

Vacuum UV (VUV) SiC Photodiodes



- UV detection to wavelengths as low as 170nm.
- Robust SiC photodiodes in hermetic TO-style packages (TO-5, TO-18)
- Applications include use with VUV excimer lasers for curing and processing (172nm), detection for new disinfecting systems (222nm), and low-pressure Hg lamp monitoring used for TOC reduction and water purification (185nm)



 **Boston**Electronics

www.boselec.com | shop.boselec.com | uv@boselec.com | (617)566-3821

SG03R05-5

Broadband SiC based UV photodiode A = 0.5 mm² with VUV responsivity



GENERAL FEATURES



Properties of the SG03R05-5 UV photodiode

- Broadband UVA+UVB+UVC, enhanced VUV responsivity
- Usable for 185nm (Hg low pressure lamp) or 172nm (excimer) detection
- Active Area A = 0.5 mm² (circular active area)
- TO5 hermetically sealed metal housing with sapphire glass window
- 10 mW/cm² peak radiation results a current of approx. 8 μA

About the sglux Silicon Carbide (SiC) SG03 series

The difference between the sglux standard SG01 series and the SG03 series is the production method of the pn junction. The standard SG01 series works with vapor phase epitaxy generated pn junction. The SG03 series uses an ion implantation process. This process allows to position the depletion zone closer to the chip surface which leads to an improved spectral responsivity for wavelengths lower than 200nm. Accordingly, the SG03-series SiC photodiodes can be applied for measurement of 185nm UV radiation used for grease and odor reduction in canteen kitchens, TOC (total organic carbon) reduction (water treatment). Also UV irradiance generated by 172nm excimer sources as used for UV curing and matting of coatings can be detected. The photodiodes are available with five different active chip areas from 0.1 mm² up to 8 mm². By default, the photodiode is sensitive from VUV to UVA. Photodiodes with customized optical filters (e.g. 185nm Hg low pressure lamp measurement while being blind for 254nm) are available on request. Please contact us for details.

NOMENCLATURE

SG03		
Chip area	Spectral response	Housing
R01. R05. R10. R20. R80	nothing, customized	5. 5ISO90
R01 0.1 mm ²	nothing = broadband $\lambda_{max} = 280 \text{ nm}$ $\lambda_{510\%} = 170 \text{ nm} \dots 355 \text{ nm}$	5 2-pin TO5 housing, h = 4.3 mm for broadband responsivity; h = 6.7 mm for photodiodes with optical filter
R05 0.5 mm ²	customized $\lambda_{max} = \text{customized}$ $\lambda_{510\%} = \text{customized}$	5ISO90 3-pin TO5 housing, h = 4.2 mm, 2 pins isolated, 1 pin grounded
R10 1.0 mm ²	We are happy to tailor the spectral response according to individual customer requirements. Please contact us.	
R20 2.0 mm ²		
R80 8.0 mm ²		

