Rev. 1.0 Oct. 2016

MZ7KM1T9HMJP-00005
MZ7KM960HMJP-00005
MZ7KM480HMHQ-00005
MZ7KM240HMHQ-00005

2.5"SATA 6Gbps SM863a

SAMSUNG Solid State Drive

SAMSUNG ELECTRONICS

datasheet

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Revision History

Revision No.	History	Draft Date	Remark	Editor	Review by
1.0	1. Initial release.	Oct. 10. 2016	Final	H.I Choi	I.Y Kim

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SAMSUNG Solid State Drive SM863a Features

Part Number	Capacity[1)]
MZ7KM1T9HMJP-00005	1,920GB
MZ7KM960HMJP-00005	960GB
MZ7KM480HMHQ-00005	480GB
MZ7KM240HMHQ-00005	240GB

FEATURES

- SATA 6Gbps
- 2.5" 7mmT
- Fully Complies with ATA/ATAPI-7 Standard
- Fully Complies with Serial ATA 3.2 Standard
- AES 256-bit Encryption
- Support NCQ (up to 32 depth) Command Set
- Support TRIM Command
- RoHS Compliant

PERFORMANCE

• Data Transfer Rate	
- Sequential Read	Up to 510 MB/s[2)]
- Sequential Write	Up to 485 MB/s[2)]
- Random Read (8KB)	Up to 55 KIOPS[3)]
- Random Write (8KB)	Up to 13 KIOPS[3)]
- Random Read (4KB)	Up to 95 KIOPS[3)]
- Random Write (4KB)	Up to 28 KIOPS[3)]
• IOPS Consistency (Read/Write @4KB)	99 / 97%
• Latency (Read/Write @4KB, QD1)	110 / 35us
• Quality of Service(99.99%)	
- Read (4KB, QD=1)	0.16 ms
- Write (4KB, QD=1)	0.15 ms
- Read (4KB, QD=32)	0.7 ms
- Write (4KB, QD=32)	3.0 ms

RELIABILITY

• Non-recoverable Read Error	1 sector per 10^{17} bits read
• MTBF	2,000,000 hours
• TBW	
(1920GB)	10,512 TB
(960GB)	5,256 TB
(480GB)	2,628 TB
(240GB)	1,314 TB

ENVIRONMENTAL SPECIFICATIONS[4)]

• Temperature	
- Operating	0 ~ 70 °C
- Non-operating	-40 ~ 85 °C
• Humidity (non-condensing)	5 ~ 95%
• Shock (1/2 sine pulse)	1,500 G (0.5ms)
• Vibration (non-operating)	
- 20 ~ 2,000 Hz (Sinusoidal)	20 Gpeak
- 7~800Hz (Random)	2.17Grms

POWER REQUIREMENTS [5) 6)]

• Supply Voltage	+5V ± 5%
• Voltage Ripple/Noise (max.)	100mV p-p
• Active (Read) (Typ.)	2.5 W
• Active (Write) (Typ.)	3.0 W
• Idle (Typ.)	1.4 W

PHYSICAL DIMENSION

• Width	100.20 ± 0.25 mm
• Depth	69.85 ± 0.25 mm
• Height	6.80 ± 0.20 mm
• Weight	Up to 60 g

NOTE: *Specifications are subject to change without notice.*

1) 1MB = 1,000,000 Bytes, 1GB = 1,000,000,000 Bytes, Unformatted Capacity. User accessible capacity may vary depending on operating environment and formatting.
2) Sequential performance was measured by using FIO 2.1.3 in Linux RHEL 6.6 with 128KB (131,072 bytes) of data transfer size in Queue Depth=32 by 1 worker.
3) Random performance was measured by using FIO 2.1.3 in Linux RHEL 6.6 with 4KB (4,096 bytes), 8KB (8,192 bytes) of data transfer size in Queue Depth=32 by 1 workers. Measurements were performed on a full Logical Block Address (LBA) span of the drive in sustained state. The actual performance may vary depending on use conditions and environment.
4) Operating Temperature (0 ~ 70°C / Tc) is measured at the hottest point on the case. Sufficient airflow is recommended to be operated properly on heavier workloads whin device operating temperature.
5) Active Read power is measured on 4 KB random read.
Active Write power is measured on 128 KB sequential write.
6) Idle power is measured with DIPM off.

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1.0 Introduction

1.1 General Description

This document describes the specification of the SM863a SSD which use SATA 6Gb/s interface. SM863a are fully consist of semiconductor device and using NAND Flash Memory which has a high reliability and a high technology for a storage media. As the SSD doesn't have a moving parts such as platter (disk) and head media, it gives a good solution for a storage device with a high performance, high capacity.
SM863a delivers 510GB/s for sequential read and 485GB/s for sequential write speed under up to 3.0W power.

