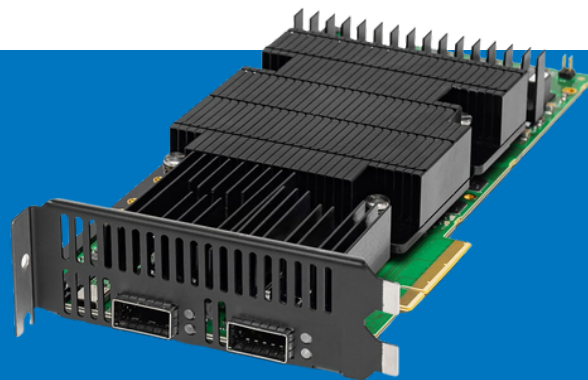


# Z400qx Thor

Testing 7 different 56G PAM4 and NRZ speeds up to 400Gbps via QSFP-DD/QSFP56/QSFP28



## Key Features

- Dual QSFP-DD/QSFP56/QSFP28 cages
- Supports, 400GE, 200GE, 100GE & 50GE speeds using 56G PAM4
- Supports 100GE, 50GE, 40GE, 25GE & 10GE speeds using 10G NRZ
- Traffic Generation and analysis
- Test with optics, LPOs, AECs, ACCs and DAC's
- Advanced Physical Layer testing with Xena PHY providing valuable Layer 1 insights
- Advanced Auto-Negotiation & Link Training (AN/LT) analysis on PAM4 signals
- Extensive software package including test suites for RFC2544, RFC2889 and RFC3918
- Python-based open-source automation framework
- Ease of use

**Z400qx Thor 2 port traffic generator module can test seven Ethernet speeds - 400GE, 200GE, 100GE, 50GE, 40GE, 25GE and 10GE using 56G/25G/10G SerDes**

Z400qx Thor is a versatile solution for testing the performance and functionality of Ethernet network infrastructure and equipment including switches, routers and NICs.

Equipped with 2 QSFP-DD cages this module can test speeds ranging from 10GE NRZ all the way to 400GE using 56G PAM4 SerDes, Z400qx Thor is really the ultimate test module when it comes to flexibility.

The module also provides advanced tool to help developers optimize signal integrity and Bit Error Rate (BER) performance on the tested links.

Z400qx Thor supports extensive L1 test features. With the integrated Xena PHY providing valuable insights into advanced PCS and PMA layer testing including dynamic transceiver clock sweep, lane skewing and PRBS modes. Signals can be analyzed in advanced Signal Integrity View (SIV), to provide visual information on signal quality.

Z400qx Thor can be installed in the Xena B2400 chassis for up to 12 400G ports, or it can be delivered in our Compact chassis, making it a small and lightweight 400G Ethernet test solution.

Z400qx Thor comes complete with XenaManager, the intuitive multi-user management software for generating and analyzing traffic. Also included is Xena OpenAutomation (XOA), an open-source scripting and automation framework designed to help test engineers make the most of Xena testers with tailored tests and standardized test methodologies.

## Ethernet Auto-Negotiation & Link Training Test Tools

Z400qx Thor traffic generators support Auto-Negotiation and Link Training (AN/LT) on 56G SerDes (PAM4).

Z400qx Thor also provides a AN/LT Utility making additional AN/LT tools available for thorough testing of the endpoint behavior during AN and LT process.

The AN/LT Utility adds insight, visibility, and configuration possibilities to the AN and LT process making it easy to analyze DUT behavior during AN/LT, configure and optimize the relevant AN parameters and LT coefficients, on PAM4 signals.