SG03R05-5

Broadband SiC based UV photodiode A = 0.5 mm² with VUV responsivity

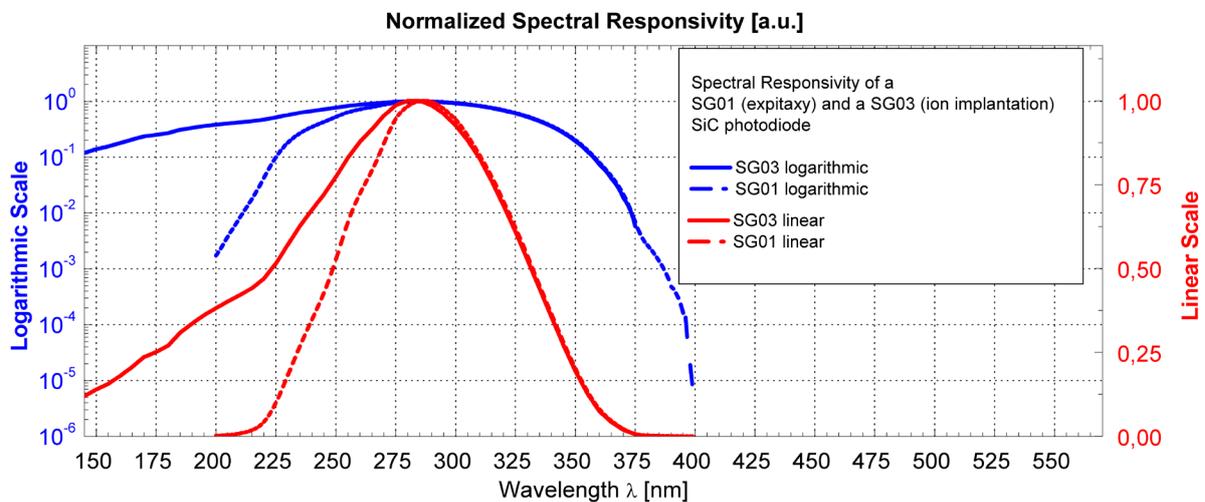


SPECIFICATIONS

Parameter	Symbol	Value	Unit
Spectral Characteristics			
Typical Responsivity at Peak Wavelength	S_{max}	0.160	AW^{-1}
Wavelength of max. Spectral Responsivity	λ_{max}	280	nm
Responsivity Range ($S=0.1 \cdot S_{max}$)	–	170 ... 355	nm
Visible Blindness ($S_{max}/S_{>405nm}$)	VB	$> 10^5$	–
General Characteristics (T=25°C)			
Active Area	A	0.5	mm ²
Dark Current (1V reverse bias)	I_d	0.2	fA
Capacitance	C	75	pF
Short Circuit (10 mW/cm ² at peak)	I_o	8	μA
Temperature Coefficient	T_c	< 0.1	%/K
Maximum Ratings			
Operating Temperature	T_{opt}	-55 ... +170	°C
Storage Temperature	T_{stor}	-55 ... +170	°C
Soldering Temperature (3s)	T_{sold}	260	°C
Reverse Voltage	V_{Rmax}	20	V

NORMALIZED SPECTRAL RESPONSIVITY

The below graph compares the SR of the standard SG01 series with the SR of the SG03 series

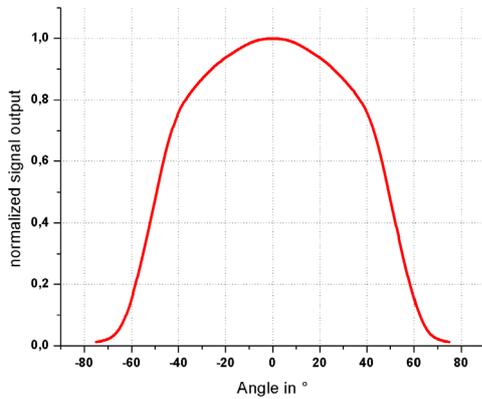


SG03R05-5

Broadband SiC based UV photodiode A = 0.5 mm² with VUV responsivity



FIELD OF VIEW

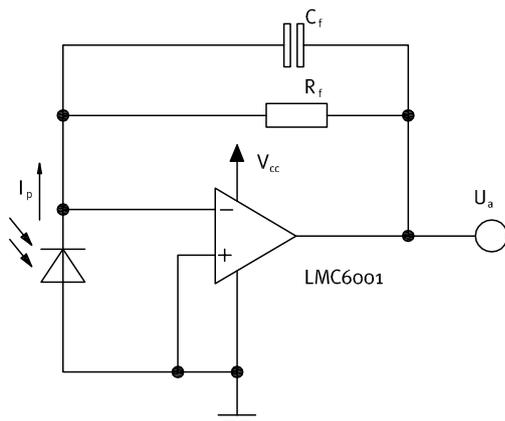


Measurement Setup:

lamp aperture diameter: 10 mm
 distance lamp aperture to second aperture: 17 mm
 second aperture diameter: 10 mm
 distance second aperture to detector: 93 mm

pivot level = top surface of the photodiode window

TYPICAL CIRCUIT



Calculations and Limits:

$$U_a = I_p \times R_f = 0 \dots \sim V_{cc}$$

$U_{a,max}$ depends on load and amplifier type

$R_f = 10k\Omega \dots \sim 10G\Omega$, $C_f \geq 3pF$
 Recommendation: $R_f \times C_f \geq 10^{-3}s$

