QUANTIFI PHOTONICS®
A Teradyne Company

POL

1200 SERIES

High-Speed Polarization Controller

PXIE USER MANUAL

quantifiphotonics.com

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User manual version: 1.06

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 POL 1200 Series Setting up hardware Installing software
Working with your POL	**CohesionUI GUI:** CohesionUI - Overview Controlling your POL with CohesionUI **SCPI commands:** Controlling your POL with SCPI commands Programming applications
Maintenance	Cohesion Manager Cohesion Firmware Updater

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.

WARNING - High Voltage Inside

To protect yourself from harm caused by unsafe voltage inside the product:

- Do not attempt to open the product.
- To obtain after-sales service or technical support for this product, contact Quantifi Photonics on support@quantifiphotonics.com.

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.

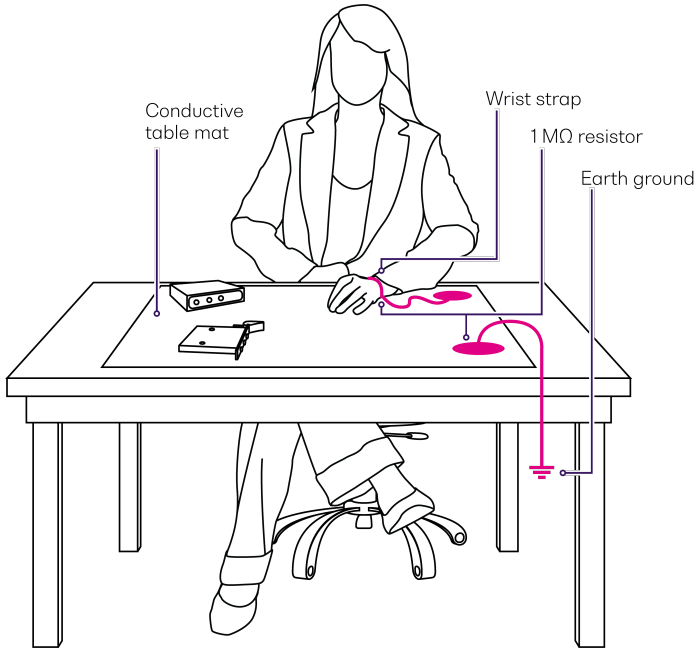
This symbol on the unit refers to documentation provided with the product for related safety information. Ensure that the required conditions are met and understood before using the product.

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 1200 Series

The POL 1200 Series Polarization Controller delivers extremely high-speed automated polarization control for polarization dependent testing procedures in high-volume manufacturing environments.

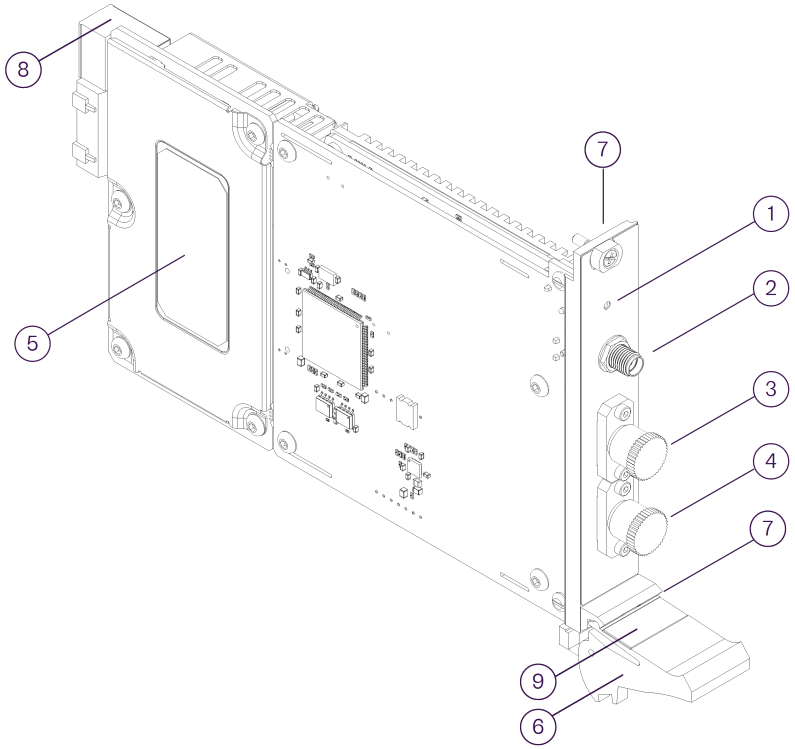
Programming interfaces

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 LED	6	Fastening clip
2	RF input: SMA connector, 0V to 5V	7	Fastening screw
3	Optical input: PANDA polarization maintaining fiber (PMF) keyed to the slow axis	8	PXIe header
4	Optical output: SMF-28 single mode fiber	9	Module identifier label
5	Product label		

4.2 Status LEDs

The LED shows the status of the channel:

LED	Meaning
OFF	Product is powered OFF
flashing RED	**During startup:** Product is initializing
	After startup, if flashing persists for more than 15 seconds: An error has occurred. This might be caused by the CohesionDriver software service on the controller not running. Check the status of CohesionDriver service and start it if required (refer to Cohesion Manager).
solid RED	A fault or error has occurred, e.g. over-temperature fault.
solid GREEN	Product is operating in manual mode
flashing GREEN	Product is operating in one of the other modes (not manual).

4.3 How it works

The product utilizes two digitally-controlled electro-optic crystals to position the polarization state at any point on the Poincaré sphere. The product sets the state of polarization (SOP) via a three-step process:

Step 1: Polarizer

Polarization aligned to the slow axis, S1.

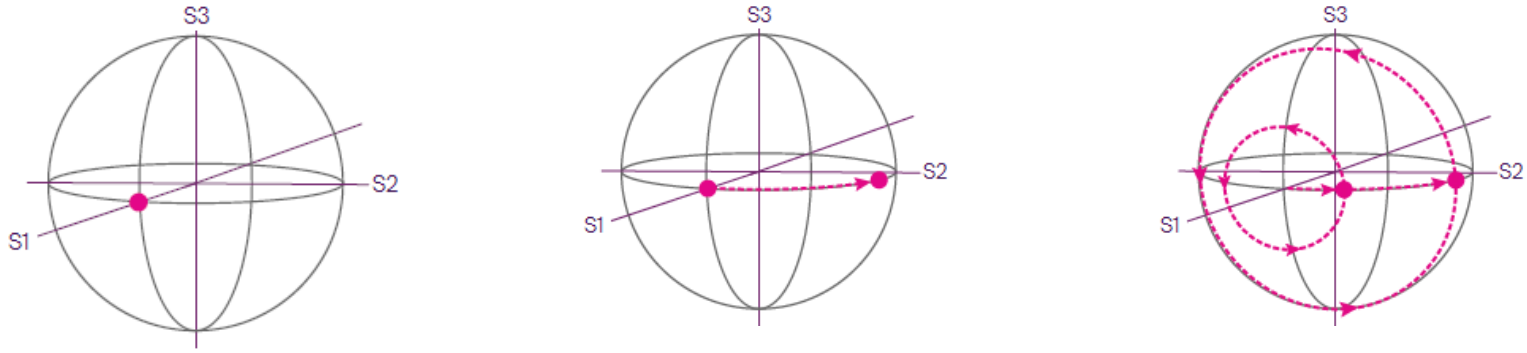
Align the incoming optical signal to the slow axis of the input PM fiber to avoid higher than necessary losses through the polarizer.

Step 2: Phase retarder

Theta θ rotates the SOP along the azimuth from S1.

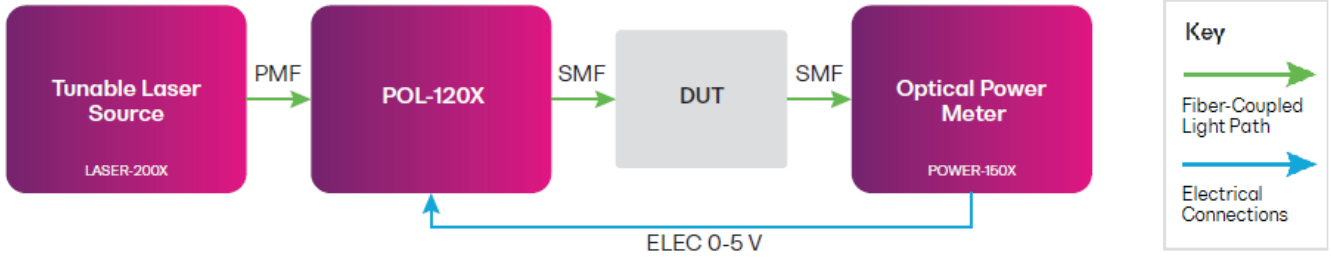
Step 3: Phase retarder

Phi Φ rotates the SOP around the S1 axis to reach the desired position.



4.4 Example test setup

In this setup the POL-12XX runs the scan and optimize mode on the DUT. The POWER-150X passes an electrical signal to the POL-12XX via the RF input.



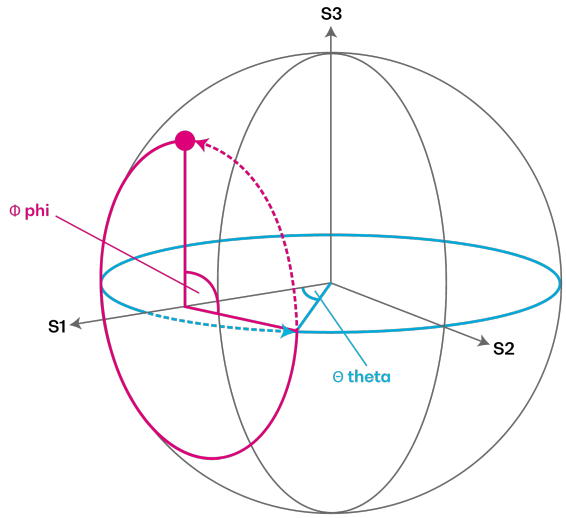
4.5 Operation modes

4.5.1 Manual mode

In manual mode, you can set the state of polarization (SOP) of your signal by manually setting angles theta θ and phi Φ:

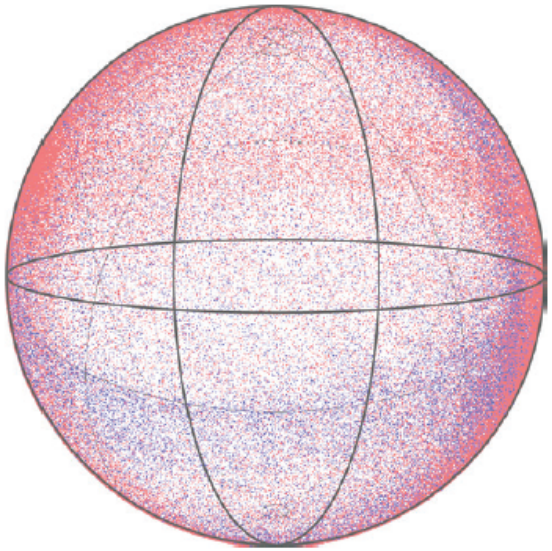
- **Theta** θ rotates the SOP along the azimuth from S1.
- **Phi** Φ rotates the SOP around the S1 axis to reach the desired position.

Both theta θ and phi Φ are normalized with 1 representing a full 360 degree rotation.



4.5.2 Depolarize mode

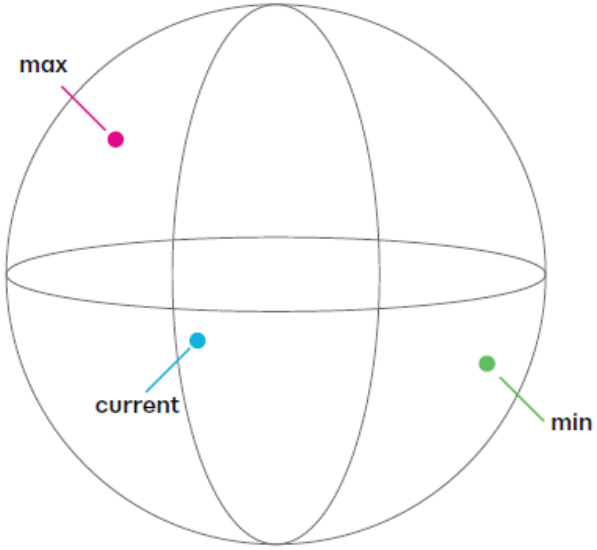
In depolarize mode, the state of polarization (SOP) of the output signal is varied rapidly to provide a uniform coverage of the Poincaré sphere.



4.5.3 Scan mode

In scan mode, the device quickly changes the state of polarization to scan the entire Poincaré sphere while simultaneously measuring the voltage on the RF input. The device stores angles theta θ and phi Φ against RF input values and time in its data buffer.

Based on the data set you can quickly identify areas of interest such as state of polarizations associated with minimum or maximum loss due to the polarization dependence of your device under test.



Using SCPI commands or the graphical user interface CohesionUI, you can retrieve scan data from the data buffer. Output comes as a comma-separated array of values, or in a tabled format with the following columns (from left to right):

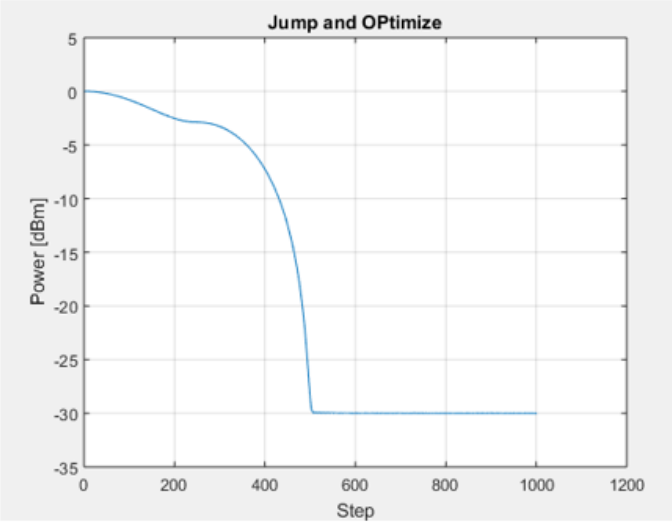
- Time stamp (from the start of the scan in ms)
- Theta (pi)
- Phi (pi)
- RF input signal (V)

For example:

```
tDelta (ms),Theta (pi),Phi (pi),Signal (V)
0,0,0,0.986374
0.000978,0.000845,0.032048,0.977509
0.001955,0.001972,0.064095,1.042784
...
```

4.5.4 Optimize mode

In optimize mode, the device uses the RF input as a feedback signal to either minimize, maximize or maintain the RF input voltage.



4.5.5 Scan and optimize mode

In a combined scan and optimize mode, the POL-12XX automatically scans, adjusts and optimizes the polarization based on a feedback signal to minimize or maximize loss due to polarization:

1. Scan
2. Jump to global max/min position
3. Optimize for global max/min

5 Setting up hardware

Quantifi Photonicsmodules are designed for easy installation in a PXIe-compatible chassis.

Make sure to follow these instructions when installing or removing a Quantifi Photonics module from a PXIe chassis.

Ensure that the chassis being used supports PXIe (or contains PXI-hybrid compatible slots). If you are unsure if your chassis is compatible with your Quantifi Photonics product, please contact Quantifi Photonics Customer Support.

WARNING - High Voltage Inside

To protect yourself from harm caused by unsafe voltage inside the product:

- Do not attempt to open the product.
- To obtain after-sales service or technical support for this product, contact Quantifi Photonics on support@quantifiphotonics.com.

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

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.

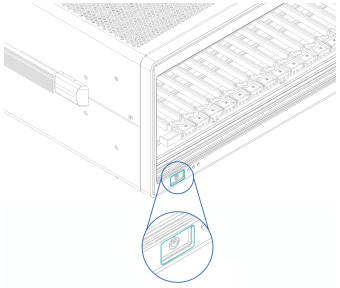
5.1 Install the module in a PXIe chassis

WARNING

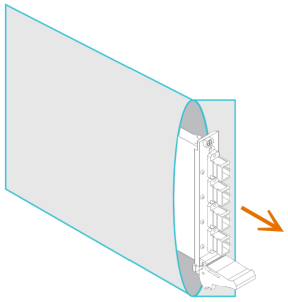
When attempting to install or remove a module or any component of the PXIe chassis:

- Power the chassis OFF.
- Follow these installation instructions.
- After powering the PXIe chassis ON, please wait at least 2 minutes before attempting to communicate with the module. This gives the chassis time to boot and initialize the communication server.

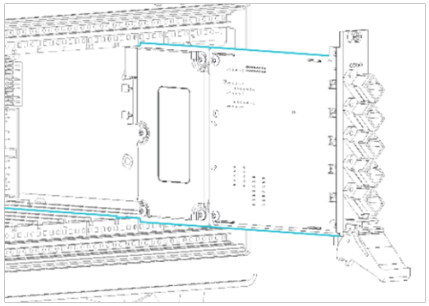
1 Power the chassis OFF.



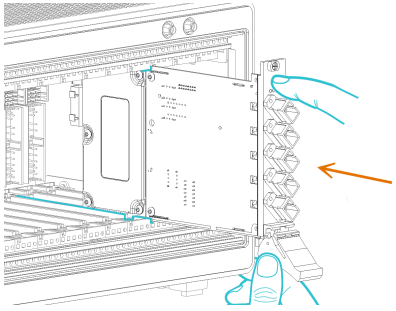
2 Remove the module from the anti-static bag. Retain the bag.