1.2 Product List

Form factor	Density	Part Number
2.5" 7mmT	1,920GB	MZ7KM1T9HMJP-00005
	960GB	MZ7KM960HMJP-00005
	480GB	MZ7KM480HMHQ-00005
	240GB	MZ7KM240HMHQ-00005

1.3 Ordering Information

M Z X X X X X X X X X X - X X X X X
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

1. Memory (M)

2. Module Classification
Z: SSD

3. Form Factor
7: 2.5" 7mmT SATA

4. Line-Up
K: VM: Client/SV (VNAND 2bit MLC)

5. SSD CTRL
M: Mercury

6~8. SSD Density
1T9: 1,920 GB
960: 960 GB
480: 480GB
240: 240GB

9. NAND PKG
H: BGA

10. Flash Generation
M: 1st Generation

11~12. NAND Density
JP: 2T ODP 8CE
HQ: 1T QDP 4CE

13. " - "

14. Default
"0"

15. HW revision
0: No revision

16. Packing type
0: Bulk

17~18. Customer
05: General

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2.0 Product Specifications

2.1 Interface and Compliance

- SATA 6.0Gbps
- Fully compatible with ATA/ATAPI-7 Standard
- Compatible with ATA/ATAPI-8 ACS3 Mandatory Command
- Native Command Queuing (NCQ) Command Set
- Support Data Set Management Command

2.2 Drive Capacity

[Table 1] User Capacity and Addressable Sectors

	240GB	480GB	960GB	1,920 GB
User-Addressable Sectors	468,862,128	937,703,088	1,875,385,008	3,750,748,848
Bytes per Sector	512 Bytes			

NOTE:
1. Megabyte (MB) = 1 Million bytes; 1 Gigabyte (GB) = 1 Billion bytes
2. Actual usable capacity may be less (due to formatting, partitioning, operating system, applications or otherwise).

2.3 Performance

[Table 2] Sequential Read / Write Performance

Read / Write	240GB	480GB	960GB	1,920 GB
Sequential Read (128 KB)	410MB/s	510MB/s	510MB/s	510MB/s
Sequential Write (128 KB)	450MB/s	485MB/s	485MB/s	485MB/s

[Table 3] Sustained Random Read / Write Performance

Read / Write	240GB	480GB	960GB	1,920 GB
Random Read IOPS (8 KB)	50K	55K	55K	55K
Random Write IOPS (8 KB)	5K	9K	12K	13K
Random Read IOPS (4 KB)	90K	95K	95K	95K
Random Write IOPS (4 KB)	10K	19K	25K	28K

NOTE:
1) Actual performance may vary depending on use conditions and environment.
2) Performance measured using FIO 2.1.3 with queue depth 32, C216 Intel SATA 6G port.
3) Measurements are performed on whole LBA range.
4) Write cache enabled.
5) 1 MB/sec = 1,048,576 bytes/sec was used in sequential performance.

[Table 4] IOPS Consistency

IOPS Consistency	240GB	480GB	960GB	1,920 GB
Random Read (4 KB)	99%	99%	99%	99%
Random Write (4 KB)	92%	97%	97%	97%

NOTE:
1) IOPS consistency measured using FIO with queue depth 32.
2) IOPS Consistency (%) = (99.9% IOPS) / (Average IOPS) x 100.

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[Table 5] Latency

Latency	240GB	480GB	960GB	1,920 GB
Read (4 KB)	110us	110us	110us	110us
Write (4 KB)	85us	50us	35us	35us

NOTE:
1) Latency is measured using FIO with queue depth 1 on 4KB random and write.

[Table 6] Quality of Service (QoS)

Quality of Service (99%)	240GB	480GB	960GB	1,920 GB
Read (4 KB, QD=1)	0.13 ms	0.13 ms	0.13 ms	0.13 ms
Write (4 KB, QD=1)	0.13 ms	0.12 ms	0.12 ms	0.12 ms
Read (4 KB, QD=32)	1.0 ms	0.6 ms	0.6 ms	0.6 ms
Write (4 KB, QD=32)	4.0 ms	3.0 ms	2.7 ms	2.5 ms

Quality of Service (99.99 %)	240GB	480GB	960GB	1,920 GB
Read (4 KB, QD=1)	0.16 ms	0.16 ms	0.16 ms	0.16 ms
Write (4 KB, QD=1)	0.16 ms	0.15 ms	0.15 ms	0.15 ms
Read (4 KB, QD=32)	1.4 ms	0.7 ms	0.7 ms	0.7 ms
Write (4 KB, QD=32)	5.3 ms	3.0 ms	3.0 ms	3.0 ms

NOTE:
1) QoS is measured using Fio 2.1.3 (99 and 99.99%) in Linux RHEL 6.5 (Kernel 2.6.32) with queue depth 1, 32 on 4KB random read and write.
2) QoS is measured as the maximum round-trip time taken for 99 and 99.99% of commands to host.

2.4 Electrical Characteristics

[Table 7] Operating Voltage

Item	Requirements
Allowable voltage	5.0 V ± 5%
Allowable noise / ripple	100 mV p-p or less

NOTE:
1) The measurement value of inrush current is also compatible with the standard specification of “Enterprise SSD Form Factor Version 1.0a”

[Table 8] Power Consumption

Read/Write	240GB	480GB	960GB	1,920 GB
Active Write[1] (Typ.)	2.5W	2.8W	2.9W	3.0 W
Active Read[2] (Typ.)	2.0W	2.3W	2.4W	2.5 W
Idle[3]	1.3W	1.3W	1.3W	1.4 W

NOTE:
1) Active Write power is measured on 128 KB sequential write (QD32, Worker1)
2) Active Read power is measured on 4 KB random read (QD4, Worker4)
3) Idle power is measured with DIPM off.
4)The Active and Idle power is defined as the highest averaged power value, which is the max RMS average value over 100ms duration.

