

■ High-end array spectroradiometer BTS2048-VL

High-end array spectroradiometer with wide dynamic range, CW and pulse measurement, high responsivity, and fast data reading

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Requirements of a modern, versatile array spectroradiometer

There are many factors to be considered when assessing the suitability of array spectrometer systems for the absolute measurement of optical radiation parameters. For instance, the measurement of lamps that have different power ratings is only possible using array detectors that have a wide dynamic range. Precise, absolute measurements require the entire dynamic range of the spectroradiometer to be completely linearized and also require an accurate, traceable calibration. If the electronically controlled dynamic range (set by the integration time) is not sufficient, additional attenuating filters are needed. The filter wheel must be mechanically robust to ensure long-term stability of the measurement system.

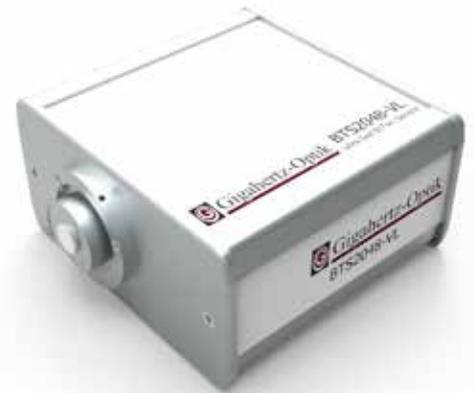
For time-critical applications such as LED binning in pulsed mode, the electronically controlled dynamic range must be large enough to avoid the need for a time-consuming filter change during the measurement. For absolute measurements, an automated dark signal adjustment of the CCD is state of the art. Spectroradiometers that are used for binning of front-end and back-end LEDs must accommodate precise synchronization of the measurement with the test LEDs operated in

pulsed mode requiring suitable trigger interface and fast data readout. Flash measurements, i.e. measurements within a light pulse, require an electronic shutter for instantaneous (ns) zero setting of all pixels before a measurement is triggered. The measurement of the luminous flux, luminous intensity, and luminous intensity distribution requires additional accessory components e.g., integrating spheres, optics, and goniometers.

A reproducible mounting between spectroradiometer and accessories is essential and helps avoiding influences of flexible light guide connections. Among the requirements of color measurements are precise calculations in accordance with CIE 13.3, CIE 15, and TM-30-15. For applications in the LED and semiconductor industries, the systems must also conform to the CIE S025 and LM-79-08 standards.

BTS2048-VL, diode array spectroradiometer with BiTec detector

The BTS2048-VL meets all the requirements of a high-end array spectroradiometer as well as being favourably priced despite its cutting-edge design.



Spectroradiometer BTS2048-VL

Measurands

- spectral irradiance ($W / (m^2 nm)$), irradiance (W / m^2), 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: additional radiation power (W / nm) and luminous flux (lm)
- Option goniometer: spectral radiance distribution (W / sr) and light intensity distribution (cd)

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One of its unique features is the innovative BiTec detector that consists of a V(λ) filtered Si photodiode and a spectroradiometer unit based on a back-thinned CCD. This makes it extremely linear, stable, and fast. 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).

The fully linearized 2048 pixel CCD detector with an electronic shutter allows for integration times ranging between 2 μ s and 4 s and hence offers an extremely high dynamic range (three orders of magnitude more than with common ms integration times and hence three OD filters are not needed). An even wider dynamic range is provided by the TEC-cooled spectroradiometer (BTS2048-VL-TEC). This variant has integration times ranging from 2 μ s to 60 s. The 2 nm optical bandwidth ensures accurate spectral measurement values in the range between 280 nm and 1050 nm (0.4 nm/pixel). Mathematical bandwidth correction in accordance with CIE 214 has also been implemented for auto-correction of the measurement values.

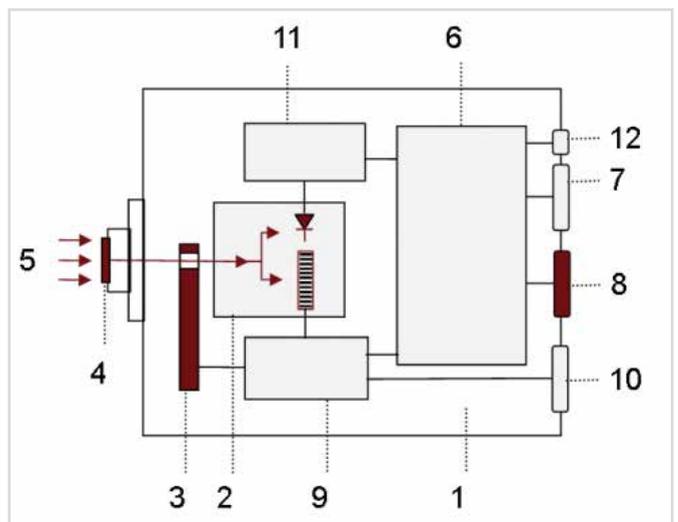
Si photodiodes exhibit exceptionally high linearity across their dynamic range. This makes them ideal for linearization of the CCD within the BiTec detector (see article on BTS technology). The constantly measuring diode can also be used to synchronize the measurement to PWM signals. This enables automatic recording of absolute spectral data using the BTS2048-VL, which is very difficult for conventional spectroradiometers without a BiTec sensor due to the integration time. In addition, the Si photodiode, which is fitted with a photometric filter (CIE V- λ), can be used independent of the CCD. The device can therefore be used to perform fast measurements on very low signals, something that makes the BTS2048-VL ideal for integration in goniometers and other systems. Another advantage of the BiTec technology in this context is the ability to integrate online correction of the spectral mismatch (f_1') of the diode using spectral data. Despite its compact dimensions of 103 mm x 107 mm x 52 mm (l x w x h), the BTS2048-VL spectroradiometer has a remote-controlled filter wheel with an OD1 and OD2 attenuation filter as well as a shutter for dark measurement.

