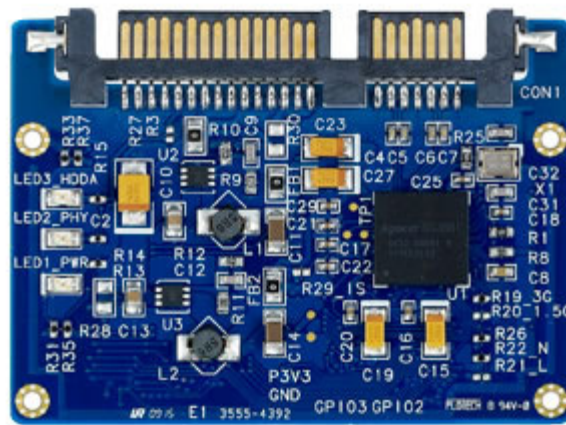


RoHS Compliant
SATA Flash Drive Series
Datasheet for SAFD 18S4 Mini Form Factor SSD

March 23, 2012
Revision 1.2



***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 – 1.8” Mini

FMS-SAFD18S45xxxGS-XX



Features:

- **Standard Serial SATA 2.6 (Gen. 2)**
 - SATA command set compatible
 - Serial SATA 2 –3.0 Gbps
 - ATA compatible command set
- **Low power consumption (typical)**
 - Supply voltage: 5V±5%
 - Active mode: 333 mA
 - Sleep mode: 95 mA
- **Performance**
 - Burst transfer rate: 300 MB/sec
 - Sustained read: up to 165 MB/sec
 - Sustained write: up to 150 MB/sec
- **Capacity**
 - 4, 8, 16, 32, 64 GB
- **NAND flash type: SLC**
- **Temperature ranges**
 - Operation:
 - Standard Temperature: 0 °C to 70 °C
 - Industrial Temperature: -40 °C to 85 °C
 - Storage: -40 °C to 100 °C
- **Intelligent endurance design**
 - Built-in hardware ECC, enabling up to 14/28 bit correction per 1Kbyte sector
 - 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
 - SMART Command
 - *Power Failure Management*
 - *ATA Secure Erase*
 - *Trim Command*
- **Connector Type**
 - 7-pin signal connector
 - 15-pin power connector
- **Form factor**
 - JEDEC MO-297
 - Only 4mm in thickness
 - Dimensions (54 mm x 39.8 mm x 4 mm)
- **RoHS compliant**



Table of Contents

1 Product Description.....	4
1.1 General Description.....	4
1.2 Functional Block	4
1.3 SATA Mode Support.....	5
1.4 Capacity Specification	5
1.5 Performance Specification	5
1.6 Pin Assignments.....	6
2. Software Interface	8
2.1 Command Set.....	8
3. Flash Management	9
3.1 Error Correction/Detection.....	9
3.2 Wear Leveling.....	9
3.3 Power Failure Management	9
3.4 ATA Secure Erase.....	9
3.5 S.M.A.R.T. Technology.....	9
3.6 TRIM Command Support	9
4. Environmental Specifications	10
4.1 Environments	10
4.2 Mean Time Between Failures (MTBF).....	10
4.3 Certification and Compliance.....	10
5. Electrical Specification.....	11
5.2 Power Consumption	11
6. Physical Characteristics.....	12
6.1 Dimensions	12
7. Product Ordering Information	14
7.1 Product Code Designations.....	14
7.2 Valid Combinations.....	15
8. Revision History	16

1 Product Description

1.1 General Description

Fortasa’s SAFD18S4 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 SAFD18S4 drive offers capacities of up to 64 gigabytes, providing full support for the SATA II high-speed interface standard. It can operate at sustained access rates of up to 150 megabytes per second, which is much faster than other solid-state or traditional HDD SATA drives currently available on the market.

SAFD18S4 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 SAFD18S4 also offers Self-Monitoring Analysis and Reporting Technology (S.M.A.R.T.) feature that follows the SATA Rev. 2.5, ATA/ATAPI-7 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 SAFD18S4 drive includes a single-chip SATA II Flash Controller and the flash media. The controller integrates the flash management unit with the controller itself to support multi-channel, multi-bank flash arrays. Figure 1-1 shows the functional block diagram.

