QSFP112 Test Adapter

User Manual

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Introduction

This user's guide documents the QSFP112 Host (Plug) and QSFP112 Device Module (Receptacle) Test Adapters. There are two versions of the QSFP112 Plug and Receptacle TPAs one with 2.4 cable terminations and one with 1.85 terminations. The model numbers for the QSFP112 TPAs are as follows:

Model Numbers:

HCB 4 Channel:	
QSFP112-TPA2.4-HCB-P	4 Channel HCB with 2.4mm Female Connectors
QSFP112-TPA1.85-HCB-P	4 Channel HCB with 1.85mm Female Connectors
MCB 4 Channel:	
QSFP112-TPA2.4-MCB-R	4 Channel MCB with 2.4mm Female Connectors
QSFP112-TPA1.85-MCB-R	4 Channel MCB with 1.85mm Female Connectors

The test adapters, shown in Figures 1 and 2 on the following pages, test QSFP112 interface cables, hosts, and modules to the requirements of the QSFP112 MSA and IEEE 802.3ck Standards.

The QSFP112-TPAxxx-HCB-P and QSFP112-TPAxxx-MCB-R test adapter assemblies allow access, via 2.4mm or 1.85mm coaxial (High-Speed) connections, to measure or inject data signals.

NOTE: To avoid damaging the cables, use the handling techniques described in the Care and Handling section before making any connections or configuring a test setup.

Always use a static-safe workstation when performing tests, as explained in the "Electrostatic Discharge Information" section.

QSFP112-TPAxxx-HCB-P (4-Channel)

The QSFP112 Host Compliance Test Adapter can be used for testing compliance of QSFP112 Host Devices to MSA and IEEE 802.3ck standards.

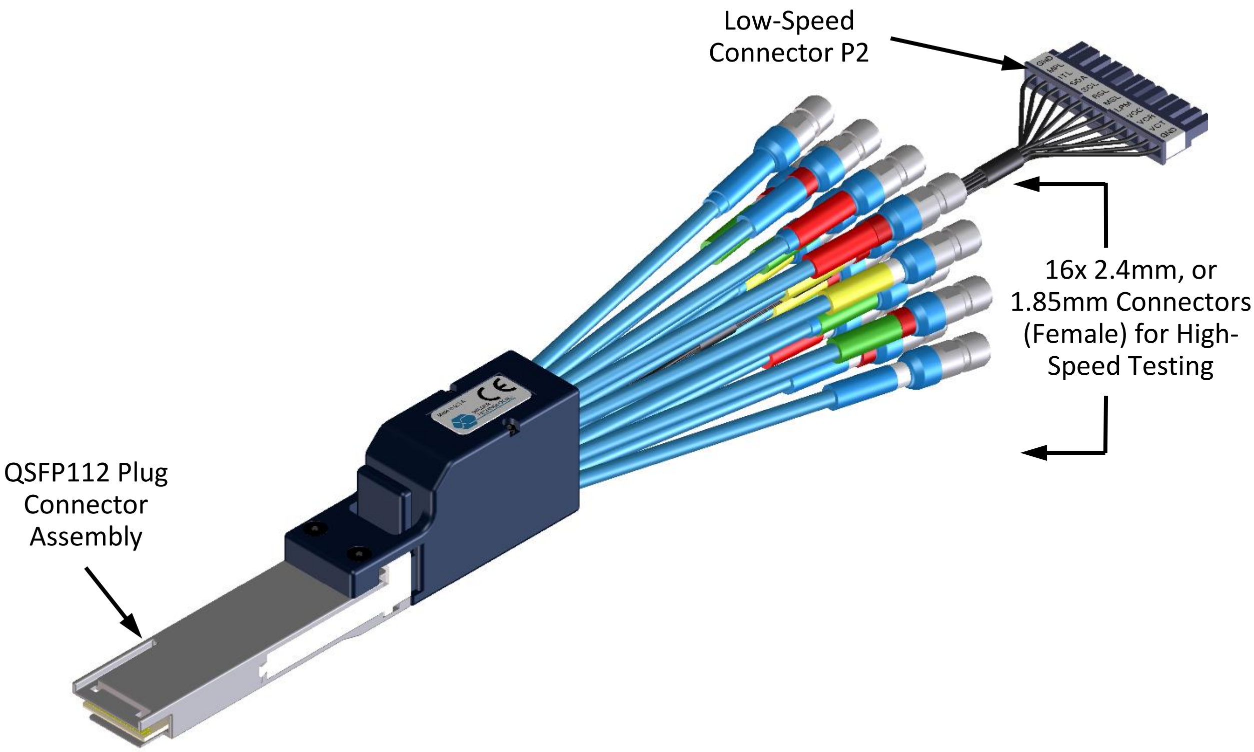


Figure 1. The QSFP112 HCB (Plug)Test Adapter (Note: Coaxial cables shown coaxial cables are configuration dependent and may be terminated with different style connectors than what is shown).

Included with the QSFP112-TPAxxx-HCB-P is a spare Molex male plug connector. This is provided for users to interface with the Low-Speed connection on the HCB. The Molex part numbers for the included plug, and contact pins are as follows.

12-position MicroFit Plug Header (Spare)	Molex PN 43640-1201
Plug Male Contact Pins (Spare)	Molex PN 43031-0011

QSFP112-TPAxxx-MCB-R (4-Channel)

The QSFP112 Module Compliance Test Adapter can be used for testing compliance of QSFP112 Module devices to MSA and IEEE 802.3ck standards.

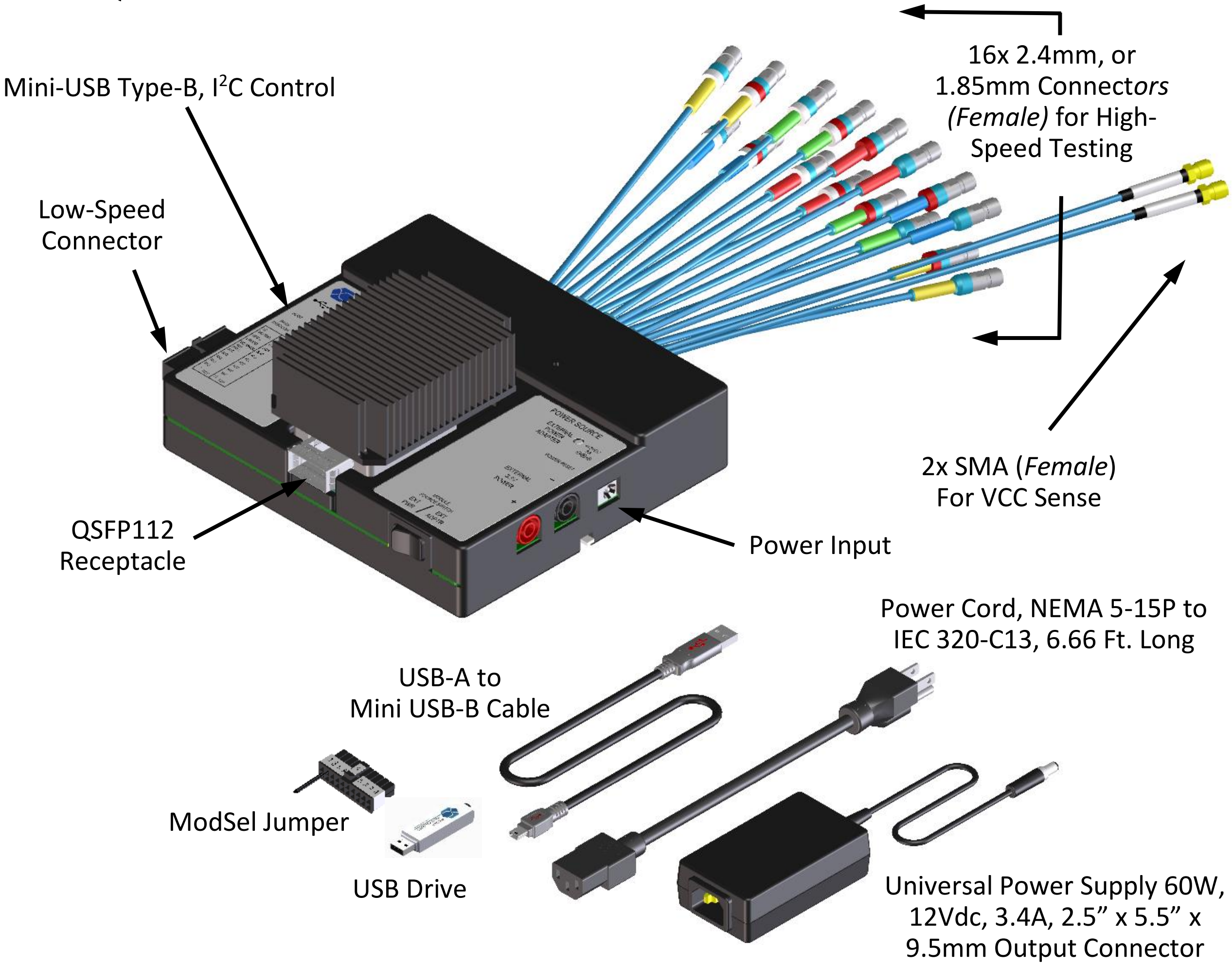


Figure 2. The QSFP112 MCB (Receptacle) Test Adapter and its included cabling (Note: The coaxial cables are configuration dependent and may be terminated with different connectors than what is shown.)

Included with the QSFP112-TPAxxx-MCB-R is a spare Molex receptacle connector, provided for users to interface with the Low-Speed connection on the MCB. The Molex part numbers for the included receptacle, and contact pins are as follows.

20-position 2 row MicroFit Receptacle Housing (Spare)	Molex PN 43025-2000
Receptacle Female Contact Terminal Pins (Spare)	Molex PN 43030-0011

Replacement parts for the MCB and HCB low-speed connections can be additionally purchased through Molex distributors.

NOTE: The receiver High-Speed connections for QSFP112 are normally AC coupled. The QSFP112 plug and receptacle TPAs do NOT have internal DC Blocks. This allows for parametric testing through the TPAs. Normal testing may require DC Blocks (Some DC blocks may be optionally ordered from Wilder Technologies or refer to the following table for purchasing options).

DC Block Specfications and Source Information				
Interface	**Frequency Range**	**VSWR**	**IL**	**Possible DC Block Sources**
1.85mm	≤10MHz - 67GHz	1.5:1	≤1.25	Centric RF Part Number C1067
2.4mm	≤10MHz - 50GHz	1.35:1	≤1.25	Centric RF Part Number C0150

NOTE: RF Terminators may be required to support specific user test configurations. (Some RF Terminators may be optionally ordered from Wilder Technologies or refer to the following table for purchasing options).

RF Terminator Specfications and Source Information				
Interface	**Frequency Range**	**VSWR**	**Power**	**Possible RF Terminator Sources**
1.85mm	0 - 67GHz	1.3:1	1W	Centric RF Part Number C673
2.4mm	0 - 50GHz	1.3:1	1W	Centric RF Part Number C505 Pasternack Part Number PE6TR1103

NOTE: The metal shell of both the plug (QSFP112 HCB) and receptacle (QSFP112 MCB) connector housing or cage tie high-speed ground to chassis ground.

Cooling Module Accessory

The Cooling Module Accessory (Included with product or optional accessory) can be installed to the QSFP112 MCB (Receptacle) Test Adapter. This will increase airflow through the TPA's heat sink and subsequently keep the device temperature within the standard operating range. The Cooling Module is optional to this product.

To install the Cooling Module, first mount the T-shaped rail guide to the MCB housing using the provided flat head screws. Then, slide the Cooling Module assembly onto the mounting rail guide until the assembly clicks in place.

A separate 12V AC-DC Power Adapter (not shown) is provided with the assembly and plugs into the Cooling Module's DC Jack, to power the fan.

NOTE: The Cooling Module is required while testing high power modules but is detachable for carrying purposes.

