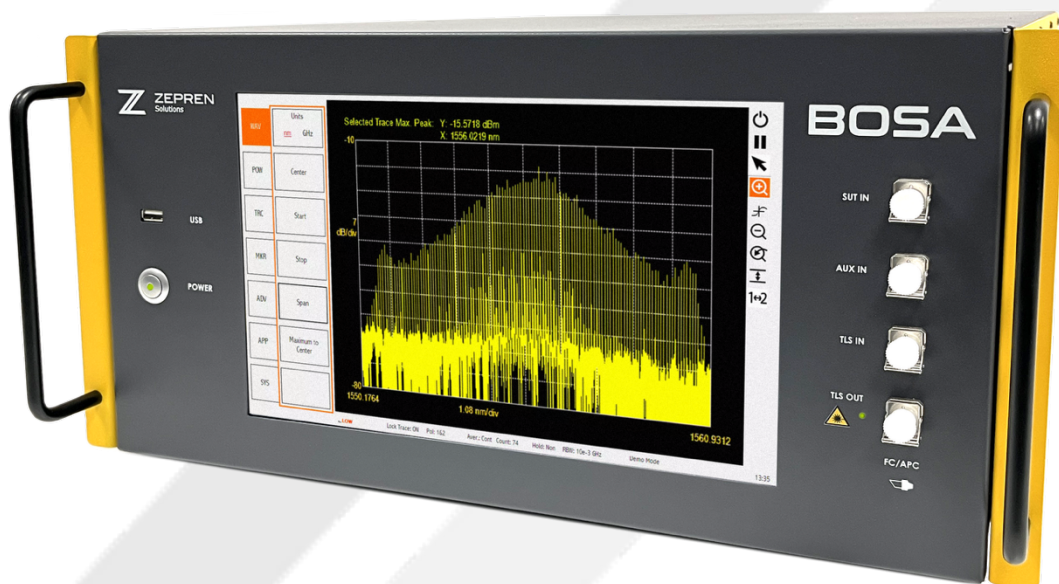


# BOSA

## *User Guide*

*[2026, Rev. 1]*



| Version | Date       | Autor  | Reviewer | Comments |
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## 1. Safety Considerations

### 1.1. Safety Symbols

The following signs will be used in this guide and must be followed by the user to ensure safe operation and maintain the product in a safe condition.



The warning sign denotes a hazard. It calls attention to a procedure which, if not correctly performed, could result in injury or loss of life. Do not proceed beyond a caution or warning sign until the indicated conditions are fully understood and met.



The caution sign indicates a hazard. It calls attention to a procedure which, if not correctly performed, could result in damage to or destruction of the product. Do not proceed beyond a caution or warning sign until the indicated conditions are fully understood and met.

The instrument will be marked with the following symbols:



Power button of the unit.



It indicates the front USB 2.0 port.



It indicates that laser radiation may be output from the connector (option X10 and X20).



The AC symbol is used to indicate the required nature of the line module input power.

### 1.2. General Considerations

The BOSA is a Safety Class 1 instrument, that is, an instrument with a metal chassis directly connected to earth via power supply cable. The main plug shall only be inserted in a socket outlet provided with a protective earth contact. Any interruption of the protective conductor inside or outside of the product is likely to make the product dangerous. Intentional interruption is prohibited.

Before operation, check the instrument and this manual for safety considerations. This section describes general safety precautions that must be observed during the operation of this instrument and to maintain the instrument in safe condition.

If this product is not used as specified, the protection provided by the equipment could be impaired. This product must be used in a normal condition (in which all means for protections are intact) only.



No operator serviceable parts inside. Refer servicing to qualified service personnel. To prevent electrical shock do not remove covers.



Ventilation requirements: the device should be located so that the convection into and out of the product must not be restricted.



The instrument must not be positioned on its rear part; the connectors on the back panel could be damaged.

### 1.3. Specific Considerations for BOSA option X10 & X20

The BOSA Option X10 and X20 has an optical output connector for the internal laser source in the front panel indicated as "AUX Output".



Please pay attention to the following laser safety warnings:



Under no circumstances look into the end of an optical cable attached to the optical laser output when the device is operational. The laser radiation can seriously damage your eyesight.



Do not activate the laser output when there is no fiber attached to the optical output connector.



The laser output is enabled by pressing the "Switch On" button in the Tunable Laser application (option X10) or performing a measurement in the component Analyzer application (option X20). The laser is on when the green LED on the front panel of the instrument is lit.



The use of other optical instruments with this product will increase the hazard to your eyes.

## 1.4. Initial Inspection

Inspect the shipping package for damage. If there is any damage to the container, please keep it until you have checked the contents of the shipment for completeness and verified the external aspect of the instrument. If there are no signs of damage, verify the instrument performance.



If there are any signs of damage to any part of the outer enclosure, do not perform any electrical testing. Please, contact to Zepren Solutions service.



For repair and calibration, the device must be returned to Zepren Solutions service.

## 1.5. Line Power Requirements and Connections

The instrument has a three-wire power cable. This cable is connected directly in the appliance coupler located at the rear of the instrument and to the mains.



Do not remove instrument covers under any circumstances. Components replacement and internal adjustment must be made only by qualified service in Zepren Solutions.



Do not connect AC power until you have verified the line voltage above indicated. Damage to the equipment could result.



To operate with the instrument, it is necessary to switch on the power button located in the front panel of the device. Then a LED on the processing unit is lit



To switch off the instrument press the power button located in the front panel of the device. Then the green LED on the button will not light. Please, note that the power button on the front panel of the instrument does not stop the flow of power to the instrument.



If you need to turn off the power, unplug the instrument at the mains or remove the power cable connector from the appliance coupler at the rear of the device.

The instrument BOSA (complies with overvoltage category II) can operate from the single-phase AC power source that supplies between 100 V and 240 at a frequency range of 50 to 60Hz. The maximum power consumption is 140 W.



## 1.6. Operation Environment

The BOSA instrument has been designed for indoor use only.

The device should be protected from temperature extremes and changes in temperature that might cause condensation within it.

The specified operation temperature range for this device is +15°C to 35°C.



To prevent potential fire or shock hazard do not expose the instrument to rain or other excessive moisture.



To prevent electrical shock, disconnect the instrument from mains before cleaning. Use a dry cloth to clean the external case parts. Do not attempt to clean internally.

## 1.7. Input/Output Connectors

The electrical ports located in the rear of the instrument are showed in the following Figure 1-2 - BOSA rear panel. A brief description of each one is indicated below.

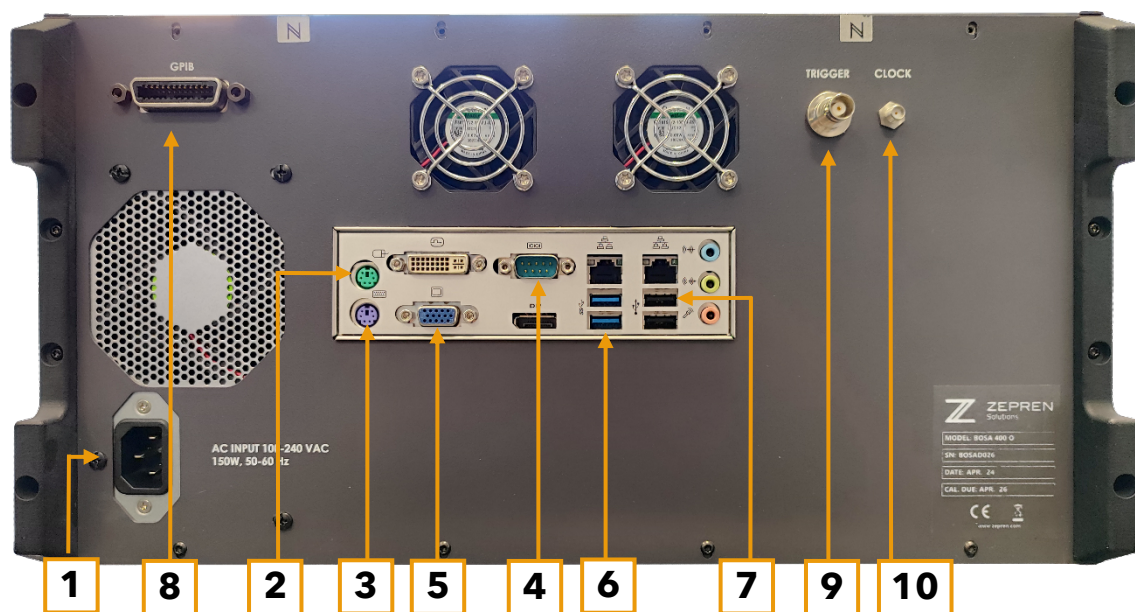


Figure 1-1 - BOSA rear panel

1. Power Cable connector.
2. Mouse connector: standard PS/2 connector.
3. Keyboard connector: standard PS/2 connector.
4. Serial Port.



This port is not available.

5. VGA connector (VGA OUT)
6. USB out ports: a memory stick can be used to export data.



Controller devices must not be connected to these USB ports.

7. RJ 45 connector (Ethernet Port): connector 10/100 base-T. Available port for remote control.
8. GPIB: Available for remote control with SCPI commands.
  - a. BOSA 100 series: port used for communication with the external tunable laser source.
  - b. On other options, it is available under request.
9. BNC TRIGGER:
  - a. Trigger IN (BOSA 100 series): trigger synchronization with the external tunable laser.
  - b. Trigger OUT (BOSA Option X10 and X20): output trigger for the internal tunable laser (for trigger configuration please refer to section 5 "Tunable Laser Source Application")
10. SMA RF Clock (Option X40)
  - a. Synchronization feed required for the phase measurement.

The optical connectors located in the front panel are showed in Figure 1-3. They may change depending on the BOSA option. Unless requested otherwise, all the optical connectors are FC/APC.

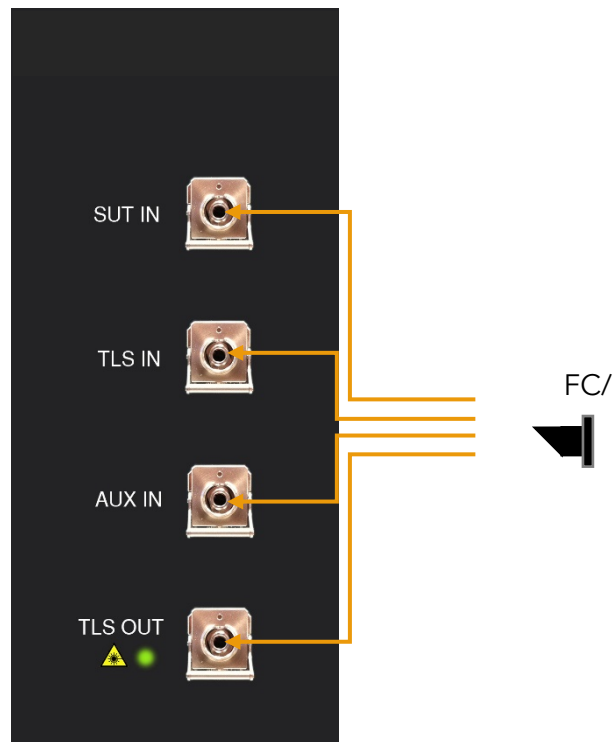


Figure 1-3 – BOSA front panel

The optical connectors located in the front panel are the following:

1. SUT IN: optical input for the signal under test.



The maximum optical power of the signal under test must not exceed the value of +20 dBm.

2. TLS IN (BOSA 100 series): the external tunable laser is connected here.
3. TLS OUT (option X10 and X20): optical output for the internal tunable laser source. A green LED is activated when there is power being output through this connector.



Invisible laser radiation. Do not view directly with optical instruments. Class 1 laser product. Refer to section 1.3 for specific considerations.

4. AUX IN (option X20): Input optical connector for the Component Analyzer application.

For those models which are also used as Tunable Lasers for other HDCA unit, the optical connector TLS IN is replaced for TLS HDCA. A PM patchcord will be used for connecting this port and the HDCA unit TLS IN port.

## 2. What is a BOSA?

The BOSA is a high-resolution optical spectrum analyzer, which measures in real time the optical spectrum of a signal under test (SUT) in the available wavelength ranges (see Specifications) with the main following characteristics:

- Very high optical resolution: 10MHz.
- High Sensitivity: -70dBm/0.1pm.
- Wide dynamic range: >80 dB. All Spurious-free.
- Real time measurement, fast speed

### 2.1. BOSA technology

The BOSA technology utilizing Stimulated Brillouin Scattering (SBS), relies on a pure optical analysis of the SUT transmitted through a nonlinear medium stimulated by a counter-propagating probe laser (TLS) (see Figure 2-1). This process creates the equivalent of an optical filter of Gaussian profile that allows reaching high resolution optical measurements at any span range. This backscattered optical signal is directly detected in a photo detector, processed, and displayed on the screen under the control of an internal computer.



Figure 2-1 - BOSA principle

### 2.2. Applications

In real time, and keeping at the same time high resolution and high dynamic range, it is possible to quickly and easily measure optical spectra of:

- Laser sources: direct modulated, external modulated, pulsed.
- PRBS signals. DWDM signals. RF Photonics.

Where it is possible:

- Identify laser lines, chirp effects, linewidth.
- Show laser drift (wavelength), modulation effects.

The BOSA has a built-in Macro Tool function that allows you to automate measurements process and control via GPIB interface other instruments in your measurement set-up. Alternatively, the BOSA can be remotely controlled over both GPIB bus and the communication network through the Ethernet interface.

NOTE: Signals under test at modulation frequency lower than 25 kHz can derive in optical measurements with optical artefacts appearing in the noise floor.

## 2.3. Some practical considerations

When measuring the optical power spectrum with a very narrow resolution such as the one used in the BOSA, some differences compared with the use of traditional OSAs must be considered:

- In OSAs, signal power corresponds to the peak power for those signals that are narrow compared with the resolution bandwidth. With BOSA even carrier line widths can be of the order of the resolution bandwidth, and of course channels are much wider. In order to avoid underestimation of the total power, the **power integral** of the frequency region should be taken instead of the peak power.
- When the line shape is the target of the measurement and averaging is desired to improve the signal to noise ratio of the measurement, measurement repeatability can be critical. For this purpose, a feature called **trace locking** has been implemented in BOSA application. Trace locking performs a correlation of the actual measured trace with the previous averaged trace and displaces the measured trace so that the correlation is maximum before computing it to obtain the averaged signal.

## 3. Setting up the BOSA

### 3.1. Items included in the shipment

The following items are included in the BOSA shipment:

1. BOSA



The default configuration includes angled FC/APC connectors. The unit may have other type of connectors.

2. Power Cord
3. GPIB Cable (BOSA 100 series)
4. BNC Cable (BOSA 100 series)
5. Polarization Maintaining Fiber patch cord (BOSA 100 series)
6. User Guide
7. Programming Guide

### 3.2. Connecting the BOSA

When operating, the BOSA should be located with a clearance of at least 75 mm in each side and at the rear of the instrument.

Follow the steps described below to properly start up the unit.

1. In case of using an external monitor, it may be connected to the computer VGA connector.
2. The front panel LCD is a touch sensitive screen. In addition, an optical mouse can be connected at the rear panel using the PS2 or USB ports.
3. Connect the BOSA to the electric line using the supplied power cord (Figure 3-1).
4. In case of using an external monitor connect it to the electric line using the proper power cord or adaptor of your country.
5. Turn on the BOSA pressing the power button located in the front panel.



Figure 3-1 - BOSA setup

### 3.2.1. Connecting an external tunable laser (BOSA 100 series)

BOSA 100 series requires the following additional steps in order to properly connect an external tunable laser to the BOSA. Check section **¡Error! No se encuentra el origen de la referencia.** in this manual for a list of compatible external tunable lasers.

- **GPIB Laser**

If the external tunable laser uses the GPIB bus to communicate with the BOSA please follow the next connection procedure:

1. Turn off the BOSA and use the GPIB cable to connect the BOSA unit to the external laser source.
2. Use the BNC cable included in the shipment to connect the "Trigger Input" connector on the rear panel of the BOSA to the "Trigger Output" connector on the laser.
3. Use the polarization maintaining fiber included in the shipment to connect the external laser optical output to the "TLS Input" on the front panel of the BOSA.
4. Turn on the BOSA.

- **USB Laser (Luna)**

The installation of a USB laser must be carried out with the BOSA unit turned on. Please refer to section 3.4 and then continue with the following steps. The installation process is basically the same one described in the Phoenix laser manual but substituting the default installation directory by "C:\Program Files\ZEPREN\Luna". The detailed installation process is described:



1. Turn on the BOSA unit without making any connection between the laser and the unit.
2. Go to the "Application Selector Screen" (see section 3.4). Go to help->Software Update and click on "USB TLS Installation". A warning message will appear indicating that the BOSA application will be closed.



Once the BOSA application is closed the user has full access to the operating system ONLY for TLS installation purposes. Do not perform any other operation apart from the ones described in this manual. Zepren Solutions is not responsible of any malfunction derived from additional actions performed in the operating system.

3. Copy the laser drivers in a USB stick from the CD of the manufacturer. Plug the USB stick in a USB port of the rear panel of the BOSA. Open the Phoenix 1400 folder, run setup.exe and follow on-screen instructions. **When asked for an installation directory use "Program Files\ZEPREN\Luna".**

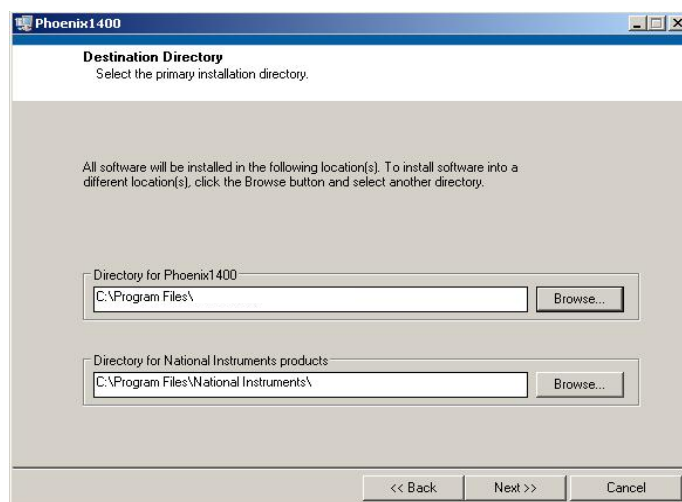


Figure 3-2 - Directory for Luna drivers installation

4. After finishing the installation, connect the laser and the BOSA using a USB cable and turn on the laser.
5. After a few moments the BOSA will automatically detect the device and display the "Found New Hardware Wizard".
6. Select "No, not this time" option and click the "Next" button to continue.
7. Select the "Install from a list or specific location (Advance)" option and click the "Next" button.
8. Select the "Search for the best driver in these locations" option and check the "Include this location in the search" checkbox. Click the "Browse" button and select the folder **"C:\Program Files\ZEPREN\Luna\USB\_Drivers"**. Click "Next".
9. Another dialog box will alert the user to wait while the Wizard searches.
10. An alert dialog will be display. Click "Continue Anyway" button to proceed.



11. If any other file is required select the driver installation directory (**C:\Program Files\ZEPREN\Luna\USB\_Drivers**) using the "browse" button.
12. In the last window click "Finish" button to complete installation of the driver.
13. Turn off the BOSA. Remove the USB stick previously plugged in step 3.
14. Use the BNC cable included in the shipment to connect the "Trigger Input" connector on the rear panel of the BOSA to the "Trigger Output" connector on the laser.
15. Use the polarization maintaining fiber included in the shipment to connect the external laser optical output to the "TLS Input" on the front panel of the BOSA.
16. Turn on the BOSA.



This installation procedure must be repeated for different TLS units. If only one TLS unit is used the installation process needs to be carried out just once, even if different USB ports of the BOSA are used.

### 3.3. Turning on the BOSA

When the BOSA unit starts an OS based in Windows 10 is launched. After a few seconds a User Account selector screen appears with two options:

- **ZEPREN Support:** password protected account for remote support and administration purposes. Not accessible by the user.
- **BOSA:** password protected account for the use of the BOSA application. By default, the password is "**ZSB21**", it can be changed afterwards in the application selector screen, see section 3.4.2.

### 3.4. Application selector screen

Once the BOSA unit is started an application selector screen appears. It is possible to select between several applications depending on the BOSA option.



Figure 3-3 - Application Selector Screen

1. BOSA: runs the High-Resolution Optical Spectrum Analyzer application (see section 4).
2. Tunable laser: runs the internal tunable laser application (see section 5).



Invisible laser radiation. Do not view directly with optical instruments. Class 1 laser product. Refer to section 1.3 for specific considerations.

3. Component analyzer: runs the Component Analyzer application (see section 5).



Invisible laser radiation. Do not view directly with optical instruments. Class 1 laser product. Refer to section 1.3 for specific considerations.

4. BOSA PHASE: runs the phase measurement application (see section 8).

The application selector screen is always accessible from any of the applications through the Exit to App Selector button located in the System menu.

### 3.4.1. Application by default

It is possible to configure a specific application to automatically run on BOSA start up. The "Configure" dialog box is accessible through the set-up menu.

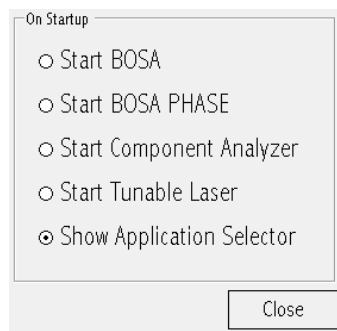
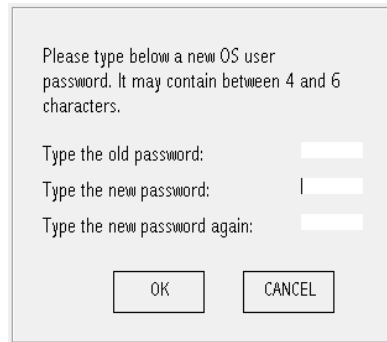


Figure 3-4 - Configure default application dialog box.

