QUANTIFI PHOTONICS™

IQTX

COHERENT MODULATION TRANSMITTER

USER MANUAL

quantifiphotonics.com

Trademarks

Units of Measurement

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

EU Authorized Representative

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Version: 1.06

Contents

1 Conventions

Before using the IQTX instrument described in this manual, 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 product 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 IQTX instrument, 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 FDA Certification

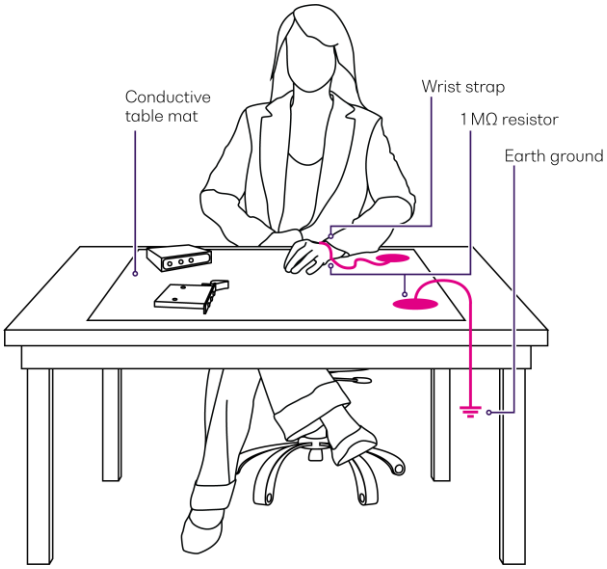
This IQTX complies with 21 CFR 1040.10 and 1040.11 except for deviations pursuant to laser notice no.50, dated June 24, 2007.

2.3 Electrostatic discharge precautions

CAUTION

The IQTX is sensitive to electrostatic discharge (ESD). Store the unused instrument in the original protective electrostatic packaging that the IQTX was shipped in.

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



2.4 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.

3 Introducing the IQTX

The IQTX enables quick and simple generation of phase modulated optical signals in one, simple to use, bench-top package.

The IQTX is available in two configurations - single-polarization with dual-polarization emulator and full dual-polarization, allowing the customer flexibility from the outset. Its high bandwidth of up to 40 GHz (typical) ensures high quality optical signal generation, even at Baud rates exceeding 80 Gbaud, making it the ideal 'Golden' optical signal source for coherent communications applications. It uses the highest quality, high bandwidth, linear RF amplifiers to enable generation of any multi-level optical modulation formats when used with an RF Arbitrary Waveform Generator (AWG).

IQTX's emulated dual-polarization capability uses optical multiplexing technique to generate a dual-polarization signal from a single-polarization modulated signal. It enables the use of only two channels of RF signal source to generate a dual-polarization coherent modulation format, leading to a significant system cost reduction. This approach is widely used in R&D environments where there is no need to have independent data pattern on all four tributaries.

The IQTX comes with a narrow linewidth, high-power, tunable internal laser, which can conveniently be controlled using the touchscreen LCD or remotely from a PC using the web-based software interface.

The internal laser is externally connectorized on the front panel for maximum flexibility. Users simply connect its output to the modulator input using a short PMF patch cord supplied with the instrument. This external connection allows you to use your own laser if preferred.

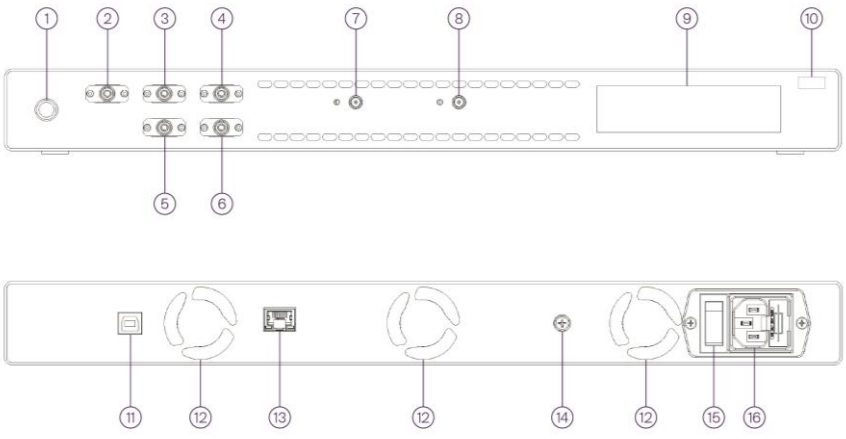
3.1 IQTX 1100 Series overview & features

Front panel

1 Power On / Off
2 Built-in laser output PM FC/PM
3 Modulator laser input PM FC/PC
4 Modulated single-Pol signal output PM
5 Dual-Pol emulator input PM
6 Dual-Pol emulator output PM
7 RF signal In-Phase input
8 RF signal Quadrature input
9 LCD screen
10 Connector type information

Rear panel

11 USB connection to PC
12 Ventilation fans (DO NOT OBSTRUCT)
13 Ethernet port
14 Chassis grounding screw
15 Mains power on / off isolation switch
16 AC power ~100 - 240 V; 50/60 Hz; 70 W Max



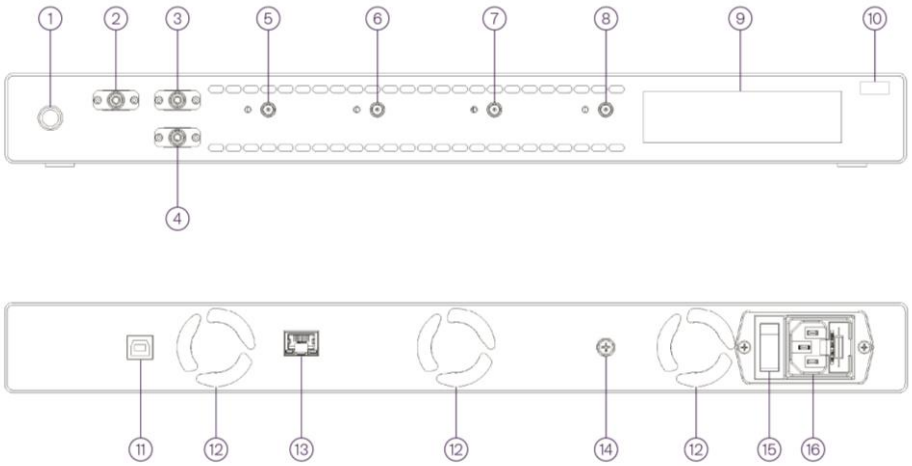
3.2 IQTX 1200 Series overview & features

Front panel

1 Power On / Off
2 Built-in laser output PM
3 Modulator laser input PM
4 Modulated Dual-Pol signal output
5 RF signal X-Pol-I input
6 RF signal X-Pol-Q input
7 RF signal Y-Pol-I input
8 RF signal Y-Pol-Q input
9 LCD screen
10 Connector type information

Rear panel

11 USB connection to PC
12 Ventilation fans (DO NOT OBSTRUCT)
13 Ethernet port
14 Chassis grounding screw
15 Mains power on / off isolation switch
16 AC power ~100 - 240 V; 50/60 Hz; 70 W Max



⚠ IMPORTANT

- You must use the IEC cable that has been supplied by Quantifi Photonics with the unit

4 Working with electrical connectors

Quantifi Photonics products are equipped with high-quality RF signal connectors.

4.1 Connector care

Although all connectors eventually wear, with proper technique you can maximize accuracy and repeatability of measurements, and the lifetime of coaxial connectors:

- Use high quality cables, connectors and adapters to avoid damaging the unit. Mating of low quality SMA components to female connectors may damage or degrade the female center pin.
- Handle connectors in the high-frequency range with precision dimensions properly to avoid inadvertent damage.
- Avoid bad connections due to malfunctioning connectors as they are the most common cause of measurement errors.
- Where possible, avoid frequent connections/disconnections of the RF Coax array on the front panel as it will gradually wear each time the harness is connected or disconnected.
- Do not bend or deform rigid cables, as this will cause damage

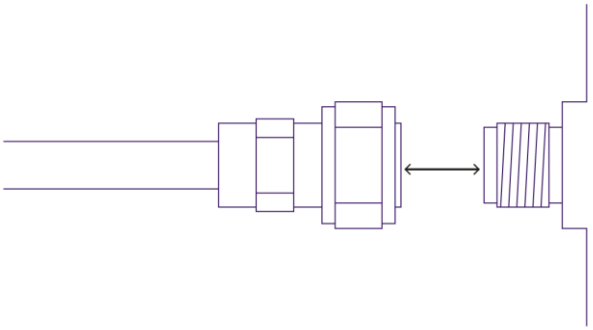
NOTE

Use ESD protection at all times, especially when handling RF input / output connectors.

4.2 Making a connection

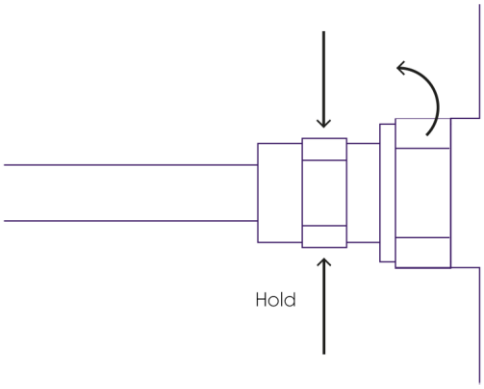
When making a connection:

- Wear a grounded wrist strap.
- Inspect, clean, and gauge connectors. All connectors must be undamaged, clean, and within mechanical specification.
- Carefully align the center axis of both devices. Push the connectors straight together so they can engage smoothly. The male center conductor pin must slip concentrically into the contact finger of the female connector.



NOTE

Rotate only the connector nut — NOT THE DEVICE OR CONNECTOR BODY — until finger-tight, being careful not to cross the threads. Damage to both connectors will occur if the male center pin is allowed to rotate in the female contact fingers.



4.3 Separating a connection

When separating a connection:

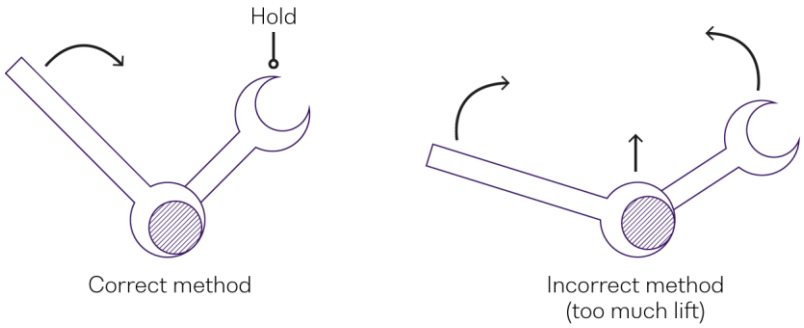
- Support the devices to avoid any twisting, rocking, or bending force on either connector.
- Use an open-end wrench to prevent the device body from turning.
- Use another open-end wrench to loosen the connector nut.
- Complete the disconnection by hand, turning only the connector nut.
- Pull the connectors straight apart.

4.4 Using a torque wrench

Applying the correct torqueing force by using a torque wrench avoids damage due to over or under tightening connections. It significantly improves measurement accuracy and repeatability at mm-wave frequencies, avoids signal failure and extends connector life.

When using a torque wrench:

- Make sure the torque wrench is set to the correct torque setting (refer 4.5 Torque settings).
- Position torque wrench, and a second wrench to hold the device or cable, within 90° of each other before applying force. Make sure to support the devices to avoid putting stress on the connectors.



- Hold the torque wrench lightly at the end of the handle then apply force perpendicular to the torque wrench handle. Tighten until the “break” point of the torque wrench is reached. Do not push beyond initial break point.

4.5 Torque settings

Wrench type	Torque settings
1.0 mm	4 in-lb (45 N-cm)
1.85 mm	8 in-lb (90 N-cm)
2.4 mm	8 in-lb (90 N-cm)
NMD 2.4 mm	8 in-lb (90 N-cm)
2.92 mm	8 in-lb (90 N-cm)
3.5 mm	8 in-lb (90 N-cm)
NMD 3.5 mm	8 in-lb (90 N-cm)
SMA	5 in-lb (56 N-cm)

5 Working with optical fibers

Quantifi Photonics products are equipped with high-quality optical connectors in compliance with EIA-455-21A standards.

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 IQTX instrument can be found printed on the front plate of the product. **Joining mismatched connectors will damage the ferrules and fibre faces**.
Do not connect FC/APC type connectors directly to the instrument, as it will damage the connector. A convertor patch cord can be used in case FC/APC connectors are needed.

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.

5.1 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 port (step 6).
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.

6 Setting up IQTX and powering ON

CAUTION

- The IQTX is sensitive to ESD. Ensure you are wearing a grounded wrist strap at all times when handling the instrument to prevent damage from electrostatic discharge.
- Do not remove the IQTX instrument from the antistatic packaging until required.
- Take care not to handle the optical connectors on the IQTX instrument, as once they are exposed to skin contact this may leave corrosive residue and damage the connector.

⚠ IMPORTANT

- You must use the IEC cable that has been supplied by Quantifi Photonics with the unit.

6.1 Setting up IQTX and powering ON

The RF signal connectors are used to input an RF generated pattern for optical transmission. Depending on the IQTX model, a single or dual polarization optical signal can be generated from the RF input signals.

CAUTION

- Ensure that the IQTX is ON before applying any RF signals to the RF signal inputs.
- Ensure the input RF signal voltage remains below the specified 500 mV pk-pk.
- For advice on connector care, refer section 4 Working with electrical connectors.

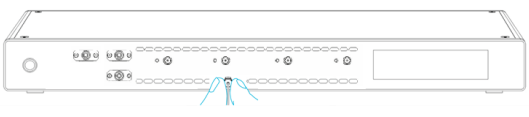
STEP 1: Connect AC mains power to the instrument to provide ground connection.

STEP 2: Via USB – Connect a USB cable

STEP 2: Via Ethernet – Connect an Ethernet cable

STEP 3:

Make all required electrical and optical connections. For details refer section Setting up IQTX for single polarization or Setting up IQTX for dual polarization.

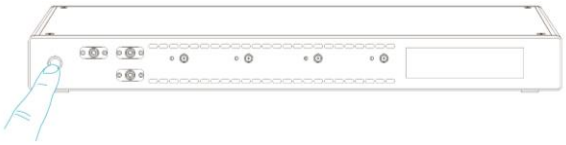


STEP 4:

Once all connections are completed, turn ON the isolation switch located next to the mains socket. The switch will illuminate indicating that the AC power supply is live and the IQTX is ready to be powered ON.

STEP 5:

Power ON the instrument.



STEP 6:

IP address will appear on the LCD screen. If IQTX is connected via Ethernet and USB, the display will alternate between the USB and Ethernet IP address (for details refer section 10.2.1).

⚠ IMPORTANT

After powering on, please wait at least **1 minute** before attempting to communicate with IQTX. This gives IQTX time to finish boot procedures and initialize the communication server.

6.2 Setting up IQTX for single polarization (IQTX 1100 Series models only)

CAUTION

- Ensure that the IQTX is **ON** before applying any RF signals to the RF signal inputs.
- Ensure the input RF signal voltage remains below the specified 500 mV pk-pk.
- For advice on connector care, refer 4 Working with electrical connectors.

To generate a single polarization signal (QPSK) aligned to a single state of polarization:

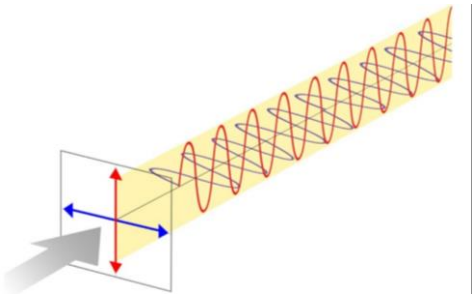
1. Connect the data channels from the RF source to the In-phase and Quadrature RF signal inputs.
2. Connect the Internal Laser Output to the Modulator Laser Input using the short (20 cm) blue PM patch cord supplied with the instrument. Alternatively, you can connect your own narrow-linewidth Laser with a PM output using a PM patch cord (linewidth needs to be less than 500 kHz).
3. Use the output port of the modulator for a linearly polarized single polarization signal.

CAUTION

The power level going into the modulator Laser input port **must not exceed the Max Input power** specified for the model.

6.3 Setting up IQTX for dual polarization

IQTX models enable to generate dual polarization signals where the optical signal can be transmitted along two orthogonal polar planes in the optical fiber. However, the IQTX 1100 Series will only duplicate and delay modulated signals along both polarizations.



optical fiber

CAUTION

- Ensure that the IQTX is ON before applying any RF signals to the RF signal inputs.
- Ensure the input RF signal voltage remains below the specified 500 mV pk-pk.
- For advice on connector care, refer section 4 Working with electrical connectors

6.3.1 IQTX 1100 Series (Emulated Dual Polarization)

To generate a dual polarization signal:

Follow the instructions in section

Setting up IQTX for single polarization (IQTX 1100 Series models only) establish a single polarization modulation signal.

1. Connect the Single Polarization SIGNAL OUT to the Dual Polarization SIGNAL IN using a PMF patch-cord, to generate the Y-pol modulation signal.
2. The dual polarization modulated signal generated from the input RF pattern is then output from the optical port labelled Dual Polarization SIGNAL OUT.

6.3.2 IQTX 1200 Series (Full Dual Polarization)

The IQTX 1200 Series instrument can generate optical signals from up to four independent RF channel sources. One channel pair from the RF input signals is modulated on the X-pol, the second pair is modulated on the Y-pol.

To generate a dual polarization signal:

1. Connect the data channels from the RF source to the RF Signal Inputs IN-PHASE electrical and RF Signal Inputs QUADRATURE connectors.
2. Connect the internal Laser output to the Modulator Input. If using your own narrow-linewidth Laser, the linewidth needs to be less than 500kHz.

   CAUTION

   Please make sure the Laser power connected to the modulator input does not exceed the maximum optical power specification.

3. The dual polarization modulated signal is output from the modulator output port.

7 Installing software

7.1 Installing Cohesion Operator software package on client computer(s)

Set up any computer you use to connect with the instrument by installing the latest Cohesion Operator software package. Cohesion Operator enables you to connect with Quantifi Photonics instruments on your network and manage firmware upgrades.

The package is included on the USB media device that we provide with your instrument, or you can download it from quantifiphotonics.com (go to **Resources** > **Drivers, software and manuals** > **EPIQ Series**).

> **⚠ IMPORTANT**
> If **another IQTX instrument is already connected** to the client computer **over USB**, consult the **Network and Update settings** on configuring the Ethernet / USB IP address for multi-instrument control.

To install the software package on a client computer:

- (recommended) Save your work and close all programs.
- If using the USB media device, insert it on the computer.
- Double-click **CohesionOperator-<version>.exe** and follow the prompts.

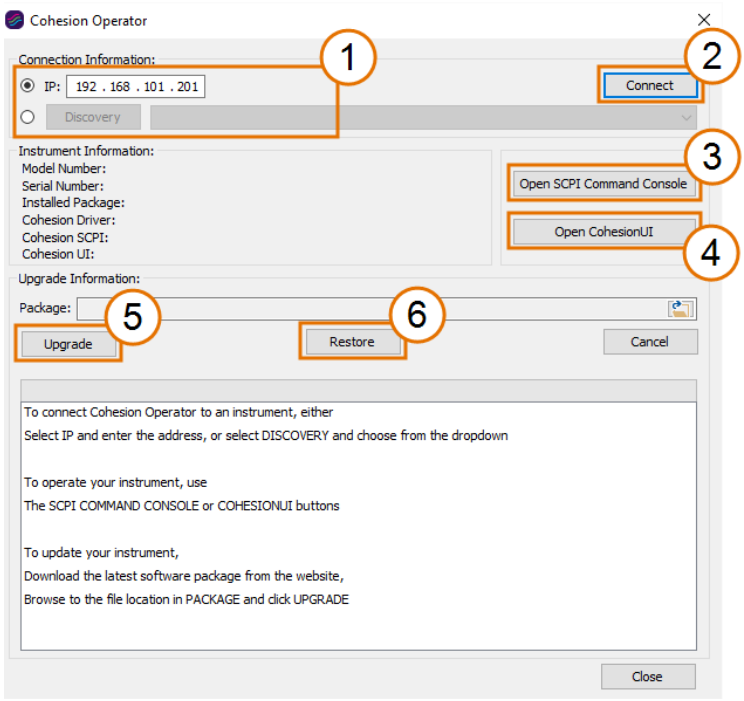
  A Windows Security Alert may prompt you to allow network access. We recommend that you allow access to both, private and public networks, to enable any network configuration.
  The installation wizard will install required drivers, applications, and desktop icons on the computer.

To open the Cohesion Operator application:

- Double-click the Cohesion Operator desktop icon or open Cohesion Operator from the Start menu.

From Cohesion Operator you can:

1. Select a Quantifi Photonics instrument that is available on your network.
2. Validate the IP address of the instrument and retrieve instrument information (refer 0).
3. Communicate with the instrument through the SCPI Command Console (refer 11.7).
4. Access the instrument through CohesionUI, a web-based graphical user interface (refer 8.1).
5. Upgrade instrument firmware (refer 7.3).
6. Restore the instrument to factory settings (refer 7.4).

