Data Sheet

QFX10002 AND QFX10003 FIXED ETHERNET SWITCHES

Product Description

Juniper Networks® QFX10000 line of Switches offers 400GbE, 100GbE, 40GbE, and 10GbE options in a compact form factor. All switches support quad small form-factor pluggable plus transceiver (QSFP+ transceiver) and QSFP28 ports for 40GbE and 100GbE speeds, respectively. With support for 400GbE, 100GbE, 40GbE, and 10GbE in a single platform, the QFX10000 Switches provide the foundation for today's data center, delivering long-term investment protection for current and emerging requirements.

Built on custom, Juniper-designed Q5 ASICs, the high-performance, highly versatile QFX10000 fixed-configuration switches scale up to 6 Tbps of throughput. These switches offer the industry's highest 100GbE port density with deep buffers—up to 60 ports in a 2 U fixed form factor. The switches enable a simple, consolidated network design and allow customers to seamlessly evolve data center networks from existing 10GbE and 40GbE architectures to 100GbE to keep pace with evolving needs.

The QFX10000 line of fixed configuration switches includes two members: Juniper Networks QFX10002 Switch and QFX10003 Switch.

- **QFX10002** switches can be deployed in a number of different designs and fabrics for Layer 2 and Layer 3 networks, including multichassis link aggregation (MC-LAG), Juniper Networks Junos® Fusion, and Ethernet VPN/Virtual Extensible LAN (EVPN/VXLAN)-based configurations on IP fabric underlay. The open architecture enables customers to build on top of Juniper Networks Junos® operating system to accelerate their pace of innovation. The 2 U QFX10002 switches also support Data Center Interconnect (DCI), critical to workload mobility and application availability.

- **QFX10003** switches are the industry’s first 400GbE-capable data center switching platform, focused on high-density 100GbE and 400GbE next-generation IP fabric data centers. Optimized for modern data centers running 25GbE, 40GbE, 50GbE, and 100GbE top-of-rack (TOR) and interconnect links, the compact 3 U QFX10003—the third-generation QFX10000 data center fixed form-factor switch—is easily deployable in small to medium-sized cloud environments. The QFX10003 provides flexible deployment options for data centers of various sizes and complexity, providing a robust platform for supporting large-scale 100GbE and 400GbE fabrics and allowing customers to cost-effectively expand their 100GbE footprint into 400GbE in a fraction of the space.

For networks evolving to SDN, the QFX10002 and QFX10003 switches can integrate with OpenContrail® and VMware NSX SDN controllers, giving users options for SDN systems. The switches perform both VXLAN L2 and L3 gateway functionality. The open, standards-based platform also interoperates with Open vSwitch Database (OVSDB) to support automated management and control capabilities.
QFX10003 Highlights

- Up to 160 x 100GbE ports in a 3 U form factor
- Two configuration options available: the QFX10003-80C (80 x 100GbE) or QFX10003-160C (160 x 100GbE)
- Up to 16 Tbps Layer 2 and Layer 3 performance
- Unparalleled investment protection with support for 100GbE and 400GbE in the same platform
- On-chip memory per Packet Forwarding Engine (PFE) for media access control (MAC) and access control list (ACL)
- Flexible network architectures including L3 fabric and for L2 and L3 networks (IP Fabric, EVPN/VXLAN)
- Juniper virtualized open network operating system framework for programmability through APIs
- Rich MPLS feature capability
- Rich automation capabilities with Python, Chef Puppet, and zero-touch provisioning (ZTP)

QFX10002 Highlights

- Up to 60 100GbE ports and 72 40GbE ports in a 2 U form factor
- Up to 6 Tbps Layer 2 and Layer 3 performance
- Unparalleled investment protection with support for 10GbE, 40GbE, and 100GbE in the same platform
- Highest logical L2/L3 scale—up to 1 million MAC addresses, 2 million host routes, and 2 million forwarding information base forwarding tables
- Unparalleled congestion management with deep buffers using Hybrid Memory Cube (HMC) memory (100 ms per port)
- On-chip memory per PFE for MAC and ACL
- No head-of-line blocking with virtual output queue (VOQ)-based architecture
- Flexible network architectures, including L3 fabric and Juniper’s MC-LAG for L2 and L3 networks (EVPN/VXLAN; Junos Fusion)
- Juniper virtualized open network operating system framework for programmability through APIs
- Rich MPLS feature capability (L2CKT, L3VPN, 6VPE, MPLS-TE/FRR)
- Advanced multicast capabilities (NG-MVPN, MoFRR)
- Industry-leading EVPN/VXLAN data center fabric capabilities
- Advanced DCI capabilities (with features such as EVPN/MPLS, P2MP-TE, MLDP)
- Advanced visibility with streaming telemetry support
- Rich automation capabilities with Python, Chef Puppet, and ZTP

Architecture and Key Components

QFX10003 Switch Models

The QFX10003 includes two fixed 3 U switch models, each providing wire-speed packet performance in 10GbE, 40GbE, and 100GbE speeds. Both switches provide a rich set of Junos OS features. In addition to a high-throughput 1 Tbps Q5 ASIC, the control plane performance on all QFX10003 switches is further enhanced with a powerful 1.9 GHz 12-core Intel CPU with 64 GB of SDRAM.

- QFX10003-80C: 25GbE/100GbE/200GbE/400GbE switch ports with two redundant 3000 W AC/DC power supplies and three fan trays.
- QFX10003-160C: 25GbE/100GbE/200GbE/400GbE switch ports with four redundant 3000 W AC/DC power supplies and five fan trays.

QFX10002 Switch Models

The QFX10002 includes three fixed 2 U switch models, each providing wire-speed packet performance in 10GbE, 40GbE, and 100GbE speeds. All three switches provide a rich set of Junos OS features. In addition to a high throughput Q5 ASIC, the control plane performance on all QFX10002 switches is further enhanced with a powerful 2.5 GHz quad core Intel CPU and from 16 to 32 GB of SDRAM.

- QFX10002-60C: The QFX10002-60C 100GbE switch features 60 QSFP28 ports, 60 QSFP+ 40GbE ports, or 192 QSFP+ 10GbE ports with four redundant 1600 W AC/DC power supplies and three fan trays.
- QFX10002-36Q: The QFX10002-36Q 40GbE switch features 36 QSFP+ ports or 12 QSFP28 100GbE ports with two redundant 1600 W AC/DC power supplies and three fan trays.
- QFX10002-72Q: The QFX10002-72Q 40GbE switch offers 72 QSFP+ ports or 24 QSFP28 100GbE ports with four redundant 1600 W AC/DC power supplies and three fan trays.

