



Pluvio² S

Applications

Climatology
Meteorological Observation
Flood warning
Hydropower



Precipitation Gauge

Compact universal weighing precipitation gauge

Compact and relatively light precipitation gauge, with a weather resistant collecting bucket for 400 mm of precipitation

Minimum space requirement - no problem to install on existing 50 cm x 50 cm concrete bases with 2-inch pedestal

The intensity and cumulative data output fulfils the WMO directive No. 308

Considerable measuring accuracy of ± 1 mm, wide measuring range, and a high data accessibility of 99%

Output of high precipitation intensities of up to 3,000 mm/h without any time delay

Various output interfaces (SDI-12, RS-485, pulse/contact), configurable through USB by means of tablet PC or notebook

State-of-the-art technology

The high-quality OTT Pluvio² S weighing precipitation gauge uses the weighing principle for dependably and precisely measuring the intensity and cumulative precipitation in each weather condition. Its compact designed collecting bucket featuring a 200 cm² collecting area accepts up to 400 mm of precipitation. The instrument is a further development of the OTT Pluvio series that has been successfully used in more than 10,000 stations worldwide and offers state-of-the-art technology in compact design. It is designed for professional use, and is suited for weather observer measuring networks as well as for urban precipitation stations or weather service measuring fields where only limited space is available.

Long service life with low maintenance

Its advanced technologies for data logging and processing including signal analysis, filtering, and noise reduction

provide highly accurate results in a broad measuring range of 0 to 3000 mm/h. The sophisticated mechanical and electronic design as well as lifetime calibration ensure long useful life with minimum maintenance requirements. Even units fitted with orifice rim heater may be used in reduced voltage operation for solar-powered stations.

Compact Design

Because of its compact design, the Pluvio² S unit needs only little space and may be installed to 2-inch pedestals. Thus, it can be used to easily replace tipping buckets or manual rain gauges in existing installations and can even be installed to their device carriers, eliminating the need for any concrete work.

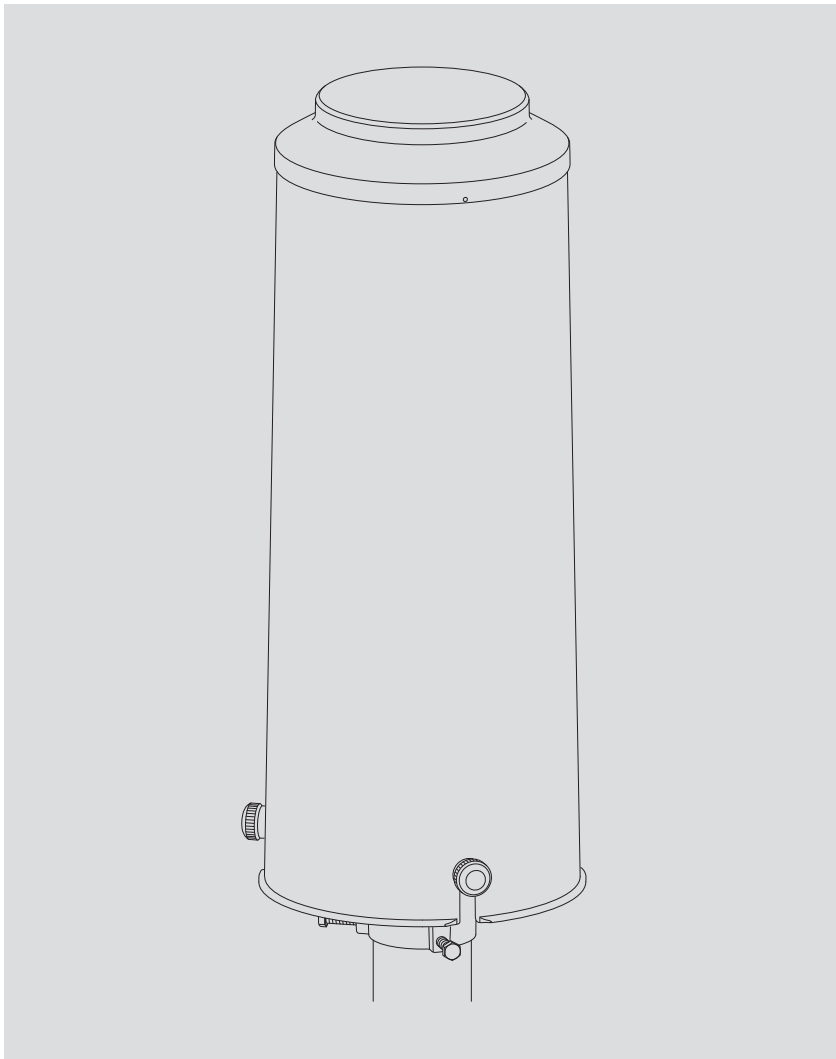
Technical Specifications

	Feature	Value
GENERAL	Recordable precipitation	Liquid, solid, and mixed
	Collecting area	200 cm ²
	Recordable precipitation amount	400 mm (approx. 8 l)
MEASUREMENT	Measurement method	Weighing measurement method
	Sensor element	Sealed load cell
	Measuring range precipitation	0 ... 50 mm/min or 0 ... 3000 mm/h
	Cumulative precipitation threshold at 60 min collection time	0.03 mm
	Precipitation intensity threshold	0.1 mm/min or 6 mm/h
ACCURACY	Amount	±0.1 mm or ±1 % of measured value
	Intensity	±0.1 mm/min, ±6 mm/h or ±1 % of measured value
RESOLUTION	SDI-12 and RS-485 interface:	Amount: 0.00a mm Intensity: 0.001 mm/min or 0.01 mm/h
	Impulse output	0.05/0.1/0.2 mm (remaining amounts in 1/100 mm will be factored in during the collecting time of 60 minutes)
INTERVALS	Intensity output interval	1 minute
	Query interval	1 minute ... 60 minutes
	Output delay	Real-time: < 1 minute Non real-time: 5 minutes
OUTPUT	Measurement output	Intensity *RT, amount *RT/*NRT, amount *NRT, amount total *NRT, bucket content *RT and *NRT, temperature of load cell
	Status output	Pluvio ² S status, heating status (if present)
INTERFACES	Analogue	SDI-12 V1.3, RS-485 (2- or 4-wire) SDI-12 protocol and ASCII.txt
	Digital outputs (2 / 5 Hz)	Impulse 0.05/0.1/0.2 mm (adjustable) status 0 ... 120 impulses/min; USB 2.0 (for service mode) (no overvoltage protection)
ELECTRICAL DATA	Power supply	5.5 ... 28 VDC, typically 12 VDC secured against reverse polarity
	Current consumption (without heating)	Typically 9.2 mA at 12 VDC
	Power consumption (without heating)	≤ 110 mW
	Ring heating, optional	12 ... 28 VDC, typ. 12/24 VDC; secured against reverse polarity Max. 2.2 A; Max. 50 W at 24 VDC temperature control range 45 K (wind speed 0 m/s); Max. 12.5 W at 12 VDC temperature control range 12 K (wind speed 0 m/s)
RIM HEATER	Target temperature for orifice ring rim	+2 ... +9 °C, factory setting +4 °C
	Operating range of orifice rim heater	-40 ... +60 °C (ambient temperature)
	Modes of operation of orifice rim heater	heater control system: - disabled; - continuously enabled; - continuously enabled within a specified temperature range; - US NWS standard, time-controlled; - enabled in case of precipitation (adjustable after-run time) US NWS standard, time-controlled Enabled in case of precipitation (adjustable after-run time)
DIMENSIONS & WEIGHT	Dimensions	Pluvio ² S (Ø x h): 288 mm x 651 mm Pedestal: Ø 2" / 50 ... 60 mm
	Weight (bucket empty)	approx. 7.8 kg
MATERIAL	Base plate	Stainless steel / aluminium
	Collecting bucket	Polyethylene
	Bucket support	ASA, UV-resistant
	Pipe housing	ASA, UV-resistant
ENVIRONMENTAL CONDITIONS	Temperature, in operation	-40 ... +60 °C
	Temperature, storage	-40 ... +70 °C
	Relative humidity	0 ... 100 % rF, non-condensing
PROTECTION	Pipe housing closed	IP65
	Pipe housing open	IP63
	Load cell	IP68
STANDARDS	EMC	2004/108/EG; EN61326-1:2013
	Salt resistance	EN 60068-2-11

