TESTING PIC AND PASSIVE COMPONENTS

TECHNICAL REFERENCE POSTER

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 01/23 20180634v2 SAP1075653

TESTING PIC AND PASSIVE COMPONENTS

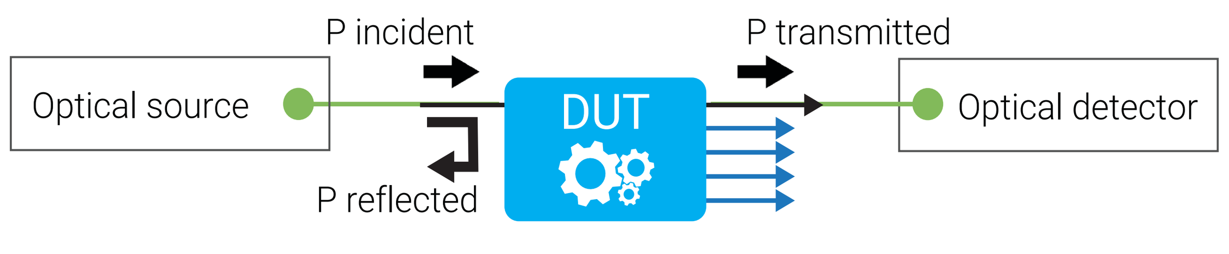
IL, RL, PDL

Three key parameters for a comprehensive approach to component testing

Insertion loss (IL) and return loss (RL)

IL is the basic measurement for passive component characterization. Most characteristics are derived from this measurement: loss, central wavelength, ripple, bandwidth, adjacent and nonadjacent isolation.

RL characterizes the amount of light reflected back from the device under test (DUT) into a given port (input or output).

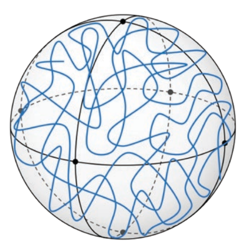
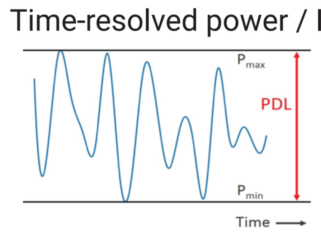
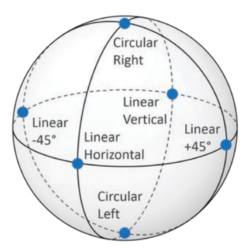


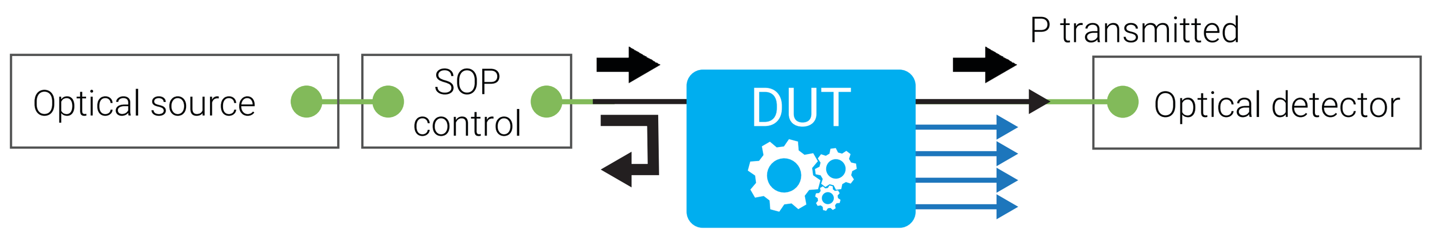
IL/RL measurement configuration: Insertion Loss$_{(dB)}$ = P incident$_{(dBm)}$ - P transmitted$_{(dBm)}$; Return Loss$_{(dB)}$ = P incident$_{(dBm)}$ - P reflected$_{(dBm)}$

Polarization-dependent loss (PDL)

PDL characterizes maximum IL variation as the state of polarization (SOP) varies across all polarization states.

The table below illustrates two different measurement methods.

