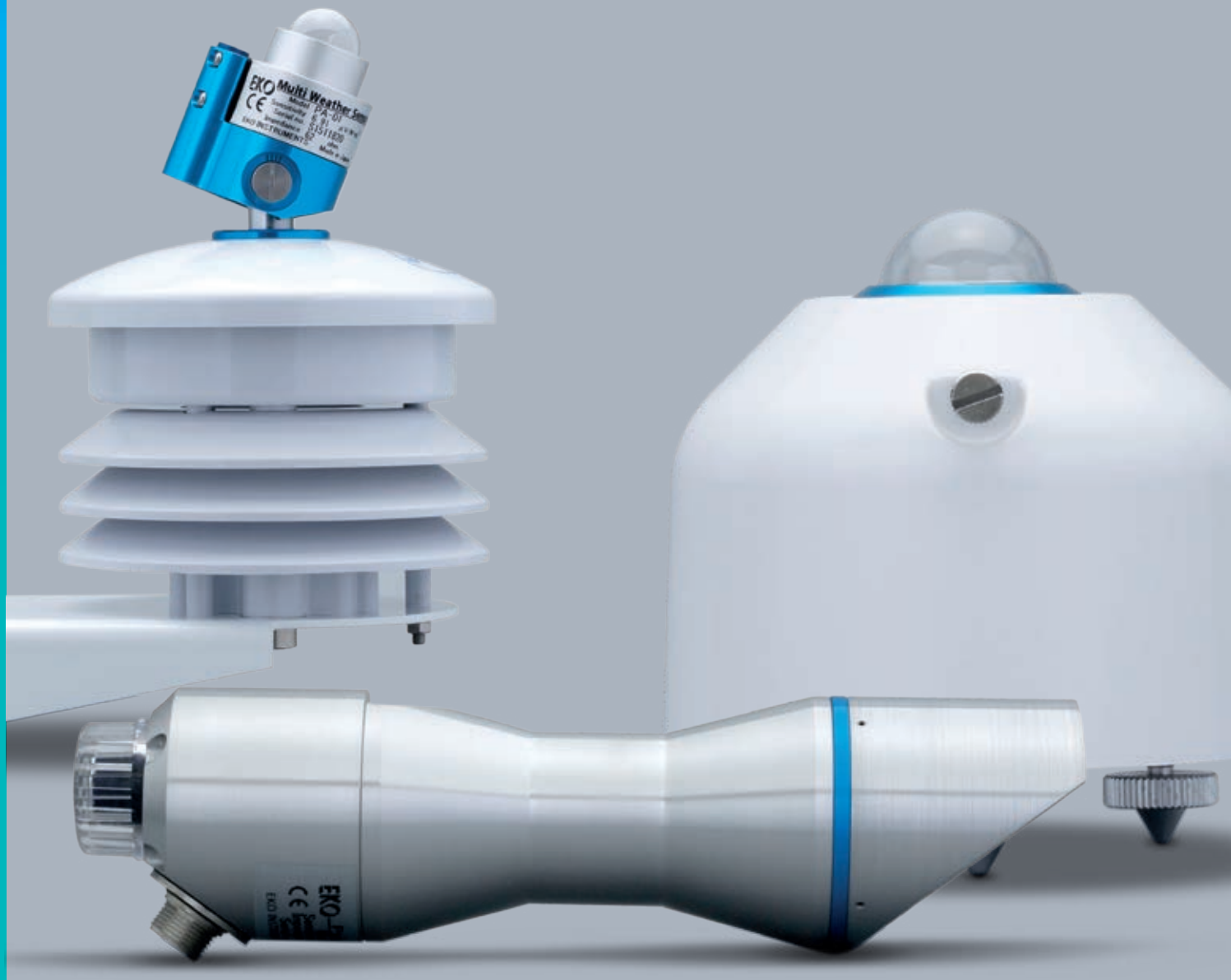
PRODUCT GUIDE 2016

EKO

Solar Radiation & Photonic Sensors

High Precision Instruments for Solar Energy and Meteorological Research

2016



The Company. 90 years of Japanese reliability and precision

Established in Tokyo in 1927, EKO began with the distribution of instruments for the Japanese meteorological and environmental market. In the 50's, the company developed and produced its first solar radiation sensors to meet with the ever evolving needs of the scientific community. Since the beginning **renewable energy and environmental topics are our interests** and directed our main strategy.

We now offer a unique range of high precision broadband and spectral radiometers, as well as various I-V measurement devices for the evaluation of photovoltaic components, systems, and energy plants. **All products are manufactured with a high emphasis on quality**, innovation and creativity. EKO is also a center of competence offering know-how and customized services for the photovoltaic industry and instrumental meteorology on an outstanding scientific level.

We are the only solar sensor manufacturer having its own ISO 17025 accredited testing laboratory for the calibration of pyranometers and pyrheliometers. ISO 17025 gives our clients another proof of the precision and reliability of our measuring instruments and calibration methods.

International customers will benefit from smart instrument synergies and innovative services, which persistently improve and optimize the efficiency and quality of their photovoltaic systems and meteorological research. Through its worldwide distribution network and regional offices, EKO developed into a **leading global player**, which is known for its instrument durability, reliability and precision.

The Market. Energy Meteorology

It is the aim of EKO to help its customers to get ahead by **developing turn-key research solutions** and services for the photovoltaic and meteorological markets. With our high level of know-how and latest technologies used in the photovoltaic measurement equipment and solar radiation sensors, we aim to extend your **solar research capabilities in functionality, accuracy and quality.** EKO unique Solar Monitoring Station (SMS) is considered a reference in PV to collect high-quality solar irradiance data on-site.

The principle of PV performance monitoring is to relate the total energy input, which is the incidence solar irradiance, to the energy output in units of electrical power produced by the photovoltaic cells, modules, or installations. EKO's distinct range of I-V tracers and high precision solar sensors can be flexibly configured as one PV evaluation system according to the latest international standards.

"A center of competence within the photovoltaic industry and environmental meteorology"

TOSHIKAZU HASEGAWA
PRESIDENT AND CEO

The Products. Each EKO sensor has its own story, which is about precision

The requirements for solar measurement applications can be different. However a researcher studying climate change, or an operator monitoring the efficiency of a solar park are both expecting a high level of precision.

Depending on the measurement circumstances and the application, users have different demands. Some will favor cost-effective, high quality sensors, while others insist to use the best available sensors in the market. The EKO range has it all and it is our role to advise the best solution for you.

The Quality. Calibration laboratory ISO 17025

EKO calibration laboratory is **accredited and certified** by PJLA to perform pyranometer and pyrheliometer calibrations in accordance with the requirements of ISO/IEC 17025.

EKO is **the only solar sensor manufacturer applying a standard in-house** ISO/IEC 17025 calibration for all pyranometers and pyrheliometers. Defined within the ISO/IEC 17025 scope of calibrations, EKO performs most accurate solar sensor calibrations compliant with the international standards defined by ISO 9847 (Indoor method) and 9059 (Outdoor method).

ISO.17025 Calibration

Accreditation No.:74158

ISO/IEC 17025 provides a globally accepted basis for laboratory accreditation, which specifies the management process and technical requirements. With all calibrations performed at the EKO laboratory we enable our customers to:

— Clearly identify the applied calibration methods, lowest measurement uncertainties and highest precision.
— Obtain repeatable and reliable calibration test results through consistent operations.
— Be traceable to the World Radiation Reference (WRR) through defined industrial standards:
    - ISO 9846 Calibration of a pyranometer using a pyrheliometer.
    - ISO 9847 Calibration of field pyranometer by comparison to a reference pyranometer.
    - ISO 9059 Calibration of field pyrheliometers by comparison to a reference pyrheliometer.

Our clients will obtain a high level of confidence when purchasing an ISO/IEC 17025 calibrated sensor. Our Accredited lab is **annualy re-examined** independently to assure strict compliance to the requirements.

