◊ **Hand-held Four-Channel Meter for Field Service and Laboratory Use**
◊ **Universal Use in any Light, Light Color and Radiation Measurement Application**
◊ **Measurement of DC and AC Signals**
◊ **Signal Range from 0.1 pA to 20 μA or 1 pA to 200 μA with 6 Gain Ranges**
◊ **1 ms bis 1 s Sampling Rate**
◊ **Adjustable Integration Time from 1 ms to 1s**
◊ **CW, Dose and Color Operation Modes**
◊ **USB Interface for Remote Control Operation**
◊ **Battery & AC Operation (via USB)**

Associated Parts / Service:
Chapter Detector Heads
Chapter Integrating Spheres
Chapter Calibration

The **X1₁** (Xone-one) optometer is one of the most versatile hand-held light measurement instruments available.

It combines a powerful electronic design packaged in a light-weight ergonomic housing. It's compact size makes it ideal for field service applications. However, it's other unique features like a USB interface and multi-application capability with an excellent price-quality-ratio qualify it as a laboratory grade instrument as well.

Four Input Channels:
A unique feature of the X1₁ is it's capability to operate detector

X1₁ with XD-9506 dual channel ACGIH Skin detector head

heads with up to 4 sensors. All 4 signals or combinations of them are shown on it's four line display with on/off backlighting.

Multi-application Capability:
The flexibility to combine the X1₁ with all Gigahertz-Optik detector heads enable it to be used in a

CT-4501 color & illuminance detector with luminance accessory

wide application range of radiometric, photometric and colorimetric measurements.

Multiple Detector Meter:
When more than one detector head is used with the X1₁ meter simple and faultless selection of the calibration data is accomplished from the menu mode.

Precise Measurements:
The X1₁ offers a high linearity 12-

bit ADC input with 6 manually or automatically selected gain ranges. The max. error within this wide dynamic range is 0.2 %.
The amplifier is connected to the four signal inputs by an electronic switch.

Two Versions:

X1₁ with XD-9502 & XD-9506 detector for UV-A/white light ratio and ACGIH Skin protection measurements of UV sources for NDT testing of surface cracks.

The X1₁ is available in two versions for low or high signal applications.

● **X1₁–LS** up to 20 μA with 0.1 pA max. resolution
● **X1₁-HS** up to 200 μA with 1.0 pA max. resolution

Both versions feature a short slew-rate of typically 3 ms, a max. sampling rate of 1 ms and an adjustable integration time from 1 ms to 1 s.

Simple Operation:
Operating the X1₁ is simple. Once it is set-up, all settings are stored and recalled on next power-up unless reprogrammed. Measurement values are displayed in absolute quantities for the particular detector connected. The meter set-up is supported by an easy to use menu. The menu allows selection of the operating mode, the detector and measurement parameter.

Functions:
The X1₁ offers a **CW mode** for DC or AC signals plus dose, color and remote control operation. In **dose mode** a measurement time of up to 256 hours can be selected.
In **color mode** with the CT-4501 detector, x,y chromaticity coordinates, color temperature and illuminance are measured. Additional accessories can be attached for the measurement of luminance, luminous flux and luminous intensity.
A USB interface allows **remote**

**control** operation of the meter (DLL file supplied).

Battery and AC Operation:
For on-site applications the X1₁ is operated by two standard 1.5 V AA batteries for a life-time of up to 500 hours.
In remote control operation the meter is powered through the USB bus for time and battery independent use.

Custom Label & Instrument:
The X1₁ can also be custom labeled and/or detectors designed to individual customer specifications. Contact the factory for more information.
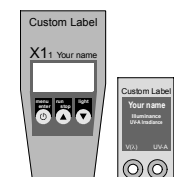
X1₁ Applications

Because of it's multiple function capabilities, high level specs and compact size the X1₁ is the right instrument for many field-service, laboratory and quality control applications.

In combination with Gigahertz-Optik's wide range of detector heads the X1₁ can be used for photometric, radiometric and colorimetric measurements.

