QUANTIFI PHOTONICS®
A Teradyne Company

POL

1000 SERIES

Polarization Controller and Scrambler

MATRIQ User Manual

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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

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.

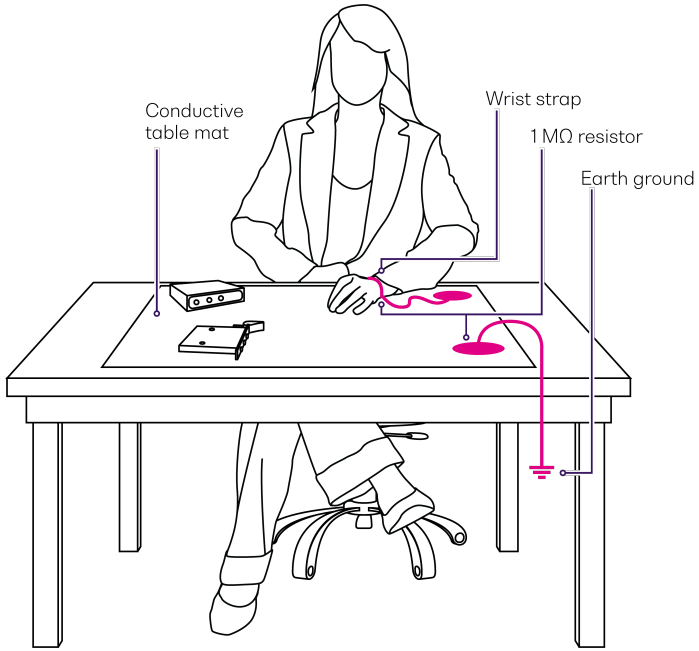

This symbol on the unit refers to documentation provided with the product for related safety information. Ensure that the required conditions are met and understood before using the product.

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 POL 1000 Series

The POL 1000 Series is an all-fiber polarization controller which provides full polarization control through three independent control set-points.

The POL can operate in two modes:

- MANUAL mode: The three set-points can be set to static values.
- SCRAMBLE mode: The user can driver each of the three independent set-points with a sinusoidal, triangular, or random waveform of a set frequency and phase.

The POL 1000 Series is a versatile addition to optical-electrical test systems for setting or randomizing the polarization of an input source.

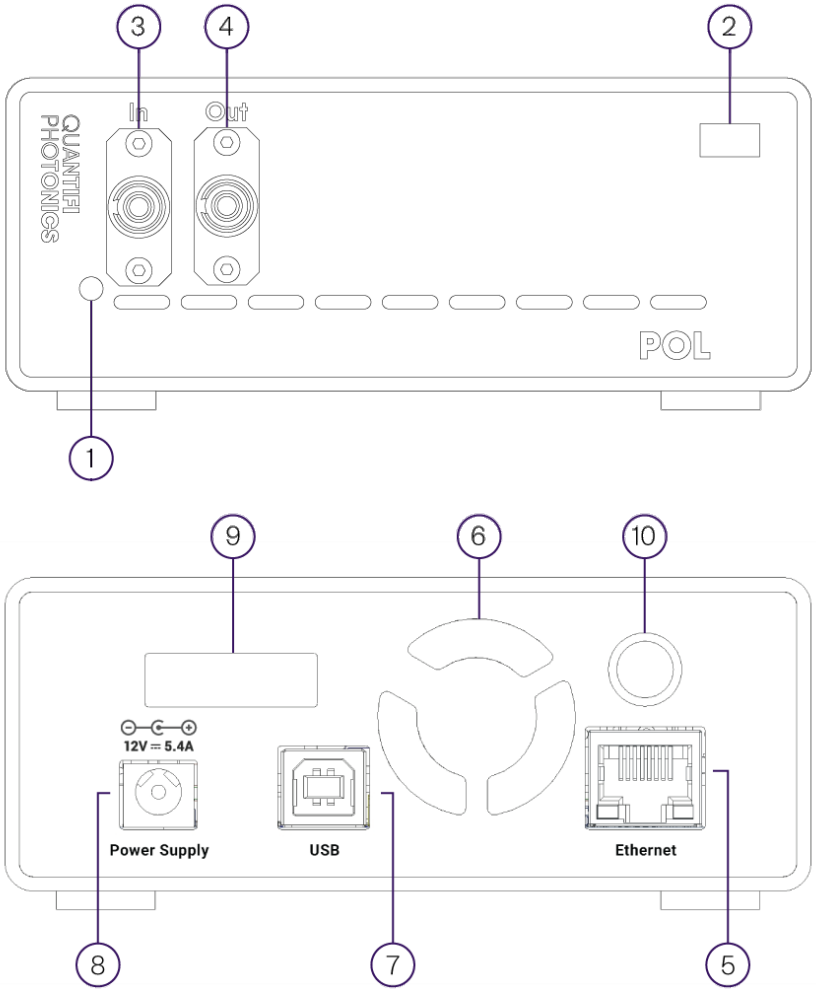
Programming interfaces

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.

4.1 Hardware description



1	Status LEDs	6	Ventilation fan (DO NOT OBSTRUCT)
2	Optical connector type	7	USB type B port
3	Optical input port	8	Power supply port
4	Optical output port	9	IP address LCD screen
5	Ethernet port	10	On / Off push button

4.2 Status LEDs

The LED shows the operation state of the POL product:

LED	Meaning
OFF	Product is powered OFF.
solid RED	Indicates that there is an error in initialization of the product.
flashing red	Indicates that there is an error, and the product is busy.
solid GREEN	Indicates that the product is operational.
flashing GREEN	Indicates that initialization was successful, and the module is busy.

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:

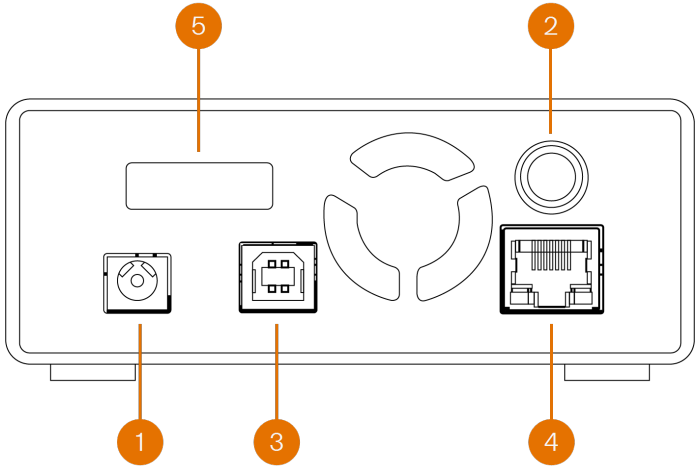
- Always clean optical end faces before mating.

NOTE

- You must use the external power supply that has been supplied by Quantifi Photonics with the unit. Any attempt to use a different external power supply may cause product damage and will void your warranty.
- The external power supply that has been supplied with the unit can only be used with that unit. Do not use it with any other product.
- 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.
- 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 POL product and power ON



▶ To set up your instrument and power ON:

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. Insert the power cord - you must use the IEC cable supplied with the unit.
2. Power the instrument ON by pushing the ON button.
3. Connect to a client computer using a USB cable,

   OR
4. Connect to your network or client computer using an Ethernet cable.
5. The instrument IP address will appear on the LCD screen. 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 Instrument IP address

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

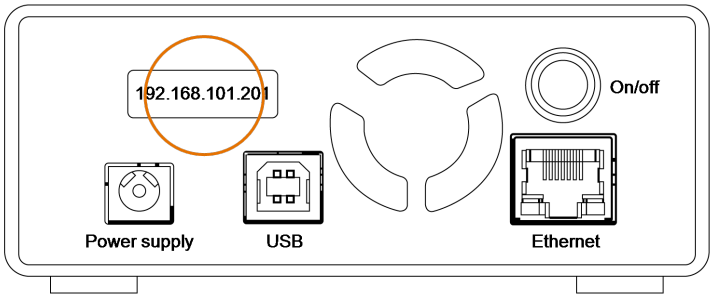
Your instrument can have two different IP addresses depending on your chosen connection method (USB or Ethernet):

- 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 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.

