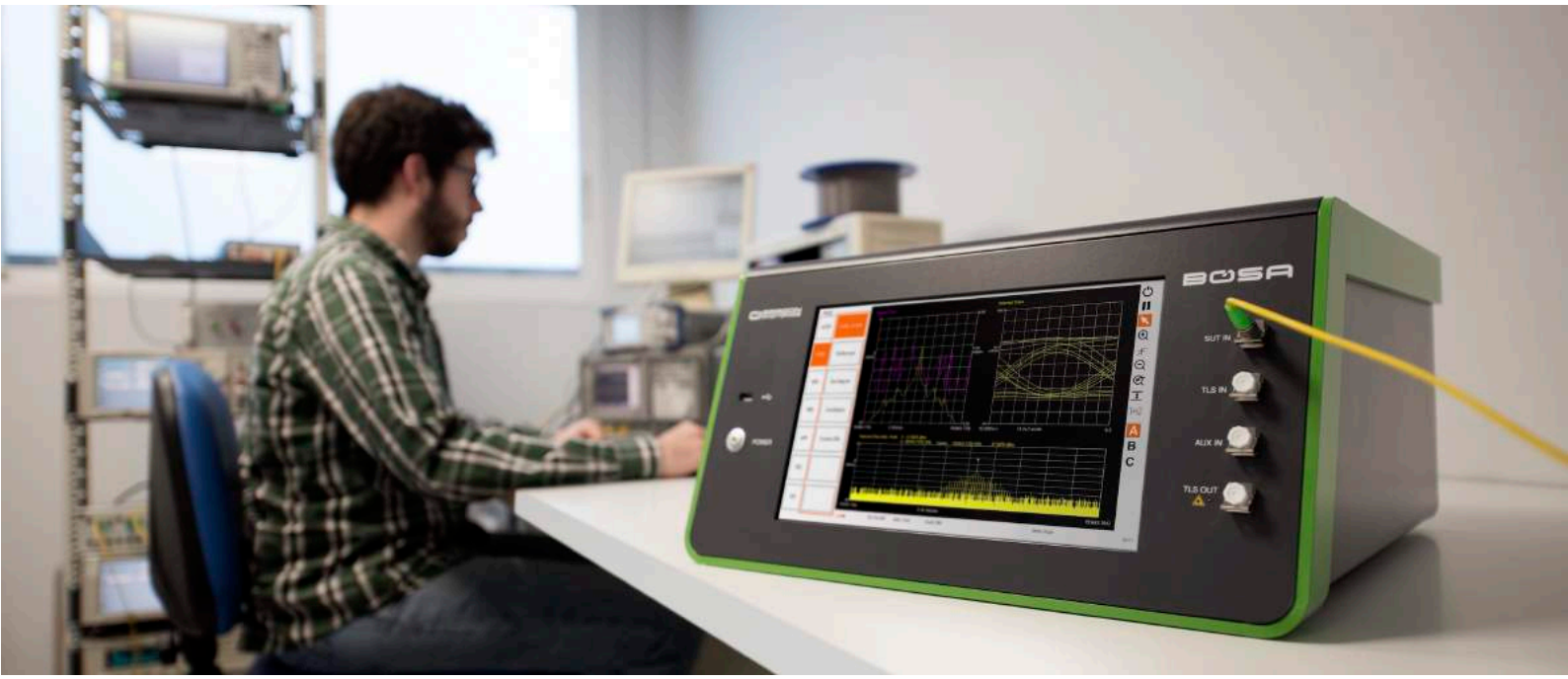
ARAGON PHOTONICS



BOSA

True high-resolution

CATALOG2016

A WORD FROM THE TEAM

Welcome to our new Catalog! Continuous innovation is at the very core of our values here at Aragon Photonics. That's how we made the BOSA 400 a reality and that is how we keep improving it to maintain its leading position in the high resolution OSA marketplace. BOSA 400 is an even faster and more accurate equipment, with a completely rethought and renewed user interface, easy to use and packed with advanced functionalities.

Some exciting news in this new catalog are the availability of BOSA technology for O-band for the first time and a new phase measurement option at 10 GHz specially designed for pulsed laser analysis.

In this catalog you will also find all the information about the complete list of options for BOSA in order to get a full packaged equipment, ready for many different applications, and also about the BOSA Lite, the most affordable high-resolution OSA in the market, and the BOSA 100, ready for measuring at non-standard wavelength ranges.

Join us!

The Aragon Photonics team

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NEW BOSA 400

The highest performance BOSA we've ever built!

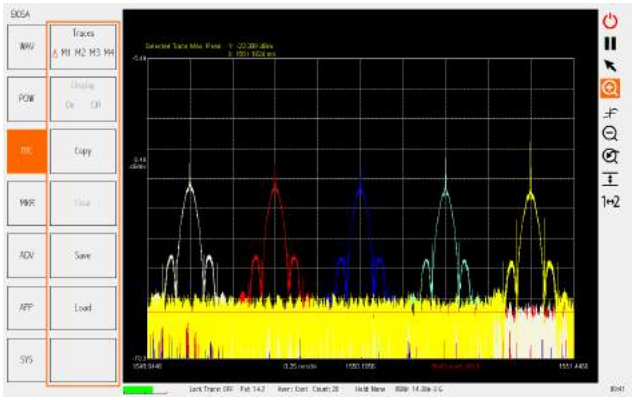
Its simultaneous 20 nm/s measuring speed, 10 MHz (80 fm) resolution and 80 dB spurious-free dynamic range, make the BOSA 400 the best performing high-resolution OSA.