$$I_{p,max} = U_{a,max} \div R_f$$

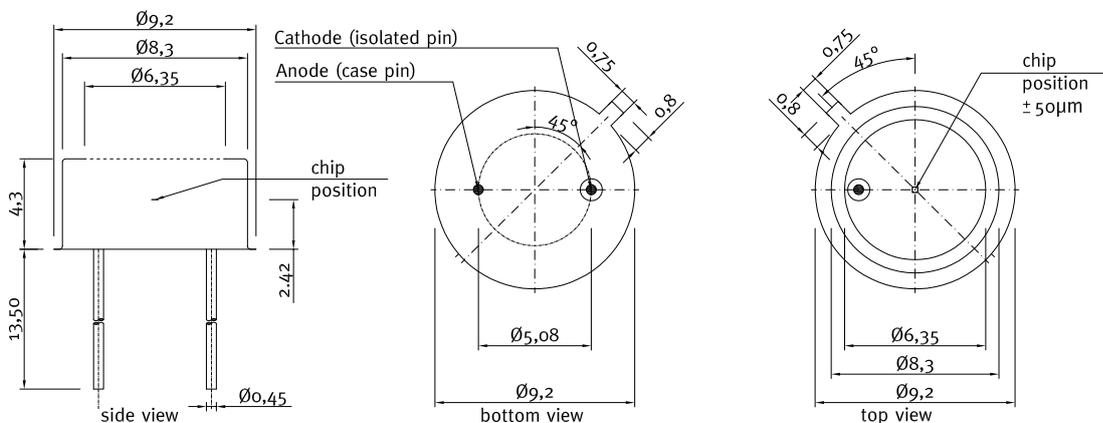
$$\text{Bandwidth} = DC \dots \frac{1}{2\pi \times R_f \times C_f}$$

Example:

$$I_p = 20nA, R_f = 100M\Omega, C_f = 100pF$$

$$U_a = 20 \times 10^{-9}A \times 100 \times 10^6\Omega = 2V$$

DRAWINGS



SG03R05-5

Broadband SiC based UV photodiode A = 0.5 mm² with VUV responsivity

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 signal transducer** circuit as shown on page 3.

UPGRADE TO A TOCON OR A PROBE



TOCONs = UV sensors with integrated signal transducer

- SiC based UV hybrid detector with signal transducer (0–5V output), no additional amplifier needed, direct connection to controller, voltmeter, etc.
- Measures irradiance from 1.8 pW/cm² up to 18 W/cm²
- UV broadband, UVA, UVB, UVC or Erythema measurements



Miniature housing with M12x1 thread for the TOCON series

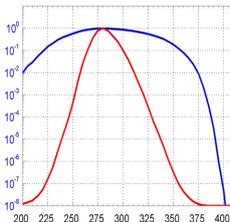
- Optional feature for all TOCON detectors
- Robust stainless steel M12x1 thread body, supply voltage 7...24 V
- Integrated sensor connector (Binder 4-Pin plug) with 2m connector cable
- Easy to mount and connect, increased EMC safety



UV probes

- Different housings e.g. with cosine response or water pressure proof
- Different electronic outputs configurable (voltage, current, USB, CAN, MODbus)
- Good EMC safety for industrial applications

CALIBRATION SERVICE



- PTB traceable calibrations and measurements:
- Calibration of sensors for irradiance measurements
- Calibration of UV sensors on discrete wavelengths
- Determination of a specific spectral sensor responsivity

SG03R10-5

Broadband SiC based UV photodiode A = 1.0 mm² with VUV responsivity



GENERAL FEATURES



Properties of the SG03R10-5 UV photodiode

- Broadband UVA+UVB+UVC, enhanced VUV responsivity
- Usable for 185nm (Hg low pressure lamp) or 172nm (excimer) detection
- Active Area A = 1.0 mm² (circular active area)
- TO5 hermetically sealed metal housing with sapphire glass window
- 10 μW/cm² peak radiation results a current of approx. 16 nA

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R20 2.0 mm ²		
R80 8.0 mm ²		

SG03R10-5

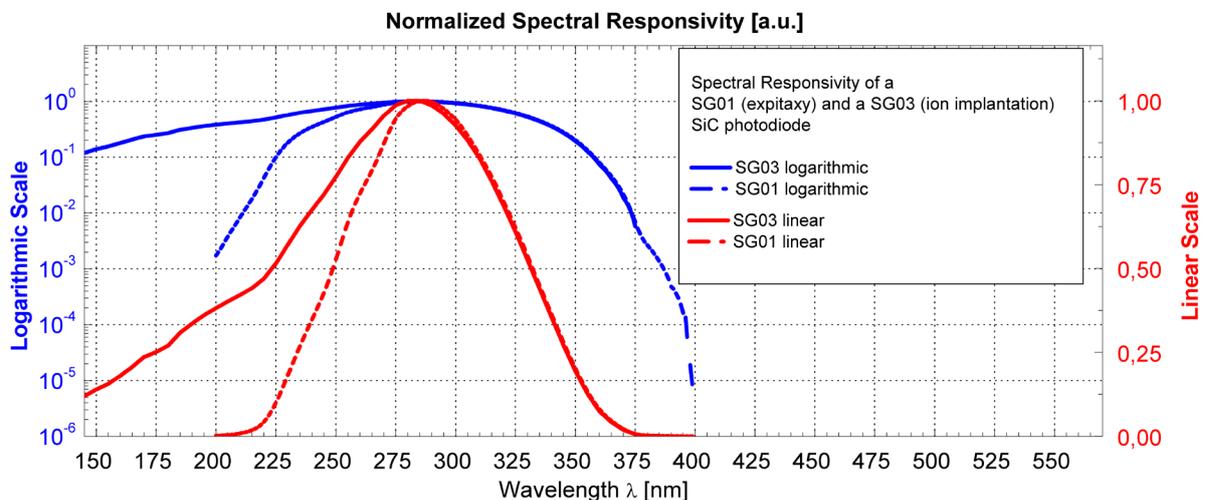
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SPECIFICATIONS