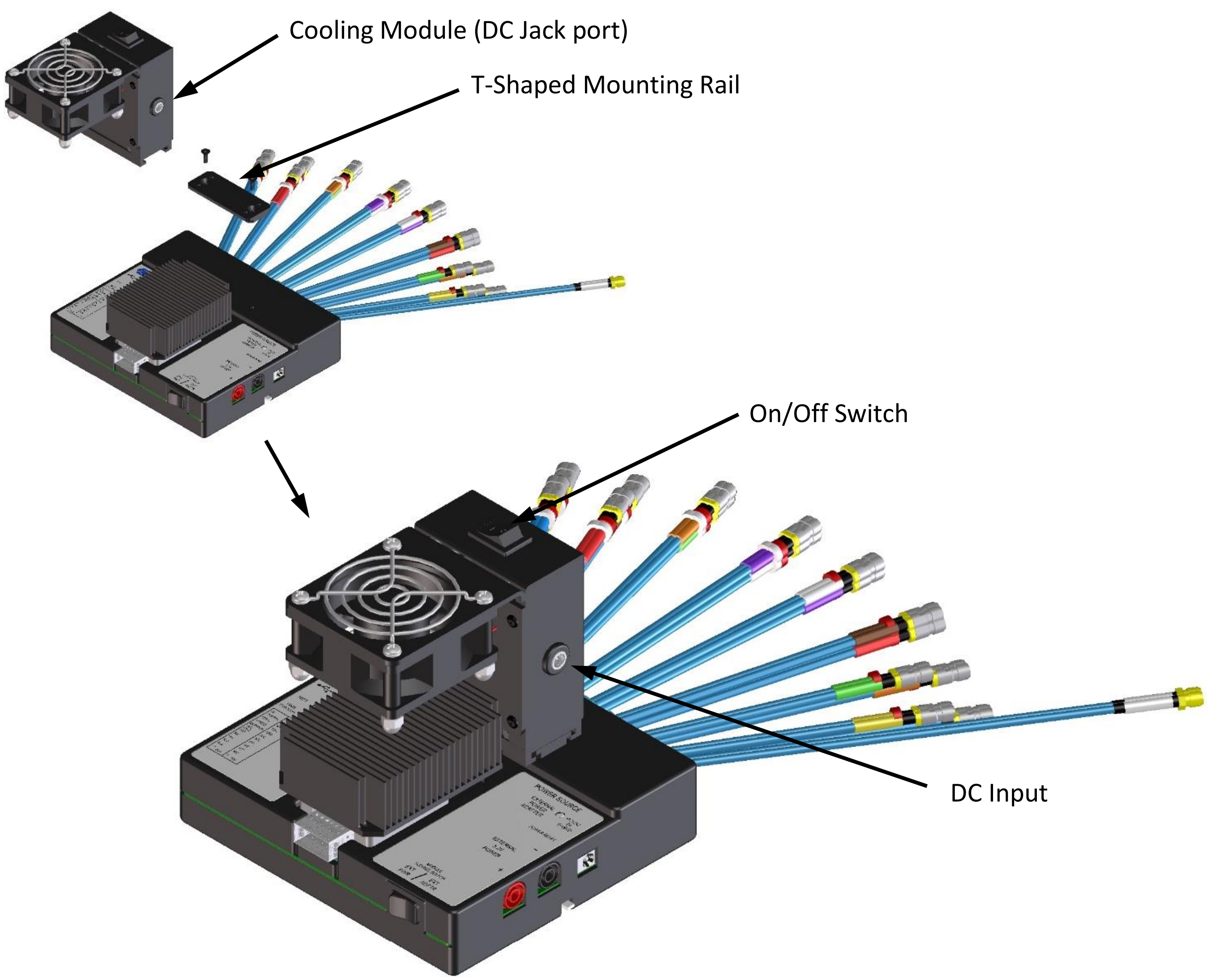


Figure 3. The QSFP112 MCB (Receptacle) Test Adapter with Cooling Module.

Table 1. Cooling Module Recommended Use

The QSFP112xxx-TPA-MCB-R was designed with a ride along heatsink that provides cooling for the QSFP112. All classes of power up to class 7, as listed in the MSA specification, is provided for without the use of an optional cooling fan module. The chart below shows temperatures for reference and were obtained through experimentation by Wilder Technologies. The classes shown relate to the QSFP112 requirements. Case and heatsink temperatures with and without the air mover are included in the table. These measurements may apply to the QSFP112 if class 8, > 5W per MSA Standards is required.

The Cooling Module is recommended at case temperatures greater than 70°C based on QSFP112 MSA Standards[2]. The Cooling Module is also recommended at Heatsink temperatures greater than 60°C based on ASTM C1055 (*Standard Guide for Heated System Surface Conditions that Produce Contact Burn Injuries*)[3].

		Without Cooling Module		With Cooling Module		
Power Class	Max Power (W)	Case Temperature[1,2] (°C)	Heatsink Temperature[1,3] (°C)	Case Temperature[1,2] (°C)	Heatsink Temperature[1,3] (°C)	Cooling Module Recommended
1	1.5	29.72	28.11	N/A	N/A	No
2	2.0	N/A	N/A	N/A	N/A	No
3	2.5	N/A	N/A	N/A	N/A	No
4	3.5	37.96	34.56	N/A	N/A	No
5	4.0	N/A	N/A	N/A	N/A	No
6	4.5	N/A	N/A	N/A	N/A	No
7	5.0	N/A	N/A	N/A	N/A	No
8	>5.0, ≤10.0	52.38 - 64.74	45.84 - 55.51	N/A	N/A	Optional
8	>10, ≤22.53	72.98 - 105.4	61.96 - 87.2	34.55 - 53.4	25.62 - 29.5	Yes

Based on measurements conducted by Wilder Technologies, the Cooling Module is recommended for use on the QSFP112 MCB (Receptacle) when testing modules of Power Class 8. At these power classes, the case temperatures and heatsink temperatures of the QSFP112 MCB exceed recommended limits (Per MSA and ASTM standards). Thus, the Cooling Module must be used to reduce temperatures to be within safe operating ranges.

[1] Temperatures interpolated from experimental data.
[2] "QSFP-DD/QSFP-DD800/QSFP112 Hardware Specification for QSFP Double Density 8X and QSFP 4X Pluggable Transceivers, Revision 6.3".
[3] "Standard Guide for Heated System Surface Conditions that Produce Contact Burn Injuries (ASTM C1055-20)." American Society for Testing and Materials, Philadelphia, PA

Product Inspection

Upon receiving the QSFP112-TPA from Wilder Technologies, perform the following product inspection:

- Inspect the outer shipping container, foam-lined instrument case, and product for damage. Retain the outer cardboard shipping container until the contents of the shipment have been inspected for completeness and the product has been checked mechanically and electrically. Use the foam-lined instrument-case for secure storage of the Wilder Technologies QSFP112 Test Adapter when not in use.

- Locate the shipping list and verify that all items ordered were received.

- In the unlikely event that the product is defective or incomplete, the "Limited Warranty" section discusses how to contact Wilder Technologies for technical assistance and/or how to package the product for return.

The QSFP112 Test Adapter Care and Handling Precautions

The QSFP112 Test Adapter requires careful handling to avoid damage. Improper handling techniques, or using too small a cable bend radius, can damage the coaxial cable connections within the adapter housing or the cables themselves. This can occur at any point along the cable. To achieve optimum performance and to prolong the QSFP112 TPA's life, observe the following handling precautions:

- **CAUTION 1: Avoid Torque Forces** (Twisting)
  While individual coaxial cables within the test adapter have some rotational freedom, twisting the QSFP112-TPA as a unit, with one end held stationary, may damage, or severely degrade performance. Adherence to Caution 5 (below) helps to avoid twisting.

- **CAUTION 2: Avoid Sharp Cable Bends**
  Never bend coaxial cables into a radius of 26 mm (1-inch) or less. Never bend cables greater than 90°. Single or multiple cable bends must be kept within this limit. Bending the QSFP112-TPA cables less than a 26mm (1-Inch) radius will permanently damage or severely degrade test adapter performance.

- **CAUTION 3: Avoid Cable Tension** (Pull Forces)
  Never apply tension (pull forces) to an individual coaxial cable that is greater than 2.3 kg (5 lbs.). To avoid applying tension, always place accessories and equipment on a surface that allows adjustment to eliminate tension on the QSFP112-TPA and cables. Use adjustable elevation stands or apparatus to accurately place and support the QSFP112-TPA.

- **CAUTION 4: Connect the QSFP112-TPA First**
  To prevent twisting, bending, or applying tension to the coaxial cables when connecting a QSFP112-TPA, always attach the QSFP112-TPA to the device under test (DUT) or cable under test before attaching any SMA connectors. Carefully align the QSFP112 connectors and then gently push the connectors together until fully seated.

  If the QSFP112-TPA must be turned or twisted to make connection to the DUT, avoid using the QSFP112-TPA housing alone to make this occur. Try to distribute the torque forces along the length of the test setup and cabling. If this is not possible, it is recommended to first loosen or disconnect the SMA connections at the QSFP112-TPA, make the connection to the DUT and then re-tighten or attach the test equipment leads.

  NOTE: Only grip the test adapter housing when inserting or extracting the QSFP112-TPA to or from the DUT. Pulling directly on the QSFP112-TPA cables or using them to insert the QSFP112-TPA may cause damage.

- **CAUTION 5: Carefully Make High Speed (2.4mm or 1.85mm) Connections**
  To connect the QSFP112-TPA high-speed connectors, follow these steps:

  1. Hold the cable stationary by grasping the cable at the black heat-shrink section near the High-Speed connector.

  2. Insert the mating high speed barrel and hand-tighten the free-spinning nut onto the connector while avoiding pulling, bending, or twisting the QSFP112-TPA coaxial cable.

3. The QSFP112-TPA high speed connectors have flats that accept an open-end 1/4-inch or 5/16-inch wrench, depending on configuration. When attaching instrument cables to the QSFP112-TPA, it is recommended that the QSFP112-TPA's high speed connectors be mechanically held and the test leads be tightened to the equipment manufacturer's torque recommendations, normally 5 in-lbs., using an open-end torque wrench.

If the test set-up requires repositioning, first loosen, or disconnect the high speed-connections to avoid any twisting, bending, or tension.

- **CAUTION 6: Independently Support Instrument Cables or Accessories**
  Excessive weight from instrument cables and/or accessories connected to the QSFP112-TPA can cause damage or affect the test adapter performance. Be sure to provide appropriate means to support and stabilize all test set-up components.

- **CAUTION 7: ESD Sensitivity**
  The QSFP112 test adapters are passive components and are not in themselves sensitive to electrostatic discharge. However, when an active DUT is installed, that device becomes susceptible to ESD. Observe proper ESD precautions, further discussed later in this document.

General Test Adapter, Cable, and Connector

Observing simple precautions can ensure accurate and reliable measurements.

Handling and Storage

Before each use of the QSFP112-TPA, ensure that all connectors are clean. Handle all cables carefully and store the QSFP112-TPA in the foam-lined instrument case when not in use, if possible. Do not set connectors contact end down. Install the high-speed connector's protective end caps when the QSFP112-TPA is not in use.

Visual Inspection

Be sure to inspect all cables carefully before making a connection. Inspect all cables for metal particles, scratches, deformed threads, dents, or bent, broken, or misaligned center conductors. Do not use damaged cables.

Cleaning

If necessary, clean the connectors using low-pressure (less than 60 PSI) compressed air or nitrogen with an effective oil-vapor filter and condensation trap. Clean the cable threads, if necessary, using a lint-free swab or cleaning cloth moistened with isopropyl alcohol. Always completely dry a connector before use. Do not use abrasives to clean the connectors. Re-inspect connectors, making sure no particles or residue remains.

Making Connections

Before making any connections, review the "Care and Handling Precautions**"** section. Follow these guidelines when making connections:

- Align cables carefully
- Make preliminary connection lightly
- To tighten, turn connector nut only
- Do not apply bending force to cable
- Do not over-tighten preliminary connections
- Do not twist or screw-in cables
- Use an appropriately sized torque wrench, and do not tighten past the "break" point of the torque wrench (normally 5-inch pounds)

Electrostatic Discharge Information

Protection against electrostatic discharge (ESD) is essential while connecting, inspecting, or cleaning the QSFP112-TPA test adapter and connectors attached to a static-sensitive circuit (such as those found in test sets).

Electrostatic discharge can damage or destroy electronic components. Be sure to perform all work on electronic assemblies at a static-safe workstation, using two types of ESD protection:

- Conductive tablemat and wrist-strap combination
- Conductive floor-mat and heel-strap combination

When used together, both types provide a significant level of ESD protection. Used alone, the tablemat and wrist-strap combination provide adequate ESD protection. To ensure user safety, the static-safe accessories must provide at least 1 MΩ of isolation from ground. Acceptable ESD accessories may be purchased from a local supplier.

WARNING: These techniques for a static-safe workstation should not be used when working on circuitry with a voltage potential greater than 500 volts.

