



StorFly® M.2 Type 2280 SATA Solid-State Drive

Series 6 (Gen1), SATA-III (6Gb/s) 2D SLC

VSFBM8PI032G-V11

Datasheet - Rev. 0.91 - Preliminary



1. Description

Virtium's StorFly® M.2 PE class is high-performance SATA-III 6Gb/s embedded solid-state drive (SSD) technology designed for the unique capacity and workload requirements of a broad range of embedded systems, including networking, industrial automation, medical monitoring and gaming equipment, point-of-sale terminals and data recorders.

Features

Capacity

- 32 GB

SLC NAND

Sequential Performance

- 128kB Sequential Read: 530 MB/s (QD: 32)
- 128kB Sequential Write: 260 MB/s (QD: 32)

Random Performance

- 4kB IOPS Read: up to 69,500 (QD: 32)
- 4kB IOPS Write: up to 53,000 (QD: 32)

Power: 3.3V±5%

- 128kB Sequential Read: 2.20 W
- 128kB Sequential Write: 2.40 W
- 4kB Random Read: 1.80 W
- 4kB Random Write: 2.10 W
- Idle: 0.40 W

Temperature Ranges

- Industrial: -40°C to 85°C
- Non-Operating: -40°C to 85°C

Reliability

- BCH ECC capable of correcting errors up to 66-Bit/1KB
- MTBF: >2M hours

Endurance

- JESD219A: 508 TBW
- Sequential: 3,176 TBW

vtGuard® Power Fail Protection

- Integrated power fail protection
- Preserves static data in the event of power failure
- Cache/buffer contents restored at power-on

SMART Attribute Reporting

- Monitors device health
- Anticipates and predicts failures

Mechanical Dimensions

- M.2 Type 2280-D2-B-M Form Factor
- Length x Width x Height mm (inches)
80.00 (3.150) x 22.00 (0.866) x 3.26 (0.128)

Compliance

- SATA Revision 3.1 (SATA-III 6Gb/s)
- ATA/ATAPI-8 (ACS-3)
- FCC, CE, UL, RoHS, WEEE

Environmental (Non-operating)

- Humidity (non-condensing): 5% to 95%
- Shock: 1500G, half-sine wave, 0.5ms duration
- Vibration: 20G, 20 Hz to 2000 Hz

Optional Data Security⁽¹⁾

- Integrated AES-256 encryption (data-at-rest)
- TCG/ Opal 2.0-compliant SED
- Crypto and military secure

StorKit™ Software - visit virtium.com to learn more.

- vtView®, vtSecure™, vtTools™

Note: (1) Available in parts with -T part number extension



Electrostatic Discharge (ESD) can damage this device. When handling the device, always wear a grounded wrist strap and use a static dissipative surface.



Any damage to the unit that occurs after its removal from the shipping package and ESD protective bag is the responsibility of the user.

Part Numbering System

V SF BM8 P I 032G - V11

| Where: | |
|-------------|---|
| V | = Virtium |
| SF | = StorFly |
| BM8 | = Form Factor / Interface: BM8 = M.2 Type 2280-D2-B-M, SATA-III 6Gb/s |
| P | = Product Class: P = PE |
| I | = Operating Temperature: I = Industrial (-40°C to 85°C) |
| 032G | = 032G = 32GB (1GB = 1,000,000,000 bytes) |
| V11 | = Virtium Proprietary |

2. Specifications

Capacity

| Unformatted Capacity (GB) ⁽¹⁾ | User-Addressable LBA ⁽²⁾ | User-Addressable Capacity Bytes |
|---|-------------------------------------|---------------------------------|
| 32 | 61,734,912 | 31,608,274,944 |
| (1) 1GB = 1,000,000,000 bytes. LBA: Logical Block Address; Logical Block Size = 512 Bytes/1 Sector. (2) LBA: Logical Block Address; Logical Block Size = 512 Bytes/1 Sector. | | |

