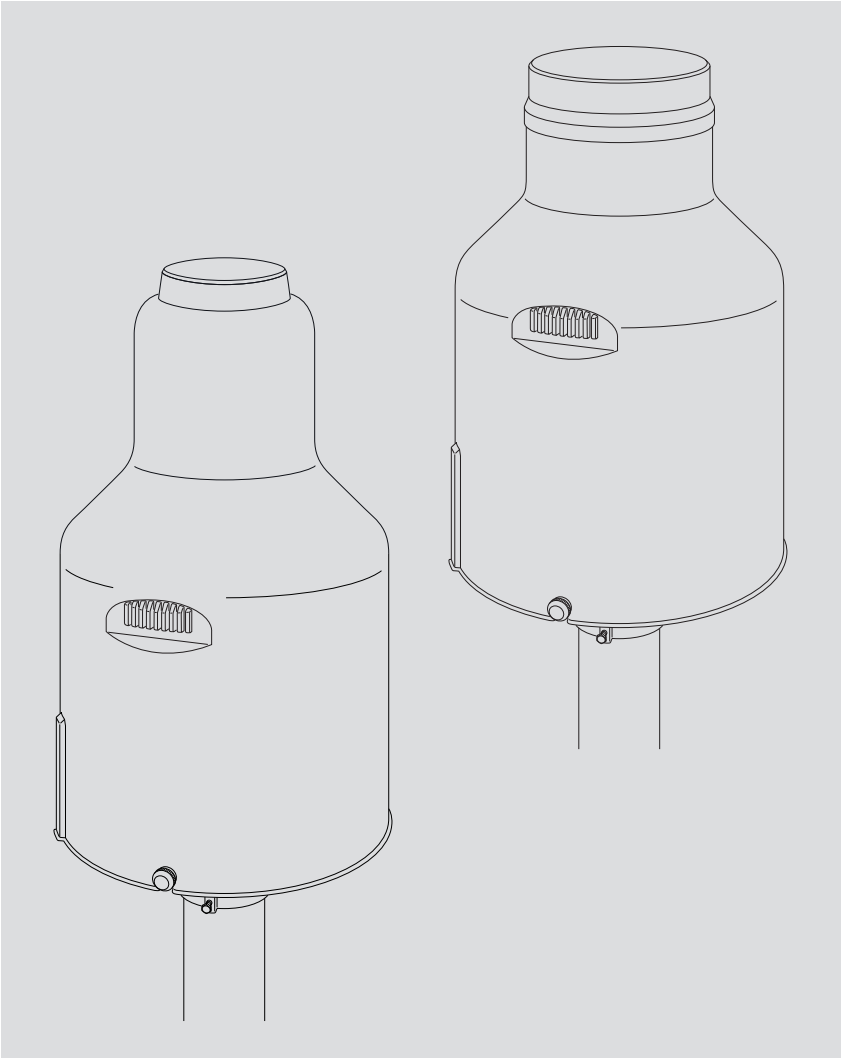
Operating Instructions

OTT Pluvio²
precipitation gauge



English

We reserve the right to make technical changes and improvements without notice.

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1 Scope of supply

OTT Pluvio²

– Precipitation gauge using the balance principle with a recording capacity of 1,500 mm (Version 200) or 750 mm (Version 400) precipitation. Consisting of: base plate with weighing mechanism, bucket support, collecting bucket, and pipe housing. With SDI-12, RS-485, and USB interfaces (for servicing purposes). Additional pulse outputs for amount of precipitation and status infos.
– Set of installation accessories
(6 hexagon bolts M 8 x 40;
1 7-pin screw terminal strip;
1 6-pin screw terminal strip;
3 cable ties 140 x 3.6;
1 open-end spanner, size: 10/13)
– USB connection cable
USB connector type A to USB connector type B, 3 m
– CD-ROM "OTT Pluvio² software" (incl. OTT Pluvio² operating software)
– Operating Instructions
– Factory acceptance test certificate (FAT)

2 Order numbers

OTT Pluvio²

Version 200 70.020.000.9.0
– collecting area: 200 cm²
– recording capacity: 1,500 mm precipitation

Version 200 RH 70.020.001.9.0
– collecting area: 200 cm²
– recording capacity: 1,500 mm precipitation
– with integrated orifice rim heater;
rated power 50 Watt

Version 400 70.020.020.9.0
– collecting area: 400 cm²
– recording capacity: 750 mm precipitation.

Version 400 RH 70.020.021.9.0
– collecting area: 400 cm²
– recording capacity: 750 mm precipitation
– with integrated orifice rim heater;
rated power 100 Watt

For accessories and replacement parts, refer to Appendix I.

3 Introduction

The OTT Pluvio² precipitation gauge is used for automatic determination of the intensity and amount of precipitation.

In contrast to conventional precipitation gauges, the OTT Pluvio² works using the balance principle. The OTT Pluvio² reliably recognizes precipitation, whether liquid or solid, by determining the weight of the collecting bucket. The OTT precipitation gauge is characterized in particular by its low maintenance needs. This is achieved by means of a high-capacity collecting bucket, the lack of a collection funnel as is typical for tipping buckets, and the very robust design of the weighing mechanism.

A high-precision, stainless steel load cell, hermetically sealed against environmental influences that remains stable over a long period, is used as the sensor element. An integrated temperature sensor compensates for the temperature changes in the weighing mechanism. The mechanical overload protection prevents damage to the load cell from forces in a vertical direction higher than permitted, e.g. during transport or when emptying the collecting bucket.

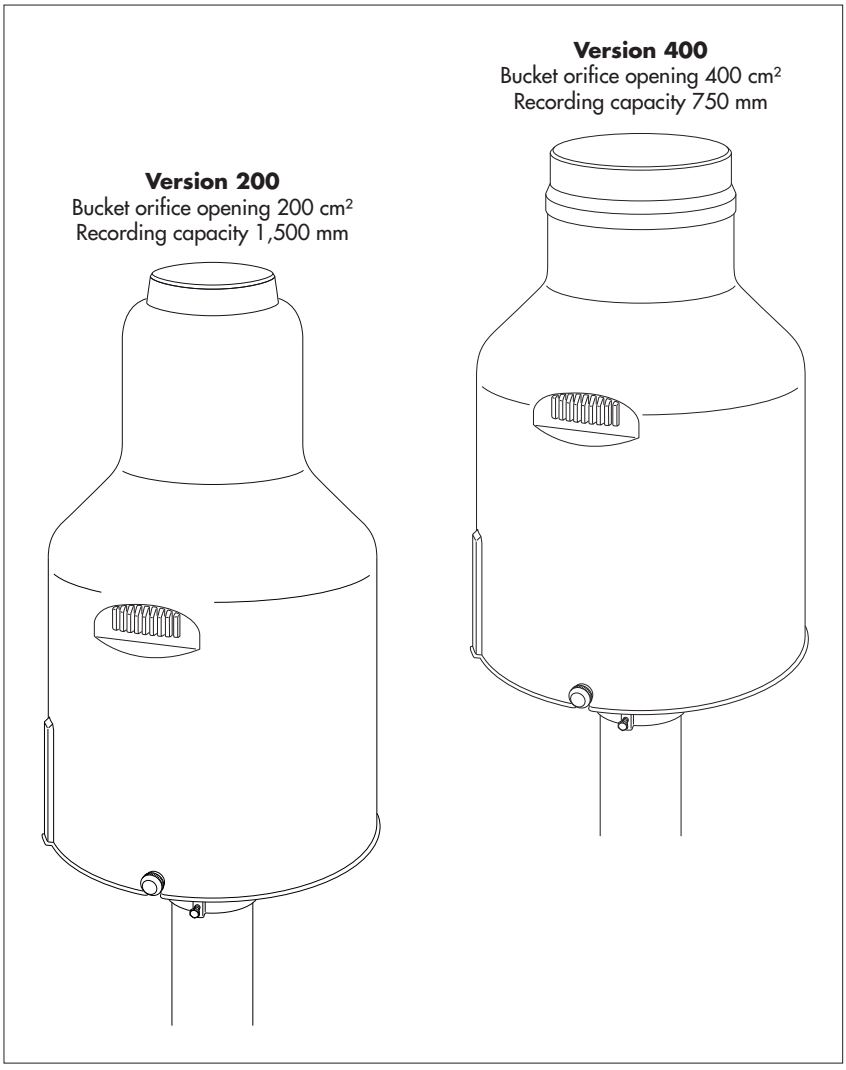


Fig. 1: Precipitation gauge OTT Pluvio².

The OTT Pluvio² is available in two versions: version 200 and version 400.

Every 6 seconds, the precipitation gauge determines the weight of the collecting bucket including its content using a resolution of 0.001 mm (= raw data). The difference between this measured value and the weight of the empty collecting bucket gives the current bucket content.

A special filter algorithm prevents incorrect measurement results in the process from effects such as wind. The difference between the current bucket content and the previous one gives the precipitation intensity in mm/min or mm/h.

These 6-second values for the precipitation intensity are added to the accumulated precipitation amount (accu total NRT – see below) by the OTT Pluvio^2.

Depending on the filter algorithm run, the measured values are available as real-time and non-real-time values:

- **Real-time output (RT):** The OTT Pluvio^2 outputs the measurement result for intensities greater than 0.1 mm/min **within one minute** after occurrence of the precipitation event. Benefit: fast response time and precipitation output with correct intensity.
- **Non-real-time output (NRT):** The OTT Pluvio^2 outputs the measurement result **5 minutes** after occurrence of the precipitation event. Advantage: more precise output with correct precipitation volume.

All measured values can be retrieved via a serial SDI-12 and RS-485 interface. In detail, these are:

- Intensity RT (fixed update interval: 1 minute)
- Accu RT/NRT (since the last measured value sample)
- Accu NRT (since the last measured value sample)
- Accu total NRT (since the last reset)
- Bucket RT
- Bucket NRT
- Temperature of load cell
- Status of OTT Pluvio^2 (since the last measurement sample)

The OTT Pluvio^2 provides the precipitation values using a resolution of 0.001 mm. Individual response thresholds of $\geq$0.05 mm within one hour are applied to these values. A detailed description of the individual measured values can be found in Chapter 3.1.

The OTT Pluvio^2 uses two pulse outputs parallel to the serial interfaces to output the amount of precipitation RT/NRT (output #1) as well as the status information (output #2). The pulse factor may be selected: one pulse equals 0.1 mm or 0.2 mm of precipitation.

Parallel operation of serial interface and pulse output allows two dataloggers or one datalogger and one PLC to be connected simultaneously.

The OTT Pluvio^2 is installed on a 4" pedestal the bottom plate of which is mounted to a concrete foundation. The standard installation height is 1 meter (height of the orifice ring rim). Alternatively, 1.2, 1.5, 2.0, 2.5 or 3.0 metres are possible.

Approximately 4 seconds after connecting the supply voltage, the OTT Pluvio^2 automatically starts measuring operation (→ red LED is flashing, refer to Fig. 17). The OTT Pluvio^2 is calibrated at the factory. On site, no further calibration is necessary.

For service purposes (test measurements, convenient setting of operating parameters and for an accuracy test) a USB interface has been provided. The particular advantage for this is that when using the USB interface, no separate power supply is required. Please note: After connecting the USB interface, the OTT Pluvio^2 interrupts communication to the serial interfaces!

The OTT test weight kit (accessory) is used to perform annual check measurements (guided accuracy test) in conjunction with the OTT Pluvio^2 operating software. Recalibration is not necessary.

The measuring system of the OTT Pluvio² prevents output of any incorrect precipitation amount and does not output any increases in precipitation through the interfaces after the following situations:

- USB interface was connected (pipe housing removed) for approx. 5 minutes;
- Emptying (large reduction in weight) for approx. 5 minutes;
- Startup/loss of electricity supply for approx. 2 minutes;

Any increases in weight greater than approx. 12 mm within 6 seconds are not output as precipitation, as they exceed a natural level of precipitation. In this way, spurious increases, such as bucket changes or filling with anti-freeze, are suppressed. Check measurements even with large reference weights (Version 200: > 240 g; Version 400: > 480 g) are possible using the "Bucket RT" and "Bucket NRT" values. The measured value sample is carried out in a joint data telegram with multiple measured values. Individual samples with different intervals are not possible.

3.1 Measured value output to the SDI-12 and RS-485 interfaces

Intensity RT

Moving precipitation growth over the last minute before the sample interval (measuring method acc. to WMO Guideline No. 8). This measured value is particularly suited, for example, for the exact determination of intensity with heavy precipitation and for alarm management, but not for daily and monthly totals.

Output delay:	Real-time output (RT)
Units:	mm/h · mm/min inch/h · inch/min
Threshold:	0.1 mm/min · 6 mm/h
Sampling interval required:	1 minute
Storage interval required:	1 minute

Note: Larger sampling intervals always give the precipitation intensity of the minute just before the sampling interval! For precipitation intensities of < 0.1 mm/min, the OTT Pluvio² sets the output value to zero. Thus, this output value may not be used for accumulating single intensity values.

Accu RT-NRT

This value is a combination of real-time and non-real-time output. This value provides the benefit of faster RT output together with subsequent non-real-time output delivering the maximum accuracy possible. It shows the accumulated amounts of precipitation over the sampling interval. If the amount of precipitation exceeds the threshold immediately, the OTT Pluvio² outputs the measurement result in real time. Otherwise, it collects the fine precipitation over a maximum of one hour and outputs the measured value in non-real time. If the fine precipitation does not reach the threshold within one hour, there will be no output. This measured value is similar to the behaviour of a precipitation gauge with tipping bucket. This measured value is particularly suited for daily or monthly totals and for alarm management.

Output delay:	Real-time output (RT) for precipitation events immediately exceeding the threshold, otherwise non-real-time output (NRT).
Units:	mm · inch
Threshold:	0.05 mm within an hour
Recommended sampling interval:	1 minute (for simultaneous sampling of the precipitation intensity)
Recommended storage interval:	any time between 1 minute and 24 hours. The datalogger must total the individual measured values using a summing function over the complete storage interval!

Note: Each interface polling resets the total amount value in the OTT Pluvio² to zero!

▶ Accu NRT

This measured value outputs the sum of the correct amounts of precipitation over the sampling interval with a fixed output delay of 5 minutes. Due to better filtering, this value provides a more precise precipitation sum. Fine precipitation is collected over a maximum of one hour and output after reaching the threshold. If the finest precipitation does not reach the threshold within one hour, there is no output. This measured value is particularly suitable for daily and monthly totals.

Output delay:	Non-real-time output (NRT)
Units:	mm · inch
Threshold:	0.05 mm within an hour
Recommended sampling interval:	1 minute (for simultaneous sampling of the precipitation intensity)
Recommended storage interval:	any time between 1 minute and 24 hours. The datalogger must total the individual measured values using a summing function over the complete storage interval!

Note: Every interface polling resets the total measured value in the OTT Pluvio² to zero. The 5 minute output delay provides the option for climatological databases to apply a time stamp correction when necessary.

▶ Accu total NRT

This measured value outputs the sum of the correct amounts of precipitation since the last device start with a fixed output delay of 5 minutes. For this purpose, the individual amounts "NRT" are added together (redundant sensor). This measured value is particularly suitable for daily or monthly totals and for plausibility checks of the "Accu NRT" and "Accu RT-NRT" values. Advantage: No loss of the collected precipitation amount values in case of temporarily disrupted data transfer.

Resetting this value is achieved
– by a separate SDI-12 reset command, or
– by switching the power supply on/off, or
– automatically if the measurement range (500 mm; 50 inch) is exceeded.

Output delay:	Non-real-time output (NRT)
Units:	mm · inch
Threshold:	0.05 mm within an hour
Recommended sampling interval:	1 minute (for simultaneous sampling of the precipitation intensity)
Recommended storage interval:	Any time between 1 minute and 24 hours (do not total/average measured values)

▶ Bucket RT

This value outputs the currently measured, unfiltered bucket content. It corresponds to the measured weight raw data and is subjected to higher uncertainty with regard to temperature and wind impact. The measured value is particularly suited for quick reference measurements of the weighing mechanism and for determining the current bucket level. Using this measured value for separately calculating the amount of precipitation in an external datalogger is not appropriate!

Output delay:	Real-time output (RT)
Units:	mm · inch
Threshold:	0.01mm (Version 200: 1mm ≙ 20 g; Version 400: 1mm ≙ 40 g)
Recommended sampling interval:	1 minute (for simultaneous sampling of the precipitation intensity)
Recommended storage interval:	any time between 1 minute and 24 hours (possibly averaging over 10 minutes)

▶ Bucket NRT

This measured value outputs the currently measured, filtered bucket content. It corresponds to the filtered weight value and is subject to measuring uncertainty due to the influence of temperature. The value is particularly suited for determining the content of the bucket and for calculating the evaporation behaviour. Using this measured value for separately calculating the amount of precipitation in an external datalogger is not appropriate!

Output delay:	Non-real-time output (RT)
Units:	mm · inch
Threshold:	0.01mm (Version 200: 1mm ≙ 20 g; Version 400: 1mm ≙ 40 g)
Recommended sampling interval:	1 minute (for simultaneous sampling of the precipitation intensity)
Recommended storage interval:	any time between 1 minute and 24 hours

▶ Temperature of load cell

Internal temperature of the load cell for compensating for the temperature change. This value is only relevant to internal purposes and generally differs from the current ambient temperature by several °C.

Units:	°C · °F
Recommended sampling interval:	1 minute (for simultaneous sampling of the precipitation intensity)
Recommended storage interval:	only as required (any time between 1 minute and 24 hours)

3.2 Measured value output to the pulse output

The OTT Pluvio² uses two pulse outputs parallel to the serial interfaces to output the amount of precipitation RT/NRT (output #1) as well as the status information (output 2). Parallel operation of serial interface and pulse output allows two dataloggers or one datalogger and one PLC to be connected simultaneously.

Electrical characteristics of the pulse and status outputs

Pulse ON:	Contact closed
Pulse/pause ratio:	1:1 for 5 Hz ≙ 100/100 ms for 2 Hz ≙ 250/250 ms
Contact design:	bounce-free, polarity-independent, galvanically isolated (from hardware index "E/1"; index can be queried with SDI-12 command **`aOOB!`**)
Current capacity, I_{max}:	≤120 mA (short-circuit proof)
Voltage, U_{max}:	≤28 V_{DC}

▶ Pulse accu RT-NRT

This measured value is same as Accu RT-NRT. However, the threshold is determined by the resolution of the pulse output (0.1 mm · 0.2 mm). The measured value is output as a pulse sequence using a rate of 5 Hz (default) or 2 Hz (configurable through the OTT Pluvio² operating software via USB interface).

Output delay:	refer to Accu RT-NRT
Pulse factor (selectable):	0.1 mm · 0.2 mm (1 mm = 10 or 5 pulses) 0.01 inch
Resolution:	0.1 mm · 0.2 mm
Recommended sampling interval:	continuous counting of the pulses
Recommended storage interval:	any time between 1 minute and 24 hours

▶ Pulse status information

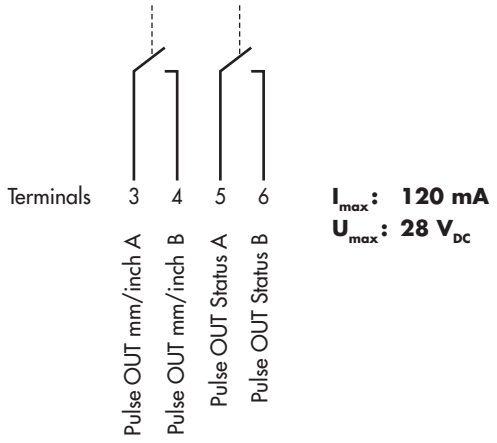
This measured value corresponds to the current bucket level and additionally shows status information. Moreover, status information may be used as an “Alive” signal.

