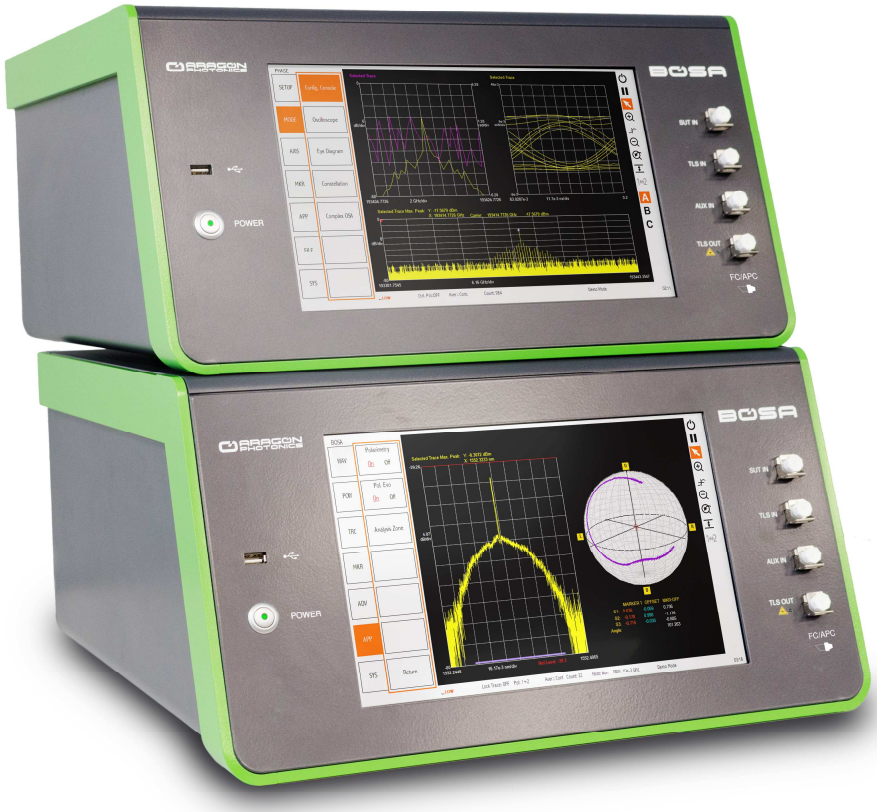
ARAGON PHOTONICS



BOSA

True high-resolution

CATALOG2018

A WORD FROM THE TEAM

Welcome to our latest 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 the most reliable High-Resolution OSA, easy to use and packed with really advanced functionalities.

Some exciting news in this new catalog are the improvement of BOSA phase measurement option in a wider pattern frequency range giving more versatility to this option and its availability for BOSA Lite+ model, or the extension in the L band up to 1615nm for BOSA 400.

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 with your own laser.

Join us!

The Aragon Photonics team

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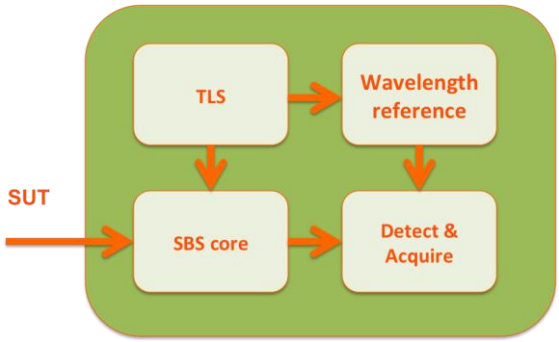
Brillouin spectrometry, a unique and powerful high-resolution OSA technology

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 **250 times higher resolution** than a standard OSA.
- **Maximum reliability**: Full spurious-free dynamic range

