



StorFly® M.2 Type 2280 Solid-State Drive

PCIe Gen3 x4 / NVMe 1.3 - Series 6, 3D TLC

VSFAN8CC240G-V11-H

VSFAN8CI240G-V11-H

Datasheet - Rev. 1.0



1. Description

Virtium's StorFly Series 6 M.2 NVMe PCIe solid-state drive (SSD) technology is a performance-oriented solution designed for the unique storage demands and workload requirements of a broad range of industrial embedded systems, including communications equipment, industrial automation, medical imaging, transportation control, and data recorders where read and write demands are higher than typical boot or mixed workload solutions. StorFly Series 6 M.2 NVMe PCIe solid-state drives are mainstream productivity solutions designed to provide the ideal balance of power, performance, endurance, reliability, long ordering life, and cost all in a rugged industrial design suitable for environmental extremes.

Features

Capacity

- 240 GB

3D TLC NAND

Sequential Performance

- 128kB Sequential Read: 1,700 MB/s
- 128kB Sequential Write: 1,000 MB/s

Random Performance

- 4kB IOPS Read: up to 150,000
- 4kB IOPS Write: up to 150,000

Power: 3.3V±5%

- 128kB Sequential Read: 3.82 W
- 128kB Sequential Write: 3.14 W
- 4kB Random Read: 2.83 W
- 4kB Random Write: 2.99 W
- Idle: 0.63 W

Temperature Ranges

- Commercial: 0°C to 70°C
- Industrial: -40°C to 85°C
- Non-Operating: -40°C to 85°C

Reliability

- Advanced LDPC ECC
- MTBF: >2M hours

Endurance

- JESD219A: 183 TBW
- Sequential: 765 TBW

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

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-M Form Factor
- Length x Width x Height mm (inches)
80.00 (3.14) x 22.00 (0.866) x 3.00 (0.118)

Compliance

- PCIe Specification, Revision 3.1a
- NVMe Specification, Revision 1.3
- 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

Data Security

- Integrated AES-256 encryption (data-at-rest)
- Crypto Erase
- TCG/ Opal 2.0-compliant SED⁽¹⁾

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

- vtView®, vtSecure™, vtTools™



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 AN8 C C 240G - V11 - H

| Where: | |
|-------------|--|
| V | = Virtium |
| SF | = StorFly |
| AN8 | = Form Factor / Interface: AN8 = M.2 Type 2280-D2-M, NVMe / PCIe 3.1 High Performance Gen3 x4 NVMe 1.3 DRAM SSD controller |
| C | = Product Class: C = CE |
| C/I | = Operating Temperature: C : Commercial (0°C to 70°C) I : Industrial (-40°C to 85°C) |
| 240G | = 240GB (1GB = 1,000,000,000 bytes) |
| V11 | = Virtium Proprietary |
| H | = With Heat spreader |

2. Specifications

Interface

| | |
|------------------|--|
| Interface | PCI Express Base Specification Rev 3.1a (PCIe) |
| Command | NVM Express Revision 1.3 |

Capacity

| Unformatted Capacity (GB) ⁽¹⁾ | User-Addressable LBA ⁽²⁾ | User-Addressable Capacity Bytes |
|---|-------------------------------------|---------------------------------|
| 240 | 468,862,128 | 240,057,409,536 |
| (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) = 64 | | IOPS ⁽¹⁾ 4kB File, Queue Depth (QD) = 64 | |
|---|--|-----------------------|--|-------------------|
| | Sequential Read MB/s | Sequential Write MB/s | 100% Random Read | 100% Random Write |
| 240 | 1,700 | 1,000 | 150,000 | 150,000 |
| (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 |
|---|---|--|---|--------|
| 3.82 W | 3.14 W | 2.83 W | 2.99 W | 0.63 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) |
|---|-----------------------|--|---------------------------|
| VSFAN8CC240G-V11-H | 0°C to 70°C | -40°C to 85°C | 5% to 95% |
| VSFAN8CI240G-V11-H | -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) |
| 240 | 183 | 0.70 | 765 | 2.91 |
| (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

