BTS2048-VL-TEC

https://www.gigahertz-optik.com/en-us/product/bts2048-vl-tec/

Product tags: VIS ,



Description

BTS2048-VL-TEC, CCD spectroradiometer with thermoelectric cooling of the CCD detector



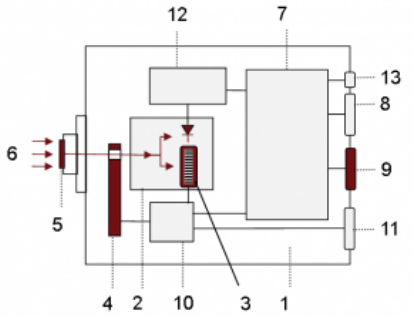
TE-cooled CCD spectroradiometer with wide dynamic range

The BTS2048-VL-TEC variant of the BTS2048-VL incorporates thermoelectric cooling of its CCD detector. The device meets all the requirements of a high-end diode array spectroradiometer and is favourably priced despite its cutting-edge design.

Thermoelectric cooling of the CCD detector minimizes the dark noise signal and enables integration times ranging from 2 µs to 60 s whereas those of the BTS2048-VL lie between 2 µs and 4 s. The BTS2048-VL-TEC is therefore ideal for applications with very low light intensities or rarely possible dark signal measurements due to its high stability. It is also ideal for luminous flux measurements in which the integrating sphere connected to the device is significantly heated up by high-power lamps. See also our technical article about **SSL/LED testing**. The BTS2048-VL-TEC can be easily attached on an integrating sphere. Gigahertz-Optik offers many integrating standard spheres like the perfectly for **LED binning** suited ISD-15-BTS2048-VL. We also offer customized solutions to address your needs, see our Integrating Sphere Construction Kit or other examples in Integrating Sphere Based Spectroradiometer Systems**.**

*One of its unique features is the from Gigahertz-Optik developed innovative **BiTec sensor** that consists of a V(lambda) filtered Si photodiode and a spectroradiometer unit. This makes it extremely linear, stable, and fastand is therefore a guarantee for higher measurement accuracy which is not accompanied by any disadvantages. Both sensors can be used independently and the mutual correction of the sensors is advantageous for accuracy, speed and versatility (see article on **BTS technology**).

From a formal point of view with the CIE 231:2019 and DIN 5032-7:2024 photometers with built-in spectral mismatch correction by spectral measurements are treated the same way as classic photometers. Resulting parameters such as f_1' can be determined in accordance with DIN EN 13032-1, provided that the spectral and integral measurements are performed with the same input optics, which is always the case with our BTS devices. The BTS were already ahead of their time, and standardization has now caught up.



1) BTS2048-VL-TEC 2) BiTec sensor with Si photodiode, CCD array spectrometer 3) TE cooled CCD 4) Filter wheel with OD1, OD2 and shutter 5) Precise cosine diffuser 6) Light incident 7) Microprocessor for data procesing and communication 8) USB 2.0 Interface 9) High Speed ethernet Interface 10) Microprocessor CCD sensor control 11) Trigger In/Out 12) Microprocessor photodiode 13) DC voltage supply

Optimized stray light behavior, especially in the UV range

Precise measurements in the UV require minimal influence from spectral stray light. This goal is achieved in the BTS2048 series through an optimized beam path design. In addition, it is possible to characterize the stray light matrix of the spectroradiometer, thereby further reducing the residual stray light signal. (see technical Article about stray light suppression for details).

Specifically for the large spectral range from 350 nm to 1050 nm, the BTS2048-VL-2-TEC variant offers not only stray light matrix correction but additionally the use of an out-of-range (OoR) filter for stray light reduction. This measurement method can also be used without a stray light matrix and significantly improves measurement performance in the UV range. The available measuring range can be extended to the range from 280 nm to 1050 nm when required.



