

BTS2048-VL ultra-fast BiTec sensor light meter for high-quality photometric, radiometric, spectral-radiometric and colorimetric measurements.

The BTS2048-VL is a high-quality light meter whose compact design and elaborate optical, electronic and mechanical interfaces make it ideal for integration in complex industrial and scientific measurement tasks.

BiTec light sensor for high-end light measurement

One of the outstanding features of this exceptional light meter is its BiTec light sensor. This combines the special properties of a silicon photodiode with those of a back-thinned CCD diode array. Through bilateral correction of measurement signals from both sensors, the BiTec sensor ensures extremely precise photometric and spectral-radiometric measurement values over a large dynamic range.

High-quality back-thinned CMOS detector

The diode array comprising of 2048 pixels has a utilizable spectral responsivity range between 280 and 1050nm. It has a 2nm optical bandwidth and a pixel resolution of 0.4nm/pixel. Due to the back-thinned technology, this CCD chip is substantially more sensitive as compared to conventional front-illuminated CCD chips.

Flash spectral radiometer for LED binning

Another of its features is that the back-thinned CMOS detector is equipped with an electronic shutter. This makes the measurement within a light flash possible. Together with the diverse trigger functions, integration times of between 2 μ s and 4000ms, the powerful micro-processor and the very fast LAN interface (7ms for a complete data file), the BTS2048-VL qualifies for LED binning applications as well as for measurement of light flashes.

Precise spectral radiometry

To facilitate optimum use of the CCD sensor's dynamic range, there is a remote controlled filter wheel (Open, Closed, OD1 and OD2) located in the optical beam path. This enables amplification of the dynamic range of the CCD sensor and offset compensation to additionally ensure precise measurement of light sources having varying intensities.

Diffuser window instead light guide

As for the input optics, the BTS2048-VL has an incorporated diffuser window with a cosine corrected field of view. The fact that a light guide has not been used to this effect makes room for improved photosensitivity and calibration stability for reduced measurement un-



BTS2048-VL with diffuser window input optic



BTS2048-VL backside with I/O trigger and RS232 (RS485), USB2.0 and Ethernet interface connections



BTS2048-VL with a 1m diameter integrating sphere

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certainty. The f2 adjustment of the cosine corrected field of view to less than 3% makes it possible to use the BTS2048-VL for direct light measurement in absolute photometric, colorimetric and radiometric measurements as well.

- Illuminance (lx)
- Luminous intensity (cd)
- Color temperature
- Color Rendering Index
- Color coordinates
- Irradiance (W/m²)
- Spectral irradiance (W/m² nm)
- Radiant intensity (W/sr)
- Spectral radiant intensity (W/sr nm)

Luminous flux measurement

In connection with integrating spheres, the BTS2048-VL is the optimal light meter for measurement of the luminous flux, spectral radiant flux and luminous color. The prefixed diffuser window can be positioned in the sphere such that an uninterrupted hemispherical field of view is created. This thereby enables the sphere photometer to fulfill one of the essential requirements for the LM79 as well as meet other standards. Gigahertz-Optik manufactures a wide range of integrating spheres as well as the necessary accessories e.g. calibration standards.

Measurement of the luminous intensity distribution

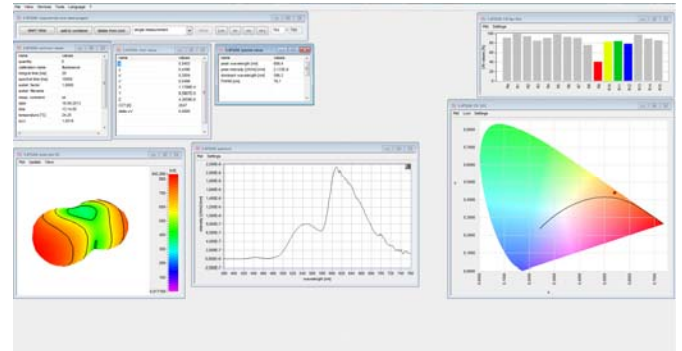
Goniometers are used to measure the luminous intensity distribution of lamps and other luminaires. For these type of applications, the BTS2048-VL offers ideal conditions to shorten the entire measurement time of the goniometric measurement:

- Fast, photometric matched photodiode for short measurement times over a large dynamic range. Photodiode with active correction of the spectral mismatch through spectral measurement values
- Fast, spectral measurements through the optimized optics and the high-quality diode array
- Synchronized measurements through the diode array with electronic aperture and trigger functions
- Ethernet and USB2.0 interfaces for fast data exchange (30ms for 2048 float values via ethernet)

