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Datasheet for:

M.2 (2280) SATA SSD

PSFEM5xxxxBxxx

Embedded/Industrial Applications

PRELIMINARY PRELIMINARY PRELIMINARY

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Revision History

Date	Revision	Description	Checked by
1/16/18	A	Initial release based PSFEM6xxxxBxxx_A. Change PN's and mechanical outline	
7/31/18	A1	Add PNs: VRFEM5400GBCHWT3 VRFEM5800GBCFWT3	

Ordering Information for the M.2 (2280) SATA SSD

Part Number	SATA Interface	Application	Useable Capacity (GB) ¹	LBA ²	Temperature Range	NAND Device
VRFEM5960GBIFWT3	6Gb/s	Enterprise	960	1,875,385,008	(-40to+85°C)	Toshiba 3D NAND
VRFEM5960GBCFWT3	6Gb/s	Enterprise	960	1,875,385,008	(0to+70'c)	Toshiba 3D NAND
VRFEM5800GBCFWT3	6Gb/s	Enterprise	800	1,562,824,368	(0to+70'c)	Toshiba 3D NAND
VRFEM5480GBIHWT3	6Gb/s	Enterprise	480	937,703,088	(-40to+85°C)	Toshiba 3D NAND
VRFEM5480GBCHWT3	6Gb/s	Enterprise	480	937,703,088	(0to+70'c)	Toshiba 3D NAND
VRFEM5400GBCHWT3	6Gb/s	Enterprise	400	781,422,768	(0to+70'c)	Toshiba 3D NAND
VRFEM5240GBI5WT3	6Gb/s	Enterprise	240	468,862,128	(-40to+85°C)	Toshiba 3D NAND
VRFEM5240GBC5WT3	6Gb/s	Enterprise	240	468,862,128	(0to+70'c)	Toshiba 3D NAND
VRFEM5120GBI5WT3	6Gb/s	Enterprise	120	234,441,648	(-40to+85°C)	Toshiba 3D NAND
VRFEM5120GBC5WT3	6Gb/s	Enterprise	120	234,441,648	(0to+70'c)	Toshiba 3D NAND
VRFEM5060GBI5WT3	6Gb/s	Enterprise	60	117,231,408	(-40to+85°C)	Toshiba 3D NAND
VRFEM5060GBC5WT3	6Gb/s	Enterprise	60	117,231,408	(0to+70'c)	Toshiba 3D NAND

Notes:

1. User capacity is reported as a decimal count of bytes. The capacity is determined using the industry standard method as defined by the International Drive Equipment Manufacturers Association (IDEMA).
2. Logical Block Address (LBA) Configuration: The drive is set to report the number of logical block addresses (LBA) that will ensure sufficient storage space for the specified density. Standard LBA settings, based on the IDEMA standard (LBA1-03).
3. Contact Viking for availability dates
4. The lowercase letters x,y and z are wildcard characters that indicate product or customer specific information. Refer to the Viking part number coversheet or PN decoder for details.

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1 Introduction

The Viking M.2 (2280) SATA SSD combines performance and reliability with low power operation to make the ideal mobile drive. The high read and write performance will satisfy the most demanding power user. While the low power mode extends battery life for the road warrior.

Providing an industry-leading bandwidth, the Viking M.2 (2280) SATA SSD can approach the limits of the SATA 6Gb/s interface on large transfers. I/O performance reaches enterprise class standards.

A robust LDPC algorithm and StaticDataRefresh technology protect the data. Efficient bad block management and reduced write amplification further bolster endurance. Drive health is monitored using an SSD-specific set of S.M.A.R.T. attributes. The combination of these techniques provides data protection unrivaled in the storage industry.

1.1 FEATURES

Reduced Power Requirements

- No moving parts
- Super-low operating and standby power needs
- Power requirements notably reduced over a typical HD

Fast Performance

- Virtually zero spin up or seek times
- Zero rotational latency
- High sustained data transfer rate

Reliable

- No volatile memory elements
- Improved resistance to shock & vibration
- Predictable and manageable failure modes reduce IT costs

