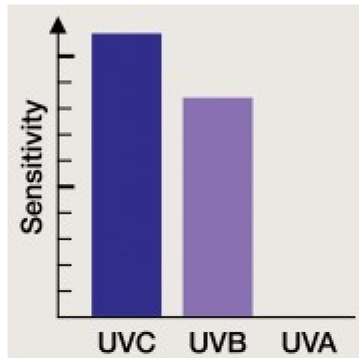
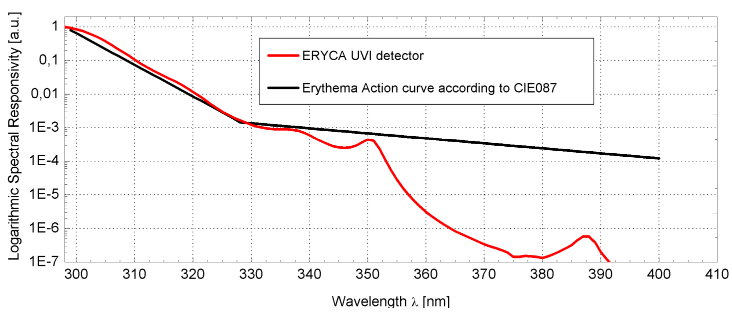
UV-Index Photodiodes
Data Sheets





- **For UV-Index measurement according ot CIE087, 3 % error only = most precise currently available detector, cosine corrected, different packagings, sorted by detector areas.**

sglux
The UV Experts

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UV-Index Measurements

Catalog

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The UV Experts

DEFINITION OF THE UV-INDEX

The UV Index is defined by ISO 17166 and quantifies the risk of sunburn (Erythema Solare) at a given solar UV exposure spectrum. Please check the video at the right column of this page for further information.

APPROACHES TO MEASURE THE UV INDEX

Precise measurement of the UV Index is usually based on data generated by spectrometers. These spectrometers measure the ultraviolet spectrum of the sun. Subsequently the UV Index is calculated by multiplication and integration of this spectrum with the human skin's erythema action curve. A handy alternative to spectrometer based UV Index measurement is using radiometers such as photodiode based integrating sensors. This method requires precision matching of the photodiode's spectral responsivity with the erythema action curve of the human skin and a cosine field of view. This precision is needed because the spectrum of the source (the sun) varies strongly depending on time of day, place, date, clouds, shadow and the local ozone layer thickness. A radiometer sold as an "UV Index Sensor" that does not precisely match the erythema action curve is not a valid UV Index Sensor, it is just a UV Sensor. As a result of many years of R&D the sglux ERYCA UV Index sensors nearly perfectly match the erythemal action curve. The mean error is 1.3% only.

SGLUX ERYCA RADIOMETER BASED GLOBAL METEOROLOGICAL NETWORK

Since 2014 Berlin's first UV Index measuring station works on the roof of sglux's building. This station bases on a UV Index sensor probe ("UV-Cosine_UV-Index") and a LAN transmitter module ("SKYLINK UV-transmitter"). Since October 2015 a duplicate station works in the Southern hemisphere, in Florianopolis, a city in the South of Brasil. On our website the values of these two stations are displayed.

OUR PRODUCTS

Our components and systems for measurement of the UV Index are listed on page 2. It starts with a selection of UV-Index photodiodes (external amplifier needed). Easiest to use components are the UV-Index TOCONs (photodiodes with internal amplifier for 0 to 5V voltage output). The sglux UV-Cosine_UV-Index probe is a waterproof sensor ready-to-mount outdoors with cosine field of view. To display and control the sensor's signal sglux offers the UVTOUCH and UV Control Pad displays as well as datalogger units. Our "SYKLINK UV transmitter" unit converts the sensor's signal into a web graph and transmits this graph to one or more multiple webpages. All items will be delivered calibrated on request.

Contact sglux and discover YOUR opportunities to precisely detect and report the sun's UV-Index.

UV-Index Measurements

Catalog

PHOTODIODES AND SENSORS (MEASUREMENT MEAN ERROR ‹ 1.3%)

SiC UV photodiodes

UV-Index photodiodes, different active chip areas and housings, with erythema filter

SiC TOCONs

UV-Index hybrid sensor in a TO5 housing with 0 - 5 V signal output, with erythema filter

TOCON_PTFE24V_UVI

UV-Index hybrid sensor (TOCON) in PTFE housing (male thread M12x1), EMC safe, with erythema filter

TOCON_UVI

UV-Index hybrid sensor (TOCON) in PTFE housing (with G1/4" thread), EMC safe, with erythema filter

UV-Surface_UVI

top looking surface-mount UV sensor probe with cosine FOV, EMC safe, with erythema filter

UV-Cosine_UVI

waterproof UV-Index sensor probe with cosine FOV, EMC safe, for outdoor use, with erythema filter

UV-INDEX DISPLAYS AND NETWORK COMPUTERS

UV-Index reference radiometer

Reference radiometer for UV-Index measurements, incl. calibrated (PTB traceable) UVI sensor probe

Skylink UV transmitter

network computer with UV-Index sensor

SG01D-E18 (ERYCA_custom)
high precision UV-Index photodiode

General Features

Properties of the ERYCA_custom photodiode

- DIN5050/ CIE087 UV-Index measurement with very small error <± 3%
- TO18 hermetically sealed housing, 1 UVI (2,5 µW/cm2) ≈ 1,25 nA

Information about the UV-Index (UVI)
The UV index is an international standard measurement of how strong the ultraviolet (UV) radiation from the sun is at a particular place on a particular day. It is a scale primarily used in daily forecasts aimed at the general public. The UV-Index is calculated by integrating the sun's UV spectrum multiplied with the Erythema action curve (fig. 1, black curve and fig. 2, formula 1). That integral is divided by 25 mW/m^2 to generate a convenient index value, which becomes essentially a scale of 0 to 10. The Erythema action curve is a wavelength resolved measure of the sunburn danger. It is maximised at 297nm (UVB) and then strongly decreases towards UVA radiation. Literature: A. F. McKinlay and B. L. Diffey, "A reference action spectrum for ultraviolet induced erythema in human skin" CIE Journal, 6-1, 17-22 (1987)

