OTT HydroMet

KIPP & ZONEN

an OTT HydroMet brand

RaZON+

ALL-IN-ONE Solar Monitoring System

DNI measurement with impressive accuracy

ALL-IN-ONE system including a pyrheliometer, pyranometer and data logger

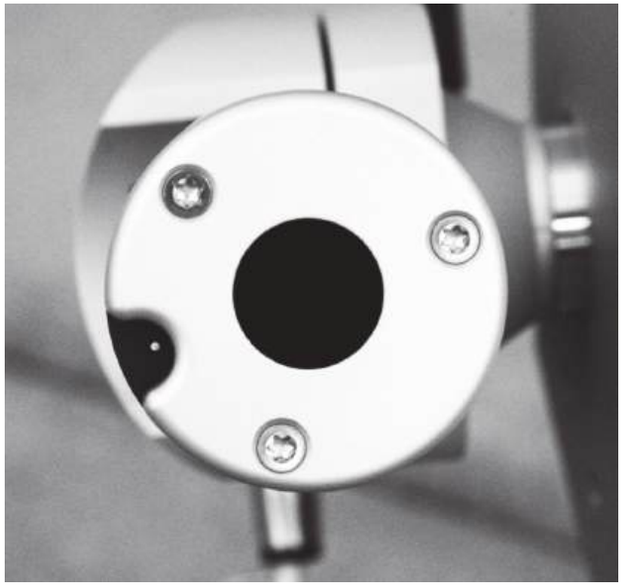
Designed for remote locations and resistant to soiling

User-friendly from installation to operation, to maintenance

There are several ways to acquire solar radiation data. The most accurate, of course, is to measure it with high quality instrumentation. Global horizontal irradiance (GHI) and diffuse horizontal irradiance (DHI) are measured with pyranometers. Measuring direct normal irradiance (DNI) requires a pyrheliometer to be accurately pointed at the sun throughout the day. An automatic sun tracking device is used that also shades the DHI pyranometer from the direct sun.

Meteorologists regularly make high quality measurements using pyrheliometers mounted on sun trackers. In mature solar energy markets around the world, especially in Concentrating Solar Power (CSP) and Concentrating Photovoltaic (CPV) systems, direct solar irradiance measurement has become part of the daily operating and monitoring routine.

Performance ratio and efficiency of plants are key inputs for investors, operation and maintenance parties and other stakeholders. They need to know the exact ratio of power generated to the solar energy available on site. Local, accurate and real time solar irradiance measurements are a necessity; not only for daily operation but also to indicate the fundamental value of a plant and to inform decisions for future investments.



This is an innovative ALL-IN-ONE solar monitoring system with integrated pyrheliometer, shaded pyranometer, digital data processing, GPS receiver and data logger. It measures DNI from the sun and DHI from the sky and, knowing the sun position, calculates GHI that matches secondary standard value. From the DNI measurements sunshine duration is calculated much more accurately than any sunshine duration sensor on the market.

Measurements are acquired every second and averaged over one minute. The integrated data logger presents the stored averages as DNI, DHI and GHI irradiance measurements in W/m^2; sunshine duration in hours and energy in kWh/m^2.

RaZON+ outperforms all rotating shadow band and shadow mask systems on the market, none of which actually measure DNI. **RaZON+** provides a complete set of solar radiation data, accurately, affordably and in accordance with ISO 9060:1990.

The pyranometer and pyrheliometer are Smart sensors connected via Modbus® to the **RaZON+** Smart sun tracker. There will be a future update to connect further Smart devices. Ethernet and RS-485 ports provide all the necessary interfaces and data formats for communication with industrial data acquisition and control systems.

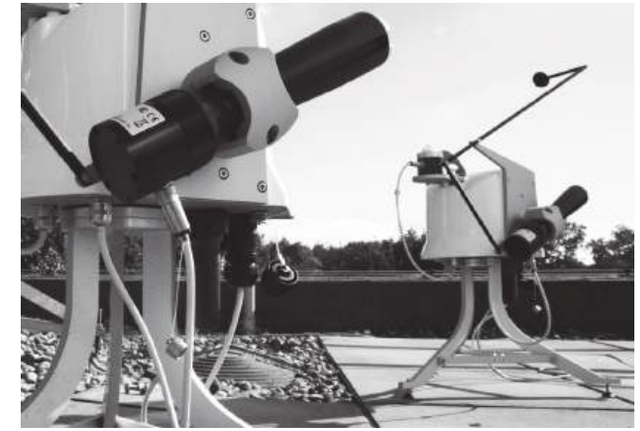
New and innovative sensor technology

- New Smart pyrheliometer with anti-soiling design
- ISO 9060
- New Smart pyranometer with quartz diffuser technology

For the **Razon+** Kipp & Zonen has designed an innovative pyrheliometer that resists soiling and a shaded pyranometer with a quartz diffuser that is optimized for DHI measurements.

