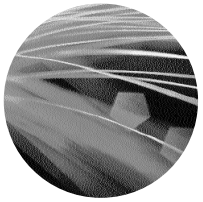
# Agilent 81910A
## Photonic All-parameter Analyzer



**Thorough, accurate and fast**

Agilent Technologies

# Passive optical component test solution

## A mandatory change of process

**Agilent 81910A Photonic All-parameter Analyzer**

- Simultaneous measurement of insertion loss (IL), polarization dependent loss (PDL), group delay (GD) and differential group delay (DGD) with a single connection setup
- Thorough test of optical devices for loss and dispersion with highest accuracy
- Swept wavelength operation for high throughput testing
- Evolution of the industry's leading solution for loss measurements
- Integrated optical bench for ease of use in manufacturing

**New test challenges for new transmission standards**

Fiber optic network technology has taken a major leap forward with dense wavelength-division multiplexing (DWDM). Now, as networks move to speeds of 10 or 40 Gbps and channel spacing decreases to 25 GHz and below, run-time properties become increasingly important. Components must fulfill stringent requirements for spectral loss and polarization dependent loss, group delay and differential group delay. This extension of the standard test requirements for passive optical components beyond simple loss measurements puts new demands on the accuracy and flexibility of test equipment. The 81910A is a new and unique solution that responds to these needs.

**Measures two-port devices in transmission and reflection**

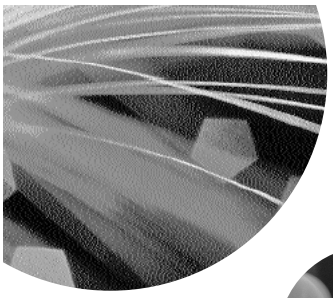
Records eight traces simultaneously

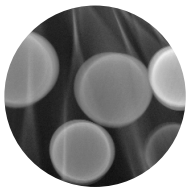
- Insertion loss (IL)
- Polarization dependent loss (PDL)
- Group delay (GD)
- Differential group delay (DGD)

CD is derived from GD data.

As transmission speed increases, the pressure is on components to meet specified performance criteria in terms of both intensity and timing characteristics over both wavelength and polarization. I believe Agilent's 81910A provides an innovative solution to meet this challenge, using a patented swept homodyne interferometry method.

Gunther Holtz, Optical Engineer
Agilent Technologies





**Measures two-port devices in transmission and reflection**

Records eight traces simultaneously:

- Insertion loss (IL)
- Polarization dependent loss (PDL)
- Group delay (GD)
- Differential group delay (DGD)

Chromatic dispersion is derived from the group delay data

**Simple DUT connection using two patch cords**

# Advantages

The Agilent 81910A Photonic All-parameter Analyzer is a unique solution to measure "all parameters" fast, precisely, both in transmission and reflection, using single setup. What's more, it provides you with unparalleled advantages:

- Simultaneous measurement of spectral loss, PDL, GD, and DGD in a single device connection. This saves setup and test time, reducing cost of test, and minimizing test uncertainties.
- A unique set of specifications for thorough measurements – all relevant test parameters for the test of passive optical components are measured with highest accuracy, using the same setup.
- Combines industry-leading loss performance with a high-resolution dispersion test method – you do not have to compromise on the performance you're used to, while expanding your tests into dispersion.
- Swept performance of all measurements leads to highly accurate, high-throughput test and characterization of optical components.
- Loss and GD are always calculated as the average of their polarization dependency. This removes uncertainty due to environmental changes to input polarization.
- An integrated optical bench and device holder is designed to ease workflow processes in manufacturing.
- As a member of the Agilent Lightwave measurement system, the 81910A can be used to enhance existing measurement setups. It offers a growth path for those who already work in passive component test. Upgrading existing tunable laser sources saves prior investments.

**An innovative solution to improve your cost of test**

Passive components route, redirect, or block light channels. Typical devices include fiber Bragg gratings, thin film filters or arrayed waveguide gratings. As their first purpose is wavelength routing, they have to be specified precisely for loss during the manufacturing process.