191007-ME-OT-WT-ds-Pluvio2-S-EN



Operating Instructions
Precipitation gauge
OTT Pluvio² S



English

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

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1 Scope of supply

- ▶ **OTT Pluvio² S**
 - Weighing precipitation gauge;
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 information.
Optionally available with additional internal orifice rim heater.
 - Installation accessory kit
(6 hexagon bolts M8 x 30;
3 Phillips screws M5 x 35
1 8-wire screw terminal strip;
1 6-wire screw terminal strip;
3 cable ties 140 x 3.6;
1 Jumper
1 open-ended wrench, size: 10/13
 - USB cable
USB connector type A to USB connector type B, 3 m
 - Operating Instructions
 - Factory acceptance test (FAT) certificate

2 Order numbers

- ▶ **OTT Pluvio² S**
 - collecting area: 200 cm²; bucket orifice according to international standards 70.030.002.9.0
 - collecting volume 8 l; corresponds to 400 mm of precipitation
- ▶ **OTT Pluvio² S**
 - Orifice ring heater** 70.030.001.9.0
 - collecting area: 200 cm²; bucket orifice according to international standards
 - collecting volume 8 l; corresponds to 400 mm of precipitation
 - with integrated orifice rim heater;
rated power 50 Watt; for climates with icing and snowfall

For accessories and replacement parts, refer to Appendix E

3 Basic safety information

3.1 Markings and symbols used in the instruction

■ This bullet point indicates an instruction relating to a specific action.

▶ This bullet point indicates an item in a list.

– This bullet point indicates a sub-item in a list.

• **Remark:** ...

▶ Information on easier and more efficient work

▶ Further information

▶ Definition



Please note: ...

Information that prevents potential damage or malfunction on the OTT Pluvio² L.

3.2 Explanation of safety information used

The safety information used in these operating instructions is classified according to the nature and severity of a particular hazard. The hazard levels defined are indicated by the signal words **Warning/Caution** and associated pictograms **orange/yellow warning triangle** in these operating instructions:

WARNING

Warning of a hazardous situation with a medium level of risk



The safety information specifies the nature and source of the hazard. If you fail to carry out the specified actions, the hazardous situation can result in **death** or **serious injuries**.

▶ Action to prevent the hazardous situation!

▶ Action to prevent the hazardous situation!

CAUTION

Warning of a hazardous situation with a lower level of risk



The safety information specifies the nature and source of the hazard. If you fail to carry out the specified actions, the hazardous situation can result in **minor** or **moderately severe injuries**.

▶ Action to prevent the hazardous situation!

▶ Action to prevent the hazardous situation!

3.3 Note the following for safe and trouble-free operation

- ! ▶ Please read these Operating Instructions before using the OTT Pluvio² S for the first time! Make yourself completely familiar with the installation and operation of the OTT Pluvio² S! Keep these Operating Instructions for later reference.
- ▶ Only use the OTT Pluvio² S as described in these operating instructions! The intended use of the OTT Pluvio² S is the automatic determination of the meteorological precipitation quantity and intensity.
For further information → see Chapter 4, „Introduction“.
- ▶ Note all the detailed safety information given within the individual steps.
- ▶ Avoid heavy shaking and shocks during transport and operation!
The OTT Pluvio² S is equipped with a highly sensitive electronic weighing mechanism. 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 S! If changes or modifications are made, any warranty will be void.
- ▶ Have a defective OTT Pluvio² S checked and repaired only by the OTT repair center. On no account carry out repairs yourself! Only a qualified repair followed by a factory final test ensures the specified measurement accuracy.
For further information → refer to Chapter 8, „Repair“.
- ! ▶ Properly dispose of the OTT Pluvio² S after taking out of service. On no account put the OTT Pluvio² S into the normal household waste.
For further information → see Chapter 9, „Notes on the disposal of used units“.

4 Introduction

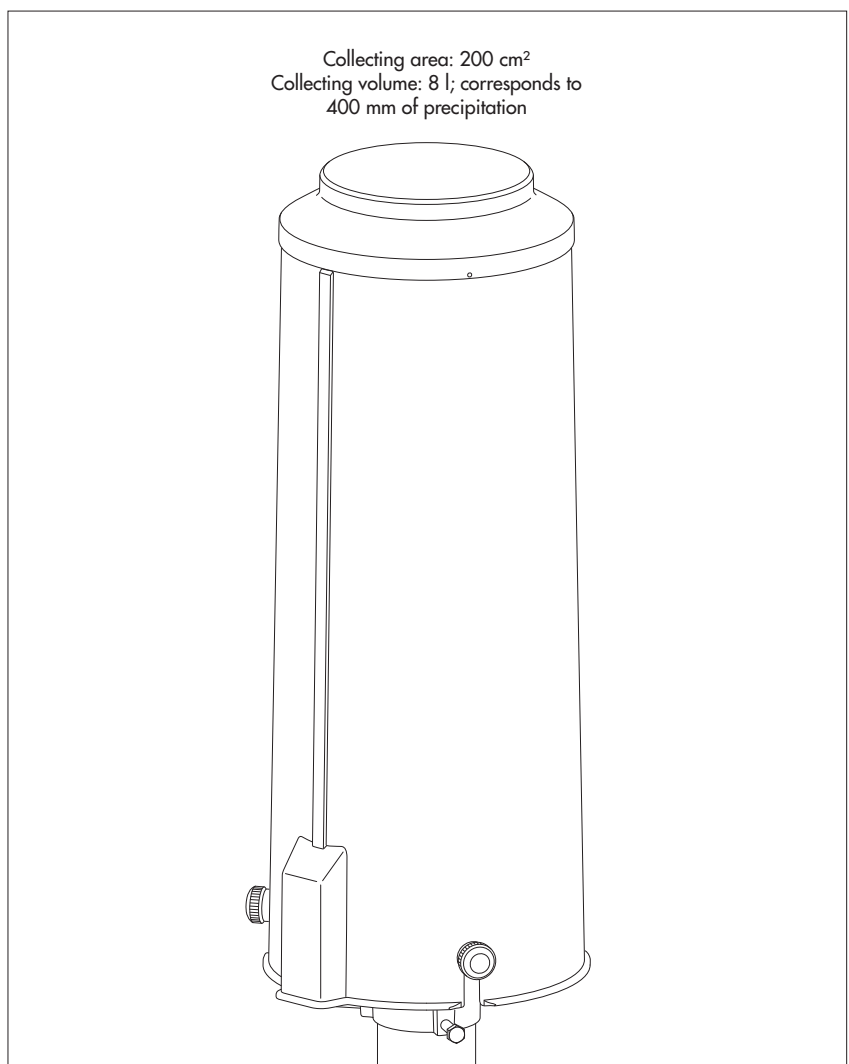
The OTT Pluvio² S precipitation gauge is used for automatic determination of the meteorological intensity and amount of precipitation.

