3.9 Goniometric Radiometers

3.9.1 LD 8900, LD 8900R Far-Field Profilers

Profiling divergent light sources presents many challenges, but Photon's far-field profilers characterize the angular radiation intensity of light simply and accurately in real time. Both the LD 8900 and LD 8900R (wide dynamic range Goniometric Radiometer) provide full 3-dimensional measurements of the far-field pattern in minutes or less, with far better resolution than a CCD camera. The LD 8900 far-field profiler provides direct real-time far-field measurements with >24dB dynamic range, while the wide dynamic range LD 8900R has a dynamic range of >36dB, which provides greater detail in the "tails" of the far-field pattern. Both models have an angular sampling resolution of 0.055º and a field-of-view of ±72° (144°), and are ideal for characterizing the light flux from many sources, including VCSELs, laser diodes (LDs), optical fibers, optical waveguides, and more. With the LD 8900R, measurement of the mode field diameter of optical fiber is possible in real time with greater than 5% accuracy. The LD 8900 and the LD 8900R are available with either a silicon or InGaAs detector and have a standard entrance aperture of 2mm, with an optional 10mm entrance aperture for use with larger sources such as LEDs and LD bars.

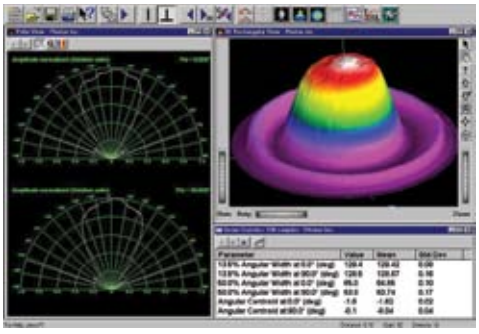
LD 8900 and LD 8900R complete systems include:

- The Scan Unit
- The Motion Control Module
- Goniometric Radiometer Acquisition and Analysis Software for Microsoft Windows operating systems
- PCI Interface Box
- Power and instrument cables
- An optional semi-custom source mount, specifically designed to meet your application needs, can be quoted upon request for either the LD 8900 or the LD 8900R

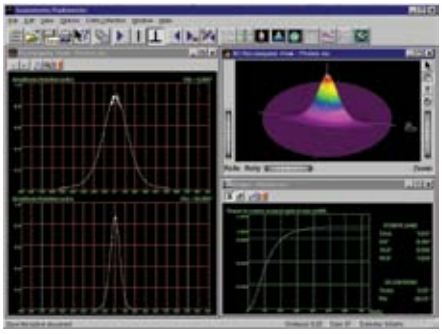
Mode Field Diameter in Real Time with LD 8900R

The LD 8900R allows for real-time measurements of Mode Field Diameter (MFD) with an accuracy of ±5%* for a nominal 10µm single-mode fiber. Mode Field Diameter (MFD) of single-mode optical fiber is measured using the methodology described in the Telecommunication Industry Association/ Electronic Industries Association (TIA/EIA) Standard FOTP-191. Specifically, the MFD is calculated using the Petermann II integral, with data sampled at angular resolution of 0.055° and collected over an angular extent of ±72° (144° viewing angle).

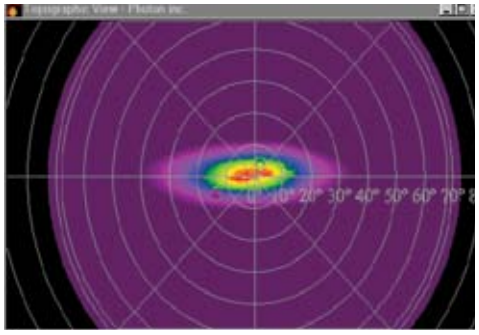
*If greater accuracy is required, Photon's LD 8900HDR is specifically designed to measure MFD and A_{eff} to greater than 0.5%