0	pulses/min	system fault, device or cable at the pulse output faulty (output 2)
10 … 100	pulses/min	0 … 100 % of the approximate bucket content
120	pulses/min	maintenance via USB operation

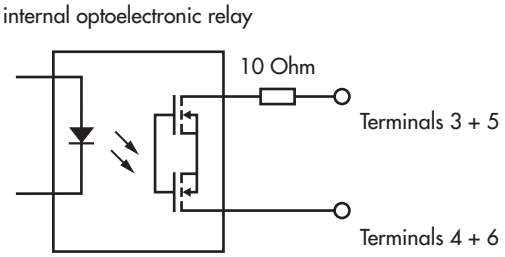
Fig. 2: Pulse output circuit diagram.

The locations of the terminals are shown in Fig. 6.
Output 1: terminals 3 and 4
Output 2.. Terminals 5 and 6.

Simplified schematic diagram



Detailed diagram



Please note:
When the pulse outputs are connected to
– OTT dataloggers → no additional wiring is required. You may directly connect the pulse outputs to the pulse inputs of an OTT datalogger.
– Third-party dataloggers → external wiring at the pulse and status outputs must be designed in such a way that the limits for $I_{max} \leq 120$ mA and $U_{max} \leq 28$ V will be kept in all operating conditions! Use a pull-up resistor as applicable!

3.3 Graphical display of measured value output for different precipitation intensities

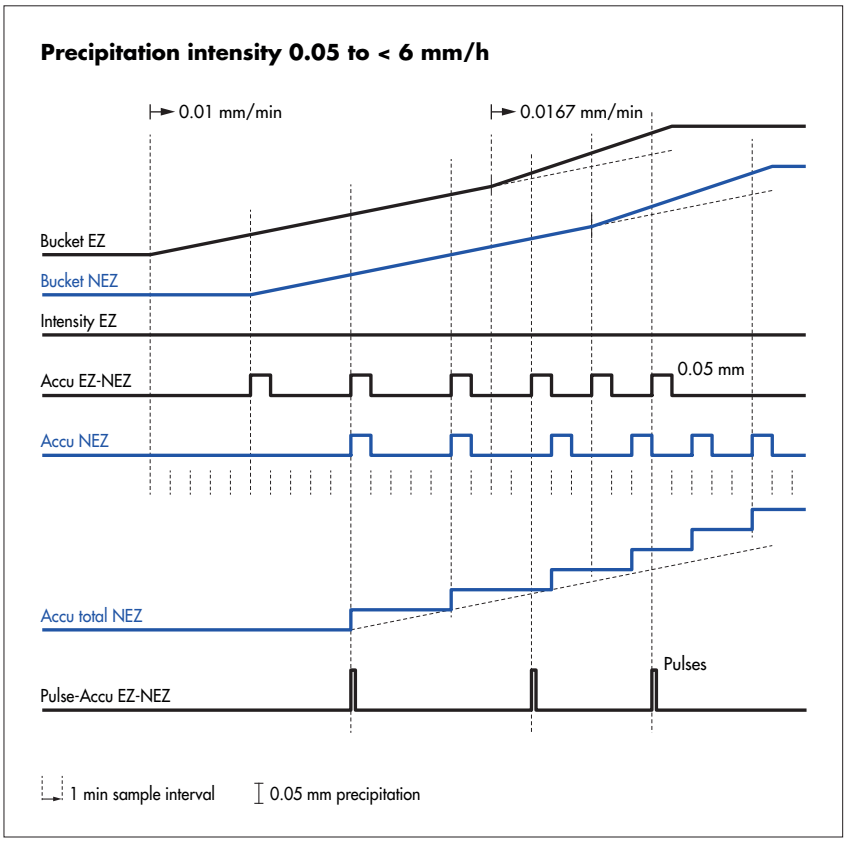


Fig. 3: Precipitation intensity 0.05 … < 6 mm/h.

Fig. 4: Precipitation intensity ≥ 6 mm/h.

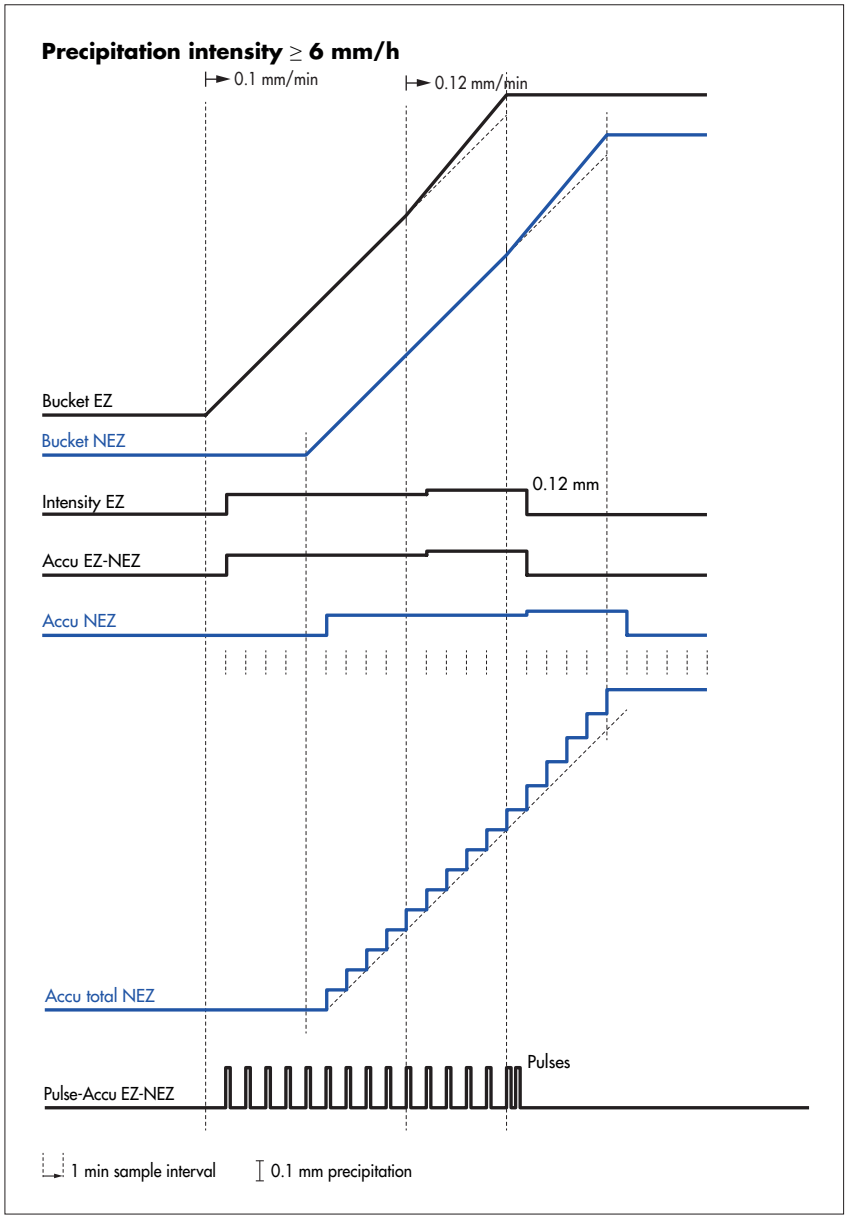
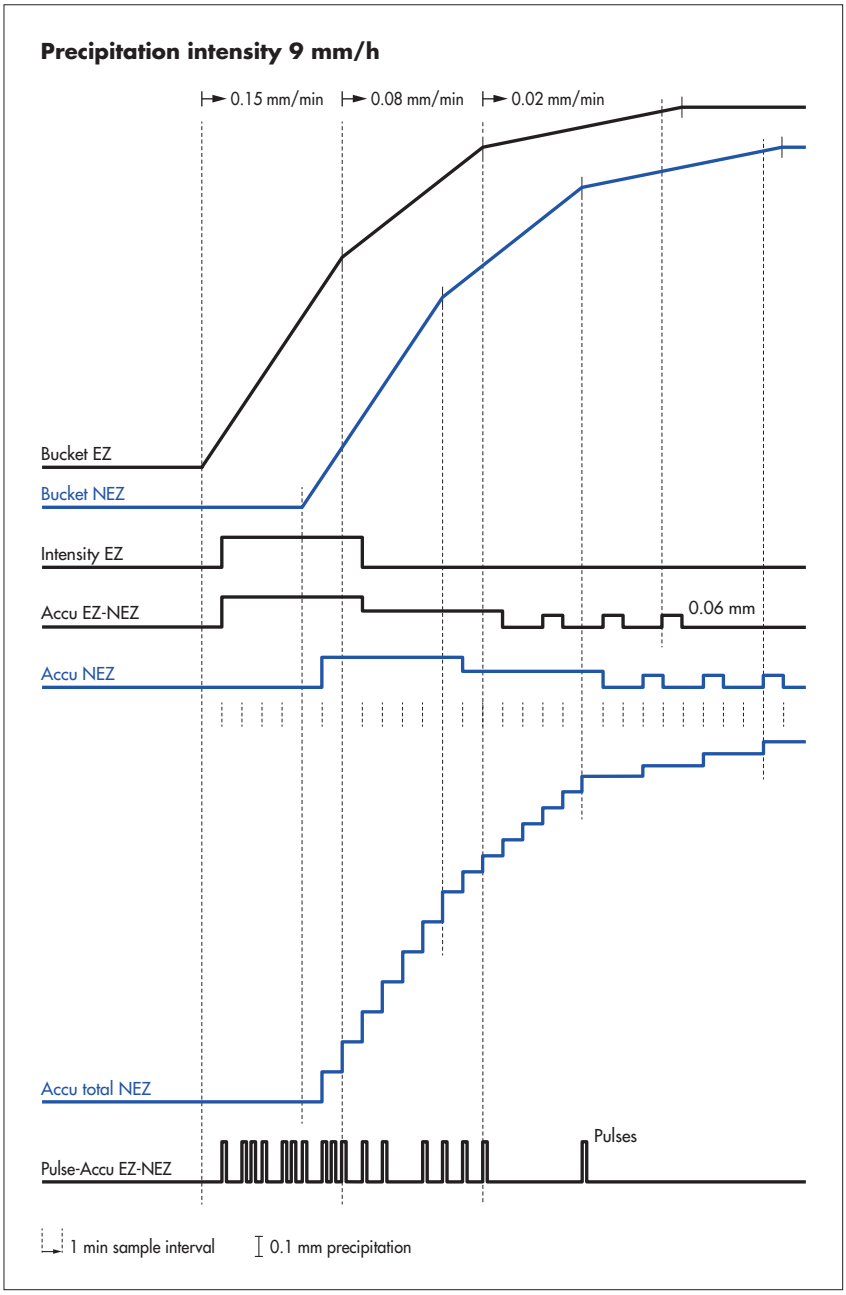


Fig. 5: Precipitation intensity 9 mm/h.



3.4 Orifice rim heating

Both versions of the OTT Pluvio² are available with optional orifice rim heating. This reliably keeps the orifice rim free of snow and ice during low temperatures (e.g. no snow build-up).

The orifice rim heater consists of a ring-shaped heating element integrated in the pipe housing with temperature sensor and an electronic rim heater module for controlling and monitoring the heating function.

Only the orifice rim is heated so as to avoid unwanted losses from evaporation. The orifice rim heater therefore does not prevent the contents of the collecting container from freezing! The heater control unit reliably prevents a stack effect (errors in precipitation measurement caused by thermal effects) by using a low and continuously monitored orifice rim temperature.

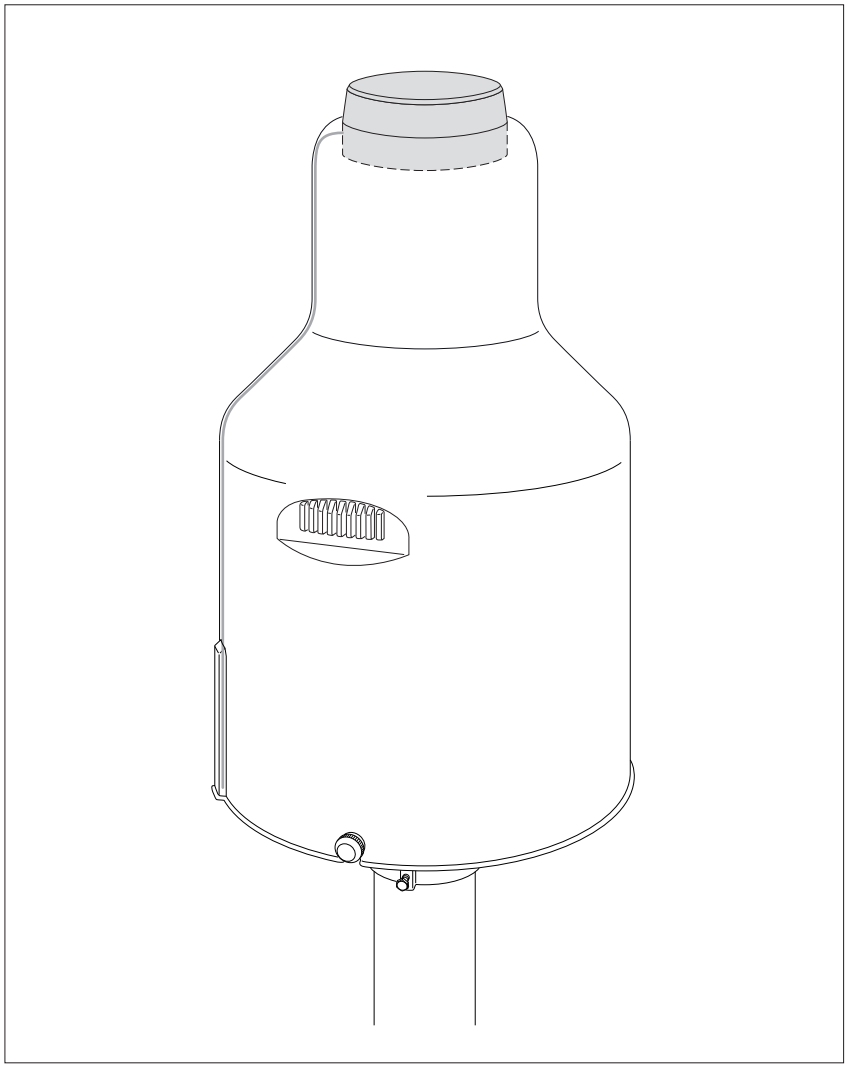


Fig. 6: Schematic diagram of the OTT Pluvio² orifice rim heater.

The surface shown in grey (orifice rim) is the heated part of the pipe housing.

The electrical connection of the heater cable is established automatically via two plug contacts when the pipe housing is placed onto the base plate.

The heating control has been designed such that it is active over an ambient temperature range of –40 ... +4 °C. Experience shows that snow and ice do not build up outside this temperature range.

The orifice rim heater is used to heat the orifice rim until the preset target temperature of +4 °C (factory setting) has been reached.

To achieve this, the rim heater control module measures both ambient temperature and orifice rim temperature and uses these values together with the target temperature (+4 °C) to calculate the pulse/pause ratio for the heater control system. Depending on their levels, the rim heater module supplies electricity to the heating element for 5 to 120 seconds.

In the temperature range –40 to +30 °C, the Pluvio² continuously carries out functional checks for the recognition of any error states. The result is used for system checks in the measuring areas. The functional check is successful if after a short heating period an increase in rim temperature of +0.5 °C can be recorded. The duration of this short heating period is dependent on the outside temperature. This functional check is also carried out in summer periods at 10-hour intervals. For this, there is a minimum heating capacity of 1 W. If the fault cannot be rectified (unusual operating states or heating defect), the status information "Functional check of orifice rim heating was defective" follows. See SDI-12 command **aD1!** (after **aM!**), Chapter 6.1. The first result of the functional check will be available approx. 10 minutes after a restart of the OTT Pluvio².

If the orifice rim or load cell temperature is higher than +30 °C, no heating is carried out and there is no functional check. If the measured rim temperature increases above 42 °C during heating operation, the rim heater module triggers an automatic safety shutoff of the heating element.

The orifice rim heater can be switched on/off using an advanced SDI-12 command or via the separate power supply. Thus, it is possible to completely switch off the orifice rim heater, for example in summer. In the delivery state set at the factory, the orifice rim heater is switched on.

When the heater is switched off, this is shown in the status information.

The nominal supply voltage for operating the orifice rim heater is 24 V_{DC}. The maximum heating power at very low environmental temperatures approx. 50 Watt for Version 200 RH and 100 Watt for Version 400 RH. Optionally, the supply voltage of the orifice rim heater can be fed separately from or together with the supply voltage for the precipitation gauge.

As a special option, the orifice rim heater may be operated based on 12 V_{DC}. In this case, effective heating power is 25 % of the rated power. For operation in moderate climate zones and using 12 V solar systems, this type of operation is basically allowed. The data specified for 24 V_{DC} operation cannot be maintained across the entire temperature range (refer to the Specifications section). For temperatures below –5 … –10 °C, partly frozen orifice ring rims are to be expected.

4 Basic safety information

- Read these operating instructions before using the OTT Pluvio² for the first time! Make yourself completely familiar with the installation and operation of the OTT Pluvio². Keep these Operating Instructions for later reference.
- The OTT Pluvio² is used for automatic determination of the meteorological intensity and amount of precipitation. Only use the OTT Pluvio² as described in these operating instructions!
  For further information, → see Chapter 3, "Introduction".

- Note all the detailed safety information given within the individual steps. Any safety information in these operating instructions is identified by the warning symbol shown here.
- Only transport the precipitation gauge with the transportation lock in place. **Please note:** even with the transportation lock fitted, this is no absolute protection against damage.
  For further information, → see Chapter 5.4, "Preparing the base plate".
- Avoid heavy shaking and shocks during transport and operation! Only use the original packaging for transport.
- Ensure the electrical, mechanical, and climatic specifications listed in the technical data are adhered to.
  For further information → see Chapter 10, "Technical Data".
- Carry out all recommended maintenance work at the frequencies specified. See Chapter 7, "Carrying out maintenance work".
- Do not make any changes or retrofits to the OTT Pluvio²! If changes or modifications are made, any warranty will be void.
- Only have a defective OTT Pluvio² checked and repaired by the OTT repair centre. On no account carry out repairs yourself!
  For further information → refer to Chapter 8, "Repair".
- Dispose of the OTT Pluvio² properly after taking out of service. On no account dispose of the OTT Pluvio² in household waste.
  For further information → refer to Chapter 9, "Notes on the disposal of old units".

5 Installing the OTT Pluvio²

The installation of the OTT Pluvio² is carried out on a 4" pedestal made of galvanized steel (possible external diameter of pedestal 100 ... 120 mm). The pedestal must be securely attached to a concrete foundation having the appropriate dimensions. The pedestals that are available from OTT as accessories are fitted with a bottom plate designed for this purpose.

The standard installation height recommended by the World Meteorological Organization, WMO, for precipitation gauges is 1 metre (height of bucket orifice). Alternatives of 1.2, 1.5, 2.0, 2.5 or 3.0 metres are possible.

Carefully choose your setup location according to your meteorological requirements. At the same time, ensure the location is free of vibration. For example, traffic on a nearby road can affect the measurement results through vibration.

The maximum distance to the data collection device and the power supply to which the OTT Pluvio² is to be connected is dependent on the interface used:

- SDI-12: 70 metres
- RS-485: 1,000 meters
- Pulse output: 1,000 meters

With an OTT Pluvio² with orifice rim heating, the maximum distance to the mains adapter of the orifice rim heating is 125 meters.

Please note: The OTT Pluvio² precipitation gauge is equipped with a highly sensitive electronic balance mechanism. Only proceed during installation as described in these operating instructions.
In order to prevent damage to the OTT Pluvio² balance mechanism during installation: avoid strong vibration of and large forces on the bucket overlay (for position see Fig. 8)!

