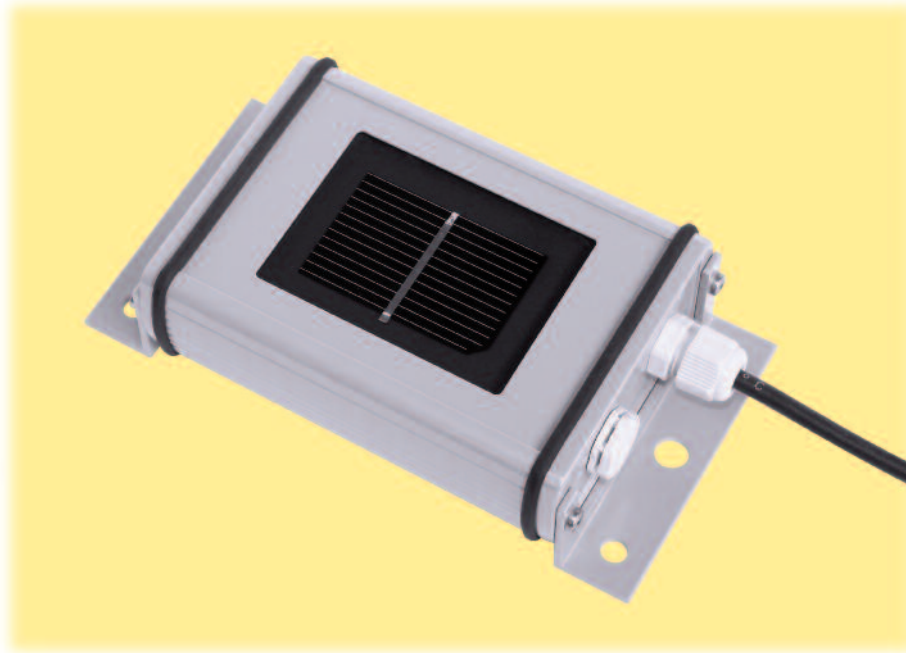


# SILICON IRRADIANCE SENSOR

## Measurement of Solar Irradiance

Since 1994 we have been developing and producing different types of silicon irradiance sensors. Until the year 2010 more than 18000 sensors were sold worldwide. Our silicon sensor is an affordable solution for measurement of solar irradiance. The powder-coated aluminium case in conjunction with the solar cell laminated between glass and Tedlar foil builds a very reliable and rugged sensor.



## General Information

### Mode of Operation

A silicon solar cell can be used as an irradiance sensor, because the short-circuit current is proportional to irradiance. Our sensors are built out of a monocrystalline solar cell connected to a shunt. Due to the low resistance of the shunt the cell operates next to short-circuit.

The temperature coefficient of the short-circuit current creates a small error. Therefore all of our silicon sensors with the extension „TC“ have an active temperature compensation, which reduces this error by factor 20. The compensation is realized by using a specific temperature sensor laminated to the rear side of the solar cell. The electronic circuit integrated for this compensation has a very low power consumption. The current consumption of the Si-01TC out of the internal Lithium battery is only about 15  $\mu$ A.

Our silicon sensors are manufactured in different types with an internal or external power supply, with different output signals and with an optional sensor output for the cell temperature.

All sensors are calibrated in simulated sunlight against a reference cell of the same type. The reference cell is periodically calibrated against a reference cell calibrated by Fraunhofer ISE, Freiburg.

### Mechanical Construction

The solar cell is embedded in Ethylen-Vinyl-Acetat (EVA) between glass and Tedlar. The laminated cell is integrated into a case of powder-coated aluminium. Therefore the sensor construction is comparable to that of a standard PV module. The electrical connection is realized by a 3 m cable or a waterproof (IP67) connector.

### Optional Temperature Measurement

Additionally to the irradiance measurement our silicon sensors with the extension “-T” are able to measure the temperature of the solar cell. Therefore a temperature sensor is mounted to the rear side of the cell to detect the correct cell temperature.