Improved Operation

- Noise and vibration free
- Virtually no heat emissions

2 M.2 (2280) SATA SSD Technical Specifications

Attributes

- Silicon Motion SM2258 controller
- DDR3 external cache
- SLC caching accelerates burst performance
- Direct-to-MLC mode enhances sustained write performance
- Global wear leveling evens program/erase counts to extend drive lifespan
- StaticDataRefresh technology ensures data integrity
- Intelligent garbage collection routines for advanced free space management
- TRIM command support (OS dependent)
- S.M.A.R.T. support
- LDPC hard and soft decode ECC
- DEVSLP support
- Internal flash RAID-like parity scheme for an additional layer of error correction
- Field-upgradeable firmware
- SATA 3.1 Compliant SATA 6Gb/s – backwards compatible to SATA 3Gb/s and 1.5Gb/s
- ATA/ATAPI-8-ACS3 command set compliant
- Industry-standard 512 byte sector support
- Native Command Queuing (NCQ) support with 32 command queue depth
- RoHS-compliant package
- 3D NAND
- AES 256-bit Encryption
- OPAL 2.0 Support

Performance

- Sequential Read: Up to 550MB/s
- Sequential Write: Up to 520MB/s
- Random Read: Up to 100K IOPS (4K block size)
- Random Write: Up to 90K IOPS (4K block size)

Endurance

- TBW: Up to 544
- DWPD: 1

Security

- User selectable ATA password support
- Secure Erase support

Reliability

- MTBF: 1.5 million device hours (per Telcordia SR-332 reliability prediction procedure)
- Low Density Parity Check (LDPC) ECC
- Static and dynamic wear leveling
- Uncorrectable Bit Error Rate: ≤ 1 sector per 10^{16} bits read

Electrical/Mechanical

- +3.0VDC ($\pm 5\%$) power supply
- Power Consumption: up to 1.55W (Active), 0.82W (Idle)

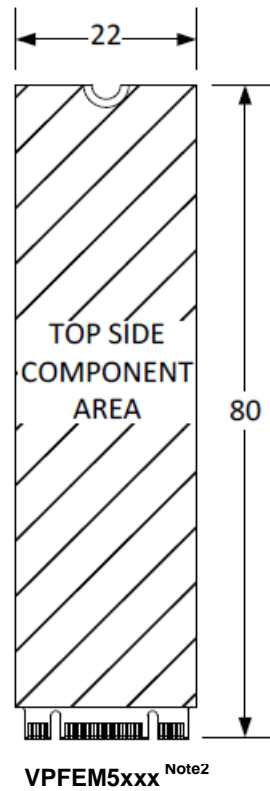
Environmental

- Operating (Commercial Temperature): 0-70°C
- Operating (Industrial Temperature): -40-85°C
- Non-Operating temperature: -40-85°C
- Operating humidity: 5-95% relative
- Shock: 1500G/0.5ms
- Vibration: 2-500Hz, 3.1G

