BTS256-EF - mobile light meter for photopic and scotopic illuminance, EVE factor, luminous color, color rendering index, luminous spectrum and flicker.

The BTS256-EF is a high-quality light meter that is well suited for illuminance and luminous color measurements in all application areas thanks to its compact design, high-quality light sensor and precise cosine field of view function. Another special feature of the device is its ability to perform flicker measurements.

BiTec light sensor for complex light measurements

One of the outstanding properties of this mobile light meter is its BiTec light sensor. This combines the characteristic properties of a silicon photodiode with those of a noise-free CMOS diode array. The BiTec sensor guarantees extremely precise photometric and spectral-radiometric measurement values over a large dynamic range through mutual correction of the measurement signals of both sensors.

Silicon photodiode detector, fast and linear

When taking into account the dynamic range, linearity and speed, silicon photodiodes have always been and are still the ultimate radiation detectors. A silicon photodiode is therefore integrated in the BiTec light sensor of the BTS256-EF light meter. Its matching to the photometric V(λ) responsivity is improved by correction with the spectral measurement data of the diode array. The photodiode is be used to determine the frequency of modulated light and thus evaluate the flicker risk.

Flicker measurement

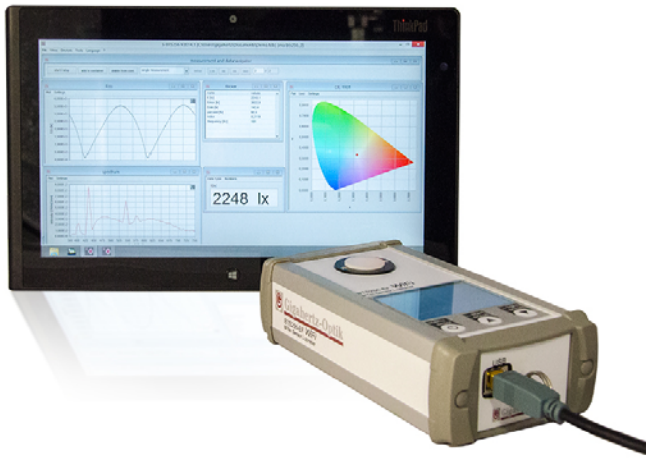
Flicker measurement entails identification of a possible AC component of the light signal with a 5kHz bandwidth. Besides the flicker frequency, other flicker parameters i.e. Flicker percent and flicker index are also displayed. The device additionally performs a Fast Fourier Transformation so as to display other frequency components in the signal. *For more details, see the technical article on flicker measurements under: www.gigahertz-optik.de/226-1-+Flicker+measurment+with+BTS256-EF.html*

Diode array detector for spectral measurement data

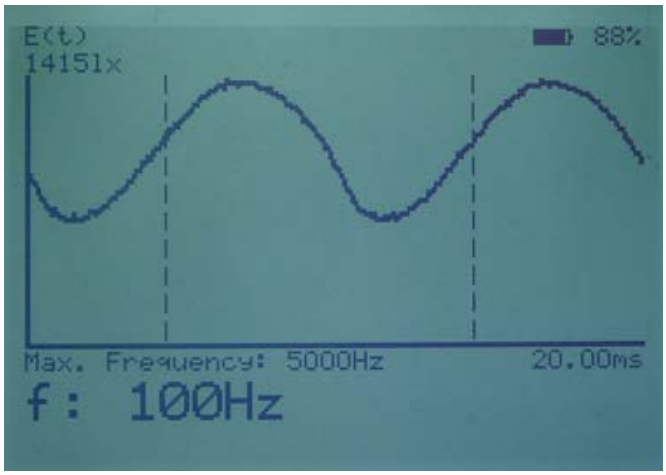
The CMOS diode array of the BiTec Light sensor provides precise measurement data required for the luminous spectrum. This data is then used for calculation of the color values and scotopic illuminance as well as for optimization of the photometric responsivity.

