56G PAM4 Test Solution
QPHY-56G-PAM4

Key Features

Performs automated transmitter testing for 56 Gb/s (28 Gbaud) PAM4 interfaces as specified in:
- OIF CEI-56G-VSR-PAM4
- OIF CEI-56G-MR-PAM4
- OIF CEI-56G-LR-PAM4
- IEEE 802.3bs
- IEEE 802.3cd

Includes measurements for:
- Eye diagrams
- Eye widths and heights
- Linearity (RLM and eye linearity)
- Signal to noise and distortion ratio (SNDR)
- Transition time
- Linear fit pulse peak
- PAM4 Jitter measurements:
  - UUGJ
  - UBHPJ
  - EOJ

Use Virtual Probe technology to de-embed test fixtures, emulate reference channels, and simulate compliance boards

Includes a simple utility for selecting the optimum peaking value for the CEI 56G reference receiver CTLE

QualiPHY report generation creates comprehensive reports with all pertinent test information

PAM4 interfaces running at 28 Gbaud enable 56 Gb/s data rates, with rapidly-evolving standards that define a challenging set of test requirements for designers and test engineers. Teledyne LeCroy's QPHY-56G-PAM4 simplifies and automates testing to the OIF CEI-56G-PAM4 and relevant PAM4-based IEEE 802.3 interface standards

PAM4 signaling represents the next generation of serial data communications technology, enabling very high data throughput with lower bandwidth requirements than traditional NRZ signaling. But this efficiency comes with a set of complex test requirements, characterizing signal shape and quality to a variety of evolving industry specifications.

QPHY-56G-PAM4 makes the process of testing devices to the various OIF and IEEE specifications quick and easy. The process is simple: select the standard variant to test, follow the simple onscreen instructions to connect your device, and click "start". QPHY-56G-PAM4 automatically acquires the signal, detects the test pattern, and performs the appropriate measurements on the relevant sections of the waveform. When a problem is detected, use the power of the serial data analysis tools to help find the root cause of excessive jitter or eye diagram failures.

QPHY-56G-PAM4 provides a highly automated and easy-to-use solution for PAM4 device testing.
**PAM4 TEST COVERAGE**

<table>
<thead>
<tr>
<th>OIF CEI-56G-PAM4</th>
<th>IEEE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>XSR</td>
</tr>
<tr>
<td>Baud Rate</td>
<td>✓</td>
</tr>
<tr>
<td>Output Voltage</td>
<td>✓</td>
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<tr>
<td></td>
<td>Output differential voltage</td>
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<tr>
<td></td>
<td>Common Mode Voltage</td>
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<tr>
<td></td>
<td>Common Mode Noise</td>
</tr>
<tr>
<td>R_LM (Level separation mismatch ratio)</td>
<td>✓</td>
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<tr>
<td>Linear Fit Pulse Peak</td>
<td>✓</td>
</tr>
<tr>
<td>SNDR (Signal-to-Noise-and-Distortion Ratio)</td>
<td>✓</td>
</tr>
<tr>
<td>Transition time</td>
<td>✓</td>
</tr>
<tr>
<td>Jitter</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>Uncorrelated Unbounded Gaussian RMS Jitter - Max</td>
</tr>
<tr>
<td></td>
<td>Uncorrelated Bounded High Probability Jitter - Max</td>
</tr>
<tr>
<td></td>
<td>Even-Odd Jitter - Max</td>
</tr>
<tr>
<td>Eye Diagram</td>
<td>✓</td>
</tr>
<tr>
<td>Eye Mask</td>
<td>✓</td>
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<tr>
<td>Eye Diagram measurements</td>
<td>✓</td>
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<tr>
<td></td>
<td>Eye Linearity</td>
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<td></td>
<td>Eye Width @ 10^-9</td>
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<td></td>
<td>Eye Width @ 10^-9, Far End</td>
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<tr>
<td></td>
<td>Eye Height @ 10^-6</td>
</tr>
<tr>
<td></td>
<td>Eye Height @ 10^-6, Far End</td>
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</tbody>
</table>

**QPHY-56G-PAM4 simplifies complex testing**

Standards compliance testing can be a very difficult task. The user must make the necessary connections between the oscilloscope and the device under test, manually configure the oscilloscope for the appropriate measurement, perform the test procedure as specified by the test specification, record the results and finally compare the results to the appropriate limit in the compliance specification. QPHY-PAM4-56G performs many of these steps automatically, decreasing test time and improving repeatability and confidence.

