

IBM BladeCenter HS23

IBM Redbooks Product Guide

The IBM® BladeCenter® HS23 is a next-generation two-socket blade server running the Intel® Xeon® processor E5-2600 product family. With its industry-leading RAS features, energy efficiency, outstanding performance, flexible and scalable I/O, and complete systems management, HS23 offers a robust platform optimized for your mission-critical applications. Standard 30 mm single-wide form-factor protects your investments by providing compatibility with the IBM BladeCenter H, E, S, and HT chassis.

Suggested use: versatile platform to run a broad range of workloads, including infrastructure, virtualization, and enterprise applications.

Figure 1 shows the HS23.



Figure 1. IBM BladeCenter HS23

Did you know?

IBM BladeCenter HS23 is the first BladeCenter server that offers four integrated LAN ports: dual-port Gigabit Ethernet and dual-port 10Gb Ethernet with IBM Virtual Fabric capability. With Emulex 10GbE Virtual Fabric Adapter II for HS23 CFFh expansion card, HS23 scales up to 14 virtual NICs (vNICs) per single-wide blade server for a total of 18 I/O ports with the choice of Ethernet, Fibre Channel, SAS, iSCSI, and FCoE connectivity.

Key features

The IBM BladeCenter HS23 gives you the networking capacity that you need to manage your data center. The new Virtual Fabric capable integrated 10 GbE offers extreme speed, and the HS23 is designed with highly scalable I/O to give you a total of up to four 10 Gb physical ports that can be divided into up to 14 virtual ports, as well as the ability to run multiple I/O protocols (FCoE/iSCSI). Sixteen DIMM slots supporting up to 256 GB of DDR3 memory allow you to fit more and larger virtual machines per blade. In addition, the HS23 is backward-compatible with all BladeCenter chassis, including the original BladeCenter E. (Some configurations might have restrictions. See Table 5 for compatibility details.)

Availability and serviceability

The BladeCenter HS23 provides many features to simplify serviceability and increase system uptime:

- Dual independent power and signal connectors to the BladeCenter chassis midplane provide fault tolerance to increase uptime.
- The HS23 offers memory mirroring and memory rank sparing for redundancy in the event of a non-correctable memory failure.
- Tool-less cover removal provides easy access to upgrades and serviceable parts, such as CPU, memory, and adapter cards.
- The server offers hot-swap drives supporting integrated RAID 1 redundancy for data protection and greater system uptime.
- The power source independent light path diagnostics panel and individual light path LEDs quickly lead the technician to failed (or failing) components. This simplifies servicing, speeds up problem resolution, and helps improve system availability.
- The Predictive Failure Analysis (PFA) detects when system components (processors, memory, and hard disk drives) operate outside of standard thresholds and generates pro-active alerts in advance of 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 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 speeds up troubleshooting tasks to reduce service time.
- Three-year customer replaceable unit and onsite limited warranty, next business day 9x 5. Optional service upgrades are available.

Scalability and performance

The BladeCenter HS23 offers numerous features to boost performance, improve scalability, and reduce costs:

- The Intel Xeon processor E5-2600 product family improves productivity by offering superior system performance with up to 8-core processors and up to 3.0 GHz core speeds depending on the CPU's number of cores, up to 20 MB of L3 cache, and QPI interconnect links of up to 8 GT/s.
- Up to two processors, 16 cores, and 32 threads maximize the concurrent execution of multi-threaded applications.
- Intelligent and adaptive system performance with Intel Turbo Boost Technology 2.0 allows CPU cores to run at maximum speeds during peak workloads by temporarily going beyond processor TDP.

- Intel Hyper-Threading Technology boosts performance for multi-threaded applications by enabling simultaneous multi-threading within each processor core, up to two threads per core.
- Intel Virtualization Technology integrates hardware-level virtualization hooks that allow operating system vendors to better utilize the hardware for virtualization workloads.
- Intel Advanced Vector Extensions (AVX) significantly improve floating point performance for compute-intensive technical and scientific applications compared with Intel Xeon 5600 series processors.
- Up to 16 DDR3 ECC memory RDIMMs provide speeds up to 1600 MHz and a memory capacity of up to 256 GB. (See Table 7 for details.)
- The theoretical maximum memory bandwidth of the Intel Xeon processor E5 family is 51.6 GBps, which is 60% more than in the previous generation of Intel Xeon processors.
- 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.
- The HS23 scales to 18 I/O ports on a single-wide blade with integrated Gigabit Ethernet and 10 Gb Ethernet ports and optional expansion cards, offering the choice of Ethernet, Fibre Channel, SAS, iSCSI, and FCoE connectivity.
- The HS23 offers PCI Express 3.0 I/O expansion capabilities that improve the theoretical maximum bandwidth by 60% (8 GT/s per link), compared with the previous generation of PCI Express 2.0.
- With Intel Integrated I/O Technology, the PCI Express 3.0 controller is integrated into the Intel Xeon processor E5 family. This helps to dramatically reduce I/O latency and increase overall system performance.

Manageability and security

Powerful systems management features simplify local and remote management of the HS23:

- The HS23 includes an Integrated Management Module II (IMM2) 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.
- Industry-standard AES NI support for faster, stronger encryption.
- IBM Systems Director is included for proactive systems management. It offers comprehensive systems management tools that help to increase up-time, reduce costs, and improve productivity through advanced server management capabilities.
- Open Fabric Manager simplifies deployment of infrastructure connections by managing network and storage address assignments.
- IBM FastSetup simplifies, automates, and speeds up the deployment process from server power-up to production, making BladeCenter easier to manage, deploy, and maintain.
- Intel Execute Disable Bit functionality can help prevent certain classes of malicious buffer overflow attacks when combined with a supporting operating system.
- Intel Trusted Execution Technology provides enhanced security through hardware-based resistance to malicious software attacks, allowing an application to run in its own isolated space protected from all other software running on a system.

Energy efficiency

The HS23 offers the following energy-efficiency features to save energy, reduce operational costs, increase energy availability, and contribute to the green environment:

- Component-sharing design of the BladeCenter chassis provides ultimate power and cooling savings.
- The 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.
- Intel Intelligent Power Capability powers individual processor elements on and off as needed, to reduce power draw.
- Low-voltage Intel Xeon processors draw less energy to satisfy demands of power and thermally constrained data centers and telecommunication environments.
- Low-voltage 1.35 V DDR3 memory RDIMMs consume 15% less energy than 1.5 V DDR3 RDIMMs.
- Solid state drives (SSDs) consume as much as 80% less power than traditional spinning 2.5-inch HDDs.
- The HS23 uses hexagonal ventilation holes, 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 power management features with actual real-time energy monitoring, reporting, and capping features.

Locations of key components and connectors

Figure 2 shows the front view of the server, indicating key components.

