



Proven Rugged Design

Class A accuracy at any cable length

Overview

The CS241 is the next generation of Campbell Scientific back-of-module temperature sensors with new features designed for bifacial photovoltaic (PV) module performance assessment and soiling. The probe head has been redesigned for easier installation. The measurement performance has been improved with a smaller footprint that is optimized to reduce back-of-module shading and

eliminate surface cooling. Other improvements include greater sensor-to-module bonding/adhesion and a thinner Teflon cable with a higher temperature rating. To meet the requirements of performance validation, every CS241 is supplied with a NIST-traceable, serialized calibration certificate.

Benefits and Features

- ▶ Redesigned for optimal performance on bifacial PV module
- ▶ Easy installation with maximum sensor-to-module bonding strength and smaller profile
- ▶ NIST-traceable, serialized calibration certificate supplied with every sensor
- ▶ Meets or exceeds IEC 61724 Class A performance specifications
- ▶ Precision Pt-1000 Class A sensing element
- ▶ Compliant with IEC 60751, DIN EN 60751 (according to IEC 751)
- ▶ IP68 rating, making the sensor suitable for use on floating PV arrays
- ▶ Slim design to minimize sensor impact on bifaciality (<2% of full-size cell area)
- ▶ Thermal conductance greater than 600 W/(m²*K)
- ▶ Maximum sensor-to-module bonding
- ▶ High temperature rating to 150°C
- ▶ Two-wire and four-wire configuration to satisfy data logger channel count and accuracy—at any cable length
- ▶ Quick sensor head connection for easier installation and replacement

Technical Description

The CS241 provides PV stakeholders with the most accurate back-of-module temperature, even at long cable lengths, for use in power assessment and soiling of solar PV modules. Back-of-module temperature is critical for the evaluation of effective irradiance, soiling, and power conversion, making

the sensor that can collect this data a vital part of any PV performance monitoring system.

The CS241 consists of a Pt-1000 Class A platinum resistance thermometer (PRT) encased in a specially designed, slim-profile, low-mass aluminum disk. The slim design minimizes

sensor impact on bifaciality with less than two percent area coverage on a full-sized cell. The disk shields the PRT from rapid temperature fluctuations while protecting the fragile PRT element during installation. It minimizes heat transfer, which eliminates surface cooling and results in the highest efficiency in measuring true temperature of the solar module. The disk adhesive has excellent thermal properties including a thermal conductance greater than 600 W/(m²*K), and it is extremely strong. This eliminates the need for high-temperature epoxy or tape for maximum sensor-to-module bonding, making the installation much easier.

The CS241 cable has been upgraded to a thin polytetrafluoroethylene (PTFE) Teflon-jacketed cable. This has two distinct advantages:

1. The thin diameter is small enough to fit between the cells of a bifacial module, eliminating any module shading due to cabling.
2. The Teflon jacket allows for a higher maximum temperature rating of 150°C. The cable includes

sensor leads for either two-wire or four-wire measurements, allowing for maximum data logger channel count efficiency when cable lengths are limited (<7.62 m [<25 ft]) and for maintaining the highest level of accuracy when cable lengths are longer (>7.62 to 304.8 m [>25 to 1,000 ft]). The cable includes a quick sensor head connection that is 0.91 m (3 ft) from the sensor head to allow for easier installation and sensor head replacement.

Combining the highest-quality components and thoughtful, coherent CS241 sensor design results in the highest back-of-module temperature-sensor performance. The CS241 sensor meets or exceeds the thermal properties, accuracy, and uncertainty specifications defined by IEC 61724 for Class A performance and is compliant with IEC 60751, DIN EN 60751 (according to IEC 751).

Every CS241 includes a NIST-traceable, serialized calibration; alcohol swab; and zip ties that clip to the edge of a module frame.

Specifications

Sensor	Precision 1000 ohm Class A platinum sensing element (Pt-1000)
Operating Temperature Range	-40° to +150°C
Class A PRT Accuracy	$\pm(0.15 + 0.002T)^\circ\text{C}$
Temperature Coefficient	TCR = 3850 ppm/K
Long-Term Stability	Maximum R ₀ drift 0.04% (after 1000 h at 400°C)
Measuring Current	0.1 to 0.3 mA
Uncertainty	The temperature uncertainty is $\pm 0.3^\circ$ to 0.4°C in the measurement range of -40° to $+100^\circ\text{C}$ when measured using the CR1000X Measurement and Control Datalogger .
Disk Material	Anodized aluminum
Disk Diameter	2.54 cm (1.0 in.)
Height	0.419 cm (0.165 in.)
Weight	~27 g (0.06 lb) with connector and 1 m (3 ft) cable
Sensor Cable	
Jacket Material	White semi-gloss PFA
Minimum Bend Radius	6 mm (0.25 in) at least 6 mm (0.25 in) away from sensor disk

Cable Diameter	0.216 cm (0.085 in.)
Cable Length	0.9144 m (3 ft)
Main Cable	
Jacket Material	Black semi-gloss PVC, UL VW-1 sunlight resistant for outdoor use
UL	AWM 10012 1000V 105°C
Cable Diameter	0.622 cm (0.245 in.)
Compliance	
-NOTE-	<i>Compliance information can be found in the Documents section of the web page.</i>
Approvals	UL AWM 2586 1000V 105°C; CSA AWM 600V 105°C FT1
EMC Compliance	Conforms with Electromagnetic Compatibility Directive (EMC).
RoHS2	Conforms with the Restriction of Hazardous Substances Directive (RoHS2).
Industry Approvals	Compliant with IEC 60751, DIN EN 60751, Industrial Design (IEC Class 4) (according to IEC 751)
IP Rating	IP68 rating (self certified): 1 m submersion for 90 min

For comprehensive details, visit: www.campbellsci.eu/cs241 



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