

# CoRx

## AUTOMATED COHERENT RECEIVER TESTER

### USER MANUAL



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### **Units of Measurement**

Units of measurement in this publication conform to SI standards and practices.

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## 1 Conventions

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Before using the instruments described in this document, take note of the following conventions:

### **WARNING**

Indicates a potentially hazardous situation which, if not avoided, could result in **death or serious injury**. Do not proceed unless the required conditions are met and understood.

### **CAUTION**

Indicates a potentially hazardous situation which, if not avoided, may result in **minor or moderate injury**. Do not proceed unless the required conditions are met and understood.

### **CAUTION**

Indicates a potentially hazardous situation which, if not avoided, may result in **component damage**. Do not proceed unless the required conditions are met and understood.

### **IMPORTANT**

Refers to information about this module that you should not overlook.

### **NOTE**

Indicates some information that requires your attention or some extra information for the current topic.

## 2 Safety information

Before using the CoRx Tester, ensure that the following safety information has been read and understood.

### 2.1 Optical laser radiation precautions



#### ⚠ WARNING

**Do not install or terminate fibers while the light source is active.** Care must be taken to ensure that the instrument has been **turned OFF before inspecting the end face(s) of the instrument, or any optical patch cords** connected to this instrument. Never look directly into a live fiber; ensure that your eyes are protected at all times.

#### ⚠ CAUTION

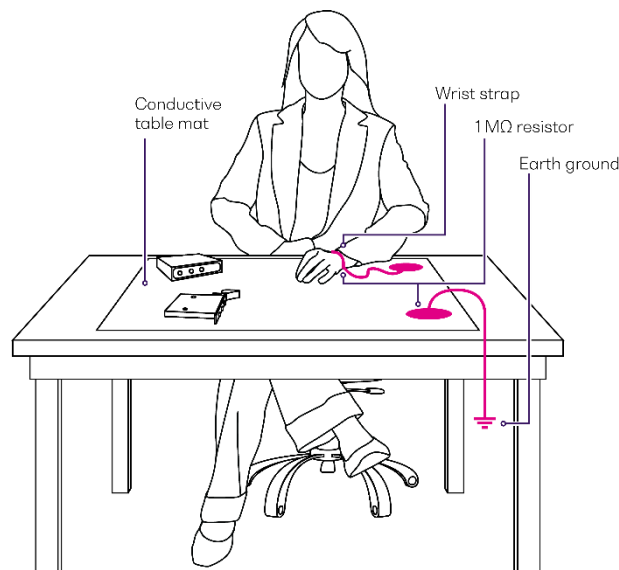
The use of controls, adjustments, and procedures other than those specified herein may result in exposure to hazardous situations involving optical radiation.

### 2.2 Electrostatic discharge precautions

#### ⚠ CAUTION


The CoRx Tester expansion modules are sensitive to electrostatic discharge (ESD). Store the unused instrument in the original protective electrostatic packaging that the CoRx Tester expansion modules were shipped in.

Ensure that a wrist strap and grounding table mat is used when unpacking or handling the CoRx Tester expansion modules. Proper grounding and ESD management practices should always be followed to ensure that no ESD damage is caused to the instrument.



## 2.3 Electromagnetic compatibility

### CAUTION

- For electromagnetic compatibility, this instrument is a **Class A** product. It is intended for use in an industrial environment. There may be potential difficulties in ensuring electromagnetic compatibility in other environments, due to conducted as well as radiated disturbances.
- Wherever the  symbol is printed on the unit, refer to the instructions provided in the device documentation for related safety information. Ensure that the required conditions are met and understood before using the product.

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## 3 Connecting optical fibers

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### CAUTION

To ensure maximum power and to avoid erroneous readings always inspect fiber end faces. Make sure they are cleaned as detailed below before inserting into any port. **Quantifi Photonics is not responsible for damage or errors caused by bad fiber cleaning or handling.**

### IMPORTANT

The type of optical connectors on the CoRx Tester expansion modules can be found printed on the front plate of the expansion modules. **Joining mismatched connectors will damage the ferrules and fibre faces.**

To keep connectors clean and in good condition, Quantifi Photonics strongly recommends inspection with a fiber inspection probe before connecting them. Failure to do so will result in permanent damage to the connectors and degradation of future measurements.

Quantifi Photonics uses high quality connectors in compliance with EIA-455-21A standards.

### 3.1 Cleaning and connecting optical fibers

**To connect the fiber-optic cable to the port:**

1. Inspect the fiber using a fiber inspection microscope. If the fiber is clean, proceed to connect it to the desired port.
2. If the fiber is dirty, clean it as detailed below.
3. Gently wipe the fiber end with a lint-free swab dipped in isopropyl alcohol.
4. Use compressed air to dry completely.
5. Visually inspect the fiber end to ensure its cleanliness.
6. Carefully align the connector and port to prevent the fiber end from touching the outside of the port or rubbing against other surfaces. If the connector features a key, ensure that it is correctly mated into the corresponding notch of the port bulkhead.
7. Push the connector in so that the fiber-optic cable is firmly in place, thus ensuring adequate contact. If your connector features a screw sleeve, tighten the connector enough to firmly maintain the fiber in place. **Do not over tighten, as this will damage the fiber and the port bulkhead.**

### NOTE

If your fiber-optic cable is not properly aligned and/or connected, you will notice large signal loss and reflection.

