Lenovo 12Gb SAS Enterprise Performance SSDs for System x
Product Guide (withdrawn product)

The 12 Gb SAS Enterprise Performance solid-state drives (SSDs) for System x use MLC NAND flash memory technology with a 12 Gb SAS interface to provide a high-performance, high-endurance storage solution in either 2.5-inch or 3.5-inch drive form factor.

The 12 Gb SAS drives with 10 full drives writes per day (DWPD) are an excellent choice for applications demanding high write performance, such as High Performance Computing (HPC), High Definition Imaging and Video (HDIV), high data rate analytics and databases, large-scale virtualization, and video on demand content delivery.

The 12 Gb SAS Enterprise Performance solid-state drive is shown in the following figure.

Figure 1. 12 Gb SAS Enterprise Performance SSD (hot-swap tray removed)

Did you know?

These drives offer very high random read & write performance (IOPS) and very high throughput (MBps) making them ideal for high-performance dynamic data caching applications. The drives also offer a 12 Gb SAS interface which means they are the best selection for multi-threaded applications.

Rigorous testing of 12Gb SAS Enterprise Performance SSDs by Lenovo through the ServerProven program ensures a high degree of storage subsystem compatibility and reliability. Providing additional peace of mind, these drives are covered under Lenovo warranty.

Part number information

The following table lists the information for ordering part numbers and feature codes.

Withdrawn: All drives listed in this product guide are withdrawn from marketing.

Table 1. Ordering information

Part number	Feature	Description
2.5-inch hot-swap drives		
00FN379	AS7C	200GB 12G SAS 2.5" MLC G3HS Enterprise SSD
00FN389	AS7E	400GB 12G SAS 2.5" MLC G3HS Enterprise SSD
00FN399	AS7G	800GB 12G SAS 2.5" MLC G3HS Enterprise SSD
00FN409	AS7J	1.6TB 12G SAS 2.5" MLC G3HS Enterprise SSD
3.5-inch hot-swap drives		
01GR881	AUBU	1.6TB 12Gb SAS 3.5" MLC HS Enterprise SSD

The part numbers include the following items:

- One 2.5-inch SSD with either a 2.5-inch or 3.5-inch a hot-swap tray attached
- Support Flyer for SSDs
- Warranty flyer and Important Notices document

ThinkServer SSDs: The 12Gb SAS Enterprise Performance SSDs available for ThinkServer systems (4XB0G45730, 4XB0G45731, and 4XB0G45732) are not covered in this product guide.

Features

The 12Gb SAS Enterprise Performance SSDs have the following features:

- Industry-standard 2.5-inch drive with 2.5-inch or 3.5-inch System x drive tray attached
- Based on proven HGST Ultrastar SSD1600MM drive technology
- Uses 20 nm Multi-Level Cell (MLC) NAND flash memory
- Endurance of 10 drive writes per day (DWPD) for 5 years. This equates to a total bytes written (TBW) value of:
    - 200 GB drive: 3.65 PB
    - 400 GB drive: 7.3 PB
    - 800 GB drive: 14.6 PB
    - 1.6 TB drive: 29.2 PB
- SAS MLC solid-state drive with high read performance and consistently low latencies to fulfill client needs in the enterprise space
- High reliability and enhanced ruggedness
- Energy saving, with 9 W typical power consumption per drive
- Absence of moving parts to reduce potential failure points in the server
- S.M.A.R.T. support
- Advanced Encrypting Standard (AES) 256-bit encryption
- Supports Sanitize Cryptographic Erase

- Full end-to-end data path protection
  - T10 Data Integrity Field (DIF) standard
  - Extended error correction code (ECC)
  - Exclusive-OR (XOR) parity to protect against Flash die failure
  - Parity-checked internal data paths without an external write cache
  - Power loss data management without the need for a supercapacitor

The key difference between Enterprise Performance SSDs such as the 12Gb SAS SSDs described here and Enterprise Entry and Enterprise Mainstream SSDs, is their endurance (life expectancy). SSDs have a huge, but finite, number of program/erase (P/E) cycles, which determines how long the drives can perform write operations and thus their life expectancy. Enterprise Performance SSDs have better endurance than the Enterprise Mainstream and Enterprise Entry SSDs, but at a higher cost/IOPS ratio.