The New BOSA 400 series can be made only thanks to the high quality components inside and the careful control of all of them. Thus, maximum filtering efficiency, low noise detection, fast high quality 16-bit acquisition, fast scanning and maximum wavelength accuracy make the most accurate optical spectrum analyzer.

- 20 nm/s measurement speed
- 10 MHz pure optical resolution
- >80 dB spurious-free dynamic range
- Up to 0.5 pm wavelength accuracy

Modern and intuitive

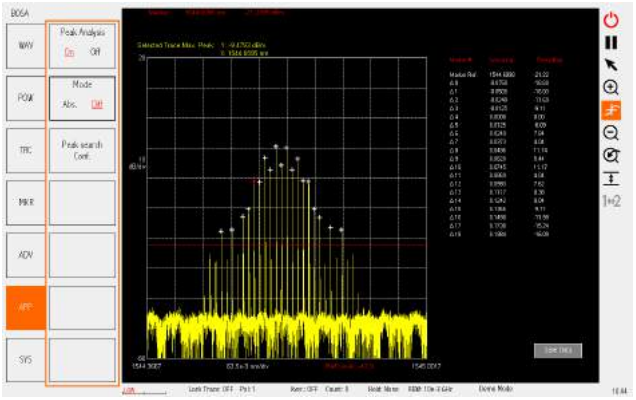
Not only the box is completely new, all the graphic user interface has been completely redesigned to be fast and operative either through its included touch screen (with big clear buttons, ideal for use when mounted in a rack) or with mouse and keyboard and external monitor (getting advantage of shortcuts and contextual menus, great when installed in a lab workbench or in a cart).



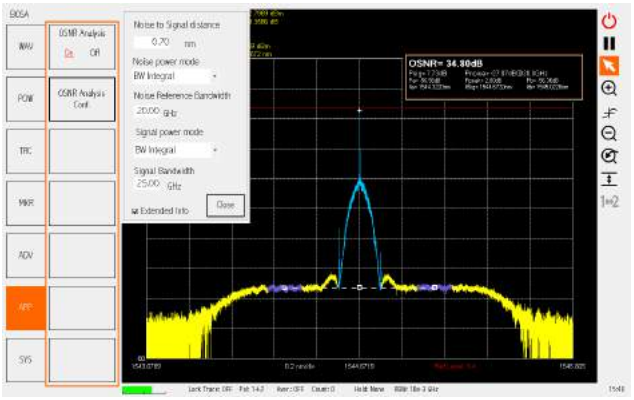
Full of utilities to make your work easier

Take the most out of your measurements with some of the advanced functions:

- New peak analysis function, that lets you characterize a comb in a second and export the data in a csv file.



- New OSNR measurement application.



- Trace locking, uses an automatic or user-defined portion of the spectrum for reference to lock traces and obtain the most accurate averaging results.
- Variable resolution, to get results more easily comparable with your old OSA while you get used to the amount of detail a BOSA gives you.
- Power integral, that allows measuring the total power of the signal in a user-defined portion of the spectrum.
- Dual-channel polarization measurement, that allow seeing the separate orthogonal polarization components of the signal simultaneously.
- Easy automation. Control your BOSA remotely through GPIB or Ethernet using SCPI commands or automate measurements using the built-in Macro Editor.

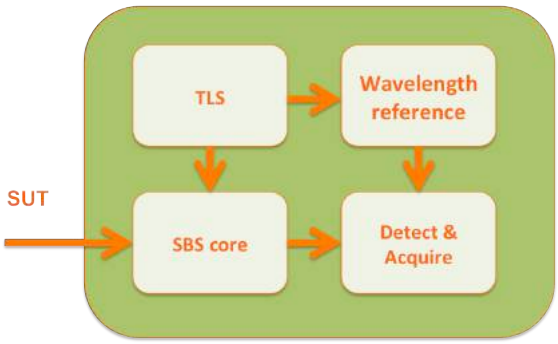
In addition to high resolution spectrum analysis, BOSA has several upgrade options: Tunable Laser Output, Component Analyzer, Polarimetry extension, and Phase Measurement Options. Check them on page 8-10.

Brillouin spectrometry, a unique and powerful high-resolution OSA technology

Based on revolutionary **all-optical patented technology**, Aragon Photonics produces the most advanced and versatile Subpicometric Optical Spectrum Analyzer products.

The principle behind BOSA performance is stimulated Brillouin scattering (SBS), a non-linear optical effect produced by narrow-linewidth high-power light propagating through an optical medium that causes a very narrow filtering effect. By pumping SBS with an external cavity tunable laser source (TLS), the filter is swept along the spectral region of interest, revealing the high-resolution optical spectrum.

