

- © **Compact Single-Channel Meter for Service and Laboratory Use**
- © **Universal Use in any Light Measurement Application**
- © **Calibration Data Connector for Simple & Unlimited Detector Exchange**
- © **Measurement of DC, AC and Flash Signals**
- © **Short Slew-Rate for Fast Measurements**
- © **100 μ s Fast Sampling Rate**
- © **Adjustable Integration Time from 100 μ s to 6 s**
- © **Wide Detector Signal Dynamic Range from 0.1 pA to 2 mA**
- © **RS232 Interface for Remote Control Operation**
- © **Optional Windows Software**

Associated Parts / Service:

Chapter Detector Heads
Chapter Integrating Spheres
Chapter Calibration



The P-9710 Optometer is a highly efficient single-channel instrument designed for multipurpose use in any photometric and radiometric application.

In spite of its compact size it offers many high-level features complementing sixteen different measurement modes. These functions plus portability enable the P-9710 to be characterized as both a laboratory grade instrument and a field service meter.

Calibration Data Connector:

A unique feature of the P-9710 is its detector head calibration data connector. All data pertaining to a detector including the model and serial number are stored in the connector. When plugged into the meter, this data is automatically transmitted and the system is ready to go. This guarantees faultless handling of the instrument when used with any number of different detector heads.

Wide Dynamic Range:

The P-9710's wide signal range of 0.1 pA to 2 mA covers the dynamic range of most current semiconductor photodiodes for nearly unrestricted use in any light measurement application.

Fast Measurements:

The P-9710 offers a fast signal input with 2 to 10 ms slew-rate (gain dependent). Its fast 100 μ s sample rate allows use of the P-9710 as a fast data logger. Another key feature for individual application set-ups is an adjustable integration time (calculated average) of up to 6 seconds.

Precision Measurement:

The P-9710 offers a linear 12-bit ADC input with 8 manually or automatically selected gain ranges with a maximum error over this large dynamic range 0.2 %.

Remote Control:

A bi-directional RS232 serial interface allows external remote control. Optional Windows based software is available for a quick turn-key solution or user generated programming is possible using the complete command set supplied. End-user recalibration by adjustment of the factory programmed calibration factors is possible using the OS CAL software via the RS232 interface or manually by menu function.

Process Integration:

An optional relay switch board is available for activation by the P-9710 in process control applications. A 'low-ok-high' indication through menu controlled set-up of the limit values is simple.

Multiple Applications:

The P-9710 mates with most of

GO's detector heads to cover any photometric and radiometric measurement quantity.

Mobility:

The hand-held P-9710 is battery (rechargeable) or AC operated. A tough hard-shell case holds one, two or more detector heads for secure portability in service use.

Numerous Functions:

The unit's many functional modes of operation includes CW, dose, pulse energy, data-logger measurements and many more. If the sixteen different operation modes do not include the one you need we do offer custom design modifications.

Two Different Models:

The P-9710-1 is the right choice for most kinds of light measurement applications. Its short range dependent slew-rate allows the measurement of fast changing high power level sig-

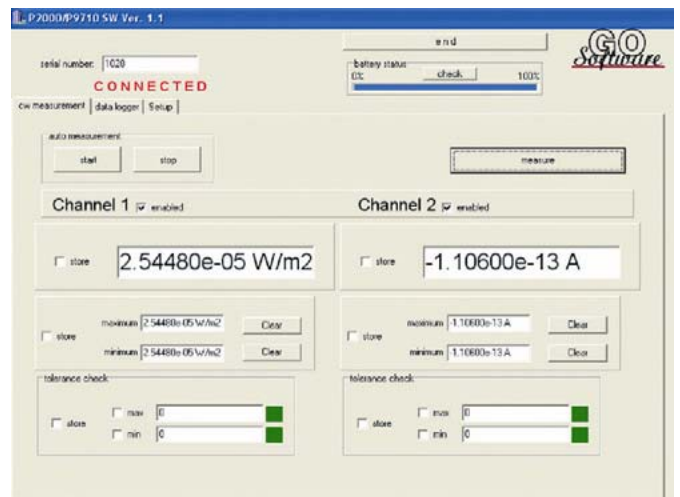
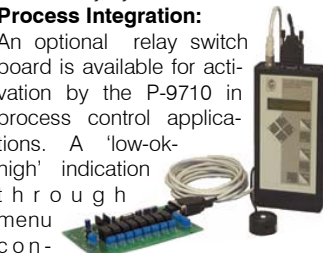
nals. In the pulse energy mode the energy of single pulses > 20 ms in pulse length can be measured.