SSD write endurance is typically measured by the number of program/erase cycles that the drive can incur over its lifetime, which is listed as TBW in the device specification. The TBW value that is assigned to a solid-state device is the total bytes of written data that a drive can be guaranteed to complete. Reaching this limit does not cause the drive to immediately fail; the TBW simply denotes the maximum number of writes that can be guaranteed.

A solid-state device does not fail upon reaching the specified TBW, but at some point after surpassing the TBW value (and based on manufacturing variance margins), the drive reaches the end-of-life point, at which time the drive goes into read-only mode. Because of such behavior, careful planning must be done to use SSDs in the application environments to ensure that the TBW of the drive is not exceeded before the required life expectancy.

For example, the 200GB 12G SAS 2.5" MLC G3HS Enterprise SSD has an endurance of 3,600 TB (3.6 PB) of total bytes written (TBW). This means that for full operation over five years, write workload must be limited to no more than 2 TB of writes per day, which is equivalent to 10 full drive writes per day (DWPD). For the device to last in three years, the drive write workload must be limited to no more than 3.3 TB of writes per day, which is equivalent to 16.4 full drive writes per day.

Technical specifications

The following table presents technical specifications for the 12Gb SAS Enterprise Performance SSDs.

Table 2. Technical specifications

Feature	200 GB drive	400 GB drive	800 GB drive	1.6 TB drive
Part number - 2.5" G3HS	00FN379	00FN389	00FN399	00FN409
Part number - 3.5" HS	None	None	None	01GR881
Interface	12 Gbps SAS	12 Gbps SAS	12 Gbps SAS	12 Gbps SAS
Capacity	200 GB	400 GB	800 GB	1.6 TB
Endurance (drive writes per day over 5 years)	10 DWPD	10 DWPD	10 DWPD	10 DWPD
Endurance (total bytes written)	3.6 PB	7.3 PB	14.6 PB	29.2 PB
Data reliability	1 in 10^{17} bits read	1 in 10^{17} bits read	1 in 10^{17} bits read	1 in 10^{17} bits read
MTBF	2,500,000 hours	2,500,000 hours	2,500,000 hours	2,500,000 hours
IOPS reads (4 KB blocks)	130,000	130,000	130,000	130,000
IOPS writes (4 KB blocks)	100,000	100,000	100,000	100,000
Sequential read rate (64 KB blocks)	1100 MBps	1100 MBps	1100 MBps	1100 MBps
Sequential write rate (64 KB blocks)	765 MBps	765 MBps	765 MBps	765 MBps
Read latency (seq)	100 µs	100 µs	100 µs	100 µs
Write latency (seq)	45 µs	45 µs	45 µs	45 µs
Shock, operating	1,000 G (Max) at 0.5 ms	1,000 G (Max) at 0.5 ms	1,000 G (Max) at 0.5 ms	1,000 G (Max) at 0.5 ms
Vibration, operating	2.16 G_{RMS} (5-700 Hz)	2.16 G_{RMS} (5-700 Hz)	2.16 G_{RMS} (5-700 Hz)	2.16 G_{RMS} (5-700 Hz)
Typical power	8.47 W	8.47 W	8.47 W	8.47 W

Server support

The following tables list the Lenovo servers that are compatible.

