Optical Instrumentation

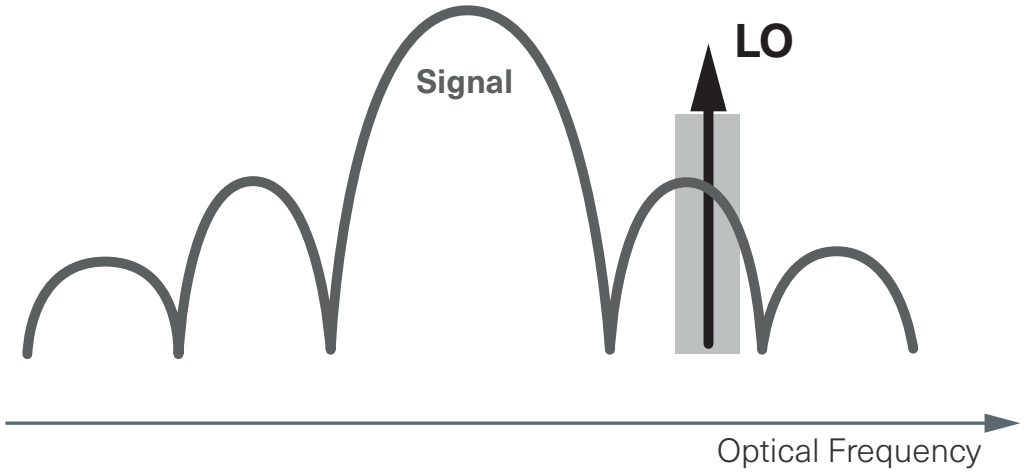
WAVEANALYZER™

Family of Optical Spectrum Analyzers

The WaveAnalyzer™ family of Optical Spectrum Analyzers is designed for researchers and engineers working in research labs on advanced concepts of optical transmission systems as well as for technicians on the manufacturing floor aiming for high throughput of their devices under test.

COHERENT

The WaveAnalyzer family uses a heterodyne measurement principle in which a fast sweeping laser, serving as local oscillator (LO), is scanning across the wavelength range of interest. The beat signal, generated by mixing the local oscillator signal with the signal under test, is detected by a Polarization Multiplex Receiver. The fast sweeping Modulated Grating Y-branch laser is electronically tuned so the instrument does not contain any moving parts (except the fan in the WaveAnalyzer 400A and 1500S/1500B).



This measurement principle provides a unique combination of measurement performance and speed. All members of the WaveAnalyzer family can provide highest spectral resolution and maximum measurement (sweep) speed at the same time. For example, the WaveAnalyzer (WA) 1500S/1500B provide a resolution bandwidth of 180 MHz (about 1.4 pm) while taking measurements with update rates of up to 10 sweeps per second.

Software Package

- Graphical User Interface (GUI) included, which controls the WA 200A, the WA 400A, and the 1500S plus 1500B
- GUI serves as a viewer for measurement traces taken with the WA 200A
- WaveAnalyzer Analysis Server included, which provides comprehensive analysis capabilities on measurement data taken with all WaveAnalyzer instruments
- Server can be accessed via a RESTful http based Application Programming Interface (API)
- Runs on Windows 10 / 11
- The WaveAnalyzer GUI Package is available for download on https://www.coherent.com/resources.

WaveAnalyzer 200A

Portable Optical Spectrum Analyzer

The WaveAnalyzer 200A is a lightweight portable Optical Spectrum Analyzer covering the C-band of optical communications. It has been designed for flexible use in the laboratory and also during installation, turn up and trouble shooting of optical networks in telecom and datacenter applications. Automatic ranging allows signals from +20 dBm to -50 dBm to be characterized without adjusting settings or adding attenuators. The instrument is controlled via touch-screen using Coherent's WaveAnalyzer GUI. A protective rubber bumper comes along with the instrument allowing operation of the unit in rugged environments.

The WA 200A is based on a coherent measurement principle which allows operation without any moving part inside the instrument.

Features

- Full C-band coverage
- Resolution bandwidth: 1.75 GHz
- Fast: 2 updates / second (typ.)
- Battery operated
- Remote Control via Ethernet
- Language support (incl. Japanese and Chinese)
- No moving parts

Applications

- System turn up and trouble shooting
- DWDM testing
- Channel power and OSNR testing
- Channel equalizing
- Lab, network and data center

Language Support

The WA 200A includes localized GUI with language support for English, Japanese, Chinese and Italian.