## INTERFACES AND STANDARDS

|                                   |                                                               |                  |                                   |
|-----------------------------------|---------------------------------------------------------------|------------------|-----------------------------------|
| Number of module cages/connectors | 2 x QSFP-DD/QSFP56/QSFP28                                     |                  |                                   |
| Interface options in each cage    | <b>56G Serdes</b>                                             | <b>Line Code</b> | <b>IEEE/ETC*</b>                  |
|                                   | 1 x 400GE                                                     | PAM4             | IEEE 802.3bs or ETC* 400G         |
|                                   | 2 x 200GE                                                     | PAM4             | 802.3cd                           |
|                                   | 4 x 100GE                                                     | PAM4             | 802.3cd                           |
|                                   | 8 x 50GE                                                      | PAM4             | 802.3cd                           |
|                                   | <b>25G/10G Serdes</b>                                         | <b>Line Code</b> | <b>IEEE/ETC*</b>                  |
|                                   | 2 x 100GE                                                     | NRZ              | 802.3bj                           |
|                                   | 4 x 50GE                                                      | NRZ              | ETC* 25G/50G R2.0                 |
|                                   | 2 x 40GE                                                      | NRZ              | 802.3ba                           |
|                                   | 8 x 25GE                                                      | NRZ              | IEEE 802.3by or ETC* 25G/50G R2.0 |
|                                   | 8 x 10GE                                                      | NRZ              | 802.3ae                           |
|                                   | Power capacity using single cage:<br>QSFP-DD: 25W             |                  |                                   |
|                                   | Power capacity using both cages:<br>QSFP-DD: 15W in each cage |                  |                                   |
|                                   | * ETC = Ethernet Technology Consortium                        |                  |                                   |

| LAYER 1 FEATURES                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|---------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Pattern Generation                                      | <ul style="list-style-type: none"> <li>• PRBS-13, PRBS-31, PRBS-13Q, PRBS-31Q</li> <li>• SSPRQ test pattern (IEEE 802.3 Clause 120.5.11.2.3)</li> <li>• Square Wave (IEEE 802.3 Clause 120.5.11.2.4)</li> <li>• Statistics: Lock status, PRBS errors, PRBS error rate</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                             |
| Physical Coding Sublayer                                | <ul style="list-style-type: none"> <li>• PCS virtual lane-to-SerDes mapping configuration</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Forward Error Correction                                | <ul style="list-style-type: none"> <li>• RS-FEC KP (544,514,t=15), IEEE 802.3 Clause 119 (200GE/400GE)</li> <li>• RS-FEC KR (528,514,t=7), IEEE 802.3 Clause 91 (100GE)</li> <li>• RS-FEC KP (544,514,t=15), IEEE 802.3 Clause 91 (100GE)</li> <li>• RS-FEC KP (544,514,t=15), IEEE 802.3 802.3cd Clause 134 (50GE/100GE)</li> <li>• RS-FEC KR (528,514,t=7), IEEE 802.3 Clause 108 (25GE)</li> <li>• RS-FEC KR (528,514,t=7), 25/50G Ethernet Consortium (25GE/50GE)</li> <li>• BASE-R FEC (Firecode) 2112,2080 IEEE 802.3 Clause 74 (10GE/25GE)</li> </ul>                                                                                                                                 |
| FEC Error Injection                                     | <ul style="list-style-type: none"> <li>• RS-FEC KP (544, 514, T=15)</li> <li>• RS-FEC KR (528, 514, T=7)</li> <li>• Configuration: Consecutive, Errored Codewords, Total Codewords Per Cycle, Errored Symbols Per Codeword</li> <li>• Bit error mask modes: Static, Rotate, Increment</li> <li>• Pre-defined profiles: Max. Consecutive Uncorrectable w/o Link Loss, Min. Consecutive Uncorrectable with Link Loss</li> <li>• Loop modes: Single, Continuous, Repeat</li> <li>• Injection statistics: Injected FEC Errors; Total Codewords, Total Uncorrectable Codewords, Total Correctable Codewords, Total Error-Free Codewords, Codeword Error Ratio, and Total Symbol Errors</li> </ul> |
| Reconciliation Sublayer<br>(Local/Remote Fault feature) | <ul style="list-style-type: none"> <li>• Normal: Acts according to 802.3 standard</li> <li>• Force Local: Port will continuously transmit "Local Fault indication".</li> <li>• Force Remote: Port will continuously transmit "Remote Fault indication".</li> <li>• Disabled: Port does not respond to Local/Remote Fault from DUT</li> </ul>                                                                                                                                                                                                                                                                                                                                                 |
| PMA Error Injection                                     | <ul style="list-style-type: none"> <li>• Repeatable error injection periods at PMA layer with millisecond precision.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Link Flap                                               | <ul style="list-style-type: none"> <li>• Single shot or repeatable link-down with millisecond precision.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Equalization Controls                                   | <ul style="list-style-type: none"> <li>• Tx Equalization Control</li> <li>• Rx Equalization Control: CTLE, AGC Adapt, OC Adapt, DFE Tap, CDR, Pre FFEs, and Post FFEs</li> <li>• Support value freezing and auto on Rx equalizations</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Signal Integrity Analysis                               | <ul style="list-style-type: none"> <li>• Advanced Signal Integrity View for modulated signal quality analysis</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| PPM Sweep                                               | <ul style="list-style-type: none"> <li>• Configurable</li> <li>• linear or step sweep +/- 400 ppm in steps of 1ppm (shared across all ports on module)</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Auto Negotiation and Link Training                      | <ul style="list-style-type: none"> <li>• Auto-negotiation: IEEE 802.3 Clause 73, ETC 25G/50G</li> <li>• Link training: IEEE 802.3 Clause 72, 136 and 161</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Advanced AN and LT analysis**                           | Capture, Decode and analysis of Auto Negotiation and Link Training protocol                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |

