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NVMe PCIe SSD
2.5” SSD
Manual

NVMe PCIe SSD is a non-volatile, solid-state storage device delivering uncompromising performance, reliability and ruggedness for environmentally challenging applications.

Revision History

Date	Revision	Description	Checked By
3/13/2017	A	Initial Release revised to new format from PSFN22xxxxWxxx_PM963_B. Add enterprise features. Update performance. Revise height to 14.8mm	
4/10/2017	B	Revise for 1725a by updating mechanical dimensions and performance. Revised all DC and AC characteristics, PBW, power, LBA, and environmental. Add UEFI EXPANSION ROM and VPD structure. Remove SPOR. Add Hot plug. Revised Supported Command Set.	
3/26/18	C	Remove SR-IOV info	

Legal Information

Legal Information

Ordering Information: 2.5 inch PCIe SSD Solid-State Drive

Part Numbers	Interface	Application	Useable Capacity (GB)[1]	Port	Temperature Range	NAND
VSFN25800GYCZWSE	PCIe/NVMe	Enterprise PM1725a	800 GB	Dual	(0 to +70'c)	Samsung TLC, V3 VNAND
VSFN251T60YCZWSE	PCIe/NVMe	Enterprise PM1725a	1600 GB	Dual	(0 to +70'c)	Samsung TLC V3 VNAND
VSFN253T20YCFWSM	PCIe/NVMe	Enterprise PM1725a	3200 GB	Dual	(0 to +70'c)	Samsung TLC V3 VNAND
VSFN256T40YCGWSM	PCIe/NVMe	Enterprise PM1725a	6400 GB	Dual	(0 to +70'c)	Samsung TLC V3 VNAND

Notes:

1. Usable capacity based on a level of over-provisioning applied to wear leveling, bad sectors, index tables etc.
2. SSD's ship unformatted from the factory unless otherwise requested.
3. 1 GB = 1,000,000,000 Byte
4. One Sector = 512 Byte.
5. SFF-8639 combo (SATA, SAS, PCIe) standard connector

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Product Picture(s)

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1 Introduction

Viking's 2.5 inch SSD presents outstanding performance with instant responsiveness to the host system, by applying the Peripheral Component Interconnect Express (PCIe) 3.0 interface standard, as well as highly efficient Non-Volatile Memory Express (NVMe) Protocol.

The Viking's 2.5 inch SSD delivers wide bandwidth of up to 3300 MB/s for sequential read speed and up to 2950 MB/s for sequential write speed under 23W of power. With the help of Toggle 2.0 NAND Flash interface, the Viking's 2.5 inch SSD delivers random performance of up to 800K IOPS for random 4KB read and up to 160K IOPS for random 128KB write in the sustained state.

By combining the enhanced reliability of NAND Flash memory silicon with NAND Flash management technologies, the Viking's 2.5 inch SSD delivers the extended endurance suitable for enterprise applications, in 2.5 inch form factor.

In addition, the Viking's 2.5 inch SSD supports Power Loss Protection that can guarantee that data issued by the host system are written to the storage media without any loss in the event of sudden power off or sudden power failure. Inrush current handler can protect the internal components from the electrical and physical damages.

1.1 Features

The SSD delivers the following features:

- Native-PCIe SSD for enterprise application
- LPDDR3 DRAM Buffer Memory
- PCI Express Gen3: Dual port X4 lanes
- Compliant with PCI Express Base Specification Rev. 3.0
- Compliant with NVM Express Specification Rev.1.1a
- Enhanced Power-Loss Data Protection
- End-to-End Data Protection
- Support SSD Enhanced S.M.A.R.T. Feature Set
- Static and Dynamic Wear Leveling
- RoHS / Halogen-Free Compliant

1.2 PCIE Interface

- PCI Express Gen3:
- Compliant with PCI Express Base Specification Rev. 3.0
- Compliant with NVM Express Specification Rev.1.1a

For a list of supported commands and other specifics, please see Chapter 5.