These new Smart Sensors have digital signal processing and a temperature correction, have a very fast response time and meet the requirements of ISO 9060 and are integrated parts of the **RaZON+**.

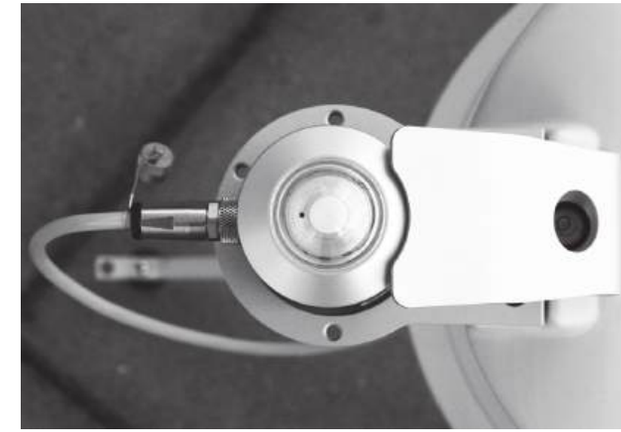
.With built-in data processing and data logging, it makes it a complete turn-key system for solar radiation monitoring. This is the first all-in-one system to measure DNI accurately and affordably.



Extremely low maintenance

- Gear Drive sun tracker with no maintenance
- Integrated remote status check
- New anti-soiling pyrheliometer design
- Long lasting integrated desiccant

One of the important innovations in **RaZON+** is the new pyrheliometer design. The open collimator tube and the quartz diffusor minimize the effect of soiling, so less cleaning is needed. The sensors have long life internal desiccant that does not need to be regularly inspected or changed. Thanks to decades of experience with sun tracking systems, Kipp & Zonen has selected completely maintenance free gear drive components for **RaZON+**, making it reliable and robust.



Complete solar radiation data

Accurate DNI, DHI, calculated GHI (in W/m²) | Sunshine duration | Status info | GPS time, date and location | Sun position, zenith and azimuth

The most accurate way to measure global horizontal irradiance (GHI) is by calculation from direct sun and diffuse sky radiation and the solar zenith angle. The **RaZON⁺** uses this method. The integrated GPS receiver provides precise time and location information to calculate the sun position and time-stamp the logged data.

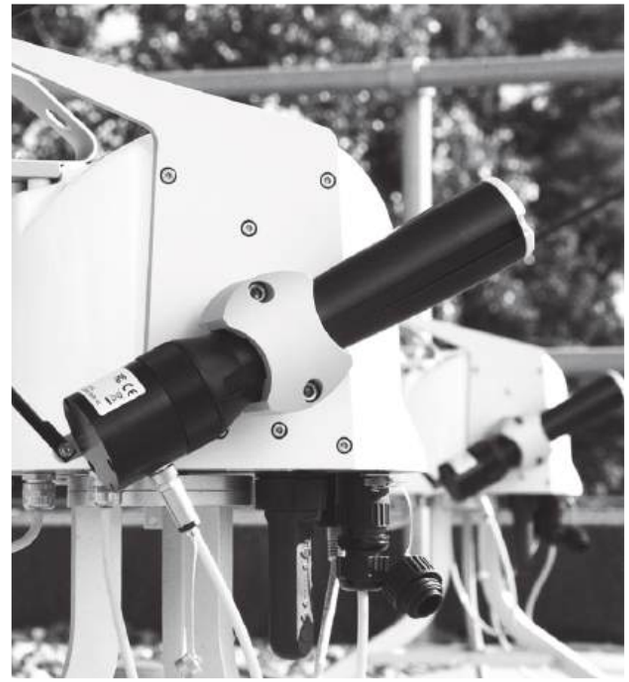
Internal data logging with Web access

Integrated webpage | Ethernet and RS-485 Modbus® connections | Download of logged data

RaZON⁺ is the world's first ALL-IN-ONE solar monitoring system with internal logging of all relevant parameters in one data set. It is equipped with both Ethernet and RS-485 interfaces that have various communication format options. Use either, or both, to download the data. An extra Modbus® input connector is provided for future use with compatible devices. The data set consists of DNI, DHI, GHI, sunshine duration, solar energy, GPS time and location information, sun position, and system status.