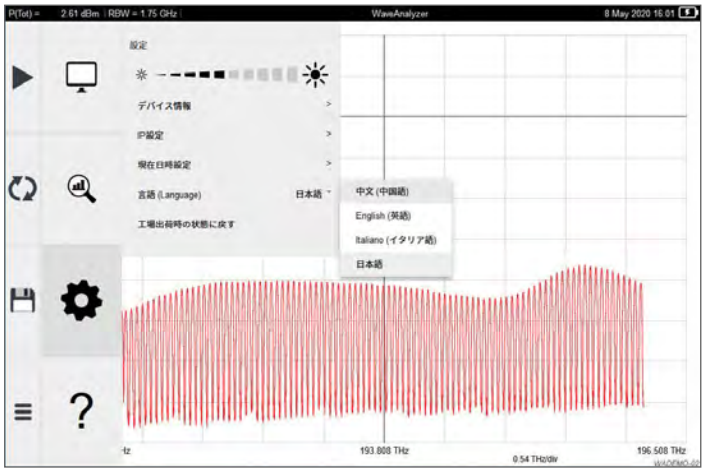
Ruggedness

A special protective bumper ensures the integrity of the instrument even in rugged environments or when dropped on the floor. The instrument comes in a hard-shell case proving protection during transportation and shipment.

Control

The WA 200A can be connected through an Ethernet port to Local Area Networks and allows signal monitoring and data gathering or simply remotely controlling either via the internal webserver which can be accessed by any browser or through the integrated RESTful API. The WA 200A supports both acquiring the IP address through DHCP and setting a fixed address. The USB port allows time-stamped data to be saved for later analysis when no network is available.

The WA 200A integrates with Coherent's well-known WaveAnalyzer PC software. The WaveAnalyzer GUI serves as PC based viewer for measurement traces collected on the WA 200A.

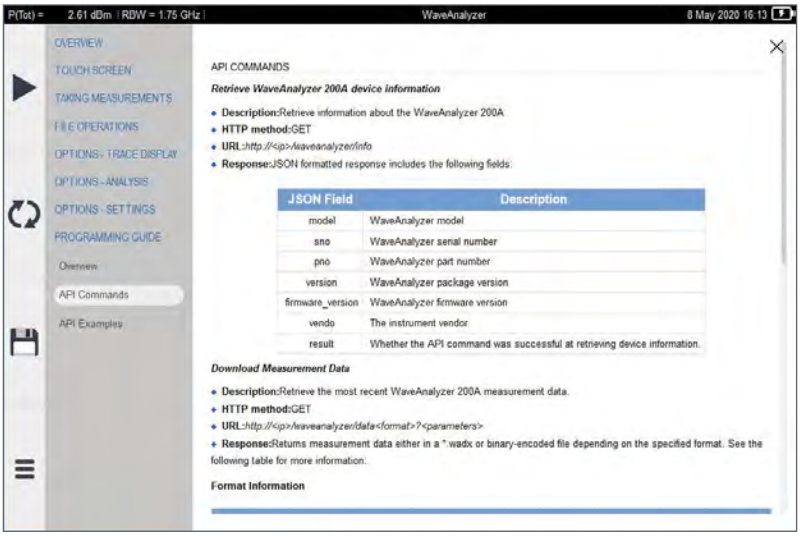


In-built Signal Analysis

The WA 200A provides full channel analysis of 50 and 100 GHz channels, as well as supporting proposed non-standard channel spacings such as 37.5 GHz for future high-capacity 400 Gb/s interconnects. Reporting includes channel power, center frequency and OSNR measurements.

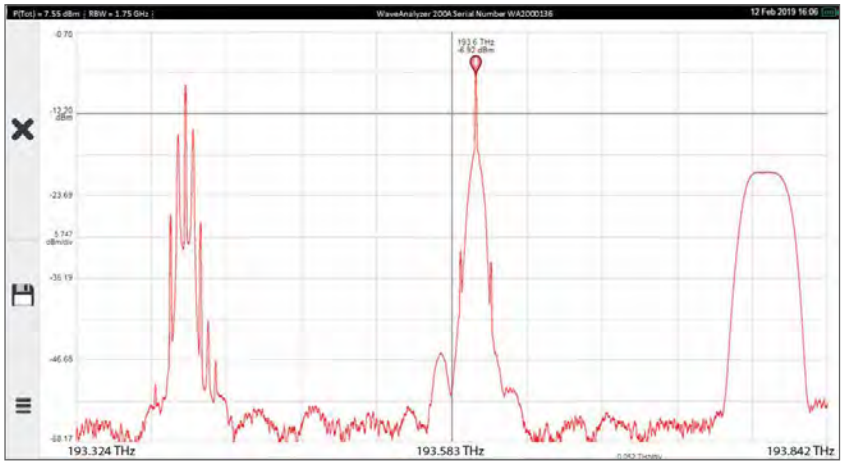
Onscreen Help

The WA 200A includes a detailed Onscreen Help function, which supports the user in all important measurement tasks.



