OTT HydroMet

KIPP & ZONEN
an OTT HydroMet brand

RaZON+ Solar Monitoring System

Operational Manual

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1 Scope of supply

The following items are included with delivery, depending on the ordered version:

RaZON+ All-IN-ONE Solar Monitoring System

- RaZON+ tracker
- The PR1 pyranometer and PH1 pyrheliometer are pre-mounted
- Shading Assembly (bars and disc plus the required screws)
- DC power plug
- Tools for mounting shading rod and disc

or

RaZON+ Smart Solar Monitoring Base

- RaZON+ tracker
- Shading Assembly (bars and disc plus the required screws)
- DC power plug
- Tools for mounting shading rod and disc
- SMP enabling kit
  - Isolation feet for SMP pyranometer
  - New extension rod for shading arm
  - Larger shading disc

The required cables are not included in the scope of supply.

2 Order numbers and variant code

2.1 Product variants

Variant	Order number
RaZON+ All-IN-ONE Solar Monitoring System	0382900
RaZON+ Smart Solar Monitoring Base	0382910

2.2 Accessories and spare parts

Item	Order number
RaZON+ Tripod	0382420
RaZON+ Pole Mount	0382430
RaZON+ SMP Enabling Kit	0382120
Smart Powered Hub, for up to 6 smart instruments, with integrated AC to 24 V DC power supply	0382440
Smart Hub, for up to 6 smart instruments, for external DC power	0382445
Smart Hub Pole Mount	0382446
Waterproof 8-pin plug only	2523146
10 m cable, pre-wired with waterproof 8-pin plug	0362621
25 m cable, pre-wired with waterproof 8-pin plug	0362623
50 m cable, pre-wired with waterproof 8-pin plug	0362624
100 m cable, pre-wired with waterproof 8-pin plug	0362625

3 About this manual

3.1 Other applicable documents

The following documents contain further information on installation, maintenance and calibration:

– Instruction Manual RaZON+ Solar Monitoring System

3.2 General signs and symbols

The signs and symbols used in the operational manual have the following meaning:

Practical tip

This symbol indicates important and useful information.

Action

✓ Prerequisite that must be met before performing an action.

▸ Step 1

⇨ Intermediate result of an action

▸ Step 2

⇨ Result of a completed action

List

– List item, 1st level

– List item, 2nd level

3.3 Explanation of warnings

To avoid personal injury and material damage, you must observe the safety information and warnings in the operating manual. The warnings use the following danger levels:

WARNING

WARNING

This indicates a potentially hazardous situation. If the hazardous situation is not avoided, it may result in death or serious injuries.

CAUTION

CAUTION

This indicates a potentially hazardous situation. If the hazardous situation is not avoided, it may result in moderately serious or minor injuries.

NOTICE

NOTE

This indicates a situation from which damage may arise. If the situation is not avoided, products may be damaged.

4 General safety instructions

4.1 Intended use

The RaZON+ is a solar monitoring system for measuring and logging accurate solar radiation data and solar position information.

4.2 Potential misuse

Any use of the product that does not comply with the intended use, be this intentional or negligent, is forbidden by the manufacturer.

- Use the product only as described in the operational manual.

4.3 Personnel qualification

The equipment described in this manual must be installed, operated, maintained and repaired by qualified personnel only.

- Obtain training from OTT HydroMet if necessary.

4.4 Operator obligations

The installer is responsible for observing the safety regulations. Unqualified personnel working on the product can cause risks that could lead to serious injury.

- Have all activities carried out by qualified personnel.
- Ensure that everybody who works on or with the product has read and understood the operational manual.
- Ensure that safety information is observed.
- File the operational manual together with the documentation of the entire system and ensure that it is accessible at all times.
- The operational manual is part of the product, forward the operational manual together with the product.

4.5 Personnel obligations

To avoid equipment damage and injury when handling the product, personnel are obliged to the following:

- Read the operational manual carefully before using the product for the first time.
- Pay attention to all safety information and warnings.
- If you do not understand the information and procedure explanations in this manual, stop the action and contact the service provider for assistance.
- Wear the necessary personal protective equipment.

4.6 Correct handling

If the product is not installed, used and maintained correctly, there is a risk of injury. The manufacturer does not accept any liability for personal injury or material damage resulting from incorrect handling.

- Install and operate the product under the technical conditions described in the operational manual.
- Do not change or convert the product in any way.
- Do not perform any repairs yourself.
- Get OTT HydroMet to examine and repair any defects.
- Ensure that the product is correctly disposed of. Do not dispose of it in household waste.

4.7 Certification

4.7.1 Europe, USA and Canada

CE (EU)
The equipment meets the essential requirements of EMC Directive 2014/30/EU.

FCC (US)
FCC Part 15, Class "B" Limits

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:

1. This device may not cause harmful interference.
2. This device must accept any interference received, including interference that may cause undesired operation.

IC (CA)
Canadian Radio Interference-Causing Equipment Regulation, ICES-003, "Class B"

This Class B digital apparatus meets all requirements of the Canadian Interference-Causing Equipment Regulations.

Cet appareil numèrique de la classe A respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada.