Measurement method	PDL calculation	Appropriate application
All-states method (deterministic or not) 	Time-resolved power / IL measurement.  $PDL = 10\log\left(\frac{P_{max}}{P_{min}}\right)$	• Single-wavelength testing • Stepped-wavelength measurement • High PDL values
Mueller method (4 or 6 SOP) 	Polarization-resolved power or IL measurement. PDL value calculated using Mueller matrix. $\begin{pmatrix} m_{00}\\ m_{01}\\ m_{02}\\ m_{03}\end{pmatrix} \rightarrow T_{max}, T_{min} \rightarrow PDL = 10\log\left(\frac{T_{max}}{T_{min}}\right)$	• Swept-wavelength characterization • Fast and highly resolved measurement



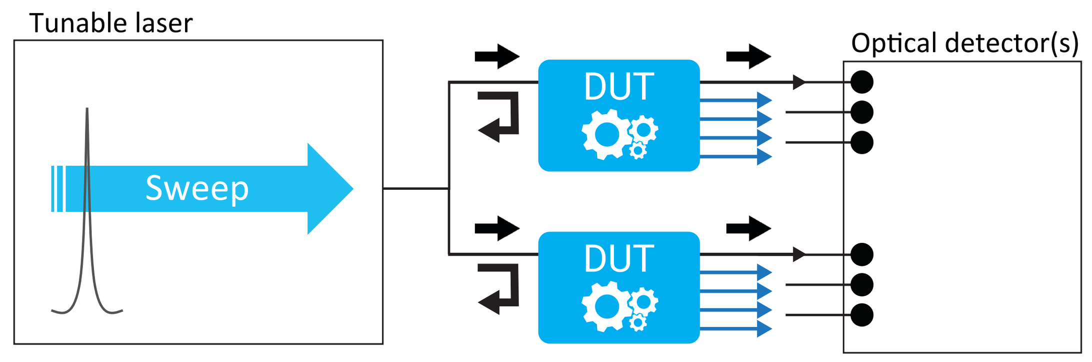
PDL measurement configuration

Swept wavelength measurements

Quick measurement with high sampling resolution

Using a continuously tunable laser and fast optical

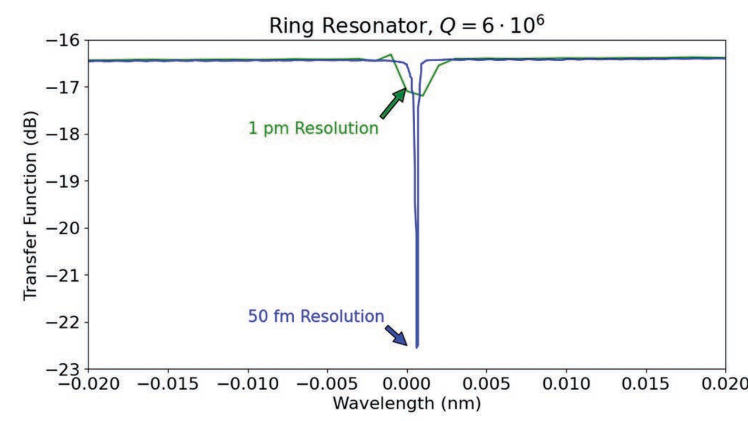
Using a continuously tunable laser and fast optical detectors/power meters to synchronize wavelength and power acquisition during a wavelength sweep, spectral characterization can be achieved within seconds and with picometer-scale wavelength resolution. This is ideal for testing large volumes of DUTs.

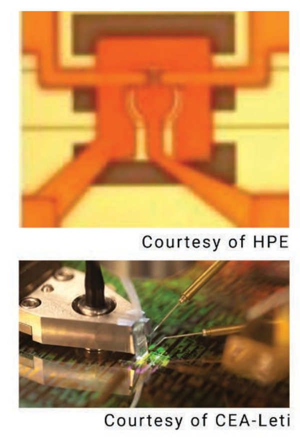


Swept tunable laser technique for spectral characterization

Use case 1: Micro-ring resonator

PIC-based interferometric structures with extreme Q-factors. Spectral characteristics are challenging to measure because of sharp contrast, requiring sub-picometer resolution.

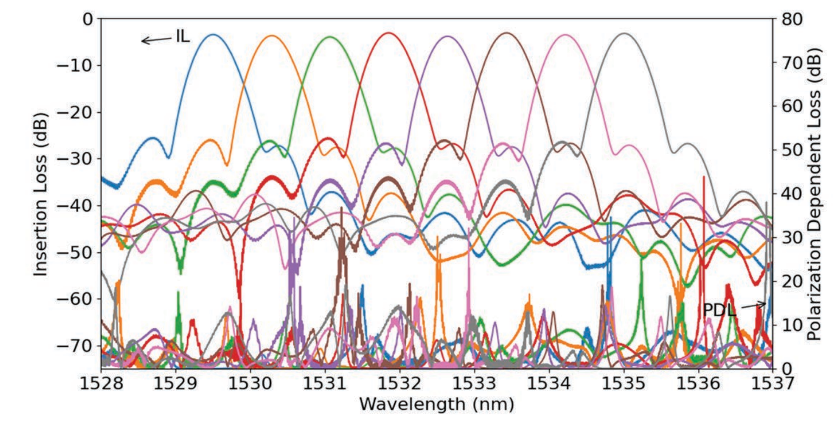




High-Q ring-resonator response using two sampling resolutions in the CTP10 at 1550 nm: 1 pm (green trace) and 50 fm (blue trace)