In contrast to conventional precipitation gauges, the OTT Pluvio² S works using the weighing principle. The OTT Pluvio² S reliably detects 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. when emptying the collecting bucket.

Fig. 1: OTT Pluvio² S precipitation gauge.

The OTT Pluvio² S is available in two versions:
– without orifice rim heating;
– with integrated orifice rim heating (for climates with icing and snowfall)
Both versions are visually identical.



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

A special filter algorithm prevents falsifications of the measurement results caused by 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 Pluvio² S.

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 Pluvio² S outputs the measurement result for intensities greater than 0.1 mm/min **within a minute** after occurrence of the precipitation event. Benefit: fast response time and precipitation output with correct intensity.



Please note: Real-time measured values are not suitable for quantity recordings! They are subject to greater fluctuation and are not accumulated.

▶ **Non-real-time output (NRT):** The OTT Pluvio² S outputs the measurement result **5 minutes** after occurrence of the precipitation event. Benefit: 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
- ▶ Accu NRT (since the last measured value sample)
- ▶ Accu total NRT (since the last reset)
- ▶ Accu RT-NRT (since the last measured value sample)
- ▶ Bucket RT
- ▶ Bucket NRT
- ▶ Temperature of load cell
- ▶ Status OTT Pluvio² S (since the last measured value sample)

The OTT Pluvio² S provides the precipitation values using a resolution of 0.001 mm. Individual response thresholds of ≥ 0.03 mm are applied to these values within one hour. A detailed description of the individual measured values can be found in Chapter 4.1.

The OTT Pluvio² S uses two pulse outputs to output the amount of precipitation RT/NRT (output #1) as well as the status information (output #2) in parallel. The pulse factor may be selected: one pulse equals 0.05 mm, 0.1 mm, 0.2 mm, 0.5 mm or 1.0 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 Pluvio² S is installed to a 2" 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 or 1.5 meters are possible.

After connecting the supply voltage, the OTT Pluvio² S automatically starts measuring operation (→ red LED is flashing, refer to Fig. 18). The OTT Pluvio² S is calibrated in the factory. On site, no further calibration is necessary.

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. Thus, spurious increases such as bucket changes or filling with anti-freeze are suppressed. Check measurements, even with large reference weights (> 240 g), are possible using the values of Bucket RT and Bucket NRT. The measured value sample is carried out in a joint data telegram with multiple measured values. Individual samples with different intervals are not possible.

For service purposes (test measurements, convenient setting of operating parameters and for an accuracy test) a USB interface has been provided. The particular advantage of this is: when using the USB interface, no separate power supply is required.



Please note: After connecting the USB interface, the OTT Pluvio² S interrupts communication on the serial interfaces!

The measuring system of the OTT Pluvio² S 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/power failure for approx. 2 minutes

The OTT test weight kit (accessory) is used to perform annual check measurements (guided accuracy test) in conjunction with the OTT Pluvio² operating software.

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

▶ Intensity RT

Moving precipitation growth over the last minute before the sampling 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
Storing 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 S sets the output value to zero. Thus, this output value may not be used for accumulating single intensity values.

▶ 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 valuable provides a more precise precipitation sum. Fine precipitation is collected over a maximum of one hour and output after reaching the threshold. If the fine precipitation does not reach the threshold within an hour, there will be no output. This value is particularly suited for daily and monthly totals and to calculate highly precise intensities (mm/h · mm/min) (alternative value to "Intensity RT"; output delayed).

Output delay:	Non-real-time output (NRT)
Units:	mm · inch
Threshold:	0.03 mm within an hour
Recommended sampling interval:	1 minute (with simultaneous sampling of the precipitation intensity)
Recommended storing interval:	Any time between 1 minute and 24 hours. The datalogger must total the individual measured values using a summing function over the complete storing interval!

- **Note:** Every interface polling resets the total measured value in the OTT Pluvio² S to zero. The 5 minute output delay provides the option for climatological databases to apply a timestamp 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 Accu NRT values are totalled (redundant sensor). This value is particularly suited for daily or monthly totals as well as for tracking the plausibility of the Accu NRT and Accu RT-NRT values. Benefit: 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

Only the 8-pole screw terminal strip is required for this application automatically if the measurement range (500 mm; 50 inch) is exceeded

Output delay:	Non-real-time output (NRT)
Units:	mm · inch
Threshold:	0.03 mm within an hour
Recommended sampling interval:	1 minute (with simultaneous sampling of the precipitation intensity)
Recommended storing interval:	Any time between 1 minute and 24 hours (do not total/average measured values)

► Accu RT-NRT

This value is a combination of real-time and non-real-time output. This provides the benefit of faster outputs of measured values compared to accu NRT. It shows the accumulated amounts of precipitation over the sampling interval. If the amount of precipitation exceeds the threshold, the OTT Pluvio² S 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 an 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 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:	0.03 mm within an hour
Recommended sampling interval:	1 minute (with simultaneous sampling of the precipitation intensity)
Recommended storing interval:	Any time between 1 minute and 24 hours. The datalogger must total the individual measured values using a summing function over the complete storing interval!

- **Note:** Every interface polling resets the total amount values in the OTT Pluvio² S to zero!

► **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 reasonable!

Output delay:	real-time output (RT)
Units:	mm · inch
Resolution:	0.001 mm (1 mm $\hat{=}$ 20 g)
Recommended sampling interval:	1 minute (with simultaneous sampling of the precipitation intensity)
Recommended storing interval:	any time between 1 minute and 24 hours (possibly averaging over 10 minutes)

► **Bucket NRT**

This value outputs the currently measured, filtered bucket content. It corresponds to the filtered weight value and is subjected to uncertainty with regard to temperature impact. 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 reasonable!

Output delay:	non-real-time output (NRT)
Units:	mm · inch
Resolution:	0.001 mm (1 mm $\hat{=}$ 20 g)
Recommended sampling interval:	1 minute (with simultaneous sampling of the precipitation intensity)
Recommended storing 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 (with simultaneous sampling of the precipitation intensity)
Recommended storing interval:	only as required (any time between 1 minute and 24 hours)

4.2 Measured value output at pulse output

The OTT Pluvio² S uses two pulse outputs to output the amount of precipitation RT/NRT (output #1) as well as the status information (output #2) in parallel. 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 $\hat{=}$ 100/100 ms for 2 Hz $\hat{=}$ 250/250 ms
Contact design:	non-bouncing, polarity independent, isolated
Current capacity, I_{\max} :	≤ 100 mA (short-circuit proof; load cut-off at 200 mA)
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 (0.05 mm · 0.1 mm · 0.2 mm · 0.5 mm · 1.0 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 S operating software via USB interface).

