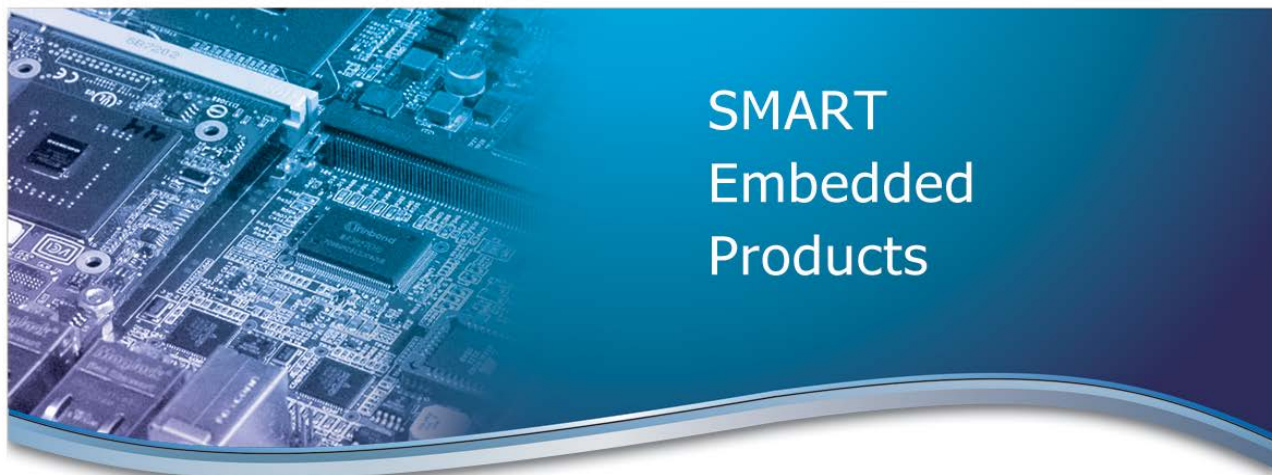
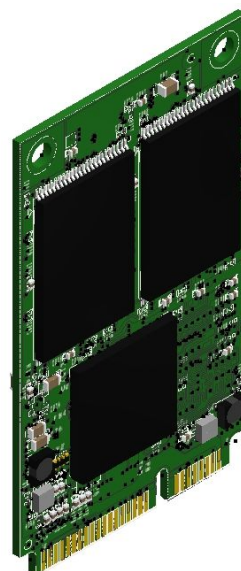




SMART Embedded Products

SMART MODULAR mSATA XP+ SLC MO-300 SH9MST6DxxxGHSxx



February 2015, Rev A



www.smartm.com

REVISION HISTORY

Date	Revision	Section(s)	Description
February 2015	A	All	Initial Release for firmware FW1027 and Low Halogen parts.



ESD Caution – Handling

Static electricity may be discharged through this disk subsystem. In extreme cases, this may temporarily interrupt the operation or damage components. To prevent this, make sure you are working in an ESD-safe environment. For example, before handling the disk subsystem, touch a grounded device, such as a computer case, prior to handling.

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1. GENERAL DESCRIPTION

1.1. Overview

The SMART Modular mSATA XP+ industrial-grade embedded (internal) SATA module is a robust, single-level cell (SLC) solid state drive product. This drive specifically targets the needs of OEM markets, such as server, storage cache/accelerators, networking, and data communications applications requiring reliable internal storage with a small footprint. The embedded products are also a natural fit for mobile and embedded computing, medical, automotive, and industrial applications. The low power consumption and fast data throughput are major advantages of the SMART Modular mSATA XP+ modules over traditional rotating hard disk drives (HDDs).

Utilizing an industry-standard SATA interface, mSATA XP+ modules are easily integrated into a host system without any special BIOS modifications or additional device drivers. These modules are available in capacities of 8 GBytes to 128 GBytes.

SMART Modular industrial-grade mSATA XP+ products address the need for enhanced reliability by incorporating on-board error detection and correction with static and dynamic wear leveling algorithms that provide reliable operation over the product life cycle.

SMART has built its foundation by providing proven technology and quality products to the most demanding Fortune 100 OEMs. SMART engineers its products to perform at the highest degree of reliability and compatibility while backing these products with outstanding services and technology expertise.

1.2. Features

- **Form Factor:** JEDEC[®] MO-300, mSATA
- **Interface:** Industry standard Serial ATA, SATA 3.0 compliant
- **Supported SATA Modes**
 - **PIO Modes:** 0-4
 - **Multiword DMA Modes:** 0-2
 - **Ultra DMA Modes:** 0-6
- **SATA Interface Transfer Rate:** 6 Gbps with support for 3 Gbps & 1.5 Gbps
- **NAND Technology:** Single Level Cell (SLC)
- **Capacity:** 8 to 128 GBytes
- **Data Rates:**
 - **Read, Sustained:**
 - up to 510 MB/s (64GB and 128GB)
 - up to 480 MB/s (16GB and 32GB)
 - up to 250 MB/s (8GB)
 - **Write, Sustained:**
 - up to 380 MB/s (64GB and 128GB)
 - up to 300 MB/s (32GB)
 - up to 155 MB/s (16GB)
 - up to 81 MB/s (8GB)
- **Operating Temperature:** 0°C to +70°C Standard
-40°C to +85°C Industrial
- **Input Power:** 3.3V ± 5%

1.3. Unique Features

- Static and Dynamic Wear Leveling
- Advanced Error Detection/Correction circuitry for superior data reliability
- Self-Monitoring Analysis and Reporting Technology (S.M.A.R.T.) support
- Supports for 48bit LBA addressing with larger max transfer size
- Improved shock and vibration performance over rotating media
- ATA and SATA Interface Power Management Support
- External LED Activity Signaling through the connector
- Native Command Queuing (NCQ) support with a maximum queue depth of 32
- Zero seek time
- Noiseless operation
- Supports TRIM command based on the ATA-8 Standard
- Supports ATA Download Microcode

1.4. Operational Characteristics

All listed values are typical unless otherwise stated.

