QFX3500 SWITCH

Product Overview

The Juniper Networks QFX3500 Switch delivers a high-performance, ultra low latency, feature rich Layer 2 and Layer 3 solution for the most demanding data center environments. Featuring standards-based Fibre Channel I/O convergence capabilities in a compact form factor, the QFX3500 is a versatile, high density 10GbE platform that also delivers a fabric-ready edge solution for the Juniper Networks QFabric architecture.

Product Description

The high-performance Juniper Networks® QFX3500 Switch addresses a wide range of deployment scenarios, which include traditional data centers, virtualized data centers, high-performance computing, network-attached storage, converged server I/O, and cloud computing.

Featuring 48 dual-mode small form-factor pluggable transceiver (SFP+/SFP) ports and four quad small form-factor pluggable plus (QSFP+) ports in a 1 U form factor, the QFX3500 Switch delivers feature rich Layer 2 and Layer 3 connectivity to networked devices such as rack servers, blade servers, storage systems, and other switches in highly demanding, high-performance data center environments. For converged server edge access environments, the QFX3500 is also a standards-based Fibre Channel over Ethernet (FCoE) Transit Switch and FCoE to Fibre Channel (FCoE-FC) Gateway, enabling customers to protect their investments in existing data center aggregation and Fibre Channel storage area network (SAN) infrastructures.

When deployed with other components of the Juniper Networks QFabric™ architecture, the QFX3500 delivers a fabric-ready edge solution that contributes to a high-performance, low latency fabric, unleashing the power of the exponential data center and providing investment protection for users migrating from traditional multitier networks.

For added configuration flexibility, up to 36 of the QFX3500's 48 pluggable SFP+ ports can be used in 10GbE or 1GbE mode with up to 18 of the 1GbE ports being copper. The remaining 12 ports can be used to support 2, 4, or 8 Gbps Fibre Channel modes. Each of the four QSFP+ high speed ports can operate in 4x10GbE mode and are capable of supporting 40Gbps optics* in the future, providing investment protection.
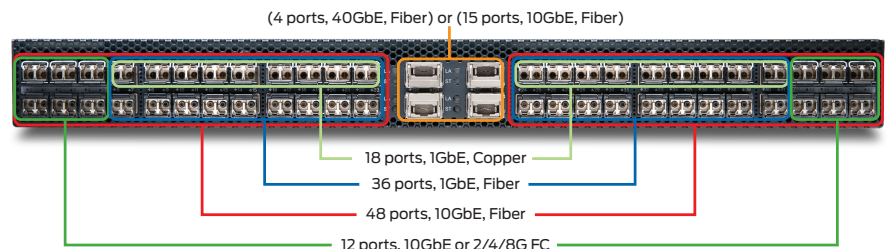

(4 ports, 40GbE, Fiber) or (15 ports, 10GbE, Fiber)
18 ports, 1GbE, Copper
36 ports, 1GbE, Fiber
48 ports, 10GbE, Fiber
12 ports, 10GbE or 2/4/8G FC

Figure 1: QFX3500 Switch (rear view)

*Roadmap

Data Center Deployments

Today's data centers are built with high-performance, small form-factor, multi-core blade and rack servers. The greater compute capacity and server densities enabled by these devices is increasing traffic levels, creating the need for a high speed, low latency, storage- and I/O-converged networking solution that can maximize performance for physical servers, virtual servers, and storage in the data center.

The QFX3500 Switch delivers the ultra low latency, lossless high density 10GbE interfaces, and FCoE Transit Switch and FCoE-FC Gateway functionality demanded by today's data center—all in a compact form factor designed to support high-performance, converged data center access networks. The QFX3500's low power consumption optimizes the switch's power use effectiveness (PUE) ratio to reduce data center operating costs, while front-to-back air flow meets hot and cold aisle isolation requirements.