PH1 Smart Pyrheliometer

The new PH1 pyrheliometer design is optimized for low maintenance. The open collimation tube minimizes soiling and dew on the quartz diffusor. The housing can easily be opened by a bayonet connection to inspect and clean the diffusor and collimation tube. PH1 has a fast detector, Smart interface with temperature correction and communicates via Modbus® with the sun tracker. Both direct radiation and status information are given every second for averaging and logging.



PR1 Smart Pyranometer

The new PR1 pyranometer incorporates the same fast detector and quartz diffusor technology as the PH1. PR1 is continuously shaded from the direct sun by an arm and disk on the sun tracker. Due to the new detector and quartz diffusor very good linearity and low offsets are achieved. Because the PR1 is designed specifically for the **RaZON⁺** it needs no bubble level or adjustable feet.

Upgrade

RaZON⁺ can be upgraded with other Kipp & Zonen Smart radiometers. SHP1 can be fitted instead of the PH1 pyrheliometer. To replace the PR1 by a SMP6, SMP10, or other higher grade pyranometer, an adapter kit is available. The adapter kit consists of an extension to the shading assembly arm and a pyranometer mounting plate.

Future

RaZON⁺ is designed for the future, new features and accessories are planned. For example, it will be possible to connect additional sensors to RS-485 Modbus® port; such as a plane of array (POA) pyranometer, PV panel temperature or even a compact weather station. New features will include calibration and soiling checks. Updates are implemented by uploading new firmware via the Ethernet connection. Watch the **RaZON⁺** web page for the latest update news.

About PR1 & PH1

The **RaZON+** radiometers consist of the novel design PH1 Smart pyrheliometer to measure DNI, which has inherently low sensitivity to fouling, and the new PR1 Smart pyranometer that has been designed specifically for the shaded measurement of DHI.

These devices communicate by Modbus® RTU protocol to the Smart sun tracker, which aggregates the measurement results for DNI and DHI and calculates GHI and sunshine duration.

The tracker has a gear drive system that requires no maintenance and a GPS receiver enables calculation of the sun position and accurate time synchronisation of the on-board data logger.

About the PH1 Smart Pyrheliometer

The novel PH1 pyrheliometer has an open collimation tube, without front window. This provides the required 5 field of view and 1 slope angle and a series of holes along the lower side allow rain water to exit the tube.

At the rear of the tube is a removable detector unit with a diffuser for the detection or irradiance. This concept is inherently insensitive to soiling mainly for two reasons.

Firstly the amount of soiling particles that reach the diffuser is lower than for the front window of a conventional pyrheliometer. This is because the particles that normally deposit on the window are now distributed over the entire internal area of the collimation tube.

The much larger area ensures that the density of the soiling particles on the actual diffusor is much lower than on the window in a classical pyrheliometer design.

Secondly, if soiling particles reach the diffusor the detector is less likely to be sensitive to them. This is because the detector is already scattering the light in a similar way to the soiling particles and the additional scattering due to soiling has a relatively small effect.

The detector unit is easily removed (without tools) to clean the diffuser

The PH1 Smart Pyrheliometer also has the following specifications which include:

- Response time 0.2 seconds
- No front window, only diffusor directly in front of detector
- Area for soiling deposition: from 3cm² front window enlarged to entire inside tube (270 cm²) a reduction of soiling sensitivity by a factor of 90.

PR1 Smart Pyranometer

PR1 Smart Pyranometer has a novel design made specifically for the shaded measurement of Diffuse radiation. This along with the use of thermopile detectors in combination with diffusors reduces zero offsets to negligible values. Additional specifications include:

- Response time 0.2 seconds (3τ)
- Zero offset A < 0.5 W/m²
- Uses “component sum” to obtain global radiation so directional errors are avoided.

The PR1 pyranometer is a ISO 9060 second class instrument. The PR1 pyranometer only sees the diffuse radiation from the sky and atmosphere, so it is already less sensitive to the effects of soiling on the precision machined and polished glass done than a GHI pyranometer.

The PR1 has a similar detector unit to the PH1 with a diffuser. Also, the PR1 is continuously shaded from the direct sun by an arm and disk on the sun tracker. Again, with the new detector and quartz diffusor very good linearity and low offsets are achieved.