The Q5 ASIC

![The custom-built Juniper Q5 ASIC](image)
The QFX10002 and QFX10003 switches are built with the Juniper custom Q5 Express ASIC, which offers industry-leading performance and scale with 500 Gbps or 1 Tbps of switching throughput and support for network virtualization with VXLAN, EVPN, and MPLS. The Q5 ASIC is 400GbE-ready and embedded with an on-chip analytics capability, along with a precision timing protocol and high-frequency monitoring. The 1 Tbps Q5 Express Plus ASIC adds support for 25GbE/50GbE, 400GbE, and Media Access Control Security (MACsec) per port based on 16 nm technology.

**Flexible Network Architectures**

QFX10002 and QFX10003 fixed-configuration switches support a diverse set of deployment options, including L3 fabric and L2 and L3 networks with MC-LAG. Customers can choose the architecture that best suits their deployment needs and easily adapt and evolve as requirements change over time. The QFX10002 and QFX10003 serve as the universal building block for all of these switching architectures, enabling data center operators to build cloud networks their way.

- **Layer 3 Fabric**: For customers looking to build scale-out data centers, a Layer 3 spine and leaf Clos fabric is ideal due to its nonblocking and predictable performance and scale characteristics. For example, a two-tier fabric with QFX10002 or QFX10003 switches as the spine and QFX5100 switches as leafs can scale to support more than 6900 10GbE server ports at 3:1 oversubscription.

One of the most complicated tasks in building an IP fabric is assigning all of the details such as IP addresses, BGP autonomous system (AS) numbers, routing policy, loopback address assignments, and many other implementation details. The second largest problem is automating the creation of an IP fabric at a large scale. Juniper has created the OpenClos project to provide free and open-source tools to automate the creation of IP fabrics in the data center. OpenClos is a set of Python scripts that has been developed as an open-source project and lives on GitHub. OpenClos takes a set of inputs that describe the shape and size of a data center and it outputs network switch configuration files and even a cabling plan.

- **MC-LAG**: QFX10002 and QFX10003 switches eliminate Spanning Tree Protocol (STP) in traditional L2 networks when deployed in an MC-LAG configuration. The active/active operation of MC-LAG ensures complete bandwidth utilization between the network’s access and aggregation layers, while the dual control plane technology ensures highest availability for applications.

- **Overlays**: Customers can deploy overlay networks to provide Layer 2 adjacencies for applications over Layer 3 fabrics. The overlay networks use VXLAN in the data plane and EVPN or OVSDB for programming the overlays. The overlays can operate without a controller or can be orchestrated with an SDN controller like OpenContrail or VMware NSX.

**Carrier-Class Operating System**

The QFX10002 fixed-configuration switches run the same Junos OS used by all other Juniper Networks EX Series and QFX Series Ethernet Switches, as well as the Juniper Networks routers that power the world’s largest and most complex networks.

By using a common operating system, Juniper delivers a consistent implementation and operation of control plane features across all products. Junos OS employs a highly available modular architecture that prevents isolated failures from bringing down an entire system. Key Junos OS features that enhance the functionality and capabilities of the QFX10002 and QFX10003 switches include:

- Software modularity, with process modules running independently in their own protected memory space and with the ability to do process restarts
- Uninterrupted routing and forwarding, with features such as nonstop routing (NSR) and nonstop bridging (NSB)
- Commit and rollback functionality, which ensures error-free network configurations
- A powerful set of scripts for on-box problem detection, reporting, and resolution

Additionally, the QFX10003 switches run a new distributed, open, and extendable Junos OS architecture. This evolved Junos
OS architecture features the following capabilities:

- Gracefully handles very high scale and complex network topology events
- Supports a rich application infrastructure
- Minimizes boilerplate application code
- Simplifies application development
- Supports modern programming languages and paradigms
- Offers data-driven design with rich visibility
- Features modular design with clean interfaces between components
- Provides fault isolation between components
- Supports fault tolerance to component failures
- Offers high availability
- Supports component upgrades without system reboot

Junos OS Evolved uses a stable base operating system with Linux WRL 9, while Juniper provides additional kernel modules and applications which allow fast base OS upgrades, portability, and the use of standard Linux tools. It also uses a Distributed Data Store (DDS) to hold and share the state of the events between different daemons. DDS holds both operational and configuration state, i.e., committed configuration, interface state, routes, hardware state.

Figure 3 shows the Junos OS Evolved interaction between different daemons when using distributed data store infrastructure.

Juniper Virtualized Open Network Operating System Framework

The QFX10002 and QFX10003 switches have an open software architecture that enables customers to innovate along with Juniper to accelerate the pace of innovation. Customers can create and run applications alongside Junos OS; these applications can then follow their own software release schedules.

This new solution offers modularity and direct programmability through APIs. The platform and Packet Forwarding Engine (PFE) modules are separate from the control module(s). Customers can create and run guest applications, either as a VM or a Linux process (daemon), alongside Junos OS. They can also communicate with Junos OS as well as directly with platform tools.
and PFE modules through normalized programmable APIs. Having the ability to build applications that can program the QFX10002 and QFX10003 control plane, data plane, and the platform itself, customers can implement specific and unique network forwarding functions and automate the control and management by integrating with their own SDN controller and orchestration tools. The QFX10002 and QFX10003 programmable APIs have a stable abstraction so that the customer’s applications can work across Juniper platforms as well as future Junos OS releases. Based on Apache Thrift, the QFX10002 and QFX10003 switches support standardized API definitions via Interface Description Language (IDL), while allowing users to employ their favorite programming language. Other services such as analytics and automation can also run as separate processes (daemons) and can be directly accessed through orchestration tools.

Junos Telemetry Interface

The QFX10002 and QFX10003 support Junos Telemetry Interface, a modern telemetry streaming tool designed for performance monitoring in complex, dynamic data centers. Streaming data to a performance management system enables network administrators to measure trends in link and node utilization, and troubleshoot such issues as network congestion in real time. Junos Telemetry Interface provides the following capabilities:

- Application visibility and performance management by provisioning sensors to collect and stream data and analyze application and workload flow through the network
- Capacity planning and optimization by proactively detecting hotspots and monitoring latency and microbursts
- Troubleshooting and root cause analysis via high-frequency monitoring and correlation of overlay and underlay networks

Monitoring and Analytics with Juniper AppFormix

Juniper AppFormix®, a network and device monitoring platform, provides comprehensive visualization and smart analytics for the QFX10002 and QFX10003 switches. Powered by machine learning and artificial intelligence, AppFormix automatically learns network and device performance profiles, detects faults, and facilitates preventative remediation in real time at scale. Based on a distributed policy and analytics architecture, AppFormix seamlessly collects and analyzes telemetry in real time from the QFX10000 fixed-configuration platforms via Junos Telemetry Interface or OpenConfig, generating events and alert notifications and providing actionable insights to the operator. AppFormix delivers the following features and benefits:

- **Real-time metrics and alarms**: AppFormix collects and analyzes comprehensive metrics in real time for monitored networks and devices, displaying them in the AppFormix dashboard as real-time charts and graphs. With AppFormix, an operator can also configure alarms for individual or groups of metrics that are triggered when specific values or conditions are met, or when anomalies occur, notifying the operator in real time. AppFormix software also plots these alarms on both real-time and historical charts, giving the operator a holistic view of current status as well as prevailing trends.
• **SLA Monitor**: The AppFormix dashboard includes an SLA Monitor pane that provides operators with an overview indicating the current state of the network and devices. The SLA status indicates whether the network and the device are currently operating outside a user-defined performance threshold, while risk predicts whether the device may be unhealthy in the future based on historical trends.

