QUANTIFI PHOTONICS®
A Teradyne Company

BERT

1000 SERIES

Bit Error Rate Tester

PXIE USER MANUAL

quantifiphotonics.com

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User manual version: 3.04

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2 Conventions

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

WARNING

Indicates a potentially hazardous situation which, if not avoided, could result in **death or serious injury**.

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

CAUTION

Indicates a potentially hazardous situation which, if not avoided, may result in **minor or moderate injury** or **component damage**.

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

NOTE

Indicates relevant information that requires your attention.

3 Safety information

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

3.1 Optical laser radiation precautions

WARNING

To protect yourself from harm caused by optical radiation:

- Do not install or terminate fibers while the light source is active.
- Turn the Quantifi Photonics product OFF before inspecting the end face(s) of the product, or any optical patch cords connected to it.
- Never look directly into a live fiber; ensure that your eyes are protected at all times.

CAUTION

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

3.2 Electromagnetic compatibility

CAUTION

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

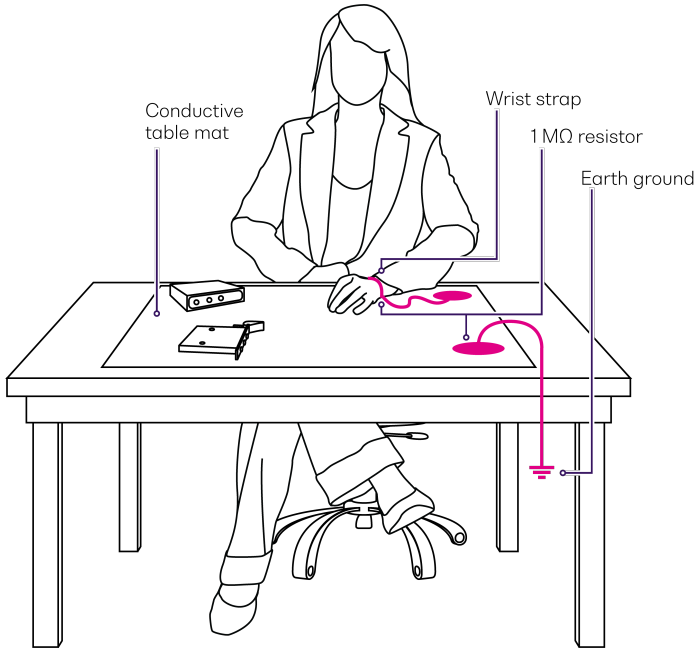

This symbol on the unit refers to documentation provided with the product for related safety information. Ensure that the required conditions are met and understood before using the product.

3.3 Electrostatic discharge precautions

CAUTION

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

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



4 Introducing the BERT 1000 Series

The BERT 1000 Series comprises of a 2- or 4-channel pattern generator and error detector for the design, characterization, and production of optical transceivers and opto-electrical components.

Programming interfaces

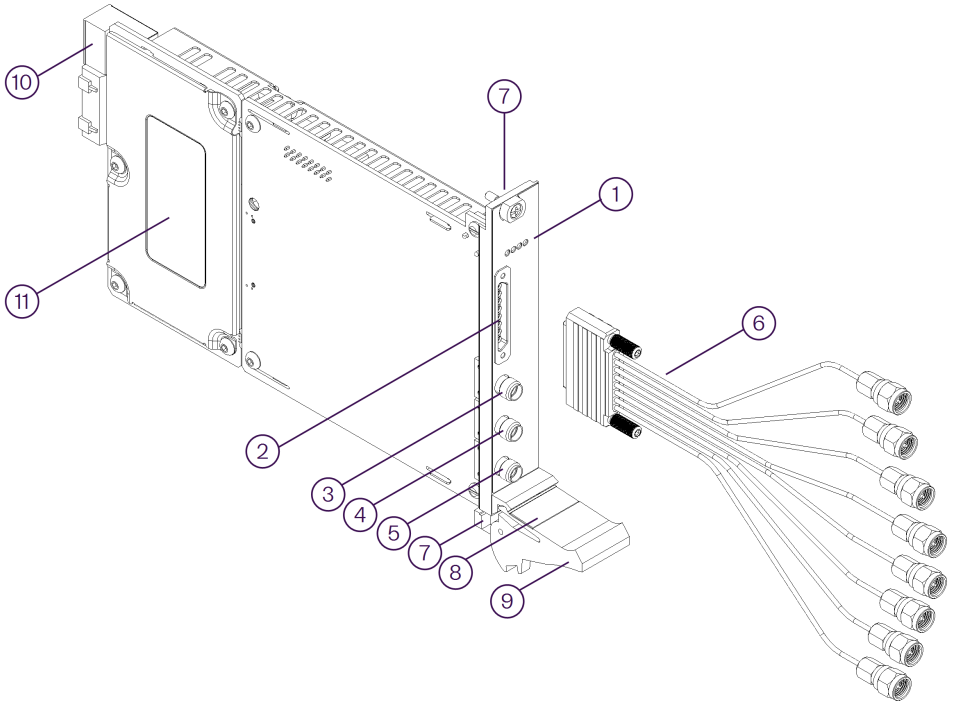
Through its programming interfaces you can take advantage of the SCPI-compliant command language and choose from programming tools such as LabView, C++, Python, or any of the other popular programming languages used to control automatic test equipment (ATE).

CohesionUI™

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

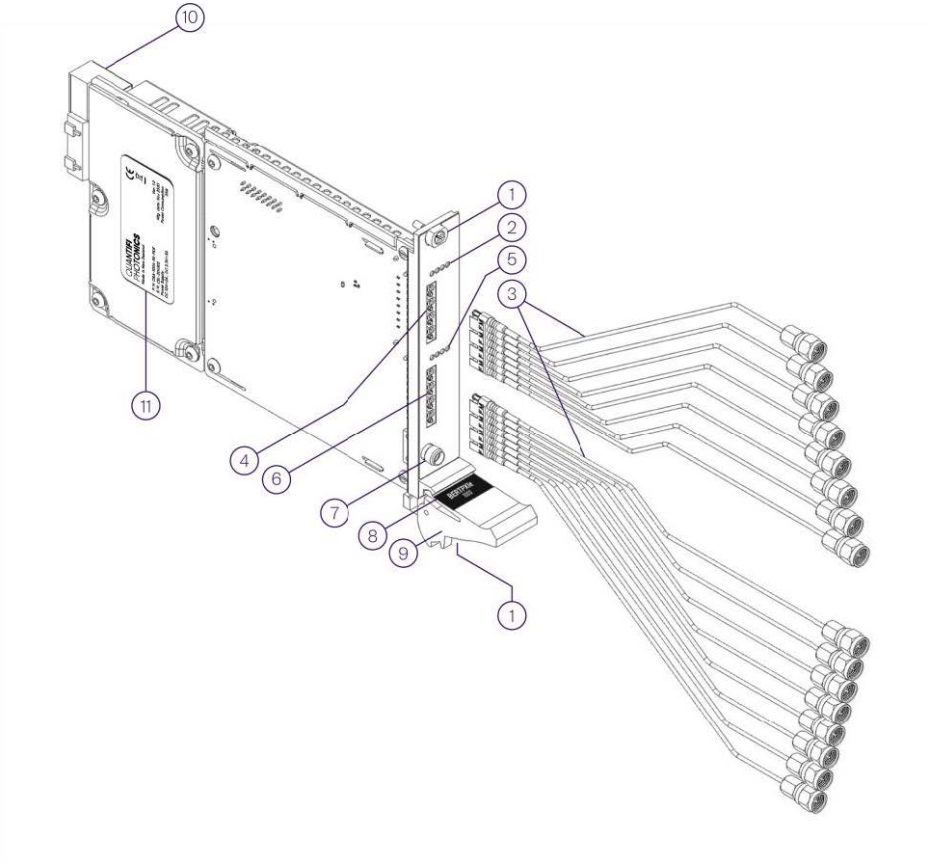
4.1 Hardware description

4.1.1 BERT-1001



1	Status LEDs for error detector and pattern generator	7	Fastening screws
2	Error detector RF input / Pattern generator RF output	8	Model identifier label
3	CR Out	9	Fastening clip
4	Clock out	10	PXIe headers
5	Divided clock output	11	BERT PXIe module information
6	RF harness		

4.1.2 BERT-1003/5

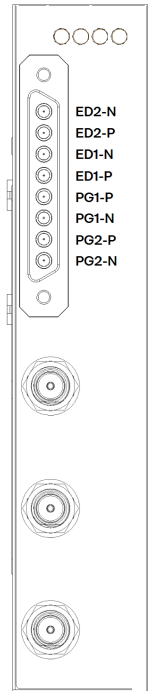


1	Fastening screws	7	Divided clock output
2	Status LEDs for error detector	8	Model identifier label
3	RF harness	9	Fastening clip
4	Error detector RF input	10	PXIe headers
5	Status LEDs for pattern generator	11	BERT PXIe module information
6	Pattern generator RF output		

4.2 RF input (error detector) and RF output (pattern generator)

4.2.1 BERT-1001

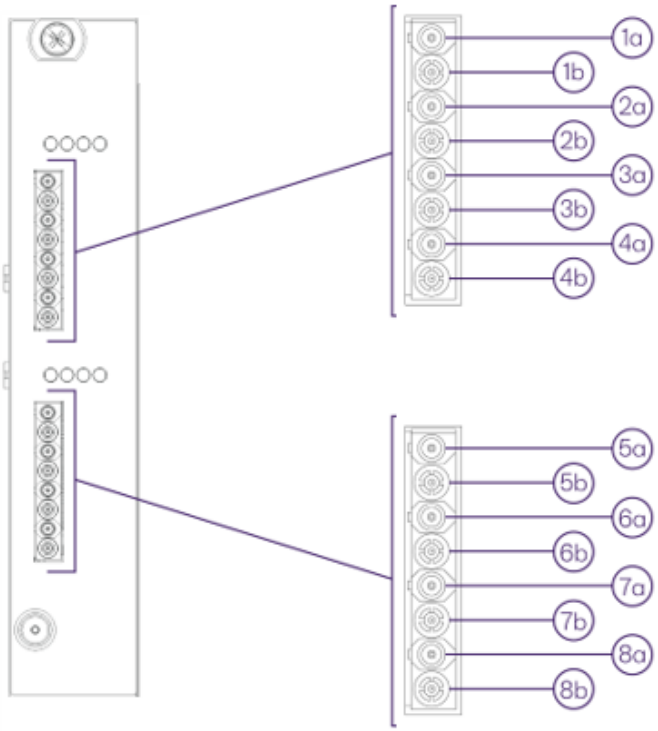
Each data output and input channel is labeled in pairs with positive and negative polarity.



PGx -	Pattern generator channel x (negative)	EDx -	Error detector channel x (negative)
PGx +	Pattern generator channel x (positive)	EDx +	Error detector channel x (positive)

4.2.2 BERT-1003/5

Each data output and input channel is labeled in pairs with positive and negative polarity.



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

4.3 Status LEDs

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

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)**:

LED	Meaning
🟢	Pattern generation is running
⚪ OFF	BERT is powered OFF
	BERT is powered ON and no pattern generation is running

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

LED	Meaning
🟢	Error detection is running
🟠	Eye scan is running
⚪ OFF	BERT is powered OFF
	BERT is powered ON and no pattern generation or eye scan is running

5 Setting up hardware

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

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

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

CAUTION

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

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

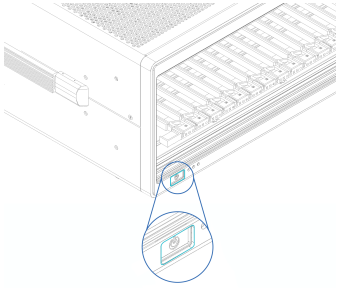
5.1 Install the module in a PXIe chassis

WARNING

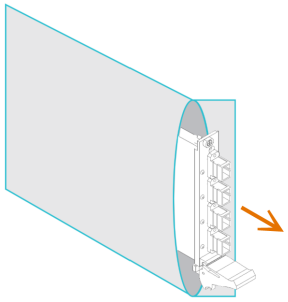
When attempting to install or remove a module or any component of the PXIe chassis:

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

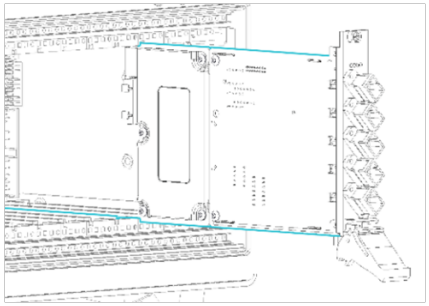
1 Power the chassis OFF.



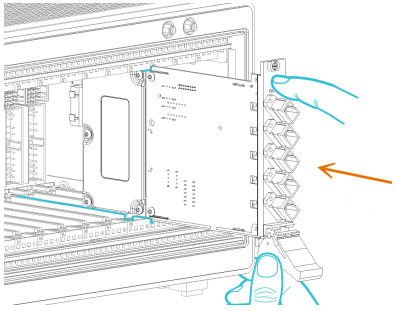
2 Remove the module from the anti-static bag. Retain the bag.



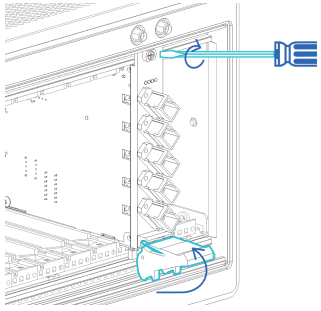
3 Align the module with the slot guide rails.



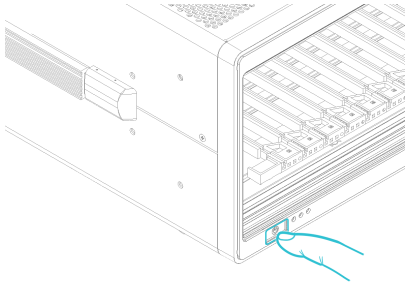
4 Push module into slot until you feel resistance from the backplane connection.



5 Engage the fastening clip. Secure all fastening screws.



6 Power the chassis ON.



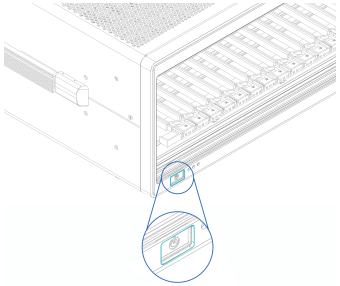
5.2 Uninstall the module from a PXIe chassis

WARNING

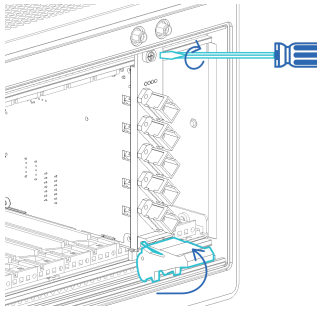
When attempting to install or remove a module or any component of the PXIe chassis:

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

1 Power the chassis OFF.

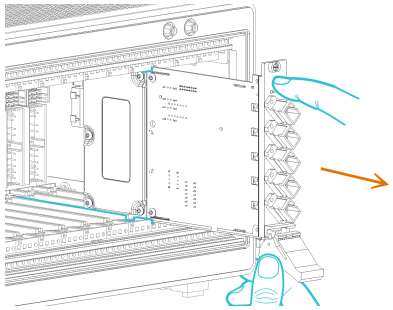


2 Unsecure the fastening screws and fastening clip.

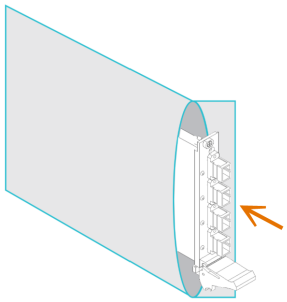


3 Pull out the module.

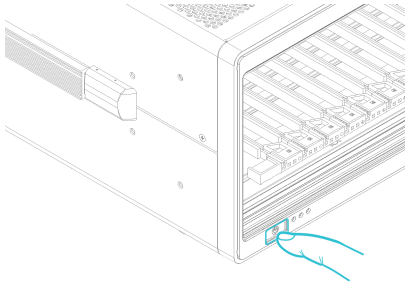
Use the fastening clip to pull. Do NOT pull on the connectors.



4 Store the module in its antistatic bag.



5 Power ON the chassis.



5.3 Working with electrical connectors

To connect to your BERT, 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.

NOTE

Use electrostatic discharge (ESD) protection at all times, especially when handling RF input / output connectors.

5.3.1 Connector care

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

The RF Coax array on the BERT front panel will gradually wear each time the harness is 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.

NOTE

- 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.

5.3.2 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.

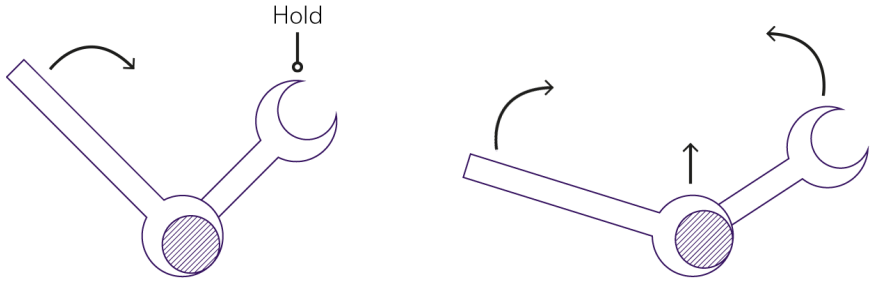
For slow signals with large bit periods, a cable mismatch such as 5 ps has little impact on the results. However, for fast signals with small bit periods, the impact is significant. For example, for a data rate of 14.5 Gb/s that has the bit period of 70 ps, a cable mismatch of 5 ps may lead to a significant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

The 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.

5.3.2.1 Using a torque wrench

- When using a torque wrench, follow these steps:

1. Make sure the torque wrench is set to the correct torque settings (refer Torque settings).
2. Position the torque wrench, and a second wrench to hold the device or cable, within 90° of each other before applying force. Make sure to support the devices to avoid putting stress on the connectors.
3. Hold the torque wrench lightly at the end of the handle, then apply force perpendicular to the torque wrench handle.
4. Tighten until the “break” point of the torque wrench is reached. Do not push beyond initial break point



Correct method

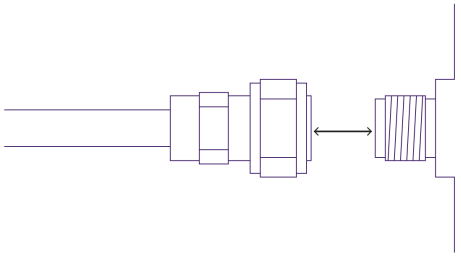
Incorrect method
(too much lift)

5.3.3 Making a connection

To make a connection, follow these steps:

1. Wear a grounded wrist strap.
2. Inspect, clean, and measure connectors. All connectors must be undamaged, clean, and within mechanical specification.
3. 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.
4. 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.

5.3.4 Separating a connection

To separate a connection, follow these steps:

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

5.3.5 Torque settings

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)

6 Installing software

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

The Cohesion Installer contains all required drivers and software:

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

6.1 Install the Cohesion Installer software package

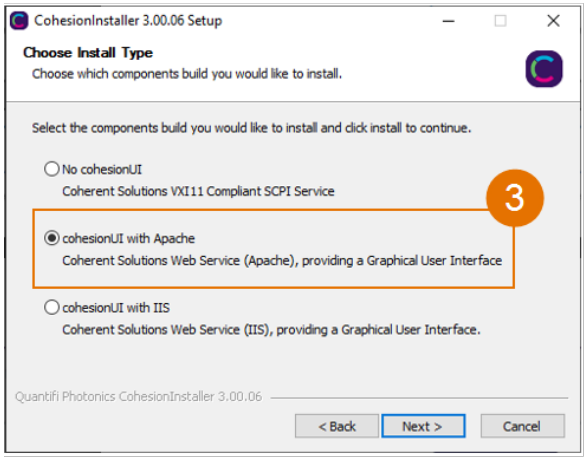
Install Cohesion Installer on:

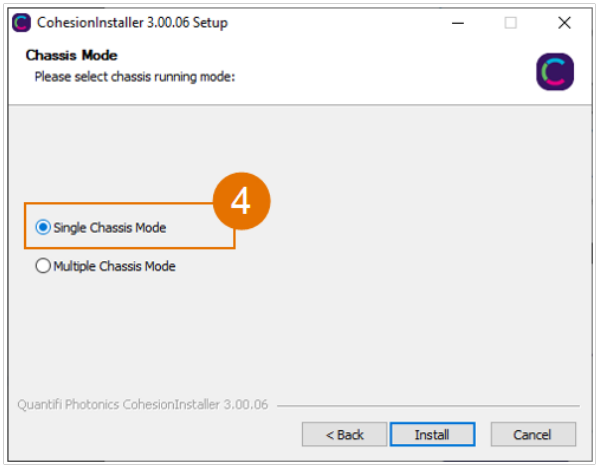
- the PXIe controller of the PXIe Chassis in which the Quantifi Photonics module(s) will be installed, or
- the controller PC (multi-chassis MXI setup)

▶ To install Cohesion Installer:

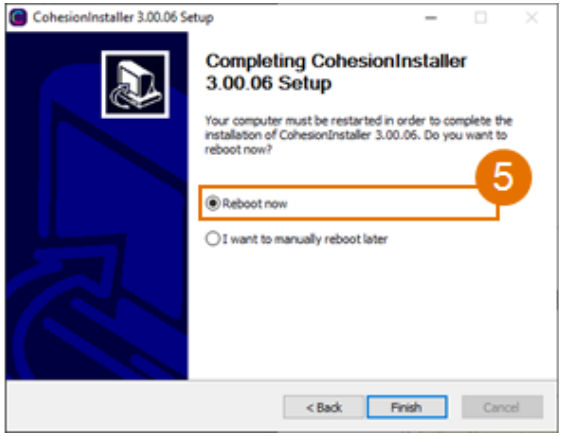
1. We recommended that you save your work and close open programs before installing Cohesion Installer.
2. Locate and run **CohesionInstaller-<version_number>.exe** from the provided USB media device (or download it from the Quantifi Photonics website) and follow the on-screen installation prompts.
3.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

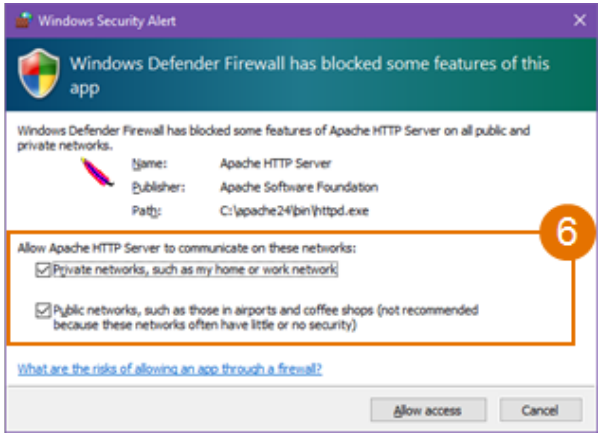
   To operate in Multiple Chassis Mode, additional hardware modules are required. As you can change the Chassis Mode later, we recommend to select **Single Mode** unless all other configuration requirements have been met.





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





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

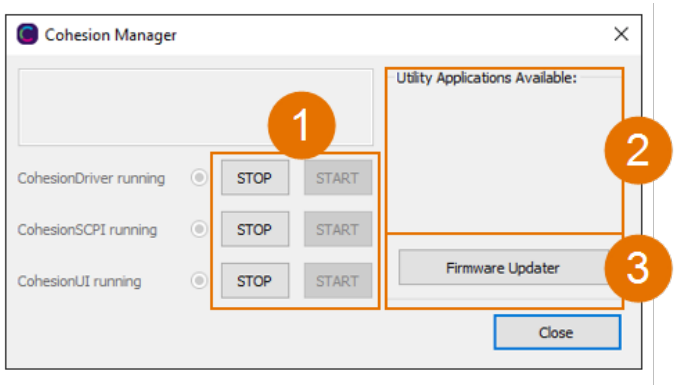
6.2 Cohesion Manager

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

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

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

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



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

6.3 Cohesion Firmware Updater

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

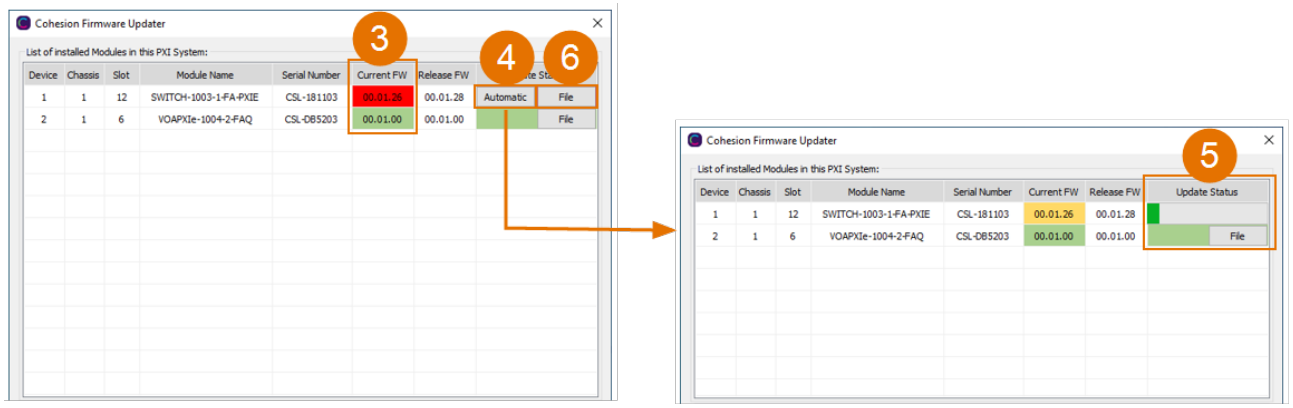
It is a single-window summary application that enables you to:

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

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

▶ To upgrade firmware:

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

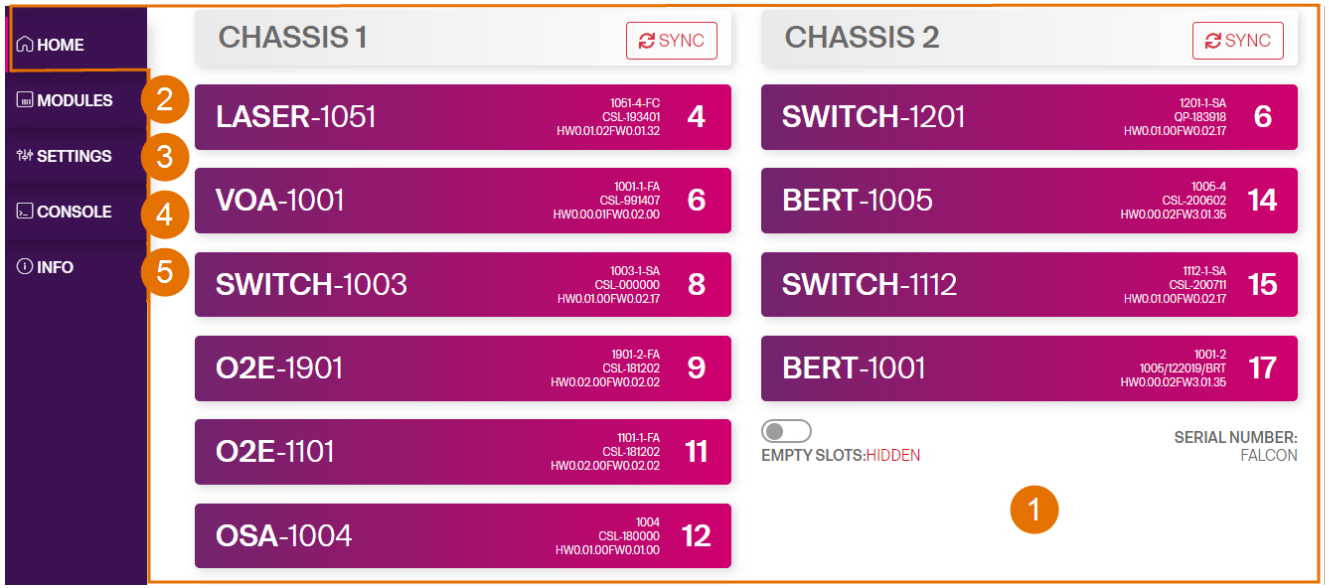


7 CohesionUI - Overview

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

> CohesionUI is part of the Cohesion Installer software package.