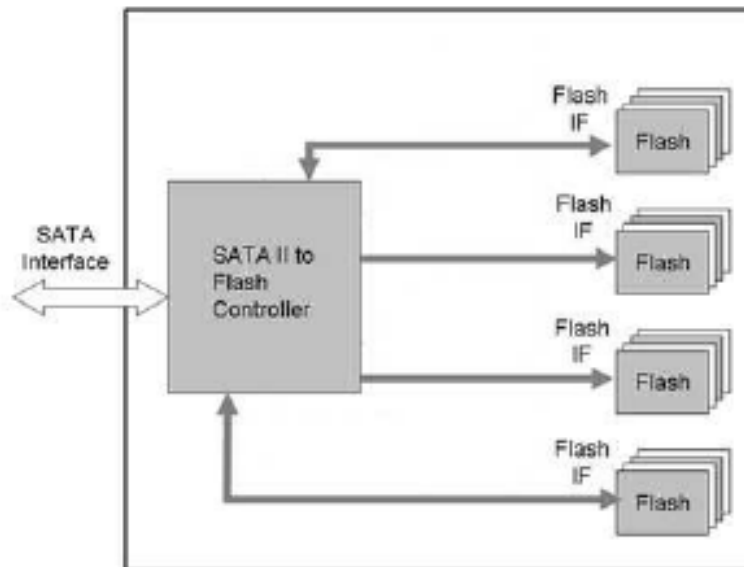


Figure 1-1: Functional block diagram

1.3 SATA Mode Support

The SATA-Flash Drive supports the following SATA operating modes:

- Supports up to PIO Mode-4
- Supports up to Multi-word DMA Mode-2
- Supports up to Ultra DMA Mode-5

1.4 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
4GB	4,011,614,208	7,773	16	63	7,835,184
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

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.

1.5 Performance Specification

Performances of the SAFD18S4 SATA Flash Drive are listed in Table 1-2.

Table 1-2: Standard Performance specifications

Capacity \ Performance	4GB	8GB	16GB	32GB	64GB
Sustained read (MB/s)	150	150	150	150	165
Sustained write (MB/s)	50	95	95	145	150

1.6 Pin Assignments

Figure 1-2: SATA connectors

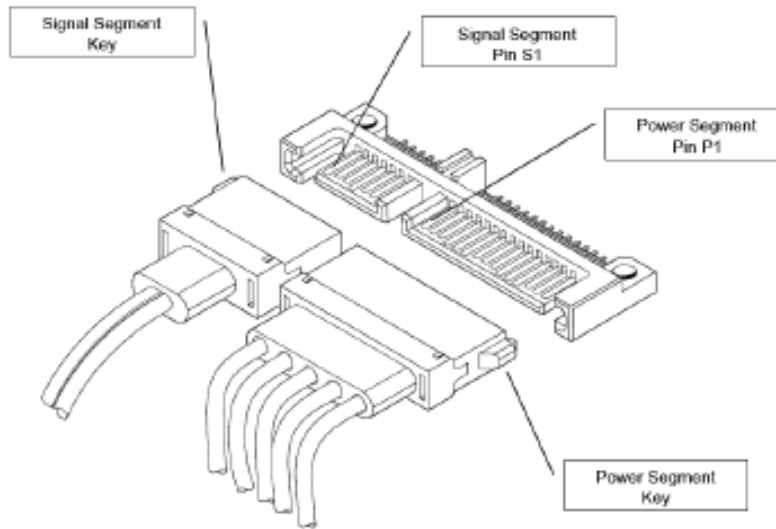


Table 1-3: Signal Segment

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	Not Used (3.3V)
P4	Ground
P5	Ground
P6	Ground
P7	5V
P8	5V
P9	5V
P10	Ground
P11	Reserved/Ground
P12	Ground
P13	Not Used (12V)
P14	Not Used (12V)
P15	Not Used (12V)

