



Environmental
Monitoring Solutions

SOLAR ENERGY

Monitoring equipment

• **Meteorological station for PV plants
and PV module station**

• **Field system for environmental
parameters**

Environmental operating conditions, together with the accumulation of soiling on module surfaces, are among the main external factors affecting the performance of a photovoltaic plant. Solar irradiance — the primary energy input of the system — as well as ambient and module temperatures directly influence plant efficiency, while additional variables such as wind speed and direction, rainfall, relative humidity, and snow contribute to defining the site's operating conditions and to assessing risks during adverse weather events, as outlined in IEC 61724-1:2021. For accurate performance evaluation and to detect deviations from expected behaviour, it is therefore essential to continuously monitor global and diffuse irradiance, ambient air temperature and humidity, module temperature, wind speed and direction, rainfall, and snow conditions.

LSI LASTEM designs and manufactures sensors and integrated systems for the acquisition, processing, and distribution of environmental data used to verify the performance of photovoltaic plants. Through an integrated approach, LSI LASTEM supports designers and plant operators in monitoring, maintenance, and performance assessment activities, ensuring reliable measurements and consistent evaluation of plant operation.

► Meteorological station for PV plants and field system on the PV module

The monitoring system is structured into two complementary subsystems.

The first subsystem is a central meteorological station designed to characterize the overall environmental and solar conditions at the PV plant. It integrates a data logger and sensors for the measurement of global horizontal irradiance (GHI), ground-reflected irradiance (RI), direct normal irradiance (DNI), diffuse horizontal irradiance (Gd), wind speed and direction, ambient air temperature, relative humidity, and precipitation. These variables collectively describe the site's meteorological conditions and provide the baseline environmental context required by IEC 61724-1:2021 for plant performance assessment.

The second subsystem (PV module station), interfaced with the main meteorological station, focuses on measurements taken directly on the PV modules. It includes sensors for in-plane irradiance (POA), rear-side in-plane irradiance in bifacial PV installations, PV module temperature, and the soiling ratio. These parameters enable a precise evaluation of the operating conditions experienced by the modules and therefore support accurate calculation of the plant's performance indicators.



► Field system for environmental parameters

In addition to the standard configuration based on a data logger, the monitoring system also supports the use of the Modbus Sensor Box (MSB). The MSB is a compact conditioning module that converts common sensor signals — such as millivolt outputs from pyranometers, Pt100 temperature probes, wind-speed pulses, and storm-front detector data — into Modbus RTU over RS-485, enabling direct connection to PLC or SCADA systems. This allows environmental and module-level sensors (global irradiance, ambient and module temperature, wind speed, and storm-front distance) to be integrated without a dedicated data logger, simplifying wiring and offering a flexible alternative for both complete monitoring stations and more compact installations.



► IEC 61724-1:2021 Requirements for PV System Monitoring

The IEC 61724-1:2021 standard on Photovoltaic System Performance – Part 1: Monitoring defines the accuracy classes and measurement requirements for monitoring systems used in PV plants. These classes depend not only on the hardware specifications of sensors and acquisition equipment, but also on calibration routines, quality-control procedures, installation criteria, and maintenance practices established for the monitoring system. The purpose of the standard is to minimize measurement uncertainty and ensure consistent, comparable performance assessment across different PV installations.

The standard introduces two accuracy classes for monitoring systems (Class A and Class B), each associated with specific accuracy requirements, calibration and maintenance intervals, and minimum quantities of sensors based on plant size. These prescriptions ensure that irradiance, temperature, and environmental measurements are collected with the level of precision required for reliable performance evaluation.

IEC 61724-1:2021 identifies a comprehensive set of solar variables needed to assess PV plant performance, which go beyond global horizontal irradiance (GHI) and include:

- Global horizontal irradiance (GHI)
- In-plane irradiance (POA front)
- Ground-reflected irradiance (RI)
- Diffuse irradiance (Gd)
- Direct normal irradiance (DNI)
- Albedo, calculated as RI / GHI

For bifacial PV systems, the standard additionally requires measurements of:

- In-plane rear-side irradiance (POA rear)
- In-plane rear-side irradiance ratio, calculated as $POA\ rear / POA\ front$

Other climatic variables are also considered essential, as they directly influence expected performance and operating conditions:

- PV module temperature
- Ambient air temperature
- Wind speed and direction
- Relative humidity
- Rain and snow
- Soiling accumulation on module surfaces

Together, these variables define the environmental and operating framework against which the actual performance of the photovoltaic system is evaluated.

IEC 61724-1:2021 Monitoring Classes and Sensor Requirements

The IEC 61724-1:2021 standard defines two accuracy classes for PV performance monitoring systems, Class A and Class B. These classes are determined not only by the specific sensors employed, but also by calibration routines, inspection frequency, cleaning intervals and the overall maintenance procedures adopted for the monitoring equipment. The objective is to minimize measurement uncertainty and ensure that irradiance, temperature and environmental data used for performance assessment are reliable and comparable across PV plants. Below are the key requirements for pyranometers and environmental sensors as defined in IEC 61724-1:2021.

