QUANTIFI PHOTONICS™

OSA

1000 Series

Optical Spectrum Analyzer

MATRIQ User Manual

quantifiphotonics.com

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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.

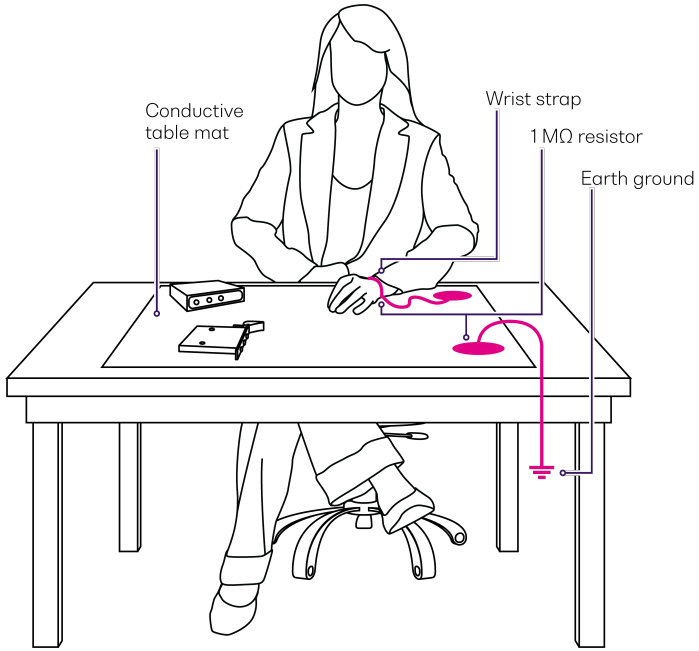
This symbol on the unit refers to documentation provided with the product for related safety information. Ensure that the required conditions are met and understood before using the product.

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 OSA 1000 Series

The OSA 1000 Series enables cost-effective spectral test and measurement in a compact form factor. The OSA is grating-based and is designed for efficient, space saving performance where space and time are critical. It is an excellent fit for fully automated production testing of optical sources, amplifiers, transceivers, and passive optical components.

Programming interfaces

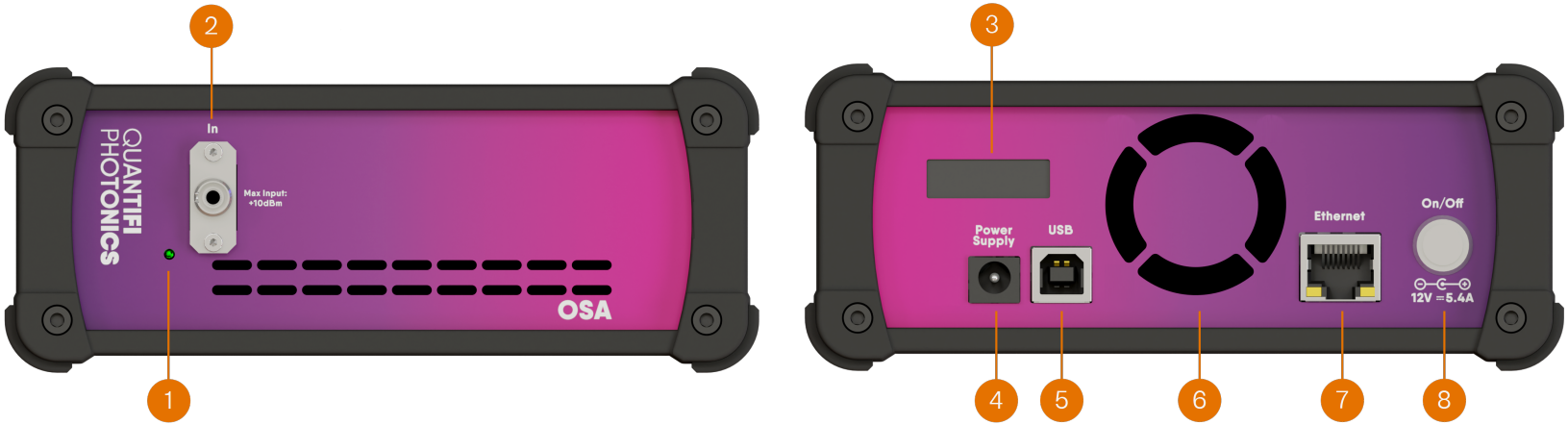
Through its programming interfaces you can take advantage of the SCPI-compliant command language and choose from programming tools such as LabView, C++, Python, or any of the other popular programming languages used to control automatic test equipment (ATE).

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.

> Product images in this user manual show examples of the OSA 1000 product range. Appearance and dimensions as well as the rear panel layout of your instrument may vary, but this will not affect factory specifications.

4.1 Hardware description



Front		Rear	
1	Status LED	3	IP address LCD screen
2	Input optical port	4	Power supply port
		5	USB type B port
		6	Ventilation fan (DO NOT OBSTRUCT)
		7	Ethernet port
		8	On / Off push button

4.2 Status LEDs

The LED shows the status of the channel:

LED	Meaning
OFF	Product is powered OFF
solid GREEN	Product is powered ON

5 Setting up hardware

Follow the instructions in this section when setting up your instrument.

⚠ CAUTION

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

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

⚠ CAUTION

Skin contact may leave corrosive residue and damage a connector:

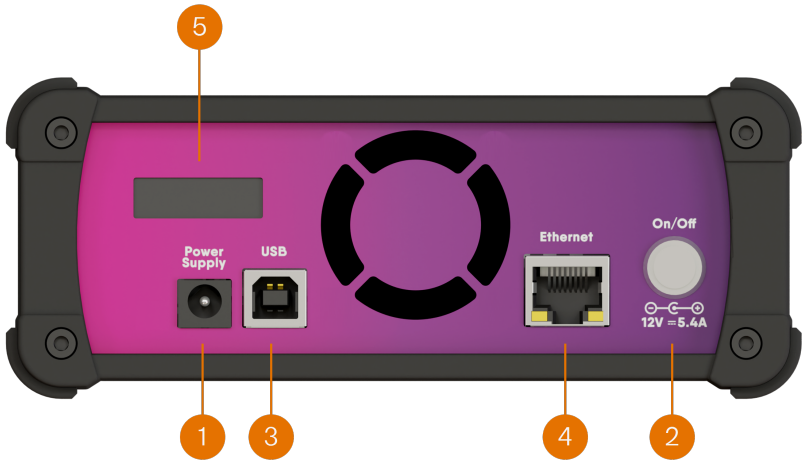
> Always clean optical end faces before mating.

NOTE

- You must use the external power supply that has been supplied by Quantifi Photonics with the unit. Any attempt to use a different external power supply may cause product damage and will void your warranty.
- The external power supply that has been supplied with the unit can only be used with that unit. Do not use it with any other product.
- DO NOT attempt to remove or adjust any component of the product while the power is on. Ensure the product is powered OFF, and that the correct handling procedure detailed herein is followed when you remove or install any products.
- Please check for the fiber end-face type of the optical ports, such as PC or APC, and only use the same type optical connector to avoid damaging the end-face.

For advice on connector and fiber care, please refer to Working with optical fibers.

5.1 Set up your OSA 1000 Series product and power ON



▶ To set up your instrument and power ON:

To allow for optimal air flow and avoid thermal issues, do not block the ventilation fans in the front and back of the instrument and set up your instrument with a minimum clearance of 2 inches (50.8mm) around it.

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

   OR

4. Connect to your network or client computer using an Ethernet cable.
5. The instrument IP address will appear on the LCD screen. When the unit is connected via both Ethernet and USB cable, both the Ethernet and USB IP addresses are displayed.

After powering ON, please wait at least **1 minute** before attempting to communicate with the unit. This gives the unit time to finish boot procedures and initialize the communication server.

If a query is sent to the OSA before initialization has successfully completed, it will return an array of zeroes (0).

5.2 Instrument IP address

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

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

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

To view an instrument's IP address:

With your instrument powered ON, you can view the current IP address on the LCD display.

If your instrument is connected with both, Ethernet and USB cables, both the USB and Ethernet IP address are displayed.

To change an instrument's IP address:

You can change the instrument's static USB IP address and you can assign a static Ethernet IP address using CohesionUI.

Multi-instrument control

If you have several Quantifi Photonics instruments with static IP addresses on your network, make sure to assign a unique IP address to each instrument before connecting.

For details, refer to Change the instrument IP address.

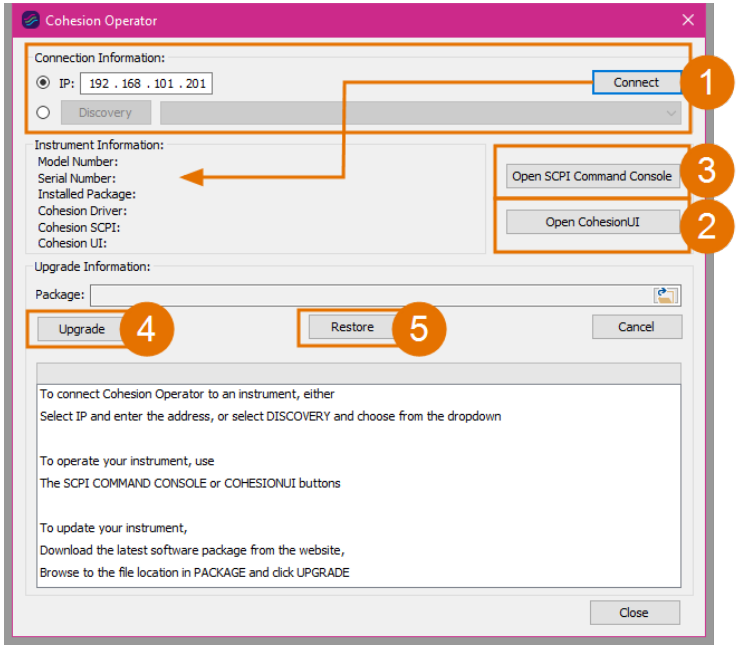
6 Installing software

To work with Quantifi Photonics MATRIQ and EPIQ instruments, you need to install the latest version of the **Cohesion Operator** software package on any computer that you use to connect with your instrument (client computer).

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

Cohesion Operator enables you to:

1. **Connect** with MATRIQ and EPIQ instruments that are available on your network to retrieve instrument information and validate the instrument's IP address.
2. Access an instrument using **CohesionUI**, a web-based graphical user interface.
3. Work with an instrument using the **SCPI Command Console**.
4. Upgrade instrument **firmware**.
5. Restore an instrument to **factory settings**.



6.1 Install the Cohesion Operator software package

▶ To install the software package on a client computer:

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

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

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

Multi-instrument control

If another Quantifi Photonics instrument is already connected to the client computer via USB, make sure each instrument has a unique USB IP address to avoid any addressing conflicts.

▶ To open the Cohesion Operator application:

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

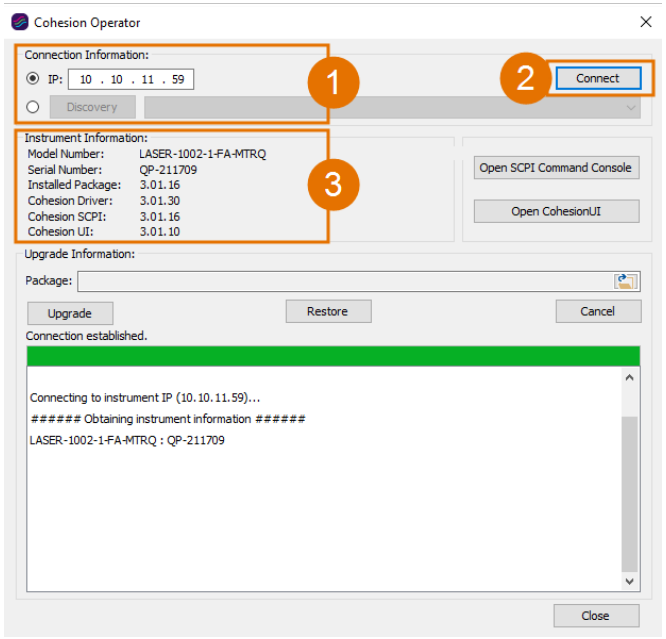
6.2 Check firmware version and other information

Using Cohesion Operator, you can check the firmware version and other details of MATRIQ and EPIQ instruments that are available on your network.

▶ To check details in Cohesion Operator:

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

   Installed Package refers to the currently loaded firmware version.

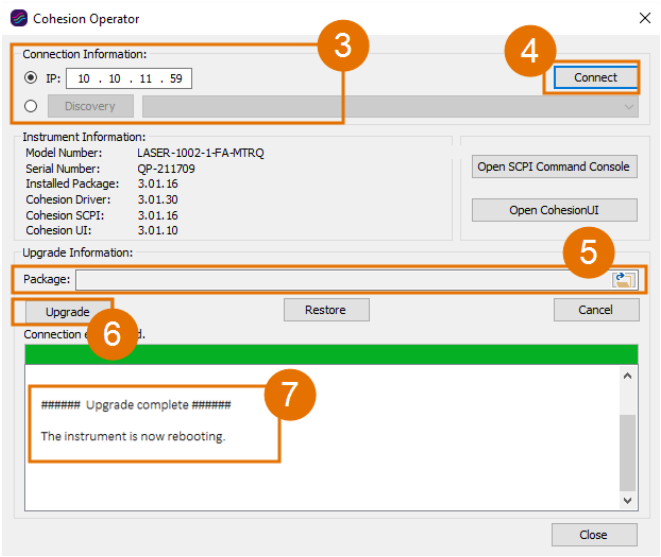


6.3 Upgrade firmware

We recommend that you upgrade firmware via a USB connection to prevent possible connection loss when using an Ethernet connection.

To upgrade an instrument with the latest firmware:

1. Get the latest MATRIQ firmware package **CohesionMATRIQ-<version>.qfw**, for example by downloading it from quantifiphotonics.com (go to **Resources > Drivers, software and manuals > MATRIQ Series**), and save it to your network.
2. Open the Cohesion Operator, for example by double-clicking the **Cohesion Operator** desktop icon.



3. Select the instrument by entering its **IP address** or by selecting it from the **Discovery** drop down list.
4. To confirm that you have selected the correct instrument, click **Connect**.
   This will retrieve instrument information, with **Installed Package** showing the current firmware version.
5. In **Package**, click the Browse button, navigate to the previously downloaded firmware package and select it.
6. Click **Upgrade**.
   The instrument will be upgraded to the selected firmware package. This can take a few minutes and the instrument might reboot several times in the process.
7. A message shows when the upgrade is complete.

To verify the new firmware version, click **Connect** (4) to retrieve the latest instrument information.

NOTE

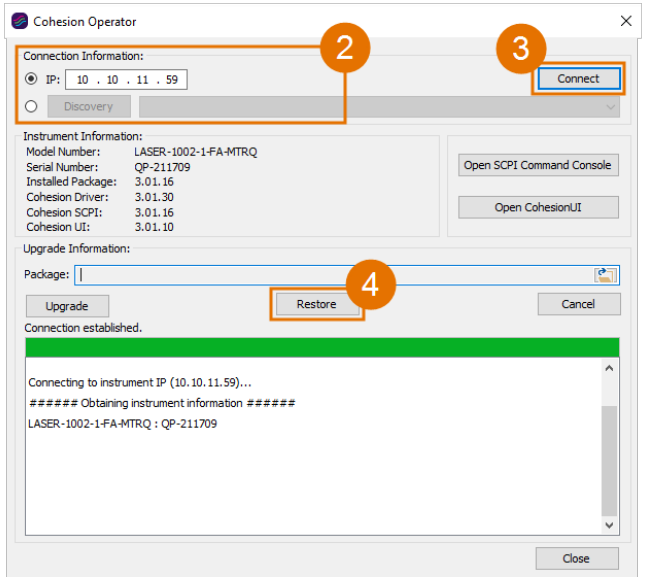
If an upgrade attempt is unsuccessful, the Cohesion Operator will stop the upgrade process and restore the instrument to its previous firmware version. Messages will be displayed accordingly.

6.4 Restore factory settings

We recommend that you restore factory settings via a USB connection to prevent possible connection loss when using an Ethernet connection.