The following pages offer typical X1₁ application's.

Our **Light Measurement Guide**, shown in our catalog and website offers additional tutorials and application notes dealing with the Measurement of Light and Measurement with Light.

Precise Illuminance & Luminance Meter with USB Interface

Facilities that integrate daylight into their lighting strategy need to check and monitor the lighting design over time. An efficient tool for long term data logging is a laptop computer with a USB interface remote controlled instrument.

The X1₁ with VL-3704 & LDM-9801 detector heads form a DIN Quality Class B qualified illuminance and luminance meter with a USB interface. Along with the photometric detectors other detectors for light color, UV, VIS, and NIR can be combined with the X1 1.

UV Hazard (DGZfP-Merkblatt EM6) & Contrast (DIN EN 1956, ASTM and MIL Standard) Qualification of UV Radiation Sources used in Nondestructive Testing for Surface Defects

UV radiation sources are used to stimulate fluorescence in the **Liquid Penetration Method,** used in NDT to detect surface cracks in nonporous materials.

The ideal emission spectrum of these sources is high intensity UV-A radiation with no white light and very low levels of shorter wave UV-B and UV-C.

White light reduces the contrast of the fluorescence emitted from the defect while UV-C and UV-B radiation increase the risk for skin and eye damage. Any spectral leakage of the deeper UV and white light blocking filters used with these lamps due to age and use create two risks:

1. reduced contrast between fluorescence and background
2. increased UV hazard risk for operators skin and eye

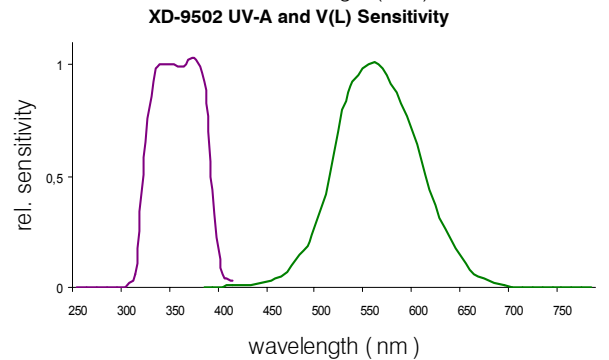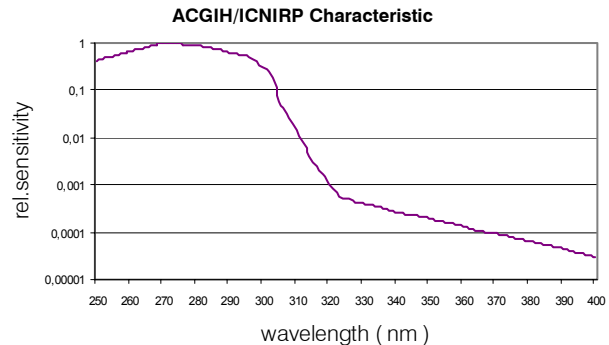Consequently periodical measurement of the UV sources with respect to UV hazard and contrast is needed.

Contrast Measurement:

DIN EN 1956, ASTM and MIL Standards exist that describe the general conditions and standard practices for the test examina-tions, including the procedures to be followed. The minimum requirements for the illumination or irradiation conditions, test procedures to be used for checking the specified levels and suitable measurement equipment specifications are also covered.

The XD-9502 detector head is a great choice for the contrast measurement. A precise illuminance detector with a f1' photopic error of less than 6 % and a solar blind UV-A detector are combined in one housing for quick and simple measurements. Both sensors are traceably calibrated to the ISO EN 17025 accredited part of Gigahertz-Optik's calibration laboratory for optical radiation measurement quantities.

UV Hazard Measurement:

The assessment of UV radiation under the aspect of UV hazard is the subject of the new **DGZfP-Merkblatt EM6** regulation. EM6 specifies that all UV sources used in fluorescence penetrant test applications must be classified and regularly tested. The protective measures taken for the operators depend on the safety classification.