The P-9710-2 is required if the energy of a single pulse or pulse-chain of pulse lengths > 1 μ s must be measured. The 20 ms slew-rate is independent of the gain range.

Other than the difference in pulse width measurement capa-



bility both versions offer the same functionality and technical qualities.



P-9710-1 / P-9710-2 Applications

Features like multiple functional modes, bench-top laboratory level specs and calibration data connector for error-free detector interchange make the P-9710 the

right instrument for many field-service, laboratory and process applications. To complete the system, one or more of GO's wide range of photometric and

radiometric detectors must be selected for use with the P-9710.

Our **Light Measurement Guide**, available in our catalog

and on our website, offers additional tutorials and application notes relating to the Measurement of Light and Measurement with Light.

Illuminance and Luminance Photometer

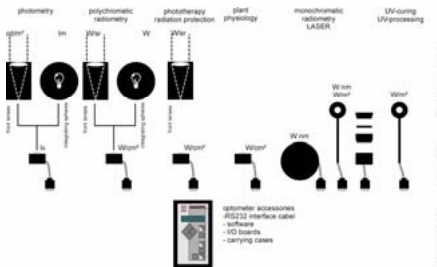
Because of its wide dynamic range the P-9710 is suitable for high-level photometric applications. In combination with the VL-3701-2 detector, illuminance levels from 100 mx (1 mx resolution) to 1,000 kx can be measured. The LDM-9810-2 luminance detector head extends the application range of the P-9710. It's

three selectable viewing angles of 20°, 1° and 6° plus its brilliant ocular view allow the precise location of the measurement area of interest. Both detector heads offer a low CIE standard V(Lambda) photometric matching uncertainty f_1 equal to or less than 3% (DIN Class A).



Universal Light Meter

The P-9710's calibration data connector ensures that you never have to remember to up-date the meter set-up when changing detector heads. This feature becomes very important if the P-9710 is to be used in multiple applications involving different detector heads. With so many modes of operation available,



this is often the case. The P-9710 is the right choice when maximum versatility is a requirement.

UV-Hazard Meter

The adverse effects of overexposure to incoherent optical radiation on skin and eye is being afforded increasing attention. The reasons can be attributed to rising ultraviolet levels in sunlight and the widespread use of high powered lamps in light therapy, cosmetics, UV curing, UV surface inspection, UV sterilization and others. A growing number of regulations exist describing how to measure, assess and classify light sources according to poten-

tial UV hazard. Typical spectral weighting functions for the acutely harmful effects of optical radiation are ACGIH, Erythema and Blue-Light Hazard. The flexible P-9710 with the UV-3704-2 (erythema), UV-3708-2 (ACGIH) irradiance detectors and the LDM-9811 (Blue-Light Hazard, Retinal thermal hazard) radiance detector offer all required functional modes and features for accurate UV hazard measurement.

Effective Luminous Intensity Meter

To increase the intensity of light sources with limited average power they are used in flash mode which allows much higher peak power and the CW peak power do not show a linear correlation. Because of this evaluation of the effective intensity of pulsed light signals is done according to the Schmidt-Clausen method using with two different

time constants C for daylight observation (0.1 s for light adapted eye) and night time observation (0.2 s for dark adapted eye).