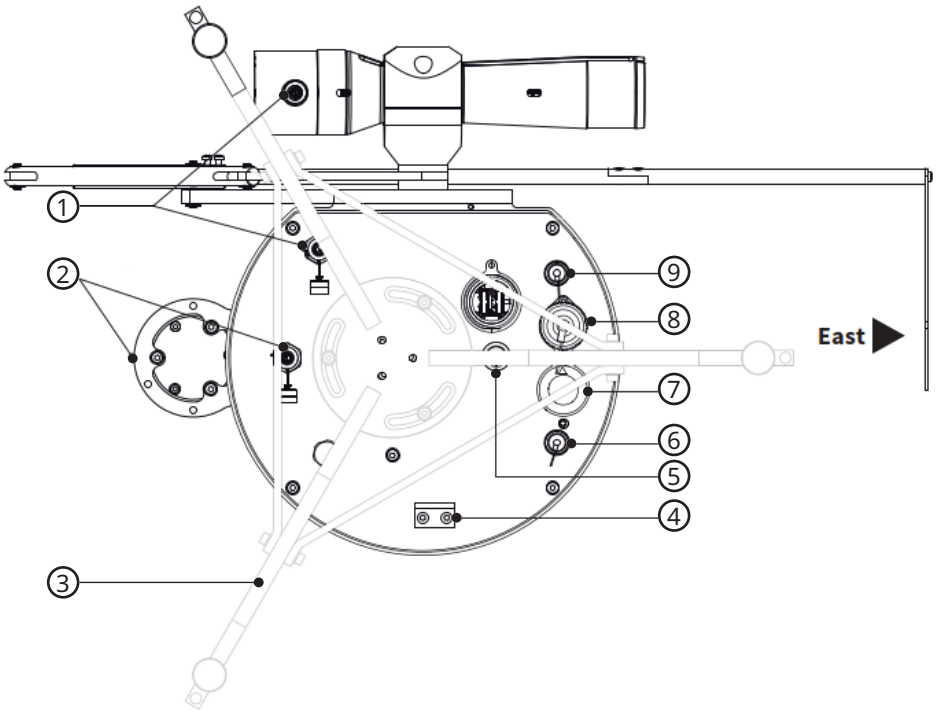
5 Product description

5.1 Design and function

The solar monitoring system measures all required components of the solar radiation to accurately monitor a solar energy power plant and provide solar radiation data for meteorological networks.

RaZON+ is available as ALL-IN-ONE system or monitoring base for use with Kipp & Zonen smart radiometers. Both versions are automatic sun trackers with integrated data logger and GPS receiver that store accurately time stamped 1 minute logging averages. Multiple interfaces are available to retrieve the data from the RaZON+ to the network or PC. To mount the RaZON+ a tripod or pole-mount are available.

5.2 Product overview



RaZON+ with tripod stand, bottom view

1	Pyrheliometer connection	6	RS-232/ RS-485 Aux in
2	Pyranometer connection	7	Ethernet 10/100
3	Tripod stand	8	DC power input 20 to 30 V, 13 W
4	Cable mounting	9	RS-485 to host
5	Reset switch		

6 Transport, storage, and unpacking

6.1 Transport

- Transport the product always in its original packaging.
- Ensure that the product is not mechanically stressed during transport.

6.2 Storage

- Store within specified temperature ranges.
- Store in dry area.
- Store in original box where possible.

6.3 Unpacking

- Carefully remove the product from the packaging.
- Check that the delivery is complete and undamaged.
- If you find any damage or if the delivery is incomplete, then immediately contact your supplier or manufacturer.
- Keep the original packaging for any further transportation.

7 Installation

7.1 Mechanical installation

7.1.1 Required tools and aids

The following tools and aids are required:

For pyrheliometer mounting (PH1 comes pre-mounted):

- Allen key, 5 mm

For pyranometer mounting (PR1 comes pre-mounted):

- Allen key, 3 mm

Shading arm and shading assembly:

- Allen key, 2.5 mm
- wrench, 5.5 mm
- Phillips screwdriver

Tripod:

- Allen key, 3 mm

Pole mount:

- Allen key, 3 mm
- Allen key, 6 mm

- compass

7.1.2 Choosing a site

The instrument should be mounted on a solid, horizontal surface (preferably a concrete, stone or steel platform). The minimal operating area for the complete instrument (including a tripod stand and shading assembly) is 580 x 940 mm (width x height), diameter 720 mm.

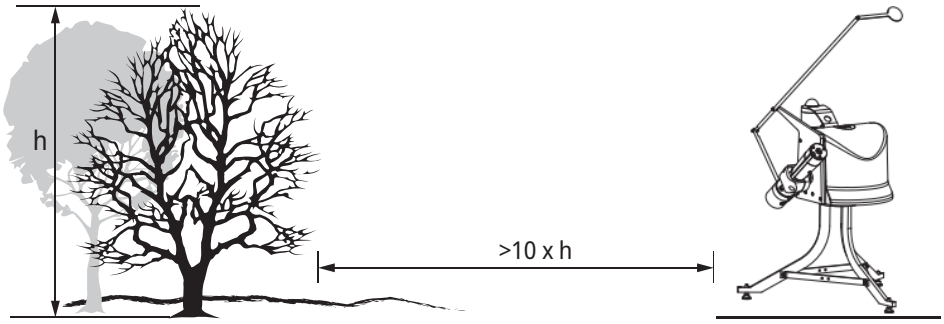
▸ Ensure the following at the site:

- Free access to the equipment for maintenance works
- Reliable power supply for permanent operation
- Material to secure the tripod or pole mount to the floor or pole

7.1.2.1 Installing instrument

When selecting the installation location, ensure there are no obstructions to the field of vision above the instrument's sensor elements. If this is not possible, the location of the instrument must be chosen to ensure that obstacles do not rise by more than 5 degrees above the azimuth range between sunrise after the shortest night and sunset on the longest day.

The 5 degrees correspond to a minimum distance from the instrument to the obstacle of 10 times the height of the obstacle:



Minimum distance from instrument to obstacle

- Choose a shadow free location with 360° free view to the horizon at the height of the instrument.
- Keep a minimum distance from the instrument to an obstacle of 10 times the height of the obstacle, e.g. trees, masts or buildings.
- Install the instrument on top of a concrete or steel platform.
- Either install the instrument on a tripod stand or on a pole mount.

