IBM System Storage SAN06B-R Extension Switch

IBM Redbooks Product Guide

This IBM® Redbooks® Product Guide describes the IBM System Storage® SAN06B-R extension switch. The SAN06B-R extension switch uses advanced Fibre Channel and Fibre Channel over IP (FCIP) technology to provide a fast, highly reliable, and cost-effective network infrastructure for remote data replication, backup, and migration. Leveraging FCIP technology, the SAN06B-R extension switch provides a flexible and extensible platform to move more data faster and further than ever before.

Whether configured for simple point-to-point or comprehensive multisite SAN extension, the SAN06B-R extension switch addresses the most demanding business continuity, compliance, and global data access requirements. Up to sixteen 8 Gbps Fibre Channel ports and six 1 Gigabit Ethernet (GbE) ports provide the Fibre Channel and FCIP bandwidth, port density, and throughput that is required to help maximize application performance over WAN links.

Figure 1 shows the SAN06B-R extension switch.

Figure 1. IBM System Storage SAN06B-R extension switch

Did you know?

- The SAN06B-R extension switch maximizes replication, backup, and migration throughput over distance.
- You can use the SAN06B-R extension switch to enable consolidation while providing traffic isolation in mixed environments.
- The SAN06B-R extension switch can help maximize flexibility to support a broad range of SAN extension requirements with an extensible hardware platform and flexible software licensing.

Architecture and key components

The SAN06B-R extension switch provides an ideal platform for building or expanding a high-performance SAN extension infrastructure for disaster recovery, data protection, and data mobility storage solutions (see Figure 2). It leverages cost-effective IP WAN transport to extend open systems and mainframe disk and tape storage applications over distances that are otherwise impossible, impractical, or too expensive with standard Fibre Channel connections. The SAN06B-R extension switch provides flexible deployment options to extend disaster recovery, data protection, and data mobility storage solutions across any distance.

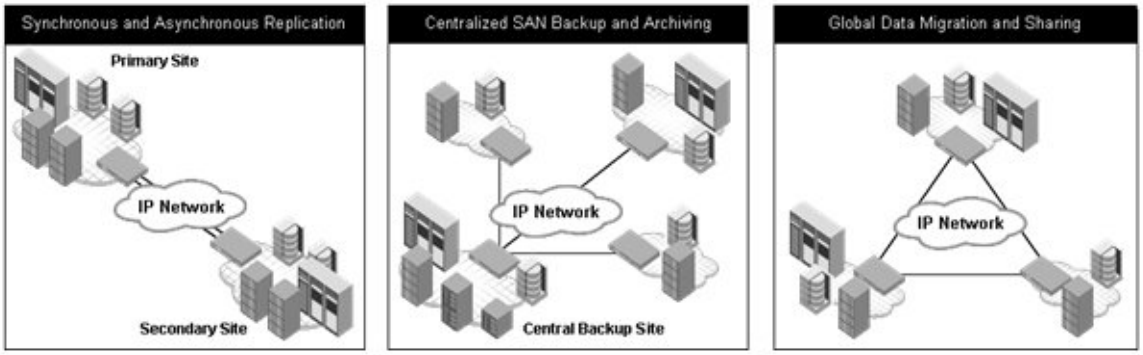

Figure 2. SAN06B-R extension switch flexible deployment options

Configurations

Available in two possible configurations, the SAN06B-R extension switch supports various architectures and deployment models to address current and future SAN extension requirements. A broad range of optional advanced extension, IBM FICON®, and SAN fabric services are available to address the most challenging extension and storage networking requirements.

The SAN06B-R extension switch, when configured as a 4/2 Extension Switch (base configuration), is a cost-effective option for smaller data centers and remote offices, and for open systems and mainframe environments. Organizations can optimize bandwidth and throughput through four 8 Gbps Fibre Channel ports and two 1 GbE ports. The SAN06B-R extension switch 4/2 configuration can be easily upgraded to the SAN06B-R extension switch 16/6 configuration through software licensing, providing scalability and investment protection for growing environments. The SAN06B-R extension switch that is configured with 4/2 is ideal for the following situations:

- Point-to-point synchronous and asynchronous open systems disk replication
- Point-to-point IBM z/OS® Global Mirror (zGM) (formerly known as Extended Remote Copy (XRC)) and mainframe tape extension
- Global data and storage resource migration, distribution, and sharing

