# Lenovo PM1635 Enterprise Mainstream 12Gb SAS SSDs

**Product Guide (withdrawn product)**

The Lenovo PM1635 Enterprise Mainstream 12Gb SAS solid-state drives (SSDs) in capacities of 400 GB, 800 GB and 1.6 TB capacity are next-generation high-performance SSDs suitable for a wide range of applications of running on both System x and ThinkServer platforms.



Figure 1. Lenovo PM1635 Enterprise Mainstream 12Gb SAS 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, PM1635 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. The first table is for System x options and the second table is for ThinkServer options.

Withdrawn: All drives listed in this product guide are withdrawn from marketing.

Table 1. Ordering part numbers and feature codes - System x

| Part number | Feature code | Description |
|---|---|---|
| 2.5-inch hot-swap drives with G3HS tray | | |
| 00YC460 | AT9M | 400GB Enterprise Mainstream 12Gb SAS G3HS 2.5" SSD |
| 00YC465 | AT9N | 800GB Enterprise Mainstream 12Gb SAS G3HS 2.5" SSD |
| 00YC470 | AT9P | 1.6TB Enterprise Mainstream 12Gb SAS G3HS 2.5" SSD |

Table 2. Ordering part numbers - ThinkServer

| Part number | Description |
|---|---|
| 2.5-inch hot-swap drives | |
| 4XB0K12258 | Lenovo ThinkServer 2.5" 400GB PM1635 Enterprise Mainstream 12Gb SAS Hot Swap Solid State Drive |
| 4XB0K12259 | Lenovo ThinkServer 2.5" 800GB PM1635 Enterprise Mainstream 12Gb SAS Hot Swap Solid State Drive |
| 4XB0K12260 | Lenovo ThinkServer 2.5" 1.6TB PM1635 Enterprise Mainstream 12Gb SAS Hot Swap Solid State Drive |
| 3.5-inch hot-swap drives | |
| 4XB0K12261 | Lenovo ThinkServer 3.5" 400GB PM1635 Enterprise Mainstream 12Gb SAS Hot Swap Solid State Drive |
| 4XB0K12262 | Lenovo ThinkServer 3.5" 800GB PM1635 Enterprise Mainstream 12Gb SAS HS SSD |
| 4XB0K12263 | Lenovo ThinkServer 3.5" 1.6TB PM1635 Enterprise Mainstream 12Gb SAS Hot Swap Solid State Drive |

The part numbers include the following items:

- One solid-state drive (HS parts include a hot-swap tray)
- Support Flyer for SSDs
- Warranty Flyer
- Important Notices Flyer

## Features

The PM1635 Enterprise Mainstream 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

Enterprise Entry SSDs and Enterprise 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). Enterprise Mainstream SSDs have better endurance but lower cost/IOPS ratio compared to Enterprise 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.

Because of such behavior by Enterprise Entry solid-state drives, careful planning must be done to use them only in read-intensive or mixed up to 70% read/30% write environments to ensure that the TBW of the drive will not be exceeded before the required life expectancy.

For example, the 1.6TB Enterprise Mainstream 12Gb SAS G3HS 2.5" 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 4.8 TB of writes per day, which is equivalent to 3 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 TB of writes per day, which is equivalent to 5 full drive writes per day.

## Technical specifications

The following tables present technical specifications for the PM1635 Enterprise Mainstream SSDs.

Table 3. Technical specifications

| Feature | 400 GB drive | 800 GB drive | 1.6 TB drive |
|---|---|---|---|
| System x part numbers | 00YC460 | 00YC465 | 00YC470 |
| ThinkServer part numbers | 4XB0K12258 4XB0K12261 | 4XB0K12259 4XB0K12262 | 4XB0K12260 4XB0K12263 |
| Interface | 12 Gbps SAS | 12 Gbps SAS | 12 Gbps SAS |
| Capacity | 400 GB | 800 GB | 1.6 TB |
| Endurance (drive writes per day for 5 years) | 3 DWPD | 3 DWPD | 3 DWPD |
| Endurance (total bytes written) | 2,190 TB | 4,380 TB | 8,760 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) | 190,000 | 190,000 | 190,000 |
| IOPS writes (4 KB blocks) | 50,000 | 74,000 | 68,000 |
| Sequential read rate (128 KB blocks) | 950 MBps | 950 MBps | 940 MBps |
| Sequential write rate (128 KB blocks) | 530 MBps | 870 MBps | 790 MBps |
| Read latency (ran) | 106 μs | 106 μs | 106 μs |
| Write latency (ran) | 52 μs | 52 μs | 52 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 |

## Supported servers - System x

The following tables list the System x servers that are compatible with the PM1635 Enterprise Mainstream SSDs.