Measurement

The screenshots show measurements taken with the WaveAnalyzer 200A on DWDM channels across the C-band.



Modulation sidebands on signals modulated with 10 Gb/s can be identified on the channel in the center and on the left; the channel on the right has been shaped out of an ASE signal

The DWDM Analysis provides precise information on the ITU channel number, the center frequency, power level and the OSNR

WaveAnalyzer 200A Specifications

Spectral	Frequency Range	191.1 to 196.2 THz (1527.8 to 1568.8 nm)
	Spectral Sampling Resolution	312.5 MHz
	Resolution Bandwidth (FWHM)	1.75 GHz (15 pm)
	Absolute Frequency Accuracy (1)	+/- 1 GHz
	Frequency Repeatability (sweep to sweep)	200 MHz
	Measurement Update Rate Full C-band scan	2 updates / s (typical)
Power	Max Total Power	27 dBm
	Max Power Density	+11.5 dBm / 1.75 GHz
	Noise floor	-58.5 dBm / 1.75 GHz
	Relative Power Accuracy	+/-0.5 dB (2)
Mechanical, Electrical and Environment	Operating Temperature	5°C to 35°C
	Operating Humidity	10% to 85%
	Communications Interface	Ethernet, USB 2.0 (master)
	Power Consumption (3)	100 V - 240 V; 40 VA
	Connector Type	FC/APC, LC/UPC
	Size Instrument only	255 mm x 140 mm x 30 mm
	instrument including protective bumper	273 mm x 168 mm x 50 mm
	Weight Instrument only	1.25 kg
	instrument including protective bumper	1.5 kg

Notes:

(1) Valid within recommended recalibration period

(2) Guaranteed when using an ASE source

(3) Condition: Battery is charging and instrument is operated

Part Number	Description
WA-00200A-C-P-1-AA-00	WaveAnalyzer 200A Portable Optical Spectrum Analyzer, C-Band, FC-APC Connector
WA-00200A-C-P-4-AA-00	WaveAnalyzer 200A Portable Optical Spectrum Analyzer, C-Band, LC-PC Connector

WaveAnalyzer 400A

Optical Spectrum Analyzer

The WaveAnalyzer 400A is a compact Optical Spectrum Analyzer for testing optical signals in the C-, in the Super C- and in the C+L band of optical communications. The instrument has been designed for Research & Development purposes as well as for Production Applications.

- The WA 400A uses coherent detection technology and can display the x- and the y-Polarization separately.
- The instrument is very compact with only half a rack width and a height of 1U.
- The detachable sub-panel on the front allows easy cleaning of the internal connector.

The WA 400A can be connected through an Ethernet port to Local Area Networks and allows signal monitoring and data gathering or simply remotely controlling either via the internal webserver which can be accessed by any browser or through the integrated RESTful Application Programming Interface (API). The WA 400A supports both acquiring the IP address through DHCP and setting a fixed address.

Features

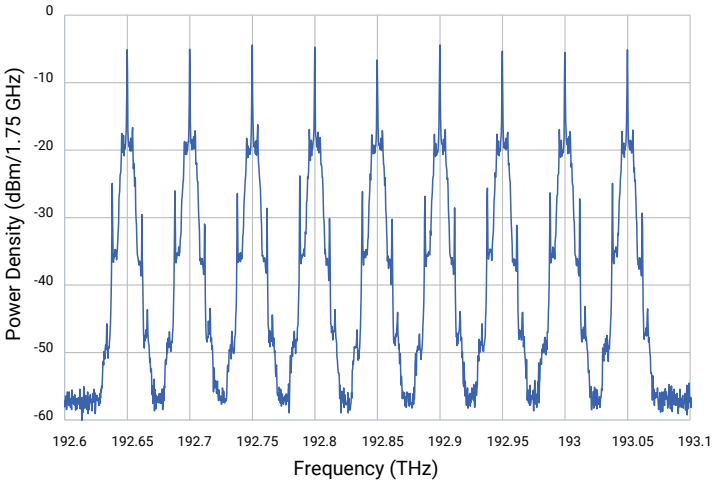
- Product versions available for
  - C-band
  - Super C-band
  - C+L band
- Resolution bandwidth: 650 MHz (typ.)
- Fast: 2 scans / second (typ.)
- Dual Polarization detection
- Ethernet Interface
- Internal WebServer
- Compact, no moving parts