Laser Stray-Light Meter

Laser are very useful tools in many measurement and production applications due to the attributes of high power, monochromatic and directional beam radiation. But laser radiation is also a health risk to the human eye. Laser stray-light (indirect or scattered) may even be a risk due to these high power levels. Standard EN 60825-1/11.01 describes these risks and measurements for hazard classifica-

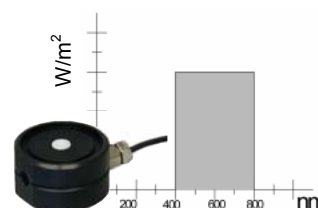
tion. The common tool used to measure laser stray-light employs detectors such as the LP-9901 with a 7 mm dia. free aperture which mimics the open pupil. The functional operation modes of P-9710 such as peak hold, data-logger & pulse energy support these measurement



VIS-NIR Radiometer / Pyrometer

Radiometric measurements, such as irradiance (W/m^2), in the visible and near infrared part of the optical radiation spectrum are getting more attention since more VIS & NIR sources are being used in sensor, photomedicine, photocuring and other applications. Gigahertz-Optik offers different types of detector heads for use with the P-9710 for irradiance measurements in the visible (400

to 800 nm), VIS/NIR (400-1100 nm), NIR/IR (800-1800 nm) including specific spectral ranges within the 400 to 1800 nm region.



Radiant Power and Laser Power Meter

Light sources with diverging (non collimated) beams such as LED's, laser diodes & dispersed laser beams measured with flat surface photodiodes may cause high measurement uncertainties due to differing incident angles and polarization. The re-reflected light from the detector surface can cause additional problems by interference effects in the

cavities of laser diodes. To avoid these problems power detectors mounted to integrating spheres are recommended. Gigahertz-Optik offers sphere based detectors from 8 to 500 mm diameter for use with the P-9710.



Flash Energy Meter

Short pulse length flash lamps, normally associated with photographic strobes, are also used in ophthalmology and UV-curing processes. Measurement of the energy in a single light flash or in a pulse train of light flashes is typically done using light meters that store the detected signal in a capacitive circuit. In applications with very different pulse

energy levels, common to light measurement, these meters are not very linear and difficult to calibrate. The P-9710 performs flash measurements using the extended pulse sampling method (EPSM) offering higher linearity for flashes $\geq 1\mu s$. Calibration with DC calibration source standards ensure much lower calibration uncertainties.

Plant Physiology Meter >> Section Tutorials

LED Luminous Flux Meter >> Section Tutorials

LED Luminous Intensity Meter >> Section Tutorials

UV Curing Meter >> Section Tutorials

Power Meter for Telecom Application >> Section Tutorials

Detector Heads for use with P-9710 >> Section Light Detectors

P-9710-1 & -2, Operation Function Modes & Specifications

Operation Modes:

Because of its unique electronic design and its powerful micro-processor the P-9710 optometer is more than just a simple instrument for light intensity readings.

Sixteen different modes of operation (functions) in combination with variable measurement parameter set-up capabilities makes the P-9710 one of the

most flexible and powerful meters available. It can be found in both manual and remote control use in process control, long-term stability monitoring, service,

teaching and R&D applications. This page shows the currently available functions and specifications. Custom design for user specified functions is available.

CW Measurement

CW mode is used to measure continuous DC or AC signals at the selected integration time from 100 μ s to 6 s. The reading, units of measurement and the

selected wavelength as applicable for the connected detector are displayed on the LCD. Manual or auto-range operation as selected.

CW Offset

A constant offset value, such as an ambient light level, can be

entered for subtraction from the CW measured value.

CW Minimum or CW Maximum

Min. or max. value attained during the measurement period is displayed along with the current

reading, during a measurement period (deleted by pressing 'reset' button).

Peak Minimum or Maximum, Peak to Peak

These modes allow analysis of signal stability within the selected integration interval (e.g. flicker of light sources). The min., max. or p-p values are displayed to-

gether with the CW average value. Only signals longer than the gain dependent slew-rate (see table below) can be measured.

I-Effective

Evaluation of the effective luminous intensity of a single light flash according to the Schmidt-Clausen method. The measurement is manually started by pressing the 'run' button. The integration time is selected in the

'set-up/pulse measurement time' menu function. The time constant C for daylight (0.1 s) and night time observation (0.2 s) can be selected in the 'set-up/IF time constant' menu function.

Pulse Energy

Energy measurement of a single pulse or a series of pulses within a selected measurement time. The measurement time is selected in the 'set-up/pulse measurement time' menu function.

Pressing the 'run' button starts the measurement. In auto-range mode 'UL/ OL' (under/over-load) is displayed if a gain change is necessary.

