For Data Centers

S.M.A.R.T.

Self-Monitoring, Analysis and Reporting Technology

Application note

Self-Monitoring, Analysis and Reporting Technology

S.M.A.R.T.

1. What is S.M.A.R.T. ?

SMART (also written S.M.A.R.T.), which stands for Self-Monitoring, Analysis and Reporting Technology, is an industry standard reliability prediction indicator for both IDE/ATA and SCSI storage drives. When analyzing SMART attributes, it is very important to remember that they vary in meaning and interpretation by manufacturer. SMART simply refers to a signaling method between sensors in the drive and the host computer.

2. Technology Overview

S.M.A.R.T. monitors computer drives to detect and report on various reliability indicators. The technology aims to anticipate failures and warn users of impending drive failure, allowing the user to replace an ailing drive to avoid data loss and/or unexpected outages. Of course, SMART can only warn of predictable errors, which result from slow processes like mechanical wear and can be predicted by analyzing certain indicators (such mechanical problems accounted for 60% of HDD failures). Unpredictable failures, like a sudden mechanical failure resulting from an electrical surge, have no measurable variables to track and analyze. Modern SMART implementations (in HDDs) also try to prevent failures by attempting to detect and repair sector errors. All data and all sectors are tested to confirm the drive's health during periods of inactivity.

In addition to the functions discussed above and the individual SMART attributes outlined in the next section, SMART- enabled drives are also capable of reporting a SMART status. This status represents one of two values, usually "drive OK" and "drive fail" or "threshold not exceeded" and "threshold exceeded." A "drive fail" or "threshold exceeded" value indicates there is a high probability the drive will fail in the future; however, the failure may not be catastrophic – the SMART Status simply indicates that the drive will not perform within the manufacturer's declared specifications. So, for example, rather than complete data loss, the drive may simply begin to run slower. As with any technology, the SMART status is not infallible and may not necessarily indicate past or present reliability. The SMART sensors may malfunction, for instance, or a serious mechanical failure may destroy access to the SMART status.

Finally, it is important to remember that SMART attributes vary in both meaning and interpretation by manufacturer. Some attributes are considered trade secrets, and not all drives report the same SMART attributes. A manufacturer, in theory, could report only one SMART value and advertise its drive as SMART-enabled. The SMART standard simply refers to a signaling method between sensors in the drive and the host computer, not a standardization of the attributes themselves.

3. S.M.A.R.T. Attributes

The following represents S.M.A.R.T. attributes supporting 845 DC PRO and EVO.

ID		
5	Reallocated Sector Count	The raw value of this attribute represents the number of sectors that have been moved as a result of a read error, write error, or a verification error. If the firmware detects any of these types of errors, all valid data in the block the error originates from must be transferred to a new block. This number should be low because a high number would indicate a large number of failures.
9	Power-on Hours	The raw value of this attribute shows the total count of hours the drive has spent in the power-on state.
12	Power-on Count	The raw value of this attribute reports the cumulative number of power on/off cycles. This includes both sudden power off and normal power off cases.
177	Wear Leveling Count	This attribute represents the number of times a block has been erased. This value is directly related to the lifetime of the SSD. The raw value of this attribute shows the average erase cycles of total blocks.
179	Used Reserved Block Count (total)	This attribute represents the number of reserved blocks that have been used as a result of a read, program or erase failure. This value is related to attribute 5 (Reallocated Sector Count) and will vary based on SSD density.
180	Unused Reserved Block Count (total)	This attribute represents the number of reserved blocks in case that the device does not use blocks being allocated for read, program, erase operation.
181	Program Fail Count (total)	This attribute represents a total count of the number of failed program requests (failed writes).
182	Erase Fail Count (total)	This attribute represents a total count of the number of failed erase requests.
183	Runtime Bad Count (total)	Equal to the sum of the Program Fail count (attribute 181), the Program Erase Fail count (attribute 182), and the Read Fail count. This summary value represents the total count of all read/program/erase failures.
184	End to End Error data path Error Count	The number of errors encountered within the SSD data path from host to NAND or from NAND to host.
187	Uncorrectable Error Count	The total number of errors that could not be recovered using ECC.
190	Airflow Temperature	The current temperature of the area surrounding the NAND chips inside of the SSD.