5.1 Recommended cable types/maximum cable lengths

For operating the OTT Pluvio², the following connections have to be made:

- power supply for the precipitation gauge,
- power supply of the orifice rim heater (optional),
- data collection device (SDI-12/RS-485 interface, pulse output), and
- earth clamp

For the precipitation gauge power supply and the connection of the data collection device, a common connection cable can be used.

For a OTT Pluvio² with orifice rim heater, an additional connection cable may be used. Benefit: The orifice rim heater can be switched on and off separately from the precipitation gauge. In addition, power consumption of the orifice rim heater requires a larger wire cross-section to be used for longer connection cables.

In total, the connection area of the OTT Pluvio² has two cable entrances (rubber grommets).

Please note: the protection concept of the OTT Pluvio² against overloads is designed such that all overvoltages occurring are discharged via an earth connection. For this, the proper and functional installation of an earth cable is absolutely necessary! This is connected to the OTT Pluvio² at the earth terminal and at the other end in the area of the data collection device or directly at the OTT Pluvio² to a concrete footing earth or earth rod.

Please note: all connection cables must be UV-resistant and suitable to be laid in the earth!

Connection cable for data collection device/precipitation gauge power supply

SDI-12 interface	– Cable length: maximum 70 m [1] – Cable type: unshielded low-voltage cable – Wire size: 3 x 0.5 mm² [2]
RS-485 interface	– Cable length maximum 1,000 m – Cable type: twisted-pair cable [3]; shielded or unshielded design – Wire size: 2 x 2 x 0.5 mm²
Pulse output	– Maximum cable length: 1,000 m – Cable type: unshielded low-voltage cable – Wire size: 6 x 0.5 mm²

The connection cable recommended in each case includes the wires for power supply and data collection device.

[1] with a point-to-point connection (no SDI-12 bus operation), a cable length of up to 300 m is possible
[2] with standard SDI-12 wiring, alternative 4 x 0.5 mm² wire with separate power supply.
[3] the wires intended for the power supply can be twisted pair, but do not have to be.

Connection cable for orifice rim heater power supply

– Cable length: maximum 125 m
– Cable type: unshielded low-voltage cable
– Wire size

	OTT Pluvio² 200 RH	OTT Pluvio² 400 RH
1 … 25 m:	2 x 0.5 mm²	2 x 1.0 mm²
25 … 50 m:	2 x 1.0 mm²	2 x 1.5 mm²
50 … 75 m:	2 x 1.5 mm²	2 x 2.5 mm²
75 … 125 m:	2 x 2.5 mm²	–

Calculation is based on: Output voltage of the 24 V_{DC} power supply (e.g. mains adapter). If required, an output voltage of 28 V_{DC} allows the cable length to be doubled in each case.

Earth cable

– Cable length: maximum 5 m
– Cable type: unshielded, low-voltage cable
– Wire size: 1 x 10 mm²

USB cable

If any changes are to be made to the factory settings, a USB cable is temporarily required during commissioning (supplied). Maximum cable length: 3 m.
Please note: The USB interface has no overload protection. It is designed to be temporarily used as a service interface.

5.2 Tools/equipment required

- Open-ended spanner, size 13 mm (supplied)
- Phillips screwdriver, size: PH 2
- Slotted screwdriver, size: 0.8 mm x 4 mm and 1.0 mm x 6 mm
- Tool for stripping insulation on electrical cables
- Wire-cutting pliers
- For a connection cable with wires made of strands: wire end sleeves and sleeve crimping pliers

5.3 Preparing the installation location

Please note: The depth of the concrete foundation must be adapted to local conditions: The foundation must reach into the frost-free zone in the ground. The dimensions given for the foundation depth are typical values for conditions in Central Europe.

We recommend that an empty conduit pipe (with a wire for pulling in) for the connection and earth cables is incorporated into the concrete foundation.

- Attach the pedestal with bottom plate to a concrete foundation measuring approx. 45 x 45 x 80 cm using the "4" pedestal mounting kit" (refer to accessories) (hole diameter of the bottom plate: 16 mm).
  Please note: The pedestal must be as vertical as possible! See Figure 7 in Appendices B and C.
- Pull the connection cable for the data collection device/power supply of the precipitation gauge into the empty conduit pipe.
- OTT Pluvio² with orifice rim heating: pull additional connection cable for the orifice rim heating power supply into the empty conduit pipe.
- In the case of the earth for the OTT Pluvio² being implemented centrally in the area of the data collection device: also pull the earth cable into the empty conduit pipe (alternatively, the earth is established directly at the OTT Pluvio² with a concrete footing earth or earth rod).

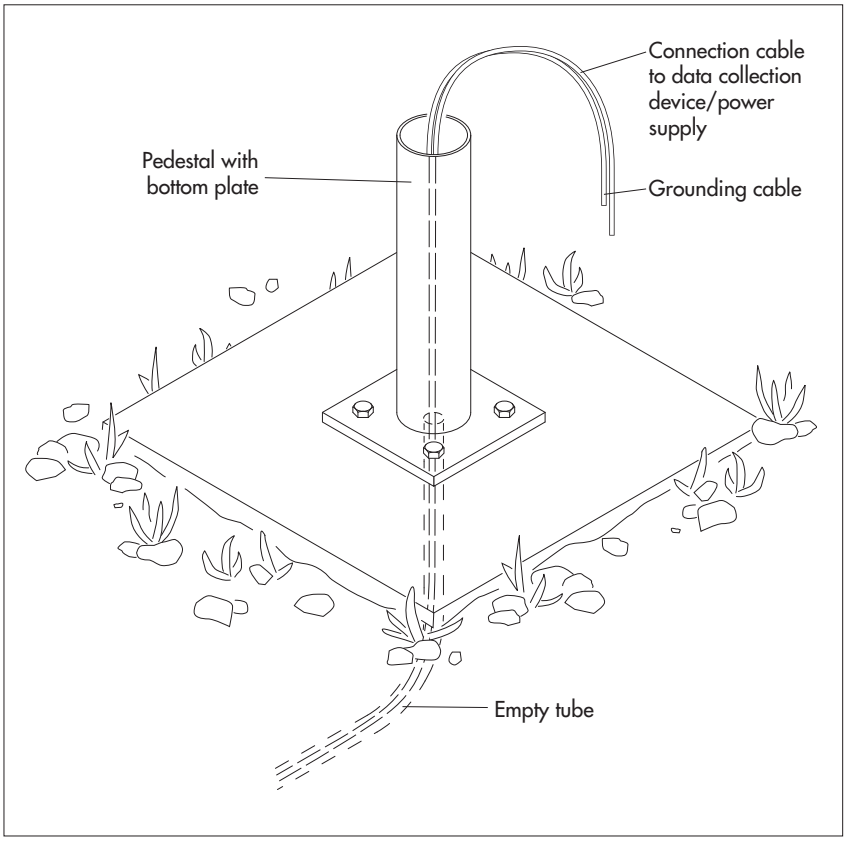


Fig. 7: The location prepared for installing the OTT Pluvio².

With an OTT Pluvio² with orifice rim heating, an additional connection cable is possible for supplying power to the orifice rim heating.

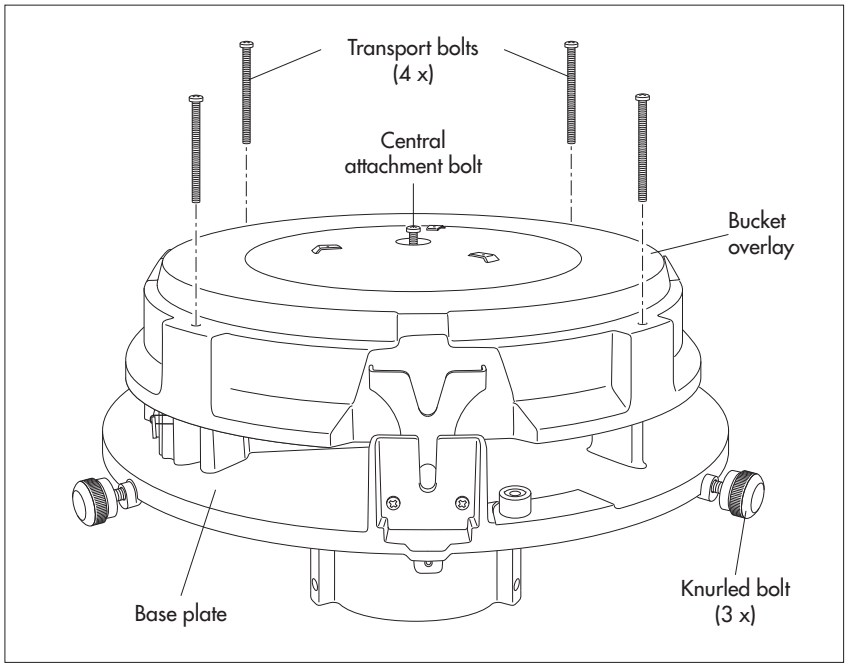
The cables may alternatively be routed outside of the pedestal. To protect the cables (e.g. against animal bites), routing the cables inside the pedestal is recommended.

5.4 Preparing the base plate

- Transport the OTT Pluvio² carefully to the installation location upright in the transport box.
- Turn the OTT Pluvio² transport box upside down.
- Open the transport box and remove the upper foam insert.
- Remove the box with the installation materials.
- Unscrew the three knurled screws on the pipe housing. Remove base plate from transport box. OTT Pluvio² with orifice rim heating: Follow the sheet included to take the base plate out of the pipe housing! (For now, leave the collecting bucket and pipe housing in the transport box.)
- Place the base plate on a level surface.

The balance mechanism of the OTT Pluvio² has a transportation lock, consisting of four cross-head bolts (M 5 x 60). These reduce the risk of damage to the electronic balance mechanism during transport.

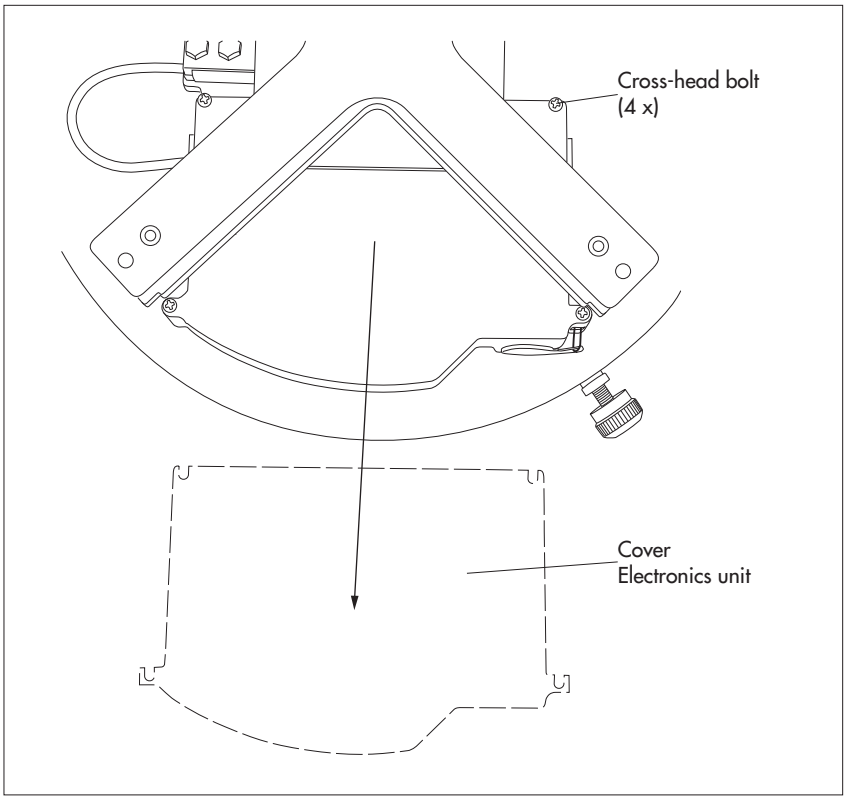
Fig. 8: Removing transportation lock and taking off bucket overlay.



- Take out the four outside cross-head bolts (transportation lock) in the bucket overlay. Retain the cross-head bolts for later transport!
- Loosen the central attachment bolt in the bucket overlay (the attachment bolt is secured against falling out with two hexagonal nuts).
- Remove the bucket overlay.

- Unscrew 4 cross-head screws on the cover of the electronics unit approx. 3 mm, raise the cover slightly and pull it off forwards. If the foam rubber seal for the cover is stuck to the surface below, carefully lever off the cover with a slotted screwdriver.

Fig. 9: Removing the cover from the electronics unit.



5.5 Assembling the connection cable

Connection cable for data collection device/precipitation gauge power supply

- Cut the connection cable so that it sticks out approx. 35 … 40 cm above the pedestal. (The "excess" cable can be stored in the pedestal later.)
- Take the rubber grommet out of the electronics unit (see Fig. 13). Remove the white blanking plug from the rubber grommet and push the grommet onto the connection cable.
- Strip approx. 8 cm of the outer sheath of the connection cable.
- Strip approx. 5 mm of the insulation from the individual wires.
- For a stranded connection cable: push end sleeves onto the wires and crimp using crimping pliers.
- Attach the connection cable to the 6-pin (only if using pulse output) and 7-pin screw terminal strip (supplied in plastic bag).
  - SDI-12 interface → see Figure 10
  - RS-485 interface → 7-pin screw terminal strip, contacts 1/2 + 5/6
  - Pulse output → 6-pin screw terminal strip, contacts 3/4 + 5/6 (if required) and 7-pin screw terminal strip, contacts 5/6

Orifice rim heater connection cable (optional)

- Assemble connection cable as described above and connect to the 7-pin screw terminal strip. See Figure 11.

Please note: If it is a shielded connection cable, only connect the shielding on the side of the data collection device/power supply!

Fig. 10: Connecting the cable for the data recording device/power supply for the precipitation gauge to 6-pin and/or 7-pin screw terminal strip (example: SDI-12 interface).

Standard SDI-12 wiring has three wires (SDI-12 DATA, GND, and power supply (+12 V)). For separate power supplies, an additional GND wire is available.

Contacts 3, 6 and 7 of the 7-pin screw terminal strip are bridged internally!

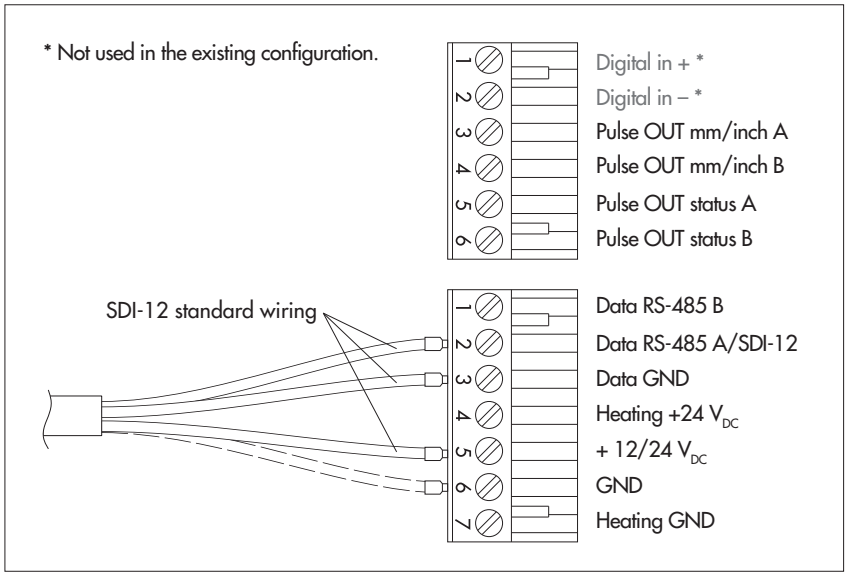
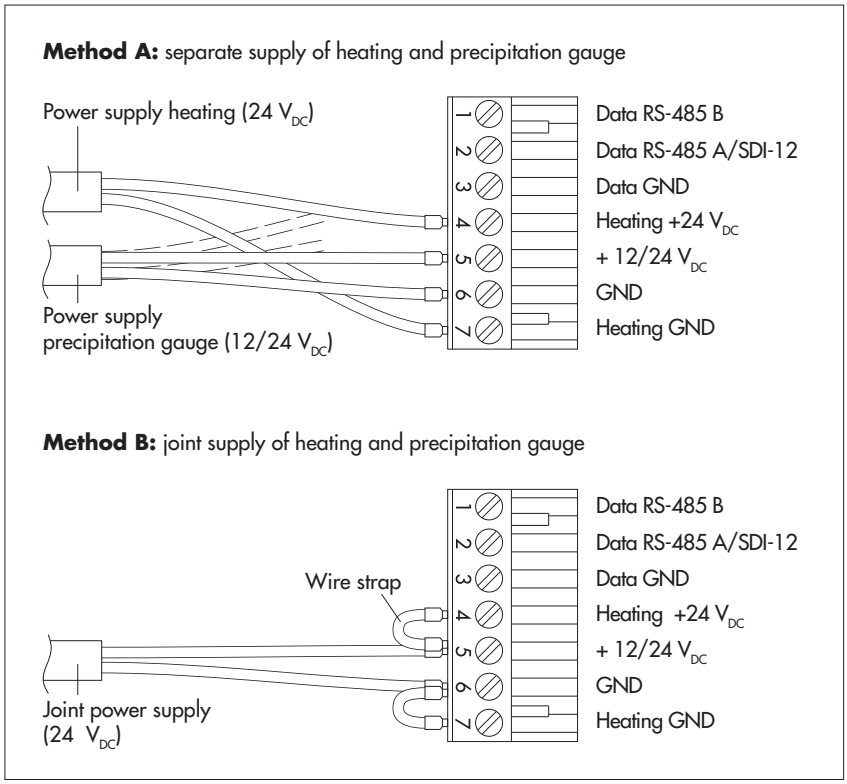


Fig. 11: **OTT Pluvio² with orifice rim heating:** Connection possibilities for power supply with precipitation gauge and orifice rim heating.

Please note: With variant B, the supply voltage must be 24 V_{DC}!

The wires for connecting the data recording device are either not shown or shown as dashed lines for clarity.

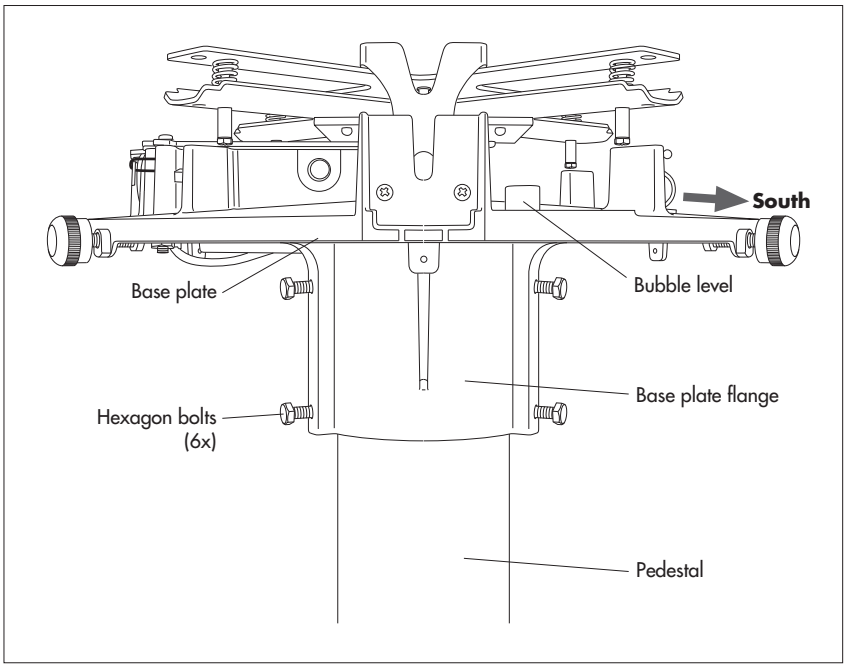
Likewise for version B, a jumper should also be established between contacts 6 and 7 (high power consumption of the orifice rim heater)!