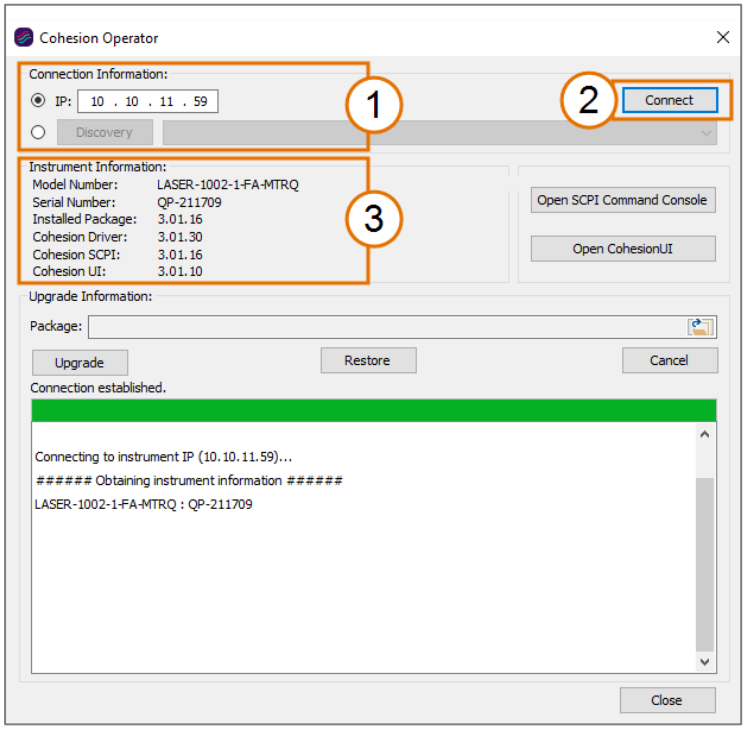

Cohesion Operator
Connection Information:
IP: 192 . 168 . 101 . 201
Discovery
Connect
Instrument Information:
Model Number:
Serial Number:
Installed Package:
Cohesion Driver:
Cohesion SCPI:
Cohesion UI:
Open SCPI Command Console
Open CohesionUI
Upgrade Information:
Package:
Upgrade
Restore
Cancel
To connect Cohesion Operator to an instrument, either
Select IP and enter the address, or select DISCOVERY and choose from the dropdown
To operate your instrument, use
The SCPI COMMAND CONSOLE or COHESIONUI buttons
To update your instrument,
Download the latest software package from the website,
Browse to the file location in PACKAGE and click UPGRADE
Close
1
2
3
4
5
6

7.2 Checking instrument firmware versions and other product information

You can check the details of an instrument in Cohesion Operator or in CohesionUI.

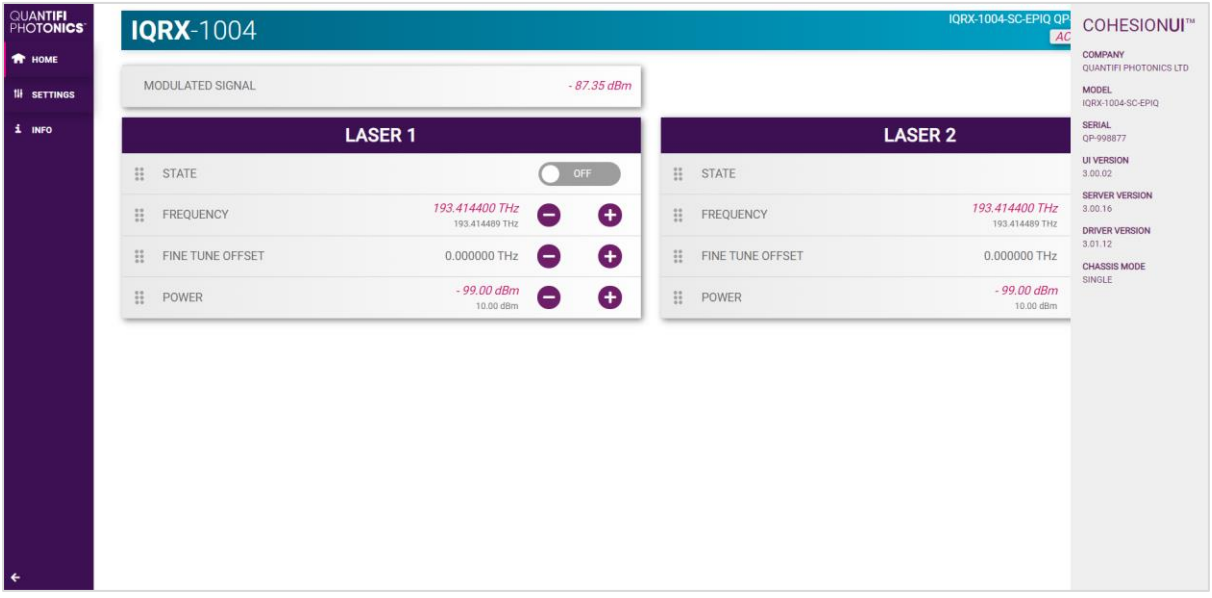
In Cohesion Operator:

1. Select the instrument.
2. Click **Connect**.
3. Current instrument information will be displayed.



In CohesionUI:

1. Select **INFO** on the menu.
2. Instrument information will be displayed in the info panel.



7.3 Upgrading an instrument with the latest firmware

NOTE

The Cohesion Operator can upgrade instruments that currently use firmware package version 2.08.24 or greater. To upgrade instruments that use older software packages, refer to the user manual that came with your instrument.

To upgrade an instrument:

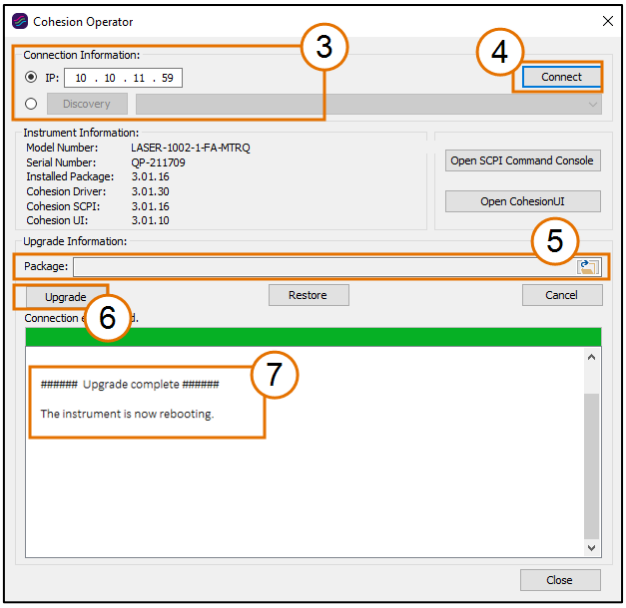
1. Get the latest EPIQ firmware package **CohesionEPIQ-<version>.tgz**, for example by downloading it from quantifiphotonics.com (go to **Resources > Drivers, software and manuals > EPIQ Series**), and save it to your network.
2. Open the Cohesion Operator, for example by double-clicking the **Cohesion Operator** desktop icon.
3. Select the instrument by entering its **IP address** or by selecting it from the **Discovery** drop down list.
4. To confirm that you have selected the correct instrument, click **Connect**.This will retrieve instrument information, with **Installed Package** showing the current firmware version.
5. In **Package**, click the Browse button, navigate to the previously downloaded firmware package and select it.
6. Click **Upgrade**.
   The instrument will be upgraded to the selected firmware package. This can take a few minutes and the instrument might reboot several times in the process.
7. A message shows when the upgrade is complete.

NOTE

To confirm the new firmware version, click **Connect** to retrieve the latest instrument information.

NOTE

If an upgrade attempt is unsuccessful, the Cohesion Operator will stop the upgrade process and restore the instrument to its previous firmware version. Messages will be displayed accordingly.



7.4 Restoring factory settings on an instrument

NOTE

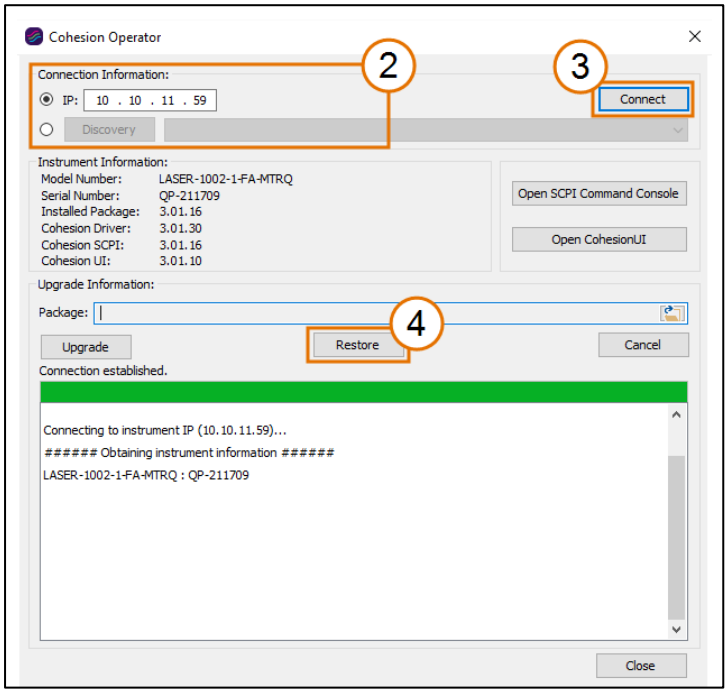
The Cohesion Operator can restore instruments that currently use firmware package version 2.08.24 or greater. To restore instruments that use older software packages, refer to the user manual that came with your instrument.

To restore factory settings:

1. Open the Cohesion Operator, for example by double-clicking the **Cohesion Operator** desktop icon.
2. Select the instrument by entering its **IP address** or by selecting it from the **Discovery** drop down list.
3. (optional) Retrieve instrument information, including current firmware versions, by clicking **Connect**.
4. Click **Restore**.

NOTE

IP address settings will also revert to factory settings.



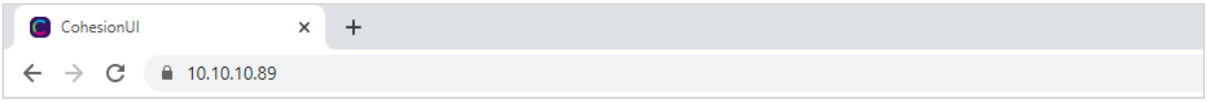
8 CohesionUI – Overview

CohesionUI is a web-based graphical user interface that you can use to control the IQTX instrument. Its cutting-edge design offers a sleek modern interface, cross-device compatibility, multi-instrument control, customizable views, and remote access.

CohesionUI is part of the Cohesion Installer software package, refer 7.1 Installing Cohesion Operator software package on client computer(s).

8.1 Accessing CohesionUI

Open CohesionUI from Cohesion Operator (refer 7.1) or launch Google Chrome or Microsoft Edge on a computer, and type in the IQTX IP address into the address bar of the browser e.g. 10.10.10.89.



The IP address of the IQTX is displayed on the LCD screen on the front of the instrument for both, access via USB or Ethernet.

> **NOTE**
> When both Ethernet and USB cables are connected to the IQTX, the IP displayed on the LCD will alternate between the USB and Ethernet IP addresses.

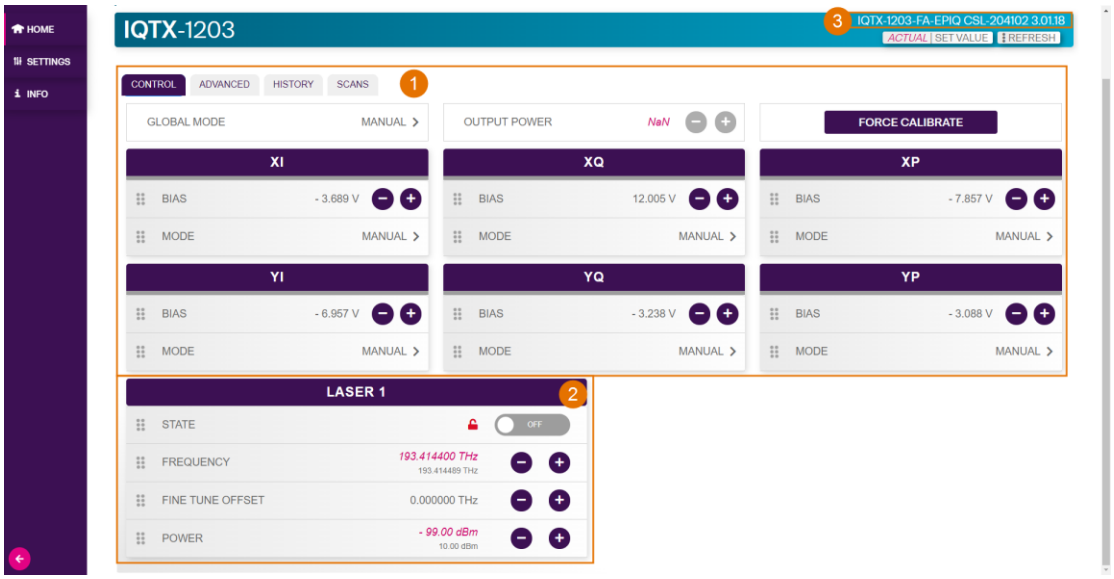
If needed, the IP address can be statically assigned to the Ethernet or USB connection (see section 0

Managing network settings.

8.2 Home page

The HOME page is the main landing page in CohesionUI; it displays the following:

1. Modulation channels
2. Laser controls
3. Information relating to the instrument such as the model number, serial number and firmware versions.

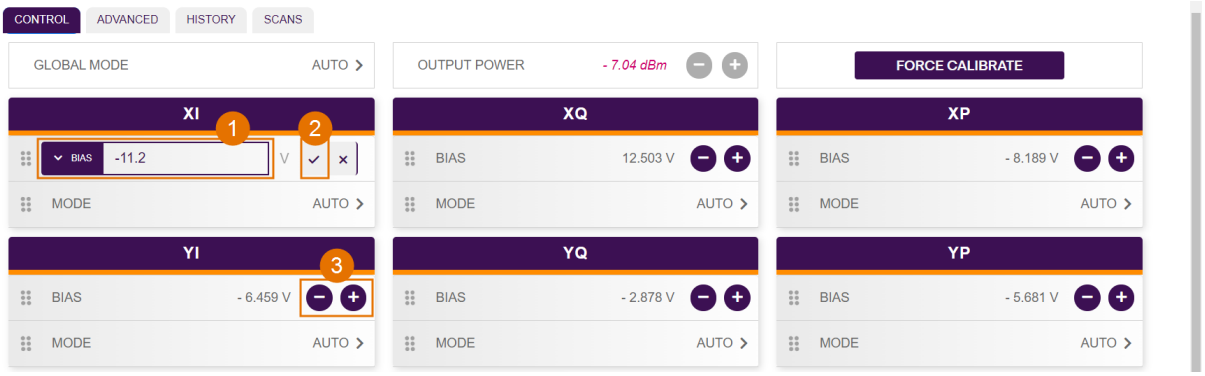


8.3 Setting values

In CohesionUI you can manually set values for parameters where applicable.

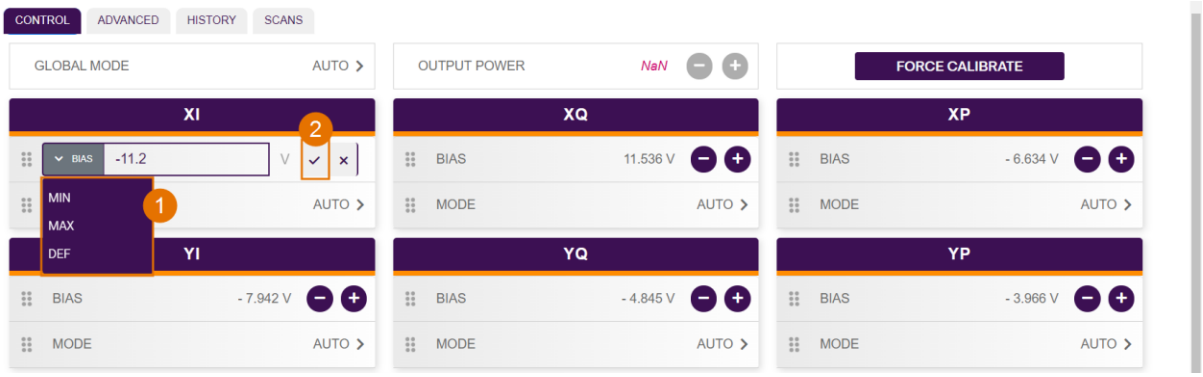
To set a value:

1. Click on a parameter and enter a value.
2. Confirm the value.
3. Alternatively, you can use + and – to increase or decrease the value.
   You can edit the step size in the SETTINGS menu (refer 8.5 Managing CohesionUI settings).



To set a value to a pre-defined value, for example MIN, MAX or DEF:

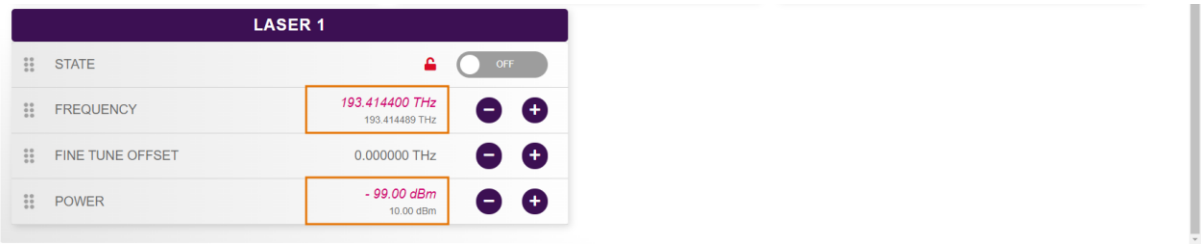
1. Click on a parameter and select a value from the dropdown menu.
2. Confirm the value.



8.4 SET values and ACTUAL values

In some cases, you can manually set a value that is displayed alongside the actual value as follows:

- *ACTUAL*: the actual value of the parameter as queried by the module
- SET: the intended value of a given parameter as set by the user



For details on setting a value, refer 8.3 Setting values.

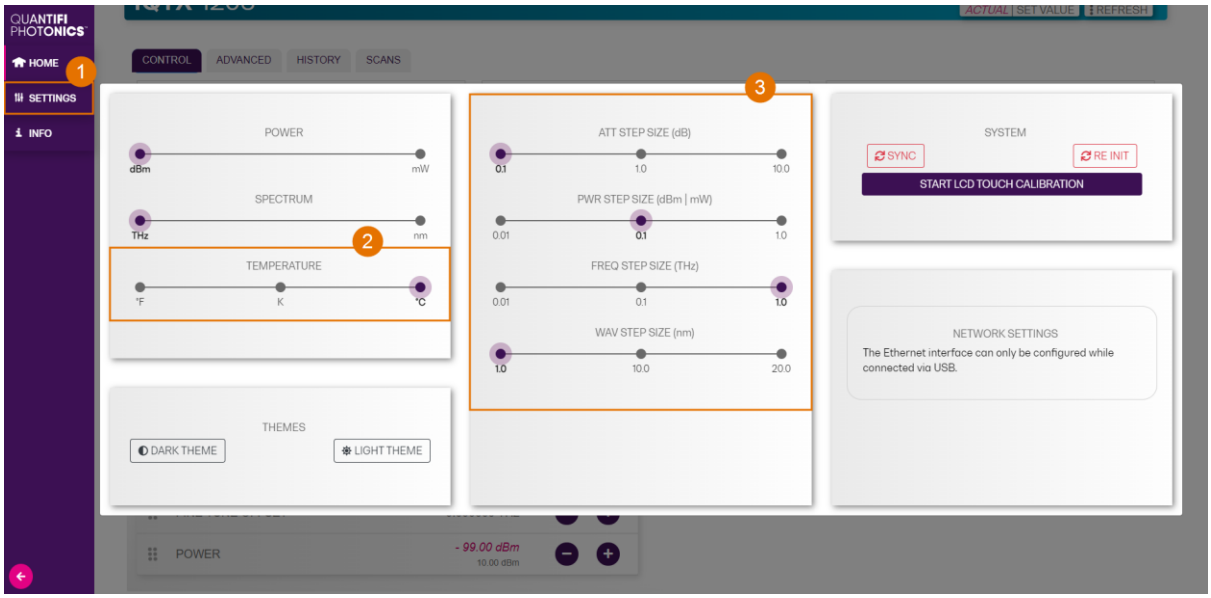
8.5 Managing CohesionUI settings

On the **SETTINGS** page you can configure CohesionUI settings and unit preferences.

Step size refers to the amount by which the attenuation, frequency, or power increases / decreases when the **+** or **-** button is clicked.