• **Notifications**: AppFormix can be configured to notify external systems when events and alarms are triggered. For each event or alarm, AppFormix can post a structured description of the event as a JavaScript Object Notation (JSON) payload to an external HTTP endpoint. These notifications can initiate an action or workflow, whether corrective, preventive, or otherwise, to keep the network and devices operating in an optimal state. For operator convenience, AppFormix comes preconfigured with PagerDuty, ServiceNow, and Slack, some of the industry’s most popular incident management and collaboration platforms.

• **Reports**: AppFormix reports allow users to analyze how networks and devices are being consumed over time. The dashboard displays reports in both graphical and tabular formats. Users may also download the data as an HTML-formatted report, raw comma-separated value (CSV) file, or JSON-formatted statistics for further analysis.

**Contrail Networking**

The QFX10000 fixed-configuration switches can be managed with Juniper Networks Contrail Networking™, a fabric management and SDN overlay solution that provides full life-cycle management for both data center and data center interconnect infrastructures. Contrail Networking automates data center operations so users can focus on revenue-generating services rather than operational networking procedures.

Contrail Networking works with any standard IP Clos architecture, performing configuration operations across virtual networks and physical devices by leveraging open protocols such as Network Configuration Protocol/remote procedure call (NETCONF/RPC). Using a centralized controller with a management interface, Contrail Networking provides customizable configuration templates that adapt to a vast array of architectures and use cases to ease network and device operations. Contrail Networking abstracts network connectivity using virtual overlays connecting cloud-native workloads with traditional workloads running on bare-metal servers attached to the QFX10002 and QFX10003.

Contrail Networking also enables the provisioning and automation of data center fabrics and DCI using a common, consistent data model for configuring devices. Key capabilities include:

- Infrastructure, multicloud interconnect, and service life-cycle management
- Open, scalable, and standards-based protocol support: EVPN/VXLAN, BGP, NETCONF/RPC, sFlow/gRPC/SNMP
- Autodiscovery, zero-touch provisioning (ZTP), zero-touch replacement (ZTR), and upgrades of data center fabrics, including QFX10000 switches
- Overlay and underlay management from a single orchestration layer
- Seamless connection between legacy and cloud-native workloads
- Network and device topology discovery with role configuration
- BGP EVPN across QFX Series switches and virtual routers

Contrail Networking and AppFormix are fundamental building blocks of Juniper Contrail® Enterprise Multicloud, a data center software suite to connect, orchestrate, monitor, and secure multiclouds.

**Features and Benefits**

**Virtual Output Queue (VOQ)**

The QFX10000 fixed-configuration switches support a virtual output queue (VOQ)-based architecture designed for very large deployments. VOQ refers to a queue on the egress port that is maintained by the ingress PFE. With VOQ architecture, packets are queued and dropped on ingress during congestion with no head-of-line blocking.

**Deep Buffer**

The use of HMC memory for packet buffering on the ingress provides uncompromised congestion management capabilities and 100 ms of buffering per port.

**Automation**

The QFX10000 fixed-configuration switches support a number of network automation features, including operations and event scripts, automatic rollback, ZTP, and Python scripting. The switches also integrate with VMware NSX, OpenContrail, Puppet, OpenStack, and CloudStack.

**MPLS**

The QFX10000 fixed-configuration switches support a broad set of MPLS features, including L3 VPN, IPv6 provider edge router (6PE, 6VPE), RSVP traffic engineering, and LDP to allow standards-based network segmentation and virtualization.

**VXLAN**

The QFX10000 fixed-configuration switches support L2 and L3 gateway services that enable VXLAN-to-VLAN connectivity at any tier of the data center network, from server access to the edge. The QFX10000 switches can integrate with VMware NSX through data plane (VXLAN) and control and management plane (OVSDB) protocols to centrally automate and orchestrate the data center network.
# Specifications

## Hardware

### Table 1: QFX10002 System Capacity

<table>
<thead>
<tr>
<th>Model</th>
<th>QFX10002-36Q</th>
<th>QFX10002-72Q</th>
<th>QFX10002-60C</th>
<th>QFX10003-80C</th>
<th>QFX10003-160C</th>
</tr>
</thead>
<tbody>
<tr>
<td>System throughput</td>
<td>Up to 2.88 Tbps</td>
<td>Up to 5.76 Tbps</td>
<td>Up to 12 Tbps</td>
<td>Up to 16 Tbps</td>
<td>Up to 32 Tbps</td>
</tr>
<tr>
<td>Forwarding capacity</td>
<td>Up to 1 Bpps</td>
<td>Up to 2 Bpps</td>
<td>Up to 4 Bpps</td>
<td>Up to 5.3 Bpps</td>
<td>Up to 10.6 Bpps</td>
</tr>
<tr>
<td>Maximum 10GbE port density</td>
<td>144</td>
<td>288</td>
<td>192</td>
<td>160</td>
<td>320</td>
</tr>
<tr>
<td>Maximum 25GbE port density</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>160</td>
<td>320</td>
</tr>
<tr>
<td>Maximum 40GbE port density</td>
<td>36</td>
<td>72</td>
<td>60</td>
<td>40</td>
<td>80</td>
</tr>
<tr>
<td>Maximum 100GbE port density</td>
<td>12</td>
<td>24</td>
<td>60</td>
<td>80</td>
<td>160</td>
</tr>
<tr>
<td>Maximum 200GbE port density</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>32</td>
<td>64</td>
</tr>
<tr>
<td>Maximum 400GbE port density</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>16</td>
<td>32</td>
</tr>
</tbody>
</table>