Applications

- Optical system test
- DWDM testing
- Channel power and OSNR testing
- Production floor: High throughput
- component test

The WA 400A integrates with Coherent's well-known WaveAnalyzer PC software. This package offers a variety of analysis functions including Optical Signal to Noise Ratio (OSNR) measurement, Side Mode Suppression Ratio (SMSR) measurement, Multi-Channel (WDM-) Analysis, Peak detection, etc.

The WA 400A offers a resolution bandwidth down to 650 MHz (Full Width Half Maximum). This allows display of fine spectral details like modulation sidebands as well as measurement of the noise floor between densely spaced channels – as shown in the measurement trace below. The coherent detection technology of the instrument provides separate measurements of the x- and the y-polarization – supporting analysis of dual polarization transmission schemes.



50 GHz spaced 10G DWDM channels modulated with a PRBS of 2^{31}-1 bits. The high resolution capability of the WA 400A allows accurate measurement of the noise floor between the channels.

WaveAnalyzer 400A Specifications (preliminary)

Specifications are guaranteed except where stated as typical (typ).

		WA 400A / C-band	WA 400A / Super C-band	WA 400A / C+L band
Spectral	Frequency Range	191.1 to 196.2 THz (1527.8 to 1568.8 nm)	190.623 to 196.727 THz (1523.9 to 1572.7 nm)	186.2 to 196.2 THz (1527.8 to 1610.05 nm)
	Resolution Bandwidth (FWHM)	650 MHz (typical)		
	Absolute Frequency Accuracy (1)	+/- 1 GHz		
	Frequency Repeatability (sweep to sweep)	200 MHz		
	Measurement Update Rate Full scan	2 updates / s (typical)		
Power	Max Total Power	26 dBm	29 dBm	
	Max Power Density	+11.5 dBm / 1.75 GHz	+14.5 dBm / 1.75 GHz	
	Noise floor	-57.5 dBm / 1.75 GHz	-54.5 dBm / 1.75 GHz	
	Relative Power Accuracy	+/-0.5 dB (2)		
Mechanical, Electrical & Environment	Operating Temperature	15°C to 35°C		
	Operating Humidity	10% to 85%		
	Communications Interface	Ethernet		
	Power Consumption	100 V - 240 V; <20 VA		
	Connector Type	FC/APC, SC/APC		
	Size (Benchtop) (width x depth x height)	221 mm x 221 mm x 44 mm (height with feet: 51 mm)		
	Weight	1.5 kg		

Notes:

(1) Valid within recommended recalibration period

(2) Guaranteed when using an ASE source and setting Resolution Bandwidth to 1.75 GHz

Model	Order Code	Description	Wavelength Band	Housing Type	Connector Type
WaveAnalyzer 400A	WA-00400A-C-S-1-AA-00	Optical Spectrum Analyzer	C-band	Benchtop	FC/APC
	WA-00400A-C-S-6-AA-00	Optical Spectrum Analyzer	C-band	Benchtop	SC/APC
	WA-00400A-D-S-1-AA-00	Optical Spectrum Analyzer	Super C-band	Benchtop	FC/APC
	WA-00400A-D-S-6-AA-00	Optical Spectrum Analyzer	Super C-band	Benchtop	SC/APC
	WA-00400A-X-S-1-AA-00	Optical Spectrum Analyzer	C+L band	Benchtop	FC/APC
	WA-00400A-X-S-6-AA-00	Optical Spectrum Analyzer	C+L band	Benchtop	SC/APC
	WA-00400A-RACK-KIT	Rack-Mount brackets for conversion of Benchtop WA 400A to Rack-Mount			

Rack-Mount option available upon request. Please contact your local sales partner or waveanalyzer@finisar.com.

