

PRINCETON LYNX² 2.5" 3D TLC SSD

Take system performance to the next level with the PRINCETON LYNX² 2.5" 3D TLC SSD. Featuring the Silicon Motion SM2258 controller and quality 3D TLC NAND, these SSDs are loaded with enhancements to promote a high performing and reliable computing environment. TRIM, Wear Leveling, StaticDataRefresh, and LDPC ECC functions optimize data processing efficiency. S.M.A.R.T. and a built-in temperature sensor assist with monitoring drive health.

The 3D TLC SSD provides outstanding transfer speeds. Improved system startup, data access, application loading, and backup times are typically realized when upgrading systems from a traditional spinning disk hard drive to a 3D TLC SSD. External DRAM and SLC Cache is included and further enhances read/write and IOPS ratings. The 3D TLC SSD is an ultra-low-power storage solution with DevSleep support, providing improved notebook battery life and lower cooling costs in datacenters.

3D TLC SSDs are compatible with any operating system and work in both SATA and SAS environments.

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

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3D TLC SSD Technical Specifications



Features

- Silicon Motion SM2258 controller
- SLC caching accelerates burst 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
- Field-upgradeable firmware
- SATA 3.1 Compliant SATA 6Gb/s – backwards compatible with SATA 3Gb/s and 1.5Gb/s
- ATA/ATAPI-8-ACS3 command set compliant
- Industry-standard 512 byte sector support
- Temperature sensor
- Native Command Queuing (NCQ) support with 32 command queue depth
- RoHS-compliant package
- 3D TLC NAND
- DRAM support

Performance

- Sequential Read: Up to 565MB/s
- Sequential Write: Up to 525MB/s
- Random Read: Up to 84K IOPS (4K block size)
- Random Write: Up to 81K IOPS (4K block size)

Endurance

- TBW: Up to 300TB
- DWPD: 1.238

Security

- User selectable ATA password support
- Secure Erase support

Reliability

- MTBF: 1.5 million device hours*
- Low Density Parity Check (LDPC) ECC
- Static and dynamic wear leveling
- Uncorrectable Bit Error Rate: ≤ 1 sector per 10^{15} bits read

Electrical/Mechanical

- +5VDC ($\pm 5\%$) power supply
- Power Consumption: up to 2.1W (Active), 0.09W (Idle)
- 2.5-inch form factor: 100.45 x 69.85 x 7mm
- Weight: 60g

Environmental

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

*Based on Telcordia SR-332 reliability prediction procedure.

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Patents pending.

Revision History

September 2017 Preliminary Rev 1.0 – initial release

Ordering Information

Table 1 – Ordering Information

User Capacity*	Part Number	LBA**
120GB	SSSD120GBTSU2-E7	234,441,648
240GB	SSSD240GBTSU2-E7	468,862,128
250GB	SSSD250GBTSU2-E7	488,397,168
480GB	SSSD480GBTSU2-E7	937,703,088
500GB	SSSD500GBTSU2-E7	976,773,168
960GB	SSSD960GBTSU2-E7	1,875,385,008
1000GB	SSSD001TBTSU2-E7	1,953,525,168

xx = customer specific, see sales rep

*User Capacity: The 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).

**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).

Mechanical Dimensions

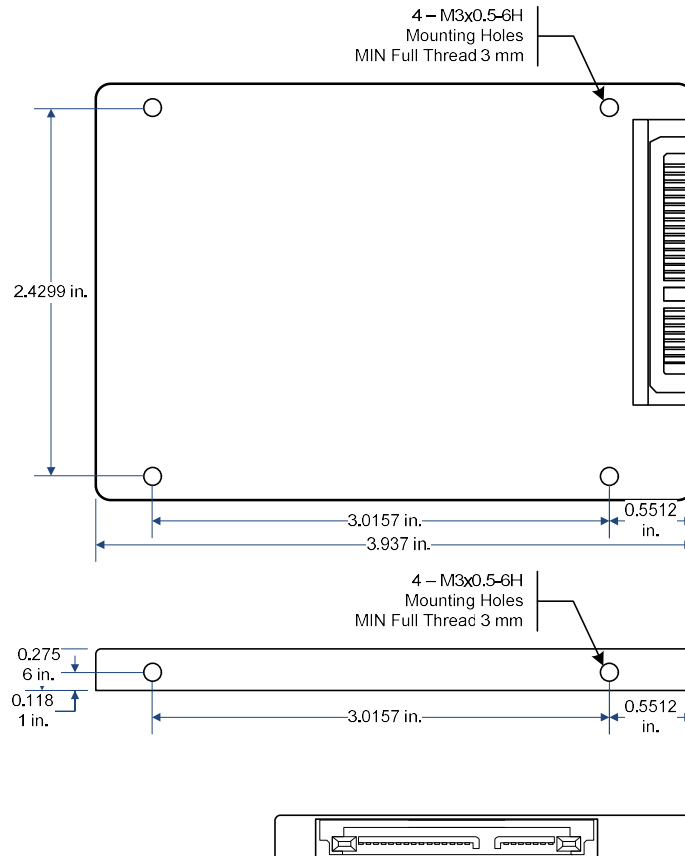


Figure 1: 2.5" SATA SSD

Architecture

PRINCETON LYNX² 2.5" 3D TLC SSDs employs a single chip controller with a SATA Revision 3.1 interface on the host side and up to 16 NAND flash packages internally