Optimized Signal to Noise Ratio

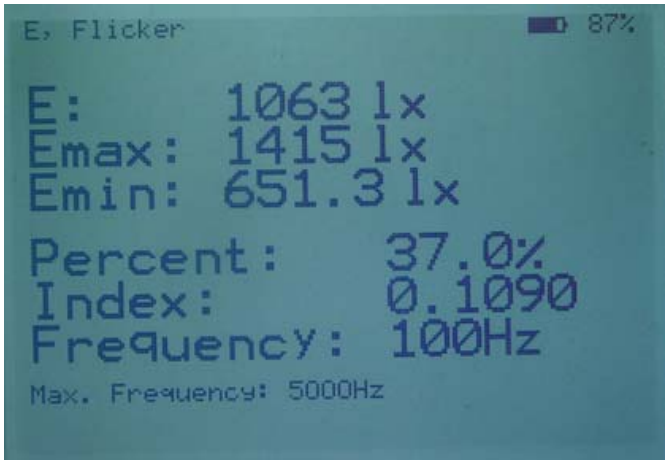
The noise signal from diode array detectors has significant effect on the signal to noise ratio (SNR) and hence on the quality of the measurement signal as well. A remote controlled aperture in the BiTec light sensor enables online compensation of the dark signals that are dependent on the temperature



Compact, splashproof light meter with flicker measurement function for mobile use



Standard display showing the signal progression and signal frequency



Standard display showing the illuminance and flicker parameters

and integration time.

Pulse Width Modulated (PWM) LED lamps

The fast photodiode of the BiTec light sensor enables the BTS256-EF to automatically synchronize itself to the frequency of lamps operated in PWM mode.

Precise cosine corrected field of view

A cosine corrected field of view is absolutely necessary for illuminance measurement devices. For extended illuminance setups, the cosine goodness-of-fit has significant influence on the measurement uncertainty of the light meter. The BTS256-EF light meter is equipped with a diffuser window that has a 20mm diameter whose cosine matching ensures an f2 ≤ 3% uncertainty which corresponds to the DIN 5036 requirements for the quality class B. Both detectors of the BiTec light sensor are centrally aligned behind the diffuser window and therefore have the same view angle.

DIN quality class A and B luxmeter

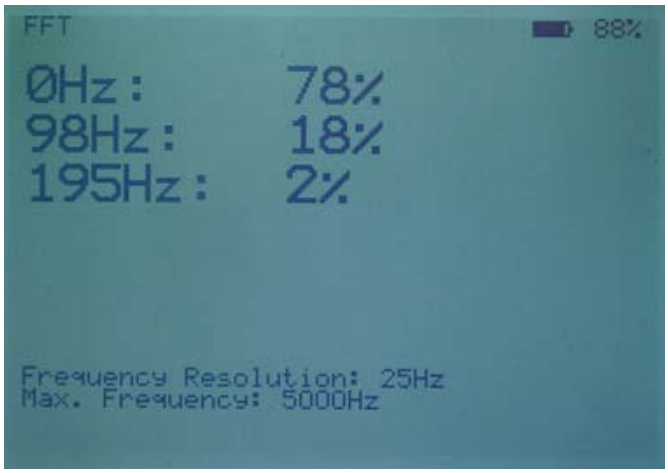
Through the cutting-edge Bi-Technology sensor concept, use of modern electronics, online dark signal adjustment and the possibility to perform temperature compensation, the device meets the conditions specified for two of the DIN 5036 quality classes.

- In terms of the f2 uncertainty i.e. ≤ 3%, the device corresponds to the quality class B (DIN 5032 section 7).
- In applications where limitation of the viewing angle is acceptable, the BTS256-EF , with its f1', u, f3 and f4 values, corresponds to the quality class A (DIN 5032 section 7).