The QFX3500 is an ideal platform for:

- High-performance Ethernet L2 and L3 access environments (Figure 2)
- High-performance data center bridging (DCB), storage and I/O convergence environments (Figure 3):
  - FCoE Transit Switch
  - FCoE-FC Gateway
- Fabric edge deployments in the Juniper Networks QFabric architecture (Figure 4)

High-Performance L2 / L3 Access Deployments

With its compact, 1U form factor, high density 10GbE ports, front-to-back airflow, and rear-port design, the QFX3500 is ideal for top-of-rack deployments in high-performance, highly demanding data centers. Featuring 1.28 Tbps throughput, 960 Mpps forwarding capacity, and low power consumption, the QFX3500 is a highly efficient solution for aggregating high-performance servers in the data center. The QFX3500 can operate in both cut-through and store-and-forward modes and delivers sustained wire-speed switching with sub-microsecond latency and low jitter for any packet size (including jumbo frames) in both modes.
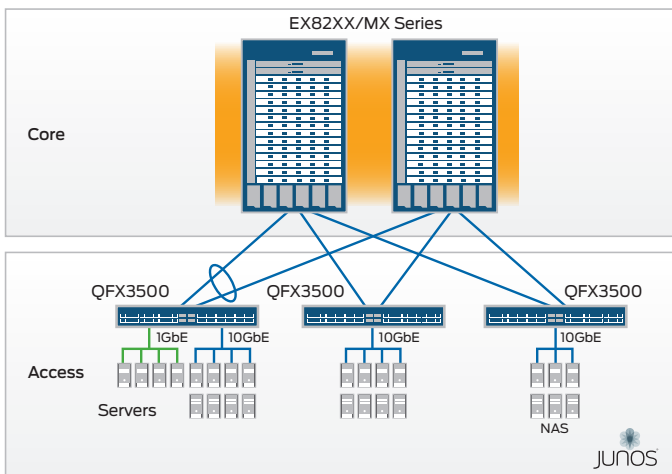
High-Performance DCB, Storage, and I/O Convergence Deployments

The QFX3500 is a fully IEEE DCB- and T11 FC-BB-5-based FCoE Transit Switch and FCoE-FC Gateway, delivering a high-performance solution for converged server edge access environments. The QFX3500 provides configurable ports capable of 1GbE, 10GbE, and 2/4/8 Gbps FC connectivity.

- **FCoE Transit Switch:** As an FCoE Transit Switch, the QFX3500 provides a pure IEEE DCB converged access layer between FCoE-enabled servers and an FCoE-enabled Fibre Channel SAN (see Figure 3, Scenario 1). The QFX3500 offers a full featured DCB implementation that provides strong monitoring capabilities on the top-of-rack switch for SAN and LAN administration teams, while maintaining a clear separation of management. In addition, FC Initiation Protocol (FIP) snooping provides perimeter protection, ensuring that the presence of an Ethernet layer does not impact existing SAN security policies. The FCoE Transit Switch functionality, along with Priority-based Flow Control (PFC), Enhanced Transmission Selection (ETS), and Data Center Bridging Exchange (DCBX), are included as part of the default software; no additional licenses are required.
- **FCoE-FC Gateway:** In FCoE-FC Gateway mode, the QFX3500 eliminates the need for FCoE enablement in the SAN backbone. Organizations can add a converged access layer and interoperate with existing SANs without disrupting the network. The QFX3500 allows up to 12 ports to be converted to Fibre Channel without requiring additional switch hardware modules, and gateway functionality can be soft provisioned with a software license to protect existing investments. The QFX3500 provides N-Port ID virtualization (NPIV) proxy functionality between FCoE-enabled servers and traditional Fibre Channel SANs. As a top-of-rack switch with FCoE-FC Gateway functionality, the QFX3500 presents itself as an FCoE-enabled switch to the rack or blade servers, and as a group of logical FC servers to the traditional Fibre Channel SAN (see Figure 3, Scenario 2).
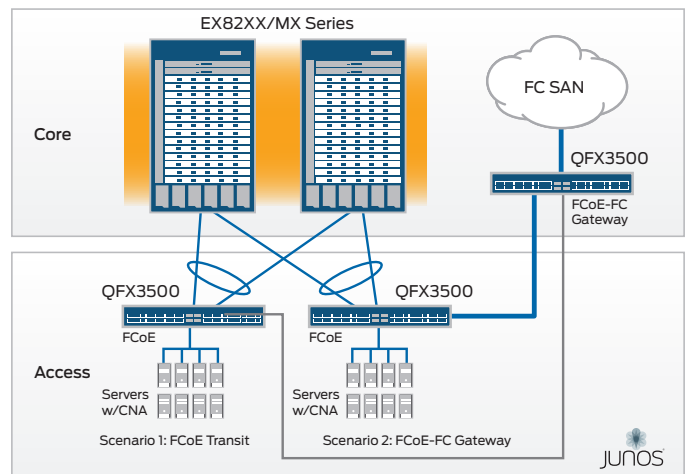