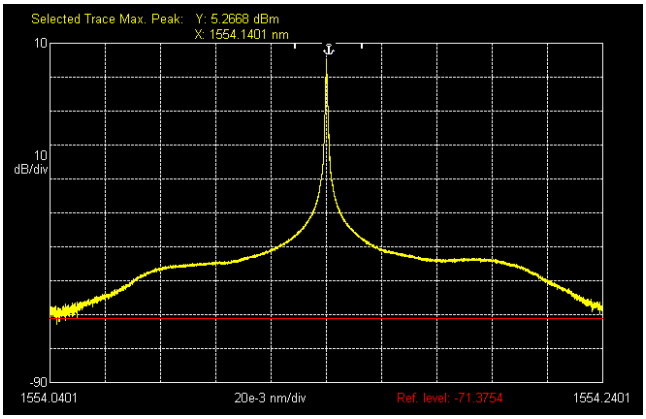


The non-linearity of SBS gives the BOSA great advantages over other classic spectroscopy methods such as diffraction gratings, Fabry-Perot filters or heterodyne OSAs, all of them linear. The amplification effect of SBS greatly enhances the dynamic range of the measurement compared to passive filtering. 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

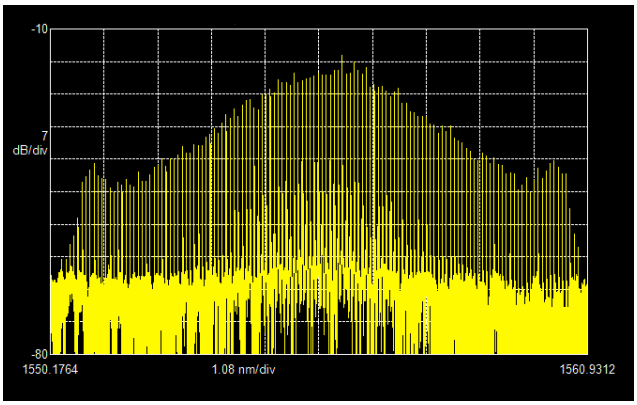
The characterization of laser parameters such as **relative intensity noise (RIN)** or relaxation oscillations frequency can be a tedious in the electrical domain. However, the optical spectrum of a laser contains meaningful information about many of these laser parameters in its spectral shape.



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.

