Virtium
Solid State Storage and Memory

Virtium StorFly® 200 – SlimSATA 6Gbps SSD
VSF202PC008-ERC Product Specification

1.0   Introduction

Virtium's StorFly® 200 is 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 and gaming equipment as well as point-of-sale terminals, data recorders and wearable computers. StorFly 200PE SSDs are Virtium's entry level solid state drives that are designed to meet the critical storage demands of read-intensive and boot applications.

2.0   Features

- Capacity: 8GB
- Industrial SLC
- Sequential Performance
  - Read: up to 250MB/s
  - Write: up to 68MB/s
- Random Performance
  - Read IOPS: up to 32,600
  - Write IOPS: up to 1,400
- Temperature
  - Commercial Operating: 0°C to 70°C
  - Non-operating: -55°C to +95°C
- Power 5.0V
  - Maximum: 4.77W
  - Typical: 3.73
  - Idle: 0.66W
- Reliability
  - vtGuard™ Data Protection during unexpected power down.
  - MTBF: 2,000,000 hours
  - Endurance: up to 1,425 TBW
- S.M.A.R.T. Attribute Reporting
- Compliance
  - SATA Revision 3.1 (SATA 6Gbps)
  - ATA/ATAPI-8 (ACS-2)
  - FCC, CE, UL, RoHS

- Mechanical Dimensions
  Length x Width x Height mm (inches)
  54 (2.13) x 39 (1.54) x 4 (0.16)
- Weight: 10.5±2g
- Environmental (Operating/Non-operating)
  - MIL-STD-810F
  - Shock: 1500G, 0.5ms duration
  - Vibration: 16.4G_{RMS}
  - Altitude: 80,000 feet

3.0   Ordering Information and Part Numbering System

3.1   Part Number Decoder

V SF 202 P C 008G - ERC

Where:		
V	=	Virtium
SF	=	StorFly
202	=	Slim SATA 6Gbps SSD
P	=	Product Class PE, SLC
C	=	Operating Temperature: C = Commercial (0ºC to 70ºC)
008G	=	Capacity 008G = 8GB (1GB = 1,000,000,000)
-	-	-
ERC		Virtium Proprietary

3.2   Ordering Information

Part Number	Capacity
VSF202PC008G-ERC	8GB

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4.0 Specifications

4.1 Capacity

Table 1: Capacity

Unformatted Capacity (GB)[1]	User-Addressable LBA[2]	User-Addressable Capacity Bytes
8	15,433,488	7,901,945,856

(1) 1GB = 1,000,000,000 bytes.
(2) LBA: Logical Block Address. Logical block size of 512 bytes (1 sector).

4.2 Performance

Table 2: Performance

Capacity (GB)	Throughput[1] 64KB File Queue Depth (QD) = 32		IOPS[1] 4KB File, Queue Depth (QD) = 32, 100% Random	
	Sequential Read MB/s	Sequential Write MB/s	Random Read	Random Write
8	250	68	32,600	1,400

(1) OakGate tester, fully preconditioned drive, mixed compressed/uncompressed data pattern, 4K aligned, write cache enabled
OMeter 2006 with write cache enabled

4.3 Environmental Specifications

4.3.1 Temperature and Humidity

Table 3: Temperature and Humidity

Part Number	Operating Temperature	Non-Operating Temperature[1] Moisture Sensitivity
VSF202PC###G-XXX	0°C to 70°C	-55°C to +95°C 5% to 95% (Non-condensing)

(1)   Please contact your Virtium representative for details on the non-operating temperature range.