### Table 2: QFX10002 System Specifications

<table>
<thead>
<tr>
<th>Model</th>
<th>QFX10002-36Q</th>
<th>QFX10002-72Q</th>
<th>QFX10002-60C</th>
<th>QFX10003-80C</th>
<th>QFX10003-160C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dimensions (W x H x D):</td>
<td>17.4 x 3.46 x 31 in (44.2 x 8.8 x 78.7 cm)</td>
<td>17.4 x 3.46 x 31 in (44.2 x 8.8 x 78.7 cm)</td>
<td>17.4 x 3.46 x 31 in (44.2 x 8.8 x 78.7 cm)</td>
<td>17.4 x 5.25 x 31 in (44.2 x 13.3 x 78.7 cm)</td>
<td>17.4 x 5.25 x 31 in (44.2 x 13.3 x 78.7 cm)</td>
</tr>
<tr>
<td>Rack units</td>
<td>2U</td>
<td>2U</td>
<td>2U</td>
<td>3 U</td>
<td>3 U</td>
</tr>
<tr>
<td>Weight</td>
<td>50 lbs. (23 Kg)</td>
<td>68.6 lbs. (31 Kg)</td>
<td>80.5 lb (36.5 kg)</td>
<td>88 lb (40 kg)</td>
<td>110 lb (50 kg)</td>
</tr>
<tr>
<td>Operating System</td>
<td>Junos OS</td>
<td>Junos OS</td>
<td>Junos OS</td>
<td>Junos OS Evolved</td>
<td>Junos OS Evolved</td>
</tr>
<tr>
<td>CPU</td>
<td>Intel Quad Core Ivy Bridge 2.5 GHz CPU, 16 GB SDRAM</td>
<td>Intel Ivy Bridge 4C/2.3 GHz processor</td>
<td>Intel Ivy Bridge 4C/2.3 GHz processor</td>
<td>Intel Broadwell CPU with 12 cores</td>
<td>Intel Broadwell CPU with 12 cores</td>
</tr>
<tr>
<td>Management and Precision Time Protocol (PTP) interfaces</td>
<td>1 small form-factor pluggable transceiver (SFP/SFP+ transceiver) port for PTP Grandmaster Fiber (SFP) or 10/100/1000BASE-T (RJ-45) Ethernet management port SMB in, SMB out, 10 MHz in, 10 MHz out</td>
<td>One console port USB 2.0 storage interface</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power</td>
<td>2 x 1600 AC/DC power supply</td>
<td>4 x 1600 AC/DC power supply</td>
<td>4 x 1600 AC/DC power supply</td>
<td>2 x 3000 watts (AC/DC)</td>
<td>4 x 3000 watts (AC/DC)</td>
</tr>
<tr>
<td>Cooling</td>
<td>Front-to-back airflow 3 hot-swapable fan modules with redundant fans</td>
<td>Front-to-back airflow 3 hot-swapable fan modules with redundant fans</td>
<td>Front-to-back airflow 3 hot-swapable fan modules with redundant fans</td>
<td>Front-to-back 3 hot-swapable redundant fans</td>
<td>Front-to-back 5 hot-swapable redundant fans</td>
</tr>
<tr>
<td>Total packet buffer</td>
<td>12 GB</td>
<td>24 GB</td>
<td>24 GB</td>
<td>64 GB</td>
<td>128 GB</td>
</tr>
<tr>
<td>Latency</td>
<td>As low as 2.5 microseconds within a PFE</td>
<td>As low as 2.5 microseconds across PFEs</td>
<td>As low as 2.5 microseconds within a PFE, 5 microseconds between PFEs</td>
<td>2.5 microseconds within a PFE, 5 microseconds between PFEs</td>
<td></td>
</tr>
<tr>
<td>Warranty</td>
<td>Juniper standard one-year warranty</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>
Software

Table 3: QFX10002 Scale (Unidimensional)

<table>
<thead>
<tr>
<th></th>
<th>QFX10002-36Q</th>
<th>QFX10002-72Q</th>
<th>QFX10002-60C</th>
<th>QFX10003-80C/ QFX10003-160C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Media access control (MAC) addresses</td>
<td>Up to 256,000; up to 96,000 learned per PFE</td>
<td>Up to 512,000; up to 96,000 learned per PFE</td>
<td>Up to 1 million</td>
<td>Up to 1 million</td>
</tr>
<tr>
<td>Address Resolution Protocol (ARP) entries</td>
<td>Up to 192,000, or 64,000 per PFE</td>
<td>Up to 340,000, or 64,000 per PFE</td>
<td>Up to 340,000, or 64,000 per PFE</td>
<td>64,000 per PFE</td>
</tr>
<tr>
<td>Jumbo frames</td>
<td></td>
<td>9216 bytes maximum</td>
<td></td>
<td></td>
</tr>
<tr>
<td>VLANs</td>
<td></td>
<td></td>
<td>4000</td>
<td></td>
</tr>
<tr>
<td>Forwarding information base (FIB) (IPv4/IPv6)</td>
<td></td>
<td>Up to 2 million</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Routing information base (RIB) (v4)</td>
<td></td>
<td>10 million</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Routing information base (RIB) (v6)</td>
<td>4 million</td>
<td>6 million</td>
<td>6 million</td>
<td>6 million</td>
</tr>
<tr>
<td>Host routes</td>
<td></td>
<td>Up to 2 million</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equal-cost multipath (ECMP)</td>
<td></td>
<td>64-way</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IPv4 multicast routes</td>
<td></td>
<td>Up to 128,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IPv6 multicast routes</td>
<td></td>
<td>Up to 128,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multicast groups</td>
<td></td>
<td>Up to 128,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Filters</td>
<td></td>
<td>Up to 8000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Filter terms</td>
<td></td>
<td>Up to 64,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Policers</td>
<td></td>
<td>Up to 8000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output queues per port</td>
<td></td>
<td>8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>VOQs</td>
<td>384,000 per PFE</td>
<td>192,000 per PFE</td>
<td>192,000 per PFE</td>
<td>192,000 per PFE</td>
</tr>
<tr>
<td>Link aggregation groups (LAGs)</td>
<td>72</td>
<td>144</td>
<td>192</td>
<td>192</td>
</tr>
<tr>
<td>Members per LAG</td>
<td></td>
<td>64</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BGP neighbors (License)</td>
<td></td>
<td>1024</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Generic routing encapsulation (GRE) tunnels</td>
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<tr>
<td>MPLS L3 VPNs (License)</td>
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<tr>
<td>LSPs (ingress/egress/transit) (License)</td>
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Layer 2 Features
- 802.1D: Spanning Tree Protocol (STP)
- 802.1w: Rapid Spanning Tree Protocol (RSTP)
- 802.1s: Multiple Spanning Tree Protocol (MSTP)
- VLAN Spanning Tree Protocol (VSTP)
- 802.1AB Link Layer Discovery Protocol (LLDP)
- VLAN Registration Protocol
- QinQ