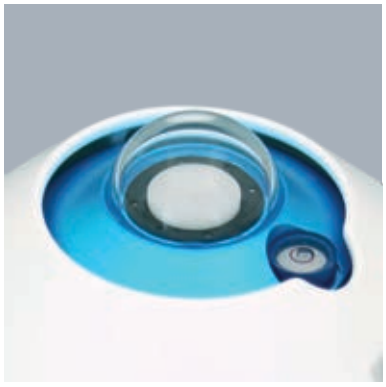
Pyranometers

MS-80
New generation
ISO 9060 Secondary standard

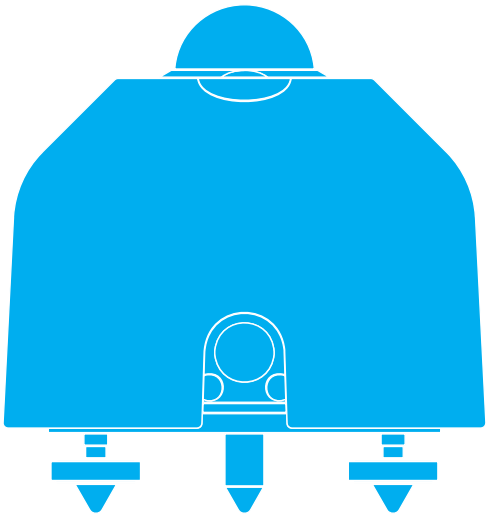
Revolutionary new standard, lowest measurement uncertainty: EKO's new generation pyranometers broke with the traditional pyranometer architecture. The innovative design was inspired by the latest technologies enabling a break through in unprecedented low offset behaviour and fast thermopile sensor response. Providing the **lowest measurement uncertainties** under all atmospheric conditions when deployed in harsh environments. The MS-80 secondary standard Solar sensor is made for **long-term unattended operation**, comes with 5 years warranty, 5 years recommended re-calibration interval and no longer need to inspect or change the dessicant.

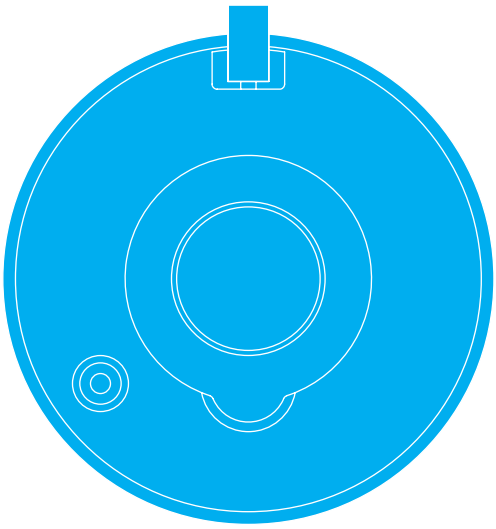
Elegancy in all details

Revolutionairy properties




NEW
2016





MS-80M

If you believed that “High-end” Solar sensors are only meant for research purposes, the “High-end” MS-80 secondary standard pyranometer was designed for industrial application and meteorological sensor networks. The MS-80 is a unique combination of EKO’s isolated detector architecture and novel optical design. It pushed the limits of traditional pyranometer characteristics to become a new reference in its class. The compact sensor with single dome is immune to offsets and easily integrates all value added features such as a ventilator, heater and different industrial interfaces.

MS-80M (RS-485 MODBUS® RTU)

Preserve the high accuracy of the sensor while complying with the output standards used in the industry. The MS-80M can be used whenever RS-485 Modbus® RTU signal is required. With Modbus®, up to 100 sensors or other converter units can be addressed and connected in one network.

MS-80A (4-20MA)

The MS-80A with 4-20mA current output can be operated with long cables.

Features

— Secondary Standard pyranometer
— Lowest zero offsets
— Fastest analog response time
— Lowest temperature dependency
— 5 years warranty & re-calibration period
— No need for dessicant inspection or change.
— ISO 17025 accredited calibration
— Optional built in 4-20mA or MODBUS 485 RTU interface
— Optional ventilator / heater (MV-01)

STANDARD 5 YEARS WARRANTY

ISO.17025 Calibration

ISO.9060 Compliant

Specifications

	MS-80	MS-80A	MS-80M
ISO 9060 classification	Secondary standard		
Detector	Thermopile		
Response time 95 %	< 0.5 s	< 1.5 s	< 1.0 s
Zero offset A - Thermal radiation (200W/m²)	< 1 W/m² (unventilated or ventilated)		
Zero offset B - Temperature change (5K/hr)	+/- 1 W/m²		
Long-term stability (change/yr)	< 0.5 % / 5 years		
Non-linearity (100 to 1000W/m²)	+/- 0.2 %		
Directional response (at 1000W/m² | 0 to 80°)	+/- 10 W/m²		
Spectral selectivity (0.35 to 1.5µm)	+/- 3 %		
Temperature dependency (-20 to 50°C)	<1 %	<0.4 %	<0.4 %
Tilt response (0-90° | 1000W/m²)	< 0.2 %		
Wavelength range (nm)	285 to 3000		
Irradiance range (W/m²)	0 to 4000		
Nominal sensitivity (µV/W/m²)	10	1mA / 100W/m²	-
Signal output	0 - 15mV	4 - 20mA	Modbus RTU
Nominal impedance	45 kΩ*	-	-
Operating temperature	- 40 to 80°C	- 40 to 80°C	- 40 to 80°C
Supply voltage	-	12-24 VDC +/- 20 %	
Power consumption	-	0.08 - 0.5 W	< 0.3W
Ingress Protection	IP 67		
Calibration traceability / uncertainty	ISO 17025 / WRR / < 0.7 % (k = 1.96)		
Case temperature sensor	10kΩ NTC		
Standard cable length 10 m (Optional lengths 20 m, 30 m, 50 m)			

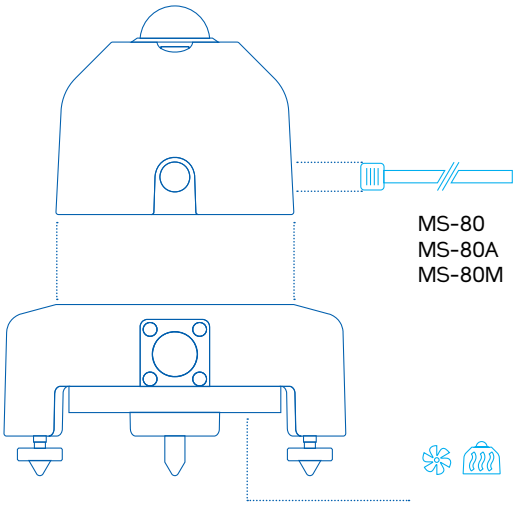
*Use measuring device with input impedance more than 100MΩ

MS-80 ACCESSORIES
New generation
ISO 9060 Secondary standard

Create a powerfull combination of the compact MS-80 pyranometer models with integrated ventilator and heater. The MS-80 with ventilator will **extend the sensor maintenance interval period** and assures the availablity of solar data when deployed in cold climate regions or desert environments.

MV-01 VENTILATOR & HEATER

In harsh environments Irradiance measurements can be affected easily. The MS-80 in combination with the MV-01 will keep the pyranometer dome free of dew, ice and snow. In combination with the ventilator the best possible measures are taken for reliable unattended operation.



Specifications

	MV-01
Compatible sensors	MS-80, MS-80A, MS-80M
Operating Voltage	DC 10.8 to 13.2V
Power consumption	Fan (1.9W) + heater (7W)
Operating temperature	-40 to 80°C
Temperature increase of glass dome	<0.25°C (fan) and >1°C (fan + heater)
Induced Zero offsets	<1W/m²
Tacho output	Pulse / 100Hz / 3000 rpm
Environmental protection	IP 54 (IEC60529)

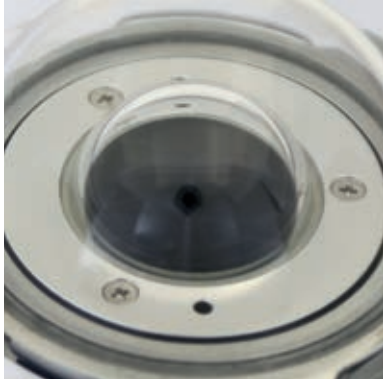
Standard cable length 10 m
(Optional lengths 20 m, 30 m, 50 m)
Optional: Air filter kit