2 Product Specifications

2.1 Capacity and LBA count

User Capacity (GB)	Max LBA Count
800GB	1,562,824,367
1.6TB	3,125,627,567
3.2TB	6,251,233,967
6.4TB	12,502,446,767

Notes:

1. Per www.idema.org, LBA1-03 spec. The max. LBA shown in Table represents the total user addressable sectors in LBA mode and calculated by IDEMA rule.
   LBA counts = (97,696,368) + (1,953,504 * (Advertised Capacity in GBytes – 50))
2. Gigabyte (GB) = 1,000,000,000 Bytes, 1 Sector = 512Bytes
3. Capacity shown in Tablerepresents the total usable capacity of the SSD which may be less than the total physical capacity. A certain area in physical capacity, not in the area shown to the user, might be used for the purpose of NAND flash management.

2.2 Performance

Table 2-1: Maximum Sustained Read and Write Bandwidth

Access Type	800 GB	1600 GB	3200 GB	6400 GB
Sequential Read, 256K, MB/s	Up to 3300	Up to 3300	Up to 3300	Up to 3300
Sequential Write, 256K, MB/s	Up to 1000	Up to 2200	Up to 3000	Up to 3300

Notes:

1. Based on PCI Express Gen3 x4, Random performance measured using FIO 2.1.3 in Linux RHEL 6.5(Kernel 2.6.32) with queue depth 32 by 4 workers and Sequential performance with queue depth 32 by 1 worker. Actual performance may vary depending on use conditions and environment.
2. Refer to Application Note AN0006 for Viking SSD Benchmarking Methodology.

Table 2-2: Maximum Random Read and Write Input/Output Operations per Second (IOPS)

Access Type	800 GB	1600 GB	3200 GB	6400 GB
Read, 4K, IOPS	Up to 700K	Up to 750K	Up to 800K	Up to 800K
Write, 4K, IOPS	Up to 70K	Up to 130K	Up to 160K	Up to 160K
Read, 8K, IOPS	Up to 390K	Up to 430K	Up to 430K	Up to 430K
Write, 8K, IOPS	Up to 36K	Up to 70K	Up to 95K	Up to 95K

Notes:

1. Based on PCI Express Gen3 x4, Random performance measured using FIO 2.1.3 in Linux RHEL 6.5(Kernel 2.6.32) with queue depth 32 by 4 workers and Sequential performance with queue depth 32 by 1 worker. Actual performance may vary depending on use conditions and environment.
2. Refer to Application Note AN0006 for Viking SSD Benchmarking Methodology

2.3 Timing / Latency

Table 2-3: Timing Specifications

Type (Queue Depth = 1)	800, 1600, 3200, 6400 GB
Random Read/Write Latency	90/30 µs
Sequential Read/Write Latency	115/125 µs
Power On Ready (POR), Drive Ready Time, 3840 GB	2 sec

Notes:

1. The random latency is measured by using FIO 2.1.3 in Linux RHEL 6.5(Kernel 2.6.32) and 4KB transfer size with queue depth 1 by 1 worker
2. The sequential latency is measured by using FIO 2.1.3 in Linux RHEL 6.5(Kernel 2.6.32) and 4KB transfer size with queue depth 1 by 1 worker

2.4 Quality of Service (QoS)

Table 2-4: Quality of Service (QoS)

Quality of Service (99%)	Unit	800GB	1.6TB	3.2TB	6.4TB
Read(4KB)(QD=1)	us	160	160	170	170
Write(4KB)(QD=1)	us	80	80	90	100
Read(4KB)(QD=128)	us	500	420	420	420
Write(4KB)(QD=128)	us	3500	2500	2500	2500
Quality of Service (99.99%)	**Unit**	**800GB**	**1.6TB**	**3.2TB**	**6.4TB**
Read(4KB)(QD=1)	us	180	180	300	300
Write(4KB)(QD=1)	us	150	250	500	500
Read(4KB)(QD=128)	us	780	550	570	570
Write(4KB)(QD=128)	us	7300	4000	4000	4000

Notes:

1. QoS is measured using Fio 2.1.3 (99 and 99.99%) in Linux RHEL 6.5 (Kernel 2.6.32) with queue depth 1, 32 on 4KB random read and write.
2. QoS is measured as the maximum round-trip time taken for 99 and 99.99% of commands to host

.

Table 2-5: Operating Voltage IOPS Consistency

IOPS Consistency[1, 2]	Unit	800GB	1.6TB	3.2TB	6.4TB
Random Read (4 KB)	%	98	94	98	88
Random Write (4 KB)	%	90	88	92	98
Random Read (8 KB)	%	98	90	90	90
Random Write (8 KB)	%	90	90	90	90

NOTE:

1) IOPS consistency measured using FIO with queue depth 128.
2) IOPS Consistency (%) = (IOPS in the 99.9% slowest 1-second interval)/(average IOPS during the test).

