

IBM System x3690 X5

IBM Redbooks Product Guide

IBM® System x3690 X5 is a powerful two-socket 2U rack-mount server using the latest Intel Xeon processors. The x3690 X5 servers can be combined with the IBM MAX5 memory expansion unit for up to 2 TB of memory. Add to that the 16 2.5-inch disk drive bays and you have a high performance workhorse in a rack-dense package. The x3690 X5 server belongs to the family of a new generation of Enterprise X-Architecture® servers. The server delivers innovation with enhanced reliability and availability features to enable optimal performance for databases, enterprise applications, and virtualized environments.

The IBM System x3690 X5 is shown in Figure 1.



Figure 1. The IBM System x3690 X5

Did you know?

The x3690 X5 offers a two step approach to expanding the system with memory. You can first start with 16 DIMMs installed just on the system board, then as needs require, install the memory mezzanine and an additional 16 DIMMs. The for applications that can use the most amount of RAM, use the 1U MAX5 memory expansion unit which adds an additional 32 DIMM sockets. The MAX5 scalability and memory expansion feature is a unique IBM enhancement, not offered by other x86 server architectures. The total number of DIMM sockets available to the system is then 64 DIMMs -- in only 3U of rack space -- and with 32 GB DIMMs, that is 2 TB of RAM.

The x3690 X5 servers also contain up to 16 HDD bays that support 2.5-inch hot-swap internal SAS/SATA drives totaling up to 8TB, or up to 24 solid-state drive bays, supporting 1.8-inch hot-swap SSDs, using up to three IBM eXFlash storage options. *Each* individual SSD is capable of sustaining approximately 4,300 IOPS, which is more than 10X what an enterprise 15,000 RPM 2.5-inch 146.8GB SAS HDD can achieve (420 IOPS).

Key features

The x3690 X5 is an outstanding 2U two-socket mission-critical server, offering outstanding performance, superior reliability, and fault-tolerant memory characteristics.

IBM® has been designing and implementing servers under the X-Architecture® name since 2001. IBM eX5 technology represents the fifth generation of enterprise servers based on the same design principle IBM began with in 1997: to offer systems that are expandable, offer “big iron” reliability, availability, and serviceability (RAS) features, with extremely competitive price/performance on an Intel Xeon processor-based system.

Scalability and performance

The x3690 X5 offers numerous features to boost performance, improve scalability, and reduce costs:

- The x3690 X5 supports up to two high-performance Intel Xeon E7 family allowing you to upgrade as business needs require.
- Supports the Intel Xeon E7-2800, E7-4800 and E7-8800 families of high performance processors, up to 10 cores each, offering superior system performance
- Intel Turbo Boost Technology dynamically turns off unused processor cores and increases the clock speed of the cores in use, by up to three model frequencies. For example, with 7-10 cores active, a 2.4 GHz E7-2870 10-core processor can run the cores at up to 2.53 GHz. With 5-6 cores active, it can run those cores at 2.67 GHz; with only 1-4 cores active, it can run those cores at 2.8 GHz
- Each processor includes two integrated memory controllers, to reduce memory bottlenecks and improve performance. Memory access is at up to 1066 MHz frequency, depending on the processor model and memory used.
- The MAX5 V2 adds an additional four memory controllers for a total of eight memory controllers to maximize memory parallelism and performance.
- In processors implementing Hyper-Threading technology, each core has two threads capable of running an independent process. Thus, an 8-core processor can run 16 threads concurrently.
- Intel’s Virtualization Technology (VT) integrates hardware-level virtualization hooks that allow operating system vendors to better utilize the hardware for virtualization workloads.
- Intel QuickPath Interconnect (QPI) technology for processor-to-processor connectivity and Intel Scalable Memory Interconnect (SMI) processor-to-memory connectivity:
 - Intel QPI link topology at up to 6.4 Gbps with four QPI links per CPU
 - Intel SMI link topology at up to 6.4 Gbps with four SMI links per CPU
- Up to 32 dual inline memory modules (DIMMs) in the base system (16 on the system planar and 16 on an optional memory mezzanine inside the server), plus an additional 32 DIMMs with an optional 1U MAX5 V2 memory expansion unit, for a total of 64 DIMM sockets.
- Support for 32 GB DIMMs for a maximum of 2 TB per x3690 X5 with MAX5 V2
- The use of solid-state drives (SSDs) instead of, or along with, traditional spinning drives (HDDs) can significantly improve I/O performance. An SSD can support up to 100 times more I/O operations per second (IOPS) than a typical HDD.
- Up to 24 1.8-inch SSD bays, or up to 16 2.5-inch bays together with the option of an optical drive, provide a flexible and scalable all-in-one platform to meet your increasing demands.

Availability and serviceability

The x3690 X5 provides many features to simplify serviceability and increase system uptime:

- Support for machine check architecture (MCA) recovery, a feature of the Intel Xeon processor E7 family, which enables the handling of system errors that otherwise require the operating system to be halted. SAP HANA is one of the first application which leverages the MCA recovery to handle system errors in order to prevent the application from being terminated in case of a system error.
- Extensive memory protection with IBM Chipkill, and, with DIMMs containing x4 DRAM modules, Redundant Bit Steering (RBS) (also known as Double Device Data Correction or DDDC) is also supported. The combination of IBM Chipkill and RBS provides very robust memory protection that sustains to two sequential memory DRAM chip failures without affecting overall system performance.
- Redundant CPU-to-I/O hub interconnect links provide ability to self-recover from CPU failure. If primary CPU fails then eX5 systems can use the second CPU to boot the OS as they still have access to the integrated I/O devices because of redundant links between CPUs and I/O hubs.
- Memory mirroring and memory rank sparing for redundancy in the event of a non-correctable memory failure.
- Hot-swap drives, supporting RAID redundancy for data protection and greater system uptime.
- Four redundant hot-swap power supplies and five redundant hot-swap fans to provide availability for business-critical applications.
- The power source independent light path diagnostics panel and individual light path LEDs quickly lead the technician to failed (or failing) components, which simplifies servicing, speeds up problem resolution, and helps improve system availability.
- Predictive Failure Analysis (PFA) detects when system components (processors, VRMs, memory, HDDs, fans, and power supplies) operate outside of standard thresholds and generates proactive alerts in advance of a possible failure, therefore increasing uptime.
- Solid-state drives (SSDs) offer significantly better reliability than traditional mechanical HDDs for greater uptime.
- Built-in Integrated Management Module Version II (IMM2) continuously monitors system parameters, triggers alerts, and performs recovering actions in case of failures to minimize downtime.
- Built-in diagnostics, using Dynamic Systems Analysis (DSA) Preboot, speed up troubleshooting tasks to reduce service time.
- Three-year customer-replaceable unit and on-site limited warranty, 9x5 next business day. Optional service upgrades are available.

Manageability and security

Powerful systems management features simplify local and remote management of the x3690 X5:

- The server includes an Integrated Management Module (IMM) to monitor server availability and perform remote management.
- Integrated industry-standard Unified Extensible Firmware Interface (UEFI) enables improved setup, configuration, and updates, and simplifies error handling.
- Integrated Trusted Platform Module (TPM) 1.2 support enables advanced cryptographic functionality, such as digital signatures and remote attestation.
- IBM Systems Director is included for proactive systems management. It offers comprehensive systems management tools that help to increase uptime, reduce costs, and improve productivity through advanced server management capabilities.

Energy efficiency

The x3690 X5 offers the following energy-efficiency features to save energy, reduce operational costs, increase energy availability, and contribute to the green environment:

- Energy-efficient planar components help lower operational costs.
- Support for one, two or four highly efficient 675 W ac power supplies allows for efficient use and scalability to meet the power requirements of the installed components.
- Intel Xeon processor E5-2600 product family offers significantly better performance over the previous generation while fitting into the same thermal design power (TDP) limits.
- Low-voltage Intel Xeon processors draw less energy to satisfy the demands of power and thermally constrained data centers and telecommunication environments.
- Low-voltage 1.35 V DDR3 memory RDIMMs consume 15% less energy compared to 1.5 V DDR3 RDIMMs.
- Solid state drives (SSDs) consume as much as 80% less power than traditional spinning 2.5-inch HDDs.
- The server uses hexagonal ventilation holes, which is a part of IBM Calibrated Vectors Cooling™ technology. Hexagonal holes can be grouped more densely than round holes, providing more efficient airflow through the system.
- IBM Systems Director Active Energy Manager™ provides advanced data center power notification and management to help achieve lower heat output and reduced cooling needs.

Locations of key components and connectors

Figure 2 shows the front of the server.

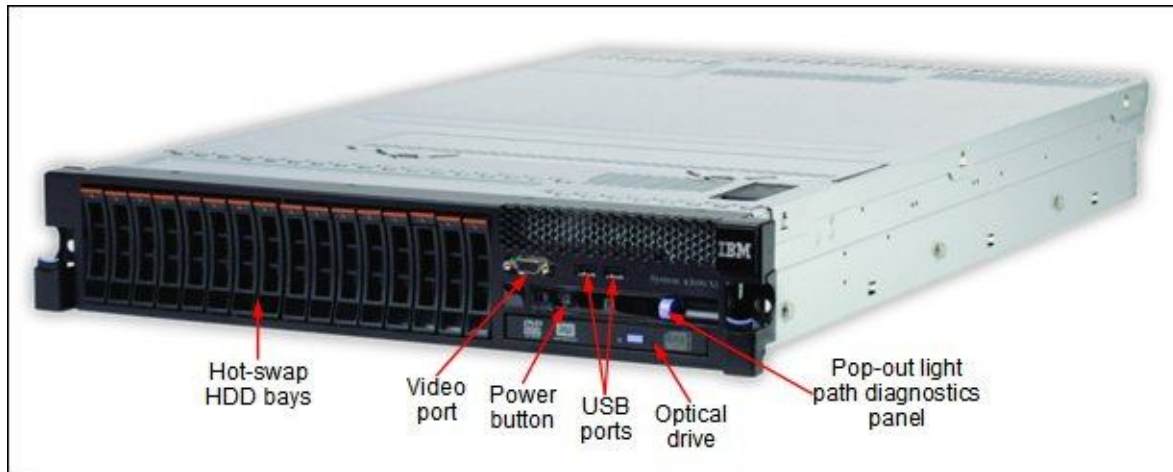


Figure 2. Front view of the IBM System x3690 X5

Figure 3 shows the rear of the server.