- **Unique technology** → Unique solutions
- More than **100 times higher resolution** than a standard OSA.
- **Maximum reliability**: Full spurious-free dynamic range

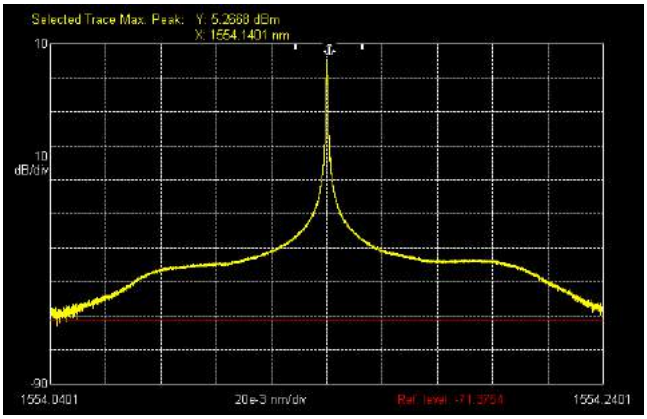


The non-linearity of SBS gives the BOSA great advantages over other classic spectroscopy methods such as diffraction gratings, Fabry-Perot filters or heterodyne OSAs, all of them linear. The amplification effect of SBS greatly enhances the dynamic range of the measurement compared to passive filtering. The threshold imposed by SBS also helps cancel the spurious effects of the local oscillator sidemodes and lineshape that produce measurement artifacts in heterodyne OSAs, giving the **highest spurious-free dynamic range** measurement available in any high-resolution OSA.

BOSA's unique combination of high-resolution and high dynamic-range brings a new range of measurement possibilities to the optical domain. BOSA reveals the optical spectra of the signals with a detail and precision that enables direct measurement of performance parameters for lasers and modulated signals that until now had to be measured by complicated setups or could not be measured at all.

Laser characterization

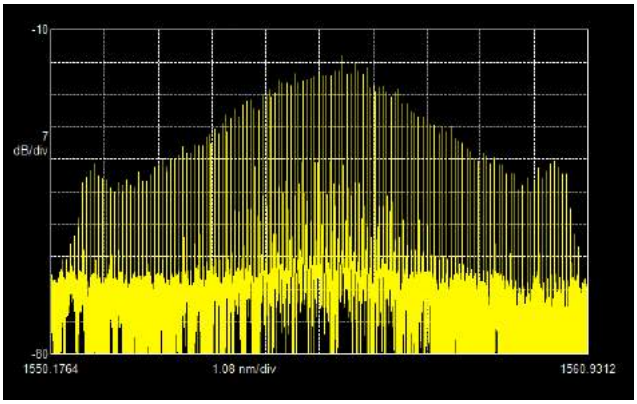
The characterization of laser parameters such as **relative intensity noise (RIN)** or relaxation oscillations frequency can be a tedious and time-consuming in the electrical domain. However, the optical spectrum of a laser contains meaningful information about many of these laser parameters in its spectral shape.



In this measurement the spectral shape of a DFB laser is shown. Just by measuring the spectral linewidth at different bias currents the linewidth enhancement factor can be extracted.

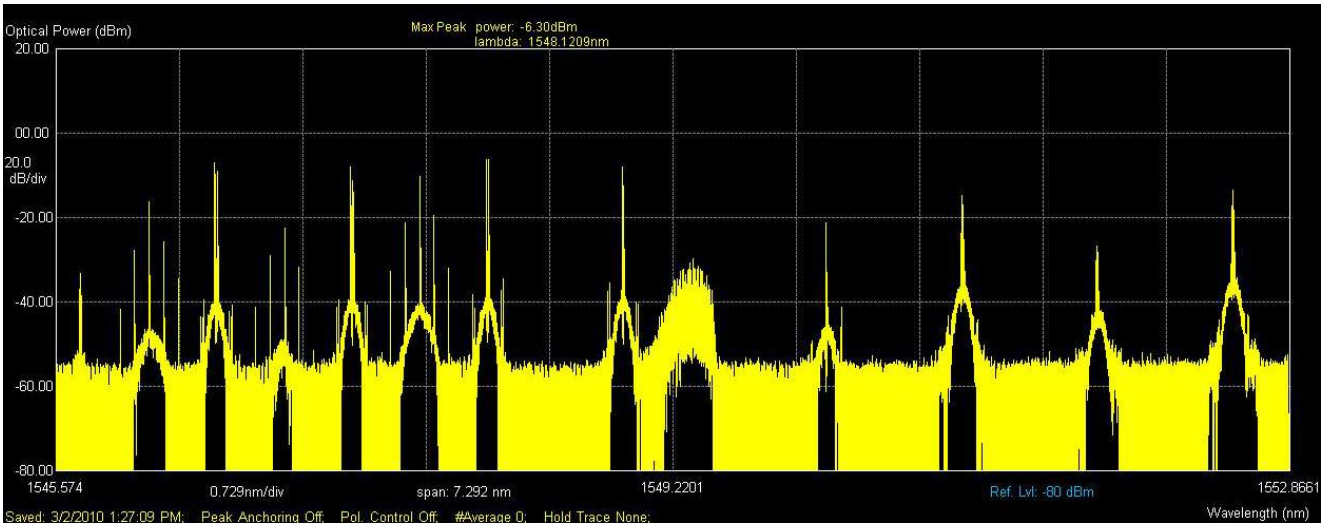
Comb/Pulsed sources characterization

BOSA is also a great tool to analyze **dynamic effects** on lasers and semiconductor devices. In the measurement example below we can observe a close-up of a picosecond pulsed laser with a 10 GHz repetition rate.