1.4.1. Performance

Table 1: Performance Characteristics

Item	Capacity	Performance Max
128K Sequential Read Sustained	128GB	510 MB/s
	64GB	510 MB/s
	32GB	480 MB/s
	16GB	480 MB/s
	8GB	250 MB/s
128K Sequential Write Sustained	128GB	380 MB/s
	64GB	380 MB/s
	32GB	300 MB/s
	16GB	155 MB/s
	8GB	81 MB/s
4K Random Read Maximum	All	> 35K IOPS
4K Random Write Maximum	128GB	60K IOPS
	64GB	52K IOPS
	32GB	52K IOPS
	16GB	42K IOPS
	8GB	18K IOPS
Host Interface Transfer Rate	All	6.0 Gbps / 3.0 Gbps / 1.5 Gbps (depends on host connection)
Access Time	All	< 150ms (max) ¹ < 2ms (typical)

1.4.2. Power

Table 2: Power Requirements (3.3V)

Parameter	Value (Typ)	Value (Max)	Unit
Vcc	3.3	3.5	V
Read	900	1000	mA
Write	1000	1100	mA
Idle	106	-	mA

¹ Maximum Write Latency based on 99.99% confidence level

1.4.3. Reliability

Table 3: Reliability Characteristics

Item		Value
Mean Time Between Failures (MTBF)		> 1.7 Million hours
Data Reliability		< 1 Non-Recoverable Error in 10 ¹⁵ bits read
Data Retention (@ 25°C)		10 years > 90% life remaining
		1 year < 10% life remaining
Endurance ¹	100% Sequential Workload	700 TBW (8GB); 1400 TBW (16GB); 2800 (32GB); 5600 TBW (64GB); 11200 TBW (128GB);
	JEDEC Enterprise Class Workload	80 TBW (8GB); 120 TBW (16GB); 240 (32GB); 480 TBW (64GB); 960 TBW (128GB);
Error Correction / Error Detection		Up to 24 bits for every 1 Kbyte sector

¹Endurance is directly related to the User specific workload

1.4.4. Environmental Conditions

Table 4: Environmental Conditions and Testing

Parameter	Value
Shock – Non-Operating	1500g half-sine, 0.5 msec, 1 shock along each axis, X,Y,Z in each direction
Shock – Operating	50 g half-sine, 11 msec, 3 shocks along each axis, X, Y, and Z
Vibration – Operating	16.4g rms 10-2000 Hz, 3 axis
Humidity	5% to 95%, non-condensing, relative humidity ²

1.4.5. Physical Characteristics

Table 5: Physical Characteristics

Parameter	Value
Length	50.80 mm [2.00 in]
Width	29.9 mm [1.18 in]
Height	< 4.85 mm [0.19 in]
Weight (max)	< 10 g