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Responsivity Range ($S=0.1 \cdot S_{max}$)	–	170 ... 355	nm
Visible Blindness ($S_{max}/S_{>405nm}$)	VB	$> 10^5$	–
General Characteristics (T=25°C)			
Active Area	A	1.0	mm ²
Dark Current (1V reverse bias)	I_d	0.2	fA
Capacitance	C	150	pF
Short Circuit (10 $\mu W/cm^2$ at peak)	I_o	16	nA
Temperature Coefficient	T_c	< 0.1	%/K
Maximum Ratings			
Operating Temperature	T_{opt}	-55 ... +170	°C
Storage Temperature	T_{stor}	-55 ... +170	°C
Soldering Temperature (3s)	T_{sold}	260	°C
Reverse Voltage	V_{Rmax}	20	V

NORMALIZED SPECTRAL RESPONSIVITY

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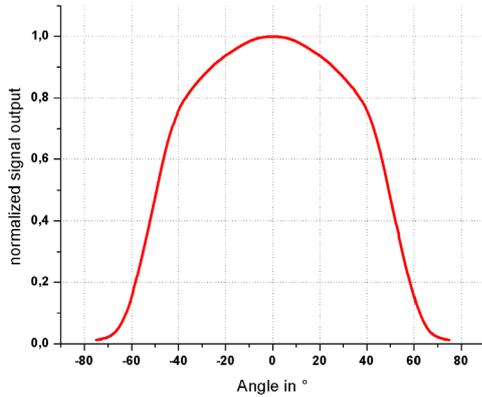


SG03R10-5

Broadband SiC based UV photodiode A = 1.0 mm² with VUV responsivity



FIELD OF VIEW

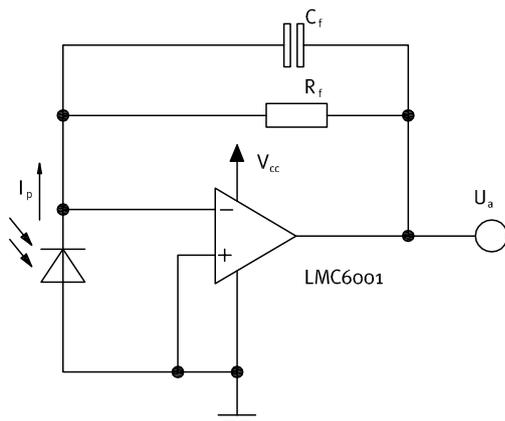


Measurement Setup:

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 second aperture diameter: 10 mm
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pivot level = top surface of the photodiode window

TYPICAL CIRCUIT



Calculations and Limits:

$$U_a = I_p \times R_f = 0 \dots \sim V_{cc}$$

$U_{a,max}$ depends on load and amplifier type

$R_f = 10k\Omega \dots \sim 10G\Omega$, $C_f \geq 3pF$
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$$I_{p,max} = U_{a,max} \div R_f$$

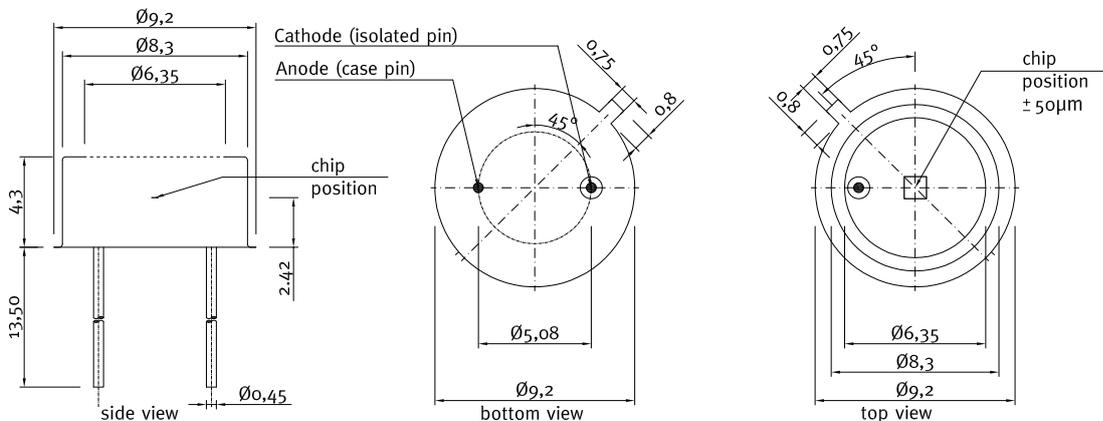
$$\text{Bandwidth} = DC \dots \frac{1}{2\pi \times R_f \times C_f}$$