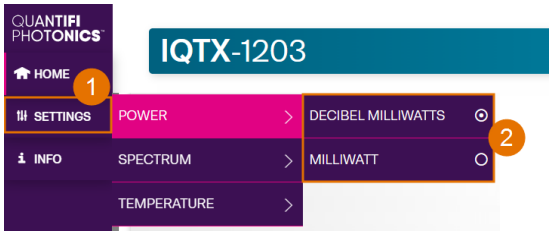
To view all settings and unit preferences and adjust as required:

1. Click **SETTINGS**.
2. Change settings or unit preferences as required, for example temperature units.
3. **Step size** refers to the amount by which a value is increased or decreased when clicking the **+** or **–** button.



To adjust unit preferences one at a time:

1. Hover over SETTINGS.
2. Select a unit from the dropdown, for example the power unit.



8.6 Managing network settings

To communicate with IQTX, you require

- the USB IP address for access via a USB connection, or
- the Ethernet IP address for access via an Ethernet connection

You can display both IP addresses on the LCD screen of the unit.

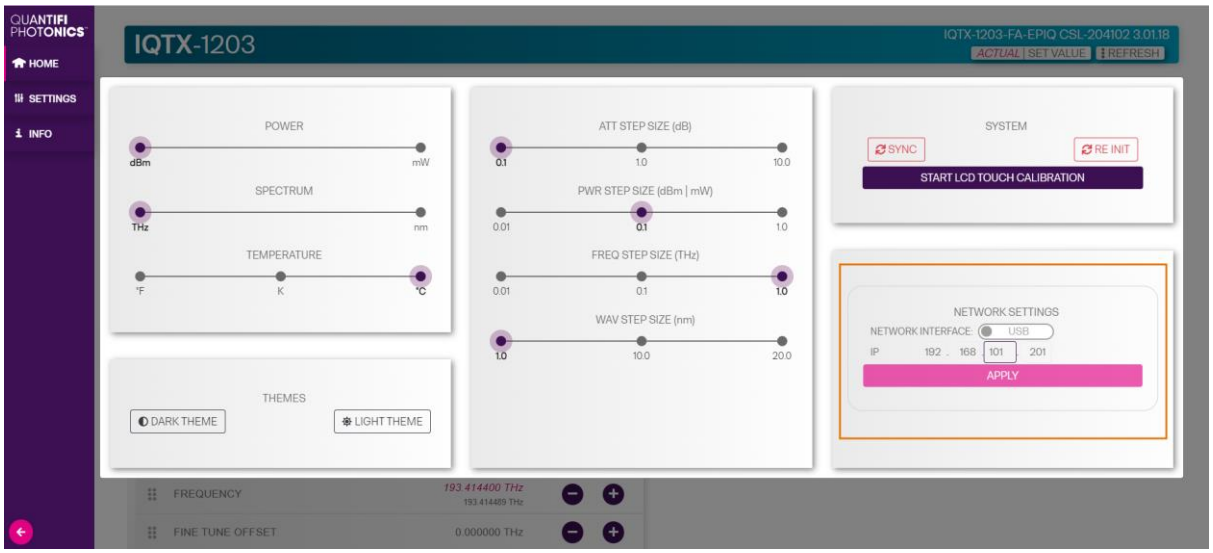
If required, you can change the IP addresses in the SETTINGS page in CohesionUI.

> **NOTE**
> Network settings controls in CohesionUI are **only available when connected over USB**. When connected over Ethernet network settings will be locked.

8.6.1 Setting the USB IP address

When connected via USB, the default IP address is **192.168.101.201**. This is a static address set during instrument calibration. If necessary, you can change this address.

Typing the default IP address in a supported web browser will open the CohesionUI page for the instrument. The network settings controls are available in the **SETTINGS** page.



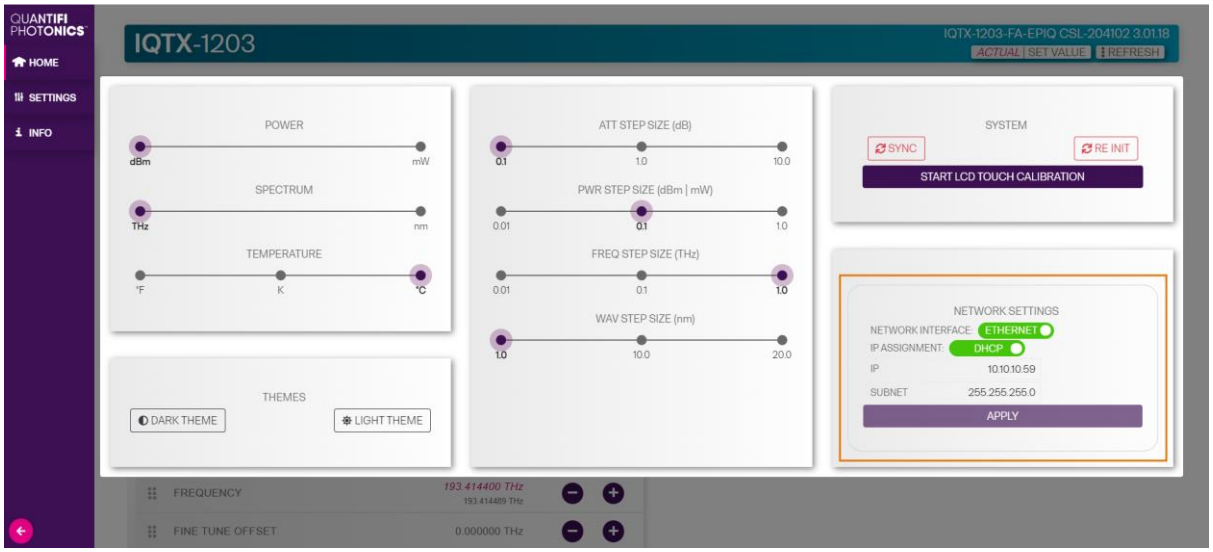
The **value in the 3rd octet of the IP address can be changed** to any available value. It is important to make sure that any other instruments connected to the computer do not share this new IP address, as there will be an addressing conflict.

Clicking **APPLY** will write the new IP address to the instrument settings. Once set, the new IP address will be displayed on the LCD screen.

8.6.2 Setting the Ethernet IP address

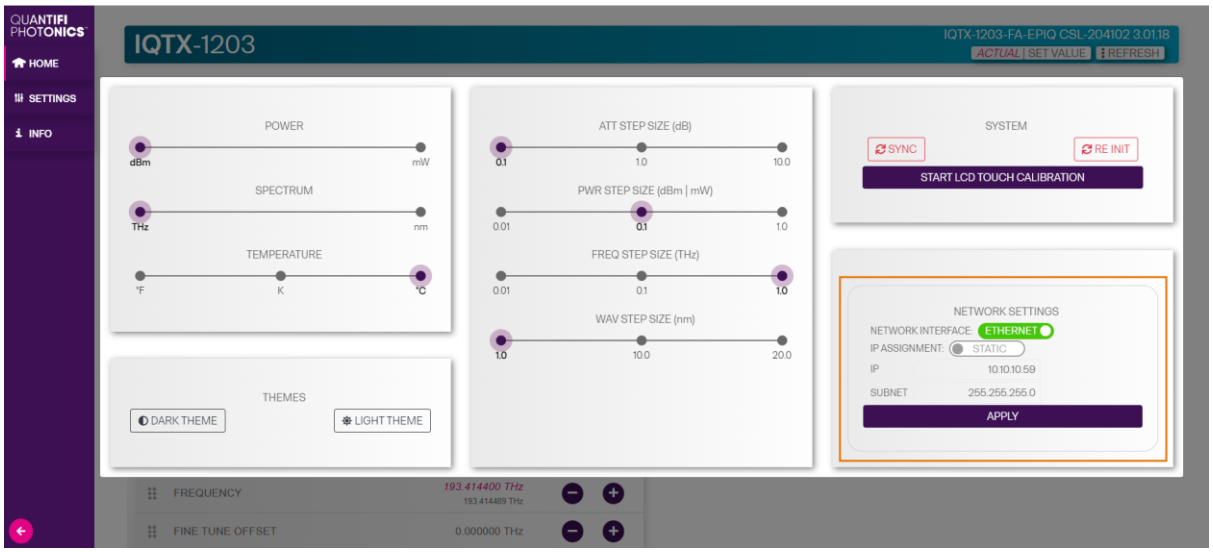
The default Ethernet IP addressing method is dynamic, as the DHCP will automatically assign the instrument an IP address. This address can be found on the LCD screen.

While connected over USB, typing in the assigned IP address in a supported web browser will open the CohesionUI page for the instrument.



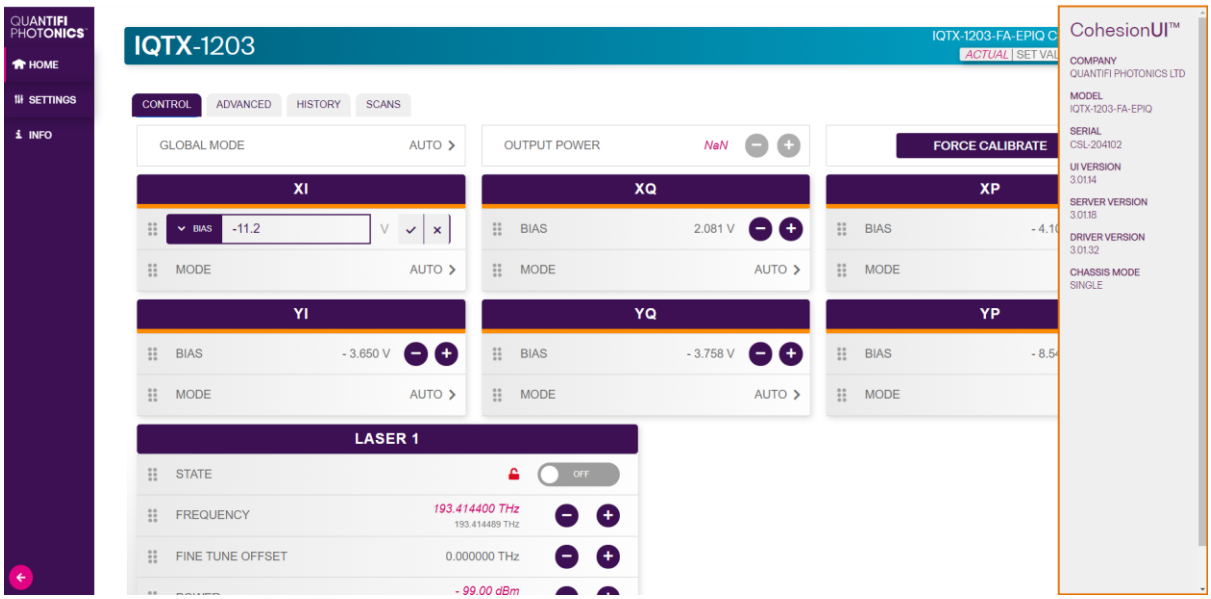
The addressing method can be changed to a static method, where the IQTX instrument will always have the same IP address over Ethernet. Typing in a **valid IP address and Subnet mask**, and then clicking **APPLY** will save the IP address into the settings of the instrument.

To test if the IP addressing has worked, power **OFF** the instrument, and disconnect the USB cable. Turn the unit back **ON**, and once it has finished booting, check the IP address shown on the LCD screen.



8.7 Info panel

Clicking the **INFO** button will display an information panel on the right-hand side of the page. Information such as the chassis operation mode, manufacturer, model, and serial number of the chassis, CohesionUI version number, and the version of CohesionSCPI service running on the chassis is displayed in this panel.



9 Operating IQTX with CohesionUI

You can install CohesionUI on a client computer as part of the Cohesion Installer software package, refer 7.1 Installing Cohesion Operator software package on client computer(s).

For an introduction to CohesionUI and basic functionality, refer 8 CohesionUI – Overview.

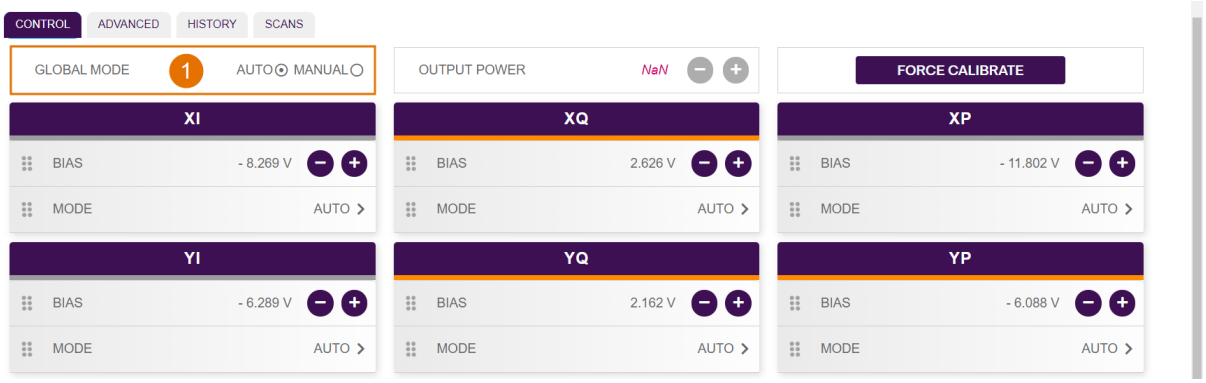
On the CohesionUI IQTX HOME screen, the following tabs are available:

- CONTROL: Control mode and bias values of the modulation channels, and laser settings.
- ADVANCED: Control modulator dither size values and interval.
- HISTORY: Review modulator bias values vs time error history plots.
- SCANS: Review modulator biases power vs biases voltage plots

9.1 Setting the modulation channels mode

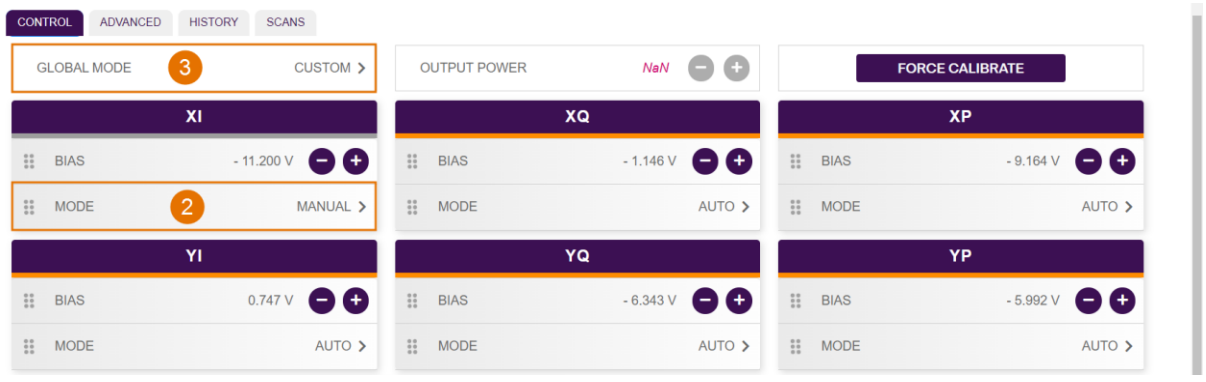
The IQTX modulation channels can operate in AUTO mode (default) or MANUAL mode.
To set the mode for all modulation channels:

1. In the CONTROL tab, click GLOBAL MODE and select a mode.



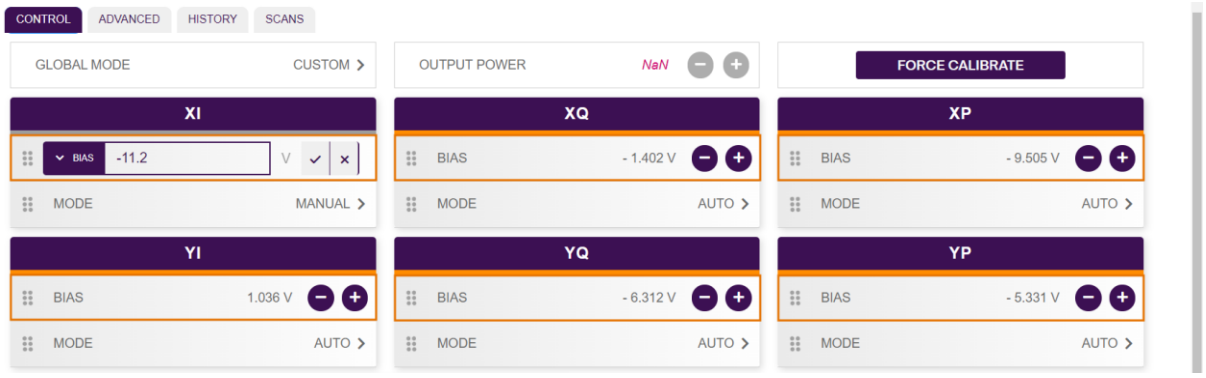
To set the mode for a selected modulation channel:

2. In the CONTROL tab, click MODE for a modulation channel and select a mode.
3. GLOBAL MODE will change to CUSTOM.



9.2 Setting the modulation channels bias values

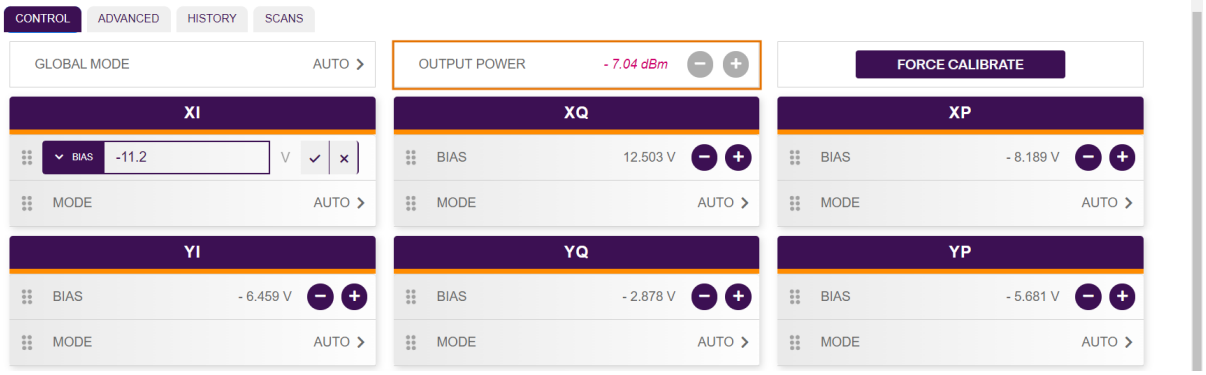
In the CONTROL tab, you can set the BIAS value for each modulation channel.



For details on how to set a value, refer 8.4 SET values and ACTUAL values.

9.3 Output power value

The global **OUTPUT POWER** of the IQTX instrument is displayed in the CONTROL tab on the top-middle ribbon of the screen.

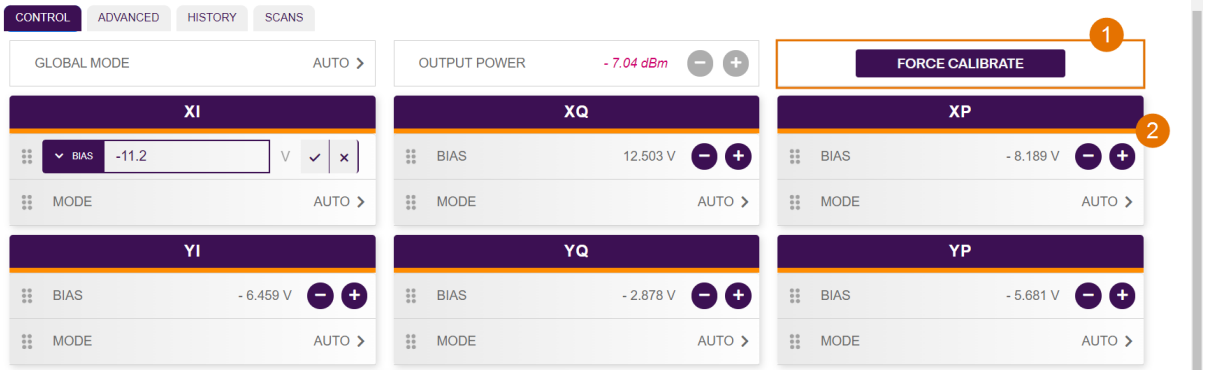


9.4 Initiating a DC-bias scan

You can initiate a new DC-bias scan after the initial power-up of the unit and when you require a new scan of the current Min-Min-Quad bias points.

To initiate the scan:

1. Click FORCE CALIBRATE in the CONTROL tab or in the HISTORY tab.
2. During the re-calibration process, the color strip under the bias label will turn orange. Once the unit has found the correct bias point, the color strip will turn green.