Use case 2: Arrayed waveguide grating (AWG)

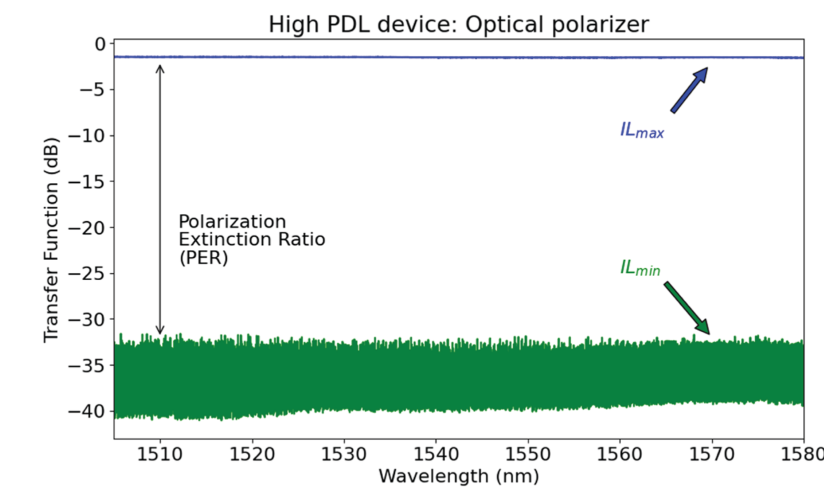
Integrated photonic components with multiple outputs, spectral filters based on WDM grid. Simultaneous measurement of every channel with analysis of center wavelength and isolation PDL.



Multiport spectral response and isolation PDL of an AWG measured with a CTP10 platform

Use case 3: High-PER device

Spectral characterization of highly polarizing devices using fast polarization controller with feedback capability-locking on maximum or minimum IL.



Maximum/Minimum IL of an optical polarizer using the CTP10 with external high-speed polarization controller

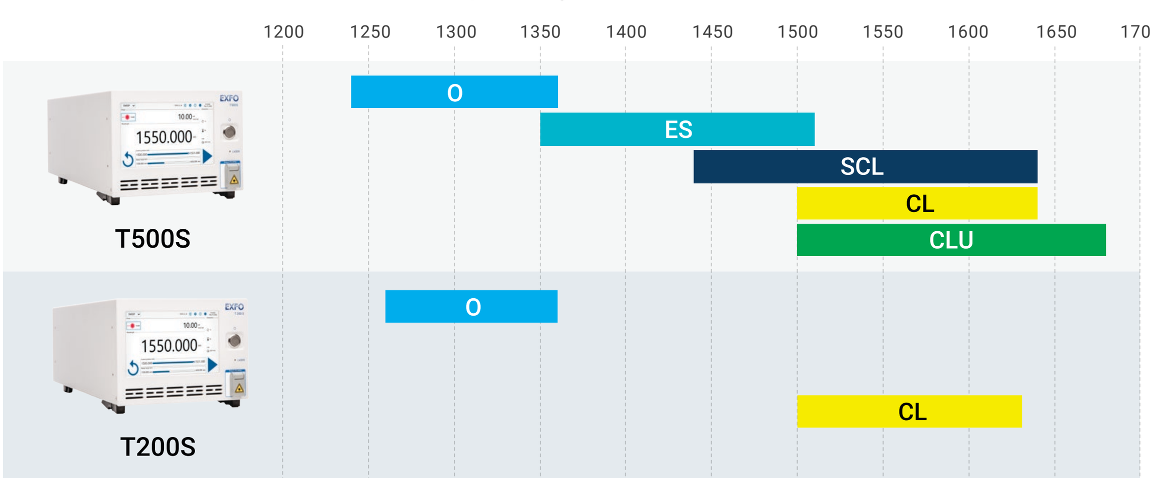
Other components that require spectral testing