The SAN06B-R extension switch, when configured as a 16/6 extension switch, is a robust platform for data centers and multisite environments implementing disk and tape solutions for open systems and mainframe environments. Organizations can optimize bandwidth and throughput through sixteen 8 Gbps Fibre Channel ports and six 1 GbE ports. The SAN06B-R extension switch that is configured with 16/6 is ideal for the following situations:

- Open systems and mainframe disk and tape extension
- Multisite synchronous and asynchronous storage replication

- Centralized SAN backup, recovery, and archiving
- Global data and storage resource migration, distribution, and sharing

Performance and optimization

Purpose-built Fibre Channel and FCIP switch port density, bandwidth, and throughput are designed to address today's dynamic I/O and workload requirements and to meet the evolving requirements of highly virtualized data centers. The SAN06B-R extension switch is designed to maximize replication, backup, and migration throughput over distance using advanced Fibre Channel frame compression, disk and tape protocol acceleration, and FCIP networking technology. Supporting up to 350 ms Round-Trip Time (RTT) of latency, the SAN06B-R extension switch enables a cost-effective SAN extension solution over distances up to 17,500 kilometers (nearly 11,000 miles).

The SAN06B-R extension switch maximizes replication, backup, and migration throughput over distance using advanced Fibre Channel frame compression, disk and tape protocol acceleration, and FCIP networking technology. Unique features and technologies include the following items:

- **FCIP Trunking** combines multiple IP source and destination address pairs into a single logical high-bandwidth FCIP trunk spanning multiple physical ports to provide load balancing and network failure resiliency.
- **Adaptive Rate Limiting** dynamically adjusts bandwidth between minimum and maximum rate limits to optimize bandwidth utilization and sharing.
- **FCIP quality of service (QoS)** provides high-, medium-, and low-priority handling of initiator-target flows within the same FCIP tunnel for transmission over the WAN with individual TCP sessions per QoS class.
- **IPSec support** ensures secure transport over WAN links by encrypting data-in-flight with a standard 256-bit AES algorithm.
- **Advanced compression architecture** provides multiple modes to optimize compression ratios for various throughput requirements.
- **FCIP Fast Write** accelerates SCSI write processing, maximizing performance of synchronous and asynchronous replication applications across high-latency WAN connections.
- **Open Systems Tape Pipelining** accelerates read and write tape processing over distance, minimizing backup and restore windows.
- **Advanced Accelerator for FICON** uses advanced networking technologies, data management techniques, and protocol intelligence to accelerate IBM zGM, mainframe tape read and write operations, and z/OS host connection to Teradata warehousing systems over distance.
- **Storage-Optimized TCP** optimizes TCP window size and flow control, accelerating TCP transport for storage applications.
- **Virtual Fabrics** allow fabrics that are configured with specific characteristics for open systems or z/OS environments to share the same platform and even the same Gigabit Ethernet interface, enabling consolidation and greater resource utilization.

Disaster recovery and data protection

The SAN06B-R extension switch extends open systems and mainframe disk and tape storage applications over distances that are otherwise impossible, impractical, or too expensive with native Fibre Channel connections. This extended distance connectivity enables Metro Mirror and Global Mirror disk-based, disaster tolerant solutions, and consolidated remote tape vaulting data protection solutions.

The advanced performance and network optimization features of the SAN06B-R extension switch enable replication and backup applications to send more data over FCIP links in less time, protecting time-sensitive synchronous or other high-priority traffic, and optimizing the available WAN bandwidth.

Acceleration for SCSI writes (FastWrite) and IBM zGM maximize replication performance and enable cost-effective synchronous and asynchronous replication across any distance. In addition, Tape Pipelining for open systems and mainframe tapes uses unique read and write tape processing to significantly reduce backup and recovery times over distance anywhere in the world. Optional FCIP Trunking provides FCIP tunnel redundancy for lossless path failover and ensured in-order data delivery if there is a failure.

The SAN06B-R extension switch uses the core technology of b-type SAN fabric platforms, consistently delivering 99.9999% uptime in the world's most demanding data centers. It combines enterprise-class availability features, such as hot-pluggable redundant power supplies and fans, with nondisruptive software upgrades to maximize application uptime and minimize outages. These unique capabilities enable a high-performance and highly reliable network infrastructure for disaster recovery and data protection.