▶ To restore factory settings:

1. Open the Cohesion Operator, for example by double-clicking the **Cohesion Operator** desktop icon.



2. Select the instrument by entering its **IP address** or by selecting it from the **Discovery** drop down list.
3. To confirm that you have selected the correct instrument, click **Connect**.
   This will retrieve instrument information, with **Installed Package** showing the current firmware version.
4. Click **Restore**.
   The instrument will be returned to factory settings, including IP address settings.

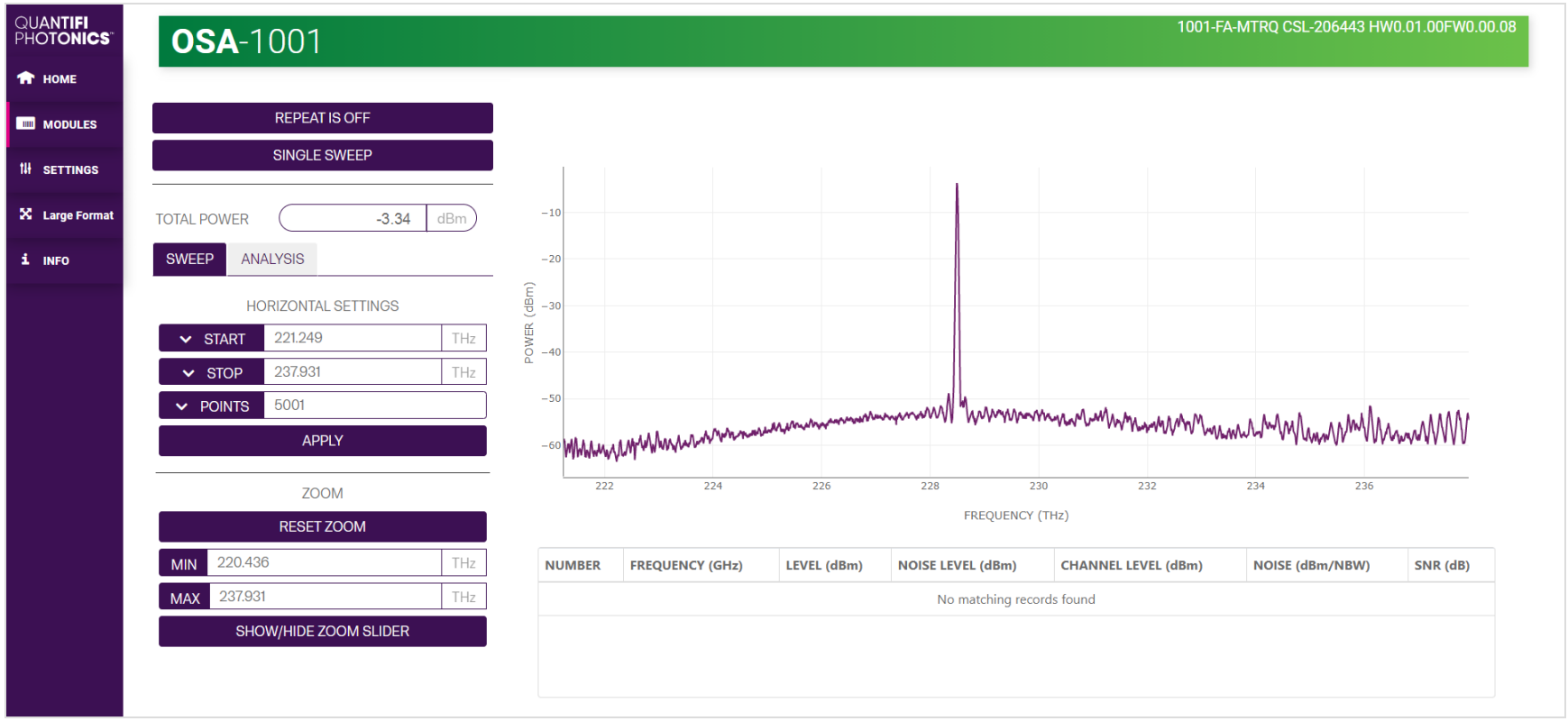
7 CohesionUI - Overview

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

> CohesionUI is part of the MATRIQ firmware package running on your Quantifi Photonics instrument.

From the menu on the left you can navigate to the following pages:

1. **HOME**: This is your main page. From here you can access all controls for your instrument
2. **SETTINGS**: Here you can change CohesionUI settings and/or instrument IP address
3. **INFO**: Here you can display instrument information, e.g. model number and firmware version



7.1 Access instruments with CohesionUI

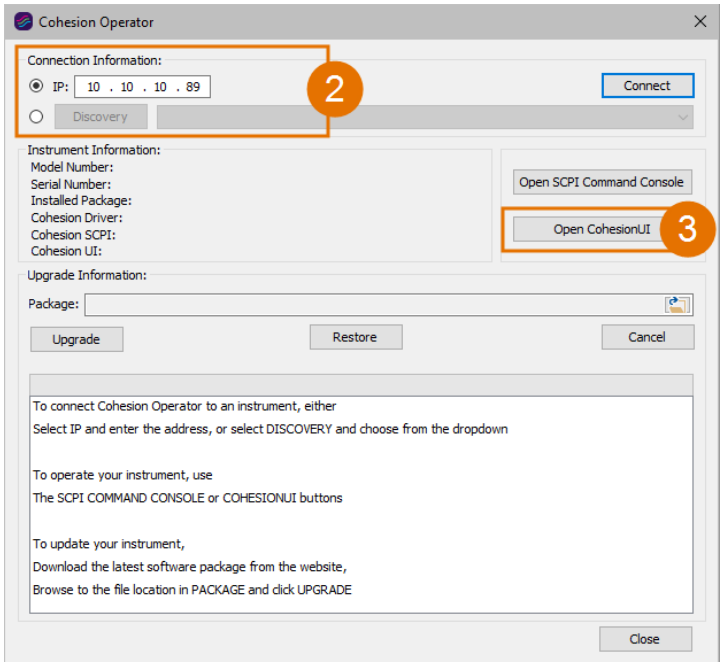
You can open CohesionUI for Quantifi Photonics MATRIQ and EPIQ instruments:

- from Cohesion Operator, or
- in a supported browser by entering the instrument IP in the address bar.

> To open CohesionUI, you need the IP address of the instrument. For details, refer to the Instrument IP address section.

▶ To open CohesionUI from Cohesion Operator:

1. Open **Cohesion Operator** on a client computer, for example by double-clicking the Cohesion Operator desktop icon
2. Select the instrument by entering its **IP address** or by selecting it from the **Discovery** dropdown.
3. Click **Open CohesionUI**.
   CohesionUI will open in your standard browser.



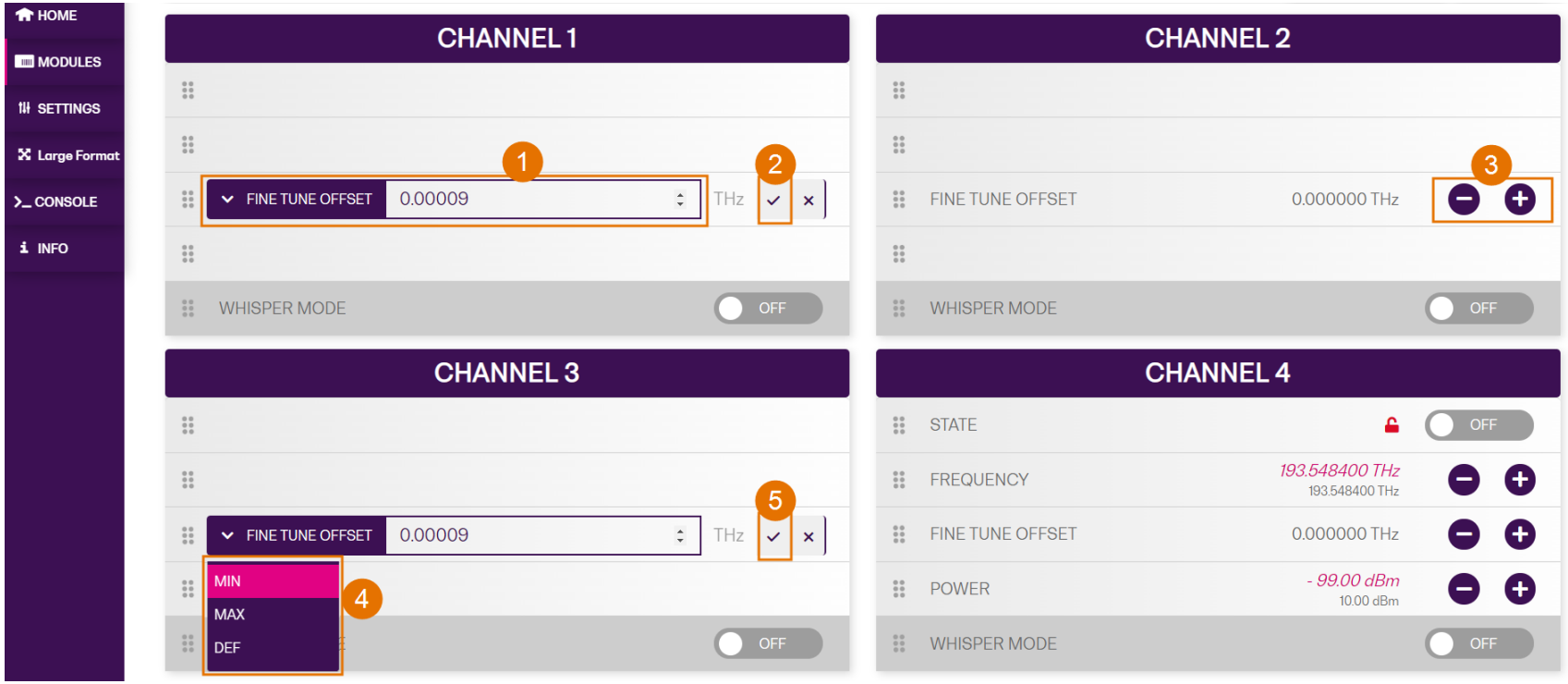
To open CohesionUI in a browser:

1. Launch a supported **browser**.
2. Enter the instrument **IP address** in the address bar.
   CohesionUI will launch in the browser.

7.2 Set values

In CohesionUI you can set values for parameters where applicable.

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

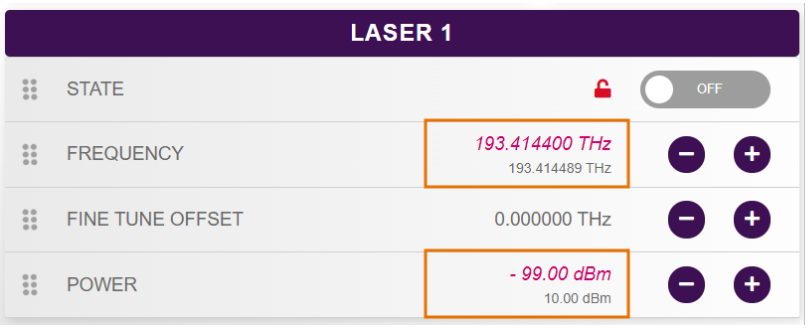


For details on how to change the step size, refer to Manage CohesionUI settings.

7.3 SET values and ACTUAL values

In some cases you can manually set a value that will be displayed alongside the actual value as follows:

- ***ACTUAL***: The actual value of the parameter as queried by the product.
- SET: The intended value of a given parameter as set by the user.



7.4 Manage CohesionUI settings

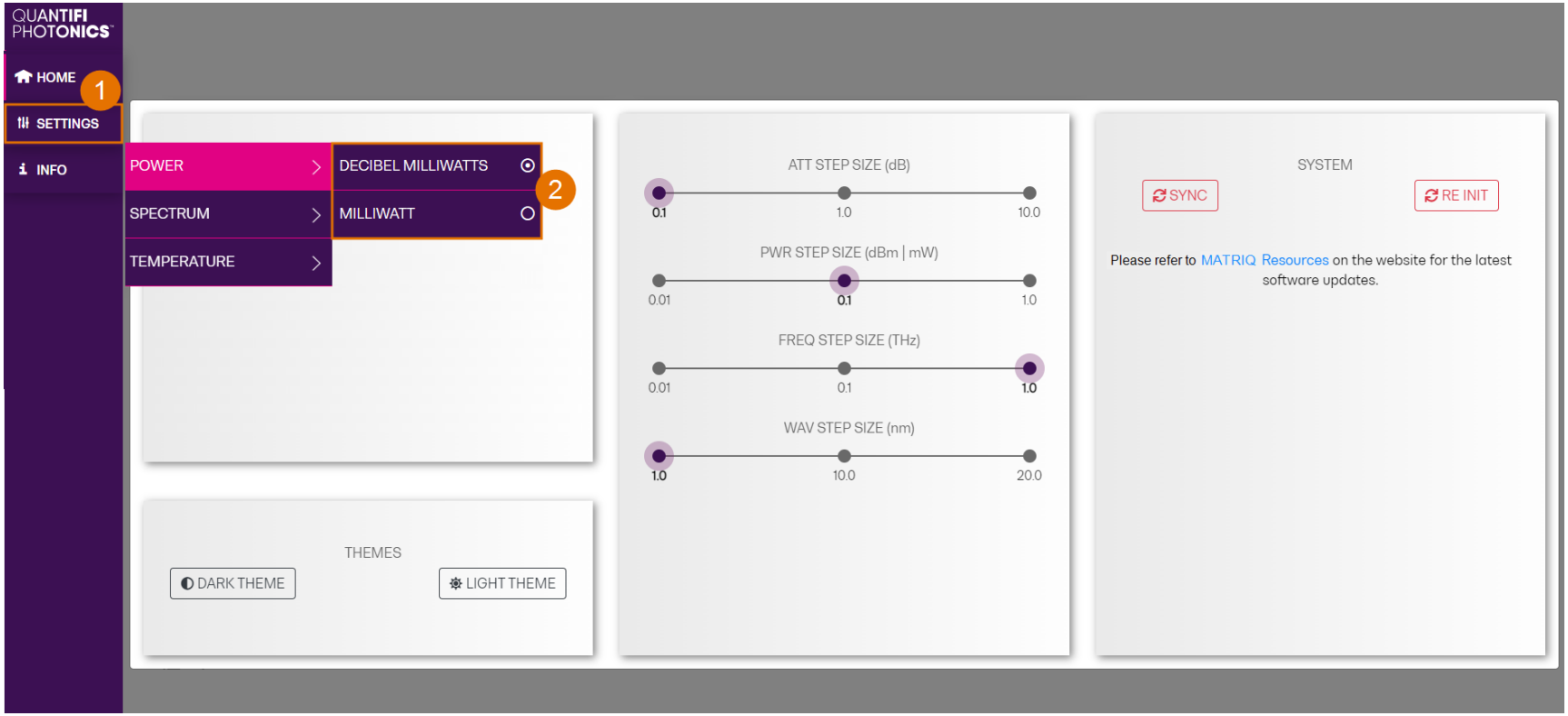
On the **SETTINGS** page you can configure CohesionUI settings and unit preferences.

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

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

To adjust unit preferences one at a time:

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



7.5 Change the instrument IP address

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

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

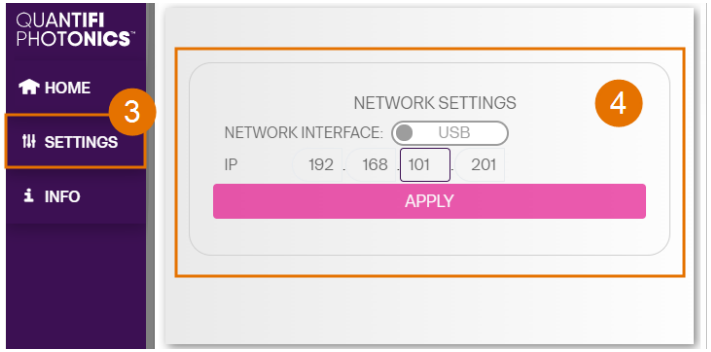
You can change the instrument's static USB IP address, and assign a static Ethernet IP address if required.

Multi-instrument control

If you have several Quantifi Photonics instruments with static IP addresses on your network, make sure to assign a unique IP address to each instrument before connecting.