Optical communications systems analysis

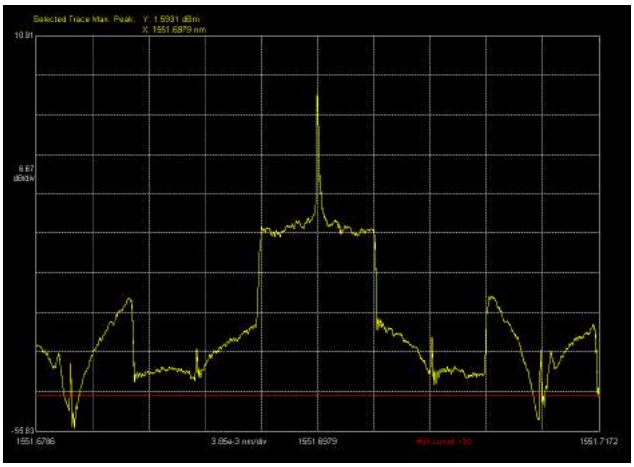
The additional detail provided by the high-resolution spectrum of advanced modulation formats can give you very useful performance information of modulated signals. In the next measurement example several channels of an in-service DWDM network are captured. 10G RZ and NRZ channels with a 100G PolMux QPSK in the middle are shown. The BOSA captures the measurement with the **maximum resolution and dynamic range whatever the span is**, so a full band measurement contains all the spectral detail for all channels.



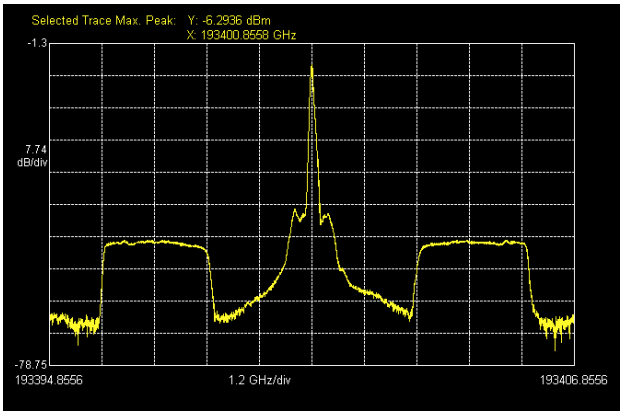
Advanced modulation formats analysis

For new modulation formats aimed at ultra-high spectral efficiency such as **OFDM** and **Nyquist –WDM**, the high-resolution spectrum is mandatory to assess the proper behavior of the subsystems.

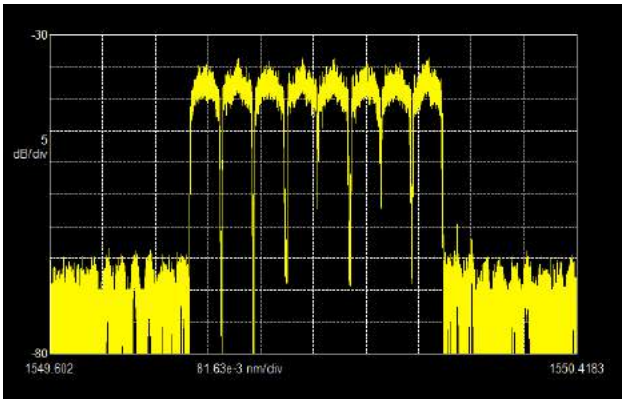
In the example below, a 1 Gb/s Nyquist modulation can be observed. The higher order modulation residual components created by the digital-to-analog converted can be easily seen so that you can apply optical filtering very precisely.



In the example below, an upconverted **OFDM** signal after optimizing the ADC stage thanks to the information obtained by BOSA. Seeing the spectral shape is critical!



In the example below, **8 OFDM channels** are shown. Aligning these signals to avoid overlapping with a normal OSA requires constantly switching off channels to see the carrier wavelength and taking leaps of faith on the unseen spectrum, whereas with BOSA all the information is seen in a single scan.



Aragon Photonics provides two solutions for High Resolution Spectroscopy very affordable: BOSA Lite / Lite+ and BOSA 100 series. Don´t be fooled by the price, these two models can be exactly what you need.

BOSA *Lite / Lite+*

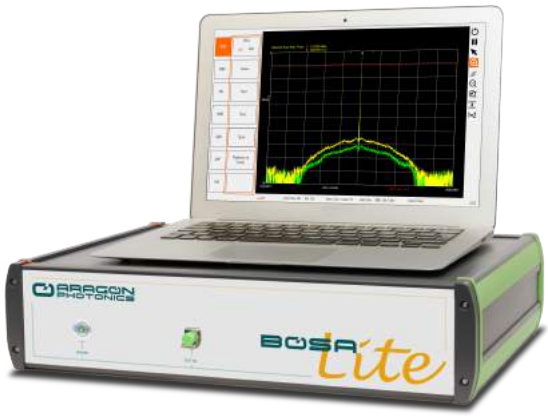
Designed to find the best balance between performance, features and cost, the new BOSA Lite is the new access point to the world of ultra-high optical resolution and the most affordable sub-picometric OSA in the market.

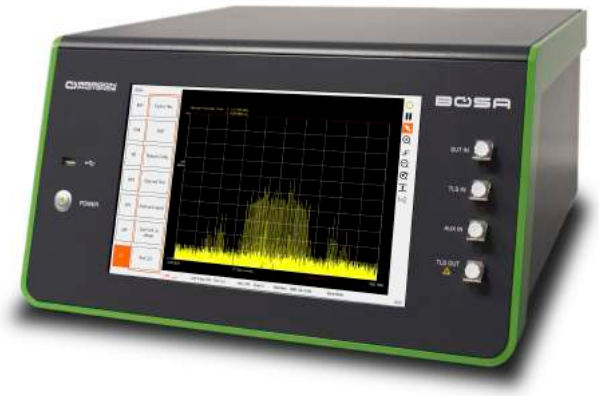
- **20 MHz** (0.16 pm) optical resolution
- **80 dB** spurious-free dynamic range
- Two orthogonal polarization channels

Despite its small form factor and light weight, BOSA Lite is a fully functional BOSA (including the scanning laser) that only requires a single USB connection to a PC to work.