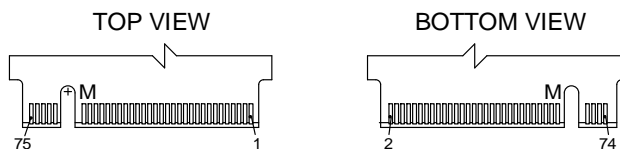
vtGuard is an integrated power failure protection technology that will preserve data on the SSD if a sudden power failure should occur. It will also transfer the write cache (metadata, mapping tables) contents to the non-volatile flash and restore the contents upon power restoration. This data will be 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

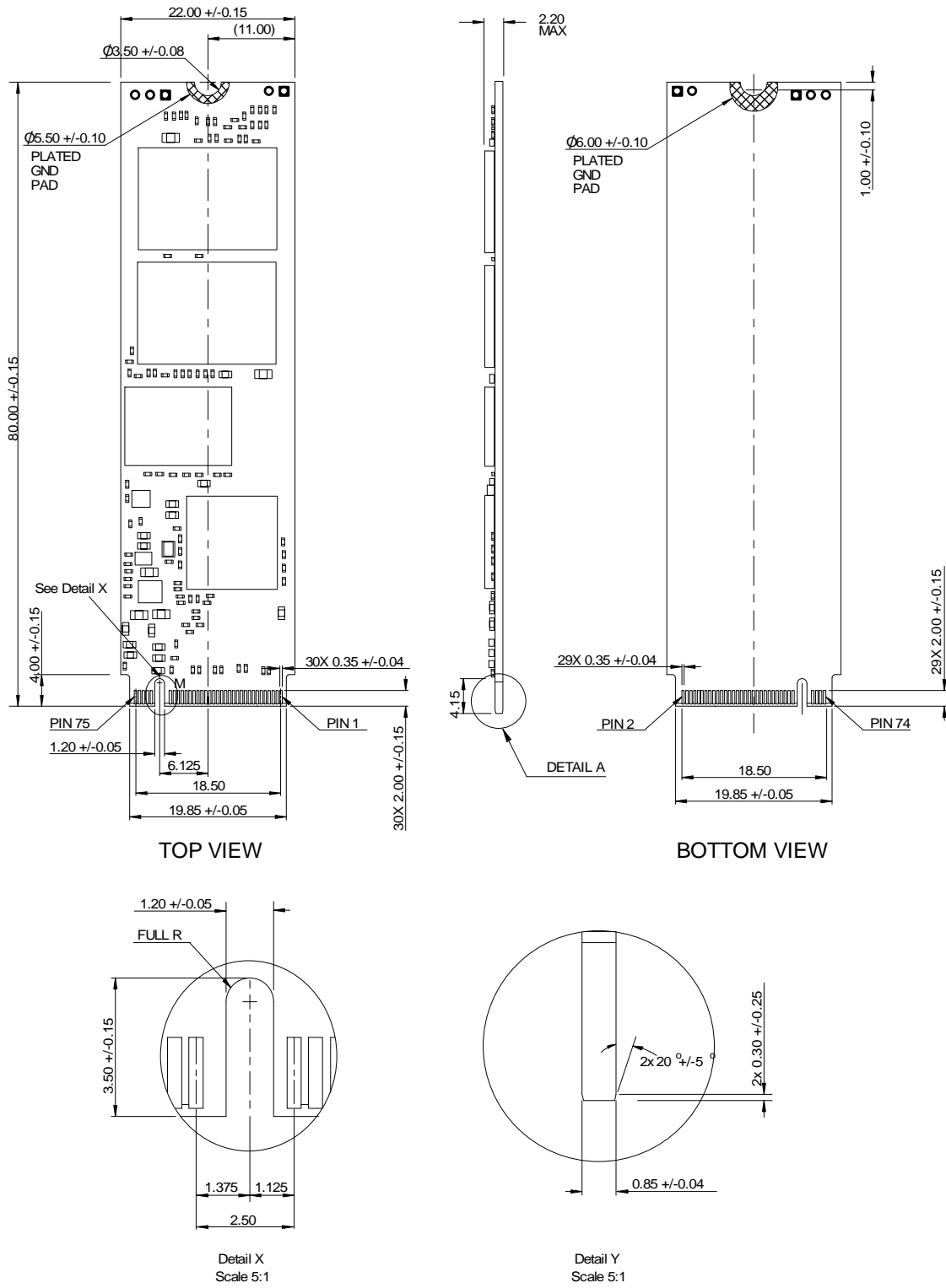
| Pin | Signal | Description | Pin | Signal | Description |
|------------|----------|-----------------------|------------|---------|----------------------------|
| 1 | CONFIG_3 | Ground | 2 | 3.3V | 3.3V Source |
| 3 | GND | Ground | 4 | 3.3V | 3.3V Source |
| 5 | PETn3 | PCIe Lane 3 Tx- | 6 | N/C | No Connect |
| 7 | PETp3 | PCIe Lane 3 Tx+ | 8 | N/C | No Connect |
| 9 | GND | Ground | 10 | LED1# | Device Active Signal# |
| 11 | PERn3 | PCIe Lane 3 Rx- | 12 | 3.3V | 3.3V Source |
| 13 | PERp3 | PCIe Lane 3 Rx+ | 14 | 3.3V | 3.3V Source |
| 15 | GND | Ground | 16 | 3.3V | 3.3V Source |
| 17 | PETn2 | PCIe Lane 2 Tx- | 16 | 3.3V | 3.3V Source |
| 19 | PETp2 | PCIe Lane 2 Tx+ | 20 | N/C | No Connect |
| 21 | CONFIG_0 | Ground | 22 | N/C | No Connect |
| 23 | PERn2 | PCIe Lane 2 Rx- | 24 | N/C | No Connect |
