

Automated Physical-layer Testing for PCI Express

PCI Express 4.0 Tx Rx Test Solution

PCI Express 4.0 introduces a new set of physical-layer testing demands, as sophisticated protocol-aware capabilities are required at new transfer rates of 16 Gbit/s. Anritsu and Teledyne LeCroy address these challenges with a fully-integrated compliance test solution for both Transmitter (Tx) and Receiver (Rx) testing to the PCIe Gen4 CEM specification. Calibration, test execution and report generation are automated for maximum simplicity and repeatability. The solution can be easily expanded to 32 Gbit/s, making it the first end-to-end solution to address PCI Express 5.0 requirements. PCI Express 3.0 transmitter, receiver and link equalization testing are also supported, for complete PCIe ecosystem coverage.



Receiver testing

Fully automated stressed-eye calibration for PCIe Gen4 receiver BER testing

Link Training/Equalization and LTSSM Analysis

High speed BERT from 2.4 Gbit/s to 32.1 Gbit/s

Maximum 10 Tap Emphasis function

12 dB CTLE and clock recovery functions

Transmitter testing

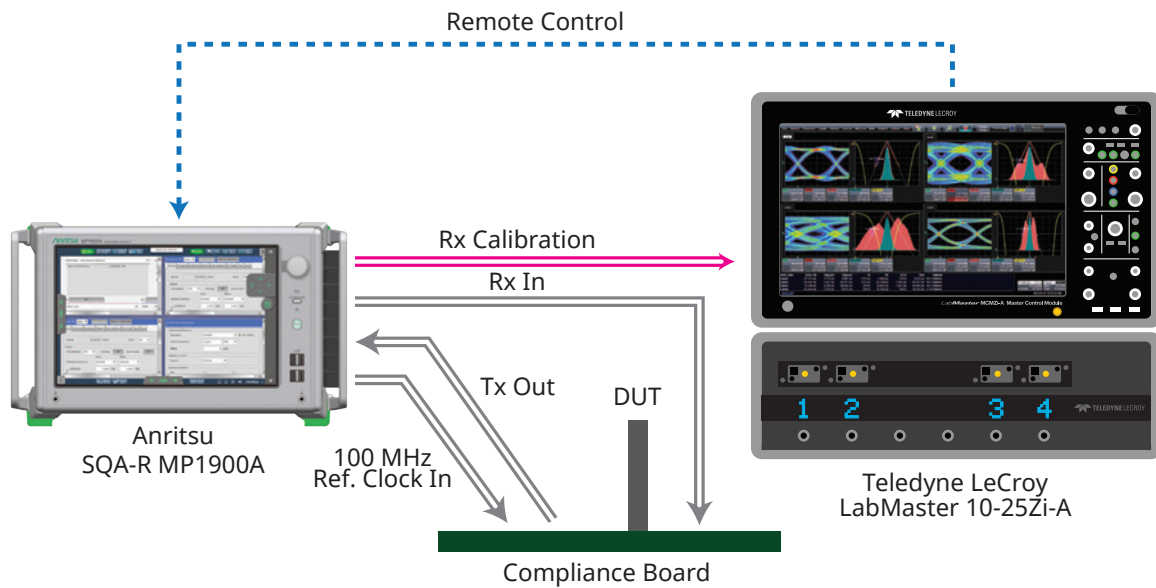
Automated collection and analysis of transmitted waveforms for preset and signal quality tests

Oscilloscope models from 25 GHz to 100 GHz, to support 16 Gbit/s, 32 Gbit/s and beyond