WaveAnalyzer 1500S

High Resolution Optical Spectrum Analyzer

The WaveAnalyzer 1500S Optical Spectrum Analyzer is a real-time, very-high-resolution optical spectrum analyzer for R&D and production test applications. Based on Coherent's fast-stepping solid-state laser, the WA 1500S uses coherent detection techniques to achieve an outstanding combination of resolution, dynamic range and measurement speed. Instrument versions are available for C- and L-bands.

This next-generation Optical Spectrum Analyzer provides spectral measurements with sub-pm resolution at an update rate of 4 measurements per second across the entire C- or L-band. Scanning across smaller spectral regions is even faster, with update rates of over 10 measurements per second across any 200 GHz window, enabling interactive adjustment of optical components and systems.

The WaveAnalyzer's coherent receiver provides polarization resolved data of the signal while its two input ports, for different power levels, ensures coverage of a large range of optical input signals. Low power single channel signals can be analyzed as accurately as high power WDM signals.

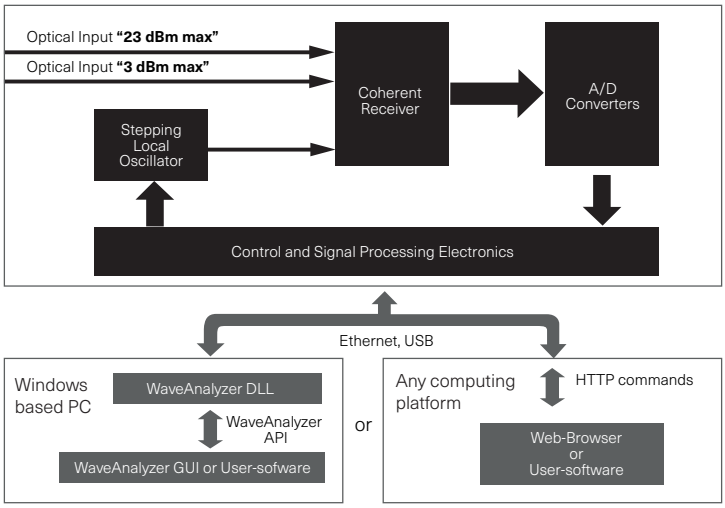
The WA 1500S is very compact and rugged, as it contains no moving parts. It is controlled using a USB or Ethernet connection to a Windows-based computer which runs Coherent's WaveAnalyzer software package.

Features

- High spectral resolution
- Real time measurement
- Instrument versions for C-band and for L-band available
- Update rate:
  - 4 Hz for full C- or L-band scan
  - 10 Hz for scan across any 200 GHz window
- Spurious-free dynamic range > 50 dB
- External trigger
- Internal web server

Applications

- High-resolution spectral analysis on optical components
- OSNR measurements
- Modulation analysis on optical signals
- Modulator test
- Modulator bias and polarization adjustments
- Transceiver test
- Side-mode Suppression Ratio (SMSR) measurements
- Network monitoring
- General purpose spectral analysis in optical labs



Block diagram of WaveAnalyzer 1500S system

WaveAnalyzer 1500B

High Resolution Optical Spectrum Analyzer with sub-pm absolute wavelength accuracy

The new WaveAnalyzer 1500B has been optimized for transceiver test applications. It includes a frequency reference unit which ensures an absolute frequency accuracy of better than 100 MHz (which is about 0.8 pm). Both, the C and the L Band od optical communications are covered in a single unit in a seamless way. The instrument provides measurement update rates of up to 10 measurement sweeps per second.

The optical characteristics are similar or superiour to the WaveAnalyzer 1500S.

The WaveAnalyzer 1500B has been designed for transceiver test applications. It allows verifying various parameters which previously required using multiple instruments:

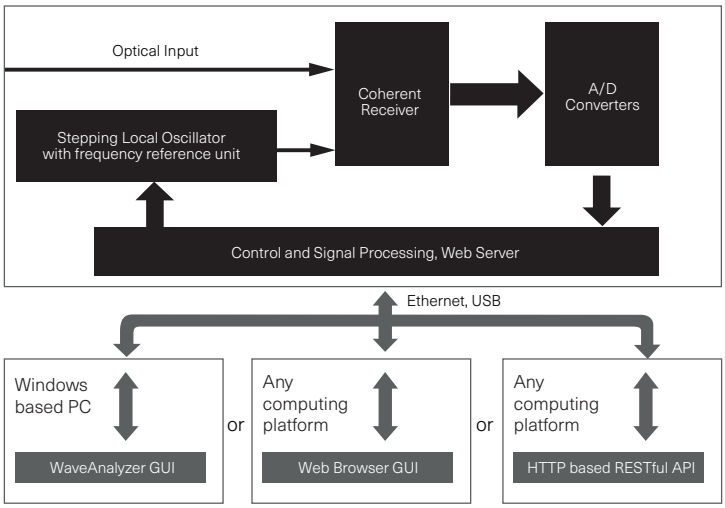
- The spectral shape of the signal is measured with a very fine resolution bandwidth of about 180 MHz so that any remaining carriers, modulation sidebands etc can be identified.
- The precise measurement of the spectral shape in combination with the low noise floor allow accurate Optical Signal to Noise Ratio (OSNR) measurements – eliminating the need of using a separate instrument for this parameter.
- The absolute frequency accuracy of less than 100 MHz enables frequency verification of the transceivers without using an additional wavelength meter – as it has been done in traditional setups
- The high measurement repittion rate of up to 10 sweeps per second ensures high throughput of devices on the manufacturing floor

Features
(in addition to the ones listed under WA 1500S):

- C+L Band coverage in one instrument
- Absolute Frequency accuracy of 100 MHz
- Detachable sub front-panel for easy connector cleaning

Applications
(in addition to the ones listed under WA 1500S):

- Transceiver test
- iTLA calibration

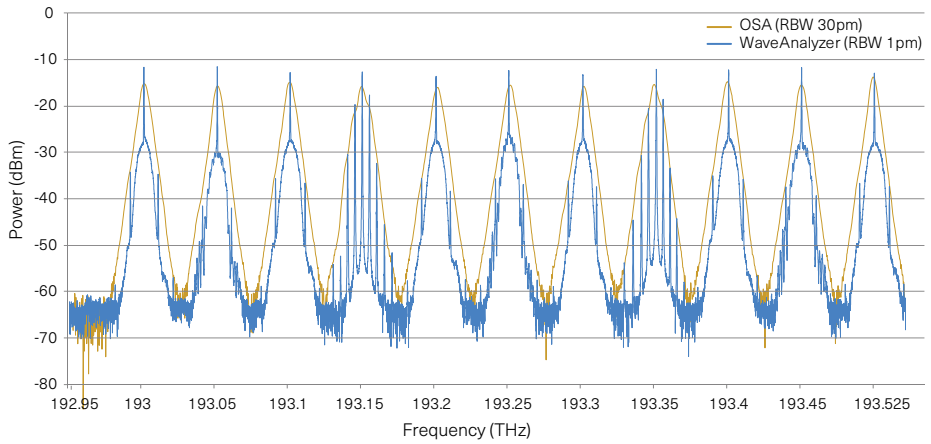


Block diagram of WaveAnalyzer 1500B system

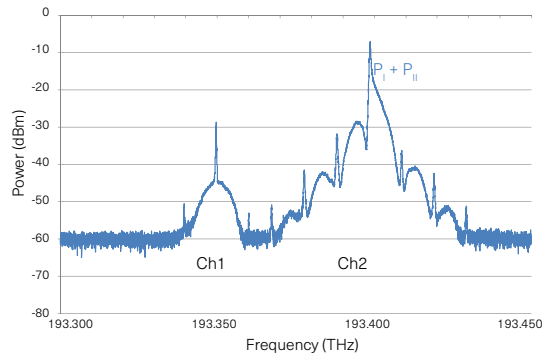
Measurement

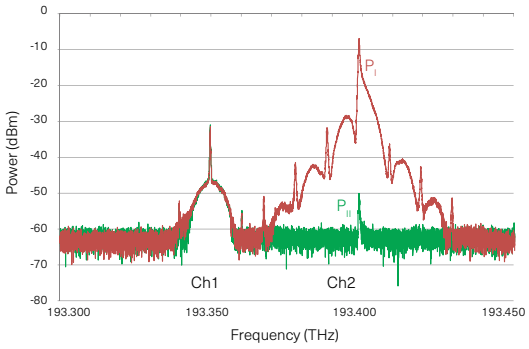
The WA 1500S supports spectral measurement applications in various domains, including communications and pulsed lasers, as shown in the examples below.