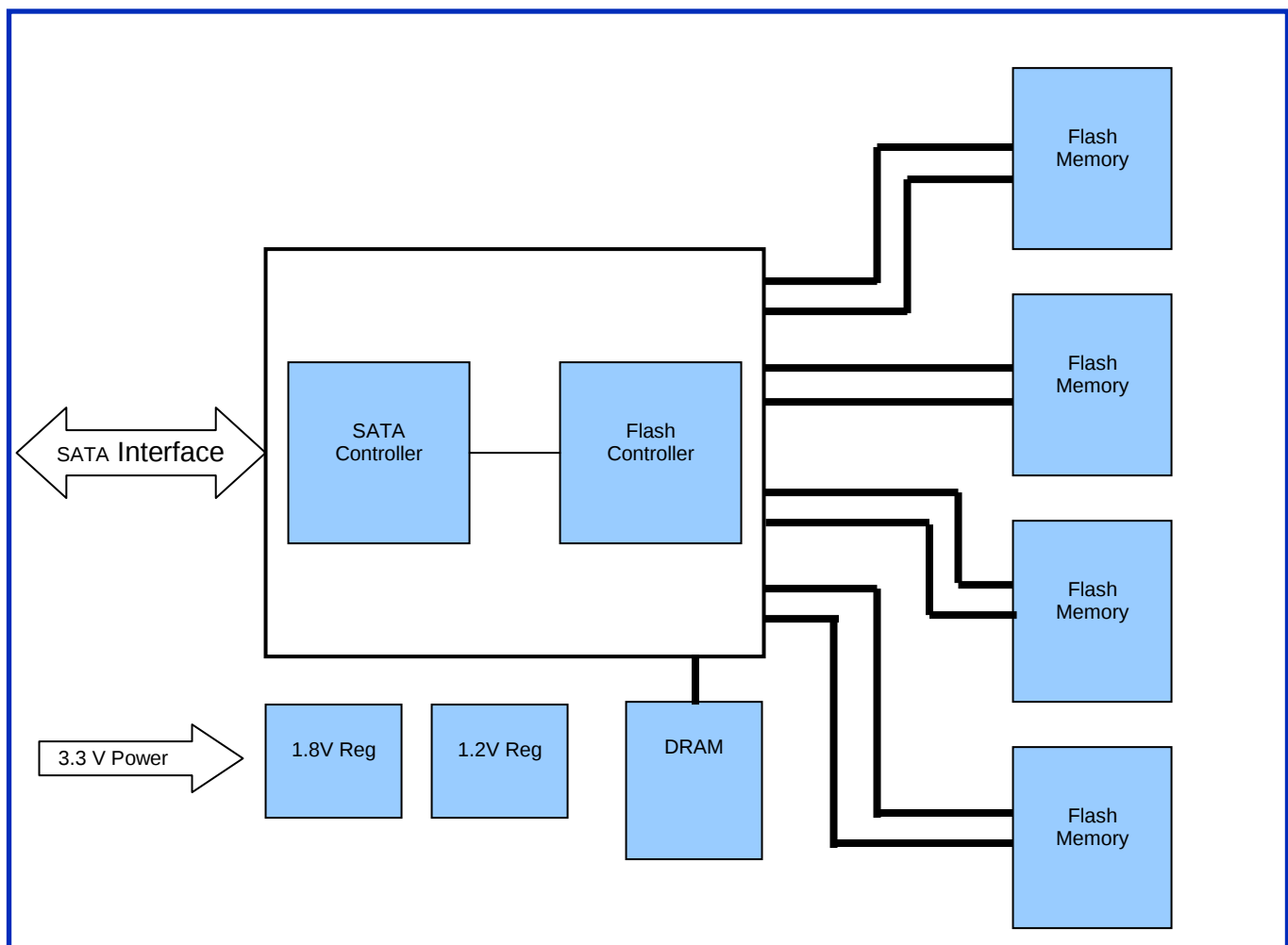
² Based on RDF2000 UTE C80-810.

2. PRODUCT DESCRIPTION

The SMART mSATA XP+ contains a 6 Gb/sec SATA interface controller and a NAND flash controller with corresponding flash memory devices. This system architecture logically and efficiently translates standard SATA HDD commands into flash memory accesses. Parallel access to the flash memory allows overlapped, multi-block access to complete data transfer requests rapidly. Efficient local voltage converters provide the power for logic and memory from the standard SATA power connection using switching regulators to minimize wasted power.

2.1. Functional Block Diagram

Figure 1: mSATA XP+ Block Diagram



2.3. Suggested Mounting Method

To install the mSATA XP+ module, align the interface connector on the mSATA XP+ module with the connector to be installed to.



Insert the mSATA XP+ module at an angle into the connector.



Push down on the mSATA XP+ module until it locks into place.



2.4. Endurance

- **Static & Dynamic Wear Leveling:** This feature eliminates overstressing flash media by spreading the data writes across all flash physical address space, including logical areas that are not written by the user. The data is wear leveled across the entire drive.
- **ECC:** mSATA XP+ products utilize BCH ECC to provide correction of up to 24 random single-bit errors per 1 KByte block of user data.
- **Bad Block Management:** This feature tracks all manufacturing and run-time bad blocks of flash media and replaces them with new ones from the spare pool.

2.5. Mean Time Between Failures (MTBF)

SMART Modular Technology has derived the following reliability statistics using **Telcordia SR-332, Issue 2 - Parts Count Method** and based upon numerous specifics related to and including; internal component packaging, pin configurations, component density, and internal component substrate architecture. Product reliability modeling for SMART Modular Technology is based upon continual usage of the product, within accepted normal operating parameters. Compromise of the published normal operating parameters will adversely affect the product life-span reliability model.

Table 6: MTBF Values - Telcordia SR-332, Issue 2 - Parts Count Method

Drive@50C	MTBF (Hours)
All Capacities	> 1,700,000

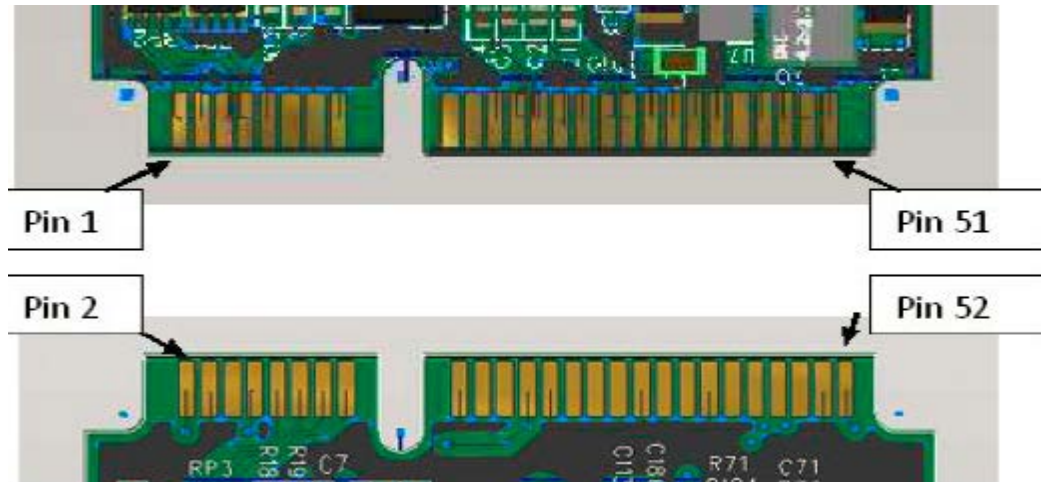
3. ELECTRICAL SPECIFICATION

3.1. Electrical Interface

The mSATA XP+ drive is compliant with the SATA III, 6.0 Gb/sec standard.