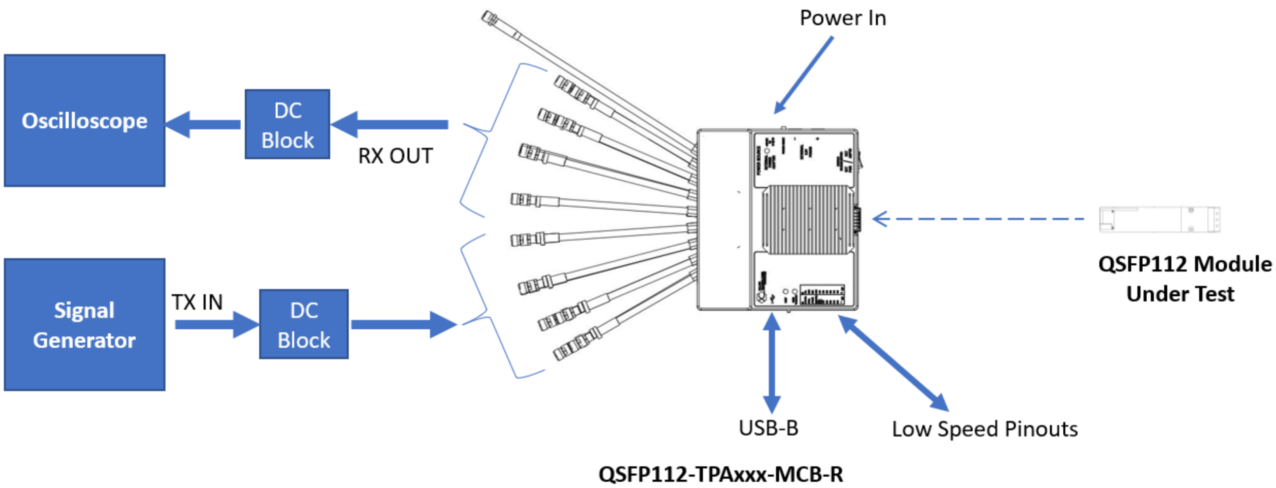
User Model

The QSFP112 TPA's are capable of performing to the requirements of both MSA and IEEE 802.3ck standards, limited only by the specifications, environmental, care and handling of this document.

The two most common testing configurations are shown below.

QSFP112 MCB

QSFP112-TPAxxx-MCB-R is used to test a QSFP112 Module:



*DC blocks are accessories and not provided with this product.

Figure 4. QSFP112 MCB User Model

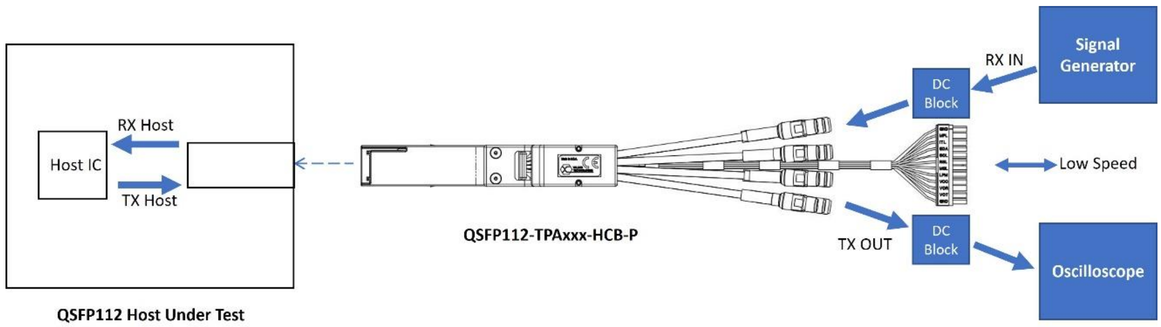
In this configuration, the QSFP112-MCB is used to test a QSFP112 Module. The MCB must be powered by the 12V power supply provided.

The MCB receives input signals from a signal generator connected to its TX lines (indicated by TX IN). These signals are then transferred to the QSFP112 module under test (indicated by TX OUT). The module responds with the RX IN signal, which is transferred through the MCB, and outputted to a connected oscilloscope through its RX lines.

*Note that between the Signal Generator and MCB and the MCB and Oscilloscope are DC Blocks which need to be separately obtained.

QSFP112 HCB

QSFP112-TPAxxx-HCB-P is used to test a QSFP112 Host:



*DC blocks are accessories and not provided with this product.

Figure 5. QSFP112 HCB User Model

In this configuration, the QSFP112 HCB is used to test a QSFP112 Host.

An RX signal, inputted from a connected Signal Generator, is transferred through the HCB RX lines into the QSFP112 host under test. The Host responds by outputting TX signals which are transferred through the HCB, out through its TX lines into a connected Oscilloscope for measurement.

*Note that between the Signal Generator and MCB and the MCB and Oscilloscope are DC Blocks which need to be separately obtained.

Note: In the case where the laboratory source or load is not used in the test, each unused signal line must be replaced with RF Terminators. Not provided with this product

Channel De-Embedding

The QSFP112 Test Adapters are fully passive components. Therefore, calibration compensating for the losses must occur within the test instrumentation that drives the QSFP112 Receivers or looks at the response of the QSFP112 Transmitters.

The QSFP112 TPA's have Touchstone S4P files for de-embedding the electrical length and losses within the TPA up to the QSFP112 connector interface pads. (Contact Wilder Technologies, support@wilder-tech.com, to obtain a copy of the S4P files.) The Touchstone S4P files enable the test engineer to compensate for the last four of the following six repeatable, systematic errors that occur when moving the reference plane:

- Signal leakage effects: *Directivity errors*
- Signal leakage effects: *Crosstalk errors*
- Reflection effects: *Source Impedance Mismatching errors*
- Reflection effects: *Load Impedance Mismatching errors*
- Bandwidth effects: *Receiver Transmission in Test Equipment errors*
- Bandwidth effects: *Receiver Reflection-tracking in Test Equipment errors*

These errors are corrected on each port. Refer to the Instrument Manual for instructions on the instrument's specific de-embedding process.

NOTE: The reference plane is the boundary, both physically and electrically, between the calibrated and uncalibrated portions of the circuit. Everything outside the reference plane is considered part of the DUT. Any instrument that does not use calibration or de-embedding of the test fixture defines the DUT as the total of externally connected components. If the de-embedding file is not used, all of the QSFP112-TPA and associated coaxial cables, as well as cables connecting the TPA assembly to the test instrument, would be a part of the DUT.

Non-repeatable errors, such as drift or random errors, can be reduced but not corrected. Drift errors aggregate over time or with environmental changes such as temperature shift. To eliminate drift errors, perform an instrumentation-level calibration.

A random error cannot be corrected through calibration since the error occurred randomly. Random errors are typically associated with either test instrument noise or test repeatability problems. Reduce test instrument noise by increasing source power, lowering the IF bandwidth, or averaging results over multiple sweeps. Reduce test repeatability problems through the use of a torque wrench or, again, by averaging over multiple sweeps.

Mechanical and Environmental Specifications

NOTE: All specifications in this manual are subject to change.

Table 2. General Specifications

ITEM	DESCRIPTION
Usage Environment	Controlled indoor environment
Plug Test Adapter Length (w/standard cables)	215.9 mm +/- 2 mm (8.50 inches +/- .08 inches) (Characteristic)
Receptacle Test Adapter Length (w/standard cables, end to end)	273.5 mm +/- 2 mm (10.77 inches +/- .08 inches) (Characteristic)
Receptacle Test Adapter Housing Dimensions	137.2 x 151.1 x 67.3 (5.40 x 5.95 x 2.65 inches) (L, W, H)
Operating Temperature	0°C to +55°C (32°F to +131°F) (Characteristic)
Storage Temperature	-40°C to +70°C (-40°F to +158°F) (Characteristic)

QSFP112-TPAxxx-HCB-P Cable Pinout

The QSFP112-TPA cables provide sixteen 2.4mm or 1.85mm (High Speed) connectors (four lanes of primary differential TX and RX signals). Color coded heat shrink labels clearly mark each cable or connector. The following figure refers to the pin-description tables for the QSFP112-TPAxxx-HCB-P (Plug) test adapter. See table 4.

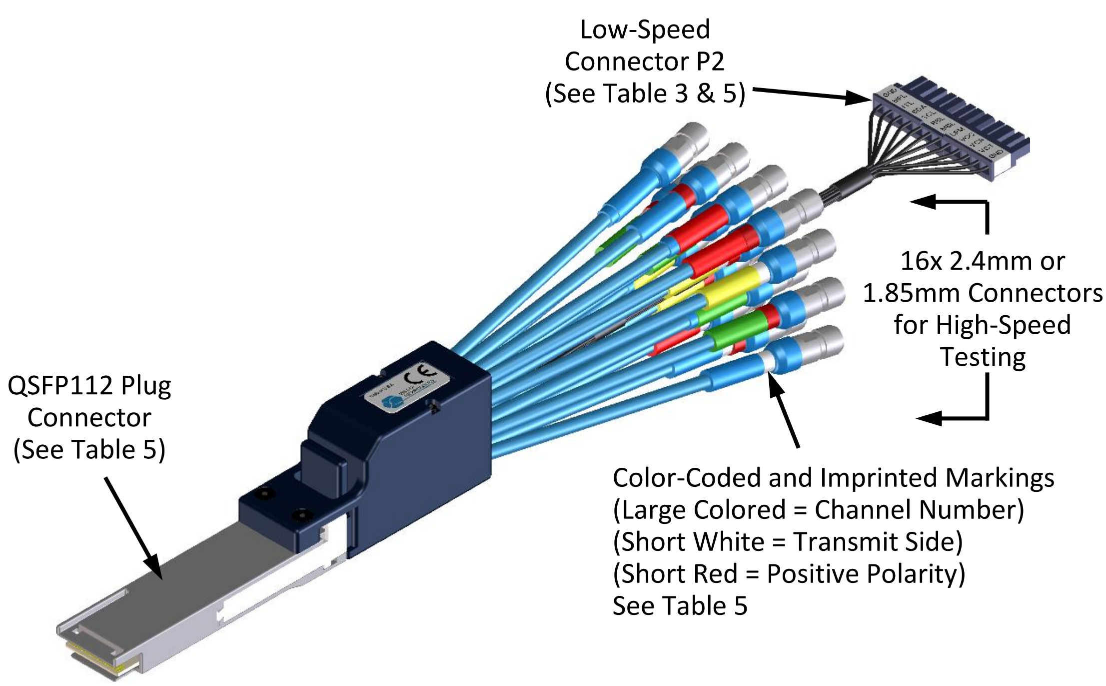


Figure 6. Cable Connectors (QSFP112-TPAxxx-HCB-P shown)

QSFP112-TPAxxx-MCB-R Cable Pinout

The QSFP112-TPA cables provide sixteen 2.4mm or 1.85mm (High Speed) connectors (four lanes of primary differential TX and RX signals). Color coded heat shrink labels clearly mark each cable or connector. The following figure refers to the pin-description tables for the QSFP112-TPAxxx-MCB-R (Receptacle) test adapter. See table 4.

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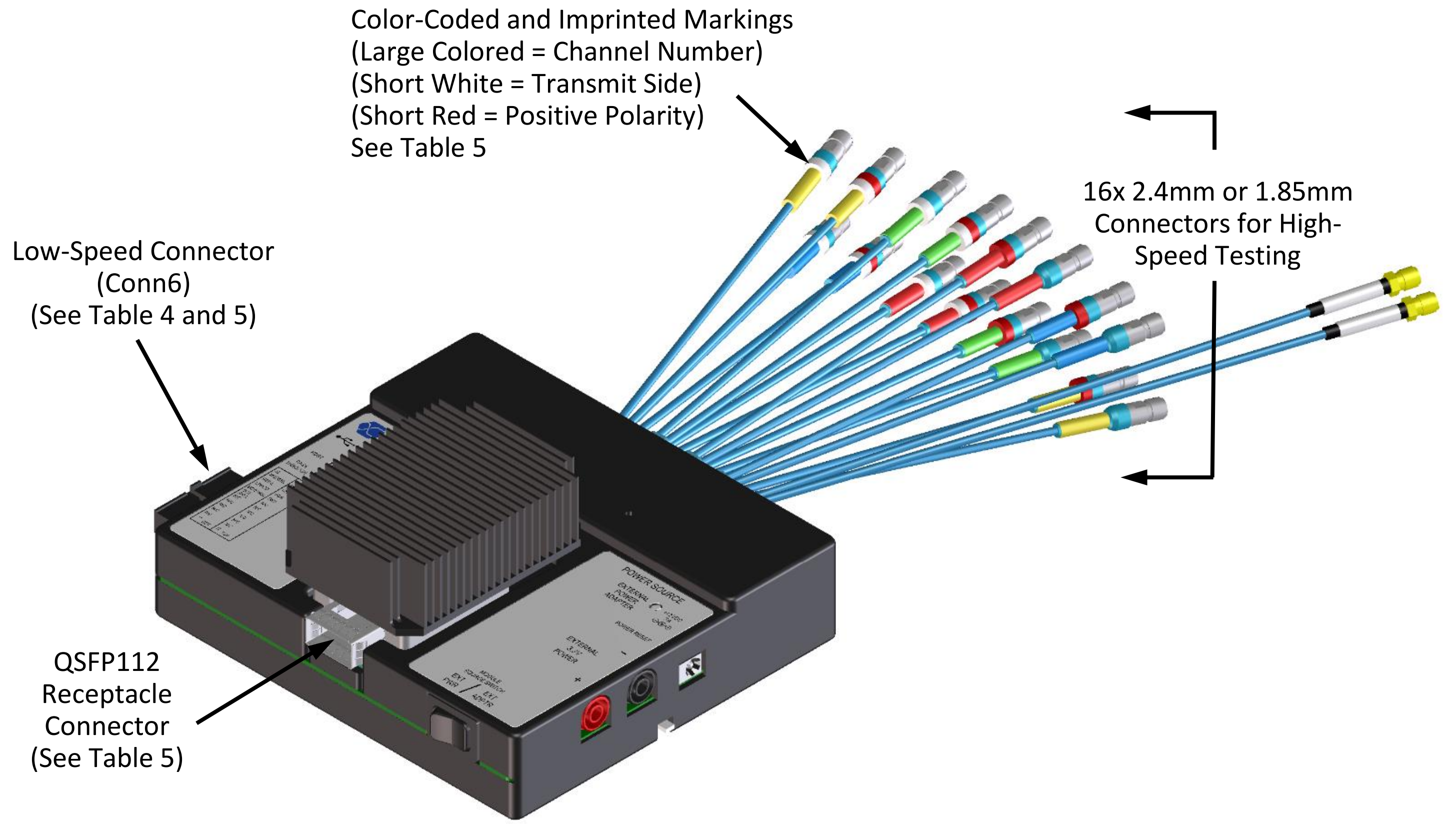