[Table 9] Inrush Current

Parameter	Requirements
Inrush Current	1.2A, <1sec

NOTE:
1) The measurement value of inrush current is also compatible with the standard specification of “Enterprise SSD Form Factor Version 1.0a” released by SSD Form Factor Working Group.

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2.5 Environmental Specifications

[Table 10] Environmental Specifications

Features	Operating	Non-Operating
Temperature[1]	0 °C to 70 °C	-40 °C to 85 °C
Temperature Gradient	30 °C /Hr	30 °C /Hr
Humidity	5% to 95%, non-condensing	
Shock	1500 G, duration 0.5 ms, Half Sine Wave	
Vibration	20G, 20 ~ 2,000 Hz, Sinusoidal 2.17Grms, 7~800Hz, Random	

NOTE:
1) Operating Temperature (0 ~ 70°C / Tc) is measured at the hottest point on the case. Sufficient airflow is recommended to be operated properly on heavier workloads wthin device operating temperature.

2.6 Reliability

[Table 11] MTBF Specifications

Parameter	240GB	480GB	960GB	1,920 GB
MTBF	2,000,000 Hours			

NOTE:
1) MTBF is Mean Time Between Failure. As same word, annual failure ratio is 0.438%.

[Table 12] UBER Specifications

Parameter	240GB	480GB	960GB	1,920 GB
UBER	1 sector per 10^{17}bits read			

NOTE:
1) Uncorrectable Bit Error Rate (UBER) is a metric for the rate of occurrence of data errors, equal to the number of data errors per bits read as specified in the JESD218 document of JEDEC standard. For the enterprise application, JEDEC recommends that UBER shall be below 10^{-16}.

[Table 13] TBW (TeraBytes Written) Specifications

Parameter	240GB	480GB	960GB	1,920 GB
TBW	1,314 TB	2,628 TB	5,256 TB	10,512 TB

NOTE:
1) TBW is measured while running 100 % random 4 KB writes across the entire SSD.(TBW = DWPD x 365 x 5years x User capacity)

[Table 14] Drive Write Per Day (DWPD) Specifications

Parameter	240GB	480GB	960GB	1,920 GB
DWPD	3.0 (5Years)			

[Table 15] Data Retention Specifications

Parameter	240GB	480GB	960GB	1,920 GB
Data Retention	3months			

NOTE:
1) Data retention was measured by assuming that SSD reaches the maximum rated endurance at 40'C in power-off state.

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3.0 Mechanical Specification

[Table 16] Physical Dimensions and Weight

Model	Height (mm)	Width (mm)	Length (mm)	Weight (gram)
240/480/960/1,920GB	6.80 ± 0.20	69.85 ± 0.25	100.20 ± 0.25	Max 60g