Performance

| Capacity GB | Performance Throughput ⁽¹⁾ 128kB File, Queue Depth (QD) = 32 | | IOPS ⁽¹⁾ 4kB File, Queue Depth (QD) = 32 | |
|---|--|-----------------------|--|-------------------|
| | Sequential Read MB/s | Sequential Write MB/s | 100% Random Read | 100% Random Write |
| 32 | 530 | 260 | 69,500 | 53,000 |
| (1) Performance is based on fresh out-of-box condition formatted with NTFS filesystem and running CrystalDiskMark 7.0.0 with file size 1024MB. Actual results may vary depending on file system, workload, and SSD condition. | | | | |

Power Consumption - 3.3V Supply

| Sequential Read ⁽¹⁾ 128kB, QD = 32 | Sequential Write ⁽¹⁾ 128kB, QD = 32 | Random Read ⁽¹⁾ 4kB, QD = 32 | Random Write ⁽¹⁾ 4kB, QD = 32 | Idle |
|---|---|--|---|--------|
| 2.20 W | 2.40 W | 1.80 W | 2.10 W | 0.40 W |
| (1) Power consumption tests were done using Oakgate test system at 25°C | | | | |

Temperature and Humidity

| Part Number | Operating Temperature | Non-Operating ⁽¹⁾ Temperature | Humidity (Non-Condensing) |
|---|-----------------------|--|---------------------------|
| VSFBM8PI032G-V11 | -40°C to 85°C | -40°C to 85°C | 5% to 95% |
| (1) Maximum non-operating temperature assumes data is stored on the SSD. Temperatures above 85°C are beyond NAND specification for data retention. Please see <i>Temperature Considerations for Industrial Embedded SSDs</i> whitepaper under the industrial SSD section of Virtium website (Virtium.com) | | | |

Shock and Vibration

| Reliability | Test Conditions | Reference Standards |
|-------------|---------------------------------------|---------------------|
| Shock | 1500G, half-sine wave, 0.5ms duration | JESD22-B110B.01 |
| Vibration | 20G, 20 Hz to 2000 Hz | JESD22-B103B.01 |

3. Reliability

Endurance

| Capacity (GB) | JESD218A ⁽¹⁾ & JESD219 Enterprise Workloads | | 100% Sequential Workloads | |
|--|--|--------------------------------|------------------------------|--------------------------------|
| | Total Bytes Written TBW (TB) | Drive Writes per day (3 years) | Total Bytes Written TBW (TB) | Drive Writes per day (3 years) |
| 32 | 508 | 14.50 | 3,176 | 90.60 |
| (1) JESD218A assumes an active temperature at 55°C and a retention temperature at 40°C | | | | |

Mean Time Between Failures (MTBF)

The SSD achieves a MTBF of greater than 2,000,000 hours predicted and is derived from the component reliability data using Telcordia SR-332 methods at 40°C and tested under standard environmental operating conditions.

vtGuard® Power-Fail Protection

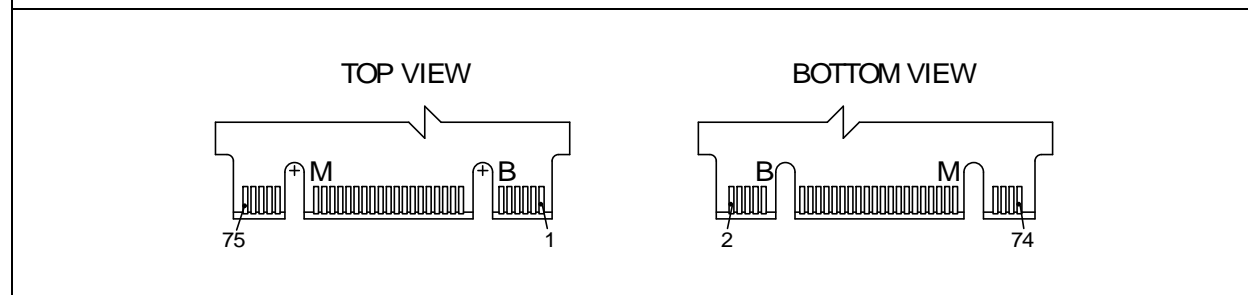
vtGuard® is an integrated power failure protection technology that will preserve data on the SSD if a sudden power failure should occur. It will also transfer the write cache (metadata, mapping tables) contents to the non-volatile flash and restore the contents upon power restoration. This data will be preserved regardless of the duration of the power failure event. This technology also ensures that the SSD will be recoverable after sudden power failure events although a rebuild of the mapping tables may delay readiness of the SSD on the ensuing power cycle on larger capacities.

