

RoHS Compliant
SATA Flash Drive Series
Datasheet for SAFD 25N

July 10, 2014

Revision 1.1

***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-XAX



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:
 - Active mode: 275 mA
 - Idle mode: 105 mA
 - High speed:
 - Active mode: 470 mA
 - Idle mode: 95 mA
- **Performance**
 - Burst transfer rate: 600 MB/sec
 - Standard speed:
 - Sustained read: up to 160 MB/sec
 - Sustained write: up to 150 MB/sec
 - High speed:
 - Sustained read: up to 530 MB/sec
 - Sustained write: up to 445 MB/sec
 - Random read (4K): up to 82,000 IOPS
 - Random write (4K): up to 76,000 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*
- **Connector Type**
 - 7-pin signal connector
 - 15-pin power connector
- **Form factor**
 - 2.5 inch (100.00 x 69.84 x 9.30, unit: mm)
- **RoHS compliant**
- **Capacity**
 - 8, 16, 32, 64, 128 GB
- **NAND flash type: SLC**
- **MTBF (hours): >2,000,000**
- **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 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 drive offers capacities of up to 128 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 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 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 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
8 GB	8,012,390,400	15,525	16	63	15,649,200
16 GB	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

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	8GB	16GB	32GB	64GB	128GB
Performance					
Sustained read (MB/s)	155	155	160	160	160
Sustained write (MB/s)	110	145	145	150	150

Table 1-2: High Performance specifications

Capacity	32GB	64GB	128GB
Performance			
Sustained read (MB/s)	160	160	160
Sustained write (MB/s)	145	150	150
Random Read IOPS (4K)	81,000	82,000	82,000
Random Write IOPS (4K)	82,000	73,000	76,000

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

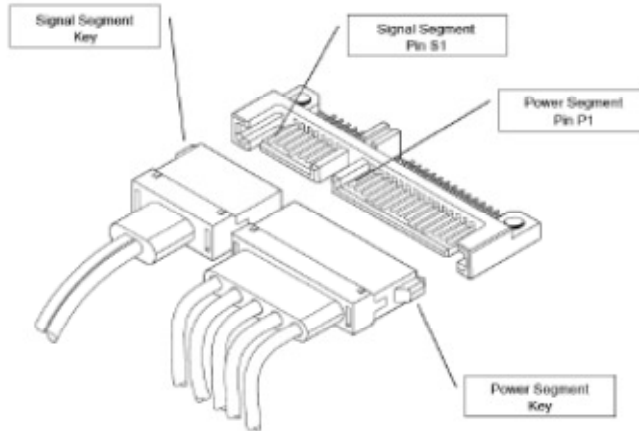


Table 1-3: Signal Segment

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 2,000,000 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 complies with the following standards:

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

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 power consumption.

Table 5-2 Typical power consumption (Standard Speed)

Capacity \ Performance	8GB	16GB	32GB	64GB	128GB
Active Mode (mA)	220	275	275	275	275
Idle Mode (mA)	100	100	100	100	105

Table 5-3 Typical power consumption (High Speed)

Capacity \ Performance	32GB	64GB	128GB
Active Mode (mA)	320	460	470
Idle Mode (mA)	95	95	95

