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Datasheet for:

1.8" SATA SSD

PSFS11xxxxWxxx

Embedded/Industrial Applications

Legal Information

Revision History

Date	Revision	Description	Checked by
1/18/18	A	Initial release PSFS22xxxxWxxx_A Change voltage to 3.3, pinout and MO Change 2.5" to 1.8".	
9/18/18	B	revise SMART attrib	

Ordering Information for the 1.8" SATA SSD

Part Number	SATA Interface	Application	Useable Capacity (GB)[1]	LBA[2]	NAND Type	Temperature Range	NAND Device
VRFS11030GWCBMTL	6Gb/s	Client	30	58,626,288	MLC	(0 to +70'c)	Toshiba L-die
VRFS11030GWIBMTL	6Gb/s	Client	30	58,626,288	MLC	(-40 to +85'c)	Toshiba L-die
VRFS11060GWCBMTL	6Gb/s	Client	60	117,231,408	MLC	(0 to +70'c)	Toshiba L-die
VRFS11060GWIBMTL	6Gb/s	Client	60	117,231,408	MLC	(-40 to +85'c)	Toshiba L-die
VRFS11120GWCBMTL	6Gb/s	Client	120	234,441,648	MLC	(0 to +70'c)	Toshiba L-die
VRFS11120GWIBMTL	6Gb/s	Client	120	234,441,648	MLC	(-40 to +85'c)	Toshiba L-die
VRFS11240GWCBMTL	6Gb/s	Client	240	468,862,128	MLC	(0 to +70'c)	Toshiba L-die
VRFS11240GWIBMTL	6Gb/s	Client	240	468,862,128	MLC	(-40 to +85'c)	Toshiba L-die
VRFS11480GWCAMTL	6Gb/s	Client	480	937,703,088	MLC	(0 to +70'c)	Toshiba L-die
VRFS11480GWIAMTL	6Gb/s	Client	480	937,703,088	MLC	(-40 to +85'c)	Toshiba L-die
VRFS11960GWCZMTL	6Gb/s	Client	960	1,875,385,008	MLC	(0 to +70'c)	Toshiba L-die
VRFS11960GWIZMTL	6Gb/s	Client	960	1,875,385,008	MLC	(-40 to +85'c)	Toshiba L-die
VRFS111T92WCCMTL	6Gb/s	Client	1920	3,750,748,848	MLC	(0 to +70'c)	Toshiba L-die
VRFS111T92WICMTL	6Gb/s	Client	1920	3,750,748,848	MLC	(-40 to +85'c)	Toshiba L-die

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 1.8" 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 1.8" 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 1.8" SATA SSD Technical Specifications

Attributes
• Silicon Motion SM2246EN 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
• AES 256-bit Encryption
• OPAL 2.0 Support

Performance
• Sequential Read: Up to 520MB/s
• Sequential Write: Up to 460MB/s
• Random Read: Up to 76K IOPS (4K block size)
• Random Write: Up to 46K IOPS (4K block size)

Endurance
• TBW: Up to 1044
• DWPD: 0.80

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
• +3.3VDC (±5%) power supply

- Power Consumption: up to 1.55W (Active), 0.82W (Idle)
- Weight: 60g

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

Capacity (GB)	Dimensions	Units
Height / Thickness	5.0 +/- 0.15	mm
Width	54 +/- 0.2	mm
Length	78.5 +/-0.3	mm

