Thor-100G-5S-4P

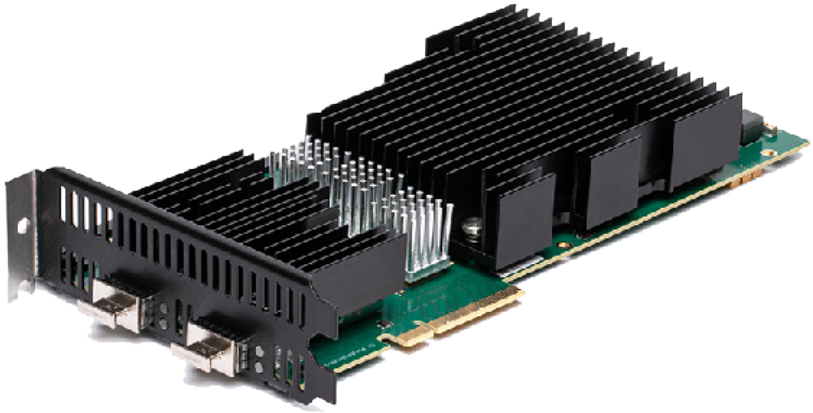
5-speed PAM4/NRZ 100G test module

Xena's Thor-100G-5S-4P test module can test five different Ethernet network speeds - 100GE, 50GE, 40GE, 25GE and 10GE. This unique flexibility is provided via two physical transceiver cages – one supporting QSFP-DD/56/28/+ transceivers, and the other supporting QSFP56/28/+ transceivers.

The QSFP-DD cage can support the following speeds and ports: 1x100G, 2x100G, 4x100G, 2x50G, 4x50G, 8x 50G, 1x40G, 4x25G, and 4x10G Ethernet test ports. The QSFP56 cage can support the exact same speeds except for 4x100G or 8x50G Ethernet. Both cages can be active simultaneously except when the QSFP-DD cage runs 4x100G or 8x50G.

Thor-100G-5S-4P is the only test module on the market that can test both NRZ & PAM4 speeds, plus perform Auto-Negotiation and Link Training (AN/LT) with a comprehensive level of interoperability testing.

The result is a highly versatile solution for performance and functional testing of network infrastructure and Ethernet equipment that support 100GE including switches, routers, NICs, TAPs, packet-brokers, and backhaul platforms.



TOP FEATURES

- 5-speed flexibility: 100GE, 50GE, 40GE, 25GE and 10GE
- Supports both NRZ & PAM4 speeds
- Support for Auto-neg & Link Training (AN/LT) - interoperability tested
- Industry's best automation options
- Dual media value

XENA VALUE PACK*

Included with every Thor-100G-5S-4P:

- User-friendly software (ValkyrieManager, Valkyrie3918, Valkyrie2544, Valkyrie1564 Valkyrie2889 and ValkyrieCLI, ValkyrieREST-API)
- Three years' free software updates
- Three years' free hardware warranty
- Free tech support & training for the product lifetime