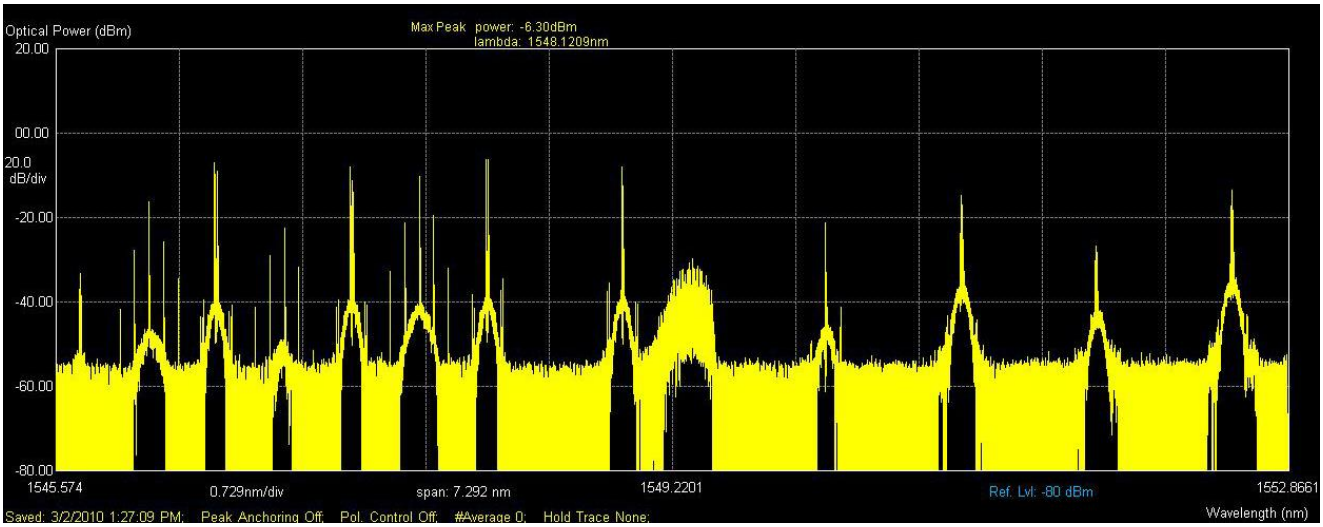
Comb/Pulsed sources characterization

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

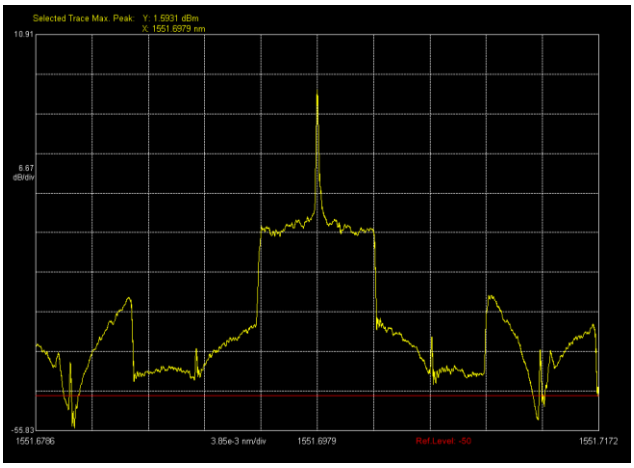
The additional detail provided by the high-resolution spectrum of advanced modulation formats can give you very useful performance information of modulated signals. In the next measurement example several channels of an in-service DWDM network are captured. 10G RZ and NRZ channels with a 100G PolMux 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.



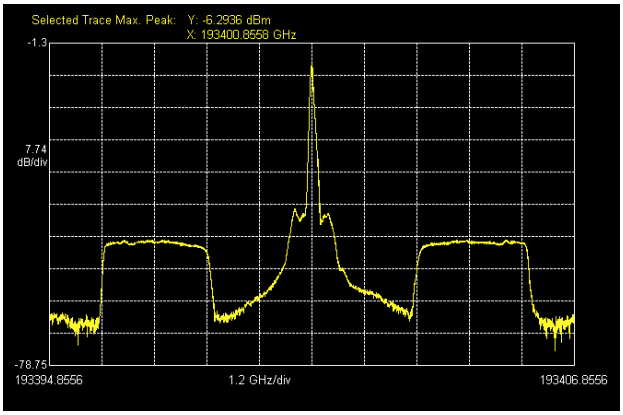
Advanced modulation formats analysis

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.

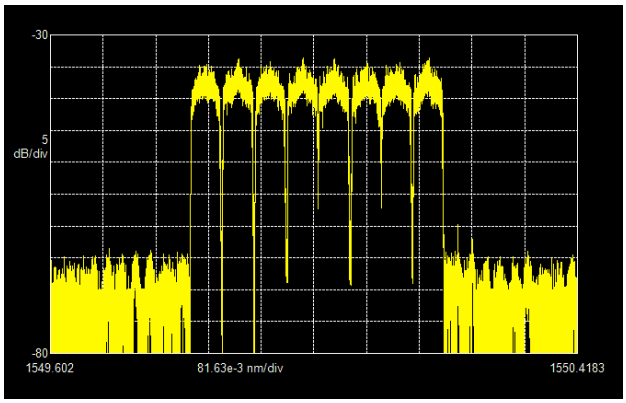
In the example below, a 1 Gb/s Nyquist modulation can be observed. The higher order modulation residual components created by the digital-to-analog converted can be easily seen so that you can apply optical filtering very precisely.



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.