5.6 Installing base plate on pedestal

- Place the base plate onto the pedestal such that the connection and earth cables come out of the slit in the base plate flange (see Fig. 14).
- **Rotate the base plate so that the knurled screw next to the bubble level faces south*!** See also the Figure in Appendix E.
  This prevents incorrect precipitation data in extreme climatic conditions. These may occur during large, rapid temperature variations together with lateral solar radiation.
  * in the southern hemisphere, towards the north
- Screw the six hexagon bolts into the base plate flange with open-ended wrench, size 13 mm (supplied). **Please note:** screw in all hexagon bolts approximately to the same depth! Do not yet fully tighten the hexagon bolts!

Fig. 12: Installing baseplate onto pedestal.

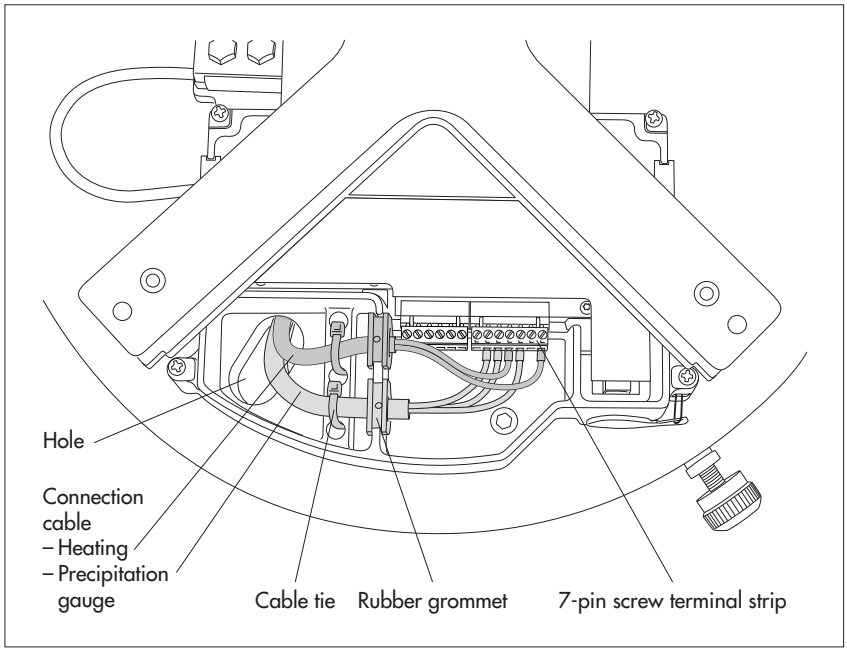


5.7 Connecting the connection cable

- Feed connection cable through hole in base plate.
- Push rubber grommet(s) with connection cable into the slot.
- Connect 6-pin (only if using the pulse output) and 7-pin screw terminal strip to the appropriate PCB socket(s).
- If necessary, pull back connection cable and store in pedestal (raise base plate again if necessary).
- Push a cable tie through the holes in the base plate and fix the connection cable with the cable tie.

Fig. 13: Connecting the cable in the electronics unit.

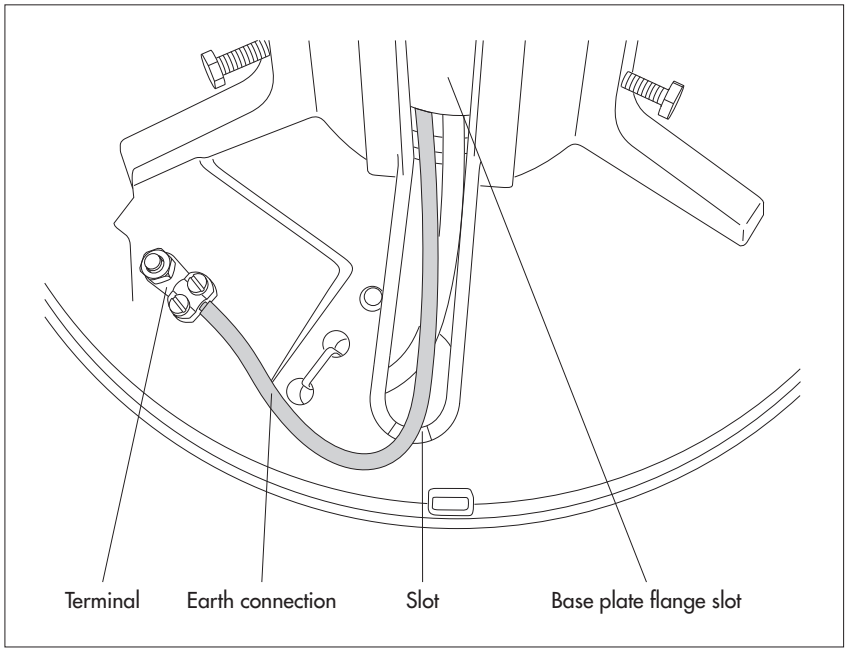
(The illustration shows the example of a standard SDI-12 wiring with optional orifice rim heating.)



5.8 Connecting the earth cable

- Cut the earth cable (cross-section 10 mm²) to approx. 30 … 35 cm.
- Strip approx. 10 mm of the earth cable insulation and connect to the terminal on the underside of the base plate. For a stranded earth wire: push on end sleeves and crimp using crimping pliers.
- Connect the earth connection to a concrete footing earth or earth rod.

Fig. 14: Connecting earth cable.

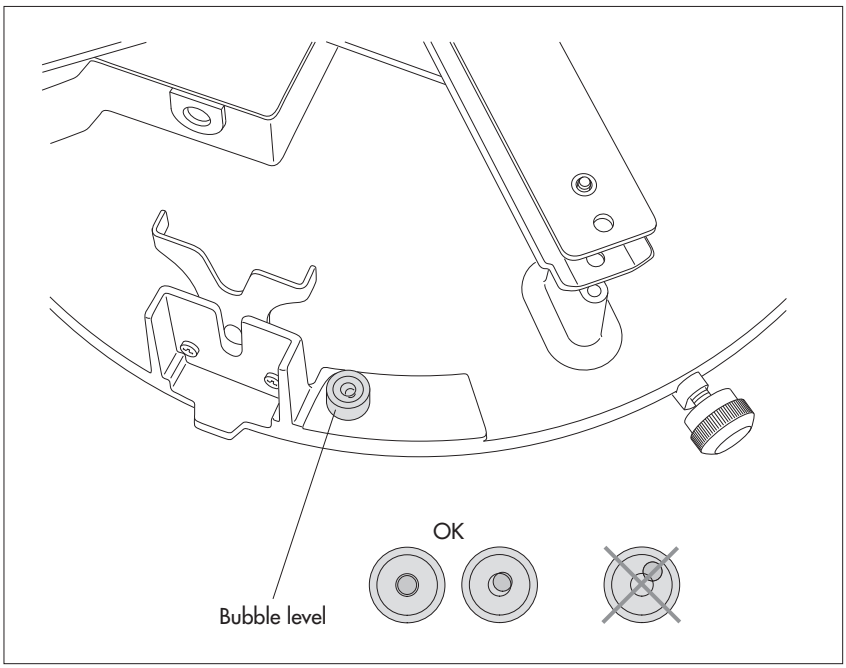


5.9 Aligning the base plate

- First fix the base plate with the three upper hexagon bolts.
  Alternately tighten the bolts until all are touching the pedestal.
  Important: screw in all hexagon bolts approximately to the same depth!
- Using the lower hexagon bolts, adjust the base plate such that the air bubble in the bubble level is within the marked ring. While screwing in a hexagon bolt, the air bubble moves in the direction of this bolt position. In case of large adjustment travel (pedestal is outside the vertical position for several degrees) use opposite bolts as applicable!
- Alternately tighten all hexagon bolts, thus preventing deformation of the base plate! Maximum torque: 6 Nm.
- Again check bubble level for correct adjustment.

Fig. 15: Levelling the OTT Pluvio^2.

Correct functioning of the balance mechanism is only ensured if the base plate is optimally levelled!



5.10 Final work

- Replace the electronics unit cover and tighten the four Phillips screws.
- Position bucket overlay (note protection against incorrect positioning) and fix using the central attachment bolt.
- Take the pipe housing out of the transport box with the collecting bucket and push the collecting bucket out of the pipe housing from above.
- Place collecting bucket onto bucket overlay. Ensure secure positioning of bucket!

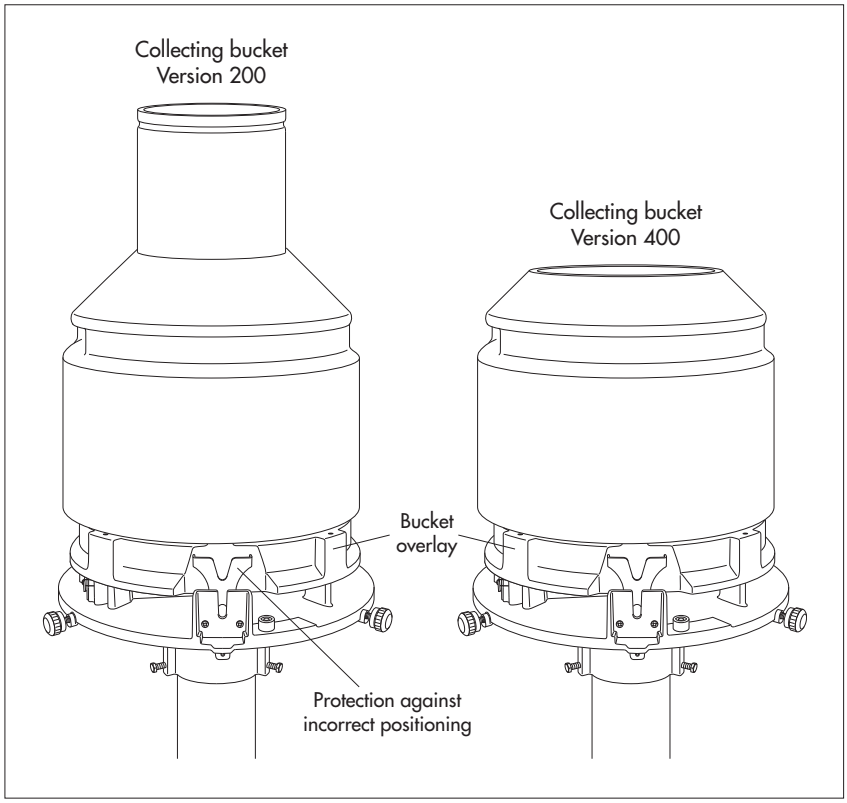


Fig. 16: Placing the collecting bucket onto bucket overlay.

- If necessary: change the factory settings using the OTT Pluvio² operating software. For installation procedure and using the operating software, refer to Section 7.6.

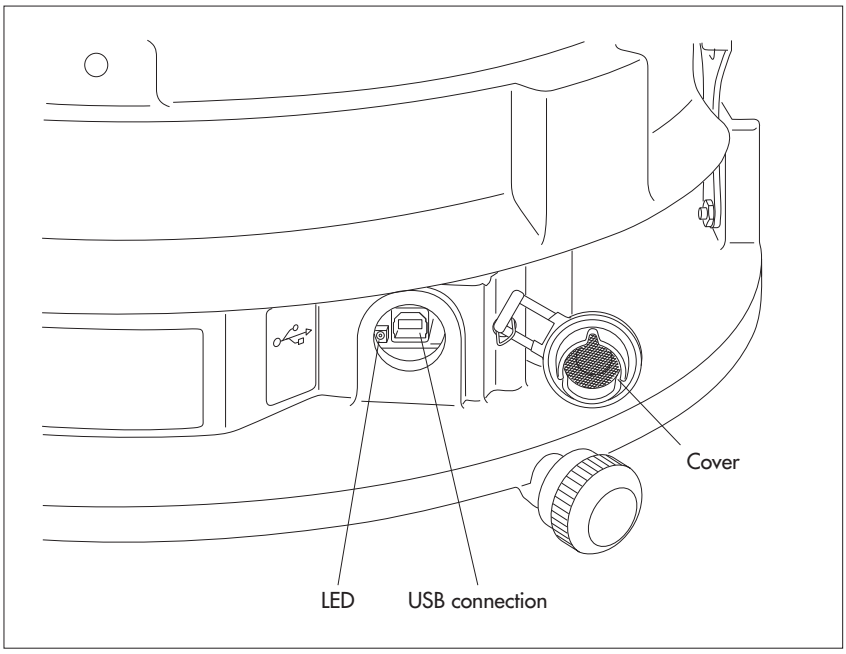
  Factory settings:

– SDI-12 sensor address	0
– Serial interface	SDI-12
– Temperature unit of measurement	°C
– Intensity unit of measurement	mm/min
– Pulse factor	0.1
– Pulse output frequency	5 Hz
– Orifice ring heating*	on
– Target temperature orifice ring heating*	+4 °C

  * version 200 RH and 400 RH
- Fill with anti-freeze for negative environmental temperatures; For details see Chapter 7.2.
- Connect the cable of the data collection device/power supply of the precipitation gauge to the data collection device. For RS-485 interface and pulse output: additionally, connect the cable to an external power supply.
- OTT Pluvio² with orifice rim heating and separate power supply: Connect the cable for the orifice rim heater to the power supply.
- Configure the data collection device. For this, refer to the manual for the data collection device. For SDI-12 commands and responses used, see Chapter 6.

- Carrying out the functional check: Remove cover of the USB interface → red LED must briefly flash once a second.
- Replace cover.

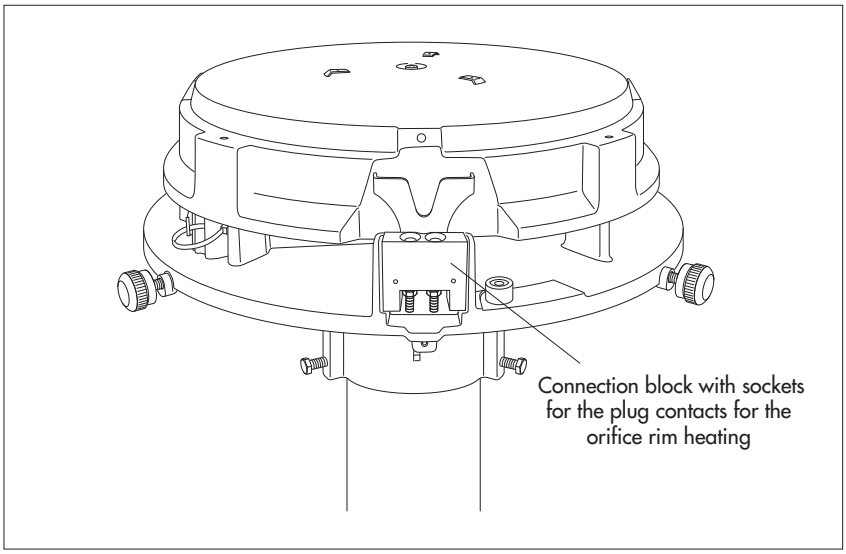
Fig. 17: Carrying out the functional check.



- Place the pipe housing level onto the base plate (note protection against incorrect positioning). OTT Pluvio² with orifice rim heating: Ensure that the sockets in the connection block are not contaminated.

Fig. 18: Connection block for the plug contacts for the orifice rim heater.

Please note: Always place and remove the pipe housing of the OTT Pluvio² with orifice rim heating level!



- Tighten three knurled screws

Please note:
after startup, the OTT Pluvio² uses a 2 minute delay to output the measured values. During this period, the precipitation values are identified in the status information as not completely available yet.

6 SDI-12 Commands and responses

6.1 Basic Commands

All SDI-12 standard commands are implemented in the OTT Pluvio². The following SDI-12 standard commands are relevant for the operation of the OTT Pluvio².

Conventions applicable to measured value formats:
p – Sign (+,–)
b – Number before the decimal point: output occurs without leading zeros!
e – Number after decimal point

Command	Response	Description
a!	**a<CR><LF>**	Acknowledgement active **a** sensor address; factory setting = 0
aI!	**allccccccccmmmmmm** … … **vvvxxxx<CR><LF>**	Send identification **a** – sensor address **ll** – SDI-12 protocol version **cccccccc** – Manufacturer identification (company name) **mmmmmm** – Label for sensor **vvv** – Sensor version (firmware) **xxxxxx** – Serial number Response OTT Pluvio² = 013OTTHACHPLUVIO100xxxxxx
aAb!	**b<CR><LF>**	Change sensor address **a** – old sensor address **b** – new sensor address
?!	**a<CR><LF>**	Query sensor address (not possible with SDI-12 bus operation) **a** – sensor address
aM! / **aM1!**	**atttn<CR><LF>** and after 1 second **a<CR><LF>**	Start Measurement **a** – sensor address **ttt** – Time in seconds until the sensor has determined the measurement result Response OTT Pluvio² = 001 **n** – Number of measured values Response OTT Pluvio² = 9 on **aM** 3 on **aM1!**
aMC! / **aMC1!**	**atttn<CR><LF>** and after 1 second **a<CR><LF>**	Start measurement and request CRC (Cyclic Redundancy Check). For details, see command **aM!**. The responses to the **aD0!** … **aD2!** commands in this case are extended by a CRC value (example): **a<value1><value2><value3><value4><CRC><CR><LF>**
aC! / **aC1!**	**atttnn<CR><LF>**	Start concurrent measurement (simultaneous measurement with multiple sensors on one bus line). For details see command **aM!** The number of measured values in the response to this command is two-digit: **nn** = 09 or 03.
aCC! / **aCC1!**	**atttnn<CR><LF>**	Start concurrent measurement (simultaneous measurement with multiple sensors on one bus line) and request CRC (Cyclic Redundancy Check). For more details, see command **aM!** The number of measured values in the response to these commands is two-digit: **nn** = 09 or 03. The responses to the **aD0!** … **aD2!** commands in this case are extended by a CRC value (example): **a<value1><value2><value3><value4><CRC><CR><LF>**

Note: Each **aM!** command resets the total measured values *Accu RT-NRT* and *Accu NRT* to zero!

Command	Response	Description
aD0!* * after **aM!**, **aMC!**, **aC!**, **aCC!**	**a<value1><value2>** … … **<value3><value4><CR><LF>**	Send data **a** – sensor address **<value1>** – **Intensity RT** [mm/h]: **pbbbb.ee** (6.00 … 3000.00) [mm/min]: **pbb.ee** (0.10 … 50.00) [inch/h]: **pbbb.eee** (0.236 … 118.110) [inch/min]: **pb.eee** (0.004 … 1.968) **<value2>** – **Accu RT-NRT** [mm]: **pbbb.ee** (0.05 … 500.00) [inch]: **pbb.d** (0.002 … 19.685) **<value3>** – **Accu NRT** Format as *Accu RT-NRT* **<value4>** – **Accu total NRT** Format as *Accu RT-NRT*
aD1! * after **aM!**, **aMC!**, **aC!**, **aCC!**	**a<value5><value6>** … … **<value7><value8><CR><LF>**	Send data **a** – sensor address **<value5>** – **Bucket RT** 200 [mm]: **pbbbb.ee** (40.00 … 1800.00) 200 [inch]: **pbb.eee** (1.575 … 70.866) 400 [mm]: **pbbb.ee** (20.00 … 900.00) 400 [inch]: **pbb.eee** (0.787 … 35.433) **<value6>** – **Bucket NRT** Format as Bucket *RT* **<value7>** – **Temperature of load cell** [°C]: **pbb.e** (–50.0 … +70.0) [°F]: **pbbb.e** (–58.0 … +158.0) **<value8>** – **Heater status** **pbbb** +0 = Orifice rim heating operating properly +1 = W: orifice rim temperature > 40 °C +2 = A: orifice rim temperature < –20 °C +4 = A: temperature sensor not connected +8 = A: temperature sensor short-circuited +16 = A: communication to ring heating module defective (the pipe housing has possibly been removed) +32 = A: functional check of orifice rim heating was defective +64 = not used +128 = W: orifice rim heating deactivated or not present W = warning; A = alarm. If the OTT Pluvio² outputs other values than those listed here, multiple events have occurred simultaneously. The individual values are summed in this case. Example: "+17" → total of warning "+1" and "+16". The status information output – assuming the cause has been corrected – is reset the next time the command **aM!** is used.