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



7.1 Access a module with CohesionUI

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

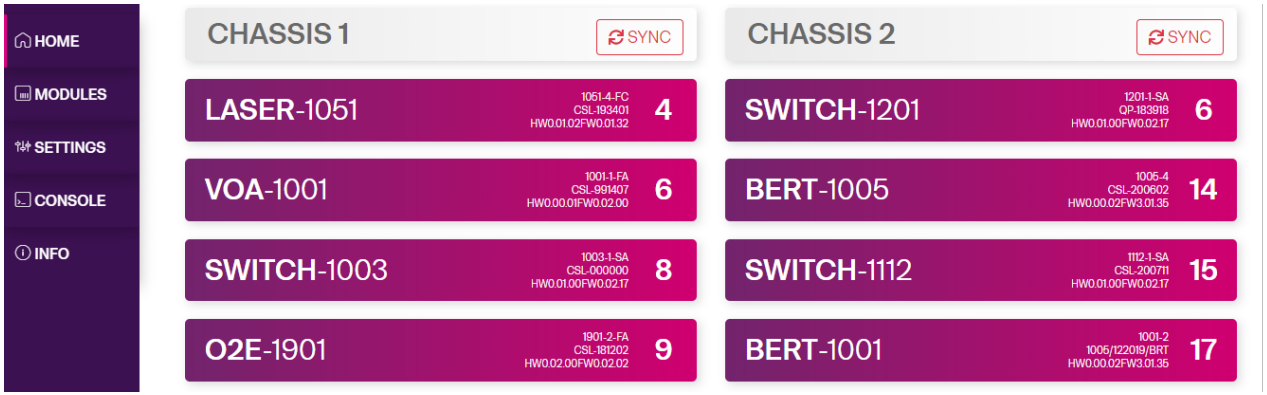
To connect with a module, you need the IP address of the chassis the module is installed in.

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

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

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

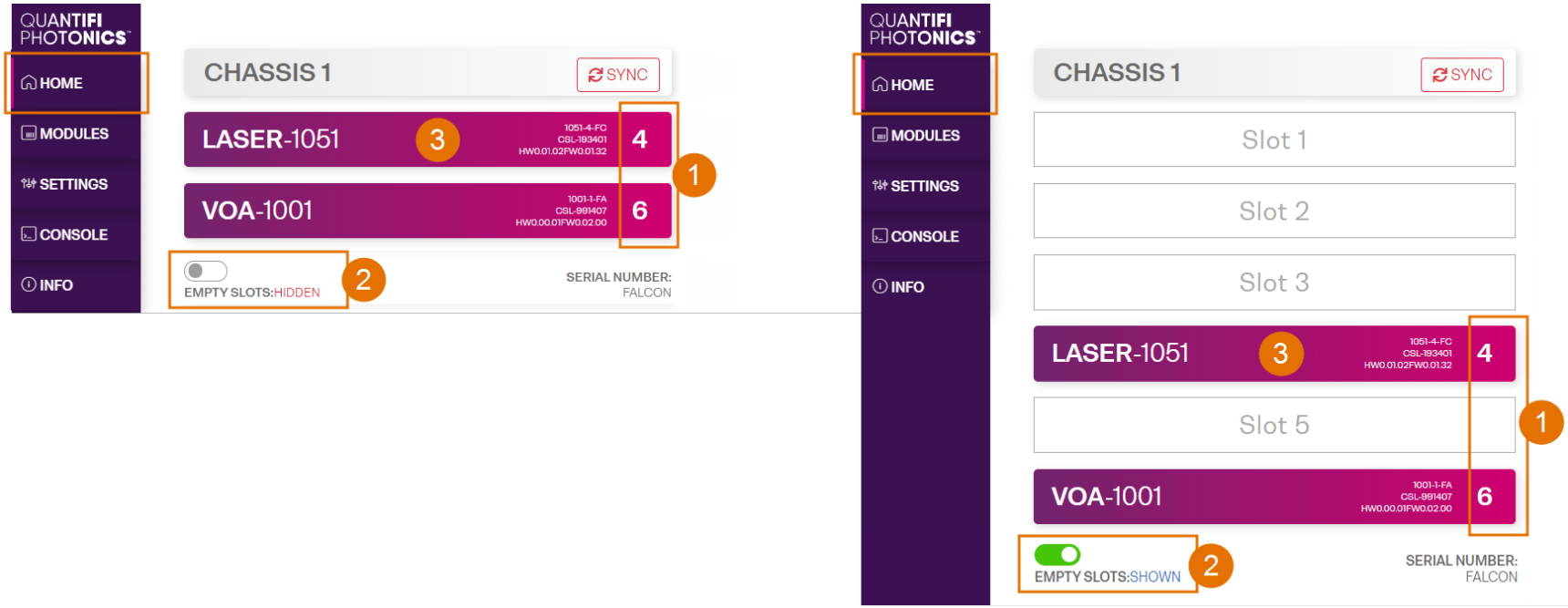
  3. CohesionUI will launch in the browser, listing all available Quantifi Photonics modules installed in the chassis.



7.2 Display modules in a chassis

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

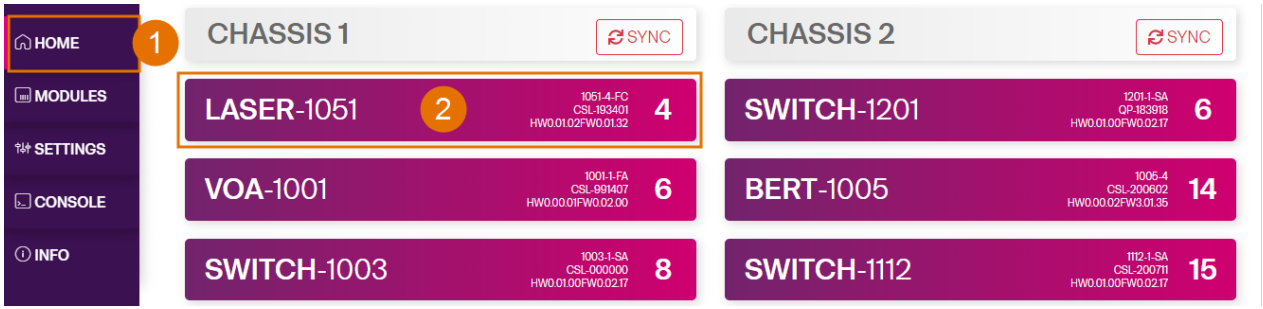
1. Numbers indicate the slots the modules are installed in.
2. You can hide (default setting) or show empty slots in the PXIe chassis by toggling the **EMPTY SLOTS** button.
3. You can select a module to work with by clicking it.



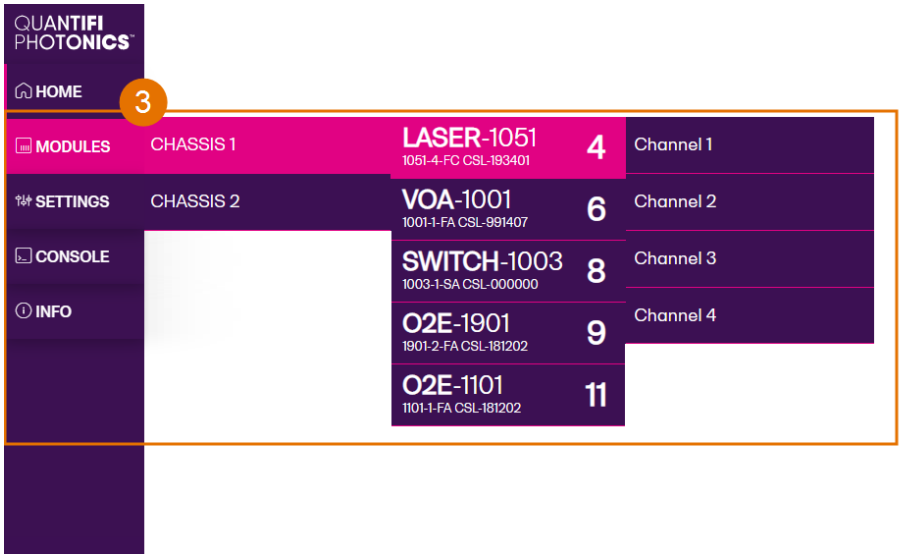
7.3 Select a module to work with

To select a module:

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



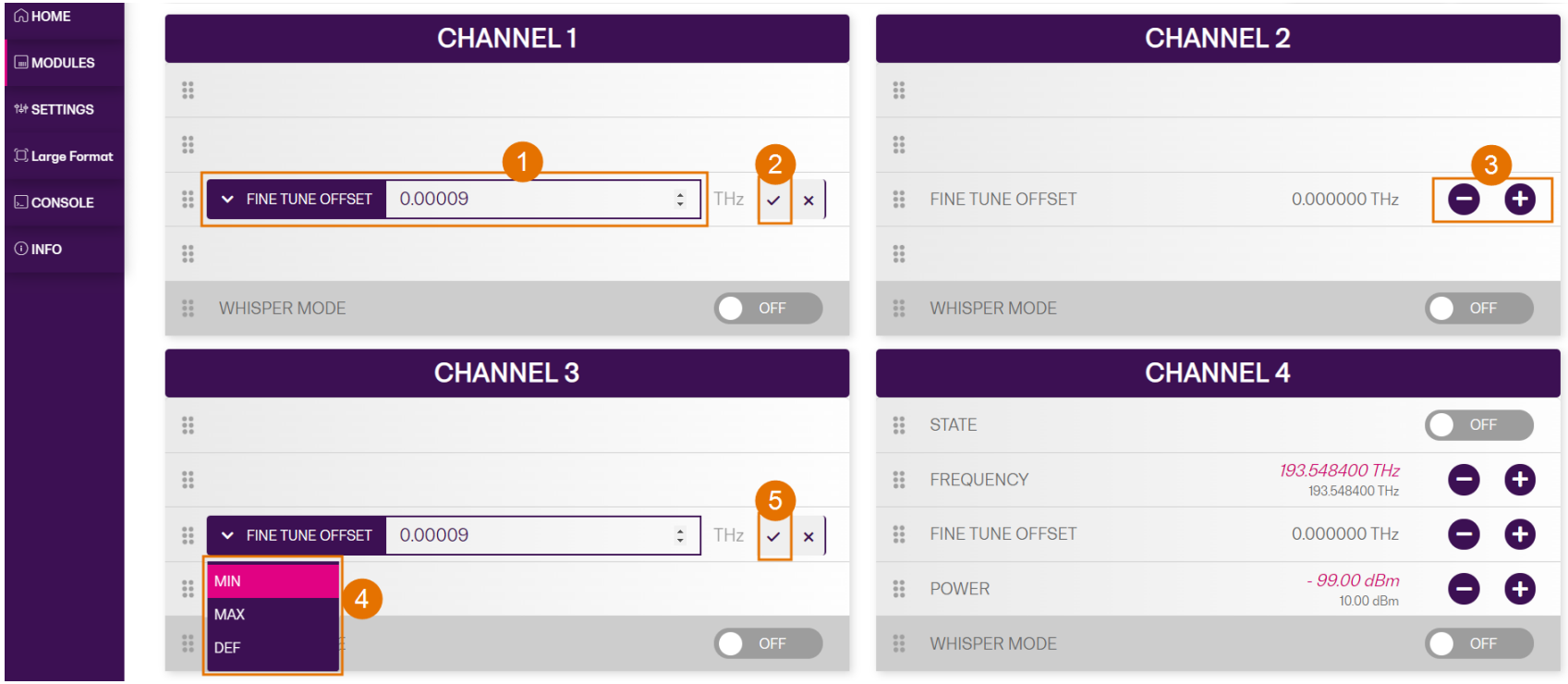
3. Or, hover over the **MODULES** menu and select a module or channel from the list.



7.4 Set values

In CohesionUI you can set values for parameters where applicable.

- To set a value:
  1. Click on a parameter and enter a value.
  2. Confirm the value.
  3. Alternatively, you can use + and - to increase or decrease the value. You can edit the step size in the **SETTINGS** menu.
- To set a pre-defined value, for example **MIN**, **MAX** or **DEF**:
  4. Click on a parameter and select a value from the dropdown menu.
  5. Confirm the value.



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

7.5 Manage CohesionUI settings

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

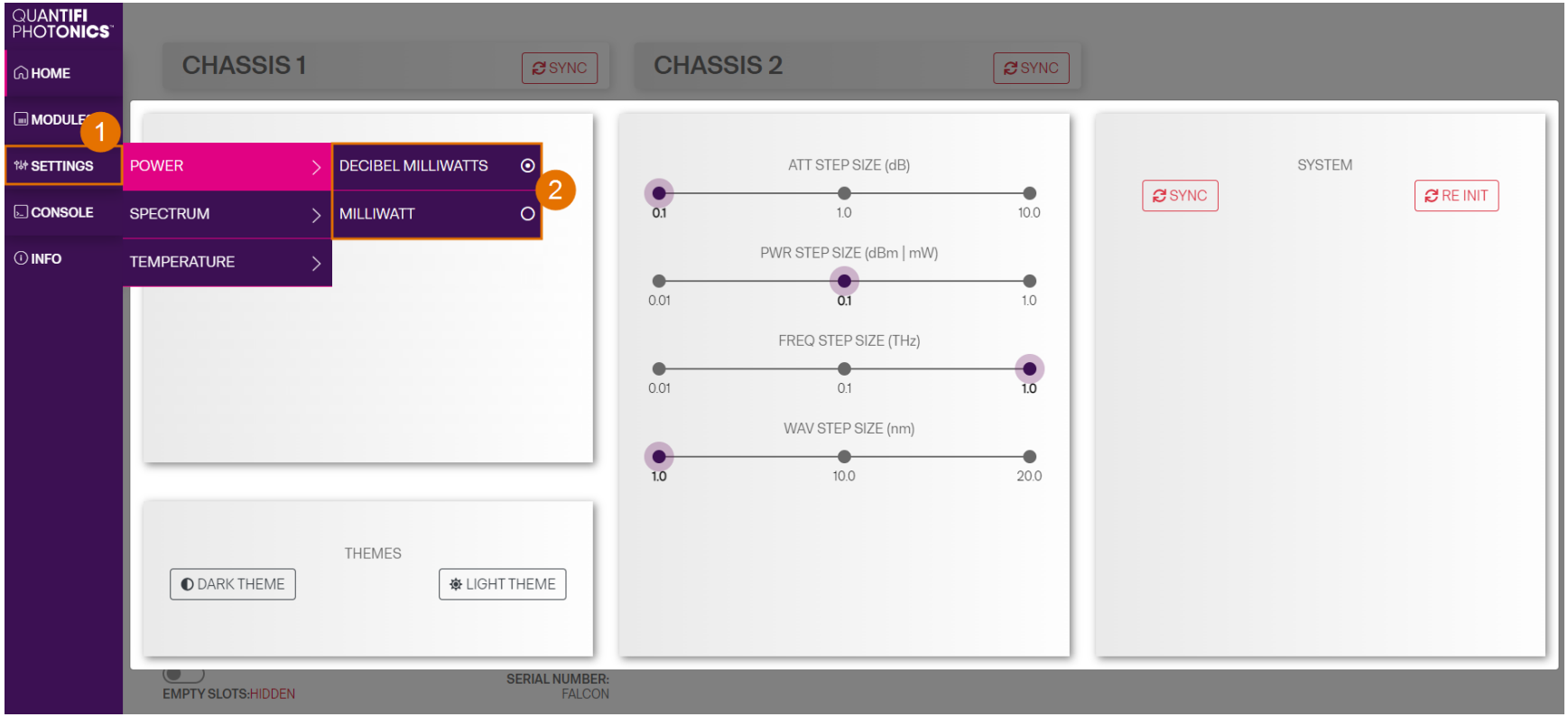
> **NOTE**
>
> CohesionUI reverts to default settings when power-cycling the chassis.

▶ To view all settings and unit preferences and adjust as required:

1. Click **SETTINGS**.
2. Change settings or unit preferences as required, for example temperature units.
   Please note that the units displayed on this page are not always relevant for each product.
3. **Step size** refers to the amount by which a value is increased or decreased when clicking the **+** or **-** button.

To adjust unit preferences one at a time:

1. Hover over **SETTINGS**.
2. Select a unit from the dropdown, for example the power unit.



7.6 Synchronize and reinitialize CohesionUI

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

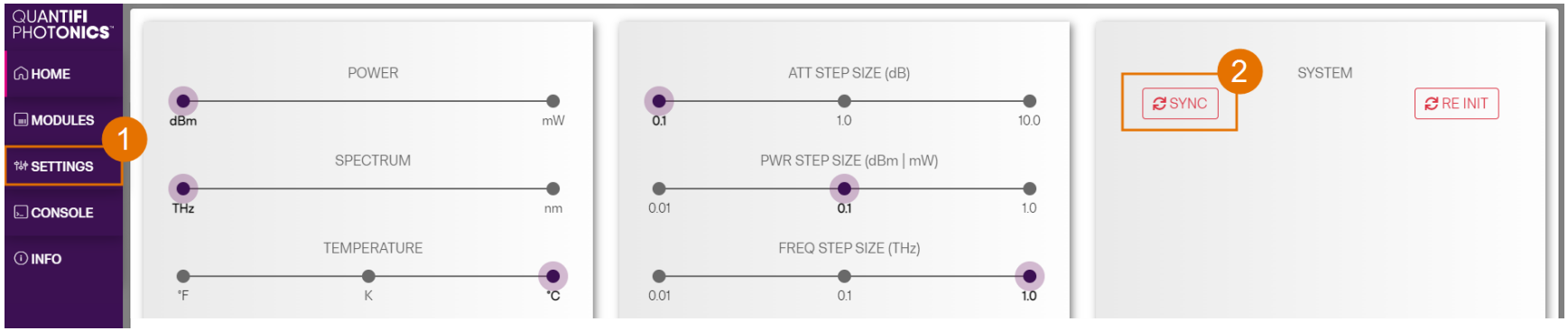
Synchronizing	Updates **CohesionUI** with the latest information from the **CohesionSCPI service**
Reinitializing	Updates **CohesionUI and the CohesionSCPI service** with the latest information from the **CohesionDriver service**

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

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

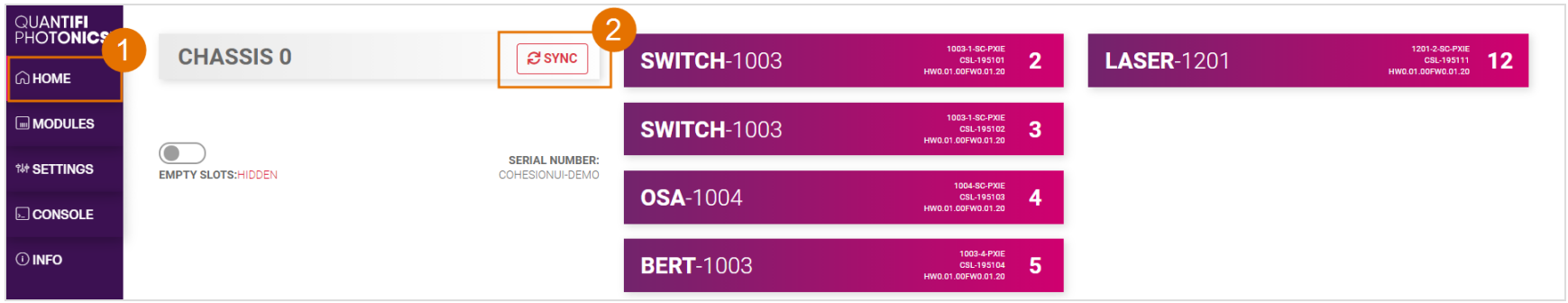
▶ To **synchronize** CohesionUI across **all modules in all chassis**:

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



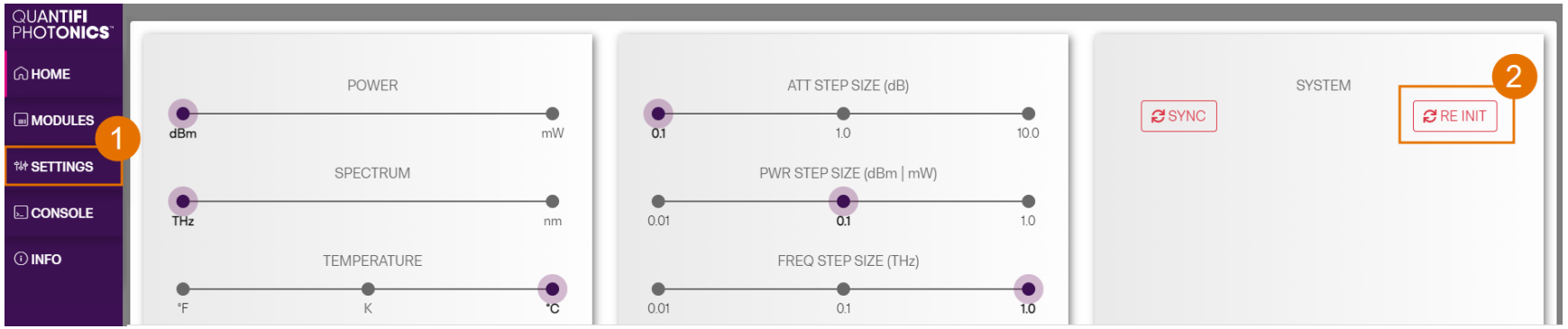
- To **synchronize** CohesionUI across **all modules in a selected chassis** only:

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



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

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



7.7 SCPI CohesionUI Command Console

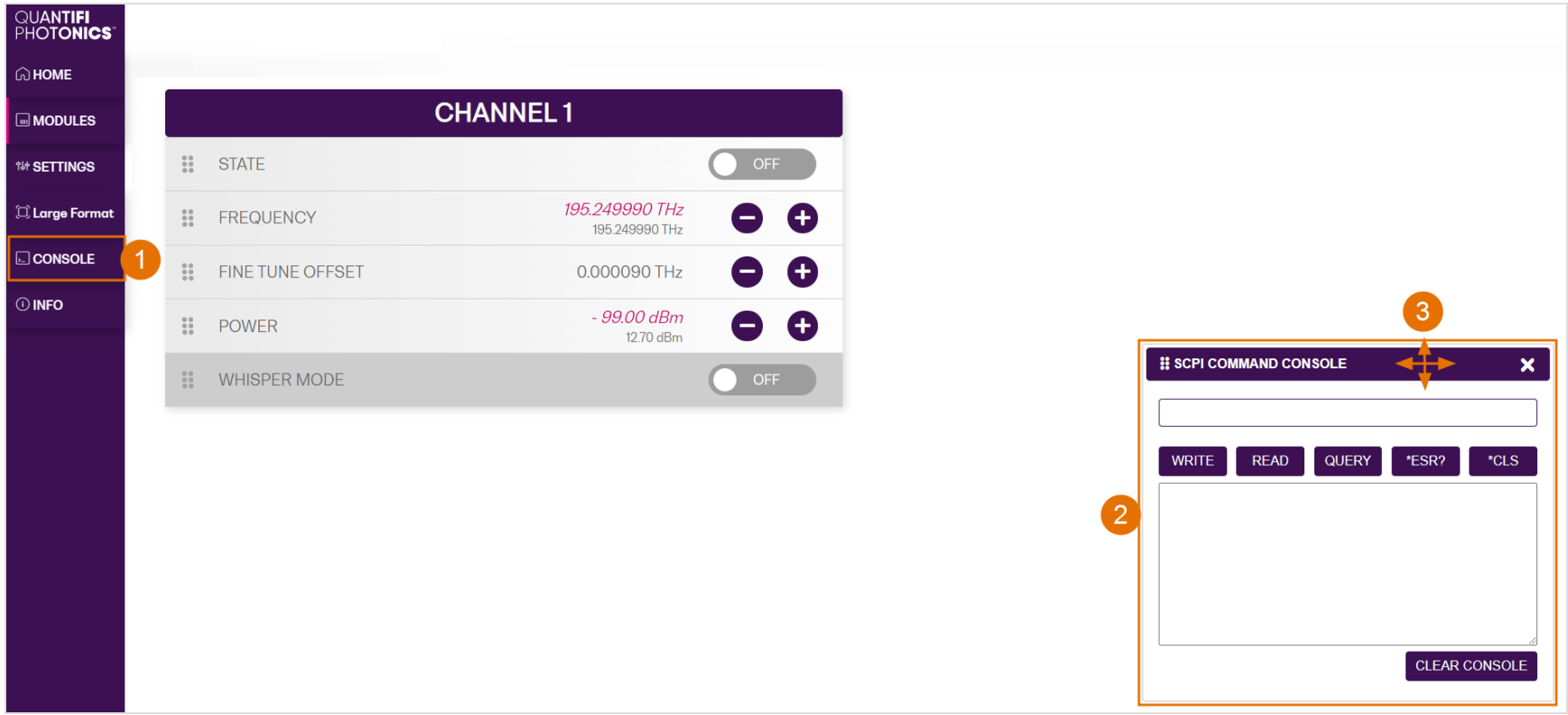
The CohesionUI SCPI Command Console enables you to communicate with Quantifi Photonics PXIE modules via SCPI commands. It enables you to test commands and verify their syntax.

