QUANTIFI PHOTONICS™

VOA

VARIABLE OPTICAL ATTENUATOR

USER MANUAL

quantifiphotonics.com

Trademarks

Quantifi Photonics' trademarks have been identified as such. However, the presence or absence of such identification does not affect the legal status of any trademark.

LabVIEW™, MATLAB® and Python® are trademarks of National Instruments, The MathWorks Inc., and the Python Software Foundation, respectively. Neither Quantifi Photonics nor any software programs or other goods or services offered by Quantifi Photonics are affiliated with, endorsed by, or sponsored by National Instruments, The MathWorks Inc., and the Python Software Foundation.

Units of Measurement

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

Version: 3.01

Contents

1   Conventions

Before using the instrument described in this manual, take note of the following conventions:

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

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

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

⚠ IMPORTANT
Refers to information about this product that you should not overlook.

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

2   Safety information

Before using the VOA product, ensure that the following safety information has been read and understood.

2.1   Optical laser radiation precautions

� WARNING

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

✤ CAUTION

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

2.2   Electrostatic discharge precautions

✤ CAUTION

The VOA products are sensitive to electrostatic discharge (ESD). Store the unused products in the original protective electrostatic packaging that the product was shipped in.

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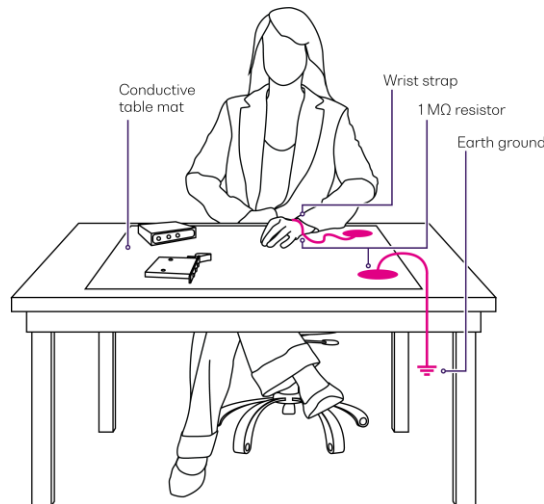
2.3   Electromagnetic compatibility

✤ CAUTION

- For electromagnetic compatibility, this instrument is a **Class A** product. It is intended for use in an industrial environment. There may be potential difficulties in ensuring electromagnetic compatibility in other environments, due to conducted as well as radiated disturbances.

- Wherever the ⚠ symbol is printed on the unit, refer to the instructions provided in the device documentation for related safety information. Ensure that the required conditions are met and understood before using the product.

3   Introducing the VOA – Variable optical attenuator

The VOA is a reliable, fast, and high-density optical attenuation solution for research and production environments with a built-in power meter.

3.1   VOA 1000/1100/1300 PXIe module overview & features

1	Fastening screws
2a	Channel 1 optical input port
2b	Channel 2 optical input port
3a	Channel 1 optical output port
3b	Channel 2 optical output port
4	Module identifier information
5	Fastening clip
6	Status LEDs
7	VOA PXIe module information
8	PXIe headers
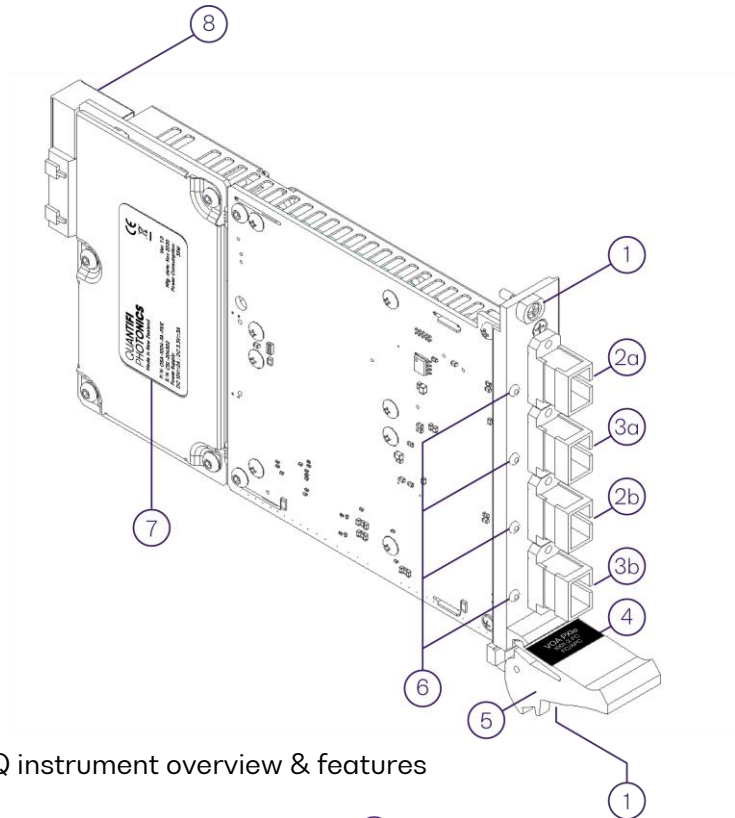
3.2   VOA 1000/1100/1300 MATRIQ instrument overview & features

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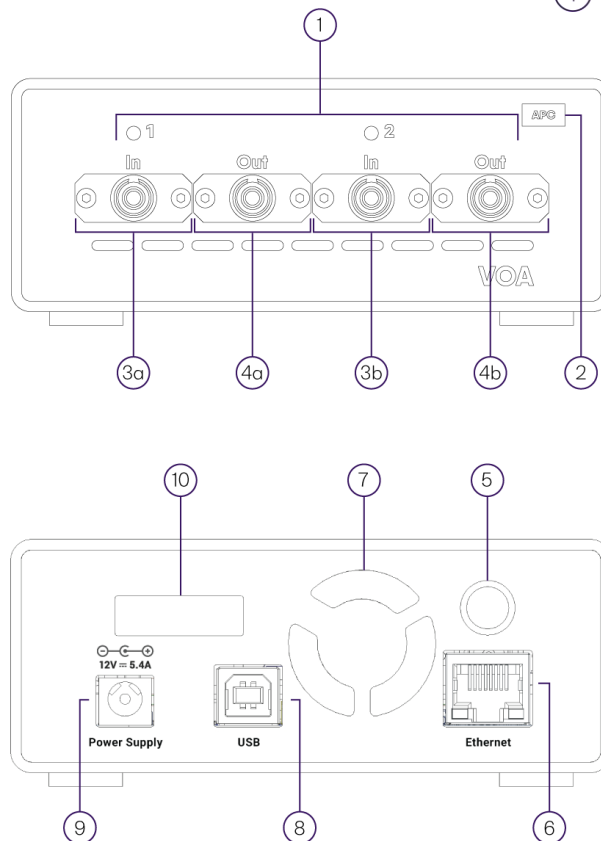
3.3 Status LEDs

The status LEDs are used to denote the operation state of the VOA products:

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

4   Connecting optical fibers

❊ CAUTION

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

⚠ IMPORTANT

The type of optical connectors on the VOA product can be found printed on the front plate of the product. **Joining mismatched connectors will damage the ferrules and fibre faces**.

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

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

4.1   Cleaning and connecting optical fibers

To connect the fiber-optic cable to the port:

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

▤ NOTE

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

5 Multimode models – VOA 1100 Series

The VOA 1100 Series represents the multimode variant of the VOA product line, using MEMS based attenuators.

When using the VOA 1100 Series products, it is necessary to consider the following information for optimal performance of the product.

5.1 Encircled flux compliance

When using multimode fiber in testing and instrumentation, it is important to consider the cross-sectional fill of the optical fiber. An overfilled fiber could result in overestimated signal power loss, while an underfilled fiber could result in underestimated signal loss.

To mitigate against these issues with multimode fiber link-loss measurements, the TIA-526-14-B (formerly IEC 61280-4-1) standard defines a certain input fill radius to ensure that fiber of a given diameter will produce repeatable loss values.

This is particularly important when launching light into the VOA 1100 Series product, since any extra or less loss in the optical path may incorrectly manifest itself as the product attenuating incorrectly. It is recommended that a Mode Conditioner is used on the optical input to the VOA, to ensure EF compliance, and hence dependable results.

The use of a Mode Conditioner would also ensure repeatable launch conditions of the input signal into the product and help to mitigate the modal dependency that is seen with all multimode fiber-based components.

5.2 Optical fiber mismatch

To ensure repeatable performance using the VOA 1100 Series product, it is recommended that the input and output cables be of the same fiber type as the VOA product to avoid optical fiber mismatch, which could induce extra loss into the optical path.

The fiber type of a given model can be found in the VOA spec sheet on the Quantifi Photonics website.

> ⚠ **IMPORTANT**
> Ensure EF compliance is satisfied with an appropriate Mode Conditioner used on the input of the VOA 1100 Series product.
> Correct optical fibres should be used to mitigate against optical fibre mismatch induced loss.

6 Handling the VOA products

☼ CAUTION

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

6.1 VOA 1000/1100/1300 PXIe module installation

� WARNING

DO NOT attempt to remove or adjust any component of the PXIe chassis while the power is on. **Ensure the chassis is powered OFF, and that the correct handling procedure detailed herein is followed when removing or installing any modules**.

STEP 1: Power OFF the Chassis

STEP 2: Remove the module from the antistatic bag. Retain bag

STEP 3: Align module with slot guide rails

STEP 4: Push module into slot until resistance is felt from the backplane connection

STEP 5: Engage the fastening clip. Secure all fastening screws
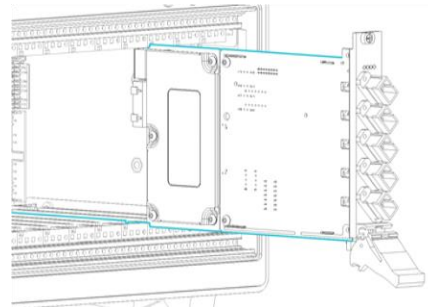
STEP 6: Power ON the chassis
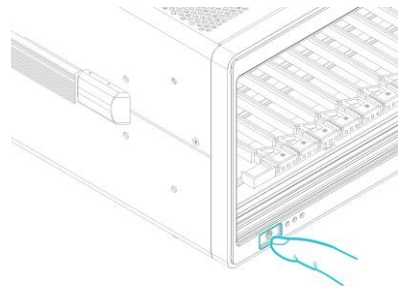
⚠ IMPORTANT

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

6.2 VOA 1000/1100/1300 PXIe module uninstallation

STEP 1: Power OFF the chassis
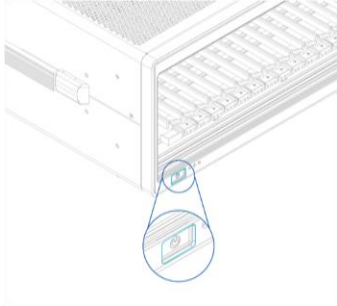
STEP 2: Unsecure the fastening screws and fastening clip
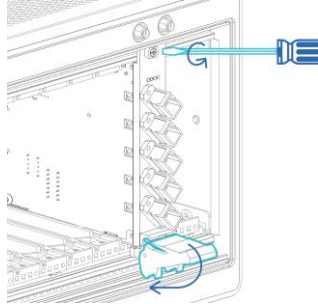
STEP 3: Pull out the module. USE THE FASTENING CLIP TO PULL. DO NOT PULL ON THE CONNECTORS
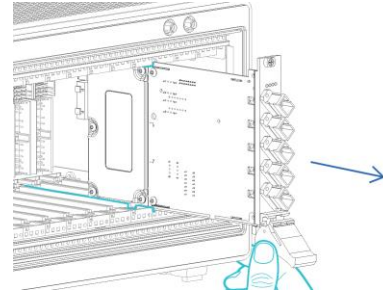
STEP 4: Store module in antistatic bag
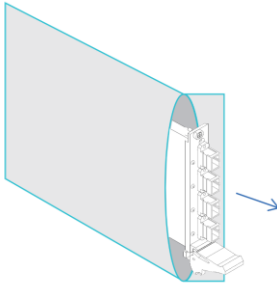
STEP 5: Power ON the chassis
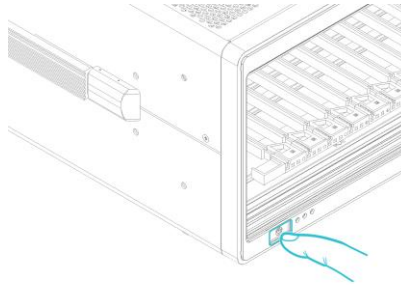
6.3 VOA 1000/1100/1300 MATRIQ instrument installation

STEP 1:
Insert power cord
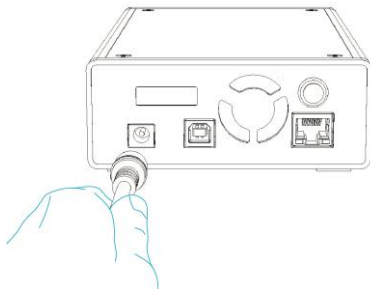
STEP 2:
Power ON the instrument
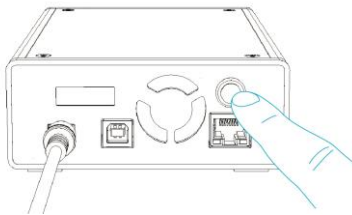
STEP 3:
via USB – Connect USB cable
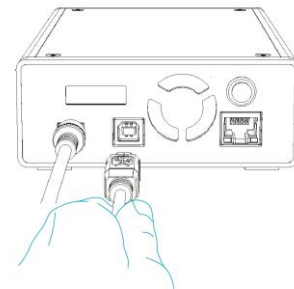
STEP 3:
via Ethernet – Connect Ethernet cable
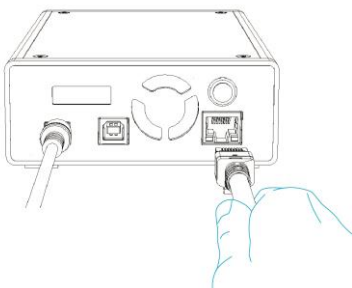
STEP 4:
IP address will appear on the LCD screen
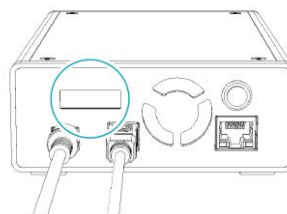
via USB

via Ethernet

7 Software installation information for VOA 1000/1100/1300 Series

⚠ **IMPORTANT**

The software installation process varies between the PXIe Modules (7.1) and the MATRIQ Instrument (7.3). Refer to the relevant section according to the product type.

7.1 Cohesion Installer information for PXIe modules

⚠ **IMPORTANT**

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

Minimum System Requirements: 64bit OS, Windows 7 or above.
Recommended System Requirements: 64bit Windows 10.

The Cohesion Installer is a **single installation package** that contains all the required drivers and software, to support and control Quantifi Photonics modules on the PXIe Platform.

7.1.1 Installation overview

For the PXIe Controller to communicate with the VOA module installed in the chassis, software and driver installations are necessary. This software is contained in the **Cohesion Installer** single installer package.

- CohesionDriver: Drivers for Quantifi Photonics PXIe Modules
- CohesionSCPI: VXI11 compliant server for remote SCPI communication
- CohesionUI: Web-based Graphical User Interface

⚠ **IMPORTANT**

It recommended that you **save all work and close any open programs** before attempting to install the required software packages above.