3.1.1. mSATA Interface Connector

Figure 3: mSATA XP+ Interface Connector



3.1.2. Pinout Descriptions

Table 7: Pinout Descriptions

Pin	Signal Name	Signal Description
P1	NC	Reserved
P2	3.3V	3.3V Supply Voltage
P3	NC	Reserved
P4	GND	Ground Signal
P5	NC	Reserved
P6	NC	1.5V is not used
P7	NC	Reserved
P8	NC	Reserved
P9	GND	Ground Signal
P10	NC	Reserved
P11	NC	Reserved
P12	NC	Reserved
P13	NC	Reserved
P14	NC	Reserved
P15	GND	Ground Signal
P16	NC	Reserved

Table 8: Pinout Descriptions (continued)

Pin	Signal Name	Signal Description
P17	NC	Reserved
P18	GND	Ground Signal
P19	NC	Reserved
P20	NC	Reserved
P21	GND	Ground Signal
P22	NC	Reserved
P23	+B	+ Host Receive signal (output)
P24	3.3V	3.3V Supply Voltage
P25	-B	- Host Receive signal (output)
P26	GND	Ground Signal
P27	GND	Ground Signal
P28	NC	1.5V is not used
P29	GND	Ground Signal
P30	NC	Two Wire CLK
P31	-A	- Host Transmit signal (input)
P32	NC	Two Wire DATA
P33	+A	+ Host Transmit signal (input)
P34	GND	Ground Signal
P35	GND	Ground Signal
P36	NC	Reserved
P37	GND	Ground Signal
P38	NC	Reserved
P39	3.3V	3.3V Supply Voltage
P40	GND	Ground Signal
P41	3.3V	3.3V Supply Voltage
P42	NC	Reserved
P43	NC	Device Type not used
P44	NC	Reserved
P45	NC	Reserved
P46	NC	Reserved
P47	NC	Reserved
P48	NC	1.5V is not used
P49	DA	Device Activity Signal
P50	GND	Ground Signal
P51	Presence Detect	Pulled to GND by Device
P52	3.3V	3.3V Supply Voltage

3.2. Absolute Maximum Ratings

Table 9: Absolute Maximum Ratings*

Symbol	Parameter	Minimum Value	Maximum Value	Unit
V _{CC3}	3.3 V Supply Voltage	-0.3	3.6	V
V _{IN3}	3.3 V Input Voltage	GND – 0.2	V _{CC} + 0.2	V
I _{IN3}	3.3 V DC Input Current		1100	mA
T _A	Operating Temperature – (Commercial)	0	+70	°C
T _A	Operating Temperature – (Industrial)	-40	+85	°C
T _{STG}	Storage Temperature	-40	+85	°C

* Stress beyond the Absolute Maximum Rating conditions may result in permanent damage to the device. These are stress ratings only and functional operation should be restricted to those indicated in the operational sections of this specification. Exposure to conditions beyond recommended, up to and including the Absolute Maximum Rating conditions, for extended periods may affect device reliability.

3.3. Recommended Operating Conditions

Table 10: Recommended Operating Conditions

Parameter	Ratings
3.3 V Supply Voltage	3.3V ± 5%
Operating Temperature - Commercial	0° C to +70° C
Operating Temperature - Industrial	-40° C to +85° C

3.4. DC Characteristics

Table 11: DC Characteristics

Symbol	Parameter	Typical	Max	Unit	Condition
I _{rd5}	Active Read Current	900	1000	mA	V _{cc} = 3.3V
I _{wr5}	Active Write Current	1000	1100	mA	V _{cc} = 3.3V
I _{idle5}	Idle Current	106	-	mA	V _{cc} = 3.3V

4. ATA COMMANDS

This section documents the host interface commands the mSATA XP+ supports.

4.1. Supported ATA Commands

The mSATA XP+ module supports the standard commands listed in the table below. For more detailed descriptions of the commands, please refer to the ATA-8 specification.

Table 12: Supported ATA Commands

Command Name	Op Code (Hex)	Command Set (Category)
Check Power Mode	E5	PwrMgmt
	98	PwrMgmt
Device Configuration Overlay	B1	DCO
Download Microcode	92	Genearl
Execute Device Diagnostics	90	General
Flush Cache	E7	General
Flush Cache Ext	EA	48-bit Address
Identify Device	EC	General
Idle	E3	PwrMgmt
	97	PwrMgmt
Idle Immediate	E1	PwrMgmt
	95	PwrMgmt
Initialize Device Parameters	91	General
NOP	00	General
Read Buffer	E4	General
Read DMA	C8	General
Read DMA Ext	25	48-bit Address
Read FPDMA Queued	60	General
Read Log Ext	2F	48-bit Address
Read Multiple	C4	General
Read Multiple Ext	29	48-bit Address
Read Native Max Address	F8	HPA
Read Native Max Address Ext	27	48-bit Address
Read Sectors	20	General
Read Sectors Ext	24	48-bit Address
Read Verify Sectors	40	General
	41	General
Read Verify Sectors Ext	42	48-bit Address
Security Disable Password	F6	Security
Security Erase Prepare	F3	Security

Table 13: Supported ATA Commands Cont.