| 25 | PERp2 | PCIe Lane 2 Rx+ | 26 | N/C | No Connect |
| 27 | GND | Ground | 28 | N/C | No Connect |
| 29 | PETn1 | PCIe Lane 1 Tx- | 30 | N/C | No Connect |
| 31 | PETp1 | PCIe Lane 1 Tx+ | 32 | N/C | No Connect |
| 33 | GND | Ground | 34 | N/C | No Connect |
| 35 | PERn1 | PCIe Lane 1 Rx- | 36 | N/C | No Connect |
| 37 | PERp1 | PCIe Lane 1 Rx+ | 38 | DEVSLP | No Connect |
| 39 | GND | Ground | 40 | N/C | No Connect |
| 41 | PETn0 | PCIe Lane 0 Tx- | 42 | N/C | No Connect |
| 43 | PETp0 | PCIe Lane 0 Tx+ | 44 | N/C | No Connect |
| 45 | GND | Ground | 46 | N/C | No Connect |
| 47 | PERn0 | PCIe Lane 0 Rx- | 48 | N/C | No Connect |
| 49 | PERp0 | PCIe Lane 0 Rx+ | 50 | PERST# | PCIe Reset# |
| 51 | GND | Ground | 52 | CLKREQ# | PCIe Device Clock Request# |
| 53 | REFCLKN | PCIe Reference Clock- | 54 | PEWake# | No Connect |
| 55 | REFCLKP | PCIe Reference Clock+ | 56 | N/C | No Connect |
| 57 | GND | Ground | 58 | N/C | No Connect |
| Key | | | Key | | |
| 67 | N/C | No Connect | 68 | SUSCLK | No Connect |
| 69 | CONFIG_1 | No Connect | 70 | 3.3V | 3.3V Source |
| 71 | GND | Ground | 72 | 3.3V | 3.3V Source |
| 73 | GND | Ground | 74 | 3.3V | 3.3V Source |
| 75 | CONFIG_2 | Ground | - | - | - |

Note: Pins 59 - 66 are displaced by the connector key.



