

S.M.A.R.T. (Self-Monitoring, Analysis and Reporting Technology) for **Kesender** series

What is “SMART”?

S.M.A.R.T. (Self-Monitoring, Analysis and Reporting Technology) is implemented into all of the modern hard disks. A special program inside the disk constantly keeps tracking the condition of a range of the vital parameters: driver, disk heads, surface state, electronics, etc.

S.M.A.R.T. technology is able to predict future problems! In order to test and read this SMART information, you firstly have to retrieve it from the disk and analyze it. This is one of the Kesender features and you can use to test hard drives as well.

SMART Attributes

Each drive manufacturer defines a set of attributes and selects threshold values which should not be exceeded under normal operation. Attribute values can range from 1 to 253 (1 representing the worst case and 253 representing the best). **Manufacturers do not necessarily agree on precise attribute definitions and measurement units; therefore the following list should be regarded as a general reference only**

*The SMART attributes are not standardized among hard drive manufacturers; therefore **BEST PRACTICE is to use Kesender series to read RAW SMART data** instead of reading attribute or interpretation by computer soft wares. (Software Company does great job to speculate the SMART uniqueness; however there is limit for reverse engineering...)

*SMART Attribute**See appendix-A for details

| ID | Attribute Name |
|--------------|--|
| ID0 | (Show to be unused attribute data) |
| ID1 | Read Error Rate |
| ID2 | Through Put Performance |
| ID3 | Spin Up Time |
| ID4 | Start/Stop Count |
| ID5 | Reallocated Sector Count |
| ID6 | -- |
| ID7 | Seek Error Rate |
| ID8 | Seek Time Performance |
| ID9 | Power On Hours Count |
| ID10 | Spindle Motor Start Retry Count |
| ID 12 | Power On/Off Count |
| ID13 – ID198 | (Reserved) |
| DI 199 | Ultra ATA CRC Error Rate |
| ID 200 | Write Error Rate |
| ID 201-255 | (Vender Unique) |
| IDA | Spin Retry Count |
| IDB | -- |
| IDC | Power Cycle Count |
| IDC2 | Temperature |
| IDC3 | Hardware ECC recovered |
| IDC4 | Reallocation Event Count |

***Commonly Monitor Attributes**

Kesender Series Advantage

<TEST> **“You can perform complete SMART related TESTS!”**

SMART STATUS TEST

This will retrieve SMART status for each attributes from the disk and judge if any attribute is over manufacturer’s threshold value. If any attribute is over threshold, Kesender will return [RETURN STATUS ERR].

SMART QUICK TEST

This will test the hard drive according to the critical SMART attributes and judge if any attribute is over manufacturer’s threshold value. If any attribute is over, Kesender will return [SELF TEST ERR].

SMART COMPREHENSIVE TEST

This will test the hard drive according to all SMART attributes and judge if any attribute is over manufacturer’s threshold value. If any attribute is over, Kesender will return [SELF TEST ERR].

<ANALYSIS> **“You can analyze COMPLETE raw SMART data!”**

**This is HEX value extractions from raw SMART data table*

| SMART Information | | | | |
|-------------------|---------------------------|-----------|----------------------|-----------|
| ID | Name | Parameter | Recorded Worst Value | Threshold |
| 1 | READ_ERROR_RATE | 0042 | 3B | 06 |
| 2 | THROUGHPUT_PERFORMANCE | | | |
| 3 | SPIN_UP_TIME | 0062 | 62 | 00 |
| 4 | START/STOP_COUNT | 0064 | 64 | 14 |
| 5 | REALLOCATED_SECTOR_COUNT | 0064 | 64 | 24 |
| 6 | READ_CHANNEL_MARGIN_TEST | | | |
| 7 | SEEK_ERROR_RATE | 003F | 3C | 1E |
| 8 | SEEK_TIME_PERFORMANCE | | | |
| 9 | POWER_ON_HOURS_COUNT | 0064 | 64 | 00 |
| A | SPIN_RETRY_COUNT | 0064 | 64 | 61 |
| B | RECALIBRATION_RETRY_COUNT | | | |
| C | POWER_OFF_RETRACT_COUNT | 0064 | 64 | 14 |
| D | RESERVED | | | |

*Kesender SMART DATA TABLE consist of 24 bytes and first 12 bytes are for Actual Value and the last 12 bytes are for THRESHOLD

First 12 bytes: SMART READ

The screenshot shows the 'CH 1 SMART Info' window. It has a 'General' tab selected. Below the tab is a grid with 24 columns labeled 'ID Number' from 1 to 24. The first 12 columns (1-12) are enclosed in a purple border, and the last 12 columns (13-24) are enclosed in a brown border. A box above the grid points to the purple border, and a box below points to the brown border.

(Refer www.t13.org -ATA standard- for SMART)

Last 12 bytes: SMART READ

-----APPENDIX-A-----

Attributes

Attributes are being used to retrieve current physical/logical state of a drive and to show their meaning in much more readable form for end-user.

