QUANTIFI PHOTONICS®
A Teradyne Company

IQRX

High Performance Coherent Optical Receiver

EPIQ User Manual

quantifiphotonics.com

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Units of Measurement

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

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Table of contents

1 What's in this user manual?

You can find the following information in this document:

Before you begin	Conventions Safety information Working with optical fibers System requirements
Getting started	Introducing the IQRX - High performance coherent optical receiver Setting up hardware Installing software
Working with your device	**CohesionUI GUI:** CohesionUI - Overview Controlling your IQRX with CohesionUI **SCPI commands:** Controlling your IQRX with SCPI commands Programming examples and applications **Touchscreen:** Operating your IQRX from the LCD interface
Maintenance	Upgrade firmware Restore factory settings

2 Conventions

Please make yourself familiar with these conventions; we use them throughout this user manual:

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** or **component damage**.

Do not proceed unless the required conditions are met and understood.

NOTE

Indicates relevant information that requires your attention.

3 Safety information

Carefully read all safety information before using your Quantifi Photonics product.

3.1 Optical laser radiation precautions

Quantifi Photonics IQRX products are Class 1M laser products.

WARNING

To protect yourself from harm caused by optical radiation:

- Do not install or terminate fibers while the light source is active.
- Turn the Quantifi Photonics product OFF before inspecting the end face(s) of the product, or any optical patch cords connected to it.
- 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 in this document may result in exposure to hazardous situations involving optical radiation.

3.2 Electromagnetic compatibility

CAUTION

For electromagnetic compatibility, this product 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.

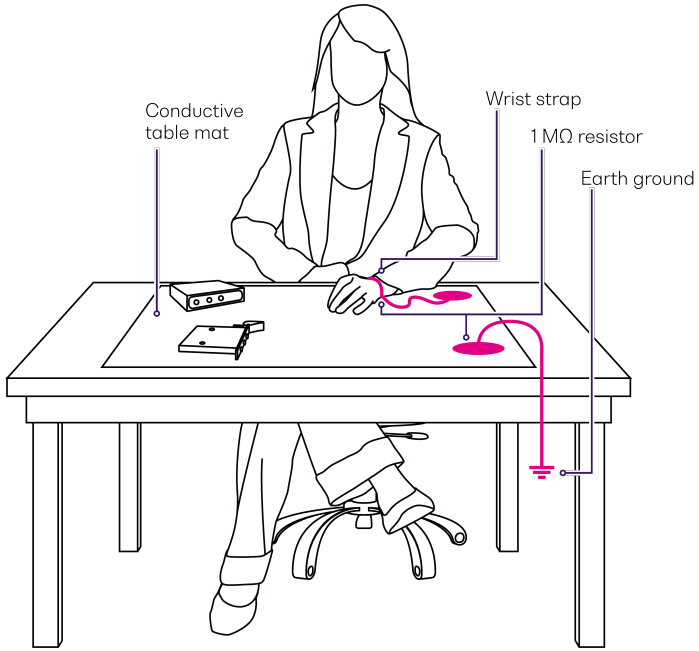
This symbol on the unit refers to documentation provided with the product for related safety information. Ensure that the required conditions are met and understood before using the product.

3.3 Electrostatic discharge precautions

CAUTION

The product is sensitive to electrostatic discharge (ESD). To ensure that you do not cause ESD damage to the product:

- Always follow proper grounding and ESD management practices.
- Store the unused product in the original protective electrostatic packaging that it was shipped in.
- Use a wrist strap and grounding table mat when unpacking or handling the product.



4 Introducing the IQRX - High performance coherent optical receiver

IQRX is designed and built using the highest-performing discrete fiber optic components to provide superior fidelity measurement of coherently modulated signals. To minimize noise, IQRX does not use a transimpedance amplifier (TIA), a component often found in commercially available ICRs.

Designed to be used with any real time oscilloscopes with sufficient bandwidth and sampling rate, the single-ended outputs make it convenient to pair with the four input channels of most oscilloscopes. In high-bandwidth oscilloscope configurations where there are only two channels per unit, IQRX's slim profile and wide footprint enable it to be placed between multiple oscilloscope units.

IQRX houses polarization selective hardware to characterize polarization multiplexed signals. LO input, signal output and internal laser outputs all use polarization maintaining (PM) fiber for the highest versatility.

IQRX comes with a built-in narrow 100 kHz instantaneous linewidth laser, making it perfect for coherent modulation formats that require high phase stability.

IQRX can be paired with the optional rack mount brackets for easy mounting in any 19-inch rack.

Programming interfaces

Through its programming interfaces you can take advantage of the SCPI-compliant command language and choose from programming tools such as LabView, C++, Python, or any of the other popular programming languages used to control automatic test equipment (ATE).

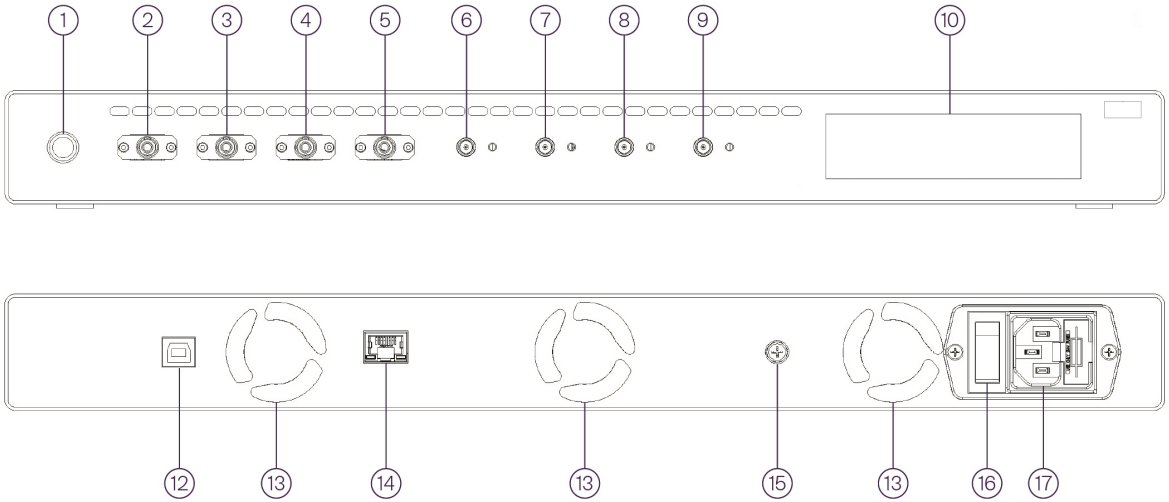
CohesionUI™

Quantifi Photonics' web-based graphical user interface CohesionUI is hosted on Microsoft Windows® and enables you to control your device from any supported web browser.

Touchscreen display

The touchscreen display makes it easy to quickly view and change a number of relevant settings.

4.1 Hardware description



Front		Rear	
1	Power ON/OFF	12	USB connection to PC
2	Modulated signal input	13	Ventilation fans (DO NOT OBSTRUCT)
3	Local oscillator input PM	14	Ethernet port
4	Built-in laser 1 output PM (max 16.5 dBm)	15	Chassis grounding screw
5	Built-in laser 2 output PM (max 15 dBm)	16	Mains power on / off isolation switch
6	RF signal X-Pol-I output	17	AC power ~100-240V; 50/60Hz; 85W Max
7	RF signal X-Pol-Q output		
8	RF signal Y-Pol-I output		
9	RF signal Y-Pol-Q output		
10	LCD touchscreen		

NOTE

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

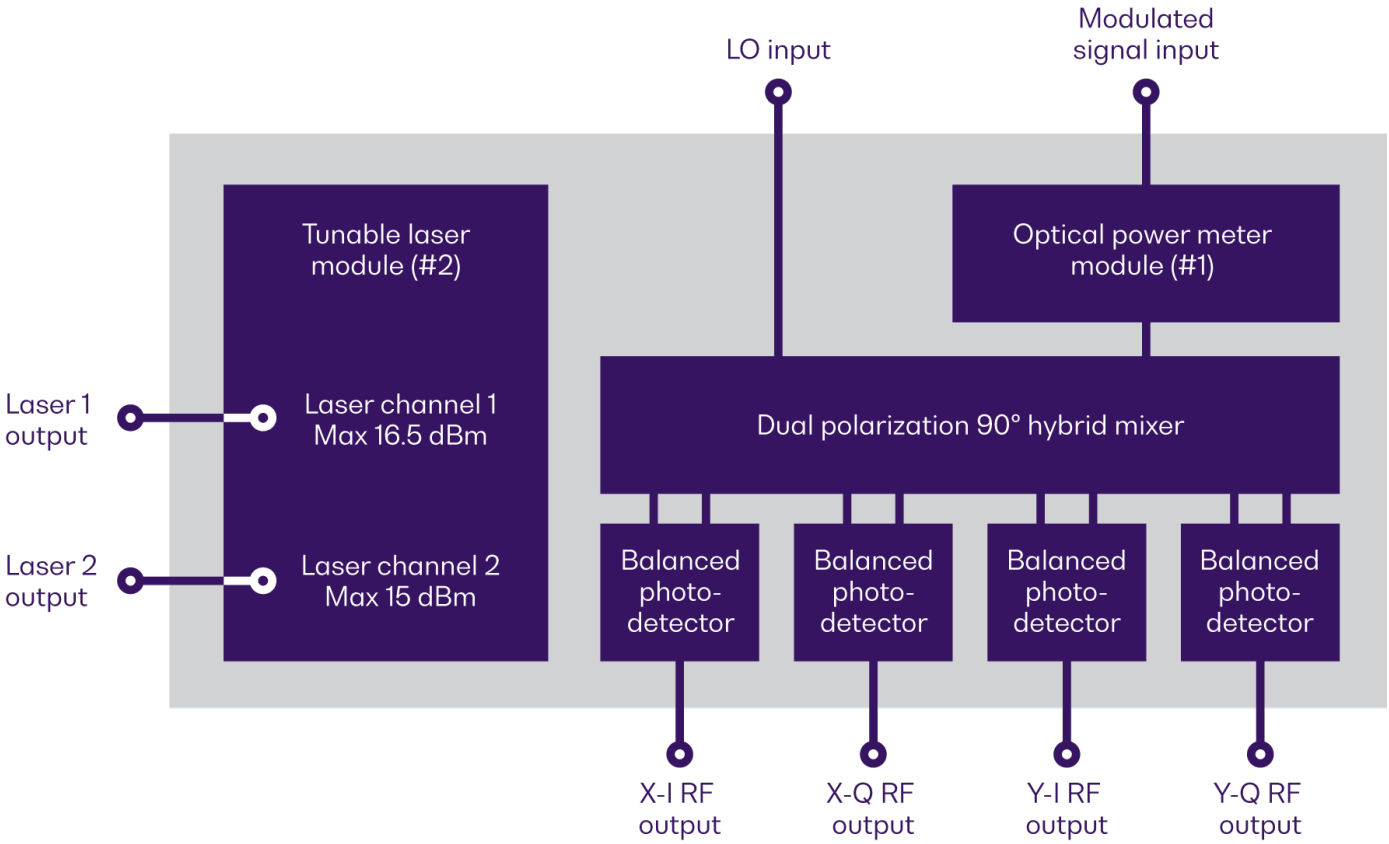
4.2 Environmental conditions

Range of environmental conditions:

Indoor or outdoor use	Indoor only
Altitude	Max. 2000m
Main supply voltage	100-240V~, 50/60Hz, 85W
Main supply voltage fluctuations	±10%
Fuse specification	3.15A, 250VAC

For fuse replacement, please adhere to the specifications provided in the table above.

4.3 IQRX 1000 Series schematic diagram



5 Setting up hardware

Follow the instructions in this section when setting up your instrument.

CAUTION

The product is sensitive to electrostatic discharge (ESD). To prevent damage from ESD:

- Do not remove the product from the antistatic packaging until required to do so.
- Wear a grounded wrist strap at all times when handling the product.

CAUTION

Skin contact may leave corrosive residue and damage a connector:

- Always clean optical end faces before mating.

NOTE

- You must use the IEC cable that Quantifi Photonics supplies with the unit.
- DO NOT attempt to remove or adjust any component of the product while the power is on. Ensure the product is powered OFF, and that the correct handling procedure detailed herein is followed when you remove or install any products.