BOSA 400

The highest performance BOSA

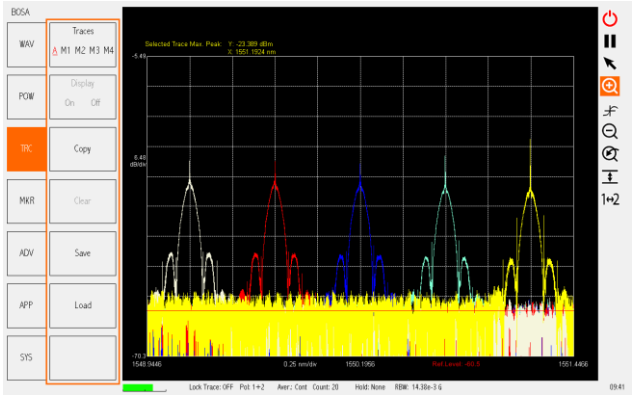
Its simultaneous 20 nm/s measuring speed, 10 MHz (80 fm) resolution and 80 dB spurious-free dynamic range, make the BOSA 400 the best performing high-resolution OSA.

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

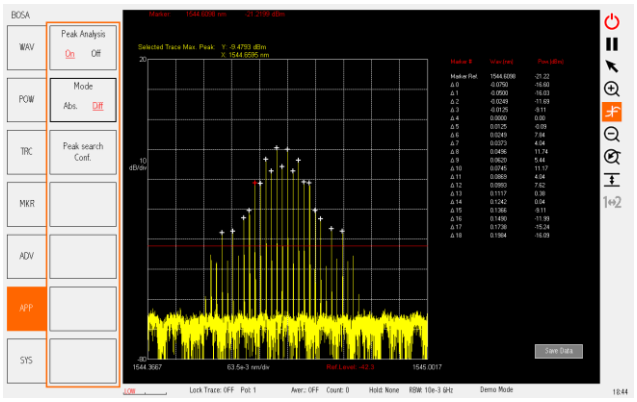
All the graphic user interface has been completely redesigned to be fast and operative either through its included touch screen (with big clear buttons, ideal for use when mounted in a rack) or with mouse and keyboard and external monitor (getting advantage of shortcuts and contextual menus, great when installed in a lab workbench or in a cart).



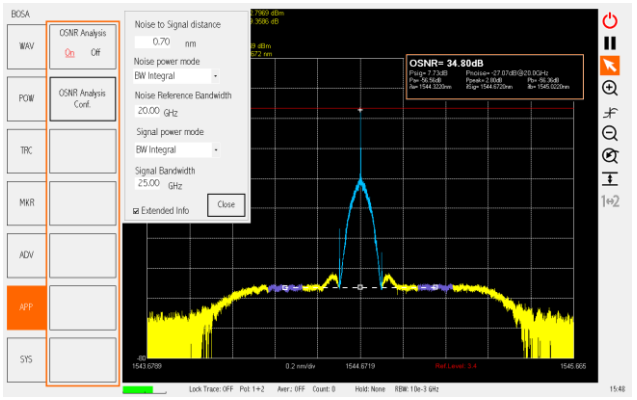
Full of utilities to make your work easier

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**.

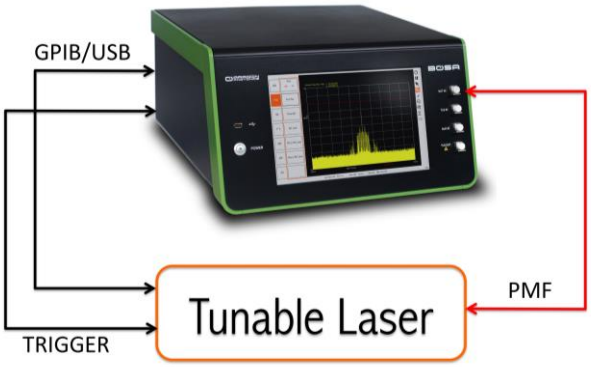


- **Trace locking**, uses an automatic or user-defined portion of the spectrum for reference to lock traces and obtain the most accurate averaging results.
- **Variable resolution**, to get results more easily comparable with your old OSA while you get used to the amount of detail a BOSA gives you.
- **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.

BOSA 100

The tunable laser needed for scanning in the BOSA is the engine of the system. In Aragon Photonics we know that you may already have or prefer an external tunable laser source for your high resolution measurements. And we have worked hard to make most of them compatible with our BOSA technology.