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

▶ To open the SCPI Command Console:

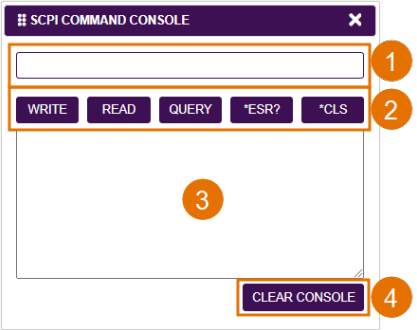
1. On the CohesionUI menu, click **CONSOLE**.
2. The console will appear in the bottom right corner of the screen.
3. You can move the console by clicking on the title bar and dragging it to any position on the screen. On closing and re-opening, the console will re-appear at its last position.

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



To communicate with a module via the SCPI Command Console:

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



You can choose from these SCPI command actions:

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

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

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

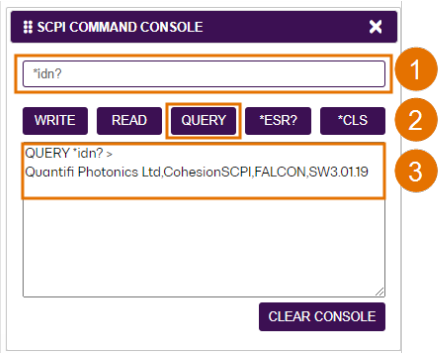
Example 2: What happens when I send an incorrect command?

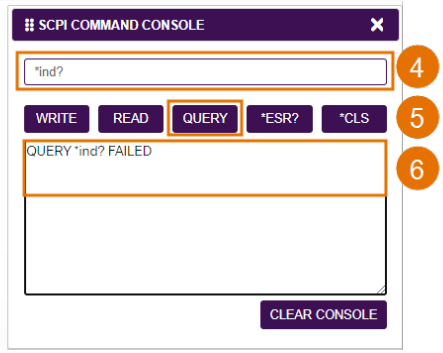
4. Enter an incorrect command, for example: ***ind?**
5. Click **QUERY**.
6. The module returns **FAILED**.

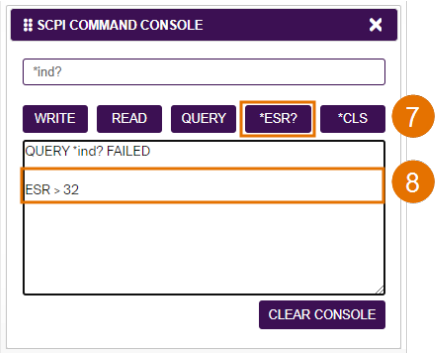
Example 3: Investigate a command failure:

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

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





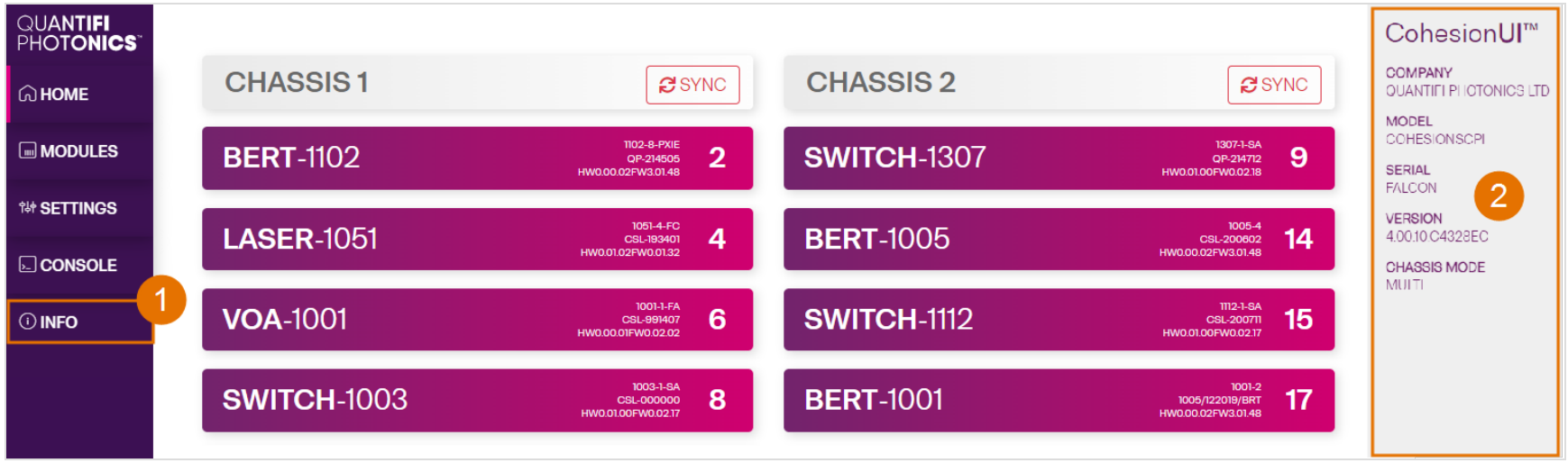


7.8 View system information

7.8.1 PXIe Chassis

- To display chassis information:

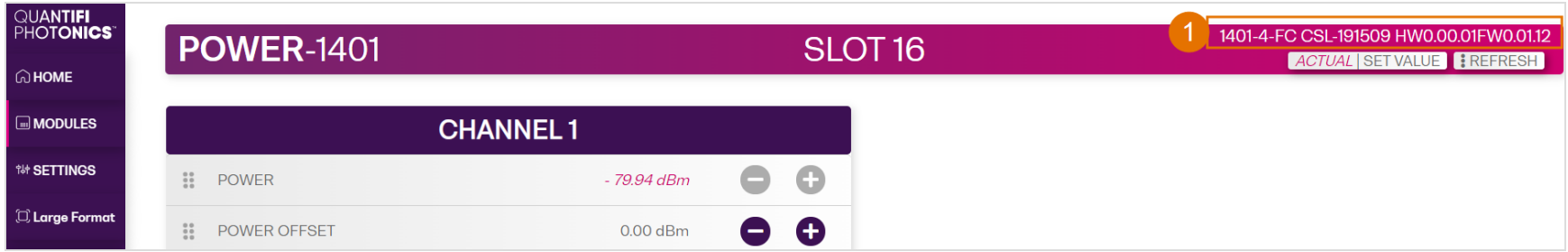
1. Click **INFO**.
2. The information panel will display operation mode, manufacturer, model, and serial number of the chassis, and the version of CohesionUI and CohesionSCPI service running on the chassis.



7.8.2 Module

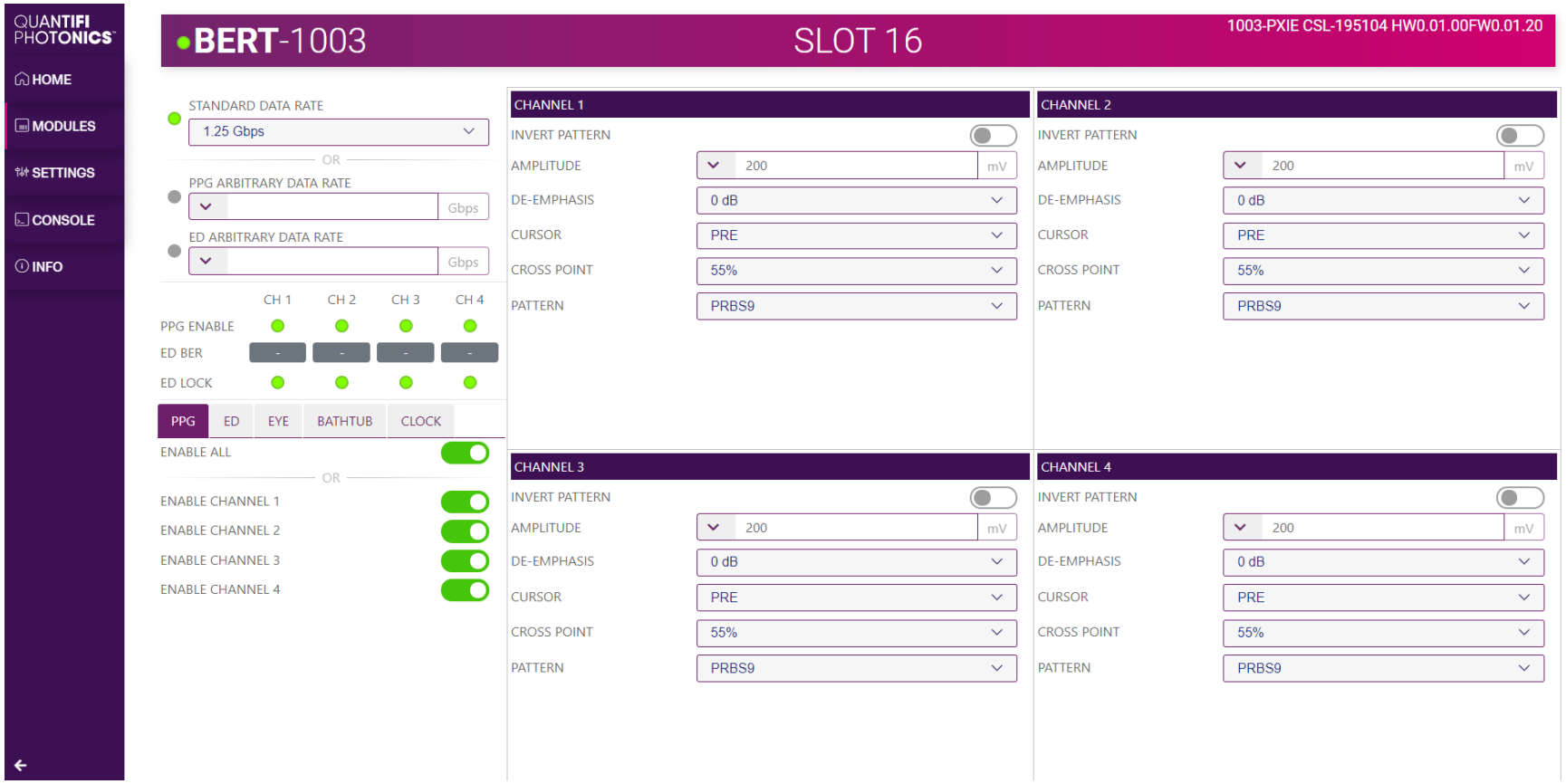
- To view module information when working with a module in CohesionUI:

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



8 Controlling your BERT with CohesionUI

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



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

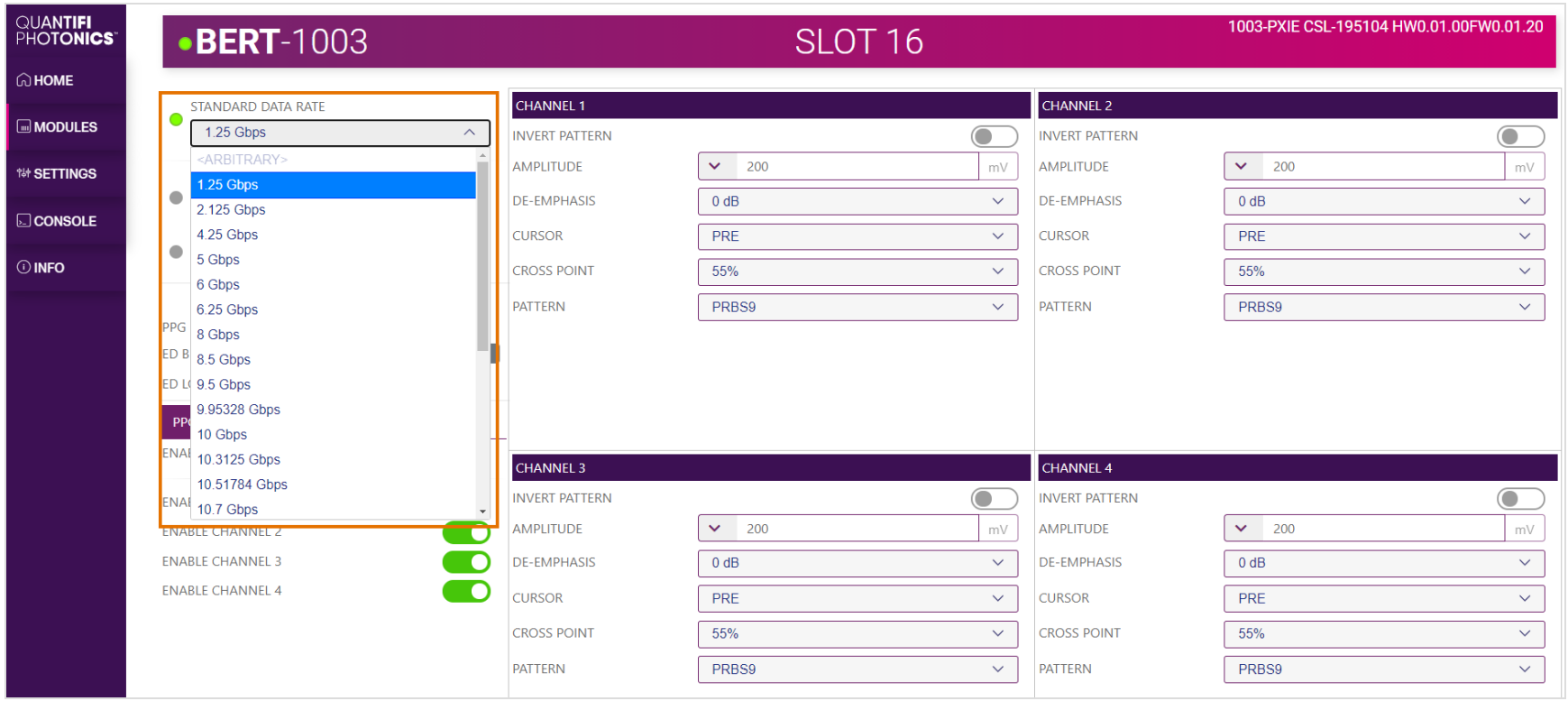
Before starting to use your module to perform error detection or pattern generation, ensure that the instrument is configured correctly.

8.1.1 Set up the data rate

Each module 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.

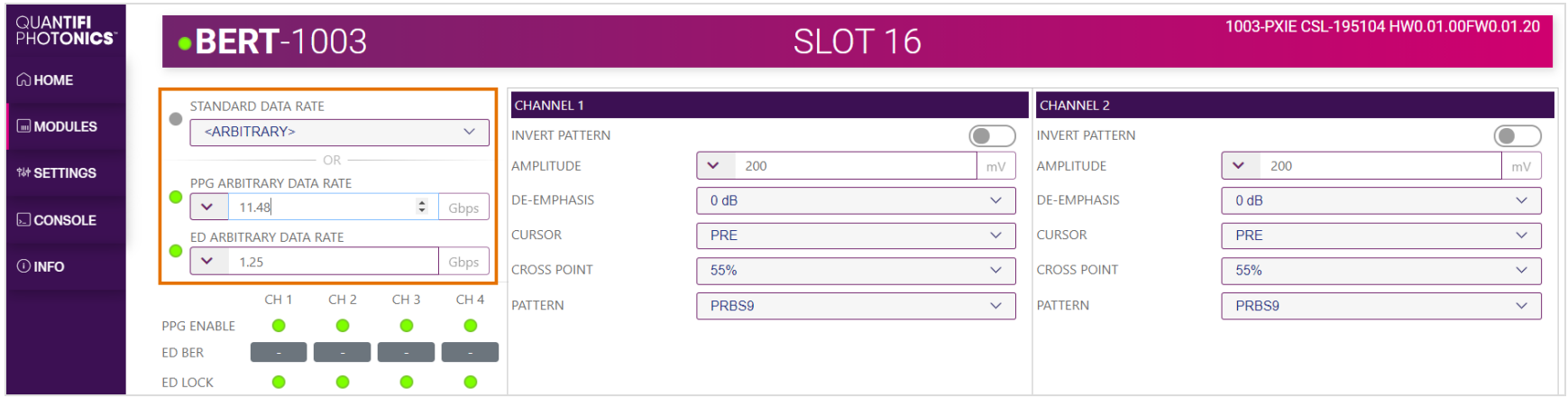
▶ To set the standard data rate:

1. Click the **STANDARD DATA RATE** drop-down list.
2. Select an appropriate data rate value.



To set an arbitrary data rate for pattern generation or error detection (available for BERT-1003/5):

1. 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** and **MAX** 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.

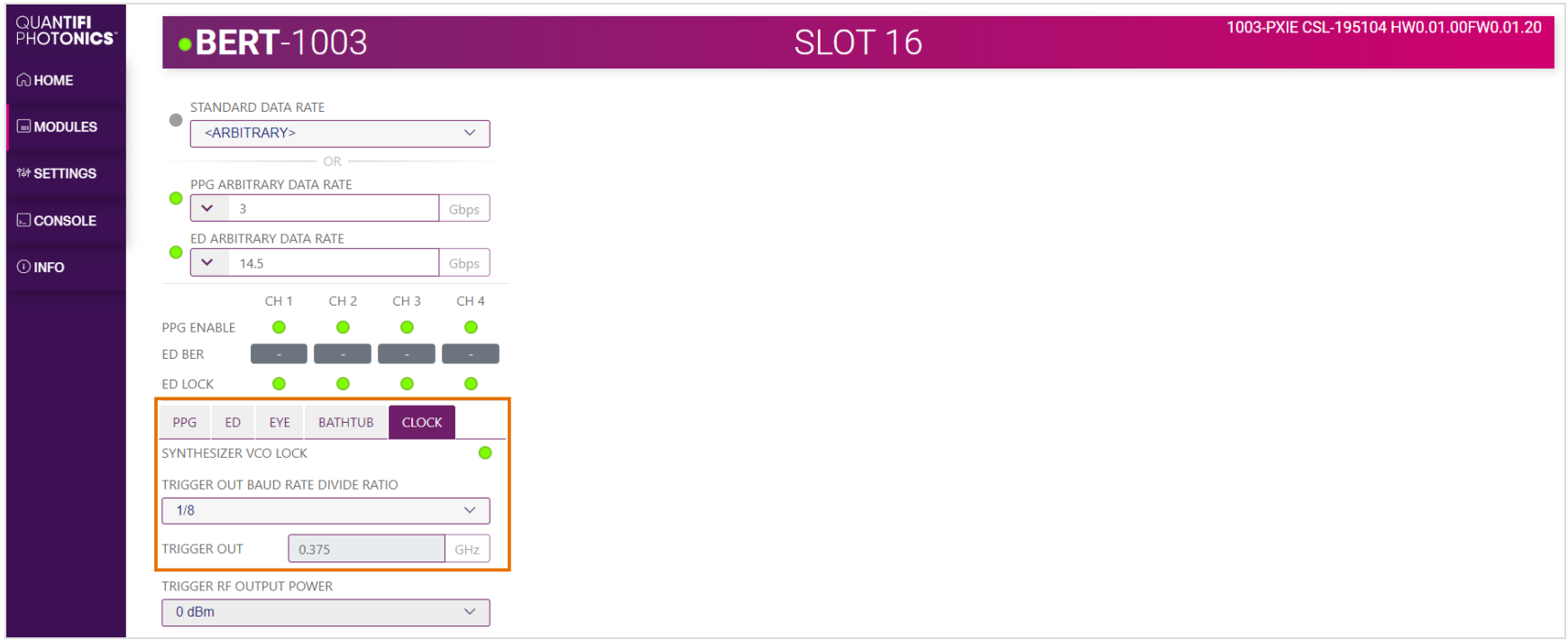
After changing the frequency, the lock indicator turns to dark green , once the synthesizer is locked to the new frequency it turns to light green .

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** as follows:

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.

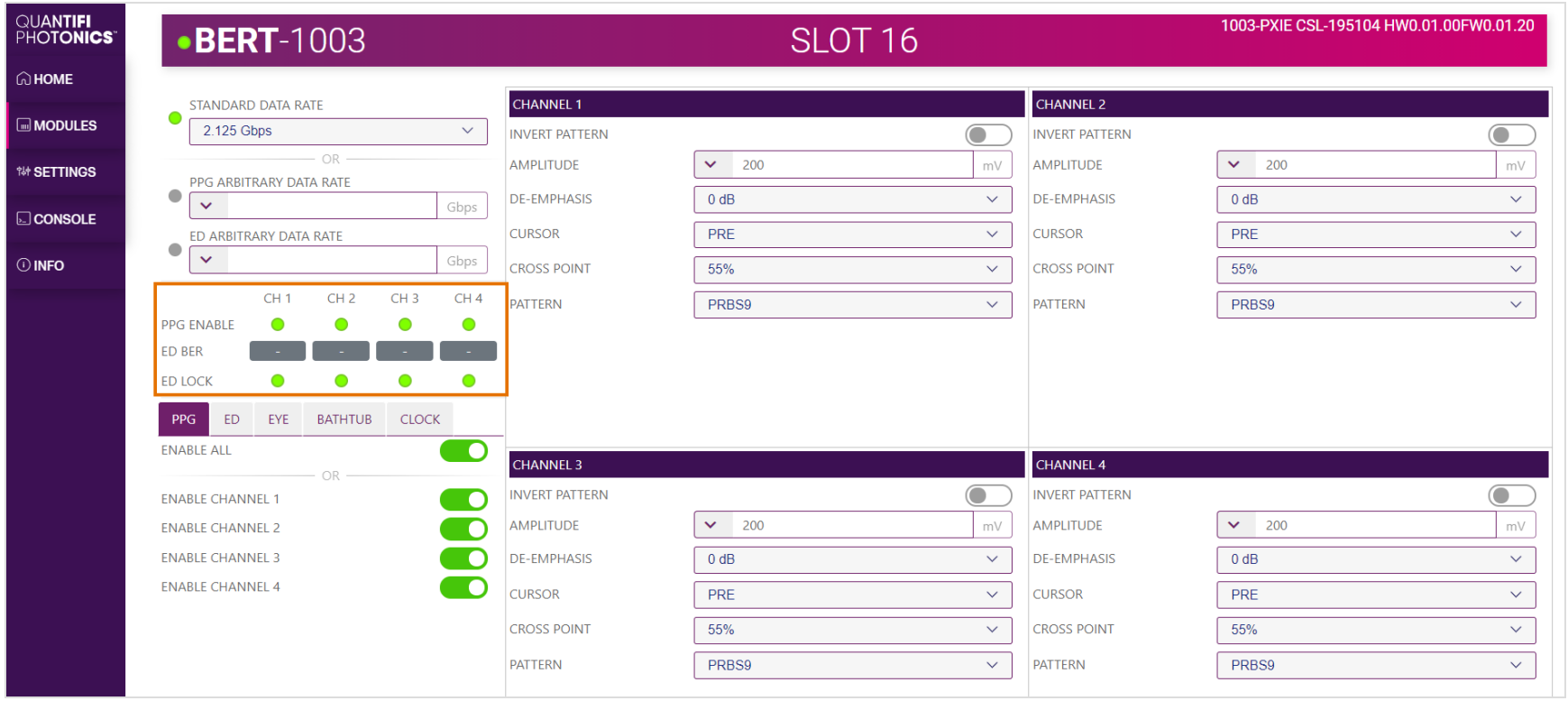


NOTE

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

8.2 Check channel status

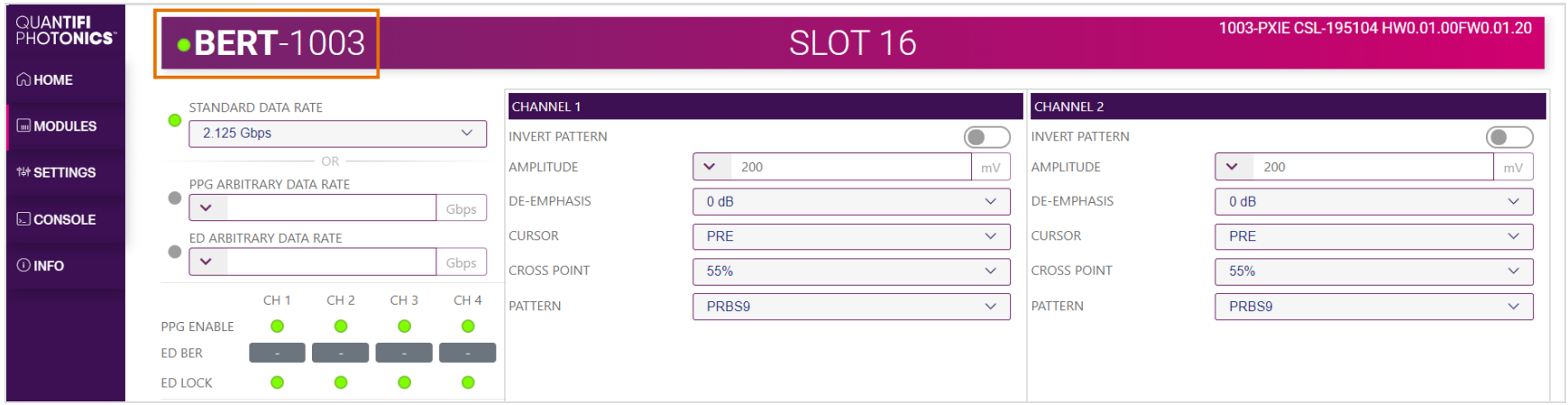
The operation status of each channel is displayed in the channel status panel.



