

■ Spectroradiometer sensor BTS2048-UV-S-WP

Spectroradiometer BiTec sensor BTS2048-UV-S-WP for high-quality outdoor UV measurements

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The BTS2048-UV-S-WP is a high-quality spectroradiometer whose compact design and elaborate optical, electronic and mechanical interfaces make it ideal for high precision outdoor UV measurements. Due to its innovative filter and spectrometer design it is able to measure solar radiation with a very good straylight reduction performance. Accordingly, even the edge of the sun below 300 nm can be resolved for some orders of magnitude (see figure 2). With the included S-BTS2048 application software, precise measurements and data analysis (Erythema, ICNRIP, etc.) can be performed intuitively. In addition, the spectral range can be extended from the UV to the NIR with the complementary BTS2048-VL-TEC-WP. Applications in the whole Si spectral region (e.g. solar-cells) are possible.

BiTec sensor for high-end light measurement

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

Spectrometer based on a high-quality back-thinned CCD detector

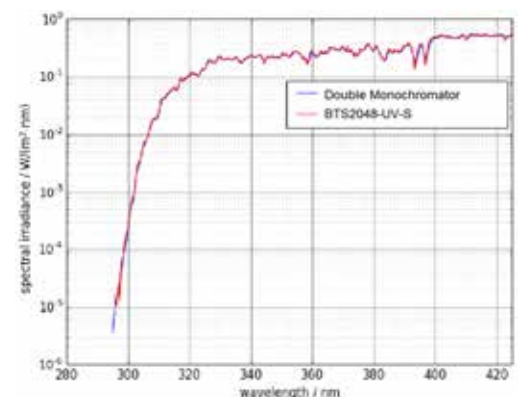
The spectrometer unit is based on a CCD with usable spectral responsivity range between 190 nm and 430 nm. It has a 0.7 nm optical bandwidth and a pixel resolution of 0.13 nm/pixel. Due to the back-thinned technology, the CCD is substantially more sensitive as compared to conventional front-illuminated CCD chips. Furthermore, the CCD is one stage cooled (1TEC) to reduce the dark current and thereby increase the signal to noise ratio.

Precise spectral radiometry (low straylight)

To facilitate optimum use of the CCD sensor's dynamic range and to overcome the problems of most array spectroradiometers in the UV range, a remote-controlled filter wheel (open, closed, optical filters) is located in the optical beam path. This filters combined with smart measurement and stray light correction routines enables high quality measurements of the BTS2048-UV-S. Results are comparable with double monochromator results (see figure). However, the measurement duration is significantly lower. Since the BTS2048-UV-S contains a filter wheel with 8 filter positions, a further smart measurement



BTS2048-UV-S-WP



Comparison of a solar measurement of the BTS2048-UV-S and a standard double monochromator. The BTS2048-UV-S achieves about the same quality in a measurement time of a few s compared to about 1.5 min of the double monochromator.

Measurands

- Spectral irradiance (W/(m² nm))
- Irradiance (W/m²)
- Peak wavelength
- Center wavelength
- Centroid wavelength
- Erythema
- ICNRIP

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routine for stray light reduction is implemented compared to the BTS2048-UV.

WP means weather proof

The housing of the BTS2048-UV-S-WP is designed for outdoor measurements. The cooled back-thinned CCD and the spectrometer unit are temperature controlled in a second housing. In this housing, humidity is removed by an exchangeable cartridge. In order to avoid deposits of dust, rain or snow on the entrance optics on the entrance optics the quartz dome is blow-dried by warm air.

Diffuser window directly connected instead of light guide

As for the input optics, the BTS2048-UV-S-WP has an incorporated diffuser window with a cosine corrected field of view. The fact that a light guide has not been used improves sensitivity and calibration stability which is a big advantage for outdoor use. The device's compact size is also of significant benefit. The f2 error of the cosine corrected field of view to less than 3% makes it possible to use the BTS2048-UV-S-WP for direct measurement in absolute radiometric quantities:

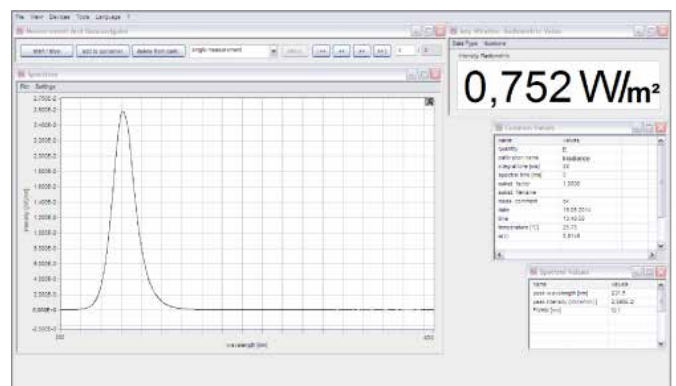
- Irradiance (W/m^2)
- Spectral irradiance ($W/(m^2 \text{ nm})$)

State of the art interface

The BTS2048-UV-S-WP is controlled via a USB 2.0 or Ethernet interface. With regards to the communication speed and cable length, the Ethernet port is superior to the USB2.0 interface. Furthermore, data preparation occurs in the BTS2048-UV-S-WP to optimize the data-transfer speed. For this purpose, an independent, high-performance micro-processor is incorporated. Data and power interface are of course of weather-proof design as well.



Side View of the BTS2048-UV-S-WP



S-BTS2048 software for the BTS2048-UV-S-WP

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User software with flexible desktop structure

The BTS2048-UV-S-WP's scope of delivery includes 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 potpourri of graphical and numerical display windows from which the user can choose:

- Freely definable numerical displays in decimal or scientific representation. Zoom function.

- Numerical display fields for radiometric, spectral and other measurands.
- Measurement protocol of the selected measurement parameters.
- Spectrum. Zoom function.
- Data logger. Zoom function.

Specifications BTS2048-UV-S-WP

General	
Short description	CCD based spectroradiometer with large dynamic for CW-, Datalogger- and Single measurements of spectral irradiance and derivative quantities (spectrum, erythema, ICNIRP, etc.) in the UV spectral region for outdoor use.
Range of measurement	Spectral: 3E-5 W/(m ² nm) to 3E4 W/(m ² nm) @325nm. Responsivity from 190 nm to 430 nm. Integral: 2E5 W/m ² to noise equivalent level by 5E-3 W/m ²
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	
Integration time	2 μs - 60 s *1
Spectral range	(190 - 430) nm
Optical bandwidth	0.8 nm
Pixel resolution	~0.13 nm/Pixel
Number of pixels	2048
ADC	16bit (25 ns instruction cycle time)
Peak wavelength	± 0.05 nm
Linearity	completely linearized chip >99.6%
Dynamic range	>9 Magnitudes
Integral Detector	
Filter	Spectral responsivity with radiometric matching. Online correction of the radiometric matching through spectral measurement data (spectral mismatch factor correction).
Measurement time	(0.1 - 6000) ms
Measurement range	seven (7) measurement ranges with transcendent offset correction
Measurement range	(5E-3 - 2E5) W/m ² *2

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Miscellaneous	
Processors	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
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.
Dimensions	Diameter: 160 mm; Height: 222 mm (see detailed drawing)
Weight	2.85 kg
Temperature range	Storage: (-10 to 50) °C; Operation: (-25 to 50) °C *3
Temperature stability	inside WP housing (electronics): $\leq \pm 1$ °C; CCD Chip: $\leq \pm 0.25$ °C
IP class	Housing IP66 (without fan for hot air flow); Housing IP55; Optical Sensor IP67

*3 Device requires for temperature stabilization approx. 25min (power supply is needed for outdoor use). 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.



With its innovative and high-quality products as well as application solutions, Gigahertz-Optik enjoys a high regard from its international customers within the field of optical radiation measurement technology. As a manufacturer, Gigahertz-Optik offers standard and custom-made solutions. Regular investments in new technologies ensure that Gigahertz-Optik is able to offer modern measuring solutions to its customers in industry and science.

Broadband light measurement devices

- UV Radiometer
- Photometer
- Hazard

Spectral light meter

- Handheld devices
- High-end devices
- UV Spectroradiometer
- Weather-proof devices
- Light transmission

Complementary products

- Integrating spheres
- Integrating sphere light sources
- Calibration standards
- Electronics, optomechanics
- Optically diffuse materials

GIGAHERTZ Optik Vertriebsgesellschaft für technische Optik mbH

An der Kaelberweide 12
82299 Tuerkenfeld / Germany
Phone +49 8193-93700-0
info@gigahertz-optik.de

Gigahertz-Optik Inc.

Boston North Technology Park
Bldg B · Ste 205 / 110 Haverhill Road
Amesbury MA 01913 / USA
Phone +1-978-462-1818
info-us@gigahertz-optik.com