Samsung V-NAND SSD 883 DCT

2018 Data Sheet

Revision 1.3

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Revision History

Revision	Description	Date
1.0	Initial Release	April, 2018
1.1	Corrected typographical errors	July, 2018
1.2	Corrected Product List information	August, 2018
1.3	Corrected 240GB model sequential write performance	September, 2018

Samsung V-NAND SSD 883 DCT

Model Name	Capacity (GB[1])	Model code
Samsung SSD 883 DCT	3,840 GB*	MZ-7LH3T8NE
	1,920 GB*	MZ-7LH1T9NE
	960 GB*	MZ-7LH960NE
	480 GB*	MZ-7LH480NE
	240 GB*	MZ-7LH240NE

Product Features

- SATA 3.3 compliant
- Form factor: 2.5" 7mmT
- Samsung V-NAND 3bit MLC
- Fully complies with ATA/ATAPI-7 Standard
- Support NCQ (up to 32 depth) command set
- Hardware based AES 256-bit Encryption
- Support TRIM Command
- RoHS compliant

Performance[2]

- Data transfer rate[3]
  - Sequential Reads: up to 550 MB/s
  - Sequential Writes: up to 520 MB/s
  - Random 4KB Reads: up to 98 KIOPS
  - Random 4KB Writes: up to 28 KIOPS
- IOPS consistency (4KB)
  - Reads: 99%
  - Writes: 90%
- Latency (4KB)
  - Reads: up to 140us
  - Write: up to 70us
- Quality of Service (99.99%)
  - Read(4KB, QD1/QD32): 0.5ms/0.9ms
  - Write(4KB, QD1/QD32): 0.3ms/3.2ms

Power[4]

- Supply Voltage: +5V ± 5%
- Voltage Ripple/Noise (max.): 100mV p-p
- Active[5] (Typ. Read/Write) up to 2.3W/3.6W
  Idle[6](Typ.) up to 1.3W

ENVIRONMENTAL SPECIFICATIONS

- Temperature
  - Operating[7]: 0 ~ 70 °C
  - Non-operating: -40 ~ 85 °C
- Humidity(non-condensing): 5 ~ 95%
- Shock (1/2 sine pulse): 1,500G/0.5ms
- Vibration
  - Non-operating 20 G
    (20 ~ 2,000 Hz, Sweep Sine)
  - 20min /axis on 3 axes,

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

Reliability

- Endurance(TBW[8]):
  - 3,840 GB: 5,466 TB[9]
  - 1,920 GB: 2,733 TB[9]
  - 960 GB: 1,366 TB[9]
  - 480 GB: 683 TB[9]
  - 240 GB: 341 TB[9]
- Non-Recoverable Read Error:
  1sector per 10^{17} bits read
- MTBF: 2,000,000 hours

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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) Performance measured using FIO 2.18 with queue depth 32, Z170 Intel SATA 6G port. Measurements are performed on whole LBA range. Write cache enabled. Performance vary depending on capacity

3) Performance vary depending on capacity.

4) Power consumption measured using FIO 2.14 with Z270 Intel SATA 6G port., CentOS 7.2, Kernel 3.10.0/327, CPU(Intel® Core™ i7-6700K CPU @ 4.20GHz) and 16GB RAM.

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.

7) Operating Temperature measured by SSD temperature sensor (SMART Attribute 194), Proper airflow recommended.

8) TBW means Total Bytes Written.

9) All documented endurance test results are obtained in compliance with JESD218 Standards. Please visit www.jedec.org for detailed information on JESD218 Standards

Table of Contents

1 Introduction

1.1 General Description

This document describes the specification of the 883 DCT SSD which uses SATA 6Gb/s interface. 883 DCT is 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. 883 DCT delivers 550MB/s for sequential read and 520MB/s for sequential write speed under up to 3.6W power

1.2 Product list

Model name	Capacity[1)]	Model code
Samsung SSD 883 DCT	3,840 GB*	MZ-7LH3T8NE
	1,920 GB*	MZ-7LH1T9NE
	960 GB*	MZ-7LH960NE
	480 GB*	MZ-7LH480NE
	240 GB*	MZ-7LH240NE

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.