2.5 Electrical Characteristics

2.5.1 Absolute Maximum Ratings

Values shown are stress ratings only. Functional operation outside normal operating values is not implied. Extended exposure to absolute maximum ratings may affect reliability.

2.5.2 Supply Voltage

The operating voltage is 12V

Table 2-6: Operating Voltage

Description	800GB/1.6/3.2/6.4TB
Operating Voltage	800GB/1.6/3.2/6.4TB
12V[2]	10%
12V Rise time (Max/Min)	50ms/1ms
12V Fall time (Max/Min)[4]	5s/1ms
12V Noise level	300 mV pp 10Hz – 100 KHz 50 mV pp 100KHz – 20 MHz
3.3Vaux[3]	10%
3.3Vaux Rise time (Max/Min)	50ms/1ms
3.3Vaux Fall time (Max/Min)[4]	5s/1ms
3.3Vaux Noise level	300 mV pp 10Hz – 100 KHz 50 mV pp 100KHz – 20 MHz

Notes:

1) The components inside SSD were designed to endure the range of voltage fluctuations, which might be induced by the host system.
2) For 12V operating voltage, the minimum allowable is 10.8V and the maximum 13.2V.

2.5.3 Power Consumption

The SSD is implemented in standardized 2.5-inch form factor and gets primary 12V power as well as auxiliary 3.3V (3.3Vaux) power through the indicated pins (#P13~15 for 12V and #E3 for 3.3Vaux in SFF-8639 connector plug) from the host system.

Table 2-7: Typical Power Consumption at 12V

Power Mode		800GB	1.6TB	3.2TB	6.4TB
Active[2]	Read	16W	16W	16W	17W
	Write	15W	21W	21W	21W
Idle[3]	7.5W	7.5W	7.5W	7.5W	
Off	0W				

Notes:

1) Power consumption was measured in the 12V power pins (#P13~#P15) of the connector plug in SSD. The active and idle power is defined as the highest averaged power value, which is the maximum RMS average value over 100 ms duration.
2) The measurement condition for active power is assumed for 100% sequential read or write.
3) The idle state is defined as the state that the host system can issue any commands into SSD at any time.

Inrush Current	800GB/1.6/3.2/6.4TB
at 12V	1.8A[1]

Notes:

1) The measurement value of inrush current is also compatible with the standard specification of "Enterprise SSD Form Factor Version 1.0a" released by SSD Form Factor Working Group

2.6 Environmental Conditions

2.6.1 Temperature and Altitude

Table 2-8: Temperature and Altitude Related Specifications

Conditions	Operating	Shipping	Storage
Commercial Temperature- Case [1]	0 to 70°C	-40 to 85°C	-40 to 85°C
Humidity (non-condensing)	-	5 to 95%	5 to 95%

Notes:

1. Tc is measured at the surface of NAND Flash package

2.6.2 Shock and Vibration

SSD products are tested in accordance with environmental specification for shock and vibration.

Table 2-9: Shock and Vibration Specifications

		800GB/1.6/3.2/6.4TB
Shock[1]	Non-operating	1,500G
Vibration[2]	Non-operating	20 Gpeak (10~2,000Hz, Sweep sine)

NOTE:

1) Shock specifications assume that SSD shall be mounted with screws when input vibration is applied. Vibration may be applied in 3 axes (x, y and z) with a half sine waveform of 0.5ms duration in non-operating condition.
2) Vibration specifications assume that SSD shall be mounted with screws when input vibration is applied. The input vibration may be applied in 3 axes (x, y and z) and lasts during 15 minutes per axis.

2.6.3 Electromagnetic Immunity

2.5 inch is an embedded product for host systems and is designed not to impair with system functionality or hinder system EMI/FCC compliance.