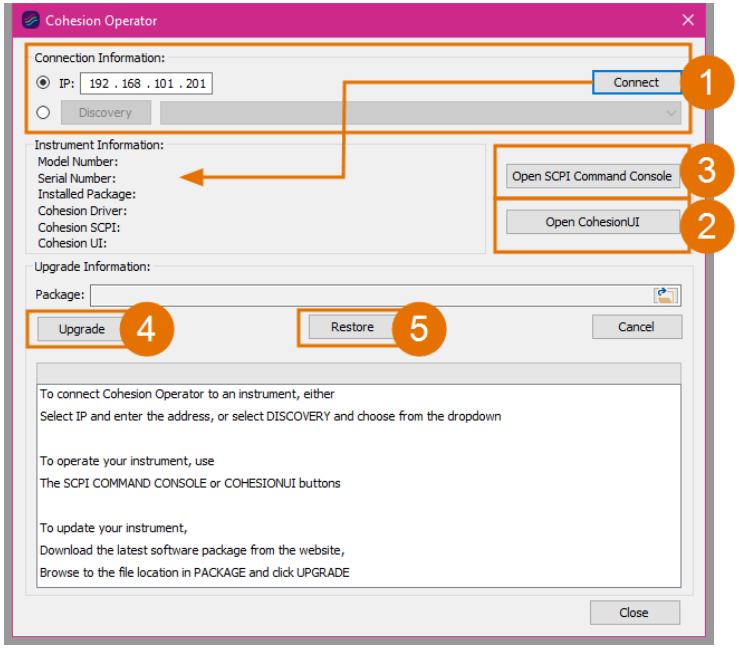
6 Installing software

To work with Quantifi Photonics 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 > MATRIQ Series).

Cohesion Operator enables you to:

1. **Connect** with 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.

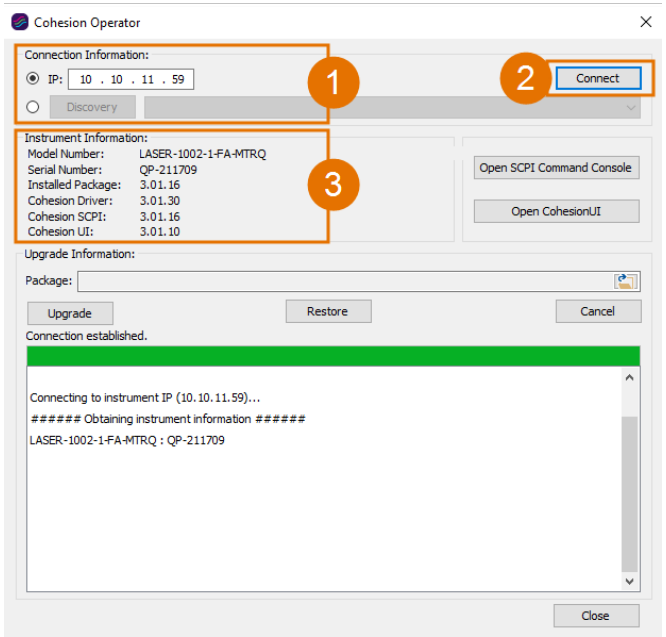
6.2 Check firmware version and other information

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.

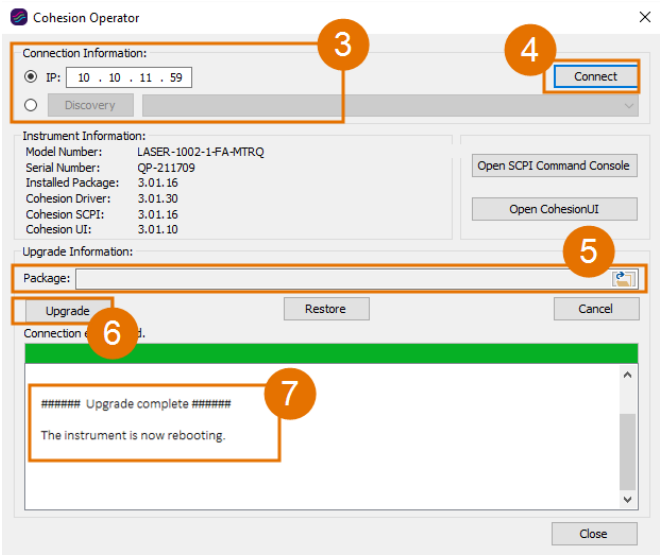


6.3 Upgrade firmware

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 MATRIQ firmware package **CohesionMATRIQ-<version>.qfw**, for example by downloading it from quantifiphotonics.com (go to **Resources > Drivers, software and manuals > MATRIQ 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

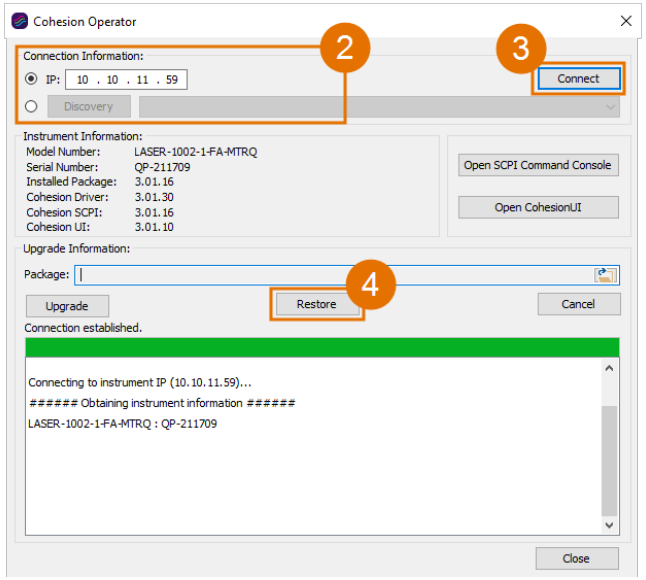
If an upgrade attempt is unsuccessful, the Cohesion Operator will stop the upgrade process and restore the instrument to its previous firmware version. Messages will be displayed accordingly.

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.