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

Table 3. 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)
00FN379	200GB 12G SAS 2.5" MLC G3HS Enterprise SSD	N	N	Y	Y	Y	Y	Y
00FN389	400GB 12G SAS 2.5" MLC G3HS Enterprise SSD	N	N	Y	Y	Y	Y	Y
00FN399	800GB 12G SAS 2.5" MLC G3HS Enterprise SSD	N	N	Y	Y	Y	Y	N
00FN409	1.6TB 12G SAS 2.5" MLC G3HS Enterprise SSD	N	N	Y	Y	Y	Y	N
01GR881	1.6TB 12Gb SAS 3.5" MLC HS Enterprise SSD	N	N	N	Y	N	N	N

Support for System x and dense servers with Intel Xeon v3 processors

Table 4. 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)
00FN379	200GB 12G SAS 2.5" MLC G3HS Enterprise SSD	N	N	Y	Y	Y	Y	Y
00FN389	400GB 12G SAS 2.5" MLC G3HS Enterprise SSD	N	N	Y	Y	Y	Y	Y
00FN399	800GB 12G SAS 2.5" MLC G3HS Enterprise SSD	N	N	Y	Y	Y	Y	Y
00FN409	1.6TB 12G SAS 2.5" MLC G3HS Enterprise SSD	N	N	Y	Y	Y	Y	Y
01GR881	1.6TB 12Gb SAS 3.5" MLC HS Enterprise SSD	N	N	N	N	N	N	N

Support for servers with Intel Xeon v2 processors

Table 5. Support for servers with Intel Xeon v2 processors

Part number	Description	x3300 M4 (7382)	x3500 M4 (7383, E5-2600 v2)	x3550 M4 (7914, E5-2600 v2)	x3630 M4 (7158, E5-2400 v2)	x3650 M4 (7915, E5-2600 v2)	x3650 M4 BD (5466)	x3750 M4 (8753)	x3850 X6/x3950 X6 (6241, E7 v2)
00FN379	200GB 12G SAS 2.5" MLC G3HS Enterprise SSD	N	N	N	N	N	N	N	Y
00FN389	400GB 12G SAS 2.5" MLC G3HS Enterprise SSD	N	N	N	N	N	N	N	Y
00FN399	800GB 12G SAS 2.5" MLC G3HS Enterprise SSD	N	N	N	N	N	N	N	Y
00FN409	1.6TB 12G SAS 2.5" MLC G3HS Enterprise SSD	N	N	N	N	N	N	N	Y
01GR881	1.6TB 12Gb SAS 3.5" MLC HS Enterprise SSD	N	N	N	N	N	N	N	N

Support for Flex System compute nodes

Table 6. Support for Flex System servers

Part number	Description	x240 (8737, E5-2600 v2)	x240 (7162)	x240 M5 (9532)	x440 (7167)	x880/x480/x280 X6 (7903)	x280/x480/x880 X6 (7196)	Storage Expansion Node
00FN379	200GB 12G SAS 2.5" MLC G3HS Enterprise SSD	N	N	Y	N	N	N	N
00FN389	400GB 12G SAS 2.5" MLC G3HS Enterprise SSD	N	N	Y	N	N	N	N
00FN399	800GB 12G SAS 2.5" MLC G3HS Enterprise SSD	N	N	Y	N	N	N	N
00FN409	1.6TB 12G SAS 2.5" MLC G3HS Enterprise SSD	N	N	Y	N	N	N	N
01GR881	1.6TB 12Gb SAS 3.5" MLC HS Enterprise SSD	N	N	N	N	N	N	N

Storage controller support

The 12Gb SAS Enterprise Performance SSDs require a supported SAS controller. The following table lists the controllers and the servers that support those controllers.