Link Aggregation
- 802.3ad: Link Aggregation Control Protocol (LACP)
- MC-LAG

Layer 3 Features
- Static routing
- RIP v1/v2
- OSPF v1/v2
- OSPF v3
- Filter-based forwarding
- Virtual Router Redundancy Protocol (VRRP)
- IPv6
- Bidirectional Forwarding Detection (BFD)
- Virtual routers
- Unicast RPF (uRPF)
- Loop-free alternate (LFA)
- BGP
- IS-IS
- Dynamic Host Configuration Protocol (DHCP) v4/v6 relay
- VR-aware DHCP
- IPv4 / IPv6 over GRE tunnels (interface-based)
Multicast
- Internet Group Management Protocol (IGMP) v1/v2/v3
- Multicast Listener Discovery (MLD) v1/v2
- IGMP Proxy, Querier
- IGMP snooping
- MLD snooping
- Protocol Independent Multicast PIM-SM, PIM-SSM, PIM-DM
- Multicast Source Discovery Protocol (MSDP)
- Multicast only Fast Re-Route (MoFRR)
- NG-MVPN

Firewall Filters
- Ingress and egress L2-L4 access control lists (ACLs)
  - Port ACLs
  - VLAN ACLs
  - Router ACLs
- Control plane denial-of-service (DoS) protection

Quality of Service (QoS)
- Single rate three color policer
- Two rate three color policer
- Congestion prevention
  - Weighted random early detection (WRED)
  - Tail drop
  - ECN marking
- Priority-based scheduling
  - Low latency queuing with strict high priority
  - Weighted round-robin (WRR) queuing
- Data Center Bridging Quantized Congestion Notification
- Class of service (CoS)-based forwarding

MPLS (Advanced Feature License)
- LDP
- RSVP
- LDP tunneling (LDP over RSVP)
- Fast reroute (FRR)
- IPv6 tunneling (6PE)
- Ingress, transit, and Egress LSPs
- IPv4 Layer 3 VPNs
- IPv6 Layer 3 VPNs (6VPE)
- Layer 2 circuits
- MPLSoUDP
- Segment routing

Overlays
- Integration with Juniper Networks Contrail
- Integration with VMware NSX SDN controller
- VXLAN
- Open vSwitch Database (OVSDB)
  - VXLAN L2 Gateway
  - VXLAN L3 Gateway
  - EVPN/VXLAN
  - EVPN multihoming

High Availability
- Graceful Routing Engine switchover (GRES)
- BFD

Timing
- Precision Timing Protocol (PTP)
  - Transparent Clock
  - Boundary Clock

Visibility
- Switched Port Analyzer (SPAN)
- Remote SPAN (RSPAN)
- Encapsulated Remote SPAN (ERSPAN)
- Firewall filter-based port mirroring
  - sFlow v5
  - IPFIX

Data Center Bridging
- Priority-based flow control (PFC)—IEEE 802.1Qbb
- Data Center Bridging Exchange Protocol (DCBX), DCBx Fibre Channel over Ethernet (FCoE), and iSCSI type, length, and value (TLVs)

Management and Operations
- Contrail Networking
- ZTP
- Streaming telemetry
- Junos Space® Network Director
- Junos OS CLI via console, telnet, SSH
- Out-of-band management: Serial; 10/100/1000BASE-T Ethernet
- Role-based CLI management and access
- Junos XML management protocol
- ASCII configuration file
- SNMP v1/v2/v3
- RADIUS
- TACACS+
- Extensive MIB support
- Junos OS configuration rescue and rollback
- Image rollback
- OpenStack Neutron Plug-in
- Puppet
- Chef
- Python
- Junos OS event, commit, and OP scripts
• RMON (RFC 2819): Groups 1, 2, 3, 9
• Network Time Protocol (NTP)
• SSHv2
• Secure copy
• DNS resolver
• System logging
• Environment monitoring
• Temperature sensor
• Configuration backup via FTP/secure copy
• IEEE 802.3ah Link Fault Management (LFM)

Troubleshooting
• Debugging: CLI via console, telnet, or SSH
• Diagnostics: Show, debug, and statistics commands
• Port mirroring:
  – Local
  – Remote
• IP tools: Extended ping and trace
• Juniper Networks commit and rollback

IEEE Compliance
• IEEE 802.1AB: Link Layer Discovery Protocol (LLDP)
• IEEE 802.1ad: QinQ
• IEEE 802.1D-2004: Spanning Tree Protocol (STP)
• IEEE 802.1p: Class-of-service (CoS) prioritization
• IEEE 802.1Q: Virtual Bridged Local Area Networks
• IEEE 802.1s: Multiple Spanning Tree Protocol (MSTP)
• IEEE 802.1w: Rapid Spanning Tree Protocol (RSTP)
• IEEE 802.3: 10BASE-T
• IEEE 802.3u: 100BASE-T
• IEEE 802.3ab: 1000BASE-T
• IEEE 802.3z: 1000BASE-X
• IEEE 802.3ae: 10-Gigabit Ethernet
• IEEE 802.3ba: 40-Gigabit/100-Gigabit Ethernet
• IEEE 802.3ad: Link Aggregation Control Protocol (LACP)
• IEEE 802.1Qbb: Priority-based Flow Control
• IEEE 802.1Qaz: Enhanced Transmission Selection