1.3 Ordering Information

Contact your local Samsung sales representative for ordering information.

2 Product Specifications

2.1 Interface and Compliance

- SATA 3.3 6.0Gbps
- Fully compatible with ATA/ATAPI-7 Standard
- Compatible with ATA/ATAPI-8 ACS4 Mandatory Command
- Native Command Queuing (NCQ) Command Set
- Support Data Set Management Command

2.2 Drive Capacity

[Table 1] User Capacity and Addressable Sectors

	3,840 GB	1,920 GB	960 GB	480 GB	240 GB
User-Addressable Sectors	7,501,476,528	3,750,748,848	1,875,385,008	937,703,088	468,862,128
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

	Unit	3,840 GB	1,920 GB	960 GB	480 GB	240 GB
Sequential Read (128KB)	MB/s	550	550	550	550	550
Sequential Write (128KB)	MB/s	520	520	520	520	320

[Table 3] Sustained Random Read/Write Performance

	Unit	3,840 GB	1,920 GB	960 GB	480 GB	240GB
Random Read (4KB)	IOPS	98,000	98,000	98,000	98,000	98,000
Random Write (4KB)	IOPS	28,000	25,000	25,000	24,000	14,000

Note

1. Actual performance may vary based on users' conditions and environments such as system hardware and configuration.
2. Performance measured using FIO. 2.18 with queue depth 32, Z270 Intel SATA 6G port
3. Measurements are performed on whole LBA range.
4. Write cache enabled
5. 1 MB/s = 1,048,576 bytes/s is used in sequential performances

[Table 4] IOPS consistency

	3,840 GB	1,920 GB	960 GB	480 GB	240 GB
Random Read (4KB)	99%				
Random Write (4KB)	90%				

Note

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

[Table 5] Latency

	3,840 GB	1,920 GB	960 GB	480 GB	240 GB
Read (4KB)	140 us	140 us	120 us	120 us	120 us
Write (4KB)	40 us	40 us	40 us	40 us	70 us

Note

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

[Table 6] Quality of Service (QoS)

QoS 99%	3,840 GB	1,920 GB	960 GB	480 GB	240 GB
Read (4KB, QD1)	0.25 ms	0.25 ms	0.25 ms	0.25 ms	0.25 ms
Write (4KB, QD1)	0.15 ms	0.15 ms	0.15 ms	0.15 ms	0.15 ms
Read (4KB, QD32)	0.5 ms	0.5 ms	0.5 ms	0.5 ms	1.5 ms
Write (4KB, QD32)	2.7 ms	2.7 ms	2.7 ms	2.7 ms	2.7 ms

QoS 99.99%	3,840 GB	1,920 GB	960 GB	480 GB	240 GB
Read (4KB, QD1)	0.5 ms	0.5 ms	0.5 ms	0.5 ms	0.5 ms
Write (4KB, QD1)	0.3 ms	0.3 ms	0.3 ms	0.3 ms	0.3 ms
Read (4KB, QD32)	0.9 ms	0.9 ms	0.9 ms	0.9 ms	2 ms
Write (4KB, QD32)	3.2 ms	3.2 ms	3.2 ms	3.2 ms	3.2 ms

Note

1. OoS is measured using FIO 2.7 (99 and 99.99%) in Linux RHEL (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" released by SSD Form Factor Working Group.

[Table 8] Power Consumption

	3,840 GB	1,920 GB	960 GB	480 GB	240 GB
Active Read[1)]	3.6 W	3.4 W	3.1 W	2.9 W	2.6 W
Active Write[2)]	2.3 W	2.3 W	2.3 W	2.3 W	2.3 W
Idle[3)]	1.3 W	1.3 W	1.3 W	1.3 W	1.3 W

Note

1. Active Read power is measured on 4KB random read
2. Active Write power is measured on 128KB sequential write
3. Idle power is measured with DIPM off.