Direct attachment of the device to accessory components

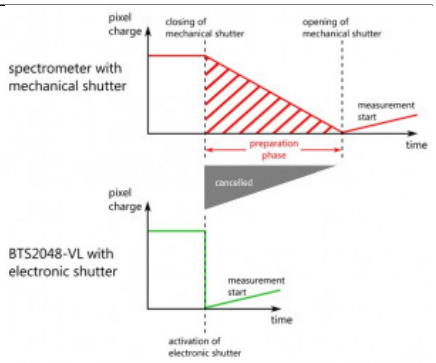
User software and developer software

The standard S-BTS2048 user software has a customizable user interface and a large number of display and function modules which can be activated when configuring the BTS2048-VL-TEC with the respective accessory components from Gigahertz Optik GmbH. The S-SDK-BTS2048 developer software is offered for the integration of the BTS2048-VL-TEC in the customer's own software.

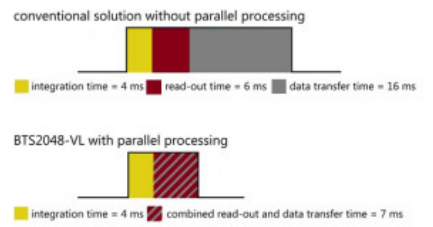
Calibration of the BTS2048-VL-TEC

One essential quality feature of BTS2048-VL-TEC devices is their precise and traceable

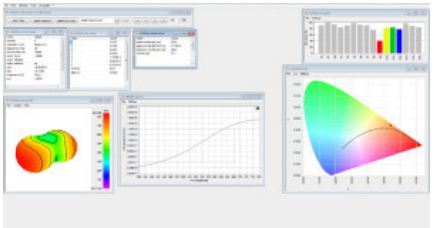
calibration. The BTS2048-VL-TEC is calibrated by Gigahertz-Optik's ISO/IEC 17025 calibration laboratory that was accredited by DAkkS (D-K-15047-01-00) for the spectral responsivity **and** spectral irradiance **according to ISO/IEC 17025. The calibration also included the corresponding accessory components. Every BTS2048-VL-TEC device is delivered with its respective calibration certificate.**



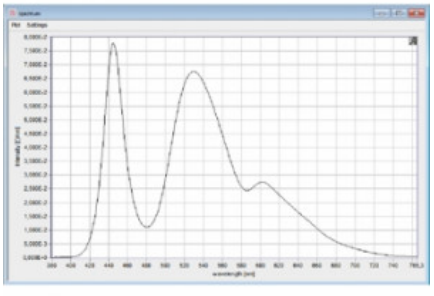
Electronic Shutter reduces the measurement time



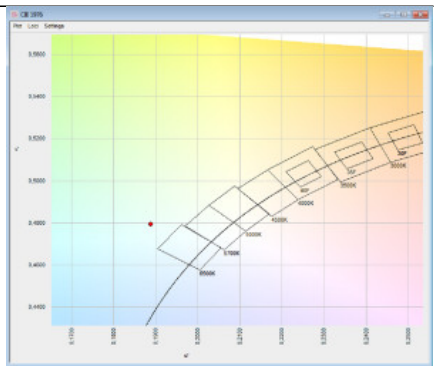
Ethernet interface reduces the datatransfer time