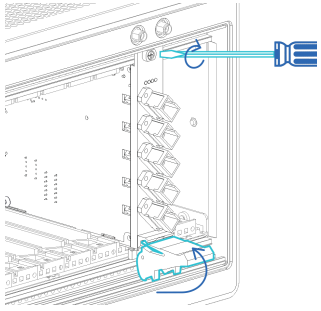
3 Align the module with the slot guide rails.



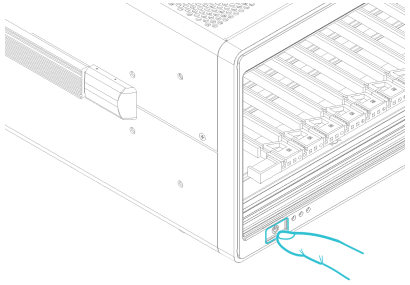
4 Push module into slot until you feel resistance from the backplane connection.



5 Engage the fastening clip. Secure all fastening screws.



6 Power the chassis ON.



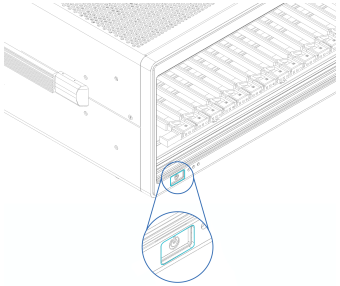
5.2 Uninstall the module from a PXIe chassis

WARNING

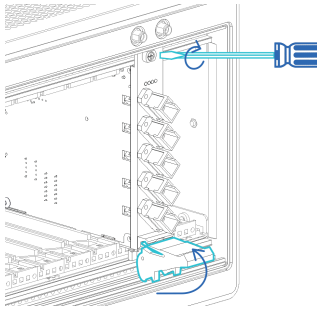
When attempting to install or remove a module or any component of the PXIe chassis:

- Power the chassis OFF.
- Follow these installation instructions.

1 Power the chassis OFF.

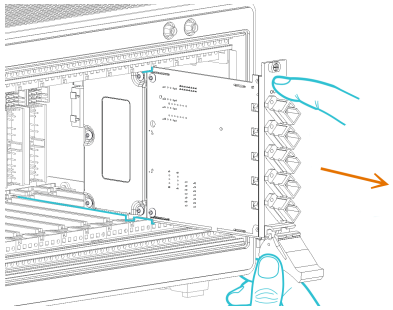


2 Unsecure the fastening screws and fastening clip.

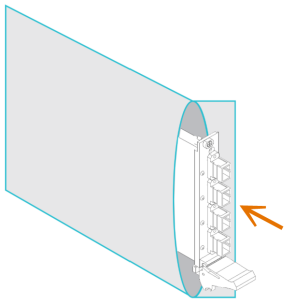


3 Pull out the module.

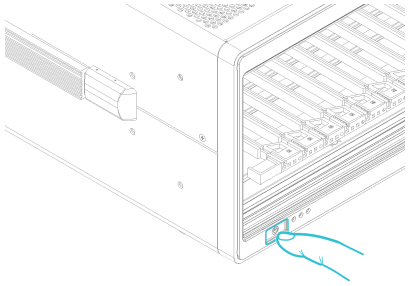
Use the fastening clip to pull. Do NOT pull on the connectors.



4 Store the module in its antistatic bag.



5 Power ON the chassis.



6 Installing software

The Cohesion Installer software package enables communication between the PXIe controller and Quantifi Photonics modules installed in a chassis.

The Cohesion Installer contains all required drivers and software:

CohesionDriver	Driver Service for Quantifi Photonics PXIe modules
CohesionSCPI	VXI11 compliant server for remote SCPI communication
CohesionUI	Web-based Graphical User Interface
Cohesion Manager	Single-window utility application that shows the status of all Cohesion Software Services running on the system.
Cohesion Firmware Updater	Single-window utility application that shows the current firmware status of all Quantifi Photonics PXIe modules installed in the chassis.

6.1 Install the Cohesion Installer software package

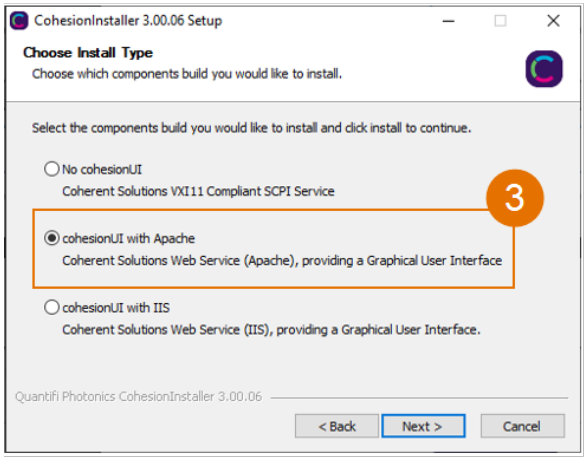
Install Cohesion Installer on:

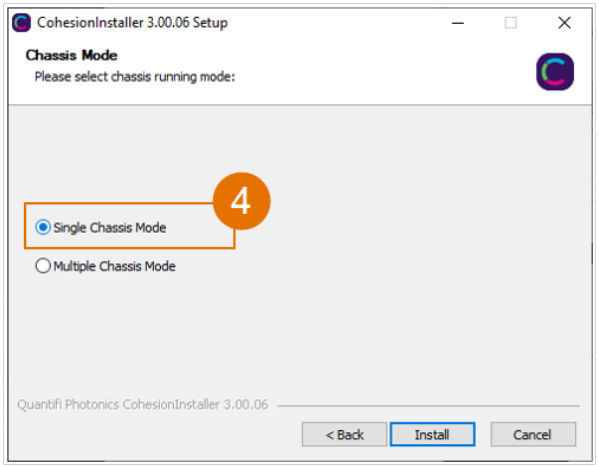
- the PXIe controller of the PXIe Chassis in which the Quantifi Photonics module(s) will be installed, or
- the controller PC (multi-chassis MXI setup)

▶ To install Cohesion Installer:

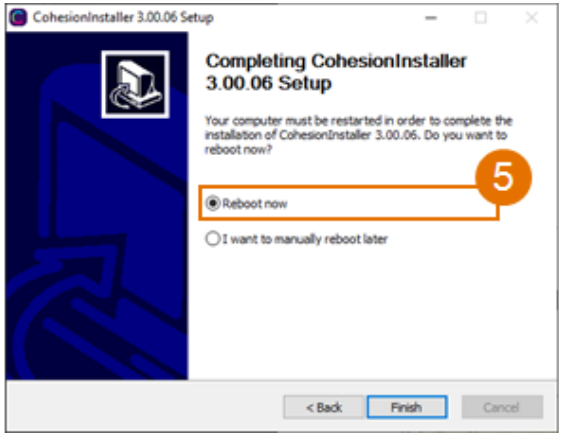
1. We recommended that you save your work and close open programs before installing Cohesion Installer.
2. Locate and run **CohesionInstaller-<version_number>.exe** from the provided USB media device (or download it from the Quantifi Photonics website) and follow the on-screen installation prompts.
3. Select the Installation Type: **CohesionUI with Apache** (this is the default setting)
4. Select the Chassis Mode: **Single Chassis Mode** (this is the default setting). If unsure, select this default setting.

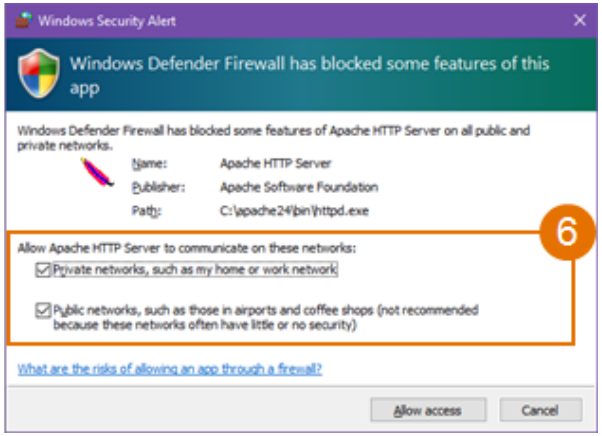
   To operate in Multiple Chassis Mode, additional hardware modules are required. As you can change the Chassis Mode later, we recommend to select **Single Mode** unless all other configuration requirements have been met.





5. At the end of the installation, we recommend you select the **Reboot now** option, and click **Finish** to complete the installation process.
6. A Windows Security Alert may prompt the user for network access. We recommend that **both options are ticked**, to allow any network configuration.





7. On startup after rebooting the system a User Account Control prompt might be displayed.
   Click **Yes** to allow running of the **Cohesion Firmware Updater Utility** and proceed with the application.

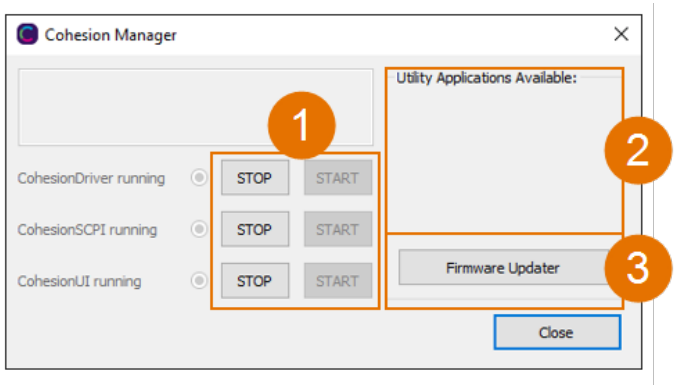
6.2 Cohesion Manager

Cohesion Manager is a single-window utitlity application that shows the status of all Cohesion Software Services running on the system.

By default, these Cohesion Software Services will start automatically on startup of Windows and need to be running to facilitate proper communication with the Quantifi Photonics PXIe modules.

CohesionDriver	required	manages installed Quantifi Photonics modules
CohesionSCPI	required	VXI11 compliant SCPI interface for TCP communication with the installed Quantifi Photonics modules
CohesionUI	optional	web service providing a graphical interface for simplified operation of installed Quantifi Photonics modules

- To open Cohesion Manager:
  - Search for Cohesion Manager in the Windows Start Menu.
- From Cohesion Manager you can:
  1. Start or stop the CohesionDriver service, CohesionSCPI service, or CohesionUI service independently.
  2. View all installed Quantifi Photonics system utilities.
  3. In this example you can open the Cohesion Firmware Updater application.



- If you can't detect or communicate with modules:
  - Open Cohesion Manager.
  - Check the status of software services, and start a service if required.

6.3 Cohesion Firmware Updater

Cohesion Firmware Updater launches automatically when you install a new version of Cohesion Installer on the system and reboot. Or, you can open it via the Cohesion Manager application.

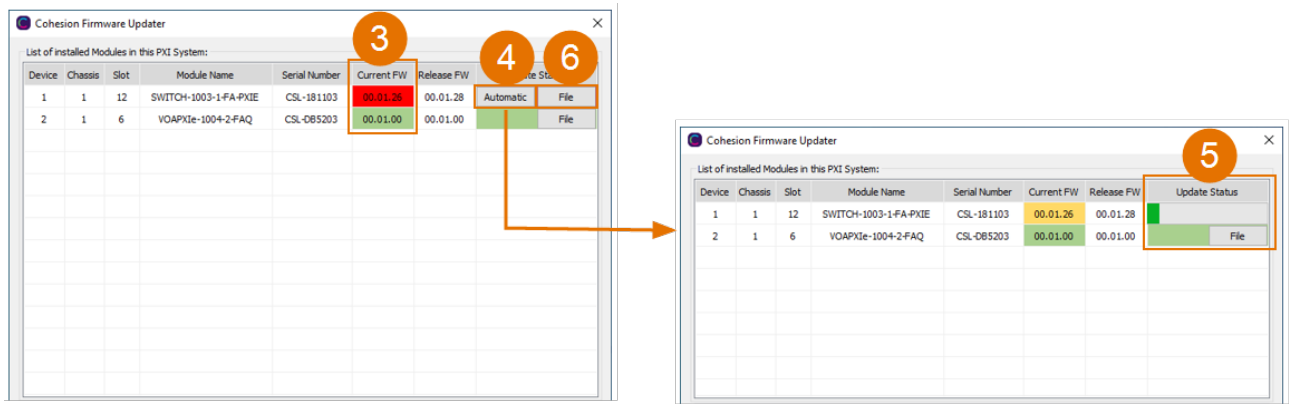
It is a single-window summary application that enables you to:

- view the current firmware status of all Quantifi Photonics PXIe modules installed in the chassis.
- update firmware to a new version if available.

> We recommended that you update firmware if a new version is available.

▶ To upgrade firmware:

1. Open **Cohesion Manager**, for example by searching for it in the Windows Start Menu.
2. In **Cohesion Manager**, click **Firmware Updater**.
3. Modules with out-of-date firmware are highlighted red.
4. Click **Automatic** to update automatically.
5. Progress will be displayed in **Update Status**.
6. Click **File** to update to a specific firmware package.

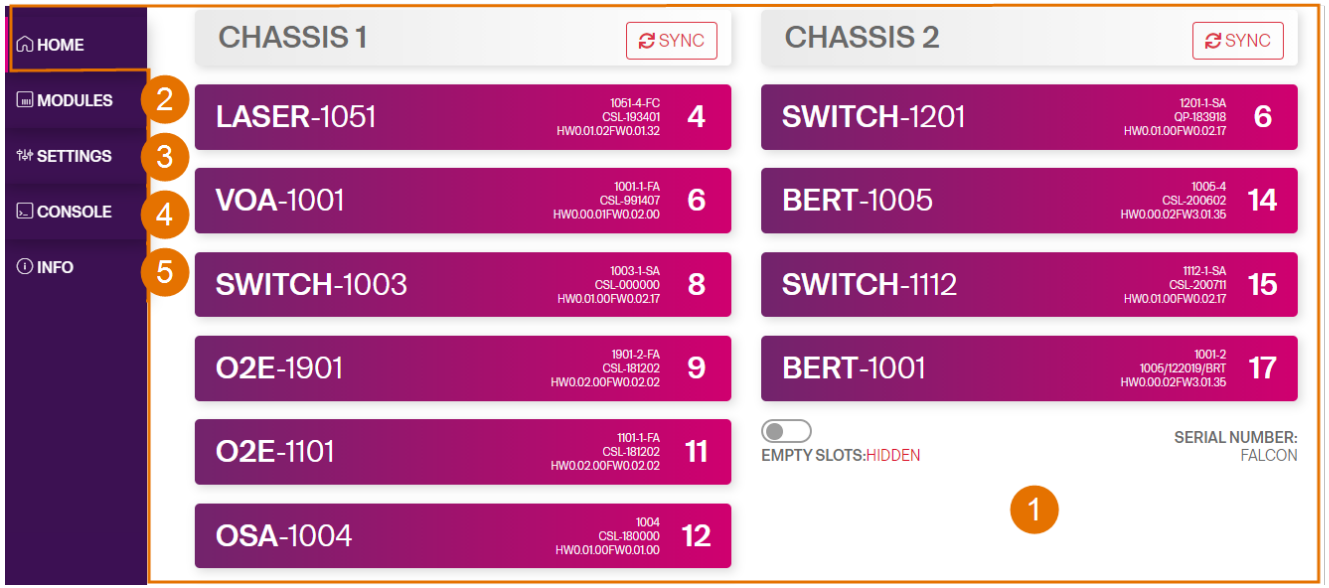


7 CohesionUI - Overview

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

> CohesionUI is part of the Cohesion Installer software package.

1. **HOME**: View all modules in the chassis
2. **MODULES**: Access a module
3. **SETTINGS**: Change CohesionUI settings
4. **CONSOLE**: Communicate with modules using SCPI commands
5. **INFO**: Display chassis information



7.1 Access a module with CohesionUI

You can access Quantifi Photonics modules via CohesionUI from the chassis controller, or from a controller PC.

To connect with a module, you need the IP address of the chassis the module is installed in.

▶ To obtain the IP address of the chassis:

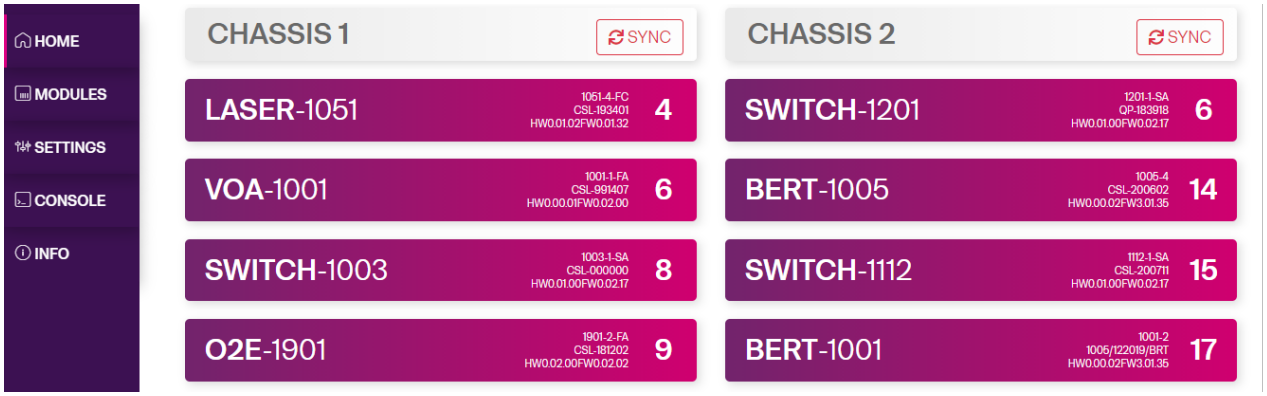
1. Open the **Command Prompt** window on the chassis controller.
2. Run the `ipconfig` command.
3. Note down the IPv4 address that is displayed.

