

RoHS Compliant
SATA Flash Drive Series
Datasheet for SAFD 25N-M

June 26, 2014

Revision 1.5

***This Specification Describes the Features and Capabilities of
the Standard and Industrial Temperature
SATA Flash Drives***

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



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SATA Flash Drive – 2.5”

FMS-SAFD25NxBxxxx-XAxx



Features:

- **Standard Serial SATA 3.1**
 - SATA 3.1 command set compatible
 - Serial SATA 6.0 Gbps Interface
 - Backward compatible with SATA 1.5 and 3.0 Gbps interfaces
 - ATA-8 compatible command set
- **Low power consumption (typical)**
 - Supply voltage: 5V±5%
 - Standard Speed:
 - Active mode: 385 mA
 - Idle mode: 105 mA
 - High speed:
 - Active mode: 680 mA
 - Idle mode: 50 mA
- **Connector Type**
 - 7-pin signal connector
 - 15-pin power connector
- **Performance**
 - Burst transfer rate: 600 MB/sec
 - Standard speed:
 - Sustained read: up to 385 MB/sec
 - Sustained write: up to 170 MB/sec
 - High speed:
 - Sustained read: up to 525 MB/sec
 - Sustained write: up to 455 MB/sec
 - Random read (4K): up to 86,000 IOPS
 - Random write (4K): up to 79,000 IOPS
- **Intelligent endurance design**
 - Built-in hardware ECC, enabling up to 40 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*
 - *ATA Secure Erase*
 - *SMART Command*
 - *Trim Command*
- **Form factor Choices**
 - 2.5 inch
 - 7mm thick enclosure - 100.00 x 69.85 x 6.90, unit: mm
 - 9mm thick enclosure - 100.00 x 69.85 x 9.30, unit: mm
- **RoHS compliant**
- **Capacity**
 - Standard Speed: 16, 32, 64, 128, 256 GB
 - High Speed: 32, 64, 128, 256 GB
- **NAND flash type: MLC**
- **MTBF (hours):** >1,000,000
- **Endurance (in Terabytes Written: TBW)**
 - 16GB: 34 TBW
 - 32GB: 68 TBW
 - 64GB: 136 TBW
 - 128GB: 272 TBW
 - 256 GB: 545 TBW
- **Temperature ranges**
 - Operation:
 - Standard: 0°C to 70°C (32° ~ 158°F)
 - Industrial: -40°C to 85°C (-40° ~ 185°F)
 - Storage: -40°C to 100°C (-40° ~ 212°F)
- **Shock and Vibration**
 - Shock: 1500g (approx.)
 - Vibration: 15g (approx.)



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1 Product Description

1.1 General Description

Fortasa’s SAFD25N-M is a high-performance, SATA interface, solid state drive (SSD) designed to replace a conventional SATA hard disk drive. SAFD 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 SAFD Series is the best drop-in replacement for high-maintenance HDD where reliability is of a major importance.

The SAFD25N-M drive offers capacities of up to 256 gigabytes, providing full support for the SATA 6GBps high-speed interface standard. It can operate at sustained access rates of up to 550 megabytes per second, which is much faster than other solid-state or traditional HDD SATA drives currently available on the market.

SAFD25N-M 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. The SAFD25N-M also offers Self-Monitoring Analysis and Reporting Technology (S.M.A.R.T.) feature that follows the ATA/ATAPI specifications and uses the standard SMART command B0h to read data from the drive. This capability monitors the drive accesses and provides the host with vital information about drive condition to schedule maintenance and service times.

1.2 Functional Block

The SAFD25N-M drive includes a SATA 6.0 Gps Flash Controller and flash media. The Flash controller integrates the flash management unit to support multi-channel, multi-bank flash arrays.

1.3 Capacity Specification

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

Table 1-1: Capacity specifications

| Capacity | Total Bytes | Cylinders | Heads | Sectors | Max LBA |
|----------|-----------------|---------------------|-------|---------|-------------|
| 16GB | 16,013,942,784 | 16,383 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 |
| 256GB | 256,060,514,304 | 16383 ¹ | 16 | 63 | 500,118,192 |

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

Please contact factory for any non-listed SATA Flash Drive capacity or custom CHS requirement.

