

# BERT

## BIT ERROR RATE TESTER

### USER MANUAL



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## 1 Conventions

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Before using the product 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 BERT 1005 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**

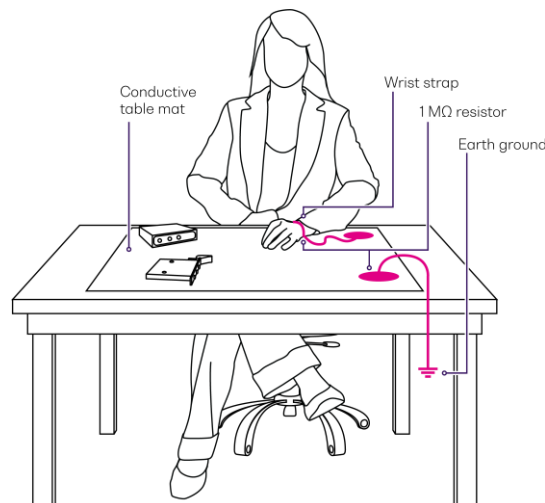
The use of controls, adjustments, and procedures other than those specified herein may result in exposure to hazardous situations involving optical radiation.

### 2.2 Electrostatic discharge precautions

#### **CAUTION**


The BERT 1005 product is sensitive to electrostatic discharge (ESD). Store the unused product 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 BERT 1005 product. Proper grounding and ESD management practices should always be followed to ensure that no ESD damage is caused to the BERT product.



### 2.3 Electromagnetic compatibility

#### **CAUTION**

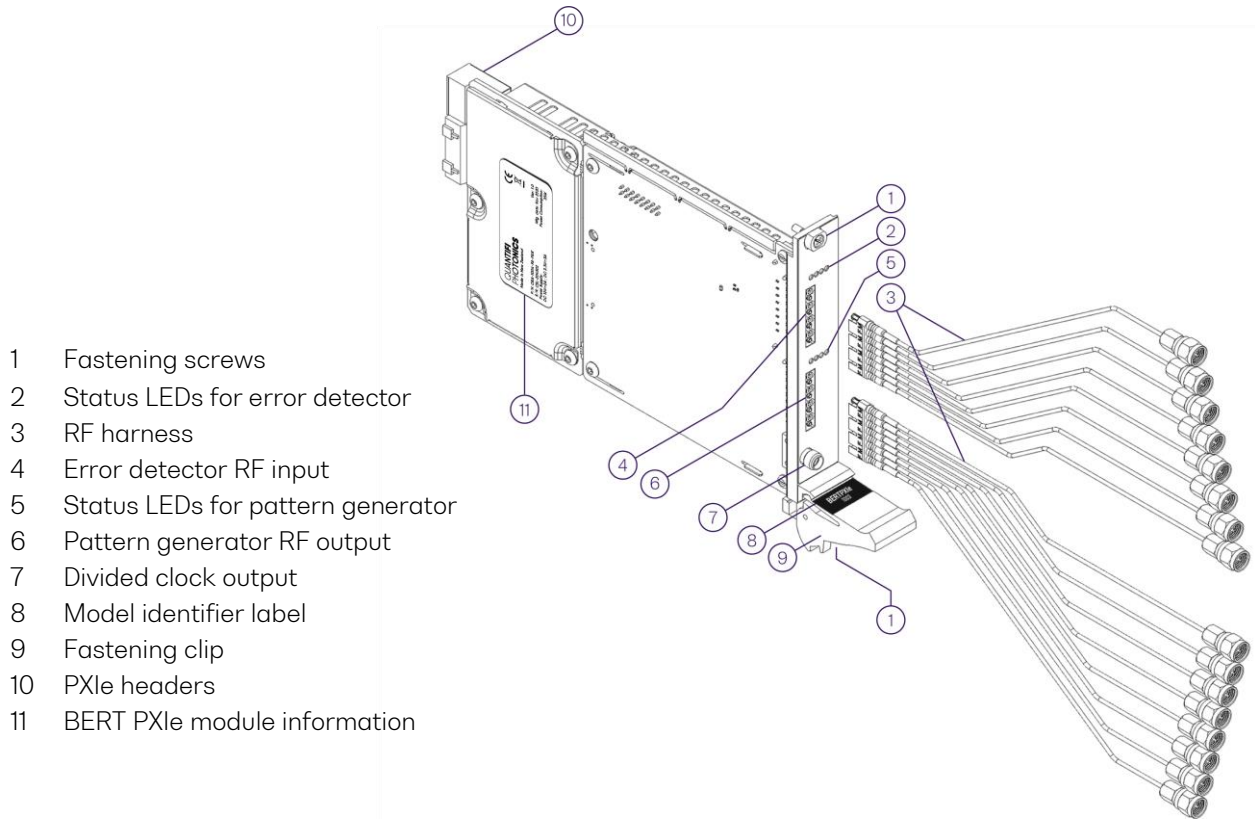
- For electromagnetic compatibility, this instrument is a **Class A** product. It is intended for use in an industrial environment. There may be potential difficulties in ensuring electromagnetic compatibility in other environments, due to conducted as well as radiated disturbances.
- Wherever the  symbol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



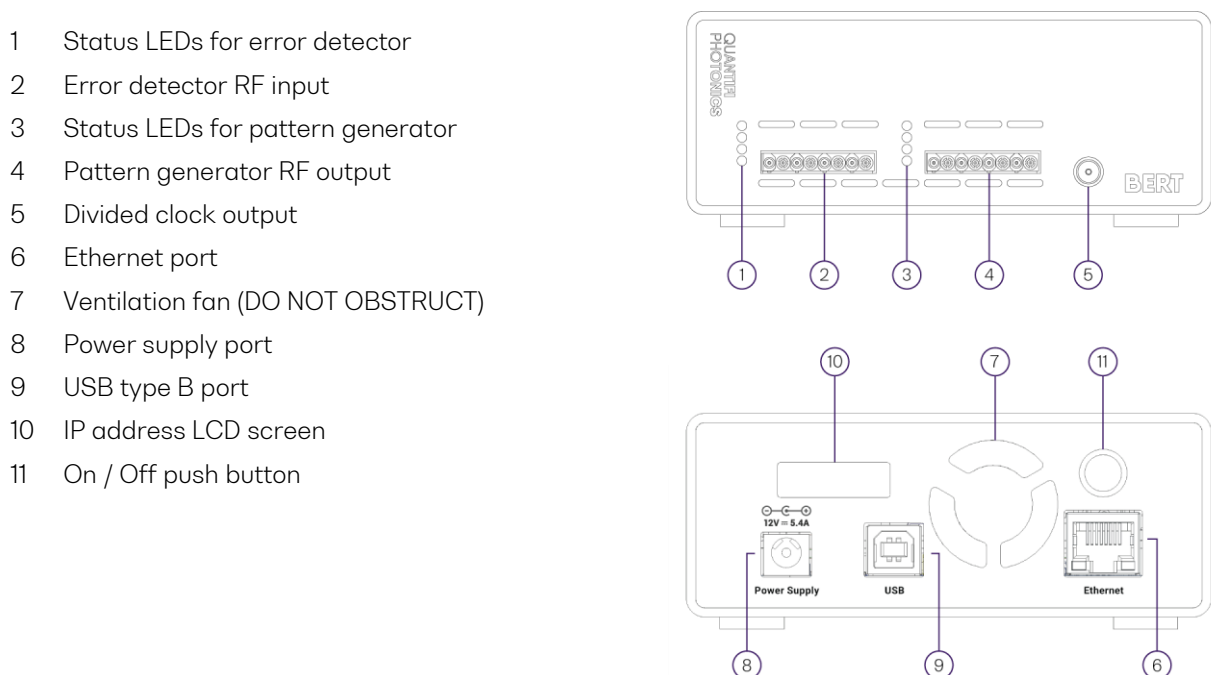
### 3 Introducing the BERT 1005 – Bit error rate tester

The BERT 1005 product is a 4-channel pattern generator and error detector for the design, characterization, and production of optical transceivers and opto-electrical components at data rates up to 14.5 Gb/s.

#### 3.1 BERT 1005 PXle module overview & features



#### 3.2 BERT 1005 MATRIQ instrument overview & features

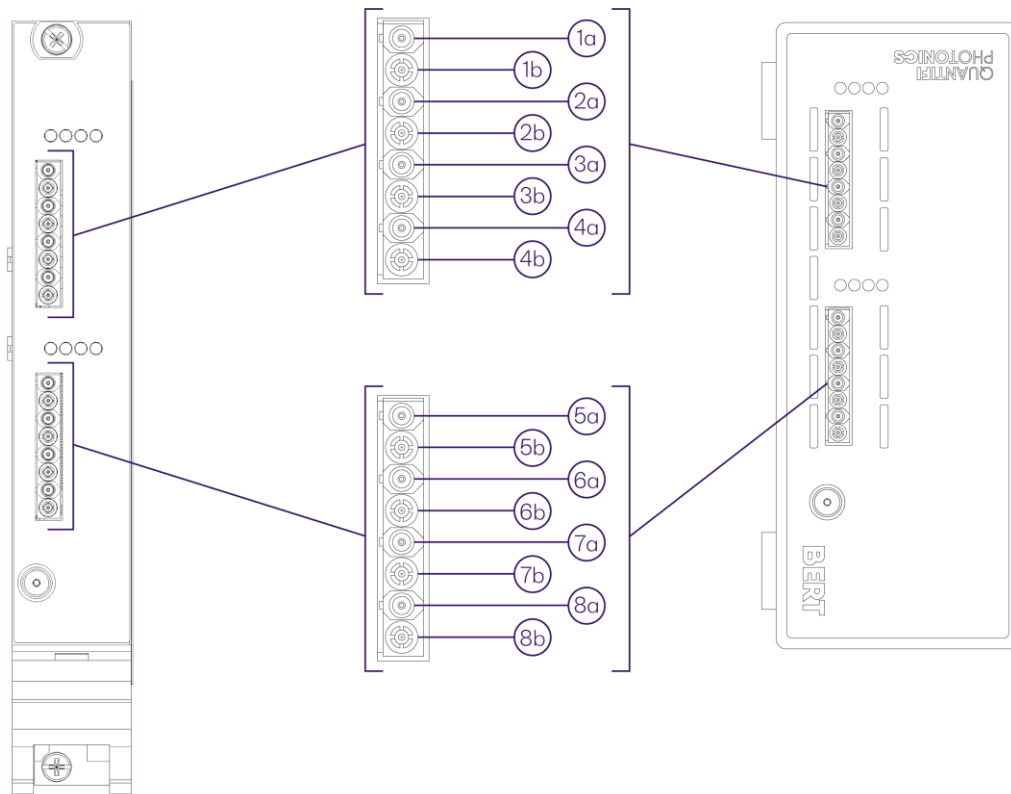


**⚠ IMPORTANT**

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

**3.3 BERT 1005 error detector RF input and the pattern generator RF output**

1a	Error detector channel 1 (Positive)	5a	Pattern generator channel 1 (Positive)
1b	Error detector channel 1 (Negative)	5b	Pattern generator channel 1 (Negative)
2a	Error detector channel 2 (Positive)	6a	Pattern generator channel 2 (Positive)
2b	Error detector channel 2 (Negative)	6b	Pattern generator channel 2 (Negative)
3a	Error detector channel 3 (Positive)	7a	Pattern generator channel 3 (Positive)
3b	Error detector channel 3 (Negative)	7b	Pattern generator channel 3 (Negative)
4a	Error detector channel 4 (Positive)	8a	Pattern generator channel 4 (Positive)
4b	Error detector channel 4 (Negative)	8b	Pattern generator channel 4 (Negative)



### 3.4 Status LEDs

The status LEDs are used to show the operation state of the BERT 1005 product.

When the system is powered on, the LEDs are turned sequentially in green and then red. Afterwards, the color changes to orange, to show the initialization state of the system, and then the LEDs are turned off.

For each channel of the **pulse pattern generator** (PPG):

- **Green** – Pattern generation is running.
- **Off** – The module is powered off or no pattern generation is running.

For each channel of the **error detector** (ED):

- **Green** – Error detection is running.
- **Orange** – Eye scan is running.
- **Off** – The module is powered off or no error detection or eye scan is running.

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## 4 Connecting optical fibers

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### **WARNING**

**DO NOT** attempt to remove or adjust any component of the product while the power is on.

Ensure the product is powered OFF, and that the correct handling procedure detailed herein is followed when you remove or install any products.

### **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 BERT 1005 product can be found printed on the front plate of the product. **Joining mismatched connectors will damage the ferrules and fibre faces.**

After a cold boot, wait at least **30 minutes** before starting to use the error detection or pattern generation modules.

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.

## 4.2 Connector care

To connect to the BERT 1005 product, RF Coax array harness is required. Connectors in the high frequency range have precision dimensions and require proper handling to avoid inadvertent damage. The most common cause of measurement error is bad connections caused by malfunctioning connectors.

Although all connectors eventually wear, with knowledge, care, and proper technique, you can maximize the accuracy, repeatability, and lifetime of coaxial connectors.

The RF Coax array on the BERT front panel will gradually wear each time the harness is connected or disconnected from the front panel. Where possible, avoid frequent connection/disconnections.

To connect or remove the RF Coax array, always use the proper connector removal tool

### **⚠ IMPORTANT**

- If you use a pattern generation or error detection channel as single-ended output or input, terminate the other end with a 50 ohm terminator.
- To avoid waveform distortion and therefore ensure module performance, terminate the RF ports of all unused channels with 50 ohm terminators.

## 4.3 Cable selection

When measuring differential signals or using the pattern generator to drive a differential circuit, consider matching the phase of the cables being used. The cables used to attach the DUT must have the same time difference and the same length.

For slow signals with large bit periods, a cable mismatch such as 5 ps has little impact on the results. However, for fast signals with small bit periods, the impact is significant. For example, for a data rate of 14.5 Gb/s that has the bit period of 70 ps, a cable mismatch of 5 ps may lead to a significant error.

The BERT harness accessories offered by Quantifi Photonics for these products, with breakout SMA and / or 2.92 mm connectors, are skew matched at the factory to within <2 ps of each other.

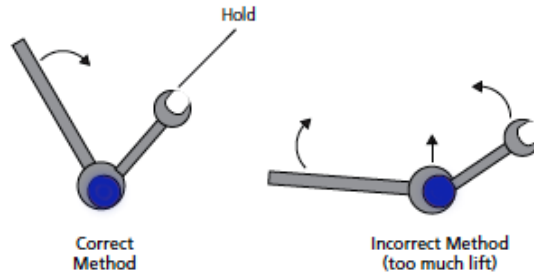
### 4.3.1 Use a torque wrench

To use a torque wrench correctly follow the steps below:

1. Make sure the torque wrench is set to the correct torque settings based on the table below:

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

- Position the torque wrench and a second wrench to hold the device or cable within 90° of each other before applying force. Support the devices to avoid putting stress on the connectors. Proper torque on the connector can help avoid damage due to over-tightening, improve measurement repeatability and extend connector life. Repeatable measurements require consistent torque on all the connections in a setup.

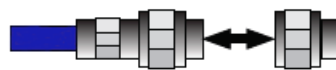


- Hold the torque wrench lightly at the end of the handle then apply force perpendicular to the torque wrench handle.
- Tighten until the “break” point of the torque wrench is reached. Do not push beyond the initial break point.

#### 4.3.2 Make a connection

To make a connection, follow the steps below:

- Wear a grounded wrist strap.
- Inspect, clean, and measure connectors. All connectors must be undamaged, clean, and within mechanical specification.
- For long coaxial cables, briefly short the centre conductor to the outer ground.  
Long lengths of coaxial cable that have been disconnected at both ends can contain significant electrical charges at voltage potentials high enough to cause conducted-static charge damage to high speed instruments.
- Carefully align the center axis of both devices. Push the connectors straight together so they can engage smoothly. The male center conductor pin must slip concentrically into the contact finger of the female connector, as illustrated below:



#### CAUTION

Rotate only the connector nut — NOT the device or connector body — until finger-tight, without crossing the threads. Damage to both connectors will occur if the male center pin rotates in the female contact fingers.

#### 4.3.3 Separate a connection

To separate a connection, follow the steps below:

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

## 5 Handling the BERT 1005

### ⚠ CAUTION

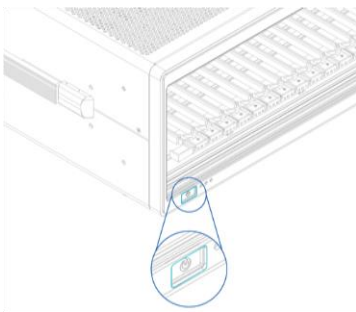
- Do not remove the BERT 1005 product from the antistatic packaging until instructed during the following installation procedure.
- The BERT 1005 product is sensitive to ESD. Ensure you are wearing a grounded wrist strap at all times when handling the BERT product to prevent damage from electrostatic discharge .
- Take care not to handle the optical connectors on the BERT, as once they are exposed to skin contact this may leave corrosive residue which can damage the connector.

### 5.1 BERT 1005 PXIe module installation

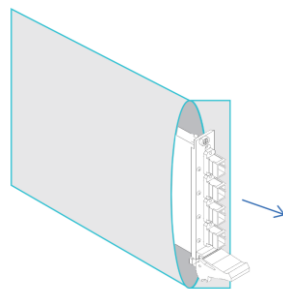
#### ⚠ WARNING

**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.

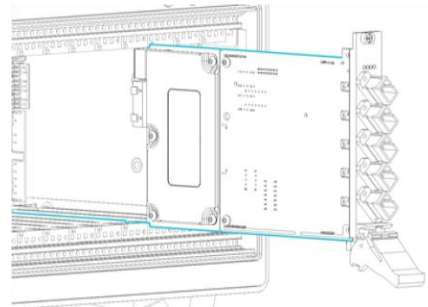
**STEP 1:** Power OFF the Chassis



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

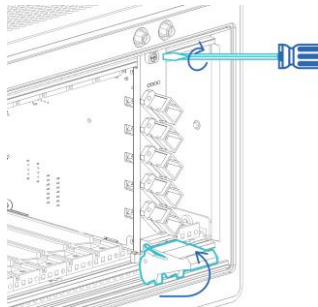
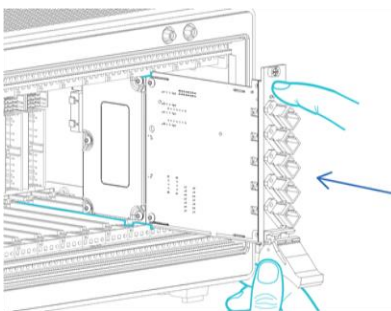


**STEP 3:** Align module with slot guide rails

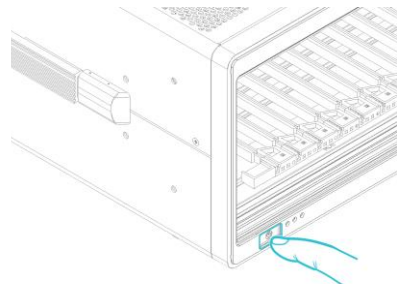


**STEP 4:** Push module into slot until resistance is felt from the backplane connection

**STEP 5:** Engage the fastening clip. Secure all fastening screws



**STEP 6:** Power ON the chassis

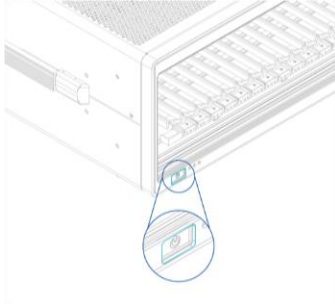


### ⚠ IMPORTANT

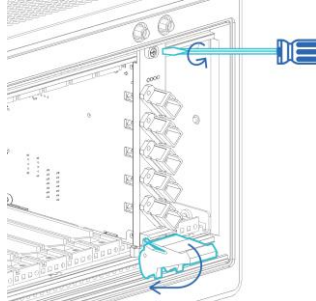
After powering on the PXIe chassis, please wait at least **2 minutes** before attempting to communicate with the instrument. This will allow the chassis enough time to finish boot procedures and initialize the communication server.

## 5.2 BERT 1005 PXle module uninstallation

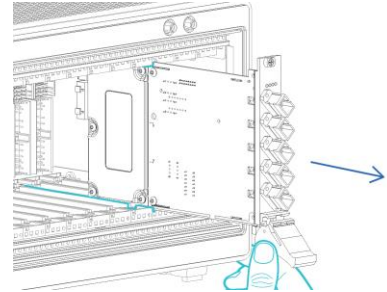
**STEP 1:** Power OFF the chassis



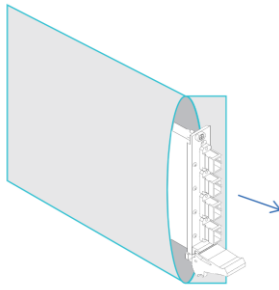
**STEP 2:** Unsecure the fastening screws and fastening clip



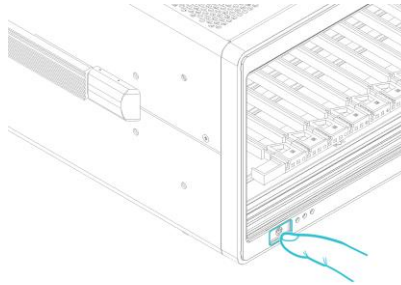
**STEP 3:** Pull out the module.  
USE THE FASTENING CLIP TO PULL. DO NOT PULL ON THE CONNECTORS



**STEP 4:** Store module in antistatic bag



**STEP 5:** Power ON the chassis

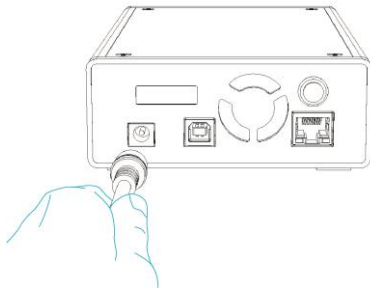




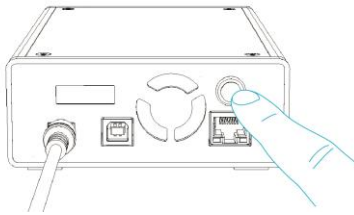
### 5.3 BERT 1005 MATRIQ instrument installation

**STEP 1:**

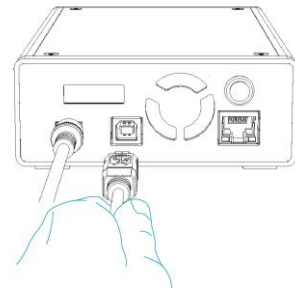
Insert power cord

**STEP 2:**

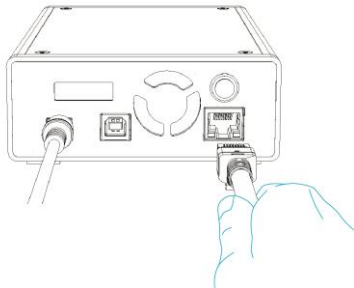
Power ON the instrument

**STEP 3:**

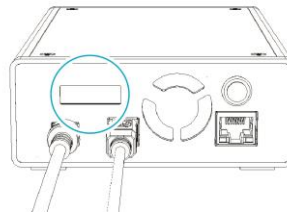
via USB – Connect USB cable

**STEP 3:**

via Ethernet – Connect Ethernet cable

**STEP 4:**

IP address will appear on the LCD screen



via USB



via Ethernet

#### **⚠ IMPORTANT**

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

## 6 Software installation for the BERT 1005

### ⚠ IMPORTANT

The software installation process varies between the PXle Modules (6.1) and the MATRIQ Instrument (6.3). Refer to the relevant section according to the product type.

### 6.1 Cohesion Installer information for PXle modules

#### ⚠ IMPORTANT

The software must be installed on the PXle Controller for the PXle 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 PXle Platform.

#### 6.1.1 Installation overview

For the PXle Controller to communicate with the BERT 1005 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 PXle Modules
- CohesionSCPI: VXI11 compliant server for remote SCPI communication
- CohesionUI: Web-based Graphical User Interface

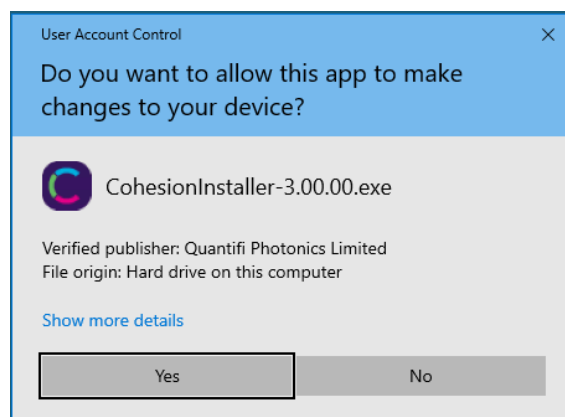
#### ⚠ IMPORTANT

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

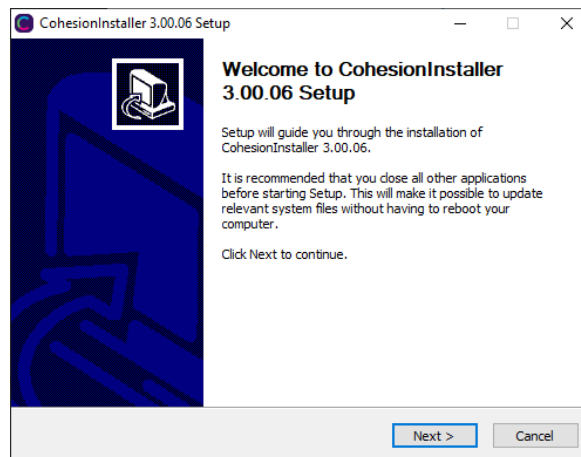
#### 6.1.2 Installation process

**Windows 10 64bit:**

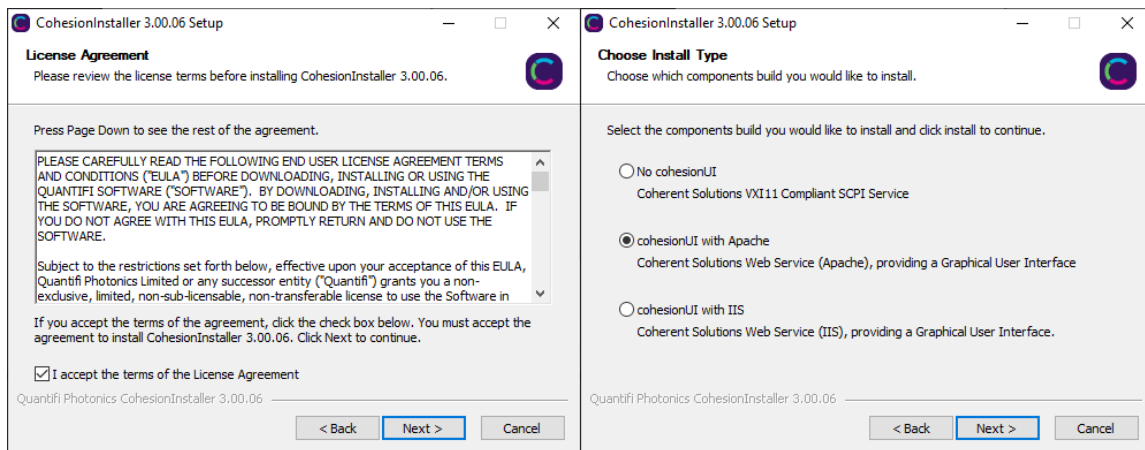
1. Locate and run the installer **CohesionInstaller-3.XX.XX.exe** from the provided USB media device (or download from the Quantifi Photonics [website](#)).



