

# MIPI M-PHY Test Solutions

## QPHY-MIPI-MPHY



### Key Features

- Compliant with the MIPI Alliance Conformance Test Suite (CTS) for MPHY 3.0
- QualiPHY automated test framework provides connection diagrams, automated oscilloscope operation, and report generation
- Test HS-MODE, PWM-MODE, and SYS-MODE operation in all gears
- Debug conformance failures with integrated M-PHY physical layer debug tools
- Integrated M-PHY protocol decoder for additional analysis
- Acquire signals using the cost-effective M-PHY input adapter for highest signal fidelity
- Built-in differential probe support for use with legacy fixtures or “in-situ” testing

**The QPHY-MIPI-MPHY Test Solution provides automated control of Teledyne LeCroy oscilloscopes for performing transmitter physical layer tests as described by the MIPI Alliance Specification for M-PHY version 3.0.**

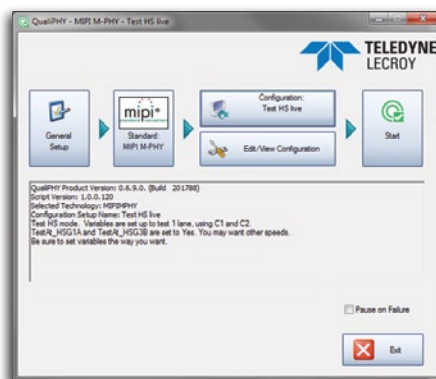
QPHY-MIPI-MPHY enables the user to obtain the highest level of confidence in their M-PHY interface. By measuring a large number of cycles in a very short period of time, the user can be confident that they are testing the true behavior of their device against the M-PHY standard.

QPHY-MIPI-MPHY allows users to test HS-MODE, PWM-MODE, and SYS-MODE signals at all GEARS currently specified. Connection to the DUT via the new Teledyne LeCroy M-PHY input adapter is simpler, lower cost, and higher fidelity than

approaches using probes. Probe connection is also supported for legacy fixtures, or for testing “in-situ” on a system board.

The Teledyne LeCroy QualiPHY platform provides an easy-to-configure user interface, allows for custom test and limit selection, displays connection diagrams to the user to ensure proper connectivity, and generates a comprehensive test report. All of the waveforms tested by QPHY-MIPI-MPHY can be saved to easily share information, or rerun the tests at a later time.

In addition to automated characterization of MIPI M-PHY signals, QPHY-MIPI-MPHY also enables powerful M-PHY debug capability within the oscilloscope. The integrated MIPI M-PHY Debug utility and decoders are the perfect combination for identifying the root cause of conformance failures.



# A COMPLETE M-PHY TEST ENVIRONMENT

## Integrated Conformance Testing and Debugging

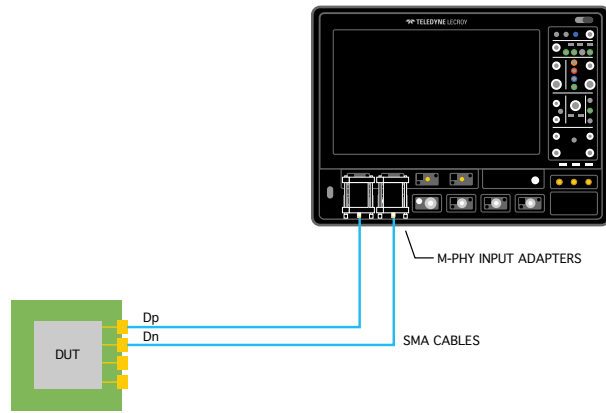
QPHY-MIPI-MPHY operates with a simple, logical flow. First, select the tests to perform. The software helps connect to the DUT correctly by providing clear connection diagrams. It then controls the oscilloscope, fully automating the requested tests in a seamless manner.

When the tests have been completed, QualiPHY creates a comprehensive report in HTML and/or PDF format. The report contains a high-level summary of test results as well as details and screenshots of each test as performed on the DUT.

Initial conformance tests often expose problems and issues with devices. The ability to easily transition from automated measurements to in-depth debugging operation is vital under these circumstances.

QPHY-MIPI-MPHY leverages the power and flexibility of Teledyne LeCroy's comprehensive M-PHY Decode and Physical Layer Test package to provide an environment where problems highlighted in the conformance test can be quickly and easily pinpointed and diagnosed.