PORT LEVEL FEATURES

Interface category	QSFP-DD - 100G, 50G Ethernet QSFP56 - 100G, 50G Ethernet QSFP28 - 100G, 50G, 40G*, 25GE and 10G* Ethernet QSFP+ - 40G, 10G Ethernet
Total number of test ports	4x100G, 8x50G, 2x40G, 8x25G, and 8x10G Ethernet
Interface options	**Line Code / Standard** QSFP-DD cage • 4 x 100GBASE-CR2, or 4 x 100GBASE-DR, or — PAM4 — 802.3cd • 2 x 100GBASE-SR2/CR2, 2 x 100GBASE-DR — PAM4 — 802.3cd (dual CS connector) or • 1 x 100GBASE-SR4/LR4/CR4, or — NRZ — 802.3bj • 8 x 50GBASE-SR/CR, or — PAM4 — 802.3cd • 4 x 50GBASE-SR/CR, or — PAM4 — 802.3cd • 2 x 50GBASE-SR2/LR2/CR2, or — NRZ — Consortium** • 1 x 40GBASE-SR4/LR4/CR4, or — NRZ — 802.3ba • 4 x 25GBASE-SR/LR/CR, or — NRZ — 802.3by/Consortium** • 4 x 10GBASE-SR/LR/CR — NRZ — 802.3ae QSFP56 cage: Same as QSFP-DD minus support for 4 x 100GBASE-DR, 4 x 100GBASE-CR2 and 8 x 50GBASE-SR/CR. Actual interface options depend on the capabilities of the inserted transceiver. Both cages can be active simultaneously except when the QSFP-DD cage runs 4 x 100GBASE-DR or 8 x 50GBASE-SR/CR. Both cages must run with the same base interface configuration (e.g. 2 x 50G). Power capacity per QSFP-DD/QSFP56 cage: 15 watts. ** As defined by 25/50 Gigabit Ethernet Consortium
Auto Negotiation and Link Training	IEEE 802.3 Clause 73, Auto-negotiation IEEE 802.3 Clause 72, Link training
Forward Error Correction (FEC)	RS-FEC (Reed Solomon) (528,514,t=7), IEEE 802.3 Clause 91 (100GE) RS-FEC (Reed Solomon) (544,514,t=15), IEEE 802.3 Clause 134 (100GE/50GE 802.3cd) RS-FEC (Reed Solomon) (528,514,t=7), IEEE 802.3 Clause 108 (25GE) RS-FEC (Reed Solomon) (528,514,t=7), 25/50G Ethernet Consortium (25/50GE)

Port statistics (counter size: 64 bits)	• Link state, FCS errors, pause frames, ARP/PING, error injections, training packet • All traffic: RX and TX Mbit/s, packets/s, packets, bytes • Traffic w/o test payload: RX and TX Mbit/s, packets/s, packets, bytes
Adjustable Inter Frame Gap (IFG)	Configurable from 16 to 56 bytes, default is 20B (12B IFG + 8B preamble)
Transmit line rate adjustment	Ability to adjust the effective line rate by forcing idle gaps equivalent to -1000 ppm (increments of 10 ppm)
Transmit line clock adjustment	From -100 to 100 ppm in steps of 0.001 ppm (shared across all ports)
ARP/PING	Supported (configurable IP and MAC address per port)
Field upgradeable	System is fully field upgradeable to product releases (FPGA images and software)
Histogram statistics (counter size: 64 bits)	Two real-time histograms per port. Each histogram can measure one of RX/TX packet length, IFG, jitter, or latency distribution for all traffic, a specific stream, or a filter
Tx disable	Enable/disable of optical laser or copper link
IGMPv2 multicast join/leave	IGMPv2 continuous multicast join, with configurable repeat interval
Loopback modes	• L1RX2TX - RX-to-TX, transmit byte-by-byte copy of the incoming packet • L2RX2TX - RX-to-TX, swap source and destination MAC addresses (*only at 10G) • L3RX2TX - RX-to-TX, swap source and destination MAC addresses and IP addresses (*only at 10G) • TXON2RX - TX-to-RX, packet is also transmitted from the port • TXOFF2RX - TX-to-RX, port's transmitter is idle • Port-to-port - Inline loop mode where all traffic is looped 100% transparent at L1
Oscillator characteristics	• Initial Accuracy is 3 ppm • Frequency drift over 1st year: +/- 3 ppm (over 15 years: +/- 15 ppm) • Temperature Stability: +/- 20 ppm (Total Stability is +/- 35 ppm)

100/50/40/25GE FRAMED PRBS AND PCS LAYERS

Payload Test pattern	PRBS-7, PRBS-9, PRBS-10, PRBS-11, PRBS-13, PRBS-15, PRBS-20, PRBS-23, PRBS-31, PRBS-49, PRBS-58
Error Injection	Manual single shot bit-errors or bursts, automatic continuous error injection
Alarms	Pattern loss
Error analysis	Bit-errors: seconds, count, rate
PCS virtual lane configuration	User-defined skew insertion per Tx virtual lane, and user defined virtual lane to SerDes mapping for testing of the Rx PCS virtual lane re-order function.
PCS virtual lane statistics	Relative virtual lane skew measurement (up to 2048 bits) PAM4: Corrected Bit error, PreFEC BER NRZ, No FEC: sync header and PCS lane marker error counters, indicators for loss of sync header and lane marker, BIP8 errors
FEC Total Statistics	PAM4: Total corrected FEC symbols, Total uncorrected FEC symbols, Estimated Pre-FEC BER, Estimated Post-FEC BER, Pre-FEC Error Distribution Graph
Link Flap	Single short or repeatable link down events with ms precision

