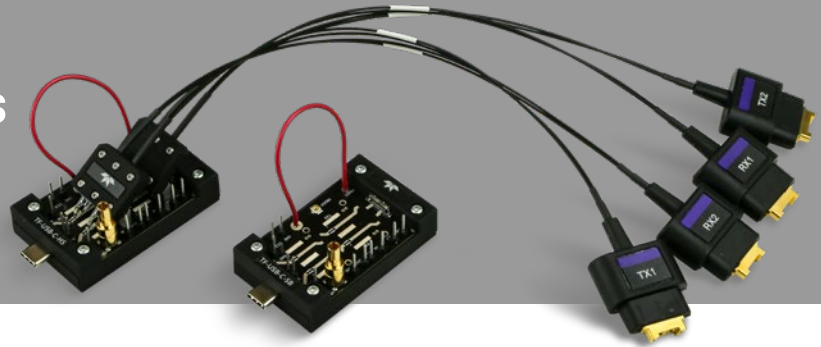# USB-C® USB4®
# Test Coupon Fixtures
## TF-USB-C-HS
## TF-USB-C-SB

## Key Features

**Access to all USB Type-C® signals at the connector:**

- Tx1/Rx1, Tx2/Rx2 High-Speed Data
- CC1/CC2 Power Delivery
- VCONN
- VBUS (voltage and current)
- USB 2.0 D+/D-
- SBU1/SBU2 Sideband Usage

**'Signal Integrity Transparency'**

**For use with USB Type-C PHY-Logic and Sideband analysis software:**

- USB4 DME, USB4-SB TDMP
- USB 3.2 D
- USB 2.0 TDME
- USB-PD TDMP
- DP-AUX DMP
- ProtoSync

**And with various Protocol Exerciser/Analyzers:**

- Voyager USB Exerciser/Analyzers
- Mercury USB-C Sideband Analyzers
- DisplayPort™ Video Analyzers

**PHY logic layer and sideband negotiation issues account for many compliance and interoperability failures in USB Type-C connected devices. These failures can be quickly debugged using unmatched PHY-logic layer and sideband debug solutions on a wide range of oscilloscopes.**

## Access all USB Type-C Signals

USB Type-C Test Coupon Fixtures provide probing access to all high-speed and sideband signals 'transparently' – without impacting system performance.

## High-speed PHY-logic Debug

USB4, Thunderbolt 3/4, DisplayPort 2.0/1.4, and USB 3.2 standards define four Tx/Rx signaling pairs carrying up to 20 Gb/s data over the USB Type-C connector. The TF-USB-C-HS High-speed and sideband coupon fixture, when used with the LabMaster 10 Zi-A or SDA 8 Zi-B and high-speed serial decode and ProtoSync analysis software, provides the industry's most comprehensive test solution for debugging PHY-Logic layer failures.

## Sideband Debug

When USB Type-C devices are connected, sideband signals are used to establish how the link will be configured. The 'power contract' between devices and DisplayPort 'Alt Mode' is negotiated using CC1/CC2 pins. DisplayPort and USB4 protocols use the SBU (Sideband Usage) pins for link training. The TF-USB-C-SB Sideband Test Coupon fixture, when used with any Teledyne LeCroy Oscilloscope provides unmatched Trigger, Decode, Measure/Graph and Physical layer testing for USB-C sidebands.

## Protocol Analysis

For more elusive problems, cross-trigger your oscilloscope with Teledyne LeCroy USB Voyager and Mercury protocol exerciser/analyzers.