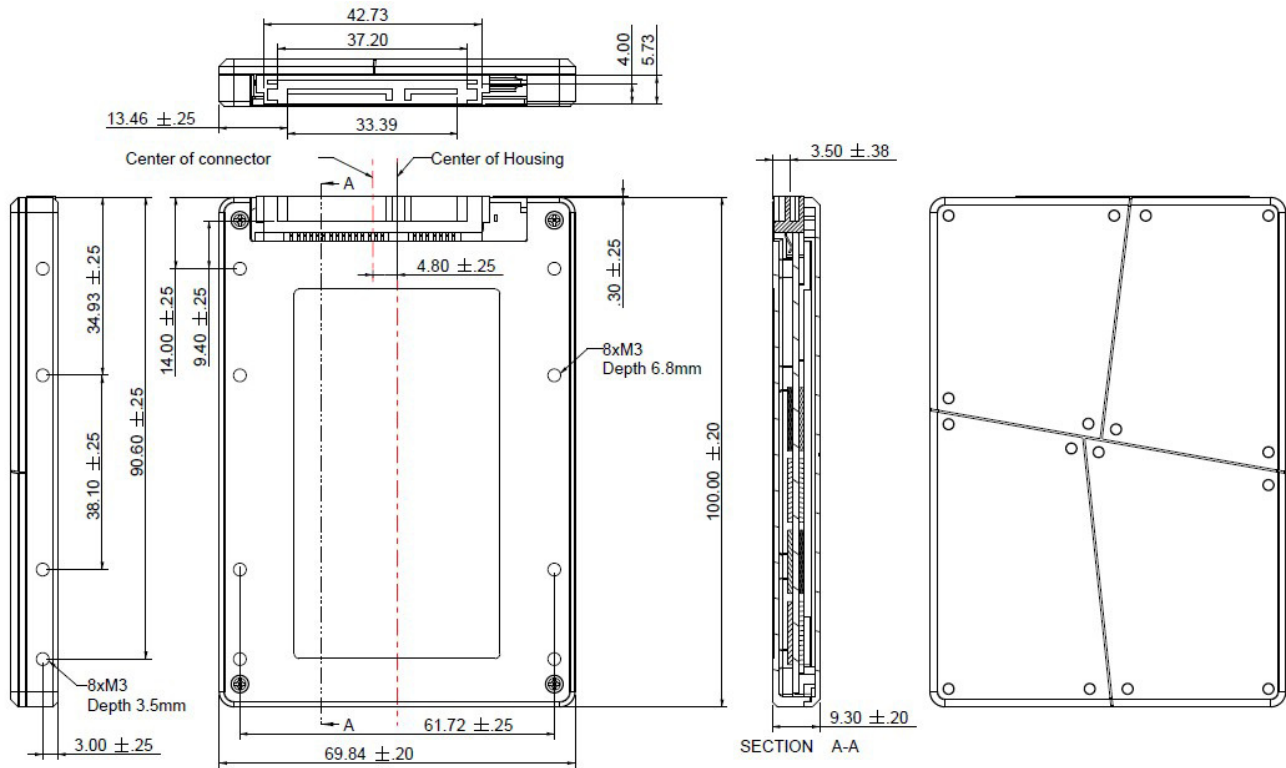
6. Physical Characteristics

6.1 Dimensions

Figure 6-1 illustrates the overall dimensions of the SAFD drive, as listed in Table 6-1.