▶ To connect with modules via CohesionUI:

1. On the controller or controller PC, open CohesionUI, for example by double-clicking the desktop icon, or open a supported browser.
2. Enter the IP address of the chassis as the URL.

   On the controller you can use `127.0.0.1` as the URL instead.

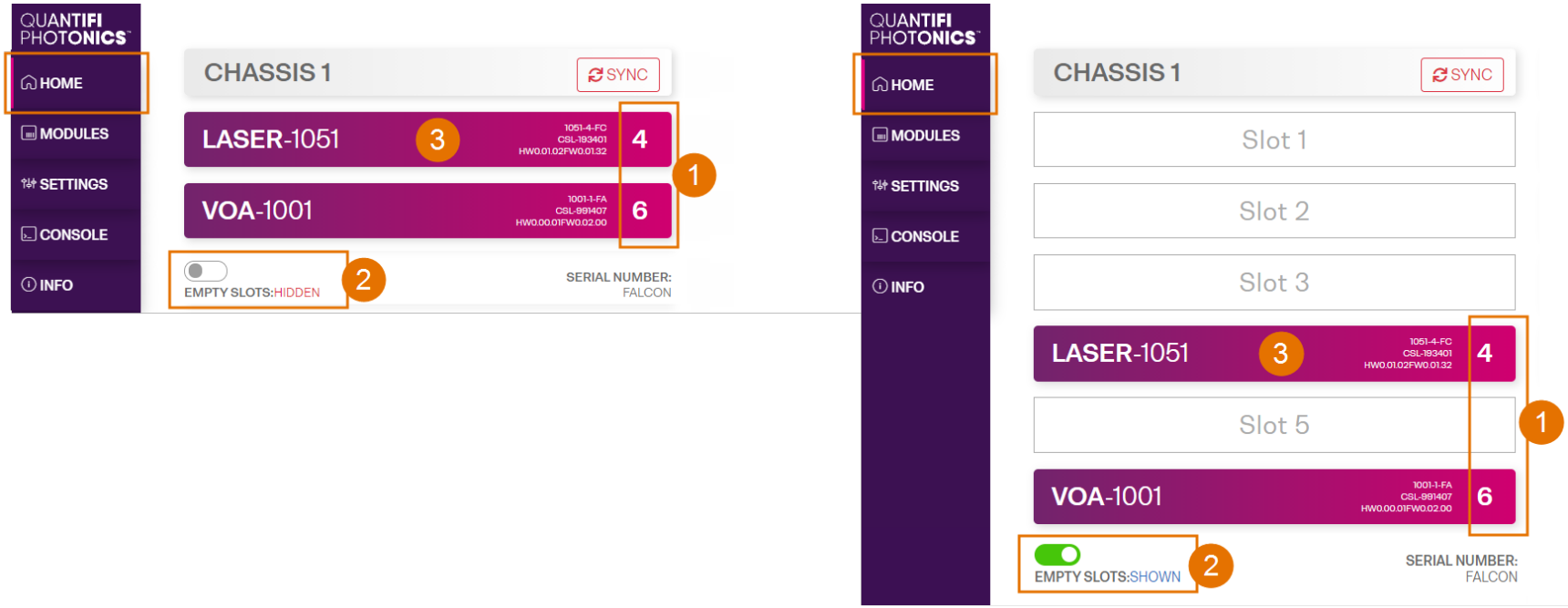
3. CohesionUI will launch in the browser, listing all available Quantifi Photonics modules installed in the chassis.



7.2 Display modules in a chassis

The **HOME** page is the main landing page in CohesionUI; it displays all available Quantifi Photonics modules in the PXIe chassis.

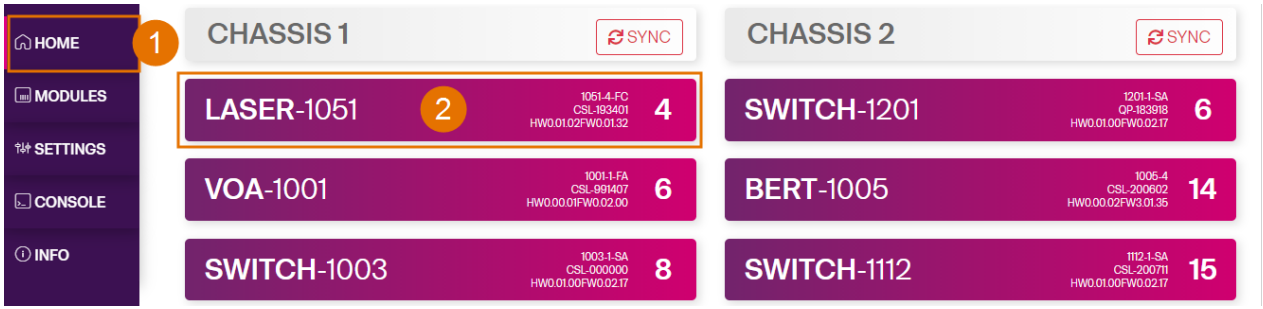
1. Numbers indicate the slots the modules are installed in.
2. You can hide (default setting) or show empty slots in the PXIe chassis by toggling the **EMPTY SLOTS** button.
3. You can select a module to work with by clicking it.



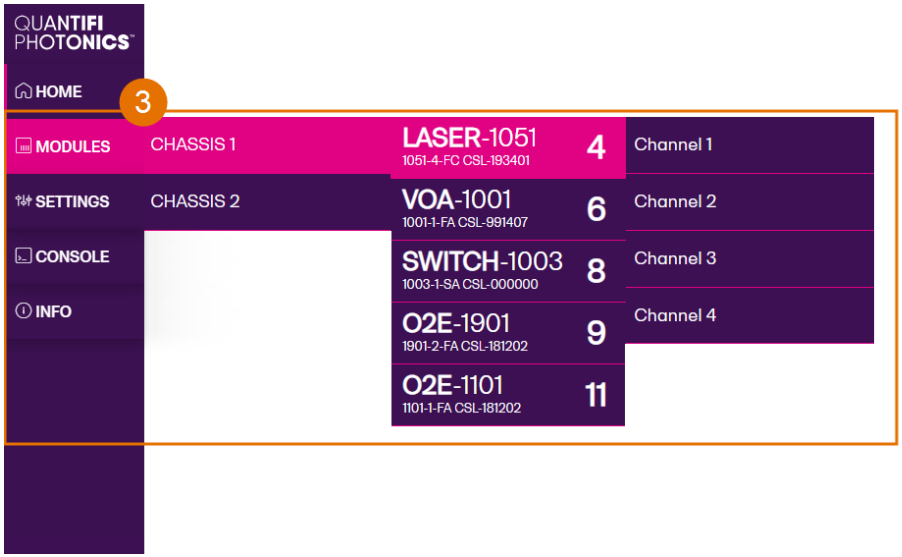
7.3 Select a module to work with

To select a module:

1. Go to the **HOME** page.
2. Click the on the module.



3. Or, hover over the **MODULES** menu and select a module or channel from the list.



7.4 Manage CohesionUI settings

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

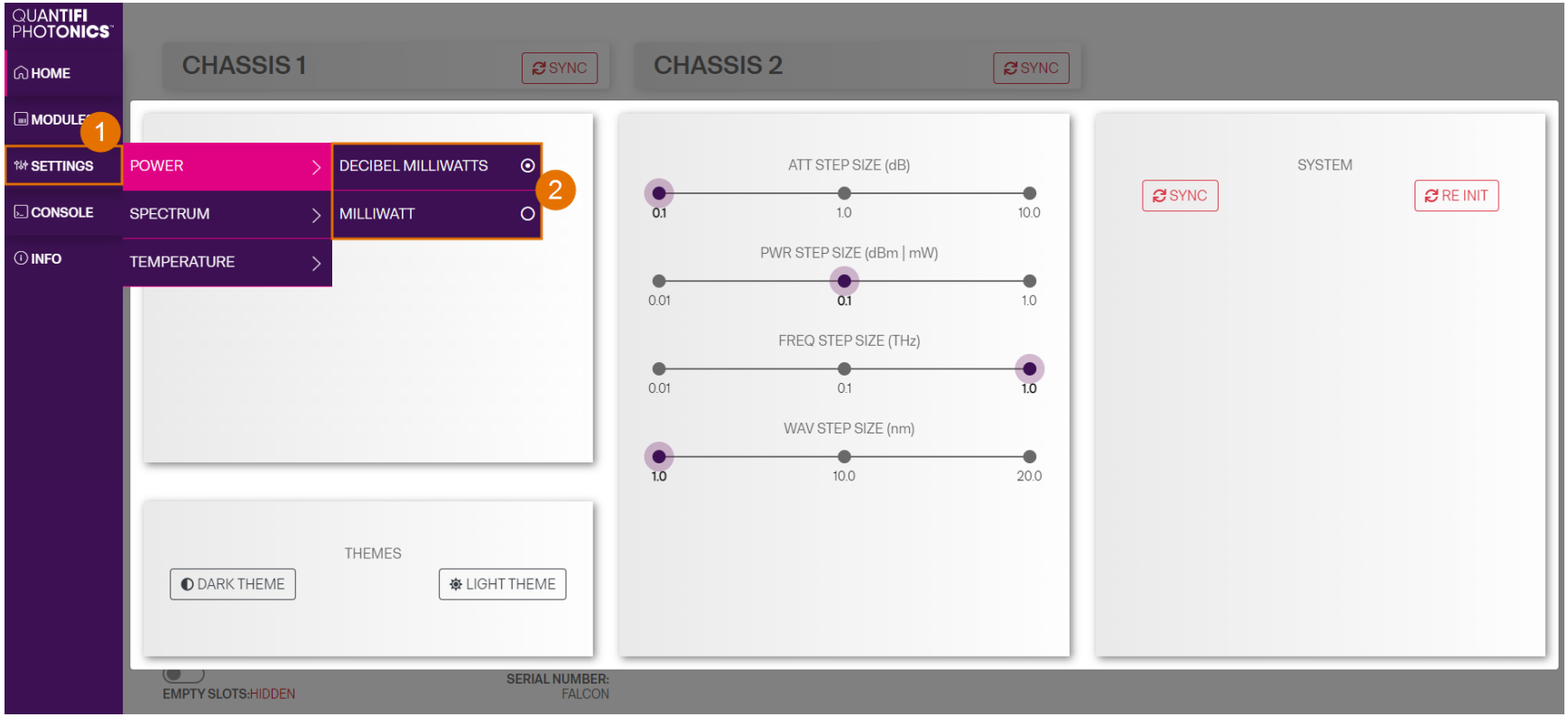
> **NOTE**
>
> CohesionUI reverts to default settings when power-cycling the chassis.

▶ 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 Synchronize and reinitialize CohesionUI

You can update CohesionUI with the latest information from your Quantifi Photonics modules by synchronizing or reinitializing.

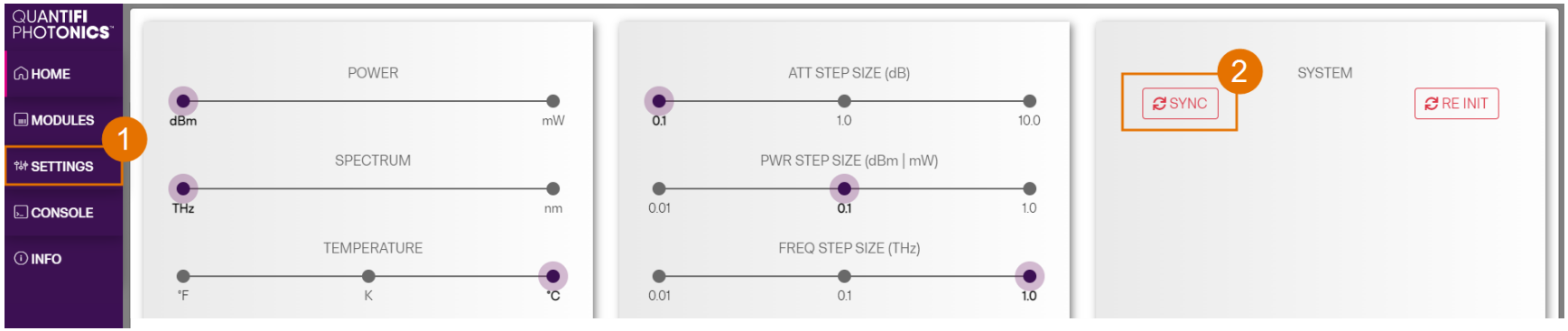
Synchronizing	Updates **CohesionUI** with the latest information from the **CohesionSCPI service**
Reinitializing	Updates **CohesionUI and the CohesionSCPI service** with the latest information from the **CohesionDriver service**

This can be particularly useful when operating a multi-chassis MXI setup and enables you to:

- Re-discover modules that CohesionUI does not display as expected.
- Discover modules that have been installed after the initial startup.

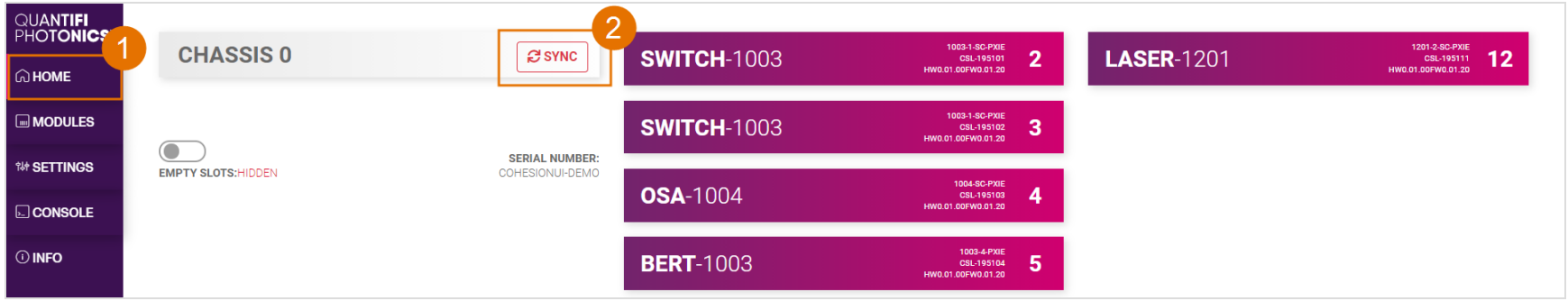
▶ To **synchronize** CohesionUI across **all modules in all chassis**:

1. Click **SETTINGS**.
2. Click **SYNC**.
3. The page will be disabled while synchronizing.



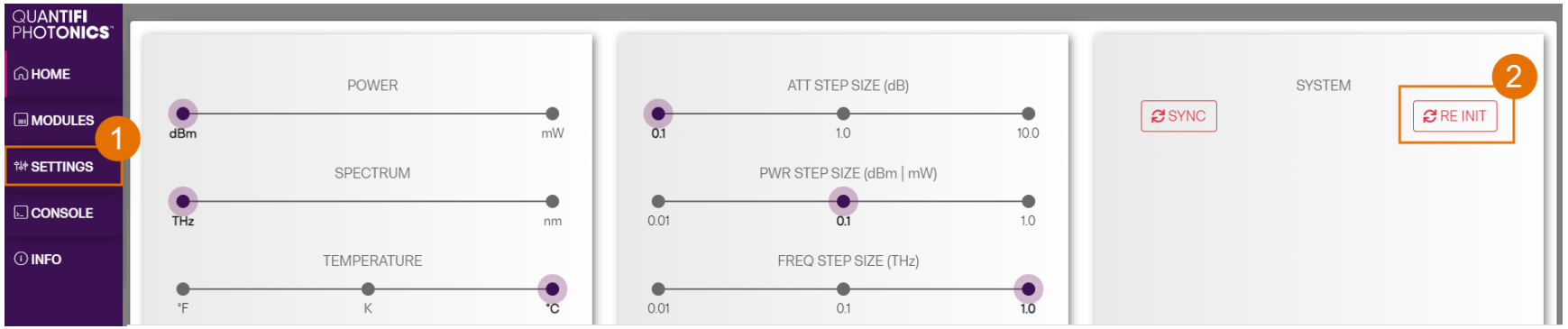
- To **synchronize** CohesionUI across **all modules in a selected chassis** only:

  1. Click **HOME**.
  2. Click **SYNC** for a selected chassis.
  3. The page will be disabled while synchronizing.



- To **reinitialize** CohesionUI across **all modules in all chassis**:

  1. Click **SETTINGS**.
  2. Click **RE-INIT**.
  3. All modules will be disabled and temporarily disconnected while reinitializing.