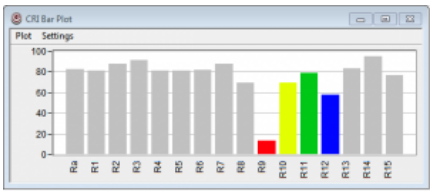
S-BTS2048 User software interface



Graphical view of the spectrum



CIE 1976 Chromaticity diagram



CRI Bar Plot

Specifications

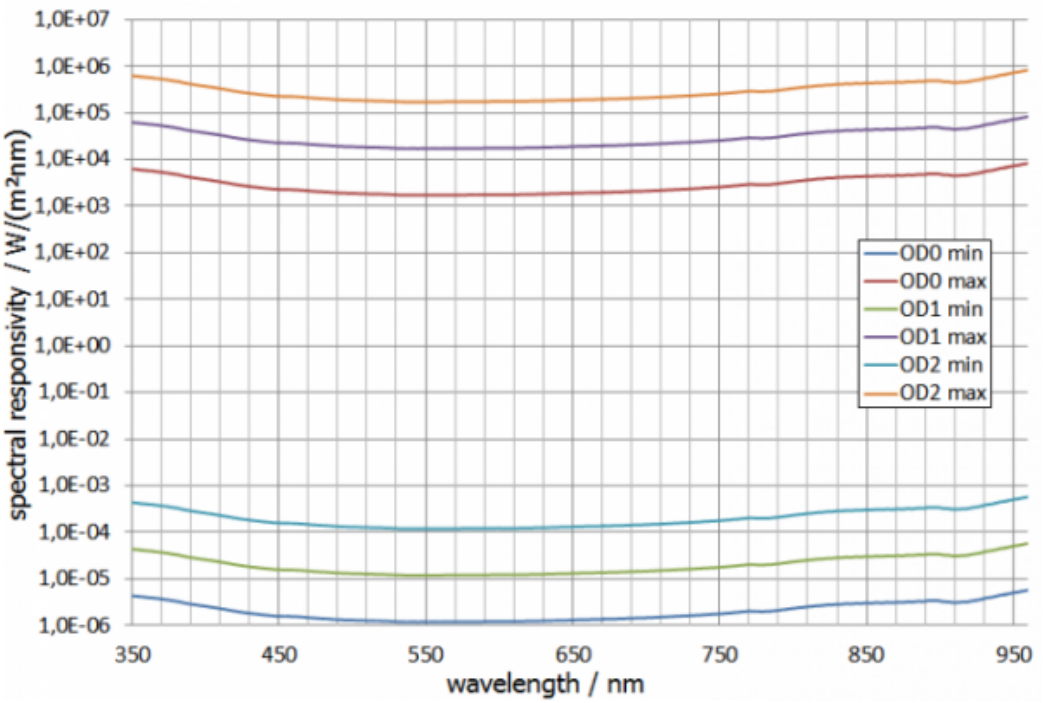
General	
Short description	High speed TE cooled CCD spectroradiometer with a wide dynamic range for CW and pulsed measurements of irradiance/illuminance, spectrum, luminous color, and color rendering index. Accessories for measurement of other parameters.
Main features	Compact device. BiTec detector with back-thinned TE cooled CCD (2048 pixels, 2 nm optical resolution, electronic shutter) and Si-photodiode with V(lambda) filter. Optical bandwidth correction (CIE214). Filter wheel with shutter and attenuation filters. Input lens with a diffusor window that has a cosine field of view. Automatic PWM synchronization
Measurement range	Spectral: 0.2 lx to 3E8 lx 280 nm to 1050 nm (min. level by white LED with low saturation). Integral: photometric 360 nm to 830 nm, 0.1 lx Noise signal up to 3E8 lx
Typical applications	CCD spectroradiometer for design applications. Module for integration in test systems for front-end and back-end LED binning
Calibration	Factory calibration. Traceable to international calibration standards
Product	
Measured Quantity	Spectral irradiance (W/(m² nm)), irradiance (W/m²), illuminance (lx), spectral radiant intensity (W/(sr nm)), radiant Intensity (W/sr), luminous intensity (cd), 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, TM-30-15, CQS, CIE-170, etc.. Option integrating sphere: in addition spectral flux (W/nm) and luminous flux (lm) Option goniometer: in addition radiant intensity (W/sr) distribution and luminous intensity (cd) distribution
Sensor	class B DIN 5032 part 7 or AA according to JIS C 1609-1:2006 class A DIN 5032 part 7 for f_4, or general precision class according to JIS C 1609-1:2006 class L DIN 5032 part 7 for f_1' and UV response, IR response, f_3, f_6 and f_7
Input optics	Diffusor, cosine corrected field of view (f2 ≤ 3 %)