Figure 2: QFX3500 high-performance Ethernet L2 and L3 access deployment scenario

Figure 3: High-performance DCB, storage, and I/O convergence deployment scenarios

Fabric Edge Solution of Juniper Networks QFabric Architecture

The QFX3500 also delivers a fabric-ready solution that, with a simple configuration change, easily transitions into a QFabric Node edge device that serves as a building block for the Juniper Networks QFabric federated architecture, protecting existing investments while providing a seamless architectural migration to a single-tier data center network.
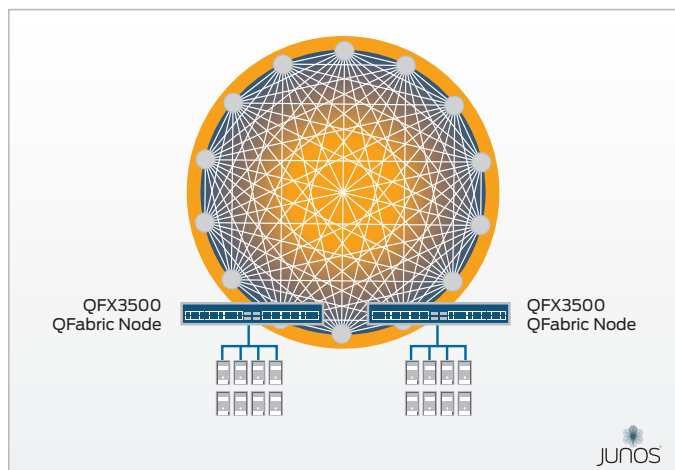

Figure 4: The QFX3500 can also serve as a fabric edge solution of the Juniper Networks QFabric architecture

Junos Operating System

The QFX3500 runs the same reliable and high-performance Juniper Networks Junos® operating system that is used by Juniper Networks EX Series Ethernet Switches, Juniper Networks routers, and Juniper Networks SRX Series Services Gateways. By utilizing a common operating system, Juniper delivers a consistent implementation and operation of control plane features across products. To maintain that consistency, Junos OS adheres to a highly disciplined development process, follows a single release track, and employs a highly available modular architecture that prevents isolated failures from bringing down an entire system. These attributes are fundamental to the core value of the software, enabling Junos OS-powered products to be updated simultaneously with the same software release. Features are fully regression tested, making each new release a superset of the previous version. Customers can deploy the software with confidence that existing capabilities will be maintained and operate consistently.

Management Capabilities

The following system management options are available for the QFX3500 Switch.