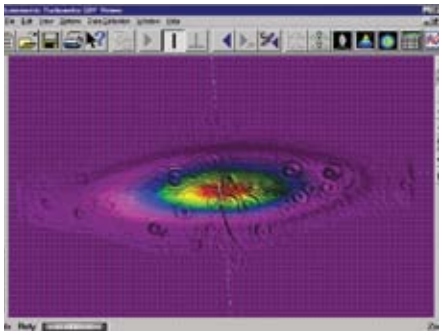
Polar View (left); 3D View (top); Beam Statistics (bottom) with LD 8900R



Windows Showing uniformity of a Laser Diode



Topographical View - LD 8900R



Laser Diode Diffraction Rings

3.9.1.1 LD 8900/LD 8900R System Specifications

Sensor/Detector	
Scan Radius	84mm
Pinhole Size	1000µm (options available)
Entrance Aperture	2mm standard (optional 1cm)
Field of View	±72° (144 degrees)
Azimuthal Scans	1, 2, 10, 20, 50, 100, or 200
Spatial Sampling Resolution	0.055 degrees, 3241points/scan
Spectral Range	
Silicon detector	320-1100nm
InGaAs detector	800-1700nm
Optional UV	190-~1100nm
Source Input Power for >400nm	
Mirror Damage Threshold CW	900 W/cm^2
Mirror Damage Threshold Pulsed	1 J/cm^2
LDs, multi-mode fiber w/ NA >0.5	10's of µW to 10's of W*
Single-mode fiber	1µW to 1W**
For wavelengths <400nm	Contact Factory
Higher power options available	Contact Factory
Source Output	CW or Pulsed (rep rates >10kHz)
Parameters Measured	
Angular Widths	FWHM, 5%, 13.5%, 2 user-specified clip levels
Numerical Apertures	FWHM, 5%, 13.5%, 2 user-specified clip levels
Angular Width Ratios	FWHM, 5%, 13.5%, 2 user-specified clip levels
Angular Position	Centroid, Peak
Intensity or Amplitude	Centroid, Peak, 2 user-specified locations
Mode-Field Diameter	LD 8900R only
Relative Integrated Power	Relative Power in user-specified cone angles about an arbitrary axis
Data Update Rates	
Single scan updates:	~ 5Hz
Perpendicular Scan updates	~ 0.5Hz
3D Profile Acquisition Time*	* Times are PC dependent
10 azimuthal scans	~7s
20 azimuthal scans	~14s
50 azimuthal scans	~35s
100 azimuthal scans	~70s
200 azimuthal scans	~140s
File Saving and Data Logging	
	Program Data and Setup Configuration Files
	ASCII file Profiles and Summary Parameters
	Raw 3D Scan Data in binary format
	Screen Captures: BMP, JPG, GIF, TIFF, PNG
	Log to Files and COM Ports
Communications	
	RS-232 Serial COM port required ActiveX Automation
Electrical/Mechanical	
AC Power Required	110V ~ 60Hz standard, 220V ~ 50Hz optional (Installation Category: Class II)
Main supply voltage fluctuations:	Not to exceed ±10% of the nominal voltage; Transient overvoltage according to Installation Category II; Pollution Degree 1 or 2 in accordance with IEC 664.
Dimensions mm	
Scanning Unit	318 × 228 × 241
Scanner	203 × 165 × 165
Motion Controller	51 × 89 × 248
Environmental Conditions	
	Indoor use
Temperature	5°C – 40°C
Altitude	Up to 2000m
Maximum relative humidity	80% for temperature up to 31°C decreasing linearly to 50% relative humidity at 40°C

3.9.1.2 Ordering Information - Goniometric Radiometer Far-Field Profilers

All Goniometric Radiometer LD 8900 Far-Field Profiler Systems include the Scan Unit, PCI Controller Interface, software for windows 7 (32/64) including ActiveX Automation commands. Tower/desktop computers with available PCI slot, it is not compatible with laptop. All LD 8900R systems include the above as well as a dynamic range >36dB with 0dB source. System incorporates 16-bit digitizer, light scatter control and special amplifiers to achieve higher dynamic range than standard LD8900. For pulsed operation, please consult the factory.

