

## Soiling Monitoring for Photovoltaic Modules.

### SPPM-PV

#### INTRODUCTION

The SPPM-PV is a system for monitoring the dirt (soiling) that accumulates on photovoltaic modules, based on the SPPM-PV control unit and a METEODATA-4000 datalogger. It provides the information needed to determine the optimal cleaning time for the plant's PV modules by quantifying the energy loss caused by accumulated dust and dirt.

Soiling is assessed using reference PV modules with the same technology as the plant, giving representative, site-specific information. The system implements IEC 61724-1 algorithms, using short-circuit current and temperature measurements from two reference panels. The SPPM-PV control unit offers >1.5 kVAC galvanic isolation to protect the measuring equipment from array discharges and extend system lifetime, and is compatible with virtually any commercial PV technology.

#### FEATURES

##### Soiling monitor for PV plants

Monitors soiling on solar photovoltaic modules using a dedicated control unit plus METEODATA-4000 datalogger, providing key data to optimise cleaning schedules and energy production.

##### Reference clean and soiled panels

Uses two identical reference modules: a CLEAN PANEL kept regularly cleaned and a SOILED PANEL cleaned only with the rest of the plant, so the calculated soiling directly reflects real plant behaviour.

##### IEC 61724-1 compliant processing

Implements algorithms recommended by IEC 61724-1, based on the measurement of short-circuit current and temperature of the two reference panels, to derive a soiling index linked to energy loss.

##### High electrical safety

Control unit with >1.5 kVAC galvanic insulation prevents possible discharges from the PV array towards measuring instruments, maximising system lifetime.

##### Compatible with multiple PV technologies

Designed to work with virtually any PV module technology; best result quality is obtained with monofacial modules, followed by bifacial modules with covered backs and then bifacial modules with uncovered backs on uniform reflective ground.

##### Integrated data management tools

Supported by the GEO-DataView software suite (Geo-DataLink app, Teletrans and Webtrans-4K) for configuration, data recovery, database storage and web/mobile visualisation.

#### CONFIGURATION & MEASUREMENT

##### Measured parameters and data channels

SPPM-PV provides eight data channels for soiling assessment and system diagnostics:

Channel	Unit	Description
Solar Elevation	°	(Opt.) Angle of elevation of the Sun above the horizon.
Hour Angle	°	Angular deviation with respect to solar noon (15°/h).
C.P. Temperature	°C	Clean panel temperature.
S.P. Temperature	°C	Soiled panel temperature.
Clean panel $I_{sc}$	A	Clean panel short-circuit current.
Soiled Panel $I_{sc}$	A	Soiled panel short-circuit current.
SPPM-PV Status	-	Binary code represented in bits with information on diagnosis and cleaning and pairing operations.
Soiling	-	Ratio of energy loss due to accumulation of soiling on the panel.



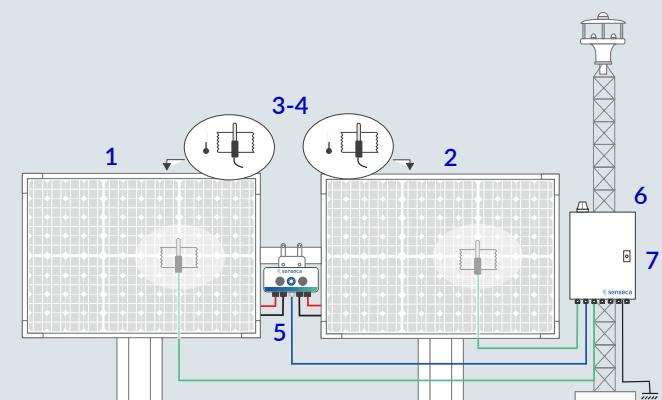
- **MONITORS PV SOILING USING A CLEAN AND A SOILED REFERENCE PANEL**
- **IEC 61724-1-BASED PROCESSING ON ISC AND TEMPERATURE TO QUANTIFY SOILING AND ENERGY LOSS**
- **8 DATA CHANNELS: SOLAR GEOMETRY, PANEL TEMPERATURES, ISC, STATUS AND SOILING INDEX**
- **CONTROL UNIT WITH >1.5 KVAC GALVANIC ISOLATION FOR SAFE, LONG-LIFE MEASUREMENTS**
- **WORKS WITH MOST PV TECHNOLOGIES**
- **INTEGRATED WITH METEODATA-4000 AND GEO-DATAVIEW FOR LOGGING AND VISUALISATION**