\*\*Advanced ANLT Solution track, purchased separate

## TRANSMIT ENGINES

|                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|--------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Traffic Generation             | <ul style="list-style-type: none"> <li>• Wire-speed multi-stream traffic generation</li> <li>• Up to 256 hardware streams per port</li> <li>• Each stream can generate millions of traffic flows using field modifier</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                           |
| Transmit Line Clock Adjustment | <ul style="list-style-type: none"> <li>• From -400 to 400 ppm in steps of 1 ppm (shared across all ports on module)</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Oscillator Characteristics     | <ul style="list-style-type: none"> <li>• Initial Accuracy is +/- 1,5 ppm including temperature Stability.</li> <li>• Frequency drift over 1st year: +/- 2.5 ppm including temperature Stability.</li> <li>• Frequency drift over over 20 years: +/- 3.5 ppm including temperature Stability.</li> <li>• Temperature Stability mentioned above is +/- 0.5 ppm</li> </ul>                                                                                                                                                                                                                                                                    |
| Transmit Control               | <ul style="list-style-type: none"> <li>• Support adjustment of the effective line rate by forcing idle gaps equivalent to -1000 ppm (increments of 10 ppm)</li> <li>• Configurable average Inter-Frame Gap (IFG) from 18 to 63 bytes, default is 20B (12B IFG + 8B preamble)</li> <li>• Support optical laser or copper link enable/disable</li> </ul>                                                                                                                                                                                                                                                                                     |
| Loopback Modes                 | <ul style="list-style-type: none"> <li>• L1 RX-to-TX: Any received packet is bounced back through TX</li> <li>• TX(on)-to-RX: Packet goes out of TX but also internally direct to RX</li> <li>• TX(off)-to-RX: Packet goes directly to RX (No link sync needed)</li> <li>• Port-to-Port: Any received packet goes out through the neighbor port</li> </ul>                                                                                                                                                                                                                                                                                 |
| Port Transmit Scheduling Modes | <ul style="list-style-type: none"> <li>• Normal (stream interleaved mode): Default scheduling mode, precise rates, minor variation in packet inter-frame gap.</li> <li>• Uniform: With 100% uniform packet inter-frame gap, minor deviation from configured rates is available.</li> <li>• Sequential: Streams are scheduled continuously in sequential order, with configurable number of packets per stream.</li> <li>• Burst: Packets in a stream are organized in bursts. Bursts from active streams form a burst group is available. The user specifies time from start of one burst group till start of next burst group.</li> </ul> |
| Stream Profile                 | <ul style="list-style-type: none"> <li>• Packet Length: Fixed; Incrementing, Random, Butterfly. Minimum 56 bytes, maximum 16K bytes.</li> <li>• Packet Payload: Incrementing 8-bit, custom pattern (up to 18B repeated)</li> <li>• Burst Traffic with configurable Burst Size, and Burst Density</li> <li>• Flow Control: PFC support for both VLAN tagged and untagged traffic</li> </ul>                                                                                                                                                                                                                                                 |
| Stream Header Types            | Ethernet, VLAN, ARP, IPv4, IPv6, UDP, TCP, LLC, SNAP, GTP, ICMP, RTP, RTCP, STP, SCTP, MacCtrl, MPLS, PBB, FCoE, FC, IGMPv2, GRE, GTP, VxLAN, NVGRE, DHCPv4, Geneve, eCPRI, RoE, PWE, PFC, Custom.                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Stream Modifiers               | <ul style="list-style-type: none"> <li>• Maximum 8 x 24-bit modifiers per stream</li> <li>• 24-bit header field modifiers with incremental, decremental, or random mode.</li> <li>• Each modifier has configurable bit-mask, repetition, min, max, and step parameters.</li> </ul>                                                                                                                                                                                                                                                                                                                                                         |

