

# SQFlash SMART ID Definition

## (For 830, 910, 640 Series)

|                     |             |                  |             |                       |                |
|---------------------|-------------|------------------|-------------|-----------------------|----------------|
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## 1. Table of SMART ID

| ID   | ATTRIBUTE_NAME                  | DATA ADDRESS (Byte)                 |   |                             |                                   |                             |                               |
|------|---------------------------------|-------------------------------------|---|-----------------------------|-----------------------------------|-----------------------------|-------------------------------|
|      |                                 | 10                                  | 9 | 8                           | 7                                 | 6                           | 5                             |
| 01h  | Raw_Read_Error_Rate             | Uncorrectable ECC Count             |   |                             |                                   |                             |                               |
| 09h  | Power_On_Hours                  | Power on Hours                      |   |                             |                                   |                             |                               |
| 0Ch  | Power_Cycle_Count               | Power on/off counts                 |   |                             |                                   |                             |                               |
| 0Eh  | Device Capacity                 | 0                                   | 0 | Device Capacity             |                                   |                             |                               |
| 0Fh  | User Capacity                   | 0                                   | 0 | User Capacity               |                                   |                             |                               |
| 10h  | Initial Spare Blocks Available  | 0                                   | 0 | Total Available Spare Block |                                   |                             |                               |
| 11h  | Spare Blocks Remaining          | 0                                   | 0 | Remaining Spare Block       |                                   |                             |                               |
| 64h  | Total Erase Count               | 0                                   | 0 | Total Erase Count           |                                   |                             |                               |
| A8h  | SATA PHY Error Count            | SATA PHY Error Count                |   |                             |                                   |                             |                               |
| AAh  | Bad Block count                 | Later Bad                           |   | 0                           | 0                                 | Early Bad                   |                               |
| ADh  | Erase count                     | 0                                   | 0 | Avg. Erase                  |                                   | Max Erase                   |                               |
| A Eh | Unexpected Power Loss Count     | 0                                   | 0 | Unexpected Power Loss Count |                                   |                             |                               |
| AFh  | Power Failure Protection Status | Voltage Stabilizer Trigger<br>Count |   |                             | Guaranteed Flush<br>(0x01 Enable) |                             | Drive Status<br>(0x00 Normal) |
| C0h  | Unexpected Power Loss Count     | 0                                   | 0 | 0                           | 0                                 | Unexpected Power Loss Count |                               |
| C2h  | Temperature                     | Max Temp.                           |   | Min Temp.                   |                                   | Current Temp.               |                               |
| CAh  | Percentage of Spares Remaining  | 0                                   | 0 | 0                           | 0                                 | 0                           | SSD Life Used                 |
| DAh  | CRC error                       | CRC Error Count                     |   |                             |                                   |                             |                               |
| E7h  | SSD Life Remaining              | 0                                   | 0 | 0                           | 0                                 | 0                           | SSD Life Left                 |
| EAh  | Total NAND Read                 | Total NAND Read (Sector, 512B)      |   |                             |                                   |                             |                               |
| EBh  | Total NAND Written              | Total NAND Written (Sector, 512B)   |   |                             |                                   |                             |                               |
| F1h  | Total Host Write                | Host Write (Sector, 512B)           |   |                             |                                   |                             |                               |
| F2h  | Total Host Read                 | Host Read (Sector, 512B)            |   |                             |                                   |                             |                               |

## 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. |   |
|     |                | 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 |   |   |   |   |   |

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      |   |   |   |   |   |

Power on Hours is 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 |   |   |   |   |   |

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 |   |   |   |

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 |   |   |   |

This Value is the capacity that 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 |   |   |   |

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 |   |   |   |

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 |   |   |   |

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 |   |   |   |   |   |

SATA PHY Error Count 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 error, please help to use 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           |   | 0 | 0 | Early Bad |   |

Block is a capacity unit of NAND flash. And the bad block is the damaged block that SSD controller mark as “no use”. There are two kind of bad block, 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 |   |

Erase count 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.

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

The endurance of the SSD will depend on NAND flash type, please refer to the below table:

| NAND flash type | Endurance (times) |
|-----------------|-------------------|
| MLC             | 3,000             |
| UltraMLC        | 30,000            |
| SLC             | 100,000           |

For example, if the average erase count of the MLC SSD is over 3,000 times, it means the SSD is run out of their lifetime.

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

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 |
| C0h | Unexpected Power Loss Count | 0                   | 0 | 0 | 0 | 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 | Temperature    | Max Temp.           |   | Min Temp. |   | Current Temp. |   |

Current Temperature / Minimum Temperature / Maximum Temperature



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

SSD Life Used, in percentage, calculated by average erase count and NAND reference erase count.

$$\text{SSD Life Left} = (\text{Avg. erase count} / \text{endurance})\%$$

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

CRC error 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 | SSD Life Remaining | 0                   | 0 | 0 | 0 | 0 | SSD Life Left |

SSD Life Left, in percentage, calculated by average erase count and NAND reference erase count.

$$\text{SSD Life Left} = 1 - (\text{Avg erase count} / \text{endurance})\%$$

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

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 | Total NAND Written | Total NAND Written (Sector, 512B) |   |   |   |   |   |

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) |   |   |   |   |   |

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) |   |   |   |   |   |

The total data size that Host read from SSD. The unit is sector (512Byte).