▶ To change the **USB IP address**:

1. Connect with the instrument from a client computer via USB. Ensure that this is the only Quantifi Photonics instrument currently connected via USB.
2. Open CohesionUI using the currently assigned USB IP address.
3. Go to **SETTINGS**.
4. In **NETWORK SETTINGS**:
   - Select **Network Interface: USB**.
   - In **IP**, the currently assigned IP address is displayed. Enter the new IP address by changing the **3rd octet** of the IP address.
     To avoid any addressing conflicts, make sure that this is a unique IP address that is not shared with any other instrument on the network.
   - Click **APPLY**. The new IP address will show in CohesionUI and on the display.



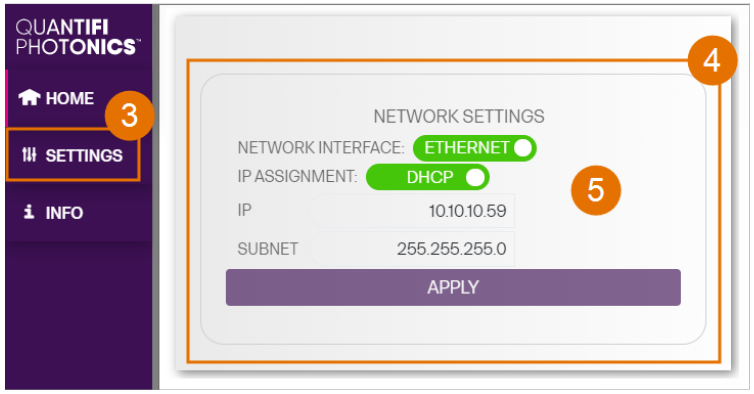
To change the **Ethernet IP address**:

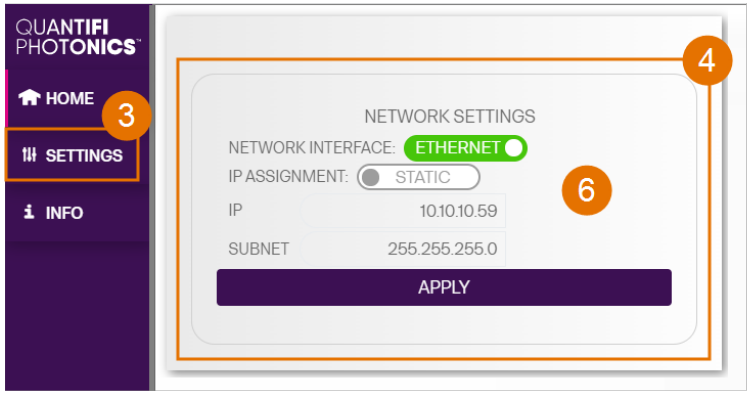
1. Connect with the instrument from a client computer via USB. Ensure that this the only Quantifi Photonics instrument currently connected via USB.
2. Open CohesionUI using the currently assigned USB IP address.
3. Go to **SETTINGS**.
4. In **NETWORK SETTINGS**, select **Network Interface: Ethernet**.
5. Select **IP ASSIGNMENT: DHCP** to enable the DHCP to automatically assign the Ethernet IP address (this is the default setting) and click **APPLY**.

   OR

6. Select **IP ASSIGNMENT: STATIC** to assign a static Ethernet IP address.
   Enter the new IP address by changing the **3rd octet** of the IP address and click **APPLY**.
   To avoid any addressing conflicts, make sure that this is a unique IP address that is not shared with any other instruments on the network.

   The new IP address will show in CohesionUI and on the display.



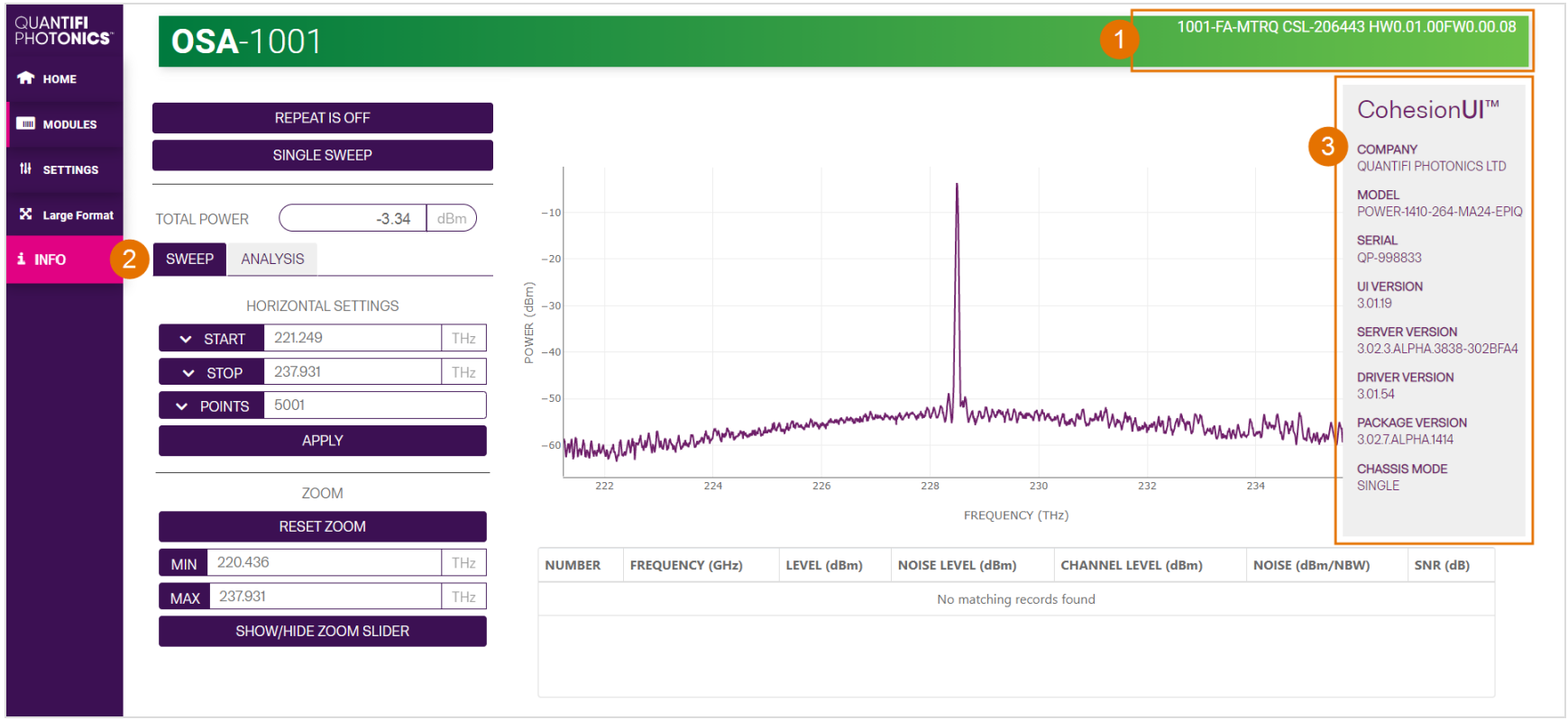


7.6 View system information

You can easily access instrument information, for example the model number and firmware version.

- To display instrument information in CohesionUI:

1. Refer to the top right corner in CohesionUI.
2. For more details, click **INFO** to display the information panel.
3. The information panel lists the instrument's serial number, and software and firmware versions.

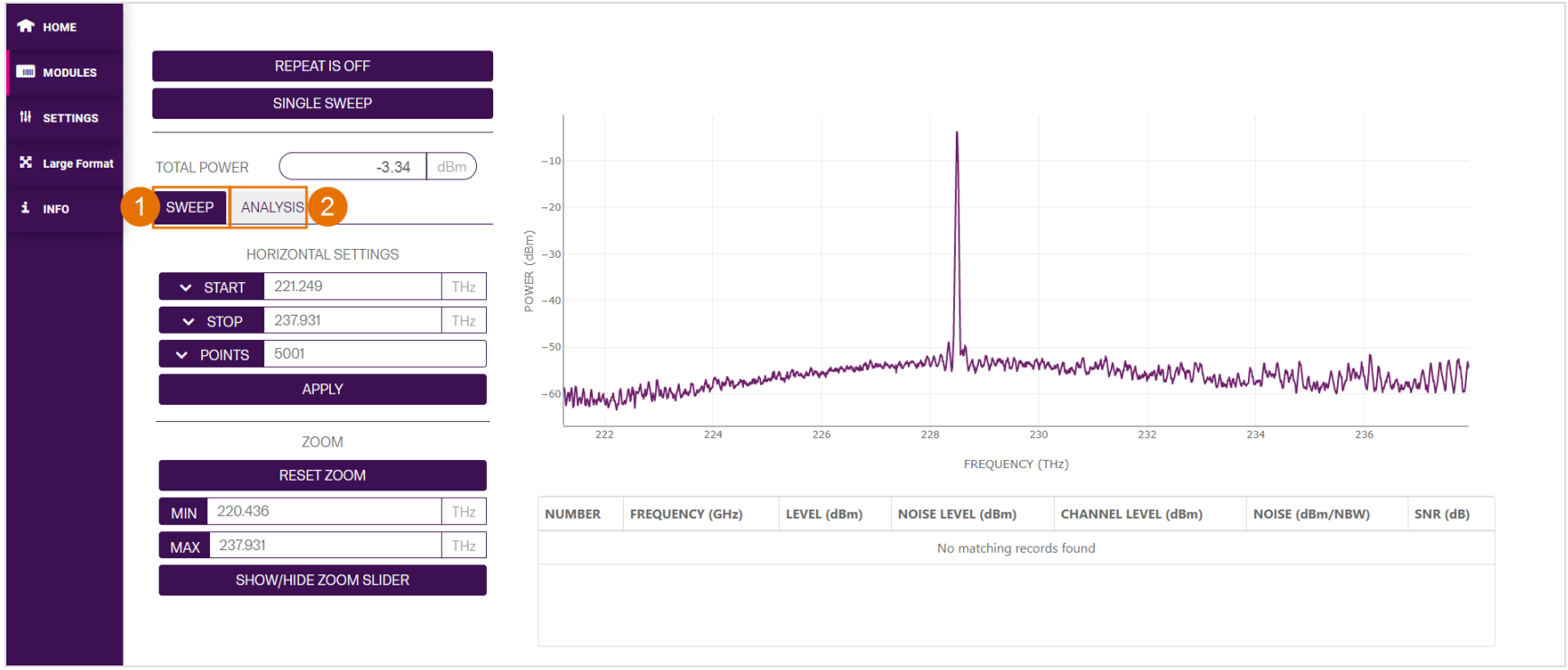


8 Controlling your OSA with CohesionUI

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

In CohesionUI you can control:

1. OSA sweep settings
2. OSA analysis settings



8.1 OSA sweep settings

Parameters and settings in the **SWEEP** tab control the start and stop values, between which the spectrum of the optical input will be recorded. The spectrum can also be zoomed to show a specific section of the recorded spectrum, by clicking and dragging the desired area with the cursor.

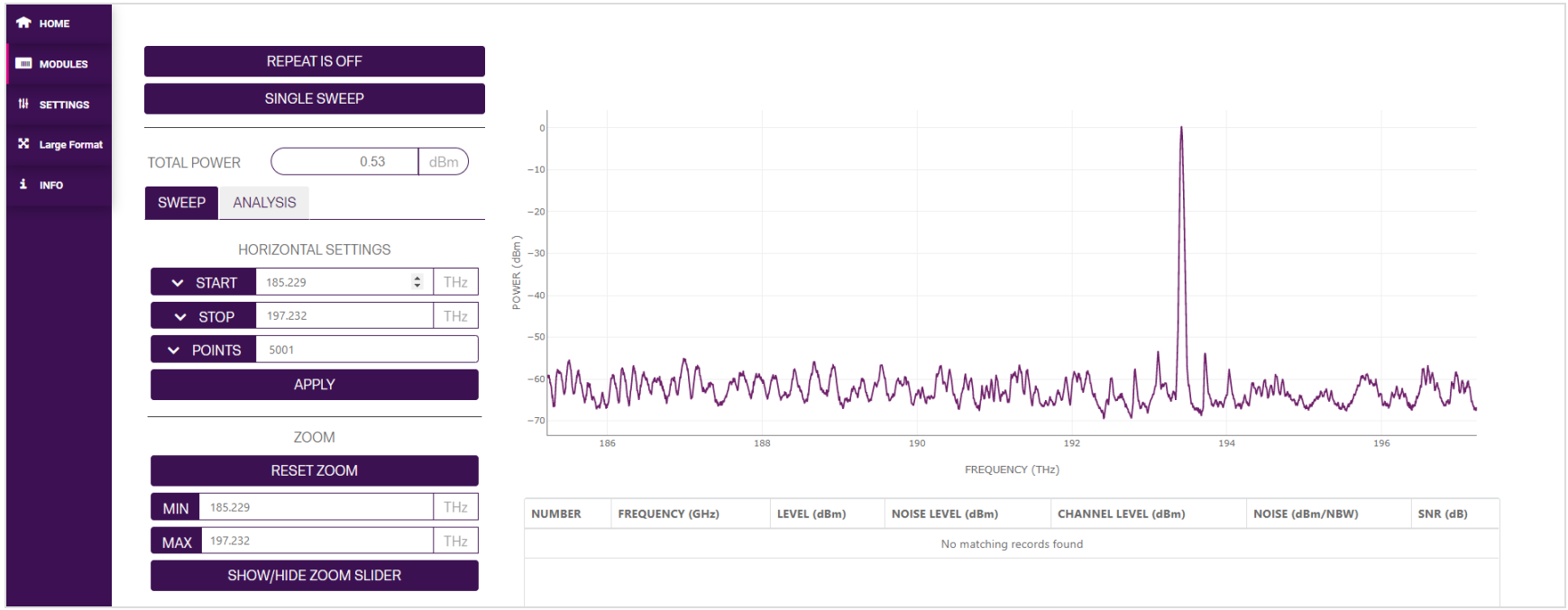
The sweep settings for an OSA can be entered manually into any parameter field, or by clicking the up and down arrow buttons in the value field, to increment or decrement the value by a set amount. This step size is set in the **SETTINGS** menu. Alternatively, the parameter can also be set to the **MIN**, **MAX** or **DEFAULT** values by clicking the dropdown menu in the name of the parameter.

This applies to the following parameters:

- **START**: The frequency (wavelength) value that the OSA should begin scanning from.
- **STOP**: The frequency (wavelength) value that the OSA should stop scanning at.
- **POINTS**: The number of data points that the OSA will gather between the **START** and **STOP** frequencies (wavelengths).

The integrated power across the START / STOP bandwidth is displayed as the **TOTAL POWER**.

After setting the **START** and **STOP** frequency / wavelength values and the number of sweep **POINTS**, clicking **APPLY** will save the parameter values into memory and update the sweep settings of the OSA.