The PR1 was designed specifically for the **RaZON+** and needs no bubble level or adjustable feet. New developments for the **RaZON+** solar monitoring system include the use of a Kipp & Zonen pyranometer to measure plane-of-array (POA) tilted global radiation, a PV panel temperature sensor and an all-in-one automatic weather station. This would provide a complete station for solar energy prospecting.

Solar Monitoring Stations

For monitoring all the components of solar radiation, DNI, DHI and GHI, a solar monitoring station is required. These are often used for solar energy research and as a reference system for larger operating solar power plants.

Typically, this comprises a SOLYS2 or a SOLYS Gear Drive automatic sun tracker with a sun sensor for active tracking and a pyrheliometer for DNI measurement. The shading ball assembly allows for mounting two Class A pyranome-ters on the tracker, one is shaded for DHI and one unshaded for GHI.

A high quality data logger or digital data acquisition system completes the equipment, and usually there is an automatic weather station to monitor meteorological parameters, including wind speed and direction, ambient temperature and humidity and percipitation.

Where soiling is an issue, the pyranometers can be fitted with CVF4 ventilation units and the pyrheliometer with an AirShield DNI.

RaZON+

At a lower cost and with a slightly lower performance is the alternative: the Kipp & Zonen **RaZON+** all-in-one solar monitoring system. The RaZON+ measures DNI and DHI with dedicated designs for soiling resistance for the pyrheliometer and shaded pyranometer.

Using GPS information the solar zenith angle is derived and GHI is calculated. A built-in data logger samples every second and stores the average values every minute, along with the running total of the energy received.

It has an auxiliary serial input so data can be logged frmo compatible Modbus instruments, such as SMP pyranometers for POA, a panel temperature sensor and Lufft UMB series all-in-one weather station.

The **RaZON+** is a solar monitoring system for measuring and logging accurate solar radiation data and solar position information. The main applications are performance monitoring for solar power plants and in providing accurate solar radiation data for meteorological networks. Communication is possible via Modbus® or an ethernet connection.

The **RaZON+** solar monitoring system measures all required components of solar radiation to accurately monitor a solar energy power plant. It provides global and direct radiation, as well as sunshine duration, solar angles, and status information.

The integrated data logger and GPS receiver store accurately and time-stamped one minute logging averages. Multiple interfaces are available to retreive any data from the **RaZON+** to your PC. A tripod or a pole-mount are available accessories.

At Kipp & Zonen, an OTT HydroMet brand, the goal was to develop a cost effective all-in-one solar monitoring system. This system would be comparable to the SPN1 and RSR2, while at the same time offering improved performance.

Recommended Application Use

We would advise using the **RaZON+** as a reliable, accurate, and cost-effective solution for solar energy and meteorological applications.

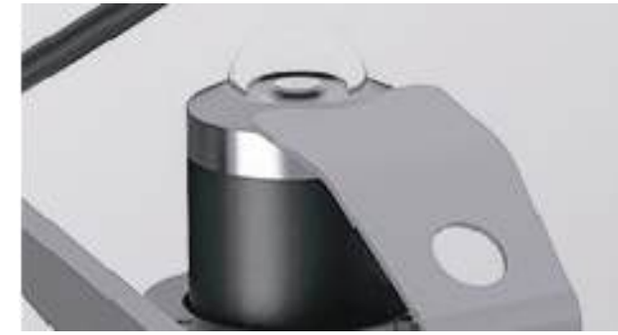
For solar energy, we expect it to be deployed on both prospecting and operational sites, where low maintenance and ease of use are an added and welcomed benefit. During installation there are less cables involved, you have just serial data and 24 VDC power.

For prospecting, the possible absence of a logger infrastructure is no problem for the **RaZON+** as it comes with an on-board data storage that does not need any additional setup.

RaZON+ also gives you all of the three components of solar irradiance which enables you to find the best installation angle for your panels depending upon the typical sky conditions.

For overcast conditions diffuse radiation and horizontally positioned panels are optimal. Whereas, for clear skies, panels normal to the direct sun are more ideal.

For operational sites the option to connect the **RaZON+** directly to the SCADA system, either through Modbus® RS-485 or Ethernet is an attractive feature. An auxiliary Modbus® input enables the connection of compatible plane-of-array pyranometers, PV panel temp. and all-in-one weather stations. There is also the possibility for a more sophisticated interaction between the Smart instruments and the Smart sun tracker in other versions of the system.