*Eye Diagram Test* — This figure shows a 56G PAM4 eye diagram test, including the horizontal mask which simultaneously tests for both eye widths and upper/middle/lower eye skew.
Jitter measurements made easy
While jitter measurements have become an established part of virtually all high-speed serial transmitter testing, PAM4-based signaling technologies require a new approach to jitter analysis. QPHY-56G-PAM4 extracts the Uncorrelated Jitter (UJ) distribution from the acquired signal waveform for each of the upper, middle, and lower eyes. From there, it calculates the jitter parameters required by the standard: Uncorrelated Unbounded Gaussian Jitter (UUGJ), Uncorrelated Unbounded High-Probability Jitter (UBHPJ) and Even-Odd Jitter (EOJ).

Optimized CTLE settings
Some PAM4 standards, such as CEI-56G-VSR-PAM4, require the oscilloscope to implement a reference receiver with a variable level of CTLE peaking. Selecting the optimal CTLE peaking value for the specific signal under test is crucial to obtaining the best results. QPHY-PAM4-56G includes a fast, simple utility test to determine the optimal CTLE peaking value for use in subsequent tests.

Easily emulate reference channels
Several PAM4-based standards require the use of compliance boards. While physical compliance boards may be used, QPHY-56G-PAM4 includes the ability to emulate the behavior of an ideal compliance board via Virtual Probing technology, and even includes the required S-parameter files in many cases. In the case where “far-end” measurements are needed, the required reference channel model is included, and inserted automatically into the virtual signal path.
QualiPHY

QualiPHY is designed to reduce the time, effort and specialized knowledge needed to perform compliance testing on high-speed serial buses.

- Guides the user through each test setup
- Performs each measurement in accordance with the relevant test procedure
- Compares each measured value with the applicable specification limits
- Fully documents all results
- QualiPHY helps the user perform testing the right way—every time!

Compliance Reports contain all of the tested values, the specific test limits and screen captures.

Ordering Information

Product Description

QualiPHY Enabled 56G PAM4 Software Option

Product Code

QPHY-56G-PAM4

Recommended Oscilloscopes

50, 59, 65 GHz, 160 GS/s, 2 Ch, 64 Mpts/Ch
LabMaster 10 Zi-A Acquisition Module with 50 Ω input
SDA Master Control Module for LabMaster 10 Zi-A

LabMaster 10-50Zi-A, 10-59Zi-A, 10-65Zi-A, 10-100Zi-A
SDA MCM-Zi-A

Also supported*

30, 36, 48 GHz, 80 GS/s, 4 Ch, 32 Mpts/Ch
LabMaster 10 Zi-A Acquisition Module with 50 Ω input

LabMaster 10-30Zi-A, 10-36Zi-A
30 GHz, 80 GS/s, 64 Mpts/Ch WaveMaster Digital Oscilloscope

WaveMaster 830Zi-B

*Some tests require a higher bandwidth than these instruments offer; results should be interpreted as informative only.

Required Software Options

SDAIII Serial Data Analysis (LM10Zi-SDAIII/WM8Zi-SDAIII - included standard with SDA MCM-Zi and SDA 8 Zi family oscilloscopes)
PAM4 Signal Analysis (LM10Zi-PAM4/WM8Zi-PAM4)
Advanced De-embedding, Emulation and Virtual Probing Toolkit (LM10Zi-VIRTUALPROBE/WM8Zi-VIRTUALPROBE)

Customer Service

Teledyne LeCroy oscilloscopes and probes are designed, built, and tested to ensure high reliability. In the unlikely event you experience difficulties, our digital oscilloscopes are fully warranted for three years and our probes are warranted for one year. This warranty includes:

- No charge for return shipping
- Long-term 7-year support
- Upgrade to latest software at no charge