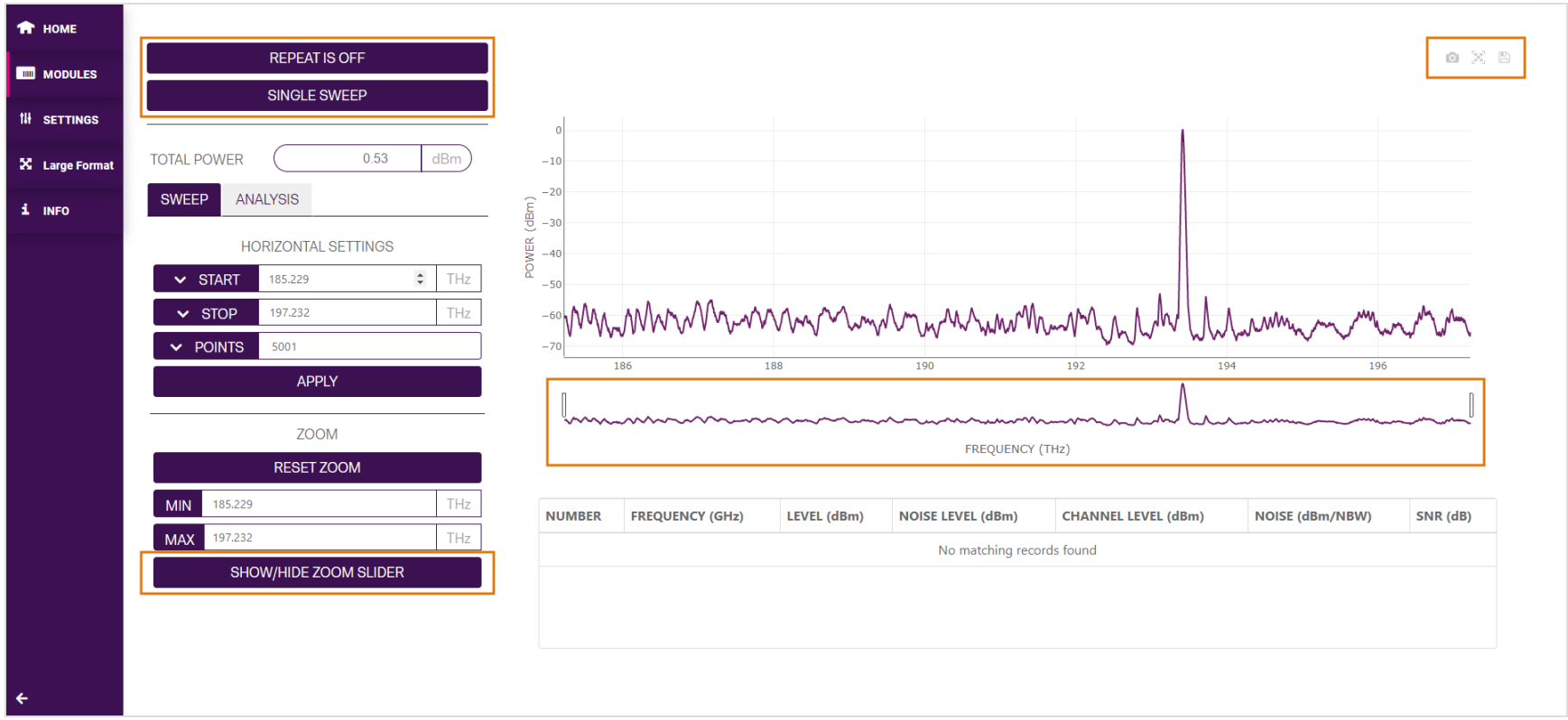
Clicking the **SINGLE SWEEP** button will conduct a single scan over the set frequency / wavelength span.

If a continuously repeating scan is desired, then clicking the **REPEAT IS OFF** toggle button will conduct repeated sweeps of the frequency / wavelength range, and the button will display **REPEAT IS ON** text.

By clicking **SHOW / HIDE ZOOM SLIDER** an interactive OSA trace is displayed below the main trace.

This second panel has two draggable bars at either end of the frequency / wavelength span, which can be moved to zoom the main trace view to a specific range.

Zooming does not change the actual START and STOP frequency / wavelength sweep values; it only changes the displayed trace.



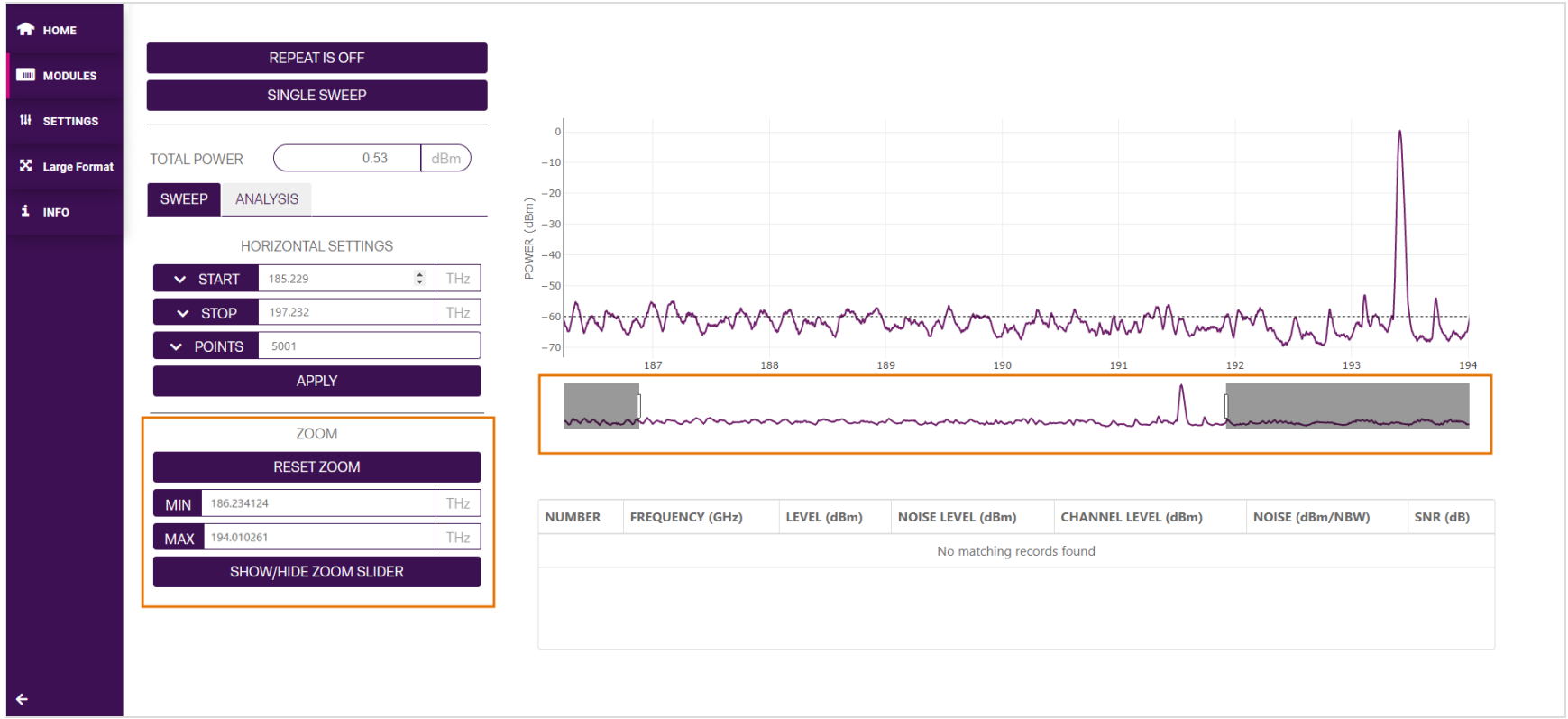
You can download the trace as a .png file, export a .csv file that lists Power (dBm), Wavelength (nm) and Frequency (THz) values of the trace, or autoscale the trace by using one of the options in the top right corner (available from Cohesion version 4.00.06).

The zoomed trace will show the zoom window by rendering a mask over the second OSA trace to illustrate the position of the zoom window.

When the interactive zoom bars are dragged around, their corresponding values are automatically populated into the **MIN** and **MAX** fields. These values denote the minimum and maximum frequency / wavelength values that form the zoom window. The values can be set to their minimum or maximum by clicking the parameter name. This will automatically change the display window to reflect the **MIN** / **MAX** values.

Clicking **RESET ZOOM** will revert the zoom window to the full frequency / wavelength span as defined in the SWEEP settings. Alternatively, clicking and dragging over the main trace window will also zoom the trace. Double clicking anywhere in the trace window will reset the zoom to the default view.

> The **MIN** and **MAX** values are limited by the **START** and **STOP** values that were set in the **SWEEP** settings. The OSA cannot zoom the display to a value outside the **START / STOP** range.



8.2 OSA analysis settings

Parameters and controls in the **ANALYSIS** tab allow the user to perform some processing on the OSA traces. These functions provide the user with analysis ability for the most common actions that are performed on OSA traces. Clicking the dropdown menu will display the following options:

- **OSNR** – Optical Signal to Noise Ratio
- **SMSR** – Side Mode Suppression Ratio
- **SPECTRAL WIDTH**
- **FIND PEAKS**

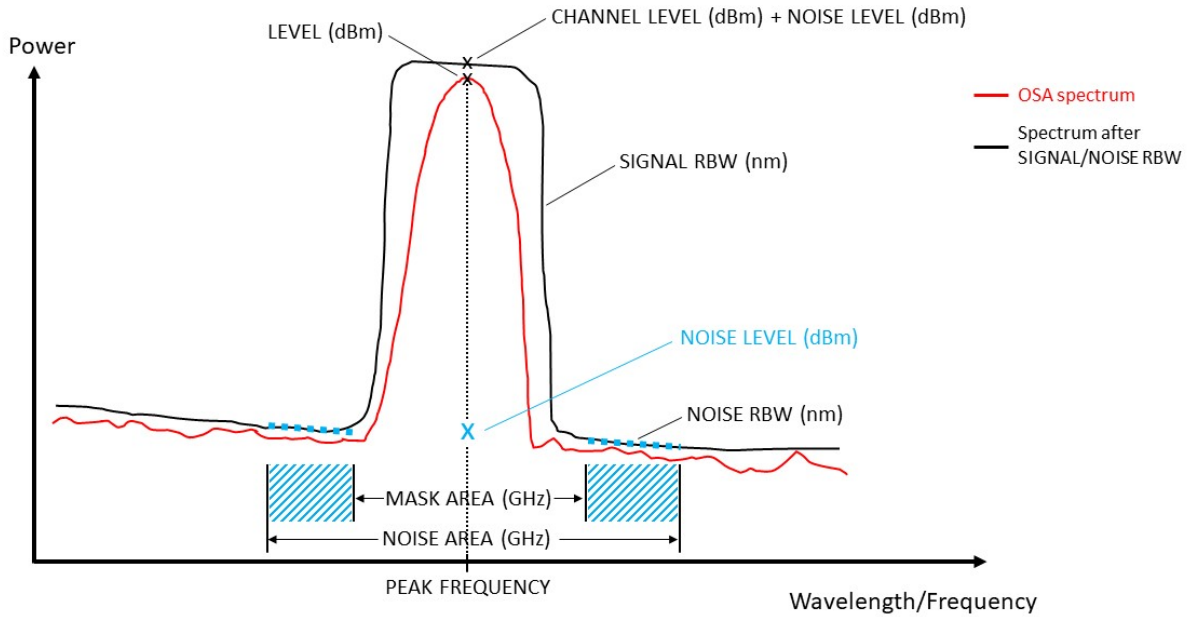
8.2.1 OSNR

The OSNR (Optical Signal to Noise Ratio) can be computed between all detected peaks and the average noise level of the OSA trace.

Parameters:

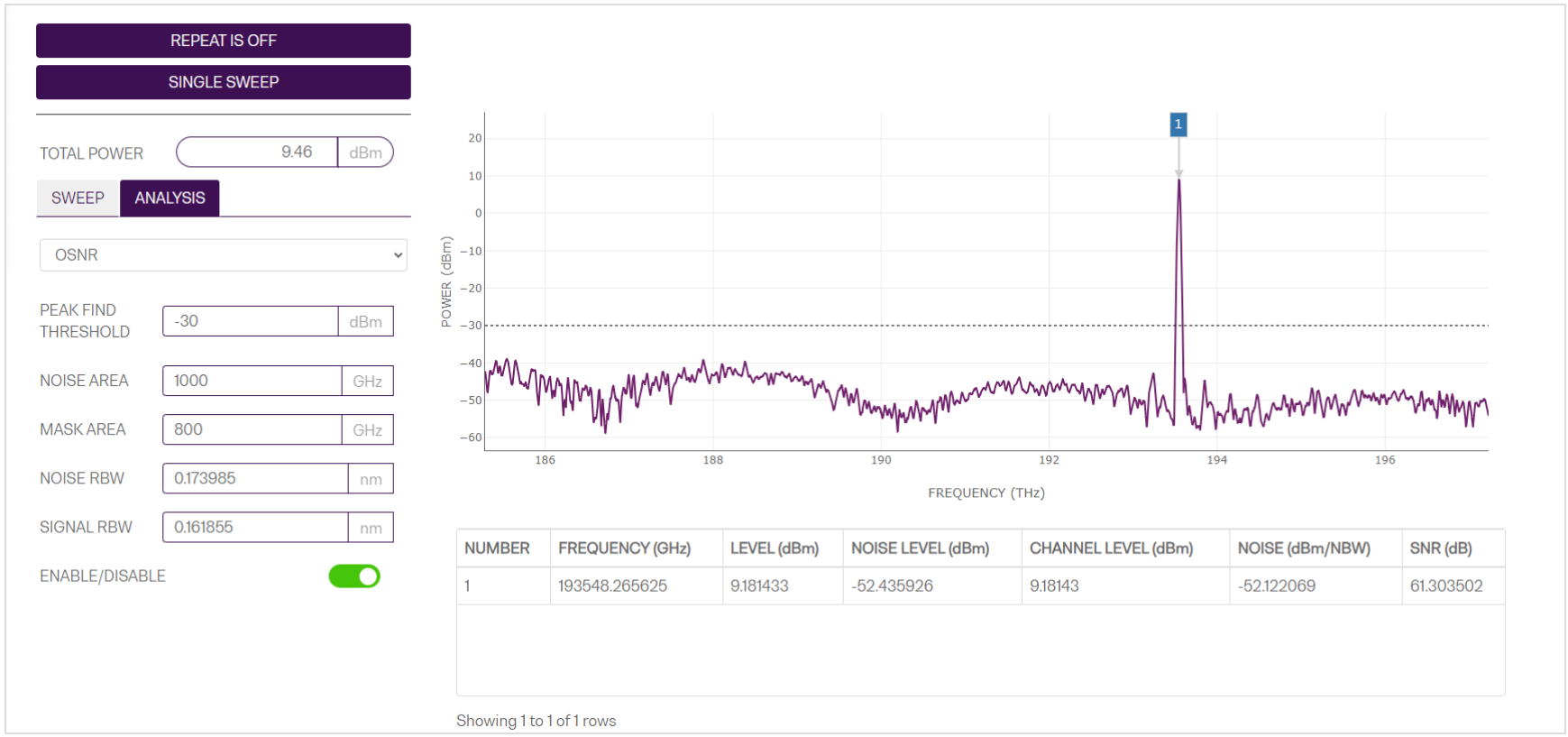
PEAK FIND THRESHOLD (dBm)	Power level above which the OSA will detect peaks. NOTE: If set close to the noise floor of the OSA, more peaks will be detected. If the threshold value is lower than the noise floor (so that the ratio of peak power to noise power is negative), an error will be returned, and no peaks will be detected at all. In this instance it is advisable to increase the threshold value.
NOISE AREA (GHz)	The **NOISE AREA (GHz)** is centered at the peak. By default, or if you enter a zero value, this value represents the full channel bandwidth (if only one peak is found), or the distance between adjacent peaks (if there are multiple peaks). The OSA rejects any side peaks in the **NOISE AREA (GHz)**. **NOISE AREA (GHz) excluding MASK AREA (GHz)** defines the part of the OSA trace that is used for calculating noise values.
MASK AREA (GHz)	The **MASK AREA (GHz)** is centered at the peak and defines the part of the OSA trace that is excluded from the **NOISE AREA (GHz)** for noise calcualations. By default, or if you enter a zero value, this value represents half of the noise area. If **MASK AREA (GHz) = NOISE AREA (GHz)**, the OSA will use the entire **NOISE AREA (GHz)** for noise calculations. If set **MASK AREA (GHz) > NOISE AREA (GHz)**, the OSA will decrease the **MASK AREA (GHz)** to equal the **NOISE AREA (GHz)**.

SIGNAL RBW (nm)	Signal resolution bandwidth. The bandwidth of the signal as measured 3dB below the peak value of the OSA filter response.
NOISE RBW (nm)	Noise resolution bandwidth. Determined by the width of the rectangle that represents the same area as the spectrum area of the OSA filter response at the **SIGNAL RBW (nm)**.
NUMBER	Refers to a detected peak
FREQUENCY (GHz)	Peak frequency
LEVEL (dBm)	Peak signal power, adjusted by set **SIGNAL RBW (nm)** for an integrated power value.
NOISE LEVEL (dBm)	Average noise power, calculated based on the noise power values within the set **NOISE AREA (GHz)** of the peak (excluding **MASK AREA (GHz)**).
NOISE (dBm/NBW)	Normalized noise power, adjusted for **NOISE RBW (nm) ≠ SIGNAL RBW (nm)**: $$\mathbf{NOISE}\ (dBm/NBW) = \mathbf{NOISE\ LEVEL}\ (\mathbf{dBm}) + 10 \times \log_{10}\left(\frac{\mathbf{NOISE\ RBW\ (nm)}}{\mathbf{SIGNAL\ RBW\ (nm)}}\right)$$
CHANNEL LEVEL (dBm)	Channel power at **SIGNAL RBW (nm)**. **CHANNEL LEVEL (dBm) = LEVEL (dBm) – NOISE (dBm/NBW)**
SNR (dB)	Optical signal to noise ratio **SNR=CHANNEL LEVEL (dBm)-NOISE (dBm/NBW)**


Power
LEVEL (dBm)
CHANNEL LEVEL (dBm) + NOISE LEVEL (dBm)
OSA spectrum
Spectrum after SIGNAL/NOISE RBW
SIGNAL RBW (nm)
NOISE LEVEL (dBm)
NOISE RBW (nm)
MASK AREA (GHz)
NOISE AREA (GHz)
PEAK FREQUENCY
Wavelength/Frequency

To analyze a scan:

- Set parameters: **PEAK FIND THRESHOLD**, **NOISE AREA** and **MASK AREA**.
- Apply the parameters by toggling the **ENABLE/DISABLE** button to **ENABLE**.
- Detected peaks will be highlighted in the trace, measurements will be displayed in the table below the trace.