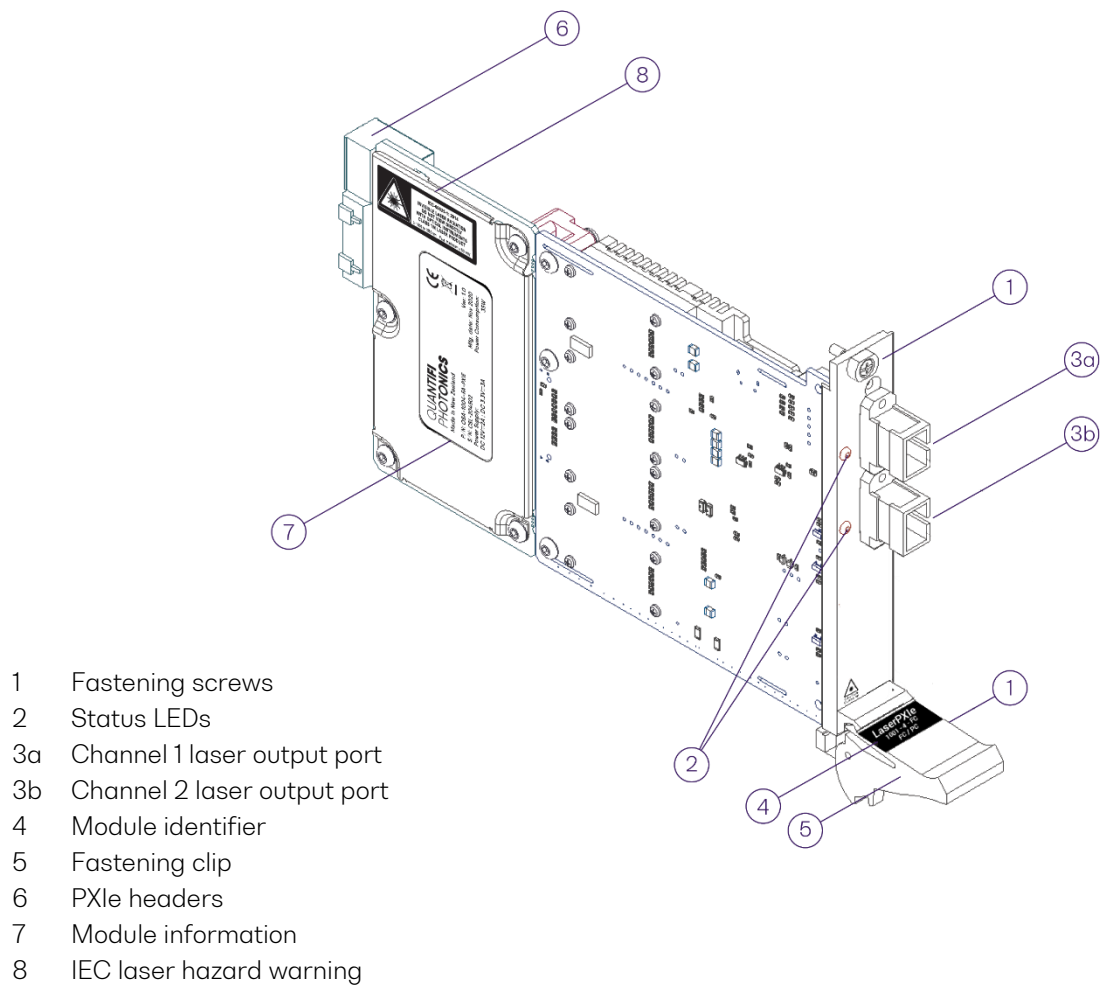


## 4 Introducing the CoRx Tester

The CoRx Tester provides automated measurement of key coherent receiver performance parameters. The CoRx Tester is comprised of a pre-configured PXIe chassis, a two channel Laser PXIe module, a Pol (Polarization Controller) PXIe module and a VOA (Variable Optical Attenuator) PXIe module with built-in power meter, making the CoRx Tester a flexible and versatile tool for any environment.

### 4.1 CoRx Tester expansion modules overview & features

#### 4.1.1 Laser-1002-2-FA-PXIe module

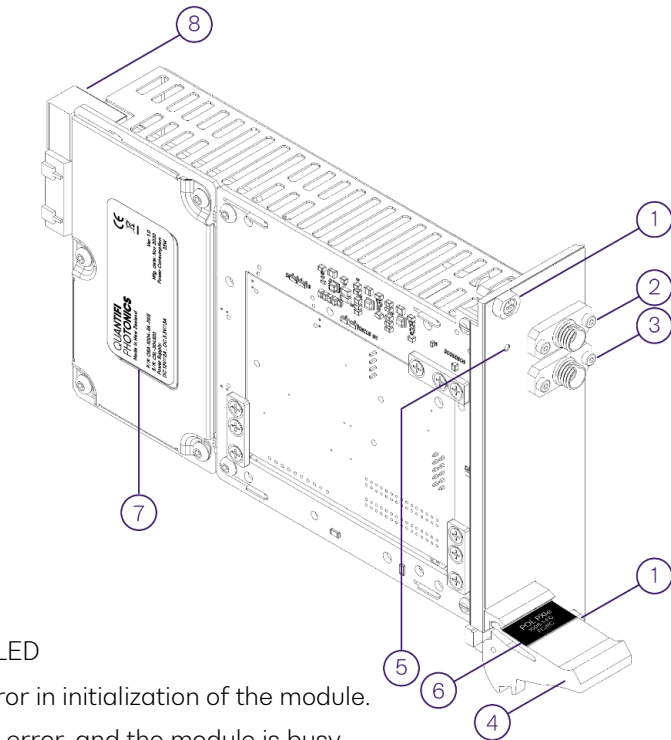


##### 4.1.1.1 Laser-1002-2-FA-PXIe module status LEDs

- **Off** - Indicates that the laser is **DISABLED**.
- **Solid red** - Indicates that the laser is **ENABLED**. Do not look into or inspect the fiber when the source is active.
- **Blinking red** - Indicates initialization of the module during startup. If blinking persists for more than a few seconds, it indicates an error was registered.