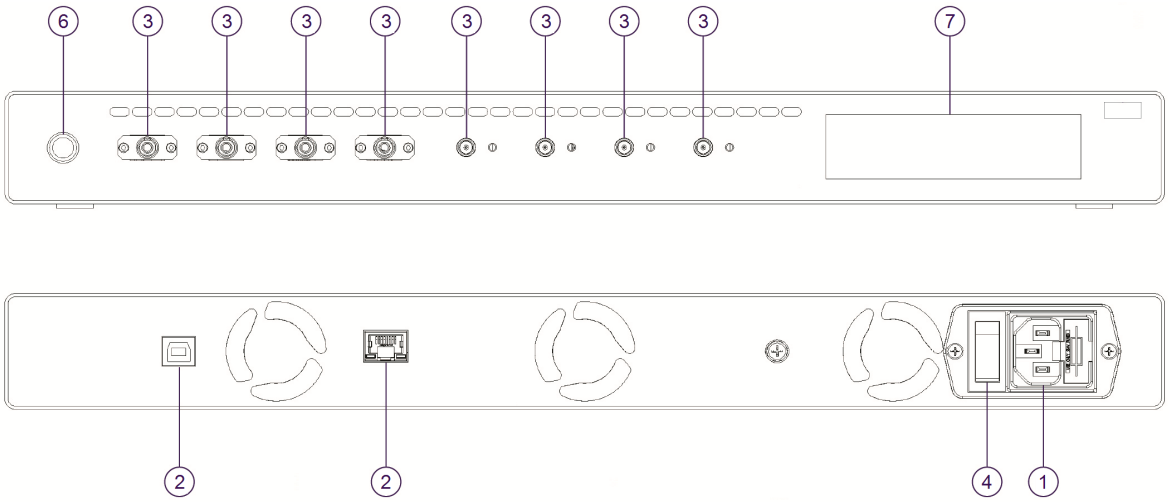
NOTE

Please check for the fiber end-face type of the optical ports, such as PC or APC, and only use the same type optical connector to avoid damaging the end-face.

For advice on connector and fiber care, please refer to Working with optical fibers.

5.1 Set up your IQRX product and power ON

The AC mains power (110-240 V, 50-60 Hz AC) socket is located on the rear panel of the instrument.



▶ Follow the instructions below to correctly power on the instrument:

To allow for optimal air flow and avoid thermal issues, do not block the ventilation fans in the front and back of the instrument and set up your instrument with a minimum clearance of 2 inches (50.8mm) around it.

1. Connect AC mains power to the instrument to provide ground connection.
2. Connect to a client computer using a USB cable, or onnect to your network or client computer using an Ethernet cable.
3. Ensure all required electrical and optical connections are made before powering on the instrument (refer to RF electrical connections and Working with optical fibers for more information).
4. Once all connections are completed, turn ON the isolation switch located next to the mains socket.
5. The switch will illuminate indicating that the AC power supply is live and the IQRX is ready to be powered ON.
6. Power ON the instrument.
7. The instrument IP address will appear on the touchscreen display. When the unit is connected via both Ethernet and USB cable, both the Ethernet and USB IP addresses are displayed.

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

5.2 RF electrical connections

The IQRX converts the optical signal into four RF electrical tributary signals. These RF outputs need to be connected to an appropriate oscilloscope or data acquisition instrument using phase matched high-quality RF cables. These RF connectors are precision high-bandwidth connectors and must be handled with care at all times.

CAUTION

- When making RF connections, always hold on to the cable/component while tightening the hex nut to prevent the center pin from twisting inside the female connector.
- **Do not** bend or deform the rigid cables, as this will cause damage.
- Use a torque wrench to control the tightening pressure on all RF connections.

5.3 Instrument IP address

To access your Quantifi Photonics instrument from a client computer, you need the IP address of the instrument.

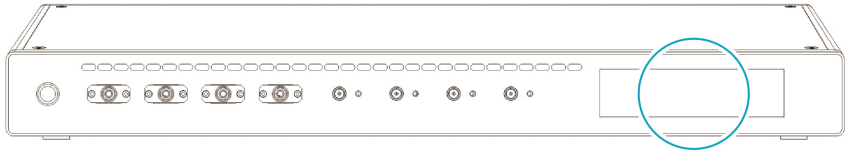
Your instrument can have two different IP addresses depending on your chosen connection method (USB or Ethernet):

- The default **USB IP address** is **192.168.101.201**. This is a static address set during instrument calibration.
- The default **Ethernet IP address** is dynamically assigned by the DHCP.

▶ To view an instrument's IP address:

With your instrument powered ON, you can view the current IP address on the LCD display.

If your instrument is connected with both, Ethernet and USB cables, both the USB and Ethernet IP address are displayed.



▶ To change an instrument's IP address:

You can change the instrument's static USB IP address and you can assign a static Ethernet IP address:

- using the touchscreen display
- using CohesionUI

Multi-instrument control

If you have several Quantifi Photonics instruments with static IP addresses on your network, make sure to assign a unique IP address to each instrument before connecting.

For details, refer to Change the instrument IP address (CohesionUI) or Operating your IQRX from the LCD interface.

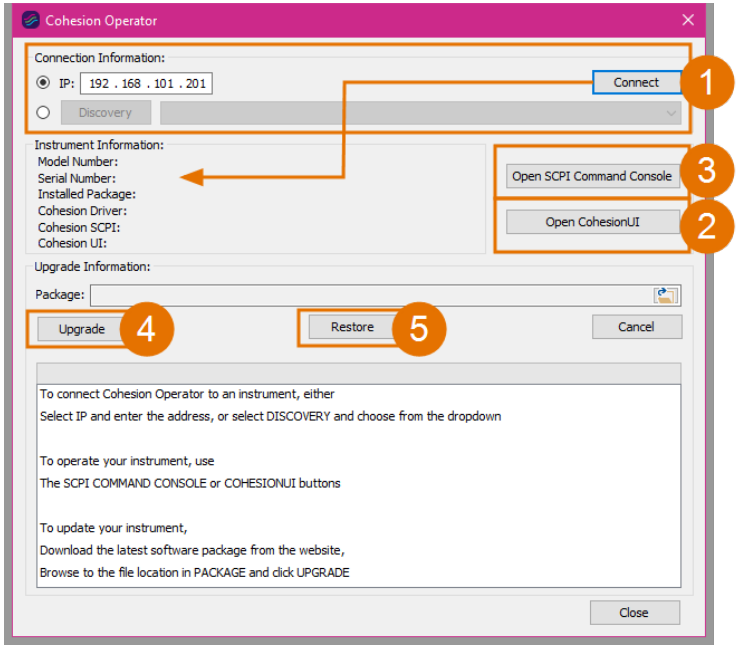
6 Installing software

To work with Quantifi Photonics MATRIQ and EPIQ instruments, you need to install the latest version of the **Cohesion Operator** software package on any computer that you use to connect with your instrument (client computer).

The software 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).

Cohesion Operator enables you to:

1. **Connect** with MATRIQ and EPIQ instruments that are available on your network to retrieve instrument information and validate the instrument's IP address.
2. Access an instrument using **CohesionUI**, a web-based graphical user interface.
3. Work with an instrument using the **SCPI Command Console**.
4. Upgrade instrument **firmware**.
5. Restore an instrument to **factory settings**.



6.1 Install the Cohesion Operator software package

▶ To install the software package on a client computer:

1. (recommended) Save your work and close all programs.
2. If using the **USB media device**, insert it in the computer.
3. 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.

Multi-instrument control

If another Quantifi Photonics instrument is already connected to the client computer via USB, make sure each instrument has a unique USB IP address to avoid any addressing conflicts.

▶ To open the Cohesion Operator application:

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

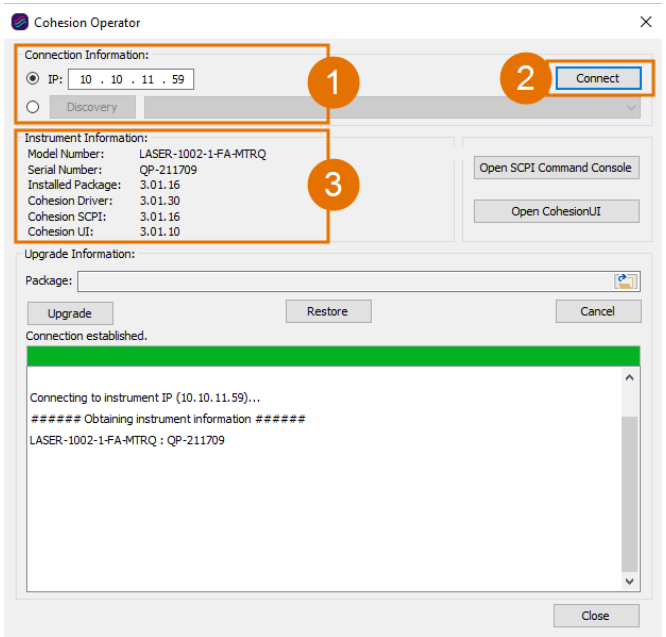
6.2 Check firmware version and other information

Using Cohesion Operator, you can check the firmware version and other details of Quantifi Photonics instruments that are available on your network.

▶ To check details in Cohesion Operator:

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

   Installed Package refers to the currently loaded firmware version.

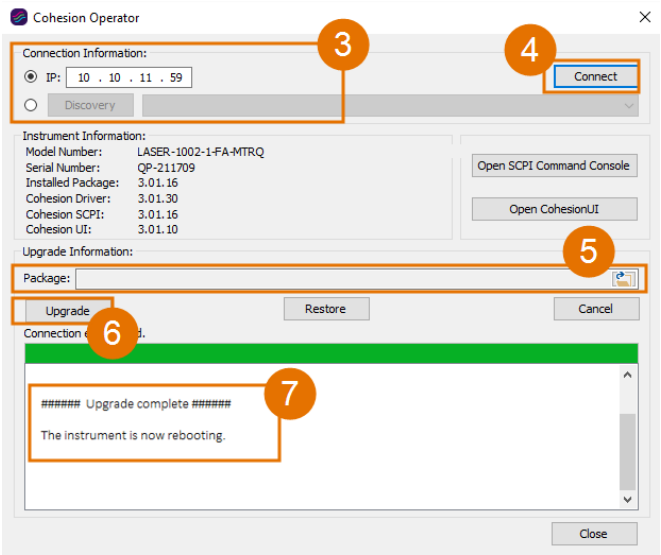


6.3 Upgrade firmware

We recommend that you upgrade firmware via a USB connection to prevent possible connection loss when using an Ethernet connection.

▶ To upgrade an instrument with the latest firmware:

1. Get the latest EPIQ firmware package **CohesionEPIQ-<version>.qfw**, 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.

   To verify the new firmware version, click **Connect** (4) to retrieve the latest instrument information.

NOTE

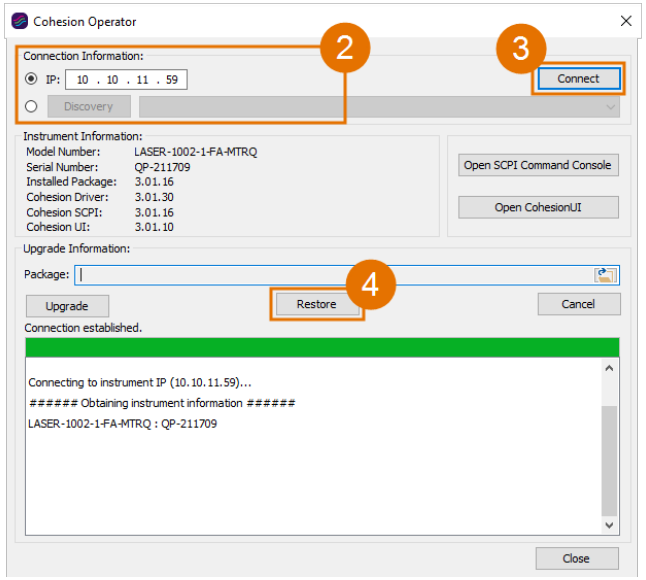
If an upgrade attempt is unsuccessful, the Cohesion Operator will stop the upgrade process and restore the instrument to its previous firmware version. Messages will be displayed accordingly.

6.4 Restore factory settings

We recommend that you restore factory settings via a USB connection to prevent possible connection loss when using an Ethernet connection.

▶ 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. To confirm that you have selected the correct instrument, click **Connect**.
   This will retrieve instrument information, with **Installed Package** showing the current firmware version.
4. Click **Restore**.
   The instrument will be returned to factory settings, including IP address settings.