8.2.2 SMSR

The SMSR (Side Mode Suppression Ratio) can be computed between the primary peak and adjacent peaks of lower optical power in the OSA trace.

The following adjacent peak detection methods are available for calculating SMSR:

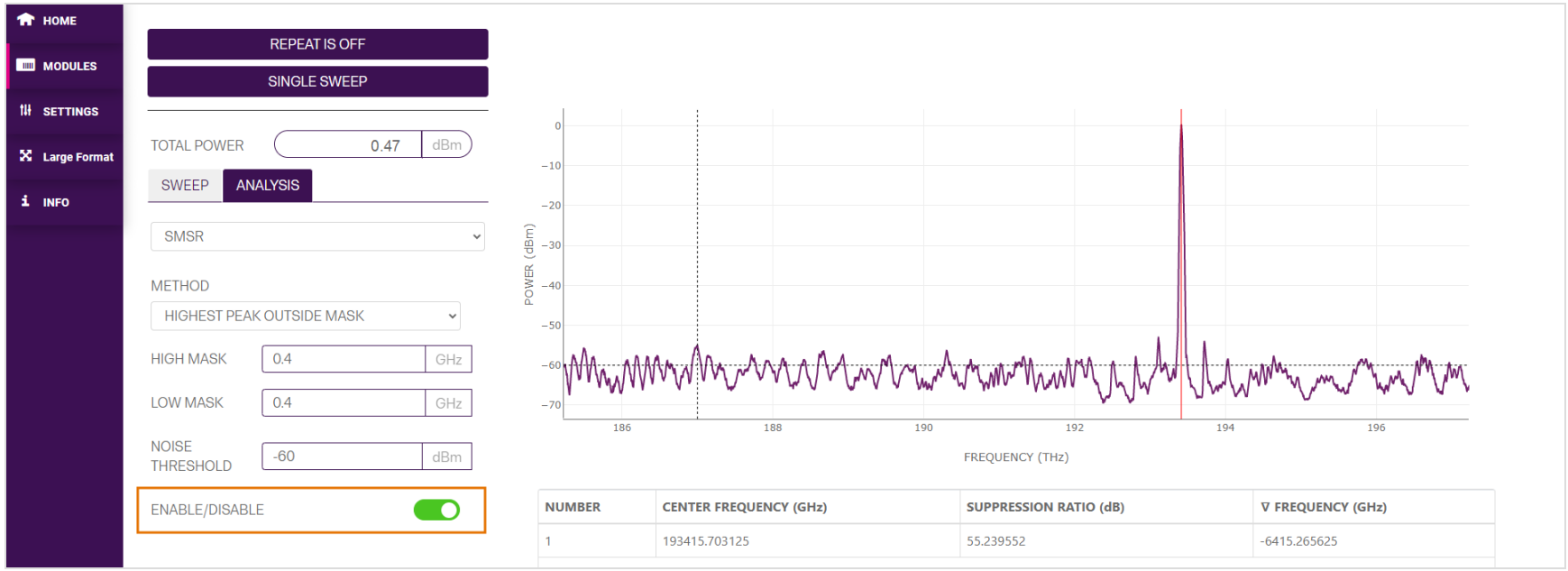
- Highest peak outside mask
- Highest adjacent peak
- Highest peaks on either side of mask
- Highest adjacent peaks on either side

For all the SMSR functions, there are options to set a **LOW MASK**, **HIGH MASK** or **NOISE THRESHOLD**. Each of these parameters can either be set by manually entering a valid number or by using the arrows to increment or decrement to the desired value.

> It is important to note that the **LOW MASK** and **HIGH MASK** values must be **positive**.

The different SMSR calculation methods are included to allow control over the peak detection constraints. Instances when these methods are beneficial are illustrated in the **HIGHEST ADJACENT PEAK** and **HIGHEST PEAKS ON EITHER SIDE OF MASK** methods.

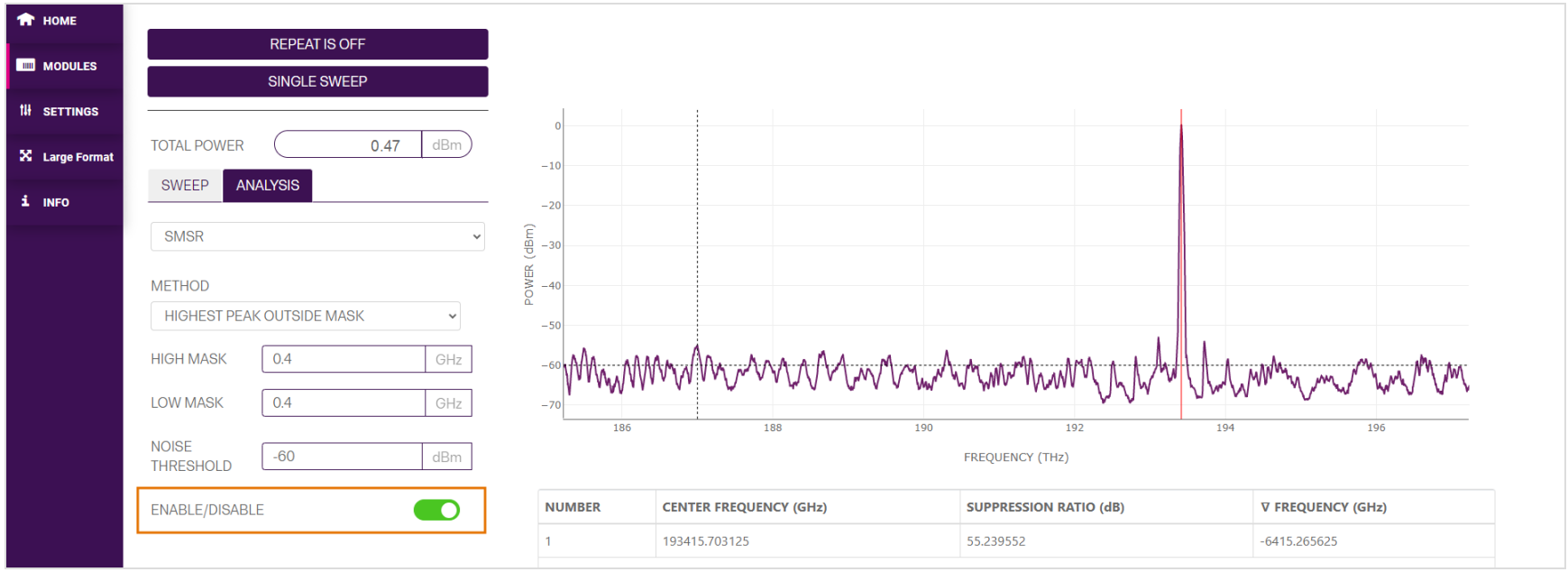
After all parameters have been set, toggle the **ENABLE / DISABLE** button to apply the changes.



8.2.2.1 Highest peak outside mask

This detection mode for SMSR calculation will find the primary peak of highest power. It will then apply a mask either side of this peak, and only detect the highest peak that is outside this mask and above the set **NOISE THRESHOLD**.

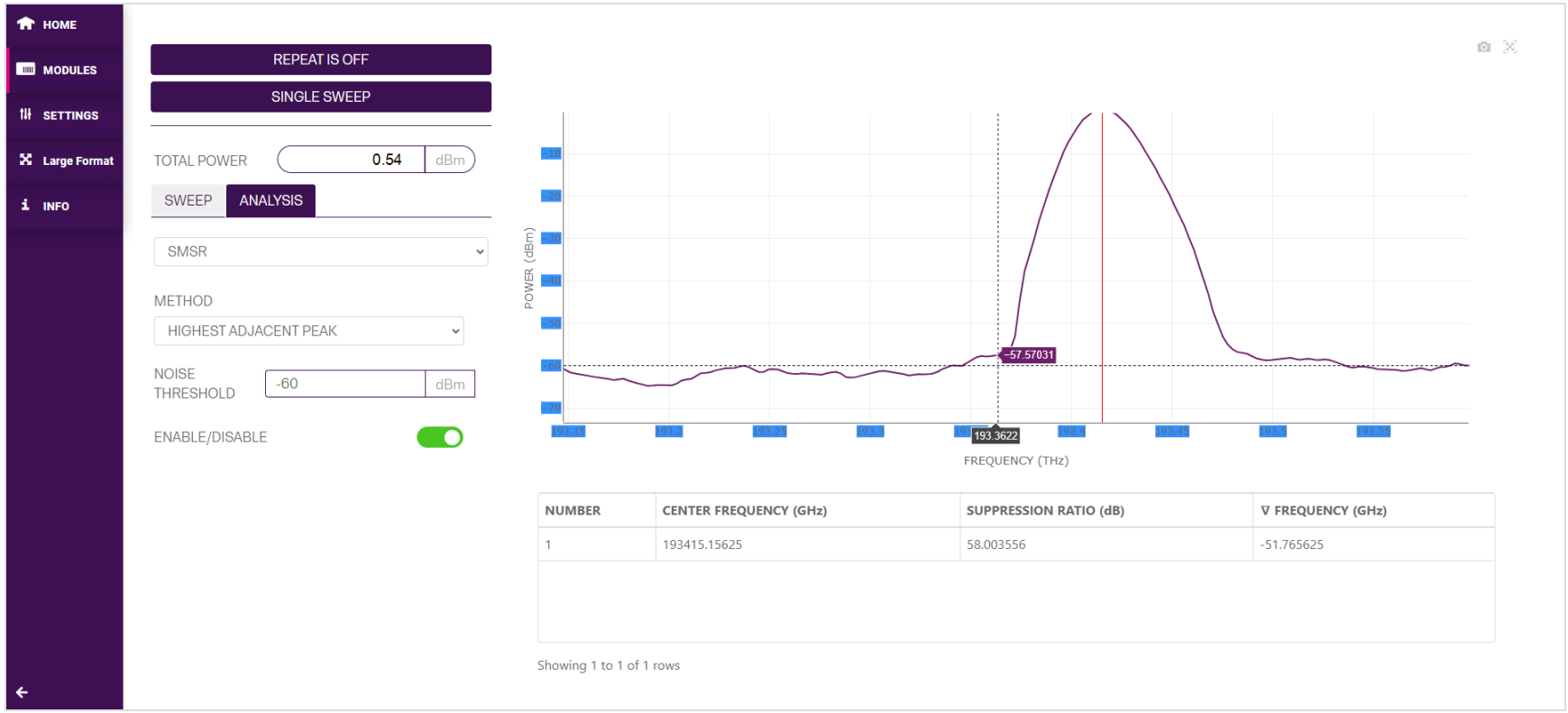
In the example below, the mask has been set to be 400 GHz either side of the primary peak at approximately 193.415 THz (as shown in the **CENTER FREQUENCY**). The **NOISE THRESHOLD** has also been moved down to -60 dBm, to facilitate valid peak detection.



8.2.2.2 Highest adjacent peak

This detection mode for SMSR calculation will find the primary peak of highest power. It will then scan and find the closest peak of highest power that is above the set **NOISE THRESHOLD**.

In the example below, the laser has a secondary peak within the primary mode, at approximately 193.362 THz. This could be a valid side mode that exists very close to the primary mode but could have been missed with a masking method.