Practical, versatile

BOSA 100 series is a very practical tool for scientists and engineers involved in the research and development of next-generation photonic devices and optical systems. And moreover if there is already an independent tunable laser source in you Lab.

Use **your laser** individually or **combine** it **with our BOSA 100** and perform fast and accurate measurements. It can be smoothly integrated with the rest of the laboratory infrastructure thanks to its automation capabilities.

Main features

- Use your own TLS
- 10 MHz pure optical resolution
- 80 dB spurious-free dynamic range
- C, L & O bands
- Fast scanning

Besides, BOSA 100 series can be upgraded with all the add-on options available: TLS output, component analyzer, polarimetry extension, and phase measurement. Also, the BOSA 100 can be upgraded to BOSA 400 at any time.

Compatible TLS's

BOSA 100 controls the third-party TLS using GPIB or USB. Some compatible TLS's are: Agilent/Keysight, Luna Phoenix, Yenista Tunics, Santec, NewFocus. Contact us for compatibility confirmation.

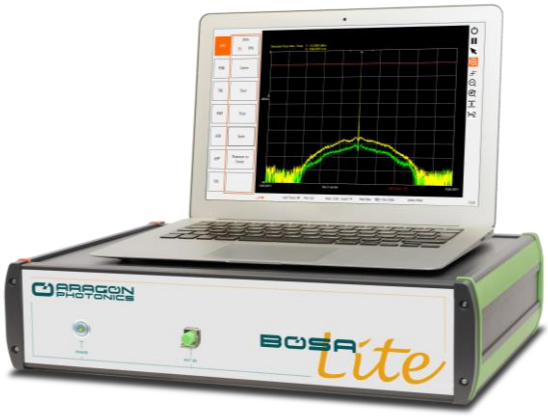
BOSA Lite / Lite+

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.

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.

Main features

- 20 MHz (0.16 pm) optical resolution
- >80 dB spurious-free dynamic range
- Wavelength accuracy 2pm
- 2.5nm/s measurement speed
- Two orthogonal polarization channels
- Compact & lightweight
- C & L bands available



Models available

BOSA Lite is also available in mainframe version (including computer and screen) renamed as BOSA Lite+. It includes TLS Output and Components Analyzer options and polarimetry and phase measurement options can be added as well. C+L model is available in this Lite+ version.

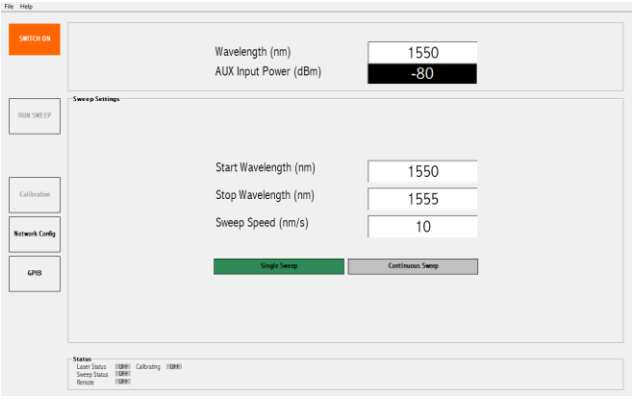
Integrated in the same mainframe, BOSA options **add multiple measurement capabilities** to your unit, making it a real all-terrain instrument for your research lab. or Network. Additional measurement modes with specific software can be selected when hardware options are installed.

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.