7.6 SCPI CohesionUI Command Console

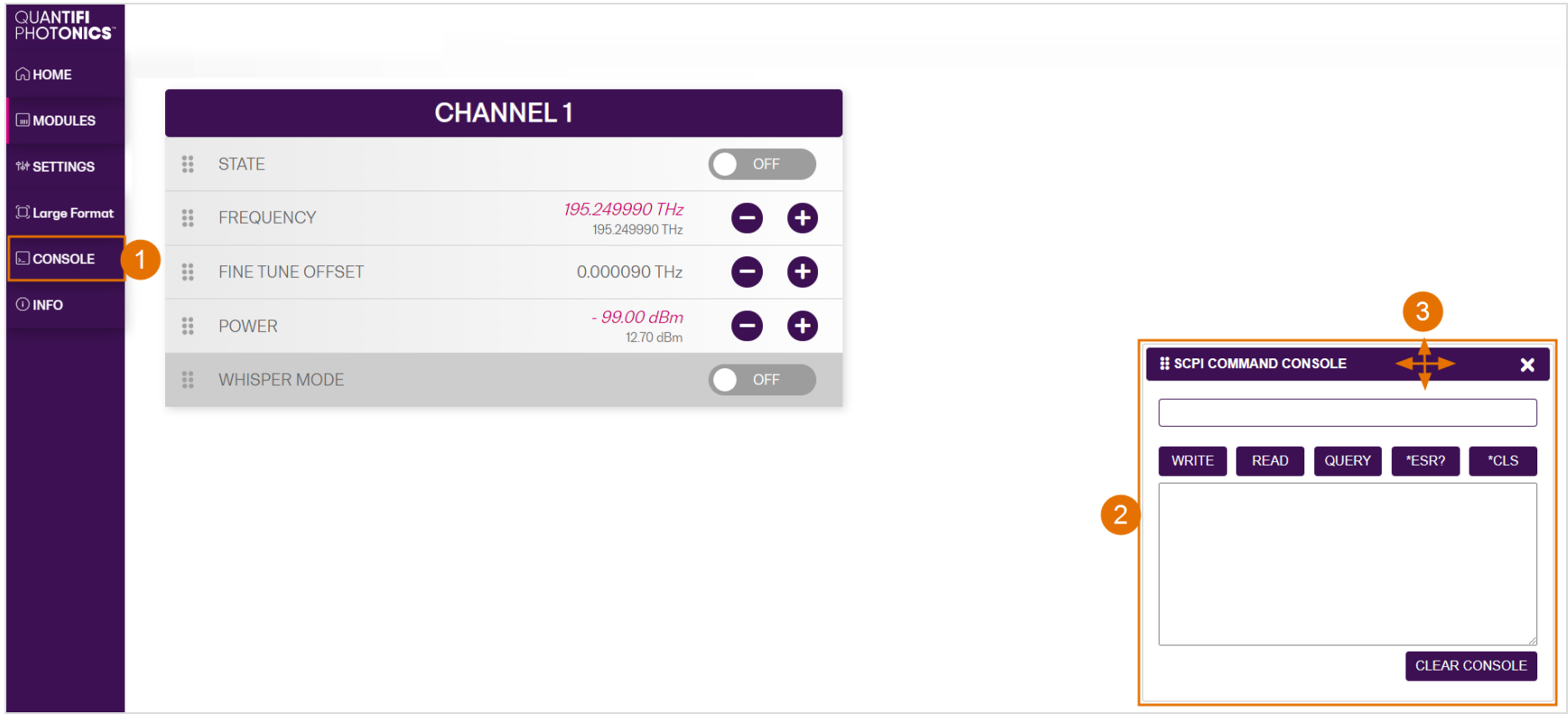
The CohesionUI SCPI Command Console enables you to communicate with Quantifi Photonics PXIE modules via SCPI commands. It enables you to test commands and verify their syntax.

For details on available SCPI commands, refer to the SCPI command section.

▶ To open the SCPI Command Console:

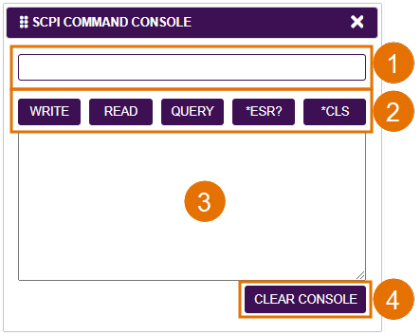
1. On the CohesionUI menu, click **CONSOLE**.
2. The console will appear in the bottom right corner of the screen.
3. You can move the console by clicking on the title bar and dragging it to any position on the screen. On closing and re-opening, the console will re-appear at its last position.

The console remains open when navigating between different modules. It floats on top of the UI so that you can observe the effect of SCPI commands on a module in real-time.



▶ To communicate with a module via the SCPI Command Console:

1. Enter a command.
2. Select action(s).
3. Review the action response in the output area.
4. (optional) Clear the output area.



You can choose from these SCPI command actions:

Action	Meaning	FAILED response
WRITE	Send the command to the instrument	The command is invalid. Please check the command and syntax.
READ	(after WRITE) Request the response from the instrument	Response buffer is empty.
QUERY	WRITE and READ	
*ESR?	Query the status event status register (ESR) – this will give you more details and specific information about command failures. For details on error codes, please refer to the programming guide in this manual.	
*CLS	Clear the response buffer and start fresh – useful when getting out of sync with WRITE and READ actions	

Example 1: Send instrument identification query `*idn?`

1. Enter the command: `*idn?`
2. Click **QUERY**.
3. The module returns the requested information.

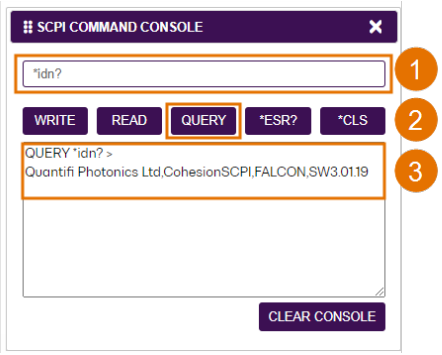
Example 2: What happens when I send an incorrect command?

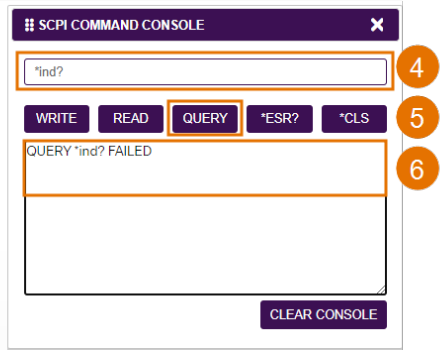
4. Enter an incorrect command, for example: ***ind?**
5. Click **QUERY**.
6. The module returns **FAILED**.

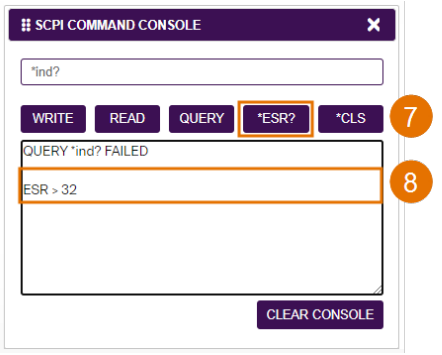
Example 3: Investigate a command failure:

7. Click `*ESR?` to query the event status register and request information about the command failure.
8. The instrument returns the error code, for example 32.

   For details on error codes, please refer to the *ESR? command in the programming guide.





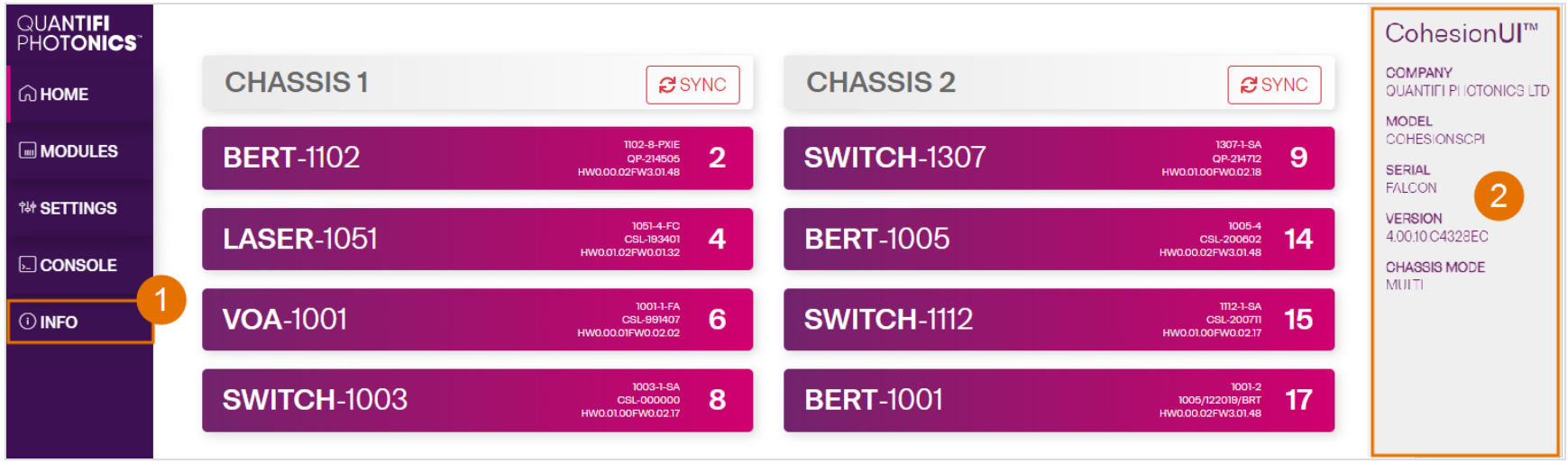


7.7 View system information

7.7.1 PXIe Chassis

- To display chassis information:

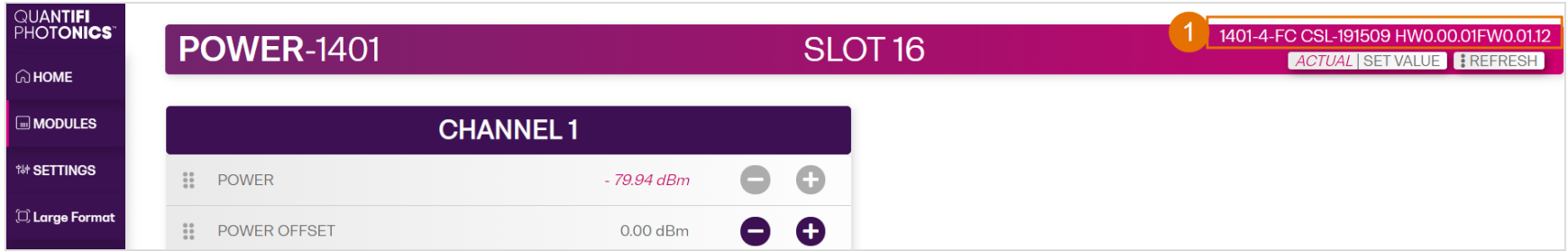
1. Click **INFO**.
2. The information panel will display operation mode, manufacturer, model, and serial number of the chassis, and the version of CohesionUI and CohesionSCPI service running on the chassis.



7.7.2 Module

- To view module information when working with a module in CohesionUI:

1. Model number, serial number and firmware versions are displayed in the top right corner.

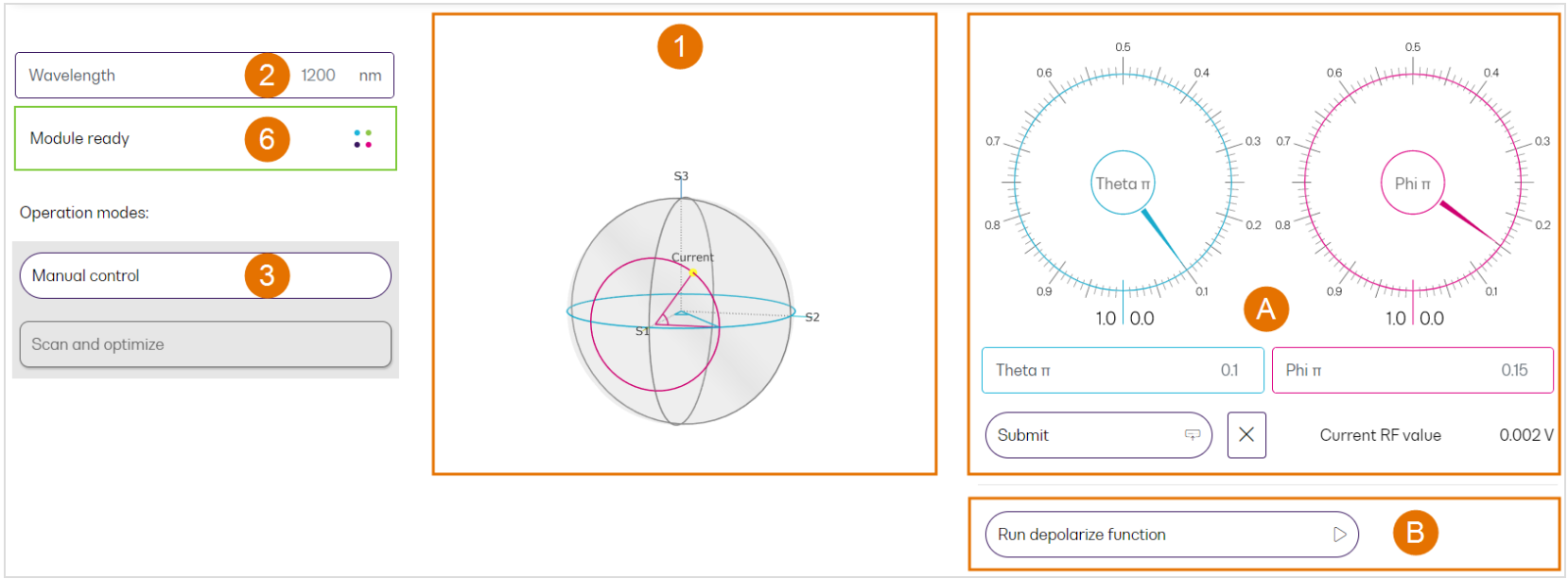


8 Controlling your POL with CohesionUI

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.

In CohesionUI you can quickly and accurately set, scan and optimize the polarization of your optical signal as required.

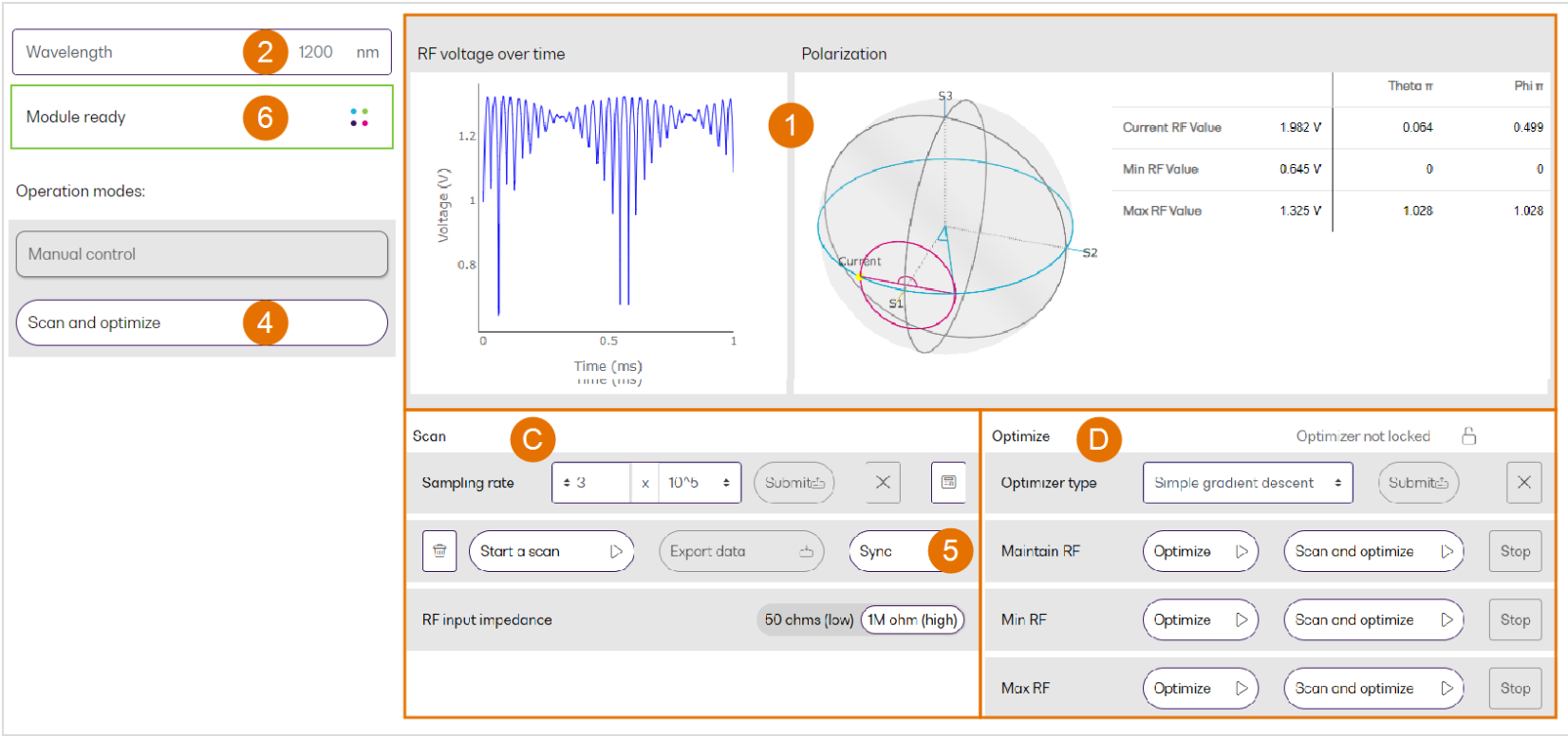
1. Interactive graphs and tables visualize the state of polarization (SOP) on the Poincaré sphere and display measurements in real time (refer to Work with the graphical elements in CohesionUI).
2. You can set the **Wavelength** of the incoming optical signal; this will apply to all operation modes.
3. In **Manual control** mode, you can:
   A. Manually set an SOP by entering angles theta θ and phi Φ (refer to Manually set a state of polarization (SOP))
   B. Run the depolarization function to scramble the SOP of the signal (refer to Depolarize the signal)



4. In **Scan and optimize** mode, you can:

   C. Run a scan on your device under test (DUT) (refer to Scan the signal)

   D. Optimize or scan and optimze the SOP of your signal against RF input voltage (refer to Optimize the signal)



NOTE

5. To ensure that the scan data graph, and minimum and maximum RF input values in CohesionUI are based on the latest scan, you can manually synchronize CohesionUI with the POL module (refer to Synchronize CohesionUI with the module).
6. A status indicator shows the current status of the module. While the POL is busy, for example when optimization is in progress, other polarization control functions in CohesionUI are locked. To unlock access to all controls, please wait for the current process to finish, or manually stop it.