Command Name	Op Code (Hex)	Command Set (Category)
Security Erase Unit	F4	Security
Security Freeze Lock	F5	Security
Security Unlock	F2	Security
Seek	70	General
Set Features	EF	General
Set Max Address	F9	HPA
Set Max Address Ext	37	48-bit Address
Set Max Set Password	F9	HPA
Set Max Lock	F9	HPA
Set Max Freeze Lock	F9	HPA
Set Max Unlock	F9	HPA
Set Multiple Mode (Max = 1)	C6	General
Set Sleep Mode	E6	PwrMgmt
	99	PwrMgmt
Sleep	E6	PwrMgmt
S.M.A.R.T. Operations	B0	S.M.A.R.T.
Standby	E2	PwrMgmt
Standby Immediate	E0	PwrMgmt
	94	PwrMgmt
Write Buffer	E8	General
Write DMA	CA	General
Write DMA Ext	35	48-bit Address
Write DMA FUA Ext	35	48-bit Address
Write FPDMA Queued	3D	General
Write Log Ext	61	48-bit Address
Write Multiple	C5	General
Write Multiple Ext	39	48-bit Address
Write Multiple FUA Ext	CE	48-bit Address
Write Sectors	30	General
Write Sectors Ext	34	48-bit Address
Write Verify	3C	General

4.2. Supported S.M.A.R.T. Operations

Self-monitoring analysis and reporting technology (S.M.A.R.T.) commands provide diagnostic information regarding drive operation and, in certain cases, can assist in predicting drive degradation. Because S.M.A.R.T. alerts the host of possible drive problems, users can assess the situation and back up data prior to an operational failure.

Each S.M.A.R.T. attribute monitors a specific drive condition, with threshold levels configured for select attributes. When the drive exceeds these thresholds, the S.M.A.R.T. attribute reports the condition. In many cases, exceeding the threshold simply indicates you should monitor the drive more closely. Host systems initiate commands, generated manually or with a third-party diagnostic tool, to monitor S.M.A.R.T. attributes.

Although the mSATA XP+ supports several S.M.A.R.T. operations, which are subcommands of the S.M.A.R.T. Operations command (see [Table 14](#)), the S.M.A.R.T. Return Status and S.M.A.R.T. Read Data subcommands are used for monitoring the drive.

Initiating a S.M.A.R.T. Return Status command returns the current state of the drive, specifying whether or not an attribute exceeded the assigned threshold. If an attribute has exceeded a threshold level, SMART Modular Technologies recommends issuing the S.M.A.R.T. Read Data command to identify the specific attribute (see [Table 16](#)).

S.M.A.R.T. commands are issued with B0h in the Command register and the code for the desired operation in the Features register. A S.M.A.R.T. Enable Operations must be issued before any other S.M.A.R.T. command can be performed.

4.2.1. Supported S.M.A.R.T. Subcommands

Table 14: Supported S.M.A.R.T. Subcommands

Subcommand Name	Feature Code (Hex)
S.M.A.R.T. Read Data	D0
S.M.A.R.T. Read Attribute Thresholds	D1 (obsolete)
S.M.A.R.T. Enable/Disable Autosave	D2
S.M.A.R.T. Save Attribute Values	D3 (obsolete)
S.M.A.R.T. Execute Off-Line Immediate	D4
S.M.A.R.T. Enable Operations	D8
S.M.A.R.T. Disable Operations	D9
S.M.A.R.T. Return Status	DA

4.2.2. Supported S.M.A.R.T. Data Structure

Table 15: Supported S.M.A.R.T. Subcommands

Byte	Description
0-1	Revision code
2-361	Vendor-specific
362	Offline data collection status
363	Self-test execution status byte
364-365	Total time in seconds to complete offline data collection activity
366	Vendor-specific
367	Offline data collection capability
368-369	S.M.A.R.T. capability
370	Error logging capability 7-1 Reserved 0 1 = Device error logging supported
371	Vendor-specific
372	Short self-test routine recommended polling time (in minutes)
373	Extended self-test routine recommended polling time (in minutes)
374	Conveyance self-test routine recommended polling time (in minutes)
386-395	Firmware version/data code
396-397	Number of initial invalid block (396 = MSB, 397 = LSB)
400-406	SMART
407-415	Vendor-specific
417	Program/write the strong page only
418-419	Number of spare blocks
446-510	Vendor-specific
511	Data structure checksum