4.3.2 Shock, Vibration and Altitude

Table 4: Shock, Vibration and Altitude

Reliability	Test Conditions
Shock[1]	1500G, half-sine, 0.5ms duration
Vibration[2]	$16.4G_{RMS}$
Altitude[3]	80,000 feet

(1)   MIL-STD-810F, Method 516.5
(2)   MIL-STD-810F, Method 514.5
(3)   MIL-STD-810F, Method 500.4

4.4 System Reliability

4.4.1 Endurance

Table 5: Endurance

Capacity (GB)	JESD218A[1] & JESD219 Enterprise Workloads		100% Sequential Workloads	
	Total Byte Written TBW (TB)	Drive Writes per day (3 years)	Total Byte Written TBW (TB)	Drive Writes per day (3 years)
8	91.7	10.5	760.2	86.9

(1)   JESD218 assumes active temperature at 55°C and a retention temperature at 40°C. Please contact your Virtium representative for endurance values at other temperatures.

4.4.2 Mean Time Between Failures (MTBF)

The StorFly 202PE SSD class achieves MTBF of 2,000,000 hours predicted based on the component reliability data using Telcordia SR-332 methods at 40°C.

4.4.3 vtGuard™

The vtGuard system protects the StorFly SSDs from data loss during unexpected power-down or brown-out conditions. vtGUARD is proprietary hardware and firmware technology that detects power falling below a predefined threshold. Once detected, the StorFly SSD blocks any new data coming from the host and uses on-board power-loss protection capacitance to provide enough power to ensure that data in temporary buffers is committed to the NAND flash, thereby protecting user data. Virtium StorFly SSDs have been tested to over 3,000 random power-down cycles.

4.5 Power Requirements

Table 6: Power Consumption

Maximum[1]	Typical[2]	Idle
4.77W	3.73W	0.66W

(1) For a 256GB, based on 5V input.
(2) For a 70/30 read/write workload.

4.6 Certifications and Compliance

Table 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

5.0 Physical Specification

5.1 Pin Assignments

Table 8: Pin Assignments

Signal Pin Assignments		
S1	GND	Ground
S2	Rx+	Device Transmit Signal
S3	Rx-	
S4	GND	Ground
S5	Tx-	Device Receive Signal
S6	Tx+	
S7	GND	Ground
Key	Key	Key
Power Pin Assignments		
Key	Key	Key
P1	V33	3.3V Power option, NC default
P2	V33	3.3V Power option, NC default
P3	V33	3.3V Power option, NC default
P4	GND	Ground
P5	GND	Ground
P6	GND	Ground
P7	V5	5V Power (±10%)
P8	V5	5V Power (±10%)
P9	V5	5V Power (±10%)
P10	GND	Ground
P11	DAS/DSS	Device Active Signal/Disable Staggered Spinup
P12	GND	Ground
P13	V12	No Connect
P14	V12	No Connect
P15	V12	No Connect
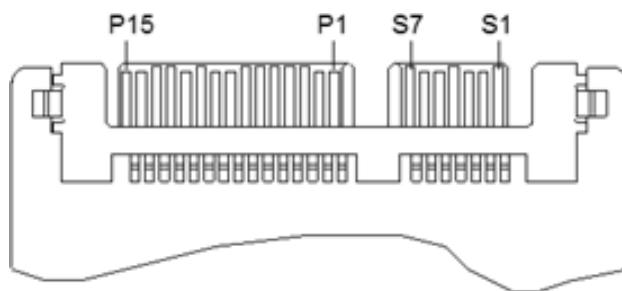
Figure 1: Signal Segment and Power Segment