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1.4 Performance Specification

Performances of the SATA Flash Drive are listed in Table 1-2 and 1-3.

Table 1-2: Standard Performance specifications

| Capacity \ Performance | 16GB | 32GB | 64GB | 128GB | 256GB |
|-------------------------------|------|------|------|-------|-------|
| Sustained read (MB/s) | 200 | 370 | 350 | 385 | 385 |
| Sustained write (MB/s) | 22 | 42 | 80 | 170 | 170 |

Table 1-2: High Performance specifications

| Capacity \ Performance | 32GB | 64GB | 128GB | 128GB |
|-------------------------------|--------|--------|--------|--------|
| Sustained read (MB/s) | 380 | 515 | 520 | 525 |
| Sustained write (MB/s) | 85 | 145 | 300 | 455 |
| Random Read IOPS (4K) | 46,000 | 79,000 | 85,000 | 86,000 |
| Random Write IOPS (4K) | 19,000 | 35,000 | 71,000 | 79,000 |

Note: Performance varies from flash configurations or host system settings.
IOPS: measured on 8GB span (16777216 sectors Disk Size), 32 Outstanding I/Os (QD=32), Full Random Data pattern, 4KB Align I/Os and test durations 15minutes

1.5 Pin Assignments

Figure 1-2: Micro-SATA connectors

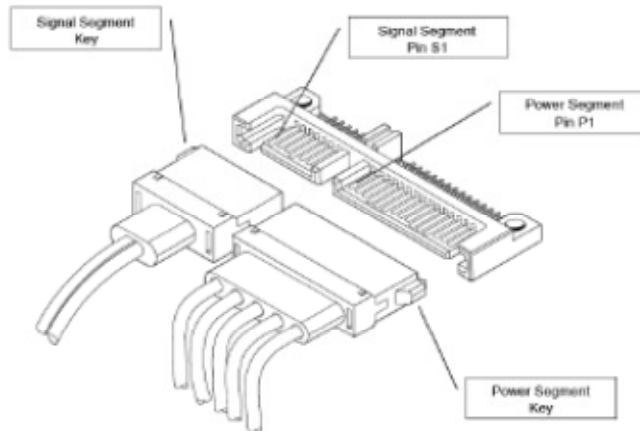


Table 1-3: Signal Segment

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

Table 1-4: Power Segment

| Pin | Signal |
|-----|--------------------------|
| P1 | Not Used (3.3V) |
| P2 | Not Used (3.3V) |
| P3 | Unused or Device Sleep * |
| 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) |

*P3 can be configured as Device Sleep trigger by Configuration Option

2. Software Interface

2.1 Command Set

Table 2-1 summarizes the command set with the paragraphs that follow describing the individual commands and the task file for each.

Table 2-1: Command set

| Command | Code | Command | Code |
|-----------------------------|-------------|---------------------------|-------------|
| Check-Power-Mode | E5H | Security-Disable-Password | F6H |
| Execute-Drive-Diagnostic | 90H | Security-Erase-Prepare | F3H |
| Flush-Cache | E7H | Security-Erase-Unit | F4H |
| Identify-Drive | ECH | Security-Freeze-Lock | F5H |
| Idle | E3H | Security-Set-Password | F1H |
| Idle-Immediate | E1H | Security-Unlock | F2H |
| Initialize-Drive-Parameters | 91H | Seek | 7XH |
| Read DMA | C8H | Set-Features | EFH |
| Read DMA EXT | 25H | Set-Multiple-Mode | C6H |
| Read FPDMA Queued | 60H | Set-Sleep-Mode | E6H |
| Read Log DMA EXT | 47H | SMART | B0H |
| Read Log EXT | 2FH | Stand-By | E2H |
| Read-Multiple | C4H | Stand-By-Immediate | E0H |
| Read-Sector | 20H or 21H | Write DMA | CAH |
| Read-Verify-Sectors | 40H or 41H | Write DMA EXT | 35H |
| Recalibrate | 10H | Write FPDMA Queued | 61H |
| Write Log DMA EXT | 57H | Write Log EXT | 3FH |
| Write-Multiple | C5H | Write-Sector | 30H or 31H |

3. Flash Management

3.1 Error Correction/Detection

The SATA Flash Drive implements a hardware BCH-based ECC scheme to achieve up to 40 bit correction per 1024-byte page.