4. Physical Specifications

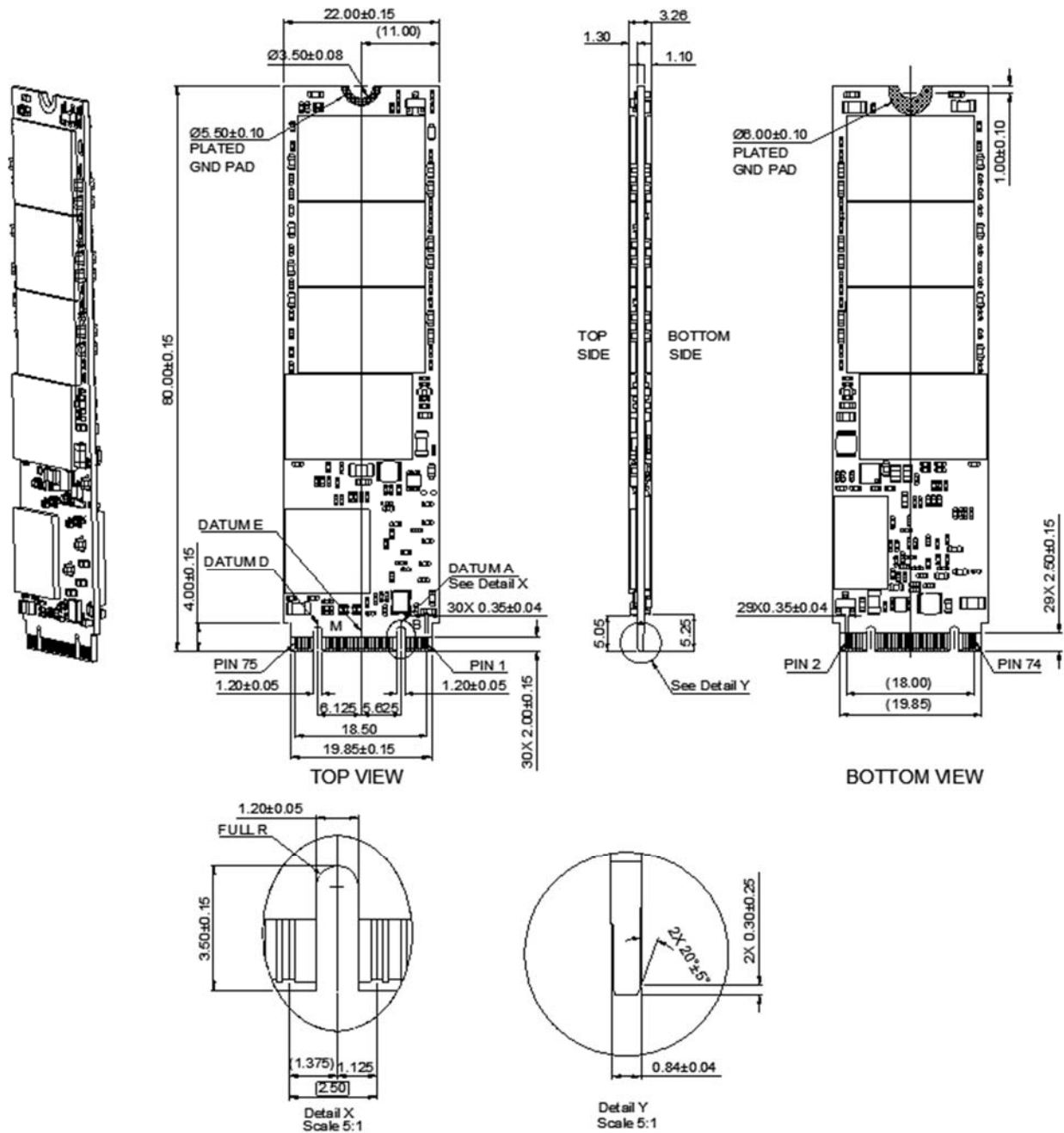
Pin Layout / Assignments

| Pin Assignments | | | | | |
|-----------------|-------------|--------------------------|-------------|-------------|------------------------|
| Top Side | | | Bottom Side | | |
| Pin | Signal Name | Description | Pin | Signal Name | Description |
| 1 | CONFIG_3 | Ground | | | |
| 3 | GND | Ground | 2 | 3.3V | 3.3V Source |
| 5 | N/C | No Connect | 4 | 3.3V | 3.3V Source |
| 7 | N/C | No Connect | 6 | N/C | No Connect |
| 9 | N/C | No Connect | 8 | N/C | No Connect |
| 11 | N/C | No Connect | 10 | DAS/DSS | Device Activity Signal |
| Key | | | Key | | |
| 21 | CONFIG_0 | Ground | 20 | N/C | No Connect |
| 23 | N/C | No Connect | 22 | N/C | No Connect |
| 25 | N/C | No Connect | 24 | N/C | No Connect |
| 27 | GND | Ground | 26 | N/C | No Connect |
| 29 | N/C | No Connect | 28 | N/C | No Connect |
| 31 | N/C | No Connect | 30 | N/C | No Connect |
| 33 | GND | Ground | 32 | N/C | No Connect |
| 35 | N/C | No Connect | 34 | N/C | No Connect |
| 37 | N/C | No Connect | 36 | N/C | No Connect |
| 39 | GND | Ground | 38 | DEVSLP | No Connect |
| 41 | SATA +B | SATA B differential pair | 40 | N/C | No Connect |
| 43 | SATA -B | | 42 | N/C | No Connect |
| 45 | GND | Ground | 44 | N/C | No Connect |
| 47 | SATA -A | SATA A differential pair | 46 | N/C | No Connect |
| 49 | SATA +A | | 48 | N/C | No Connect |
| 51 | GND | Ground | 50 | N/C | No Connect |