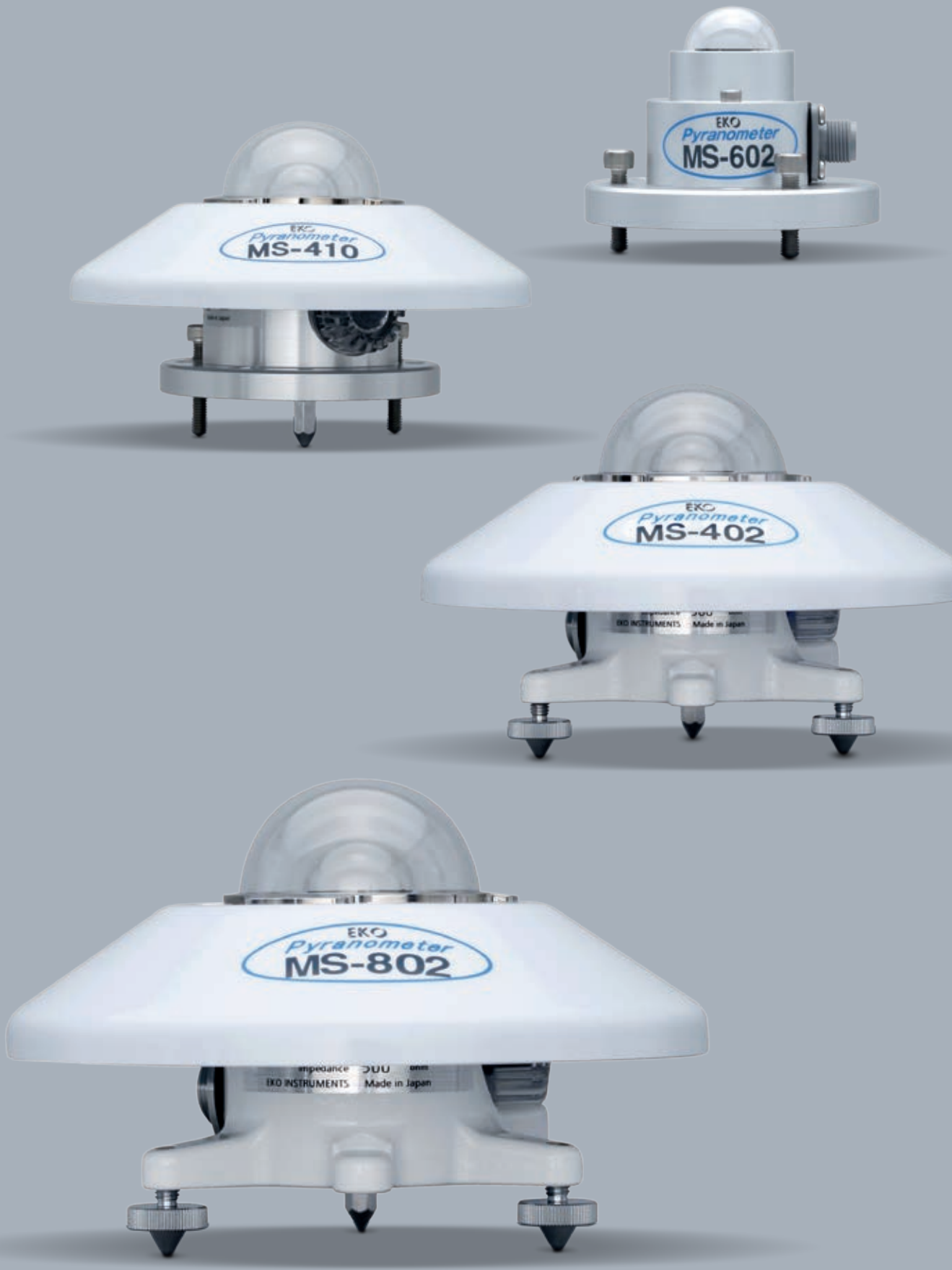
MS-802, MS-402, MS-410, MS-602
Measuring global radiation and a lot more

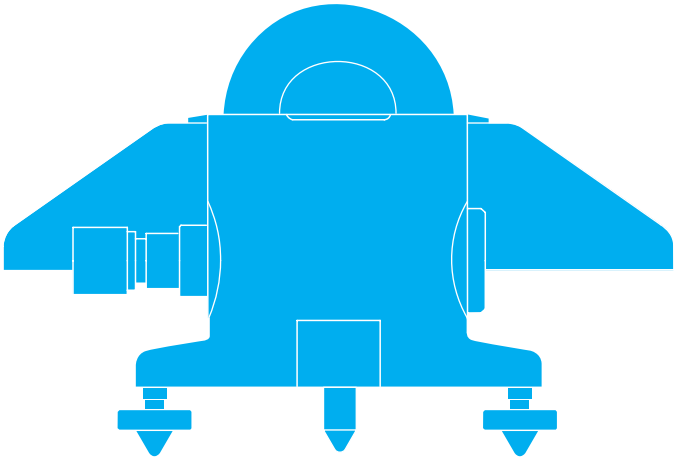
EKO Pyranometers measure the total hemispherical solar radiant energy, a fundamental quantity in all climate-related phenomena. These are predominantly used in photovoltaic and solar thermal applications as well as for meteorological and climatological studies. **Pyranometers can also be used for plant growth studies, material durability tests and many other applications**. The measurement technology of those sensors is based on a thermopile detector, which has a flat spectral response and an hemispherical field-of-view. Therefore, pyranometers are also called global broadband sensors. ISO 9060 classifies pyranometers into three categories: Secondary Standard, First Class and Second Class.

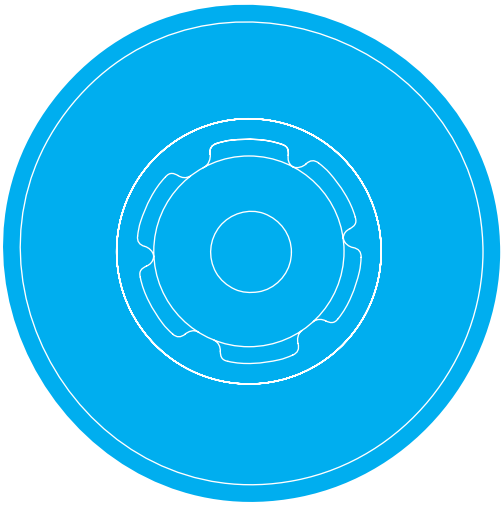
Proven reliability

Thermal sensor technologie




EKO
Pyranometer
MS-602
EKO
Pyranometer
MS-410
EKO
Pyranometer
MS-402
EKO INSTRUMENTS Made in Japan
EKO
Pyranometer
MS-802
EKO INSTRUMENTS Made in Japan





MS-802

As an ISO Secondary standard pyranometer, the MS-802 is a reliable reference sensor to measure global broad-band radiation with high precision. It is used as a standard in PV research and climatological studies around the world.

A high quality double-dome construction is adopted to improve the accuracy of the measurement and to minimize unwanted thermal offsets.

The ventilation unit of the MS-802F model will reduce the deposition of dust, dew, frost, snow, etc.

Features

— Secondary standard pyranometer
— Optimal cosine characteristics
— Fast analog response time
— Compensated low temperature dependency
— ISO 17025 accredited calibration
— Optional 4-20mA or MODBUS 485 RTU interface

MS-402 AND MS-410

The ISO First Class pyranometers MS-402 and MS-410 are perfectly suited for the sampling of 10 minute averaged solar radiative fluxes in horizontal or tilted measurement configurations.

The two high-quality glass domes protect the detector efficiently from any thermal effects. The MS-402 is the only temperature-compensated First Class pyranometer on the market.

The ventilation unit of the MS-402F model will reduce the deposition of dust, dew, frost, snow, etc.

Features

— First class pyranometer
— Low thermal offset
— Low temperature dependency (MS-402 compensated)
— ISO 17025 accredited calibration
— Optional 4-20mA or MODBUS 485 RTU interface

MS-602

Within the MS-pyranometer series the MS-602 is the most compact thermopile pyranometer. It is a cost-effective solution for global solar radiation measurements. MS-602 meets the ISO Second Class performance criteria. However its excellent temperature dependency characteristics can only be found on higher class pyranometers. This radiation sensor is used in many meteorological networks and professional small-scale PV sites where reliability matters.