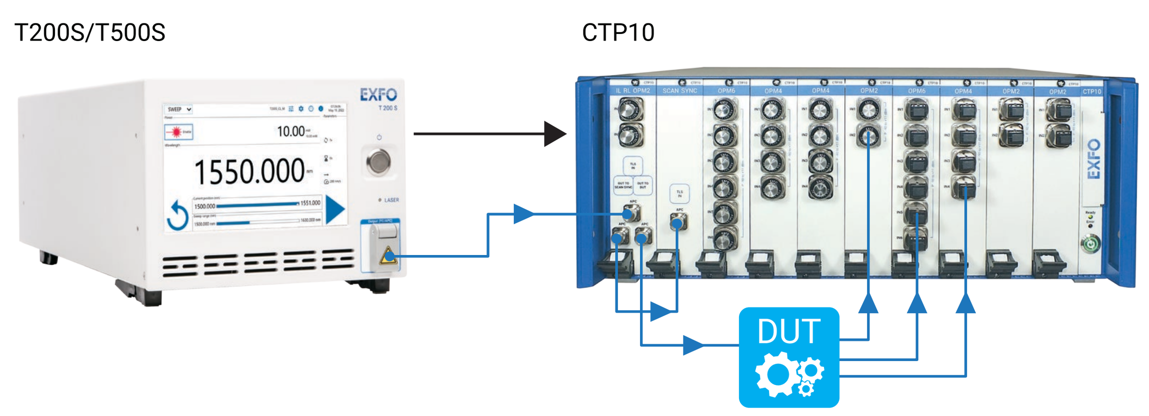
Multiplexers/demultiplexers, interleavers, wavelength selective switches (WSS), thin film filters (TFF), Gain flattening filters.

Optical testing solutions

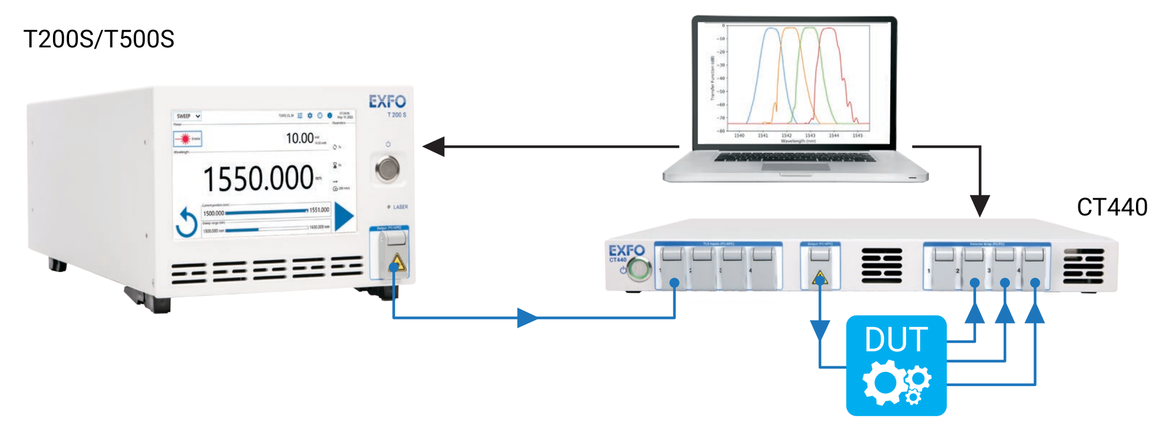
Optical sources: tunable laser	Continuously tunable lasers with high-power and low spontaneous emission	**T200S & T500S**
Component test platforms	Optical component testing platform for WDM components and photonic integrated circuits	**CT440 & CTP10**

- Measurement time: 3 s typical for 100 nm
- IL, RL, PDL (Mueller) and photocurrent measurements
- Optical sampling resolution < 1 pm and dynamic range > 70 dB
- Multichannel measurement capability