**Support for System x and dense servers with Xeon E5/E7 v4 and E3 v5 processors**

Table 4. Support for System x and dense servers with Xeon E5/E7 v4 and E3 v5 processors

| Part number | Description | x3250 M6 (3943) | x3250 M6 (3633) | x3550 M5 (8869) | x3650 M5 (8871) | x3850 X6/x3950 X6 (6241, E7 v4) | nx360 M5 (5465, E5-2600 v4) | sd350 (5493) |
|---|---|---|---|---|---|---|---|---|
| 00YC460 | 400GB Enterprise Mainstream 12Gb SAS G3HS 2.5" SSD | N | N | Y | Y | Y | Y | N |
| 00YC465 | 800GB Enterprise Mainstream 12Gb SAS G3HS 2.5" SSD | N | N | Y | Y | Y | Y | N |
| 00YC470 | 1600GB Enterprise Mainstream 12Gb SAS G3HS 2.5" SSD | N | N | Y | Y | Y | Y | N |

**Support for System x and dense servers with Intel E5 v3 and E3 v3 processors**

Table 5. Support for servers with Intel Xeon v3 processors

| Part number | Description | x3100 M5 (5457) | x3250 M5 (5458) | x3500 M5 (5464) | x3550 M5 (5463) | x3650 M5 (5462) | x3850 X6/x3950 X6 (6241, E7 v3) | nx360 M5 (5465) |
|---|---|---|---|---|---|---|---|---|
| 00YC460 | 400GB Enterprise Mainstream 12Gb SAS G3HS 2.5" SSD | N | N | Y | Y | Y | Y | Y |
| 00YC465 | 800GB Enterprise Mainstream 12Gb SAS G3HS 2.5" SSD | N | N | Y | Y | Y | Y | Y |
| 00YC470 | 1.6TB Enterprise Mainstream 12Gb SAS G3HS 2.5" SSD | N | N | Y | Y | Y | Y | Y |

**Support for servers with Intel Xeon v2 processors**

Table 6. Support for servers with Intel Xeon v2 processors

| Part number | Description | x3500 M4 (7383, E5-2600 v2) | x3530 M4 (7160, E5-2400 v2) | x3550 M4 (7914, E5-2600 v2) | x3630 M4 (7158, E5-2400 v2) | x3650 M4 (7915, E5-2600 v2) | x3650 M4 BD (5466) | x3650 M4 HD (5460) | x3750 M4 (8752) | x3750 M4 (8753) | x3850 X6/x3950 X6 (3837) | x3850 X6/x3950 X6 (6241, E7 v2) | dx360 M4 (E5-2600 v2) | nx360 M4 (5455) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 00YC460 | 400GB Enterprise Mainstream 12Gb SAS G3HS 2.5" SSD | N | N | N | N | N | N | N | N | N | N | Y | N | N |
| 00YC465 | 800GB Enterprise Mainstream 12Gb SAS G3HS 2.5" SSD | N | N | N | N | N | N | N | N | N | N | Y | N | N |
| 00YC470 | 1.6TB Enterprise Mainstream 12Gb SAS G3HS 2.5" SSD | N | N | N | N | N | N | N | N | N | N | Y | N | N |

## Supported servers - ThinkServer

The following tables list the ThinkServer systems that are compatible with the PM1635 Enterprise Mainstream SSDs.

**Support for ThinkServer Generation 5 servers with E5 v4 and E3 v5 processors**

Table 7. Support for ThinkServer Generation 5 servers with E5 v4 and E3 v5 processors

| Part number | Description | TS150 | TS450 | TS460 | RS160 | TD350 | RD350 (70Qx) | RD450 (70Qx) | RD550 (70Rx/70Sx) | RD650 (70Rx) |
|---|---|---|---|---|---|---|---|---|---|---|
| 4XB0K12261 | Lenovo ThinkServer 3.5" 400GB PM1635 Enterprise Mainstream 12Gb SAS Hot Swap Solid State Drive | N | N | N | N | Y | Y | Y | Y | Y |
| 4XB0K12262 | Lenovo ThinkServer 3.5" 800GB PM1635 Enterprise Mainstream 12Gb SAS HS SSD | N | N | N | N | Y | Y | Y | Y | Y |
| 4XB0K12263 | Lenovo ThinkServer 3.5" 1.6TB PM1635 Enterprise Mainstream 12Gb SAS Hot Swap Solid State Drive | N | N | N | N | Y | Y | Y | Y | Y |
| 4XB0K12258 | Lenovo ThinkServer 2.5" 400GB PM1635 Enterprise Mainstream 12Gb SAS Hot Swap Solid State Drive | N | N | N | N | Y | Y | Y | Y | Y |
| 4XB0K12259 | Lenovo ThinkServer 2.5" 800GB PM1635 Enterprise Mainstream 12Gb SAS Hot Swap Solid State Drive | N | N | N | N | Y | Y | Y | Y | Y |
| 4XB0K12260 | Lenovo ThinkServer 2.5" 1.6TB PM1635 Enterprise Mainstream 12Gb SAS Hot Swap Solid State Drive | N | N | N | N | Y | Y | Y | Y | Y |