3.2 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 Flash Drive 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 Flash Drive products offer advanced data wear leveling which distributes Flash writes evenly across the SATA Flash Drive memory space. By utilizing this advanced wear leveling feature, the lifetime of the media can be significantly extended.

3.3 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 Flash Drive due to system power glitches.

Note: The Flash controller unit of this product model is designed with an External DRAM as a write cache for improved performance and data efficiency. Though unlikely to happen in most cases, the data cached in the volatile DRAM might be potentially affected if a sudden power loss / brown-out condition takes place before the cached data is flushed into non-volatile NAND flash memory.

3.4 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.

3.5 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 follows the ATA/ATAPI specifications, using the standard SMART command B0h to read data from the drive. Fortasa SMART defines vendor-specified SMART Attribute IDs in the SATA Flash Drive products. They represent initial bad block count, total later bad block count, maximum erase count, average erase count, power on hours and power cycle. Please contact Fortasa sales for SMART ID definitions.

3.6 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. A TRIM enabled SSD running an OS with TRIM support will stay closer to its peak performance without much performance variance.

3.6 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 μ s (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.

Device Sleep (DevSleep or DEVSLP): PHY powered down; power consumption \leq 5 mW; host assertion time \leq 10 ms; exit timeout from this state \leq 20 ms (unless specified otherwise in SATA Identify Device Log).

Note:

1. The behaviors of power management features would depend on host/device settings.
2. Device Sleep mode is optional, depending on product ordering selections

4. Environmental Specifications

4.1 Environments

Environmental specification of the SATA Flash Drive series follows the MIL-STD-810F standard as shown in Table 4-1.

Table 4-1: Environmental specifications

| Environment | | Specification |
|-----------------|-----------|--|
| Temperature | Operation | 0°C to 70°C (standard); -40°C to 85°C (industrial) |
| | Storage | -40°C to 100°C |
| Vibration | | Sine wave: 5~55~5 Hz (X, Y, Z) Random: 10-2000 Hz, 16.3 G (X, Y, Z) |
| Shock-Operating | | Acceleration: 1,500 G, 0.5 ms Peak acceleration: 50 G, 11 ms |

4.2 Mean Time Between Failures (MTBF)

Mean Time Between Failures (MTBF) is predicted based on reliability data for the individual components in the SAFD drive. Based on provided component data, SATA Flash Drive 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.

4.3 Certification and Compliance

The SAFD25N-M complies with the following standards:

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

4.4 Endurance

The endurance of a storage device is predicted by TeraBytes Written based on several factors related to usage, such as the amount of data written into the drive, block management conditions, and daily workload for the drive. Thus, key factors, such as Write Amplifications and the number of P/E cycles, can influence the lifespan of the drive.

| Capacity | TeraBytesWritten (TBW) |
|----------|------------------------|
| 16 GB | 34 |
| 32 GB | 68 |
| 64 GB | 136 |
| 128 GB | 272 |
| 256 GB | 545 |

Notes:

The measurement assumes the data written to the SSD for test is under a typical and constant rate.
The measurement follows the standard metric: 1 TB (Terabyte) = 1000 GB

5. Electrical Specification

5.1 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 5-1: Operating range

| Range | Ambient Temperature | Conditions |
|------------|---------------------|------------------------|
| Commercial | 0°C to +70°C | 5.0 V ±10% (4.5-5.5 V) |
| Industrial | -40°C to 85°C | 5.0 V ±10% (4.5-5.5 V) |

5.2 Power Consumption

Table 5-2 and 5-3 list the SAFD 25N-M power consumption.