Features

— Second class pyranometer
— Low temperature dependency
— ISO 17025 accredited calibration
— Optional 4-20mA or MODBUS 485 RTU interface

STANDARD 5 YEARS WARRANTY

ISO.17025 Calibration

ISO.9060 Compliant

Specifications

	MS-802/802F	MS-402/402F	MS-410	MS-602
ISO 9060 classification	Secondary standard	First class	First class	Second class
Detector	Thermopile	Thermopile	Thermopile	Thermopile
Wavelength range (nm)	285 to 3000	285 to 3000	285 to 3000	285 to 3000
Response time 95 %	< 5 s	< 8 s	< 18 s	< 17 s
Zero offset A Thermal radiation (200W/m²)	< 6 W/m²	< 6 W/m²	< 6 W/m²	< 10 W/m²
Zero offset B Temperature change (5K/hr)	+/- 2 W/m²	+/- 2 W/m²	+/- 2 W/m²	+/- 6 W/m²
Non-stability (change/yr)	< 0.5 %	< 0.5 %	< 1.5 %	< 1.7 %
Non-linearity (100 to 1000W/m²)	+/- 0.2 %	+/- 0.2 %	+/- 1 %	+/- 1.5 %
Directional response (at 1000W/m² | 0 to 80°)	+/- 10 W/m²	+/- 20 W/m²	+/-20 W/m²	+/- 25 W/m²
Spectral selectivity (0.35 to 1.5µm)	+/- 1 %	+/- 1 %	+/- 1 %	+/- 1 %
Temperature dependency (-10 to 40°C)	< 1 %	< 1 %	< 2 %	< 2 %
Tilt response (0-90° | 1000W/m²)	+/- 0.2 %	+/- 0.2 %	+/- 2 %	+/- 2 %
Irradiance range (W/m²)	0 to 4000	0 to 4000	0 to 2000	0 to 2000
Nominal sensitivity (µV/W/m²)	7	7	7 - 14	7
Nominal impedance	500 Ω	500 Ω	20 - 140 Ω	20 - 140 Ω
Operating temperature	- 40 to 80°C	- 40 to 80°C	- 40 to 80°C	- 40 to 80°C
Ingress Protection	IP 67	IP 67	IP 67	IP 67

Standard cable length 10 m (Optional lengths 20 m, 30 m, 50 m)

Sensor Signal Converters

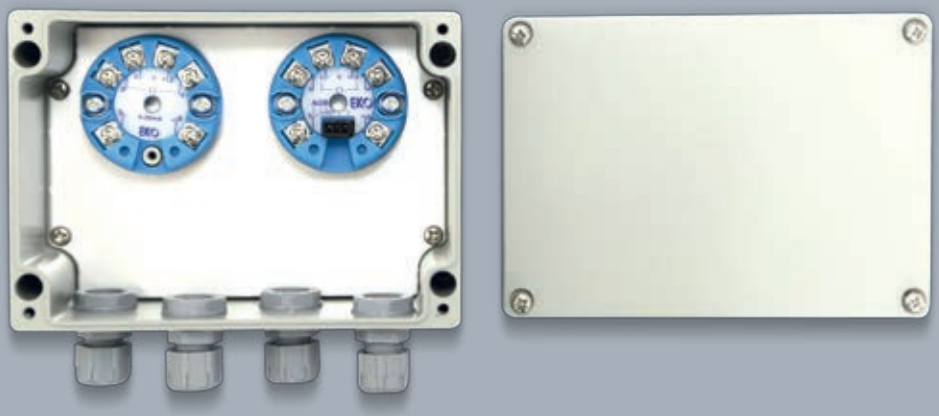
A-BOX, M-BOX

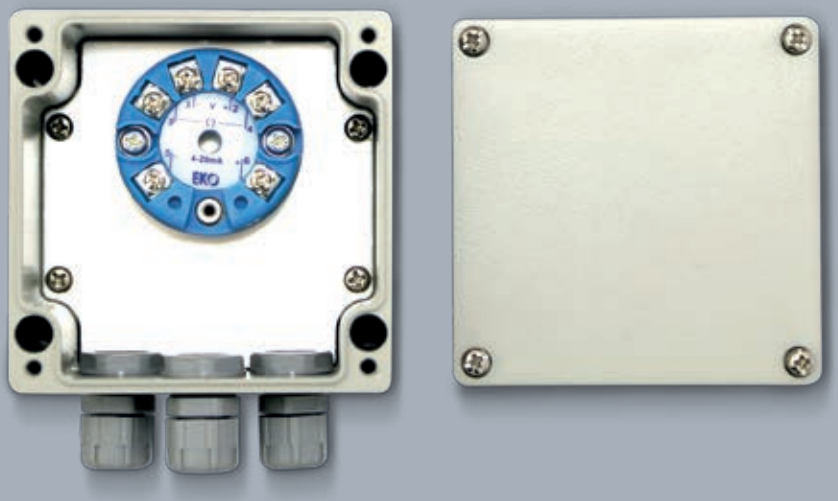
Out of the box digital sensor technology for the industry

PV system performance rating and testing methods require solar irradiance as an input parameter. For PV monitoring applications Solar Irradiance and PV module temperature are commonly measured. EKO universal 4-20mA and Modbus RS-485 RTU converters give full flexibility to **combine different type of sensors within a multi sensor network**. Solar radiation sensors and temperature sensors can be easily integrated. Preserve or improve the sensor accuracy while complying to the output standards used in the industry.

MC-20 (MODBUS 485 RTU)


EKO
4 -20mA Converter
www.eko.co.jp
SN: 150379.21.15
EKO Instruments
Made in EU





A-BOX

It converts the output voltage of a solar radiation sensor into a 4-20mA current ouput.

It can be used with all passive EKO sensors or any other sensor (Irradiance and temperature) with mV output whenever a 4-20mA signal is required.

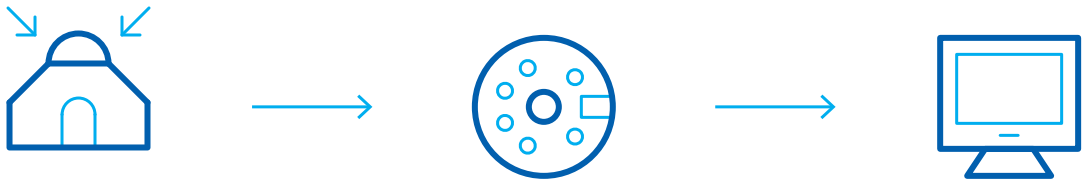
M-BOX

It converts the output voltage of a solar radiation sensor, PT-100 or 10kΩ NTC temperature sensor into a MODBUS 485 RTU output. The “M-Box” can be used with all passive EKO sensors (Irradiance and temperature) or any other sensor with mV output whenever MODBUS 485 RTU signal is required. With MODBUS, up to 100 sensors and converter units can be addressed and connected in parallel.

For practical installation, the converter models are accommodated inside an IP65 aluminium box with universal cable glands. It has robust input/output screw terminals, which can be easily connected to any cable and measurements system at the installation site. With the signal converter the sensor cable can be extended over a long distance without any signal loss or potential electromagnetic interference.

With the optional USB controller and EKO Sense software the converter settings and advanced sensor parameters (Temperature dependency correction / non-linearity correction) can be applied and verified.

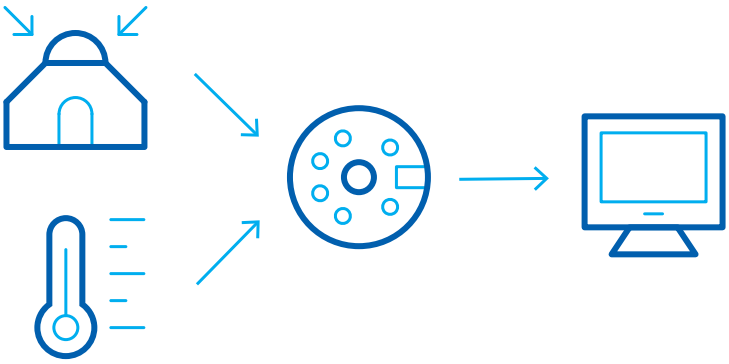
ANALOG TO DIGITAL SENSOR INTERFACE



MC-11 (4-20MA)

MC-20 (MODBUS 485 RTU)

4-20mA (MC-11)

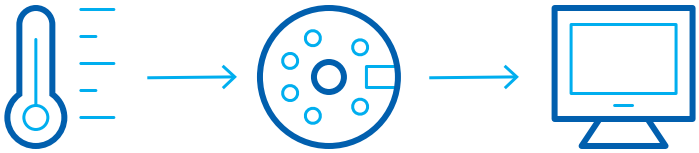


2 Inputs
— mV (sensor)
— Ω (Temperature sensor PT-100 / 10kΩ NTC)

1 Output
— 4-20mA output (4 - 20 mA / 0 ... 1600 W/m²)

The temperature sensor can be a 10kΩ thermistor (NTC) or a 2 Wire PT-100 which can be used for temperature correction of the mV signal (Sensor).