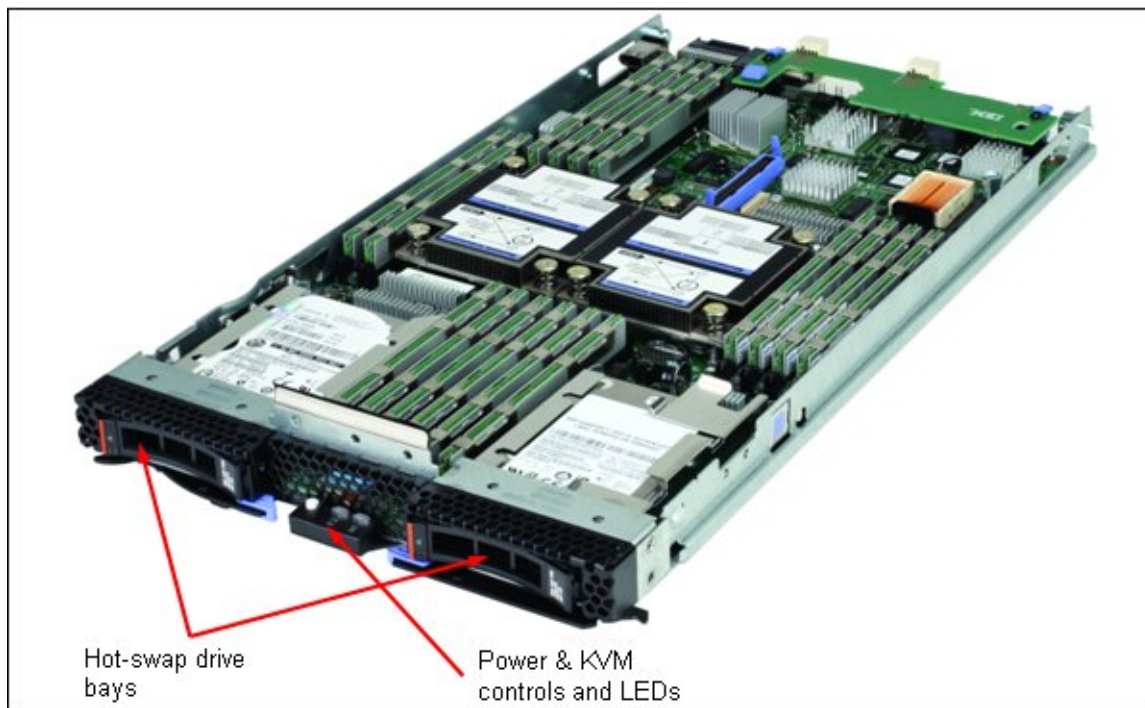


Figure 2. Front view of the IBM BladeCenter HS23

Figure 3 shows the top view of the server, indicating key components.

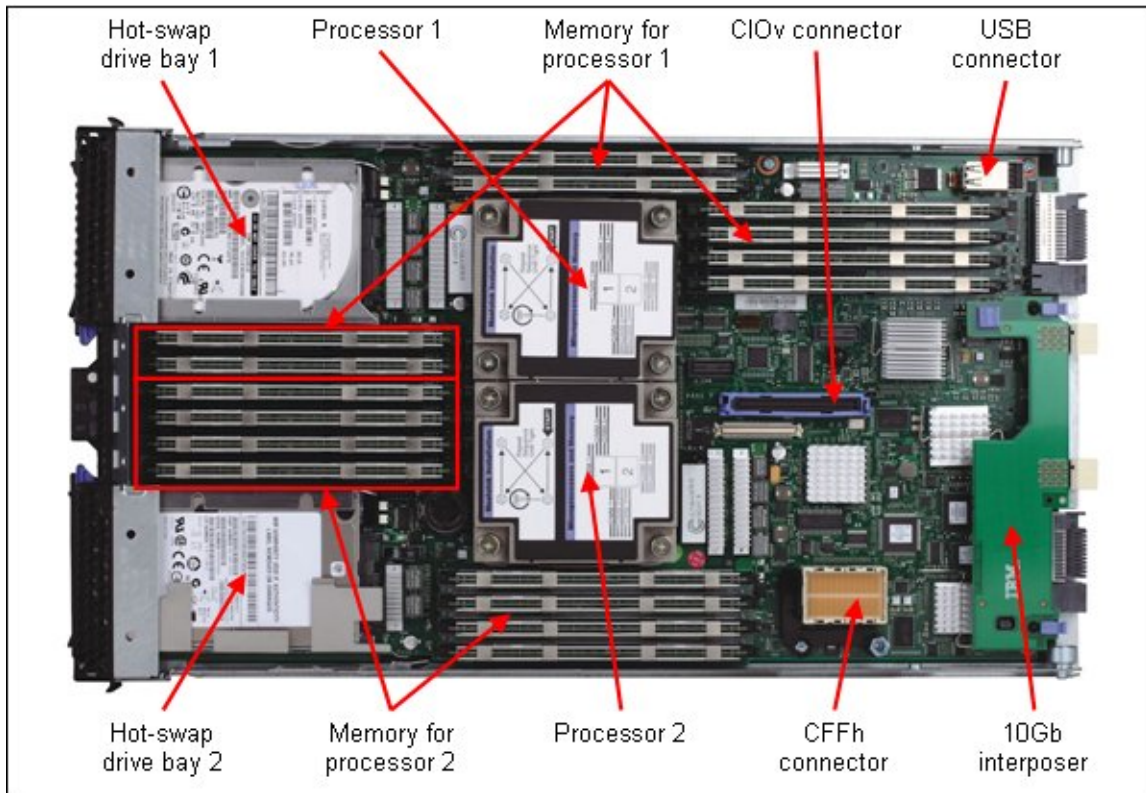


Figure 3. Top view of the IBM BladeCenter HS23

Figure 4 shows the bottom view of the IBM BladeCenter HS23 (contains light path diagnostics panel).

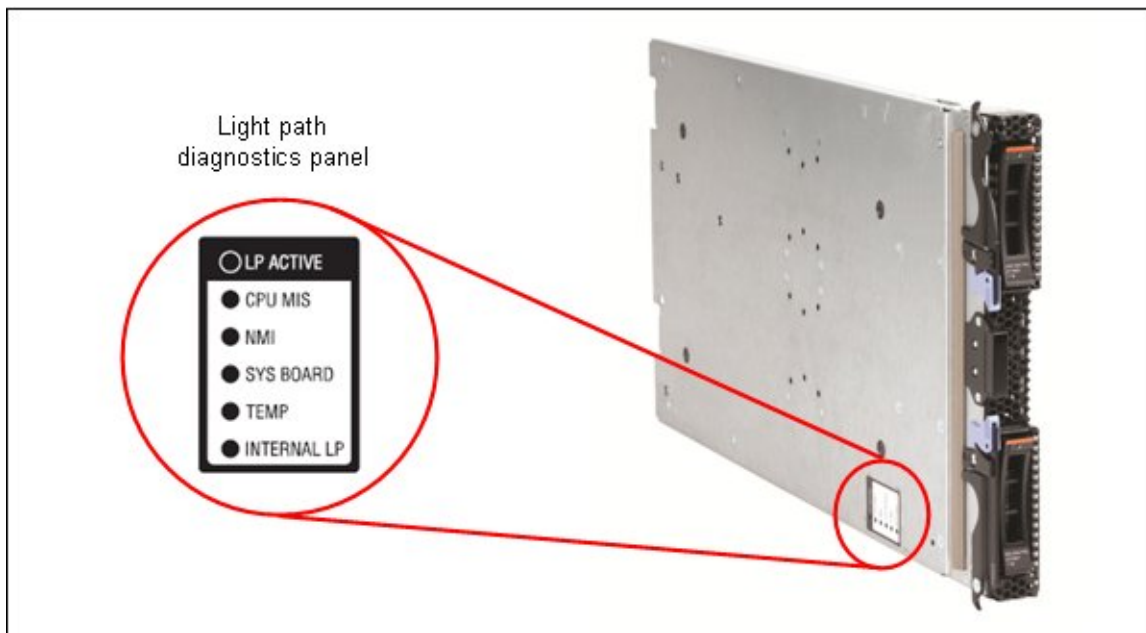


Figure 4. Bottom view of the IBM BladeCenter HS23 (shows light path diagnostics panel)

Standard specifications

Table 1 lists the standard specifications.