Table 5-2 Typical power consumption (Standard Speed)

| Capacity | 16GB | 32GB | 64GB | 128GB | 256GB |
|-------------------------|------|------|------|-------|-------|
| Performance | | | | | |
| Active Mode (mA) | 255 | 255 | 255 | 385 | 385 |
| Idle Mode (mA) | 105 | 105 | 105 | 105 | 105 |

Table 5-3 Typical power consumption (High Speed)

| Capacity | 32GB | 64GB | 128GB | 256GB |
|-------------------------|------|------|-------|-------|
| Performance | | | | |
| Active Mode (mA) | 240 | 300 | 470 | 680 |
| Idle Mode (mA) | 50 | 50 | 50 | 50 |

6. Physical Characteristics

6.1 7mm Thickness Enclosure

Figure 6-2 illustrates the overall dimensions of the SAFD drive packaged in a 7mm Housing, as listed in Table 6-2.

Table 6-1 SAFD dimensions

| Dimension | Millimeters (mm) |
|-----------|------------------|
| Height | 6.90 ± 0.20 |
| Width | 69.85 ± 0.20 |
| Length | 100.00 ± 0.20 |

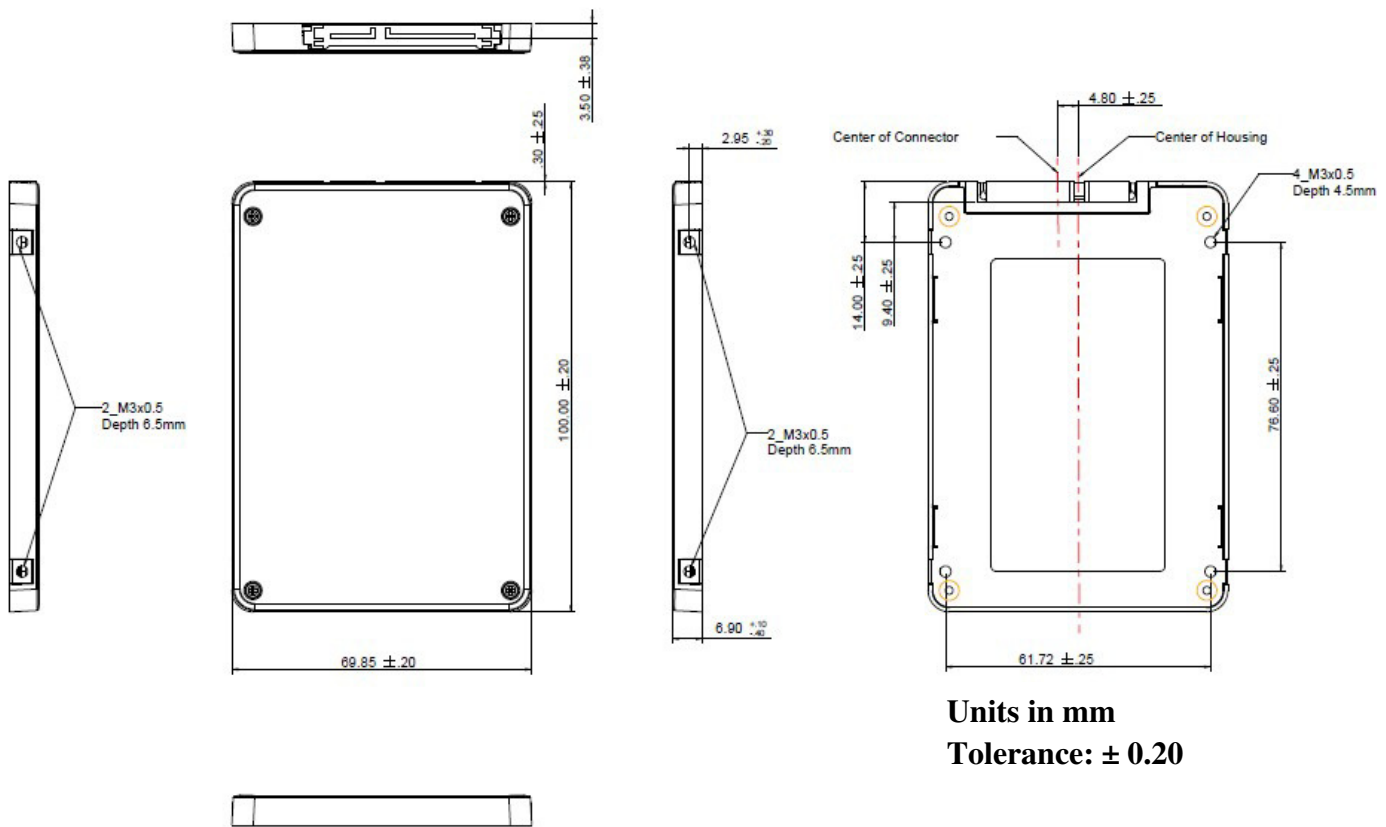


Figure 6-1 SFD25N-M with 7mm Housing physical dimensions

SATA Flash Drive – 2.5” FMS-SAFD25NxBxxxx-XAxx

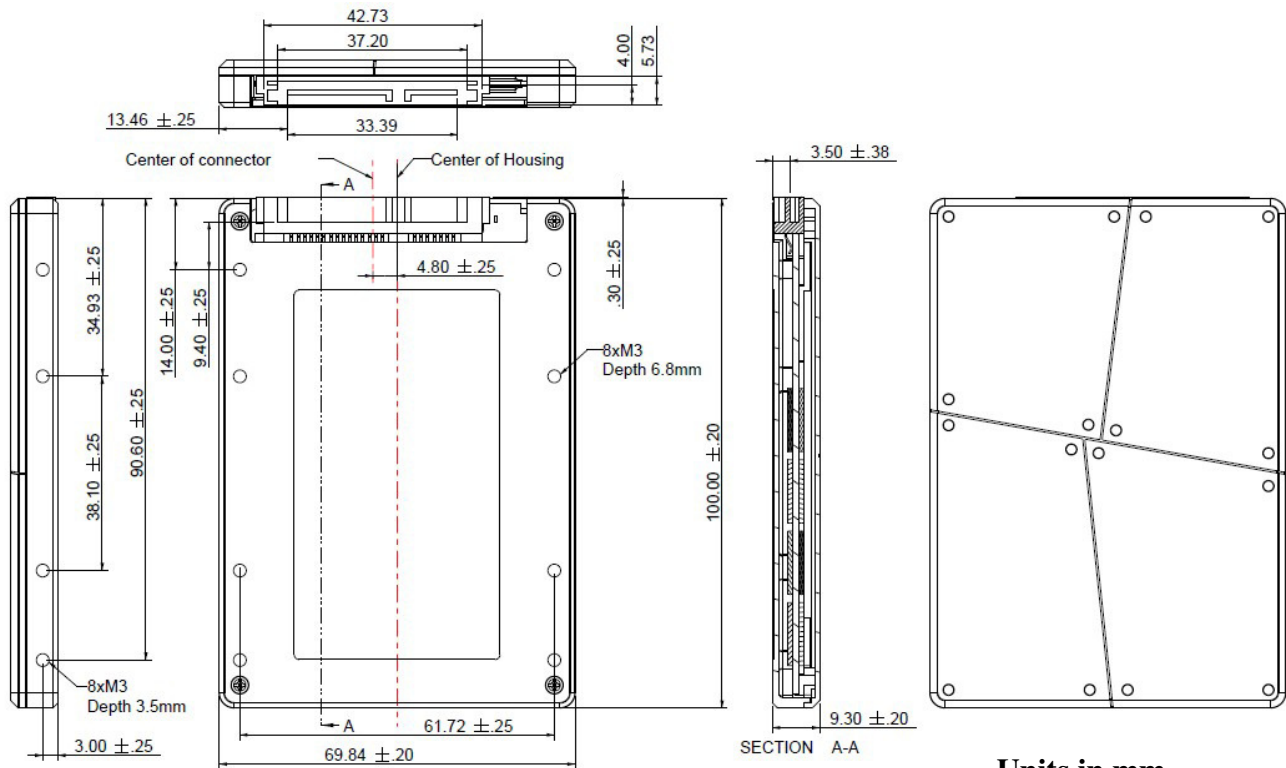


6.2 9mm Thickness Enclosure

Figure 6-2 illustrates the overall dimensions of the SAFD drive packaged in a 9mm Housing, as listed in Table 6-2.