- The standard Junos OS command-line interface (CLI) and SNMP module offers the same granular management capabilities and scripting parameters found in any router or switch powered by Junos OS.
- QFX3500 fault, performance, and configuration data can also be exported to leading third-party management systems such as HP OpenView, IBM Tivoli, and Computer Associates Unicenter software, providing a complete, consolidated view of network operations.
- The QFX3500 is supported by Juniper Networks Junos® Space, an open, programmable application platform for hosting a comprehensive suite of network operational application tools that provide an open approach for automating the deployment and operation of a Juniper infrastructure. Explicitly designed to allow partners and customers to build and deploy smart, simple, and easy-to-use applications, Junos Space provides multiple management and infrastructure applications for managing Juniper resources and assets, including inventory management, device and interface configuration, automated software management and deployment, and event-driven fault management. These Junos Space applications offer predefined automation schemes and best practice templates to enable rapid and accurate deployments.
- The QFX3500 also supports the Junos XML management protocol and Junos XML management protocol automation tools. The Junos XML management protocol facilitates the quick and easy development of custom applications and scripts using the XML programming language. Junos XML management protocol automation tools provide early detection and automatic resolution of potential problems related to the operating system.

Features and Benefits

The QFX3500 Switch includes the following key features and benefits:

- **Performance**: The QFX3500 delivers 1.28 Tbps of throughput and 960 Mpps of switching capacity to sustain wire-speed switching with ultra low latency and low jitter. All ports can run at full wire-speed capacity with full performance in both L2 and L3 mode, with the option to operate in either cut-through or store-and-forward mode.

- **Reliability**: The QFX3500 is designed with robust high availability features that include redundant power supplies and fan modules to ensure hardware availability. Control plane and data plane separation, combined with the Junos OS high availability design, ensures maximum systems-level availability.

- **Server Virtualization**: The QFX3500 Switch supports a large media access control (MAC) address table that enables large-scale server virtualization deployment. The QFX3500 is also supported by Junos Space Virtual Control, which unifies physical and virtual infrastructures to provide network operators with a comprehensive view into the complete end-to-end network. In addition, the QFX3500 Switch will support the IEEE 802.1Qbg standard to enable Virtual Ethernet Port Aggregator (VEPA) deployment.

- **Energy Efficiency and Environmental Friendliness:** The QFX3500 is an environmentally conscious green solution that lowers operational expenses. The switch consumes less than 5 watts per 10GbE port, while variable speed fans dynamically adjust their speed based on ambient temperature to optimize operating power. With maximum power consumption of 365 W and nominal power of 295 W, the QFX3500 is certified for Silver PSU Efficiency at 85%.

The QFX3500 is also certified for environmentally responsible compliance with labels such as Reduction of Hazardous Substances (ROHS), Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH), and Waste Electronics and Electrical Equipment (WEEE).

QFX3500

QFX3500 Switch Specifications

Hardware

System
- Switching capacity: 1.28 Tbps and 960 Mpps switching capacity
- Switching mode: Cut-through and store-and-forward
- Weight: 30.75 lb (13.95 kg) with dual power supplies and fan modules
- Front-to-back airflow (for hot aisle/cold isle deployment)
- Rear port connections

Interface Options
- 48 SFP+ ports
  - 36 dual-mode 10GbE or GbE ports
  - 12 dual-mode 10GbE or 2/4/8 Gbps FC ports
- Four QSFP+ ports*
  - Each QSFP+ port can be configured as a 4 x 10GbE interface*
  - Each QSFP+ port can be configured as a 40 Gbps port*
- Dual management ports
- USB port
- Console port

Supported Transceiver and Direct Attach Cable
- SFP+ 10GbE optical modules
- SFP+ DAC cables: 1/3/5 m twinax copper and 1/3/5 m active twinax copper
- SFP Fibre Channel 2/4/8 Gbps module
- SFP GbE optical and copper module

Dimension
- Height: 1.75 in (4.45 cm), 1 U
- Width: 17.25 in (43.82 cm)
- Depth: 28 in (71.12 cm)

Rack Installation Kit
- Versatile four post mounting options for 19-in server rack or datacom rack

Display and Ports
- LCD panel for system monitoring

Airflow
- Front-to-back cooling
- Redundant variable-speed fans to reduce power draw