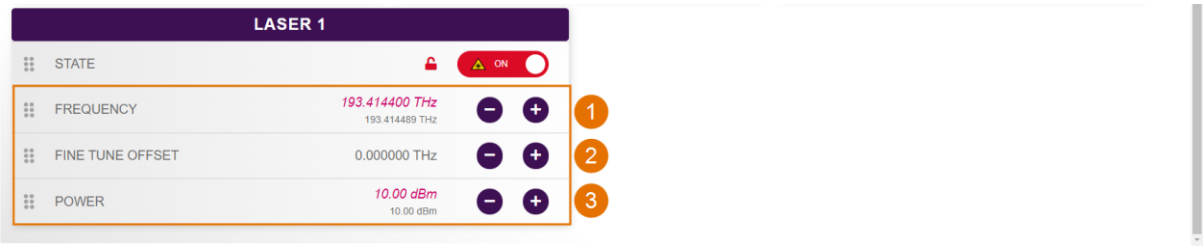


9.5 Setting the laser source parameters

In the CONTROL tab, you can set the following laser source parameters for a laser channel:

1. FREQUENCY (WAVELENGTH)
   The frequency (wavelength) of light for the IQTX to output. This corresponds to the spectral location of the central peak of the laser.
2. FINE TUNE OFFSET
   See section 9.6 Tuning the laser source.
3. POWER:
   IQTX output power.

For details on how to set a value, refer 8.4 SET values and ACTUAL values.



9.6 Tuning the laser source

The IQTX instrument allows the user to tune the laser to any spectral set point in the operational range of the laser. The user can operate in either FREQUENCY (Hz) or WAVELENGTH (nm) units.

Tuning can be realised through the following commands. See the Programming Guide (section 0) for specific information about the listed commands.

Commands	Description
`SOURce<n>:CHANnel<m>:FREQuency/?`	- Set / query the laser output frequency value, with 1 MHz resolution. - Set / query the fine tune laser output frequency up to +/- 6 GHz around the closest GRID point, with 1 MHz resolution. - Set / query the laser output wavelength value, with 0.01 pm resolution.
`SOURce<n>:CHANnel<m>:FREQuency:FINE/?`	
`SOURce<n>:CHANnel<m>:WAVelength/?`	

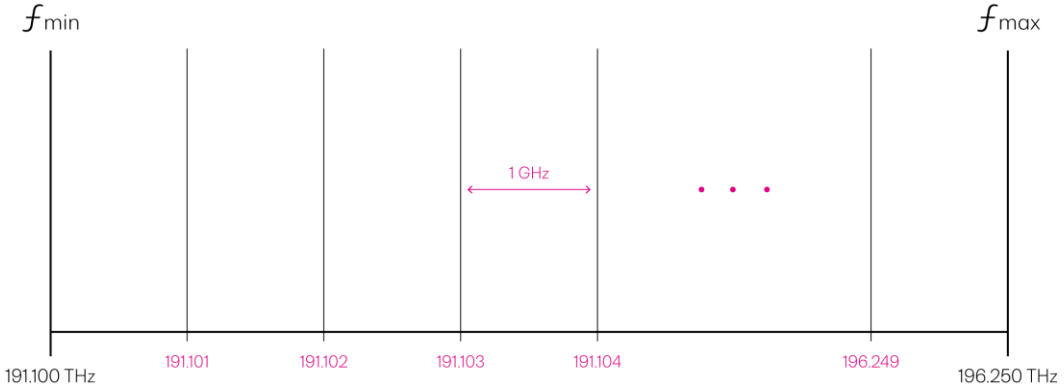
All lasers with firmware versions equal to or higher than 1.30 will support full spectral tunability down to the minimum resolution of 1 MHz/ 0.01 pm. Older versions only support full tuning down to the 1 MHz / 0.01 pm resolution with the separate FREQUENCY and FREQUENCY:FINE commands.

9.6.1 Grid setting and min & max frequency values

The default state of the laser is to operate in Frequency (Hz) mode. The entire frequency operation range of the laser can be divided up into a **GRID**. Each **GRID point** is spaced apart by an equal amount, called the **GRID spacing**.

The user can set this GRID spacing using the `SOURce<n>:CHANnel<m>:GRID/?` command, between the values of 100 MHz and 50 GHz.

Each laser source will have a MIN and MAX frequency value, which defines its operation range. For example, the lasers used in the IQTX 1100 Series have MIN and MAX frequency values of 191.1 THz (1527.605 nm) and 196.25 THz (1568.773 nm), respectively. If the user were then to set a GRID spacing of 1 GHz, then the frequency grid would be as shown in the below image.



The general rule for the set of valid frequency GRID points is:
F_MIN + [GRID x [N + 1]], where GRID = GRID spacing set by user, N >= 1

Whenever a user sets the frequency to an intended value, the instrument will use the defined GRID to first set the laser to the closest value (GRID point) on the frequency grid. If there is still an offset between the user intended frequency value and the GRID point, then a FINE TUNE OFFSET will be applied to move the laser to, or as close as possible to the user intended value. This is due to the +/- 6 GHz tunability range of the FINE TUNE OFFSET, meaning that there could be regions where the laser is not able to tune to (see the **Frequency FINE tuning** section 9.6.3 for more information).

9.6.2 Frequency tuning

The user can directly set a frequency value down to 1 MHz precision using the `SOURce<n>:CHANnel<m>:FREQuency/?` command. If the intended value is above the minimum resolution of 1 MHz, then the value will be directly set. If the intended value is specified to below the minimum resolution, then the outstanding value will be truncated (highlighted below in red).

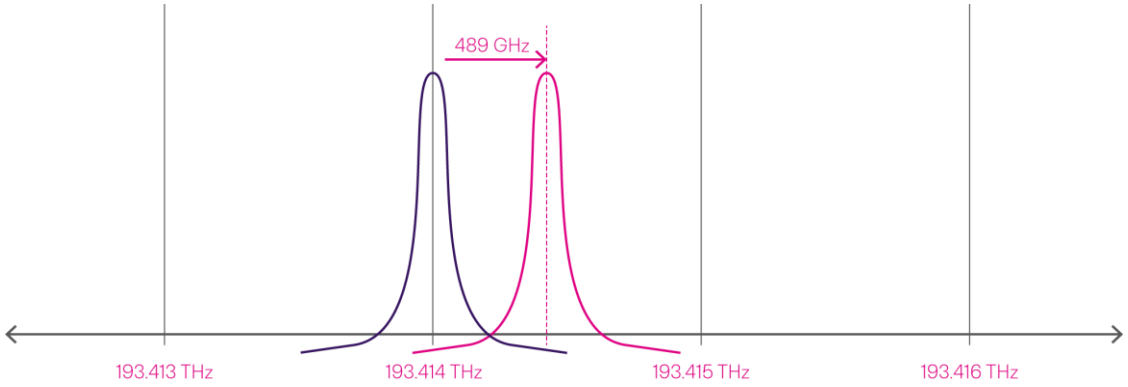
Intended user frequency value	Accepted frequency value	Applied frequency value
193.41448 THz	193.4144800 THz	193.414480 THz
193.4144890 THz	193.414489 THz	193.414489 THz
193.41448905 THz	193.414489 THz	193.414489 THz
193.000000055 THz	193.000000 THz	193.000000 THz

The table below details the intended vs. the actual set of values for a variety of these examples. Note that the GRID spacing is set to 1 GHz for the following examples.

Intended user frequency value	Command	Current GRID value	Actual set frequency value
193.414 THz	`SOUR1:CHAN1:FREQ 193.414 THz`	193.414 THz	193.414000 THz
193.42501 THz	`SOUR1:CHAN1:FREQ 193.42501 THz`	193.425 THz	193.425010 THz
193.414489 THz	`SOUR1:CHAN1:FREQ 193.414489 THz`	193.414 THz	193.414489 THz
193.4144895 THz	`SOUR1:CHAN1:FREQ 193.4144895 THz`	193.414 THz	193.414489 THz
193.4000001 THz	`SOUR1:CHAN1:FREQ 193.4000001 THz`	193.400 THz	193.400000 THz

An important point to note is that when a frequency value is specified by the user, if the value lies in between any two adjacent GRID points, and can be tuned to, it will tune up from the lower GRID point value. The laser will never tune down from a GRID point value to reach the final point.

In the example below, the user sets the output frequency to 193.414489 THz, with a GRID spacing of 1 GHz. The laser first tunes to the closest GRID point below the intended frequency value (193.414 THz), and then uses FINE TUNE OFFSET to fine tune by 489 MHz up to the final set point



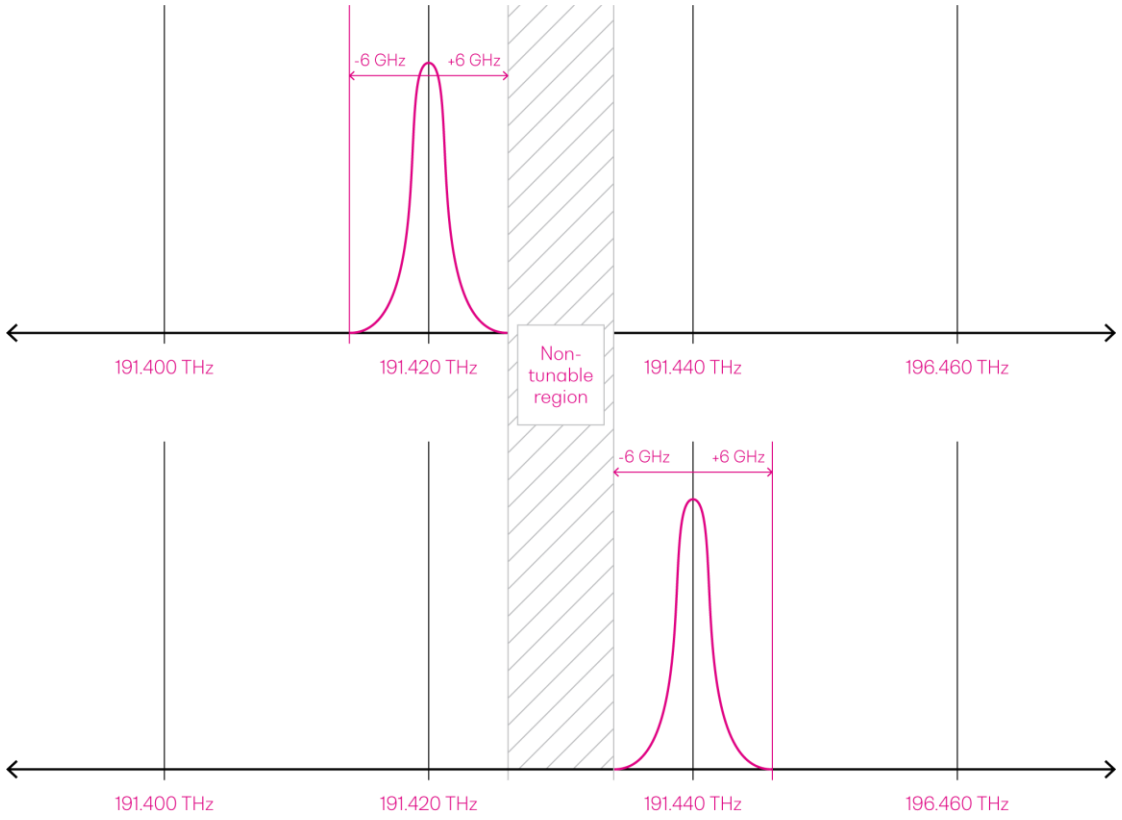
9.6.3 Frequency fine tuning

Another option a user has is to use the FREQUENCY:FINE tuning functionality to tune the laser by +/- 6 GHz around the set GRID point value.

Commands	Description
`SOUR1:CHAN1:GRID` 1 GHz `SOUR1:CHAN1:FREQ` 193.414489 THz `SOUR1:CHAN1:FREQ:FINE?` -> 489 MHz `SOUR1:CHAN1:FREQ:FINE` 50 MHz `SOUR1:CHAN1:FREQ?` -> 193.414050 THz	- Query the frequency fine setting. - Fine tune the frequency by +50 MHz from the current GRID point (193.414 THz). - Query the current frequency setting

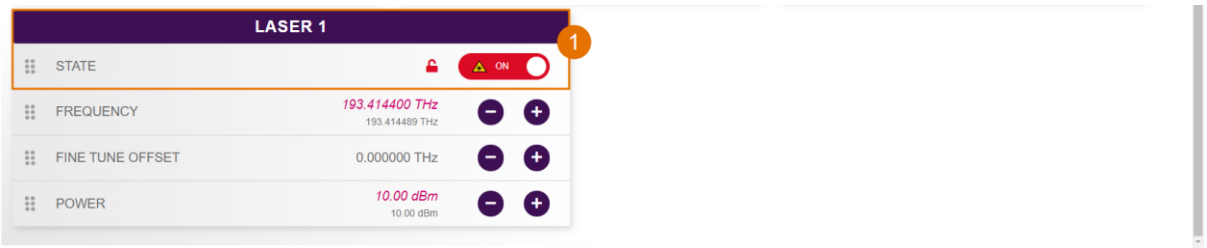
It should be noted that if the GRID spacing has been set to a value larger than 6 GHz, then there will be a range of values that sit between adjacent frequency grid points which will be impossible to tune to, using the fine tuning functionality.

In the example below, the GRID spacing has been set to 20 GHz, meaning that between any two adjacent GRID points, there lies an 8 GHz region that is non-accessible. If tunability is a primary concern, it is suggested that the user set the GRID spacing to be <= 6 GHz.



9.7 Toggling the laser on / off

In the CONTROL tab, you can toggle the laser in a specific channel of the IQTX **ON** or **OFF** by clicking the **STATE** button.



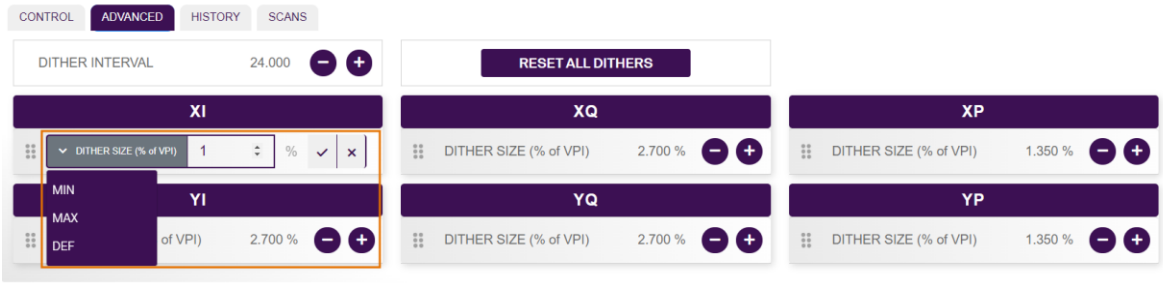
9.8 Setting the dither size

The DITHER SIZE value (percentage of VPI) for each modulator bias can be set in the ADVANCED tab by clicking the parameter field, or by using the + and – control buttons to increase or decrease the value by a set amount. The step size is set to 2%.

Alternatively, the DITHER SIZE can also be set to the MIN and MAX value by clicking the dropdown in the name of the parameter.

Increasing the dither size will lead to a more accurate bias optimization, but a larger dither will show up as an occasional perturbation to the bias voltage.

It is recommended to use the default dither size unless a residual bias error is constantly observed. In such cases, increasing the step size can improve the bias convergence accuracy.

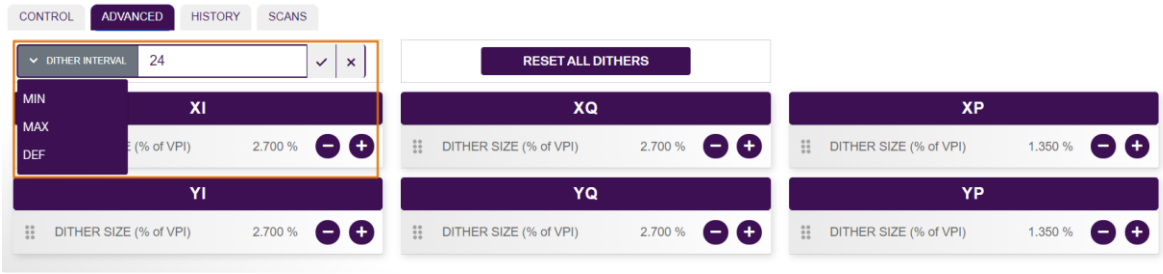


9.9 Setting the dither interval

The DITHER INTERVAL value for each modulator can be set in the ADVANCED tab by clicking the parameter field, or by using the + and – control buttons to increase or decrease the value by a set amount.

Alternatively, the DITHER INTERVAL can also be set to the MIN and MAX value by clicking the dropdown in the name of the parameter.

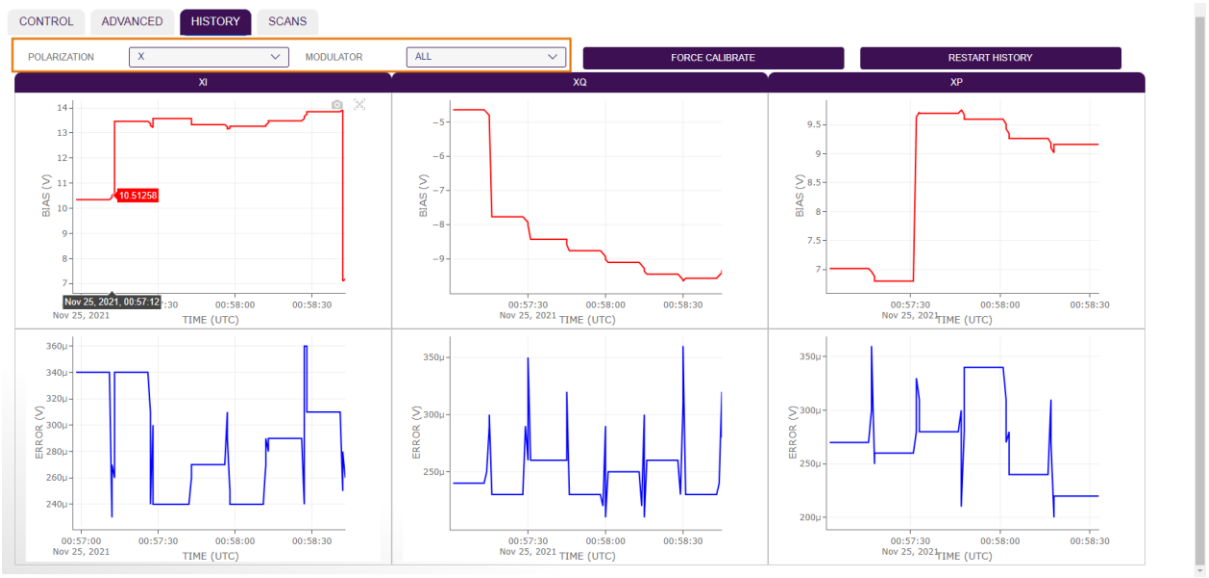
The dither interval determines how frequently the bias control dither is applied. Lower dither interval will result in a faster convergence, while a higher dither interval will result in a more stable bias control.



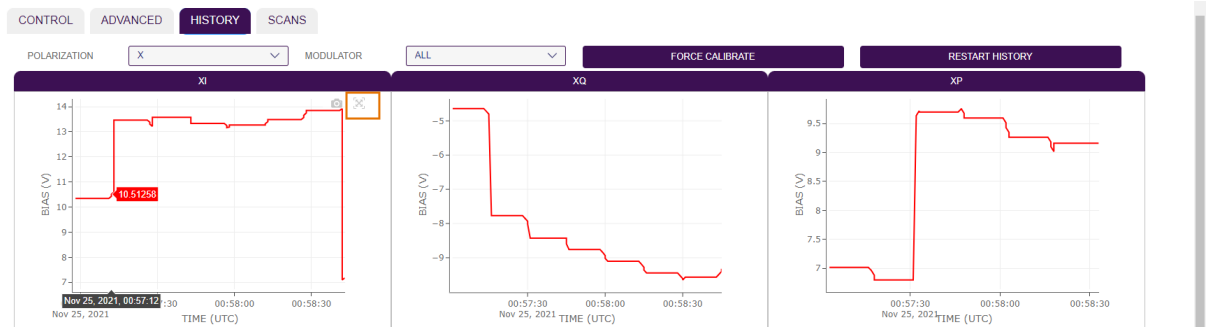
9.10 Reviewing modulator bias values vs time error history plots

To review modulator bias value vs. time error history plots, click the HISTORY tab.

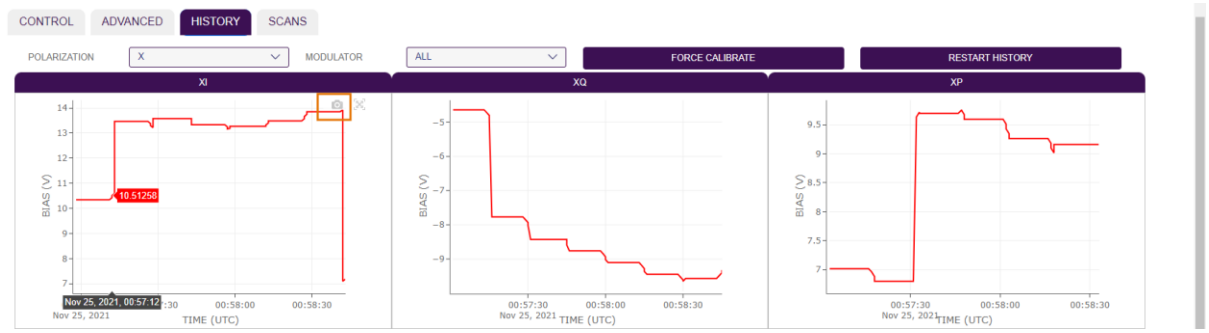
The polarization (X or Y) and the modulator biases (All, I, Q, P) can be selected and filtered by clicking the drop down lists above the plots area.