7.1.3 Mounting tripod stand

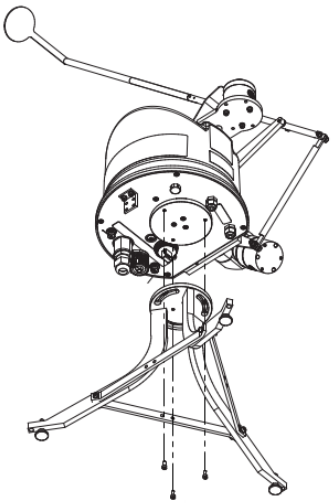
When installing the instrument on a tripod stand, the supplied tripod kit contains bolts and washers.

> Mount the tripod stand, while the RaZON+ is still in its box with the instrument's bottom flange facing up.

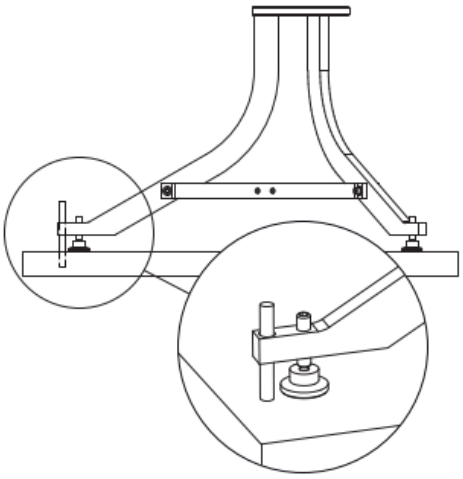
- Mount the tripod stand.

> The instrument should be mounted with the east mark on the bottom flange and one leg of the tripod pointing East ±30°. It is possible to fine adjust the degree, when the instrument is powered on.

- Fit the instrument's bottom flange with the 3 M4 x 10 mm bolts to the tripod stand.
- Make sure the bolts are in the middle of the tripod slots.



- Level the instrument, refer to Leveling [▸ 17].
- Align the M6 adjusting feet.
- Tighten the tripod feet to the base with the 3 bolts only after the Azimuth fine adjustment has been confirmed, see Instrument set-up [▸ 23].



7.1.4 Mounting pole mount

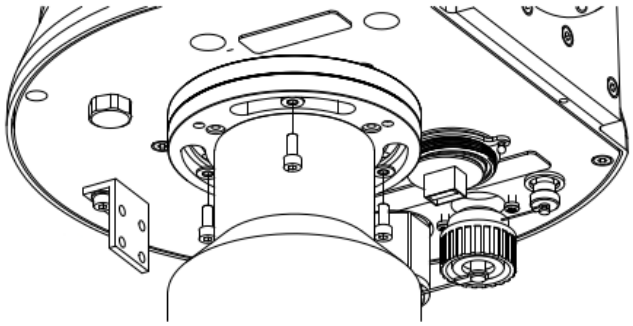
To install the device on a small surface like an extension tube or pole, the pole mount can be used.

> Mount 3 bolts of M4 x 10 mm, while the RaZON+ is still in its box with the instrument's bottom flange facing up.

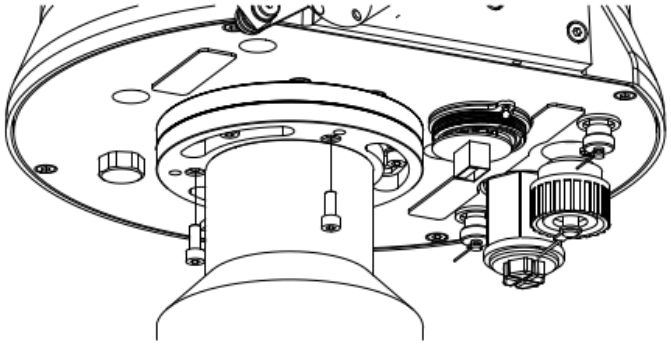
- Mount the pole mount: fit the bottom flange to the pillar with the 4 supplied bolts (M8 x 20 mm).
- Fit the top flange to the pillar with the 6 supplied bolts (M4 x 10 mm) and washers.

> With the help of a compass (f.ex. compass-app on a smartphone), the instrument should be mounted with the east mark on the bottom flange pointing East ±30°. It is possible to fine adjust the degree, when the instrument is powered on.

- Secure the top plate of the pole to the bottom flange of the RaZON+ with the 3 bolts (M4 x 10 mm) loosely.



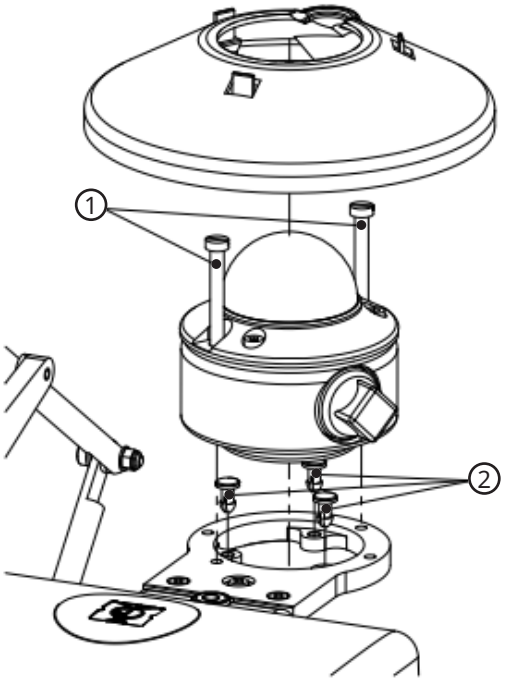
- Add the 3 leveling bolts to the top flange of the pole mount.



- Fasten these leveling bolts connecting the pole mount to the RaZON+, leveling the RaZON+.
- Fasten the 3 bolts connecting the top plate to the bottom flange of the RaZON+ only after the Azimuth fine adjustment has been confirmed, see Instrument set-up [▸ 23].