#### 4.1.2 Pol-1001-1-FA-PXle module

- 1 Fastening screws
- 2 Optical input port
- 3 Optical output port
- 4 Fastening clip
- 5 Status LED
- 6 Module identifier
- 7 Module information
- 8 PXle headers

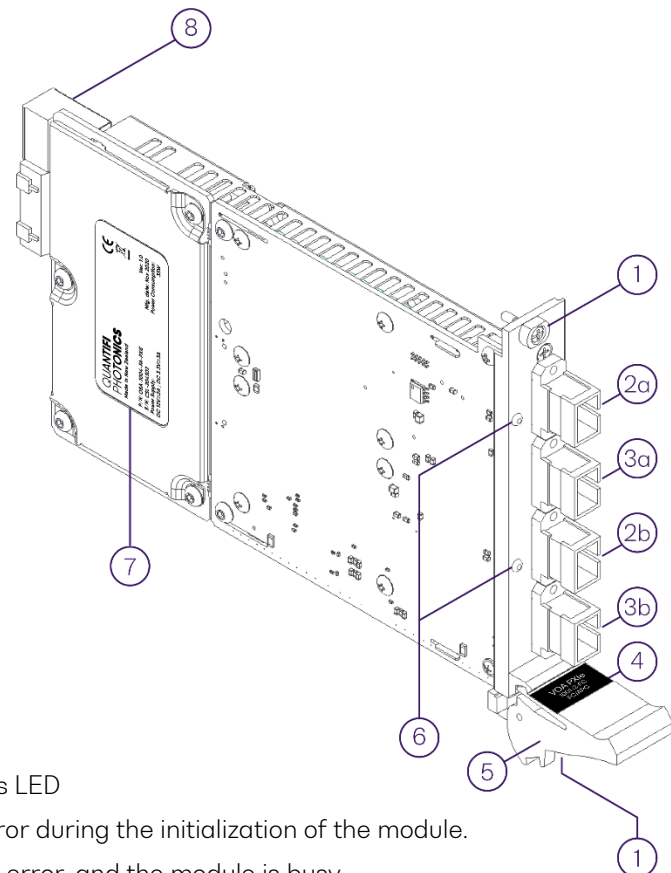


##### 4.1.2.1 Pol-1001-1-FA-PXle module status LED

- **Solid red** – Indicates that there is an error in initialization of the module.
- **Blinking red** – Indicates that there is an error, and the module is busy.
- **Solid green** – Indicates that the module is operational.
- **Blinking green** – Indicates that initialization was successful, and the module is busy.

#### 4.1.3 VOA-1301-2-FA-PXle module

- 1 Fastening screws
- 2a Channel 1 optical input port
- 2b Channel 2 optical input port
- 3a Channel 1 optical output port
- 3b Channel 2 optical output port
- 4 Module identifier
- 5 Fastening clip
- 6 Status LEDs
- 7 Module information
- 8 PXle headers



##### 4.1.3.1 VOA-1301-2-FA-PXle module status LED

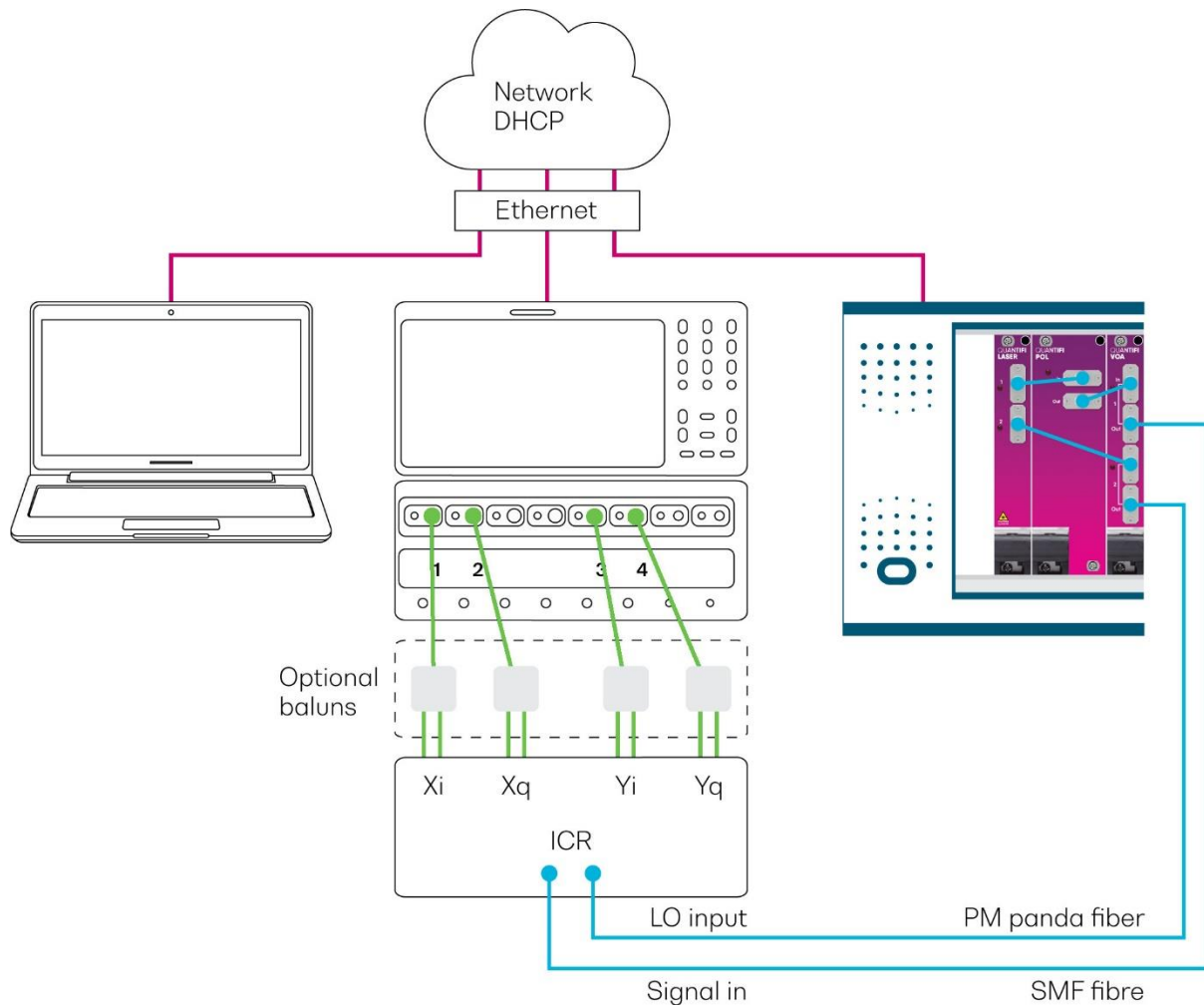
- **Solid red** – Indicates that there is an error during the initialization of the module.
- **Blinking red** – Indicates that there is an error, and the module is busy.
- **Solid green** – Indicates that the module is operational.
- **Blinking green** – Indicates that initialization was successful, and the module is busy.