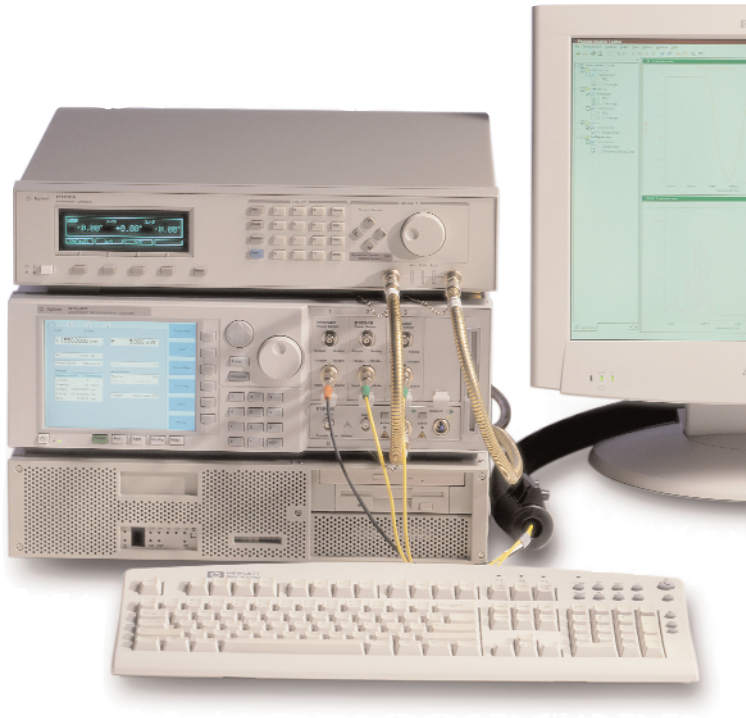
Narrow-channel devices challenge today's methods of determining dispersion properties because narrow-channel loss characteristics always go hand in hand with steep dispersion traces. For advanced components, test requirements are therefore best described as "high accuracy, high dynamic range, and high resolution" – both for loss and dispersion. To address this properly, our setup combines a tunable laser source with low-noise output for loss measurement and swept homodyne interferometry for measurement of dispersion properties. Swept homodyne interferometry mixes signals all-optically in the test head to achieve highest resolution, in shorter periods of time.

# One test for all your parameters

## New test challenges for new transmission standards

**Key specifications**

| | |
|---|---|
| **Insertion loss**<br>uncertainty < ± 10 mdB<br>Dynamic Range > 55 dB | **Group delay**<br>uncertainty < ± 50 fs |
| **Polarization dependent loss**<br>uncertainty < ± 30 mdB | **Differential group delay**<br>uncertainty 80 fs |

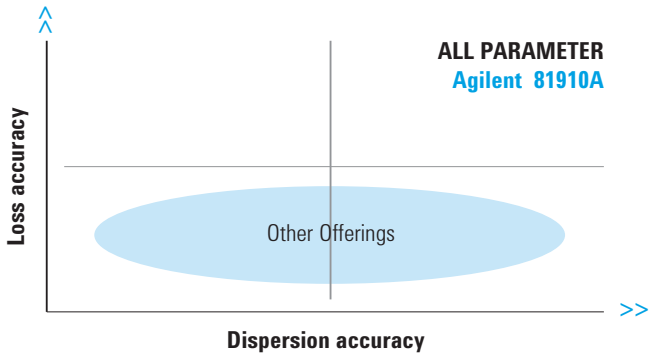


**Single test setup**
Until now, the measurement of loss and delay (dispersion) were treated as separate tasks and addressed by separate test solutions, or by solutions that where optimized to test a single parameter. The 81910A introduces a paradigm shift in test instrumentation as it allows for precise characterization of all relevant device parameters in equal importance in a single setup.