3 Mechanical Dimensions

3.1 Dimensions

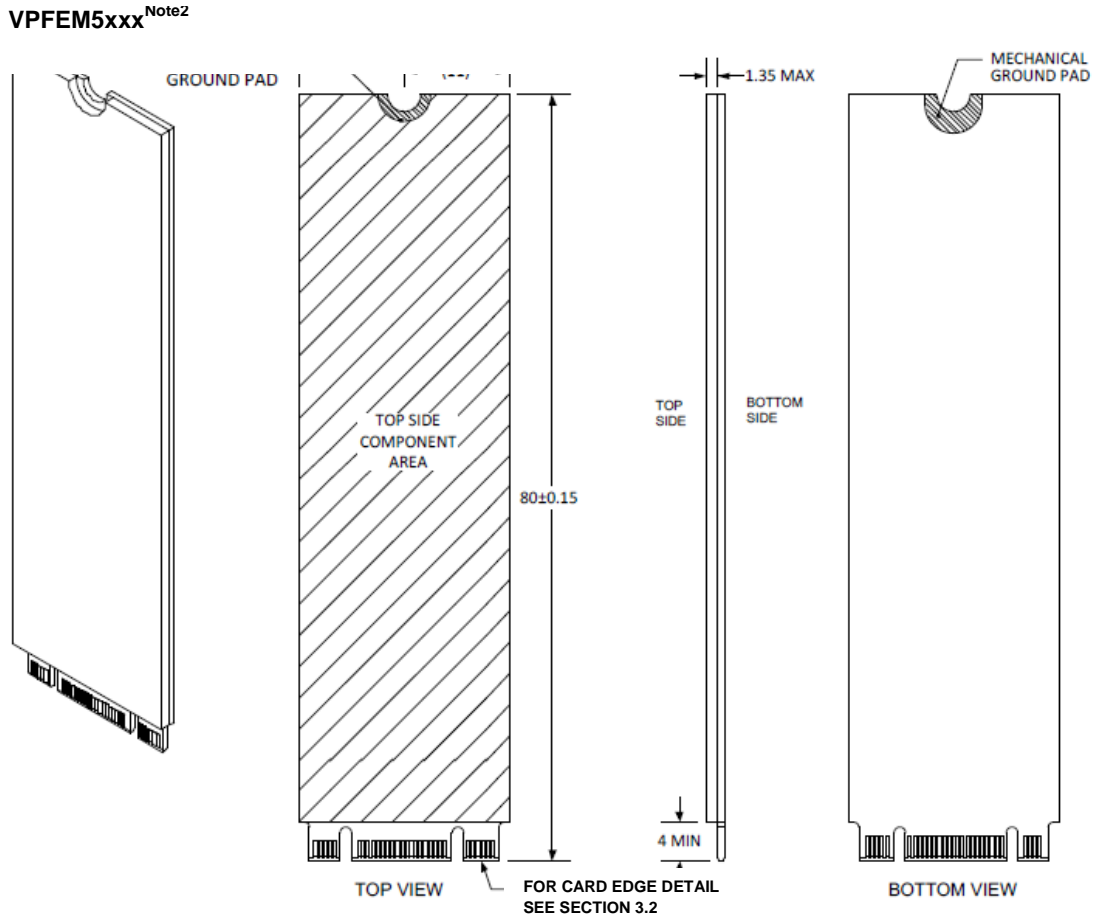
Figure 3-1: Dimensions



Notes:

1. All dimensions are in millimeter. General tolerance is ± 0.15 . PCB thickness 0.8 ± 0.08
2. Refer to Ordering Information table for the complete Viking part number that describes the "xxx".

Figure 3-2: Dimension Details for M.2 80mm length

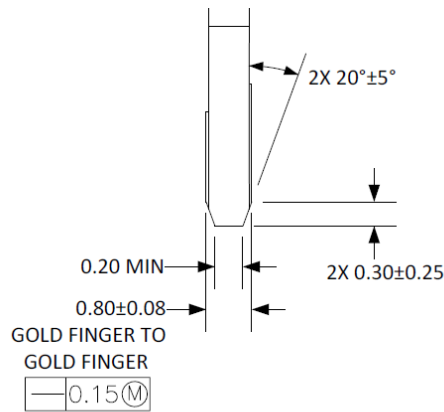


Notes:

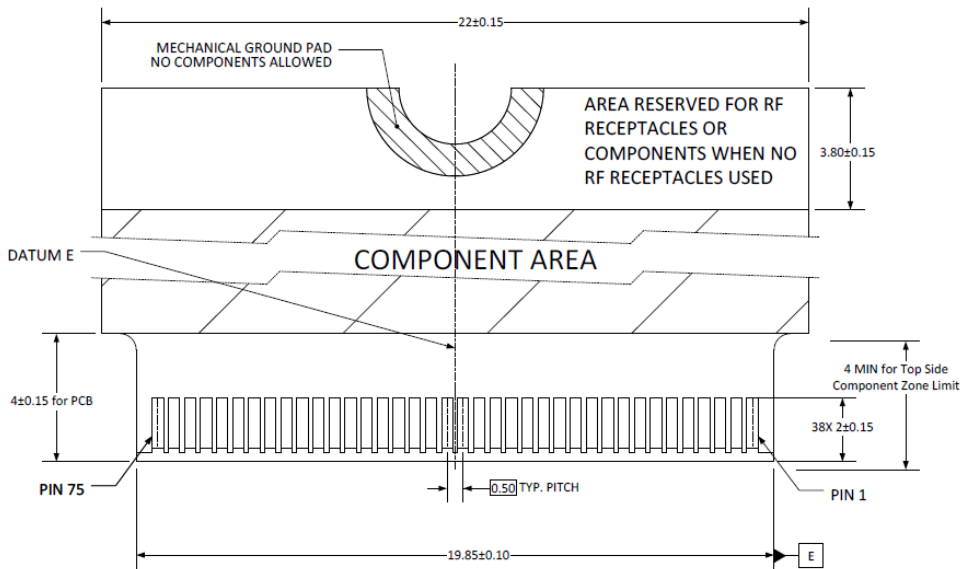
1. All dimensions are in millimeter. General tolerance is ± 0.15 . PCB thickness 0.8 ± 0.08
2. Refer to Ordering Information table for the complete Viking part number that describes the "xxx".