4-20mA PT-100 (MC-12)

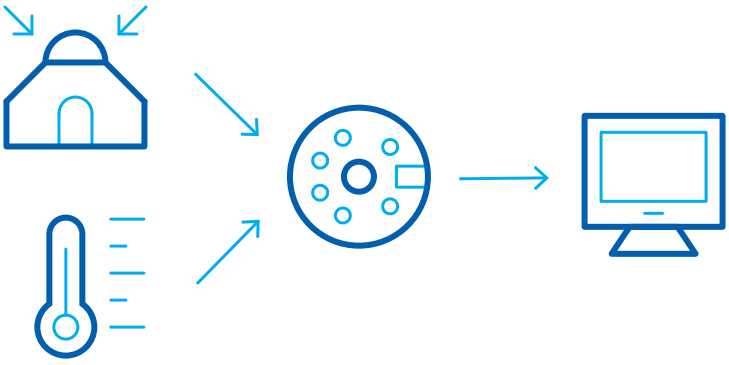


1 Inputs
— Ω (Temperature sensor 2W/3W/4W PT-100)

1 Output
— 4-20mA output (4 - 20 mA / -40°C ... 120°C)

The PT-100 sensor can be connected in a 2 Wire, 3W or 4W mode.

MODBUS® 485 RTU (MC-20)



2 Inputs
— mV (sensor)
— Ω (Temperature sensor PT-100 / 10kΩ NTC)

1 Outputs
— (Irradiance, Sensor parameters, Temperature)

The temperature sensor can be 10kΩ thermistor (NTC) or a 2 Wire PT-100 which can be used for temperature correction of the mV signal (Sensor). The converter can also be operated where the PT-100 sensor can be connected in a 2 Wire, 3W or 4W mode with with temperature as output (°C/F/K).

Specifications

	A-Box	A-Box PT-100	M-Box
Converter model	MC-11	MC-12	MC-20
Input 1 (Irradiance sensor)	0 to 100mV	-	0 to 100mV
Input 2 (Temperature sensor)	2W PT-100 / 10kΩ NTC	2W, 3W, 4W PT-100	10kΩ (Thermistor) / 2W, *3W, *4W PT-100
Output	4 to 20 mA	4 to 20 mA	Digital (Modbus 485 RTU)
Output parameters	0 - 1600 W/m² / 4 to 20 mA	-40°C - 120 °C / 4 to 20 mA	W/m² / Temperature (°C, K, F) / Sensor parameters
Resolution	< 5 µV / < 0.1°C	< 0.1°C	< 5 µV / < 0.1°C
Input Impedance	> 10 MΩ	-	> 10 MΩ
Temperature Response (-20 to 50°C)	< 0.2 %	< 0.2 %	< 0.2 %
Response Time	1 s	1 s	<1 s
Non-Linearity	< 0.1 %	< 0.1 %	< 0.1 %
Operating temprature range	-40°C to 80°C	-40°C to 80°C	-40°C to 80°C
Power Supply	12 - 24 VDC ± 20 %	12 - 24 VDC ± 20 %	12 - 24 VDC ± 20 %
Power Consumption	0.08 to 0.5 W	0.08 to 0.5 W	< 0.3 W
Dimension (converter)	ø45 × 23 mm	ø45 × 23 mm	ø45 × 27.1 mm
Weight (converter + box)	0.24 kg	0.24 kg	0.30 kg
Ingress Protection	IP 65	IP 65	IP 65
****Aluminium box dimensions**	64 x 98 x 36 mm Cable gland M12 (Cable ø 3-6 mm)	64 x 98 x 36 mm Cable gland M12 (Cable ø 3-6 mm)	80 x 125 x 57 mm Cable gland M12 (Cable ø 3-6 mm)

* Combined input terminals 1 and 2.
** Box dimensions are indicative which depend on the application
Specifications are subject to change without further notice

Multi Weather Sensor

PA-01
Combining meteorological requirements & industrial applications

The EKO multi weather sensor is an all-in-one compact instrument measuring solar irradiance and ambient temperature. Designed for **easy setup** in automated weather and PV monitoring systems. Pole mounting bracket for fast installation and 4-20mA digital interface.

Situated on top of the PA-01 the tiltable MS-602 ISO Second Class Solar irradiance sensor is most suitable for PV applications. The aspirated ambient temperature sensor with solar shield provides maximum airflow around the sensor, protection from sunlight and precipitation.

Features
— Tiltable Second class pyranometer
— Ventilated for accurate temperature measurements
— Solar sensor with ISO 17025 accredited calibration
— 4-20 mA output for solar radiation and temperature

Specifications

	PA-01
Solar sensor	
ISO 9060 classification	Second class
Model	MS-602
Output	4-20 mA
Temperature sensor	
Measurement element	Pt100Ω 4-wires (Class A)
Output	4-20 mA
Integrated fan	DC fan
Operating temperature	-40 to +80°C
Power supply	9 to 36 VDC / 15W

Standard cable length 10 m
(Optional lengths 20 m, 30 m, 50 m)
Specifications are subject to change without further notice

ISO.17025
Calibration

Small Sensors

ML-01
Great performance

The ML-01 is an industrial grade solar sensor for quantative radiation measurements control in the fields of photovoltaics, horticulture, agriculture and industry. Due to its compact dimensions, this sensor can be **easily integrated into any application**.

The ML-01 Si-photodiode sensor with cone-shaped diffusor has a proper cosine response to the incoming radiation at low solar elevation angles. The diffusor also minimizes soiling effects, which usually affect the quality of the measurement. For global horizontal measurement applications the sensor can be mounted in horizontal position thanks to the standard removable mounting plate with spirit level and leveling feet.

Features
— Si-photodiode pyranometer
— Optimal cosine characteristics
— Fast analog response time
— ISO 17025 accredited calibration
— Optional 4-20mA or MODBUS 485 RTU interface

Specifications

	ML-01
Detector	Photodiode
Wavelength range	400 to 1100 nm
Irradiance range	0 to 2000 W/m²
Nominal sensitivity (µV/W/m²)	50
Response time	<1 ms
Operating temperature	-30 to 70°C
Temperature dependency (-10 to 40°C)	<0.15 %/°C
Directional response (at 1000W/m² | 0 to 80°)	<+/-5 %
Non-stability (change/yr)	< 2 %

Standard cable length 5 m
(Optional lengths 10 m, 30 m, 60 m)
Specifications are subject to change without further notice

ISO.17025
Calibration

ML-020
Great performance

The ML-020 small sensors are used as **multi-purpose, cost-effective photonic sensors** in the fields of horticulture, agriculture, building automation and industry. Three different sensor models with specific spectral response characteristics are available.

ML-020 small sensors accurately match the spectral sensitivity of the human eye (Lux sensor) or the action spectrum of plant leaves (PAR sensor). ML-020S is available as an indoor (S-I) and an outdoor version (S-O) with greater dynamic range.

All ML-020 sensors have an optical-quality glass dome, minimizing soiling of the diffusor and optimizing the cosine response. Their excellent temperature stability and compact design make them suitable for any application.

Features
- Specific spectral response
- Low temperature dependency
- Fast response time
- Small and light weight
- Optimized cosine response and glass dome
- IP65 weather proof

Specifications

	ML-020S-O	ML-020S-I	ML-020P
	Outdoor Lux sensor	Indoor Lux sensor	PAR sensor
Detector	Photodiode	Photodiode	Photodiode
Spectral response	CIE Photopic Curve	CIE Photopic Curve	Photosynthetically Photon Flux Density
Measuring range	0 to 150.000 lx	0 to 30.000 lx	0 to 3000 µmol•s-1•m-2
Output	0 to 30 mV	0 to 30 mV	0 to 10 mV
Nominal impedance	280 Ω	1300 Ω	160 Ω
Temperature dependency (-10 to 50°C)	0.4 %	0.4 %	1.1 %

Standard cable length 5 m (Optional lengths 10 m, 30 m, 50 m)
Specifications are subject to change without further notice


sensor
Made in Japan

Pyrheliometers

MS-56, MS-57
The world's fastest response time

The EKO pyrheliometers, also called DNI sensors, provide highly accurate DNI measurement data for meteorological and Solar energy research. It can be used as a reference sensor for routine DNI Solar irradiance measurements in combination with pyranometers on an automated Sun Tracker.

MS-56
The broadband detector of the MS-56 combines a unique fast analog response time (<1s 95 %), a high sensitivity and an excellent thermal stability. The detector is temperature-compensated for reliable operation under all climate and temperature conditions. The integrated low power window heater prevents any dew deposition or frost on the quartz window.