Output delay:	refer to Accu RT-NRT
Pulse factor (selectable):	0.05 mm · 0.1 mm · 0.2 mm · 0.5 mm · 1.0 mm (1 mm $\hat{=}$ 20 · 10 · 5 · 2 · 1 pulse(s)) 0.01 inch
Resolution:	0.05 mm · 0.1 mm · 0.2 mm · 0.5 mm · 1.0 mm 0.01 inch
Recommended sampling interval:	continuous pulse counting
Recommended storing interval:	any time between 1 minute and 24 hours

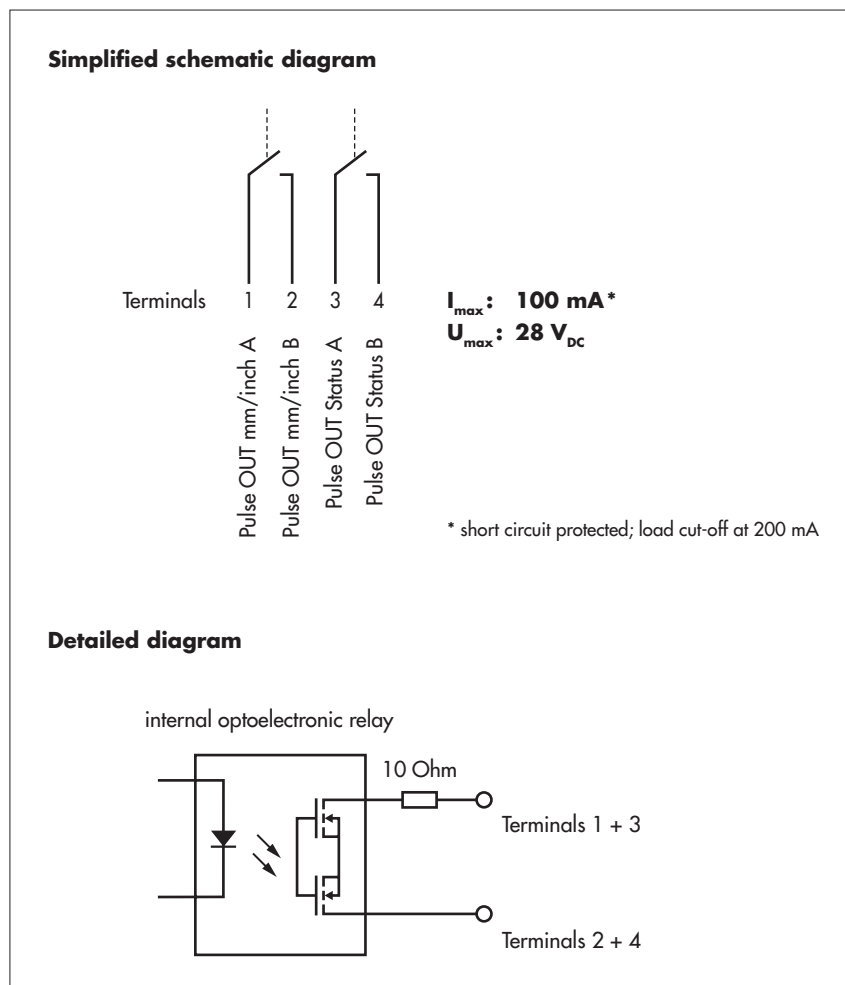
► **Pulse status information**

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 error, device or cable at the pulse output faulty (output #2)
10 ... 100	pulses/min	0 ... 100 % of the approx. bucket level
120	pulses/min	maintenance by means of operation through USB

Fig. 2: Pulse output circuit diagram.

The locations of the terminals are shown in Fig. 13.
Output #1: Terminals #1 and #2.
Output #2: Terminals #3 and #4.





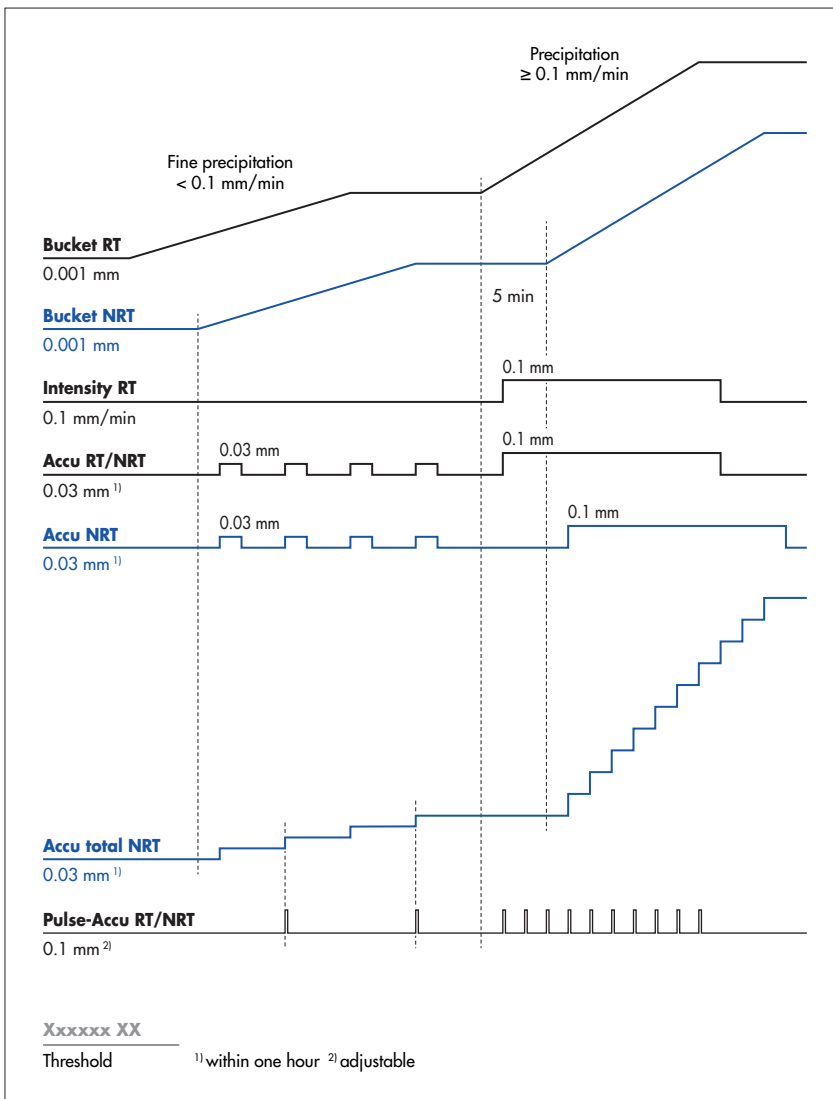
Please note:

When the pulse outputs are connected to

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

4.3 Graphic display of measured value output for different precipitation intensities

Fig. 3: Schematic display of measured value output for different precipitation values of the OTT Pluvio² S for fine precipitation (< 0.1 mm/min) and precipitation (≥ 0.1 mm/min).
The respective response thresholds of the channels are indicated below the hydrographs.