Fabric Operating System and management

The SAN06B-R extension switch uses the same Fabric Operating System (FOS) that supports the entire Systems Storage b-type SAN family, from the IBM System Networking SAN24B-5 switch to the IBM System Storage SAN768B-2/SAN384B-2 switches, with Gen 5 Fibre Channel. This helps ensure seamless interoperability with optional advanced features, such as ISL Trunking, Adaptive Networking, Advanced Performance Monitoring, Fabric Watch, Integrated Routing, Extended Fabric, Server Application Optimization (SAO), or Fabric Vision.

In addition, organizations can perform management and administrative tasks through familiar management tools, including IBM Network Advisor, web tools, and the command-line interface (CLI). Moreover, optional FICON Control Unit Port (CUP) capabilities enable legacy management applications to seamlessly support FICON environments.

The SAN06B-R extension switch requires FOS V6.3 or higher. FOS V6.4.0, or higher is required for some optional features. FOS offers the following "pay-as-you-grow" advanced functions:

- The **8 Gbps Advanced Extension license** enables two features: FCIP Trunking and Adaptive Rate Limiting (ARL). FCIP Trunking allows multiple IP source and destination address pairs (defined as FCIP circuits) through multiple interfaces to provide a high-bandwidth FCIP tunnel and failover resiliency. Up to four IP source and destination pairs are supported in FOS V6.3. The Adaptive Rate Limiting feature provides a minimum bandwidth guarantee for each tunnel with full usage of the available network bandwidth without impacting throughput performance under high traffic load.
- **Adaptive Networkin**g activates FC and FCIP QoS functionality, providing high-, medium-, and low-priority handling of initiator-target flows within the same FCIP tunnel for transmission over the WAN.
- An **SAN06B-R Upgrade license** enables all 16 FC and 6 GbE ports and support for additional advanced functionality. The base SAN06B-R extension switch includes activation of four FC ports and two GbE ports. The SAN06B-R Upgrade is required for open systems tape pipelining.
- **Advanced Performance Monitoring** helps identify end-to-end bandwidth usage by host/target pairs and is designed to provide for capacity planning.
- **Integrated Routing** isolates local or remote fabrics for higher levels of scalability and fault isolation.
- **Extended Fabric** extends SAN fabrics beyond the FC standard 10 km by optimizing the internal switch buffers to help maintain performance on inter-switch links (ISLs) at distances up to 3,000 km (depending on the platform).

- **Fabric Watch** enables real-time proactive awareness of the health, performance, and security of each switch. Fabric Watch also includes port fencing capabilities. It automatically alerts network managers to problems and helps avoid costly failures by providing the following services:
  - Real-time tracking of numerous fabric and switch elements.
  - Automatic event notifications when switch and fabric elements exceed thresholds.
  - Security, availability, and congestion monitoring thresholds and alerts.
- **FICON Accelerator** uses advanced networking technologies, data management techniques, and protocol intelligence to accelerate FICON disk and tape read/write operations over a distance. FOS V6.4.0c or later is required for this function.
- **FICON with control unit port (CUP)** is designed to enable in-band management for IBM OS/390® or IBM z/OS on IBM System z10® EC, z10™ BC, z9® EC, z9 BC, and zSeries® 990, 900, 890, and 800 servers. To enable in-band management on multiple routers, switches, and directors, each router, switch, or director must be licensed. In addition, 8 Gbps Advanced Extension must be enabled before you enable FICON with CUP Activation.
- **ISL Trunking** enables FC packets to be efficiently distributed across multiple ISLs between two IBM SAN b-type fabric switches or directors while preserving in-order delivery. Both SAN b-type devices must have trunking activated.
- **Server Application Optimization (SAO)** is designed to bring QoS enhancements for server consolidation and virtualization. It isolates and prioritizes individual VM data flow for end-to-end QoS, preserving individual service level agreements (SLAs) from each VM through the SAN. SAO and adaptive networking features must both be activated on the SAN switches.
- **Enterprise Bundle** offers a convenient package of advanced FOS functions. It includes Advanced Performance Monitor, ISL Trunking Activation, Adaptive Networking, Fabric Watch, and Fabric Vision licenses. Requires FOS V7.2 or later to activate all Fabric Vision license features.
- **Fabric Vision license** offers a collection of breakthrough features and tools that are bundled into an optional licensed feature. It includes Flow Vision and Monitoring and Alerting Policy Suite (MAPS) advanced technologies and capabilities. Requires FOS V7.2 or later.