7.1.5 Mounting pyranometer

The PR1 is pre-mounted with 3 M4 bolts to the pyranometer mounting plate on top of the RaZON+. If any other SMP pyranometer has to be mounted the standard supplied M5 x 80 bolts have to be used.



Mounting a SMP pyranometer

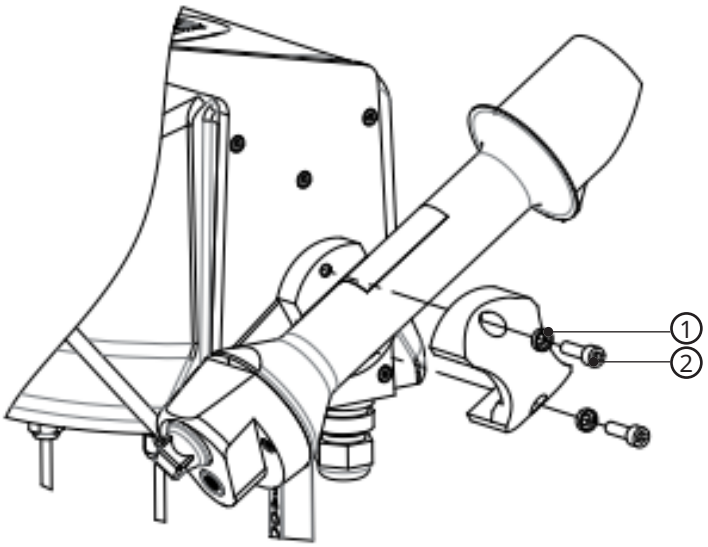
1	M5 bolts	2	Isolation push pins

A SMP pyranometer can be mounted with the SMP enabling kit with the following steps:

- Mount the 3 isolation push-pins.
- Fix the pyranometer with the 2 M5 bolts.

7.1.6 Mounting pyrheliometer

The PH1 is pre-mounted on the outer side of the RaZON+. If a SHP1 has to be mounted 2 x 5 mm bolts and washers have to be used.



Mounting a SHP1 pyrheliometer

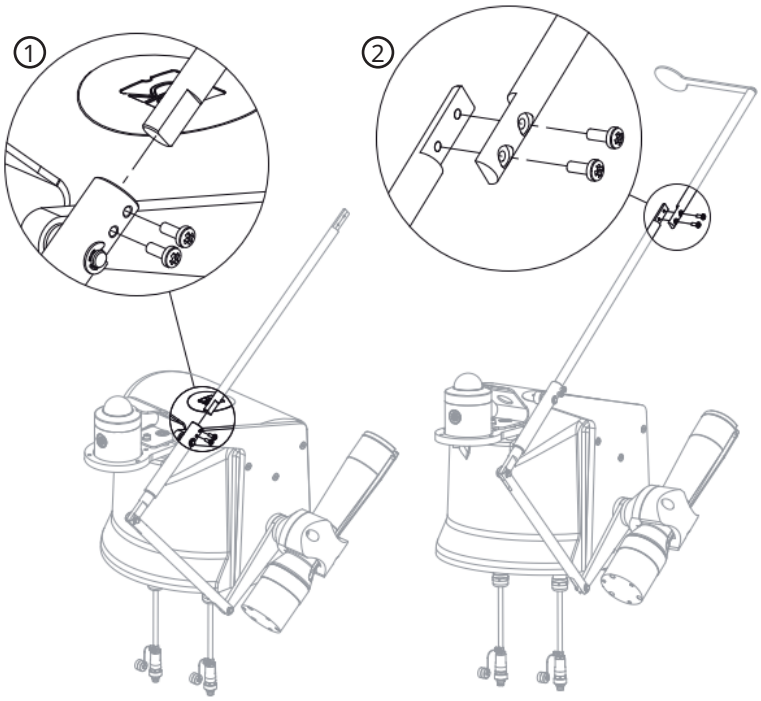
1	5 mm washer	2	5 mm bolt

A SHP1 can be mounted to the RaZON+ with the following steps:

- Mount the SHP1 with the alignment target on top.
- Fix the pyrheliometer with the 2 bolts and washers.

7.1.7 Mounting shading assembly

Depending on the pyranometer, the shading assembly supplied with the RaZON+ consists of a below section and of a short top section with small shading disc or long top section with large shading disc.



Mounting the shading assembly

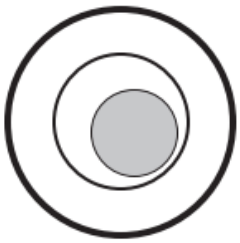
1 Below connection of shading assembly

2 Top connection of shading assembly

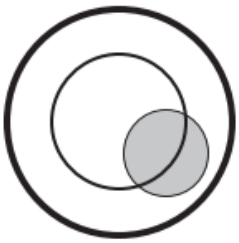
- Mount the below section with 2 screws.
- Mount the top section with the shading disc with 2 screws.

7.1.8 Leveling

Prior to activating the RaZON+, it must be leveled on its mounting surface. Therefore, the RaZON+ is equipped with a high accuracy bubble on top of the housing. The accuracy of the RaZON+ is within 0.1° when the bubble is at least half within the circle:



Position 1: bubble fully within circle: leveling smaller than 0.1 degrees



Position 2: bubble half in circle: leveling within 0.1 degrees

with the tripod stand:

> Rotating the RaZON+ on the tripod is possible before the 3 M8 bolts are placed. The bubble level will move when the tracker is rotated 180°. It is recommended to adjust the leveling feet in such a way that the average bubble position is in the middle.