Meßgeräte für die Solartechnik

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# SILICON IRRADIANCE SENSOR

## Technical Data

### SI-SENSOR General information

- Solar cell: Monocrystalline Silicon (50 mm x 33 mm)
- Temperature coefficient of solar cell for Si-02-types: approx. 0.0005 1/K
- Current shunt: 0,1  $\Omega$  (TC = 20 ppm / K) with 1 V and 20 mA output  
0,12  $\Omega$  (TC = 20 ppm / K) with 10 V output
- Operating temperature: -20 °C to 70 °C
- Electrical connection done via shielded cable, length 3 m
- Case, protection mode: Powder-coated aluminum, IP 65
- Dimension, weight: 145mm x 86mm x 39mm, appr. 340 g

### ACCURACY Irradiance

- Error with temperature compensation compared to pyranometer within the operating range of -20 °C to 70 °C and vertically beam of irradiance:  $\pm 5 \%$
- Non-linearity of the electronic circuit:  $\pm 0,3\%$  from reading for 50 to 1300 W/m<sup>2</sup>
- Accuracy at 25 °C:  $\pm 1,5 \text{ }^\circ\text{C}$
- Non-linearity:  $\pm 0,5 \text{ }^\circ\text{C}$
- Error (over operating temperature range of -20...-70°C):  $\pm 2,0 \text{ }^\circ\text{C}$

### Temperature

### Customs Numbers

for all silicon irradiance sensors 85 41 40 90

### Sensor Types:

Typ	Irradiance		Cell Temperature
	Power Supply	Temperature Compensation	Output Signal
Si-01TC	Internal Li-Battery	Yes	0 to 1 V per 0 to 1000 W/m <sup>2</sup> ./.
Si-01TCext-K	5 to 28 V <sub>DC</sub>	Yes	0 to 1 V per 0 to 1000 W/m <sup>2</sup> ./.
Si01TC-T-K	5 to 28 V <sub>DC</sub>	Yes	0 to 1 V per 0 to 1000 W/m <sup>2</sup> 1,235 V + T[°C]*10mV/°C
Si-02-K	./.	No	appr. 60 mV per 1000 W/m <sup>2</sup> ./.
Si-02-Pt100-K, Si-02-T-K Si-02-Pt1000-K	./.	No	appr. 60 mV per 1000 W/m <sup>2</sup> KTY 81-210 Pt100 / Pt1000, class A
Si-10TC-K	12 to 28 V <sub>DC</sub>	Yes	0 to 10 V per 0 to 1000 W/m <sup>2</sup> ./.
Si-420TC-K	12 to 28 V <sub>DC</sub>	Yes	4 to 20 mA per 0 to 1200 W/m <sup>2</sup> ./.
Si-420TC-T-K	12 to 28 V <sub>DC</sub>	Yes	4 to 20 mA per 0 to 1200 W/m <sup>2</sup> (13,88+0,08/°C*T[°C])mA
Si-13TC-K	12 to 28 V <sub>DC</sub>	Yes	0 to 10 V 0 to 1300 W/m <sup>2</sup> ./.
Si-13TC-T-K	12 to 28 V <sub>DC</sub>	Yes	0 to 10 V 0 to 1300 W/m <sup>2</sup> 2,268V+86,9mV/°C*T

### EXTEND OF SUPPLY

### Options

- Silicon sensor with shielded cable, 0,14 mm<sup>2</sup>, UV- and temperature resistant
- Ready-made cable of the requested length
- Version with waterproof connector (Si-01TC always with connector)

# SILICON IRRADIANCE SENSOR

## Electrical connection and Pin numbers

### ELECTRICAL CONNECTION

#### Colors of cable (all versions „-K“)

Irradiance:	Orange
Power Supply (Plus):	Red
Power Supply / Signal (Minus):	Black
Temperature:	Brown; only versions with „-T“
Shield:	Black (bigger diameter)

The electrical connection of the Si sensor is realized with the inbuilt connector and the suitable plug.