7.1.2 Installation process

Windows 10 64bit:

1. Locate and run the installer **CohesionInstaller-3.XX.XX.exe** from the provided USB media device (or download from the Quantifi Photonics [website)](#).
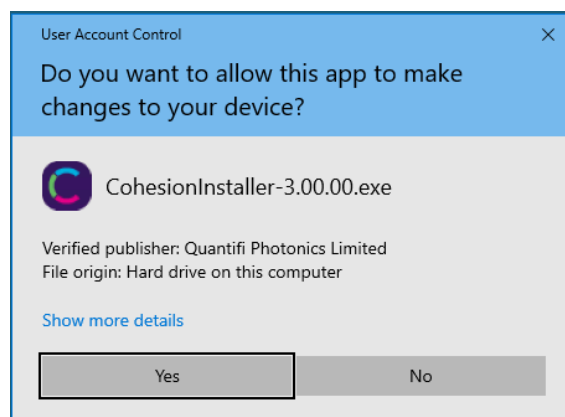
2. Follow the on-screen installation prompts.
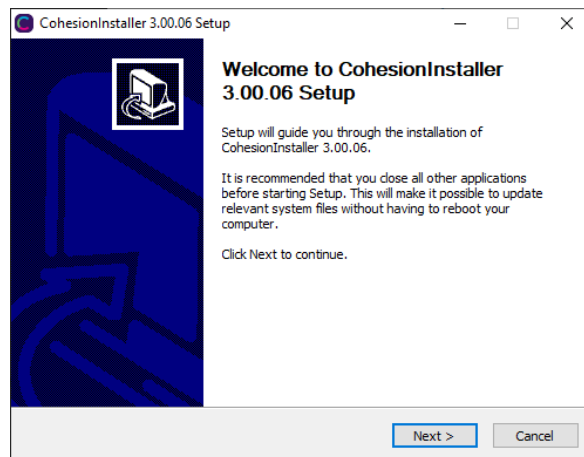
3. Continue with the installation by following the on-screen installation prompts. Choose the default installation type – CohesionUI with Apache.
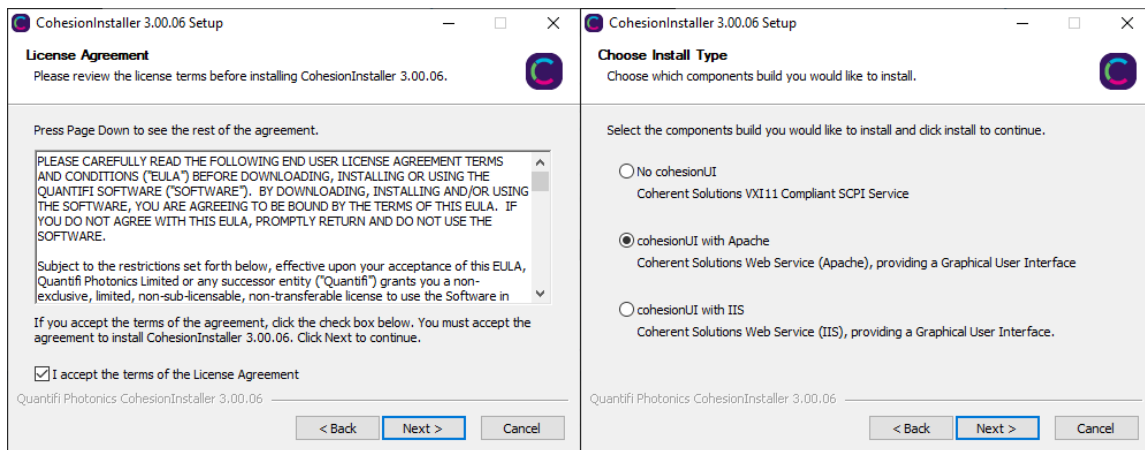
4. Installation will continue with the **Chassis Mode** selection. The default setting is **Single Chassis Mode**. If unsure, proceed with the default mode setting.
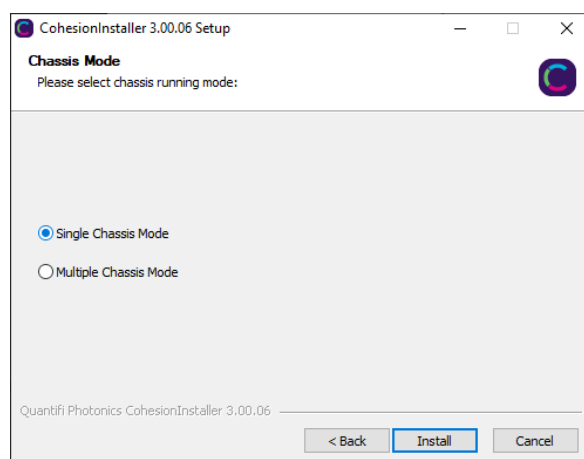
⚠ **IMPORTANT**

To operate in Multiple Chassis Mode, additional hardware modules are required. The Chassis Mode can be changed at any time, so it is recommended to select **Single Mode** until all other configuration requirements have been met.

5. At the end of the installation, **it is recommended to select the Reboot now** option, and click **Finish** to complete the installation process.
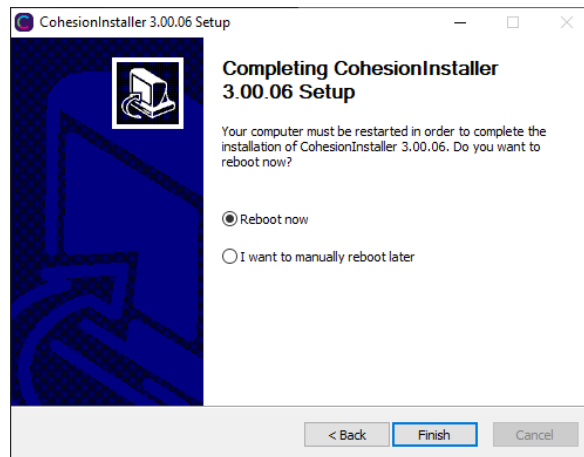
6. Windows Security Alert may prompt the user for network access. It is **recommended that both options be ticked**, to allow any network configuration.
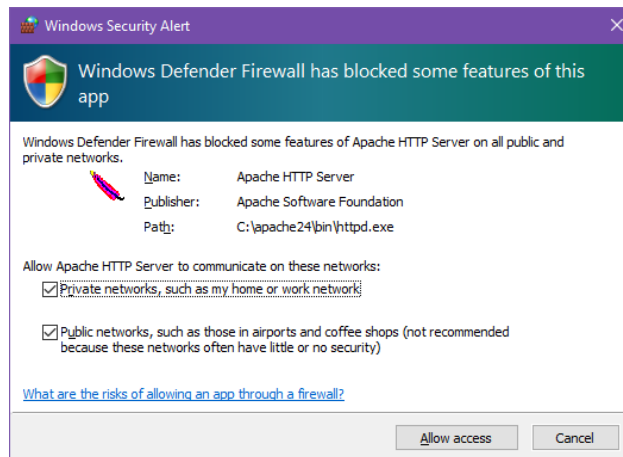
7. After rebooting the system, on startup a User Account Control prompt will be displayed to run the Cohesion Firmware Updater Utility. Click **Yes** and proceed with the application.
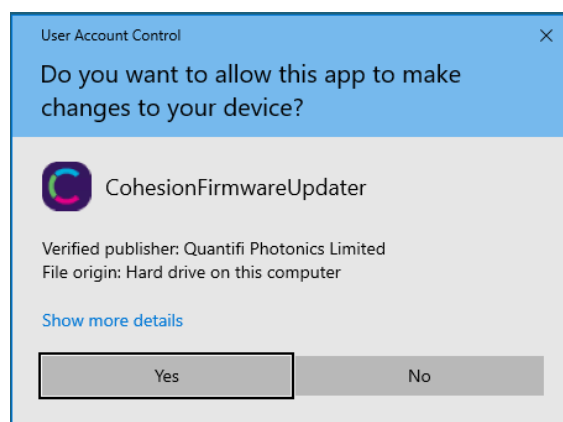
7.2 Quantifi Photonics PXIe system utility applications

Contained within the CohesionInstaller 3.XX.XX are two utility applications:

- Cohesion Manager
- Cohesion Firmware Updater

7.2.1 Cohesion Manager utility

The Cohesion Manager utility serves as a single window application to give the user an overview of the status of all the Cohesion Software Services running on the system. The Cohesion Manager can be accessed via the Windows Start Menu.

Cohesion Manager is designed as a single reference source to check the status of all the running services in one contained window. The utility also allows the user to start or stop the **CohesionDriver service, CohesionSCPI service**, or **CohesionUI service** independently.

By default, all these Cohesion Software Services will start automatically on startup of the Windows OS and need to be running to facilitate proper communication with the Quantifi Photonics PXIe modules. If there is an issue in detecting or communicating with the modules, run the Cohesion Manager to check the status of the software services.
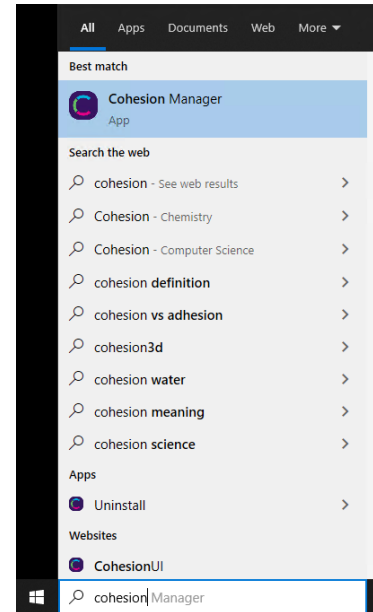
- **(Required) CohesionDriver** – The CohesionDriver service which directly manages the installed Quantifi Photonics modules.
- **(Required) CohesionSCPI** – The CohesionSCPI service which is the VXI11 compliant SCPI interface for TCP communication with the installed Quantifi Photonics modules.
- **(Optional) CohesionUI** – An optional web service providing a graphical interface for simplified operation of the installed Quantifi Photonics modules.
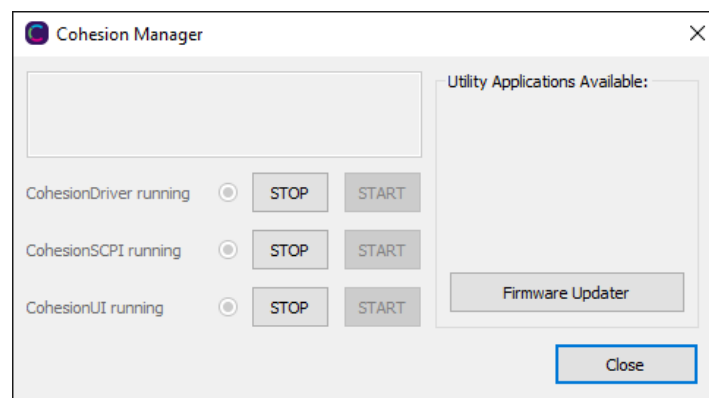
⚠ **IMPORTANT**

The **Driver and SCPI services** need to be running to facilitate communication with any installed Quantifi Photonics module, **therefore they are listed as REQUIRED**.

On the right-hand side of the Cohesion Manager window a list of all the installed Quantifi Photonics system utilities is displayed.

7.2.2   Cohesion Firmware Updater utility

The Cohesion Firmware Updater utility serves as a single window summary application to display the current firmware status of all the Quantifi Photonics PXIe modules installed in the chassis.

The Cohesion Firmware Updater utility can be accessed via the Cohesion Manager application (see Section for more 7.2.1 information).
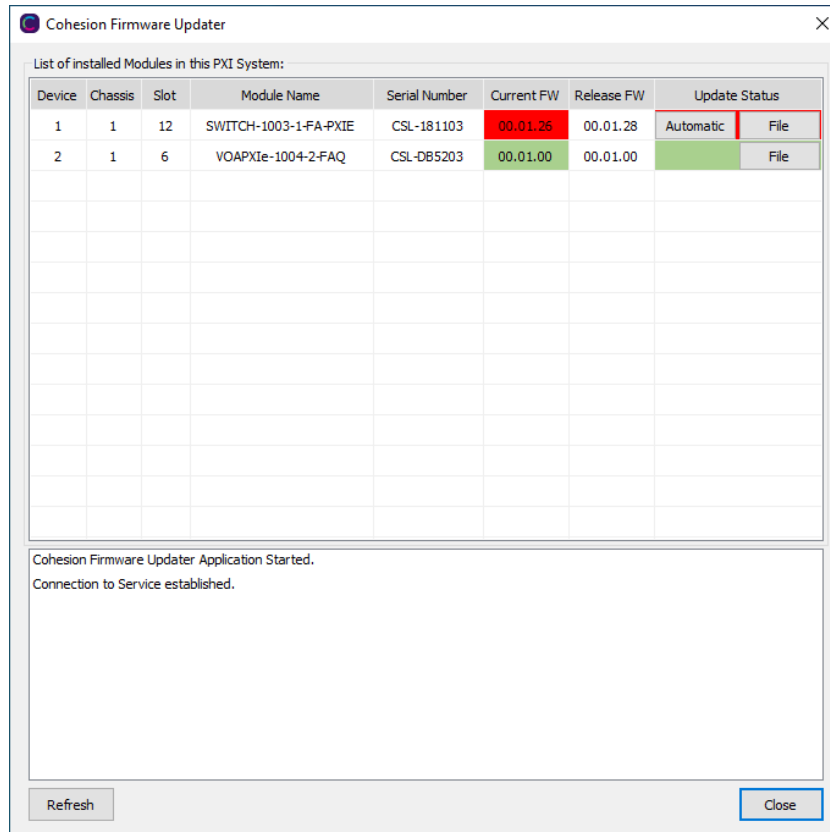
Whenever a new version of the CohesionInstaller is installed on the system, the Cohesion Firmware Updater utility will automatically launch after the system is rebooted. It will show the user the firmware status of all installed Quantifi Photonics modules and allow the user to update the firmware to a new version if applicable.

If a module's firmware is out of date, it is highly recommended to update the firmware to the new available version. Clicking the **Automatic** button will update the module(s) to the latest supported firmware for the installed packages on the system.
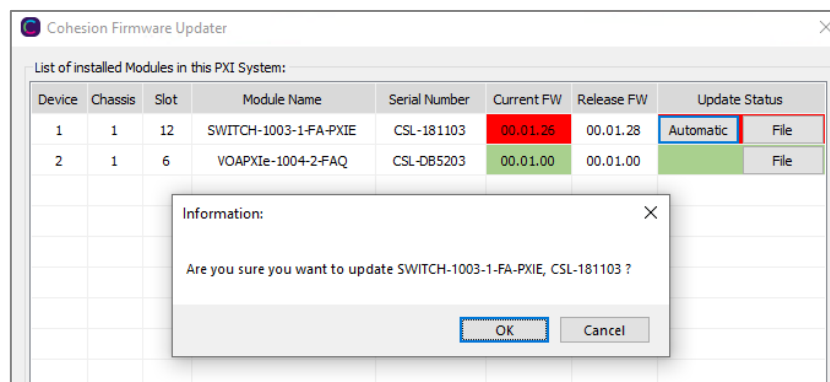
After clicking **OK**, the firmware update progress will be shown in the **Update Status** column.

The **File** button is reserved for updating a module to a specific firmware version if required.
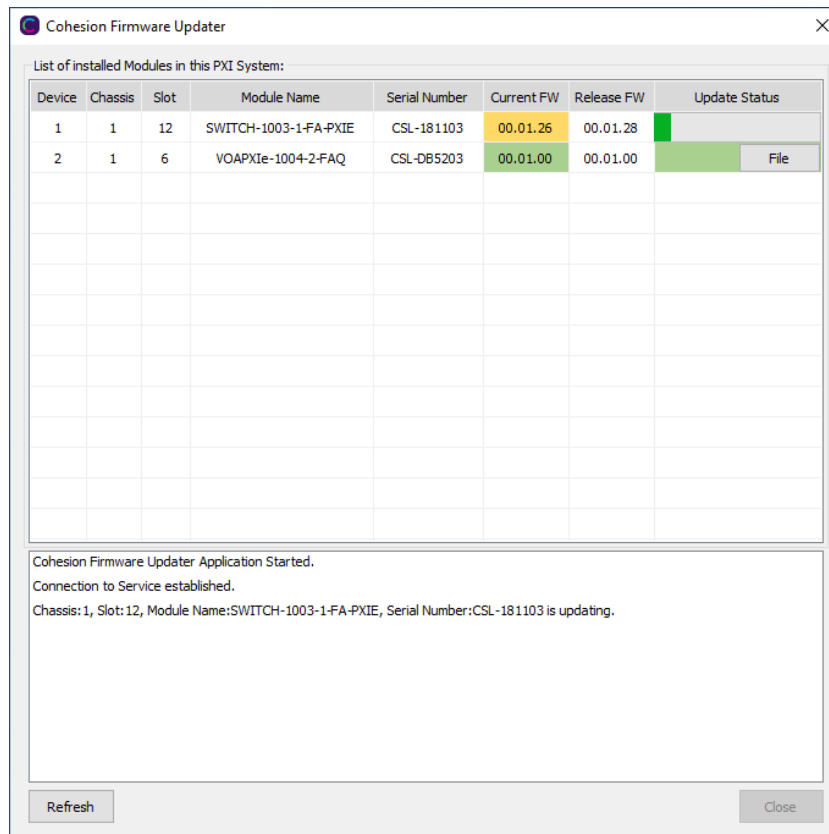
7.3   MATRIQ Installer information for MATRIQ instruments

> ⚠ **IMPORTANT**
>
> If **another MATRIQ instrument is already connected** to the client computer **over USB**, consult the **Network and Update settings** (8.5.6) section below on configuring the Ethernet / USB IP address for multi-instrument control.