- Adjust the leveling feet on the tripod stand to move the bubble into the center of the level with a 3.5 mm Allen key.

with the pole mount:

- Adjust the tilting bolts in the pole mount to move the bubble into the center of the level with a 5 mm Allen key.

When a different pyranometer with its own bubble level (f.ex. SMP10) is mounted, it is advised to use the RaZON+'s bubble level and not the level of the pyranometer. Because the pyranometer on the RaZON+ measures only diffuse, the accuracy of leveling has much less effect than for direct measurement.

7.2 Electrical installation

7.2.1 Electrical connections

An optional waterproof AC/DC power supply (50 W) and Modbus® junction box is available to power the instrument and additional sensors.

If the instrument is powered using a DC power supply connected to the mains, it must be properly grounded to protective ground using a wire diameter equal to the mains power supply wiring of the applied DC power supply. This condition will in general be fulfilled if a DC installation cable of 3 x 1.5 m^2 is selected.

If the instrument is powered via an AC/DC power supply an external switch or circuit breaker is required in the AC line with a switching capacity ≥ 1A.

If the RaZON+ is powered using a (24 V) battery the power consumption is 13 W. DC batteries can have very high short circuit currents, therefore adequate fusing ≤ 4A is required.

Internally the RaZON+ power inputs are fused with two 4 A slow blow fuses.

The instrument has a 4-pin plug. The DC power plug is on the bottom of the instrument. This serves to connect the supply voltage and the interfaces via the connection cable.

RaZON+ is supplied with a waterproof plug for 24 V DC. This plug is in accordance with the safety regulations for outdoor usage. The voltage drop over the cable should not cause the supplied voltage to be out of the operating limits (V DC should be between 20 to 30 V DC). The 24 V DC power plug is male (chassis part is female). The DC power plug is suitable for cable diameters between 6 and 12 mm. For 6 to 9 mm and 9 to 12 mm different sealing rings are used. The DC power plug is a male type Hirschmann CA 3 LS plug. The maximal cable resistance should be less than 2 x 0.5 Ω.

Make sure the used cable is flexible enough to withstand the daily movement of the tracker.

Pin assignment in male power plug

Pin	Color	Assignment
1	Red	+24 VDC
2	Black	+24 VDC GND
3	Green/Yellow	Not connected
Earth		Protected Earth

Ground and protected earth are connected.

7.2.2 Connecting DC power supply

The ground connection is raised slightly above the other connections. A connection point on the instrument is created on the side of the bottom plate to start the cable loop that moves down to the tripod or pole mount.

- Insert the cable.
- To check the cable length and flexibility of the RaZON+ and all connected cables is sufficient, rotate the instrument by hand plus and minus 270°.
- Connect the power.
  - ⇨ The instrument finds its reference position and checks the operation of all internal components. This can take up to 5 minutes.

7.2.3 Supply voltage

The supply voltage for the instrument is 20 to 30 V DC. Operation with a supply voltage of 24 V is recommended. The voltage drop over the cable should not cause the supplied voltage to be out of the operating limits. The DC power plug is suitable for cable diameters between 6 and 12 mm. Depending on the diameter, different sealing rings are used.

The power supply should be Cat. III or CAT IV for outdoor use. When used at a height over 2000 m the power supply should be specified for this type of use.

7.2.4 Ethernet interface

The instrument has an Ethernet interface for communication. A RJ-45 plug can be fitted to the Ethernet interface. The cable and RJ-45 plug are not included. Ensure to use a cable that is rated for outdoor use and continuous rotation.

- Locate the supplied cable gland for the Ethernet cable.
- Remove the plastic plug from the Ethernet cable entry.
- Remove the RJ-45 release clip and the rubber cover.
- Slide the cable through the cable gland.
- Apply self-fusing tape around the Ethernet cable with 2 turns.
- Insert Ethernet plug into and screw the upper part of the Ethernet cable gland in the housing.
- Push the cable upwards, so the plug remains in place.
- Tighten the nut to make the connection waterproof, keeping the tape in place.

i If the cable has to be removed again, only the nut needs to be unscrewed.

7.2.5 RS-485 Interface

The instrument has an electrically isolated, 4 wire RS-485 interface for configuration, measurement polling and the firmware update. The RS-485 interface has a default baud rate of 19200 (even parity, 8 data bits, 1 stop bit), but other baud rates are supported (adjustable baud rates: 9600, 14400, 28800, 34800, 56000, 576000, 115200).

Pin assignment for RS-485

Number	Color	Signal	Direction	Description	Host connection
1	Red				
2	Blue				
3	Green				
4	Yellow	RD+	input	RS-485 receive data (B)	RS-485 transmit data (Z)
5	Grey	RD-	input	RS-485 receive data (A)	RS-485 transmit data (Y)
6	Brown	SG		RS-485 signal ground	RS-485 signal ground
7	White	TG+	output	RS-485 transmit data (Z)	RS-485 receive data (B)
8	Black	TG-	output	RS-485 transmit data (Y)	RS-485 receive data (A)

The colors apply to the standard yellow 8 wire cable as used for the SMP pyranometers.

To use this port as 2 wire RS-485 proceed as follows:

- Connect the RD+ and TD+ together (as D+).
- Connect the RD- and TD- together (as D-).
- In the web interface: select the 2-wire option in the communication parameters (refer to Adjusting the communication parameters [▶ 23]).
  - ⇨ The local echo is switched off.

7.2.6 Setting-up instrument without smart device or Ethernet

The instrument can be set-up without connection to a smart device, PC or communication as follows:

- ✓ The instrument is in factory default mode.
- ✓ The instrument is leveled.
- ✓ One leg of the tripod or the east mark on the pole mount is pointing East.
- ✓ The east mark on the bottom flange of the instrument is pointing East.
- ✓ Power is connected at least for 5 minutes to have a proper GPS fix.
- ✓ M4 mounting screws are inserted but not tightened.
- ✓ Direct radiation is above 300 W/m^2 to allow alignment.
- To reset the instrument to factory default mode, press the reset button for 10 seconds during power on.
  - ⇨ The RaZON+ starts tracking.