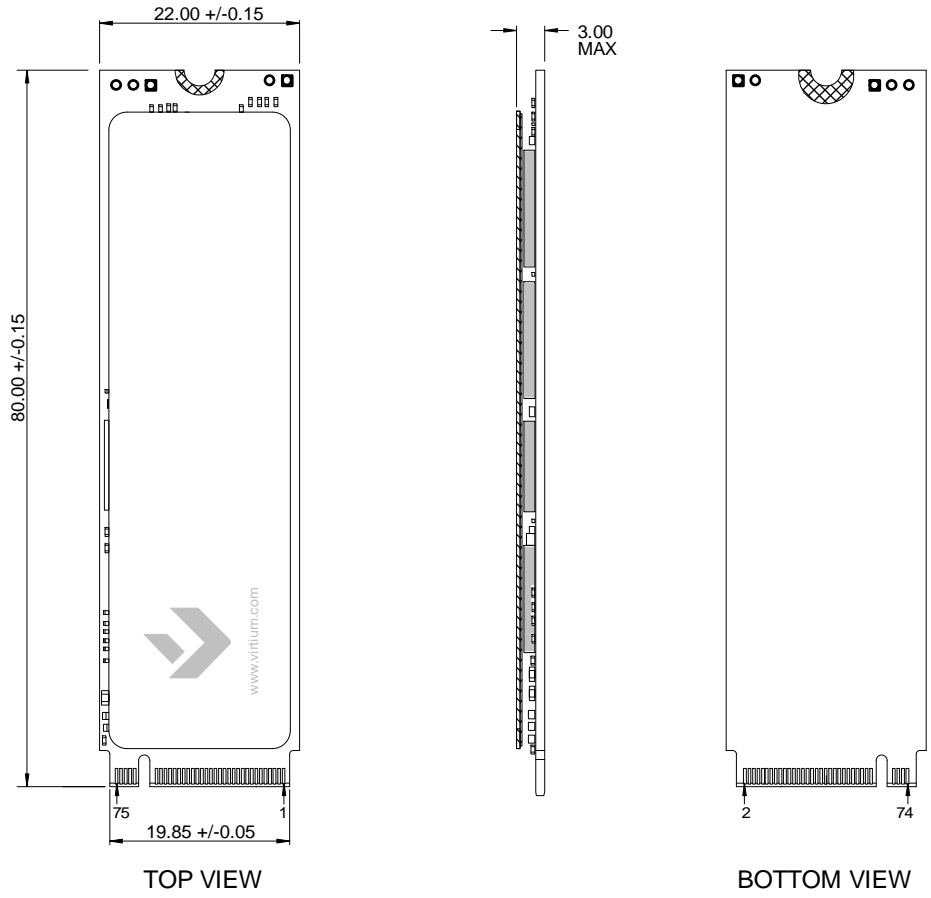
Pin Layout

Mechanical Dimensions

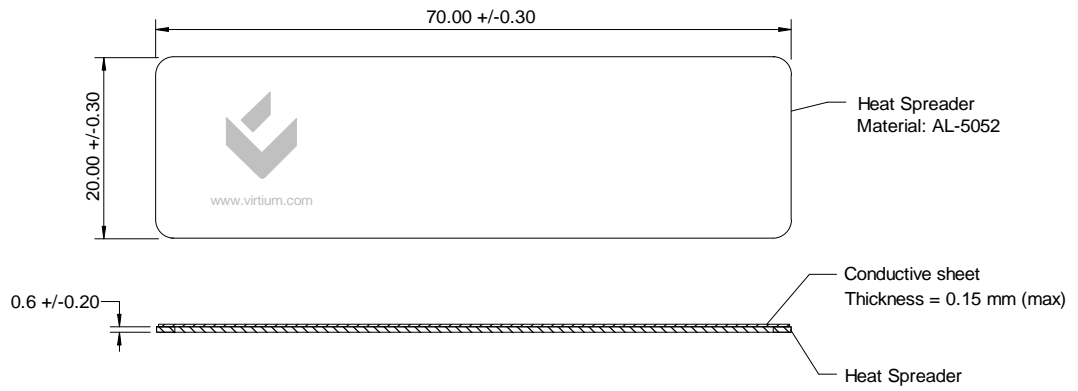


- Note:
1. All dimensions are in millimeters
 2. The dimensional diagram is for reference only