Filter wheel	VL Version: 4 positions (open, closed, OD1, OD2). Use for remote dark current measurement and dynamic range extension. VL-2 Version: 4 positions (open, closed, OoR, OD1). Use for remote dark current measurement, stray light correction and dynamic range extension.
BiTec	Parallel measurement with diode and array is possible, thereby linearity correction of the array through the diode and online correction of the spectral mismatch of the diode through a*($s_z(\lambda)$) respectively F*($s_z(\lambda)$).
Spectral Detector	
Calibration uncertainty	Spectral irradiance λ u(*k*=2) (280 - 304) nm: ± 7 % (305 - 349) nm: ± 5 % (350 - 399) nm: ± 4.5 % (400 - 780) nm: ± 4 % (781 - 1030) nm: ± 4.5 % (1031 - 1050) nm: ± 5.5 % Spectral irradiance responsivity (280 - 1050) nm. Standard calibration (350 - 1050) nm. Optional calibration (280 - 1050) nm.
Integration Time	2 µs - 60 s *1
Spectral range	(280 -1050) nm
Optical Bandwidth	2 nm
Pixel resolution	~0.4 nm/Pixel
Number of pixels	2048
Chip	One stage cooled highly sensitive back-thinned CCD chip
ADC	16bit
Peak wavelength	± 0.2 nm
Dominant wavelength	± 0.5 nm *2
Δy Δx uncertainty	± 0.0015 (Standard illuminant A, white LED) ± 0.0020 (common LED)
Repeatability Δx and Δy	± 0.0001
ΔCCT	Standard illuminant A 30K; LED up to +/- 1.5 % depending of the LED spectrum
Band-pass correction	mathematical online band-pass correction is supported
Linearity	completely linearized chip >99.6%
Stray Light	2E-4 *3
Base line noise	5 cts *4
SNR	5000 *5
Dynamic range	>10 Magnitudes
Spectral irradiance responsivity range	(1E-6 - 1E5) W/(m²nm) *6*7
CRI (color rendering index)	Ra and R1 to R15
Typical measurement time	10 lx 1.5 s *10 100 lx 150 ms *10 1000 lx 15 ms *10
Integral Detector	

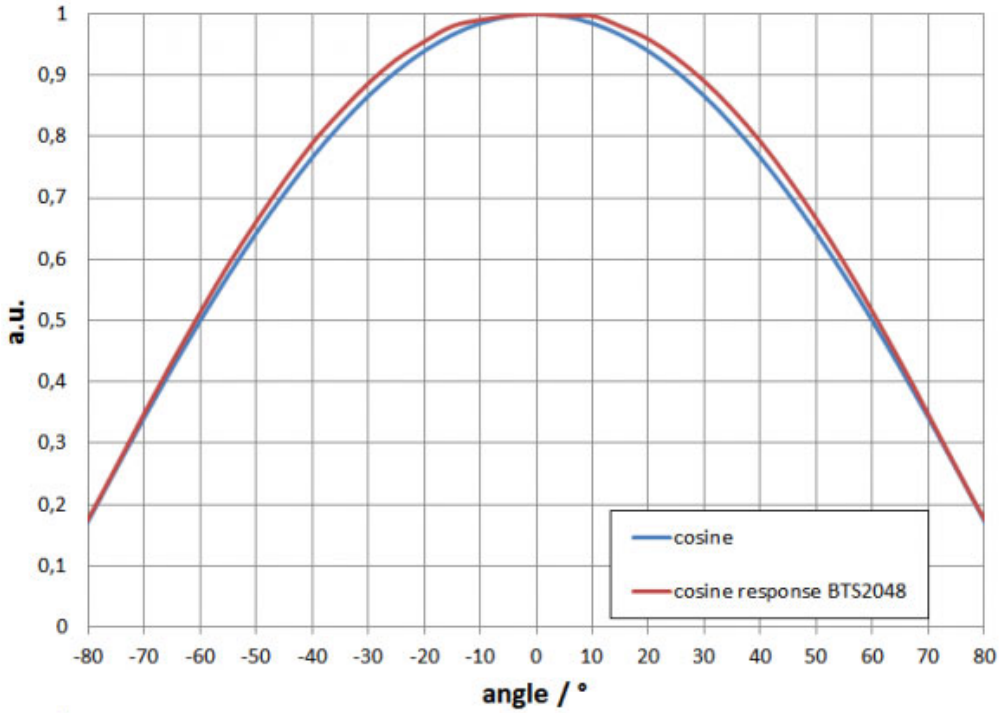
Filter	Spectral responsivity with fine CIE photometric matching. Online correction of the photometric matching through spectral measurement data (spectral missmatch factor correction).
Measurement range	Nine (9) measurement ranges with transcendent offset correction
Measurement range	Max measureable illuminance value 3E8lx [*7] Noise equivalent illuminance value 1E-1lx
Calibration	Illuminance ± 2,2 %
f1' (spectral mismatch)	≤ 6 % (uncorrected) ≤ 1.5 % (f1' a*($s_z(\lambda)$) respectively F*($s_z(\lambda)$) corrected by spectral data, done automatically by BTS technology)
ADC	16bit