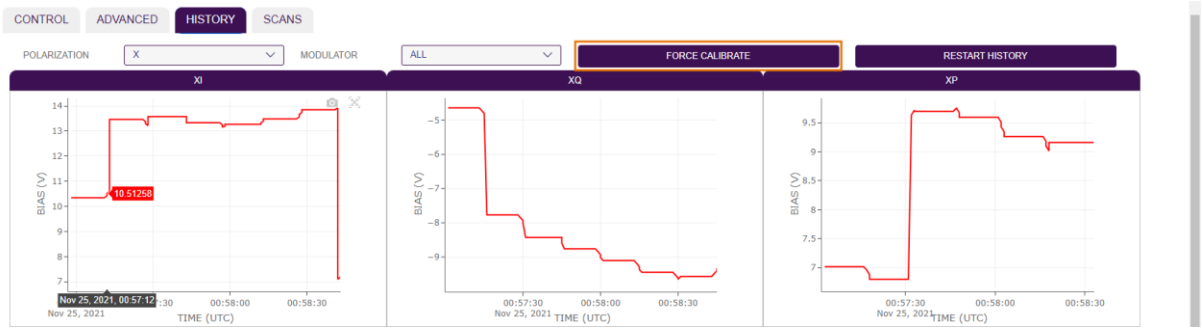
The plots can be zoomed to show a specific section of the analysis by clicking and dragging the desired area with the cursor. To reset the zoom, click the Autoscale button or double-click on the plot area.



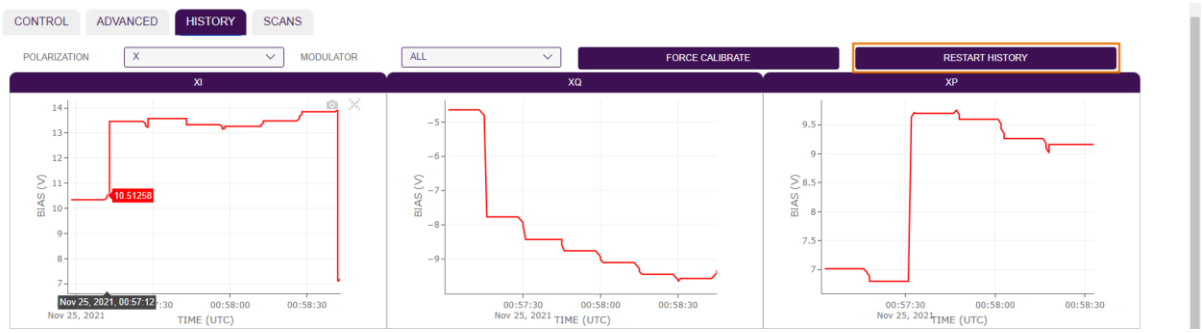
To download a plot as a PNG file, click the 'Download plot as a png' button.



Clicking the FORCE CALIBRATE button will initiate a new DC bias scan.



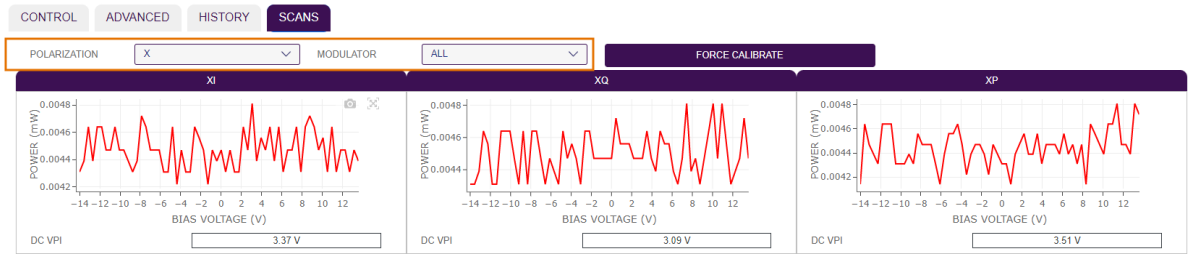
To clear the modulator's error plots history, click the RESTART HISTORY button.



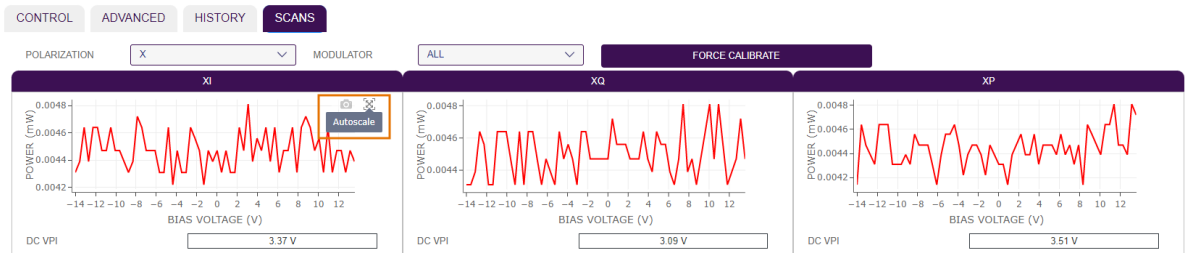
9.11 Reviewing modulator biases power vs biases voltage plots

To review modulator biases power vs. biases voltage plots, click the SCANS tab.

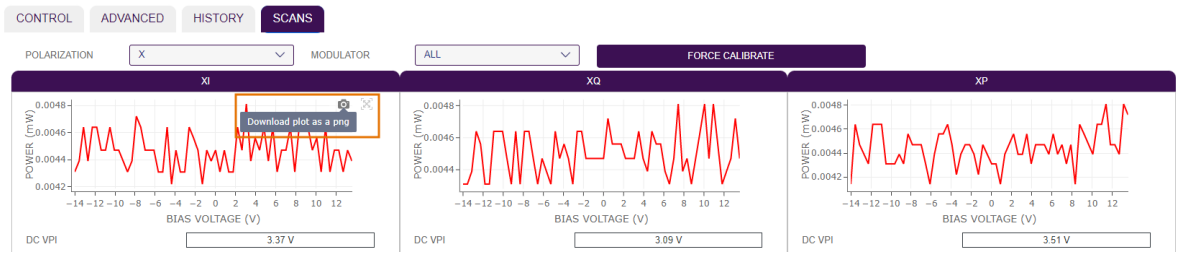
The polarization (X or Y) and the modulator biases (All, I, Q, P) can be selected and filtered by clicking the drop down lists above the plots area.



The plots can be zoomed to show a specific section of the analysis by clicking and dragging the desired area with the cursor. To reset the zoom, click the Autoscale button or double-click on the plot area.



To download a plot as a PNG file, click the ‘Download plot as a png’ button.



10 Operating IQTX from the LCD interface

10.1 Powering on / off the IQTX instrument

To power on the IQTX press the On / Off button; the button will become illuminated to verify the instrument is powered on.

⚠ IMPORTANT

After powering on the IQTX, please wait at least 1 minute before attempting to communicate with the instrument. This will allow the IQTX enough time to finish boot procedures and initialize the communication server.

To power Off the IQTX press the On / Off button. The button will no longer be illuminated, indicating the instrument is Off.

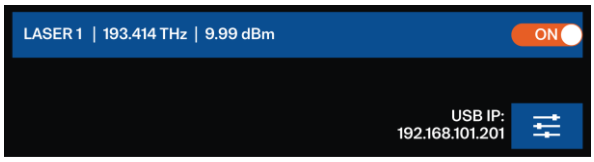
10.2 LCD control touch-screen Graphical User Interface (GUI)

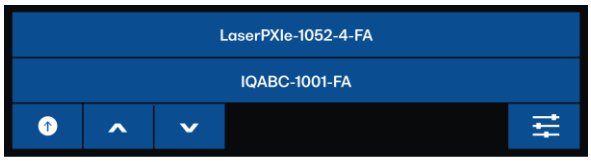
The IQTX has a touch-screen Graphical User Interface (GUI; referred to as the 'Display') which provides a local access to the web server application.

10.2.1 Main display

The main display shows the available laser channels and their frequency and power values, along with the option to power on / off a specific laser channel and to adjust the settings of the instrument.

The IQTX IP address is displayed irrespective of the operation mode (access over USB or Ethernet). When both USB and Ethernet cables are connected to the instrument, the IP displayed on the LCD will alternate between USB and Ethernet IP addresses.





10.2.2 Setting laser channel parameter values

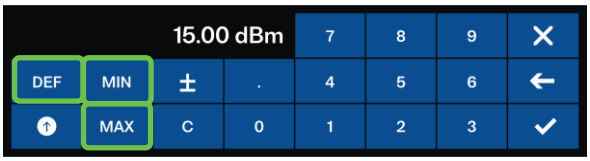
Clicking the laser channel row in the main display will open the configuration panel of the laser channel.

Specific parameters of the laser channel can be set either by clicking the parameter name, or by using the + and – control buttons to increase or decrease the value field by a set amount. This step size is set in the STEP SIZE tab in the menu.

This applies to the following parameters:

- FREQUENCY (Wavelength): The desired frequency (wavelength) of light that the IQTX instrument should output. This corresponds to the spectral location of the central peak of the laser.
- POWER: The desired output power of the IQTX instrument.

Alternatively, the parameter can also be set to the MIN, MAX or DEF value by clicking the buttons in the parameter settings panel. In the example below, the POWER has been set to the MAX value of 15 dBm. To apply the changes, click the tick mark.



⚠ IMPORTANT

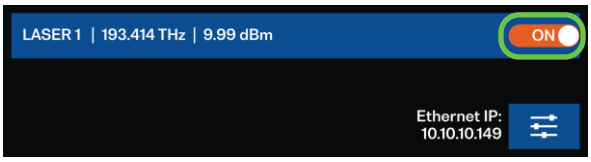
The tick mark **MUST** be clicked in order for any changes or values that were entered to be applied successfully.

10.2.3 Toggling the laser channel on / off

To toggle the laser in a specific channel ON or OFF, click the ON / OFF toggle button.

⚠ IMPORTANT

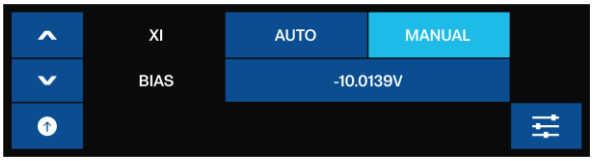
After toggling the laser channel **from OFF to ON**, the IQTX instrument will take up to **30 seconds to stabilise** its power and frequency.



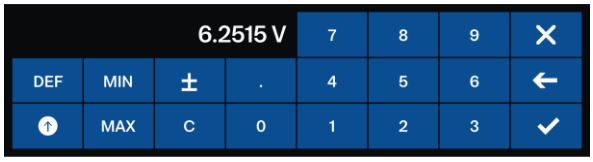
10.2.4 Setting modulation channel parameters

Clicking the IQABC row in the main display will open the configuration panel of the modulation channels.

Select a channel and set the mode to AUTO or MANUAL.



In manual mode you can set the BIAS value for the channel.



10.2.5 Settings menu

The settings menu is used to configure the IQTX instrument settings and unit preferences. These controls can be accessed by clicking the settings button on the right-hand bottom corner.

10.2.6 Navigation within the settings menu

The up and down arrows are used to scroll the selections of the menu when there are more options than can be displayed.

The bottom button is used to take a step 'back' one level in the menu system. This will return you to the previous menu page.

10.2.7 Device information

To access the information about the IQTX instrument, click on the DEVICE INFO tab in the menu. IQTX's model name and serial number will be displayed along with the software version number.

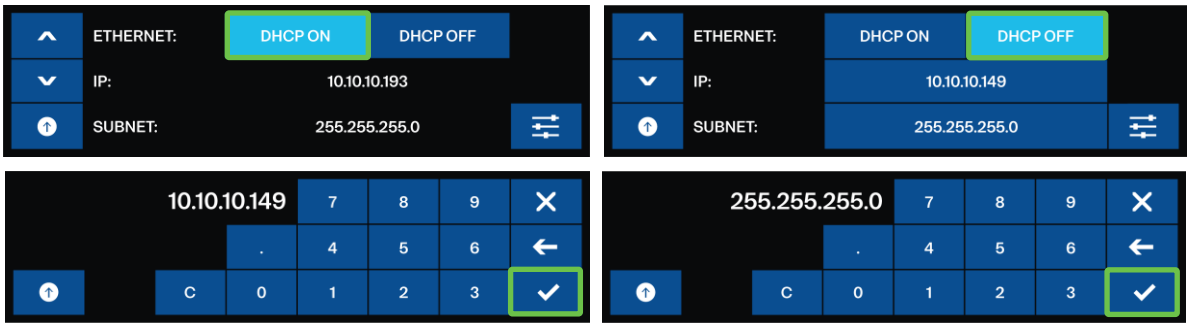
10.2.8 Ethernet connectivity configuration

To access the Ethernet connectivity configuration, click on the ETHERNET tab in the menu.

To set a dynamic IP addressing method, select the DHCP ON button. The DHCP will automatically assign the instrument an IP address.

To set a static IP address over the Ethernet, select the DHCP OFF button and set the IP address and the Subnet mask by clicking on the IP / SUBNET filed and typing in a valid value. To save and apply the changes click the tick mark.

To test if the IP addressing has worked, power OFF the instrument, and disconnect the USB cable. Turn the unit back ON, and once it has finished booting, check the IP address shown on the main LCD display.

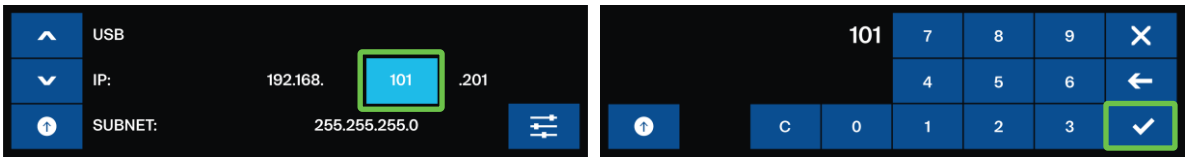


10.2.9 USB connectivity configuration

To access the USB connectivity configuration, click on the USB tab in the menu.

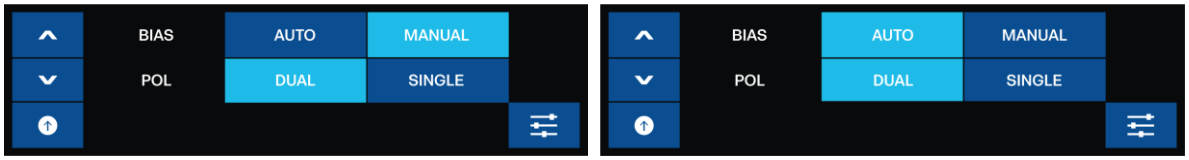
When connected via USB, the default IP address is **192.168.101.201**. This is a static address set during instrument calibration. If necessary, this address can be changed. Typing the default IP address in a supported web browser will open the CohesionUI page for the instrument.

To change the USB IP address, click on the 3rd octet of the IP address and set to any available value. It is important to make sure that any other instruments connected to the computer do not share this new IP address, as there will be an addressing conflict. To save and apply the changes click the tick mark.



10.2.10 ABC setup settings

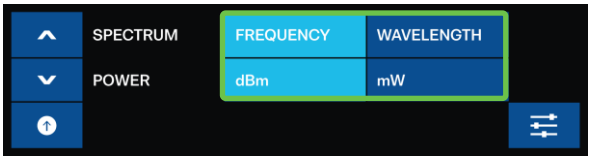
To access the ABC setup settings, click on ABC SETUP in the Settings menu.



10.2.11 Unit settings

To access the unit settings, click on the UNITS tab in the menu.

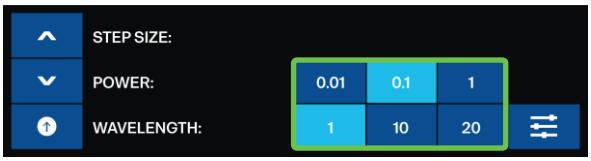
Set the preferred measuring unit of the spectrum and the power by selecting the desired unit type next to the value.



10.2.12 Step size settings

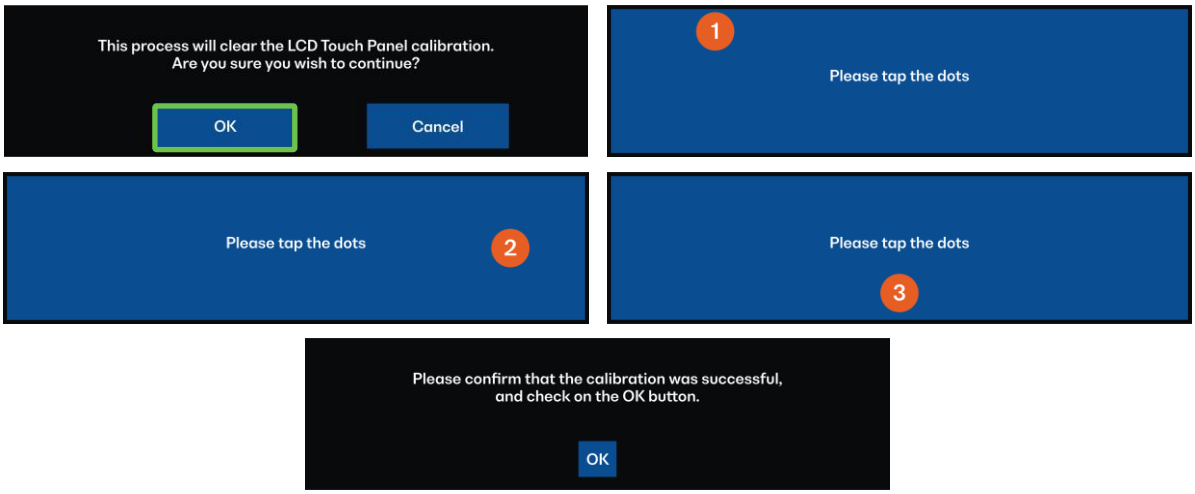
To access the step size settings, click on the STEP SIZE tab in the menu.

Step size refers to the amount by which the wavelength, power and additional values increase or decrease when the + or - button are clicked.



10.2.13 LCD calibration reset

To reset the LCD interface settings and calibration, click on the LCD CALIBRATION tab in the menu and select OK. Follow the instructions on the display to calibrate the LCD interface.


This process will clear the LCD Touch Panel calibration.
Are you sure you wish to continue?
OK
Cancel
1
Please tap the dots
Please tap the dots
2
Please tap the dots
3
Please confirm that the calibration was successful,
and check on the OK button.
OK

11 Programming guide

Introduction

Remote communication with the CohesionSCPI service is achieved through the Standard Commands for Programmable Instruments (SCPI). Support for VISA I/O API over TCP/IP is provided by the VXI-11 compliant CohesionSCPI service. With VISA communication drivers installed on the client, the implementation of VISA programming within environments such as MATLAB becomes available.

This guide provides general information on the commands available to communicate with the CohesionSCPI service remotely using the VISA I/O.

> **⚠ IMPORTANT**
>
> In NI-MAX a RIO interface will show up, however there are no communication methods available or implemented on this interface. Quantifi Photonics products are **ONLY** accessible through the **VISA TCPIP INSTR** interface provided by the CohesionSCPI service installed on the system.

11.1 Programming conventions

This section details the programming and measurement conventions to follow while executing the commands for the CohesionSCPI service.

Parameter	Default Unit	Alternative Units
Power	DBM	MDBM, UDBM, W, MW, UW
Frequency	HZ	THZ, GHZ, MHZ, KHZ
Frequency Fine	HZ	THZ, GHZ, MHZ, KHZ
Wavelength	NM	M, MM, UM, PM
Bias	V	MV
Offset	UI	
Grid size	HZ	THZ, GHZ, MHZ, kHZ
Time	S	MS, US, NS

Argument	Data Format
`<wsp>`	Specifies whitespace character (01_{16} – 09_{16}, $0B_{16}$ – 20_{16}).
`<value>`	Is numerical data, an integer, a decimal, exponential (10e-9 or 5.8e6) or string
`[VALUE1|VALUE2]`	A parameter choice. The '|' separates the unique parameters available, only one of the choices can be used. In the example, either the input parameter `[VALUE1]` or `[VALUE2]` can be used, but not both. Some commands may have more than two choices available. This parameter can be omitted where the command has a default defined in the command description.

11.1.1 Index addressing of modules (slot, source) and units (channel)

When executing commands, it is almost always necessary to provide the index of a specific module or an index of a specific installed unit.