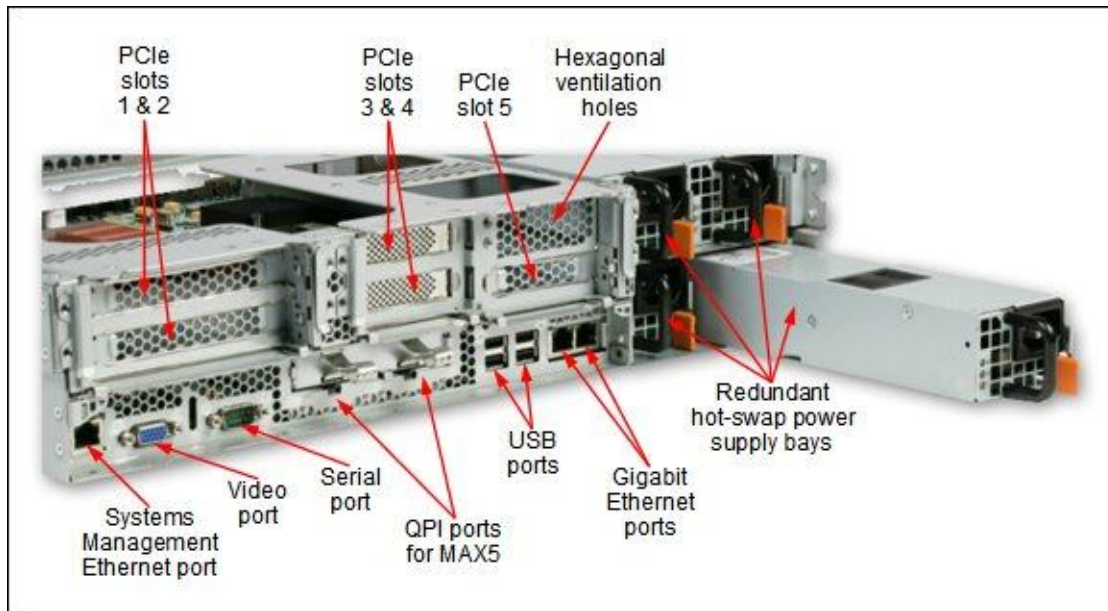


Figure 3. Rear view of the IBM System x3690 X5

Figure 4 shows the locations of key components inside the server.

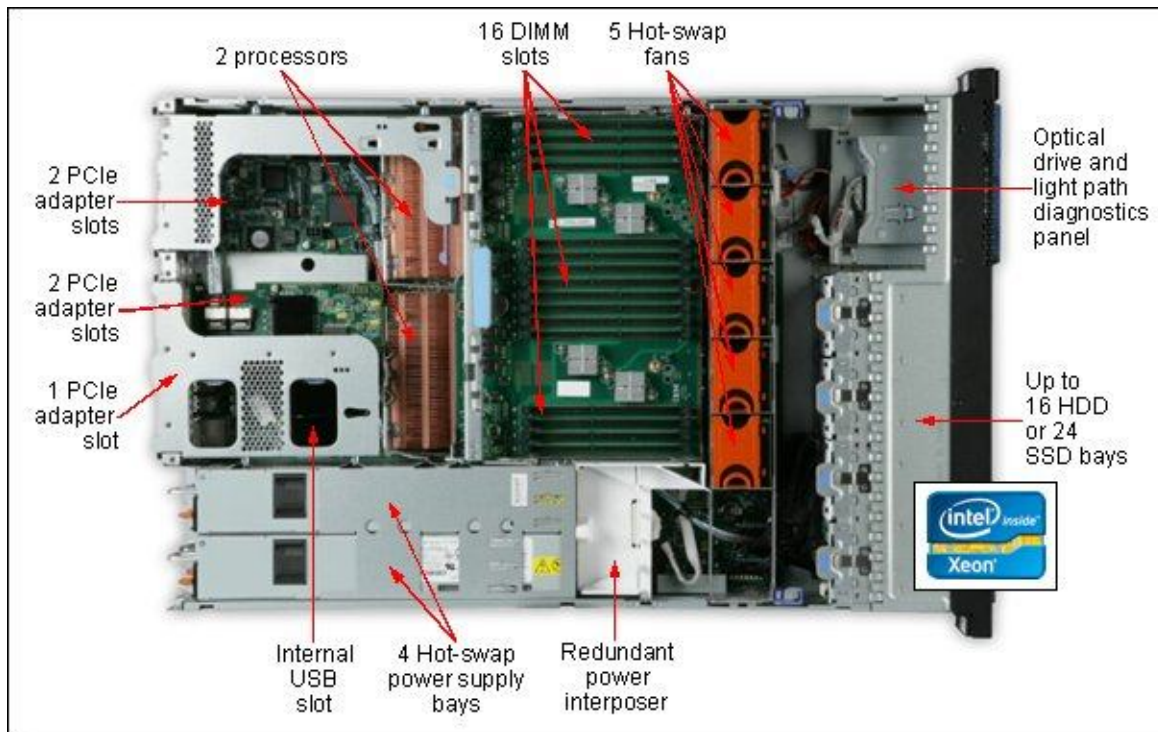


Figure 4. Inside view of the IBM System x3690 X5

Figure 5 shows the MAX5 optional memory expansion unit.

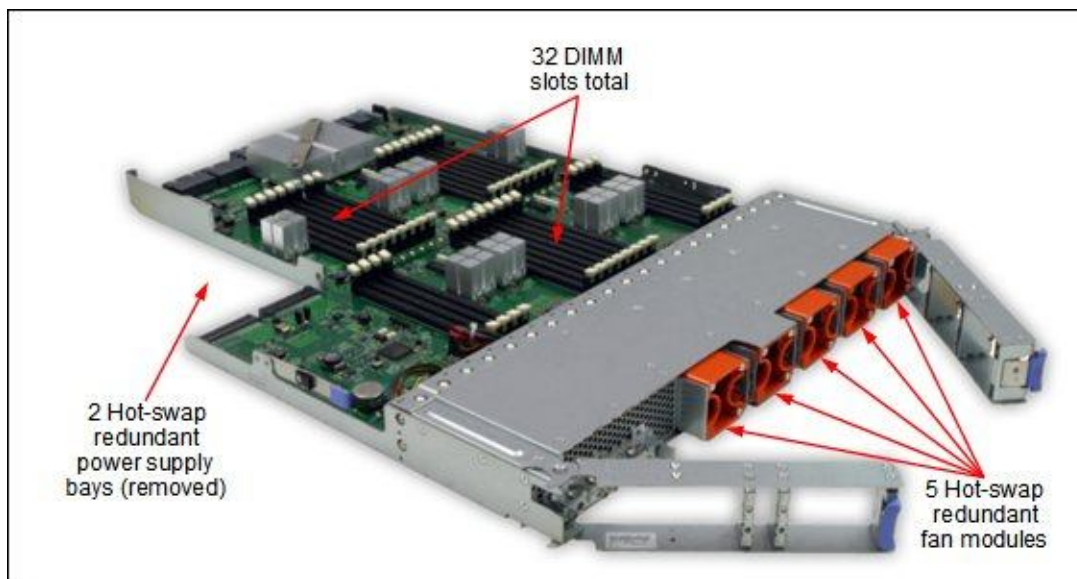


Figure 5. Inside view of the MAX5 optional memory expansion unit for the IBM System x3690 X5

Standard specifications

Table 1. Standard specifications

Components	Specification
Form factor/height	Rack/2U per chassis; MAX5 adds 1U
Processor (max)	Machine type 7147: Intel Xeon E7-2800, E7-4800 and E7-8800 families, up to 10 cores
Number of processors	1 or 2 standard (model dependent), 2 maximum
Cache (max)	Up to 30 MB
Memory DIMM sockets	Up to 64 DIMM sockets: <ul style="list-style-type: none"> • 16 on the system planar • 32 total with optional memory mezzanine • 64 total with optional MAX5 and memory mezzanine
Memory maximums	Up to 2 TB of RAM using all 32 GB DIMMs: <ul style="list-style-type: none"> • 512 GB without the memory mezzanine • 1 TB total with the memory mezzanine populated • 2 TB total with the memory mezzanine and MAX5 populated
Expansion slots	Up to 5 PCIe 2.0 slots depending on the riser cards used
Disk bays	Up to 16x 2.5-inch SAS hot-swap bays; or Up to 24x 1.8-inch SSD hot-swap bays
Optical drive	Optional
Maximum internal storage	16 TB per chassis (using 1 TB 2.5-inch NL SAS drives)
Network interface	2x 1 Gb Ethernet ports, based on the Broadcom BCM5709C controller. 2x 10 Gb Ethernet ports (standard on some models, optional on the others) 1x Intel Ethernet Quad Port Server Adapter I340-T4 (standard on some workload-optimized models)
Power supply (std/max)	1 / 4 - 675 W 220 V
Hot-swap components	Power supplies, fans, hard disk drives
RAID support	Most models: ServeRAID M1015 controller standard supporting RAID 0, 1, 10, 5, and 50.
Systems management	Alert on LAN 2, automatic server restart, IBM Director, IBM ServerGuide, IMM, light path diagnostics (independently powered), predictive failure analysis on hard disk drives, processors, VRMs, fans and memory, Wake on LAN, dynamic system analysis
Operating systems supported	Microsoft® Windows® Server 2008 (Standard, Enterprise and Datacenter editions 64-bit), 64-bit Red Hat Enterprise Linux® and SUSE Enterprise Linux, (Server and Advanced Server), VMware vSphere
Limited warranty	3-year customer replaceable unit and on-site limited warranty
Dimensions	Height: 86 mm (3.5 inches, 2U), depth: 698 mm (27.4 inches), width: 429 mm (16.8 inches)
Weight	31.3 kg (69 lb) when fully configured

The x3690 X5 servers are shipped with the following items:

- Rack rails and hardware
- Cable management hardware
- Country kit carton
- Two 2.8m 220 V intra-rack cables
- On/off switch cover
- Documentation CD
- IBM Systems Director 6.2 DVD

Standard models

Table 2 lists the standard models.