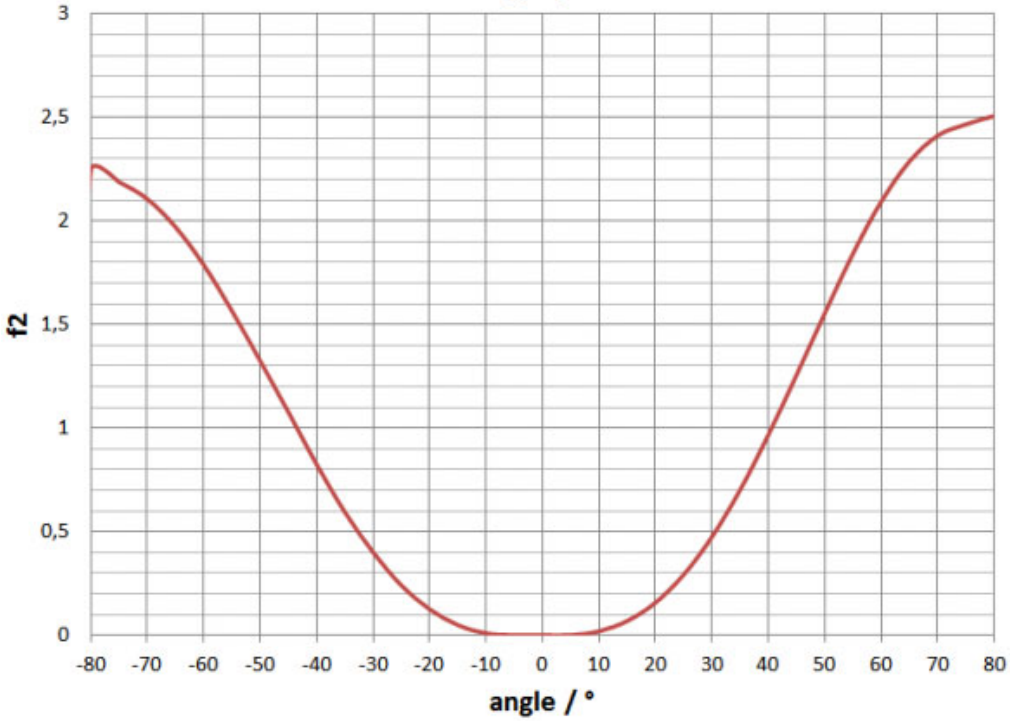
Graphs

Spectral responsivity



f2 (directional response/cosine error)