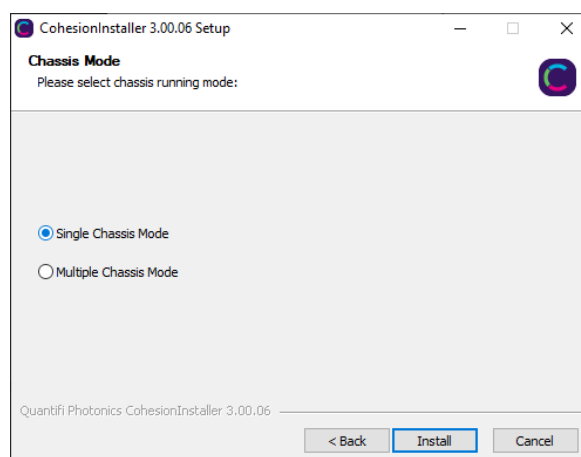
- Follow the on-screen installation prompts.



- Continue with the installation by following the on-screen installation prompts. Choose the default installation type – CohesionUI with Apache.



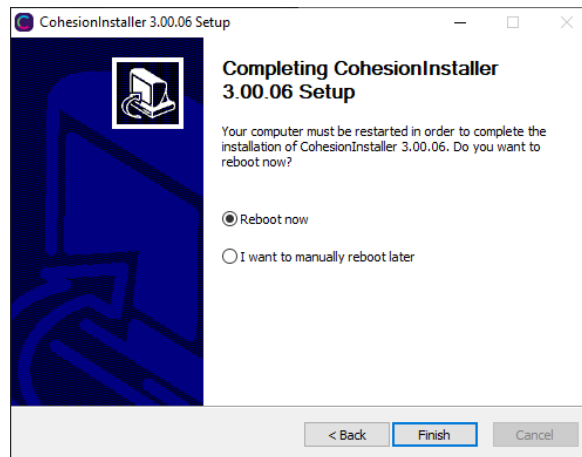
- Installation will continue with the **Chassis Mode** selection. The default setting is **Single Chassis Mode**. If unsure, proceed with the default mode setting.



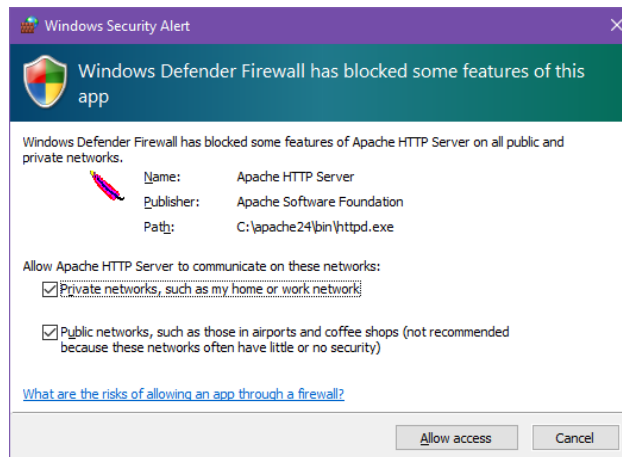
### **⚠ IMPORTANT**

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.

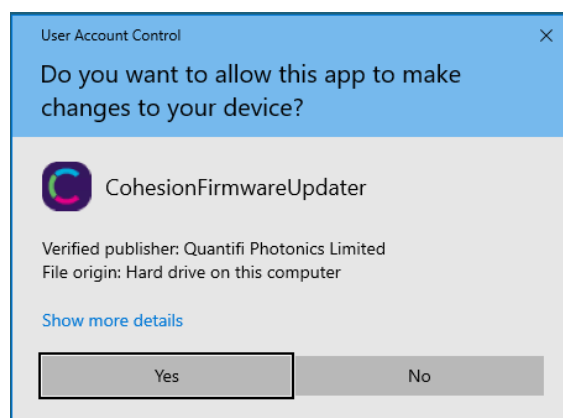
5. At the end of the installation, it is recommended to select the **Reboot now** option, and click **Finish** to complete the installation process.



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.



## 6.2 Quantifi Photonics PXle system utility applications

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

- Cohesion Manager
- Cohesion Firmware Updater

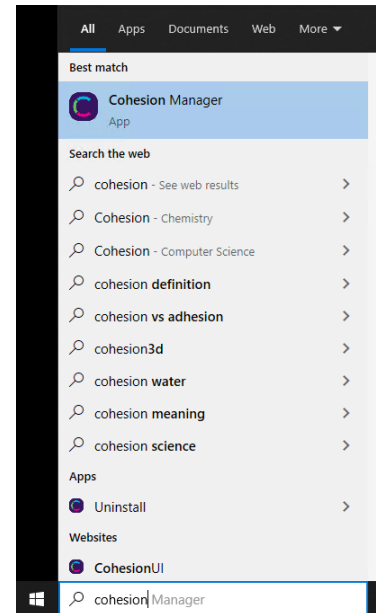
### 6.2.1 Cohesion Manager utility

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.

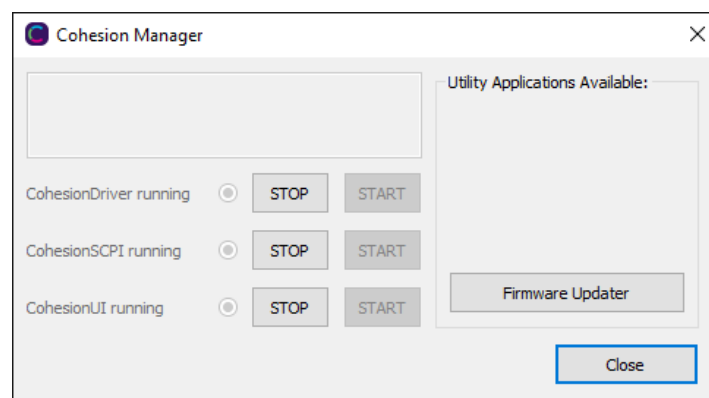
The Cohesion Manager can be accessed via the Windows Start Menu.

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 PXle 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

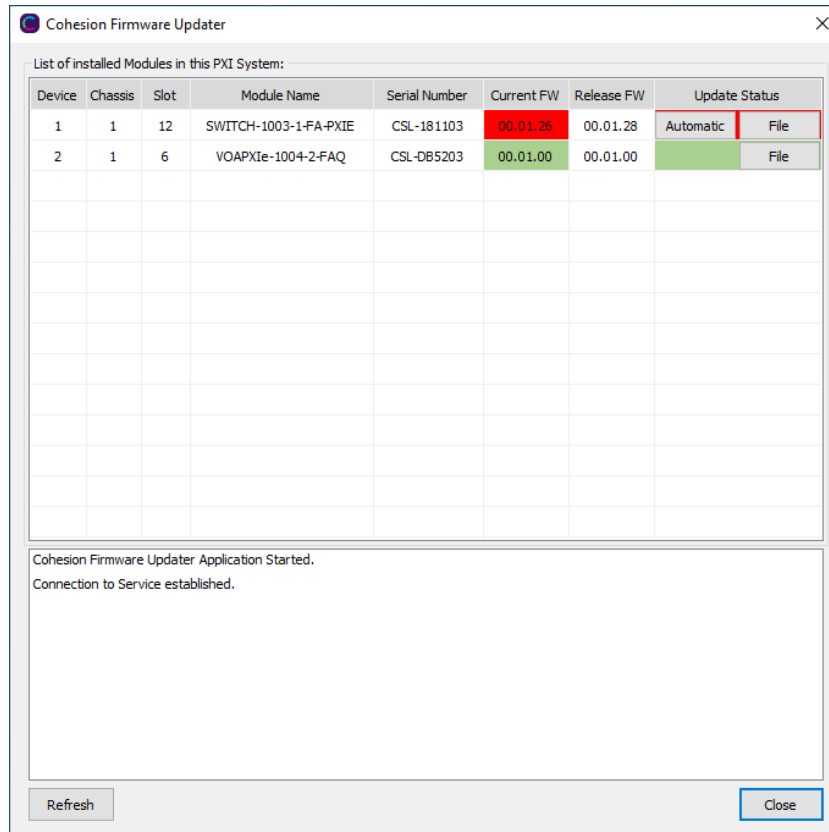
The **Driver and SCPI services** need to be running to facilitate communication with any installed Quantifi Photonics module, **therefore they are listed as REQUIRED**.

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

### 6.2.2 Cohesion Firmware Updater utility

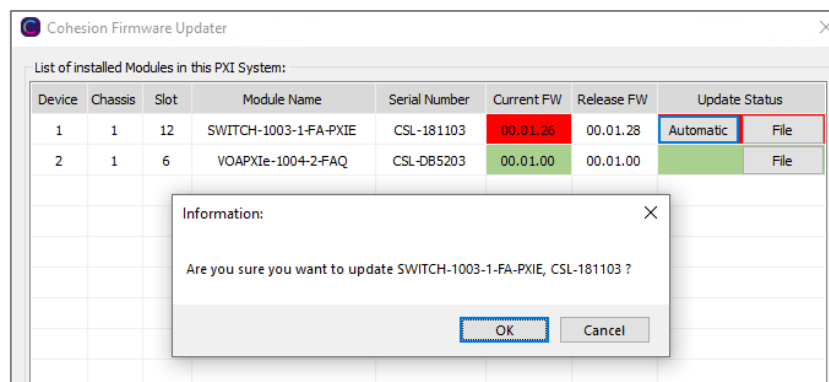
The Cohesion Firmware Updater utility serves as a single window summary application to display the current firmware status of all the Quantifi Photonics PXIe modules installed in the chassis.

The Cohesion Firmware Updater utility can be accessed via the Cohesion Manager application (see Section for more 6.2.1 information).

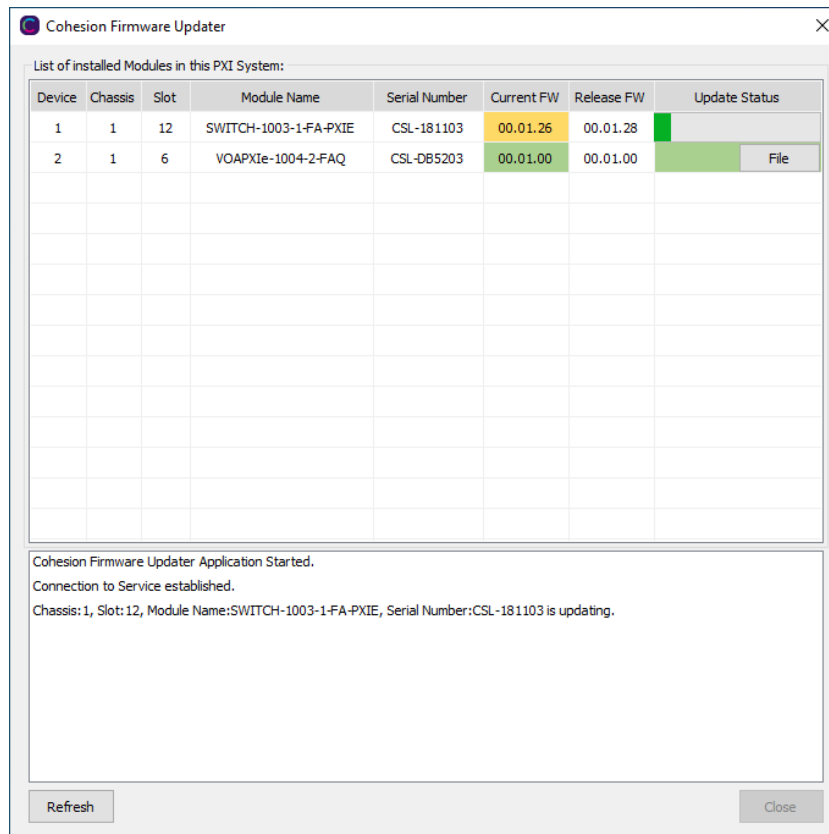


Whenever a new version of the CohesionInstaller is installed on the system, the Cohesion Firmware Updater utility will automatically launch after the system is rebooted. It will show the user the firmware status of all installed Quantifi Photonics modules and allow the user to update the firmware to 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.



## 6.3 Installing software for MatriQ instruments

### 6.3.1 Installing Cohesion Operator on client computer(s)

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

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

#### **⚠ IMPORTANT**

If **another MatriQ instrument is already connected** to the client computer **over USB**, consult the **Network and Update settings** (7.5.4) section below on configuring the Ethernet / USB IP address for multi-instrument control.

To install the software package on a client computer:

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

**NOTE:** A Windows Security Alert may prompt you to allow network access. We recommend that you allow access to both, private and public networks, to enable any network configuration.

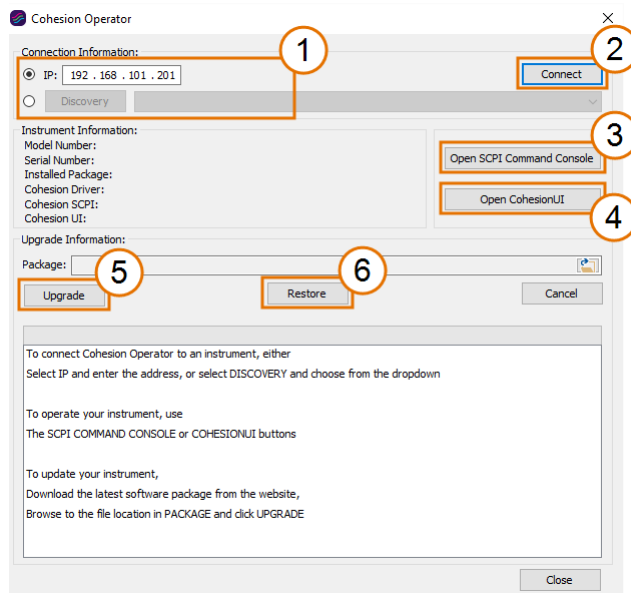
The installation wizard will install required drivers, applications, and desktop icons on the computer.

To open the Cohesion Operator application:

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

From Cohesion Operator you can:

1. Select a **Quantifi Photonics** instrument that is available on your network.
2. Validate the IP address of the instrument and retrieve instrument information (refer 6.3.2).
3. Communicate with the instrument through the SCPI Command Console (refer 9.7).
4. Access the instrument through CohesionUI, a web-based graphical user interface (refer 7.2).
5. Upgrade instrument firmware (refer 6.3.3).
6. Restore the instrument to factory settings (refer 0).



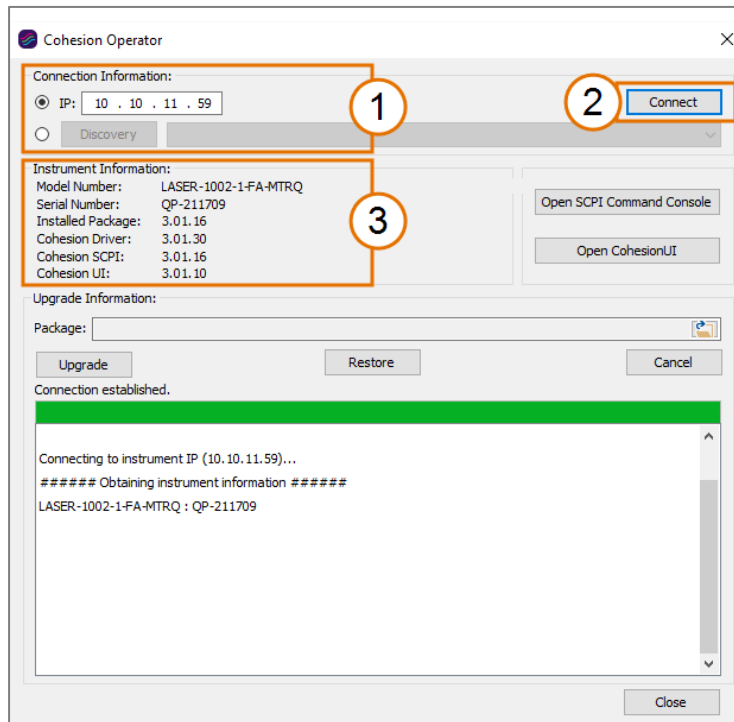


### 6.3.2 Checking MatriQ firmware versions and other product information

You can check the details of a MatriQ instrument, for example by doing one of the following:

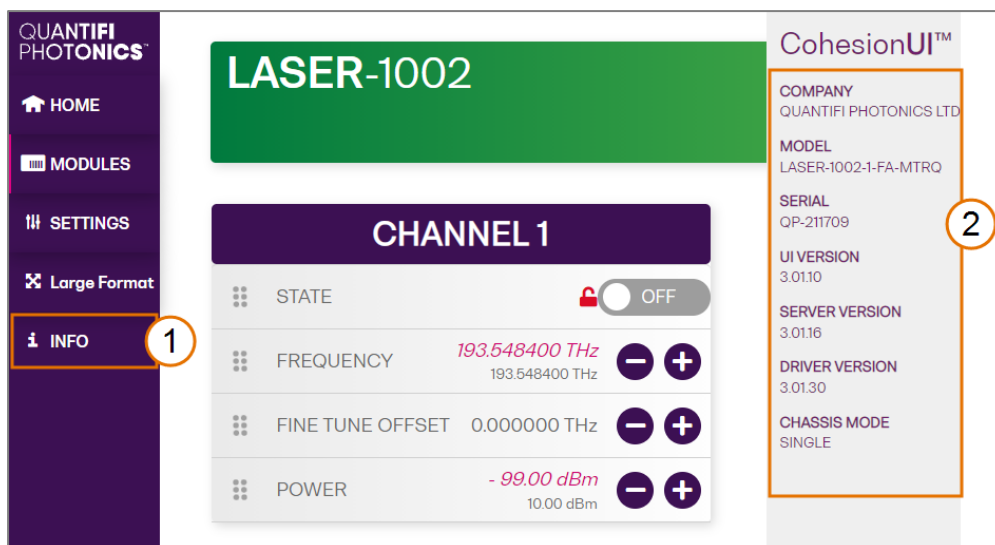
In the Cohesion Operator:

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



In CohesionUI:

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



### 6.3.3 Upgrading a MatriQ instrument with the latest firmware

#### **NOTE**

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

To upgrade a MatriQ instrument:

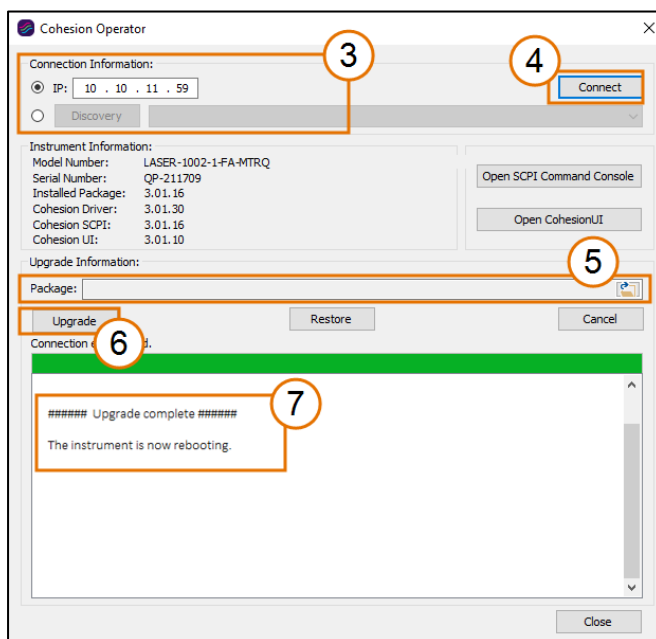
1. Get the latest MatriQ firmware package **CohesionMTRQ-<version>.tgz**, for example by downloading it from [quantifiphotonics.com](http://quantifiphotonics.com) (go to **Resources > Drivers, software and manuals > MatriQ Series**), and save it to your network.
2. Open the Cohesion Operator, for example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

#### **NOTE**

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

#### **NOTE**

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



### 6.3.4 Restoring factory settings on a MATRIQ instrument

#### **NOTE**

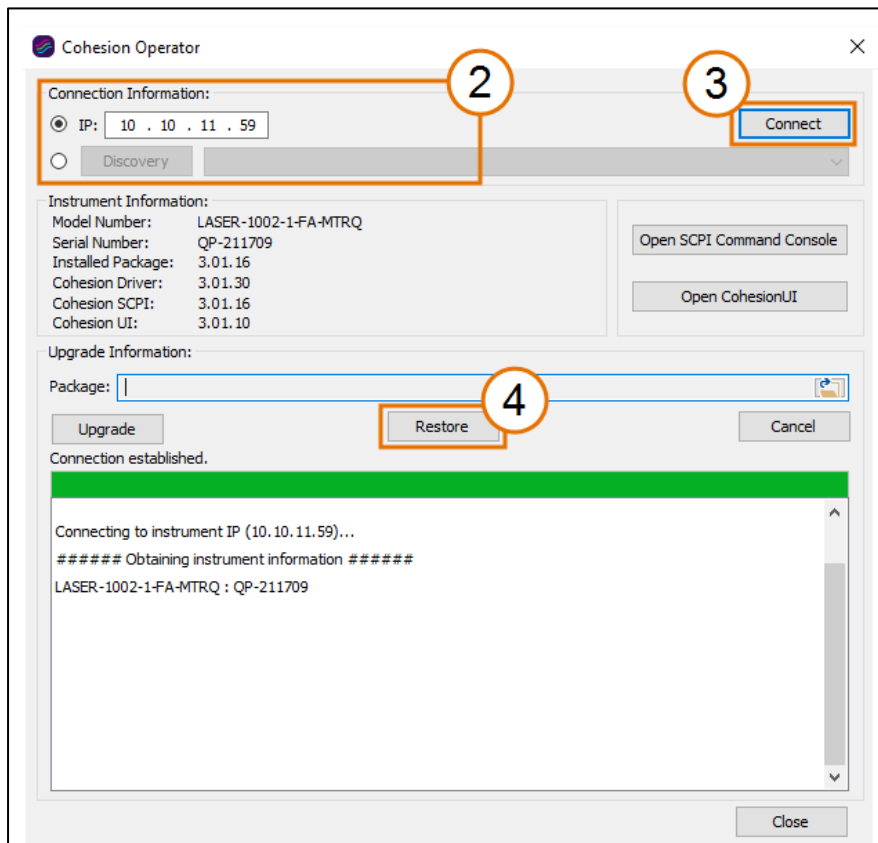
The Cohesion Operator can restore MATRIQ instruments that currently use firmware package version 2.08.24 or greater. To restore MATRIQ instruments that use older software packages, refer to the user manual that came with your instrument.

To restore factory settings:

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

#### **NOTE**

IP address settings will also revert to factory settings.



## 7 CohesionUI

CohesionUI is a web-based application that you can use to control any BERT 1005 product from Quantifi Photonics. Its cutting-edge design offers a sleek modern interface, cross-device compatibility, multi-instrument control, customizable views, and remote access.

### 7.1 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.



### 7.2 Accessing CohesionUI for MatriQ instruments

You can open CohesionUI:

- from the Cohesion Operator application, or
- from your browser.

#### **NOTE**

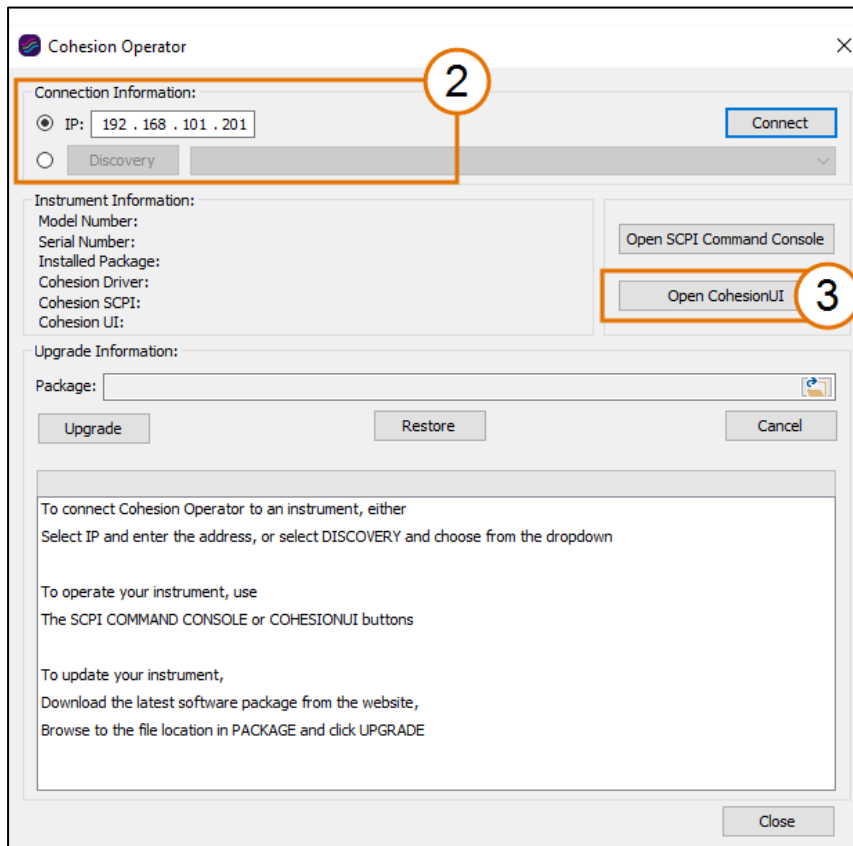
The IP address of the MatriQ instrument is displayed on the LCD screen on the back of the instrument. When the instrument is connected via both, Ethernet and USB cables, the displayed IP address will alternate between the USB and Ethernet IP address.

#### **NOTE**

If required, the IP address can be statically assigned to the Ethernet or USB connection.

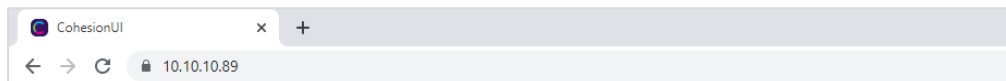
To open CohesionUI from Cohesion Operator:

1. Open Cohesion Operator on a client computer, for example by double-clicking the **Cohesion Operator** desktop icon.
2. Select the instrument by entering its **IP address** or by selecting it from the **Discovery** drop down list.
3. Click Open **CohesionUI**.



To open CohesionUI from a browser:

1. Launch Google Chrome or Microsoft Edge on a client computer.
2. Type in the MATRIQ instrument IP address into the address bar of the browser, e.g. **10.10.10.89**.



### 7.3 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.

The interface displays the modules installed in CHASSIS 0. The left sidebar contains navigation options: HOME, MODULES, SETTINGS, and INFO. The main area shows a list of modules with their names, serial numbers, and firmware versions.

**CHASSIS 0** SYNC

**EMPTY SLOTS: HIDDEN** SERIAL NUMBER: COHESIONUR-DEMO

Module Name	Serial Number	Firmware Version	Slot
SWITCH-1003	1003-1-8C-PHX	CSL-190101	2
SWITCH-1003	1003-1-8C-PHX	CSL-190101	3
OSA-1004	1004-8C-PHX	CSL-190103	4
BERT-1003	1003-4-PHX	CSL-190104	5
POWER-1501	1501-2-8C-PHX	CSL-190103	6
O2E-1101	1101-2-8C-PHX	CSL-190104	7
LASER-1001	1001-2-8C-PHX	CSL-190101	8
VOA-1001	1001-1-8C-PHX	CSL-190104	9
EDFA-1001	1001-1-8C-PHX	CSL-190104	10
LASER-1201	1201-2-8C-PHX	CSL-190101	12

**CHASSIS 0** SYNC

**EMPTY SLOTS: SHOWN** SERIAL NUMBER: COHESIONUR-DEMO

Module Name	Serial Number	Firmware Version	Slot
SWITCH-1003	1003-1-8C-PHX	CSL-190101	2
SWITCH-1003	1003-1-8C-PHX	CSL-190101	3
OSA-1004	1004-8C-PHX	CSL-190103	4
BERT-1003	1003-4-PHX	CSL-190104	5
POWER-1501	1501-2-8C-PHX	CSL-190103	6
O2E-1101	1101-2-8C-PHX	CSL-190104	7
LASER-1001	1001-2-8C-PHX	CSL-190101	8
VOA-1001	1001-1-8C-PHX	CSL-190104	9
EDFA-1001	1001-1-8C-PHX	CSL-190104	10
LASER-1201	1201-2-8C-PHX	CSL-190101	12
Slot 11			
Slot 13			
Slot 14			
Slot 15			
Slot 16			
Slot 17			
Slot 18			

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.