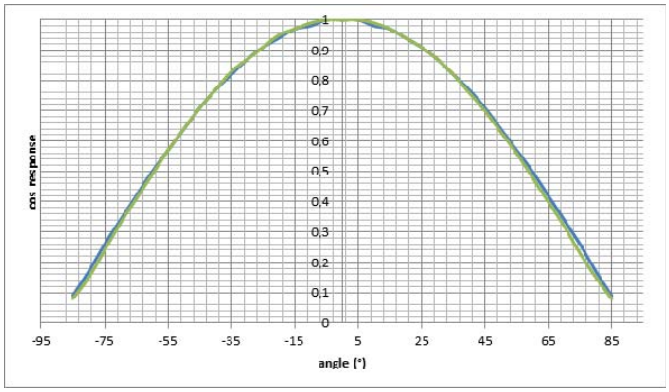
Diverse photometric and colorimetric measurands

A much broader diversity of measurands as the one offered by conventional light meters is required for verification and testing of LED lamps. The BTS256-EF offers fourteen measurands and thereby meets all the requirements for a modern light meter:

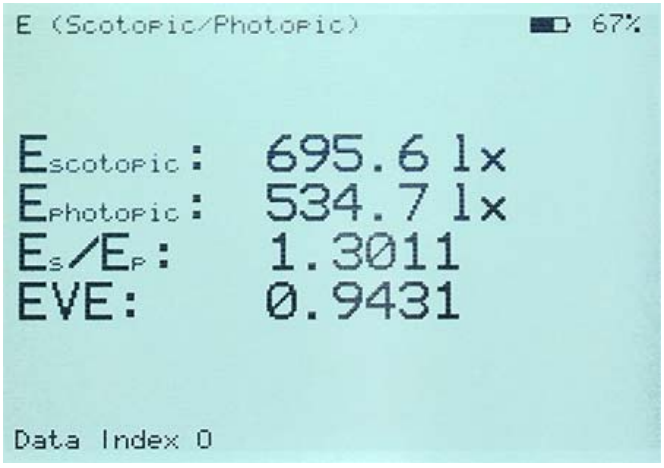
- Ep photopic illuminance
- Es scotopic illuminance
- Es/Ep ratio of night and daylight vision
- EVE "Equivalent Visual Efficiency" factor
- Ee irradiance
- Eλ spectral irradiance
- x, y CIE 1931 color coordinates
- u', v' CIE 1976 color coordinates
- CT color temperature
- Δ_{uv} deviation from the blackbody locus
- λ_{dom} dominant wavelength
- λp peak intensity wavelength
- $\lambda_{0,5}$ spectral half-width
- Purity color purity



Standard display showing frequency components determined through Fast Fourier Transformation



Light meter with precise cosine field of view function



Display showing the scotopic and photopic illuminance and the S/P ratio as per IES TM-24-13

- CRI Ra and R1 to R15 Color Rendering Index

Display modes for standard measurements

The BTS256-EF Bi-Tec sensor luxmeter has several display modes where the necessary measurands for the common photometric measurements are incorporated. The cursor buttons can be used to switch between the displays.

User display modes

The BTS256-EF enables users to individually configure and save display modes. The required measurands can hereby be selected.

Info display for measurement parameters

An incorporated Info Display shows all the relevant measurement parameters.

Easy operation and handling

Three control buttons and the diligently structured menu navigation make the device easy and safe to operate the device. For instance, in the standard measurement mode, the user does not have to manually set the measurement parameters since these are automatically and perfectly adjusted to match the measurement conditions. In the expert mode, the user has access to all measurement parameters.

Many useful extra functions

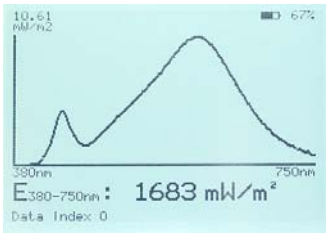
◊ If the user wants to distance himself from the device's field of view, he/she can set a time-delayed measurement.
◊ The display can automatically be dimmed during the measurement.
◊ An acoustic signal can be set to mark the end of a measurement.
◊ A layout created using a PC with the support points for the single measurements can be adopted in the device for measurement of the illuminance distribution. The measurement points can be progressively processed and saved.
◊ Fast data logger measurement mode where time-clocked readings of the photodiode can be recorded at a maximum measurement rate of up to 100ms.
◊ A second data logger measurement mode that enables time-clocked recording of all measurands including the spectral measurement data.
◊ Date and time in real-time can also be set.

Tripod mount

The measurement device has a tripod stand socket on the bottom side.