Characteristic	Class A	Class B
Pyranometer type	Spectrally Flat Class A	Spectrally Flat Class B
Recalibration	Every 2 years	As specified by manufact.
Cleaning	Every week	Optional
Heater and Ventilation	Required. Except in locations where dew or frost occurrence is demonstrated to be less than 2% of the annual GHI hours	Optional

IEC 61724-1:2021 specifies additional environmental and module-level variables that may be required depending on the monitoring class, PV technology and site conditions, because they directly influence PV system performance. Unlike irradiance, for which the IEC refers to ISO 9060 pyranometer classes, the required accuracy and resolution for environmental sensors are explicitly defined in **Section 9** of the standard (Module Temperature, Air Temperature, Wind Speed, Wind Direction), while other variables follow manufacturer specifications. LSI LASTEM provides sensors whose specifications satisfy or exceed the requirements for Class A and Class B monitoring systems.

Variable	Characteristic	LSI LASTEM* Sensor	Class A	Class B
PV module Temperature	Required	DLE124A	Yes	Yes or estimated
	Accuracy	0.15 °C	±1 °C	±1 °C
Air Temperature	Required	DMA033A	Yes	Yes or estimated
	Resolution	0.01 °C	≤0.1°C	≤0.1°C
	Accuracy	0.1 °C	±1 °C	±1 °C
Wind speed	Required	DNB201	Yes	Yes or estimated
	Accuracy	0.12 m/s @ < 5 m/s 2.5% @ > 5 m/s	≤0.5 m/s @ ≤ 5 m/s ≤10% @ > 5 m/s	≤0.5 m/s @ ≤ 5 m/s ≤10% @ > 5 m/s
Wind direction	Required	DNB201	Yes	-
	Accuracy	<1%	±5°	-
Module soiling	Required	PRRDA4030	Yes	-
	Cleaning freq.		Every day for reference cell	
Rainfall	Required	DQA230.1	Yes	Yes or estimated
	Accuracy	0...20 mm/h: ± 0.2 mm	-	-
Snow	Required	DQL011.1	-	-
Humidity	Required	DMA672.1	-	-

* LSI LASTEM sensor models used in photovoltaic applications able to satisfy Class A according to the IEC 61724-1:2021 standard

ISO 9060:2018 Classification of Thermopile Pyranometers

In addition to the monitoring requirements defined by IEC 61724-1:2021, the selection of pyranometers must comply with the ISO 9060:2018 standard, which classifies thermopile pyranometers based on their radiometric performance. The standard defines several spectral and operational parameters — such as response time, zero offset, directional response, non-linearity, and temperature dependence — establishing three main classes: Class A, Class B, and Class C. These classes provide a clear and internationally recognized framework for evaluating the quality of solar irradiance measurements and for selecting instruments suitable for high-accuracy PV monitoring.

Parameters (as reported in the ISO 9060:2018 standard)	Class A Acceptance intervals (guard bands)	Class B Acceptance intervals (guard bands)	Class C Acceptance intervals (guard bands)
Response time (time for 95% response)	< 10 s (1 s)	< 20 s (1 s)	< 30 s (1 s)
Zero offset A (response to -200 W/m ² net thermal radiation)	±7 W/m ² (2 W/m ²)	±15 W/m ² (2 W/m ²)	±30 W/m ² (3 W/m ²)
Zero offset B (response to 5 K/h change in ambient temperature)	±2 W/m ² (0.5 W/m ²)	±4 W/m ² (0.5 W/m ²)	±8 W/m ² (1 W/m ²)
Total zero offset (including the effects A, B and other sources)	±10 W/m ² (2 W/m ²)	±21 W/m ² (2 W/m ²)	±41 W/m ² (3 W/m ²)
Non-stability (percentage change in responsivity per year)	±0.8% (0.25%)	±1.5% (0.25%)	±3% (0.5%)
Non-linearity (percentage deviation from the responsivity at 500 W/m ² due to the change in irradiance within 100 to 1000 W/m ²)	±0.5% (0.2%)	±1% (0.2%)	±3% (0.5%)
Directional response (error at 1000 W/m ²)	±10 W/m ² (4 W/m ²)	±20 W/m ² (5 W/m ²)	±30 W/m ² (7 W/m ²)
Clear sky global horizontal irradiance spectral error	±0.5% (0.1%)	±1% (0.5%)	±5% (1%)
Temperature response (-10...40 °C vs 20 °C)	±1% (0.2%)	±2% (0.2%)	±4% (0.5%)
Tilt response (0...180°, 1000 W/m ²)	±0.5 % (0.2%)	±2% (0.2%)	±5% (0.5%)
Additional signal processing errors	±2 W/m ² (2 W/m ²)	±5 W/m ² (2 W/m ²)	±10 W/m ² (2 W/m ²)

LSI LASTEM's thermopile Pyranometers

LSI LASTEM manufactures ISO 9060:2018-compliant pyranometers in Class A, B, and C, covering the accuracy requirements of different photovoltaic applications. The table below summarizes the performance specifications of LSI LASTEM thermopile pyranometers under ISO 9060:2018.



