



Datasheet

A5000

SATA3 Solid State Drive

Version 1.4

Dec 2013

Document Version

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1. Introduction

1.1 General Description

A5000 SSD support SATA III 6.0 Gb/s and compatible SATA II 3.0 Gb/s. SSD Processors is architected to leverage today's densest MLC NAND Flash memory. A5000 SSD is the best-in-class performance, endurance, security, and power efficiency

SSDs greatly outperform traditional HDDs, and in many cases reach the limits of the bus interface. Advanced high speed SATA interfaces have been implemented in newer systems to remove this performance bottleneck. SSD is perfect to take advantage of that higher speed interface. A5000 SSD performance that maximizes the throughput of a 6.0 Gb/s SATA interface with balanced read/write speeds. In extremely low-power environments, the A5000 SSD can tune total SSD power consumption vs. performance by limiting the number of simultaneously active flash devices. It also supports an ultra-low power sleep mode to maximize battery life of mobile product.

1.2 Feature

- Supports SATAIII 6.0Gb/s, SATAII 3.0Gb/s, SATAI 1.5Gb/s and ATA-8 Command Set
- Support Asynchronous, Synchronous (Toggle & ONFI) Nand Flash
- Native Command Queuing support
- S.M.A.R.T. command transport (SCT) technology
- Superior wear-leveling
- Intelligent Flash memory block management
- Up to 40 bits/1KB correctable (BCH) ECC Recovery
- Self-monitoring
- RoHS CE and FCC compatibility
- Halogen-free
- Supports Firmware upgrade function
- Shock/Vibration
 - Operating 1,500G duration 0.5ms half sine wave
 - Vibration 15Gpeak 10~2000Hz with (15mins/Axis) 3axis
- Humidity:
 - 0°C ~55°C/5~95% RH 10cycles
- Temperature
 - Standard Operating Temperature: 0°C ~70°C
 - Extended Operating Temperature: -40°C ~85°C
 - Storage Temperature: - 55°C ~95°C
- Low Power consumption: 3W Active, 1.6W Idle

Spec

| Form factor | Size | Capacity |
|-------------|------------------------|--------------------------|
| 2.5" SATA | 100.10 x 69.85 x 6.9mm | 32GB, 64GB, 128GB, 256GB |

Performance

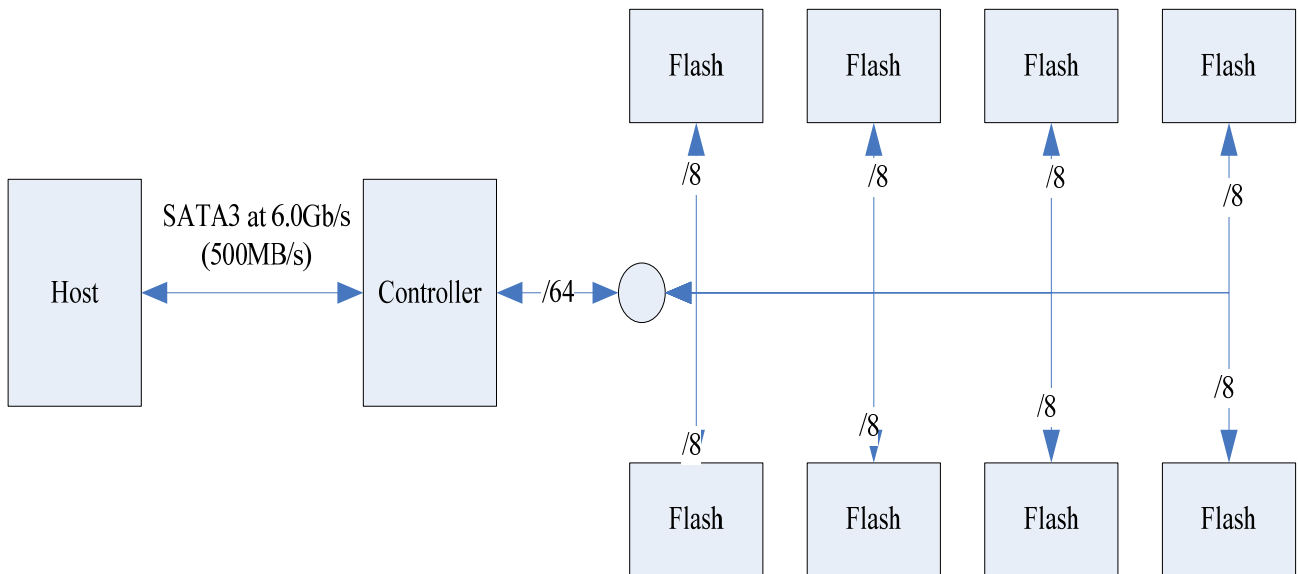
| Item | Max Read | Max Write | Random 4K read | Random 4K write |
|-------|-----------|-----------|-------------------|-------------------|
| A5000 | 490MB/Sec | 330MB/Sec | Up to 66,336 IOPS | Up to 65,765 IOPS |