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

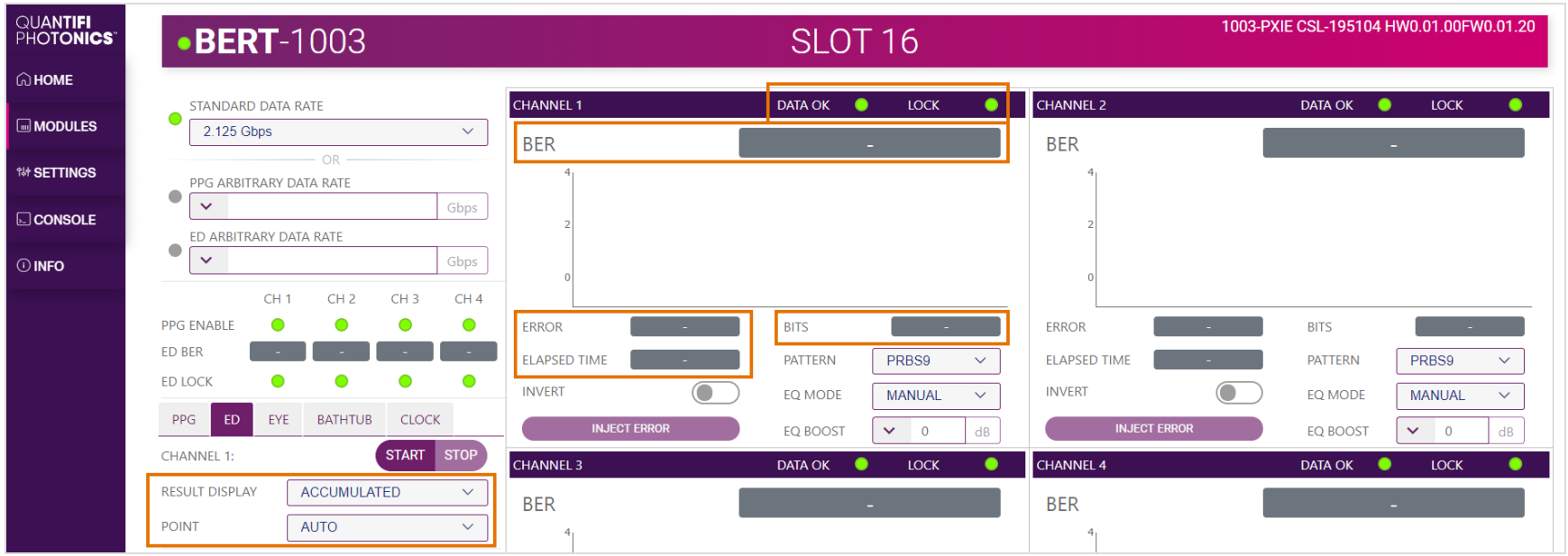
The ED channel inputs must be connected to the signal for the error detectors to work properly. Follow the suggested configuration and meet proper torquing requirements for RF cables and bulkheads to guarantee error free operation.

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.

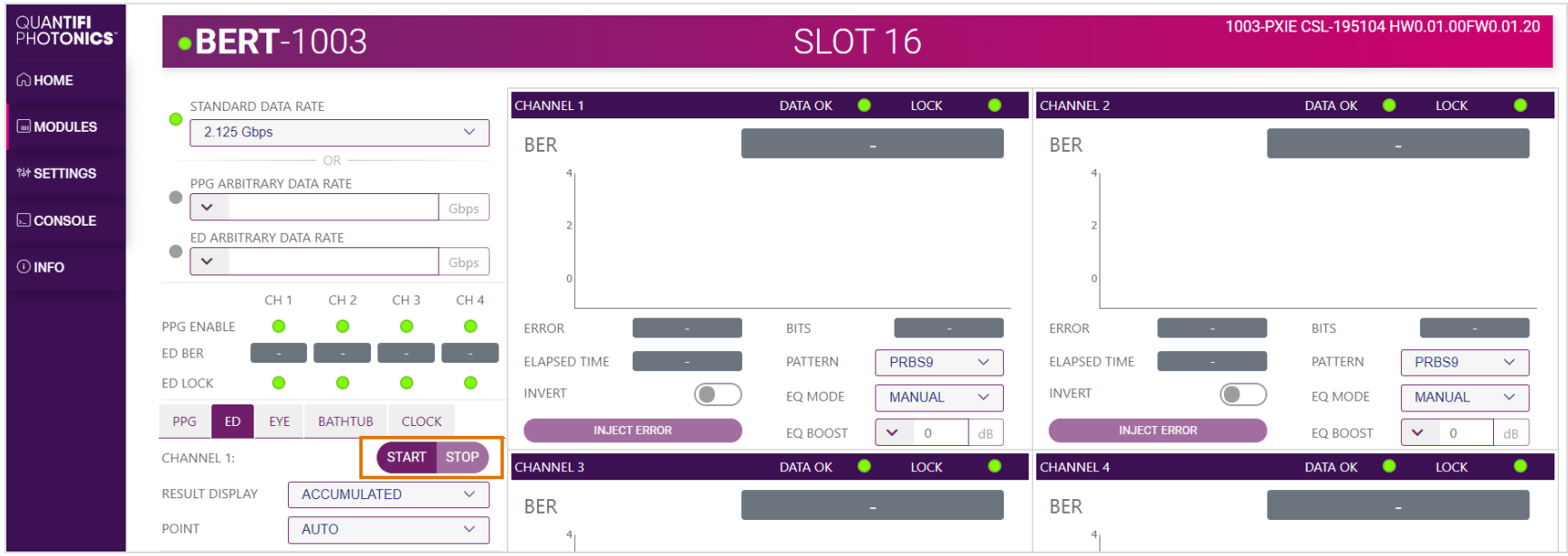


NOTE

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 264-1.**

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.

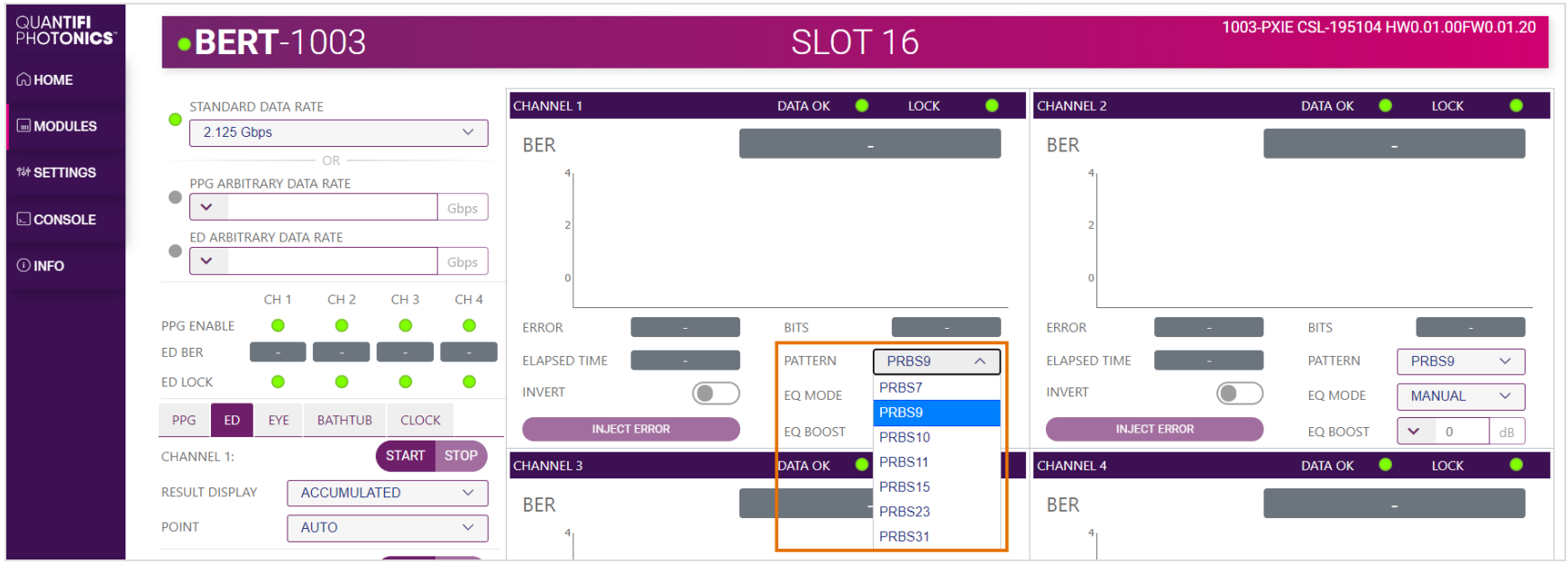


The receiver of the error detector has a limiting amplifier to protect sensitive electronics. The front-end amplifier may clamp the receiver inputs.

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.

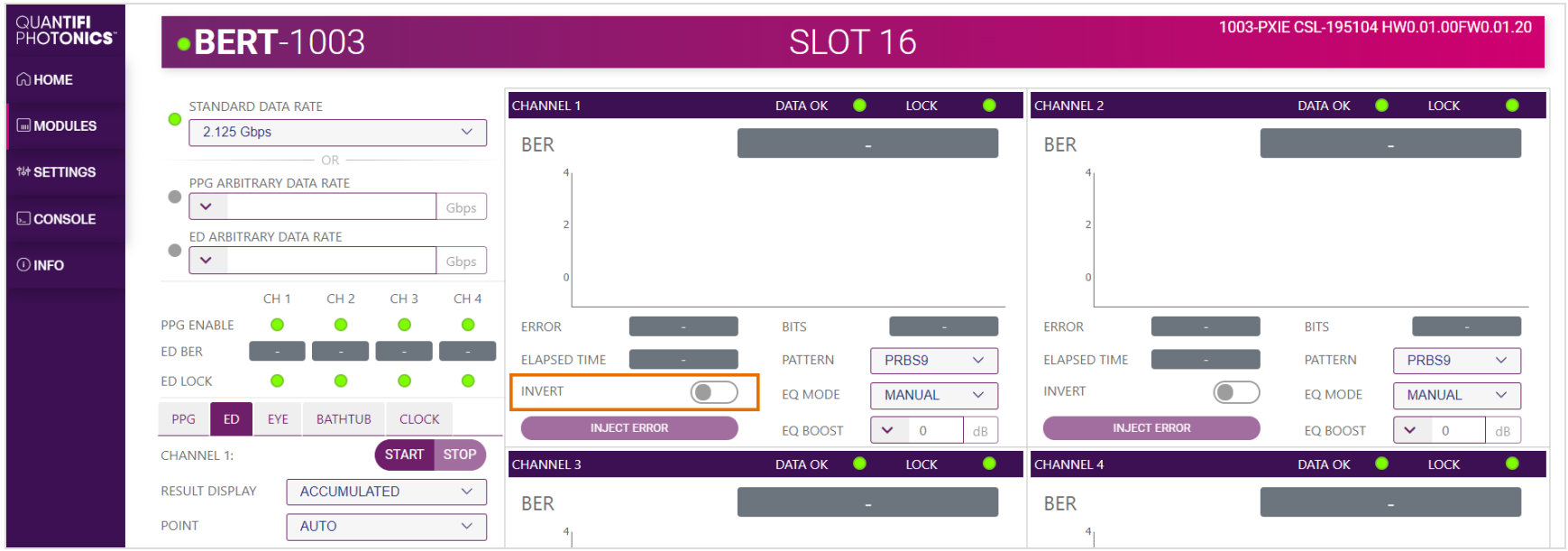
All the **PRBS** patterns have an odd length of 2^n-1 bits, where 'n' = 7,9,10,11,15,23 and 31.



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.

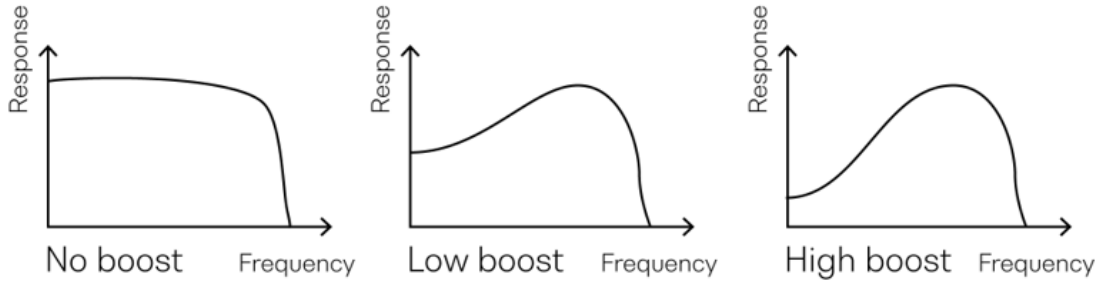


8.3.5 Configure the receiver equalization setting

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.

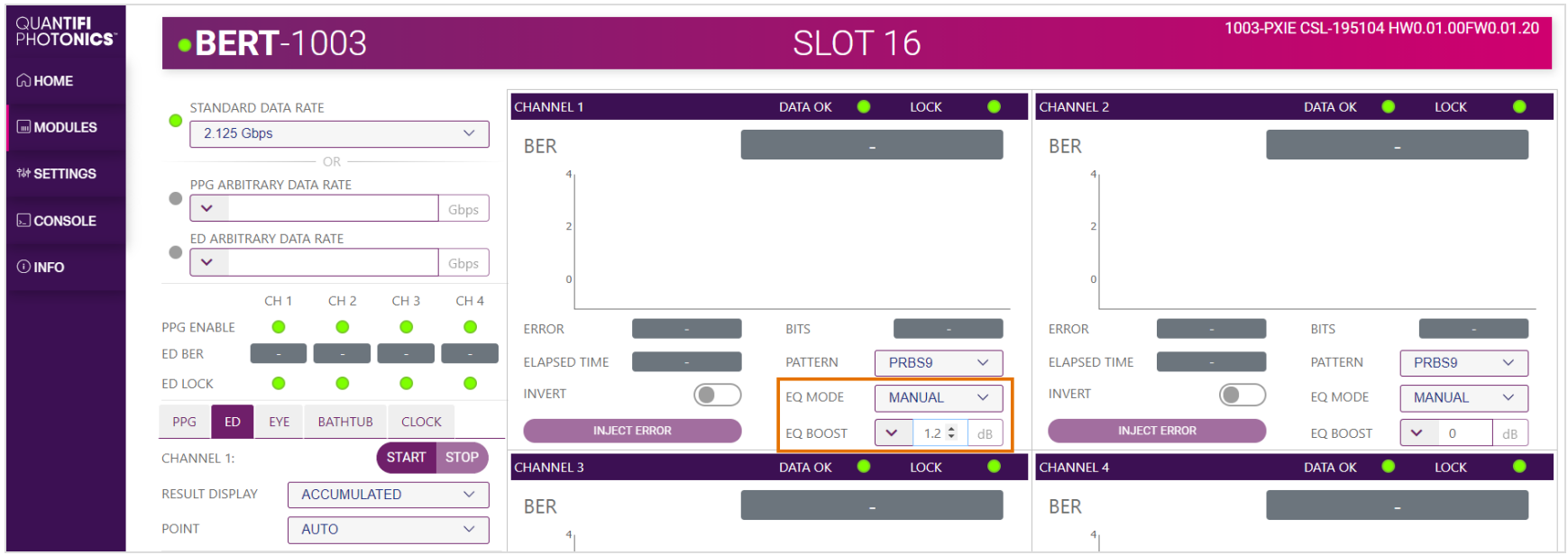
The response curve of the equalizer for the varying EQ boost values is shown below.



To specify the receiver equalization setting:

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 rage 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.

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

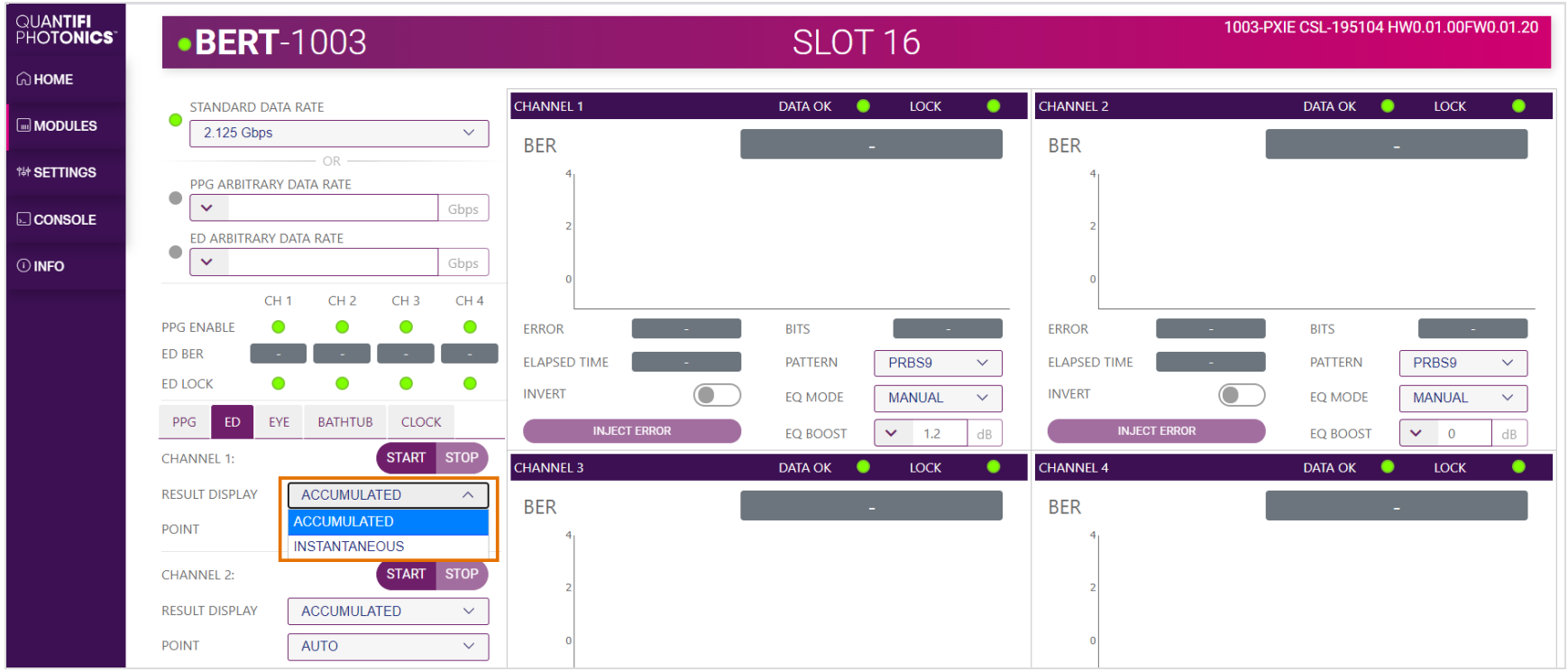
8.3.7 Specify the result display type

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.

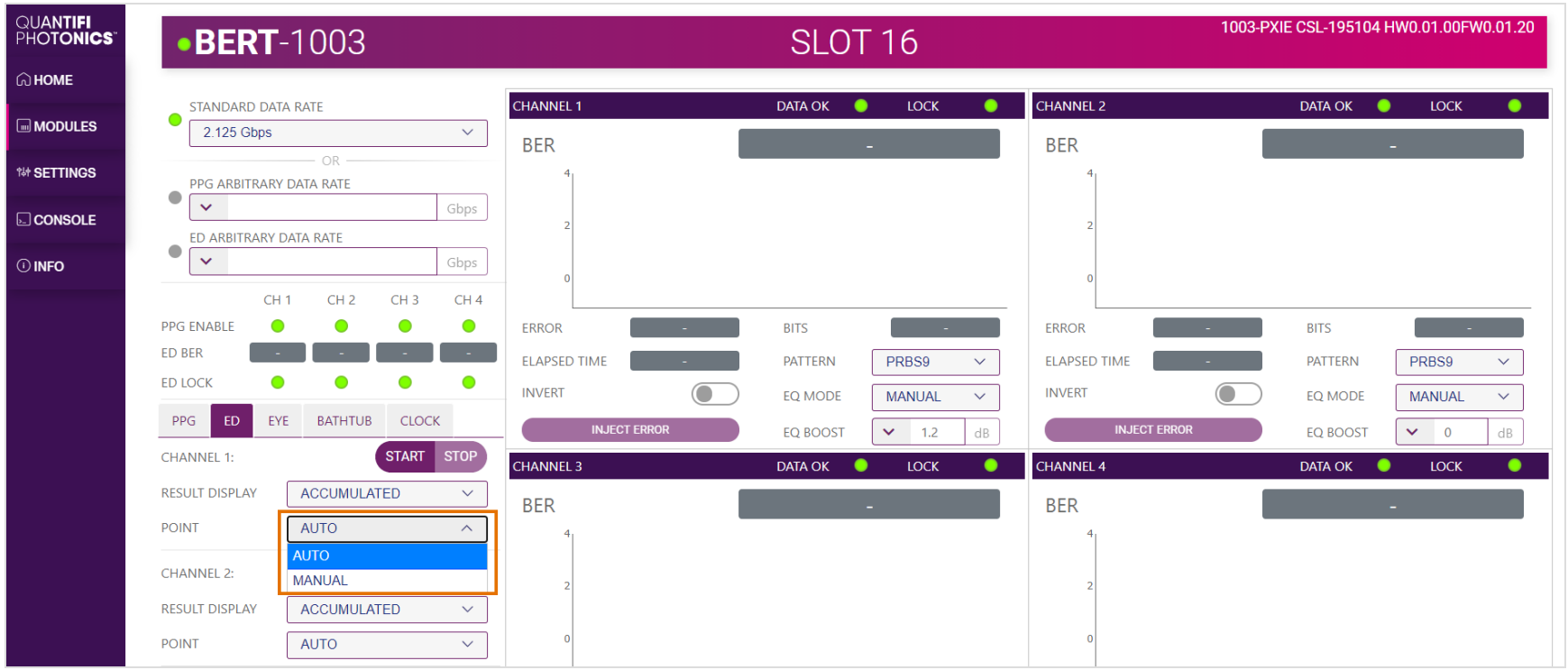
▶ To set the result display type,

1. Click the **RESULT DISPLAY** drop-down list.
2. 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.

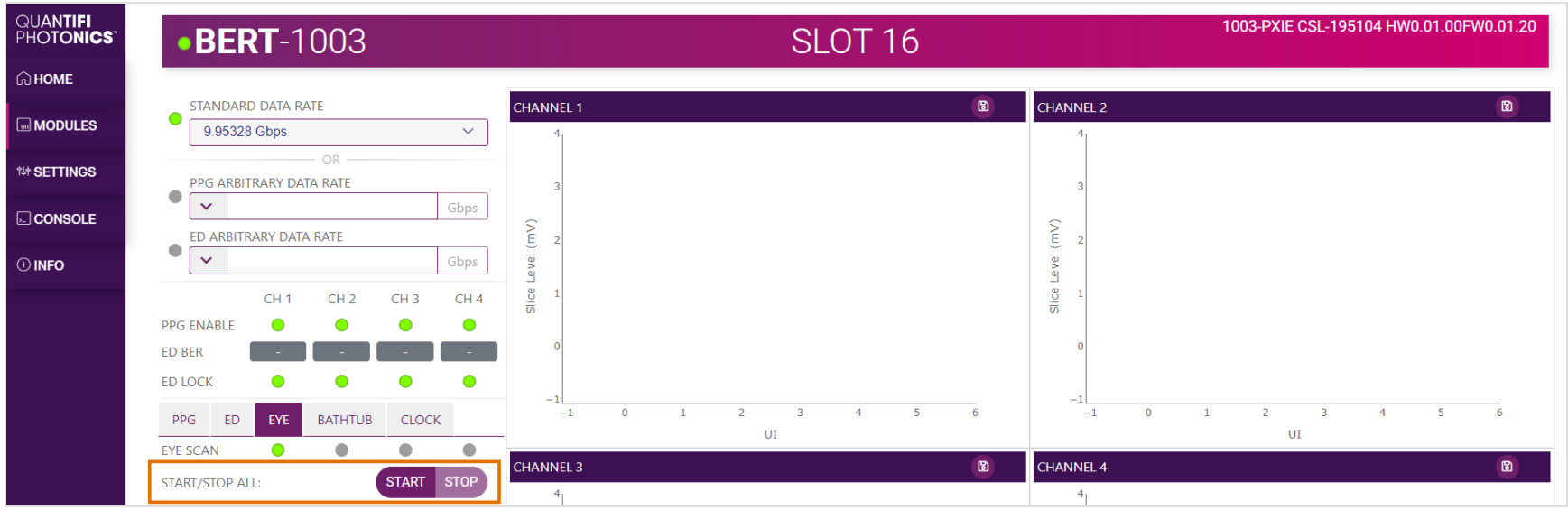
8.3.9.1 Configure eye scan settings

To configure the eye scan settings for a channel:

1. Click the **EYE** tab.
2. 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.



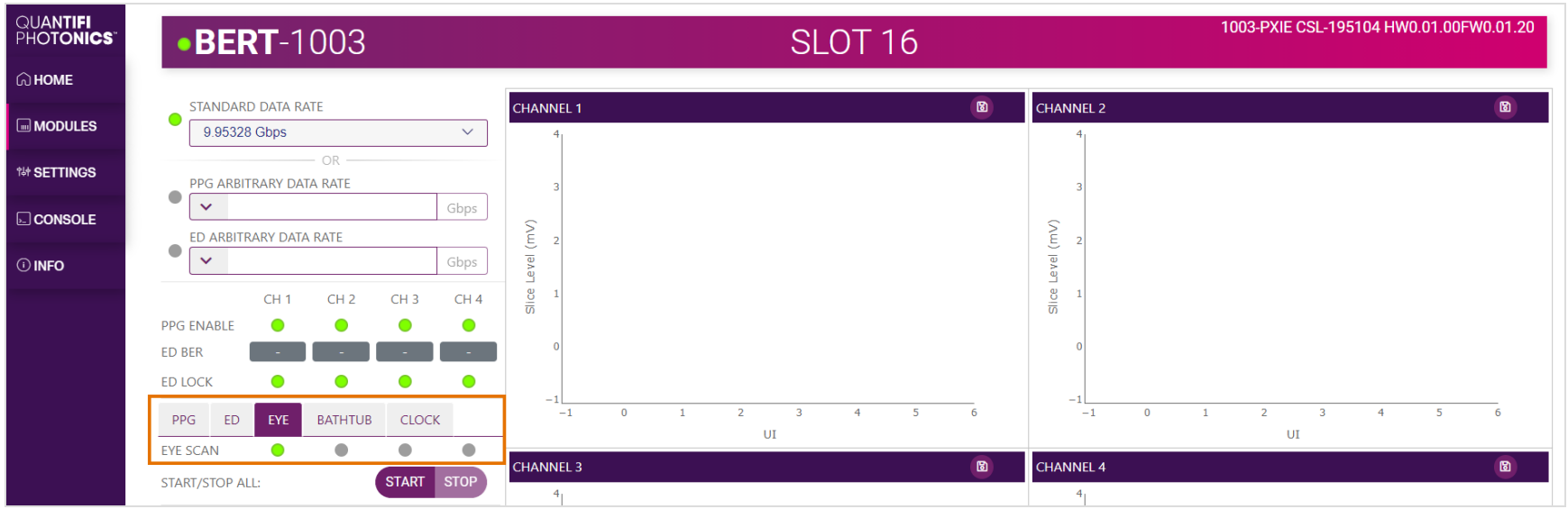
NOTE

- 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 (available for BERT 1003/5)

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 x 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 x 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.

