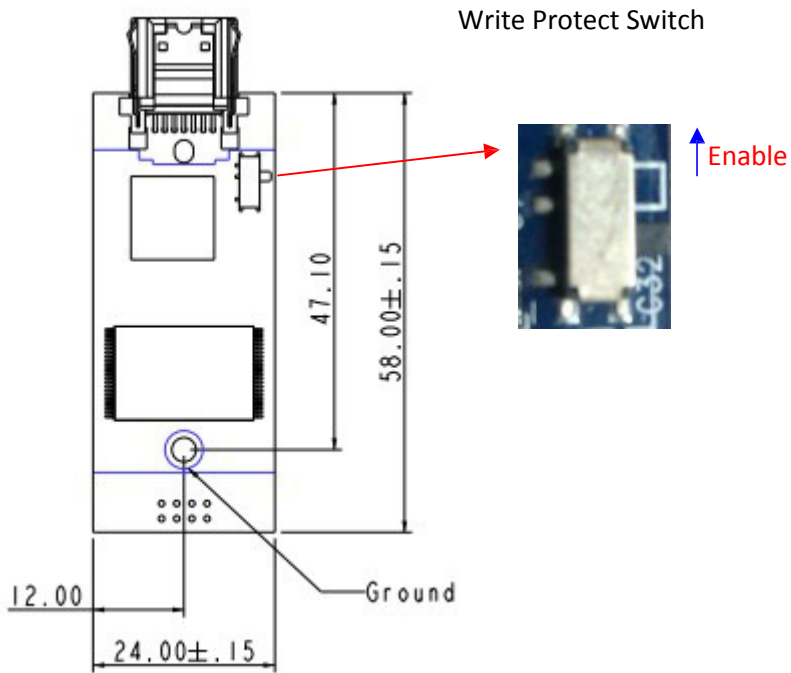
Description of Fortasa Write Protect:

Fortasa Flash Controller firmware implements a Virtual Write scheme that allows the write commands to be accepted by the flash controller without posting any error messages. The OS continues to function uninterrupted but since the write process is virtual, no physical data has been actually written into the Flash memory cells. Since the Virtual Write scheme runs at device level, it requires no software or driver installation and is fully transparent to the host OS.

9. Product Ordering Information

9.1 Product Code Designations

FMS – SDM5   xxxx   5 3   X – A X TM

Flash Type

Temperature
Blank: Standard
I: Industrial Temp

Version Control

| W: | Write Protect |
| A: | No Write Protect |

Reserved

Package Modifier
5: 7P/180D – Medium Profile

Capacity
0008G:	8GB
0016G:	16GB
0032G:	32GB
0064G:	64GB

SATA Disk Module – SDM5

Fortasa Memory Systems Product Code

9.2 Valid Combinations

7P/180D: With Write Protect Switch

Standard Temperature		Industrial Temperature	
Capacity	Model Number	Capacity	Model Number
8GB	FMS- SDM5008G53W-ATM	8GB	FMS- SDM5008G53W-AITM
16GB	FMS- SDM5016G53W-ATM	16GB	FMS- SDM5016G53W-AITM
32GB	FMS- SDM5032G53W-ATM	32GB	FMS- SDM5032G53W-AITM
64GB	FMS- SDM5064G53W-ATM	64GB	FMS- SDM5064G53W-AITM

7P/180D: Without Write Protect Switch

Standard Temperature		Industrial Temperature	
Capacity	Model Number	Capacity	Model Number
8GB	FMS- SDM5008G53A-ATM	8GB	FMS- SDM5008G53A-AITM
16GB	FMS- SDM5016G53A-ATM	16GB	FMS- SDM5016G53A-AITM
32GB	FMS- SDM5032G53A-ATM	32GB	FMS- SDM5032G53A-AITM
64GB	FMS- SDM5064G53A-ATM	64GB	FMS- SDM5064G53A-AITM

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 combinations.

10. Revision History

Revision	Date	Description	Comments
1.0	8/6/2014	Initial Release	