RoHS Compliant

SATA Disk Module 5 Series

Datasheet for SDM5-M 22P / 180D

July 9, 2014

Revision 1.1

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

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

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- **Standard Serial ATA Revision 3.1**
  - – SATA 6.0 Gbps interface
  - – ATA-8 command set
  - – Backward compatible with SATA 1.5/3.0 Gbps
- **Connector Type**
  - – 7-pin signal connector
  - – 15-pin power connector
- **Low power consumption (typical)**
  - – Supply voltage: 5V
  - – Standard Speed
    - – Active mode: 250 mA
    - – Idle mode: 70 mA
  - – High Speed
    - – Active mode: 360 mA
    - – Idle mode: 70 mA
- **Performance**
  - – Burst transfer rate: 600 MB/sec
  - – Standard Speed:
    - – Sustained read: up to 200 MB/sec
    - – Sustained write: up to 85 MB/sec
  - – High Speed:
    - – Sustained read: up to 310 MB/sec
    - – Sustained write: up to 245 MB/sec
- **Capacity**
  - – Standard Speed: 8, 16, 32, 64 GB
  - – High Speed: 16, 32, 64, 128 GB4, 8, 16, 32, 64, 128 GB
- **NAND flash type: MLC**
- **Superior Reliability Through Built-in Hardware ECC**
  - – Corrects up to 40 bit correction per 1K-byte sector
- **Temperature ranges**
  - – Operation:
    - Standard Temperature: 0℃ to 70℃
    - Industrial Temperature: -40℃ to 85℃
  - – Storage: -40℃ to 100℃
- **Flash management**
  - – Intelligent endurance design
    - *Advanced wear-leveling algorithms*
    - *S.M.A.R.T. Technology*
    - *ATA Secure Erase*
    - *Trim*
  - – Intelligent power failure recovery
- **RoHS compliant**
- **Form Factor**
  - – SATA Disk Module (45.80 x 32.80 x 1.00 unit: mm)
- **MTBF:** >1,000,000

Table of Contents

1. General Description

Fortasa's SATA-Disk Module (SDM5) 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. **Though built with Multi-Level Cell (MLC) NAND Flash, this SSD can work in highly demanding environment and can withstand ambient operating temperature range from -40℃ to +85℃ (for certain capacities only).**

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 128 gigabytes, providing full support for the SATA 6.0 Gbit high-speed interface standard. It can operate at sustained access rates of up to 300 megabytes per second, which is much faster than other solid-state or traditional HDD SATA drives currently available on the market.

2. Pin Assignments

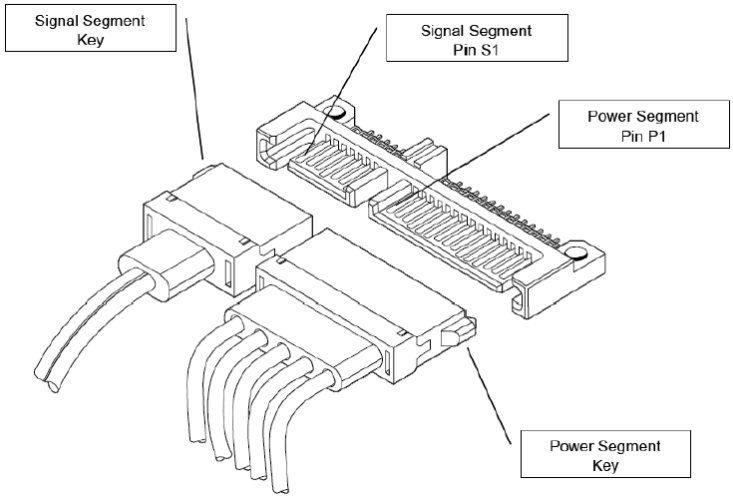


Table 2-1: Signal Segment

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

Table 2-2: Power Segment

Pin	Signal
P1	Not Used (3.3V)
P2	Not Used (3.3V)
P3	Not Used (3.3V)
P4	Ground
P5	Ground
P6	Ground
P7	5V
P8	5V
P9	5V
P10	Ground
P11	DAS
P12	Ground
P13	Not Used (12V)
P14	Not Used (12V)
P15	Not Used (12V)

3. Product Specification

3.1 Functional Specification

3.1.1 Capacity Specifications

Standard capacity specification of the SATA Disk Module product are shown in Table 3-1. The table lists the specific capacity and the default numbers of heads, sectors and cylinders (CHS) for each product line.