Other standard displays

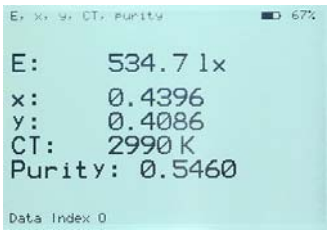
Spectral illuminance lx



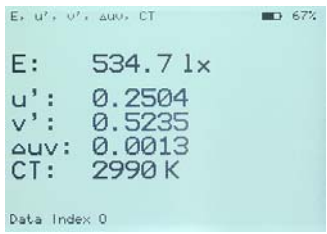
Spectral irradiance W/m²

Photopic illuminance

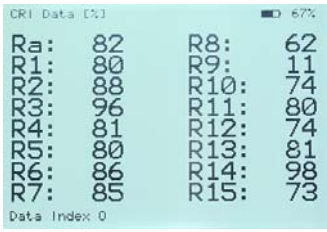
Scotopic illuminance



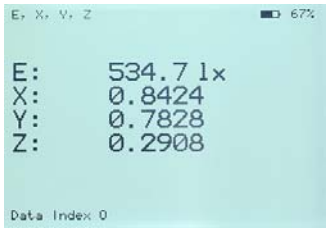
x,y color coordinates



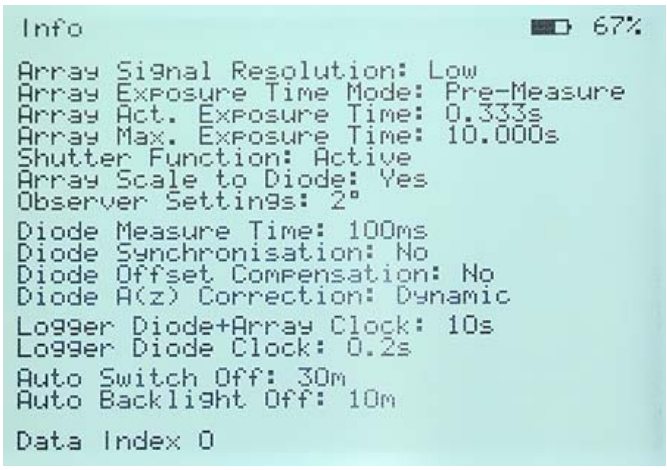
u',v' color coordinates



Color Rendering Index



Normal color values



The measurement parameters protocol is saved together with a measurement data file

Protective cap with chain

The protective cap for the diffuser window is attached onto the device.

Use without PC

The BTS256-EF has all the necessary functions enabling free operation of the device without having to depend on a computer. Furthermore, the rechargeable batteries have a capacity of more than 8 operation hours. The USB power adapter enables recharging of the device without a PC.

Use with PC

The BTS256-E has a USB2 and WiFi interface. The USB interface enables both data exchange and battery charging.

User software

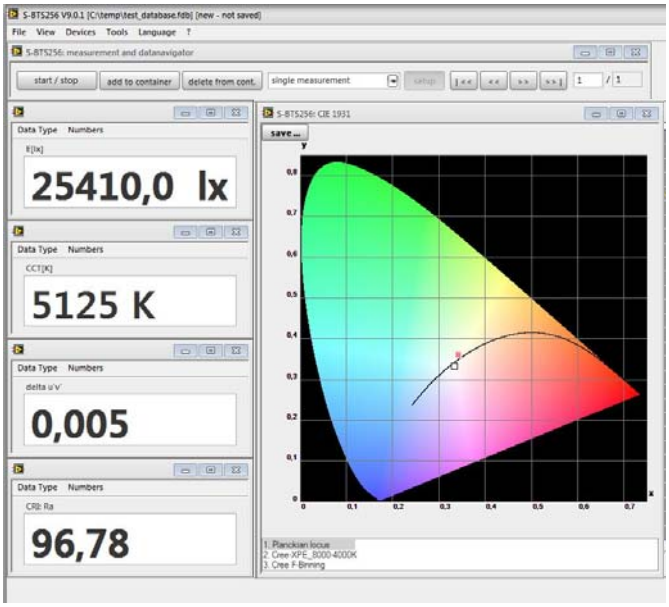
The S-BTS256-E software included in the device's price provides all the necessary functions for the measurements, measurement data display and data transfer. The cutting-edge, flexible desktop concept of the software offers the user an individual constellation of the required measurement values. This can be a full screen filled with lux measurement values or a matrix with both numerical and graphical fields. Each desktop constellation can easily be saved for future use.