#### Technical Data of the plug

- Cable dimensions (best / max): 0,14 mm<sup>2</sup> / 0,25 mm<sup>2</sup> (AWG26 / AWG24)
- Diameter for cable: 3,5 ... 5 mm
- Protection mode: IP67 in conjunction with the suitable connector

The connection of the different Silicon irradiance sensors are listed in the following table. The pin numbers are printed at the inside of the plug. Please take care of the mounting of the plugs as shown at the end of the next page. Only if these mounting steps are done the plug reaches IP67 when connected.

### ELECTRICAL CONNECTION OPTIONAL VERSION WITH CONNECTOR

Typ	Pin Numbers of the plug			
	Pin 1	Pin 2	Pin 3	Pin 4
Si-01TC	Plus Signal Irradiance	Minus Signal Irradiance	not available	not available
Si-01TCext	Plus Signal Irradiance	Minus Signal* Irradiance	Plus Signal Power Supply	not available
Si01TC-T	Plus Signal Temperature	Plus Signal Irradiance	Plus Signal Power Supply	Minus Signal* Irradiance
Si-02	Plus Signal Irradiance	Minus Signal Irradiance	not available	not available
Si-02-Pt100, Si-02-T Si-02-Pt1000	Plus Signal Irradiance	Minus Signal Irradiance	Pt100, KTY, Pt1000	Pt100, KTY, Pt1000
Si-10TC	Plus Signal Irradiance	Minus Signal* Irradiance	Plus Signal Power Supply	not available
Si-420TC	Plus Signal Irradiance	Minus Signal* Irradiance	Plus Signal Power Supply	not available
Si-420TC-T	Plus Signal Temperature	Plus Signal Irradiance	Plus Signal Power Supply	Minus Signal* Irradiance
Si-13TC	Plus Signal Irradiance	Minus Signal* Irradiance	Plus Signal Power Supply	not available
Si-13TC-T	Plus Signal Temperature	Plus Signal Irradiance	Plus Signal Power Supply	Minus Signal* Irradiance

\* Minus signals of all sensors are identical to supply ground

# SILICON IRRADIANCE SENSOR

## Handling and Installation

### SPECIALS

- The Si-01TC can be used for direct reading of irradiance via a digital voltmeter because of its internal Lithium battery and the calibration factor of 1 V per 1000 W/m<sup>2</sup>.
- **Attention:** Because of the internal Lithium battery of the Si-01TC please use only voltmeters with a high input resistance (more than 1 MΩ).
- **Attention:** The maximum load at the output signals with the Si-420TC(-T) is 400 Ω.
- **Attention:** Horizontally mounting leads to increased reflexion on the glass surface and therefore to higher measurement errors.

### MECHANICAL INSTALLATION

The Si sensor has two tongues with each three M6 drills. The installation at a suitable construction must use at least one M6 screw with washers at each mounting bracket.

During installation the pressure compensation element near the electrical connection must not be damaged. If the cap of the element has loosened, it can be snapped on again.

### HANDLING CASE

The Si sensor can be cleaned using a smooth cotton cloth, water and a mild cleaning fluid.

**An opening of the sensor case by the user or installation staff is not necessary. If the case is opened, we can not guarantee the seal of the case anymore.**

### SI-02-PT100-K WITH PRECISION SHUNT

Additional to the sensor specifications mentioned above, we offer the Si-02-Pt100-K with a precision shunt for short circuit measurement.

The differing technical specifications are

#### Shunt

Type:	Burster Type 1178
Resistor Value:	0.1 Ohm
Precision:	±0.1 %
Temperature Coefficient:	10 ppm
Long term stability:	0.02 %

#### Cable

4 m LiYCY 6 x AWG26, weather and uv-proof

#### Temperature Sensor

Pt100 class A with 4-wire-connection

### MOUNTING OF PLUG