Pyranometer models: μV output	DPA252.2	DPA154	DPA053A
Pyranometer models: 4...20 mA output	DPA952.2	DPA855	DPA863
Pyranometer models: RS485 Modbus output	DPA952.3	DPA980	DPA983
ISO 9060 Classification	Spectrally flat Class A	Spectrally flat Class B	Spectrally flat Class C
Daily total uncertainty	$\pm 2\%$	$\pm 5\%$	$\pm 10\%$
Spectral range	285...3000 nm	285...3000 nm	285...3000 nm
Thermopile sensitivity	8...25 μ V/W/m ²	10...15 μ V/W/m ²	10...15 μ V/W/m ²
Response time	< 5 s	< 15 s	< 30 s
Zero offset A	± 7 W/m ²	± 13 W/m ²	± 30 W/m ²
Zero offset B	± 2 W/m ²	± 3 W/m ²	± 8 W/m ²
Total zero offset	± 10 W/m ²	± 21 W/m ²	± 41 W/m ²
Non-stability	$\pm 0.8\%$	$\pm 1\%$	$\pm 3\%$
Non-linearity	$\pm 0.5\%$	$\pm 1\%$	$\pm 1\%$
Directional response	± 10 W/m ²	± 20 W/m ²	± 30 W/m ²
Clear sky global horizontal irradiance spectral error	$\pm 0.5\%$	$\pm 1\%$	$\pm 5\%$
Temperature response	$\pm 1\%$	$\pm 2\%$	$\pm 4\%$
Tilt response	$\pm 0.5\%$	$\pm 2\%$	$\pm 5\%$
Additional signal processing errors	± 2 W/m ²	± 5 W/m ²	± 10 W/m ²

Pyranometer mounting accessories

LSI LASTEM provides several accessories for the installation of pyranometers. Here are some options:

	Installation of the pyranometer for global horizontal irradiance (GHI) measurement only. Installation on a pole (45...65 mm diameter) Accessories: TYA050+TYA200
	Installation of the pyranometer for global horizontal irradiance (GHI) and Ground-reflected irradiance (RI) measurements. Installation on a pole (45...65 mm diameter) Accessories: TYA050+TYA250
	Installation of the pyranometer for in-plane irradiance (POA front). Installation on solar panel frame Accessory: DYA060
	Installation of the pyranometer for in-plane rear-side irradiance (POA rear). Installation on solar panel frame Accessory: DYA060

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► Pyranometers

These are the main sensors for solar applications. They measure 1) the global horizontal irradiance (GHI), 2) the plane-of-array irradiance (POA front), 3) the ground-reflected irradiance (RI), 4) the rear-side plane of array irradiance (POA rear) 5) diffuse irradiance (Gd). LSI LASTEM can supply Class A, B and C pyranometers according to ISO 9060:2018.



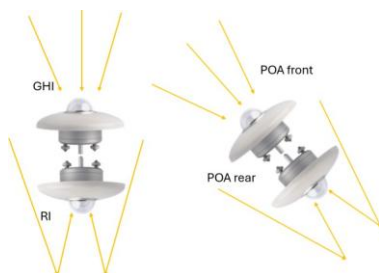
► Surface temperature sensor (T_{mod})

Pt100 sensors are available for contact temperature measurement of PV modules with 1/3 DIN accuracy (0.1 °C). They are supplied with a 4-wire cable $L = 20$ m. The sensors are easily attached to the photovoltaic modules by means of a heat-conductive paste and an adhesive strip.



► Soiling sensor (SR)

In order to monitor the soiling on the photovoltaic module, the soiling monitoring sensor is placed near the module, which evaluates the performance of the module, indicating the state of soiling on the element.



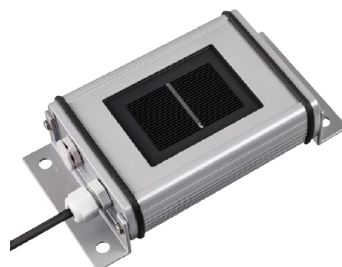
► Albedo and Rear irradiance ratio

Albedo is the fraction of incident solar radiation reflected by a surface, defined as the ratio of ground-reflected irradiance (RI) to Global Horizontal Irradiance (GHI). For bifacial PV systems, the In-plane rear-side irradiance ratio ("POA rear" divided by "POA front" irradiance) is used to assess rear-side contribution. Both Albedo and In-plane rear-side irradiance ratio can be calculated by the LSI LASTEM's data logger.



► Direct Radiation (DNI)

LSI LASTEM produces a sensor to measure the direct beam solar irradiance with high accuracy. It employs a rotating band to continuously block direct and calculate diffuse and reflected radiation, capturing only sunlight incident along the solar vector. It provides high temporal resolution for dynamic solar tracking.



► Calibrated cells for soiling

Alternatively, two calibrated cells installed next to the photovoltaic module can be used. One cell is cleaned regularly, while the other is left soiled; from the difference in efficiency of the two sensors, the state of soiling can be calculated.



► ALL-IN-ONE weather station

ALL-IN-ONE sensors are extremely compact and allow several environmental parameters to be monitored simultaneously: temperature, humidity, pressure, wind direction and speed and rain.



► Diffuse radiation (Gd)

LSI LASTEM provides a shadow band for the measurement of the diffuse solar radiation, this is a simple, robust and cost-effective mechanical solution compared with more complex sun-tracking shading devices. Diffuse radiation can also be calculated by the LSI LASTEM data logger using GHI and DNI measurements with the equation reported in the WMO - Guide Nr. 8, Chapt. 8, eq. 8.2.



► Wind sensor

Ultra-sonic and cups&vane wind sensors are available. Wind speed, by reducing the temperature of photovoltaic modules, affects their electrical efficiency. Furthermore, in strong winds, a warning system can be useful for activating plant safety strategies.

