# Spirent **fX2**

## 40 GbE, 10 GbE and 10 GbE, 1 GbE Dual-Speed Test Modules

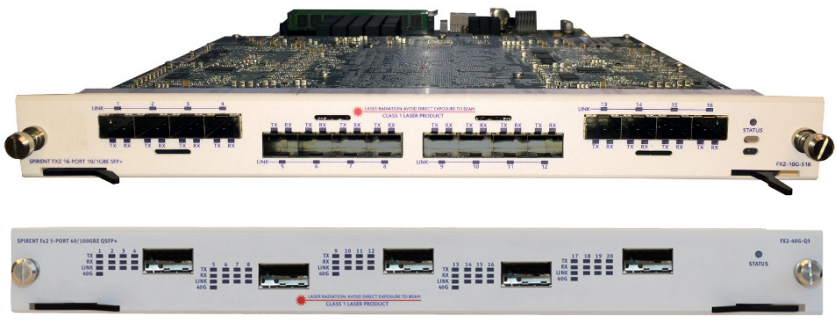
**The Spirent fX2 40/10 G and 10/1 G Ethernet dual-speed test modules deliver the highest density and lowest total cost of ownership in its class. Spirent's Layer 2–3 traffic generation and analysis is combined with powerful network emulation and application traffic to deliver the perfect blend of realism, scalability and performance required to test today's networks.**

The Spirent fX2 40/10 G and 10/1 G Ethernet dual-speed test modules combine Spirent's industry-leading Layer 2–3 traffic generation and analysis with powerful network emulation and application layer protocols for emulating a wide range of device types, users and protocols. These modules deliver the highest performance per dollar for Layer 2–7 testing. Reduced power consumption and the ability to use a single module throughout the test lifecycle results in lower CAPEX and OPEX. These modules are ideal for functional, conformance and performance testing of data center and service provider network infrastructure and evolving SDN and NFV technologies.

The Spirent fX2 module is available in several port count and speed variations to match your test needs and budget. For dual speed 40 GbE versions each of the 40 G ports can be configured as 4x10 GbE for a maximum density of twenty 10 GbE ports per slot.  Dual speed modules are also available for 10/1 GbE operation from a single port

## Features & benefits

- High-density 5-port 40 GbE, 20-port 10 GbE or a dual speed 40/10 GbE offers a highly scalable test platform
  - High-density 5-port form factor supports five 40 GbE or twenty 10 GbE ports per slot, 240 40 GbE ports or 960 10 GbE ports per 19-inch rack
  - Lower density four, three and two port modules are perfect for development testing at lower port counts or performance testing of smaller edge devices with 40 GbE uplinks
- 10/1 G Ethernet versions are the only high-density dual-speed modules of their type
  - Ports are software controlled for operation in 10 GbE mode or 1 GbE mode and are individually reservable
  - Uses SFP+/SFP form-factor for more flexible 10 GbE and 1 GbE interconnect options



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## Applications

- SDN and Data Center—Validate forwarding performance and functional capabilities of Software Define Networks (SDN) with ultra-low latency and high port density. Supports key technologies like VXLAN, OpenFlow, and FCoE
- Device Benchmarking—Test using IETF RFC 2544, RFC 2889 and RFC 3918 methodologies with easy test setup using dynamically bound traffic and automated wizards
- Core and Edge Routers & Switches—Verify scale, reliability, performance of Layer 2 & 3 services including data, multicast and video delivered via unicast routing, multicast routing, switching and MPLS VPN technologies
- Carrier Ethernet—Verify scale, reliability, performance of Ethernet services delivered via Ethernet OAM, MPLS-TP, VPLS, PWE3 Psuedowires, bridged Ethernet, packet transport protocols or combinations of these technologies
- Subscriber Emulation—Verify setup & teardown of thousands of access subscribers using different services over various tunneling technologies (VLAN, L2GRE, MPLS, VPNs, VPLS etc) under normal or exceptional traffic conditions
- Functional, Conformance and Performance Testing— Validate features, conformance to standards and measure system performance. Multiple port count versions meet your density and cost needs

