OPTICAL WAVEGUIDE ANALYZER

9500

OWA-9500

R&D AND MANUFACTURING

- Innovative refractive index profiler for integrated optics devices
- High-end, automated waveguide RIP profiler
- Waveguide scan and raster scan capabilities
- Accurate measurement of refractive index in the 1.45 to 1.60 range
- Compatible with OptiBPM software

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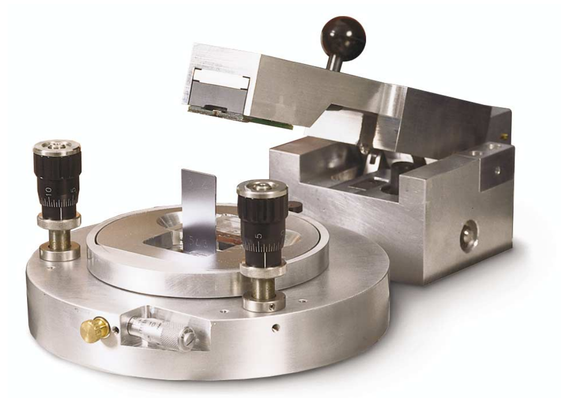
Telecommunications Test and Measurement

EXFO
EXPERTISE REACHING OUT

Next-Generation Technology

EXFO's OWA-9500 Optical Waveguide Analyzer is the first commercial refractive index profiler for integrated optics waveguides. As more and more next-generation optical devices use these waveguides, their accurate characterization becomes critical. The OWA-9500 provides easy and accurate refractive index profile (RIP) measurements on glass-based and fused silica-based devices. With its refracted near-field (RNF) approach, it helps planar waveguide designers and scientists accurately control and optimize the planar lightguide circuit (PLC) manufacturing process at a very early stage, increasing production yields.



KEY FEATURES

- Benefit from submicron spatial resolution capabilities
- Optimize PLC manufacturing
- Increase productivity
- Attain peak RNF performance

Multiple RIP Applications

RIP is a key measurement tool for designers and manufacturers of optical fibers and integrated optics (IO) devices including:

- NxN star couplers used in high-speed, multiple-access optical networks
- Arrayed-waveguide gratings (AWGs) used to increase the aggregated transmission capacity of single-strand optical fiber
- Flat-spectral-response AWGs
- Uniform-loss and cyclic-frequency AWGs
- Athermal AWGs
- Phase-error-compensated AWGs
- Optical add-drop multiplexers
- NxN matrix switches
- Lattice-form programmable filters

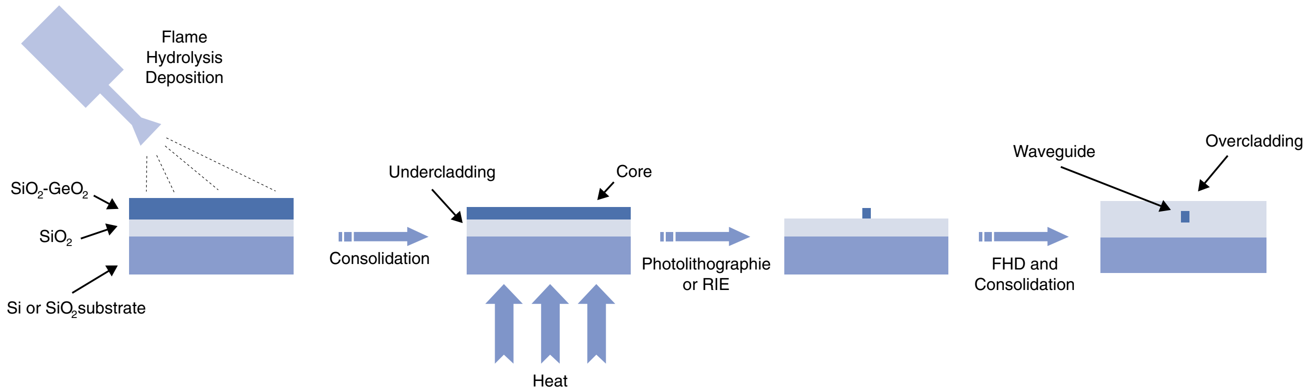
Both active and passive devices can be tested regardless of function or composition; the OWA-9500 tests glass-based and fused silica-based bulk SiO_2 or SiO_2/Si) devices. This instrument can also test SiON devices with a refractive index of 1.45 to 1.60, as well as polymer-based devices.