Each attribute can have a certain collection of flags:

- **Pre-failure warranty attribute (PW)** - indicates a pre-failure condition (caused by exceeded threshold) where imminent loss of data is being predicted
- **Online collection attribute (OC)** - indicates that the value of this attribute is calculated during Online test
- **Performance attribute (PE)** - indicates degradation of performance caused by usage or age of a drive
- **Error rate attribute (ER)** - indicates that attribute measure frequency of errors
- **Error count attribute (EC)** - indicates that attribute is a counter of events
- **Self-preserving attribute (SP)** - indicates that attribute is automatically preservable and restored each time when performing S.M.A.R.T. tests

Threshold is the worst value for attribute. Any value lower than (or equal to) threshold means decreased performance or even hard disk failure.

| ID | Name of attribute | Description |
|-----|--------------------------|---|
| 1 | Raw Read Error Rate | Frequency of errors appearance while reading RAW data from a disk |
| 2 | Throughput Performance | The average efficiency of hard disk |
| 3 | Spin Up Time | Time needed by spindle to spin-up |
| 4 | Start/Stop Count | Number of start/stop cycles of spindle |
| 5 | Reallocated Sector Count | Quantity of remapped sectors |
| 6 | Read Channel Margin | Reserve of channel while reading |
| 7 | Seek Error Rate | Frequency of errors appearance while positioning |
| 8 | Seek Time Performance | The average efficiency of operations while positioning |
| 9 | Power-On Hours Count | Quantity of elapsed hours in the switched-on state |
| 10 | Spin-up Retry Count | Number of attempts to start a spindle of a disk |
| 11 | Calibration Retry Count | Number of attempts to calibrate a drive |
| 12 | Power Cycle Count | Number of complete start/stop cycles of hard disk |
| 13 | Soft Read Error Rate | Frequency of "program" errors appearance while reading data from a disk |
| 191 | G-Sense Error Rate | Frequency of mistakes appearance as a result of impact loads |
| 192 | Power-Off Retract Cycle | Number of the fixed 'turning off drive' cycles (Fujitsu: Emergency Retract Cycle Count) |
| 193 | Load/Unload Cycle Count | Number of cycles into Landing Zone position |
| 194 | HDA Temperature | Temperature of a Hard Disk Assembly |
| 195 | Hardware ECC Recovered | Frequency of the on the fly errors (Fujitsu: ECC On The Fly Count) |
| 196 | Reallocated Event Count | Quantity of remapping operations |

| | | |
|-----|-----------------------------------|---|
| 197 | Current Pending Sector Count | Current quantity of unstable sectors (waiting for remapping) |
| 198 | Off-line Scan Uncorrectable Count | Quantity of uncorrected errors |
| 199 | UltraDMA CRC Error Rate | Total quantity of errors CRC during UltraDMA mode |
| 200 | Write Error Rate | Frequency of errors appearance while recording data into disk (Western Digital: Multi Zone Error Rate) |
| 201 | Soft Read Error Rate | Frequency of the off track errors (Maxtor: Off Track Errors) |
| 202 | Data Address Mark Errors | Frequency of the Data Address Mark errors |
| 203 | Run Out Cancel | Frequency of the ECC errors (Maxtor: ECC Errors) |
| 204 | Soft ECC Correction | Quantity of errors corrected by software ECC |
| 205 | Thermal Asperity Rate | Frequency of the thermal asperity errors |
| 206 | Flying Height | The height of the disk heads above the disk surface |
| 207 | Spin High Current | Quantity of used high current to spin up drive |
| 208 | Spin Buzz | Quantity of used buzz routines to spin up drive |
| 209 | Offline Seek Performance | Drive's seek performance during offline operations |
| 220 | Disk Shift | Shift of disk is possible as a result of strong shock loading in the store, as a result of it's falling or for other reasons (sometimes: Temperature) |
| 221 | G-Sense Error Rate | This attribute is an indication of shock-sensitive sensor - total quantity of errors appearance as a result of impact loads (dropping drive, for example) |
| 222 | Loaded Hours | Loading on drive caused by the general operating time of hours it stores |
| 223 | Load/Unload Retry Count | Loading on drive caused by numerous recurrences of operations like: reading, recording, positioning of heads, etc. |
| 224 | Load Friction | Loading on drive caused by friction in mechanical parts of the store |
| 225 | Load/Unload Cycle Count | Total of cycles of loading on drive |
| 226 | Load-in Time | General time of loading for drive |
| 227 | Torque Amplification Count | Quantity efforts of the rotating moment of a drive |
| 228 | Power-Off Retract Count | Quantity of the fixed turning off's a drive |
| 230 | GMR Head Amplitude | Amplitude of heads trembling (GMR-head) in running mode |
| 231 | Temperature | Temperature of a drive |
| 240 | Head Flying Hours | Time while head is positioning |
| 250 | Read Error Retry Rate | Frequency of errors appearance while reading data from a disk |

Please note that some disk manufacturers use their own ID's for attributes.
Thanks to Bruce Allen for attributes and descriptions.

-----APPENDIX-B-----

Attribute Value Locations

| Byte | Contents | |
|-----------------|--|------------------------------|
| 00 01 | ID Number | |
| 02 | ID1 | ID Number from Figure 5.10.1 |
| 03 04 | | Status Flag |
| 05 | | Parameter |
| 06 | | Worst Value |
| 07 0C | | Threshold |
| 0D | | Reserved |
| 0E 169 | ID2 ID30 | Reserved |
| 16A | Offline/Data Collection Status | |
| 16B | Self Test Status | |
| 16C 16D | Offline Data Collection Time (seconds) | |
| 16E | Reserve | |
| 16F | Offline/Data Collection Ability | |
| 170 171 | Distraction Expect Ability Flag | |
| 172 | Drive Error Login Ability | |
| 173 | Self Test illegal Output Ability | |
| 174 | Quick Test Completion Time | |
| 175 | Comprehensive Test Completion Time | |
| 176 181 | Reserved | |
| 182 1FE | Vendor Unique | |
| 1FF | Check Sum | |