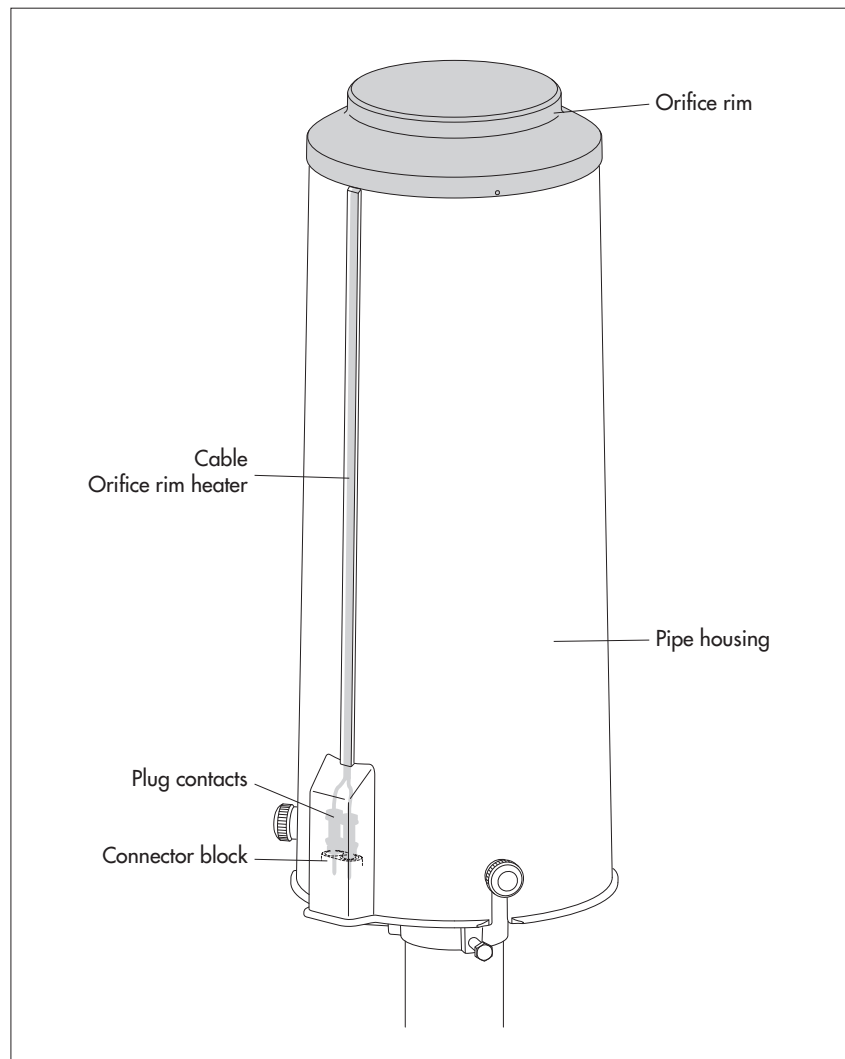
4.4 Orifice ring rim heater

For the OTT Pluvio² S, an optional orifice rim heater is available. This heater reliably keeps the orifice rim free of snow and ice at low ambient temperatures (e.g. no snow or ice build-up). No snow will accumulate at the orifice rim.

The orifice rim heater consists of a ring-shaped heating element within the pipe housing with temperature sensor and an electronic heater control module for controlling and monitoring the heating function. The heater cable electrical connection is established automatically via two plug contacts and a connector block once the pipe housing is placed onto the base plate.

Only the orifice rim is heated to avoid unwanted losses caused by evaporation. Therefore, the orifice rim heater 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. 4: Schematic diagram of the OTT Pluvio² S orifice rim heater. The surface shown in grey (orifice rim) is the heated part of the pipe housing.



The OTT Pluvio² S unit heats the orifice rim until the target temperature of +4 °C (factory setting) is reached – as far as heating power and ambient conditions allow. To achieve this, the heater control system measures both ambient and orifice rim temperatures and uses these values together with the target temperature to calculate the pulse/pause ratio. Depending on this value, the heater control system supplies electricity to the heating element for 5 to 120 seconds.

In addition to this, several modes of operation provide the option of enabling/disabling the heater control system based on certain criteria (see below).

When the heater control system is enabled, the OTT Pluvio² S unit continuously performs a functional test for the orifice rim heater (heater self-test) to detect potential error conditions. When the heater control system is temporarily disabled, performing the heater self-test depends on the mode of operation set. The result is used for system checks in the measuring area. In case the error cannot be corrected (unusual operating conditions or faulty orifice rim heater), the "Heater functional check failed" status information is shown, refer to the response to the SDI-12 command `aD2!`, Chapter 6.1.

When the measured rim temperature exceeds 50 °C in heating mode, the rim heater system 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 a separate power supply. Thus, the orifice rim heater may completely be switched OFF, for example in summer. In such case, a message is shown in the Status Information (response to the SDI-12 command `aD2!`; `<value 8> = +64`).

The nominal supply voltage for operating the orifice rim heater is 24 V_{DC}, and the maximum heating capacity with very low ambient temperatures is approx. 50 Watt. 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 Chapter 10, „Technical Data“). For temperatures below –5 ... –10 °C, snow or ice may adhere to the unit.

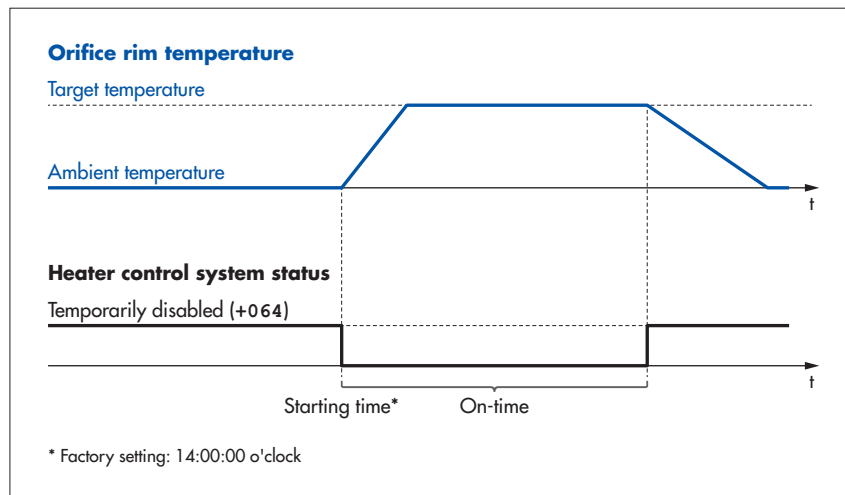
Orifice rim heater modes of operation:

- ▶ **Mode #0** Orifice rim heater is completely switched OFF.
(No heater self-test is performed).
- ▶ **Mode #1** Heater control system is continuously enabled.
The heater control system keeps the temperature of the orifice rim at the preset target temperature.
(Factory setting)
- ▶ **Mode #2** Within a specified temperature range, the heater control system is continuously enabled.
Same as Mode #1 with the heater control system temporarily disabling the heater when the temperature is below an adjustable temperature limit (–40 ... +9 °C). Below the temperature limit, the heater self-test is performed based on a selectable interval (1 h ... 7 d).

- **Mode #3** The heater is controlled based on the National Weather Service (NWS) Standard. The heater control is active from a preset time (starting time) on and continuously keeps the orifice rim temperature at the predetermined setpoint. The On-time may be adjusted as well (1 ... 1440 minutes). Outside this On-time, the heater self-test is performed based on a selectable interval (1 h ... 7 d).

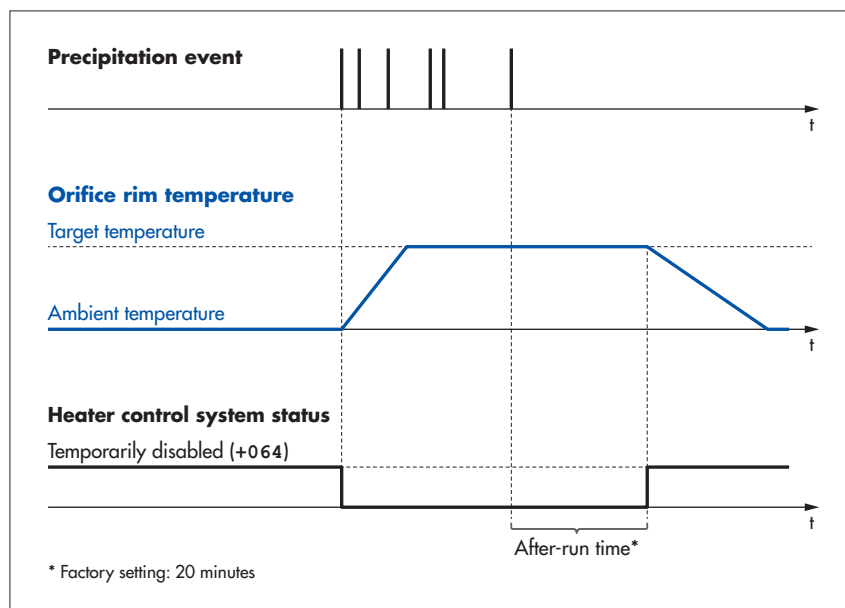
! **Please note:** This mode requires the OTT Pluvio² S system time to be set correctly. In case a power failure lasts longer than 10 minutes, the OTT Pluvio² S system time will be lost. This will result in incorrect heater control system operation!