| 53 | N/C | No Connect | 52 | N/C | No Connect |
| 55 | N/C | No Connect | 54 | N/C | No Connect |
| 57 | GND | Ground | 56 | MFG1 | No Connect |
| | | | 58 | MFG2 | No Connect |
| Key | | | Key | | |
| 67 | N/C | No Connect | | | |
| 69 | CONFIG_1 | Ground | 68 | SUSCLK | No Connect |
| 71 | GND | Ground | 70 | 3.3V | 3.3V Source |
| 73 | GND | Ground | 72 | 3.3V | 3.3V Source |
| 75 | CONFIG_2 | Ground | 74 | 3.3V | 3.3V Source |

Pin Layout



Mechanical Dimensions



Note:
 1. All dimensions are in millimeters
 2. The dimensional diagram is for reference only

5. ATA Commands

The SSDs support all mandatory ATA commands as defined in the ATA/ATAPI-8 (ACS-3) specification.

General Feature Set

| Command | Code | Protocol |
|---------------------------|------------|---------------------------|
| Execute Device Diagnostic | 90h | Execute Device Diagnostic |
| Flush Cache | E7h | Non-data |
| Identify Device | ECh | PIO data-in |
| Read DMA | C8h | DMA |
| Read Multiple | C4h | PIO data-in |
| Read Sector(s) | 20h | PIO data-in |
| Read Verify Sector(s) | 40h or 41h | Non-data |
| Set Feature | EFh | Non-data |
| Set Multiple Mode | C6h | Non-data |
| Write DMA | CAh | DMA |
| Write Multiple | C5h | PIO data-out |
| Write Sector(s) | 30h | PIO data-out |
| NOP | 00h | Non-data |
| Read Buffer | E4h | PIO data-in |
| Write Buffer | E8h | PIO data-out |
| Write Buffer DMA | E9h | DMA |
| Download Microcode | 92h | PIO data-out |
| Download Microcode DMA | 93h | DMA |

