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## General Information

Gigahertz-Optik manufactures light detectors for use in combination with Gigahertz-Optik optometers and accessories to form complete radiometric and photometric measurement systems. Detectors can also be used with integrating spheres to form the basis of uniform light sources and reflectance/transmittance instruments. A typical sensor head may consist of a photodiode, optical bandpass filter, diffuser, lens assembly or other optical elements. A complete range of detector head housings and configurations designed around the specific application demands of dynamic range, spectral range, physical size and measurement environment are available. All optical radiation detectors are calibrated and certified by Gigahertz-Optik's calibration laboratory with both absolute sensitivity data and spectral responsivity plot provided.

Gigahertz-Optik

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| Model | Spectral Function | Wavelength Range | Diffuser Diameter | Aperture ( mm ) | Sphere diameter | Unit | Package | | Specifi-cations |
|---|---|---|---|---|---|---|---|---|---|
| | | nm | mm | F.O.V. | mm | | Type | Page | Page |
| **High Sensitivity Broadband UV Irradiance Detectors** | | | | | | | | | |
| **UV-3710** | Radiometric *UV-A* | 320-400 | 11 | Cosine | - | W/m²; W/cm² | 37/32 | 90 | 69 |
| **UV-3711** | Radiometric *UV-B* | 280-320 | 11 | Cosine | - | W/m²; W/cm² | 37/50 | 90 | 69 |
| **UV-3716** | Radiometric *UV-A* | 305-400 | 11 | Cosine | - | W/m²; W/cm² | 37/32 | 90 | 69 |
| **UV-3717** | UV-A Visible Blind | 325-400 | 11 | Cosine | - | W/m²; W/cm² | 37/32 | 90 | 69 |
| **UV-3718** | Narrowband UV-C | 254 | 11 | Cosine | - | W/m²; W/cm² | 37/32 | 90 | 69 |
| **UV-3719** | Broadband UV | 250-400 | 11 | Cosine | - | W/m²; W/cm² | 37/32 | 90 | 69 |
| **Photobiological Actinic Irradiance Detectors** | | | | | | | | | |
| **UV-3704** | UV-Erythema | 250-400 | 11 | Cosine | - | W/m²; W/cm² | 37/32 | 90 | 69/70 |
| **UV-3706** | Bilirubin | 420-530 | 11 | Cosine | - | W/m²; W/cm² | 37/32 | 90 | 69/70 |
| **UV-3708** | ACGIH/ICNIRP | 250-400 | 11 | Cosine | - | W/m²; W/cm² | 37/50 | 90 | 69/70 |
| **UV-3709** | Blue-Light Hazard | 400-520 | 11 | Cosine | - | W/m²; W/cm² | 37/32 | 90 | 69/70 |
| **Plant Physiology Irradiance Detectors** | | | | | | | | | |
| **PS-3701** | PAR | 400-700 | 11 | Cosine | - | µMol/m²/s | 37/32 | 90 | 71 |
| **PS-3702** | Photon Effective | 320-500 | 11 | Cosine | - | µMol/m²/s | 37/32 | 90 | 71 |
| **PS-3703** | Photon Effective | 590-900 | 11 | Cosine | - | µMol/m²/s | 37/32 | 90 | 71 |
| **High Intensity/Temperature Irradiance Detectors / UV-Curing Detectors** | | | | | | | | | |
| **RCH-006** | Broadband UV | 250-400 | 9 | Cosine | - | W/m²; W/cm² | 37/8/F | 91 | 72/73 |
| **RCH-008** | Narrowband UVA | 365 peak | 9 | Cosine | - | W/m²; W/cm² | 37/8/F | 91 | 72/73 |
| **RCH-009** | Narrowband BLUE | 430 peak | 9 | Cosine | - | W/m²; W/cm² | 37/8/F | 91 | 72/73 |
| **RCH-106** | Broadband UV | 250-400 | 9 | Cosine | - | W/m²; W/cm² | 37/8/R | 91 | 72/73 |
| **RCH-108** | Narrowband UVA | 365 peak | 9 | Cosine | - | W/m²; W/cm² | 37/8/R | 91 | 72/73 |
| **RCH-109** | Narrowband BLUE | 430 peak | 9 | Cosine | - | W/m²; W/cm² | 37/8/R | 91 | 72/73 |
| **RCH-506** | Broadband UV | 250-400 | 6 | Cosine | - | W/m²; W/cm² | 15 | 91 | 72/73 |
| **RCH-508** | Narrowband UVA | 365 peak | 6 | Cosine | - | W/m²; W/cm² | 15 | 91 | 72/73 |
| **RCH-509** | Narrowband BLUE | 430 peak | 6 | Cosine | - | W/m²; W/cm² | 15 | 91 | 72/73 |
| **360 Degree Field-Of-View UV-C Irradiance Detectors** | | | | | | | | | |
| **ROD-360** | Narrowband UV-C | 254 | ROD | 360 Deg | - | W/m²; W/cm² | ROD | 92 | 73 |
| **Multi-Channel Illuminance & Irradiance Detectors** | | | | | | | | | |
| **XD-9501** | UV-A 315-400 & UV-B 280-315 | | 8 | Cosine | - | W/m²; W/cm² | XD95 | 91 | 74/75 |
| **XD-9502** | UVA 315-400 & Photopic | | 8 | Cosine | - | W/m²; W/cm² & lx | XD95 | 91 | 74/75 |
| **XD-9503** | UV-A/B 240-340 & UV-A 310-400 | | 8 | Cosine | - | W/m²; W/cm² | XD95 | 91 | 74/75 |
| **XD-9504** | Radiometric VISIBLE & NIR | | 8 | Cosine | - | W/m²; W/cm² | XD95 | 91 | 74/75 |
| **XD-9505** | UV Broadband | 250-400 | 8 | Cosine | - | W/m²; W/cm² | XD95 | 91 | 74/75 |
| **XD-9506** | ACGIH 250-314/315-400 EM6, EN14255 | | 8 | Cosine | - | W/m²; W/cm² | XD95 | 91 | 74/75 |
| **XD-9509** | Erythema I250-320/320-400 | | 8 | Cosine | - | W/m²; W/cm² | XD95 | 91 | 74/75 |
| **XD-9510** | ACGIH 250-314/315-400 DIN EN 12198 | | 8 | Cosine | - | W/m²; W/cm² | XD95 | 91 | 74/75 |
| **XD-9511** | UV-A visible blind | 315-400 | 8 | Cosine | - | W/m²; W/cm² | XD95 | 91 | 74/75 |
| **TP-4501** | Triple PAR & Photopic | | 8 | Cosine | - | µMol/m²/s & lx | 45 | 91 | 74/75 |
| **Luminous Color & Illuminance Detectors** | | | | | | | | | |
| **CT-3701** | x,y,z, 2 Degrees | 380-780 | 10 | Cosine | - | x,y; u,v; K, lx | 37/TC | 92 | 76 |
| **CT-4501** | x,y,z, 2 Degrees | 380-780 | 10 | Cosine | - | x,y; u,v; K, lx | 45 | 90 | 76 |
| **Luminance & Radiance Detectors** | | | | | | | | | |
| **LDM-9810** | Interchangeable PD-16 detectors Spectral function PD-16 dependent | | 20', 1° and 6° Selectable | | | PD-16 dependent | LDM98 | 92 | 77/78 |
| **LDM-9811** | | | 1.7, 11 and 100 mrad Selectable | | | PD-16 dependent | LDM98 | 92 | 77/78 |
| **PD-16-BLH** | Blue Light Hazard | 400-520 | - | 5.8 x 5.8 | - | W/m²sr | PD16 | 92 | 77/78 |

| Model | Spectral Function | Wavelength Range | Diffuser Diameter | Aperture ( mm ) | Sphere Diameter | Unit | Package | | Specifi-cation |
|---|---|---|---|---|---|---|---|---|---|
| | | nm | mm | F.O.V. | mm | | Type | Page | Page |
| **Luminance & Radiance Detectors** | | | | | | | | | |
| **PD-16-RTH** | Retinal Thermal Hazard | 500-1200 | - | 5.8 x 5.8 | - | W/m²sr | PD16 | 92 | 77/78 |
| **PD-16-RTHA** | RTH IR-A | 800-1200 | - | 5.8 x 5.8 | - | W/m²sr | PD16 | 92 | 77/78 |
| **PD-16-RW05** | Radiometric *VIS-NIR* | 400-1000 | - | 5.8 x 5.8 | - | W/m²sr | PD16 | 92 | 77/78 |
| **PD-16-VL01** | Photopic, f1≤3% | 380-780 | - | 5.8 x 5.8 | - | cd/m² | PD16 | 92 | 77/78 |
| **LDM-98Z-NL** | - | 380 - 1000 | - | 50 | - | - | LDM98 | 92 | 77/78 |
| **LDM-98Z-FC** | - | Fiber Coupler for flexible light guide bundles | | | | | | 92 | 77/78 |
| **LDM-9901** | Photopic, f1≤5% | 380-780 | - | 1° | - | cd/m² | LDM99 | 92 | 79 |
| **SRT-M37** | A Range of Front Lenses is Offered for the VL, RW and UV Detectors for Luminance & Radiance Set-ups | | | | | | | 89 | 80 |
| **Luminous Flux & Radiant Power Detectors** | | | | | | | | | |
| **LSM-9901** | Photopic, f1≤5% | 380-780 | - | 12.5 ∅ | 50 | lm | 11/50 | 91 | 81 |
| **PRW-0505** | Radiometric *VIS-NIR* | 400-1000 | - | 12.5 ∅ | 50 | W | 11/50 | 91 | 81 |
| **Integrating Spheres** | Spheres from 100 mm (4 inch) to 500 mm (20 inch) Diameter are Offered which can be Combined with VL, RW, UV & PS Detectors for Luminous Flux and/or Radiant Power Measurement Set-ups | | | | | | | See Integrating Spheres | |
| **Laser Stray-light and Laser Power Detectors** | | | | | | | | | |
| **LP-9901** | Si Photodiode | 350-1100 | - | 7 ∅ | - | W/m² nm / W nm | 37/8.5 | 91 | 82 |
| **Laser Power Detectors with Integrating Spheres** | | | | | | | | | |
| **LP-0101** | InGaAs Photodiode | 800-1800 | - | 5 ∅ | 30 | W nm | 11/30 | 91 | 82/83 |
| **LP-0102** | Si & InGaAs Photodiode | 350-1800 | - | 5 ∅ | 30 | W nm | 11/30 | 91 | 82/83 |
| **LP-0103** | Si Photodiode | 350-1100 | - | 5 ∅ | 30 | W nm | 11/30 | 91 | 82/83 |
| **LP-0201** | Si LP Photodiode | 400-1100 | - | 2 ∅ | 8 | W nm | 11/8 | 91 | 82/83 |
| **LP-9910** | Si Photodiode | 400-1100 | - | 12.5 ∅ | 50 | W nm | 11/50 | 91 | 83 |
| **LP-9920** | InGaAs Photodiode | 800-1800 | - | 12.5 ∅ | 50 | W nm | 11/50 | 91 | 83 |
| **LP-9930** | Si & InGaAs Photodiode | 400-1800 | - | 12.5 ∅ | 50 | W nm | 11/50 | 91 | 83 |
| **Laser Pulse Shape Radiant Power Detector** | | | | | | | | | |
| **LPPA-9901** | Si LP Photodiode | 400-1060 | - | 12.5 ∅ | 50 | V / W nm | LPPA | 91 | 84 |
| **Compact Size Modular Detectors** | | | | | | | | | |
| **PD-1101** | Si Photodiode | 200-1100 | - | 3.6 x 3.6 | - | With Accessory | 11 | 90 | 85 |
| **PD-1102** | InGaAs Photodiode | 800-1800 | - | 0.3 ∅ | - | With Accessory | 11 | 90 | 85 |
| **PD-1103** | InGaAs Photodiode | 800-1800 | - | 1 ∅ | - | With Accessory | 11 | 90 | 85 |
| **PD-1104** | InGaAs Photodiode | 800-1800 | - | 3 ∅ | - | With Accessory | 11 | 90 | 85 |
| **PD-1105** | SiC Photodiode | 200-400 | - | 1.1 x 1.1 | - | With Accessory | 11 | 90 | 85 |
| **PD-1106** | Si LP Photodiode | 400-1050 | - | 0.5 x 0.5 | - | With Accessory | 11 | 90 | 85 |
| **PD-1107** | Si LP Photodiode | 400-1050 | - | 1.9 x 1.9 | - | With Accessory | 11 | 90 | 85 |
| **PD-1108** | Si LP Photodiode | 400-1050 | - | 3.4 x 3.4 | - | With Accessory | 11 | 90 | 85 |
| **PD-1109** | GaP Photodiode | 250-550 | - | 1.1 x 1.1 | - | With Accessory | 11 | 90 | 85 |
| **PD-1110** | GaAsP Photodiode | 200-760 | - | 2.3 x 2.3 | | | | | |
| **Integrating Spheres** | Spheres from 100 mm (4 inch) to 500 mm (20 inch) Diameter are Offered which can be Combined with PD-11 Detectors for Radiant Power Measurement Set-ups | | | | | | | See Integrating Spheres | |
| **Temperature Controlled Modular Detectors** | | | | | | | | | |
| **TD-1101** | Si Photodiode | 200-1100 | - | 3.6 x 3.6 | - | With Accessory | TD11 | 90 | 86 |
| **TD-1102** | InGaAs Photodiode | 800-1800 | - | 0.3 ∅ | - | With Accessory | TD11 | 90 | 86 |
| **TD-1103** | InGaAs Photodiode | 800-1800 | - | 1 ∅ | - | With Accessory | TD11 | 90 | 86 |
| **Integrating Spheres** | Spheres from 100 mm (4 inch) to 500 mm (20 inch) Diameter are Offered which can be Combined with TD-11 Detectors for Radiant Power Measurement Set-ups | | | | | | | See Integrating Spheres | |
| **Modular Detectors** | | | | | | | | | |
| **MD-37-GP6** | GaP Photodiode | 250-550 | - | 2.5 x 2.5 | - | With Accessory | MD37 | 90 | 86 |

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| Model | Spectral Function | Wavelength Range | Diffuser Diameter | Aperture ( mm ) | Sphere Diameter | Unit | Package | | Specifi-cation |
|---|---|---|---|---|---|---|---|---|---|
| | | nm | mm | F.O.V. | mm | | Type | Page | Page |
| **Modular Detectors** | | | | | | | | | |
| **MD-37-GAP** | GaAsP Photodiode | 200-790 | - | 2.3 x 2.3 | - | With Accessory | MD37 | 90 | 86 |
| **MD-37-IGA1** | InGaAs Photodiode | 800-1800 | - | 1 ∅ | - | With Accessory | MD37 | 90 | 86 |
| **MD-37-IGA3** | InGaAs Photodiode | 800-1800 | - | 3 ∅ | - | With Accessory | MD37 | 90 | 86 |
| **MD-37-SC1** | SiC Photodiode | 200-400 | - | 1 x 1 | - | With Accessory | MD37 | 32 | 86 |
| **MD-37-SU13** | Si Photodiode | 200-1100 | - | 3.6 x 3.6 | - | With Accessory | MD37 | 32 | 86 |
| **MD-37-SU33** | Si Photodiode | 200-1100 | - | 5.8 x 5.8 | - | With Accessory | MD37 | 32 | 86 |
| **MD-37-SU100** | Si Photodiode | 200-1100 | - | 10 x 10 | - | With Accessory | MD37 | 32 | 86 |
| **MD-37Z-C11** | Front Cap Adapter | | | 11 ∅ | - | - | MD37 | 32 | 86 |
| **MD-37Z-DR11** | RADIN Diffuser Cap | 200-2500 | - | 11 ∅ | - | - | MD37 | 32 | 86 |
| **MD-37Z-H7** | Filter Adapter for 0.5 or 1 inch Diameter Filter | | | | | | MD37 | 32 | 86 |
| **MD-37Z-H7xx** | Filter Adapter with Custom Specified Band-pass or Wedge Filter | | | | | | MD37 | 32 | 86 |
| **Integrating Spheres** | Spheres from 100 mm (4 inch) to 500 mm (20 inch) Diameter are Offered which can be Combined with MD-37 Detectors for Radiant Power Measurement Set-ups | | | | | | | See Integrating Spheres | |
| **1 cm² Circular Area Modular Detectors** | | | | | | | | | |
| **PD-9304** | Si Photodiode | 350-1100 | - | 11.28 ∅ | - | W nm | PD93 | 91 | 87/88 |
| **PD-9306** | UV-Si Photodiode | 250-1100 | - | 11.28 ∅ | - | W nm | PD93 | 91 | 87/88 |
| **PD-9302-VL** | Photopic Front Filter | 380-780 | - | 15.5 ∅ | - | - | PD93 | 91 | 87/88 |
| **PD-9302-RW** | Radiometric Front Filter | 400-1100 | - | 11.28 ∅ | - | - | PD93 | 91 | 87/88 |
| **PD-9303-COS** | Diffuser Front Cap | 380-1100 | 20 | Cosine | - | - | PD93 | 91 | 87/88 |
| **Averaged LED Intensity Front Adapter** | | | | | | | | | |
| **PD-9311** | 0.01 Steradian Solid Angle Front Tube for PD-9304; CIE 127 Condition B | | | | | cd or W/sr | PD93 | 91 | 87/88 |
| **PD-9312** | 0.001 Steradian Solid Angle Front Tube for PD-9304; CIE 127 Condition A | | | | | cd or W/sr | PD93 | 91 | 87/88 |
| **Weather Proof Option** | | | | | | | | | |
| **WPD-01** | Weather Proof Detector Housing to be Equip with Photometric or Radiometric Detector | | | | | | WPD | 92 | 88 |
| **Light Detector Accessories** | | | | | | | | | |
| **UMB** | Integrating Spheres from 100 mm / 4 in to 500 mm / 20 in Diameter with Accessory for System Set-ups | | | | | | | Int. Spheres | |
| **UP** | Precise Machined Integrating Spheres from 8 mm / 0.3 in to 10 in Dia. with Accessory for System set-ups | | | | | | | Int. Spheres | |
| **SRT-M37** | Front Lenses, Barrels & Adapters for 37-type Detectors | | | | | | 37 | 89 | 89 |
| **/WQ** | Waterproofing Option for 37-type Detectors | | | | | | | 92 | 90 |
| **/LC** | Cable Length Extension | | | | | | | | 90 |
| **BHO** | Carrying Cases | | | | | | | | 90 |
| **Other Custom Light Detectors, Accessory and Complete Application Solutions Available on Request** | | | | | | | | | |

## Optometer Model Depending Plug Types:

Gigahertz-Optik light detectors come equipped with a plug type compatible with the particular optometer it will used with (see table).
The -2 calibration data plug contains an Eeprom that stores the detectors serial number, model, units and calibration data or data table for automatic information transfer to the meter when connected.
Both standard BNC (-1) and ITT-9PIN (-4) connectors are straight forward plugs without internal Eeprom.

*- 1 BNC Connector*

*- 2 Calibration Data Connector*

*- 4 ITT Type Connector*

| Plug Type | | Meter |
|---|---|---|
| BNC | -1 | P-9202, P9801, P-9802, TR-9600 |
| Calibration Data | -2 | P-9710, P-2000 |
| ITT (MSDM9) | -4 | X9, X1, HCT-99 |

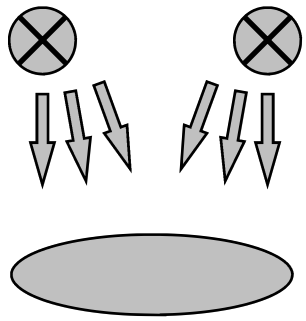
# Measurement Range Calculation; Illuminance & Irradiance

## Calculation of the Maximum Measurable Intensity and Resolution:

Typical sensitivity factors for each light detector in its calibrated units are included in the specifications listed on the following pages. The maximum measurable intensity and attainable resolution with the different models of optometer offered can be calculated as follows

**Maximum Resolution**
= Meter Current Signal Resolution / Detector Sensitivity
e.g. 0.1 pA / 3 nA / ( mW / cm² ) = 0.33 nW / cm²
**Maximum Signal** = Max Meter Signal Current / Detector Sensitivity
e.g. 20 µA / 3 nA / ( mW / cm² ) = 6.66 W / cm²

## Illuminance E



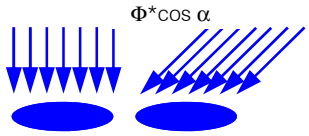
Illuminance refers to the luminous flux per unit area impinging on a particular surface from one or more sources of light. Illuminance is measured horizontally and vertically in the units of lux (lx) or footcandles (fc). When the incident light is not parallel, which in practice is normal, a cosine diffuser must be used as the measurement geometry for "lux detector heads".

lx = lm / m²
fc = lm / ft²

## Irradiance E

Irradiance refers to the radiant power impinging on a particular surface from one or more sources of optical radiation. Irradiance is measured horizontally and vertically in the units of watts per square meter (W/m²).
When the incident optical radiation is not parallel, which in practice is normal, a cosine diffuser must be used to correct the measurement geometry for irradiance detector heads.

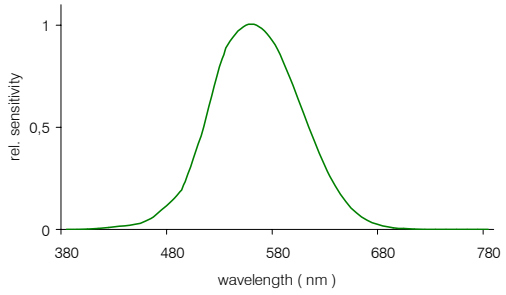
## Cosine Corrected Field of View




Each optical radiation quantity calls for its own measurement geometry for the proper reception of the radiation. Illuminance and irradiance measurement systems require a cosine corrected field of view. Only then can the laws for the incidence of diffuse radiation from one or more sources be satisfied.
If the incident radiation is not parallel, the accuracy of the cosine function is critically important to the result of the measurement.