About the sglux ERYCA sensors
The ERYCA is designed for accurate measurement of the UV-Index. ERYCA's error is <3% only which is sufficiently small for scientific and high performance commercial applications. The ERYCA is available as:

ERYCA_custom (SG01D-E18) photodiode, 1,25nA/UVI (0,50mm^2 SiC detector chip)

ERYCA_advanced (SG01L-E5) cosine corrected photodiode, 2nA/UVI (1,0mm^2 SiC chip)

ERYCA_science (SG01XL-E5) cosine corrected photodiode, 8nA/UVI (4,0mm^2 SiC chip)

TOCON_ERYCA pre-amplified cosine corrected hermetically sealed low noise sensor with 5-15V power supply and approx. 100mV/UVI voltage output (SiC detector chip)

How ERYCA's <3% error is calculated?
A good erythema sensor's response needs to follow the Erythema Action curve (fig 1) as close as possible. Additionally the visible blindness needs to be extremely high as the visible part of sun's radiation exceeds the erythema causing radiation by five orders of magnitude. ERYCA works with a 4H SiC detector chip providing a visible blindness of more than ten orders of magnitude. That means that absolutely no visible light interferes the sensors output value. Sensors with a visible blindness of less than six orders of magnitude are unsuited for UVI measurement even if they match with the CIE curve. ERYCA's curve (fig. 1, red curve) has a near perfect match from 295nm to 320nm. From 320nm a leakage of approx. 0,1% is seen. To find out how that leakage negatively influences the UVI measurement a closer look at different sun spectra (varying tilt angle and ozone layer thickness) is needed. Fig. 4 shows different sun UV spectra issued by the Swiss governmental institute of meteorology. In total nine different sun spectra calculating an UVI from 1,12 to 10,92 were used. For error calculation the different sun spectra were integrated with the Erythema action curve and subsequently the integral of the same spectra with ERYCA's response curve (fig. 2, formula 1 and 2) were calculated. Finally the error was calculated by using formula 3 (fig. 2). As shown by the blue curve (fig. 3) the error of all UVI is less than 3%.

Fig. 1 Spectral Response

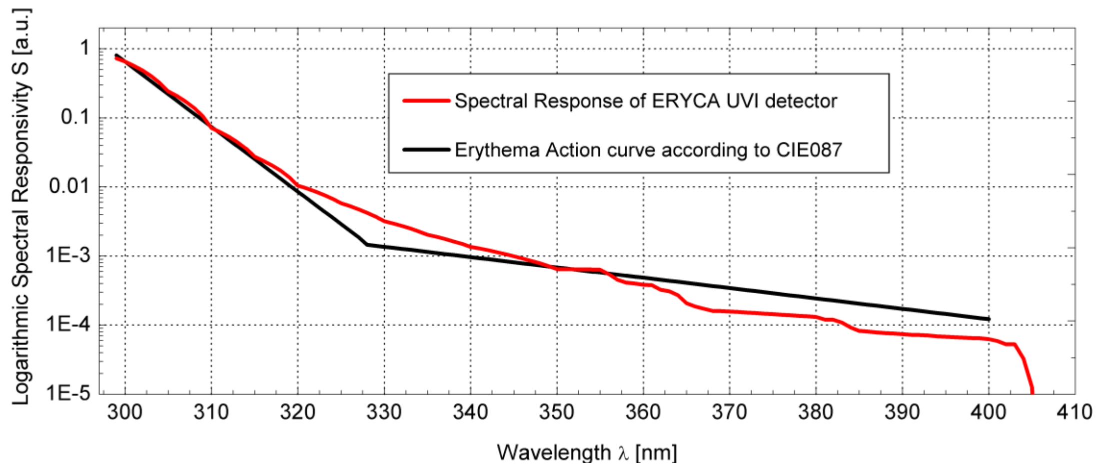


Fig. 2 Calculation Formulae

$$UVI_{ideal} = \int_{\lambda=297\,nm}^{\lambda=400\,nm} \frac{S(\lambda)\cdot CIE(\lambda)}{25mW/m^2} d\lambda \quad (1)$$

$$UVI_{real} = \int_{\lambda=297\,nm}^{\lambda=400\,nm} \frac{S(\lambda)\cdot ERYCA(\lambda)}{25mW/m^2} d\lambda \quad (2)$$

$$E = \frac{(UVI_{ideal} - UVI_{real})\cdot 100}{UVI_{ideal}} \quad (3)$$

Legend

$S(\lambda)$= sun UV spectrum
$CIE(\lambda)$= CIE087 standard curve
$ERYCA(\lambda)$= ERYCA response curve
E= error in %

Fig. 3 Error Graph

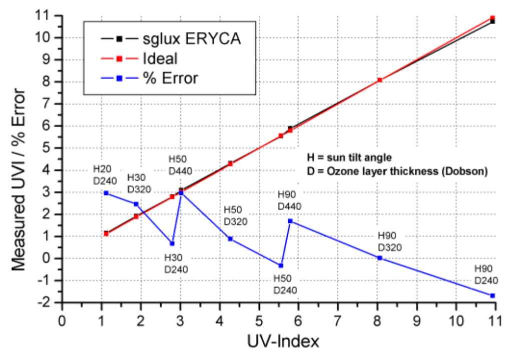
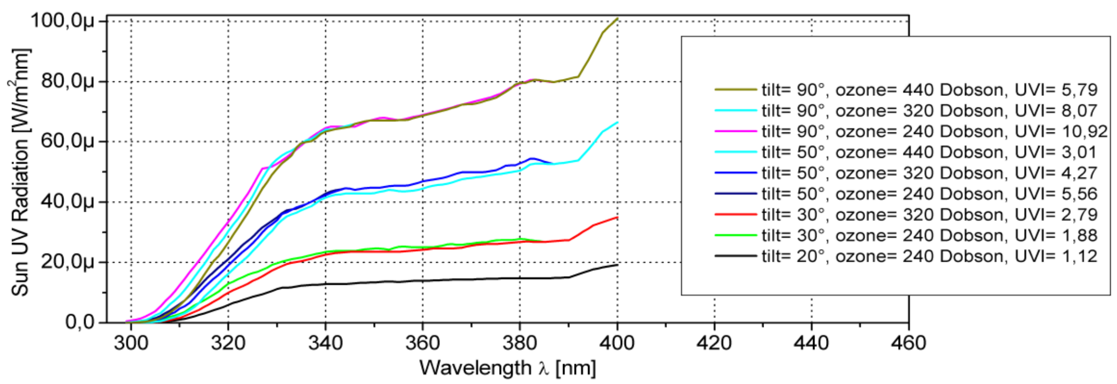