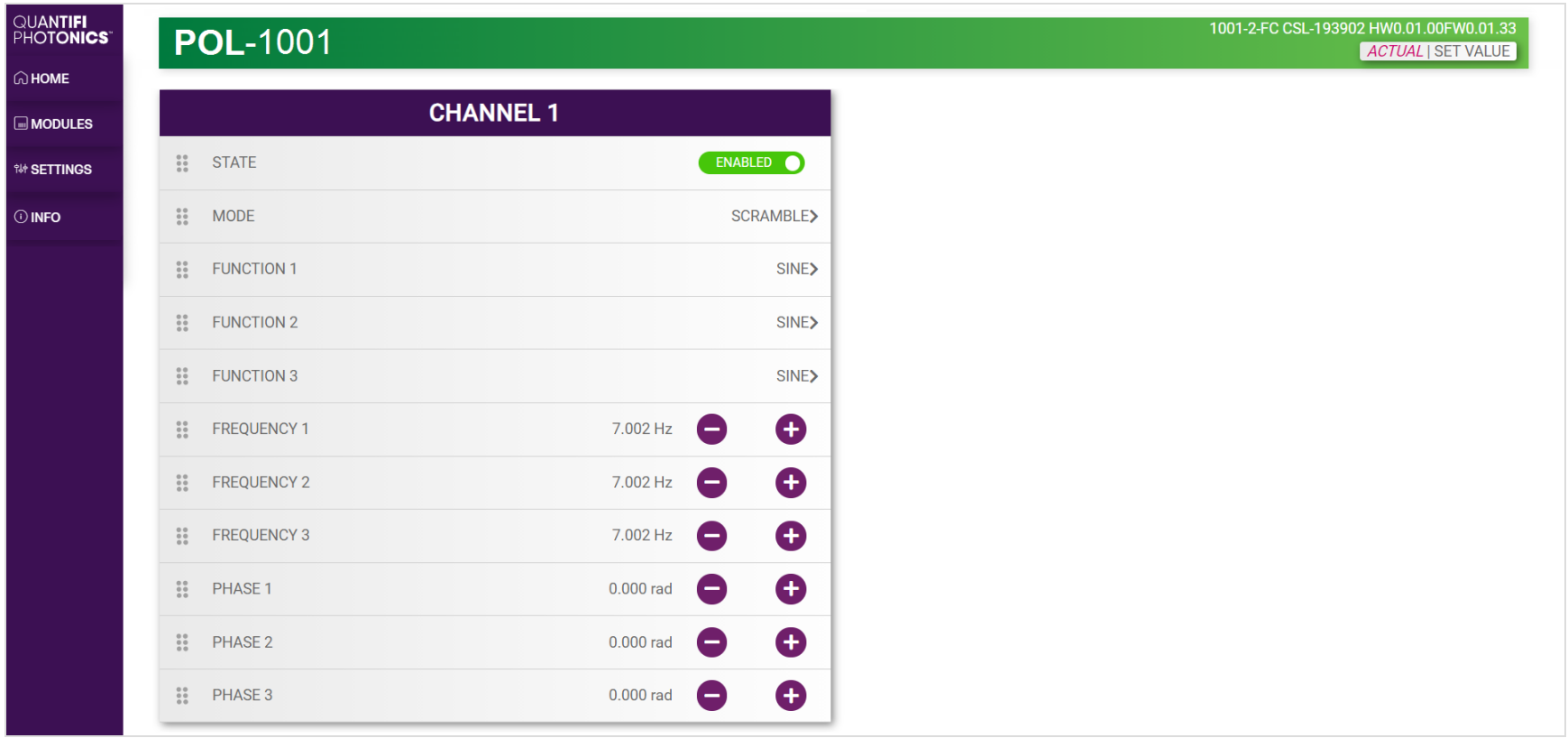
7 CohesionUI - Overview

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

> CohesionUI is part of the MATRIQ 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

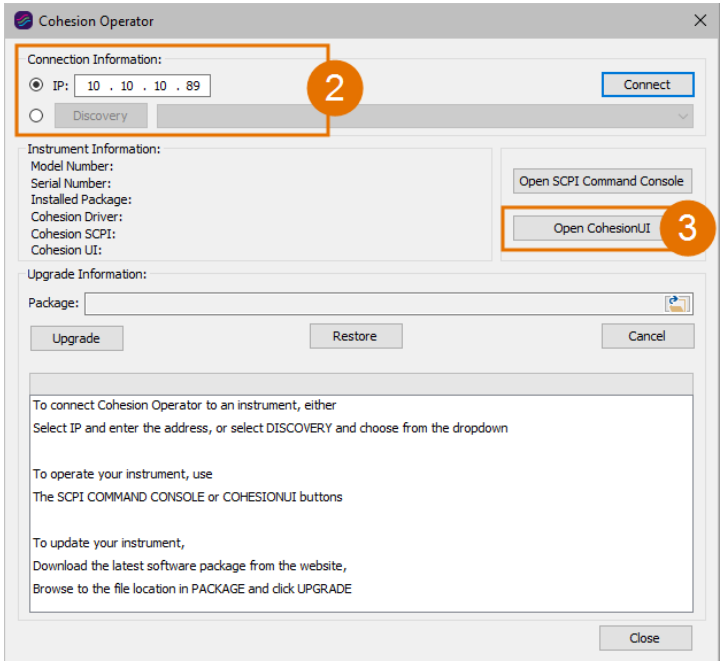
You can open CohesionUI for Quantifi Photonics MATRIQ and EPIQ instruments:

- 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.



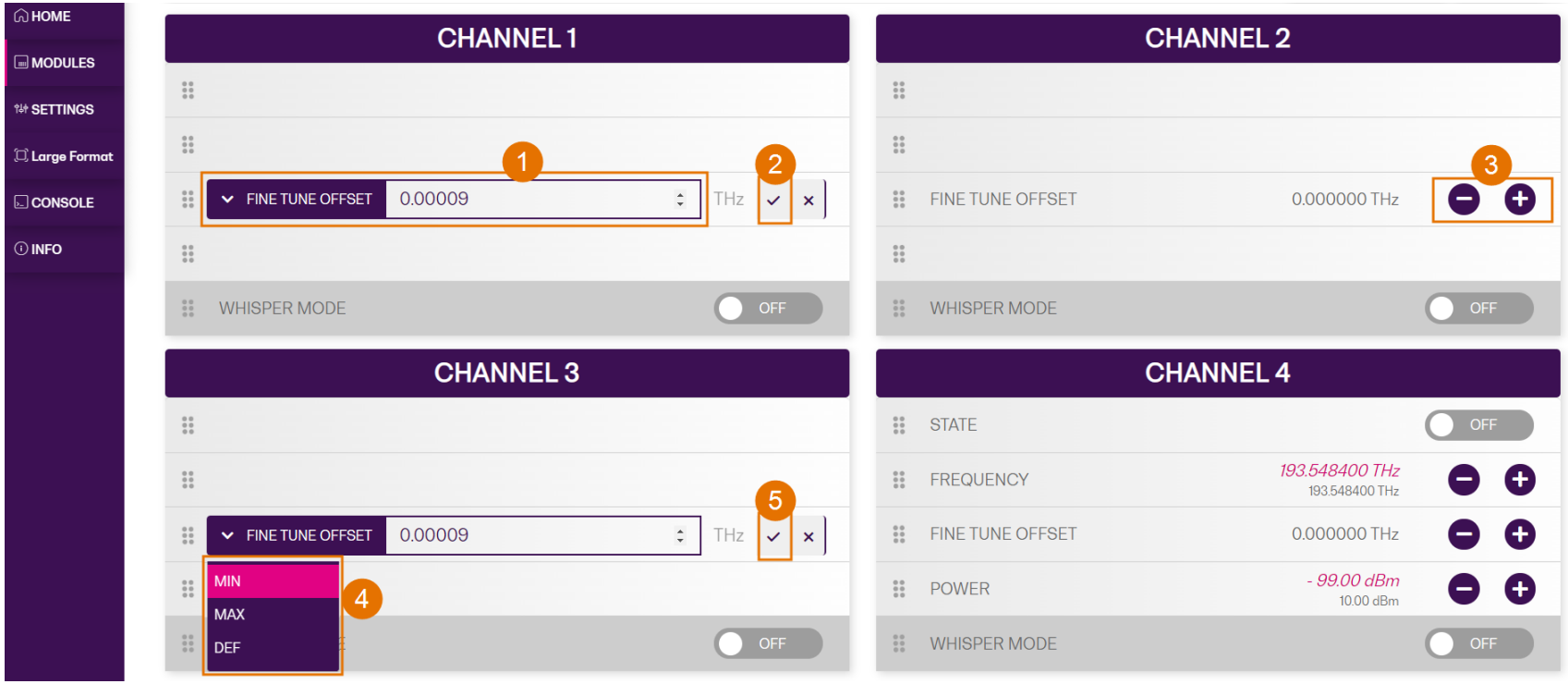
To open CohesionUI in a browser:

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.

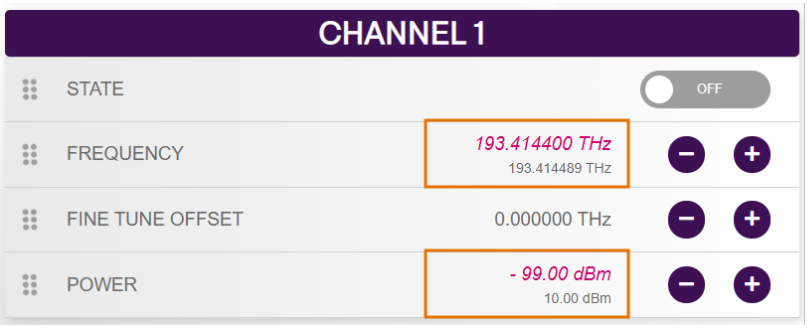


For details on how to change the step size, refer to Manage CohesionUI settings.