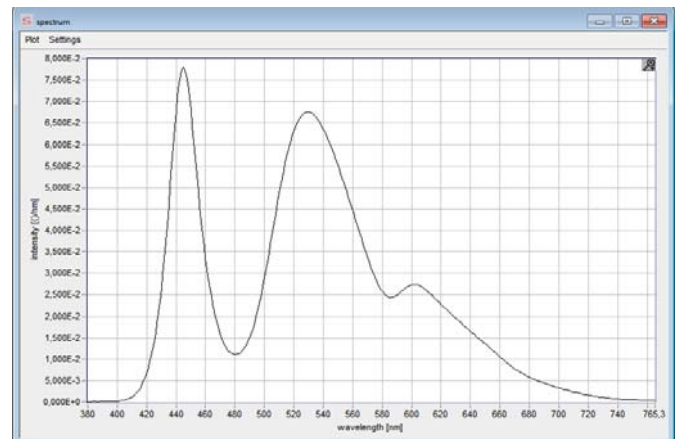
Gigahertz-Optik manufactures goniometers in different designs.

Ultra fast interfaces

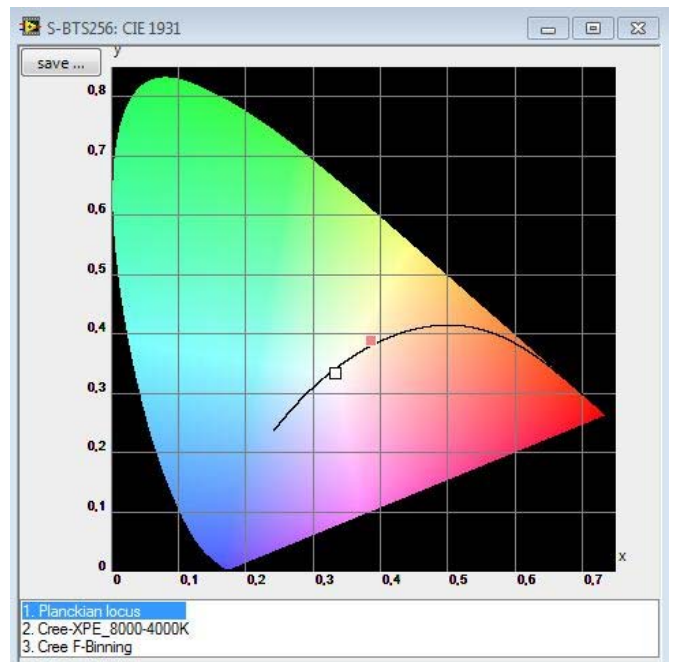
The BTS2048-VL is controlled via a USB2.0, ethernet, RS232 or RS485 interface. With regards to the communication speed, ethernet port is superior to the



S-BTS2048 User software interface



Graphical view of the spectrum



CIE 1931 Chromaticity diagram

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USB2.0 interface. Furthermore, the amount of data to be sent is thereby limited so that data preparation occurs in the BTS2048-VL. For this purpose, an independent, high-performance microprocessor is incorporated.

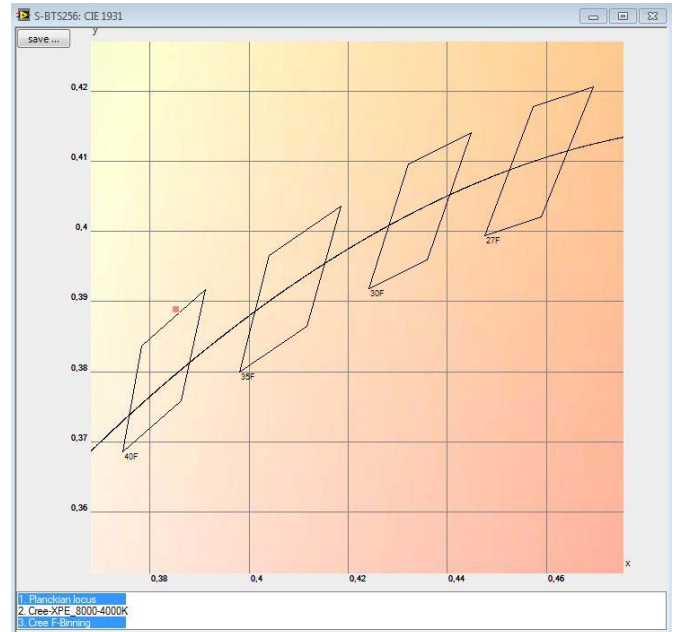
User software with flexible desktop structure