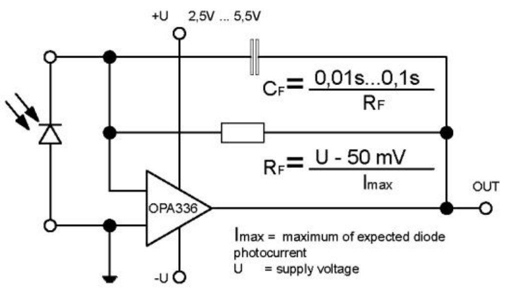
Fig. 4 Sun Spectra Issued by the Swiss Meteo Institute



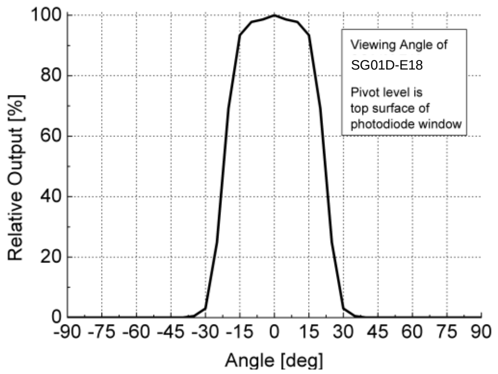
Specifications

Parameter	Symbol	Value	Unit
Maximum Ratings			
Operating Temperature Range	T_{opt}	*-55 … +170*	*°C*
Storage Temperature Range	T_{stor}	*-55 … +170*	*°C*
Soldering Temperature (3s)	T_{sold}	*260*	*°C*
Reverse voltage	V_{Rmax}	*20*	*V*
General Characteristics (*T*=25°C)			
Active Area	A	*0,50*	mm^2
Dark current (1V reverse bias)	I_d	*2,5*	*fA*
Capacitance	C	*188*	*pF*
Short circuit (1 UVI)	I_0	*1,25*	*nA*
Temperature coefficient	*Tc*	*<-0,1*	*%/K*

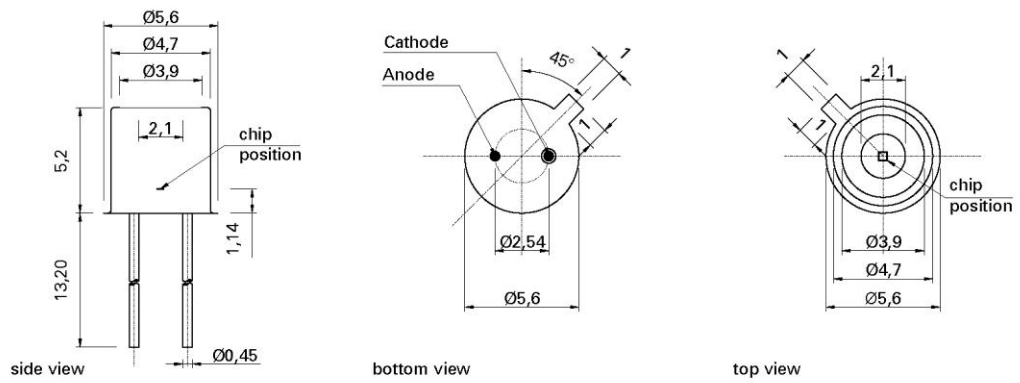
Circuit



Viewing Angle



Drawing



Application Note for Photodiodes

For correct reading of the photodiode the current (and NOT the voltage) must be analyzed. This requires a short circuiting of the photodiode. Usual approaches are using a **Picoamperemeter** or a **transimpedance amplifier** circuit.

To make the photodiode running reliably, in particular in harsh environment, EMC compatibility and protection against dust, water and mechanical influences is needed. Below listed modules base on a SiC photodiode and guarantee this protection and safety.

TOCONs = UV Sensors with integrated amplifier

- SiC based UV hybrid detector with pre-amplifier (0-5V output), no additional amplifier needed, direct connection to controller, voltmeter, etc.
- Measures intensities from 1,8 pW/cm2 up to 18 W/cm2
- UV broadband, UVA, UVB, UVC or Erythema measurements
- Upgrade to M12x1 housing with Hirschmann connector available

Industrial UV probes

- Different housings e.g. with cosine response, water pressure proof or Sapphire windows
- Different electronic outputs configurable (voltage, current, USB, CAN, LAN)

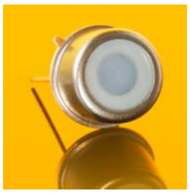
Laboratory Equipment & Calibration

The below listed sglux products & services are helpful if you like to learn more about the UV radiation generated by your UV source:

- UV Radiometers for intensity check
- UV Dosimeters for dose control, e.g. curing applications
- UV Controllers to control lamps, valves etc.
- NIST and PTB traceable calibration for all sglux sensors

SG01L-E5 (ERYCA_advanced)
high precision UV-Index photodiode

General Features



Properties of the ERYCA_advanced photodiode

- DIN5050/ CIE087 UV-Index measurement with very small error <± 3%
- TO5 housing, 1 UVI (2,5 μW/cm2) ≈ 2 nA, cosine correction

Information about the UV-Index (UVI)