Table 1. Standard specifications (part 1)

| Components | Specifications |
|--------------------------|---|
| Form factor | Single-wide (30 mm) blade server. |
| Chassis support | BladeCenter H, BladeCenter HT, BladeCenter S, BladeCenter E. (Some configurations might have restrictions. See Table 5 for compatibility details.) |
| Processor | Up to two Intel Xeon processor E5-2600 product family CPUs with eight-core (up to 2.7 GHz) or six-core (up to 2.9 GHz) or quad-core (up to 2.4 GHz) or dual-core (up to 3.0 GHz). Two QPI links up to 8.0 GT/s each. Up to 1600 MHz memory speed. Up to 20 MB L3 cache. |
| Chipset | Intel C600. |
| Memory | Up to 16 DDR3 DIMM sockets (8 DIMMs per processor) using Very Low Profile (VLP) DIMMs. Support for up to 1600 MHz memory speed depending on the processor. Four memory channels per processor (2 DIMMs per channel). |
| Memory maximums | Up to 256 GB with 16x 16 GB RDIMMs and two processors. |
| Memory protection | ECC, memory mirroring, and memory sparing. |
| Disk drive bays | Two 2.5" hot-swap SAS/SATA drive bays supporting SAS, SATA, and SSD drives. |
| Maximum internal storage | Up to 1.8 TB with 900 GB 2.5" SAS HDDs, or up to 2 TB with 1 TB 2.5" NL SAS HDDs, or up to 2 TB with 1 TB 2.5" SATA HDDs, or up to 512 GB with 256 GB 2.5" SATA SSDs. Intermix of SAS and SATA HDDs and SSDs is supported. |
| RAID support | RAID 0, 1, 1E, and 10 with integrated LSI SAS2004 controller. |
| Network interfaces | Two Gigabit Ethernet ports and two 10 Gb Ethernet ports with integrated Emulex BladeEngine 3 (BE3) controller. |
| PCI Expansion slots | One CIOv slot (PCIe 3.0 x8) and one CFFh slot (PCIe 3.0 x16). Two additional PCIe 2.0 x8 standard form factor slots (slot 1 is full-height full-length, slot 2 is full-height half-length) with the optional PCI Express Gen 2 Expansion Blade II. One HS23 supports up to four PCIe expansion blades (8 slots). Up to four optional GPU expansion blades with either NVIDIA Tesla M2090, M2075, or M2070Q graphics processing units. |
| Ports | One internal USB port (for embedded hypervisor). |
| Hot-swap components | Hard drives. |
| Systems management | UEFI, IBM Integrated Management Module II (IMM2) with Renesas SH7757 controller, Predictive Failure Analysis, light path diagnostics, Automatic Server Restart, IBM Systems Director, and IBM Systems Director Active Energy Manager, IBM ServerGuide. |
| Security features | Power-on password, administrator's password, Trusted Platform Module (TPM 1.2). |

Table 1. Standard specifications (part 2)

| Components | Specification |
|-----------------------------|---|
| Video | Matrox G200eR2 video core with 16 MB video memory integrated into the IMM2. Maximum resolution is 1600x1200 at 75 Hz with 16 M colors (32 bits per pixel). |
| Operating systems supported | Microsoft Windows Server 2008 R2 and 2008, Red Hat Enterprise Linux 5 and 6 (x64), SUSE Linux Enterprise Server 10 and 11 (for AMD64/EM64T), VMware vSphere 5. |
| Limited warranty | 3-year customer-replaceable unit and onsite limited warranty with 9x5/next business day response time. |
| Service and support | Optional service upgrades are available through IBM ServicePacs®: 4-hour or 2-hour response time, 8-hour fix time, 1-year or 2-year warranty extension, remote technical support for IBM hardware and selected IBM and third-party (Microsoft, Linux, VMware) software. |
| Dimensions | Height: 245 mm (9.7 in), width: 29 mm (1.14 in), depth: 446 mm (17.6 in). |
| Weight | Maximum configuration (single-wide blade): 5.4 kg (12 lb). |

The IBM BladeCenter HS23 servers are shipped with the following items:

- Documentation CD
- Registration Flyer
- Statement of Limited Warranty
- Important Notices
- Technical Note Flyer

Standard models

Table 2 lists standard models.

Table 2. Standard models (part 1)

| Model* | Intel Xeon processor** (2 max) | Memory (std / max) | RAID controller | Drive bays (used / max) | Disk drives | Standard Ethernet | I/O slots (used / max) |
|----------|--|---------------------|------------------------|-------------------------|-------------|-------------------|------------------------|
| 7875-A1x | 1x Xeon E5-2603 4C 1.8GHz 10MB 1066MHz 80 W | 1x 4 GB / 256 GB | Integrated SAS/SATA | 0 / 2 | Optional | 2x 1Gb# | 0 / 2 |
| 7875-A2x | 1x Xeon E5-2609 4C 2.4GHz 10MB 1066MHz 80 W | 4x 4 GB / 256 GB | Integrated SAS/SATA | 0 / 2 | Optional | 2x 1Gb# | 0 / 2 |
| 7875-B1x | 1x Xeon E5-2620 6C 2.0GHz 15MB 1333MHz 95W | 4x 4 GB / 256 GB | Integrated SAS/SATA | 0 / 2 | Optional | 2x 1Gb 2x 10Gb | 0 / 2 |
| 7875-B2x | 1x Xeon E5-2640 6C 2.5GHz 15MB 1333MHz 95W | 4x 4 GB / 256 GB | Integrated SAS/SATA | 0 / 2 | Optional | 2x 1Gb 2x 10Gb | 0 / 2 |
| 7875-B3x | 1x Xeon E5-2630 6C 2.3GHz 15MB 1333MHz 95W | 4x 4 GB / 256 GB | Integrated SAS/SATA | 0 / 2 | Optional | 2x 1Gb 2x 10Gb | 0 / 2 |
| 7875-C1x | 1x Xeon E5-2650 8C 2.0GHz 20MB 1600MHz 95W | 4x 4 GB / 256 GB | Integrated SAS/SATA | 0 / 2 | Optional | 2x 1Gb 2x 10Gb | 0 / 2 |
| 7875-C2x | 1x Xeon E5-2660 8C 2.2GHz 20MB 1600MHz 95W | 4x 4 GB / 256 GB | Integrated SAS/SATA | 0 / 2 | Optional | 2x 1Gb 2x 10Gb | 0 / 2 |

Table 2. Standard models (part 2)