[Table 9] Inrush Current

Parameter	Requirements
Inrush Current	1.2 A, < 1 second

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

2.5 Environmental Specifications

[Table 10] Environmental Specifications

Features	Operating	Non-operating
Temperature[1)]	0 °C to 70 °C	-40 °C to 85 °C
Humidity	5% to 95%, non-condensing	
Shock	1500G, duration 0.5 ms, Half sine wave	
Vibration	20G, 20 ~ 2,000 Hz, Sinusoidal	

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 and UBER Specifications

Parameter	3,840 GB	1,920 GB	960 GB	480 GB	240 GB
Mean Time Between Failures (MTBF)[1)]	2,000,000 Hours				
UBER[2)]	1 sector per 10^{17} bits read				

Note

1. AS same word, annual failure ration is 0.438%
2. 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 applications, JEDEC recommends that UBER shall be below 10^{-16}

[Table 12] TotalBytes Written(TBW) and Drive Write Per Day(DWPD) Specifications

Parameter	3,840 GB	1,920 GB	960 GB	480 GB	240 GB
TBW[1)]	5,466 TB	2,733 TB	1,366 TB	683 TB	341 TB
DWPD[2)] (3-years)	1.3				

Note

1. TBW is measured while running 100 % random 4 KB writes across the entire SSD (TBW = DWPD x 365 x 3 x User capacity)
2. For 5- years warranty case, please contact your local Samsung sales representative.