## Features & benefits (continued)

- Low total cost of ownership compared to other test modules in its class
  - Excellent price-performance ratio that delivers faster time-to-market by combining leading-edge technical innovation with Spirent's extensive testing experience
  - Intelligent power control to shut down unused test modules and allows faster boot time to bring capacity back on-line quickly (software update expected 2H'15)
  - More total throughput than the competition for a given power footprint
  - Enhanced chassis software license value—Two to four times the device or end-user emulation per chassis with no increase in software costs
  - Topology emulation lowers Capex by eliminating the need for multiple DUTs in multi-protocol tests
  - Intelligent results gets answers in a fraction of the test time required by competitive products
  - Faster boot and firmware upgrade times mean less downtime in continuous running 24x7 regression test beds
- Spirent TestCenter's industry-leading Layer 2–3 feature set
  - "Hardened" system already proven for testing from a single port up to 2,100 ports
  - Stress ASIC and backplane designs with live traffic changes. The number of emulated devices, the traffic they emanate and the rate at which they send it can all be changed "on the fly" making for more realistic tests and faster troubleshooting
  - Best-in-industry for measuring ultra-low sub-microsecond latencies with 10ns precision and 2.5ns resolution
- 19 different scheduling algorithms available for finding the right traffic to emulate the real-world or tax the device's ability to handle any traffic pattern—from micro-bursts to carefully timed sequences of "killer" frames
- fX2 modules support Spirent TestCenter's deep analysis system
  - Port counts, rates, errors and protocol summaries provide a high-level view for quick drill-down to specific issues
  - Broadest set of per stream metrics with simultaneous control and data plane results allows most tests to be run in a single pass
  - Real-time traffic filters allow analysis down to specific fields. Multiple metrics can be simultaneously collected and instantly analyzed
  - Dynamic views feature multi-metric extraction, sorting and operation in real-time or post test
  - Full packet capture enables timing, sequencing and content analysis for individual packets. Powerful filters ensure the capture buffer is filled with relevant data

## Technical information

### fX2 module specifications

| Maximum port density | Speed | Maximum ports per slot | Maximum ports per STP-N11U chassis | Maximum ports per SPT-N4U chassis |
|---|---|---|---|---|
| fX2-40G-Q5 supports dual speed 40/10 G<br>fX2-40GO-Q5 supports 40 G only | 40/10 G | 5 | 60 | 10 |
| fX2-10G-Q5 supports 10 G only | 10 G | 20 | 240 | 40 |
| fX2-10G-S12 supports dual speed 10/1 G | 10/1 G | 16 | 192 | 32 |

| | | |
|---|---|---|
| **Media support**<br>**See accessory table below for part numbers** | ■ 40GBASE-CR4 (with Clause 73 Auto-Negotiation and Link Training)<br>■ 40GBASE-SR4<br>■ 40GBASE-LR4<br>■ 10 GbE Direct Attach Copper Cable | ■ 10GBASE-SR<br>■ 10GBASE-LR<br>■ 1000BASE-SX<br>■ 1000BASE-LX<br>■ 1000BASE-T |
| **Line clocking and packet time stamping – fX2 modules get their transmit line clocking and time-stamping from the control modules on the SPT-N11U and SPT-N4U.** | ■ Stratum-3 rated oscillator is the default time source. Transmit line clock is at the precise nominal Ethernet rate +/- < 1 PPM on initial shipment. Accurate to +/- 4.6 PPM over 15 years of operation.<br>■ Frame time stamp resolution of 2.5ns.<br>■ GPS and CDMA-based external time sources are supported<br>■ IEEE 1588v2 and NTP packet-based external time sources are supported<br>■ TIA/EIA-95B-based external time sources are supported | |
| **Inter-module and inter-chassis time synchronization** | Modules in the same chassis are phase-locked to the timing source of the control module. For modules in separate chassis:<br>■ Spirent-patented self-calibrating inter-chassis timing chain using dedicated port on chassis control module delivers precise synchronization +/- 20ns<br>■ Synchronized via external GPS or CDMA network<br>■ Using IEEE 1588 or NTP packet-based approaches<br>■ With TIA/EIA-95B timing inputs | |
| **Transmit clock adjustment** | **40 G**: +/- 102 PPM in 1 PPM increments per port<br>**10 G**: +/- 102 PPM in 1 PPM increments per 4 ports sharing QSFP+ connector<br>**10/1 G**: +/- 102 PPM in 1 PPM increments per 4 ports (1–4, 5–8, 9–12) | |
| **Port CPU** | High-performance, server-class, stackable multi-core CPU | |
| **Processor resource aggregation (user-defined aggregation)** | TBD | |
| **User reservation** | Per 40 G, 10 G or 10/1 G port | |
| **Module weight** | Q5 ver: 2.65 kg, Q4 and S16 ver: 2.55 kg., Q3 and S12 ver: 2.15 kg., Q2 and S8 ver: 2.05 kg. | |
| **Module predicted MTBF** | Q5 versions = 35133, Q4/S16 versions = 38428, Q3/S12 versions = 49,523 hours, Q2/S8 versions = 56,330 hours of continuous operation | |
| **Operating temperature range** | Q5 modules supported for 59° to 86° F (15° to 30° C) ambient temperature. All other fX2 modules are supported for 59° to 95° F (15° to 35° C) ambient temperature. 20% to 80% relative humidity. | |
| **Max power draw per module** | FX2-40G-Q5 draws a maximum of 430 W per slot. | |