Table 2. Standard models - Machine type 7147 (Intel Xeon E7-2800 and E7-8800 series processors)

Model	Intel Xeon (2 maximum)	MAX5	Memory	Memory mezz.	RAID	Disk bays*	Disks	Network	DVD	675W Power*
7147-A1x	1x E7-2803 6C 1.73GHz 18MB 800MHz 105w	No support	2x 4GB	Optional	Optional	Open	Open	2x 1Gb	Open	1 / 4
7147-A2x	1x E7-2820 8C 2.00GHz 18MB 978MHz 105w	No support	2x 4GB	Optional	M1015	4x 2.5" / 16	Open	2x 1Gb	Open	2 / 4
7147-A3x	1x E7-2830 8C 2.13GHz 24MB 1066MHz 105w	Optional	2x 4GB	Optional	M1015	4x 2.5" / 16	Open	2x 1Gb	Open	2 / 4
7147-A5x	1x E7-2850 10C 2.00GHz 24MB 1066MHz 130w	Optional	2x 4GB	Optional	M1015	4x 2.5" / 16	Open	2x 1Gb	Open	2 / 4
7147-A6x	1x E7-2860 10C 2.26GHz 24MB 1066MHz 130w	Optional	2x 4GB	Optional	M1015	4x 2.5" / 16	Open	2x 1Gb	Open	2 / 4
7147-A7x	1x E7-2870 10C 2.40GHz 30MB 1066MHz 130w	Optional	2x 4GB	Optional	M1015	4x 2.5" / 16	Open	2x 1Gb	Open	2 / 4
7147-C1x	1x E7-8837 8C 2.67GHz 24MB 1066MHz 130W	Optional	2x 4GB	Optional	M1015	4x 2.5" / 16	Open	2x 1Gb	Open	2 / 4

* Standard / Maximum

Refer to the Standard Specifications section for information about standard features of the server.

Workload-optimized models

Table 3 lists the announced workload-optimized models. These are systems that are specially configured to meet the requirements of a particular software stack.

Table 3. Workload optimized models - Machine type 7147 (Intel Xeon E7-2800 series processors)

Model 7147-	Processor** (2 max)	MAX5	RAM	Mem mez.	RAID	Disk bays	Disks	Network†	PS
Database workload-optimized models									
D1x	2x Xeon E7-2860 10C 2.26GHz 24MB 1066	Opt	16x 4 GB	Opt	4x B5015	16x1.8"/ 24	16x 200GB SSD	2x 1Gb+ 2x 10Gb	4 / 4
D2x	2x Xeon E7-2860 10C 2.26GHz 24MB 1066	Opt	16x 4 GB	Opt	2x 6Gb SSD HBA	16x1.8"/ 24	16x 200GB SSD	2x 1Gb+ 2x 10Gb	4 / 4
D3x	2x Xeon E7-2860 10C 2.26GHz 24MB 1066	Opt	16x 4 GB	Opt	2x M5015 (+Perf keys)	16x1.8"/ 24	16x 200GB SSD	2x 1Gb+ 2x 10Gb	4 / 4
D4x	2x Xeon E7-2860 10C 2.26GHz 24MB 1066	Opt	16x 4 GB	Opt	2x 6Gb SSD HBA	16x1.8"/ 24	16x 200GB SSD	2x 1Gb+ 2x 10Gb	4 / 4
SAP HANA workload-optimized models									
Hx	2x Xeon E7-2870 10C 2.40GHz 30MB 1066	NS‡	8x 16 GB	Std	2x M5015 (+Perf keys)	16x1.8"/24	10x 200GB SSD DVD Multiburner	6x 1Gb 4x 10Gb	4 / 4
Hx	2x Xeon E7-2870 10C 2.40GHz 30MB 1066	NS‡	16x 16 GB	Std	2x M5015 (+Perf keys)	16x1.8"/24	10x 200GB SSD DVD Multiburner	6x 1Gb 4x 10Gb	4 / 4
Virtualization workload-optimized models									
F1x (ESX)	2x Xeon E7-2860 10C 2.26GHz 24MB 1066	Std	64x 4GB	Std	1x M1015	4x 2.5" / 16	None	2x 1Gb + 2x 10Gb	4 / 4
F2x (RH)	2x Xeon E7-2860 10C 2.26GHz 24MB 1066	Std	64x 4GB	Std	1x M1015	4x 2.5" / 16	None	2x 1Gb + 2x 10Gb	4 / 4

** Processor detail: model, core speed, cores, L3 cache, memory speed

† The Hx and Hx models include two Emulex 10GbE Integrated Virtual Fabric Adapter II (each with two IBM 10GbE SW SFP+ Transceivers) and one Intel Ethernet Quad Port Server Adapter I340-T4. The D1x, D2x, F1x, and F2x models include one Emulex 10GbE Integrated Virtual Fabric Adapter (no transceivers included). The D3x and D4x models include one Emulex 10GbE Integrated Virtual Fabric Adapter II (no transceivers included)

‡ NS = Not supported. MAX5 is not currently certified for use with SAP HANA and is therefore not supported.

About these models:

- **Models 7147-D1x, D2x, D3x, D4x:** These models are designed for database applications and uses solid state drives for the best I/O performance.

Backplane connections for 16 1.8-inch solid state drives (SSD) are standard as are 16 200GB high-performance solid-state drives. Model D1x includes four SSD-optimized ServeRAID B5015 RAID controllers, models D2x and D4x includes two SSD host bus adapters, and model D3x includes two ServeRAID M5015 RAID controllers each with the ServeRAID M5000 Series Performance Accelerator Key.

- **Models 7147-HAx, HBx:** These models are optimized to run the SAP High-Performance Analytic Appliance (HANA) solution.

HANA is an integrated, ready-to-run, hardware-software offering, featuring the new SAP In-Memory Computing Engine. These models include a preload comprised of SLES for SAP, IBM GPFS™, and the SAP HANA software stack. They include two processors, 128 or 256 GB of memory and choice of either all eXFlash solid state drives or a combination of solid state and spinning disk. They are designed for use in small to mid-sized SAP HANA configurations. Note: MAX5 is not currently certified for use with SAP HANA and is therefore not supported. H models also include a SATA Multiburner optical drive.

- **Model 7147-F1x:** This model is designed for virtualization applications and include VMware ESXi 4.1 Update 1 on an integrated bootable USB memory key. The model comes standard with the MAX5 memory expansion unit and 256 GB of memory implemented using cost-effective 4GB memory DIMMs (128 GB in the server and in the MAX5).
- **Model 7147-F2x:** This model is designed for Open Virtualization and includes Red Hat Enterprise Linux with the Red Hat Enterprise Virtualization Hypervisor (Kernel-Based Virtual Machine, KVM). The software is not preloaded. The model comes standard with the MAX5 memory expansion unit and 256 GB of memory implemented using cost-effective 4GB memory DIMMs (128 GB in the server and 128 GB in the MAX5).

Processor options

The server supports the processor options listed in the following table. The server supports one or two processors. Some processors do not support the attachment of the MAX5 memory expansion unit - these are noted in the table. The table also shows which server models have each processor standard. If there is no corresponding *where-used* model for a particular processor, then this processor is only available through configure-to-order (CTO).

Table 4. Processor options - Machine type 7147 (Intel Xeon E7-2800 and E7-8800 series processors)

Part number	Intel Xeon processor description	MAX5 supported	Models where used
88Y5654	Xeon E7-8867L 10C 2.13GHz 30MB 1066MHz 105w	Yes	-
88Y5657	Xeon E7-8837 8C 2.67GHz 24MB 1066MHz 130W	Yes	7147-C1x
88Y5662	Xeon E7-4807 6C 1.86GHz 18MB 800MHz 95w	Yes	-
88Y5663	Xeon E7-2870 10C 2.40GHz 30MB 1066MHz 130w	Yes	7147-A7x, HAx, HBx
88Y5664	Xeon E7-2860 10C 2.26GHz 24MB 1066MHz 130w	Yes	7147-A6x, Add Dxx models, F1x, F2x
88Y5720	Xeon E7-2850 10C 2.00GHz 24MB 1066MHz 130w	Yes	7147-A5x
88Y5665	Xeon E7-2830 8C 2.13GHz 24MB 1066MHz 105w	Yes	7147-A3x
88Y5666	Xeon E7-2820 8C 2.00GHz 18MB 978MHz 105w	No	7147-A2x
88Y5667	Xeon E7-2803 6C 1.73GHz 18MB 800MHz 105w	No	7147-A1x

MAX5 memory expansion unit

The IBM MAX5 memory expansion unit is a 1U unit that has 32 DDR3 DIMM sockets, two 675-watt power supplies, and five 40-mm hot-swap speed-controlled fans. It provides added memory for the x3690 X5 server. Some models include the MAX5 standard as listed in the model table above. The MAX5 options are listed in Table 5.

There are two MAX5 options available as listed in the table:

- IBM MAX5 for System x®, part number 59Y6265 (also known as MAX5 V1)
- IBM MAX5 V2 for System x, part number 88Y6529

MAX5 V2 is the second generation unit and features newer versions of the Intel scalable memory buffers, which enable support for both 1.35V DIMMs and 32 GB DIMMs.

Note that some models and some processors do not support the MAX5 (either generation). See the model table and the processor options table for details. The MAX5 (V1) includes one power supply. The second power supply is optional (part 60Y0332) and provides redundancy. The MAX5 V2 includes two power supplies; no additional power supplies are needed or available.

Table 5. MAX5

Part number	Feature code	Description	Maximum supported
59Y6265	4199	IBM MAX5 for System x (also known as MAX5 V1)	1
88Y6529	A19H	IBM MAX5 V2 for System x	1
60Y0332	4782	IBM High Efficiency 675W Power Supply (for MAX5 V1 only, part 59Y6265)	1 (MAX5 V1 only)
59Y6269	7481	IBM MAX5 to x3690 X5 Cable Kit	1

Memory options

IBM DDR3 memory is compatibility tested and tuned for optimal System x performance and throughput. IBM memory specifications are integrated into the light path diagnostics for immediate system performance feedback and optimum system uptime. From a service and support standpoint, IBM memory automatically assumes the IBM system warranty, and IBM provides service and support worldwide.

The IBM System x3690 X5 supports DDR3 memory. Memory is installed in DIMM sockets either on the system planar (16 sockets) in an optional memory mezzanine tray (16 sockets). The DIMMs on the system planar are directly connected to the first processor, and the DIMMs on the mezzanine are directly connected to the second processor. If you install the mezzanine then you must install the second processor. However the reverse is different: you do not have to install the mezzanine if you have two processors installed (although for performance reasons the mezzanine is recommended).