Product Specification
StorFly 202 SSD
VSF202PC008G-ERC
Revision
1.00

Virtium
Solid State Storage and Memory

5.2   Mechanical Dimensions
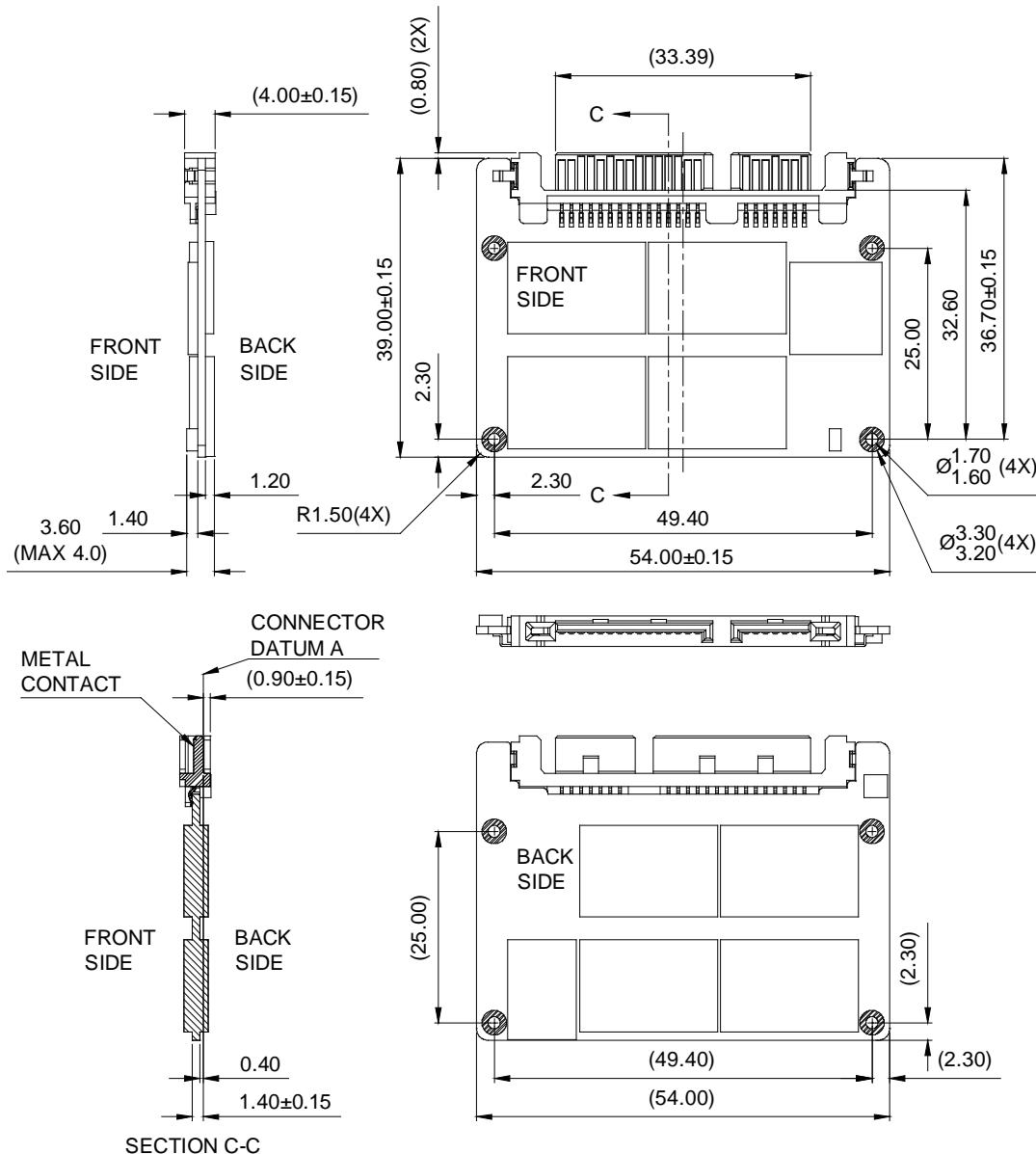
Figure 2: Mechanical Dimensions

6.0 ATA Commands

VSF202P SSDs support all mandatory ATA commands defined in the ATA/ATAPI-8 (ACS-2) specification.