- Rotate the instrument on its mount until the alignment target of the pyrheliometer is aligned with the sun.
  ⇨ The beam of light falls through the first hole and makes a light spot around the second hole.
- Check the leveling and tighten the 3 M4 bolts.
- Fix the mounting to the base, refer to Mounting tripod stand [▶ 13].

7.2.7 Connecting to smart device or PC

Connecting the instrument to Ethernet or a Wi-Fi enabled smart device during set-up, enables additional configuration.

For Ethernet connection:

- Connect the instrument with a standard Ethernet cable to the local LAN.
- Open the browser on the smart device or PC and enter: http://razon<serialnumber>.

⇨ The RaZON+ dashboard will open in the browser.

7.2.8 Cable routing

When all required cables are connected, the cable routing can be created:

- Disconnect the power.
- Combine all outgoing cables together on the cable clamp on the bottom of the instrument.
- Strap the cables with a tie-rap together with the outgoing side facing down.
- Rotate the instrument to its home position (the middle between +270° and -270°).

with the tripod stand:

- Create a loop and tie it down to the middle of the nearest horizontal bar of the tripod. (The length of the loop between the 2 connection points is ~45 cm.

with the pole mount:

- Secure the end of the loop to one of the nearest screws on the bottom of the pole mount.

7.2.9 Connecting pyranometer and pyrheliometer

In order to define the settings for the pyranometer and pyrheliometer, refer to the operating instructions of the SMP manual.

8 Commissioning

8.1 Connecting web interface

When using communication as assistance during set-up, the interface must be connected prior to installation.

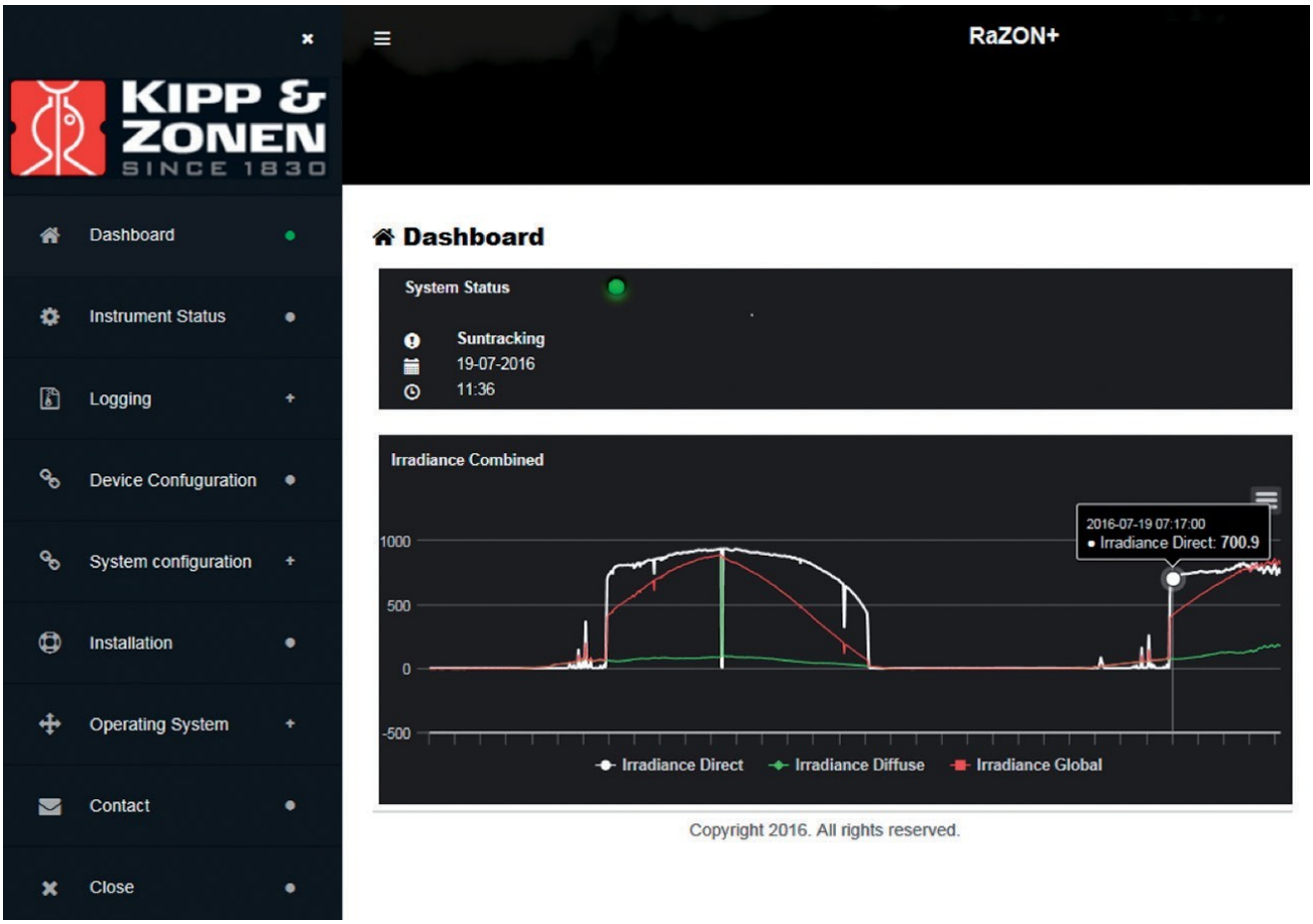
If the equipment is installed and connected without smart device or Ethernet, the following is required at the latest for configuration and testing purposes:

- interface (Ethernet interface or isolated serial interface)
- RaZON+ dashboard

- Open a browser and go to razon.nl.
  - ⇨ The user interface inside the RaZON+ opens with a dashboard overview.