Note on *Bucket RT* and *Bucket NRT* values: These content measured values are not referenced to zero, but include the weight of the bucket overlay and the collecting bucket. As a result, the following measured values should be expected:

Content	Type 200	Type 400
0 % ≙ 0 l *	263 ±20 mm	117 ±10 mm
70 % ≙ 21 l	1313 ±20 mm	642 ±10 mm
100 % ≙ 30 l	1763 ±20 mm	867 ±10 mm

* collecting bucket empty

Command	Response	Description
aD2! * after **aM!**, **aMC!**, **aC!**, **aCC!**	**a<value9><CR><LF>**	Send data **a** – sensor address **<value9>** – **Status** **pbbbb** +0 = Precipitation gauge operating properly +1 = W: bucket filling level ≥ 80 % +2 = W: USB interface is/was connected +4 = W: restart (due to power failure) +8 = W: restart (due to firmware) +16 = W: weight change not permitted +32 = W: supply voltage < 7 V +64 = A: weight measurement unstable +128 = A: weight measurement defective +256 = A: weight less than minimum +512 = A: weight greater than maximum +1024 = A: no weight calibration W = Warning; A = Alarm; see also note on "Heating status" on page 29
aD0!* * after **aM1!**, **aMC1!**, **aC1!**, **aCC1!**	**a<value1><value2><value3>** … … **<CR><LF>**	Send data **a** – sensor address **<value1>** – **Temperature electronics unit** (approximately the ambient temperature with time delay) [°C]: **pbb.e** (–50.0 … +70.0) [°F]: **pbbb.e** (–58.0 … +158.0) **<value2>** – **Supply voltage** **pbb.e** (+4.5 … 28.0) **<value3>** – **orifice rim temperature** [°C]: **pbb.e** (–50.0 … +70.0) [°F]: **pbbb.e** (–58.0 … +158.0)

More information on the SDI-12 standard commands can be found in the document *SDI-12; A Serial-Digital Interface Standard for Microprocessor-Based Sensors, Version 1.3* (see Internet page*www.sdi-12.org*).

6.2 Advanced SDI-12 commands

All advanced SDI-12 commands start with an "**O**" for OTT. With these commands it is possible, for example, to use the transparent mode of a datalogger to query additional information from an OTT Pluvio² or to configure an OTT Pluvio².

Command	Response	Description
▶ Read out firmware release		
aOOV!	**ac.cc.cc<CR><LF>**	Read out firmware version of the OTT Pluvio² **a** – sensor address **c.cc.ccc** – Firmware version Example: V1.00.00 (first firmware version supplied)
▶ Set/read the unit for the temperature measured values		
aOUTb! **aOUT!**	**ab<CR><LF>** **ab<CR><LF>**	Set unit Read out unit **a** – sensor address **b** – 0 = °C; factory setting 1 = °F

▶ Set/read the unit for the intensity measurements
(this command changes the units for "Accu…" and "Bucket…" at the same time; mm ↔ inch)

aOUIb!	**ab<CR><LF>**	Set unit
aOUI!	**ab<CR><LF>**	Read out unit
		a – sensor address
		b – 0 = mm/min; factory setting
		1 = mm/h
		2 = inch/min
		3 = inch/h

▶ Set/read pulse factor

aOSIb!	**ab<CR><LF>**	Set pulse factor
aOSI!	**ab<CR><LF>**	Read out pulse factor
		a – sensor address
		b – 1 = 0.1 mm; factory setting
		2 = 0.2 mm

▶ Set/read pulse output frequency

aOCIb!	**ab<CR><LF>**	Set output frequency
aOCI!	**ab<CR><LF>**	Read out output frequency
		a – sensor address
		b – 0 = 5 Hz; factory setting
		1 = 2 Hz

▶ Switch orifice rim heating on/off (OTT Pluvio² with orifice rim heating)

aOCHb!	**ab<CR><LF>**	Switch orifice rim heating on/off
		a – sensor address
		b – 0 = switch **off** orifice rim heating
		1 = switch **on** orifice rim heating

▶ Set target temperature of the orifice rim heating (OTT Pluvio² with orifice rim heating)

aOCHSbb!	**abb<CR><LF>**	Set target temperature of orifice rim heating
		a – sensor address
		b – 5 … 20 (+2 … +20 °C);
		factory setting +4 °C

▶ Set/read serial interface (SDI-12 or RS-485)

aOCLb!	**ab<CR><LF>**	Set serial interface
aOCL!	**ab<CR><LF>**	Read out serial interface
		a – sensor address
		b – 0 = SDI-12; factory setting
		1 = RS-485

▶ Set/read protocol on the RS-485 interface

aOCMb!	**ab<CR><LF>**	Set protocol
aOCM!	**ab<CR><LF>**	Read out protocol
		a – sensor address
		b – 0 = SDI-12 protocol; factory setting
		1 = 19200 bit/s
		2 = 9600 bit/s
		3 = 4800 bit/s
		4 = 2400 bit/s
		5 = 1200 bit/s
		RS-485 command line mode (ASCII text retrieval)

▶ Reset value "Accu total NRT"

aOMR!	**a1<CR><LF>**	Reset Accu total NRT
		a – sensor address

6.3 RS-485 command line mode (ASCII text retrieval)

When using the RS-485 interface, the default transmission protocol is the SDI-12 protocol. This assumes that the data recording device connected can process the SDI-12 protocol. The OTT netDL or OTT DuoSens dataloggers can handle this protocol.

To achieve simple system integration of the OTT Pluvio² into any measuring station infrastructure, a so-called command line mode is implemented in the OTT Pluvio². Using a compact command set in ASCII format, all measured values can be retrieved and various settings made. This command set must be programmed in the data recording device.

Switching to RS-485 command line mode

Set in the OTT Pluvio² operating software	Communication interface:	RS-485
	RS-485 protocol type:	ASCII text retrieval

Transmission parameters 1200 … 19.200 8 N 1 (can be set with the OTT Pluvio² operating software; sample interval < 30 s → baud rate ≥ 9600)

Units The units are set using the OTT Pluvio² operating software.
Temperature values: °C and °F
Intensity: mm/min and mm/h
inch/min and inch/h

Commands

M[separator]<CR> returns the measurements Intensity RT; Accu RT/NRT; Accu NRT; Accu total NRT; Bucket RT; Bucket NRT; Temperature load cell; Heating status and Status as a sequence of ASCII characters.
Immediately after the character **M**, any separator can follow optionally. This character then separates the individual values from each other in the response from the OTT Pluvio².

Format	**metric**	**imperial**
RT intensity	+0000.00/+00.00	+000.000/+0.000
Accu RT/NRT	+0000.00	+00.000
Accu NRT	+0000.00	+00.000
Accu total NRT	+0000.00	+00.000
Bucket RT*	+0000.00	+00.000
Bucket NRT*	+0000.00	+00.000
Temperature load cell	+00.0	+000.0
Status heating**	+000	+000
Status**	+000	+000

* observe note on page 29!
** for description of the status information, see Chapter 6.1

E<CR> additionally to the command **M** returns the values "Temperature electronics unit", "Supply voltage" and "Temperature orifice ring rim"

R<CR> resets the value "Accu total NRT" to zero

W<CR> switches the orifice rim heater on

S<CR> switches the orifice rim heater off

I<CR> retrieves various pieces of information from the device: Serial number, firmware, device version, unit, hardware index, PCB number, load cell number

Examples

M;<CR>
```
+0000.00;+0000.00;+0000.00;+0031.04;
+0463.60;+0463.62;+23.7;+000;+000;<CR><LF>
```

E;<CR>
```
+0020.61;+0000.40;+0000.27;+0028.22;+0587.66;+0585.96;
+24.4;+000;+000;+24.6;+13.0+24.3;<CR><LF>
```

R<CR>
```
OK<CR><LF>
```

W<CR>
```
Heating ON<CR><LF>
OK<CR><LF>
```

S<CR>
```
Heating OFF<CR><LF>
OK<CR><LF>
```

I<CR>
```
226770;V1.12.000;200;mm/min;d2;498680083;30405378<CR><LF>
OK<CR><LF>
```

Note: Each command **M!** or **E** resets the total measured values *Accu RT-NRT* and Accu NRT to zero!

7 Carrying out maintenance work

To guarantee trouble-free operation of the precipitation gauge, we recommend the following maintenance work is carried out at the intervals given:

▶ Emptying:	Bucket filling level ≥ 80 %
▶ Visual check:	once a year
▶ Check measurement:	once a year
▶ Add anti-freeze:	Environmental temperature < 0 °C; For details see below

7.1 Emptying the orifice rim heater

To prevent the collecting bucket overflowing, the bucket should be emptied after long periods of precipitation.

If the status information "+001"is present in the status signal (response to SDI-12 command "`aD2!`"), emptying is necessary (depending on region approx. 1 to 2 times a year).

You can empty the bucket contents at any time, independently of how full it is. Any overflowing of the collecting bucket will lead to inaccurate measurements, but will not damage the weighing mechanism.

- Unscrew the three knurled screws on the pipe housing.
- Remove pipe housing.
- Carefully remove the collecting bucket and empty it. If necessary, enlist the help of a second person.
  Caution: a full collecting bucket is very heavy! Depending on how full it is, it can weigh over 30 kg! Careless handling will result in a risk of injury from a falling collecting bucket! It is also possible that the weighing mechanism could be damaged!
- Position the pipe housing (note position of alignment aid).
- Retighten the three knurled screws.
- Alternatively, a pump can be used for emptying. For this it is not necessary to remove the pipe housing.

7.2 Adding anti-freeze solution for winter operation

For temperatures below 0 °C, we recommend adding anti-freeze agent to the collecting bucket. This anti-freeze causes the collected solid precipitation to gradually thaw in the collecting bucket. This also prevents substantial deformation of the bottom of the bucket – even if all of the collected precipitation freezes. Use POWERCOOL DC 924-PXL anti-freeze for this as an aqueous solution; see Appendix I – Accessories/replacement parts (manufacturer: Thermochema GmbH, A-4460 Losenstein, Austria; phone+43 7255 42440; www.thermochema.at.)

* constant negative temperatures throughout the day < approx. –5 °C. If positive temperatures occur during the day over a long period, no addition is necessary.

How to add the anti-freeze:

- Preparing the anti-freeze solution: Mix 5 litres of anti-freeze with 2 litres of water.
- Add the anti-freeze solution to the collecting bucket (the pipe housing does not have to be removed for this).
- If necessary after precipitation, carefully stir the anti-freeze manually (incorrect results can arise due to vibrations).

Please note: Fill the anti-freeze only as an aqueous solution (add 40 % water)! Never use undiluted! (POWERCOOL has hygroscopic properties.)

Note on disposing of anti-freeze solution:
Typically, the anti-freeze solution of a single precipitation gauge may be disposed of into the public sewage. However, observe all applicable local regulations. Please refer to your local authority responsible for questions regarding disposal and/or contact Thermochema GmbH.

Note on winter operation without anti-freeze:
Complete freezing of the collected precipitation with levels above approx. 200 mm precipitation usually leads to deformation of the bucket floor and tipping of the collecting bucket, so that the bucket is lying against the pipe housing (secondary path of force). This causes inaccurate measurement results.

Reliable winter operation without anti-freeze is thus only possible with bucket filling levels of less than 200 mm of precipitation. Regular checking and emptying is absolutely necessary in this case!

Note on third-party anti-freeze solution products:
Third-party products can be used under consideration of the following factors:
- Easily dissolved in water, with low density (no sinking of the anti-freeze under the water).
- Low evaporation (do not use methanol).
- Low corrosion with regard to aluminium and stainless steel.
- Low freezing point even with high filling level in the collecting bucket.
- Low hygroscopic properties (absorption of moisture from the air, which would affect the measurement results).
- Note chemical compatibility with collecting bucket (ASA and polyethylene).
- No gumming after use in open containers for several months.

7.3 Carrying out visual check

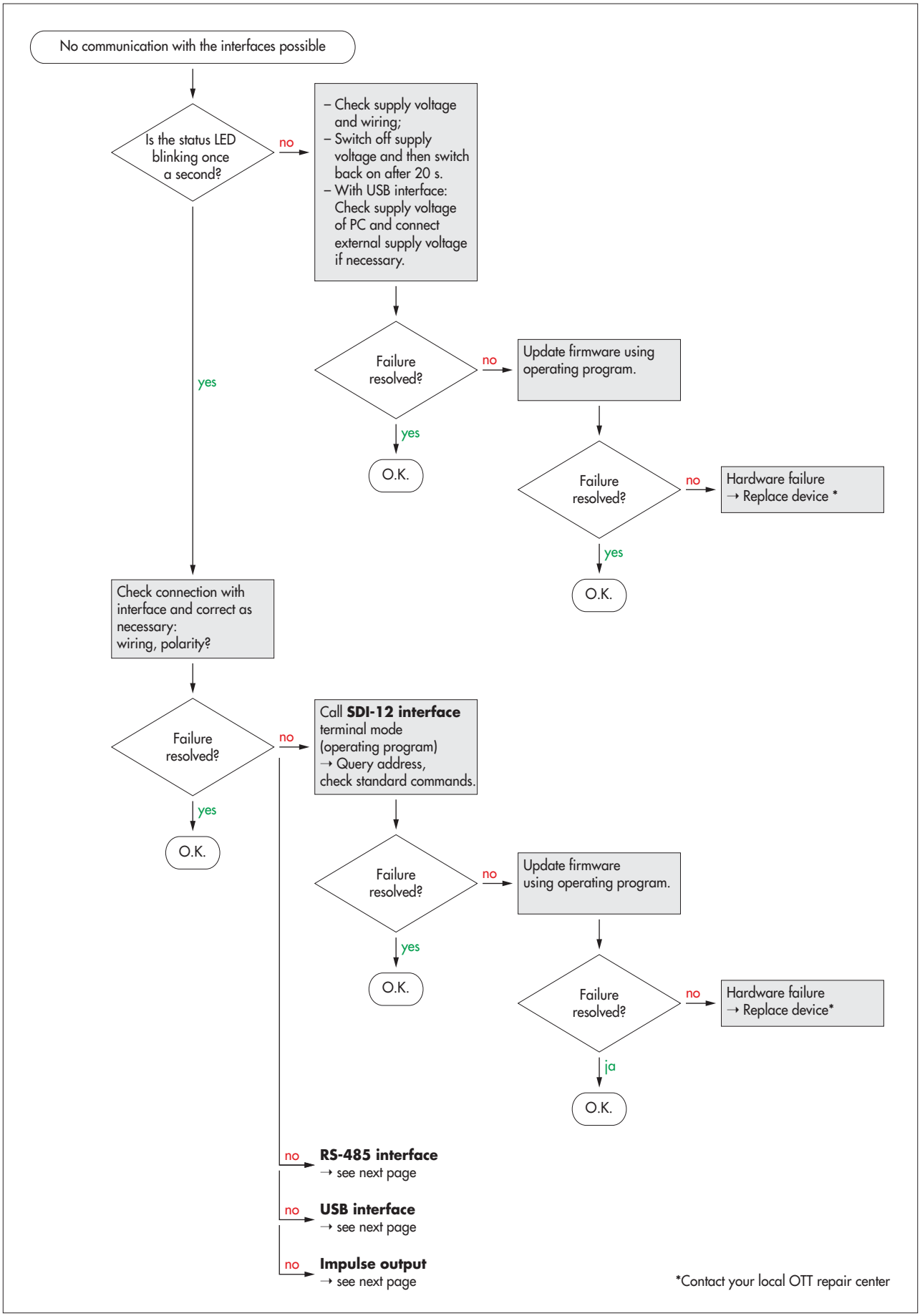
- Check the ease of movement of the collecting bucket in all directions at the lower edge of the bucket orifice. To do this, with the pipe housing closed, move the bucket slightly with a sideways tap on the inside. The upper bucket edge must not contact the housing.
  Note: A short movement can affect the measured value “Intensity RT” (short delay time)!
- If present, carefully remove dirt (e.g. insects, insect nests, spiders’ webs, etc.) and ice.

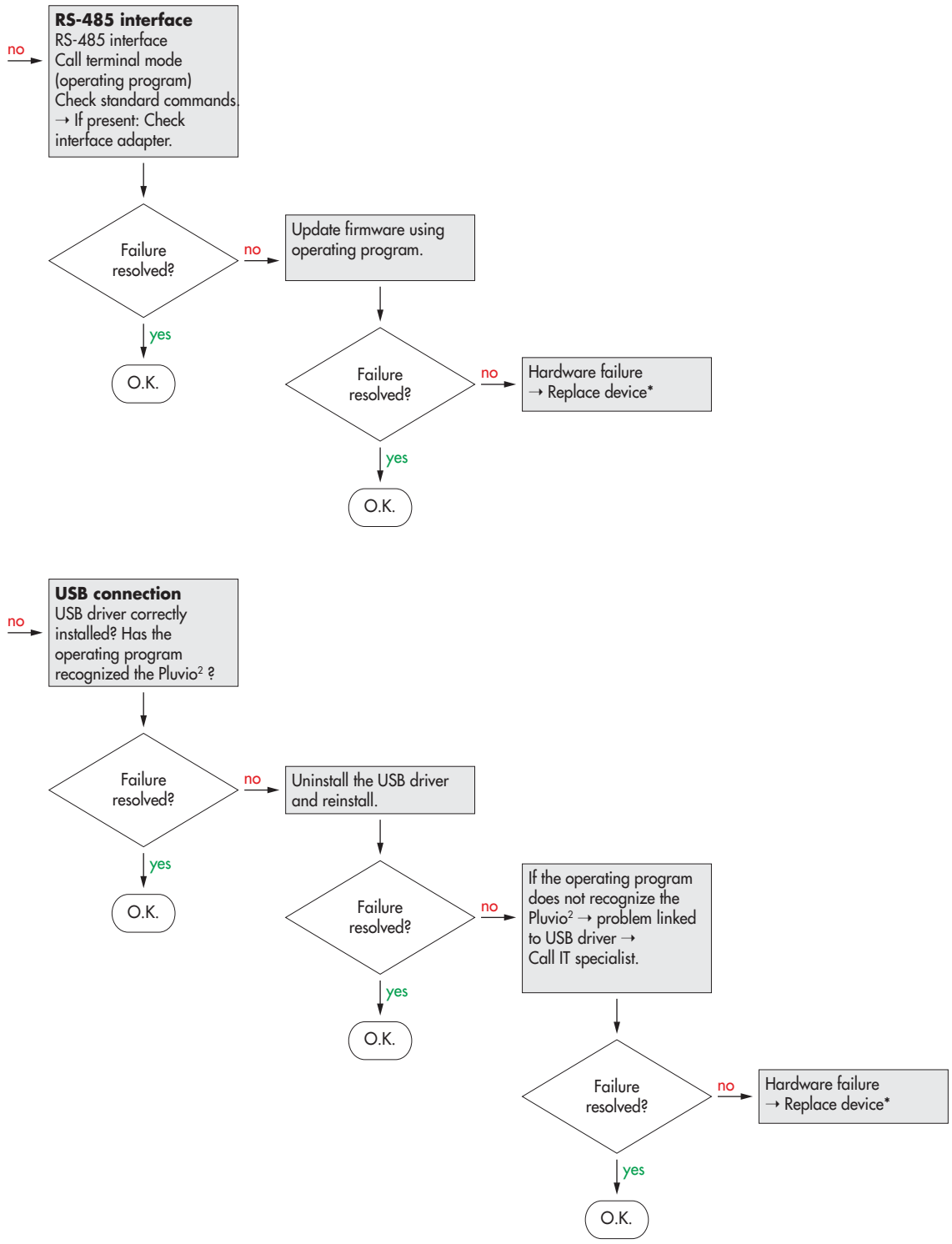
7.4 Additional checks in cases of defect