**Loss**
The Agilent 81910A uses the industry leading solution to check for spectral loss and polarization dependent loss both in transmission and reflection.

**Dispersion**
The Agilent 81910A characterizes the impact your component has on wavelength dependent signal delay caused by the component; with direct measurements of group delay and differential group delay.

**81910A Focus on all parameters in equal importance**





**A solid foundation**
The Agilent 81910A, and the Photonic Analysis Toolbox software supplied with it, are based on Agilent's established and proven Photonic Foundation Library (PFL). This library provides a solid set of ready functionalities that make it quick and easy to implement specific tests, tasks and analysis.

The comprehensive collection of basic and advanced functions helps you run precisely the tests you require, and get exactly the results you need, to support your development or manufacturing processes.

**www.photonic-all-parameter.com**
To learn more about the 81910A, and to find related products and application information, go to the Agilent web site.

# A pioneering approach

**Fig.1**

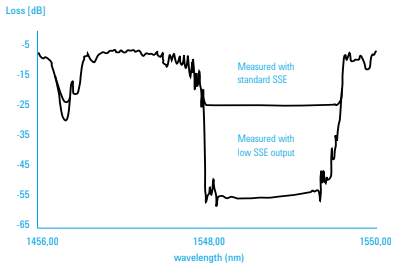



**Fig. 2**

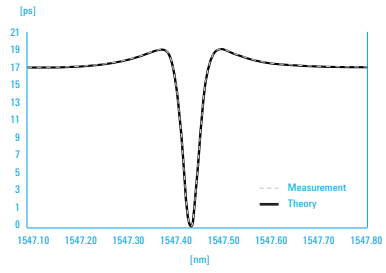
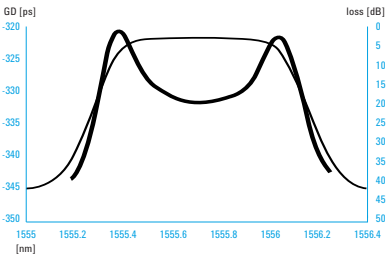



**Fig.3**




Non-ambiguous measurements: Swept homodyne interferometry (SHI) is a new method to determine dispersion properties. A polarization controller records group delay (GD) for more than one input polarization to find corresponding eigenmodes, often called TE and TM modes. This gives the maximum deviation for GD as a function of polarization – this the definition of differential group delay (DGD). Group delay is inherently calculated as average of its polarization dependency – this removes uncertainty due to environmental changes to input polarization. GD and DGD are always recorded in a swept mode.

**Measurement examples**
Typical devices requiring test for loss and dispersion include fiber Bragg gratings, arrayed waveguide gratings, or thin film filters.

**Fig. 1**
Having a laser with high signal purity means to have a laser with low noise. This is the basis to characterize your components down to the limits.

**Fig. 2**
SHI allows for dispersion measurements with highest resolution and accuracy. Even testing an absorption gas cell for GD is not a real challenge for the 81910A.

**Fig. 3**
This figure depicts the GD and insertion loss characteristics of a 100 GHz thin film filter. Swept homodyne in test measures clean GD traces even at a device loss of 30dB or more.

**Fig. 4**
Birefringence is a material property which is inherent not only to fiber Bragg gratings and arrayed wave guide gratings. Birefringence results in a shift for GD spectra for two principal states of polarization. GD peaks are accompanied by similar sharp double-dent DGD structures as well. This double dent exhibits a centered minimum where the GD value is identical for both principal states of polarization.