Figure 7. Cable Connectors (QSFP112-TPAxxx-MCB-R shown)

Closeup of MCB Interface and Functional Ports

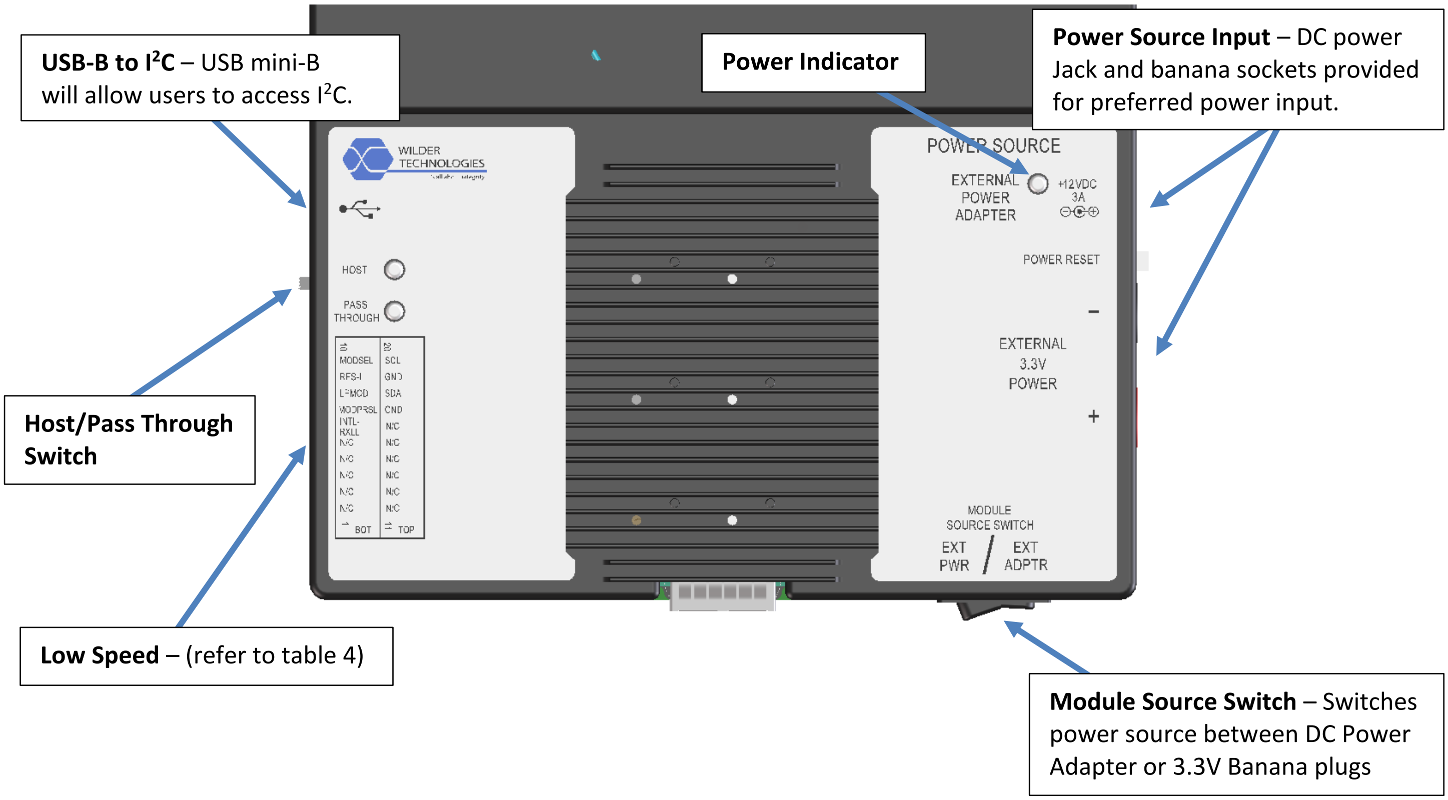

Figure 8. Closeup of QSFP112 I/0's and External Functions

The **Module Source Switch** allows a user to select which power input supplies the 3.3V SFP-DD module VCC pins. With the switch in the **EXT PWR** position the module will take power from the **External 3.3V Power** connectors (banana jacks). With the switch in the **EXT ADPTR** position the module will take power from the **External Power Adapter** (+12VDC, 60-Watt Power Adapter). The 12V to 3.3V regulator can supply up to 8 amps to the module. Note: To run software applications, the external power adapter is required even when switched to **EXT PWR** mode.

The **Power Reset** circuit breaker will trip if power consumption exceeds 38W while in **EXT ADPTR** Mode. When tripped, a **Power Reset** button will pop out of the MCB casing. The **Power Reset** button must be pushed back into the MCB casing to allow power into the MCB once again.

Note: The user should provide an external current limiter, fuse, or breaker to prevent any possible short circuit damage while in **EXT PWR** mode. In EXT PWR mode, the MCB **Power Reset** circuit breaker will still trip if there is a short circuit within the MCB host emulation circuitry.

The **Host/Pass Through Switch** switches between a host emulation mode and a signal passthrough mode. In host emulation mode, the MCB can communicate with the Wilder Technologies CMIS GUI software that is running on an external PC. This allows the user to monitor and control the data registers of the system. In signal passthrough mode, the MCB will connect all low-speed signals to the low-speed header on the side of the MCB. This gives users access to all low-speed signals for their own monitoring and control. Note: CMIS GUI monitoring and control will be disabled in passthrough mode. If the CMIS GUI is unavailable and the MCB is placed in passthrough mode, a ModSel-GND Jumper has been provided with the MCB to permit communications per the MSA QSFP-DD/QSFP-DD800/QSFP112 Hardware Specification

Rev 6.3 Paragraph 4.2.1." "Insert the ModSel-GND Jumper into the 20-pin low-speed header on the MCB to ensure that any module you connect to the MCB is enabled to respond to TWI serial communication commands."

The **USB to I2C –** CMIS (Common Management Interface Specification) is a standardized way for manufacturers to define what data goes in registers based on Two Wire Interface. To access this information, use the Wilder Technologies CMIS GUI software. Installation and instructions are in the CMIS GUI user manual (910-0070-000). This manual is provided on USB Flash Drive supplied with the QSFP112 MCB product.

The **VCC Sense** SMA connectors (Cable interface at the rear of the unit not shown) can be used to precisely monitor TX and RX supply voltages. Voltage outputs are situated close to the QSFP112 primary connector contact-lead pads.

The following table refers to the pin-descriptions for the HCB (plug).

Table 3. QSFP112-TPAxxx-HCB-P 12-Position (P2) Cable Connector (Low-Speed)

LABEL	PIN NO.	COLOR ID FOR HCB	DESCRIPTION
GND	Pin 1	Black/NA	Signal (RF Ground) and Supply (Power) Common
MPL	Pin 2	Black/NA	Module Present
ITL	Pin 3	Black/NA	Interrupt
SDA	Pin 4	Black/NA	SDA, I^2C Data
SCL	Pin 5	Black/NA	SCL, I^2C Clock
RSL	Pin 6	Black/NA	Module Reset
MSL	Pin 7	Black/NA	Module Select
LPM	Pin 8	Black/NA	Low Power Mode
VCC	Pin 9	Not Present	Vcc1 module power supply (+3.3V)
VCR	Pin 10	Not Present	VccR, module receiver power supply (+3.3V)
VCT	Pin 11	Not Present	VccT, module transmitter power supply (+3.3V)
GND	Pin 12	Black/NA	Signal (RF Ground) and Supply (Power) Common

The following table refers to the pin-descriptions for the MCB (receptacle).

Table 4. QSFP112-TPAxxx-MCB-R (Conn6) 20-Position Fixture-Mounted Connector (Low-Speed)

LABEL	PIN NO.	DESCRIPTION
N/C	Pin 1	No Connection
N/C	Pin 2	No Connection
N/C	Pin 3	No Connection
N/C	Pin 4	No Connection
N/C	Pin 5	No Connection
INTL-RXLL	Pin 6	Interrupt
MODPRSL	Pin 7	Module Present
LPMOD/TxDis	Pin 8	Low Power Mode Optional TX Disable
RESET-L	Pin 9	Module Reset
MODSEL	Pin 10	Module Select
N/C	Pin 11	No Connection
N/C	Pin 12	No Connection
N/C	Pin 13	No Connection
N/C	Pin 14	No Connection
N/C	Pin 15	No Connection
N/C	Pin 16	No Connection
GND	Pin 17	Signal (RF Ground) and Supply (Power) Common
SDA	Pin 18	SDA, I^2C Data
GND	Pin 19	Signal (RF Ground) and Supply (Power) Common
SCL	Pin 20	SCL, I^2C Clock

Table 5. QSFP112-TPAxxx-HCB-P (Plug) and QSFP112-TPAxxx-MCB-R (Receptacle) Pin Assignments

Pin Description	Connector Pin Number	Destination (HCB/MCB)*	Color ID for Data Line Polarity	Color Identification (HCB/MCB)	
Ground	1	P2 Pin 1 & 12/ Conn6 Pin 17 & 19	N/A	Black Insulation	
Tx2n	2	Tx2-	Black	White/Blue	
Tx2p	3	Tx2+	Red	White/Blue	
Ground	4	P2 Pin 1 & 12/ Conn6 Pin 17 & 19	N/A	Black Insulation	
Tx4n	5	Tx4-	Black	White/Red	
Tx4p	6	Tx4+	Red	White/Red	
Ground	7	P2 Pin 1 & 12/ Conn6 Pin 17 & 19	N/A	Black Insulation	
ModSelL	8	P2 Pin 7 Conn6 Pin 10	N/A	Black Insulation	
RestL	9	P2 Pin 6 Conn6 Pin 9	N/A	Black Insulation	
VccR	10	MCB-Regulated PWR/HCB-Not Connected	N/A	NC	NA
SCL	11	P2 Pin 5 Conn 6 Pin 20	N/A	Black Insulation	
SDA	12	P2 Pin 4 Conn6 Pin 18	N/A	Black Insulation	
Ground	13	P2 Pin 1 & 12/ Conn6 Pin 17 & 19	N/A	Black Insulation	
Rx3p	14	Rx3+	Red	Green	
Rx3n	15	Rx3-	Black	Green	
Ground	16	P2 Pin 1 & 12/ Conn6 Pin 17 & 19	N/A	Black Insulation	
Rx1p	17	Rx1+	Red	Yellow	
Rx1n	18	Rx1-	Black	Yellow	
Ground	19	P2 Pin 1 & 12/ Conn6 Pin 17 & 19	N/A	Black Insulation	
Ground	20	P2 Pin 1 & 12/ Conn6 Pin 17 & 19	N/A	Black Insulation	
Rx2n	21	Rx2-	Black	Blue	
Rx2p	22	Rx2+	Red	Blue	
Ground	23	P2 Pin 1 & 12/ Conn6 Pin 17 & 19	N/A	Black Insulation	
Rx4n	24	Rx4-	Black	Red	
Rx4p	25	Rx4+	Red	Red	
Ground	26	P2 Pin 1 & 12/ Conn6 Pin 17 & 19	N/A	Black Insulation	

ModPrsL	27	P2 Pin 2 Conn6 Pin 7	N/A	Black Insulation	
IntL/RxLOS	28	P2 Pin 3 Conn6 Pin 6	N/A	Black Insulation	
VccT	29	MCB-Regulated PWR/HCB-Not Connected	N/A	NC	NA
Vcc1	30	MCB-Regulated PWR/HCB-Not Connected	N/A	NC	NA
LPMode/TxDis	31	P2 Pin 8 Conn6 Pin 8	N/A	Black Insulation	
Ground	32	P2 Pin 1 & 12/ Conn6 Pin 17 & 19	N/A	Black Insulation	
Tx3p	33	Tx3+	Red	White/Green	
Tx3n	34	Tx3-	Black	White/Green	
Ground	35	P2 Pin 1 & 12/ Conn6 Pin 17 & 19	N/A	Black Insulation	
Tx1p	36	Tx1+	Red	White/Yellow	
Tx1n	37	Tx1-	Black	White/Yellow	
Ground	38	P2 Pin 1 & 12/ Conn6 Pin 17 & 19	N/A	Black Insulation	

* All high-speed coax cable shields are connected to common ground plane

Electrical Responses Data

Documented in the following pages are the typical electrical responses of the Wilder QSFP112 TPAs. HCB loss, MCB loss, MTF response and ICN data is shown.