Figure 3-1: 1.8" SSD Dimensions
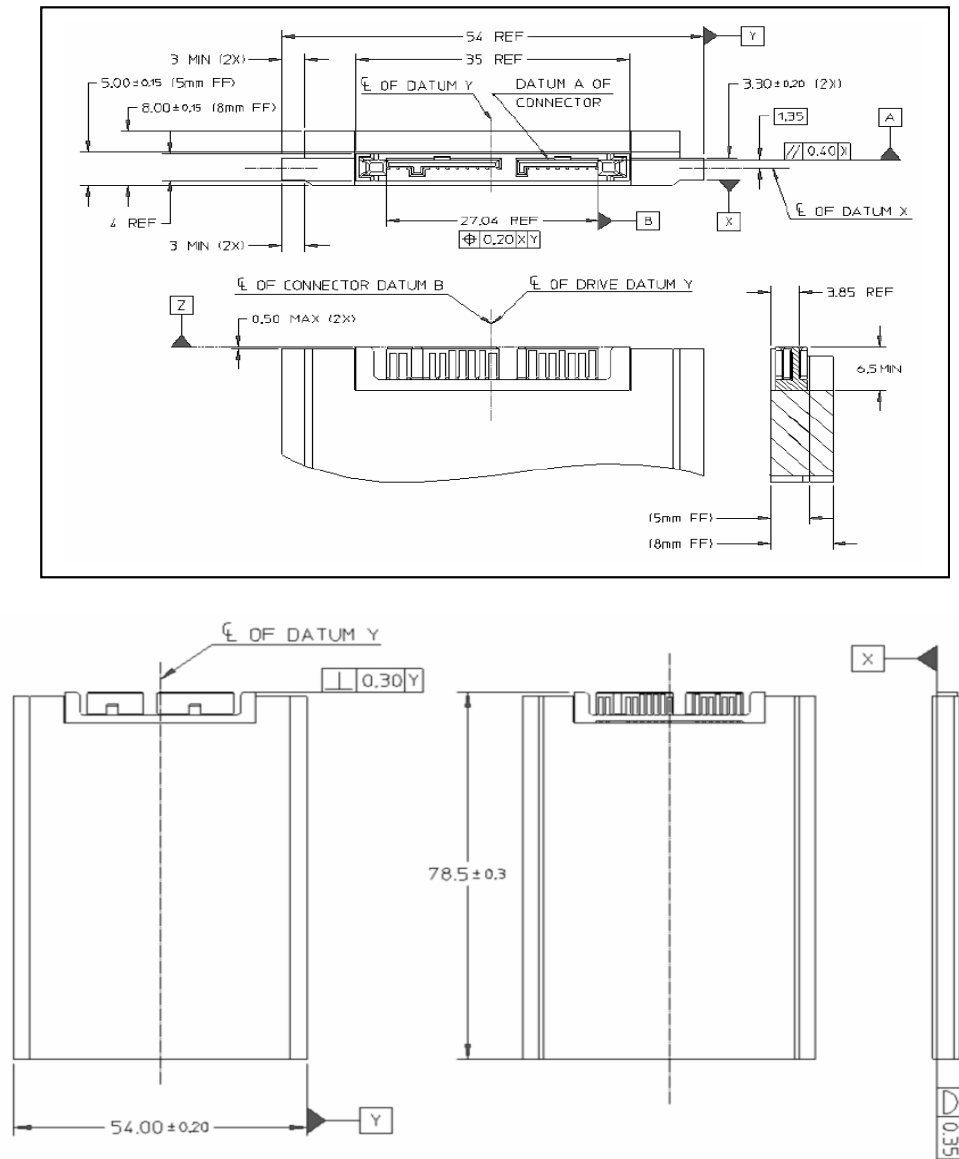
Notes: All dimensions are in millimeters, +/- 0.2mm, unless otherwise stated. Reference SATA connector specifications

3.1 SSD Weight

The weight of the 1.8" SSD is approximately 30 grams

4 Architecture

The Viking 1.8" 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.
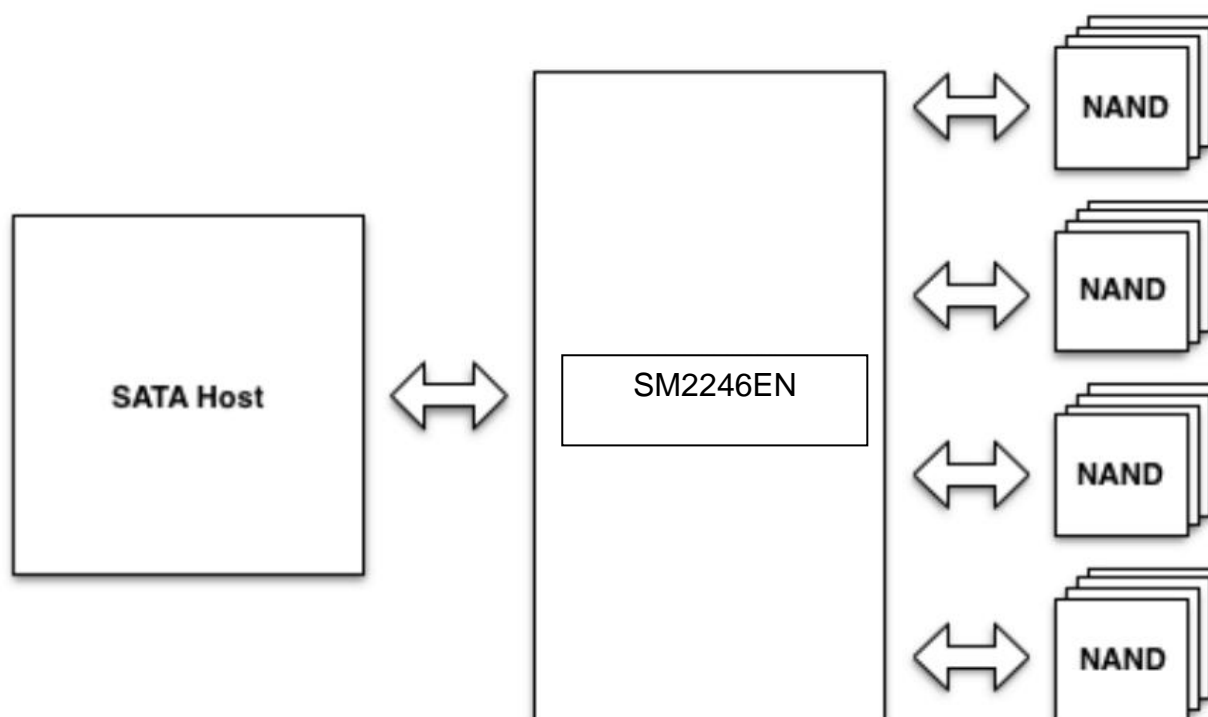
Figure 4-1: Block Diagram