# Spirent **fX2**

40 GbE, 10 GbE and 10 GbE, 1 GbE Dual-Speed Test Modules

| Technical information | |
|---|---|
| **Spirent TestCenter Layer 1 testing-supported for 40 GbE modules only** | |
| **PCS layer testing** | PCS skew injection and measurement for each lane. PCS lane swapping and swap detection. Sync header and alignment marker lock status per lane. Alignment errors, coding errors per PCS. PCS sync header errors, BIP8 errors, sync errors, length errors, consecutive errors, marker errors per PCS lane. Error counts include instantaneous LED indicator, count, number in last second, number of erred seconds and the error rate per second. |
| **PMA layer testing** | PRBS pattern generation per PMA lane. Pattern detection, errors, error rate per lane. |
| **Spirent TestCenter Layer 2–3 traffic generation** | |
| **Transmit streams per port (arbitrary values)** | 64K |
| **Stream block definitions per port** | 512 stream block definitions each capable of generating multiple streams |
| **Frame templates per port** | 256 unique frame templates can be transmitted from each port |
| **Transmit statistics per port** | Nearly 50 transmit stats per port reported in real time. Stats include Layer 1, Layer 2 and Layer 3+ counters and rates and include counts for frames generated with CRC errors and checksum errors. |
| **Transmit statistics per stream** | Tx frame count and rate—all Tx statistics accurate even with random frame sizes and rates. |
| **Error and fault generation** | Link Fault Signaling and streamblock FCS error and IP checksum errors |
| **Variable Field Definition (VFD) per port** | 256 VFD indices per port each with 6 VFDs |
| **VFDs per stream** | 6 VFDs per stream |
| **Route Insertion Table (RIT) entries per port** | 8M 4-byte entries for dynamic label or random IP/MAC address assignments |
| **RIT or list VFD entries per stream** | 8 RIT insertions or List VFD insertions per stream |
| **Frame length range** | 100% line rate for frames of 58-16383 bytes. Sub-line rate for frames from 33–57 bytes. |
| **Frame length controls** | Fixed, increment, decrement, random, automatic based on user frame, IMIX w/ weighting for 4 nodes |
| **Frame rate minimum and maximum at wire rate** | 1 every 3.43s to 102% of line rate |
| **Scheduler mode support** | **Port Based**: Traffic scheduling handled at the port level<br>**Rate Based**: Key parameters determined at the port level with division among the individual stream blocks<br>**Priority Based**:Scheduling determined at the stream block level using user-assigned priorities. Precise scheduling of CBR and bursty traffic for QoS testing.<br>**Manual Mode**: Manual control of stream sequence. |
| **Priority flow control** | Generator supports up to 8 queues for responding to PFC Pause frames. Queue support can be integrated with DCBX emulation for automatic setup.<br>PFC Pause frames can be sent manually for DUT response testing or triggered automatically based on configurable received traffic behavior. |
| **Spirent TestCenter Layer 2–3 traffic analysis** | |
| **Trackable streams per port** | 128K |
| **Ssatistics per stream** | Over 40 real-time measurements per stream—includes standard frame and packet counters and rates and advanced sequence checking, RFC 4689 jitter, latency, FCS errors and checksum errors.<br>▪ **Advanced sequencing**: In-order, lost, reordered, late and duplicate<br>▪ **Latency**: Avg, min, max and short-term avg; first/last frame arrival timestamp<br>▪ **Data integrity**: IP checksum, TCP/UDP checksum, frame CRC, embedded CRC and PRBS bit errors |
| **Statistics per port** | ▪ Over 50 transmit stats per port reported in real time. Stats include Layer 1, Layer 2 and Layer 3+ counters and rates and include received FCS, checksum, and PRBS errors and rates. Also available are per-priority level PFC counters and six user-defined (pattern match) counters.<br>▪ Protocol port counters available for tracking key protocol message and state information for Routing and MPLS, Carrier Ethernet, GRE, ARP and PFC control plane. |