Table 6-1 SAFD dimensions

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



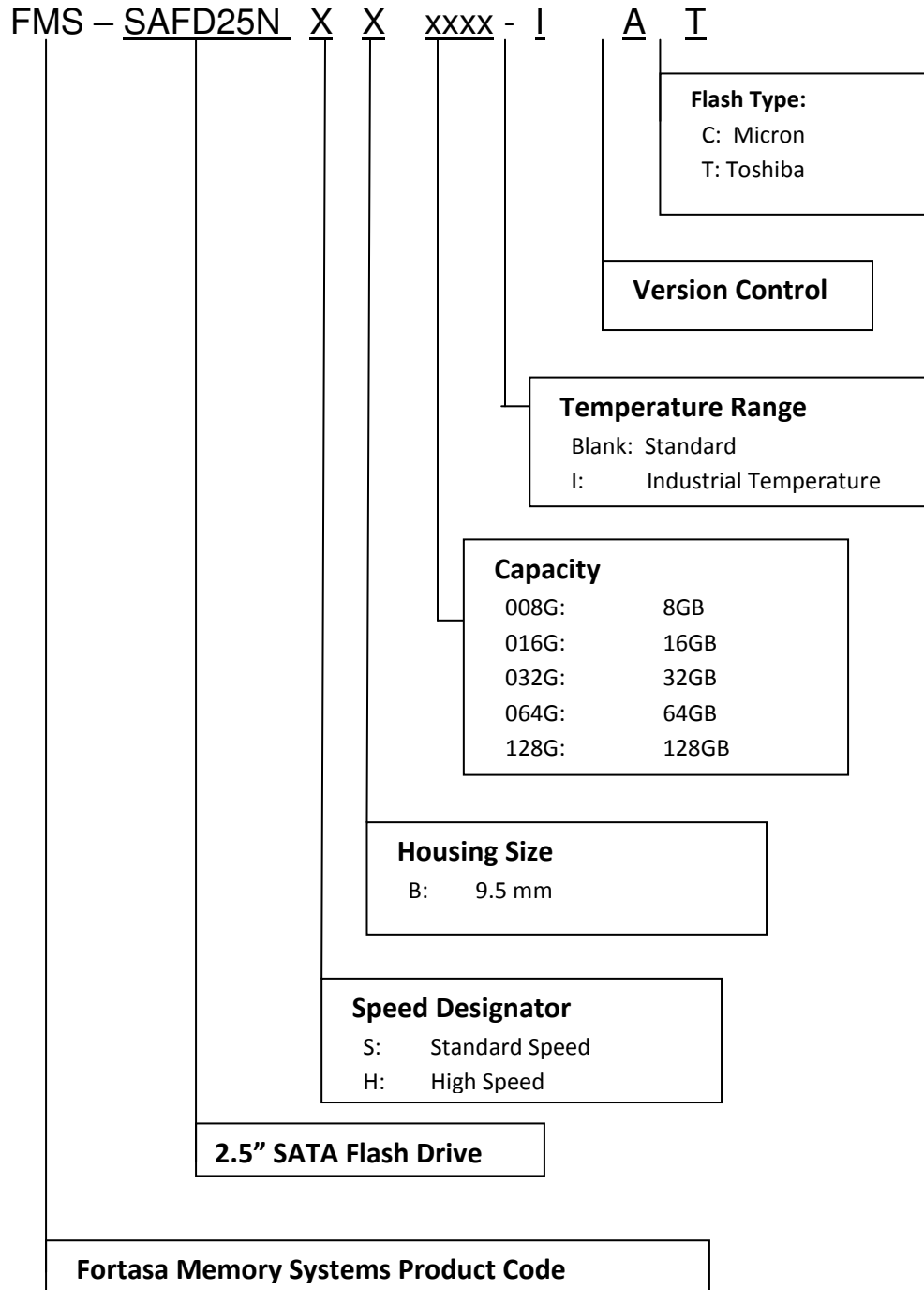
**Units in mm
Tolerance: ± 0.20**

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7. Product Ordering Information

7.1 Product Code Designations



SATA Flash Drive – 2.5” FMS-SAFD25NxBxxxx-XAX



7.2 Valid Combinations

Standard Speed

Capacity	Standard Temperature Model Numbers	Industrial Temperature Model Numbers
8GB	FMS-SAFD25NSB008G-AT	FMS-SAFD25NSB008G-IAT
16GB	FMS-SAFD25NSB016G-AT	FMS-SAFD25NSB016G-IAT
32GB	FMS-SAFD25NSB032G-AT	FMS-SAFD25NSB032G-IAT
64GB	FMS-SAFD25NSB064G-AT	FMS-SAFD25NSB064G-IAT
128GB	FMS-SAFD25NSB128G-AT	FMS-SAFD25NSB128G-IAT

High Speed

Capacity	Standard Temperature Model Numbers	Industrial Temperature Model Numbers
32GB	FMS-SAFD25NHB032G-AT	FMS-SAFD25NHB032G-IAT
64GB	FMS-SAFD25NHB064G-AT	FMS-SAFD25NHB064G-IAT
128GB	FMS-SAFD25NHB128G-AT	FMS-SAFD25NHB128G-IAT

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	1/17/2014	Initial Release	
1.1	7/10/2014	Added High Speed 32GB, 64GB and 128GB Capacities	