User Manual

SM1-485 PRO Certified

SM1-485 PRO Certified

The SunMeter® (SM1-485 PRO Certified) calibrated by Fraunhofer Institute for Solar Energy Systems (DAKKS accred.)is a high technology electronic device primary designed to accurately measure the solar radiation.

It's mainly intended, but not limited, to be used in solar energy conversion applications (both thermal and photovoltaic) for preliminary studies, for commissioning testing and for continuous performance checking and monitoring.

It's based on a photovoltaic mono crystalline cell element that through a termally stable Shunt is sampled and managed by a high performance DSP (Digital Signal Processor) in order to enhance the signal precision and stability, achieving results that are comparable to best class radiometers.

It's equipped with an additional input for an external Temperature sensor in order to sense the temperature of nearby photovoltaic modules.

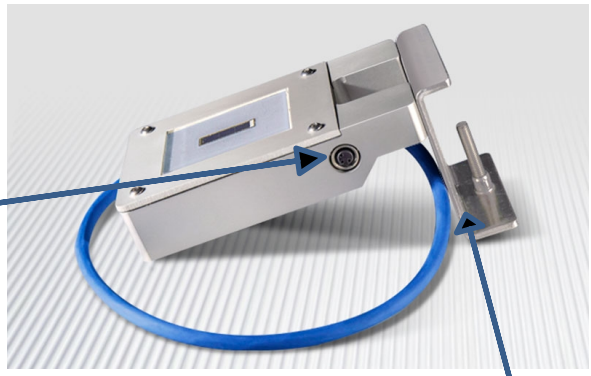
The measures can be read by a powerful versatile EIA/TIA-RS485 bus interface with the well known industry standard protocol Modbus RTU.

SM1-485 PRO Certified installation overview

TM4 (optional)

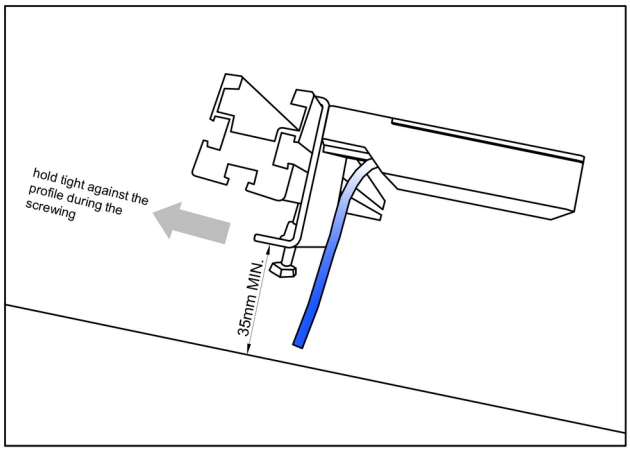
FEMALE M8 3P CONNECTOR
FOR TM4

SM1-485 PRO Certified



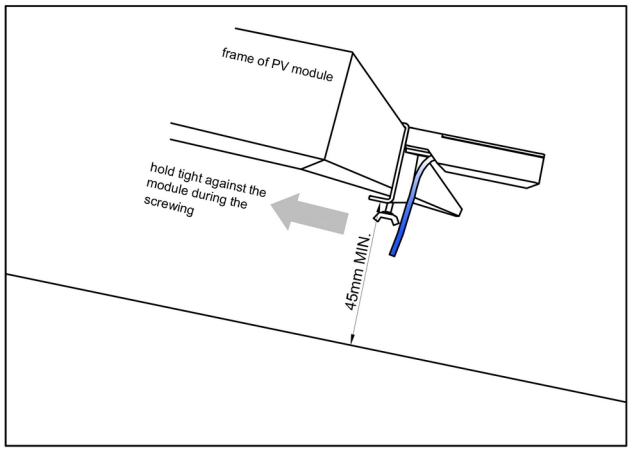
MOUNTING BRACKET

SM is provided with a bracket to apply it to structures or directly to a PV module as shown in Fig. 1 and 2:



SUNMETER mounted with screws for long term monitoring

Fig 1



SUNMETER mounted with butterfly-screws for short time monitoring

Fig 2

Installation steps

1. Select the location for the SM1-485 PRO Certified
2. Install the PV Panel Temperature Sensor (optional)
3. Wire the M12 female connector of SM1-485 PRO Certified to the wires of the Management System
4. Make connections to 9 ÷30 VDC power supply and to Management System through RS485
5. Verify and validate the installation via the Management System

Equipment and supplies

We supply:	You supply:
SM1-485 PRO Certified, which includes: Sunmeter with aluminium bracket 1 stainless steel screw (permanent positioning) 1 Female M12 connector field installable (optional) PV Panel Temperature Sensor	9 ÷30 VDC Power RS485 line Field cable

Tab 1

Site selection and mounting

SM1-485 PRO Certified location

We suggest to mount SM1-485 PRO Certified on the lateral side of a PV module because, if applied on the top side of array PV fields, it can cause a shadow on the next array!

In this way you can get a more accurate control of the system's performance (P.R.) as it assumes same tilt and azimut (orientation) of the PV.

Take into account the needs of all attached sensors to determine the optimal mounting location. Ambient air temperature and irradiance measurements can be affected by obstructions, local topography, and shadowings.

A simple way to think of obstruction is the rule of 5. It is good if the obstruction is at a distance of at least 5 times its height above the location of Sunmeter.

TM4 Temperature Sensor (optional)

Fig 3

This sensor is designed to be attached directly to any solar panel. When placed on the center back side of the panel, it accurately measures the temperature of the panel.

Prior to installation of the TM4 temperature sensor onto the PV panel, the installation area of the panel back should be thoroughly cleaned. This cleaning will ensure a good bond between sensor and panel and allows accurate panel temperature readings.

After cleaning, peel off the protective adhesive tape on the temperature sensor and stick it onto the back of the panel. Firmly press the sensor into place.

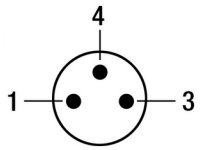
Run the cable back to the SM1-485 PRO Certified unit and connect to the TM3 temperature sensor terminals.

We suggest to connect the TM4 to the SM1-485 PRO Certified before powering the SM1-485 PRO Certified, otherwise you will have to wait 5 minutes for the SM1-485 PRO Certified to read the TM4. This is because the SM1-485 PRO Certified has a system that protects the sensitive reading of TM4, so the system disables the channel when it is open and periodically checks for a connection.

The IP67 3-pin M8 connector carries the temperature signal to the SM1-485 PRO Certified as in the following table and figure, that shows a front view of the female connector on the side of the SM1-485 PRO Certified:

#	Name	Description
1	Temperature Sensor.1	GND
3	Temperature Sensor.2	Signal
4	Supply	5V DC

Tab 2



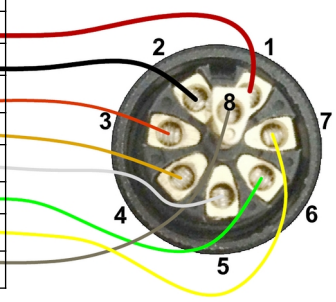
Wiring instructions for the SM1-485 PRO Certified

Connections

The IP67 8-pin circular male connector carries all the signals to and from the SM PRO Certified as in Tab. 3 and Fig. 4A, which shows a back view of the female connector:

#	Name	Description	Cable colors
1	SUPPLY +VIN	power supply input, 9-30 Vdc, typ. 90mA @ 12 Vdc	Red thick
2	GND	power supply ground reference and for output signals	Black thick
3	Testing	PV cell positive socket	Red thin
4			
5	RS485-/A	communication bus inverting bus signal	White
6	RS485+/B	communication bus non inverting signal	Green
7			
8	Testing	PV cell negative socket	Gray

Female connector back view with connection scheme



Connection to the monitoring or management system

Here is shown a schematic of typical The Modbus (RS485) connection/usage of Sunmeter