Miscellaneous	
Microprocessor	32bit for device control,16bit for CCD array control, 8bit for photodiode control
Interface	USB V2.0, Ethernet (LAN UDP protocol), RS232, RS485
Data transfer	Standard for 2048 float array values via ethernet 7ms, via USB 2.0 140 ms
Input Interfaces	2x (0 - 25) VDC, 1x optocoupler isolated 5 V / 5 mA
Output Interfaces	2x open collector, max. 25 V, max. 500 mA
Trigger	Trigger input incorporated (different options, rising/falling edge, delayed, etc.)
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 power supply: DC Input 5V (±10 %) at 700 mA With USB bus (500mA) *8
Dimensions	103 mm x 107 mm x 52 mm (Length x Width x Height)
Weight	500g
Mounting	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 to 50) °C Operation: (10 to 30) °C *9
Info	**1 It is recommended to perform a new dark signal measurement for every change in the integration time* **2 typical value, the uncertainty of the dominant wavelength depends on the spectral distribution of the LED* **3 typical value, measured 100nm left of the peak of a cold white broadband LED* **4 *5 typical value measured without averaging for a 4ms measurement time and full scale control of the array. Averaging results in quadratic rise of the S/N* *i.e. quadratic fall of the base noise e.g. averaging to a factor 100 improves the S/N by a factor 10* **6 Minimum 500/1 S/N. Maximum at full scale control.* **7 Irradiation only allowed for a short time so as to avoid thermal damage* **8 during USB connection, not all functions are available due to the limited current supply e.g. no Ethernet and TEC cooling* **9 Device required for temperature stabilization in approx. 25min. In measurement is performed in the warm-up phase, or if measurements are performed* *under varying temperatures, dark signal measurement is required for each measurement* **10 measurement of a white LED and 20000 counts (signal-dark) saturation* **The typical uncertainty considerations in the data sheet refer to the calibration conditions (temperature, humidity, warm-up, modulation, etc.) and, as this is not possible, do not include user effects such as aging, contamination, etc.*
Temperature range	CCD Chip: ≤ ± 0.25 °C

Option: 150mm Integrating Sphere (UMBB-150)

Spectral radiant flux responsivity range (spectral measurement)	(5E-9 - 5E2) W/nm
Luminous flux measurement range (integral measurement)	(3E-5 - 1E5) lm
Sphere diameter	150 mm
Typical measurement time	measurement with 20000 cts: 1 lm 80 ms 10 lm 8 ms 100 lm 800 µs optimized measurement time with 5000 cts and noise reduction: 10 lm 2 ms
Calibration	Luminous flux: ± 4 % Spectral radiant power: (350 - 399) nm: OD0: ± 8 % OD1: ± 10 % OD2: ± 10 % (400 - 800) nm: OD0: ± 4,5 % OD1: ± 4,5 % OD2: ± 4,5 % (801 - 1000) nm: OD0: ± 6,5 % OD1: ± 6,5 % OD2: ± 6,5 % (1001 - 1050) nm: OD0: ± 8 % OD1: ± 10 % OD2: ± 10 % Spectral radiant power responsivity (350 - 1050) nm

Option: 210mm Integrating Sphere (UMBB-210)

Spectral radiant flux responsivity range (spectral measurement)	(1E-8 - 1E3) W/nm

Luminous flux measurement range (integral measurement)	(7E-5 - 2E5) lm
Sphere diameter	210 mm
Typical measurement time	measurement with 20000 cts: 1 lm 160 ms 10 lm 16 ms 100 lm 1600 µs optimized measurement time with 5000 cts and noise reduction: 10 lm 4 ms
Calibration	Luminous flux: ± 4 % Spectral radiant power: (350 - 399) nm: OD0: ± 8 % OD1: ± 10 % OD2: ± 10 % (400 - 800) nm: OD0: ± 4,5 % OD1: ± 4,5 % OD2: ± 4,5 % (801 - 1000) nm: OD0: ± 6,5 % OD1: ± 6,5 % OD2: ± 6,5 % (1001 - 1050) nm: OD0: ± 8 % OD1: ± 10 % OD2: ± 10 % Spectral radiant power responsivity (350 - 1050) nm

Option: 1000mm Integrating Sphere (UMTB-1000-HFT)

Spectral radiant flux responsivity range (spectral measurement)	(2E-7 - 2E4) W/nm
Luminous flux measurement range (integral measurement)	(1E-3 - 4E6) lm
Sphere diameter	1000 mm
Typical measurement time	measurement with 20000 cts: 10 lm 450 ms 100 lm 45 ms 1000 lm 4,5 s optimized measurement time with 5000 cts and noise reduction: 10 lm 112 ms
Calibration	Luminous flux: ± 4 % Spectral radiant power: (350 - 399) nm: OD0: ± 8 % OD1: ± 11 % OD2: ± 11 % (400 - 800) nm: OD0: ± 4,5 % OD1: ± 5 % OD2: ± 5 % (801 - 1000) nm: OD0: ± 6,5 % OD1: ± 7 % OD2: ± 7 % (1001 - 1050) nm: OD0: ± 8 % OD1: ± 11 % OD2: ± 11 % Spectral radiant power responsivity (350 - 1050) nm