[Table 13] Data Retention Specifications

Parameter	3,840 GB	1,920 GB	960 GB	480 GB	240 GB
Data Retention	3 months				

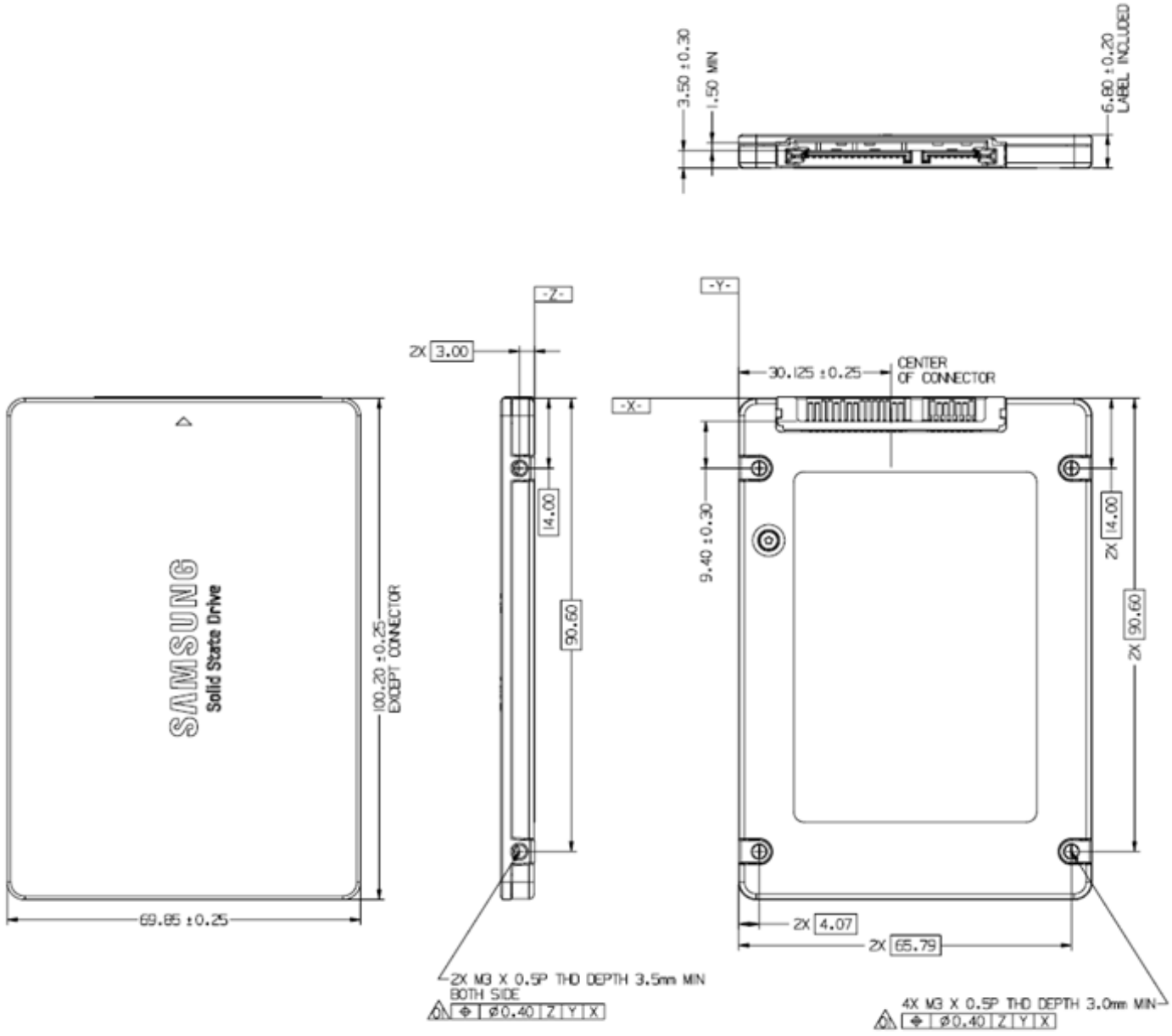
Note

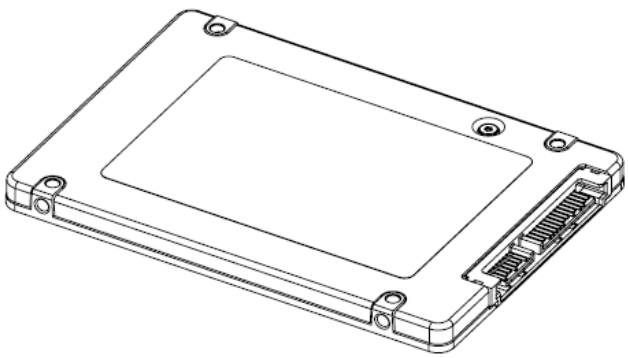
1. Data retention was measured by assuming that SSD reaches the maximum rated endurance at 40℃ in power-off state.

3 Mechanical Specifications

[Table 14] Physical Dimensions (mm) and Weight (gram)

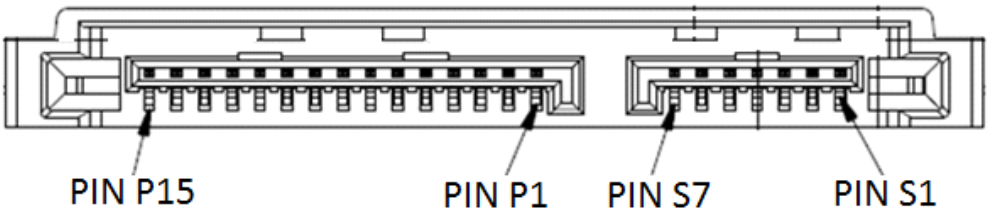
Model Capacity	Height	Width	Length	Weight
3,840/1,920/960/480/240 GB	6.80 ± 0.20	69.85 ± 0.25	100.20 ± 0.25	70 g (Max)





4 Electrical Interface Specification

4.1 Serial ATA Interface Connector



4.2 Pin Assignments

[Table 15] Pin Assignments[1)]

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	Retired	3rd mate
	P2	Retired	3rd mate
	P3	DEVSLP/PWDIS	2nd mate (Not Support DEVSLP)
	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	2 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

4.3 P3 Electrical Specification

Parameter	Value	Parameter	Value
Absolute Maximum Input Voltage	3.6 V	VIH(High Level Input Voltage)	2.03 V
VIL(Low Level Input Voltage)	1.98 V	Deglitch Time	5 us