1.3 Application

Consumer application: Desktops, Laptops, Smart TV, STB, etc.

Industrial PCs: Rugged laptops, military devices, thin clients, POS, telecom, medical instruments, etc.

1.4 SSD Functional Block Diagram



1.5 Part Number Definition

| Code | Definition | symbol | Description |
|--|-----------------------|--------|---------------------|
| X ₁ X ₂ | Interface | SA | SATA SSD |
| X ₃ X ₄ X ₅ X ₆ | Model Series | 5000 | 2.5" SATA III A5000 |
| X ₇ X ₈ X ₉ X ₁₀ | Total Capacity | 032G | 32GB |
| | | 064G | 64GB |
| | | 128G | 128GB |
| | | 256G | 256GB |
| X ₁₁ | Housing | M | Metal Housing |
| X ₁₂ | | - | - |
| X ₁₃ | Operating temperature | C | 0°C~70°C |
| | | H | -40°C~85°C |
| X ₁₄ | Solution | E | Sync MLC |

1.6 Ordering Information

| Part Number | Capacity | Description |
|----------------|----------|--|
| SA5000032GM-CE | 32 GB | A5000 32GB SATA III 2.5" SSD Consumer |
| SA5000064GM-CE | 64 GB | A5000 64GB SATA III 2.5" SSD Consumer |
| SA5000128GM-CE | 128 GB | A5000 128GB SATA III 2.5" SSD Consumer |
| SA5000256GM-CE | 256 GB | A5000 256GB SATA III 2.5" SSD Consumer |

| Part Number | Capacity | Description |
|----------------|----------|--|
| SA5000032GM-HE | 32 GB | A5000 32GB SATA III 2.5" SSD Industrial |
| SA5000064GM-HE | 64 GB | A5000 64GB SATA III 2.5" SSD Industrial |
| SA5000128GM-HE | 128 GB | A5000 128GB SATA III 2.5" SSD Industrial |
| SA5000256GM-HE | 256 GB | A5000 256GB SATA III 2.5" SSD Industrial |

1.7 System Performance

Test program: ATTO

| Capacity | Sequential Read Sector | Sequential Write Sector |
|----------|------------------------|-------------------------|
| 32GB | 290 MB/s | 50 MB/s |
| 64GB | 480 MB/s | 98 MB/s |
| 128GB | 490 MB/s | 194 MB/s |
| 256GB | 490 MB/s | 330 MB/s |

Test program: CrystalDiskMark 3.0

| Capacity | Sequential Read | Sequential Write | 4K Read | 4K Write | 4K QD32 Read | 4K QD32 Write |
|----------|-----------------|------------------|------------|------------|--------------|---------------|
| 32GB | 280 MB/s | 50 MB/s | 28.11 MB/s | 48.09 MB/s | 122.0 MB/s | 48.3 MB/s |
| 64GB | 409 MB/s | 97 MB/s | 29.54 MB/s | 74.55 MB/s | 184.1 MB/s | 96.25 MB/s |
| 128GB | 433 MB/s | 192 MB/s | 33.08 MB/s | 72.48 MB/s | 180.3 MB/s | 185.2 MB/s |
| 256GB | 460 MB/s | 327 MB/s* | 33.59 MB/s | 62.95 MB/s | 183.3 MB/s | 206.3 MB/s |