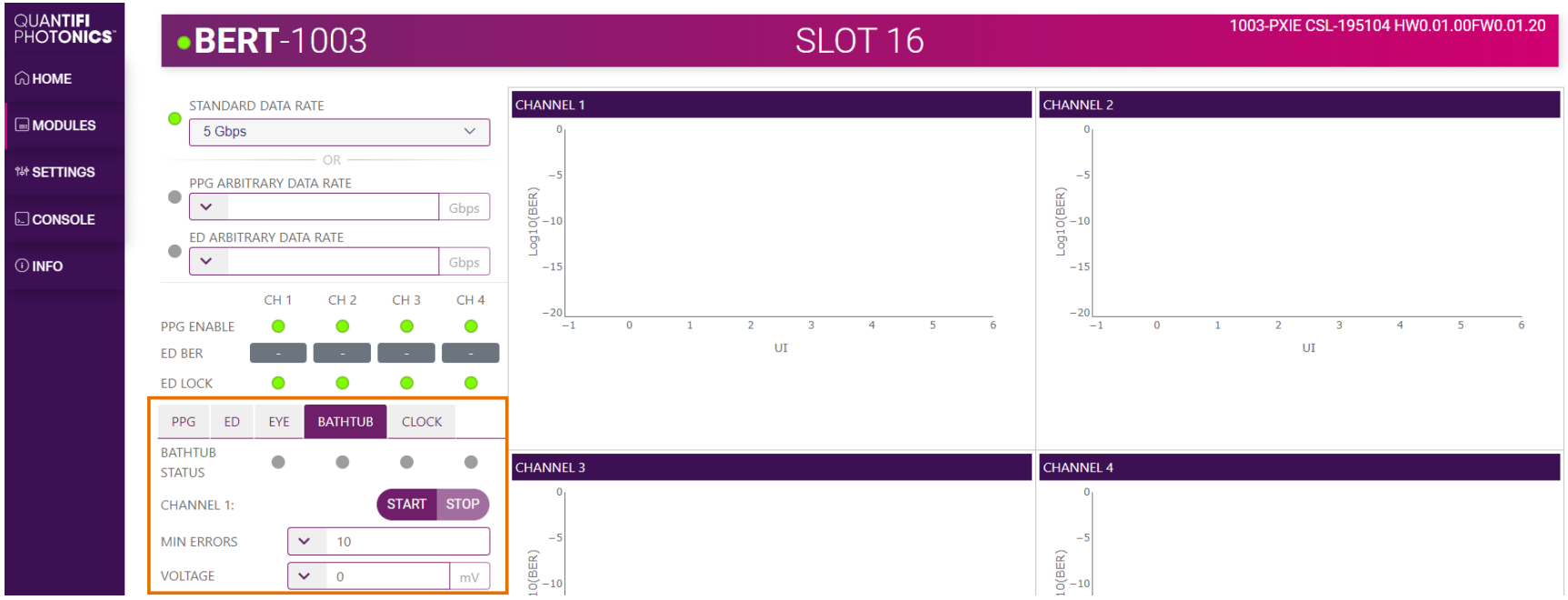
8.3.10.1 Configure bathtub scan settings

To configure the bathtub scan:

1. Click the **BATHTUB** tab.
2. 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

▶ To start or stop the bathtub scan for a channel:

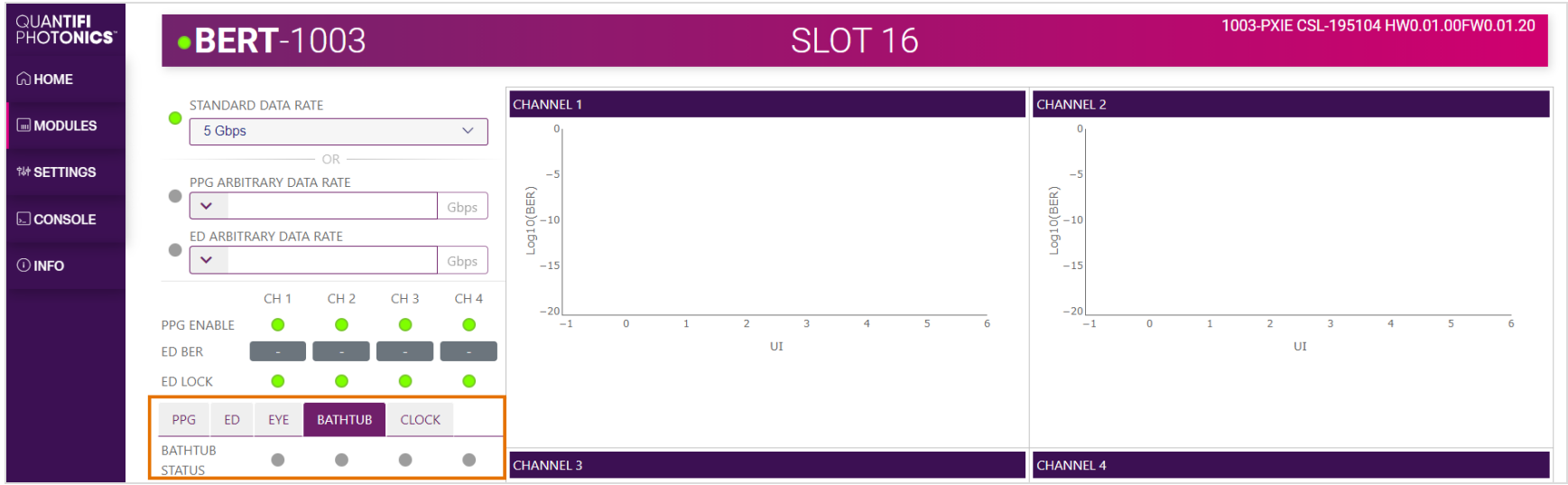
- Click the **START / STOP** buttons under the corresponding channel section.

> **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

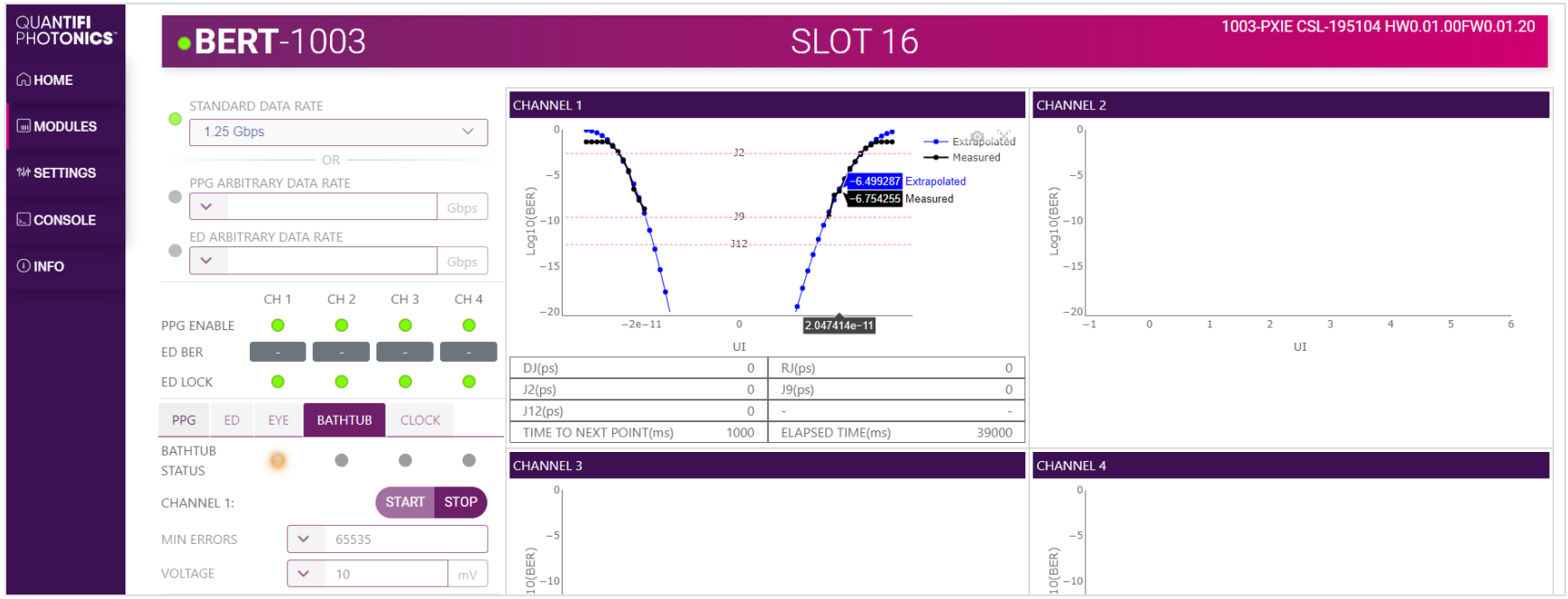
The bathtub scan status of each channel is represented by indicators in the BATHTUB tab as follows:

- **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

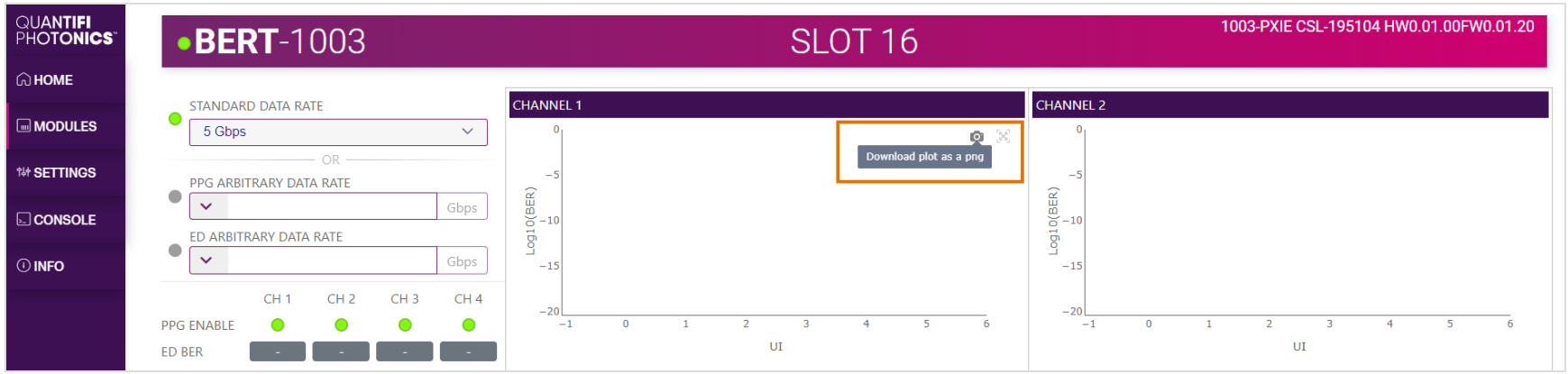
The bathtub scan plot window shows the **measured** (black curve) and **extrapolated** (blue curve) bit error rates at each sampling point. The table below the plot window shows the total jitter values at each J level, the random and deterministic jitter as calculated by the Dual Dirac method, the total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



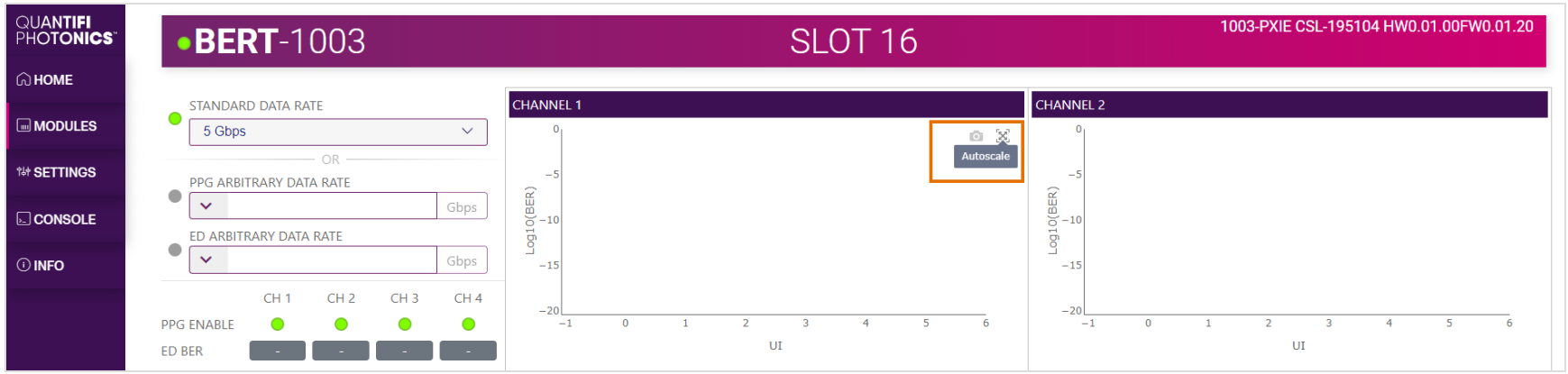
8.4 Chart operations

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.

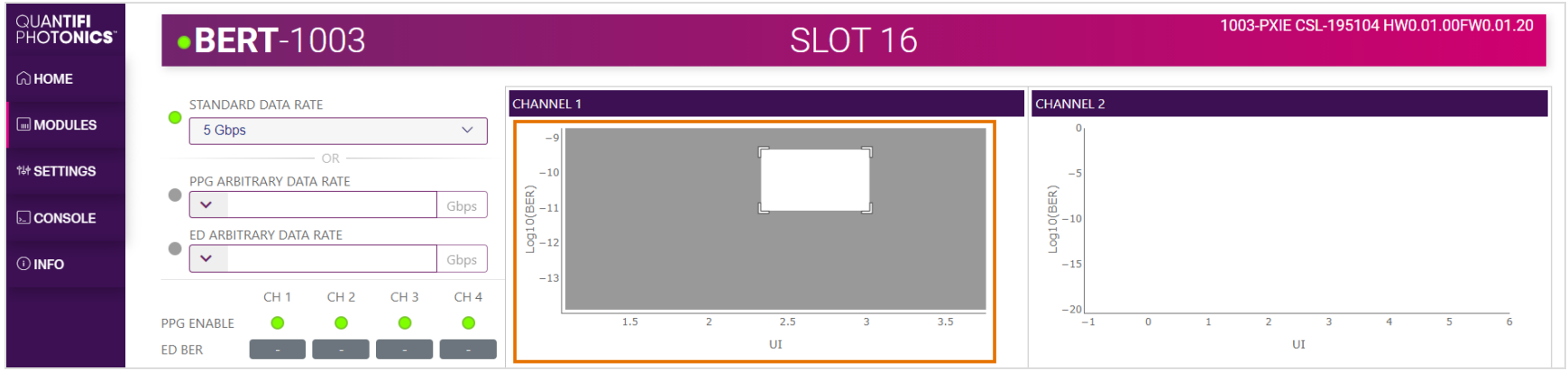


- To scale the plot automatically to include all the viewable data:
  - Click the scaling button.



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 (PPG)

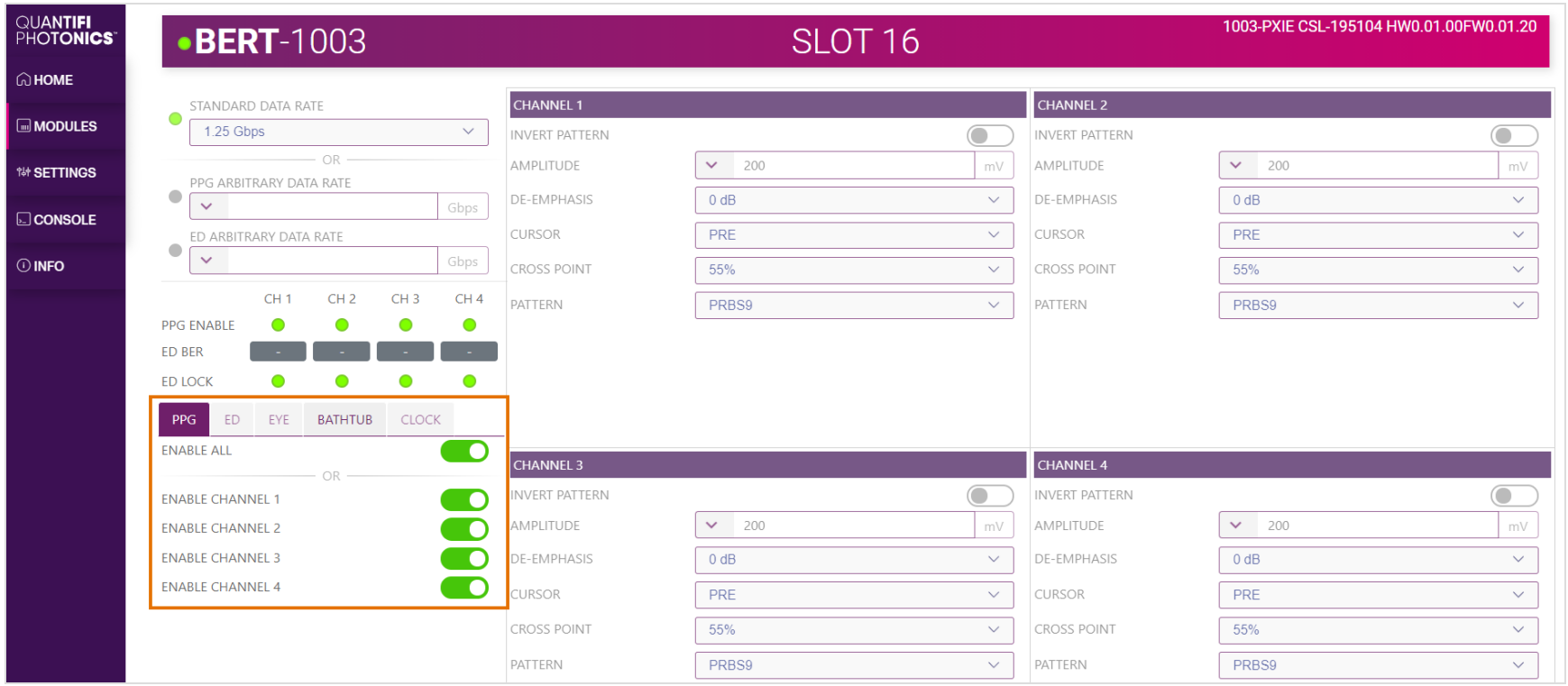
The Pulse Pattern Generator generates signals with different patterns, such as PRBS9 or DIV8. The output voltage, de-emphasis levels, cursor, and cross point values can be set independently for each PPG channel, and can be inverted to a digital NRZ format pattern at the pattern generator output.

The BERT PXIe takes advantage of the common 10MHz and 100MHz clocks on the PXIe chassis backplane, which allows the user to install multiple BERT PXIe 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**.

> 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.



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/unclocked 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.

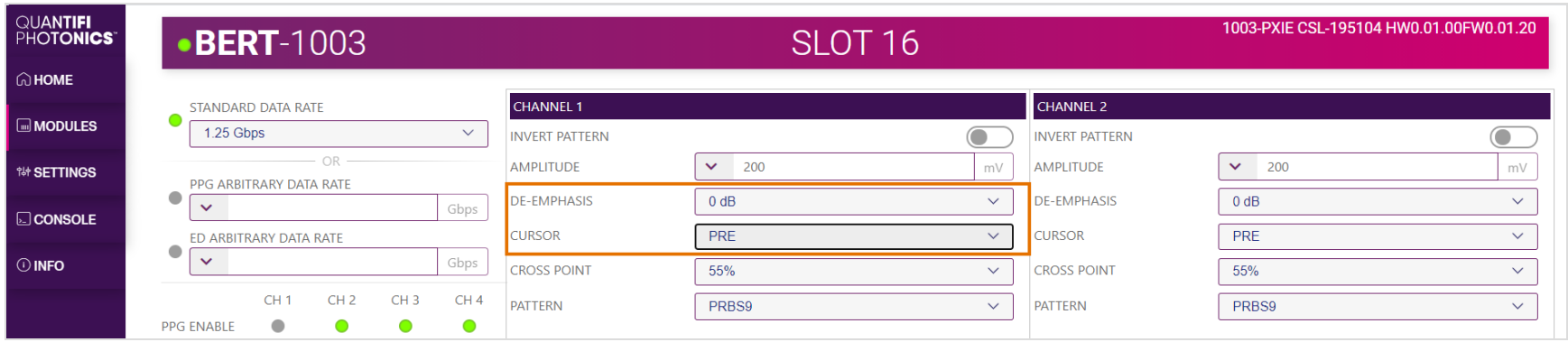
The PLL must be enabled and locked for the pre-cursor or post-cursor de-emphasis to operate. De-emphasis of the output waveform is realized by summation of the contributions of a main tap and the pre-cursor tap. By default, there is no de-emphasis applied upon power-on.

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

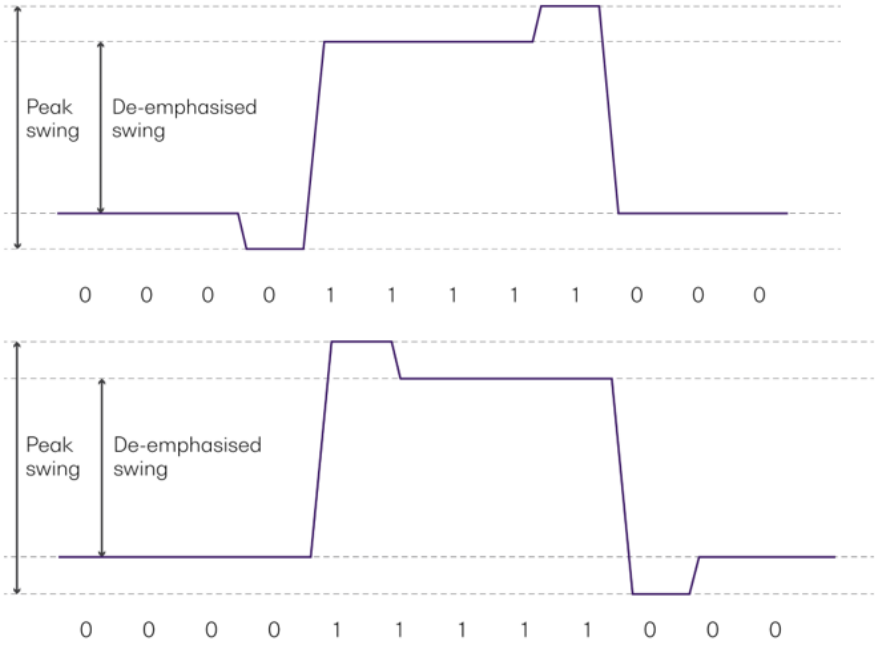
- To set the pre-cursor or post-cursor de-emphasis:

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
< 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.