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
Check-Power-Mode	E5H
Data Set Management	06H
Execute-Drive-Diagnostic	90H
Flush-Cache	E7H
Flush-Cache EXT	EAH
Identify-Drive	ECH
Idle	E3H
Idle-Immediate	E1H
Initialize-Drive-Parameters	91H
Read DMA	C8H
Read DMA EXT	25H
Read-Multiple	C4H
Read-Multiple EXT	29H
Read-Sector(s)	20H
Read-Sector(s) EXT	24H
Read-Verify-Sector(s)	40H
Read-Verify-Sector(s) EXT	42H
Recalibrate	10H
Security-Disable-Password	F6H
Security-Erase-Prepare	F3H
Security-Erase-Unit	F4H
Security-Freeze-Lock	F5H
Security-Set-Password	F1H
Security-Unlock	F2H
Seek	70H
Set-Features	EFH
SMART	B0H
Set-Multiple-Mode	C6H
Set-Sleep-Mode	E6H
Stand-By	E2H
Stand-By-Immediate	E0H
Write DMA	CAH
Write DMA EXT	35H
Write-Multiple	C5H
Write-Multiple EXT	39H
Write-Sector(s)	30H
Write-Sector(s) EXT	34H

3. Flash Management

3.1 Error Correction/Detection

The SATA Flash Drive implements a hardware BCH-based ECC scheme to achieve up to 16 or 24 bit corrections per 1kbyte 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.

3.4 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.

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 SATA Rev. 2.5, ATA/ATAPI-7 specifications, using the standard SMART command B0h to read data from the drive. And based on the SFF-8035i Rev. 2.0 specifications, Fortasa SMART defines vendor-specified SMART Attribute IDs (A0-A5H and 0CH) in the SATA Flash Drive SAFD18S4 products. They represent initial bad block count, bad block count, maximum erase count and average erase counts, respectively.

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.

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: 10~2000 Hz, 15G (X, Y, Z) Random: 10-2000 Hz, 7.7Grms (X, Y, Z)
Shock		Operating: 50 G, 11 ms Non-operating: 1500 G, 0.5 ms
Humidity		5% to 95% RH (Non-condensing)
Altitude		80,000 ft

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.

4.3 Certification and Compliance

The SAFD18S4 complies with the following standards:

- CE – EN55022/55024
- FCC 47CFR Part15 Class B
- RoHS
- MIL-STD-810F
- SATA II (SATA Rev. 2.5)
- Up to ATA/ATAPI-7 (including S.M.A.R.T.)

5. 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 5-1: Operating range

Range	Ambient Temperature	5V
Commercial	0°C to +70°C	4.75-5.25V
Industrial	-40°C to +85°C	

5.2 Power Consumption

Table 5-2 lists the SAFD 18S4 power consumption.