# USB TYPE-C TEST COUPON FIXTURES

## Signal Integrity Transparency

**USB Type-C Coupons provide probing access to all signals at connector test points (TP2 or TP3) without impacting the performance of the system under test. TF-USB-C-HS and TF-USB-C-SB both provide 'signal integrity transparency' that is essential for system debug.**
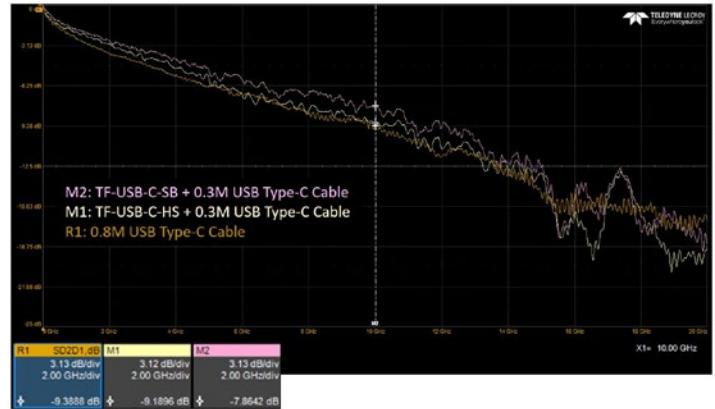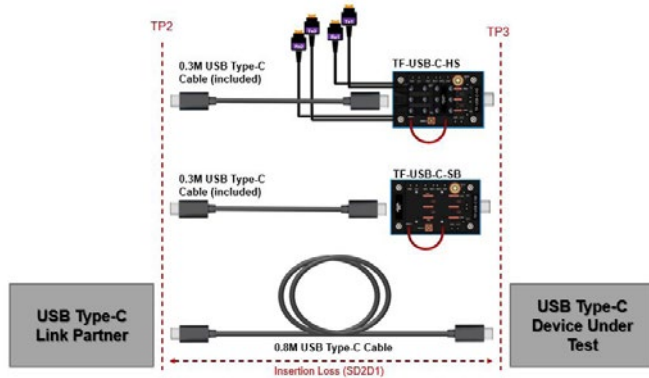


When connected to the included 0.3M Type-C Test Cable, the USB Type-C Test Coupon Fixtures replace a certified 0.8M Type-C cable in the system with equivalent insertion loss; providing probing access without impacting 20 Gb/s system performance.

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## USB Type-C High-Speed PHY-Logic Debug

**High-speed link training failures can be found while performing interoperability testing with Teledyne LeCroy Exerciser/Analyzers or when testing with a known good device. In either case, the TF-USB-C-HS Test Coupon Fixture is used with LabMaster 10 Zi-A or SDA 8 Zi-B oscilloscopes to isolate 'link up' failures for all USB-C high-speed serial standards.**



### USB4 and Thunderbolt 3/4

USB4 and Thunderbolt 3/4 link training uses USB4-SB (sideband channel) for link equalization until the link acheives symbol lock. Then high-speed Tx/Rx signal pairs are used to complete link training. USB4-TDMP is used to trigger on the TxFFE register state, while USB4 DME and decodes the data packets and performs signal integrity tests on the router or retimer transmitter under test.