Item	Description	P/N
LD8900/InGaAs	Goniometric Radiometer for characterizing the angular radiation intensity from a laser diode between 800nm and 1700nm wavelength. Entrance aperture 2mm	PH00173
LD8900/Si	Goniometric Radiometer for characterizing the angular radiation intensity from a laser diode between 320nm and 1100nm wavelength. Entrance aperture 2mm. Full 3D capability. Features dynamic range >36dB with 0 dB source	PH00174
LD8900R/InGaAs	Wide Dynamic Range Goniometric Radiometer for characterizing the angular radiation irradiance from a fiber optic, wave guide, laser diode, VCSEL, or LED between 800nm and 1700nm wavelength	PH00175
LD8900R/Si	Wide Dynamic Range Goniometric Radiometer for characterizing the angular radiation irradiance from a fiber optic, waveguide, laser diode, VCSEL or LED between 320nm and 1100nm wavelength. Full 3D capability	PH00176
Options		
Pulsed InGaAs Option	Failsafe operation for pulsed sources operating at repetition rates >10kHz with pulse widths >500ns. For operation below 10kHz, there are possible gain saturation states, dependent on repetition rate, pulse width, and source power. Consult the factory when operating under these conditions for failure mode assessment. When questionable, pulsed source operation should be verified against CW operation	PH00185
Pulsed InGaAs Upgrade Option	Pulsed Upgrade Option to an existing Goniometric Radiometer InGaAs system. Failsafe operation for pulsed sources operating at repetition rates >10kHz with pulse widths >500ns. For operation below 10kHz, there are possible gain saturation states, dependent on repetition rate, pulse width, and source power. Consult the factory when operating under these conditions for failure mode assessment. When questionable, pulse source operation should be verified against CW operation. Includes software upgrade. Contact Factory for details	PH00186
PCI Controller Upgrade	Interface to allow use with standard PCI interface of desktop PC. Includes an interface box for 9180 controller card, PCI Interface card and cable, and factory calibration and realignment. System should be returned to Photon for installation. Includes software upgrade	PH00187
Optional Mount of User Device -LD 8900 Mount	Photon will provide one semi-custom mount of customer's laser diode device. Submit device particulars for specific quote. With this option, the instrument can be used immediately and provides one example test fixture	PH00181
LD8900 Software Viewer	Goniometric Radiometer Software Viewer for LD8900 models (8-bit). Allows users to open, review and re-analyze files that are saved using any PC computer. The Viewer has all the data processing features of the software. You can read files saved	PH00182
LD8900R Software Viewer	Goniometric Radiometer Software Viewer for LD8900R models (16-bit). Allows users to open, review and re-analyze files that are saved using any PC computer. The Viewer has all the data processing features of the software. You can read files saved	PH00439
Fiber Mount - /FC	Plate and mount for a single mode fiber with FC connector. Label on plate includes reference distance between source and datum plane	PH00189
Fiber Mount - /SC	Plate and mount for a single mode fiber with SC connector. Label on plate includes reference distance between source and datum plane	PH00190
Fiber Mount - /ST	Plate and mount for a single mode fiber with ST connector. Label on plate includes reference distance between source and datum plane	PH00191
Fiber Mount -/BF	Plate and mount for a single mode fiber without connector. Label on plate includes reference distance between source and datum plane	PH00192
Option to Fiber Mount /BF - / Ribbon	Optional 4-Fiber Ribbon Cartridge for the Fiber Mount /BF (Bare Fiber). Requires /BF	PH00193
NIST Reference Standard	N.A. Reference Standard: traceable to NIST for use with Goniometric Radiometer/Far-Field profilers; i.e. LD8900 and/or LD8900R. Data provided: N.A. and Angular Widths at 50%, 13.5% and 5% clip levels, with standard deviation [with a recorded, exact source to aperture distance]. NIST reference standard includes: LD source Single Mode Test Fiber Required Mounting Plate in a storage case	PH00188