8.2 Dashboard with main menu

The dashboard gives an overview of the system status and the graph shows the 3 recorded solar irradiance components (direct, diffuse and global) over the last day.



- To switch an irradiance graph on or off, click on the type of irradiance below the chart.
- To select an individual value in the chart, click on one point.
  - ⇨ Date, time and value of an individual point are given.
- To zoom-in, click-and-drag the data you want to zoom to.
- When using a touchscreen, pinch-to-zoom the data you want to zoom to.

The main menu gives options as described in the following chapters.

8.2.1 Instrument status

In the menu the **instrument status** shows the status of all different RaZON+ parts, including connected sensors. Prior to operation, all connected instrument states should display *success* in green.

8.2.2 Operating system

In the menu the **operating system** shows a list with system information, hardware and software revisions and serial number.

8.2.3 Configuring external sensors

The device must be configured for the selected type of external sensor to enable the correct evaluation of the measurement data.

- Select **device configuration** in the main menu.
- Click on the **Add Device** button to add an external sensor.

8.2.4 Changing operating mode

With the tracker modes the tracker can be set in a (special) functional mode. The following operating modes can be set:

- Sun tracking mode
  This is the normal operating sun tracking mode for the instrument.
- Demo mode (10 minutes/day)
  With this demo mode a full day rotation or cable movement can be simulated in 10 minutes. When in demo mode, the RaZON+ is not sun tracking.
- Demo mode (5 minutes/day)
  With this demo mode a full day rotation or cable movement can be simulated in 5 minutes. When in demo mode, the RaZON+ is not sun tracking.

- Select **system configuration** in the main menu.
- To change the tracking mode, select **tracker mode**.
- Choose the appropriate mode.

8.2.5 Adjusting the communication parameters

The communication parameters of the RS-485 communication to the data collecting device can be set in the communication settings.

- Select **system configuration** in the main menu.
- Click on the **communication settings** to access the current communication parameters.
- To change a communication parameter, choose the appropriate checkbox.
- Switch the local echo on or off with the 2/4 wire *transmission* checkbox.
- Click on the **save** button to save the settings.

8.3 Instrument set-up

In the main menu, the **installation** menu assists during the set-up of the instrument, performing the required checks. Each check can be confirmed with **Done**. By clicking **Back**, you return to the installation menu. All 5 checkboxes must be checked during mechanical installation in the given order to complete the installation:

Device
The connection and status function of all connected sensors is checked here and must display *success* in green.

GPS
A 3D fix is required for operation. A 3D fix gives full longitude and altitude position. It needs contact with a minimum of 4 satellites. It can take up to 20 minutes after power-on, before a proper fix is available: GPS position and time are used, then the local longitude and latitude are shown.

Raw Azimuth
The raw Azimuth position is found with the east mark (on the tripod or pole mount) pointing East.

Leveling / Cable routing
The instrument is leveled and the cable routing has been created on the bottom of the instrument.

Azimuth Fine
This check assists with final adjustments of the azimuth alignment on the sun. The instrument must be rotated, until the sun falling through the first alignment target hole from the pyrheliometer makes a round spot of light around the second alignment target hole.

- ✓ the power supply is switched on.
- ✓ The instrument is in sun tracking mode.
- ✓ the sun is shining with unobstructed sky (DNI > 300 W/m^2).
- ✓ The instrument is correctly leveled.
- ✓ The east mark on the flange is pointing East.
- ✓ The 3 M4 bolts in the tripod or pole mount are fastened

▸ Rotate the instrument with the buttons **Left** and **Right** to adjust the pyrheliometer.

⇨ After about 10 seconds the instrument reacts to the buttons.

▸ Confirm the Azimuth fine adjustment with the button **Done**.

9 Operation

9.1 Downloading log data

Log data can be downloaded. The maximum interval of the file is two months.

- In the dashboard, select **Logging** in the main menu.
- Select **Export Log File**.
- Select the desired time span.
- Change the file name, if required.
- Use the button **Save as** to save the log data.

Examples of logging files can be found in the Instruction Manual RaZON+.

9.2 Downloading graphs

Graphs can be viewed and downloaded in .png format.

- In the dashboard, select **Logging** in the main menu.
- Select **Chart**.
- Select the desired time span.
- To download a desired graph, click on the icon in the top right hand corner.
- Use the button **Save as** to save the graph.

10 Maintenance

10.1 Maintenance schedule

The frequency of cleaning is dependent upon the local weather and environmental conditions.

To ensure the RaZON+ Solar Monitoring System provides accurate solar radiation measurements, regular maintenance is required. Always ensure proper safety measures are in place during maintenance.

The following maintenance intervals are recommended:

Interval	Activity	Performed by
Monthly	▸ Check all cables and plugs for damage. Ensure proper routing and secure attachment. Replace if needed.	Operator
Monthly	▸ Use the bubble level on the RaZON+ base and the pyranometer to check for proper leveling. Adjust the leveling feet if required.	Operator
Monthly	▸ Inspect the shading assembly to ensure it is properly aligned. Verify that washers and nuts are secure, and that the arm is neither bent nor loose. Adjust as necessary.	Operator

PR1 and PH1

Interval	Activity	Performed by
Monthly	▸ Check that the pyrheliometer is securely mounted and aligned at the correct angle. Adjust the pyrheliometer for direct component if required.	Operator
Monthly	▸ Check that the pyranometer is securely mounted and aligned at the correct angle. Adjust the pyranometer for diffuse radiation if required.	Operator
Monthly	▸ Clean the pyranometer dome with distilled water or alcohol and a soft cloth. ▸ Clean the pyrheliometer by unscrewing the sensor part and clean the diffuser with distilled water or alcohol and a soft cloth. ▸ Check the pyrheliometer tube for dirt and clean if required. ▸ Remount the sensor part and rotate until it blocks. ▸ Ensure that no streaks or deposits are left on the domes.	Operator

Radiometer

Interval	Activity	Performed by
2 years	▸ Have a recalibration of the radiometers on the RaZON+ performed.	OTT HydroMet

Interval	Activity	Performed by
5 years or during recalibration	▸ Replace the desiccant in the pyranometer or pyrheliometer.	OTT HydroMet

10.2 Updating firmware

The firmware can be updated on a Windows PC via the RaZON+ web interface.