IBM Network Advisor Software provides end-to-end management of data center fabrics from storage ports on networked storage systems to host bus adapters that are attached to physical or virtualized servers. IBM Network Advisor V12.0 or later is necessary to support transitions to cloud environments. IBM Network Advisor V12.1 or later is required to support Fabric Vision license capabilities.

Fabric Vision technology

The SAN06B-R extension switch incorporates Fabric Vision, a breakthrough hardware and software technology that is designed to maximize uptime, simplify SAN management, and provide outstanding visibility and insight across the storage network. Offering innovative diagnostic, monitoring, and management capabilities, the SAN06B-R extension switch with Fabric Vision technology helps administrators avoid problems, maximize application performance, and reduce operational costs. The SAN06B-R extension switch supports the following Fabric Vision technology features:

- **Flow Monitor** provides comprehensive visibility into flows in the fabric, including the ability to automatically learn (discover) flows and nondisruptively monitor flow performance. Users can monitor all flows from a specific host to multiple targets/LUNs or from multiple hosts to a specific target/LUN, monitor all flows across a specific ISL, or perform LUN-level monitoring of specific frame types to identify resource contention or congestion that is impacting application performance.

- **Monitoring and Alerting Policy Suite (MAPS)** simplifies fabric-wide threshold configuration and monitoring. By using pre-built rule/policy-based templates, applying thresholds and alerts to ports is a simple two-step process. Organizations can configure the entire fabric (or multiple fabrics) at one time using common rules and policies, or customize policies for specific ports, all through a single dialog. The integrated dashboard displays an overall switch health report, along with details about out-of-policy conditions, to help administrators quickly pinpoint potential issues.
- **Bottleneck Detection** identifies and alerts administrators to device or ISL congestion and abnormal levels of latency in the fabric. This feature works with IBM Network Advisor to automatically monitor and detect network congestion and latency in the fabric, providing visualization of bottlenecks in a connectivity map and product tree, and identifying exactly which devices and hosts are impacted by a bottlenecked port.
- **Integration into IBM Network Advisor** provides customizable health and performance dashboard views to pinpoint problems faster, simplify SAN configuration and management, and reduce operational costs.
- **Critical diagnostic and monitoring capabilities** help ensure early problem detection and recovery.
- **Non-intrusive and nondisruptive monitoring on every port** provides a comprehensive end-to-end view of the entire fabric using capabilities that are integrated into hardware, allowing sophisticated monitoring without imposing an additional burden on switches with frequent polling activity.

Specifications

Table 1 lists the specifications for the SAN06B-R extension switch.

Table 1. SAN06B-R extension switch specifications (part 1 of 4)

Item	Description
Product number	2498-R06
Base fabric switch	IBM System Storage SAN06B-R extension switch with 4 active FC ports, 2 Ethernet IP ports, and Fabric OS (FOS) V6.3 or later, hardcopy Installation Guide, CD-ROM (with manuals), service and wrap tools, SFP extraction tool, two 110 V power cords for rack installation, rail kit, Advanced Zoning, FCIP Activation, Full Fabric Activation, and Web Tools. All active ports must be populated with SFPs.
Fans and power supplies	Dual redundant, hot-swappable power supplies with dual fans
Hot-swappable components	SFP transceivers and power supply/dual-fan modules
Non-rack support	Non-rack installation is supported. Country-specific power cords are required and must be ordered.
Servers supported*	• IBM System z® • IBM Power Systems™ • IBM System p® • IBM System x® • Other Intel processor-based servers with Linux, Microsoft Windows 2008, and Windows 2012 • Selected Sun and HP servers

* For more information, see product details in the IBM System Storage Interoperation Center (SSIC) at http://www.ibm.com/systems/support/storage/ssic/interoperability.wss.
** The Enterprise Bundle includes one license for each of the following items: Fabric Watch, Advanced Performance Monitor, Trunking Activation, Adaptive Networking, and Fabric Vision.