Among the BTS2048-VL delivery contents is the S-BTS2048 user software. One of the characteristic features it has to offer is the flexible desktop that can be individually configured by the user. This entails a pot-pourri from which the user can choose graphical and numerical display windows:

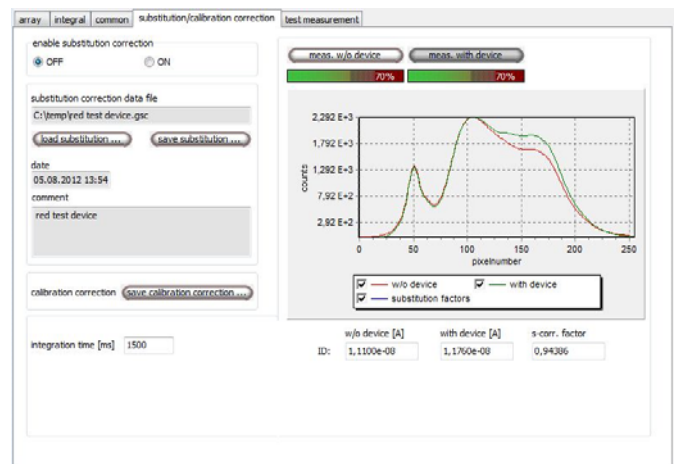
- Freely definable numerical displays in decimal or scientific representation. Zoom function.
- Numerical display fields for radiometric, photometric, colorimetric, Ra to R15 color rendering index, spectral and other measurands.
- Measurement protocol of the selected measurement parameters.
- CIE 1931 chromaticity diagram. Zoom function.
- CIE 1976 chromaticity diagram. Zoom function.
- Spectrum. Zoom function.
- Data logger. Zoom function.
- etc.

Traceable calibration

Calibration of the BTS2048-VL, including its accessories, is performed by Gigahertz-Optik calibration laboratory for optical measurands with reference to national and international calibration standards.



Part of the CIE 1931 chromaticity diagram with binning tolerance fields for the color temperature



Application window: substitution correction

Options for extension of the function range of the BTS2048-VL

Integrating spheres

The measurement functions of the BTS2048-VL can be enhanced using integrating spheres so as to measure the luminous flux and spectral radiant power.

Wide range of integrating spheres

Gigahertz-Optik manufactures a wide range of integrating spheres in different sizes and with different configurations. Spheres for luminous flux measurements are equipped with auxiliary lamps to compensate for the self absorption effect by the test object on the responsivity of the measurement device.

LM79 integrating sphere luminous flux meter

When in connection with 1m diameter integrating spheres, the BTS2048-VL meets the requirements of the LM79 for luminous flux photometers and sphere spectrometers.

Traceable calibrations

The Gigahertz-Optik calibration laboratory for optical radiation measurands offers standard lamps for recalibration of the spectral photometer for the luminous flux, luminous color and spectral radiant flux. The recalibration is supported by the S-BTS2048 user software.

Goniometer photometer

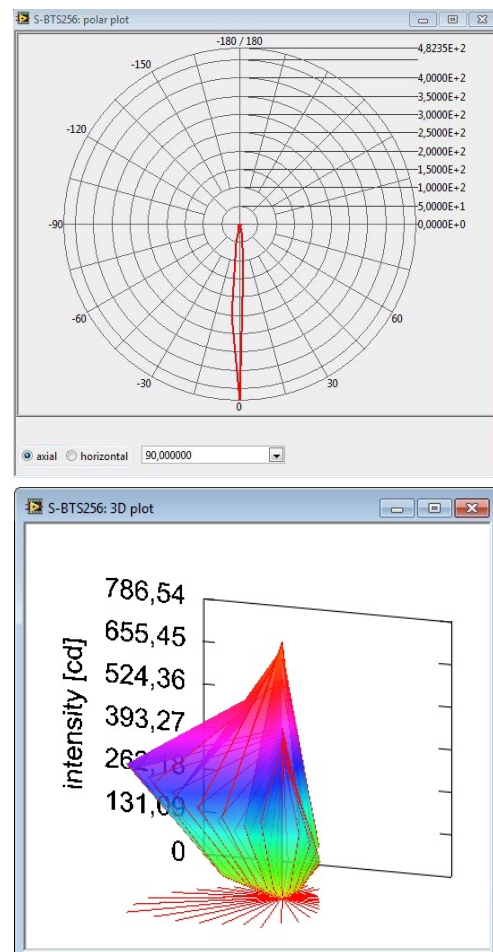
Gigahertz-Optik manufactures goniometers for both directed and all-round radiating light sources. When connected with the BTS2048-VL, these can be used to form a high-quality photo-goniometer for measurement of the radiation characteristics of lamps and other luminaires.