ISO/IEC 17025:2017 LSI LASTEM's calibration service for radiometric sensors

LSI LASTEM not only manufactures environmental and radiometric instrumentation, but also operates an ISO/IEC 17025:2017 accredited laboratory for the calibration of radiometric sensors, including pyranometers used for solar radiation measurements. This accreditation provides two key advantages: measurement reliability and full traceability. All calibration activities follow rigorous metrological procedures in accordance with international standards, ensuring that each sensor is certified with legally recognized documentation. These certificates can be used for internal audits, quality system certifications, and compliance verification.



Certificato di Accreditazione
Accreditation Certificate

Accreditamento n. **00389 Calibration REV. 006**
Accreditation n.

Emesso da
Issued by **Dipartimento Laboratori di Taratura**

Si dichiara che
We declare that **LSI LASTEM s.r.l.**

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È conforme ai requisiti della norma
Meets the requirements of the standard **UNI CEI EN ISO/IEC 17025:2018**
ISO/IEC 17025:2017

Qualità
As **Laboratorio di taratura**
Calibration laboratory

Data di 1ª emissione
1st issue date **06-03-2008**

Data di revisione
Revision date **26-05-2025**

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Expiry date **05-03-2028**

ISO/IEC 17025:2017 LSI LASTEM's field calibration service for radiometric sensors

LSI LASTEM also offers an ISO/IEC 17025:2017-compliant field calibration service designed specifically for photovoltaic applications. The IEC 61724-1 standard places strong emphasis not only on sensor specifications but also on periodic verification and frequent recalibration, which plant operators must ensure throughout the system's lifetime. To support these requirements, LSI LASTEM provides on-site recalibration of pyranometers using a dedicated field calibration kit.

Field calibration is carried out under direct solar radiation and clear-sky conditions.

The calibration kit includes:

- a reference pyranometer (Class A),
- an air temperature probe,
- a data logger, available in configurations for 3-sensor or 8-sensor calibration,
- mechanical accessories for mounting and alignment
- transport and protection equipment.

During the procedure, the data logger directly computes the calibration factor for each sensor with voltage output. This factor is then included in the calibration report issued at the end of the process, ensuring complete traceability and conformity to metrological requirements.



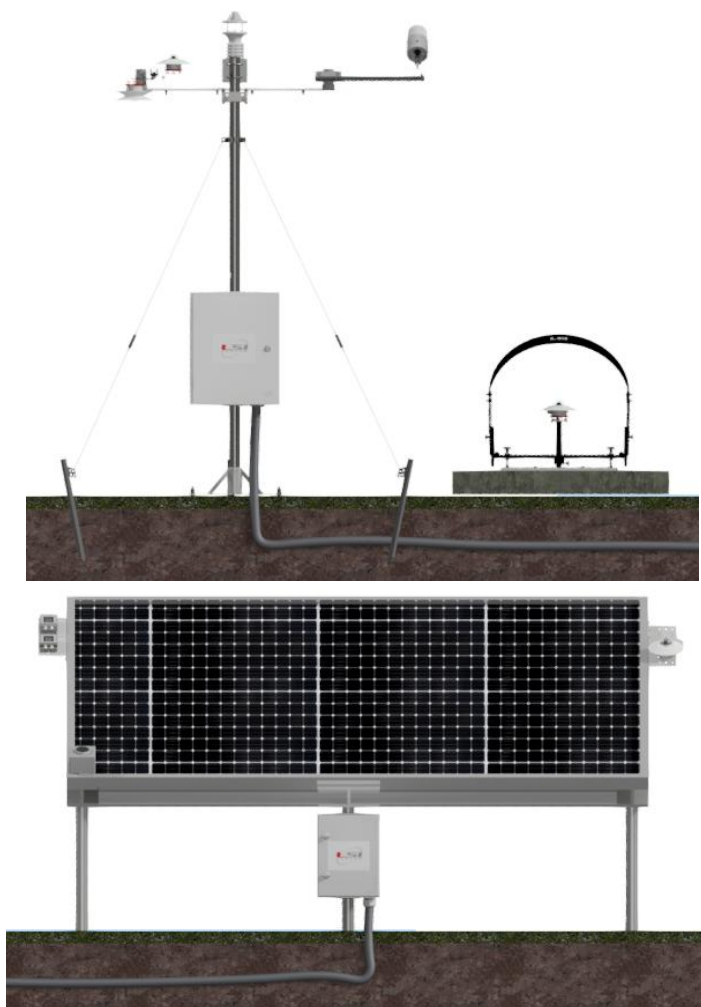
Meteorological station for PV plants and field system on the PV module

The system is structured into two distinct subsystems:

1. Main central meteorological station with sensors representing the general environmental and solar conditions of the site mounted on a pole to avoid shading conditions from local surroundings.

Data logger interfaced with the plant SCADA system via Modbus RTU or Modbus TCP protocols. In addition to real-time data transmission, the system is capable of local data storage, remote data forwarding to one or more servers, and alarm management. Alarm notifications can be issued via SMS, e-mail, or relay outputs to activate local signaling devices in the event of predefined conditions or anomalies.