Software Development Kit

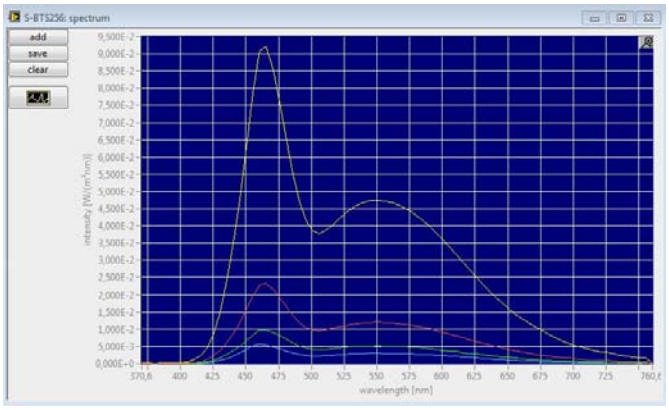
Gigahertz-Optik offers programmers the S-SDK-BTS256-E Software Development Tool. This can be used with LabView from National Instruments, .NET from Microsoft and C/C++. The SDKs simplify integration of the BTS256-E in an internally developed software.

Socket with tripod thread

Hard-top casing for safe transport and storage of the BTS256-E and accessories



S-BTS256 user software with modular setup desktop



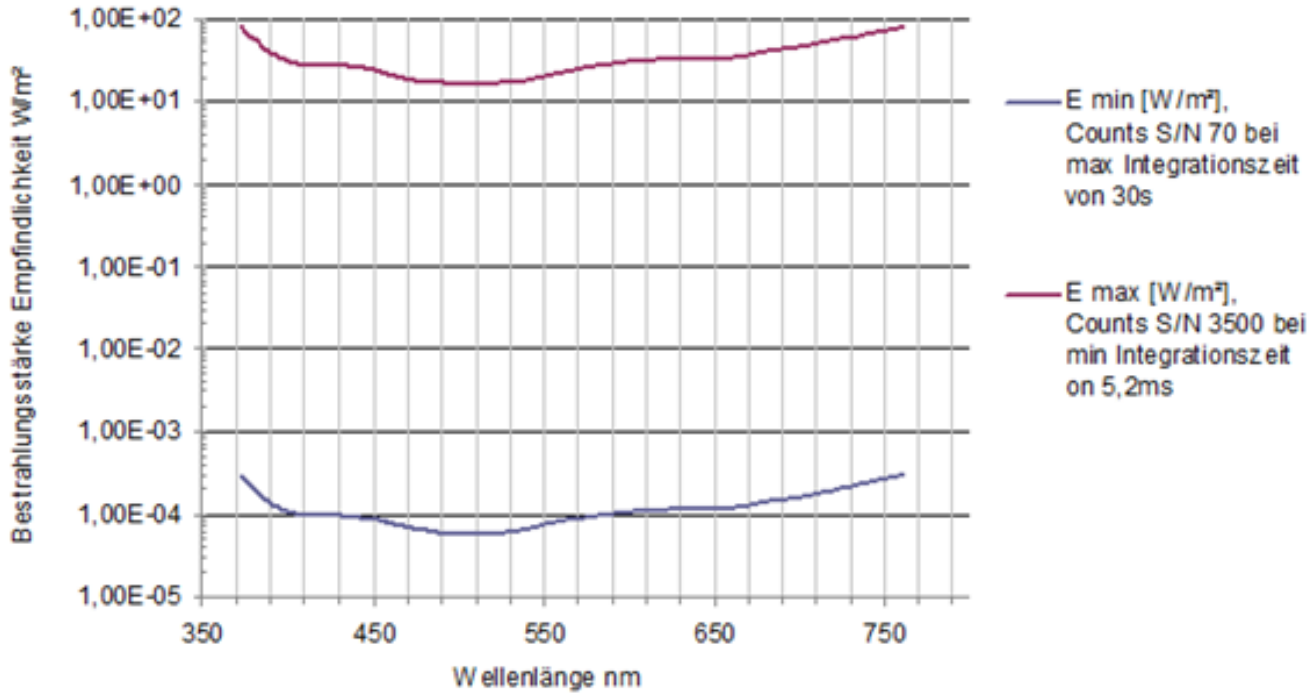
The graphical display module can be zoomed to full screen