Power Management

| Command | Code | Protocol |
|-------------------|------|----------|
| Check Power Mode | E5h | Non-data |
| Idle | E3h | Non-data |
| Idle Immediate | E1h | Non-data |
| Sleep | E6h | Non-data |
| Standby | E2h | Non-data |
| Standby Immediate | E0h | Non-data |

Sanitize

| Command | Code | Protocol |
|----------|------|----------|
| Sanitize | B4h | Non-data |

Security Mode

| Command | Code | Protocol |
|---------------------------|------|--------------|
| Security Set Password | F1h | PIO data-out |
| Security Unlock | F2h | PIO data-out |
| Security Erase Prepare | F3h | Non-data |
| Security Erase Unit | F4h | PIO data-out |
| Security Freeze Lock | F5h | Non-data |
| Security Disable Password | F6h | PIO data-out |

SMART Commands

| Command | Code | Protocol |
|----------------------------------|------|--------------|
| SMART Disable Operations | B0h | Non-data |
| SMART Enable/Disable Autosave | B0h | Non-data |
| SMART Enable Operations | B0h | Non-data |
| SMART Execute OFF-LINE Immediate | B0h | Non-data |
| SMART Read Log | B0h | PIO data-in |
| SMART Read Data | B0h | PIO data-in |
| SMART Read Threshold | B0h | PIO data-in |
| SMART Return Status | B0h | Non-data |
| SMART Save Attribute Values | B0h | Non-data |
| SMART Write Log | B0h | PIO data-out |
| SMART Write Thresholds | B0h | PIO data-out |

Host Protected Area

| Command | Code | Protocol |
|-------------------------|------|--------------|
| Read Native Max Address | F8h | Non-data |
| Set Max Address | F9h | Non-data |
| Set Max Set Password | F9h | PIO data-out |
| Set Max Lock | F9h | Non-data |
| Set Max Freeze Lock | F9h | Non-data |
| Set Max Unlock | F9h | PIO data-out |

48-bit Address Feature Set

| Command | Code | Protocol |
|-----------------------------|------|--------------|
| Flush Cache Ext | EAh | Non-data |
| Read Sector(s) Ext | 24h | PIO data-in |
| Read DMA Ext | 25h | DMA |
| Read Log Ext | 2Fh | PIO data-in |
| Read Log DMA Ext | 47h | DMA |
| Read Multiple Ext | 29h | PIO data-in |
| Read Native Max Address Ext | 27h | Non-data |
| Read Verify Sector(s) Ext | 42h | Non-data |
| Set Max Address Ext | 37h | Non-data |
| Write DMA Ext | 35h | DMA |
| Write DMA FUA Ext | 3Dh | DMA |
| Write Multiple Ext | 39h | PIO data-out |
| Write Multiple FUA Ext | CEh | PIO data-out |
| Write Sector(s) Ext | 34h | PIO data-out |

Native Command Queuing (NCQ)

| Command | Code | Protocol |
|--------------------|------|------------|
| Read FPDMA Queued | 60h | DMA Queued |
| Write FPDMA Queued | 61h | DMA Queued |

Trusted

| Command | Code | Protocol |
|---------------------|------|--------------|
| Trusted Send | 5Eh | PIO data-out |
| Trusted Send DMA | 5Fh | DMA |
| Trusted Receive | 5Ch | PIO data-in |
| Trusted Receive DMA | 5Dh | DMA |
| Trusted (Non-Data) | 5Bh | Non-data |
| Trusted Send | 5Eh | PIO data-out |

Data Set Management and Seek

| Command | Code | Protocol |
|---------------------|------|----------|
| Data Set Management | 06h | DMA |
| Seek | 70h | Non-data |

Identify Device (ECh) Data

The Identify Device (ECh) command enables the host to receive parameter information from the controller. This command has the same protocol as the Read Sector(s) command. The parameter words in the buffer have the arrangement and meanings defined in the following table.