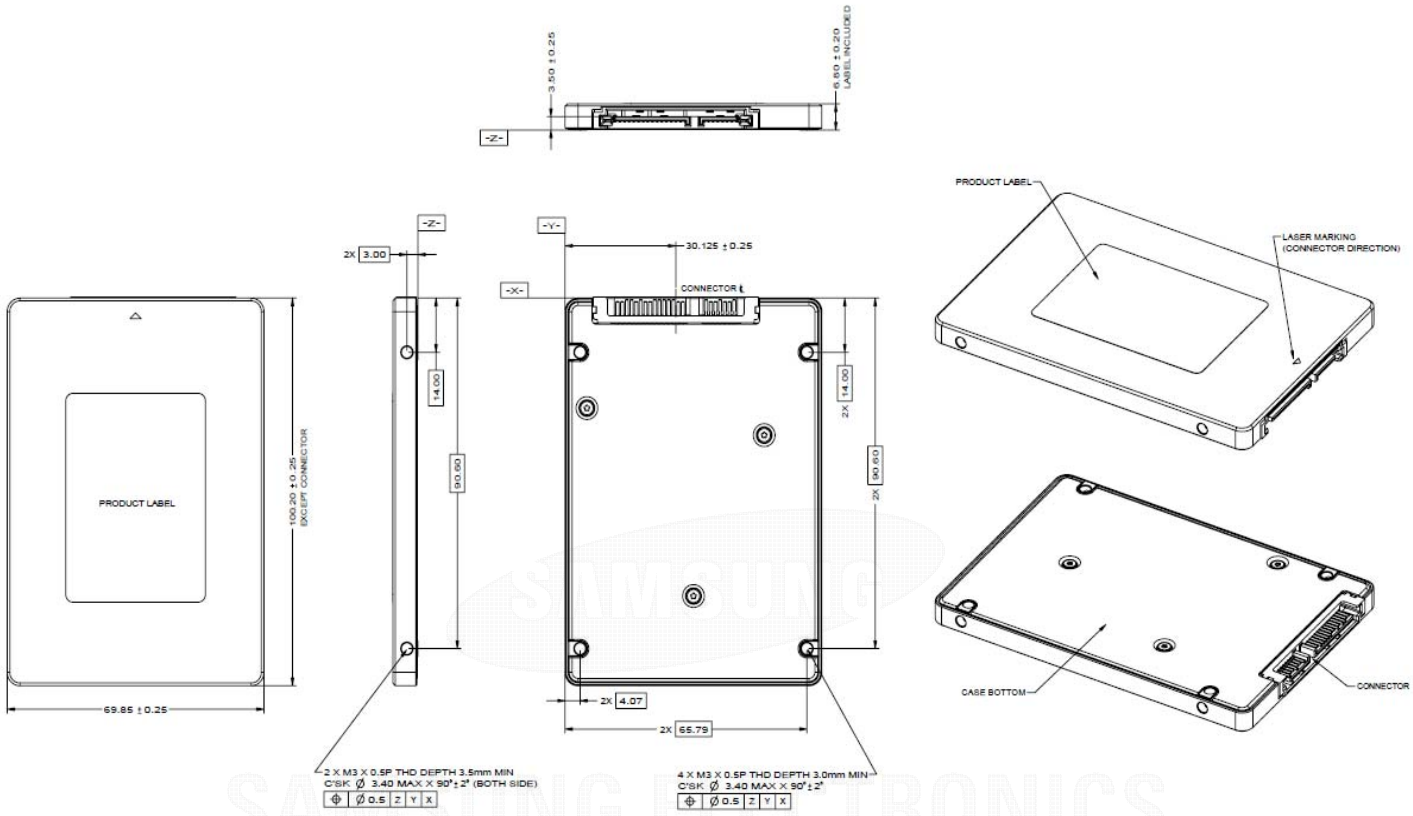

Figure 1. Physical Dimension

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4.0 Electrical Interface Specification

4.1 Serial ATA Interface Connector

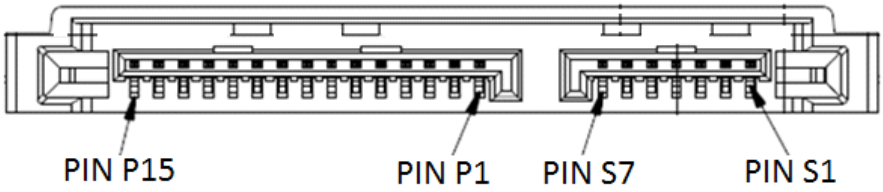

Figure 2. Drive Plug Connector

4.2 Pin Assignments

[Table 17] Pin Assignments

Word	No.	Plug Connector pin definition	
Signal	S1	GND	2nd mate
	S2	A +	Differential signal A from Phy
	S3	A -	
	S4	GND	2nd mate
	S5	B -	Differential signal B from Phy
	S6	B +	
	S7	GND	2nd mate
Key and spacing separate signal and power segments			
Power	P1	V33	3.3 V power (Unused)
	P2	V33	3.3 V power (Unused)
	P3	V33	3.3 V power, pre-charge, 2nd mate (Unused)
	P4	GND	1st mate
	P5	GND	2nd mate
	P6	GND	2nd mate
	P7	V5	5 V power, pre-charge, 2nd mate
	P8	V5	5 V power
	P9	V5	5 V power
	P10	GND	2nd mate
	P11	DAS / DSS	Device Activity Signal / Disable Staggered Spin-up
	P12	GND	1st mate
	P13	V12	12 V power, pre-charge, 2nd mate (Unused)
	P14	V12	12 V power (Unused)
	P15	V12	12 V power (Unused)

NOTE:
1. Uses 5 V power only. 3.3 V and 12 V power are not used

[Table 18] Simple Indicator Protocol for Device Activity (Pin 11)

Device State	Pin Out
Active	Toggle
Idle	Hight1)

NOTE:
1) DAS Pin is toggle when host initiated Background job.

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5.0 Command Descriptions

5.1 Supported ATA Commands

[Table 19] Supported ATA Commands Summary

Command Name	Command Code (Hex)	Command Name	Command Code (Hex)
CHECK POWER MODE	E5h / 98h	SET MULTIPLE MODE	C6h
DEVICE CONFIGURATION	B1h	SLEEP	E6h / 99h
DOWNLOAD MICROCODE	92h	S.M.A.R.T.	B0h
DOWNLOAD MICROCODE DMA	93h	STANDBY	E2h / 96h
EXECUTE DEVICE DIAGNOSTIC	90h	STANDBY IMMEDIATE	E0h / 94h
FLUSH CACHE	E7h	TRIM	06h
FLUSH CACHE EXT	EAh	WRITE BUFFER	E8h
IDENTIFY DEVICE	ECh	WRITE BUFFER DMA	EBh
IDLE	E3h / 97h	WRITE DMA	CAh
IDLE IMMEDIATE	E1h / 95h	WRITE DMA (w/o retry)	CBh
INITIALIZE DEVICE PARMETERS	91h	WRITE DMA EXT	35h
READ BUFFER	E4h	WRITE DMA FUA EXT	3Dh
READ BUFFER DMA	E9h	WRITE FPDMA QUEUED	61h
READ DMA	C8h	WRITE LOG DMA EXT	57h
READ DMA (w/o retry)	C9h	WRITE LOG EXT	3Fh
READ DMA EXT	25h	WRITE MULTIPLE	C5h
READ FPDMA QUEUED	60h	WRITE MULTIPLE EXT	39h
READ LOG DMA EXT	47h	WRITE MULTIPLE FUA EXT	CEh
READ LOG EXT	2Fh	WRITE SECTORS	30h
READ MULTIPLE	C4h	WRITE SECTORS (w/o retry)	31h
READ MULTIPLE EXT	29h	WRITE SECTORS EXT	34h
READ NATIVE MAX ADDRESS	27h	WRITE UNCORRECTABLE EXT	45h
READ NATIVE MAX ADDRESS EXT	F8h	SET FEATURES	EFh
READ SECTORS	20h	SET MAX ADDRESS	F9h
READ SECTORS (w/o retry)	21h		
READ SECTORS EXT	24h		
READ VERIFY SECTORS	40h		
READ VERIFY SECTORS (w/o retry)	41h		
READ VERIFY SECTORS EXT	42h		
RECALIBRATE	10h		
RECEIVE FPDMA QUEUED	65h		
SANITIZE DEVICE	B4h		
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		
SEND FPDMA QUEUED	64h		
SET DATE N TIME	77h		