RFC Compliance
• RFC 768: UDP
• RFC 783: Trivial File Transfer Protocol (TFTP)
• RFC 791: IP
• RFC 792: Internet Control Message Protocol (ICMP)
• RFC 793: TCP
• RFC 826: ARP
• RFC 854: Telnet client and server
• RFC 894: IP over Ethernet
• RFC 903: Reverse Address Resolution Protocol (RARP)
• RFC 906: TFTP Bootstrap
• RFC 951, RFC 1542: BootP
• RFC 1027: Proxy ARP
• RFC 1058: RIP v1
• RFC 1112: IGMP v1
• RFC 1122: Host Requirements
• RFC 1142: OSI IS-IS Intra-domain Routing Protocol
• RFC 1256: IPv4 ICMP Router Discovery Protocol (IRDP)
• RFC 1492: TACACS+
• RFC 1519: Classless Interdomain Routing (CIDR)
• RFC 1587: OSPF NSSA Option
• RFC 1591: Domain Name System (DNS)
• RFC 1745: TACACS+
• RFC 1765: OSPF Database Overflow
• RFC 1771: Border Gateway Protocol 4
• RFC 1772: Application of the Border Gateway Protocol in the Internet
• RFC 1812: Requirements for IP Version 4 Routers
• RFC 1965: Autonomous System Confederations for BGP
• RFC 1981: Path maximum transmission unit (MTU) discovery for IPv6
• RFC 1997: BGP Communities Attribute
• RFC 2030: Simple Network Time Protocol (SNTP)
• RFC 2068: HTTP server
• RFC 2080: RIPng for IPv6
• RFC 2081: RIPng Protocol Applicability Statement
• RFC 2131: BOOTP/DHCP relay agent and DHCP server
• RFC 2138: RADIUS Authentication
• RFC 2139: RADIUS Accounting
• RFC 2154: OSPF with Digital Signatures (password, Message Digest 5)
• RFC 2236: IGMP v2
• RFC 2267: Network Ingress Filtering
• RFC 2270: BGP-4 Dedicated autonomous system (AS) for sites/single provider
• RFC 2283: Multiprotocol Extensions for BGP-4
• RFC 2328: OSPF v2 (Edge mode)
• RFC 2338: VRRP
• RFC 2362: PIM-SM (Edge mode)
• RFC 2370: OSPF Opaque LSA Option
• RFC 2373: IPv6 Addressing Architecture
• RFC 2375: IPv6 Multicast Address Assignments
• RFC 2385: TCP MD5 Authentication for BGPv4
• RFC 2439: BGP Route Flap Damping
• RFC 2453: RIP v2
• RFC 2460: Internet Protocol, v6 (IPv6) specification
• RFC 2461: Neighbor Discovery for IP Version 6 (IPv6)
• RFC 2462: IPv6 Stateless Address Autoconfiguration
• RFC 2463: ICMPv6
• RFC 2464: Transmission of IPv6 Packets over Ethernet Networks
• RFC 2474: DiffServ Precedence, including 8 queues/port
• RFC 2526: Reserved IPv6 Subnet Anycast Addresses
• RFC 2545: Use of BGP-4 Multiprotocol Extensions for IPv6 Interdomain Routing
• RFC 2547: BGP/MPLS VPNs
• RFC 2597: DiffServ Assured Forwarding (AF)
• RFC 2598: DiffServ Expedited Forwarding (EF)
• RFC 2697: A Single Rate Three Color Marker
• RFC 2698: A Two Rate Three Color Marker
• RFC 2710: Multicast Listener Discovery (MLD) for IPv6
• RFC 2711: IPv6 Router Alert Option
• RFC 2740: OSPF for IPv6
• RFC 2796: BGP Route Reflection (supersedes RFC 1966)
• RFC 2797: Route Reflection
• RFC 2858: Multiprotocol Extensions for BGP-4
• RFC 2893: Transition Mechanisms for IPv6 Hosts and Routers
• RFC 2918: Route Refresh Capability for BGP-4
• RFC 3031: Multiprotocol Label Switching Architecture
• RFC 3032: MPLS Label Stack Encoding
• RFC 3036: LDP Specification
• RFC 3065: Autonomous System Confederations for BGP
• RFC 3176: sFlow
• RFC 3215: LDP State Machine
• RFC 3306: Unicast Prefix-based IPv6 Multicast Addresses
• RFC 3376: IGMP v3
• RFC 3392: Capabilities Advertisement with BGP-4
• RFC 3446: Anycast Rendezvous Point (RP) Mechanism using PIM and MSDP
• RFC 3478: Graceful Restart for Label Distribution Protocol
• RFC 3484: Default Address Selection for IPv6
• RFC 3513: Internet Protocol Version 6 (IPv6) Addressing
• RFC 3569: PIM-SSM PIM Source Specific Multicast
• RFC 3587: IPv6 Global Unicast Address Format
• RFC 3618: Multicast Source Discovery Protocol (MSDP)
• RFC 3623: OSPF Graceful Restart
• RFC 3768: Virtual Router Redundancy Protocol (VRRP)
• RFC 3810: Multicast Listener Discovery Version 2 (MLDv2) for IP
• RFC 3973: PIM-Dense Mode
• RFC 4213: Basic Transition Mechanisms for IPv6 Hosts and Routers
• RFC 4291: IPv6 Addressing Architecture
• RFC 4360: BGP Extended Communities Attribute
• RFC 4364: BGP/MPLS IP Virtual Private Networks (VPNs)
• RFC 4443: ICMPv6 for the IPv6 specification
• RFC 4486: Sub codes for BGP Cease Notification message
• RFC 4552: Authentication/Confidentiality for OSPFv3
• RFC 4604: Using Internet Group Management Protocol Version 3 (IGMPv3)
• RFC 4724: Graceful Restart Mechanism for BGP
• RFC 4798: Connecting IPv6 Islands over IPv4 MPLS Using IPv6 Provider Edge Routers (6PE)
• RFC 4861: Neighbor Discovery for IPv6
• RFC 4862: IPv6 Stateless Address Autoconfiguration
• RFC 5095: Deprecation of Type 0 Routing Headers in IPv6
• RFC 5286, Basic Specification for IP Fast Reroute: Loop-Free Alternates
• RFC 5306: Restart Signaling for IS-IS
• RFC 5308: Routing IPv6 with IS-IS
• RFC 5340: OSPF for IPv6
• RFC 5880: Bidirectional Forwarding Detection

Network Management—MIB Support
• RFC 1155: Structure of Management Information (SMI)
• RFC 1157: SNMPv1
• RFC 1212, RFC 1213, RFC 1215: MIB-II, Ethernet-like MIB, and traps
• RFC 1657: BGP-4 MIB
• RFC 1724: RIPv2 MIB
• RFC 1850: OSPFv2 MIB
• RFC 2011: SNMPv2 for IP using SMIv2
• RFC 2012: SNMPv2 for transmission control protocol using SMv2
• RFC 2013: SNMPv2 for user datagram protocol using SMv2
• RFC 2096: IPv4 Forwarding Table MIB
• RFC 2287: System Application Packages MIB
• RFC 2465: Management Information Base for IP Version 6
• RFC 2570-2575: SNMPv3, user-based security, encryption, and authentication
• 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 SMv2
• RFC 2665: Ethernet-like interface MIB
• RFC 2787: VRRP MIB
• RFC 2819: RMON MIB
• RFC 2863: Interface Group MIB
• RFC 2863: Interface MIB
• RFC 2922: LLDP MIB
• RFC 2925: Ping/Traceroute MIB
• RFC 2932: IPv4 Multicast 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: SNMP Application 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
• RFC 4188: STP and Extensions MIB
• RFC 4363: Definitions of Managed Objects for Bridges with traffic classes, multicast filtering, and VLAN extensions
• Draft-ietf-idr-bgp4-mibv2-02.txt: Enhanced BGP-4 MIB
• Draft-ietf-isis-wg-mib-07
• Draft-reeder-snmpv3-usm-3desede-00
• Draft-ietf-idmr-igmp-mib-13
• Draft-ietf-idmr-pim-mib-09
• Draft-ietf-bfd-mib-02.txt