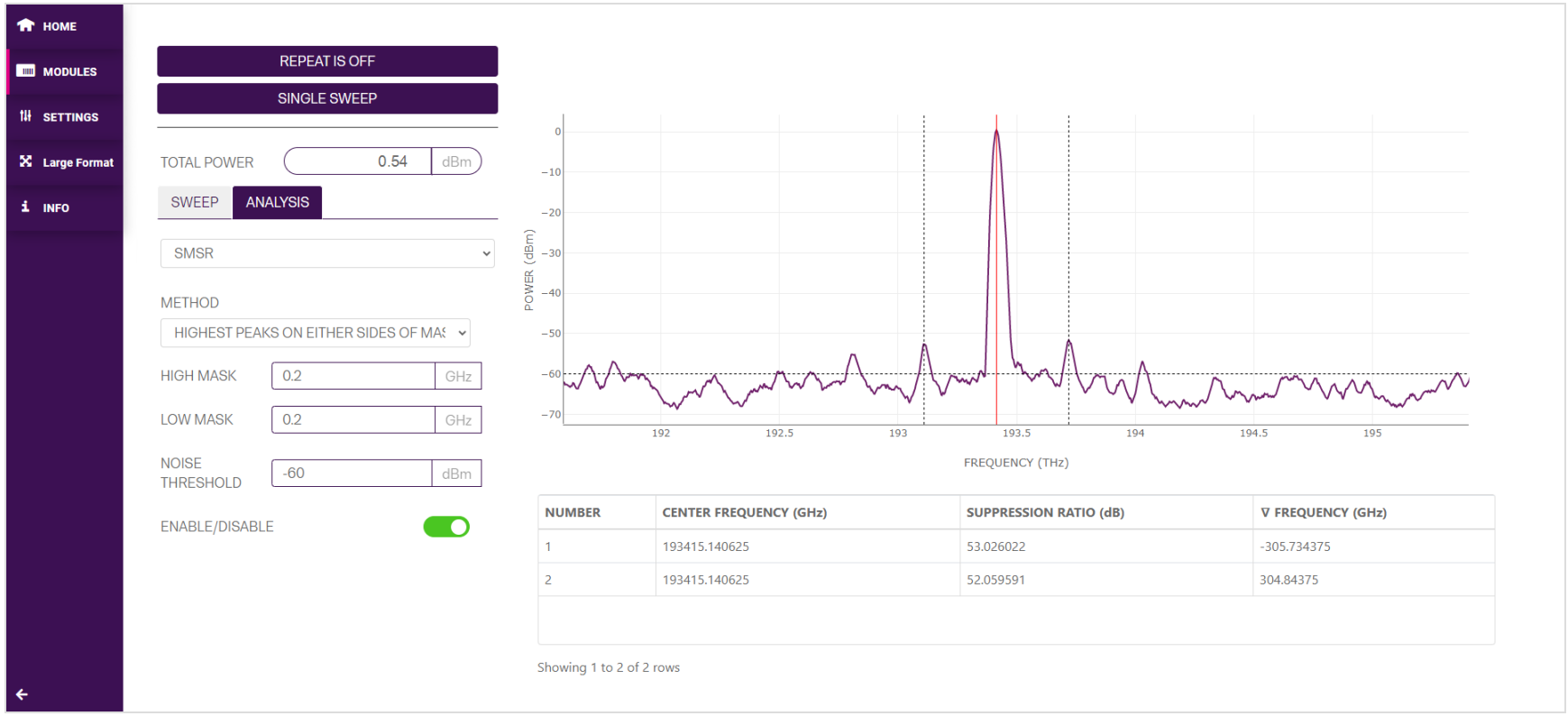


8.2.2.3 Highest peaks on either side of mask

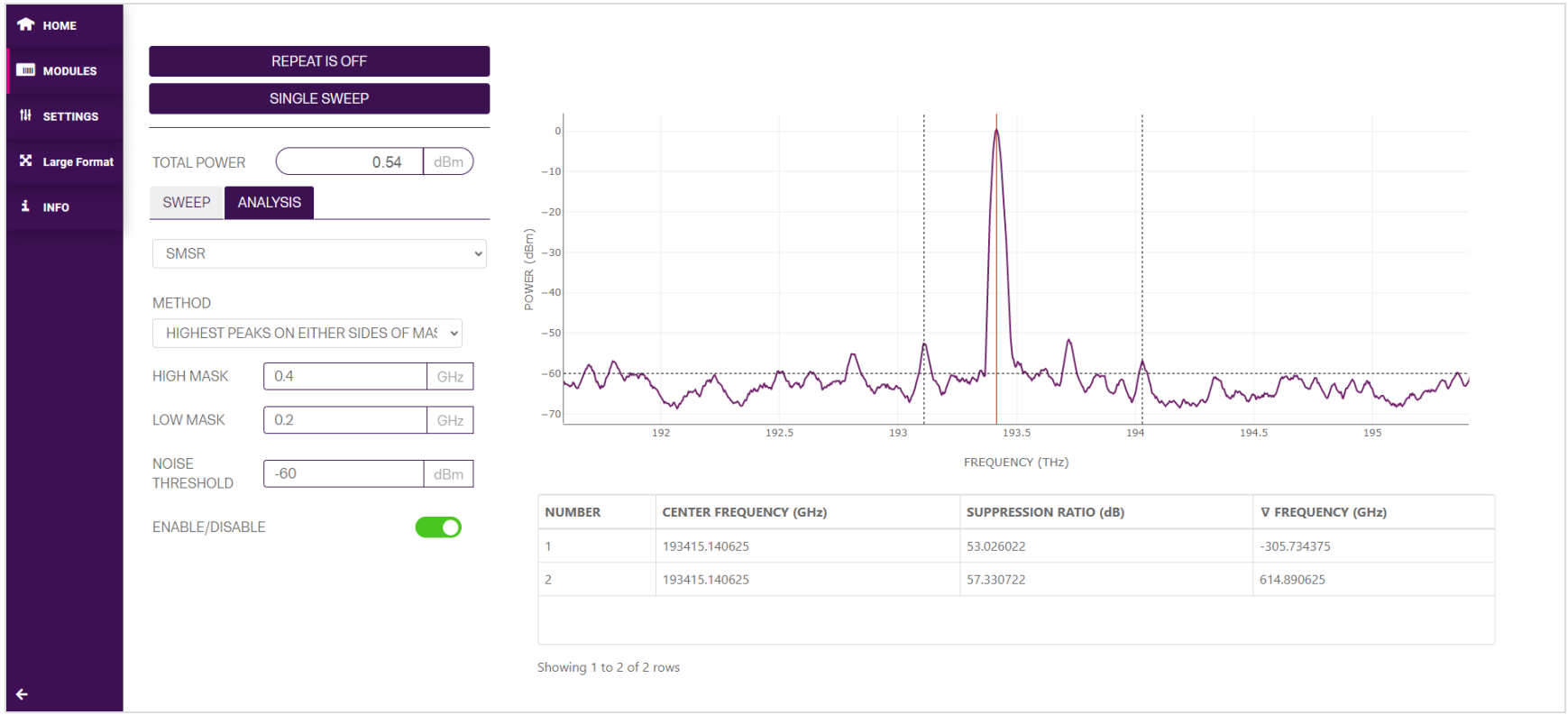
This detection mode for SMSR calculation will find the primary peak of highest power. It will then apply a mask either side of the primary peak and detect the highest peaks on either side of this mask that are also above the set **NOISE THRESHOLD**.

The benefit of this detection method is the ability to mask out the secondary peak that exists in the primary mode.

In the example below, it detects and calculates the SMSR between the primary peak and the two detected peaks at approximately 193.109 THz and 193.719 THz.

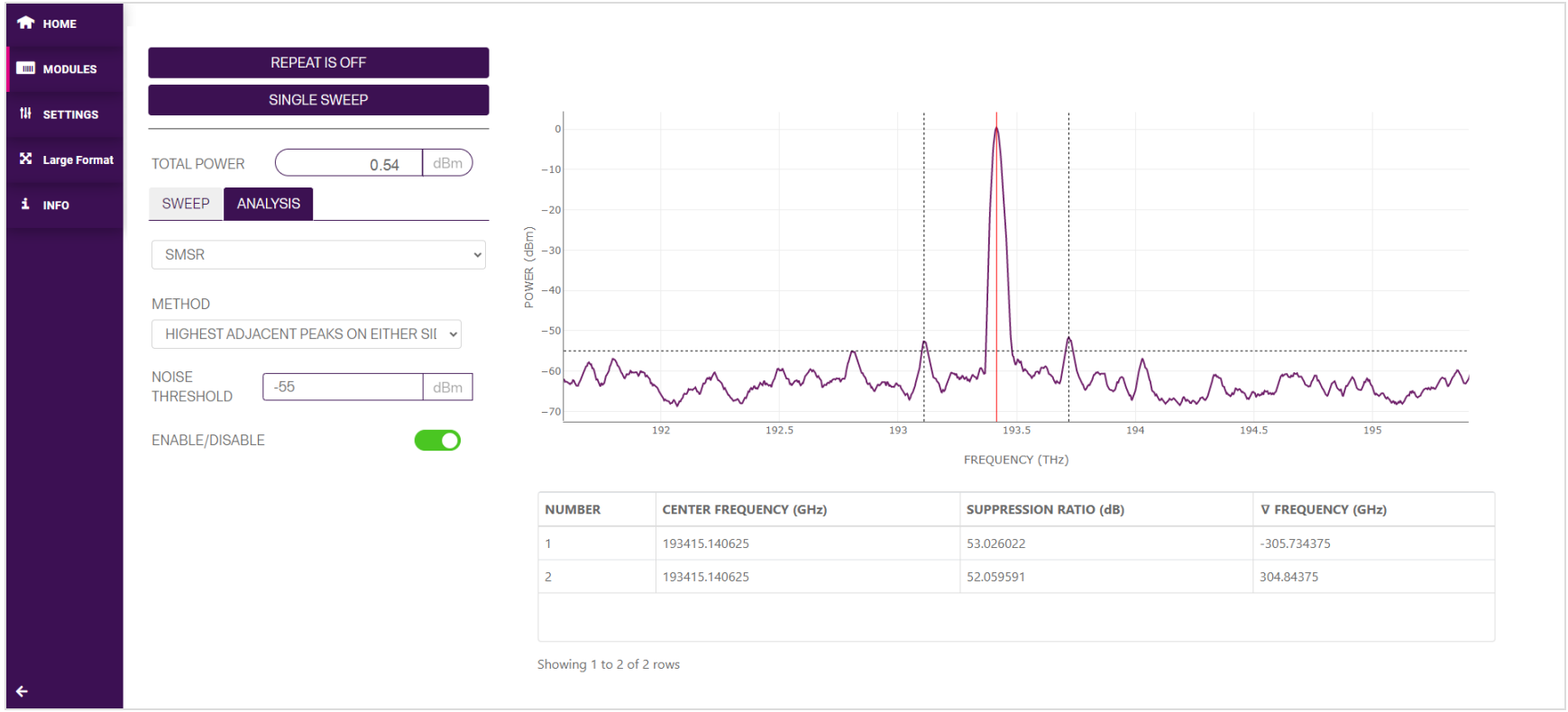


A non-symmetric mask can also be applied with this SMSR method, to facilitate SMSR calculation between other side modes. In the example below, the SMSR is calculated between the peaks at approximately 193.109 THz and 194.030 THz.



8.2.2.4 Highest adjacent peaks on either side

This detection mode for SMSR calculation will find the primary peak of highest power. It will then detect the highest peaks on either side of this primary peak that are also above the set **NOISE THRESHOLD**.



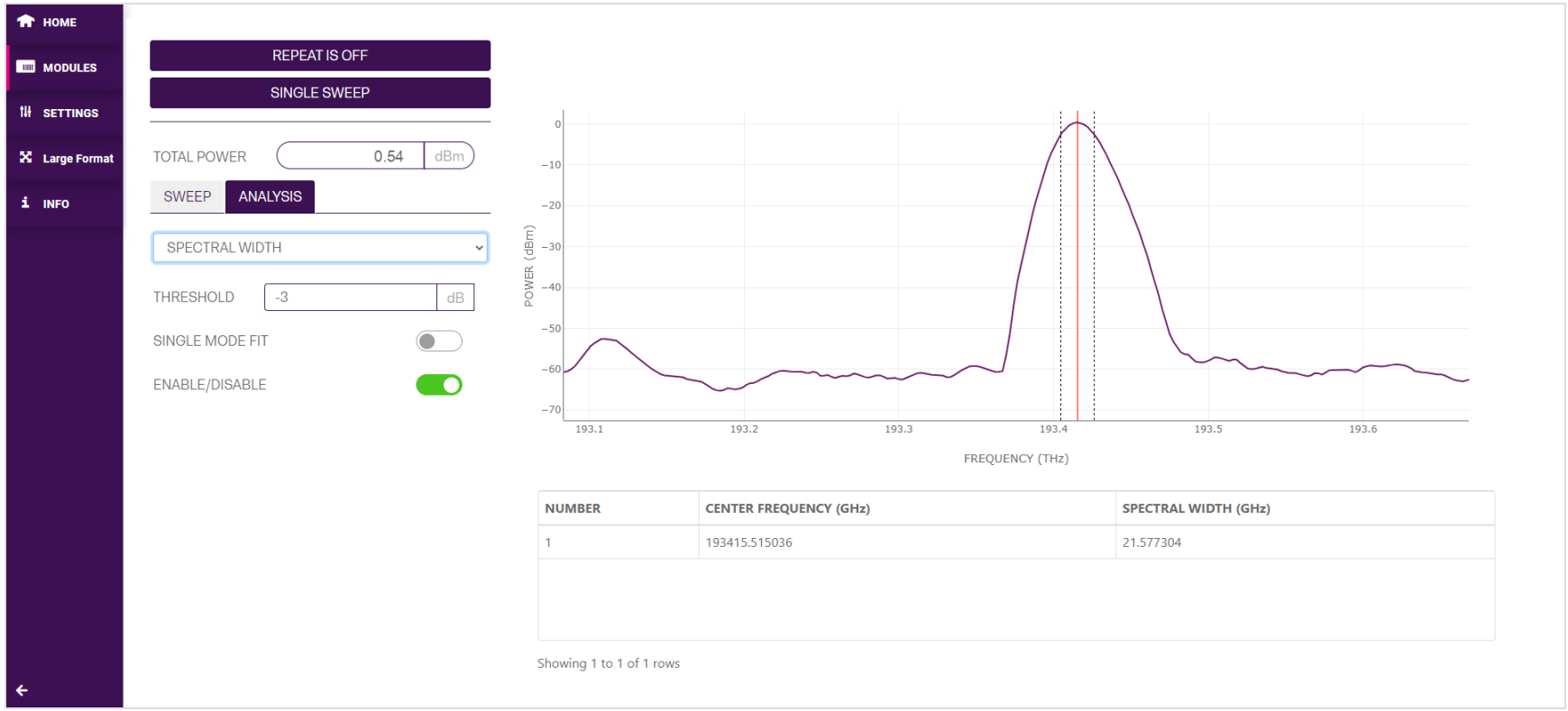
8.2.3 Spectral width

The **SPECTRAL WIDTH** function allows the user to calculate the width of a given peak in the OSA trace.

The **THRESHOLD** value sets how far below the peak power to calculate the spectral width between. This parameter can be entered manually or by using the arrows to increment or decrement the value. **This value must be a negative number.**

In the example below, the **THRESHOLD** has been set to 30 dB below the peak power value. The spectral width is then calculated as the frequency difference between the two points that are closest to the threshold on either side of the peak power value.

To calculate the **SPECTRAL WIDTH**, toggle the **ENABLE / DISABLE** button.



8.2.4 Find peaks

The **FIND PEAKS** function will detect all valid peaks above a given **THRESHOLD** level in an OSA trace.

The **THRESHOLD** value is the power level above which all valid peaks will be detected and displayed. This parameter can be entered manually or by using the arrows to increment or decrement the value.

If the THRESHOLD is set close to the noise floor of the OSA, more peaks will be detected and displayed.

To calculate and display the peaks, toggle the **ENABLE / DISABLE** button.

9 Controlling your OSA 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 OSA product 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	M	NM, PM

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

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

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

For the commands that require index values:

Index	Description	Value
<n>		integer 1
<m>	the channel index of a specific unit in the module	integer <1 to 4>

Message queues

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

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

9.3 Status and event registers

9.3.1 Standard Event Status Register

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

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

9.3.2 Standard Event Status Enable Register (Mask)

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

NOTE

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

9.3.3 Status Byte Register

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

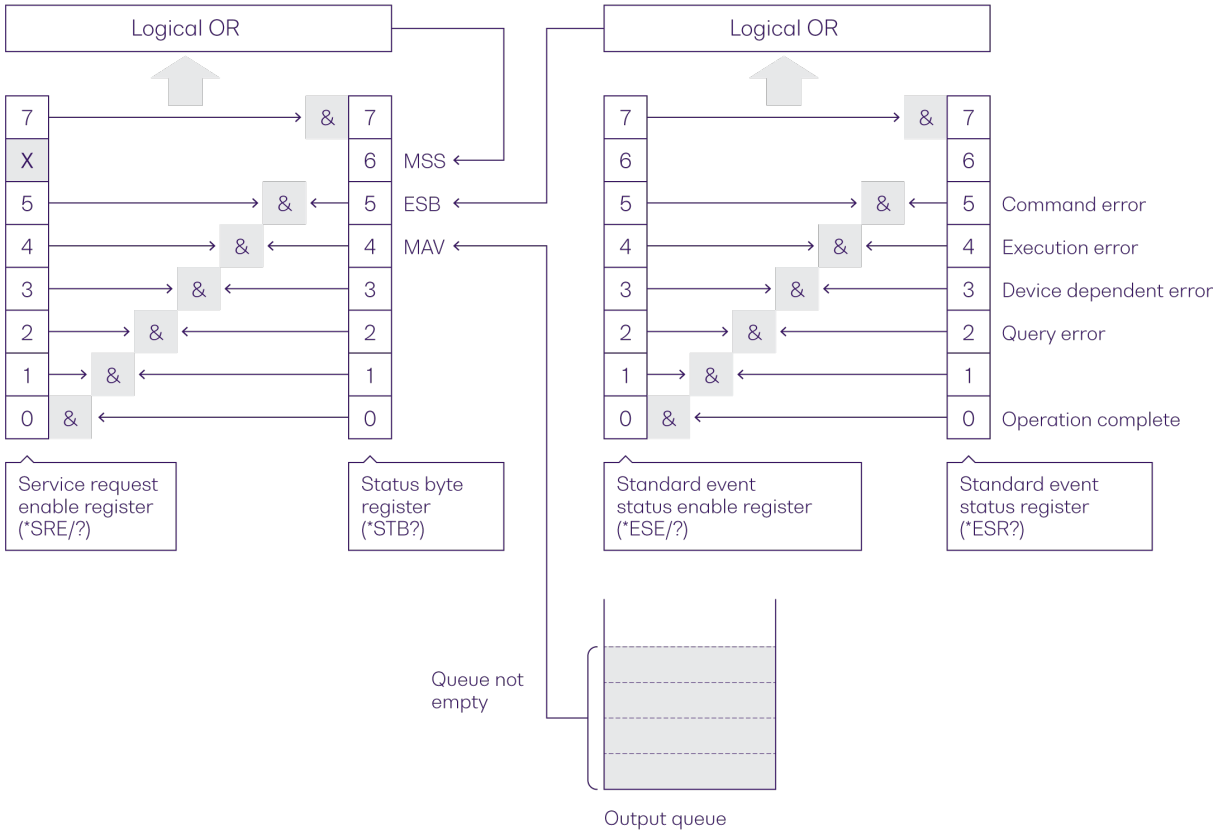
Bit	Description
7 (MSB)	Not used
6	The Master Summary Status (MSS) bit is set from the STB and SRE Mask
5	The Event Status Bit (ESB) is set from the SESR and the SESR Mask
4	Message Available (MAV) is set when there is data in the output queue
3, 2, 1, 0 (LSB)	Not used

9.3.4 Service Request Enable Register (Mask)

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

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

9.3.5 Status and event registers diagram



9.4 Command summary

9.4.1 Common commands

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

9.4.2 Slot commands

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

9.4.3 Configuration commands

Configuration commands	Description
:INITiate<n>	
:CHANnel<m>	
:SWEep	Initiate the Sweep to populate the data buffer >>
:SMODe?	Query the sweep mode >>
:SMODe	Set the sweep mode >>
:SENSe<n>	
:CHANnel<m>	
:WAVelength	
:STARt?	Query the start wavelength for the wavelength sweep >>
:STARt	Set the start wavelength for the wavelength sweep >>
:STOP?	Query the stop wavelength for the wavelength sweep >>
:STOP	Set the stop wavelength for the wavelength sweep >>
:FREQuency	
:STARt?	Query the start frequency for the frequency sweep >>
:STARt	Set the start frequency for the frequency sweep >>
:STOP?	Query the stop frequency for the frequency sweep >>
:STOP	Set the stop frequency for the frequency sweep >>
:SWEep	
:WAVelength?	Query the wavelength sweep (Y data) >>
:FREQuency?	Query the frequency sweep (Y data) >>
:POINts?	Query the number of sweep points >>
:POINts	Set the number of sweep points >>
:CALCulate<n>	
:CATegory<m>	
:OSNR?	Query the OSNR measurement of a sweep >>
:POWer?	Query the Total Power of a sweep >>
:SMSR?	Query the SMSR measurement of a sweep >>
:SWTHresh?	Query the Spectral Width of a peak in a sweep >>
:MARKer<m>	
:MSEarch?	Query the peak locations of a sweep >>

9.5 Command descriptions

9.5.1 Common commands

Command	***IDN?**	Summary >>
Syntax	`*IDN?`	
Description	Query the instrument identification	
Parameters	N/A	
Response	Comma separated string with the <manufacturer>,<server name>,<chassis controller name>,<server version>	
Example	`*IDN? -> Quantifi Photonics, CohesionSCPI service,PXIE-8133,FW2.0.15`	

Command	***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 installed in the instrument	
Parameters	N/A	
Response	Comma separated string of the installed modules	
Example		

Command	***OPC?**	Summary >>
Syntax	`*OPC?`	
Description	Query the Operation Complete Status	
Parameters		
Response	**1**: ready to execute commands	
	0: commands to execute are still in the input queue	
	NOTE: Any commands sent to the module when `*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.