Features
- Less than one second response time
- Accurate temperature compensation
- Low power 12V / 0.5W window heater
- ISO 17025/9059
- Optional 4-20mA or MODBUS 485 RTU interface

MS-57
First class remains first class even when the MS-57 shows the best performance characteristics. Beyond accuracy was EKO motivation to push the design limits to improve the sensor and lower the expanded measurement uncertainty.

Features
- Less than 200 ms response time
- Full linear response
- Accurate temperature compensation
- Outdoor calibration ISO 17025/9059

Specifications

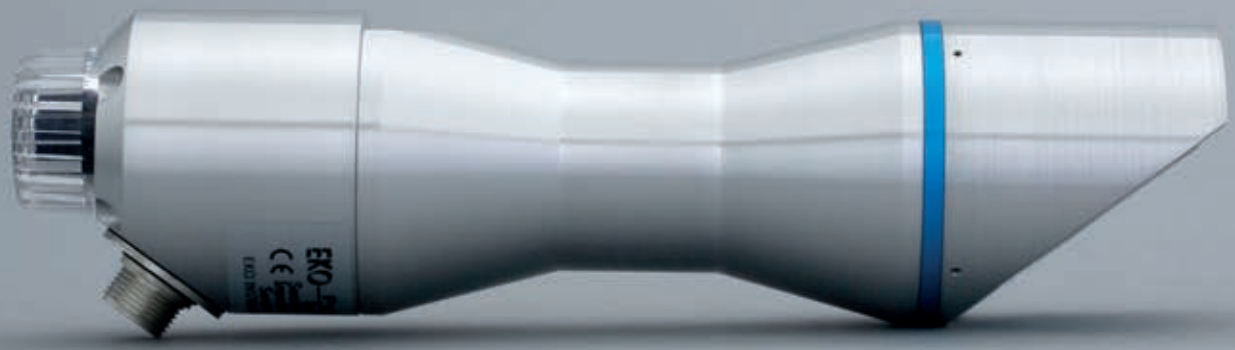
	MS-56	MS-57
ISO 9060 classification	First class	First class
Detector	Thermopile	Thermopile
Wavelength range	200 to 4000 nm	200 to 4000 nm
Response time 95 %	< 1 s	< 0,2 s
Zero offset A Thermal radiation (200W/m²)	0 W/m²	0 W/m²
Zero offset B Temperature change (5K/hr)	+/- < 1 W/m²	+/- < 1 W/m²
Non-stability (change/yr)	< 0.5 %	< 0.5 %
Non-linearity (100 - 1000W/m²)	< 0.5 %	< 0.2 %
Directional response	N/A	N/A
Spectral selectivity (0.35 to 1.5µm)	< 1 %	< 1 %
Temp. response (-20°C to 50°C)	< 0.5 %	< 0.5 %
Tilt response (0-90° | 1000W/m²)	< 0.2 %	< 0.2 %
Irradiance range (W/m²)	0 to 2000	0 to 4000
Nominal Sensitivity (µV/W/m²)	10	7
Nominal Impedance	< 5 kΩ	< 15 kΩ
Operating temperature	- 40 to 80°C	- 40 to 80°C
Ingress Protection	IP 67	IP 67

Standard cable length 10 m (Optional lengths 20 m, 30 m)
Specifications are subject to change without further notice

STANDARD 5 YEARS WARRANTY

ISO.17025 Calibration

ISO.9060 Compliant



Sun Tracking Systems

STR
Precise tracking for accurate solar measurements

The compact STR sun trackers are perfectly suited to support all kinds of measurement sensors for measuring global, diffuse and direct solar radiation.

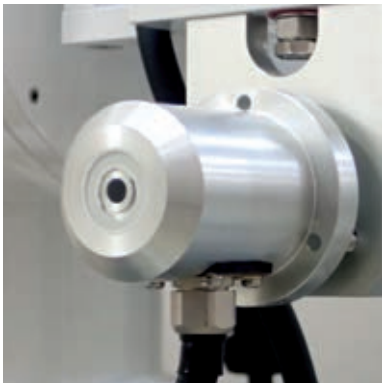
Two independent tracking modes
Accurate tracking of the solar beam in close loop mode through mathematical positioning and sun-sensor feedback.

Positioning function
While the STR sun trackers work autonomously, they can also be fully controlled through an open command protocol. This allows to point the dual-axis tracker arm at any angle by using a PC or programmable data logger.

Easy Set-Up
Thanks to the embedded GPS receiver, the tracker position and time information is updated automatically. With the standard sun sensor, set-up will be easy as the STR sun tracker will automatically compensate for any misalignment (+/- 15° acceptance angle).

Durable compact drive
High precision, maintenance free, maximum torque, small size and durability are the most valuable assets offered by the HarmonicDrive® used inside the STR Sun trackers. Due to their high working efficiency, the motors are relatively small and use little power (< 10W).

Sun position sensor



SOLAR MEASUREMENT CONFIGURATIONS
DIRECT NORMAL INCIDENCE (DNI)

A compact measurement system based on STR-21G Sun tracker and ISO 9060 First class pyrheliometer MS-56.

SOLAR MEASUREMENT CONFIGURATIONS
DNI + DIFFUSE (DHI) + GLOBAL (CALCULATED GHI) RADIATION

STR-22G sun tracker, shading ball MB-12-1 and pyranometer MS-802 measuring diffuse radiation (DHI). MS-56 pyrheliometer simultaneously measures the DNI.

SPECTRAL DIRECT NORMAL INCIDENCE IRRADIANCE
STR-32G + MS-711 + MS-712

STR-32G high torque Sun tracker, MS-711 + MS-712 spectroradiometers with collimating tube provide direct spectral irradiance in the range 300 - 1700 nm.

Specifications

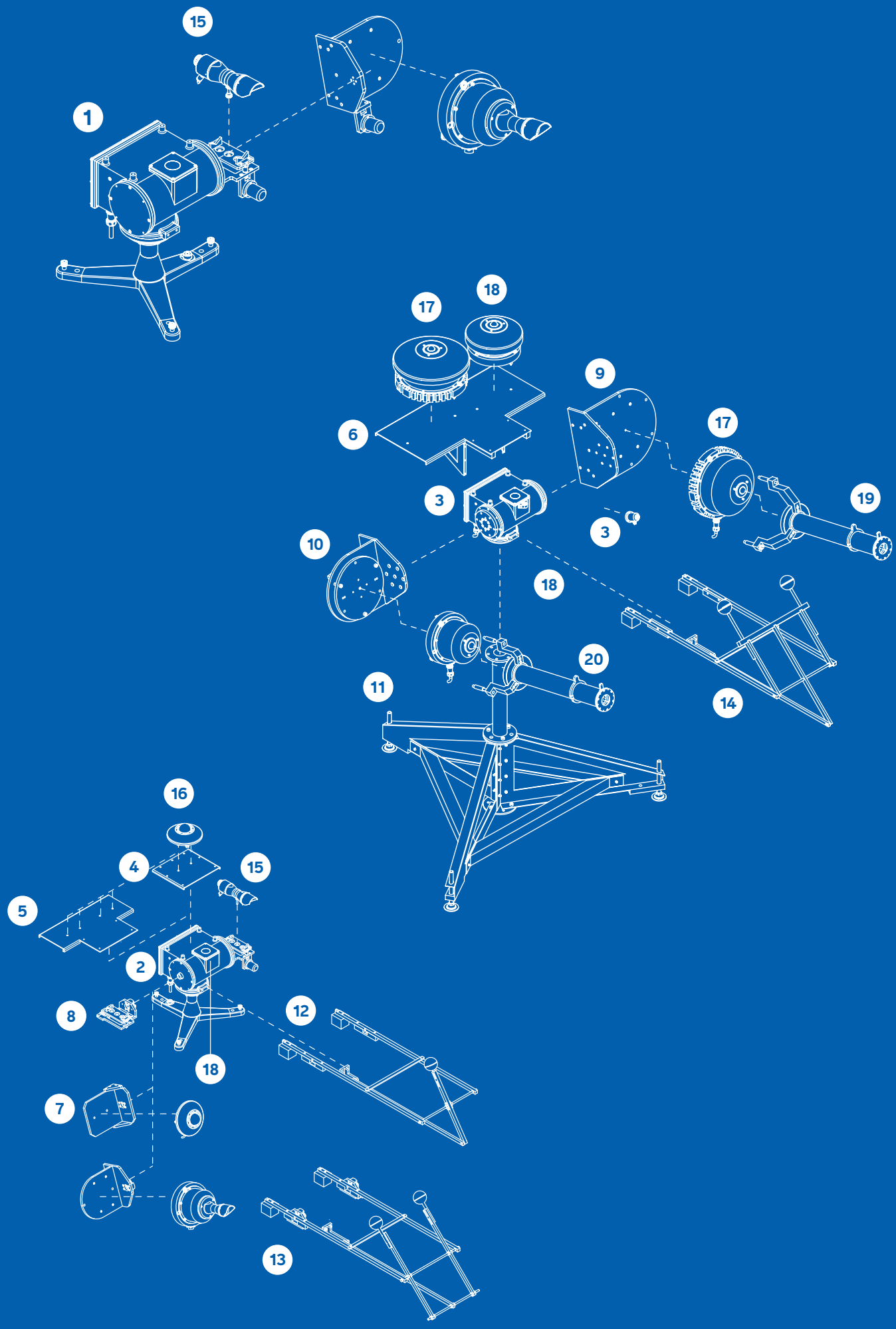
	STR-21G	STR-22G	STR-32G
	Single arm	**Double arm**	**Double arm**
Motor	Stepping motor		
Driving technology	HarmonicDrive®		
Pointing accuracy	< 0.01° (Solar Elevation: 0 to 87°)		
Angle resolution	0.009°	0.009°	0.000375°
Rotation angle	Elevation-angle (-15° to +95°), Azimuth-angle (0° to 360°)		
Torque	12 Nm	24 (12+12) Nm	60 (30 +30) Nm
Payload (balanced)	7 kg	20 kg	60 kg
Tracking mode	Sun-sensor mode and mathematic mode		
Tracking accuracy of Sun-sensor mode	+/- 0.01°		
Sun-sensor field of view	+/- 15°		
Ingress Protection	IP65		
Operating temperature	-40 to 50°C (-30°C at cold start)		
Communication	RS-232C		
Nominal power consumption	< 10W		
Power supply requirements	21 to 32VDC, 20W or AC100 to 240V, 50/60Hz, 25W (external power supply)		
Sun-sensor	Standard		Standard
Tripod	Standard		Optional
Pyrheliometer mount	Standard		Optional