Power Supply and Fan Modules
- Dual redundant (1+1) and hot-pluggable power supplies
- 110-240 V single phase AC power
- Redundant and hot-pluggable fan modules

Performance Scale
- MAC addresses per system: 96,000
- VLAN IDs: 4,095 active, 4,089 configurable
- Number of link aggregation groups (LAGs): 48
- Number of ports per LAG: 8
- Firewall filters: 1,500
- IPv4 unicast routes: 12,000 prefixes; 8,000 host routes
- Multicast groups: 3,500
- Jumbo frame: 9,216 bytes
- Spanning Tree Protocol (STP)
  - Multiple Spanning Tree Protocol (MSTP) instances: 64
  - VLAN Spanning Tree Protocol (VSTP) instances: 253
- Traffic mirroring
  - Mirroring destination ports per switch: 4
  - Maximum number of mirroring sessions: 4
  - Mirroring destination VLANs per switch: 4

*Roadmap

QFX3500 Switch Specifications (continued)

Layer 2 Features

- STP – IEEE 802.1D (802.1D-2004)
- Rapid Spanning Tree Protocol (RSTP) (IEEE 802.1w), MSTP (IEEE 802.1s)
- Bridge protocol data unit (BPDU) protect
- Loop protect
- Root protect
- RSTP and VSTP running concurrently
- VLAN – IEEE 802.1Q VLAN trunking
- Routed VLAN Interface (RVI)
- Port-based VLAN
- MAC address filtering
- Static MAC address assignment for interface
- Per VLAN MAC learning (limit)
- MAC learning disable
- Link Aggregation and Link Aggregation Control Protocol (LACP) (IEEE 802.3ad)
- IEEE 802.1AB Link Layer Discovery Protocol (LLDP)
- Jumbo frame (9,216 bytes)

Link Aggregation

- LAG load sharing algorithm—bridged or routed (unicast or multicast) traffic:
  - IP: SIP, Dynamic Internet Protocol (DIP), TCP/UDP source port, TCP/UDP destination port
  - Layer 2 and non-IP: MAC SA, MAC DA, Ethertype, VLAN ID, source port
  - FCoE packet: Source ID (SID), Destination ID (DID), Originator exchange ID (OXID), source port

Layer 3 Features (IPv4)

- Static routing
- Routing policy
- Routing protocols (OSPF, BGP etc.)*
- Virtual Router Redundancy Protocol (VRRP)*
- Bidirectional Forwarding Detection (BFD) protocol*
- Virtual router*
- Dynamic Host Configuration Protocol (DHCP) relay*

Multicast Features

- Internet Group Management Protocol (IGMP) snooping v1 and v2
- IGMP snooping v3*
- L3 multicast routing protocols*
- Multicast Source Directory Protocol (MSDP)*

Security and Filters

- Secure interface login and password
- RADIUS
- TACACS+
- Ingress and egress filters: Allow and deny, port filters, VLAN filters, routed filters
- Filter actions: Logging, system logging, reject, mirror to an interface, counters, assign forwarding class, permit, drop, police, mark
- SSH v1, v2
- Static Address Resolution Protocol (ARP) support
- Storm control, port error disable, and auto-recovery
- Control plane denial of service (DoS) protection

Quality of Service (QoS)

- L2 QoS: Classification, rewrite, queuing
- L3 QoS
- Rate limiting:
  - Ingress policing: 1 rate 2 color, 2 rate 3 color
  - Egress policer, policer mark down action
  - Egress shaping: Per queue, per port
- 12 hardware queues per port (8 unicast and 4 multicast)
- Strict priority queuing (LLQ) , smoothed deficit weighted round-robin (SDWRR), weighted random early detection (WRED), weighted tail drop
- 802.1p remarking
- Layer 2 classification criteria: Interface, MAC address, Ethertype, 802.1p, VLAN
- Congestion avoidance capabilities: WRED
- Trust IEEE 802.1p/DSCP (ingress)
- Remarking of bridged packets

Data Center Bridging (DCB)