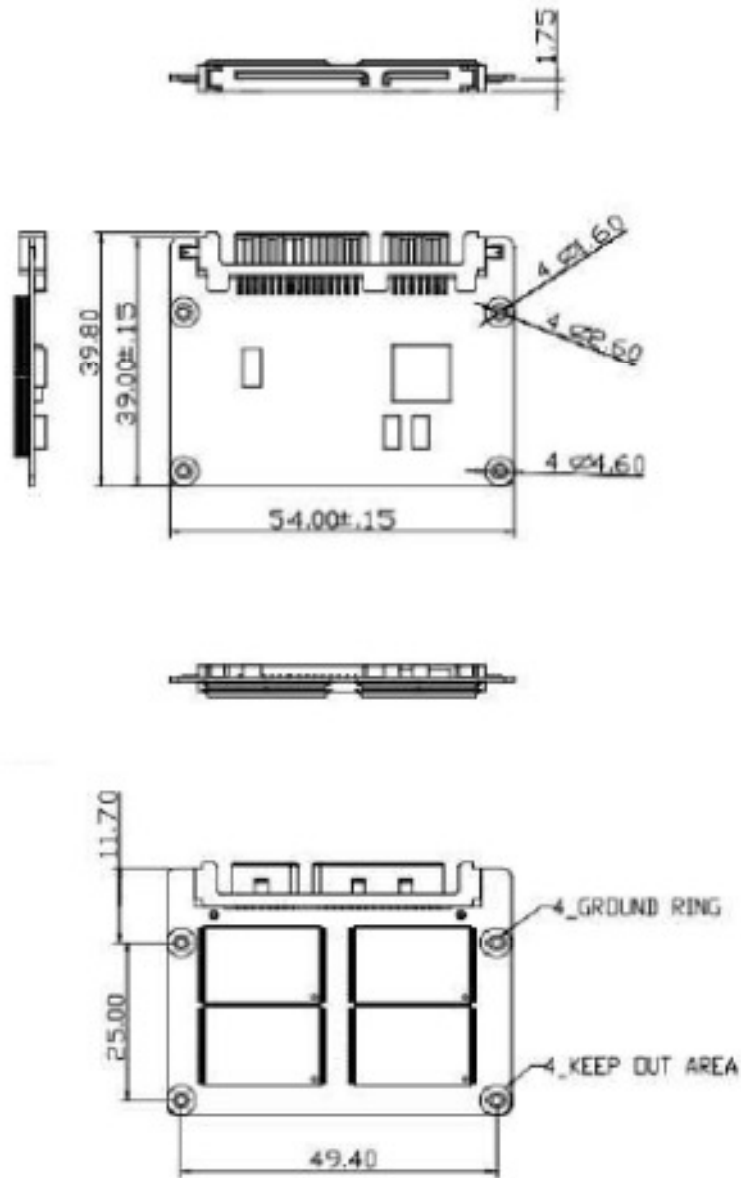
Table 5-2 SAFD 18S4 power consumption (typical)

Performance \ Capacity	4GB	8GB	16GB	32GB	64GB
	Active Mode (mA)	255	333	333	280
Idle Mode (mA)	85	95	95	77	80