Accurate RIP characterization results in optimum performance, higher yields, faster development time, increased throughput and a more stable manufacturing process.

Creating Silica Waveguides

Simple, well-defined structure is the most prominent feature of silica waveguides. This configuration allows photonics component manufacturers to produce a wide variety of devices.

PLCs using silica-based optical waveguides are fabricated on silicon or silica substrate by a combination of flame hydrolysis deposition and reactive ion etching. Fine glass particles are produced in the oxyhydrogen flame and deposited on the host substrate (Si or SiO_2). After undercladding and core glass layers are deposited, the wafer is heated to high temperature for consolidation. The circuit pattern is fabricated by means of photolithography and reactive ion etching. Finally, core ridge structures are covered with an overcladding layer and consolidated again.



Planar waveguide fabrication technique

Boost Throughput

The OWA-9500 meets the industry's need for RIP characterization during the optical waveguide fabrication process.

Manufacturing PLCs without analyzing them before the integrated optics devices are fully packaged reduces productivity and yield. Devices that fail end-of-chain analysis represent energy and time wasted during the fabrication and packaging stages. These failures cause throughput to decrease dramatically and result in an inefficient manufacturing scheme. Reduce optical-waveguide device manufacturing costs through tight control of the planar-lightguide fabrication processes by accurately measuring RIP using the first refractive index profiler commercially available to PLC manufacturers, EXFO's OWA-9500.

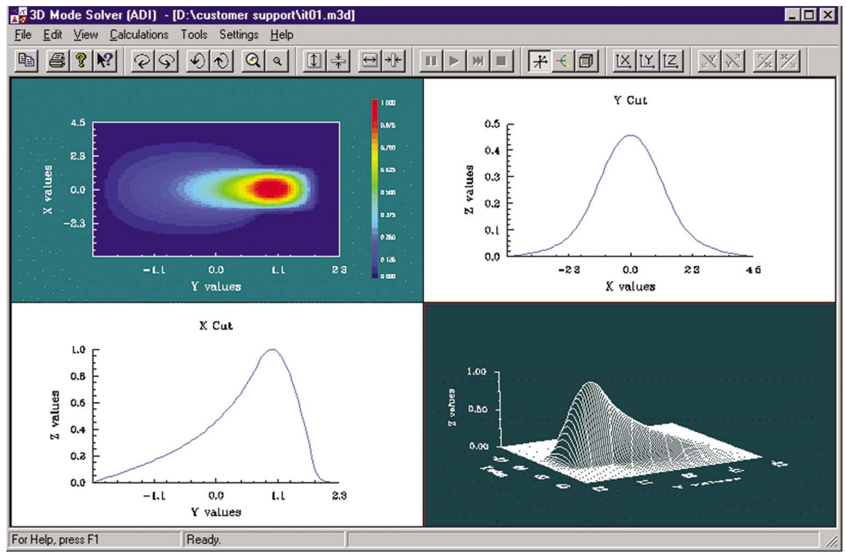
Photonic integrated-circuit devices, currently in the early R&D stage, will also use waveguides. Manufacturers of this new technology will benefit from OWA-9500 RIP characterization.

Software Capabilities

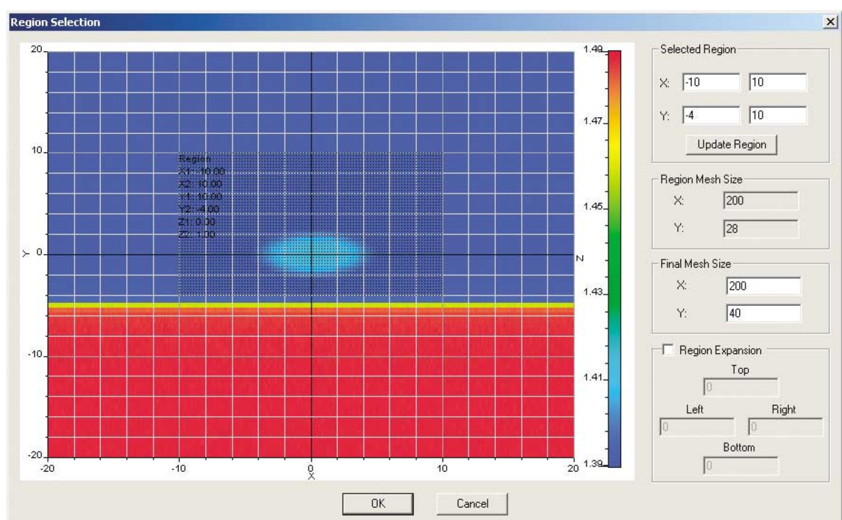
Directly upload RIP results obtained from the OWA–9500 with Optiwave Corporation's OptiBPM software.