- Transportation lock removed?
- Is the bucket distorted?
- Is the bucket standing securely on the bucket support?
- Is the pipe housing positioned correctly and undamaged?
- Does the moving part of the weighing mechanism makes contact with fixed parts?
- Is the LED flashing? See also Chapter 7.5

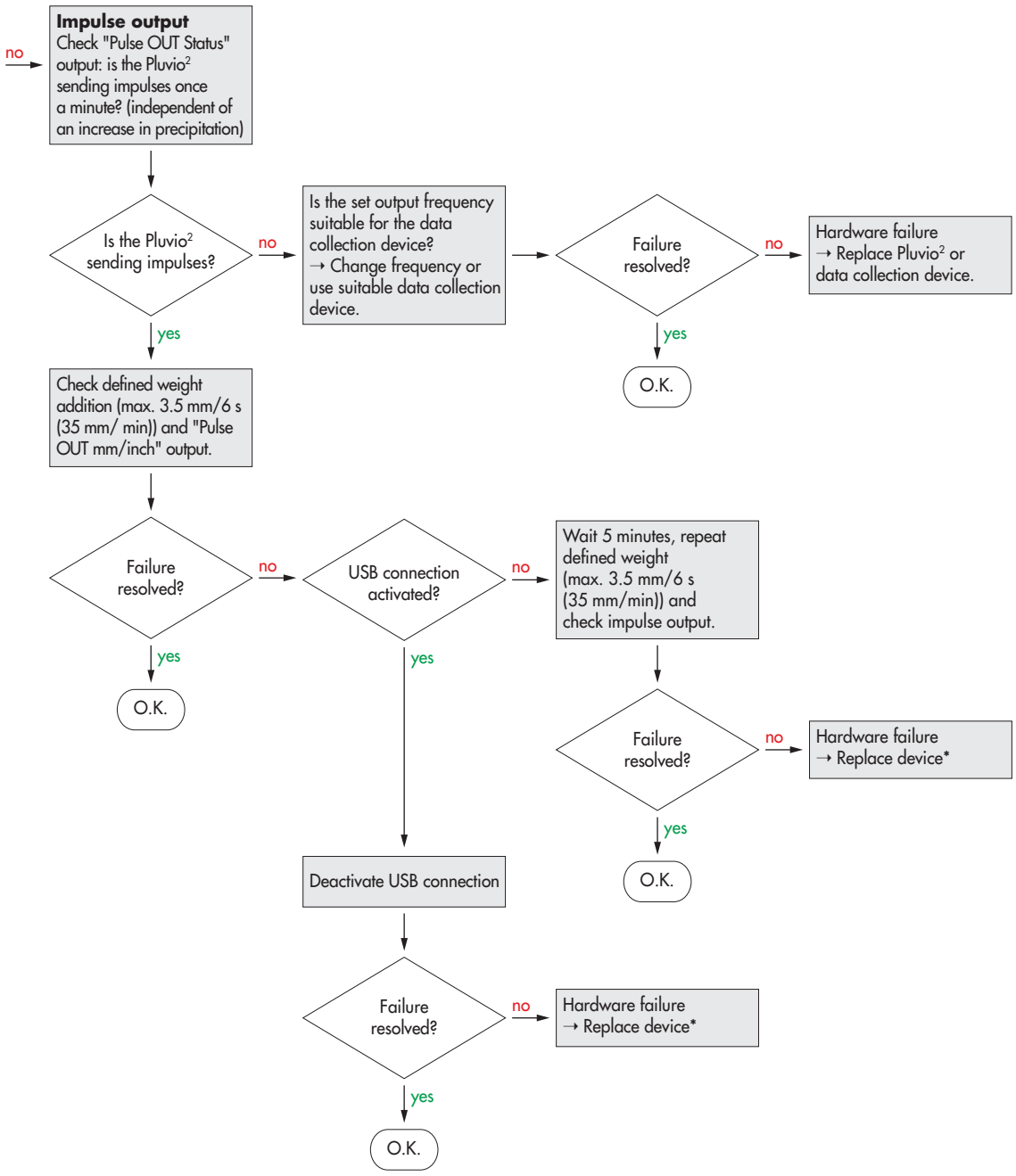
- If in doubt, carry out an accuracy test as described in Chapter 7.6.

7.5 Troubleshooting

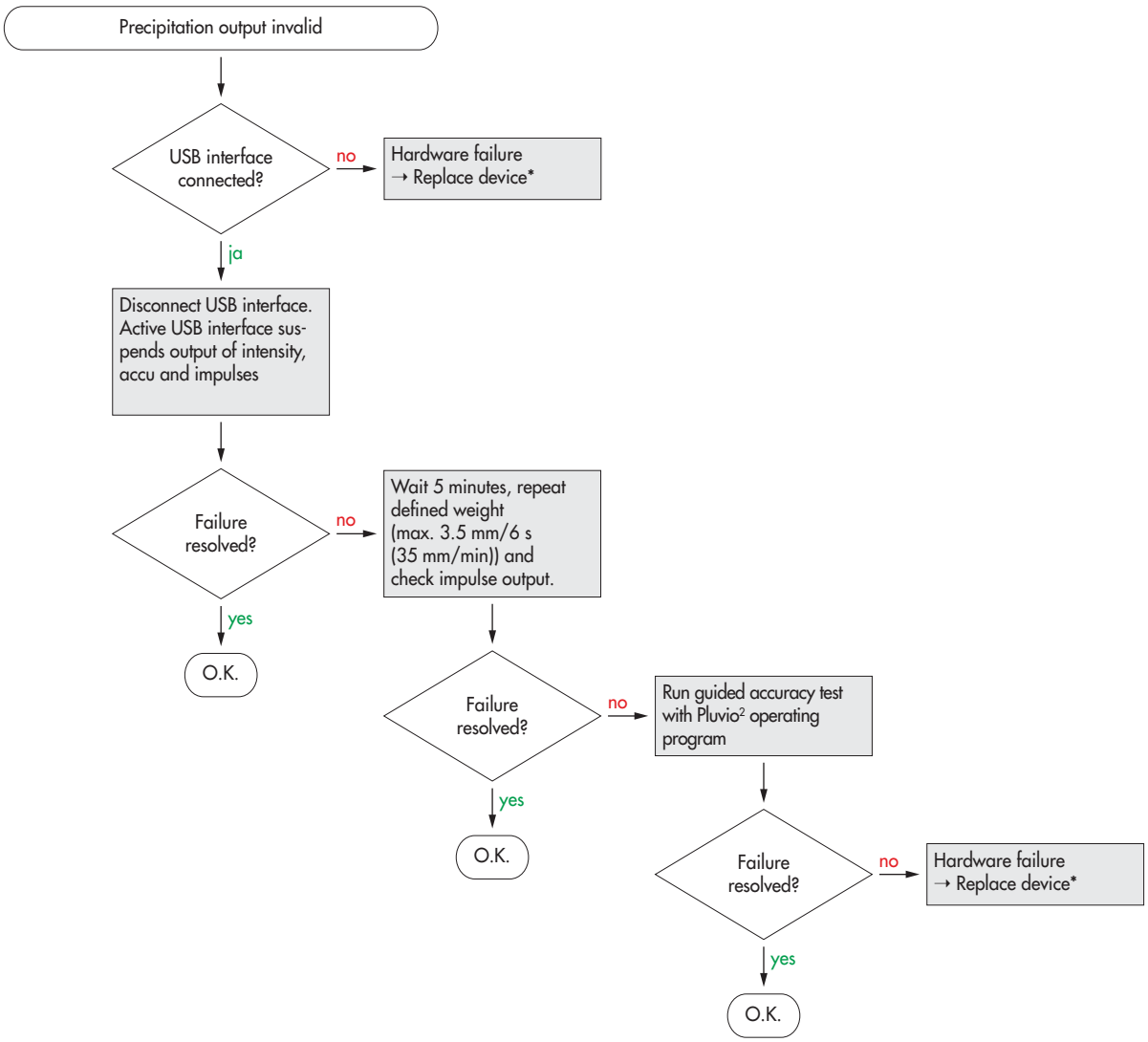




*Contact your local OTT repair center



*Contact your local OTT repair center



*Contact your local OTT repair center

7.6 Carrying out guided accuracy test (check measurement)

The OTT Pluvio² operating program is supplied with the OTT Pluvio² on the CD-ROM "OTT Pluvio² Software". With the help of this software, you can carry out a Guided Accuracy Test. Using this test, the OTT Pluvio² can be simply and quickly checked on site for correct function.

With the OTT Pluvio² operating program, you can also make basic settings for the OTT Pluvio², start a measurement or carry out a software update.

Please note: Only carry out the accuracy test on calm days with no precipitation! (Otherwise, the test will be affected by wind and unwanted precipitation.) The USB interface also supplies operating voltage to the OTT Pluvio². An additional attached power supply is not necessary, but it does not have to be removed for this.

Preparatory work

- Install the OTT Pluvio² operating software on a notebook with a Microsoft Windows 7 operating system or higher: For this, copy the file "Pluvio2Param.exe" to any folder on the PC.
- Install the USB interface driver (FTDI driver) on the notebook: Log on to the PC using administrator privileges! Copy the file "CDM 2.08.22.exe" [1] to any directory on the PC. Connect the OTT Pluvio² to the PC using a USB cable (supplied). See Figure 19. Close the hardware installation assistant that automatically starts and run the file "CDM 2.08.02.exe" [1].

[1] or higher version

Carrying out the accuracy test

- Unscrew the three knurled screws on the pipe housing.
- Remove pipe housing and collecting bucket.
- Connect the OTT Pluvio² to the PC using a USB cable (supplied). See Figure 19.
- Start the OTT Pluvio² operating software.
- Launch the "Guided Accuracy Test" function. A wizard now guides you through the accuracy test. Ensure you follow all the work steps and notes shown on the display.
- At the end of the accuracy test, remove the USB cable.
- Replace the cover for the USB interface.
- If necessary, empty the collecting bucket and put it back.
- Position the pipe housing (note position of alignment aid).
- Retighten the three knurled screws.

Please note: After attaching the USB interface, the OTT Pluvio² interrupts communication on the other interfaces!

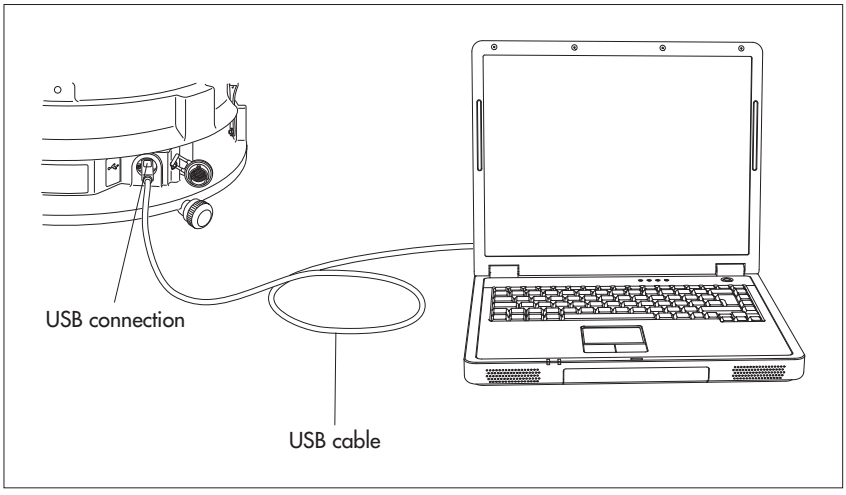


Fig. 19: Connecting the OTT Pluvio² to the PC using the USB interface.

8 Maintenance

- In case of a device malfunction, use Section 7.5 to see if you can resolve the problem yourself.
- In case of unit failure, please contact the OTT repair centre:

OTT Hydromet GmbH
Repaircenter
Ludwigstrasse 16
87437 Kempten · Germany
Telephone +49 831 5617433
Fax +49 831 5617489
repair@ott.com

Please note: Only have a defective OTT Pluvio² checked and repaired by the OTT repair centre! Never attempt to repair the unit yourself! Any repairs or attempted repairs carried out by the client will void any warranty.

After being properly trained, expressly authorized partner companies or clients are allowed to perform repairs on their own. For more information, please contact the OTT Hydroservice department.

9 Notes on the disposal of old units

Within the member countries of the European Union
In accordance with the European Union guideline 2002/96/EC, OTT takes back old devices within the member countries of the European Union and disposes of them in an appropriate way. The devices concerned by this are marked with the symbol shown aside.

- FFor further information on the return procedure, please contact your ocal sales contact. You will find the addresses of all sales partners in the internet on *www.ott.com*. Please take into consideration also the national implementation of the EU guideline 2002/96/EC of your country.

For all other countries

- Dispose of the OTT Pluvio² properly after taking out of service.
- Observe any applicable local regulations for the disposal of electronic devices!
- Never put the OTT Pluvio² into the normal household waste.

Materials used:

Base plate:	Aluminium
Collecting bucket:	Polyethylene, PE
Bucket overlay:	ASA
Pipe housing:	ASA

The material identification is found on the component itself for plastic parts.

10 Technical data

Supply voltage	5.5 … 28 V_{DC}; typ. 24 V_{DC}; reverse-polarity protected
Current consumption	≤ 5 mA at 12 V
Power consumption	≤ 60 mW
Recordable precipitation	liquid, solid, mixed
Recordable precipitation amount	
Version 200	1,500 mm
Version 400	750 mm
Resolution	
intensity	0.01 mm/min or mm/h
Precipitation amount	0.01 mm
Accuracy	refer to "Limits/accuracy"
Measuring range	
bucket content	750/1,500 mm ≙ 30 l
Collecting area	
Version 200	200 cm^2 (Ø 159.6 $^{\pm 0.3}$ mm)
Version 400	400 cm^2 (Ø 225.7 $^{\pm 0.4}$ mm)
Sample interval (poll)	1 minute … 60 minutes
Output delay	
Real-time	< 1 minute
Non-real-time (filtered measurements)	5 minutes (collecting period is max. 60 minutes)
Interfaces	
USB	version 1.1 (only for service purposes – no overload protection!)
SDI-12	version 1.3
RS-485 (two-wire configuration, 19200 8 N 1)	SDI-12 protocol and RS-485 command line mode
Pulse output	2 or 5 Hz
Measurement/status values output	Intensity RT, Accu RT/NRT, Accu NRT, Accu total NRT, Bucket RT, Bucket NRT, Temperature of load cell, OTT Pluvio² status, Heating status
Supply voltage orifice rim heating	12 … 28 V_{DC}; typ. 12/24 V_{DC}; reverse-polarity protected (no galvanic isolation of the power supply for the orifice rim heating and the precipitation gauge necessary)
Current consumption	
OTT Pluvio² 200	typ. 2.1 A; max. 2.2 A
OTT Pluvio² 400	typ. 4.2 A; max. 4.4 A
Heating power	
OTT Pluvio² 200	at 12 V*: 12.5 Watt at 24 V: 50 Watt
OTT Pluvio² 400	at 12 V*: 25 Watt at 24 V: 100 Watt
	* temperature ramp of the orifice rim temperature restricted to 12 K (...200) / 7 K (… 400) (wind speed 0 m/s each).
Operating range of the orifice rim heater (ambient temperature)	–40 … +20 °C
Measuring range of the orifice rim temperature	–20 … +40 °C
Target temperature of orifice rim	+2 … +8 °C; factory setting: +4 °C
Accuracy of target temperature	±1 °C
Dimensions Ø x H	450 mm x 670 mm
Weight (empty)	approx. 15 kg
Housing material	
Base plate	stainless steel/aluminium
Collecting bucket	polyethylene
Bucket overlay	ASA
Pipe housing	ASA, UV resistant
Degree of protection	
Pipe housing closed	IP 65 (resistant to salt fog)
Pipe housing open	IP 63
Load cell:	IP 67

Temperature range	
Operation	–40 … +60 °C
Storage	–50 … +70 °C
Temperature compensation	–25 … +45 °C
Max. wind speed with accuracy maintained	33 m/s
Max. wind speed without device fault	50 m/s
Relative humidity	0 … 100 %, non-condensing
EMC	complies with EN 61000-4-2/3/4/5/6

CE

Value	Unit	Measuring range 1. Value = threshold	Resolution	Accuracy absolute	Accuracy relative	Output delay -
				the larger value in each case counts		minutes
SDI-12/RS-485 interface						
▶ Intensity RT	mm/h	6.00 … 3,000.00	0.60	±6	±1 %	<1
	mm/min	0.10 … 50.00	0.01	±0.1	±1 %	<1
▶ Accu RT/NRT	mm	0.05 … 500.00	0.01	±0.1	±1 %	1 … 65
▶ Accu NRT	mm	0.05 … 500.00	0.01	±0.1	±1 %	5 … 65
▶ Accu total NRT	mm	0.05 … 500.00	0.01	±0.1	±1 %	5 … 65
▶ Bucket RT	mm	20.00 … 1,800.00	0.01	±0.1	±0.2 %	<1
▶ Bucket NRT	mm/h	20.00 … 1,800.00	0.01	±0.1	±0.2 %	<5
▶ Temperature of load cell	°C	–50.0 … +70.0	0.1	±1		<1
▶ Heating status		0 … 128	1			<1
▶ Status OTT Pluvio[2]		0 … 1024	1			<1
▶ Temperature electronics unit	°C	–50.0 … +70.0	0.1	±1		<1
▶ Supply voltage	V	+4.5 … +28.0	0.1	±0.5		<1
▶ Temperature electronics unit	°C	–50.0 … +70.0	0.1	±1		<1
Pulse outputs						
▶ Pulse status information		0 … 128	1			<1
▶ Pulse-Accu RT-NRT	mm					
– Output frequency 2 Hz		0.1 … 12.0* / 0.2 … 24.0**	0.1/0.2	±0.1/0.2	±1 %	<1
– Output frequency 5 Hz		0.1 … 30.0* / 0.2 … 60.0**	0.1/0.2	±0.1/0.2	±1 %	<1

* Pulse factor: 0.1 ** Pulse factor: 0.2

Appendix A – Connecting the OTT Pluvio² to an OTT datalogger

A.1 Connecting the OTT Pluvio² to an OTT netDL or OTT DuoSens via SDI-12 or RS-485 interface

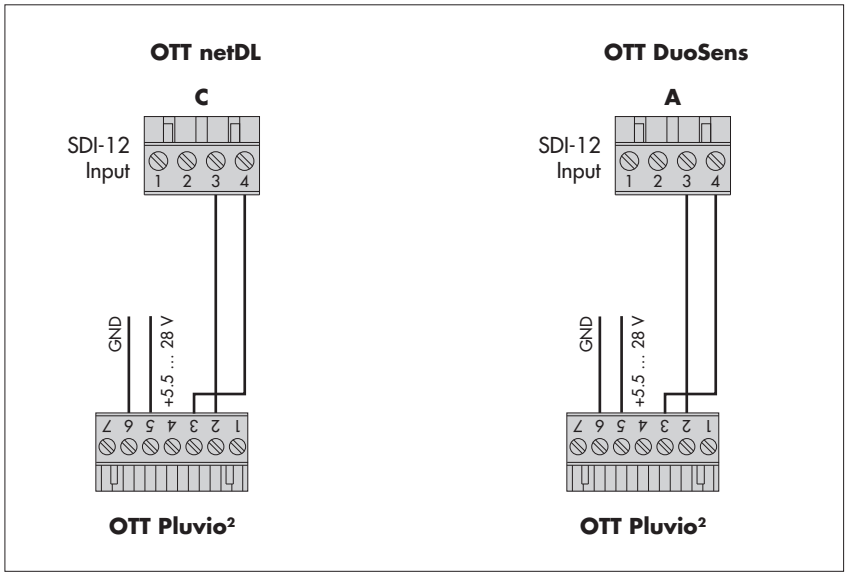
Method A: Connecting the OTT Pluvio² via the SDI-12 interface (protocol and physical interface: SDI-12). The maximum length of the cable is 70 m!

