

USB4™ Electrical Test Solution QPHY-USB4-TX-RX



Key Features

Supports USB-C® Compliance Test Specifications (CTS):

- USB4 Router Assembly
- USB4 Captive Device
- Thunderbolt™ 3 Host/Device
- USB4 Active Cable – CTS TBD

Tests Supported:

- Transmitter (Tx) tests
- Receiver (Rx) tests
- Receiver channel calibration
- Cable measurements

Automated testing for USB4 hosts, devices, hubs, passive cables and active cable assemblies

Multi-Lane analysis, compliance, and debug of USB4 ports

Device Under Test (DUT) control using automated controller and fixtures

Insertion loss measurement of USB-C cables

QualiPHY report generation feature creates comprehensive reports with all pertinent test information

Universal Serial Bus 4 (USB4) introduces new performance and capabilities to the USB Type-C® connector with two lanes of 20 Gb/s per lane, largely based off the successful Thunderbolt 3 physical layer (PHY) specification. Teledyne LeCroy's LabMaster 10 Zi-A Oscilloscope, WavePulser 40iX High-speed Interconnect Analyzer, and Anritsu's MP1900A Signal Quality Analyzer-R BERT (Bit Error Rate Tester) compose a comprehensive system that provides USB4 test engineers with an integrated electrical test solution for automated compliance testing, accelerated debug, and faster time-to-market.

Compliance Testing

QPHY-USB4-TX-RX software automates USB4 tests in accordance with the USB4 Router Assembly and Captive Device CTS. Also supported is the Thunderbolt 3 Host/Device CTS which also uses the USB-C connector. Tests are performed using the Teledyne LeCroy LabMaster 10 Zi-A and Anritsu MP1900A. The solution controls the Oscilloscope, BERT, and test controller to perform parametric, jitter, and eye compliance on the transmitters (Tx); and calibrating the stressed eye and performing BER measurements on the receivers (Rx).

Multi-Lane Testing

USB4 architecture defines two signaling lanes of 20 Gb/s. The LabMaster 10 Zi-A provides acquisition, analysis, and compliance tests on both lanes simultaneously, significantly saving time in test setup, compliance, and debug.

Test Channel Calibration

USB4 receiver testing requires direct insertion loss measurements of test cables and fixtures. The WavePulser 40iX High-speed Interconnect Analyzer brings cost effective 40 GHz S-parameters, impedance profile measurements, and analysis to the USB4 test bench.

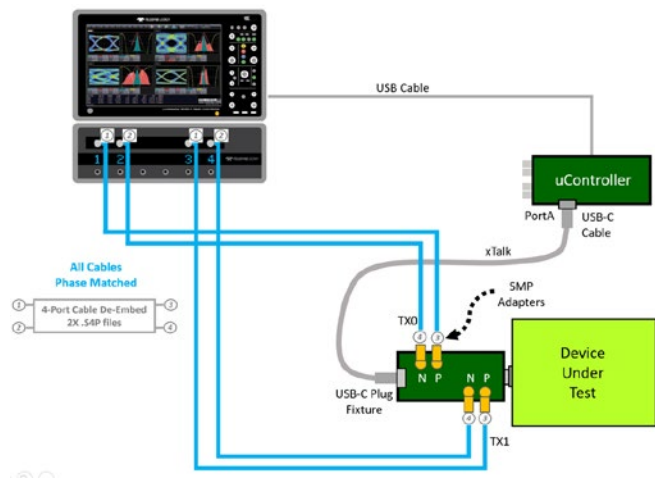
QPHY-USB4 AUTOMATES USB4 COMPLIANCE TESTING

Standards-based testing for USB4 and Thunderbolt 3 technologies includes transmitter (Tx) and receiver (Rx) testing on two lanes (Lane0, Lane1). QPHY-USB4-TX-RX covers both cases – it first provides a step-by-step guide of how to correctly connect the test system to the device. It then automatically configures the instrument and DUT settings and features, performs the test, and records the results in a compliance test report.

Multi-Lane Transmitter Testing

QPHY-USB4-TX-RX running on the LabMaster 10 Zi-A with SDAIII-CompleTelinQ provides a unique solution that automatically captures, analyzes, and performs TX compliance measurements on both Lane0 and Lane1 simultaneously. The SDA 8 Zi-B can be used to test the two lanes 'lane-by-lane' sequentially.