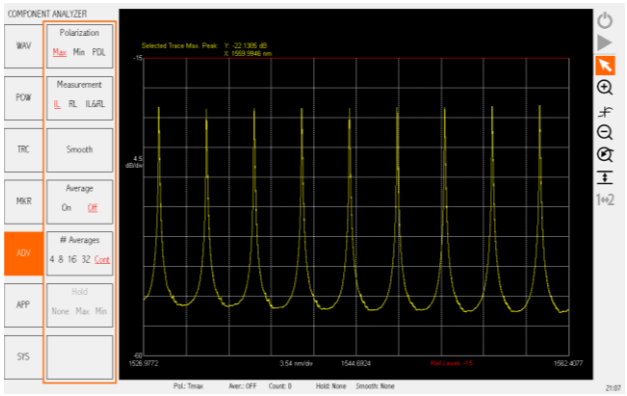


Option 420 – Component analyzer

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:

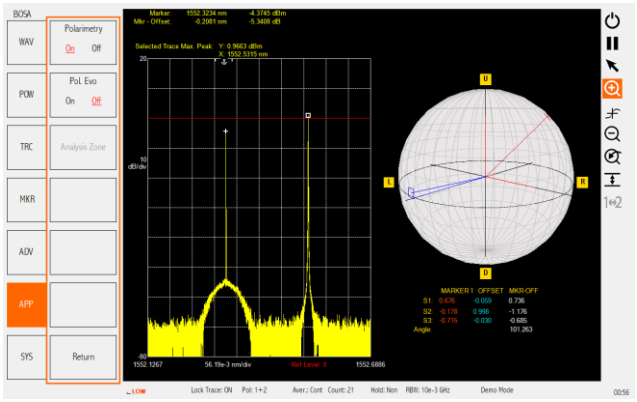
- Fully programmable through GPIB or Ethernet. Build you own monitoring applications easily!
- Internal reference gas cell for wavelength referencing and locking allows great accuracy.
- Simultaneous measurement of Insertion and Return Losses for complete characterization of your filters or gratings.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

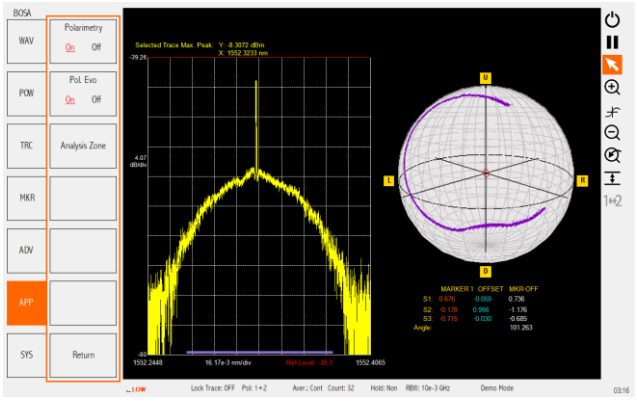
- Simultaneous measurement of Optical spectrum and Poincare sphere
- DGD & PMD measurement enabled

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.



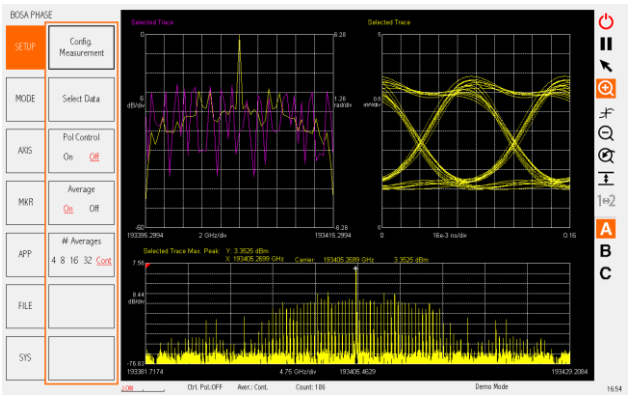
The continuous evolution of the state of polarization can also be measured. Select a portion of the measured span to plot the evolution of the SOP with high resolution.

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



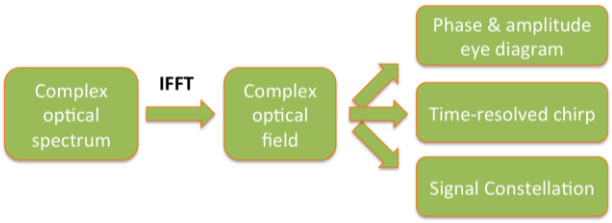
This enables real-time measurement of the instantaneous **differential group delay** (DGD) of the channels present in an in-service DWDM link. By monitoring DGD over time, **polarization mode dispersion** (PMD) of the fiber can be measured.