We have rounded up some of the most common frequently asked questions related to the **RaZON+** instrument, installation, software, and calibration (or maintenance) .

We hope this helps answer any of your questions as you explore the varying sun tracker options available on the market.

What is included with the RaZON+ ?

It comes with the following:

1. base unit including logger
2. Smart pyranometer (PR1)
3. Pyrheliometer (PH1) plus cables
4. Two year product warranty
5. Five year warranty on the sensors
6. Power connector for 24 VDC

Is the RaZON+ really plug & play?

The **RaZON+** is 100% operational ready. For customers, the only thing they will have to provide is a 24 VDC power supply.

Other than that, the **RaZON+** is completely plug and play.

How easy is the installation?

The **RaZON+** is easy to install. In fact, the **RaZON+** will guide you and the installation procedure can be done via Ethernet on any Smart device.

You only need to mount the system on a pole or its tripod and make sure to level it. The PH1 and PR1 come pre-installed. On a sunny day, point the system to roughly east and start.

If any azimuth adjusting is needed it can be rotated on its tripod collar.

How does the software work?

You can access the software on any device with Ethernet. When accessing the data of the **RaZON+** you can do it in one of four ways:

1. Through Modbus® (pull)
2. Through ASCII string (push)
3. Through Ethernet (database query)

Data logging can be done via the Ethernet or through the RS-485 port.

What are the calibration requirements?

With the **RaZON+** not everything needs calibration.

The only items that require calibration, and this is only every two years, are the sensors. But, a great thing to note is that because the sensors are Smart sensors, you can easily opt to exchange them with another sensor.

By doing this, you can prevent data gaps while you recalibrate the main sensors on the **RaZON+.**

What is the Payload of RaZON+ ?

The payload is as follows:

- Only one pyrheliometer, the new pyrheliometer PH1 or you can use the SHP1
- Only one pyranometer, the new pyranometer PR1 or you can use any SMP

When it comes to the **RaZON+** this is the main payload.

Will soiling be an issue?

The **RaZON+** is more resistant to soiling than traditional systems.

What makes the **RaZON+** more resistant to soiling is mainly because of the way the PH1 pyrheliometer is designed. The PH1 and the PR1 pyranometer are Smart instrruments with a fast response that can follow rapidly changing levels of irradiance.

The unique design of the PH1 pyrheliometer has no front window for the colimation tube and a diffuser in frront of the thermopile radiation sensor. This reduces sensitivity to soiling and has been demonstrated in testing.

In addition, the detector assembly is easily removed from the colimation tube without tools, for cleaning the diffuser.

In regards to the PR1, since it is shaded and does not see the direct beam from the sun, and measures diffuse light frrom all directions, it is less susceptible to soiling particles that would block part of the light through the dome.

However, there is also the option to go for even higher performance

with the **RaZON+** by opting to use a SHP1 first class pyrheliometer instead of the PH1 pyrheliometer and then by opting to use an SMP12 secondary standard pyranometer (with adapter kit).

What is Being Measured?

The **RaZON+** in an all-in-one solar monitoring station that was developed and engineered by a dedicated team at Kipp & Zonen, an OTT HydroMet brand.

The system provides the three components of solar radiation:

1. direct
2. diffuse
3. global

Direct and diffuse are measures and the global solar radiation is calculated using the time and location from the GPS.

Are There Recommended Accessories?

For the**RaZON+** the additional accessories that the team advises include the following Kipp & Zonen items:

- The PMU485 Smart Setup Hub
- Smart Powered Hub and Smart Hub

The PMU485 is a power source and data connection between a Smart Kipp & Zonen device and a PC.

The Smart Hub is a passive 6 to 1 weatherproof hub for 2-wire RS-485 connections. The Smart Powered Hub adds a heavy duty 2.2A power supply.

How Does the Tracker Work?

The Smart electronics in the **RaZON+** sun tracker act as a data hub for the pyrheliometer and pyranometer and the additional Modbus® enabled external sensors and as a data processing and storage system.

The microprocessor uses data from the on-board GPS receiver to calculate the sun position (which is also available as a data output) and this also calculates GHI from DHI and DNI values.

Using the World Meteorological Organization (WMO) defined sunny/not sunny threshold of 120 w/m^2 of direct solar radiation, the **RaZON+** accurately calculates sunshine duration from DNI.

What Other Sun Trackers are Available?