| Word | F/V/X | Value | Description |
|-------|-------|-------|---|
| 0 | F | 0040h | General Configuration |
| 1 | X | 3FFFh | Default Number of Cylinders |
| 2 | V | C837h | Reserved |
| 3 | X | 0010h | Default Number of Heads |
| 4 | X | 0000h | Obsolete |
| 5 | X | 0000h | Obsolete |
| 6 | X | 003Fh | Default Number of Sectors per Track |
| 7-8 | V | 0000h | Reserved |
| 9 | X | 0000h | Obsolete |
| 10-19 | F | XXXXh | Serial Number in ASCII (Right justified) |
| 20 | X | 0000h | Obsolete |
| 21 | X | 0000h | Obsolete |
| 22 | X | 0000h | Obsolete |
| 23-26 | F | XXXXh | Firmware Revision in ASCII; Big Endian Byte Order in Word |
| 27-46 | F | XXXXh | Model Number in ASCII (Left justified); Big Endian Byte Order in Word |
| 47 | F | 0000h | Maximum Number of Sectors on Read/Write Multiple Command |
| 48 | F | 4001h | Trusted computing feature set options |
| 49 | F | 2F00h | Capabilities |
| 50 | F | XXXXh | Capabilities |
| 51 | X | 0000h | Obsolete |
| 52 | X | 0000h | Obsolete |
| 53 | F | 0007h | Words 88 and 70 :64 valid |
| 54 | X | 3FFFh | Current number of cylinders |
| 55 | X | 0010h | Current number of heads |
| 56 | X | 003Fh | Current sectors per track |
| 57-58 | X | XXXXh | Current capacity in LBAs |
| 59 | V | B000h | Multiple Sector Setting |
| 60-61 | F | XXXXh | Total number of user addressable logical sectors |
| 62 | X | 0000h | Obsolete |
| 63 | F | 0007h | Multiple DMA transfer |
| 64 | F | 0003h | Advanced PIO transfer mode supported |

| Word | F/V/X | Value | Description |
|---------|-------|-------|--|
| 65 | F | 0078h | Minimum Multiword DMA Transfer Cycle Time per Word |
| 66 | F | 0078h | Recommended Multiword DMA Transfer Cycle Time |
| 67 | F | 0078h | Minimum PIO Transfer Cycle Time without Flow Control |
| 68 | F | 0078h | Minimum PIO Transfer Cycle Time with IORDY Flow Control |
| 69 | F | 4D30h | CFAST support |
| 70-74 | F | 0000h | Reserved |
| 75 | F | 001Fh | Queue Depth |
| 76 | F | 870Eh | Serial ATA Capabilities |
| 77 | F | 0086h | Serial ATA Additional Capability; DevSleep_to_ReducedPowerState |
| 78 | F | 016Ch | Serial ATA Features Supported |
| 79 | V | 0040h | Serial ATA features enabled |
| 80 | F | 07FCh | Major Version Number (ACS-3) |
| 81 | F | FFFFh | Minor Version Number |
| 82 | F | 746Bh | Command Sets Supported 0 |
| 83 | F | 7401h | Command Sets Supported 1 |
| 84 | F | 4063h | Command Sets Supported 2 |
| 85 | V | 7469h | Command Set/Feature Enabled |
| 86 | V | B401h | Command Set/Feature Enabled |
| 87 | V | 4063h | Command Set/Feature Enabled |
| 88 | V | 047Fh | Ultra DMA Mode Supported and Selected |
| 89 | F | 0002h | Time required for a Normal Erase Mode Security Erase Unit Command |
| 90 | F | 0002h | Time required for an Enhanced Erase Mode Security Erase Unit Command |
| 91 | V | 00FEh | Current Advanced Power Management Value |
| 92 | V | FFFEh | Master Password revision code |
| 93-99 | V | 0000h | Reserved |
| 100-103 | V | XXXXh | Maximum User LBA for 48-bit Address Feature Set |
| 104-105 | V | 0000h | Reserved |
| 106 | F | 4000h | Sector size |
| 107-127 | V | 0000h | Reserved |
| 128 | V | 0021h | Security Status |
| 129-159 | X | XXXXh | Virtium Specific |
| 160 | X | 0000h | Power Requirement Description |
| 161-167 | X | 0000h | Reserved |
| 168 | F | 0000h | Reserved |
| 169 | X | 0001h | Data Set Management supported |
| 170-208 | F | 0000h | Reserved |
| 209 | X | 4000h | Reserved |
| 210-216 | X | 0000h | Reserved |
| 217 | X | 0001h | Non-rotating Media (SSD) |
| 218-221 | X | 0000h | Reserved |
| 222 | X | 10FFh | Transport Major Revision (SATA Revision 3.1) |
| 223-233 | X | 0000h | Reserved |
| 234 | X | 0002h | Minimum number of 512 byte units per segmented download |
| 235 | X | 0200h | Maximum number of 512 byte units per segmented download |
| 236-254 | X | 0000h | Reserved |
| 255 | X | XXXXh | Integrity Word - Checksum |