Communication with the VOA instrument can be realised over an **Ethernet** or **USB** connection. Both connection methods will allow control of the instrument through the CohesionUI graphical user interface and with SCPI commands. To control or communicate with the MATRIQ instrument, a USB driver needs to be installed onto the client computer.

The **MATRIQ Installer** (included on the provided USB drive as **MATRIQ-1.X.X.exe**) will install the driver and create a Desktop icon to help connect to the CohesionUI running on your MATRIQ instrument.

The MATRIQ Installer is also available for download from Quantifi Photonics [website](#).

1. Run the MATRIQ Installer: Double click and run the **MATRIQ-1.X.X.exe** MATRIQ Installer from the provided USB drive.
2. Run the MATRIQ application: Double click and run the **MATRIQ** desktop application.
3. Follow the on-screen prompts from the MATRIQ application landing page to use CohesionUI to control the MATRIQ instrument.

8   CohesionUI application

CohesionUI is a web-based application that you can use to control any VOA product from Quantifi Photonics. Its cutting-edge design offers a sleek modern interface, cross-device compatibility, multi-instrument control, customizable views, and remote access.

8.1   Accessing CohesionUI for PXIe modules

To use CohesionUI, you need the IP address of the host chassis, with which you can access the chassis either locally or remotely. For local access, use the embedded PXIe controller operating system, and for remote access, use any compatible device that is connected to the PXIe chassis via an ethernet connection.

To obtain the IP address, open the **Command Prompt** window on the chassis controller and then run the `ipconfig` command. Note down the IPv4 address that is displayed. For the local IP address, you can use `127.0.0.1` instead.

To access CohesionUI locally or remotely, open a compatible browser (Google Chrome or Microsoft Edge) and use the IP address `127.0.0.1` as the URL. Alternatively, you can double-click the desktop icon for CohesionUI or select it from the **Start** menu.

8.2   Accessing CohesionUI for MATRIQ instruments

The IP address of the MATRIQ is displayed on the LCD screen on the back of the instrument. Irrespective of the operation mode of the MATRIQ (access over USB or Ethernet), the appropriate IP address will be displayed on the screen.

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

Launch Google Chrome or Microsoft Edge on a computer, and type in the MATRIQ instrument IP address into the address bar of the browser e.g. **10.10.10.89**.
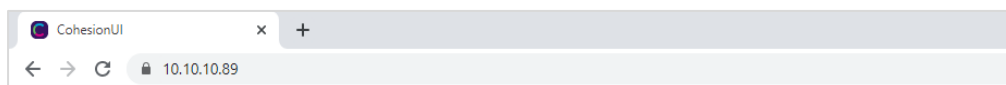
If needed, the IP address can be statically assigned to the Ethernet or USB connection (see 8.5.6).

8.3 Home page

The main landing page in CohesionUI is called the **HOME** page. It displays a graphical representation of the module arrangement in the PXIe chassis or the MATRIQ instrument channels.

For PXIe modules, white numbers are displayed beside each module corresponding the slot in which they are installed. The **EMPTY SLOTS** button will toggle the page view to hide (HIDDEN), or to show (SHOWN) the empty slots in the PXIe chassis. The default setting is HIDDEN.
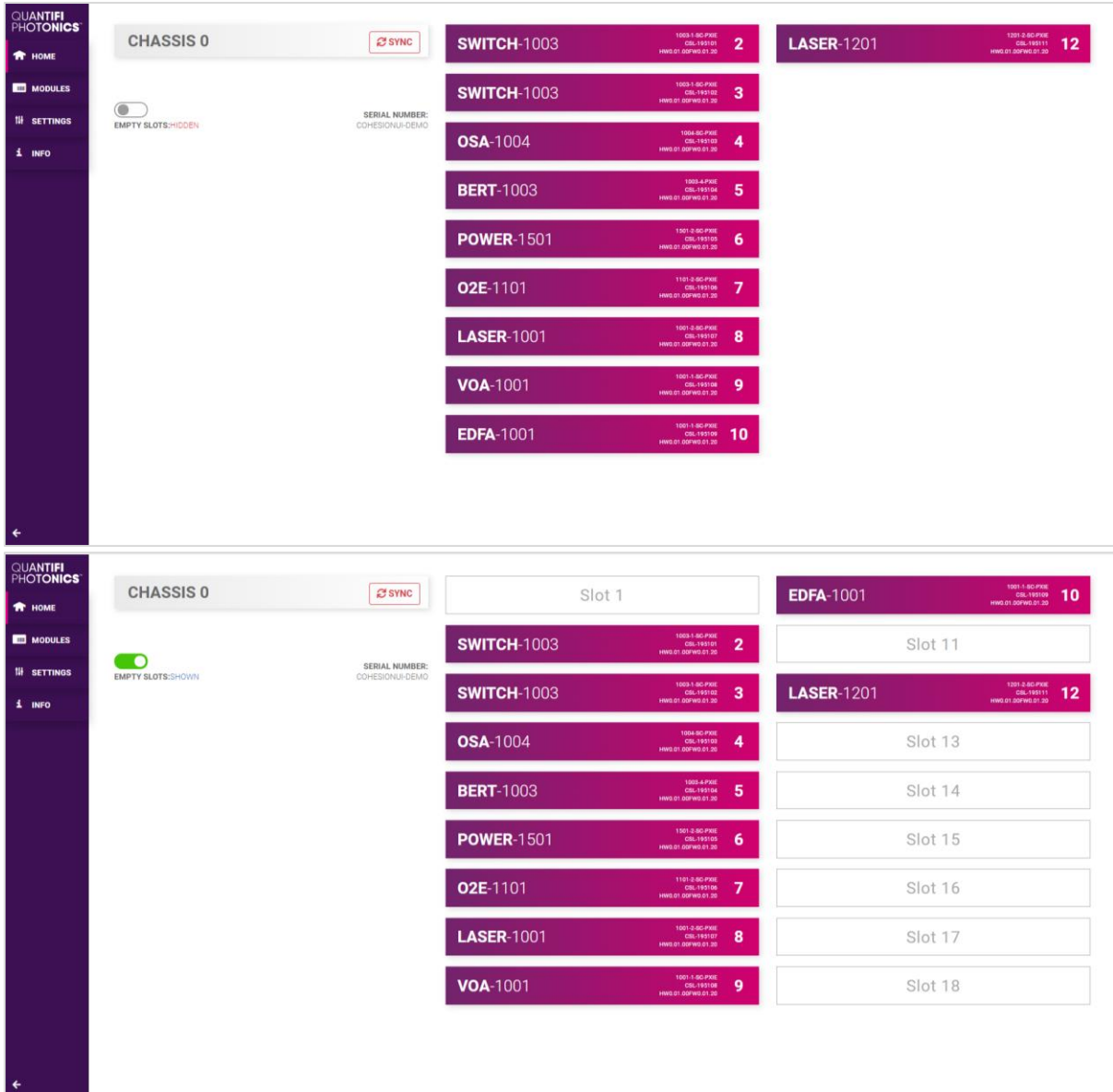
For MATRIQ instruments, all the information relating to the instrument such as the model number, serial number and firmware versions are displayed in the top right corner of the window.
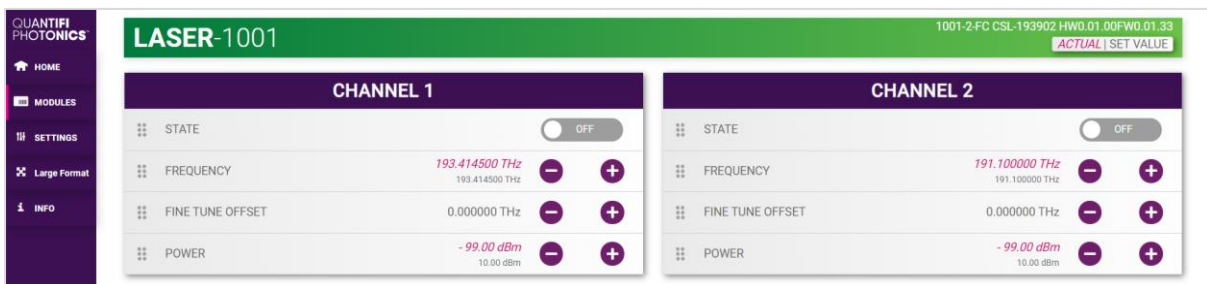
8.4   Modules list

All the installed modules are displayed on the **HOME** page. To access the controls for a module, click the corresponding module name, or hover over the **MODULES** button and select a module from the displayed list. Controls for a specific module, or a channel in a module are then displayed.

8.4.1   Set and Actual values

Some Quantifi Photonics products will allow the user to set a given parameter's value and then read that parameter (eg. Laser, VOA, O2E, etc). In order to help the user to distinguish between a set value and an actual read value, CohesionUI will format these values differently according to the legend in the top right corner of the window.

- *ACTUAL*: the actual value of the parameter, defined by querying the module
- SET: the intended value of a given parameter, defined by user input

In the following example, the POWER is SET to 10.00 dBm, but the *ACTUAL* value is *-16.02 dBm*. Thus, the user can see both the current and user defined value of a given parameter.

The SET and *ACTUAL* values are only displayed for appropriate parameters which require user input. For parameters that report a value and do not depend on user input, only an *ACTUAL* value is displayed.

8.5   Settings page

The **SETTINGS** page is used to configure the CohesionUI settings and unit preferences or to synchronize / reinitialize the system. These controls can be accessed by clicking the **SETTINGS** button.

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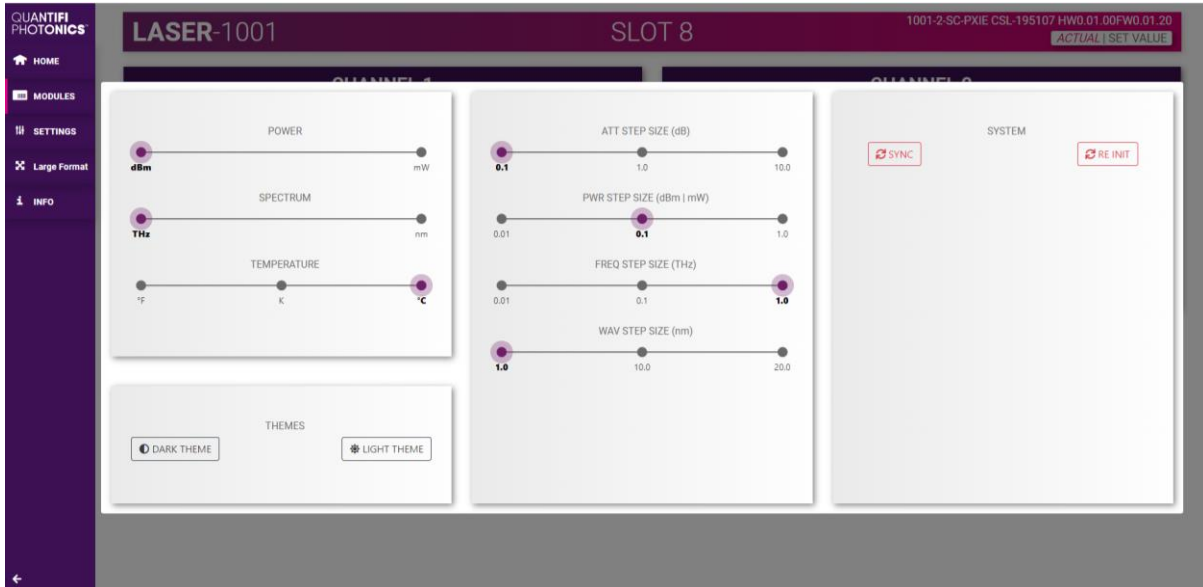
📋 **NOTE**

- The unit preferences and settings can be set by hovering over the **SETTINGS** button in the left-hand side menu. This will bring up a dropdown menu that lists all settings for a quick access.
- Whenever the chassis is power cycled, CohesionUI reverts to default settings.

8.5.1   System controls for PXIe modules

On the SETTINGS window there is a SYSTEM controls section. These controls are to facilitate re-discovery of any Quantifi Photonics PXIe modules there may have been installed after initial startup, or if no modules are displayed in the CohesionUI window. This is useful for users who are operating in a multi-chassis MXI setup, instead of the standard PXIe embedded controller setup.

There are two actions in the SYSTEM controls section:

- **SYNC**: Synchronize CohesionUI with the latest information from the CohesionSCPI service.
- **RE-INIT**: Re-initialize CohesionUI by synchronizing the CohesionSCPI service with the CohesionDriver service.

The **SYNC** button is also displayed on the **HOME** page beside every chassis in the setup. This allows any chassis to be synchronized independently. After clicking the **SYNC** button, CohesionUI will disable the page while it is synchronizing with the CohesionSCPI service. Once it is complete, the page will be functional again.
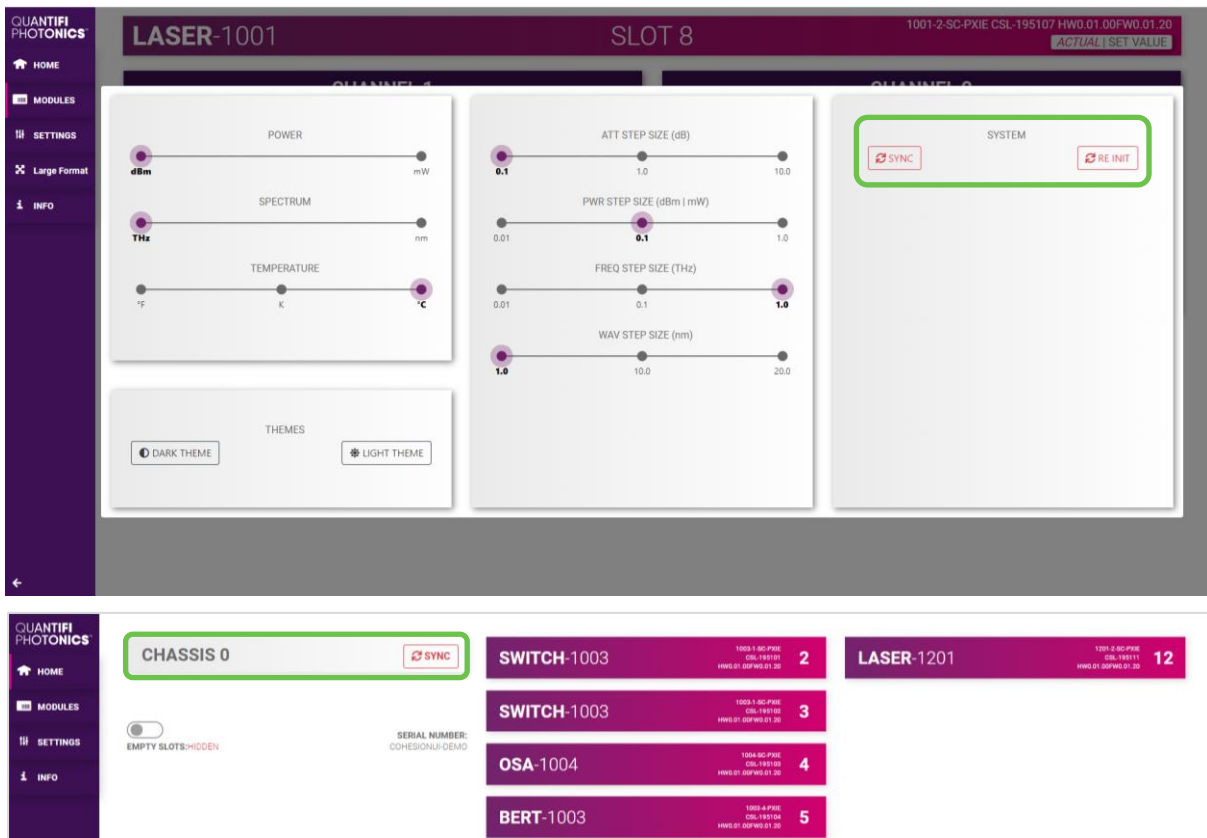
Clicking the **RE-INIT** button will bring up a prompt to continue, since this action will temporarily disconnect all modules while the re-initialization with the CohesionDriver service is in progress. Once it is complete, the page will be functional again.