BOSA Lite is also available in mainframe version (including computer and screen) as BOSA Lite+. It includes TLS Output and Components Analyzer options.

- BOSA Lite: Compact & lightweight: very **portable**.
- BOSA Lite+: Rack-mount version.





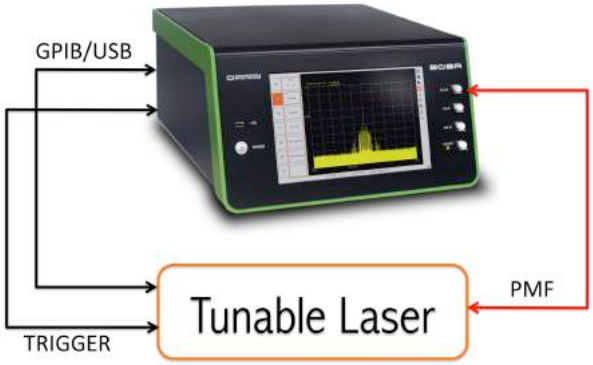
BOSA 100

If you already own a compatible Tunable Laser Source (TLS) you can achieve the maximum performance of BOSA at a very **affordable** price with BOSA100.

- Use your own laser and save money.
- Available for: **C, L & O bands.** S band on request.

BOSA 100 controls the third-party TLS using GPIB or USB. Some compatible TLS are: Yenista Tunics 100S/R/Reference, Agilent 81600 series or Luna Phoenix 1400. Also, BOSA 100 is **upgradeable** to BOSA 400 anytime.

Contact us and customize your BOSA with your own laser!



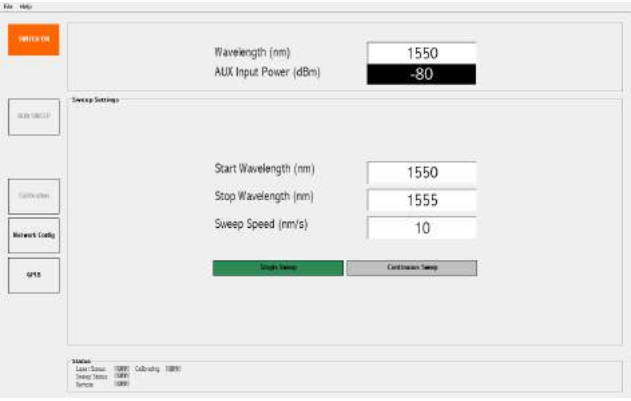
Integrated in the same mainframe, BOSA options **add multiple measurement capabilities** to your unit, making it a real all-terrain instrument for your research lab. or Network. Additional measurement modes with specific software can be selected when hardware options are installed.

Option 410 – Tunable laser output

This option provides access to the internal tunable laser source included in BOSA 400 series and in BOSA Lite+, so that it can be used for additional applications.

- High accuracy.
- High scanning repeatability.
- Output power >0dBm.
- Remote control.
- Trigger synchronization.
- Use our TLS for your own purposes!

BOSA TLS is a high-quality **external cavity laser** with very good scanning performance. It can be controlled through GPIB or Ethernet interfaces with SCPI commands.

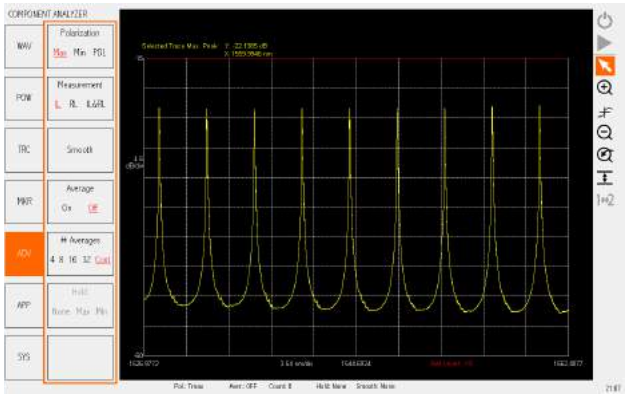


Option 420 – Component analyzer

This option turns your BOSA into a **passive component** analyzer (Tunable laser output option is required) by including a high-dynamic range measurement port synchronized with the TLS sweep.

- Insertion Losses
- Return Losses
- Polarization Dependent Losses (with option 430)
- **100 nm/s scanning speed**

Connect a passive optical device between the AUX Output and AUX Input ports of your BOSA and the spectral profile of insertion loss (IL) and return loss (RL) of your passive optical devices can be measured with great detail and precision thanks to the benefits of BOSA technology.