OptiBPM is a powerful, user-friendly application that allows computer modeling of a variety of integrated and fiber optics guided wave problems. The beam propagation method (BPM) is a step-by-step way of simulating the passage of light through any waveguiding medium. In integrated and fiber optics, an optical field can be tracked at any point as it propagates along a guiding structure. BPM allows computer-simulated observations of the light field distribution. The radiation, as well as the guided field, can be considered simultaneously.

Optiwave CORPORATION



3D mode solver capabilities of OptiBPM software



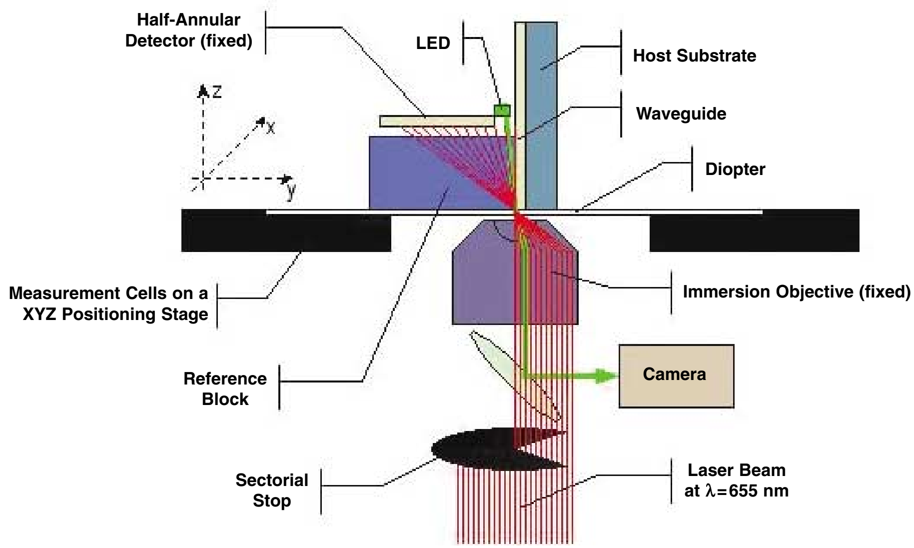
The Converter software application lets you easily transform the data acquired with then OWA-9500 into a format usable by OptiBPM.

Optimum Performance

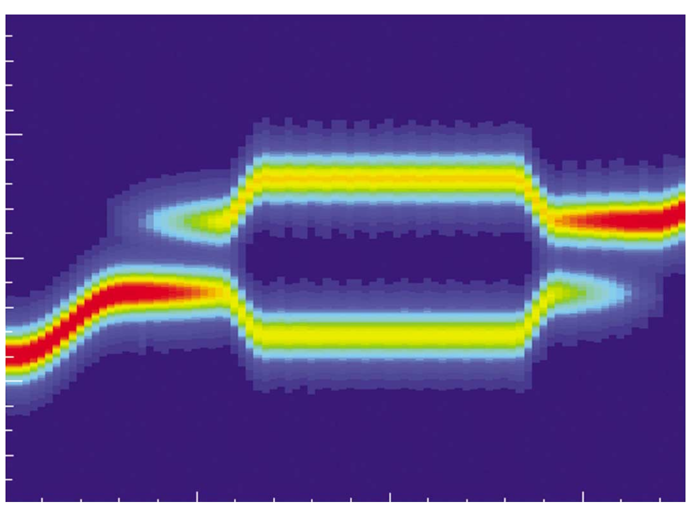
The OWA-9500 uses the RNF technique to measure waveguide RIP. The RNF source is typically a laser with a wavelength ranging from 630 to 850 nm; shorter RNF laser wavelength produces a higher spatial resolution. EXFO's OWA-9500 uses a long-life, 655 nm, temperature- and power-controlled laser diode for optimum RNF performance, providing a spatial resolution of 0.5 μm. RIP is measured as follows:

1. A collimated light beam emitted by a laser source is precisely focused on the endface of the waveguide under test (WUT).
2. The WUT end is placed vertically in a test cell.
3. The test cell is scanned in 0.1 μm steps in x-y directions across the RNF laser beam, focused by a high-numerical-aperture immersion objective lens.
4. The z direction positioning system allows the laser beam to be focused accurately on the WUT endface.
5. A silicon detector placed above the sample endface collects the portion of the beam refracted out of the WUT.

