SMART ATTRIBUTE DETAILS of SP Industrial PCIe NVMe SSD

Overview

SMART (Self-Monitoring, Analysis and Reporting Technology) is an open standard used by drives and hosts to monitor drive health and report potential problems. This application note describes how to get SMART attributes supported by Silicon Power Industrial PCIe NVMe SSD for different platforms and operation systems.

Intel/AMD x86 architecture Platform

- Windows 10: Please download the latest SP Toolbox for Windows 10 from SP official website.
  https://www.silicon-power.com/web/download-ToolBox
- Linux Ubuntu 20.04 64 bit: Linux version SP Toolbox download link by request (SSD designation “nvme0”)
  # sudo ./smartctl -a /dev/nvme0

ARM architecture Platform

- Linux Ubuntu 20.04 64 bit: Linux version SP Toolbox download link by request (SSD designation “nvme0”)
  # sudo ./smartctl -a /dev/nvme0

```
=== START OF SMART DATA SECTION ===
SMART overall-health self-assessment test result: PASSED

SMART/Health Information (NVMe Log 0x02)
Critical Warning:                   0x00
Temperature:                        47 Celsius
Available Spare:                    100%
Available Spare Threshold:          5%
Percentage Used:                    0%
Data Units Read:                    82 [41.9 MB]
Data Units Written:                 0
Host Read Commands:                 2,956
Host Write Commands:                0
Controller Busy Time:               0
Power Cycles:                       203
Power On Hours:                     165
Unsafe Shutdowns:                   175
Media and Data Integrity Errors:    0
Error Information Log Entries:      6
Warning  Comp. Temperature Time:    0
Critical Comp. Temperature Time:    0
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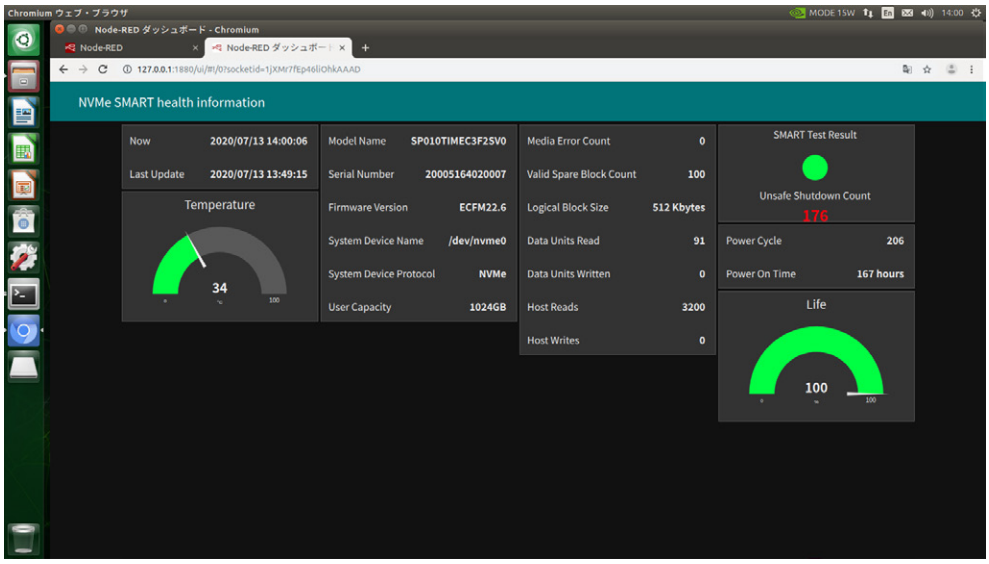
- GUI Mode SP Dashboard:
  - Visual programing environment: IBM Node Red
  - SP Dashboard IBM Node Red script file: download by request



SMART Attribute Details (NVMe 1.3)

The following table lists the SMART attributes supported by SP Industrial PCIe NVMe SSD.

# of Bytes	Byte Index	Attributes	Description
1	0	Critical Warning: Bit Definition 00: If set to '1', then the available spare space has fallen below the threshold. 01: If set to '1', then a temperature is above an over temperature threshold or below an under temperature threshold. 02: If set to '1', then the NVM subsystem reliability has been degraded due to signifi-cant media related errors or any internal error that degrades NVM subsystem reliability. 03: If set to '1', then the media has been placed in read only mode. 04: If set to '1', then the volatile memory backup device has failed. This field is only valid if the controller has a volatile memory backup solution. 07:05: Reserved	This field indicates critical warnings for the state of the controller. Each bit corresponds to a critical warning type; multiple bits may be set. If a bit is cleared to '0', then that critical warning does not apply. Critical warnings may result in an asynchronous event notification to the host. Bits in this field represent the current associated state and are not persistent.
2	2:1	Composite Temperature:	Contains a value corresponding to a temperature in degrees Kelvin that represents the current composite temperature of the controller and namespace(s) associated with that controller. The manner in which this value is computed is implementation specific and may not represent the actual temperature of any physical point in the NVM subsystem. The value of this field may be used to trigger an asynchronous event. Warning and critical overheating composite tempera-ture threshold values are reported by the WCTEMP and CCTEMP fields in the Identify Controller data structure.

# of Bytes	Byte Index	Attributes	Description
1	3	Available Spare:	Contains a normalized percentage (0 to 100%) of the remaining spare capacity available
1	4	Available Spare Threshold:	When the Available Spare falls below the threshold indicated in this field, an asynchronous event completion may occur. The value is indicated as a normalized percentage (0 to 100%).