### 3.4.2. Change user password

It is possible to change the default User account password in the BOSA. Click in SetUp->Change User Password and introduce the required information.



Please type below a new OS user password. It may contain between 4 and 6 characters.

Type the old password:

Type the new password:

Type the new password again:

OK CANCEL

Figure 3-5 - Change or set the password of the User account.

### 3.4.3. Updates and installation

Zepren Solution may eventually share software upgrades to add new functionalities to the existing equipment. The BOSA may be updated by inserting a USB pen drive containing the ".msi" file provided by Zepren Solutions. User can upgrade the software by clicking on the Help -> Software Update menu.

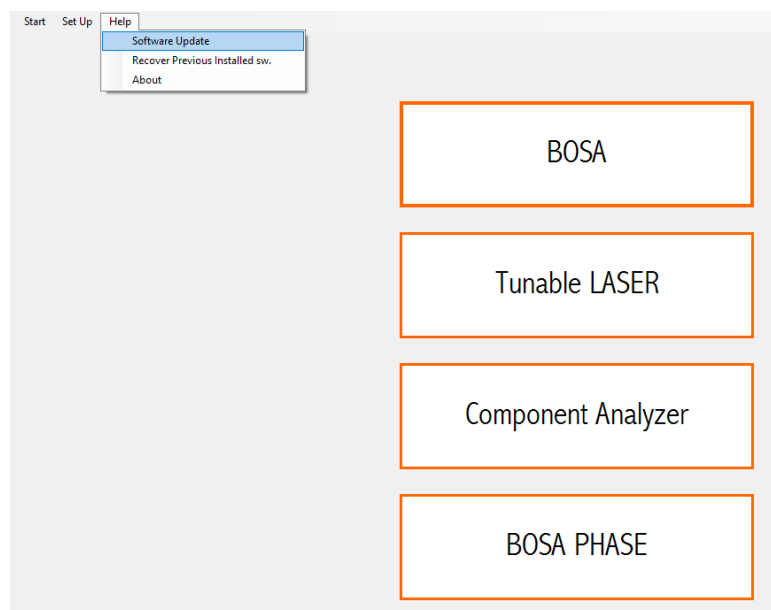


Figure 3-6 - BOSA software upgrade menu.

## 4. BOSA: High Resolution Optical Spectrum Analyzer

### 4.1. Graphical User Interface

In this chapter, the user interface of the BOSA is presented. All menu options and user keys are summarized. Next, a brief description of each feature is made for the ease of understanding.

#### 4.1.1. Interface Keys Overview

The interface is composed of two main areas, as shown in Figure 4.1. These are: Button Bar and Measurement Area. The measurement area includes the measurement representation, context menu, current measurement settings and markers information.

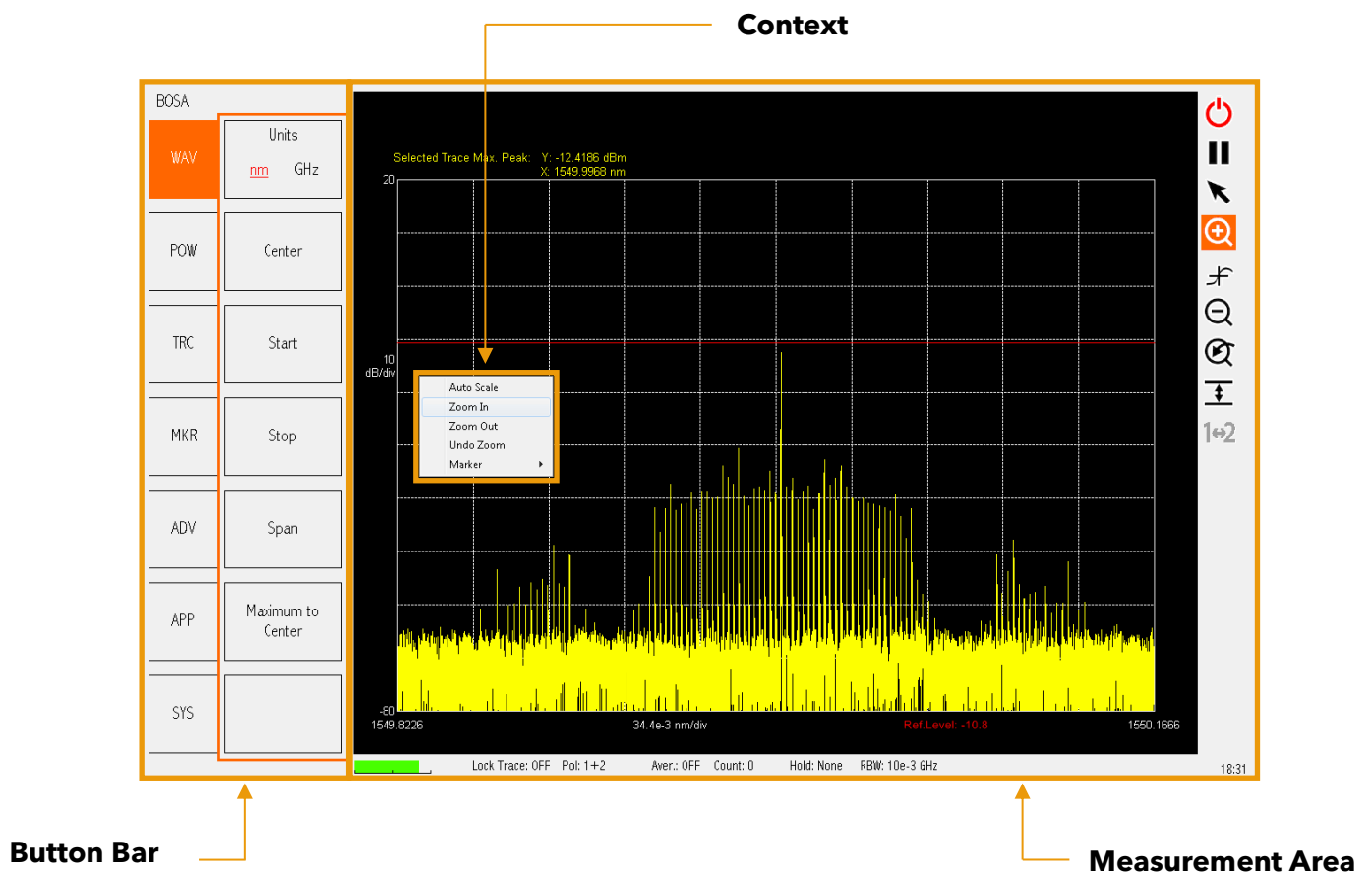


Figure 4-1 - BOSA user interface

#### 4.1.1.1. The Measurement Area

The measurement area shows the optical spectrum of the current Signal under Test (SUT). Results are offered via traces and numerical data. In Figure 4-2 the trace plotting area is represented.

The measurement area can be further divided into a graphical representation area, data collection area, operation parameters area and quick function bar.

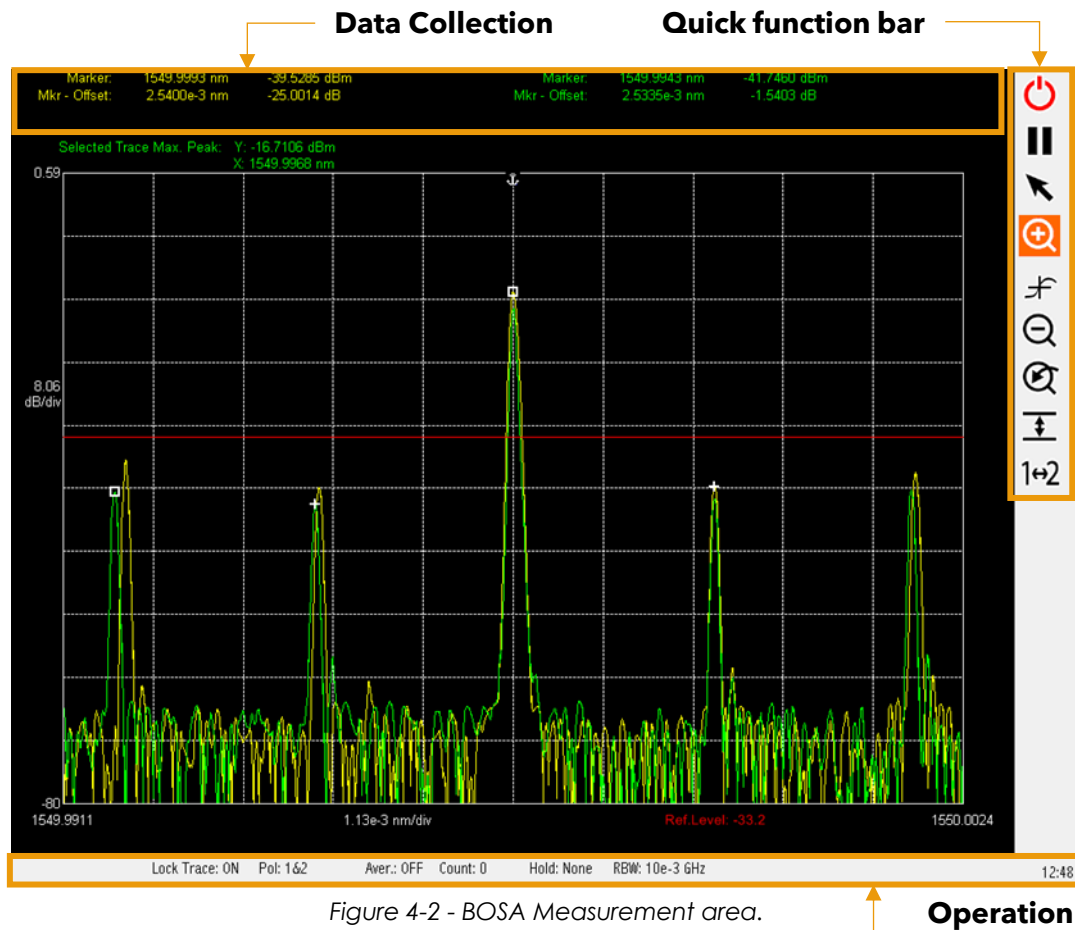


Figure 4-2 - BOSA Measurement area.

- **Data collection area** in the top side of the measurement area shows markers information (optical power and wavelength) for traces.
- **Operation parameters area** the lower part of the measurement area shows information about the operation conditions of the system such as resolution bandwidth, polarization control, average state and hold function stage (refers to Figure 4-2). A power bar indicates the optical power level of the SUT. Any internal error will be output at the right in this area (please refer to 14.1 Error Messages for details).
- **Quick function bar** at the top right of the measurement area which allows the user to perform commonly used actions in an easy way.

Quick bar description:

|                                                                                     |                                                                                                                                                                                                                                    |
|-------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|    | No mode is selected                                                                                                                                                                                                                |
|    | Sets the zoom-in mode. The representation area on a chart can be amplified by a click and drag operation.                                                                                                                          |
|    | Places a marker on the trace.                                                                                                                                                                                                      |
|    | Extends the wavelength representation range by a factor of two.                                                                                                                                                                    |
|    | Undoes up to three zooming actions.                                                                                                                                                                                                |
|    | Fits the vertical axis to the displayed data.                                                                                                                                                                                      |
|    | Switches among active traces in the chart.                                                                                                                                                                                         |
|   | Freezes the current measurement on the screen. The unit is fully working in second plane, but the data is not displayed.                                                                                                           |
|  | Allows the user to start or stop the current measurement at any time. Even when stopped, the configuration parameters of the BOSA can be modified; if the measurement is later initialized, the new parameter values will be used. |

- **Graphical representation area** where the current SUT spectrum is plotted. Attached to the graph the following measurement conditions are indicated:
  1. Reference Level information
  2. Scales per division for both power and wavelength

When the Total Power is selected, the power Integral value and the integration width is indicated in the top left corner of the grid in orange color.

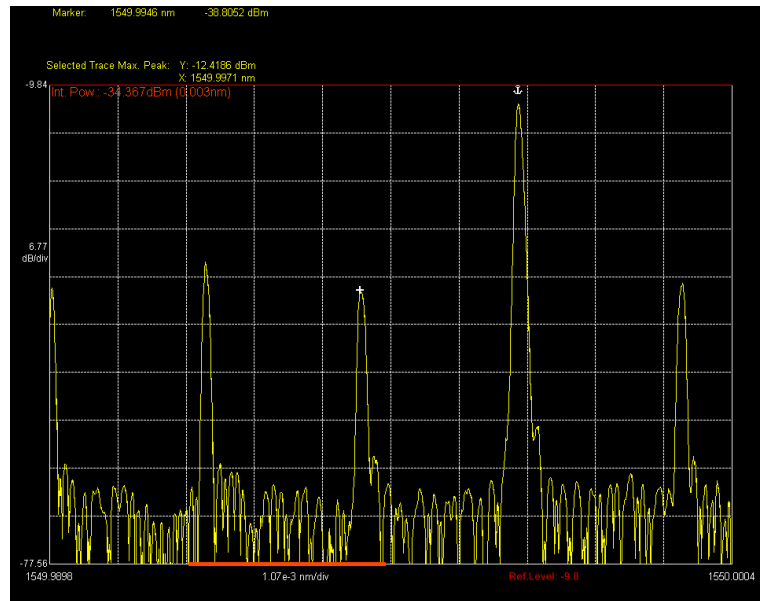


Figure 4-3 - BOSA Graphical representation area

It is possible to view several traces simultaneously, a live trace (Trace A) and loaded traces identified as Trace M1 to Trace M4. Markers can also be added to active traces and can be shifted just by clicking and dragging the mouse pointer over them.

In the operation parameters area, some related parameters are shown. These include:

1. Device Status (i.e. starting, calibrating,...)
2. Power bar for optical power level of the SUT.
3. Resolution bandwidth.
4. Polarization control information, averaging information and holding function state.
5. Time.

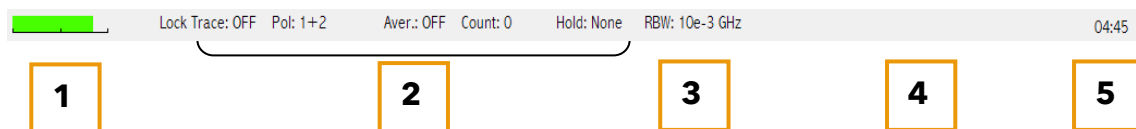


Figure 4-4 - BOSA operation parameters area.

#### 4.1.1.2. The button bar

The Button Bar encompasses user keys related to Wavelength, Optical Power, Markers, Traces, Advanced and System issues, respectively. Following figures show the button tree diagram of the BOSA.

## Button bar description

The button bar contains all user keys related to the measurement options. From the main bar the user can set all the operation parameters of the BOSA by means of the touch sensitive screen or using a mouse.

Those options which require data to be typed in, display an emerging keyboard. This allows the use of the system without the need of an external keyboard. Changes can be confirmed with the "Apply" button or dismissed by clicking "Cancel" button or clicking outside the keyboard. Note that it is always possible to type the data using an external keyboard.

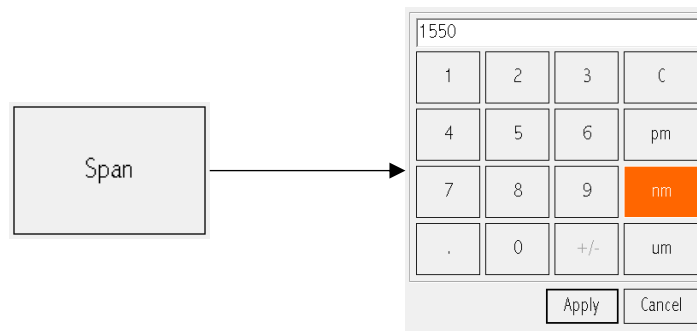


Figure 4-5 - Keyboard.

Some buttons allow the user to choose between different options. By pressing the button, all the options are consecutively activated. These are called Option Buttons.

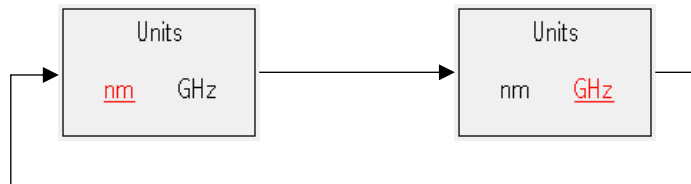


Figure 4-6 - Example of option button.



#### 4.1.1.2.1. Wavelength button

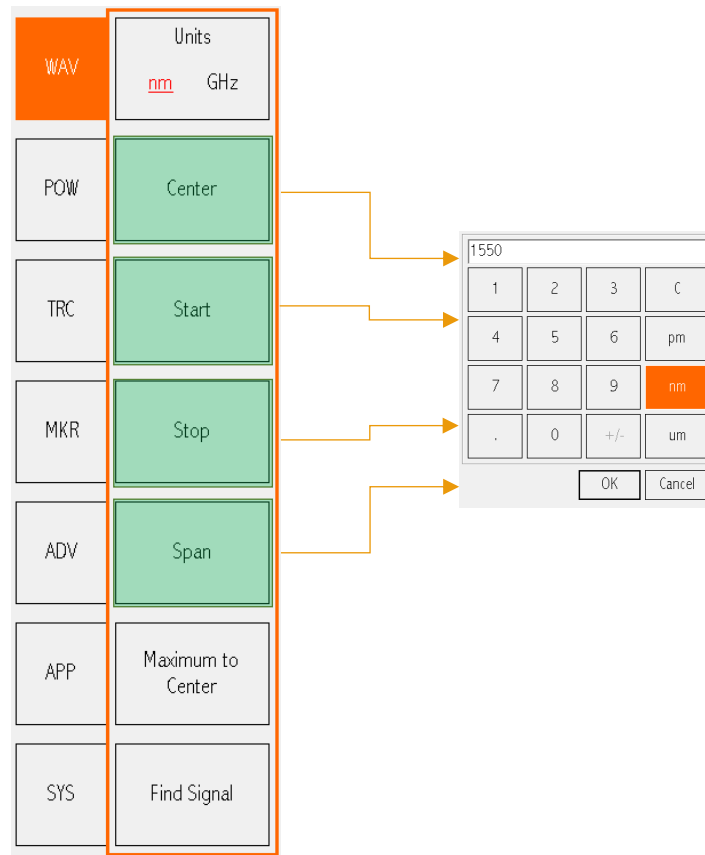


Figure 4-7 - BOSA wavelength button bar tree diagram.

## Wavelength Submenu

|                                       |                                                                                                                                                                                                                                                       |
|---------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <div>Units</div> <div>nm    GHz</div> | <p>This is an option button. Changes the units of the horizontal axis from nm to GHz or vice versa. All the information in the button bar or data collection area related to the horizontal axis is properly switched to the current scale units.</p> |
| <div>Center</div>                     | <p>Sets the central value for the wavelength or frequency to be represented.</p>                                                                                                                                                                      |
| <div>Start</div>                      | <p>Sets the initial wavelength or frequency value for the measurement range.</p>                                                                                                                                                                      |
| <div>Stop</div>                       | <p>Sets the final wavelength or frequency value for the measurement range.</p>                                                                                                                                                                        |
| <div>Span</div>                       | <p>Sets the total measurement range.</p>                                                                                                                                                                                                              |
| <div>Maximum to Center</div>          | <p>Shifts the wavelength or frequency range in order to represent the maximum power peak of the current trace at the center of the plotting area.</p>                                                                                                 |
| <div>Find Signal</div>                | <p>Performs a sweep of the maximum span and automatically centers the wavelength of the signal.</p>                                                                                                                                                   |

#### 4.1.1.2.2. Power button

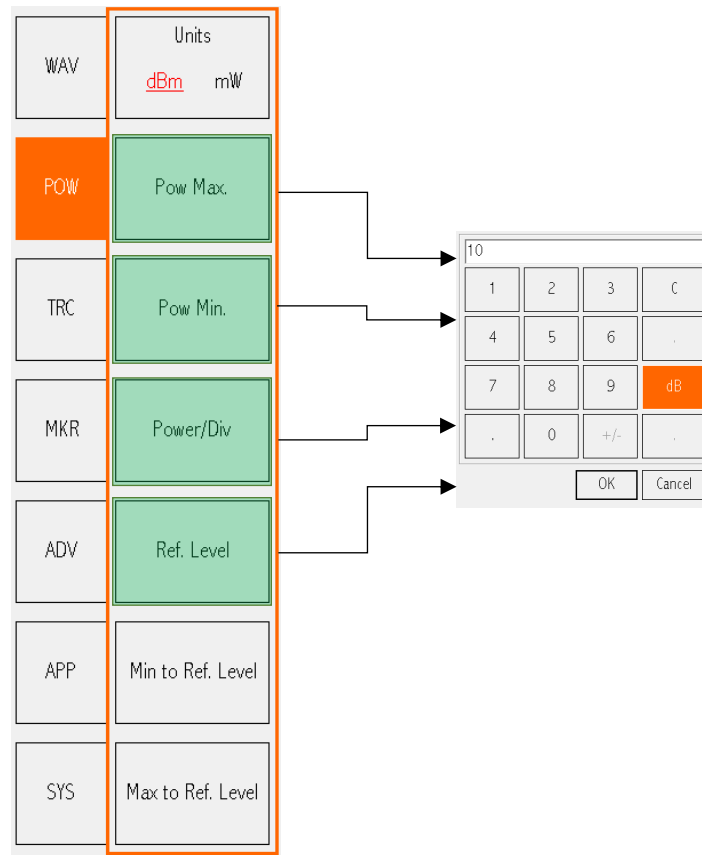
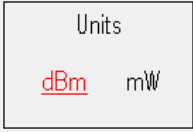
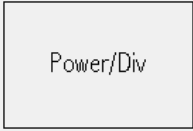
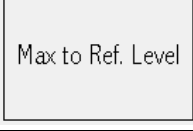


Figure 4-8 - BOSA Power button bar tree diagram.