## VL-1101: Compact Size Illuminance Detector

VL-1101 with UPB-50-L




Photopic Spectral Response

**The VL-1101** detector offers a compact package with flange mount that allows arrangement of discrete linear arrays (11 mm grid size) to measure the luminous intensity distribution of spot lamps.
The detector can be combined with integrating spheres with 11-type adapter for luminous flux measurements.
Calibration is offered with or without accessory.

| Ordering Information & typical Specifications | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Model** | λresp InGaAs | $f_1$ | Typical Sensitivity | Imax | Sensing Area | cable | Temp. | plug | package |
| | | ≤ % | nA/lx | mA | photodiode | m | °C | | page |
| **VL-1101** | V(λ) | 5 | 0.3 | 1 | 1.1 mm Ø | 2 | 5 - 40 | 1,2,4 | 90 |
| **K-VL1101-I** | Calibration of the illuminance sensitivity in lx or fc. Including K-SR in order with new detector | | | | | | | | |
| **KDW-S** | Calibration of the spectral sensitivity in combination with accessory | | | | | | | | |
| **KDW-P** | Calibration of the integral photometric sensitivity in combination with accessory | | | | | | | | |

## VL-3701, VL-3702, VL-3704 & VL-3705: Photopic & Scotopic Illuminance Detectors

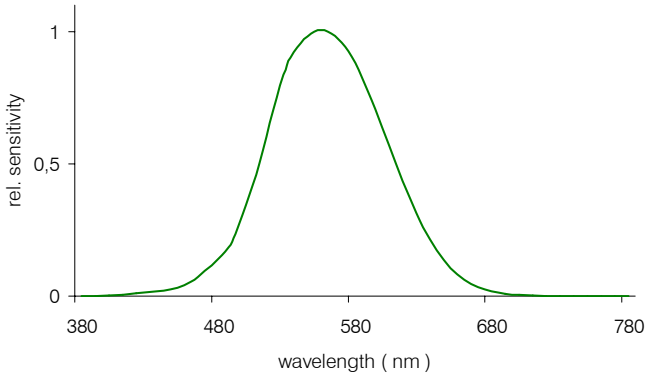
Illuminance is one of the most important measurements in the field of commercial or industrial lighting. It enables us to see things properly and comfortably.
Illuminance detector's spectral responsiveness must be equal the photopic vision characteristic V(λ), as defined by the CIE. The very best matching of the detector spectral response to the photopic vision function is necessary especially if the measurements involve different kinds of light sources such as daylight, tungsten, fluorescent lamps, LED's etc.
Illuminance detectors require a cosine field-of-view characteristic. This spatial response properly 'weights' the effects of the illumination reaching the detector from different angles of incidence. The accuracy of the cosine correction is as equally important as the photometric responsivity for illuminance detectors.
The height of the detector is an other important factor, since the illuminance should be measured close to the subject surface. To measure the ANSI Lumen rating of projectors a max. height of 20 mm is specified.

Gigahertz-Optik

# Illuminance

## VL-3701: Photopic with DIN Class A Parameters

The VL-3701 is a high quality detector for the measurement of illuminance. Its specifications satisfy the requirements for lux detector heads according to DIN 5032 Part 7.
The VL-3701's spectral adaptation to the V(λ) function for daylight vision is better than 3%. The precise adaptation of its spectral sensitivity to the ideal V(λ) function makes this detector head appropriate where sharply different spectra need to be measured (arc lamps, color monitors, LEDs, etc.). The deviation from the cosine function is < 1.5 %.
The low detector profile of 20 mm allows its use in applications where the height of the detectors surface over the illuminated surface is restricted.
Calibration of the illuminance, in lux or fc is performed at Gigahertz-Optik's Calibration Laboratory for Optical Radiation Quantities, and is supported by a factory certificate.




Photopic Spectral Response

## VL-3702: Photopic with DIN Class B Parameters

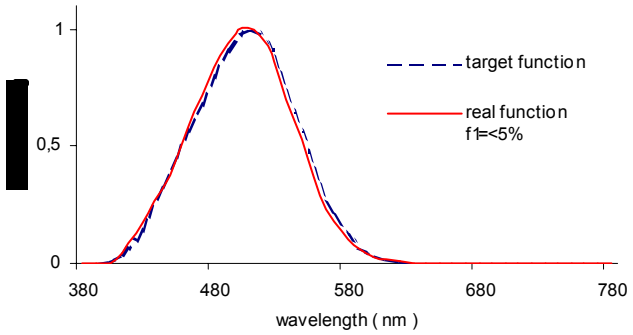
The VL-3702 detector is constructed the same as the VL-3701 model, but has a lower precision of photometric adaptation, at 6 %, sufficient for DIN quality class B, and a maximum deviation of 3 % from the cosine function. Available versions and calibration are the same as model VL-3701.

## VL-3704: Photopic with DIN Class B Parameters

The VL-3704 detector specifications are equal to that of the VL-3702 detector except that it is less sensitive. This allows the VL-3704 detector to be used with optometers like the X11, X91 and P-9802 with amplifiers having a limited signal range.

## VL-3705: Scotopic

The spectral response of the human eye changes with light intensity. In daylight conditions >0.1 lx the photopic action spectrum applies. In low brightness applications 0.01 to 0.0001 lx the spectral eye response changes to the scotopic (dark adapted) action spectrum. Light intensities below 0.0001 lx can not be detected by the human eye.
The VL-3705 detector offers a precise scotopic spectral match with an $f_1$ =< 5%. This is within DIN class B specifications qualifying the VL-3705 for use in most low light level application.




Scotopic Spectral Response

| Ordering Information & typical Specifications | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Model** | λresp | $f_1$ | Typical Sensitivity | | Imax | Sensing Area | cable | Operation | plug | package |
| | | ≤ % | nA/lx | nA/fc | mA | Diffuser | m | Temp. | | page |
| **VL-3701** | V(λ) | 3 | 0.5 | 5 | 1 | 7 mm Ø | 2 | 5 - 40 | 1,2,4 | 90 |
| **VL-3702** | V(λ) | 5 | 0.5 | 5 | 1 | 7 mm Ø | 2 | 5 - 40 | 1,2,4 | 90 |
| **VL-3704** | V(λ) | 5 | 20 pA/lx | 200 pA/fc | 1 | 7 mm Ø | 2 | 5 - 40 | 4 | 90 |
| **VL-3705** | V'(λ) | 5 | 0.5 | 5 | 1 | 7 mm Ø | 2 | 5 - 40 | 1,2,4 | 90 |
| **K-VL37xx-I** | Calibration of illuminance sensitivity in lx or fc. Including K-SR with new detector order. xx = model number | | | | | | | | | |
| **KDW-S** | Calibration of spectral sensitivity with accessory components | | | | | | | | | |
| **KDW-P** | Calibration of integral photometric sensitivity in combination with accessory | | | | | | | | | |
| **K-FOV** | Calibration of cosine field of view function. Included with new detector order | | | | | | | | | |

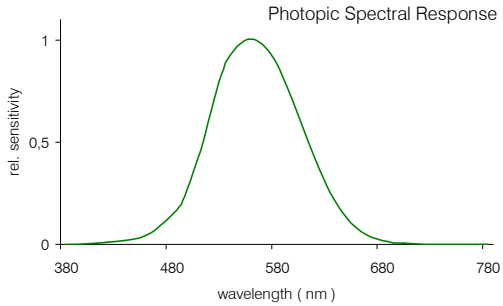
| VL-37xx Illuminance Detectors comparison DIN 5032 Class Limits (%) | | | | | | |
|---|---|---|---|---|---|---|
| **Characteristic** | **Symbol** | **DIN 5032 Class A** | **DIN 5032 Class B** | **VL-3701** | **VL-3702** | **VL-3704** |
| Calibration Uncertainty | $U_{kal}$ | 1.5 | 3 | 1.1 | 1.1 | 1.1 |
| V(λ) Match Characteristic | $f_1$ | 3 | 6 | 3 | 5 | 5 |
| UV Response Characteristic | u | 1 | 2 | 0.01 | 0.01 | 0.01 |
| IR Response Characteristic | r | 1 | 2 | 0.01 | 0.01 | 0.01 |
| Directional Response (Cosine) | $f_2$ | 1.5 | 3 | 1.5 | 3 | 3 |
| Linearity Characteristic | $f_3$ | 1 | 2 | 0.2 | 0.2 | 0.2 |
| Fatigue Characteristic (at 1 klx) | $f_5$ | 0.5 | 1 | 0.1 | 0.1 | 0.1 |
| Temperature Dependence Characterist. | $f_6$ | 2 | 10 | 1 | 1 | 1 |

## Accessories:

Mating SRT-M37 front lens adapters allow VL-37 detectors to be adapted for luminance measurements. See page 89 for specifications.

VL-37 detectors can be combined with integrating spheres for luminous flux measurements. See integrating sphere chapter .

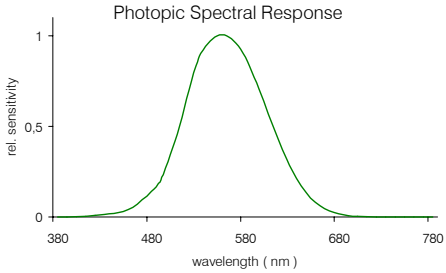
## PD-9310: High Sensitivity Photopic Illuminance Detector




**The PD-9310** detector offers a large 30 mm diameter diffuser window combined with a large 100 mm² area photodiode. It's high sensitivity makes this detector ideal for all applications in which very low light levels needs to be measured.
The detector can be combined with the PD-93 modular detector accessories and with integrating spheres with 37-type adapters.
Calibrations are offered with or without accessory.

| Ordering Information & typical Specifications | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Model** | λresp | $f_1$ | Typical Sensitivity | Imax | Sensing Area | cable | Operation Temp. | plug | package |
| | | ≤ % | nA/lx | mA | Diffuser | m | | | page |
| **PD-9310A** | V(λ) | 3 | 2.8 | 1 | 30 mm Ø | 2 | 5-40 °C | 1,2,4 | 91 |
| **PD-9310B** | V(λ) | 6 | 2.8 | 1 | 30 mm Ø | 2 | 5-40 °C | 1,2,4 | 91 |
| **K-PD9310-I** | Calibration of the photometric sensitivity in lx or fc. Including K-SR in order with new detector | | | | | | | | |
| **KDW-S** | Calibration of the spectral sensitivity in combination with accessory | | | | | | | | |
| **KDW-P** | Calibration of the integral photometric sensitivity in combination with accessory | | | | | | | | |

## TD-11VL01: Temperature Controlled Illuminance Detector



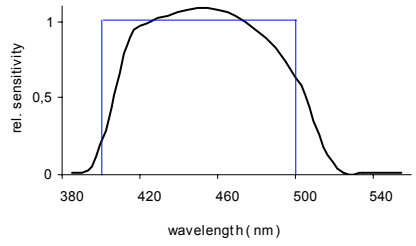

TD-11VL-01 with UMB

**The TD-11VL01** detector offers a unique temperature control for filter and photodiode by precise heating to a higher operation temperature than the ambient temperature. The control electronic is supplied in an external housing with plug-in power supply. The detector can be combined with integrating spheres with 11-type adapter for luminous flux measurements.
Calibrations are offered with or without accessory.

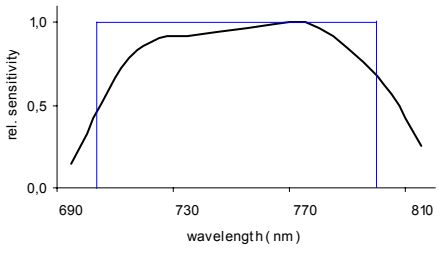
| Ordering Information & typical Specifications | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Model** | λresp | $f_1$ | Typical Sensitivity | Imax | Sensing Area | cable | Operation Temp. | plug | package |
| | | ≤ % | nA/lx | mA | photodiode | m | | | page |
| **TD-11VL01** | V(λ) | 5 | tbc with sphere | 1 | 2.77 mm x 2.77 mm | 2 | 55°C | 1,2,4 | 90 |
| **K-TD11VL01-I** | Calibration of the photometric sensitivity in lx or fc. Including K-SR in order with new detector | | | | | | | | |
| **KDW-S** | Calibration of the spectral sensitivity in combination with accessory | | | | | | | | |
| **KDW-P** | Calibration of the integral photometric sensitivity in combination with accessory | | | | | | | | |

## *VISIBLE-NIR* Polychromatic Radiometric Light Detectors

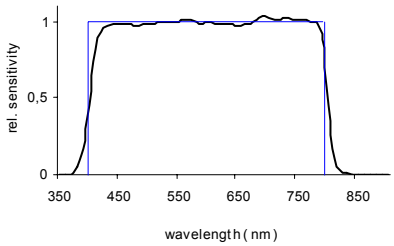
Polychromatic radiometric detectors are primarily used for integral intensity measurements in a defined range of wavelengths. Correction filters are used to shape the bare detector response to the desired bandpass function, and ensure a radiometric responsiveness function.
The plots below and on the following page summarizes the standard measurement heads offered with correction filters and spectral responses. Customer-specific solutions with respect to spectral range, measurement geometry and other design features are available along with full assistance from our sales engineers.




**RW-01** ***BLUE***$_{400\text{-}500\ nm}$ Spectral Response




**RW-02** ***RED***$_{700\text{-}800\ nm}$ Spectral Response

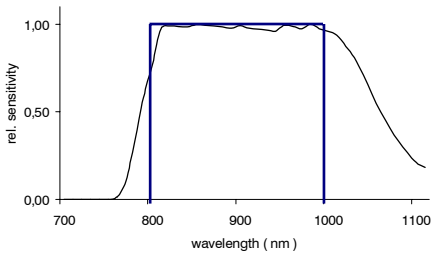



**RW-03** ***VISIBLE***$_{400\text{-}800\ nm}$ Spectral Response

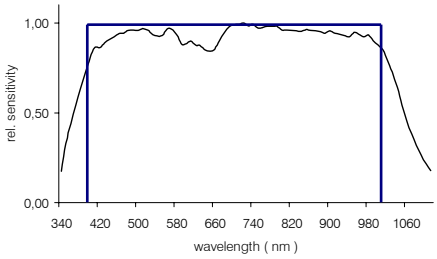
Gigahertz-Optik

# Irradiance

## *VISIBLE-NIR* Polychromatic Radiometric Light Detectors




**RW-04 *NIR*$_{800\text{-}1000\ nm}$** Spectral Response




**RW-05 *VISNIR*$_{400\text{-}1000\ nm}$** Spectral Response

## RW-11: Compact Size *VISIBLE-NIR* Polychromatic Radiometric Detectors

**The RW-11** detectors offer a compact package with flange mount which allows arrangement of discrete linear arrays with a grid of 11 mm to measure the radiant intensity distribution of light sources.
The detector can be combined with integrating spheres with 11-type adapter for radiant power measurements.
Calibrations are offered with or without accessory.

RW-11 assembled to UM series sphere

| Ordering Information & typical Specifications | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Model** | λresp | Response | Typical Sensitivity | | Imax | Sensing Area | cable | Operation Temp. | plug | package |
| | polychromatic | Page | nA/W/m² | nA/W | mA | photodiode | m | | | page |
| **RW-1103** | VISIBLE$_{400\text{-}800\ nm}$ | 65 | tbc with sphere | | 1 | 1.1 x 1.1 mm | 2 | 5-40 °C | 1,2,4 | 90 |
| **RW-1104** | NIR$_{800\text{-}1000\ nm}$ | 66 | | | 1 | 1.1 x 1.1 mm | 2 | 5-40 °C | 1,2,4 | 90 |
| **RW-1105** | VISNIR$_{400\text{-}1000\ nm}$ | 66 | | | 1 | 1.1 x 1.1 mm | 2 | 5-40 °C | 1,2,4 | 90 |
| **K-RW11xx-I** | Calibration of the irradiance sensitivity in A/W/m² and A/W/cm². Including K-SR in order with new detector. xx = detector model | | | | | | | | | |
| **KDW-S2** | Calibration of the spectral irradiance sensitivity at one or a chain of wavelength without or in combination with accessory | | | | | | | | | |
| **KDW-R** | Calibration of the integral radiometric sensitivity in combination with accessory | | | | | | | | | |

## TD-11RW: Temperature Controlled *VISIBLE-NIR* Polychromatic Radiometric Light Detectors

**The TD-11RW** detectors offers a unique temperature control for filter and photodiode by precise heating to a higher operation temperature than the ambient temperature.
The control electronic is supplied in an external housing with plug-in power supply.

The detector can be combined with integrating spheres with 11-type adapter for radiant power measurements.
Three different kinds of spectral responses e.g. TD-11RW03, TD-11RW04 and TD-11RW05 are offered which fulfill the need of most radiometric applications for integral detectors.
Calibrations are offered with or without accessory.

| Ordering Information & typical Specifications | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Model** | λresp | Response | Typical Sensitivity | | Imax | Sensing Area | cable | Operation Temp. | plug | package |
| | polychromatic | Page | nA/W/m² | nA/W | mA | photodiode | m | | | page |
| **TD-11RW03** | VISIBLE$_{400\text{-}800\ nm}$ | 65 | tbc with sphere | | 1 | 2.8 x 2.8 mm | 2 | 55°C | 1,2,4 | 90 |
| **TD-11RW04** | NIR$_{800\text{-}1000\ nm}$ | 66 | | | 1 | 2.8 x 2.8 mm | 2 | 55°C | 1,2,4 | 90 |
| **TD-11RW05** | VISNIR$_{400\text{-}1000\ nm}$ | 66 | | | 1 | 2.8 x 2.8 mm | 2 | 55°C | 1,2,4 | 90 |
| **K-TD-11RWxx-I** | Calibration of the irradiance sensitivity in A/W/m² and A/W/cm². Including K-SR in order with new detector | | | | | | | | | |
| **KDW-S** | Calibration of the spectral sensitivity in combination with accessory | | | | | | | | | |
| **KDW-R** | Calibration of the integral radiometric sensitivity in combination with accessory | | | | | | | | | |

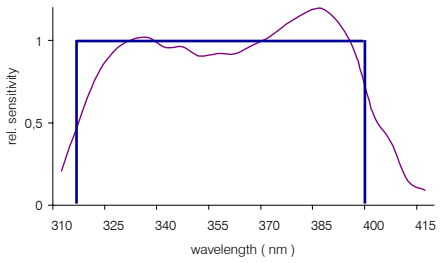
## RW-37: High Sensitivity *VISIBLE-NIR* Broadband Irradiance Detectors

**The RW-37** irradiance detectors are for use in radiometric applications requiring high sensitivity. The diffuser window offers a cosine corrected field-of-view. The compact 37-type package fits into tight spaces in end-on viewing set-up. A side M6 tapped hole allows post mounting or fixturing into the application.
The detector can mounted to integrating spheres using 37-type adapters and calibrated for radiant power measurements. See Integrating Spheres chapter.
For simple radiometric radiance measurements the RW-37 detectors can be combined and calibrated with SRT-M37 front lenses. Calibrations are offered with or without components attached.

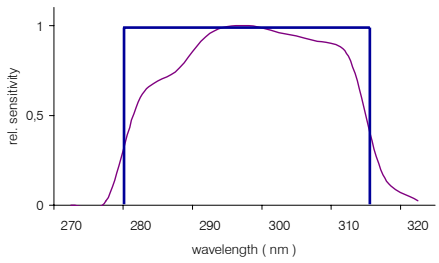
| Ordering Information & typical Specifications | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Model** | λresp | Response | Typical Sensitivity | | Imax | Sensing Area | cable | Temp. °C | plug | package |
| | Broadband | Page | nA/W/m² | mA/W/cm² | mA | Diffuser | m | | | page |
| **RW-3701** | BLUE 400-500 nm | 65 | 70 | 0.7 | 1 | 11 mm Ø | 2 | 5-40 | 1,2,4 | 90 |
| **RW-3702** | RED 700-800 nm | 65 | 70 | 0.7 | 1 | 11 mm Ø | 2 | 5-40 | 1,2,4 | 90 |
| **RW-3703** | VISIBLE 400-800 nm | 65 | 1.7 | 0.017 | 1 | 11 mm Ø | 2 | 5-40 | 1,2,4 | 90 |
| **RW-3704** | NIR 800-1000 nm | 66 | 200 | 2 | 1 | 11 mm Ø | 2 | 5-40 | 1,2,4 | 90 |
| **RW-3705** | VISNIR 400-1000 nm | 66 | 400 | 4 | 1 | 11 mm Ø | 2 | 5-40 | 1,2,4 | 90 |
| **K-RW37xx-I** | Calibration of radiometric sensitivity in A/W/m² and A/W/cm². Includes K-SR in new detector order. xx = detector model | | | | | | | | | |
| **KDW-S** | Calibration of spectral sensitivity at one or multiple wavelengths without or in combination with accessory components | | | | | | | | | |
| **KDW-R** | Calibration of integral radiometric sensitivity in combination with accessory components. | | | | | | | | | |

## *ULTRAVIOLET* Polychromatic Irradiance Light Detectors

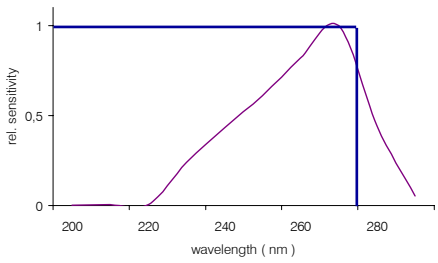
*ULTRAVIOLET* broadband radiometric detectors are primarily used for integral intensity measurements in defined UV band pass ranges of wavelengths. Correction filters are used to shape the bare detector response to the desired spectral response.
The plots below and on the following page summarize the standard measurement heads offered with correction filters and spectral responses. Customer-specific solutions with respect to spectral range, measurement geometry and other design features are available along with full assistance from our sales engineers.