Specifications

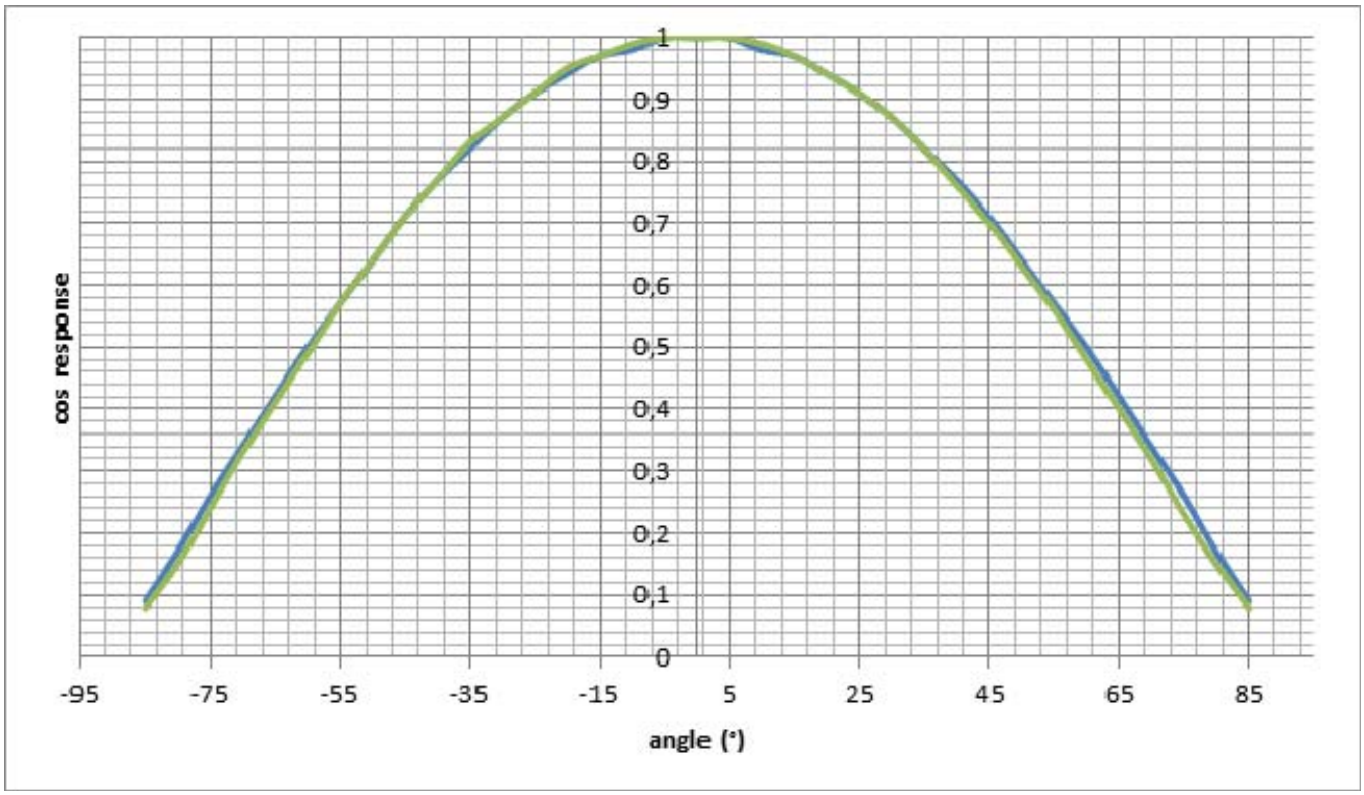
Light meter	DIN class B (DIN 5032 part 7) DIN class A for f1', u, f3 and f4 (DIN 5032 part 7)
Light sensor	Bi-Technology Sensor with a photodiode broadband sensor and a 256 pixel CMOS diode-array. Integrated aperture for automatic dark signal adjustment.
Input optic	Diffuser window with 20mm diameter, cosine corrected field of view, F2 Error ≤3%
Broadband Sensor	Silicon photodiode with photometric correction filter f1≤6% (f1 A(z) corrected ≤3%). Transimpedance amplifier with adjustable integration time (from 100µs to 6s). Seven (7) measurement ranges with offset correction. 16 Bit ADC.
	Maximum measurable illuminance value ≥199,999 lx Noise equivalent illuminance value ≤0.01lx
	Calibration uncertainty of photopic Illuminance +/-2.2%
	Flicker measurands: Frequency, Index, Percentage Measurement Range 0Hz - 5kHz Uncertainty: 1% +/- 0.5 Hz at sufficient S/N (e.g.100lx at max. frequency 5kHz) For more information see: www.gigahertz-optik.com
Spectral sensor	CMOS diode-array spectral radiometer. Spectral range from 380 to 750nm. Pixel resolution 1.5nm. Optical resolution 10nm.