Example:

$$I_p = 20nA, R_f = 100M\Omega, C_f = 100pF$$

$$U_a = 20 \times 10^{-9}A \times 100 \times 10^6\Omega = 2V$$

DRAWINGS



SG03R10-5

Broadband SiC based UV photodiode A = 1.0 mm² with VUV responsivity



APPLICATION NOTE FOR PHOTODIODES

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UPGRADE TO A TOCON OR A PROBE



TOCONs = UV sensors with integrated signal transducer

- SiC based UV hybrid detector with signal transducer (0–5V output), no additional amplifier needed, direct connection to controller, voltmeter, etc.
- Measures irradiance from 1.8 pW/cm² up to 18 W/cm²
- UV broadband, UVA, UVB, UVC or Erythema measurements



Miniature housing with M12x1 thread for the TOCON series

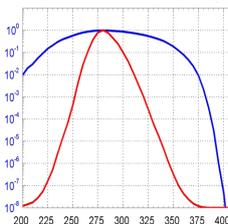
- Optional feature for all TOCON detectors
- Robust stainless steel M12x1 thread body, supply voltage 7...24 V
- Integrated sensor connector (Binder 4-Pin plug) with 2m connector cable
- Easy to mount and connect, increased EMC safety



UV probes

- Different housings e.g. with cosine response or water pressure proof
- Different electronic outputs configurable (voltage, current, USB, CAN, MODbus)
- Good EMC safety for industrial applications

CALIBRATION SERVICE



- PTB traceable calibrations and measurements:
- Calibration of sensors for irradiance measurements
- Calibration of UV sensors on discrete wavelengths
- Determination of a specific spectral sensor responsivity

SG03R20-5

Broadband SiC based UV photodiode A = 2.0 mm² with VUV responsivity



GENERAL FEATURES



Properties of the SG03R20-5 UV photodiode

- Broadband UVA+UVB+UVC, enhanced VUV responsivity
- Usable for 185nm (Hg low pressure lamp) or 172nm (excimer) detection
- Active Area A = 2.0 mm² (circular active area)
- TO5 hermetically sealed metal housing with sapphire glass window
- 10 μW/cm² peak radiation results a current of approx. 32 nA

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R05 0.5 mm ²	customized $\lambda_{max} = \text{customized}$ $\lambda_{510\%} = \text{customized}$	5ISO90 3-pin TO5 housing, h = 4.2 mm, 2 pins isolated, 1 pin grounded
R10 1.0 mm ²	We are happy to tailor the spectral response according to individual customer requirements. Please contact us.	
R20 2.0 mm ²		
R80 8.0 mm ²		