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

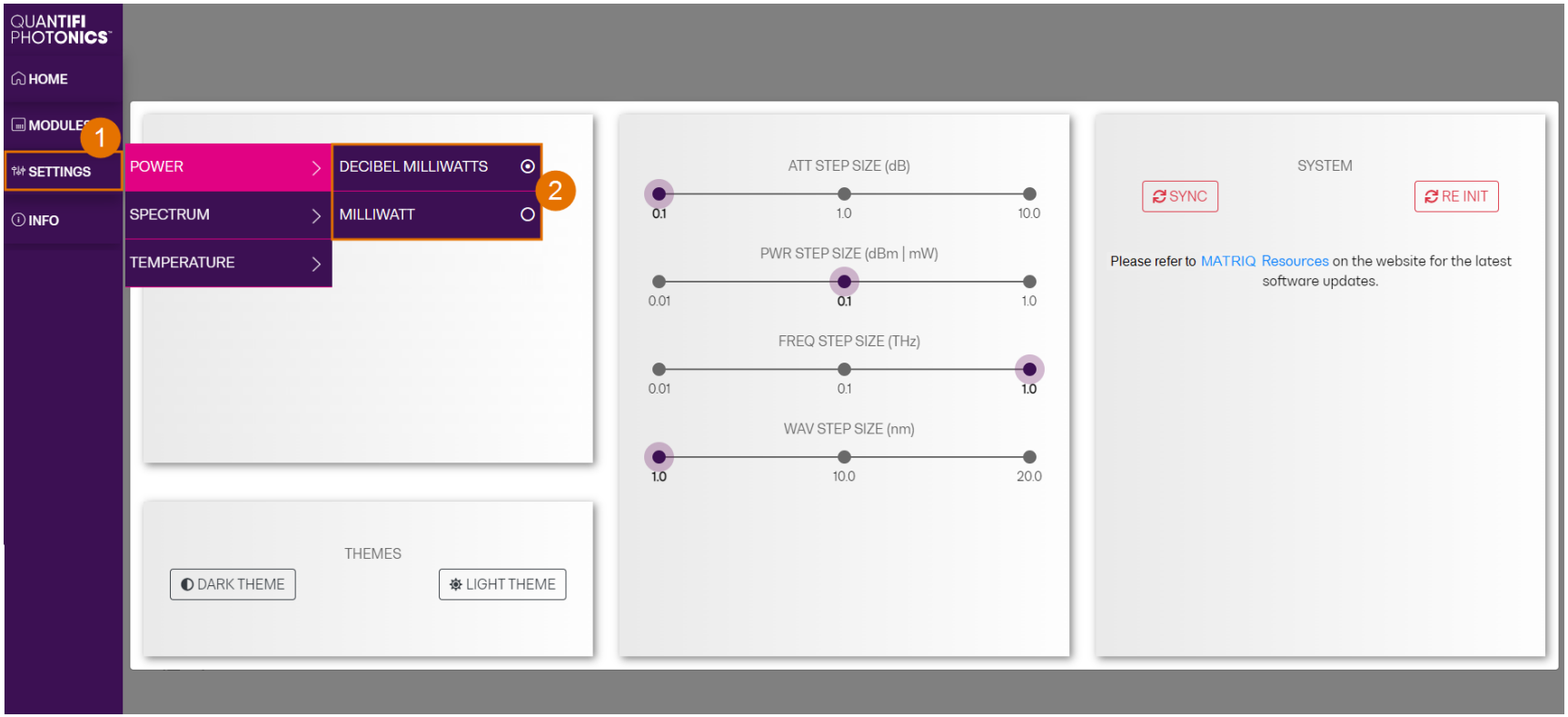
On the **SETTINGS** page you can configure CohesionUI settings and unit preferences.

▶ 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):

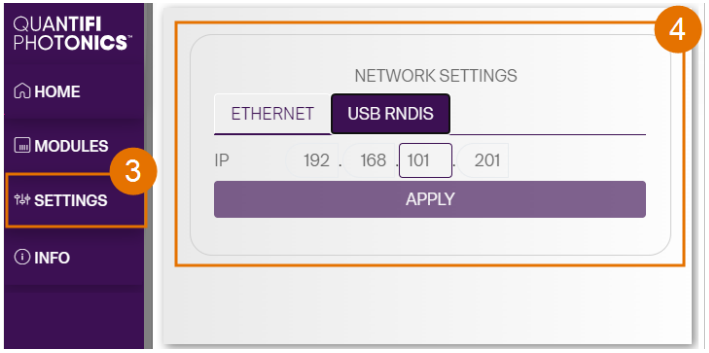
- The default **USB IP address** is **192.168.101.201**. This is a static address set during instrument calibration.
- The default **Ethernet IP address** is dynamically assigned by the DHCP.

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.



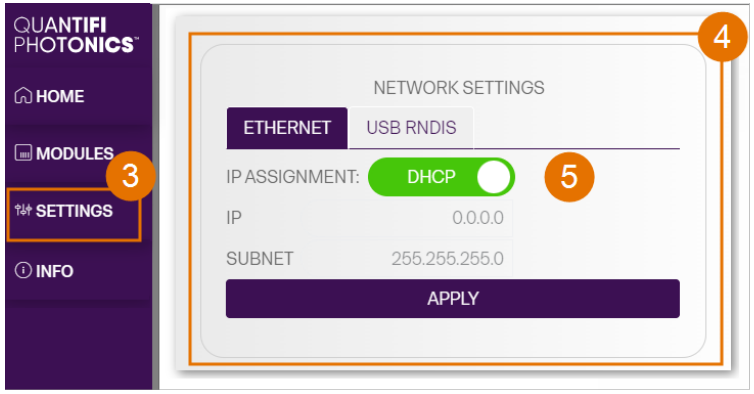
To change the **Ethernet IP address**:

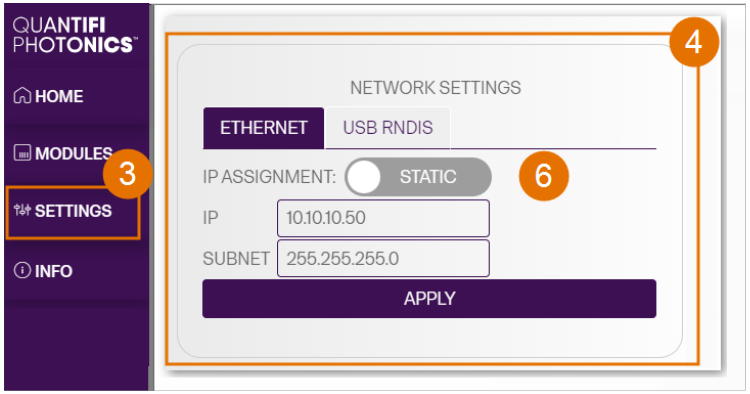
1. Connect with the instrument from a client computer via USB. Ensure that this the only Quantifi Photonics instrument currently connected via USB.
2. Open CohesionUI using the currently assigned USB IP address.
3. Go to **SETTINGS**.
4. In **NETWORK SETTINGS > ETHERNET** tab:
5. Toggle **IP ASSIGNMENT** 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.