2.7 Reliability

Table 2-10: Reliability Specifications

Parameter	Description			
Uncorrectable Bit Error Rate (UBER)	1 sector per 10^{17} bits read			
MTBF	2,000,000 hours			
Read Endurance	Unlimited			
Write Endurance (Petabytes Written)	**800GB**	**1600GB**	**3200GB**	**6400GB**
	7.3 PBW	14.6 PBW	29.2 TBW	58.4 TBW
Drive Write per day	5 DWPD over 5 years			
Data retention	> 90 days at NAND expiration			

Notes:
1. The reliability specification follows JEDEC standards JESD218A and JESD219A
2. TBW=(GB capacity x DWPD x 365 x years)/1000

2.8 Data Security

2.8.1 Power Loss Protection

By using internal back-up power technology, the Viking SSD supports power loss protection feature to guarantee the reliability of data requested by the host system. When power is unpredictably lost, the SSD can detect automatically this abnormal situation and transfer all user data and meta-data cached in DRAM into the Flash media during any SSD operations.

2.9 Hot Plug Support

2.9.1 Power Loss Protection

By using internal back-up power technology, the Samsung SSD supports power loss protection (PLP) feature to guarantee the reliability of data requested by the host system. When power is unpredictably lost, SSD can detect automatically this abnormal situation and transfer all user data and meta-data cached in DRAM into the Flash media during any SSD operations.

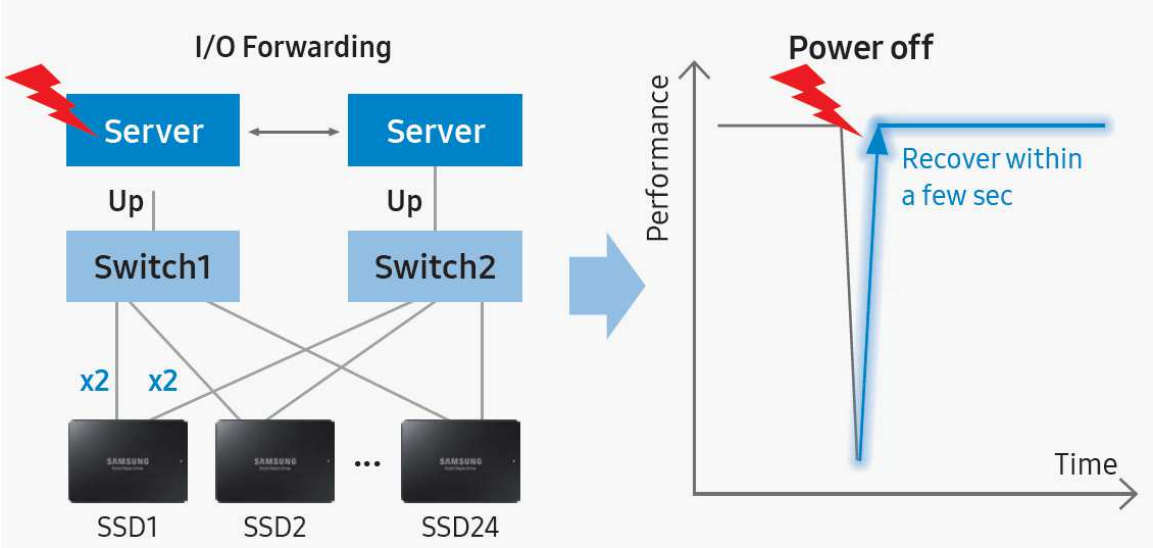
2.9.2 Inrush Current Protection

When the SSD plugs in the backplane of host system, the significant amount of current is induced through 12V power rail. The SSD has protection circuitry including a set of resisters and capacitors to alleviate the impact by inrush current through 12V power.

2.10 Enterprise Class Storage Features

2.10.1 Dual Port Capability

IT and data center managers need features that can provide access to storage data without interruptions. Viking has taken this need into consideration by including a key feature that provides access by smartly using dualport PCIe® (PCI Express®) SSDs to get the most out of highperformance enterprise applications. Viking has enabled this feature which provides the ability to create two fault domains and increases availability, providing non-interrupt service for accessing storage data. Even if a failure occurs in one of the paths to a port, preventing access along that path, the device is still accessible using the second port. The SSD provides virtually non-stop service with this dual-port feature support.



2.10.2 Multi-namespace support

The SSD supports multiple namespaces, where a single SSD can be partitioned into multiple hardware partitions. A namespace can be assigned to multiple hosts or dedicated to a single host. The SSD supports up to 32 multiple namespaces.