	5.2ms to 30s integration time, manual or automatic control.
	Automatic shutter for dark signal measurements with an integration time similar to that of the bright measurement. Shutter on/off response time 100ms
	Measurement time by 199,999 lx ≤ 5ms (white light) Measurement time by 100 lx ≤ 1s (white light)
	Scotopic measurement range spectral 1 to >199999 lx
	Calibration uncertainty of scotopic Illuminance +/-2.2%
	Color measurement range spectral 1 to >199999 lx
	Peak wavelength: +/- 1nm
	Dominant wavelength: +/- 1nm
	Δx, Δy reproduce: Standard illuminant A +/-0.0001, LEDs +/- 0.0002 at 2000cts peak output
	Δx, Δy uncertainty : Standard illuminant A +/-0.002, LED +/- 0.004
	CCT Measurement range: 1700 to 17000 K
	ΔCCT: Standard illuminant A 50K; LED to +/- 4% depending on the LED Spectrum
	Color rendering index Ra and R1 to R15
Microprocessor	16Bit, 25ns instruction cycle time
Charging voltage	5VDC, 450mA per USB
Interface	USB2; Mini USB Port
Temperature	Operation: 10 to 30°C Storage: -10 to 50°C
Housing	Splashproof Dimension / weight 159 x 85 x 45mm (LBH) / 500g
Transport case	Plastic hard-top casing, 333 x 280 x 70mm, 650g