TRANSMIT ENGINES

Number of transmit streams per port	256 (wire-speed). Each stream can generate millions of traffic flows using field modifiers
Test payload insertion per stream	Wire-speed packet generation with timestamps, sequence numbers, and data integrity signature optionally inserted into each packet.
Stream statistics	TX Mbit/s, packets/s, packets, bytes, FCS error
Bandwidth profiles	Burst size and density can be specified. Uniform and bursty bandwidth profile streams can be interleaved
Field modifiers	16-bit or 32-bit header field modifiers with inc, dec, or random mode. Each modifier has configurable bit-mask, repetition, min, max, and step parameters. 8 16-bit modifiers per stream or 4 32-bit modifiers per stream
Packet length controls	Fixed, random, butterfly, and incrementing packet length distributions from 56 to 12288 bytes
Packet payloads (basic)	Repeated user specified 1 to 18B pattern, an 8-bit incrementing pattern
Error generation	Undersize length (56 bytes min) and oversize length (12288 bytes max.) packet lengths, injection of sequence, misorder, payload integrity, and FCS errors
TX packet header support and RX autodecodes	Ethernet, Ethernet II, VLAN, ARP, IPv4, IPv6, UDP, TCP, LLC, SNAP, GTP, ICMP, RTP, RTCP, STP, MPLS, PBB, or fully specified by user
Packet scheduling modes	• Normal (stream interleaved mode) – standard scheduling mode, precise rates, minor variation in packet inter-frame gap. • Strict Uniform – new scheduling mode, with 100% uniform packet inter-frame gap, minor deviation from configured rates. • Sequential packet scheduling (sequential stream scheduling). Streams are scheduled continuously in sequential order, with configurable number of packets per stream. • Burst. Packets in a stream are organized in bursts. Bursts from active streams form a burst group. The user specifies time from start of one burst group till start of next burst group.

NOTE: Text in blue are features that will be added soon.

RECEIVE ENGINE

Number of traceable Rx streams per port	2016 (wire-speed)
Automatic detection of test payload for received packets	Real-time reporting of statistics and latency, loss, payload integrity, sequence error, and misorder error checking
Jitter measurement	Jitter (Packet Delay Variation) measurements compliant to MEF10 standard with 8 ns accuracy Jitter can be measured on up to 32 streams
Stream statistics	• RX Mbit/s, packets/s, packets, bytes. • Loss, payload integrity errors, sequence errors, misorder errors • Min latency, max latency, average latency • Min jitter, max jitter, average jitter
Latency measurements accuracy	±32 ns
Latency measurement resolution	8 ns *(Latency measurements can calibrate and remove latency from transceiver modules)*
Number of filters:	• 6 x 64-bit user-definable match-term patterns with mask, and offset • 6 x frame length comparator terms (longer, shorter) • 6 x user-defined filters expressed from AND/OR'ing of the match and length terms.
Filter statistics	Per filter: RX Mbit/s, packets/s, packets, bytes.

CAPTURE

Capture criteria	All traffic, stream, FCS errors, filter match, or traffic without test payloads
Capture start/stop triggers	Capture start and stop trigger: none, FCS error, filter match
Capture limit per packet	16 – 12288 bytes
Wire-speed capture buffer per port	384 kB for 400GE 192 kB for 200GE 96 kB for 100GE 48 kB for 50GE 48 kB for 40GE 32 kB for 25GE 16 kB for 10GE
Low speed capture buffer per port (10Mbit/s speed)	4096 packets (any size)