Fig. 5: Diagram of orifice rim heater Mode #3.



- **Mode #4** Heater control system is operated based on precipitation events. Once precipitation has started, the heater control will be active for a preset after-run time (1 ... 1440 minutes) and continuously keep the orifice rim temperature at the predetermined setpoint. Outside this after-run time, the heater self-test is performed based on a selectable interval (1 h ... 7 d).

Fig. 6: Diagram of orifice rim heater Mode #4.



5 Installing the OTT Pluvio² S

CAUTION Risk of injury from flying components



If there is a stormy wind during installation, there is a risk of injury from flying components.

- ▶ Do not perform installation in stormy wind!

The installation of the OTT Pluvio² S is carried out on a 2" pedestal made of galvanized steel (possible external diameter of pedestal 50 to 60.3 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 meter (height of bucket orifice). Alternatively, an installation height of 1.2 or 1.5 m is allowed.

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 S is to be connected depends on the interface used:

- ▶ SDI-12 interface: 70 meters
- ▶ RS-485 interface: 1000 meters
- ▶ Pulse output: 1000 meters

For an OTT Pluvio² S with orifice rim heater, the maximum distance to the mains adapter of the orifice rim heater is 125 meters.

! **Please note:** The OTT Pluvio² S precipitation gauge is equipped with a highly sensitive electronic weighing mechanism! Install the unit only as described in these Operating Instructions. To avoid damage to the OTT Pluvio² S weighing mechanism during installation: Avoid heavy shocks and large forces acting on the load cell and the bracket for the bucket support (for these items, please refer to Fig. 8)!

5.1 Recommended cable types/maximum cable lengths

For operating the OTT Pluvio² S, 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),
- ▶ ground terminal.

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

For an OTT Pluvio² S with orifice rim heater, an additional connection cable may be used (alternatively two additional wires in the common connection cable). 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 S has two cable entrances (rubber grommets).

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

! **Please note:** All connection cables must be UV-resistant and suitable to be laid in the ground!

Connection cable for data collection device/precipitation gauge

SDI-12 interface	– Cable length: maximum 70 m ¹⁾ – Cable type: shielded low-voltage cable – Wire size: 3 x 0.5 mm ^{2 2)}
RS-485 interface	– Cable length: maximum 1000 m – Cable type: twisted-pair cable ³⁾ ; shielded design – Wire size: 2 x 2 x 0.5 mm ²
Pulse output	– Cable length: maximum 1000 m – Cable type: shielded low-voltage cable – Wire size: 6 x 0.5 mm ²

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 power supply can be twisted pair, but do not have to be.

Connection cable for orifice rim heater power supply ⁴⁾

- Cable length: maximum 125 m
- Cable type: unshielded low-voltage cable
- Wire size:
 - 1 ... 25 m: 2 x 0,5 mm²
 - 25 ... 50 m: 2 x 1,0 mm²
 - 50 ... 75 m: 2 x 1,5 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)

⁴⁾ optional: As necessary, alternatively provide two additional wires in the cable between data recording unit and power supply considering adequate wire cross-section.

Grounding cable

- Cable length: max. 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 port has no overload protection. It is designed to be temporarily used as a service interface.

5.2 Required tools and equipment

- ▶ Open-ended wrench, 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: Ferrules and crimping pliers

5.3 Preparing the installation location

WARNING

Risk of injury due to pedestal falling over/down



The OTT Pluvio² pedestal has a weight of up to 8.5 kg (depending on its length)!

- ▶ Wear safety shoes when mounting the pedestal!
- ▶ Temporarily secure the pedestal against falling over during assembly.

CAUTION

Danger of eye injuries due to drilling dust and chemicals



- ▶ Wear protective goggles during drilling work and when setting the composite anchor cartridges!



Please note: The depth of the concrete foundation should be determined by the 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 grounding 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 "Mounting kit for 2" pedestal" (refer to accessories); refer to Fig. 7 and appendix B.

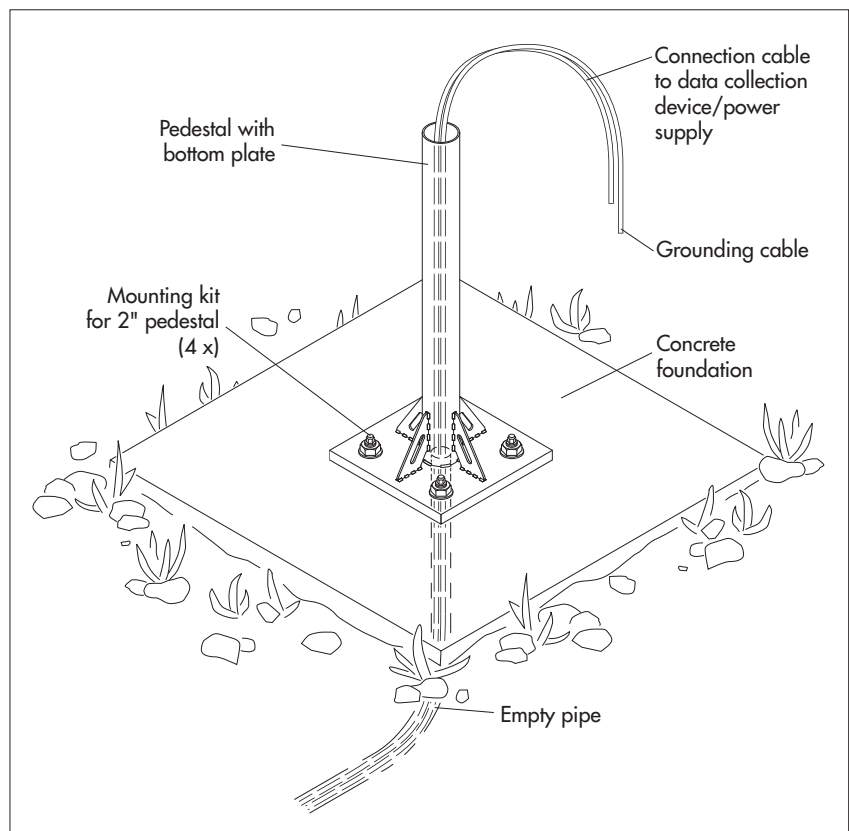


- **Please note:** The pedestal must be as vertical as possible!
- Pull the connection cable for the data collection device/power supply into the empty conduit pipe.
- OTT Pluvio² S with orifice rim heater: As applicable, pull additional connection cable for the orifice rim heater power supply into the empty conduit pipe.
- In case the ground for the OTT Pluvio² S is implemented centrally in the area of the data collection device: Also pull the grounding cable into the empty conduit pipe (alternatively, the ground is established directly at the OTT Pluvio² S using a concrete footing ground or ground rod).

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

For an OTT Pluvio² S with orifice rim heater, an additional connection cable may be used for supplying power to the orifice rim heater.