5 Command Descriptions

5.1 Supported ATA Commands

[Table 16] Supported ATA Commands Summary

Command Name	Command code (Hex)	Command Name	Command code (Hex)
CHECK POWER MODE	E5h / 98h	SEND FPDMA QUEUED	64h
DEVICE CONFIGURATION	B1h	SEEK	70h
DOWNLOAD MICROCODE	92h	SET DATA N TIME	77h
DOWNLOAD MICROCODE DMA	93h	SET FEATURES	EFh
EXECUTE DEVICE DIAGNOSTIC	90h	SET MAX ADDRESS	F9h
FLUSH CACHE	E7h	SET MAX ADDRESS EXT	37h
FLUSH CACHE EXT	EAh	SET MULTIPLE MODE	C6h
IDENTIFY DEVICE	ECh	SLEEP	E6h / 99h
IDLE	E3h / 97h	S.M.A.R.T.	B0h
IDLE IMMEDIATE	E1h / 95h	STANDBY	E2h / 96h
INITIALIZE DEVICE PARMETERS	91h	STANDBY IMMEDIATE	E0h / 94h
NOP	00h	TRIM	06h
READ BUFFER	E4h	WRITE BUFFER	E8h
READ BUFFER DMA	E9h	WRITE BUFFER DMA	EBh
READ DMA	C8h	WRITE DMA	Cah
READ DMA (w/o retry)	C9h	WRITE DMA (w/o retry)	CBh
READ DMA EXT	25h	WRITE DMA EXT	35h
READ FPDMA QUEUED	60h	WRITE DMA FUA EXT	3Dh
READ LOG DMA EXT	47h	WRITE FPDMA QUEUED	61h
READ LOG EXT	2Fh	WRITE LOG DMA EXT	57h
READ MULTIPLE	C4h	WRITE LOG EXT	3Fh
READ MULTIPLE EXT	29h	WRITE MULTIPLE	C5h
READ NATIVE MAX ADDRESS	27h	WRITE MULTIPLE EXT	39h
READ NATIVE MAX ADDRESS EXT	F8h	WRITE MULTIPLE FUA EXT	CEh
READ SECTORS	20h	WRITE SECTORS	30h
READ SECTORS (w/o retry)	21h	WRITE SECTORS (w/o retry)	31h
READ SECTORS EXT	24h	WRITE SECTORS EXT	34h
READ VERIFY SECTORS	40h	WRITE UNCORRECTABLE EXT	45h
READ VERIFY SECTORS (w/o retry)	41h		
READ VERIFY SECTORS EXT	42h		
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		

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 17] 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 maybe 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

The device supports following Attribute ID numbers

[Table 18] SMART Attributes

ID	Attribute name	Status Flag	Threshold(%)
5	Reallocated Sector Count	110011	10
9	Power-on Hours	110010	-
12	Power-on Count	110010	-
177	Wear Leveling Count	010011	5
179	Used Reserved Block Count (total)	010011	10
180	Unused Reserved Block Count (total)	010011	10
181	Program Fail Count (total)	110010	10
182	Erase Fail Count (total)	110010	10
183	Runtime Bad Count (total)	010011	10
184	End to End Error data path Error count	110011	97
187	Uncorrectable Error Count	110010	-
190	Airflow Temperature	110010	-
194	Temperature	100010	-
195	ECC Error Rate	011010	-
197	Pending Sector Count	110010	-
199	CRC Error Count	111110	-
202	SSD Mode Status	110011	10
235	POR Recovery Count	010010	-
241	Total LBAs Written	110010	-
242	Total LBAs Read	110010	-
243	SATA Downshift Control	110010	-
244	Thermal Throttle Status	110010	-
245	Timed Workload Media Wear	110010	-
246	Timed Workload Host Read / Write Ratio	110010	-
247	Timed Workload Timer	110010	-
251	NAND Writes	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” allow 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.
  - 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).
- 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 and 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