9.5.2 Slot commands

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

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

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

Command	**:SLOT<n>:IDN?** Summary >>
Syntax	:SLOT<n>:IDN?
Description	Query the module identification
Parameters	N/A
Response	A comma-separated string containing "<manufacturer>,<model name>,<serial number>,<hardware version><firmware version>". Note that the hardware and firmware versions are not comma separated.
Example	:SLOT1:IDN? -> Quantifi Photonics,LaserPXIe-1002-2-FA,QuantifiPhotonics-192001,HW1.0FW1.021,QP-000000,HW0.00.01FW0.00.01

Command	**:SLOT<n>:CHANnel<m>:TEMPerature?** Summary >>
Syntax	:SLOT<n>:CHANnel<m>:TEMPerature?<wsp>[MIN|MAX|ACT|ALL>]
Description	Query the module temperature
Parameters	**MIN**: Returns the minimum temperature
	MAX: Returns the maximum temperature
	ACT: Returns the actual measured temperature
	ALL: Returns all the above values in a comma separated string
Response	A single value, or a comma-separated array of values
Example	:SLOT1:CHAN1:TEMP? ALL -> 5.0,60.0,17.1

9.5.3 Configuration Commands

Command	**:INITiate<n>:CHANnel<m>:SWEep**	Summary >>
Syntax	`:INITiate<n>:CHANnel<m>:SWEep`	
Description	Initiate the Sweep to populate the data buffer	
Parameters	N/A	
Response	N/A	
Example	`:INIT1:CHAN1:SWE`	

Command	**:INITiate<n>:CHANnel<m>:SMODe?**	Summary >>
Syntax	`:INITiate<n>:CHANnel<m>:SMODe?<wsp>[DEF|LIST|SET|ALL]`	
Description	Query the sweep mode	
Parameters	**DEF**: Returns the default sweep mode	
	LIST: Returns a comma separated list of the supported sweep modes	
	SET: Returns the set sweep mode	
	ALL: Returns all the above values in a comma separated list	
Response	A single value, or a comma-separated array of values	
Example	`:INIT1:CHAN1:SMOD? -> REP`	

Command	**:INITiate<n>:CHANnel<m>:SMODe**	Summary >>
Syntax	`:INITiate<n>:CHANnel<m>:SMODe<wsp>[DEF|REPeat|SINGLe]`	
Description	Set the sweep mode	
Parameters	**DEF**: Sets the sweep mode to the default (SINGLE)	
	REPeat: Sets the sweep mode to a REPEAT sweep	
	SINGLe: Sets the sweep mode to a SINGLE sweep	
Response	N/A	
Example	`:INIT1:CHAN1:SMOD REP`	

Command	**:SENSe<n>:CHANnel<m>:WAVelength:STARt?**	Summary >>
Syntax	:SENSe<n>:CHANnel<m>:WAVelength:STARt?<wsp>[MIN|MAX|DEF|SET]	
Description	Query the start wavelength for the wavelength sweep	
Parameters	**MIN**: Returns the minimum start wavelength value	
	MAX: Returns the maximum start wavelength value	
	DEF: Returns the default start wavelength value	
	SET: Returns the set start wavelength value (default units of nm)	
Response	A single value, or a comma-separated array of values	
Example	:SENS1:CHANnel1:WAV:STAR? SET -> 1520.006784	

Command	**:SENSe<n>:CHANnel<m>:WAVelength:STARt**	Summary >>
Syntax	:SENSe<n>:CHANnel<m>:WAVelength:STARt<wsp>[<value>|MIN|MAX|DEF]	
Description	Set the start wavelength for the wavelength sweep	
Parameters	**<value>**: Sets the start wavelength to the user defined value (default units of nm)	
	MIN: Sets the start wavelength to the minimum wavelength value	
	MAX: Sets the start wavelength to the maximum wavelength value	
	DEF: Sets the start wavelength to the default wavelength value	
Response	N/A	
Example	:SENS1:CHAN1:WAV:STAR 1520	

Command	**:SENSe<n>:CHANnel<m>:WAVelength:STOP?**	Summary >>
Syntax	:SENSe<n>:CHANnel<m>:WAVelength:STOP?<wsp>[MIN|MAX|DEF|SET]	
Description	Query the stop wavelength for the wavelength sweep	
Parameters	**MIN**: Returns the minimum stop wavelength value	
	MAX: Returns the maximum stop wavelength value	
	DEF: Returns the default stop wavelength value	
	SET: Returns the set stop wavelength value (default units of nm)	
Response	A single value, or a comma-separated array of values	
Example	:SENS1:CHANnel1:WAV:STOP? SET -> 1600.002444	

Command	**:SENSe<n>:CHANnel<m>:WAVelength:STOP**	Summary >>
Syntax	:SENSe<n>:CHANnel<m>:WAVelength:STOP<wsp>[<value>|MIN|MAX|DEF]	
Description	Set the stop wavelength for the wavelength sweep	
Parameters	**<value>**: Sets the stop wavelength to the user defined value (default units of nm)	
	MIN: Sets the stop wavelength to the minimum wavelength value	
	MAX: Sets the stop wavelength to the maximum wavelength value	
	DEF: Sets the stop wavelength to the default wavelength value	
Response	N/A	
Example	:SENS1:CHAN1:WAV:STOP 1600	

Command	**:SENSe<n>:CHANnel<m>:FREQuency:STARt?**	Summary >>
Syntax	:SENSe<n>:CHANnel<m>:FREQuency:STARt?<wsp>[MIN|MAX|DEF|SET]	
Description	Query the start frequency for the frequency sweep	
Parameters	**MIN**: Returns the minimum start frequency value	
	MAX: Returns the maximum start frequency value	
	DEF: Returns the default start frequency value	
	SET: Returns the set start frequency value (default units of GHz)	
Response	A single value, or a comma-separated array of values	
Example	:SENS1:CHANnel1:FREQ:STAR? SET -> 186000	

Command	**:SENSe<n>:CHANnel<m>:FREQuncy:STARt**	Summary >>
Syntax	:SENSe<n>:CHANnel<m>:FREQuncy:STARt<wsp>[<value>|MIN|MAX|DEF]	
Description	Set the start frequency for the frequency sweep	
Parameters	**<value>**: Sets the start frequency to the user defined value (default units of GHz)	
	MIN: Sets the start frequency to the minimum frequency value	
	MAX: Sets the start frequency to the maximum frequency value	
	DEF: Sets the start frequency to the default frequency value	
Response	N/A	
Example	:SENS1:CHAN1:FREQ:STAR 186000	

Command	**:SENSe<n>:CHANnel<m>:FREQuency:STOP?**	Summary >>
Syntax	:SENSe<n>:CHANnel<m>:FREQuency:STOP?<wsp>[MIN|MAX|DEF|SET]	
Description	Query the stop frequency for the frequency sweep	
Parameters	**MIN**: Returns the minimum stop frequency value	
	MAX: Returns the maximum stop frequency value	
	DEF: Returns the default stop frequency value	
	SET: Returns the set stop frequency value (default units of GHz)	
Response	A single value, or a comma-separated array of values	
Example	:SENS1:CHANnel1:FREQ:STOP? SET -> 191000	

Command	**:SENSe<n>:CHANnel<m>:FREQuency:STOP**	Summary >>
Syntax	:SENSe<n>:CHANnel<m>:FREQuency:STOP<wsp>[<value>|MIN|MAX|DEF]	
Description	Set the stop frequency for the frequency sweep	
Parameters	**<value>**: Sets the stop frequency to the user defined value (default units of GHz)	
	MIN: Sets the stop frequency to the minimum frequency value	
	MAX: Sets the stop frequency to the maximum frequency value	
	DEF: Sets the stop frequency to the default frequency value	
Response	N/A	
Example	:SENS1:CHAN1:FREQ:STOP 191000	

Command	**:SENSe<n>:CHANnel<m>:SWEep:WAVelength?** Summary >>
Syntax	:SENSe<n>:CHANnel<m>:SWEep:WAVelength?[<wsp><X|Y|FULL>]
Description	Query the wavelength sweep (Y data)
Parameters	**X**: Returns the array of wavelength data
	Y: Returns the array of power
	FULL: Returns both arrays of wavelength data and power
Response	A comma separated string with the <wavelength data>, <power>, <number of points>, <sweep data>.
Example	:SENS1:CHAN1:SWE:WAV? -> 1520.006784, 1600.002444, 10, -67.304688,-67.007813,-67.910156,-68.132813,-67.324219, -66.691406,-67.230469, -67.277344,-67.230469,-67.265625 :SENS1:CHAN2:SWEEP:WAV? X ->> 10,1522.051816,1530.335876,1538.710604,1547.177498,1555.738087,1564.393935,1573.146642, 1581.997841,1590.949205,1600.002444'In :SENS1:CHAN2:SWEEP:WAV? Y ->> 10,-62.019531,-52.089844,-50.312500,-55.757813,-51.796875,-47.878906,-48.628906, -55.117188,-45.941406,-44.242188 :SENS1:CHAN2:SWEEP:WAV? FULL ->> 10,X,1522.051816,1530.335876,1538.710604,1547.177498,1555.738087, 1564.393935,1573.146642,1581.997841,1590.949205,1600.002444,Y,-62.019531,-52.089844, -50.312500,-55.757813,-51.796875,-47.878906,-48.628906,-55.117188,-45.941406,-44.242188'

Command	**:SENSe<n>:CHANnel<m>:SWEep:FREQuency?**	Summary >>
Syntax	:SENSe<n>:CHANnel<m>:SWEep:FREQuency?[<wsp><X|Y|FULL>]	
Description	Query the frequency sweep (Y data)	
Parameters	**X**: Returns the array of frequency data	
	Y: Returns the array of power	
	FULL: Returns both arrays of frequency data and power	
Response	A comma separated string with the <frequency data>, <power>, <number of points>, <sweep data>.	
Example	:SENS1:CHANnel1:SWE:FREQ? -> 186000, 191000, 10, -76.867188,-76.878906,-76.300781,-75.781250,-75.949219, -75.800781,-75.914063,-75.953125,-75.617188,-75.007813,-74.457031 :SENSE12:CHANnel12:SWEEP:FREQ? X ->> 10,187370.000000,188436.222222,189502.444444,190568.666667,191634.888889,192701.111111, 193767.333333,194833.555556,195899.777778,196966.000000 :SENSE12:CHANnel12:SWEEP:FREQ? Y ->> 10,-44.242188,-45.941406,-55.117188,-48.628906,-47.878906,-51.796875,-55.757813, -50.312500,-52.089844,-62.019531 :SENSE12:CHANnel12:SWEEP:FREQ? FULL ->> 10,X,187370.000000,188436.222222,189502.444444,190568.666667,191634.888889,192701.111111, 193767.333333,194833.555556,195899.777778,196966.000000,Y,-44.242188,-45.941406,-55.117188, -48.628906,-47.878906,-51.796875,-55.757813,-50.312500,-52.089844,-62.019531'	

Command	**:SENSe<n>:CHANnel<m>:SWEep:POINts?**	Summary >>
Syntax	:SENSe<n>:CHANnel<m>:SWEep:POINts?<wsp>[MIN|MAX|DEF|SET]	
Description	Query the number of sweep points	
Parameters	**MIN**: Returns the minimum number of sweep points	
	MAX: Returns the maximum number of sweep points	
	DEF: Returns the default number of sweep points	
	SET: Returns the number of sweep points to the user defined value	
Response	A single value, or a comma-separated array of values	
Example	:SENS1:CHANnel1:SWE:POIN? -> 1000	

Command	**:SENSe<n>:CHANnel<m>:SWEep:POINts** Summary >>
Syntax	:SENSe<n>:CHANnel<m>:SWEep:POINts<wsp>[MIN|MAX|DEF|<value>]
Description	Set the number of sweep points
Parameters	**<value>**: Sets the number of sweep points to the user defined value
	MIN: Sets the minimum number of sweep points
	MAX: Sets the maximum number of sweep points
	DEF: Sets the default number of sweep points
Response	N/A
Example	:SENS1:CHAN1:SWE:POIN 1000

Command	**:CALCulate<n>:CATegory<m>:OSNR?** Summary >>
Syntax	:CALCulate<n>:CATegory<m>:OSNR?<wsp><PTH>,<IBW>,<NOISE>,<MASK>,<NBW>,<SBW>
Description	Query the OSNR measurement of a sweep
Parameters	**PTH**: The power threshold above which peaks should be detected (units of dBm)
	IBW: The integration bandwidth for power calculation of each detected peak (units of GHz)
	NOISE: The noise area, centered at the peak. The OSA rejects any side peaks in this area. (units of GHz)
	MASK: The mask area, centered at the peak. The OSA will exclude this area from OSNR callculations (units of GHz)
	NBW: Noise resolution bandwidth (units of nm)
	SBW: Signal resolution bandwidth (units of nm)
Response	A comma separated string containing <peak number>,<peak frequency>,<peak power>,<noise power>,<channel power>,<noise power per NBW>,<SNR>. <peak frequency> in units of GHz <peak power> in units of dBm <noise power> in units of dBm <channel power> in units of dBm <noise power per NBW> in units of dBm/NBW <SNR> in units of dB
Example	:CALC1:CAT1:OSNR? -30,0.5,0,0,0,0 -> 1,193542.578125,-12.710617,-66.198472,-12.710636,-66.198472,53.487855

Command	**:CALCulate<n>:CATegory<m>:POWer?**	Summary >>
Syntax	:CALCulate<n>:CATegory<m>:POWer?	
Description	Query the Total Power of a sweep	
Parameters	N/A	
Response	A string of the value representing total calculated optical power in units of dBm.	
Example	:CALC1:CAT1:POW? -> -5.3265	

Command	**:CALCulate<n>:CATegory<m>:SMSR?**	Summary >>
Syntax	:CALCulate<n>:CATegory<m>:SMSR?<wsp><MTH>,<MSH>,<MSL>,<PTH> :CALCulate<n>:CATegory<m>:SMSR?<wsp><MTH>,<PTH>	
Description	Query the SMSR measurement of a sweep	
Parameters	**MTH**: The SMSR method to base the calculation on. Valid options are: 1. Highest peak outside mask 2. Highest adjacent peak 3. Highest peaks on either sides of mask 4. Highest adjacent peaks on either sides of mask	
	MSH: The maximum frequency location of the mask in THz	
	MSL:The minimum frequency location of the mask in THz	
	PTH: The power threshold above which peaks should be detected (units of dBm)	
Response	A comma separated string containing the <peaks>,<center freq GHz>,<suppression ratio dB>,<delta freq GHz>	
Example	:CALC1:CAT1:SMSR? 1,0,0,-50 ->\n1,193409.171875,50.379475,-304.25 :CALC1:CAT1:SMSR? 2,-50 ->\n1,193409.171875,50.379475,-304.25 :CALC1:CAT1:SMSR? 3,0,0,-50 ->\n1,193409.171875,50.379475,-304.25\n2,193409.171875,52.401028,303.875 :CALC1:CAT1:SMSR? 4,-50 ->\n1,193409.171875,50.379475,-304.25\n2,193409.171875,52.401028,303.875	

Command	**:CALCulate<n>:CATegory<m>:SWTHresh?** Summary >>
Syntax	:CALCulate<n>:CATegory<m>:SWTHresh?<wsp><FIT>,<PTH>[DBM]
Description	Query the Spectral Width of a peak in a sweep
Parameters	**FIT**: Enable (1) or disable (0) single mode fit.
	PTH: The power threshold below the peak power at which the spectral width should be calculated (units of dB).
Response	A comma separated string containing the <peak frequency>,<spectral width>. <peak frequency> in units of GHz <spectral width> in units of GHz
Example	:CALC1:CAT1:SWTH? 0,-3 -> 193542.664143,20.940859

Command	**:CALCulate<n>:MARKer<m>:MSEarch?** Summary >>
Syntax	:CALCulate<n>:MARKer<m>:MSEarch? <PTH>
Description	Query the peak locations of a sweep
Parameters	**PTH**: The power threshold above which to register a peak (units of dBm)
Response	A comma separated string containing the <number of peaks>,<peak frequency locations>,<peak powers>. <peak frequency locations> a comma separated string of all peaks above the specified power threshold in ascending value order. <peak powers> a comma separated string of each recorded peak's corresponding optical power in units of dBm.
Example	:CALC1:MARK1:MSE? -58 -> 3,185641.921875,185648.765625,193542.796875,-57.020798,-56.928300,-11.050784

9.6 Programming examples

The following is a simple example of how to control the OSA 1000 Series using SCPI commands. See the previous section for specific details and extra parameters that the listed commands accept.