Integration time	Sampling Rate	Upper cut-off frequency	Lower cut-off frequency	Frequency measurement uncertainty at acceptable S/N ratio	FFT frequency Resolution
50ms	20µs	5kHz	60Hz	1% +-0.5Hz	25Hz
100ms	40µs	5kHz	30Hz	1% +-0.5Hz	12.5Hz
200ms	80µs	2.5kHz	15Hz	1% +-0.5Hz	6.3Hz
500ms	160µs	1.2kHz	8Hz	1% +-0.5Hz	3.2Hz
1000ms	320µs	0.6kHz	4Hz	1% +-0.5Hz	1.6Hz

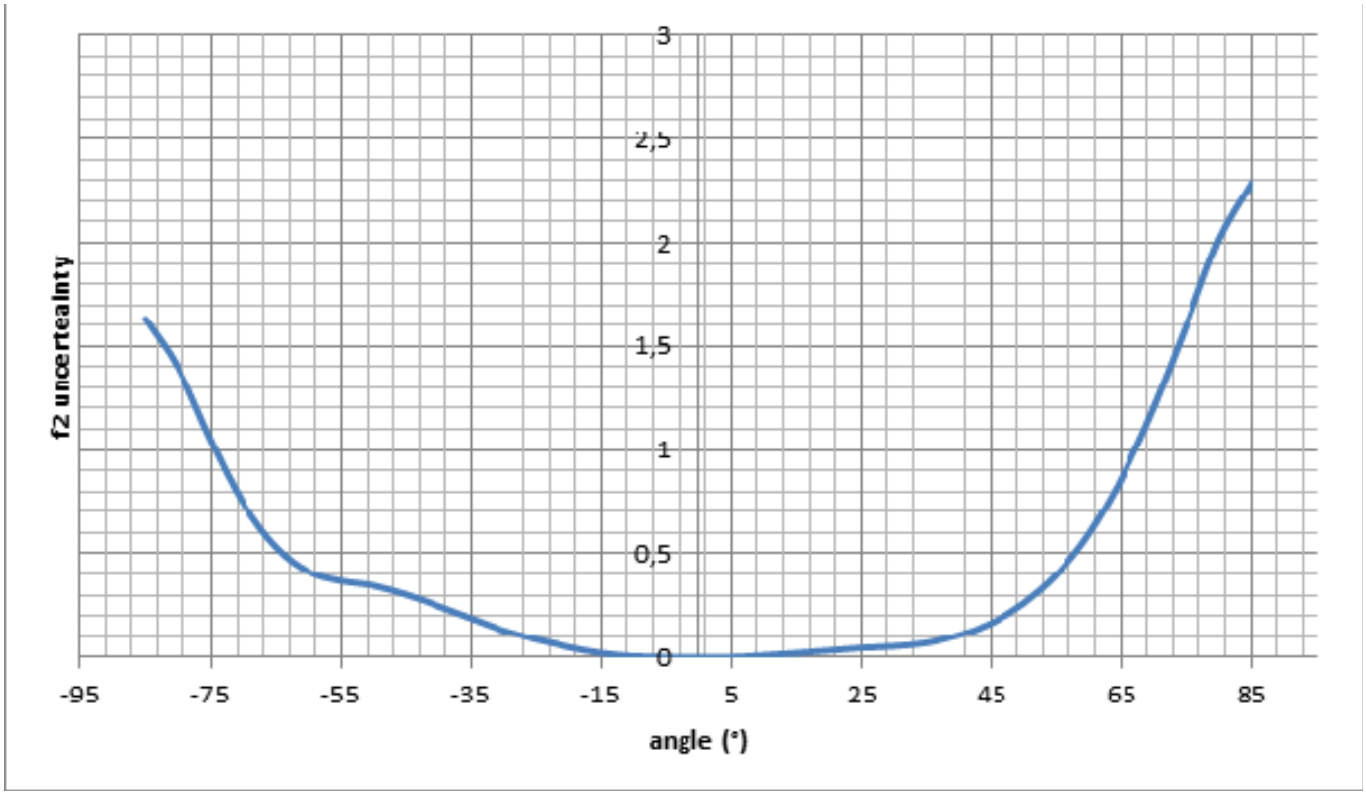
Effect of the photodiode's integration time on the cut-off frequency.



Typical spectral responsivity at different integration times.



Typical cosine field of view function.



Typical deviation of the cosine field of view function.

Purchasing information

Model	Item number	Description
BTS256-EF	102938	BTS256-EF, user manual (D or E), S-BTS256 user software CD, USB cable for PC operation and battery charging using the PC, USB power adapter (EU, USA or GB), BHO-17 hard-top casing
S-SDK-BTS256	102777	Software Development Kit; Software and handbook CD
Recalibration:		
K-BTS256E-I	301374	BTS256-E, BTS256-EF recalibration with calibration certificate.
Other versions		
BTS256-E	102826-1	Standard version
BTS256-E WiFi	102919	Additional to the BTS256-E: WiFi interface
BTS256-EF WiFi	102939	Additional to the BTS256-EF: WiFi interface
BTS256-PAR	102947	Additional to the BTS256-E: PAR effective function; input function additional actinic spectral functions.
BTS256-PAR WiFi	102948	Additional to the BTS256-PAR: WiFi interface