6 Identify Device Data

Word	3,840 GB	1,920 GB	960 GB	480 GB	240 GB	General Information
0	0040h	0040h	0040h	0040h	0040h	Obsolete
1	3FFFh	3FFFh	3FFFh	3FFFh	3FFFh	Obsolete
2	C837h	C837h	C837h	C837h	C837h	Obsolete
3	0010h	0010h	0010h	0010h	0010h	Retired
4 - 5	0000h	0000h	0000h	0000h	0000h	Obsolete
6	003Fh	003Fh	003Fh	003Fh	003Fh	Obsolete
7 - 8	0000h	0000h	0000h	0000h	0000h	Reserved for the Compact Flash Association
9	0000h	0000h	0000h	0000h	0000h	Retired
10 - 19	XXXXh	XXXXh	XXXXh	XXXXh	XXXXh	Serial Number (ATA string)
20 - 21	0000h	0000h	0000h	0000h	0000h	Obsolete
22	0000h	0000h	0000h	0000h	0000h	Obsolete
23 – 26	XXXXh	XXXXh	XXXXh	XXXXh	XXXXh	Firmware Revision (ATA string)
27 - 46	XXXXh	XXXXh	XXXXh	XXXXh	XXXXh	Model Number
47	8010h	8010h	8010h	8010h	8010h	Read / Write Multiple Support
48	4000h	4000h	4000h	4000h	4000h	Trusted Computing Feature Set Options
49	2F00h	2F00h	2F00h	2F00h	2F00h	Capabilities
50	4000h	4000h	4000h	4000h	4000h	Capabilities
51 - 52	0200h	0200h	0200h	0200h	0200h	Obsolete
53	0007h	0007h	0007h	0007h	0007h	Obsolete
54	3FFFh	3FFFh	3FFFh	3FFFh	3FFFh	Obsolete
55	0010h	0010h	0010h	0010h	0010h	Obsolete
56	003Fh	003Fh	003Fh	003Fh	003Fh	Obsolete
57	FC10h	FC10h	FC10h	FC10h	FC10h	Obsolete
58	00FBh	00FBh	00FBh	00FBh	00FBh	Obsolete
59	BD10h	BD10h	BD10h	BD10h	BD10h	Multiple Logical Setting
60	FFFFh	FFFFh	FFFFh	FFFFh	FFFFh	Obsolete
61	0FFFh	0FFFh	0FFFh	0FFFh	0FFFh	Obsolete
62	0000h	0000h	0000h	0000h	0000h	Obsolete
63	0007h	0007h	0007h	0007h	0007h	Multi-word DMA Transfer
64	0003h	0003h	0003h	0003h	0003h	PIO Transfer Modes Supported
65	0078h	0078h	0078h	0078h	0078h	Minimum Multiword DMA Transfer Cycle Time per Word (ns)
66	0078h	0078h	0078h	0078h	0078h	Manufacturer's Recommended Multiword DMA Cycle Time (ns)
67	0078h	0078h	0078h	0078h	0078h	Minimum PIO Transfer Cycle Time without IORDY Flow Control (ns)

Word	3,840 GB	1,920 GB	960 GB	480 GB	240 GB	General Information
68	0078h	0078h	0078h	0078h	0078h	Minimum PIO Transfer Cycle Time with IORDY Flow Control (ns)
69	4F30h	4F30h	4F30h	4F30h	4F30h	Additional Supported
70 - 74	0000h	0000h	0000h	0000h	0000h	Reserved
75	001Fh	001Fh	001Fh	001Fh	001Fh	Queue Depth
76	850Eh	850Eh	850Eh	850Eh	850Eh	Serial ATA Capabilities
77	0066h	0066h	0066h	0066h	0066h	Serial ATA Additional Capabilities
78	0064h	0064h	0064h	0064h	0064h	Serial ATA Features Supported
79	0060h	0060h	0060h	0060h	0060h	Serial ATA Features Enabled
80	0FFCh	00FCh	00FCh	00FCh	00FCh	Major Version Number
81	005Eh	005Eh	005Eh	005Eh	005Eh	Minor Version Number
82	746Bh	746Bh	746Bh	746Bh	746Bh	Commands and Feature Sets Supported
83	7D01h	7D01h	7D01h	7D01h	7D01h	Commands and Feature Sets Supported
84	4163h	4163h	4163h	4163h	4163h	Commands and Feature Sets Supported or Enabled
85	7469h	7469h	7469h	7469h	7469h	Commands and Feature Sets Supported or Enabled
86	BC01h	BC01h	BC01h	BC01h	BC01h	Commands and Feature Sets Supported or Enabled
87	4163h	4163h	4163h	4163h	4163h	Commands and Feature Sets Supported or Enabled
88	407Fh	407Fh	407Fh	407Fh	407Fh	Ultra DMA Modes
89	0010h	0010h	0010h	0010h	0010h	Normal Security Erase Unit Time
90	0010h	0010h	0010h	0010h	0010h	Enhanced Security Erase Unit Time
91	0000h	0000h	0000h	0000h	0000h	Advanced Power Management Level
92	FFFEh	FFFEh	FFFEh	FFFEh	FFFEh	Master Password Revision Code
93	0000h	0000h	0000h	0000h	0000h	Hardware Reset Result
94	0000h	0000h	0000h	0000h	0000h	Obsolete
95	0000h	0000h	0000h	0000h	0000h	Stream Minimum Request Size
96	0000h	0000h	0000h	0000h	0000h	Streaming Transfer Time - DMA
97	0000h	0000h	0000h	0000h	0000h	Streaming Access Latency – DMA and PIO
98 - 99	0000h	0000h	0000h	0000h	0000h	Streaming Performance Granularity (DWord)
100-103	XXXXh	XXXXh	XXXXh	XXXXh	XXXXh	Total Number of User 48-Bit LBA
104	0000h	0000h	0000h	0000h	0000h	Streaming Transfer Time - PIO
105	0008h	0008h	0008h	0008h	0008h	Maximum Number of 512-byte Data Blocks of LBA Range Entries per DATA SET MANAGEMENT Command
106	6003h	6003h	6003h	6003h	6003h	Physical Sector Size / Logical Sector Size
107	0000h	0000h	0000h	0000h	0000h	Inter-seek Delay for ISO 7779 Standard Acoustic Testing
108	5002h	5002h	5002h	5002h	5002h	World Wide Name