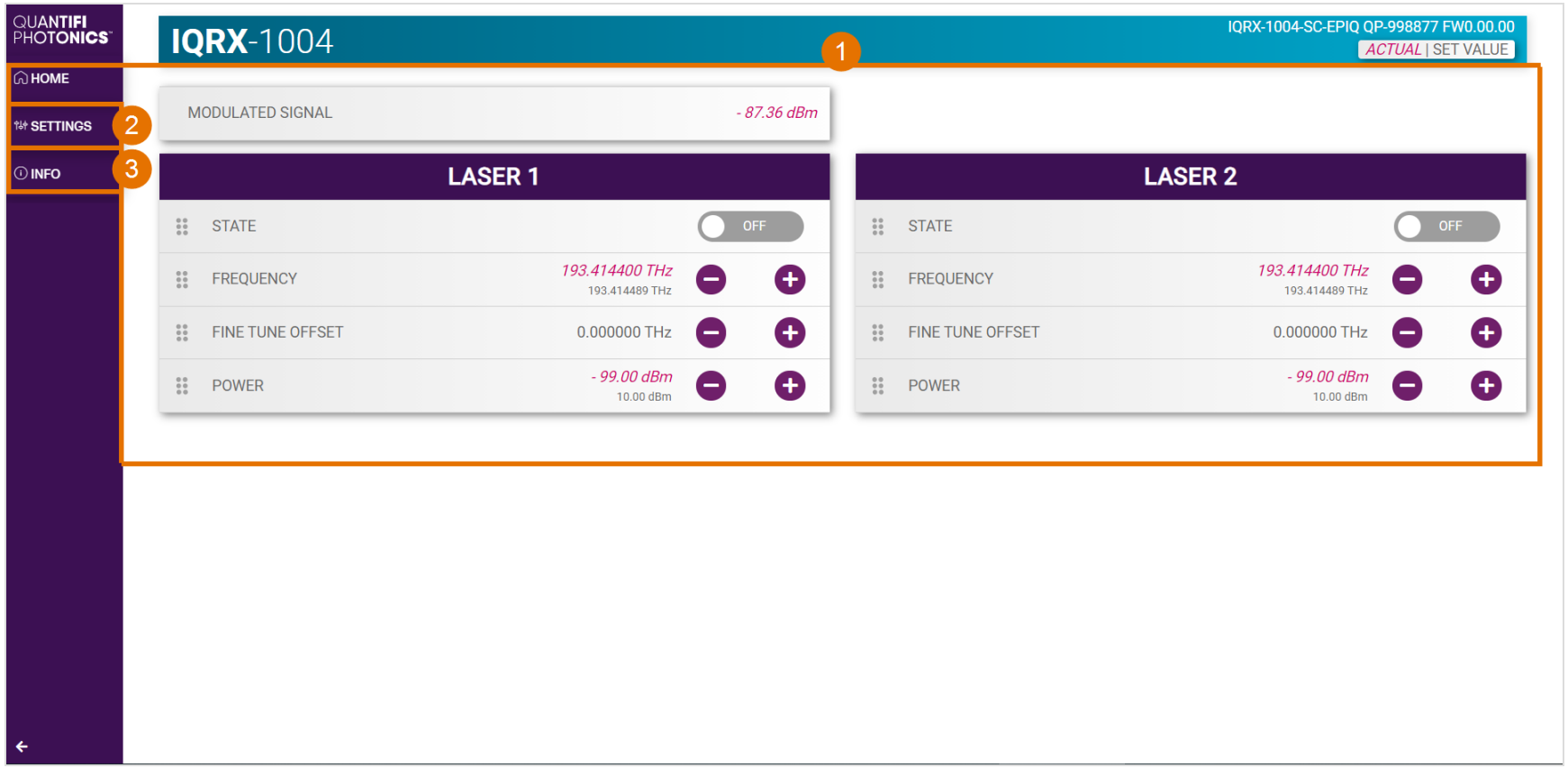
7 CohesionUI - Overview

CohesionUI is a web-based graphical interface that you can use to work with your Quantifi Photonics product.

> CohesionUI is part of the EPIQ firmware package running on your Quantifi Photonics instrument.

From the menu on the left you can navigate to the following pages:

1. **HOME**: This is your main page. From here you can access all controls for your instrument
2. **SETTINGS**: Here you can change CohesionUI settings and/or instrument IP address
3. **INFO**: Here you can display instrument information, e.g. model number and firmware version



7.1 Access instruments with CohesionUI

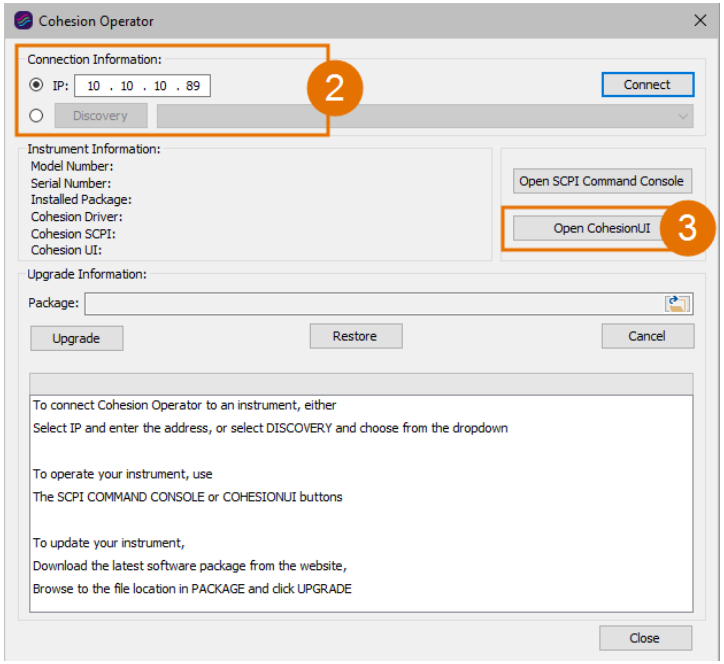
You can open CohesionUI for Quantifi Photonics MATRIQ and EPIQ instruments:

- from Cohesion Operator, or
- in a supported browser by entering the instrument IP in the address bar.

To open CohesionUI, you need the IP address of the instrument. For details, refer to the Instrument IP address section.

▶ To open CohesionUI from Cohesion Operator:

1. Open **Cohesion Operator** on a client computer, 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** dropdown.
3. Click **Open CohesionUI**.
   CohesionUI will open in your standard browser.



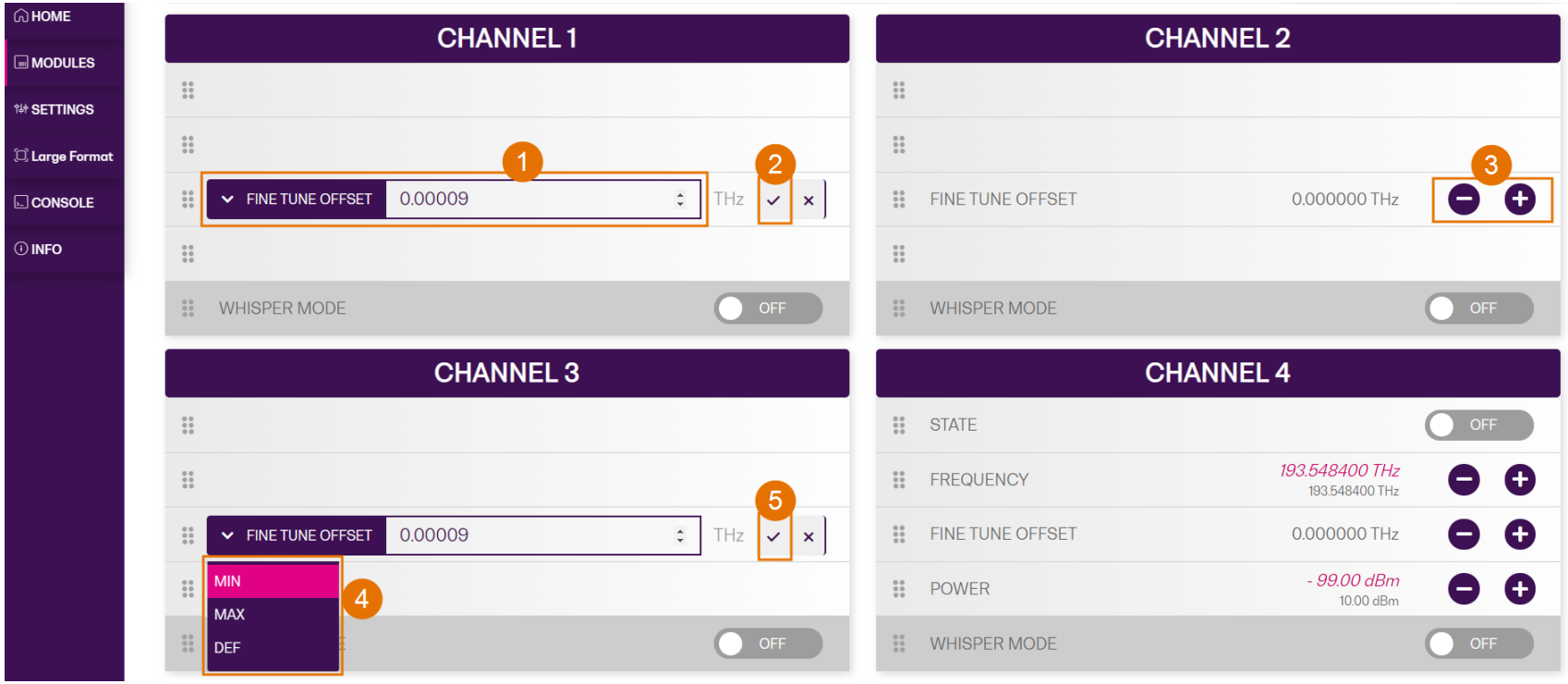
To open CohesionUI in a browser:

1. Launch a supported **browser**.
2. Enter the instrument **IP address** in the address bar.
   CohesionUI will launch in the browser.

7.2 Set values

In CohesionUI you can 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.
- To set a pre-defined value, for example **MIN**, **MAX** or **DEF**:
  4. Click on a parameter and select a value from the dropdown menu.
  5. Confirm the value.

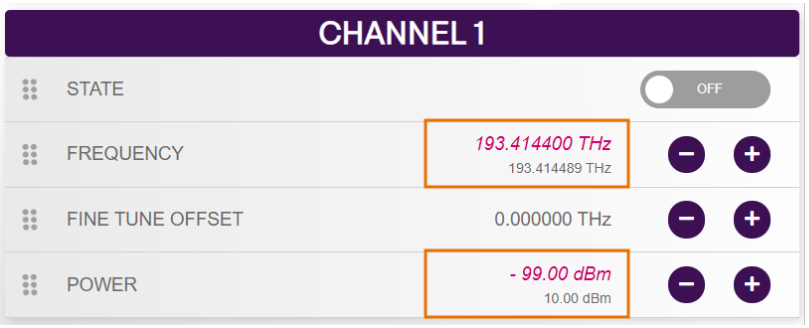


For details on how to change the step size, refer to Manage CohesionUI settings.

7.3 SET values and ACTUAL values

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

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



7.4 Manage CohesionUI settings

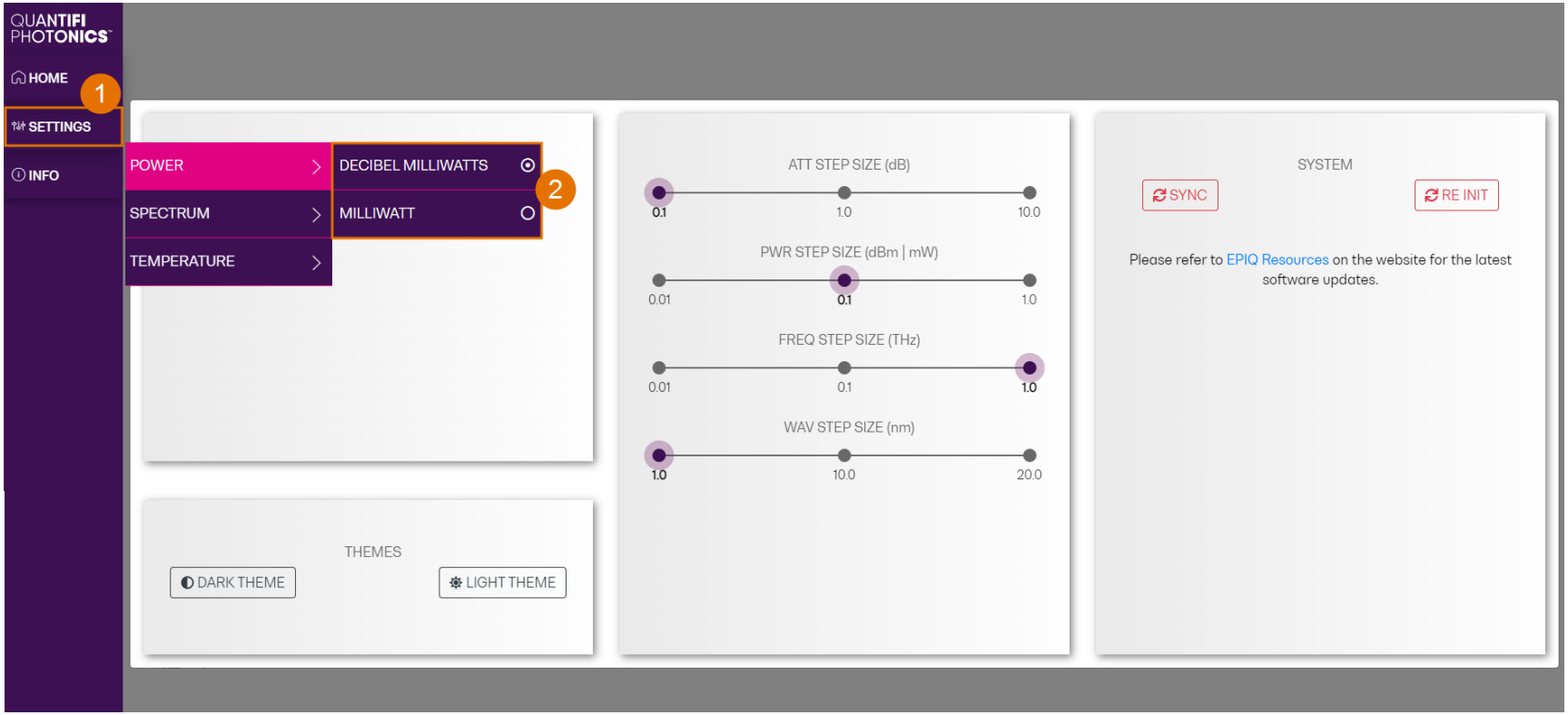
On the **SETTINGS** page you can configure CohesionUI settings and unit preferences.