Table 6-2 SAFD dimensions

| Dimension | Millimeters (mm) |
|-----------|------------------|
| Height | 9.30 ± 0.20 |
| Width | 69.84 ± 0.20 |
| Length | 100.00 ± 0.20 |



Units in mm
Tolerance: ± 0.20

Figure 6-1 SFD25N-M with 9mm Housing physical dimensions

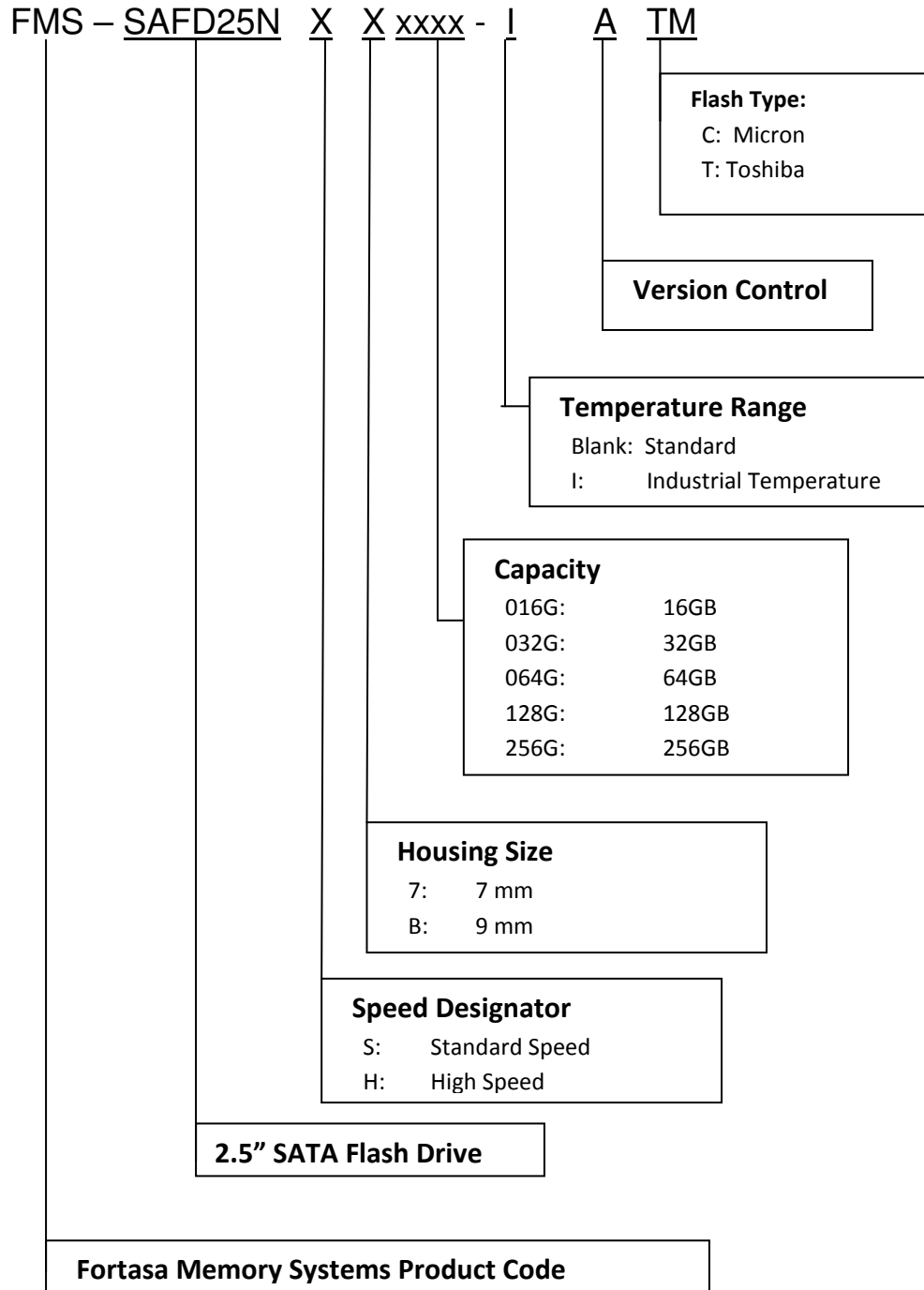
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7. Product Ordering Information