We recommend that you use the `*ESR?` query after every command that is sent to the device. This enables you to debug unreceived or incorrect commands sent to the product.

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

#Configurig the OSA product
:SOURce1:CHANnel1:POWer 10 DBM          #Set the laser output power to 10 dBm
:SENSe1:CHANnel1:FREQuency:STARt MIN    #Set the start frequency sweep value to MINIMUM
:SENSe1:CHANnel1:FREQuency:STOP 195THZ  #Set the stop frequency sweep value 195.0 THz
:SENSe1:CHANnel1:SWEep:POINts 4000      #Set the number of sweep points
:INITiate1:CHANnel1:SMODe SINGLe        #Set the sweep mode to single, so that a single spectrum is captured once SWEep
is executed

#Querying the OSA product configuration values
:SENSe1:CHANnel1:FREQuency:STARt?       #Query the set start frequency sweep value
:SENSe1:CHANnel1:FREQuency:STOP?        #Query the set stop frequency sweep value
:SENSe1:CHANnel1:SWEep:POINts?          #Query the set number of sweep points
:INITiate1:CHANnel1:SMODe?              #Query the set sweep mode

#Initiating an OSA sweep and querying the sweep data
:INITiate1:CHAN1:SWEep                  #Initiate the sweep to populate the data buffer
:SENSe1:CHAN1:SWEep:FREQuency?          #Query the sweep data, with the x values as frequencies

#Using the analysis functions on an OSA trace
:CALCulate1:CATegory1:POWer?            #Query the total optical power in the OSA trace
:CALCulate1:MARKer1:MSEarch? -35DBM     #Find all peaks in the OSA trace above -35 dBm in power
```

9.7 SCPI Command Console

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

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

The two most common error codes are:

17: IO writer error: The command was invalid or not accepted by the instrument.

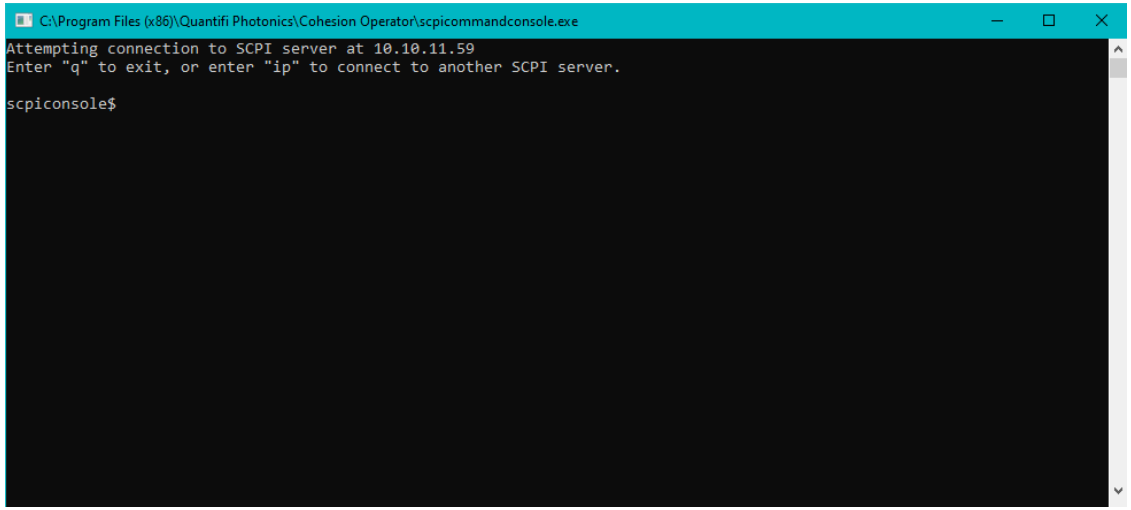
15: IO timeout: there was no response available before expiry of the reading wait time.

▶ To open the SCPI Command Console:

> Open the Cohesion Operator, for example by double-clicking the **Cohesion Operator** desktop icon.

> Select the instrument by entering its **IP address** or by selecting it from the **Discovery** drop down list.

> Click **Open SCPI Command Console**.



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

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

2. To switch to another Quantifi Photonics device:

- Enter `ip` and press **<ENTER>**.
- Enter the IP address of the Quantifi Photonics product you would like to switch to and press **<ENTER>**.
- Confirm that you are communicating with the right product: Enter `*idn?` and press **<ENTER>**.

  The device will return identification details

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

- Enter a command and press **<ENTER>**.
- The device will execute the command and return an action response to the console if applicable.

4. To exit the SCPI Command Console:

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

Example: Send instrument identification query *idn?

5. Enter the command: `*idn?`

   The instrument returns the requested information.

6. If you enter the command incorrectly, for example: `*ind?`

   The instrument returns **error code 32**.

   For details on error codes, please refer to the `*ESR?` command.

Example: Send a WRITE only command

7. If you enter a command correctly, for example: `*cls`

   The instrument executes the command, there will be no action response.

8. If you enter a command incorrectly, for example: `*csl`

   The instrument returns **error code 17: IO write error**.

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.

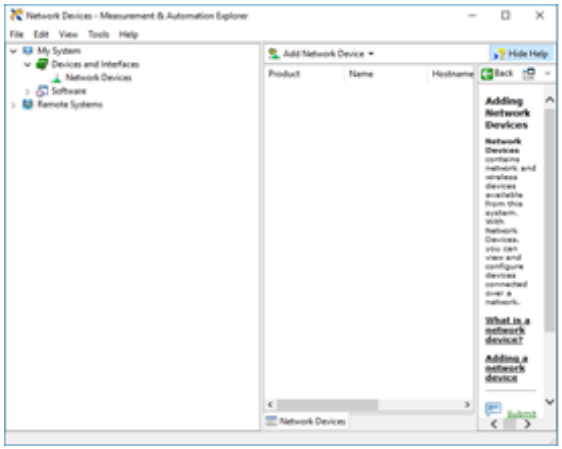
NOTE

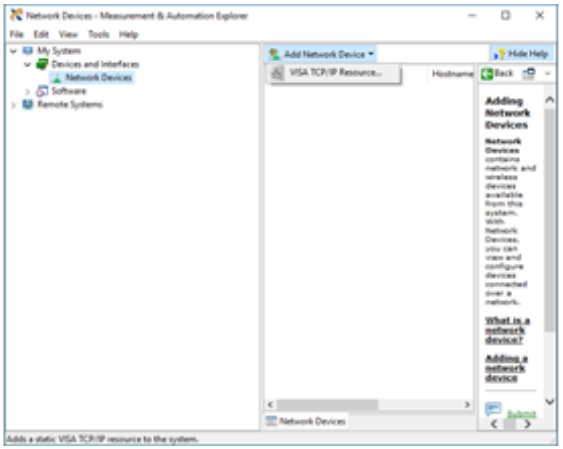
In NI-MAX a RIO interface will show up, however there are no communication methods available or implemented on this interface. Quantifi Photonics products are **ONLY** accessible through the **VISA TCPIP INSTR** interface provided by the CohesionSCPI service installed on the system.

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**.



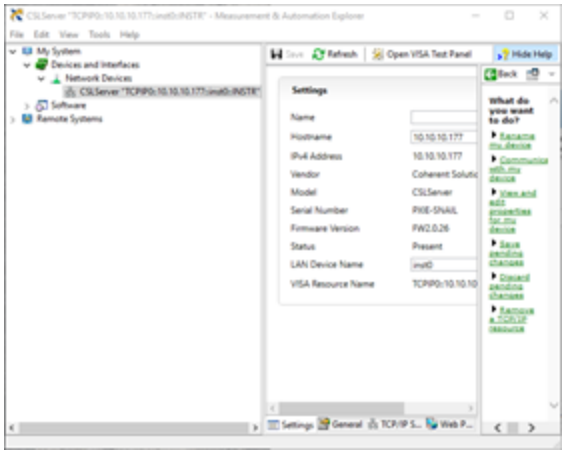


3. Select **Manual Entry of LAN Instrument**. Enter in the Hostname or IP Address.
   Note when operating locally, enter in the localhost IP address of **127.0.0.1**. Click **Finish** to end the setup process.

10.2 Setting up NI-VISA application

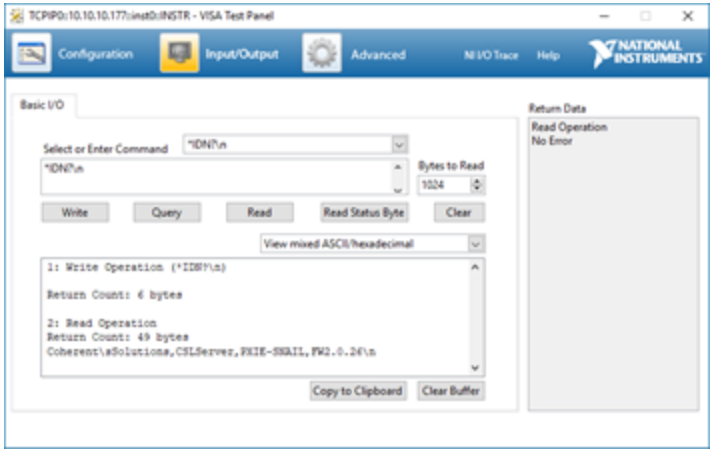
NI-VISA is used to communicate with the PXIe chassis or installed modules / instruments. The above steps must be completed before attempting to communicate using NI-VISA.

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® 2.7 code example

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

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

10.4 MATLAB® code example

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

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

NOTE

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

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

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

11 Working with optical fibers

Quantifi Photonics products are equipped with high quality optical connectors in compliance with EIA-455-21A standards.

⚠ CAUTION

Keep connectors clean and in good condition to ensure maximum power and to avoid erroneous readings:

> Always inspect fiber end faces for cleanliness using a fiber inspection probe before inserting them into a port..
> If required, clean fibers and faces as detailed below.

Quantifi Photonics is not responsible for damage or errors caused by bad fiber cleaning or handling.

NOTE

To avoid damaging ferrules or fiber faces due to mismatched connectors, always check ports and connector type information before inserting a connector. All Quantifi Photonics units are labeled with connector type information.

▶ When connecting a fiber-optic cable to a port:

1. Visually inspect the fiber end face using a fiber inspection microscope.
2. If a **connector end face** is dirty:
   > Wipe the connector end face using a reel-type cleaner and inspect again.
   > For stubborn hard to clean connectors:
   - Use lint-free fiber-cleaning wipes soaked in a fiber optic cleaning solution.
   - Wipe the connector on the soaked part.
   - Dry the connector by wiping on the dry part of the wipe, or by using a reel-type cleaner.

   > Repeat the process until connector inspection shows a clean fiber face.
3. If a **bulkhead inner connector face** is dirty:
   > Use a pen-type dry cleaner, align the cleaning tip with the port and push the cleaner until you hear the characteristic click. Inspect again.
   > For stubborn hard to clean bulkhead connectors:
   - Use a stick-type cleaner dipped in a fiber optic cleaning solution.
   - Carefully align and insert the stick into the connector and gently rotate the stick for several seconds applying light pressure.
   - Use a pen-type cleaner to dry the connector.

   > Repeat the process until connector inspection shows a clean fiber face.
4. If the fiber end face is clean:
   > Carefully align the connector and port to prevent the fiber end from touching the outside of the port or other surfaces.
   If the connector features a key, mate it correctly into the corresponding notch of the port bulkhead.

> Push the connector in so that the fiber-optic cable is firmly in place with adequate contact.
If your connector features a screw sleeve, tighten the connector to firmly maintain the fiber in place. Do not over-tighten, as this will damage the fiber and the port bulkhead.

NOTE

Failing to align and/or connect fiber-optic cables properly will result in significant signal loss and reflection.

12 System requirements

Quantifi Photonics PXIe modules

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

Quantifi Photonics MATRIQ / EPIQ instruments

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

13 Maintenance

To help ensure long, trouble-free operation:

- Always inspect fiber-optic connectors before using them and clean them if necessary.
- Keep the unit free of dust.
- Store the unit at room temperature in a clean and dry area. Keep the unit out of direct sunlight.
- Avoid high humidity or significant temperature fluctuations.
- Avoid unnecessary shocks and vibrations.
- If any liquids are spilled on or into the unit, power off the chassis immediately. Remove the unit and allow to dry completely.
- To allow for sufficient air flow and avoid thermal issues, set up your instrument with a minimum clearance of 2 inches (50.8mm) around it and do not block any ventilation fans.

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

13.1 Annual calibration schedule

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

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

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

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

14 Technical Support

14.1 Contacting the Technical Support Group

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

support@quantifiphotonics.com

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

14.2 Transportation

Maintain a temperature range within specifications when transporting the unit.

Transportation damage can occur from improper handling.

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

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

15 Warranty Information

15.1 General information

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

NOTE

The warranty can become null and void if:

- The unit has been tampered with, repaired, or worked upon by unauthorized individuals or non-Quantifi Photonics personnel.
- The warranty sticker has been removed.
- The unit has been opened, other than as explained in this guide.
- The unit serial number has been altered, erased, or removed.
- The unit has been misused, neglected, or damaged by accident.
- The unit has been used with an external power supply not supplied by Quantifi Photonics with the unit.

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

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

15.2 Liability

Quantifi Photonics shall not be liable for damages resulting from the use of the product, nor shall be responsible for any failure in the performance of other items to which theproduct is connected or the operation of any system of which the product may be a part.

Quantifi Photonics shall not be liable for damages resulting from improper usage, transportation or unauthorized modification of the product, its accompanying accessories and software.

The external power supply that has been supplied by Quantifi Photonics with the unit can only be used with that unit, do not use it with any other product.

15.3 Exclusions

Quantifi Photonics reserves the right to make changes in the design or construction of any of its products at any time without incurring obligation to make any changes whatsoever on units purchased. Accessories, including but not limited to fuses, pilot lamps, batteries and universal interfaces (EUI) used with Quantifi Photonics products are not covered by this warranty.

This warranty excludes failure resulting from: Improper use or installation, normal wear and tear, accident, abuse, neglect, fire, water, lightning or other acts of nature, causes external to the product or other factors beyond the control of Quantifi Photonics.

15.4 Certification

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

15.5 Service and repairs

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

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