Notes:

1. F = content (byte) is fixed and does not change.
2. V = content (byte) is variable and may change depending on the state of the device or the commands executed by the device.
3. X = content (byte) is specific to manufacturer and may be fixed or variable.

6. SMART Attributes

Introduction

Self-Monitoring, Analysis, and Reporting Technology (SMART) is a system that monitors the device condition according to indicators reported by the device itself. This system is designed to anticipate and predict any failures that might occur, thereby allowing the user to prevent data loss or corruption.

This section is for informational purposes only and about the SMART commands and attributes implemented by Virtium LLC., including the data structures returned by those commands.

Note: Please refer to ACS-3 Specification for information on how to invoke the SMART command.

SMART Subcommands

The following table defines the SMART command set that is supported by the SSDs.

| Value | Command |
|-------|----------------------------------|
| D0h | SMART Read Data |
| D1h | SMART Read Attribute Threshold |
| D2h | SMART Enable/Disable Auto-save |
| D3h | SMART Save Attribute Values |
| D4h | SMART Execute Off-Line immediate |
| D5h | SMART Read Log |
| D6h | SMART Write Log |
| D8h | SMART Enable Operations |
| D9h | SMART Disable Operations |
| DAh | SMART Return Status |

SMART Attribute Definitions

The following table defines the SMART data attributes that are currently supported. These SMART attributes are located at Offset 2 of the SMART Data Structure.

| ID (Hex) | ID (Decimal) | Description | Type |
|----------|--------------|---|-------------------|
| 01 | 1 | Raw Error Rate: Rate of CRC errors over the total number of LBA's read. | Reset on Power On |
| 05 | 5 | Reallocated Block Count: Total number of block failures during operation. | Life Cumulative |
| 09 | 9 | Power On Hours: Cumulative number of power-on hours while drive is in active mode over the life of the device. Partial/slumber/DEVSLP will not be counted as power on hours. FW won't increase the POH if the power on time is less than 60min. | Life Cumulative |
| 0C | 12 | Power Cycle Count: Cumulative number of drive power cycles. This attribute includes both graceful and ungraceful power-downs. | Life Cumulative |
| 0E | 14 | Device Capacity : Raw capacity (512B sectors) per IDEMA standard | Fixed Value |
| 0F | 15 | User Capacity : Addressable user capacity (512B sectors) | Fixed Value |
| 10 | 16 | Spare Block Count: The initial lowest TLC physical spare block count across all NAND die planes | Fixed Value |
| 64 | 100 | Total Erase Count: The total TLC physical block Program/Erase cycle count over the entire drive. | Life Cumulative |