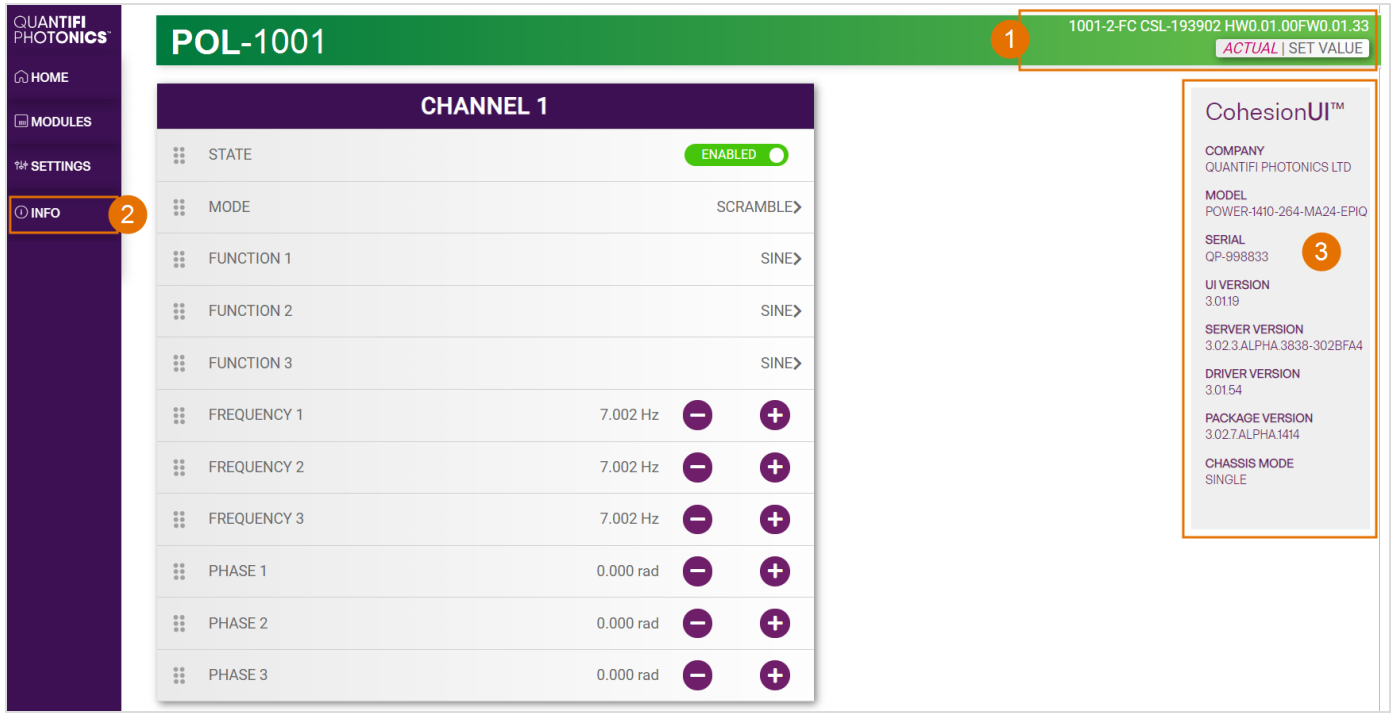


7.6 View system information

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 POL with CohesionUI

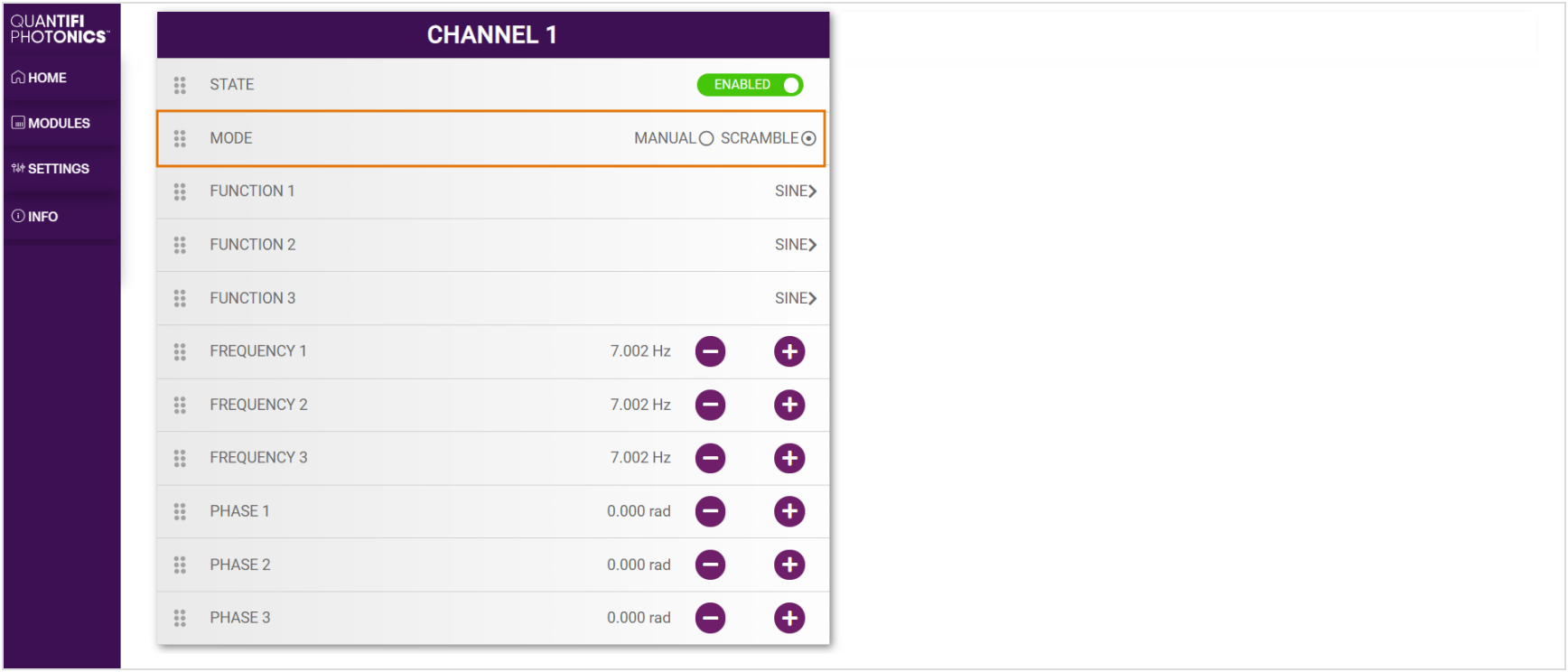
You can use Quantifi Photonics' graphical user interface CohesionUI to work with your module. For details on how to get started with CohesionUI, refer to CohesionUI - Overview.

8.1 POL control modes

The POL can operate in two modes:

- MANUAL mode: The POL changes the set-point of each independent polarization controller.
- SCRAMBLE mode: The POL will scramble the set-point of the three independent polarization controllers, to alter the polarization state based on three properties: A waveform, a frequency, and a phase.

Clicking the current control mode will expand it into the available options (MANUAL and SCRAMBLE), and after clicking on the desired mode it will collapse and display the selected mode.



8.2 Setting channel parameter values

Specific control parameters for a given channel in the POL 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.

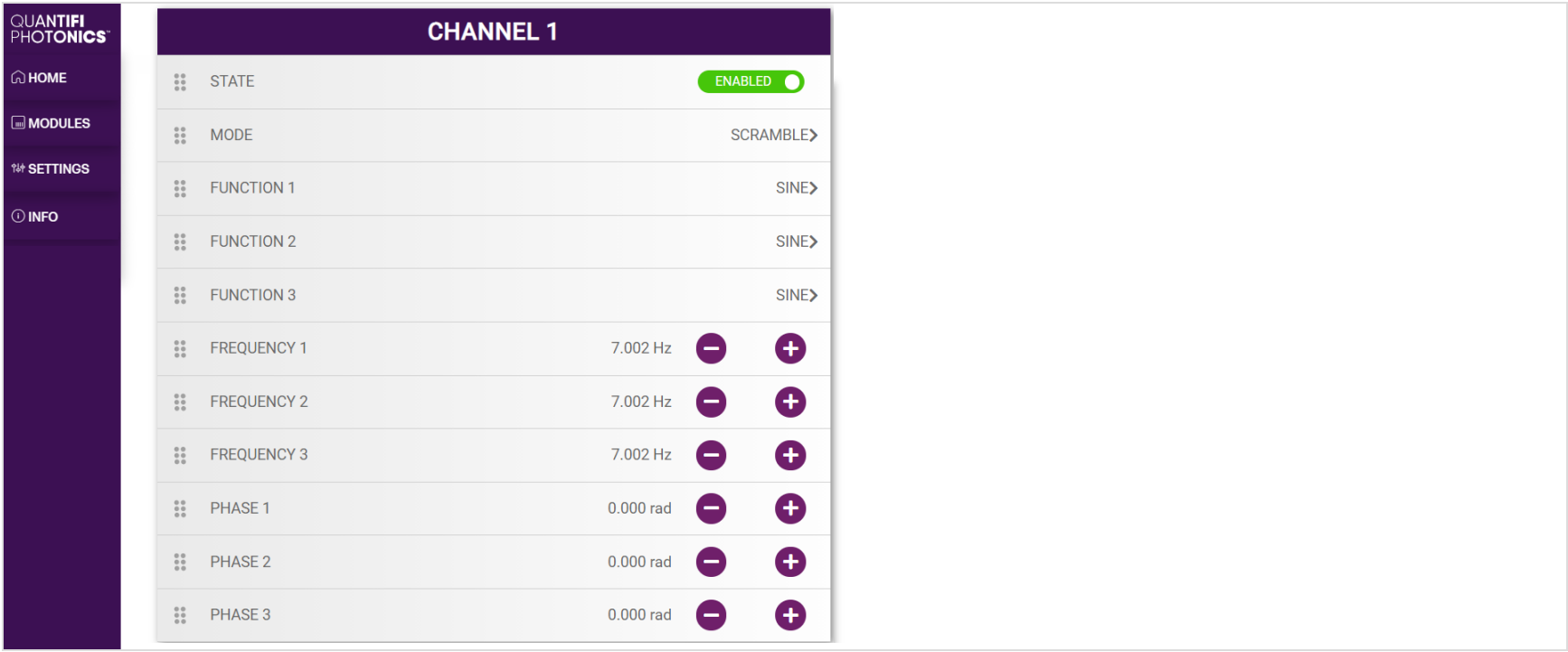
This applies to the following parameters:

In MANUAL mode:

- **SET 1** - **SET 3**: The set-point for each polarization controller.