| Model* | Intel Xeon processor** (2 max) | Memory (std / max) | RAID controller | Drive bays (used / max) | Disk drives | Standard Ethernet | I/O slots (used / max) |
|------------|--|-----------------------|------------------------|----------------------------------|----------------|----------------------|------------------------------|
| 7875-C3x | 1x Xeon E5-2665 8C 2.4GHz 20MB 1600MHz 115W | 4x 4 GB / 256 GB | Integrated SAS/SATA | 0 / 2 | Optional | 2x 1Gb 2x 10Gb | 0 / 2 |
| 7875-C4x | 1x Xeon E5-2670 8C 2.6GHz 20MB 1600MHz 115W | 4x 4 GB / 256 GB | Integrated SAS/SATA | 0 / 2 | Optional | 2x 1Gb 2x 10Gb | 0 / 2 |
| 7875-C5x | 1x Xeon E5-2680 8C 2.7GHz 20MB 1600MHz 130W | 4x 4 GB / 256 GB | Integrated SAS/SATA | 0 / 2 | Optional | 2x 1Gb 2x 10Gb | 0 / 2 |
| 7875-D1x | 1x Xeon E5-2650L 8C 1.8GHz 20MB 1600MHz 70W | 4x 4 GB / 256 GB | Integrated SAS/SATA | 0 / 2 | Optional | 2x 1Gb 2x 10Gb | 0 / 2 |
| 7875-F1x | 1x Xeon E5-2648L 8C 1.8GHz 20MB 1600MHz 70W | 4x 4GB / 256 GB | Integrated SAS/SATA | 0 / 2 | Optional | 2x 1Gb 2x 10Gb | 0 / 2 |
| 7875-G1x†§ | 1x Xeon E5-2630 6C 2.3GHz 15MB 1333MHz 95W | 4x 4GB / 256 GB | Integrated SAS/SATA | 0 / 2 | Optional | 2x 1Gb 4x 10Gb | 1 / 2 |
| 7875-G2x†§ | 1x Xeon E5-2670 8C 2.6GHz 20MB 1600MHz 115W | 4x 4 GB / 256 GB | Integrated SAS/SATA | 0 / 2 | Optional | 2x 1Gb 4x 10Gb | 1 / 2 |
| 7875-91x‡ | 2x Xeon E5-2620 6C 2.0GHz 15MB 1333MHz 95W | 16x 8GB / 256 GB | Integrated SAS/SATA | 0 / 2 | Optional | 2x 1Gb 2x 10Gb | 0 / 2 |
| 7875-92x‡ | 2x Xeon E5-2650 8C 2.0GHz 20MB 1600MHz 95W | 16x 8GB / 256 GB | Integrated SAS/SATA | 0 / 2 | Optional | 2x 1Gb 2x 10Gb | 0 / 2 |

* x in the Machine Type Model (MTM) represents a country-specific letter (for example, the EMEA MTM is 7875A1G, and the US MTM is 7875A1U). Ask your local IBM representative for specifics.

** Processor detail: Model, cores, core speed, L3 cache, memory speed, power.

Supports 10Gb with the addition of the 10 Gb Interposer Card for IBM BladeCenter HS23, 94Y8550.

† These models ship standard with Emulex 10GbE VFA Advanced II for IBM BladeCenter HS23, 90Y9332.

§ These models ship standard with IBM Virtual Fabric Advanced Software Upgrade (LOM), 90Y9310.

‡ These models ship standard with IBM USB Memory Key for VMWare ESXi 5.0, 41Y8300.

Express models

Table 3 lists Express models.

Table 3. Express models

| Model* | Intel Xeon processor** (2 max) | Memory (std / max) | RAID controller | Drive bays (used / max) | Disk drives | Standard Ethernet | I/O slots (used / max) |
|----------|--|-----------------------|------------------------|----------------------------------|----------------|----------------------|------------------------------|
| 7875-E1x | 2x Xeon E5-2620 6C 2.0GHz 15MB 1333MHz 95W | 8x 4 GB / 256 GB | Integrated SAS/SATA | 0 / 2 | Optional | 2x 1Gb 2x 10Gb | 0 / 2 |
| 7875-E2x | 2x Xeon E5-2630 6C 2.3GHz 15MB 1333MHz 95W | 8x 8 GB / 256 GB | Integrated SAS/SATA | 0 / 2 | Optional | 2x 1Gb 2x 10Gb | 0 / 2 |
| 7875-E3x | 2x Xeon E5-2670 8C 2.6GHz 20MB 1600MHz 115W | 8x 8 GB / 256 GB | Integrated SAS/SATA | 0 / 2 | Optional | 2x 1Gb 2x 10Gb | 0 / 2 |

* x in the MTM represents a country-specific letter (for example, the EMEA MTM is 86774TG, and the US MTM is 86774TU). Ask your local IBM representative for specifics.

** Processor detail: Model, cores, core speed, L3 cache, memory speed, power.

Chassis support

The HS23 is supported in the various BladeCenter chassis listed in Table 4.

Table 4. Chassis support

| Description | BC-E (8677) | BC-T | BC-S (8886) | BC-H (8852) | BC-HT AC (8750) | BC-HT DC (8740) |
|-----------------------------|--------------|------|-------------|--------------|-----------------|-----------------|
| HS23 with 115W or 130W CPUs | No | No | Full | Some limits* | Full | Full |
| HS23 with up to 95W CPUs | Some limits* | No | Full | Some limits* | Full | Full |

* See Table 5 for details.

The number of HS23 servers supported in each chassis depends on the thermal design power of the processors used in the servers (Table 5). Table 5 uses the following conventions:

- A green cell means that the chassis can be filled with HS23 blade servers up to the maximum number of blade bays in the chassis (for example, 14 blades in the BladeCenter H).
- A yellow cell means that the maximum number of HS23 blades that the chassis can hold is fewer than the total available blade bays (for example, 12 in a BladeCenter E). Other bays in the chassis *must* remain empty. Consult the BladeCenter Interoperability Guide for specific details:
<http://ibm.com/support/entry/portal/docdisplay?indocid=MIGR-5073016>

Note: The HS23 is not supported in the BladeCenter E with power supplies smaller than 2000 W.

Table 5. Chassis support (detailed)

| CPU TDP* | Maximum number of HS23 servers supported in each chassis | | | | | | | | | |
|---|--|-----------------------|----------------------|--|------------------|-------------------|-------------------|-----------------------|----------------------------|----------------------------|
| | BC-E with AMM (8677) (14 bays) | | BC-S (8886) (6 bays) | BC-H (models other than 4Tx) (14 bays) | | | | BC-H (-4Tx) (14 bays) | BC-HT AC§ (8750) (12 bays) | BC-HT DC§ (8740) (12 bays) |
| | 2000 W power supplies | 2320 W power supplies | | 2900W supplies | | 2980W supplies** | | | | |
| | | | Standard blowers | Enhanced blowers† | Standard blowers | Enhanced blowers† | Enhanced blowers† | | | |
| Intel Xeon processors | | | | | | | | | | |
| 130W | None‡ | None‡ | 6 | None‡ | 14 | None‡ | 14 | 14 | 12 | 12 |
| 115W | None‡ | None‡ | 6 | None‡ | 14 | None‡ | 14 | 14 | 12 | 12 |
| 95W | None‡ | None‡ | 6 | None‡ | 14 | None‡ | 14 | 14 | 12 | 12 |
| 80W | 6+7 | 14 | 6 | 14 | 14 | 14 | 14 | 14 | 12 | 12 |
| 70W | None‡ | None‡ | 6 | None‡ | 14 | None‡ | 14 | 14 | 12 | 12 |
| 60W | None‡ | None‡ | 6 | None‡ | 14 | None‡ | 14 | 14 | 12 | 12 |
| Intel Xeon Embedded processors # | | | | | | | | | | |
| 95W | 5+7 | 14 | 6 | 14 | 14 | 14 | 14 | 14 | 12 | 12 |
| 70W | 14 | 14 | 6 | 14 | 14 | 14 | 14 | 14 | 12 | 12 |

* Thermal Design Power.

** IBM BladeCenter H 2980W AC Power Modules, 68Y6601 (standard in 4Tx, optional with all other BC-H models).

† IBM BladeCenter H Enhanced Cooling Modules, 68Y6650 (standard in 4Tx, optional with all other BC-H models).

‡ Not supported.

Intel Xeon E5-2648L (70 W) and E5-2658 (95 W) are embedded processors used in HS23.

§ Support shown is for non-NEBS environments.

Processor options

The HS23 supports the processor options listed in Table 6. The server supports one or two processors. Table 6 also shows which server models have each processor standard. If no corresponding *where used* model for a particular processor is listed, then this processor is available only through Configure to Order (CTO).

