The Loki-100G-5S-2P is a 2 port 100GE test module that can also test these Ethernet network speeds: 50GE, 40GE, 25GE and 10GE. This unique flexibility is provided via two physical transceiver cages, both supporting QSFP28 and QSFP+ transceivers. Both cages can be active simultaneously.

The result is a highly versatile solution for performance and functional testing of network infrastructure and Ethernet equipment capable of supporting 100GE such as switches, routers, NICs, taps, packet-brokers, and backhaul platforms.

**PORT LEVEL FEATURES**

<table>
<thead>
<tr>
<th>Interface category</th>
<th>QSFP28</th>
<th>QSFP+</th>
</tr>
</thead>
<tbody>
<tr>
<td>100GE, 50GE, 40GE*, 25GE, and 10GE*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>40GE and 10GE Ethernet</td>
<td></td>
<td></td>
</tr>
<tr>
<td>* Depending on transceiver capabilities</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Number of test ports (software configurable) |
| 2x100GE, 4x50GE, 2x50GE PAM4, 2x40GE, 8x25GE, and 8x10GE |

<table>
<thead>
<tr>
<th>Interface options</th>
</tr>
</thead>
<tbody>
<tr>
<td>Each cage</td>
</tr>
<tr>
<td>1 x 100GBASE-SR4/LR4/CR4, or 802.3bj</td>
</tr>
<tr>
<td>2 x 50GBASE-SR2/LR2/CR2, or Consortium**</td>
</tr>
<tr>
<td>1 x 50GBASE-SR/CR (PAM4) or 802.3cd</td>
</tr>
<tr>
<td>1 x 40GBASE-SR4/LR4/CR4, or 802.3ba</td>
</tr>
<tr>
<td>4 x 25GBASE-SR/LR/CR, or 802.3by/Consortium**</td>
</tr>
<tr>
<td>4 x 10GBASE-SR/LR/CR 802.3ae</td>
</tr>
</tbody>
</table>

Actual interface options depend on the capabilities of the inserted transceiver. Both cages must run with the same base interface configuration (e.g. 2 x 100GE)

**Support of 50GBASE-SR/CR (PAM4)**

- 26.5625 Gbps (NRZ “KP” RS-FEC)
- 26.5625 Gbps (SOGAUI-2 RS-FEC)
- 26.5625 Gbps (SR-FEC)
- 53.125 Gbps (PAM4 multiplexing transceiver)

**Forward Error Correction (FEC)**

- RS-FEC (Reed Solomon) FEC, IEEE 802.3 Clause 91 (100GE)
- RS-FEC (Reed Solomon) FEC, IEEE 802.3 Clause 134 (50GE PAM4)
- RS-FEC (Reed Solomon) FEC, IEEE 802.3 Clause 108 (25GE)
- RS-FEC (Reed Solomon) FEC, 25/50G Ethernet Consortium (25/50GE)

**Number of transceiver module cages**

- 2xQSFP28/QSFP+

**Adjustable Inter Frame Gap (IFG)**

- Configurable from 16 to 56 bytes, default is 208 (128 IFG + 88 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 -400 to 400 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)
### Payload Test pattern
- PRBS 2^31

### Error Injection
- Manual single shot bit-errors or bursts, automatic continuous error injection

### Frame size and header
- Fixed size from 56 to 9200 bytes, any layer 2/3/4 frame header

### Alarms
- Pattern loss, bit-error rate threshold

### Error analysis
- bit-errors: seconds, count, rate
- mismatch '0' / '1': 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), sync header and PCS lane marker error counters, indicators for loss of sync header and lane marker, BIP8 errors

### TRANSMIT ENGINES

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

### RECEIVE ENGINE

<table>
<thead>
<tr>
<th>Feature</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of traceable Rx streams per port</td>
<td>2016 (wire-speed)</td>
</tr>
<tr>
<td>Automatic detection of test payload for received packets</td>
<td>Real-time reporting of statistics and latency, loss, payload integrity, sequence error, and misorder error checking</td>
</tr>
<tr>
<td>Jitter measurement</td>
<td>Jitter (Packet Delay Variation) measurements compliant to MEF10 standard with 8 ns accuracy. Jitter can be measured on up to 32 streams</td>
</tr>
<tr>
<td>Stream statistics</td>
<td>RX Mbit/s, packets/s, packets, bytes.</td>
</tr>
<tr>
<td></td>
<td>Loss, payload integrity errors, sequence errors, misorder errors</td>
</tr>
<tr>
<td></td>
<td>Min latency, max latency, average latency</td>
</tr>
<tr>
<td></td>
<td>Min jitter, max jitter, average jitter</td>
</tr>
<tr>
<td>Latency measurements accuracy</td>
<td>±16 ns</td>
</tr>
<tr>
<td>Latency measurement resolution</td>
<td>8 ns (Latency measurements can calibrate and remove latency from transceiver modules)</td>
</tr>
<tr>
<td>Number of filters</td>
<td>4 x 64-bit user-definable match-term patterns with mask, and offset</td>
</tr>
<tr>
<td></td>
<td>4 x frame length comparator terms (longer, shorter)</td>
</tr>
<tr>
<td></td>
<td>4 x user-defined filters expressed from AND/OR’ing of the match and length terms.</td>
</tr>
<tr>
<td>Filter statistics</td>
<td>Per filter: RX Mbit/s, packets/s, packets, bytes.</td>
</tr>
</tbody>
</table>
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
- 256 kB for 100G
- 128 kB for 40G

Low speed capture buffer per port (10Mbit/s speed)
4096 packets (any size)

ADVANCED PHY FEATURES

Transmit Equalization Controls
- Tx Transmit Equalization Controls Pre-emphasis
- Tx Attenuation
- Tx Post-emphasis Signal Integrity Analysis
- Rx Optional Auto-Tune of PHY 50 & 25Gbps Rx SerDes

One module - multiple options

The Loki-100G-SS-2P has 2 transceiver cages. The type of transceiver used determines the speeds and number of ports available. The port number / speed configuration must be the same for both cages.

This is defined using ValkyrieManager - Xena’s free traffic generation and analysis software.

SPECIFICATIONS

Dimensions
1U ValkyrieCompact
- W: 19” (48.26 cm)
- H: 1.75” (4.45 cm)
- D: 9.8” (25 cm)
- Weight: 10 lbs (4.5 kg)

Max. Noise
- ValkyrieCompact: 49 dBA
- ValkyrieBay: 58.5 dBA

4U ValkyrieBay (2 slots)
- W: 19” (48.26 cm)
- H: 7” (17.78 cm)
- D: 19.7” (50 cm)
- Weight: 36.4 lbs (16.5 kg)

This module is only supported by the Val-C12-2400 chassis.

Environmental
- Operating Temperature: 10 to 35°C
- Storage Temperature: -40 to 70°C
- Humidity: 8% to 90% non-condensing

Power
- AC Voltage: 100-240V
- Frequency: 50-60Hz
- Max. Power: 90W (ValkyrieCompact)
- 120W (ValkyrieBay)

Regulatory
- FCC (US), CE (Europe)