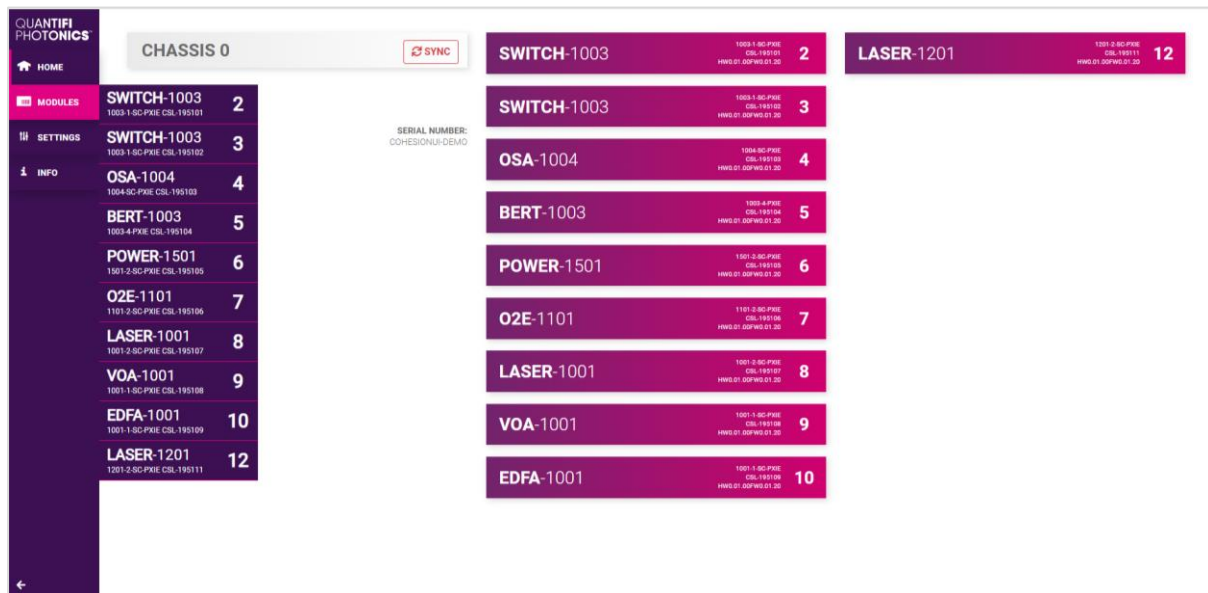
The interface displays the controls for the LASER-1001 module. The top bar shows the module name and the instrument model and firmware version: 1001-2-FC CSL-193902 HW0.01.00FW0.01.33. The left sidebar contains navigation options: HOME, MODULES, SETTINGS, and INFO. The main area shows the controls for CHANNEL 1 and CHANNEL 2.

**LASER-1001** 1001-2-FC CSL-193902 HW0.01.00FW0.01.33 ACTUAL | SET VALUE

Channel	State	Frequency	Fine Tune Offset	Power
CHANNEL 1	OFF	193.414500 THz 193.414500 THz	0.000000 THz	-99.00 dBm 10.00 dBm
CHANNEL 2	OFF	191.100000 THz 191.100000 THz	0.000000 THz	-99.00 dBm 10.00 dBm

## 7.4 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.



### 7.4.1 Set and Actual values

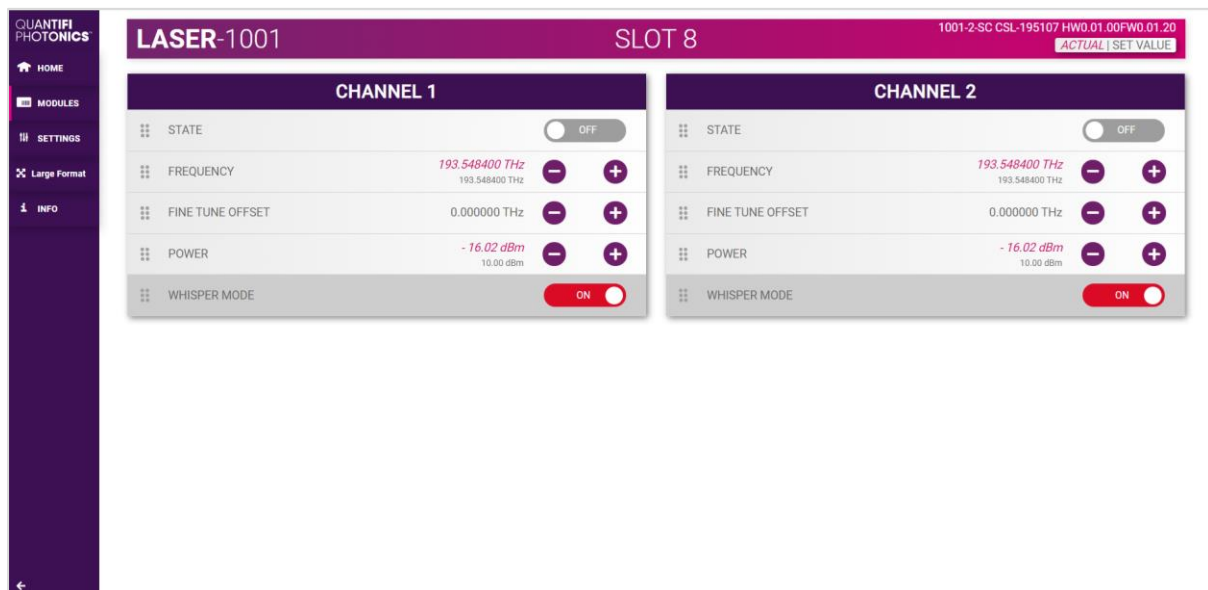
Some Quantifi Photonics products will allow the user to set a given parameter's value and then read that parameter (eg. Laser, VOA, O2E, etc). In order to help the user to distinguish between a set value and an actual read value, CohesionUI will format these values differently according to the legend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

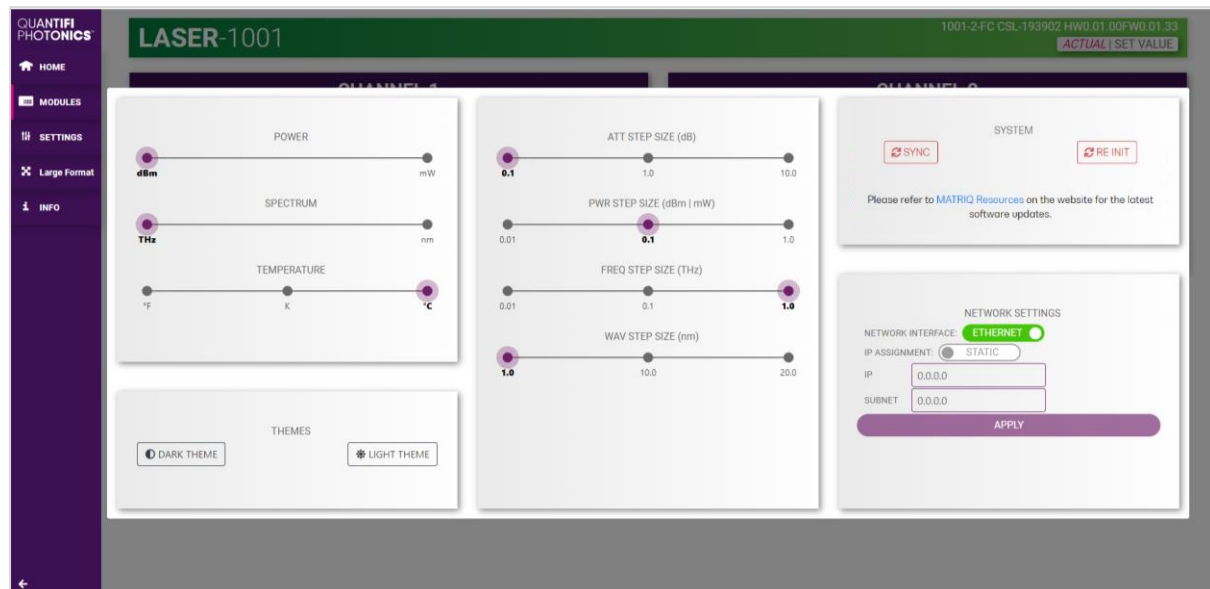
For parameters that report a value and do not depend on user input, only an **ACTUAL** value is displayed.



## 7.5 Settings page

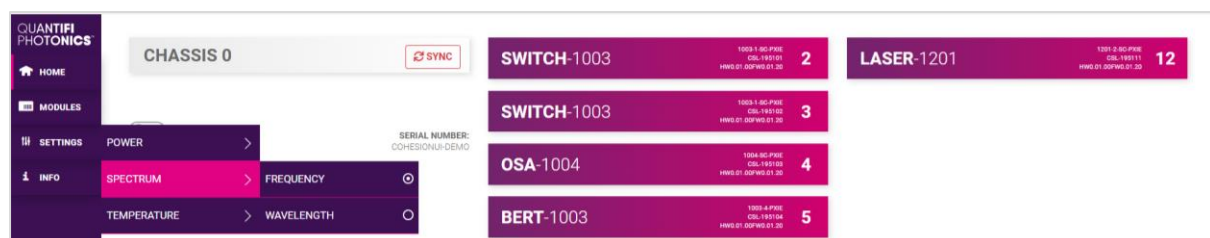
The **SETTINGS** page is used to configure the CohesionUI settings and unit preferences or to synchronize / reinitialize the system. These controls can be accessed by clicking the **SETTINGS** button.

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 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.



### 7.5.1 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

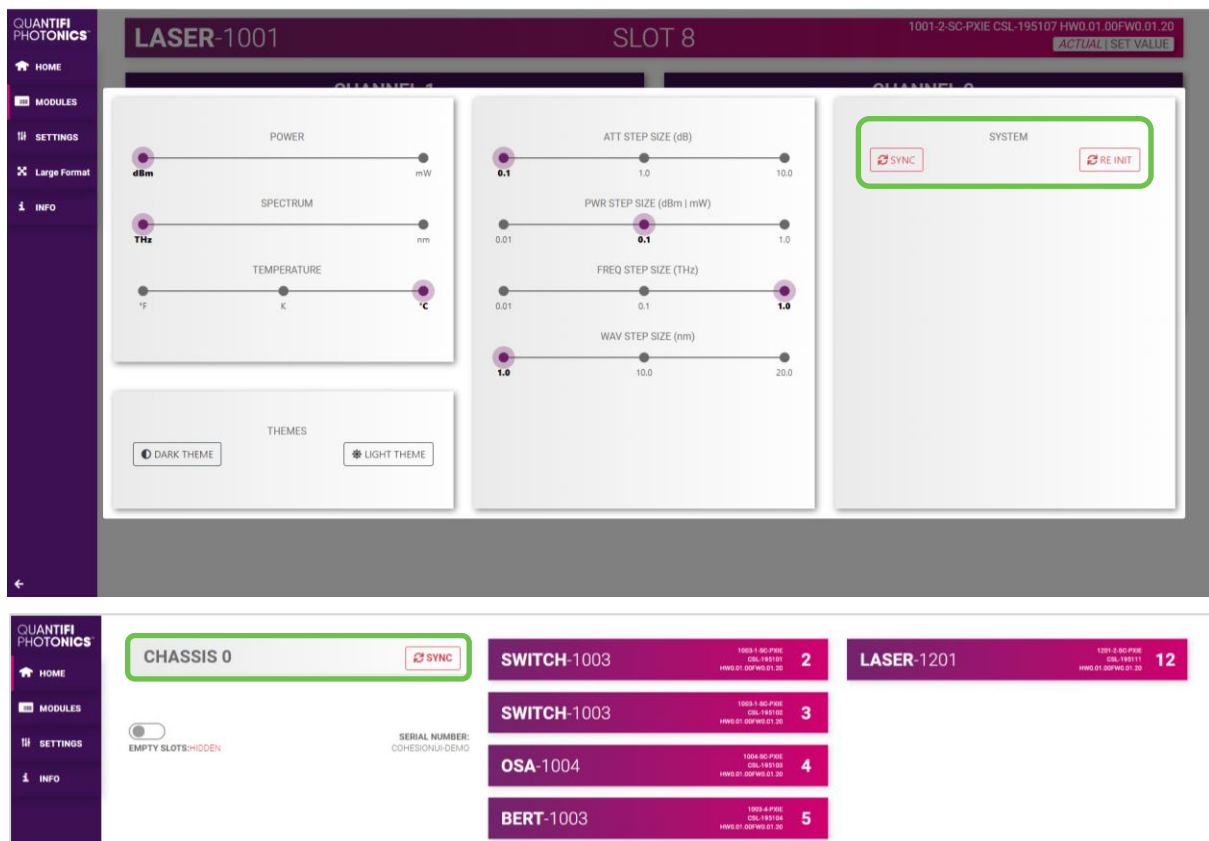


no modules are displayed in the CohesionUI window. This is useful for users who are operating in a multi-chassis MXI setup, instead of the standard PXIe embedded controller setup.

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.

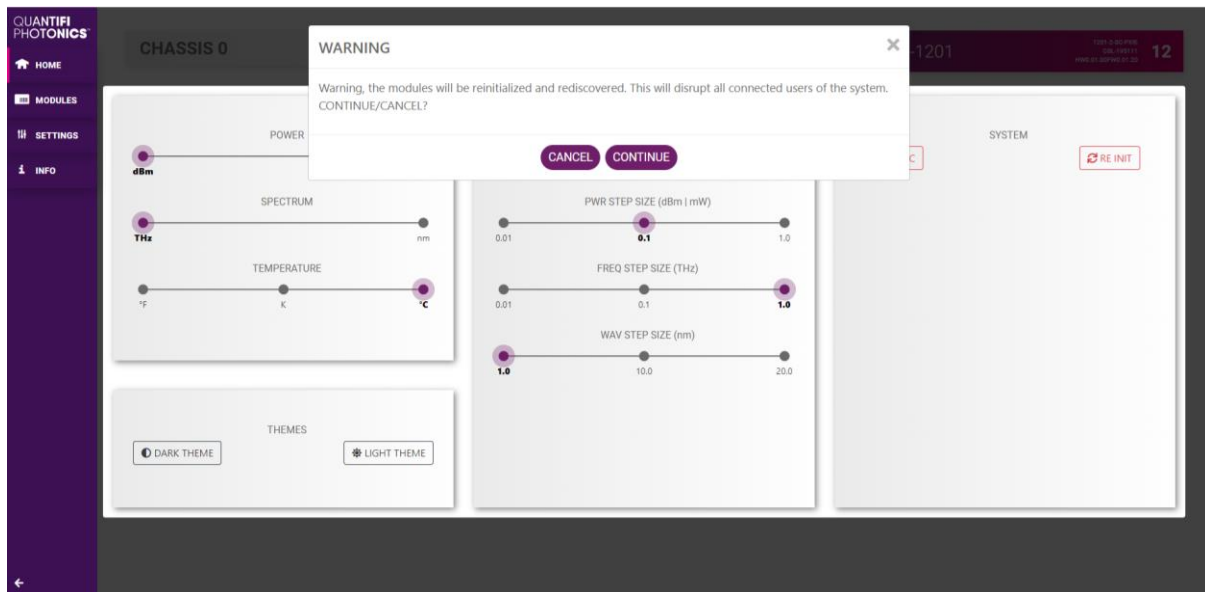
The **SYNC** button is also displayed on the **HOME** page beside every chassis in the setup. This allows any chassis to be synchronized independently. After clicking the **SYNC** button, CohesionUI will disable the page while it is synchronizing with the CohesionSCPI service. Once it is complete, the 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.



### 7.5.2 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**

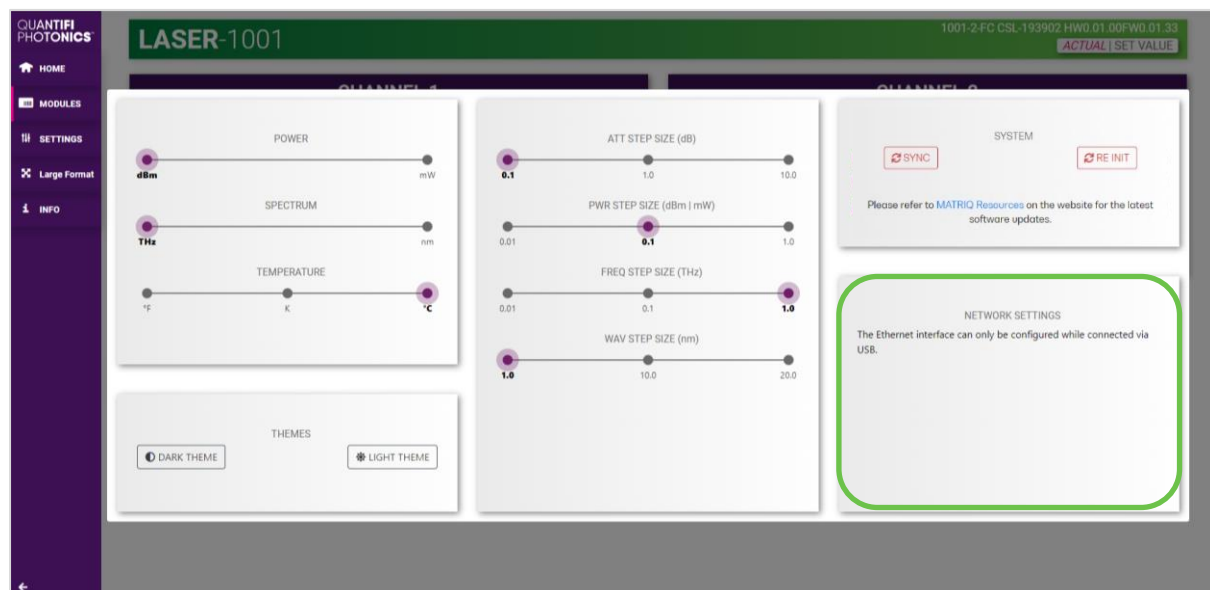
The Network interface controls are only available when connected over **USB**.

### 7.5.3 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. In order to configure ANY network interface settings, the **MATRIQ instrument will have to be connected via a USB cable** to a computer.

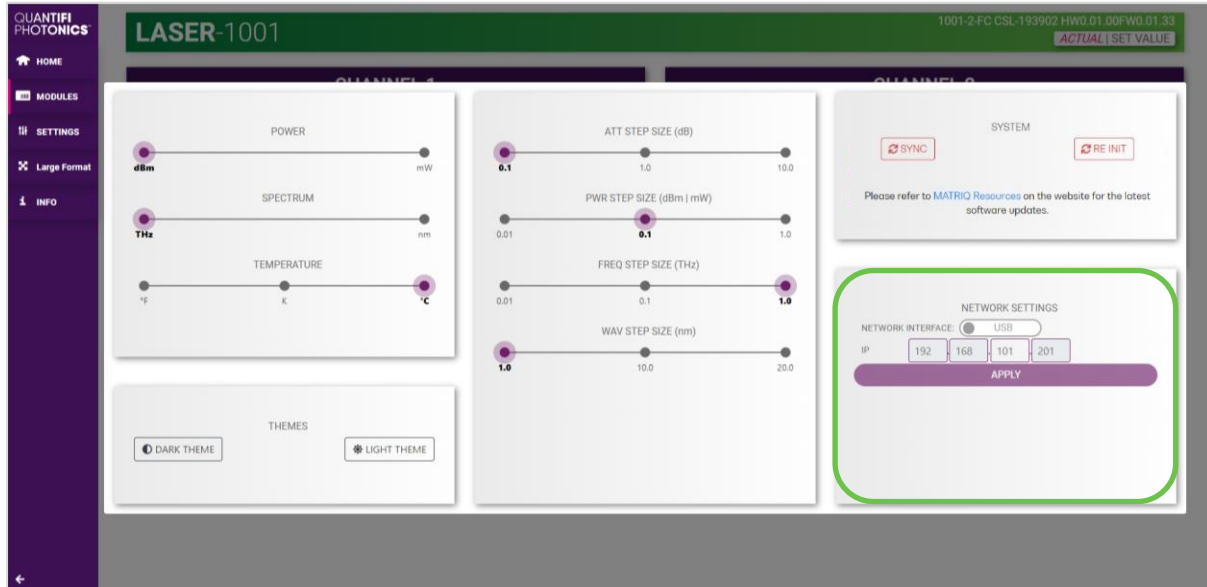
#### **NOTE**

The Network interface controls are only available when connected over USB. When connected over Ethernet the settings will be locked, as highlighted as follows.



### 7.5.4 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.



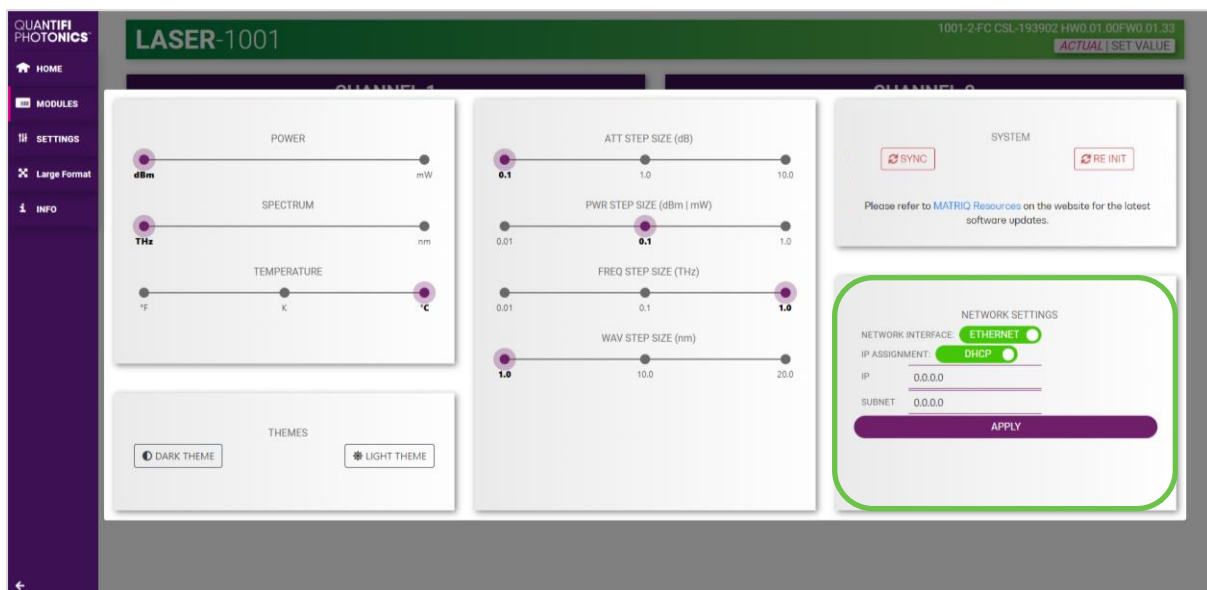
The value in the 3<sup>rd</sup> octet of the IP address can be changed to any available value. It is important to make sure that any other instruments connected to the computer do not share this new IP address, as there will be an addressing conflict.

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.

### 7.5.5 Setting the Ethernet IP address for MATRIQ instruments

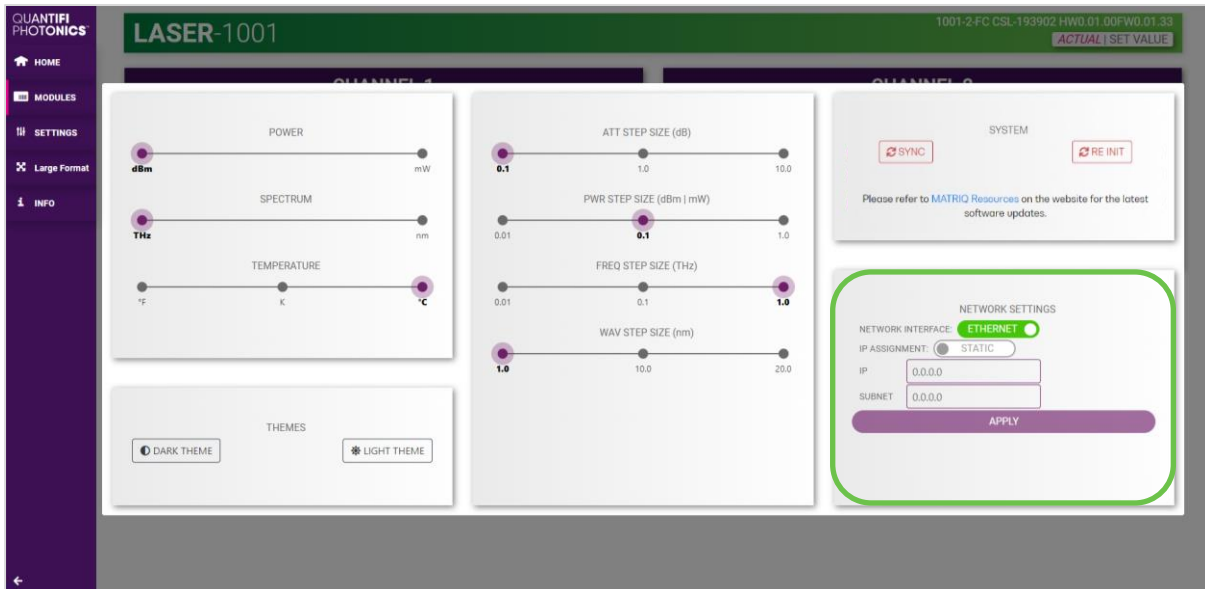
The default Ethernet IP addressing method is dynamic, as the DHCP will automatically assign the instrument an IP address. This address can be found on the back of the instrument on the LCD screen.

**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.



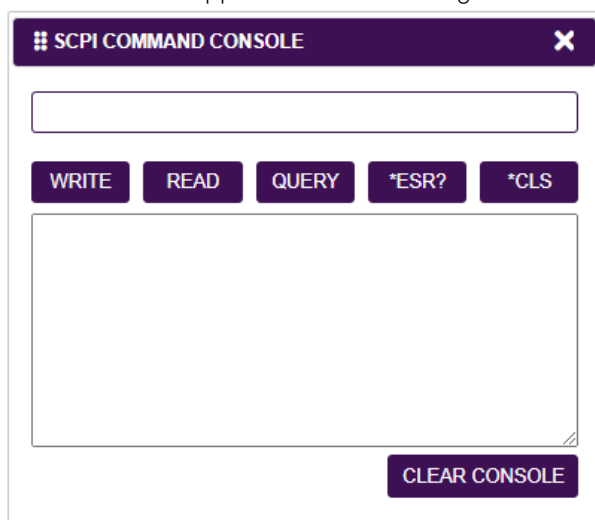
## 7.6 SCPI Command Console (available on PXIe modules)

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

For details on available SCPI commands, refer 9.

To open the SCPI Command Console:

- On the CohesionUI menu, click **CONSOLE**. The console will appear in the bottom right corner.

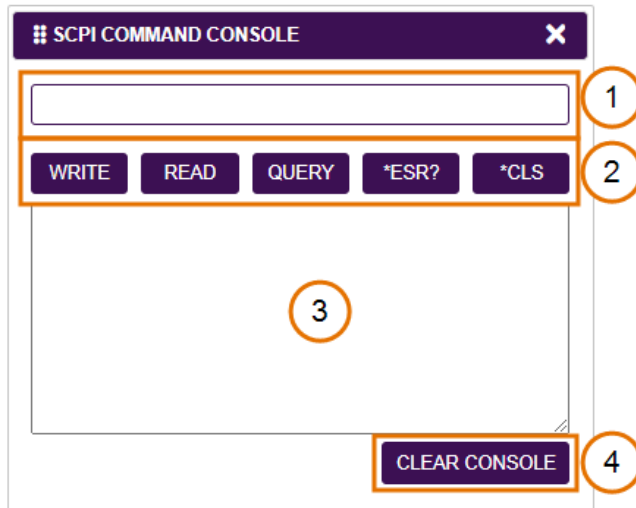


You can move the console by clicking on the title bar and dragging it to any position on the screen. On closing and re-opening, the console will re-appear at its last position.