5 Performance

Table 5-1: 1.8" SATA SSD Performance

Capacity (GB)		30	60	120	240	480	960	1920
Max Sequential Read (up to)	(MB/s)	500	500	500	520	520	520	520
Max Sequential Write (up to)	(MB/s)	420	420	420	460	470	470	470
Max 4K Random Read (up to)	(IOPS)	50K	50K	50K	76K	76K	76K	76K
Max 4K Random Write (up to)	(IOPS)	44K	44K	44K	46K	46K	46K	46K

Notes:
1.estimated for 30Gto 120G

6 Endurance

Table 6-1: TBW

Capacity (GB)	TBW (TB)	DWPD (3yr)
30	48	0.8
60	90	0.8
120	181	0.8
240	262	0.8
480	544	0.8
960	1044	0.8
1920	2080	0.8

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
480	<0.820	<1.05	<1.55	A
960	<0.820	<1.05	<1.55	A
1920	<0.820	<1.05	<1.55	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 1.8" SATA SSD uses the industry standard connector.

10 Pin and Signal Descriptions

10.1 3.3V 1.8" SSD Signal and Power Description Tables

Table 10-1: 1.8" SSD Serial ATA Connector Pin Signal Definitions

Pin	Function	Definition	Mating Order
S1	SGND_1	Signal Ground	2nd
S2	RX+ on SSD, TX+ on Host	Differential Signal	
S3	RX- on SSD, TX- on Host	Differential Signal	
S4	SGND_2	Signal Ground	2nd

Pin	Function	Definition	Mating Order
S5	TX- on SSD, RX- on Host	Differential Signal	
S6	TX+ on SSD, RX+ on Host	Differential Signal	
S7	SGND_3	Signal Ground	2nd

Notes:

1. Key and spacing separate signal and power segments.

2. Pin locations and layout are consistent with SATA specification.

Table 10-2: 1.8" SSD Serial ATA Power Pin Definitions

Pin	Function	Definition	Mating Order
P1	3.3V_1	3.3 V Power	2nd
P2	3.3V_2	3.3 V Power, Pre-charge	1st
P3	GND_1	Ground	1st
P4	GND_2	Ground	1st
P5	5V_1	Not connected (open circuit)	
P6	5V_2	Not connected (open circuit)	
P7	LED	Activity signal	2nd
KEY	KEY	KEY	NC
P8	Optional	Vendor specific	2nd
P9	Optional	Vendor specific	2nd

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

Command Name	Code	Subcode / Page
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)		

Command Name	Code	Subcode / Page
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	

Command Name	Code	Subcode / Page
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
Set Max Freeze Lock		04h

12 SMART Attributes

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

ID	Attribute Name	Description
ID	Attribute Name	Comment
0x01	Read Error Rate	CRC Error count/Total LBAs Read
0x05	Reallocated Sectors Count	(Runtime Bad) = g16TotalBadCnt-(initial invalid block)
0x09	Power On Hours	Number of hours elapsed in the power-on state. The value shall be incremented by one every one hour.
0x0C	Power Cycle Count	Number of device power cycling. The value shall be incremented by one on each power cycling after disk initialization is done
0xA0	Uncorrectable Sector Count On Line	Uncorrectable Sector Count when read/write
0xA1	Number of Pure Spare	Number of vaild spare block
0xA3	Number of Initial Invlid Block	Number of initial invalid block
0xA4	Total Erase Count	Total erase count
0xA5	Max Erase Count	Maximum erase count
0xA6	Min Erase Count	Mimimum Erase count
0xA7	Average Erase Count	Average erase count
0xA8	Max Erase Count in Spec	Max Erase Count of Spec
0xA9	Remain Life Percentage	Remain Life(%)
0xAF	Worst Die Program Fail Count	Program fail count in worst die

0xB0	Worst Die Erase Fail Count	Erase fail count in worst die
0xB1	WearLeveling Count	Total wearlevel count
0xB2	Used Reserved Block Count	Runtime invalid block count
0xB5	Program Fail Count	Total program fail count
0xB6	Erase Fail Count	Total Erase fail count
0xC0	Power off Retract Count	Number of times unexpected power off occurred. (power off when drive is in active state) The value shall be incremented by one on each unexpected power off.
0xC2	Temperature	On-chip temperature sensor value.
0xC3	Hardware ECC recovered	Total correctable count
0xC4	Reallocation Event Count	Uncorrectable error count
0xC5	Current pending sector count:	waiting move sector count
0xC6	Uncorrectable Sector Count OffLine	Total uncorrectable count when off-line
0xC7	UDMA CRC Error	UltraDMA CRC Error Count
0xE8	Available Reserved Space	Remain Space(%)
0xF1	Write Sector Count	Total LBAs Written (each write unit = 32MB)
0xF2	Read Sector Count	Total LBAs Read (each read unit = 32MB)
0xF5	Flash Write count	Total sector write to flash (each write unit = 32MB)

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).