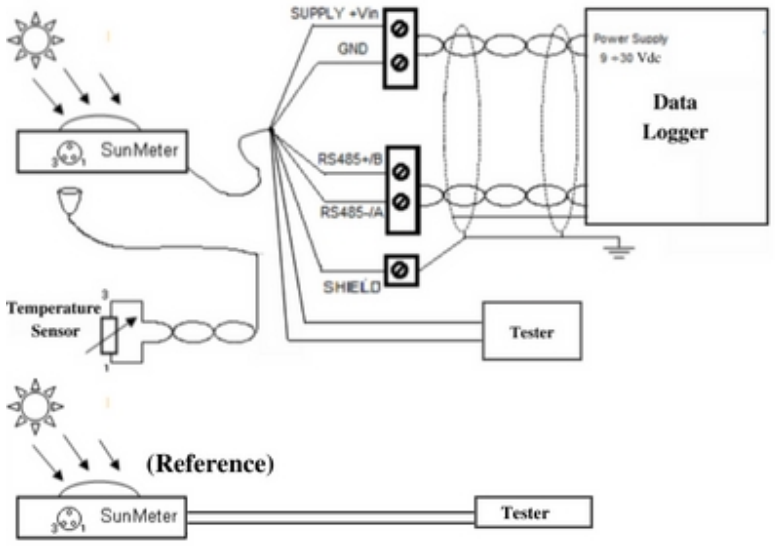


Fig 4B

Wherever is needed more length than 3m We strongly suggest to use a shielded connection cable with twisted pairs, AWG22 / 0.32mm2 to connect the poles the a wires' poles.

Notes:

Balanced differential bus RS485 needs to be terminated, at the extremities of the bus, by a 100-120 Ω resistor (1/4 W) between RS485+/RS485- lines in order to avoid signal's reflections. In the case that SM is the device at one extremity, place the resistor into the supplied female connector.
Even if RS485 have –7/+12Vdc common mode rejection range, normally sufficient to compensate ground potential difference between connected devices, it is strongly recommended to always carry a ground reference among the bus's signals and to connect it to the SM's GND.

Do not attempt to supply voltage to these wires

Connection to the monitoring and calibration control Unit

In order to perform the verification of performance parameters of the SunMeter Pro certified sensor it is possible for the user to use a reference sensor (calibrated) for comparison. Refer Tab.3 for connection information.

MODBUS PROTOCOL

Modbus is a Master-Slave protocol, widely used as an industry standard. Simple, efficient and reliable, can be easily used to access and collect data or exchange information between digital systems over a serial line local bus (and with its TCP/IP extension through a LAN or World Wide Web).Please refer to specific detailed documentation and implementations freely available at www.modbus.org

The default address of the SM1-485 PRO Certified is 1. If you need to change the address you can download from the FIMER site the program SMConfig, in this way you can change the address by connecting the SM1-485 PRO Certified to a PC with a USB-RS485 cable. You cannot have two SM1-485 PRO Certified in the same RS 485 chain unless the address of one of the sensor is changed.If you were to find some problem Contact Customer Support.

SM PRO Certified is a Modbus RTU slave that implements the following standard access functions:

Function code	Description
0x03	READ HOLDING REGISTERS
0x04	READ INPUT REGISTERS
0x06	WRITE SINGLE REGISTER
0x10	WRITE MULTIPLE REGISTERS

Please note that in the current implementation of SM PRO Certified function codes 0x03 and 0x04 are equivalent and address the same data area.

Data is accessible through Modbus's functions by 16 bits units called "registers". In the current implementation of SM PRO Certified are available in these registers:

Register #	Description	Access	NV save
0x0101 or 0x0201	**Current irradiance level** [W/m^2],	R	
0x0102	**Current PT100 temperature** [°C], 2-complement value, fixed point 14.2 format (14 bits integer, 2 bits fractional)	R	
0x0202	**Current PT100 temperature** [°C], format multipl. by 10 (to get value in °C divide by 10)	R	
0x0103	**Status**, bit coded Bit 0: Factory calibration/configuration 1 = OK; 0 = need recalibration Bit 1: Not volatile parameters 1 = OK; 0 = default loaded, need to be changed/saved Bit 2: Digital input monitor 1 = not active (open); 0 = active (shorted to GND) Bit 3: PT100 RTD element 1 = OK; 0 = shorted or open circuit (not present/malfunctioning) Bit 4: Analog output 1 = OK; 0 = output current can't flow at desired level due to wire break/ high load impedance/output voltage approaching positive supply Bit 5: Watchdog 1 = reset by watchdog timeout occurred; 0 = normal operation all undefined bits read as 0	R	
0x8001	**Serial number**, least significant word	R	
0x8002	**Serial number**, most significant word	R	
0x8003	**Firmware main version**, hexadecimal	R	
0x8004	**Firmware minor version**, hexadecimal	R	
0x8005	**Node address**, range 1 ÷ 247, decimal, **default 1**	R/W	Y