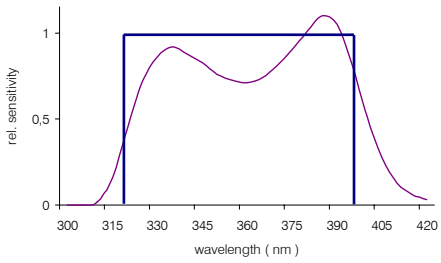

**UV-01 Spectral Response: UV-A 315-400 nm**



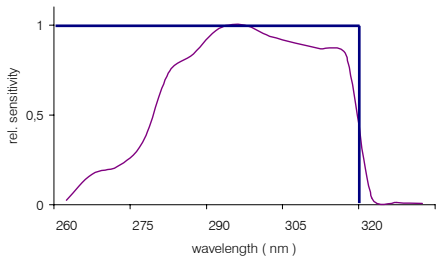

**UV-02 Spectral Response: UV-B 280-315 nm**



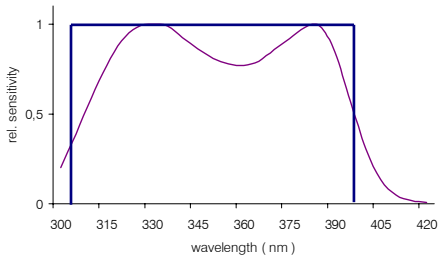

**UV-03 Spectral Response: UV-C 200/250-280 nm**




**UV-10 Spectral Response: UV-A 320-400 nm**



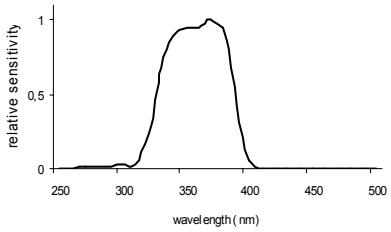

**UV-11 Spectral Response: UV-B 280-320 nm**



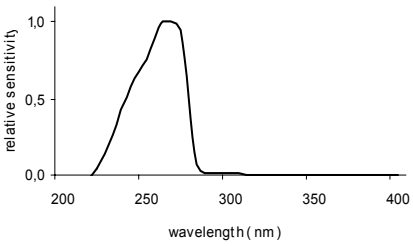

**UV-16 Spectral Response: UV-A 305-400 nm**

# Irradiance

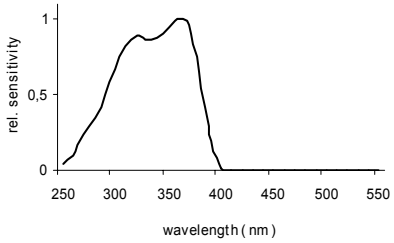
## *ULTRAVIOLET* Broadband Irradiance Detectors




**UV-17 Spectral Response: UV-A $_{320\text{-}400\ nm}$**




**UV-18 Spectral Response: UV-C $_{254\ nm\ peak}$**




**UV-19 Spectral Response: UV-Broad-band**

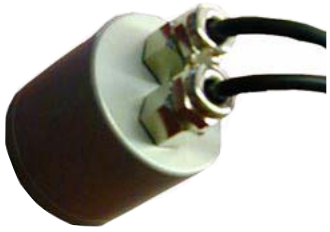
## UV-11: Compact Size UV Broadband Irradiance Detectors

**UV-A/UV-B** are the most frequently used wavelength ranges in the qualification procedure of light sources used in photobiological and industrial application. Besides standard narrow band detectors, Gigahertz-Optik offers real broadband detectors.
**The UV-11** detectors offer a compact package with flange mount to arrange detector arrays with only a grid size of 11 mm. Or they can be combined with integrating spheres using 11-type adapters for radiant power measurements.
Calibrations are offered with or without accessory components.

| **Ordering Information & typical Specifications** | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Model** | λresp | Response | Typical Sensitivity | | Imax | Sensing Area | cable | Temp. °C | plug | package |
| | Broadband | Page | nA/W/m² | nA/W | mA | photodiode | m | | | page |
| **UV-1101** | UV-A $_{315\text{-}400\ nm}$ | 67 | tbc | tbc with sphere | 0.2 | 2.5 x 2.5 mm | 2 | 5-40 | 1,2 or 4 | 90 |
| **UV-1102** | UV-B$_{280\text{-}315\ nm}$ | 67 | tbc | | 0.05 | 1.1 x 1.1 mm | 2 | 5-40 | 1,2 or 4 | 90 |
| **K-UV11xx-I** | Calibration of radiometric sensitivity in A/W/m² and A/W/cm². Includes K-SR in with new detector order. xx = detector model | | | | | | | | | |
| **KDW-S** | Calibration of spectral sensitivity at one or a chain of wavelength without or in combination with accessory components. | | | | | | | | | |
| **KDW-R** | Calibration of integral radiometric sensitivity with accessory components | | | | | | | | | |

## TD-11UV: Temperature Controlled UV Broadband Radiometric Detectors

**The TD-11UV** detectors offer a unique temperature control feature where the filter and photodiode are heated to a higher operating temperature than the ambient temperature.
The control electronics are supplied in an external housing with a plug-in power supply.
The detector can be combined with integrating spheres with 11-type adapter for radiant power measurements.
Two different kinds of spectral responses, UV-A$_{315\text{-}400\ nm}$ and UV-B$_{280\text{-}315\ nm}$ are offered which fulfill the need of most radiometric applications for integral detectors.
Calibrations are offered with or without accessory components.



| **Ordering Information & typical Specifications** | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Model** | λresp | Response | Typical Sensitivity | | Imax | Sensing Area | cable | Operation Temp. | plug | package |
| | Broadband | Page | nA/W/m² | nA/W | mA | photodiode | m | | | page |
| **TD-11UV01** | UV-A $_{315\text{-}400\ nm}$ | 67 | tbc | tbc with sphere | 0.2 | 2.5 x 2.5 mm | 2 | 55°C | 1,2,4 | 90 |
| **TD-11UV02** | UV-B$_{280\text{-}315\ nm}$ | 67 | tbc | | 0.05 | 1.1 x 1.1 mm | 2 | 55°C | 1,2,4 | 90 |
| **K-TD11UVxx-I** | Calibration of radiometric sensitivity in A/W/m² and A/W/cm². Includes K-SR in new detector order. xx = detector | | | | | | | | | |
| **KDW-S** | Calibration of spectral sensitivity at one or multiple wavelengths without or in combination with accessory components | | | | | | | | | |
| **KDW-R** | Calibration of integral radiometric sensitivity with accessory components | | | | | | | | | |

## UV-37: High Sensitivity Broadband UV Irradiance Detectors

### UV-3701, UV-3702, UV-3703

These detectors represents the classic DIN and CIE ultraviolet radiation wavelength bands UV-$A_{315\text{-}400\ nm}$, UV-$B_{280\text{-}315\ nm}$ and UV-$C_{100\text{-}280\ nm}$. Deep UV in the range of 100 to 250 nm is very rarely observed in radiometry. So the UV-3703 offers a practical UV-C solution with a sensitivity range from 250 to 280 nm.

### UV-3710, UV-3711

Some non-biological disciplines specify the wavelength ranges 320 to 400 and 280 to 320 nm for the evaluation of UV-A and UV-B radiation. The UV-3701 and UV-3702 irradiance detectors are designed for this application.

### UV-3716

The sharply increasing short-wave spectral component of modern lamps creates a potential risk of exposure of the eyes to excessive UV-A radiation. The limit values for $E_{305–400\ nm}$ irradiance were established to limit the intensity this radiation on the retina as when optical fibers are used in eye operations (aphakic eye operation).

### UV-3717

In applications where the UV-A irradiance must measured amidst intense blue & visible light, the UV-3701 and UV-3710 may not offer sufficient visible wavelength range signal rejection. This will produce an inaccurately high UV-A reading. A good example of this is fluorescent lamps which generate significant mercury lines at 405, 436, 546 and 577 nm. The UV-3717 is visible blind for best stray light rejection >400 nm..


### UV-3718

The model UV-3718 is designed for narrow band UV-light sources with distinct 254 nm peak emission spectrum. The RADIN type diffuser offers high UV stability under UV-C irradiation. The detector is calibrated with a narrow band light source at 254 nm.

### UV-3719

The model UV-3719 offers a broadband spectral sensitivity from 250 to 390 nm. This detector is typically used in applications where the lamp emission spectrum is known allowing an a (z) calibration correction.

### UV-37

The UV-37 detectors are high sensitivity irradiance detectors for radiometric applications involging polychromatic optical radiation. The diffuser window provides a cosine corrected field-of-view for diffuse light signals. The compact 37-type package fits into tight spaces with a vertical end-on view. An M6 tapped hole allows post mounting or fixturing in the application. The detectors can be combined and calibrated with integrating spheres or SRT-M37 quartz front lenses.

**Ordering Information & typical Specifications**

| Model | λresp | Response | Typical Sensitivity | | Imax | Sensing Area | cable | Temp. °C | plug | package |
|---|---|---|---|---|---|---|---|---|---|---|
| | Broadband | Page | nA/W/m² | μA/W/cm² | mA | Diffuser | m | | | page |
| **UV-3701** | UV-A 315-400 nm | 67 | 4 | 40 | 0.1 | 11 mm Ø | 2 | 5-40 | 1,2 or 4 | 90 |
| **UV-3702** | UV-B 280-315 nm | 67 | 1.7 | 17 | 0.05 | 11 mm Ø | 2 | 5-40 | 1,2 or 4 | 90 |
| **UV-3703** | UV-C 200/250-280 nm | 67 | 2 | 20 | 0.05 | 11 mm Ø | 2 | 5-40 | 1,2 or 4 | 90 |
| **UV-3710** | UV-A 320-400 nm | 67 | 7 | 70 | 0.1 | 11 mm Ø | 2 | 5-40 | 1,2 or 4 | 90 |
| **UV-3711** | UV-B 280-320 nm | 67 | 3 | 30 | 0.05 | 11 mm Ø | 2 | 5-40 | 1,2 or 4 | 90 |
| **UV-3716** | UV-A 305-400 nm | 67 | 10 | 100 | 0.1 | 11 mm Ø | 2 | 5-40 | 1,2 or 4 | 90 |
| **UV-3717** | UV-A 325-400 nm | 68 | 1 | 10 | 0.1 | 11 mm Ø | 2 | 5-40 | 1,2 or 4 | 90 |
| **UV-3718** | UV-C 254 nm | 68 | 2 | 20 | 0.05 | 11 mm Ø | 2 | 5-40 | 1,2 or 4 | 90 |
| **UV-3719** | UV-A 250-400 nm | 68 | 3 | 30 | 0.1 | 11 mm Ø | 2 | 5-40 | 1,2 or 4 | 90 |
| **K-UV37xx-I** | Calibration of radiometric sensitivity in A/W/m² and A/W/cm². Includes K-SR in new detector order. xx = detector model | | | | | | | | | |
| **KDW-S2** | Calibration of spectral irradiance sensitivity at one or multiple wavelengths without or in combination with accessory components | | | | | | | | | |
| **KDW-R** | Calibration of radiometric sensitivity with accessory components | | | | | | | | | |

## UV-37: High Sensitivity Photobiologically Actinic UV Irradiance Detectors

Photobiology is concerned with the interaction of optical radiation and living organisms. Photobiological radiometric measurement systems are essential tools used for the evaluation of sources of optical radiation in cosmetics, medical and therapeutic, health and safety and other areas. The photodetectors used in these various application areas require spectral sensitivities corresponding directly to a particular photobiological response function. This enables direct measurement of the photobiological dose of a radiation source.

The spectral response function of the sensor is generated by optical correction filters used to tailor the bare detector response. Since the ideal target function cannot be perfectly duplicated, it is necessary to find the best possible compromise through extensive computer simulation taking a great variety of lamp spectra into account to minimize error. The associated series of measurements, which are an essential part of this engineering process, are carried out at Gigahertz-Optik's Calibration Laboratory for Optical Radiation Quantities.

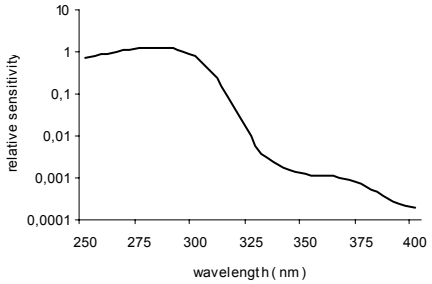
On the following page, irradiance light detectors available from Gigahertz-Optik that are primarily intended for applications in the fields of radiation protection and of radiation therapy are presented. For a specific response function not shown, or if you should require more detailed information, please contact our technical sales department directly.

Gigahertz-Optik

# Actinic Irradiance

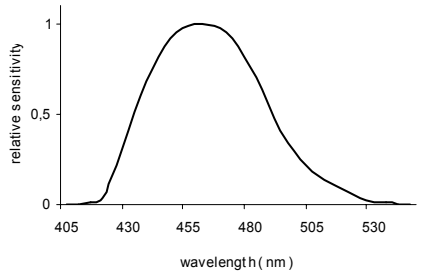
## UV-3704: UV-Erythemal Actinic Irradiance Detector

The typical symptom of UV erythema is acute skin inflammation caused by UV radiation (sunburn) which has been linked to skin cancer over prolonged exposure times.
The UV-3704 detector permits direct measurement of the UV Erythema effective irradiance by means of it's spectral sensitivity adaptation to the nominal CIE Erythemal spectral function.
Measurement uncertainty can be evaluated and reduced using Gigahertz-Optik's a(z) method when the lamp emission spectra is known with dataset provided.



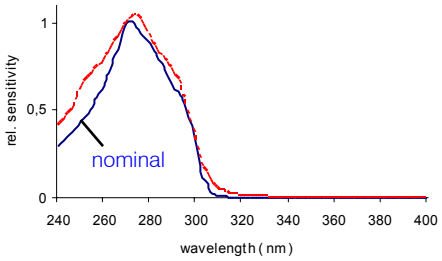

## UV-3706: Bilirubin Actinic Irradiance Detector

Newborn jaundice or neonatal hyperbilirubinaemia, a yellowish appearance of the skin and whites of the eyes, is present to some degree in almost all newborn infants. This is caused by an elevated level of bilirubin molecule in the blood which results from immaturity of the liver function combined with the destruction of red blood cells present. When these levels are very high, one method of clearing the jaundice is by exposing the newborn to light in the blue spectral region between 400 to 550 nm.
The UV-3706 detector allows the direct measurement of phototherapeutically effective irradiance employed for lowering the bilirubin level in newborn infants.



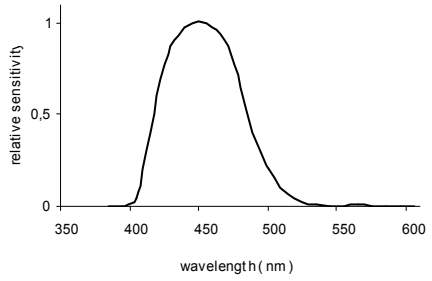

## UV-3708: ACGIH/ICNIRP Actinic Irradiance Detector

The spectral weighting function for the acutely harmful effects of UV radiation, was developed by the *American Conference of Governmental Industrial Hygienists (ACGIH) and* the *International Commission on Non-Ionising Radiation Protection (ICNIRP).*
*T*he spectral effectiveness in the UV-C and UV-B ranges is very high as compared to the UV-A range.
The UV-3708 detector permits direct measurement of effective irradiance according to ACGIH/ICNIRP guidelines.
Measurement uncertainty can be evaluated and reduced using Gigahertz-Optik's a(z) method when the lamp emission spectra is known with dataset provided.




## UV-3709: Blue-Light Hazard Actinic Irradiance Detector

If optical radiation in the wavelength range between 380 and 550 nm of sufficient intensity reaches the retina it can cause photochemical injury. Radiation in the "blue" part of the spectrum triggers photochemical reactions, if the photon energy in the radiation is high enough, converting chemically unstable molecules into one or more other molecule types. BLH irradiance is relevant exclusively in connection with ophthalmic instruments (microscopes, observation devices used in optician's practices). Otherwise the measurement of radiance applies.
The UV-3709 detector head is designed for direct measurement of the effective irradiance for blue light hazard, responsible for retinal damage.




**Ordering Information & Specifications**

| Model | λresp | Wavelength Range | Typical Sensitivity | | Imax | Sensing Area | cable | Temp. °C | plug | package |
|---|---|---|---|---|---|---|---|---|---|---|
| | Biological Effective | | nA/W/m² | µA/W/cm² | mA | Diffuser | m | | | page |
| **UV-3704** | Erythema | 250-400 nm | 3 | 30 | 0.05 | 11 mm Ø | 2 | 5-40 | 1, 2, 4 | 90 |
| **UV-3706** | Billirubin | 400-550 nm | 200 | 2000 | 1 | 11 mm Ø | 2 | 5-40 | 1, 2, 4 | 90 |
| **UV-3708** | ACGIH/ICNIRP | 250-400 nm | 1,5 | 15 | 0.05 | 11 mm Ø | 2 | 5-40 | 1, 2, 4 | 90 |
| **UV-3709** | Blue-light Hazard | 400-520 nm | 150 | 15000 | 1 | 11 mm Ø | 2 | 5-40 | 1, 2, 4 | 90 |
| **K-UV37xx-I** | Calibration of actinic irradiance sensitivity in A/W/m² and A/W/cm². Includes K-SR in new detector order. xx = detector | | | | | | | | | |
| **KDW-S** | Calibration of spectral sensitivity with accessory components | | | | | | | | | |
| **KDW-R** | Calibration of radiometric sensitivity with accessory components | | | | | | | | | |

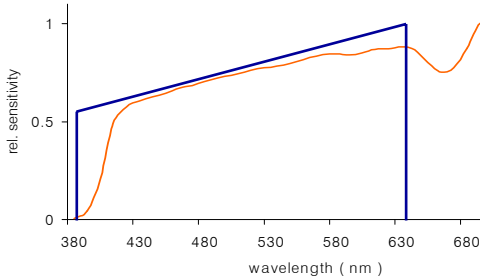
## PS-37: Plant Physiology Actinic Irradiance Detectors

The radiation conditions used in determining the rate of photosynthesis and the photosynthetic potential of various plant or algae types are not the same in all research institutions. Results obtained under very different radiation conditions, using detector heads with non-uniform rectangular (radiometric) characteristics, and then relating them to one another, may lead to false conclusions. This is because the varying spectra of the radiation sources in use are ignored in obtaining the measurement.
The solution is to evaluate the irradiance with a sensor with an appropriate spectral response function. It is presently assumed that the number of light quanta absorbed is responsible for plant growth, which implies that it is quantum magnitudes effective in plant biology that need to be measured. The most important magnitude is the photosynthetic photon irradiance $E_{p,sy}$.
The wavelength limits of integration band pass need to be specified. If, for example, the photosynthetic photon irradiance is to be measured in the range of wavelengths between 400 nm and 700 nm, 320 nm and 500 nm and 590 nm to 900 nm, the integration is carried out in the corresponding spectral segments.
This numerical integration can be performed implicitly by means of a cosine corrected integral detector such as the PS-37 series.

*Waterproof version of the PS-37 type detector head with dome cover*

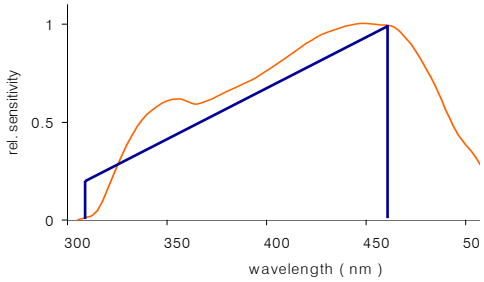
## PS-3701: PAR Irradiance Detector

**Photosynthesis** is one of the most important biochemical processes on the planet. In the process of photosynthesis green plants absorb carbon dioxide from the atmosphere and water from the soil, combining them with the aid of radiation energy to build sugar, releasing oxygen and water into the atmosphere.
In general plant physiology, the term **P**hotosynthetically **A**ctive **R**adiation (**PAR**) refers to the radiation in the range of wavelengths between 400 nm and 720 nm.
The PS-3701 detector is designed for direct evaluation of **P**hotosynthetically **A**ctive **R**adiation in the 400 to 700 nm wavelength range. This detector can also be supplied with an optional water proof dome cover.



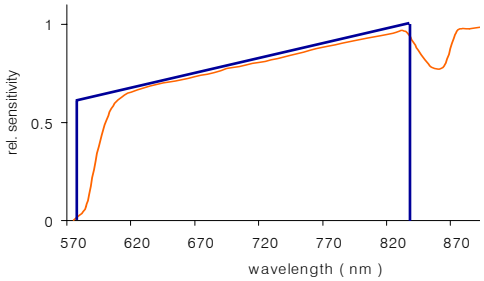

## PS-3702: BLUE$_{320\text{-}500\ nm}$ Plant Physiology Irradiance Detector

**Phototropism** describes the effect of optical radiation on the direction of plant growth. The regions of maximum effect lie in the blue range between 380 nm and 520 nm. Radiation can have the effect of causing parts of plants to move.
The PS-3702 detector is designed for direct evaluation of the **phototropism** effective irradiation over the spectral range from 320 to 500 nm for UV-A to green/visible assessment.
This detector can also be supplied with an optional water proof dome cover.




## PS-3703: RED$_{560\text{-}900\ nm}$ Plant Physiology Irradiance Detector

**Photomorphogenesis** describes the way in which plants are formed under the influence of optical radiation. Radiation in the red region of the spectrum encourages linear growth, while blue radiation yields small, strong plants. To be more precise, the ratio of the radiation intensities in the range of wavelengths from 690 nm to 780 nm (long wavelength red) to the range of wavelengths from 560 nm to 680 nm (short wavelength red) is of great importance for the plant's biological processes. The PS-3703 detector evaluates photomorphogenesis effective radiation in the wavelength range from 590 to 900 nm.
This detector can also be supplied with an optional water proof dome cover.




**Ordering Information & typical Specifications**

| Model | λresp | Wavelength Range | Typical Sensitivity | Imax | Sensing Area | cable | Operation Temp. | plug | package |
|---|---|---|---|---|---|---|---|---|---|
| | Plant Physiology | | nA / µMol*m$^{-2}$*s$^{-1}$ | mA | Diffuser | m | | | page |
| **PS-3701** | PAR | 400-700 nm | 100 | 1 | 11 mm Ø | 2 | 5-40°C | 1, 2, 4 | 90 |
| **PS-3702** | BLUE | 320-500 nm | 2 | 1 | 11 mm Ø | 2 | 5-40°C | 1, 2, 4 | 90 |
| **PS-3703** | RED | 590-900 nm | 100 | 1 | 11 mm Ø | 2 | 5-40°C | 1, 2, 4 | 90 |
| **K-PS37xx-I** | Calibration of PAR sensitivity in A/µMol*m$^{-2}$*s$^{-1}$. Includes K-SR in new detector order. xx = detector model | | | | | | | | |
| **KDW-S** | Calibration of spectral sensitivity at one or multiple wavelengths without or in combination with accessory components | | | | | | | | |
| **KDW-R** | Calibration of integral radiometric sensitivity in combination with accessory components | | | | | | | | |

Gigahertz-Optik

## High Intensity Irradiance / UV-Curing

### High Intensity Irradiance Detectors for UV-Curing Applications

Gigahertz-Optik offers irradiance detectors specially designed for hostile ambient conditions involving high intensity irradiation and high temperature.
The detectors consist of two main components, the passive RADIN element and the detector that are connected by a flexible or rigid light guide.
The light guide protects the detector and corrective band pass filter from heat damage and also reduces measurement errors due to the temperature coefficient (drift) of the photodiode.
RADIN itself is high UV irradiation and temperature stable up to 100° C with short peak measurements to 200° C. The low profile (9 mm) RADIN sensor element permits irradiance measurement close to the sample surface of the probe and offers a cosine adapted field-of-view.
Irradiances of up to 40 W/cm$^2$ can be measured.
For spot curing applications, adapters are available for simple positioning of different size light guide nozzles in front of the RADIN sensor.

### Three Different Package Designs

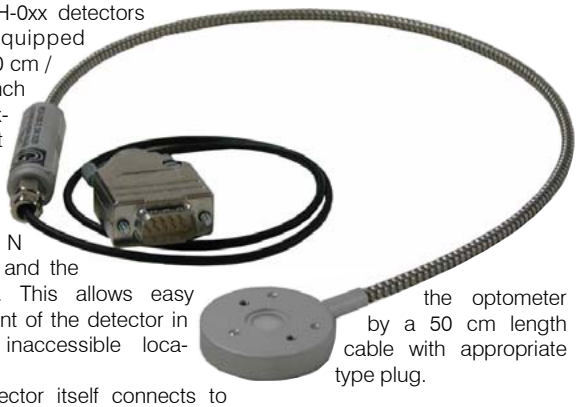
The RCH type detectors are offered in three different packages for use in the most common UV curing applications.

### Three Different Spectral Sensitivities

Detector spectral responses are available for the most common 365 nm peak UVA as well as UV broadband and BLUE ranges.