The UV index is an international standard measurement of how strong the ultraviolet (UV) radiation from the sun is at a particular place on a particular day. It is a scale primarily used in daily forecasts aimed at the general public. The UV-Index is calculated by integrating the sun's UV spectrum multiplied with the Erythema action curve (fig. 1, black curve and fig. 2, formula 1). That integral is divided by 25 mW/m^2 to generate a convenient index value, which becomes essentially a scale of 0 to 10. The Erythema action curve is a wavelength resolved measure of the sunburn danger. It is maximised at 297nm (UVB) and then strongly decreases towards UVA radiation. Literature: A. F. McKinlay and B. L. Diffey, "A reference action spectrum for ultraviolet induced erythema in human skin" CIE Journal, 6-1, 17-22 (1987)

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ERYCA_science (SG01XL-E5) cosine corrected photodiode, 8nA/UVI (4,0mm^2 SiC chip)

TOCON_ERYCA pre-amplified cosine corrected hermetically sealed low noise sensor with 5-15V power supply and approx. 100mV/UVI voltage output (SiC detector chip)

How ERYCA's <3% error is calculated?

A good erythema sensor's response needs to follow the Erythema Action curve (fig 1) as close as possible. Additionally the visible blindness needs to be extremely high as the visible part of sun's radiation exceeds the erythema causing radiation by five orders of magnitude. ERYCA works with a 4H SiC detector chip providing a visible blindness of more than ten orders of magnitude. That means that absolutely no visible light interferes the sensors output value. Sensors with a visible blindness of less than six orders of magnitude are unsuited for UVI measurement even if they match with the CIE curve. ERYCA's curve (fig. 1, red curve) has a near perfect match from 295nm to 320nm. From 320nm a leakage of approx. 0,1% is seen. To find out how that leakage negatively influences the UVI measurement a closer look at different sun spectra (varying tilt angle and ozone layer thickness) is needed. Fig. 4 shows different sun UV spectra issued by the Swiss governmental institute of meteorology. In total nine different sun spectra calculating an UVI from 1,12 to 10,92 were used. For error calculation the different sun spectra were integrated with the Erythema action curve and subsequently the integral of the same spectra with ERYCA's response curve (fig. 2, formula 1 and 2) were calculated. Finally the error was calculated by using formula 3 (fig. 2). As shown by the blue curve (fig. 3) the error of all UVI is less than 3%.

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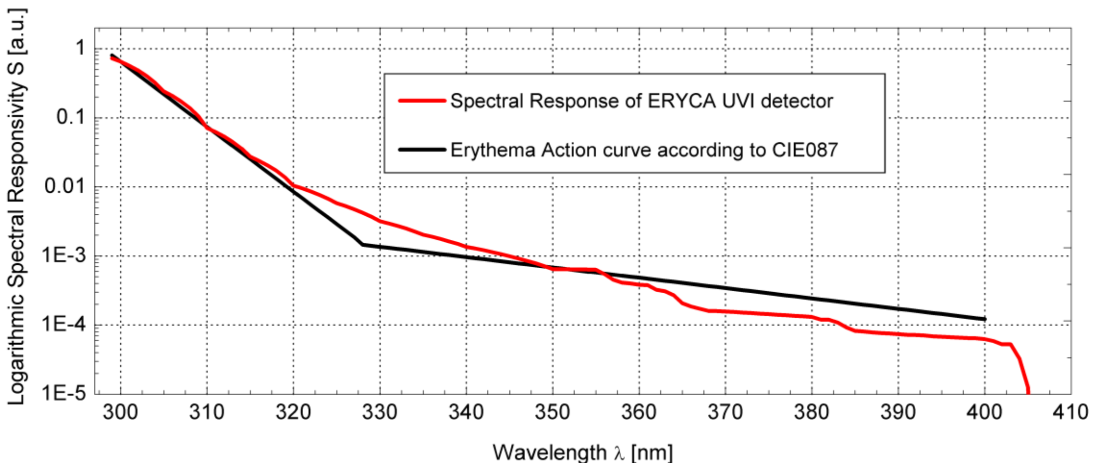

Fig. 2 Calculation Formulae

$$\mathrm{UVI}_{\mathrm{ideal}} = \int_{\lambda=297\,\mathrm{nm}}^{\lambda=400\,\mathrm{nm}} \frac{S(\lambda)\cdot \mathrm{CIE}(\lambda)}{25\mathrm{mW/m^2}}\,d\lambda \quad (1)$$

$$\mathrm{UVI}_{\mathrm{real}} = \int_{\lambda=297\,\mathrm{nm}}^{\lambda=400\,\mathrm{nm}} \frac{S(\lambda)\cdot \mathrm{ERYCA}(\lambda)}{25\mathrm{mW/m^2}}\,d\lambda \quad (2)$$

$$E = \frac{(\mathrm{UVI}_{\mathrm{ideal}} - \mathrm{UVI}_{\mathrm{real}})\cdot 100}{\mathrm{UVI}_{\mathrm{ideal}}} \quad (3)$$

Legend
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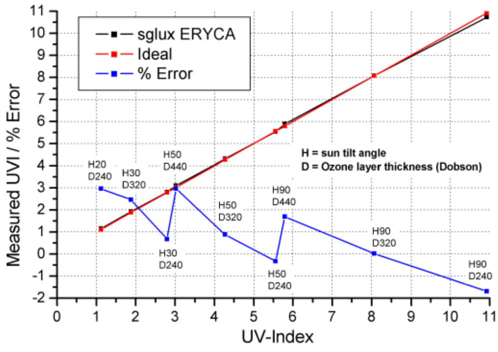