| Technical information | |
|---|---|
| **Spirent TestCenter Layer 2–3 traffic analysis (continued)** | |
| **User-defined statistics per port** | Six user-defined statistics (count and rate for each) specified by regular expression (using AND, OR and NOT) consisting of byte pattern and offset match and/or frame length range match. |
| **Analyzer real-time filtering—Identify, display and filter by user-configurable protocol field values and ranges.** | Four 16-bit and one 32-bit analyzer filters available per-port for real-time stream analysis of test signature and non-test signature traffic.<br>Filters can be placed over protocol fields with masks and ranges to isolate specific types of traffic and by quality of service values such as: transmit stream ID, IPv4/v6 SA/DA, MAC SA/DA, IP TOS/DiffServ, TCP/UDP port, VLAN ID, VLAN priority, MPLS label, MPLS exp plus more |
| **Capture buffer size** | 1 GB per port in 40 GBE mode and 256 MB per port in 10GBE mode |
| **Capture buffer controls—Spirent TestCenter's unique capture capability allows maximum effectiveness when debugging hard to find hardware or protocol problems.** | Several modes of operation that include: Filter by protocol fields, filter by byte offset and range; store slices or full-frames; store signature or all frames; store tx/rx control plane with data plane; real-time mode for control plane traffic; wrap or stop buffer at end.<br>User-defined pattern definitions can logically combine 8 filters of up to 32 total bytes. Patterns can be applied to start, filter (quality) or stop capture.<br>In addition to user-patterns, filtering, starting and stopping capture contains the following pre-defined events: FCS, PRBS, IPv4 checksum, TCP/UDP/IGMP checksum, and sequence errors; undersize, oversize, jumbo, and user-defined frame length; IPv4, IPv6, TCP, UDP and IGMP packets; test signature present and test stream ID match. Each event can be independently set to ignore, include or exclude. |
| **Priority flow control** | Per-priority measurements for Xon response time, PFC transmit time and post-PFC receive time. |
| **Latency modes** | Benchmark tests support LIFO, LILO, FIFO or FILO latency calculation methods. |
| **High-resolution sampling—High-resolution sampling and charting available for select port or stream-block counters. Allows detailed analysis of events happening at the millisecond level (e.g., fail-over and re-route performance analysis)** | Available on any receive port or streamblock frame/bit/byte counter or rate.<br>1000 samples available at intervals of 1–100ms.<br>Sample trigger set by relational operator of user-defined value of sampled statistic.<br>User-defined trigger location within buffer. |
| **Histograms** | Port-level histograms |
| **Spirent TestCenter protocol emulation** | |
| **Spirent TestCenter protocols available as separately licensed packages. Below is a sample list of supported protocols. Contact Spirent for a full list of capabilities and packages.** | |
| **Enterprise and data center switch protocol support** | ▪ **OpenFlow 1.3/1.0**: OpenFlow switch and controller emulation and switch conformance testing<br>▪ **Routing, multicast and bridging**: All major IPv4 and IPv6 unicast and multicast routing protocols, IGMPv1/v2/v3, MLDv1/v2, LACP, STP, RSTP and MSTP<br>▪ **Data center**: DCBX, FCoE, FIP, 802.1Qbb<br>▪ **Stateful Layer 4–7**: HTTP, SIP and FTP |
| **Service provider protocol support** | ▪ **SDN/NFV**: PCE and Segment Routing<br>▪ **Routing and MPLS**: All major IPv4 and IPv6 unicast and multicast routing protocols, RSVP-TE, LDP, VPLS-LDP, VPLS-BGP, BGP/MPLS-VPN, Fast Re-route, EVPN, mVPN, P2MP-TE, BFD, TWAMP and PWE3 (RFC4447)<br>▪ **Access**: ANCP, PPPoE, DHCP, L2TP, IGMPv1/v2/v3, MLDv1/v2, DHCPv6 and PPPoEv6<br>▪ **Carrier Ethernet and bridging**: LACP, STP, RSTP and MSTP, 802.1ag CFM, Y.1731, PBB, PBB-TE, Link OAM<br>▪ **Stateful Layer 4–7**: HTTP, SIP and FTP, Unicast/Multicast RTSP and RAW TCP<br>▪ **Mobile Backhaul**: MPLS-TP, 1588v2 and Synchronous Ethernet as supported protocols |