## Optical Power Submenu

|                                                                                     |                                                                                                                                                                                                                                                                                         |
|-------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|    | <p>This is an option button. It changes the units of the vertical axis from dBm to mW or vice versa.</p> <p>NOTE: The grid is always divided into 10 parts. Besides, when measuring in dBm the maximum does not change and when measuring in mW the minimum does not change either.</p> |
|    | <p>Sets the scale factor of the vertical axis. Power axis is rescaled with the indicated power per division.</p>                                                                                                                                                                        |
|    | <p>"Pow Max" sets the maximum value of the power axis.</p>                                                                                                                                                                                                                              |
|    | <p>"Pow Min" sets the minimum value of the power axis.</p>                                                                                                                                                                                                                              |
|   | <p>Sets the power value of the reference level.</p>                                                                                                                                                                                                                                     |
|  | <p>Makes the minimum vertical axis value equal to the reference level.</p>                                                                                                                                                                                                              |
|  | <p>Makes the maximum vertical axis value equal to the reference level.</p>                                                                                                                                                                                                              |

### 4.1.1.2.3. Traces button

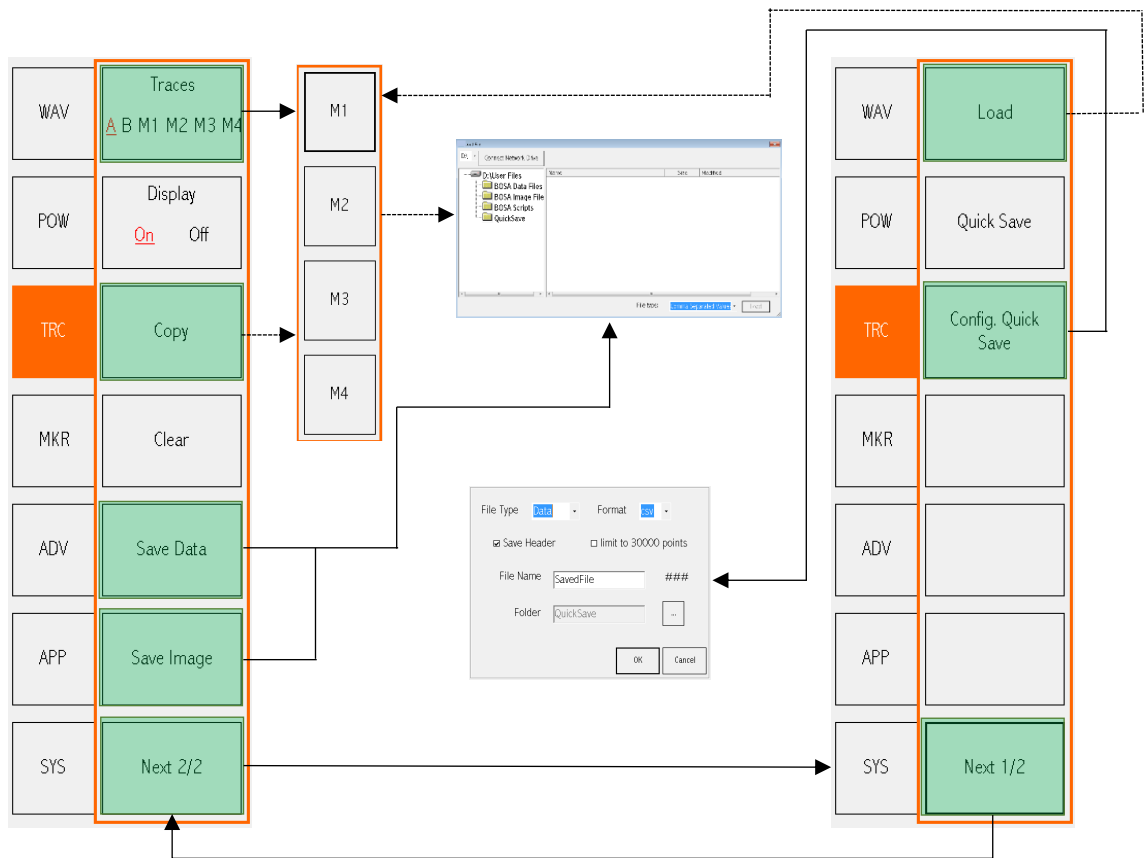


Figure 4-9 - BOSA Traces button bar tree diagram.

## Traces submenu

The spectra of the current measured SUT will be displayed in yellow.

|                                              |                                                                                                                                                                                     |
|----------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <div>Traces</div> <div>A B M1 M2 M3 M4</div> | <p>Changes the active trace among the measured traces, A and B, and the stored memories, M1 M2 M3 M4 when used. The application reserves the trace A and B for the polarization</p> |
| <div>Display</div> <div>On Off</div>         | <p>Enables or disables the display of the current memory trace.</p>                                                                                                                 |
| <div>Copy</div>                              | <p>Performs a copy of the active trace A or B to the trace selected through the displayed menu.</p>                                                                                 |
| <div>Load</div>                              | <p>Loads a data file, previously saved by the user (in local or external disc), in the trace selected through the displayed menu.</p>                                               |
| <div>Clear</div>                             | <p>Clears the active trace.</p>                                                                                                                                                     |
| <div>Save Data</div>                         | <p>Opens a new windows form to save the active trace. Available formats are: .bdf, .txt, csv. More information in section 4.2.4.</p>                                                |
| <div>Save Image</div>                        | <p>Opens a new windows form to save the image displayed in the measurement area. Available formats are jpeg, bitmap, gif or tiff image formats.</p>                                 |
| <div>Quick Save</div>                        | <p>Performs a Quick Save operation in one click in the conditions set in Config. Quick Save button.</p>                                                                             |
| <div>Config. Quick Save</div>                | <p>Displays a dialog box to set the way in which the Quick Save operation is performed: File type, format, name, folder.</p>                                                        |

#### 4.1.1.2.4. Markers button

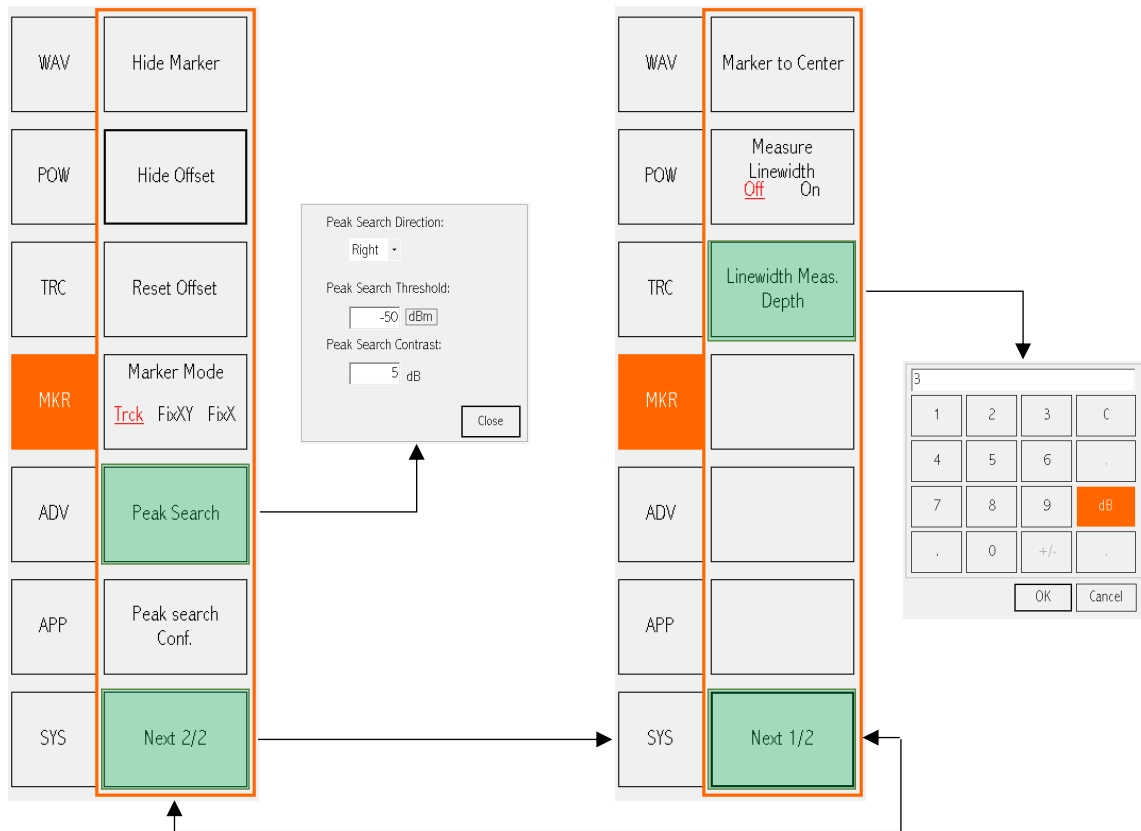


Figure 4-10 - BOSA Markers button bar tree diagram.

## Markers submenu

One marker and its offset can be placed on any of the two traces.

|                                |                                                                                                                                                                                                                                                             |
|--------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Show Marker                    | Shows or hides a marker on the active trace. It is represented on the chart with a cross. Automatically the data appears on the data section on top of chart.                                                                                               |
| Show Offset                    | Shows or hides the offset of a marker. It is represented on the chart with a square. Data appears on the data section on top of chart together with marker-offset information.                                                                              |
| Reset Offset                   | Sets the offset to zero and the square is placed at the same position of the marker.                                                                                                                                                                        |
| Marker Mode<br>Trck FixXY FixX | This is an option button. Three options are allowed: <ul style="list-style-type: none"> <li>Trck: the marker tracks the peak.</li> <li>Fix XY: the marker is fixed in the screen.</li> <li>Fix X: marker is fixed in X axis and updates Y value.</li> </ul> |
| Peak Search                    | Moves the active marker to the next peak. The criteria of peak searching are defined through Peak Search Configuration button.                                                                                                                              |
| Peak search Conf.              | Opens a new window that allows user to configure the peak searching criteria. Detailed description available at 4.3.1.4.                                                                                                                                    |
| Marker to Center               | Moves the center of the screen to the position of the active marker.                                                                                                                                                                                        |
| Measure Linewidth<br>Off On    | This is an option button. When ON, the linewidth of the peak selected with the marker is displayed above the measurement area after a "LW X dB:" label, where X is the value configured with the "linewidth measurement depth" window.                      |
| Linewidth Meas. Depth          | Opens a new window that allows configuration of the depth level at which linewidth value is calculated.                                                                                                                                                     |



#### 4.1.1.2.5. Advanced button

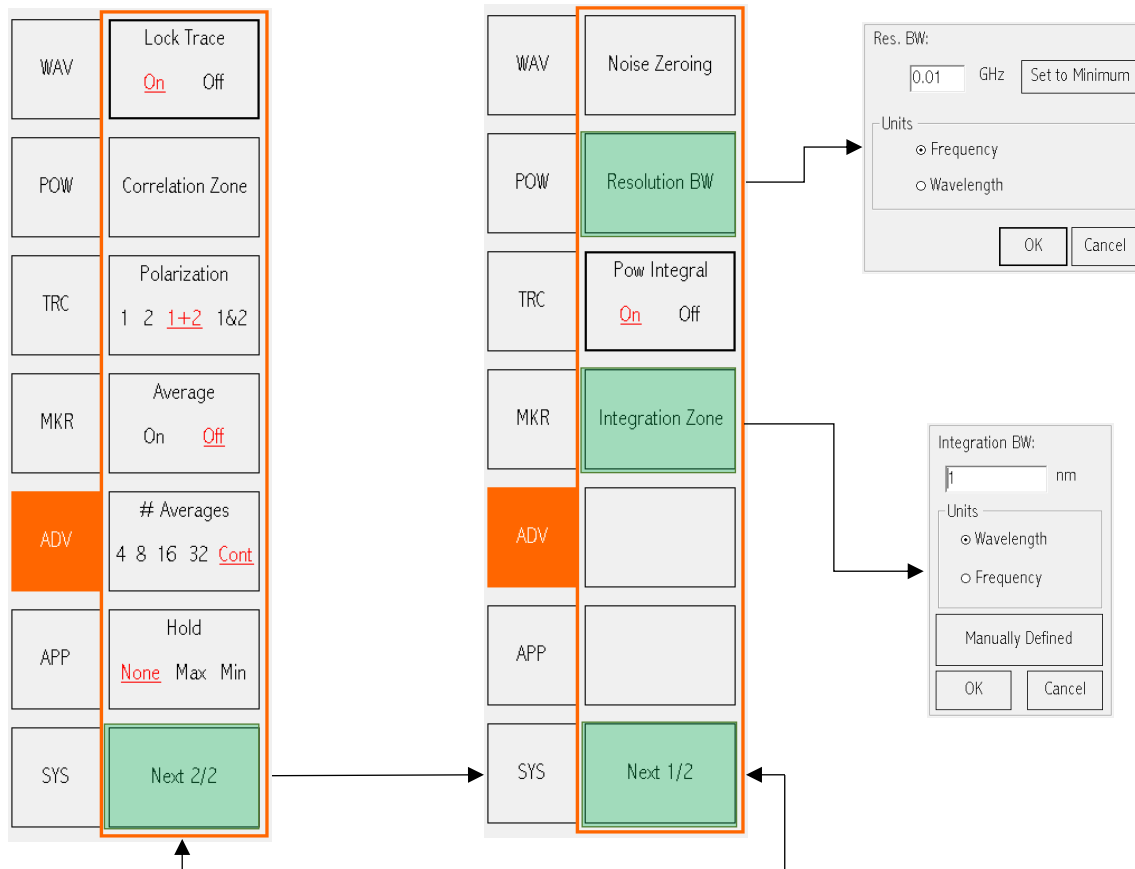


Figure 4-11 - BOSA Advanced button bar tree diagram.

## Advanced submenu

|                                                    |                                                                                                                                                                                   |
|----------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <div>Lock Trace</div> <div>On Off</div>            | <p>This is an option button. It provides a procedure to avoid trace fading when averaging. This is done defining a correlation zone.</p>                                          |
| <div>Correlation Zone</div>                        | <p>This button changes the mouse mode to "click and drag" mode. By clicking the measurement area, the center of the correlation zone is defined.</p>                              |
| <div>Polarization</div> <div>1 2 1+2 1&amp;2</div> | <p>This is an option button. 1, 2 or 1&amp;2 show the two orthogonal polarization measurements separately or together. 1+2 provides highest power accuracy.</p>                   |
| <div>Average</div> <div>On Off</div>               | <p>This is an option button. It performs trace averaging for noise reduction purposes.</p>                                                                                        |
| <div># Averages</div> <div>4 8 16 32 Cont</div>    | <p>This is an option button. Five averaging modes are available: 4, 8, 16, 32 traces averaging and continuous averaging.</p>                                                      |
| <div>Noise Zeroing</div>                           | <p>Takes an instantaneous update of the noise floor pattern measurement performing a noise correction in the current measurement.</p>                                             |
| <div>Hold</div> <div>None Max Min</div>            | <p>This is an option button. It compares consecutive sweeps and shows the maximum or minimum for each point of the trace.</p>                                                     |
| <div>Resolution BW</div>                           | <p>Only for representation purposes the video bandwidth resolution of the measurement can be changed. Note that the optical resolution of the unit is not changed.</p>            |
| <div>Pow Integral</div> <div>On Off</div>          | <p>This is an option button. It integrates the optical power of the active trace under a spectral region defined as integration zone.</p>                                         |
| <div>Integration Zone</div>                        | <p>Refers to the spectral region where the Total Power function is performed. This zone is selected manually after drag operation with the mouse or typing the desired value.</p> |

#### 4.1.1.2.6. Applications button

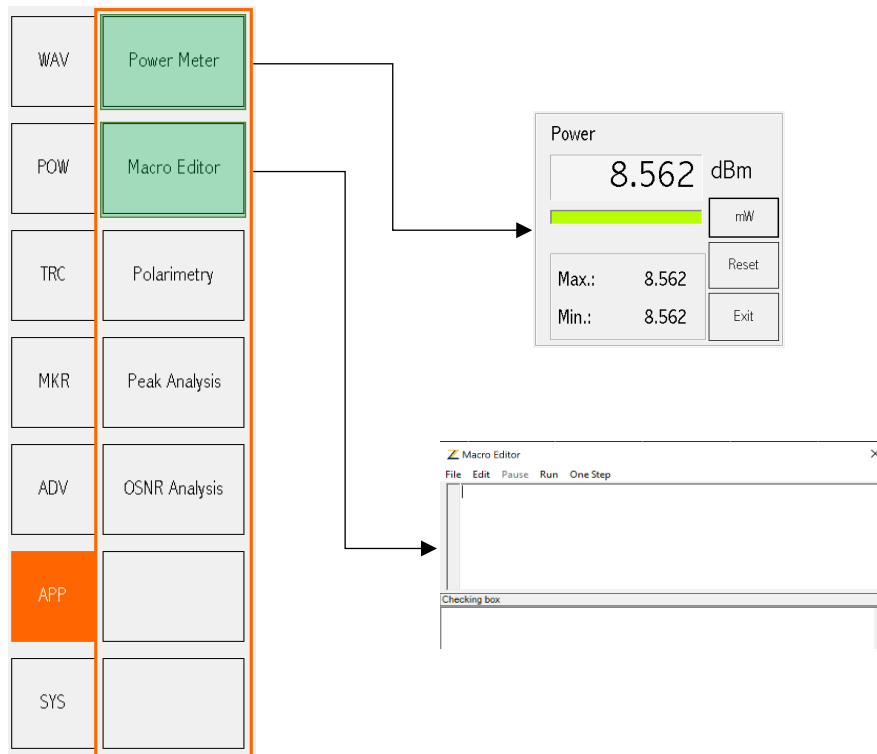


Figure 4-12 - BOSA Applications button bar tree diagram.

#### Applications submenu

|               |                                                                                                                                                                                                                                                                                                                              |
|---------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Power Meter   | Displays the power meter application which measures the optical power value of the SUT. Only available while RUN/STOP button displays "RUN" (BOSA stopped).                                                                                                                                                                  |
| Macro Editor  | This application allows the user to perform automatic measurements and procedures in the BOSA. Moreover, the unit can control other external devices through GPIB protocol. Please, refer to section <b>¡Error! No se encuentra el origen de la referencia.</b> of this guide and "BOSA Programming Guide" for more details. |
| Polarimetry   | Only in BOSA option X30. This application allows the user to perform polarimetry measurements. For more details go to section 7.                                                                                                                                                                                             |
| Peak Analysis | Displays the Peak Analysis application for the identification and analysis of multiple peaks in the active measurement. Detail description in section 4.3.1.                                                                                                                                                                 |

|               |                                                                                                                              |
|---------------|------------------------------------------------------------------------------------------------------------------------------|
| OSNR Analysis | Displays the OSNR Analysis application for the signal characterization. Detail description and information in section 4.3.2. |
|---------------|------------------------------------------------------------------------------------------------------------------------------|

#### 4.1.1.2.7. System button

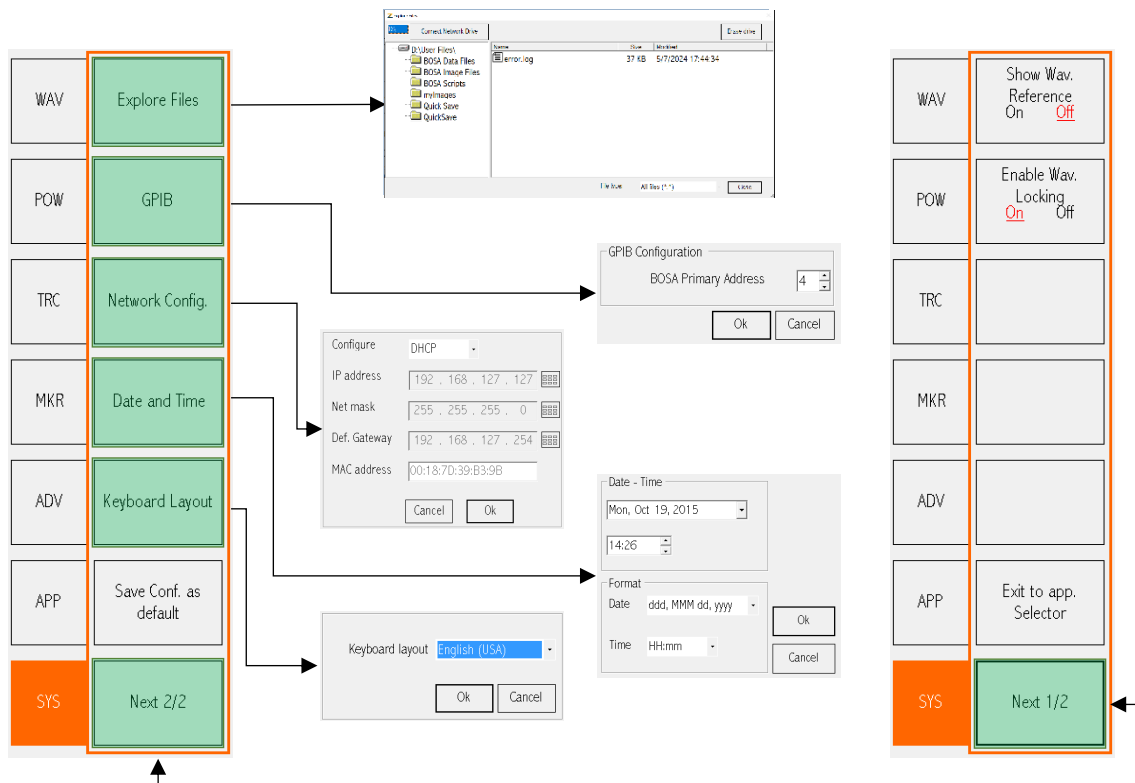


Figure 4-13 - BOSA System bar tree diagram.