Table 6. Processor options

| Part number | Intel Xeon processor description | Models where used |
|-------------|--|-------------------|
| 81Y9292 | Intel Xeon Processor E5-2603 4C 1.8GHz 10MB 1066MHz 80 W | A1x |
| 81Y9294 | Intel Xeon Processor E5-2609 4C 2.4GHz 10MB 1066MHz 80 W | A2x |
| 81Y9295 | Intel Xeon Processor E5-2620 6C 2.0GHz 15MB 1333MHz 95W | B1x, 91x, E1x |
| 94Y8572 | Intel Xeon Processor E5-2630 6C 2.3GHz 15MB 1333MHz 95W | B3x, E2x, G1x |
| 81Y9304 | Intel Xeon Processor E5-2630L 6C 2.0GHz 15MB 1333MHz 60W | - |
| 94Y8570 | Intel Xeon Processor E5-2637 2C 3.0GHz 5MB 1600MHz 80W | - |
| 94Y8571 | Intel Xeon Processor E5-2640 6C 2.5GHz 15MB 1333MHz 95W | B2x |
| 94Y8562* | Intel Xeon Processor E5-2648L 8C 1.8GHz 20MB 1600MHz 70W | F1x |
| 81Y9298 | Intel Xeon Processor E5-2650 8C 2.0GHz 20MB 1600MHz 95W | C1x, 92x |
| 81Y9305 | Intel Xeon Processor E5-2650L 8C 1.8GHz 20MB 1600MHz 70W | D1xy |
| 94Y8565* | Intel Xeon Processor E5-2658 8C 2.1GHz 20MB 1600MHz 95W | - |
| 81Y9299 | Intel Xeon Processor E5-2660 8C 2.2GHz 20MB 1600MHz 95W | C2x |
| 94Y8671 | Intel Xeon Processor E5-2665 8C 2.4GHz 20MB 1600MHz 115W | C3x |
| 81Y9302 | Intel Xeon Processor E5-2667 6C 2.9GHz 15MB 1600MHz 130W | - |
| 94Y8589 | Intel Xeon Processor E5-2670 8C 2.6GHz 20MB 1600MHz 115W | C4x, E3x, G2x |
| 81Y9300 | Intel Xeon Processor E5-2680 8C 2.7GHz 20MB 1600MHz 130W | C5x |

* Note: Intel Xeon Embedded processors.

Memory options

IBM DDR3 memory is compatibility tested and tuned for optimal IBM System x® and BladeCenter 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 BladeCenter HS23 supports Very Low Profile (VLP) DDR3 memory RDIMMs. The server supports up to eight DIMMs when one processor is installed and up to 16 DIMMs when two processors are installed. Each processor has four memory channels, and there are two DIMMs per channel. The following rules apply when selecting the memory configuration:

- Mixing 1.5 V and 1.35 V DIMMs in the same server is supported. In such a case all DIMMs operate at 1.5 V.
- The maximum number of ranks supported per channel is eight.
- The maximum quantity of DIMMs that can be installed in the server depends on the number of CPUs, DIMM rank, and operating voltage, as shown in the "Max. qty supported" row in Table 7.
- All DIMMs in all CPU memory channels operate at the same speed, which is determined as the lowest value of:
 - Memory speed supported by specific CPU
 - Lowest maximum operating speed for the selected memory configuration that depends on rated speed, as shown under the "Max. operating speed" section in Table 7.

Table 7. Maximum memory speeds

| DIMM specification | DIMM type | | RDIMM | | | |
|-----------------------------------|-----------|-------|-------------|----------|-----------|----------|
| | | | Single rank | | Dual rank | |
| Rank | | | | | | |
| Rated speed | | | 1333 MHz | 1600 MHz | 1333 MHz | 1600 MHz |
| Rated voltage | | | 1.35 V | 1.5 V | 1.35 V | 1.5 V |
| Operating voltage | 1.35 V | 1.5 V | 1.5 V | 1.35 V | 1.5 V | 1.5 V |
| Max. qty supported* | 16 | 16 | 16 | 16 | 16 | 16 |
| Max. DIMM capacity | 4 GB | 4 GB | 4 GB | 16 GB | 16 GB | 8 GB |
| Max. memory capacity | 64 GB | 64 GB | 64 GB | 256 GB | 256 GB | 128 GB |
| Max. operating speed (MHz) | | | | | | |
| 1 DIMM per channel | 1333 | 1333 | 1600 | 1333 | 1333 | 1600 |
| 2 DIMMs per channel | 1333 | 1333 | 1600 | 1333 | 1333 | 1600 |

* The maximum quantity supported is shown for two processors installed. When one processor is installed the maximum quantity supported is a half of that shown.

The following memory protection technologies are supported:

- ECC
- Memory mirroring
- Memory sparing (rank sparing)

If memory mirroring is used, then DIMMs must be installed in pairs (minimum of one pair per CPU), and both DIMMs in a pair must be identical in type and size. The effective memory available to the system is only half of that installed.

If memory sparing (rank sparing) is used, then DIMMs population order is the same as that for independent channel mode (the DIMMs can be installed without matching sizes). In rank sparing mode, one rank of a DIMM in each populated channel is reserved as spare memory. The size of a rank varies depending on the DIMMs installed.

Tables 8 lists memory options available for the HS23 server. DIMMs can be installed one at a time, but for performance reasons, install them in sets of four (one for each of the four memory channels).

Table 8. Memory options for the HS23

| Part number | Description | Max qty supported | Models where used |
|-----------------------|---|-------------------|---|
| 1333 MHz DIMMs | | | |
| 46C0563 | 4 GB (1x 4 GB, 1Rx4, 1.35 V) PC3L-10600 CL9 ECC DDR3 1333 MHz VLP | 16 | - |
| 46C0564 | 4 GB (1x 4 GB, 2Rx8, 1.35 V) PC3L-10600 CL9 ECC DDR3 1333 MHz VLP | 16 | A1x, A2x, B1x, B2x, B3x, D1x, E1x, F1x, G1x |
| 46C0568 | 8 GB (1x 8 GB, 2Rx4, 1.35 V) PC3-10600 CL9 ECC DDR3 1333 MHz VLP | 16 | 91x, E2x |
| 46C0599 | 16 GB (1x 16 GB, 2Rx4, 1.35 V) PC3L-10600 CL9 ECC DDR3 1333 MHz VLP | 16 | - |
| 1600 MHz DIMMs | | | |
| 90Y3147 | 4 GB (2Gb, 1Rx4, 1.5 V) PC3-12800 CL11 ECC DDR3 1600 MHz VLP RDIMM | 16 | - |
| 90Y3148 | 4 GB (2Gb, 2Rx8, 1.5 V) PC3-12800 CL11 ECC DDR3 1600 MHz VLP RDIMM | 16 | C1x, C2x, C3x, C4x, C5x, G2x |
| 90Y3149 | 8 GB (2Gb, 2Rx4, 1.5 V) PC3-12800 CL11 ECC DDR3 1600 MHz VLP RDIMM | 16 | 92x, E3x |

Internal disk storage options

The HS23 server has two hot-swap drive bays accessible from the front of the blade server. These bays are connected to the integrated 4-port LSI SAS2004 6 Gbps SAS/SATA RAID-on-Chip (ROC) controller.