## TRANSMIT ENGINES, CONT.

|                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|-------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Layer 2 Error Injection | <ul style="list-style-type: none"> <li>Undersize (56 bytes min), and oversize (16000 bytes max.) packet lengths</li> <li>FCS Error, Sequence Error, Misordering Error, Payload Integrity Error, Test Payload Error</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Multicast               | <ul style="list-style-type: none"> <li>Support for IPv4</li> <li>Up to 8 multicast group addresses</li> <li>IGMPv2: Join (with configurable repeat interval), Leave All-Devices, Leave, General Query, Group Query</li> <li>IGMPv3: Exclude (with configurable repeat interval), Include, Change-to-Exclude, Change-to-Include, Multi-group record support</li> </ul>                                                                                                                                                                                                                                                                                                                                      |
| ARP/NDP/Ping            | <ul style="list-style-type: none"> <li>Auto address resolution</li> <li>Auto reply to request per port and per stream</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| LLDP                    | <ul style="list-style-type: none"> <li>Configurable LLDP operation mode, timers, and TLVs</li> <li>Support mandatory and optional TLV types</li> <li>Display received LLDP information</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Transmit Statistics     | <ul style="list-style-type: none"> <li>Per-stream: bits/s, bytes/s, packets/s, packets, bytes</li> <li>Per-port: ARP, NDP, Ping, requests and replies</li> <li>Per-port injected errors: FCS Error, Sequence Error, Misordering Error, Payload Integrity Error, Test Payload Error</li> <li>Two real-time histograms per port: TX Packet Length, IFG, or latency distribution for all traffic, a specific stream, or a filter</li> </ul>                                                                                                                                                                                                                                                                   |
| Packet Scheduling Modes | <ul style="list-style-type: none"> <li>Normal (stream interleaved mode) – standard scheduling mode, precise rates, minor variation in packet inter-frame gap.</li> <li>Strict Uniform – with 100% uniform packet inter-frame gap, minor deviation from configured rates is available.</li> <li>Sequential packet scheduling (sequential stream scheduling) is available. Streams are scheduled continuously in sequential order, with configurable number of packets per stream.</li> <li>Burst. Packets in a stream are organized in bursts. Bursts from active streams form a burst group is available. The user specifies time from start of one burst group till start of next burst group.</li> </ul> |