The following table lists memory options available for x3690 X5 server and for the MAX5 memory expansion unit.

Table 6. Memory options - Machine type 7147 (Intel Xeon E7-2800 and E7-8800 series processors)

Part number	Feature code**	Description	Supported in MAX5 V2	Maximum supported	Models where used
81Y8926	A15H	IBM x3690 X5 16-DIMM Internal Memory Expansion	No	1	All Fxx and Hxx models
44T1592	1712 / 2429	2GB (1x2GB, 1Rx8, 1.5V) PC3-10600 CL9 ECC DDR3 1333MHz LP RDIMM	Yes	32	-
44T1481*	3964*	2GB (1x2GB) Dual Rank PC3-10600 CL9 ECC DDR3-1333 LP RDIMM	No	32	-
49Y1433	8934	2GB (1x2GB, 2Rx8, 1.5V) PC3-10600 CL9 ECC DDR3 1333MHz LP RDIMM	No	32	-
49Y1407	8942 / A1MH	4GB (1x4GB, 2Rx8, 1.35V) PC3L-10600 CL9 ECC DDR3 1333MHz LP RDIMM	Yes	32	All models except Hxx
44T1599	1713 / 2431	4GB (1x4GB, Dual Rankx8) PC3-10600 CL9 ECC DDR3-1333MHz LP RDIMM	Yes	32	F1x (MAX5)
46C7448	1701	4GB (1x4GB, Quad Rankx8) PC3-8500 CL7 ECC DDR3-1066MHz LP RDIMM	No	32	-
49Y1399	A14E / A1N7	8GB (1x8GB, 4Rx8, 1.35V) PC3L-8500 CL7 ECC DDR3 1066MHz LP RDIMM	Yes	32	-
46C7482	1706 / 2432	8GB (1x8GB, Quad Rankx8) PC3-8500 CL7 ECC DDR3 1066MHz LP RDIMM	Yes	32	-
49Y1400	8939 / A1N8	16GB (1x16GB, 4Rx4, 1.35V) PC3L-8500 CL7 ECC DDR3 1066MHz LP RDIMM	Yes	32	All Hxx models
46C7483	1707 / 2433	16GB (1x16GB, Quad Rankx4) PC3-8500 CL7 ECC DDR3 1066MHz LP RDIMM	Yes	32	-
49Y1563	A1QT / A3E1	16GB (1x16GB, 2Rx4, 1.35V) PC3L-10600 CL9 ECC DDR3 1333MHz LP RDIMM	Yes	32	-
90Y3101	A1CP / A1R2	32GB (1x32GB, 4Rx4, 1.35V) PC3L-8500 CL7 ECC DDR3 1066MHz LP RDIMM	Yes	32	-

* Withdrawn from marketing

** When two feature codes are listed, the first is the feature code when the DIMM is used in the server, and the second is the feature code when the DIMM is used in the MAX5 V2.

The MAX5 V2 supports a subset of the memory DIMMs listed as shown in the table. The 16 GB and 32 GB x4 memory options that are supported in the MAX5 as listed in the above table are only supported when it is the only type of memory used in the MAX5. No other memory options can be used in the MAX5 if one of the 16 GB or 32 GB DIMMs options are used in the MAX5. These x4 DIMM also supports redundant bit steering (RBS) when used in the MAX5 or when used in x3690 X5 servers with E7 processors (machine type 7147).

The following memory protection technologies are supported:

- ECC
- ChipKill
- Memory Mirroring
- Memory Sparing
- Redundant Bit Steering (MAX5 or servers with E7 processors only, x4 DIMMs only)

Internal disk storage options

IBM System x3690 X5 server supports internally up to 16 2.5-inch SAS or SATA drives, or up to 24 1.8-inch solid state drives (SSDs). The number of drives that can be inserted depends on the backplanes that are installed. Backplane options are listed in the following table. The backplanes that are standard in each model are listed in Table 2. Only certain combinations of backplanes are supported; see the *Installation and User's Guide* for information.

Table 7. Drive backplane options

Part number	Feature code	Name	Maximum supported
60Y0339	9287	IBM 4x 2.5" HS SAS HDD Backplane Supports up to eight 2.5-inch SAS or SATA hot-swap drives.	4*
60Y0381	1790	IBM 8x 2.5" HS SAS HDD Backplane Supports up to eight 2.5-inch SAS or SATA hot-swap drives.	2
60Y0360	9281	IBM eXFlash 8x 1.8" HS SAS SSD Backplane Supports up to eight 1.8-inch hot-swap SSDs.	3

* Only two 4x 2.5" are supported when building an initial configuration using one of the configurators, however the server does support four 4x 2.5" backplanes if installed after an initial configuration.

The following table lists the hard drive options available for internal storage.

Table 8. Disk drive options for internal disk storage (Part 1)

Part number	Feature code	Description	Maximum supported
1.8-inch solid state drives (SSDs)			
00W1120	A3HQ	IBM 100GB SATA 1.8" MLC Enterprise SSD	24
49Y6119	A3AN	IBM 200GB SATA 1.8" MLC Enterprise SSD	24
49Y6124	A3AP	IBM 400GB SATA 1.8" MLC Enterprise SSD	24
00W1222	A3TG	IBM 128GB SATA 1.8" MLC Enterprise Value SSD	24
00W1227	A3TH	IBM 256GB SATA 1.8" MLC Enterprise Value SSD	24
49Y5834	A3AQ	IBM 64GB SATA 1.8" MLC Enterprise Value SSD	24
49Y5993	A3AR	IBM 512GB SATA 1.8" MLC Enterprise Value SSD	24
43W7726	5428	IBM 50GB SATA 1.8" MLC SSD	24
43W7746	5420	IBM 200GB SATA 1.8" MLC SSD	24
2.5-inch solid state drives (SSDs)			
49Y6139	A3F0	IBM 800GB SAS 2.5" MLC HS Enterprise SSD	16
49Y6134	A3EY	IBM 400GB SAS 2.5" MLC HS Enterprise SSD	16
49Y6129	A3EW	IBM 200GB SAS 2.5" MLC HS Enterprise SSD	16
00W1125	A3HR	IBM 100GB SATA 2.5" MLC HS Enterprise SSD	16
49Y5839	A3AS	IBM 64GB SATA 2.5" MLC HS Enterprise Value SSD	16
49Y5844	A3AU	IBM 512GB SATA 2.5" MLC HS Enterprise Value SSD	16
90Y8643	A2U3	IBM 256GB SATA 2.5" MLC HS Enterprise Value SSD	16
90Y8648	A2U4	IBM 128GB SATA 2.5" MLC HS Enterprise Value SSD	16
43W7718	A2FN	IBM 200GB SATA 2.5" MLC HS SSD	16
2.5-inch 15K SAS hot-swap HDDs			
90Y8926	A2XB	IBM 146GB 15K 6Gbps SAS 2.5" SFF G2HS HDD	16
42D0677	5536	IBM 146GB 15K 6Gbps SAS 2.5" SFF Slim-HS HDD	16
81Y9670	A283	IBM 300GB 15K 6Gbps SAS 2.5" SFF HS HDD	16
2.5-inch 15K SAS hot-swap SEDs			
90Y8944	A2ZK	IBM 146GB 15K 6Gbps SAS 2.5" SFF G2HS SED	16
44W2294	5412	IBM 146GB 15K 6Gbps SAS 2.5" SFF Slim-HS SED	16
81Y9662	A3EG	IBM 900GB 10K 6Gbps SAS 2.5" SFF G2HS SED	16

Table 8. Disk drive options for internal disk storage (Part 2)

Part number	Feature code	Description	Maximum supported
2.5-inch 10K SAS hot-swap HDDs			
90Y8877	A2XC	IBM 300GB 10K 6Gbps SAS 2.5" SFF G2HS HDD	16
42D0637	5599	IBM 300GB 10K 6Gbps SAS 2.5" SFF Slim-HS HDD	16
90Y8872	A2XD	IBM 600GB 10K 6Gbps SAS 2.5" SFF G2HS HDD	16
49Y2003	5433	IBM 600GB 10K 6Gbps SAS 2.5" SFF Slim-HS HDD	16
81Y9650	A282	IBM 900GB 10K 6Gbps SAS 2.5" SFF HS HDD	16
2.5-inch 10K SAS hot-swap SEDs			
90Y8913	A2XF	IBM 300GB 10K 6Gbps SAS 2.5" SFF G2HS SED	16
44W2264	5413	IBM 300GB 10K 6Gbps SAS 2.5" SFF Slim-HS SED	16
90Y8908	A3EF	IBM 600GB 10K 6Gbps SAS 2.5" SFF G2HS SED	16
2.5-inch NL SAS hot-swap HDDs			
81Y9690	A1P3	IBM 1TB 7.2K 6Gbps NL SAS 2.5" SFF HS HDD	16
90Y8953	A2XE	IBM 500GB 7.2K 6Gbps NL SAS 2.5" SFF G2HS HDD	16
42D0707	5409	IBM 500GB 7200 6Gbps NL SAS 2.5" SFF Slim-HS HDD	16
2.5-inch NL SATA hot-swap HDDs			
81Y9730	A1AV	IBM 1TB 7.2K 6Gbps NL SATA 2.5" SFF HS HDD	16
81Y9722	A1NX	IBM 250GB 7.2K 6Gbps NL SATA 2.5" SFF HS HDD	16
81Y9726	A1NZ	IBM 500GB 7.2K 6Gbps NL SATA 2.5" SFF HS HDD	16
2.5-inch SATA hot-swap HDDs			
None*	5414	IBM 500GB 7200 SATA 2.5" SFF Slim-HS HDD	1

* Available via special bid or configure-to-order (CTO) only

The following table lists the RAID controllers, SAS HBAs and other options used for internal disk storage of x3690 X5 server.