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.

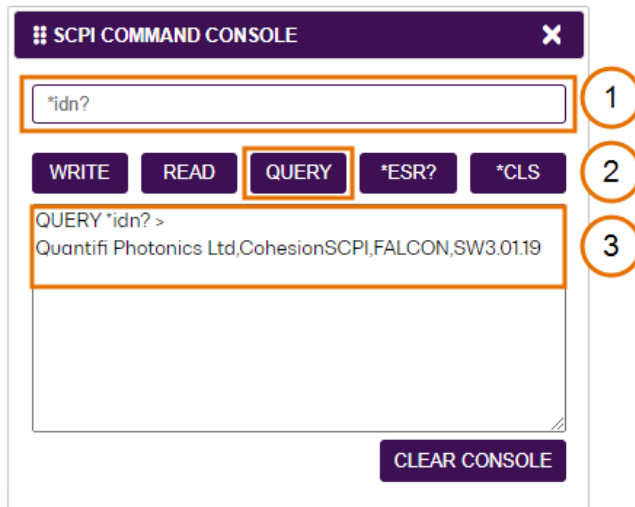


You can choose from these SCPI command actions:

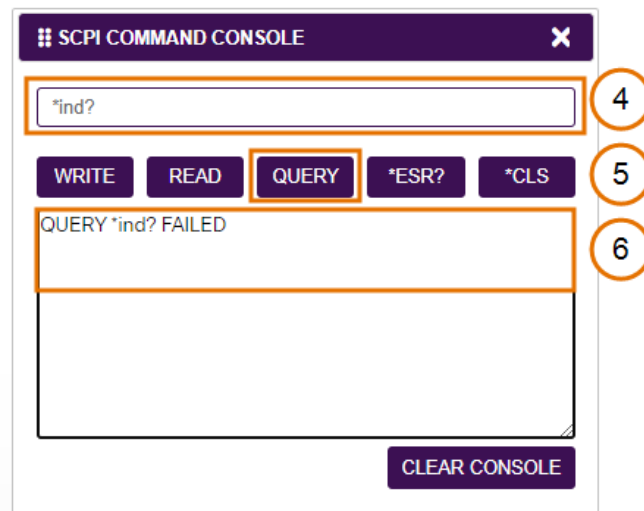
Action	Meaning	FAILED response
WRITE	Send the command to the instrument	The command is invalid. Please check the command and syntax.
READ	(after WRITE) Request the response from the instrument	Response buffer is empty.
QUERY	WRITE and READ	
*ESR?	Query the status event status register (ESR) – this will give you more details and specific information about command failures. For details on error codes, please refer to 9	
*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?`**

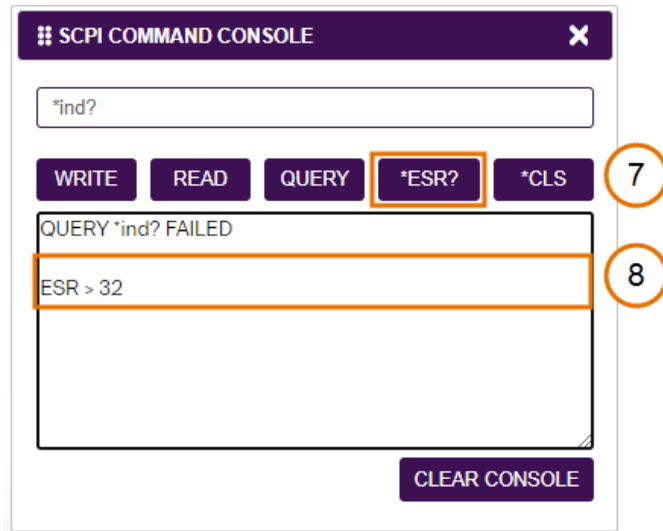
1. Enter the command: `*idn?`
2. Click **QUERY**.
3. The module returns the requested information.

**Example 2: What happens when you send an incorrect command?**

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

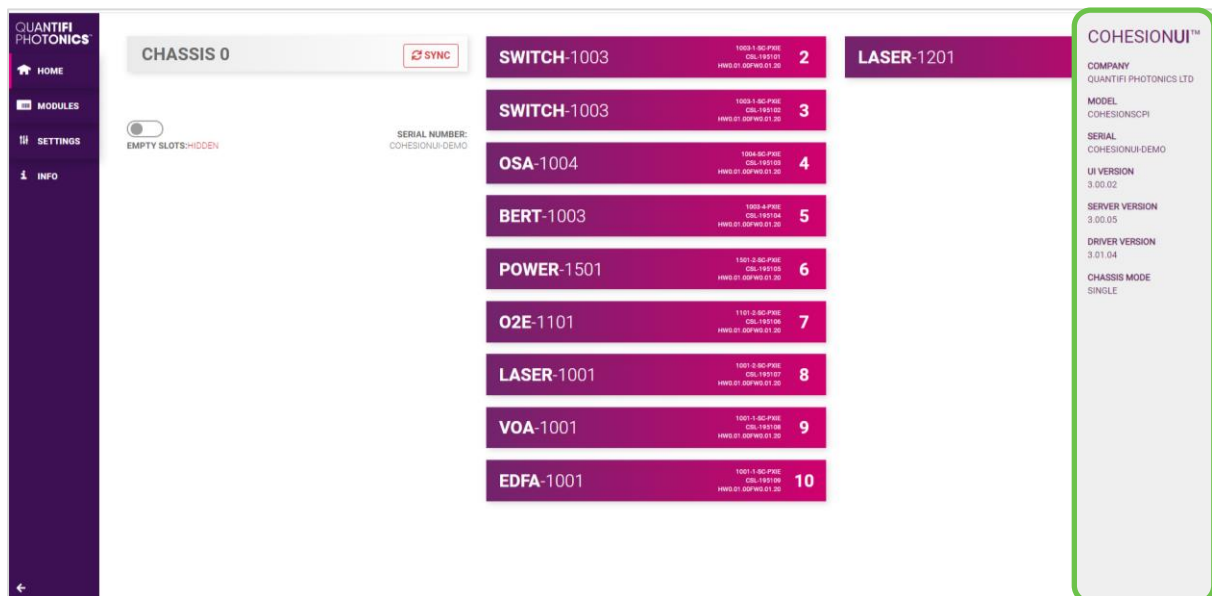
**Example 3: Investigate a command failure**

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.



## 7.7 Info panel

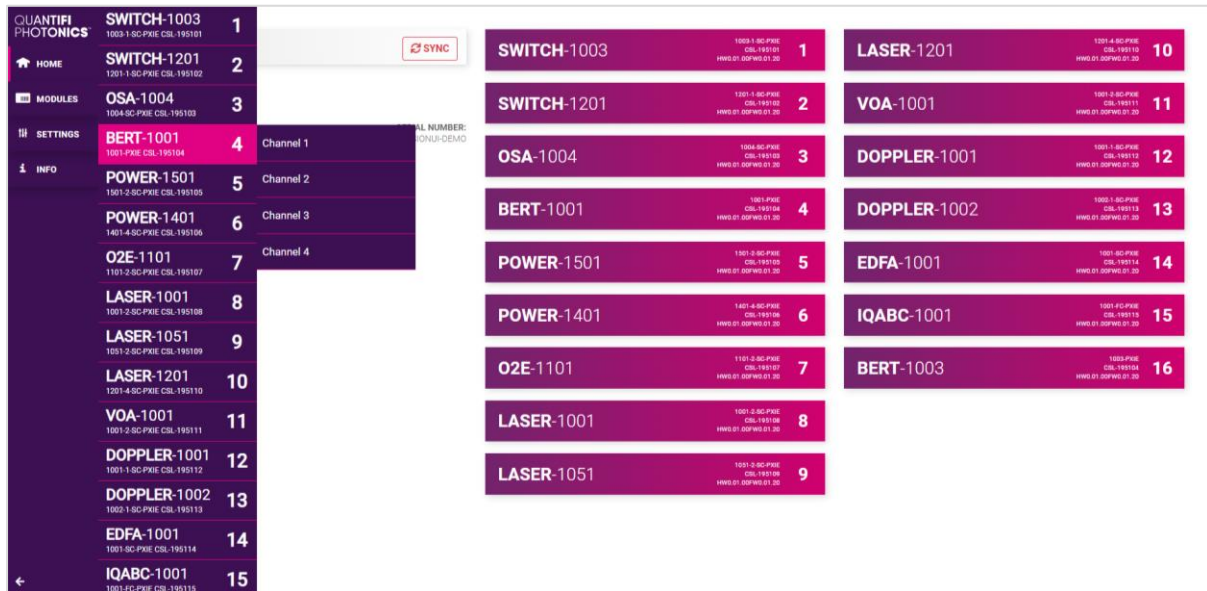
Clicking the **INFO** button will display an information panel on the right side of the page. Information such as the chassis operation mode, manufacturer, model, and serial number of the chassis, CohesionUI version number, and the version of CohesionSCPI service running on the chassis is displayed in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



## 8 BERT 1005 control with CohesionUI

To control the BERT 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 BERT module can also be selected from.

To control the BERT MatriQ instrument, click **HOME** to display controls for all channels.



After clicking the desired BERT 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.



### NOTE

When the system is busy you cannot use some features. For example, when the system is busy running error detection or eye scan, you cannot change the pattern generation settings.



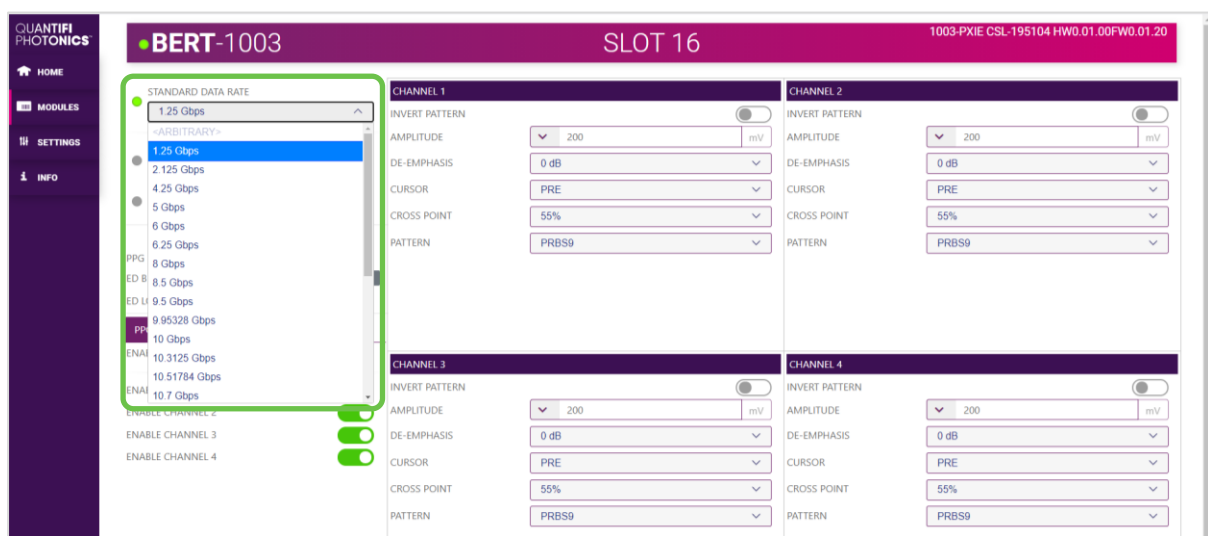
## 8.1 Module configuration

Before starting to use the BERT product to perform error detection or pattern generation, ensure that the instrument is configured correctly.

### 8.1.1 Set up the data rate

Each BERT product has an integrated, low noise, fractional clock synthesizer, which can set the relevant frequency based on the data rate that has been set. A list of commonly used data rates has been programmed and stored inside the product, with the relative frequency calibration files for optimal frequency accuracy and lowest RMS clock jitter.

To set the standard data rate, click the **STANDARD DATA RATE** drop-down list and select an appropriate data rate value.



To set an arbitrary data rate for pattern generation or error detection, type an appropriate value in the **ARBITRARY DATA RATE OF PPG** or the **ARBITRARY DATA RATE OF ED** fields. In this case, the value of the **STANDARD DATA RATE** field automatically changes to **<ARBITRARY>**, as shown below. You can also use the arrows to increase or decrease the value.



The arbitrary data rate must be within the valid range. The parameter can also be set to the **MIN** (1.25 Gbps) and **MAX** (14.5 Gbps) value by clicking the dropdown in the name of the parameter.



Each time the data rate is changed, the clock synthesizer is unlocked for the frequency to change, and then locked once the frequency is set. The lock status is indicated by the **SYNTHESIZER VCO LOCK** indicator on the **CLOCK** tab.



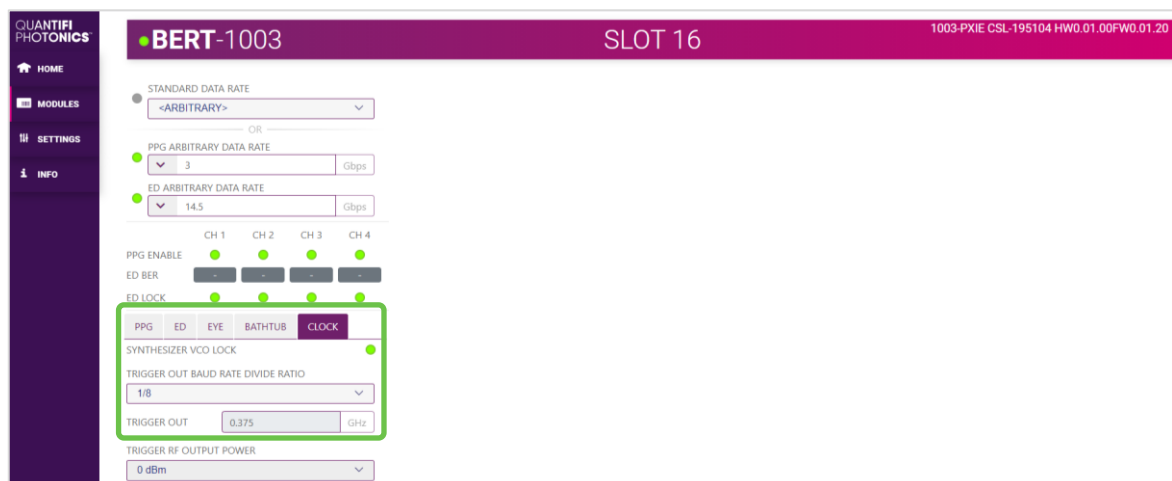
After changing the frequency, the lock indicator turns to dark green (●), and once the synthesizer is locked to the new frequency it turns to light green (●).

### 8.1.2 Configure the trigger out signal

To set the trigger-out frequency for the internal clock synthesizer, set the **TRIGGER-OUT DIVIDE RATIO** according to the following steps:

1. Click the **CLOCK** tab at the lower-left part of the page.
2. Select an appropriate value from the **TRIGGER OUT BAUD RATE DIVIDE RATIO** drop-down list.

The frequency value in the **TRIGGER OUT** field will change accordingly.



3. To set the trigger RF output power, select an appropriate value in the **TRIGGER RF OUTPUT POWER** drop-down list.

#### NOTE

Multiple BERT PXIe modules residing in the same PXIe chassis are automatically synchronized using the internal PXIe chassis 10MHz clock.

## 8.2 Check channels status

The operation status of each channel is displayed in the channel status panel.



The indicators are used to show the operational state of each channel as follows:

- **PPG ENABLE** (Pattern generation):
  - Green – Indicates that the pattern generation is **enabled**.
  - Gray - Indicates that the pattern generation is **disabled**.
- **ED BER** (Error detection):
  - BER value displayed – Indicates that the error detection is **running**.
  - BER value hidden - Indicates that the error detection is **stopped**.
- **ED LOCK** (Error detection PLL lock):
  - Green – Indicates that the PLL lock for error detection is **enabled**.
  - Gray- Indicates that the PLL lock for error detection is **disabled**.
  - Orange- Indicates that the PLL lock is **being changed**.

A general status indicator is displayed to the left of the product model number. A green indicator represents that the product is ready to operate, and an orange indicator represents that it is busy.



### 8.3 Error detection

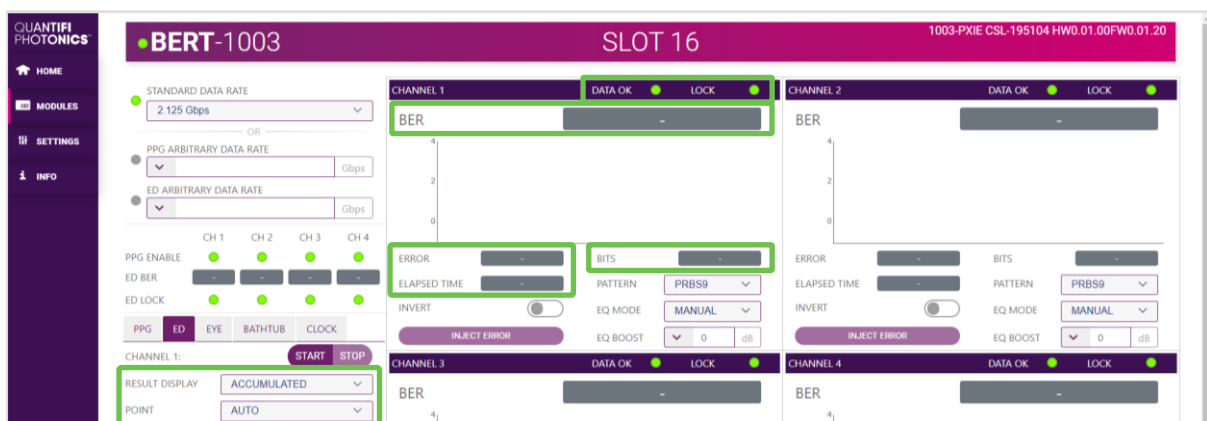
The ED channel inputs must be connected to the signal for the error detectors to work properly. Follow the suggested configuration and meet proper torquing requirements for RF cables and bulkheads to guarantee error free operation.

For error analysis, an error rate vs. time plot is displayed, showing the error rate trend. The graph is a strip chart that displays the BER count of the last 20 seconds, with one data point per second. The strip chart can be used to monitor either the total error count (accumulated BER mode) or the instantaneous error count (error rate calculated over the last one second). The time plot tool can be very helpful in isolating repetitive errors that occur at low frequencies, error bursts, and other thermal cycling or changing conditions that can affect digital communications.

#### 8.3.1 Error detection indicators

The following indicators are used to indicate the data, error, and operation status:

- **RESULT DISPLAY:** Display the result type of the BER measurement (see section 8.3.7).
- **POINT:** The current ED point mode status (see section 8.3.8 for more information).
- **DATA OK:** The presence of valid data at the input of the ED circuits.
  - Green indicator – Indicates that data is present at the ED input.
  - Gray indicator – Indicates that no data is present at the ED input.
- **LOCK:** The lock status of the input data of the internal PLL (phase-locked loop). PLL must be locked for the bit counter to start measuring BER.
  - Green indicator – Indicates that the PLL is locked to the ED input pattern.
  - Red indicator – Indicates that the PLL is not locked to the ED input pattern. Check the input pattern and force a re-sync to lock the PLL before attempting to start the BER counter.
- **BER (Bit Error Rate):** Current BER of the incoming data pattern.
- **ERROR:** Number of error bits since the start of the ED counter.
- **BITS:** Number of incoming bits counted since the start of the ED counter.
- **ELAPSED TIME:** Elapsed time in seconds measured since the start of the ED counter.

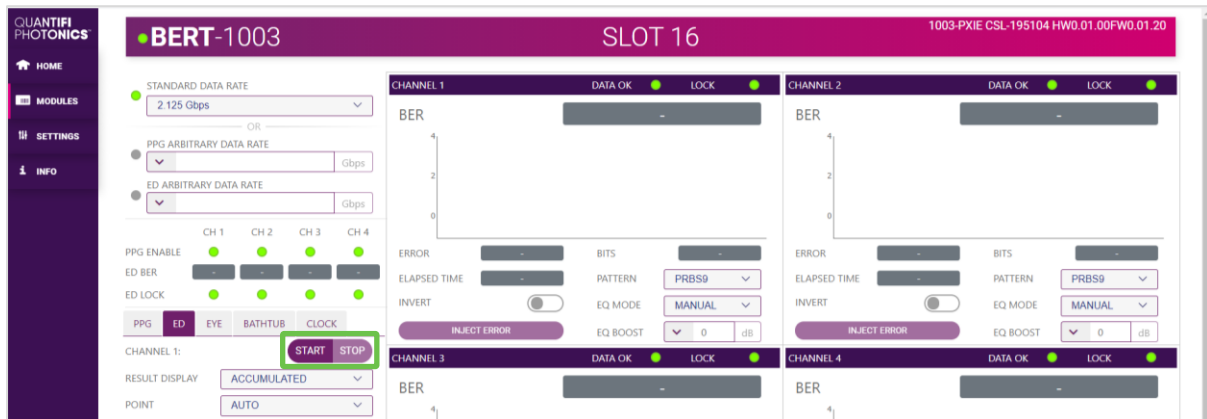


#### NOTE

If the **ERROR** count exceeds the maximum allowable number of errors for the error detector, the error detector will automatically stop, and the **ERROR** field will turn red. The maximum number of errors for the ED mode is  $2^{64}-1$ .

### 8.3.2 Start / Stop error detection

The error detection for a channel can be started or stopped at any time, by clicking the START / STOP buttons under the corresponding channel section.



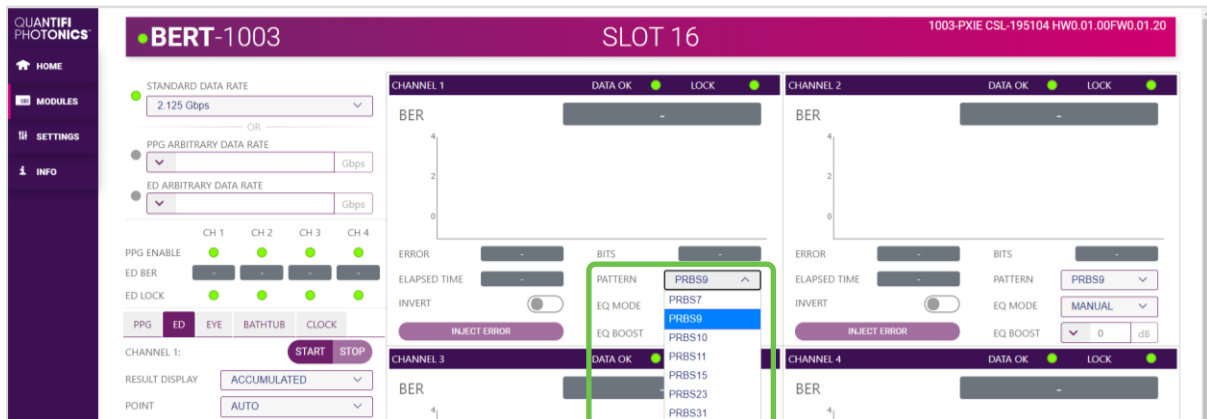
#### NOTE

The receiver of the error detector has a limiting amplifier to protect sensitive electronics. The front-end amplifier may clamp the receiver inputs.

### 8.3.3 Specify the pattern of the input signal

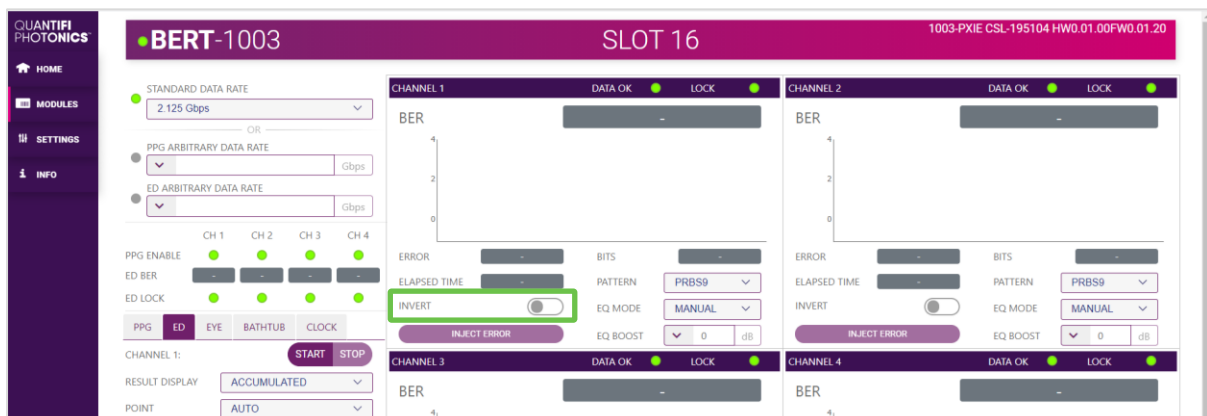
To set the test pattern of the input signal, select the pattern from the **PATTERN** drop-down list.

All the PRBS patterns have an odd length of  $2^n - 1$  bits, where 'n' = 7,9,10,11,15,23 and 31.



### 8.3.4 Invert the polarity of the test pattern

The polarity of the test pattern can be inverted at the ED input level by toggling the INVERT button. Test pattern inversion can only be implemented **before the ED is enabled**. While test pattern inversion is enabled, the color of the toggle button will be green.

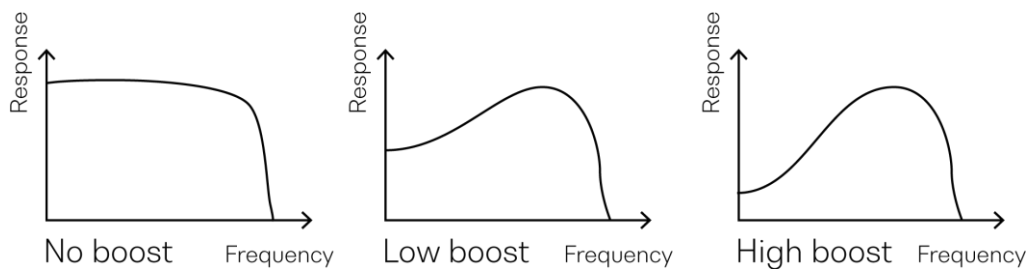


### 8.3.5 Configure the receiver equalization setting

The input stage for each error detector channel includes a continuous-time linear equalizer (CTLE) providing channel independent adjustable gain control. The ratio of the gain at 14 GHz to the low-frequency gain of the equalization can be adjusted by changing the equalizer (EQ) boost value for a channel. The adjustment range is between 0 dB and 21 dB, where the default setting for the EQ boost is 0 dB for each channel.

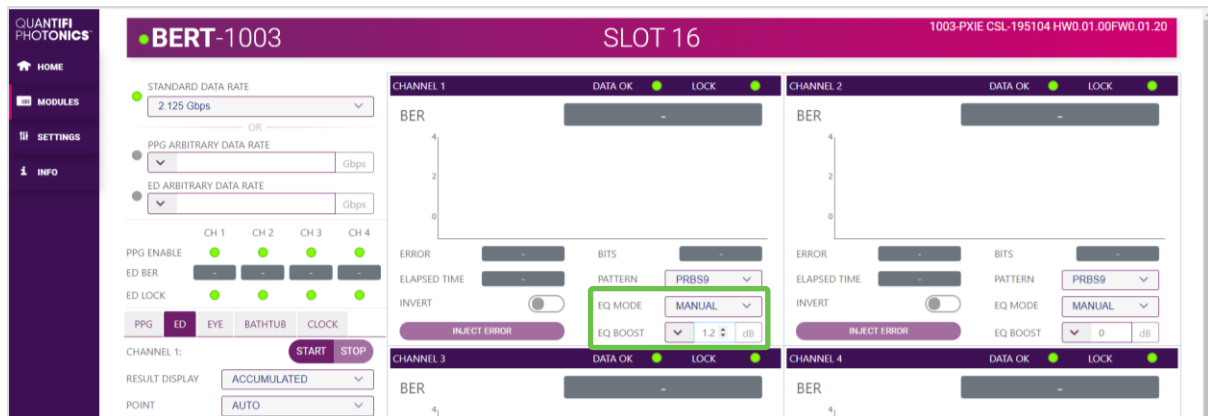
There are two modes for the EQ boost: Automatic and Manual. With the automatic mode, the system automatically determines the optimal value of the EQ boost. The manual mode enables the flexibility to specify the EQ boost value.