MODULE WITH HEAT SPREADER



HEAT SPREADER DESIGN



DO NOT SCALE

Note:

1. All dimensions are in millimeter

5. NVMe Command Set Specifications

Introduction

NVM Express, or NVMe, is a register level interface that is intended to simplify the configuration of NVMe devices. The standard is comprised of various terms that are important to know when implementing NVMe devices.

Note: This section is intended for informational purposes and presents an overview of the NVMe command set specification. The user should consult the cited NVMe Specification, Revision 1.3 for details.

Admin Command Set

| Opcode (Hex) | Command | Opcode (07) | Opcode (06:02) | Opcode (01:00) | Namespace Identifier Used |
|--------------|-----------------------------|-----------------|----------------|----------------|---------------------------|
| | | Generic Command | Function | Data Transfer | |
| 00h | Delete I/O Submission Queue | 0b | 000 00b | 00b | No |
| 01h | Create I/O Submission Queue | 0b | 000 00b | 01b | No |
| 02h | Get Log Page | 0b | 000 00b | 10b | Yes |
| 04h | Delete I/O Completion Queue | 0b | 000 01b | 00b | No |
| 05h | Create I/O Completion Queue | 0b | 000 01b | 01b | No |
| 06h | Identify | 0b | 000 01b | 10b | Yes |
| 08h | Abort | 0b | 000 10b | 00b | No |
| 09h | Set Features | 0b | 000 10b | 01b | Yes |
| 0Ah | Get Features | 0b | 000 10b | 10b | Yes |
| 10h | Firmware Activate | 0b | 001 00b | 00b | No |
| 11h | Firmware Image Download | 0b | 001 00b | 01b | No |
| 80h | Format NVM | 1b | 000 00b | 00b | Yes |
| 0Ch | Asynchronous Event Request | 0b | 000 11b | 00b | No |

NVMe I/O Command Set

| Opcode (Hex) | Command | Opcode (06:02) Function | Opcode (01:00) Data Transfer |
|--------------|---------------------|-------------------------|------------------------------|
| 00h | Flush | 000 00b | 00b |
| 01h | Write | 000 00b | 01b |
| 02h | Read | 000 00b | 10b |
| 04h | Write Uncorrectable | 000 01b | 00b |
| 05h | Compare | 000 01b | 01b |
| 08h | Write Zeros | 000 10b | 00b |
| 09h | Dataset Management | 000 10b | 01b |

NVMe Log Pages

The following table lists the mandatory log pages that are supported by the M.2 NVMe PCIe SSD. These log pages are defined in the NVMe 1.3 Specification. See *the NVMe 1.3 Specification, Section 5.15*.

| Command | Protocol |
|---------|--|
| 00h | Reserved |
| 01h | Error Information |
| 02h | SMART / Health Information |
| 03h | Firmware Slot Information |
| 04h | Changed Namespace List |
| 05h | Commands Supported and Effects |
| 06h | Device Self-test |
| 07h | Telemetry Host-Initiated |
| 08h | Telemetry Controller-Initiated |
| 09h-6Fh | Reserved |
| 70h | Discovery (refer to the NVMe over Fabrics specification) |
| 71h-7Fh | Reserved for NVMe over Fabrics |
| 80h-BFh | I/O Command Set Specific |
| C0h-FFh | Vendor specific |