Table 9. RAID controllers for internal storage

Part number	Feature code	Description	Maximum supported
60Y0309	4164	IBM x3690 X5 RAID Expansion Adapter	1
46M0831	0095	ServeRAID M1015 SAS/SATA Controller	2
46M0916	3877	ServeRAID M5014 SAS/SATA Controller	4
46M0829	0093	ServeRAID M5015 SAS/SATA Controller	4
90Y4304	A2NF	ServeRAID M5016 SAS/SATA Controller	4
88Y5874	A39R	ServeRAID M5016 battery tray	2 (1 per pair of M5016)
46M0969	3889	ServeRAID B5015 SSD Controller	4
46M0930	5106	ServeRAID M5000 Series Advance Feature Key†	1 per one M5015 or M5014
81Y4426	A10C	ServeRAID M5000 Series Performance Accelerator Key†	1 per one M5015 or M5014
46M0912	3876	IBM 6Gb Performance Optimized HBA	3

† Only one key is supported in each controller, either the Advance Feature Key or the Performance Accelerator Key.

The IBM x3690 X5 RAID Expansion Adapter (also known as the ServeRAID Expansion Adapter or IBM 4x4 Drive Backplane ServeRAID Expansion adapter) is a SAS expander that allows you to create RAID arrays of up to 16 drives and across up to four backplanes. You can use only the 2.5-inch hot-swap drive backplanes with this adapter. You can use the Expansion Adapter only with the following RAID controllers:

- ServeRAID M1015 SAS/SATA adapter
- ServeRAID M5014 SAS/SATA adapter
- ServeRAID M5015 SAS/SATA adapter

The Expansion Adapter must be installed in PCI Slot 1 and the ServeRAID adapter must be installed in PCI Slot 3.

The ServeRAID M1015 SAS/SATA Controller has the following specifications:

- Two Mini-SAS internal connectors
- Supports RAID levels 0, 1, and 10
- Supports RAID levels 5 and 50 with optional ServeRAID M1000 Series Advanced Feature Key
- 6 Gbps throughput per port
- Based on the LSI SAS2008 6 Gbps RAID on Chip (ROC) controller
- PCI Express 2.0 x8 host interface
- Configurable stripe size up to 64 KB

The ServeRAID M5014 SAS/SATA Controller has the following specifications:

- Two Mini-SAS internal connectors
- Supports RAID levels 0, 1, 5, 10, and 50
- Supports RAID 6 and 60 with the optional M5000 Advanced Feature Key
- Performance optimization for SSD drives with optional M5000 Series Performance Accelerator Key
- 6 Gbps throughput per port
- PCI Express 2.0 x8 host interface
- Based on the LSI SAS2108 6 Gbps ROC controller
- 256 MB of onboard cache
- Optional Intelligent Li-Ion-based battery backup unit with the ServeRAID M5000 Series Battery Kit

The ServeRAID M5015 SAS/SATA Controller has the following specifications:

- Two Mini-SAS internal connectors
- Supports RAID levels 0, 1, 5, 10, and 50
- Supports RAID 6 and 60 with the optional M5000 Advanced Feature Key
- Performance optimization for SSD drives with optional M5000 Series Performance Accelerator Key
- 6 Gbps throughput per port
- PCI Express 2.0 x8 host interface
- Based on the LSI SAS2108 6 Gbps ROC controller
- 512 MB of onboard cache
- Standard Intelligent Li-Ion-based battery backup unit with up to 48 hours of data retention

The ServeRAID M5016 SAS/SATA Controller has the following specifications:

- Two Mini-SAS internal connectors (SFF-8087)
- Eight internal 6 Gbps SAS/SATA ports
- 6 Gbps throughput per port
- 800 MHz dual-core PowerPC® processor
- Based on the LSI SAS2208 6 Gbps RAID on Chip (ROC) controller
- PCI Express x8 Gen 2 host interface
- 1 GB of onboard data cache (DDR3 running at 1333 MHz)
- CacheVault technology to protect data in cache in case of critical power or server failure
- Supports RAID levels 0, 1, 5, 6, 10, 50, and 60
- Connects to up to 128 SAS or SATA drives
- Intermix of SAS and SATA drives are supported, but the mixing of SAS and SATA drives in the same RAID array is not supported
- Supports up to 64 logical volumes
- Supports LUN sizes up to 64 TB
- Configurable stripe size up to 1 MB

The ServeRAID B5015 SSD Controller has the following specifications:

- Two Mini-SAS internal connectors
- Supports RAID levels 1 and 5
- 6 Gbps throughput per SAS port
- PCI Express 2.0 x8 host interface
- Based on PMC-Sierra PM8013 maxSAS 6 Gb/s SAS RoC controller
- Performance optimized for SSDs
- Stripe size of up to 1 MB

For more information, see the list of IBM Redbooks® Product Guides in the RAID adapters category:
<http://www.redbooks.ibm.com/portals/systemx?Open&page=pg&cat=raid>

Internal backup drives

The server does not support an internal backup option.

Optical drives

The server supports the optical drive options listed in the following table.

Table 10. Optical drives

Part number	Feature code	Description	Maximum supported	Standard models where used
46M0902	4163	UltraSlim Enhanced SATA Multi-Burner	1	All Hxx models

IBM UltraSlim Enhanced SATA Multi-Burner (part number 46M0902) supports the following media and speeds for reading:

- CD-ROM 24X
- CD-DA (DAE) 20X
- CD-R 24X
- CD-RW 24X
- DVD-ROM (single layer) 8X
- DVD-ROM (dual layer) 8X
- DVD-R (4.7 GB) 6X
- DVD-R DL 4X
- DVD+R 6X
- DVD+R DL 4X
- DVD-RW (4.7 GB) 4X
- DVD+RW 4X
- DVD-RAM (4.7/9.4 GB) 4X

IBM UltraSlim Enhanced SATA Multi-Burner (part number 46M0902) supports the following media and speeds for writing:

- CD-R 24X
- CD-RW 4X
- High Speed CD-RW 10X
- Ultra Speed CD-RW 16X
- Ultra Speed Plus CD-RW 16X
- DVD-R 8X
- DVD-R DL 6X
- DVD+R 8X
- DVD+R DL 6X
- DVD-RW 6X
- DVD+RW 8X
- DVD-RAM 5X

I/O expansion options

The server offers the up to five PCI Express 2.0 slots through two riser slots. The slots available depend on the riser cards used. None of the slots are hot-swap. All slots are available regardless of whether one or two processors are installed.

Riser slot 1 can accept one of the riser cards listed in the following table, however, all standard models have the 2x8 riser card installed. This card provides the following PCIe 2.0 slots:

- Slot 1, PCIe 2.0 x8 full height, half length slot
- Slot 2, PCIe 2.0 x8 full height, half length slot

For CTO customers, the 2x8 riser can be replaced by another riser with one PCIe 2.0 x16 slot, either a full-length slot or a 3/4-length slot, as listed in the following table. This x16 slot is suitable for graphics processing unit (GPU) adapters. Additional power for the adapter is available from an on-board power connector if needed. Note that you cannot install the full-length riser (60Y0337) if the memory mezzanine is installed.

Table 11. Riser cards for riser slot 1

Part number	Feature code	Description	Standard models where used
60Y0329	9285	IBM System x3690 X5 PCI-Express (2x8) Riser Card (standard in all models)	All models
60Y0331	9282	IBM System x3690 X5 PCI-Express (1x16) Riser Card-3/4 length	-
60Y0337	9283	IBM System x3690 X5 PCI-Express (1x16) Riser Card- full length*	-

* The 1x16 full-length riser cannot be used if the memory mezzanine is installed in the server.

Riser slot 2 has the 3x8 riser card installed in all standard models, except for model 7148-ARx. For model ARx, it can be ordered using 60Y0366. See the following table. This riser card has the following three slots:

- Slot 3, PCIe 2.0 x8 low profile adapter.
- Slot 4, PCIe 2.0 x4 low profile adapter (x8 mechanical).
- Slot 5, PCIe 2.0 x8 low profile adapter. The Emulex 10Gb Ethernet adapter is installed in this slot if the adapter is part of the server configuration.

The 3x8 riser card also contains two USB ports, one of which supports the use of an embedded hypervisor key with VMware ESXi installed on it. The other USB port is not used.

Table 12. Riser cards for riser slot 2

Part number	Feature code	Description	Standard models where used
60Y0366	9280	IBM System x3690 X5 PCI-Express (3x8) Riser Card*	All models except ARx

* Some IBM ordering systems refer to this option as the IBM PCIe x4 and x8 Adapter with 2 USB Ports

Note: Full-length adapters cannot be installed in any slots if the memory mezzanine is also installed. Instead, adapters up to 3/4 length are supported.

Network adapters

The x3690 X5 offers two integrated Gigabit Ethernet ports, based on the Broadcom BCM5709C controller. The following table lists additional supported network adapters.

Table 13. Network adapters

Part number	Feature code	Description	Maximum supported
40 Gb Ethernet			
00D9550	A3PN	Mellanox ConnectX-3 FDR VPI IB/E Adapter for IBM System x	4
10 Gb Ethernet			
49Y7910	A18Y	Broadcom NetXtreme II Dual Port 10GBaseT Adapter for IBM System x	4
42C1820	1637	Brocade 10Gb CNA for IBM System x	4
None	A148	Emulex 10GbE Integrated Virtual Fabric Adapter II for IBM System x	1
49Y7950	A18Z	Emulex 10GbE Virtual Fabric Adapter II for IBM System x	3*
49Y4274	5715	Emulex VFA II FCoE/iSCSI License for IBM System x (Features on Demand upgrade for 49Y7950)	3*
95Y3751	A348	Emulex Dual Port VFAII Adapter & FCoE/iSCSI License for IBM System x	3*
49Y7960	A2EC	Intel X520 Dual Port 10GbE SFP+ Adapter for IBM System x	3
49Y7970	A2ED	Intel X540-T2 Dual Port 10GBaseT Adapter for IBM System x	3
81Y9990	A1M4	Mellanox ConnectX-2 Dual Port 10GbE Adapter for IBM System x	4
00D9690	A3PM	Mellanox ConnectX-3 10GbE Adapter for IBM System x	4
42C1800	5751	QLogic 10Gb CNA for IBM System x	4
1 Gb Ethernet			
90Y9370	A2V4	Broadcom NetXtreme I Dual Port GbE Adapter for IBM System x	4
90Y9352	A2V3	Broadcom NetXtreme I Quad Port GbE Adapter for IBM System x	4
49Y4230	5767	Intel Ethernet Dual Port Server Adapter I340-T2 for IBM System x	4
49Y4240	5768	Intel Ethernet Quad Port Server Adapter I340-T4 for IBM System x	4
42C1780	2995	NetXtreme II 1000 Express Dual Port Ethernet Adapter	4
None	1485	NetXtreme II 1000 Express G Ethernet Adapter- PCIe	4
49Y4220	5766	NetXtreme II 1000 Express Quad Port Ethernet Adapter	4
42C1750	2975	PRO/1000 PF Server Adapter	3
InfiniBand			
95Y3750	A2MY	Mellanox ConnectX-2 Dual-port QSFP QDR IB Adapter for IBM System x	1
00D9550	A3PN	Mellanox ConnectX-3 FDR VPI IB/E Adapter for IBM System x	4

* Maximum of 3 if Emulex 10GbE Integrated Virtual Fabric Adapter II for IBM System x (FC A148) is not installed, otherwise maximum of 2

For more information, see the list of IBM Redbooks Product Guides in the Networking adapters category: <http://www.redbooks.ibm.com/portals/systemx?Open&page=pg&cat=networkadapters>

Storage host bus adapters

The following table lists storage HBAs supported by x3690 X5 server.