Table 3-1: 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	16383[1]	16	63	31,277,232
32GB	32,017,047,552	16383[1]	16	63	62,533,296
64GB	64,023,257,088	16383[1]	16	63	125,045,424
128GB	128,035,676,160	16383[1]	16	63	250,069,680

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.

3.2 Performance Specification

Performances of the SATA Disk Modules are listed in Table 3-2 and Table 3-3.

Table 3-2: Standard Speed Performance specifications

Performance \ Capacity	8GB	16GB	32GB	64GB
Sustained read (MB/s)	100	200	200	200
Sustained write (MB/s)	12	23	44	85

Table 3-3: High Speed Performance specifications

Performance \ Capacity	16GB	32GB	64GB	128GB
Sustained read (MB/s)	260	310	310	310
Sustained write (MB/s)	41	80	150	245

4. 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.

4.1 Error Correction/Detection

The Fortasa Flash Controller uses superior BCH Error Detection Code (EDC) and Error Correction Code (ECC) algorithm which can correct up to 40-bit errors per 1,024 byte data. This built-in hardware ECC performs parity generation and error detection/correction for data integrity.

4.2 Wear Leveling

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.

4.3 Power Failure Management

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.

4.4 ATA Secure Erase

Accomplished by the Secure Erase (SE) command, which added to the open 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. It is a positive easy-to-use data destroy command, amounting to electronic data shredding. Executing the command causes a drive to internally completely erase all possible user data. This command is carried out within disk drives, so no additional software is required. 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.

4.5 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 should allow taking proactive actions to prevent impending drive failure. Fortasa SMART feature adopts the conventional SMART command B0h to read data from the drive. By using the SMART Utility running on the host, the system can monitor and analyze the SATA Disk Module status and determine the end of useful life for a graceful and scheduled maintenance and replacement.

Fortasa memory products come with S.M.A.R.T. commands and subcommands for users to obtain information of drive status and to predict potential drive failures. Users can take advantage of the following commands/subcommands to monitor the health of the drive.

Code	SMART Subcommand
D0h	READ DATA
D1h	READ ATTRIBUTE THRESHOLDS
D2h	Enable/Disable Attribute Autosave
D4h	Execute Off-line Immediate
D5h	Read Log (optional)
D6h	Write Log (optional)
D8h	Enable Operations
D9h	Disable operations
DAh	Return Status

General SMART attribute structure

Byte	Description
0	ID (Hex)
1 – 2	Status flag
3	Value
4	Worst
5*-11	Raw Data

*Byte 5: LSB

SMART

ID (Hex)	Attribute Name
9 (0x09)	Power-on hours
12 (0x0C)	Power cycle count
163 (0xA3)	Max. erase count
164 (0xA4)	Avg. erase count
166 (0xA6)	Total later bad block count
167 (0xA7)	SSD Protect Mode (vendor specific)
168 (0xA8)	SATA PHY Error Count
175 (0xAF)	Bad Cluster Table Count
192 (0xC0)	Unexpected Power Loss Count
194 (0xC2)	Temperature
241 (0xF1)	Total sectors of write

4.6 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.

5 Command Set

Table 5-1 summarizes the command set with the paragraphs that follow describing the individual commands and the task file for each.

Table 5-1: Command set

Code	Command	Code	Command
E5h	Check Power Mode	F6h	Security Disable Password
90h	Execute Diagnostics	F3h	Security Erase Prepare
E7h	Flush Cache	F4h	Security Erase Unit
ECh	Identify Device	F5h	Security Freeze Lock
E3h	Idle	F1h	Security Set Password
E1h	Idle Immediate	F2h	Security Unlock
91h	Initialize Device Parameters	7xh	Seek
C8h	Read DMA	EFh	Set Features
25h	Read DMA EXT	C6h	Set Multiple Mode
60h	Read FPDMA Queued	E6h	Sleep
47h	Read Log DMA EXT	B0h	S.M.A.R.T.
2Fh	Read Log EXT	E2h	Standby
C4h	Read Multiple	E0h	Standby Immediate
20 or 21h	Read Sector(s)	CAh	Write DMA
40 or 41h	Read Verify Sector(s)	35h	Write DMA EXT
10h	Recalibrate	61h	Write FPDMA Queued
57h	Write Log DMA EXT	3Fh	Write Log EXT
C5h	Write Multiple	30h or 31h	Write Sector(s)

