ThinkSystem PM1645 Mainstream SAS 12Gb SSDs
Product Guide

The ThinkSystem PM1645 Mainstream SAS 12Gb solid-state drives (SSDs) in capacities of up to 3.2 TB are next-generation high-performance SSDs suitable for a wide range of applications of running on ThinkSystem servers. The PM1645 Mainstream SAS 12Gb SSD is shown in the following figure.

Figure 1. ThinkSystem PM1645 Mainstream SAS 12Gb SSD

Did you know?

Unlike SATA drives, the 12 Gb/s SAS interface on these drives supports full duplex data transfer for higher performance, as well as dual port connectivity and enterprise-level error recovery for better availability. By combining the enhanced reliability of Samsung NAND flash memory silicon with NAND Flash management technologies, PM1645 SSDs deliver the extended endurance of up to 3 drive writes per day (DWPD) for 5 years, which is suitable for many enterprise applications.

Part number information

The following tables list the information for ordering part numbers and feature codes.

Table 1. Ordering part numbers and feature codes

Part number	Feature code	Description
2.5-inch hot-swap drives		
4XB7A13653	B4A0	ThinkSystem 2.5" PM1645 800GB Mainstream SAS 12Gb Hot Swap SSD
4XB7A13654	B4A1	ThinkSystem 2.5" PM1645 1.6TB Mainstream SAS 12Gb Hot Swap SSD
4XB7A13655	B4A2	ThinkSystem 2.5" PM1645 3.2TB Mainstream SAS 12Gb Hot Swap SSD
3.5-inch hot-swap drives		
4XB7A13657	B4A3	ThinkSystem 3.5" PM1645 800GB Mainstream SAS 12Gb Hot Swap SSD
4XB7A13658	B4A4	ThinkSystem 3.5" PM1645 1.6TB Mainstream SAS 12Gb Hot Swap SSD
4XB7A13659	B4A5	ThinkSystem 3.5" PM1645 3.2TB Mainstream SAS 12Gb Hot Swap SSD

The part numbers include the following items:

- One solid-state drive with a hot-swap tray
- Documentation flyer

Features

The PM1645 Mainstream SAS 12Gb SSDs have the following features:

- Mainstream server SSD suitable for mixed read-write-intensive workloads
- Endurance of 3 drive-writes per day (DWPD)
- 2.5-inch or 3.5-inch industry standard form factor with hot-swap tray
- SAS 12 Gbps interface
- Active-active dual port host interface
- Protect data integrity from unexpected power loss with Samsung's advanced power-loss protection architecture
- Supports Self-Monitoring, Analysis and Reporting Technology (S.M.A.R.T)
- End-to-end data protection
- Support 16 Initiator with Tag Command Queuing (TCQ) Command Set with a queue-depth of up to 128 commands
- Compliant with SCSI Specification (SAS-3 / SPL-3 / SBC-4 / SPC-4 / SAM-5)
- RoHS Compliant

Entry SSDs and Mainstream SSDs have similar read and write IOPS performance, but the key difference between them is their endurance (or lifetime) (that is, how long they can perform write operations because SSDs have a finite number of program/erase (P/E) cycles). Mainstream SSDs have better endurance but lower cost/IOPS ratio compared to Entry SSDs. SSD write endurance is typically measured by the number of program/erase (P/E) cycles that the drive incurs over its lifetime, listed as the total bytes of written data (TBW) in the device specification.

The TBW value assigned to a solid-state device is the total bytes of written data (based on the number of P/E cycles) that a drive can be guaranteed to complete (% of remaining P/E cycles = % of remaining TBW). Reaching this limit does not cause the drive to immediately fail. It simply denotes the maximum number of writes that can be guaranteed. A solid-state device will not fail upon reaching the specified TBW. At some point based on manufacturing variance margin, after surpassing the TBW value, the drive will reach the end-of-life point, at which the drive will go into a read-only mode.

For example, the 1.6TB PM1645 SSD has an endurance of 8,760 TB of total bytes written (TBW). This means that for full operation over five years, write workload must be limited to no more than 4,800 GB of writes per day, which is equivalent to 3.0 full drive writes per day (DWPD). For the device to last three years, the drive write workload must be limited to no more than 8,000 GB of writes per day, which is equivalent to 5.0 full drive writes per day.

Technical specifications

The following tables present technical specifications for the PM1645 Mainstream SAS 12Gb SSDs.

Table 2. Technical specifications

Feature	**800 GB drive**	**1.6 TB drive**	**3.2 TB drive**
Interface	12 Gbps SAS	12 Gbps SAS	12 Gbps SAS
Capacity	800 GB	1.6 TB	3.2 TB
Endurance (drive writes per day for 5 years)	3 DWPD	3 DWPD	3 DWPD
Endurance (total bytes written)	4,380 TB	8,760 TB	17,520 TB
Data reliability (UBER)	< 1 in 10^{17} bits read	< 1 in 10^{17} bits read	< 1 in 10^{17} bits read
MTBF	2,000,000 hours	2,000,000 hours	2,000,000 hours
IOPS reads (4 KB blocks)	230,000	230,000	230,000
IOPS writes (4 KB blocks)	70,000	90,000	90,000
Sequential read rate (128 KB blocks)	1000 MBps	1000 MBps	1000 MBps
Sequential write rate (128 KB blocks)	1000 MBps	1200 MBps	1200 MBps
Read latency (ran)	106 µs	106 µs	106 µs
Write latency (ran)	60 µs	60 µs	60 µs
Shock, non-operating	1,500 G (Max) at 0.5 ms	1,500 G (Max) at 0.5 ms	1,500 G (Max) at 0.5 ms
Vibration, non-operating	20 G_{RMS} (10-2000 Hz)	20 G_{RMS} (10-2000 Hz)	20 G_{RMS} (10-2000 Hz)
Typical power (R / W)	9 W / 9 W	9 W / 9 W	9 W / 9 W

Server support

The following table lists the ThinkSystem servers that are compatible.