The integrated LSI SAS2004 ROC has the following features:

- Four-port controller with 6 Gbps throughput per port
- PCIe x4 Gen 2 host interface
- Two SAS ports routed internally to the two hot-swap drive bays
- Two ports can be routed externally to the chassis I/O bays 3 and 4 with SAS Connectivity Card (CIOv)
- Supports RAID levels 0 (Integrated Striping), 1 (Integrated Mirroring), 10 (Integrated Mirroring and Striping), and 1E (Integrated Mirroring Enhanced)
- Supports up to 14 drives (up to 12 integrated RAID drives and up to two hot-spare drives) for integrated RAID configurations
- Supports up to 10 integrated RAID drives per integrated volume
- Supports up to two integrated volumes
- Supports volumes greater than 2 TB for RAID 0, 10, and 1E

- Supports SAS and SATA HDDs and SSDs
- Supports connectivity to the EXP2500 series and EXP3000 storage expansion enclosures
- Support connectivity to the tape drives and external storage systems

Table 9 lists the hard drive options that are available for internal storage.

Table 9. Disk drive options for internal disk storage

| Part number | Description | Maximum quantity supported |
|--------------------|--|----------------------------|
| SAS HDDs | | |
| 90Y8926 | IBM 146GB 15K 6Gbps SAS 2.5" SFF G2HS HDD | 2 |
| 90Y8877 | IBM 300GB 10K 6Gbps SAS 2.5" SFF G2HS HDD | 2 |
| 81Y9670 | IBM 300GB 15K 6Gbps SAS 2.5" Slim-HS HDD | 2 |
| 90Y8872 | IBM 600GB 10K 6Gbps SAS 2.5" SFF G2HS HDD | 2 |
| 81Y9650 | IBM 900GB 10K 6Gbps SAS 2.5" Slim-HS HDD | 2 |
| NL SAS HDDs | | |
| 90Y8953 | IBM 500GB 7.2K 6Gbps NL SAS 2.5" SFF G2HS HDD | 2 |
| 81Y9690 | IBM 1TB 7.2K 6Gbps NL SAS 2.5" SFF Slim-HS HDD | 2 |
| SATA HDDs | | |
| 81Y9722 | IBM 250GB 7.2K 6Gbps SATA 2.5" SFF Slim-HS HDD | 2 |
| 81Y9726 | IBM 500GB 7.2K 6Gbps SATA 2.5" SFF Slim-HS HDD | 2 |
| 81Y9730 | IBM 1TB 7.2K 6Gbps SATA 2.5" SFF Slim-HS HDD | 2 |
| SATA SSDs | | |
| 43W7718 | IBM 200GB SATA 2.5" SFF Slim-HS SSD | 2 |
| 90Y8648 | IBM 128GB SATA 2.5" SFF HS SSD | 2 |
| 90Y8643 | IBM 256GB SATA 2.5" SFF HS SSD | 2 |

Internal tape drives

The server does not support an internal tape drive. However, it can be attached to external tape drives using SAS or Fibre Channel connectivity (Table 25).

Optical drives

The server does not support an optical drive option. However, it does interface to the optical drive installed in the BladeCenter chassis media tray if one is installed there.

I/O expansion options

The HS23 server offers the following PCI Express 3.0 slots:

- CIOv expansion slot: PCIe 3.0 x8
- CFFh expansion slot: PCIe 3.0 x16

The CIOv I/O expansion connector provides I/O connections through the midplane of the chassis to modules located in bays 3 and 4 of a supported BladeCenter chassis. The CFFh I/O expansion connector provides I/O connections to high-speed switch modules that are located in bays 7, 8, 9, and 10 of a BladeCenter H or BladeCenter HT chassis, or to switch bay 2 in a BladeCenter S chassis.

The HS23 optionally supports the PCI Express Gen 2 Expansion Blade II. The expansion blade provides the capability to attach selected PCI Express cards to the HS23. This capability is ideal for many applications that require special telecommunications network interfaces or hardware acceleration using a PCI Express card (Table 10).

The expansion blade provides one full-height and full-length PCI Express x16 (x8-wired) Gen 2 slot and one full-height and half-length PCI Express x16 (x8-wired) Gen 2 slot with a maximum power usage of 75 watts for each slot. It integrates PCI Express card support capability into the BladeCenter architecture. Up to four expansion blades can be attached to an HS23. Each expansion blade occupies a bay in the BladeCenter chassis.

Table 10. PCIe expansion blades

| Part number | Description | Maximum quantity supported |
|-------------|--|----------------------------|
| 68Y7484 | IBM BladeCenter PCI Express Gen 2 Expansion Blade II | 4 |

The HS23 server optionally supports GPU Expansion Blade expansion units. This capability is ideal for many applications written to take advantage of acceleration and visualization performance advantages that are offered in general-purpose computing on GPUs. This product ships integrated with one NVIDIA Tesla M2090, one NVIDIA Tesla M2075, or one NVIDIA Tesla M2070Q GPU.

The stacking capability of the IBM BladeCenter GPU Expansion Blade II allows you to connect up to four of them to a single blade server. In addition, you can still use a CFFh I/O expansion card adapter by installing it in the top-most expansion blade.

Table 11 lists the ordering information for the IBM BladeCenter GPU Expansion Blade II variants.

Table 11. GPU expansion blades

| Part number | Description | Maximum quantity supported |
|-------------|---|----------------------------|
| 00D6881 | IBM BladeCenter GPU Expansion Blade II with NVIDIA Tesla M2090 | 4 |
| 68Y7478 | IBM BladeCenter GPU Expansion Blade II with NVIDIA Tesla M2075 | 4 |
| 68Y7479 | IBM BladeCenter GPU Expansion Blade II with NVIDIA Tesla M2070Q | 4 |

Network adapters

The HS23 offers two integrated Gigabit Ethernet ports and two integrated 10 Gb Ethernet ports with the integrated Emulex BladeEngine 3 (BE3) controller. Two Gigabit Ethernet ports are routed to the chassis I/O bays 1 and 2, and two 10 Gb Ethernet ports are routed to the chassis I/O bays 7 and 9 using either 10Gb LOM Interposer Card or Emulex Virtual Fabric Adapter II for HS23.

The integrated BE3 4-port NIC has the following features:

- Two Gigabit Ethernet ports and two 10 Gb Ethernet ports (1 Gb and 10 Gb auto-negotiation).
- Full-duplex (FDX) capability.
- 10 Gb ports operate in either a virtual NIC (vNIC) or physical NIC (pNIC) mode:
 - vNIC mode: Up to six vNICs (up to three vNICs per one 10 Gb port)
 - Virtual Fabric mode or Switch Independent operational mode.
 - Virtual port bandwidth allocation in 100 Mbps increments.
 - Up to two vNICs can be configured as an iSCSI or FCoE vNICs (one per port) with optional Advanced Upgrade (90Y9310).
 - pNIC mode: dual-port 1/10 Gb Ethernet adapter
- IPv4/IPv6 offload:
 - TCP, UDP checksum offload
 - Large send offload (LSO)
 - Large receive offload (LRO)
 - Receive side scaling (RSS)
- IPv4 TCP Chimney Offload.
- IEEE 802.1Q VLAN tagging.
- VLAN insertion and extraction.
- Jumbo frames up to 9000 bytes.
- Load balancing and failover teaming support, including adapter fault tolerance (AFT), switch fault tolerance (SFT), adaptive load balancing (ALB), and IEEE 802.3ad.
- Enhanced Ethernet (draft) support:
 - Enhanced Transmission Selection (ETS) (P802.1Qaz)
 - Priority-based Flow Control (PFC) (P802.1Qbb)
 - Data Center Bridging eXchange Protocol (DCBX) (P802.1Qaz)
- Supports Serial over LAN (SoL) and concurrent KVM (cKVM).
- Preboot Execution Environment (PXE) support .
- Wake On LAN support.
- PCIe x8 Gen 2 host interface.
- Message Signal Interrupt (MSI-X) support.

