

SQFlash SMART ID Definition (For SATA Products)

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Revision History

Rev.	Date	History
1.0	2017/06/20	1. Preliminary
1.1	2020/01/15	1. Update attribute and support list
1.2	2021/11/18	1. Update Support controller
1.3	2022/04/26	1. Update SMART ID with decimal 2. Update support controller
1.4	2023/02/02	1. Add Endurance Information
1.5	2024/01/02	1. Update attribute for 100K PE Count. 2. Update support series
1.5.1	2024/01/26	1. Update attribute ID.

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1. Table of SMART ID

ID		ATTRIBUTE_NAME	DATA ADDRESS (Byte)					
Hex.	Dec.		10	9	8	7	6	5
01h	001	Raw_Read_Error_Rate	Uncorrectable ECC Count					
09h	009	Power_On_Hours	Power on Hours					
0Ch	012	Power_Cycle_Count	Power on/off counts					
0Eh	014	Device Capacity	0	0	Device Capacity			
0Fh	015	User Capacity	0	0	User Capacity			
10h	016	Initial Spare Blocks Available	0	0	Total Available Spare Block			
11h	017	Spare Blocks Remaining	0	0	Remaining Spare Block			
64h	100	Total Erase Count	0	0	Total Erase Count			
A8h	168	SATA PHY Error Count	SATA PHY Error Count					
AAh	170	Bad Block count	Later Bad Block			Early Bad Block		
ADh	173	Erase count	0	0	Avg. Erase		Max Erase	
AEh	174	Unexpected Power Loss Count	0	0	Unexpected Power Loss Count			
AFh	175	Power Failure Protection Status	Voltage Stabilizer Trigger Count		Guaranteed Flush (0x01 Enable)		Drive Status (0x00 Normal)	
C0h	192	Unexpected Power Loss Count	0	0	Unexpected Power Loss Count			
C2h	194	Temperature	Max Temp.		Min Temp.		Current Temp.	
CAh	202	Percentage of Spares Remaining	0	0	0	0	SSD Life Used	
DAh	218	CRC error	CRC Error Count					
E7h	231	SSD Life Remaining	0	0	0	0	SSD Life Left	
EAh	234	Total NAND Read	Total NAND Read (Sector, 512B)					
EBh	235	Total NAND Written	Total NAND Written (Sector, 512B)					
F1h	241	Total Host Write	Host Write (Sector, 512B)					
F2h	242	Total Host Read	Host Read (Sector, 512B)					
F4h	244	Average Erase Count	Average Erase Count					
F5h	245	Max Erase Count	Max Erase Count					

2. How to look up table

The raw data you get from the SQFlash Utility is Hex code, so you need to look up the table and transfer the Hex data to decimal data. Please refer to the below example:

I get the Temperature value from SSD.

C2 Temperature 001D0018001A

The Raw data is 001D0018001A. After I look up the table and separate the Raw data in to 3 value as below table.

ID	ATTRIBUTE_NAME	DATA ADDRESS (Byte)					
		10	9	8	7	6	5
C2h	Temperature	Max Temp.		Min Temp.		Current Temp.	
194		001D		0018		001A	

And then I can get 3 value,

Max Temp. = 001D (Hex) = 29 (decimal)

Min Temp. = 0018 (Hex) = 24 (decimal)

Current Temp. = 001A (Hex) = 26 (decimal)

3. SMART ID Statement

ID	ATTRIBUTE_NAME	DATA ADDRESS (Byte)					
		10	9	8	7	6	5
01h	Raw_Read_Error_Rate	Uncorrectable ECC Count					
01							

- **Raw_Read_Error_Rate:** Uncorrectable ECC Count is data error coding between SSD controller and NAND flash. This value need to be 0. If the value is not 0, there may be some problem between SSD controller and NAND flash.

ID	ATTRIBUTE_NAME	DATA ADDRESS (Byte)					
		10	9	8	7	6	5
09h	Power_On_Hours	Power on Hours					
09							

- **Power on Hours:** A counter that counts the power on time of the SSD, and the unit is hour.

ID	ATTRIBUTE_NAME	DATA ADDRESS (Byte)					
		10	9	8	7	6	5
0Ch	Power_Cycle_Count	Power on/off counts					
12							

- **Power_Cycle_Count:** When SSD has one power on and power off cycle, the counter will add one.