Photo-goniometer

Control of the goniometer and data reading from the BTS2048-VL is done remotely through the S-BTS2048 user software. The user can setup the measurement sequence for symmetric or individual measurement procedures. Measurement values showing the radiation characteristics are displayed both numerically and graphically. Furthermore, the measurement values can be converted to ASCII, excel, IES and EULUMDAT data formats and saved. Besides the luminous intensity distribution, the entire or effective luminous flux is also calculated.



Integrating sphere with 1m diameter



2D and 3D plots of the luminous intensity distribution

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Specifications

BTS2048-VL	Lightmeter with spectroradiometer and photometer function.
Bi-Technology detector:	Parallel measurement with diode and array, linearity correction of the array through the diode. Online correction of the spectral mismatch of the diode through a(Z) and/or F*.
Measurands:	Spectral irradiance (W/(m ² nm)), illuminance (lx), dominant wavelength, peak wavelength, center wavelength, centroid wavelength, x, y, u', v', X,Y,Z, delta uv, color temperature, color rendering index (CRI) Ra, R1-R15, Option integrating sphere: in addition spectral flux (W/nm) and luminous flux (lm) Option goniometer: in addition radiant intensity and luminous intensity distribution
Spectroradiometer:	Check spectral detectors specifications
Photometer:	Accuracy class B according to DIN 5032 and CIE No. 69 Accuracy class A for f1', u, f3 and f4 according to DIN 5032 and CIE No. 69
Input optics:	Input diffuser with cosine corrected field of view (f2 < 3 %)
Filter wheel:	4 positions (open, closed, OD1, OD2). Use for remote dark current measurement and dynamic range extension.
BiTec light detector:	Parallel measurement with diode and array, linearity correction of the array through the diode. Online correction of the spectral mismatch of the diode through a(Z) and/or F*.
Processors:	32bit for device control, 16bit for CCD array control, 8bit for photodiode control
Interfaces:	USB V2.0, Ethernet (LAN UDP protocol), RS232, RS485
Data transfer:	Standard for 2048 float array values via ethernet 30ms, via USB 140ms
Input Interfaces:	2x (0 - 25) VDC, 1x optocoupler isolated 5 V / 5 mA
Output Interfaces:	2x open collector, max. 25 V, max. 500 mA
Triggering:	Trigger input incorporated (different options, rising/falling edge, delayed, etc.)
Spectral Detector:	
Spectral range:	(280 - 1050) nm
Optical bandwidth:	2 nm
Pixel resolution:	0,4 nm/pixel
Number of pixels:	2048
Array-Type:	Highly sensitive back-thinned CCD chip
ADC:	16bit (25 ns instruction cycle time)
Integration time:	(2 - 500) μs * ¹ (0,5 - 4000) ms * ²
Peak wavelength:	±0,2 nm
Dominant wavelength:	±0,5 nm
Δx and Δy:	±0,0020 (Standard illuminant A) ±0,0025 (common LED)
Repeatability Δx and Δy:	±0,0001
ΔCCT:	Standard illuminant A 50K; LED up to +/- 4% depending of the LED spectrum
Band-pass correction:	mathematical online band-pass correction is supported
Linearity:	completely linearized chip >99.6%
Scattered light:	2E-4 * ³
Base line noise:	5 cts * ⁴
S/N:	5000 * ⁵
Dynamic range:	>9 decades
Responsivity range spectral irradiance:	(1E-5 - 1E5) W/(m ² nm) * ⁶