In SCRAMBLE mode:

- **FUNCTION 1** - **FUNCTION 3**: The waveform function for each polarization controller. The available functions are SINE, TRIANGLE, and RANDOM.
- **FREQUENCY 1** - **FREQUENCY 3**: The frequency of the function for each polarization controller. Setting the FREQUENCY to a 0 value will halt all scrambling of the polarization set-points, which will remain at their present values until the FREQUENCY is set to a non-zero value.
- **PHASE 1** - **PHASE 3**: The phase of the function for each polarization controller.



In the above example, the **FREQUENCY 1** for CHANNEL 1 has been set to **7.002 Hz** by manual input. Alternatively clicking the MIN button in the dropdown menu will set the minimum value. To apply the changes, click the tick mark.

9 Controlling your POL 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.

9.1 Overview

You can operate your Quantifi Photonics module using SCPI commands.

For details on available SCPI commands, refer to:

- Command summary
- Command descriptions

9.2 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
Frequency	HZ	
Phase	RAD	

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.

9.2.1 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:

Index	Description	Value
<n>		integer 1
<m>	the channel index of a specific unit in the module	integer <1 to 4>
<a>	the number of the independent polarization controller within the module	integer <1 to 3>

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.

9.3 Status and event registers

9.3.1 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

9.3.2 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.

9.3.3 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.

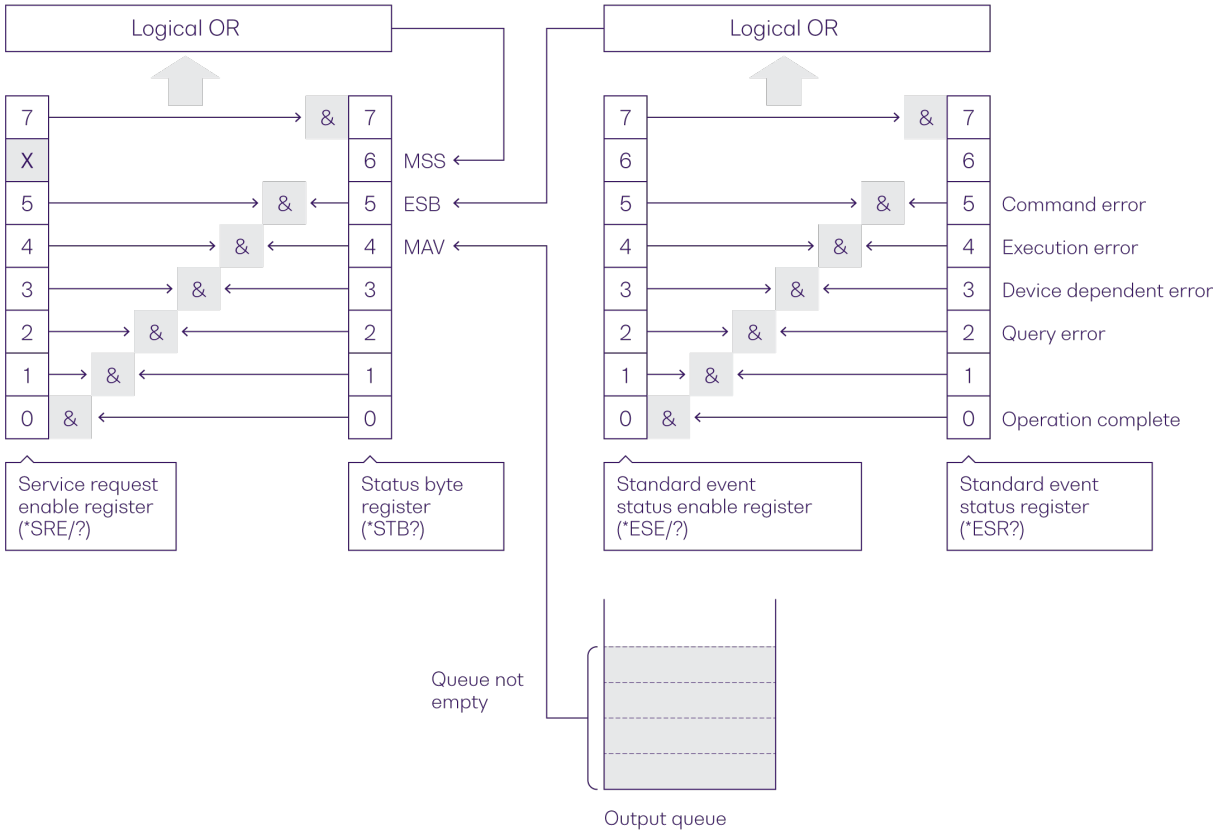
Bit	Description
7 (MSB)	Not used
6	The Master Summary Status (MSS) bit is set from the STB and SRE Mask
5	The Event Status Bit (ESB) is set from the SESR and the SESR Mask
4	Message Available (MAV) is set when there is data in the output queue
3, 2, 1, 0 (LSB)	Not used

9.3.4 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

9.3.5 Status and event registers diagram



9.4 Command summary

9.4.1 Common commands

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

9.4.2 Slot commands

Slot commands	Description
:SLOT<n>	
:OPC?	Query the Operation Complete Status of the module >>
:OPTions?	Query installed modules >>
:IDN?	Query the module identification >>
:ReSeT	Reset the module to default power-on settings >>
:TeST?	Query the module self-test status >>

9.4.3 Configuration commands

Configuration commands	Description
:OUTPut<n>	
:CHANnel<m>	
:STATE?	Query the state of the POL channel>>
:STATE	Set the state of the POL channel >>
:POL<n>	
:CHANnel<m>	
:MODE?	Query the control mode of the POL channel >>
:MODE	Set the control mode of the POL channel >>
:MANUal	
:SET<a>?	Query the set-point of one of the polarization controllers >>
:SET<a>	Set the set-point of one of the polarization controllers >>
:SCRAmble	
:FREQuency<a>?	Query the frequency of one of the polarization controllers >>
:FREQuency<a>	Set the frequency of one of the polarization controllers >>
:FUNCtion<a>?	Query the function of one of the polarization controllers >>
:FUNCtion<a>	Set the function of one of the polarization controllers >>
:PHASe<a>?	Query the phase of one of the polarization controllers >>
:PHASe<a>	Set the phase of one of the polarization controllers >>

9.5 Command descriptions

9.5.1 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, CohesionSCPI service, PXIE-8133, FW2.0.15`	

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

Command	***OPT?**	Summary >>
Syntax	`*OPT?`	
Description	Query the modules installed in the instrument	
Parameters	N/A	
Response	Comma separated string of the installed modules in the chassis	
Example	`*OPT? -> ,Switch-1002-2-FA-PXIe,Switch-1003-1-FC-PXIe,,VOA-1001-2-FA-PXIe,,,,O2E-1001-1-FC-PXIe,,,,,,,,`	

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.