- TX compliance Measurements:
 - Transmitter Equalization
 - Minimum Unit Interval
 - Spread Spectrum Clock (SSC) Down Spread Range
 - SSC Down Spread Rate
 - SSC Phase Deviation
 - SSC Slew Rate
 - Tx Frequency Variation Training
 - Lane to Lane Skew
 - Rise/Fall Time
 - Electrical Idle Voltage
 - AC Common Mode (ACCM)
 - Total Jitter (TJ)
 - Uncorrelated Jitter (UJ)
 - Uncorrelated Deterministic Jitter (UDJ)
 - Low Frequency UDJ (UDJ_LF)
 - DCD (Odd/Even) Jitter (OEJ)
 - Eye Diagram & Mask Test
 - Wireless Band Conducted Emissions

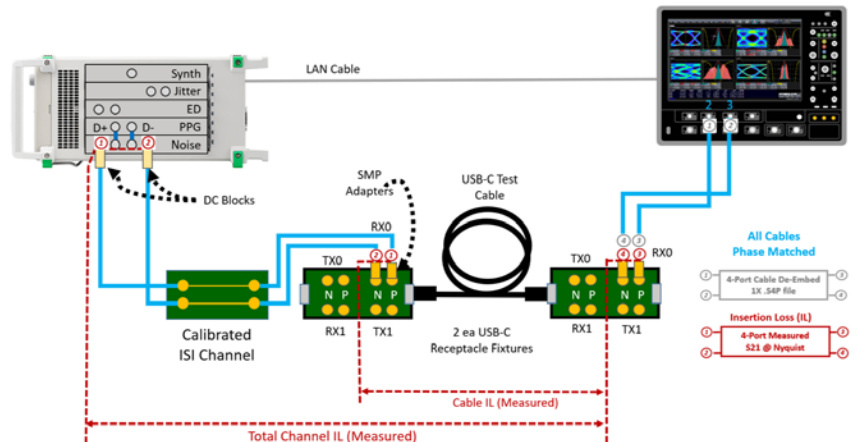


Automated Transmitter Testing – This diagram details the required connections for Multi-lane Tx testing. QPHY-USB4-TX-RX uses clear connection diagrams to simplify all setup steps.

Receiver Test Calibration

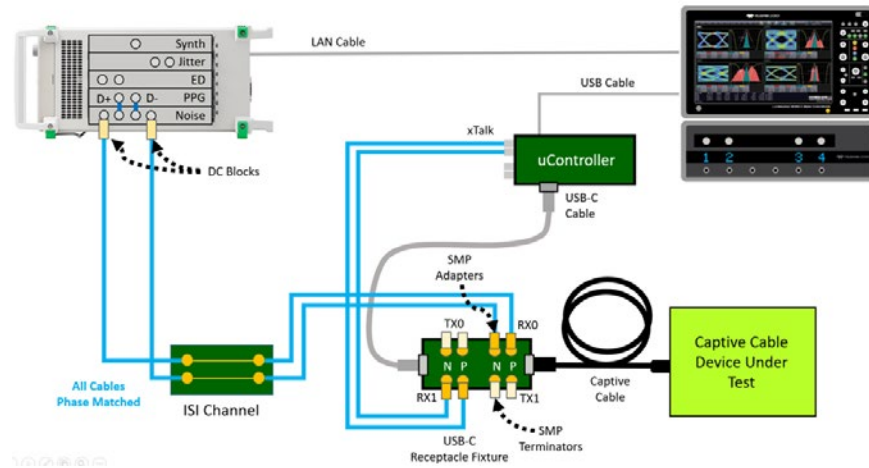
Receiver test calibration is fully automated by QPHY-USB4-TX-RX. Here QPHY controls the Anritsu MP1900A and LabMaster 10 Zi-A oscilloscope to calibrate the receiver stressed eye parameters. The insertion loss (IL) of the total channel must be calibrated and the cables to the oscilloscope (for both Tx measurements and Rx calibration) must be de-embedded using S-parameter measurements.

- Stressed Eye Parameters:
 - Spread Spectrum Clock (SSC)
 - Data Dependent Jitter (DDJ) for captive devices and active cables
 - AC - Common Mode Voltage (ACCM)
 - Random Jitter (RJ)
 - Periodic Jitter (PJ)
 - Total Jitter (TJ)
 - Eye Height and Width (EH/EW)



Receiver BER Testing

After the calibration is complete, the oscilloscope is replaced in the setup by the DUT. Bit error rate (BER) testing is performed by reading the error registers in the DUT's receiver circuit for a specified observation time while the calibrated stressed eye signal is applied. The microcontroller polls the DUT's error count register using SBTX/SBRX sideband signals through the USB-C Cable. QPHY-USB4-TX-RX supports automation of the BER testing and provides a full test report.