6. Electrical Specification

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 6-1: Operating range

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

Table 6-2: Power Consumption - Standard speed– (typical)

Mode \ Capacity	8GB	16GB	32GB	64GB
Active (mA)	135	155	170	250
Standby (mA)	70	70	70	70

Table 6-3: Power Consumption – High speed – (typical)

Mode \ Capacity	16GB	32GB	64GB	128GB
Active (mA)	170	195	260	360
Standby (mA)	70	70	70	70

7. Environmental Specifications

7.1 Environments

Environmental specification of the SATA Disk Module series follows the MIL-STD-810F standard as shown in Table 7-1.

Table 7-1: Environmental specifications

Environment		Specification
Temperature	Operation	0°C to 70°C (standard temperature); -40°C to 85°C (Industrial temperature)
	Storage	-40°C to 100°C
Vibration		Sine wave: 5~55~5 Hz (X, Y, Z) Random: 10-2000 Hz, 16.3 G (X, Y, Z)
Operating Shock		50(G), 11(ms), half-sine wave
Non-Operating Shock		1500(G), 0.5(ms), half-sine wave
Humidity		10~95% R.H, 30(℃) max. wet bulb temp., operating

7.2 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 SDM5-M is rated at more than 1,000,000 hours.

Notes about the MTBF:
The MTBF is predicated and calculated based on “Telcordia Technologies Special Report, SR-332, Issue 2” method.

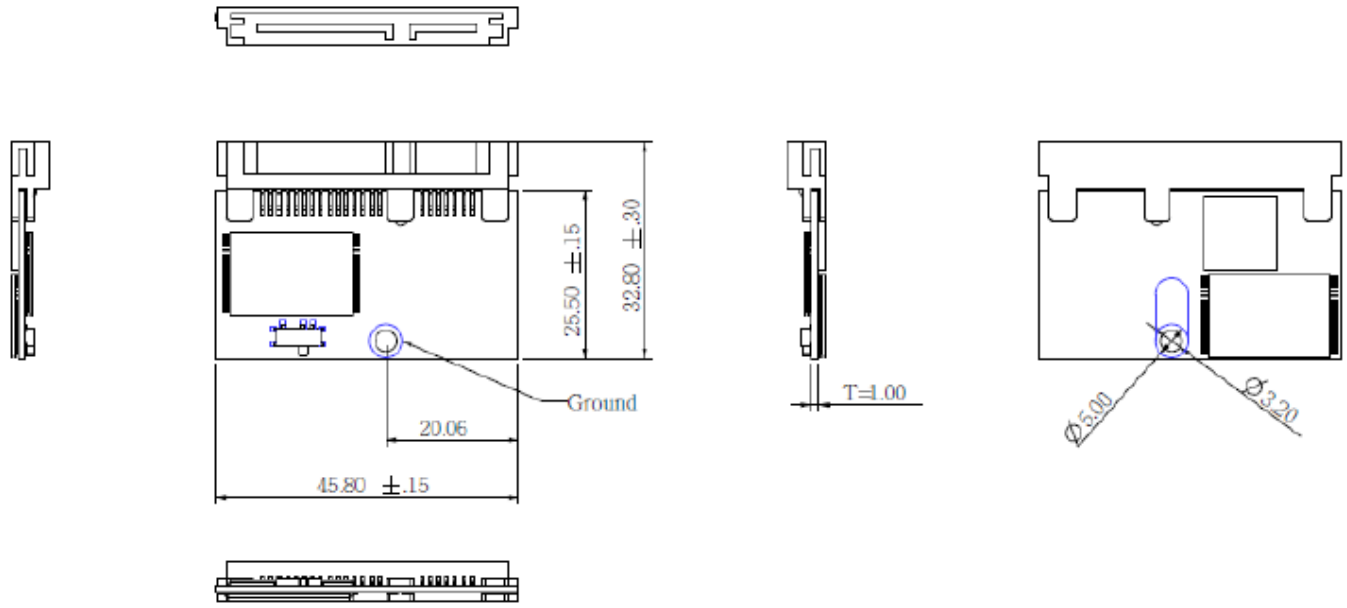
7.3 Certification and Compliance

The SDM complies with the following standards:

- CE
- FCC
- RoHS
- MIL-STD-810F

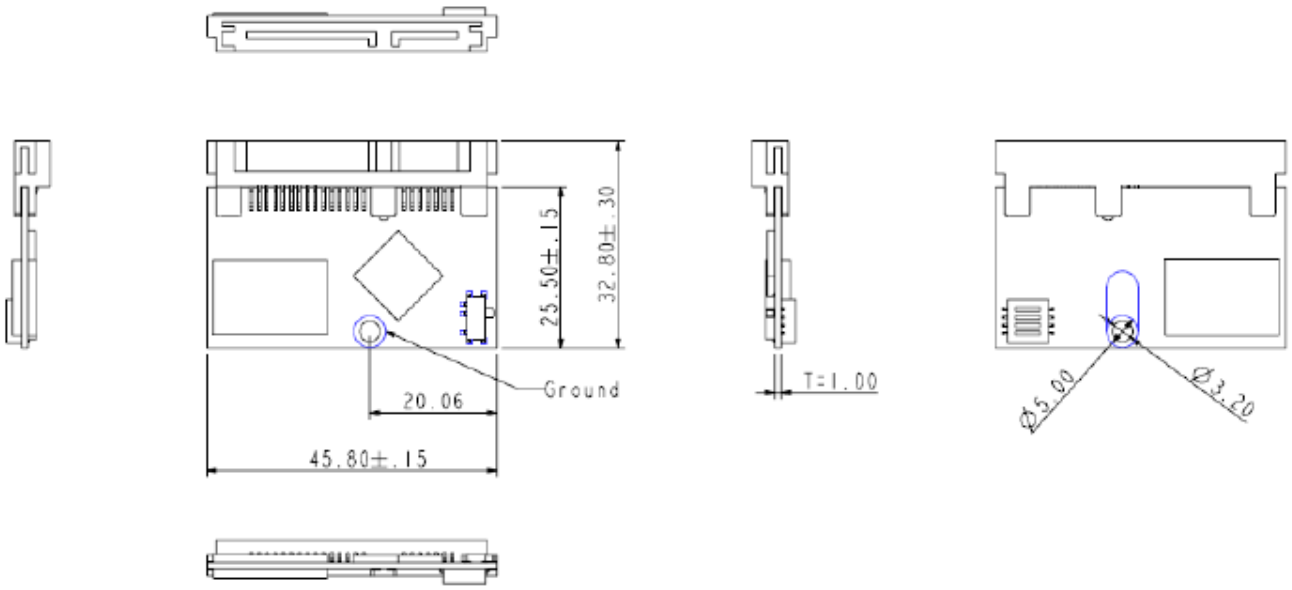
8. Physical Characteristics

8.1 Standard Speed Physical Dimensions



Units in mm
Tolerance: ± 0.25

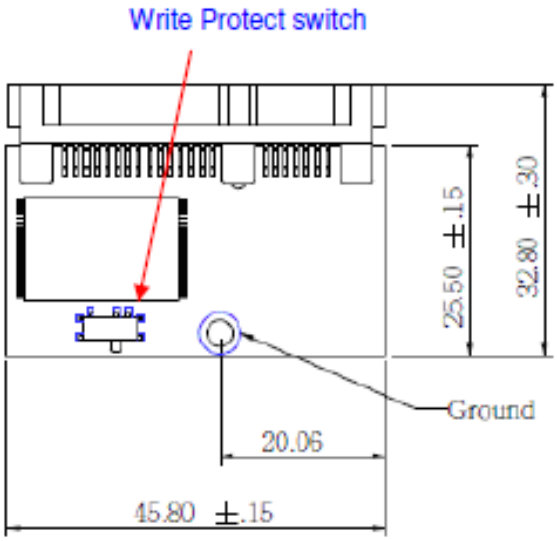
8.2 High Speed Physical Dimensions

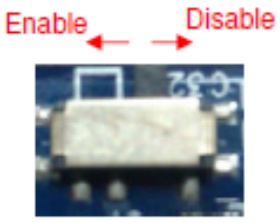


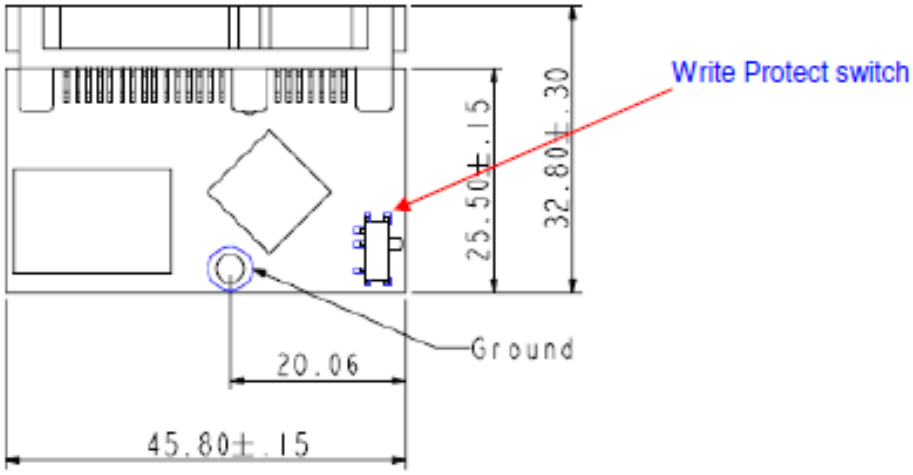
Units in mm
Tolerance: ± 0.25

8. Write Protect Switch (optional)

Fortasa implements the Write Protect scheme that permits destructive (program/erase) commands to go through the flash but not allow data has been actually modified on the flash media. Since the Write Protect scheme runs inside the Flash Controller, it requires no custom software or device driver installation and is independent from the host OS