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5.2 Individual Attribute Data Structure

The following defines the 12 bytes that make up the information for each Attribute entry in the Device Attribute Data Structure.

[Table 20] Attribute Entry in Device Attribute Data Structure

Byte	Descriptions
0	Attribute ID number 01-FFh
1 - 2	Status flag bit 0 (pre-failure / advisory bit) bit 0 = 0: If attribute value is less than the threshold, the drive is in advisory condition. Product life period may expired. bit 0 = 1: If attribute value is less than the threshold, the drive is in pre-failure condition. The drive may have failure. bit 1 (on-line data collection bit) bit 1 = 0: Attribute value will be changed during off-line data collection operation. bit 1 = 1: Attribute value will be changed during normal operation. bit 2 (Performance Attribute bit) bit 3 (Error rate Attribute bit) bit 4 (Event Count Attribute bit) bit 5 (Self-Preserving Attribute bit) bit 6 - 15 Reserved
3	Attribute value 01h - FDh *1 00h, FEh, FFh = Not in use 01h = Minimum value 64h = Initial value Fdh = Maximum value
4	Worst Ever normalized Attribute Value (valid values from 01h - FEh)
5 - 10	Raw Attribute Value Attribute specific raw data (FFFFFFh - reserved as saturated value)
11	Reserved (00h)
*1 For ID = 199 CRC Error Count	

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The device supports following Attribute ID Numbers.

[Table 21] SMART Attributes

ID (Word)	Attribute Name	Description	Status Flag	Threshold (%)
5	Reallocated Sector Count	The raw value indicates the number of reserved blocks which has replaced the retired blocks since leaving the vendor factory.	110011	10
9	Power-on Hours	The raw value indicates th total number of power on hours since leaving vendor factory.	110010	-
12	Power-on Count	The raw value indicates the cumulative number of power cycle events over the life of the device.	110010	-
177	Wear Leveling Count	The raw value reports the average number of erase cycle of the NAND media increasing from 0 to the maximum rated cycles. Normalized value declines linearly from 100 to 1. Once the normalized value reaches 1, the number will not decrease, although it is likely that significant additional wear can be put on the device.	010011	5
179	Used Reserved Block Count (total)	The raw value indicates the total number of reserved blocks that have been used as a result of a program or erase failure.	010011	10
180	Unused Reserved Block Count (total)	The raw value indicates the total number of reserved blocks that have been unused. Normalized value begins at 100, which corresponds to 100 percent availability of the reserved space.	010011	10
181	Program Fail Count (total)	The raw value indicates total count of program fails. Normalized value begins at 100, describes the percent remaining of allowable program fails.	110010	-
182	Erase Fail Count (total)	The raw value indicates total count of erase fails. Normalized value, begins at 100, shows the percent remaining of allowable erase fails.	110010	-
183	Runtime Bad Count (in total)	The raw value indicates the number of growing bad blocks. See Attribute (ID) 5.	010011	10
184	End to End data path Error Count	Show the End to End Error Detection/Correction rate based on the number of ECC errors in DRAM. This is not including error on media(NAND).	110011	97
187	Uncorrectable Error Count	The raw value indicates the number of uncorrectable error count.	110010	-
190	Airflow temperature	Indicates the current temperature, in degrees Celsius, of temperature sensor.	110010	-
194	Drive Temperature	Indicates the maximum, minimum and current temperature, in degrees Celsius, of temperature sensor.	100010	-
195	ECC Error Rate	Indicates number of errors corrected by the internal error correcting mechanism.	011010	-
197	Pending Sector Count	Indicates the number of current unrecoverable read errors that will be re-allocated on next write.	110010	-
199	CRC Error Count	The raw value indicates total number of occured interface CRC errors.	111110	-
202	SSD Mode Status	The raw value indicates the current status of tantal capacitor health. For example, 0x00(or 0 as dec) means normal mode, 0x10(or 16 as dec) means tantal cap failure.	110011	10
235	Power Recovery Count	The raw value indicates the number of sudden power off count.	010010	-
241	Total LBA Written	The raw value indicates total number of sectors written by the host system, increasing by 1 for every sector(512Byte) written by the host.	110010	-
242	Total LBA Read	The raw value indicates total number of sectors read by the host system, increasing by 1 for every sectors(512Byte) read by the host.	110010	-
243	SATA Downshift Control	The raw value indicates the number of times SATA interface selected lower signaling caused by error.	110010	-
244	Thermal Throttle Status	The raw value indicates the number of times thermal throttling has activated.	110010	-

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245	Timed Workload Media Wear	Indicates the percentage of wear indicator seen by the SSD Refer to below for detail and example case.	110010	-
246	Timed Workload Host Read/Write Ratio	Indicates the percentage of read operation across I/O requested by the host system. Refer to below for detail and example case.	111010	-
247	Timed Workload Timer	Indicates the percentage of read operation across I/O requested by the host system. Refer to below for detail and example case.	110010	-
251	NAND Writes	Raw value reports the number of writes to NAND in 512Byte (a sector size) increments.	110010	-

NOTE:
1. Any nonzero value in the Attribute ID Number indicates an active attribute.