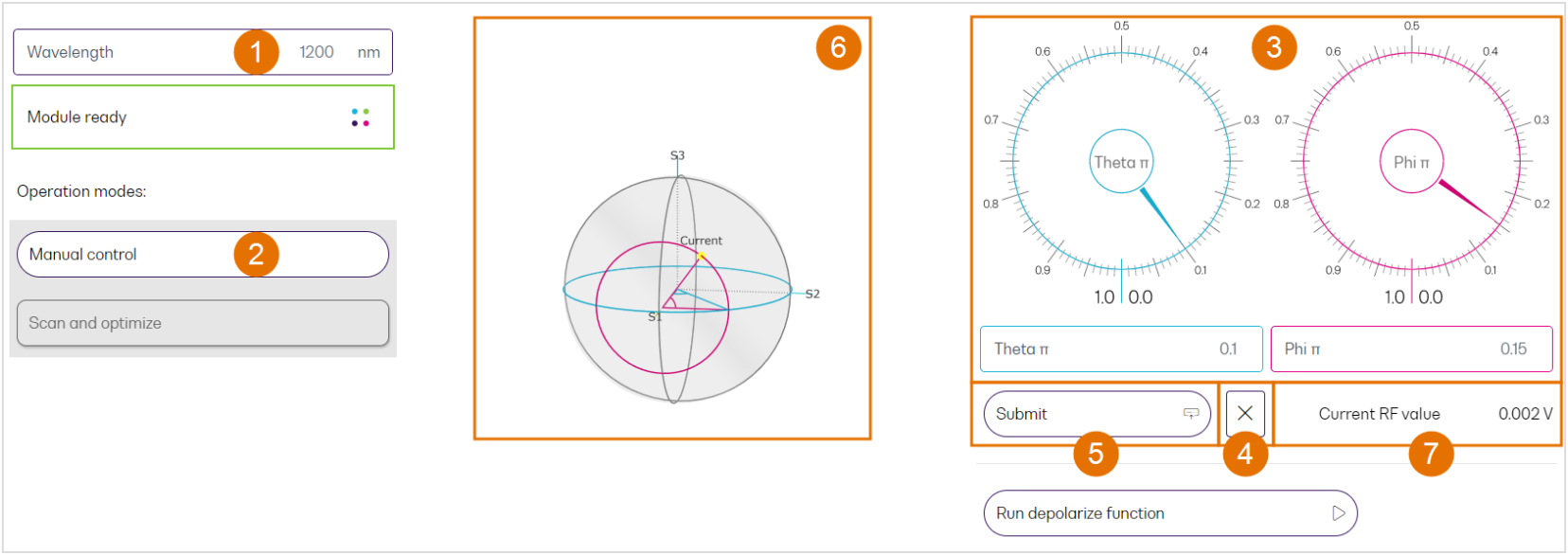
8.1 Manually set a state of polarization (SOP)

In manual mode, you can set the SOP of your outgoing optical signal to a static position by manually setting angles theta θ and phi Φ. The currently set SOP is visualized on the Poincaré sphere.

> The values for theta θ and phi Φ are normalized to a range of 0.0 to 1.0 with 0.0 = 0° rotation and 1.0 = full 360° rotation.

To manually set the SOP of your signal:

1. Enter/Select the **wavelength** of the optical signal.
2. Go to **Manual control** mode.
3. Enter/Select angles **theta θ** and **phi Φ**.
4. Cancel to enter a different set of values,
   or
5. Click **Submit Vpi** to save and apply the values to the signal and set the SOP accordingly.
6. The resulting SOP is displayed on the Poincaré sphere.
7. The value of the currently measured RF input signal is displayed.

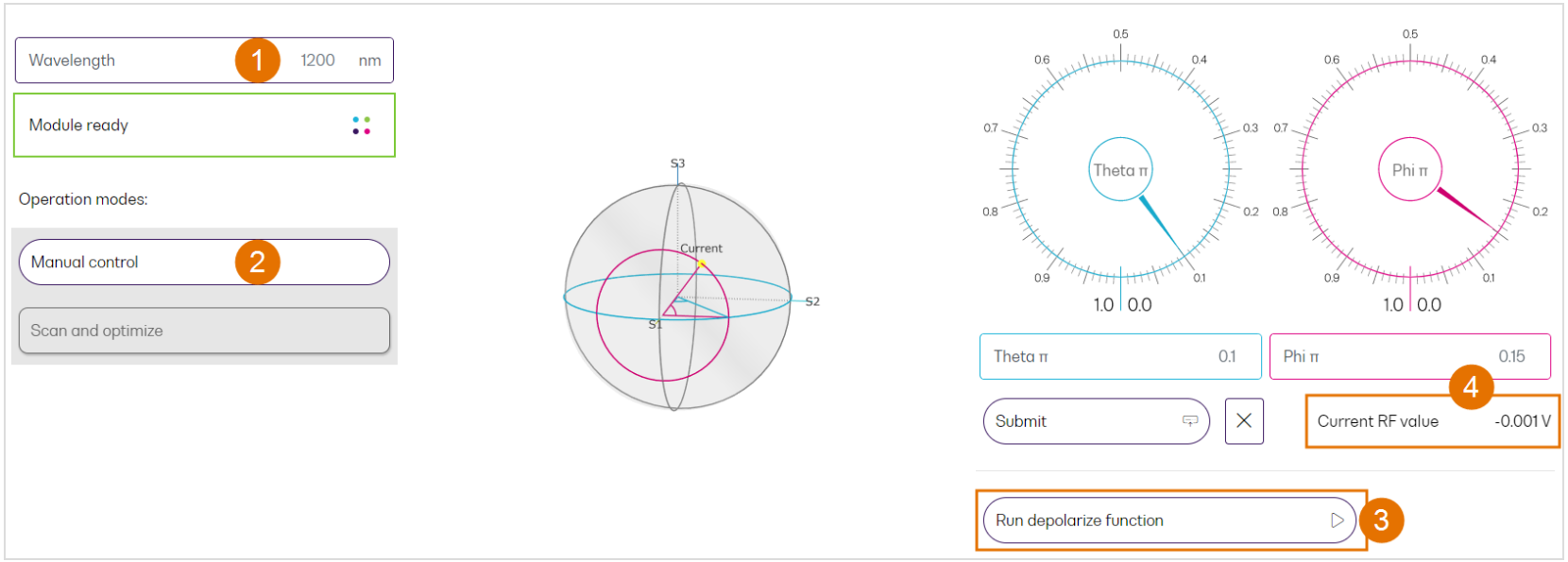


8.2 Depolarize the signal

The POL can depolarize the output signal by rapidly changing the state of polarization (SOP). Once inititated, depolarization will continue until you stop it.

To depolarize the signal:

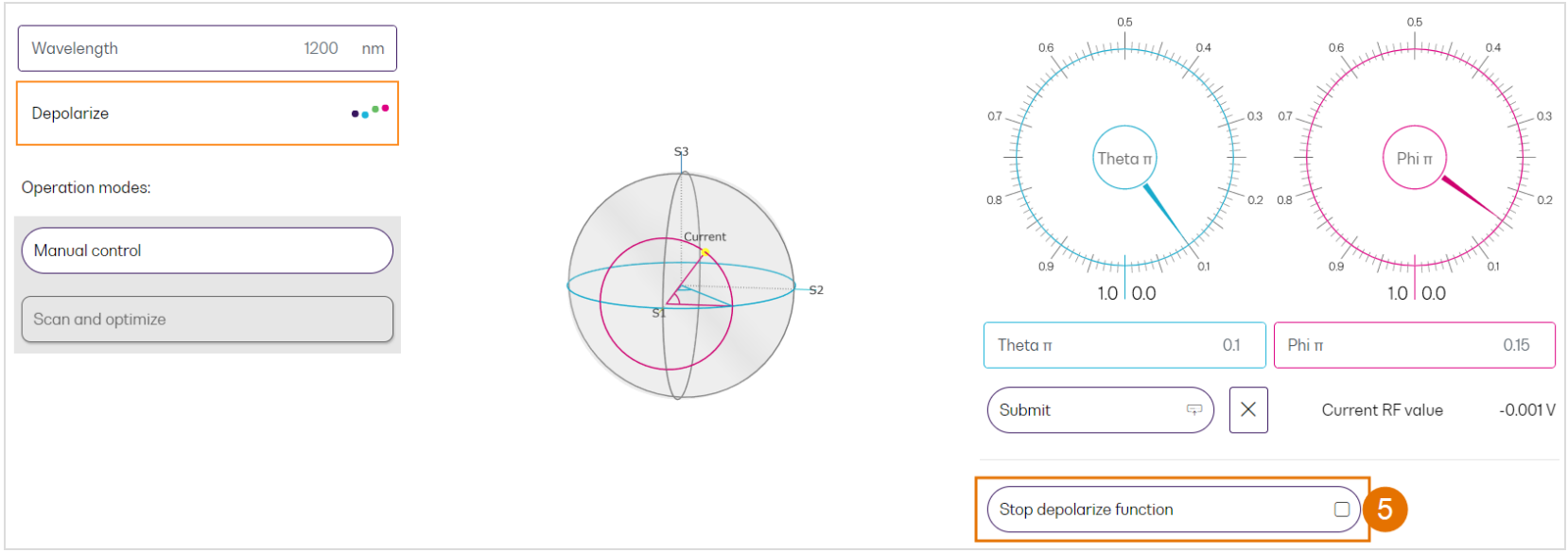
1. Enter/Select the **wavelength** of the optical signal.
2. Go to **Manual control** mode.
3. Click **Run depolarize function**.
4. The value of the currently measured RF input signal is displayed.



To stop the depolarizing of the signal:

5. Click **Stop depolarize function**.

   The depolarization of the signal will stop, the POL will maintain the polarization wherever it was stopped.



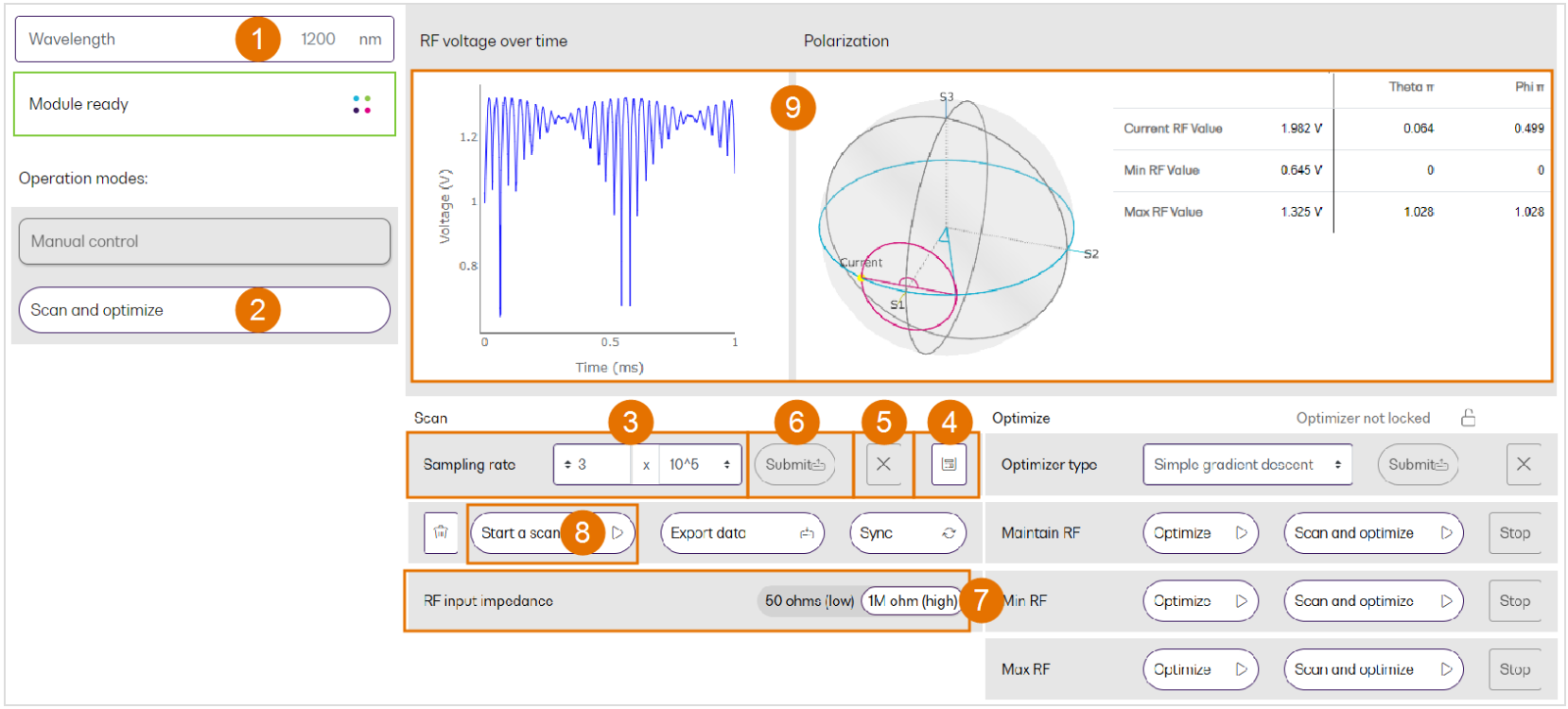
8.3 Scan the signal

You can run a scan to record angles theta θ and phi Φ against measured RF input values to quickly identify areas of interest . You can:

- Configure and start/stop a scan
- Download recorded scan data
- Delete currently stored scan data

To configure and start/stop a scan:

1. Enter/Select the **wavelength** of the optical signal.
2. Go to **Scan and optimize** mode.



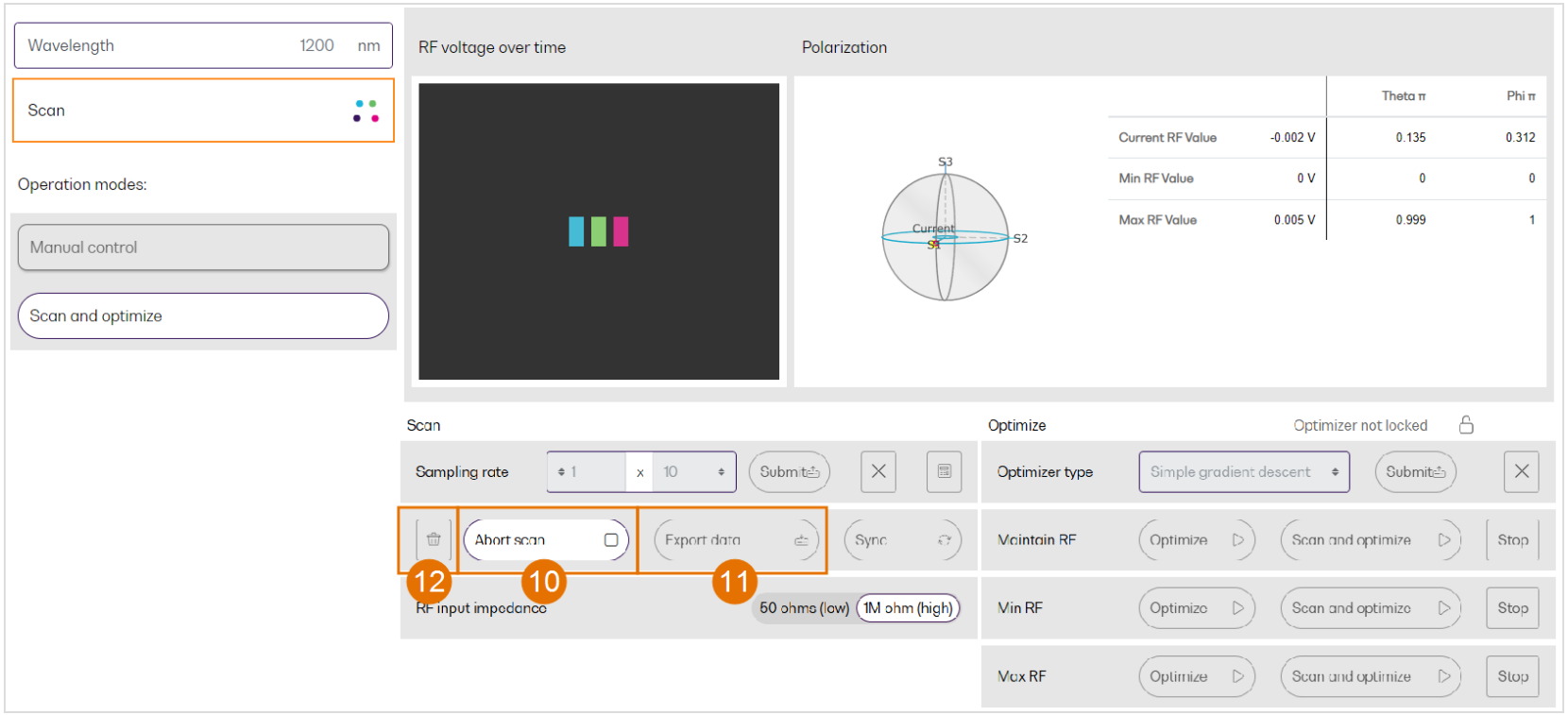
3. Select the **Sampling rate** in samples per second (s/s).
4. Alternatively, use the sampling rate calculator to have CohesionUI select an appropriate sampling rate based on the fiber length of your setup.