Table 12 lists additional supported network adapters and upgrades.

Table 12. Network adapters

| Part number | Description | Slots supported | Maximum supported |
|---|--|----------------------|-------------------|
| Virtual Fabric Adapters and Upgrades | | | |
| 81Y3133 | Broadcom 2-port 10Gb Virtual Fabric Adapter | CFFh | 1 |
| 90Y9310 | IBM Virtual Fabric Advanced Software Upgrade (LOM) | (License only) | 1 |
| 81Y3120 | Emulex 10GbE Virtual Fabric Adapter II for HS23 | CFFh† | 1 |
| 90Y9350 | Virtual Fabric Advanced FOD Upgrade | (License only) | 1 |
| 90Y9332 | Emulex 10GbE Virtual Fabric Adapter Advanced II for HS23 | CFFh† | 1 |
| Converged Network Adapters | | | |
| 81Y1650 | Brocade 2 port 10GbE Converged Network Adapter (CFFh) | CFFh | 1 |
| 42C1830 | QLogic 2-pt 10Gb Converged Network Adapter (CFFh) | CFFh | 1 |
| 10 Gb Ethernet | | | |
| 94Y8550 | 10Gb LOM Interposer Card | Dedicated connector* | 1 |
| 46M6168 | Broadcom 10Gb Gen2 2-port Ethernet Expansion Card (CFFh) | CFFh | 1 |
| 46M6164 | Broadcom 10Gb Gen2 4-port Ethernet Expansion Card (CFFh) | CFFh | 1 |
| 42C1810 | Intel 10Gb 2-port Ethernet Expansion Card CFFh | CFFh | 1 |
| 90Y3570 | Mellanox 2-port 10Gb Enet Expansion Card (CFFh) | CFFh | 1 |
| 1 Gb Ethernet | | | |
| 44W4479 | 2/4 Port Ethernet Expansion Card (CFFh) | CFFh | 1 |
| 44W4475 | Ethernet Expansion Card (CIOv) | CIOv | 1 |
| InfiniBand | | | |
| 46M6001 | 2-port 40Gb InfiniBand Expansion Card (CFFh) | CFFh | 1 |

† With Emulex Virtual Fabrics Adapters II for HS23 installed in a blade server, two 10 Gb Ethernet ports on the adapter itself are routed to the chassis I/O bays 8 and 10 (unlike other CFFh cards), and two 10 Gb Ethernet ports integrated on a blade itself are routed to the chassis I/O bays 7 and 9.

* While the 10Gb LOM Interposer card does not consume a CFFh slot, you have to remove it if you plan to install a CFFh expansion card.

Storage host bus adapters

Table 13 lists storage HBAs supported by the HS23 server.

Table 13. Storage adapters

| Part number | Description | Slots supported | Max quantity supported |
|---------------|--|-----------------|------------------------|
| Fibre Channel | | | |
| 46M6140 | Emulex 8Gb Fibre Channel Expansion Card (CIOv) | CIOv | 1 |
| 44X1940 | QLogic Eth and 8Gb Fibre Channel Exp Card (CFFh) | CFFh | 1 |
| 44X1945 | Qlogic 8Gb Fibre Channel Expansion Card (CIOv) | CIOv | 1 |
| 46M6065 | QLogic 4Gb Fibre Channel Expansion Card (CIOv) | CIOv | 1 |
| SAS | | | |
| 43W4068 | SAS Connectivity Card (CIOv) | CIOv | 1 |

PCIe SSD adapters

The HS23 server supports the High IOPS SSD adapters listed in Table 14. The adapters must be installed in an IBM BladeCenter PCI Express Gen 2 Expansion Blade II.

Table 14. SSD adapters

| Part number | Description | Slots supported | Max quantity |
|-------------|---|--|--------------|
| 46M0878 | IBM 320GB High IOPS SD Class SSD PCIe Adapter | PCI Express Gen 2 Expansion Blade II (68Y7484) | 2 |

For information about this adapter, see the *IBM High IOPS SSD PCIe Adapters at-a-glance* guide: <http://www.redbooks.ibm.com/abstracts/tips0729.html?Open>

Power supplies

Server power is derived from the power supplies installed in the BladeCenter chassis. There are no server options regarding power supplies.

Integrated virtualization

The server supports VMware ESXi installed on a USB memory key. The key is installed in a USB socket inside the server. Table 15 lists the virtualization options.

Table 15. Virtualization options

| Part number | Description | Max quantity supported |
|-------------|--|------------------------|
| 41Y8298 | IBM Blank USB Memory Key for VMWare ESXi Downloads | 1 |
| 41Y8300 | IBM USB Memory Key for VMWare ESXi 5.0 | 1 |

Remote management

The server contains an IBM Integrated Management Module II (IMM2), which is based on the Renesas SH7757 chip, and interfaces with the advanced management module in the BladeCenter chassis. The combination of these provides advanced service-processor control, monitoring, and an alerting function. If an environmental condition exceeds a threshold or if a system component fails, LEDs on the system board are lit to help you diagnose the problem, the error is recorded in the event log, and you are alerted to the problem. A virtual presence capability comes standard for remote server management.

Remote server management is provided 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 with up to 23 bits per pixel, 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 IMM2 memory and mapping it to the server as a virtual drive
- Capturing blue-screen errors

Supported operating systems

The server supports the following operating systems:

- Microsoft Windows Server 2008 R2
- Microsoft Windows Server 2008, Datacenter x86 Edition
- Microsoft Windows Server 2008, Datacenter x64 Edition
- Microsoft Windows Server 2008, Enterprise x86 Edition
- Microsoft Windows Server 2008, Enterprise x64 Edition
- Microsoft Windows Server 2008 HPC Edition
- Microsoft Windows Server 2008, Standard x86 Edition
- Microsoft Windows Server 2008, Standard x64 Edition
- Microsoft Windows Server 2008, Web x86 Edition
- Microsoft Windows Server 2008, Web x64 Edition
- Windows Small Business Server 2008 Premium Edition
- Windows Small Business Server 2008 Standard Edition
- SUSE LINUX Enterprise Server 10 for AMD64/EM64T
- SUSE LINUX Enterprise Server 11 for AMD64/EM64T
- SUSE LINUX Enterprise Server 11 with Xen for AMD64/EM64T
- Red Hat Enterprise Linux 5 Server x64 Edition
- Red Hat Enterprise Linux 5 Server with Xen x64 Edition
- Red Hat Enterprise Linux 6 Server Edition
- Red Hat Enterprise Linux 6 Server x64 Edition
- VMware vSphere 5

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 specifications

Dimensions and weight (approximate, for single-wide blade):

- Height: 245 mm (9.7 in)
- Depth: 446 mm (17.6 in)
- Width: 29 mm (1.14 in)
- Maximum weight: 5.4 kg (12 lb)

Shipping dimensions and weight (approximate, for single-wide blade):

- Height: 330 mm (13.0 in)
- Depth: 600 mm (23.5 in)
- Width: 165 mm (6.5 in)
- Weight: 4.2 kg (9.4 lb)

Supported environment:

- Air temperature
 - Server on:
 - 10 to 35 °C (50 to 95 °F); altitude: 0 to 914 m (0 to 3,000 ft)
 - 10 to 32 °C (50 to 89.6 °F); altitude: 914 to 2133 m (3,000 to 7,000 ft)
 - Server off: 10 to 43 °C (50 to 109.4 °F)
 - Shipment: -40 to +60 °C (-40 to 140 °F)
- Humidity
 - Server on: 8 to 80%
 - Server off: 8 to 80%

Warranty options

The BladeCenter HS23 has a three-year on-site 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 ServicePac 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>.