Estimating Life-time of an SSD using SMART attributes

Looking at smart attributes “ID 245”, “ID 246” and “ID 247” allows users to understand the wear of their SSD given a particular workload and time period. Alternatively, these attributes allow users to extrapolate the life time of their SSD.

Definitions

ID 247 - represents the seconds that the SSD has been in operation since the workload timer was started. (Users can start/stop said timer at their discretion or let it run continuously. It is controlled through their SSD Software tools).

ID 246 – shows the share of I/O operations that are read commands since the workload timer (ID 247) was started and is measured in percent. (Conversely, the share of write I/O operations can be determined by subtracting the given smart attribute reading from 100).

ID 245 – measures the wear of the SSD given the workload (ID 246) and the period of time over which these workloads have been sustained (ID 247). It is displayed as a per mille reading of the total wear of the SSD over its useful lifetime (i.e. a reading of 1000 would mean that the SSD has been worn out over the given time & usage pattern).

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Example

A user has witnessed that the usage pattern of his SSD has recently changed from 80% to 70% read I/O operations and he would like to understand what impact this change has on the life-time of his SSD. He has decided to run a test for 1 week. At the end of his test run the Smart attributes read as follows:

ID 245: 4

ID 246: 70

ID 247: 604,800 (7days x 24hours x 60minutes x 60seconds)

To find the estimated end of life given the above readings, the user would need to do the following calculations:

First, the user would want to understand how many more cycles could be run under the given test scenario before the SSD would wear out completely. He would therefore calculate 1000 / 4 = 250
Second, the user would then multiply this number by the duration of the test run to find the total expected lifetime of the SSD in seconds. This calculation would yield 250 x 604,800 = 151,200,000

Given the relatively abstract nature of large numbers expressed in seconds, the user would then want to express the life-time in years, months or weeks. If we chose to express the lifetime in years, we would make the following calculation: 151,200,000 / (365 x 24 x 60 x 60) = 4.79years

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6.0 Identify Device Data

[Table 22] Identify Device Data

Word	240GB	480GB	960 GB	1,920 GB	General Information
0	0040h	0040h	0040h	0040h	Obsolete
1	3FFFh	3FFFh	3FFFh	3FFFh	Obsolete
2	C837h	C837h	C837h	C837h	Obsolete
3	0010h	0010h	0010h	0010h	Retired
4 - 5	0000h	0000h	0000h	0000h	Obsolete
6	003Fh	003Fh	003Fh	003Fh	Obsolete
7 - 8	0000h	0000h	0000h	0000h	Reserved for the Compact Flash Association
9	0000h	0000h	0000h	0000h	Retired
10 - 19	XXXXh	XXXXh	XXXXh	XXXXh	Serial Number (ATA string)
20-21	0000h	0000h	0000h	0000h	Obsolete
22	0000h	0000h	0000h	0000h	Obsolete
23-26	XXXXh	XXXXh	XXXXh	XXXXh	Firmware Revision (ATA string)
27-46	XXXXh	XXXXh	XXXXh	XXXXh	Model Number
47	8010h	8010h	8010h	8010h	Read / Write Multiple Support
48	4000h	4000h	4000h	4000h	Trusted Computing Feature Set Options
49	2F00h	2F00h	2F00h	2F00h	Capabilities
50	4000h	4000h	4000h	4000h	Capabilities
51-52	0200h	0200h	0200h	0200h	Obsolete
53	0007h	0007h	0007h	0007h	Obsolete
54	3FFFh	3FFFh	3FFFh	3FFFh	Obsolete
55	0010h	0010h	0010h	0010h	Obsolete
56	003Fh	003Fh	003Fh	003Fh	Obsolete
57	FC10h	FC10h	FC10h	FC10h	Obsolete
58	00FBh	00FBh	00FBh	00FBh	Obsolete
59	BD10h	BD10h	BD10h	BD10h	Multiple Logical Setting
60	FFFFh	FFFFh	FFFFh	FFFFh	Obsolete
61	0FFFh	0FFFh	0FFFh	0FFFh	Obsolete
62	0000h	0000h	0000h	0000h	Obsolete
63	0007h	0007h	0007h	0007h	Multi-word DMA Transfer
64	0003h	0003h	0003h	0003h	PIO Transfer Modes Supported
65	0078h	0078h	0078h	0078h	Minimum Multiword DMA Transfer Cycle Time per Word (ns)
66	0078h	0078h	0078h	0078h	Manufacturer's Recommended Multiword DMA Cycle Time (ns)
67	0078h	0078h	0078h	0078h	Minimum PIO Transfer Cycle Time without IORDY Flow Control (ns)
68	0078h	0078h	0078h	0078h	Minimum PIO Transfer Cycle Time with IORDY Flow Control (ns)
69	4F30h	4F30h	4F30h	4F30h	Additional Supported
70-74	0000h	0000h	0000h	0000h	Reserved
75	001Fh	001Fh	001Fh	001Fh	Queue Depth
76	850Eh	850Eh	850Eh	850Eh	Serial ATA Capabilities
77	0046h	0046h	0046h	0046h	Serial ATA Additional Capabilities
78	0064h	0064h	0064h	0064h	Serial ATA Features Supported
79	0060h	0060h	0060h	0060h	Serial ATA Features Enabled
80	03FCh	03FCh	03FCh	03FCh	Major Version Number
81	0039h	0039h	0039h	0039h	Minor Version Number
82	746Bh	746Bh	746Bh	746Bh	Commands and Feature Sets Supported
83	7D29h	7D29h	7D29h	7D29h	Commands and Feature Sets Supported
84	4163h	4163h	4163h	4163h	Commands and Feature Sets Supported or Enabled