2. PV module station with pyranometers placed at the same tilt angle as the PV modules. This station is connected by RS485 to the Main central meteorological station's data logger or directly to SCADA by RS485 Modbus RTU (option Modbus TCP). Several Module stations can be connected to the same Main Central meteorological station.



The **Main Central meteorological station** integrates an Alpha-Log data logger and can support the following sensors:

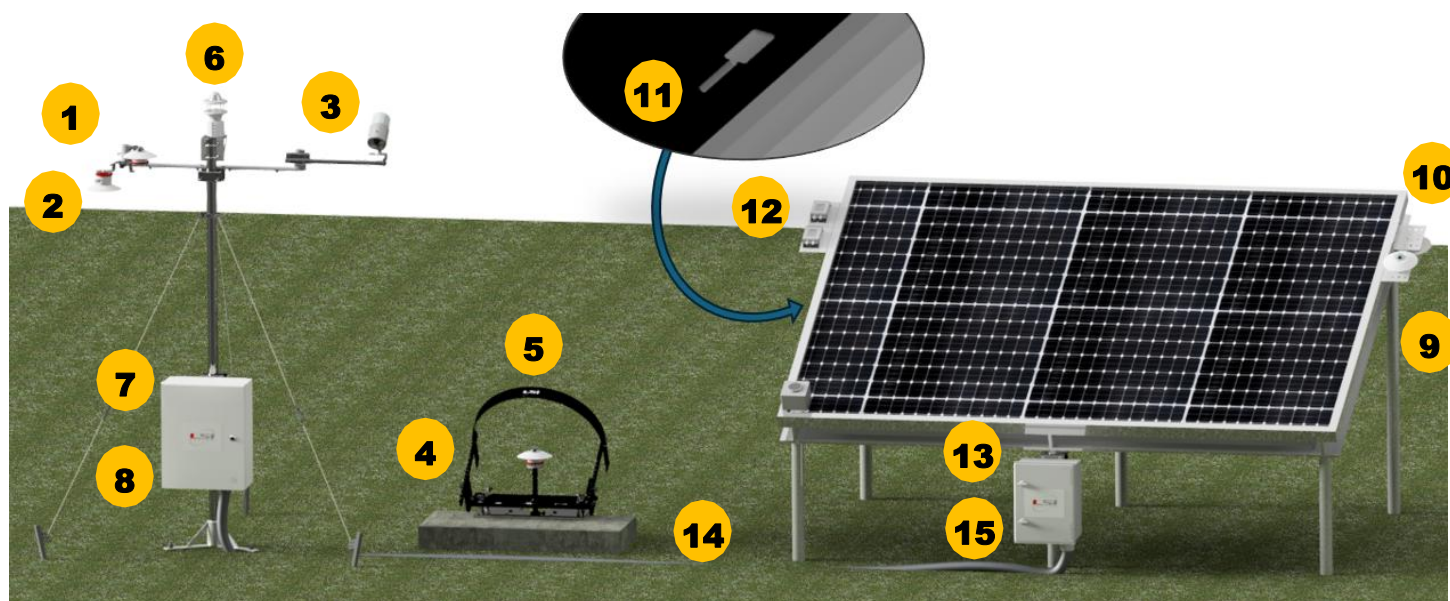
- Pyranometer for Global Horizontal Irradiance (GHI)
- Pyranometer for ground-reflected irradiance (RI). Used, with GHI, for Albedo calculation by Alpha-Log data logger
- Direct normal irradiance (DNI) sensor
- Pyranometer for Diffuse irradiance (Gd) using shadow band. Alternatively, Diffuse irradiance can be calculated by Alpha-Log data logger using Global Horizontal irradiance and Direct normal Irradiance parameters
- ALL-IN-ONE meteorological sensor (wind speed, wind direction, air temperature, relative humidity, pressure and rain).

The **PV Module station** with a signal collector for connecting sensors to data logger mounted on the Main central meteorological station via one RS485 cable and sensors installed on the PV module, as:

- Pyranometer for in-plane irradiance (POA)
- Pyranometer for in-plane rear-side irradiance* (POA rear). Used, with POA for In-plane rear side irradiance ratio calculation. Ratio can be calculated by Alpha-Log data logger
- PV module temperature sensors
- Soiling ratio device (using N.2 PV reference cells). Soiling ratio calculation by Signal collector device.
- Alternative to the PV reference cells for soiling ratio: optical device. Connected via RS485 to the main meteorological station data logger.