## 5 Connecting the hardware

### ⚠ CAUTION

- Do not remove the CoRx Tester expansion modules from the antistatic packaging until instructed during the following installation procedure.
- The CoRx Tester expansion modules are sensitive to ESD. Ensure you are wearing a grounded wrist strap at all times when handling the CoRx Tester expansion modules to prevent damage from electrostatic discharge.**
- Take care not to handle the optical connectors on the modules, as once they are exposed to skin contact this may leave corrosive residue and damage the connector.

Please follow the diagram below to connect the CoRx Tester expansion modules to the Hardware.



### ⚠ IMPORTANT

After powering on the PXIe chassis, please wait at least **2 minutes** before attempting to communicate with the modules. This will allow the chassis enough time to finish boot procedures and initialize the communication server.

## 6 Software installation

### ⚠ IMPORTANT

The software must be installed on the PXIe controller for the PXIe Chassis in which the Quantifi Photonics modules will be installed, or the controller PC in the case of a MXI setup.

**Minimum System Requirements:** 64-bit OS, Windows 10 or above.

**Software Version Requirements:** CoRx Tester v2.00 or above.

**Free Hard Disk Space:** 1 GB.

**Communication Port:** USB 2.0 (Ethernet and USB 2.0 recommended)

### 6.1 Keysight IO Libraries Suite

The CoRx Tester software uses the Keysight Connection Expert to manage the VISA (SCPI) clients. This VISA software must be installed for the CoRx Tester software to function. The Keysight connection Expert installer is located on the media USB drive provided with the hardware.

Execute the *IOLibSuite\_18\_1\_23218.exe* installer and follow the instructions provided.

When installed, run the *Keysight Connection Expert 2020* from the tray icon and click on the '+Add' button to add the PXIe controller and the real-time oscilloscope as new LAN instruments. These will automatically be detected and listed as 'Discovered instruments on the subnet'. If not found, please manually enter the IP address of the VXI-11 instrument. Once the instruments are successfully added, please keep the Keysight Connection Expert running in the background.

### 6.2 CoRx Tester installer

Located on the media USB drive provided with the hardware you will find the CoRx Tester installer *coRxTester\_v2.XX\_mcr.exe*.

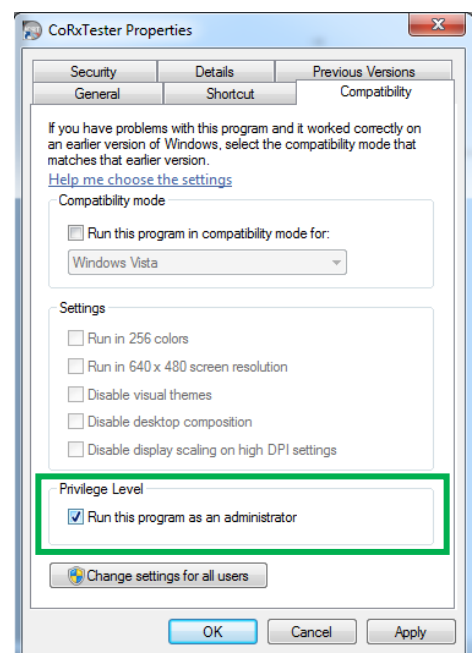
Execute the installer and follow the instructions provided. The installer will also install a MATLAB runtime engine required for the software to function properly.

### 6.3 Configure the CoRx Tester software

The CoRx Tester software must run in an Administrator Mode to function properly.