Word	3,840 GB	1,920 GB	960 GB	480 GB	240 GB	General Information
109	538Ch	538Ch	538Ch	538Ch	538Ch	World Wide Name
110-111	XXXXh	XXXXh	XXXXh	XXXXh	XXXXh	World Wide Name
112-115	0000h	0000h	0000h	0000h	0000h	Reserved
116	0000h	0000h	0000h	0000h	0000h	Reserved for TLC
117-118	0000h	0000h	0000h	0000h	0000h	Logical Sector Size (Dword)
119	401Eh	401Eh	401Eh	401Eh	401Eh	Commands and Feature Sets Supported
120	401Ch	401Ch	401Ch	401Ch	401Ch	Commands and Feature Sets Supported or Enabled
121-126	0000h	0000h	0000h	0000h	0000h	Reserved for Expanded Supported and Enabled Settings
127	0000h	0000h	0000h	0000h	0000h	Obsolete
128	0021h	0021h	0021h	0021h	0021h	Security Status
129-159	0000h	0000h	0000h	0000h	0000h	Vendor Specific
160	0000h	0000h	0000h	0000h	0000h	CFA Power Mode
161-167	0000h	0000h	0000h	0000h	0000h	Reserved for the Compact Flash Association
168	0003h	0003h	0003h	0003h	0003h	Device Nominal Form Factor
169	0001h	0001h	0001h	0001h	0001h	DATA SET MANAGEMENT is Supported
170-173	2020h	2020h	2020h	2020h	2020h	Additional Product Identifier (ATA String)
174-175	0000h	0000h	0000h	0000h	0000h	Reserved
176-205	0000h	0000h	0000h	0000h	0000h	Current Media Serial Number
206	003Dh	003Dh	003Dh	003Dh	003Dh	SCT Command Transport
207-208	0000h	0000h	0000h	0000h	0000h	Reserved for CE-ATA
209	4000h	4000h	4000h	4000h	4000h	Alignment of Logical Blocks within a Physical Block
210-211	0000h	0000h	0000h	0000h	0000h	Write-Read-Verify Sector Count Mode 3
212-213	0000h	0000h	0000h	0000h	0000h	Write-Read-Verify Sector Count Mode 2
214	0000h	0000h	0000h	0000h	0000h	Obsolete
215-216	0000h	0000h	0000h	0000h	0000h	Obsolete
217	0001h	0001h	0001h	0001h	0001h	Nominal Media Rotation Rate
218	0000h	0000h	0000h	0000h	0000h	Reserved
219	0000h	0000h	0000h	0000h	0000h	Obsolete
220	0000h	0000h	0000h	0000h	0000h	Write-Read-Verify Mode
221	0000h	0000h	0000h	0000h	0000h	Reserved
222	10FFh	10FFh	10FFh	10FFh	10FFh	Transport Major Version Number
223	0000h	0000h	0000h	0000h	0000h	Transport Major Version Number
224-229	0000h	0000h	0000h	0000h	0000h	Reserved