# Spirent fX2

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## Requirements

- Spirent Chassis and Controller (see table below)
- Windows-based workstation with 10/100/1000 Mbps Ethernet NIC; mouse and color monitor required for GUI operation. For complete GUI requirements, please refer to Spirent TestCenter Generator and Analyzer Base Package A data sheet (P/N 79-000028)
- Linux or Windows-based workstation for command line automation. For complete automation system requirements, refer to the Spirent TestCenter Extreme Automation Package data sheet
- Spirent TestCenter hardware requires BPK-1001A for packet generation and analysis

## Spirent services

Spirent Global Services provides a variety of professional services, support services and education services—all focused on helping customers meet their complex testing and service assurance requirements. For more information, visit the Global Services website at **www.spirent.com** or contact your Spirent sales representative.

| Ordering information | |
|---|---|
| Test modules | |
| Description | Part number |
| Spirent fX2 40/10 GbE QSFP+ 5-ports | FX2-40G-Q5 |
| Spirent fX2 40/10 GbE QSFP+ 4-ports | FX2-40G-Q4 |
| Spirent fX2 40/10 GbE QSFP+ 3-ports | FX2-40G-Q3 |
| Spirent fX2 40/10 GbE QSFP+ 2-ports | FX2-40G-Q2 |
| Spirent fX2 40 GbE QSFP+ 5-port | FX2-40GO-Q5 |
| Spirent fX2 40 GbE QSFP+ 4-port | FX2-40GO-Q4 |
| Spirent fX2 40 GbE only QSFP+ 3-ports | FX2-40GO-Q3 |
| Spirent fX2 40 GbE only QSFP+ 2-ports | FX2-40GO-Q2 |
| Spirent fX2 10 GbE only QSFP+ 20-ports | FX2-10G-Q5 |
| Spirent fX2 10 GbE QSFP+ 16-ports | FX2-10G-Q4 |
| Spirent fX2 10 GbE QSFP+ 12-ports | FX2-10G-Q3 |
| Spirent fX2 10 GbE QSFP+ 8-ports | FX2-10G-Q2 |
| Spirent fX2 10/1 GbE SFP+ 16-ports | FX2-10G-S16 |
| Spirent fX2 10/1 GbE SFP+ 12-ports | FX2-10G-S12 |
| Spirent fX2 10/1 GbE SFP+ 8-ports | FX2-10G-S8 |
| Accessories for QSFP+ interfaces | |
| Optical transceiver, QSFP+, 40GBASE-SR4, 850NM, MPO, MMF | ACC-6076A |
| Optical transceiver, QSFP+, 40GBASE-LR4, 1310NM, SMF | ACC-6077A |
| Copper direct-attach cable, QSFP+ to QSFP+, 3-meter | ACC-6085A |
| Copper breakout cable assembly, QSFP+ to 4 X SFP+, 3-meter | ACC-6087A |
| Optical transceiver, QSFP+ dual-rate, 40GBASE-SR4 / 4x10GBASE-SR, 850NM, MMF | ACC-6089A |
| Optical transceiver, QSFP+ TO 4x10GBASE-LR, SMF | ACC-6090A |
| Accessories for SFP+ interfaces | |
| Optical transceiver SFP+ MSA, 10 GBE, 10GBASE-SR, MMF | ACC-6050A |
| Optical transceiver SFP+ MSA, 10 GBE, 10GBASE-LR, SMF | ACC-6051A |
| SFP+ passive copper cable assembly, 1-meter | ACC-6060A |
| SFP+ pasive copper cable assembly, 3-meter | ACC-6061A |
| Optical transceiver, SFP+ dual-rate, 10 G-1 G, 850NM, MMF | ACC-6081A |
| Optical transceiver SFP+ dual-rate, 10 G-1 G, 1310NM, SMF | ACC-6082A |
| Copper transceiver, SFP, 1000BASE-T RJ-45 | ACC-6092A |
| Spirent chassis | |
| Spirent N11U chassis and controller with 110 V AC power supplies | SPT-N11U-110 |
| Spirent N11U chassis and controller with 220 V AC power supplies | SPT-N11U-220 |
| Spirent N4U chassis and controller with 110 V AC power supplies | SPT-N4U-110 |
| Spirent N4U chassis and controller with 220 V AC power supplies | SPT-N4U-220 |

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