3.2 Card Edge Detail

Figure 3-3: Dimension Details for M.2 card edge



Card Edge Bevel



Card Edge Outline-Topside

4 Architecture

The Viking M.2 (2280) SATA SSD employs a single chip controller with a SATA Revision 3.1 interface on the host side and up to 16 NAND flash packages internally.

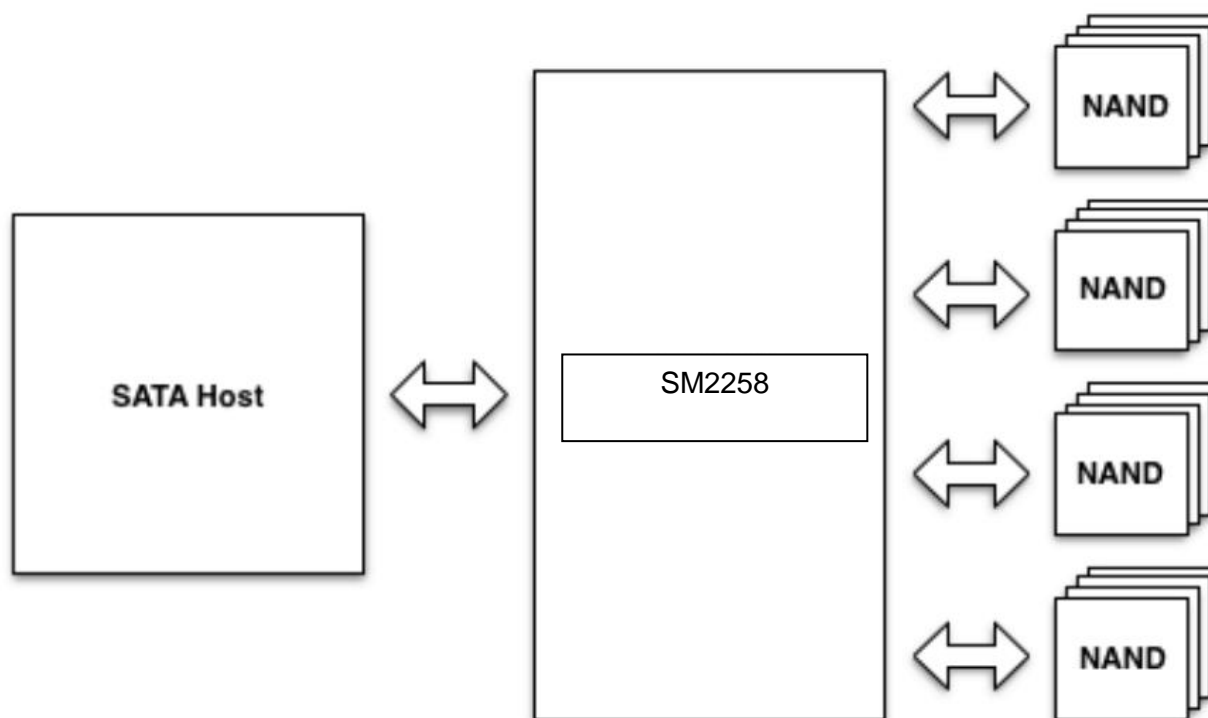


Figure 4-1: Block Diagram

5 Performance

Table 5-1: M.2 (2280) SATA SSD Performance

Capacity (GB)		30	60	120	240	400	480	800	960
Max Sequential Read (up to)	(MB/s)	500	500	500	550	TBD	550	TBD	TBD
Max Sequential Write (up to)	(MB/s)	420	420	420	520	TBD	520	TBD	TBD
Max 4K Random Read (up to)	(IOPS)	50K	50K	50K	100K	TBD	100K	TBD	TBD
Max 4K Random Write (up to)	(IOPS)	44K	44K	44K	90K	TBD	90K	TBD	TBD

Notes:

1.estimated for 30Gto 120G

6 Endurance

Table 6-1: TBW

Capacity (GB)	TBW (TB)	DWPD (3yr)
30	48	1
60	90	1
120	181	1
240	262	1
400	438	1
480	544	1
800	876	1
960	1051	1

Note:

1.estimated

7 Electrical Characteristics

Table 7-1: Power Consumption

Capacity (GB)	Idle	100% Read	100% Write	Unit
30	<0.820	<.95	<1.05	A
60	<0.820	<.95	<1.05	A
120	<0.820	<.95	<1.05	A
240	<0.820	<1.05	<1.55	A
400	<0.820	<1.05	<1.55	A
480	<0.820	<1.05	<1.55	A
800	TBD	TBD	TBD	A
960	TBD	TBD	TBD	A

Notes

1 Idle power consumption measured with LPM enabled on host

2 Active power consumption measured with IOMeter 1.1x64-4KiB Aligned Random

3 estimated for 30Gto 120G

8 Data Security

8.1 Encryption

The SSD drive is a self-encrypting drive (SED), with a bulk data encryption feature that provides automatic hardware-based data security and enhanced secure erase capability.

A self-encrypting drives, scrambles data using a data encryption key as it is written to the drive and then descrambles it with the key as it is retrieved. This gives the user the highest level of data protection available and provides a fast erase simply by deleting the encryption key, eliminating the need for time consuming data-overwrite. Data on the drive is instantly rendered unreadable.

The SSD supports AES-256 encryption and ATA Secure Erase features to protect sensitive data.

The SSD drives support the following security features:

- AES 256 on the fly support.
- RSA 512/1024/2048
- SHA 160/256/512
- TCG OPAL SSC

9 Interface

Viking M.2 (2280) SATA SSD uses the industry standard connector.

10 Pin and Signal Descriptions

10.1 Signal and Power Description Tables

Table 10-1: M.2 SATA Connector Pin Signal Definitions

Pin	Description	Description	Pin
74	3.3V	CONFIG_2 = GND	75
72	3.3V	GND	73
70	3.3V	GND	71
68	SUSCLK(32kHz) (I)(0/3.3V)	CONFIG_1 = GND	69

Pin	Description	Description	Pin
66	Module Key	N/C	67
64	Module Key	Module Key	65
62	Module Key	Module Key	63
60	Module Key	Module Key	61
58	N/C	Module Key	59
56	Reserved for MFG_DATA	GND	57
54	N/C	N/C	55
52	N/C	N/C	53
50	N/C	GND	51
48	N/C	SATA-A+	49
46	N/C	SATA-A-	47
44	N/C	GND	45
42	N/C	SATA-B-	43
40	N/C	SATA-B+	41
38	DEVSLP (I)(0/3.3V)	GND	39
36	N/C	N/C	37
34	N/C	N/C	35
32	N/C	GND	33
30	N/C	N/C	31
28	N/C	N/C	29
26	N/C	GND	27
24	N/C	N/C	25
22	N/C	N/C	23
20	N/C	CONFIG_0 = GND	21
18	Module Key	Module Key	19

Pin	Description	Description	Pin
16	Module Key	Module Key	17
14	Module Key	Module Key	15
12	Module Key	Module Key	13
10	DAS/DSS# (I/O)	N/C	11
8	N/C	N/C	9
6	N/C	N/C	7
4	3.3V	N/C	5
2	3.3V	GND	3
		CONFIG_3 = GND	1

Notes:

1. No connect on the host side.
2. Socket-2 SATA-based SSD Module pinout per PCI Express M.2 Specification, Revision 1.0 (p134)

11 Commands

Table 11-1: Supported ATA Commands

Command Name	Code	Subcode / Page
General Feature Set		
NOP	00h	
Data Set Management	06h	
Trim		01h
Recalibrate	1Xh	
Read Sectors	20h	
Read Sectors (w/o retry)	21h	
Read Sectors Ext	24h	
Read DMA Ext	25h	
Read Native Max Address Ext	27h	
Read Multiple Ext	29h	
Read Log Ext	2Fh	
Log Directory		00h
Extended Comprehensive SMART Error Log		03h
Device Statistics Logs		04h
List of supported log pages		00h
General Statistics		01h
General Errors Statistics		04h
Transport Statistics		06h
SSD Statistics		07h
Extended SMART Self-test Log		07h
NCQ Error Log		10h
SATA Phy Event Counters Log		11h
Identify Device Data Log		30h
List of Supported Pages		00h
Copy of IDENTIFY DEVICE Data		01h
Capacity		02h
Supported Capabilities		03h
Current Settings		04h
ATA Strings		05h
Security		06h
Serial ATA		08h
Write Sectors	30h	
Write Sectors Ext	34h	
Write DMA Ext	35h	