Table 16 explains warranty service definitions in more detail.

Table 16. Warranty service definitions

| Term | Description |
|--------------------------|---|
| IBM on-site 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 24-hour service, 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 24-hour service, 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 on-site 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, these are the types of IBM ServicePacs:

- Warranty and maintenance service upgrades
 - One, two, three, four, or five years of 9x5 or 24x7 service coverage
 - On-site repair from the next business day to four or two hours
 - One or two years of warranty extension
- Remote technical support services
 - One or three years with 24x7 coverage (severity 1) or 9-5 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 Director

Regulatory compliance

The server conforms to the following standards:

- FCC - Verified to comply with Part 15 of the FCC Rules, Class A
- Canada ICES-003, issue 4, Class A
- UL/IEC 60950-1
- CSA C22.2 No. 60950-1-03
- Japan VCCI, Class A
- Australia/New Zealand AS/NZS CISPR 22:2006, Class A
- IEC 60950-1(CB Certificate and CB Test Report)
- Taiwan BSMI CNS13438, Class A
- Korea KN22, Class A; KN24
- Russia/GOST ME01, IEC-60950-1, GOST R 51318.22-99, GOST R 51318.24-99, GOST R 51317.3.2-2006, GOST R 51317.3.3-99
- IEC 60950-1 (CB Certificate and CB Test Report)

- CE Mark (EN55022 Class A, EN60950-1, EN55024, EN61000-3-2, EN61000-3-3)
- CISPR 22, Class A

External disk storage expansion

SAS Connectivity Modules (one or two) must be installed into the chassis to support external disk storage expansion. Table 17 lists the SAS Connectivity Module.

Table 17. SAS Connectivity Modules

| Part number | Description | Maximum quantity supported per one chassis |
|-------------|-------------------------|--|
| 39Y9195 | SAS Connectivity Module | 2 |

The external disk storage expansion enclosures listed in Table 18 are supported with HS23.

Table 18. External storage expansion enclosures

| Part number | Description | Maximum quantity supported per one blade server |
|-------------|------------------------------------|---|
| 172701X | IBM System Storage® EXP3000 | 1 |
| 174712X | IBM System Storage EXP2512 Express | 1 |
| 174724X | IBM System Storage EXP2524 Express | 1 |

Table 19 lists the drives supported by EXP3000 external expansion enclosures.

Table 19. Drive options for EXP3000 external expansion enclosures

| Part number | Description | Maximum quantity supported per one enclosure |
|----------------|---|--|
| SATA 3.5" HDDs | | |
| 43W7630 | IBM 1 TB 7200 Dual Port SATA 3.5" HS HDD | 12 |
| 49Y1940 | IBM 2 TB 7200 Dual Port SATA 3.5" HS HDD | 12 |
| SAS 3.5" HDDs | | |
| 44W2234 | IBM 300 GB 15K 6 Gbps SAS 3.5" Hot-Swap HDD | 12 |
| 44W2239 | IBM 450 GB 15K 6 Gbps SAS 3.5" Hot-Swap HDD | 12 |
| 44W2244 | IBM 600 GB 15K 6 Gbps SAS 3.5" Hot-Swap HDD | 12 |

Table 20 lists the drives supported by EXP2512 external expansion enclosures.

Table 20. Drive options for EXP2512 external expansion enclosures

| Part number | Description | Maximum quantity supported per one enclosure |
|------------------|-----------------------------------|--|
| NL SAS 3.5" HDDs | | |
| 49Y1903 | 1TB 7,200 rpm 6Gb SAS NL 3.5" HDD | 12 |
| 49Y1902 | 2TB 7,200 rpm 6Gb SAS NL 3.5" HDD | 12 |
| 90Y8720 | 3TB 7,200 rpm 6Gb SAS NL 3.5" HDD | 12 |
| SAS 3.5" HDDs | | |
| 49Y1899 | 300GB 15,000 rpm 6Gb SAS 3.5" HDD | 12 |
| 49Y1900 | 450GB 15,000 rpm 6Gb SAS 3.5" HDD | 12 |
| 49Y1901 | 600GB 15,000 rpm 6Gb SAS 3.5" HDD | 12 |

Table 21 lists the hard disk drives supported by EXP2524 external expansion enclosures.

Table 21. Drive options for EXP2524 external expansion enclosures

| Part number | Description | Maximum quantity supported per one enclosure* |
|------------------|-------------------------------------|---|
| NL SAS 2.5" HDDs | | |
| 49Y1898 | 500GB 7,200 rpm 6Gb SAS NL 2.5" HDD | 12 |
| 81Y9952 | 1TB 7,200 rpm 6Gb SAS NL 2.5" HDD | 12 |
| SAS 2.5" HDDs | | |
| 49Y1896 | 146GB 15,000 rpm 6Gb SAS 2.5" HDD | 12 |
| 49Y1895 | 300GB 10,000 rpm 6Gb SAS 2.5" HDD | 12 |
| 81Y9944 | 300GB 15,000 rpm 6Gb SAS 2.5" HDD | 12 |
| 81Y9596 | 600GB 10,000 rpm 6Gb SAS 2.5" HDD | 12 |
| 81Y9948 | 900GB 10,000 rpm 6Gb SAS 2.5" HDD | 12 |
| SAS 2.5" SSDs | | |
| 81Y9956 | 200GB 2.5" SAS SSD | 12 |
| 81Y9960 | 400GB 2.5" SAS SSD | 12 |

* Note: While the maximum number of drives supported by EXP2524 is 24, the integrated LSI SAS2004 ROC controller supports up to 14 drives in a RAID configuration. Blade server hosts two internal drives, therefore limiting the number of drives in one EXP2524 to 12.

The external expansion enclosures are supported by the integrated LSI SAS2004 ROC controller together with the SAS connectivity card installed in the CIOv slot of the blade server. Table 22 lists the connectivity card.

Table 22. SAS connectivity card for external storage expansion enclosures

| Part number | Description | Maximum quantity supported |
|-------------|------------------------------|----------------------------|
| 43W4068 | SAS Connectivity Card (CIOv) | 1 |

The external SAS cables listed in the Table 23 are supported with external expansion enclosures connected to SAS Connectivity Modules.

Table 23. 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 |

External disk storage systems

Table 24 lists the external storage systems that are supported by HS23 and that can be ordered through the System x sales channel. The HS23 blade might support other IBM disk systems that are not listed in this table. Refer to the IBM System Storage® Interoperability Center for further information.

Table 24. 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 |

External backup units

The server supports the external backup attachment options listed in Table 25.

Table 25. 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 |

Table 25. 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 and rack mount kit |
| 3572S5R | TS2900 Tape Library with LTO5 HH SAS drive and 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 the System x sales channel. The server might 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.

Related publications and links

For more information, see the following resources:

- IBM US Announcement Letter
<http://ibm.com/common/ssi/cgi-bin/ssialias?infotype=dd&subtype=ca&&htmlfid=897/ENUS112-044>
- IBM BladeCenter HS23 product page
<http://ibm.com/systems/bladecenter/hardware/servers/hs23>
- IBM BladeCenter Information Center
<http://publib.boulder.ibm.com/infocenter/bladectr/documentation>
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- IBM BladeCenter HS23 Problem Determination and Service Guide
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- ServerProven hardware compatibility page for the HS23
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- ServerProven compatibility page for operating system support
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