Test program: AS SSD

| Capacity | Sequential Read | Sequential Write | 4K Read IOPS | 4K Write IOPS | 4K-64Thrd Read IOPS | 4K-64Thrd Write IOPS |
|----------|-----------------|------------------|--------------|---------------|---------------------|----------------------|
| 32GB | 270 MB/s | 47 MB/s | 6277 | 11961 | 36271 | 10368 |
| 64GB | 407 MB/s | 93 MB/s | 6738 | 12560 | 72433 | 20509 |
| 128GB | 435 MB/s | 182 MB/s | 7664 | 13840 | 78332 | 42461 |
| 256GB | 439 MB/s | 312 MB/s | 7224 | 11030 | 66336 | 65765 |

Actual performance may vary depending on use conditions and environment

2. Product Specification

2.1 Dimension

| Form Factor | Measures |
|-------------|---------------------------|
| 2.5" | 100.1mm x 69.85mm x 6.9mm |

2.2 Product Outline

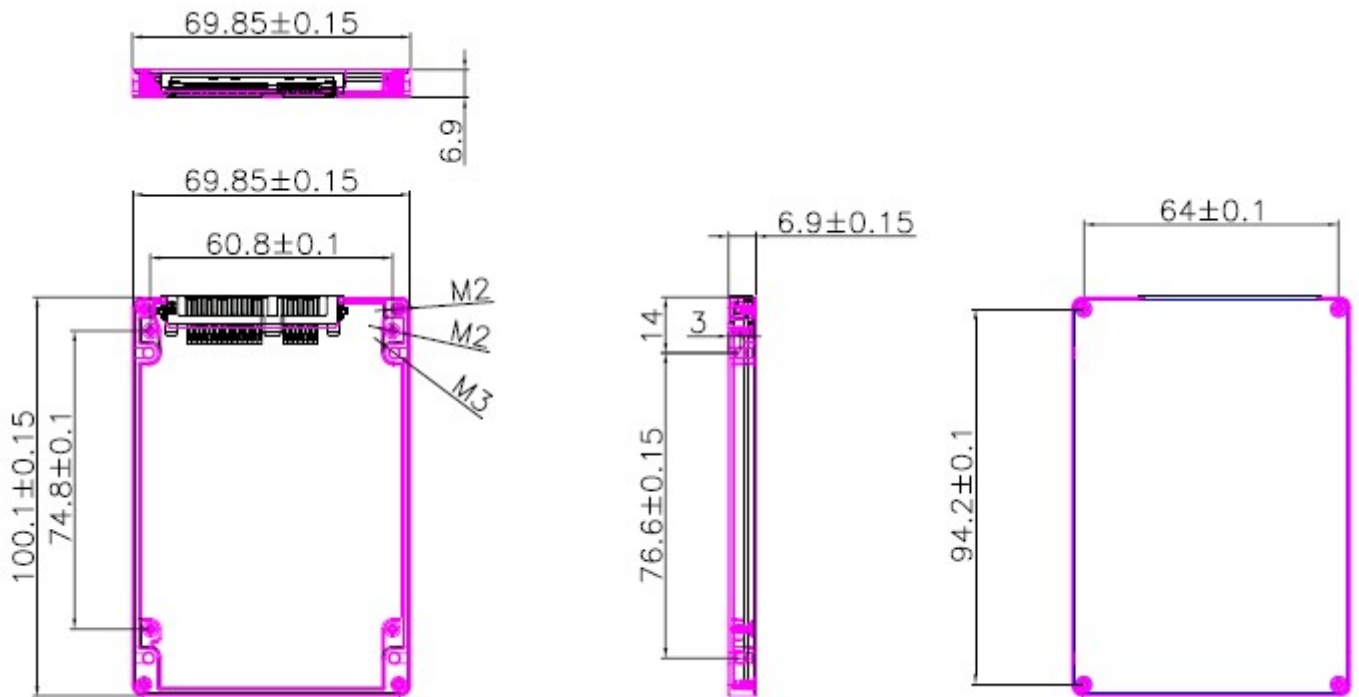
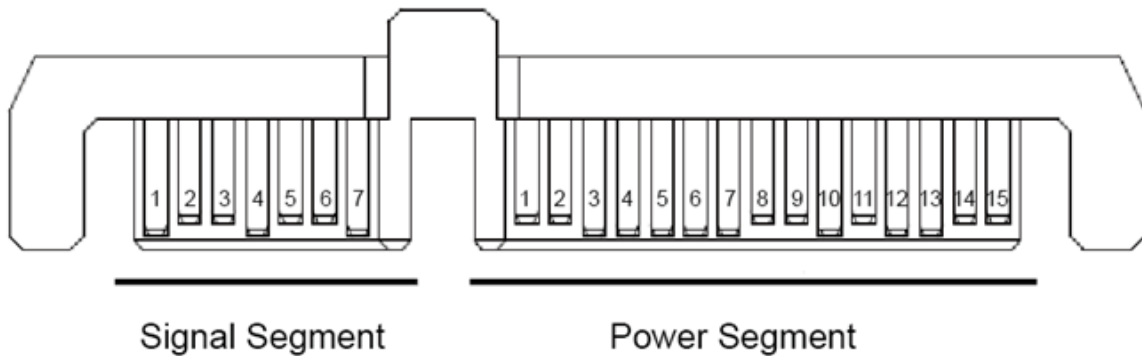