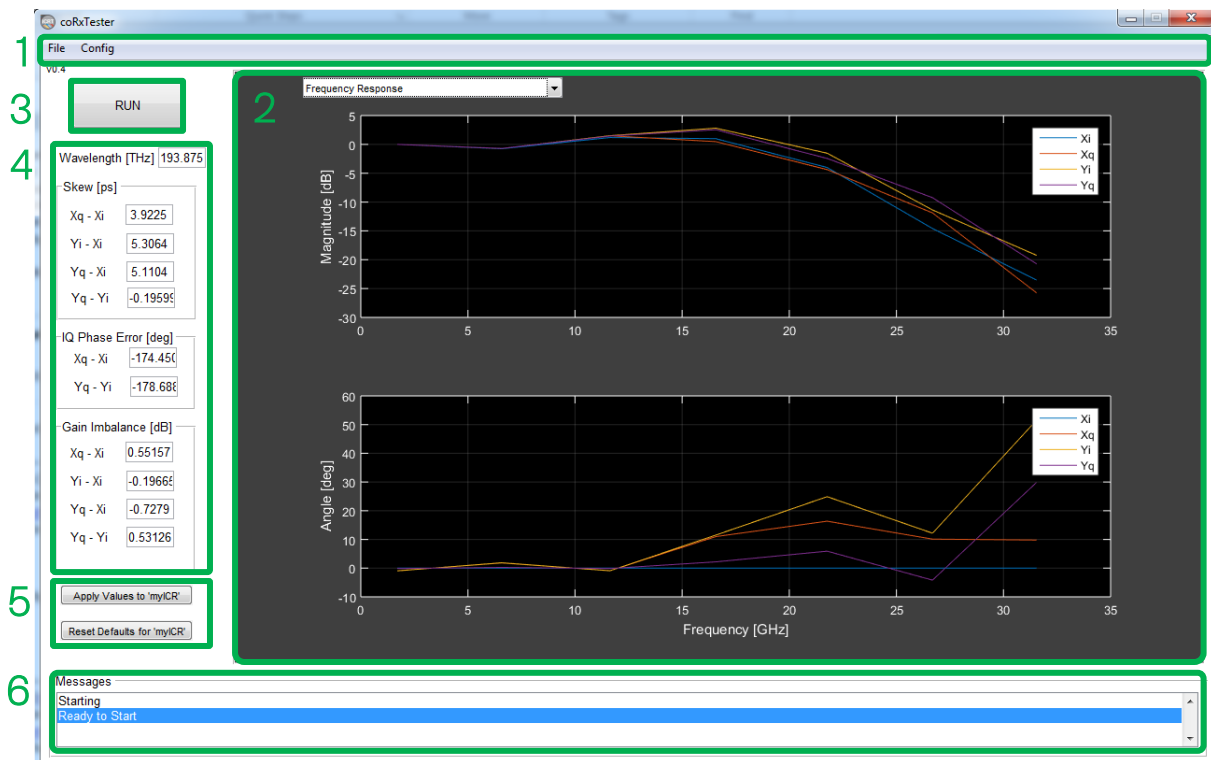
Follow the steps below to configure the Administrator Mode:

1. Locate the CoRx Tester software in the Windows Start Menu.
2. Right click on the CoRx Tester software and select the Properties tab.
3. Open the Compatibility tab and check-mark the 'Run this Program as Administrator' check box.
4. Click on the 'Change settings for all users' button.
5. Click on the 'OK' button to apply the changes and finish the configuration.



## 7 Using the CoRx Tester software

### 7.1 Main screen layout



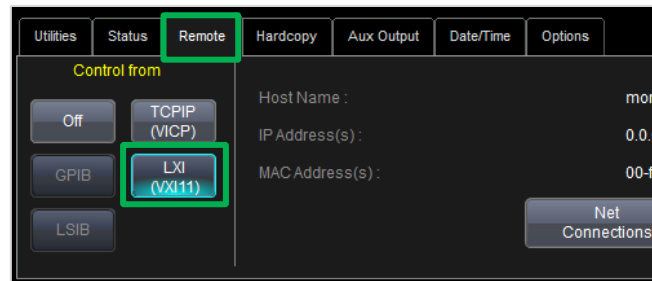
1. **Toolbar:** A menu that enables saving results and configuring the measurements.
2. **Plot window:** Toggle between the various visual displays of the measurements results.
3. **Run button:** Clicking the button starts the measurements. Depending on the configuration, this process can take between 1 to 10 minutes.
4. **Results:** A summary display of the key coherent-receiver parameters results.
5. **myICR: buttons:** Click the Apply button to set the calibration data, or Reset to clear the data.
6. **Messages:** The status results messages.

## 7.2 Instrument configuration

### ⚠ IMPORTANT

For Lecroy oscilloscopes, the remote mode must be in LXI (VXI11) mode.

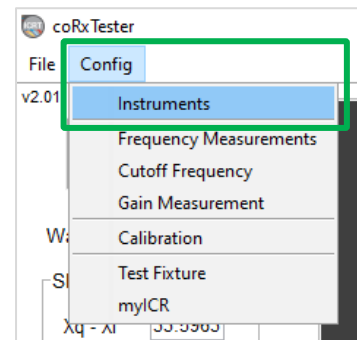
Click on the Support button in the Scope toolbar and select About, then open the Remote tab and change the 'Control from' setting.



The PXIe chassis and the oscilloscope must be configured in the CoRx Tester software.