For the commands that require index values:

- `<c>`: is the chassis index in which the specific blade module is installed; this is an integer, inclusive of 0.
- `<n>`: is the slot (or source) index of the specific ID, this is an integer, <1 to 18>
- `<m>`: is the channel index of a specific channel, this is an integer, <1 to 6>.

Message queues

Information is exchanged in the form of messages. These messages are held in input and output queues. The output queue stores responses to query commands. The CohesionSCPI service transmits any data in the output queue when a read request is received. Unless specified in the command description, all output response data is transmitted in ASCII format.

11.2 Status and event registers

11.2.1 Standard Event Status Register

The Standard Event Status Register (SESR) is modified by the IQTX with the results of the command operations.

Bit	Description
7 (MSB), 6	Not used
5	Is set when a **Command Error** event has been detected
4	Is set when a command **Execution Error** has been detected
3	Is set when a **Device Dependent Error** event has been detected
2	Is set when there a **Query Error** event has been detected
1	Not used
0 (LSB)	Is set when an **Operation Complete** event has been generated

11.2.2 Standard Event Status Enable Register (Mask)

The Standard Event Status Enable Register (SESR Mask) is used to build the Event Status Bit (ESB) within the Status Byte Register (STB). To ignore any of the events detected and set in the SESR, set the corresponding bit within the SESR Mask to 0. The STB can then be queried and the value of the ESB can be used to determine service request requirements based on the SESR Mask applied.

NOTE

The default bit values within the SESR Mask are all 0.

11.2.3 Status Byte Register

The Status Byte Register (STB) is built from all other status registers and masks. This register can be used in queries to determine if an event has been detected and where that event has been detected.

Bit	Description
7 (MSB)	Not used
6	The Master Summary Status (MSS) bit is set from the **STB** and **SRE** Mask
5	The Event Status Bit (ESB) is set from the **SESR** and the **SESR** Mask
4	Message Available (MAV) is set when there is **data in the output queue**
3, 2, 1, 0 (LSB)	Not used

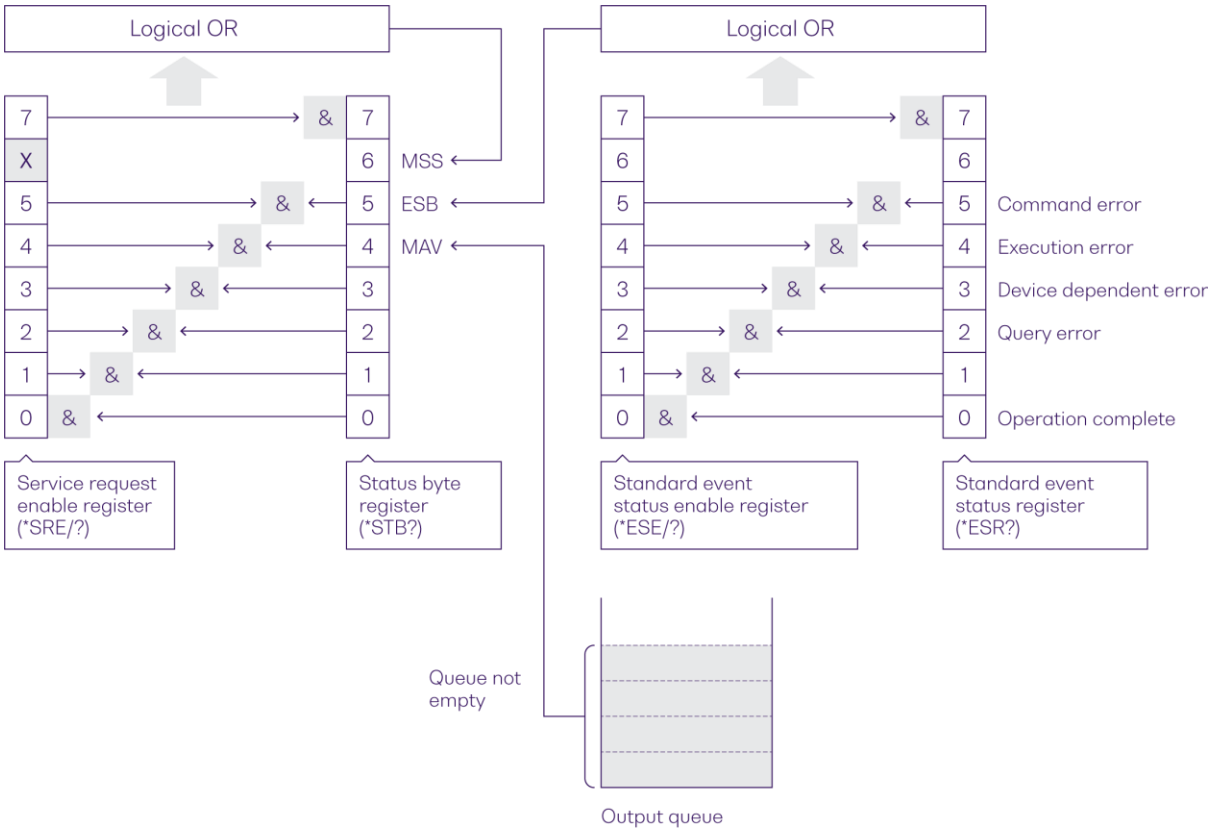
11.2.4 Service Request Enable Register (Mask)

The Standard Request Enable Register (SRE Mask) is used to build the Master Summary Status Bit (MSS) within the Status Byte Register (STB). To ignore any of the events detected and set in the STB register itself, set the corresponding bit within the SRE Mask to 0. The STB can then be queried and the value of the MSS can be used to determine the type of service request required based on the SRE Mask applied.

NOTE

The default bit values within the SESR Mask are all 0.

Bit	Description
7 (MSB)	Not used
6	The Master Summary Status (MSS) bit is set from the STB and SRE Mask
5	The Event Status Bit (ESB) is set from the SESR and the SESR Mask
4	Message Available (MAV) is set when there is data in the output queue
3, 2, 1, 0 (LSB)	Not used



11.3 Common system command summary

Common Commands	Description
`*IDN?`	- Query the chassis identification
`*OPC?`	- Query the Operation Complete Status
`*OPT?`	- Query the modules managed by the CohesionSCPI service
`*ESR?`	- Query the Standard Event Status Register
`*ESE?`	- Set or query the Standard Event Status Enable
`*RST`	- Reset command
`*TST?`	- Query a Self-Test

11.4 Common system command descriptions

Command	`*IDN?`
Syntax	`*IDN?`
Description	Query the chassis identification
Parameters	No parameters
Response	Comma separated string with the `<manufacturer>,<server name>,<chassis controller name>,<server version>`
Example	`*IDN? -> Quantifi Photonics Ltd, IQTX-1203-FA-EPIQ,CSL-204102, HW0.00.00SW3.00.02`

Command	*OPC?
Syntax	*OPC?
Description	Query the Operation Complete Status
Parameters	No parameters
Response	1 is returned if all the modules installed in the chassis are ready to execute commands 0 is returned if any module installed in the chassis still has a command to execute in the input queue
Example	*OPC? -> 1

Command	*OPT?
Syntax	*OPT?
Description	Query the modules managed by the CohesionSCPI service
Parameters	No parameters
Response	Response will be a comma separated string of the installed modules in the chassis
Example	*OPT? -> LASER,IQABC

Command	*ESR?
Syntax	*ESR?
Description	Query the Standard Event Status Register
Parameters	No parameters
Response	Unsigned integer 8 bit value for the register <0 to 255>, as a string. Bit / Description / Decimal Value 7 (MSB) / Not used / 0 6 / Not used / 0 5 / Command Error / 32 4 / Execution Error / 16 3 / Device dependent Error / 8 2 / Not used / 0 1 / Not used / 0 0 (LSB) / Operation Complete / 1
Example	*ESR? -> 8

⚠ IMPORTANT

It is recommended to use the *ESR? command query after every command that is sent to the device. The *ESR? query will be able to catch:

- Device dependent Error – the device is reporting an error in operation
- Execution Error – SCPI was unable to execute the given command
- Command Error – SCPI was unable to parse the command, likely due to an incorrect command

Command	*ESE
Syntax	*ESE<wsp><value>
Description	Sets the Standard Event Status Enable Register (Mask) which defines the logic in determining the state of the Event Status Bit (ESB) bit, within the Status Byte Register. This register is cleared when the IQTX is powered on or a <value> of 0 is set. This register is not cleared by the *RST command.
Parameters	Integer bit value for the register <0 to 255> Bit / Description / Decimal Value 7 (MSB) / Not used / 0 6 / Not used / 0 5 / Command Error / 32 4 / Execution Error / 16 3 / Device Dependent Error / 8 2 / Not used / 0 1 / Not used / 0 0 (LSB) / Operation Complete / 1
Response	No response
Example	*ESE 61

Command	*ESE?
Syntax	*ESE?
Description	Query the Standard Event Status Enable Register (Mask)
Parameters	No parameters
Response	Integer bit value for the register <0 to 255> **Bit** **Description** **Decimal Value** 7 (MSB) Not used 0 6 Not used 0 5 Command Error 32 4 Execution Error 16 3 Device Dependent Error 8 2 Not used 0 1 Not used 0 0 (LSB) Operation Complete 1
Example	*ESE? -> 61

Command	*RST
Syntax	*RST
Description	The reset command will clear all current configuration settings and restart the IQTX. Effectively power cycling the instrument and restarting with stored configuration settings.
Parameters	No parameters
Response	No response
Example	*RST

Command	*TST?
Syntax	*TST?
Description	Perform a Self-test query on the IQTransmitter
Parameters	No parameters
Response	Integer bit value <0 to 65535> **Bit** **Description** **Decimal Value** 5 – 15 (MSB) Not Used 0 4 Slot 4 16 3 Slot 3 8 2 Slot 2 4 1 Slot 1 2 0 (LSB) IQTX 1 Any bits set to 1 indicate an error in that component. This command will return “0” if all components are working correctly.
Example	*TST? -> 18

11.5 Specific command summary

System commands	Description
:SYSTEM	
:INFO?	- Query the driver and the server version numbers from the IQTX
:SLOTS?	- Query the number of slots installed in the IQTX
:VERSion?	- Query the SCPI compliance version number
Slot commands	
:ABC	
:OPC/?	- Query the status of the Operation Complete bit
:OPTions?	- Query the modules installed on the slot
:IDN?	- Query the Identifier for the slot; returns the manufacturer, part number, serial number, hardware, and firmware versions
Configuration commands	
:ABC	
:[XI|XQ|XP|YI|YQ|YP]	
:PILOT/?	- Set or query the modulation channel auto-bias state
:BIAS/?	- Set or query the modulation channel DC bias voltage
:LOCK?	- Query whether the bias is locked to its optimal position
:PDPower/?	- Set or query the output power of the unit (mW)
:CALibrate/?	- Force or query the recalibration of the auto-bias control system
:OUTPut	
:CHANnel[m]	
:STATE/?	- Set or query the optical output state of the laser
:SOURce	
:CHANnel[m]	
:POWer/?	- Set or query the laser output power
:WAVelength/?	- Set or query the laser output wavelength value, with 0.01 pm resolution
:FREQuency/?	- Set or query the laser output frequency value, with 1 MHz resolution
:FINE/?	- Set or query the fine-tuning laser output frequency up to +/- 6 GHz around the closest GRID point, with 1 MHz resolution
:GRID/?	- Set or query the grid spacing
:WHISper/?	- Set or query the Whisper mode state of the laser
:TEMPerature?	- Query the laser temperature

11.6 Specific command descriptions

11.6.1 System commands

Command	:SYSTEM:INFO?
Syntax	:SYSTEM:INFO?<wsp>[ALL|SERVER|DRIVER]
Description	Query the driver and the server version numbers from the IQTX
Parameters	ALL: Get the driver and the server version numbers SERVER: Get the server version number DRIVER: Get the driver version number
Response	Comma separated string containing the <parameter>,<version number>
Example	:SYSTEM:INFO? -> IQTX-1203-XX-EPIQ :SYSTEM:INFO? ALL -> DRIVER,3.01.04 SERVER,3.00.02

Command	:SYSTEM:SLOTS?
Syntax	:SYSTEM:SLOTS?
Description	Query the number of slots installed in the IQTX
Parameters	No parameters
Response	Returns the number of slots installed in the IQTX
Example	:SYSTEM:SLOTS? -> 1

Command	:SYSTEM:VERSion?
Syntax	:SYSTEM:VERSion?
Description	Query the SCPI compliance version from the IQTX
Parameters	No parameters
Response	The decimal version number of SCPI compliance
Example	:SYSTEM:VERS? -> 1990.0

11.6.2 Slot commands

Command	:ABC:OPC?
Syntax	:ABC:OPC?
Description	Query the status of the Operation Complete bit
Parameters	No parameters
Response	1 is returned if the module is ready to execute a new operation 0 is returned if the module is busy
Example	:ABC:OPC? -> 1

Command	:ABC:OPTions?
Syntax	:ABC:OPTions?
Description	Query the modules installed on the slot
Parameters	No parameters
Response	Comma separated string of detectors installed in the IQTX. If a module is not installed in a channel, it will not return any identification string
Example	:ABC:OPT? -> 1,1,1,1,1,1

Command	:ABC:IDN?
Syntax	:ABC:IDN?
Description	Query the Identifier for the slot; returns the manufacturer, part number, serial number, hardware and firmware versions
Parameters	No parameters
Response	Comma separated string containing the <manufacturer>, <part number>, <serial number>,<hardware version><firmware version>
Example	:ABC:IDN? -> Quantifi Photonics Ltd, IQABC-1001-FA, CSL-000000, HW0.01.06FW0.00.05 Hardware and firmware versions are not separated by a comma

11.6.3 Configuration commands

Command	:ABC:[XI|XQ|XP|YI|YQ|YP]:PILOT
Syntax	:ABC:[XI|XQ|XP|YI|YQ|YP]:PILOT<wsp>[1|ON|0|OFF|DEF]
Description	Set the modulator channel auto-bias state
Parameters	1 | ON: Set to the modulation auto-bias state to on 0 | OFF: Set to the modulation auto-bias state to off DEF: Set the default programmable modulator channel auto-bias state
Response	No response
Example	:ABC:XI:PILOT ON

Command	:ABC:[XI|XQ|XP|YI|YQ|YP]:PILOT?
Syntax	:ABC:[XI|XQ|XP|YI|YQ|YP]:PILOT?<wsp>[DEF|ALL|SET|INFO]
Description	Query the modulator channel auto-bias state
Parameters	DEF: Query the default programmable modulator channel auto-bias state SET: Query the set programmable modulator channel auto-bias state ALL: Returns all the modulator channel auto-bias states in a comma separated string INFO: Returns the string for the specified channel auto-bias state
Response	1 is returned if the modulator channel auto-bias state is AUTO 0 is returned if the modulator channel auto-bias state is MANUAL
Example	:ABC:XI:PILOT? ALL -> 0,1

Command	:ABC:[XI|XQ|XP|YI|YQ|YP]:BIAS
Syntax	:ABC:[XI|XQ|XP|YI|YQ|YP]:BIAS<wsp>[MIN|MAX|DEF|<value>]
Description	Set the modulator channel bias voltage
Parameters	MIN: Set to the minimum programmable value MAX: Set to the maximum programmable value DEF: Set to the default programmable value <value>: Sets to the user value (V is default) The valid range is <-14.0 to 24.0>
Response	No response
Example	:ABC:XI:BIAS 1

Command	:ABC:[XI|XQ|XP|YI|YQ|YP]:BIAS?
Syntax	:ABC:[XI|XQ|XP|YI|YQ|YP]:BIAS?<wsp>[MIN|MAX|DEF|SET|ALL|STEP|UNIT]
Description	Query the modulator channel bias voltage
Parameters	MIN: Get the minimum programmable value MAX: Get the maximum programmable value DEF: Get the default programmable value SET: Get the desired set value ALL: Returns all of the above parameters in a comma separated string STEP: Returns the step size value UNIT: Returns the BIAS measurement unit
Response	Returns the string for the modulator DC bias voltage for the specified channel
Example	:ABC:XI:BIAS? ALL -> -14.0000,14.0000,6.0000,-3.932

Command	:ABC:[XI|XQ|XP|YI|YQ|YP]:LOCK?
Syntax	:ABC:[XI|XQ|XP|YI|YQ|YP]:LOCK?<wsp>[INFO]
Description	Query whether the bias is locked to its optimal position
Parameters	INFO: Returns the string for the specified channel LOCK states
Response	1 is returned if the modulator channel is LOCKED 0 is returned if the modulator channel is UNLOCKED
Example	:ABC:XI:LOCK? INFO -> 0:FALSE 1:TRUE

Command	:ABC:<XI|XQ|XP|YI|YQ|YP>:HISTory?
Syntax	:ABC:<XI|XQ|XP|YI|YQ|YP>:HISTory?<wsp>[<start_time>,<end_time><BIAS|ERROR|FULL]
Description	Query the error history timeframe and reason
Parameters	<wsp>: The start and end time of the error history BIAS: The bias voltage value and time when the error occurred ERROR: The error number and time when the error occurred FULL: Returns all of the above parameters in a comma separated string
Response	<wsp>: <starttime>,<endtime> BIAS: <timestamp[1]+startTime>:<vbias[1]> ERROR: <timestamp[1]+startTime>:<error[1]> FULL: <timestamp[1]+startTime>:<vbias[1]>,<error[1]>
Example	:ABC1:XI:HISTory? FULL -> 41000203.456:2.54,4.55

Command	:ABC:<XI|XQ|XP|YI|YQ|YP>:SCAN?
Syntax	:ABC:<XI|XQ|XP|YI|YQ|YP>:SCAN?<wsp>[POWER|ERROR|PHASE|FULL|UNIT]
Description	Query the ABC modulator scan results
Parameters	POWER: The measured power values at the time of the scan for the current bias value ERROR: The error numbers at the time of the scan for the current bias value PHASE: The phase values at the time of the scan for the current bias value FULL: Returns all of the above parameters in a comma separated string UNIT: Get the scan measurement unit
Response	POWER: <number of points N>:<dcbias x-axis for all>:<power1,...,powerN> ERROR: <number of points N>:<dcbias x-axis for all>:<error1,...,errorN> PHASE: <number of points N>:<dcbias x-axis for all>:<phase1,...,phaseN> FULL: <number of points N>:<dcbias x-axis for all>:<power1,...,powerN>:<error1,...,errorN>:<phase1,...,phaseN> UNIT: The scan measurement unit
Example	:ABC1:XI:SCAN? POWER -> 32:-14.000000,-13.125000,-12.250000,-11.375000,-10.500000,-9.625000,-8.750000,-7.875000,-7.000000,-6.125000,-5.250000,-4.375000,-3.500000,-2.625000,-1.750000,-0.875000,0.000000,0.875000,1.750000,2.625000,3.500000,4.375000,5.250000,6.125000,7.000000,7.875000,8.750000,9.625000,10.500000,11.375000,12.250000,13.125000:0.000987,0.000926,0.000987,0.001094,0.000865,0.001048,0.000865,0.000926,0.000835,0.000987,0.000774,0.001018,0.000850,0.001109,0.000896,0.000896,0.000957,0.000926,0.000822,0.001021,0.143313,0.143236,0.143236,0.143236,0.143267,0.143145,0.143221,0.143236,0.143175,0.143099,0.143221,0.143130

Command	:ABC:<XI|XQ|XP|YI|YQ|YP>:GAIN
Syntax	:ABC:<XI|XQ|XP|YI|YQ|YP>:GAIN<wsp><value|MIN|MAX|DEF>
Description	Set the gain VPi percentage
Parameters	Value: Set the gain VPi percentage value of the modulation channel MIN: Set the minimum gain VPi percentage value of the modulation channel MAX: Set the maximum gain VPi percentage value of the modulation channel DEF: Set the default gain VPi percentage value of the modulation channel
Response	No response
Example	:ABC1:XI:GAIN SET 20.75

Command	:ABC:<XI|XQ|XP|YI|YQ|YP>:GAIN?
Syntax	:ABC:<XI|XQ|XP|YI|YQ|YP>:GAIN?<wsp>[MIN|MAX|DEF|SET|ALL|UNIT]
Description	Query the gain VPi percentage
Parameters	MIN: Get the minimum gain VPi percentage value of the modulation channel MAX: Get the maximum gain VPi percentage value of the modulation channel DEF: Get the default gain VPi percentage value of the modulation channel SET: Get the default gain VPi percentage value of the modulation channel ALL: Returns all of the above parameters in a comma separated string UNIT: Get the modulation channel gain VPi percentage measurement unit
Response	Depending on the parameters the response will be a single value or a comma separated string of values.
Example	:ABC1:XI:GAIN? SET -> 20.75

Command	:ABC:PDPower?
Syntax	:ABC:PDPower?<wsp>[MIN|MAX|ALL|UNIT|TIME?|TIME?UNIT]
Description	Query the output power of the unit in mW
Parameters	MIN: Get the minimum output power value of the unit MAX: Get the maximum output power value of the unit ALL: Returns all of the above parameters in a comma separated string UNIT: Get the output power measurement unit TIME?: Get the TIME?UNIT: Get the time measurement unit
Response	Returns the current output power of the unit in mW
Example	:ABC:PDP? ALL -> 0.000, 10.000, 0.142