Option: Goniometer (GB-GD-360-RB40)

Spectral radiant intensity responsivity range	(1E-6 - 1E5) W/(sr nm) ; by 1m measurement distance
Luminous intensity measurement range (integral measurement)	(1E-1 - 3E8) cd ; by 1m measurement distance

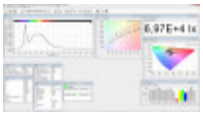
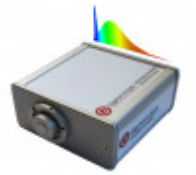
Calibration	Luminous intensity: ± 4 % Spectral Radiant intensity: (350 - 399) nm: OD0: ± 7 % OD1: ± 8 % OD2: ± 9 % (400 - 800) nm: OD0: ± 4 % OD1: ± 4 % OD2: ± 4 % (801 - 1000) nm: OD0: ± 6 % OD1: ± 6 % OD2: ± 6 % (1001 - 1050) nm: OD0: ± 7 % OD1: ± 8 % OD2: ± 9 % Spectral radiant intensity responsivity (350 - 1050) nm
Option: ILED-B (CP-ILED-B-IS-1.0-HL)	
Spectral radiant intensity (ILED-B) responsivity range (spectral measurement)	(5E-8 - 5E3) W/nm
Measurment range ILED-B (integral measurement)	(3E-4 - 1E6) cd
Calibration	Luminous intensity ILED-B: ± 4 % Spectral Radiant intensity ILED-B: (350 - 399) nm: OD0: ± 7 % OD1: ± 8 % OD2: ± 9 % (400 - 800) nm: OD0: ± 4 % OD1: ± 4 % OD2: ± 4 % (801 - 1000) nm: OD0: ± 6 % OD1: ± 6 % OD2: ± 6 % (1001 - 1050) nm: OD0: ± 7 % OD1: ± 8 % OD2: ± 9 % Spectral radiant intensity responsivity (350 - 1050) nm
Option: SRT-60-1.0HL-L2-UV	
Radiance	(5 - 6E9) cd/m², for typical white LED based on spectral responsivity
Spectral radiance	(3E-4 - 3E8) W/(m²sr·nm)

Downloads

Type	Description	File-Type	Download
BTS2048-Series	BTS2048 'Not just another spectrometer' brochure	pdf	https://www.gigahertz-optik.com/assets/BTS2048_broschuere_DINA4_hoch_V2_2022.pdf

Configurable with

Product Name	Product Image	Description	Go to product
UMTB-1000-HFT		Sphere for the luminous flux measurement of 2π and 4π light fixtures inside a sphere. Features: Turnable Integrating sphere with a 1000 mm diameter, extra measurement ports for 2π luminaires with diameters of up to 254mm and auxiliary lamp.	https://www.gigahertz-optik.com/en-us/product/umtb-1000-hft/
UMTB-500-HF		Preconfigured hollow sphere of the UM series modular construction integrating spheres	https://www.gigahertz-optik.com/en-us/product/umtb-500-hf/