Follow the steps below to configure the instrument:

1. Click on the Config button in the CoRx Tester software toolbar and then select the Instruments configuration button.



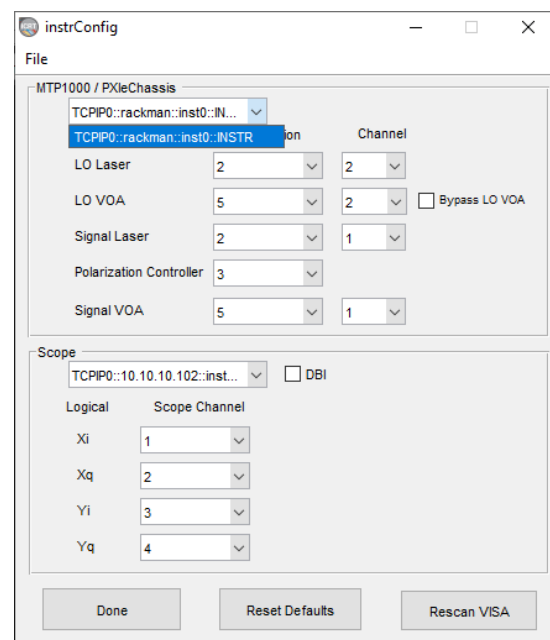
2. The Instruments configuration window will appear.

The drop-down lists show the VISA IP address of the PXIe chassis and the oscilloscope IP address, respectively.

The IP addresses are obtained automatically from the Keysight Connection Expert. If the instruments of interest are not located in the drop-down lists, click on the Rescan VISA button to refresh the list.

The PXIe chassis configuration matches the recommended configuration (slot positions and channel numbers) as described in section 5 - Connecting the hardware.

The scope channels must be mapped to the coherent-receiver Logical channels.

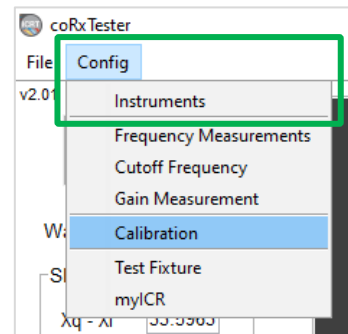


### 7.3 Calibrating frequency offsets

It is strongly recommended to calibrate the frequency offset between the two lasers in the CoRx Tester.

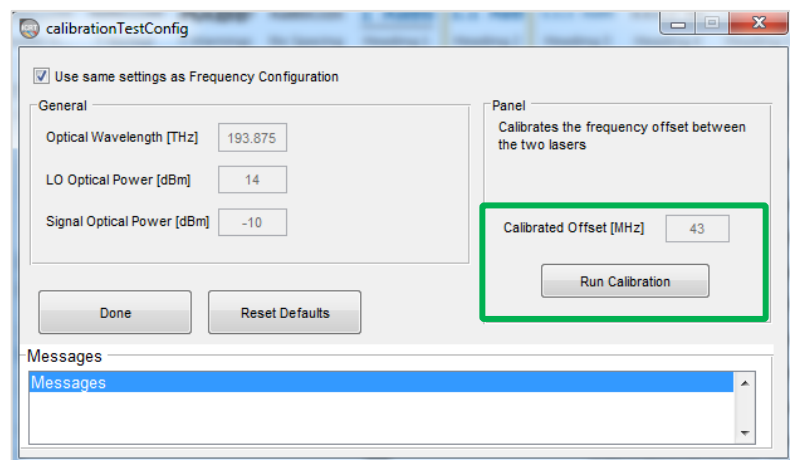
Follow the steps below to calibrate the lasers:

1. Click on the Config button in the CoRx Tester software toolbar and then select the Calibration configuration button.



2. Click on the Run Calibration button.

Once the calibration has completed, the results will be displayed in the Calibrated Offset [MHz] field above the button.

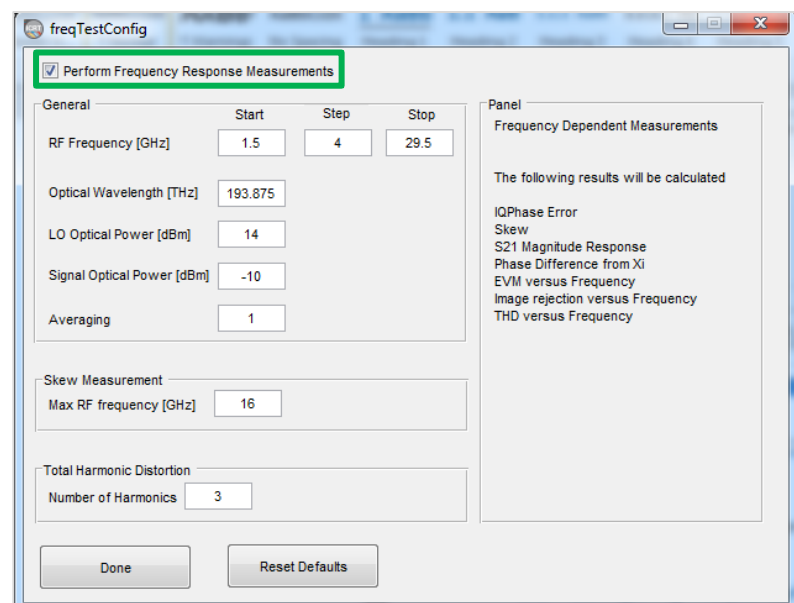


### 7.4 Configuring frequency measurements

The Frequency Response Measurement performs a single frequency sweep of the LO laser, and calculates the following measurements:

1. IQPhase error
2. Skew
3. S21 magnitude versus frequency
4. S21 phase difference
5. EVM versus frequency
6. Image rejection versus frequency
7. Total Harmonic Distortion versus frequency

To activate the Frequency Response Measurement, click the tick-mark box in the top ribbon.