Figure 1: Mechanical Dimensions of 2.5" A5000 SSD

2.3 Pin out



Pin Assignment and Description

| Group | No | Type | Description |
|--|-----|---------|---|
| Signal | S1 | GND | 2 nd mate |
| | S2 | TXDP | Differential TX positive signal form PHY |
| | S3 | TXDN | Differential TX negative signal form PHY |
| | S4 | GND | 2 nd mate |
| | S5 | RXDN | Differential RX negative signal form PHY |
| | S6 | RXDP | Differential RX positive signal form PHY |
| | S7 | GND | 2 nd mate |
| Key and spacing separate and power segments | | | |
| Power | P1 | V33 | 3.3Voltage Power Supply (Unused) |
| | P2 | V33 | 3.3Voltage Power Supply (Unused) |
| | P3 | V33 | 3.3Voltage pre-charge (Unused), 2 nd mate (Unused) |
| | P4 | GND | 1 st mate |
| | P5 | GND | 2 nd mate |
| | P6 | GND | 2 nd matte |
| | P7 | V5 | 5Voltage pre-charge, 2 nd mate |
| | P8 | V5 | 5Voltage Power Supply |
| | P9 | V5 | 5Voltage Power Supply |
| | P10 | GND | 2 nd mate |
| | P11 | DAS/DSS | Device activity signal/Disable staggered spinup |
| | P12 | GND | 1 st mate |
| | P13 | V12 | 12Voltage pre-charge, 2 nd mate(Unused) |
| | P14 | V12 | 12Voltage Power Supply (Unused) |
| | P15 | V12 | 12Voltage Power Supply (Unused) |

NOTE: Uses 5V power only. 3.3V and 12V power are not used.

3. Command Descriptions

3.1 SUPPORTED ATA COMMANDS

| Command Name | Command Code (Hex) | Command Name | Command Code (Hex) |
|------------------------------|--------------------|-----------------------|--------------------|
| CHECK POWER MODE | E5h | SECURITY ERASE UNIT | F4h |
| EXECUTE DIAGNOSTICS | 90h | SECURITY FREEZE LOCK | F5h |
| FLUSH CACHE | E7h | SECURITY SET PASSWORD | F1h |
| IDENTIFY DEVICE | ECh | SECURITY UNLOCK | F2h |
| IDLE | E3h | SEEK | 7xh |
| IDLE IMMEDIATE | E1h | SET FEATURES | EFh |
| INITIALIZE DEVICE PARAMETERS | 91h | SET MULTIPLE MODE | C6h |
| READ DMA | C8h | SLEEP | E6h |
| READ DMA EXT | 25h | SMART | B0h |
| READ FPDMA QUEUED | 60h | STANDY | E2h |
| READ LOG DMA EXT | 47h | STANDY IMMEDIATE | E0h |
| READ LOG EXT | 2Fh | WRITE DMA | CAh |
| READ MULTIPLE | C4h | WRITE DMA EXT | 35h |
| READ SECTOR(S) | 20h/21h | WRITE FPDMA QUEUED | 61h |
| READ VERIFY SECTOR(S) | 40h/41h | WRITE LOG DMA EXT | 57h |
| RECALIBRATE | 10h | WRITE LOG EXT | 3Fh |
| SECURITY DISABLE PASSWORD | F6h | WRITE MULTIPLE | C5h |
| SECURITY ERASE PREPARE | F3h | WRITE SECTOR(S) | 30h/31h |