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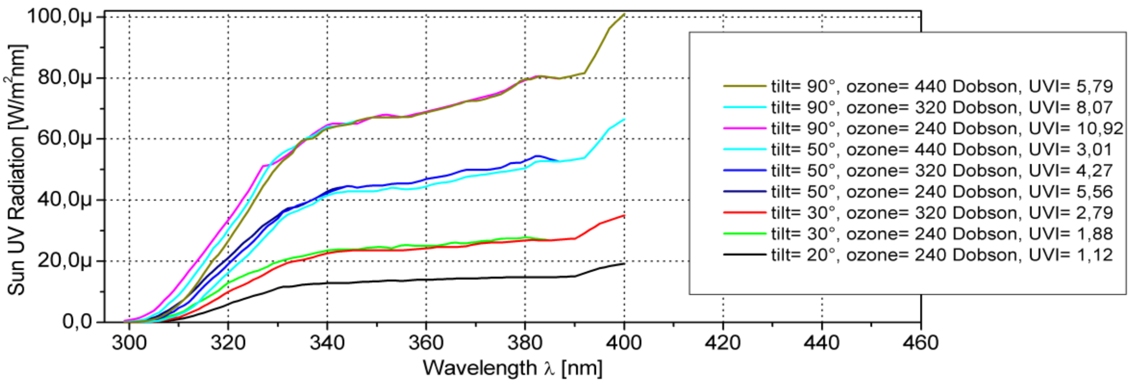

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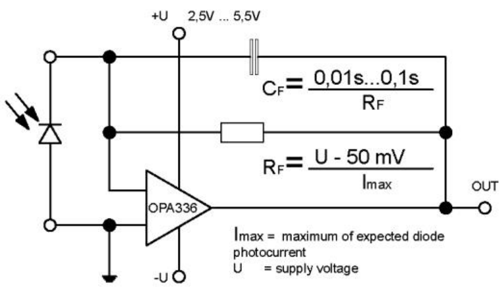
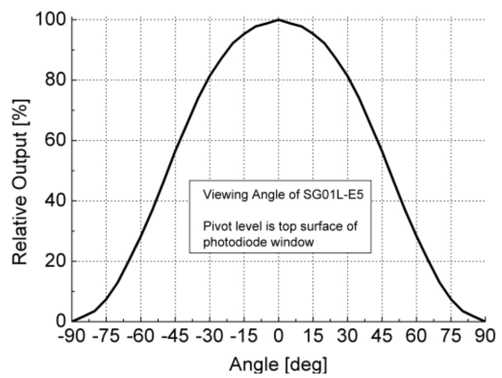
Reverse voltage	V_{Rmax}	20	V
General Characteristics (T=25°C)			
Active Area	A	1,00	mm^2
Dark current (1V reverse bias)	I_d	4	fA
Capacitance	C	200	pF
Short circuit (1 UVI)	I_0	2	nA
Temperature coefficient	Tc	<-0,1	%/K

Circuit



Viewing Angle



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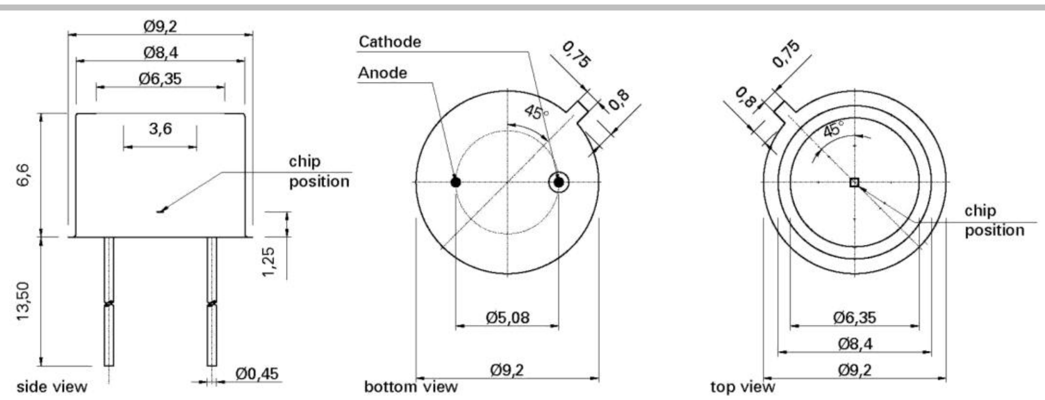

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SG01M-E18 (ERYCA_custom)
high precision UV-Index photodiode

General Features

Properties of the ERYCA_custom photodiode

- DIN5050/ CIE087 UV-Index measurement with very small error <± 3%
- TO18 hermetically sealed housing, 1 UVI (2,5 µW/cm2) ≈ 500 pA

Information about the UV-Index (UVI)
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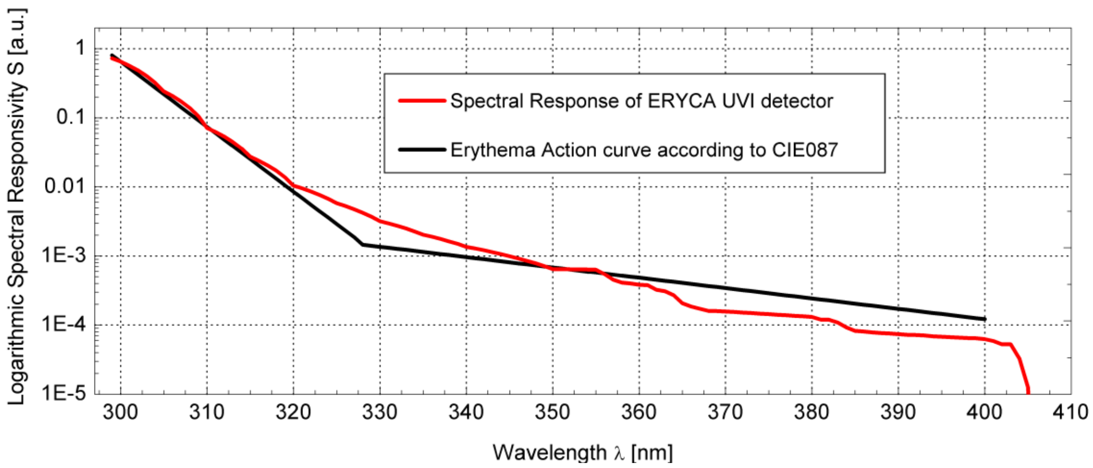