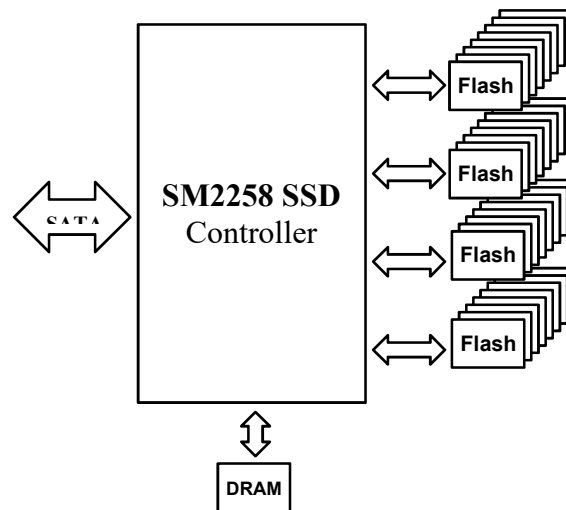


Figure 2: Block Diagram

Performance

Table 2: Performance

Capacity (GB)		120	240	250	480	500	960	1000
Max Sequential Read (up to)	(MB/s)	530	565	565	565	565	565	565
Max Sequential Write (up to)	(MB/s)	475	510	500	520	520	520	520
Max 4K Random Read (up to)	(IOPS)	28K	60K	60K	80K	80K	80K	80K
Max 4K Random Write (up to)	(IOPS)	73K	74K	74K	72K	72K	72K	72K
Access Time (ms)		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1

Endurance

Table 3: TBW

Part Number	Capacity (GB)	Raw Flash Capacity (GiB)	TBW (TB)	DWPD (3yr)	DWPD (5yr)
SSSD120GBTSU2-E7	120	128	37	0.309	0.185
SSSD240GBTSU2-E7	240	256	75	0.309	0.185
SSSD250GBTSU2-E7	250	256	75	0.309	0.185
SSSD480GBTSU2-E7	480	512	150	0.309	0.185
SSSD500GBTSU2-E7	500	512	150	0.309	0.185
SSSD960GBTSU2-E7	960	1024	300	0.309	0.185
SSSD001TBTSU2-E7	1000	1024	300	0.309	0.185

Electrical Characteristics

Table 4: Power Consumption

Capacity (GB)	Idle	100% Read	100% Write	Unit
120	<0.014	<0.296	<0.411	A
240	<0.014	<0.296	<0.411	A
250	<0.014	<0.296	<0.411	A
480	<0.014	<0.296	<0.411	A
500	<0.014	<0.296	<0.411	A
960	<0.017	<0.300	<0.420	A
1000	<0.017	<0.300	<0.420	A

¹Idle power consumption measured with LPM enabled on host

²Active power consumption measured with CrystalDiskMark 3.0.1 x64 sequential access

Interface

PRINCETON LYNX² 2.5" 3D TLC SSDs use an industry-standard SATA connector as defined by SATA-IO. The pinout of the signal and power segments of this connector are shown in Figure 4.

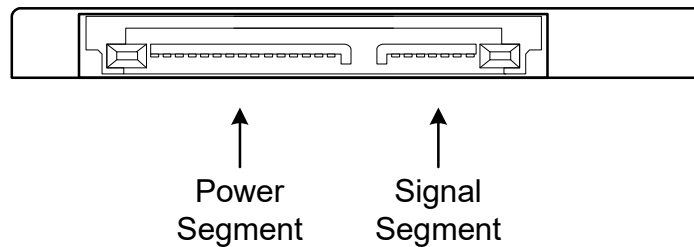


Figure 3: SATA connector

Table 5: Signal Segment Pinout

Signal Name	Type	Description
S1	GND	Ground
S2	A+	A+ (transmit)
S3	A-	A- (transmit)
S4	GND	Ground
S5	B-	B- (receive)
S6	B+	B+ (receive)
S7	GND	Ground

Table 6: Power Segment Pinout

Pin #	Type	Description
P1	+3.3VDC	3.3V Power; not used
P2	+3.3VDC	3.3V Power; not used
P3	DEVSLP	Device Sleep Pin
P4	GND	Ground
P5	GND	Ground
P6	GND	Ground
P7	+5VDC	5V Power
P8	+5VDC	5V Power
P9	+5VDC	5V Power
P10	GND	Ground
P11	DAS	Device Activity Signal
P12	GND	Ground
P13	+12VDC	12V Power; not used
P14	+12VDC	12V Power; not used
P15	+12VDC	12V Power; not used

Commands

Table 7: 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
Set Max Freeze Lock		04h

SMART Attributes

Table 8: 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

Compliance

Princeton Technology, Inc. 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)

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