The classification criteria are the UV hazard effective irradiation E_{eff} based on the ACGIH/ICNIRP (*American Conference of Governmental Industrial Hygienists / International Commission on Non-Ionizing Radiation Protection*) regulation. In stationary testers EM6 states a potential risk to the skin only, because of built-in eye protection devices. The risk to the eye due to stray light is low because of its diffuse character.

The XD-9506 detector head is designed with two sensors (ACGIH-UV-B/C 250 to 325 nm and ACGIH-UV-A$_{skin}$ 325 to 400 nm) to avoid any cross-talk between UV-A & UV-B/UV-C radiation. This cross-talk is a typical problem for single channel detectors when measuring UV-A rich sources.

The X1₁ is the right meter for both applications. In combination with the XD-9506 it displays the UV-A and UV-B effective irradiance as well as the total ACGIH effective irradiance.

ACGIH/ICNIRP Characteristic

wavelength (nm)

XD-9502 UV-A and V(L) Sensitivity

wavelength (nm)

Light Color Meter

All Gigahertz-Optik optometers are characterized by their universal nature in photometric and radiometric measurement applications. The X1₁ offers the additional capability of performing colorimetric measurements of light sources as well.

Combined with the CT-4501 detector head the X1₁ not only measures the x,y chromaticity values but also color temperature and illuminance in lx or fc (luminance, luminous intensity and luminous flux with attachments).

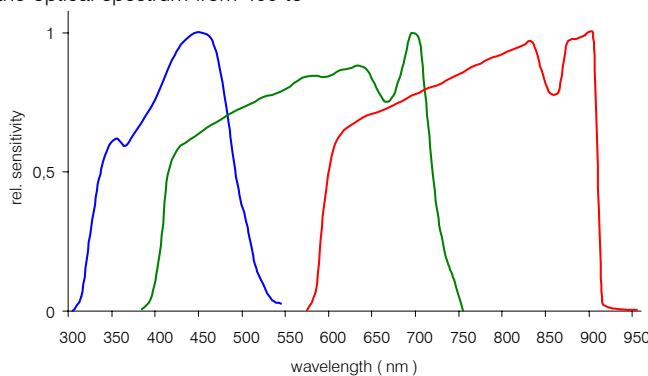The CT-4501 is a precision 4-cell color detector which offers a full X_{short}, X_{long}, Y and Z spectral characteristic allowing the measurement of blue-enhanced light sources and tube lamps with low measurement uncertainty.

The low profile detector height of only 20 mm qualifies it for ANSI Lumen measurements.

Triple PAR Meter

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.

To understand and control the interrelation of optical radiation and plants precise and predictable measurement is needed.

Most commercially available instruments measure the photosynthetic active radiation PAR, which covers the visible part of the optical spectrum from 400 to 700 nm. But optical radiation outside the visible spectrum also effects plant growth. To cover this entire spectral range of interest Gigahertz-Optik offers the TP-4501 "Triple PAR" detector head which includes one PAR sensor plus one sensor each for the shorter, 320 to 500 nm, and longer wavelength range from 590 to 900 nm. A fourth illuminance cell allows comparison of light intensity to the human eye response. The X1₁ optometer displays all four values at once. Dose measurement over a set-able time period of up to 100 hours is possible.

Universal Meter for Photometry, Radiometry and Colorimetry

Light is everywhere and many companies are involved in making light or using it. Typical examples are light source manufacturers including traffic lights, endoscopes and light guides.

The best known measurement quantity used to qualify light is illuminance measured in lx or fc. But in today's situation where the color and color temperature of light are qualifying characteristics, where the luminance contrast on monitors in medical diagnostic applications needs to be regularly qualified, where intense light sources create potential risk for UV and blue-light hazard, simple lightmeters no longer do the job.

The X1₁ with all its available detector heads and accessories is the right answer for all who need to measure more than simply light intensity.

X1₁ Light Meter:
Combined with a VL-3704 & LDM-9901 detector head, spectrum independent light source measurements of illuminance & luminance can be precisely accomplished.