Aside frrom the **RaZON+** Kipp & Zonen also offers the SOLYS2 and the SOLYS Gear Drive. Below we will outline the main features from the SOLYS2 and the SOLYS Gear Drive.

SOLYS2

The SOLYS2 is a versatile sun tracking solution. With the SOLYS2 you have a wide range of options when it comes to radiometers that can be mounted.

Additionally, with the integrated GPS, you can automatically configure location and time. Solar position and status monitoring information is available via the communication ports.

The SOLYS2 is recommended for use in harsher climats and when you want to carry multiple instruments. Applications for the SOLYS2 include meteorology, climatology and BSRN stations. It is recommended for use in olar energy site prospecting and plant monitoring as well.

SOLYS Gear Drive

The SOLYS Gear DRive is a high-end sun tracker for all weather conditions and locations. This sun tracker builds on the features of the SOLYS2 and has enhanced capabilities that make it suitable for use with heavy loafs and in the harshest of climates.

For example, the SOLYS Gear Drive can be used in extrerme polar conditions.

The SOLYS Gear Drive was engineered and designed to be useed in extreme climates. You can use the sun tracker in very hot or very cold regions and in places with high wind speeds.

With the SOLYS Gear Drive you can also carry a large number of instruments and also heavy loads. This sun tracker is ideal for many scientific research purposes.

SOLYS2 & SOLYS Gear Drive

Both the SOLYS2 and the SOLYS Gear Drive allow for the fitting of non Kipp & Zonen radiometers. They have a 1 to 2% degrere of daily uncertainty GHI and a 1% degree of daily uncertainty for DNI. Both are Baseline Surface Radiation Network (BSRN) compatible.

Scan the QR code to download this RaZon+ brochure

Specifications RaZON+

Pointing accuracy	0.2°
Payload	Sufficient for 1 pyranometer and 1 pyrheliometer
Angular velocity	30 °/s
Rotation	110° zenith, 600° azimuth
Protection against over rotation	Physical limit stops
Supply voltage	20 to 30 VDC
Power	13 W
Operating temperature range	-20 °C to +50 °C
Weight	9 kg
Dimensions (WxDxH)	60x60x48 cm
Accuracy of bubble level	< 0.1 °
Ingress Protection (IP) rating	65
CE/FCC compliance	Yes
RoHS	Yes
Transmission	Gear drives
Power connections	DC power
Communication interface	RS-485 Modbus® for external sensor/system RS-485 to host, Modbus® or ASCII Ethernet RJ-45 web based Modbus® TCP Wi-Fi (accessory adapter)
Data logging	1 s sampling, 1 minute average logging
GPS, location and time/date	Standard
Installation	Plug-and-play, Wi-Fi enabled device used
Functional self-test	Standard
Test/diagnostic facility	Standard via Ethernet connection
Sun tracking mode	Standard
PC system requirements	Ethernet connection, web browser
Firmware update possible	Flash memory
Maintenance	No scheduled maintenance required Annual inspection recommended
Restart after power interruption	Automatic

Specifications PR1 Smart Pyranometer

Classification to ISO 9060:1990	Second Class
Response time (95%)	< 0.2 s
Response time (63%)	< 0.1 s
Spectral range (50% points)	310 to 2700 nm
Zero offsets (a) thermal radiation (at 200 W/m²) (b) temperature change (5 K/h)	 1 W/m² 1 W/m²
Non-linearity (100 to 1000 W/m²)	< 0.3 %
Directional response (up to 80 ° with 1000 W/m² beam)	< 20 W/m²
Temperature response	< 1 % (-20 °C to +50 °C)
Field of view	180 °
Measurement range	0 to 1500 W/m²
Operating temperature range	-40 °C to +80 °C
Ingress Protection (IP) rating	67

Specifications PH1 Smart Pyrheliometer

Classification to ISO 9060:1990	Second Class
Response time (95%)	< 0.2 s
Response time (63%)	< 0.1 s
Spectral range (50% points)	310 to 2700 nm
Zero offsets (b) temperature change (5 K/h)	 1 W/m²
Non-linearity (100 to 1000 W/m²)	< 0.3 %
Temperature response	< 1 % (-20 °C to +50 °C)
Field of view	5 ° ±0.2 °
Slope angle	1 ° ±0.2 °
Measurement range	0 to 1500 W/m²
Operating temperature range	-40 °C to +80 °C
Ingress Protection (IP) rating	67

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