- Connect the OTT Pluvio² to the OTT netDL or the compact datalogger OTT DuoSens IP datalogger as shown in Figure A1. Also take note of the operating instructions for the OTT netDL/OTT DuoSens.

Fig. A1: Connecting the OTT Pluvio² to an OTT netDL or OTT DuoSens via the SDI-12 interface.

The letters above the screw terminal strips identify the connectivity options available on the OTT netDL/OTT DuoSens.

For this application, only the 7-pin screw terminal strip is needed.



Method B: Connecting the OTT Pluvio² using the physical RS-485 interface (SDI-12 protocol via physical RS-485 interface). The maximum length of the cable is 1,000 m!

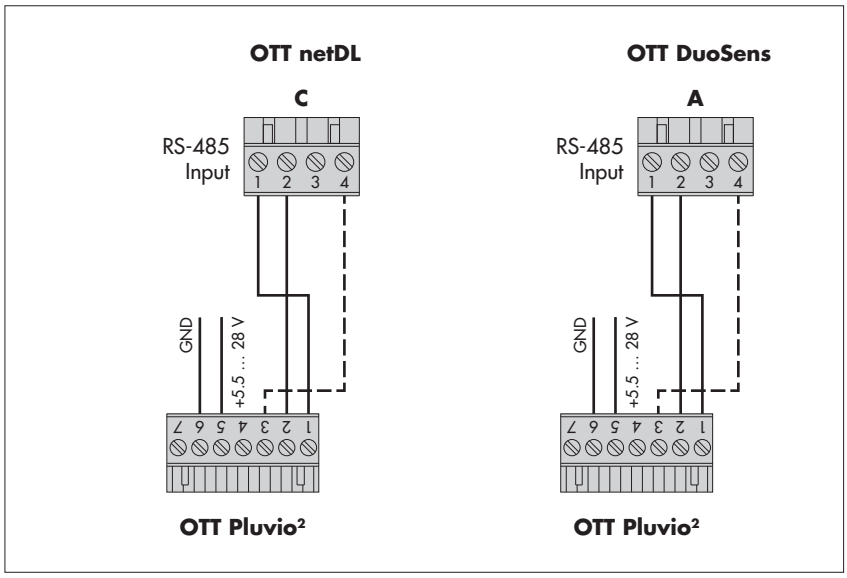
- Connect the OTT Pluvio² to the OTT netDL or the compact datalogger OTT DuoSens IP datalogger as shown in Figure A2. Also take note of the operating instructions for the OTT netDL/OTT DuoSens.

Fig. A2: Connect the OTT Pluvio² using the RS-485 interface (SDI-12 protocol) to the OTT netDL or OTT DuoSens.

The letters above the screw terminal strips identify the connectivity options available on the OTT netDL/OTT DuoSens.

For this application, only the 7-pin screw terminal strip is needed.

The GND connection represented by the dashed line is necessary only where the OTT Pluvio² and the OTT netDL/ OTT DuoSens are powered by separate power supplies.



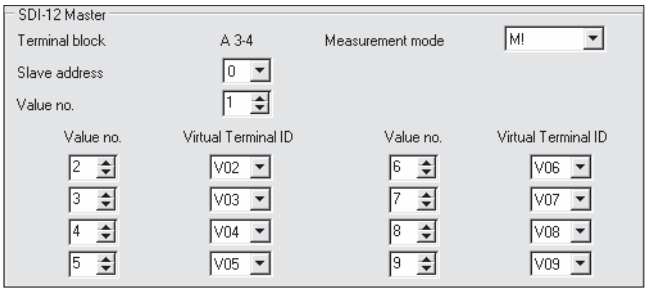
Configuring the OTT netDL/OTT DuoSens for the OTT Pluvio² with SDI-12 interface

- Create an OTT netDL/OTT DuoSens channel with *SDI-12 Master* or *OTT SDI RS485* function block (*serial sensors* tab).
- Make the following settings:

Fig. A3: Setting the operating parameters of the OTT netDL/OTT DuoSens *SDI-12 Master* function block.

The function block *OTT SDI RS485* is set in the same way.

(Example shown: OTT DuoSens).



- Terminal block — OTT netDL *SDI-12 Master*: C 3-4 (specified); OTT netDL *OTT SDI RS485*: C 1-2 (specified); OTT DuoSens *SDI-12 Master*: A 3-4 (specified); DuoSens *OTT SDI RS485*: A 1-2 (specified) terminal block used (screw terminal strip) of the OTT netDL/OTT DuoSens.
- Slave address — SDI-12 bus address. Each slave address may be assigned only once on an SDI-12 bus line. (check/set: refer to OTT netDL/OTT DuoSens Operating Instructions, Chapter *SDI-12 Transparent Mode*.) Typical setting: *0* (only one OTT Pluvio² is connected to the terminal block: no bus operation).
- Value no. — Identifies which value (the xth of *n* values) of the OTT Pluvio² is recorded in this channel. Typical setting: *1* (first one of nine (Measuring mode*M!*) or three (Measuring mode*M1!*) measured values)
- Measuring mode — *M!* or *M1!* (for allocating the measured values, refer to Chapter 6, *SDI-12 commands and responses*)
- Measured value no./ Virtual terminal no. — Allocating the additional measured values of the OTT Pluvio² to virtual terminals (for allocating the measured values, refer to Chapter 6, *SDI-12 commands and responses*).
- Concurrent mode — only with OTT netDL. See online help for operating program
- Instantaneous value — only with OTT netDL. See online help for operating program

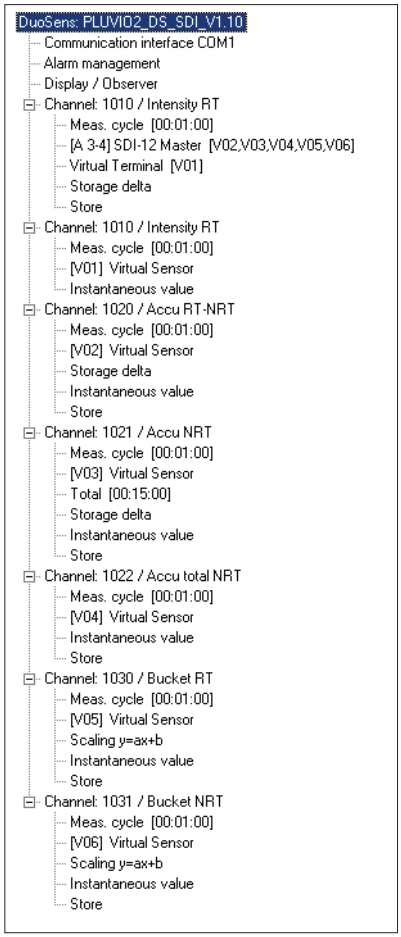
- In the respective *channel* function blocks, set the required units and number of digits after the decimal place.

Notes:

- For recording all the 12 measured values + status information for an OTT Pluvio², 12 channels in the OTT netDL/OTT DuoSens are thus necessary. The first channel contains the function block *SDI-12 Master* or *OTT SDI RS485* as the input signal. The other channels each contain one function block as the input signal *virtual sensor* (V02 to V09) as the input signal, (V03 in case of *M1!*).
  Of course, just individual channels can also be recorded. In this case, there are fewer entries required in the *Value no./Virtual terminal ID* field.
- Further information on the SDI-12 commands and responses used can be found in Chapter 6, *"SDI-12 commands and responses"*.
- The OTT Pluvio² makes the measurement results available for retrieval 1 second after the **`aM!`** and **`aM1!`** SDI-12 commands.

Fig. A4: Example configuration of an OTT DuoSens with 6 values recorded.

Further configuration examples can be found on the *OTT Pluvio² Software* CD-ROM.



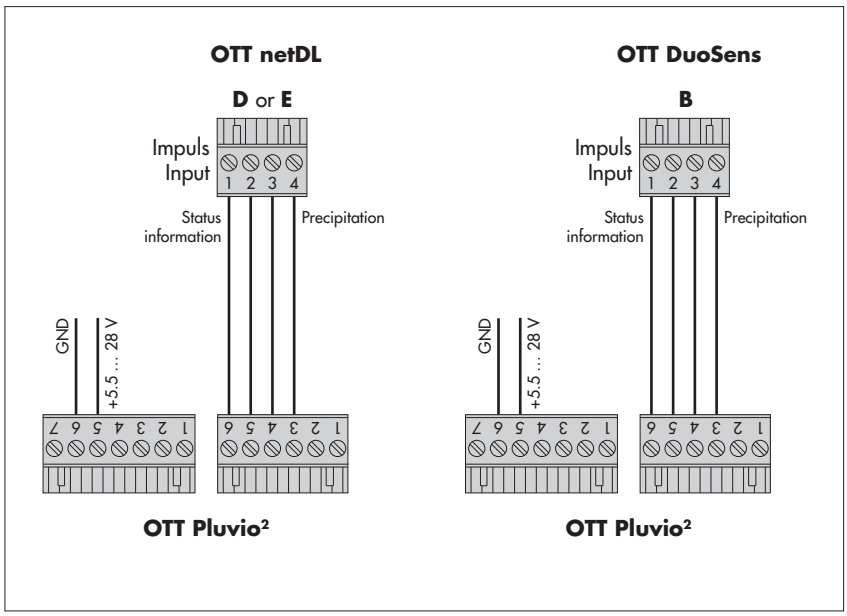
A.2 Connecting the OTT Pluvio² to an OTT netDL or OTT DuoSens via the pulse output.

- Connect the OTT Pluvio² to the IP datalogger OTT netDL or the compact datalogger OTT DuoSens as shown in Figure A5.
  Also take note of the operating instructions for the OTT netDL/OTT DuoSens.
  Maximum cable length 1,000 m.

Fig. A5: Connecting the OTT Pluvio² to an OTT netDL or OTT DuoSens via the pulse output.

The letters above the screw terminal strips identify the connectivity options available on the OTT netDL/OTT DuoSens.

One pulse input of the OTT netDL/DuoSens is used in each case for the precipitation amount and the status information.



Configuring the OTT netDL/OTT DuoSens for the OTT Pluvio² with pulse output

- Create two OTT netDL/OTT DuoSens channels with function blocks *Pulse input* (*Digital Sensors* tab). (If you only want to record the amount of precipitation, one function block is sufficient.)
- Make the following settings:

Fig. A6: Setting operating parameters of the OTT netDL/OTT DuoSens *pulse input* function block (example shown: OTT DuoSens).

▶ Terminal block	OTT netDL:	D 1-2, D 3-4, E 1-2 or E 3-4
	OTT DuoSens	B 1-2 or B 3-4
▶ Pulse factor	Pulse factor	
	– Precipitation amount:	0.1 or 0.2 (one pulse corresponds to 0.1 mm, or 0.2 mm of precipitation.)
	– Status information:	1
▶ Debounce delay [ms]	Only for OTT netDL: time in milliseconds during which the pulse input is disabled after recording a pulse. This prevents the OTT netDL recording unwanted pulses caused by "bouncing" switch contacts. Set to 8 ms for OTT Pluvio².	

Please note:

– always position a pulse input at the beginning (top) of the function tree.
– After changing the pulse factor, a data reset (reset the OTT netDL/OTT DuoSens) is necessary!

- In the *Channel* function block, set the required unit and number of digits after the decimal place.

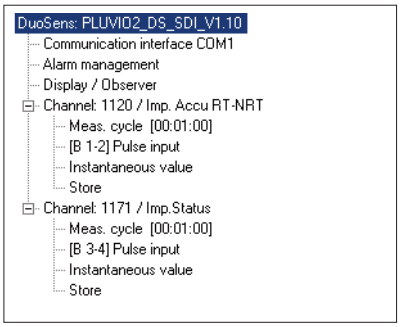
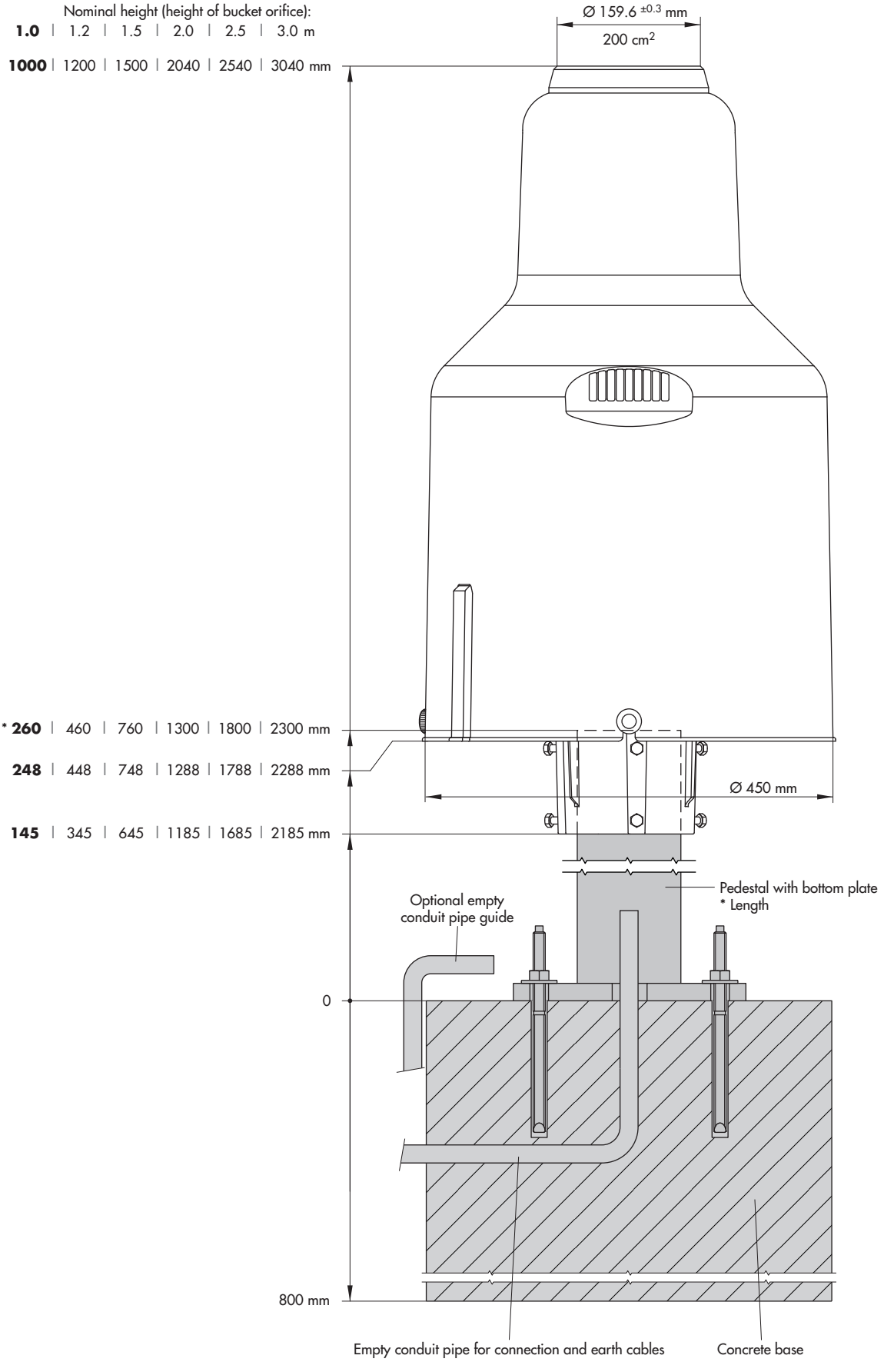


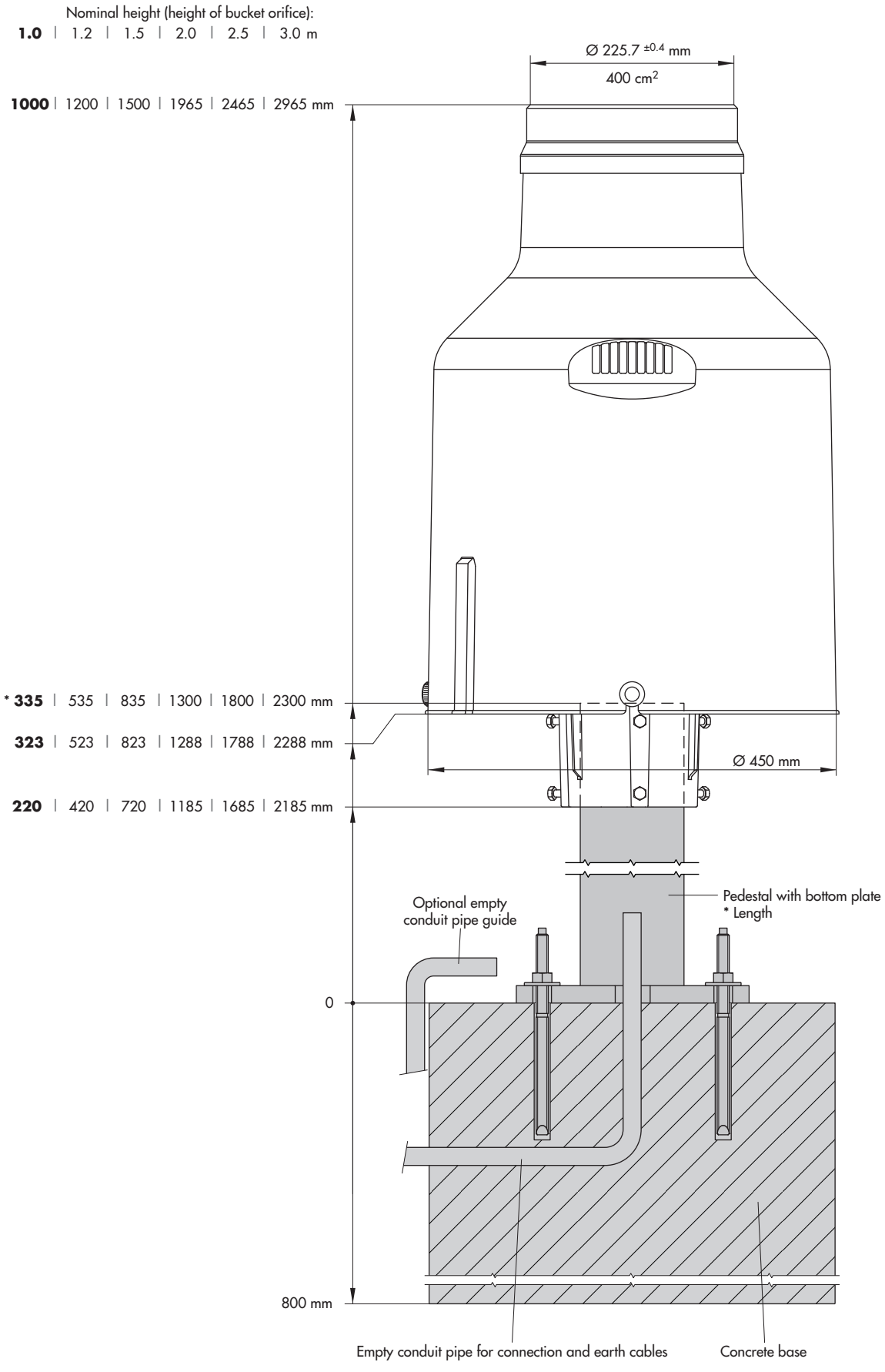
Fig. A7: Example configuration of an OTT DuoSens with 2 values recorded.

Further configuration examples can be found on the *OTT Pluvio² Software* CD-ROM.