X1₁ Light & Light Color Meter:
Together with the CT-4501 detector head the X1₁ measures x,y chromaticity values, color temperature and illuminance. The 4-cell detector head technology ensures low measurement uncertainty in most situations. Combined and calibrated with an integrating sphere the X1₁ allows the measurement of luminous flux & light color parameters.

X1₁ UV Hazard Meter:
Gigahertz Optik offers detector heads for UV-A, UV-B, UV-C, blue-light hazard, ACGIH and Erythema measurements.

X1₁ Universal Meter:
All applications described and several more based on GO's wide variety of detector heads and accessories require only one X1₁ optometer.

Functions:

The X1₁ optometer offers several modes of operation fulfilling it's multipurpose use capability.

Because of it's ability to operate detector heads with up to four cells, the X1₁ is the right meter for all Gigahertz-Optik multi-cell detectors. Not only does the meter work for single value display functions, special operational modes when in use with the CT-4501 tristimulus color detector head and the 2-cell ACGIH_skin detector head XD-9506 are included. The USB mode enables the X1₁ to be used in data logger and full remote control operations.

All available functions at the time of printing this catalog are described. If you do not see a feature or function you require or if custom labeling of the X1₁ based on a specific application is of interest, please contact the factory to discuss our custom design services.

CW Measurement

CW mode is used to measure continuous DC or AC signals at the selected integration time from 1 ms to 1s. Both the measurement value and the measurement quantity is displayed. For multi-cell detector heads the readings and units of each cell are displayed on a single line. Selectable manual and auto-ranging operation.

ACGIH_skin Irradiance Measurement (XD-9506)

Assessment of UV radiation sources characterized as 'UV-A rich' requires 2-cell detector head technology as offered by the XD-9506. The ACGIH effective UV-A and UV-B+UV-C irradiance values are displayed together with the SUM signal which represents the effective ACGIH 'weighted' irradiance.

Dose Measurement (Integrated Energy)

Measurement values are accumulated with a logger rate of 1 s and displayed as dose. The measurement can be manually started and stopped or be automatically stopped at a pre-set max. dose measurement time (1 s to 256 h).

Detector Selection

The calibration data of all detector heads ordered with the X1₁ are stored in the meter's calibration data eeprom. The detector connected to the meter is simply selected in the menu mode and all associated calibration data is applied.

Light Color Measurement (with CT-4501)

Combined with the CT-4501 detector head, the X1₁ measures x,y or u'/v' chromaticity values, color temperature and illuminance in lux or foot-candles.

With accessory attachments and additional calibrations, measurement of luminance (front lens), luminous flux (integrating sphere) and luminous intensity (calibration at a given distance) is possible.

The chromaticity color values, color temperature and the light intensity of the accessory dependent measurement quantity are all simultaneously displayed.

Accessory Selection

The calibration data of any accessory components ordered and calibrated with the detector heads are stored in the X1₁ meter's calibration data eeprom. The calibration data for the connected detector head /component combination are applied when selected in the menu mode.

Remote Control Operation

On X1₁ USB connection to a computer the meter will automatically activate itself for remote control operation via the USB interface. All meter buttons are de-activated.

Gigahertz-Optik

X1₁ Specifications & Ordering Information

Specifications X1₁ Meter

Signal Input	
Detector Input	Photocurrent to voltage converter amplifier with following voltage to voltage amplifier (x10). 6 decade stepped gain ranges with max. gain signal values from 20 μA to 200.0 pA (X1₁ LS) or 200 μA to 2.000 nA (X1₁ HS) model . Manual or automatic range switching. 12 bit ADC with up to 14 bit at longer integration times.
Signal Processing	A/D converter with 1 ms time interval. Longer integration (1 ms to 1 s) through averaging of multiple measurements.
Frequency Range	Signal conversion from 0.166 Hz (1s integration time setting) to >300 MHz
Zero Setting	Gain independent offset subtraction of unwanted ambient light signal
Detector Connector	9 pin MDSM9-socket (type –4)

| Function	
Parameter Settings	Menu controlled parameter set-up. Retention of the last settings in continuous memory. 3 function buttons.
Measurement Quantity	Ampere calibrated with DKD calibrated current source. Current signal multiplied with calibration correction factor to display measurement values in photometric, radiometric or colorimetric quantities. Calibration data stored in meter.
Dose Measurement	Adjustable max. measurement time from 1 s to 256 h.