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Calibration:	Spectral irradiance (350 - 400) nm: OD0: $\pm 7\%$ OD1: $\pm 8\%$ OD2: $\pm 9\%$ (400 - 800) nm: OD0: $\pm 4\%$ OD1: $\pm 4\%$ OD2: $\pm 4\%$ (800 - 1000) nm: OD0: $\pm 6\%$ OD1: $\pm 6\%$ OD2: $\pm 6\%$ Spectral irradiance responsivity (350 - 1000) nm
Photometric detector:	
Integration time:	(0,1 - 6000) ms
Measurement range:	seven (7) measurement ranges with transcendent offset correction
ADC:	16bit (25 ns instruction cycle time)
Spectral responsivity:	Spectral responsivity with fine CIE photometric standard matching. On-line improvement of the photometric matching by the measured spectral data of the light source.
Measurement range illuminance:	Max measureable illuminance value $3E8lx$ ^{*7} Noise equivalent illuminance value $1E-1lx$
Calibration:	Illuminance $\pm 2,2\%$
General specification:	
Software:	User software S-BTS2048 Optional software development kit S-SDK-BTS2048 for user software set-ups based on .dll's in C, C++,C# or in LabView.
Power supply:	With poser supply: DC Input 5V ($\pm 10\%$) at 700 mA With USB bus (500mA) ^{*8}
Dimensions:	103 mm x 107 mm x 52 mm (Length x Width x Height) 102827.pdf
Weight:	500g
Mount:	Tripod and M6 screw threads Front adapter UMPA-1.0-HL for use with integrating sphere port-frame UMPF-1.0-HL
Temperature range:	Storage: (-10 - 50) $^{\circ}C$, Operation: (10 - 30) $^{\circ}C$

*1	no linear dark current i.e. dark measurement is required for each integration time.
*2	linear dark current i.e. dark current measurement can be scaled with the integration time in this range.
*3	It is however recommended to perform a new dark measurement for each integration time.
*4	typical value measured 100nm left of the peak of a coldwhite broadband LED.
*5	typical value measured without averaging in a measurement time of 4ms and full scale of the array.
	By averaging, the S/N rises on rather the base noise decrease quadratic e.g. 100 times averaging corresponds to a factor 10 improvement.
*6	Min value at s/n of 1/500. Max value at full level control.
*7	Irradiation time limited in case of high temperature radiation to avoid thermal damaging of the device.
*8	If connection is via USB, not all device functions are supported due to the limited power. For instance no Ethernet.