Option 440 – Phase measurement

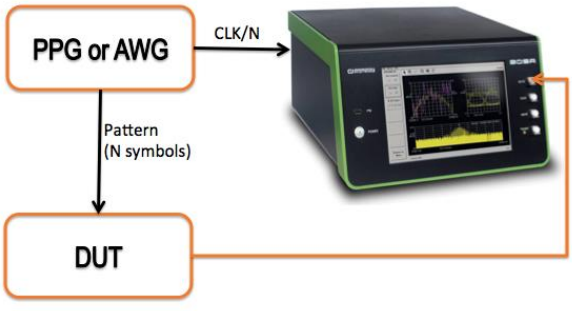


BOSA option 440 (BOSAphase) turns the BOSA into an **Optical Complex Spectrum Analyzer** (OCSA) which is another patented technology by Aragon Photonics.

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.

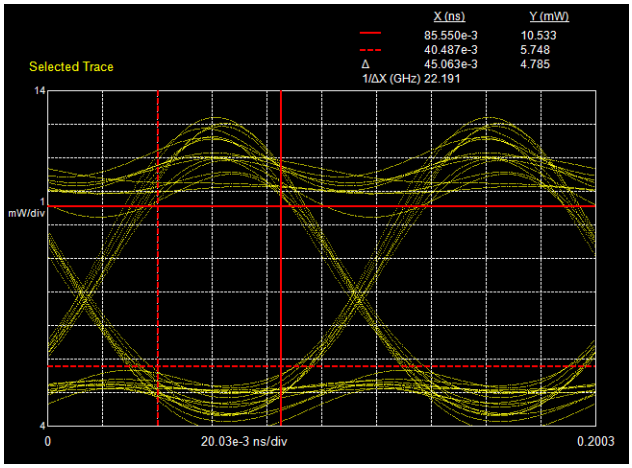


The phase of any optical signal modulated with a pattern that is repeated with a **pattern frequency between 70 MHz and 2 GHz** can be measured. You can easily generate these test signals with most commercially available PPGs or AWGs. The BOSA just requires the optical signal to measure and a reference pattern clock (pattern repetition frequency = baud rate divided by the number of symbols in the pattern).

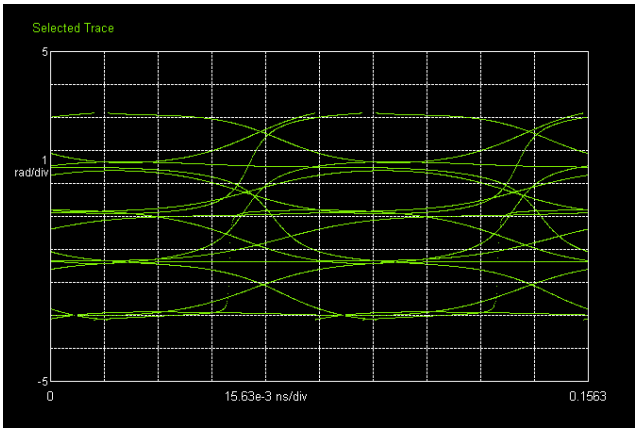


Eye-diagram

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.

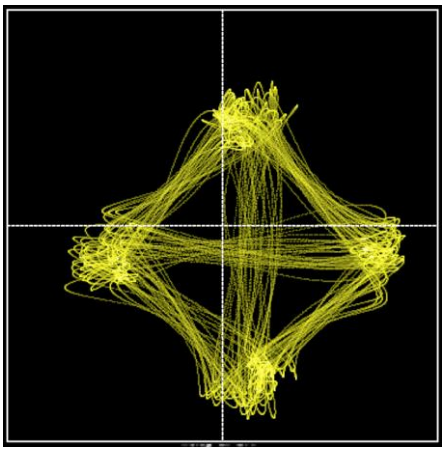


For phase measurements, only the I and Q eye diagrams can be measured as they require demodulation. However, as BOSAphase performs its measurement with **no need for demodulation**, the real phase eye diagram can be obtained. This allows as shown in the example measurement below, rendering the **multi-level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