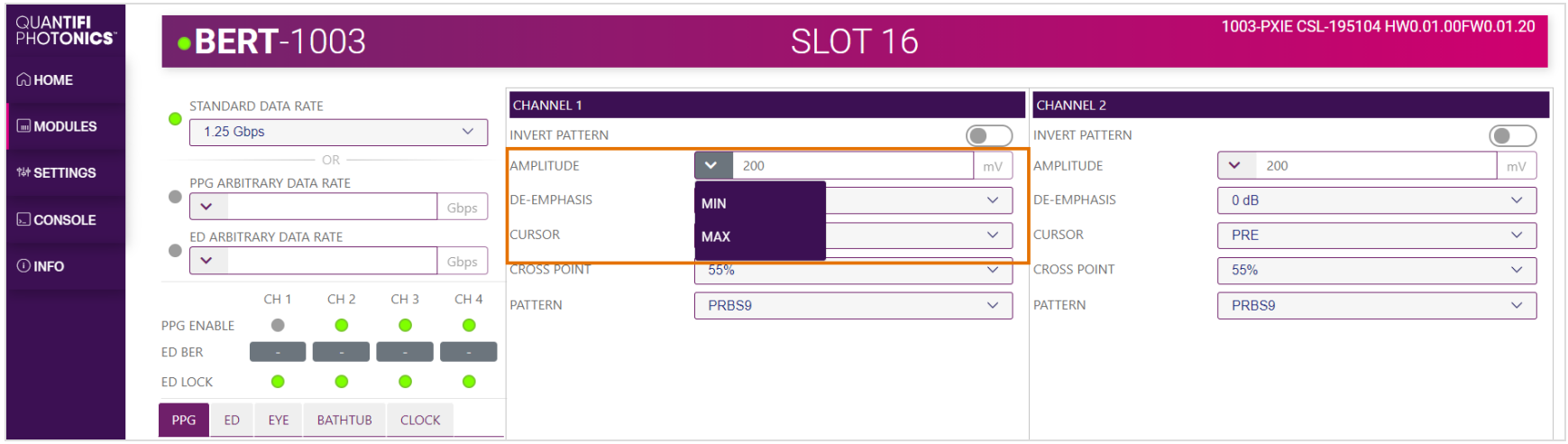
The difference between the 0 and 1 levels for the above example would be: $n = \left(\frac{800\text{mV}}{10^{\frac{4dB}{20}}}\right) = 505mV$

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.

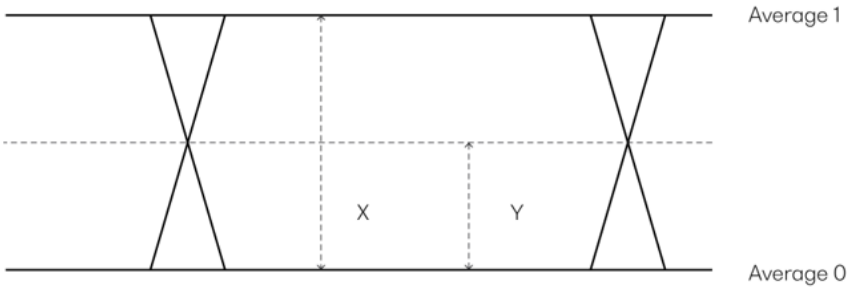
▶ To set the amplitude for a channel:

- 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%.

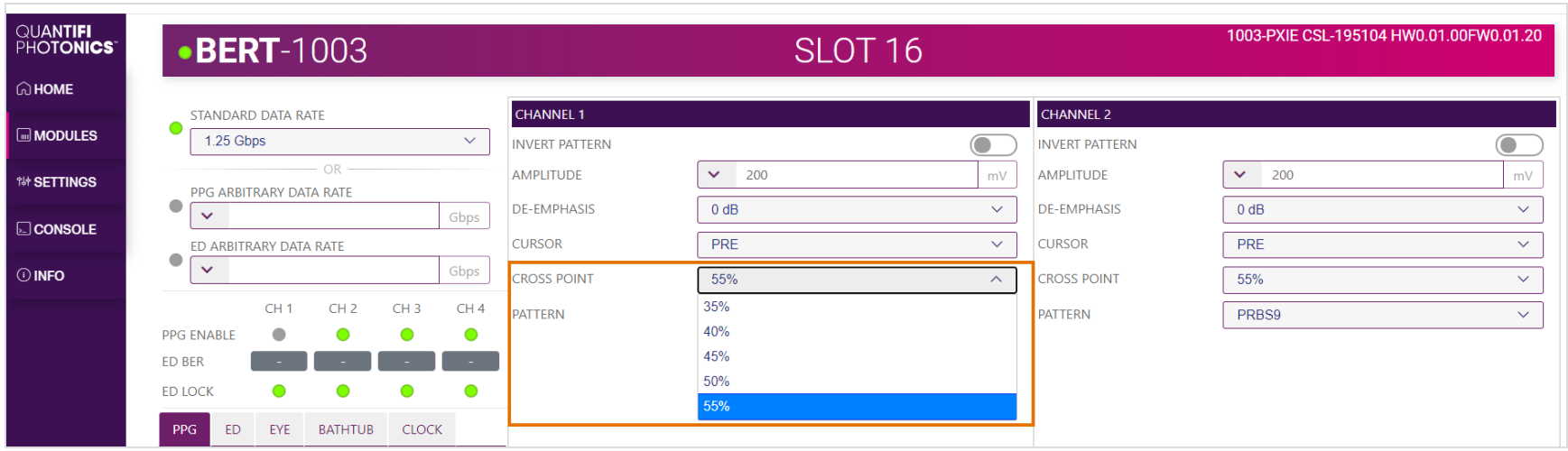


$$CPA = \left(\frac{Y - Average\ 0}{X - Average\ 0}\right) \times 100$$

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.

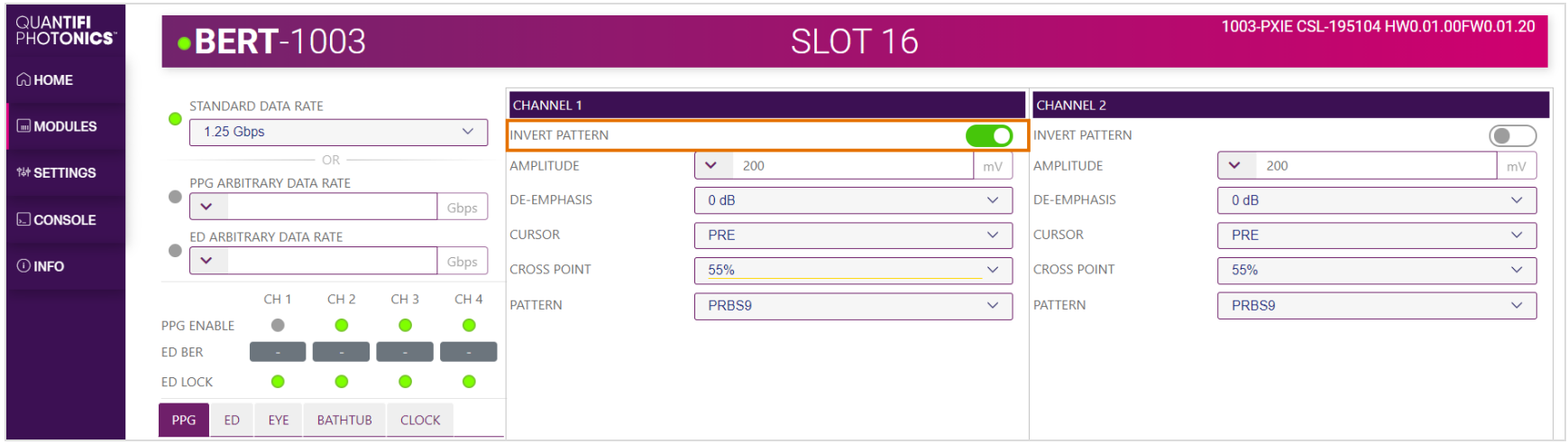


8.5.3 Invert the generated pattern

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**.



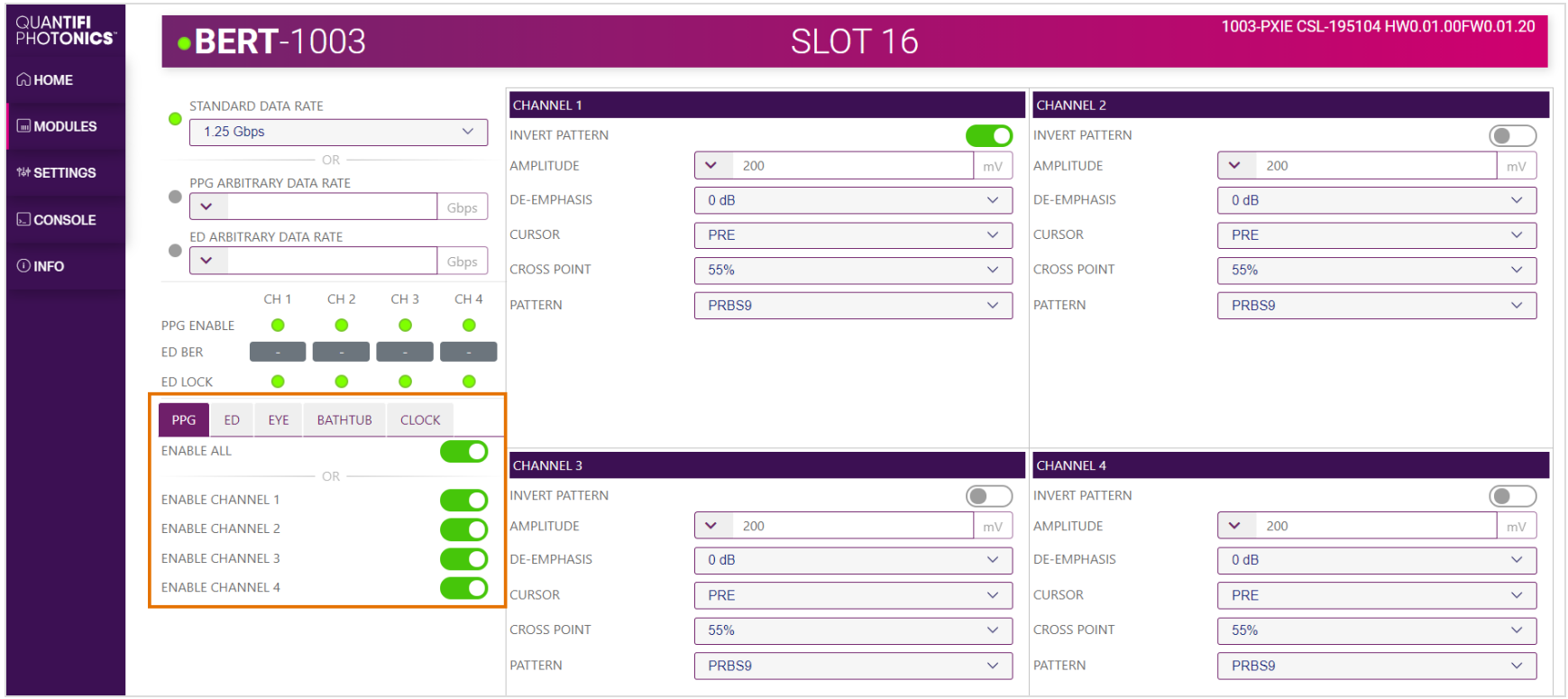
8.5.4 Enable/Disable pattern generation

To start or stop the pattern generation for a channel:

- Click the **ENABLE** toggle buttons under the corresponding channel section in the **PPG** tab.
- Use the **ENABLE ALL** button to apply the function on all channels.

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**.



NOTE

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

9 Controlling your BERT with SCPI commands

Remote communication with the CohesionSCPI service is achieved through the Standard Commands for Programmable Instruments (SCPI).

Support for VISA I/O API over TCP/IP is provided by the VXI-11 compliant CohesionSCPI service. With VISA communication drivers installed on the client, the implementation of VISA programming within environments such as MATLAB becomes available.

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

NOTE

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

9.1 Overview

You can operate your Quantifi Photonics module using SCPI commands.

For details on available SCPI commands, refer to:

- Command summary
- Command descriptions

9.2 Programming conventions

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

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

Argument	Data Format
`<wsp>`	Specifies whitespace character (0116 – 0916, 0B16 – 2016)
`<value>`	Is numerical data, an integer, a decimal, exponential (10e-9 or 5.8e6) or string
`[VALUE1 | VALUE2]`	A parameter choice. The '|' separates the unique parameters available, only one of the choices can be used. In the example, either the input parameter `[VALUE1]` or `[VALUE2]` can be used, but not both. Some commands may have more than two choices available. This parameter can be omitted where the command has a default defined in the command description.

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

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

For the commands that require index values:

Index	Description	Value
<c>	the chassis index in which the specific blade module is installed	integer, inclusive of 0
<n>		integer 1
<m>	the channel index of a specific unit in the module	integer <0 to 4>

Message queues

Information is exchanged in the form of messages. These messages are held in input and output queues.

The output queue stores responses to query commands. The CohesionSCPI service transmits any data in the output queue when a read request is received. Unless specified, all output response data is transmitted in ASCII format.

9.3 Status and event registers

9.3.1 Standard Event Status Register

The Standard Event Status Register (SESR) is modified by the Quantifi Photonics product with the results of the command operations.

Bit	Description
7 (MSB), 6	Not used
5	Is set when a Command Error event has been detected
4	Is set when a command Execution Error has been detected
3	Is set when a Device Dependent Error event has been detected
2	Is set when there a Query Error event has been detected
1	Not used
0 (LSB)	Is set when an Operation Complete event has been generated

9.3.2 Standard Event Status Enable Register (Mask)

The Standard Event Status Enable Register (SESR Mask) is used to build the Event Status Bit (ESB) within the Status Byte Register (STB). To ignore any of the events detected and set in the SESR, set the corresponding bit within the SESR Mask to 0. The STB can then be queried and the value of the ESB can be used to determine service request requirements based on the SESR Mask applied.

NOTE

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

9.3.3 Status Byte Register

The Status Byte Register (STB) is built from all other status registers and masks. This register can be used in queries to determine if an event has been detected and where that event has been detected.

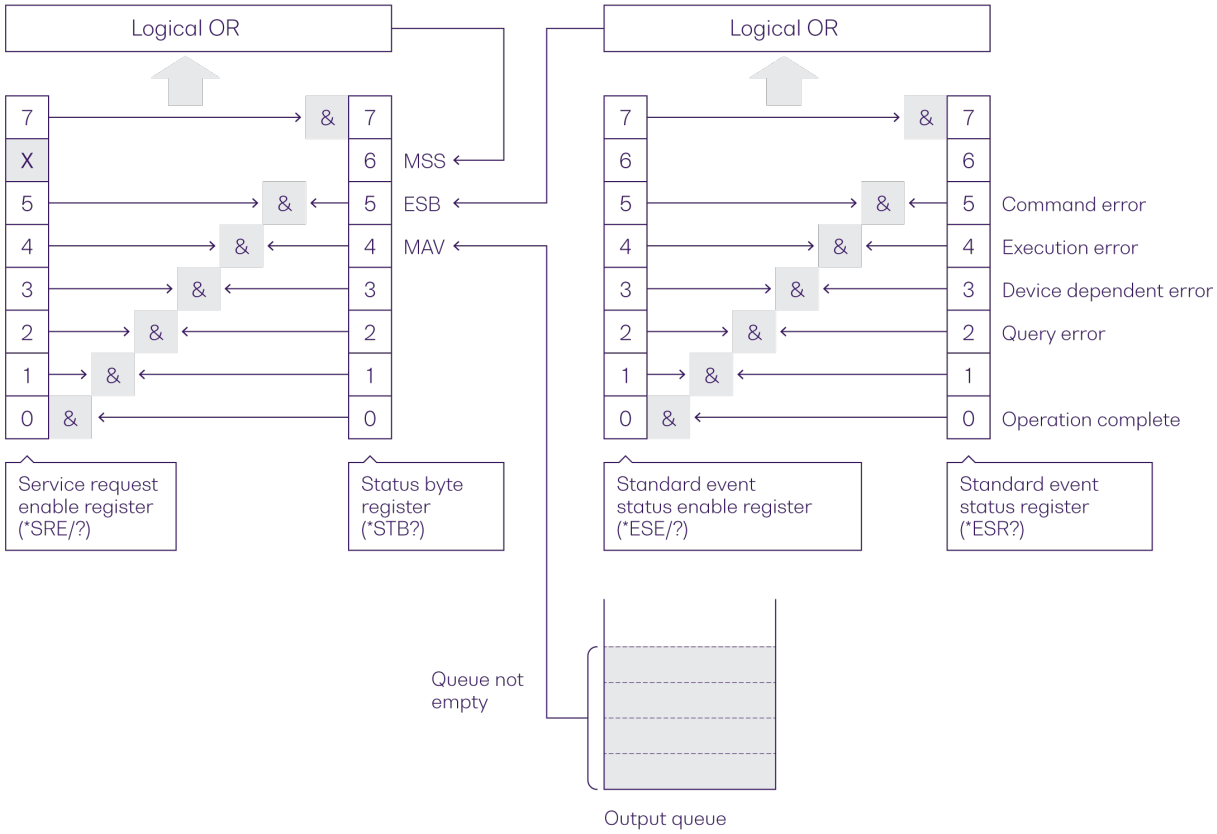
Bit	Description
7 (MSB)	Not used
6	The Master Summary Status (MSS) bit is set from the STB and SRE Mask
5	The Event Status Bit (ESB) is set from the SESR and the SESR Mask
4	Message Available (MAV) is set when there is data in the output queue
3, 2, 1, 0 (LSB)	Not used

9.3.4 Service Request Enable Register (Mask)

The Standard Request Enable Register (SRE Mask) is used to build the Master Summary Status Bit (MSS) within the Status Byte Register (STB). To ignore any of the events detected and set in the STB register itself, set the corresponding bit within the SRE Mask to 0. The STB can then be queried and the value of the MSS can be used to determine the type of service request required based on the SRE Mask applied.

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

9.3.5 Status and event registers diagram



9.4 PXIe Multi Chassis mode operation

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

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

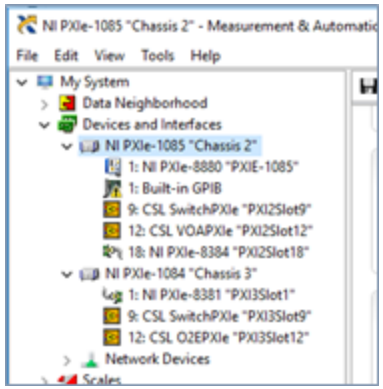
9.4.1 NI-MAX application Multi Chassis mode

NOTE

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

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

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



9.4.2 SCPI Multi Chassis commands

NOTE

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

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

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

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

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

Common command example:

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

Specific command example:

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

9.5 Command summary

9.5.1 Common commands

Command	Description
*IDN?	Query the CohesionSCPI service identification >>
*CLS	Clear session message queues >>
*OPT?	Query the modules managed by the CohesionSCPI service >>
*OPC?	Query the Operation Complete Status >>
*ESR?	Query the Standard Event Status Register >>

9.5.2 Slot commands

Slot commands	Description
:SLOT<n>	
:TeST?	Query the module self-test status >>
:OPC?	Query the Operation Complete Status of the module >>
:IDN?	Query the slot identification >>
:OPTions?	Query the modules managed by the CohesionSCPI service >>
:GRouP?	
:PPG?	Query the PPG channels within the specified group >>
:ED?	Query the ED channels within the specified group >>
:TEMPerature?	Query the temperature of all groups of channels >>

9.5.3 Configuration commands

Configuration commands	Description
:CALCulate<n>	
:DATA<m>	
:EALarm?	Query the ED error measurement >>
:ELAPsed?	Query the elapsed (running time) of the ED measurement >>
:EDIagram?	Query the eye scan measurement data. >>
:STATus?	Query the eye scan measurement status >>
:BATHtub?	Query the BER values from the bathtub measurement (available for BERT 1003/5) >>
:STATus?	Query the status of the bathtub measurement (available for BERT 1003/5) >>
:ELAPsed?	Query the elapsed time of the bathtub measurement and the time to next point (available for BERT 1003/5) >>
:Q?	Query the Q values from the bathtub measurement (available for BERT 1003/5) >>
:BERFloor?	Query the BER floor value from the bathtub measurement (available for BERT 1003/5) >>
:CENTer?	Query the center of the eye from the bathtub measurement (available for BERT 1003/5) >>
:JITTer?	Query the jitter values from the bathtub measurement (available for BERT 1003/5) >>

Configuration commands	Description
:OUTPut<n>	
:CLOCk	
:VCOLock?	Query the stability of the clock synthesizer >>
:DIVIde?	Query the clock synthesizer divide ratio >>
:DIVIde	Set the clock synthesizer divide ratio >>
:FREQuency	
:ARBitrary?	Query the synthesizer frequency arbitrary settings >>
:ARBitrary	Set the synthesizer frequency to an arbitrary value within the valid operating range >>
:STanDard?	Query the current synthesizer frequency standard settings >>
:STanDard	Set the current synthesizer frequency to a standard value >>
:POWer?	Query the power of the RF output clock >>
:POWer	Set the power for the RF output clock >>
:DATA<m>	
:AMPlitude?	Query the voltage 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 (available for BERT 1003/5) >>
:ARBitrary	Set the current ED frequency to an arbitrary value within the valid operating range (available for BERT 1003/5) >>
:STanDard?	Query the current ED frequency standard settings (available for BERT 1003/5) >>
:STanDard	Set the current ED frequency to a standard value (available for BERT 1003/5) >>

Configuration commands	Description
:SENSe<n>	
:MEASure<m>	
:BATHtub	
:STARt	Start the bathtub measurement (available for BERT 1003/5) >>
:STOP	Stop the bathtub measurement (available for BERT 1003/5) >>
:MINErrors?	Query the minimum error threshold for the bathtub measurement (available for BERT 1003/5) >>
:MINErrors	Set the threshold number of errors for the bathtub measurement (available for BERT 1003/5) >>
:VOLTage?	Query the bathtub voltage (available for BERT 1003/5) >>
:VOLTage	Set the bathtub voltage (available for BERT 1003/5) >>
:EALarm	
:MODE?	Query the mode of ED measurement >>
:MODE	Set the mode of the ED measurement >>
:POINt?	Query the mode of the ED point measurement >>
:POINt	Set the mode of the ED point measurement >>
:VOLTage?	Query the voltage of the ED point measurement >>
:VOLTage	Set the ED point voltage >>
:PHASe?	Query the phase of the ED point measurement >>
:PHASe	Set the phase of the ED point measurement >>
:STARt	Start the ED measurement >>
:STOP	Stop 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 eye measurement pattern length (2^n bits) resolution >>
:PatternLENgth	Set the eye measurement pattern length (2^n bits) resolution >>
:STARt	Start the eye scan measurement >>
:STOP	Stop a running 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 >>

Configuration commands	Description
:SENSe<n>	
: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 equilizer 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	Add a small random burst of errors into the ED measurement (Error injection) >>

Configuration commands	Description
:SOURce<m>	
:PATTern<m>	
:DEEMphasis?	Query the pattern de-emphasis >>
:DEEMphasis	Set the pattern de-emphasis >>
:CURSor?	Query the pattern de-emphassis 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 >>

9.6 Command descriptions

9.6.1 Common commands

Command	***IDN?**	Summary >>
Syntax	`*IDN?`	
Description	Query the CohesionSCPI service identification	
Parameters	N/A	
Response	Comma separated string with the <manufacturer>,<server name>,<chassis controller name>,<server version>	
Example	`*IDN? -> Quantifi Photonics Ltd,CohesionSCPI,ARCTURUS,SW3.02.11.00`	

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

Command	***OPT?**	Summary >>
Syntax	`*OPT?`	
Description	Query the modules managed by the CohesionSCPI service	
Parameters	N/A	
Response	Comma separated string of the installed modules in the chassis	
Example	`*OPT? -> ,LASER-2001-1-FA-PXIE,SWITCH-1003-1-FC-PXIE,,VOA-1001-2-FA-PXIE,,,,O2E-1001-1-FC-PXIE,,,,,,,,`	

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

Command	***ESR?**		Summary >>
Syntax	`*ESR?`		
Description	Query the Standard Event Status Register		
Parameters	N/A		
Response	Unsigned integer 8 bit value for the register <0 to 255>, as a string.		
	Bit	Description	Decimal Value
	7 (MSB)	Not used	0
	6	Not used	0
	5	Command error	32
	4	Command Execution Error	16
	3	Device Dependent Error	8
	2	Not used	0
	1	Not used	0
	0 (LSB)	Operation Complete	1
Example	`*ESR? -> 8` `*ESR? -> 32`		

NOTE

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

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

9.6.2 Slot commands

Command	**:SLOT<n>:TeST?**	Summary >>
Syntax	:SLOT<n>:TeST?	
Description	Query the module self-test status	
Parameters	N/A	
Response	Functional readiness status of the module. A non-zero response reports an error.	
Example	:SLOT1:TST? -> 0	

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

Command	**:SLOT<n>:IDN?**	Summary >>
Syntax	:SLOT<n>:IDN?	
Description	Query the slot identification	
Parameters	N/A	
Response	A comma-separated string containing "<manufacturer>,<model name>,<serial number>,<hardware version><firmware version>". Note that the hardware and firmware versions are not comma separated.	
Example	:SLOT1:IDN? -> Quantifi Photonics Ltd,LASER-2001,QP-000000,HW0.00.01FW0.00.01	

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

Command	**:SLOT<n>:GRouP?:PPG?**	Summary >>
Syntax	:SLOT<n>:GRouP?:PPG?	
Description	Query the PPG channels within the specified group	
Parameters	**ACT**: Returns the actual measured temperature	
	UNIT: Returns the default temperature unit	
Example		
Syntax	:SLOT1:TEMP? ACT -> 30.100000	

Command	**:SLOT<n>:GRouP?:ED?**	Summary >>
Syntax	:SLOT<n>:GRouP?:ED?	
Description	Query the ED channels within the specified group	
Parameters	**ACT**: Returns the actual measured temperature	
	UNIT: Returns the default temperature unit	
Example		
Syntax	:SLOT1:TEMP? ACT -> 30.100000	

Command	**:SLOT<n>:GRouP?:TEMPerature?**	Summary >>
Syntax	:SLOT<n>:GRouP?:TEMPerature?[<wsp><ACT|UNIT>]	
Description	Query the temperature of all groups of channels	
Parameters	**ACT**: Returns the actual measured temperature	
	UNIT: Returns the default temperature unit	
Example		
Syntax	:SLOT1:TEMP? ACT -> 30.100000	