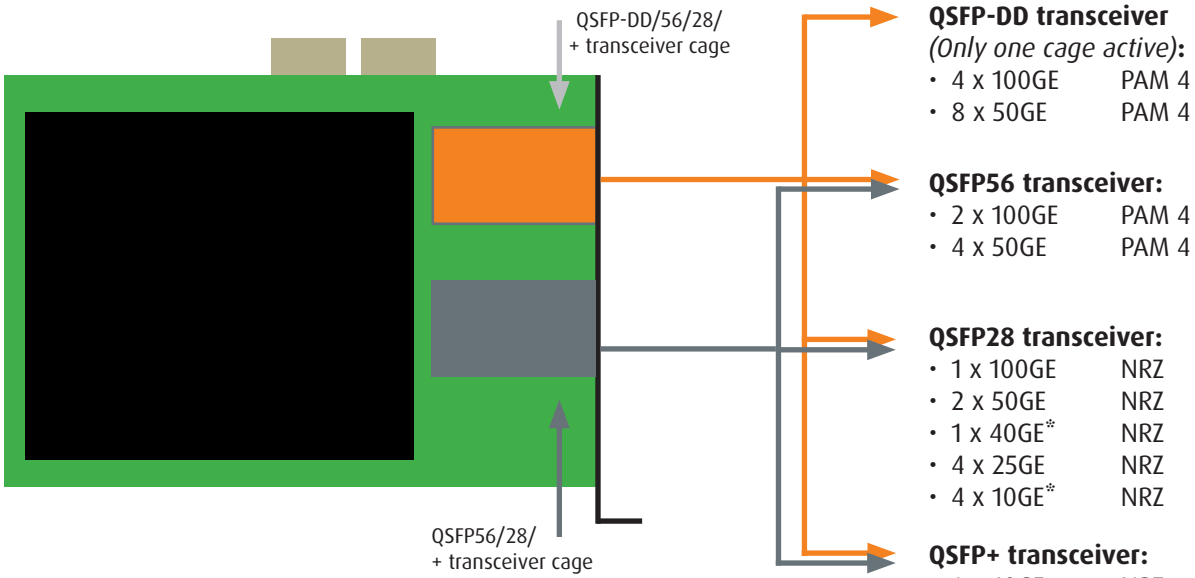
ADVANCED PHY FEATURES

Equalization Controls	Tx Transmit Equalization Controls • Pre-emphasis • Tx Attenuation • Tx Post-emphasis Signal Integrity Analysis Optional Auto-Tune of Rx equalizer/CTLE
Signal Integrity Analysis	• FEC error correction chart

NOTE: Text in blue are features that will be added soon.

One module - multiple options

The Thor-100G-5S-4P has 2 transceiver cages. The type of transceiver used determines the speeds and number of ports you can use. The port number / speed configuration must be the same for both cages. This is defined using ValkyrieManager, the traffic generation and analysis software provided by Xena with all Valkyrie test systems.



QSFP-DD transceiver
(Only one cage active):
- 4 x 100GE PAM 4
- 8 x 50GE PAM 4

QSFP56 transceiver:
- 2 x 100GE PAM 4
- 4 x 50GE PAM 4

QSFP28 transceiver:
- 1 x 100GE NRZ
- 2 x 50GE NRZ
- 1 x 40GE* NRZ
- 4 x 25GE NRZ
- 4 x 10GE* NRZ

QSFP+ transceiver:
- 1 x 40GE NRZ
- 4 x 10GE NRZ

* Depending on transceiver capabilities

HW SPECIFICATIONS

Max. Power	• 174W
Weight	• 2.31 lbs (1.05 kg)
Environmental	• Operating Temperature: 10 to 35° C • Storage Temperature: -40 to 70° C • Humidity: 8% to 90% non-condensing
Regulatory	• FCC (US), CE (Europe)
Notes	• This module is only supported by the Val-C12-2400 chassis • This module requires two slots in the Val-C12-2400 chassis

PRODUCT NUMBERS (P/N)

- Thor-100G-5S-4P - test module for ValkyrieBay chassis (only Val-C12-2400)
- C-Thor-100G-5S-4P - mounted in ValkyrieCompact chassis

XENA™
Test. Improve. Repeat.