2.10.3 Remote Health Monitoring

This SSD provides a remote health-monitoring feature by an SSD Toolkit. The SSD Toolkit is a Samsung proprietary software designed to help users with easy-to-use SSD management and diagnostic features for server and data center usage.
The CLI (command line interface) tool currently supports NVMe SSDs and supports Linux®. The Samsung version of the SSD Toolkit is available from the Samsung SSD website at
http://www.samsung.com/global/business/semiconductor/minisite/SSD/global/html/support/server_downloads.html

Remote health monitoring features include:

- **Health monitoring:** Provides vital drive status information and supports users to update firmware, measure drive performance, initialize drives, calculate drive lifetime and more.

- **Remote health monitoring for FA (failure analysis):** Provides a smart way for resolving field issues by the remote health monitoring feature. This way of issue handling reduces turnaround time compared to the traditional way of handling the issue, such as dispatching an engineer, and provides quicker resolution.
  The customer can get the initial resolution in two steps: first by running the SSD Toolkit and second by sending the debug information back to the factory and getting the resolution effectively.

3 Mechanical Information

3.1 Dimensions

Table 3-1: Physical Dimensions

	Dimensions	Units
Height / Thickness	15.00+0.00, -0.50	mm
Width	69.85±0.25	mm
Length	100.20±0.25	mm