Applications in front-end and back-end LED binning

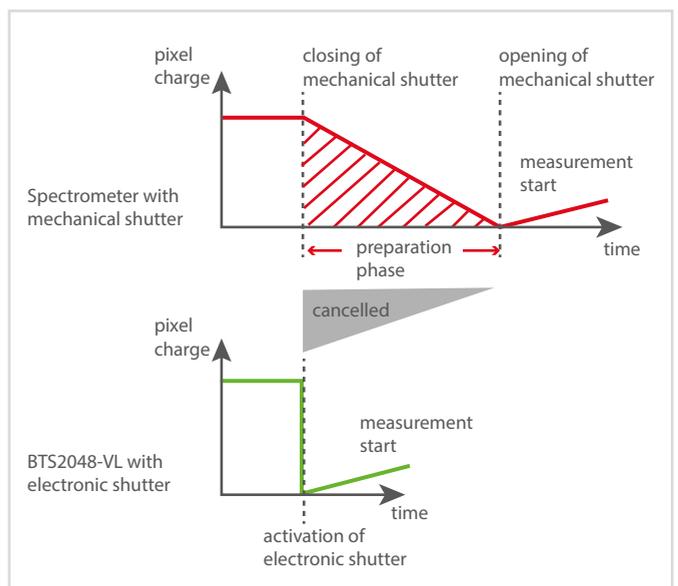
The BTS2048-VL is perfectly suited for industrial front-end and back-end LED binning applications. Its back-thinned CCD based spectrometer, incorporates an electronic zero setting feature of all pixels before a measurement is triggered. The electronic shutter and triggering of the measurement can be synchronized with the power supply via a trigger port when the test LED is operated in pulsed current mode. The powerful microprocessor only requires 7 ms to transfer a complete dataset to the system computer via the fast LAN interface.



Rear of the BTS2048-VL with connections



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



Electronic shutter shortens the measuring time

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Direct mounting instead of using a light guide

The BTS2048-VL spectroradiometer has a diffusor window and can therefore be used to measure the irradiance/illuminance, spectrum, color, and color rendering index, without any additional equipment. With the diffusor window, the BTS2048-VL can also be mounted directly onto accessories such as integrating spheres, luminance optics (according to CIE 127), and goniometers in order to measure the luminous flux, luminous intensity, and luminous intensity distribution. Gigahertz-Optik also offers the BTS2048-VL-F for applications with light guides.

User software and developer software

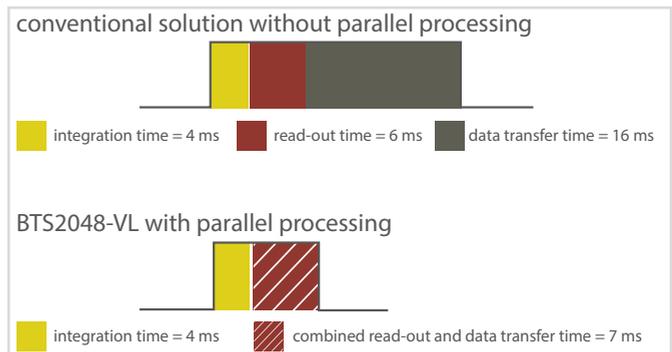
The standard S-BTS2048 user software has a customizable user interface and is extremely easy to use. It has a large number of display and function modules which can be activated when configuring the BTS2048-VL with the respective accessories from Gigahertz-Optik GmbH.

The S-SDK-BTS2048 developer software is recommended for integration of the BTS2048-VL in the customer's own software.

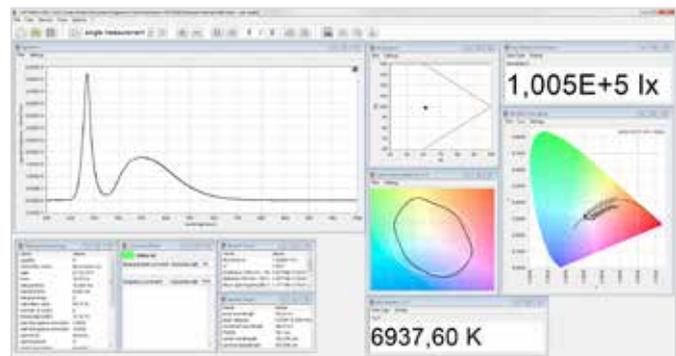
Calibration and adjustment

With its individual wavelength and linearity correction, the meter provides a cost effective solution for high precision light measurements, irrespective of the intensity or spectral distribution of the source.

A key quality feature of Gigahertz-Optik's light meters is their precise and traceable calibration. The calibration laboratory of Gigahertz-Optik GmbH guarantees the high quality and traceability of their factory calibrations. The calibration of the BTS2048-VL is confirmed by a factory calibration certificate.



The Ethernet interface reduces the data transfer time



S-BTS2048 Desktop of the user software

■ Specifications spectroradiometer BTS2048-VL

Specifications	
Measured Quantities	Spectral irradiance (W/(m ² nm)), irradiance (W/m ²), 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	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	Diffusor, cosine corrected field of view (f2 ≤ 3 %)
Filterwheel	4 positions (open, closed, OD1, OD2). Use for remote dark current measurement 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*(sz(λ)) respectively F*(sz(λ)).
Integration time	2 μs - 4 s
Spectral range	nine (9) measurement ranges with transcendent offset correction
Optical bandwidth	2 nm
Pixel resolution	~0.4 nm/Pixel
ADC	16bit (25ns instruction cycle time)



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

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