6.1 Supported Commands

6.1.1 General Commands

Table 9: Supported ATA Commands

Command	Code	Protocol
Execute Drive Diagnostic	90h	Device diagnostic
Flush Cache	E7h	Non-data
Identify Device	ECh	PIO data-in
Initialize Drive Parameters	91h	Non-data
Read DMA	C8h	DMA
Read Log Ext	2Fh	PIO data-in
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

6.1.2   Power Management Commands

Table 10: Power Management Commands

Command	Code	Protocol
Check Power Mode	E5h or 98h	Non-data
Idle	E3h or 97h	Non-data
Idle Immediate	E1h or 95h	Non-data
Sleep	E6h or 99h	Non-data
Standby	E2h or 96h	Non-data
Standby Immediate	E0h or 94h	Non-data

6.1.3   Security Mode Commands

Table 11: Security Mode Commands

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

6.1.4   S.M.A.R.T. Commands

Table 12: S.M.A.R.T 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

6.1.5 48-bit Address Feature Set

Table 13: 48-bit Address Feature Set Commands

Command	Code	Protocol
Flush Cache Ext	EAh	Non-data
Read Sector(s) Ext	24h	PIO data-in
Read DMA Ext	25h	DMA
Read Multiple Ext	29h	PIO data-in
Read Verify Sector(s) Ext	42h	Non-data
Write DMA Ext	35h	DMA
Write Multiple Ext	39h	PIO data-out
Write Sector(s) Ext	34h	PIO data-out

6.1.6 Native Command Queuing (NCQ)

Table 14: Native Command Queuing (NCQ)

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

6.1.7 Data Set Management and Seek Commands

Table 15: Data Set Management and Seek Commands

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

6.2 Identify Device Data

The Identify Device 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.

Table 16: Identify Device Data

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	0240h	Obsolete
6	F	003Fh	Default number of sectors per track
7-8	V	0000h	Reserved
9	X	0000h	Obsolete
10-19	X	XXXXh	Serial number in ASCII (Right justified)
20	X	0000h	Obsolete
21	X	FFFFh	Obsolete
22	X	0004h	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	8002h	Maximum number of sectors on Read/Write Multiple command
48	F	0000h	Reserved
49	F	XXXXh	Capabilities
50	F	XXXXh	Capabilities
51	F	0200h	Obsolete
52	X	0000h	Obsolete
53	F	0007h	Field validity
54-58	X	XXXXh	Obsolete
59	F	0101h	Multiple sector setting
60	V	XXXXh	Total number of user addressable logical sectors for 28-bit commands
61	V	XXXXh	(DWord)
62	X	0000h	Obsolete
63	F	0207h	Multiword DMA transfer
64	F	0003h	Supports MDMA mode 0, 1 and 2 Advanced PIO modes 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	4D20h	Additional supported
70-74	F	0000h	Reserved
75	F	001Fh	Queue depth
76	F	830Eh	Serial ATA capabilities • Supports Serial ATA Gen3 • Supports Serial ATA Gen2 • Supports Serial ATA Gen1 • Supports receipt of host initiated power management requests Supports Native Command Queuing
77	F	0040h	Serial ATA additional capability DevSleep_to_ReducedPwerState
78	F	0148h	Serial ATA features supported • Supports software settings preservation Device supports initiating power management
79	V	0040h	• Reserved
80	F	03F0h	• Major version number (ACS-2)
81	F	0000h	• Minor version number
82	F	746Bh	Command sets supported 0
83	F	7701h	Command sets supported 1
84	F	4063h	Command sets supported 2
85	V	7468h	Command set/feature enabled
86	V	B401h	Command set/feature enabled
87	V	4063h	Command set/feature enabled
88	V	007Fh	Ultra DMA mode supported and selected
89	F	0001h	Time required for a Normal Erase mode Security Erase Unit command
90	F	0001h	Time required for an Enhanced Erase mode Security Erase Unit command
91	V	0000h	Current advanced power management value
92	V	FFFEh	Master Password identifier
93-99	V	0000h	Reserved
100 101 102 103	V	XXXXh XXXXh XXXXh XXXXh	Maximum user LBA for 48-bit Address feature set
104	V	0000h	Reserved
105	F	0008h	Maximum number of 512-byte blocks per Data Set Management command

Word	F/V/X	Value	Description
106-127	V	0000h	Reserved
128	V	0021h	Security status
129-159	X	XXXXh	Virtium specific
160	F	0000h	Power requirement description
161-167	X	0000h	Reserved
168	V	0000h	Reserved
169	F	0001h	Data Set Management supported
170-208	V	0000h	Reserved
209	V	4000h	Reserved
210-216	V	0000h	Reserved
217	F	0001h	Non-rotating media (SSD)
218-221	X	0000h	Reserved
222	F	107Fh	Transport major revision (SATA Rev 3.1)
223-254	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.