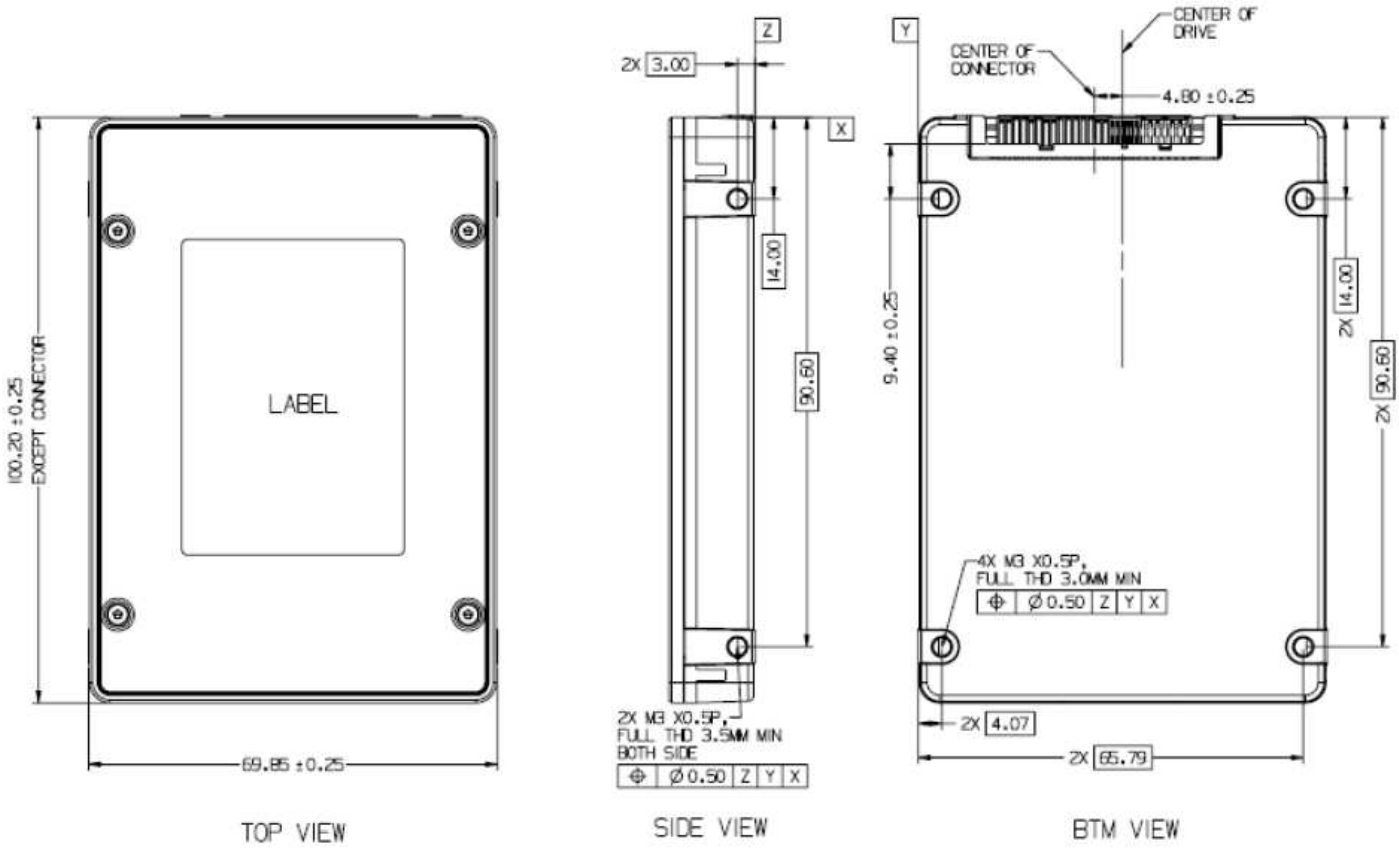


Figure 3-1: SDD Dimensions

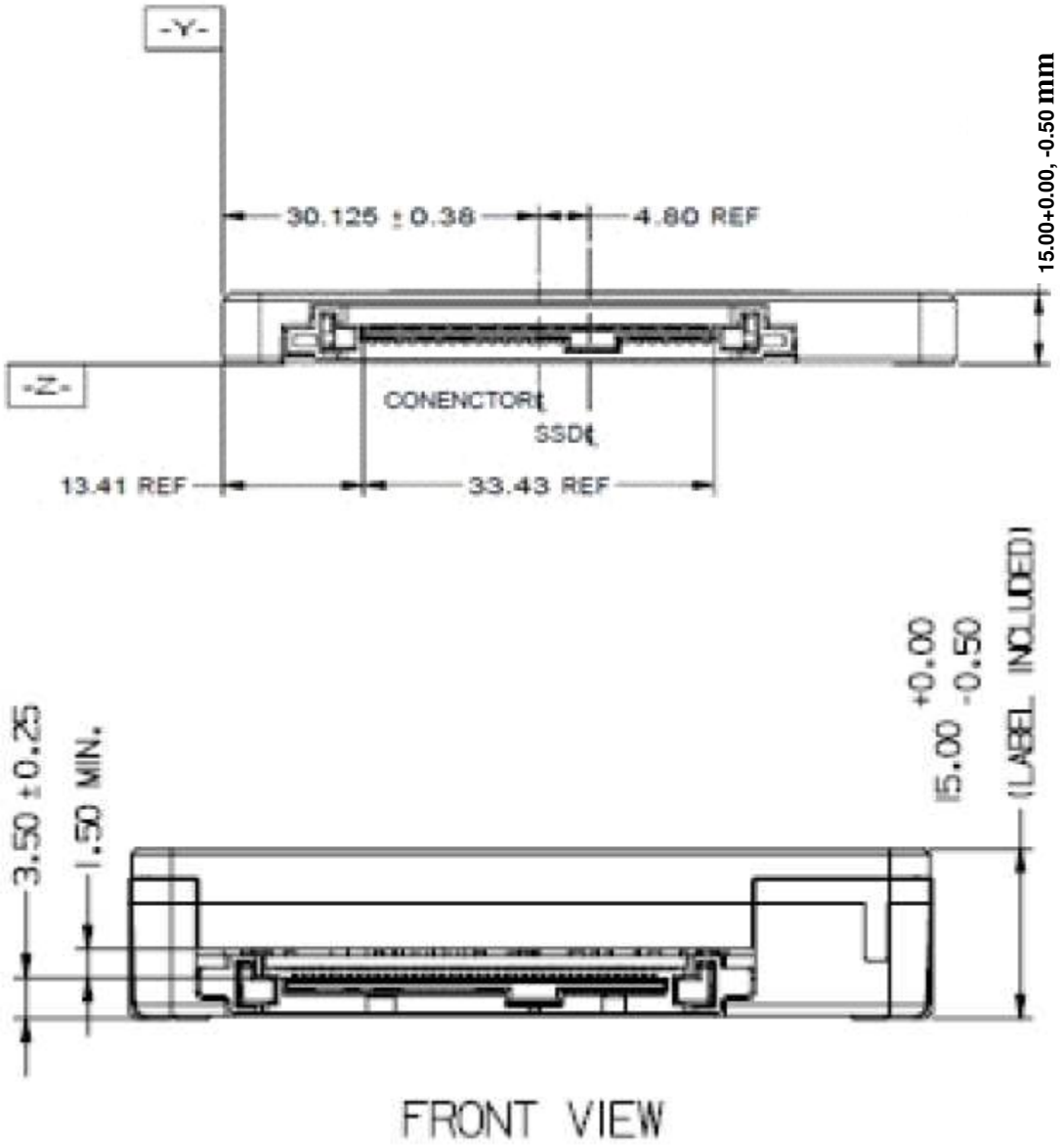
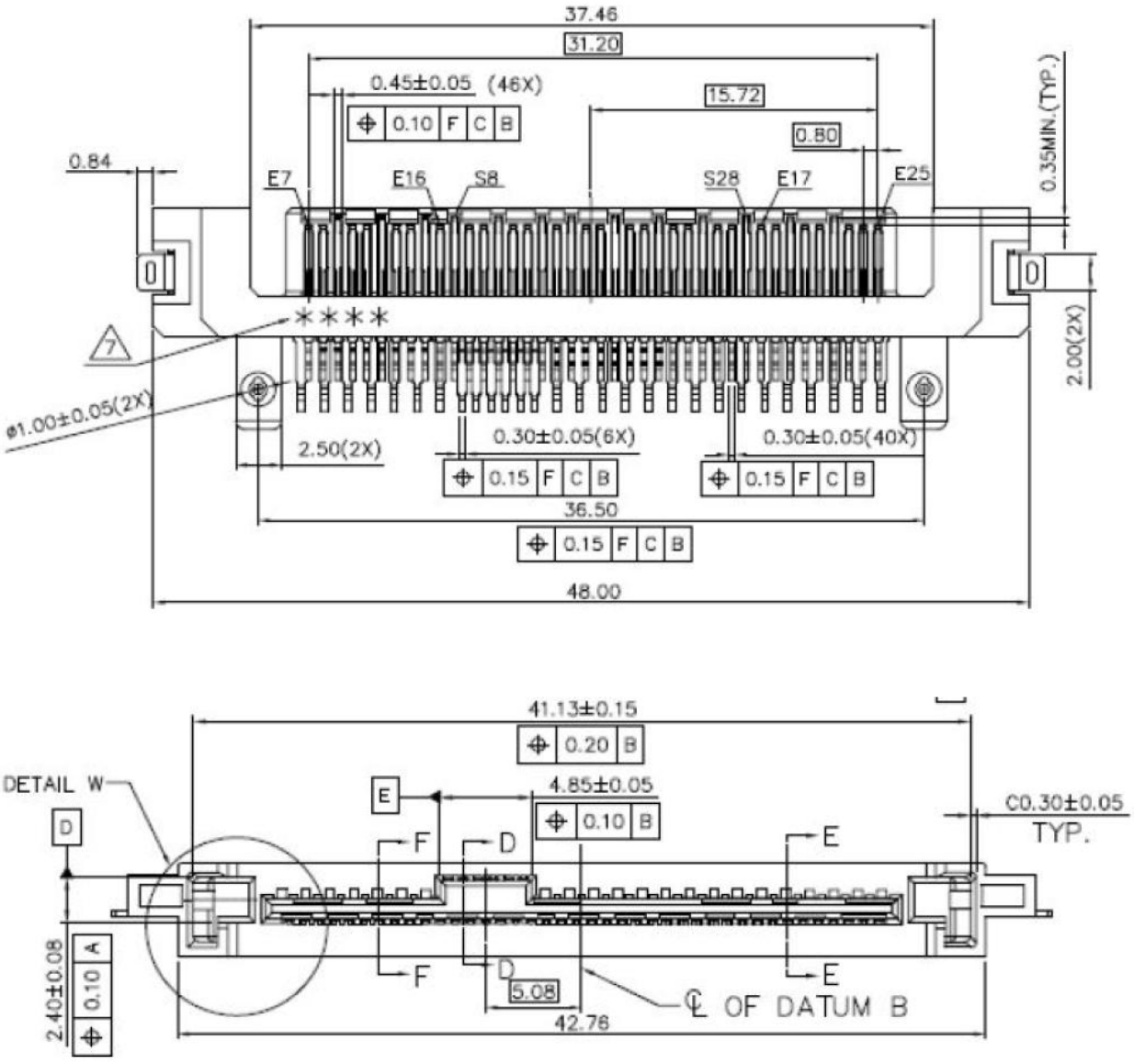


Figure 3-2: SDD Dimensions, Side View

Notes:

1. All dimensions are in millimeter. General tolerance is ± 0.15.



Note: SFF-8639 combo (SATA, SAS, PCIe) standard connector

Figure 3-3: Dimension Details for 2.5 inch connector