▶ 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.
   Please note that the units displayed on this page are not always relevant for each product.
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.



7.5 Change the instrument IP address

Your instrument can have two different IP addresses depending on your chosen connection method (USB or Ethernet):

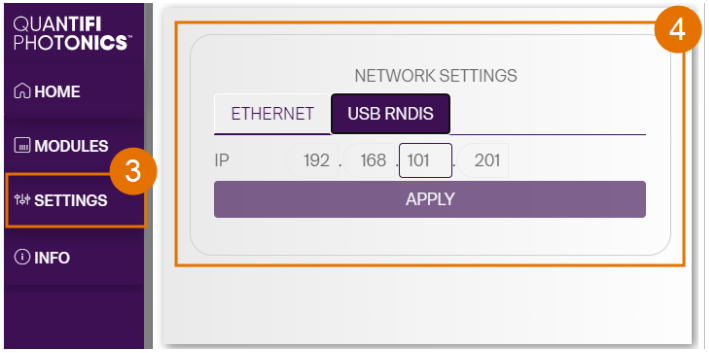
- The default **USB IP address** is **192.168.101.201**. This is a static address set during instrument calibration.
- The default **Ethernet IP address** is dynamically assigned by the DHCP.

You can change the instrument's static USB IP address, and assign a static Ethernet IP address if required.

> **Multi-instrument control**
>
> If you have several Quantifi Photonics instruments with static IP addresses on your network, make sure to assign a unique IP address to each instrument before connecting.

▶ To change the **USB IP address**:

1. Connect with the instrument from a client computer via USB. Ensure that this is the only Quantifi Photonics instrument currently connected via USB.
2. Open CohesionUI using the currently assigned USB IP address.
3. Go to **SETTINGS**.
4. In **NETWORK SETTINGS > USB RNDIS** tab:
   - The currently assigned IP address is displayed. Enter the new IP address by changing the **3rd octet** of the IP address.
     To avoid any addressing conflicts, make sure that this is a unique IP address that is not shared with any other instrument on the network.
   - Click **APPLY**. The new IP address will show in CohesionUI and on the display.



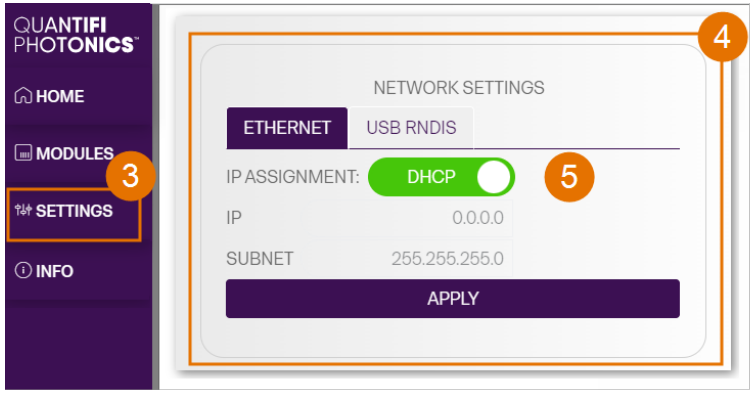
To change the **Ethernet IP address**:

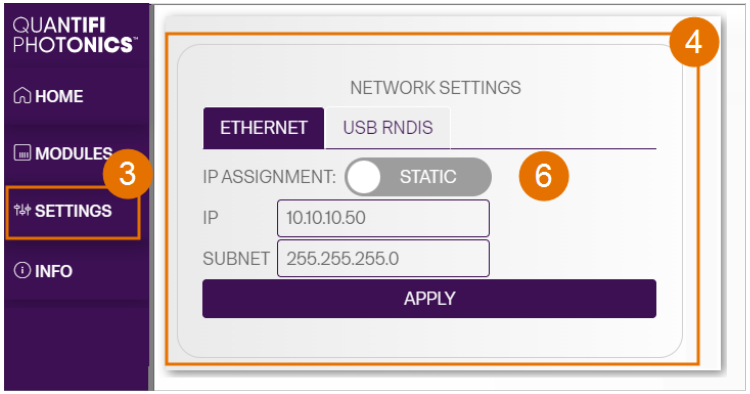
1. Connect with the instrument from a client computer via USB. Ensure that this the only Quantifi Photonics instrument currently connected via USB.
2. Open CohesionUI using the currently assigned USB IP address.
3. Go to **SETTINGS**.
4. In **NETWORK SETTINGS > ETHERNET** tab:
5. Toggle **IP ASSIGNMENT** to **DHCP** to enable the DHCP to automatically assign the Ethernet IP address (this is the default setting) and click **APPLY**.

   OR

6. Toggle **IP ASSIGNMENT** to **STATIC** to assign a static Ethernet IP address.
   Enter the new **IP address** and **SUBNET mask** and click **APPLY**.
   To avoid any addressing conflicts, make sure that this is a unique IP address that is not shared with any other instruments on the network.

   The new IP address will show in CohesionUI and on the display.



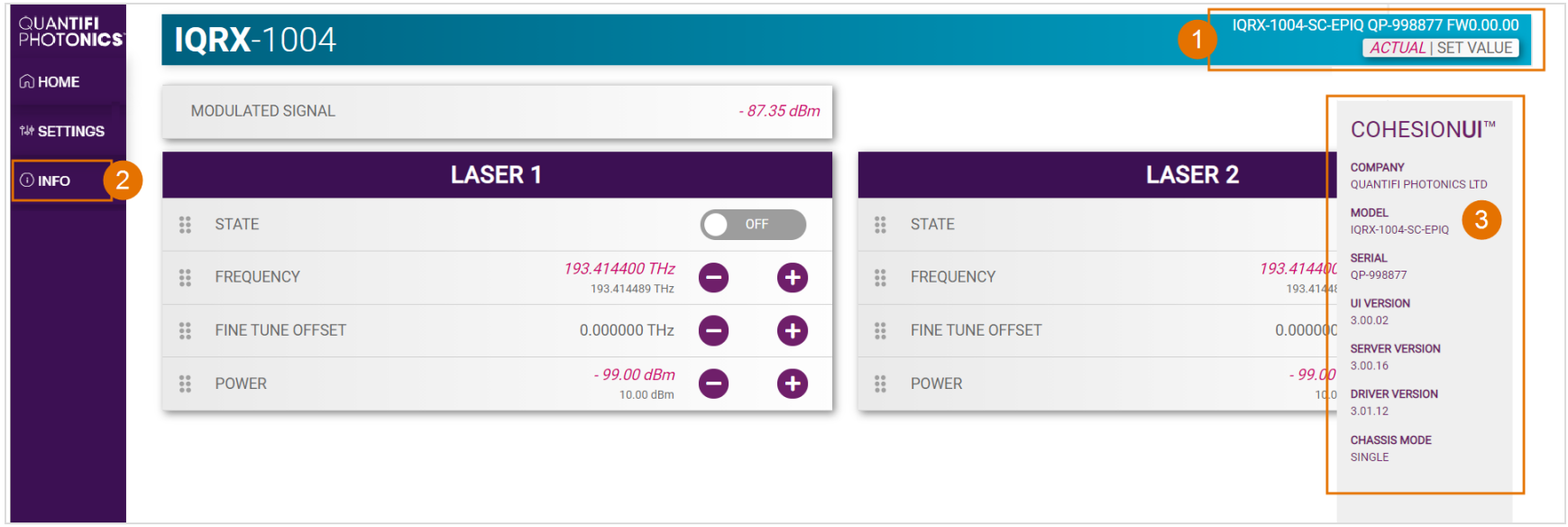


7.6 View system information

You can easily access instrument information, for example the model number and firmware version.

- To display instrument information in CohesionUI:

1. Refer to the top right corner in CohesionUI.
2. For more details, click **INFO** to display the information panel.
3. The information panel lists the instrument's serial number, and software and firmware versions.

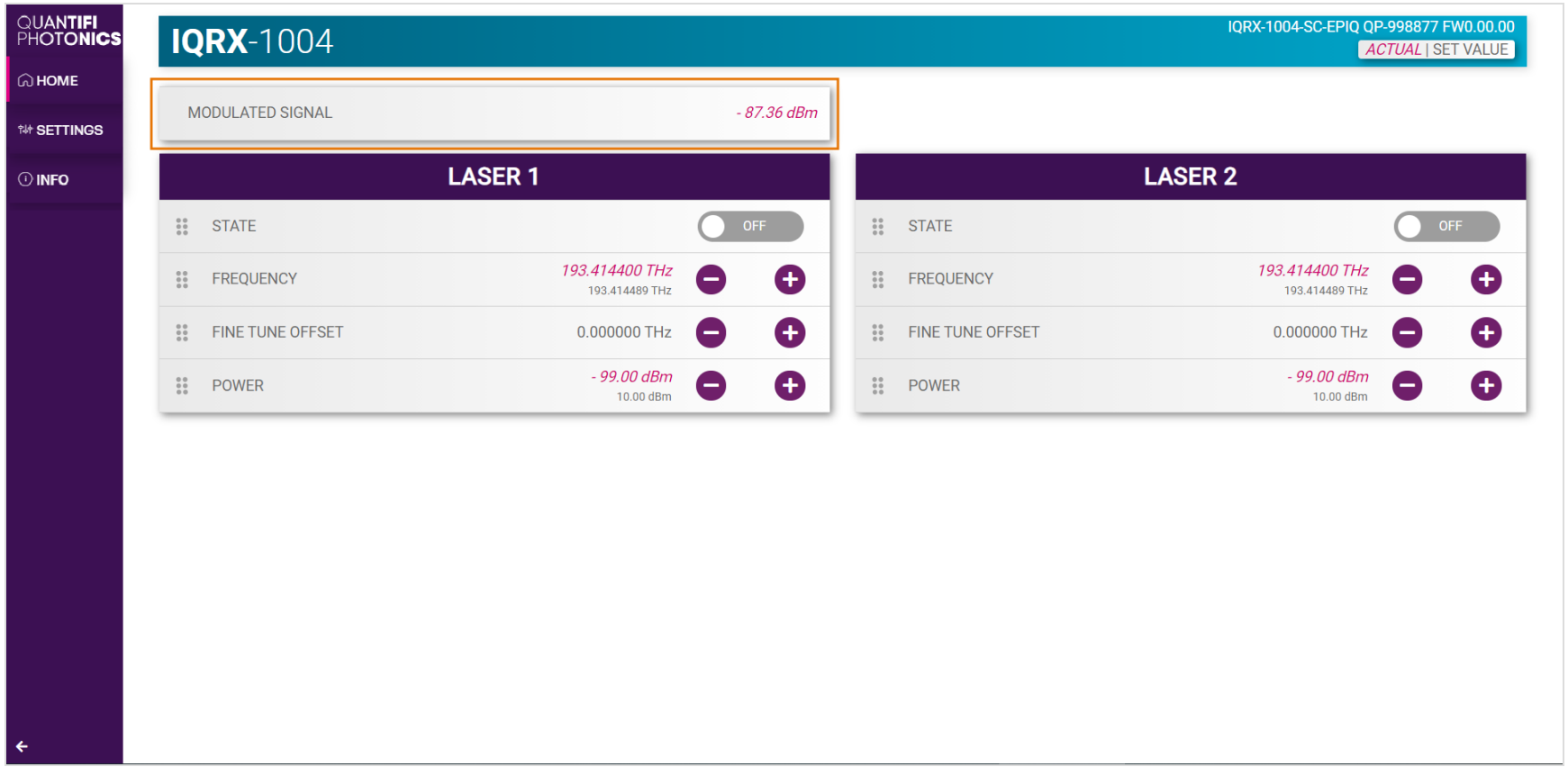


8 Controlling your IQRX with CohesionUI

You can use Quantifi Photonics' graphical user interface CohesionUI to work with your product. For details on how to get started with CohesionUI, refer to CohesionUI - Overview.

8.1 Modulated signal value

The measured optical power is shown as MODULATED SIGNAL.