Pulse Offset

A pre-set offset value, such as an ambient light level, can be subtracted from the I-Effective and Pulse Energy reading. 'Static Offset' subtracts a constant

value. 'Continuous Offset' subtracts the actual measured value before the pulse measurement is started. Subtraction selection is made in 'pulse offset' menu.

Ratio relative (%), log. (dB), factor

Measurement of the ratio between a reference value and the actual measured value. Dis-

played as relative ratio (%) or logarithm ratio/attenuation (dB or dBm) or ratio factor.

Reference

The reference value is used for ratio measurements (see Ratio function). The ref. value can be set to 1 with the selected unit such as 1 W, 1 A.

be stored as reference value. A manually entered value can be used as reference.

A CW measurement value can

The reference value '1.000 mW' can be used to measure attenuation in dBm.

Hold

Beside the actual measurement value a current reading can be

'frozen' by pressing 'reset' button.

CW Level Check

Compares the measured CW value with stored pre-set lower and upper limit values. The actual measurement value and its status is displayed. The limit values can be entered manually or via

the RS232. The relay board P-9710Z-02 can be remote controlled to indicate the status by external lamps or integrate the meter in process control application.

Dose (Integrated Energy)

Measurement values are accumulated at a logging rate of 1 s and displayed as dose. The measurement can be manually started and stopped or be auto-

matically stopped at a preset max. dose measurement time (1 s to 1,000 h) or a max. dose value. The actual measurement status can be displayed.

Automatic Data Logger

Up to 12,288 measurement values can be stored with a sam-

pling rate of 0.1 to 6000 s.

Manually Data Logger

Up to 150 individual data records (meas. values & parameters) can

be stored by pressing the run button

Manual Calibration Data

Individual calibration correction

data can be manually entered

Remote Control

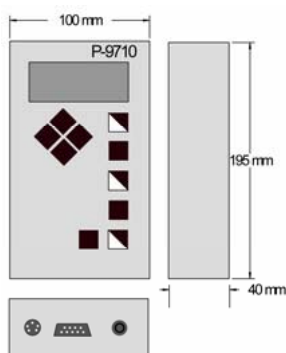
Instrument set-up for remote

control operation via RS232

Default Initiation

Resets all parameters to the

default condition

Specifications:**Dimensions:****Range and Uncertainty Specifications**

Range (A/V)	Range max. signal	Slew-Rate (10-90%) P-9710-1 / -2		Error (with offset compensation) 1 year 23°C +/-5°C +/-(% of reading + % of range)	Gain (A/V) Analog Output
P-9710-1 & P-9710-2		P-9710-1	P-9710-2	P-9710-1 & P-9710-2	
1 x 10 ⁻³	2.000 mA	2 ms	20 ms	0.2 % + 0.05 %	1 x 10 ⁻³
1 x 10 ⁻⁴	200.0 μ A	2 ms	20 ms	0.2 % + 0.05 %	1 x 10 ⁻³
1 x 10 ⁻⁵	20.00 μ A	3 ms	20 ms	0.2 % + 0.05 %	1 x 10 ⁻⁵
1 x 10 ⁻⁶	2.000 μ A	3 ms	20 ms	0.2 % + 0.05 %	1 x 10 ⁻⁵
1 x 10 ⁻⁷	200.0 nA	4 ms	20 ms	0.2 % + 0.05 %	1 x 10 ⁻⁷
1 x 10 ⁻⁸	20.00 nA	4 ms	20 ms	0.2 % + 0.05 %	1 x 10 ⁻⁷
1 x 10 ⁻⁹	2.000 nA	10 ms	20 ms	0.2 % + 0.05 %	1 x 10 ⁻⁹
1 x 10 ⁻¹⁰	200.0 pA	10 ms	20 ms	0.2 % + 0.05 %	1 x 10 ⁻⁹

P-9710-1 & P-9710-2, Specification & Ordering Information

Specification:

Signal Input	
Detector Input	Photocurrent to voltage converter amplifier with following voltage to voltage amplifier (x10). 8 decade stepped gain ranges with max. gain signal values from 2.000 mA to 200.0 pA . Manual or automatic range switching. 12 bit ADC with up to 14 bits at longer integration times.
Signal Processing	A/D converter with 100 μ s time interval. Longer integration (100 μ s to 6s) through averaging of multiple measurements.
Frequency Range	Signal conversion from 0.166 Hz (6s integration time setting) to >300 MHz. .
Zero Setting	Gain independent offset subtraction of unwanted ambient light signal.
Detector Connector	9 pin DSUB-socket . Detector heads with calibration data connector (type –2).