- Priority-based Flow Control (PFC) – IEEE 802.1Qbb
- Enhanced Transmission Selection (ETS) – IEEE 802.1Qaz
- Data Center Bridging Exchange Protocol (DCBX) – part of the ETS standard
- Ethernet Congestion Management (QCN) – IEEE 802.1Qau*

Fibre Channel over Ethernet (FCoE)

- FCoE Transit Switch (FIP snooping)
- FCoE-FC Gateway (with FC feature license)

Fibre Channel Standard

- FC port speeds: 2, 4, 8 Gbps
- FC port types: N_Port, VF_Port
- FC classes of service: Class 3
- FC services: N_Port ID Virtualization (NPIV) gateway
- FCoE support: FC-BB-5 FC-BB_E, including FIP snooping

Server Virtualization Management

- Junos Space Virtual Control
- IEEE 802.1Qbg*

Management and Operations

- Role-based CLI management and access
- CLI via console, telnet, or SSH
- Show and debug commands, statistics
- Extended ping and traceroute
- Junos OS configuration rescue and rollback
- Image rollback
- SNMP v1/v2/v3
- Junos XML management protocol

Traffic Mirroring

- Port-based
- LAG port
- VLAN-based
- Filter-based
- Mirror to local
- Mirror to remote destinations (L2 over VLAN)

*Roadmap

QFX3500 Switch Specifications (continued)

Standards Compliance

IEEE standard

- IEEE 802.1D
- IEEE 802.1w
- IEEE 802.1
- IEEE 802.1Q
- IEEE 802.1p
- IEEE 802.3ad
- IEEE 802.1AB
- IEEE 802.3x
- IEEE 802.1Qbb
- IEEE 802.1Qaz
- IEEE 802.1Qau*
- IEEE 802.1Qbg*

T11 Standards

- INCITS T11 FC-BB-5
- Supported RFC
- RFC 768 UDP
- RFC 783 Trivial File Transfer Protocol (TFTP)
- RFC 791 IP
- RFC 792 ICMP
- RFC 793 TCP
- RFC 826 ARP
- RFC 854 Telnet client and server
- RFC 894 IP over Ethernet
- RFC 903 RARP
- RFC 906 TFTP Bootstrap
- RFC 951, 1542 BootP
- RFC 1122 Host requirements
- RFC 1256 IPv4 ICMP Router Discovery (IRDP)
- RFC 1492 TACACS+
- RFC 1519 Classless Interdomain Routing (CIDR)
- RFC 1812 Requirements for IP Version 4 routers
- RFC 2030 SNTP, Simple Network Time Protocol
- RFC 2068 HTTP server
- RFC 2138 RADIUS Authentication
- RFC 2139 RADIUS Accounting
- RFC 2267 Network ingress filtering
- RFC 5176 Dynamic Authorization Extensions to RADIUS

Supported MIBs

- RFC 1155 SMI
- RFC 1157 SNMPv1
- RFC 1212, RFC 1213, RFC 1215 MIB-II, Ethernet-Like MIB and TRAPs
- RFC 1901 Introduction to Community-based SNMPv2
- RFC 2011 SNMPv2 for Internet protocol using SMIv2
- RFC 2012 SNMPv2 for transmission control protocol using SMIv2
- RFC 2013 SNMPv2 for user datagram protocol using SMIv2
- RFC 2233, The Interfaces Group MIB Using SMIv2
- RFC 2287 System Application Packages MIB
- RFC 2570 Introduction to Version 3 of the Internet-standard Network Management Framework
- RFC 2571, An Architecture for describing SNMP Management Frameworks (read-only access)

Supported MIBs (continued)