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ID		
195	ECC Error Rate	The percentage of ECC correctable errors.
199	CRC Error Count	The number of Cycle Redundancy Check (CRC) errors. If there is a problem between the host and the SSD, the CRC engine will tally the error and store it in this attribute.
202	SSD Mode Status	This represents the internal SSD status. When the device operates normally, it shows 0x00 When the tantal-cap fails, it shows 0x10 When the mode is on Read only service, it shows 0x20
235	POR Recovery Count	A count of the number of sudden power off cases. If there is a sudden power off, the firmware must recover all of the mapping and user data during the next power on. This is a count of the number of times this has happened.
241	Total LBA Written	Represents the total size of all LBAs (Logical Block Address) required for all of the write requests sent to the SSD from the OS. To calculate the total size (in Bytes), multiply the raw value of this attribute by 512B.
242	Total LBA Read	This represents the total size of all LBAs (Logical Block Address) read count.
250	SATA Interface Downshifts (total)	This attribute is used to count the number of interface downshifts encountered between the host and the device. If the current connection speed is lower than the previous negotiation speed. The interface downshift count increases.

< Magician ver 1.0 for 845 DC PRO/EVO >

```
[root@localhost 64bin]# ./magician -d 2:0:1 -S
================================================================================
Samsung(R) SSD Magician DC Version 1.0
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================================================================================

Disk Number: 2:0:1 | Model Name: Samsung SSD 845DC PRO 800GB | Firmware Version: DXV8AX3Q

| ID  |  Description                                  |  Raw     |  Normalized |  Worst |  Threshold |  Status |
|-----|-----------------------------------------------|----------|-------------|--------|------------|---------|
| 5   | Reallocated Sector Count                      | 0        | 100         | 100    | 10         | OK      |
| 9   | Power-on Hours                                | 0        | 100         | 100    | 0          | OK      |
| 12  | Power-on Count                                | 16       | 99          | 99     | 0          | OK      |
| 177 | Wear Leveling Count                           | 0        | 100         | 100    | 5          | OK      |
| 179 | Used Reserved Block Count (total)             | 0        | 100         | 100    | 10         | OK      |
| 180 | Unused Reserved Block Count (total) - Warranty| 7040     | 100         | 100    | 10         | OK      |
| 181 | Program Fail Count (total)                    | 0        | 100         | 100    | 0          | OK      |
| 182 | Erase Fail Count (total)                      | 0        | 100         | 100    | 0          | OK      |
| 183 | Runtime Bad Count (total)                     | 0        | 100         | 100    | 10         | OK      |
| 184 | Error Detection                               | 0        | 100         | 100    | 97         | OK      |
| 187 | Uncorrectable Error Count                     | 0        | 100         | 100    | 0          | OK      |
| 190 | Airflow Temperature                           | 33       | 67          | 67     | 0          | OK      |
| 195 | ECC Error Rate                                | 0        | 200         | 200    | 0          | OK      |
| 199 | CRC Error Count                               | 0        | 100         | 100    | 0          | OK      |
| 202 | SSD Mode Status                               | 0        | 100         | 100    | 10         | OK      |
| 235 | POR Recovery Count                            | 5        | 99          | 99     | 0          | OK      |
| 241 | Total LBAs Written                            | 1972942  | 99          | 99     | 0          | OK      |
| 242 | Total LBAs Read                               | 1987706  | 99          | 99     | 0          | OK      |
| 250 | SATA Interface Downshifts (total)             | 0        | 100         | 100    | 1          | OK      |

DRIVE HEALTH STATUS : GOOD
```