**used in bifacial PV plants*

► **Main Central meteorological station and PV Module station**



Drw. Ref. PN	Description	Kit1	Ref. Notes
	Main central meteorological station		
	Class A pyranometer for Global Horizontal Irradiance (GHI) (see catalogue MW9000-11)		
1	DPA952.3 Sensor/Pyranometer/Class A/RS485	1	
	DWA405A Cable DIN47100 L=5 m/DPA952.3 sensor	1	
	TYA050 Short-leg kit/AISI304/L.500mm tubing/D45...65 mm pole fixing collar	1	
	TYA250 Double multiple sensors bracket/AISI304/D22 mm tube clamp ring	Altern. to TYA200	A
	DYA046 Arm/Multiple sensors/to D=45÷65mm.pole	1	
	Class A pyranometer for ground-reflected irradiance (RI). Used, with GHI, for Albedo calculation (see catalogues MW9000-11, MW9005-06)		
2	DPA952.3 Sensor/Pyranometer/Class A/RS485	1	
	DWA405A Cable DIN47100 L=5 m/DPA952.3 sensor	1	
	Direct normal irradiance (DNI) and sunshine duration sensor (see catalogues MW9000-16, MW9005-06)		
3	DPD504.1 Sensor/Sunshine+Direct Radiation/On-Off+4...20mA/12V	1	
	DWA505A Cable STD/L=5m/sensors	1	
	TYA050 Short-leg kit/AISI304/L.500mm tubing/D45...65 mm pole fixing collar	1	
	TYA200 Multiple sensors bracket/AISI304/D22 mm tube clamp ring	1	
	Class A pyranometer for Diffuse irradiance (Gd) - Diffuse radiation shadow band (see catalogues MW9000-11, MW9005-06)		
4	DPA952.3 Sensor/Pyranometer/Class A/RS485	1	
	DWA410A Cable DIN47100 L=10m/DPA952.3 sensor	1	
5	DPA245 Shadow-band for diffuse radiation	1	B
	DYA150 Kit plate and screws for DPA952.3 pyranometer installation on DPA245 shadow band	1	
	ALL-IN-ONE meteorological sensor (wind speed, wind direction, air temperature, relative humidity, rain) (see catalogue MW9000-08)		
6	DNB201 Sensor/AIO Compact/WS+WD+T+RH+Press+Rain/RS485/10÷30V	1	
	DWA054 Cable/L=5 m/4 pole/sonic digital sensor w/out heating	1	
	Alpha-Log data logger (see catalogue MW9005-01)		
7	DLALB0100 Alpha-Log/5GB/n.2 RS232/n.1 RS485/n.2 USB/n.1 Ethernet	1	

Drw. Ref.	PN	Description	Kit2	Ref. Notes
8	IP66 enclosure for data logger (see catalogue MW9000-07)			
	ELF340.8	Box IP66/50x40x16cm/230V->13.8V/50W/Compatible with RS485 connections	1	
	DYA074	Arm/ELFxxx/to D=45÷65mm.pole	1	
	Electrical Protection unit (see catalogue MW9000-07)			
	EDEPA1100	Protection unit-SPD/Power line 230 V single phase/DIN rail mounting	1	
	EDEPA1101	Protection unit-SPD/RS-485 communication line/DIN rail mounting	1	C
	EDEPA1102	Protection unit-SPD/Ethernet communication line/DIN rail mounting	1	D
	H.2 m pole with tie-rods for installation (see catalogue MW9007-01)			
	DYA006.1	Pole/H=2m/D=50mm	1	
	DYA020	Tripod/concrete installation/pole D= 50 mm	1	
9	DYA020.1	Anchoring bolts for tripod/3 set	1	
	DYA028	Tie rods/H=2-3m	1	
	DYA026	Ground picket/L=1m/3set	1	
	PV module station (connection by RS485 to the Main central meteorological station's data logger; or directly to SCADA via RS485 Modbus RTU or TCP)			
	Class A pyranometer for in-plane of array irradiance (POA) (see catalogue MW9000-11)			
	DPA252.2	Sensor/Pyranometer/Class A/μV	1	
	DWA625A	Cable DIN47100 L=25 m/DPA252.2 sensor	1	
	DYA060	Anodized All. side support for solar panel for Pyranometer/Silicon global radiation sensor	1	
	Class B pyranometer for In-plane rear-side irradiance (see catalogue MW9000-11)			E
	DPA154	Sensor/Pyranometer/Class B/μV	1	
10	DWA625A	Cable DIN47100 L=25 m/DPA154 sensor	1	
	DYA060	Anodized All. side support for solar panel for Pyranometer/Silicon global radiation sensor	1	
	PV module temperature sensors (see catalogue MW9000-04)			
	DLE124A	Sensor/Surface Temp/Pt100/Cable STD L.20 m	1	
	Soiling ratio device (using N.2 PV reference cells) (see catalogue MW9000-30)			F
	PRRDA4030	Sensor/Radiom.cell/amorfo/4...20mA/Cable L=3 m+connector	2	
	DWA525A	Cable STD/L=25m/sensors	2	
	DYA060	Anodized All. side support for solar panel for Pyranometer/Silicon global radiation sensor	2	
	Optical technology system (see catalogue MW9000-12)		Altern. to reference cells	G
	PRPMA4100	Soiling particle deposition sensor, out RS-485 Modbus-RTU, power supply 10..30 V DC 6 W	1	
12	CCCFA0500	Cable with connector and free wires for PRPMA4100 sensor, length 25 m	1	
	Signal collector. Connection by RS485 to Alpha-Log data logger (Main central meteorological station) or directly to SCADA via Modbus RTU (or Modbus TCP)			
	MDMMB1110.1	ALIEM/Inputs extension/N.8 Analog.+4 Digitals/RS485-Modbus RTU	1	
	DEA509	RS232-422-485->Modbus TCP gateway/DIN bar	Altern. to ALIEM	H
	MN1510.25RI	Cable/Lan 4X2Xawg24/I-S/Ftp-Cmx Cat5-Sch/L=25 m	Altern. to ALIEM	I
	IP66 enclosure for signal collector (see catalogue MW9005-07)			
	ELK340	Box IP66/40x30x20cm/230V->13,8V/50W/batt.2Ah	1	
	MAGFA1002	Wall bracket kit for ELKxxx (1 kit 4 pcs)	1	

