



## CS241DM

PT-1000 Class A, Precision Back-of-Module Temperature Sensor  
with Digital Modbus RS-485 Output



## Digital Modbus Smart Sensor

With rugged, surface-mountable PRT

### Overview

The CS241DM is a surface-mountable, back-of-module temperature sensor with 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 CS241DM is supplied with a NIST-traceable, serialized calibration certificate.

This best-in-class smart sensor is a digital Modbus version of the [CS241 PT-1000 Class A, Back-of-Module Temperature Sensor](#).

### Benefits and Features

- › Digital Modbus output
- › 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/(m<sup>2</sup>\*K)
- › Maximum sensor-to-module bonding
- › High temperature rating to 150°C
- › Internal four-wire measurement with 24-bit A/D and precision resistor to maximize measurement accuracy
- › Quick sensor head connection for easier installation and replacement

### Detailed Description

The CS241DM 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 CS241DM 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/(m<sup>2</sup>\*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 CS241DM 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 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 CS241DM sensor design results in the highest back-of-module temperature-sensor performance. The CS241DM 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 CS241DM includes a NIST-traceable, serialized calibration; alcohol swab; and zip ties that clip to the edge of a module frame.

## Specifications

Measurement Uncertainty	±0.3°C
Surge Protection	1200 V isolation
Supply Voltage	5 to 30 Vdc
Power Draw	15 mA
Operating Temperature Range	-40° to +150°C
Shipping Dimensions	17.15 x 11.13 x 6.05 cm (6.75 x 4.38 x 2.38 in.)
Shipping Weight	90.7 g (0.2 lb)

Sensor	
Sensor	Precision 1000 ohm Class A platinum sensing element (PT-1000)
Class A PRT Accuracy	±(0.15 + 0.002t)°C
Temperature Coefficient	TCR = 3850 ppm/K
Long-Term Stability	Maximum R <sub>0</sub> drift 0.04% (after 1000 h at 400°C)
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

IP Rating	IP68 rating (self certified): 1 m submersion for 90 min
Industry Approvals	Compliant with IEC 60751, DIN EN 60751, Industrial Design (IEC Class 4) (according to IEC 751)

## Communications

Protocol	Modbus RTU protocol (over RS-485)
Format	8 data bits, 1 stop bit, even parity as default (user-configurable)
Baud Rate	19,200 bps as default (user-configurable)
Modbus ID	Last two digits of serial number as default (user-configurable)

## Cable (Sensor Head to DM Board)

Jacket Material	White semi-gloss PFA insulated (Teflon)
Jacket Rating	-75° to +250°C
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)

## Cable (DM Board to PT)

Maximum Temperature Rating	75°C and 80°C (jacket 105°C; oil 75°C)
Minimum Temperature Rating	-40°C
Conductor Material	22 AWG 19/0.0058 stranded tinned copper
Cable Type	4 twisted pairs twisted together and wrapped with clear polyester tape to form a cable core
Jacket Material	Thermoplastic elastomer, 1.07 mm (0.042 in.) nominal wall thickness (pressure)
Insulation Material	High-density polyethylene 0.254 mm (0.01 in.) nominal wall thickness
Dielectric Strength	2000 V RMS
Approvals	» PENNSYLVANIA D.E.P. – MSHA

- » NEC (UL) TYPE CMX OUTDOOR – CM
- » NEC (UL) TYPE PLTC
- » UL AWM 2463 (80C 600V)
- » CEC C(UL) TYPE CMX OUTDOOR – CM

Overall Cable Diameter	7.37 mm nominal ± 0.13 mm (0.29 in. nominal ± 0.005 in.)
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## Compliance

EMC Compliance	Conforms with Electromagnetic Compatibility Directive (EMC).
RoHS2	Conforms with the Restriction of Hazardous Substances Directive (RoHS2).
POE Compliant	POE compliant (802.3af) to 100 meters when installed per recommendations in TIA TSB-184.
CAT5e	Cable will meet CAT5e channel requirements to 100 meter length.

For comprehensive details, visit: [www.campbellsci.com/cs241dm](http://www.campbellsci.com/cs241dm) 



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