9.5.2 Slot commands

Command	**:SLOT<n>:OPC?** Summary >>
Syntax	:SLOT<n>:OPC?
Description	Query the Operation Complete Status of the module
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 :SLOT<n>:OPC? is NOT 1, may not execute or return an error.
Description	:SLOT1:OPC? -> 1

Command	**:SLOT<n>:OPTions?** Summary >>
Syntax	:SLOT<n>:OPTions?
Description	Query installed modules
Parameters	N/A
Response	A comma separated array, or a single integer value based on the arguments given
Example	:SLOT1:OPT? -> 1,1,,

Command	**:SLOT<n>:IDN?** Summary >>
Syntax	:SLOT<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	:SLOT1:IDN? -> Quantifi Photonics,POL-1001-1-FA-PXIE,QP-180101,HW1.0FW1.02

Command	**:SLOT<slot>:ReSeT** Summary >>
Syntax	:SLOT<slot>:ReSeT
Description	Reset the module to default power-on settings
Parameters	N/A
Response	N/A
Example	SLOT1:RST

Command	**:SLOT<slot>:TeST?** Summary >>
Syntax	:SLOT<slot>:TeST?
Description	Query the module self-test status
Parameters	N/A
Response	Returns the functional readiness status of the module.
	0: No error
	non-zero response: Error
Example	:SLOT1:TST? -> 0

9.5.3 Configuration Commands

Command	**:OUTPut<n>[:CHANnel<m>]:STATE?** Summary >>
Syntax	:OUTPut<n>[:CHANnel<m>]:STATE?[<wsp><DEF|SET|INFO>]
Description	Query the state of the POL channel
Parameters	**DEF**: Returns the default state
	SET: Returns the set state
	INFO: Return the mapping between the numeral and the text form of the control mode
Response	**0|OFF**: The polarization state is not being controlled
	1|ON: The polarization state is being controlled
Example	:OUTPUT6:CHANnel1:STATe? -> 1 :OUTPUT6:CHANnel1:STATe? INFO -> 0:OFF 1:ON

Command	**:OUTPut<n>[:CHANnel<m>]:STATE** Summary >>
Syntax	:OUTPut<n>[:CHANnel<m>]:STATE<wsp><value|DEF|ON|OFF>
Description	Set the state of the POL channel
Parameters	**<value>**: Sets the state to this value
	DEF: Sets the state to the default
	ON: Sets the state to ON
	OFF: Sets the state to OFF
Response	N/A
Example	:OUTP1:CHAN1:STATE ON

Command	**:POL<n>[:CHANnel<m>]:MODE?** Summary >>
Syntax	:POL<n>[:CHANnel<m>]:MODE?[<wsp><DEF|SET|INFO>]
Description	Query the control mode of the POL channel
Parameters	**DEF**: Returns the default control mode
	SET: Returns the set control mode
	INFO: Returns the mapping between the numeral and the text form of the control mode
Response	**0|MANUAL**: The POL channel is operating in manual mode
	1|SCRAMBLE: The POL channel is operating in scramble mode
Example	:POL6:CHANnel1:MODE? -> 0 :POL6:CHANnel1:MODE? INFO -> 0:MANUAL 1:SCRAMBLE

Command	**:POL<n>[:CHANnel<m>]:MODE** Summary >>
Syntax	:POL<n>[:CHANnel<m>]:MODE<wsp><value|DEF|MANUAL|SCRAMBLE>
Description	Set the control mode of the POL channel
Parameters	**<value>**: Sets the state to this value
	DEF: Sets the state to the default
	MANUAL: Sets the state to ON
	SCRAMBLE: Sets the state to OFF
Response	N/A
Example	:POL6:CHANnel1:MODE MANUAL

Command	**:POL<n>[:CHANnel<m>]:MANUal:SET<a>?** Summary >>
Syntax	:POL<n>[:CHANnel<m>]:MANUal:SET<a>?[<wsp><MIN|MAX|DEF|SET|ALL|UNIT|STEP>]
Description	Query the set-point of one of the polarization controllers
Parameters	**MIN**: Returns the minimum set-point
	MAX: Returns the maximum set-point
	DEF: Returns the default set-point
	SET: Returns the set set-point
	ALL: Returns the above parameters in the format: MIN,MAX,DEF,SET
	STEP: Returns the minimum step size of the set-point
Response	A single value, or a comma-separated array of values
Example	:POL6:CHANnel1:MANU:SET1? SET -> 0.400 :POL6:CHANnel1:MANU:SET1? ALL -> 0.000,1.000,1.000,0.400

Command	**:POL<n>[:CHANnel<m>]:MANUal:SET<a>** Summary >>
Syntax	:POL<n>[:CHANnel<m>]:MANUal:SET<a>[<wsp><value|MIN|MAX|DEF>]
Description	Set the set-point of one of the polarization controllers
Parameters	**<value>**: Sets the set-point to this value
	MIN: Sets the set-point to the minimum value
	MAX: Sets the set-point to the maximum value
	DEF: Sets the set-point to the default value
Response	N/A
Example	:POL6:CHANnel1:MANU:SET1 0.400

Command	**:POL<n>[:CHANnel<m>]:SCRAmble:FREQuency<a>?**	Summary >>
Syntax	:POL<n>[:CHANnel<m>]:SCRAmble:FREQuency<a>?[<wsp><MIN|MAX|DEF|SET|ALL|UNIT|STEP>]	
Description	Query the frequency of one of the polarization controllers	
Parameters	**MIN**: Returns the minimum frequency	
	MAX: Returns the maximum frequency	
	DEF: Returns the default frequency	
	SET: Returns the set frequency	
	ALL: Returns the above parameters in the format: MIN,MAX,DEF,SET	
	STEP: Returns the minimum step size of the frequency	
Response	A single value, or a comma-separated array of values	
Example	:POL6:CHANnel1:SCRAmble:FREQuency1? SET -> 1.997 :POL6:CHANnel1:SCRAmble:FREQuency1? UNIT -> Hz :POL6:CHANnel1:SCRAmble:FREQuency1? ALL -> 0.000,10.002,9.900,9.900	

Command	**:POL<n>[:CHANnel<m>]:SCRAmble:FREQuency<a>**	Summary >>
Syntax	:POL<n>[:CHANnel<m>]:SCRAmble:FREQuency<a> [<wsp><value|MIN|MAX|DEF>]	
Description	Set the frequency of one of the polarization controllers	
Parameters	**<value>**: Sets the frequency to this value	
	MIN: Sets the frequency to the minimum value	
	MAX: Sets the frequency to the maximum value	
	DEF: Sets the frequency to the default value	
Response	N/A	
Example	:POL6:CHANnel1:SCRAmble:FREQuency1 2.499	

Command	**:POL<n>[:CHANnel<m>]:SCRAmble:FUNCtion<a>?** Summary >>
Syntax	:POL<n>[:CHANnel<m>]:SCRAmble:FUNCtion<a>?<wsp><DEF|SET|ALL|LIST|INFO>
Description	Query the function of one of the polarization controllers
Parameters	**DEF**: Returns the default function
	SET: Returns the set function
	ALL: Returns the above parameters in the format: DEF,SET
	LIST: Returns the list of discrete options for configurable values
	INFO: Returns the mapping between the numeral and the text form of the function
Response	A single value, a comma-separated array of values, or the mapping between numerals and text format
Example	:POL6:CHAN1:SCRAMBLE:FUNC1? -> 0 :POL6:CHAN1:SCRAMBLE:FUNC1? INFO -> 0:SINE 1:TRIANGLE 2:RANDOM

Command	**:POL<n>[:CHANnel<m>]:SCRAmble:FUNCtion<a>** Summary >>
Syntax	:POL<n>[:CHANnel<m>]:SCRAmble:FUNCtion<a><wsp><DEF|TRI|TRIANGLE|SIN|SINE|RAND|RANDOM>
Description	Set the function of one of the polarization controllers
Parameters	**DEF**: Sets the function to the default value
	TRI|TRIANGLE: Sets the function to a triangle waveform
	SIN|SINE: Sets the function to a sine waveform
	RAND|RANDOM: Sets the function to a random waveform
Response	N/A
Example	:POL6:CHAN1:SCRAMBLE:FUNC1 TRIANGLE