**Fig. 5**
Polarization resolved swept homodyne allows for resolution of modes within devices like an AWG.

Fig. 4

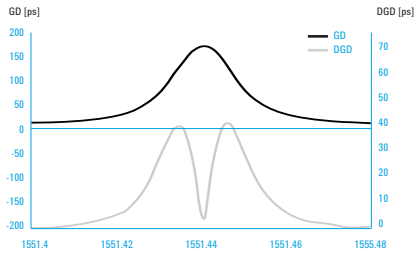
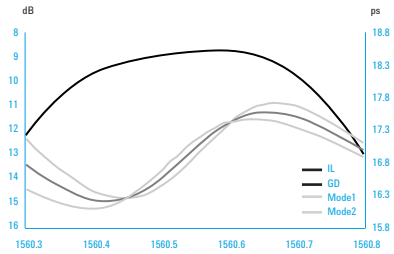



Fig. 5



| Technical specifications | |
|---|---|
| Required test station controller and software | PC with min. 800 MHz CPU, 256 MB RAM, Windows NT or 2000, 250 MB free hard disk space; 2 free PCI slots |
| Wavelength range | 1520 nm to 1620 nm |
| Measurement time | Typically 3-5 minutes for a narrow-band device, including loss, polarization dependent loss, group delay and differential group delay measurement. Includes instrument initialization, measurement of device under test, data acquisition and display. Reference measurements excluded. |

Loss and polarization dependent loss specifications:

| | Transmission | Reflection |
|---|---|---|
| Loss measurement uncertainty | | |
| loss ≧0.5 dB | ±0.010 dB | ±0.020 dB |
| loss ≧ 10 dB | ±0.015 dB | ±0.025 dB |
| loss ≧ 35 dB | ±0.025 dB | ±0.035 dB |
| loss ≧ 40 dB | ±0.050 dB | |
| Loss measurement range (typical) | >55 dB | >45 dB |
| | | |
| Polarization dependent loss (PDL) uncertainty | | |
| loss ≧0.5 dB | ±(0.030 dB +3% * device PDL) | ±(0.045 dB +3% * device PDL) |
| loss ≧ 10 dB | ±(0.040 dB +3% * device PDL) | ±(0.055 dB +3% * device PDL) |
| loss ≧ 35 dB | ±(0.060 dB +3% * device PDL) | ±(0.075 dB +3% * device PDL) |
| Absolute wavelength uncertainty | ±4 pm | |

Dispersion specifications:

| | Transmission | Reflection |
|---|---|---|
| Group delay measurement range (typical) | 10 ns | |
| Group delay loss range (typical) | 30 dB | |
| Group delay resolution | 1 fs | |
| Group delay uncertainty | | |
| noise with 2 m standard single mode patchcord | <±50 fs | |
| relative uncertainty with HCN molecular gas cell | ±1% of Group Delay | |

| | |
|---|---|
| Differential group delay measurement range (typical) | 0.5 ns |
| Differential group delay loss range (typical) | 30 dB |
| Differential group delay resolution | 1 fs |
| Differential group delay (DGD) measurement uncertainty | |
| with 2 m standard single mode patchcord | <±80 fs |

| | |
|---|---|
| Absolute wavelength uncertainty | ±1 pm |
| Maximum device optical path length | 20 m |

Ordering instructions:

81910A #001: Complete system including 81640B tunable laser, 8164B mainframe, 8169A polarization controller, 81634B power meters, system controller, licensed software, accessories and optical test head. Does not include host PC.

81910A #002: Upgrade system including tunable laser upgrade, 8169A polarization controller, 81634B power meters, system controller, licensed software, accessories and optical test head. Does not include host PC. Return one tunable laser source 81640A, 81680A, or 81480A to Agilent Technologies for conversion into a 81640B tunable laser.

Related literature

Communications Network Test Solutions. Test Innovations that Improve Your Bottom Line, p/n 5988-2360EN

Optical Component Test Solutions, p/n 5988-1930EN

State of the art characterization of optical components for DWDM applications, p/n 5980-1454E

Polarization dependent loss measurement of passive optical components. Agilent application note, p/n 5988-1232EN

81910A Photonic All-parameter Analyzer. Product note, p/n 5988-4565EN

Lightwave Test and Measurement 2002 Catalog, p/n 5988-4183EN

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Pub No. 5988-5818EN
Publication Date 23rd May, 2002


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