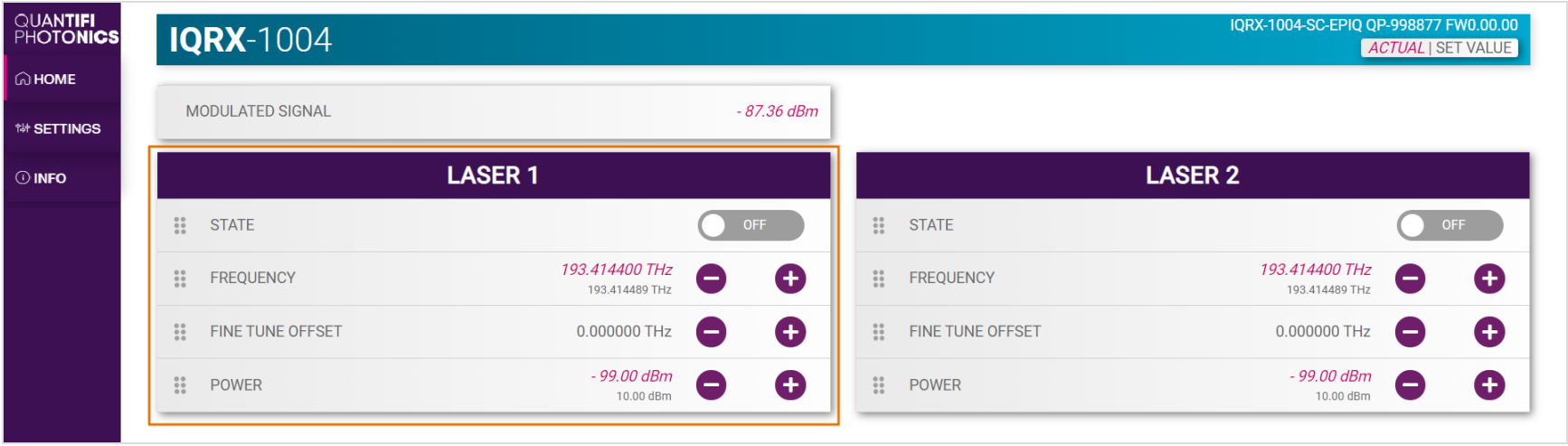
8.2 Setting the laser source parameters

The parameters for a given laser channel in the IQRX product can be set by clicking the parameter button, 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 SETTINGS menu.

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

This applies to the following parameters:

- **FREQUENCY (WAVELENGTH)**: The desired frequency (wavelength) of light that the IQRX instrument should output. This corresponds to the spectral location of the central peak of the laser.
- **FINE TUNE OFFSET**: See section Tuning the laser source.
- **POWER**: The desired output power of the IQRX instrument.



NOTE

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

8.3 Tuning the laser source

The product 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.

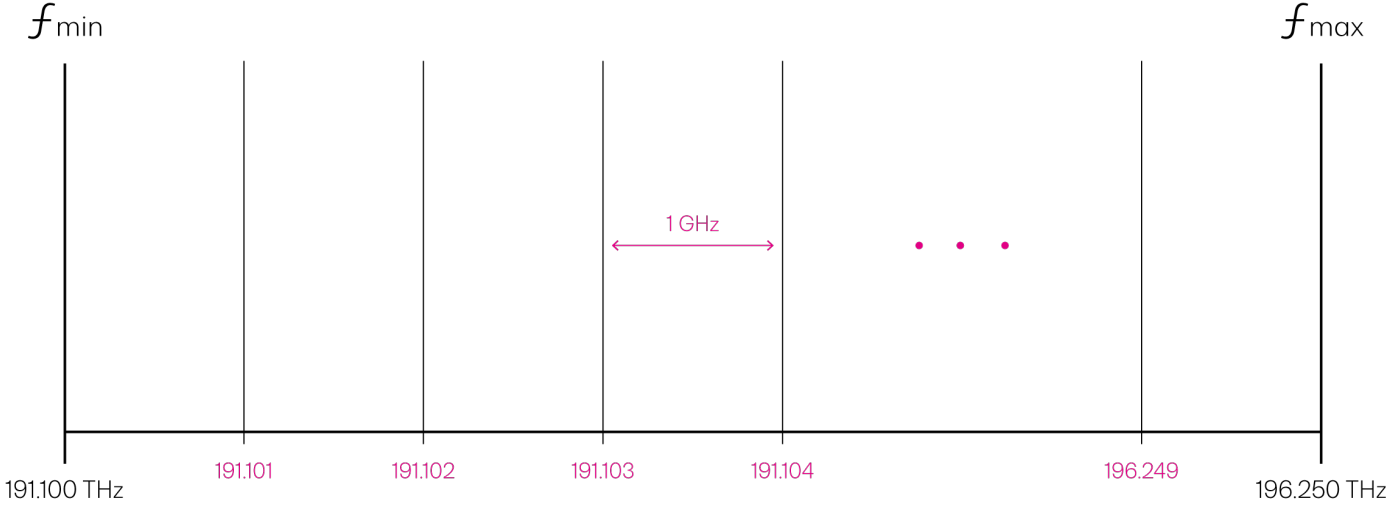
Tuning can be realized through the following commands. Refer to the SCPI command section for specific information about the listed commands.

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

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.

8.3.1 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 model will have a MIN and MAX frequency value, which defines its operation range. For example 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 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 (refer to Frequency Fine tuning for more information).

8.3.2 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).

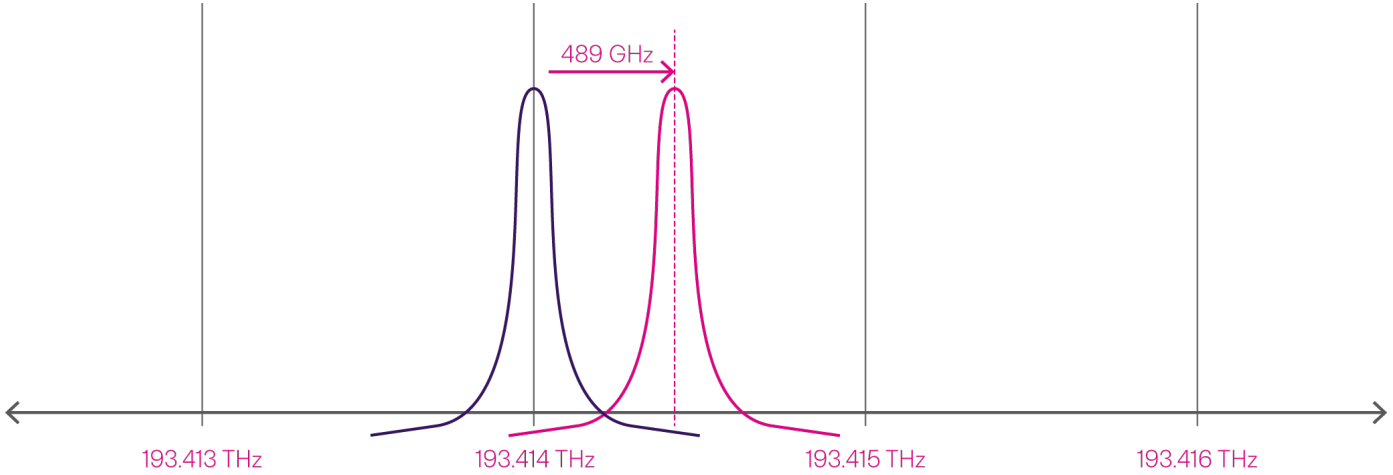
Intended user frequency value	Accepted frequency value	Applied frequency value
193.41448 THz	193.4144800 THz	193.414480 THz
193.4144890 THz	193.414489 THz	193.414489 THz
193.41448905 THz	193.414489 THz	193.414489 THz
193.000000055 THz	193.000000 THz	193.000000 THz

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	`:SOUR2:CHAN1:FREQ 193.414 THz`	193.414 THz	193.414000 THz
193.42501 THz	`:SOUR2:CHAN1:FREQ 193.42501 THz`	193.425 THz	193.425010 THz
193.414489 THz	`:SOUR2:CHAN1:FREQ 193.414489 THz`	193.414 THz	193.414489 THz
193.4144895 THz	`:SOUR2:CHAN1:FREQ 193.4144895 THz`	193.414 THz	193.414489 THz
193.4000001 THz	`:SOUR2: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.

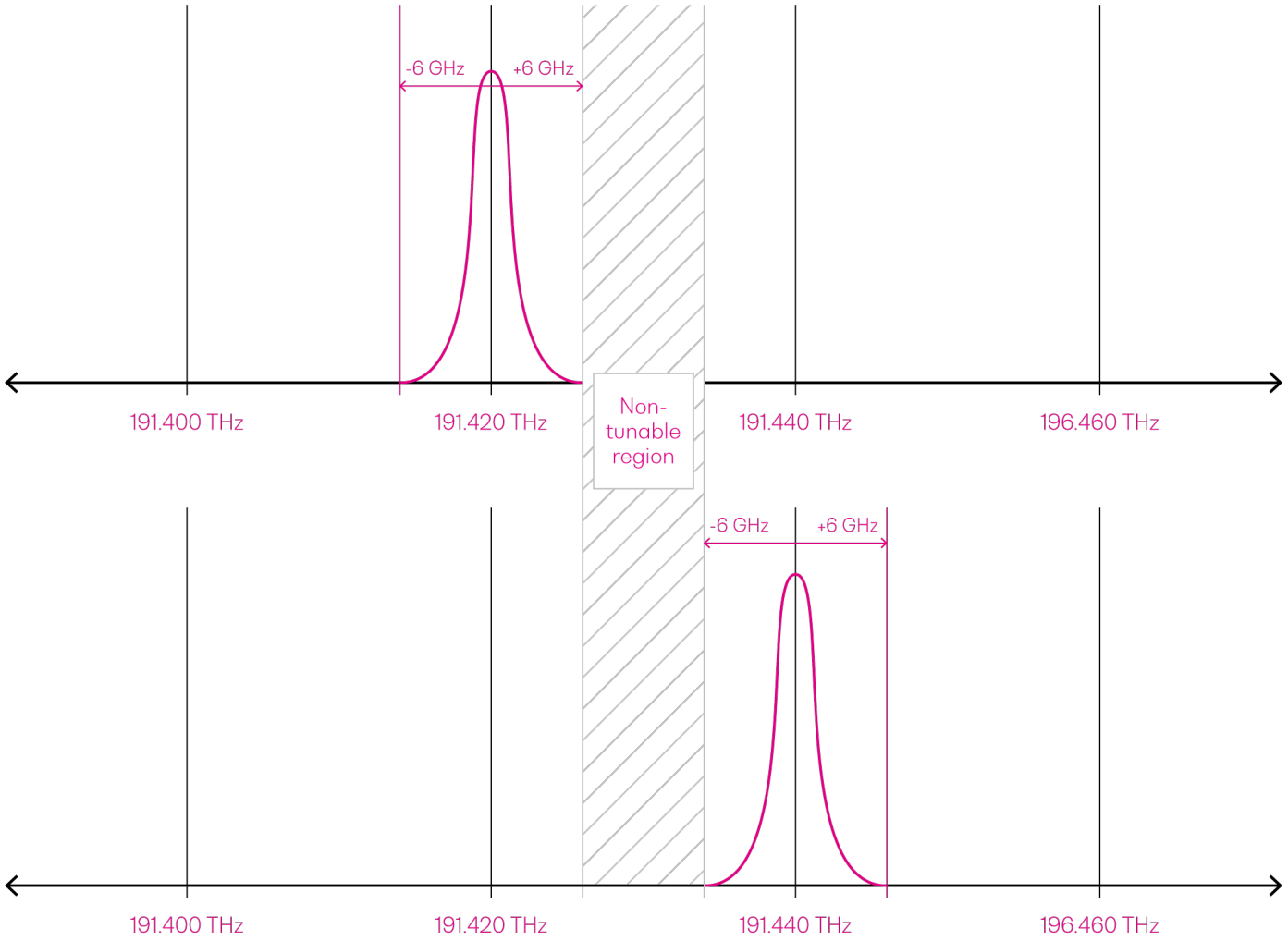


8.3.3 Frequency Fine tuning

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.