3.2 IDENTIFY DEVICE (ECh)

| Word | Value | Description |
|------|-------|-----------------------------|
| 0 | 0040h | General information |
| 1 | XXXXh | Number of logical cylinders |
| 2 | C837h | Specific configuration |
| 3 | 00XXh | Number of logical heads |

| | | |
|-------|-------|--|
| 4-5 | XXXXh | Retired |
| 6 | XXXXh | Number of logical sector per logical track |
| 7-8 | XXXXh | Reserved for assignment by the CompactFlash_ Association |
| 9 | 000Eh | Retired |
| 10-19 | XXXXh | Serial number (20 ASCII characters) |
| 20-21 | XXXXh | Retired |
| 22 | 003Fh | Obsolete |
| 23-26 | XXXXh | Firmware revision (8 ASCII characters) |
| 27-46 | XXXXh | Model number (40 ASCII characters) |
| 47 | 8000h | Number of sectors on multiple commands |
| 48 | 4000h | Reserved |
| 49 | 2F00h | Capabilities |
| 50 | 4000h | Capabilities |
| 51-52 | 0000h | Obsolete |
| 53 | 0007h | Reserved |
| 54-58 | XXXXh | Obsolete |
| 59 | 0000h | Multiple sector setting |
| 60-61 | XXXXh | Total number of user addressable sectors |
| 62 | 0000h | Obsolete |
| 63 | 0007h | Multi-word DMA transfer |
| 64 | 0003h | Advanced PIO modes supported |
| 65 | 0078h | Minimum Multiword DMA transfer cycle time per word |
| 66 | 0078h | Manufacturer's recommended Multiword DMA transfer cycle time |
| 67 | 0078h | Minimum PIO transfer cycle time without flow control |
| 68 | 0078h | Minimum PIO transfer cycle time with IORDY flow control |
| 69-74 | 0000h | Reserved (for future command overlap and queuing) |
| 75 | 0000h | Queue depth |
| 76 | xh | Serial ATA Capabilities |
| 77 | | Reserved |
| 78 | xh | Serial ATA features supported |
| 79 | xh | Serial ATA features enabled |
| 80 | 01FEh | Major version number 0000h or FFFFh = device does not report version |
| 81 | 0021h | Minor version number |
| 82 | 0068h | Command set supported. |
| 83 | 5000h | Command sets supported |
| 84 | 4000h | Command set/feature supported extension. |

| | | |
|---------|-------|---|
| 85 | 0008h | Command set/feature enabled. |
| 86 | 5000h | Command set/feature enabled. |
| 87 | 4000h | Command set/feature default. |
| 88 | xh | Ultra DMA transfer |
| 89 | 0000h | Time required for security erase unit completion |
| 90 | 0000h | Time required for Enhanced security erase completion |
| 91 | 0000h | Current advanced power management value |
| 92 | 0000h | Master Password Revision Code |
| 93 | 0000h | Hardware reset result |
| 94-126 | 0000h | Reserved |
| 127 | 0000h | Removable Media Status Notification feature set support |
| 128 | 0001h | Security status |
| 129-159 | 0000h | Vendor specific |
| 160-254 | 0000h | Reserved |
| 255 | 0000h | Integrity word |

Note: X = the content of the word may be fixed or variable.