### USB 3.2

USB 3.2 link training consists of transactions between the High-speed Tx/Rx signal pairs as the link works its way through the LTSSM (Link Training and State Status Machine). USB3.2bus D software and ProtoSync are used to identify link training issues.
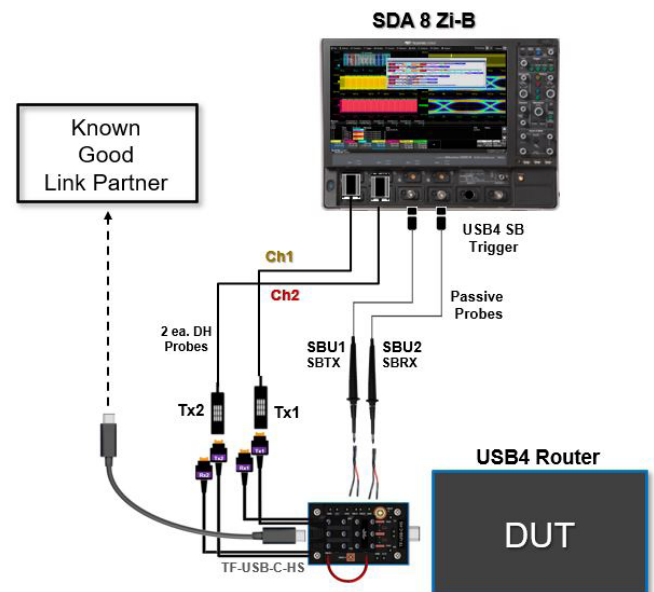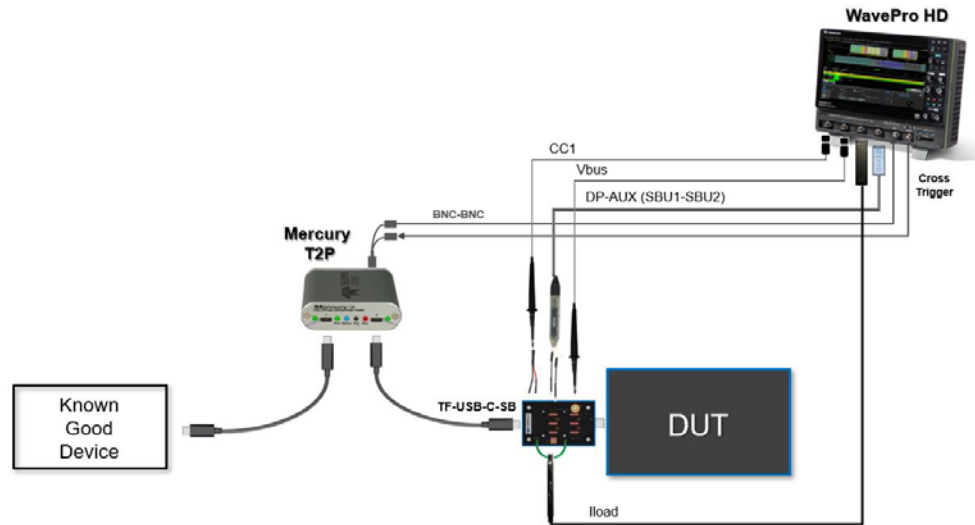
### DisplayPort over USB Type-C

The DisplayPort video link is established after USB-PD protocol initiates DisplayPort 'alt mode', pin assignments, and Hot Plug Detect. Then the Main link is negotiated over the DP-AUX channel. USB-PD TDMP, DP-AUX DMP, and SDA-III analysis software are used to validate Source or Link-Training Tunable PHY Repeater (LTTPR) system performance.

## USB Type-C Sideband Debug

**Power Delivery, DisplayPort AUX Channel, USB4 sideband, and USB2 are all protocols using the USB-C Connector. TF-USB-C-SB sideband test coupon fixtures provide sideband probing access.**



### USB Power Delivery and DisplayPort Alt Mode

The USB-PD power contract is the first thing that gets negotiated when two USB Type-C devices are connected. Tested with USB-PD TDMP software.
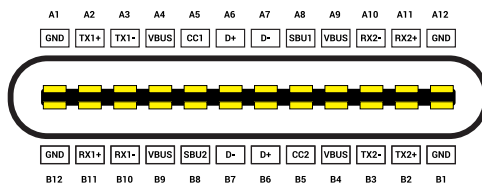
### DisplayPort Alt Mode

DisplayPort also uses USB-PD messages for 'alt mode' entry/exit and hot plug detect. Tested using USB-PD TDMP and DP-AUX DMP software.
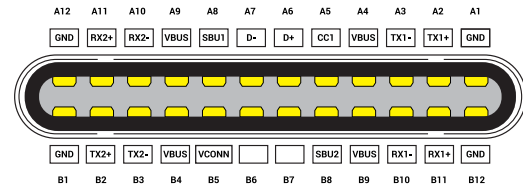
### USB 2.0

USB 2.0 continues to be the interface for many devices such as mice keyboards, human interface devices, and docking station ports. Tested using USB2bus D and USB 2.0 ProtoSync software.