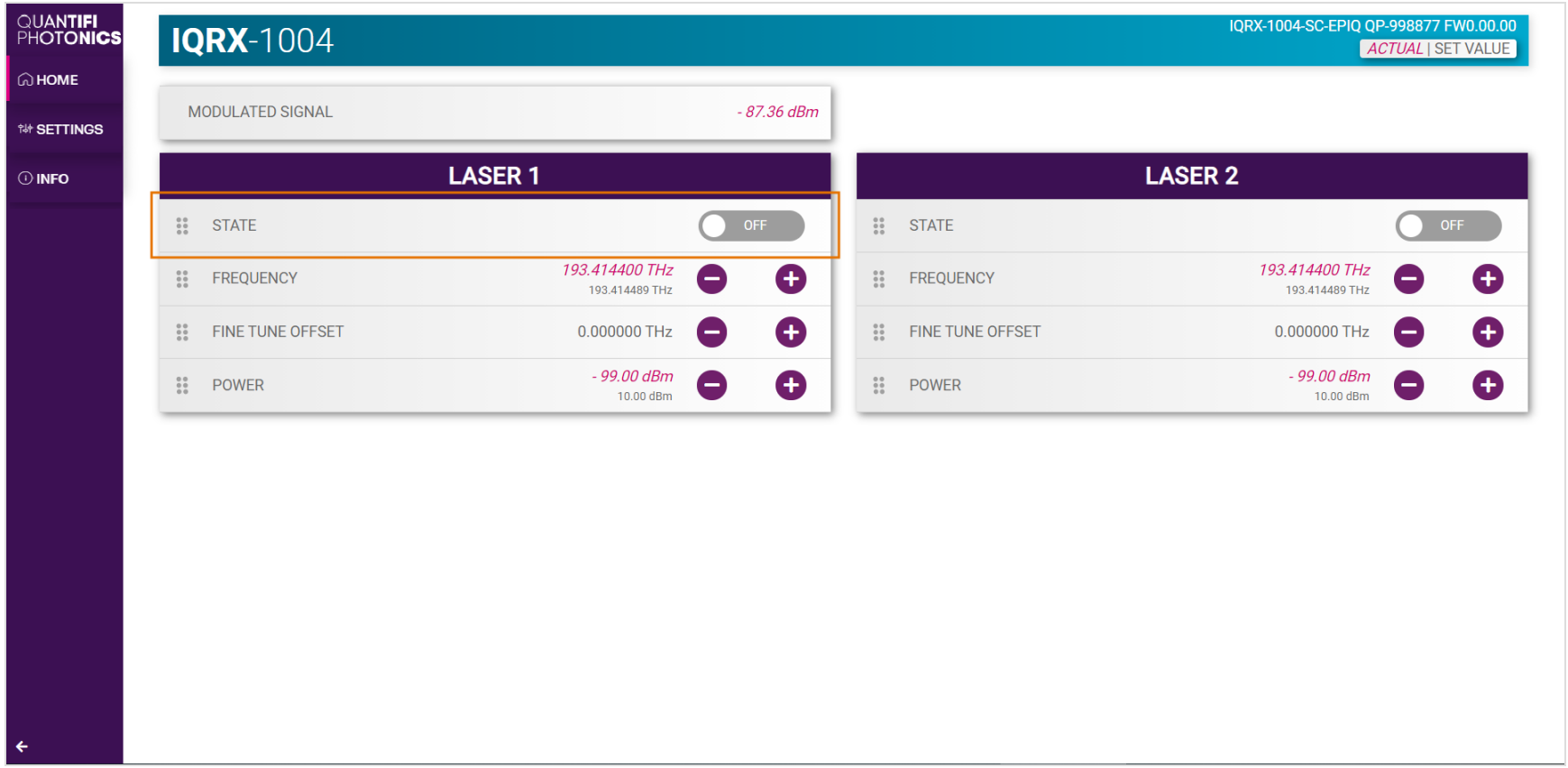
Commands	Description
`:SOUR2:CHAN1:GRID 1 GHz`	
`:SOUR2:CHAN1:FREQ 193.414489 THz`	
`:SOUR2:CHAN1:FREQ:FINE? -> 489 MHz`	Query the frequency fine setting.
`:SOUR2:CHAN1:FREQ:FINE 50 MHz`	Fine tune the frequency by +50 MHz from the current GRID point (193.414 THz).
`:SOUR2:CHAN1:FREQ? -> 193.414050 THz`	Query the current frequency setting.

One thing to note is 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.


-6 GHz
+6 GHz
191.400 THz
191.420 THz
Non-
tunable
region
191.440 THz
196.460 THz
-6 GHz
+6 GHz
191.400 THz
191.420 THz
191.440 THz
196.460 THz

8.4 Toggling the laser on/off

To toggle the laser in a specific channel of the IQRX on or off, toggle the **STATE ON/OFF** button.



8.5 Downloading the receiver calibration settings file

To download the receiver calibration settings json file, click the **DOWNLOAD** button. The file will be saved in the Downloads folder in your computer as **receiverSettings.json**.

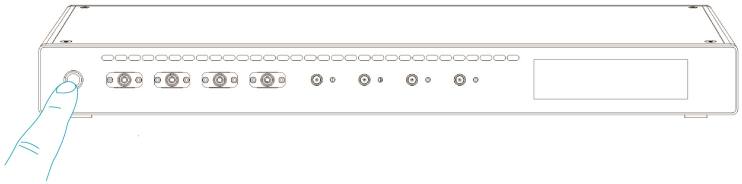
9 Operating your IQRX from the LCD interface

9.1 Powering the IQRX on / off

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

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

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



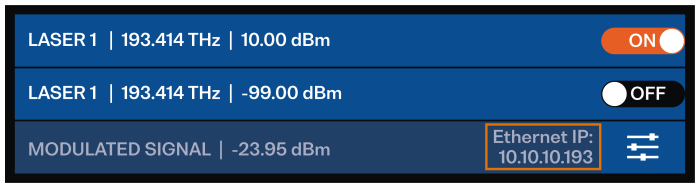
9.2 LCD control touch-screen Graphical User Interface (GUI)

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

9.2.1 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 IQRX 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.



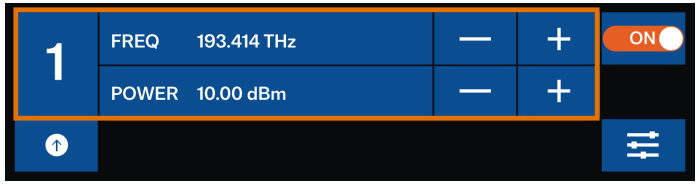
9.2.2 Setting laser channel parameter values

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

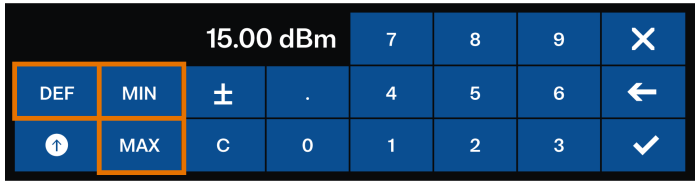
Specific parameters of the laser channel can be set either by clicking the parameter name, or by using the **+** and **–** control buttons to increase or decrease the value field by a set amount. This step size is set in the **STEP SIZE** tab in the menu.

This applies to the following parameters:

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



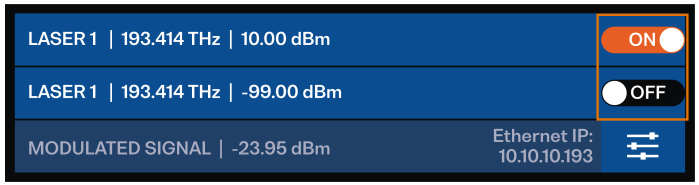
NOTE

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

9.2.3 Toggling the laser channel on / off

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

> **NOTE**
>
> After toggling the laser channel **from OFF to ON**, the IQRX instrument will take up to **30 seconds to stabilize** its power and frequency.



9.2.4 Settings menu

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

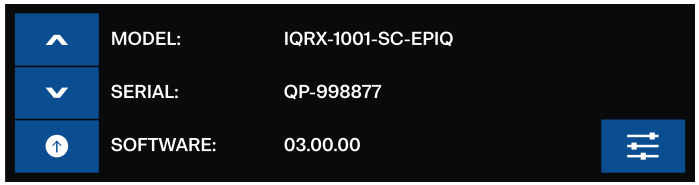
9.2.5 Navigation within the settings menu

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.

9.2.6 Device information

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



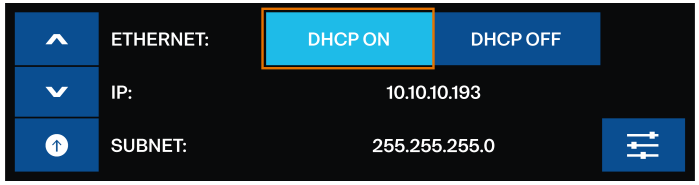
9.2.7 Ethernet connectivity configuration

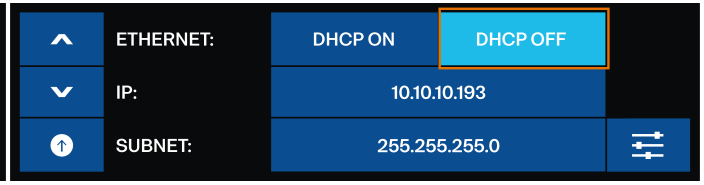
To access the Ethernet connectivity configuration, click on the **ETHERNET** tab in the menu.

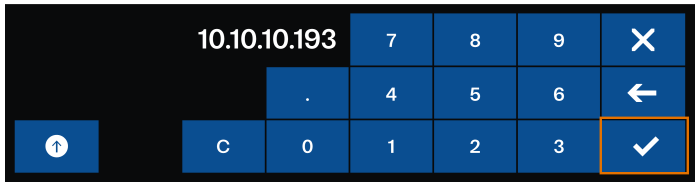
To set a dynamic IP addressing method, select the **DHCP ON** button. The DHCP will automatically assign the instrument an IP address.

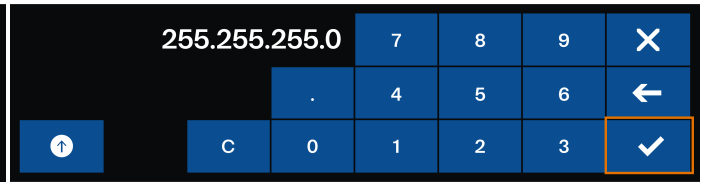
To set a static IP address over the Ethernet, select the **DHCP OFF** button and set the IP address and the Subnet mask by clicking on the **IP / SUBNET** filed and typing in a valid value. To save and apply the changes click the tick mark.

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.







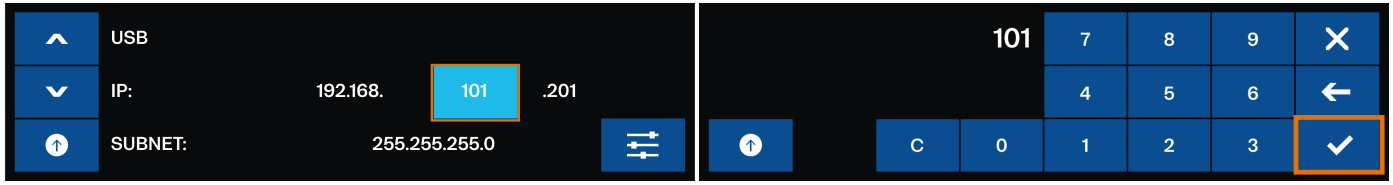


9.2.8 USB connectivity configuration

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.

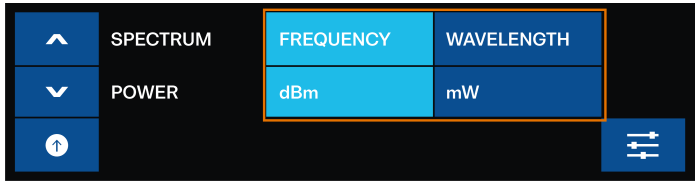
To change the USB IP address, click on the **3rd octet** of the IP address and set to any available value. It is important to make sure that any other instruments connected to the computer do not share this new IP address, as there will be an addressing conflict. To save and apply the changes click the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



9.2.9 Unit settings

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

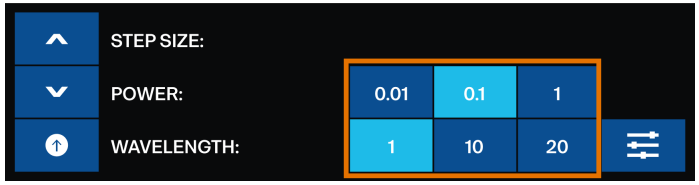
Set the preferred measuring unit of the spectrum and the power by selecting the desired unit type next to the value.



9.2.10 Step size settings

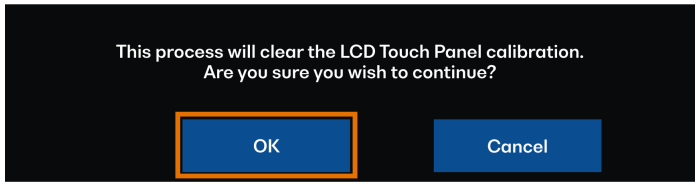
To access the step size settings, click on the **STEP SIZE** tab in the menu.

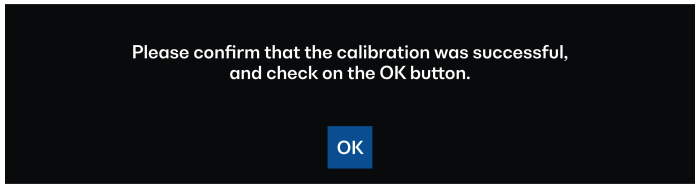
Step size refers to the amount by which the wavelength, power and additional values increase or decrease when the + or - button are clicked.



9.2.11 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.





10 Controlling your IQRX with SCPI commands

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

NOTE

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.

10.1 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	DBM
Frequency	HZ	THZ, GHZ, MHZ, KHZ
Frequency Fine	HZ	THZ, GHZ, MHZ, KHZ
Wavelength	M	NM, PM

Argument	Data Format
`<wsp>`	Specifies whitespace character (0116 – 0916, 0B16 – 2016).
`<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.

10.1.1 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:

<n> is the module index of the specific module within the IQRX instrument, this is an integer > 0.

<m> is the channel index of a specific channel, this is an integer, <1 to 4>.

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, all output response data is transmitted in ASCII format.

10.2 Status and event registers

10.2.1 Standard Event Status Register

The Standard Event Status Register (SESR) is modified by the Quantifi Photonics product 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

10.2.2 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 0 (LSB) value within the SESR Mask is 0.

10.2.3 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.