**Environmental Ranges**
- Operating temperature: 32° to 104° F (0° to 40° C)
- Storage temperature: -40° to 158° F (-40° to 70° C)
- Operating altitude: Up to 10,000 ft. (3,048 m)
- Relative humidity operating: 5 to 90% (noncondensing)
- Relative humidity nonoperating: 5 to 95% (noncondensing)
- Seismic: Designed to meet GR-63, Zone 4 earthquake requirements

**Maximum Thermal Output**
*(estimated, subject to change)*
- **QFX10002-36Q:**
  - Maximum power draw: 800 W (AC, DC), 2,730 BTU/hr
  - Typical power draw: 560 W (AC, DC), 1,911 BTU/hr
- **QFX10002-72Q:**
  - Maximum power draw: 1,425 W (AC, DC), 4,862 BTU/hr
  - Typical power draw: 1,050 W (AC, DC), 3,583 BTU/hr
- **QFX10002-60C:**
  - Maximum power draw: 2,500 W (AC, DC), 8,530 BTU/hr
  - Typical power draw: 2,000 W (AC, DC), 6,825 BTU/hr

**Safety and Compliance**
- **Safety**
  - CAN/CSA-C22.2 No. 60950-1 Information Technology Equipment—Safety
  - UL 60950-1 Information Technology Equipment—Safety
  - EN 60950-1 Information Technology Equipment—Safety
  - IEC 60950-1 Information Technology Equipment—Safety (All country deviations)
  - EN 60825-1 Safety of Laser Products—Part 1: Equipment Classification

**Electromagnetic Compatibility**
- 47CFR Part 15, (FCC) Class A
- ICES-003 Class A
- EN 55022 Class A
- CISPR 22 Class A
- EN 55024
- CISPR 24
- EN 300 386
- VCCI Class A
- AS/NZA CISPR22 Class A
- KN22 Class A
- CNS 13438 Class A
- EN 61000-3-2
- EN 61000-3-3
- ETSI
- ETSI EN 300 019: Environmental Conditions & Environmental Tests for Telecommunications Equipment
- ETSI EN 300 019-2-1 (2000)—Storage
- ETSI EN 300 019-2-2 (1999)—Transportation
- ETSI EN 300 019-2-3 (2003)—Stationary Use at Weather-protected Locations
- ETSI EN 300 019-2-4 (2003)—Stationary Use at Non-Weather-protected Locations
- ETS 300753 (1997)—Acoustic noise emitted by telecommunications equipment

**Environmental Ranges**
- Operating temperature: 32° to 104° F (0° to 40° C)
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- Relative humidity nonoperating: 5 to 95% (noncondensing)
- Seismic: Designed to meet GR-63, Zone 4 earthquake requirements
Environmental Compliance

Restriction of Hazardous Substances (ROHS) 6/6
China Restriction of Hazardous Substances (ROHS)
Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH)
Waste Electronics and Electrical Equipment (WEEE)
Recycled material
80 Plus Silver PSU Efficiency

Telco
- Common Language Equipment Identifier (CLEI) code

Juniper Networks Services and Support

Juniper Networks is the leader in performance-enabling services that are designed to accelerate, extend, and optimize your high-performance network. Our services allow you to maximize operational efficiency while reducing costs and minimizing risk, achieving a faster time to value for your network. Juniper Networks ensures operational excellence by optimizing the network to maintain required levels of performance, reliability, and availability. For more details, please visit www.juniper.net/us/en/products-services.

Ordering Information

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<tr>
<th>Product Number</th>
<th>Description</th>
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<tbody>
<tr>
<td>QFX10002-60C</td>
<td>QFX10002 system with 60-port 100GbE QSFP28 / 60-port 40GbE QSFP+ / 192-port 10GbE SFP+ with 4 1600 W AC power supplies, 4 power cables, and 3 fan trays</td>
</tr>
<tr>
<td>QFX10002-60C-DC</td>
<td>QFX10002 system with 60-port 100GbE QSFP28 / 60-port 40GbE QSFP+ / 192-port 10GbE SFP+ with 4 1600 W DC power supplies and 3 fan trays</td>
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<tr>
<td>QFX10002-72Q</td>
<td>QFX10002 system with 72-port 40GbE QSFP+ / 24-port 100GbE QSFP28 / 288-port 10GbE SFP+ with 4 1600 W AC power supplies and 3 fan trays</td>
</tr>
<tr>
<td>QFX10002-36Q</td>
<td>QFX10002 system with 36-port 40GbE QSFP+ / 12-port 100GbE QSFP28 / 144-port 10GbE SFP+ with 2 1600 W AC power supplies and 3 fan trays</td>
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<tr>
<td>QFX10002-72Q-DC</td>
<td>QFX10002 system with 72-port 40GbE QSFP+ / 24-port 100GbE QSFP28 / 288-port 10GbE SFP+ with 4 1600 W DC power supplies and 3 fan trays</td>
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<tr>
<td>QFX10002-36Q-DC</td>
<td>QFX10002 system with 36-port 40GbE QSFP+ / 12-port 100GbE QSFP28 / 144-port 10GbE SFP+ with 2 1600 W DC power supplies and 3 fan trays</td>
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<tr>
<td>QPSU-1600W-DC-AFO</td>
<td>QFX10002 1600 W DC power supply</td>
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QFX10002 Hardware

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<tr>
<th>Product Number</th>
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<tr>
<td>QFX10003-160C</td>
<td>QFX10003-160C base system with 160 100GbE ports or 32 400GbE ports, four 3000 W AC power supplies, 4 power cables, and 5 fan trays, with standard tier right-to-use license</td>
</tr>
<tr>
<td>QFX10003-160C-DC</td>
<td>QFX10003-160C base system with 160 100GbE ports or 32 400GbE ports, four 3000 W DC power supplies, and 5 fan trays, with standard tier right-to-use license</td>
</tr>
<tr>
<td>QFX10003-80C</td>
<td>QFX10003-80C base system with 80 100GbE ports or 16 400GbE ports, two 3000 W AC power supplies, 2 power cables, and 3 fan trays, with standard tier right-to-use license</td>
</tr>
<tr>
<td>QFX10003-80C-DC</td>
<td>QFX10003-80C base system with 80 100GbE ports or 16 400GbE ports, two 3000 W DC power supplies, and 3 fan trays, with standard tier right-to-use license</td>
</tr>
<tr>
<td>QFX10003-160C-CHAS</td>
<td>JNP10003-160C spare chassis with 160 100GbE ports or 32 400GbE ports</td>
</tr>
<tr>
<td>QFX10003-80C-CHAS</td>
<td>JNP10003-80C spare chassis with 80 100GbE ports or 16 400GbE ports</td>
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<tr>
<td>QNP10003-FAN</td>
<td>Fan tray for 3 U -80C and -160C fixed platforms</td>
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<tr>
<td>QNP-3000W-AC-AFO</td>
<td>AC power supply for JNP10003-160C and JNP10003-80C fixed platforms</td>
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<tr>
<td>QNP-3000W-DC-AFO</td>
<td>DC power supply for JNP10003-160C and JNP10003-80C fixed platforms</td>
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QFX10000 Pluggable Optics