## System submenu

|                               |                                                                                                                                                                                                   |
|-------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Explore Files                 | Manages the user files. Allows user to delete files, create new folders, rename files or move them to USB stick. It also allows to connect to a network drive (see section 9.3)                   |
| Save Conf. as default         | Saves the current measurement configuration (X axis, Y axis) to be set up the next time the BOSA is started.                                                                                      |
| Network Config.               | Displays a dialog box to configure the network allowing remote access to the BOSA.                                                                                                                |
| GPIB                          | Pops up a dialog box to configure the GPIB properties.                                                                                                                                            |
| Date and Time                 | Shows data and time information.                                                                                                                                                                  |
| Keyboard Layout               | Allows the user to select the keyboard layout.                                                                                                                                                    |
| Show Wav. Reference<br>On Off | Displays the absorption spectrum of the internal gas cell. See Appendix I for details.                                                                                                            |
| Enable Wav. Locking<br>On Off | Enables continuous wavelength correction based on the internal gas cell. For small spans, less than absorption lines separation, this function may not work properly. See Appendix I for details. |
| Exit to app. Selector         | Exits to the application selector screen.                                                                                                                                                         |

### 4.1.1.3. The Context Menu

The Context Menu appears when right-clicking on the graphical representation area, and comprises some important user keys related to the representation itself and is only accessible when using an external mouse.

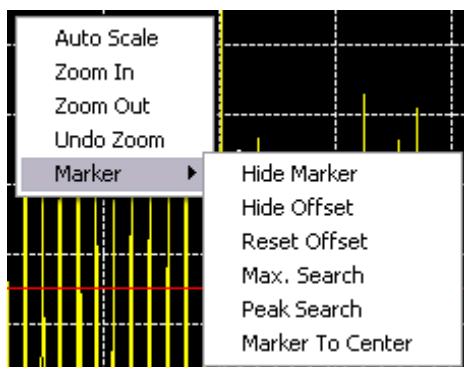


Figure 4-14 - BOSA Context Menu

#### Context Menu description

The context menu contains interface keys related to the graphical representation itself.

|                                     |                                                                                                      |
|-------------------------------------|------------------------------------------------------------------------------------------------------|
| <i>Auto Scale</i>                   | Performs an auto scale operation in the vertical axis of the chart                                   |
| <i>Zoom In</i>                      | Enables the zoom mode to perform a zoom-in operation                                                 |
| <i>Zoom Out</i>                     | Performs a zoom-out operation on the chart                                                           |
| <i>Undo Zoom</i>                    | Retrieves the previous axis configuration on the chart                                               |
| <i>Marker-&gt; Show Marker</i>      | Shows or hides a marker on the active trace                                                          |
| <i>Marker-&gt; Show Offset</i>      | Shows a marker offset to obtain relative measurements                                                |
| <i>Marker-&gt; Reset Offset</i>     | Sets the offset to zero and moves the square symbol of the offset to the marker position             |
| <i>Marker-&gt; Max Search</i>       | Moves the marker to the maximum value of the display data                                            |
| <i>Marker-&gt; Peak Search</i>      | Moves the marker to the position of the next peak                                                    |
| <i>Marker-&gt; Marker to Center</i> | Changes the horizontal axis configuration to set the marker in the center of the representation area |

#### 4.1.1.4. Interfaces shortcuts

Some of the configuration parameters can be easily changed through the active zones of the graphical interface. By double clicking in these zones, marked in Figure 4-15, the application opens the corresponding menu to set the value of the related parameter.

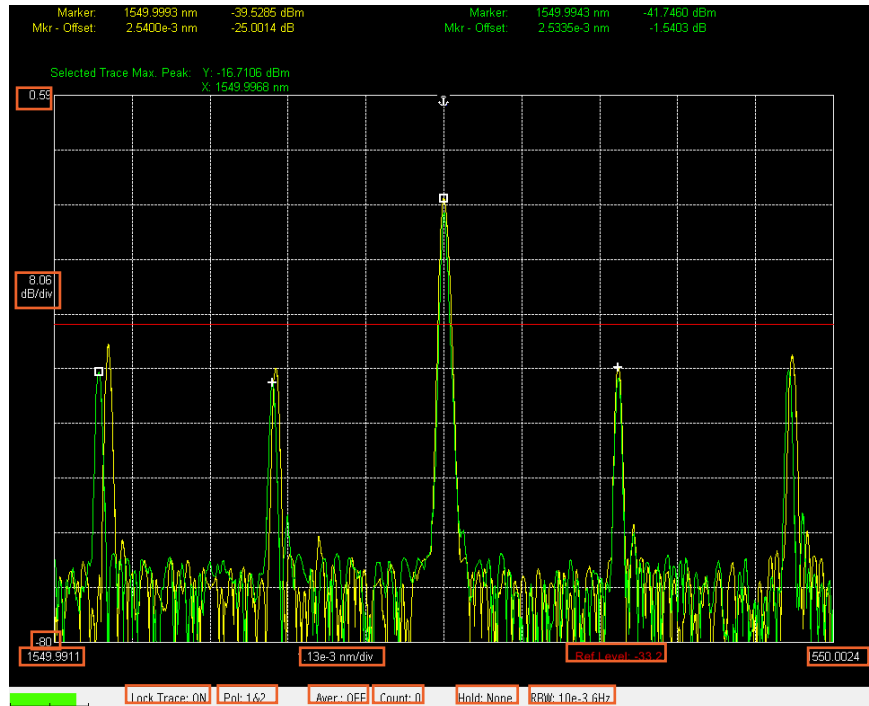


Figure 4-15 - BOSA Graphical Interface shortcuts.

## 4.2. Taking measurements

### 4.2.1. Hooking Up the Signal Under Test (SUT)

Using a single mode fiber optic patch cord, connect the signal under test to the optical front panel input connector, identified as SUT IN. Make sure that the connectors are clean and undamaged. In the operation parameters area, a bar indicates the optical power level of the SUT.



If the power level of the SUT is higher than +13 dBm the power meter will be saturated. On the contrary, if the power level of the SUT is too low the label SUT signal input loss appears close to the power bar.



Check the connector type for SUT before connecting it. Unless requested otherwise, the input connector type of the BOSA is FC/APC.

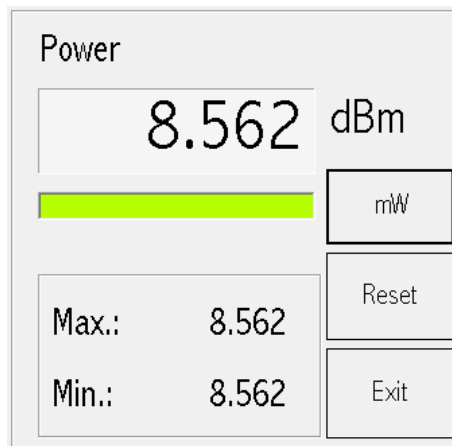


Figure 4-16 - SUT Power Meter.

#### 4.2.2. Viewing the SUT Trace

Prepare the instrument to make measurements as explained in section 3 "Setting up the BOSA". Measurements require to press the Run button placed on the top right corner to start.

If the optical spectrum is not viewed set the start and stop wavelength accordingly in the wavelength tab.

**NOTE:** Noise Zeroing in the Advanced submenu is a function that allows user to update instantly the noise pattern. In the next sweep a new noise background will be taken improving the noise pattern.

**NOTE:** The current measurement can be stopped at any time by pressing the OFF button, which is located at the right top corner of the screen. Later, the measurement can be continued by pressing the ON button.

#### 4.2.3. Making measurement with Averaging function

It is possible to reduce the noise in the spectrum using the Averaging function.

1. Select the Advanced submenu.
2. Choose the average count (4, 8, 16, 32 or Continuous) pressing #Averages button.
3. Activate the average process pressing Average button.

It is possible to see some trace fading when averaging. In this case, it is recommendable to lock the trace before averaging. There are two options.

##### Option 1:

1. Select the Advanced submenu.
2. Set Lock Trace button On. The main visible peak is locked and this will avoid trace fading when averaging.



3. Choose the average count (4, 8, 16, 32 or Continuous) pressing #Averages button.
4. Activate the average process pressing Average button.

**Option 2:**

1. Select the Advanced submenu.
2. Press the Correlation Zone button. This option allows the user to select the region to be locked through a click and drag operation.
3. Set Lock trace button On.
4. Choose the average count to make (4, 8, 16, 32 or Continuous).
5. Activate the average process pressing Average button.

This option is recommendable when you wish to get definitive results.

#### 4.2.4. Saving and loading measurements

##### 4.2.4.1. Save

1. Select Traces submenu and press Save button.
2. Select Save Data or Image button.
3. Choose the format you wish to use for saving the measurement.
4. Enter a filename and choose the destination for the saved measurement.
5. Press OK button.

**Save data:**

Opens a new windows form to save the active trace. Available formats are:

- .bdf/.bin: binary format.
- .txt: it is a text file which can be opened by any text editor.
- .csv: comma separated values file. Wavelength and power values are saved in each row separated by a comma.

The total number of points in the current view will be saved. Note that some widely used applications present limitations on the number of points to be managed. A down sampling to 44000 points can be set in the Save window.

**Save image:**

Opens a new windows form to save the image displayed in the measurement area. Available formats are jpeg, bitmap, gif or tiff image formats. Please consider that jpeg format will not preserve the level of quality displayed in the screen.

##### 4.2.4.2. Quick save

Before performing a quick save, it is possible to configure it.

1. Select Traces submenu.
2. Select the Configure Quick Save option.
3. Select the File Type and Format.
4. Write the File name.
5. Select the Folder.
6. Press OK button.

To perform a Quick Save, proceed as below:

1. Select Traces submenu.
2. Select the Quick Save option.

The measurement is automatically saved with the configuration defined in Configure Quick Save.

#### **4.2.4.3. Load**

In order to load data, follow the next steps:

1. Select Traces in the main button bar.
2. Select the Load option.
3. Select the drive.
4. Select the file you wish to load and press OK button.

### **4.3. Applications**

#### **4.3.1. Peak Analysis**

The peak analysis application provides fast and dynamic measurement of multiple peaks in a live signal. Based on the threshold level set by the user, the system locates all the peaks in the span and displays their information.

##### **4.3.1.1. Interface description**

The application presents all the identified peaks by setting individual markers in all of them. In the right side of the display, all the information is sorted and presented in a table according to the units set by the user.

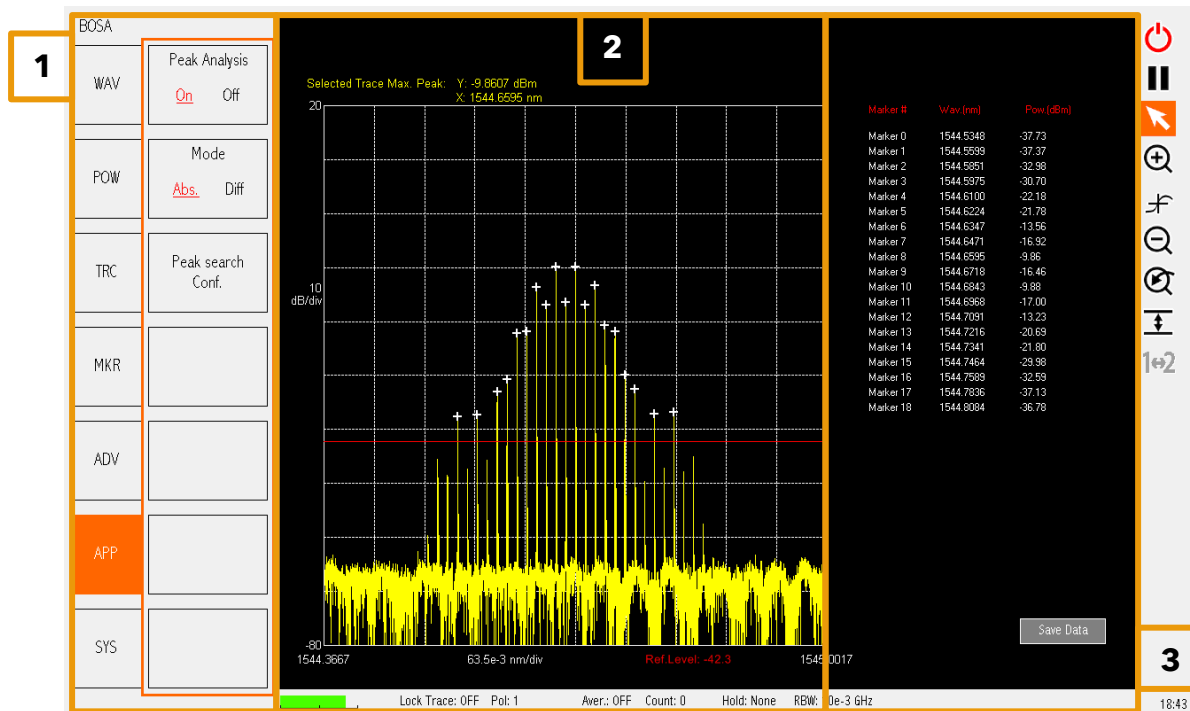


Figure 4-17 - BOSA Peak Analysis Interface.

#### 4.3.1.2. GUI Area Description

- 1** Specific buttons for the peak analysis application are located here. See below interface keys description for more details.
- 2** Spectrum measurement area. All the identified peaks will be marked in this area based on the threshold level set by the user. All BOSA tabs and functionalities can be used to set the most suitable spectrum measurement for peak analysis.
- 3** Data display area. It presents all the information of each of the detected peaks according to the selected mode and units.

#### 4.3.1.3. Interface Keys Description

|                                            |                                                                                                                                                                                                                 |
|--------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <div>Peak Analysis</div> <div>On Off</div> | Activate or deactivate the Peak Analysis application.                                                                                                                                                           |
| <div>Mode</div> <div>Abs. Diff</div>       | Switch between the two modes for the peak analysis. The "Abs." mode shows the absolute value for the parameters, while the "Diff" mode shows the values relative to a spectral component defined by the marker. |

Peak search  
Conf.

It is used to define the configuration parameters for the peak identification.

#### 4.3.1.4. Peak Search Configuration

In order to change the threshold level for the peak identification the user has two options. The first one is to manually change the reference level by dragging the red line with the mouse in the arrow cursor mode. The second option is to manually set the level by clicking in the "Peak Search Conf" menu and type the desired level in the emerged menu. In this menu the user can also define the contrast level for the peak identification.

#### 4.3.1.5. Display Mode

The application also compares the power and wavelength/frequency with respect to any desired point of the spectrum. For that purpose, the user can place the marker in any point of the spectra, including any of the already identified peaks, and select the "Differential Mode". In this mode the table shows the absolute information of the marked point in the spectra, and its difference with each of the identified peaks.

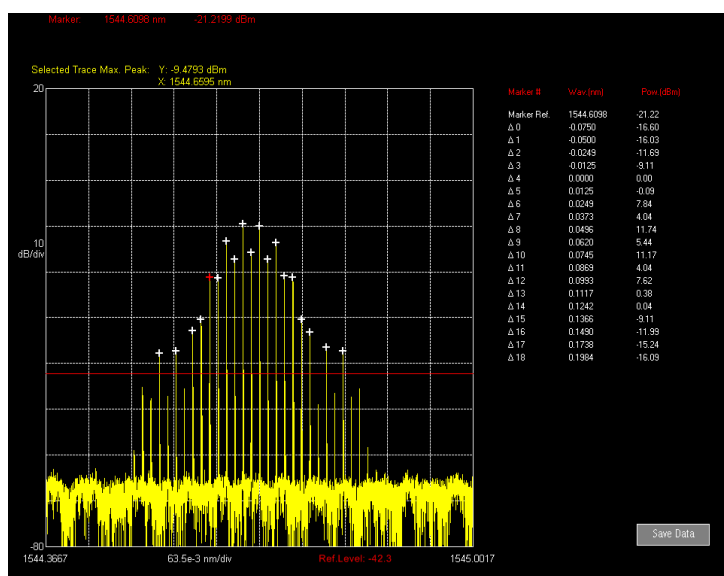


Figure 4-18 - Peak Analysis graphical user interface in differential mode.

#### 4.3.1.6. Save and Export

All the displayed information in the table can be saved at any time by clicking the "Save Data" in the lower part of the data display area. Data can be saved in both modes along with an optional header with all the measurement configuration parameters.

### 4.3.2. OSNR Analysis

The OSNR analysis application evaluates the value of the Optical Signal-to-Noise ratio of the signal under test. The application measures the signal power and, based on the user defined parameters, interpolates the value of the noise to display the value of the OSNR according to the IEC 61280-2-9:2009 standard.

#### 4.3.2.1. Interface Description

The application presents an advanced marker mode that allows the visualization of the different configuration parameters. In the top right side of the display, the final value of the OSNR is displayed according to all the set parameters. In the extended info mode, the displays shows also the value of the signal and the interpolated noise power.

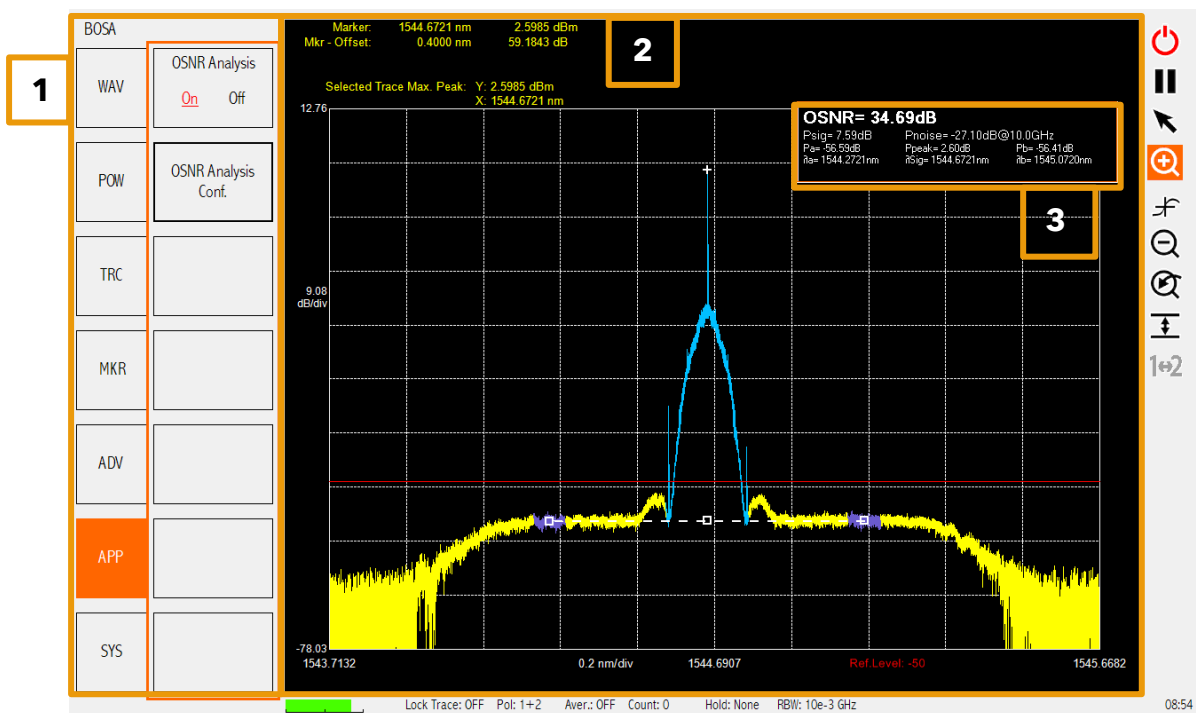


Figure 4-19 - OSNR Analysis application GUI

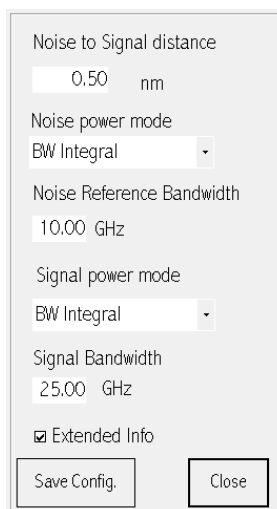
#### 4.3.2.2. GUI Area description

|   |                                                                                                                                               |
|---|-----------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Specific buttons for the OSNR analysis application are located here. See below interface keys description for more details.                   |
| 2 | Spectrum measurement area. All BOSA tabs and functionalities can be used to set the most suitable spectrum measurement for the OSNR analysis. |
| 3 | Data display area. It presents all the information of the measured components and displays the final OSNR value.                              |

### 4.3.2.3. Interface Key Description

|                                            |                                                                                                        |
|--------------------------------------------|--------------------------------------------------------------------------------------------------------|
| <div>OSNR Analysis</div> <div>On Off</div> | Activates or deactivates the OSNR Analysis application.                                                |
| <div>OSNR Analysis Conf.</div>             | Shows the OSNR configuration menu where the user can set the different parameters for the measurement. |

### 4.3.2.4. OSNR Configuration Parameters



The screenshot shows the OSNR Configuration menu with the following parameters:

- Noise to Signal distance: 0.50 nm
- Noise power mode: BW Integral (dropdown)
- Noise Reference Bandwidth: 10.00 GHz
- Signal power mode: BW Integral (dropdown)
- Signal Bandwidth: 25.00 GHz
- ☒ Extended Info
- Buttons: Save Config., Close

Figure 4-20 - OSNR Configuration menu.

#### 4.3.2.4.1. Noise to Signal distance

This value set the measuring point for the noise value. By placing this point in the out-of-channel area the user ensures that the measured power corresponds to noise only.

#### 4.3.2.4.2. Noise power mode

This option defines how the noise power is measured, either peak power mode, where the value of the noise is measured through the value at a single point, or the bandwidth integral mode, where the value of the noise is measured through the average value in the region defined by the noise reference bandwidth, plotted in purple.

#### 4.3.2.4.3. Noise reference bandwidth

It defines the spectral region for the noise average when the noise power is set to bandwidth integral. Provides better stability than the peak power mode.

#### 4.3.2.4.4. Signal power mode

It defines the spectral region for the noise average when the noise power is set to bandwidth integral. Provides better stability than the peak power mode.

#### 4.3.2.4.5. Signal bandwidth

It defines the spectral region for the signal when the signal power is set to bandwidth integral. This value provides more accurate OSNR values as it considers the whole signal power instead of the peak power of the signal.