Table 7. Controllers for supported servers

Part number	Description	Xeon v3					Xeon v4					FS
		x3500 M5 (5464)	x3550 M5 (5463)	x3650 M5 (5462)	x3850 X6/x3950 X6 (6241, E7 v3)	nx360 M5 (5465, E5-2600 v3)	x3550 M5 (8869)	x3650 M5 (8871)	x3850 X6/x3950 X6 (6241, E7 v4)	nx360 M5 (5465, E5-2600 v4)	sd350 (5493)	x240 M5 (9532)
Onboard	ServeRAID M1200e Controller	N	N	N	N	N	N	N	N	N	N	Y
46C9114	ServeRAID M1215 Controller	Y	Y	Y	N	Y	Y	Y	N	Y	N	N
81Y4481	ServeRAID M5110 Controller	N	N	N	N	N	N	N	N	N	N	N
46C9110	ServeRAID M5210 Controller	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N
00JX142	ServeRAID M5215 Controller	N	N	N	N	N	N	N	N	N	N	Y
00YD430	H701-L 6Gb HBA Mezz Card	N	N	N	N	N	N	N	N	N	Y	N
46C8988	N2115 SAS/SATA HBA	N	N	N	N	N	N	N	N	N	N	N
47C8675	N2215 SAS/SATA HBA	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N

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 2008, Datacenter x64 Edition
- Microsoft Windows Server 2008, Datacenter x86 Edition
- Microsoft Windows Server 2008, Enterprise x64 Edition
- Microsoft Windows Server 2008, Enterprise x86 Edition
- Microsoft Windows Server 2008, Standard x64 Edition
- Microsoft Windows Server 2008, Standard x86 Edition
- Microsoft Windows Server 2008, Web x64 Edition
- Microsoft Windows Server 2008, Web x86 Edition
- Microsoft Windows Server 2012
- Microsoft Windows Server 2012 R2
- 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 10 for AMD64/EM64T
- SUSE LINUX Enterprise Server 10 for x86
- 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 ESX 4.1
- VMware ESXi 4.1
- VMware vSphere 5.0 (ESXi)
- VMware vSphere 5.1 (ESXi)
- VMware vSphere 5.5 (ESXi)

For the latest information about the specific supported operating system versions and service packs, see ServerProven:
http://www.lenovo.com/us/en/serverproven/xseries/controllers/matrix.shtml

Select the check mark box that is associated with the controller and server combination in question to see the details about operating system support.

Warranty

The 12 Gb SAS Enterprise Performance 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 12Gb SAS Enterprise Performance SSDs have the following physical specifications.

Dimensions and weight (approximate, without drive tray):

- Height: 15 mm (0.6 in.)
- Width: 70 mm (2.8 in.)
- Depth: 100 mm (4.0 in.)
- Weight: 187 g (6.6 oz lb)

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

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

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

- Height: 95 mm (3.7 in.)
- Width: 257 mm (10.1 in.)
- Depth: 193 mm (7.6 in.)

Operating environment

The 12Gb SAS Enterprise Performance SSDs are supported in the following environment:

- Temperature, operational: 0 to 70° C (32 to 158° F)
- Temperature, storage: -40 to 85° C (-40 to 185° F)
- Relative humidity: 5 to 90% (noncondensing)
- Maximum altitude: 3,050 m (10,000 ft)

Agency approvals

The 12Gb SAS Enterprise Performance SSDs conform to the following regulations:

- FCC Title 47, Part 15B, Class B
- CA/CSA-CEI/IEC CISPR 22:02
- EN 55024: 1998
- EN 55022: 2006
- EN-60950-1 2nd Edition
- UL/CSA EN-60950-1 2nd Edition
- Low Voltage Directive 2006/95/EC
- C-Tick: AS/NZS3584
- VCCI V-3/2013-04 Class B
- CNS 13438: 2006
- KCC Article 11.1
- RoHS DIRECTIVE 2011/65/EU
- REACH 1907/2006
- WEEE Directive 2002/96/EC

Related publications and links

For more information, see the following documents:

- Lenovo System x storage options product page
  https://www3.lenovo.com/us/en/data-center/servers/server-options/system-x-options/server-storage/c/system-x-storage
- HGST Ultrastar SSD1600MM SAS SSD product page
  https://www.hgst.com/products/solid-state-solutions/ultrastar-ssd1600mm
- ServerProven for SSDs
  http://www.lenovo.com/us/en/serverproven/xseries/storage/hssdmatrix.shtml
- ServeRAID Adapter Quick Reference
  http://lenovopress.com/tips0054

Related product families

Product families related to this document are the following:

- Drives

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