Table 14. Storage adapters

Part number	Feature code	Description	Maximum supported
16 Gb Fibre Channel HBAs			
81Y1675	A2XV	Brocade 16Gb FC Dual-port HBA for IBM System x	4
81Y1668	A2XU	Brocade 16Gb FC Single-port HBA for IBM System x	4
81Y1662	A2W6	Emulex 16Gb FC Dual-port HBA for IBM System x	4
81Y1655	A2W5	Emulex 16Gb FC Single-port HBA for IBM System x	4
00Y3337	A3KW	QLogic 16Gb FC Single-port HBA for IBM System x	4
00Y3341	A3KX	QLogic 16Gb FC Dual-port HBA for IBM System x	4
8 Gb Fibre Channel HBAs			
46M6050	3591	Brocade 8Gb FC Dual-port HBA for IBM System x	4
46M6049	3589	Brocade 8Gb FC Single-port HBA for IBM System x	4
42D0494	3581	Emulex 8Gb FC Dual-port HBA for IBM System x	4
42D0485	3580	Emulex 8Gb FC Single-port HBA for IBM System x	4
42D0510	3579	QLogic 8Gb FC Dual-port HBA for IBM System x	4
42D0501	3578	QLogic 8Gb FC Single-port HBA for IBM System x	4
4 Gb Fibre Channel HBAs			
59Y1993	3886	Brocade 4Gb FC Dual-port HBA for IBM System x	4
59Y1987	3885	Brocade 4Gb FC Single-port HBA for IBM System x	4
42C2071	1699	Emulex 4Gb FC Dual-Port PCI-E HBA for IBM System x	4
42C2069	1698	Emulex 4Gb FC Single-Port PCI-E HBA for IBM System x	4
39R6527	3568	QLogic 4Gb FC Dual-Port PCIe HBA for System x	4
39R6525	3567	QLogic 4Gb FC Single-Port PCIe HBA for System x	4
SAS HBAs			
46M0907	5982	IBM 6Gb SAS HBA	4

For more information, see the list of IBM Redbooks Product Guides in the Host bus adapters category:
<http://www.redbooks.ibm.com/portals/systemx?Open&page=pg&cat=hba>

PCIe SSD adapters

The server supports the High IOPS SSD adapters listed in the following table.

Table 15. High IOPS SSD adapters

Part number	Feature code	Description	Maximum supported
46C9078	A3J3	IBM 365GB High IOPS MLC Mono Adapter	4
46C9081	A3J4	IBM 785GB High IOPS MLC Mono Adapter	4
46M0877	0096	IBM 160GB High IOPS SS Class SSD PCIe Adapter	4
46M0878	0097	IBM 320GB High IOPS SD Class SSD PCIe Adapter	2
46M0898	1649	IBM 320GB High IOPS MS Class SSD PCIe Adapter	4
90Y4377	A3DY	IBM 1.2TB High IOPS MLC Mono Adapter	4
90Y4397	A3DZ	IBM 2.4TB High IOPS MLC Duo Adapter	2

For more information, see the list of IBM Redbooks Product Guides in the Internal Storage category: <http://www.redbooks.ibm.com/portals/systemx?Open&page=pg&cat=internalstorage>

Power supplies

The x3690 X5 power subsystem consists of up to four hot-pluggable 675W auto-sensing power supplies. The modules are independently powered by AC line cords. Most standard models have one or two power supplies as standard; workload-optimized models have all four standard. An AC power supply ships standard with one 2.8 m C13 - C14 power cord.

One power supply is sufficient when the total power budget is less than 675W. Use the IBM System x and BladeCenter® Power Configurator to determine the power requirements of your configuration. The Power Configurator is available at <http://www.ibm.com/systems/bladecenter/resources/powerconfig.html>

For power budgets under 675W, installing a second power supply provides redundancy. To install a second power supply, use the IBM High Efficiency 675W Power Supply, part number 60Y0332. Installing four power supplies ensures redundancy even with a fully loaded server. To install the third and fourth power supplies, use the IBM 675W Redundant Power Supply Kit, part number 60Y0327. The power subsystem is designed for N+N operation and hot-swap exchange. Having four power supplies installed allows for N+N redundancy, where N=2 (that is, a total of four power supplies where two are redundant backups for the other two). The following table lists the part numbers.

The MAX5 V1 has one power supply standard and a second optional power supply for redundancy. See the MAX5 section for details. The MAX5 V2 has two power supplies installed. No further power supplies are needed or available.

Table 16. Power supplies

Part number	Feature code	Description	Maximum supported
60Y0332	4782	IBM High Efficiency 675W Power Supply Use for x3690 X5 power supply 2 and MAX5 V1	1 (x3690 X5) 1 (MAX5 V1)
60Y0327	9279	IBM 675W Redundant Power Supply Kit Use for power supplies 3 and 4.	1

Integrated virtualization

The server supports VMware ESXi installed on a USB memory key. The key is installed in a USB socket inside the server on a riser card. The following table lists the virtualization options.

Note: The IBM System x3690 X5 PCI-Express (3x8) Riser Card, part number 60Y0366, is required.

Table 17. Virtualization options

Part number	Feature code	Description	Maximum supported
41Y8298	A2G0	IBM Blank USB Memory Key for VMware ESXi Downloads	1
41Y8296	A1NP	IBM USB Memory Key for VMware ESXi 4.1 Update 1	1
41Y8300	A2VC	IBM USB Memory Key for VMWare ESXi 5.0	1
41Y8307	A383	IBM USB Memory Key for VMware ESXi 5.0 Update1	1
41Y8311	A2R3	IBM USB Memory Key for VMWare ESXi 5.1	1

Remote management

The server contains IBM Integrated Management Module (IMM), which provides advanced service-processor control, monitoring, and an alerting function. If an environmental condition exceeds a threshold or if a system component fails, the IMM lights LEDs to help you diagnose the problem, records the error in the event log, and alerts you to the problem. The IMM also provides a virtual presence capability for remote server management capabilities.

The IMM provides remote server management through industry-standard interfaces:

- Intelligent Platform Management Interface (IPMI) Version 2.0
- Simple Network Management Protocol (SNMP) Version 3
- Common Information Model (CIM)
- Web browser

The server also supports virtual media and remote control features which provide the following functions:

- Remotely viewing video with graphics resolutions up to 1600x1200 at 75 Hz, regardless of the system state
- Remotely accessing the server using the keyboard and mouse from a remote client
- Mapping the CD or DVD drive, diskette drive, and USB flash drive on a remote client, and mapping ISO and diskette image files as virtual drives that are available for use by the server
- Uploading a diskette image to the IMM memory and mapping it to the server as a virtual drive
- Capture blue-screen errors

Supported operating systems

The server supports the following operating systems:

- Microsoft Windows Server 2008 R2
- Microsoft Windows Server 2008, Datacenter x64 Edition
- Microsoft Windows Server 2008, Enterprise x64 Edition
- Microsoft Windows Server 2008, Standard x64 Edition

- Microsoft Windows Server 2008, Web x64 Edition
- Microsoft Windows Server 2012
- Red Hat Enterprise Linux 5 Server with Xen x64 Edition
- Red Hat Enterprise Linux 5 Server x64 Edition
- Red Hat Enterprise Linux 6 Server x64 Edition
- SUSE LINUX Enterprise Server 10 for AMD64/EM64T
- SUSE LINUX Enterprise Server 10 with Xen for AMD64/EM64T
- SUSE LINUX Enterprise Server 11 for AMD64/EM64T
- SUSE LINUX Enterprise Server 11 with Xen for AMD64/EM64T
- VMware ESX 4.1
- VMware ESXi 4.1
- VMware vSphere 5
- VMware vSphere 5.1

See the IBM ServerProven® website for the latest information about the specific versions and service levels supported and any other prerequisites:

<http://www.ibm.com/systems/info/x86servers/serverproven/compat/us/nos/matrix.shtml>

Physical and electrical specifications

Dimensions:

- Height: 86 mm (3.5 inches, 2U)
- Depth: 698 mm (27.4 inches)
- Width: 429 mm (16.8 inches)

Maximum weight: 31.3 kg (69 lb) when fully configured

Electrical:

- 100 to 127 (nominal) V ac; 50 Hz or 60 Hz; System 20A (10A/PS)
- 200 to 208 (nominal) V ac; 50 Hz or 60 Hz; System 10A
- 200 to 240 (nominal) V ac; 50 Hz or 60 Hz; System 9A
 - Minimum configuration: 0.20 kVA (one power supply)
 - Minimum configuration: 0.26 kVA (two power supplies)
 - Typical configuration: 1.12 kVA (two power supplies)
 - Maximum configuration: 2.16 kVA (two power supplies)

BTU output:

- Ship configuration (1 power supply): 648 BTU/hr (190 watts)
- Ship configuration (2 power supplies): 802 BTU/hr (235 watts)
- Typical configuration: 3,753 BTU/hr (1100 watts)
- Full configuration (chassis/MAX5): 5115 BTU/hr (1498 watts)

Noise level: 6.3 bels

Note: The noise emission level stated is the declared (upper limit) sound power level, in bels, for a random sample of machines. All measurements are made in accordance with ISO 7779 and reported in conformance with ISO 9296.