6. Physical Characteristics

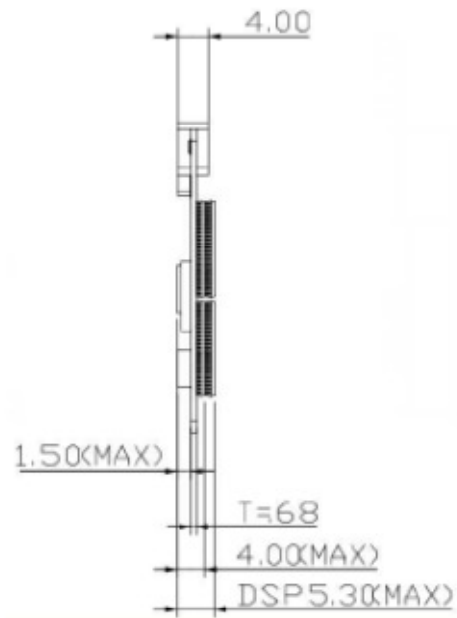
6.1 Dimensions

FIGURE 6-1: Physical dimensions



Unit: mm
Tolerance: ± 0.2

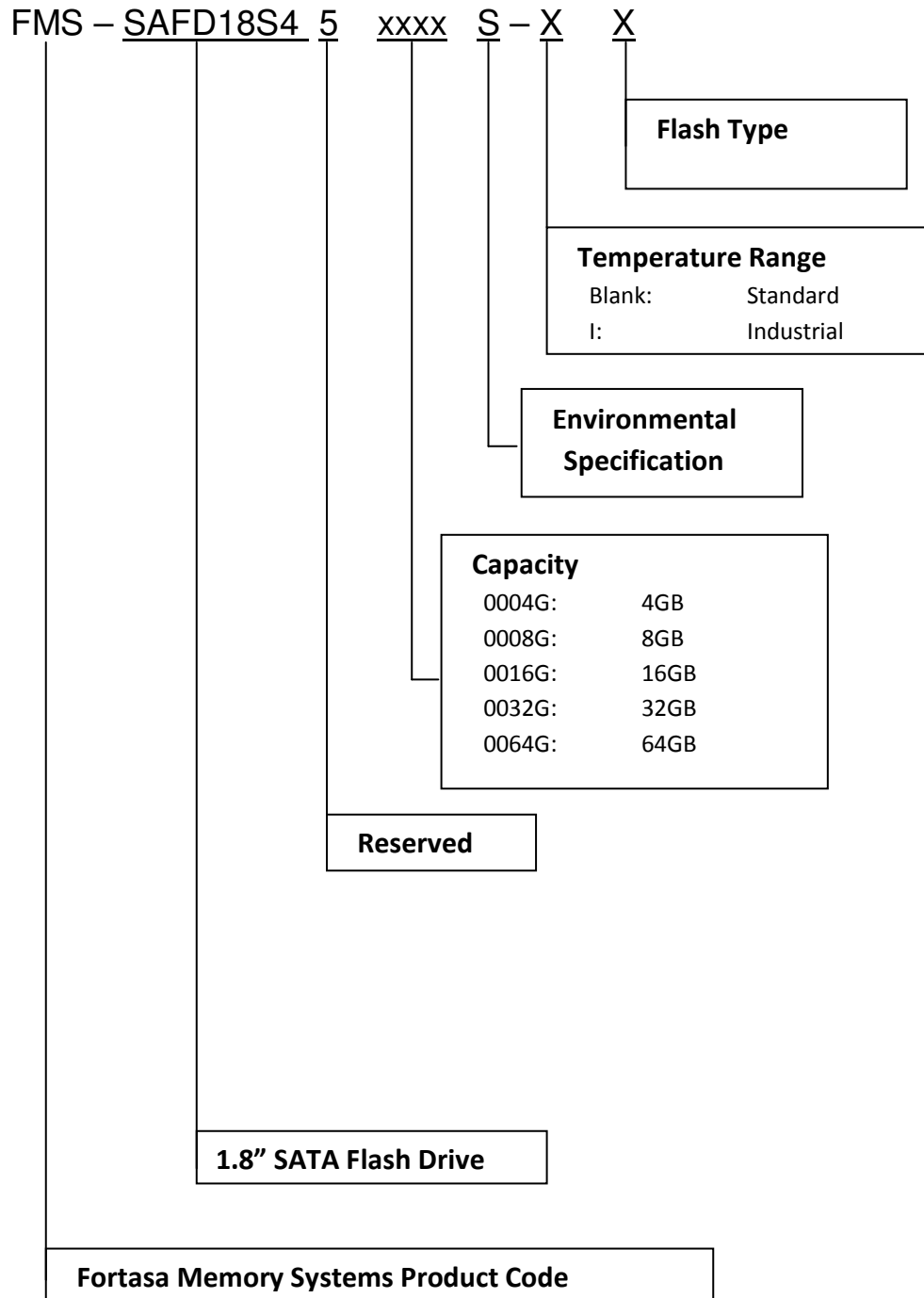
SATA Flash Drive – 1.8” Mini FMS-SAFD18S45xxxGS-XX



Unit: mm
Tolerance: ± 0.2

7. Product Ordering Information

7.1 Product Code Designations



SATA Flash Drive – 1.8” Mini

FMS-SAFD18S45xxxGS-XX



7.2 Valid Combinations

Capacity	Standard Temperature	Industrial Temperature
4GB	FMS-SAFD18S45004GS-T	FMS-SAFD18S45004GS-IT
8GB	FMS-SAFD18S45008GS-T	FMS-SAFD18S45008GS-IT
16GB	FMS-SAFD18S45016GS-T	FMS-SAFD18S45016GS-IT
32GB	FMS-SAFD18S45032GS-C	FMS-SAFD18S45032GS-IC
64GB	FMS-SAFD18S45064GS-C	FMS-SAFD18S45064GS-IC

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	12/02/2011	Initial Release	
1.1	1/20/2012	Updated Performance Specifications	
1.2	3/23/2012	Updated SMART Command	