ID	ATTRIBUTE_NAME	DATA ADDRESS (Byte)					
		10	9	8	7	6	5
0Eh	Device Capacity	0	0	Device Capacity			
14							

- **Device Capacity:** This value is the capacity of the storage, each count equals to 512 Byte.

ID	ATTRIBUTE_NAME	DATA ADDRESS (Byte)					
		10	9	8	7	6	5
0Fh	User Capacity	0	0	User Capacity			
15							

- **User Capacity:** This Value is the capacity that the user can use, each count equal to 512 Byte.

ID	ATTRIBUTE_NAME	DATA ADDRESS (Byte)					
		10	9	8	7	6	5
10h	Initial Spare Blocks Available	0	0	Total Available Spare Block			
16							

- **Initial Spare Blocks Available:** The spare block counts when the SSD is newly made.

ID	ATTRIBUTE_NAME	DATA ADDRESS (Byte)					
		10	9	8	7	6	5
11h	Spare Blocks Remaining	0	0	Remaining Spare Block			
17							

- **Spare Blocks Remaining:** The current available spare blocks.

ID	ATTRIBUTE_NAME	DATA ADDRESS (Byte)					
		10	9	8	7	6	5
64h	Total Erase Count	0	0	Total Erase Count			
100							

- **Total Erase Count:** Sum of erase count from all blocks.

ID	ATTRIBUTE_NAME	DATA ADDRESS (Byte)					
		10	9	8	7	6	5
A8h	SATA PHY Error Count	SATA PHY Error Count					
168							

- **SATA PHY Error Count:** This value will record all PHY error count (ex data FIS CRC, code error, disparity error, command FIS CRC...). This value will reset to zero, after power off. If you found a lot of SATA PHY errors, please help to use a new SATA cable or check if the SATA connector is loose or not.

ID	ATTRIBUTE_NAME	DATA ADDRESS (Byte)					
		10	9	8	7	6	5
AAh	Bad Block count	Later Bad Block		0	0	Early Bad Block	
170							

- **Bad Block Count:** Block is a capacity unit of NAND flash. And the bad block is the damaged block that the SSD controller mark as “no use”. There are two kinds of bad blocks, one is Early bad block, another one is Later bad block.
 - Early bad block is the bad block that caused during manufacture. SQF standard is less than 2%.
 - Later bad block is caused by artificial usage. If the block has too many ECC, the SSD controller will mark the block as Later bad block. But it also need to check the erase count. If the SSD is going to run out of their lifetime, the Later bad blocks are normal.

ID	ATTRIBUTE_NAME	DATA ADDRESS (Byte)					
		10	9	8	7	6	5
ADh	Erase count	0	0	Avg. Erase		Max Erase	
173							

- **Erase Count:** It is the parameter that we check the lifetime of the SSD. There are two kind of erase count, one is average erase count and another one is max erase count. The endurance of the SSD will depend on NAND flash type, please refer to the below table. For example, if the average erase count of the SSD is over 3,000 times, it means the SSD is run out of their lifetime.

Flash Code	NAND flash type	Endurance (times)
S	SLC	60,000
U	Ultra MLC	30,000
M	MLC	3,000
V	3D TLC	3,000
C	3D cTLC	5,000
Z	3D sTLC	30,000 for BiCS3/4 50,000 for BiCS5

- Average erase count is the average of all block’s erase count.
- Max erase count is the biggest erase count of all blocks.

ID	ATTRIBUTE_NAME	DATA ADDRESS (Byte)					
		10	9	8	7	6	5
AEh 174	Unexpected Power Loss Count	0	0	Unexpected Power Loss Count			

- **Unexpected Power Loss Count:** If SSD power off before host issue standby command, the Unexpected Power Loss Count will add 1.

ID	ATTRIBUTE_NAME	DATA ADDRESS (Byte)					
		10	9	8	7	6	5
AFh 175	Power Failure Protection Status	Voltage Stabilizer Trigger Count		Guaranteed Flush (0x01 Enable)		Drive Status (0x00 Normal)	

- **Power Failure Protection Status:** The status of power failure protection related functions.
 - Voltage Stabilizer Trigger Count: the count of how many times Voltage Stabilizer circuit has been triggered.
 - Guaranteed Flush: the feature on/off status.
 - Drive Status: error code of power failure protection related functions.