Power Cable length 10 m (Optional lengths 20 m, 30 m) / RS-232 Cable length 3 m (Optional lengths 5 m, 10 m, 15 m)
Specifications are subject to change without further notice

STR. ACCESSORIES
Optional items for the STR Sun-tracker range

Part number ordering codes

Item		Model
1	Sun Tracker (Single Arm)	STR-21G
2	Sun Tracker (Dual Arm)	STR-22G
3	Sun Tracker (High Torque Dual Arm)	STR-32G
4	Top Mounting Plate for one Pyranometer	TMP-S-80/802/402/410/602
5	Top Mounting Plate for two Pyranometers	TMP-D-80/802/402/410/602
6	Top Mounting Plate for WISER (MS-711, MS-712, MS-713)	TMP-WISER
7	Mounting Plate for a Pyranometer (Normal Incidence)	STR-22-SMP
8	Extra Pyrheliometer Mount	STR-22-AD
9	Mounting plate for (MS-712) Spectroradiometer (Primary), (MS-713)	STR-32-P
10	Mounting plate for (MS-711) Spectroradiometer (Secondary), (MS-700N)	STR-32-S
11	Tripod for STR-32G	STR-32-T
12	Shading Ball Assembly (Single Type)	MB-12-1
13	Shading Ball Assembly (Dual Type)	MB-12-2
14	Shading Ball Assembly for WISER (MS-711, MS-712), (MS-713)	MB-13-2
15	Pyrheliometer	MS-56, MS-57
16	Pyranometer	MS-80, MS-802, MS-402, MS-410, MS-802F, MS-402F, MV-01
17	Spectroradiometer	MS-712, MS-713
18	Spectroradiometer	MS-700N, MS-711
19	Collimation Tube for MS-712, MS-713	STR-32-CT712, STR-32-CT713
20	Collimation Tube for MS-700N, MS-711	STR-32-CT700N, STR-32-CT711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Spectroradiometers

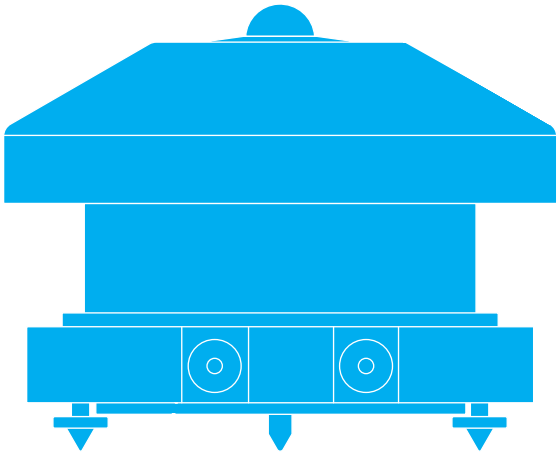
MS-700N, MS-711, MS-712, MS-713

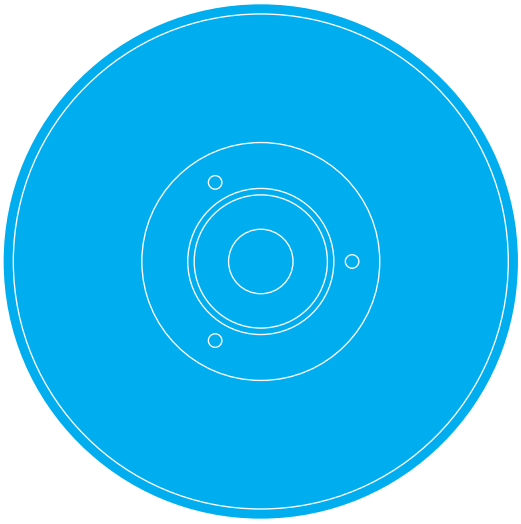
The reference for spectral solar irradiance measurements

EKO offers an impressive range of outdoor spectroradiometers. Temperature-controlled grating technology is applied to measure the solar spectrum with the **highest measurement accuracy** and a long-term stability. The optical design of the diffusor input optics makes the EKO spectroradiome concept superior to any other fiber optic spectroradiometer. A **wide range of accessories** is available to configure a complete system for horizontal, tilted, diffuse and direct spectral solar radiation measurements.

The basis for quality measurements


MS-712
MS-711
MS-713





NEW MS-700N

For over 15 years, EKO spectroradiometers have proven to be a stable, reliable and accurate reference for solar spectral radiation measurements. While preserving the reliable hardware characteristics, PC software and calibration methods have been improved permanently.

The latest generation MS-700N is controlled by an external PC and can be flexible operated through easy to use software. The MS-700N all weather instrument accomodates a temperature controlled spectrometer to be used in a wide temperature range and application.

Features

— Spectral range 350 to 1050 nm
— Excellent long-term stability
— Integrated diffusor and optics
— Low temperature dependency
— High quality calibration NIST traceable

MS-711

The MS-711 is an unique spectroradiometer covering a broad spectral range from 300 nm to 1100 nm (UV / Visible / NIR). The spectrometer unit inside the MS-711 is controlled at a stable temperature to ensure an optimal accuracy and performance in a wide operating temperature range. Excellent cosine characteristics could be obtained through precise optical design of the MS-711 diffusor optics. The spectroradiometer is accurately calibrated and traceable to the international radiation methods.

Features

— Spectral range 300 to 1100 nm
— Excellent long-term stability
— Integrated diffusor and optics
— Outstanding cosine reponse
— Wide operating temperature range
— High quality calibration NIST traceable

WISER: MS-711 / MS-712 SET

A combination of two spectroradiometers MS-711 and MS-712 is used to cover the spectral measurement range from 300 nm up to 1700 nm (UV / VIS and NIR). Each spectroradiometer is PC controlled through software which merges the individual measured spectral data. The MS-711 and MS-712-radiometer set, called “WISER”, can be used as global spectroradiometer as well as for the measurement of the direct spectral solar irradiance using the optional collimating tubes. For direct spectral radiation measurements, EKO provides a special heavy-duty Sun- tracker and collimator tubes.