- **Fiber Bragg gratings**
- Waveguides or **photonic integrated circuits**
- **WDM network components**

Component analyzer has its own optimized measurement GUI but also shares many of the advanced functionalities of BOSA:

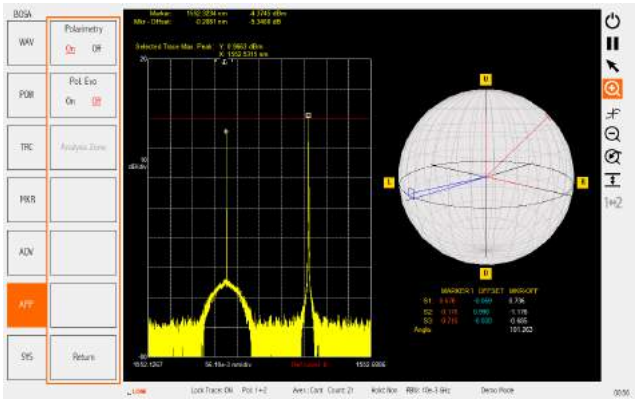
- Fully programmable through GPIB or Ethernet. Build you own monitoring applications easily!
- Internal reference gas cell for wavelength referencing and locking allows great accuracy.
- Simultaneous measurement of Insertion and Return Losses for complete characterization of your filters or gratings.
- Dual polarization scanning for PDL-independent measurement.

Option 430 – Polarization extension

With this option, you can turn your BOSA into the most advanced tool for **polarization analysis**. This option is not a stand-alone module but an extension to the spectrum analysis module and the component analyzer module.

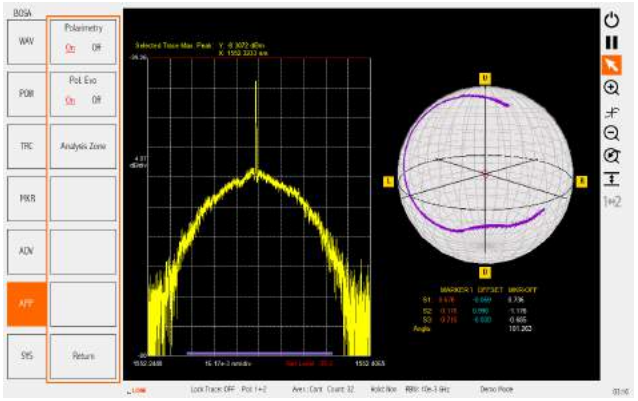
- Simultaneous measurement of Optical spectrum and Poincare sphere
- DGD & PMD measurement enabled

When using the optical spectrum analysis module with option 430 activated, the **spectrally-resolved state of polarization** (SOP) can be measured. Use markers to measure polarization differences between different light sources or different spectral components. You can also check the polarization changes of a signal under different testing conditions.



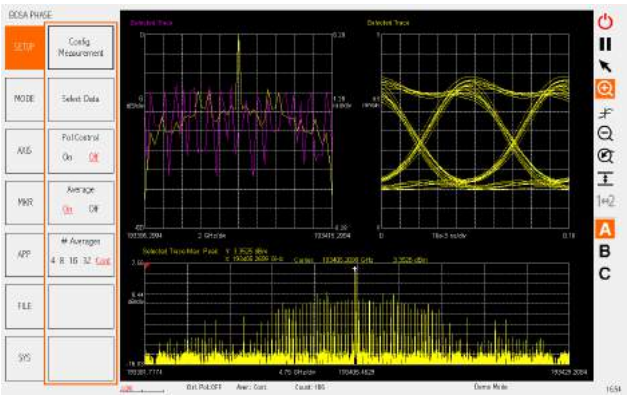
The continuous evolution of the state of polarization can also be measured. Select a portion of the measured span to plot the evolution of the SOP with high resolution.

- Polarization alignment of different optical sources
- Evolution of Polarization with wavelength



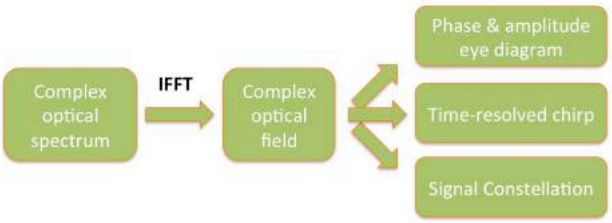
This enables real-time measurement of the instantaneous **differential group delay** (DGD) of the channels present in an in-service DWDM link. By monitoring DGD over time, **polarization mode dispersion** (PMD) of the fiber can be measured.

Option 440 – Phase measurement

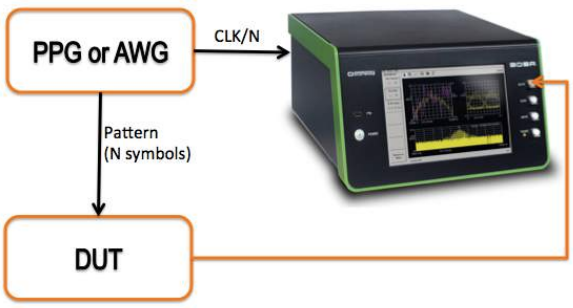


BOSA option 440 (BOSAphase) turns the BOSA into an **Optical Complex Spectrum Analyzer** (OCSA) which is another patented technology by Aragon Photonics.

Taking advantage of the SBS filtering capabilities but simultaneously selecting adjacent spectral components, the phase of the optical spectrum is measured. Together with the high-resolution spectrum information, the **complex spectrum** is obtained, opening radically new possibilities for optical signal analysis, as with the complex spectrum information and through inverse Fourier transform, all the time-domain information can be retrieved: eye diagram, constellation, **time-resolved chirp**, etc. And because the measurement is made in the spectral domain, it is not rate-limited by electronics, making it really future-proof.