   The detected signal is inversely proportional to the changes in the index of refraction encountered at the WUT end during a scan across the focus of the RNF beam. From the known refractive index values of the reference and calibration blocks, a linear interpolation provides the sample RIP.



The RNF technique is used to measure the RIP of the waveguide.



BPM simulation shows the electro-optic behaviors of a Mach-Zehnder interferometer optical switch.

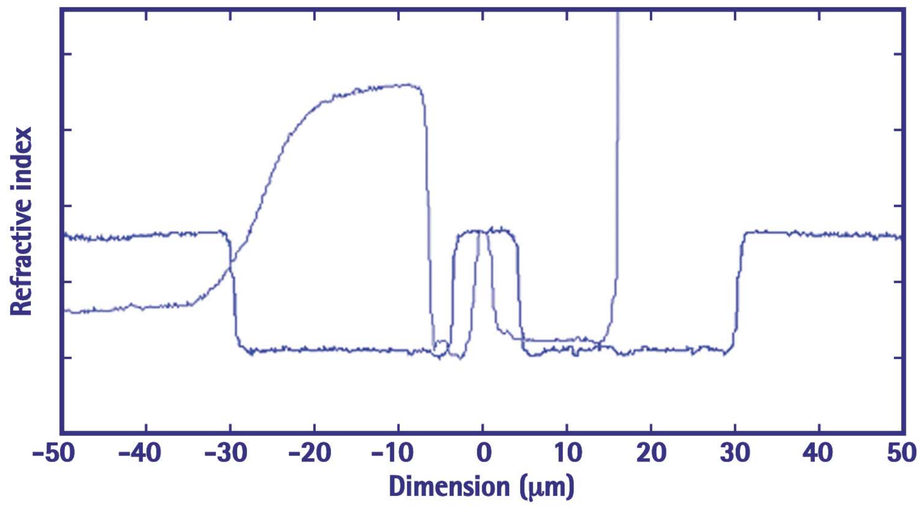
WUT Topography

Using the OWA–9500 raster scan capability, a view of the WUT's refractive index section is obtained and a contour analysis can be performed. The raster scan can be sliced at different refractive index levels to provide topographic and geometric measurements of the WUT. Topography can be downloaded to any simulation software using the beam propagation method (BPM) to simulate the various electro-optic behaviors of the device being tested.

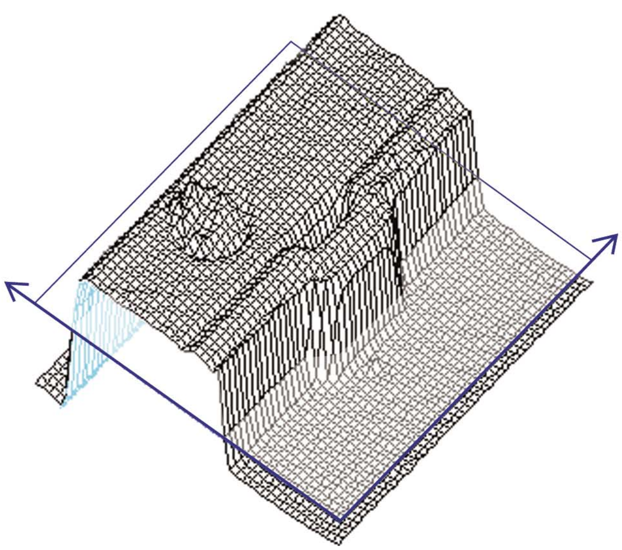
Available Feedback: Waveguide Raster Scan Capabilities

(X Scan, Y Scan and Raster)