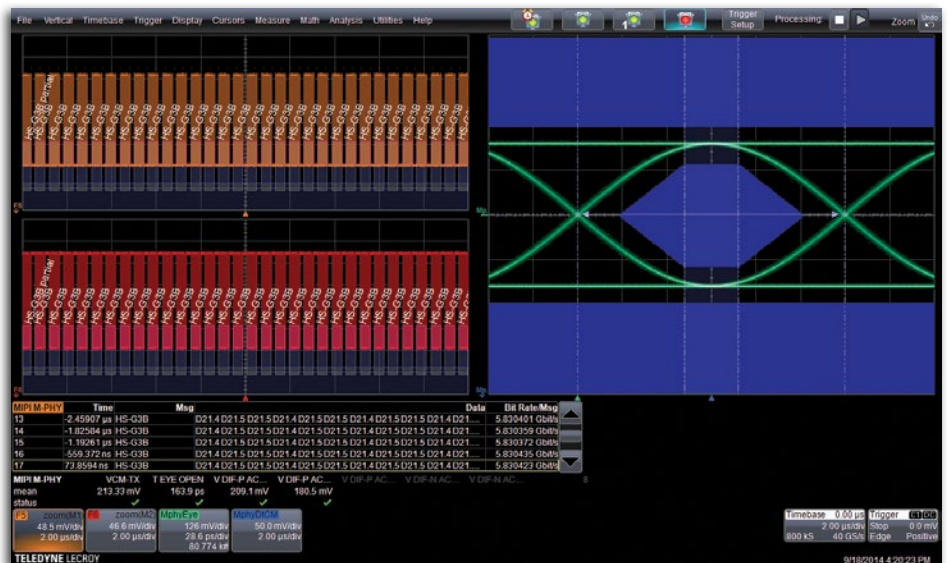
Complete time correlation between the protocol-level M-PHY decoder and physical layer waveforms and measurements means that tracking down problems is greatly simplified.



**Connection diagrams** provide easy-to-follow instructions for connecting to the Device Under Test.



**M-PHY measurements** are made automatically and compared to the limits in the specification to assess conformance.



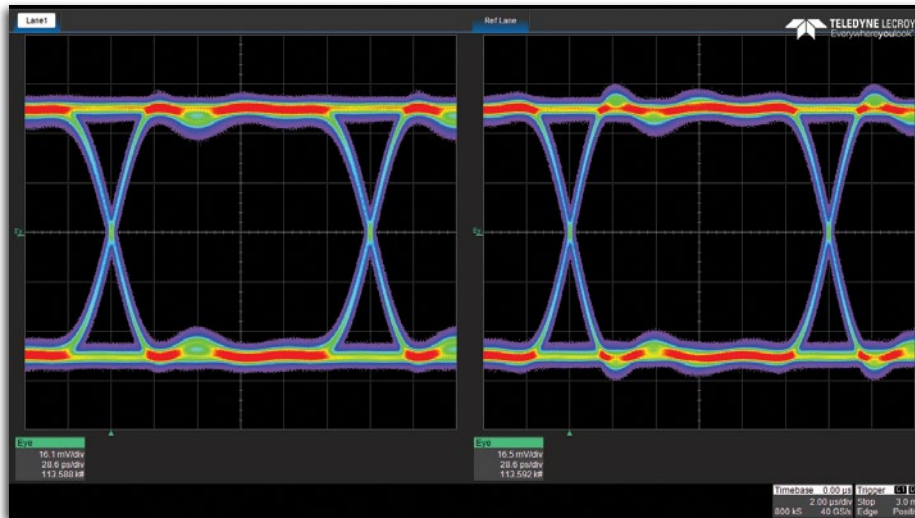
**Debug** is made easy using time-correlated protocol- and physical-layer views.

## Simple Signal Connection

When testing MIPI M-PHY, both Dp and Dn signals must be acquired on separate oscilloscope channels in order to measure parameters such as intra-pair skew. But M-PHY requires both 100  $\Omega$  differential termination and nonzero common-mode voltage. This means that simply connecting Dp and Dn to standard 50- $\Omega$  oscilloscope inputs may cause an unacceptable level of common-mode current draw from the transmitter under test.

The traditional solution to this problem involves high-bandwidth probes and a non-ideal termination fixture. This approach adds significant probe noise to the M-PHY signal, which may not be very high in amplitude to begin with. In addition, the termination scheme causes common-mode reflections, which can distort waveforms and cause inaccurate measurements.

The Teledyne LeCroy M-PHY active termination adapter solves this problem elegantly. Each adapter connects to a scope channel, accepts a Dp or Dn signal, and provides a DC termination voltage to eliminate common-mode loading. The adapter maintains a pristine path to the oscilloscope input, eliminating reflections and ensuring noise performance superior to any probe-based solution – and at a fraction of the cost.



A small-amplitude (80-mV differential), 5.8-Gb/s eye diagram captured using the M-PHY active termination adapter (left) compared to the same signal connected directly to the oscilloscope (right).



TF-MIPI-MPHY Active Termination Adapter

## QualiPHY

QualiPHY is designed to reduce the time, effort, and specialized knowledge needed to perform automated 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!