5. Cancel if you would like to enter a different sampling rate,
   or
6. Click **Submit** to save and apply the sampling rate.
7. Select the **RF input impedence**: Low or high.
8. Click **Start a scan**.

   The POL will overwrite previously captured data in the scan data buffer. If required, export data from the data buffer before running another scan.

9. Once the scan is complete, measured RF input voltage values will be displayed against time, and current, minimum and maximum RF input values will be listed.
10. Click **Abort scan** to stop a scan if required. This option is available while the scan is running.

    The POL will not save an incomplete scan, for example if you stopped a scan before it has finished.



To download scan data stored in the data buffer in a .csv file format:

11. Click **Export data**.

    A file in .csv format will be downloaded. It lists scan data in a table format with the following columns:

    - time stamp (from the start of the scan in ms)
    - Theta (pi)
    - Phi (pi)
    - RF input signal (V)

To delete currently stored scan data:

12. Click the **Delete** icon  .

8.4 Optimize the signal

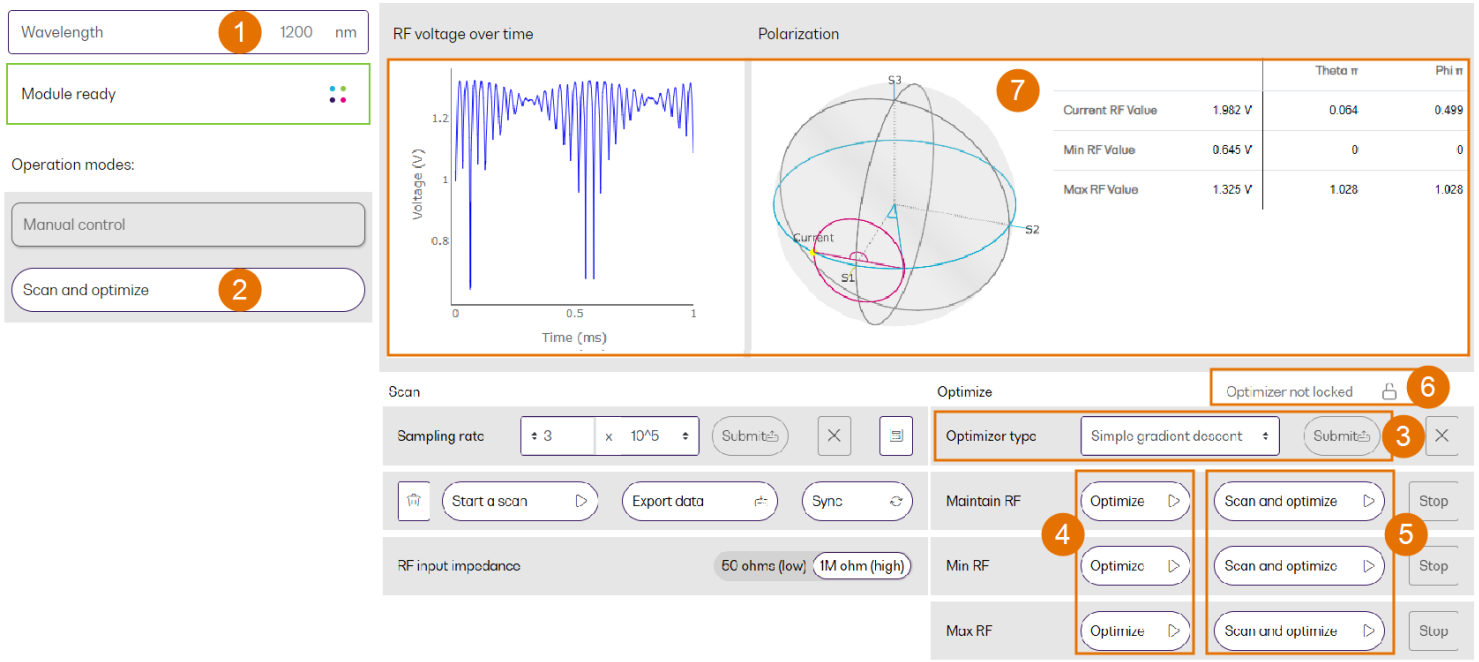
You can **optimize** the state of polarization (SOP) of your optical signal to either minimize, maximize or maintain the RF input voltage. The combined **scan and optimize** function runs a scan first, before optimizing the signal based on the scan. Once initiated, the optimize function will continue until you stop it.

Supported optimizer types:

Optimizer type	Description
Simple gradient descent	This first-order optimization algorithm iteratively adjusts parameters to minimize a given function. It calculates the gradient (the slope) of the function at a given point and moves in the opposite direction of the gradient to find the minimum. It works well for logarithmic RF input feedback into the POL, for example from Quantifi Photonics' POWER-1500 series power meters.
Levenbert marquardt	This algorithm solves non-linear least-squares problems, such as curve fitting. It combines the strengths of the Gauss-Newton algorithm and gradient descent and works well for both logarithmic and linear feedback. We especially recommend it when using linear RF input feedback into the POL.

To provide optimal feedback resolution, maximize the feedback signal voltage range to match the POL input range as close as possible.

To optimize the signal:



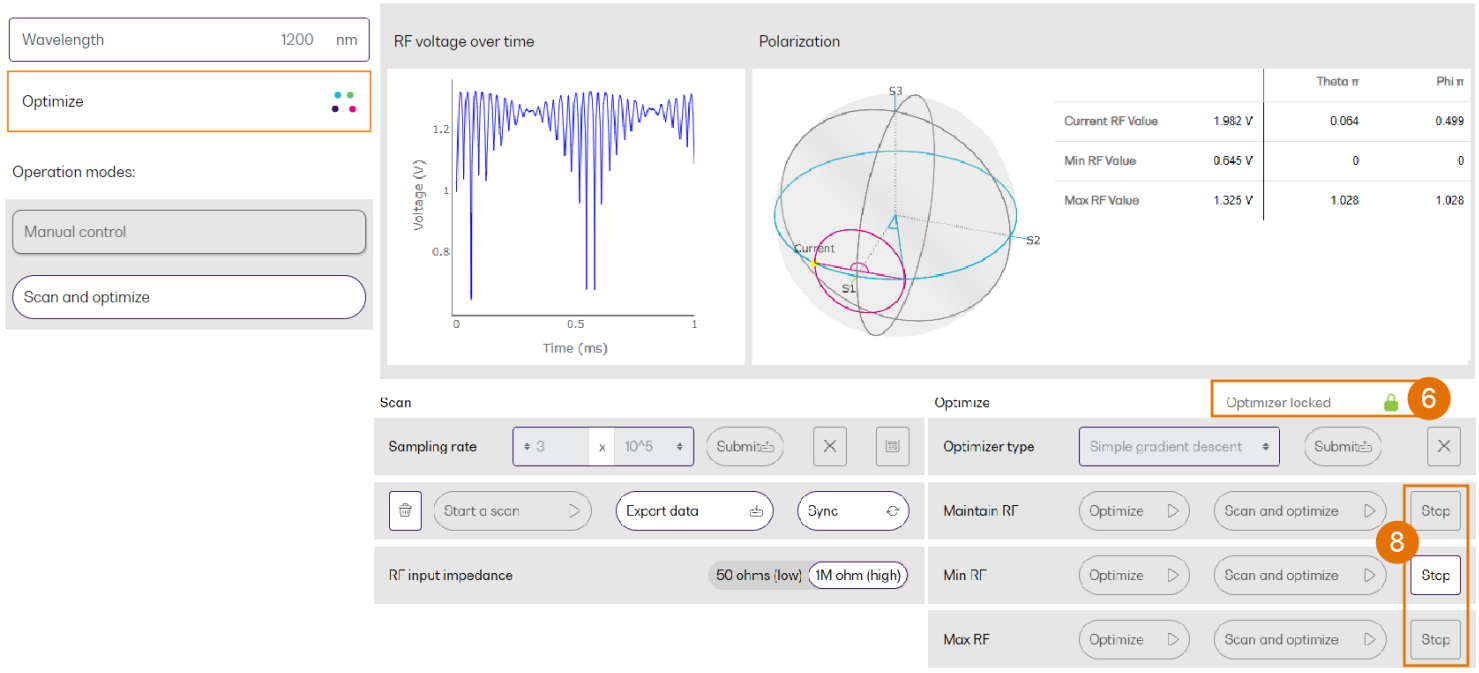
1. Enter/Select the **wavelength** of the optical signal.
2. Go to **Scan and optimize** mode.
3. Select **Optimizer type** and click **Submit** to apply the selection.
4. Click **Optimize** to either maintain, minimize or maximize the RF input voltage - the POL will optimize your signal accordingly, based on stored scan data if available.

   or

5. Click **Scan and optimize** to either maintain, minimize or maximize the RF input voltage - the POL will run a scan based on the current scan settings first (refer to Scan the signal), then optimize the signal based on the scan.
6. The indicator displays the optimization status; it turns green when the signal is at (or close to) optimum.
7. During optimization, the **Current RF value** will regularly update on the Poincaré sphere and the RF value table.

To stop the optimizing process:

8. Click **Stop**.



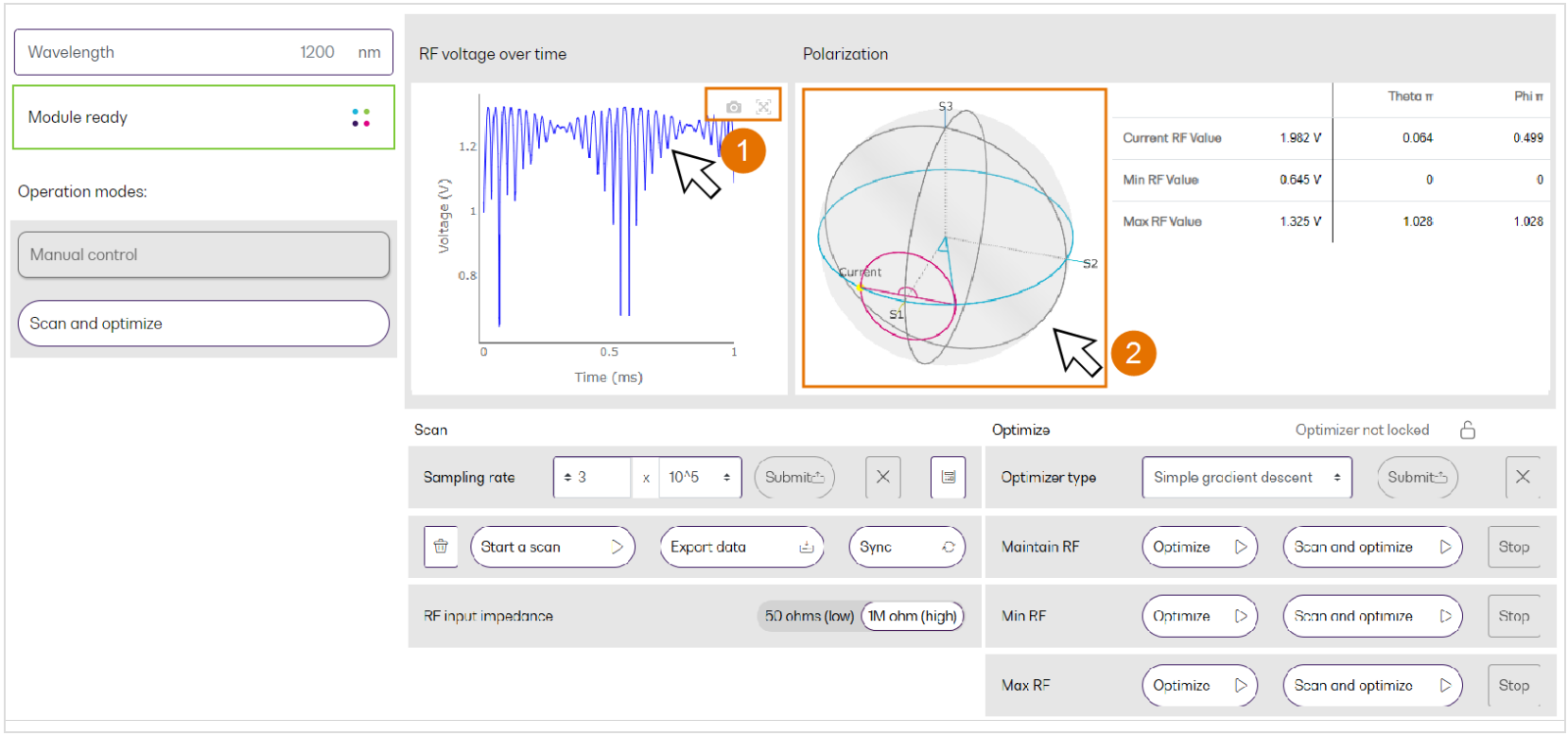
8.5 Work with the graphical elements in CohesionUI

Interactive graphs and tables visualize the effects of polarization settings and and measurements in real time.

You can optimize graphs in CohesionUI as required, for example by zooming in and panning, and you can download them for further processing or storage outside of CohesionUI.

To work with the graphical elements in CohesionUI:

1. Hover your mouse over a graph and select one of the options that is available for that graph.
2. Rotate the Poincaré sphere by clicking/holding it with your mouse and moving it as required.



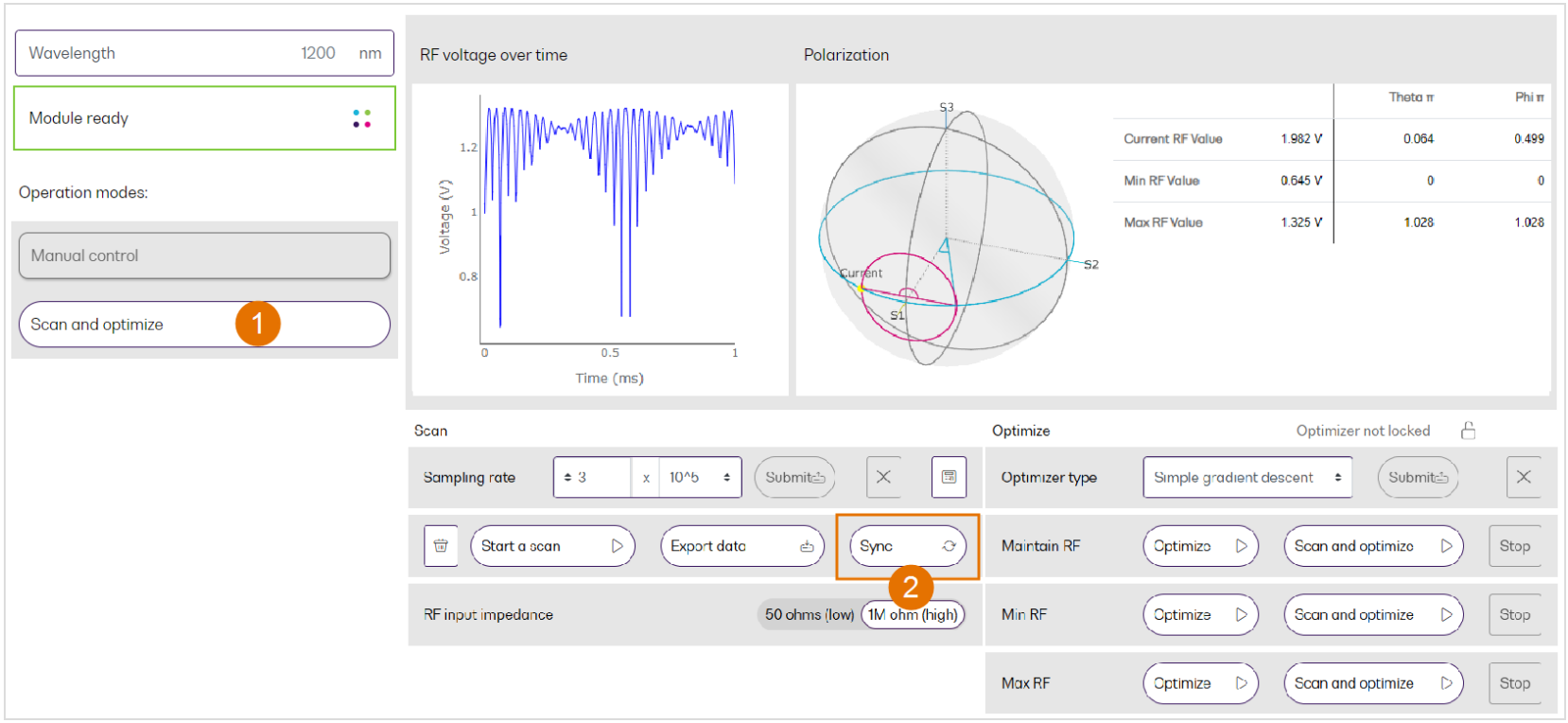
8.6 Synchronize CohesionUI with the module

To ensure that the scan data graph, and minimum and maximum RF input values in CohesionUI are based on the latest scan, you can manually synchronize CohesionUI with the POL module. This is particularly useful if working with CohesionUI as well as SCPI commands, or sharing access to the module with other users.