0x8006	**Bitrate**, coded, range 0 ÷ 4, decimal, **default 1** 0 – 9600 bps 1 – 19200 bps 2 – 38400 bps 3 – 57600 bps 4 – 115200 bps	R/W	Y
0x8007	**Serial configuration**, coded, range 0 ÷ 3, decimal, **default 0** 0 – 8N1 (8 bit / no parity / 1 stop bit) 1 – 8E1 (8 bit / even parity / 1 stop bit) 2 – 8O1 (8 bit / odd parity / 1 stop bit) 3 – 8N2 (8 bit / no parity / 2 stop bit)	R/W	Y
0x8008	**Serial reply delay** [ms], range 0 ÷ 100, decimal, **default 1**	R/W	Y
0x8009	**Analog output mode**, coded, range 0 ÷ 4, decimal, **default 2** 0 – output disabled 1 – 0 ÷ 10 V 2 – 0 ÷ 5 V 3 – 0 ÷ 20 mA current loop 4 – 4 ÷ 20 mA current loop	R/W	Y
0x800A	**Analog output select**, coded, range 0 ÷ 3, decimal, **default 2** 0 – irradiance 1 – PT100 temperature 2 – selected by digital input status: open = irradiance; close = PT100 temp. 3 – value setted by register 0x8201	R/W	Y
0x800B	**PT100 RTD reading enable**, coded, range 0 ÷ 1, decimal, **default 1** 0 – disabled 1 – enabled	R/W	Y
0x8101	**Not volatile params save command**, write 1 to execute (then wait 1 s before to send next message)	W	
0x8102	**Software reset command**, write 1 to execute (then wait 6 s before to send next message)	W	
0x8201	**Analog output level** [], range 0 ÷ 65535, decimal, fixed point 0.16 format (16 bits fractional)	W	

Tab. 4

Please note that, conventionally, Modbus register's numbering starts from 1 but register's addressing start from 0 so, to obtain the register's address you had simply to subtract 1 form its number. That's meaninful depending on, as a master, you are using an high level Modbus utility/program (that normally refer to the registers' number) or a low level driver (that normally directly work with addresses).

Specifications

Inputs:	
irradiance range:	0 ÷1500 temperature compensated
temperature range:	-30 ÷ +90 °C measurable with external Temp. Sensor
digital:	PNP-like connection
Outputs:	
serial:	RS 485, standard Modbus RTU protocol
Measurements precision:	
irradiance:	< ± 1.9%
temperature:	≤ 0.5 °C
Non-stability (per year)	≤ 1.5%
Supply:	9 ÷30 Vdc, protected against reverse polarity
Encapsulation:	small micro prismatic glass for photovoltaic modules and E.V.A
Case:	anodized aluminium with stainless steel screw-clamp to fix it on modules or montage profile
Wiring:	50 cm cable, UV resistant
Connectors:	male M12 8 pin , IP67 ; female M8 3 pin , IP67 , UV resistant, matching male not supplied; female M12 8 pin, IP67 for field installation loose pins → tab.2 (on request)
Dimensions:	114 x 70 x 22 mm, with mounting bracket 128 x 70 x 65 mm (overall)
Operating temperature:	-30°C ÷ +90 °C (transport and storage -35°C ÷ +95 °C)

Every SM PRO Cerified is calibrated by **Fraunhofer Institute for Solar Energy Systems** (DAKKS accred.)

Contact us

SMConfig, the software utilities (for MS Windows systems) for changing Modbus address with a USB-RS485 cable, can be downloaded from the ABB site;

Other software utilities (for MS Windows systems) can be requested to the following address:

Soluzione Solare

Tel. +39.0444.530234 - Fax +39.0444.1830563

Vicenza – Italy E-mail: support@soluzionesolare.it