Word	3,840 GB	1,920 GB	960 GB	480 GB	240 GB	General Information
230-233	0000h	0000h	0000h	0000h	0000h	Extended Number of User Addressable Sectors
234	0000h	0000h	0000h	0000h	0000h	Minimum Number of 512-byte Data Blocks per DOWNLOAD MICROCODE Command for Mode 03h
235	1400h	1400h	1400h	1400h	1400h	Maximum Number of 512-byte Data Blocks per DOWNLOAD MICROCODE Command for Mode 03h
236-242	0000h	0000h	0000h	0000h	0000h	Reserved
243	0000h	0000h	0000h	0000h	0000h	FDE Security Features
244-254	0000h	0000h	0000h	0000h	0000h	Reserved
255	XXA5h	XXA5h	XXA5h	XXA5h	XXA5h	Integrity Word

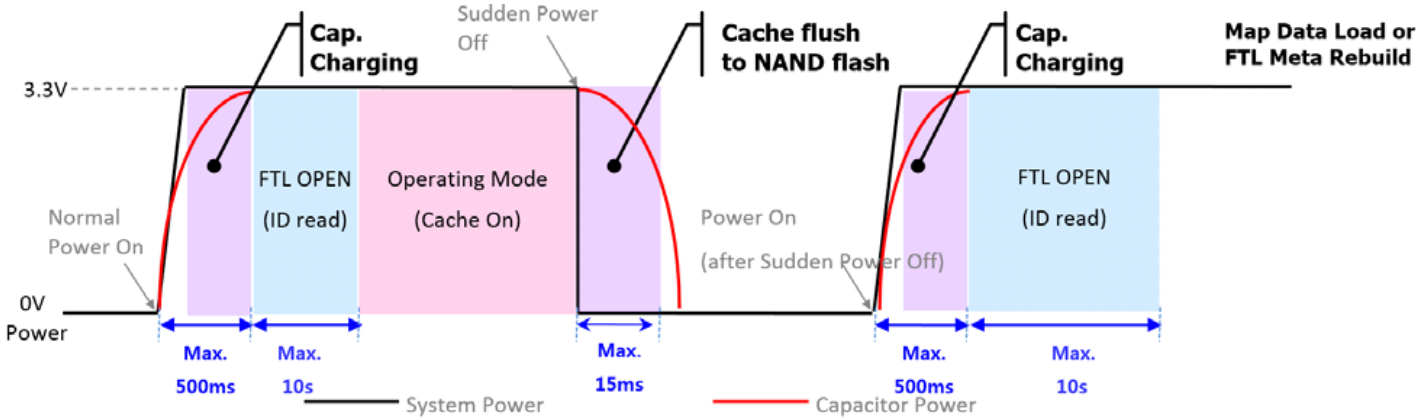
7 Sudden Power Off and Recovery(SPOR) Specification

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).



[Table 19] Device Ready Time for Normal Read/Write Operation after Sudden Power Off

Parameter	3,840 GB	1,920 GB	960 GB	480 GB	240 GB
Max. Open Time (sec)	10				

8 Product Compliance

[Table 20] Certifications and Declarations

Category	Certification
CE	Comunaute Europeenne
BSMI	BSMI Bureau of Standards, Metrology and Inspection
KCC	Korea Communications commission
VCCI	Voluntary Control Council for Interference
C-Tick	Radio Telecommunication Labeling
FCC	Federal Communications Commission
IC	Industry Canada
UL	Underwriters Laboratories, Inc.
TUV	Technischer Uberwachungs Verine e.V
CB	Scheme of the IECEE for Mutual Recognition of Test Certificates for Electrical Equipment

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 rea-sonable 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 encour-aged 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)*

9 References

[Table 21] Standards References

Item	Website
Serial ATA Revision 3.3	http://www.sata-io.org
ATA/ATAPI Command Set - 4 (ACS-4)	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