Reports contain all of the tested values, the specific test limits, and screen captures. Reports can be created as HTML, PDF, or XML.




### MIPI M-PHY Test Report

**Overall result: Pass**

OUT: Comment: Time of session start: Operator: Temperature: Standard Probe: Run: Time of run: Configuration in use: Limits in use: Oscilloscope Name: Oscilloscope Serial #: Computer: Oscilloscope Firmware version: QualiPHY core version: QualiPHY report version: Stylesheet version:	Demo 09/09/2014 16:24:23 C °C MPM M-PHY 2014/09/09 16:24:25 Demo HS Default PC0ANNALLY-NB17 Model: DD4252-A PC0ANNALLY-NB17 C.7.7.C (Build 203368) 1.6.8.0 (Build 201768) 1.0.0.100 1.0.0.E
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#### Summary Table

Pass	Run #	Test	Measurement	Current Value	Test Criteria
✓	1.1.1	u0 Bus max_HS-D1A	-8.62psm	-8.62psm	1.2480GHz±2000psm
✓	1.1.1	u0 Bus max_HS-D1A	5.33psm	5.33psm	1.2480GHz±2000psm
✓	1.1.1	u0 Bus max_HS-D1A	-0.57psm	-0.57psm	1.2480GHz±2000psm
✓	1.1.1	u0 LH HS u0-D1A	801.28250ps	799.67954uH±HS±802.8846	799.67954uH±HS±802.8846
✓	1.1.1	u0 Bus max_HS-D1A	-07.36psm	-07.36psm	1.2480GHz±2000psm
✓	1.1.1	u0 Bus max_HS-D1A	68.44psm	68.44psm	1.2480GHz±2000psm
✓	1.1.1	u0 Bus max_HS-D1A	-0.15psm	-0.15psm	1.2480GHz±2000psm
✓	1.1.1	u0 LH HS u0-D1A	801.28154ps	799.67954uH±HS±802.8846	799.67954uH±HS±802.8846
✓	1.1.1	u0 Bus max_HS-D1A	-20.46psm	-20.46psm	1.2480GHz±2000psm
✓	1.1.1	u0 Bus max_HS-D1A	29.86psm	29.86psm	1.2480GHz±2000psm

# SPECIFICATIONS AND ORDERING INFORMATION

## QPHY-MIPI-MPHY Test Coverage Specifications

### HS Mode Tests

- 1.1.1 – HS-TX Unit Interval and Frequency Offset ( $UI_{HS}$  and  $f_{OFFSET-TX}$ )
- 1.1.2 – HS-TX Common-Mode AC Power Spectral Magnitude Limit ( $PSD_{CM-TX}$ )
- 1.1.3 – HS-TX PREPARE Length ( $T_{HS-PREPARE}$ )
- 1.1.4 – HS-TX Common-Mode DC Output Voltage Amplitude ( $V_{CM-TX}$ )
- 1.1.5 – HS-TX Differential DC Output Voltage Amplitude ( $V_{DIF-DC-TX}$ )
- 1.1.6 – HS-TX G1 and G2 Differential AC Eye ( $T_{EYE-TX}$ ,  $V_{DIF-AC-TX}$ )
- 1.1.7 – HS-TX G3 Differential AC Eye ( $T_{EYE-HS-G3-TX}$ ,  $V_{DIF-AC-HS-G3-TX}$ )
- 1.1.8 – HS-TX 20/80% Rise and Fall Times ( $T_{R-HS-TX}$  and  $T_{F-HS-TX}$ )
- 1.1.9 – HS-TX Lane-to-Lane Skew ( $T_{L2L-SKEW-HS-TX}$ )
- 1.1.10 – HS-TX Slew Rate Control Range ( $SR_{DIF-TX}[MAX/MIN]$ )
- 1.1.11 – HS-TX Slew Rate State Monotonicity
- 1.1.12 – HS-TX Slew Rate State Resolution ( $\Delta SR_{DIF-TX}$ )
- 1.1.13 – HS-TX Intra-Lane Output Skew ( $T_{INTRA-SKEW-TX}$ )
- 1.1.14 – HS-TX Transmitter Pulse Width ( $T_{PULSE-TX}$ )
- 1.1.15 – HS-TX Total Jitter ( $TJ_{TX}$ )
- 1.1.16 – HS-TX Short-Term Total Jitter ( $STTJ_{TX}$ )
- 1.1.17 – HS-TX Deterministic Jitter ( $DJ_{TX}$ )
- 1.1.18 – HS-TX Short-Term Deterministic Jitter ( $STDJ_{TX}$ )