### RCH-0: Low Profile with Flexible Light Guide

The RCH-0xx detectors are equipped with a 50 cm / 20 inch long flexible light guide between the RADIN element and the detector. This allows easy placement of the detector in remote inaccessible locations.
The detector itself connects to the optometer by a 50 cm length cable with appropriate type plug.



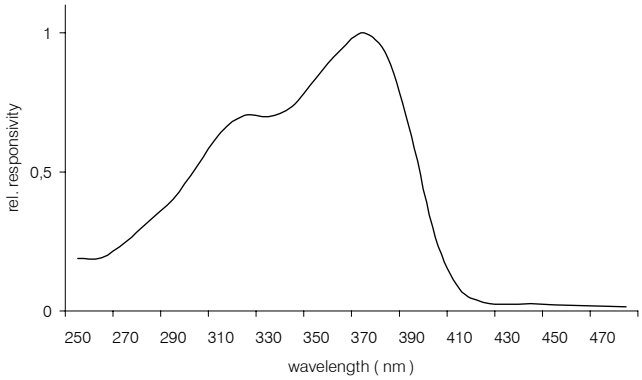
### RCH-1: Low Profile with Rigid Light Guide

The RCH-1xx detectors are supplied with a 22 cm / 8.7 inch long rigid (non-flexible) light guide between the RADIN element and the detector.
The detector is connected to the optometer by a 50 cm long cable with appropriate type plug.

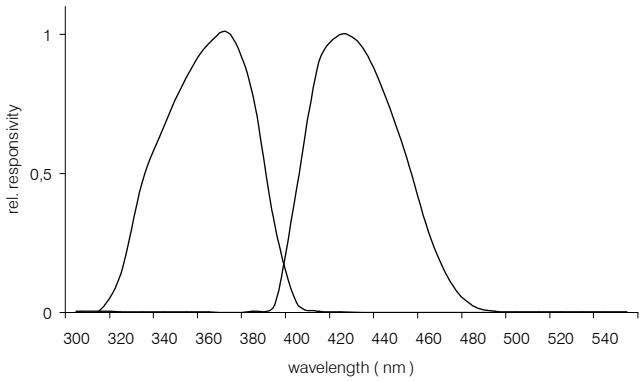
### RCH-5: In-Line Detector

The RCH-5xx detectors are designed for applications where the active detector RADIN surface must be positioned at the same height and location of the test sample surface. To accomplish this, the RADIN element is recessed in the probe housing. The sensor housing is made of stainless steel to avoid any temperature problems. The detector connects to the meter via a 2 m long cable with appropriate plug. type .

### 06: UV Broadband Sensitivity




### 08/09: UVA 365 nm Peak & BLUE Sensitivity





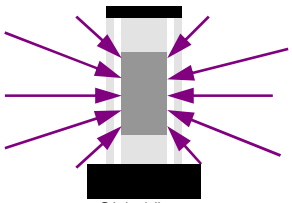
***X9 2 with RCH-1xx*** *detector and light-guide adapter. Specifications and description in chapter Optometer*

## RCH-1xx, RCH-1xx & RCH-5xx: High Intensity Irradiance Detectors

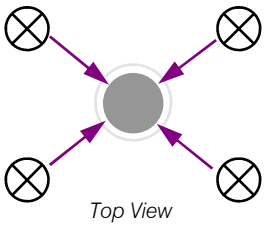
| Ordering Information & typical Specifications | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Model** | λresp | Resp. | Max. E & T | | Typ. Sensitivity | Imax | Sensing Area | Light Guide | cable | Front adapter | | plug | package |
| | Broadband | Page | W/cm² | °C | nA/mW/cm² | mA | Diffuser | cm / inch | m | Dia. | Page | | page |
| **RCH-006** | UV Broadband | 14 | 40 | 100 | 0.3 | 0.1 | 9 mm Ø | 50 / 20 | 0.5 | 5,7,10 | 91 | 1,2,4 | 91 |
| **RCH-008** | UVA Peak 365 nm | 14 | 40 | 100 | 0.3 | 0.1 | 9 mm Ø | 50 / 20 | 0.5 | 5,7,10 | 91 | 1,2,4 | 91 |
| **RCH-009** | BLUE Peak 430 nm | 14 | 40 | 100 | 0.2 | 0.1 | 9 mm Ø | 50 / 20 | 0.5 | 5,7,10 | 91 | 1,2,4 | 91 |
| **RCH-106** | UV Broadband | 14 | 40 | 100 | 0.3 | 0.1 | 9 mm Ø | 22 / 8.7 | 0.5 | 5,7,10 | 91 | 1,2,4 | 91 |
| **RCH-108** | UVA Peak 365 nm | 14 | 40 | 100 | 0.3 | 0.1 | 9 mm Ø | 22 / 8.7 | 0.5 | 5,7,10 | 91 | 1,2,4 | 91 |
| **RCH-109** | BLUE Peak 430 nm | 14 | 40 | 100 | 0.2 | 0.1 | 9 mm Ø | 22 / 8.7 | 0.5 | 5,7,10 | 91 | 1,2,4 | 91 |
| **RCH-506** | UV Broadband | 14 | 40 | 100 | 0.065 | 0.05 | 6 mm Ø | - | 2 | - | - | 1,2,4 | 91 |
| **RCH-508** | UVA Peak 365 nm | 14 | 40 | 100 | 0.096 | 0.1 | 6 mm Ø | - | 2 | - | - | 1,2,4 | 91 |
| **RCH-509** | BLUE Peak 430 nm | 14 | 40 | 100 | 0.065 | 0.1 | 6 mm Ø | - | 2 | - | - | 1,2,4 | 91 |
| **K-RCHxxx-I** | Calibration of irradiance sensitivity in A/W/cm². Includes K-SR in new detector order. xxx = detector model | | | | | | | | | | | | |
| **KDW-S2** | Calibration of spectral irradiance sensitivity at one or multiple wavelengths without or in combination with accessory components | | | | | | | | | | | | |
| **KDW-R2** | Calibration of integral irradiance sensitivity with accessory components. | | | | | | | | | | | | |

## ROD-360-UV18: 360 Degree F.O.V. UV-$C_{254nm}$ Irradiance Detectors

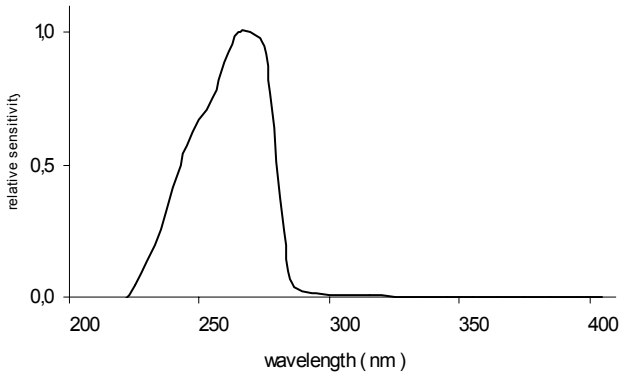
The ROD-360 is an unique irradiance detector which offers a 360 degree field-of-view.
A quartz-rod is used to collect all light irradiating it's diffuse detection window independent of the horizontal incident angle within the round angle. The vertical axis exhibits a diffuse viewing characteristic.

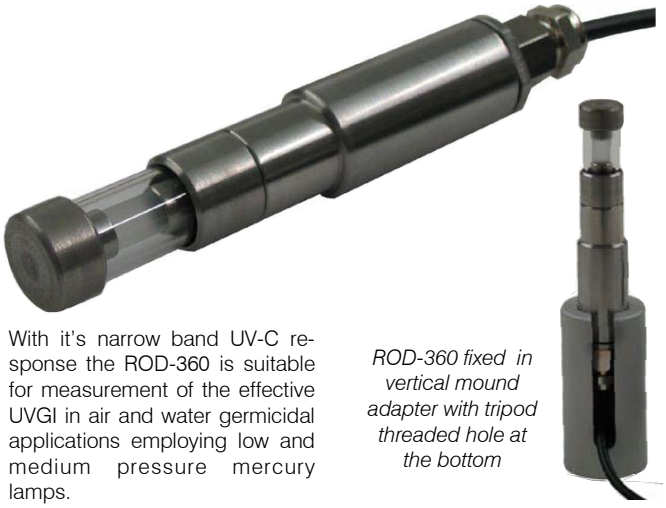


*Side View*



*Top View*



*ROD-360 fixed in vertical mound adapter with tripod threaded hole at the bottom*

With it's narrow band UV-C response the ROD-360 is suitable for measurement of the effective UVGI in air and water germicidal applications employing low and medium pressure mercury lamps.
Calibration is done using a 254 nm low pressure mercury light source.
The ROD-360 features a waterproof housing which allows measurements in humid or underwater applications. The 10 mm diameter clear quartz tube not only seals the detector rod but along with it's stainless steel housing the probe and active window can be easily cleaned. This makes the ROD-360 usable in gray water or other dirty measurement environments and also in medical applications.
A protective cap and mounting adapter is supplied to fixture the probe for vertical or horizontal use on a standard tripod or for integration into the application.

| Ordering Information & typical Specifications | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Model** | λresp | Wavelength Range | Typical Sensitivity | | Imax | Sensing Area | cable | Operation Temp. | plug | package |
| | Narrow Band | | nA/W/m² | µA/W/cm² | mA | Rod | m | | | page |
| **ROD-360-UV18** | UV-C | 220-280 nm | 0.8 | 8 | 0.1 | 5 Ø x 6.5 mm | 2 | 0-40°C | 1,2,4 | 92 |
| **K-ROD360-UV18-S** | Calibration of the irradiance sensitivity in A/W/m² and. A/W/cm² Including K-SR in order with new detector. | | | | | | | | | |
| **KDW-S2** | Calibration of spectral irradiance sensitivity at one or multiple wavelengths | | | | | | | | | |

Gigahertz-Optik

## Multi-Channel Illuminance & Irradiance

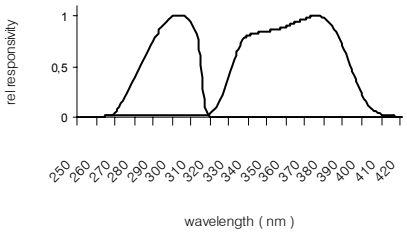
### XD-95: Single & Dual Channel Illuminance & Irradiance Detector

The XD-95 detectors are designed for use with Gigahertz-Optik's multi-channel X1 and X9 hand-held optometers. The ability to measure two wavelength ranges without having to change and replace the detector head greatly simplifies the measurement procedure.

Several detectors are offered covering common applications.
A short overview describing the various models is shown here. More information is available in the X9 and X11 optometer data descriptions.
The XD-95 detectors are supplied in a compact lightweight and low profile plastic housing with a 2 m long cable with –4 type plug for use with the X9 and X1 meters.

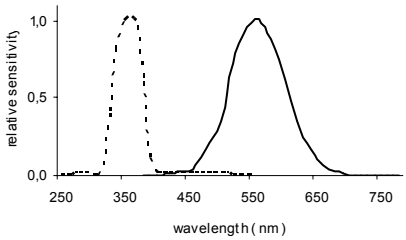
### XD-9501: UV-A & UV-B Irradiance

Ultraviolet radiation is used in the treatment of certain skin diseases like Psoriasis and for photobiological studies like SPF testing. The phototherapist needs to monitor the source irradiance or energy for accurate dosimetry. Typical wavelength ranges of interest are UV-$A_{320-400nm}$, UV-$B_{280-320nm}$ and UV-$B_{311nm}$. The XD-9501 detector offers a real polychromatic radiometric spectral match to the UV-A and UV-B spectral ranges and a precise cosine corrected field of view.



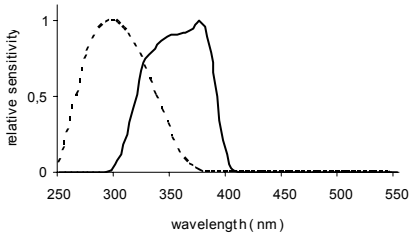

### XD-9502: UV-A Irradiance & V(λ) Illuminance

**Liquid Penetrant Testing** of surface defects using the dye penetration process (**DIN EN 1956, ASTM and MIL Standards)** and **Photostability** testing of drug and drug products as stated in ICH guidelines (International Conference for Harmonization) requires the intensity or dose control of the light sources used for test sample irradiation. The XD-9506 detector offers a real broadband radiometric UV-$A_{315-400nm}$ detector and a illuminance detector (f1' ≤6%), both with cosine diffuser for precise readings in both applications.



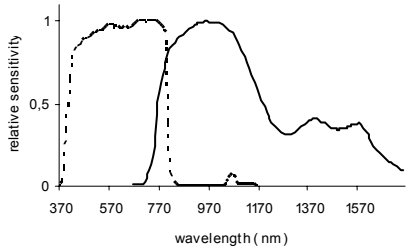

### XD-9503: UV-$B_{240-340nm}$ & UV-$A_{315-400nm}$ Irradiance

TL01 and TL12 light sources are widely used in phototherapy applications. The phototherapeutic effective radiation of the TL01 and TL12 source falls within the 240 to 340 nm bandpass with peak at 313 nm.
The XD-9503 is specially designed to measure the therapeutic effective UV-B and UV-A irradiance of TL01 and TL12 light sources. The detectors spectral sensitivity functions and calibration using TL1 and TL12 light sources ensure precise readings.



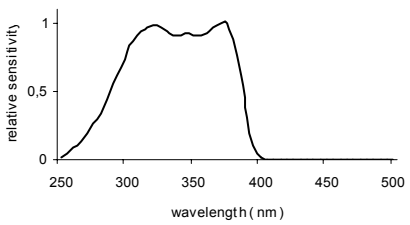

### XD-9504: VISIBLE$_{400-800nm}$ & NIR$_{800-1200nm}$ Irradiance

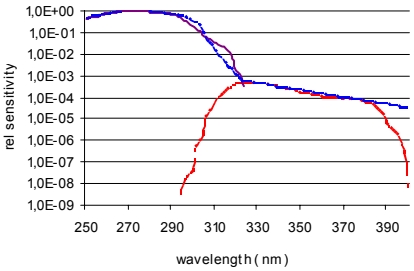
Light has therapeutic effects in many different wavelength ranges. However broadband light sources will emit light at wavelengths outside the phototherapeutic wavelength range. This 'stray light' can interfere with the treatment or even cause harm in terms of heat for example, so must be measured in order to be kept to minimal levels.
The XD-9504 is designed to measure irradiance in the 'signal' wavelength range (400-800 nm) and 'noise' range (800-1200 nm). Both detectors offer a 'flat' broadband spectral response



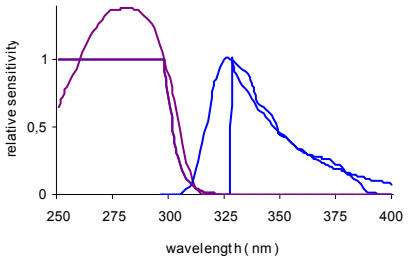

### XD-9505: UV-Broadband$_{240-400nm}$ Irradiance

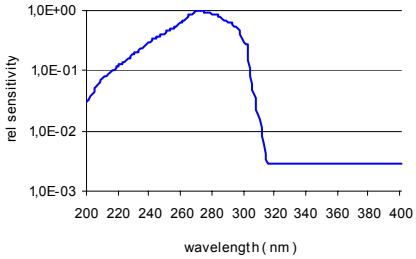
In some applications the total UV irradiance of broadband light sources needs to be measured. But because of the unavailability of ultraviolet detectors with radiometrically 'flat' spectral sensitivities across the entire UV range, relative measurements are normal. The XD-9505 can be used for relative broadband UV assessment and can provide more precise UV measurement through calibration correction when the emission spectrum of the light source is known.
The single detector offers a cosine diffuser for precise readings in diffuse irradiation zones.

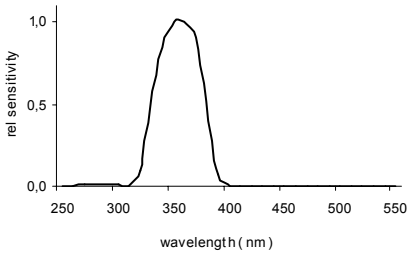





ACGIH nominal
ACGIH UV-B
ACGIH UV-A




## XD-9506: EM6 & EN14255 ACGIH Irradiance

Several guidelines and standards concerning UV hazard risk assessment exist today. Most often the ACGIH/ICNIRP spectral weighting function for the acutely harmful effects is recommended as reference for irradiance measurements (*American Conference of Governmental Industrial Hygienists (ACGIH) and* the *International Commission on Non-Ionising Radiation Protection (ICNIRP).* The XD-9506 ACGIH detector is designed to meet EM 6, DIN-EN 14255 and BGV B9 regulations. It's two cell design offers best possible isolation between UV-A and UV-B.
As part of these requirements an additional UV-A irradiance detector like the XD-9502, XD-9511 or UV-3717 is needed.

## XD-9509: 2-Channel Erythema Effective Irradiance

The typical symptom of UV erythema is acute skin inflammation caused by UV radiation (sunburn) which may be linked to skin cancer over prolonged exposure times. The XD-9509 detector permits direct measurement of the UV Erythemal effective irradiance by means of it's spectral sensitivity adaptation to the nominal CIE Erythemal spectral function. It's two cell design offers best possible isolation between the UV-A and UV-B range.

## XD-9510: DIN EN 12198 ACGIH Irradiance

The XD-9510 detector is a modified version of the XD-9506 ACGIH irradiance detector. The difference is the spectral response of the UV-A cell which simulates the *flat UV-A response* specification for DIN EN 12198. Both detectors offer a cosine diffuser.

## XD-9511: UV-A & EN 14255 UV-$A_{315-400nm}$ Irradiance

The XD-9511 offers a single detector with UV-A spectral response from 315 to 400 nm.
Because of it's good blocking of the visible spectrum above 400 nm, this detector can also be used in combination with the XD-9506 for measurement of UV-A irradiance following DIN EN 14255 and BGV B9.
The detector offers a cosine diffuser for precise measurements in diffuse light incident conditions.

**Ordering Information & typical Specifications**

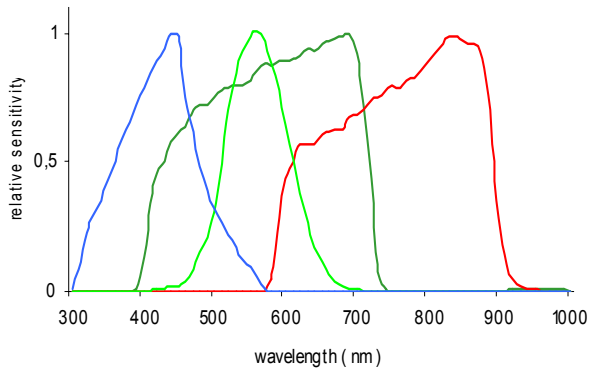
| Model | Ch1 λresp | Ch2 λresp | Typical Sensitivity | | Sensing Area | cable | Operation Temp. | Optometer | | plug | package |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | nA/.. | nA/.. | Diffuser | m | | X9 type | | | page |
| **XD-9501** | $UVA_{320-400nm}$ | $UVB_{280-320nm}$ | 17 W/m² | 2.5 W/m² | 8 mm Ø | 2 | 5-40°C | $X9_6$ | $X11_1$ | 4 | 91 |
| **XD-9502** | $UVA_{315-400nm}$ | V(λ) | 10 W/m² | 0.05 lx | 8 mm Ø | 2 | 5-40°C | $X9_8$ | $X11_1$ | 4 | 91 |
| **XD-9503** | $UVA_{315-400nm}$ | $UV_{Peak\ 311nm}$ | 4 W/m² | 2 W/m² | 8 mm Ø | 2 | 5-40°C | - | $X11_1$ | 4 | 91 |
| **XD-9504** | $VIS_{400-800nm}$ | $NIR_{800-1200nm}$ | 0.7 W/m² | 130 W/m² | 8 mm Ø | 2 | 5-40°C | - | $X11_1$ | 4 | 91 |
| **XD-9505** | $UV_{Broadband}$ | - | 13 W/m² | - | 8 mm Ø | 2 | 5-40°C | $X9_7$ | $X11_1$ | 4 | 91 |
| **XD-9506** | $UVA_{ACGIH}$ | $UVB_{ACGIH}$ | 4000 W/m² | 1.5 W/m² | 8 mm Ø | 2 | 5-40°C | - | $X11_1$ | 4 | 91 |
| **XD-9509** | $UVA_{Erythema}$ | $UVB_{Erythema}$ | tbc W/m² | tbc W/m² | 8 mm Ø | 2 | 5-40°C | - | $X11_1$ | 4 | 91 |
| **XD-9510** | $UVA_{ACGIH}$ | $UVB_{ACGIH}$ | 4000 W/m² | 1.5 W/m² | 8 mm Ø | 2 | 5-40°C | - | $X11_1$ | 4 | 91 |
| **XD-9511** | $UVA_{315-400nm}$ | - | 4 W/m² | - | 8 mm Ø | 2 | 5-40°C | $X9_7$ | $X11_1$ | 4 | 91 |
| **K-XD95xx-I** | Calibration of integral illuminance/irradiance sensitivity in A/lx or A/W/cm². Includes K-SR in new detector order. xx = detector model | | | | | | | | | | |
| **KDW-S2** | Calibration of spectral irradiance sensitivity at one or multiple wavelengths | | | | | | | | | | |

Gigahertz-Optik

## Multi-Channel Illuminance, Irradiance & Luminous Color

### TP-4501: Triple PAR Irradiance Detectors

The TP-4501 is a unique detector head designed for use with the X11 hand-held optometer to measure on-site lighting conditions in greenhouses, plant growth studies, soil and seed science.
The compact detector houses four different detectors:
**PAR:** Measures the **photonsynthetically** effective radiation in the 400 to 700 nm wavelength range actinic for green growth.
**BLUE:** Measures the **phototropism** effective radiation within the 320 to 500 nm wavelength range actinic for directional plant growth.
**RED:** Measures the **photomorphogensis** effective radiation within the 560 to 900 nm wavelength range actinic for plant growth formation.
V(λ): Measures the **photometric** illuminance which specifies the ambient lighting condition.
The low profile detector housing




is only 20 mm high with a central 10 mm diameter diffuser which ensures the cosine corrected field of view required in illuminance & irradiance applications.