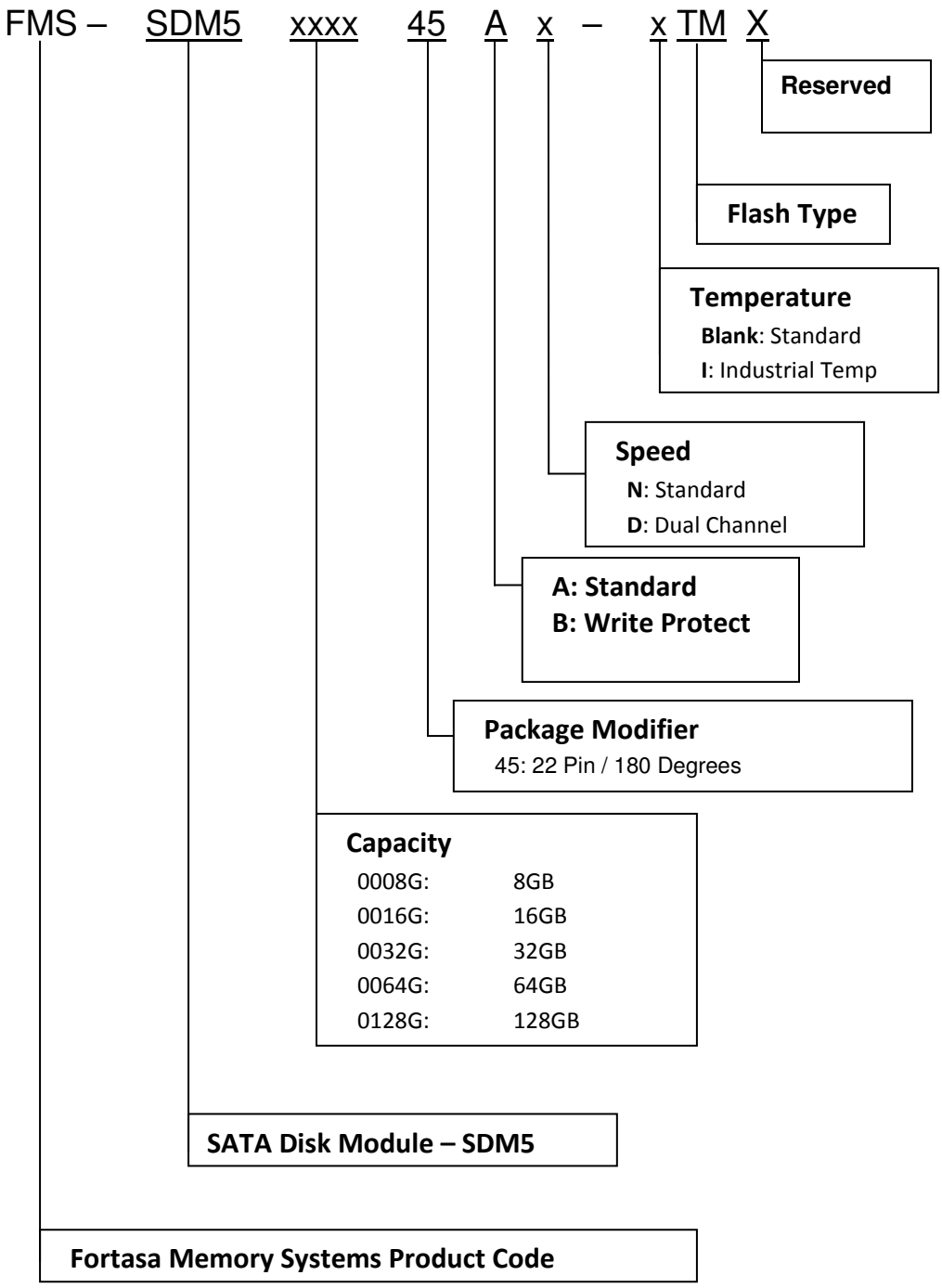




Note: Write Protect is optional.

9. Product Ordering Information

9.1 Product Code Designations



9.2 Valid Combinations

SDM5 22P/180D Standard Performance

Standard Temperature		Industrial Temperature	
Capacity	**Model Number**	**Capacity**	**Model Number**
8GB	FMS-SDM5008G45AN-TMA	**8GB**	FMS-SDM5008G45AN-ITMA
16GB	FMS-SDM5016G45AN-TMA	**16GB**	FMS-SDM5016G45AN-ITMA
32GB	FMS-SDM5032G45AN-TMA	**32GB**	FMS-SDM5032G45AN-ITMA
64GB	FMS-SDM5064G45AN-TMA	**64GB**	FMS-SDM5064G45AN-ITMA

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.

SDM5 22P/180D Standard Performance w/Write Performance

Standard Temperature		Industrial Temperature	
Capacity	**Model Number**	**Capacity**	**Model Number**
8GB	FMS-SDM5008G45WN-TMA	**8GB**	FMS-SDM5008G45WN-ITMA
16GB	FMS-SDM5016G45WN-TMA	**16GB**	FMS-SDM5016G45WN-ITMA
32GB	FMS-SDM5032G45WN-TMA	**32GB**	FMS-SDM5032G45WN-ITMA
64GB	FMS-SDM5064G45WN-TMA	**64GB**	FMS-SDM5064G45WN-ITMA