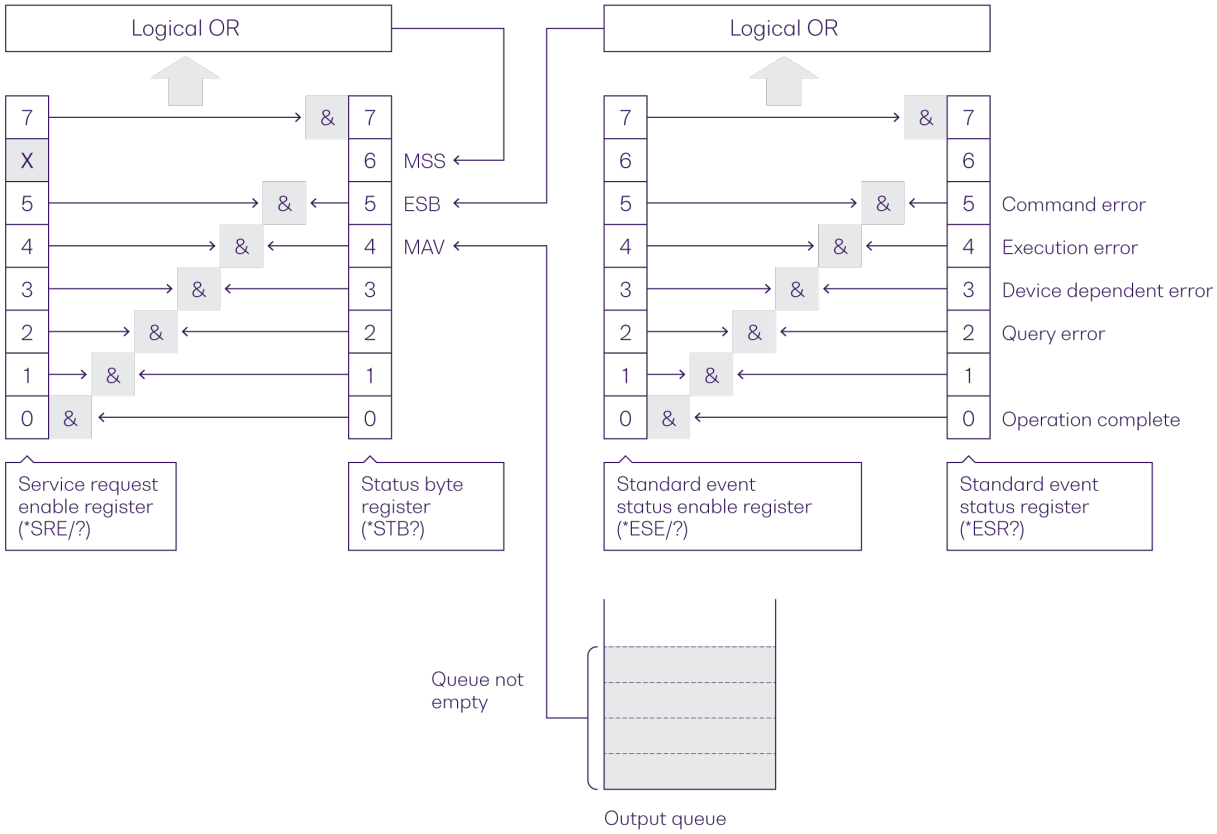
Bit	Description
7 (MSB)	Not used
6	The Master Summary Status (MSS) bit is set from the STB and SRE Mask
5	The Event Status Bit (ESB) is set from the SESR and the SESR Mask
4	Message Available (MAV) is set when there is data in the output queue
3, 2, 1, 0 (LSB)	Not used

10.2.4 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.

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

10.2.5 Status and event registers diagram



10.3 Command summary

10.3.1 Common commands

Command	Description
*CLS	Clear session message queues >>
*IDN?	Query the instrument identification >>
*OPT?	Query the modules installed in the instrument >>
*OPC?	Query the Operation Complete Status >>
*ESR?	Query the Standard Event Status Register >>
*ESE?	Query the Standard Event Status Enable Register (Mask) >>

10.3.2 System commands

Command	Description
:SYSTem	
:INFO?	Query the version of services >>
:MODUles?	Query the number of modules installed in the instrument >>

10.3.3 Module commands

Command	Description
:MODULE<n>	
:IDN?	Query the module identification >>
:OPC?	Query the Operation Complete Status of the module >>
:OPTions?	Query installed modules >>

10.3.4 Configuration commands

10.3.4.1 Power module

Command	Description
:SENSe<n>	
:SIGnal?	Query the measured modulated signal optical power >>

10.3.4.2 Laser module

Command	Description
:OUTPut<n>	
:CHANnel[m]	
:STATE?	Query the laser output state >>
:STATE	Set the laser output state >>
:SOURce<n>	
:CHANnel[m]	
:POWer?	Query the power of the selected laser >>
:POWer	Set the power of the selected laser >>
:WAVelength?	Query the laser output wavelength value >>
:WAVelength	Set the laser output wavelength value >>
:FREQuency?	Get the laser output frequency >>
:FREQuency	Set the laser output frequency >>
:FINE?	Query the fine-tuning laser output frequency >>
:FINE	Set the fine-tuning laser output frequency >>
:GRID?	Query the grid spacing >>
:GRID	Set the channel grid spacing >>
:TEMPerature?	Get the laser temperature >>

10.4 Command descriptions

10.4.1 Common commands

Command	***CLS**	Summary >>
Syntax	`*CLS`	
Description	Clear session message queues	
Parameters	N/A	
Response	N/A	
Example	`*CLS`	

Command	***IDN?**	Summary >>
Syntax	`*IDN?`	
Description	Query the instrument identification	
Parameters	N/A	
Response	Comma separated string with the <manufacturer>,<server name>,<chassis controller name>,<server version>	
Example	`*IDN? -> Quantifi Photonics Ltd,IQRX-1002-FA-EPIQ,QP-998877, HW0.00.01SW3.00.16`	

Command	***OPT?**	Summary >>
Syntax	`*OPT?[<wsp><modules>]`	
Description	Query the modules installed in the instrument	
Parameters	N/A	
Response	Comma separated string of the installed modules in the chassis	
Example	`*OPT? -> POWER-1601-1-SC,LASER-1002-2-SC`	

Command	***OPC?**	Summary >>
Syntax	`*OPC?`	
Description	Query the Operation Complete Status	
Parameters		
Response	**1**: all modules installed in the chassis are ready to execute commands	
	0: modules installed in the chassis still have commands to execute in the input queue	
	NOTE: Any commands sent to the module when `:MODUle<slot>:OPC?` is NOT equal `1`, may not execute or return an error.	
Example	`*OPC? -> 1`	

Command	***ESR?**		Summary >>
Syntax	`*ESR?`		
Description	Query the Standard Event Status Register		
Parameters	N/A		
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	Command Execution Error	16
	3	Device Dependent Error	8
	2	Not used	0
	1	Not used	0
	0 (LSB)	Operation Complete	1
Example	`*ESR? -> 8` `*ESR? -> 32`		

NOTE

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 given command, likely due to an incorrect command.

Command	***ESE?**	Summary >>
Syntax	`*ESE?`	
Description	Query the Standard Event Status Enable Register (Mask)	
Parameters	N/A	
Response	Unsigned integer 8 bit value for the register <0 to 255>, as a string.	
Example	`*ESE? -> 254`	

10.4.2 System commands

Command	**:SYSTem:INFO?** Summary >>
Syntax	:SYSTem:INFO?
Description	Query the version of services
Parameters	**SERVER**: Returns CohesionSCPI version
	DRIVER: Returns CohesionDriver version
	ALL: Returns all of the above
Response	
Example	:SYSTem:INFO? ALL -> DRIVER,3.01.12 SERVER,3.00.16

Command	**:SYSTem:MODUles?** Summary >>
Syntax	:SYSTem:MODUles?
Description	Query the number of modules installed in the instrument
Parameters	N/A
Response	Returns the number of modules installed in the IQRX
Example	:SYSTem:MODUles? -> 2

10.4.3 Module commands

Command	**:MODUle<n>:IDN?** Summary >>
Syntax	:MODUle<n>:IDN?
Description	Query the module identification
Parameters	N/A
Response	A comma-separated string containing "<manufacturer>,<model name>,<serial number>,<hardware version><firmware version>". Note that the hardware and firmware versions are not comma separated.
Example	:MODUle2:IDN? -> Quantifi Photonics Ltd,LASER-1002-2-SC,QP-997654, HW0.01.02FW0.01.32

Command	**:SLOT<slot>:OPC?** Summary >>
Syntax	:SLOT<slot>:OPC?
Description	
Parameters	N/A
Response	**1**: the module is ready to accept a new command
	0: the module is busy performing a previous operation
	NOTE: Any commands sent to the module when :MODUle<slot>:OPC? is NOT 1, may not execute or return an error.
Syntax	:SLOT1:OPC? -> 1

Command	**:MODUle<module>:OPTions?** Summary >>
Syntax	:MODUle<module>:OPTions?
Description	Query installed modules
Parameters	N/A
Response	A comma separated array, or a single integer value based on the arguments given
Example	:MODU2:OPTions? -> 1,,,,,,,

10.4.4 Configuration Commands

10.4.4.1 Power module

Command	**:SENSe<n>:SIGnal?** Summary >>
Syntax	:SENSe<n>:SIGnal?<wsp>[MIN|MAX|ACT|ALL]
Description	Query the measured modulated signal optical power
Parameters	**MIN**:Returns the minimum power that can be measured
	MAX: Returns the maximum power that can be measured
	ACT: Returns the actual measured power (default)
	ACTReturns all 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	:SENS1:SIG? ALL -> -50.00,22.00,-23.72

10.4.4.2 Laser module

Command	**:OUTPut<n>:CHANnel[m]:STATE?** Summary >>
Syntax	:OUTPut<n>:CHANnel[m]:STATE?
Description	Query the laser output state
Parameters	N/A
Response	Returns the current output state of the laser ON / OFF
Example	:OUTP2:CHAN1:STATE? -> ON

Command	**:OUTPut<n>:CHANnel[m]:STATE** Summary >>
Syntax	:OUTPut<n>:CHANnel[m]:STATE<wsp>[ON|OFF]
Description	Set the laser output state
Parameters	**ON|OFF**: Sets the output state on or off
Response	N/A
Example	:OUTP2:CHAN1:STATE ON

Command	**:SOURce<n>:CHANnel[m]:POWer?** Summary >>
Syntax	:SOURce<n>: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 min, max, set or actual (current) power for the laser by parameters
Example	:SOUR2:CHAN1:POW? SET -> 10.0

Command	**:SOURce<n>:CHANnel[m]:POWer** Summary >>
Syntax	:SOURce<n>:CHANnel[m]:POWer<wsp>[<value>|MIN|MAX|DEF]
Description	Set the power of the selected laser
Parameters	**<value>**: A valid numerical value which is in the range between the MIN and MAX response queried with the POWer? command, or seen in the IQRX 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	N/A
Example	:SOUR2:CHAN1:POW 7.0

NOTE

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<n>:CHANnel[m]:WAVelength?** Summary >>
Syntax	:SOURce<n>: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	:SOUR2:CHAN1:WAV? MAX -> 1.56877267e-06

Command	**:SOURce<n>:CHANnel[m]:WAVelength** Summary >>
Syntax	:SOURce<n>:CHANnel[m]:WAVelength<wsp>[<value&unit>|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, or found in the IQRX specifications
	MIN: Set the minimum programmable value
	MAX: Set the maximum programmable valuee
	DEF:Set the default programmable value
Response	N/A
Example	:SOUR2:CHAN1:WAV 1550 NM

Command	**:SOURce<n>:CHANnel[m]:FREQuency?** Summary >>
Syntax	:SOURce<n>: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	:SOUR2:CHAN1:FREQ? MAX -> 1.96250000e+14

Command	**:SOURce<n>:CHANnel[m]:FREQuency** Summary >>
Syntax	:SOURce<n>:CHANnel[m]:FREQuency<wsp>[<value&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, or found in the IQRX 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	N/A
Example	:SOUR2:CHAN1:FREQ 1.92 THZ

Command	**:SOURce<n>:CHANnel[m]:FREQuency:FINE?** Summary >>
Syntax	:SOURce<n>: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 min, max or currently set fine tuning frequency as set by parameters.
Example	:SOUR2:CHAN1:FREQ:FINE? -> 8.90000000e+07

Command	**:SOURce<n>:CHANnel[m]:FREQuency:FINE** Summary >>
Syntax	:SOURce<n>:CHANnel[m]:FREQuency:FINE<wsp>[<value&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	N/A
Example	:SOUR2:CHAN1:FREQ:FINE MAX

NOTE

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

Command	**:SOURce<n>:CHANnel[m]:GRID?**	Summary >>
Syntax	:SOURce<n>: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 min, max or currently set grid spacing for the laser as set by parameters.	
Example	:SOUR2:CHAN1:GRID? MIN -> 1.000000e+08	

Command	**:SOURce<n>:CHANnel[m]:GRID**	Summary >>
Syntax	:SOURce<n>:CHANnel[m]:GRID<wsp>[<value&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.	
	MIN: Set the minimum programmable value	
	MAX: Set the maximum programmable value	
	DEF: Set the default programmable value	
Response	N/A	
Example	:SOUR2:CHAN1:GRID 2 GHZ	

Command	**:SOURce<n>:CHANnel[m]:TEMPerature?**	Summary >>
Syntax	:SOURce<n>:CHANnel[m]:TEMPerature?	
Description	Get the laser temperature	
Parameters	N/A	
Response	Numerical temperature in degrees Celsius	
Example	:SOUR2:CHAN1:TEMP? -> 26.88	

10.5 Programming examples

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

> We recommend that you use the `*ESR?` query after every command that is sent to the device. This enables you to debug unreceived or incorrect commands sent to the product.