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Legend

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E= error in %

Fig. 3 Error Graph

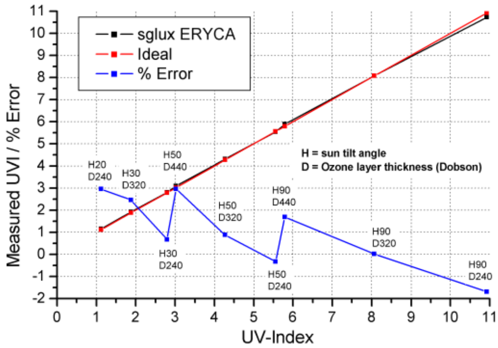
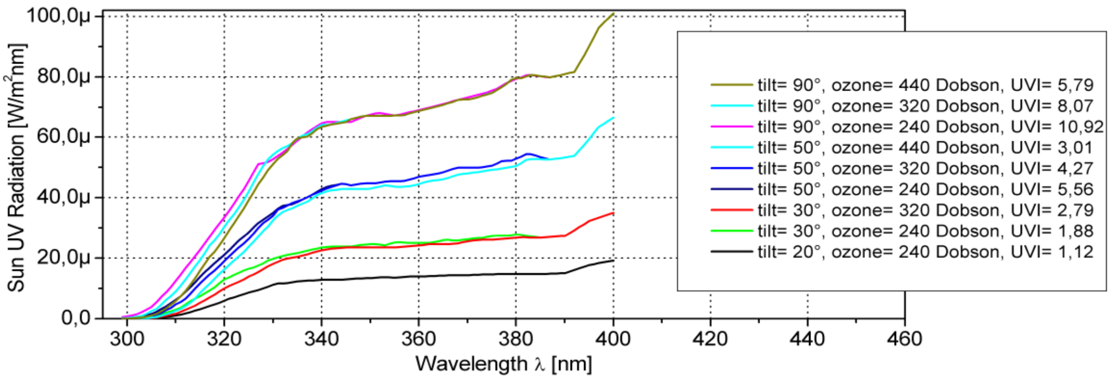


Fig. 4 Sun Spectra Issued by the Swiss Meteo Institute



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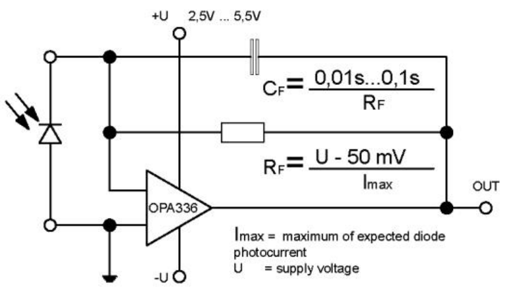
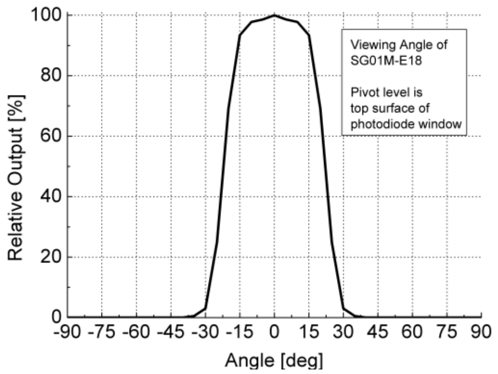
General Characteristics (*T*=25°C)			
Active Area	*A*	*0,20*	mm^2
Dark current (1V reverse bias)	I_d	*1*	*fA*
Capacitance	*C*	*75*	*pF*
Short circuit (1 UVI)	I_0	*500*	*pA*
Temperature coefficient	*Tc*	*<-0,1*	*%/K*

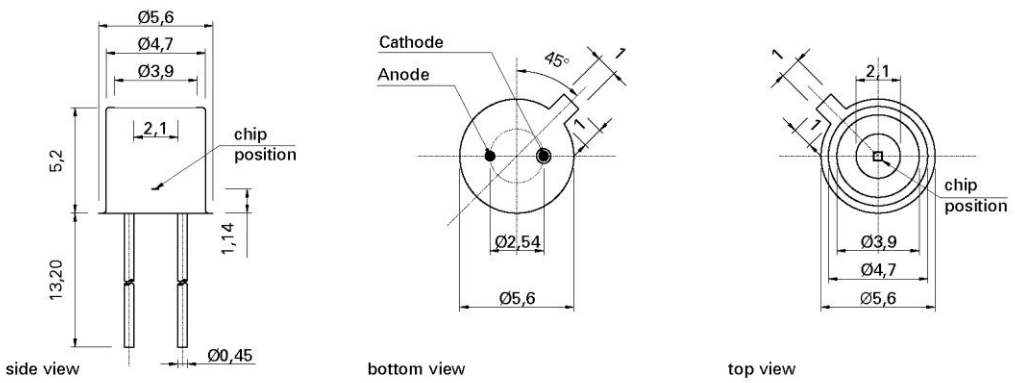
Circuit



Viewing Angle



Drawing



BOSTON ELECTRONICS | www.boselec.com | boselec@boselec.com | 617-566-3821

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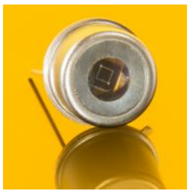
Laboratory Equipment & Calibration

The below listed sglux products & services are helpful if you like to learn more about the UV radiation generated by your UV source:

- UV Radiometers for intensity check
- UV Dosimeters for dose control, e.g. curing applications
- UV Controllers to control lamps, valves etc.
- NIST and PTB traceable calibration for all sglux sensors

SG01XL-E5 (ERYCA_science)
high precision UV-Index photodiode

General Features



Properties of the ERYCA_science photodiode

- DIN5050/ CIE087 UV-Index measurement with very small error <± 3%
- TO5 housing, 1 UVI (2,5 μW/cm2) ≈ 8 nA, cosine correction

Information about the UV-Index (UVI)