General	
Display	LCD graphic display 97x32 pixel. Display size 14.3 mm x 35.8 mm. Switch able LED backlight. 4 display lines with each 14 characters.
Operating Temperature	10 to 40 °C (50 to 104 ° F) (75 % rel. H, non-condensing). Storage Temperature: 0 to 50°C (32 to 122 °F)
Dimensions/Weight	145 x 63 x 30 mm / 150 g (5.7 x 2.5 x 1.2 in / 0.33 lb)
USB Port Settings	USB HID
Power supply	2 x battery size AA (2.2 to 3.2 V); USB operation bus powered

Interface	
USB	HID

Detector Head / Measurement Output	
Detector Heads	All available detector heads with –4 type connector. See chapter 'detector heads' to select the detector head for your application.

Dimension

Range Specifications X1₁-LS

Range (A/V)	Range max.	Slew-Rate (10 - 90%)	Error (with offset compensation) 1 year, 23°C ±5°C ±(% of reading + % of range),	Permissible Detector Capacitance
1x10-5	20.00 μA	3 ms	0.2 % + 0.05 %	2 nF
1x10-6	2.000 μA	3 ms	0.2 % + 0.05 %	2 nF
1x10-7	200.0 nA	3 ms	0.2 % + 0.05 %	10 nF
1x10-8	20.00 nA	3 ms	0.2 % + 0.05 %	10 nF
1x10-9	2.000 nA	30 ms	0.2 % + 0.05 %	10 nF
1x10-10	200.0 pA	30 ms	0.2 % + 0.05 %	10 nF
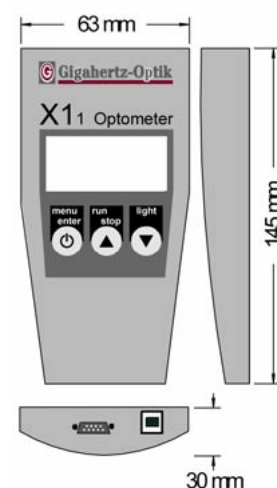
Range Specifications X1₁-HS

Range (A/V)	Range max.	Slew-Rate (10 - 90%)	Error (with offset compensation) 1 year, 23°C ±5°C ±(% of reading + % of range),	Permissible Detector Capacitance
1x10-4	200.0 μA	3 ms	0.2 % + 0.05 %	2 nF
1x10-5	20.00 μA	3 ms	0.2 % + 0.05 %	2 nF
1x10-6	2.000 μA	3 ms	0.2 % + 0.05 %	10 nF
1x10-7	200.0 nA	3 ms	0.2 % + 0.05 %	10 nF
1x10-8	20.00 nA	3 ms	0.2 % + 0.05 %	10 nF
1x10-9	2.000 nA	3 ms	0.2 % + 0.05 %	10 nF

Ordering Information	
X1₁-LS	Optometer for low signal applications. –4 type connector. Including 2 x AA type batteries, USB DLL, USB cable and manual
X1₁-HS	Optometer for high signal applications. –4 type connector. Including 2 x AA type batteries, USB DLL, USB cable and manual
OS-X1	Software for remote control operation of the X1₁
BHO-01	Carrying case for X1₁ with 37-type detectors and one LDM-9901 detector
BHO-04	Carrying case for X1₁ with 37-type detectors and accessory
BHO-05	Carrying case for X1₁ with RCH-0xx and RCH-1xx type detectors
BHO-06	Carrying case for X1₁ with one CT-4501 or TP-4501 detector
Detector Heads	See chapter 'detector heads' to select the detector and detector accessories for your application