7.1 Product Code Designations



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7.2 Valid Combinations

7.2.1 7mm Housing

Standard Speed

| Capacity | Standard Temperature Model Numbers | Industrial Temperature Model Numbers |
|----------|------------------------------------|--------------------------------------|
| 16GB | FMS-SAFD25NS7016G-ATM | FMS-SAFD25NS7016G-IATM |
| 32GB | FMS-SAFD25NS7032G-ATM | FMS-SAFD25NS7032G-IATM |
| 64GB | FMS-SAFD25NS7064G-ATM | FMS-SAFD25NS7064G-IATM |
| 128GB | FMS-SAFD25NS7128G-ATM | FMS-SAFD25NS7128G-IATM |
| 256GB | FMS-SAFD25NS7256G-ATM | FMS-SAFD25NS7256G-IATM |

High Speed

| Capacity | Standard Temperature Model Numbers | Industrial Temperature Model Numbers |
|----------|------------------------------------|--------------------------------------|
| 32GB | FMS-SAFD25NH7032G-ATM | FMS-SAFD25NH7032G-IATM |
| 64GB | FMS-SAFD25NH7064G-ATM | FMS-SAFD25NH7064G-IATM |
| 128GB | FMS-SAFD25NH7128G-ATM | FMS-SAFD25NH7128G-IATM |
| 256GB | FMS-SAFD25NH7256G-ATM | FMS-SAFD25NH7256G-IATM |

7.2.2 9mm Housing

Standard Speed

| Capacity | Standard Temperature Model Numbers | Industrial Temperature Model Numbers |
|----------|------------------------------------|--------------------------------------|
| 16GB | FMS-SAFD25NSB016G-ATM | FMS-SAFD25NSB016G-IATM |
| 32GB | FMS-SAFD25NSB032G-ATM | FMS-SAFD25NSB032G-IATM |
| 64GB | FMS-SAFD25NSB064G-ATM | FMS-SAFD25NSB064G-IATM |
| 128GB | FMS-SAFD25NSB128G-ATM | FMS-SAFD25NSB128G-IATM |
| 256GB | FMS-SAFD25NSB256G-ATM | FMS-SAFD25NSB256G-IATM |

High Speed

| Capacity | Standard Temperature Model Numbers | Industrial Temperature Model Numbers |
|----------|------------------------------------|--------------------------------------|
| 32GB | FMS-SAFD25NHB032G-ATM | FMS-SAFD25NHB032G-IATM |
| 64GB | FMS-SAFD25NHB064G-ATM | FMS-SAFD25NHB064G-IATM |
| 128GB | FMS-SAFD25NHB128G-ATM | FMS-SAFD25NHB128G-IATM |
| 256GB | FMS-SAFD25NHB256G-ATM | FMS-SAFD25NHB256G-IATM |

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

8. Revision History

| Revision | Date | Description | Comments |
|----------|------------|--|----------|
| 1.0 | 11/17/2013 | Initial Release | |
| 1.1 | 11/21/2013 | Updated performance and power consumption due to changes in components | |
| 1.2 | 12/16/2013 | Added Device Sleep option to power segment pin3 Updated 7mm type mechanical specifications Added Endurance (TBW) section | |
| 1.3 | 4/21/2014 | Added 256GB Capacity | |
| 1.4 | 5/17/2014 | Updated performance and power consumption due to firmware upgrade | |
| 1.5 | 6/26/2014 | Corrected Part Numbers | |