1	5	Percentage Used:	Contains a vendor specific estimate of the percentage of NVM subsystem life used based on the actual usage and the manufacturer's prediction of NVM life. A value of 100 indicates that the estimated endurance of the NVM in the NVM subsystem has been consumed, but may not indicate an NVM subsystem failure. The value is allowed to exceed 100. Percentages greater than 254 shall be represented as 255. This value shall be updated once per power-on hour (when the controller is not in a sleep state). Refer to the JEDEC JESD218A standard for SSD device life and endurance measurement techniques.
	31:6	Reserved	
16	47:32	Data Units Read:	Contains the number of 512 byte data units the host has read from the controller; this value does not include metadata. This value is reported in thousands (i.e., a value of 1 corresponds to 1000 units of 512 bytes read) and is rounded up. When the LBA size is a value other than 512 bytes, the controller shall convert the amount of data read to 512 byte units. For the NVM command set, logical blocks read as part of Compare and Read operations shall be included in this value.
16	63:48	Data Units Written:	Contains the number of 512 byte data units the host has written to the controller; this value does not include metadata. This value is reported in thousands (i.e., a value of 1 corresponds to 1000 units of 512 bytes written) and is rounded up. When the LBA size is a value other than 512 bytes, the controller shall convert the amount of data written to 512 byte units. For the NVM command set, logical blocks written as part of Write operations shall be included in this value. Write Uncorrectable commands shall not impact this value.
16	79:64	Host Read Commands:	Contains the number of read commands completed by the controller. For the NVM command set, this is the number of Compare and Read commands.
16	95:80	Host Write Commands:	Contains the number of write commands completed by the controller. For the NVM command set, this is the number of Write commands.
16	111:96	Controller Busy Time:	Contains the amount of time the controller is busy with I/O commands. The controller is busy when there is a command outstanding to an I/O Queue (specifically, a command was issued via an I/O Submission Queue Tail doorbell write and the corresponding completion queue entry has not been posted yet to the associated I/O Completion Queue). This value is reported in minutes.
16	127:112	Power Cycles: Contains the number of power cycles.	

# of Bytes	Byte Index	Attributes	Description
16	143:128	Power On Hours:	Contains the number of power-on hours. Power on hours is always logging, even when in low power mode.
16	159:144	Unsafe Shutdowns:	Contains the number of unsafe shutdowns. This count is incremented when a shutdown notification (CC.SHN) is not received prior to loss of power.
16	175:160	Media and Data Integrity Errors:	Contains the number of occurrences where the controller detected an unrecovered data integrity error. Errors such as uncorrectable ECC, CRC checksum failure, or LBA tag mismatch are included in this field.
16	191:176	Number of Error Information Log Entries:	Contains the number of Error Information log entries over the life of the controller.
4	195:192	Warning Composite Temperature Time:	Contains the amount of time in minutes that the controller is operational and the Composite Temperature is greater than or equal to the Warning Composite Temperature Threshold (WCTEMP) field and less than the Critical Composite Temperature Threshold (CCTEMP) field in the Identify Controller data structure. If the value of the WCTEMP or CCTEMP field is 0h, then this field is always cleared to 0h regardless of the Composite Temperature value.
4	199:196	Critical Composite Temperature Time:	Contains the amount of time in minutes that the controller is operational and the Composite Temperature is greater the Critical Composite Temperature Threshold (CCTEMP) field in the Identify Controller data structure. If the value of the CCTEMP field is 0h, then this field is always cleared to 0h regardless of the Composite Temperature value.
2	201:200	Reserved	
2	203:202	Reserved	
2	205:204	Reserved	
2	207:206	Reserved	
2	209:208	Reserved	
2	211:210	Reserved	
2	213:212	Reserved	
2	215:214	Reserved	
296	511:216	Reserved	