The UV index is an international standard measurement of how strong the ultraviolet (UV) radiation from the sun is at a particular place on a particular day. It is a scale primarily used in daily forecasts aimed at the general public. The UV-Index is calculated by integrating the sun's UV spectrum multiplied with the Erythema action curve (fig. 1, black curve and fig. 2, formula 1). That integral is divided by 25 mW/m^2 to generate a convenient index value, which becomes essentially a scale of 0 to 10. The Erythema action curve is a wavelength resolved measure of the sunburn danger. It is maximised at 297nm (UVB) and then strongly decreases towards UVA radiation. Literature: A. F. McKinlay and B. L. Diffey, "A reference action spectrum for ultraviolet induced erythema in human skin" CIE Journal, 6-1, 17-22 (1987)

About the sglux ERYCA sensors

The ERYCA is designed for accurate measurement of the UV-Index. ERYCA's error is <3% only which is sufficiently small for scientific and high performance commercial applications. The ERYCA is available as:

ERYCA_custom (SG01M-E18) photodiode, 0,5nA/UVI (0,20mm^2 SiC detector chip)

ERYCA_advanced (SG01L-E5) cosine corrected photodiode, 2nA/UVI (1,0mm^2 SiC chip)

ERYCA_science (SG01XL-E5) cosine corrected photodiode, 8nA/UVI (4,0mm^2 SiC chip)

TOCON_ERYCA pre-amplified cosine corrected hermetically sealed low noise sensor with 5-15V power supply and approx. 100mV/UVI voltage output (SiC detector chip)

How ERYCA's <3% error is calculated?

A good erythema sensor's response needs to follow the Erythema Action curve (fig 1) as close as possible. Additionally the visible blindness needs to be extremely high as the visible part of sun's radiation exceeds the erythema causing radiation by five orders of magnitude. ERYCA works with a 4H SiC detector chip providing a visible blindness of more than ten orders of magnitude. That means that absolutely no visible light interferes the sensors output value. Sensors with a visible blindness of less than six orders of magnitude are unsuited for UVI measurement even if they match with the CIE curve. ERYCA's curve (fig. 1, red curve) has a near perfect match from 295nm to 320nm. From 320nm a leakage of approx. 0,1% is seen. To find out how that leakage negatively influences the UVI measurement a closer look at different sun spectra (varying tilt angle and ozone layer thickness) is needed. Fig. 4 shows different sun UV spectra issued by the Swiss governmental institute of meteorology. In total nine different sun spectra calculating an UVI from 1,12 to 10,92 were used. For error calculation the different sun spectra were integrated with the Erythema action curve and subsequently the integral of the same spectra with ERYCA's response curve (fig. 2, formula 1 and 2) were calculated. Finally the error was calculated by using formula 3 (fig. 2). As shown by the blue curve (fig. 3) the error of all UVI is less than 3%.

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Fig. 1 Spectral Response

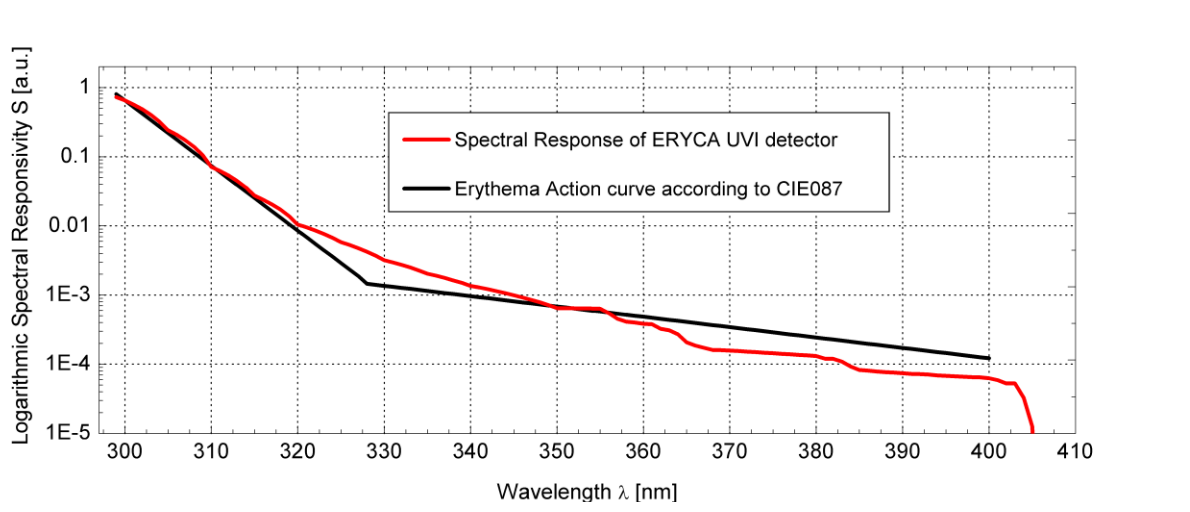


Fig. 2 Calculation Formulae

$$UVI_{ideal} = \int_{\lambda=297\,nm}^{\lambda=400\,nm} \frac{S(\lambda)\cdot CIE(\lambda)}{25mW/m^2} d\lambda \qquad (1)$$

$$UVI_{real} = \int_{\lambda=297\,nm}^{\lambda=400\,nm} \frac{S(\lambda)\cdot ERYCA(\lambda)}{25mW/m^2} d\lambda \qquad (2)$$

$$E = \frac{(UVI_{ideal} - UVI_{real})\cdot 100}{UVI_{ideal}} \qquad (3)$$

Legend

$S(\lambda)$= sun UV spectrum
$CIE(\lambda)$= CIE087 standard curve
$ERYCA(\lambda)$= ERYCA response curve
E= error in %