SG03R20-5

Broadband SiC based UV photodiode A = 2.0 mm² with VUV responsivity

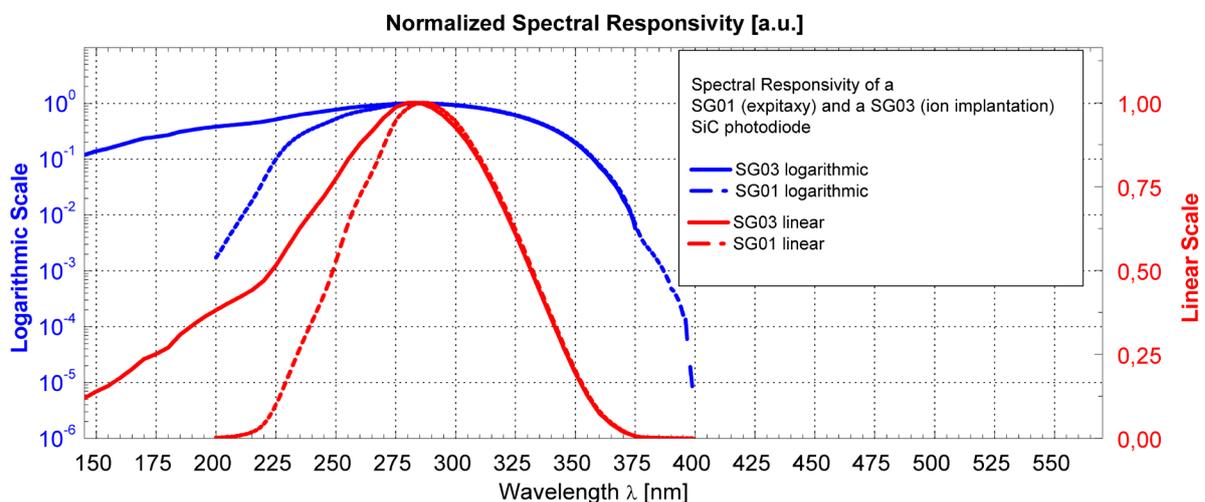


SPECIFICATIONS

Parameter	Symbol	Value	Unit
Spectral Characteristics			
Typical Responsivity at Peak Wavelength	S_{max}	0.160	AW^{-1}
Wavelength of max. Spectral Responsivity	λ_{max}	280	nm
Responsivity Range ($S=0.1 \cdot S_{max}$)	–	170 ... 355	nm
Visible Blindness ($S_{max}/S_{>405nm}$)	VB	$> 10^5$	–
General Characteristics (T=25°C)			
Active Area	A	2.0	mm ²
Dark Current (1V reverse bias)	I_d	0.2	fA
Capacitance	C	300	pF
Short Circuit (10 $\mu W/cm^2$ at peak)	I_o	32	nA
Temperature Coefficient	T_c	< 0.1	%/K
Maximum Ratings			
Operating Temperature	T_{opt}	-55 ... +170	°C
Storage Temperature	T_{stor}	-55 ... +170	°C
Soldering Temperature (3s)	T_{sold}	260	°C
Reverse Voltage	V_{Rmax}	20	V

NORMALIZED SPECTRAL RESPONSIVITY

The below graph compares the SR of the standard SG01 series with the SR of the SG03 series

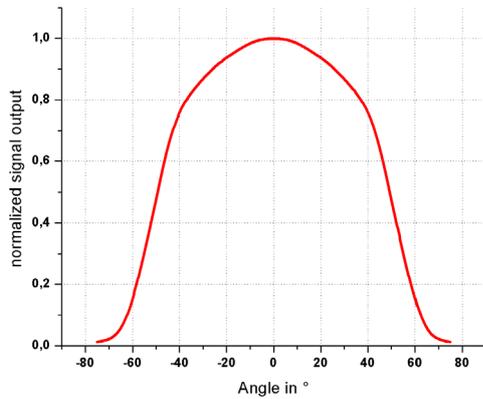


SG03R20-5

Broadband SiC based UV photodiode A = 2.0 mm² with VUV responsivity



FIELD OF VIEW

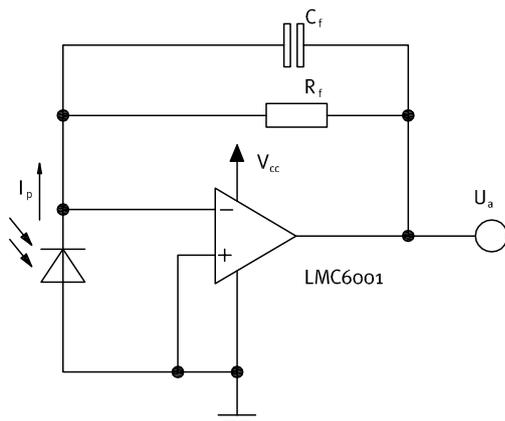


Measurement Setup:

lamp aperture diameter: 10 mm
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 second aperture diameter: 10 mm
 distance second aperture to detector: 93 mm

pivot level = top surface of the photodiode window

TYPICAL CIRCUIT



Calculations and Limits:

$$U_a = I_p \times R_f = 0 \dots \sim V_{cc}$$

$U_{a,max}$ depends on load and amplifier type

$R_f = 10k\Omega \dots \sim 10G\Omega$, $C_f \geq 3pF$
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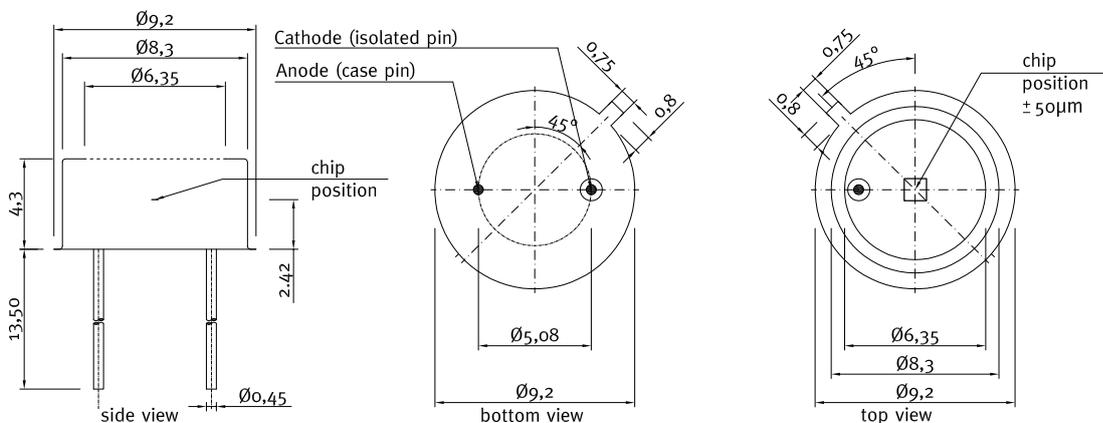
$$\text{Bandwidth} = DC \dots \frac{1}{2\pi \times R_f \times C_f}$$

Example:

$$I_p = 20nA, R_f = 100M\Omega, C_f = 100pF$$

$$U_a = 20 \times 10^{-9}A \times 100 \times 10^6\Omega = 2V$$

DRAWINGS



SG03R20-5

Broadband SiC based UV photodiode A = 2.0 mm² with VUV responsivity



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UPGRADE TO A TOCON OR A PROBE



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Miniature housing with M12x1 thread for the TOCON series

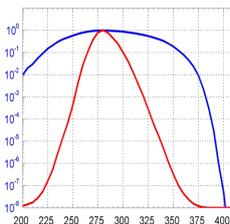
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UV probes

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CALIBRATION SERVICE



- PTB traceable calibrations and measurements:
- Calibration of sensors for irradiance measurements
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- Determination of a specific spectral sensor responsivity

SG03R80-5

Broadband SiC based UV photodiode A = 8.0 mm² with VUV responsivity

GENERAL FEATURES



Properties of the SG03R80-5 UV photodiode

- Broadband UVA+UVB+UVC, enhanced VUV responsivity
- Usable for 185nm (Hg low pressure lamp) or 172nm (excimer) detection
- Active Area A = 8.0 mm² (circular active area)
- TO5 hermetically sealed metal housing with sapphire glass window
- 1 μW/cm² peak radiation results a current of approx. 13 nA

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R20 2.0 mm ²		
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SG03R80-5

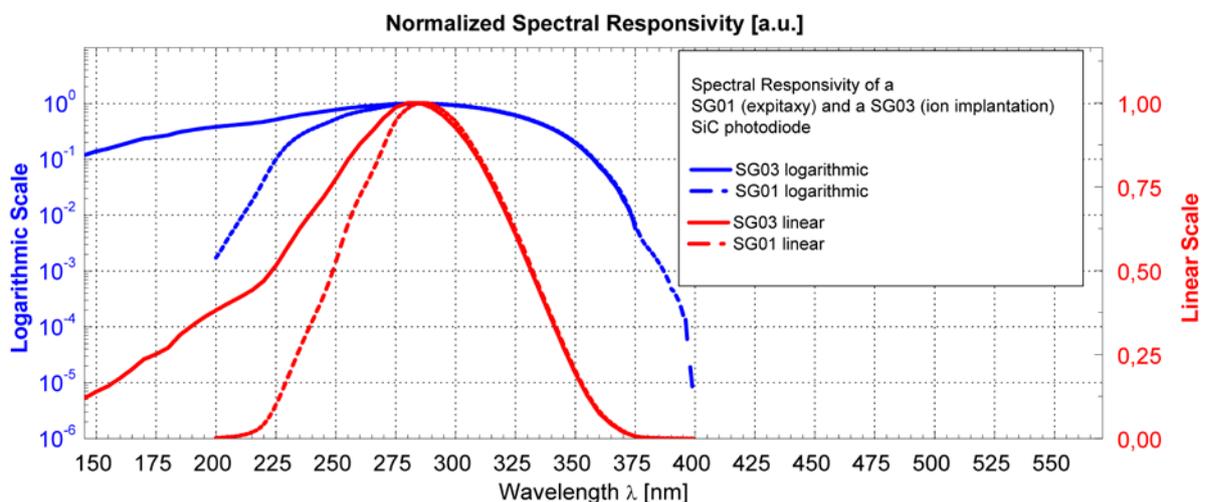
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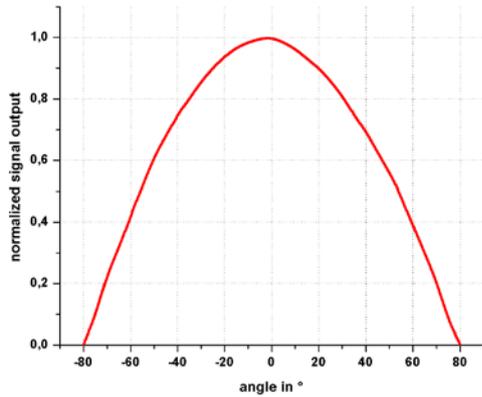
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SG03R80-5