Command	**:POL<n>[:CHANnel<m>]:SCRAmble:PHASe<a>?**	Summary >>
Syntax	:POL<n>[:CHANnel<m>]:SCRAmble:PHASe<a>?[<wsp><MIN|MAX|DEF|SET|ALL|UNIT|STEP>]	
Description	Query the phase of one of the polarization controllers	
Parameters	**MIN**: Returns the minimum phase	
	MAX: Returns the maximum phase	
	DEF: Returns the default phase	
	SET: Returns the set phase	
	ALL: Returns the above parameters in the format: MIN,MAX,DEF,SET	
	UNIT: Returns the unit of the phase	
	STEP: Returns the minimum step size of the phase	
Response	A single value, or a comma-separated array of values	
Example	:POL6:CHAN1:SCRAMBLE:PHASE1? -> 10.6 :POL6:CHAN1:SCRAMBLE:PHASE1? UNIT -> rad :POL6:CHAN1:SCRAMBLE:PHASE1? ALL -> 0.000,6.283,0.000,0.000	

Command	**:POL<n>[:CHANnel<m>]:SCRAmble:PHASe<a>**	Summary >>
Syntax	:POL<n>[:CHANnel<m>]:SCRAmble:PHASe<a><wsp><value|MIN|MAX|DEF>	
Description	Set the phase of one of the polarization controllers	
Parameters	**<value>**: Sets the phase to this value	
	MIN: Sets the phase to the minimum value	
	MAX: Sets the phase to the maximum value	
	DEF: Sets the phase to the default value	
Response	N/A	
Example	:POL6:CHAN1:SCRAMBLE:PHASE1 3.14	

9.6 Programming examples

The following is a simple example of how to control the POL product 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.

```
#Identifying the POL product
:*IDN?                                      #Query to confirm the correct instrument is setup
:*OPT?                                      #Query the available module configuration
:SLOT1:IDN?                                 #Query the identification information for a specific module

#Using slot 10 as an example, take the following steps to make sure that the instrument is ready
*OPC?                                       #Check that all modules are ready to run commands
:SLOT1:OPC?                                 #Check the operational status of the module
*ESR?                                       #Check the standard event status register to make sure the commands
                                            #have been run with no errors

#Take the following steps to check the operating mode is MANUAL
#Set the set points to three different values, assuming slot 10 and channel 1 are used
#Before running these commands, make sure the instrument is ready
:POL1:CHANnel1:MODE?                        #Check the control mode is manual
:POL1:CHANnel1:MANUAL:SET1 0.400            #Set the first polarization controller setpoint
:POL1:CHANnel1:MANUAL:SET2 0.700            #Set the second polarization controller setpoint
:POL1:CHANnel1:MANUAL:SET3 0.900            #Set the third polarization controller setpoint
:OUTPut1:CHANnel1:STATe ON                  #Enable the state

#Take the following steps to change the control mode to SCRAMBLE
#Set the function waveform to sinusoidal with varying frequencies, assuming slot 10 and channel 1 is used
#Before running these commands, make sure the instrument is ready
:POL1:CHANnel1:MODE SCRAMBLE                #Set the control mode to scramble
:POL1:CHAN1:SCRAMBLE:FUNC1 SINE             #Set the first polarization controller function to a sinusoidal waveform
:POL1:CHAN1:SCRAMBLE:FUNC2 SINE             #Set the second polarization controller function to a sinusoidal waveform
:POL1:CHAN1:SCRAMBLE:FUNC3 SINE             #Set the third polarization controller function to a sinusoidal waveform
:POL1:CHANnel1:SCRAmble:FREQuency1 3.000    #Set the first polarization controller frequency
:POL1:CHANnel1:SCRAmble:FREQuency1 6.000    #Set the second polarization controller function
:POL1:CHANnel1:SCRAmble:FREQuency1 9.000    #Set the third polarization controller function
:OUTPut1:CHANnel1:STATe ON                  #Enable the state
```

10 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.

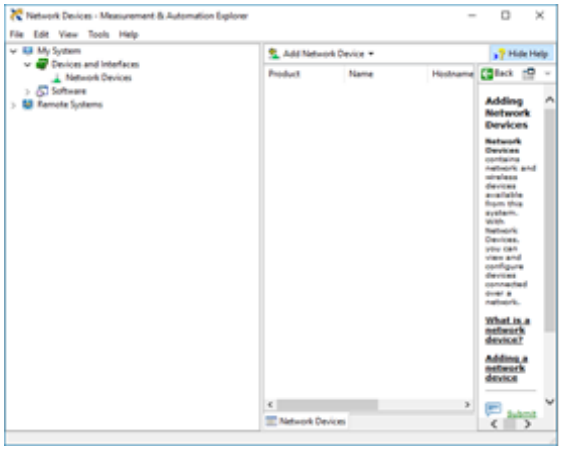
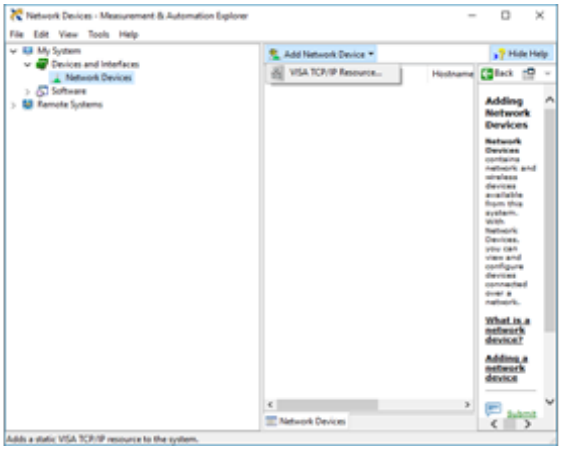
NOTE

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.

10.1 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**.

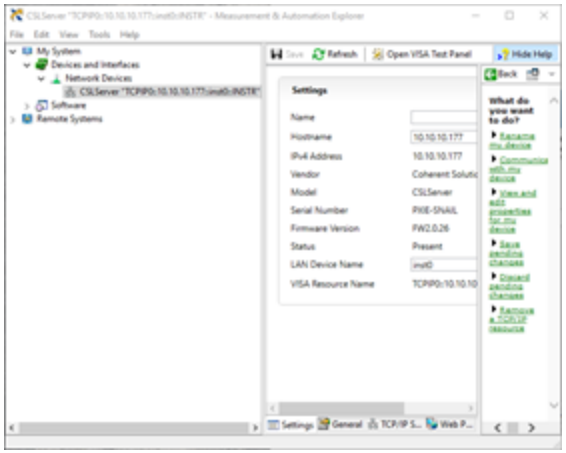



3. Select **Manual Entry of LAN Instrument**. Enter in the Hostname or IP Address.
   Note when operating locally, enter in the localhost IP address of **127.0.0.1**. Click **Finish** to end the setup process.

10.2 Setting up NI-VISA application

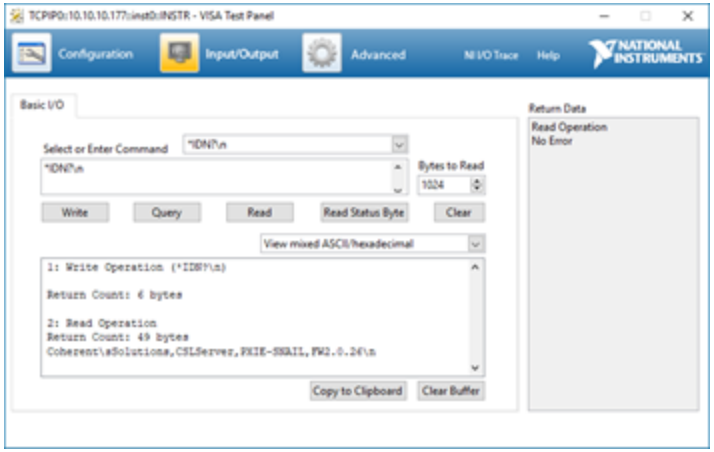
NI-VISA is used to communicate with the PXIe chassis or installed modules / instruments. The above steps must be completed before attempting to communicate using NI-VISA.

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



10.3 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))
```

10.4 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.
```

11 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.

12 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)

13 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.

13.1 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.

14 Technical Support

14.1 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.

14.2 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.

15 Warranty Information

15.1 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.
- The unit has been used with an external power supply not supplied by Quantifi Photonics with the unit.

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.

15.2 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.

15.3 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.

15.4 Certification

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

15.5 Service and repairs

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

QUANTIFI PHOTONICS®
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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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