NOTES

A	TYA250 can be used to fix two pyranometers to the same TYA050 short-leg kit: one for Global Horizontal Irradiance and one for ground-reflected irradiance. If two pyranometers are not required, the TYA200 bracket can be used instead of TYA250.
B	Without DPA245 shadow band, Diffuse radiation can also be calculated by the Alpha-Log data logger using the Global Horizontal Irradiance (GHI) and Direct normal irradiance (DNI) and the equation reported in the WMO - Guide Nr. 8, Chap. 8, eq. 8.2.
C	EDEPA1101 protection unit can be used to protect the RS485 line between Alpha-Log data logger and ALIEM module of the PV module station or to protect Alpha-Log RS485 line to SCADA when the connection is not made by Modbus TCP
D	EDEPA1102 protection unit can be used to protect the Ethernet line between Alpha-Log and SCADA when Modbus TCP is used
E	For rear-side irradiance measurements, IEC 61724-1:2021 may allow a lower-class pyranometer than the one used for front POA measurements, depending on the applicable monitoring requirements. In this configuration, a Class B pyranometer may be acceptable.
F	For soiling measurement, two PRRDA4030 reference cells are needed
G	The Soiling particle deposit sensor is normally connected directly to the SCADA system by RS485 Modbus RTU. In case of need, it can be connected to Alpha-Log data logger.
H	DEA509 can be used to convert Modbus RTU from the ALIEM signal collector module to Modbus TCP. It is needed to connect directly ALIEM to SCADA by Modbus TCP
I	In case of RS485 cable connection from the ALIEM signals collector to the Alpha-Log data logger, the CAT.5 cable is suggested. In this example a L.25 m cable is listed

Field system for environmental parameters



- ▶ Sensor kit for Performance Ratio calculation
- ▶ N.1 high-resolution input (18 bit) for Pyranometer (μV , mV) or 0...1 V. Configurable pyranometer sensitivity value
- ▶ N.2 Pt100 inputs (3-wire) with 0.5 °C accuracy
- ▶ N.1 included internal Pt100 temperature sensor as alternative to external sensor. Thermistor input also available (DEA420.2 with 4...20mA output)
- ▶ N.1 pulse/frequency input for LSI LASTEM wind speed sensors (DNA202-30x)
- ▶ N.1 input for Storm Distance Sensor (DQA601A.3)
- ▶ RS485 (2-wire) Modbus RTU port with galvanic insulation
- ▶ Model with 4...20mA output available (DEA420.1 with Pt100 input, DEA420.2 with thermistor input)

The Modbus Sensor Box (MSB) is a fast and simple solution for connecting environmental sensors to PLC/SCADA systems via Modbus RTU. It supports global irradiance sensors with configurable sensitivity, air and PV surface temperature sensors, anemometers, and storm front distance sensors. Compatible with LSI LASTEM sensors, the MSB input flexibility also allows the use of most environmental sensors on the market, including most pyranometers with compatible $\mu\text{V}/\text{mV}$ or 0...1 V outputs, by setting the thermopile sensitivity.

DNA201.1 Wind Speed (1)

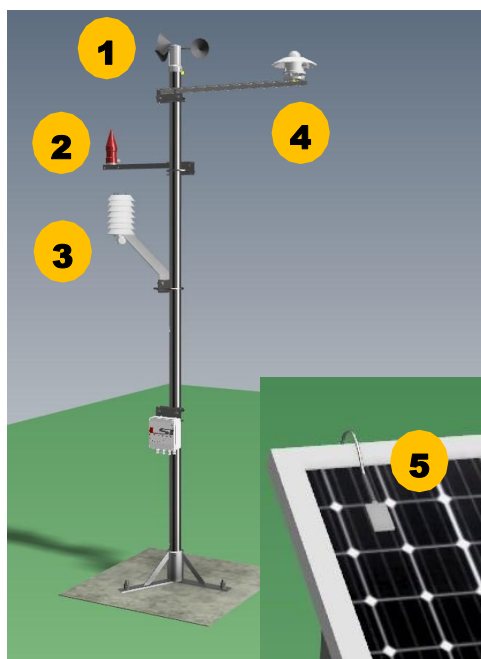
Type	Reed Relay
Range	0...75 m/s
Accuracy	2.5%

DQA601A.3 Storm distance (2)

Type	Sensitive RF receiver
Range	5...40 km
Resolution	14 steps (5, 6, 8, 10, 14, 16, 17, 20, 24, 27, 31, 34, 37, 40 km)
Cable	L = 20 m

DMA033A Air temperature (3)