Typical IL/RL spectral characterization setup using a T200S/T500S with CTP10

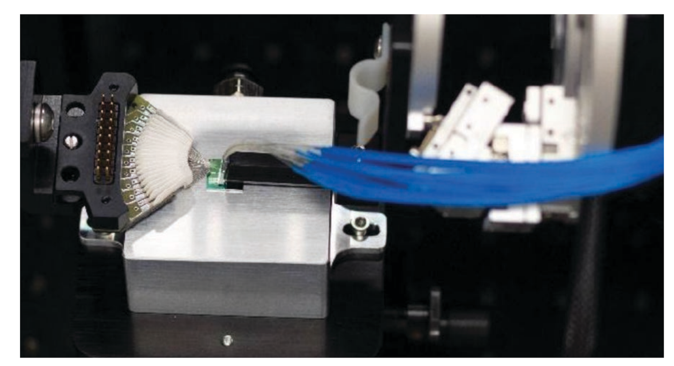


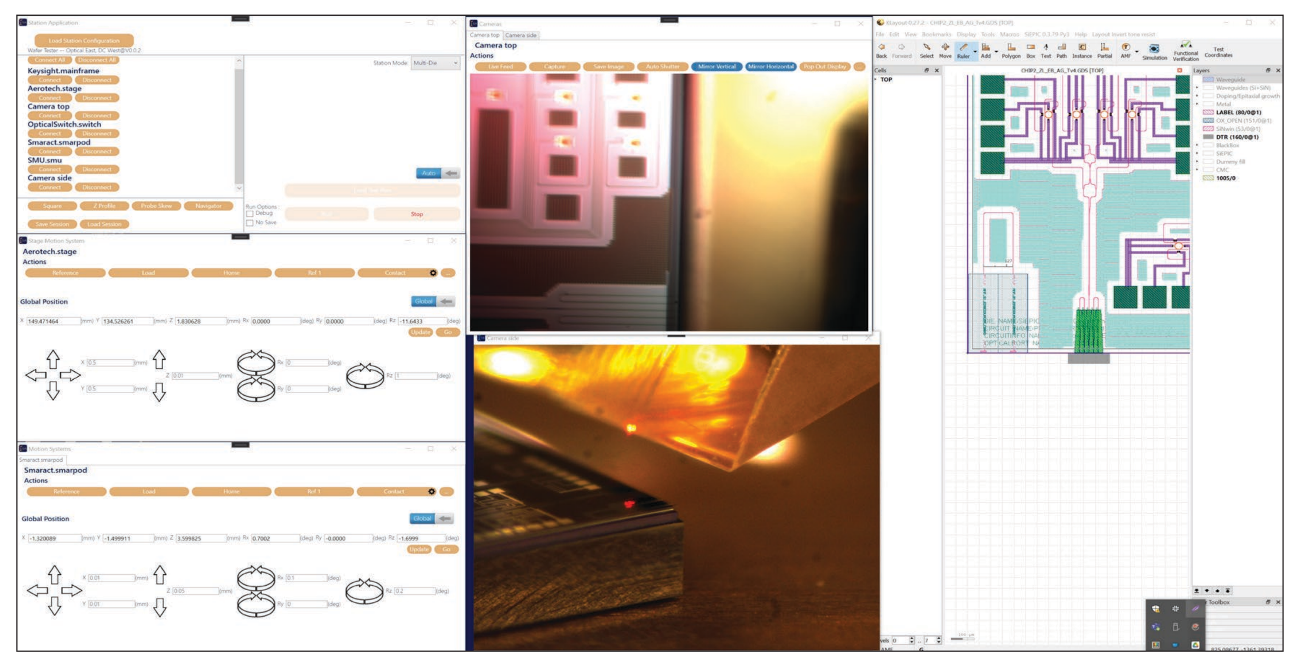
Typical IL spectral characterization setup using a T200S/T500S with CT440

Automated PIC test systems

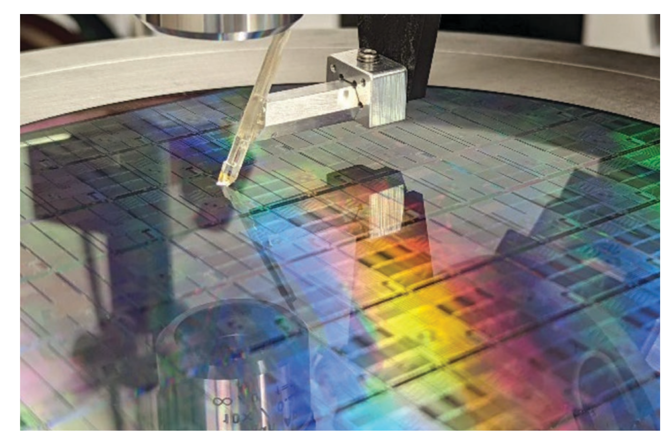
Automated test systems for integrated photonics

- Wafer-level, single-die and multi-die alignment
- Test station automation and analysis
- Integrated IL, RL and PDL measurements
- High modularity and high performance
- Optical/Electrical/RF probing up to 4 heads





PILOT software – Edge coupling on a single die



EXFO's OPAL automated test stations – Trench edge coupling