> 📖 **NOTE**
>
> The **RE-INIT** action will disconnect any connected users to the PXIe system while the action is being completed. All modules will be disabled during this time.
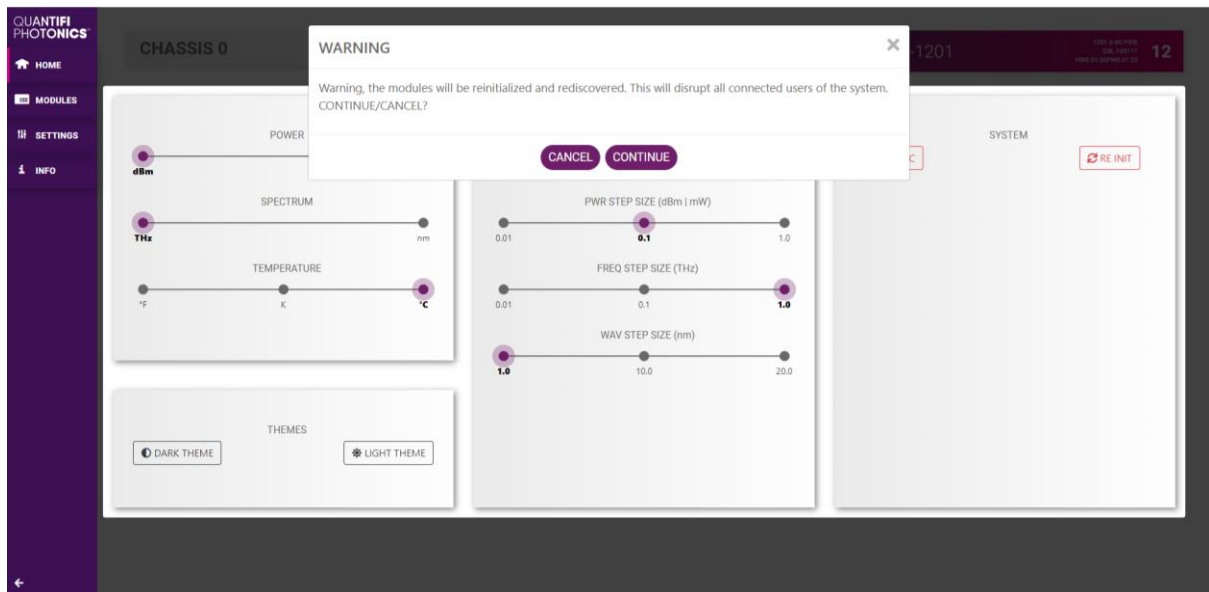
8.5.2   Network and Update settings controls for MATRIQ instruments

The network configuration control panel enables the user to set the preferred communication interface (Ethernet or USB).

> 📑 **NOTE**
>
> The Network interface controls are only available when connected over **USB.**

8.5.3   Updating firmware and CohesionUI for MATRIQ instruments

The Firmware or CohesionUI versions running on the MATRIQ instrument can be updated using the update utility on the **Settings** page.
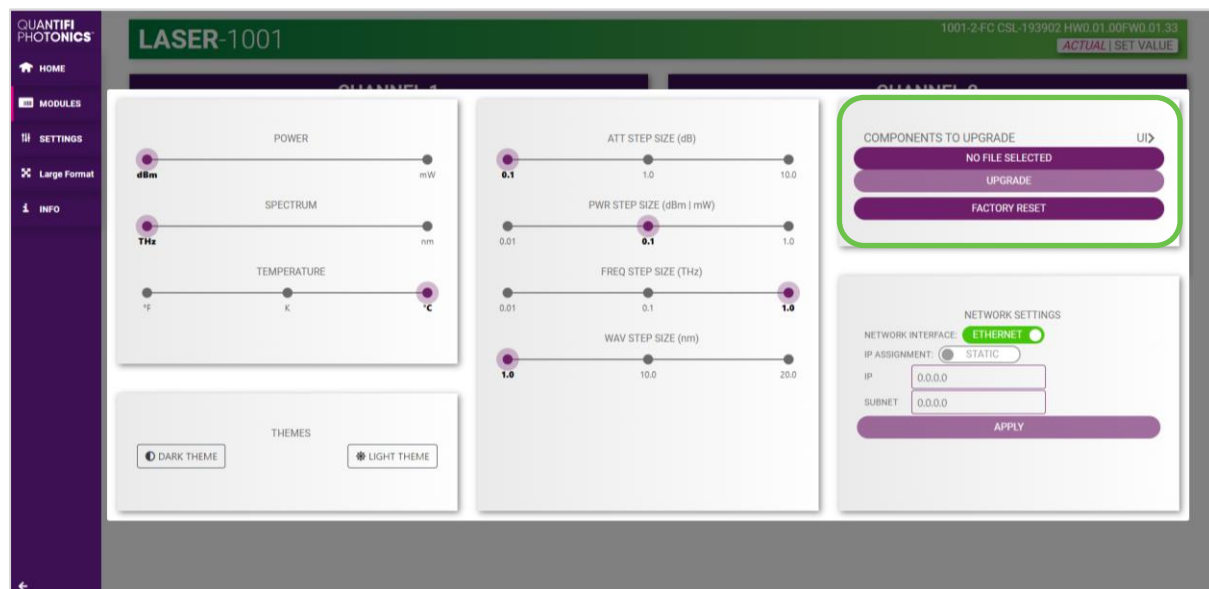
For the latest firmware and CohesionUI version files email support@quantifiphotonics.com, with the product serial and model numbers.

8.5.4   Resetting the MATRIQ instrument

If for any reason there is an issue with the MATRIQ instrument, it can be reverted to factory settings using the **FACTORY RESET** utility.
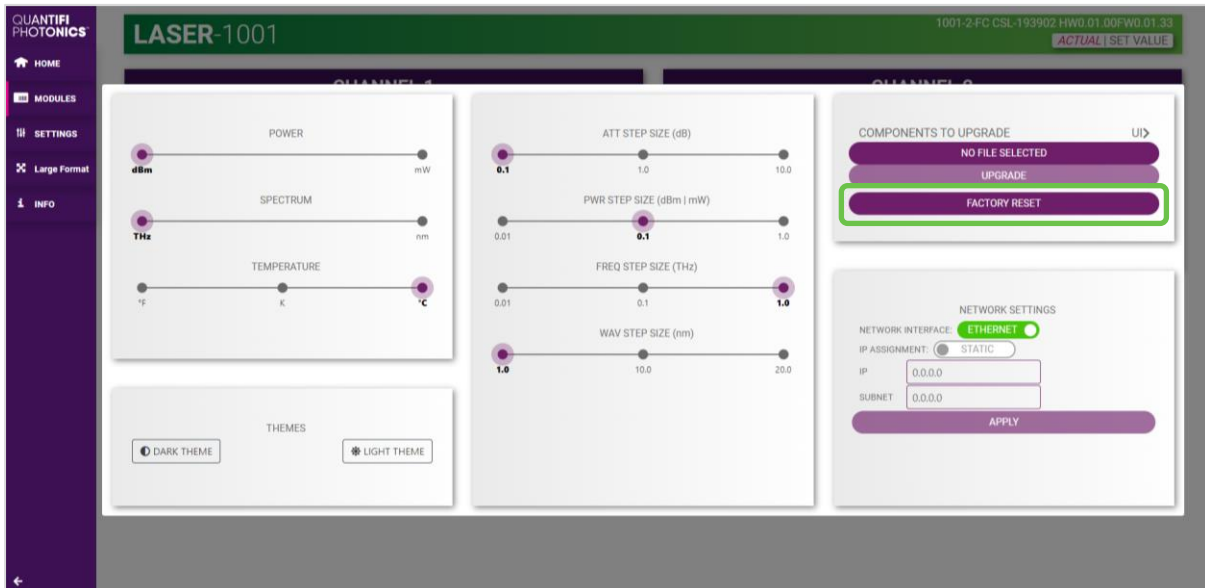
📄 **NOTE**

Any IP address settings will be reverted to factory settings when the MATRIQ instrument is reset.

8.5.5   Configuring the Network Interface settings for MATRIQ instruments

The MATRIQ instruments can operate over either an Ethernet or USB connection. To communicate with the instrument, the IP address is required.

📄 **NOTE**

The Network interface controls are **only available when connected over USB**. When connected over Ethernet the settings will be locked, as highlighted as follows.
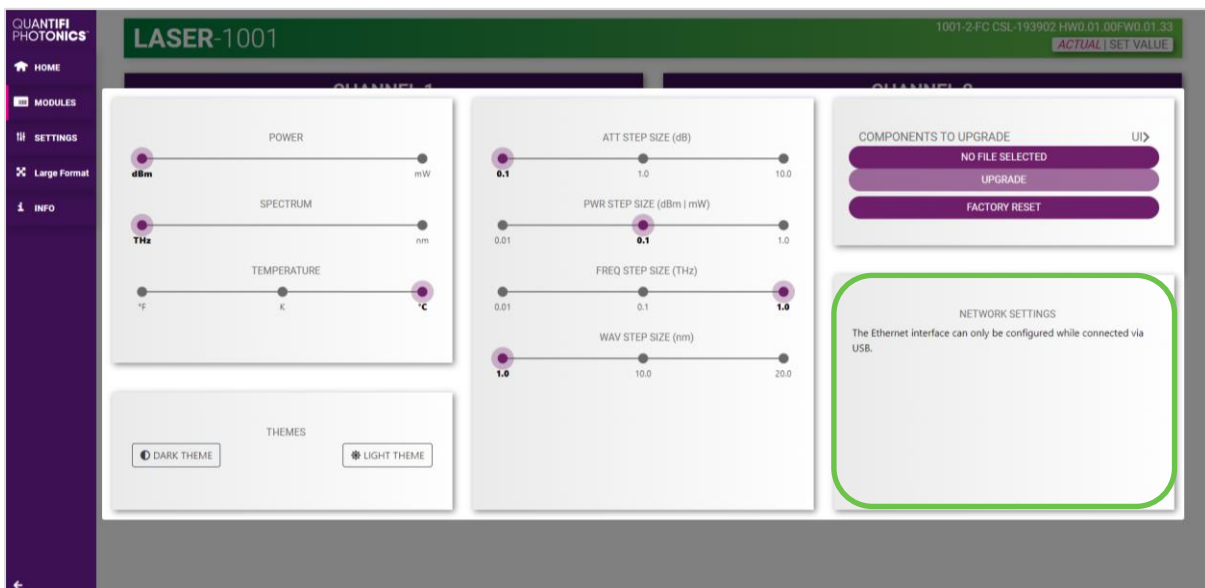
8.5.6   Setting the USB IP address for MATRIQ instruments

When connected via USB, the default IP address is **192.168.101.201**. This is a static address set during instrument calibration. If necessary, this address can be changed. Typing the default IP address in a supported web browser will open the CohesionUI page for the instrument. The Network Interface configuration controls are available in the **SETTINGS** page.
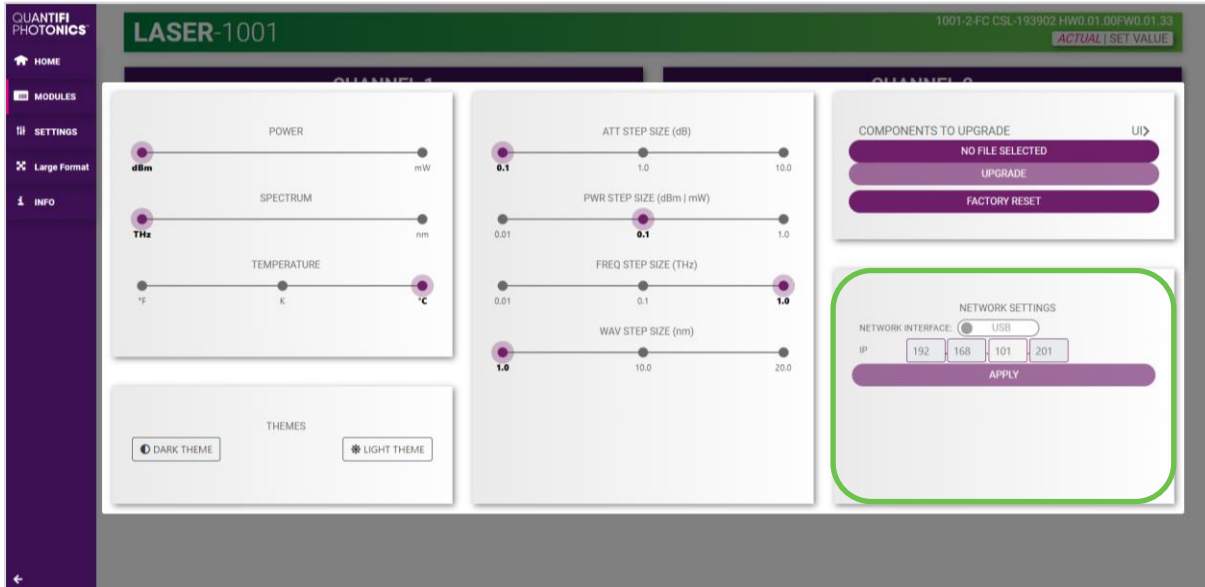
The **value in the 3rd octet of the IP address can be changed** to any available value. It is important to make sure that any other instruments connected to the computer do not share this new IP address, as there will be an addressing conflict.

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

8.5.7   Setting the Ethernet IP address for MATRIQ instruments

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

While connected over USB, typing in the assigned IP address in a supported web browser will open the CohesionUI page for the instrument.
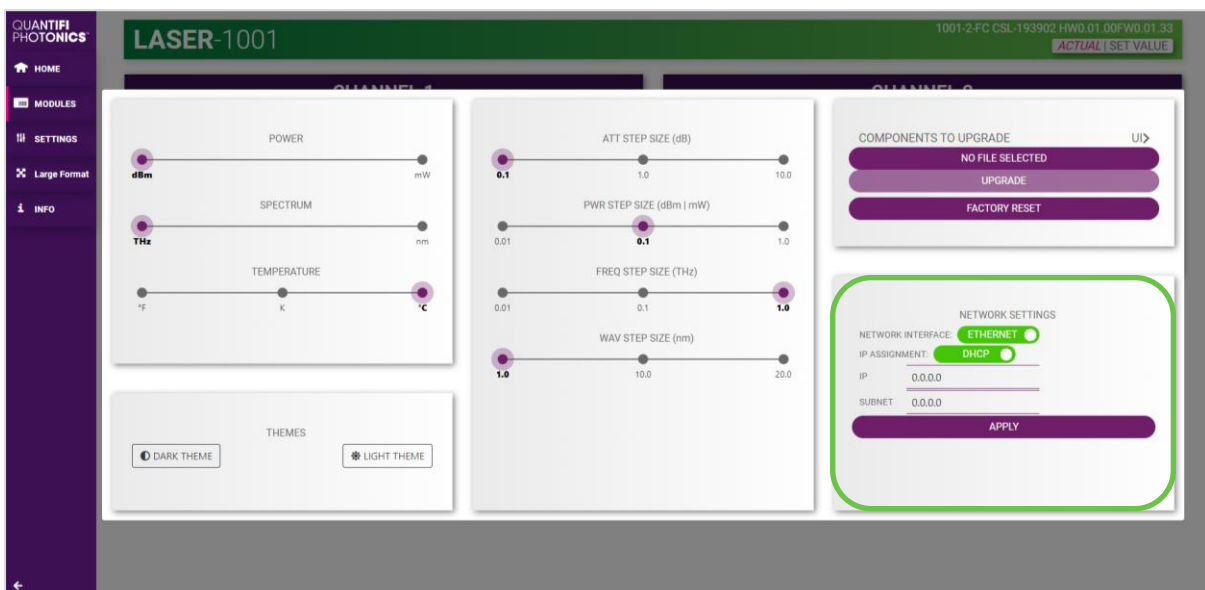
The addressing method can be changed to a static method, where the MATRIQ instrument will always have the same IP address over Ethernet. Typing in a **valid IP address and Subnet mask**, and then clicking **APPLY** will save the IP address into the settings of the instrument.