**Support for ThinkServer Generation 5 servers with E5 v3 and E3 v3 processors**

Table 8. Support for ThinkServer Generation 5 servers with E5 v3 and E3 v3 processors

| Part number | Description | TS140 | TS440 | RS140 | TD350 | RD350 (70Dx) | RD450 (70Dx) | RD550 (70Cx) | RD650 (70Dx) |
|---|---|---|---|---|---|---|---|---|---|
| 4XB0K12261 | Lenovo ThinkServer 3.5" 400GB PM1635 Enterprise Mainstream 12Gb SAS Hot Swap Solid State Drive | N | N | N | Y | Y | Y | Y | Y |
| 4XB0K12262 | Lenovo ThinkServer 3.5" 800GB PM1635 Enterprise Mainstream 12Gb SAS HS SSD | N | N | N | Y | Y | Y | Y | Y |
| 4XB0K12263 | Lenovo ThinkServer 3.5" 1.6TB PM1635 Enterprise Mainstream 12Gb SAS Hot Swap Solid State Drive | N | N | N | Y | Y | Y | Y | Y |
| 4XB0K12258 | Lenovo ThinkServer 2.5" 400GB PM1635 Enterprise Mainstream 12Gb SAS Hot Swap Solid State Drive | N | N | N | Y | Y | Y | Y | Y |
| 4XB0K12259 | Lenovo ThinkServer 2.5" 800GB PM1635 Enterprise Mainstream 12Gb SAS Hot Swap Solid State Drive | N | N | N | Y | Y | Y | Y | Y |
| 4XB0K12260 | Lenovo ThinkServer 2.5" 1.6TB PM1635 Enterprise Mainstream 12Gb SAS Hot Swap Solid State Drive | N | N | N | Y | Y | Y | Y | Y |

## Supported servers - Flex System

The PM1635 Enterprise Mainstream SSDs are currently not supported by any Flex System compute nodes.

## Supported storage controllers

The PM1635 Enterprise Mainstream SSDs require a supported disk controller.

The following table list the System x controllers that support these solid-state drives installed in a supported server.

Table 9. Supported controllers - System x

| Part number | Description | v2 x3850 X6/x3950 X6 (6241, E7 v2) | Xeon v3 x3500 M5 (5464) | Xeon v3 x3550 M5 (5463) | Xeon v3 x3650 M5 (5462) | Xeon v3 x3850 X6/x3950 X6 (6241, E7 v3) | Xeon v3 nx360 M5 (5465, E5-2600 v3) | Xeon v4 x3550 M5 (8869) | Xeon v4 x3650 M5 (8871) | Xeon v4 x3850 X6/x3950 X6 (6241, E7 v4) | Xeon v4 nx360 M5 (5465, E5-2600 v4) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 47C8675 | N2215 HBA | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| 46C9114 | ServeRAID M1215 | N | Y | Y | Y | N | Y | Y | Y | N | Y |
| 46C9110 | ServeRAID M5210 | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |

The following table list the ThinkServer controllers that support these solid-state drives installed in a supported server.

Table 10. Supported controllers - ThinkServer

| | | TD350 | RD350 | RD450 | RD550 | RD650 |
|---|---|---|---|---|---|---|
| 4XB0F28691 | AnyRAID 510i | Y | N | Y | Y | Y |
| 4XB0F28693 | AnyRAID 720i | Y | N | Y | Y | Y |
| 4XB0F28694 | AnyRAID 720ix | Y | N | Y | Y | Y |
| 4XC0G88834 | RAID 500 | N | Y | Y | N | N |
| 4XC0G88850 | RAID 520i | Y | Y | Y | Y | Y |
| 4XC0G88836 | RAID 710 | N | Y | Y | N | N |
| 4XC0G88849 | RAID 720i | Y | Y | Y | Y | Y |

## Operating system support

SSDs operate transparently to users, storage systems, applications, databases, and operating systems. The controllers that support SSDs are supported by the following operating systems:

- Microsoft Windows Server 2008 R2
- Microsoft Windows Server 2012
- Microsoft Windows Server 2012 R2
- Microsoft Windows Server 2016
- Red Hat Enterprise Linux 5 Server Edition
- Red Hat Enterprise Linux 5 Server with Xen x64 Edition
- Red Hat Enterprise Linux 5 Server x64 Edition
- Red Hat Enterprise Linux 6 Server Edition
- Red Hat Enterprise Linux 6 Server x64 Edition
- Red Hat Enterprise Linux 7
- SUSE LINUX Enterprise Server 11 for AMD64/EM64T
- SUSE LINUX Enterprise Server 11 for x86
- SUSE LINUX Enterprise Server 11 with Xen for AMD64/EM64T
- VMware vSphere 5.1 (ESXi)
- VMware vSphere 5.5 (ESXi)
- VMware vSphere 6.0 (ESXi)

For the latest information about the specific supported operating system versions and service packs, see the Operating System Interoperability Guide:
http://lenovopress.com/osig

## Warranty

The PM1635 Enterprise Mainstream 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

The PM1635 Enterprise Mainstream 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

The PM1635 Enterprise Mainstream 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

The PM1635 Enterprise Mainstream 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 ServeRAID Adapter Quick Reference
  http://lenovopress.com/tips0054

- *System x Configuration and Options Guide*
  http://www.ibm.com/systems/xbc/cog/

- ThinkServer Option Compatibility Matrix (OCM)
  http://www.lenovo.com/accessoriesguide

# Related product families

Product families related to this document are the following:

- Drives

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