Table 1. SAN06B-R extension switch specifications (part 2 of 4)

Item	Description
Operating systems supported*	• Windows 2008 and Windows 2012 • Red Hat Linux and Red Hat Linux Advanced Server • SUSE Linux and SUSE Linux Enterprise Server (SLES) • IBM AIX® • Other selected operating systems
Storage products supported*	• IBM XIV® Storage System • IBM System Storage DS8000® • IBM System Storage SAN Volume Controller • IBM Storwize® V3700, V5000, and V7000 • Other selected storage systems
Fibre Channel switches supported	Current System Storage and TotalStorage SAN b-type and m-type switches and directors (must be running current firmware)
Fiber optic cable	Fiber optic cables are required and are available in various lengths in single-mode and multimode formats.
Power cords	Jumper cables are included for rack installation. Country-specific power cords must be ordered for desktop/stand-alone installation.
Fibre Channel interface	For FC: E_Port, EX: Port, F_Port, EL Port, M Port, and U Port For FCIP: VE _Port (virtual E_Port)
Fibre Channel ports	16 ports; E, F, M, EX, and FL ports
FCIP ports	6 ports and 1 GbE (VE, VEX)
Scalability	Full fabric architecture with 239 switches maximum
Certified maximum	Single fabric: 56 domains and 7 hops Multiprotocol routing fabric: 19 hops
Fibre Channel performance	1.063 Gbps line speed and full duplex, 2.125 Gbps line speed and full duplex, 4.25 Gbps line speed and full duplex, and 8.5 Gbps line speed and full duplex. Auto-sensing of 1 Gbps, 2 Gbps, 4 Gbps, and 8 Gbps port speeds, and optionally programmable to fixed port speed. Speed matching between 1 Gbps, 2 Gbps, 4 Gbps, and 8 Gbps ports.
FCIP performance	1 Gbps line speed
ISL Trunking	Up to eight 8 Gbps ports per ISL trunk or up to 64 Gbps per ISL trunk. There is no limit to how many trunk groups can be configured in the switch.
Fibre Channel aggregate bandwidth	128 Gbps: 16 ports × 8 Gbps data rate
FCIP aggregate bandwidth	6 Gbps: 6 ports × 1 Gbps data rate
Fabric latency	700 ns with no contention and cut-through routing at 8 Gbps

* For more information, see product details in the IBM System Storage Interoperation Center (SSIC) at http://www.ibm.com/systems/support/storage/ssic/interoperability.wss.
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Table 1. SAN06B-R extension switch specifications (part 3 of 4)

Item	Description
Maximum frame size	2112-byte payload
Maximum MTU size	1500-byte Ethernet packets with FCIP
Classes of service	Class 2, Class 3, and Class F (inter-switch frames)
Port types	FL_Port, F_Port, E_Port, EX_Port, and M_Port (Mirror Port). For FCIP, VE_Port (Virtual E_Port) and VEX_Port (Virtual EX_Port).
Data traffic types	Fabric switches supporting unicast, multicast (255 groups), and broadcast
USB	One USB port for system log file downloads or firmware upgrades
Media types	Fibre Channel: Hot-pluggable Small Form Factor Pluggable (SFP) and SFP+ and LC connector, and Short-Wave Laser (SWL) and Long-Wave Laser (LWL). The distance depends on fiber-optic cable and port speed. Supports SFP+ (2, 4, and 8 Gbps) and SFP (1, 2, and 4 Gbps) optical transceivers. 1 GbE: Hot-pluggable optical SFP, Short-Wave Laser (SWL) and Long-Wave Laser (LWL), GbE Copper SFP, and built-in RJ-45 copper (two GbE ports). The distance depends on fiber-optic or copper cable and port speed.
Fabric services	Advanced Zoning, Dynamic Path Selection (DPS), FDMI, Enhanced Group Management (EGM), Frame Redirection, Registered State Change Notification (RSCN), Reliable Commit Service (RCS), Simple Name Server (SNS), Virtual Fabrics (Logical Switch), Bottleneck Detection, Adaptive Networking, and Server Application Optimization (SAO). Optional fabric services include Monitoring and Alerting Policy Suite (MAPS), Flow Monitor, Advanced Performance Monitoring, Fabric Watch, Integrated Routing, Extended Fabrics, and ISL Trunking.
Licensing options	The following optional extension features can be enabled through license keys: • **Advanced Extension:** Enables FCIP Trunking and Adaptive Rate Limiting. • **SAN06B-R Upgrade License:** Enables all ports, additional FCIP tunnels, and open systems tape read/write pipelining. • **FICON Management Server:** Control Unit Port (CUP) enables host control of switches in mainframe environments. • **Advanced Accelerator for FICON:** Accelerates IBM zGM, mainframe tapes, and z/OS host connection to Teradata systems over distance.

* For more information, see product details in the IBM System Storage Interoperation Center (SSIC) at http://www.ibm.com/systems/support/storage/ssic/interoperability.wss.
** The Enterprise Bundle includes one license for each of the following items: Fabric Watch, Advanced Performance Monitor, Trunking Activation, Adaptive Networking, and Fabric Vision.