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

CAUTION Risk of crushing when installing the base plate

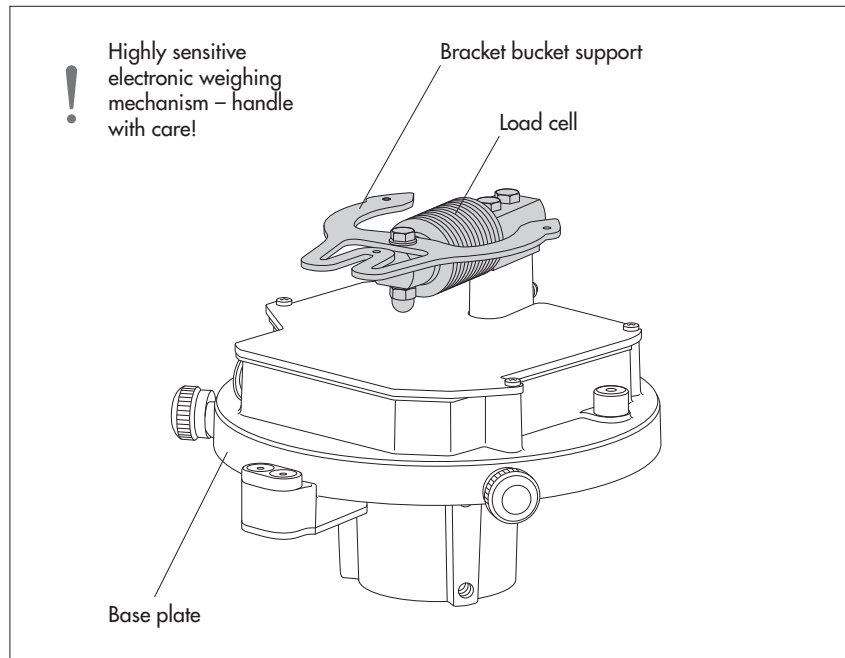


The base plate has a weight of 4 kg!

► Wear safety gloves and safety shoes when installing the base plate!

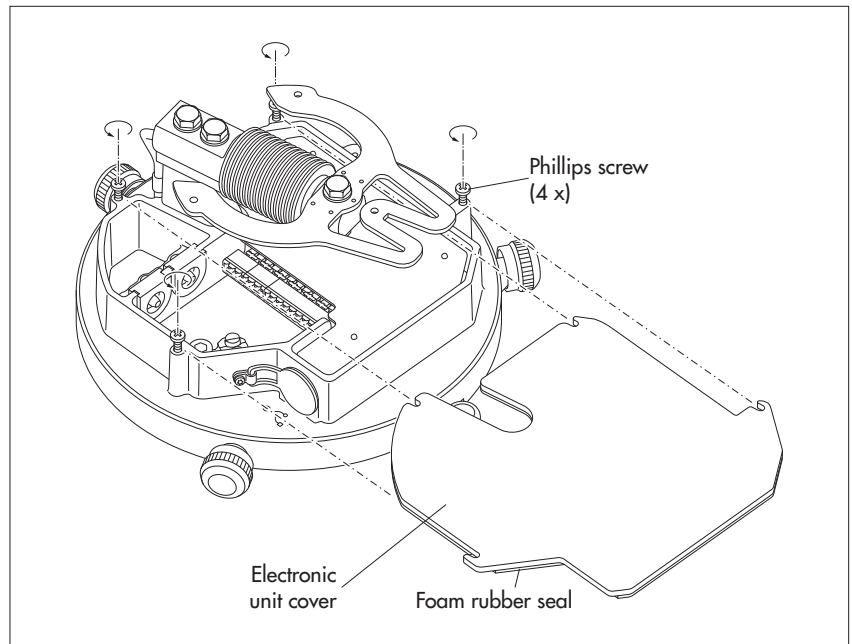
- Carefully transport the OTT Pluvio² S to the installation location in the closed shipping carton
- Open the shipping carton and remove the acceptance certificate (FAT), the polybag including installation accessories and possibly further existing accessories.
- Remove the pipe housing with collecting bucket and put it first aside.
- Remove and open the inner carton (consider the hints on the carton) and remove the shaped foam part
- Remove the base plate from the inner carton and carefully place it on a flat surface. **Please note: Do not** use the load cell or bracket for the bucket support to lift the base plate!

Fig. 8: OTT Pluvio² S base plate.



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

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



5.5 Preparing the connection cable

Connection cable for data collection device/power supply:

- Cut the connection cable so that it sticks out approx. 30 – 35 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 off approx. 10 cm of the outer sheath of the connection cable.
- Strip off approx. 5 mm of the insulation of the individual wires.
- Put the cable shielding together and twist it.
- For a stranded connection cable: push ferrules onto the wires and crimp using crimping pliers.
- Connect the cable to the supplied screw terminal strips (included in the poly-bag); see Fig. 10 and 11:
 - SDI-12 interface → 8-wire screw terminal strip, contact 3
 - RS-485 interface
 - 2-wire → 8-wire screw terminal strip, contacts 1/2
 - 4-wire → 6-wire screw terminal strip, contacts 5/6 + 8-wire screw terminal strip, contacts 1/2
 - Pulse output → 6-wire screw terminal strip, contacts 1/2 (Accu RT-NRT) + contacts 3/4 (pulse status information; as required)
 - Power supply → 8-wire screw terminal strip, contacts 6/7 (precipitation gauge) + contacts 5/8 (orifice rim heater; optional)

Orifice rim heater connection cable (optional)

- If using a separate connection cable for the orifice rim heater: Assemble the cable as described above and connect to the 8-wire screw terminal strip, see Fig. 11.

Fig. 10: Connecting the cable for the data recording device/power supply for the precipitation gauge to 6-wire and/or 8-wire 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 4, 6, and 8 of the 8-wire screw terminal strip are jumpered internally!

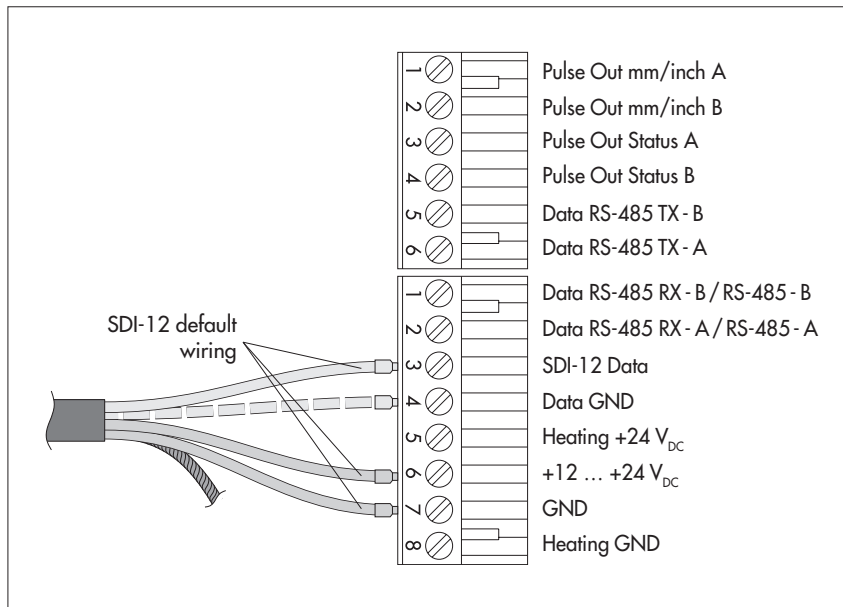


Fig. 11: **OTT Pluvio² S with orifice rim heater:** Connecting options for power supply of the precipitation gauge and orifice rim heater.