To synchronize CohesionUI with the module:

1. Go to **Scan and optimize** mode.
2. Click **Sync**.

   CohesionUI will load the current polarization settings of the POL and update CohesionUI accordingly.



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 supported operation modes, refer to Introducing the POL 1200 Series .

For details on available SCPI commands, refer to:

- Command summary
- Command descriptions

9.2 Programming conventions

9.2.1 Parameters

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	THZ, GHZ, MHZ, KHZ
Wavelength	NM	PM
Rate	S/S	
Voltage	V	
Impedance	OHM	

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.

9.2.2 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 commands that require index values:

Index	Description	Value
`<n>`	the slot index of the module	integer `<0` to `18>`

9.2.3 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.

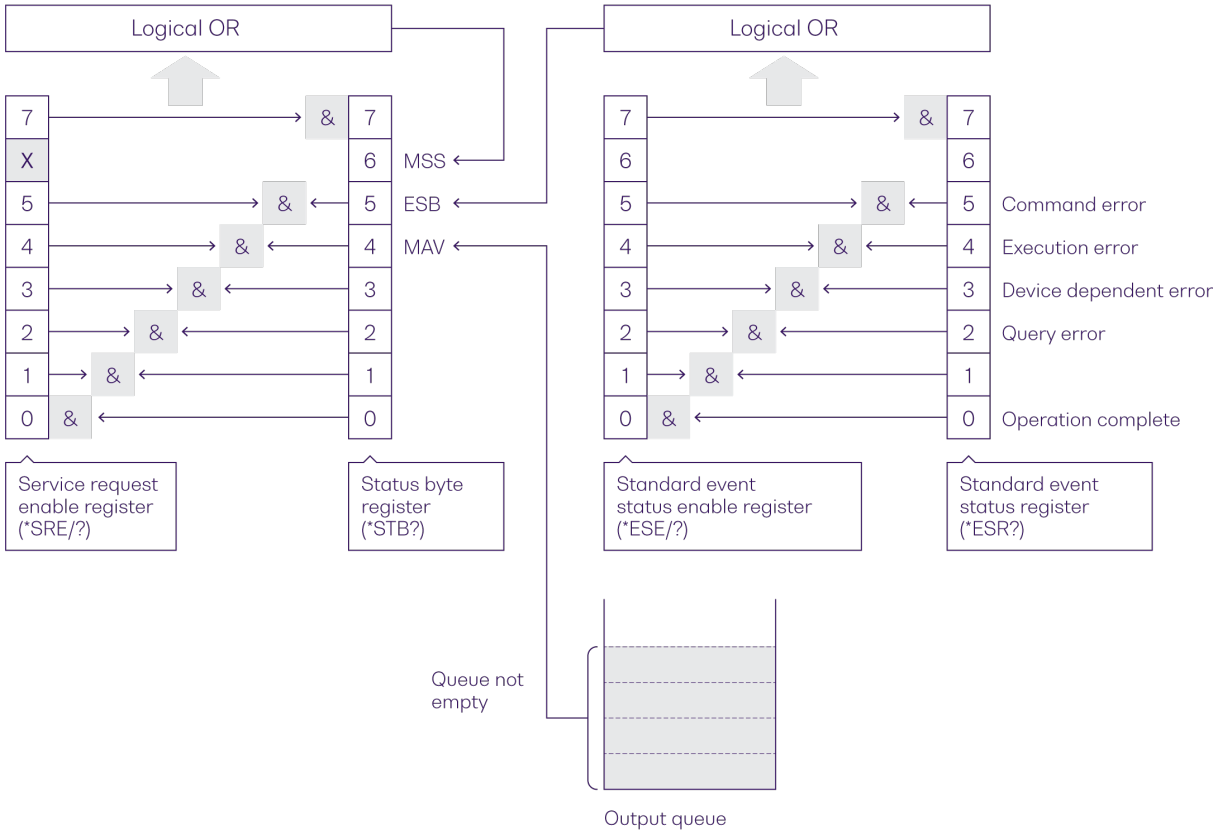
Bit	Description
7 (MSB)	Not used
6	The Master Summary Status (MSS) bit is set from the STB and SRE Mask
5	The Event Status Bit (ESB) is set from the SESR and the SESR Mask
4	Message Available (MAV) is set when there is data in the output queue
3, 2, 1, 0 (LSB)	Not used

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 PXIe Multi Chassis mode operation

Multiple chassis can be connected to operate in **Multi Chassis Mode**.

To operate in Multi Chassis Mode, **CohesionSCPI service must be version 1.02.06 or later**.

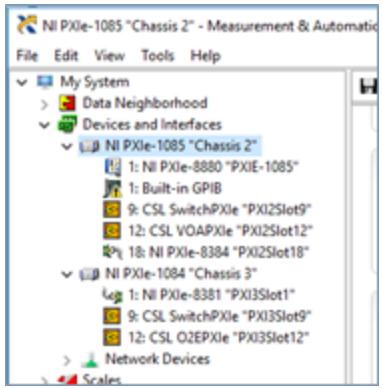
9.4.1 NI-MAX application Multi Chassis mode

NOTE

The CohesionSCPI service does not manage the chassis numbers. These are controlled by the NI Platform Services (and through NI-MAX).

Even if the CohesionSCPI service is in Multi Chassis mode, if a chassis is connected but has no installed modules, it will not show up when `*OPT?` is run.

In the example shown below, there are two chassis connected via the PXIe-8384 to PXIe-8381 connection. Chassis #2 has the controller running CohesionSCPI service, and Chassis #3 is the 'extended' chassis.



9.4.2 SCPI Multi Chassis commands

NOTE

Changing the CohesionSCPI service Chassis Mode will rediscover all Chassis and installed modules.

Command	`:SYSTEM:CHASSIS?`
Syntax	`:SYSTEM:CHASSIS?<wsp>[LIST|MODE]`
Description	Query the Chassis Mode configuration
Parameters	No parameters
Response	**`List`**: Returns a comma separated list of valid chassis index numbers discovered by the CohesionSCPI service. These are chassis that have modules installed.
	`MODE`: Returns the current Chassis Mode the CohesionSCPI service is operating in (SINGLE or MULTI).
	`None`: Returns the number of chassis managed by the CohesionSCPI service. If this is greater than 1, then the system should be set to MULTI mode for correct operation.

Example	In Single chassis mode:
	`:SYSTEM:CHASSIS? -> 1`
	`:SYSTEM:CHASSIS? LIST -> 0`
	`:SYSTEM:CHASSIS? MODE -> SINGLE`
	
	In Multi chassis mode:
	`:SYSTEM:CHASSIS? -> 2`
	`:SYSTEM:CHASSIS? LIST -> 2,3`
	`:SYSTEM:CHASSIS? MODE -> MULTI`

Command	`:SYSTEM:CHASSIS`
Syntax	`:SYSTEM:CHASSIS<wsp>[SINGLE|MULTI]`
Description	Set the Chassis Mode configuration
Parameters	**`SINGLE`**: Set CohesionSCPI service to operate in SINGLE Chassis Mode
	`MULTI`: Set CohesionSCPI service to operate in MULTI Chassis Mode
Response	No response
Example	`:SYSTEM:CHASSIS SINGLE`

In Multi chassis mode, all commands listed in the command summary section will still work, but they must be prefixed with `:CHASSIS<c>`.

Common command example:

Single Chassis Mode	`:SLOT2:IDN?`
Multi Chassis Mode	`:CHASSIS1:SLOT2:IDN?`

Specific command example:

Single Chassis Mode	`:SOUR2:CHAN2:POW? MAX`
Multi Chassis Mode	`:CHASSIS1:SOUR2:CHAN2:POW? MAX`

9.5 Command summary

9.5.1 Common commands

Command	Description
`*IDN?`	Query the CohesionSCPI service identification >>
`*CLS`	Clear session message queues >>
`*OPT?`	Query the modules managed by the CohesionSCPI service >>
`*OPC?`	Query the Operation Complete Status >>
`*ESR?`	Query the Standard Event Status Register >>
`*ESE?`	Query the Standard Event Status Enable Register (Mask) >>
`*ESE`	Set the Standard Event Status Enable Register >>
`*TST?`	Query the self-test status of all modules >>
`*RST`	Reset modules to default power-on settings >>

9.5.2 Slot commands

Command	Description
`:SLOT<slot>`	
`:TeST?`	Query the module self-test status >>
`:ReSeT`	Reset the module to default power-on settings >>
`:OPC?`	Query the Operation Complete Status of the module >>
`:IDN?`	Query the slot identification >>
`:OPTions?`	Query the modules managed by the CohesionSCPI service >>

9.5.3 Configuration commands

9.5.3.1 All operation modes

Command	Description
:POL<n>	
:WAVelength?	Query the wavelength >>
:WAVelength	Set the wavelength >>
:MODE?	Query the operation mode >>
:MODE	Set an operation mode >>

9.5.3.2 Manual mode

Command	Description
:POL<n>	
:THETa?	Query the angle theta θ >>
:THETa	Set the angle theta θ >>
:PHI?	Query the angle phi Φ >>
:PHI	Set the angle phi Φ >>

9.5.3.3 Scan mode

Command	Description
:POL<n>	
:RATE?	Query the scan sampling rate >>
:RATE	Set the scan sampling rate >>
:SCAN<n>	
:DATA?	Return all scan data from the data buffer >>
:CLeaR	Clear scan data buffer >>
:INPut<n>	
:RF?	Query the RF input signal >>
:IMPEdance?	Query RF input impedance >>
:IMPEdance	Set RF input impedance >>

9.5.3.4 Optimize mode

Command	Description
:POL<n>	
:OPTImizer	
:MODE?	Query the optimize mode >>
:MODE	Set the settings for optimize mode >>
:LOCK?	Query the optimization status of the signal >>
:TYPE?	Query the optimizer type >>
:TYPE	Set the optimizer type >>
:THETa?	Query the angle theta θ >>
:PHI?	Query the angle phi Φ >>

9.6 Command descriptions

9.6.1 Common commands

Command	***IDN?**	Summary >>
Syntax	`*IDN?`	
Description	Query the CohesionSCPI service identification	
Parameters	N/A	
Response	Comma separated string with the <manufacturer>,<server name>,<chassis controller name>,<server version>	
Example	`*IDN? -> Quantifi Photonics Ltd,CohesionSCPI,PXIE-8880,SW3.03.11.alpha.11`	

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

Command	***OPT?**	Summary >>
Syntax	`*OPT?`	
Description	Query the modules managed by the CohesionSCPI service	
Parameters	N/A	
Response	Comma separated string of the installed modules in the chassis	
Example	`*OPT? -> ,LASER-2001-1-FA-PXIE,POL-1201-1-SC-PXIE,,VOA-1001-2-FA-PXIE,,,,O2E-1001-1-FC-PXIE,,,,,,,,`	

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`	

Command	***ESE**	Summary >>
Syntax	`*ESE<wsp><value>`	
Description	Set the Standard Event Status Enable Register	
Parameters	N/A	
Response	N/A	
Example	`*ESE 254`	

Command	***TST?**	Summary >>
Syntax	`*TST?`	
Description	Query the self-test status of all modules	
Parameters	N/A	
Response	**1**: error	
	0: no error	
Command	`*TST? -> 0`	

Command	***RST**	Summary >>
Syntax	`*RST`	
Description	Reset modules to default power-on settings	
Parameters	N/A	
Response	N/A	
Command	`*RST`	

9.6.2 Slot commands

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

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>:OPC?** Summary >>
Syntax	:SLOT<slot>: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<slot>:OPC? is NOT 1, may not execute or return an error.
Syntax	:SLOT1:OPC? -> 1

Command	**:SLOT<slot>:IDN?**	Summary >>
Syntax	:SLOT<slot>:IDN?	
Description	Query the slot 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 Ltd,POL-1201-1-SC-PXIE,CSL-195114,HW0.01.00FW0.01.20	

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

9.6.3 Configuration commands

For details, please refer to Operation modes and How it works.

9.6.3.1 All operation modes

Command	**:POL<n>:WAVelength?** Summary >>
Syntax	:POL<n>:WAVelength?[<wsp><MIN|MAX|DEF|SET|ALL|STEP|UNIT>]
Description	Query the wavelength
Parameters	**MIN**: Returns the minimum wavelength
	MAX: Returns the maximum wavelength
	DEF: Returns the default wavelength
	SET: (default) Returns the currently set wavelength
	ALL: Returns all the above parameters in a comma-separated string: <MIN>,<MAX>,<DEF>,<SET>
	STEP: Returns the resolution/step size of settable values. STEP = 1 allows values of 1, 2, 3 etc. STEP = 0.1 allows values of 1.1, 1.2, 1.3 etc.
	UNIT: Returns the default wavelength unit
Response	A single value, or a comma-separated array of values
Example	:POL1:WAV? ALL -> 1200.0,1400.0,1300.0,1330.0

Command	**:POL<n>:WAVelength** Summary >>
Syntax	:POL<n>:WAVelength<wsp><value|MIN|MAX|DEF>
Description	Set the wavelength
Parameters	**value**: Sets the wavelength to this value
	MIN: Sets the minimum wavelength
	MAX: Sets the maximum wavelength
	DEF: Sets the default wavelength
Response	N/A
Example	:POL1:WAV MAX

Command	**:POL<n>:MODE?** Summary >>
Syntax	:POL<n>:MODE?[<wsp><DEF|SET|LIST|INFO>]
Description	Query the operation mode
Parameters	**DEF**: Returns the default mode
	SET: (default) Returns the currently set mode
	LIST: Returns a list of all supported modes
	INFO: Returns the mapping between the numeral and the text form of the modes
Response	A single value, a comma-separated array of values, or the mapping between numerals and text format
Example	:POL1:MODE? INFO -> 0:Manual 1:Depolarize 2:Scan 3:Optimize 4:Scan Optimize

Command	**:POL<n>:MODE** Summary >>
Syntax	:POL<n>:MODE<wsp><0|STOP|1|2|3|4>
Description	Set an operation mode
Parameters	**0|STOP**: Sets the mode to **Manual**. This is the default, idling mode.
	1: Sets the mode to **Depolarize**. Your product will remain in this mode until you set another mode.
	2: Performs a scan based on currently selected **Scan** settings (refer Scan mode) recording theta θ and phi Φ values against RF input values. Returns to **Manual** mode on completion of the scan.
	3: Sets the mode to **Optimize** and applies currently set **Optimize** settings (refer to Optimize mode). Your product will remain in this mode until you set another mode.
	4: Sets the mode to **Scan and optimize** and automatically scans, adjusts and optimizes the polarization based on currently selected **Scan** and **Optimize** settings (refer to Scan mode and Optimize mode). Optimize mode **Maintain**: Your product will remain in this mode until you set another mode. Optimize mode **Minimum** or **Maximum**: Once your product has reached **Minimum** or **Maximum** settings, it will return to **Manual** mode.
Response	N/A
Example	:POL1:MODE 2

9.6.3.2 Manual mode

Command	**:POL<n>:THETa?** Summary >>
Syntax	:POL<n>:THETa?[<wsp><MIN|MAX|DEF|SET|ALL|STEP>]
Description	Query the angle theta θ The value is normalized to a range of 0.0 to 1.0 with 0.0 = 0 degree rotation and 1.0 = full 360 degree rotation.
Parameters	**MIN**: Returns the minimum angle
	MAX: Returns the maximum angle
	DEF: Returns the default angle
	SET: (default) Returns the currently set angle
	ALL: Returns all the above parameters in a comma-separated string: <MIN>,<MAX>,<DEF>,<SET>,<LIST>
	STEP: Returns the resolution/step size of settable values. STEP = 0.25 allows values of 0.25, 0.50, 0.75 etc. STEP = 0.025 allows values of 0.025, 0.050, 0.075 etc.
Response	A single value, or a comma-separated array of values
Example	:POL1:THETa? ALL -> 0.00000,1.00000,0.50000,0.50000
	:POL1:THETa? STEP -> 0.00025

Command	**:POL<n>:THETa** Summary >>
Syntax	:POL<n>:THETa<wsp><value|MIN|MAX|DEF>
Description	Set the angle theta θ The value is normalized to a range of 0.0 to 1.0 with 0.0 = 0 degree rotation and 1.0 = full 360 degree rotation.
Parameters	**value**: Sets the angle to this value
	MIN: Sets the minimum value
	MAX: Sets the maximum value
	DEF: Sets the default value
Response	N/A
Example	:POL1:THETa DEF

Command	**:POL<n>:PHI?**	Summary >>
Syntax	`:POL<n>:PHI?[<wsp><MIN|MAX|DEF|SET|ALL|STEP>]`	
Description	Query the angle phi Φ The value is normalized to a range of 0.0 to 1.0 with 0.0 = 0 degree rotation and 1.0 = full 360 degree rotation.	
Parameters	**MIN**: Returns the minimum angle	
	MAX: Returns the maximum angle	
	DEF: Returns the default angle	
	SET: (default) Returns the currently set angle	
	ALL: Returns all the above parameters in a comma-separated string: `<MIN>,<MAX>,<DEF>,<SET>,<LIST>`	
	STEP: Returns the resolution/step size of settable values. `STEP = 0.25` allows values of 0.25, 0.50, 0.75 etc. `STEP = 0.025` allows values of 0.025, 0.050, 0.075 etc.	
Response	A single value, or a comma-separated array of values	
Example	`:POL1:PHI? ALL -> 0.00000,1.00000,0.50000,0.50000`	
	`:POL1:PHI? STEP -> 0.00025`	

Command	**:POL<n>:PHI**	Summary >>
Syntax	`:POL<n>:PHI<wsp><value|MIN|MAX|DEF>`	
Description	Set the angle phi Φ The value is normalized to a range of 0.0 to 1.0 with 0.0 = 0 degree rotation and 1.0 = full 360 degree rotation.	
Parameters	**value**: Sets the angle to this value	
	MIN: Sets the minimum value	
	MAX: Sets the maximum value	
	DEF: Sets the default value	
Response	N/A	
Example	`:POL1:PHI DEF`	

9.6.3.3 Scan mode

Command	**:POL<n>:RATE?** Summary >>
Syntax	:POL<n>:RATE?[<wsp><MIN|MAX|DEF|SET|LIST|ALL|STEP|UNIT>]
Description	Query the scan sampling rate
Parameters	**MIN**: Returns the minimum rate
	MAX: Returns the maximum rate
	DEF: Returns the default rate
	SET: (default) Returns the currently set rate
	LIST: Returns a list of all supported rates
	ALL: Returns all the above parameters in a comma-separated string: <MIN>,<MAX>,<DEF>,<SET>,<LIST>
	UNIT: Returns the default rate unit
Response	A single value, or a comma-separated array of values
Example	:POL1:RATE? ALL -> 10,600000,600000,25

Command	**:POL<n>:RATE** Summary >>
Syntax	:POL<n>:RATE<wsp><value|MIN|MAX|DEF>
Description	Set the scan sampling rate
Parameters	**value**: Sets the rate to this value
	MIN: Sets the minimum rate
	MAX: Sets the maximum rate
	DEF: Sets the default rate
Response	N/A
Example	:POL1:RATE DEF

Command	**:SCAN<n>:DATA?** Summary >>
Syntax	`:SCAN<n>:DATA?[<wsp><FULL|INFO>]`
Description	Return all scan data from the data buffer
Parameters	**<none>**: Returns scan data in a table format, each row contains: `<time from the start of the scan tDelta(ms)>,<value of Theta(pi)>,<value of Phi(pi)>,<RF input Signal (V)>`
	FULL: Returns scan data as a comma-separated array of values
	INFO: Returns the data points that will be captured in a scan
Response	A comma-separated array of values or a table listing theta θ and phi Φ values against RF input values and time. **NAN**: The data buffer does not contain data, or the scan is still in progress (operation mode **Scan** is active).