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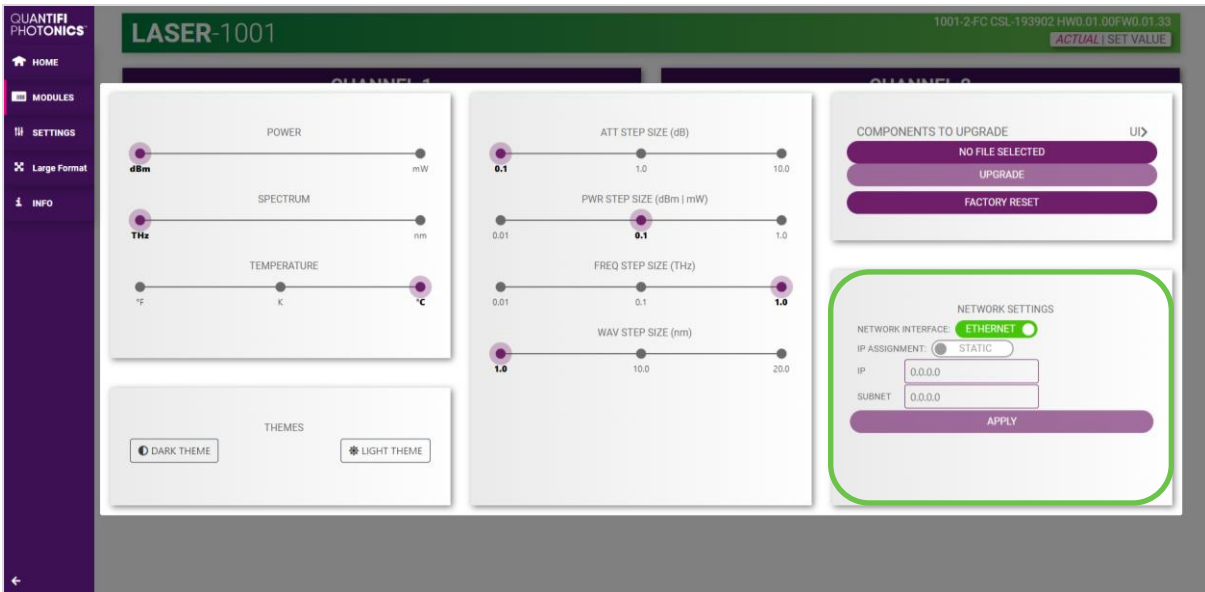
8.6   Info panel

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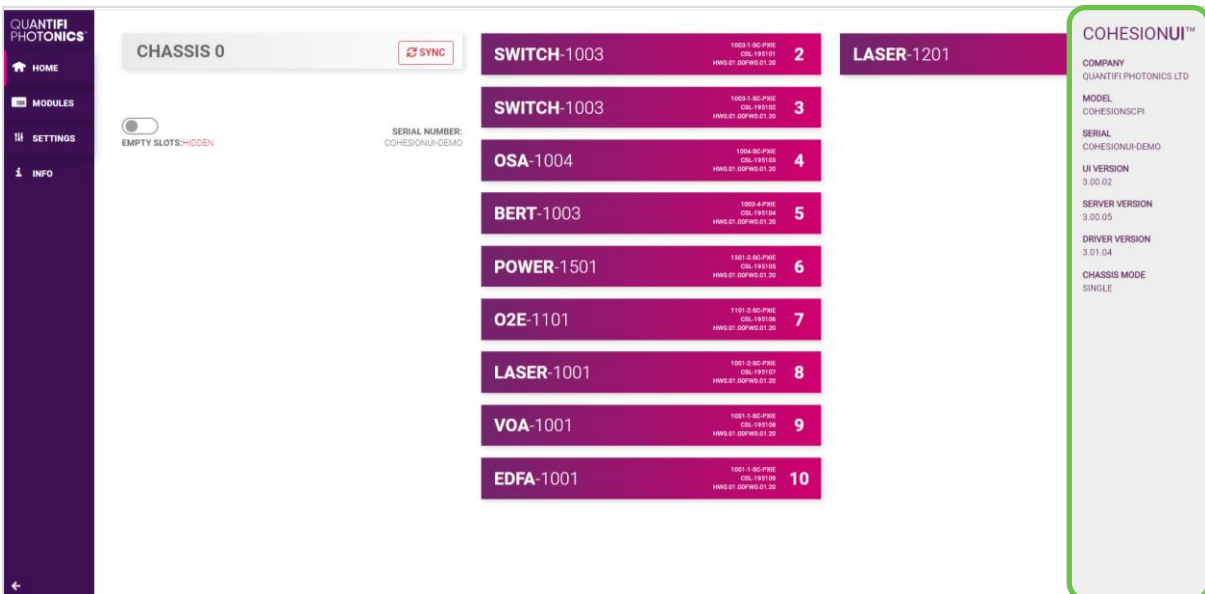
9   VOA control with CohesionUI

To control the VOA PXIe module through CohesionUI, click the desired module installed in the chassis or the desired channel. Alternatively, hovering over the **MODULES** menu button on the left will bring up a dropdown menu that the VOA module can also be selected from.

To control the VOA MATRIQ instrument, click **HOME** to display controls for all channels.
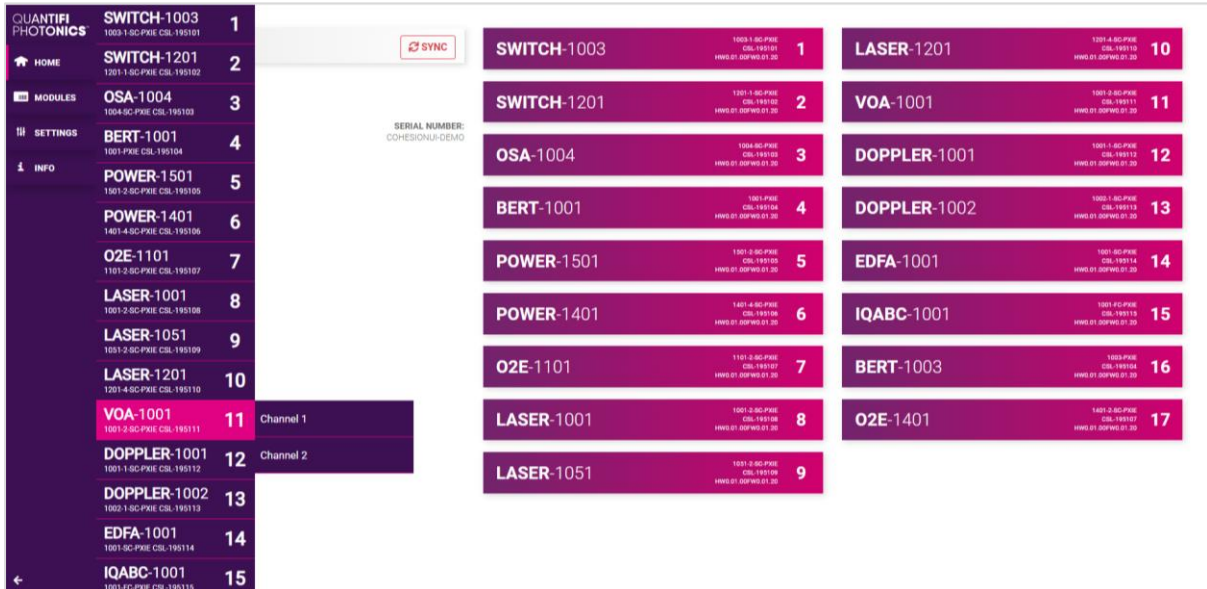
After clicking the desired VOA module, its control page is displayed. All information relating to the module such as model number, serial number and firmware versions are displayed in the top right corner of the window.
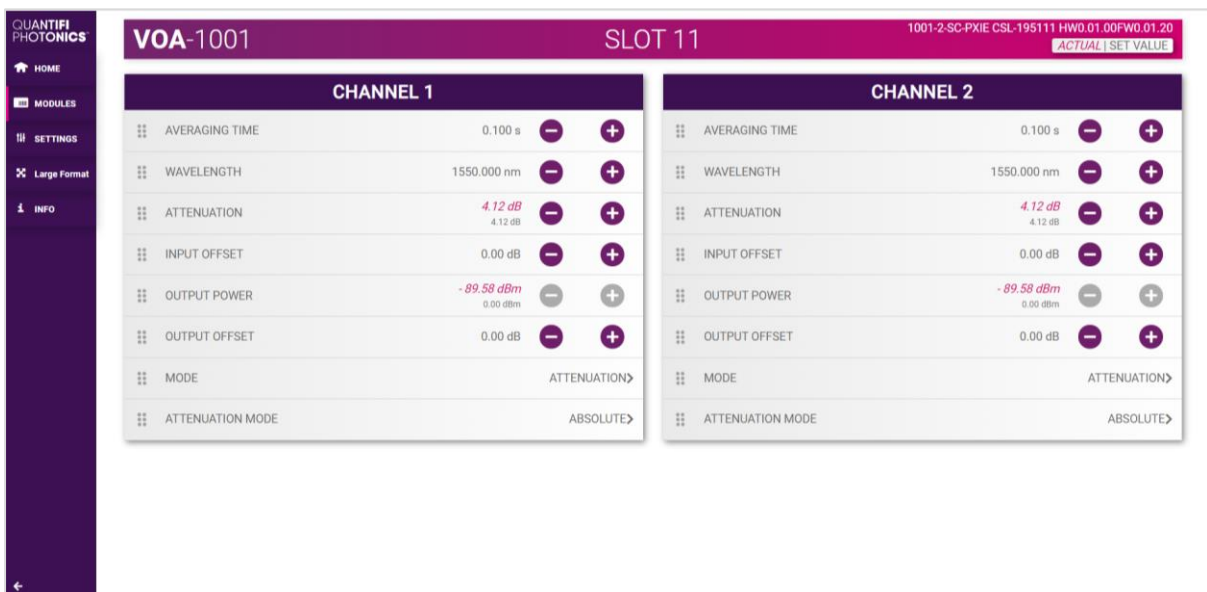
9.1 Setting channel parameter values

Specific control parameters for a given channel in the VOA 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.

This applies to the following parameters:

- **AVERAGING TIME**: The amount of time the optical power is logged for before calculating an average power reading.
- **WAVELENGTH**: The wavelength (frequency) of the input light. This is used to set the correct responsivity for calculating optical input power.
- **ATTENUATION**: Desired attenuation, when in Attenuation control mode. When in Power control mode, the current attenuation is displayed.
- **INPUT OFFSET**: If desired, enter the amount of fixed external attenuation which you wish to include as part of the VOA attenuation. Please refer to chapter 10 for more information.
- **OUTPUT OFFSET**: If desired, enter the amount of fixed external attenuation which you wish to include as part of the VOA attenuation. Please refer to chapter 10 for more information.
- **OUTPUT POWER:** Desired output power, when in Power control mode. When in Attenuation control mode, the measured output power is displayed.

Alternatively, the parameter can also be set to the **MIN** and **MAX** value by clicking the dropdown in the name of the parameter.
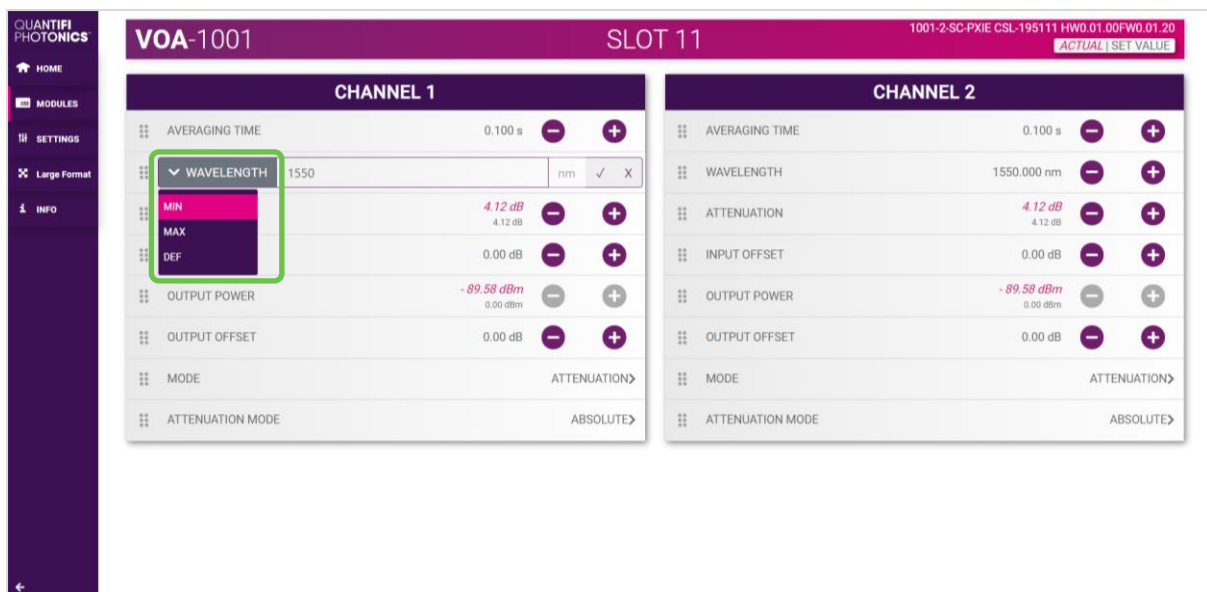
In the above example, the WAVELENGTH for CHANNEL 1 has been set to **1550 nm** by manual input. Alternatively clicking the MIN button in the dropdown menu will set the wavelength to the minimum value. To apply the changes, click the tick mark.

⚠ IMPORTANT

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

9.2   Setting channel control mode

The VOA can operate in **POWER** control mode or **ATTENUATION** control mode (see chapter 10 for more information).

Clicking the current control mode will expand it into the available options (ATTENUATION and POWER), and after clicking on the desired mode it will collapse and display the selected mode. The default control mode is ATTENUATION.

Clicking the current attenuation mode will expand it into the available options (OFFSET, ABSOLUTE and RELATIVE), and after clicking on the desired mode it will collapse and display the selected mode. The default attenuation mode is ABSOLUTE.

10 VOA operation mode overview

The VOA product enables to operate in two control modes: **ATTENUATION** control mode and **POWER** control mode:

- **Attenuation control mode**: The VOA maintains the set attenuation value by applying a constant amount of attenuation to the input optical signal. There are three sub-modes available in ATTENUATION control mode: ABSOLUTE, RELATIVE and OFFSET (see section 10.3).
- **Power control mode**: The VOA maintains the set output power value by applying an automatically calculated amount of attenuation to the input optical signal. POWER control mode can be used with / without specifying OFFSETS (see section 10.4).

10.1 No offset functional diagram

The VOA comprises an Internal Attenuator along with input and output offsets.

The functional diagram below illustrates the operation of the VOA product in the following modes:

- ABSOLUTE ATTENUATION mode
- RELATIVE ATTENUATION mode
- POWER control mode with NO OFFSETS

No offsets specified:
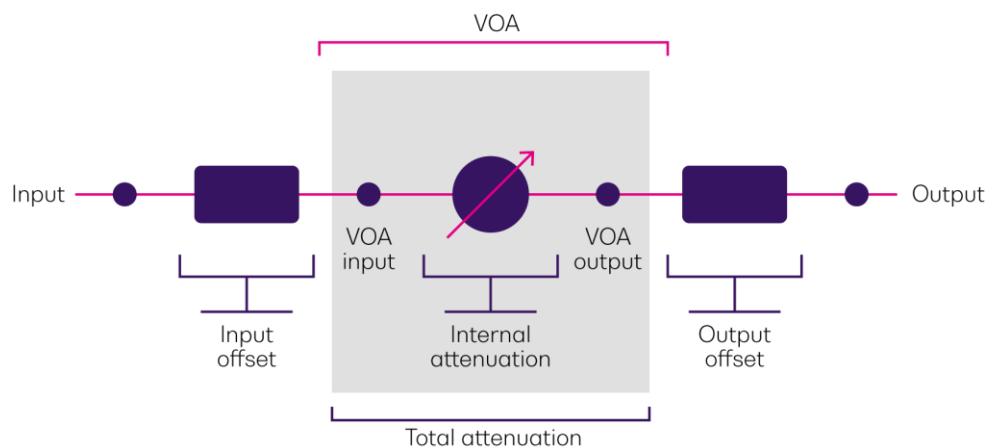
If some input and / or output offsets are specified, The VOA works as described in section 10.2. 10.2

10.2   Offset functional diagrams

The VOA accounts for any given input or output offsets when operating in the following modes:

- OFFSET ATTENUATION mode
- POWER OFFSET mode

In a test setup, this operation mode is useful if there are test components that must be accounted for before or after the VOA product. For example, splitters, amplifiers, optical stub attenuators, or fiber coils. Because of this offset inclusion, the VOA automatically adjusts any set parameters.