## USB Type-C Signal Access



*USB Type-C Receptacle*



*USB Type-C Plug*

| Signal | Description | Recommended Probe | Connection to Debug Coupon | TF-USB-C-SB | TF-USB-C-HS |
|---|---|---|---|---|---|
| TX1 (DP ML2) | Transmitter Differential Pair #1 (±) | DH Differential Probe | DH-SI Probe Tip | N | Y |
| TX2 (DP ML0) | Transmitter Differential Pair #2 (±) | DH Differential Probe | DH-SI Probe Tip | N | Y |
| RX1 (DP ML3) | Receiver Differential Pair #1 (±) | DH Differential Probe | DH-SI Probe Tip | N | Y |
| RX2 (DP ML1) | Receiver Differential Pair #2 (±) | DH Differential Probe | DH-SI Probe Tip | N | Y |
| VBUS_V | Bus Power (Voltage) | PP021 2.5 mm Barrel Passive Probe (incl.) or Rail Probe | 2.5mm Barrel Passive Probe receptacle or MCX connector | Y | Y |
| VBUS_I | Bus Power (Current) | CP030 | Current Loop (red wire) | Y | Y |
| CC1 | Configuration Channel #1 | Passive Probe with 25-mil square pin adapter (incl.) | 25-mil square pin header | Y | Y |
| CC2 (VCONN) | Configuration Channel #2 and VCONN | Passive Probe with 25-mil square pin adapter (incl.) | 25-mil square pin header | Y | Y |
| D+/D- | USB 2.0 Differential Pair (±) | ZD Differential Probe | 25-mil square pin headers | Y | Y |
| SBU1 | Side Band Use #1 (SBU-TX when in USB4 Mode) | Passive Probe with 25-mil square pin adapter (incl.) | 25-mil square pin header | Y | Y |
| SBU2 | Side Band Use #2 (SBU-RX when in USB4 Mode) | Passive Probe with 25-mil square pin adapter (incl.) | 25-mil square pin header | Y | Y |
| SBU1-SBU2 | SBU Differential (when in DisplayPort Alt Mode) | ZD Differential Probe | 25-mil square pin header | Y | Y |
| GND | GND Return | Passive Probe with 25-mil square pin adapter (incl.) | 25-mil square pin header | Y | Y |

# ORDERING INFORMATION

| Product Description | Product Code |
|---|---|
| **USB Type-C USB4 High-speed and Sideband Test Coupon Fixtures** | |
| USB4 High-speed and Sideband Test Coupon Fixture | TF-USB-C-HS |
| USB4 Sideband Test Coupon Fixture | TF-USB-C-SB |