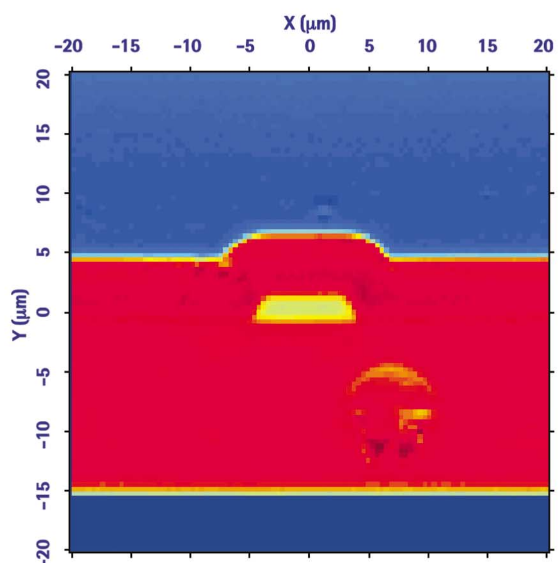
Measurement of waveguide RIP provides the information necessary to calculate the guide's numerical aperture and the number of modes propagating within the lightguide core, while defining intermodal and/or profile dispersion caused by the lightguide itself. Since the impulse response and information-carrying capacity of the waveguide is RIP-dependent, it is essential for PLC manufacturers to produce controlled waveguide profiles with high accuracy.



X scan: across the sample, from top to bottom
Y scan: along the plane of deposition
X–Y scans across the 10 x 2 µm² waveguide, showing its RIP. The refractive index scale has been set to an arbitrary unit to protect proprietary data.



X–Y raster scan of a waveguide showing a 3-D refractive index profile, where the refractive index is plotted as the third dimension.



Processed sectional raster scans of the 10 x 2 µm² SiO_2 waveguide.

ORDERING INFORMATION

Measurement technique	Refracted near-field (RNF)	
Measurement wavelength (nm)	656	
Spatial resolution (µm)	x ≤ 0.5	y ≤ 0.6
Absolute refractive index resolution	$\leq 7 \times 10^{-5}$	
Repeatability on measurement (2σ)	$\leq 6 \times 10^{-4}$	
Reproducibility on measurement (2σ)	$\leq 2.5 \times 10^{-3}$	
Uncertainty on refractive index	$\leq 2.5 \times 10^{-3}$	
Sample type	Refracted index range: 1.45 to 1.60 Material: transparent at 656 nm	
Scan time (s) (100 µm x 100 µm)	25	

OptiBPM Modeling Software

GP-270-45-CW	
GP-270-46-CJ	
GP-270-47-UW	Contact EXFO to determine the appropriate software package.
GP-270-48-UJ	

Accessories

Part number	Description
GP-270-03	Video monitor for lightguide search
GP-270-40	Test measurement cell Diopter and holder
GP-270-53	Supporting block
GP-270-44	OWA-9500 application software

Measuring Cells

Part number	Description
	Cell 1: index range of 1.45 to 1.50
GP-270-54	SiO_2 calibration block (index: 1.456)
GP-270-50	FK5 reference block (index: 1.485)
GP-270-41	Matching oil for refractive index of 1.480
	Cell 2: index range of 1.47 to 1.53
GP-270-55	FK5 calibration block (index: 1.485)
GP-270-51	BK7 reference block (index: 1.514)
GP-270-42	Matching oil for refractive index of 1.508
	Cell 3: index range of 1.50 to 1.56
GP-270-56	BK7 calibration block (index: 1.514)
GP-270-57	BAK2 reference block (index: 1.537)
GP-270-62	Matching oil for refractive index of 1.532
	Cell 4: index range of 1.53 to 1.59
GP-270-58	BAK2 calibration block (index: 1.537)
GP-270-59	BAK1 reference block (index: 1.569)
GP-270-63	Matching oil for refractive index of 1.564
	Cell 5: index range of 1.56 to 1.62
GP-270-60	BAK1 calibration block (index: 1.569)
GP-270-61	BAF4 reference block (index: 1.602)
GP-270-64	Matching oil for refractive index of 1.596

Standard Accessories

Technical support service (4 days)

Instruction manual and Certificate of Compliance

SPECIFICATIONS[1]

General Specifications

Size (H x W x D)		30.7 cm x 53.1 cm x 52.3 cm	(12 1/8 in x 20 7/8 in x 20 5/8 in)
Weight		37 kg	(81 lb)
Temperature			
	operating	21 °C to 25 °C	(70 °F to 77 °F)
	storage	10 °C to 30 °C	(50 °F to 86 °F)
Relative humidity		0 % to 80 % non-condensing	
Rating		100 V to 240 V, 50 Hz to 60 Hz	

Note

1. Guaranteed for a waveguide endface polishing angle of less than 0.5°.

Laser Safety

CLASS 1 LASER PRODUCT

21 CFR 1040.10 and IEC 60825-1: 1993+A1: 1997 + A2:2001

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