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FIELD OF VIEW

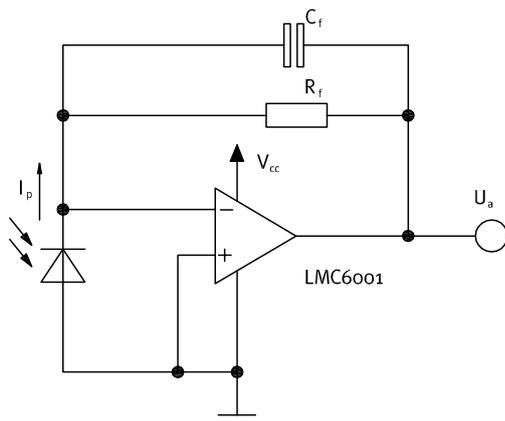


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 Recommendation: $R_f \times C_f \geq 10^{-3}s$

$$I_{p,max} = U_{a,max} \div R_f$$

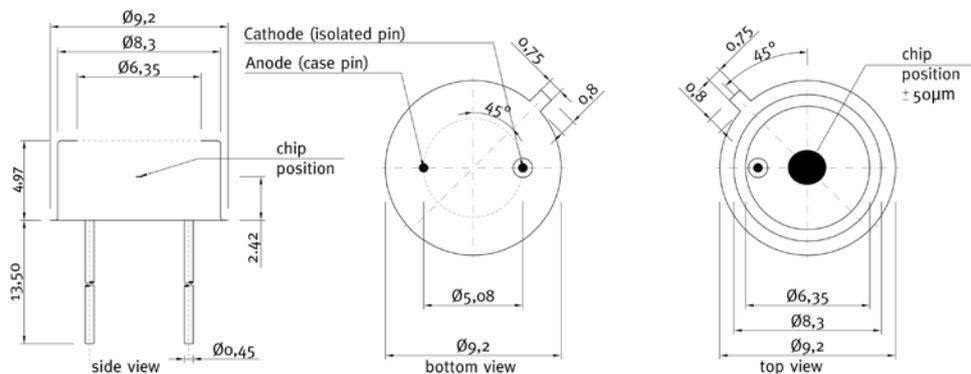
$$\text{Bandwidth} = DC \dots \frac{1}{2\pi \times R_f \times C_f}$$

Example:

$$I_p = 20nA, R_f = 100M\Omega, C_f = 100pF$$

$$U_a = 20 \times 10^{-9}A \times 100 \times 10^6\Omega = 2V$$

DRAWINGS



SG03R80-5

Broadband SiC based UV photodiode A = 8.0 mm² with VUV responsivity

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 signal transducer** circuit as shown on page 3.

UPGRADE TO A TOCON OR A PROBE



TOCONs = UV sensors with integrated signal transducer

- SiC based UV hybrid detector with signal transducer (0–5V output), no additional amplifier needed, direct connection to controller, voltmeter, etc.
- Measures irradiance from 1.8 pW/cm² up to 18 W/cm²
- UV broadband, UVA, UVB, UVC or Erythema measurements



Miniature housing with M12x1 thread for the TOCON series

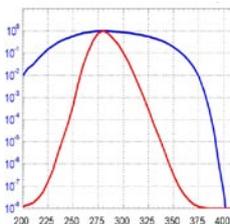
- Optional feature for all TOCON detectors
- Robust stainless steel M12x1 thread body, supply voltage 7...24 V
- Integrated sensor connector (Binder 4-Pin plug) with 2m connector cable
- Easy to mount and connect, increased EMC safety



UV probes

- Different housings e.g. with cosine response or water pressure proof
- Different electronic outputs configurable (voltage, current, USB, CAN, MODbus)
- Good EMC safety for industrial applications

CALIBRATION SERVICE



- PTB traceable calibrations and measurements:
- Calibration of sensors for irradiance measurements
- Calibration of UV sensors on discrete wavelengths
- Determination of a specific spectral sensor responsivity