#### 7.4.1 General frequency settings

- **RF Frequency [GHz]:** The frequency range of the measurement.
  - The recommended start frequency is > 500 MHz. For frequency response lower than 500 MHz, please use the cutoff frequency measurement.
  - The Stop frequency must be less than the bandwidth of the oscilloscope in use.
- **Optical Wavelength [THz]:** The optical wavelength for the measurement.
- **LO Optical Power [dBm]:** The desired optical power of the Local Oscillator input to the coherent receiver. The optical power can be set from -30 dBm to 14.5 dBm.
- **Signal Optical Power [dBm]:** The desired optical power of the signal input to the coherent receiver. The optical power can be set from -30 dBm to 14.5 dBm.
- **Averaging:** A point-to-point average can be applied to the measurement. Increasing the averaging increases the measurement time.

#### 7.4.2 Skew measurement settings

- **Max FR Frequency [GHz]:** The skew is calculated from a linear fit of the phase versus frequency data. The frequency range of the fit can be controlled by changing the Max RF frequency.

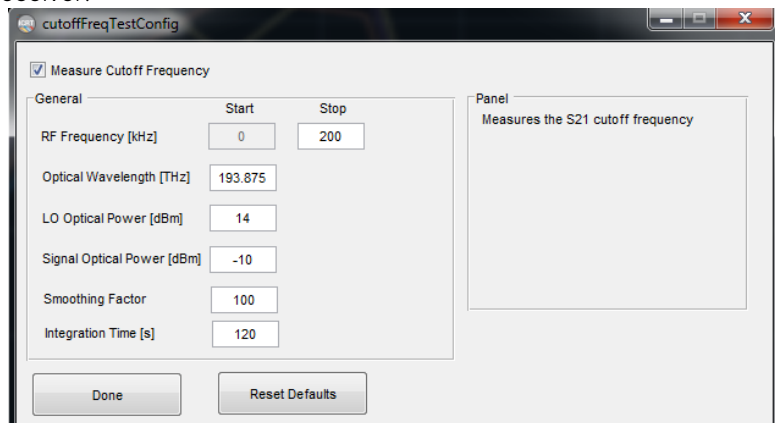
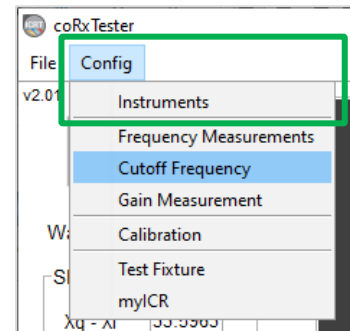
#### 7.4.3 Total Harmonic Distortion settings

- **Number of Harmonics:** The total harmonic distortion is measured from the ratio of the 1<sup>st</sup> harmonic to the sum of the N upper harmonics. As a result, the total harmonic measurement can only be measured up to the Scope Bandwidth/2.

### 7.5 Cutoff frequency

To configure the low frequency amplitude response measurement, click on the Config button in the CoRx Tester software toolbar and then select the Cutoff Frequency configuration button.

- **RF Frequency [kHz]:** The maximum frequency for the measurement
- **Optical Wavelength [THz]:** The optical wavelength for the measurement.
- **LO Optical Power [dBm]:** The desired optical power of the Local Oscillator input to the coherent receiver.  
The optical power can be set from -30 dBm to 14.5 dBm.
- **Signal Optical Power [dBm]:** The desired optical power of the signal input to the coherent receiver.  
The optical power can be set from -30 dBm to 14.5 dBm.
- **Integration Time [s]:** The measurement time.  
Longer measurement time yields more accurate results.

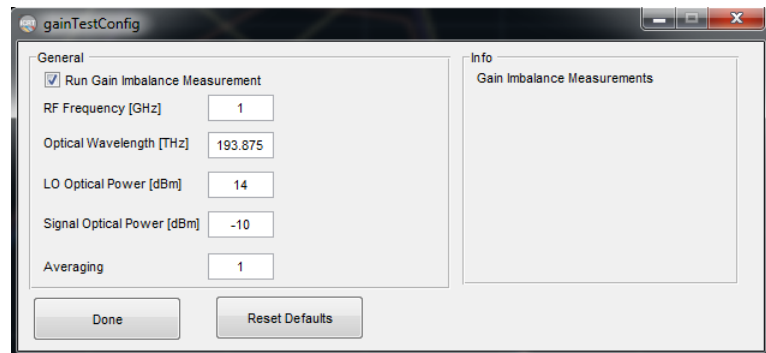
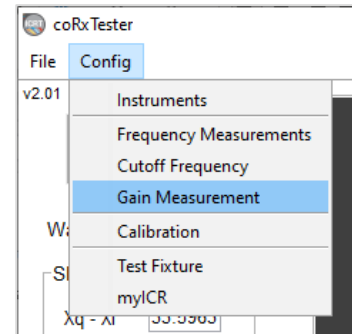




## 7.6 Gain measurement

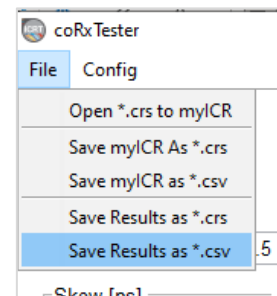
To configure the gain measurement, click on the Config button in the CoRx Tester software toolbar and then select the Cutoff Frequency configuration button.