USB4 Electrical Test Equipment And Support

Teledyne LeCroy High Performance Oscilloscopes

The Teledyne LeCroy family of oscilloscopes has several models that support the USB4 and Thunderbolt 3 transmitter compliance requirement of 21 GHz bandwidth and 80 GS/s sample rate:

- LabMaster 10 Zi-A (25 GHz - 65 GHz bandwidth models) for multi-lane acquisition
- SDA 8 Zi-B (25 GHz - 30 GHz bandwidth models) for single lane acquisition



Anritsu MP1900A Signal Quality Analyzer-R

The MP1900A is a BER test solution for R&D and compliance testing of high-speed devices. The MP1900A provides highly accurate stressed signal generation from 2.4 Gb/s to 32.1 Gb/s with the lowest intrinsic jitter available and supports high-reproducibility jitter and noise tolerance tests.



Teledyne LeCroy WavePulser 40iX High-speed Interconnect Analyzer

For Tx and Rx Calibration, the 4-port S-parameter model of the test cables must be measured and used by the oscilloscope to de-embed the cables. During receiver calibration, the insertion loss of the USB-C cable and total channel also needs to be measured at the Nyquist frequency. The WavePulser 40iX is a cost-effective alternative to a Vector Network Analyzer (VNA) for making S-parameter measurements and is simple to use.



USB4 and Thunderbolt3 Test Fixtures

High-speed test fixtures and DUT microcontrollers are available from Wilder Technologies (www.wilder-tech.com).



QPHY-USB4 Bring Up and Field Support

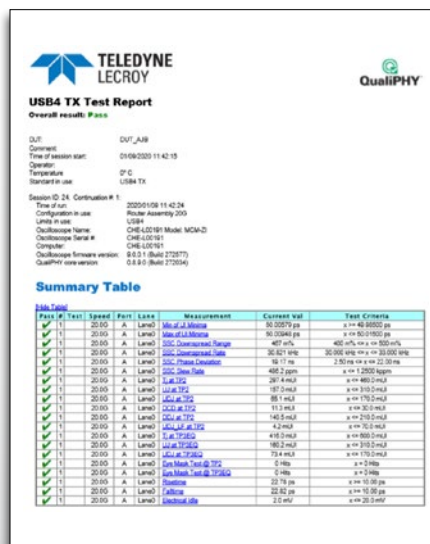
Teledyne LeCroy provides Field Application Engineer support for bring up and technical support of QPHY-USB4-TX-RX automation software using Teledyne LeCroy oscilloscopes, Anritsu MP1900A signal quality analyzers, and 3rd party test fixtures.

SPECIFICATIONS AND ORDERING INFORMATION

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. Compliance Reports can be created as HTML, PDF or XML.

Ordering Information

Product Description

QualiPHY Enabled USB4 Transmitter and Receiver Compliance Testing

Product Code

QPHY-USB4-TX-RX

Required Options

Serial Data Analysis Bundle – Multi-Lane SDA LinQ Framework, incl. Eye, Jitter, Noise, Crosstalk Meas, w/EyeDrill & VirtualProbe (Includes -LINQ and -VIRTUALPROBE required options)

LM10ZI-SDAIII-COMPLETELINQ
or SDA10ZI-COMPLETELINQ
WM8ZI-SDAIII-COMPLETELINQ
or SDA8ZI-COMPLETELINQ

64 Mpt/ch memory option (Standard on SDA MCM Zi-A models)

LM10ZI-M-64

Oscilloscope (required for Tx and Rx testing) LabMaster 10 Zi-A or SDA 8 Zi-B

	LM 10 Zi-A	SDA 8 Zi-B
LabMaster 10Zi-A MCM	MCM-10Zi	–
Models Supported by QPHY-USB4-TX-RX	10-25Zi-A to 10-65Zi-A	825Zi-B (SDA) 830Zi-B (SDA)
Bandwidth	25 GHz to 65 GHz	25 GHz to 30 GHz
USB4 Multi-Lane Acquisition	Yes	No
Sample Rate	80 GS/s on all channels	80 GS/s on 2 channels
Risetime (20-80%)	4.9 ps - 14.5 ps	11.5 ps - 13 ps
Standard Acquisition Memory	32 Mpts per channel	
Maximum Acquisition Memory	512 Mpts per channel	

See [oscilloscope datasheets](#) for more information.

WavePulser 40iX High-speed Interconnect Analyzer (required for cable de-embed and Rx channel calibration)

Product Description

High-speed Interconnect Analyzer, 4-port, S-parameters DC-40 GHz, <1 mm Spatial Resolution, Internal Calibration, 4 phase matched cables

Product Code

WavePulser-40iX

See [WavePulser-40iX datasheet](#) for options and accessories.

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



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Local sales offices are located throughout the world.
Visit our website to find the most convenient location.

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