Command	:ABC:PDPower
Syntax	:ABC:PDPower[NULL]
Description	Set the output power of the unit to NULL
Parameters	NULL: Set output power value of the unit to NULL
Response	No response
Example	:ABC:PDP:NULL

Command	:ABC:PDPower:TIMEnulling?
Syntax	:ABC:PDPower:TIMEnulling?<wsp>[UNIT]
Description	Query the dark nulling time remained to complete
Parameters	UNIT: Get the dark nulling time remained to complete measurement unit
Response	No response
Example	:ABC1:PDP:TIME? UNIT -> s

Command	:ABC:PDPower:NULLing
Syntax	:ABC:PDPower:NULLing
Description	Perform dark current nulling on the specified channel
Parameters	No parameters
Response	No response
Example	:ABC1:PDP:NULL

Command	:ABC:CALibrate
Syntax	:ABC:CALibrate[COMpleted]
Description	Forces recalibration of the auto-bias control system
Parameters	No parameters
Response	No response
Example	:ABC:CAL COM

Command	:ABC:CALibrate?
Syntax	:ABC:CALibrate<wsp>[COM|REQ|INFO]
Description	Queries the recalibration status of the auto-bias control system
Parameters	COMpleted: Get the recalibration status of the auto-bias control system REQuested: Query if the recalibration of the auto-bias control system was requested INFO: Returns a string of the auto-bias control system recalibration states
Response	1: Returned if the recalibration status is REQUESTED 0: Returned if the recalibration status is COMPLETED TRUE / FALSE: Returned depending on the REQ / COM state
Example	:ABC1:CAL? REQ -> FALSE

,

Command	:ABC:HISTory:STARt
Syntax	:ABC:HISTory:STARt
Description	Set a reset of the error history
Parameters	No parameters
Response	No response
Example	:ABC1:HIST:STAR

Command	:ABC:VPI?
Syntax	:ABC:MODulator<m>:VPI?<wsp>[POWER|ERROR|PHASE|UNIT]
Description	Query the DC scan VPi
Parameters	POWER: Get the Vpi value as measured from the Output power vs DC Voltage scan ERROR: Get the Vpi value as measured from the bias control error signal vs DC Voltage scan PHASE: Get the Vpi value as measured from the Phase vs DC Voltage scan UNIT: Get the unit of the Vpi value
Response	Depending on the parameters the response will be a single value or a comma separated string of values.
Example	:ABC1:MODulator1:VPI? POWER -> 3.073177,3.030208,3.753062,NAN,NAN,NAN

Command	:ABC:SLOWfactor
Syntax	:ABC:SLOWfactor<wsp><value|MIN|MAX|DEF>
Description	Set the optimizer timing factor
Parameters	Value: Set the optimizer timing factor value of the modulation channel MIN: Set the minimum optimizer timing factor value of the modulation channel MAX: Set the maximum optimizer timing factor value of the modulation channel DEF: Set the default optimizer timing factor value of the modulation channel
Response	No response
Example	:ABC1:SLOWfactor MAX

Command	:ABC:SLOWfactor?
Syntax	:ABC:SLOWfactor?<wsp>[MIN|MAX|DEF|SET|ALL]
Description	Set the optimizer timing factor
Parameters	MIN: Get the minimum optimizer timing factor value of the modulation channel MAX: Get the maximum optimizer timing factor value of the modulation channel DEF: Get the default optimizer timing factor value of the modulation channel SET: Get the default optimizer timing factor value of the modulation channel ALL: Returns all of the above parameters in a comma separated string
Response	Depending on the parameters the response will be a single value or a comma separated string of values.
Example	:ABC1:SLOW? MAX -> 250

Command	:OUTPut:CHANnel[m]:STATE
Syntax	:OUTPut:CHANnel[m]:STATE<wsp>[ON|OFF]
Description	Set the laser output state
Parameters	ON|OFF: To set the output state on or off
Response	No response
Example	:OUTP:CHAN1:STATE ON

Command	:OUTPut:CHANnel[m]:STATE?
Syntax	:OUTPut:CHANnel[m]:STATE?
Description	Query the laser output state
Parameters	No parameters
Response	Returns the current output state of the laser ON / OFF
Example	:OUTP:CHAN1:STATE? -> ON

Command	:SOURce:CHANnel[m]:POWer
Syntax	:SOURce:CHANnel[m]:POWer<wsp>[<value>|MIN|MAX|DEF]
Description	Set the power of the laser
Parameters	<value>: A valid numerical value which is in the range between the MIN and MAX response queried with the POWer? command seen below, or found in the IQTX specifications MIN: Set the laser power to the minimum value MAX: Set the laser power to the maximum value DEF: Set the laser power to the default value
Response	No response
Example	:SOUR:CHAN1:POW 7.0

Command	:SOURce:CHANnel[m]:POWer?
Syntax	:SOURce:CHANnel[m]:POWer?<wsp>[MIN|MAX|DEF|SET|UNIT|STEP|ACT|ALL]
Description	Query the power of the selected laser
Parameters	MIN: Get the minimum programmable value MAX: Get the maximum programmable value DEF: Get the default programmable value SET: Get the desired set value UNIT: Get the measurement unit STEP: Get the step size value ACT: Get the current value (default) ALL: Returns all of the above parameters
Response	Returns the minimum, maximum, set or actual (current) power for the laser as specified by parameters
Example	:SOUR:CHAN1:POW? SET -> 10.0

⚠ IMPORTANT

If the laser STATE is ON while setting WAVelength, FREQuency or FREQuency:FINE, there will be a minimal non-stable output generated during the transition to the new value, as the configuration commands are executed.

Command	:SOURce:CHANnel[m]:WAVelength
Syntax	:SOURce:CHANnel[m]:WAVelength<wsp>[<value>|MIN|MAX|DEF]
Description	Set the laser output wavelength value
Parameters	<value>: A valid numerical value which is in the range between the MIN and MAX response queried with the WAVelength? command seen below, or found in the IQTX specifications MIN: Set the minimum programmable value MAX: Set the maximum programmable value DEF: Set the default programmable value
Response	No response
Example	:SOUR:CHAN1:WAV MIN

Command	:SOURce:CHANnel[m]:WAVelength?
Syntax	:SOURce:CHANnel[m]:WAVelength?<wsp>[MIN|MAX|DEF|SET|UNIT|STEP|ACT|LOCK|ALL]
Description	Query the laser output wavelength value
Parameters	MIN: Get the minimum programmable value MAX: Get the maximum programmable value DEF: Get the default programmable value SET: Get the desired set value UNIT: Get the measurement unit STEP: Get the step size value ACT: Get the current value (default) LOCK: Query whether the laser is currently at the SET wavelength ALL: Returns all of the above parameters
Response	Returns the minimum, maximum or currently set value for the laser wavelength as specified by parameters. The lock parameter will return as TRUE or FALSE
Example	:SOUR:CHAN1:WAV? MAX -> 1.56877267e-06

Command	:SOURce:CHANnel[m]:FREQuency
Syntax	:SOURce:CHANnel[m]:FREQuency<wsp>[<value and unit>|MIN|MAX|DEF]
Description	Set the laser output frequency
Parameters	<value> is a valid numerical value which is in the range between the MIN and MAX response queried with the FREQuency? command seen below, or found in the IQTX specifications, along with the measurement unit MIN: Set the minimum programmable value MAX: Set the maximum programmable value DEF: Set the default programmable value
Response	No response
Example	:SOUR:CHAN1:FREQ 1.92 THZ

Command	:SOURce:CHANnel[m]:FREQuency?
Syntax	:SOURce:CHANnel[m]:FREQuency?<wsp>[MIN|MAX|DEF|SET|UNIT|STEP|ACT|LOCK|ALL]
Description	Get the laser output frequency
Parameters	MIN: Get the minimum programmable value MAX: Get the maximum programmable value DEF: Get the default programmable value SET: Get the desired set value UNIT: Get the measurement unit STEP: Get the step size value ACT: Get the current value (default) LOCK: Query whether the laser is currently at the SET frequency ALL: Returns all of the above parameters
Response	Returns the minimum, maximum or currently set frequency for the laser as specified by parameters. The lock parameter will return as true or false
Example	:SOUR:CHAN1:FREQ? MAX -> 1.96250000e+14

Command	:SOURce:CHANnel[m]:FREQuency:FINE
Syntax	:SOURce:CHANnel[m]:FREQuency:FINE<wsp>[<value and unit>|MIN|MAX|DEF]
Description	Set the fine-tuning laser output frequency
Parameters	<value>: A valid numerical value in the frequency fine tuning range. Fine tuning can increase or decrease the frequency (positive or negative value). Valid range is from -6 GHz to 6 GHz in 1 MHz increments as detailed in the specifications. MIN: Get the minimum programmable value MAX: Get the maximum programmable value DEF: Get the default programmable value
Response	No respponse
Example	:SOUR:CHAN1:FREQ:FINE MAX

Command	:SOURce:CHANnel[m]:FREQuency:FINE?
Syntax	:SOURce:CHANnel[m]:FREQuency:FINE?<wsp>[MIN|MAX|DEF|SET|UNIT|STEP|ALL]
Description	Query the fine-tuning laser output frequency
Parameters	MIN: Get the minimum programmable value MAX: Get the maximum programmable value DEF: Get the default programmable value SET: Get the desired set value UNIT: Get the measurement unit STEP: Get the step size value ALL: Returns all of the above parameters
Response	Returns the minimum, maximum or currently set fine tuning frequency for the laser as specified by parameters.
Example	:SOUR:CHAN1:FREQ:FINE? -> 8.90000000e+07

⚠ IMPORTANT

The Laser STATE must always be set to OFF before attempting to change the GRID spacing.

Command	:SOURce:CHANnel[m]:GRID
Syntax	:SOURce:CHANnel[m]:GRID<wsp>[<value and unit>|MIN|MAX|DEF]
Description	Set the channel grid spacing
Parameters	<value>: Is the channel grid spacing within the specification range given by the MIN and MAX response queried with the GRID? command below. MIN: Get the minimum programmable value MAX: Get the maximum programmable value DEF: Get the default programmable value
Response	No response
Example	:SOUR:CHAN1:GRID 2 GHZ

Command	:SOURce:CHANnel[m]:GRID?
Syntax	:SOURce:CHANnel[m]:GRID?<wsp>[MIN|MAX|DEF|SET|ALL]
Description	Query the grid spacing
Parameters	MIN: Get the minimum programmable value MAX: Get the maximum programmable value DEF: Get the default programmable value SET: Get the desired set value ALL: Returns all of the above parameters
Response	Returns the minimum, maximum or currently set grid spacing for the laser as specified by parameters.
Example	:SOUR:CHAN1:GRID? MIN -> 1.000000e+08

Command	:SOURce:CHANnel[m]:WHISper
Syntax	:SOURce:CHANnel[m]:WHISper<wsp>[ON|OFF]
Description	Set the Whisper mode state of the laser
Parameters	ON: Enable the Whisper mode functionality on the laser OFF: Disable the Whisper mode functionality on the laser
Response	No response
Example	:SOUR:CHAN1:WHIS ON

Command	:SOURce:CHANnel[m]:WHISper?
Syntax	:SOURce:CHANnel[m]:WHISper?
Description	Query the Whisper mode state of the laser
Parameters	No parameters
Response	Current Whisper mode state of the laser
Example	:SOUR:CHAN1:WHIS? -> ON

Command	:SOURce:CHANnel[m]:TEMPerature?
Syntax	:SOURce:CHANnel[m]:TEMPerature?
Description	Get the laser temperature
Parameters	No parameters
Response	Numerical temperature in degrees Celsius
Example	:SOUR:CHAN1:TEMP? -> 26.88

11.7 SCPI Command Console

The SCPI Command Console enables you to communicate with Quantifi Photonics devices via SCPI commands. You can easily test commands and verify their syntax.

NOTE

For available SCPI commands, refer to the user manual of the Quantifi Photonics device you are communicating with.

NOTE

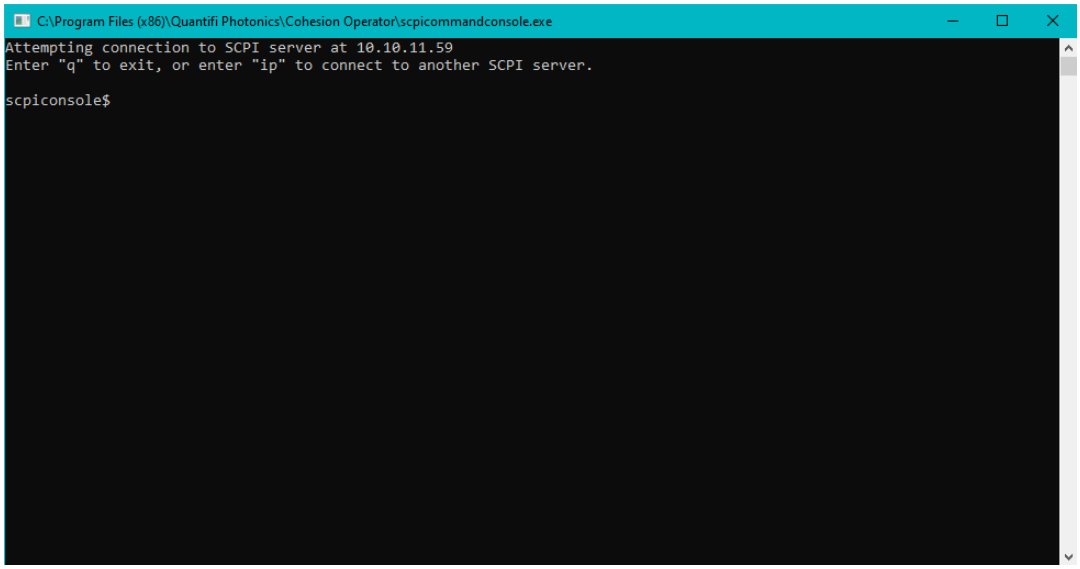
The two most common error codes are:

17: IO write error: the command was invalid or not accepted by the instrument.

15: IO timeout: there was no response available before expiry of the reading wait time.

To open the SCPI Command Console:

- Open the Cohesion Operator, for example by double-clicking the **Cohesion Operator** desktop icon.
- Select the instrument by entering its **IP address** or by selecting it from the **Discovery** drop down list.
- Click Open SCPI Command Console.



1. To verify that you are communicating with the right device:

- Enter **`*idn?`** and press <ENTER>.
- The device will return identification details.

2. To switch to another Quantifi Photonics device:

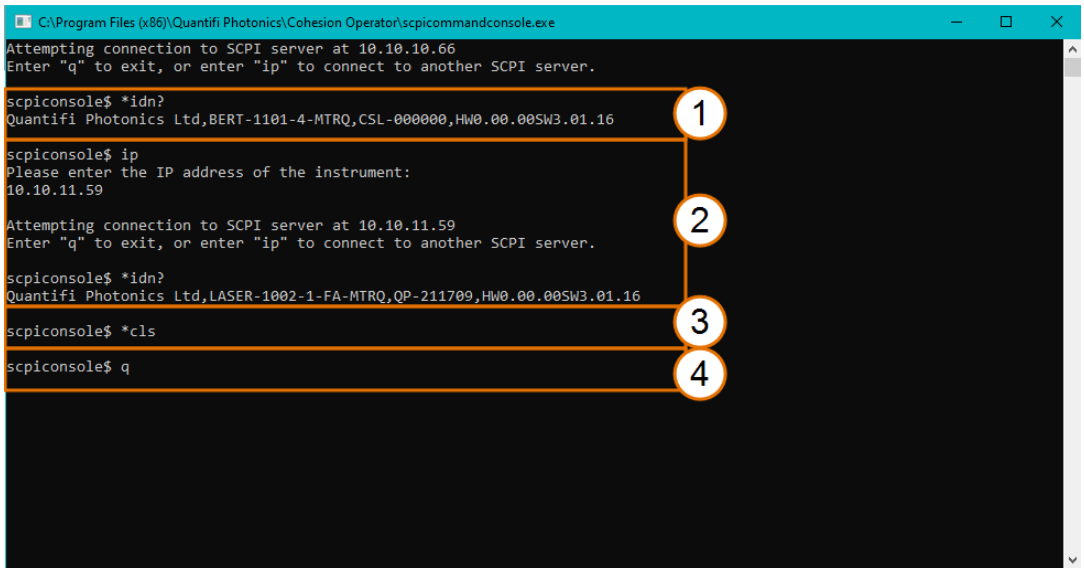
- Enter **ip** and press <ENTER>.
- Enter the IP address of the Quantifi Photonics product you would like to switch to and press <ENTER>.
- Confirm you are communicating with the right product: Enter ***idn?** and press <ENTER>. The device will return identification details.

3. To send a command or query to a Quantifi Photonics device:

- Enter a command and press <ENTER>.
- The device will execute the command and return an action response to the console if applicable.

4. To exit the SCPI Command Console:

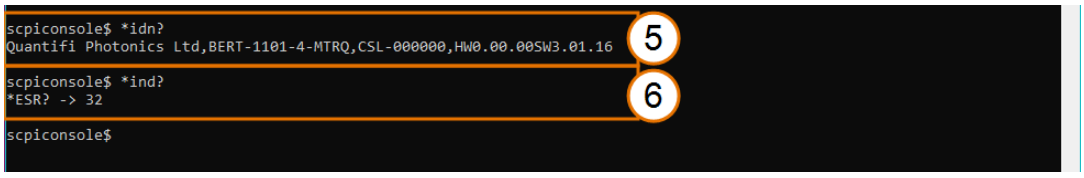
- Enter q and press <ENTER>.



Example: Send instrument identification query ***idn?**

5. Enter the command: ***idn?**
   The instrument returns the requested information.

6. If you enter the command incorrectly, for example: ***ind?**
   The instrument returns error code 32.
   For details on error codes, please refer to the `*ESR?` Command.



Example: Send a WRITE only command

7. Enter a command correctly, for example: **`*cls`**
   The instrument executes the command, there will be no action response.

8. Enter the command incorrectly: **`*csl`**
   The instrument returns error code 17: IO write error.

12 Example: Control of the IQTX with SCPI

The following is a simple example of how to control the IQTX instrument by using SCPI commands. See the previous section for specific details and extra parameters that the listed commands accept.

After any command, it is recommended to query the `*ESR?` command. This will allow debugging of unreceived or incorrect commands that were sent to the product.