Fig. 3 Error Graph

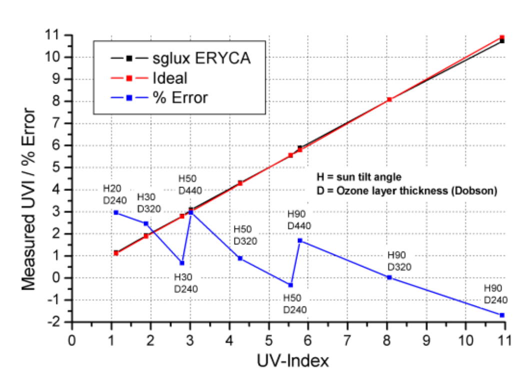
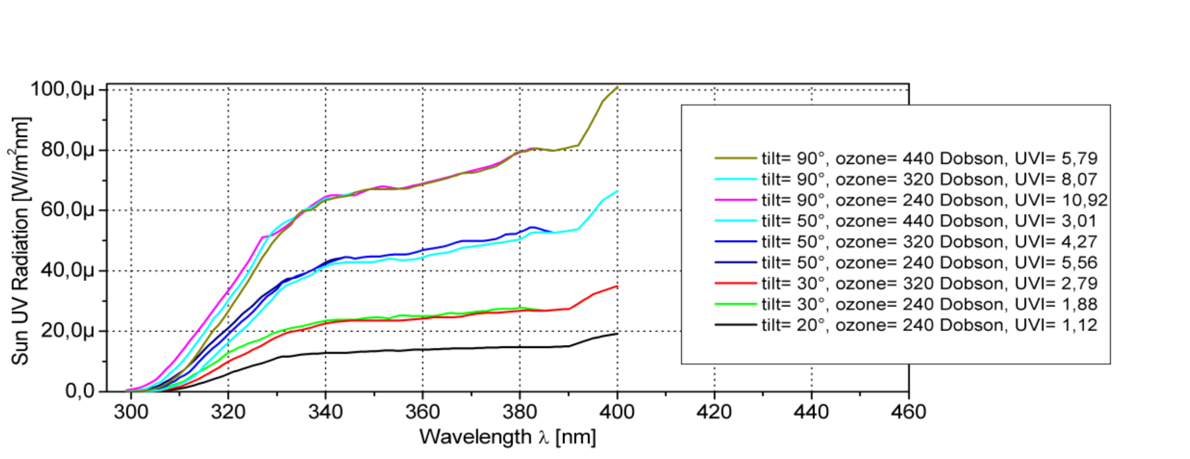


Fig. 4 Sun Spectra Issued by the Swiss Meteo Institute



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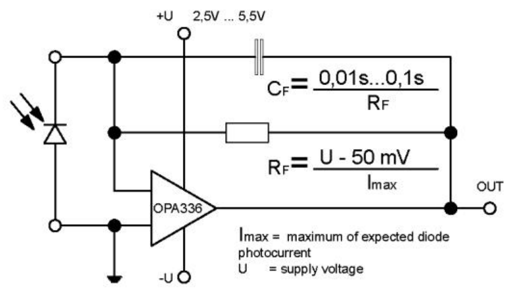
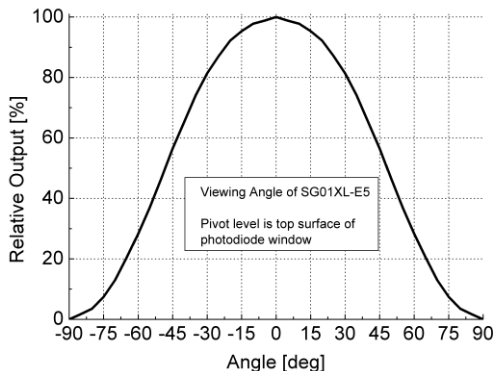
Specifications

Parameter	Symbol	Value	Unit
Maximum Ratings			
Operating Temperature Range	T_{opt}	-55 … +170	°C
Storage Temperature Range	T_{stor}	-55 … +170	°C
Soldering Temperature (3s)	T_{sold}	260	°C
Reverse voltage	V_{Rmax}	20	V
General Characteristics (T=25°C)			
Active Area	A	4,00	mm^2
Dark current (1V reverse bias)	I_d	7	fA
Capacitance	C	1,5	nF
Short circuit (1 UVI)	I_0	8	nA
Temperature coefficient	Tc	<-0,1	%/K

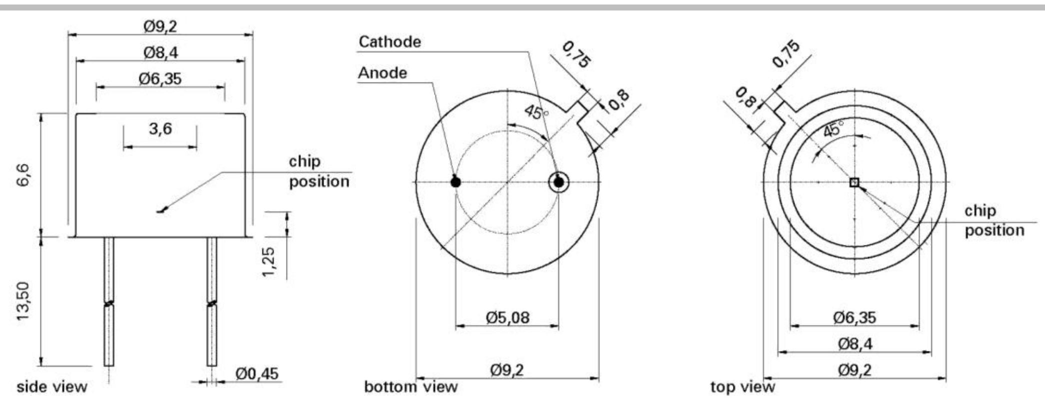
Circuit



Viewing Angle



Drawing



Application Note for Photodiodes

For correct reading of the photodiode the current (and NOT the voltage) must be analyzed. This requires a short circuiting of the photodiode. Usual approaches are using a **Picoamperemeter** or a **transimpedance amplifier** circuit.

To make the photodiode running reliably, in particular in harsh environment, EMC compatibility and protection against dust, water and mechanical influences is needed. Below listed modules base on a SiC photodiode and guarantee this protection and safety.

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