Example	`:SCAN1:DATA? ->`
	`0.000000,0.000000,0.000000,0.782491`
	`0.000978,0.000733,0.031013,0.805055`
	`0.001955,0.001709,0.062271,0.842930`
	`...`
	`0.999022,0.998046,0.062271,0.809084`
	`1.000000,0.999023,0.031013,0.835678`

	`:SCAN1:DATA? FULL ->`
	`tDelta(ms):0.000000,0.000978,0.001955,...,0.998045,0.999022,1.000000`
	`Theta(pi):0.000000,0.000733,0.001709,...,0.997070,0.998046,0.999023`
	`Phi(pi):0.000000,0.031013,0.062271,...,0.093529,0.062271,0.031013`
	`Signal(V):0.782491,0.805055,0.842930,...,0.828425,0.809084,0.835678`

	`:SCAN1:DATA? INFO ->` `tDelta(ms),Theta(pi),Phi(pi),Signal(V)`

Command	**:SCAN<n>:CLeaR** Summary >>
Syntax	`:SCAN<n>:CLeaR`
Description	Clear scan data buffer
Parameters	N/A
Response	N/A
Example	`:SCAN1:CLR`

Command	**:INPut<n>:RF?**	Summary >>
Syntax	:INPut<n>:RF?<wsp><ACT|STEP|UNIT>	
Description	Query the RF input signal	
Parameters	**ACT**: Returns the actual measured value	
	STEP: Returns the resolution/step size of settable values	
	UNIT: Returns the default RF unit	
Response	A single value	
Example	:INP1:RF? ACT -> 1.108	

Command	**:INPut<n>:IMPEdance?**	Summary >>
Syntax	:INPut<n>:IMPEdance?[<wsp><DEF|SET|LIST|INFO>]	
Description	Query RF input impedance Impedance can be set to a low or a high value.	
Parameters	**DEF**: Returns the default value	
	SET: (default) Returns the currently set value	
	LIST: Returns a list of all supported values	
	ALL: Returns all the above parameters in a comma-separated string: <DEF>,<SET>,<LIST>	
	INFO: Returns the mapping between the numeral and the text form of the modes	
Response	A single value, a comma-separated array of values, or the mapping between numerals and text format	
Example	:INP1:IMPE? INFO -> 0:50 ohms(low) 1:1M ohm(high)	

Command	**:INPut<n>:IMPEdance**	Summary >>
Syntax	:INPut<n>:IMPEdance[<wsp><DEF|LOW|HIGH>]	
Description	Set RF input impedance You can set impedance to a low or a high value.	
Parameters	**DEF**: Sets the default value	
	LOW: Sets the low value	
	HIGH: Sets the high value	
Response	N/A	
Example	:INP1:IMPE LOW	

9.6.3.4 Optimize mode

Command	**:POL<n>:OPTImizer:MODE?** Summary >>
Syntax	:POL<n>:OPTImizer:MODE?[<wsp><DEF|SET|LIST|INFO>]
Description	Query the optimize mode
Parameters	**DEF**: Returns the default mode
	SET: (default) Returns the currently set mode
	LIST: Returns a list of all supported modes
	INFO: Returns the mapping between the numeral and the text form of the modes
Response	A single value, a comma-separated array of values, or the mapping between numerals and text format
Example	:POL1:OPTI:MODE? INFO -> 0:min 1:max 2:maintain

Command	**:POL<n>:OPTImizer:MODE** Summary >>
Syntax	:POL<n>:OPTImizer:MODE<wsp><value|0|MINimum|1|MAXimum|2|MAINtain|DEF>
Description	Set the settings for optimize mode
Parameters	**value**: Sets the mode to this value
	MINimum: Minimize the RF input voltage
	MAXimum: Maximize the RF input voltage
	MAINtain: Maintain the RF input voltage
	DEF: Sets the default mode
Response	N/A
Example	:POL1:OPTI:MODE 1

Command	**:POL<n>:OPTImizer:MODE:LOCK?** Summary >>
Syntax	:POL<n>:OPTImizer:LOCK?[<wsp>INFO]
Description	Query the optimization status of the signal
Parameters	**<none>**: Returns the optimization status
	INFO: Returns the mapping between the number and the text form of the modes
Response	**0**: the signal is not yet at optimum
	1: the signal is at (or close to) optimum
Example	:POL1:OPTI:MODE:LOCK? INFO -> 0:Not locked 1:locked

Command	**:POL<n>:OPTImizer:TYPE?**	Summary >>
Syntax	`:POL<n>:OPTImizer:TYPE?[<wsp><DEF|SET|LIST|INFO>]`	
Description	Query the optimizer type	
Parameters	**DEF**: Returns the default type	
	SET: (default) Returns the currently set type	
	LIST: Returns a list of all supported types	
	INFO: Returns the mapping between the numeral and the text form of the types	
Response	A single value, a comma-separated array of values, or the mapping between numerals and text format	

Example	`:POL1:OPTI:TYPE? INFO ->`
	`0:SGD`
	`1:LM`	

Command	**:POL<n>:OPTImizer:TYPE**	Summary >>
Syntax	`:POL<n>:OPTImizer:TYPE<wsp><value|0|SGD|1|LM|DEF>`	
Description	Set the optimizer type	
Parameters	**value**: Sets the type to this value (`0` or `1`)	
	0|SGD: Sets the type to Simple Gradient Descent. This first-order optimization algorithm iteratively adjusts parameters to minimize a given function. It calculates the gradient (the slope) of the function at a given point and moves in the opposite direction of the gradient to find the minimum. It works well for logarithmic RF input feedback into the POL, for example from Quantifi Photonics' POWER-1500 series power meters.	
	1|LM: Sets the type to Levenberg Marquardt. This algorithm solves non-linear least-squares problems, such as curve fitting. It combines the strengths of the Gauss-Newton algorithm and gradient descent and works well for both logarithmic and linear feedback. We especially recommend it when using linear RF input feedback into the POL.	
	DEF: Sets the default type	
Response	N/A	
Example	`:POL1:OPTI:TYPE 1`	

Command	**:POL<n>:THETa?** Summary >>
Syntax	:POL<n>:THETa?[<wsp><MIN|MAX|DEF|SET|ALL|STEP>]
Description	Query the angle theta θ The value is normalized to a range of 0.0 to 1.0 with 0.0 = 0 degree rotation and 1.0 = full 360 degree rotation.
Parameters	**MIN**: Returns the minimum angle
	MAX: Returns the maximum angle
	DEF: Returns the default angle
	SET: (default) Returns the currently set angle
	ALL: Returns all the above parameters in a comma-separated string: <MIN>,<MAX>,<DEF>,<SET>,<LIST>
	STEP: Returns the resolution/step size of settable values. STEP = 0.25 allows values of 0.25, 0.50, 0.75 etc. STEP = 0.025 allows values of 0.025, 0.050, 0.075 etc.
Response	A single value, or a comma-separated array of values
Example	:POL1:THETa? ALL -> 0.00000,1.00000,0.50000,0.50000
	:POL1:THETa? STEP -> 0.00025

Command	**:POL<n>:PHI?** Summary >>
Syntax	:POL<n>:PHI?[<wsp><MIN|MAX|DEF|SET|ALL|STEP>]
Description	Query the angle phi Φ The value is normalized to a range of 0.0 to 1.0 with 0.0 = 0 degree rotation and 1.0 = full 360 degree rotation.
Parameters	**MIN**: Returns the minimum angle
	MAX: Returns the maximum angle
	DEF: Returns the default angle
	SET: (default) Returns the currently set angle
	ALL: Returns all the above parameters in a comma-separated string: <MIN>,<MAX>,<DEF>,<SET>,<LIST>
	STEP: Returns the resolution/step size of settable values. STEP = 0.25 allows values of 0.25, 0.50, 0.75 etc. STEP = 0.025 allows values of 0.025, 0.050, 0.075 etc.
Response	A single value, or a comma-separated array of values
Example	:POL1:PHI? ALL -> 0.00000,1.00000,0.50000,0.50000
	:POL1:PHI? STEP -> 0.00025

10 Programming examples

The following are examples of how to control your POL module using SCPI commands:

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.

10.1 Modes

```
#Get mode information
:POL3:MODE? INFO
0:Manual
1:Depolarize
2:Scan
3:Optimize
4:Scan Optimize
```

10.2 Manual

```
#Set to manual mode
:POL3:MODE 0

#Set Wavelength
:POL3:WAVELENGTH 1310

#Set position of theta
:POL3:THETA 0.56

#Set position of phi
:POL3:PHI 0.745
```

10.3 Depolarize

```
#Set to Manual mode (this stops any other mode, and all properties can be configured)
:POL3:MODE 0

#Set Wavelength
:POL3:WAVELENGTH 1310

#Initiate the Depolarize mode
:POL3:MODE 1
```

10.4 Scan

```
#Set to Manual mode (this stops any other mode, and all properties can be configured)
:POL3:MODE 0

#Set Wavelength
:POL3:WAVELENGTH 1310

#Set to sampling rate
:POL3:RATE 6e5

#Initiate the Scan mode
:POL3:MODE 2

#Get the Scan data
:SCAN3:DATA?
0.000000,0.000000,0.000000,0.000000
0.000978,0.000733,0.031013,0.000000
0.001955,0.001709,0.062271,0.000806

...

0.998045,0.997070,0.093529,0.000000
0.999022,0.998046,0.062271,0.000000
1.000000,0.999023,0.031013,0.000806

#Get the Scan data in keyed format
:SCAN3:DATA? FULL
tDelta(ms):0.000000,0.000978,0.001955,  ...  ,0.998045,0.999022,1.000000
Theta(pi):0.000000,0.000733,0.001709,  ...  ,0.997070,0.998046,0.999023
Phi(pi):0.000000,0.031013,0.062271,  ...  ,0.093529,0.062271,0.031013
Signal(V):0.000000,0.000000,0.000806, ...  ,0.001612,0.000806,0.000000
```

10.5 Optimize

```
#Set to Manual mode (this stops any other mode, and all properties can be configured)
:POL3:MODE 0

#Set Wavelength
:POL3:WAVELENGTH 1310

#Set to sampling rate
:POL3:RATE 6e5

#Set to Optimizer mode (MIN as example)
:POL3:OPTIMIZER:MODE MIN

#Initiate the Optimize mode
:POL3:MODE 3

#Read the RF signal
:INPUT3:RF?
0.056
```

10.6 Scan and optimize

```
#Set to Manual mode (this stops any other mode, and all properties can be configured)
:POL3:MODE 0

#Set Wavelength
:POL3:WAVELENGTH 1310

#Set to sampling rate
:POL3:RATE 6e5

#Set to Optimizer mode (MAX as example)
:POL3:OPTIMIZER:MODE MAX

#Initiate the Scan and Optimize mode
:POL3:MODE 4

#Read the RF signal
:INPUT3:RF?
0.056
```

11 Programming 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.

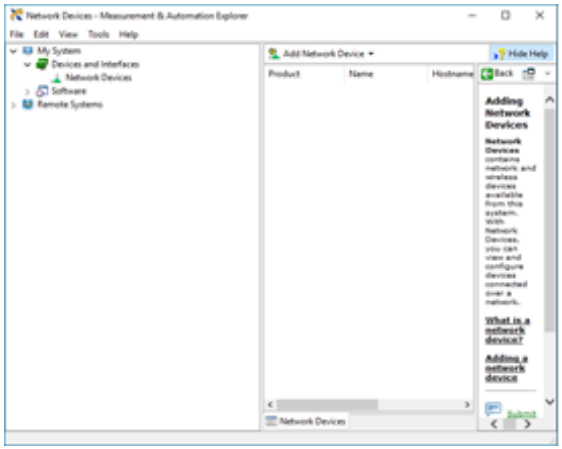
NOTE

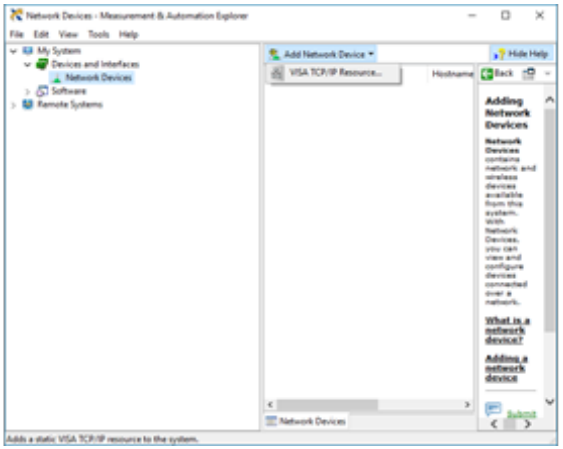
In NI-MAX a RIO interface will show up, however there are no communication methods available or implemented on this interface. Quantifi Photonics products are **ONLY** accessible through the **VISA TCPIP INSTR** interface provided by the CohesionSCPI service installed on the system.

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**.



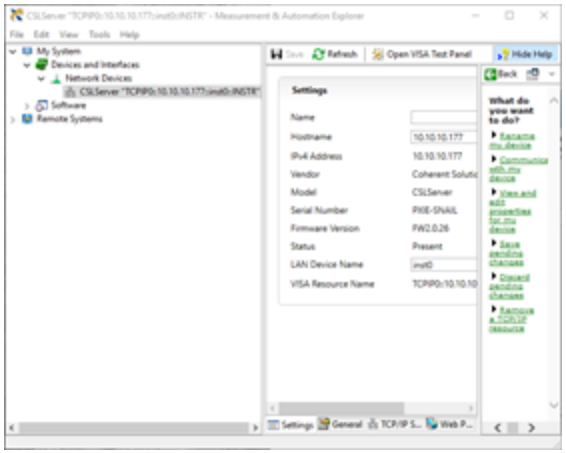


3. Select **Manual Entry of LAN Instrument**. Enter in the Hostname or IP Address.
   Note when operating locally, enter in the localhost IP address of **127.0.0.1**. Click **Finish** to end the setup process.

11.2 Setting up NI-VISA application

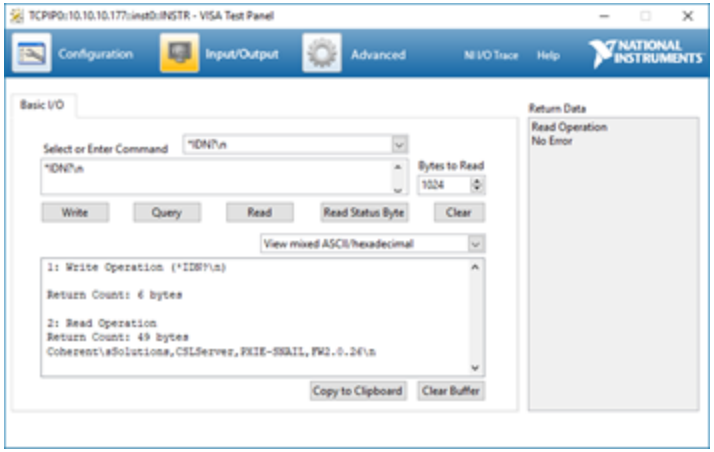
NI-VISA is used to communicate with the PXIe chassis or installed modules / instruments. The above steps must be completed before attempting to communicate using NI-VISA.

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.

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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