Wilder QSFP112 HCB Response

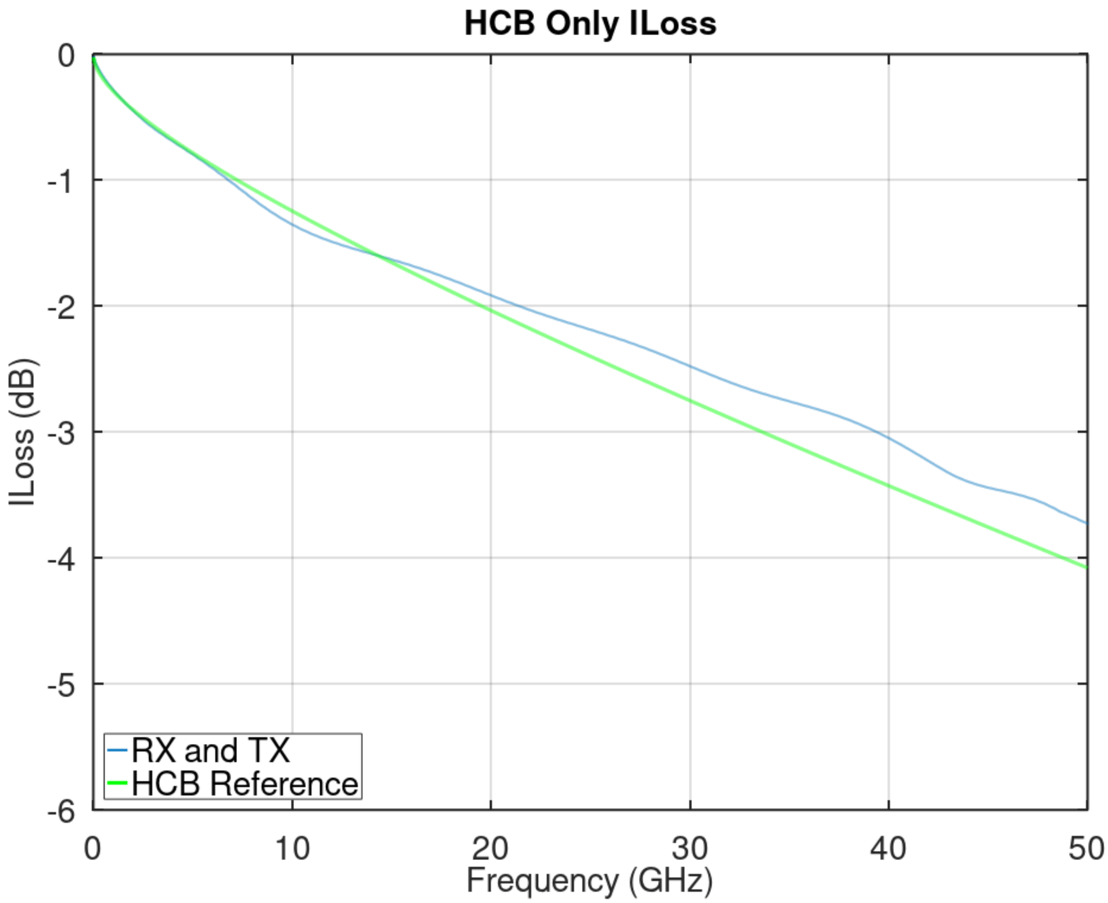

Figure 9. Plot of QSFP112 HCB Insertion Loss

The loss of the HCB up to but excluding the connector and its associated PCB pads is plotted in Figure 9. The loss at 28GHz is in table below. Note that the IEEE 802.3ck specification states that the difference between reference and true HCB response should be accounted for in the measurement.

Table 6. HCB Insertion Loss at 28GHz

Channel Group	ILoss at 28GHz (dB)
All RX and TX	-2.349416

Wilder QSFP112 MCB Response

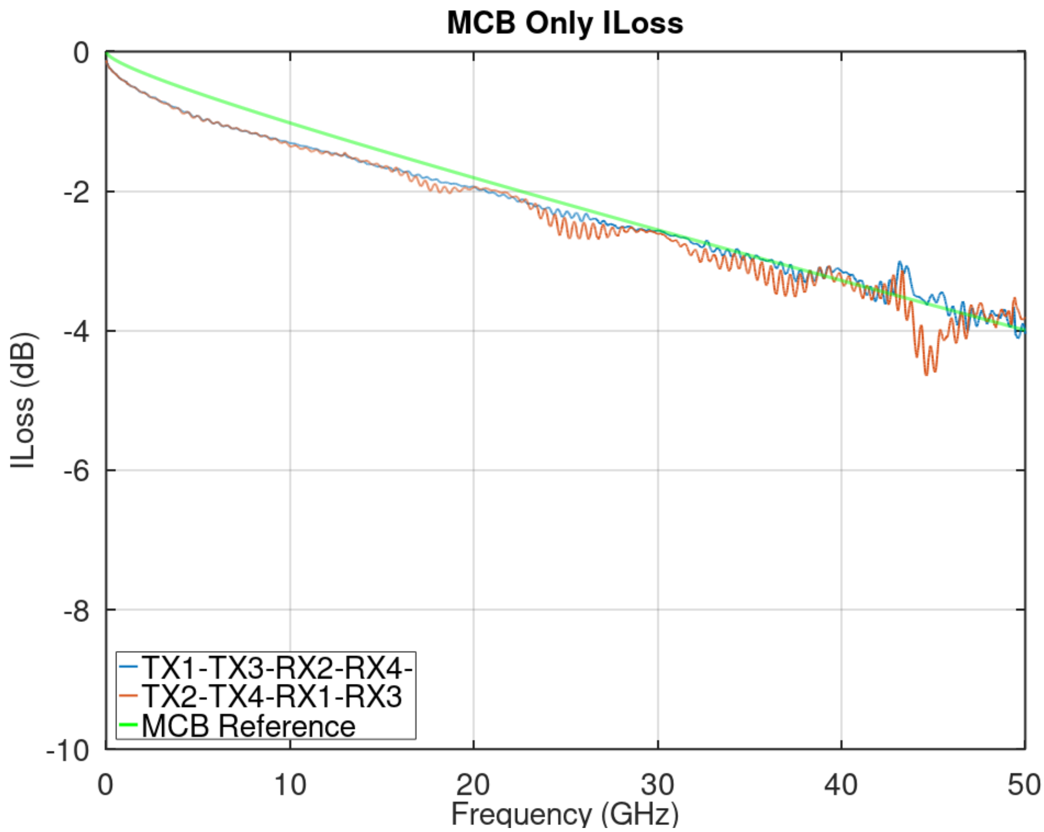

Figure 10. Plot of QSFP112 MCB Insertion Loss

The loss of the MCB up to but excluding the connector and its associated PCB pads is plotted in Figure 10. The loss at 28GHz is in table below. Note that the IEEE 802.3ck specification states that the difference between reference and HCB response should be accounted for in the measurement.

Table 7. MCB Insertion Loss at 28GHz

Channel Group	ILoss at 28GHz (dB)
TX1-TX3-RX2-RX4	-2.51769
TX2-TX4-RX1-RX3	-2.52891

Wilder QSFP112 Typical MTF Response

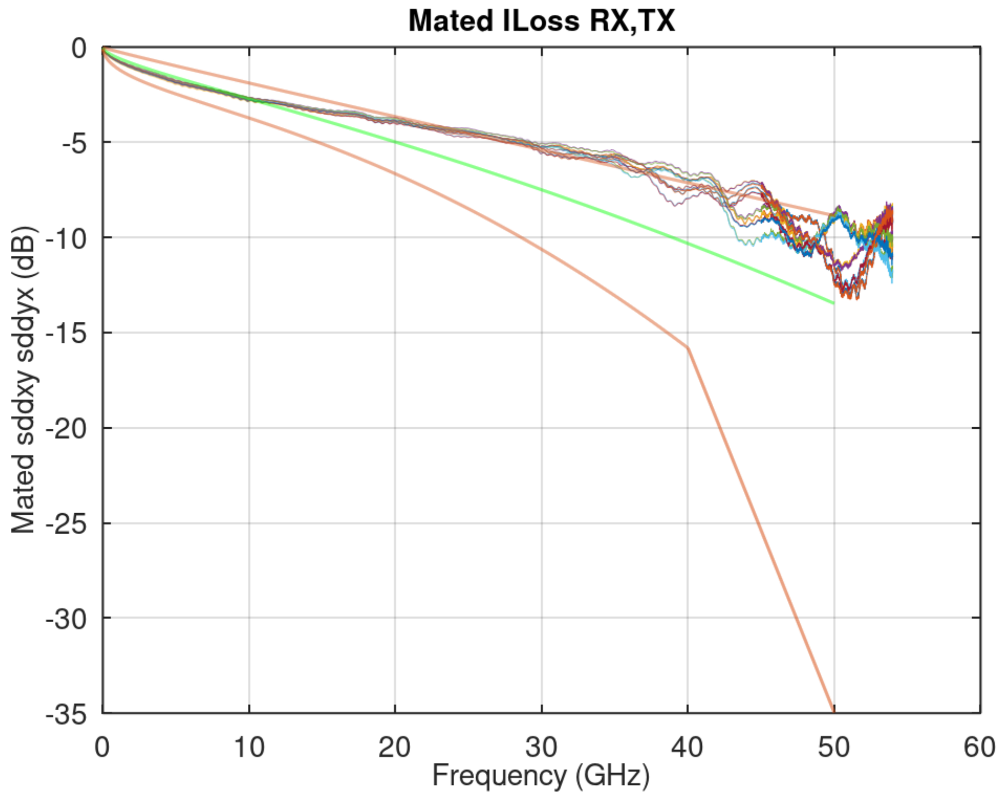

Figure 11. Plot of QSFP112 Mated Test Fixture Response (CK Limits)

MTF ILoss is plotted with 802.3ck limits and ILoss at 28GHz is in table below.

Table 8. MTF Insertion Loss at 28GHz

MTF Channel	SDD21 at 28GHz (dB)
RX1	-5.023894
RX2	-4.841596
RX3	-4.855801
RX4	-4.701814
TX1	-4.915523
TX2	-5.025526
TX3	-4.922724
TX4	-4.842816

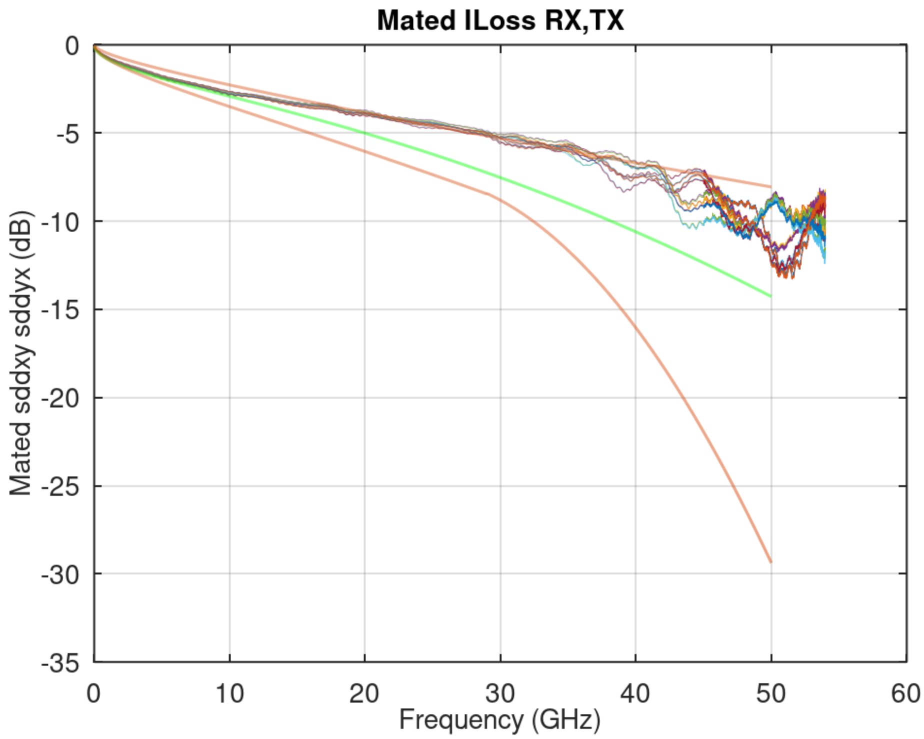

Figure 12. Plot of QSFP112 Mated Test Fixture Response (CK Limits)

MTF ILoss is plotted with OFI CEI VSR limits.