9.6.3 Configuration Commands

Command	**:CALCulate<n>:DATA<m>:EALarm?** Summary >>
Syntax	:CALCulate<n>:DATA<m>:EALarm?<wsp><STATE|DATA|LOCK|ERROR|COUNT|BITS|BER|FULL|INFO>
Description	Query the ED error measurement
Parameters	**STATE**: Query the state of the ED measurement.
	DATA: Query the presence of the data pattern.
	LOCK: Query the frequency lock status.
	COUNt|ERROR: (default) Query the total error count.
	BITS: Query the total number of bits.
	BER: Query the bit error rate.
	FULL: Query Query the information specified by all the parameters. The format is <STATE>,<DATA>,<LOCK>,<COUNt|ERROR>,<BITS>,<BER>.
	INFO: Provides a description of what the return values represent.
Response	The requested value, or a comma separated array. 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	:CALCulate1:DATA2:EALarm? FULL 1-> 1,1,1,5.035849e+11,7.522210e+03,6.694641e+07 :CALCulate1: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?**	Summary >>
Syntax	:CALCulate<n>:DATA<m>:EALarm:ELAPsed?	
Description	Query the elapsed (running time) of the ED measurement	
Parameters	N/A	
Response	The number of seconds the ED measurement has been running	
Example	:CALCulate1:DATA2:EALarm:ELAPsed? -> 7917.7923	

Command	**:CALCulate<n>:DATA<m>:EDIagram?**	Summary >>
Syntax	:CALCulate<n>:DATA<m>:EDIagram?	
Description	Query the eye scan measurement data. This command can only be run after the :CALCulate<n>:DATA<m>:EDIagram:STATus? command has returned COMPLETE.	
Parameters	N/A	
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	:CALCulate1:DATA2:EDIagram? -> "63,63,<array of 63*63 points>"	

Command	**:CALCulate<n>:DATA<m>:EDIagram:STATus?**	Summary >>
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|STOPPED**: There is no data as the scan has been cancelled or is not started. **0|RUNNING**: The scan has been started and is still sampling data. **1|COMPLETE**: The scan is complete, and all data is available.	
Example	:CALCulate1:DATA2:EDIagram:STATus? -> -1 :CALCulate1:DATA2:EDIagram:STATus? INFO -> -1:STOPPED 0:RUNNING 1:COMPLETE	

Command	**:CALCulate<n>:DATA<m>:BATHtub?**	Summary >>
Syntax	:CALCulate<n>:DATA<m>:BATHtub?	
Description	Query the BER values from the bathtub measurement (available for BERT 1003/5)	
Parameters	N/A	
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	:CALCulate1: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?**	Summary >>
Syntax	:CALCulate<n>:DATA<m>:BATHtub:STATus?[<wsp><INFO>]	
Description	Query the status of the bathtub measurement (available for BERT 1003/5)	
Parameters	**INFO**:Provides a description of what the return values represent.	
Response	The current status of the bathtub measurement. **-1|INVALID**: The bathtub measurement has not been run. **0|RUNNING**: The scan has been started and is currently sampling data. **1|STOPPED (USER)**: The scan was stopped by the user and all data is available **2|STOPPED (AUTO)**: The scan detected a loss of data and exited the bathtub scan. **3|INVALID SIGNAL**: The input data is not recognized. The bathtub cannot start.	
Example	:CALCulate1:DATA2:BATHtub:STATus? -> -1 :CALCulate1:DATA2:BATHtub:STATus? INFO -> -1:INVALID 0:RUNNING 1:STOPPED (USER) 2:STOPPED (AUTO) 3:INVALID SIGNAL	

Command	**:CALCulate<n>:DATA<m>:BATHtub:ELAPsed?**	Summary >>
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 (available for BERT 1003/5)	
Parameters	**TOTAL**: (default) Returns the total amount of time the bathtub measurement has been running	
	NEXT: Returns the estimated time to collect the next data point	
	UNIT: Returns the unit of time	
Response	A value or string	
Example	:CALCulate1:DATA2:BATHtub:ELAPsed? -> 350 :CALCulate1:DATA2:BATHtub:ELAPsed? TOTAL -> 350 :CALCulate1:DATA2:BATHtub:ELAPsed? NEXT -> 27 :CALCulate1:DATA2:BATHtub:ELAPsed? UNIT -> s	

Command	**:CALCulate<n>:DATA<m>:BATHtub:Q?**	Summary >>
Syntax	:CALCulate<n>:DATA<m>:BATHtub:Q?	
Description	Query the Q values from the bathtub measurement (available for BERT 1003/5)	
Parameters	N/A	
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	:CALCulate1: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?**	Summary >>
Syntax	:CALCulate<n>:DATA<m>:BATHtub:BERFloor?	
Description	Query the BER floor value from the bathtub measurement (available for BERT 1003/5)	
Parameters	N/A	
Response	A value representing the BER value at the center of the eye	
Example	:CALCulate1:DATA2:BATHtub:BERFloor? -> 1.2662386e-47	

Command	**:CALCulate<n>:DATA<m>:BATHtub:CENTer?** Summary >>
Syntax	:CALCulate<n>:DATA<m>:BATHtub:CENTer?[<wsp><UNIT>]
Description	Query the center of the eye from the bathtub measurement (available for BERT 1003/5)
Parameters	**UNIT**: Returns the unit of the measurement.
Response	A value representing the center of the eye calculated from the bathtub measurement
Example	:CALCulate1:DATA2:BATHtub:CENTer? -> -1.5985557e-01 :CALCulate1:DATA2:BATHtub:CENTer? UNIT -> UI

Command	**:CALCulate<n>:DATA<m>:JITTer?** Summary >>
Syntax	:CALCulate<n>:DATA<m>:JITTer?[<wsp><DJ|RJ|J2|J9|J12|UNIT>]
Description	Query the jitter values from the bathtub measurement (available for BERT 1003/5)
Parameters	**DJ**: (default) Returns the deterministic jitter
	RJ: Returns the random jitter
	J2: Returns the total jitter at J2
	J9: Returns the total jitter at J9
	J12: Returns the total jitter at J12
	UNIT: Returns 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>.
Example	:CALCulate1:DATA2:JITTer? -> 2.319684 :CALCulate1:DATA2:JITTer? DJ -> 2.319684 :CALCulate1:DATA2:JITTer? J2 -> 15.69358, 15.69358 :CALCulate1:DATA2:JITTer? UNIT -> ps

Command	**:OUTPut<n>:CLOCk:VCOLock?** Summary >>
Syntax	:OUTPut<n>:CLOCk:VCOLock?[<wsp>INFO]
Description	Query the stability of the clock synthesizer
Parameters	**INFO**: Provides a description of 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	:OUTPut1:CLOCk:VCOLock? ->1 :OUTPut1:CLOCk:VCOLock? INFO -> 0: NO LOCK 1: LOCKED

Command	**:OUTPut<n>:CLOCk:DIVIde?** Summary >>
Syntax	:OUTPut<n>:CLOCk:DIVIde?[<wsp><MIN|MAX|DEF|SET|LIST|ALL>]
Description	Query the clock synthesizer divide ratio
Parameters	**MIN**: Returns the minimum configurable value
	MAX: Returns the maximum configurable value
	DEF: Returns the default power-on value
	SET: (default) Returns the current SET value
	LIST: Returns the LIST of discrete options for configurable values (if available)
	ALL: Returns the values specified by all parameters in the format <MIN>,<MAX>,<DEF>,<SET>,<LIST>
Response	A single value or a comma separated string of values.
Example	:OUTPut1:CLOCk:DIVIde? -> 2

Command	**:OUTPut<n>:CLOCk:DIVIde** Summary >>
Syntax	:OUTPut<n>:CLOCk:DIVIde<wsp><value|MIN|MAX|DEF>
Description	Set the clock synthesizer divide ratio.
Parameters	**value**: Set to the desired new set point
	MIN: Set to the minimum value
	MAX: Set to the maximum value
	DEF: Restores to the default value
Response	N/A
Example	:OUTPut1:CLOCk:DIVIde 4

Command	**:OUTPut<n>:CLOCk:FREQuency:ARBitrary?**	Summary >>
Syntax	:OUTPut<n>:CLOCk:FREQuency:ARBitrary?[<wsp><MIN|MAX|DEF|SET|ALL|STEP|UNIT>]	
Description	Query the synthesizer frequency arbitrary settings	
Parameters	**MIN**: Returns the minimum configurable value	
	MAX: Returns the maximum configurable value	
	DEF: Returns the default power-on value	
	SET: (default) Returns the current SET value	
	ALL: Returns the values specified by the MIN, MAX, DEF, and SET parameters in the format <MIN>,<MAX>,<DEF>,<SET>,<LIST>	
	STEP: Returns the minimum resolution of the frequency value	
	UNIT: Returns the default unit for the frequency value	
Response	A single value or a comma separated string of values. If the frequency is set to a standard value, the **SET** value in the response is **NAN**.	
Example	ARBITRARY MODE: :OUTP1:CLOC:FREQ:ARB? -> 7.96 STANDARD MODE: :OUTP1:CLOC:FREQ:ARB?-> NAN	

Command	**:OUTPut<n>:CLOCk:FREQuency:ARBitrary**	Summary >>
Syntax	:OUTPut<n>:CLOCk:FREQuency:ARBitrary<wsp><value|MIN|MAX|DEF>	
Description	Set the synthesizer frequency to an arbitrary value within the valid operating range.	
Parameters	**value**: Set to the desired new value	
	MIN: Set to the minimum value	
	MAX: Set to the maximum value	
	DEF: Restores the default value	
Response	N/A	
Example	:OUTP1:CLOC:FREQ:ARB 7.96	

Command	**:OUTPut<n>:CLOCk:FREQuency:STanDard?** Summary >>
Syntax	:OUTPut<n>:CLOCk:FREQuency:STanDard?[<wsp><MIN|MAX|DEF|SET|LIST|ALL| STEP|UNIT>]
Description	Query the current synthesizer frequency standard settings
Parameters	**MIN**: Returns the minimum configurable value
	MAX: Returns the maximum configurable value
	DEF: Returns the default power-on value
	SET: (default) Returns the current SET value
	LIST: Returns the list of discrete options for configurable values (if available)
	ALL: Returns the values specified by the MIN, MAX, DEF, SET and LIST parameters in the format <MIN>,<MAX>,<DEF>,<SET>,<LIST>
	STEP: Returns the minimum resolution of the frequency value
	UNIT: Returns the default unit for the frequency value
Response	A single value or a comma separated string of values. If the frequency is set to an arbitrary value, the **SET** value in the response is **NAN**.
Example	STANDARD MODE: :OUTP1:CLOC:FREQ:STD? -> 14.5 ARBITRARY MODE: :OUTP1:CLOC:FREQ:STD? -> NAN

Command	**:OUTPut<n>:CLOCk:FREQuency:STanDard** Summary >>
Syntax	:OUTPut<n>:CLOCk:FREQuency:STanDard<wsp><value|MIN|MAX|DEF>
Description	Set the current synthesizer frequency to a standard value
Parameters	**value**: Set to the desired new value
	MIN: Set to the minimum value
	MAX: Set to the maximum value
	DEF: Restores the default value
Response	N/A
Example	:OUTP1:CLOC:FREQ:STD 14.5

Command	**:OUTPut<n>:CLOCk:POWer?** Summary >>
Syntax	:OUTPut<n>:CLOCk:POWer?[<wsp><MIN|MAX|DEF|SET|LIST|ALL|STEP|UNIT>]
Description	Query the power of the RF output clock
Parameters	**MIN**: Returns the minimum configurable value
	MAX: Returns the maximum configurable value
	DEF: Returns the default power-on value
	SET: (default) Returns the current SET value
	LIST: Returns the list of discrete options for configurable values (if available)
	ALL: Returns the values specified by the MIN, MAX, DEF, SET and LIST parameters in the format <MIN>,<MAX>,<DEF>,<SET>,<LIST>
	STEP: Returns the minimum resolution of the power value
	UNIT: Returns the default unit for the power value
Response	A single value or a comma separated string of values.
Example	:OUTPut1:CLOCk:POWer? -> 0

Command	**:OUTPut<n>:FREQuency:POWer** Summary >>
Syntax	:OUTPut<n>:FREQuency:POWer<wsp><value|MIN|MAX|DEF>
Description	Set the power for the RF output clock
Parameters	**value**: Set to the desired new set point
	MIN: Set to the minimum value
	MAX: Set to the maximum value
	DEF: Restores the default value
Response	N/A
Example	:OUTPut1:CLOCk:POWer 0.0

Command	**:OUTPut<n>:DATA<m>:AMPlitude?** Summary >>
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	**MIN**: Returns the minimum configurable value
	MAX: Returns the maximum configurable value
	DEF: Returns the default power-on value
	SET: (default) Returns the current SET value
	LIST: Returns the list of discrete options for configurable values (if available)
	ALL: Returns the values specified by the MIN, MAX, DEF, SET and LIST parameters in the format `<MIN>,<MAX>,<DEF>,<SET>,<LIST>`
	STEP: Returns the minimum resolution of the amplitude value
	UNIT: Returns the default unit for the amplitude value
	LINKED: Returns the linked channels
Response	A single value, or a comma separated array.
Example	`:OUTPut1:DATA2:AMPlitude? ALL -> 200,1100,200,200,NAN` This command does not have a discrete LIST.

Command	**:OUTPut<n>:DATA<m>:AMPlitude** Summary >>
Syntax	`:OUTPut<n>:DATA<m>:AMPlitude<wsp><value|MIN|MAX|DEF>`
Description	Set the amplitude of the output signal
Parameters	**value**: Set to the desired new set point
	MIN: Set to the minimum value
	MAX: Set to the maximum value
	DEF: Restores the default value
Response	N/A
Example	`:OUTPut1:DATA2:AMPlitude 0.60`

Command	**:OUTPut<n>:DATA<m>:CPOint?**	Summary >>
Syntax	:OUTPut<n>:DATA<m>:CPOint?[<wsp><MIN|MAX|DEF|SET|LIST|ALL>]	
Description	Query the pattern cross point (%)	
Parameters	**MIN**: Returns the minimum configurable value	
	MAX: Returns the maximum configurable value	
	DEF: Returns the default power-on value	
	SET: (default) Returns the current SET value	
	LIST: Returns the list of discrete options for configurable values (if available)	
	ALL: Returns the values specified by the MIN, MAX, DEF, SET and LIST parameters in the format <MIN>,<MAX>,<DEF>,<SET>,<LIST>	
Response	A single value, or a comma separated array.	
Example	:OUTPut1:DATA2:CPOint? LIST -> 35,40,45,50,55	

Command	**:OUTPut<n>:DATA<m>:CPOint**	Summary >>
Syntax	:OUTPut<n>:DATA<m>:CPOint<wsp><value|MIN|MAX|DEF>	
Description	Set the pattern cross point (%)).	
Parameters	**value**: Set to the desired new set point	
	MIN: Set to the minimum value	
	MAX: Set to the maximum value	
	DEF: Restores the default value	
Response	N/A	
Example	:OUTPut1:DATA2:CPOint 25	

Command	**:OUTPut<n>:DATA<m>:OUTPut?**	Summary >>
Syntax	:OUTPut<n>:DATA<m>:OUTPut?[<wsp><DEF|SET|INFO>]	
Description	Query the state of the pattern generator output	
Parameters	**DEF**: Returns the default power-on value	
	SET: (default) Returns the current SET value	
	INFO: Provides a description of what the return values represent	
Response	An integer indicating the state of the pattern generator output.	
Example	:OUTPut1:DATA2:OUTPut? -> 1 :OUTPut1:DATA2:OUTPut? INFO -> 0:OFF 1:ON	

Command	**:OUTPut<n>:DATA<m>:OUTPut**	Summary >>
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	**1|ON**: Set the output to the ON state	
	0|OFF: Set the output to the OFF state	
	DEF: Restores the default state	
	ON_ALL: Set the output of all PPG channels to ON	
	OFF_ALL: Set the output of all PPG channels to OFF	
Response	N/A	
Example	:OUTPut1:DATA2:OUTPut 1 :OUTPut1:DATA:OUTPut ON_ALL	

Command	**:SENSe<n>:CLOCk:FREQuency:ARBitrary?**	Summary >>
Syntax	:SENSe<n>:CLOCk:FREQuency:ARBitrary?[<wsp><MIN|MAX|DEF|SET|ALL|STEP|UNIT>]	
Description	Query the current ED frequency arbitrary settings (available for BERT 1003/5)	
Parameters	**MIN**: Returns the minimum configurable value	
	MAX: Returns the maximum configurable value	
	DEF: Returns the default power-on value	
	SET: (default) Returns the current SET value	
	ALL: Returns the values specified by the MIN, MAX, DEF, and SET parameters in the format <MIN>,<MAX>,<DEF>,<SET>,<LIST>	
	STEP: Returns the minimum resolution of the frequency value	
	UNIT: Returns the default unit for the frequency value	
Response	A single value or a comma separated string of values. If the frequency is set to a standard value, the **SET** value in the response is **NAN**.	
Example	ARBITRARY MODE: :SENS1:CLOC:FREQ:ARB? -> 7.96 STANDARD MODE: :SENS1:CLOC:FREQ:ARB? -> NAN	

Command	**:SENSe<n>:CLOCk:FREQuency:ARBitrary**	Summary >>
Syntax	:SENSe<n>:CLOCk:FREQuency:ARBitrarywsp><value|MIN|MAX|DEF>	
Description	Set the current ED frequency to an arbitrary value within the valid operating range (available for BERT 1003/5)	
Parameters	**value**: Set to the desired new value	
	MIN: Set to the minimum value	
	MAX: Set to the maximum value	
	DEF: Restores the default value	
Response	N/A	
Example	:SENS1:CLOC:FREQ:ARB 7.96	

Command	**:SENSe<n>:CLOCk:FREQuency:STanDard?**	Summary >>
Syntax	:SENSe<n>:CLOCk:FREQuency:STanDard?[<wsp><MIN|MAX|DEF|SET|LIST|ALL|STEP|UNIT>]	
Description	Query the current ED frequency standard settings (available for BERT 1003/5)	
Parameters	**MIN**: Returns the minimum configurable value	
	MAX: Returns the maximum configurable value	
	DEF: Returns the default power-on value	
	SET: (default) Returns the current SET value	
	LIST: Returns the list of discrete options for configurable values (if available)	
	ALL: Returns the values specified by the MIN, MAX, DEF, SET and LIST parameters in the format <MIN>,<MAX>,<DEF>,<SET>,<LIST>	
	STEP: Returns the minimum resolution of the frequency value	
	UNIT: Returns the default unit for the frequency value	
Response	A single value or a comma separated string of values. If the frequency is set to an arbitrary value, the SET value in the response is NAN.	
Example	STANDARD MODE: :SENS1:CLOC:FREQ:STD? -> 14.5 ARBITRARY MODE: :SENS1:CLOC:FREQ:STD? -> NAN	

Command	**:SENSe<n>:CLOCk:FREQuency:STanDard**	Summary >>
Syntax	:SENSe<n>:CLOCk:FREQuency:STanDard<wsp><value|MIN|MAX|DEF>	
Description	Set the current ED frequency to a standard value (available for BERT 1003/5)	
Parameters	**value**: Set to the desired new value	
	MIN: Set to the minimum value	
	MAX: Set to the maximum value	
	DEF: Restores the default value	
Response	N/A	
Example	:SENS1:CLOC:FREQ:STD 14.5	

Command	**:SENSe<n>:MEASure<m>:BATHtub:STARt**	Summary >>
Syntax	:SENSe<n>:MEASure<m>:BATHtub:STARt	
Description	Start the bathtub measurement (available for BERT 1003/5)	
Parameters	N/A	
Response	N/A	
Example	:SENSe1:MEASure2:BATHtub:STARt	

Command	**:SENSe<n>:MEASure<m>:BATHtub:STOP**	Summary >>
Syntax	:SENSe<n>:MEASure<m>:BATHtub:STOP	
Description	Stop the bathtub measurement (available for BERT 1003/5)	
Parameters	N/A	
Response	N/A	
Example	:SENSe1:MEASure2:BATHtub:STOP	

Command	**:SENSe<n>:MEASure<m>:BATHtub:MINErrors?** Summary >>
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 (available for BERT 1003/5)
Parameters	**MIN**: Returns the minimum threshold
	MAX: Returns the maximum threshold
	DEF: Returns the default threshold
	SET: (default) Returns the current SET value
	ALL: Returns the values specified by the MIN, MAX, DEF, SET parameters in the format <MIN>,<MAX>,<DEF>,<SET>
	STEP: Returns the minimum step between thresholds
	UNIT: Returns the default unit of the threshold
	LINKED: Returns the linked channels
Response	A single integer value, or a comma separated integer array.
Example	:SENSe1:MEASure2:BATHtub:MINErrors? -> 10 :SENSe1:MEASure2:BATHtub:MINErrors? MIN -> 0 :SENSe1:MEASure2:BATHtub:MINErrors? MAX -> 65535 :SENSe1:MEASure2:BATHtub:MINErrors? DEF -> 10 :SENSe1:MEASure2:BATHtub:MINErrors? SET -> 10 :SENSe1:MEASure2:BATHtub:MINErrors? ALL -> 0, 65535, 10, 10 :SENSe1:MEASure2:BATHtub:MINErrors? UNIT -> bits :SENSe1:MEASure2:BATHtub:MINErrors? LINKED -> 1

Command	**:SENSe<n>:MEASure<m>:BATHtub:MINErrors** Summary >>
Syntax	:SENSe<n>:MEASure<m>:BATHtub:MINErrors<wsp><value|DEF>
Description	Set the threshold number of errors for the bathtub measurement (available for BERT 1003/5)
Parameters	**value**: The desired new value
	DEF: Restores the default value
Response	N/A
Example	:SENSe1:MEASure1:BATHtub:MINErrors 5 :SENSe1:MEASure1:BATHtub:MINErrors DEF

Command	**:SENSe<n>:MEASure<m>:BATHtub:VOLTage?** Summary >>
Syntax	:SENSe<n>:MEASure<m>:BATHtub:VOLTage?[<wsp><MIN|MAX|DEF|SET|ALL|STEP|UNIT|LINKED>]
Description	Query the bathtub voltage (available for BERT 1003/5)
Parameters	**MIN**: Returns the minimum bathtub voltage
	MAX: Returns the maximum bathtub voltage
	DEF: Returns the default bathtub voltage
	SET: (default) Returns the current set bathtub voltage
	ALL: Returns the values specified by the MIN, MAX, DEF, SET parameters in the format <MIN>,<MAX>,<DEF>,<SET>
	STEP: Returns the minimum step between bathtub voltages
	UNIT: Returns the default unit of the bathtub voltage
	LINKED: Returns the linked channels
Response	A single integer value, or a comma separated integer array.
Example	:SENSe1:MEASure2:BATHtub:VOLTage? ->0.000000 :SENSe1:MEASure2:BATHtub:VOLTage? MIN ->-217.000000 :SENSe1:MEASure2:BATHtub:VOLTage? MAX ->217.000000 :SENSe1:MEASure2:BATHtub:VOLTage? DEF ->0.000000 :SENSe1:MEASure2:BATHtub:VOLTage? SET ->0.000000 :SENSe1:MEASure2:BATHtub:VOLTage? ALL ->-217.000000,217.000000,0.000000,0.000000 :SENSe1:MEASure2:BATHtub:VOLTage? STEP ->7.000000 :SENSe1:MEASure2:BATHtub:VOLTage? UNIT ->mV :SENSe1:MEASure2:BATHtub:VOLTage? LINKED -> 1

Command	**:SENSe<n>:MEASure<m>:BATHtub:VOLTage** Summary >>
Syntax	:SENSe<n>:MEASure<m>:BATHtub:VOLTage<wsp><value|DEF>
Description	Set the bathtub voltage (available for BERT 1003/5)
Parameters	**value**: Set the desired new value.
	DEF: Restore the default value.
Response	N/A
Example	:SENSe1:MEASure2:BATHtub:VOLTage 7

Command	**:SENSe<n>:MEASure<m>:EALarm:MODE?** Summary >>
Syntax	:SENSe<n>:MEASure<m>:EALarm:MODE?[<wsp><DEF|SET|LIST|ALL|INFO>]
Description	Query the mode of ED measurement
Parameters	**DEF**: Returns the default power-on value
	SET: (default) Returns the current SET value
	LIST: Returns the list of discrete options for configurable values (if available)
	ALL: Returns the values specified by the DEF, SET and LIST parameters in the format <DEF>,<SET>,<LIST>
	INFO: Provides a description of what the return values represent
Response	A single integer value, or a comma separated integer array.
Example	:SENSe1:MEASure2:EALarm:MODE? -> 0 :SENSe1:MEASure2:EALarm:MODE? INFO -> 0:ACCUMULATED 1:INSTANTANEOUS

Command	**:SENSe<n>:MEASure<m>:EALarm:MODE** Summary >>
Syntax	:SENSe<n>:MEASure<m>:EALarm:MODE<wsp><1|INSTantaneous|0|ACCUmulated| DEF>
Description	Set the mode of the ED measurement
Parameters	**value**: Set the desired new value.
	INSTantaneous: Set the mode to one second intervals.
	ACCUmulated: Set the mode to continually record data until it is stopped.
	DEF: Restore the default value.
Response	N/A
Example	:SENSe1:MEASure2:EALarm:MODE INST

Command	**:SENSe<n>:MEASure<m>:EALarm:POINt?** Summary >>
Syntax	:SENSe<n>:MEASure<m>:EALarm:POINt?[<wsp><DEF|SET|INFO|LINKED>]
Description	Query the mode of the ED point measurement
Parameters	**DEF**: Returns the default value
	SET: (default) Returns the current SET value
	INFO: Provides a description of what the return values represent
	LINKED: Returns the linked channels
Response	A single integer value, or a string.
Example	:SENSe1:MEASure2:EALarm:POINt? ->0 :SENSe1:MEASure2:EALarm:POINt? DEF ->0 :SENSe1:MEASure2:EALarm:POINt? SET ->0 :SENSe1:MEASure2:EALarm:POINt? LINKED ->1,2,3,4 :SENSe1:MEASure2:EALarm:POINt? INFO -> 0:AUTO 1:MANUAL