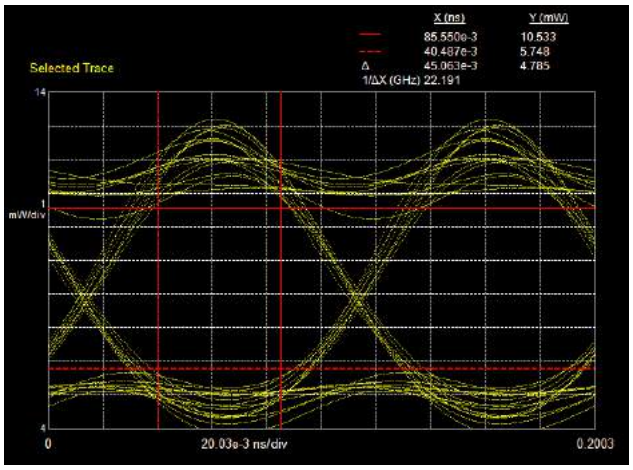


The phase of any optical signal modulated with a pattern that is repeated with a **pattern frequency between 88 MHz and 1.45 GHz** can be measured. You can easily generate these test signals with most commercially available PPGs or AWGs. The BOSA just requires the optical signal to measure and a reference pattern clock (pattern repetition frequency = baud rate divided by the number of symbols in the pattern).

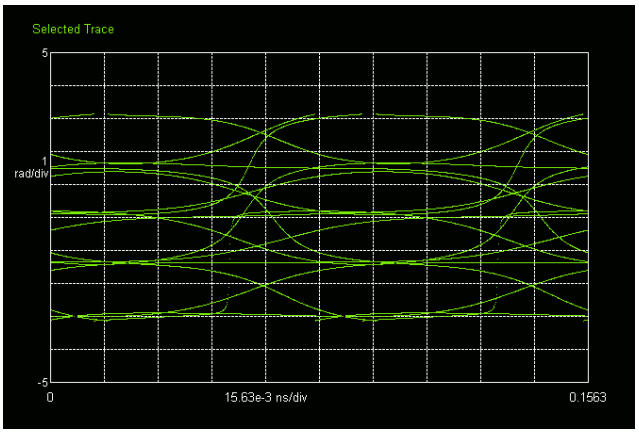


Eye-diagram

The eye diagram represents the possible transitions that occur in a modulated signal, giving a clear idea of the quality of the signal. Measuring the eye diagram of high bit-rate signals gives rise to noisy traces and with low bit-depth. With BOSAphase the measurement is carried out in the spectral domain and the measurement bandwidth is orders of magnitude lower than the measured, virtually suppressing the noise.

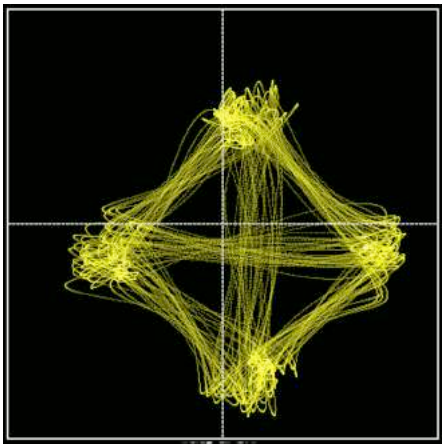


For phase measurements, only the I and Q eye diagrams can be measured as they require demodulation. However, as BOSAphase performs its measurement with **no need for demodulation**, the real phase eye diagram can be obtained. This allows as shown in the example measurement below, rendering the **multi-level phase eye diagram** of a QPSK modulation.



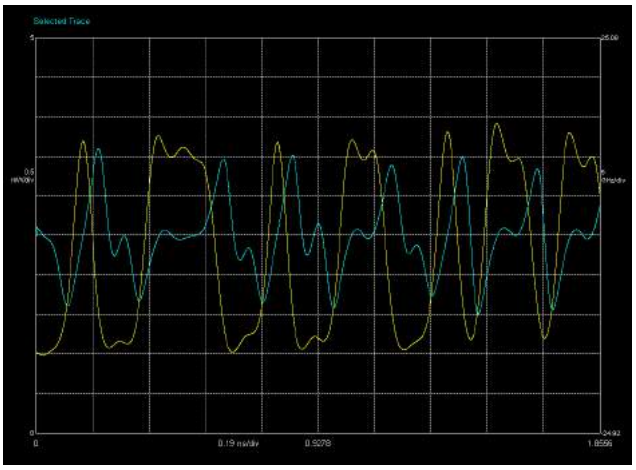
Constellation

The constellation diagram normally shows the sampled points of a signal modulated in amplitude and/or phase in phase (I) and quadrature (Q) after a demodulator. With BOSAphase not only the sampling point is represented, but the **complete I-Q transition plot**, showing much more detail from the modulator performance and allowing the assessment of complex impairments distorting the signal.



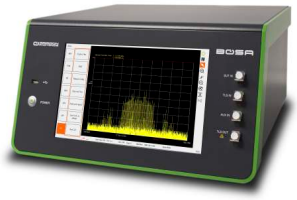
Time-Resolved Chirp

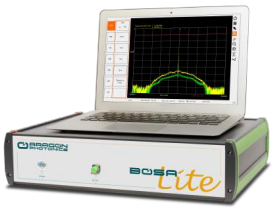
Frequency chirp is a critical parameter that is very difficult to measure due to the lack of appropriate tools. The time-resolved chirp (TRC) represents the instantaneous frequency drift of a signal modulated in amplitude and is normally measured using FROG methods that have low sensitivity, high noise and poor repeatability. From a BOSAphase measurement, the TRC is easily extracted as the derivative of the instantaneous phase, rendering the TRC with good detail. Calculating the alpha parameter (aka LEF) is also very direct.