Function	
Parameter Settings	Menu controlled parameter set-up. Retention of the last settings in continuous memory. 10 function buttons.
Measurement Quantity	Ampere calibrated with DKD calibrated current source. Current signal multiplied with calibration correction factor to display absolute photometric or radiometric quantities. Calibration data stored in calibration data connector of the detector heads manually entered into the meter storage.
Dose Measurement	Integration of the measurement signal with 1 s sampling rate. Adjustable max. measurement time from 1 s to 1000 h. Adjustable maximum dose limit value. Current status display function.
Data Logger	Storage of up to 12,288 readings. Adjustable sampling rate from 0.1 to 6000 seconds. Manual recording mode. Display of readings stored in the flash Eproms on the display or on computer using the RS232 interface and software.
Analog Output	Gain dependent: 0 - 200 mV or 0 - 2 V (10 k Ω internal resistance). Integrated into RS232 connector.

General	
Display	2 x 16 character LCD with switch-able LED backlight.
Operating Temperature	5 to 40°C (41 to 104°F) (75 % rel. H, non-condensing). Storage Temperature: 0 to 50°C (32 to 122°F).
Dimensions/Weight	195 x 100 x 40 mm / 500 g (7.7 x 3.9 x 1.6 in / 1.1 lb).
Serial Port Settings	RS232 (9600 baud, 8 data bits, 1 stop bit, no parity) 5 pin cylindrical TRIAD01 connector..
Power supply	Battery or AC operation. Built-in rechargeable lead battery, 6V,0.5 Ah. Approx 6 h with display illumination. Battery charge under 8 % is displayed. Operation from AC plug-in power supply 230V/50 Hz (other values on request) with specific U/I recharge characteristic.

Interface	
RS232	9600 Baud, 8 data bit, 1 stop bit, no parity. TRIAD01 / 5 pin connector with integrated analogue output.

Detector Head / Measurement Output	
Detector Heads	All available detector heads with –2 type calibration data connector. See chapter 'detector heads' to select the detector head for your application.
Data Connector	Storage of sensor data such as detector model number, serial number, calibration data . Calibration data of integral sensitivity or spectral sensitivity with or without accessory. Selection of the calibration data or the wavelength in the menu function of the P-9710. Automatic data transfer if detector head is connected to the meter.

Ordering Information	
P-9710-1	Optometer with gain dependent slew-rate, rechargeable battery with plug-in power supply and manual
P-9710-2	Optometer with gain independent slew-rate, rechargeable battery with plug-in power supply and manual
Detector Heads	All Gigahertz-Optik detector heads with –2 type calibration data connector (example VL-3701-2)
P-9710Z-01	RS232 Interface Cable to connect P-9710 to a PC (9 pin serial connector) or P-9710Z-02 Relay Motherboard
P-9710Z-02	Relay Motherboard (power supply and housing not supplied)
P-9710Z-03	PCI I/O Interface Card
P-9710Z-04	Plug for the RS232/analog-output signal socket of the P-9710 optometer
P-9710Z-1/2	Adapter cable to connect detector with BNC-type connectors to P-9710
P-9710Z-2/1	Adapter cable to connect detector with calibration data connector (-2) to meters with BNC-type socket input
OS-P9710	Software for remote control of the P-9710-1, including OS-CAL.
OS-CAL	Software to enter calibration data via the P-9710 meter into –2 type data connector
BHO-01	Hard-shell Case for P-9701 with detector heads and accessories
BHO-02	Hard -shell Case for P-9710 with LDM-98xx detector head and accessories
BHO-08	Hard -shell Case 450x320x150 mm/17,7x12,5x5,9 in; (length x width x height) for individual use with P-9710 and accessories
BHO-09	Hard -shell Case 350x260x120 mm/13,7x10,2x4,7 in; (length x width x height) for individual use with P-9710 and accessories