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85	7469h	7469h	7469h	7469h	Commands and Feature Sets Supported or Enabled
86	BC01h	BC01h	BC01h	BC01h	Commands and Feature Sets Supported or Enabled
87	4163h	4163h	4163h	4163h	Commands and Feature Sets Supported or Enabled
88	407Fh	407Fh	407Fh	407Fh	Ultra DMA Modes
89	0010h	0010h	0010h	0010h	Normal Security Erase Unit Time
90	0010h	0010h	0010h	0010h	Enhanced Security Erase Unit Time
91	00FEh	00FEh	00FEh	00FEh	Advanced Power Management Level
92	FFFEh	FFFEh	FFFEh	FFFEh	Master Password Revision Code
93	0000h	0000h	0000h	0000h	Hardware Reset Result
94	0000h	0000h	0000h	0000h	Obsolete
95	0000h	0000h	0000h	0000h	Stream Minimum Request Size
96	0000h	0000h	0000h	0000h	Streaming Transfer Time - DMA
97	0000h	0000h	0000h	0000h	Streaming Access Latency - DMA and PIO
98-99	0000h	0000h	0000h	0000h	Streaming Performance Granularity (DWord)
100-103	XXXXh	XXXXh	XXXXh	XXXXh	Total Number of User 48-Bit LBA
104	0000h	0000h	0000h	0000h	Streaming Transfer Time - PIO
105	0008h	0008h	0008h	0008h	Maximum Number of 512-byte Data Blocks of LBA Range Entries per DATA SET MANAGEMENTCommand
106	4000h	4000h	4000h	4000h	Pysical Sector Size / Logical Sector Size
107	0000h	0000h	0000h	0000h	Inter-seek Delay for ISO 7779 Standard Acoustic Testing
108	5002h	5002h	5002h	5002h	World Wide Name
109	538Ch	538Ch	538Ch	538Ch	World Wide Name
110-111	XXXXh	XXXXh	XXXXh	XXXXh	World Wide Name
112-115	0000h	0000h	0000h	0000h	Reserved
116	0000h	0000h	0000h	0000h	Reserved for TLC
117-118	0000h	0000h	0000h	0000h	Logical Sector Size (Dword)
119	409Eh	409Eh	409Eh	409Eh	Commands and Feature Sets Supported
120	401Ch	401Ch	401Ch	401Ch	Commands and Feature Sets Supported or Enabled
121-126	0000h	0000h	0000h	0000h	Reserved for Expanded Supported and Enabled Settings
127	0000h	0000h	0000h	0000h	Obsolete
128	0021h	0021h	0021h	0021h	Security Status
129-159	0000h	0000h	0000h	0000h	Vendor Specific
160	0000h	0000h	0000h	0000h	CFA Power Mode
161-167	0000h	0000h	0000h	0000h	Reserved for the Compact Flash Association
168	0003h	0003h	0003h	0003h	Device Nominal Form Factor
169	0001h	0001h	0001h	0001h	DATA SET MANAGEMENT is Supported
170-173	2020h	2020h	2020h	2020h	Additional Product Identifier (ATA string)
174-175	0000h	0000h	0000h	0000h	Reserved
176-205	0000h	0000h	0000h	0000h	Current Media Serial Number
206	003Dh	003Dh	003Dh	003Dh	SCT Command Transport
207-208	0000h	0000h	0000h	0000h	Reserved for CE-ATA
209	4000h	4000h	4000h	4000h	Alignment of Logical Blocks within a Physical Block
210-211	0000h	0000h	0000h	0000h	Write-Read-Verify Sector Count Mode 3
212-213	0000h	0000h	0000h	0000h	Write-Read-Verify Sector Count Mode 2
214	0000h	0000h	0000h	0000h	Obsolete
215-216	0000h	0000h	0000h	0000h	Obsolete
217	0001h	0001h	0001h	0001h	Nominal Media Rotation Rate
218	0000h	0000h	0000h	0000h	Reserved
219	0000h	0000h	0000h	0000h	Obsolete
220	0000h	0000h	0000h	0000h	Write Read Verify Mode