#### 4.3.2.5. OSNR Extended Info

In the Extended Info mode, the user can find the following information:

- **Psig:** Power of the signal based on the central position of the marker and the signal power mode.
- **Pnoise:** Power of the noise interpolated in the central position of the marker and measured with a 10GHz reference bandwidth as stated in the IEC standard.
- **Pa and Pb:** Power of the noise value measured in the two spectral regions  $\lambda_a$  and  $\lambda_b$ .
- **Ppeak:** Peak value of the signal defined by the marker position.
- **$\lambda_{sig}$ :** Spectral position of the center of the signal defined by the marker.
- **$\lambda_a$  and  $\lambda_b$ :** Spectral position of the measured values for the noise. It is set by the noise to signal distance.

## 5. Tunable Laser Source (Option X10)

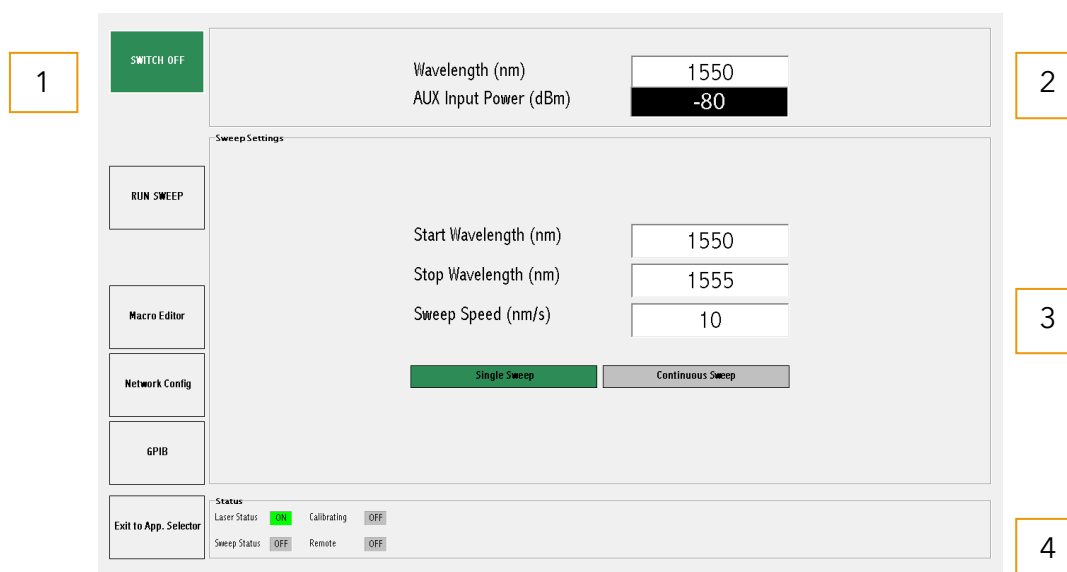
### 5.1. Description

The BOSA option X10 allows the user to access the internal tunable laser and use it as a standalone laser. The optical output connector is located in the front panel. There is a green LED placed close to the optical connector which is lit any time there is optical power being output.



Invisible laser radiation. Do not view directly with optical instruments. Class 1 laser product. Refer to Specific Considerations for BOSA option X10 & X20 for specific considerations.

#### Graphical User Interface



#### 1. General configuration

- **SWITCH ON/OFF:** the laser is switched on and off. The laser needs to be switch on before any other parameter is available.
- **RUN SWEEP:** the laser performs a sweep under the conditions configured in the "Sweep Settings" box.
- **MACRO EDITOR:** **shows the macro editor tool to perform automatic measurements and procedures with the TLS (section ¡Error! No se encuentra el origen de la referencia.)**
- **NETWORK CONFIG:** a dialog box is displayed to configure an Ethernet remote communication.
- **GPIB:** a dialog box is displayed in order to configure a remote GPIB communication.



**2.** Static laser configuration

- *WAVELENGTH*: current laser wavelength in nm.
- *AUX INPUT POWER*: current optical input power in of the Aux Input in dBm.

**3.** Dynamic laser configuration

- *START WAVELENGTH*: starting wavelength for the sweep in nm.
- *STOP WAVELENGTH*: stopping wavelength for the sweep in nm.
- *SWEEP SPEED*: speed for the sweep.
- *SINGLE/CONTINUOUS SWEEP*: single sweep performs just one scan while continuous sweep maintains the laser sweeping until the user stops it.

**4.** Status Area. Actual status of the laser is indicated here as well as any error in the configuration parameters.

## 6. Component Analyzer (Option X20)

### 6.1. Description

With option X20 the Insertion and Return Loss of optical passive devices can be measured. The interface can display the maximum and minimum transmission values across the required spectral width. It can also show the Polarization Dependent Loss for both IL and RL (Option X30).

### 6.2. Graphical User Interface

The Component Analyzer application, accessible from the App selector, uses a very similar graphical user interface as the BOSA application. In this section the specific functions of the Component Analyzer mode of those whose behavior is different to BOSA mode are described. For the rest of the functions please refer to section 4.1.

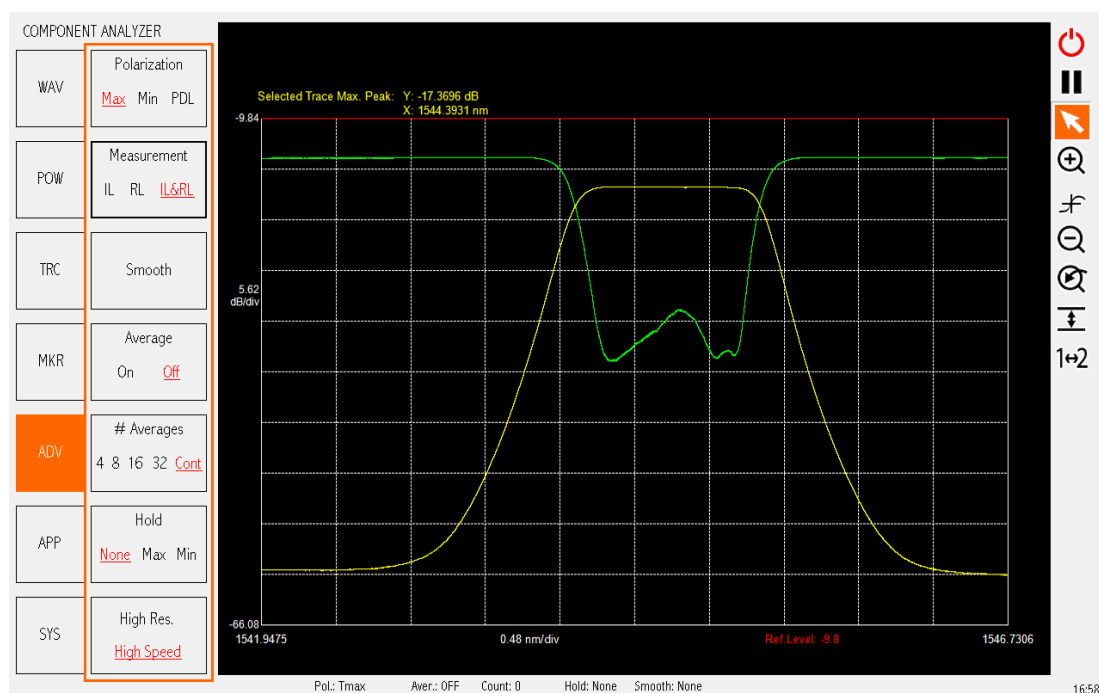


Figure 6-1 - Component analyzer GUI.

## 6.2.1. Interface Keys Description

### 6.2.1.1. Advanced submenu

|                                                          |                                                                                                                                                                       |
|----------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <div>Measurement</div> <div>IL RL <u>IL&amp;RL</u></div> | <p>This is an option button. It allows the user to switch between Insertion Loss and Return Loss measurement.</p>                                                     |
| <div>Polarization</div> <div><u>Max</u> Min PDL</div>    | <p>Refers to the maximum and minimum transmission of the device for a polarized input. The ratio between both values is the PDL that can be represented directly.</p> |
| <div>Smooth</div>                                        | <p>Performs a moving average on the active trace. The width of the average is set in a dialog box.</p>                                                                |
| <div>High Res.</div> <div><u>High Speed</u></div>        | <p>Switches between measurement modes prioritizing the speed or the resolution.</p>                                                                                   |

### 6.2.1.2. System Submenu (next 2/2)

|                                                         |                                                                                                                                                                                                                                                                                              |
|---------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <div>Muller matrix mode</div> <div>On <u>Off</u></div>  | <p>This is an option button. It allows the user to disable the standard Polarization (in Advanced submenu) measurement. Then the following Polarization button is displayed:</p>                                                                                                             |
| <div>Polarization</div> <div><u>P1</u> P2 Avg Sim</div> | <p>This is an option button. P1 and P2 represent two relative orthogonal polarizations at the output of the TLS OUT port. If PDL is not required, we recommend P1 measurement (after having deselected the Muller Matrix mode). Average or Simultaneous P1 and P2 can be also performed.</p> |

### 6.2.1.3. Power Submenu

|                                                |                                                                                       |
|------------------------------------------------|---------------------------------------------------------------------------------------|
| <div>Normalized</div> <div><u>On</u> Off</div> | <p>This is an option button. It allows the user to normalize the losses from 0dB.</p> |
|------------------------------------------------|---------------------------------------------------------------------------------------|

## 6.3. Taking measurements

### 6.3.1. Hooking Up the Device Under Test (DUT)

Using a single mode fiber, connect an optical patchcord from the AUX Output port on the front panel of the BOSA to the input fiber of the device under test. Connect then the output fiber of the device under test to the AUX Input port on the front panel of the BOSA. Now the BOSA is ready to start measuring the DUT.

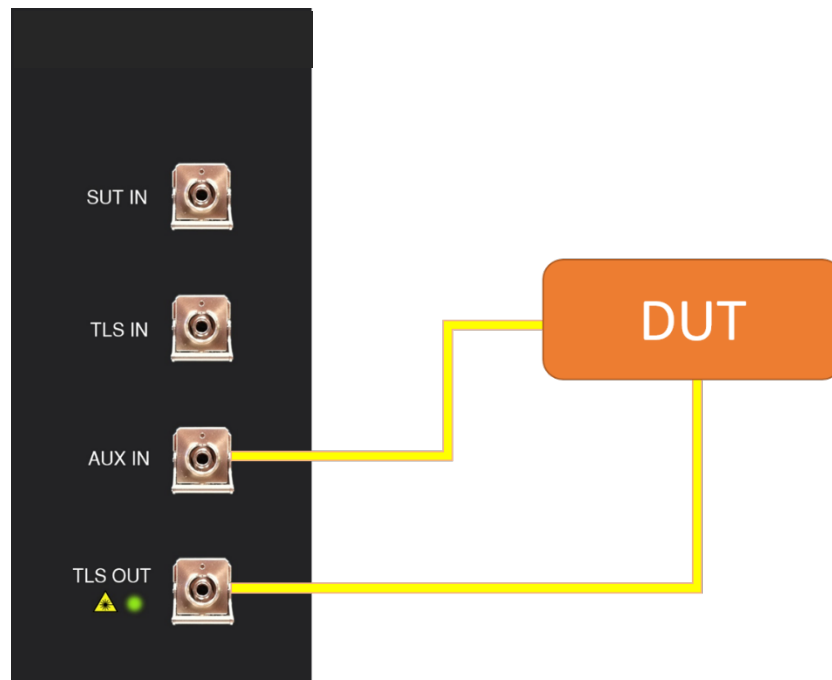


Figure 6-2 - Diagram of the connections for the component analyzer measurement.



Check the connector type for DUT before connecting it.



Invisible laser radiation. Do not view directly with optical instruments. Class 1 laser product. Refer to section 1.3 for specific considerations.

## 7. Spectral polarimetry (Option X30)

### 7.1. Description

With option X30 the spectrally-resolved state of polarization (SOP) can be measured. Markers can be used to measure polarization differences between different light sources or different spectral components. Polarization changes under different testing conditions can also be checked.

### 7.2. Graphical User Interface

The polarimetry extension can be found in the Applications tab of the BOSA. An overview of the GUI is shown.

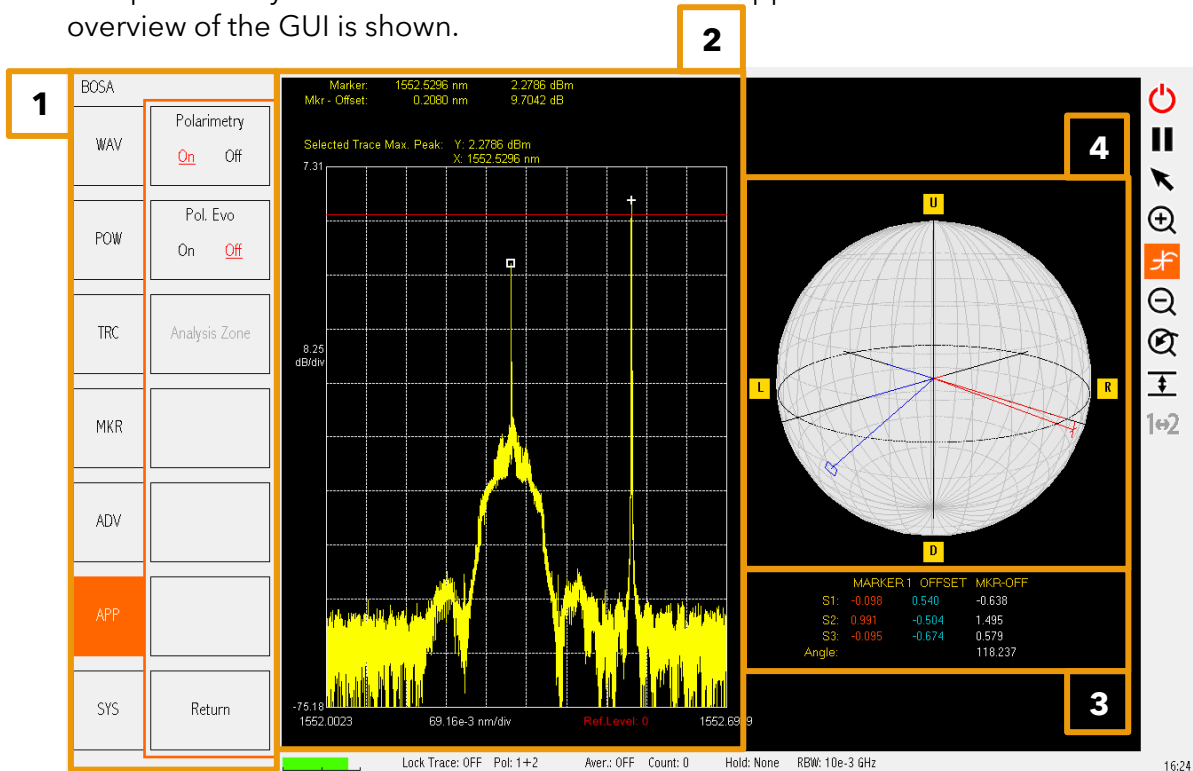


Figure 7-1 - Polarimetry extension GUI.

### 7.2.1. GUI Area Description

|          |                                                                                                                                                                                                                                               |
|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>1</b> | Specific buttons for the polarimetry extension are located here. See interface keys description for more details. All the other buttons and tabs of the BOSA user interface are still accessible even if the polarimetry option is activated. |
| <b>2</b> | Spectrum measurement area. Polarimetry measurements will be performed over the optical spectrum shown here. All BOSA tabs and functionalities can be used to set the most suitable spectrum measurement for polarization analysis.            |
| <b>3</b> | Data display area. Cartesian values for the SOP in the Poincare Sphere are shown here.                                                                                                                                                        |
| <b>4</b> | SOP representation. The Poincare sphere is used to represent the measured SOP of the point selected with the marker. The sphere is normalized.                                                                                                |

### 7.2.2. Interface Keys description

|                                          |                                                                                                                                                                                                                                                                                                              |
|------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <div>Polarimetry</div> <div>On Off</div> | Activate or deactivate the polarization analysis function.                                                                                                                                                                                                                                                   |
| <div>Pol. Evo</div> <div>On Off</div>    | Activate or deactivate the polarization evolution analysis. When this function is activated, it is possible to define a spectral region in which the SOP is continuously measured. The SOP measured of all spectral components inside the defined region is simultaneously plotted over the Poincare sphere. |
| <div>Analysis Zone</div>                 | It is used to define the spectral region in which the SOP is measured.                                                                                                                                                                                                                                       |

## 7.3. How to Perform Measurements

### 7.3.1. Polarization Measurement Using Markers

The SOP of a selected spectral component is measured using markers. The measured polarization corresponding to the marker and the offset marker positions are plotted in the Poincare Sphere as a vector pointing to certain position in the sphere surface. The polarization difference angle between marker and offset is also displayed.

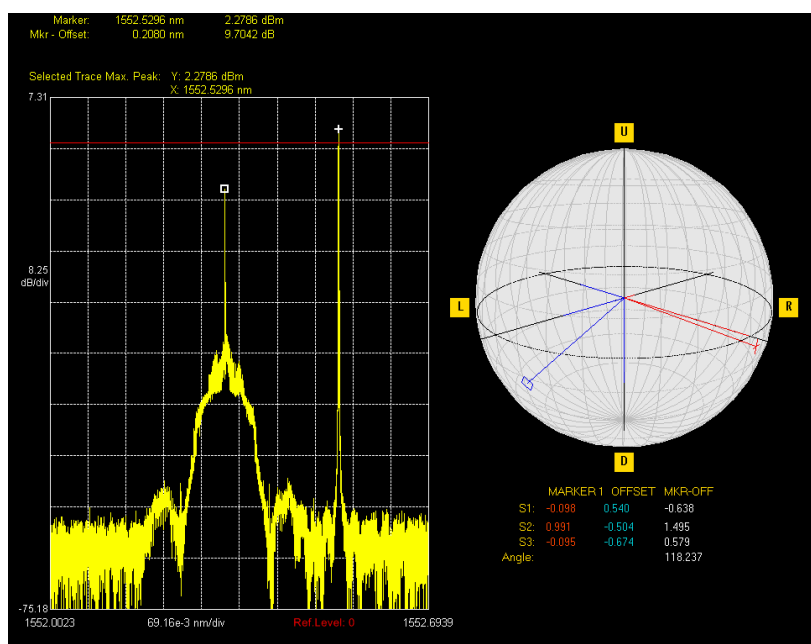


Figure 7-2 - Polarization interface using markers.

### 7.3.2. Polarization Evolution Measurement

It is possible to measure the continuous polarization evolution over a certain spectral region. To do that it is necessary to activate the Pol. Evo. Option in the polarization tab and define an analysis region. A solid violet bar appears at the bottom of the spectral measurement indicating the measured region.

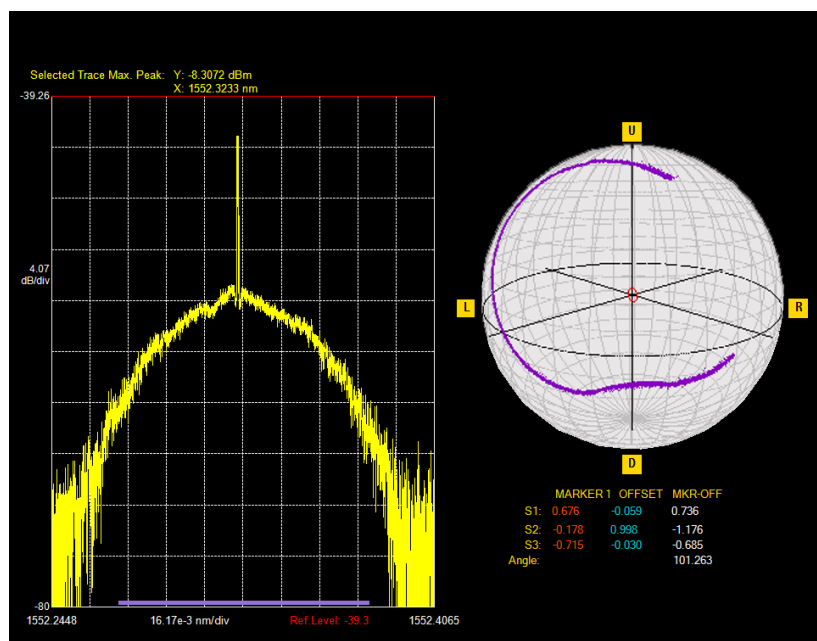


Figure 7-3 - Polarization interface using polarization evolution.

The set of SOP measurements are simultaneously plotted in the Poincaré Sphere so the polarization evolution across the defined spectral region is displayed.

## 8. Complex Spectrum Analyzer (Option X40)

### 8.1. Description

With option X40, the Complex Spectrum of the signal under test can be measured. By performing an IFFT, the application recovers the temporal trace. Based on this reconstruction the interface can plot the temporal and frequency data in four different modes: Oscilloscope, Eye Diagram, Constellation and Complex OSA.

### 8.2. Graphical User Interface

In this chapter, the user interface of the BOSA Phase is presented. First, all menu options and user keys are summarized. Next, a brief description of each feature is made for the ease of understanding.

The interface is composed by two main areas, as shown in Figure 8.1. These are: Button Bar and Measurement Area. The measurement area includes the measurement representation, context menu, current measurement settings and markers information.



Figure 8-1 - BOSA Phase graphical user interface



### 8.2.1. Measurement Area Description

The measurement area contains the measurement charts and information about the measurement conditions.