4.2.3. Supported S.M.A.R.T. Attributes

Figure 4 Supported S.M.A.R.T. Attributes

Attribute Name	ID	Flags		Val	Min	Raw Attribute Value						
		1	2	3	4	5	6	7	8	9	10	11
Reported UECC Count	01h	08h	00h	64h	64h	Uncorrectable ECC Count		00h	00h	00h	00h	00h
Reallocated Block Count	05h	13h	00h	64h	64h	Grown Bad Block Count		00h	00h	00h	00h	00h
Power On Hours	09h	12h	00h	64h	64h	Power on Hours				00h	00h	00h
Power Cycle Count	0Ch	12h	00h	64h	64h	Power on/off cycles				00h	00h	00h
Device Capacity	0Eh	12h	00h	64h	64h	Device Capacity				00h	00h	00h
User Capacity	0Fh	12h	00h	64h	64h	User Capacity				00h	00h	00h
Initial Spare Blocks Available	10h	12h	00h	64h	64h	Spare Blocks Available		00h	00h	00h	00h	00h
Spare Blocks Remaining	11h	12h	00h	64h	64h	Remaining Spare Blocks		00h	00h	00h	00h	00h
Total PE cycle Count (Drive)	64h	12h	00h	64h	64h	Total Erase Count						00h
SATA PHY Error Count	A8h	12h	00h	64h	64h	SATA PHY Error Count			00h	00h	00h	00h
Total Bad Block Count	AAh	03h	00h	64h	64h	Initial Bad Block		00h	00h	00h	00h	00h
Total Block Erase Failures	ACh	12h	00h	64h	64h	Total Block Erase Failures		00h	00h	00h	00h	00h
Max PE cycle Count (Block)	ADh	12h	00h	64h	64h	Max Erase Count				00h	00h	00h
Unexpected Power Loss Count	AEh	12h	00h	64h	64h	Surprise Power Removal Count				00h	00h	00h
Average PE cycle Count (Block)	AFh	12h	00h	64h	64h	Average Erase Count				00h	00h	00h
Total Block Program Failure	B5h	12h	00h	64h	64h	Program Fail Count		00h	00h	00h	00h	00h
Vendor Unique	BBh	12h	00h	64h	64h			00h	00h	00h	00h	00h
Temperature	C2h	23h	00h	100-Current Temp	100-Highest value	Current Temp		00h	00h	00h	00h	00h
N/A	C5h	32h	00h	64h	64h	00h	00h	00h	00h	00h	00h	00h
N/A	C6h	12h	00h	64h	64h	00h	00h	00h	00h	00h	00h	00h
SATA FIS CRC Errors	C7h	08h	00h	64h	64h	CRC Error Count				00h	00h	00h
% of Spares Remaining ¹	CAh	12h	00h	64h	64h	%Spare Remain		00h	00h	00h	00h	00h
% SSD Life Remaining ²	E7h	13h	00h	64h	64h	% Life Remain		00h	00h	00h	00h	00h
Vendor Unique	E8h	13h	00h	64h	64h			00h	00h	00h	00h	00h
Total Flash Sectors Read	EAh	08h	00h	64h	64h	Lifetime Reads from Flash (Sector)						00h
Total Flash Sectors Written	EBh	08h	00h	64h	64h	Lifetime Writes to Flash (Sector)						00h
Total Host Sectors Written	F1h	12h	00h	64h	64h	Lifetime Writes from Host (Sector)						00h
Total Host Sectors Read	F2h	12h	00h	64h	64h	Lifetime Reads from Host (Sector)						00h
Vendor Unique	F7h	12h	00h	64h	64h			00h	00h	00h	00h	00h
Vendor Unique	F8h	12h	00h	64h	64h			00h	00h	00h	00h	00h

¹ % of Spares Remaining = 100 – [(# Spare Blocks / # Initial Spare Blocks) x 100]

² % Life Remaining = 100 – [(Max Erase Count / P/E Endurance Spec of NAND) x 100]

4.3. Supported DCO Subcommands

Device Configuration Overlay (DCO) subcommands are issued with B1h in the Command register and the code for the desired command in the Feature register. See the following table for the supported subcommands and the corresponding Feature code.

Figure 5 Supported DCO Subcommands

Subcommand Name	Code (Hex)
Device Configuration Freeze Lock	C1
Device Configuration Identify	C2
Device Configuration Restore	C0
Device Configuration Set	C3

4.4. Supported HPA Subcommands

Host Protected Area (HPA) subcommands are issued with F9h in the Command register and the code for the desired command in the Feature register. See the following table for the supported subcommands and the corresponding Feature code.

Figure 6 Supported HPA Subcommands

Subcommand Name	Code (Hex)
Set Max Address	00
Set Max Freeze Lock	04
Set Max Lock	02
Set Max Set Password	01
Set Max Unlock	03

4.5. Identify Drive

This command passes to the Host one sector of data describing the Flash drive's parameters. See Table for a detailed description of the Identify Drive data.