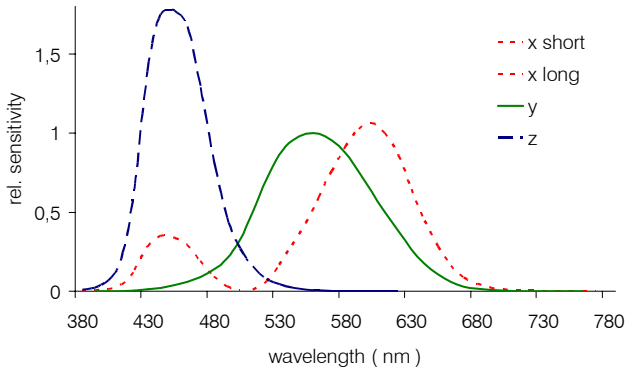
| Ordering Information & Specifications | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Model** | λresp | λresp | λresp | λresp | Typical Sensitivity | | | | Sensing Area | cable | Operation Temp. °C | Meter Type | plug | package |
| | Ch1 | Ch2 | Ch3 | Ch4 | CH1 | CH2 | CH3 | CH4 | | m | | | | page |
| | photometric | Plant Physiology Effective | | | pA/lx | pA/μMol*m$^{-2}$*s$^{-2}$ | | | Diffuser | | | | | |
| **TP-4501** | V(λ) | $PAR_{400-700\ nm}$ | $BLUE_{320-500\ nm}$ | $RED_{560-900\ nm}$ | 40 | 0.1 | 2 | 70 | 10 mm Ø | 2 | 5-45 | X11 | 4 | 90 |
| **K-TP4501-I** | Calibration of photometric & plant physiology effective sensitivity in A/lx & A/μMol*m$^{-2}$*s$^{-2}$. Includes K-SR in new detector order. | | | | | | | | | | | | | |
| **KDW-S2** | Calibration of spectral irradiance sensitivity at one or multiple wavelengths without or in combination with accessory components. | | | | | | | | | | | | | |

### CT-3701 & CT-4501: Luminous Color and Illuminance Detectors

*CT-3701*

*CT-4501-4*

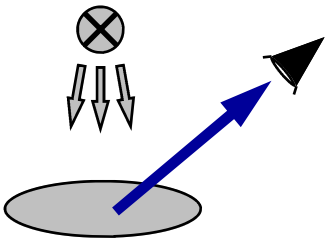
The CT-3701 and CT-4501 luminous color detectors are designed with precise x,y,z tristimulus matching functions to measure the illuminance, x,y chromaticity values and color temperature of broad band emitting light sources. Four detectors mounted in one compact housing are used to form the $x_{short}$, $x_{long}$, y and z spectral tristimulus values for the 2 degree viewer.
Both probes feature two separate $x_{short}$ and $x_{long}$ functions to provide more accurate readings in the blue region over detectors with only the $x_{long}$ function and a simulated $x_{short}$ using the z values.
Sandwich filtering technology allows a very compact housing design with a only 10 mm diameter diffuser window. This ensures a uniform illumination of the diffuser as required for the measurement of illuminance.
A special feature of the CT-3701 detector is temperature control of it's photodiodes and filters for ambient temperature independent operation. This allows the CT-3701 to be integrated into industrial qualification process control applications where long term stability is essential. CT-3701 and CT-4501 can be combined with other components like luminance steradian tubes.




| Ordering Information & Specifications | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Model** | λresp | λresp | λresp | λresp | Typical Sensitivity | | | | Sensing Area | cable | Operation Temp. | Meter Type | plug | package |
| | Ch1 | Ch2 | Ch3 | Ch4 | CH1 | CH2 | CH3 | CH4 | | m | | | | page |
| | 380-500 nm | 500-730 nm | 380-780 nm | 380-580 nm | nA/lx at 2856 K | | | | Diffuser | | | | | |
| **CT-3701** | x short | x long | y | z | 0.07 | 0.03 | 0.08 | 0.02 | 10 mm Ø | 2 | +40°C | P-9801 | 1 | 92 |
| **CT-4501** | x short | x long | y | z | 0.07 | 0.03 | 0.04 | 0.01 | 10 mm Ø | 2 | 5-40°C | X11 | 4 | 90 |
| **K-CT3701** | Calibration of illuminance sensitivity A/lx, x,y chromaticity values and color temperature. Includes K-SR in new detector order. | | | | | | | | | | | | | |
| **K-CT4501** | Calibration of illuminance sensitivity A/lx, x,y chromaticity values and color temperature. Includes K-SR in new detector order. | | | | | | | | | | | | | |
| **KDW-S** | Calibration of spectral sensitivity at one or multiple wavelengths without or in combination with accessory components | | | | | | | | | | | | | |

## Luminance & Radiance

**Radiance L** is described as the intensity of optical radiation from an irradiated or irradiating surface in a particular direction measured with a specified solid angle.
The units of radiance are W/(m²*sr). Light detectors with a defined angle of view are used to measure radiance.



**Luminance L** is described as the measurable photometric brightness of an illuminated or illuminating surface. In many cases luminance describes the quality of illumination much better than illuminance. The units of luminance are candela per unit area (cd/m²) or nit and foot-lamberts (fL). Detector heads with a defined angle of view are used to measure luminance so that a small area within a larger uniform field is sampled.

$cd/m^2 = nit = lm/(m^2 * sr)$
$fL = lm/(ft^2 * sr)$
$1\ cd/m^2 = 2.919x10^{-1}\ fl$

## LDM-9810 & LDM-9811: Luminance & Radiance Detectors

LDM-9810 and LDM-9811 are modularly designed viewer modules that are combined with PD-16 detectors to form luminance and radiance measurement heads offering flexible spot size diameter selection. Both units are built with stable aluminium housings to ensure precise measurement in laboratory or field use.
The unit's wide aperture focussing objective is achromatically corrected, and satisfies the tightest requirements for the suppression of stray light and image formation.
Both viewer modules offer three selectable fields of view:

- **LDM-9810**:
  20', 1° and 6°
- **LDM-9811**:
  1.7, 11 and 100 mrad

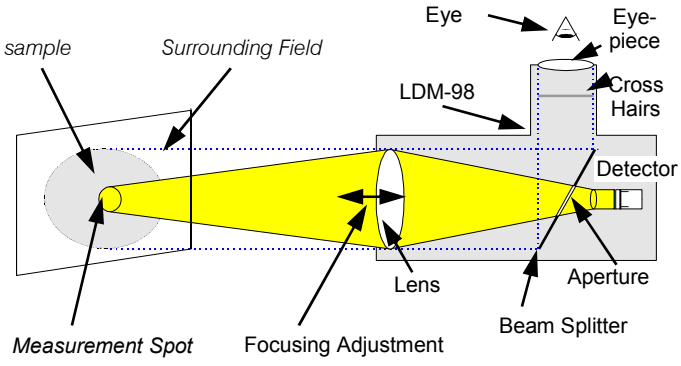
A f.o.v. selector knob is located on the rear of the device. The resultant size measurement spot is visible through the ocular viewfinder. In combination with the cross-hair targeting aid alignment of the LDM-98 to the zone of interest is simple.
Focussing is achieved by adjusting the sharpness of the image on the viewfinder screen.
The useable measurement distance of the LDM-98 spans from 0.3m to ∞. The area of the measured surface depends on the distance to the target and on the angle chosen for the field of view.

**Photometric and Radiometric detectors** from the PD-16 series combine with the LDM-9810 and LDM-9811 viewing module to set up a luminance or radiance measurement device.

**Luminance Measurement:**

The **PD-16VL01** photometric detector has been adapted with great care to the ideal V(λ) function, and in combination with the LDM-98 meets the DIN class A specification for the adaptation error of $f_1$ ' less than or equal to 3%. Typical applications of the luminance detector LDM-98/PD-16VL01 include photometric brightness measurement of:

- Luminous surfaces such as monitor screens, alphanumeric displays, information signs, emergency lighting and illuminated control panels
- Reflecting surfaces such as walls and workplace equipment, projection screens, traffic and information signs, roadways and roller tracks
- Light emission in accordance with Federal Emissions Statutes
- Fluorescent pigments with long afterglow decay
- In lighting design stage of workplace and office design




**Radiance Measurement:**

**The PD-16RW05** radiometric detectors with spectral sensitivity within the wavelength range from 400 to 1000 nm are the right choice for radiance measurement in the visible and near infrared wavelength region.

**Light Hazard Protection:**

The quantity used for determination of blue light hazard and retinal thermal hazard to the human eye is radiance, measured in the radiometric unit of W/m²*sr.
Three different spectral response functions are typically used for light hazard protection radiance measurements:

- **Blue-light Hazard**
  (400-520 nm)
- **Retinal Thermal Hazard**
  (520-1400 nm)
- **Retinal Thermal Hazard IR-A**
  (780-1400 nm)

Gigahertz-Optik offers three different PD-16 detectors to be combined with the **LDM-9811** viewer module for this application.

- **PD-16BLH:**
  Blue light hazard detector
- **PD-16RTH:** Retinal thermal hazard detector
- **PD-16RTHA:** Retinal thermal hazard IR-A detector

**Optional Accessories:**

**The LDM-98NL** narrow lens provides a variable 1:1 to 2:1 near field magnification for measurement of spot diameters down to 0.1 mm.
**The LDM-98FC** enables coupling a flexible **fibre bundle** instead of a PD-16 detector to the LDM-98 to allow connection and use with spectral radiometers.
**The BHO-01** hard carrying case holds the LDM-98/PD16 with P-

9710 optometer for mobile applications.

**Calibration in Light Measurement Units:**

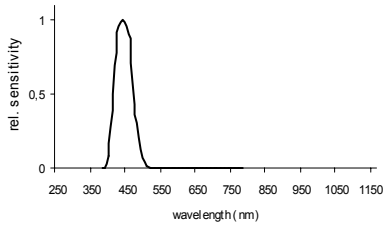
Calibration of the detector is carried out by Gigahertz-Optik's Calibration Laboratory for Optical Radiation Quantities, traceable to international standards.
Calibration in the units related to the selected PD-16 detector is supplied for each viewing angle with and without optional narrow lens.
For best handling of the multiple calibration factors the P-9710 and P-2000 optometers are recommended for use with the LDM-98/PD16 luminance and radiance detector heads outfitted with (-2) programmable data connectors.

*PD-16 Light Detector*

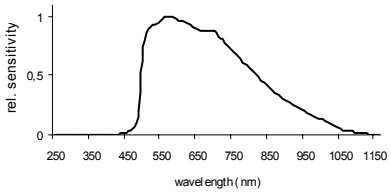
Gigahertz-Optik

## Luminance & Radiance

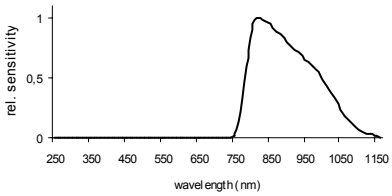
### LDM-9810 & LDM-9811: Luminance & Radiance Detectors



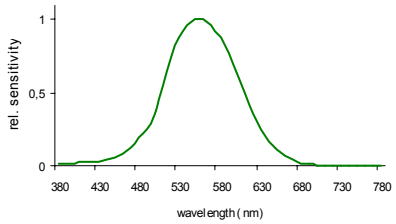

*PD-16BLH*



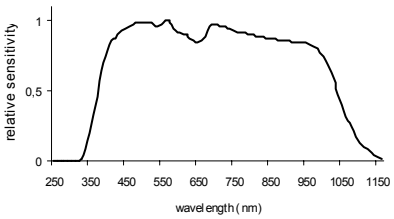

*PD-16RTH*



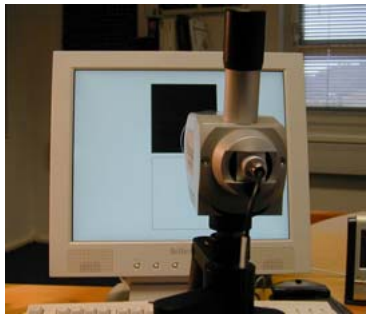

*PD-16RTHA*




*PD-16VL01*




*PD-16RW05*



| Measurement Spot Diameters (mm) | | | | | | |
|---|---|---|---|---|---|---|
| **F.O.V. Distance** | **LDM-9810** | | | **LDM-9811** | | |
| | **6°** | **1°** | **20'** | **100 mrad** | **11 mrad** | **1.7 mrad** |
| 0.3 m | 21 | 3.5 | 1.2 | 19.9 | 2.2 | 0.4 |
| 0.5 m | 41.9 | 7 | 2.3 | 39.8 | 4.4 | 0.8 |
| 1 m | 94.3 | 15.8 | 5.2 | 89.6 | 9.9 | 1.8 |
| 2 m | 199 | 33.2 | 11 | 189.2 | 20.9 | 3.8 |
| 10 m | 1037 | 173 | 57 | 986 | 109 | 19.8 |
| **With LDM-98NL Narrow Lens (Optional)** | | | | | | |
| 100 mm / f=∞ | 10.5 | 1.8 | 0.6 | 10 | 1.1 | 0.2 |
| 75 mm / f=0.3m | 5.2 | 0.9 | 0.3 | 5 | 0.6 | 0.1 |

| Ordering Information & typical Specifications | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Model** | λresp | Wavelength Range | f1 | Typical Sensitivity | | | Imax | Sensing Area | cable | Operation Temp. | plug | package |
| | | | ≤ % | *) nA/cd*m² or **) nA/W/m²sr | | | mA | Lens | m | | | page |
| **LDM-9810** | | | | 20' | 1° | 6° | | 50 mm Ø | | 5-40°C | | 92 |
| **PD-16VL01** | V(λ) | 380-400 | 3 | 0.0035 *) | 0.033 *) | 0.9 *) | 1 | 5.8 x 5.8 | 2 | 5-40°C | 1,2,4 | 92 |
| **LDM-9811** | | | | 1.7 mrad | 11 mrad | 100 mrad | | 50 mm Ø | | 5-40°C | | 92 |
| **PD-16BLH** | BLH | 400-520 | - | 0.2 **) | 5.7 **) | 380 **) | 1 | 5.8 x 5.8 | 2 | 5-40°C | 1,2,4 | 92 |
| **PD-16RTH** | RTH | 500-1200 | - | 0.3 **) | 11 **) | 780 **) | 1 | 5.8 x 5.8 | 2 | 5-40°C | 1,2,4 | 92 |
| **PD-16RTHA** | RTHA | 800-1200 | - | 0.2 **) | 5 **) | 360 **) | 1 | 5.8 x 5.8 | 2 | 5-40°C | 1,2,4 | 92 |
| **PD-16RW05** | RW05 | 400-1000 | - | 0.38 **) | 12 **) | 840 **) | 1 | 5.8 x 5.8 | 2 | 5-40°C | 1,2,4 | 92 |
| **PD-16VL01** | V(λ) | 380-400 | 3 | 0.00004 *) | 0.00015 *) | 1.1 *) | 1 | 5.8 x 5.8 | 2 | 5-40°C | 1,2,4 | 92 |
| **LDM-98Z-NL** | Narrow Lens for use with LDM-9810 and LDM-9811 | | | | | | | | | | | |
| **LDM-98Z-FC** | Fiber Coupler to adapt flexible light guide bundles to the LDM-9810 and LDM-9811 | | | | | | | | | | | |
| **K-LDM98BLH** | Calibration of effective BLH radiance sensitivity with **or** without LDM-98NL in A/W/m²*sr (at 3 f.o.v. angles). 1) | | | | | | | | | | | |
| **K-LDM98RTH** | Calibration of effective RTH radiance sensitivity with **or** without LDM-98NL in A/W/m²*sr (at 3 viewing angles). 1) | | | | | | | | | | | |
| **K-LDM98RTHA** | Calibration of effective RTHA radiance sensitivity with **or** without LDM-98NL in A/W/m²*sr (at 3 viewing angles). 1) | | | | | | | | | | | |
| **K-LDM98RW05** | Calibration of 400-1000 nm radiance sensitivity with **or** without LDM-98NL in A/W/m²*sr (at 3 viewing angles). 1) | | | | | | | | | | | |
| **K-LDM98VL01** | Calibration of luminance sensitivity with **or** without LDM-98NL in A/cd/m² (at 3 viewing angles). 1) | | | | | | | | | | | |
| **K-LDM98NL** | Additional calibration of luminance or radiance sensitivity for LDM-98 with LDM-98NL narrow lens | | | | | | | | | | | |
| **KDW-S** | Calibration of spectral sensitivity at one or multiple wavelengths without or in combination with accessory components | | | | | | | | | | | |
| 1) Includes K-SR with new detector order | | | | | | | | | | | | |

## LDM-9901: Luminance Detector

Luminance detectors that are characterized as quality class A or B, in accordance with DIN 5032 Part 7, need to be constructed from carefully selected elements. These include optics with achromatic correction and low stray light, and a photopic detector with a response curve that has been carefully adapted to the ideal V(λ) function. Add an expensive telescopic finder and a focusing optical system for locating the target area and these luminance detector heads become too costly for many applications. The widely used auxiliary lenses that can be attached to illuminance detector heads for luminance measurement are not a good alternative, since they typically do not satisfy the requirements of DIN 5032 Part 7.
An economical alternative which does satisfy the requirements of IEC 61223-2-5 and DIN 5032 Part 7 is the LDM-9901. It is a high quality photometric detector for determining luminance in cd/m². Its properties satisfy the requirements for Quality Class B of DIN 5032 Part 7.

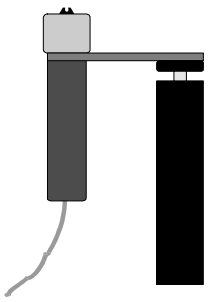
**The LDM-9901 detector** key components are:

- ©achromatically corrected low stray light lens to collect light with a 1° field of view
- ©high-quality photodiode with accurate V(λ) correction filter
- ©sight for locating the target measuring area

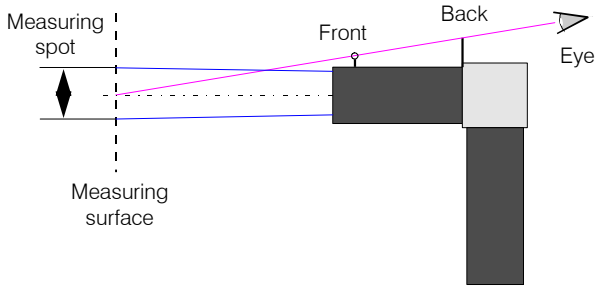
The low-stray-light achromatic corrected objective is designed so that in its useable measurement range of 40 cm to infinity it is not necessary to make focusing adjustments to the lens. The 1° field of view means that the diameter of the measurement spot differs depending on the measuring distance.
The adaptation for photopic vision offers a $f_1$'of ≤ 5 %. This means that the LDM-9901 detector can be used to measure the output of monitors, LED displays and other sources without suffering from an unacceptable increase in measurement uncertainty due to the quasi-monochromatic type radiation of these sources.

The LDM-9901 detector has an externally mounted targeting These back and front sights are adjusted for measuring distances of 70 cm, 140 cm and ∞ as shown below. In order to locate the object to be measured, the detector head is held in front of the eye at such a distance (about 25 cm) that the back and front sights appear sharp. Depending on the observer's age, other distances may be appropriate. The two sights are then aligned with the desired part of the object being measured.
The sights consists of a black slotted V-notch and a white ball. The following figure shows the different alignments for various measuring distances.
In many applications a luminance detector is used with a tripod. An adapter plate to attach the detector and tripod are offered as options.
The detector is connected to the optometer via a 1 m flexible connecting cable .
Calibration of luminance sensitivity in A/(m²cd⁻¹) is carried out at Gigahertz-Optik's Calibration Laboratory and is confirmed by a factory certificate.

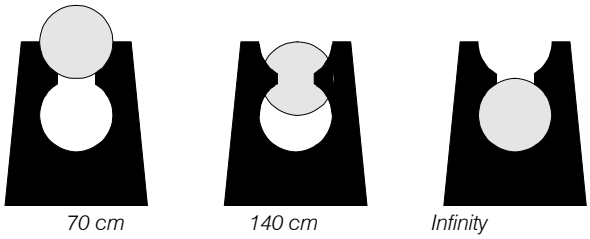
| Distance to Spot Comparison | |
|---|---|
| distance | spot diameter |
| 0.5 m | ~ 31 mm |
| 0.7 m | ~ 35 mm |
| 1 m | ~41 mm |
| 5 m | ~ 120 mm |
| 10 m | ~ 220 mm |
| 50 m | ~ 1000 mm |
| 100 m | ~ 2000 mm |



*Tripod Adapter (Option)*




*Notch and Bead Sight*



*70 cm* *140 cm* *Infinity*
*Notch and Bead Sight at difference Distances*

| LDM-9901 Comparison to DIN 5032 Class B Limits (%) | | | |
|---|---|---|---|
| Characteristics | Symbol | LDM-9901 | DIN |
| Calibration Uncertainty | $U_{kal}$ | 1.5 | 4 |
| V(λ) Match Characteristic | $f_1$ | 5 | 6 |
| UV Response Characteristic | u | 0.01 | 2 |
| IR Response Characteristic | r | 0.01 | 2 |
| Linearity Characteristic | $f_3$ | 0.2 | 2 |
| Fatigue Characteristic (at 1 klx) | $f_5$ | 0.1 | 1 |
| Temperature Dependence Characteristic | $f_6$ | 1 | 10 |

**Ordering Information & typical Specifications**

| Model | λresp | Wavelength Range | f1 | Typical Sensitivity | Imax | Sensing Area | cable | Operation Temp. | plug | package |
|---|---|---|---|---|---|---|---|---|---|---|
| | Photometric | | ≤ % | pA/cd*m² | mA | Lens | m | | | page |
| **LDM-9901** | V(λ) | 380-780 nm | 5 | 25 | 1 | 22 mm Ø | 2 | 0-40°C | 1, 2, 4 | 92 |
| **LDM-99Z-02** | Ambient light shade made by elastic rubber to place the LDM-99 direct on the monitor surface | | | | | | | | | |
| **K-LDM9901** | Calibration of integral luminance sensitivity in A/cd/m². Including K-SR in new detector order. | | | | | | | | | |
| **KDW-S** | Calibration of spectral sensitivity at one or multiples wavelengths | | | | | | | | | |

## SRT-M37: Front Lenses for 37-Type and 45-Type Illuminance & Irradiance Detectors

In some applications simple front lenses are required to limit the field of view of irradiance and luminance light detectors.
The SRT-M37L series front lenses can be combined with the 37-type and 45-type irradiance, illuminance and luminous color detectors for this purpose.
The detector itself is mounted into the SRT-M45/37 base mount that has a M37x1 front thread where the SRT-M37L front lens can be attached.
The base mount offers a side M6 and camera type (1/4"-20 BSW) threaded hole for standard tripod or bench post or to fixture the device into an application.
Beside the four front lenses offered custom solutions with quartz lenses, other lens diameters are available on special request.
Contact an applications engineer to discuss your requirements.