| RECEIVE ENGINE                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|----------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Traffic Receive Capability                   | Number Of Traceable Rx Streams Per Port : 2016 (wire-speed)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Receive Statistics                           | <ul style="list-style-type: none"> <li>• Per-stream: bits/s, bytes/s, packets/s, packets, bytes</li> <li>• Per-stream: Packet Loss, Misordered, Payload Errors</li> <li>• Per-stream: Latency and jitter with minimum, maximum and average</li> <li>• Per-port: ARP, NDP, Ping, with requests and replies</li> <li>• Per-port injected errors: FCS Error, Sequence Error, Misordering Error, Payload Integrity Error, Test Payload Error</li> <li>• Two real-time histograms per port: RX Packet Length, IFG, or latency distribution for all traffic, a specific stream, or a filter</li> <li>• Filter statistics: bits/s, bytes/s, packets/s, packets, bytes</li> </ul> |
| Latency Measurement                          | <ul style="list-style-type: none"> <li>• Latency can be measured on up to 2016 streams</li> <li>• Accuracy: <math>\pm 16</math> ns</li> <li>• Resolution: 1 ns</li> </ul> <p>(Latency measurements can be calibrated to remove latency from transceiver modules)</p> <ul style="list-style-type: none"> <li>• Measurement modes: Last-to-last, last-to-first, first-to-last, first-to-first</li> </ul>                                                                                                                                                                                                                                                                    |
| Jitter Measurement                           | <ul style="list-style-type: none"> <li>• Jitter can be measured on up to 2016 streams</li> <li>• Jitter (Packet Delay Variation) measurements compliant to MEF10 standard with 1ns accuracy.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Traffic Filter                               | <ul style="list-style-type: none"> <li>• 6 x 64-bit configurable match-term patterns with mask, and offset</li> <li>• 6 x frame length comparator terms (longer, shorter)</li> <li>• 6 x configurable filters expressed in logical expressions of the match and length terms</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                   |
| Filter Statistics<br>(Counter size: 64 bits) | <p>Per filter:</p> <ul style="list-style-type: none"> <li>• RX Mbit/s</li> <li>• packets/s</li> <li>• packets</li> <li>• bytes</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Capture                                      | <ul style="list-style-type: none"> <li>• Start Trigger Criteria: FCS errors, filter match, payload error, manual</li> <li>• Stop Trigger Criteria: FCS errors, filter match, payload error, manual, buffer full</li> <li>• Capture Limit Per Packet: 16 – 16383 bytes</li> <li>• Wire-Speed Capture Buffer Per Port: 64 kB</li> <li>• Low Speed Capture Buffer Per Port (10 Mbits/s): 4096 packets (any size)</li> <li>• Packet header auto decode</li> </ul>                                                                                                                                                                                                             |

| SPECIFICATIONS       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Max. Power           | <ul style="list-style-type: none"><li>• 100 W</li></ul>                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Weight               | <ul style="list-style-type: none"><li>• 2.32 lbs (1.05 kg)</li></ul>                                                                                                                                                                                                                                                                                                                                                                                                          |
| Environmental        | <ul style="list-style-type: none"><li>• Operating Temperature: 10 to 30°C</li><li>• Storage Temperature: -40 to 70°C</li><li>• Humidity: 8% to 90% non-condensing</li></ul>                                                                                                                                                                                                                                                                                                   |
| Regulatory           | <ul style="list-style-type: none"><li>• FCC (US)</li><li>• CE (Europe)</li></ul>                                                                                                                                                                                                                                                                                                                                                                                              |
| User interface       | <ul style="list-style-type: none"><li>• XenaManager (XM), XenaManager3 (XM3), Xena OpenAutomation (XOA) and XOA CLI</li><li>• Xena2544, Xena2889, Xena3918, Xena1564</li></ul>                                                                                                                                                                                                                                                                                                |
| Connector insertions | <p>Xena uses high-quality 112Gbps-capable electrical connectors on Z400 Thor modules for optimal signal integrity and performance. However, all connectors experience wear when inserted, resulting in decreased signal integrity over time. The specification below is the minimum number of insertions where optimal signal integrity is guaranteed:</p> <ul style="list-style-type: none"><li>• Connectors, minimum number of guaranteed insertions: 1000 cycles</li></ul> |
| Notes                | <ul style="list-style-type: none"><li>• The Z400qx Thor occupies 2 slot in a B2400 chassis. Please refer to module install guide for additional info and instruction if air guides are required.</li><li>• The Z400qx Thor is also available in the standalone Compact chassis (P/N Z400qxc Thor)</li></ul>                                                                                                                                                                   |

Ordering Information

| Product Description                                                                                                   | Product Code      |
|-----------------------------------------------------------------------------------------------------------------------|-------------------|
| Z400qxc Thor 2 port QSFP-DD/QSFP56/QSFP28 7-speed 400G (112G/56G PAM4, 25G/10G NRZ) test module in 1U Compact Chassis | C-Thor-400G-7S-2P |
| Z400qx Thor 2 port QSFP-DD/QSFP56/QSFP28 7-speed 400G (112G/56G PAM4, 25G/10G NRZ) test module                        | Thor-400G-7S-2P   |



Local sales offices are located throughout the world. Visit our website to find the most convenient location.  
1-800-5-LeCroy • [teledynelecroy.com](http://teledynelecroy.com)



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