- RFC 2572, Message Processing and Dispatching for the SNMP (read-only access)
- RFC 2576 Coexistence between SNMP Version 1, Version 2, and Version 3
- RFC 2578 SNMP Structure of Management Information MIB
- RFC 2579 SNMP Textual Conventions for SMIv2
- RFC 2580 Conformance Statements for SMIv2
- RFC 2665 Ethernet-like interface MIB
- RFC 2790 Host Resources MIB
- RFC 2819 RMON MIB
- RFC 2863 Interface Group MIB
- RFC 3410 Introduction and Applicability Statements for Internet Standard Management Framework
- RFC 3411 An architecture for describing SNMP Management Frameworks
- RFC 3412 Message Processing and Dispatching for the SNMP
- RFC 3413 Simple Network Management Protocol (SNMP) – (all MIBs are supported except the Proxy MIB)
- RFC 3414 User-based Security Model (USM) for version 3 of SNMPv3
- RFC 3415 View-based Access Control Model (VACM) for the SNMP
- RFC 3416 Version 2 of the Protocol Operations for the SNMP
- RFC 3417 Transport Mappings for the SNMP
- RFC 3418 Management Information Base (MIB) for the SNMP
- RFC 3584 Coexistence between Version 1, Version 2, and Version 3 of the Internet-standard Network Management Framework
- RFC 3826 The Advanced Encryption Standard (AES) Cipher Algorithm in the SNMP User-based Security Model
- RFC 4188 Definitions of Managed Objects for Bridges
- RFC 4318 Definitions of Managed Objects for Bridges with Rapid Spanning Tree Protocol
- RFC 4363b Q-Bridge VLAN MIB

Safety

- CAN/CSA-C22.2 No. 60950-1 (2007) Information Technology Equipment - Safety
- UL 60950-1 (2nd Ed.) Information Technology Equipment - Safety
- EN 60950-1 (2005) Information Technology Equipment - Safety
- IEC 60950-1 (2005) Information Technology Equipment - Safety (All country deviations): CB Scheme report.
- EN 60825-1 +A1+A2 (1994) Safety of Laser Products - Part 1: Equipment Classification
- GR-63-Core (2006) Network Equipment, Building Systems (NEBS) Physical Protection
- GR-1089-Core (2006) EMC and Electrical Safety for Network Telecommunications Equipment
- SR-3580 (1995) NEBS Criteria Levels (Level 3) (pending)

EMC

- FCC 47CFR , Part 15 Class A (2009) USA Radiated Emissions
- EN 55022 Class A (2006)+ A1 2007 European Radiated Emissions
- VCCI Class A (2007) Japanese Radiated Emissions
- BSMI CNS 13438 and NCC C6357 Taiwan Radiated Emissions
- AS/NZS CISPR22:2009

*Roadmap

QFX3500 Switch Specifications (continued)

Environmental Compliance

Restriction of Hazardous Substances (ROHS) 6/6

Silver PSU Efficiency

Recycled material

Waste Electronics and Electrical Equipment (WEEE)

Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH)

China Restriction of Hazardous Substances (ROHS)

Telco
· Common Language Equipment Identifier (CLEI) code

Environmental Ranges
· Operating temperature: 32º to 104º F (0º to 40º C)
· Storage temperature: -40º to 158º F (-40º to 70º C)
· Operating altitude: up to 2,000
· Relative humidity operating: 5% to 90% (non-condensing)
· Relative humidity non-operating: 0% to 95% (non-condensing)

Juniper Networks Services and Support

Juniper Networks is the leader in performance-enabling services and support, which are designed to accelerate, extend, and optimize your high-performance network. Our services allow you to bring revenue-generating capabilities online faster so you can realize bigger productivity gains and faster rollouts of new business models and ventures. At the same time, Juniper Networks ensures operational excellence by optimizing your network to maintain required levels of performance, reliability, and availability. For more details, please visit **www.juniper.net/us/en/ products-services**.