Integrated eye diagram and jitter analysis tools

PCI Express decoding with waveform annotation and tabular analysis

1. END-TO-END PCIE ANALYSIS

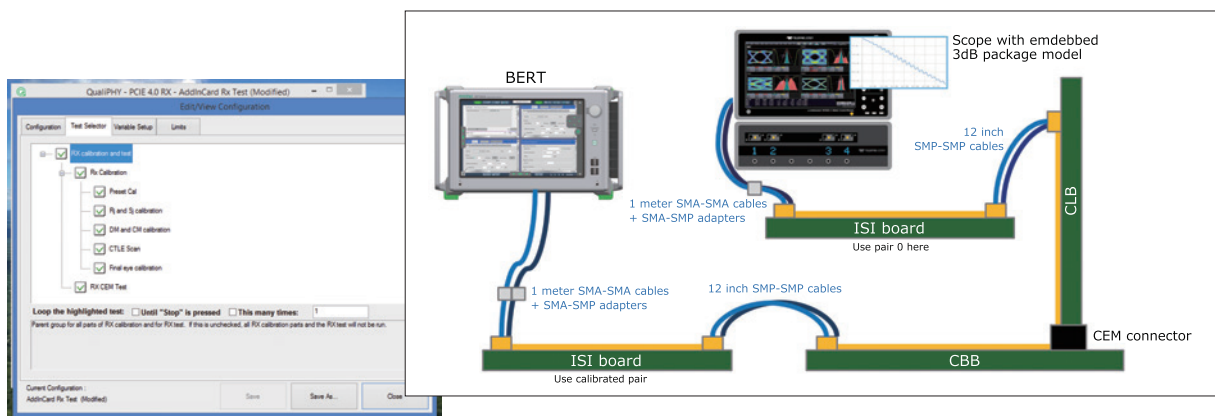


Best-in-class PCI Express test

PCI Express testing requires uniquely capable tools for both signal generation and analysis. Teledyne LeCroy and Anritsu have seamlessly integrated class-leading instruments to create the most capable PCI Express solution available, with capabilities spanning all PCIe generations - up to the Gen5 rate of 32 Gbit/s. The Anritsu SQA-R MP1900A can conduct highly accurate link training/equalization and Link Training and Status State Machine (LTSSM) analysis from 2.4 Gbit/s to 32.1 Gbit/s with full signal stress, emphasis and CTLE capabilities. The Teledyne LeCroy LabMaster 10-25Zi-A oscilloscope provides the necessary bandwidth for PCIe transmitter testing and receiver test calibration, and may be upgraded to support next generation serial standards at 32 Gbit/s and higher.

Full test integration with QualiPHY

Teledyne LeCroy's QPHY-PCIe4-Tx-Rx software performs all necessary automation and control of the LabMaster 10 Zi-A and SQA-R MP1900A for PCIe transmitter, receiver, and link equalization compliance tests. QPHY-PCIe4-Tx-Rx guides the user through making the necessary connections between the instruments and the device under test. It then automatically configures the system to make the appropriate measurements, performs the test procedure as defined in the test specification, and finally compares the results to the appropriate limits in the compliance specification. The process produces full reports in HTML or PDF format, and may be externally automated for high-throughput validation and production testing.

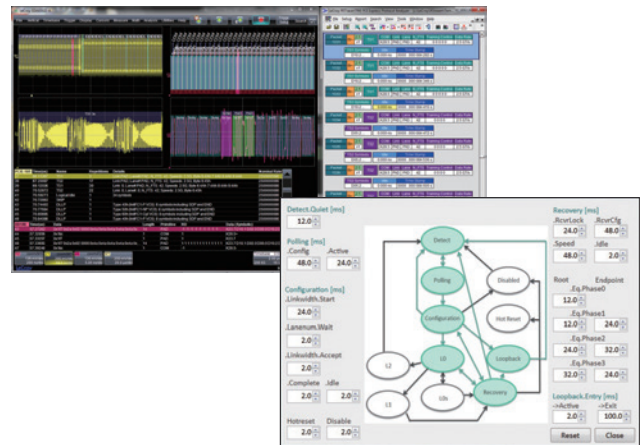


2. SIMPLIFY AND ACCELERATE TESTING

Sophisticated test capabilities

PCI Express testing requires a uniquely integrated view of both protocol and physical layers. The Anritsu SQA-R MP1900A provides fully-flexible PCI Express link equalization capabilities and link training analysis, enabling complete LTSSM control, navigation and trigger generation.

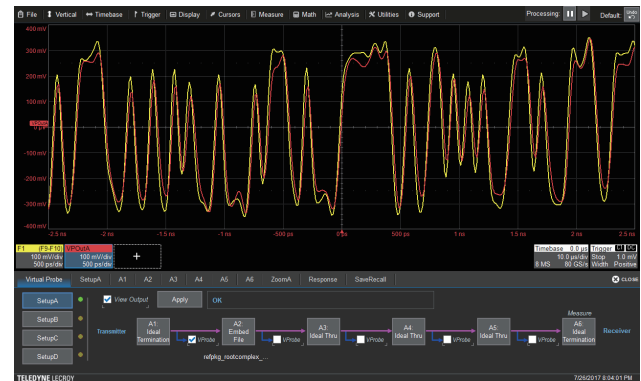
When combined with the LabMaster 10 Zi-A's unparalleled toolkit - including eye, jitter and noise analysis tools and PCI Express decode up to the protocol layer - the system provides the most comprehensive PCI Express debug platform available.



From Physical Layer to Protocol Layer- The combination of Anritsu's LTSSM analysis and Teledyne LeCroy's ProtoSync protocol decode software enable fast, efficient link equalization debug.