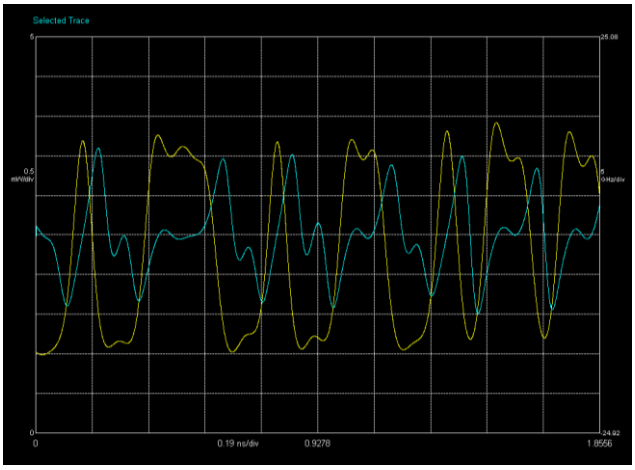
Constellation

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.



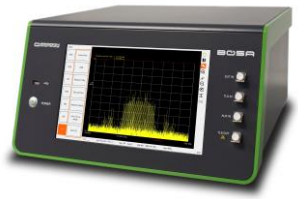
Time-Resolved Chirp

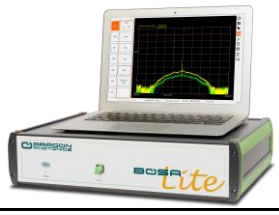
Frequency chirp is a critical parameter that is very difficult to measure due to the lack of appropriate tools. The time-resolved chirp (TRC) represents the instantaneous frequency drift of a signal modulated in amplitude and is normally measured using FROG methods that have low sensitivity, high noise 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	1525-1615 nm	1265-1345 nm	1525-1565 nm	1525-1605 nm
Wavelength accuracy	±0.5 pm	±0.5 pm	±1.0 pm	±2.0 pm	±2.0 pm
Spurious-free dynamic range[2]	>80 dB			>80 dB	
Close in dynamic range[2]	>40 dB @ ±0.2 pm >60 dB @ ±0.4 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 Full Polarization Analysis with Option 030	
Measurement time	20 nm/s			2.5 nm/s	
Internal Wavelength Calibrator	Yes	Yes	Yes	Yes	Yes
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. 18Kg. (BOSA 400) Máx. 15Kg. (BOSA 100)			420x310x100 (mm). Máx. 7Kg	430x230x470 (mm). Máx 17Kg
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	1525-1605 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	1525-1605 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 430/030				
Polarization repeatability	±5°		±5°	
Temperature dependence	±0.2°/°C		±0.2°/°C	
Measurement time	6 scans at 20 nm/s		6 scans at 2.5 nm/s	
Sensitivity for polarization meas.	-40 dBm		-40 dBm	
Polarization crosstalk	<20 dB		<20 dB	
Option 440/040				
Wavelength range	1525-1565 nm	1525-1615 nm	1525-1565 nm	1525-1605 nm
Bandwidth	80 MHz to full span		80 MHz to full span	
Pattern Frequency Range	70 MHz to 2 GHz		70 MHz to 2 GHz	
Phase accuracy	±1°		±1°	
Sensitivity	-70 dBm		-70 dBm	
Electrical Reference input power	+5 to -15 dBm		+5 to -15 dBm	
Measurement time	1 s for 10 nm		1 s for 2.5 nm	

WHAT'S NEW

- ✓ Now BOSA technology is available in L band up to **1615nm**.
- ✓ New **70MHz- 2GHz** pattern frequency range for BOSA phase measurement.
- ✓ Now **BOSA Lite+** has also available the phase measurement option.

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