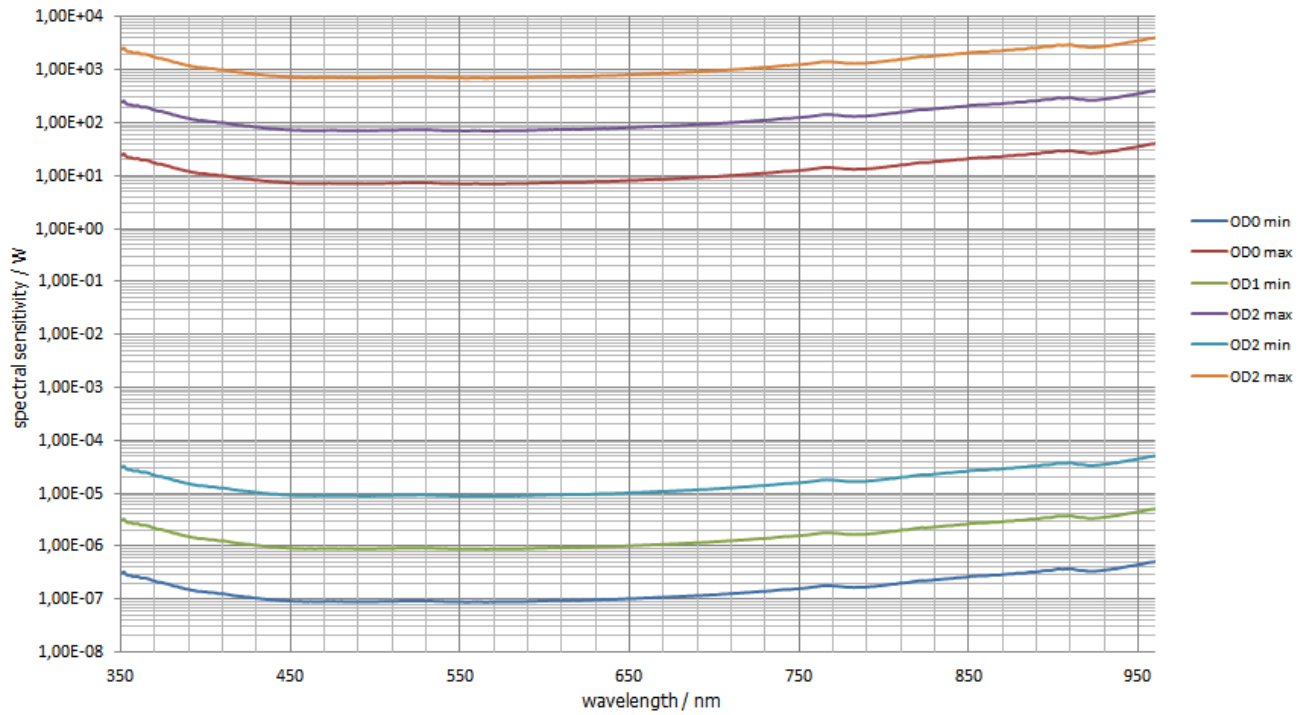


Location of tripod and M6 screw threads

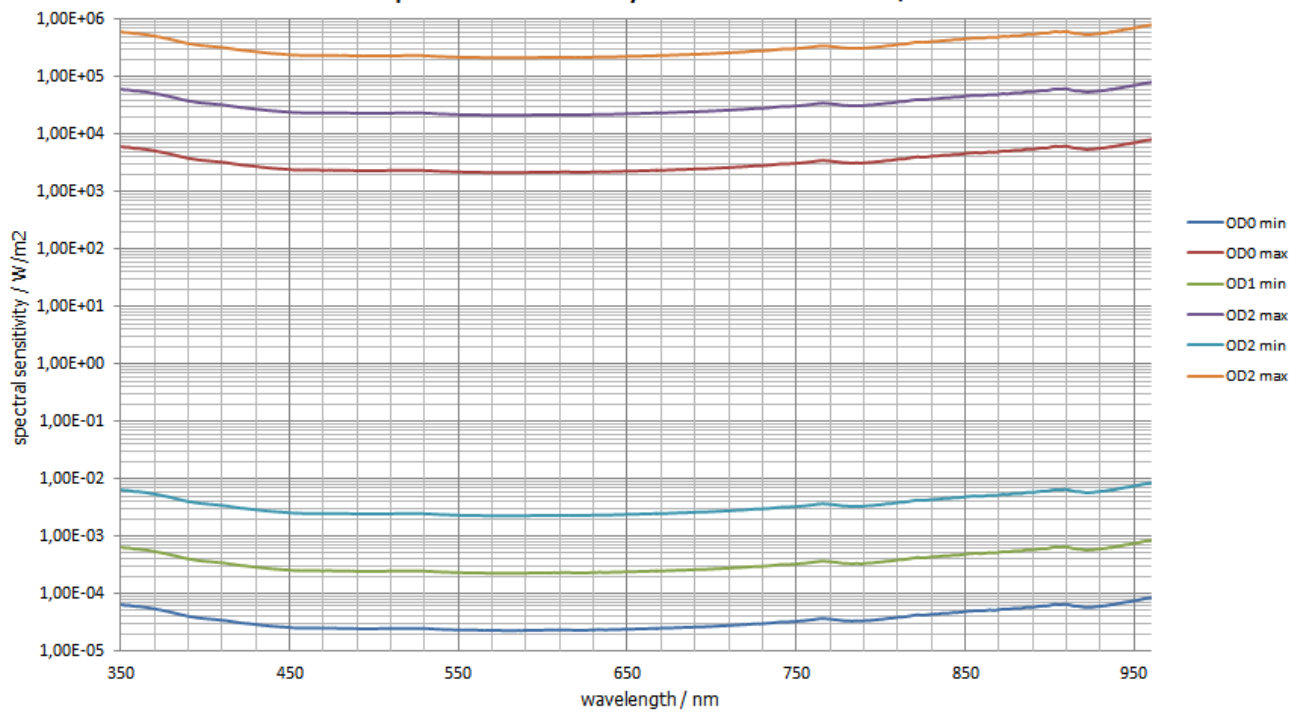
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spectral sensitivity BTS2048-VL in W (150mm Sphere)



spectral sensitivity BTS2048-VL in W/m²



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Purchasing information

Model	Item no.	Description
BTS2048-VL	102827	Measuring device, hard cover box, users guide, software CD, calibration certificate
S-SDK-BTS2048-VL	102962	Software development kit, software CD with users guide
Recalibration:		
K-BTS2048-VL-I	300589	Recalibration of the BTS2048-VL with calibration certificate

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