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221	0000h	0000h	0000h	0000h	Reserved
222	107Fh	107Fh	107Fh	107Fh	Transport Major Version Number
223	0000h	0000h	0000h	0000h	Transport Minor Version Number
224-229	0000h	0000h	0000h	0000h	Reserved
230-233	0000h	0000h	0000h	0000h	Extended Number of User Addressable Sectors
234	0000h	0000h	0000h	0000h	Minimum Number of 512-byte Data Blocks per DOWNLOAD MICROCODE Command for Mode 03h
235	0800h	0800h	0800h	0800h	Maximum Number of 512-byte Data Blocks per DOWNLOAD MICROCODE Command for Mode 03h
236-242	0000h	0000h	0000h	0000h	Reserved
243	4000h	4000h	4000h	4000h	FDE Security Features
244-254	0000h	0000h	0000h	0000h	Reserved
255	XXA5h	XXA5h	XXA5h	XXA5h	Integrity Word

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7.0 SPOR Specification (Sudden Power Off and Recovery)

7.1 Data Recovery in Sudden Power Off

If power interruption is detected, SSD dumps all cached user data and meta data to NAND Flash. SSD could protect even the user data in DRAM from sudden power off while SSD is used with cache on. Commonly, data is protected all of the operation period.

7.2 Time to Ready Sequence

In normal power-off recovery status, SSD needs less than 10 seconds to reach operating mode where SSD works perfectly with cache-on state. SSD is ready to respond Identify Device command during FTL OPEN. When the sudden power-off occurs, the user data in DRAM will be dumped into to NAND Flash using the stored power in the capacitor. In sudden power-off recovery condition, mapping data will be loaded or the FTL meta data be rebuilt perfectly for initial max. 10 seconds. During this period, Identify Device command is still supported. It is called SPOR (Sudden Power Off and Recovery).

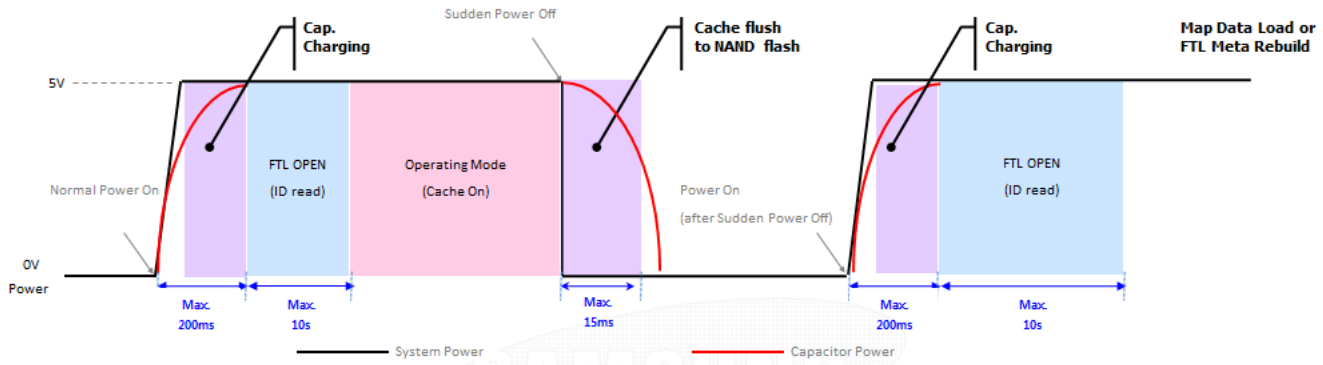

Figure 3. Time to Ready Sequence

[Table 23] Device Ready Time for Normal Read / Write Operation after Sudden Power Off

	240GB	480GB	960GB	1,920 GB
Max. Open Time (sec)	10s			

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8.0 Product Compliance

[Table 24] Certifications and Declarations

Category	Certifications
Safety	c-UL-us
	CE
	TUV
	CB
EMC	CE (EU)
	BSMI (Taiwan)
	KCC (South Korea)
	VCCI (Japan)
	RCM (Australia)*
	FCC (USA)
	IC (CANADA)

* The three existing compliance marks (C-Tick, A-Tick and RCM) are consolidated into a single compliance mark - the RCM

Caution: Any changes or modifications in construction of this device which are not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

NOTE:
This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications, However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:
- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio / TV technician for help.
Modifications not expressly approved by the manufacturer could void the user's authority to operated the equipment under FCC rules.

1. 기자재 명칭 : SSD (Solid State Drive)
2. 모델명(Model): 라벨 별도 표기
3. 제조연월 : 라벨 별도 표기
4. 제조자 : 삼성전자(주)
5. 제조국가 : 대한민국
6. 상호명 : 삼성전자(주)

Industry Canada ICES-003 Compliance Label:
CAN ICES-3 (B)/NMB-3(B)

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9.0 References

[Table 25] Standards References

Item	Website
Serial ATA Revision 3.2	http://www.sata-io.org
ATA/ATAPI Command Set - 3 (ACS-3)	http://www.t13.org
SFF-8223, 2.5-inch Drive with Serial Attachment Connector	http://www.sffcommittee.org
SFF-8201, 2.5-inch drive form factor	http://www.sffcommittee.org
Solid-State Drive Requirements and Endurance Test Method (JESD218A)	http://www.jedec.org/standards-documents/docs/jesd218a
Solid-State Drive Requirements and Endurance Test Method (JESD219A)	http://www.jedec.org/standards-documents/docs/jesd219a

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