Set Max Address Ext	37h	
Write Multiple Ext	39h	
Write DMA FUA Ext	3Dh	
Write Log Ext	3Fh	
Selective Self-Test log(SMART)		09h
Host Specific(SMART)		80h-9Fh
SCT Command/Status(SCT)		E0h
SCT Data Transfer(SCT)		E1h
Read Verify Sectors	40h	
Read Verify Sectors (w/o retry)	41h	
Read Verify Sectors Ext	42h	
Write Uncorrectable Ext	45h	
Pseudo-UECC with logging		55h
Read FPDMA Queued	60h	
Write FPDMA Queued	61h	
Seek	7xh	
Execute Device Diagnostic	90h	
Initialize Drive Parameters	91h	
Download Microcode	92h	
Download with offsets and save microcode for immediate and future use.		03h
Download (without offsets) and save microcode		07h
Download with offsets and save microcode for future use / Activate downloaded microcode		0Eh/0Fh
SMART	B0h	
Read Data		D0h
Read Thresholds		D1h
Enable/Disable Attr Autosave		D2h
Save Attribute Values		D3h
Exec Off-line Immediate		D4h
Execute Off-Line routine		
Execute Short Self-test routine (Off-Line)		
Execute Extended Self-test routine (Off-Line)		
Abort Off-Line Self-test routine		
Execute Short Self-test routine (Captive)		
Execute Extended Self-test routine (Captive)		
Read Log Sector		

Write Log Sector		
Enable Operations		
Disable Operations		
Return Status		
Sanitize Device	B4h	
Sanitize Status Ext		00h
Crypto Scramble Ext		11h
Block Erase Ext		12h
Overwrite Ext		14h
Sanitize Freeze Lock Ext		20h
Read Multiple	C4h	
Write Multiple	C5h	
Set Multiple Mode	C6h	
Read DMA	C8h	
Read DMA (w/o retry)	C9h	
Write DMA	CAh	
Write DMA (w/o retry)	CBh	
Write Multiple FUA Ext	CEh	
Standby Immediate	E0h	
Idle Immediate	E1h	
Standby	E2h	
Idle	E3h	
Read Buffer	E4h	
Check Power Mode	E5h	
Sleep	E6h	
Flush Cache	E7h	
Write Buffer	E8h	
Flush Cache Ext	EAh	
Identify Device	ECh	
Set Features	EFh	
Security Set Password	F1h	
Security Unlock	F2h	
Security Erase Prepare	F3h	
Security Erase Unit	F4h	
Security Freeze Lock	F5h	
Security Disable Password	F6h	
Read Native Max Address	F8h	
Set Max Address	F9h	
Set Max Set Password		01h
Set Max Lock		02h
Set Max Unlock		03h

12 SMART Attributes

Table 12-1: Supported S.M.A.R.T Attributes

ID	Item	Threshold
01	Read Error Rate	0
05	Physical Bad Block Count when run-time	0
09	Power-On Hours	0
0C	Power-On Count	0
A0	Uncorrectable UNC Sector Count When Read/Write	0
A1	Number of Pure Spare Block	0
A3	Number of Initial Invalid Block	0
A4	Total Erase Count TLC	0
A5	Maximum Erase Count TLC	0
A6	Minimum Erase Count TLC	0
A7	Average Erase Count TLC	0
94	Total Erase Count SLC	0
95	Maximum Erase Count SLC	0
96	Minimum Erase Count SLC	0
97	Average Erase Count SLC	0
A9	Remain Life Percentage	0
B1	Total wearlevel count	50
B5	Total program fail count	0
B6	Total Erase fail count	0
C0	Sudden Power-off Count	0
C2	Temperature	0
C4	Uncorrectable Error Count	16
C7	UltraDMA CRC Error Count	50
E8	Remain free Space(%)	0
F1	Host Total LBAs Written (each write unit = 32MB)	0
F2	Host Total LBAs Read (each read unit = 32MB)	0
F5	Flash Total Units Written TLC (each write unit = 32MB)	0

13 Compliance

Viking Technology SSDs comply with the following:

- RoHS “green”
- CE (Europe): EN55022, 2006 Class B and EN55024, 1998 + A1: 2001 + A2:2003
- FCC: CFR Title 47, Part 15, ICES-003, all Class B
- BSMI (Taiwan): approval to CNS 13438 (testing in progress)
- C-TICK (Australia, New Zealand): approval to AS/NZS CISPR22 (testing in progress)
- TUV (Germany): approval to IEC60950/EN60950 (testing in progress)
- VCCI (testing in progress).