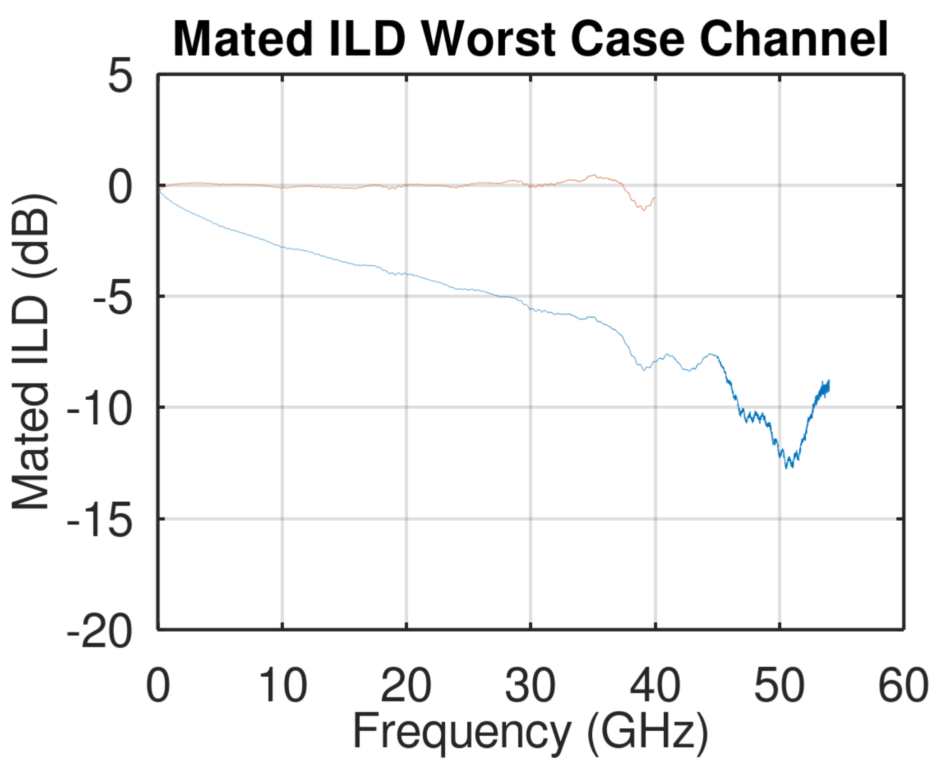

Figure 13. Plot of QSFP112 Mated Test Fixture Worst Case Response

Worst case FOM_ild is plotted in Figure 12 and typical results for all 8 channels are shown in the table below. FOM_ild below is calculated using IEEE 802.3ck and CEI VSR parameters.

Table 9. MTF FOM ild for CK and VSR

MTF Channel	FOM_ild CK Parameters (dB)	FOM_ild VSR Parameters (dB)
RX1	0.051247	0.053764
RX2	0.046095	0.047500
RX3	0.056748	0.059596
RX4	0.041030	0.042165
TX1	0.053772	0.055745
TX2	0.064166	0.067994
TX3	0.046879	0.048439
TX4	0.052922	0.056026

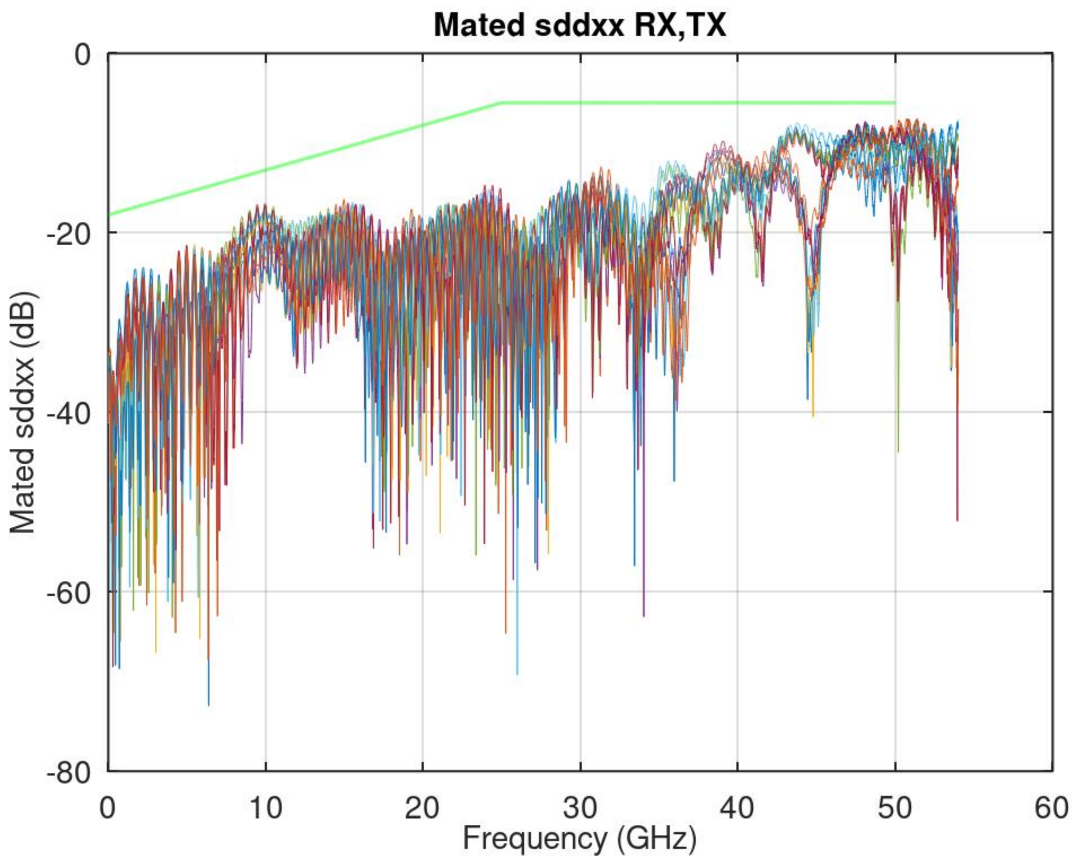

Figure 14. Plot of QSFP112 Mated Test Fixture Return Loss with Original 802.3ck Limits (Informative)

MTF RLoss is shown for information only.

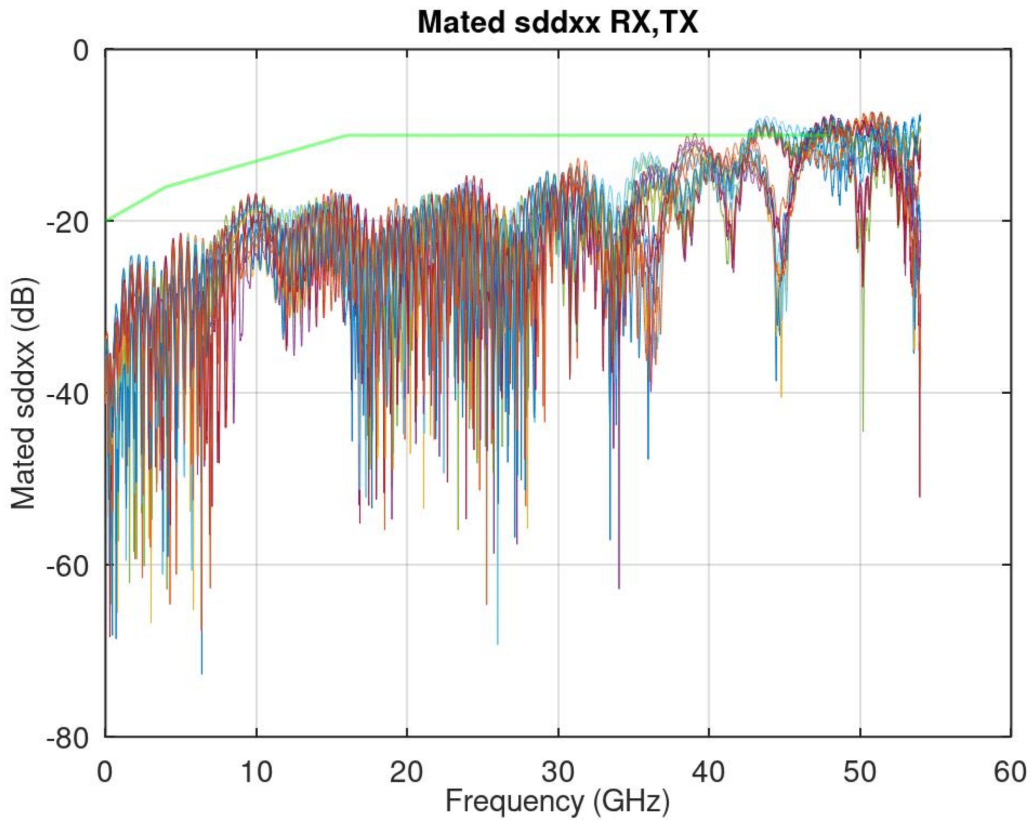

Figure 15. Plot of QSFP112 Mated Test Fixture Return Loss with Original CEI VSR Limit (Informative)

MTF RLoss is shown for information only.

The ERL numbers below are for all 8 measured channels for a typical mated fixture set and are calculated with no gating. ERL11 is from the HCB side. ERL22 is from the MCB side.

Table 10. ERL Numbers

	ERL11 (dB)	ERL22 (dB)	ERL (dB)	ERL Limit (dB)
RX1	15.7829	16.1431	15.7829	10.3
RX2	15.5457	15.5457	15.5457	
RX3	15.4012	16.2046	15.4012	
RX4	15.7456	15.983	15.7456	
TX1	15.5301	15.3706	15.3706	
TX2	15.2542	16.0104	15.2542	
TX3	16.5363	16.1822	16.1822	
TX4	15.6188	15.9448	15.6188	

