Apacer S.M.A.R.T Technology

White Paper

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Apacer
Access the best

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Apacer S.M.A.R.T. Technology

Apacer memory products come with S.M.A.R.T. commands and subcommands for users to obtain information of drive status and to predict potential drive failures. Users can take advantage of the following commands/subcommands to monitor the health of the SSD drive supported by the firmware for SATA/PATA controller.

SMART Commands

SMART Read Data

COMMAND CODE

B0h with the content of the Features register equal to D0h

SUBCOMMAND

D0h – Read SMART Data

PROTOCOL

PIO data-in

INPUTS

The Features register shall be set to D0h. The LBA Mid register shall be set to 4Fh. The LBA High register shall be set to C2h.

Register	7	6	5	4	3	2	1	0
Features	Subcommand							
Sector Count	na							
LBA Low	na							
LBA Mid	4Fh							
LBA High	C2h							
Device	Obs	na	Obs	DEV	na			
Command	B0h							

Device register

DEV shall specify the selected device.

NORMAL OUTPUTS

If this command succeeds, the drive will return 512 bytes of data and normal status; otherwise, the drive will return error status.

Register	7	6	5	4	3	2	1	0
Features	na							
Sector Count	na							
LBA Low	na							
LBA Mid	na							
LBA High	na							
Device	Obs	na	Obs	DEV	na			
Command	BSY	DRDY	DF	na	DRQ	na	na	ERR

Device register

DEV indicates the selected device

Status register

BSY shall be cleared to zero
DRDY shall be set to one
DF (Device Fault) shall be cleared to zero
DRQ shall be cleared to zero
ERR shall be cleared to zero

ERROR OUTPUTS

If the device does not support this command, if SMART is disabled, or if the values in the Features, LBA Mid, or LBA High registers are invalid, the device shall return command aborted.

Register	7	6	5	4	3	2	1	0
Error	na	UNC	na	IDNF	na	ABRT	na	obs
Sector Count	na							
LBA Low	na							
LBA Mid	na							
LBA High	na							
Device	Obs	na	Obs	DEV	na			
Status	BSY	DRDY	DF	na	DRQ	na	na	ERR

Error register

UNC shall be set to one if SMART is uncorrectable

IDNF shall be set to one if SMART data sector's ID field not be found or data structure checksum occurred.

ABRT shall be set to one if this command is not supported, if SMART is not enabled, or if register values are invalid. ABRT may be set to one if the device is not able to complete the action requested by the command.

Device register

DEV indicates the selected device.

Status register

BSY shall be cleared to zero indicating command completion.
DRDY shall be set to one indicating that the device is capable of receiving any command.
DF (Device Fault) shall be cleared to zero indicating that a device fault has occurred.
DRQ shall be cleared to zero indicating that there is no data to be transferred.
ERR shall be cleared to zero if any Error register bit is set to one.

DRDY set to one. SMART enabled.

Description

This command returns 512-byte SMART Data Structure. All multi-byte fields shown in this structure follow the byte ordering described in the table below.

SMART Data Structure

Byte	Description
0-1	Vendor specific
2-361	1st – 30th SMART attribute data (Vendor specific)
362	Off-line data collection status
363	Self-test execution status byte
364-365	Total time in seconds to complete off-line data collection activity
366	Vendor specific
367	Off-line data collection capability
368-369	SMART capability
370	Error logging capability 7:1 Reserved 0 1=Device error logging supported
371	Vendor specific
372	Short self-test routine recommended polling time (in minutes)
373	Extended self-test routine recommended polling time (in minutes)
374-385	Reserved
386-510	Vendor Specific
511	Data structure checksum

SMART Attribute Structure

Byte	Description
0	ID (Hex)
1	Reserved
2	Reserved
3	Value (0x64)
4	Worst (0x64)
5*-11	Raw Data

*Byte5: LSB

SMART Attribute ID list

ID (Hex)	Attribute Name*	Note
9(0x09)	Power on hours	
12 (0x0C)	Power cycle	
163 (0xA3)	Max. erase count	
164 (0xA4)	Avg. erase count	
166 (0xA6)	Total later bad block count	BlockU**
167 (0xA7)	SSD Protect Mode	0: R/W, 3: Read Only*** 7: Unusual Read Only****
168 (0xA8)	SATA PHY Error Count	Command Fail Count
171 (0xAB)	Program fail count	
172 (0xAC)	Erase fail count	
175 (0xAF)	ECC Fail Count	
192 (0xC0)	Unexpected Power Loss Count	ATA Standby Command
194 (0xC2)	Temperature	PCB Temperature
231 (0xE7)	Lifetime left	
241 (0xF1)	Total sectors of write	LBA

Notes:

* Attributes, IDs and values may vary from product models due to different solution design and supporting capabilities.

** One BlockU equals to two NAND Flash blocks (Plane 0 + Plane 1)

*** If write protect triggered by GPIO, the value of 0xA7 should report “3” read only also.

**** Occurs when free blocks are running short or encountering excessive later bad blocks, thus the drive will self-initiate its read-only state.

Attribute Description

Power on hours
The number of hours that the monitored SSD has been powered on.

Power cycle
Indicates the times that an SSD has been powered on /off.

Maximum erase count
Indicates that the max number of erases on any block. It refers to the actual run-time max erase count not the max rated cycles for the NAND component used in the SSD.

Average erase count
Indicates that the average number of erases across all blocks by calculating the sum of total erase count divided by total usable blocks.

Total later bad block count
The total number of later bad blocks

SSD Protect Mode
Displays a number that corresponds to certain device protect mode.

SATA PHY Error Count
Indicates the number of SATA PHY error. (Signal disconnection)

Program fail count
Displays the number of times when write to a flash memory failed.
(Note: Information of this attribute may not appear for some product models)

Erase fail count
Displays the number of times when erase operation on a flash memory failed.
(Note: Information of this attribute may not appear for some product models)

ECC Fail Count
Displays the number of uncorrectable ECC failed count.

Unexpected Power Loss Count
Indicates the number of unexpected power failures.

Temperature
The temperature of the device.

Lifetime left
Indicates the approximate SSD life left.
(Note: Information of this attribute may not appear for some product models)

Total sectors of write
The total sectors of write in the drive. This attribute functions as LBA, so that the unit is in byte.
(Note: Information of this attribute may not appear for some product models).

Revision History

Revision	Date	Description	Remark
1.0	2016/05/26	Official release	

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