10G channels, 50GHz spaced, with various modulation formats



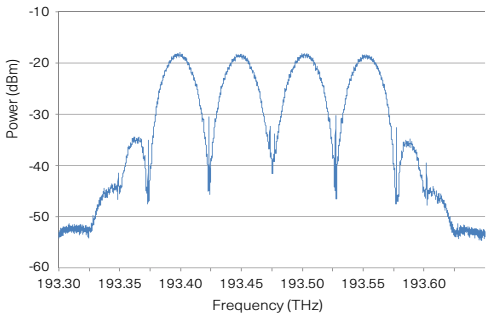
10 Gb/s NRZ





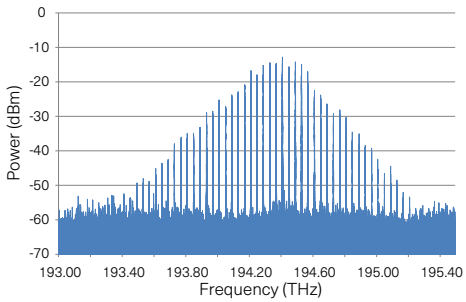
Two 10 Gb/s channels separated by 50 GHz; Channel 1 being attenuated by 20 dB. The graph top shows the sum of the two polarization components, whereas the graph right displays the polarization components P_I and P_{II} separately.

4 channel 100G DQPSK



Measurement taken on 4 channels of a dual polarization DQPSK signal, spaced by 50 GHz

40 GHz mode-locked laser



Spectral details of the mode-structure of a 40 GHz mode-locked laser. The real-time update rate supports precise adjustment of the laser cavity.

WaveAnalyzer 1500S and 1500B Specifications

Model		WA 1500S / C-Band	WA 1500S / L-Band	WA 1500B / X
Spectral	Frequency Range	191.05 to 196.35 THz (1526.8 to 1569.1 nm)	186.0 to 191.05 THz (1569.1 to 1611.7 nm)	185.90 to 196.35 THz (1526.8 to 1612.6 nm)
	Spectral Sampling Resolution	20 MHz		
	Resolution Bandwidth (FWHM)	180 MHz (typ.)		
	Absolute Frequency Accuracy (1)	+/- 500 MHz		+/- 100 MHz
	Frequency Repeatability (sweep to sweep)	50 MHz		+/- 40 MHz
	Measurement Update Rate (2):	Full C- or L- band scan: 4 updates / s Scan across any 200 GHz window: 10 updates / s		Full C+L scan: 2 updates / s Full C- or L-band scan: 4 updates / s Scan across any 200 GHz window: 10 updates / s
Power	Max Total Power	23 dBm (3 dBm for "3 dBm max" optical input)		23 dBm
	Max Power Density	0 dBm / 20 MHz		
	Relative Power Accuracy	+/-0.2 dB (4)		
	Spurious Free Dynamic Range (1)	> 50 dB		
	Close-In Dynamic Range (5)	> 38 dB @ +/- 2 GHz		
Mechanical, Electrical and Environment	Operating Temperature	15°C to 35°C		
	Operating Humidity	10% to 85%		
	Communications Interface	USB 2.0, Ethernet		
	Trigger Input	TTL (SMA)		
	Trigger Output	TTL (SMA)		
	Power Consumption	100 V - 240 V; 20 VA		
	Connector Type	FC/APC		
	Size	241 mm x 88 mm x 316 mm		241 mm x 88 mm x 375.5 mm
	Weight	< 4 kg		< 4.5 kg

Notes:

(1) Valid within recommended recalibration period

(2) Requires a PC with at least an i7 processor or equivalent and a Gigabit Ethernet connection

(3) Specifications valid on the "23 dBm max" optical port, except where stated differently

(4) Guaranteed when using an ASE source

(5) When measuring on one optical channel

(6) Specifications for the WaveAnalyzer 1500B are preliminary

Part Number	Description
WA-AA-1500S-ZZ-H	WaveAnalyzer 1500S, bench-top, C-band
WA-AA-1500S-RM-H	WaveAnalyzer 1500S, rack-mount, C-band
WA-AA-1500S-L-H	WaveAnalyzer 1500S, bench-top, L-band
WA-AA-1500S-LR-H	WaveAnalyzer 1500S, rack-mount, L-band
WA-01500B-X-S-1-AA-01	WaveAnalyzer 1500B, Benchtop, C+L band, Gas-Absorption Cell
WA-01500B-X-R-1-AA-01	WaveAnalyzer 1500B, Rackmount, C+L band, Gas-Absorption Cell

WaveAnalyzer GUI

Measurement Analysis Functions

The PC based GUI package offers various analysis functions:

The **3-point-measurement** allows very simple and quick OSNR measurements using the traditional approach in which a 0.1nm resolution bandwidth measurement scan is taken from which the noise and the signal powers are estimated.