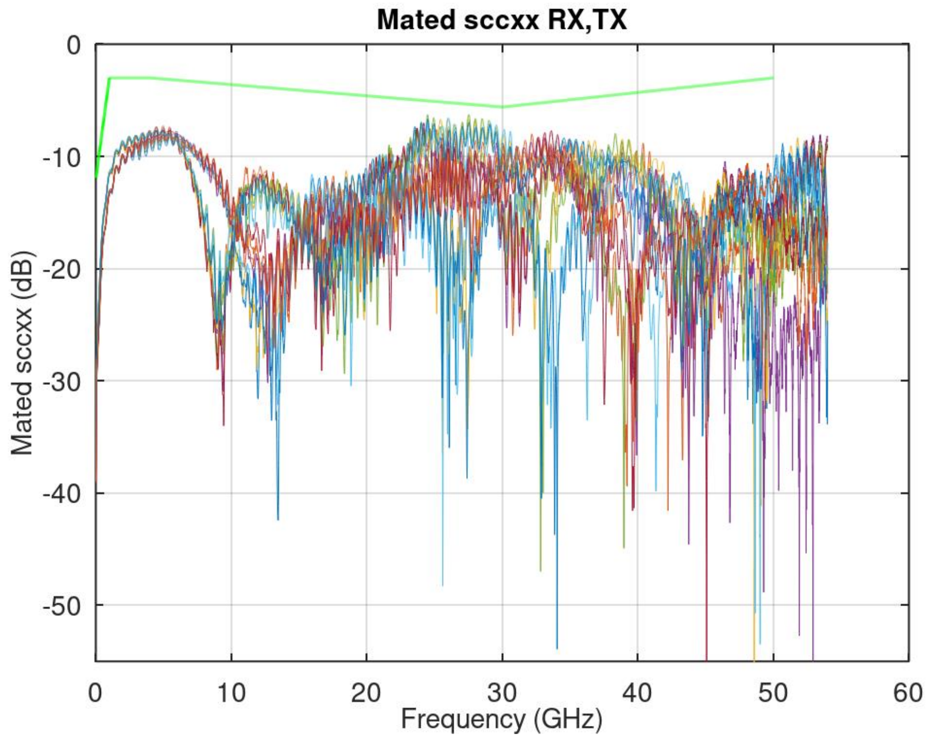

Figure 16. Plot of QSFP112 MTF Common Mode Return Loss with 802.3ck limit

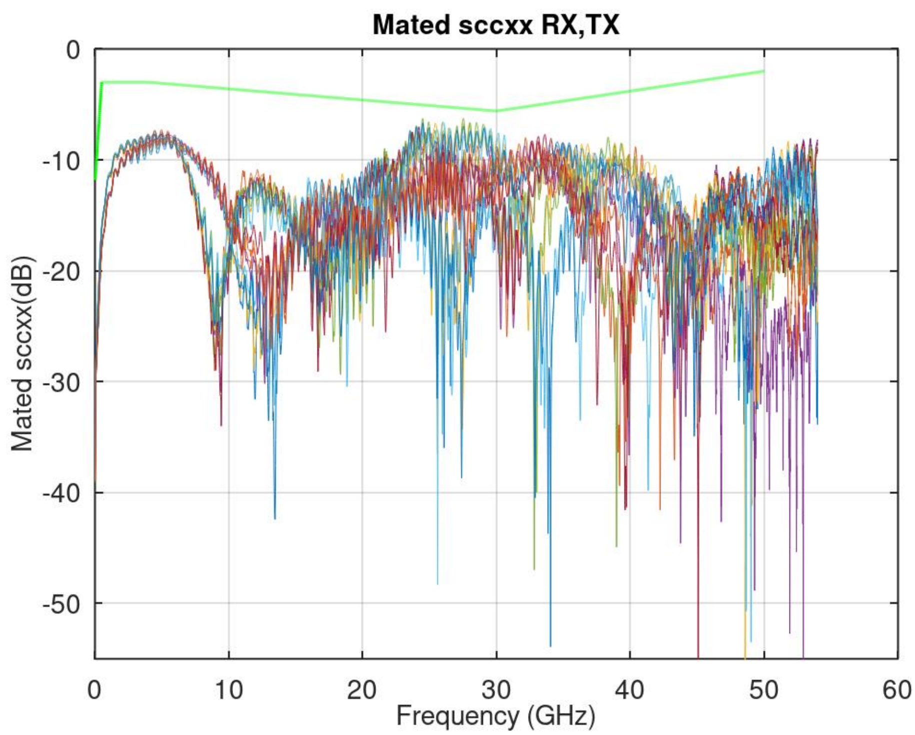

Figure 17. Plot of QSFP112 MTF Common Mode Return Loss with CEI VSR limit

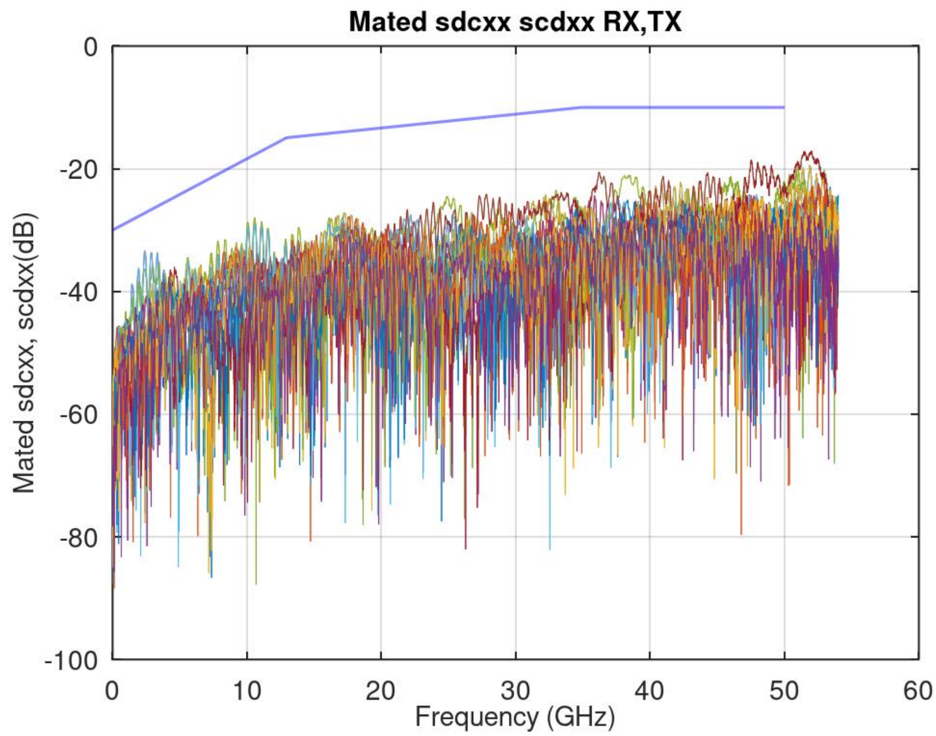

Figure 18. Plot of QSFP112 MTF Conversion Return Loss with 802.3ck Limit

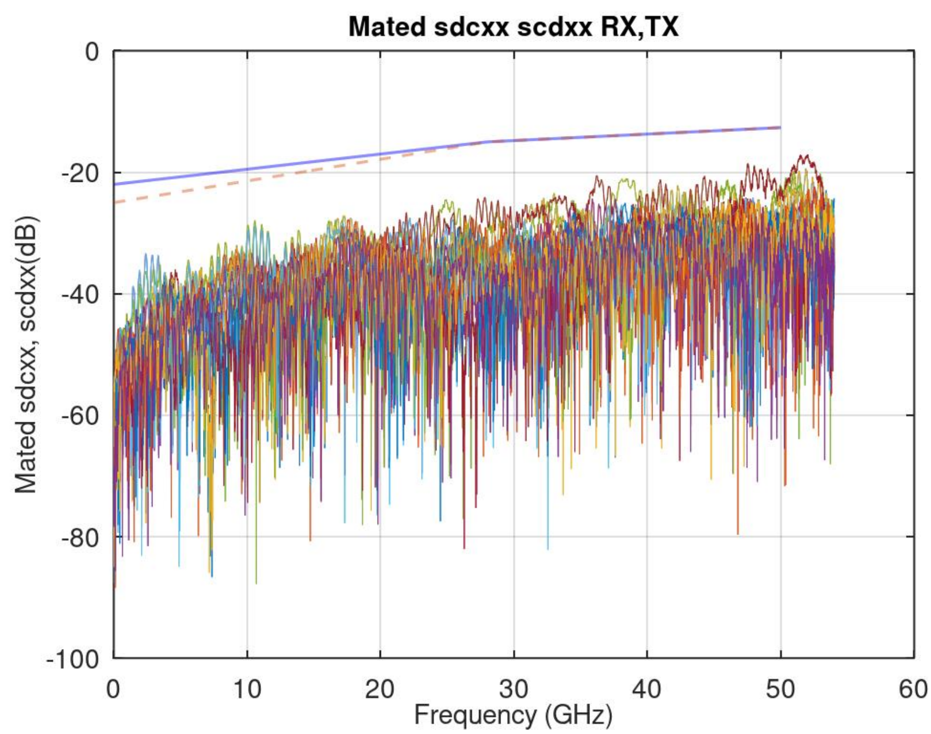

Figure 19. Plot of QSFP112 MTF Conversion Return Loss with CEI VSR Limit

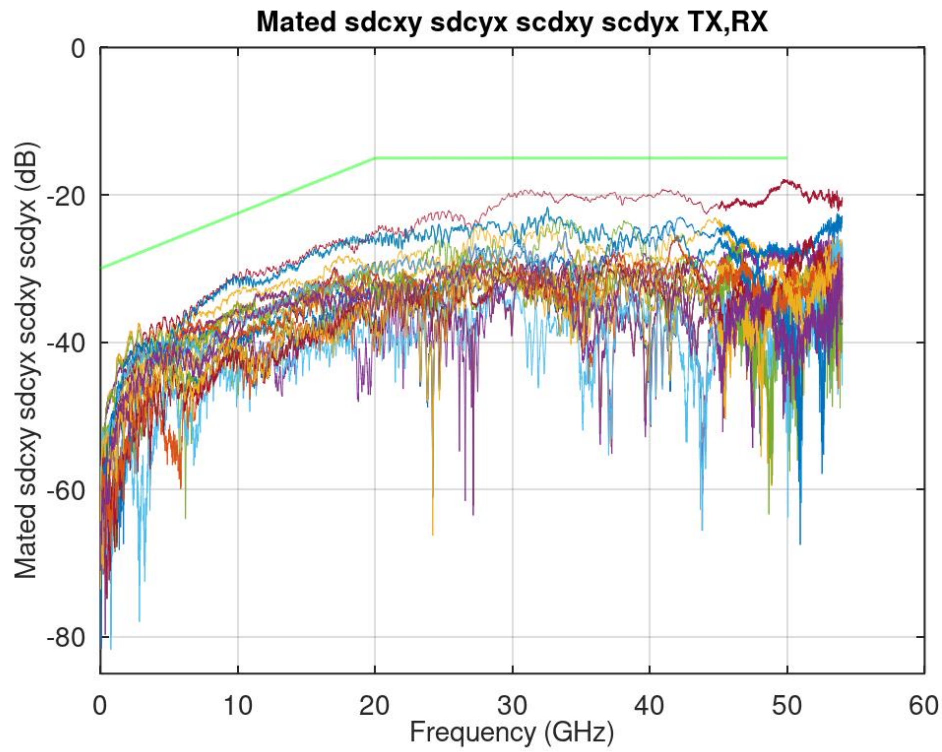

Figure 20. Plot of QSFP112 MTF Conversion Insertion Loss with 802.3ck and CEI VSR Limit

Wilder QSFP112 ICN

TX victim is on HCB side and aggressors for TX victim are TX1in-TX[n]in on MCB (excluding thru channel) and TX1in-TX[n]in on MCB which make up the FEXT and NEXT responses, respectively.

RX victim is on MCB side and aggressors for RX victim are RX1in-RX[n]in on HCB (excluding thru channel) and TX1in-TX[n]in on MCB which make up the FEXT and NEXT responses, respectively.

For each victim, all FEXT aggressors are power summed, and all NEXT aggressors are power summed then each are integrated as outlined in the CK and OIF specification. Both single valued integrated noise levels are then added RSS to give the total ICN value.

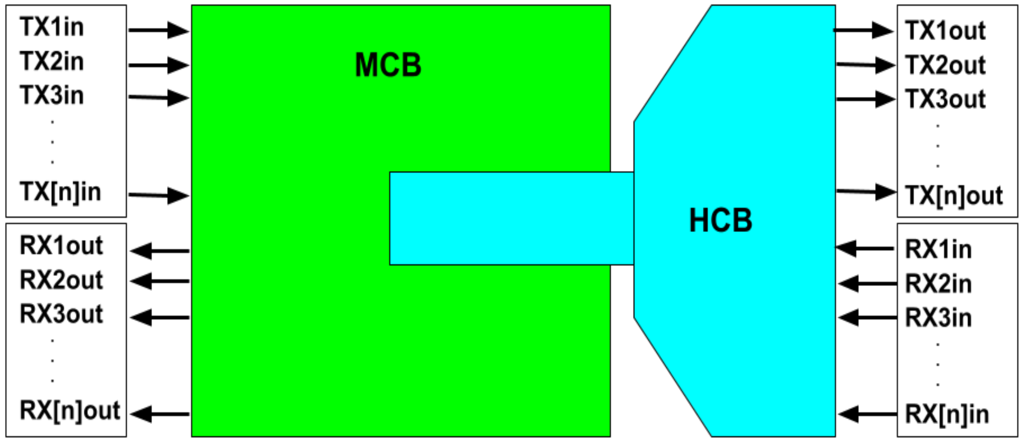

Figure 21. Diagram showing TX and RX Victim and Aggressors on QSFP112

Table 11. TX ICN Data (802.3ck)

ICN (mV) from TX FEXT	Victim (HCB) p=port1, n=port2			
Aggressor (MCB) p=port3, n=port4	TX1 (mV)	TX2 (mV)	TX3 (mV)	TX4 (mV)
TX1	NA	0.96404	1.233135	0.261874
TX2	0.758888	NA	0.322506	1.355585
TX3	2.34273	0.2885	NA	0.821831
TX4	0.318418	1.77684	0.678685	NA
TX MDFEXT	2.483079	2.04201	1.444038	1.606734

ICN (mV) from TX NEXT	Victim (HCB) p=port1, n=port2			
Aggressor (HCB) p=port1, n=port2	TX1 (mV)	TX2 (mV)	TX3 (mV)	TX4 (mV)
RX1	0.232375	0.27461	0.218098	0.184105
RX2	0.312266	0.18043	0.158756	0.165833
RX3	0.187132	0.19752	0.207999	0.258895
RX4	0.195373	0.21581	0.276362	0.281365
TX MDNEXT	0.474022	0.43995	0.438645	0.455618

TX ICN total (mV)	2.52792	2.08886	1.50919	1.670085

The table above is ICN data calculated as outlined in 802.3CK for the TX victim responses.