## USB Type-C Technologies PHY Compliance and PHY-Logic/Sideband Debug Oscilloscope Configuration Guide

| | USB-C High-speed PHY-Logic Layer and Sideband Debug | | USB-C Sideband Debug | | |
|---|---|---|---|---|---|
| | **LabMaster 10 Zi-A** | **WaveMaster 8 Zi-B** | **WavePro HD** | **WaveRunner 8000HD** | **HDO4000A/HDO6000B** |
| **Available Bandwidths** | 20 GHz - 65 GHz | 4 GHz - 30 GHz | 2.5 GHz - 8 GHz | 350 MHz - 2 GHz | 200 MHz - 1 GHz |
| **Available Sample Rate** | 80 GS on 4Ch | 80 GS on 2Ch | 20 GS on 4Ch | 10 GS on 8Ch | 10 GS on 4Ch |
| **Sideband Trigger (USB4-SB and USB-PD)** | No | Yes | Yes | Yes | Yes |
| **Mixed Signal Oscilloscope (for Sidebands)** | No | Yes (with MS-500) | Yes | Yes | Yes |
| **USB Voyager & Mercury Protocol Analyzer Cross Trigger** | Yes | Yes | Yes | Yes | Yes |
| **Recommended Models by Application** | | | | | |
| **LabMaster SDA 10Zi-A MCM** | SDA MCM 10Zi A | – | – | – | – |
| **USB4, Thunderbolt 3/4, and DisplayPort 2.0 PHY Compliance and PHY-Logic Debug** | LM 10-25Zi-A to LM 10-65Zi-A | SDA 825 Zi-B to SDA 830 Zi-B | – | – | – |
| **Multi-Lane Compliance** | Yes | No | – | – | – |
| **USB 3.2 (Gen1/Gen2) PHY Compliance and PHY-Logic Debug** | LM 10-20Zi-A to LM 10-65Zi-A | SDA 816 Zi-B to SDA 830 Zi-B | – | – | – |
| **USB 3.2 (Gen1) PHY Compliance and PHY-Logic Debug** | LM 10-20Zi-A to LM 10-65Zi-A | SDA 808 Zi-B to SDA 830 Zi-B | *WPHD804 | – | – |
| **DisplayPort 1.4 PHY Compliance and PHY-Logic Debug** | LM 10-20Zi-A to LM 10-65Zi-A | SDA 816 Zi-B to SDA 830 Zi-B | – | – | – |
| **Required Options for above Compliance Testing** | LM10Zi-SDAIII-COMPLETELINQ and LM10ZI-M-64 | WM8Zi-SDAIII-COMPLETELINQ | – | – | – |
| **Required BERT for above USB RX or DP Sink Testing** | MP1900A BERT | MP1900A BERT | – | – | – |
| **Differential Probes for Compliance Testing** | | | | | |
| **2 ea. for USB 2.0 HS Compliance 1 ea. for DP-AUX Compliance** | n/a ZD1500 and L2.92A-PBUS | ZD1500 ZD1500 | ZD1500 ZD1500 | ZD1500 ZD1500 | – |
| **PHY Compliance Software Options** | | | | | |
| **USB4 and Thunderbolt 3/4 Tx/Rx Compliance** | QPHY-USB4-TXRX | | – | – | – |
| **USB 3.2 (Gen1/Gen2) Tx/Rx Compliance** | QPHY-USB32-TXRX | | – | – | – |
| **USB 2.0 Compliance** | No | QPHY-USB | QPHY-USB | QPHY-USB | QPHY-USB |
| **DisplayPort 2.0/1.4 Source/Sink Compliance (Includes DP-AUX)** | QPHY-DP20-SOURCE (Includes DP14-Source) QPHY-DP14-SOURCE QPHY-DP20-SINK | | – | – | – |
| **PHY-Logic and Sideband Debug Options** | | | | | |
| **USB Type-C High-speed and/or Sideband Debug Coupon Fixture** | TF-USB-C-HS | TF-USB-C-HS | *TF-USB-C-HS or TF-USB-C-SB | TF-USB-C-SB | TF-USB-C-SB |
| **DH Series Differential Probes (1ea. per high-speed Tx/Rx lane tested)** | DH25-2.92 MM to DH30-2.92 MM | DH08-PL to DH20-PL | *DH08-PB2 and LPA-PB2 | – | – |
| **Differential Probe for USB 2.0 and DP-AUX Debug** | ZD1500 and L2.92A-PBUS | ZD1500 | ZD1500 | ZD1500 | – |
| **Current Probe for USB-PD Debug** | CP030 | CP030 | CP030 | CP030 | CP030 |
| **USB4 PHY-Logic and Sideband Debug** | USB4 DME and USB4-SB TDMP Beta available at www.teledynelecroy.com/lpp | | USB4-SB TDMP Beta available at www.teledynelecroy.com/lpp | | |
| **USB 3.2 PHY-Logic Debug** | LM10ZI-USB32bus D and ProtoSync | WM8ZI-USB32bus D and ProtoSync | *WPHD-USB32bus D and ProtoSync | – | – |
| **USB 2.0 PHY-Logic Debug** | LM10ZI-USB2bus DME and ProtoSync | WM8ZI-USB2bus TDME and ProtoSync | WPHD-USB2bus TDME and ProtoSync | WR8KHD-USB2bus TDME and ProtoSync | HDO4K-USB2bus TD HDO6K-USB2bus TDME and ProtoSync |
| **USB Power Delivery Debug** | LM10ZI-USBPD DMP | LM10ZI-USBPD TDMP | WPHD-USBPD TDMP | WR8KHD-USBPD TDMP | HDO4K-USBPD TD HDO6K-USBPD TDMP |
| **DisplayPort Link Layer Debug** | LM10ZI-DPAUX DMP | LM10ZI-DPAUX DMP | WPHD-DPAUX DMP | WR8KHD-DPAUX DMP | HDO4K-DPAUX DMP HDO6K-DPAUX DMP |

*\* WPHD804 to be used for USB3.2 (Gen1) debug only, compliance requires 40 GS/s minimum sample rate.*

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usb-c-usb4-test-coupon-ds_26apr22