The response curve of the equalizer for the varying EQ boost values is shown below.



To specify the receiver equalization setting, take the following steps:

1. Click the **EQ MODE** drop-down list and select **MANUAL** or **AUTO** mode.
2. If **MANUAL** mode was selected, type a value within the valid range in the **EQ BOOST** field.  
The parameter can also be set to the **MIN** and **MAX** value by clicking the dropdown in the **EQ BOOST** field.



### 8.3.6 Inject errors

A burst of errors can be injected on each channel to test the functionality of the error detector circuitry. To inject errors, click the **INJECT ERROR** button. Each time the button is clicked, the pattern being generated by the pattern generator inverts its polarity temporarily to force errors in the error detector.

#### NOTE

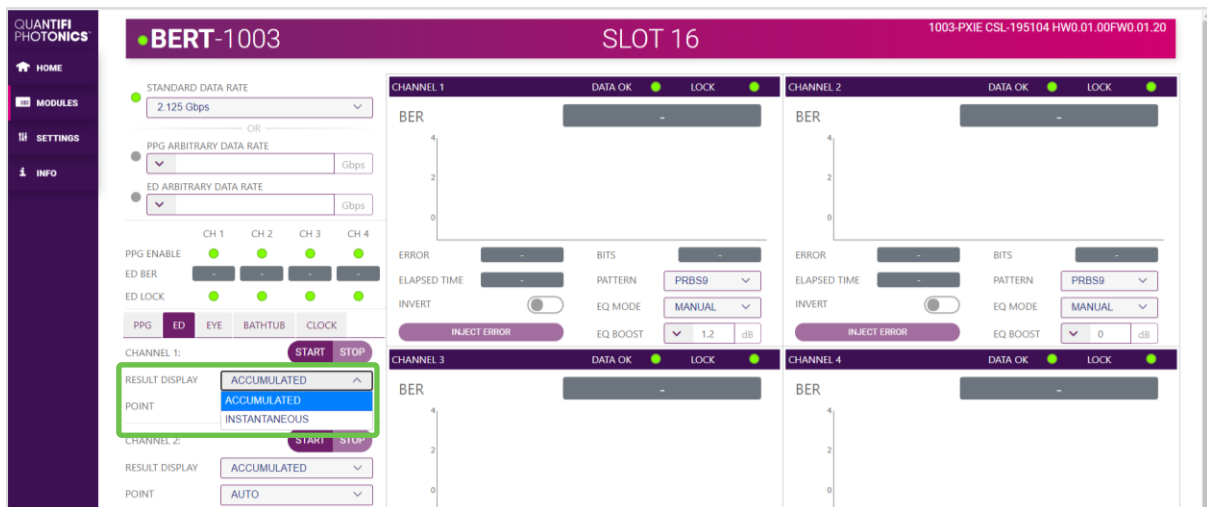
**INJECT ERROR** functionality is disabled when running in ED point mode.

### 8.3.7 Specify the result display type

The BER measurement can be displayed either by the accumulated BER information or by the instantaneous BER information.

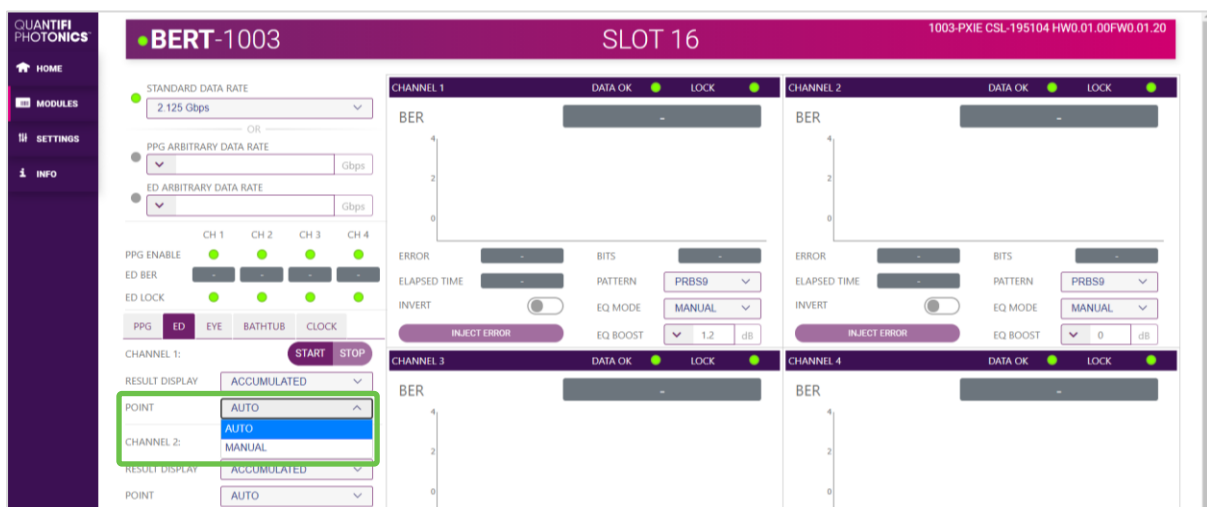
- **ACCUMULATED BER** – Indicates that the BER value is calculated from the beginning of the measurement. The BER value is equal to the ratio between the error counter and the bit counter since the beginning of the measurement.
- **INSTANTANEOUS BER** – Indicates that the BER value is calculated from the last point of the data reading. The BER value is equal to the ratio between the error counter and the bit counter since the last point of reading. The counters are reset after each reading.

To set the result display type, click the **RESULT DISPLAY** drop-down list and select the display mode.



### 8.3.8 ED point mode

The ED point mode of the error detector can be enabled by changing the mode to **MANUAL** using the drop-down list. When operating in manual ED point mode, the voltage and phase decision levels for the error detector can be modified.



#### NOTE

When operating in manual mode, the maximum ERROR count is  $2^{16}-1$ .

### 8.3.9 Eye scan

An eye scan is used for diagnostic testing and validation. The horizontal axis of the eye represents the clock phase alignment of the error detector to the received bit, and the vertical axis represents the decision threshold voltage level, also referred to as the slicer level. At each point on this two-dimensional matrix of clock phase alignment and slicer level, the counted bit error rate is represented on a logarithmic color map.

The bit error rate tester (BERT) eye scan differs from the traditional oscilloscope eye pattern, mainly in the sampling rate. The BERT samples all bits as they are received during testing, whereas a traditional equivalent-time sampling scope only takes one sample per trigger (such that it is only sampling for a small fraction of the time). Therefore, for error rates that are very low, the BERT method of the eye pattern testing is much more precise in showing where the thresholds in the contour are.

#### 8.3.9.1 Configure eye scan settings

To configure the eye scan settings for a channel, click the **EYE** tab and configure the following settings:

- **VERTICAL RESOLUTION:** The voltage step-size that is used as the vertical resolution of the eye diagram.
- **HORIZONTAL RESOLUTION:** The phase step-size that is used as the horizontal resolution of the eye diagram.
- **PATTERN:** The data pattern that the ED is expecting to receive.



#### 8.3.9.2 Start / Stop eye scan

The eye scan for a channel can be started or stopped by clicking the **START / STOP** buttons under the corresponding channel. To apply the function on all channels, use the top **START / STOP ALL** buttons.



#### NOTE

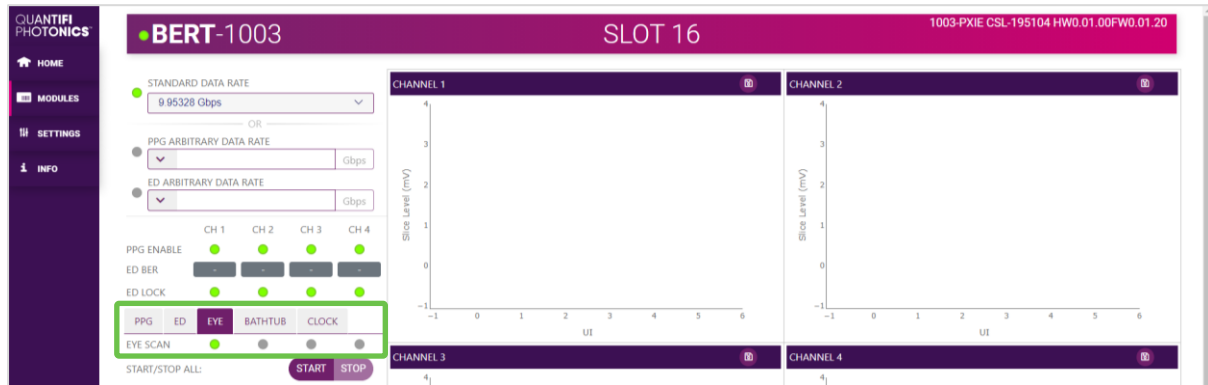
- Eye scan can only be run for **one channel at a time**. If you start or stop the eye scan for all channels, it will be started or stopped for each channel sequentially.
- Eye scan cannot be started for a channel if error detection is in progress for the same channel.



### 8.3.9.3 Eye scan status

The eye scan status of each channel is represented by indicators in the EYE tab as follows:

- **Green** – Indicates that the eye scan operation has been **completed successfully**.
- **Gray** – Indicates that the eye scan operation is **not started or has been stopped**.
- **Orange** – Indicates that the operation is currently **in progress**.



### 8.3.10 Bathtub scan

The bathtub scan is used to measure the jitter of a data signal. The horizontal axis of the bathtub represents the clock phase alignment of the error detector to the received bit, and the vertical axis represents the bit error rate at a set voltage decision point. The bathtub plot is a one-dimensional representation of the information taken from a horizontal slice of an eye diagram. The bit error rate decreases as you move into the center of the eye, which gives the bathtub plot its distinctive shape.

A bathtub scan starts by measuring the BER at sampling points outside the eye width, on both the left and the right sides of the eye. The clock phase alignment is then increased for the left side of the plot or decreased for the right side of the plot so that the scan progresses towards the center of the eye. The BER will continue to be measured at each point until the number of errors drops below a set value. When the measured number of errors fails to meet this threshold, the BERT will dynamically increase the time spent at that point to accurately measure the BER for the set sampling point. An estimated time is given for the measurement of the next data point, which may reset if the number of errors is less than the threshold at the end of the wait time.

Due to the long waiting time associated with low values of BER, the bathtub scan provides extrapolation of the BER values. This allows users to easily determine the total jitter at BER levels associated with J2, J9 and J12.

The terms J2, J9, and J12 are terms defined by the IEEE 802.3 standards referring to the various portions of jitter that are comprised of a systems total jitter.

- J2 – The time interval that contains all but  $10^{(-2)}$  bit error rate of the total jitter. Contains most of the jitter due to the inter-symbol interference (also referred to as Data Dependent Jitter or DDJ).
- J9 – Indicates the time interval of the outer one-billionth of the distribution, from  $BER = 2.5 \times 10^{(-10)}$  and lower. J9 is dominated by the Gaussian tails of the random jitter distribution.
- J12 – A common pass/fail point for an error rate in  $BER = 2.5 \times 10^{(-13)}$  and lower.

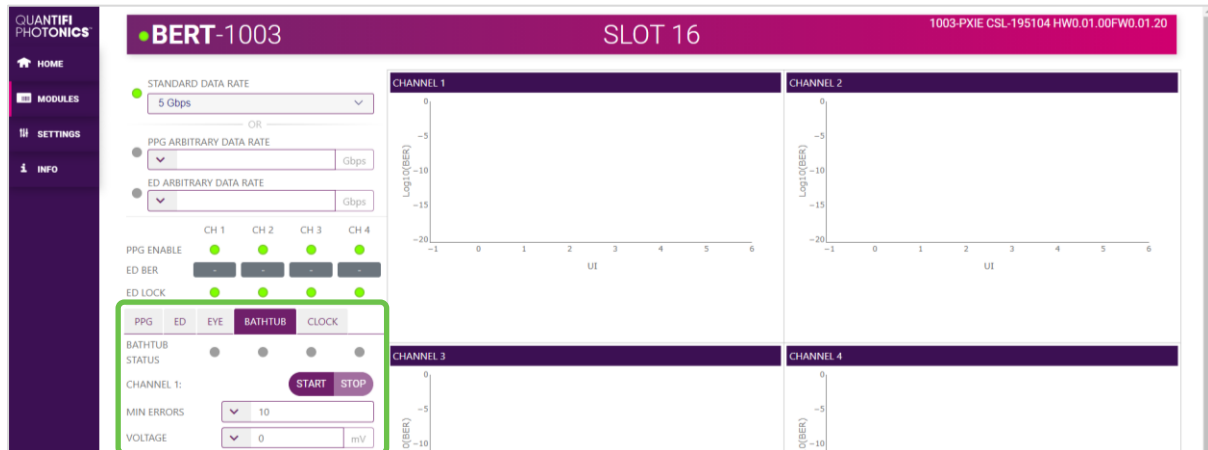
The well-known Dual Dirac jitter model has been used to decompose the total jitter into deterministic jitter and random jitter.

### 8.3.10.1 Configure bathtub scan settings

To configure the bathtub scan, click the **BATHTUB** tab and configure the following settings:

- **Minimum error threshold:** The minimum number of errors to measure for each point. To set the minimum error threshold, select an appropriate value from the **MIN ERRORS** drop-down list.
- **Voltage decision point:** The voltage that is used as the decision point of the bathtub scan. This usually shows the most useful information at the centre of the eye. To set the voltage decision point, select an appropriate value from the **VOLTAGE** drop-down list.

The parameter can also be set to the **MIN** and **MAX** value by clicking the dropdown lists in the fields.



### 8.3.10.2 Start / Stop bathtub scan

The bathtub scan for a channel can be started or stopped by clicking the **START** / **STOP** buttons under the corresponding channel section.

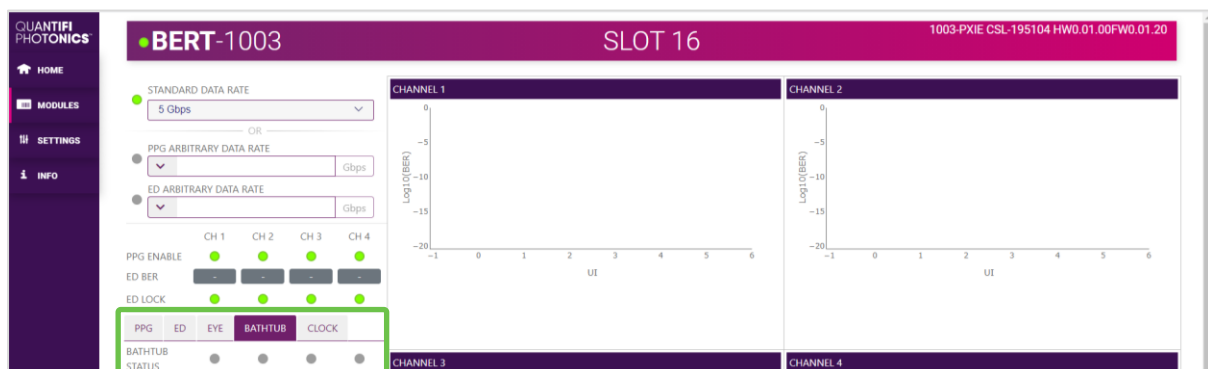
#### NOTE

The bathtub scan can be run for multiple channels at the same time by clicking on the **START** / **STOP ALL** buttons.

### 8.3.10.3 Bathtub scan status

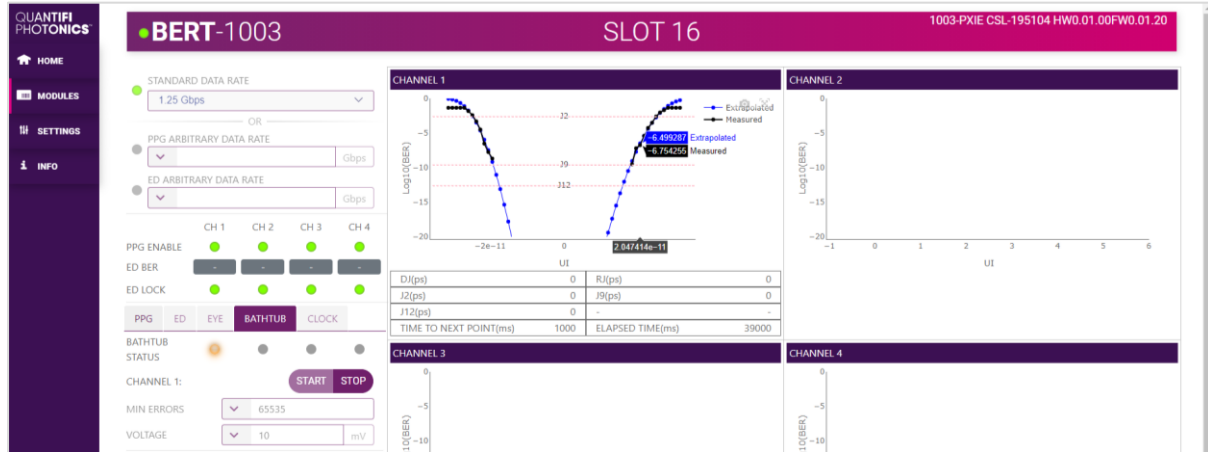
The bathtub scan status of each channel is represented by indicators in the BATHTUB tab as follows:

- **Green** – Indicates that the bathtub scan operation **has been run and completed**.
- **Gray** – Indicates that the bathtub scan operation **has not been started**.
- **Orange** – Indicates that the operation is currently **in progress**.



### 8.3.10.4 Bathtub scan plot window

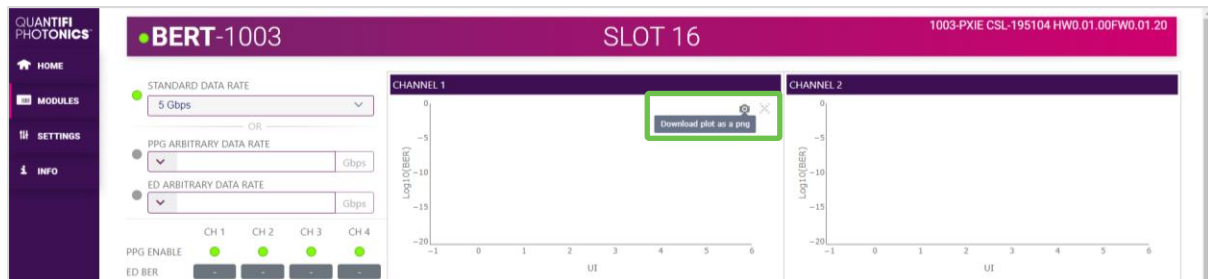
The bathtub scan plot window shows the **measured** (black curve) and **extrapolated** (blue curve) bit error rates at each sampling point. The table below the plot window shows the total jitter values at each J level, the random and deterministic jitter as calculated by the Dual Dirac method, the total time elapsed to run the scan, and the estimated time to measure the next point.



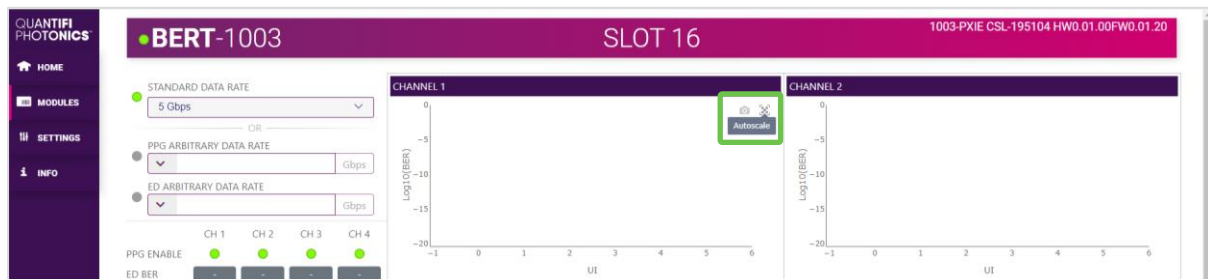
## 8.4 Chart operations

Useful functionalities such as downloading screenshots or zooming in / out on the graph are available for the error detection strip charts, the eye scan plot, and the bathtub plot. To see these options, hover over the plot window, and a toolbar will be displayed.

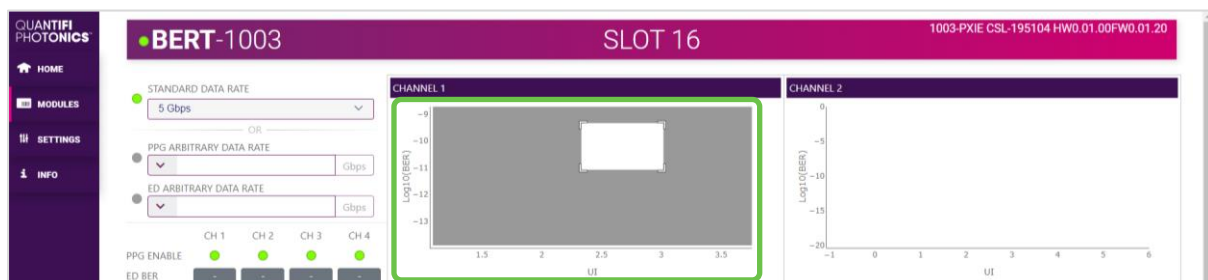
To download the plot window as a .png image click the camera button.



To scale the plot automatically to include all the viewable data click the scaling button.



To zoom in/out, click and drag the cursor on the plot. Double-click to reset to the default zoom settings.



## 8.5 Pulse pattern generation

The Pulse Pattern Generator (PPG) generates signals with different patterns, such as PRBS9 or DIV8. The output voltage, de-emphasis levels, cursor, and cross point values can be set independently for each PPG channel, and can be also inverted to a digital NRZ format pattern at the pattern generator output.

The BERT PXle takes advantage of the common 10MHz and 100MHz clocks on the PXle chassis backplane, which allows the user to install multiple BERT PXle modules on the same chassis to have a **common clock reference**. Therefore, all the PPG channels in the chassis synchronize to each other. This ability is useful when testing **more than four channels**.

### NOTE

All PPG channels are linked to the same pattern. The amplitude, de-emphasis, cursor, and cross-point are not linked and can be independently controlled on a per-channel basis.

To configure the pattern generation settings, click the **PPG** tab.



### NOTE

To reduce crosstalk between channels, ensure 50ohm loads are used to terminate unused PPG channels.

### 8.5.1 Set up the transmitter de-emphasis

The pattern generator features adjustable two-tap clocked/ unlocked output de-emphasis, to respectively compensate for the pre-cursor or the post-cursor inter-symbol interference in the transmission medium. The generator can be programmed to enable either the pre-cursor de-emphasis or post-cursor de-emphasis, but not both simultaneously.

De-emphasis on the output channels boosts the high frequency content by the selected amount. This type of adjustment can be useful for counter-balancing the loss of higher frequency components in the signal as it travels down a length of coaxial cable.

The PLL must be enabled and locked for the pre-cursor or post-cursor de-emphasis to operate.

De-emphasis of the output waveform is realized by summation of the contributions of a main tap and the pre-cursor tap. By default, there is no de-emphasis applied upon power-on.

The control of the post-cursor de-emphasis is available at any data rate; however, the control of the pre-cursor is only available for input data rates between 6.25Gbps to 7.25Gbps, 12.5Gbps to 14.5Gbps, or 25Gbps to 29Gbps. When both the pre-cursor and the post cursor de-emphasis are available, they are mutually exclusive.

## 8.5.1.1 Set the cursor and de-emphasis

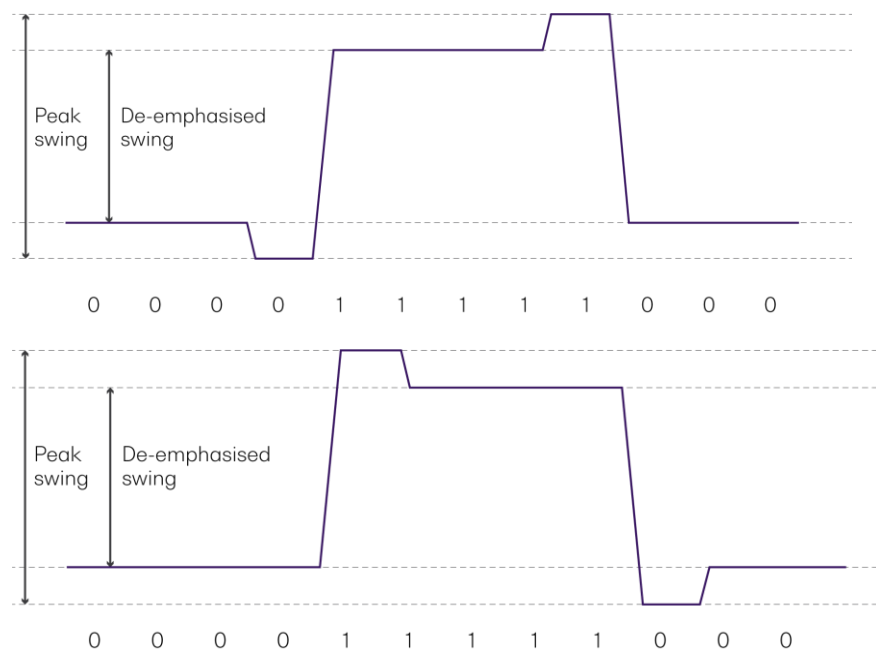
To set the pre-cursor or post-cursor de-emphasis, follow the steps below:

1. Select an appropriate value from the DE-EMPHASIS drop-down list.
2. Select PRE or POST from the CURSOR drop-down list.



## 8.5.1.2 Example of setting the pre-cursor and post-cursor de-emphasis

Consider the following pre-cursor and post-cursor example:



Pre-De-emphasis is set to a lower number while it is x for the post-De-emphasis

The Peak Swing is set by the **AMPLITUDE** field. The de-emphasis control leaves the Peak Swing unchanged, but it reduces the De-emphasized Swing, to provide the desired level of de-emphasis.

The De-emphasis swing is calculated as  $d = 20 \times \log\left(\frac{m}{n}\right)$ , where  $d$  represents the de-emphasis,  $m$  represents the Peak Swing, and  $n$  represents the De-emphasized Swing.

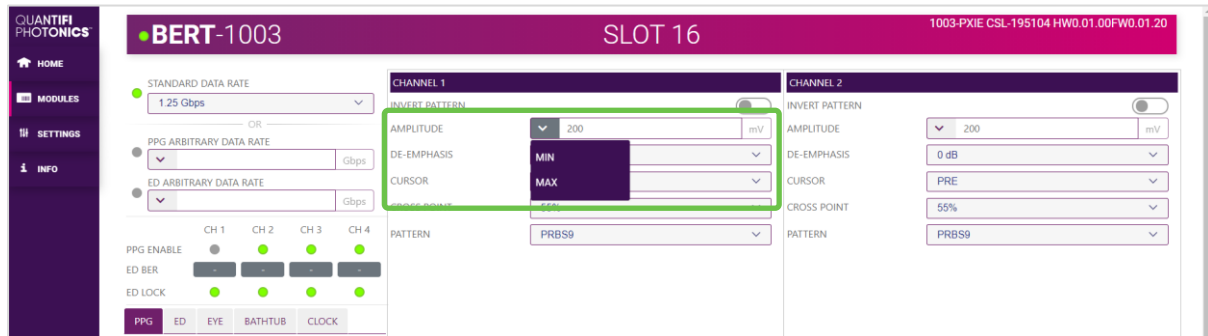
For example, if the value of the **AMPLITUDE** field (Peak Swing) is set to 800 mV, and the value of De-emphasized Swing is 505 mV, it can be calculated that the value of the **DE-EMPHASIS** field must be set to 4 dB.