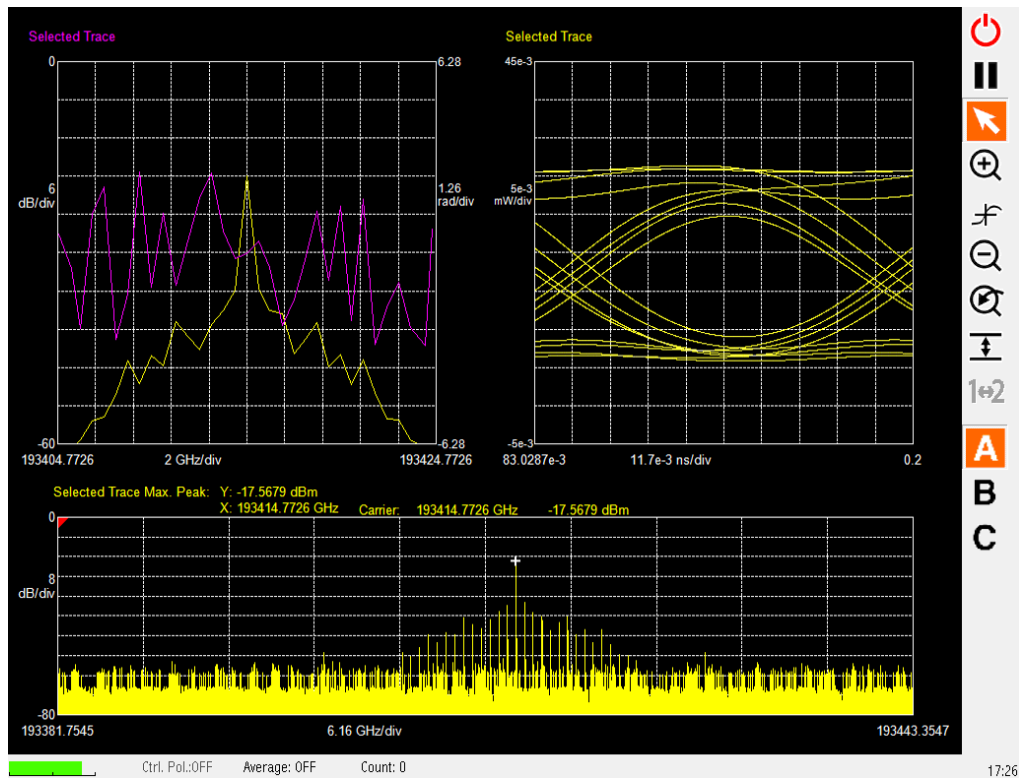


Figure 8-2 - BOSA Phase measurement area description

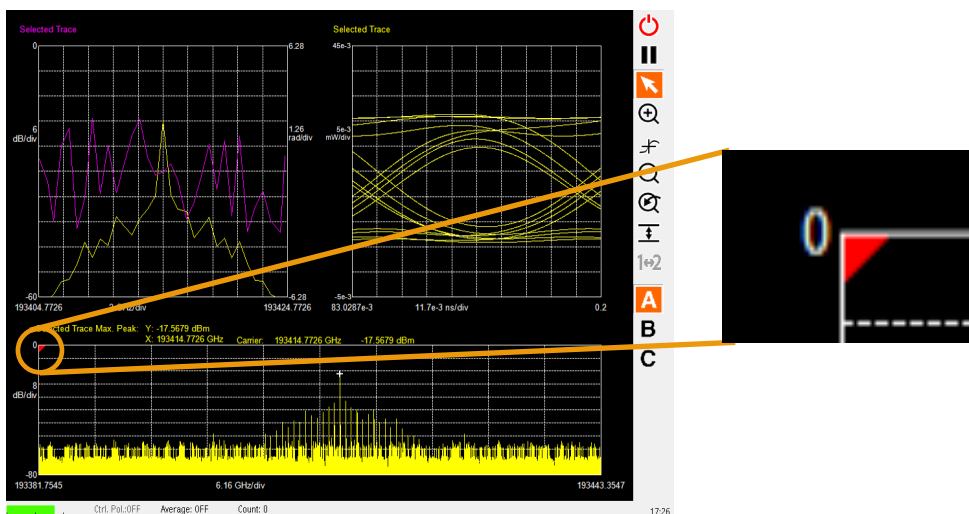


Figure 8-3 - BOSA Phase active chart identification

The bottom area is used to display general measurement conditions, system warnings and a visual indicator for the optical power of the signal under test:



In addition, a quick function button bar is placed at the right of the measurement area which allows the user to perform common actions in an easy way.

|                                                                                                                                                                            |                                                                                                                                                                                                                                    |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                           | Selects the active chart.                                                                                                                                                                                                          |
|                                                                                           | Sets the zoom-in mode. The representation area on a chart can be amplified by a click and drag operation.                                                                                                                          |
|                                                                                           | Places a marker on the trace. It is also used to select the carrier in the chart A.                                                                                                                                                |
|                                                                                           | Extends the wavelength representation range by a factor of two.                                                                                                                                                                    |
|                                                                                         | Undoes up to three zooming actions.                                                                                                                                                                                                |
|                                                                                         | Fits the vertical axis to the displayed data.                                                                                                                                                                                      |
|                                                                                         | Switches among active traces in the chart.                                                                                                                                                                                         |
| <b>A</b>                                                                                                                                                                   | Sets the A chart as the active chart.                                                                                                                                                                                              |
| <b>B</b>                                                                                                                                                                   | Sets the B chart as the active chart.                                                                                                                                                                                              |
| <b>C</b>                                                                                                                                                                   | Sets the C chart as the active chart.                                                                                                                                                                                              |
| <br> | Freezes the current measurement on the screen. The unit is fully working in second plane, but the data is not displayed.                                                                                                           |
|                                                                                         | Allows the user to start or stop the current measurement at any time. Even when stopped, the configuration parameters of the BOSA can be modified; if the measurement is later initialized, the new parameter values will be used. |

## 8.2.2. The button bar

The Button Bar encompasses nonspecific function keys. The following figures show the button bar tree diagram of the BOSA Phase.

### 8.2.2.1. Set Up Button

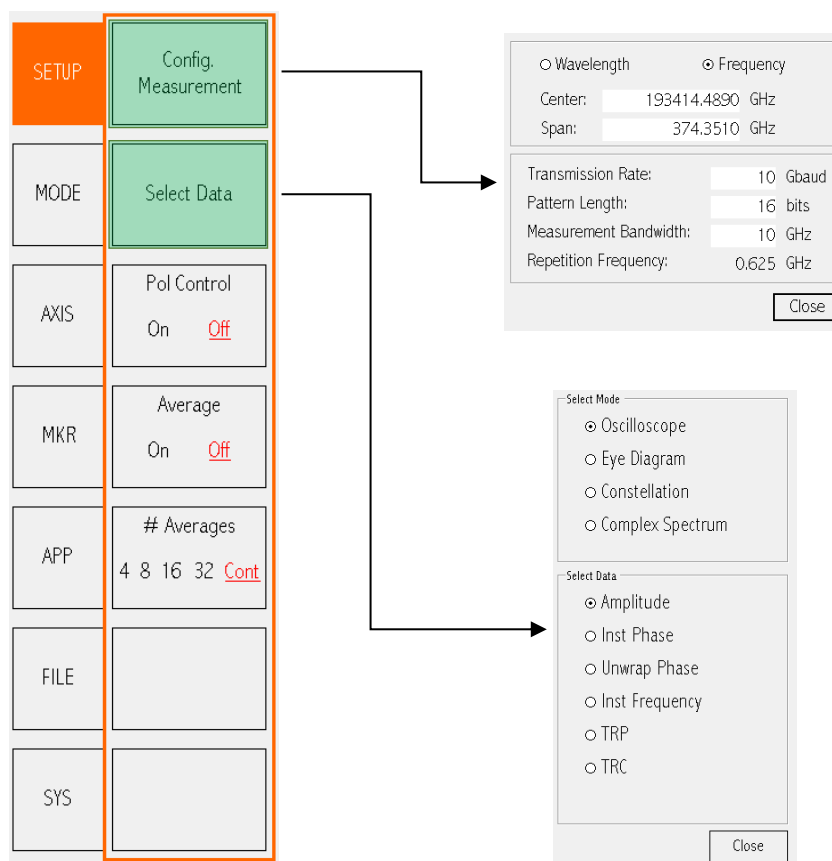
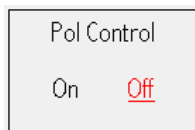


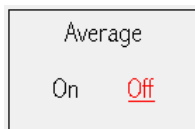
Figure 8-4 - BOSA Phase Set Up button tree diagram

### Set Up submenu

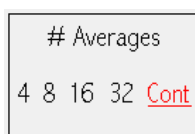
|                                    |                                                                                                                          |
|------------------------------------|--------------------------------------------------------------------------------------------------------------------------|
| <div>Config.<br/>Measurement</div> | <p>Displays the "Configure Measurement" dialog box to configure the measurement parameters of the signal under test.</p> |
| <div>Select Data</div>             | <p>Displays the "Select Data" dialog box to change the data plot depending on the current mode.</p>                      |



This is an option button. It allows the user to make more precise power measurements by means of controlling the polarization of the SUT. The unit internally performs two consecutive sweeps with polarization control and shows the result independent of the polarization. When the polarization control is active the floor noise pattern is automatically controlled.



This is an option button. It performs trace averaging for noise reduction purposes.



This is an option button. Five averaging modes are available: 4, 8, 16, 32 traces averaging and continuous averaging. The first four modes perform the averaging of the most recent traces (4, 8, 16 or 32). The continuous mode performs averaging with an accumulative number of traces. When the continuous mode is selected, the floor noise pattern is automatically controlled.

#### 8.2.2.2. Mode Button

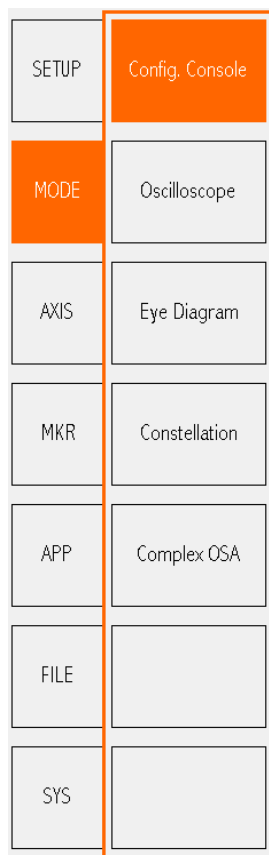


Figure 8-5 - BOSA Phase mode button tree diagram

**Set Up submenu**

---

|                 |                                                                |
|-----------------|----------------------------------------------------------------|
| Config. Console | Display the default display where the carrier can be selected. |
|-----------------|----------------------------------------------------------------|

---

|              |                             |
|--------------|-----------------------------|
| Oscilloscope | Runs the oscilloscope mode. |
|--------------|-----------------------------|

---

|             |                             |
|-------------|-----------------------------|
| Eye Diagram | Runs the eye analysis mode. |
|-------------|-----------------------------|

---

|               |                              |
|---------------|------------------------------|
| Constellation | Runs the constellation mode. |
|---------------|------------------------------|

---

|             |                                          |
|-------------|------------------------------------------|
| Complex OSA | Runs the complex spectrum analyzer mode. |
|-------------|------------------------------------------|

---

**Particular button for the Eye Analysis mode**

---

|               |                                                                                                                                                      |
|---------------|------------------------------------------------------------------------------------------------------------------------------------------------------|
| Show Eye Tool | Displays on the chart specific markers to perform specific measurements on the Eye representation. You can move them with click and drag operations. |
|---------------|------------------------------------------------------------------------------------------------------------------------------------------------------|

---

### 8.2.2.3. Axis Button

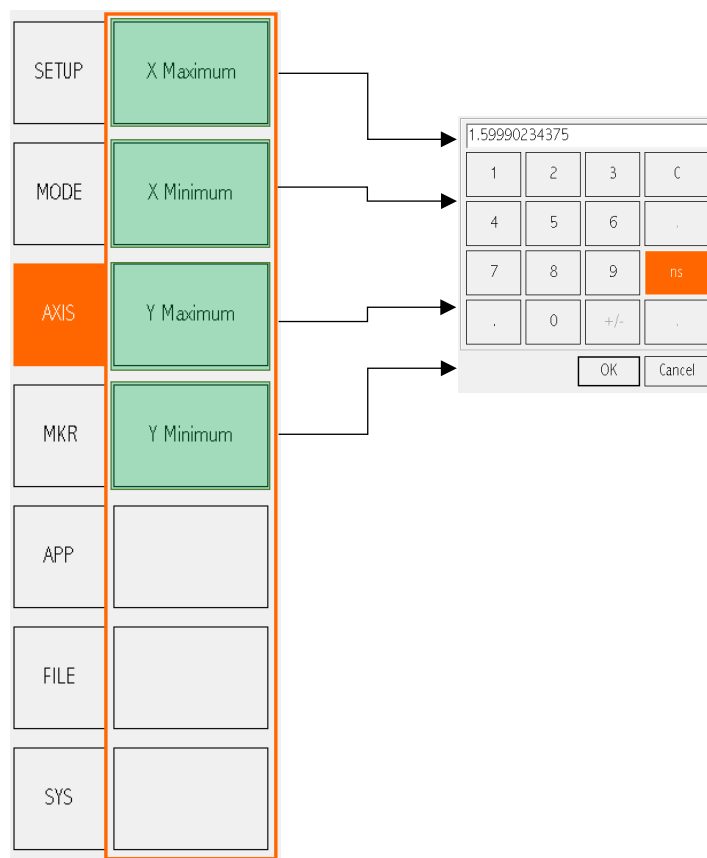


Figure 8-6 - BOSA Phase Axis button tree diagram

#### Axis submenu

|           |                                                                                      |
|-----------|--------------------------------------------------------------------------------------|
| X Maximum | Allows the user to set the maximum value of the horizontal axis in the active chart. |
| X Minimum | Allows the user to set the minimum value of the horizontal axis in the active chart. |
| Y Maximum | Allows the user to set the maximum value of the vertical axis in the active chart.   |
| Y Minimum | Allows the user to set the minimum value of the vertical axis in the active chart.   |

#### 8.2.2.4. Marker Button

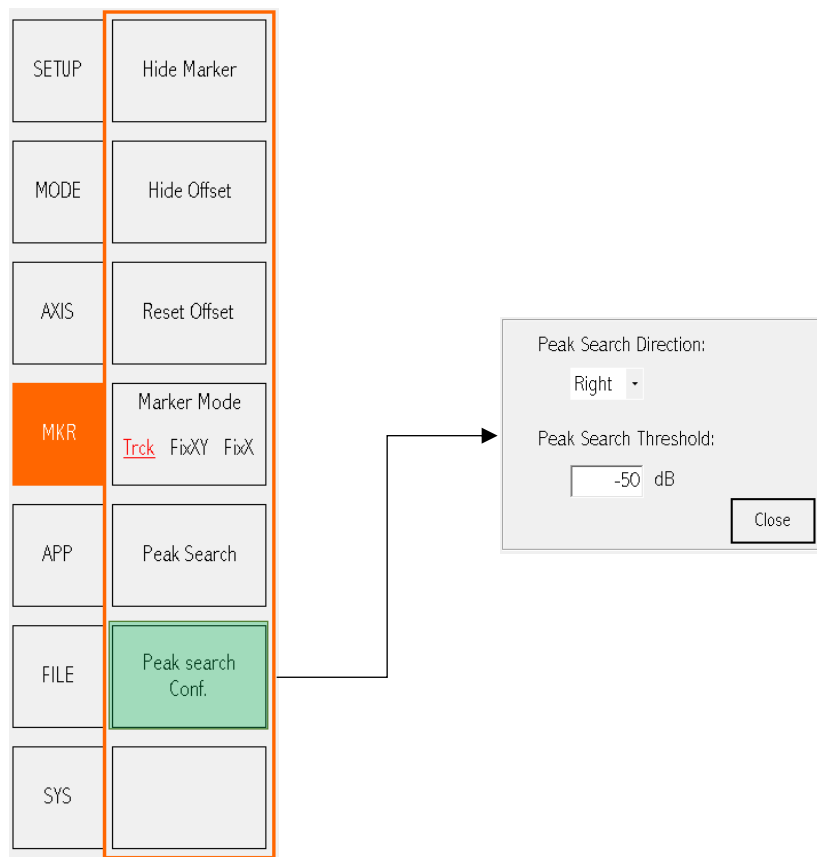


Figure 8-7 - BOSA Phase button tree diagram

#### Marker submenu

|              |                                                                                           |
|--------------|-------------------------------------------------------------------------------------------|
| Show Marker  | Shows or hides a marker on the active trace. It is represented on the chart with a cross. |
| Show Offset  | Shows or hides the offset of a marker. It's represented on the chart with a square.       |
| Reset Offset | Sets the offset to zero and the square is placed at the same position of the marker.      |

|                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|---------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <div>Marker Mode</div> <div>Trck FixXY FixX</div> | <p>This is an option button. Three options are allowed: Tracking, Fix XY and Fix X. This function allows to change the marker's behavior.</p> <ul style="list-style-type: none"> <li>Tracking: the marker will update its X and Y value to track the closest peak of the signal.</li> <li>Fix XY: The X and Y positions of the marker will remain fixed unless the user manually moves it with the mouse or peak search function.</li> <li>Fix X: The X position of the marker is fixed and updates its Y value to that of the SUT.</li> </ul> |
| <div>Peak Search</div>                            | <p>Moves the active marker to the next peak. The criteria of peak searching are defined through Peak Search Configuration button.</p>                                                                                                                                                                                                                                                                                                                                                                                                          |
| <div>Peak search Conf.</div>                      | <p>Opens a new window that allows user to configure the peak searching criteria. Detailed description available at 4.3.1.4.</p>                                                                                                                                                                                                                                                                                                                                                                                                                |

#### 8.2.2.5. Applications Button

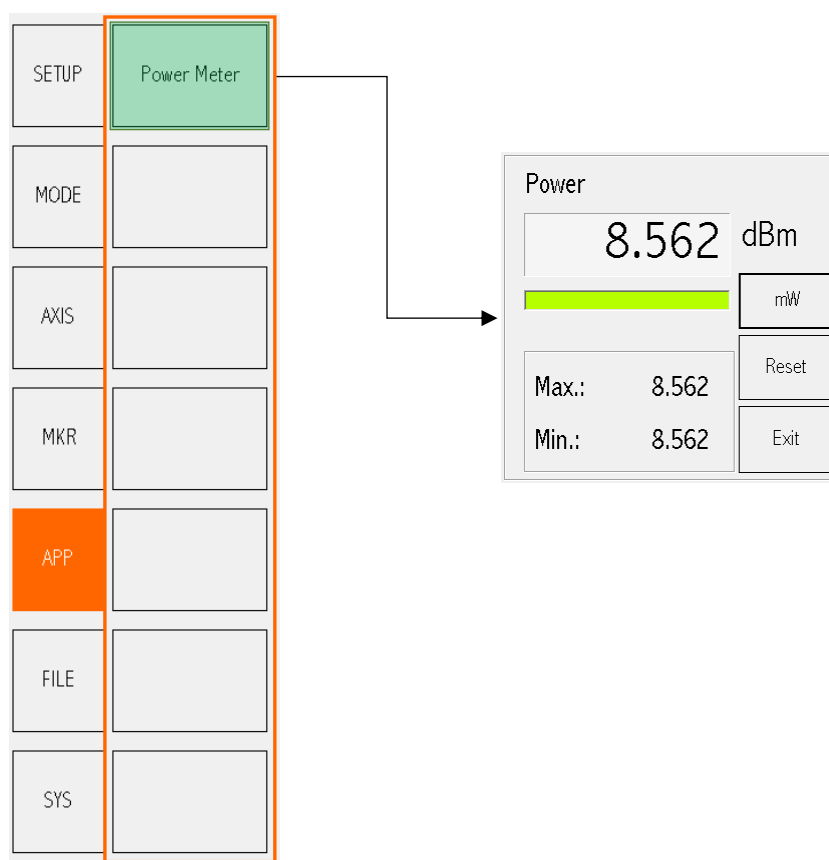
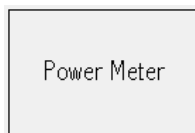


Figure 8-8 - BOSA Phase Application button tree diagram



## Applications submenu



Runs the “Power Meter” application which measures the total optical power being input on the front panel optical connector.

### 8.2.2.6. System Button

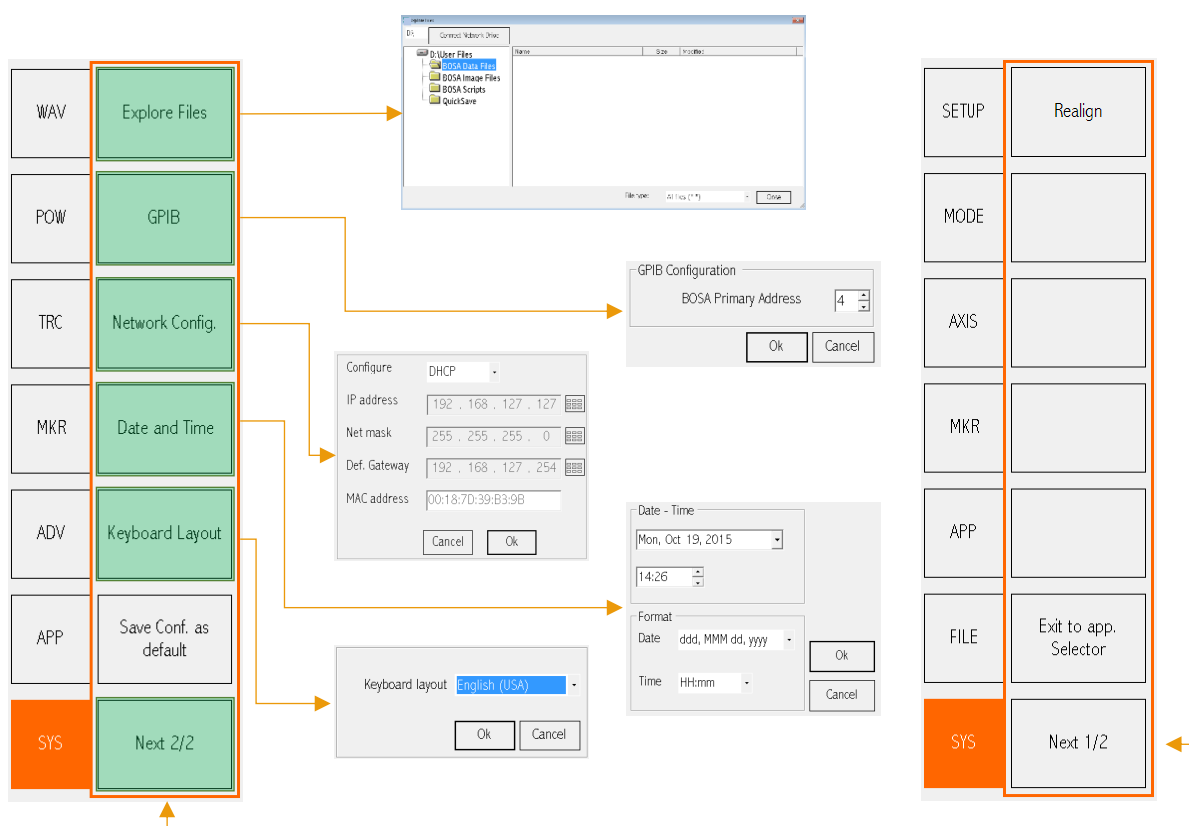
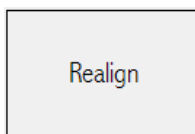


Figure 8-9 - BOSA Phase System button tree diagram

## System submenu



Performs a realignment of the internal laser.