ID	ATTRIBUTE_NAME	DATA ADDRESS (Byte)					
		10	9	8	7	6	5
COh 192	Unexpected Power Loss Count	0	0	Unexpected Power Loss Count			

- **Unexpected Power Loss Count:** If SSD power off before host issue standby command, the Unexpected Power Loss Count will add 1.

ID	ATTRIBUTE_NAME	DATA ADDRESS (Byte)					
		10	9	8	7	6	5
C2h 194	Temperature	Max Temp.		Min Temp.		Current Temp.	

- **Unexpected Power Loss Count:** The RAW value is divided inot 2 parts.
 - Current Temperature
 - Minimum Temperature
 - Maximum Temperature

ID	ATTRIBUTE_NAME	DATA ADDRESS (Byte)					
		10	9	8	7	6	5
CAh 202	Percentage of Spares Remaining	0	0	0	0	0	SSD Life Used

- **Percentage of Spares Remaining:** SSD Life Used, in percentage, calculated by average erase count and NAND reference erase count.

ID	ATTRIBUTE_NAME	DATA ADDRESS (Byte)					
		10	9	8	7	6	5
DAh 218	CRC error	CRC Error Count					

- **CRC Error:** It is the data error coding between controller and host. If the CRC error count is not 0, it means the SATA signal is not good. Please help to check the SATA trace from HOST (PCB layout, SATA cable, SATA connector).

ID	ATTRIBUTE_NAME	DATA ADDRESS (Byte)					
		10	9	8	7	6	5
E7h 231	SSD Life Remaining	0	0	0	0	0	SSD Life Left

- **SSD Life Remaining:** SSD Life Left in percentage, calculated by average erase count and NAND reference erase count. **SSD Life Left = 1 – (Avg erase count / endurance) %**

ID	ATTRIBUTE_NAME	DATA ADDRESS (Byte)					
		10	9	8	7	6	5
EAh 234	Total NAND Read	Total NAND Read (Sector, 512B)					

- **Total NAND Read:** The total data size that SSD controller read from NAND flash. The unit is sector (512Byte).

ID	ATTRIBUTE_NAME	DATA ADDRESS (Byte)					
		10	9	8	7	6	5
EBh 235	Total NAND Written	Total NAND Written (Sector, 512B)					

- **Total NAND Written:** The total data size that SSD controller write to NAND flash. The unit is sector (512Byte).

ID	ATTRIBUTE_NAME	DATA ADDRESS (Byte)					
		10	9	8	7	6	5
F1h	Total Host Write	Host Write (Sector, 512B)					
241							

- **Total Host Write:** The total data size that Host write to SSD. The unit is sector (512Byte).

ID	ATTRIBUTE_NAME	DATA ADDRESS (Byte)					
		10	9	8	7	6	5
F2h	Total Host Read	Host Read (Sector, 512B)					
242							

- **Total Host Read:** The total data size that Host read from SSD. The unit is sector (512Byte).

ID	ATTRIBUTE_NAME	DATA ADDRESS (Byte)					
		10	9	8	7	6	5
F4h	Average Erase Count	Average Erase Count					
244							

- **Average Erase Count:** the average of all block's erase count for 100K PE count solution.

Flash Code	NAND flash type	Endurance (times)
H	3D sTLC	100,000

ID	ATTRIBUTE_NAME	DATA ADDRESS (Byte)					
		10	9	8	7	6	5
F5h	Max Erase Count	Max Erase Count					
245							

- **Max erase count:** The biggest erase count of all blocks for 100K PE count solution.

Flash Code	NAND flash type	Endurance (times)
H	3D sTLC	100,000

4. Support List

Product Series	Remark
SQFlash 830 series	Including 830-V series
SQFlash 910 series	Renamed as 830-V
SQFlash 640 series	All series support
SQFlash 650 series	All series support
SQFlash 840 series	Including 840-C/ 840-V series
AMF SP111 series	
AMF SM121 series	
SQFlash 660 series	