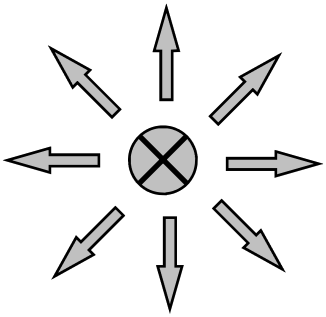
**Ordering Information & typical Specifications**

| Model | λresp | Wavelength Range | Typical Sensitivity | | Sensing Area Lens | cable m | Operation Temp. | plug | package page |
|---|---|---|---|---|---|---|---|---|---|
| **SRT-M37L-1/VL-3701** | V(λ) | 380-780 | 1.2 | pA/cd*m² | 22.4 mm Ø | 2 | 5-40°C | 1, 2 or 4 | 89 |
| **SRT-M37L-2/VL-3701** | V(λ) | 380-780 | 2.3 | pA/cd*m² | | 2 | 5-40°C | 1, 2 or 4 | 89 |
| **SRT-M37L-5/VL-3701** | V(λ) | 380-780 | 12 | pA/cd*m² | | 2 | 5-40°C | 1, 2 or 4 | 89 |
| **SRT-M37L-1/CT-4501** | V(λ) | 380-780 | 0.05 | pA/cd*m² | | 2 | 5-40°C | 1, 2 or 4 | 89 |
| **SRT-M37L-2/CT-4501** | V(λ) | 380-780 | 0.4 | pA/cd*m² | | 2 | 5-40°C | 1, 2 or 4 | 89 |
| **SRT-M37L-5/CT-4501** | V(λ) | 380-780 | 2 | pA/cd*m² | | 2 | 5-40°C | 1, 2 or 4 | 89 |
| **SRT-M37L-10/CT-4501** | V(λ) | 380-780 | 9 | pA/cd*m² | | 2 | 5-40°C | 1, 2 or 4 | 89 |
| **SRT-M37L-1/RW-3703** | Radiometric | 400-800 | 5 | nA/W/m²sr | | 2 | 5-40°C | 1, 2 or 4 | 89 |
| **SRT-M37L-2/RW-3703** | Radiometric | 400-800 | 9 | nA/W/m²sr | | 2 | 5-40°C | 1, 2 or 4 | 89 |
| **SRT-M37L-5/RW-3703** | Radiometric | 400-800 | 48 | nA/W/m²sr | | 2 | 5-40°C | 1, 2 or 4 | 89 |

Specifications for other Detector/Front Lens Combinations not shown are available on request. Quartz lenses for UV applications are available.

| | |
|---|---|
| **KDW-P3** | Calibration of integral luminance sensitivity of an illuminance detector with front lens in A/cd/m² |
| **KDW-R3** | Calibration of integral radiance sensitivity of an irradiance detector with front lens in A/W/m²*sr |
| **KDW-S3** | Calibration of spectral radiance sensitivity of an irradiance detector with front lens in A/W/m²*sr nm |
| **SRT-M45/37B** | Basic holder to mount 37-type and 45-type detectors to SRT-M37 type components |
| **SRT-M37L-1** | Front lens with 1° field of view. Needs SRT-M45/37B to couple with detector. 1 mm diameter output aperture. |
| **SRT-M37L-2** | Front lens with 2° field of view. Needs SRT-M45/37B to couple with detector. 2 mm diameter output aperture. |
| **SRT-M37L-5** | Front lens with 5° field of view. Needs SRT-M45/37B to couple with detector. 4.8 mm diameter output aperture. |
| **SRT-M37L-10** | Front lens with 10° field of view. Needs SRT-M45/37B to couple with detector. 10 mm diameter output aperture. |
| **SRT-M37Z01** | Ambient light shade made by elastic rubber to be used with the SRT-M37-L lenses or the SRT-M37-5 tube. |

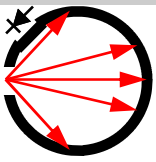
## Luminous Flux & Radiant Power



**Luminous flux** ϕ is the light power of any light source and is measured in lumens (lm). Since light is not typically emitted as a more or less parallel light beam, luminous flux must be measured with a measurement geometry that acquires the luminous flux independent of its spatial distribution. Light collecting integrating spheres or goniophotometers which can sum the angular light output over 360° are often used.
The luminous flux of a 100 W incandescent bulb is about 1380 lm, while that of a 20 W compact fluorescent lamp is about 1200 lm.

**Radiant power** ϕ is the total power of optical radiation emitted by a source measured in watts (W). The same measurement geometry as in luminous flux measurement applies only the detection system is not photopically corrected.

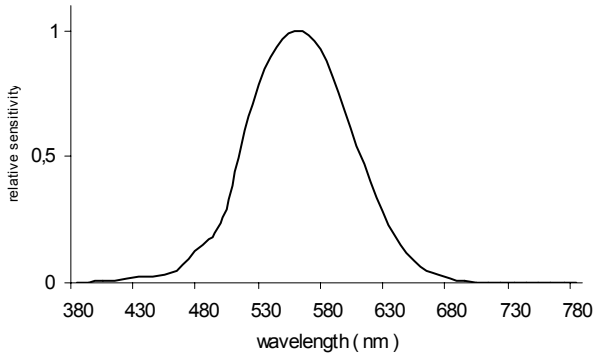
The most common method **to measure luminous flux and radiant power** from all directional emitting divergent beam sources employs an integrating sphere light detection system.
Omnidirectional emitting light sources are placed in the center of the sphere, whereas the light from spot lamps enters the sphere through a port in the sphere wall.



*Diffuse multiple reflections at the inner sphere wall suppresses disturbance effects created by the angle of incidence, formation of shadows, reflections, modes etc.*

In the "Integrating Spheres" chapter several spheres from 8 mm up to 500 mm diameter are described which can be combined with Gigahertz-Optik light detectors and optometers to form complete luminous flux and radiant power light measurement systems.

## LSM-9901: Luminous Flux Detector




**The LSM-9901** detector is used to measure the luminous flux, in lumens, of directional light beams with varying divergences. The measurement aperture size of its 50 mm diameter integrating sphere is 12.7 mm in diameter, which is sufficient for applications with endoscopes, light emitting diodes, optical fiber bundles and other beam emitters. The photometric light detector is positioned close to the entrance port in accordance with DIN guidelines and allows for an acceptance angle of up to 90°. The detector is shielded from exposure to direct radiation by a baffle

The specifications of the photodiode correspond to DIN quality class B, permitting use with cold light sources, lamps with a high color temperature, or quasi-monochromatic radiation such as that from light emitting diodes.

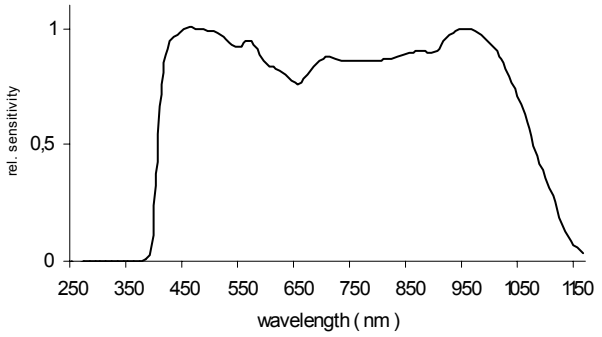
The 50 mm diameter integrating sphere is coated with $BaSO_4$, guaranteeing diffuse reflectivity and a spectrally neutral reflection characteristic. Optometer connections are made by means of a 2 m coaxial cable with appropriate plug type. Calibration of

luminous flux in lumens (lm) is carried out at Gigahertz-Optik's Calibration Laboratory for Optical Radiation Measurement, and is confirmed by a factory certificate.

**Ordering Information & typical Specifications**

| Model | λresp | Wavelength Range | f1 | Typical Sensitivity | Imax | Sphere | | cable | Operation Temp. | plug | package |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Photometric | | ≤ % | nA/lm | mA | Port | Diameter | m | | | page |
| **LSM-9901** | V(λ) | 380-780 nm | 5 | 40 | 1 | 12.5 mm Ø | 50 mm | 2 | 5-40°C | 1, 2, 4 | 91 |
| **K-LSM9901** | Calibration of integral luminous flux sensitivity in A/lm. Includes K-SR in with new detector order. | | | | | | | | | | |
| **KDW-S** | Calibration of spectral sensitivity at one or multiple wavelengths without or in combination with accessory components. | | | | | | | | | | |

## PRW-0505: Polychromatic Radiant Power Detector




Integrating spheres are commonly used in radiant power measurement systems. Functioning as an optical integrator, the integrating sphere is able to measure radiation entering it's port independent of angle.

The PRW-0505 radiometric detector for radiant power measurement in the visible and near infrared (NIR) is fitted with an integrating sphere. The sphere, with an internal diameter of 50 mm, is coated with Barium Sulfate offering a diffuse and spectrally flat reflectance characteristic within a specified wavelength range. BaSO4 offers a high reflectance of ~ 97 % ensuring good sensitivity and also good long term stability.

The detector is positioned close to the sphere's entrance port to allow highly divergent radiation beams of up to 90 degrees to be accurately measured. The input port has a diameter of 12.7 mm.

The radiometric detector is shielded from exposure to direct radiation from the measurement port by a baffle.

Its radiometric sensitivity covers wavelengths between 400-1000 nm allowing the radiant power of broadband and of quasi-monochromatic lamps (such as light emitting diodes) to be measured irregardless of their emission spectra. Gigahertz-Optik optometers are connected with a 2 m coaxial cable with an appropriate plug type. Calibration of sensitivity to radiant power

in $W_{400\text{-}1000\ nm}$ is carried out at Gigahertz-Optik's Calibration Laboratory for Optical Radiation Quantities, and is supported by a factory certificate.

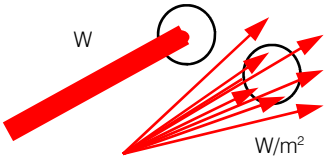
**Ordering Information & typical Specifications**

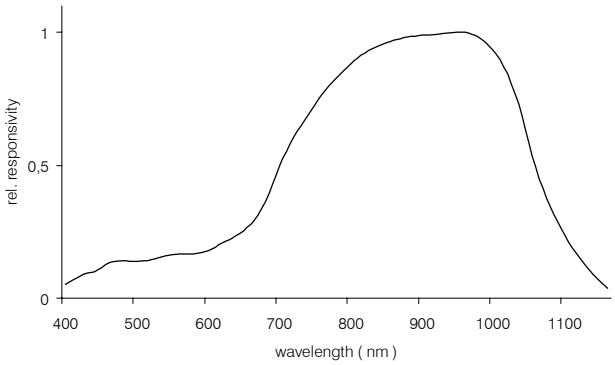
| Model | λresp | Wavelength Range | Typical Sensitivity | ϕmax | Sphere | | cable | Operation Temp. | plug | package |
|---|---|---|---|---|---|---|---|---|---|---|
| | Radiometric | | µA/W | mW | Port | Diameter | m | | | page |
| **PRW-0505** | Polychromatic | 400-1000 nm | 90 | 500 | 12.5 mm Ø | 50 mm | 2 | 5-40°C | 1, 2, 4 | 91 |
| **K-LSM9901** | Calibration of integral radiant power sensitivity in A/W. Includes K-SR in new detector order. | | | | | | | | | |
| **KDW-S1** | Calibration of spectral radiant power sensitivity at one or multiple wavelengths without or in combination with accessory components. | | | | | | | | | |

Gigahertz-Optik

## Laser Stray Light / Laser Power

### LP-9901: Laser Power and Laser Stray Light Detector




**The LP-9901** Detector is designed to measure both laser power in W (the laser beam under fills the detector active area) and laser irradiance in mW/m² (the laser beam overfills the detector active area).
The measurement aperture has a diameter of 7 mm which correlates to the maximum size of the eye's pupil.
The LP-9901 offers a dynamic range from 0.1 µW to 100 mW (at 662.8 nm) for power measurement, and 0.0026 µW/cm² to 260 mW/cm², for the determination of maximum permissible exposure. The low profile detector can be securely held in the laser beam with a rigid 100 mm long detector handle built around the cable and connects to the optometer by a 2 m long cable with appropriate plug type.
Calibration of spectral sensitivity from 400 to 1100 nm is performed in 10 nm increments. Calibration is carried out at Gigahertz-Optik's Calibration Lab and is confirmed by a works certificate.

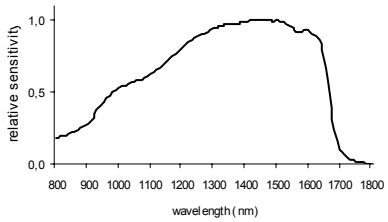
| Ordering Information & typical Specifications | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Model** | λresp | Wavelength Range | Typical Sensitivity | | ϕmax | | cable | Imax. | Operation Temp. | plug | package |
| | Photodiode | | 633 nm | 900 nm | 633 nm | 900 nm | m | mA | | | page |
| **LP-9901** | Si & ND Filter | 400-1100 nm | 1.3 mA/W | 20 mA/W | 100 mW | 50 mW | 2 | 1 | 0-40°C | 1,2,4 | 91 |
| **K-LP9901** | Calibration of spectral radiant power sensitivity in A/W nm and calculated spectral irradiance sensitivity A/W/m² | | | | | | | | | | |
| **KDW-S1** | Calibration of spectral radiant power sensitivity at one or multiple wavelengths in combination with accessory components | | | | | | | | | | |

### LP-01 & LP-02: Radiant Power Detectors with OP.DI.MA. Integrating Sphere

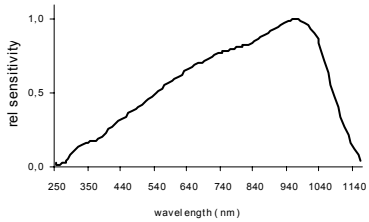
*LP-0101 & LP-0103 with FC adapter*

*LP-0201*

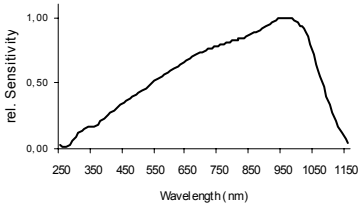
**LP-01** detectors are designed for laser power and general optical power measurements in telecommunication testing systems. **Using an integrating sphere** as a light collector enables small size, high shunt resistance photodiodes providing high sensitivity and fast rise time to be used. As a result of multiple diffuse reflectance, integrating spheres can reduce polarization effects, beam misalignment risk, signal bounce-back and PTD saturation. The machined OP.DI.MA. (optically diffuse material) spheres offer the highest reflectance (low attenuation) and longest term stability currently available. The **LP-0101, LP-0102 and LP-0103** are built around a 30 mm diameter sphere with a 5 mm measurement aperture. A unique Gigahertz-Optik baffle design offers a large light acceptance angle with no risk of direct detector irradiation.
The **LP-0201** employs an 8 mm diameter ODM integrating sphere with a 2 mm measurement port diameter for lowest attenuation. A low profile fast Si photodiode is used enabling a very short rise time.
Common features include:
**Diode array spectrometer** can be coupled to an additional detector port with SMA-type fiber connector.
**Open port configuration** is standard for direct measurement of laser diodes, LEDs or lasers.
**Fiber connector adapters** for FC, SC, ST and SMA connectors are available for the 30 mm sphere measurement port.
**Calibration** of spectral radiant power sensitivity in A/W nm is offered within the sensitivity range of each detector.




*Typical spectral sensitivity LP-0101*




*Typical spectral sensitivity LP-0103*




*Typical spectral sensitivity LP-0201*

## LP-01 Series: Radiant Power Detectors with OP.DI.MA. Integrating Sphere

| Ordering Information & typical Specifications | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Model** | λresp | Wavelength Range | Typical Sensitivity | | Sphere | | cable | Imax. | ϕmax | Operation Temp. | plug | package |
| | Photodiode | | 633 nm | 1300 nm | Port | Diameter | m | mA | mW | | | page |
| **LP-0101** | InGaAs | 800-1800 nm | - | 0.4 mA/W | 5 mm ∅ | UPK-30-L | 2 | 1 | 500 | 5-40°C | 1,2,4 | 91 |
| **LP-0102** | Si & InGaAs | 350-1800 nm | 0.6 A/W | 0.4 mA/W | 5 mm ∅ | UPK-30-L | 2 | 1 | 500 | 5-40°C | 1,2,4 | 91 |
| **LP-0103** | Si | 350-1100 nm | 0.6 mA/W | - | 5 mm ∅ | UPK-30-L | 2 | 1 | 500 | 5-40°C | 1,2,4 | 91 |
| **LP-0201** | Si LP | 400-1100 nm | 30 mA/W | - | 2 mm ∅ | UPK-8-L | 2 | 1 | 100 | 5-40°C | 1,2,4 | 91 |
| **LP-01Z-01** | Additional detector port for UPK-30-L integrating sphere of LP-01 for PD-11 type detectors or UFC-11/SMA socket | | | | | | | | | | | |
| **UFC-11/FC** | FC-type fiber socket adapter for the measurement port of LP-01 detectors with UPK-30-L integrating sphere | | | | | | | | | | | |
| **UFC-11/SC** | SC-type fiber socket adapter for the measurement port of LP-01 detectors with UPK-30-L integrating sphere | | | | | | | | | | | |
| **UFC-11/ST** | ST-type fiber socket adapter for the measurement port of LP-01 detectors with UPK-30-L integrating sphere | | | | | | | | | | | |
| **UFC-11/SMA** | SMA-type fiber socket adapter for the measurement port of LP-01 detectors with UPK-30-L integrating sphere | | | | | | | | | | | |
| **K-LP01xx** | Calibration of spectral radiant power sensitivity in A/W nm. xx = detector model number | | | | | | | | | | | |
| **K-LP0201** | Calibration of spectral radiant power sensitivity in A/W nm | | | | | | | | | | | |
| **KDW-S1** | Calibration of spectral radiant power sensitivity at one or a chain of wavelength in combination with accessory | | | | | | | | | | | |

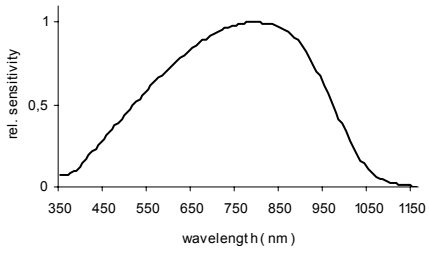
## LP-99 Series: Radiant Power Detectors with Barium Sulfate Integrating Sphere

**The LP-99** detectors are designed for general radiant power measurements of laser diodes and lasers in the wavelength range from 400 to 1700 nm.
The use of a 50 mm diameter integrating sphere as light collector offers a large 12.7 diameter measurement port and negates the need for using large diameter photodiodes. Small size photodiodes offer lower cost, higher shunt resistance and low capacitance. Also through its multiple reflectance characteristic, integrating spheres can reduce polarization effects, the risk of beam misalignment, signal bounce-back and PTD saturation. Barium sulfate is a cost effective white diffuse coating for larger diameter integrating spheres. It's 97 % reflectance in the visible spectral range exhibits low attenuation making high sensitivity sphere based detectors possible. The LP-99 detectors are built around a 50 mm diameter sphere with a 12.5 mm aperture. A unique Gigahertz-Optik baffle design offers a large light acceptance angle without direct detector irradiation.

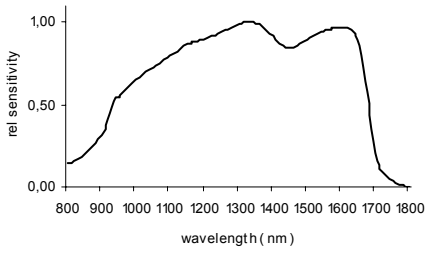

*LP-9930 with 2-Channel Optometer P-2000*

*LP-9910*

The LP-9910 is supplied with a Si photodiode covering the 400 to 1100 nm wavelength range.
The LP-9920 is supplied with an InGaAs photodiode for the 800 to 1800 nm range.
The LP-9930 offers both a Si and InGaAs photodiode for broadband use from 400 to 1800 nm with a 2-channel optometer.
The open port configuration is standard for direct measurement of laser diodes, LEDs or lasers.
**Calibration** of spectral radiant power sensitivity in A/W nm is provided.




*LP-9910*



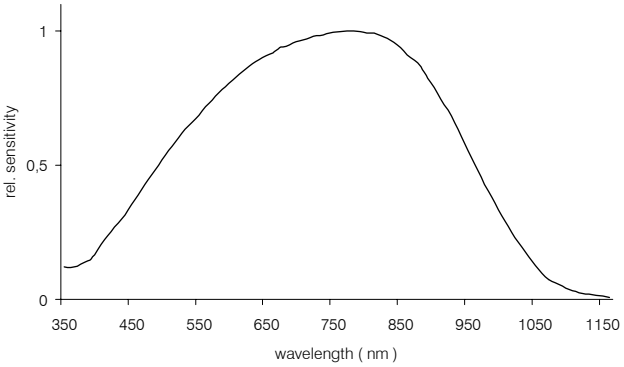

*LP-9920*

| Ordering Information & typical Specifications | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Model** | λresp | Wavelength Range | Typical Sensitivity | | Sphere | | cable | Imax. | ϕmax | Operation Temp. | plug | package |
| | Photodiode | | 633 nm | 1300 nm | Port | Diameter | m | mA | mW | | | page |
| **LP-9910** | Si | 400-1100 nm | 2.5 mA/W | - | 12.5 mm ∅ | UPB-50-L | 2 | 1 | 500 | 5-40°C | 1,2,4 | 91 |
| **LP-9920** | InGaAs | 800-1800 nm | - | 0.3 mA/W | 12.5 mm ∅ | UPB-50-L | 2 | 1 | 500 | 5-40°C | 1,2,4 | 91 |
| **LP-9930** | Si & InGaAs | 400-1800 nm | 2.5 mA/W | 0.3 mA/W | 12.5 mm ∅ | UPB-50-L | 2 | 1 | 500 | 5-40°C | 1,2,4 | 91 |
| **LP-99Z-01** | Additional detector port for UPB-50-L integrating sphere of LP-99 for PD-11 type detectors or UFC-11/SMA socket | | | | | | | | | | | |
| **K-LP99xx** | Calibration of spectral radiant power sensitivity in A/W nm. xx = detector model number | | | | | | | | | | | |
| **KDW-S1** | Calibration of spectral radiant power sensitivity at one or multiple wavelengths in combination with accessory components | | | | | | | | | | | |

Gigahertz-Optik

## Laser Power & Laser Pulse Shape

### LPPA-99: Laser Power and Pulse Shape Detector




Optoelectronic sensing systems such as laser range finders, profile scanners, distance sensors for example, make use of pulsed lasers generating high peak power and pulse lengths in the order of nanoseconds.

For general analysis or for reasons of safety the pulse shape of a single pulse or pulse train needs to be measured, a high speed detector with a rise time shorter than that of the laser pulse is required.

These photodiodes must be very low capacitance as well as offer a deep depletion zone to avoid photon absorption outside the depletion zone.

Photodiodes with small active areas cannot be used to measure radiant power at a risk that the laser beam would be larger than the photodiodes area creating measurement error.

Conventional PIN photodiodes require a large bias voltage for full depletion for long wavelengths above 800 nm.

The LPPA-99 series detectors are designed around a 50 mm diameter integrating sphere. The large 12.7 mm diameter measurement port allows the measurement of large diameter laser beams and laser diodes with divergent beams. A low-profile type Si photodiode provides a fast rise time even at 1060 nm. A baffle protects the photodiode from direct radiation exposure from the entrance port.