The functional diagrams below illustrate how the VOA accounts for input and/or output offsets:

- **Input offset only:**
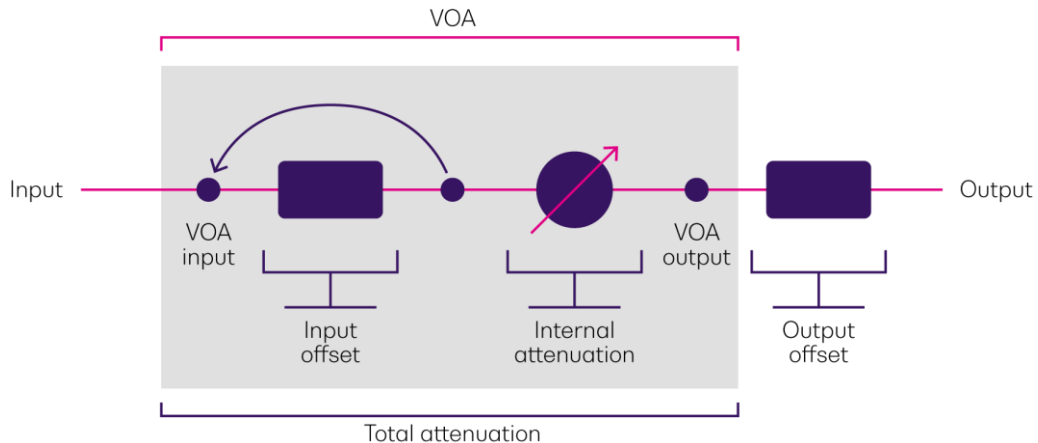
- **Output offset only:**
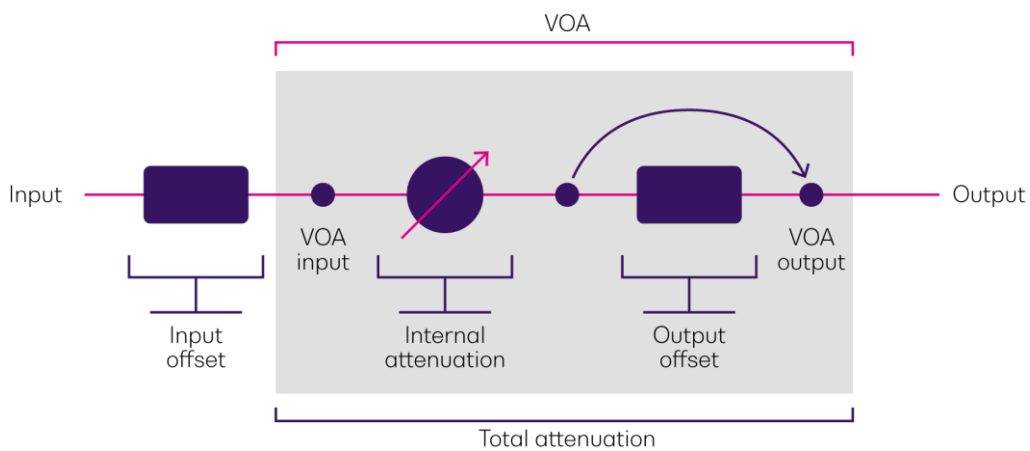
- **Both offsets:**
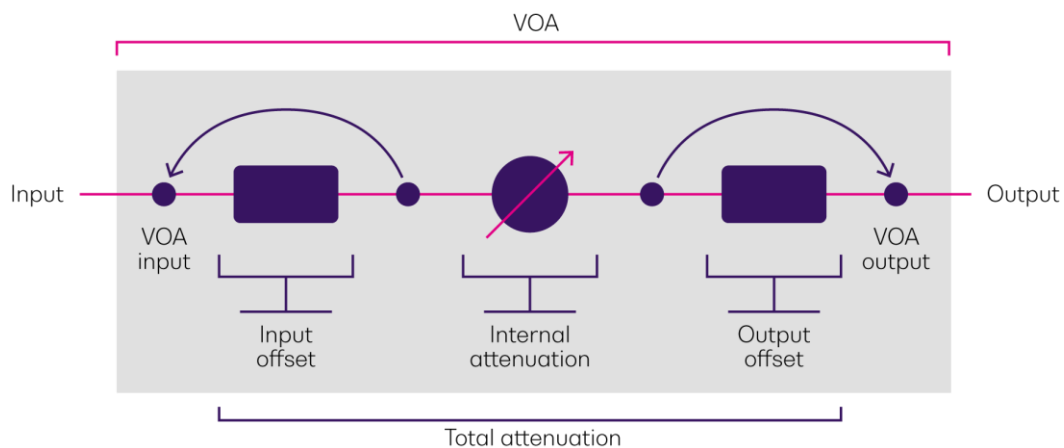
For examples of input and output offset operation with the VOA see sections 10.3 and 10.4.

10.3   Attenuation mode

When the VOA product is in an ATTENUATION control mode, it has three possible attenuation sub-modes: ABSOLUTE, OFFSET or RELATIVE.

When operating in ABSOLUTE or RELATIVE ATTENUATION control modes, the **VOA will ignore all OFFSET values**.

10.3.1   Absolute mode

When ABSOLUTE is selected for the ATTENUATION mode, the VOA evaluates the attenuation using only the internal loss of the VOA. This means that the minimum attenuation that can be applied is equal to the Insertion Loss (IL) of the VOA, as measured at factory calibration; and the maximum attenuation is equal to the Calibrated Maximum Attenuation (CAL MAX), as measured at factory calibration.

MIN Attenuation	IL
MAX Attenuation	CAL MAX

Example:

VOA Input	Set attenuation	Insertion Loss (IL)	Internal attenuation	VOA output
	MIN		0.8 dB	9.2 dBm
10 dBm	5 dB	0.8 dB	5 dB	5 dBm
	MAX		CAL MAX	10 dBm – CAL MAX

10.3.2   Relative mode

When RELATIVE is selected for the attenuation mode, the VOA channel attenuation is calculated with respect to the Insertion Loss (IL) of the VOA. This means that the applied attenuation of the VOA is offset by the Insertion Loss.

As a result, the minimum attenuation is 0 dB, and the maximum attenuation is less than the maximum attenuation as applied in the ABSOLUTE attenuation mode.

MIN Attenuation	0 dB
MAX Attenuation	CAL MAX – IL

Example:

VOA Input	Set Attenuation	Insertion Loss (IL)	Internal Attenuation	VOA Output
	MIN		0 dB	9.2 dBm
10 dBm	3 dB	0.8 dB	3 dB	6.2 dBm
	MAX		CAL MAX – 0.8 dB	10 dBm – CAL MAX – IL

10.3.3   Offset mode

When OFFSET is selected for the attenuation mode, the input and output offset values can be set for a given VOA channel.

The VOA channel attenuation is evaluated as the difference between the Internal Loss (IL) of the VOA (ABSOLUTE) and the sum of all the user specified input and output offset values.

The convention for the offset value is as follows:

- **Positive for loss**, eg. 1x2 50:50 splitter will have an offset of 3 dB
- **Negative for gain**, eg. An EDFA with 23dB of gain will have an offset of -23 dB

MIN Attenuation	IL +(Input Offset + Output Offset)
MAX Attenuation	CAL MAX + (Input Offset + Output Offset)

Example:

Input power	Input offset	Output offset	Set attenuation	Total attenuation	Internal attenuation	VOA output
10 dBm	0 dB	0 dB	15 dB	15 dB	15 dB	-5 dBm
	3 dB	0 dB			12 dB	
	0 dB	2 dB			13 dB	
	3 dB	2 dB			10 dB	

10.4   Power mode

Unlike the ATTENUATION control mode, the POWER control mode has no sub control mode options. **If an OFFSET is specified in the POWER control mode, it is always applied.**

Nominally, in POWER control mode, the VOA always works to ensure that the set output power value is maintained, which means that the VOA automatically adjusts the internal attenuation to satisfy this condition.

The convention for the offset value is as follows:

- **Positive for loss**, eg. 1x2 50:50 splitter will have an offset of 3 dB
- **Negative for gain**, eg. An EDFA with 23dB of gain will have an offset of -23 dB

MIN Output Power	Input Power – (CAL MAX + (Input Offset + Output Offset))
MAX Output Power	Input Power – (IL + (Input Offset + Output Offset))

Example:

Input Power	Input Offset	Output Offset	Set Output Power	Total Attenuation	Internal Attenuation	VOA Output
10 dBm	0 dB	0 dB	-5 dBm	15 dB	15 dB	-5 dBm
	3 dB	0 dB			12 dB	
	0 dB	2 dB			13 dB	
	3 dB	2 dB			10 dB	

11   Programming guide

Introduction

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

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

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

11.1   Programming conventions

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

Parameter	Default Unit	Alternative Units
Power	DBM	DBM
Frequency	HZ	THZ, GHZ, MHZ, KHZ
Frequency Fine	HZ	THZ, GHZ, MHZ, KHZ
Wavelength	M	NM, PM

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

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

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

For the commands that require index values:

- `<c>`: is the chassis index in which the specific blade module is installed; this is an integer, inclusive of 0.
- `<n>`: is the slot (or source) index of the specific blade module, this is an integer, <1 to 18>
- `<m>`: is the channel index of a specific unit in the module, this is an integer, <1 to 4>.

Message queues

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

11.2   Common system command summary

Common Commands	Description

`*CLS`
`*IDN?`
`*OPC?`
`*OPT?`
`*ESR?`
	-Clear Status command
	-Query the chassis identification
	-Query the Operation Complete Status
	-Query the modules managed by the CohesionSCPI service
	-Query the Standard Event Status Register

11.3   Common system command descriptions

Command	`*CLS`
Syntax	`*CLS`
Description	Clear Status command
Parameters	No parameters
Response	No response
Example	`*CLS`

Command	`*ESR?`
Syntax	`*ESR?`
Description	Query the Standard Event Status Register
Parameters	No parameters

Response	Unsigned integer 8 bit value for the register <0 to 255>, as a string.
	
	`Bit           Description                   Decimal Value`
	`7 (MSB)    Not used                       0`
	`6          Not used                       0`
	`5          Command Error                  32`
	`4          Execution Error                16`
	`3          Device dependent Error         8`
	`2          Not used                       0`
	`1          Not used                       0`
	`0 (LSB)    Not used                       0`

Example	`*ESR? -> 8` `*ESR? -> 32`

⚠ **IMPORTANT**

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

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

Command	`*IDN?`
Syntax	`*IDN?`
Description	Query the chassis identification
Parameters	No parameters
Response	Comma separated string with the `<manufacturer>,<server name>,<chassis controller name>,<server version>`
Example	`*IDN? -> Quantifi Photonics,CohesionSCPI,PXIE-8133,SW3.00.08`

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

Command	`*OPT?`
Syntax	`*OPT?`
Description	Query the modules managed by the CohesionSCPI service
Parameters	No parameters
Response	Response will be a comma separated string of the installed modules in the chassis
Example	`*OPT? -> ,Switch-1002-2-FA-PXIe,Switch-1003-1-FC-PXIe,,VOA-1001-2-FA-PXIe,,,,O2E-1001-1-FC-PXIe,,,,,,,,,`

11.4   Specific command summary

Slot commands	Description
`:SLOT<n>`	
`  :IDN?`	- Query the Identifier for the slot; returns the manufacturer, part number, serial number, hardware and firmware versions
`  :OPC?`	- Query the status of the Operation Complete bit
`  :OPTions?`	- Query the modules installed on the slot
`  :ReSeT`	- Perform a reset on the device, restoring the module to default values
`  :TeST?`	- Query the self-test status of the product
`:TRIGger<n>`	
`  :ARM/?`	- Set or query the Trigger ARMed state ready for an event
`  :DELay/?`	- Set or query the Trigger Delay
`  :MODE/?`	- Set or query the Trigger Line event mode
`  :SOURce/?`	- Set or query the Trigger Line(s) used for events

Configuration commands	Description
`:CONTrol<n>`	
`  :CHANnel<m>`	
`    :MODE/?`	-Set or query the control mode
`:INPut<n>`	
`  :CHANnel<m>`	
`    :AMODE/?`	-Set or query the attenuation mode
`    :ATTenuation/?`	-Set or query the attenuation
`    :OFFSet/?`	-Set or query the attenuation mode offset
`    :POWer?`	-Query the input optical power
`    :WAVelength/?`	-Set or query the optical wavelength configuration
`:OUTPut<n>`	
`  :CHANnel<m>`	
`    :OFFSet/?`	-Set or query the output power offset
`    :POWer/?`	-Query the output optical power
`      :AVERagingtime/?`	-Set or query the output power averaging time
`      :TIMEnulling`	-Query the dark nulling time remained to complete
`      :NULLing`	-Starts dark power nulling
`  :TRACE<n>`	
`    :CoMPlete?`	-Query the status of the Trace Complete bit
`    :PoinTS/?`	-Set or query the number of trace buffer data elements
`    :RATE/?`	-Set or query the trace buffer sampling rate
`    :TRIGger`	-Triggering of the trace sampling
`  :TRACE<m>?`	-Query the Trace buffer

11.5 Specific command descriptions

11.5.1 Slot commands

Command	`:SLOT<n>:IDN?`
Syntax	`:SLOT<n>:IDN?`
Description	Query the Identifier for the slot; returns the manufacturer, part number, serial number, hardware and firmware versions
Parameters	No parameters
Response	Comma separated string containing the `<manufacturer>`, `<part number>`, `<serial number>`,`<hardware version><firmware version>`
Example	`:SLOT1:IDN? -> Quantifi Photonics, VOA-1003-2-FC-PXIE,QP-991100,` `HW0.01.00FW01.00.00` Hardware and firmware versions are not separated by a comma

Command	`:SLOT<n>:OPC?`
Syntax	`:SLOT<n>:OPC?`
Description	Query the status of the Operation Complete bit
Parameters	No parameters
Response	`1` is returned if the module is ready to execute a new operation `0` is returned if the module is busy
Example	`:SLOT1:OPC? -> 1`

Command	`:SLOT<n>:OPTions?`
Syntax	`:SLOT<n>:OPTions?`
Description	Query the modules installed on the slot
Parameters	No parameters
Response	The response will be a comma separated string of detectors installed in the Switch. If a module is not installed in a channel, it will not return any identification string
Example	`:SLOT3:OPT? -> 1,1,,`

Command	`:SLOT<n>:ReSeT`
Syntax	`:SLOT<n>:ReSeT`
Description	Perform a reset on the device, restoring the module to default values
Parameters	No parameters
Response	No response
Example	`:SLOT1:RST`

Command	`:SLOT<n>:TeST?`
Syntax	`:SLOT<n>:TeST?`
Description	Perform a self-test of the module
Parameters	No parameters
Response	1 is returned if self-test reports an error with the module 0 is returned if self-test passed for the module
Example	`:SLOT1:TST? -> 0`

Command	`:TRIGger<n>:ARM`
Syntax	`:TRIGger<n>:ARM<wsp><ENABLE|DISABLE>`
Description	Set the Trigger ARMed state
Parameters	ENABLE: Enable the Trigger ARM, which will trigger on the next event DISABLE: Disable the Trigger ARM
Response	No response
Example	`:TRIG1:ARM ENABLE`

Command	`:TRIGger<n>:ARM?`
Syntax	`:TRIGger<n>:ARM?`
Description	Query the Trigger ARMed state
Parameters	No parameters
Response	The response will be the current state of the Trigger ARM
Example	`:TRIG1:ARM? -> ENABLE`

Command	`:TRIGger<n>:DELay`
Syntax	`:TRIGger<n>:DELay?<wsp><value>`
Description	Set the Trigger Delay of the module (in seconds)
Parameters	<value>: A valid numerical value for the desired delay (default units of seconds)
Response	No response
Example	`:TRIG1:DEL 0.5`

Command	`:TRIGger<n>:DELay?`
Syntax	`:TRIGger<n>:DELay?<wsp>[MIN|MAX|DEF|SET|ALL]`
Description	Query the Trigger Delay of the module (in seconds)
Parameters	MIN: Returns the minimum programmable value MAX: Returns the maximum programmable value DEF: Returns the default programmable value SET: Returns the current set value ALL: Returns all the above values in a comma separated string
Response	Depending on the parameters the response will be a single value or a comma separated string of values.
Example	`:TRIG1:DEL? -> 0.0000,10.0000,0.0000,0.5000`

⚠ **IMPORTANT**

Any changes to the Trigger Mode will automatically disable the current ARM state.