Complex transfer function

Measuring the complex spectrum of a frequency comb before and after propagation through a device or medium under test and simply dividing the resulting complex spectra gives you its complex transfer function. Dispersive effects can be measured using this technique.





Feature	BOSA 400 / 100[1] series			BOSA Lite / Lite+	
	C band	C+L bands	O band	C band	C+L bands
Model parameters					
Optical Resolution	10 MHz @1550 nm		10 MHz @1310 nm	20 MHz @1550 nm	
Wavelength Range	1525-1565 nm	1525-1607 nm	1265-1355 nm	1525-1565 nm	1525-1607 nm
Wavelength accuracy	±0.5 pm	±2.0 pm	±2.0 pm	±2.0 pm	±2.0 pm
Spurious-free dynamic range[2]	>80 dB			>80 dB	
Close in dynamic range[2]	>40 dB @ ±0.3 pm >60 dB @ ±0.6 pm			>40 dB @ ±0.8 pm >60 dB @ ±2.0 pm	
Calibrated Input Power Range	+13 to -70 dBm			+13 to -70 dBm	
Maximum Safe Total Input Power	+20 dBm			+20 dBm	
Sensitivity[2]	-70 dBm / 10 MHz			-70 dBm / 10 MHz	
Power Accuracy[2]	±0.5 dB			±0.5 dB	
Polarization Measurement	Two Orthogonal Polarization Channels. Full Polarization Analysis with Option 430.			Two Orthogonal Polarization Channels	
Measurement time	20 nm/s			2.5 nm/s	
Internal Wavelength Calibrator	C12 HCN	C12 HCN + C12 CO + C13 CO	HF	C12 HCN	C12 HCN + C12 CO + C13 CO
Mainframe					
Operating Temperature	+15 °C to +35 °C			+15 °C to +35 °C	
Power Requirement	110/220V; 50/60Hz Máx. 150W. (BOSA 400) Máx. 130W. (BOSA 100)			110/220V; 50/60Hz Máx. 100W.	110/220V; 50/60Hz Máx. 150W.
Dimmension & Mass	430x230x470 (mm). Máx. 25Kg. (BOSA 400) Máx. 22Kg. (BOSA 100)			420x310x100 (mm). Máx. 7Kg	430x230x470 (mm). Máx 20Kg
Optical Connections	FC/APC Others on request			FC/APC Others on request	
Interfaces availables	Ethernet, USB, GPIB			Ethernet, USB (laptop)	Ethernet, GPIB, USB

[1]BOSA100 specs may depend on TLS model used with BOSA.
[2]Typical values, measured at 0dBm @1550nm.

Option for upgrade	BOSA 400 series		BOSA Lite+	
	C band	C+L band	C band	C+L bands
Option 410/010				
Wavelength Range	1516-1565 nm	1521-1630 nm	1525-1565 nm	1525-1607 nm
Absolute accuracy	±1.5 pm	±2.0 pm	±2.0 pm	
Tunning speed	1-100 nm/s		2.5 nm/s	
Output power	>1 mW		>1 mW	
Side-mode suppresion	>43 dB	>45 dB	>43 dB	>45 dB
RIN	<-145 dB/Hz	<-140 dB/Hz	<-145 dB/Hz	<-140 dB/Hz
Linewidth	<1 MHz		<5 MHz	
Trigger output	BNC		BNC	
Option 420/020				
Wavelength range	1516-1565 nm	1521-1630 nm	1525-1565 nm	1525-1607 nm
Wavelength accuracy	±1.0 pm	±2.0 pm	±2.0 pm	
Power accuracy	±0.2 dB		±0.2 dB	
Polarization Measurement	Two orthogonal states. PDL with Opt.430		Two orthogonal states	
Output power	>0 dBm		>0 dBm	
Sensitivity	-70 dBm (IL) -45 dBm (RL)		-70 dBm (IL) -45 dBm (RL)	
Calibrated input range	-10 to -70 dBm		-10 to -70 dBm	
Spurious-free dynamic range	>80 dB		>70 dB	
Measurement time	1 s for 100 nm		1 s for 2.5 nm	
Option 430				
Polarization repeatability	±5°		-	
Temperature dependence	±0.2°/°C		-	
Measurement time	6 scans at 20 nm/s		-	
Sensitivity for polarization meas.	-40 dBm		-	
Polarization crosstalk	<20 dB		-	
Option 440				
Wavelength range	1525-1565 nm	1525-1607 nm	-	
Bandwidth	80 MHz to full span		-	
Pattern Frequency Range	88 MHz to 1450 MHz		-	
Phase accuracy	±1°			-
Sensitivity	-60 dBm		-	
Electrical Reference input power	+5 to -15 dBm		-	
Measurement time	1 s for 10 nm		-	

WHAT'S NEW

- ✓ Now BOSA technology is available in **O-band**! Finally high resolution is available for the 1310 nm wavelength range!
- ✓ New **10 GHz** frequency option for BOSA phase measurement.
- ✓ New software functionalities: peak analysis, OSNR measurement, more traces…

ARAGON PHOTONICS

C/Prado 5,local. 50009, Zaragoza (Spain).
Tel: +34 976 35 99 72 / Fax: +34 976 40 20 22
info@aragonphotonics.com

WWW.ARAGONPHOTONICS.COM

YOUR LOCAL CONTACT