Note that each row represents an ICN value as each aggressor is added to the power sum.

The maximum required MDFEXT ICN is 4.2mV, maximum required MDNEXT ICN is 1.5mV, and the maximum required Total ICN is 4.4mV.

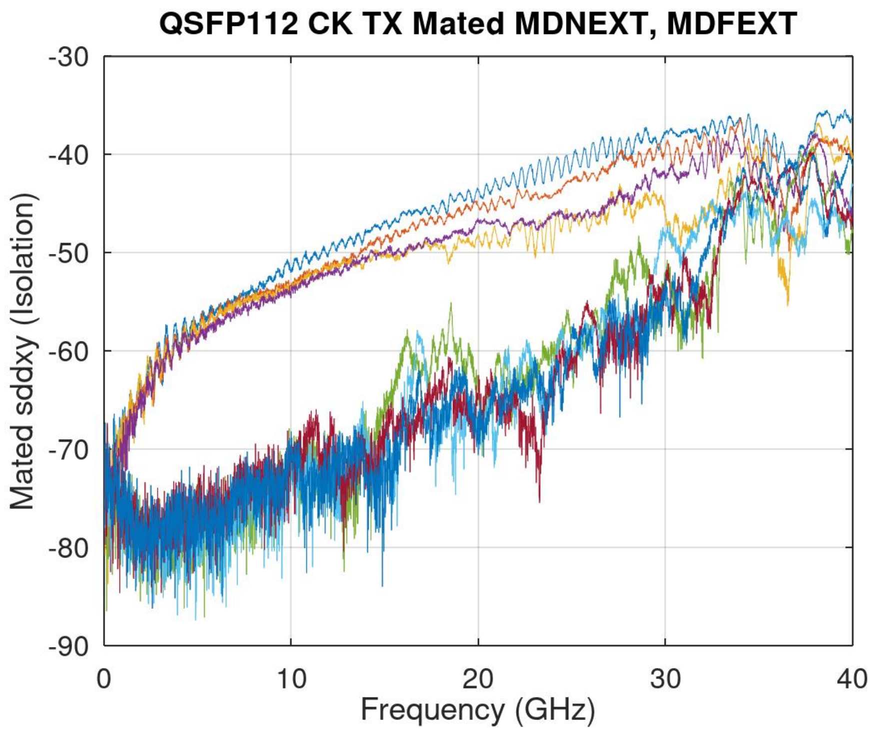

Figure 22. Plot of TX Victim Response to NEXT and FEXT

Table 12. RX ICN Data (802.3ck)

ICN (mV) from RX FEXT	Victim (MCB) p=port3, n=port4			
Aggressor (HCB) p=port1, n=port2	RX1 (mV)	RX2 (mV)	RX3 (mV)	RX4 (mV)
RX1	NA	0.95603	0.981493	0.273979
RX2	1.061877	NA	0.435298	1.513691
RX3	1.623163	0.42185	NA	0.842678
RX4	0.236331	2.05409	0.693327	NA
RX MDFEXT	1.953994	2.30461	1.278091	1.753976

ICN (mV) from RX NEXT	Victim (HCB) p=port1, n=port2			
Aggressor (HCB) p=port1, n=port2	RX1 (mV)	RX2 (mV)	RX3 (mV)	RX4 (mV)
TX1	0.282924	0.27435	0.294969	0.233848
TX2	0.316544	0.2029	0.240115	0.178346
TX3	0.178508	0.14981	0.275529	0.17853
TX4	0.16823	0.15173	0.266856	0.177094
RX MDNEXT	0.490319	0.40237	0.540177	0.386946

RX ICN total (mV)	2.014573	2.33947	1.387554	1.796151

The table above is ICN data calculated as outlined in 802.3CK for the RX victim responses.

Note that each row represents an ICN value as each aggressor is added to the power sum.

The maximum required MDFEXT ICN is 4.2mV, maximum required MDNEXT ICN is 1.5mV, and the maximum required Total ICN is 4.4mV.

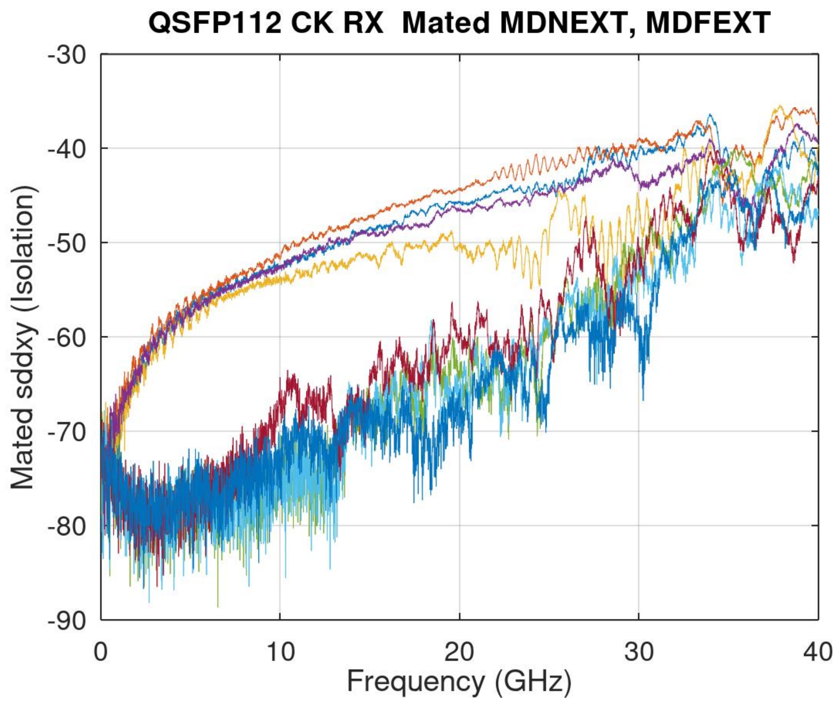

Figure 23. Plot of RX Victim Response to NEXT and FEXT

Table 13. TX ICN Data (CEI VSR)

ICN (mV) from TX FEXT	Victim (HCB) p=port1, n=port2			
Aggressor (MCB) p=port3, n=port4	TX1 (mV)	TX2 (mV)	TX3 (mV)	TX4 (mV)
TX1	NA	0.755807	0.9588	0.232752
TX2	0.5953	NA	0.279624	1.065633
TX3	1.84681	0.23258	NA	0.638973
TX4	0.275034	1.39083	0.520188	NA
TX MDFEXT	1.959779	1.599921	1.126092	1.264134

ICN (mV) from TX NEXT	Victim (HCB) p=port1, n=port2			
Aggressor (HCB) p=port1, n=port2	TX1 (mV)	TX2 (mV)	TX3 (mV)	TX4 (mV)
RX1	0.211216	0.245496	0.20502	0.182366
RX2	0.264172	0.159653	0.149154	0.161493
RX3	0.172713	0.192799	0.201089	0.228102
RX4	0.177452	0.194489	0.242323	0.262331
TX MDNEXT	0.419188	0.400943	0.404274	0.424483

TX ICN total (mV)	2.004109	1.649394	1.196462	1.333499

The table above is ICN data calculated as outlined in CEI VSR for the TX victim responses.

Note that each row represents an ICN value as each aggressor is added to the power sum.

The maximum required MDFEXT ICN is 3.6mV, maximum required MDNEXT ICN is 1.35mV, and the maximum required Total ICN is 3.85mV.

Table 14. RX ICN Data (CEI VSR)

ICN (mV) from RX FEXT	Victim (MCB) p=port3, n=port4			
Aggressor (HCB) p=port1, n=port2	RX1 (mV)	RX2 (mV)	RX3 (mV)	RX4 (mV)
RX1	NA	0.734105	0.775318	0.243392
RX2	0.826104	NA	0.385061	1.180457
RX3	1.264902	0.337647	NA	0.645212
RX4	0.203591	1.612495	0.539336	NA
RX MDFEXT	1.524426	1.803623	1.019938	1.36712

ICN (mV) from RX NEXT	Victim (HCB) p=port1, n=port2			
Aggressor (HCB) p=port1, n=port2	RX1 (mV)	RX2 (mV)	RX3 (mV)	RX4 (mV)
TX1	0.248593	0.253245	0.254683	0.21888
TX2	0.290601	0.174059	0.19602	0.156848
TX3	0.16816	0.131644	0.242662	0.155873
TX4	0.154043	0.139974	0.226558	0.184297
RX MDNEXT	0.445258	0.362426	0.462061	0.361624

RX ICN total (mV)	1.588121	1.839677	1.11972	1.414139

The table above is ICN data calculated as outlined in CEI VSR for the RX victim responses.

Note that each row represents an ICN value as each aggressor is added to the power sum.

The maximum required MDFEXT ICN is 3.6mV, maximum required MDNEXT ICN is 1.35mV, and the maximum required Total ICN is 3.85mV.

Compliance with Environmental Legislation

Wilder Technologies, LLC, is dedicated to complying with the requirements of all applicable environmental legislation and regulations, including appropriate recycling and/or disposal of our products.

WEEE Compliance Statement

The European Union adopted Directive 2002/96/EC on Waste Electrical and Electronic Equipment (WEEE), with requirements that went into effect August 13, 2005. WEEE is intended to reduce the disposal of waste from electrical and electronic equipment by establishing guidelines for prevention, reuse, recycling, and recovery.

Wilder Technologies has practices and processes in place to conform to the requirements in this important Directive.

In support of our environmental goals, effective January 1st, 2009 Wilder Technologies, LLC has partnered with EG Metals Inc. – Metal and Electronics Recycling of Hillsboro, Oregon, www.egmetalrecycling.com, to recycle our obsolete and electronic waste in accordance with the European Union Directive 2002/96/EC on waste electrical and electronic equipment ("WEEE Directive").

As a service to our customers, Wilder Technologies is also available for managing the proper recycling and/or disposal of all Wilder Technologies products that have reached the end of their useful life. For further information and return instructions, contact support@wilder-tech.com.

Compliance To RoHS 2 Substance Restrictions

Wilder Technologies, LLC certifies that the parts described in this document are compliant to the substance restrictions of Directive 2011/65/EU and Amendment Directive (EU) 2015/863 of the European Parliament, and of the Council of 8 June, 2011 and 31 March, 2015 on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS 2 Directive), prohibiting the use in homogeneous materials in excess of the listed maximum concentration value, except in cases where use is allowed by applicable exemptions listed in Annex III and Annex IV of the Directive.

Compliance with RoHS 2 has been verified through internal controls at design and production sites, including establishment of processes for specifying and controlling materials and segregation of non-compliant parts, receipt of supplier declarations of compliance and/or analytical test.

Glossary of Terms

TERMINOLOGY	DEFINITION
Aggressor	A signal imposed on a system (i.e., cable assembly) to measure response on other signal carriers.
Decibel (dB)	Ten times the common logarithm (i.e. log10) of the ratio of relative powers.
Far-end crosstalk or FEXT	Crosstalk that is propagated in a disturbed channel in the same direction as the propagation of a signal in the aggressor channel. The terminals of the aggressor channel and the victim channel are usually close to each other.
Informative	The designation of a test that is not required for compliance.
Insertion loss	The ratio, expressed in dB, of incident power to delivered power.
Near-end crosstalk or NEXT	Crosstalk that is propagated in a disturbed channel in the opposite direction as the propagation of a signal in the aggressor channel. The terminals of the aggressor channel and the victim channel are usually close to each other.
Normative	The designation of a test that is required for compliance.
Return Loss	The ratio, expressed in dB, of incident power to reflected power.
QSFP112	100 Gbps 4X Pluggable Transceiver (High-Density Quad Small Form Factor Pluggable)
QSFP112 Host	The QSFP112 Host is the fixed end of the connection supporting IEEE 802.3.
QSFP112 Module	The QSFP112 Module is the moveable end of the connection supporting IEEE 802.3.
QSFP112 TPA	QSFP112 Test Point Access. A specialized assembly that interfaces to a QSFP112 host or module and enables access of signals for measurement or stimulation.
Victim	A signal carrier on a system that has a response imposed on it by other signals in the system.

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Visit our website at www.wilder-tech.com

Wilder Technologies, LLC
11201 NE 9th St.
Vancouver WA, 98684
Phone: 360-859-3041
Fax: 360-859-3105
www.wilder-tech.com

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