- **RF Frequency [GHz]:** Frequency of the measurement.
- **Optical Wavelength [THz]:** The optical wavelength for the measurement.
- **LO Optical Power [dBm]:** The desired optical power of the Local Oscillator input to the coherent receiver. The optical power can be set from -30 dBm to 14.5 dBm.
- **Signal Optical Power [dBm]:** The desired optical power of the signal input to the coherent receiver. The optical power can be set from -30 dBm to 14.5 dBm.
- **Averaging:** A point-to-point average can be applied to the measurement. Increasing the averaging increases the measurement time.



## 7.7 Saving results

To save the measurement results, click on the File button in the CoRx Tester software toolbar and then select the Save Results as \*.csv button. A dialog window will pop-up to choose the location and the file name.



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## 8 Maintenance

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To help ensure long, trouble-free operation:

- Always inspect fiber-optic connectors before using them and clean them if necessary.
- Keep the instrument free of dust.
- Store the instrument at room temperature in a clean and dry area. Keep the unit out of direct sunlight.
- Avoid high humidity or significant temperature fluctuations.
- Avoid unnecessary shocks and vibrations.
- If any liquids are spilled on or into the instrument, power off the chassis immediately. Remove the instrument and allow to dry completely.

### **WARNING**

The use of controls, adjustments, and procedures other than those specified herein may result in exposure to hazardous situations or impair the protection provided by this unit.

### 8.1 Annual calibration schedule

To ensure that the CoRx Tester instrument is performing as expected, we recommend it is re-calibrated every 12 months. As an optical product will naturally degrade over time, it is important to periodically re-test the instrument, to confirm that it is working to specification.

All Quantifi Photonics products are calibrated during manufacture, and each product is shipped to the customer with a Calibration Certificate. On this certificate, the calibration date, as well as the next calibration due date are mentioned.

We recommend your product is returned for re-calibration before the listed due date, to ensure continued performance of the product. For re-calibration service information, or to send in a product for re-calibration service, email [support@quantifiphotonics.com](mailto:support@quantifiphotonics.com).

If the Calibration Certificate has been misplaced, or the calibration due date is not known, email [support@quantifiphotonics.com](mailto:support@quantifiphotonics.com).

## 9 Technical support

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### 9.1 Contacting the Technical Support Group

To obtain after-sales service or technical support for this instrument, contact Quantifi Photonics.

The Technical Support Group is available to take your calls Monday to Friday, 9:00 a.m. to 5:00 p.m. (New Zealand Time).

#### Technical Support Group

Tel.: +64 9 478 4849

[support@quantifiphotonics.com](mailto:support@quantifiphotonics.com)

To accelerate the process, please have information such as the name and the serial number (see the product identification label), as well as a description of your problem, close at hand.

### 9.2 Transportation

Maintain a temperature range within specifications when transporting the unit. **Transportation damage can occur from improper handling.**

The following steps are recommended to minimize the possibility of damage:

- Pack the instrument in its original packing material when shipping.
- Avoid high humidity or large temperature fluctuations.
- Keep the instrument out of direct sunlight.
- Avoid unnecessary shocks and vibrations.

## 10 Warranty

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### 10.1 General information

Quantifi Photonics Ltd. (Quantifi Photonics) warrants from the date of the original shipment (the Warranty Period) that this instrument will conform to specifications and will be free from defects in material and workmanship for the applicable Warranty Period. Quantifi Photonics also warrants that the equipment will meet applicable specifications under normal use.

#### **IMPORTANT**

The warranty can become null and void if:

- The unit has been tampered with, repaired, or worked upon by unauthorized individuals or non-Quantifi Photonics personnel.
- The warranty sticker has been removed.
- The unit has been opened, other than as explained in this guide.
- The unit serial number has been altered, erased, or removed.
- The unit has been misused, neglected, or damaged by accident.

THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES EXPRESSED, IMPLIED, OR STATUTORY, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. IN NO EVENT SHALL QUANTIFI PHOTONICS BE LIABLE FOR SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES.

For full warranty terms and conditions, please visit [www.quantifiphotonics.com](http://www.quantifiphotonics.com).

### 10.2 Liability

Quantifi Photonics shall not be liable for damages resulting from the use of the instrument, nor shall be responsible for any failure in the performance of other items to which the instrument is connected or the operation of any system of which the instrument may be a part.

Quantifi Photonics shall not be liable for damages resulting from improper usage, transportation or unauthorized modification of the instrument, its accompanying accessories and software.

### 10.3 Exclusions

Quantifi Photonics reserves the right to make changes in the design or construction of any of its products at any time without incurring obligation to make any changes whatsoever on units purchased. Accessories, including but not limited to fuses, pilot lamps, batteries and universal interfaces (EUI) used with Quantifi Photonics products are not covered by this warranty.

This warranty excludes failure resulting from: Improper use or installation, normal wear and tear, accident, abuse, neglect, fire, water, lightning or other acts of nature, causes external to the product or other factors beyond the control of Quantifi Photonics.

### 10.4 Certification

Quantifi Photonics certifies that this equipment met its published specifications at the time of shipment from the factory.

### 10.5 Service and repairs

To send any equipment for service, repair or calibration please contact the Technical Support Group.

# Test. Measure. Solve.

Quantifi Photonics is transforming the world of photonics test and measurement. Our portfolio of optical and electrical test instruments is rapidly expanding to meet the needs of engineers and scientists around the globe. From enabling ground-breaking experiments to driving highly efficient production testing, you'll find us working with customers to solve complex problems with optimal solutions.

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Technical Support  
Phone**

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400 999 3848