These unique features make the LPPA-99 detectors the right choice for pulse analysis of short and high peak power laser pulses in the absolute units of watts (W).

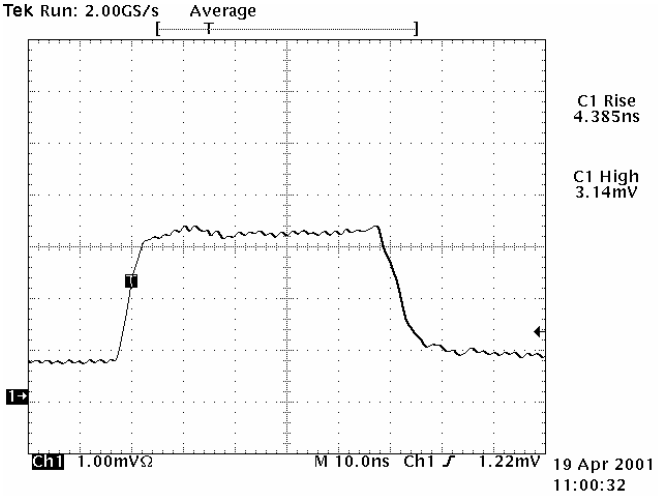
The Low Profile photodiode is operated with 12 V reverse bias, and is placed in series with a load resistor to create a voltage signal that correlates to the radiant power. The detector connects to a fast sensitive oscilloscopes to display the pulse shape.

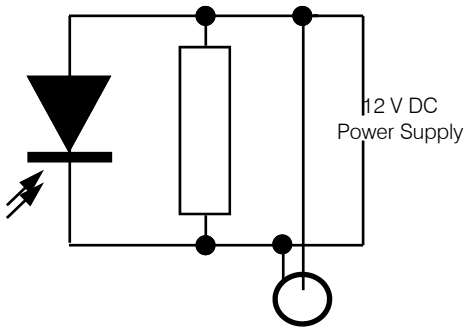
Digital storage oscilloscopes enable the user to store individual pulse shapes.

Three LPPA-99 models are available with different sensitivities and rise times.

The spectral sensitivity of the detectors in V/W nm is calibrated in 10 nm increments from 400 to 1060 nm.

Calibration is carried out at Gigahertz-Optik's Calibration Laboratory for Optical Radiation Quantities, and is confirmed by a factory certificate.




Output: SMC Socket for 50 Ohm Coaxial Cable

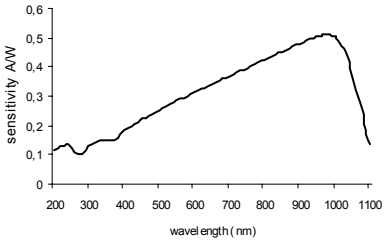
**Ordering Information & typical Specifications**

| Model | λresp | Wavelength Range nm | Typical Sensitivity | | ϕmin | ϕmax | Rise Time ns | Sphere Dimension | | cable | Load | plug | package |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Photodiode | | 633 nm | 900 nm | @800 nm | | | Port | Diameter | m | Ohm | | page |
| **LPPA-9901** | Si LP | 400-1060 | 50 mV/W | 50 mV/W | 5 mW | 100 W 1) | ≤ 8 | 12.5 mm ∅ | 50 mm | 2 | 50 | BNC | 91 |
| **LPPA-9902** | Si LP | 400-1060 | 15 mV/W | 15 mV/W | 15 mW | 333 W 1) | ≤ 5 | 12.5 mm ∅ | 50 mm | 2 | 50 | BNC | 91 |
| **LPPA-9903** | Si LP | 400-1060 | 1 mV/W | 1 mV/W | 200 mW | 5 kW 1) | ≤ 2 | 12.5 mm ∅ | 50 mm | 2 | 50 | BNC | 91 |
| **K-LPPA99** | Calibration of spectral radiant power sensitivity in V/W nm. | | | | | | | | | | | | |

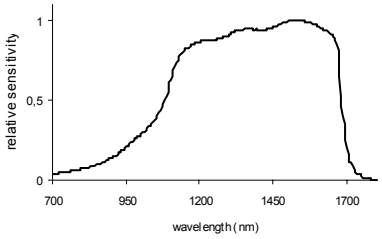
1) Pulse peak power only! Average power should not exceed 500 mW

## Modular Light Detectors

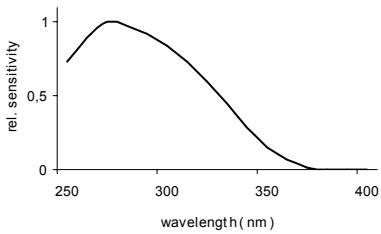
Modular light detectors offer a mechanical interface which allows accessory components such as optical filters, integrating spheres, diffuser windows and other front-end optics to be easily attached and interchanged.
A wide range of base detectors are stocked of different photodiode type and active area. This permits selection of the best fit photodiode spectral sensitivity, light responsivity, rise and fall time for the specific job.
The following spectral plots show the typical spectral sensitivities of the photodiodes available in the PD-11, TD-11 and MD-37 series modular detectors.
Note that spectral sensitivity will change when the detector is combined with an input optic component including integrating spheres. For this reason the actual measured spectral sensitivity of any detector accessory combination is provided in the detector calibration certificate. Calibrations are optional and ordered separately .



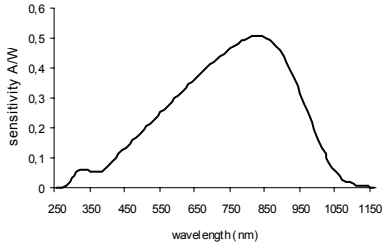

*Si Photodiode*



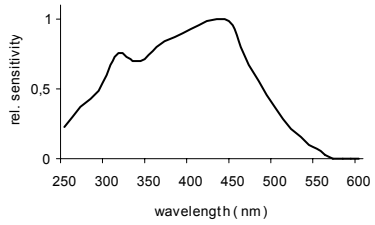

*InGaAs Photodiode*



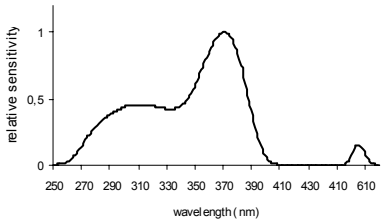

*SiC Photodiode*




*Low Profile Si Photodiode*




*GaP Photodiode*




*GaAsP Photodiode*

## PD-11: Compact Size Modular Detectors

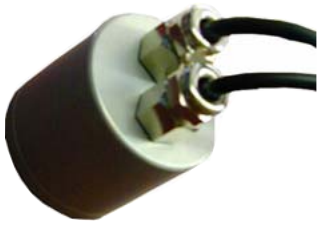
The **PD-11** series modular detectors are primarily designed to be used in combination with Gigahertz-Optik integrating spheres. A typical application example for sphere based detectors is the measurement of radiant power of lasers, laser diodes and other monochromatic light sources.
**The PD-11** detectors offer a compact package with flange mount to all spheres with 11-type port adapters. Arrangement of discrete linear arrays with a grid size of 11 mm are also possible.
Calibrations are offered with or without accessory.

**Ordering Information & typical Specifications**

| Model | Photodiode | | | | | Typ. Sensitivity A/W | | | Imax. | Operating Temp °C | plug | cable | package |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | λresp | Resp. | λrange nm | mm² | Size mm | @ 350 nm | @ 900 nm | @ 1350 nm | mA | | | m | page |
| **PD-1101** | Si | Page | 200-1100 | 13 | 3.6 x 3.6 | 0.15 | 0,5 | - | 1 | 5 to 40 | 1,2,4 | 2 | 90 |
| **PD-1102** | InGaAs | 85 | 800-1800 | 0.07 | 0.3 ∅ | - | 0.14 | 0.9 | 1 | 5 to 40 | 1,2,4 | 2 | 90 |
| **PD-1103** | InGaAs | 85 | 800-1800 | 0.79 | 1 ∅ | - | 0.14 | 0.9 | 1 | 5 to 40 | 1,2,4 | 2 | 90 |
| **PD-1104** | InGaAs | 85 | 800-1800 | 7.1 | 3 ∅ | - | 0.14 | 0.9 | 1 | 5 to 40 | 1,2,4 | 2 | 90 |
| **PD-1105** | SiC | 85 | 200-400 | 1 | 1.1 x 1.1 | 0.02 | - | - | 0.05 | 5 to 40 | 1,2,4 | 2 | 90 |
| **PD-1106** | Si LP | 85 | 400-1050 | 0.25 | 0.5 x 0.5 | 0.06 | 0.4 | - | 1 | 5 to 40 | 1,2,4 | 2 | 90 |
| **PD-1107** | Si LP | 85 | 400-1050 | 3.6 | 1.9 x 1.9 | 0.06 | 0.4 | - | 1 | 5 to 40 | 1,2,4 | 2 | 90 |
| **PD-1108** | Si LP | 85 | 400-1050 | 11.9 | 3.4 x 3.4 | 0.06 | 0.4 | - | 1 | 5 to 40 | 1,2,4 | 2 | 90 |
| **PD-1109** | GaP | 85 | 250-550 | 1.0 | 1.1 x 1.1 | 0.07 | - | - | 0.1 | 5 to 40 | 1,2,4 | 2 | 90 |
| **PD-1110** | GaAsP | 85 | 200-760 | 5.2 | 2.3 x 2.3 | 0.04 | - | - | 0.1 | 5 to 40 | 1,2,4 | 2 | 90 |

| | |
|---|---|
| **K-PD11xx** | Calibration of relative spectral sensitivity. xx = detector model number |
| **KDW-S1** | Calibration of spectral radiant power sensitivity at one or multiple wavelengths in combination with an integrating sphere |
| **KDW-S2** | Calibration of spectral irradiance sensitivity at one or multiple wavelengths in combination with a diffuser |
| **KDW-S3** | Calibration of spectral radiance sensitivity at one or multiple wavelengths in combination with radiance front tube/lens |
| **KDW-S4** | Calibration of spectral radiant intensity sensitivity at one or multiple wavelengths |

## TD-1101, TD-1102 and TD-1103: Temperature Controlled Modular Detectors



The **TD-11 family of** detectors are designed with a unique temperature control feature. The photodiode is precisely heated and maintained at a higher operation temperature than the ambient temperature.
This function ensures measurement accuracy when these detectors are to be used in applications with widely varying ambient temperatures as in laser power measurements involving sphere based detectors for example.
The control electronics are housed in an external box with a plug in power supply.
Both silicon and indium gallium arsenide photodiodes are offered for the wavelength range 200 to 1100 nm and 800 to 1800 nm respectively.
TD-11 detectors can be direct mounted to all spheres with 11-type port adapters.
Calibrations are offered for the detector with or without any accessory components.

**Ordering Information & Specifications**

| Model | Photodiode | | | | | Typ. Sensitivity A/W | | | Imax. | Operating Temp °C | plug | cable | package |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | λresp | page | λrange nm | mm² | Size mm | @ 350 nm | @ 900 nm | @ 1350 nm | mA | | | m | page |
| **TD-1101** | Si | 27 | 200-1100 | 13 | 3.6 x 3.6 | 0.15 | 0.5 | - | 1 | 55 | 1,2,4 | 2 | 90 |
| **TD-1102** | InGaAs | 27 | 800-1800 | 0.07 | 0.3 ∅ | - | 0.14 | 0.9 | 1 | 55 | 1,2,4 | 2 | 90 |
| **TD-1103** | InGaAs | 27 | 800-1800 | 0.79 | 1 ∅ | - | 0.14 | 0.9 | 1 | 55 | 1,2,4 | 2 | 90 |
| **K-TD11xx** | Calibration of relative spectral sensitivity. xx = detector model number | | | | | | | | | | | | |
| **KDW-S1** | Calibration of spectral radiant power sensitivity at one or multiple wavelengths in combination with an integrating sphere | | | | | | | | | | | | |
| **KDW-S2** | Calibration of spectral irradiance sensitivity at one or multiple wavelengths with a diffuser | | | | | | | | | | | | |
| **KDW-S3** | Calibration of spectral radiance sensitivity at one or multiple wavelengths in combination with radiance front tube/lens | | | | | | | | | | | | |
| **KDW-S4** | Calibration of spectral radiant intensity sensitivity at one or multiple wavelengths wavelengths | | | | | | | | | | | | |

## MD-37: Modular Detector

The modular light detectors of the MD-37 series feature a M30x1 threaded front interface for fast and simple screw-on assembly of mating accessory components.
For multi-purpose use modular detectors offer a wide range of base photodiode detector types and different active areas. This provides a great degree of freedom in selecting a spectral sensitivity, light responsivity, rise and fall time for a specific job.
M30x1 is the standard thread size for all 37-type accessories which mate to the MD-37 detectors.
Some typical detector set-ups for the MD-37 series include:

- Broadband irradiance detectors (MD-37 with MD-37Z-DR11 diffuser front cap)
- Narrow band irradiance detectors (MD-37 with narrow band pass filter assembled in MD-37Z-H7 plus diffuser front cap MD-37Z-FR11)

Calibrations are offered with or without accessory components attached.

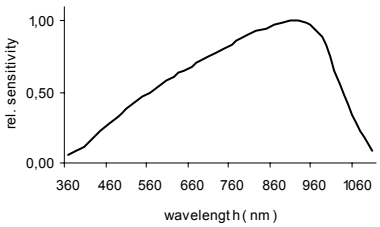
**Ordering Information & Specifications**

| Model | Photodiode | | | | | Typ. Sensitivity A/W | | | Imax. | Operating Temp °C | plug | cable | package |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | λresp | Resp. | λrange nm | mm² | Size mm | @ 350 nm | @ 900 nm | @ 1350 nm | mA | | | m | page |
| **MD-37-GP6** | GaP | 27 | 250-550 | 6.25 | 2.5 x 2.5 | 0.07 | - | - | 0.1 | 5 to 40 | 1, 2, 4 | 2 | 90 |
| **MD-37-GAP5** | GaAsP | 27 | 200-760 | 5.29 | 2.3 x 2.3 | 0.04 | - | - | 0.1 | 5 to 40 | 1, 2, 4 | 2 | 90 |
| **MD-37-IGA1** | InGaAs | 27 | 800-1800 | 0.79 | 1 ∅ | - | 0.14 | 0.9 | 1 | 5 to 40 | 1, 2, 4 | 2 | 90 |
| **MD-37-IGA3** | InGaAs | 27 | 800-1800 | 7.1 | 3 ∅ | - | 0.14 | 0.9 | 1 | 5 to 40 | 1, 2, 4 | 2 | 90 |
| **MD-37-SC1** | SiC | 27 | 800-1800 | 1 | 1 sq | 0.02 | - | - | 0.05 | 5 to 40 | 1, 2, 4 | 2 | 90 |
| **MD-37-SU13** | Si | 27 | 200-1100 | 12.96 | 3.6 x 3.6 | 0.15 | 0.5 | - | 1 | 5 to 40 | 1, 2, 4 | 2 | 90 |
| **MD-37-SU33** | Si | 27 | 200-1100 | 33,64 | 5.8 x 5.8 | 0.15 | 0.5 | - | 1 | 5 to 40 | 1, 2, 4 | 2 | 90 |
| **MD-37-SU100** | Si | 27 | 200-1100 | 100 | 10 x 10 | 0.15 | 0.5 | - | 1 | 5 to 40 | 1, 2, 4 | 2 | 90 |
| **MD-37Z-C11** | Front cap with 11 mm diameter aperture | | | | | | | | | | | | |
| **MD-37Z-DR11** | Front cap with 11 mm diameter RADIN diffuser | | | | | | | | | | | | |
| **MD-37Z-H7** | Front adapter and/or filter holder for 0.5 to 1 inch diameter filters | | | | | | | | | | | | |
| **MD-37Z-H7xx** | Front adapter with custom specified band-pass or edge filter. xx = filter type | | | | | | | | | | | | |
| **K-PD37xx** | Calibration of relative spectral sensitivity. xx = detector model number | | | | | | | | | | | | |
| **KDW-S1** | Calibration of spectral radiant power sensitivity at one or multiple wavelengths in combination with an integrating sphere | | | | | | | | | | | | |
| **KDW-S2** | Calibration of spectral irradiance sensitivity at one or multiple wavelengths in combination with a diffuser | | | | | | | | | | | | |
| **KDW-S3** | Calibration of spectral radiance sensitivity at one or multiple wavelengths in combination with radiance front tube/lens | | | | | | | | | | | | |
| **KDW-S4** | Calibration of spectral radiant intensity sensitivity at one or multiple wavelengths | | | | | | | | | | | | |

## PD-93: 1 cm² Circular Area Modular Light Detectors

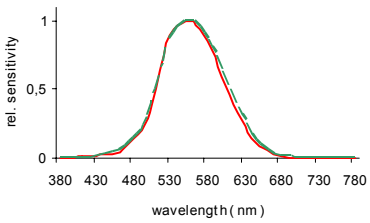
Modular light detectors using photodiodes with a one square centimetre circular active area have been offered by Gigahertz-Optik since 1986. The symmetry of a circular detection area combined with a large 11.28 mm diameter has made these detectors a standard for many applications.
The area around the light sensitive 1 cm² area is metal shielded and thus insensitive to light so that irradiance (W/cm²) can easily be calculated from a known radiant power (W) assuming the active area is to be evenly overfilled.
The photodiodes mounted into a housing that can be fastened into optical test arrangements using the threaded M6 and 1/4-20 side holes. The front of the housing is internally threaded into which accessories can be attached (common 1.3/16-24-UNS thread size). In addition to two different photodiodes, Gigahertz-Optik offers accessories to form a wide variety of detector configurations The simple design of the mechanical parts also means that special custom fabrications can be prepared easily and economically for solutions to particular applications. Our sales engineers are ready to work with you and provide advice on standard and custom configurations.

## PD-9304: 1 cm² Si-Photodiode




The **PD-9304** is a large, 1 cm² photodiode for general light measurement purposes and for use in combination with PD-93VL and PD-93RW photometric and radiometric correction filters for illuminance and integral irradiance measurements.

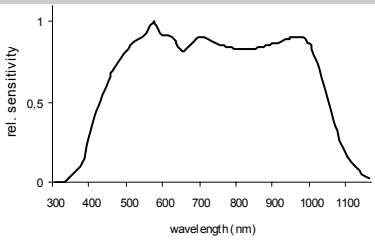
## PD-93VL: Photometric Filter




*Typical spectral sensitivity with PD-9304*

The **PD-93VL** V(λ) correction filter screws directly onto the PD-9304 detector. It's built into the PD-9302 filter holder which is internally and externally threaded (1.3/16-24-UNS) for mating to PD detectors and to accept accessories.

## PD-93RW: Radiometric Filter




*Typical spectral sensitivity with PD-9304*

The **PD-93RW** filter built into the PD-9302 filter holder, gives the PD-9304 a radiometric flat spectral sensitivity within the wavelength range from 400 and 1000 nm.

## PD-93COS: Diffuser

The **PD-93COS** diffuser cap generates a field of view approximating a cosine-corrected function, enabling the measurement of illuminance or irradiance. The diffuser screws onto the PD-9302 or PD-9304.

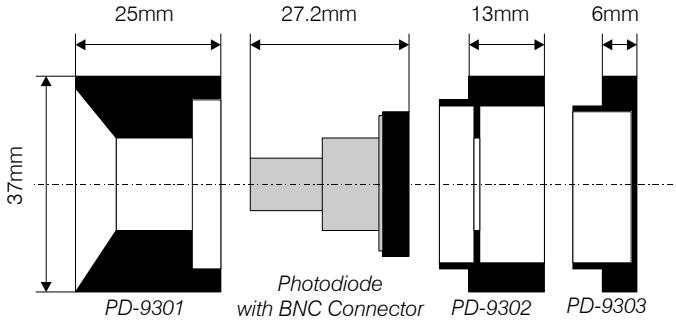
## PD-9302: Universal

The **PD-9302** universal holder is 1.3/16-24-UNS internally and externally threaded suitable for attachment to the **PD-9301** detector housing. One inch diameter filters like neutral density, band pass and correction filters can be mounted into it.

## PD-9303: Front Cap

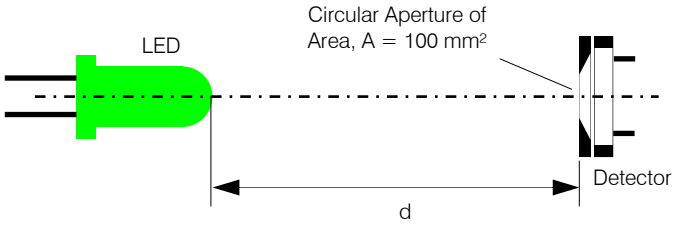
The PD-9303 cap can be used as an end piece on the PD-9301 detector housing, or the PD-9302 universal holder.

## PD-9302: Modular Schematic




## PD-9311 & PD-9312: Averaged LED Intensity Front Tubes

One of the parameters most commonly used to specify LEDs is the directional output intensity. This radiometric or photometric intensity is derived from the flux incident on a detector by the LED at specified distance.
A detector with a circular entrance aperture having 100 mm² (11.3 mm diameter) is specified for the CIE standard A and B measurement conditions for average LED intensity. The distance between the front tip of the LED and the plane of the entrance aperture of the detector is stated at d = 316 mm for CIE standard condition A and d = 100 mm for standard condition B. This corresponds to solid angles of view of 0.001 sr for Condition A and 0.01 sr for Condition B. The PD-9311 and PD-9312 front tubes attach to the PD-9304 detector with either PD-93VL photometric or PD-93RW radiometric filter for CIE Condition A and B conformal measurements. Calibration of the average LED Intensity sensitivity in cd and W/sr is offered by Gigahertz-Optics calibration laboratory.

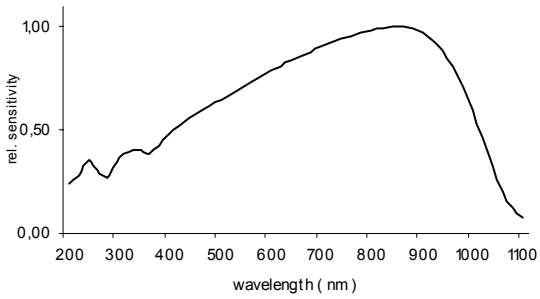



Gigahertz-Optik

## Modular, Weather Proof

### PD-9306: 1 cm² Circular Area Light Detector

The **PD-9306** is a large area 1 cm² UV-enhanced silicon photodiode for spectral radiant power and/or spectral irradiance measurements. It's large diameter active area offers higher signals for applications with low intensity monochromatic radiation.
The detector is supplied in the PD-9301 housing with internal 1.3/16-24-UNS front thread to accept other accessory components. A 2 m long coaxial cable with BNC plugs can be coupled to the BNC connector at the end of the photodiode.
Calibration of spectral radiant power sensitivity is supplied by the Gigahertz-Optik's calibration laboratory as required.