Warranty options

The IBM System x3690 X5 has a 3-year onsite warranty with 9x5/next business day terms. IBM offers the warranty service upgrades through IBM ServicePac®, discussed in this section. The IBM ServicePac is a series of prepackaged warranty maintenance upgrades and post-warranty maintenance agreements with a well-defined scope of services, including service hours, response time, term of service, and service agreement terms and conditions.

IBM ServicePac offerings are country-specific, that is, each country might have its own service types, service levels, response times, and terms and conditions. Not all covered types of ServicePacs might be available in a particular country. For more information about IBM ServicePac offerings available in your country visit the IBM ServicePac Product Selector at <https://www-304.ibm.com/sales/gss/download/spst/servicepac>.

The following table explains warranty service definitions in more detail.

Table 18. Warranty service definitions

Term	Description
IBM onsite repair (IOR)	A service technician will come to the server's location for equipment repair.
24x7x2 hour	A service technician is scheduled to arrive at your customer's location within two hours after remote problem determination is completed. We provide service around the clock, every day, including IBM holidays.
24x7x4 hour	A service technician is scheduled to arrive at your customer's location within four hours after remote problem determination is completed. We provide service around the clock, every day, including IBM holidays.
9x5x4 hour	A service technician is scheduled to arrive at your customer's location within four business hours after remote problem determination is completed. We provide service from 8:00 a.m. to 5:00 p.m. in the customer's local time zone, Monday through Friday, excluding IBM holidays. If after 1:00 p.m. it is determined that onsite service is required, the customer can expect the service technician to arrive the morning of the following business day. For noncritical service requests, a service technician will arrive by the end of the following business day.
9x5 next business day	A service technician is scheduled to arrive at your customer's location on the business day after we receive your call, following remote problem determination. We provide service from 8:00 a.m. to 5:00 p.m. in the customer's local time zone, Monday through Friday, excluding IBM holidays.

In general, the types of IBM ServicePacs are as follows:

- Warranty and maintenance service upgrades
 - One, 2, 3, 4, or 5 years of 9x5 or 24x7 service coverage
 - Onsite repair from next business day to 4 or 2 hours
 - One or 2 years of warranty extension
- Remote technical support services
 - One or three years with 24x7 coverage (severity 1) or 9x5/next business day for all severities
 - Installation and startup support for System x servers
 - Remote technical support for System x servers
 - Software support - Support Line
 - Microsoft or Linux software
 - VMware
 - IBM Systems Director

Regulatory compliance

The server conforms to the following international standards:

- FCC - Verified to comply with Part 15 of the FCC Rules, Class A
- Canada ICES-003, issue 4, Class A
- IEC/UL 60950-1, 2nd Edition
- CAN/CSA - C22.2 No. 60950-1-07 2nd Edition
- NOM-019
- Japan VCCI, Class A
- IEC-60950-1, 2nd edition (CB Certificate and CB Test Report)
- Australia and New Zealand C-Tick Mark CISPR 22, Class A
- Taiwan BSMI CNS13438, Class A and CNS14336
- China CCC (GB4943-2001), GB9254-2008 class A, GB17625.1-2003 (See note)
- Korea - MIC
- CE Mark (EN55022 Class A, EN60950, and EN55024)
- CISPR 22, Class A
- TUV-GS (EN60950-1:2001, 2nd edition)
- FCC - Verified to comply with Part 15 of the FCC Rules (Class A) prior to product delivery
- IEC-60950-1, 2nd edition (CB Certificate and CB Test Report)

External disk storage expansion

The external SAS disk storage expansion enclosures listed in the following table are available.

Table 19. External SAS storage expansion enclosures

Part number	Description	Maximum quantity supported per one M5025
172701X	IBM System Storage® EXP3000	18 (9 per port)
174712X	IBM System Storage EXP2512 Express	18 (9 per port)
174724X	IBM System Storage EXP2524 Express	9 (9 per port)

The hard disk drives listed in the following table are supported with external expansion enclosures.

Table 20. Hard drive options for external expansion enclosures

Part number	Description	Maximum quantity supported per one enclosure
SATA Hot-Swap HDDs		
-	IBM 500GB 7200 SATA 2.5" SFF Slim-HS HDD	1
43W7714	IBM 50GB SATA 2.5" SFF Slim-HS High IOPS SSD	16
SAS Hot-Swap HDDs		
42D0632	IBM 146GB 10K 6Gbps SAS 2.5" SFF Slim-HS HDD	16
42D0637	IBM 300GB 10K 6Gbps SAS 2.5" SFF Slim-HS HDD	16
42D0672	IBM 73GB 15K 6Gbps SAS 2.5" SFF Slim-HS HDD	16
42D0677	IBM 146GB 15K 6Gbps SAS 2.5" SFF Slim-HS HDD	16
42D0707	IBM 500GB 7200 6Gbps NL SAS 2.5" SFF Slim-HS HDD	16
44W2264	IBM 300GB 10K 6Gbps SAS 2.5" SFF Slim-HS SED	16
44W2294	IBM 146GB 15K 6Gbps SAS 2.5" SFF Slim-HS SED	16
49Y2003	IBM 600GB 10K 6Gbps SAS 2.5" SFF Slim-HS HDD	16

The RAID controllers listed in the following table are supported with external expansion enclosures.

Table 21. RAID controllers for external storage expansion enclosures

Part number	Feature code	Description	Maximum quantity supported
46M0830	0094	ServeRAID M5025 SAS/SATA Controller	4
46M0930	5106	ServeRAID M5000 Series Advance Feature Key†	1 per one M5025
81Y4426	A10C	ServeRAID M5000 Series Performance Accelerator Key†	1 per one M5025

† Only one key is supported in each controller, either the Advance Feature Key or the Performance Accelerator Key.

The ServeRAID M5025 SAS/SATA Controller has the following specifications:

- Two Mini-SAS external connectors
- Supports RAID levels 0, 1, 5, 10, and 50
- Supports RAID 6 and 60 with the optional M5000 Advanced Feature Key
- Performance optimization for SSD drives with optional M5000 Series Performance Accelerator Key
- 6 Gbps throughput per port
- PCI Express 2.0 x8 host interface
- Based on the LSI SAS2108 6 Gbps ROC controller
- 512 MB of onboard cache
- Intelligent Li-Ion-based battery backup unit with up to 48 hours of data retention
- Supports connectivity to the EXP3000, EXP2512, and EXP2524 storage expansion enclosures

For more information, see the *ServeRAID M5025 SAS/SATA Controller for IBM System x* Product Guide: <http://www.redbooks.ibm.com/abstracts/tips0739.html?Open>

The external SAS cables listed in the following table are supported with external expansion enclosures and M5025 RAID controllers.

Table 22. External SAS cables for external storage expansion enclosures

Part number	Description	Maximum quantity supported per enclosure*
39R6531	IBM 3 m SAS Cable	1
39R6529	IBM 1 m SAS Cable	1
2018	IBM 11U Office Enablement Kit	1

* Note: The EXP3000 and EXP2500 series can be chained with each other. In such a case, one cable is used to connect first EXP25xx or EXP3000 to the RAID controller, and every consecutive EXP unit is connected to previous one by one cable.

External disk storage systems

The following table lists the external storage systems that are supported by x3550 M4 and can be ordered through System x sales channel. The server may support other IBM disk systems that are not listed in this table. Refer to IBM System Storage Interoperability Center for further information, <http://www.ibm.com/systems/support/storage/ssic>.

Table 23. External disk storage systems

Part number	Description
1746A2D	IBM System Storage DS3512 Express Dual Controller Storage System
1746A2S	IBM System Storage DS3512 Express Single Controller Storage System
1746A4D	IBM System Storage DS3524 Express Dual Controller Storage System
1746A4S	IBM System Storage DS3524 Express Single Controller Storage System
181494H	IBM System Storage DS3950 Model 94
181498H	IBM System Storage DS3950 Model 98
181492H	IBM System Storage EXP395 Expansion Unit
1746A2E	IBM System Storage EXP3512 Express Storage™ Expansion Unit
1746A4E	IBM System Storage EXP3524 Express Storage Expansion Unit

For more information, see the list of IBM Redbooks Product Guides in the System Storage category: <http://www.redbooks.ibm.com/portals/systemx?Open&page=pg&cat=externalstorage>

External backup units

The server supports the external backup attachment options listed in the following table.

Table 24. External backup options (Part 1)

Part number	Description
External tape expansion enclosures for internal tape drives	
87651UX	1U Tape Drive Enclosure
8767HHX	Half High Tape Drive Enclosure
87651NX	1U Tape Drive Enclosure (with Nema 5-15P LineCord)
8767HNX	Half High Tape Drive Enclosure (with Nema 5-15P LineCord)
Tape enclosure adapters (with cables)	
44E8869	USB Enclosure Adapter Kit
40K2599	SAS Enclosure Adapter Kit
Internal backup drives supported by external tape enclosures	
46C5364	IBM RDX Removable Hard Disk Storage System - Internal USB 160 GB Bundle
46C5387	IBM RDX Removable Hard Disk Storage System - Internal USB 320 GB Bundle
46C5388	IBM RDX Removable Hard Disk Storage System - Internal USB 500 GB Bundle
46C5399	IBM DDS Generation 5 USB Tape Drive
39M5636	IBM DDS Generation 6 USB Tape Drive
43W8478	IBM Half High LTO Gen 3 SAS Tape Drive
44E8895	IBM Half High LTO Gen 4 SAS Tape Drive
49Y9898	IBM Half High LTO Gen 5 Internal SAS Tape Drive
00D8924	IBM Half High LTO Ultrium Gen 6 Internal SAS Tape Drive

Table 24. External tape options (Part 2)

Part number	Description
External backup units*	
362516X	IBM RDX Removable Hard Disk Storage System - External USB 160 GB Bundle
362532X	IBM RDX Removable Hard Disk Storage System - External USB 320 GB Bundle
362550X	IBM RDX Removable Hard Disk Storage System - External USB 500 GB Bundle
3628L3X	IBM Half High LTO Gen 3 External SAS Tape Drive (with US line cord)
3628L4X	IBM Half High LTO Gen 4 External SAS Tape Drive (with US line cord)
3628L5X	IBM Half High LTO Gen 5 External SAS Tape Drive (with US line cord)
3628N3X	IBM Half High LTO Gen 3 External SAS Tape Drive (without line cord)
3628N4X	IBM Half High LTO Gen 4 External SAS Tape Drive (without line cord)
3628N5X	IBM Half High LTO Gen 5 External SAS Tape Drive (without line cord)
3580S3V	System Storage TS2230 Tape Drive Express Model H3V
3580S4V	System Storage TS2240 Tape Drive Express Model H4V
3580S5E	System Storage TS2250 Tape Drive Express Model H5S
3580S5X	System Storage TS2350 Tape Drive Express Model S53
3572S4R	TS2900 Tape Library with LTO4 HH SAS drive & rack mount kit
3572S5R	TS2900 Tape Library with LTO5 HH SAS drive & rack mount kit
35732UL	TS3100 Tape Library Model L2U Driveless
35734UL	TS3200 Tape Library Model L4U Driveless
46X2682†	LTO Ultrium 5 Fibre Channel Drive
46X2683†	LTO Ultrium 5 SAS Drive Sled
46X2684†	LTO Ultrium 5 Half High Fibre Drive Sled
46X2685†	LTO Ultrium 5 Half High SAS Drive Sled
46X6912†	LTO Ultrium 4 Half High Fibre Channel Drive Sled
46X7117†	LTO Ultrium 4 Half High SAS DriveV2 Sled
46X7122†	LTO Ultrium 3 Half High SAS DriveV2 Sled

* Note: The external tape drives listed can be ordered through System x sales channel. Server may support other IBM tape drives that are not listed in this table. Refer to IBM System Storage Interoperability Center for further information.