3.3 SET FEATURES (EFh)

This command set parameter to Features register and set drive's operation. For transfer mode, parameter is set to Sector Count register. This command is used by the host to establish or select certain features.

| Value | Function |
|-------|---|
| 02h | Enable write cache |
| 03h | Set transfer mode based on value in Sector Count register |
| 55h | Disable read look-ahead feature |
| 82h | Disable write cache |
| 90h | Disable use of SATA feature |
| AAh | Enable read look-ahead feature |

4. Electrical Characteristic

4.1 Supply Voltage

| Item | Requirements |
|------------------------|-------------------|
| Allowable voltage | 5V ± 5% |
| Allowable noise/ripple | 100mV p-p or less |

4.2 System Power Consumption

| Power | Typical |
|--------|---------|
| Idle | TBD |
| Active | TBD |

5. S.M.A.R.T Support

5.1 SMART Function Set (B0h)

Performs different processing required for predicting device failures, according to the subcommand specified in the Features register. If the Features register contains an unsupported value, the Aborted Command error is returned. If the SMART function is disabled, any subcommand other than SMART ENABLE OPERATIONS results in the Aborted Command error.

| Code | Smart Subcommand |
|------|-----------------------------------|
| D0h | READ DATA |
| D1h | READ ATTRIBUTE THRESHOLDS |
| D2h | ENABLE/DISABLE ATTRIBUTE AUTOSAVE |
| D3h | SAVE ATTRIBUTE VALUES |
| D4h | EXECUTE OFF-LINE IMMEDIATE |
| D5h | READ LOG |
| D6h | WRITE LOG |
| D8h | ENABLE OPERATIONS |
| D9h | DISABLE OPERATIONS |
| DAh | RETURN STATUS |

| | |
|-----|------------------------------|
| DBh | ENABLE/DISABLE AUTO OFF-LINE |
|-----|------------------------------|

5.2 SMART READ DATA (B0h/D0h)

This command returns 512-byte SMART Data Structure to the host with PIO data-in protocol. The register file has to contain D0h for Features register, 4Fh for LBA Mid register and C2h for the LBA High register.

| Byte | Description |
|---------|---|
| 0-1 | Data structure revision number |
| 2-13 | 1st attribute data |
| 14-361 | 2nd-30th Individual attribute data |
| 362 | Off-line data collection status |
| 363 | Self-test execution status |
| 364-365 | Total time in seconds to complete off-line data collection |
| 366 | Reserved |
| 367 | Off-line data collection capability |
| 368-369 | SMART capability |
| 370 | Error logging capability |
| 371 | Self-test Failure Checkpoint |
| 372 | Short self-test routine recommended polling time(in minutes) |
| 373 | Extended self-test routine recommended polling time(in minutes) |
| 374-510 | Reserved |
| 511 | Data structure Checksum |

Byte 2-361: Individual attribute data

| Byte | Description |
|------|---------------------------------------|
| 0 | Attribute ID |
| 1-2 | Status Flag |
| 3 | Attribute Value |
| 4 | Worst Ever normalized Attribute Value |
| 5-10 | Raw Attribute Value |
| 11 | Reserved |

The attribute ID information is listed in the following table

| ID | Description |
|-----|------------------------|
| 01h | Read Error Rate |
| 02h | Throughput Performance |
| 03h | Spin Up Time |

| | |
|-----|------------------------------|
| 05h | Reallocated Sector Count |
| 07h | Seek Error Rate |
| 08h | Seek Time performance |
| 09h | Power-On hours Count |
| 0Ah | Spin Retry Count |
| 0Ch | Drive Power Cycle Count |
| A7h | SSD Protect Mode |
| A8h | SATA PHY Error Count |
| A9h | Bad Block Count |
| AAh | Max Bad Block Count |
| ADh | Erase Count |
| AFh | Bad Cluster Table Count |
| C0h | Unexpected Power Loss Count |
| C2h | Temperature |
| C5h | Current Pending Sector Count |
| F0h | Write Head |

5.3 SMART READ ATTRIBUTE THRESHOLD (B0h/D1h)

This command transfers 512 bytes of drive failure threshold data to the host.

| Byte | Description |
|---------|--|
| 0-1 | Data structure revision number |
| 2-361 | 1 st – 30 th Individual attribute threshold data |
| 362-510 | Reserved |
| 511 | Data structure checksum |

5.4 SMART ENABLE/DISABLE ATTRIBUTE AUTOSAVE (B0h/D2h)

This command enables and disables the optional attribute auto save feature of the device. This command may either allow the device, after some vendor specified event, to save the device updated attributes to non-volatile memory; or this command may cause the auto save feature to be disabled. The state of the attribute auto save feature, either enabled or disabled, shall be preserved by the device during all power and reset events.