### PWM Mode Tests

- 1.2.1 – PWM-TX Transmit Bit Duration ( $T_{PWM-TX}$ )
- 1.2.2 – PWM-TX Transmit Ratio ( $k_{PWM-TX}$ )
- 1.2.3 – PWM-TX PREPARE Length ( $T_{PWM-PREPARE}$ )
- 1.2.4 – PWM-TX Common Mode DC Output Voltage Amplitude ( $V_{CM-TX}$ )
- 1.2.5 – PWM-TX Differential DC Output Voltage Amplitude ( $V_{DIF-DC-TX}$ )
- 1.2.6 – PWM-TX Minimum Differential AC Eye Opening ( $T_{EYE-TX}$ )
- 1.2.7 – PWM-TX Maximum Differential AC Output Voltage Amplitude ( $V_{DIF-AC-TX}$ )
- 1.2.8 – PWM-TX 20/80% Rise and Fall Times ( $T_{R-PWM-TX}$  and  $T_{F-PWM-TX}$ )
- 1.2.9 – PWM-TX Lane-to-Lane Skew ( $T_{L2L-SKEW-PWM-TX}$ )
- 1.2.10 – PWM-TX Transmit Bit Duration Tolerance ( $TOL_{PWM-TX}$ ,  $TOL_{PWM-G1-LR-TX}$ )
- 1.2.11 – PWM-TX G0 Minor Duration ( $T_{PWM-MINOR-GO-TX}$ )

### SYS Mode Tests

- 1.3.1 – SYS-TX Unit Interval and Frequency Offset ( $UI_{SYS}$  and  $f_{OFFSET-TX}$ )
- 1.3.2 – SYS-TX RefClk Frequency ( $UI_{REFCLK}$  and  $f_{REFCLK-TX}$ )
- 1.3.3 – SYS-TX PREPARE Length ( $T_{SYS-PREPARE}$ )
- 1.3.4 – SYS-TX Common Mode DC Output Voltage Amplitude ( $V_{CM-TX}$ )
- 1.3.5 – SYS-TX Differential DC Output Voltage Amplitude ( $V_{DIF-DC-TX}$ )
- 1.3.6 – SYS-TX Minimum Differential AC Eye Opening ( $T_{EYE-TX}$ )
- 1.3.7 – SYS-TX Maximum Differential AC Output Voltage Amplitude ( $V_{DIF-AC-TX}$ )
- 1.3.8 – SYS-TX 20/80% Rise and Fall Times ( $T_{R-SYS-TX}$  and  $T_{F-SYS-TX}$ )
- 1.3.9 – SYS-TX Lane-to-Lane Skew ( $T_{L2L-SKEW-SYS-TX}$ )

## Ordering Information

### Product Description

QualiPHY Enabled MIPI M-PHY Software Option

### Product Code

QPHY-MIPI-MPHY

*QPHY-MIPI-MPHY includes the M-PHYbus DP package for M-PHY protocol decoding and physical layer debug.*

### Recommended Oscilloscopes

Gear	Oscilloscope Model	Product Code
GEAR 1	SDA 760Zi-A Oscilloscope 6 GHz, 20 GS/s, 4 Ch, 20 Mpts/Ch (40 GS/s and 40 Mpts/Ch in interleaved mode) with 50 $\Omega$ and 1 M $\Omega$ Input	SDA 760Zi-A
GEAR 2	SDA 806Zi-B Oscilloscope 6 GHz, 40 GS/s, 4 Ch, 32 Mpts/Ch Serial Data Analyzer with 15.3" WXGA Color Display. 50 $\Omega$ and 1 M $\Omega$ Input	SDA 806Zi-B
GEAR 2	SDA 813Zi-B Oscilloscope 13 GHz, 40 GS/s, 4 Ch, 32 Mpts/Ch Serial Data Analyzer with 15.3" WXGA Color Display. 50 $\Omega$ and 1 M $\Omega$ Input	SDA 813Zi-B
GEAR 3	SDA 820Zi-B Oscilloscope 20 GHz, 40 GS/s, 4 Ch, 32 Mpts/Ch Serial Data Analyzer with 15.3" WXGA Color Display. 50 $\Omega$ and 1 M $\Omega$ Input*	SDA 820Zi-B

\* WavePro/WaveMaster oscilloscope models with SDAIII option are also supported.

### Required Software Options

Software Option	Product Code
Channel & Fixture De-embedding/Emulation, Tx/Rx Equalization (Required for HS-GEAR3 only)	WPZI-EYEDRII WM8ZI-EYEDRII

### Recommended Accessories

Accessory	Product Code
M-PHY Active Termination Adapter Dual Pack, Including Softcase	TF-MIPI-MPHY-DUALPAK
M-PHY Active Termination Adapter, Single	TF-MIPI-MPHY
6 GHz Complete Probe System	D620-PS
13 GHz Complete Probe System	D1305-A-PS
20 GHz Complete Probe System	D2005-A-PS

### 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



1-800-5-Teledyne LeCroy  
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