Ordering Information

MODEL NUMBER	DESCRIPTION
Base Hardware	
QFX3500-48S4Q-ACR	QFX3500, 48 SFP+/SFP and 4 QSFP ports, redundant dual AC power supply, front to back air flow
Hardware Spares	
QFX3500-48S4Q	QFX3500, 48 SFP+/SFP and 4 QSFP ports (spare)
QFX3500-MB	Management board for QFX3500-48S4Q (spare)
QFX3500-FANAI	Fan module A (Intake) for QFX3500-48S4Q (spare)
QFXC01-PWRACI-650A	650 W power supply A (with Intake air flow) for QFX (spare)
QFX3500-RMAR	Rear rack mount bracket A for QFX (spare)
Power Cables	
CBL-EX-PWR-C13-US	AC power cable, US (13 A/125 V, 2.5 meter)
CBL-EX-PWR-C13-EU	AC power cable, Europe (10 A/250 V, 2.5 meter)
CBL-EX-PWR-C13-AU	AC power cable, Australia (10 A/250 V, 2.5 meter)
CBL-EX-PWR-C13-CH	AC power cable, China (10 A/250 V, 2.5 meter)
CBL-EX-PWR-C13-IT	AC power cable, Italy (10 A/250 V, 2.5 meter)
CBL-EX-PWR-C13-JP	AC power cable, Japan (12 A/125 V, 2.5 meter)
CBL-EX-PWR-C13-KR	AC power cable, Korea (10 A/250 V, 2.5 meter)
CBL-EX-PWR-C13-SZ	AC power cable, Switzerland (10 A/250 V, 2.5 meter)
CBL-EX-PWR-C13-UK	AC power cable, UK (10 A/250 V, 2.5 meter)
Optics and Transceivers	
QFX-SFP-10GE-SR	SFP+ 10GBASE-SR 10 Gigabit Ethernet Optics, 850 nm for up to 300 m transmission on multimode fiber-optic (MMF)
QFX-SFP-10GE-USR	SFP+ 10 Gigabit Ethernet Ultra Short Reach Optics, 850 nm for 10 m on OM1, 20 m on OM2, 100 m on OM3 multimode fiber
QFX-SFP-10GE-LR	SFP+ 10GBASE-LR 10 Gigabit Ethernet Optics, 1310 nm for 10 km transmission on single mode fiber-optic (SMF)
QFX-SFP-DAC-1M	SFP+ 10 Gigabit Ethernet Direct Attach Copper (twinax copper cable) 1 m
QFX-SFP-DAC-3M	SFP+ 10 Gigabit Ethernet Direct Attach Copper (twinax copper cable) 3 m
QFX-SFP-DAC-5M	SFP+ 10 Gigabit Ethernet Direct Attach Copper (twinax copper cable) 5 m
QFX-SFP-DAC-1MA	SFP+ 10 Gigabit Ethernet Direct Attach Copper (active twinax copper cable) 1 m
QFX-SFP-DAC-3MA	SFP+ 10 Gigabit Ethernet Direct Attach Copper (active twinax copper cable) 3 m
QFX-SFP-DAC-5MA	SFP+ 10 Gigabit Ethernet Direct Attach Copper (active twinax copper cable) 5 m
QFX-SFP-8GFC-SW	SFP 2/4/8-Gbps Fibre Channel SW Optics
QFX-SFP-1GE-T	SFP 1000BASE-T Copper Transceiver Module for up to 100 m transmission on Cat5
QFX-SFP-1GE-SX	SFP 1000BASE-SX Gigabit Ethernet Optics, 850 nm for up to 550 m transmission on MMF
QFX-SFP-1GE-LX	SFP 1000BASE-LX Gigabit Ethernet Optics, 1310 nm for 10 km transmission on SMF
Clustering Licenses	
QFX-JSL-EDGE-FC	QFX Series edge feature license for FCoE-FC gateway

About Juniper Networks

Juniper Networks is in the business of network innovation. From devices to data centers, from consumers to cloud providers, Juniper Networks delivers the software, silicon and systems that transform the experience and economics of networking. The company serves customers and partners worldwide. Additional information can be found at **www.juniper.net**.

Printed on recycled paper