- ▸ Connect the RaZON+ with a (straight) Ethernet cable to the LAN.
- ▸ Make sure the RaZON+ receives an IP address from the DHCP server.
- ▸ Browse on the PC to http://razonyynnnn:81, yynnnn being the serial number.
  - ⇨ The *software update* page appears.
- ▸ Select **Upload**.
  - ⇨ Once the upload is completed, the system will reboot (this can take 10 minutes).
  - ⇨ After reboot, the update is installed (this can take up to 5 minutes).
- ▸ Go to http://razonyynnnn and verify that the latest version of the firmware has been activated.

11 Troubleshooting

11.1 Error elimination

If the instrument does not work properly and the problem is not clear, check the following:

- Power is supplied to the unit.
- Instrument status via the Ethernet or Wi-Fi-connection
- GPS reception is possible. The GPS antenna should not be obstructed by instruments or nearby objects. Also GPS testing in a building can block the reception.

If the instrument does not follow the sun properly and the problem is not clear, check the following:

- Check via Ethernet or Wi-Fi-connection. GPS does not have a good fix.
- Check the bubble level, if the bubble is still at least half in the ring.
- Is the alignment target (from the pyrheliometer) correctly pointing at the sun?
- Is the RaZON+ sun tracking and not in demo mode?

If the instrument is not aligned properly, refer to the appropriate installation chapters.

If the instrument should be moved by hand, ensure that the power supply is switched off.

12 Repair

12.1 Customer support

- Have repairs carried out by OTT HydroMet service personnel.
- Only carry out repairs yourself, if you have first consulted OTT HydroMet.
- Contact your local representative: www.otthydromet.com/en/contact-us
- Include the following information:

– instrument model
– instrument serial number
– firmware version (only for devices used with ConfigTool.NET)
– details of the fault or problem
– examples of data files
– readout device or data acquisition system
– interfaces and power supplies
– history of any previous repairs or modifications
– pictures of the installation
– overview of the local environment conditions

OTT HydroMet repair service

13 Notes on disposing of old devices

Member States of the European Union

In accordance with the German Electrical and Electronic Equipment Act (ElektroG; national implementation of EU Directive 2012/19/EU), OTT HydroMet takes back old devices in the Member States of the European Union and disposes of them in the proper manner. The devices that this concerns are labeled with the following symbol:

- For further information on the take-back procedure contact OTT HydroMet:

OTT HydroMet B.V.
Service & Technical Support
Delftechpark 36
2628 XH Delft
The Netherlands
phone: +31 15 2755 210
email: solar-info@otthydromet.com

All other countries

- Dispose of the product in the proper manner following decommissioning.
- Observe the country-specific regulations on disposing of electronic equipment.
- Do NOT dispose of the product in household waste.

14 Technical data

14.1 Optical and electrical data

Specification	Value
Pointing accuracy	0.2°
Payload	Sufficient for 1 pyranometer and 1 pyrheliometer
Angular velocity	30 °/s
Rotation	110° zenith, 540° azimuth
Protection against over rotation	Physical limit stops
Supply voltage	20 to 30 V DC, nominal 24 V DC
Power	13 W
Humidity range	0 to 100 %
Accuracy of bubble level	< 0.1°
Operating and storage temperature range	-20 to +50 °C
Altitude	0 to 5000 m*
Air pressure	45 to 110 kPa
Protection rating	IP65, IEC 60529
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
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

*Above 2000 m a special power supply should be used for the appropriate height.

Specifications of the PR1 Smart Pyranometer

Specification	Value
Classification to ISO 9060:2018	Class C
Response time (63 %)	< 0.1 s

Specification	Value
Response time (95 %)	< 0.2 s
Spectral range (50 % points)	310 to 2700 nm
Zero offsets:	
– Thermal radiation (at 200 W/m^2)	1 W/m^2
– Temperature change (5 K/h)	1 W/m^2
Directional response (up to 80° with 1000 W/m^2 beam)	< 20 W/m^2
Non-linearity (100 to 1000 W/m^2)	< 0.3 %
Temperature response	< 1 % (-20 °C to +50 °C)
Field view	180°
Measurement range	0 to 1500 W/m^2
Operating temperature range	-40 to +80 °C
Protection rating	IP67

Specifications of the PH1 Smart Pyrheliometer

Specification	Value
Classification to ISO 9060:2018	Class C
Response time (63 %)	< 0.1 s
Response time (95 %)	< 0.2 s
Spectral range (50 % points)	310 to 2700 nm
Zero offsets:	
– Temperature change (5 K/h)	1 W/m^2
Temperature response	< 1 % (-20 °C to +50 °C)
Non-linearity (100 to 1000 W/m^2)	< 0.3 %
Field view	5° ±0.2°
Slope angle	1° ±0.2°
Measurement range	0 to 1500 W/m^2
Operating temperature range	-40 to +80 °C
Protection rating	IP67

14.2 Dimensions and weight

Specification	Value
Dimensions (width x depth x height)	60 x 60 x 48 cm
Weight RaZON+	9000 g

OTT HydroMet

Contact Information