† Note: These part numbers are the tape drives options for 35732UL and 35734UL.

For more information, see the list of IBM Redbooks Product Guides in the Backup units category:
<http://www.redbooks.ibm.com/portals/systemx?Open&page=pg&cat=tape>

Top-of-rack Ethernet switches

The server supports the top-of-rack Ethernet switches from IBM System Networking listed in the following table.

Table 25. IBM System Networking - Top-of-rack switches

Part number	Description
IBM System Networking - 1 Gb top-of-rack switches	
0446013	IBM System Networking RackSwitch G8000R
7309CFC	IBM System Networking RackSwitch G8000F
7309CD8	IBM System Networking RackSwitch G8000DC
7309G52	IBM System Networking RackSwitch G8052R
730952F	IBM System Networking RackSwitch G8052F
427348E	IBM Ethernet Switch J48E
6630010	Juniper Networks EX2200 24 Port
6630011	Juniper Networks EX2200 24 Port with PoE
6630012	Juniper Networks EX2200 48 Port
6630013	Juniper Networks EX2200 48 Port with PoE
IBM System Networking - 10 Gb top-of-rack switches	
7309DRX	IBM System Networking RackSwitch G8264CS (Rear to Front)
7309DFX	IBM System Networking RackSwitch G8264CS (Front to Rear)
7309BD5	IBM System Networking RackSwitch G8124DC
7309BR6	IBM System Networking RackSwitch G8124ER
7309BF7	IBM System Networking RackSwitch G8124EF
7309G64	IBM System Networking RackSwitch G8264R
730964F	IBM System Networking RackSwitch G8264F
7309CR9	IBM System Networking RackSwitch G8264TR
7309CF9	IBM System Networking RackSwitch G8264TF
0719410	Juniper Networks EX4500 - Front to Back Airflow
0719420	Juniper Networks EX4500 - Back to Front Airflow
IBM System Networking - 40 Gb top-of-rack switches	
8036ARX	IBM System Networking RackSwitch G8316R
8036AFX	IBM System Networking RackSwitch G8316F

For more information, see the list of IBM Redbooks Product Guides in the Top-of-rack switches category: <http://www.redbooks.ibm.com/portals/systemx?Open&page=pg&cat=tor>

Uninterruptible power supply units

The server supports attachments to the uninterruptible power supply (UPS) units, listed in the following table.

Table 26. Uninterruptible power supply units

Part number	Description
21303RX	IBM UPS 7500XHV
21304RX	IBM UPS 10000XHV
24195KX	IBM UPS5000 HV
53956AX	IBM 6000VA LCD 4U Rack UPS (200V/208V)
53956KX	IBM 6000VA LCD 4U Rack UPS (230V)
53959KX	IBM 11000VA LCD 5U Rack UPS (200V/208V/230V)

For more information, see the list of IBM Redbooks Product Guides in the Power infrastructure category:
<http://www.redbooks.ibm.com/portals/systemx?Open&page=pg&cat=power>

Power distribution units

The server supports attachments to the power distribution units (PDUs), listed in the following table.

Table 27. Power distribution units

Part number	Description
Switched and Monitored PDUs	
46M4167	1U Switched and Monitored PDU 9 C19 / 3 C13 3 phased 30A fixed 4.3m L21-30P
46M4002	IBM 1U 9 C19/3 C13 Switched and Monitored DPI® PDU
46M4003	IBM 1U 9 C19/3 C13 Switched and Monitored 60A 3 Phase PDU
46M4004	IBM 1U 12 C13 Switched and Monitored DPI PDU
46M4005	IBM 1U 12 C13 Switched and Monitored 60A 3 Phase PDU
Enterprise	
39Y8923	IBM Enterprise C19 3 phase PDU (60a)
39Y8938	IBM Enterprise C19 3 phase PDU (60a)
39Y8939	DPI 30amp/250V Front-end PDU with NEMA L6-30P
39Y8940	DPI 60amp/250V Front-end PDU with IEC 309 2P+Gnd connector
39Y8941	IBM Enterprise C13 PDU
39Y8948	IBM Enterprise C19 PDU
71762MX	IBM Ultra Density Enterprise C19/C13 PDU+ Module
71762NX	IBM Ultra Density Enterprise C19/C13 PDU Module
71763MU	IBM Ultra Density Enterprise C19/C13 PDU+ 60A/208V/3ph
71763NU	IBM Ultra Density Enterprise C19/C13 PDU 60A/208V/3ph
Universal PDUs	
39M2816	IBM DPI C13 PDU+
39Y8905	DPI 100-127v PDU with Fixed Nema L5-15P line cord
39Y8951	DPI Universal Rack Power Distribution Unit with Nema L5-20P and L6-20P
OU Basic PDUs	
46M4116	IBM 0U 24 C13 Switched and Monitored 30A PDU
46M4134	IBM 0U 12 C19/12 C13 Switched and Monitored 50A 3 Phase PDU

For more information, see the list of IBM Redbooks Product Guides in the Power infrastructure category:
<http://www.redbooks.ibm.com/portals/systemx?Open&page=pg&cat=power>

Rack cabinets

The server supports the rack cabinets listed in the following table.

Table 28. Rack cabinets

Part number	Description
14102RX	IBM 25RU standard rack
14104RX	IBM 42U S2 standard rack
93072PX	IBM S2 25U Static Base Cabinet
93072RX	IBM 25U S2 standard rack
93074RX	NetBAY S2 42U Standard Rack Cabinet
93074XX	IBM 42U S2 expansion rack
93084EX	IBM 42U Enterprise Expansion Rack
93084PX	IBM 42U Enterprise Rack
99564RX	IBM S2 42U Dynamic Standard Rack Cabinet
99564XX	IBM S2 42U Dynamic Expansion Rack Cabinet
93604PX	42U Deep Dynamic Primary Cabinet
93604EX	42U Deep Dynamic Expansion Cabinet
93614PX	42U Deep Static Primary Cabinet
93614EX	42U Deep Static Expansion Cabinet
93624PX	47U Deep Static Primary Cabinet
93624EX	47U Deep Static Expansion Cabinet

For more information, see the list of IBM Redbooks Product Guides in the Rack cabinets and options category:

<http://www.redbooks.ibm.com/portals/systemx?Open&page=pg&cat=rack>

Rack options

The x3690 X5 is a 2U-high device (1U is one rack unit and is 1.75 inches). The MAX5 memory expansion unit is an additional 1U high unit. Both are designed to be installed in standard 19-inch racks. Three slide kits are available for use with the x3690 X5, as listed in the following table. Cable management arms are optional but useful because they help prevent cables from becoming tangled and causing server downtime. Available cable management arms are also listed.

Table 29. Rail kit options and cable management arms

Part number	Feature code	Description	Use
Rail kits			
69Y2345	4786	IBM System x3690 X5 Ball Bearing Slide Kit	Required if you plan to attach a MAX5 unit
None*	4178	Universal Slides Kit	Designed to fit telecommunications and short racks
None*	6457	Friction Slide	A low cost rail kit
Cable management arms			
69Y2346	6473	IBM CMA for Ball Bearing and Universal Slides	Use with 69Y2345
69Y2344	6474	IBM System x3690 X5 2U Cable Management Arm	Use with Universal Slides Kit
None*	6458	Friction CMA	Use with Friction Slide

* Available via special bid or CTO only

The server supports keyboards and mice, and rack console switches and conversion options, listed in the following table.

Table 30. Rack options

Part number	Description
Keyboard and mouse	
40K5372	IBM Keyboard w/ Integrated Pointing Device USB - US English 103P
40K9584	IBM Preferred Pro Keyboard USB - US English 103P
40K9200	IBM 2 Button Optical Wheel Mouse - Black - USB
Rack console switches	
172317X	1U 17in Flat Panel Console Kit
172319X	1U 19in Flat Panel Console Kit
17352GX	IBM Global 2x16 Console Mngr(GCM2)
1754D1X	IBM Global 2X2X16 Console Manager
1754D2X	IBM Global 4X2X32 Console Manager
-	3m Console Switch Cable (USB)
Conversion options	
43V6147	IBM Single Cable USB Conversion Option (UCO)
39M2895	IBM USB Conversion Option (UCO)
46M5382	IBM Serial Conversion Option (SCO)
46M5383	IBM Virtual Media Conversion Option Gen2 (VCO2)

For more information, see the list of IBM Redbooks Product Guides in the Rack cabinets and options category:

<http://www.redbooks.ibm.com/portals/systemx?Open&page=pg&cat=rack>

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Related publications and links

For more information, see the following resources:

- IBM Redpaper: Reliability, Availability, and Serviceability Features of the IBM eX5 Portfolio
<http://www.redbooks.ibm.com/abstracts/redp4864.html?Open>
- IBM Redpaper: IBM eX5 Portfolio Overview
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- IBM System x3690 X5 product page
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