Fast test execution

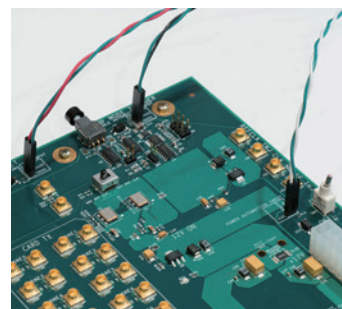
PCI Express 4.0 transmitter compliance testing and receiver test calibration require the acquisition of the specified signals with the optimal dynamic range, correct number of Unit Intervals, and appropriate emulated package loss models. QPHY-PCIe4-Tx-Rx automatically configures each acquisition cycle correctly, saves the appropriate waveform files, and processes them with the SigTest tool as required for PCI Express testing. Leveraging the LabMaster 10Zi-A's up to 20 processor cores enables many instances of SigTest to run concurrently, leading to dramatically reduced test times.



Embedding the package model- Nominal package-loss models must be embedded into waveforms for both Tx testing and Rx calibration. QualiPHY leverages Teledyne LeCroy's extensive software toolset to accomplish this automatically.

Complete test automation

Testing for PCI Express requires multiple power cycles, reset operations, and transmitter preset toggles to be applied to the device under test. In previous iterations of the standard this was either a cumbersome manual process, or required expensive additional signal generators to automate. The Teledyne LeCroy TF-PCIe4-CTRL CBB automation controller is a low-cost accessory that connects directly to the oscilloscope and is fully integrated into QPHY-PCIe4-Tx-Rx to enable total test automation for PCIe Gen4 testing - further reducing test times and eliminating the chances for operator error in complex test environments.



Total Automation- The Teledyne LeCroy TF-PCIe4-CTRL CBB automation controller is a low-cost accessory which enables complete automation of PCIe 4.0 testing.



3. A COMPLETE TEST SOLUTION



Anritsu SQA-R MP1900A

The Signal Quality Analyzer-R MP1900A series is a highperformance BER test solution for R&D and compliance testing of high-speed devices. Combining jitter and noise generation, a high-quality waveform PPG with integrated 10-tap emphasis, and a high input sensitivity ED with clock recovery and variable CTLE and Link negotiation function required by PCI Express receiver test, into one box, the MP 1900A supports high-reproducibility jitter and noise tolerance tests making design and verification efficient.

21G/32G bit/s SI PPG MU195020A

Bit Rate	2.4 Gbit/s to 32.1 Gbit/s (Opt.001)
Number of Channels	1 or 2
Output Amplitude	0.2 Vp-p to 2.6 Vp-p (differential)
Emphasis Taps	10 (max.)
Rise/Fall Time (20-80%)	Typ. 12 ps

21G/32G bit/s SI ED MU195040A

Bit Rate	2.4 Gbit/s to 32.1 Gbit/s (Opt.001)
Number of Channels	1 or 2
Input Amplitude	2 Vp-p max. (differential)
Input Sensitivity	Typ. 15 mVp-p (21 Gbit/s)
Clock Recovery (Option)	2.4 Gbit/s to 32.1 Gbit/s (SSC supported)
CTLE (Option)	0 to -12 dB

Noise Generator MU195050A

CMI frequency	0.1 GHz to 6 GHz
DMI frequency	2 GHz to 10 GHz

High-Speed Serial Data Test Software MX183000A - PL001, PL021

Link Negotiation	Yes (PL021)
JTOL auto measurement	Yes (PL001)



Teledyne LeCroy LabMaster 10 Zi-A

The LabMaster 10 Zi-A is the highest-performance oscilloscope platform available. A LabMaster 10-25Zi-A system provides the required 25 GHz bandwidth for PCI Express 4.0 transmitter testing and receiver test calibration, with upgradeability to 65 GHz or even 100 GHz to support next-generation serial standards at 32 Gbit/s and beyond.

QualiPHY software fully automates complex compliance test procedures, controlling the oscilloscope and other equipment and producing comprehensive reports.

LabMaster 10-25Zi-A

Analog Bandwidth	25 GHz
Sample Rate	80 GS/s
Rise Time (20-80%)	11.6 ps
Input channels	4 per module Up to 80 per system
Standard Acquisition memory	32 Mpts per channel
Maximum Acquisition memory	512 Mpts per channel
Sample Clock Jitter	50 fsrms (up to 3.2 ms timebase)
Sensitivity	5 mV-500 mV/div, fully variable (5-9.9 mV/div via zoom)

Recommended Software Options

Serial Data Analysis Framework, Eye and Jitter Measurements	LM10Zi-SDAIII
Advanced De-embedding, Emulation and Virtual Probing Toolkit	LM10Zi-VIRTUALPROBE
Signal Integrity Toolkit - Channel & Fixture De-embedding/Emulation, Tx/Rx Equalization	LM10Zi-EYEDRII
Multi-Lane SDA LinQ Framework, including Eye, Jitter, Noise, Crosstalk Measurements, with EyeDrII and VirtualProbe	LM10Zi-SDAIII-CompleteLinQ
PCI Express Decode Annotation Option Decode Annotation and Protocol Analyzer Software Synchronization Option for LabMaster 10 Zi Series	LM10Zi-PCIEbus D LM10Zi-PROTOSYNC



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