### 8.2.2.7. File Button

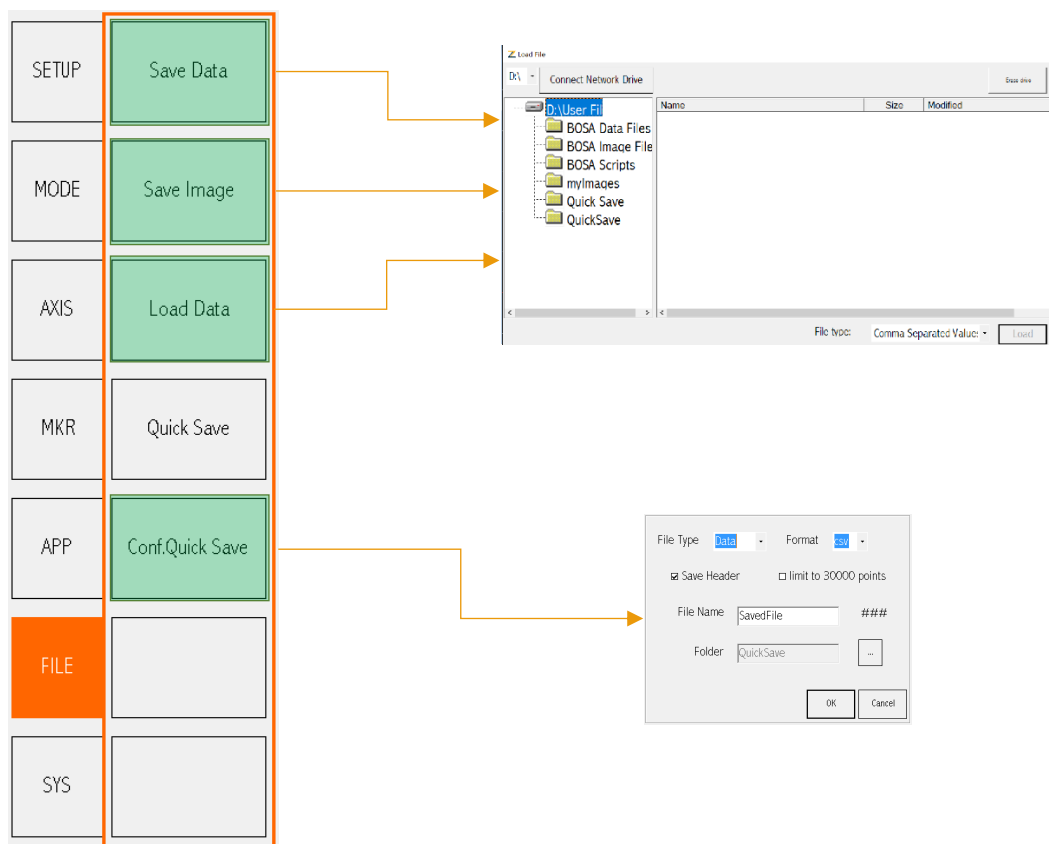


Figure 8-10 - BOSA Phase file button tree diagram

#### File submenu

|                    |                                                                                                                                                                                                                                                                                                                        |
|--------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Save Data          | <p>Opens a new windows form to save the active trace. Available formats are:</p> <ul style="list-style-type: none"> <li>.txt: it is a text file which can be opened by any text editor.</li> <li>.csv: comma separated values file. Wavelength and power values are saved in each row separated by a comma.</li> </ul> |
| Save Image         | Displays the "Save Files" dialog box to save the current measurement as an image file.                                                                                                                                                                                                                                 |
| Load Data          | Displays the "Load File" dialog box to load Complex Spectrum data previously saved.                                                                                                                                                                                                                                    |
| Quick Save         | Performs a quick save operation of the current measurement. The features of this saving are set in the "Config. Quick Save" button.                                                                                                                                                                                    |
| Config. Quick Save | Shows the "Quick Save Configuration" dialog box to configure the way in which the "Quick Save" button will proceed.                                                                                                                                                                                                    |

### 8.2.3. Context Menu Description

The context menu contains interface keys related to the graphical representation itself.

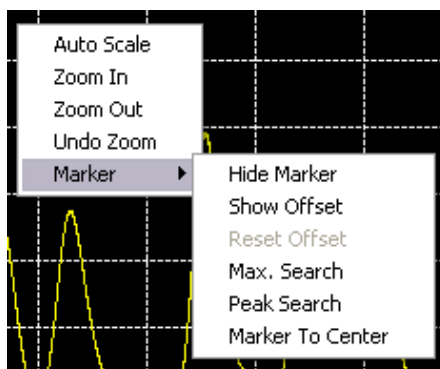


Figure 8-11 - BOSA Phase Context Menu

|                           |                                                                                                                                 |
|---------------------------|---------------------------------------------------------------------------------------------------------------------------------|
| Auto Scale                | Performs an auto scale operation in the vertical axis of the active chart.                                                      |
| Zoom In                   | Enables the zoom mode to perform a zoom-in on any of the three charts.                                                          |
| Zoom Out                  | Performs a zoom-out operation on the active chart.                                                                              |
| Undo Zoom                 | Retrieves the previous axis configuration on the active chart.                                                                  |
| Marker > Show Marker      | Only available in the analysis modes. Shows or hides a marker on the active trace.                                              |
| Marker > Show Offset      | Only available in the analysis modes. Shows a marker offset to obtain relative measurements.                                    |
| Marker > Reset Offset     | Only available in the analysis modes. Sets the offset to zero and moves the square symbol of the offset to the marker position. |
| Marker > Max Search       | Moves the marker to the maximum value of the display data.                                                                      |
| Marker > Peak Search      | Moves the marker to the position of the next peak.                                                                              |
| Marker > Marker to Centre | Changes the horizontal axis configuration to set the marker in the center of the representation area.                           |

## 8.3. Taking measurements

### 8.3.1. Hooking up the Signal Under Test (SUT)

Follow the next steps to properly connect the signal under test to the unit:

1. Use a single mode optical patchcord to connect the signal under test to the optical front panel input connector, identified as SUT IN. Please check the connectors are clean and undamaged as well as the connector type.



Check the connector type for SUT before connecting it.

2. Connect the clock signal coming from the pattern generator to the rear SMA connector in the BOSA Phase unit. This electrical signal must have a fundamental frequency equal to the pattern repetition frequency of the optical signal.
3. If necessary, run the BOSA Phase application in the Application Selector Screen and then check that optical power is being input in the system by using the Power Meter application in the Application submenu.



If the power level of the SUT is higher than +10 dBm the power meter will be saturated. On the contrary, if the power level of the SUT is too low the label SUT signal input loss appears close to the power bar.

### 8.3.2. Performing a Complex Measurement

Follow the next steps to perform a complex measurement:

1. In the BOSA Phase application click RUN button on the top right of the screen to start the measurement.
2. Press Set Up button on the left tab. On the Measurement section configure the signal under test properties. Then press Close button.
3. Select chart A, by just clicking on it, and locate the signal under test spectrum using zoom-in, zoom-out and autoscale functionalities. 
4. Use the marker mode  to select the carrier. The marker will automatically be placed at the maximum of the spectral component.
5. Press Set Up button on left tab. On the Trace section select the desired representation for the **C** chart.
6. For further analysis press on the Mode button on the left tab.

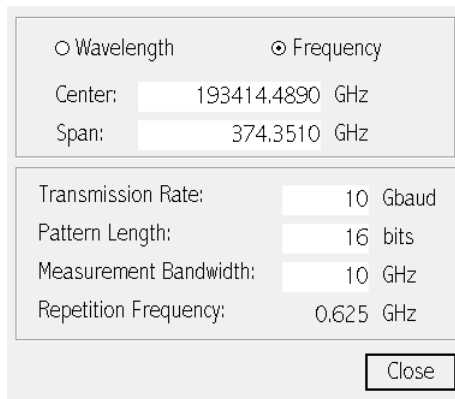
### 8.3.3. Saving a Measurement

For save a measurement follow the next steps:

1. Press Mode button on the left tab and select the desired analysis mode to save the measurement.
2. Press File and Save to File.
3. If the current measurement consists of just one trace only the Save Active Trace button will be enabled. Press it to pop up the Save Files dialog box. Select the type of file to be saved and type a name. Press Save button to finish the process.
4. If two traces are represented in the current analysis mode, the Save Data button will be also enabled. It is used to save both traces in just one file. It is also possible to save only the active trace in a single file using the Save Active Trace button. Use to switch between traces.

### 8.3.4. Configuring a Measurement

#### 8.3.4.1. The SET UP Dialog



|                                      |                 |                                            |  |
|--------------------------------------|-----------------|--------------------------------------------|--|
| <input type="radio"/> Wavelength     |                 | <input checked="" type="radio"/> Frequency |  |
| Center:                              | 193414.4890 GHz |                                            |  |
| Span:                                | 374.3510 GHz    |                                            |  |
| <hr/>                                |                 |                                            |  |
| Transmission Rate:                   | 10 Gbaud        |                                            |  |
| Pattern Length:                      | 16 bits         |                                            |  |
| Measurement Bandwidth:               | 10 GHz          |                                            |  |
| Repetition Frequency:                | 0.625 GHz       |                                            |  |
| <input type="button" value="Close"/> |                 |                                            |  |

Figure 8-12 - BOSA Phase Set Up dialog

This dialog set all the measurement parameters required for the proper synchronization of the phase measurement.

#### 8.3.4.2. The Select Data Dialog

This dialog is used to change the data displayed in the interface.

In the "Configuration Console" mode, this dialog allows users to change the mode and data of the upper right graph without exiting this mode.

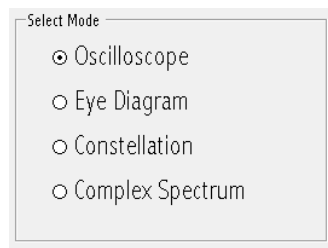


Figure 8-13 - BOSA Phase Select Data dialog in configure console mode

In the Oscilloscope mode the interface can show:

- Amplitude: It shows the temporal evolution of the amplitude trace
- Inst Phase: It shows the temporal evolution of the phase with its value constrained between  $-\pi$  and  $+\pi$ .
- Unwrap Phase: It shows the continuous value of the temporal evolution of the phase.
- Inst Frequency: It shows the temporal derivative of the phase values.
- TRP: It shows simultaneously the amplitude and phase evolution of the signal under test.
- TRC: It shows simultaneously the amplitude evolution and frequency of the signal under test.

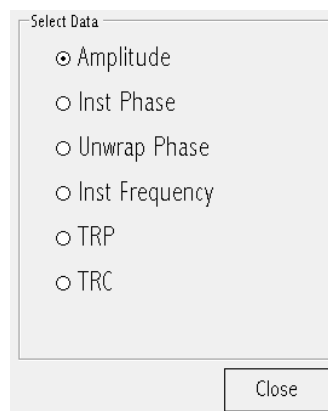


Figure 8-14 - BOSA Phase Select Data dialog in Oscilloscope mode

In the Eye Diagram mode the interface can show:

- Amplitude Eye Diagram: It shows the conventional Eye Pattern based on the amplitude values of the incoming data.
- I Eye Diagram: It displays the eye diagram based on the In-phase data recovered.
- Q Eye Diagram: It displays the eye diagram based on the Quadrature data recovered.
- Phase Eye Diagram: It shows the Eye Pattern based on the phase values of the incoming data.

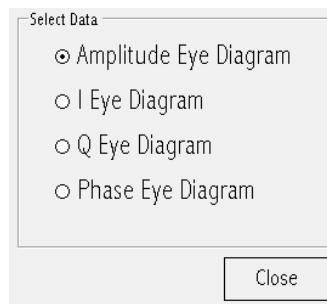


Figure 8-15 - BOSA Phase Select Data dialog in Eye Diagram mode

In the Constellation mode the interface can show:

- I-Q: It plots the constellation diagram of the symbol recovered from the data.

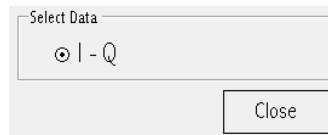


Figure 8-16 - BOSA Phase Select Data dialog in Constellation mode

In the Complex Spectrum mode the interface can show:

- Complex Spectrum: It shows the amplitude and phase measured values of the spectral components.

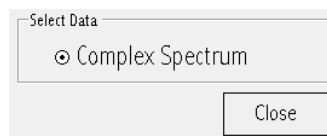


Figure 8-17- BOSA Phase Select Data dialog in Complex Spectrum mode

## 9. Remote Control

The BOSA unit can be controlled remotely by using both the GPIB (if available) and Ethernet interface (all options).

### 9.1. Using the GPIB Interface (if available)

The GPIB (General Purpose Interface Bus) is an interface used for communication between personal computers and laboratory instruments, such as the BOSA. The IEEE-488 connector on the back of the unit allows for remote operation through a standard GPIB cable. The connector is a standard female 24-pin IEEE-488 connector to use with a standard shielded IEEE-488 cable.

Before you can operate BOSA through GPIB interface you must assign a device address that is unique from the other equipment attached to the bus.

- Setting the Device Address in BOSA and Component Analyzer:
  1. Under the System menu, select GPIB. The GPIB Configuration window appears.
  2. Select a GPIB primary address for the BOSA different from the controller computer or the other instruments' addresses.
- Setting the Device Address in Tunable Laser:
  1. Click GPIB button. GPIB Configuration window appears.
  2. Select a GPIB primary address for the BOSA different from the controller computer or the other instruments' addresses.

The default GPIB address of the BOSA is 4.

- Returning to Local Control:

When the BOSA or Component Analyzer application is in remote control, the Stop/Run button in the main screen will change to Local and all the main interface of the will be disabled. Press Local button if you wish to return the instrument to local control.

NOTE: When the Laser application is in remote mode all the button in the main window is disabled. Press EXIT REMOTE MODE button if you wish to return the instrument to local control.



## 9.2. Using the Ethernet Interface

In order to use the Ethernet interface in the BOSA, it must be connected to a LAN through its 10/100/1000 base-T connector, located on the back of the instrument, and a standard network cable. To operate the instrument remotely through Ethernet interface, see the Programming Guide.

Before you can operate the BOSA through the Ethernet interface you might need to configure it. The IP address of the instrument is set by default using DHCP (Dynamic Host Configuration Protocol). If your network does not support DHCP, a manual configuration will be required. Use the following steps to configure the Ethernet interface.

- Automated configuration:
  1. Open system/configuration screen:
    - a. In BOSA or Component Analyzer:
      - i. Select the System option on the Menu bar.
      - ii. Choose the Network Configuration option. A dialog box will appear on the screen (Figure 9-1)
    - b. In Tunable Laser app:
      - i. Click Network Config. button.
  2. Choose DHCP in the Configure combo box.
  3. Press OK button to automatically configure the IP address.
  4. It is necessary to wait a few seconds until the new configuration takes effect.

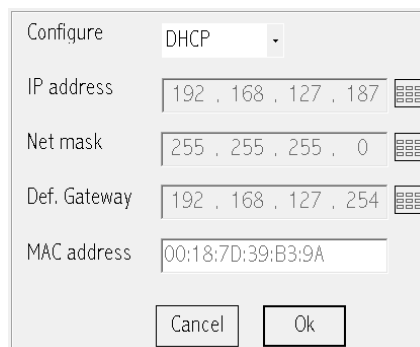


Figure 9-1 - Automated Network Configuration

- Manual configuration:
  1. Same as above.
  2. Same as above.
  3. Choose Manual in Configure combo box.
  4. IP Address, subnet mask and the default gateway will be enabled. The MAC address of the device is displayed at the bottom. Press the

button at the right of the IP address and the keypad appears. See Figure 9-2.

5. Enter the IP address, the subnet mask and the default gateway using the keypad.
6. Press OK button on the message box IP Address.
7. Press OK button on the message box Network configuration to finish.
8. It is necessary to wait a few second until the new configuration take effect.

Now the BOSA is ready to be operated through Ethernet interface. See Programming Guide for more information.

Upon receiving a command over the Ethernet interface, the instrument will set in remote mode and the functions on the screen are locked out. To return the system to local, press the LOCAL button located in the right top corner on the screen.

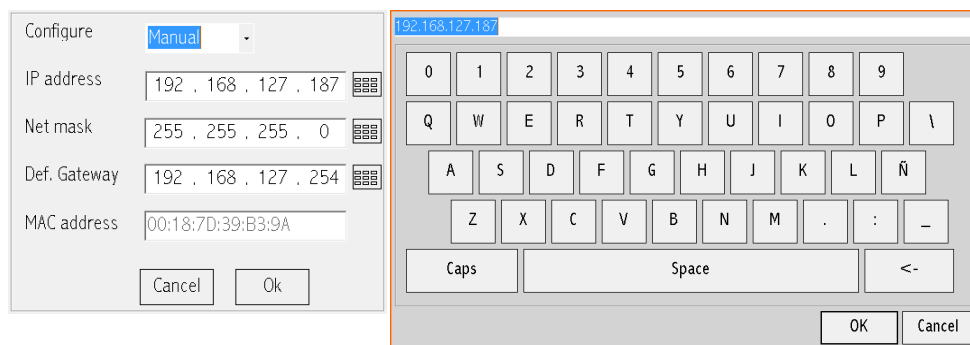


Figure 9-2 - Manual Network Configuration

### 9.3. Connecting a network drive

The equipment allows to connect a remote hard drive which is connected to the same LAN than the BOSA (BOSA must be connected to the LAN through the Ethernet connector at the rear panel). This is very useful in case the user wants to save the data externally in a proper drive so the BOSA will not contain any sensitive data. The user must select a letter to name the new network drive (from E:\ to Z:\) and its IP address following the pattern: \\AAA.BBB.CCC.DDD\name.

If the drive needs credential access due to privacy policies within your network, user must select its username and password and finally click on Map Drive. If the mapping went properly, a "Drive map successful" message will appear on screen as depicted in Figure 9-3.

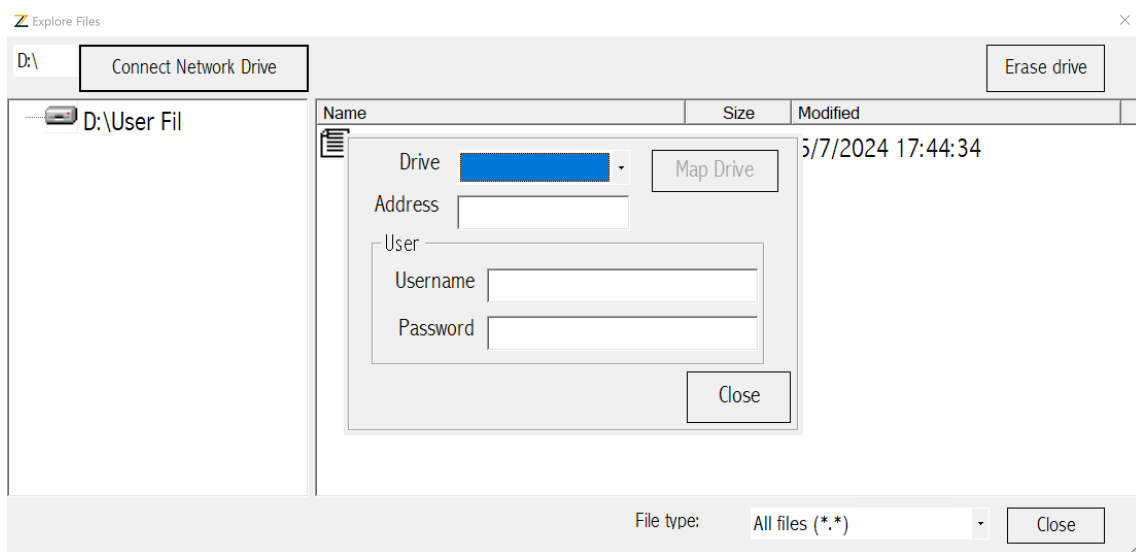


Figure 9-3 - Remote drive connection

## 10. Maintenance

For the maintenance of the device, please follow the safety considerations described in 'Safety considerations' at the beginning of this guide (section 1) and the cleaning information provided in the following points. These cleaning instructions mainly concern both optical connectors located at the front of the equipment and the external optical connectors that are being inserted.

### 10.1. Cleaning Optical Connections. General Considerations

It is important that every fiber connector and adapter is inspected and cleaned prior to mating.

Cleaning the fiber optic connections is one of the most basic and important procedures for maintaining fiber optic systems.



Any contamination in the fiber connection can cause failure of the component or failure of the whole system. A particle that partially or completely blocks the core generates strong back reflections, which can cause instability in the laser system.