Appendix B – Dimensions of the OTT Pluvio² 200 with pedestal and bottom plate



Appendix C – Dimensions of the OTT Pluvio² 400 with pedestal and bottom plate



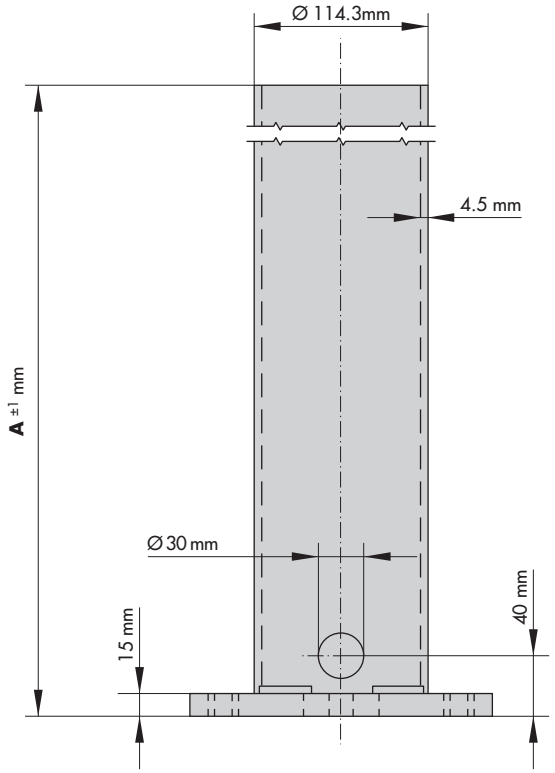
Appendix D – Dimensions of pedestal with bottom plate

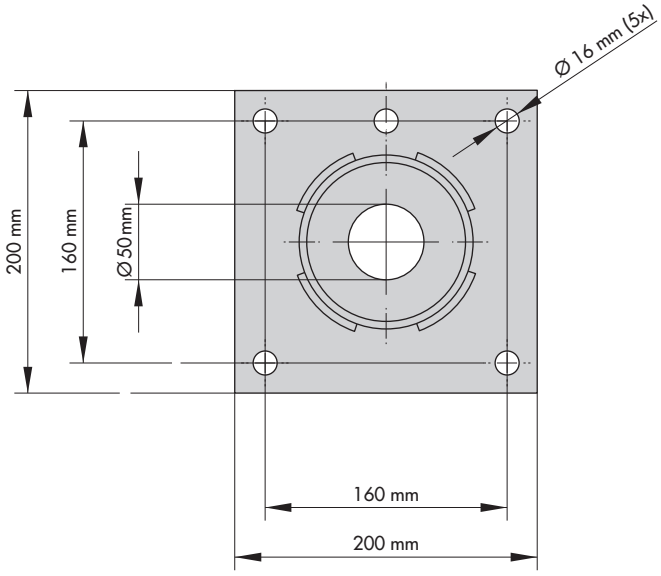
Dimension A

for OTT Pluvio² …	**200**	**400**
Nominal height **1.0 m**	260 mm [1]	335 mm [2]
Nominal height **1.2 m**	460 mm [3]	535 mm [4]
Nominal height **1.5 m**	760 mm [5]	835 mm [6]
Nominal height **2.0 m**	1300 mm [7]	
Nominal height **2.5 m**	1800 mm [8]	
Nominal height **3.0 m**	2300 mm [9]	

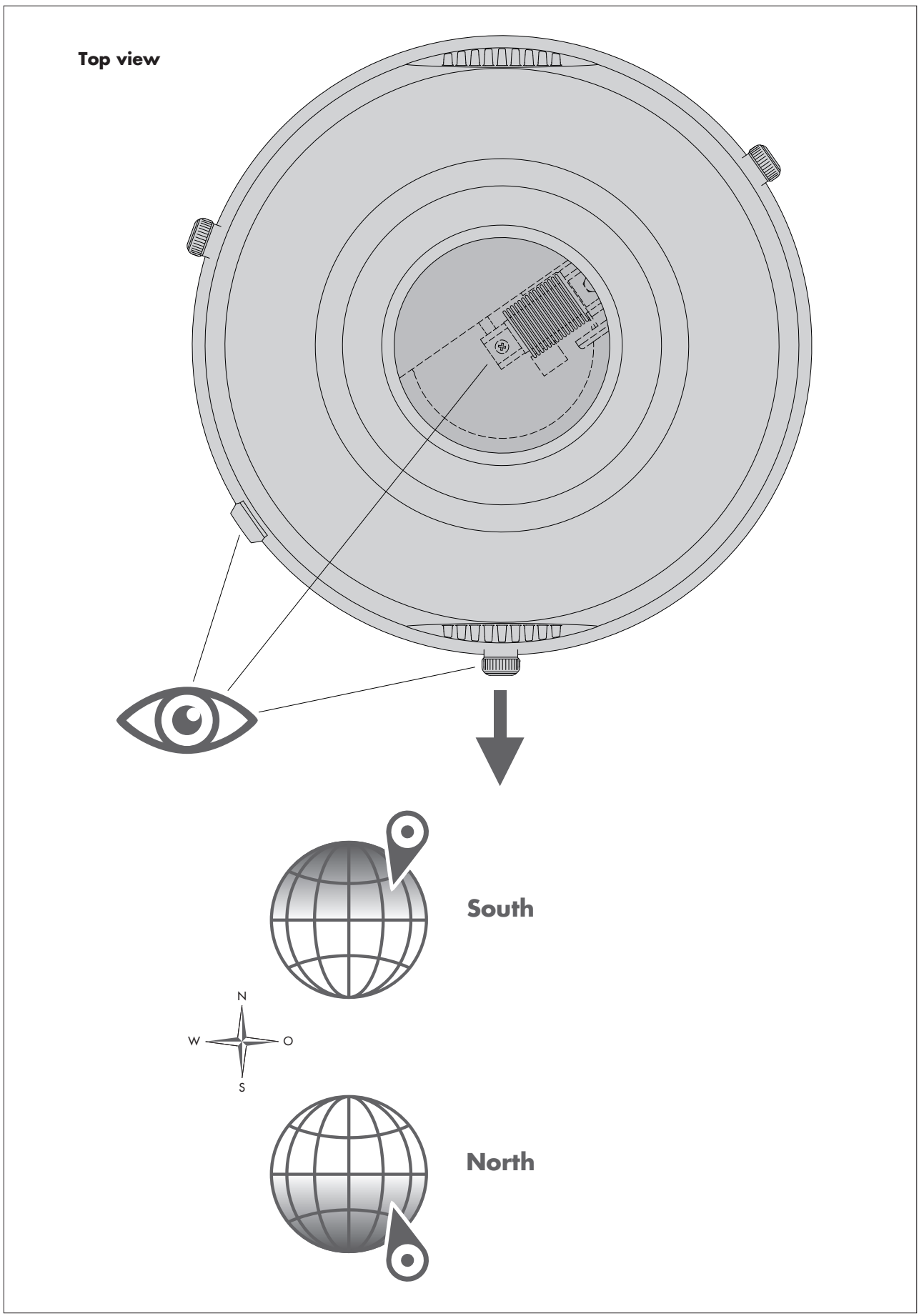
Order numbers

[1] 70.020.060.9.2 [2] 70.020.061.9.2
[3] 70.020.068.9.2 [4] 70.020.067.9.2
[5] 70.020.062.9.2 [6] 70.020.063.9.2
[7] 70.020.064.9.2
[8] 70.020.066.9.2
[9] 70.020.065.9.2



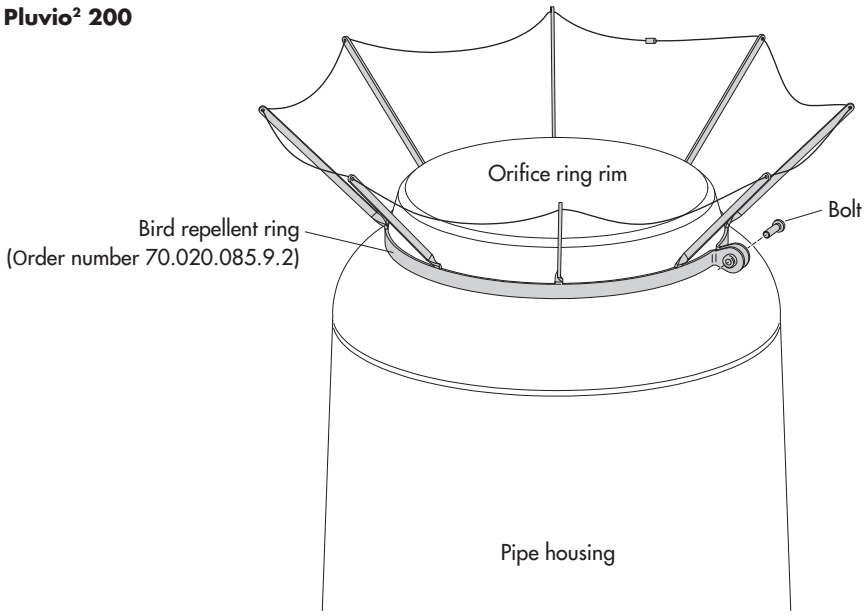


Appendix E – Aligning the OTT Pluvio²

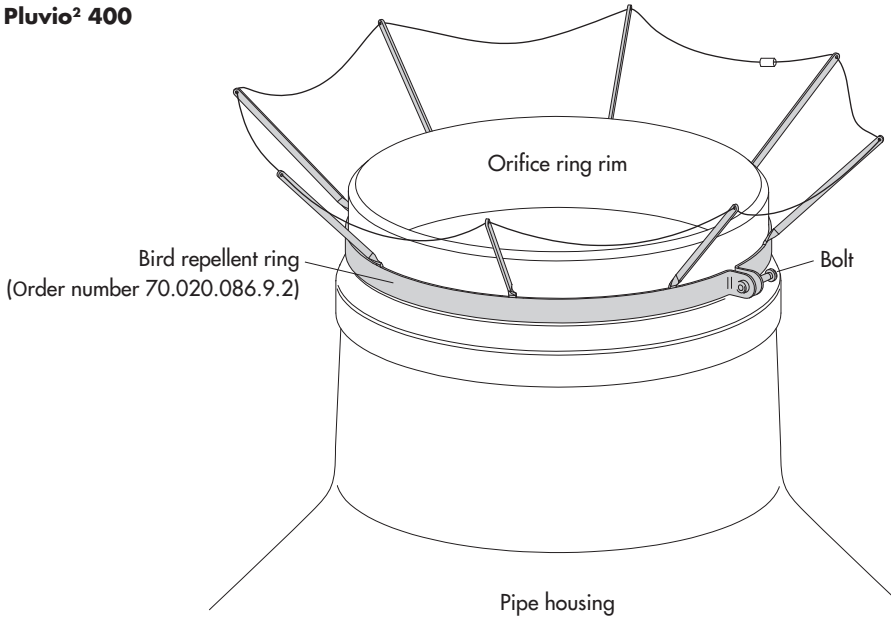


Appendix F – Installing the bird repellent ring

OTT Pluvio² 200



OTT Pluvio² 400



Appendix G – Declaration of conformity OTT Pluvio²

CE

Konformitätserklärung
Declaration of Conformity
Declaration de Conformité

Wir/ We/ Nous
Anschrift/ Address/ Adresse

OTT Messtechnik GmbH & Co. KG
Ludwigstraße 16
D-87437 Kempten

erklären, dass das Produkt/ declare that the product/ declarons que le produit

Bezeichnung/ Name/ Nom	**OTT Pluvio²**
Artikel- Nr./ Article No./ No. d' Article	**70.020.000.9.0, 70.020.001.9.0** **70.020.020.9.0, 70.020.021.9.0**

mit den Anforderungen der Normen übereinstimmt./ fulfills the requirements of the standard./ satisfait aux exigences des normes.

EG (2004/108/EG):

national:	international:
EN 61000-6-3	IEC 61000-6-3
Störaussendung/ emission/ émission	
Klasse/ class/ classe B	class/ classe B
Störfestigkeit/ noise immunity/ immunité	
EN 61000-6-2	IEC 61000-6-2
EN 61000-4-2 (4 kV/8 kV)	IEC 61000-4-2 (4 kV/8 kV)
EN 61000-4-3 (10 V/m)	IEC 61000-4-3 (10 V/m)
EN 61000-4-4 (2 kV)	IEC 61000-4-4 (2 kV)
EN 61000-4-5 (4 kV)	IEC 61000-4-5 (4 kV)
EN 61000-4-6 (10 V)	IEC 61000-4-6 (10 V)

Ort und Datum der Ausstellung/
Place and Date of Issue/
Lieu et date d' établissement

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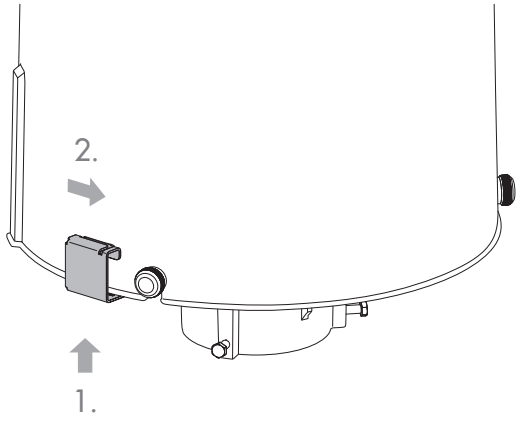
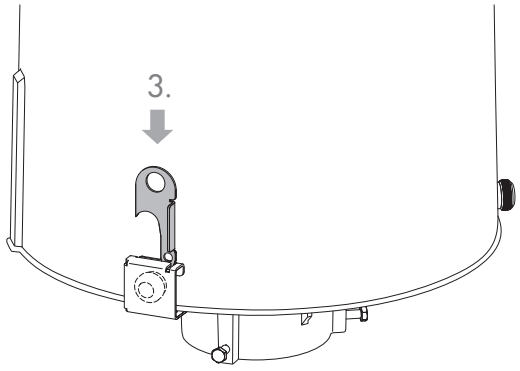
Name und Unterschrift des Befugten/
Name and Signature of authorized person/
Nom et signature de la personne autorisée

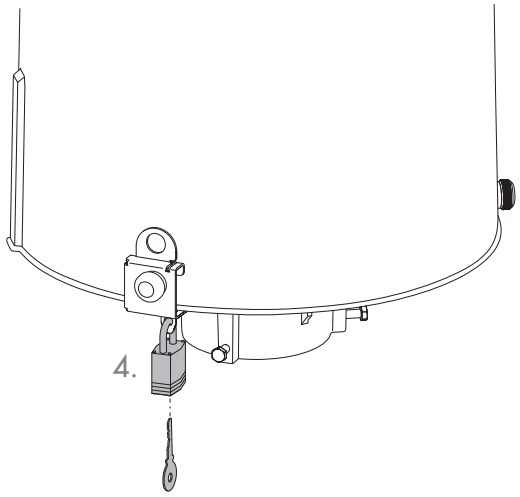
Dr. Anton Felder
(CEO)

OTT MESSTECHNIK GmbH & Co. KG
Postfach 21 40 · 87411 Kempten
Ludwigstraße 16 · 87437 Kempten
Tel.: +49(0)831/5617-0
Fax: +49(0)831/5617-209
info@ott.com
www.ott.com

Appendix H – Installing the anti-theft protection







Appendix I – Accessories/replacement parts

Accessories

4" pedestal with bottom plate; for installation height 1.0 m	
– for OTT Pluvio² 200: Length 260 mm	70.020.060.9.2
– for OTT Pluvio² 400: Length 335 mm	70.020.061.9.2
– with bottom plate for securing to concrete foundation	
– Installation (height of bucket orifice): 1.0 m	
4" pedestal with bottom plate; for installation height 1.2 m	
– for OTT Pluvio² 200: Length 460 mm	70.020.068.9.2
– for OTT Pluvio² 400: Length 535 mm	70.020.067.9.2
– with bottom plate for securing to concrete foundation	
– Installation height (height of bucket orifice): 1.2 m	
4" pedestal with bottom plate; for installation height 1.5 m	
– for OTT Pluvio² 200: Length 760 mm	70.020.062.9.2
– for OTT Pluvio² 400: Length 835 mm	70.020.063.9.2
– with bottom plate for securing to concrete foundation	
– Installation height (height of bucket orifice): 1.5 m	
4" pedestal with bottom plate; for installation height 2.0 m	
– for OTT Pluvio² 200 and 400: Length 1,300 mm	70.020.064.9.2
– with bottom plate for securing to a concrete foundation	
– Nominal installation height (height of bucket orifice): 2.0 m	
4" pedestal with bottom plate; for installation height 2.5 m	
– for OTT Pluvio² 200 and 400: Length 1,800 mm	70.020.066.9.2
– with bottom plate for securing to a concrete foundation	
– Nominal installation height (height of bucket orifice): 2.5 m	
4" pedestal with bottom plate; for installation height 3.0 m	
– for OTT Pluvio² 200 and 400: Length 2,300 mm	70.020.065.9.2
– with bottom plate for securing to a concrete foundation	
– Nominal installation height (height of bucket orifice): 3.0 m	
Mounting kit for 4" pedestal	99.020.083.9.2
– for securing the 4" pedestal to a concrete foundation	
– 4 x compound anchor cartridges	
– 4 x anchor rods M12	
– 4 x hexagon nuts M12 + washers	
Wind shield OTT PWS ...	
– … 100 for installation height 1.0 m	70.035.020.1.2
– … 120 for installation height 1.2 m	70.035.021.1.2
– … 150 for installation height 1.5 m	70.035.022.1.2
Mounting kit for wind shield OTT PWS ...	99.020.081.9.2
– for securing the wind shield to a concrete foundation	
– 4 x compound anchor cartridges	
– 4 x anchor rods M10	
– 4 x hexagon nuts M10 + washers	
OTT POD 100 platform	70.035.030.2.2
– for combination with the OTT PWS 100 or OTT PWS 150 wind shield for OTT Pluvio² installation heights 2.0 and 2.5 m	
– Height 1 m	
Mounting kit for OTT POD 100 platform	99.020.082.9.2
– for securing the platform to a concrete foundation	
– 4 x compound anchor cartridges	
– 4 x anchor rods M16	
– 4 x hexagon nuts M16 + washers	

	Mains adapter 24 V; for top hat rail installation – 50 W – 100 W – protection rating IP 20 – for top hat rail installation – Input voltage: 90 … 260 V AC	 65.030.001.9.2 65.030.003.9.2
	Mains adapter 24 V; in separate protective housing – 50 W – 100 W – Protection rating IP 65 – in the aluminium protective housing – Input voltage: 90 … 260 V AC	 97.850.012.9.5 65.030.007.4.2
	Connection cable for OTT Pluvio² without heating – twisted-pair – PUR, grey – 2 x 2 x 0.50 mm² – shielded	97.000.039.9.5
	Connection cable for OTT Pluvio² with heating – special polyurethane (PUR), grey – 7 x 0.75 mm² – shielded	97.000.038.9.5
	Anti-freeze – POWERCOOL DC 924-PXL – container size: 10 litre canister	0.929.002.002
	Bird repellent ring for Version 200 – prevents birds sitting on the orifice rim	70.020.085.9.2
	Bird repellent ring for Version 400 – prevents birds sitting on the orifice rim	70.020.086.9.2
	Anti-theft protection for OTT Pluvio²	70.020.080.9.2
	U-lock (weather-resistant) for anti-theft protection	99.000.083.9.5
	Test weight kit – Tare weight 2.5 kg ± 100 g – Test weight 200 g M1 – DKD certificate for test weight – in transport box	70.020.071.9.2
▶ **Replacement parts**	**Collecting bucket for Version 200**	70.020.414.3.1
	Collecting bucket for Version 400	70.020.461.3.1
	USB connection cable – USB connector type A to USB type B, 3 m	97.970.065.9.5
	CD-ROM Pluvio² software – with USB software driver – with OTT Pluvio² operating program – with example configurations for OTT datalogger	56.563.000.9.7

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OTT Hydromet GmbH

Ludwigstrasse 16
87437 Kempten · Germany
Phone +49 831 5617-0
Fax +49 831 5617-209

info@ott.com · www.ott.com