Command	**:SENSe<n>:MEASure<m>:EALarm:POINt** Summary >>
Syntax	:SENSe<n>:MEASure<m>:EALarm:POINt<wsp><value|0|AUTO|1|MANUAL|DEF>
Description	Set the mode of the ED point measurement
Parameters	**value**: Set the desired new value
	0: Set the point mode to automatic
	AUTO: Set the point mode to automatic
	1: Set the point mode to manual
	MANUAL: Set the point mode to manual
	DEF: Restore the default value
Response	N/A
Example	:SENSe1:MEASure1:EALarm:POINt MANUAL

Command	**:SENSe<n>:MEASure<m>:EALarm:VOLTage?** Summary >>
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	**MIN**: Returns the minimum ED point voltage
	MAX: Returns the maximum ED point voltage
	DEF: Returns the default ED point voltage
	SET: (default) Returns the current set ED point voltage
	ALL: Returns the values specified by the MIN, MAX, DEF, SET parameters in the format <MIN>,<MAX>,<DEF>,<SET>
	STEP: Returns the minimum step between ED point voltages
	UNIT: Returns the unit of the ED point voltage
	LINKED: Returns the linked channels
Response	A single integer value, or a list of comma separated values.
Example	:SENSe1:MEASure2:EALarm:VOLTage? -> 0.000000 :SENSe1:MEASure2:EALarm:VOLTage? ALL -> -217.000000,217.000000,0.000000,0.000000 :SENSe1:MEASure2:EALarm:VOLTage? STEP -> 7.000000 :SENSe1:MEASure2:EALarm:VOLTage? UNIT -> mV :SENSe1:MEASure2:EALarm:VOLTage? LINKED -> 1

Command	**:SENSe<n>:MEASure<m>:EALarm:VOLTage** Summary >>
Syntax	:SENSe<n>:MEASure<m>:EALarm:VOLTage<wsp><value|DEF>
Description	Set the ED point voltage
Parameters	**value**: Set the desired new value
	DEF: Restore the default value
Response	N/A
Example	:SENSe1:MEASure2:EALarm:VOLTage 7

Command	**:SENSe<n>:MEASure<m>:EALarm:PHASe?** Summary >>
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	**MIN**: Returns the minimum ED point phase
	MAX: Returns the maximum ED point phase
	DEF: Returns the default ED point phase
	SET: (default) Returns the current set ED point voltage
	ALL: Returns the values specified by the MIN, MAX, DEF, SET parameters in the format <MIN>,<MAX>,<DEF>,<SET>
	STEP: Returns the minimum step between ED point phases
	UNIT: Returns the unit of the ED point phase
	LINKED: Returns the linked channels
Response	A single value, or a comma separated array.
Example	:SENSe1:MEASure2:EALarm:PHASe? -> 0.000000 :SENSe1:MEASure2:EALarm:PHASe? ALL -> -2.468750,2.468750,0.000000,0.000000 :SENSe1:MEASure2:EALarm:PHASe? STEP -> 0.015625 :SENSe1:MEASure2:EALarm:PHASe? UNIT -> UI :SENSe1:MEASure2:EALarm:PHASe? LINKED -> 1

Command	**:SENSe<n>:MEASure<m>:EALarm:PHASe** Summary >>
Syntax	:SENSe<n>:MEASure<m>:EALarm:PHASe<wsp><value|DEF>
Description	Set the phase of the ED point measurement
Parameters	**value**: Set the desired new set point
	DEF: Restore the default value
Response	N/A
Example	:SENSe1:MEASure2:EALarm:PHASE 0.25 :SENSe1:MEASure2:EALarm:PHASE DEF

Command	**:SENSe<n>:MEASure<m>:STARt**	Summary >>
Syntax	:SENSe<n>:MEASure<m>:STARt	
Description	Start the ED measurement	
Parameters	N/A	
Response	N/A	
Example	:SENSe1:MEASure2:STARt	

Command	**:SENSe<n>:MEASure<m>:STOP**	Summary >>
Syntax	:SENSe<n>:MEASure<m>:STOP	
Description	Stop the ED measurement	
Parameters	N/A	
Response	N/A	
Example	:SENSe1:MEASure2:STOP	

Command	**:SENSe<n>:MEASure<m>:ENABle?**	Summary >>
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	:SENSe1:MEASure2:ENABle? -> 0 :SENSe1:MEASure2:ENABle? INFO -> 0:OFF 1:ON 2:ERROR OVERFLOW 3:OFF (AUTO) 4:OFF (FAIL)	

Command	**:SENSe<n>:MEASure<m>:EDIagram:HORIzontal?** Summary >>
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	**MIN**: Returns the minimum configurable value
	MAX: Returns the maximum configurable value
	DEF: Returns the default power-on value
	SET: (default) Returns the current SET value
	LIST: Returns the list of discrete options for configurable values (if available)
	ALL: Returns the values specified by the MIN, MAX, DEF, SET and LIST parameters in the format <MIN>,<MAX>,<DEF>,<SET>,<LIST>
	LINKED: Returns the linked channels
Response	A single value, or a comma separated array.
Example	:SENSe1:MEASure2:EDIagram:HORIzontal? -> 1

Command	**:SENSe<n>:MEASure<m>:EDIagram:HORIzontal** Summary >>
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	**value**: Set to the desired new value
	MIN: Set to the minimum value
	MAX: Set to the maximum value
	DEF: Restore the default value
Response	N/A
Example	:SENSe1:MEASure2:EDIagram:HORIzontal 4

Command	**:SENSe<n>:MEASure<m>:EDIagram:PatternLENgth?** Summary >>
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	**MIN**: Returns the minimum configurable value
	MAX: Returns the maximum configurable value
	DEF: Returns the default power-on value
	SET: (default) Returns the current SET value
	LIST: Returns the list of discrete options for configurable values (if available)
	ALL: Returns the values specified by the MIN, MAX, DEF, SET and LIST parameters in the format <MIN>,<MAX>,<DEF>,<SET>,<LIST>
	LINKED: Returns the linked channels
Response	A single value, or a comma separated array.
Example	:SENSe1:MEASure2:EDIagram:PatternLENgth? MAX -> 16

Command	**:SENSe<n>:MEASure<m>:EDIagram:PatternLENgth** Summary >>
Syntax	:SENSe<n>:MEASure<m>:EDIagram:PatternLENgth<wsp><value|MIN|MAX|DEF>
Description	Set the eye measurement pattern length (2^n bits) resolution
Parameters	**value**: Set the desired new set point
	MIN: Set to the minimum value
	MAX: Set to the maximum value
	DEF: Restore the default value
Response	N/A
Example	:SENSe1:MEASure2:EDIagram:PatternLENgth 16

Command	**:SENSe<n>:MEASure<m>:EDIagram:STARt** Summary >>
Syntax	:SENSe<n>:MEASure<m>:EDIagram:STARt
Description	Start 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	N/A
Response	N/A
Example	:SENSe1:MEASure2:EDIagram:STARt

Command	**:SENSe<n>:MEASure<m>:EDIagram:STOP**	Summary >>
Syntax	:SENSe<n>:MEASure<m>:EDIagram:STOP	
Description	Stop a running eye scan measurement	
Parameters	N/A	
Response	N/A	
Example	:SENSe1:MEASure2:EDIagram:STOP	

Command	**:SENSe<n>:MEASure<m>:EDIagram:VERTical?**	Summary >>
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	**MIN**: Returns the minimum configurable value	
	MAX: Returns the maximum configurable value	
	DEF: Returns the default power-on value	
	SET: (default) Returns the current SET value	
	LIST: Returns the list of discrete options for configurable values (if available)	
	ALL: Returns the values specified by the MIN, MAX, DEF, SET and LIST parameters in the format <MIN>,<MAX>,<DEF>,<SET>,<LIST>	
	LINKED: Returns the linked channels	
Response	A single value, or a comma separated array.	
Example	:SENSe1:MEASure2:EDIagram:VERTical? DEF -> 14.000000	

Command	**:SENSe<n>:MEASure<m>:EDIagram:VERTical**	Summary >>
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	**value**: Set the desired new set point	
	MIN: Set to the minimum value	
	MAX: Set to the maximum value	
	DEF: Restore the default value	
Response	N/A	
Example	:SENSe1:MEASure2:EDIagram:VERTical 2	

Command	**:SENSe<n>:PATTern<m>:EQBoost?** Summary >>
Syntax	:SENSe<n>:PATTern<m>:EQBoost?[<wsp><MIN|MAX|DEF|SET|LIST|ALL|STEP| UNIT|LINKED>]
Description	Query the ED equalizer boost
Parameters	**MIN**: Returns the minimum configurable value
	MAX: Returns the maximum configurable value
	DEF: Returns the default power-on value
	SET: (default) Returns the current set value
	LIST: Returns the list of discrete options for configurable values (if available)
	ALL: Returns the values specified by the MIN, MAX, DEF, SET, and LIST parameters in the format <MIN>,<MAX>,<DEF>,<SET>,<LIST>
	STEP: Returns the minimum resolution of the equalizer boost value
	UNIT: Returns the default unit for the equalizer boost value
	LINKED: Returns the linked channels
Response	A single value, or a comma separated array.
Example	:SENSe1:PATTern2:EQBoost? ALL -> 0.0,21.0,0.0,0.0,NAN

Command	**:SENSe<n>:PATTern<m>:EQBoost** Summary >>
Syntax	:SENSe<n>:PATTern<m>:EQBoost<wsp><value|MIN|MAX|DEF>
Description	Set the ED equalizer boost
Parameters	**value**: Set the desired new set point
	MIN: Set to the minimum value
	MAX: Set to the maximum value
	DEF: Restore the default value
Response	N/A
Example	:SENSe1:PATTern2:EQBoost 2.4

Command	**:SENSe<n>:PATTern<m>:EQBoost:MODE?** Summary >>
Syntax	:SENSe<n>:PATTern<m>:EQBoost:MODE?[<wsp><DEF|SET|INFO>]
Description	Query the ED equalizer boost mode
Parameters	**DEF**: Returns the default power-on value
	SET: (default) Returns the current SET value
	INFO: Provides a description of what the return values represent
Response	An integer indicating the ED equalizer boost mode.
Example	:SENSe1:PATTern2:EQBoost:MODE? -> 0

Command	**:SENSe<n>:PATTern<m>:EQBoost:MODE**	Summary >>
Syntax	:SENSe<n>:PATTern<m>:EQBoost:MODE<wsp><value|DEF>	
Description	Set the ED equilizer boost mode	
Parameters	**value**: Set the desired boost mode	
	DEF: Restore the default value	
Response	N/A	
Example	:SENSe1:PATTern2:EQBoost:MODE 0	

Command	**:SENSe<n>:PATTern<m>:LOGic?**	Summary >>
Syntax	:SENSe<n>:PATTern<m>:LOGic?[<wsp><DEF|SET|INFO>]	
Description	Query the ED pattern digital level logic	
Parameters	**DEF**: Return the default power-on value	
	SET: (default) Returns the current SET value	
	INFO: Provide a description of what the return values represent	
Response	An integer indicating the current set digital level logic.	
Example	:SENSe1:PATTern1:LOGic? INFO -> 0:HIGH,POSITIVE 1:LOW,NEGATIVE	

Command	**:SENSe<n>:PATTern<m>:LOGic**	Summary >>
Syntax	:SENSe<n>:PATTern<m>:LOGic<wsp><0|NEGative|LOW|1|POSitive|HIGH|DEF>	
Description	Set the ED pattern digital level logic	
Parameters	**NEGative|LOW**: Set to the positive logic	
	POSitive|HIGH: Set to the negative logic	
	DEF: Restore the default value	
Response	N/A	
Example	:SENSe1:PATTern2:LOGic NEG	

Command	**:SENSe<n>:PATTern<m>:TYPE?** Summary >>
Syntax	:SENSe<n>:PATTern<m>:TYPE?<wsp><DEF|SET|LIST|ALL|INFO|LINKED>
Description	Query the ED pattern type
Parameters	**DEF**: Returns the default power-on value
	SET: (default) Returns the current SET value
	LIST: Returns the list of discrete options for configurable values (if available)
	ALL: Returns the values specified by the DEF, SET and LIST parameters in the format <DEF>,<SET>,<LIST>
	INFO: Provide a description of what the return values represent
	LINKED: Return the linked channels
Response	A single integer value, or a comma separated integer array.
Example	:SENSe1:PATTern2:TYPE? LIST -> 0,1,2,3,4,5,6

Command	**:SENSe<n>:PATTern<m>:TYPE** Summary >>
Syntax	:SENSe<n>:PATTern<m>:TYPE<wsp><value|DEF>
Description	Set the ED pattern type
Parameters	**value**: Set to the desired pattern
	DEF: Restore the default value
Response	N/A
Example	:SENSe1:PATTern2:TYPE 0

Command	**:SENSe<n>:PATTern<m>:EINJect** Summary >>
Syntax	:SENSe<n>:PATTern<m>:EINJect
Description	Add a small random burst of errors into the ED measurement (Error injection)
Parameters	N/A
Response	N/A
Example	:SENSe1:PATTern2:EINJect

Command	**:SOURce<n>:PATTern<m>:DEEMphasis?** Summary >>
Syntax	:SOURce<n>:PATTern<m>:DEEMphasis?[<wsp><MIN|MAX|DEF|SET|LIST|ALL|UNIT>]
Description	Query the pattern de-emphasis
Parameters	**MIN**: Returns the minimum configurable value
	MAX: Returns the maximum configurable value
	DEF: Returns the default power-on value
	SET: (default) Returns the current SET value
	LIST: Returns the list of discrete options for configurable values (if available)
	ALL: Returns the values specified by the MIN, MAX, DEF, SET and LIST parameters in the format <MIN>,<MAX>,<DEF>,<SET>,<LIST>
	UNIT: Returns the default unit for this value
Response	A single value, or a comma separated array.
Example	:SOURce1:PATTern2:DEEMphasis? -> 0.9

Command	**:SOURce<n>:PATTern<m>:DEEMphasis** Summary >>
Syntax	:SOURce<n>:PATTern<m>:DEEMphasis<wsp><value|MIN|MAX|DEF>
Description	Set the pattern de-emphasis
Parameters	**value**: Set the desired new set point
	MIN: Set to the minimum value
	MAX: Set to the maximum value
	DEF: Restore the default value
Response	N/A
Example	:SOURce1:PATTern2:DEEMphasis 1.9

Command	**:SOURce<n>:PATTern<m>:DEEMphasis:CURSor?** Summary >>
Syntax	:SOURce<n>:PATTern<m>:DEEMphasis:CURSor?[<wsp><DEF|SET|LIST|ALL|INFO>]
Description	Query the pattern de-emphassis cursor
Parameters	**DEF**: Returns the default power-on value
	SET: (default) Returns the current SET value
	LIST: Returns the list of discrete options for configurable values (if available)
	ALL: Returns the values specified by the DEF, SET and LIST parameters in the format <DEF>,<SET>,<LIST>
	INFO: Provide a description of what the return values represent
Response	A single integer value, or a comma separated integer array.
Example	:SOURce1:PATTern1:DEEMphasis:CURSor? ->0 :SOURce1:PATTern1:DEEMphasis:CURSor? INFO -> 0:POST 1:PRE

Command	**:SOURce<n>:PATTern<m>:DEEMphasis:CURSor** Summary >>
Syntax	:SOURce<n>:PATTern<m>:DEEMphasis:CURSor<wsp><0|POST|1|PRE|DEF>
Description	Set the pattern de-emphasis cursor
Parameters	**PRE**: Set to pre-cursor
	POST: Set to post-cursor
	DEF: Restore the default value
Response	N/A
Example	:SOURce1:PATTern2:DEEMphasis:CURSor POST

Command	**:SOURce<n>:PATTern<m>:LOGic?**	Summary >>
Syntax	:SOURce<n>:PATTern<m>:LOGic?[<wsp><DEF|SET|ALL|LIST|INFO>]	
Description	Query the data pattern level logic	
Parameters	**DEF**: Returns the default power-on value	
	SET: (default) Returns the current SET value	
	LIST: Returns the list of discrete options for configurable values (if available)	
	ALL: Returns the values specified by the DEF, SET and LIST parameters in the format <DEF>,<SET>,<LIST>	
	INFO: Provide a description of what the return values represent	
Response	An integer indicating the pattern level logic.	
Example	:SOURce1:PATTern1:LOGic? -> 1 :SOURce1:PATTern1:LOGic? INFO -> 0:HIGH,POSITIVE 1:LOW,NEGATIVE	

Command	**:SOURce<n>:PATTern<m>:LOGic**	Summary >>
Syntax	:SOURce<n>:PATTern<m>:LOGic<wsp><0|NEGative|LOW|1|POSitive|HIGH|DEF>	
Description	Set the data pattern digital logic level	
Parameters	**value**: Set to the desired new set point	
	DEF: Restore the default value	
Response	N/A	
Example	:SOURce1:DATA2:LOGIc POSITIVE	

Command	**:SOURce<n>:PATTern<m>:TYPE?**	Summary >>
Syntax	:SOURce<n>:PATTern<m>:TYPE?<wsp><MIN|MAX|DEF|SET|LIST|ALL|INFO|LINKED>	
Description	Query the pattern type	
Parameters	**DEF**: Returns the default power-on value	
	SET: (default) Returns the current SET value	
	LIST: Returns the list of discrete options for configurable values (if available)	
	ALL: Returns the values specified by the DEF, SET and LIST parameters in the format <DEF>,<SET>,<LIST>	
	INFO: Provide a description of what the return values represent	
	LINKED: Return the linked channels	
Response	A single integer value, or a comma separated integer array.	
Example	:SOURce1:PATTern2:TYPE? -> 6	

Command	**:SOURce<n>:PATTern<m>:TYPE** Summary >>
Syntax	:SOURce<n>:PATTern<m>:TYPE<wsp><value|MIN|MAX|DEF>
Description	Set the pattern type
Parameters	**value**: Set the desired new set point
	MIN: Set to the minimum value
	MAX: Set to the maximum value
	DEF: Restore the default value
Response	N/A
Example	:SOURce1:PATTern2:TYPE PRBS9

10 Programming examples and applications

Remote communication with the CohesionSCPI service is achieved through the Standard Commands for Programmable Instruments (SCPI).

Support for VISA I/O API over TCP/IP is provided by the VXI-11 compliant CohesionSCPI service. With VISA communication drivers installed on the client, the implementation of VISA programming within environments such as MATLAB becomes available.

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

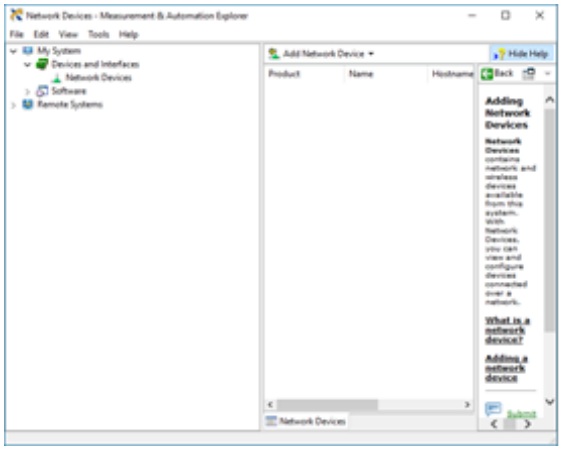
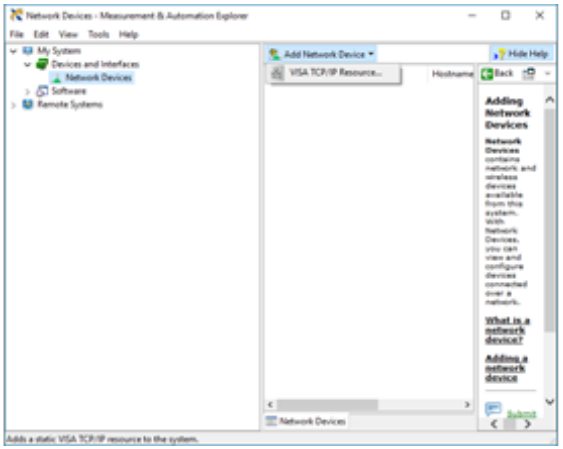
NOTE

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

10.1 Setting up NI-MAX application

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

1. After installing NI-MAX, launch the application. In the left side panel of the window, click the **Devices and Interfaces** option. A drop down of available instruments detected will show up.
2. Click on **Network Devices**, then click **Add Network Devices** and select **VISA TCP/IP Resource**.

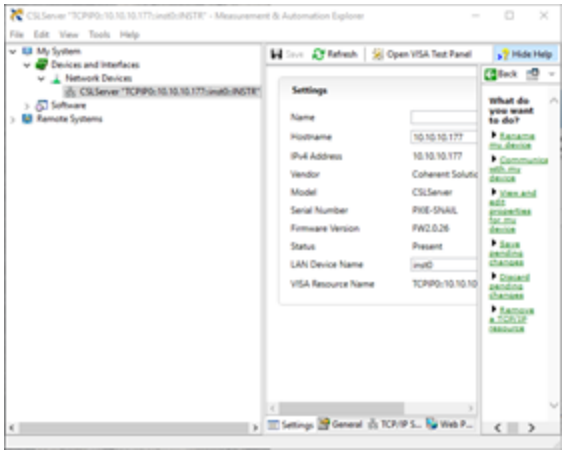



3. Select **Manual Entry of LAN Instrument**. Enter in the Hostname or IP Address.
   Note when operating locally, enter in the localhost IP address of **127.0.0.1**. Click **Finish** to end the setup process.

10.2 Setting up NI-VISA application

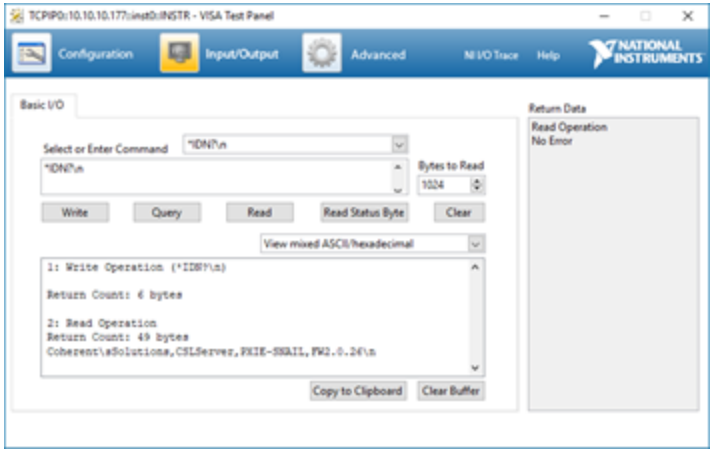
NI-VISA is used to communicate with the PXIe chassis or installed modules / instruments. The above steps must be completed before attempting to communicate using NI-VISA.

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



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

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



10.3 Python® code example

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

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

10.4 MATLAB® code example

To communicate with the Quantifi Photonics product in MATLAB® the installation of a VISA IO driver is required. These drivers enable the creation of the Interface Object for instrument communication.

If developing locally on the PXIE Platform, then these will already be installed. However, if development is on a remotely connected system the VISA Libraries, e.g. National Instruments NI-VISA will have to be installed.

NOTE

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

The following example shows how to communicate with a Quantifi Photonics product using MATLAB code.

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

11 System requirements

Quantifi Photonics PXIe modules

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

Quantifi Photonics MATRIQ / EPIQ instruments

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

12 Maintenance

To help ensure long, trouble-free operation:

- Always inspect cable connectors before using and clean them if necessary.
- Keep the unit free of dust.
- Always cover unused RF input connectors with the supplied anti-static plastic covers or with 50Ω terminators to prevent accidental ESD or EOS damage.
- Store the unit at room temperature in a clean and dry area. Keep the unit out of direct sunlight.
- Avoid high humidity or significant temperature fluctuations.
- Avoid unnecessary shocks and vibrations.
- If any liquids are spilled on or into the unit, power off the chassis immediately. Remove the unit and allow to dry completely.

WARNING

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

12.1 Annual calibration schedule

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

All Quantifi Photonics products are calibrated during manufacture, and each product is shipped to the customer with a Calibration Certificate. On this certificate, the calibration date, as well as the next calibration due date are mentioned.

We recommend your product is returned for re-calibration before the listed due date, to ensure continued performance of the product. For re-calibration service information, or to send in a product for re-calibration service, email support@quantifiphotonics.com.

If the Calibration Certificate has been misplaced, or the calibration due date is not known, email support@quantifiphotonics.com.

13 Technical Support

13.1 Contacting the Technical Support Group

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

support@quantifiphotonics.com

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

13.2 Transportation

Maintain a temperature range within specifications when transporting the unit.

Transportation damage can occur from improper handling.

The following steps are recommended to minimize the possibility of damage:

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

14 Warranty Information

14.1 General information

Quantifi Photonics Ltd (Quantifi Photonics) warrants from the date of the original shipment (the Warranty Period) that this product will conform to specifications and will be free from defects in material and workmanship for the applicable Warranty Period. Quantifi Photonics also warrants that the equipment will meet applicable specifications under normal use.

NOTE

The warranty can become null and void if:

- The unit has been tampered with, repaired, or worked upon by unauthorized individuals or non-Quantifi Photonics personnel.
- The warranty sticker has been removed.
- The unit has been opened, other than as explained in this guide.
- The unit serial number has been altered, erased, or removed.
- The unit has been misused, neglected, or damaged by accident.

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

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

14.2 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.

14.3 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.

14.4 Certification

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

14.5 Service and repairs

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

QUANTIFI PHOTONICS®
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Test. Measure. Solve.™

Quantifi Photonics is transforming the world of photonics test and measurement. Our portfolio of optical and electrical test instruments is rapidly expanding to meet the needs of engineers and scientists around the globe. From enabling ground-breaking experiments to driving highly efficient production testing, you'll find us working with customers to solve complex problems with optimal solutions.

To find out more, get in touch with us today.

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