| ID (Hex) | ID (Decimal) | Description | Type |
|----------|--------------|--|-------------------|
| A8 | 168 | SATA PHY Error Count: Number of SATA PHY errors that have occurred. | Life Cumulative |
| AA | 170 | Total Bad Block Count: Total physical bad blocks on the drive. Attribute includes both factory and grown bad blocks. | Life Cumulative |
| AC | 172 | Total Block Erase Failures: Total NAND erase failure count | Life Cumulative |
| AD | 173 | Maximum TLC P/E Cycle Count: The count of the worst case TLC P/E cycle count on any superblock across the entire drive | Life Cumulative |
| AE | 174 | Unexpected Power Loss Count: Cululative Number of ungraceful power losses. Ungraceful power loss is defined as a shut down that has not been initiated by a Standby Immediate command from the host. It also includes standby, idle, idle immediate, sleep. | Life Cumulative |
| AF | 175 | Average TLC Erase Count | Life Cumulative |
| B5 | 181 | Total Block Program Fail: Cumulative number of physical block program failures. | Life Cumulative |
| BB | 187 | Uncorrectable ECC Count: Total Number of Uncorrectable ECC Errors | Life Cumulative |
| C2 | 194 | SDD Temperature : Indicates the surface temperature of drive in degrees centigrade. The raw values (2 bytes each) represent the Max, Min, and Current temperature. The "Current" Byte represents 100 – Current temperature and the "Worst" Byte represents 100 – Max temperature | Reset at power on |
| C5 | 197 | Unused attribute | |
| C6 | 198 | RAID Recovery Count: Number of (internal) RAID recoveries | Life Cumulative |
| C7 | 199 | SATA FIS CRC Errors: Count of CRC errors occurring between the host and drive during data transfers. | Life Cumulative |
| CA | 202 | Drive Life Used: Reported as a percentage, starting at 0% and increasing to 100%. | Life Cumulative |
| E7 | 231 | Drive Life Remaining: Reported as a percentage, starting at 100% and decreasing to 0%. | Life Cumulative |
| E8 | 232 | RAID Trigger count: Number of RAID triggers (internal), including recoverable and non-recoverable events. | Life Cumulative |
| EA | 234 | Total Flash Sectors read (512 Bytes) from the NAND TLC Region | Life Cumulative |
| EB | 235 | Total Flash Sectors written (512 Bytes) to the NAND TLC Region | Life Cumulative |
| F1 | 241 | Total Host Sectors written (512 Bytes) | Life Cumulative |
| F2 | 242 | Total Host Sectors read (512 Bytes) | Life Cumulative |
| F7 | 247 | Unused attribute | |
| F8 | 248 | Unused attribute | |

7. Industry Standards

| Reference Title | Date / Revision | Location |
|---------------------------------|-----------------|---|
| ATA/ATAPI-8 | September 2008 | http://www.t13.org |
| ACS-3 - ATA/ATAPI Command Set-3 | October 2013 | http://www.t13.org |
| SATA 3.1 | July 2011 | http://www.sata-io.org |
| JEDEC | JESD22-B110B.01 | Mechanical Shock – Device and Subassembly, Revision of JESD22-B110B, June 2019, http://www.jedec.org |
| JEDEC | JESD22-B103B.01 | Vibration, Variable Frequency, Minor revision to JESD22-B103-B, September 2016, http://www.jedec.org |
| JEDEC | JESD218A | Solid-State Drive (SSD) Requirements and Endurance Test Method, February 2011, http://www.jedec.org |
| JEDEC | JESD219 | Solid-State Drive (SSD) Endurance Workloads, September 2010, http://www.jedec.org |

8. Certifications and Compliance

| Compliance / Certification | Description |
|------------------------------------|--|
| CE and FCC Compliant | Class: FCC Part 15 Subpart B Class B:2011 Declaration of Conformity registration No. STE120607699 |
| RoHS Compliant | Restriction of Hazardous Substance Directive |
| UL Certified | Underwriters Laboratories, Inc. 94V-0 |
| WEEE Certified | Waste, Electrical and Electronic Equipment Directive |
| ISO-9001 AS9001 Rev. C Certificate | Quality Management |
| ISO-14001 Certificate | Environmental Management |

9. Contact Information

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10. Revision History

| Date | Revision | Page(s) | Description |
|------------|----------|---------|--|
| 11/03/2020 | 0.90 | All | Preliminary |
| 11/16/2020 | 0.91 | 1, 3 | Update endurance numbers, TWB and DWPD |



Virtium manufactures storage and memory and solutions for the world's foremost industrial embedded OEMs. For over two decades, we have designed, manufactured and supported our products in the USA – fortified by a network of global locations. Our world-class technology and unsurpassed support provide a superior customer experience that continuously results in better industrial embedded products for an increasingly interconnected world.

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