SMART / Health Log Information

| Bytes | Description | | | | | | | | | | | | | | |
|-------|--|-----|------------|---|---|---|---|---|--|---|--|---|---|-----|----------|
| 0 | <p>Critical Warning: 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.</p> <table border="1"> <thead> <tr> <th>Bit</th> <th>Definition</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>If set to '1', then the available spare space has fallen below the threshold.</td> </tr> <tr> <td>1</td> <td>If set to '1', then a temperature is above an over temperature threshold or below an under temperature threshold (refer to section 5.21.1.4).</td> </tr> <tr> <td>2</td> <td>If set to '1', then the NVM subsystem reliability has been degraded due to significant media related errors or any internal error that degrades NVM subsystem reliability.</td> </tr> <tr> <td>3</td> <td>If set to '1', then the media has been placed in read only mode.</td> </tr> <tr> <td>4</td> <td>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.</td> </tr> <tr> <td>7:5</td> <td>Reserved</td> </tr> </tbody> </table> | Bit | Definition | 0 | If set to '1', then the available spare space has fallen below the threshold. | 1 | If set to '1', then a temperature is above an over temperature threshold or below an under temperature threshold (refer to section 5.21.1.4). | 2 | If set to '1', then the NVM subsystem reliability has been degraded due to significant media related errors or any internal error that degrades NVM subsystem reliability. | 3 | If set to '1', then the media has been placed in read only mode. | 4 | 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. | 7:5 | Reserved |
| Bit | Definition | | | | | | | | | | | | | | |
| 0 | If set to '1', then the available spare space has fallen below the threshold. | | | | | | | | | | | | | | |
| 1 | If set to '1', then a temperature is above an over temperature threshold or below an under temperature threshold (refer to section 5.21.1.4). | | | | | | | | | | | | | | |
| 2 | If set to '1', then the NVM subsystem reliability has been degraded due to significant media related errors or any internal error that degrades NVM subsystem reliability. | | | | | | | | | | | | | | |
| 3 | If set to '1', then the media has been placed in read only mode. | | | | | | | | | | | | | | |
| 4 | 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. | | | | | | | | | | | | | | |
| 7:5 | Reserved | | | | | | | | | | | | | | |
| 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. | | | | | | | | | | | | | | |
| 3 | Available Spare: Contains a normalized percentage (0 to 100%) of the remaining spare capacity available. | | | | | | | | | | | | | | |
| 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%). | | | | | | | | | | | | | | |
| 5 | Percentage Used: The percentage of NVM subsystem life used based on the actual usage and the 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). | | | | | | | | | | | | | | |
| 31:6 | Reserved | | | | | | | | | | | | | | |
| 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. | | | | | | | | | | | | | | |

| Bytes | Description |
|---------|--|
| 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. |
| 79:64 | Host Read Commands: Contains the number of read commands completed by the controller. |
| 95:80 | Host Write Commands: Contains the number of write commands completed by the controller. |
| 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. |
| 127:112 | Power Cycles: Contains the number of power cycles. |
| 143:128 | Power On Hours: Contains the number of power-on hours. This may not include time that the controller was powered and in a non-operational power state. |
| 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. |
| 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. |
| 191:176 | Number of Error Information Log Entries: Contains the number of Error Information log entries over the life of the controller. |

6. Industry Standards

| Reference Title | Date / Revision | Location |
|-----------------|-----------------|--|
| NVMe | NVMe 1.3 | NVM Express Working Group. NVM Express (NVMe) Specification, Revision 1.3, May 1, 2017. http://www.nvmexpress.org . |
| PCI-SIG | Revision 3.1a | PCI Express Base Specification, Revision 3.1a, December 7, 2015. https://pcsig.com/ |
| PCI-SIG | Revision 1.1 | PCI Express M.2 Specification, Revision 1.1, December 15, 2016. https://pcsig.com/ |
| 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 |

7. 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 |

8. Contact Information

Corporate Headquarters and Manufacturing Location:

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| | |
|--------------------------|---|
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| Customer Support | custserv@virtium.com |

9. Revision History

| Date | Revision | Page(s) | Description |
|------------|----------|---------|-----------------|
| 06/14/2021 | 1.0 | All | Initial release |
| | | | |



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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