The amplitude of the 0 and 1 levels can be calculated by dividing the **AMPLITUDE** (Peak Swing) by 10 to the power of the **DE-EMPHASIS** divided by 20. The difference between the 0 and 1 levels for the above example would be:  $n = \left(\frac{800\text{mV}}{10^{\frac{4\text{dB}}{20}}}\right) = 505\text{mV}$

### 8.5.1.3 Set the amplitude

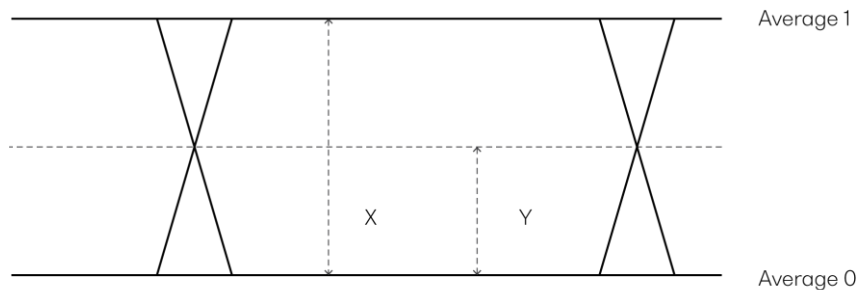
The amplitude of the output voltage can be set for each PPG channel. The value must be within the valid range of 200 mV to 1100 mV.

To set the amplitude for a channel, type an appropriate value in the **AMPLITUDE** field. The value can also be set to the **MIN** and **MAX** value by clicking the dropdown lists in the AMPLITUDE field, or by clicking the up and down arrows to increase or decrease the value.



### 8.5.2 Set the cross-point level

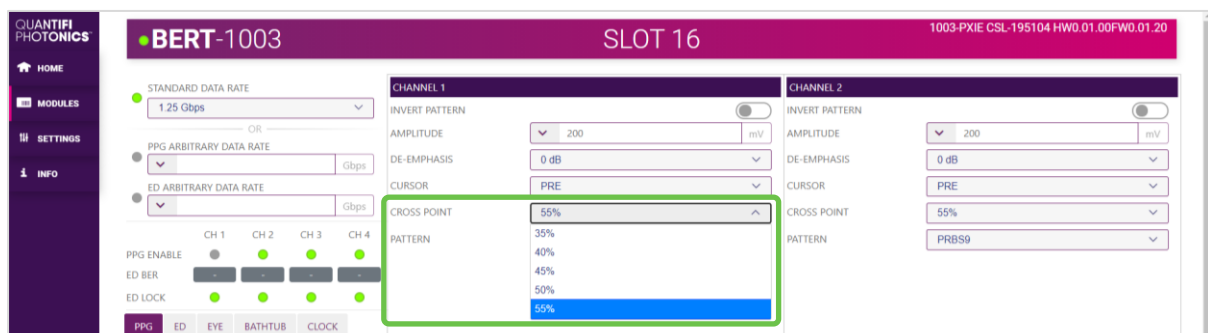
The pattern generator has a cross-point adjust function to set the output waveform crossing point as shown below. The output crossing point range is programmable from 35% to 55%.



$$CPA = \left( \frac{Y - \text{Average } 0}{X - \text{Average } 0} \right) \times 100$$

The crossing point percentage represents the amplitude of the crossing point relative to the distance between the Average zero (0) and one (1) levels. For this measurement, the average zero and one level amplitudes are measured at the center of the eye, within the middle 20% of the bit period. The crossing point amplitude is measured relative to the Average 0 level. The crossing point percentage is calculated as the crossing point amplitude (Y) divided by the distance between the average zero and one levels (X).

To the set the cross-point level for a channel, select an appropriate value from the **CROSS POINT** drop-down list.



### 8.5.3 Invert the generated pattern

The digital NRZ format pattern can be inverted at the pattern generator output, by clicking the INVERT PATTERN toggle button.

The pattern inversion status is represented by different colors of the buttons as follows:

- **Green** – Indicates that the pattern is **inverted**.
- **Gray** – Indicates that the pattern inversion is **disabled**.
- **Orange** – Indicates that the inversion operation is currently **in progress**.

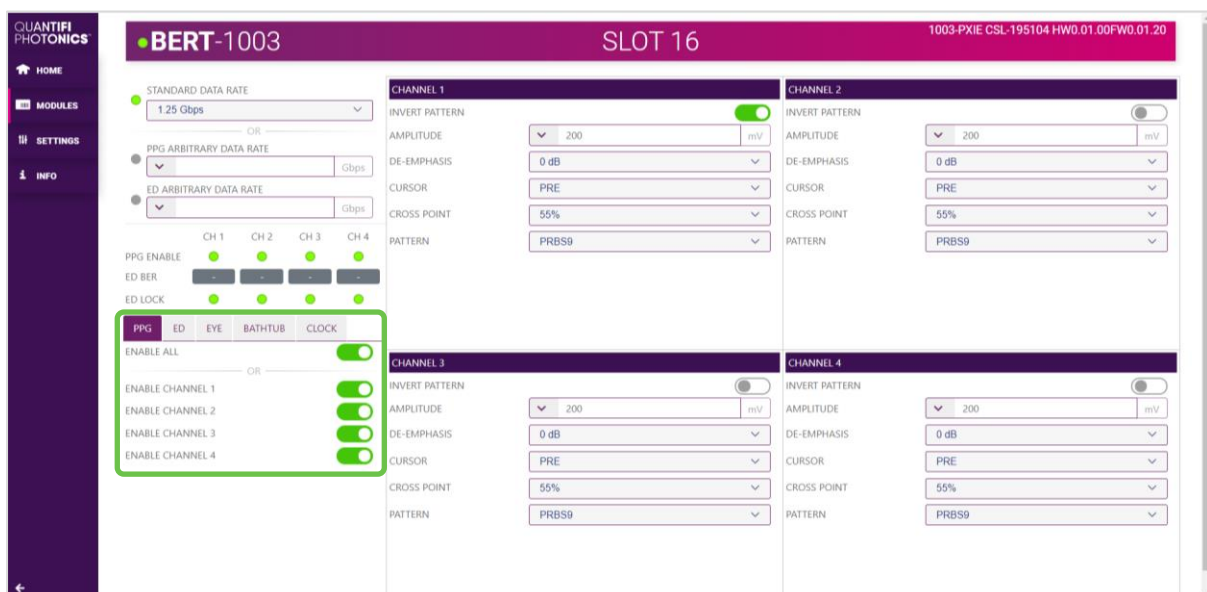


### 8.5.4 Enable / Disable pattern generation

The pattern generation for a channel can be started or stopped by clicking the **ENABLE** toggle buttons under the corresponding channel section in the PPG tab. To apply the function on all channels, use the **ENABLE ALL** button.

The channel enabling status of each channel is represented by different colors of the buttons as follows:

- **Green** – Indicates that the pattern generation is **enabled**.
- **Gray** – Indicates that the pattern generation is **disabled**.
- **Orange** – Indicates that the operation is currently **in progress**.



### ⚠ IMPORTANT

Most functions are locked when the BERT is running the ED, bathtub scan, or eye scan. It is only enabled to turn off the PPG or to stop the ED and the scans.

## 9 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.

On PXIe modules you can use the SCPI Command Console in CohesionUI (refer 7.6 SCPI Command Console (available on PXIe modules)).

On MatriQ instruments you can use the SCPI Command Console that you can access from the Cohesion Operator (refer 9.7 SCPI Command Console (available on MatriQ instruments)).

### **⚠ 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.

### 9.1 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 <sub>16</sub> – 09 <sub>16</sub> , 0B <sub>16</sub> – 20 <sub>16</sub> ).
<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.

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

When executing commands, it is almost always necessary to provide the index of a specific BERT 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.

### 9.2 Common system command summary

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

### 9.3 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 Ltd,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 in the chassis 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? -> ,LaserPXIe-1002-2-FA,SwitchPXIe-1003-1-FC,,VOAPXIe-1001-2-FA,,,,,O2EPXIe-1001-1-FC,,,,,,,,,

## 9.4 Specific command summary

Slot commands	Description
: SLOT<n> : OPC? : TeST? : OPTions? : IDN?  : GRouP? : PPG? : ED? : TEMPerature?	- Query the status of the Operation Complete bit - Perform a self-test of the module - Query the modules installed on the slot - Query the Identifier for the slot; returns the manufacturer, part number, serial number, hardware and firmware versions  - Query the PPG channels within the specified group - Query the ED channels within the specified group - Query the temperature of all groups of channels
Configuration commands	Description
: CALCulate<n> : DATA<m> : EALarm? : ELAPsed? : EDIagram? : STATus?  : BATHtub? : STATus? : ELAPsed?  : Q? : BERFloor? : CENTer? : JITTER? : OUTPut<n> : CLOCK : VCOLock? : DIVIde? : DIVIde : FREQuency : ARBitrary? : ARBitrary  : STANdard? : STANdard	- Query the ED error measurement - Query the running time for the ED measurement - Query the eye scan measurement data - Query the eye scan measurement status  - Query the BER values from the bathtub measurement - Query the status of the bathtub measurement - Query the elapsed time of the bathtub measurement and the time to next point  - Query the Q values from the bathtub measurement - Query the BER floor value from the bathtub measurement - Query the center of the eye from the bathtub measurement - Query the Jitter values from the bathtub measurement  - Query the stability of the clock synthesizer - Query the clock synthesizer divide ratio - Set the clock synthesizer divide ratio  - Query the current synthesizer frequency arbitrary settings - Set the current synthesizer frequency to an arbitrary value within the valid operating range  - Query the current synthesizer frequency standard settings - Set the current synthesizer frequency to a standard value

Slot commands	Description
:POWER?	- Query the power of the RF output clock
:POWER	- Set the power for the RF output clock
:DATA<m>	
:AMPLitude?	- Query the current amplitude of the output signal
:AMPLitude	- Set the amplitude of the output signal
:CPOint?	- Query the pattern cross point (%)
:CPOint	- Set the pattern cross point (%)
:OUTPut?	- Query the state of the pattern generator output
:OUTPut	- Set the state of the pattern generator output

Configuration commands	Description
:SENSe<n>	
:CLOCK	
:FREQuency	
:ARBitrary?	- Query the current ED frequency arbitrary settings
:ARBitrary	- Set the current ED frequency to an arbitrary value within the valid operating range
:STanDard?	- Query the current ED frequency standard settings
:STanDard	- Set the current ED frequency to a standard value
:MEASure<m>	
:BAThtub	
:START	- Start the bathtub measurement
:STOP	- Stop a running bathtub measurement
:MINErrors?	- Query the threshold number of errors for the bathtub measurement
:MINErrors	- Set the threshold number of errors for the bathtub measurement
:VOLTage?	- Query the bathtub voltage level
:VOLTage	- Set the bathtub voltage level
:EALarm	
:MODE?	- Query the mode of ED measurement
:MODE	- Set the mode of ED measurement
:POINt?	- Query the ED point mode
:POINt	- Set the ED point mode
:VOLTage?	- Query the ED point voltage level
:VOLTage	- Set the ED point voltage level
:PHASe?	- Query the ED point phase
:PHASe	- Set the ED point phase
:START	- Starts the ED measurement
:STOP	- Stops the ED measurement
:ENABle?	- Query the enabled state of the ED
:EDIagram	
:HORizontal?	- Query the horizontal (x) resolution step size of the eye measurement
:HORizontal	- Set the horizontal (x) resolution step size of the eye measurement
:PatternLENgth?	- Query the resolution of eye measurement pattern length (2^n bits)
:PatternLENgth	- Set the resolution of eye measurement pattern length (2^n bits)
:START	- Starts the eye scan measurement
:STOP	- Stops the eye scan measurement
:VERTical?	- Query the vertical (y) resolution step size of the eye measurement
:VERTical	- Set the vertical (y) resolution step size of the eye measurement
:PATtern<m>	
:EQBoost?	- Query the ED equalizer boost
:EQBoost	- Set the ED equalizer boost
:MODE?	- Query the ED equalizer boost mode
:MODE	- Set the ED equalizer boost mode
:LOGic?	- Query the ED pattern digital level logic
:LOGic	- Set the ED pattern digital level logic

:TYPE?	- Query the ED pattern type
:TYPE	- Set the ED pattern type
:EINject	- Adds a small random burst of errors into the ED measurement
:SOURce<n>	
:PATtern<m>	
:DEEMphasis?	- Query the pattern de-emphasis
:DEEMphasis	- Set the pattern de-emphasis
:CURSor?	- Query the pattern de-emphasis cursor
:CURSor	- Set the pattern de-emphasis cursor
:LOGic?	- Query the data pattern level logic
:LOGic	- Set the data pattern digital logic level
:TYPE?	- Query the pattern type
:TYPE	- Set the pattern type

## 9.5 Specific command descriptions

### 9.5.1 Slot commands

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	SLOT2:OPC? -> 1

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	:SLOT<n>:OPTions?
Syntax	:SLOT<n>:OPTions?<wsp><PPG ED>
Description	Query the modules installed on the slot
Parameters	<b>PPG:</b> Only Query the available PPG channels of the module <b>ED:</b> Only Query the available ED channels of the module By default, the command Query all the available PPG and ED channels on the module.
Response	A comma separated array, or a single integer value based on the arguments given.
Example	:SLOT3:OPTions? PPG -> 4 :SLOT3:OPTions? ED -> 2

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	A comma separated string containing the <manufacturer>, <part number>, <serial number>, <hardware version> <firmware version>
Example	SLOT2:IDN? -> Quantifi Photonics, BERTPXIe-1003-2-FA, QP-192001, HW1.0FW1.02

Command	:SLOT<n>:GROUP:PPG?
Syntax	:SLOT<n>:GROUP:PPG?
Description	Query the PPG channels within the specified group
Parameters	No parameters
Response	A value or string.
Example	:SLOT5:GROUP:PPG? -> 1

Command	:SLOT<n>:GROUP:ED?
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Syntax	:SLOT<n>:GROUP:ED?
Description	Query the ED channels within the specified group
Parameters	No parameters
Response	A value or string.
Example	:SLOT5:GROUP:ED? -> 1

Command	:SLOT<n>:GRouP:TEMPerature?
Syntax	:SLOT<n>:GRouP:TEMPerature? ALL
Description	Query the temperature of all groups of channels
Parameters	MIN: Returns the minimum temperature of the module MAX: Returns the maximum temperature of the module ACT: Returns the actual temperature of the module ALL: Returns all the above values in a comma separated string
Response	Depending on the parameters, the response will be a string, or a comma separated string of values
Example	:SLOT5:GROUP:TEMPERATURE? ALL -> 46.97

### 9.5.2 Configuration commands

Command	:CALCulate<n>:DATA<m>:EALarm?
Syntax	:CALCulate<n>:DATA<m>:EALarm?<wsp><STATE   DATA   LOCK   ERROR   COUNT   BITS   BER   FULL   INFO>
Description	Query the ED error measurement.
Parameters	<b>STATE:</b> Query the state of the ED measurement. <b>DATA:</b> Query the presence of the data pattern. <b>LOCK:</b> Query the frequency lock status. <b>COUNT ERROR:</b> Query the total error count. <b>BITS:</b> Query the total number of bits. <b>BER:</b> Query the bit error rate. <b>FULL:</b> Query the information specified by all the parameters. <b>INFO:</b> Provides a description of what the return values represent. By default, the command Query the total error count.
Response	The requested value, or a comma separated array. When FULL is requested, the format is "<STATE>, <DATA>, <LOCK>, <COUNT   ERROR>, <BITS>, <BER>". The STATE parameter returns an integer response corresponding to the following: -1: The ED has not been run by the user. 0: The ED has been stopped by the user. 1: The ED is currently running. 2: The ED has reached the error overflow. 3: The ED has been stopped automatically, data is no longer recognizable by the ED. 4: The ED cannot start as the data is not recognized by the ED.
Example	:CALCulate3:DATA2:EALarm? FULL 1-> 1,1,1,5.035849e+11,7.522210e+03,6.694641e+07 :CALCulate3:DATA2:EALARM? INFO -> -1:INVALID 0:STOPPED (USER) 1:RUNNING 2:OVERFLOW 3:STOPPED (AUTO) 4:INVALID SIGNAL

Command	:CALCulate<n>:DATA<m>:EALarm:ELAPsed?
Syntax	:CALCulate<n>:DATA<m>:EALarm:ELAPsed?
Description	Query the running time for the ED measurement.
Parameters	No parameters
Response	The number of seconds the ED measurement has been running.
Example	:CALCulate3:DATA2:EALarm:ELAPsed? -> 7917.7923

Command	:CALCulate<n>:DATA<m>:EDIagram?
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Syntax	:CALCulate<n>:DATA<m>:EDIagram?
Description	Query the eye scan measurement data. This command can only be run after :CALCulate<n>:DATA<m>:EDIagram:STATus? command has returned COMPLETE.
Parameters	No parameters
Response	The eye scan data points in a comma separated array. The format of the data is <number_of_rows>,<number_of_columns>,<points[0][0]>, ... ,<points[number_of_rows-1][number_of_columns-1]>". The number of rows and columns depends on your eye scan settings.
Example	:CALCulate3:DATA2:EDIagram? -> "63,63,<array of 63*63 points>"

Command	:CALCulate<n>:DATA<m>:EDIagram:STATus?
Syntax	:CALCulate<n>:DATA<m>:EDIagram:STATus? [<wsp><INFO>]
Description	Query the eye scan measurement status.
Parameters	INFO: Provides a description of what the return values represent
Response	The current status of the eye scan measurement. -1   <b>STOPPED</b> : There is no data as the scan has been cancelled or is not started 0   <b>RUNNING</b> : The scan has been started and is still sampling data 1   <b>COMPLETE</b> : The scan is complete, and all data is available
Example	:CALCulate3:DATA2:EDIagram:STATus? -> -1 :CALCulate3:DATA2:EDIagram:STATus? INFO -> -1:STOPPED 0:RUNNING 1:COMPLETE

Command	:CALCulate<n>:DATA<m>:BAThtub?
Syntax	:CALCulate<n>:DATA<m>:BAThtub?
Description	Query the BER values from the bathtub measurement
Parameters	No parameters
Response	A comma separated string of values, in the format <number of points>, <phase set points>, <measured BER>, <extrapolated BER> The first value in the comma separated string of values is the number of points, the next <number of points> values are the phase set points, the next <number of points> values are the measured BER, and the final <number of points> values are the extrapolated BER.
Example	:CALCulate3:DATA2:BAThtub? -> 317,-4.9375000e-01,-4.9062500e-01,-4.8750000e-01,-4.8437500e-01,-4.8125000e-01,-4.7812500e-01, -4.7500000e-01.....

Command	:CALCulate<n>:DATA<m>:BAThtub:STATus?
Syntax	:CALCulate<n>:DATA<m>:BAThtub:STATus? [<wsp><INFO>]
Description	Query the status of the bathtub measurement.
Parameters	INFO: Provides a description of what the return values represent
Response	The current status of the bathtub measurement. -1   <b>INVALID</b> : The bathtub measurement has not been run. 0   <b>RUNNING</b> : The scan has been started and is currently sampling data. 1   <b>STOPPED (USER)</b> : The scan was stopped by the user and all data is available 2   <b>STOPPED (AUTO)</b> : The scan detected a loss of data and exited the bathtub scan. 3   <b>INVALID SIGNAL</b> : The input data is not recognized. The bathtub cannot start.
Example	:CALCulate3:DATA2:BAThtub:STATus? -> -1 :CALCulate3:DATA2:BAThtub:STATus? INFO -> -1:INVALID 0:RUNNING 1:STOPPED (USER) 2:STOPPED (AUTO) 3:INVALID SIGNAL

Command	:CALCulate<n>:DATA<m>:BAThtub:ELAPsed?
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Syntax	:CALCulate<n>:DATA<m>:BAThtub:ELAPsed? [<wsp><TOTAL NEXT UNIT>]
Description	Query the elapsed time of the bathtub measurement and the time to next point.
Parameters	<b>TOTAL:</b> Query the total amount of time the bathtub measurement has been running <b>NEXT:</b> Query the estimated time to collect the next data point <b>UNIT:</b> Query the unit of time By default, TOTAL is returned.
Response	A value or string.
Example	:CALCulate3:DATA2:BAThtub:ELAPsed? -> 350 :CALCulate3:DATA2:BAThtub:ELAPsed? TOTAL -> 350 :CALCulate3:DATA2:BAThtub:ELAPsed? NEXT -> 27 :CALCulate3:DATA2:BAThtub:ELAPsed? UNIT -> s

Command	:CALCulate<n>:DATA<m>:BAThtub:Q?
Syntax	:CALCulate<n>:DATA<m>:BAThtub:Q?
Description	Query the Q values from the bathtub measurement.
Parameters	No parameters.
Response	A comma separated string of values, in the format <number of points>, <measured Q>, <extrapolated Q>. The first value in the comma separated string of values is the number of points, the next <number of points> values are the measured Q values, and the final <number of points> values are the extrapolated Q values.
Example	:CALCulate3:DATA2:BAThtub:Q? -> 317,1.6217541e+00,1.6217541e+00, 1.6217541e+00,1.6217541e+00,1.6217541e+00.....

Command	:CALCulate<n>:DATA<m>:BAThtub:BERFloor?
Syntax	:CALCulate<n>:DATA<m>:BAThtub:BERFloor?
Description	Query the BER floor value from the bathtub measurement.
Parameters	No parameters
Response	A value representing the BER value at the center of the eye
Example	:CALCulate3:DATA2:BAThtub:BERFloor? -> 1.2662386e-47

Command	:CALCulate<n>:DATA<m>:BAThtub:CENter?
Syntax	:CALCulate<n>:DATA<m>:BAThtub:CENter? [<wsp><UNIT>]
Description	Query the center of the eye from the bathtub measurement
Parameters	<b>UNIT:</b> Query the unit of the measurement
Response	A value representing the center of the eye calculated from the bathtub measurement
Example	:CALCulate3:DATA2:BAThtub:CENter? -> -1.5985557e-01 :CALCulate3:DATA2:BAThtub:CENter? UNIT -> UI

Command	:CALCulate<n>:DATA<m>:JITter?
Syntax	:CALCulate<n>:DATA<m>:JITter? [<wsp><DJ RJ J2 J9 J12 UNIT>]
Description	Query the jitter values from the bathtub measurement.
Parameters	<b>DJ:</b> Query the deterministic jitter <b>RJ:</b> Query the random jitter <b>J2:</b> Query the total jitter at J2 <b>J9:</b> Query the total jitter at J9 <b>J12:</b> Query the total jitter at J12 <b>UNIT:</b> Query the unit of jitter
Response	A comma separated list of values, or a single value. The total jitter for J2,J9, and J12 are calculated through two methods, the Dual Dirac and the total eye opening. The format of the return is <Dual Dirac>, <Eye Opening>. By default, the DJ is returned
Example	:CALCulate3:DATA2:JITter? -> 2.319684 :CALCulate3:DATA2:JITter? DJ -> 2.319684 :CALCulate3:DATA2:JITter? J2 -> 15.69358, 15.69358 :CALCulate3:DATA2:JITter? UNIT -> ps
Command	:OUTPut<n>:CLOCK:VCOlock?

Syntax	:OUTPut<n>:CLOCK:VCOlock? [<wsp>INFO]
Description	Query the stability of the clock synthesizer.
Parameters	<b>INFO:</b> Describes what the return values represent
Response	The status of the clock stability, 1 for a locked state and 0 when there is no lock established.
Example	:OUTPut5:CLOCK:VCOlock? ->1 :OUTPut5:CLOCK:VCOlock? INFO -> 0: NO LOCK 1: LOCKED

Command	:OUTPut<n>:CLOCK:DIVId?
Syntax	:OUTPut<n>:CLOCK:DIVId? [<wsp><MIN MAX DEF SET LIST ALL>]
Description	Query the clock synthesizer divide ratio.
Parameters	<b>MIN:</b> Query the minimum configurable value <b>MAX:</b> Query the maximum configurable value <b>DEF:</b> Query the default power-on value <b>SET:</b> Query the current SET value <b>LIST:</b> Query the LIST of discrete options for configurable values (if available) <b>ALL:</b> Query the values specified by all parameters By default, the command Query the current SET value.
Response	A single value or a comma separated string of values. For ALL, the format is "<MIN>,<MAX>,<DEF>,<SET>,<LIST>".
Example	:OUTPut3:CLOCK:DIVId? -> 2

Command	:OUTPut<n>:CLOCK:DIVId
Syntax	:OUTPut<n>:CLOCK:DIVId<wsp><value MIN MAX DEF>
Description	Set the clock synthesizer divide ratio.
Parameters	<b>value:</b> Set to the desired new set point <b>MIN:</b> Set to the minimum value <b>MAX:</b> Set to the maximum value <b>DEF:</b> Restores to the default value
Response	No response
Example	:OUTPut3:CLOCK:DIVId 4

Command	:OUTPut<n>:CLOCK:FREQuency:ARBitrary?
Syntax	:OUTPut<n>:CLOCK:FREQuency:ARBitrary? [<wsp><MIN MAX DEF SET ALL STEP UNIT>]
Description	Query the synthesizer frequency arbitrary settings.
Parameters	<b>MIN:</b> Query the minimum configurable value <b>MAX:</b> Query the maximum configurable value <b>DEF:</b> Query the default power-on value <b>SET:</b> Query the current SET value <b>ALL:</b> Query all the values specified by the MIN, MAX, DEF, and SET parameters <b>STEP:</b> Query the minimum resolution of the frequency value <b>UNIT:</b> Query the default unit for the frequency value By default, this command Query the current SET value.
Response	A single value or a comma separated string of values. For ALL, the format of the response is "<MIN>,<MAX>,<DEF>,<SET>". If the frequency is set to a standard value, the SET value in the response is NAN.
Example	ARBITRARY MODE: :OUTP3:CLOC:FREQ:ARB? -> 7.96  STANDARD MODE: :OUTP3:CLOC:FREQ:ARB?-> NAN

Command	:OUTPut<n>:CLOCK:FREQuency:ARBitrary
Syntax	:OUTPut<n>:CLOCK:FREQuency<wsp><value MIN MAX DEF>



Description	Set the synthesizer frequency to an arbitrary value within the valid operating range.
Parameters	<b>value:</b> The desired new value <b>MIN:</b> Set to the minimum value <b>MAX:</b> Set to the maximum value <b>DEF:</b> Restores the default value
Response	No response
Example	:OUTP3:CLOC:FREQ:ARB 7.96

Command	:OUTPut<n>:CLOCk:FREQuency:STANdard?
Syntax	:OUTPut<n>:CLOCk:FREQuency:STANdard? [<wsp><MIN MAX DEF SET LIST ALL STEP UNIT>]
Description	Query the current synthesizer frequency standard settings.
Parameters	<b>MIN:</b> Query the minimum configurable value <b>MAX:</b> Query the maximum configurable value <b>DEF:</b> Query the default power-on value <b>SET:</b> Query the current SET value <b>LIST:</b> Query the list of discrete options for configurable values (if available) <b>ALL:</b> Query all the values specified by MIN, MAX, DEF, SET, and LIST <b>STEP:</b> Query the minimum resolution of the frequency value <b>UNIT:</b> Query the default unit for the frequency value By default, this command Query the current SET value.
Response	A single value or a comma separated string of values. For ALL, the format of the response is "<MIN>,<MAX>,<DEF>,<SET>,<LIST>". If the frequency is set to an arbitrary value, the SET value in the response is NAN.
Example	STANDARD MODE: :OUTP3:CLOC:FREQ:STD? -> 14.5  ARBITRARY MODE: :OUTP3:CLOC:FREQ:STD? -> NAN

Command	:OUTPut<n>:CLOCk:FREQuency:STANdard
Syntax	:OUTPut<n>:CLOCk:FREQuency:STANdard<wsp><value MIN MAX DEF>
Description	Set the current synthesizer frequency to a standard value.
Parameters	<b>value:</b> The desired new value <b>MIN:</b> Set to the minimum value <b>MAX:</b> Set to the maximum value <b>DEF:</b> Restores the default value
Response	No response
Example	:OUTP3:CLOC:FREQ:STD 14.5

Command	:OUTPut<n>:CLOCk:POWEr?
Syntax	:OUTPut<n>:CLOCk:POWEr? [<wsp><MIN MAX DEF SET LIST ALL STEP UNIT>]
Description	Query the power of the RF output clock
Parameters	<b>MIN:</b> Query the minimum configurable value <b>MAX:</b> Query the maximum configurable value <b>DEF:</b> Query the default power-on value <b>SET:</b> Query the current SET value <b>LIST:</b> Query the list of discrete options for configurable values (if available) <b>ALL:</b> Query all the values specified by MIN, MAX, DEF, SET, and LIST <b>STEP:</b> Query the minimum resolution of the power value <b>UNIT:</b> Query the default unit for the power value By default, the command Query the current SET value.
Response	A single value or a comma separated string of values. For ALL, the format of the response is "<MIN>,<MAX>,<DEF>,<SET>,<LIST>".
Example	:OUTPut3:CLOCk:POWEr? -> 0

Command	:OUTPut<n>:CLOCk:POWEr
Syntax	:OUTPut<n>:CLOCk:POWEr<wsp><value MIN MAX DEF>

Description	Set the power for the RF output clock.
Parameters	<b>value:</b> The desired new set point <b>MIN:</b> Set to the minimum value <b>MAX:</b> Set to the maximum value <b>DEF:</b> Restores the default value
Response	No response
Example	:OUTPut<n>:CLOck:POWer 0.0

Command	:OUTPut<n>:DATA<m>:AMPlitude?
Syntax	:OUTPut<n>:DATA<m>:AMPlitude? [<wsp><MIN MAX DEF SET ALL LIST STEP UNIT LINKED>]
Description	Query the voltage amplitude of the output signal.
Parameters	<b>MIN:</b> Query the minimum configurable value <b>MAX:</b> Query the maximum configurable value <b>DEF:</b> Query the default power-on value <b>SET:</b> Query the current SET value <b>LIST:</b> Query the list of discrete options for configurable values (if available) <b>ALL:</b> Query the values specified by MIN, MAX, DEF, SET, and LIST <b>STEP:</b> Query the minimum resolution of the amplitude value <b>UNIT:</b> Query the default unit for the amplitude value <b>LINKED:</b> Query the linked channels. By default, this command Query the current SET value.
Response	A single value, or a comma separated array. When ALL is requested, the format is "<MIN>,<MAX>,<DEF>,<SET>,<LIST>"
Example	:OUTPut3:DATA2:AMPlitude? ALL ->200,1100,200,200,NAN This command does not have a discrete LIST.