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.

SDM5 22P/180D High Performance

Standard Temperature		Industrial Temperature	
Capacity	**Model Number**	**Capacity**	**Model Number**
16GB	FMS-SDM5016G45AD-TMA	**16GB**	FMS-SDM5016G45AD-ITMA
32GB	FMS-SDM5032G45AD-TMA	**32GB**	FMS-SDM5032G45AD-ITMA
64GB	FMS-SDM5064G45AD-TMA	**64GB**	FMS-SDM5064G45AD-ITMA
128GB	FMS-SDM5128G45AD-TMA	**128GB**	FMS-SDM5128G45AD-ITMA

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.

SDM5 22P/180D High Performance w/Write Performance

Standard Temperature		Industrial Temperature	
Capacity	**Model Number**	**Capacity**	**Model Number**
16GB	FMS-SDM5016G45WD-TMA	**16GB**	FMS-SDM5016G45WD-ITMA
32GB	FMS-SDM5032G45WD-TMA	**32GB**	FMS-SDM5032G45WD-ITMA
64GB	FMS-SDM5064G45WD-TMA	**64GB**	FMS-SDM5064G45WD-ITMA
128GB	FMS-SDM5128G45WD-TMA	**128GB**	FMS-SDM5128G45WD-ITMA

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	05/05/2014	Initial Release	
1.1	07/09/2014	Added Write Protect Option	