A value of zero written by the host into the device's Count field before issuing this command shall cause this feature to be disabled. Disabling this feature does not preclude the device from saving SMART data to non-volatile memory during some other normal operation (e.g., during a power-on or power-off sequence or during an error recovery sequence).

A value of F1h written by the host into the device's Count field before issuing this command shall cause this feature to be enabled. Any other other non-zero value written by the host into this field before issuing this

command is vendor specific. The meaning of any non-zero value written to this field at this time shall be preserved by the device during all power and reset events.

5.5 SMART SAVE ATTRIBUTE VALUE (B0h/D3h)

Saves any modified attribute values.

5.6 SMART EXECUTE OFF-LINE IMMEDIATE (B0h/D4h)

This command of Non-data input causes the controller to immediately initiate the set of activities that collect SMART data in a off-line mode and then save data to the nand flash memory, or execute a self-diagnostic test routine in either captive or off-line mode.

SMART EXECUTE OFF-LINE IMMEDIATE Sector Number register values

| Value | Description of subcommand to be executed |
|-------|---|
| 0 | Execute SMART off-line routine immediately in off-line mode |
| 1 | Execute SMART Short self-test routine immediately in off-line mode |
| 2 | Execute SMART Extended self-test routine immediately in off-line mode |
| 127 | Abort off-line mode self-test routine |
| 129 | Execute SMART Short self-test routine immediately in captive mode |
| 130 | Execute SMART Extended self-test routine immediately in captive mode |

5.7 SMART READ LOG (B0h/D5h)

This command returns the indicated log sector contents to the host.

Sector count –specifies the number of sectors to be read from the specified log. The log transferred by the drive shall start at the first sector in the specified log, regardless of the sector count requested.

Sector number indicates the log sector to be returned as described in the following Table.

Log Sector

| Log sector address | Content | R/W |
|--------------------|-------------------------------|-----|
| 00h | Log directory | RO |
| 01h | SMART error log | RO |
| 02h | Comprehensive SMART error log | RO |
| 04h | Device Statistics log | RO |
| 06h | SMART self-test log | RO |
| 09h | Selective Self-Test log | R/W |

| | | |
|----------|--------------------------|-----|
| 30h | Identify Device data log | RO |
| 80h ~9Fh | Host vendor specific | R/W |
| E0h | SCT Command/Status log | R/W |
| E1h | SCT Data Transfer log | R/W |

5.8 SMART WRITE LOG (B0h/D6h)

This command writes as indicated number of 512 byte data sectors to the indicated log.

5.9 SMART ENABL OPERATIONS (B0h/D8h)

Enables the SMART function. This setting is maintained when the power is turned off and then back on. Once the SMART function is enabled, subsequent SMART ENABLE OPERATIONS commands do not affect any parameters.

5.10 SMART DISABLE OPERATIONS (B0h/D9h)

Disables the SMART function. Upon receiving the command, the drive disables all SMART operations. This setting is maintained when the power is turned off and then back on.

Once this command has been received, all SMART commands other than SMART ENABLE OPERATIONS are aborted with the

Aborted Command error.

This command disables all SMART capabilities including any and all timer and event count functions related exclusively to this feature. After command acceptance, this controller will disable all SMART operations. SMART data in no longer be monitored or saved. The state of SMART is preserved across power cycles.

5.11 SMART RETURN STATUS (B0h/DAh)

Reports the drive reliability status.

Values reported when a predicted defect has not been detected:

Cylinder Low register: 4Fh

Cylinder High register: C2h

Values reported when a predicted defect has been detected:

Cylinder Low register: F4h

Cylinder High register: 2Ch

5.12 SMART ENABLE/DISABLE AUTOMATIC OFF-LINE (B0h/DBh)

Enables (when Sector Count register = "F8h") or disables (Sector Count register = "00h") the automatic off-line data collection function.

The automatic collection is disabled if a value of "00h" is set in the Sector Count register before a subcommand is issued. If automatic collection is disabled, the drive can still save attribute information during normal operation, such as during the power-on/off sequence or error correction sequence.

The automatic collection function is enabled if a value of "F8h" is set in the Sector Count register before the command is issued. Values other than "00h" and "F8h" are vendor-specific.

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