The **advanced 6-point-measurement** allows OSNR measurements even between densely spaced channels, see figure on the right. The measurement bands can be precisely adjusted to capture the noise floor and the signal accurately.

The **polarization extinction ratio** method allows in-band OSNR measurements, provided the optical signal is single polarization only (which can be verified with the WaveAnalyzer instrument).

The **sequential measurement** method supports in-band OSNR measurements of dual-polarization signals.

The **Multi Channel Analysis** function provides measurements of the OSNR, channel power and channel center frequency of all channels simultaneously with an update rate of up to 10 Hz, depending on scan range. For documentation or further analysis, the results can be exported in a table.

The **Wavelength Meter** function provides fast measurements of the power and the wavelength of multiple narrow band signals. It can measure several hundred lines simultaneously and provides a wavelength accuracy which is similar to dedicated wavelength meters.

The WaveAnalyzer GUI contains a powerful **marker scheme** which supports further analysis capabilities, like peak detection, display of difference frequencies and integrated power in user definable frequency ranges.

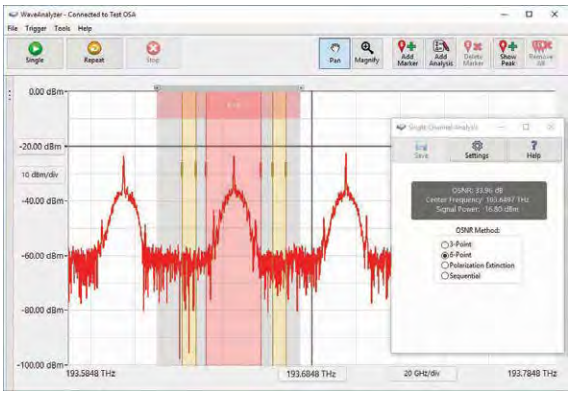
The WaveAnalyzer 1500S/1500B includes a **trigger scheme** which supports taking gated measurements. This enables, for example, taking spectral measurements of signals traveling in recirculating loops.

HTTP based programming interface

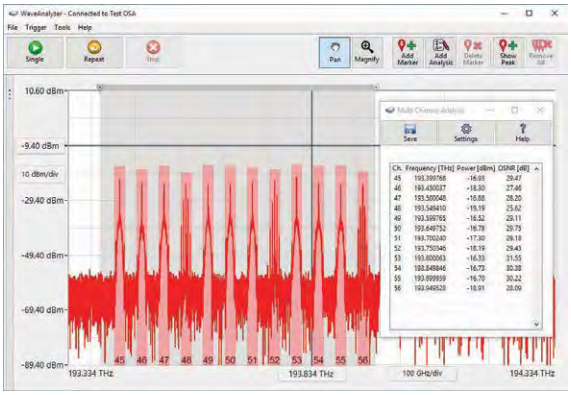
The WaveAnalyzer family offers a **RESTful HTTP based Application Programming Interface (API)**.

Web server

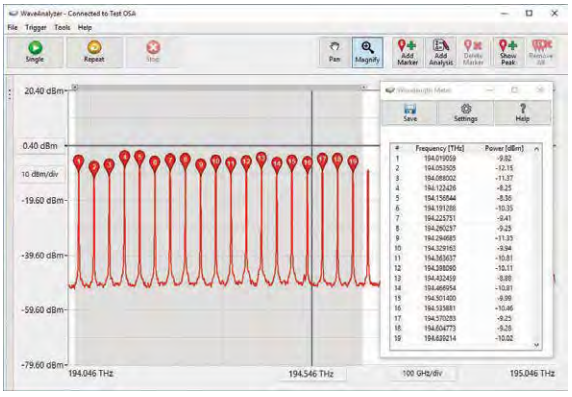
The WaveAnalyzer instrument includes a **Web Server GUI** which allows controlling the instrument and taking measurements with a web browser.



6-point OSNR measurement



Multi Channel Analysis



Wavelength Meter

Additional Resources

Visit https://www.coherent.com/networking/optical-instrumentation for the latest product information, news and software for the WaveAnalyzer product family.

WaveAnalyzer Demonstration on YouTube

Watch product demo at: https://www.youtube.com/user/iiviincorporated

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