In addition to dust, other types of contamination must also be cleaned off the endface. Such materials include:

- Oils (frequently from human hands)
- Film residues (condensed from vapours in the air)
- Powdery coatings (left after water or other solvents evaporate away)



These contaminants can also cause damage to the equipment if not removed.

When cleaning fiber connections, always follow the procedures carefully. The aim is to eliminate any dust or contamination and to provide a clean environment for the fiber-optic connection. Remember that inspection, cleaning, and re-inspection are critical steps which must be done before making any fiber-optic connection.

Before inspecting and cleaning your fiber-optic connections, review the following reminders:

- Always turn off any laser sources before you inspect fiber connectors or bulkheads.



Laser light can damage your eyes.

- Always inspect the connectors or adapters before you clean.
- Always inspect and clean the connectors before you make a connection.
- Always use the connector housing to plug or unplug a fiber.
- Always keep a protective cap on unplugged fiber connectors.
- Never clean bulkheads or receptacle devices without a way to inspecting them.
- Never touch the end face of the fiber connectors.
- Never allow cleaning alcohol to evaporate slowly off the ferrule.



Wet cleaning is not recommended for mounted bulkheads and receptacles. Damage to equipment can occur.

## 10.2. Clean Bulkheads

The fiber optic bulkheads of BOSA equipment are designed to be easily disassembled and cleaned.



Swabs for the cleaning of bulkheads is not always very effective even for experienced operators.



Wet cleaning is not recommended for mounted bulkheads and receptacles. Damage to equipment can occur.

Any bulkhead placed in the front panel of the BOSA is formed by one adapter and one APC polished connector and is designed to be disassembled with facility before being cleaned.

The **disassembling procedure** is as follows:

1. Make sure that the lasers are turned off before beginning the inspection.



Invisible laser radiation may be emitted from disconnected fibers or connectors. Do not stare into beams or view directly with optical instruments.

2. Remove the protective end cap from the adapter.
3. Remove the optical adapter pushing upwards the horizontal metal bar below the connector. With special care pull out the adapter to extract it from the front panel. Please, refer to Figure 10-1.

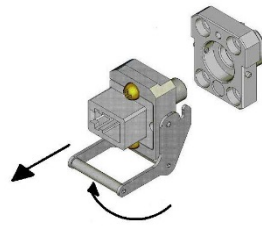


Figure 10-1 - Removable Front Adapter (connector type might be different)

4. The internal connector ferrule is now accessible to be cleaned (see following chapters).
5. Reinsert the adapter applying horizontal soft pressure.
6. Push downwards the horizontal metal bar. A “click” sound confirms that the adapter is in its proper position.

### 10.3. Connector Cleaning Procedure

1. Inspect the fiber connector, component, or bulkhead with a fiberscope. If the connector is dirty, clean it with a dry cleaning technique.
2. Inspect the connector.
3. If the connector is still dirty, repeat the dry cleaning technique.
4. Inspect the fiber connector.
5. If the connector is still dirty, clean it with a wet cleaning technique followed immediately with a dry clean to ensure no residue is left on the endface.
6. Inspect the connector again.
7. If the contaminate still cannot be removed, repeat the cleaning procedure until the end face is clean.



Wet cleaning is not recommended for mounted bulkheads and receptacles. Damage to equipment can occur.



Never use wet cleaning without ensuring that it does not leave residue on the end face. It can cause equipment damage.

#### 10.3.1. Dry Cleaning Technique

This section describes dry cleaning techniques using lint-free wipes.

1. Make sure that the lasers are turned off before beginning the inspection.



Invisible laser radiation may be emitted from disconnected fibers or connectors. Do not stare into beams or view directly with optical instruments.

2. Remove the protective endcap and store it in a small resealable container.
3. Inspect the connector with a fiberscope.
4. If the connector is dirty, clean it with a lint-free wipe.
5. Fold the wipe into a square (about 4 to 8 layers thick).



Be careful not to contaminate the cleaning area of the wipe with your hands or on a surface during folding.

6. Fold the wipe into a square (about 4 to 8 layers thick).



Do not scrub the fiber against the wipe; doing so could cause more contamination.

7. Fold the wipe into a square (about 4 to 8 layers thick) using another clean section of the wipe.
8. Properly dispose of the wipe and lightly wipe the ferrule tip with the central portion of the wipe.
9. Inspect the connector again with the fiberscope.
10. Repeat this process if necessary.

### 10.3.2. Wet Cleaning Technique

If a 'dry' cleaning procedure does not remove the dirt from the fiber endface, then try the wet cleaning method.



Improper cleaning can cause damage to the equipment. The primary concern with using isopropyl alcohol is that it be removed completely from the connector or adapter. Residual liquid alcohol will act as a transport mechanism for loose dirt on the endface. If the alcohol is allowed to evaporate slowly off the ferrule, it can leave residual material on the cladding and fiber core. This is extremely difficult to clean off without another wet cleaning and usually more difficult to remove than the original contaminant. Liquid alcohol can also remain in small crevices or cavities where it can re-emerge during fiber connection.

1. Make sure that the lasers are turned off before beginning the inspection.



Invisible laser radiation may be emitted from disconnected fibers or connectors. Do not stare into beams or view directly with optical instruments.

2. Remove the protective endcap and store it in a small resealable container.
3. Inspect the connector with a fiberscope.
4. Fold two wipes into a square (about 4 to 8 layers thick).
5. Moisten one of the wipes with one drop of 99% alcohol. Be sure the other wipe remains dry.
6. Lightly wipe the ferrule tip in the alcohol moistened wipe.
7. Immediately repeat the action on the dry wipe to remove any residual alcohol.
8. Inspect the connector again with a fiberscope.
9. Repeat the process as necessary.

#### 10.4. Adapters Cleaning Procedure

Dry cleaning techniques are recommended for adapters using lint-free swabs. Please, apply the following steps:

1. Remove the protective endcap and store it in a small resealable container.
2. Inspect the adapter.
3. If the adapter is dirty, clean it with a lint-free swab.
4. Turn the swab to clean the sleeve face.
5. Inspect the adapter again.
6. Repeat this process as necessary.

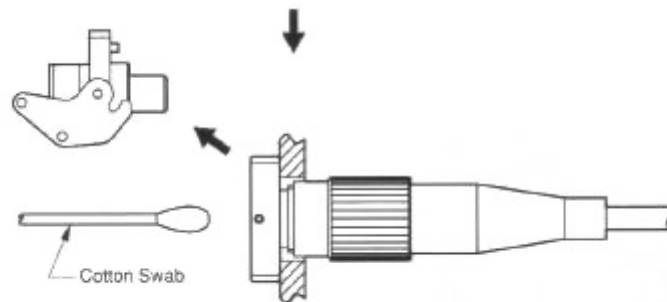


Figure 10-2 - Adapter Cleaning



## 11. Technical Service

### 11.1. ZEPREN Solutions S.L. Services and Sales Office

Any repair, maintenance or adjustment of this instrument must be performed by qualified personnel. Before returning an instrument for service, please contact our assistant engineer by internet or phone.

Phone number +34 976 919 238

Email address: [info@zepren.com](mailto:info@zepren.com)

Internet: [www.zepren.com](http://www.zepren.com)

Box mail: Calle Maria de Luna 11, CEEI ARAGON nave 3. 50018. Zaragoza.  
Spain

Also, if you need assistance with your test and measurement needs, we will be very pleased to support you.

### 11.2. Warranty

The BOSA instrument is warranted against defects in material under normal use conditions for a period of one year from the date of shipment. For warranty service the product must be returned to ZEPREN Solutions facilities.

### 11.3. Calibration

The calibration of the instrument affects to the optical power and wavelength scales and this should be done in ZEPREN Solutions facilities. A two-year calibration period is recommended unless indicated otherwise in your Calibration Certificate.

### 11.4. Returning the Device for Service

If the initial inspection of the device fails, the instrument does not meet the specifications or the device is not working correctly, notify the service office. If the instrument is to be shipped to ZEPREN Solutions facilities, the document 'Return Material Agreement request form' will be sent to be completed by you. This document should be attached to the device.

The original carton and packaging material must be used when shipping the BOSA to ZEPREN Solutions facilities. Mark with FRAGILE labels the outer side of the packaging to encourage careful handling.

## 11.5. Firmware Updates

You may need to upgrade the firmware of the instrument to enhance the usability and functionality of your instrument. New features may be available with new firmware revisions.

Load the corresponding file on a USB memory stick. Once the USB stick is connected to your BOSA you may carry out the firmware update directly through the *Help* Menu, selecting the *Software Update* option.

## 12. Specifications

| Optical                        |                                                                                                             |
|--------------------------------|-------------------------------------------------------------------------------------------------------------|
| Wavelength range               | C band: 1525-1565 nm<br>C+L bands: 1525-1610 nm<br>O band: 1265-1345 nm<br>S & T bands available on request |
| Optical resolution (FWHM)      | 10 MHz                                                                                                      |
| Calibrated power range         | +13 to -70 dBm                                                                                              |
| Maximum safe total input power | +20 dBm                                                                                                     |
| Sweep time                     | 20 nm/s                                                                                                     |
| Wavelength reference           | Linearization + absolute reference                                                                          |
| Measurement                    |                                                                                                             |
| Spurious-free dynamic range    | >80 dB                                                                                                      |
| Sensitivity (@10 MHz)          | -70 dBm                                                                                                     |
| Power accuracy                 | ±0.5 dB                                                                                                     |
| Wavelength accuracy            | ±0.5 pm (C, C+L)<br>±1.0 pm (O)                                                                             |
| Physical & electrical          |                                                                                                             |
| Operating Temperature          | +15 °C to +35 °C                                                                                            |
| Power Requirements             | 110/220V; 50/60Hz<br>Máx. 200W.                                                                             |
| Dimmension & Mass              | 430x230x470 (mm). Máx. 18Kg                                                                                 |
| Optical Connections            | FC/APC<br>Others on request                                                                                 |
| Available interfaces           | Ethernet, USB, GPIB                                                                                         |

## BOSA Options

|                |        |          |        |
|----------------|--------|----------|--------|
| Measured bands | C band | C+L band | O band |
|----------------|--------|----------|--------|

### Option 10 - Tunable laser output

|                      |              |              |              |
|----------------------|--------------|--------------|--------------|
| Wavelength Range     | 1516-1565 nm | 1521-1630 nm | 1265-1345 nm |
| Wavelength accuracy  | ±1.5 pm      | ±2.0 pm      |              |
| Tunning speed        | 1-100 nm/s   |              |              |
| Output power         | >1 mW        |              |              |
| Side-mode suppresion | >43 dB       | >45 dB       |              |
| RIN                  | <-145 dB/Hz  | <-140 dB/Hz  |              |
| Linewidth            | <1 MHz       |              |              |
| Trigger output       | BNC          |              |              |

### Option 20 - Component analyzer

|                             |                                           |              |              |
|-----------------------------|-------------------------------------------|--------------|--------------|
| Wavelength range            | 1516-1565 nm                              | 1521-1630 nm | 1265-1345 nm |
| Wavelength accuracy         | ±1.0 pm                                   | ±2.0 pm      |              |
| Power accuracy              | ±0.2 dB                                   |              |              |
| Polarization Measurement    | Two orthogonal states. PDL with option 30 |              |              |
| Output power                | >0 dBm                                    |              |              |
| Sensitivity                 | -70 dBm (IL)<br>-45 dBm (RL)              |              |              |
| Calibrated input range      | -10 to -70 dBm                            |              |              |
| Spurious-free dynamic range | >80 dB                                    |              |              |
| Measurement time            | 1 s for 100 nm                            |              |              |

### Option 30 - Spectral polarimetry

|                            |     |
|----------------------------|-----|
| Polarization repeatability | ±5° |
|----------------------------|-----|

|                          |                                    |
|--------------------------|------------------------------------|
| Temperature dependence   | $\pm 0.2^{\circ}/^{\circ}\text{C}$ |
| Measurement time         | 6 scans at 20 nm/s                 |
| Polarization sensitivity | -40 dBm                            |
| Polarization crosstalk   | <20 dB                             |

#### Option 40 - Phase measurement

|                                  |                     |              |              |
|----------------------------------|---------------------|--------------|--------------|
| Wavelength range                 | 1525-1565 nm        | 1525-1615 nm | 1265-1345 nm |
| Bandwidth                        | 80 MHz to full span |              |              |
| Pattern Frequency Range          | 70 MHz to 2 GHz     |              |              |
| Phase accuracy                   | $\pm 1^{\circ}$     |              |              |
| Sensitivity                      | -70 dBm             |              |              |
| Electrical Reference input power | +5 to -15 dBm       |              |              |
| Measurement time                 | 1 s for 20 nm       |              |              |

## 13. Glossary

The definitions of the terms used in the BOSA specification are the following:

- Close-in dynamic range  
Height, in a logarithmic scale, of the spectral filtering function<sup>1</sup> applied to input signals.
- Dynamic range  
Ratio between maximum and minimum optical powers that can be detected in a single measurement process in conditions for maximum sensitivity (averaging over 32 scans with Lock Trace on).
- Maximum Safe Total Input Power  
Specify the maximum total input power that can be applied as input signal.
- Optical resolution  
Width of the spectral filtering function FWHM\* applied to input signals.
- Power accuracy  
The uncertainty of an optical power measurement in absolute terms. It is the maximum deviation from a known reference source power level where the polarization dependence is not included. It's maximum over 32 averaging.
- Sensitivity  
Minimum detectable optical power spectral density.
- Wavelength Accuracy  
The uncertainty of the wavelength axis measured by the BOSA. It's maximum for spans <1nm

## 14. Troubleshooting

### 14.1. Error Messages

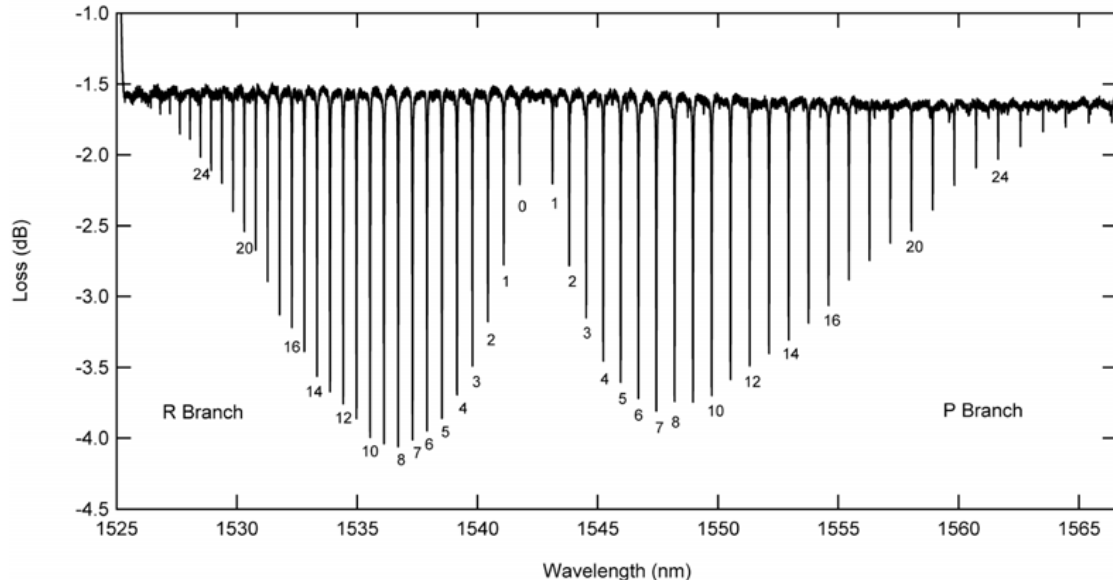
There is a list of possible system errors identified by an error code.

The Code Errors 100X, 200X, 440X, 800X and 900X are related to optical hardware errors and the Code errors 500X and 700X are related to communication hardware errors. All the error messages are shown above the operation parameters area. If any of the following error appears restart the system. If the error persists, please contact ZEPREN Solutions for further support.

| Code Error                           | Error Message                                                                                                                                   |
|--------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|
| 7001<br>7002                         | 'An internal module error has occurred, please take note on Error Code and contact ZEPREN Solutions for Technical Support.<br>Error Code: 700x' |
| 5001<br>5002<br>5005<br>5008<br>5009 | '500x: Internal device communication error'                                                                                                     |
| 5004                                 | '5004: Internal device read error'                                                                                                              |
| 5007                                 | '5007: Internal device write error'                                                                                                             |
| 8001<br>8002<br>8003                 | 'System error: 800X'                                                                                                                            |
| 9001<br>9002<br>9003                 | 'System error: 900X'                                                                                                                            |

## 15. APPENDIX I: Gas Cell Absorption Lines

[1] C band model:



| R Branch | Wavelength (nm) | P Branch | Wavelength (nm) |
|----------|-----------------|----------|-----------------|
| 25       | 1528.0541       | 1        | 1543.1148       |
| 24       | 1528.4862       | 2        | 1543.8094       |
| 23       | 1528.9271       | 3        | 1544.5147       |
| 22       | 1529.3762       | 4        | 1545.2314       |
| 21       | 1529.8376       | 5        | 1545.9563       |
| 20       | 1530.3061       | 6        | 1546.6902       |
| 19       | 1530.7856       | 7        | 1547.4354       |
| 18       | 1531.2764       | 8        | 1548.1904       |
| 17       | 1531.7738       | 9        | 1548.9554       |
| 16       | 1532.2825       | 10       | 1549.7302       |
| 15       | 1532.8024       | 11       | 1550.5149       |
| 14       | 1533.3291       | 12       | 1551.3106       |
| 13       | 1533.8671       | 13       | 1552.1157       |
| 12       | 1534.4159       | 14       | 1552.9308       |
| 11       | 1534.9723       | 15       | 1553.7560       |
| 10       | 1535.5401       | 16       | 1554.5892       |
| 9        | 1536.1170       | 17       | 1555.4346       |
| 8        | 1536.7034       | 18       | 1556.2919       |
| 7        | 1537.2997       | 19       | 1557.1573       |
| 6        | 1537.9069       | 20       | 1558.0329       |
| 5        | 1538.5224       | 21       | 1558.9185       |
| 4        | 1539.1494       | 22       | 1559.8143       |
| 3        | 1539.7855       | 23       | 1560.7185       |
| 2        | 1540.4314       | 24       | 1561.6344       |
| 1        | 1541.0872       | 25       | 1562.5625       |



[2] C+L band model:

| Band | C12 HCN     | C12 CO    | C13 CO    |
|------|-------------|-----------|-----------|
| L26  | 1519.007585 |           |           |
| L25  | 1519.421573 |           |           |
| L24  | 1519.845905 |           |           |
| L23  | 1520.28055  |           |           |
| L22  | 1520.725527 |           |           |
| L21  | 1521.180877 | 1560.5025 | 1595.3772 |
| L20  | 1521.646548 | 1560.868  | 1595.7554 |
| L19  | 1522.122606 | 1561.26   | 1596.1595 |
| L18  | 1522.609023 | 1561.6786 | 1596.5895 |
| L17  | 1523.10582  | 1562.1237 | 1597.0454 |
| L16  | 1523.613015 | 1562.5953 | 1597.5271 |
| L15  | 1524.130607 | 1563.0935 | 1598.0349 |
| L14  | 1524.658593 | 1563.6183 | 1598.5686 |
| L13  | 1525.197017 | 1564.1697 | 1599.1284 |
| L12  | 1525.745855 | 1564.7477 | 1599.7141 |
| L11  | 1526.305129 | 1565.3523 | 1600.3258 |
| L10  | 1526.874837 | 1565.9835 | 1600.9636 |
| L9   | 1527.455003 | 1566.6414 | 1601.6274 |
| L8   | 1528.045651 | 1567.3261 | 1602.3174 |
| L7   | 1528.646756 | 1568.0375 | 1603.0334 |
| L6   | 1529.258344 | 1568.7756 | 1603.7756 |
| L5   | 1529.880439 | 1569.5405 | 1604.5439 |
| L4   | 1530.513043 | 1570.3323 | 1605.3385 |
| L3   | 1531.156133 | 1571.1509 | 1606.1593 |
| L2   | 1531.809784 | 1571.9965 | 1607.0064 |
| L1   | 1532.473951 | 1572.8691 | 1607.8799 |
| L0   | 1533.148683 | 1573.7687 | 1608.7799 |
| R1   | 1534.529837 | 1575.6498 | 1610.6596 |
| R2   | 1535.23629  | 1576.6311 | 1611.6393 |
| R3   | 1535.953327 | 1577.6397 | 1612.6457 |
| R4   | 1536.680951 | 1578.6758 | 1613.6788 |
| R5   | 1537.419216 | 1579.7392 | 1614.7388 |
| R6   | 1538.168127 | 1580.83   | 1615.8255 |
| R7   | 1538.927668 | 1581.9485 | 1616.9392 |
| R8   | 1539.697845 | 1583.0945 | 1618.0797 |
| R9   | 1540.478712 | 1584.2683 | 1619.2473 |
| R10  | 1541.270255 | 1585.4698 | 1620.442  |
| R11  | 1542.072479 | 1586.6993 | 1621.6641 |
| R12  | 1542.885418 | 1587.9567 | 1622.9132 |
| R13  | 1543.709081 | 1589.2422 | 1624.1898 |
| R14  | 1544.543475 | 1590.5559 | 1625.494  |
| R15  | 1545.388588 | 1591.8978 | 1626.8257 |
| R16  | 1546.244477 | 1593.2681 | 1628.1851 |
| R17  | 1547.111151 | 1594.6669 | 1629.5723 |
| R18  | 1547.988599 | 1596.0942 | 1630.9873 |
| R19  | 1548.87683  | 1597.5502 | 1632.4303 |
| R20  | 1549.775904 |           |           |
| R21  | 1550.685785 |           |           |
| R22  | 1551.60651  |           |           |
| R23  | 1552.538091 |           |           |
| R24  | 1553.480541 |           |           |
| R25  | 1554.433873 |           |           |
| R26  | 1555.398101 |           |           |
| R27  | 1556.373239 |           |           |