Command	`:TRIGger<n>:MODE`
Syntax	`:TRIGger<n>:MODE<wsp>[OR|AND]`
Description	Set the Trigger Line event mode of the module
Parameters	OR: Any of the configured lines will trigger an event AND: Only upon all configured
Response	No response
Example	`:TRIG1:MODE OR`

Command	`:TRIGger<n>:MODE?`
Syntax	`:TRIGger:MODE?`
Description	Query the Trigger Line event mode of the module
Parameters	No parameters
Response	Response will be the current user set mode
Example	`:TRIG1:MODE? -> OR`

Command	`:TRIGger<n>:SOURce`
Syntax	`:TRIGger<n>:SOURce<wsp><<value1>[,<value2>,..,<value8>]|CLEAR>`
Description	Set the Trigger Line(s) used for events
Parameters	<value1 … 8>: Up to 8 integer values representing valid PXI trigger lines to add to the event source list CLEAR: Will remove all lines from the source list
Response	No response
Example	`:TRIG1:SOUR 0, 6, 7`

Command	`:TRIGger<n>:SOURce?`
Syntax	`:TRIGger<n>:SOURce?`
Description	Query the Trigger Line(s) used for events
Parameters	No parameters
Response	The response will be a comma separated array of the current source list
Example	`:TRIG1:SOUR? -> 0, 6, 7` `:TRIG1:SOUR? -> "NONE"(Return if the source list is cleared)`

11.5.2   Configuration commands

Command	`:CONTrol<n>:CHANnel<m>:MODE`
Syntax	`:CONTrol<n>:CHANnel<m>:MODE<wsp>[ATT|POW]`
Description	Set the control mode
Parameters	ATT: Set to Attenuation mode POW: Set to Power control mode
Response	No response
Example	`:CONT1:CHAN1:MODE ATT`

Command	`:CONTrol<n>:CHANnel<m>:MODE?`
Syntax	`:CONTrol<n>:CHANnel<m>:MODE?`
Description	Query the control mode
Parameters	No parameters
Response	Returns a string (non-abbreviated) of the current control mode for the specified channel
Example	`:CONT1:CHAN1:MODE? -> ATTENUATION`

Command	`:INPut<n>:CHANnel<m>:AMODE`
Syntax	`:INPut<n>:CHANnel<m>:AMODE<wsp>[ABS|REL|OFFSET]`
Description	Set the attenuation mode
Parameters	ABS: Set the attenuation reference to absolute REL: Set the attenuation reference to relative OFFSET: Set the attenuation reference to the user offset
Response	No response
Example	`:INP1:CHAN1:AMODE ATT`

Command	`:INPut<n>:CHANnel<m>:AMODE?`
Syntax	`:INPut<n>:CHANnel<m>:AMODE?`
Description	Query the attenuation mode
Parameters	No parameters
Response	Returns a string (non-abbreviated) of the current attenuation mode for the specified channel
Example	`:INP1:CHAN1:AMODE? -> ABSOLUTE`

Command	`:INPut<n>:CHANnel<m>:ATTenuation`
Syntax	`:INPut<n>:CHANnel<m>:ATTenuation<wsp>[<value>|MIN|MAX|DEF] [DB|MDB]`
Description	Set the attenuation
Parameters	<value>: Set to the user attenuation value with the specified units (DB default) MIN: Set to the minimum programmable attenuation value MAX :Set to the maximum programmable attenuation value DEF: Set to the default attenuation value
Response	No response
Example	`:INP1:CHAN1:ATT 5.0`

Command	`:INPut<n>:CHANnel<m>:ATTenuation?`
Syntax	`:INPut<n>:CHANnel<m>:ATTenuation<wsp>[MIN|MAX|DEF|SET|ACT|ALL]`
Description	Query the attenuation
Parameters	MIN: Return the minimum programmable attenuation value MAX: Return the maximum programmable attenuation value DEF: Return the default attenuation value SET: Return the current set attenuation value ACT: Return the actual attenuation value ALL: Return all the above parameters in a comma separated string
Response	Depending on the parameters the response will be a single value or a comma separated string of values.
Example	`:INP1:CHAN1:ATT? DEF -> 5.00`

Command	`:INPut<n>:CHANnel<m>:OFFSet`
Syntax	`:INPut<n>:CHANnel<m>:OFFSet<wsp><value>[DB|MDB]`
Description	Set the attenuation mode offset
Parameters	<value>: Set to the user offset value with the specified units (DB default)
Response	No response
Example	`:INP1:CHAN1:OFFS 5.0`

Command	`:INPut<n>:CHANnel<m>:OFFSet?`
Syntax	`:INPut<n>:CHANnel<m>:OFFSet?<wsp>[MIN|MAX|DEF|SET|ALL]`
Description	Query the attenuation mode offset
Parameters	MIN: Return the minimum programmable offset value MAX: Return the maximum programmable offset value DEF: Return the default offset value SET: Return the current set offset value ALL: Return all the above parameters in a comma separated string
Response	Depending on the parameters the response will be a single value or a comma separated string of values.
Example	`:INP1:CHAN1:OFFS? -> 5.00`

Command	`:INPut<n>:CHANnel<m>:POWer?`
Syntax	`:INPut<n>:CHANnel<m>:POWer?<wsp>[MIN|MAX|DEF|SET|ACT|ALL]`
Description	Query the constant power input
Parameters	MIN: Return the minimum programmable power value MAX: Return the maximum programmable power value DEF: Return the default power value SET: Return the current set power value ACT: Return the actual power value ALL: Return all the above parameters in a comma separated string
Response	Depending on the parameters the response will be a single value or a comma separated string of values.
Example	`:INP1:CHAN1:POW ALL -> -45.00,20.00,10.00,5.00,4.99`

Command	`:INPut<n>:CHANnel<m>:WAVelength`
Syntax	`:INPut<n>:CHANnel<m>:WAVelength<wsp><value>[NM|M|MM|UM|PM]`
Description	Set the input optical wavelength configuration
Parameters	<value>: Set to the user wavelength of the channel with the specified units (NM default)
Response	No response
Example	`:INP1:CHAN1:WAV 1310 NM`

Command	`:INPut<n>:CHANnel<m>:WAVelength?`
Syntax	`:INPut<n>:CHANnel<m>:WAVelength?<wsp>[MIN|MAX|DEF|SET|ALL]`
Description	Query the input optical wavelength configuration
Parameters	MIN: Return the minimum programmable wavelength MAX: Return the maximum programmable wavelength DEF: Return the default programmable wavelength SET: Return the current set wavelength ALL: Return all the above values
Response	Depending on the parameters the response will be a single value or a comma separated string of values.
Example	`:INP1:CHAN1:WAV? ALL -> 1271,1550,1550,1550`

Command	`:OUTPut<n>:CHANnel<m>:OFFSet`
Syntax	`:OUTPut<n>:CHANnel<m>:OFFSet<wsp><value>[DB|MDB]`
Description	Set the attenuation mode offset
Parameters	<value>: Set to the user offset value with the specified units (DB default)
Response	No response
Example	`:OUTP1:CHAN1:OFFS 5.0`

Command	`:OUTPut<n>:CHANnel<m>:OFFSet?`
Syntax	`:OUTPut<n>:CHANnel<m>:OFFSet?<wsp>[MIN|MAX|DEF|SET|ALL]`
Description	Query the attenuation mode offset
Parameters	MIN: Return the minimum programmable offset value MAX: Return the maximum programmable offset value DEF: Return the default offset value SET: Return the current set offset value ALL: Return all the above parameters in a comma separated string
Response	Depending on the parameters the response will be a single value or a comma separated string of values.
Example	`:OUTP1:CHAN1:OFFS? -> 5.00`

Command	`:OUTPut<n>:CHANnel<m>:POWer`
Syntax	`:OUTPut<n>:CHANnel<m>:POWer<wsp>[<value>|MIN|MAX|DEF] [DB|MDB]`
Description	Set the constant power output
Parameters	<value>: Set to the user power value with the specified units (DB default) MIN: Set the minimum programmable power value MAX: Set the maximum programmable power value DEF: Set the default power value
Response	No response
Example	`:OUTP1:CHAN1:POW 5.0`

Command	`:OUTPut<n>:CHANnel<m>:POWer?`
Syntax	`:OUTPut<n>:CHANnel<m>:POWer?<wsp>[MIN|MAX|DEF|SET|ACT|ALL]`
Description	Query the constant power output
Parameters	MIN: Return the minimum programmable power value MAX: Return the maximum programmable power value DEF: Return the default power value SET: Return the current set power value ACT: Return the actual power value ALL: Return all the above parameters in a comma separated string
Response	Depending on the parameters the response will be a single value or a comma separated string of values.
Example	`:OUTP1:CHAN1:POW ALL -> -45.00,20.00,10.00,5.00,4.99`

Command	`:OUTPut<n>:CHANnel<m>:POWer:AVERagingtime`
Syntax	`:OUTPut<n>:CHANnel<m>:POWer:AVERagingtime<wsp>[<value>|MIN|MAX|DEF][S|MS|US|NS]`
Description	Set the constant power averaging time
Parameters	<value>: Set to the user averaging time value with the specified units (S default) MIN: Set the minimum programmable averaging time value MAX: Set the maximum programmable averaging time value DEF: Set the default averaging time value
Response	No response
Example	`:OUTP1:CHAN1:POW:AVER 0.5`

Command	`:OUTPut<n>:CHANnel<m>:POWer:AVERagingtime?`
Syntax	`:OUTPut<n>:CHANnel<m>:POWer:AVERagingtime?<wsp>[MIN|MAX|DEF|SET|ALL]`
Description	Query the constant power averaging time
Parameters	MIN: Return the minimum programmable averaging time value MAX: Return the maximum programmable averaging time value DEF: Return the default averaging time value SET: Return the current set averaging time value ALL: Return all the above parameters in a comma separated string
Response	Depending on the parameters the response will be a single value or a comma separated string of values.
Example	`:OUTP1:CHAN1:POW:AVER? MIN -> 0.0000`

Command	`:OUTPut<n>:CHANnel<m>:POWer:TIMEnulling?`
Syntax	`:OUTPUT<n>:CHANnel<m>:POWer:TIMEnulling?`
Description	Query the time remaining for dark nulling to complete
Parameters	No parameters
Response	The remaining time in s
Example	`:OUTP2:CHAN1:POW:TIME? -> 0.00`

Command	`:OUTPut<n>:CHANnel<m>:POWer:NULLing`
Syntax	`:OUTPut<n>:CHANnel<m>:POWer:NULLing`
Description	Starts dark power nulling. Note: Use this command in conjunction with *OPC? to check for dark power nulling completion
Parameters	No parameters
Response	No response
Example	`:OUTP1:CHAN1:POW:NULL`

Command	`:OUTPut<n>:TRACE:CoMPlete?`
Syntax	`:OUTPut<n>:TRACE:CoMPlete?`
Description	Query the status of the Trace Complete bit
Parameters	No parameters
Response	1 is returned if the trace has been acquired and the buffer is ready to be read out 0 is returned if the trace acquisition is still in progress, or the buffer is not ready to be read out
Example	`:OUTP2:TRACE:CMP? -> 1`

Command	`:OUTPut<n>:TRACE:PoinTS`
Syntax	`:OUTPut<n>:TRACE:PoinTS<wsp>[|MIN|MAX|DEF|<value>]`
Description	Set the number of trace buffer data elements
Parameters	MIN: Set the minimum programmable number of points MAX: Set the maximum programmable number of points DEF: Set the default number of points which is also set at power on <value>: Set the desired number of points per trigger
Response	No response
Example	`:OUTP2:TRACE:PTS 512`

Command	`:OUTPut<n>:TRACE:PoinTS?`
Syntax	`:OUTPut<n>:TRACE:PoinTS?<wsp>[MIN|MAX|DEF|SET|ALL]`
Description	Query the number of trace buffer data elements
Parameters	MIN: Return the minimum programmable number of points MAX: Return the maximum programmable number of points DEF: Return the default number of points set at power on SET: Return the current set number of points ALL: Returns all the above parameters in a comma separated string
Response	Returns the number of points captured after each trigger
Example	`:OUTP2:TRACE:PTS? ALL -> 1,1024,1024,512`

Command	`:OUTPut<n>:TRACE:RATE`
Syntax	`:OUTPut<n>:TRACE:RATE<wsp>[<value>|MIN|MAX|DEF]`
Description	Set the trace buffer sampling rate
Parameters	<value>: Set the desired sample rate in samples per second (Hz) MIN: Set the minimum sample rate in samples per second (Hz) MAX: Set the maximum sample rate in samples per second (Hz) DEF: Set the default sample rate set at power on
Response	No response
Example	`:OUTP2:TRACE:RATE 5000`

Command	`:OUTPut<n>:TRACE:RATE?`
Syntax	`:OUTPut<n>:TRACE:RATE?<wsp>[MIN|MAX|DEF|SET|ALL]`
Description	Query the trace buffer sampling rate
Parameters	MIN: Return the minimum sample rate in samples per second (Hz) MAX: Return the maximum sample rate in samples per second (Hz) DEF: Return the default sample rate set at power on SET: Return the current set sample rate in samples per second (Hz) ALL: Returns all the above parameters in a comma separated string
Response	Sample rate for the trace in seconds per sample
Example	`:OUTP2:TRACE:RATE? ALL -> 0.183,12000.000,12000.000,5000.000`

Command	`:OUTPut<n>:TRACE:TRIG`
Syntax	`:OUTPut<n>:TRACE:TRIG<wsp>[STOP|IMMEDIATE|FORCE|SWEXT|HWINT|HWEXT|HWCLK]`
Description	Set the trace trigger mode
Parameters	IMMEDIATE | FORCE: Software trigger, start sampling immediately (default) Note: SENSE<n>:TRACE:POINTS samples is required before *OPC? completes.
Response	No response
Example	`:OUTP2:TRACE:TRIG FORCE`

Command	`:OUTPut<n>:TRACE<m>?`
Syntax	`:OUTPut<n>:TRACE<m>?`
Description	Query the Trace buffer. The user should wait for OUTP<n>:TRACE:CMP? to complete before reading this. This command will error out if no sample points have been triggered.
Parameters	No parameters
Response	Comma separated list of values for each channel, and new line [ie '\n'] separated rows per sample. The `:OUTP<n>:TRACE<m>?` command will return a comma separated string of values with units of dBm.

Example	`:OUTP2:TRACE:PTS 10`
	`:OUTP2:TRACE:RATE 0.183`
	`:OUTP2:TRACE:TRIG`
	`:OUTP2:TRACE:CMP? -> 1`
	`:OUTP2:TRACE2? ->`
	`10.01,10.01,10.02,10.01,10.01,10.01,10.02,10.02,10.02,10.02,10.01,10.01`
	`:OUTP2:TRACE:TRIG`
	`:OUTP2:TRACE:CMP? -> 1`
	`:OUTP2:TRACE2? ->`
	`10.01,10.01,10.02,10.01,10.01,10.01,10.02,10.02,10.02,10.02,10.01,10.01`

11.6   VOA 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.

11.6.1   NI-MAX application Multi Chassis mode

⚠ IMPORTANT

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.
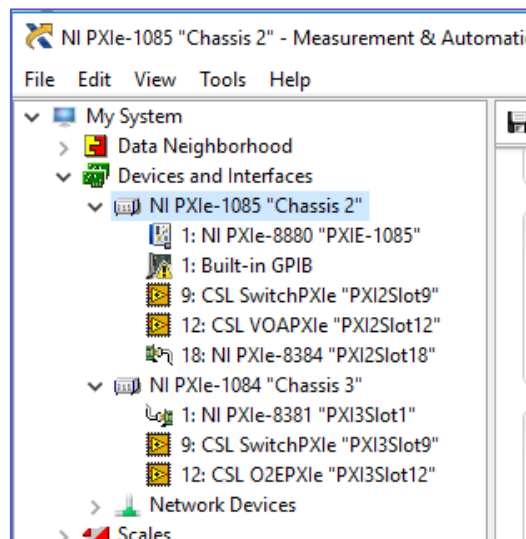
11.6.2   SCPI Multi Chassis commands

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 operating in SINGLE mode, this will always return 1
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

⚠ IMPORTANT

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

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 the commands given above in the Specific Command Summary 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`

11.7   Triggering example

This is an example of the commands and procedure for configuration and use of the system (or chassis) triggering features of the Quantifi Photonics products.