> After setting the Laser STATE to ON, **allow 30 seconds for the laser power and frequency to stabilize and reach the set point**. Any POWER or FREQUENCY (WAVELENGTH) queries during this time may return incorrect information.

```
#Identifying the IQRX instrument and installed modules
*IDN?                                    #Query to confirm the correct instrument is setup
                                         #->Quantifi Photonics Ltd,IQRX-1002-FA-EPIQ,QP-998877,HW0.00.01SW3.00.16
*OPT?                                    #Query the available instrument module configuration
                                         #->POWER-1601-1-SC,LASER-1002-2-SC
:MODUle2:IDN?                            #Query the identification information for a specific module
                                         #->Quantifi Photonics Ltd,LASER-1002-2-SC,QP-987654,HW0.01.02FW0.01.32

#Configuring the Laser module on the IQRX instrument
:SOURce2:CHANnel1:POWer 10 DBM           #Set the Laser frequency to 193.4145 THz (1550nm)
:SOURce2:CHANnel1:FREQuency 193.4145 THZ #Set state DM for logical switch 2
:OUTPut2:CHANnel1:STATE ON               #Turn the Laser ON

#Querying the Laser module on the IQRX instrument
:SOURce2:CHANnel1:POWer?                 #Query the Laser actual power
:SOURce2:CHANnel1:FREQuency?             #Query the Laser set frequency

#Querying the Signal input power from the Power module
:SENSe1:SIGnal?                          #Query the optical input power
```

10.6 SCPI Command Console

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

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

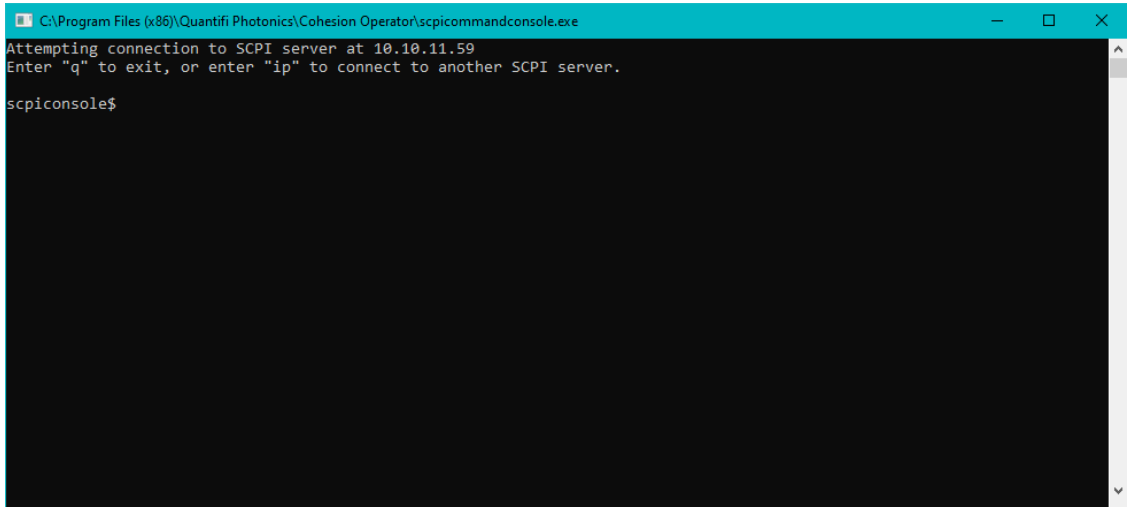
The two most common error codes are:

17: IO writer 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 that 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. If you enter a command correctly, for example: `*cls`

   The instrument executes the command, there will be no action response.

8. If you enter a command incorrectly, for example: `*csl`

   The instrument returns **error code 17: IO write error**.

11 Programming examples and applications

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

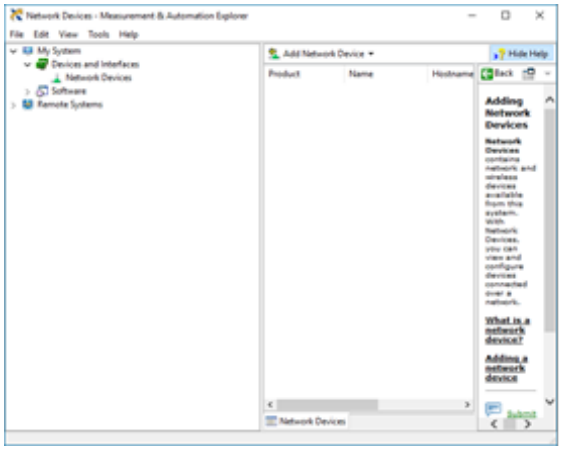
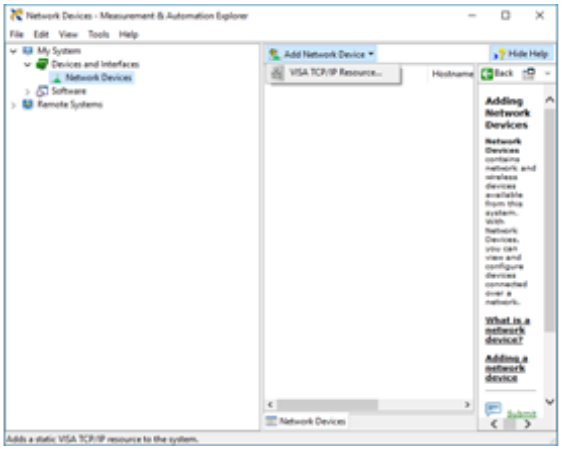
NOTE

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 Setting up NI-MAX application

To communicate with any Quantifi Photonics product, the chassis / benchtop product 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**.

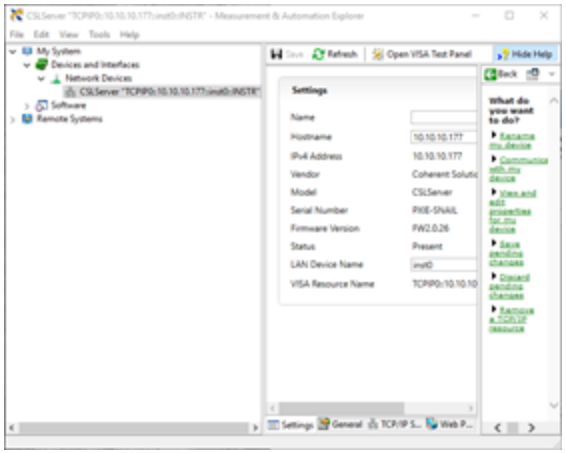



3. Select **Manual Entry of LAN Instrument**. Enter in the Hostname or IP Address.
   Note when operating locally, enter in the localhost IP address of **127.0.0.1**. Click **Finish** to end the setup process.

11.2 Setting up NI-VISA application

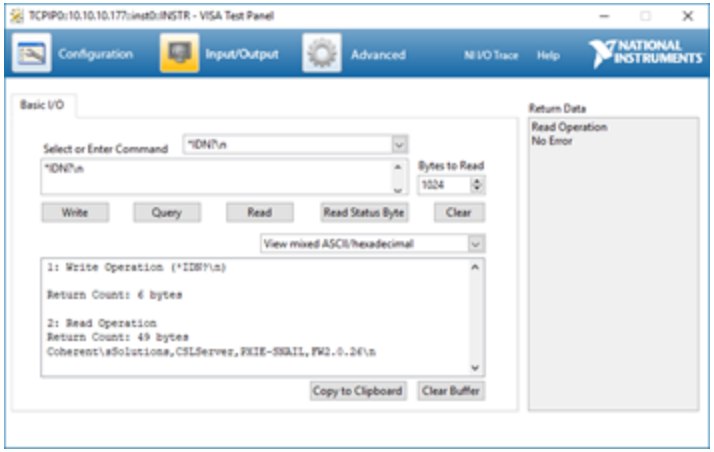
NI-VISA is used to communicate with the PXIe chassis or installed modules / instruments. The above steps must be completed before attempting to communicate using NI-VISA.

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 chassis and module commands can be entered in, and their returns queried



11.3 Python® code example

The following example shows how to communicate with the Quantifi Photonics product using Python code.

```
# 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))
```

11.4 MATLAB® code example

To communicate with the Quantifi Photonics product 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 PXIE Platform, 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.

NOTE

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 a Quantifi Photonics product using MATLAB code.

```
% 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.
```

12 Working with optical fibers

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

CAUTION

Keep connectors clean and in good condition to ensure maximum power and to avoid erroneous readings. Quantifi Photonics is not responsible for damage or errors caused by bad fiber cleaning or handling.

- Always inspect fiber end faces for cleanliness using a fiber inspection probe before inserting them into a port..
- If required, clean fibers and faces as detailed below.

NOTE

- To avoid damaging ferrules or fiber faces due to mismatched connectors, always check ports and connector type information before inserting a connector. All Quantifi Photonics units are labeled with connector type information.
- Failing to align and/or connect fiber-optic cables properly will result in significant signal loss and reflection.

▶ When connecting a fiber-optic cable to a port:

1. Visually inspect the fiber end face using a fiber inspection microscope.
2. If a **connector end face** is dirty:
    - Wipe the connector end face using a reel-type cleaner and inspect again.
    - For stubborn hard to clean connectors:
        - Use lint-free fiber-cleaning wipes soaked in a fiber optic cleaning solution.
        - Wipe the connector on the soaked part.
        - Dry the connector by wiping on the dry part of the wipe, or by using a reel-type cleaner.
    - Repeat the process until connector inspection shows a clean fiber face.
3. If a **bulkhead inner connector face** is dirty:
    - Use a pen-type dry cleaner, align the cleaning tip with the port and push the cleaner until you hear the characteristic click. Inspect again.
    - For stubborn hard to clean bulkhead connectors:
        - Use a stick-type cleaner dipped in a fiber optic cleaning solution.
        - Carefully align and insert the stick into the connector and gently rotate the stick for several seconds applying light pressure.
        - Use a pen-type cleaner to dry the connector.
    - Repeat the process until connector inspection shows a clean fiber face.
4. If the fiber end face is clean:
    - Carefully align the connector and port to prevent the fiber end from touching the outside of the port or other surfaces. If the connector features a key, mate it correctly into the corresponding notch of the port bulkhead.

- Push the connector in so that the fiber-optic cable is firmly in place with adequate contact. If your connector features a screw sleeve, tighten the connector to firmly maintain the fiber in place. Do not over-tighten, as this will dam-age the fiber and the port bulkhead.

13 System requirements

Quantifi Photonics PXIe modules

Supported browsers for working with CohesionUI	Google Chrome™ Microsoft Edge®
Chassis	PXIe-compatible chassis that • supports PXIe, or • contains PXI hybrid compatible slots
Recommended PXIe controller operating system	Microsoft Windows® 10 (64-bit)

Quantifi Photonics MATRIQ / EPIQ instruments

Supported browsers for working with CohesionUI	Google Chrome™ Microsoft Edge®
Recommended client computer operating system	Microsoft Windows® 10 (64-bit)

14 Maintenance

To help ensure long, trouble-free operation:

- Always inspect fiber-optic connectors before using them and clean them if necessary.
- Keep the unit free of dust.
- Store the unit 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 unit, power off the chassis immediately. Remove the unit and allow to dry completely.
- To allow for sufficient air flow and avoid thermal issues, set up your instrument with a minimum clearance of 2 inches (50.8mm) around it and do not block any ventilation fans.

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.

14.1 Annual calibration schedule

To ensure that the unit is performing within specification, we recommend it is re-calibrated every 12 months.

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.

15 Technical Support

15.1 Contacting the Technical Support Group

To obtain after-sales service or technical support for this product, contact Quantifi Photonics:

support@quantifiphotonics.com

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

15.2 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. If the original packaging is unavailable, use appropriate foam packaging to provide shock absorption and avoid displacement of the product inside the shipping box. Please keep all input connectors covered with the supplied anti-static plastic covers during transport and avoid any shipping material making contact with the sensitive connectors of the product.
- Avoid high humidity or large temperature fluctuations.
- Keep the product out of direct sunlight.
- Avoid unnecessary shocks and vibrations.

16 Warranty Information

16.1 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.

NOTE

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 quantifiphotonics.com.

16.2 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.

The external power supply that has been supplied by Quantifi Photonics with the unit can only be used with that unit, do not use it with any other product.

16.3 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.

16.4 Certification

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

16.5 Service and repairs

To send any equipment for service, repair or calibration please contact the Technical Support Group: support@quantifiphotonics.com.

QUANTIFI PHOTONICS®
A Teradyne Company

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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