Type	Pt100 1/3 DIN
Range	-20...80 °C
Accuracy	0.1 °C @ 0 °C



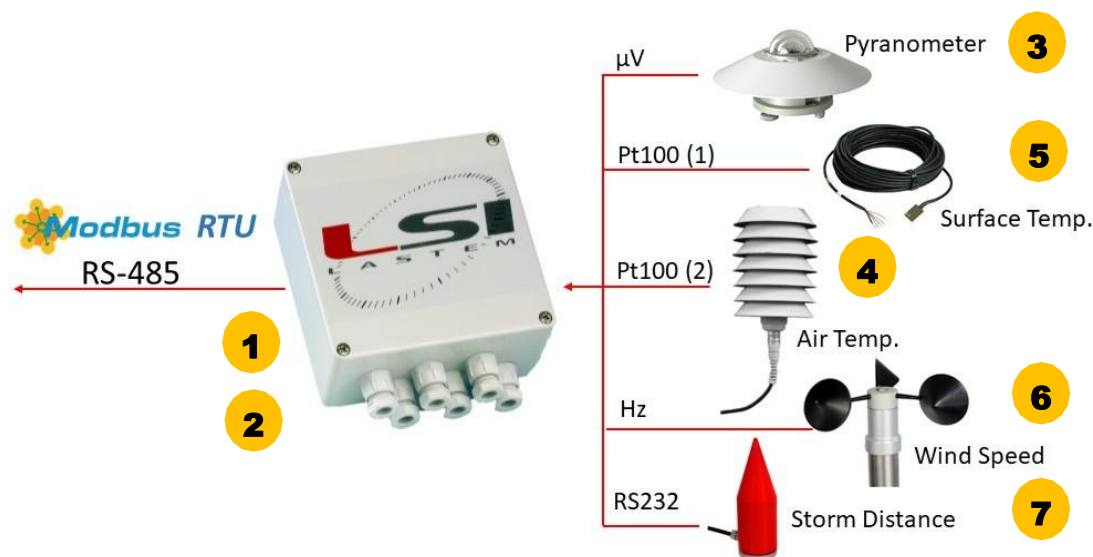
Pyranometer (4)

See table at page 6 (only μV output)

DLE124A Surface Temperature (5)

Type	Pt100 Class AA IEC60751 (DIN 1/3 class B)
Range	-100...200 °C
Accuracy	0.1 °C @ 0 °C
Operative temperature	Sensor plate: -100...200 °C Sensor cable: -40...80 °C
Response time	35 s
Cable	4 wires L= 20 m Ø 5 mm
Protection rate	IP66

► **MSB - Modbus Sensor Box**



Drw. Ref.	PN	Description	Kit2	Ref. Notes
		Modbus Sensor Box (see catalogue MW9008-05)		
1	MDMMB1010.1	MSB/N2 Pt100+mV+Hz/RS485/10÷30V	1	
2	DEA420.1	STB/N2 Pt100+mV+Hz/4x4÷20mA/10÷30V	Optional	A
2	DEA420.2	STB/Pt100+mV+Hz+TC/4x4÷20mA/10÷30V	Optional	B
		Pole installation mounting accessory	Optional	
	DYA090	Arm/MSB÷STB/to D=45÷65mm.pole	1	
3		Pyranometers (options Spectrally Flat Class A, B, C) (see catalogue MW9000-11)		
		Spectrally Flat Class A and B pyranometer		
	DPA252.2	Sensor/Pyranometer/Class A/μV	1	
	DPA154	Sensor/Pyranometer/Class B/μV	Altern. to Class A	
	DWA605A	Cable/L=5m/DPA252.2-154	1	
		Mounting accessories for DPA154 and DPA252.2 horizontal installation		
	TYA050	Short Leg kit/AISI304/L.500mm tubing/D45...65 mm pole fixing collar		
	TYA200	Multiple sensors bracket/AISI304/D22 mm tube clamp ring		
		Spectrally Flat Class C	Altern. to Class A, B	
	DPA053A	Sensor/Pyranometer/Class C/μV/Cable L=5 m	1	
		Mounting accessories for DPA053A horizontal installation		
	TYA050	Short Leg kit/AISI304/L.500mm tubing/D45...65 mm pole fixing collar		
	TYA200	Multiple sensors bracket/AISI304/D22 mm tube clamp ring		
4		Air temperature sensor (see catalogue MW9000-01)		
	DMA033A	Sensor/Air Temp/Pt100/Cable L.5 m	1	
	DYA230	Radiant screen/NV/DMA67x-033	1	
	DYA049	Collar/for sensor arm to D=45÷65mm pole	1	
5		Contact temperature sensor (see catalogue MW9000-04)		
	DLE124A	Sensor/Surface Temp/Pt100/Cable L.20 m	1	
6		Wind speed sensor - Compact version (Hz output) (see catalogue MW9000-09)		
	DNA202.1	Sensor/Cup-anem.-Compact/WS/Hz/7pin	1	
	DWA505A	Cable/L=5m/sensors	1	

Drw. Ref.	PN	Description	Kit1	Ref. Notes
7		Storm Front distance sensor (see catalogue MW9000-21)	Optional	
	DQA601A.3	Sensor/Front distance/UART-TTL/5÷24V	1	
	DYA032	Arm/DPA053-008, ESR003, DQA601A.3, DMA131/ to DYA049	1	
	DYA049	Collar/for sensor arm to D=45÷65mm pole	1	
		Pole H.2 m (see catalogue MW9007-01)		
	DYA006.1	Pole/H=2m/D=50mm	1	
	DYA020	Tripod/concrete installation/pole D= 50 mm	1	
	DYA020.1	Anchoring bolts for tripod/3 set	1	

NOTES	
A	If 4...20 mA output is required instead of RS485, inputs from N.2 Pt100 temperature sensors
B	If 4...20 mA output is required instead of RS485, inputs from N.1 Pt100 and N.1 thermocouple temperature sensor



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