11.7.1   System commands

1. Set the Triggering delay for the slot. Delay is from 0 to 10 seconds, with a resolution of 0.001 seconds. Default is 0 seconds.
    ```
    :TRIGger<slot>:DELay 0
    ```

2. Set the desired Triggering Line detection Mode to AND or OR. This represents triggering upon events on single, any or specific lines/signals.
    ```
    :TRIGger<slot>:MODE OR
    ```

3. Set the desired Triggering source(s): The sources represent the PXI trigger lines (integer values from 0 to 7) that the module can be configured for events.
    ```
    :TRIGger<slot>:SOURce 0
    ```

4. Arm the triggering in preparation for the next event.
    ```
    :TRIGger<slot>:ARM ENABLE
    ```

11.7.2   Module commands

The following is the example of a VOA PXIe installed in Slot 3:

1. Once the above system commands are configured. Set the module to the desired Trigger event mode. The following is for the sampling to be started upon a PXI trigger line event and samples aligned to the PXI Clock.
    ```
    :OUTP3:TRACE1:TRIGGER SWEXT
    ```

2. Monitor the Trace completion status.
    ```
    :OUTP3:TRACE1:COMPLETE? -> 1
    ```

3. Query (Read) the Trace buffer once populated (data elements depend on trace configuration).
    ```
    :OUTP3:TRACE1? -> "x1,x2,x3,….,xn"
    ```

Name	Trigger Event	Sampling Event	Description
STOP	None	None	triggering is disabled (or cancelled), no events will occur
FORCED | IMMEDIATE	Software	Internal Clock	triggered upon command execution and sampling aligned to internal timer
SWEXT | SWEXTERNAL	Software	PXI Clock	triggered upon command execution and sampling aligned to PXI Clock
HWINT | HWINTERNAL	PXI Line	Internal Clock	triggered upon PXI Line edge and sampling aligned to internal timer
HWEXT | HWEXTERNAL	PXI Line	PXI Clock	triggered upon PXI Line edge and sampling aligned to PXI Clock
HWCLK	PXI Line	PXI Line	triggered upon command execution and sampling aligned to PXI Line edge

12 Example: Control of the VOA with SCPI

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

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

Identifying the VOA product:
1. Query to confirm the correct instrument/PXIe chassis is setup
   `:*IDN?`
2. Query the available instrument module configuration
   `:*OPT?`
3. Query the identification information for a specific slot module
   `:SLOT3:IDN?`

Running a Trace on the VOA product:
1. Set up the Trace parameters
   `:OUTP3:TRACE:RATE 1000`
   `:OUTP3:TRACE:POINTS 1024`
   `:OUTP3:CHAN1:POW:AVER 0.02`
   `:OUTP3:CHAN2:POW:AVER 0.02`
2. Trigger the Trace acquisition
   `:OUTP3:TRACE:TRIGGER IMMEDIATE`
3. Query the status of the Trace (for completion)
   `:OUTP3:TRACE:COMPLETE?`
4. Query the Trace data once complete
   `:OUTP3:TRACE?`

⚠ **IMPORTANT**

The following section details the various methods that a user may send these commands to a VOA product via **SCPI** commands.
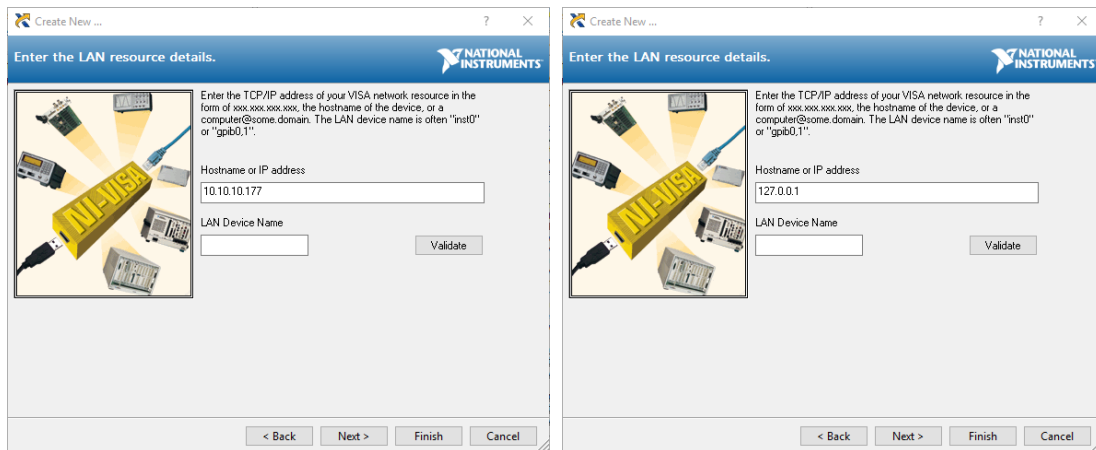
12.1   NI-MAX application

To communicate with any Quantifi Photonics PXIe or MATRIQ product, the chassis / instrument must first be setup as a TCP/IP instrument.

1. After installing NI-MAX, launch the application. In the left-hand side panel of the window, click the **Devices and Interfaces** option. A drop down of available instruments detected will show up.

2. Click on **Network Devices**, then click **Add Network Devices** and select **VISA TCP/IP Resource**.
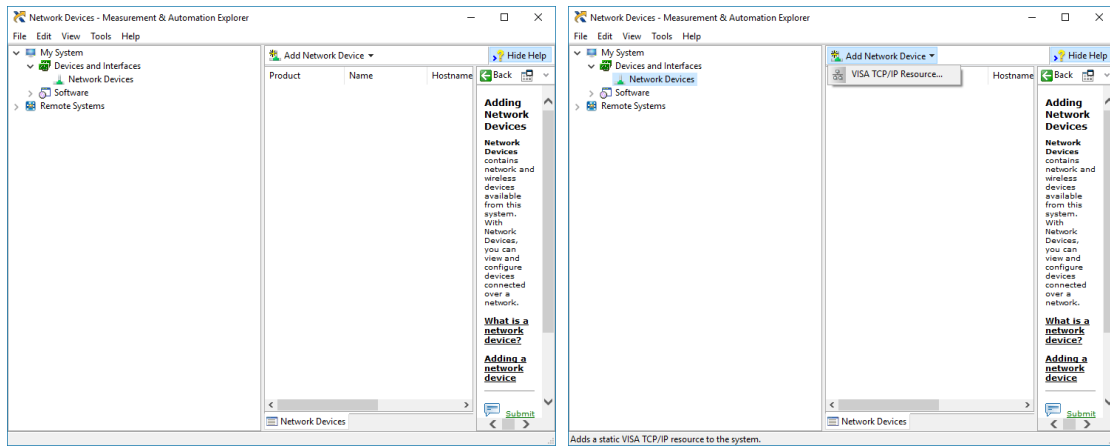

3. Select **Manual Entry of LAN Instrument**. Enter in the Hostname or IP Address. The top image is an example of operating remotely, the bottom image is an example of operating locally. Note when operating locally, enter in the localhost IP address of **127.0.0.1**. Click **Finish** to end the setup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

12.2   NI-VISA application

NI-VISA is used to communicate 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.
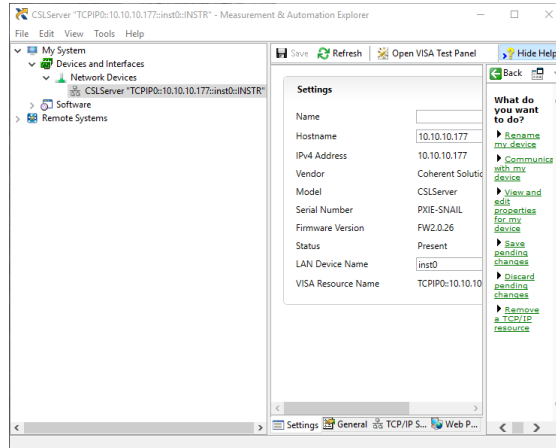
2. On the right-hand side panel, select **Open VISA Test Panel**. A new window will popup. Click the **Input / Output** button from the window menu.

Valid chassis and module commands can be entered in, and their returns queried.
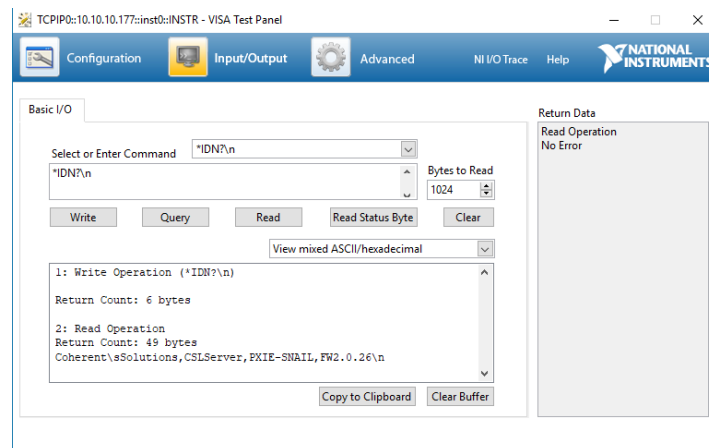
12.3 Python® 2.7 code example

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

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

12.4   MATLAB® code example

To communicate with a VOA 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 VOA 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.

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

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

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

12.5 LabVIEW™ application

12.5.1   Soft Panels

To control the VOA product with a LabVIEW™ Soft Panel, you will need to have setup the chassis / instrument as a TCP/IP Resource as shown in Section 12.1.

1. Download the LabVIEW zip file from the Quantifi Photonics website. This contains all the Soft Panels and Virtual Instruments (VIs) for Quantifi Photonics PXIe modules.
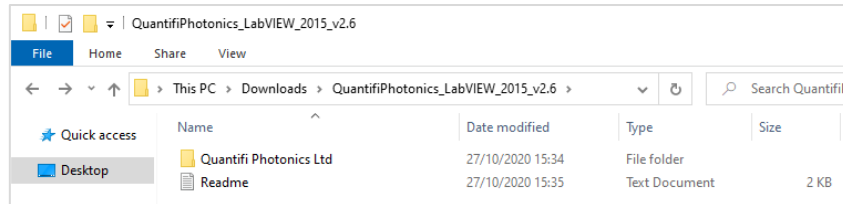
2. Open the Control Panels folder and select the corresponding Soft Panel for the desired PXIe module / MATRIQ instrument. Because these are executables, they will need LabVIEW Runtime Engine 2015 to run.
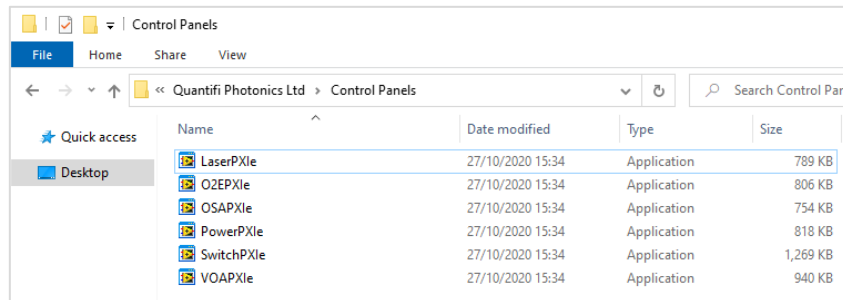
⚠ IMPORTANT

If LabVIEW Runtime Engine 2015 is not present, a system dialog will pop up. To proceed download the Runtime Engine (more information on LabVIEW website).

3. Once the desired executable has been run, select the VISA Resource corresponding to the intended instrument.
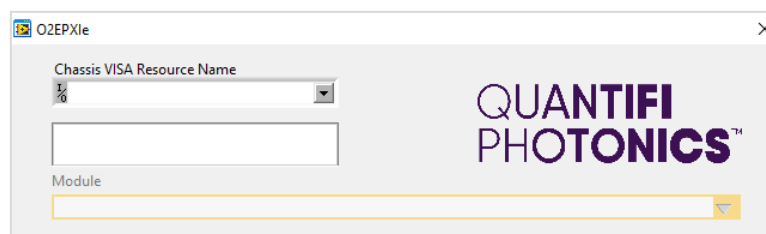
Note this step depends on the setup process shown in Section 12.1. If the instrument has not been setup, then the Soft Panel cannot be used.

12.5.2   LabVIEW™ Virtual Instruments (VIs)

Instead of using the Soft Panels, the Virtual Instruments can also be used to control the VOA product from within LabVIEW. These VIs are provided for customers who want to develop custom applications using the PXIe modules.

1. Copy the QuantifiPhotonics_LabVIEW_2015_v2.6 > **Quantifi Photonics Ltd** folder to the following path:
    C:\Program Files\National Instruments\LabVIEW 20XX\instr.lib\

2. Within the Quantifi Photonics Ltd folder, navigate to the intended module's sub folder.
    e.g. Quantifi Photonics Ltd > O2E > O2E > VXI

This VI Tree can then be added into the desired development project, therefor the Soft Panel can be rebuilt and used by other LabVIEW Runtime Engine.
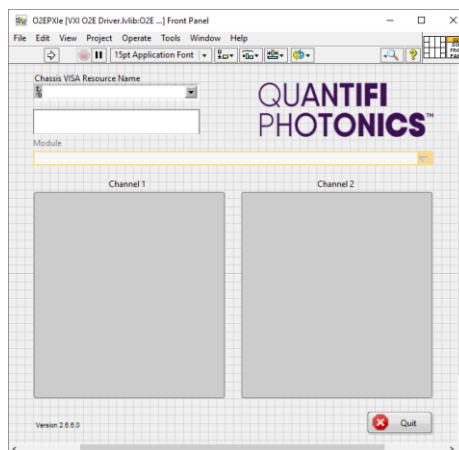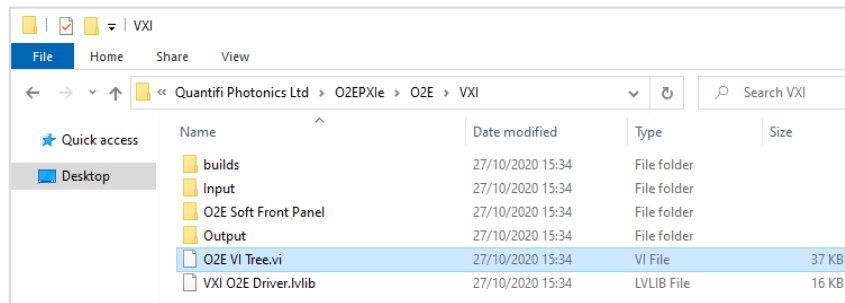
13   Maintenance

To help ensure long, trouble-free operation:

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

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

13.1   Annual calibration schedule

To ensure that the VOA product is performing as expected, it is recommended that the product be sent in for annual re-calibration. As an optical product will naturally degrade over time, it is important to periodically re-test the product, to confirm that it is working as expected.

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

Technical Support Group

Tel.: +64 9 478 4849

support@quantifiphotonics.com

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

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.
- Avoid high humidity or large temperature fluctuations.
- Keep the product out of direct sunlight.
- Avoid unnecessary shocks and vibrations.

15 Warranty

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.

> ⚠ **IMPORTANT**
>
> The warranty can become null and void if:
> - The unit has been tampered with, repaired, or worked upon by unauthorized individuals or non-Quantifi Photonics personnel.
> - The warranty sticker has been removed.
> - The unit has been opened, other than as explained in this guide.
> - The unit serial number has been altered, erased, or removed.
> - The unit has been misused, neglected, or damaged by accident.

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

For full warranty terms and conditions, please visit www.quantifiphotonics.com.

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.

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.

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.

General Enquiries	sales@quantifiphotonics.com
Technical Support	support@quantifiphotonics.com
Phone	+64 9 478 4849
North America	+1-800-803-8872

quantifiphotonics.com

QUANTIFI
PHOTONICS™