Command	:OUTPut<n>:DATA<m>:AMPlitude
Syntax	:OUTPut<n>:DATA<m>:AMPlitude<wsp><value MIN MAX DEF>
Description	Set the amplitude of the output signal.
Parameters	<b>value:</b> The desired new set point <b>MIN:</b> Set to the minimum value <b>MAX:</b> Set to the maximum value <b>DEF:</b> Restores the default value
Response	No response
Example	:OUTPut3:DATA2:AMPlitude 0.60

Command	:OUTPut<n>:DATA<m>:CPOint?
Syntax	:OUTPut<n>:DATA<m>:CPOint? [<wsp><MIN MAX DEF SET LIST ALL>]
Description	Query the pattern cross point (%).
Parameters	<b>MIN:</b> Query the minimum configurable value <b>MAX:</b> Query the maximum configurable value <b>DEF:</b> Query the default power on value <b>SET:</b> Query the current SET value <b>LIST:</b> Query the list of discrete options for configurable values (if available) <b>ALL:</b> Query the values specified by MIN, MAX, DEF, SET, and LIST. By default, the command Query the current SET value.
Response	A single value, or a comma separated array. When ALL is requested, the format is "<MIN>,<MAX>,<DEF>,<SET>,<LIST>"
Example	:OUTPut<n>:DATA<m>:CPOint? LIST -> 35,40,45,50,55

Command	:OUTPut<n>:DATA<m>:CPOint
Syntax	:OUTPut<n>:DATA<m>:CPOint<wsp><value MIN MAX DEF>

Description	Set the pattern cross point (%).
Parameters	<b>value:</b> The desired new set point <b>MIN:</b> Set to the minimum value <b>MAX:</b> Set to the maximum value <b>DEF:</b> Restores the default value
Response	No response
Example	:OUTPut<n>:DATA<m>:CPOint 25

Command	:OUTPut<n>:DATA<m>:OUTPut?
Syntax	:OUTPut<n>:DATA<m>:OUTPut? [<wsp><DEF SET INFO>]
Description	Query the state of the pattern generator output.
Parameters	<b>DEF:</b> Query the default power-on value <b>SET:</b> Query the current SET value <b>INFO:</b> Provides a description of what the return values represent By default, the command returns the current SET value.
Response	An integer indicating the state of the pattern generator output.
Example	:OUTPut3:DATA2:OUTPut? -> 1 :OUTPut3:DATA2:OUTPut? INFO -> 0:OFF 1:ON

Command	:OUTPut<n>:DATA<m>:OUTPut
Syntax	:OUTPut<n>:DATA<m>:OUTPut<wsp><0 OFF 1 ON DEF > :OUTPut<n>:DATA:OUTPut<wsp><ON_ALL OFF_ALL>
Description	Set the state of the pattern generator output.
Parameters	<b>1 ON:</b> Set the output to the ON state <b>0 OFF:</b> Set the output to the OFF state <b>DEF:</b> Restores the default state <b>ON_ALL:</b> Set the output of all PPG channels to ON <b>OFF_ALL:</b> Set the output of all PPG channels to OFF
Response	No response
Example	:OUTPut3:DATA2:OUTPut 1 :OUTPut3:DATA:OUTPut ON_ALL

Command	:SENSe<n>:CLOCK:FREQuency:ARBitary?
Syntax	:SENSe<n>:CLOCK:FREQuency:ARBitary? [<wsp><MIN MAX DEF SET ALL STEP UNIT>]
Description	Query the current ED frequency arbitrary settings.
Parameters	<b>MIN:</b> Query the minimum configurable value <b>MAX:</b> Query the maximum configurable value <b>DEF:</b> Query the default power-on value <b>SET:</b> Query the current SET value <b>ALL:</b> Query all the values specified by MIN, MAX, DEF, and SET <b>STEP:</b> Query the minimum resolution of the frequency value <b>UNIT:</b> Query the default unit for the frequency value By default, this command Query the current SET value.
Response	A single value or a comma separated string of values. For ALL, the format of the response is "<MIN>,<MAX>,<DEF>,<SET>". If the frequency is set to a standard value, the SET value in the response is NAN.
Example	ARBITRARY MODE: :SENS3:CLOC:FREQ:ARB? -> 7.96  STANDARD MODE: :SENS3:CLOC:FREQ:ARB? -> NAN

Command	:SENSe<n>:CLOCK:FREQuency:ARBitary
Syntax	:SENSe<n>:CLOCK:FREQuency<wsp><value MIN MAX DEF>

Description	Set the current ED frequency to an arbitrary value within the valid operating range.
Parameters	<b>value:</b> The desired new value <b>MIN:</b> Set to the minimum value <b>MAX:</b> Set to the maximum value <b>DEF:</b> Restores the default value
Response	No response
Example	:SENS3:CLOC:FREQ:ARB 7.96

Command	:SENSe<n>:CLOCK:FREQuency:STanDard?
Syntax	:SENSe<n>:CLOCK:FREQuency:STanDard? [<wsp><MIN MAX DEF SET LIST ALL STEP UNIT>]
Description	Query the current ED frequency standard settings.
Parameters	<b>MIN:</b> Query the minimum configurable value <b>MAX:</b> Query the maximum configurable value <b>DEF:</b> Query the default power-on value <b>SET:</b> Query the current SET value <b>LIST:</b> Query the LIST of discrete options for configurable values (if available) <b>ALL:</b> Query the values specified by MIN, MAX, DEF, SET, and LIST <b>STEP:</b> Query the minimum resolution of the frequency value <b>UNIT:</b> Query the default unit for the frequency value By default, the command Query the current SET value.
Response	A single value or a comma separated string of values. For ALL, the format of the response is "<MIN>,<MAX>,<DEF>,<SET>,<LIST>". If the frequency is set to an arbitrary value, the SET value in the response is NAN.
Example	STANDARD MODE: :SENS3:CLOC:FREQ:STD? -> 14.5  ARBITRARY MODE: :SENS3:CLOC:FREQ:STD? -> NAN

Command	:SENSe<n>:CLOCK:FREQuency:STanDard
Syntax	:SENSe<n>:CLOCK:FREQuency:STanDard<wsp><value MIN MAX DEF>
Description	Set the current ED frequency to a standard value.
Parameters	<b>value:</b> The desired new value <b>MIN:</b> Set to the minimum value <b>MAX:</b> Set to the maximum value <b>DEF:</b> Restores the default value
Response	No response
Example	:SENS3:CLOC:FREQ:STD 14.5

Command	:SENSe<n>:MEASure<m>:BATHTub:STARt
Syntax	:SENSe<n>:MEASure<m>:BATHTub:STARt
Description	Starts the bathtub measurement
Parameters	No parameters
Response	No response
Example	:SENSe3:MEASure2:BATHTub:STARt

Command	:SENSe<n>:MEASure<m>:BATHTub:STOP
Syntax	:SENSe<n>:MEASure<m>:BATHTub:STOP
Description	Stops the bathtub measurement
Parameters	No parameters
Response	No response
Example	:SENSe3:MEASure2:BATHTub:STOP
Command	:SENSe<n>:MEASure<m>:BATHTub:MINErrors?

Syntax	:SENSe<n>:MEASure<m>:BAThtub:MINErrors? [<wsp><MIN MAX DEF SET ALL STEP UNIT LINKED>]
Description	Query the minimum error threshold for the bathtub measurement
Parameters	<b>MIN:</b> Query the minimum threshold <b>MAX:</b> Query the maximum threshold <b>DEF:</b> Query the default threshold <b>SET:</b> Query the set threshold <b>ALL:</b> Query a comma separated string in the format [MIN, MAX, DEF, SET] <b>STEP:</b> Query the minimum step between thresholds <b>UNIT:</b> Returns the unit of the threshold <b>LINKED:</b> Returns the linked channels
Response	A single integer value, or a comma separated integer array.
Example	<pre>:SENSe3:MEASure2:BAThtub:MINErrors? -&gt; 10 :SENSe3:MEASure2:BAThtub:MINErrors? MIN -&gt; 0 :SENSe3:MEASure2:BAThtub:MINErrors? MAX -&gt; 65535 :SENSe3:MEASure2:BAThtub:MINErrors? DEF -&gt; 10 :SENSe3:MEASure2:BAThtub:MINErrors? SET -&gt; 10 :SENSe3:MEASure2:BAThtub:MINErrors? ALL -&gt; 0, 65535, 10, 10 :SENSe3:MEASure2:BAThtub:MINErrors? UNIT -&gt; bits :SENSe3:MEASure2:BAThtub:MINErrors? LINKED -&gt; 1</pre>

Command	:SENSe<n>:MEASure<m>:BAThtub:MINErrors
Syntax	:SENSe<n>:MEASure<m>:BAThtub:MINErrors<wsp><value DEF>
Description	Set the current ED frequency to a standard value.
Parameters	<b>value:</b> The desired new value <b>DEF:</b> Restores the default value
Response	No response
Example	<pre>:SENSe15:MEASure1:BAThtub:MINErrors 5 :SENSe15:MEASure1:BAThtub:MINErrors DEF</pre>

Command	:SENSe<n>:MEASure<m>:BAThtub:VOLTage?
Syntax	:SENSe<m>:MEASure<n>:BAThtub:VOLTage? [<wsp><MIN MAX DEF SET ALL STEP UNIT LINKED>]
Description	Query the bathtub voltage
Parameters	<b>MIN:</b> Query the minimum bathtub voltage <b>MAX:</b> Query the maximum bathtub voltage <b>DEF:</b> Query the default bathtub voltage <b>SET:</b> Query the set bathtub voltage <b>ALL:</b> Query a comma separated string in the format [MIN, MAX, DEF, SET] <b>STEP:</b> Query the minimum step between bathtub voltages <b>UNIT:</b> Query the unit of the bathtub voltage <b>LINKED:</b> Query the linked channels By default, the command Query the current SET value.
Response	A single integer value, or a comma separated integer array.
Example	<pre>:SENSe3:MEASure2:BAThtub:VOLTage? -&gt;0.000000 :SENSe3:MEASure2:BAThtub:VOLTage? MIN -&gt;-217.000000 :SENSe3:MEASure2:BAThtub:VOLTage? MAX -&gt;217.000000 :SENSe3:MEASure2:BAThtub:VOLTage? DEF -&gt;0.000000 :SENSe3:MEASure2:BAThtub:VOLTage? SET -&gt;0.000000 :SENSe3:MEASure2:BAThtub:VOLTage? ALL -&gt;- 217.000000,217.000000,0.000000,0.000000 :SENSe3:MEASure2:BAThtub:VOLTage? STEP -&gt;7.000000 :SENSe3:MEASure2:BAThtub:VOLTage? UNIT -&gt;mV :SENSe3:MEASure2:BAThtub:VOLTage? LINKED -&gt; 1</pre>

Command	:SENSe<n>:MEASure<m>:BAThtub:VOLTage
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Syntax	:SENSe<n>:MEASure<m>:BAThtub:VOLTage<wsp><value DEF>
Description	Set the bathtub voltage
Parameters	<b>value</b> : The desired new value <b>DEF</b> : Restores the default value
Response	No response
Example	:SENSe3:MEASure2:BAThtub:VOLTage 7

Command	:SENSe<n>:MEASure<m>:EALarm:MODE?
Syntax	:SENSe<n>:MEASure<m>:EALarm:MODE? [<wsp><DEF SET LIST ALL INFO>]
Description	Query the mode of ED measurement.
Parameters	<b>DEF</b> : Query the default power-on value <b>SET</b> : Query the current SET value <b>LIST</b> : Query the LIST of discrete options for configurable values <b>ALL</b> : Query the values specified by DEF, SET, and LIST <b>INFO</b> : Provides a description of what the return values represent By default, the command Query the current SET value.
Response	A single integer value, or a comma separated integer array. When ALL is requested, the format is "<DEF>,<SET>,<LIST>".
Example	:SENSe3:MEASure2:EALarm:MODE? -> 0 :SENSe3:MEASure2:EALarm:MODE? INFO -> 0:ACCUMULATED 1:INSTANTANEOUS

Command	:SENSe<n>:MEASure<m>:EALarm:MODE
Syntax	:SENSe<n>:MEASure<m>:EALarm:MODE<wsp><1 INSTantaneous 0 ACCUmulated DEF>
Description	Set the mode of the ED measurement.
Parameters	<b>value</b> : The desired new set point <b>INSTantaneous</b> : Set the mode to one second intervals <b>ACCUmulated</b> : Set the mode to continually record data until it is stopped <b>DEF</b> : Restores the default value
Response	No response
Example	:SENSe3:MEASure2:EALarm:MODE INST

Command	:SENSe<n>:MEASure<m>:EALarm:POINT?
Syntax	:SENSe<n>:MEASure<m>:EALarm:POINT? [<wsp><DEF SET INFO LINKED>]
Description	Query the mode of the ED point measurement.
Parameters	<b>DEF</b> : Query the default value <b>SET</b> : Query the set value <b>INFO</b> : Provides a description of what the return values represent <b>LINKED</b> : Query the linked channels By default, the command Query the current SET value.
Response	A single integer value, or a string.
Example	:SENSe3:MEASure2:EALarm:POINT? ->0 :SENSe3:MEASure2:EALarm:POINT? DEF ->0 :SENSe3:MEASure2:EALarm:POINT? SET ->0 :SENSe3:MEASure2:EALarm:POINT? LINKED ->1,2,3,4 :SENSe3:MEASure2:EALarm:POINT? INFO -> 0:AUTO 1:MANUAL

Command	:SENSe<n>:MEASure<m>:EALarm:POINT
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Syntax	:SENSe<n>:MEASure<m>:EALarm:POINt<wsp><value 0 AUTO 1 MANUAL DEF>
Description	Set the mode of the ED point measurement.
Parameters	<b>value:</b> The desired new set point <b>0:</b> Set the point mode to automatic <b>AUTO:</b> Set the point mode to automatic <b>1:</b> Set the point mode to manual <b>MANUAL:</b> Set the point mode to manual <b>DEF:</b> Restores the default value
Response	No response
Example	:SENSe15:MEASure1:EALarm:POINt MANUAL

Command	:SENSe<n>:MEASure<m>:EALarm:VOLTage?
Syntax	:SENSe<n>:MEASure<m>:EALarm:VOLTage? [<wsp><MIN MAX DEF SET ALL STEP UNIT LINKED>]
Description	Query the voltage of the ED point measurement
Parameters	<b>MIN:</b> Query the minimum ED point voltage <b>MAX:</b> Query the maximum ED point voltage <b>DEF:</b> Query the default ED point voltage <b>SET:</b> Query the set ED point voltage <b>ALL:</b> Query a comma separated string in the format [MIN,MAX,DEF,SET] <b>STEP:</b> Query the minimum step between ED point voltages <b>UNIT:</b> Query the unit of the ED point voltage <b>LINKED:</b> Query the linked channels
Response	A single integer value, or a list of comma separated values.
Example	:SENSe3:MEASure2:EALarm:VOLTage? ->0.000000 :SENSe3:MEASure2:EALarm:VOLTage? ALL -> -217.000000,217.000000,0.000000,0.000000 :SENSe3:MEASure2:EALarm:VOLTage? STEP ->7.000000 :SENSe3:MEASure2:EALarm:VOLTage? UNIT ->mV :SENSe3:MEASure2:EALarm:VOLTage? LINKED ->1

Command	:SENSe<n>:MEASure<m>:EALarm:VOLTage
Syntax	:SENSe<n>:MEASure<m>:EALarm:MODE<wsp><value DEF>
Description	Set the ED point voltage
Parameters	<b>value:</b> The desired new set point <b>DEF:</b> Restores the default value
Response	No response
Example	:SENSe3:MEASure2:EALarm:VOLTage 7

Command	:SENSe<n>:MEASure<m>:EALarm:PHASe?
Syntax	:SENSe<n>:MEASure<m>:EALarm:PHASe?<wsp><MIN MAX DEF SET ALL STEP UNIT LINKED>
Description	Query the phase of the ED point measurement.
Parameters	<b>MIN:</b> Query the minimum ED point phase <b>MAX:</b> Query the maximum ED point phase <b>DEF:</b> Query the default ED point phase <b>SET:</b> Query the set ED point phase <b>ALL:</b> Query a comma separated string in the format [MIN,MAX,DEF,SET] <b>STEP:</b> Query the minimum step between ED point phases <b>UNIT:</b> Query the unit of the ED point phase <b>LINKED:</b> Query the linked channels
Response	A single value, or a comma separated array. When ALL is requested, the format is "<MIN>,<MAX>,<DEF>,<SET>".
Example	:SENSe3:MEASure2:EALarm:PHASe? ->0.000000 :SENSe3:MEASure2:EALarm:PHASe? ALL -> -2.468750,2.468750,0.000000,0.000000 :SENSe3:MEASure2:EALarm:PHASe? STEP ->0.015625 :SENSe3:MEASure2:EALarm:PHASe? UNIT ->UI :SENSe3:MEASure2:EALarm:PHASe? LINKED ->1
Command	:SENSe<n>:MEASure<m>:EALarm:PHASe

Description	Set the phase of the ED point measurement.
Syntax	:SENSe15:MEASure1:EALarm:PHASe<wsp><value DEF>
Parameters	<b>value</b> : The desired new set point <b>DEF</b> : Restores the default value
Response	No response
Example	:SENSe3:MEASure2:EALarm:PHASE 0.25 :SENSe3:MEASure2:EALarm:PHASE DEF

Command	:SENSe<n>:MEASure<m>:START
Syntax	:SENSe<n>:MEASure<m>:START
Description	Starts the ED measurement.
Parameters	No parameters
Response	No response
Example	:SENSe3:MEASure2:START

Command	:SENSe<n>:MEASure<m>:STOP
Syntax	:SENSe<n>:MEASure<m>:STOP
Description	Stops the ED measurement.
Parameters	No parameters
Response	No response
Example	:SENSe3:MEASure2:STOP

Command	:SENSe<n>:MEASure<m>:ENABLE?
Syntax	:SENSe<n>:MEASure<m>:ENABLE? [<wsp><INFO>]
Description	Query the enabled state of the ED.
Parameters	INFO: Provides a description of what the return values represent
Response	An integer indicating the state of the ED. By default, the command returns the current state of the ED.
Example	:SENSe3:MEASure2:ENABLE? -> 0 :SENSe3:MEASure2:ENABLE? INFO -> 0:OFF 1:ON 2:ERROR OVERFLOW 3:OFF (AUTO) 4:OFF (FAIL)

Command	:SENSe<n>:MEASure<m>:EDIagram:HORizontal?
Syntax	:SENSe<n>:MEASure<m>:EDIagram:HORizontal? [<wsp><MIN MAX DEF SET LIST ALL LINKED>]
Description	Query the horizontal (x) resolution step size of the eye measurement.
Parameters	<b>MIN</b> : Query the minimum configurable value <b>MAX</b> : Query the maximum configurable value <b>DEF</b> : Query the default power-on value <b>SET</b> : Query the current SET value <b>LIST</b> : Query the list of discrete options for configurable values (if available) <b>ALL</b> : Query the values specified by MIN, MAX, DEF, SET, and LIST <b>LINKED</b> : Query the linked channels By default, the command Query the current SET value.
Response	A single value, or a comma separated array. When ALL is requested, the format is "<MIN>,<MAX>,<DEF>,<SET>,<LIST>".
Example	:SENSe3:MEASure2:EDIagram:HORizontal? -> 1

Command	:SENSe<n>:MEASure<m>:EDIagram:HORizontal
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Syntax	:SENSe<n>:MEASure<m>:EDIagram:HORIzontal<wsp><value   MIN   MAX   DEF>
Description	Set the horizontal (x) resolution step size of the eye measurement.
Parameters	<b>value</b> : The desired new set point <b>MIN</b> : Set to the minimum value <b>MAX</b> : Set to the maximum value <b>DEF</b> : Restores the default value
Response	No response
Example	:SENSe3:MEASure2:EDIagram:HORIzontalstep 4

Command	:SENSe<n>:MEASure<m>:EDIagram:PatternLENgth?
Syntax	:SENSe<n>:MEASure<m>:EDIagram:PatternLENgth? [<wsp><MIN   MAX   DEF   SET   LIST   ALL   LINKED>]
Description	Query the eye measurement pattern length ( $2^n$ bits) resolution.
Parameters	<b>MIN</b> : Query the minimum configurable value <b>MAX</b> : Query the maximum configurable value <b>DEF</b> : Query the default power-on value <b>SET</b> : Query the current SET value <b>LIST</b> : Query the list of discrete options for configurable values (if available) <b>ALL</b> : Query the values specified by MIN, MAX, DEF, SET, and LIST <b>LINKED</b> : Query the linked channels By default, the command Query the current SET value.
Response	A single value, or a comma separated array. When ALL is requested, the format is "<MIN>,<MAX>,<DEF>,<SET>,<LIST>".
Example	:SENSe3:MEASure2:EDIagram:PatternLENgth? MAX -> 16

Command	:SENSe<n>:MEASure<m>:EDIagram:PatternLENgth
Syntax	:SENSe<n>:MEASure<m>:EDIagram:PatternLENgth<wsp><value   MIN   MAX   DEF>
Description	Set the eye measurement pattern length ( $2^n$ bits) resolution.
Parameters	<b>value</b> : The desired new set point <b>MIN</b> : Set to the minimum value <b>MAX</b> : Set to the maximum value <b>DEF</b> : Restores the default value
Response	No response
Example	:SENSe3:MEASure2:EDIagram:PatternLENgth 16

Command	:SENSe<n>:MEASure<m>:EDIagram:START
Syntax	:SENSe<n>:MEASure<m>:EDIagram:START
Description	Starts the eye scan measurement. This command must always be used in conjunction with the :CALCulate<n>:DATA<m>:EDIagram:STATus? query to ensure that the ED measurements are not running.
Parameters	No parameters
Response	No response
Example	:SENSe3:MEASure2:EDIagram:START

Command	:SENSe<n>:MEASure<m>:EDIagram:STOP
Syntax	:SENSe<n>:MEASure<m>:EDIagram:STOP
Description	Stops a running eye scan measurement.
Parameters	No parameters
Response	No response
Example	:SENSe<n>:MEASure2:EDIagram:STOP

Command	:SENSe<n>:MEASure<m>:EDIagram:VERTical?
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Syntax	:SENSe<n>:MEASure<m>:EDIagram:VERTical? [<wsp><MIN MAX DEF SET LIST ALL LINKED>]
Description	Query the vertical (y) resolution step size of the eye measurement.
Parameters	<b>MIN</b> : Query the minimum configurable value <b>MAX</b> : Query the maximum configurable value <b>DEF</b> : Query the default power-on value <b>SET</b> : Query the current SET value <b>LIST</b> : Query the list of discrete options for configurable values (if available) <b>ALL</b> : Query the values specified by MIN, MAX, DEF, SET, and LIST <b>LINKED</b> : Query the linked channels By default, the command Query the current SET value.
Response	A single value, or a comma separated array. When ALL is requested, the format is "<MIN>,<MAX>,<DEF>,<SET>,<LIST>"
Example	:SENSe3:MEASure2:EDIagram:VERTical? DEF -> 14.000000

Command	:SENSe<n>:MEASure<m>:EDIagram:VERTical
Syntax	:SENSe<n>:MEASure<m>:EDIagram:VERTical<wsp><value MIN MAX DEF>
Description	Set the vertical (y) resolution step size of the eye measurement
Parameters	<b>value</b> : The desired new set point <b>MIN</b> : Set to the minimum value <b>MAX</b> : Set to the maximum value <b>DEF</b> : Restores the default value
Response	No response
Example	:SENSe3:MEASure2:EDIagram:VERTical 2

Command	:SENSe<n>:PATtern<m>:EQBoost?
Syntax	:SENSe<n>:PATtern<m>:EQBoost? [<wsp><MIN MAX DEF SET LIST ALL STEP UNIT LINKED>]
Description	Query the ED equalizer boost.
Parameters	<b>MIN</b> : Query the minimum configurable value <b>MAX</b> : Query the maximum configurable value <b>DEF</b> : Query the default power-on value <b>SET</b> : Query the current SET value <b>LIST</b> : Query the list of discrete options for configurable values (if available) <b>ALL</b> : Query the values specified by MIN, MAX, DEF, SET, and LIST <b>STEP</b> : Query the minimum resolution of the equalizer boost value <b>UNIT</b> : Query the default unit for the equalizer boost value <b>LINKED</b> : Query the linked channels By default, this command Query the current SET value.
Response	A single value, or a comma separated array. When ALL is requested, the format is "<MIN>,<MAX>,<DEF>,<SET>,<LIST>".
Example	:SENSe3:PATtern2:EQBoost? ALL -> 0.0,21.0,0.0,0.0,NAN

Command	:SENSe<n>:PATtern<m>:EQBoost
Syntax	:SENSe<n>:PATtern<m>:EQBoost<wsp><value MIN MAX DEF>
Description	Set the ED equalizer boost.
Parameters	<b>value</b> : The desired new set point <b>MIN</b> : Set to the minimum value <b>MAX</b> : Set to the maximum value <b>DEF</b> : Restores the default value
Response	No response
Example	:SENSe3:PATtern2:EQBoost 2.4