**Ordering Information & Specifications**

| Model | λresp | Wavelength Range | Typical Sensitivity | | Sensing Area Photodiode | Imax mA | cable m | Operating Temp °C | plug | package page |
|---|---|---|---|---|---|---|---|---|---|---|
| **PD-9304** | Si Photodiode | 380-1100 nm | 0.4 | A/W @ 633 nm | 1 cm² | 1 | 2 | 5 to 40 | 1,2,4 | 91 |
| **PD-93VL**&PD-9304 | V(λ) | 380-780 nm | 28 | nA/lx | 1 cm² | 1 | 2 | 5 to 40 | 1,2,4 | 91 |
| **PD-93COS**&PD-93VL&PD9304 | V(λ) | 380-780 nm | 2.8 | nA/lx | 1 cm² | 1 | 2 | 5 to 40 | 1,2,4 | 91 |
| **PD-9311**&PD93-VL&PD-9304 | V(λ) | 380-780 nm | 2.6 | µA/cd | 1 cm² | 1 | 2 | 5 to 40 | 1,2,4 | 91 |
| **PD-93RW**&PD-9304 | Radiometric | 400-1100 nm | 0.2 | A/W @ 800 nm | 1 cm² | 1 | 2 | 5 to 40 | 1,2,4 | 91 |
| **PD-93COS**&PD-93RW&PD-9304 | Radiometric | 400-1100 nm | 16 | mA/W/cm² | 1 cm² | 1 | 2 | 5 to 40 | 1,2,4 | 91 |
| **PD-9311**&PD-93RW&PD-9304 | Radiometric | 400-1100 nm | 1.8 | mA/W/sr | 1 cm² | 1 | 2 | 5 to 40 | 1,2,4 | 91 |
| **PD-9306** | UV Si | 250-1100 nm | 0.16 | A/W @ 350 nm | 1 cm² | 0.2 | 2 | 5 to 40 | 1,2,4 | 91 |
| **K-PD9304** | Calibration of spectral radiant power sensitivity in A/W/nm from 350 to 1100 nm in 10 nm steps | | | | | | | | | |
| **K-PD9306** | Calibration of spectral radiant power sensitivity in A/W/nm from 250 to 1100 nm in 10 nm steps | | | | | | | | | |
| **KDW-P2** | Calibration of illuminance sensitivity in lx of PD-9304/PD-93VL with or without PD-93COS | | | | | | | | | |
| **KDW-P4** | Calibration of average LED Intensity sensitivity in cd of PD-9304&PD-93VL&PD-9311 or PD-9312 | | | | | | | | | |
| **KDW-R2** | Calibration of irradiance sensitivity in W/m² of PD-9304/PD-93RW with or without PD-93COS | | | | | | | | | |
| **KDW-R4** | Calibration of average LED Intensity sensitivity in W/sr of PD-9304&PD-93RW&PD-9311 or PD-9312 | | | | | | | | | |
| **KDW-S** | Calibration of spectral sensitivity at one or multiple wavelengths without or with accessory components | | | | | | | | | |

### WPD: Weather Proof Detector

The **WPD** series weather proof detectors are designed for year round outdoor light measurements. To withstand all environmental conditions the light sensor is shielded in a rugged metal housing. The detector aperture is enclosed and sealed under a precision made quartz dome. Photodiode, filter and diffuser are temperature stabilized to +25 deg C by a peltier cooler. Temperature is stabilized to +/- 1 deg C for operation independent of the ambient conditions. The specified operating temperature range is –20 to + 50 deg. C. The electronics of the **PTC-0101** peltier temperature controller are supplied in a separate compact housing for bench-top or rack-mount use with cable connections.
In principle the sensor elements of all Gigahertz-Optik light detectors can be integrated into the WPD housing. The most common applications to date are in the ultraviolet spectral range. For example WPD detectors can serve as reference detectors for high resolution spectral radiometers monitoring global solar UV radiation.

The WPD water proof light detectors are normally connected with a Gigahertz-Optik signal amplifier or optometer for direct measurement of current or irradiance as well as data logging.

Due of the custom nature of this detector and supporting electronics interested customers should contact the factory to discuss his specific requirements .

## SRT-M37: Front Tubes and Front Lenses

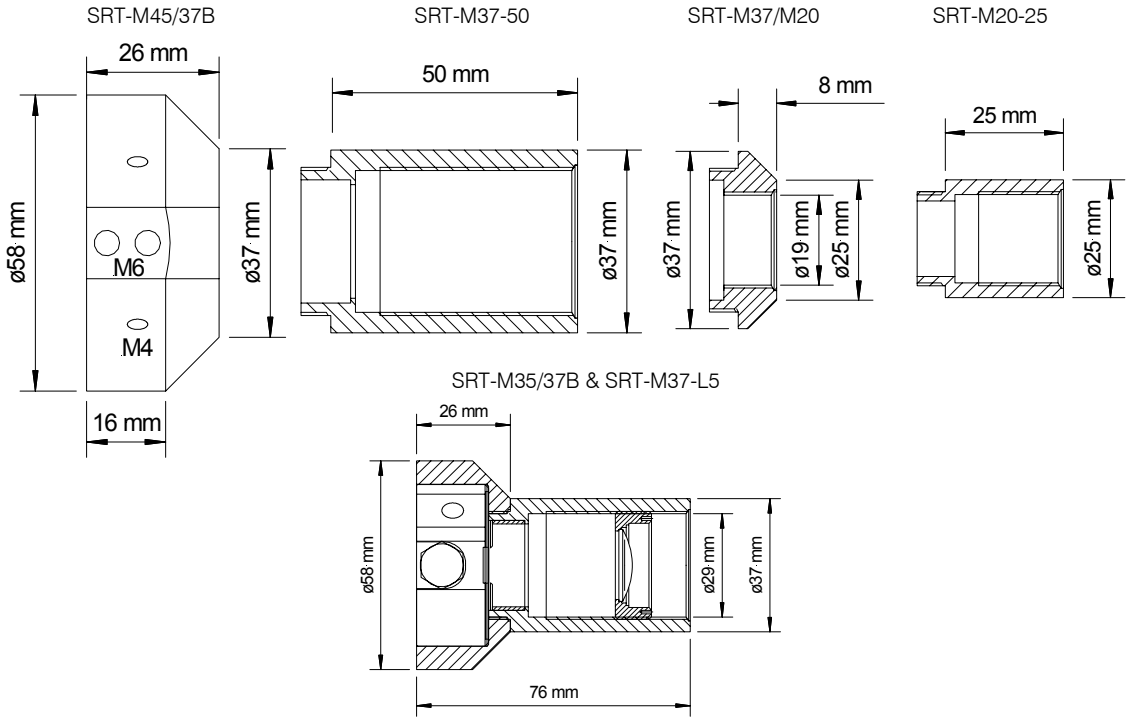
**SRT-M45/37B:** Base holder for coupling 45-type and 37-type standard light detector and 37-type solid angle tubes and SRT-37L front lenses.
M30x1 front thread. M6 and camera tripod (1/2"-20BSW) side mounting holes.

**Front Tubes:**

**SRT-M37-50:** 37 mm outside diameter tube, 50 mm length internally threaded over its complete length and externally threaded front end (both M30 x 1). Can be machined to any length down to 12.5 mm.
SRT-37-AB Apertures can be glued into the tube at either end.
**SRT-37/25:** Reducer to couple SRT-M37-50 to SRT-M25-25 to decrease the outside diameter of solid angle tubes.
**SRT-25-25:** 25 mm outside diameter tube, 25 mm length internally threaded over its complete length and externally threaded front end (both M20 x1 ). Can be machined to any length down to 12.5 mm.
**SRT-37-AB:** Aperture plate insert for SRT-M37 tubes. 2 mm diameter centering hole for drilling the aperture opening to the desired diameter.

**Front Lenses:**
The SRT-M37L Front Lenses are used with the 37-type (eg. VL-3701, RW-3701) or 45-type (eg. HCT-99) Gigahertz-Optik detectors to form economical luminance and radiance measurement set-ups. The detector plus front lens can be used for relative measurement or can be calibrated for direct readout in cd/m² or W/m²/sr with a Gigahertz-Optik optometer.
The SRT-M37L set-up consists of the SRT-M45/37B base holder which mounts onto the detector by means of its M30x1 threaded front and one of the SRT-M37L lenses mounted into it. Lenses are available with different field-of-views. The 25 mm diameter BK7 lens provides a „flat" wavelength range from 380 nm to 1500 nm. Quartz lenses are available on request

## Dimensions




| Ordering Information & Specifications | | | |
|---|---|---|---|
| **Model** | **Description** | **Min. Required Detector Aperture** | **Specifications with Detectors on Page** |
| **SRT-M45/37B** | Base holder to couple 45 and 37 type light detectors to SRT-M37 accessory | - | - |
| **SRT-M37-50** | 37 mm diameter front tube, 50 mm length and M30x1 thread | - | - |
| **SRT-M37/M20** | Adapter to mount 37 and 25 tubes together | - | - |
| **SRT-M20-25** | 25 mm diameter front tube, 25 mm length and M20x1 thread | - | - |
| **SRT-M37-AP** | Aperture plate to glue into SRT-M37-50 front tube. 2 mm center hole | - | - |
| **SRT-M37L-1** | Luminance & radiance front lens for SRT-M45/37B with 1° field-of-view | 0.7 mm Ø | 80 |
| **SRT-M37L-2** | Luminance & radiance front lens for SRT-M45/37B with 2° field-of-view | 1.4 mm Ø | 80 |
| **SRT-M37L-5** | Luminance & radiance front lens for SRT-M45/37B with 4.8° field-of-view | 3.4 mm Ø | 80 |
| **SRT-M37L10** | Luminance & radiance front lens for SRT-M45/37B with 10° field-of-view | 7 mm Ø | 80 |

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## Light Detector Accessories / Dimensions

### /WQ: Waterproof Detector Option

The /WQ Waterproof Option effectively seals any type-37 series detector housing. This modification enables full submersion of the detector in water and other liquids. UV/Vis/NIR underwater detectors can be custom tailored for many fields of study including:

- © Oceanography
- © Limnology
- © Aquaculture
- © Solar Bioeffects Research

Custom detector cable lengths and other user specific requirements are available through Gigahertz-Optik's custom design services.

A transparent dome, made from glass or UV transmitting quartz covers the cosine diffuser. The detector housing is sealed and filled with a drying agent (desiccant). This option cannot be retrofit as an after sales modification!

Please contact our application engineering department to discuss your underwater light measurement project.

| Ordering Information & Specifications | |
|---|---|
| **Model** | **Description** |
| **/WG** | Waterproof modification of 37 type detectors. Glass dome cap for VISIBLE to NIR , and internal modifications. Ordering P/N example: PS-3703-2/WG. |
| **/WQ** | Waterproof modification of 37 type detectors. Quartz dome cap for UV to NIR, and internal modifications. Ordering P/N example: PS-3702-2/WQ. |

### /LC: Cable Extension

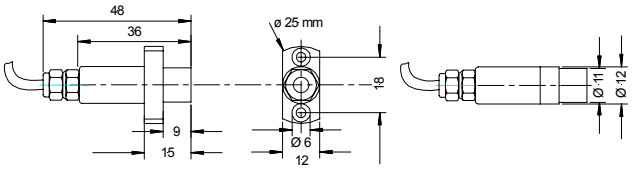
For long distance applications requiring the standard 2 m cable between optometer and light detector be extended. This option is offered for single channel detectors with BNC type (-1) and calibration type (-2) detectors only. For a VL-3701 detector requiring a total cable length of 5 m three 3 m /LC should be ordered since 2 m is already included in the detector price.

| Ordering Information & Specifications | |
|---|---|
| **Model** | **Description** |
| **/LC** | Cable extension in 1 m steps for light detectors with BNC type (-1) or calibration data type (-2) connectors |

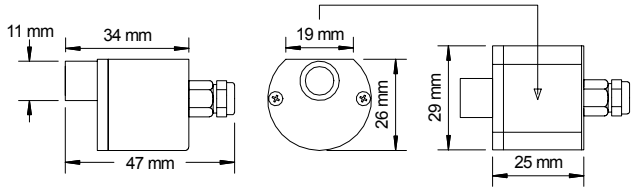
### BHO: Carrying Cases

Carrying cases are offered for storage and transporting light detectors and optometers. Please see Optometer chapter for information on available models.

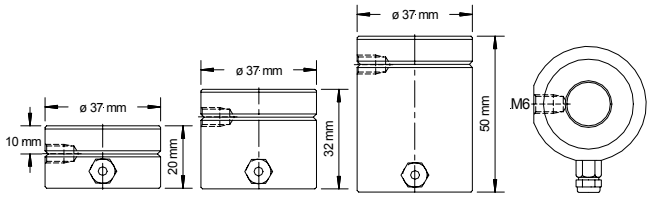
### 11 Type Housing Dimensions



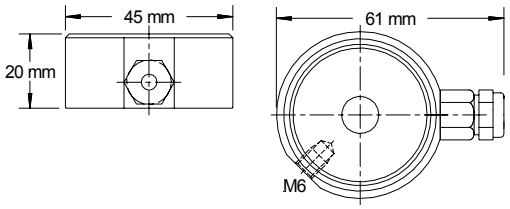

### TD-11 Type Housing Dimensions



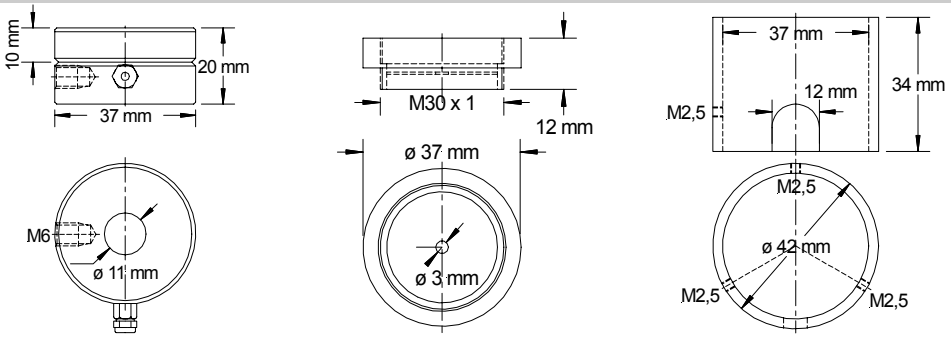

### 37 Type Housing Dimensions




### 45 Type Housing Dimensions

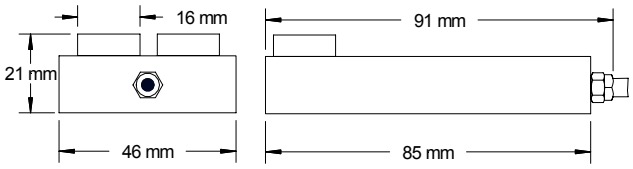



### MD-37 Type Housing Dimensions

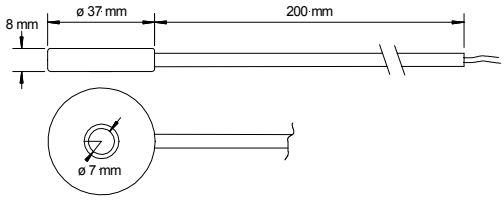


# Light Detector Dimensions

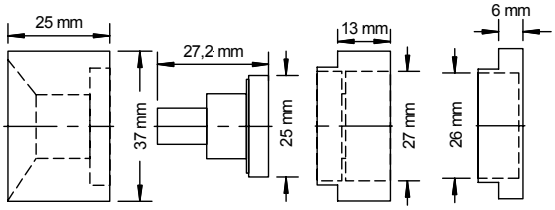
## XD-95 Series Housing Dimensions

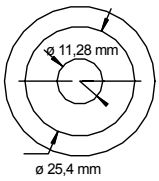


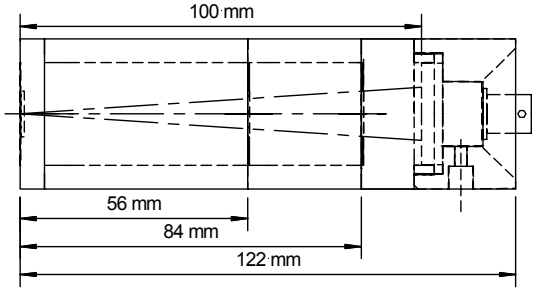

## LP-99 Housing Dimensions



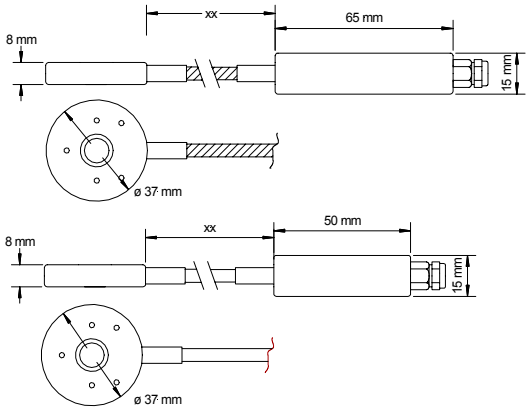

## PD-93 Series Housing Dimensions

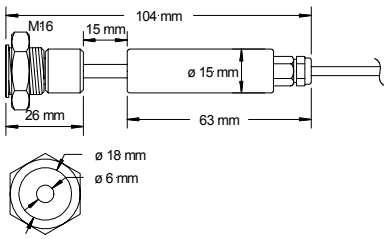


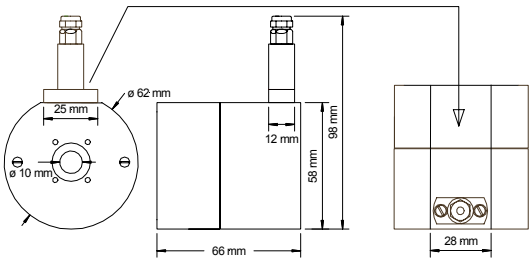




## RCH-0, RCH-1 and RCH-5 Housing Dimensions

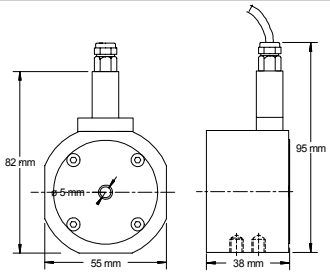


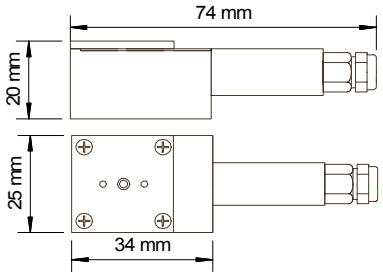

## LP-99, LSM-99 and PRW-05 Housing Dimensions



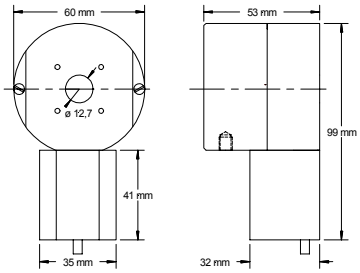

## LP-01 Series Housing Dimensions




## LP-02 Housing Dimensions




## LPPA-9901 Housing Dimensions



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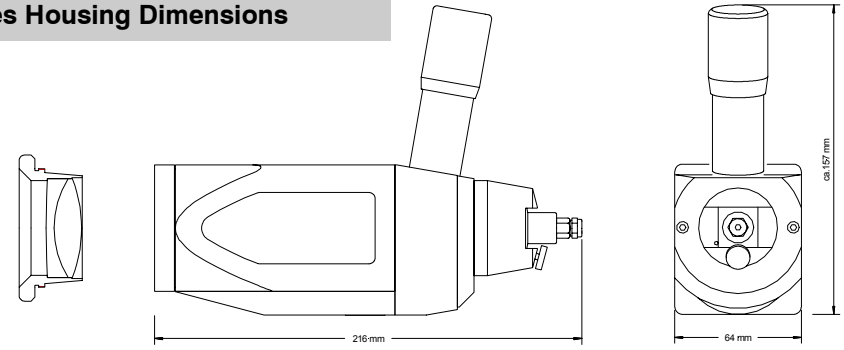
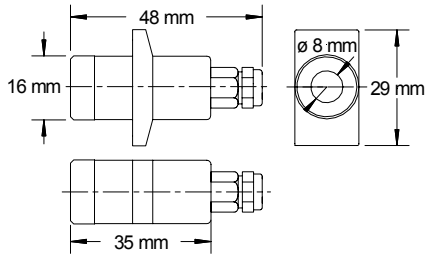
## Light Detector Dimensions

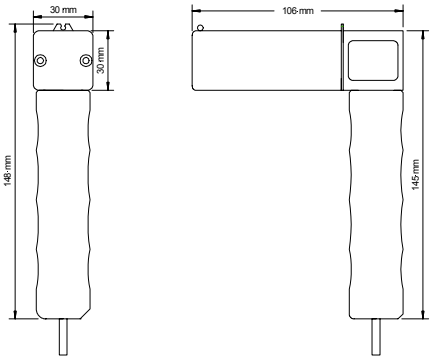
### LDM-98 Series Housing Dimensions



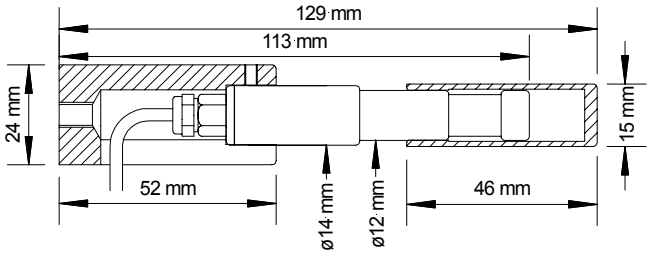

### PD-16 Series Housing Dimensions



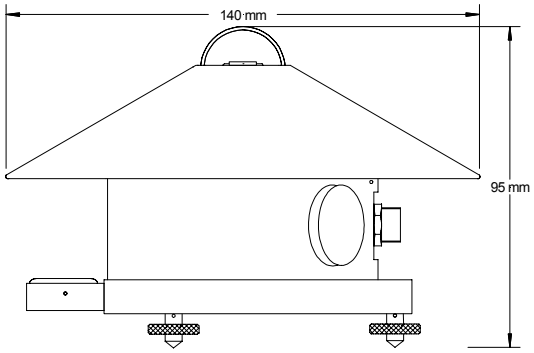

### LDM-9901 Housing Dimensions



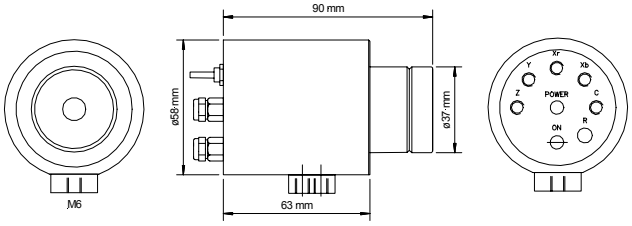

### ROD-360 Housing Dimensions




### WPD Series Housing Dimensions




### CT-3701 Housing Dimensions




### /WG and /WQ Option Dimensions

Example