Identifying the IQTX instrument and installed modules:

1. Query to confirm the correct instrument is setup

   ```
   :*IDN?
   -> Quantifi Photonics Ltd,IQTX-1102-FA-EPIQ,QP-998877,HW0.00.01SW3.01.18
   ```

2. Query the available instrument module configuration

   ```
   :*OPT?
   -> IQABC,LASER
   ```

3. Query the identification information for a specific slot module

   ```
   : MODUle2:IDN?
   -> Quantifi Photonics Ltd,LASER-1002-2-SC,QP-987654,HW0.01.02FW0.01.32
   ```

Configuring the Laser module on the IQTX instrument:

1. Set the Laser output power to 10 dBm

   ```
   : SOURce2:CHANnel1:POWer 10 DBM
   ```

2. Set the Laser frequency to 193.4145 THz (1550nm)

   ```
   : SOURce2:CHANnel1:FREQuency 193.4145 THZ
   ```

3. Turn the Laser ON

   ```
   : OUTPut2:CHANnel1:STATE ON
   ```

> **⚠ IMPORTANT**
> The following section details the various methods that a user may send these commands to the IQTX instrument via **SCPI** commands

Force calibrate of the IQABC:

1. Force the recalibration of the auto-bias control system

   ```
   :ABC1:CALibrate
   ```

2. Query the completion status of the auto-bias control system calibration

   ```
   :ABC1:CALibrate? COMpleted
   -> TRUE
   ```

Querying the status of the IQABC module:

1. Query whether the XI bias is locked in the optimal position

   ```
   :ABC1:XI:LOCK?
   -> 1
   ```

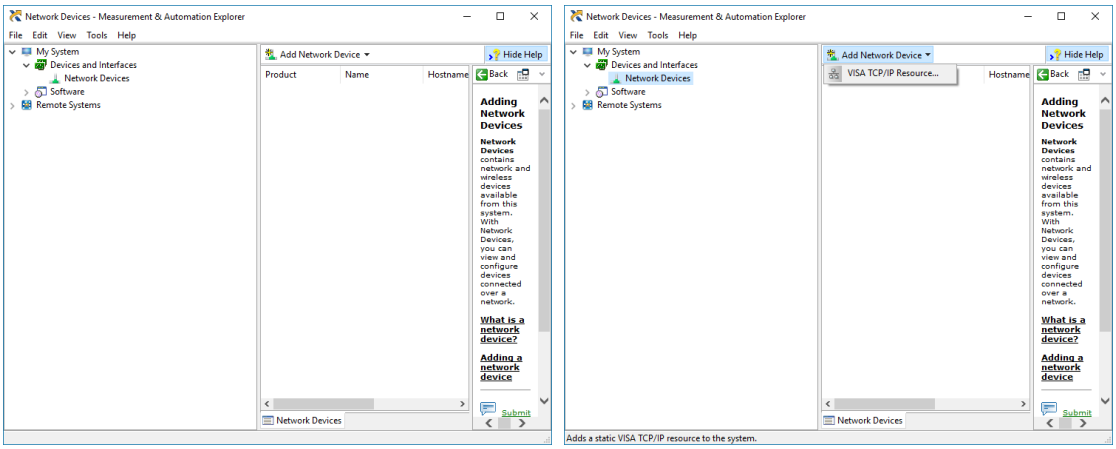
⚠ IMPORTANT

The following section details the various methods that a user may send these commands to the IQTX instrument via **SCPI** commands

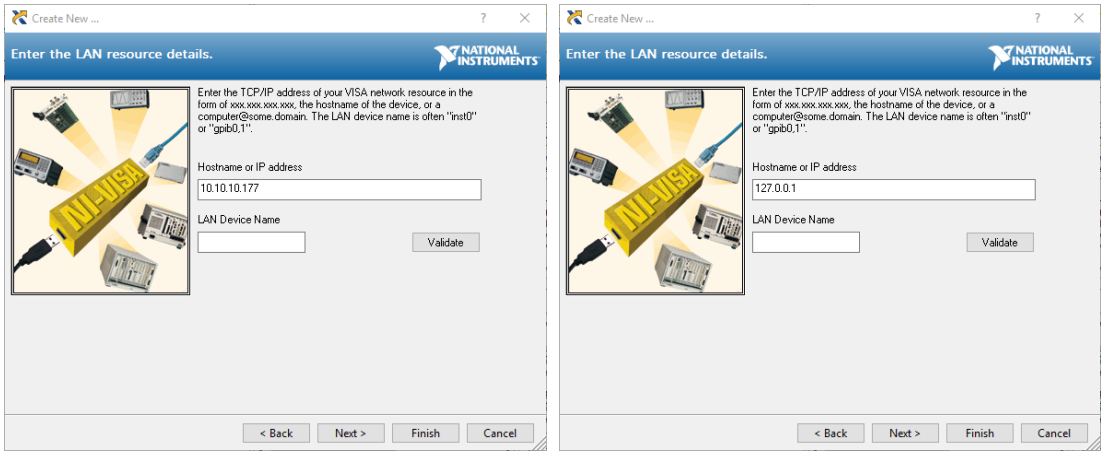
12.1 NI-MAX application

To communicate with any Quantifi Photonics IQTX instrument, it must first be setup as a TCP/IP instrument.

1. After installing NI-MAX, launch the application. In the left side panel of the window, click the **Devices and Interfaces** option. A drop down of available instruments detected will show up.
2. Click on **Network Devices**, then click **Add Network Devices** and select **VISA TCP/IP Resource**.



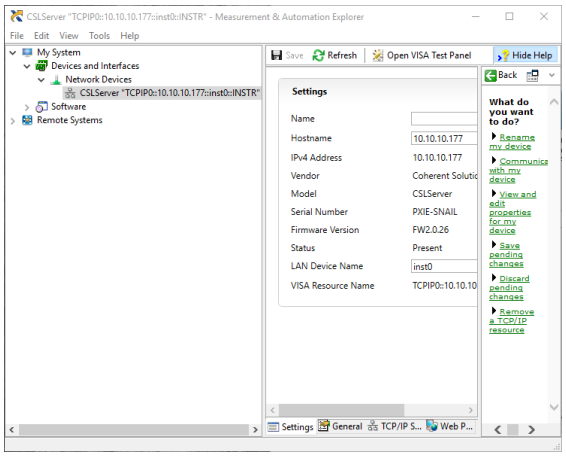
3. Select **Manual Entry of LAN Instrument**. Enter in the Hostname or IP Address. The top image is an example of operating remotely, the bottom image is an example of operating locally. Note when operating locally, enter in the localhost IP address of **127.0.0.1**. Click **Finish** to end the setup process.



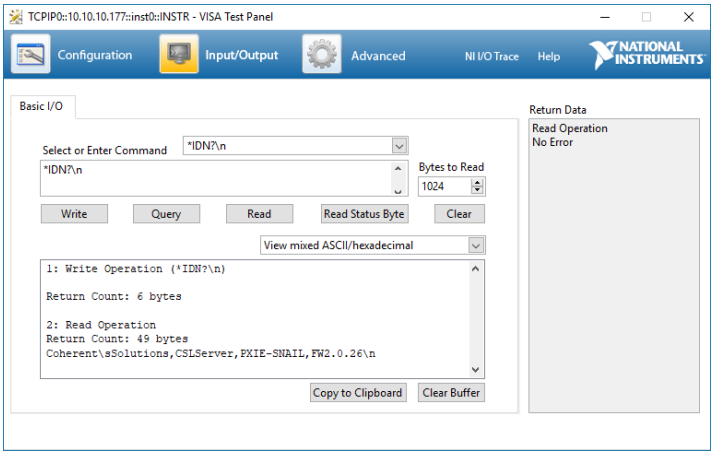
12.2 NI-VISA application

NI-VISA is used to communicate IQTX instrument. The above steps must be completed before attempting to communicate using NI-VISA.

1. Launch NI-MAX. In the left-hand side menu, select an Instrument from the **Network Devices** list.



2. On the right-hand side panel, select **Open VISA Test Panel**. A new window will popup. Click the **Input / Output** button from the window menu.
   Valid commands can be entered in, and their returns queried.



12.3 Python® 2.7 code example

The following example shows how to communicate with the IQTX using Python code. For a list of supported and valid SCPI commands, refer to the **Programming Guide**.

```
# You can get VXI11 from pip:
# pip install python-vxi11==0.9
import vxi11
from vxi11.vxi11 import Vxi11Exception
# replace this with the IP of your device
ip = "127.0.0.1"
try:
	print("connecting to " + ip + " ... ")
	instrument = vxi11.Instrument(ip)
	print("connected")
	print("checking IDN...")
	command = "*IDN?"
	data = instrument.ask(command)
	print("IDN: " + data)
	print("checking OPT...")
	command = "*OPT?"
	data = instrument.ask(command)
	print("OPT: " + data)
	# replace this with a valid command for your device (read # the
	programming guide section for examples)
	command = ""
	print("writing a specific command")
	instrument.write(command)
	print("checking ESR")
	command = "*ESR?"
	data = instrument.ask(command)
	print("*ESR?: " + data)
except Vxi11Exception as e:
	# pass
	print("ERROR" + str(e) + ", command: " + str(command))
```

12.4 MATLAB® code example

To communicate with the IQTX in MATLAB® the installation of a VISA IO driver is required. These drivers enable the creation of the Interface Object for instrument communication.

If developing locally on the IQTX instrument, then these will already be installed. However, if development is on a remotely connected system the VISA Libraries, e.g. National Instruments NI-VISA will have to be installed.

> **⚠ IMPORTANT**
> MATLAB 2010x or later with the Instrument Control Toolbox is required to execute the code detailed in this section.

The following example shows how to communicate with the IQTX using MATLAB code. For a list of supported and valid SCPI commands, refer to the **Programming Guide**.

```
% Find a VISA-TCPIP object. This is if the VISA object has already been
% created with tmtool or has been removed from the workspace without
% first being closed (cleanly disconnected).
PXIE_Chassis = instrfind('Type', 'visa-tcpip', ...
       'RsrcName', 'TCPIP0::10.10.10.89::inst0::INSTR', 'Tag', '');
% Create the 'agilent' VISA-TCPIP object if it does not exist
% otherwise use the object that was found.
if isempty(PXIE_Chassis)
       PXIE_Chassis = visa('agilent', 'TCPIP0::10.10.10.89::inst0::INSTR');
else
       fclose(PXIE_Chassis);
       PXIE_Chassis = PXIE_Chassis (1);
end
% Open the connection to the VISA object.
fopen(PXIE_Chassis);
% Query the PXIE_Chassis.
response = query(PXIE_Chassis, '*IDN?');
disp('The *IDN query response:');
disp(response);
response = query(PXIE_Chassis, '*OPT?');
disp('The *OPT query response:');
disp(response);
% Replace this with a valid command for your device (read the programming
% guide section for examples)
command = ''
% Close the connection to the object.
fclose(PXIE_Chassis);
% Clean up all objects.
delete(PXIE_Chassis);
```

13 Example: QPSK configuration procedures

The various modulation adjustments on certain models of the IQTX are used to calibrate and configure the optical signal. This section provides detail on the calibration for the example QPSK hardware setups.

13.1 Set the laser frequency and power

Make sure the laser frequency and power are set to the desired values. This is always displayed within the LCD display and CohesionUI for easy reference.

NOTE

For calibration purposes it may be convenient to set the laser to maximum power providing you are transmitting within the specifications of the coherent receiver you are using.

13.2 Setting RF delay for IQ Skew (optional, certain models only)

13.2.1 I & Q RF delay adjustment

The I & Q RF delay adjustment is used to set the correct delay between the In-phase (I) and Quadrature (Q) RF input signals, hence reducing the IQ skew (see definition below).

The delay will have to be calibrated to the particular hardware configuration in operation, due to the internal connections combined with the lengths of the RF cables connecting the RF pattern generator to the IQTX.

⚠ IMPORTANT

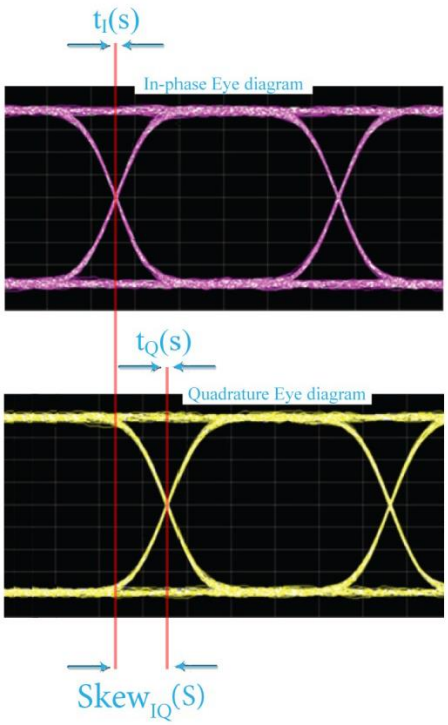
If the IQTX is connected to an IQ PPG, the I & Q RF delay can be configured and adjusted within that instrument.

13.2.2 IQ skew

To adjust the IQ skew within the IQTX modulator, the ‘I & Q RF delay dial is adjusted to increase or decrease the delay of the RF quadrature input signal. Very small adjustments should be made.

The IQ skew is a measure of the time difference between the In-phase (I) and Quadrature (Q) crossing points in the eye diagrams as shown in section 13.3.1 Modulator bias-I and bias-Q.

$$Skew_{IQ}(s) = t_I(s) - t_Q(s)$$

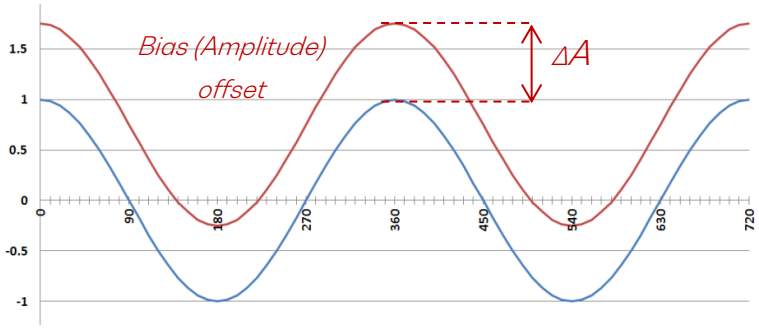


13.3 Modulator adjustments

The modulator adjustments provide manual adjustment of the In-phase (I), Quadrature (Q) and optical output signals. With the auto-bias control option, these biases will be automatically varied to compensate for the errors below and if the user wishes to manually control the bias voltages, they can do so with CohesionUI.

13.3.1 Modulator bias-I and bias-Q

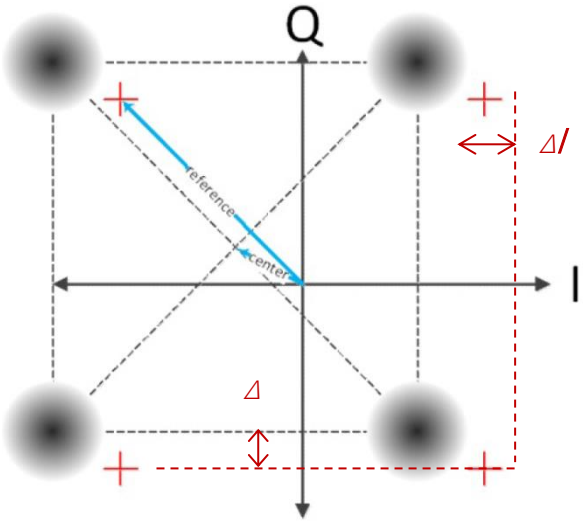
The bias-I and bias-Q dials are used to set the bias offset (*ΔA*) for either the In-phase (I) or Quadrature (Q) components of the optical signal.



Changing the bias offset for a given component (I, Q) is related to reducing bias error within the constellation, represented by *ΔI* and *ΔQ* in section 13.3.2 I & Q optical phase offset.

The bias offset is a measure of how far the center of the constellation is with respect to the ideal center point. For QPSK and QAM modulation formats, the ideal center point is [0, 0] (I, Q). It is more convenient to represent the bias errors in percentages to make it independent of the average optical power.

Additionally, the bias error can be separated into orthogonal components (I and Q) as shown in the equation below, to help identify the origin of the bias error. Since the electrical to optical transfer function of optical modulators is typically non-linear, a 5% bias offset as measured in the optical domain may not necessarily correspond to a 5% error in bias voltage.

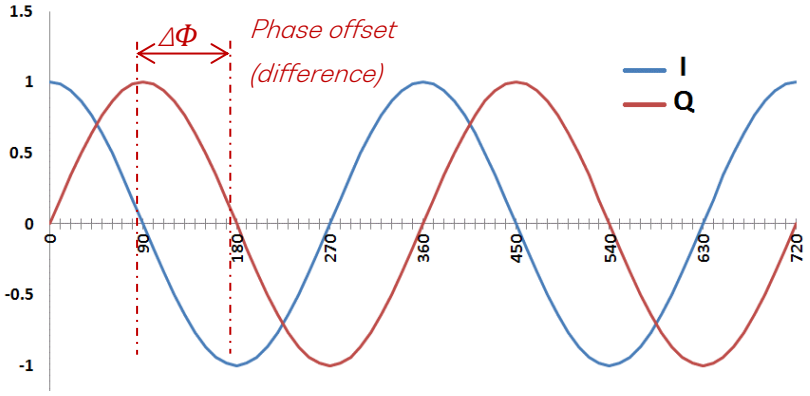


$$Ibias_{\text{Error}}\% = \frac{\Re\text{e(centre)}}{\Re\text{e(reference)}} \text{x}100$$

$$Qbias_{\text{Error}}\% = \frac{\Im\text{m(centre)}}{\Im\text{m(reference)}} \text{x}100$$

13.3.2 I & Q optical phase offset

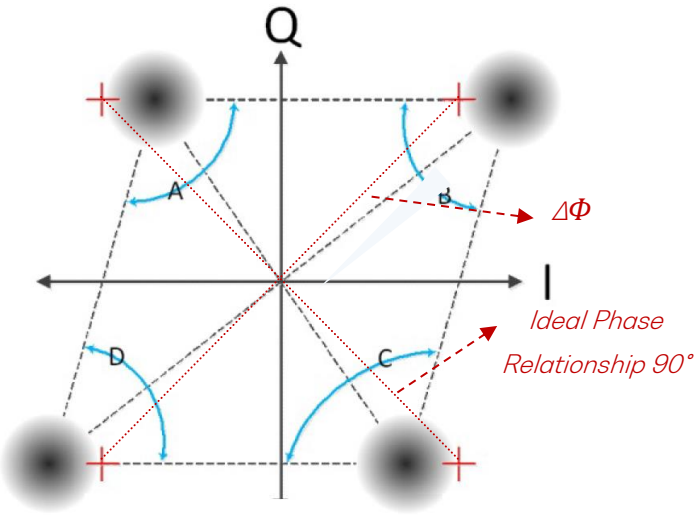
The I & Q optical phase offset dial is used to set the phase offset, or phase difference (*ΔΦ* as seen in both Figure 26 and Figure 25), between the in-phase and quadrature phase components of the optical output signal generated by the IQTX.



In-Phase (I) and Quadrature (Q) Phase Offset

The I & Q optical phase offset dial should be adjusted to align the clusters to the ideal phase relationship of 90° which is shown in Figure 26.

The quadrature error is a measure of the phase error of the constellation points with respect to the ideal phase relationship between the constellation points.
For QPSK and QAM modulation formats, the ideal phase between the constellation points is 90°.
The quadrature error is an average measurement taken over all the constellation points as shown in Equation 3.



Quadrature Error for QPSK

$$Quad_{Error} = \frac{\angle A - \angle B + \angle C - \angle D}{4}$$

Equation 2 - Quadrature Error Calculation

14 Measurement definitions

14.1 IQ RF imbalance

The IQ RF imbalance is the ratio of the in-phase component versus the quadrature component of the constellation points.

The ratio is represented as a percentage, so 10% IQ RF imbalance would mean that the in-phase component is 10% larger than the quadrature component.

$$IQ_{\text{Imbalance}}\,\% = \left(\frac{|B|}{|A|} - 1\right) \times 100$$

Equation 3 - IQ RF Imbalance Calculation

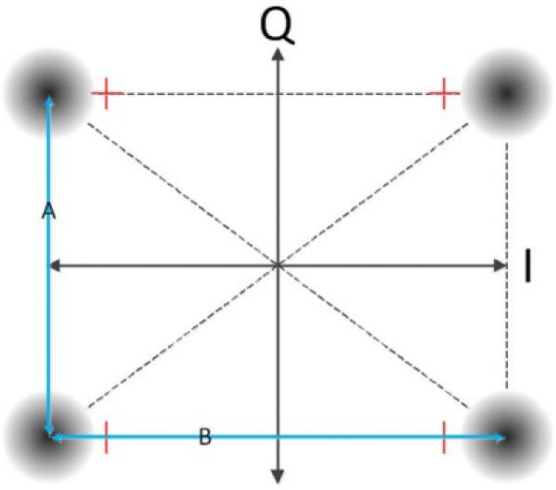


Figure 16 - IQ RF Imbalance for QPSK

14.2 Error vector

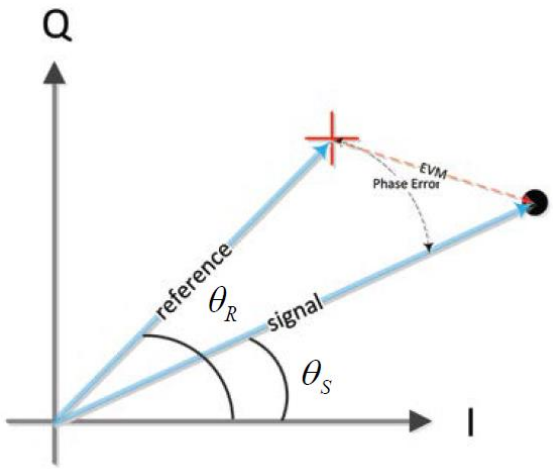
The error vector can be separated into its two primary components: Error Vector Magnitude (EVM) and Phase Error (PE). The error vector magnitude is the magnitude of the error vector, which is the difference between the signal vector and the ideal reference vector. It is more convenient to represent the EVM as a percentage to make it independent of the average signal power, as shown in Equation 5. The phase error is the phase difference between the signal vector and the ideal reference vector, as shown Equation 6.

$$EVM\% = \frac{|signal - reference|}{|reference|} \times 100$$

Equation 4 - Error Vector Magnitude Calculation

$$Phase\ Error = \theta_R - \theta_S$$

Equation 5 - Phase Error Calculation



Error Vector, Single Sample Point

15 Maintenance

To help ensure long, trouble-free operation:

- Always inspect fiber-optic connectors before using them and clean them if necessary.
- Keep the product free of dust.
- Store product 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 product, power off the IQTX instrument immediately. Remove the product 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.

15.1 Annual calibration schedule

To ensure that the IQTX 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 product, 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.

If the Calibration Certificate has been misplaced, or the calibration due date is not known, email support@quantifiphotonics.com.

16 Technical support

16.1 Contacting the Technical Support Group

To obtain after-sales service or technical support for this product, contact Quantifi Photonics. The Technical Support Group is available to take your calls from 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

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.

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

17 Warranty

17.1 General information

Quantifi Photonics Ltd. (Quantifi Photonics) warrants from the date of the original shipment (the Warranty Period) that this product 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.

17.2 Liability

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

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

17.3 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.

17.4 Certification

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

17.5 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.

To find out more, get in touch with us today.

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