## Measurement of Panel Current $I_{sc}$

Power supply	7.2 to 35 VDC (from METEODATA-4000 datalogger)
Operating temperature	-40 to +85°C
Precision $I_{sc}$	0.1% F.S.
Insulation	1.5KV AC
Surge and ESD protection	<ul style="list-style-type: none"> <li>1W SERIES Resistor + 600W TVS Diode</li> <li>10/1000 <math>\mu</math>s for signal lines</li> <li>8/20 <math>\mu</math>s varistor (Class 2)</li> </ul>
Range $I_{sc}$	0 to 20 A
Short-Circuit Activation	Programmable cycle (maintains an electrical state that does not degrade the panel)
Duality	Double panel
Measurement procedure $I_{sc}$	According to IEC 61724-1
Output $I_{sc}$	2 x 4-20 mA
Load resistance	$\text{Max.}(\Omega) \leq (V_{\text{supply}} - 7.2) / 0.023$
Soiling ratio (IEC61724-1)	0 to 1

## System Components

- 1 Reference PV module identical to the plant modules, the CLEAN PANEL is cleaned regularly to keep it free of dust and dirt
- 2 Reference PV module identical to the plant modules, the SOILED PANEL accumulates dirt at the same rate as the rest of the array.
- 3 Temperature of the Clean panel and Soiled Panel measured through Pt100 / Pt1000
- 4
- 5 SPPM-PV Control - Signal conditioning and operations control unit.
- 6 METEODATA-4000 - Unit for acquiring, processing, storing and transmitting soiling data, compatible with additional solar radiation and weather sensors.
- 7 GEO-DATAVIEW - Application suite for start-up, data retrieval, database storage and visualisation on web and mobile platforms.



## Ordering Code

**GEO-SPPM-PV** Solar Panel Power Monitor System for Soiling Measurement. The system includes: 1 x SPPM-PV module, 2 x Pt1000 panel surface temperature sensors; control box; 25 m connection cable for linking the system to the MTD-4000 unit.



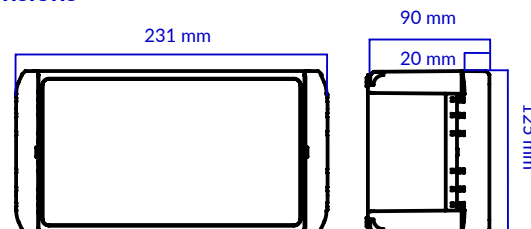
## Housing specifications

Material	Polycarbonate, UV resistant
Characteristics	<ul style="list-style-type: none"> <li>Fire retardant and self-extinguishing</li> <li>Suitable for outdoor use (f1 approval according to UL 746C)</li> </ul>
Cover	Hinge closure
Installation	Installation kit for mounting on panels, towers, masts or walls
Protection	IP66, NEMA4/4X
Connection to Solar Panels	<ul style="list-style-type: none"> <li>MC4 Panel Connector</li> <li>(Optional) Kit of 4 additional air-side MC4 connectors</li> </ul>
Connection to Meteodata-4000 Datalogger	<ul style="list-style-type: none"> <li>SAMTEC APC &amp; ACR series connector,</li> <li>10 pins</li> </ul>

## Compatibilites

Panel Technologies	<ul style="list-style-type: none"> <li>Monofacial / Bifacial</li> <li>Mono-crystalline split cell, thin film, etc.</li> </ul>
Panel Arrangement in Plan View	Panel arrays on fixed structure / Panel arrays on tracker
Panel Temperature Measurement	Pt100 / Pt1000 with resistance output/ 4-20mA / Modbus
Scada Connection	Using Modbus TCP via the METEODATA-4000 datalogger
Additional sensors	Ability to integrate any additional sensor (radiation, wind, rain, pressure, UV, etc.) through the METEODATA-4000 datalogger

## Dimensions



## Data Recovery and Analysis



### GEO-DATALINK - Mobile App

Used to configure the SPPM-PV system at start-up, it supports local (Wi-Fi) and remote (3G/4G or Ethernet) access, allowing downloading and viewing of soiling data and FTP storage of SPPM-PV data in CSV format.



### TELETRANS - PC Software

Automates remote downloading of SPPM-PV data, storing it in an SQL database and automatically generating CSV data files.



### WEBTRANS - Consultation Website

Allows viewing soiling data on the web via a subscription service (Webtrans-4K Cloud) or on your own platform (Webtrans-4K Distributable).

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