Table 16: Identify Device Information

Word	Data	Description
0	0040h	General configuration bit-significant information
1	Note	Number of Cylinders
3	Note	Number of Heads
6	Note	Number of sectors per track
7-8	0000h 0000h	Number of sectors per card (Word 7 = MSW, Word 8 = LSW)
10-19	XXXXh	20-character serial number in ASCII (right justified)
22	0000h	Number of ECC bytes passed on Read/Write Long Commands
23-26	XXXXh	Firmware revision in ASCII. Big Endian Byte Order in Word
27-46	[Manufacturer's info]	Model Number in ASCII (left justified); big-endian byte order in Word: <MPN>
47	8010h	Maximum number of sectors on Read/Write Multiple command: 16
49	2F00h	Capabilities: Standby Timer, IORDY, IORDY(DIS), LBA, DMA supported
50	4000h	Capabilities
53	0007h	Words 54-58 are valid
54	Note	Number of Current Cylinders
55	Note	Number of Current Heads
56	Note	Number of Current Sectors Per Track
57-58	Note	Current Capacity in Sectors Word 57 = LSW, Word 58 = MSW
59	0110h	Current Setting for Block Count=1 for Read Write Multiple Commands: 16 Sectors
60-61	Note	Total number of user addressable LBA's
63	xx07h	Multiword DMA mode 2 selected, Mode 0,1, & 2 supported
64	0003h	Advanced PIO modes 3 and 4 supported
65	0078h	Minimum Multiword DMA transfer cycle time per word: 120ns
66	0078h	Recommended Multiword DMA transfer cycle time: 120ns
67	0078h	Recommended Multiword DMA transfer cycle time: 120ns
68	0078h	Minimum PIO transfer cycle time without flow control: 120ns
69	0100h	Minimum PIO transfer cycle time with IORDY flow control
75	001FH	Queue Depth: 31
76	C70Eh	Serial ATA capabilities; • Supports READ LOG DMA EXT as equivalent to READ LOG EXT • Supports Device Automatic Partial to Slumber transitions • Supports Phy event counters • Supports receipt of host-initiated interface power management requests • Supports Native Command Queuing (NCQ) • Serial ATA Gen 1, Serial ATA Gen 2 & Serial ATA Gen 3 supported
77	0000h	Serial ATA Additional capabilities:

Table 17: Identify Device Information Cont.

Word	Data	Description
78	004Ch	Serial ATA Features Supported • Supports software settings preservation • Supports initiating interface power management • Supports DMA Setup Auto-Activation optimization
79	0040h	Serial ATA Features Enabled • DMA Setup Auto-Activation optimization enabled
80	03F8h	Major version number (ATA8-ACS)
81	0110h	Minor version number
82	346Bh	Features/command sets supported 0 • Read Buffer command is supported • Write Buffer command is supported • HPA feature set is supported • Read look-ahead is supported • Volatile write cache is supported • PACKET feature set is NOT supported • Mandatory Power Management feature set is supported • Security feature set is supported • SMART feature set is supported
83	7D09h	Features/command sets supported 1 • FLUSH CACHE EXT command is supported • Mandatory FLUSH CACHE is supported • DCO feature set is supported • 48-bit Address feature set is supported • SET MAX security extension is supported • APM feature set is supported • DOWNLOAD MICROCODE command is supported
84	6063h	Features/command sets supported 2 • IDLE IMMEDIATE command with UNLOAD feature is supported • WRITE DMA FUA EXT and WRITE MULTIPLE FUA EXT commands are supported • GPL feature set is supported • SMART self-test is supported • SMART error logging is supported
85	3469h	Features/command sets enabled 0 • READ BUFFER command is enabled • WRITE BUFFER command is enabled • HPA feature set is enabled • Read look-ahead is enabled • Volatile write cache is enabled • Mandatory Power Management feature is enabled • SMART feature set is enabled
86	BC01h	Features/command sets enabled 1 • Words 119-120 are valid • FLASH CACHE EXT command is enabled • FLUSH CACHE command is enabled • DCO feature set is enabled • 48-bit Address feature set is enabled • DOWNLOAD MICROCODE command is enabled

Table 177: Identify Device Information Cont.

Word	Data	Description
87	6063h	Features/command sets enabled 2 • IDLE IMMEDIATE command with UNLOAD FEATURE is enabled • WRITE DMA FUA EXT and WRITE MULTIPLE FUA EXT commands are enabled • SMART self-test is enabled • SMART error logging is enabled
88	xx7Fh	UDMA Mode Selected/Embedded • Ultra DMA mode 0-6 Supported
89	001Eh	Time required for Security erase unit completion: 30
90	001Eh	Time required for Enhanced Security erase unit completion: 30
91	0000h	Current Advanced power management value
92	FFFEh	Master password revision code
93	0000h	COMRESET result. Contents shall be cleared to zero
100-103	XXXXh	Maximum LBA for 48-bit address feature set
106	4000h	Physical Sector Size per Logical Sector Size
117-118	0100h	Logical sector size (DWord): 256
119	4015h	Commands and feature sets supported (continued from words 84:82) • DOWNLOAD MICROCODE command with mode 3 is supported • WRITE UNCORRECTABLE EXT command is supported
120	4015h	Commands and feature sets supported (continued from words 87:85) • DOWNLOAD MICROCODE command with mode 3 is supported • WRITE UNCORRECTABLE EXT command is supported
128	0021h	Security status • Enhanced security erase unit feature is supported • Security Supported
129-159	XXXXh	Vendor unique bytes
168	0005h	Device Nominal Form Factor: 5h = Less than 1.8" Form Factor
169	0001h	The TRIM bit in the DATA SET MANAGEMENT is supported
206	0000h	SCT Command Transport: Not supported
209	4000h	Alignment of logical blocks within a physical block: Offset = 0
217	0001h	Non-rotating media (SSD)
222	103Fh	Transport Major Revision: Serial; SATA Rev 3.0
223	0000h	Transport Minor Revision
234	0001h	Minimum number of 512-byte data blocks per DOWNLOAD MICROCODE command for mode 03h: 1
235	00FFh	Maximum number of 512-byte data blocks per DOWNLOAD MICROCODE command for mode 03h: 255
256	03A5h	Integrity Word

Note: This value is dependent upon the total capacity of the specific flash module.
Un-documented fields are Obsolete, Reserved, or Optional and not supported.