Table 3. ThinkSystem server support

Description and part number	E	1S Intel				2S Intel							AMD		4S Intel				Dense/ Blade			
	SE350 (7Z46/7D1X)	ST50 (7Y48/7Y50)	ST250 (7Y45/7Y46)	SR150 (7Y54)	SR250 (7Y51/7Y52)	ST550 (7X09/7X10)	SR530 (7X07/7X08)	SR550 (7X03/7X04)	SR570 (7Y02/7Y03)	SR590 (7X98/7X99)	SR630 (7X01/7X02)	SR650 (7X05/7X06)	SR670 (7Y36/37/38)	SR635 (7Y98/7Y99)	SR655 (7Y00/7Z01)	SR850 (7X18/7X19)	SR850P (7D2F/2D2G)	SR860 (7X69/7X70)	SR950 (7X11/12/13)	SD530 (7X21)	SD650 (7X58)	SN550 (7X16)	SN850 (7X15)
2.5-inch hot-swap drives																						
ThinkSystem 2.5" PM1645 800GB Mainstream SAS 12Gb Hot Swap SSD, 4XB7A13653	N	N	N	N	N	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y	Y	Y	Y	Y	N	Y	Y
ThinkSystem 2.5" PM1645 1.6TB Mainstream SAS 12Gb Hot Swap SSD, 4XB7A13654	N	N	N	N	N	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y	Y	Y	Y	Y	N	Y	Y
ThinkSystem 2.5" PM1645 3.2TB Mainstream SAS 12Gb Hot Swap SSD, 4XB7A13655	N	N	N	N	N	Y	Y	Y	Y	Y	Y	Y	N	N	N	Y	Y	Y	Y	Y	N	Y	Y
3.5-inch hot-swap drives																						
ThinkSystem 3.5" PM1645 800GB Mainstream SAS 12Gb Hot Swap SSD, 4XB7A13657	N	N	N	N	N	Y	Y	Y	Y	Y	Y	Y	N	N	N	N	N	N	N	N	N	N	N
ThinkSystem 3.5" PM1645 1.6TB Mainstream SAS 12Gb Hot Swap SSD, 4XB7A13658	N	N	N	N	N	Y	Y	Y	Y	Y	Y	Y	N	N	N	N	N	N	N	N	N	N	N
ThinkSystem 3.5" PM1645 3.2TB Mainstream SAS 12Gb Hot Swap SSD, 4XB7A13659	N	N	N	N	N	N	N	N	Y	Y	Y	Y	N	N	N	N	N	N	N	N	N	N	N

Operating system support

SAS SSDs operate transparently to users, storage systems, applications, databases, and operating systems.

Operating system support is based on the controller used to connect to the drives. Consult the controller propduct guide for more information:

- RAID controllers: https://lenovopress.com/servers/options/raid
- SAS HBAs: https://lenovopress.com/servers/options/hba

Warranty

The PM1645 Mainstream SAS 12Gb SSDs carry a one-year, customer-replaceable unit (CRU) limited warranty. When the SSDs are installed in a supported server, these drives assume the system's base warranty and any warranty upgrades.

Solid State Memory cells have an intrinsic, finite number of program/erase cycles that each cell can incur. As a result, each solid state device has a maximum amount of program/erase cycles to which it can be subjected. The warranty for Lenovo solid state drives (SSDs) is limited to drives that have not reached the maximum guaranteed number of program/erase cycles, as documented in the Official Published Specifications for the SSD product. A drive that reaches this limit may fail to operate according to its Specifications.

Physical specifications

PM1645 Mainstream SAS 12Gb SSDs have the following physical specifications:

Dimensions and weight (approximate, without the hot-swap tray, if applicable):

- Height: 15 mm (0.6 in.)
- Width: 70 mm (2.8 in.)
- Depth: 100 mm (4.0 in.)
- Weight: 140 g (4.9 oz)

Shipping dimensions and weight for the 2.5-inch drives (approximate):

- Height: 63 mm (2.5 in.)
- Width: 133 mm (5.2 in.)
- Depth: 174 mm (6.9 in.)

Shipping dimensions and weight for the 3.5-inch drives (approximate):

- Height: 95 mm (3.7 in.)
- Width: 194 mm (7.6 in.)
- Depth: 257 mm (10.0 in.)

Operating environment

PM1645 Mainstream SAS 12Gb SSDs are supported in the following environment:

- Temperature, operating: 0 - 70 °C (32 - 158 °F)
- Temperature, non-operating: -40 to 85 °C (-40 - 185 °F)
- Relative humidity: 5 - 95% (noncondensing)
- Maximum altitude: -300 - 4,572 m (-1,000 to 15,000 feet)

Agency approvals

PM1645 Mainstream SAS 12Gb SSDs conform to the following regulations:

- UL
- TUV
- FCC
- IC
- CB
- CE Mark
- C-Tick Mark
- BSMI (Taiwan)
- KCC (Korea EMI)
- VCCI

Related publications and links

For more information, see the following documents:

- Lenovo Press product guides and papers on RAID adapters and HBAs
  https://lenovopress.com/servers/options/raid
- Lenovo RAID Management Tools and Resources
  https://lenovopress.com/lp0579-lenovo-raid-management-tools-and-resources
- Lenovo RAID Introduction
  https://lenovopress.com/lp0578-lenovo-raid-introduction

Related product families

Product families related to this document are the following:

- Drives

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