Product Name	Product Image	Description	Go to product
CP-ILED-B-IS-1.0-HL		Measurement Adapter for ILED-B. Features: High uniformity, CIE 127, UMPA-1.0-HL mount.	https://www.gigahertz-optik.com/en-us/product/cp-iled-b-is-1.0-hl/
S-BTS2048		Application software for BTS2048 variants.	https://www.gigahertz-optik.com/en-us/product/s-bts2048/
S-SDK-BTS2048		Software Development Kit for BTS2048 variants.	https://www.gigahertz-optik.com/en-us/product/s-sdk-bts2048/
GB-GD-360-RB40		Goniometer for the measurement of 2π sources	https://www.gigahertz-optik.com/en-us/product/gb-gd-360-rb40/
BTS2048 Series		Compact spectroradiometers with excellent optical performance and BiTec technology for precise measurements for lab and field use.	https://www.gigahertz-optik.com/en-us/product/bts2048-series/
LDM-C50		Spectral radiance optic for BTS2048 series with integrated camera. Focus-able achromatic objective, for the usage with BTS2048 series. Different apertures and measurement distances including calibration are possible.	https://www.gigahertz-optik.com/en-us/product/ldm-c50/
LDM-1901		Photobiological risk group classification (spectral or integral measurement)	https://www.gigahertz-optik.com/en-us/product/ldm1901/
ISS-30-TLS Tunable LED Light Source		Spectral tunable LED light source with uniform field of view, high dynamic range, equipped with spectral reference sensor and variable aperture controlled by an intuitive application software	https://www.gigahertz-optik.com/en-us/product/iss-30-tls-tunable-led-light-source/

Purchasing information

Article-Nr	Modell	Description
Product		
15298687	BTS2048-VL-TEC	Measuring device, hard cover box, users guide, S-BTS2048 software, calibration certificate.
15312535	BTS2048-VL-2-TEC	Measuring device, hard cover box, users guide, S-BTS2048 software, calibration certificate.
Calibration		
15315075	K-BTS2048VL-E-S-V01	Calibration of the BTS2048-VL-TEC from 350 nm to 1050 nm in ND0 setting with calibration certificate.

Article-Nr	Modell	Description
15314795	K-BTS2048-XX-SLMC	Determination and implementation of stray light correction matrix.
15306166	K-BTS2048VL-E-S-V03	Calibration of the BTS2048-VL-TEC from 280 nm to 1050 nm in ND0 setting while applying the stray light correction matrix. Calibration certificate.
15306743	K-BTS2048VLTEC-E-S-V04	Calibration of the BTS2048-VL-TEC from 350 nm to 1050 nm in ND0 setting while applying the stray light correction matrix. Calibration certificate.
15310883	KP-BTS2048VLTEC-E-S-V01	Option: DIN EN ISO/IEC 17025:2018 Test Certificate (DAkkS). Measurement of spectral irradiance as well as illuminance in wavelength range from 280 nm to 1050 nm.
Re-calibration		
15315075	K-BTS2048VLTEC-E-S-V01	Re-calibration of the BTS2048-VL-TEC from 350 nm to 1050 nm in ND0 setting with calibration certificate
Software		
15298470	S-SDK-BTS2048	Software development kit with users guide.
15307925	S-T-RECAL-BTS2048	Software module for functional enhancement of S-BTS2048 software. Support of BTS2048 series light meter re-calibration via the user.
Accessories		
15312474	BTS2048-Z03	Triggering cable for BTS2048 series measuring devices.
15308779	CP-SRT-E	Tube for stray light reduction.
15316085	BTS2048-XX-Z08	Tube for stray light reduction. 11.5° field of view.
15309137	BTS2048-UV-S-Z01	Front tube with 80° field of view.
15309109	BTS2048-VL-Z09	Front tube with 11 mrad and 100 mrad field of view (i.e. ICNIRP, EN 62471, etc.). Material: Plastic.
15309268	BTS2048-VL-Z10	Front tube with 11 mrad and 100 mrad field of view (i.e. ICNIRP, EN 62471, etc.). Material: Aluminum.
15298714	BTS2048-VL-Z07	Adapter for mounting an SRT-M37-L accessory. Required for radiance measurements.
15298717	BTS2048-VL-Z08	Filter holder for attaching filters in front of COS diffuser of BTS2048 devices. Filter size: 18 mm x 18 mm.
15298718	BTS2048-VL-Z08S	UV transmissive protection screen for mounting in BTS2048-VL-Z08.

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- After-Sales Support
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- Repairs & Updates
- OEM & Feasibility Consulting of Customized Solutions

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