Features

— Spectral range 300 to 1700 nm
— Excellent long-term stability
— Integrated diffusor and optics
— Global and DNI configuration
— High quality calibration NIST traceable

WISER: MS-711 / MS-713 SET

Made for Solar research activities which require spectral information measured in a very broad spectral range. Such as ground validation of satellite spectral data or future Solar energy research and resource assessment. The MS-713 all weather spectroradiometer in combination with MS-711 extend the range to 2550 nm and measure >98 % of the integrated solar terrestrial spectrum.

Features

- Spectral range 300 to 2550 nm
- Robust all weather design
- Excellent long term stability
- Temperature controlled
- High quality NIST traceable calibration

Specifications

	MS-700N	MS-711	MS-712	MS-713
Detector	CCD	CCD	InGaAs	InGaAs
Wavelength range	350 - 1050 nm	300 to 1100 nm	900 - 1700 nm	900 - 2550 nm
Spectral resolution	< 10 nm	< 7 nm	< 7 nm	< 20 nm
Wavelength accuracy	+/- 0.3 nm	+/- 0.2 nm	+/- 0.2 nm	+/- 2 nm
Temperature dependency	< 2 %	< 2 %	+/- 5 %	< 2 %
Directional response (0-80°)	< 7 %	< 5 %	< 7 %	< 3 %
Temperature control	25°C	25°C	-5°C	-20°C
Exposure time	10 ms to 5 s			1 to 40 ms
Dome material	Quartz	Quartz	BK7	Quartz
Power consumption	50W	50W	65W	95W
Power supply (External)	100-240VAC, 50/60 Hz			
Operating temperature	-10 to 50°C	-10 to 50°C	-10 to 40°C	-30 to 50°C
Communication to PC	RS-422 / RS-232			
Software	Advanced control and analysis software (Windows PC)			

Standard cable length 10 m (Optional lengths 20 m, 30 m) / RS-232 Cable length 3 m (Optional lengths 5 m, 10 m, 15 m)
Specifications are subject to change without further notice

Sensor

MS-093
Reliable Sunshine duration data

The MS-093 is a high-quality sunshine duration meter. **A unique measurement concept** with rotating mirror and the broadband sensor truly measures the broad-band direct solar radiation.

The sensor uses a rotating mirror, which reflects once per revolution the direct beam onto a pyro-electric detector. By using this method the MS-093 can measure true direct broad-band radiation.
The MS-093 is unique in its kind and different from other dedicated sunshine duration sensors, which are based on an indirect measurement principle using photodiodes with a limited spectral range and accuracy.

Features
- Very precise under all measurement conditions
- Measurement uncertainty <10 minutes per day
- Pyro-electric detector (300 nm - 2500 nm)
- Economic solution to precisely measure sunshine hours
- Measures sunshine hours >120 W/m²

Specifications

	MS-093
Detector	Pyro-electric
Wavelength range	300 - 2500 nm
Output	100 pulses/h
Threshold value	120 W/m²
Operating temperature	-20 to 40°C
Power requirements	12 VDC / 5W
Mounting stand	Standard
Power supply	Optional

Standard cable length 10 m (Optional lengths 20 m, 30 m)
Specifications are subject to change without further notice

Solar Monitoring Station

SMS

Customized unique systems based on your demands and our expertise

EKO's Solar Monitoring Station (SMS) is the primary reference to collect high quality solar irradiance data on-site. This **innovative turn-key system** provides all fundamental Solar radiation and meteorological parameters for PV site evaluation, performance monitoring and cell optimizing. The SMS can be freely configured to meet all specific demands.

Our SMS system is:

Easy to use
Factory tested, no configuration or commissioning needed

High quality
Top class Solar sensors and accurate sun-tracker

Turn-key
Pre-configured and pre-programmed for easy installation

Autonomous
GPS-driven sun-tracking and solar power supply

Multi-purpose
Ideal for energy resource assessment and prediction

Tailor made
Also supports many types of third-party instruments

1 **Meteo Sensor.**
Temperature, Humidity, Wind, Precipitation

2 **GHI/DHI Pyranometer.**
Global/Diffuse Horizontal Irradiance

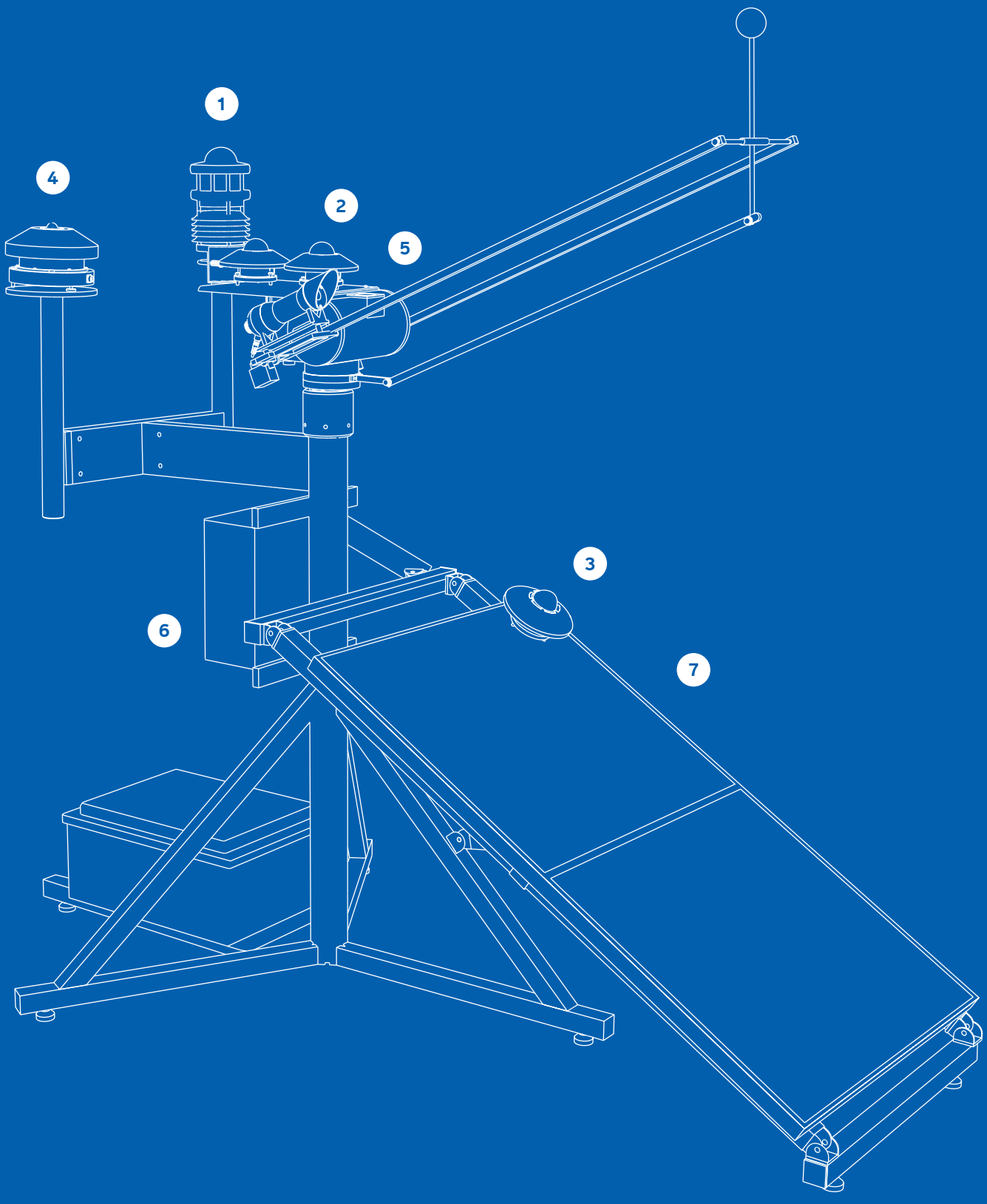
3 **POA Pyranometer.**
Plane Of Array

4 **Spectroradiometer.**
Solar Spectral Characteristics

5 **DNI Sensor - Pyrheliometer.**
Direct Normal Irradiance

6 **DAQ system.**
Data Logger and Communication

7 **Solar Power Supply.**
Modules and batteries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There are many more EKO Instruments:

Photovoltaic evaluation systems
Solar resource forecasting
I-V tracers and PV test instruments
Meteorological sensors and devices
Heat flux sensors

Please contact us for more information

Products shown in the catalogue are subject to technical alterations, inaccuracies, printing mistakes and availability. This collection of products represents the international range from EKO and some products may not be available in some countries.

EKO apologises for any inconvenience this may cause.

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