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<tr>
<th>Product Number</th>
<th>Description</th>
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<tbody>
<tr>
<td>JNP-QSFP-100G-SR4</td>
<td>QSFP+ 100GBASE-SR4 optics for up to 100 m transmission over parallel multimode fiber-optic (MMF)</td>
</tr>
<tr>
<td>JNP-QSFP-100G-LR4</td>
<td>QSFP+ 100GBASE-LR4 optics for up to 10 km transmission over serial single-mode fiber-optic (SMF)</td>
</tr>
<tr>
<td>JNP-QSFP-100G-PSM4</td>
<td>QSFP+ 100GBASE-PSM4 optics for up to 2 km transmission over parallel SMF</td>
</tr>
<tr>
<td>JNP-QSFP-100G-CWDM</td>
<td>QSFP+ 100GBASE-CWDM4 optics for up to 2 km transmission over serial SMF</td>
</tr>
<tr>
<td>JNP-QSFP28-AOC-10M</td>
<td>100GbE QSFP28 to QSFP28 active optical cables, 10 m</td>
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<tr>
<td>JNP-QSFP28-AOC-20M</td>
<td>100GbE QSFP28 to QSFP28 active optical cables, 20 m</td>
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<tr>
<td>JNP-QSFP28-AOC-30M</td>
<td>100GbE QSFP28 to QSFP28 active optical cables, 30 m</td>
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<tr>
<td>JNP-QSFP-40GE-IR4</td>
<td>QSFP+ 40GBASE-IR4 40 gigabit optics, 1310 nm for up to 2 km transmission on SMF</td>
</tr>
<tr>
<td>JNP-QSFP-40GE-LR4</td>
<td>QSFP+ 40GBASE-LR4 40 gigabit optics, 1310 nm for up to 10 km transmission on SMF</td>
</tr>
<tr>
<td>JNP-QSFP-40GE-LX4</td>
<td>QSFP+ 40GBASE-LX4 40 gigabit optics, 100 m (150 m) with OM3 (OM4) duplex MMF fiber</td>
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<tr>
<td>Product Number</td>
<td>Description</td>
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<tr>
<td>JNP-QSFP-4X10GE-IR</td>
<td>QSFP+ 40GBASE optics, up to 1.4 km transmission on parallel single mode (4x10GbE long reach up to 1.4 km)</td>
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<tr>
<td>JNP-QSFP-4X10GE-LR</td>
<td>QSFP+ 40GBASE optics, up to 10 km transmission on parallel single mode (4x10GbE long reach up to 10 km)</td>
</tr>
<tr>
<td>QFX-QSFP-40G-ESR4</td>
<td>QSFP+ 40GBASE-ESR4 40 gigabit optics, 300 m (400 m) with OM3 (OM4) MMF</td>
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<tr>
<td>JNP-QSFP-DAC-10MA</td>
<td>QSFP+ to QSFP+ Ethernet direct attach copper (twinax copper cable) 10 m active</td>
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<tr>
<td>JNP-QSFP-DAC-7MA</td>
<td>QSFP+ to QSFP+ Ethernet DAC (twinax copper cable) 7 m active</td>
</tr>
<tr>
<td>JNP-QSFP-DAC-5M</td>
<td>QSFP+ to QSFP+ Ethernet DAC (twinax copper cable) 5 m active</td>
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<tr>
<td>JNP-QSFP-DAC-3M</td>
<td>QSFP+ to QSFP+ Ethernet DAC (twinax copper cable) 3 m active</td>
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<tr>
<td>JNP-QSFP-DAC-1M</td>
<td>QSFP+ to SFP+ 10-Gigabit Ethernet direct attach break out copper (twinax copper cable) 1 m passive</td>
</tr>
<tr>
<td>JNP-QSFP-DAC-1MA</td>
<td>QSFP+ to SFP+ 10-Gigabit Ethernet DAC (twinax copper cable) 1 m active</td>
</tr>
<tr>
<td>QDD-2X100G-CWDM4</td>
<td>200G QSFP28-DD to 2x100G QSFP28 CWDM4, 1310 nm NRZ DOM break out transceiver module, 2 km reachability</td>
</tr>
<tr>
<td>QDD-2X100G-LR4</td>
<td>200G QSFP28-DD to 2x100G QSFP28 LR4, 1310 nm NRZ DOM break out transceiver module, 10 km reachability</td>
</tr>
<tr>
<td>QDD-2X100G-SR4</td>
<td>200G QSFP28-DD to 2x100G QSFP28 SR4, 850 nm NRZ DOM break out transceiver module, 100 m reachability</td>
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<tr>
<td>JNP-100G-4x25G-1M</td>
<td>100GbE QSFP28 to 4x25GbE SFP28 passive direct attach copper break out cable, 1 m</td>
</tr>
<tr>
<td>JNP-100G-4x25G-2M</td>
<td>100GbE QSFP28 to 4x25GbE SFP28 passive direct attach copper break out cable, 2 m</td>
</tr>
<tr>
<td>JNP-100G-4x25G-3M</td>
<td>100GbE QSFP28 to 4x25GbE SFP28 passive direct attach copper break out cable, 3 m</td>
</tr>
<tr>
<td>QDD-400G-FR4</td>
<td>400GbE QSFP56-DD PAM4 FR4 transceiver module, 2 km reachability</td>
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<td>QDD-400G-LR8</td>
<td>400GbE QSFP56-DD 8x50Gb PAM4 transceiver module, 10 km reachability</td>
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<tr>
<td>QDD-4100G-DR4</td>
<td>400GbE QSFP56-DD PAM4 DR4 transceiver module, 500 m reachability</td>
</tr>
<tr>
<td>QFX-QSFP-DACBO-3M</td>
<td>QSFP+ to SFP+ 10GbE direct attach break out copper (twinax copper cable), 3 m</td>
</tr>
<tr>
<td>QFX-QSFP-DACBO-1M</td>
<td>QSFP+ to SFP+ 10GbE direct attach break out copper (twinax copper cable), 1 m</td>
</tr>
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</table>
About Juniper Networks

Juniper Networks brings simplicity to networking with products, solutions and services that connect the world. Through engineering innovation, we remove the constraints and complexities of networking in the cloud era to solve the toughest challenges our customers and partners face daily. At Juniper Networks, we believe that the network is a resource for sharing knowledge and human advancement that changes the world. We are committed to imagining groundbreaking ways to deliver automated, scalable and secure networks to move at the speed of business.