Command	:SENSe<n>:PATtern<m>:EQBoost:MODE?
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Syntax	:SENSe<n>:PATTeRn<m>:EQBoost:MODE? [<wsp><DEF SET INFO>]
Description	Query the ED equalizer boost mode.
Parameters	<b>DEF</b> : Query the default power-on value <b>SET</b> : Query the current SET value <b>INFO</b> : Provides a description of what the return values represent By default, this command Query the current SET value.
Response	An integer indicating the ED equalizer boost mode.
Example	:SENSe3:PATTeRn2:EQBoost:MODE? -> 0

Command	:SENSe<n>:PATTeRn<m>:EQBoost:MODE
Syntax	:SENSe<n>:PATTeRn<m>:EQBoost:MODE<wsp><value DEF>
Description	Set the ED equalizer boost mode.
Parameters	<b>value</b> : The desired boost mode <b>DEF</b> : Restores the default value
Response	No response
Example	:SENSe3:PATTeRn2:EQBoost:MODE 0

Command	:SENSe<n>:PATTeRn<m>:LOGic?
Syntax	:SENSe<n>:PATTeRn<m>:LOGic? [<wsp><DEF SET INFO >]
Description	Query the ED pattern digital level logic.
Parameters	<b>DEF</b> : Query the default power-on value <b>SET</b> : Query the current SET value <b>INFO</b> : Provides a description of what the return values represent By default, the command Query the current SET value.
Response	An integer indicating the current set digital level logic.
Example	:SENSe5:PATTeRn1:LOGic? INFO -> 0:LOW,NEGATIVE 1:HIGH,POSITIVE

Command	:SENSe<n>:PATTeRn<m>:LOGic
Syntax	:SENSe<n>:PATTeRn<m>:LOGic<wsp><0 NEGative LOW 1 POSitive HIGH DEF>
Description	Set the ED pattern digital level logic.
Parameters	<b>NEGative LOW</b> : Set to the positive logic <b>POSitive HIGH</b> : Set to the negative logic <b>DEF</b> : Restores the default value
Response	No response
Example	:SENSe3:PATTeRn2:LOGic NEG

Command	:SENSe<n>:PATTeRn<m>:TYPE?
Syntax	:SENSe<n>:PATTeRn<m>:TYPE?<wsp><DEF SET LIST ALL INFO LINKED>
Description	Query the ED pattern type
Parameters	<b>DEF</b> : Query the default power-on value <b>SET</b> : Query the current SET value <b>LIST</b> : Query the list of discrete options for configurable values <b>ALL</b> : Query the values specified by DEF, SET, and LIST <b>INFO</b> : Provides a description of what the return values represent <b>LINKED</b> : Query the linked channels By default, the command Query the current SET value.
Response	A single integer value, or a comma separated integer array. When ALL is requested, the format is "<DEF>,<SET>,<LIST>".
Example	:SENSe3:PATTeRn2:TYPE? LIST -> 0,1,2,3,4,5,6

Command	:SENSe<n>:PATTeRn<m>:TYPE
---------	---------------------------

Syntax	:SENSe<n>:PATTeRn<m>:TYPE<wsp><value DEF>
Description	Set the ED pattern type
Parameters	<b>value:</b> Set to desired pattern <b>DEF:</b> Restores the default value
Response	No response
Example	:SENSe3:PATTeRn2:TYPE 0

Command	:SENSe<n>:PATTeRn<m>:EINJect
Syntax	:SENSe<n>:PATTeRn<m>:EINJect
Description	Adds a small random burst of errors into the ED measurement (Error injection).
Parameters	No parameters
Response	No response
Example	:SOURce3:PATTeRn2:EINJect

Command	:SOURce<n>:PATTeRn<m>:DEEMphasis?
Syntax	:SOURce<n>:PATTeRn<m>:DEEMphasis? [<wsp><MIN MAX DEF SET LIST ALL UNIT>]
Description	Query the pattern de-emphasis.
Parameters	<b>MIN:</b> Query the minimum configurable value <b>MAX:</b> Query the maximum configurable value <b>DEF:</b> Query the default power-on value <b>SET:</b> Query the current SET value <b>LIST:</b> Query the list of discrete options for configurable values (if available) <b>ALL:</b> Query the values specified by MIN, MAX, DEF, SET, and LIST <b>UNIT:</b> Query the default unit for this value By default, the command Query the current SET value.
Response	A single value, or a comma separated array. When ALL is requested, the format is "<MIN>,<MAX>,<DEF>,<SET>,<LIST>".
Example	:SOURce3:PATTeRn2:DEEMphasis? -> 0.9

Command	:SOURce<n>:PATTeRn<m>:DEEMphasis
Syntax	:SOURce<n>:PATTeRn<m>:DEEMphasis<wsp><value MIN MAX DEF>
Description	Set the pattern de-emphasis.
Parameters	<b>value:</b> The desired new set point <b>MIN:</b> Set to the minimum value <b>MAX:</b> Set to the maximum value <b>DEF:</b> Restores the default value
Response	No response
Example	:SOURce3:PATTeRn2:DEEMphasis 1.9

Command	:SOURce<n>:PATTeRn<m>:DEEMphasis:CURSor?
Syntax	:SOURce<n>:PATTeRn<m>:DEEMphasis:CURSor? [<wsp><DEF SET LIST ALL INFO>]
Description	Query the pattern de-emphasiss cursor.
Parameters	<b>DEF:</b> Query the default power-on value <b>SET:</b> Query the current SET value <b>LIST:</b> Query the LIST of discrete options for configurable values <b>ALL:</b> Query the values specified by DEF, SET, and LIST <b>INFO:</b> Provides a description of what the return values represent By default, the command Query the current SET value.
Response	A single integer value, or a comma separated integer array. When ALL is requested, the format is "<DEF>,<SET>,<LIST>".
Example	:SOURce5:PATTeRn1:DEEMphasis:CURSor? ->0 :SOURce5:PATTeRn1:DEEMphasis:CURSor? INFO -> 0:POST 1:PRE

Command	:SOURce<n>:PATTeRn<m>:DEEMphasis:CURSor
---------	---

Syntax	:SOURce<n>:PATtern<m>:DEEMphasis:CURSor<wsp><0 POST 1 PRE DEF>
Description	Set the pattern de-emphasis cursor.
Parameters	<b>PRE:</b> Set to pre-cursor <b>POST:</b> Set to post-cursor <b>DEF:</b> Restores the default value
Response	No response
Example	:SOURce3:PATtern2:DEEMphasis:CURSor POST

Command	:SOURce<n>:PATtern<m>:LOGic?
Syntax	:SOURce<n>:PATtern<m>:LOGic? [<wsp><DEF SET ALL LIST INFO>]
Description	Query the data pattern level logic
Parameters	<b>DEF:</b> Query the default power-on value <b>SET:</b> Query the current SET value <b>LIST:</b> Query the list of discrete options for configurable values <b>ALL:</b> Query the values specified by DEF, SET, and LIST <b>INFO:</b> Provides a description of what the return values represent By default, the command Query the current SET value.
Response	An integer indicating the pattern level logic.
Example	:SOURce5:PATtern1:LOGic? ->1 :SOURce5:PATtern1:LOGic? INFO -> 0:LOW, NEGATIVE 1:HIGH, POSITIVE

Command	:SOURce<n>:PATtern<m>:LOGic
Syntax	:SOURce<n>:PATtern<m>:LOGic<wsp><0 NEGative LOW 1 POSitive HIGH DEF>
Description	Set the data pattern digital logic level.
Parameters	<b>value:</b> The desired new set point <b>DEF:</b> Restores the default value
Response	No response
Example	:SOURce3:DATA2:LOGic POSITIVE

Command	:SOURce<n>:PATtern<m>:TYPE?
Syntax	:SOURce<n>:PATtern<m>:TYPE?<wsp><MIN MAX DEF SET LIST ALL INFO LINKED>
Description	Query the pattern type.
Parameters	<b>DEF:</b> Query the default power-on value <b>SET:</b> Query the current SET value <b>LIST:</b> Query the list of discrete options for configurable values <b>ALL:</b> Query the values specified by DEF, SET, and LIST <b>INFO:</b> Provides a description of what the return values represent <b>LINKED:</b> Query the linked channels By default, the command Query the current SET value.
Response	A single integer value, or a comma separated integer array. When ALL is requested, the format is "<DEF>,<SET>,<LIST>".
Example	:SOURce3:PATtern2:TYPE? -> 6

Command	:SOURce<n>:PATtern<m>:TYPE
Syntax	:SOURce<n>:PATtern<m>:TYPE<wsp><value MIN MAX DEF>
Description	Set the pattern type.
Parameters	<b>value:</b> The desired new set point <b>MIN:</b> Set to the minimum value <b>MAX:</b> Set to the maximum value <b>DEF:</b> Restores the default value
Response	No response
Example	:SOURce3:PATtern2:TYPE PRBS9

## 9.6 BERT 1005 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.

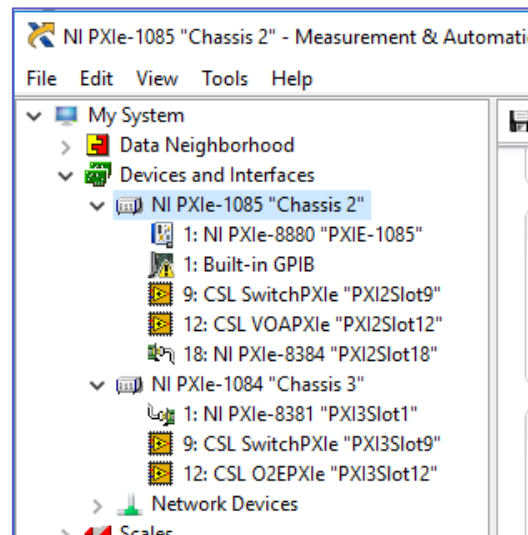
### 9.6.1 NI-MAX application Multi Chassis mode

#### **⚠ 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.



## 9.6.2 SCPI Multi Chassis commands

### ⚠ IMPORTANT

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	<p><b>LIST:</b> Returns a comma separated list of valid chassis index numbers discovered by the CohesionSCPI service. These are chassis that have modules installed</p> <p><b>MODE:</b> Returns the current Chassis Mode the CohesionSCPI service is operating in (SINGLE or MULTI)</p> <p><b>None:</b> Returns the number of chassis managed by the CohesionSCPI service. If operating in SINGLE mode, this will always return 1</p>
Example	<p>In Single chassis mode:</p> <p>SYSTEM:CHASSIS? -&gt; 1</p> <p>SYSTEM:CHASSIS? LIST -&gt; 0</p> <p>SYSTEM:CHASSIS? MODE -&gt; SINGLE</p> <p>In Multi chassis mode:</p> <p>SYSTEM:CHASSIS? -&gt; 2</p> <p>SYSTEM:CHASSIS? LIST -&gt; 2,3</p> <p>SYSTEM:CHASSIS? MODE -&gt; MULTI</p>
Command	:SYSTEM:CHASSIS
Syntax	:SYSTEM:CHASSIS<wsp>[SINGLE MULTI]
Description	Set the Chassis Mode configuration
Parameters	<p><b>SINGLE:</b> Set CohesionSCPI service to operate in SINGLE Chassis Mode</p> <p><b>MULTI:</b> Set CohesionSCPI service to operate in MULTI Chassis Mode</p>
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

## 9.7 SCPI Command Console (available on MATRIQ instruments)

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

### NOTE

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

### NOTE

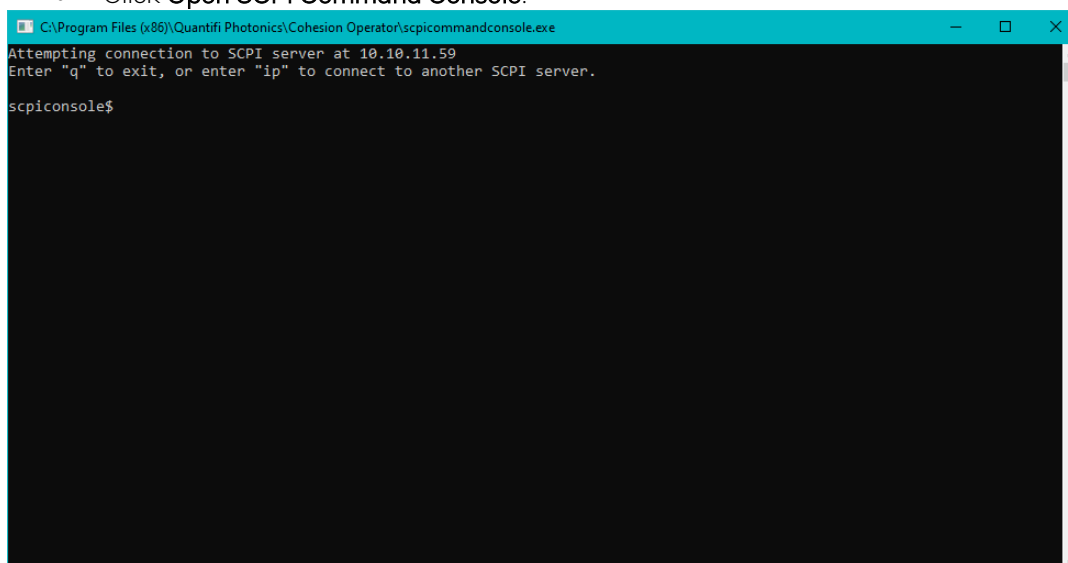
The two most common error codes are:

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

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

To open the SCPI Command Console:

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



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

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

2. To switch to another Quantifi Photonics device:

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

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

- Enter a command and press <ENTER>.



- The device will execute the command and return an action response to the console if applicable.
4. To exit the SCPI Command Console:

- Enter **q** and press <ENTER>.

```

C:\Program Files (x86)\Quantifi Photonics\Cohesion Operator\scpicommandconsole.exe
Attempting connection to SCPI server at 10.10.10.66
Enter "q" to exit, or enter "ip" to connect to another SCPI server.

scpicomsole$ *idn?
Quantifi Photonics Ltd,BERT-1101-4-MTRQ,CSL-000000,HW0.00.00SW3.01.16

scpicomsole$ ip
Please enter the IP address of the instrument:
10.10.11.59

Attempting connection to SCPI server at 10.10.11.59
Enter "q" to exit, or enter "ip" to connect to another SCPI server.

scpicomsole$ *idn?
Quantifi Photonics Ltd,LASER-1002-1-FA-MTRQ,QP-211709,HW0.00.00SW3.01.16

scpicomsole$ *cls

scpicomsole$ q

```

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

- Enter the command: **\*idn?**  
The instrument returns the requested information.
- If you enter the command incorrectly, for example: **\*ind?**  
The instrument returns **error code 32**.  
For details on error codes, please refer to the **\*ESR?** Command.

```

scpicomsole$ *idn?
Quantifi Photonics Ltd,BERT-1101-4-MTRQ,CSL-000000,HW0.00.00SW3.01.16

scpicomsole$ *ind?
*ESR? -> 32

scpicomsole$

```

Example: Send a WRITE only command

- Enter a command correctly, for example: **\*cls**  
The instrument executes the command, there will be no action response.
- Enter the command incorrectly: **\*cs1**  
The instrument returns **error code 17: IO write error**.

```

scpicomsole$ *cls

scpicomsole$ *cs1
17: IO write error

scpicomsole$

```

## 10 Example: Control of the BERT 1005 with SCPI

The following is a simple example of how to control the BERT 1005 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 BERT 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?

Using slot 10 as an example, take the following steps to make sure that the instrument is ready:

1. Check that all modules are ready to run commands:  
\*OPC?
2. Check the operational status of the module installed on slot 10:  
: SLOT10:OPC?
3. Check the standard event status register to make sure the commands have been run with no errors:  
\*ESR?
4. Start error detection:  
: SENS10:MEAS2:START
5. Check the total error count:  
: CALCulate10:DATA2:EALARM? ERROR
6. Check the total number of bits transferred:  
: CALCulate10:DATA2:EALARM? BITS
7. Check the bit error rate:  
: CALCulate10:DATA2:EALARM? BER
8. Check all the error-detection measurement information:  
: CALCulate10:DATA2:EALARM? FULL
9. Stop error detection:  
: SENSE10:MEASure2:STOP

Take the following steps to acquire eye scan measurement:

1. Set the vertical resolution step size of the eye measurement to the maximum value:  
:SENSe10:MEASure2:EDIagram:VERTical MAX
2. Start the eye scan measurement:  
:SENSe10:MEASure2:EDIagram:STARt
3. Check the eye scan measurement status:  
:CALCulate10:DATA2:EDIagram:STATus?
4. Check the vertical resolution step size of the eye measurement:  
:SENSe3:MEASure2:EDIagram:VERTical?
5. Check the eye scan measurement data:  
:CALCulate10:DATA2:EDIAGram?
6. Stop the eye scan measurement:  
:SENSe10:MEASure2:EDIagram:STOP

Take the following steps to configure and control pattern generation:

1. Set the pattern type to PRBS9:  
:SOURce10:PATtern2:TYPE PRBS9
2. Set the pattern de-emphasis cursor to pre-cursor:  
:SOURce10:PATtern2:DEEMphasis:CURSOr PRE
3. Set the pattern de-emphasis to 1.9 dB:  
:SOURce10:PATtern2:DEEMphasis 1.9
4. Start pattern generation:  
:OUTPut10:DATA2:OUTPut 1
5. Check the current SET state of the pattern generation output:  
:OUTPut10:DATA2:OUTPut? SET
6. Stop pattern generation:  
:OUTPut10:DATA2:OUTPut 0

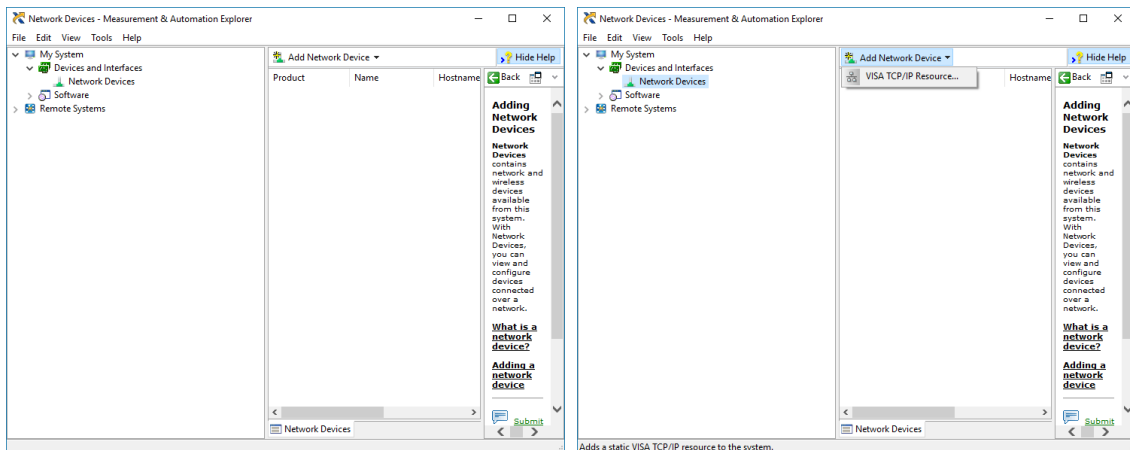
## ⚠ IMPORTANT

The following section details the various methods that a user may send these commands to an BERT 1005 product via **SCPI** commands.

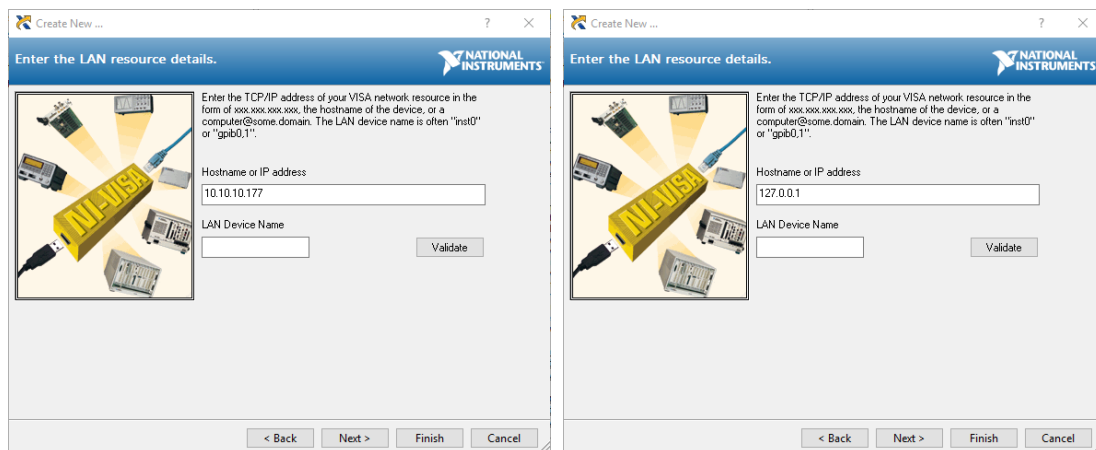
### 10.1 NI-MAX application

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 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**.



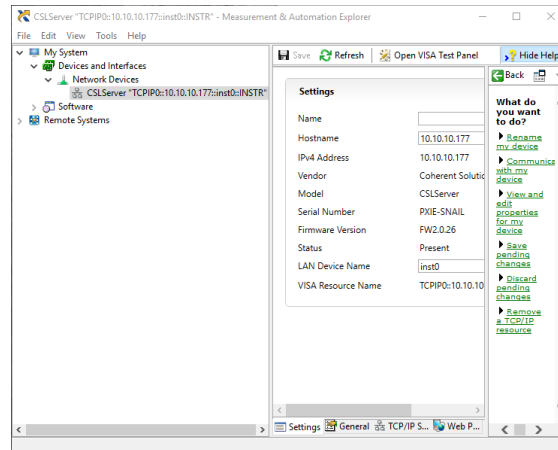
3. Select **Manual Entry of LAN Instrument**. Enter in the Hostname or IP Address. The top image is an example of operating remotely, the bottom image is an example of operating locally. Note when operating locally, enter in the localhost IP address of **127.0.0.1**. Click **Finish** to end the setup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



## 10.2 NI-VISA application

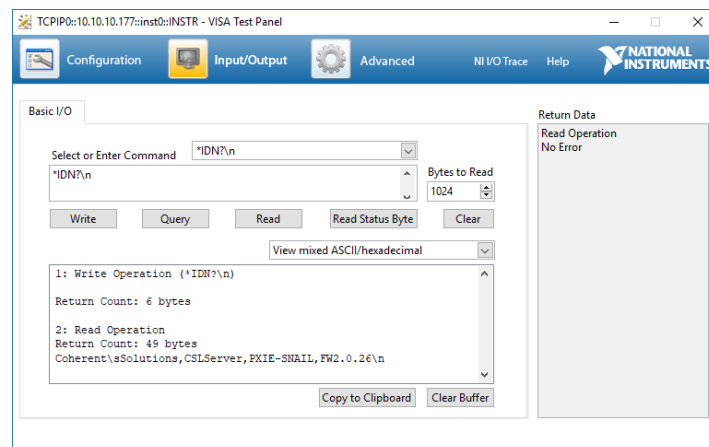
NI-VISA is used to communicate with the PXIe chassis or installed modules / instruments. The above steps must be completed before attempting to communicate using NI-VISA.

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



2. On the righthand side panel, select **Open VISA Test Panel**. A new window will popup. Click the **Input / Output** button from the window menu.

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



### 10.3 Python® 2.7 code example

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

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

## 10.4 MATLAB® code example

To communicate with a BERT 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 BERT 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 BERT product using MATLAB code. For a list of supported and valid SCPI commands, refer to the **Programming Guide**.

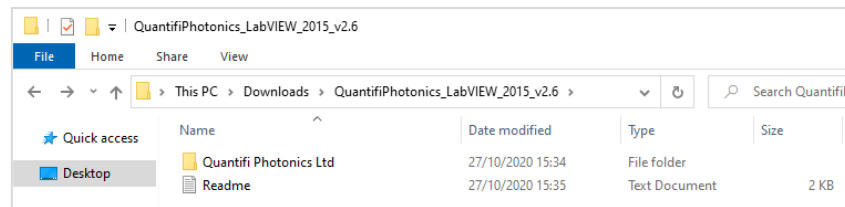
```
% Find a VISA-TCPIP object. This is if the VISA object has already been
% created with tntool or has been removed from the workspace without
% first being closed (cleanly disconnected).
PXIE_Chassis = instrfind('Type', 'visa-tcpip', ...
    'RsrcName', 'TCPIP0::10.10.10.89::inst0::INSTR', 'Tag', '');
% 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);
```

## 10.5 LabVIEW™ application

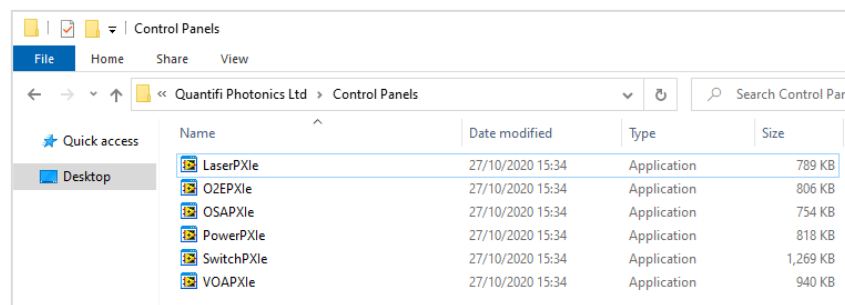
### 10.5.1 Soft Panels

To control the BERT product with a LabVIEW™ Soft Panel, you will need to have setup the chassis / instrument as a TCP/IP Resource as shown in Section 10.1.

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 10.1. If the instrument has not been setup, then the Soft Panel cannot be used.

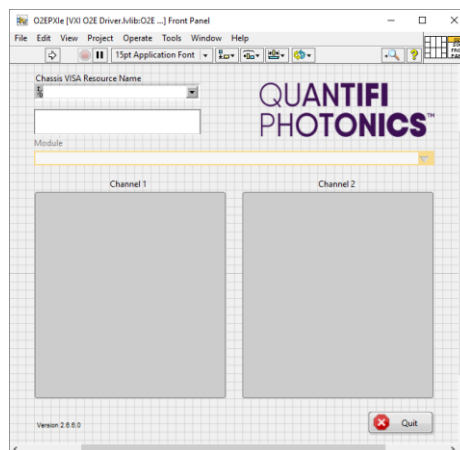
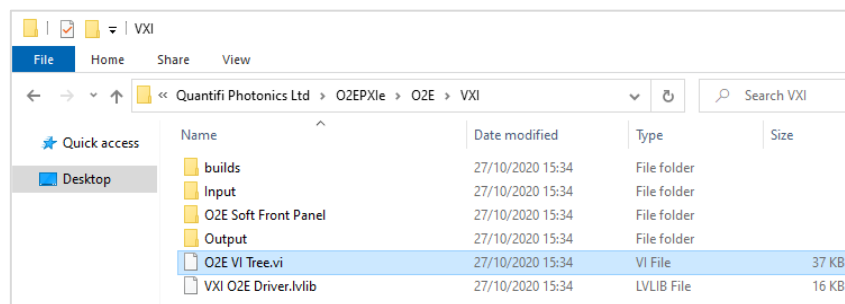


### 10.5.2 LabVIEW™ Virtual Instruments (VIs)

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

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.



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## 11 Maintenance

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To help ensure long, trouble-free operation:

- Always inspect 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.

### 11.1 Annual calibration schedule

To ensure that the BERT product is performing as expected, it is recommended that the product be sent in for annual re-calibration.

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](mailto:support@quantifiphotonics.com).

If the Calibration Certificate has been misplaced, or the calibration due date is not known, email [support@quantifiphotonics.com](mailto:support@quantifiphotonics.com).

## 12 Technical support

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### 12.1 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](mailto: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.

### 12.2 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.

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## 13 Warranty

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### 13.1 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.
- The unit has been used with an external power supply not supplied by Quantifi Photonics with the unit.

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

For full warranty terms and conditions, please visit [www.quantifiphotonics.com](http://www.quantifiphotonics.com).

### 13.2 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.

### 13.3 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.

### 13.4 Certification

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

### 13.5 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.

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