5. PART NUMBERS

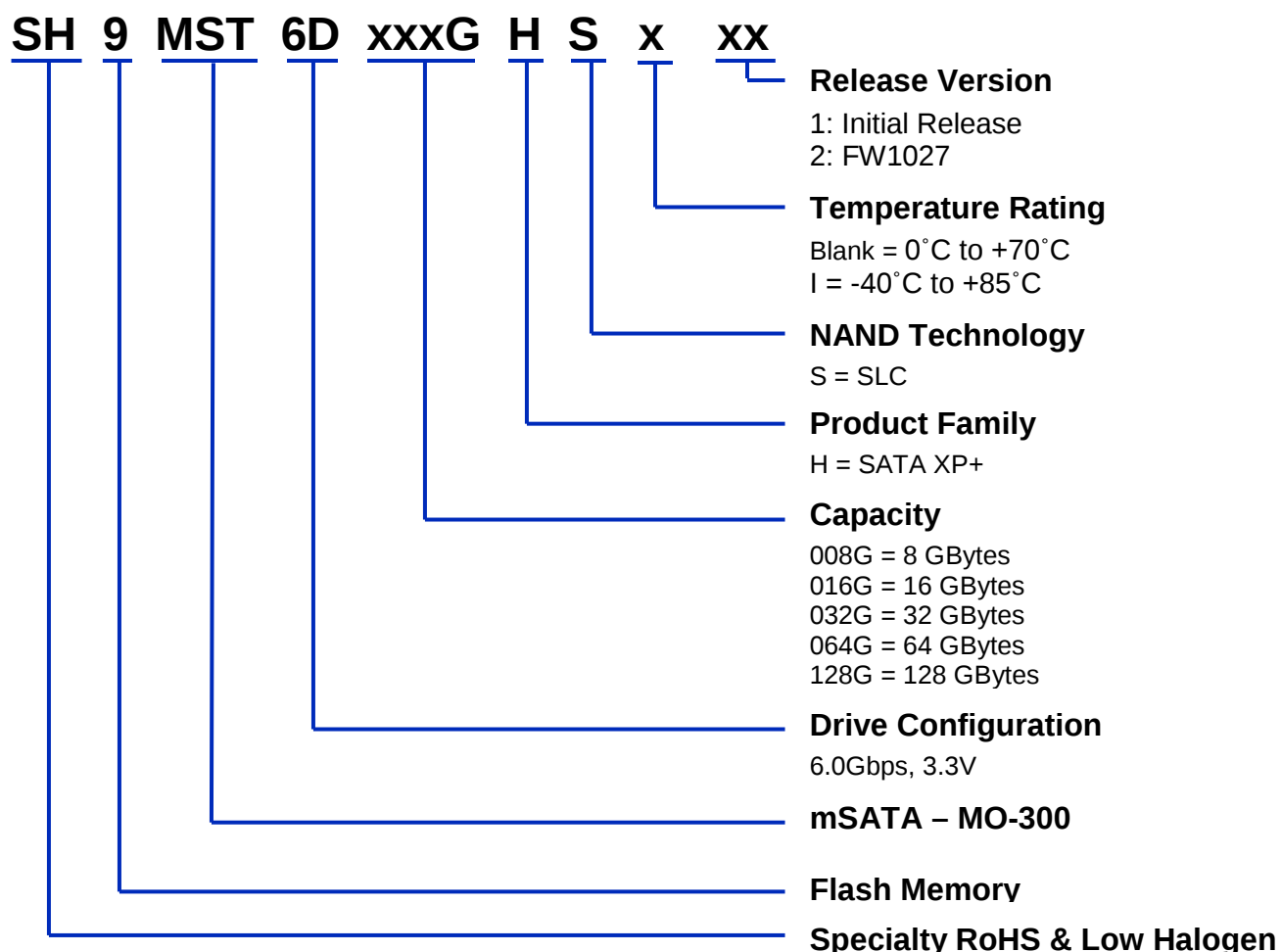
5.1. Part Numbering Information

Table 18: Part Numbering Information

SMART Part Number	Capacity	Addressable LBAs	Unformatted Capacity
SH9MST6D008GHSx02	8 GBytes	15,649,200	8,012,390,400 Bytes
SH9MST6D016GHSx02	16 GBytes	31,277,232	16,013,942,784 Bytes
SH9MST6D032GHSx02	32 GBytes	62,533,296	32,017,047,552 Bytes
SH9MST6D064GHSx02	64 GBytes	125,045,424	64,023,257,088 Bytes
SH9MST6D128GHSx02	128 GBytes	250,069,680	128,035,676,160 Bytes

x = I for Industrial Temperature, Blank for Commercial Temperature

5.2. Part Number Decoder



Declaration of Conformity

Responsible Party Name: SMART Modular Technologies, Inc.
Address: 39870 Eureka Drive
Newark, CA 94560-4809, USA
Phone: +1-510-623-1231

hereby declares that the products:

to which this declaration relates are in conformity with the following Directives and other normative documents:

RoHS Directive 2011/65/EU

Restriction of the use of certain hazardous substances in electrical and electronic equipment

- **EN 50581:2012**
Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances

Name: Jeffrey Milano
Title: Director, Worldwide Quality
Date: March 2, 2015 10:01 AM

Representative in the European Union (for regulatory topics only):

Mr. Graham Kyle
SMART Modular Technologies (Europe) Ltd.
312 Nasmyth Building, Nasmyth Avenue
Scottish Enterprise Technology Park
East Kilbride, Scotland, G75 0QR

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