6.3   S.M.A.R.T. Attributes

6.3.1   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; its purpose is to inform users about the SMART commands and attributes implemented by Virtium Technology, Inc., including the data structures returned by those commands.

Note: Please refer to ACS-2 Specification for information on how to invoke the SMART command.

6.3.2   SMART Command

The following table defines the SMART command set that is supported by the VSF202C SSDs.

Table 17: SMART Feature Register Values

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

6.3.3 SMART Attribute Definitions

The following table defines the current SMART data attributes current supported by the VSF202P SSDs. These SMART attributes are located at Offset 2 of the SMART Data Structure.

Table 18: SMART Attribute Definitions

ID (Hex)	ID (Decimal)	Description	Type
01	1	Raw Read Error Rate: Rate of CRC errors over the total number of LBAs read.	Reset at power on.
09	9	Power-on Time in Hours	Reset at power on.
0C	12	Power Cycle Count: Includes both proper power down (for example Windows or Linux Shutdown command) and unsafe power down.	Life Cumulative
C0	192	Unsafe Power Down: Power off without STANDBY-IMMEDIATE. Also known as an ungraceful power down. StorFly vtGuard allows recovery from unsafe power down.	Life Cumulative
C2	194	Temperature: Controller °C	Reset at power on.
C7	199	SATA Interface CRC Error Count	Life cumulative
A0	160	Uncorrectable Sector Count Read or Write	Reset at power on.
A1**	161	Remaining Spare Block Count: Reported as a percentage, starting at 100% and decreasing to 0%. When this value reaches 0%, the SSD enters read-only mode.	Life Cumulative
F1	241	Total LBA Write: This value increases by 1 for every 32MB (65,536 sectors at 512 bytes per sector) written.	Life Cumulative
F2	242	Total LBA Read: This value increases by 1 for every 32MB (65,536 sectors at 512 bytes per sector) read.	Life Cumulative
A9**	169	Remaining Life Left: Reported as a percentage, starting at 100% and decreasing to 0%. When this value reaches 0%, the SSD enters read-only mode.	Life Cumulative
F8*	248	Remaining Life Left: Identical to attribute A9	Life Cumulative
F9*	249	Remaining Spare Block Count: Identical to attribute A1.	Life Cumulative

Notes:

(*) – This attribute in only present in later then 0409 FW. In 0729 this attribute displays remaining in block life. In 0828 the life remaining is normalized to 100% then decreases.

(**) – This attribute is present an all FW. In 0729 this attribute displays remaining in block life. In 0828 the life remaining is normalized to 100% then decreases.

7.0   References

Reference Title	Date / Revision Number	Location
ATA/ATAPI-8	September 2008	http://www.t13.org
ACS-2 - ATA/ATAPI Command Set-2	June 2011	http://www.t13.org
MIL-STD-810F	January 2000	Department of Defense Test Method Standard for Environmental Engineering Considerations and Laboratory Tests
SATA 3.1	July 2011	http://www.sata-io.org
JESD219: Solid State Drive (SSD) Endurance Workloads	September 2010	http://www.jedec.org
JESD218A: Solid-State Drive (SSD) Requirements and Endurance Test Method	February 2011	http://www.jedec.org

8.0 Revision History

Date	Revison	Page(s)	Description
12/20/2017	1.00	All, 8	Intial release; Page 8; Table 8; corrected description for pin P3 (3.3V Power option, NC default); SVN: 11341