Table 1. SAN06B-R extension switch specifications (part 4 of 4)

Item	Description
Optional features	• Optional SAN extension licenses include 8 Gbps Advanced Extension, SAN06B-R Upgrade, Adaptive Networking, FICON Accelerator, Extended Fabric, and SAO license. • Optional SAN fabric services include Fabric Watch, Trunking Activation, Advanced Performance Monitoring, Integrated Routing, FICON with CUP Activation, Enhanced Group Management (EGM), Fabric Vision, and Enterprise Bundle**.
Warranty	1-year; customer replaceable unit (CRU) and onsite. Next business day response and warranty service upgrades are available.

* For more information, see product details in the IBM System Storage Interoperation Center (SSIC) at http://www.ibm.com/systems/support/storage/ssic/interoperability.wss.
** The Enterprise Bundle includes one license for each of the following items: Fabric Watch, Advanced Performance Monitor, Trunking Activation, Adaptive Networking, and Fabric Vision.

Table 2 lists the management features for the SAN06B-R extension switch.

Table 2. SAN06B-R extension switch management features

Item	Description
Supported management software	SSH v2, HTTP/HTTPS, SNMP v1/v3, and Telnet, SNMP (FE MIB and FC Management MIB), Web Tools, IBM Network Advisor, Command-Line Interface (CLI), and SMI-S
Security	DH-CHAP (between switches and end devices), HTTPS, IPSec, IP Filtering, LDAP, OpenLDAP, Port Binding, RADIUS, Role-Based Access Control (RBAC), TACACS+, Secure Copy (SCP), Secure RPC, SSH v2, SSL, Switch Binding, and Trusted Switch
Management access	10/100/1000 Ethernet (RJ-45), with in-band over Fibre Channel ports, and serial port (RJ-45) and one USB port
Diagnostic tests	POST and embedded online/offline diagnostic tests, including FCping, Pathinfo (FCtraceroute), and so on

Table 3 lists the physical characteristics for the SAN06B-R extension switch.

Table 3. Physical characteristics

Item	Description
Enclosure	Back-to-front airflow: 1U, 19-inch EIA-compliant, with power from back
Size	Width: 43.18 cm/17.0 in. Height: 4.45 cm/1.75 in. Depth: 64 - 14 cm/25.25 in.
System weight	10.9 kg (24.0 lbs) with two power supplies, without SFP/SFP+

Table 4 lists the environmental characteristics for the SAN06B-R extension switch.

Table 4. Environmental characteristics

Item	Description
Temperature	Operating: 0°C to 40°C (32°F to 104°F) Non-operating: −25°C to 70°C (−13°F to 158°F)
Humidity	Operating: 10% - 85% noncondensing at 40°C (104°F) Non-operating: 10% - 90% noncondensing at 70°C (158°F)
Altitude	Operating: Up to 3000 m (9842 ft) Storage: Up to 12 km (39,370 ft)
Shock	Operating: 20 g, 6 ms, half-sine Non-operating: 33 g, 11 ms, half-sine, 3/eg Axis
Vibration	Operating: 0.5 g sine, 0.4 grms random, 5 - 500 Hz Non-operating: 2.0 g sine, 1.1 grms random 5 - 500 Hz
Heat dissipation	Maximum 22 ports: 590 BTU/hr
Airflow	Maximum 60 CFM; nominal 44 CFM

Table 5 lists the electrical specifications for the SAN06B-R extension switch.

Table 5. Electrical specifications

Item	Description
Power supply	Dual hot-swappable redundant power supplies
Power inlet	C13
Input voltage	85 - 264 V ac nominal
Input line frequency	47 - 63 Hz
Inrush current	Maximum of 60 amps for period of 10 - 150 ms
Power	Nominal 145 watts; maximum 173 watts

Related information

For more information, see the following resources:

- IBM System Networking SAN b-type family product page
  http://www.ibm.com/systems/networking/switches/san/b-type/
- IBM System Storage Interoperation Center (SSIC)
  http://www.ibm.com/systems/support/storage/ssic/interoperability.wss
- IBM Offering Information page (announcement letters and sales manuals):
  http://www.ibm.com/common/ssi/index.wss?request_locale=en

  On this page, enter SAN06B-R, select the information type, and then click **Search**. On the next page, narrow your search results by geography and language.

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