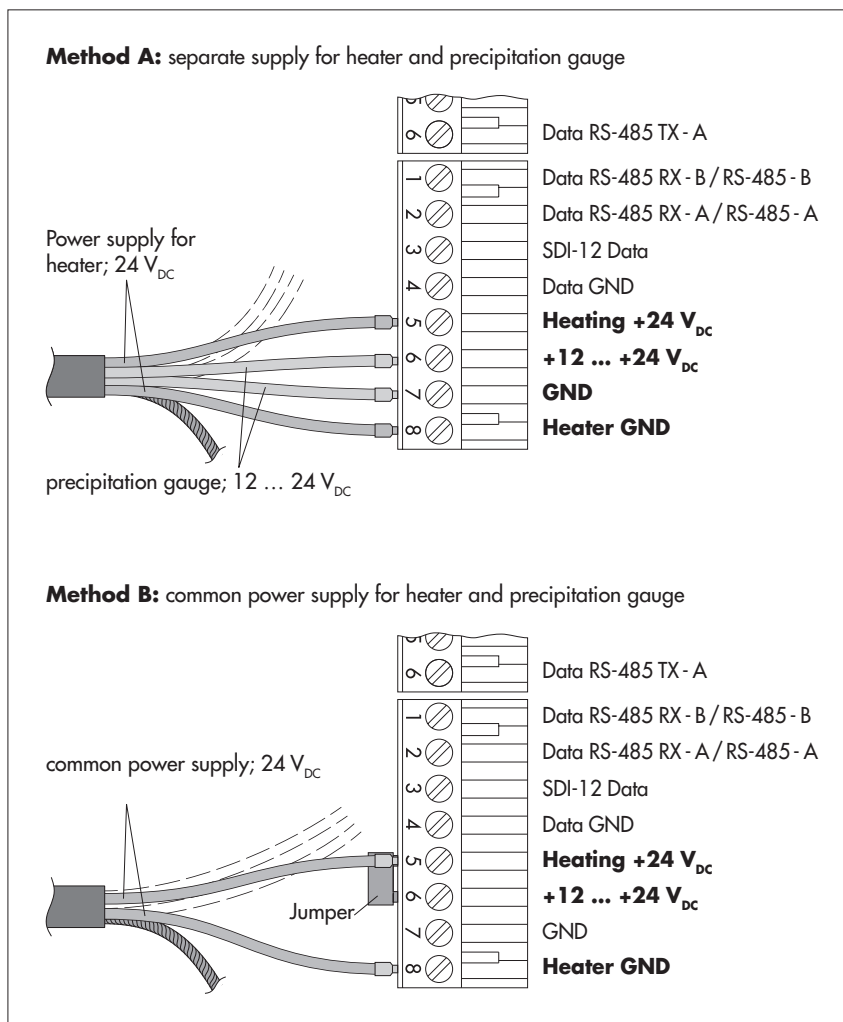
Please note: For version B, common supply voltage must be 24 V_{DC}! (Otherwise, heating power is reduced; refer to "Specifications".)

As necessary, two separate cables may be used (e.g. separate cable for optional orifice rim heater).

For clarity, the wires for connecting the data recording unit are shown as dashed lines.

The jumper is included (polybag containing installation accessories).

Contacts 4, 7, and 8 of the 8-wire screw terminal strip are jumpered internally.



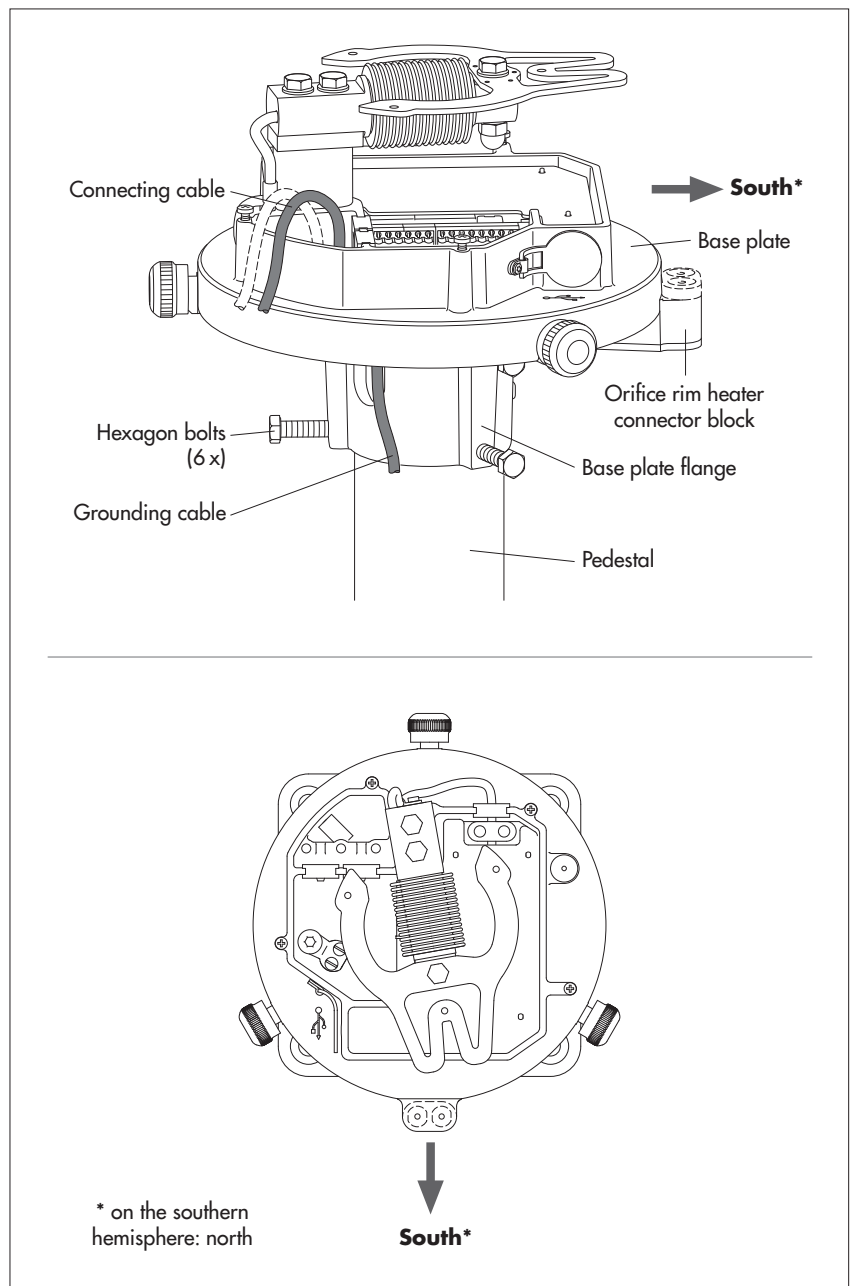
5.6 Installing the base plate on the pedestal

- Place the base plate onto the pedestal such that the connection and grounding cables come out of the slit in the base plate flange (see Fig. 14).
- Lead connection and grounding cables through the opening in the base plate upwards.
- **Rotate the base plate so that terminal block of the orifice ring heater is facing southwards*!** In extreme climatic conditions, this will prevent incorrect precipitation value output. These may occur during heavy rapid temperature variations together with lateral solar irradiation.
* on the southern hemisphere: northwards
- Insert the six hexagon bolts into the base plate flange with open-ended wrench, size 13 mm (supplied).



Please note: insert all hexagon bolts approximately to the same depth! Do not yet fully tighten the hexagon bolts!

Fig. 12: Installing base plate onto pedestal.

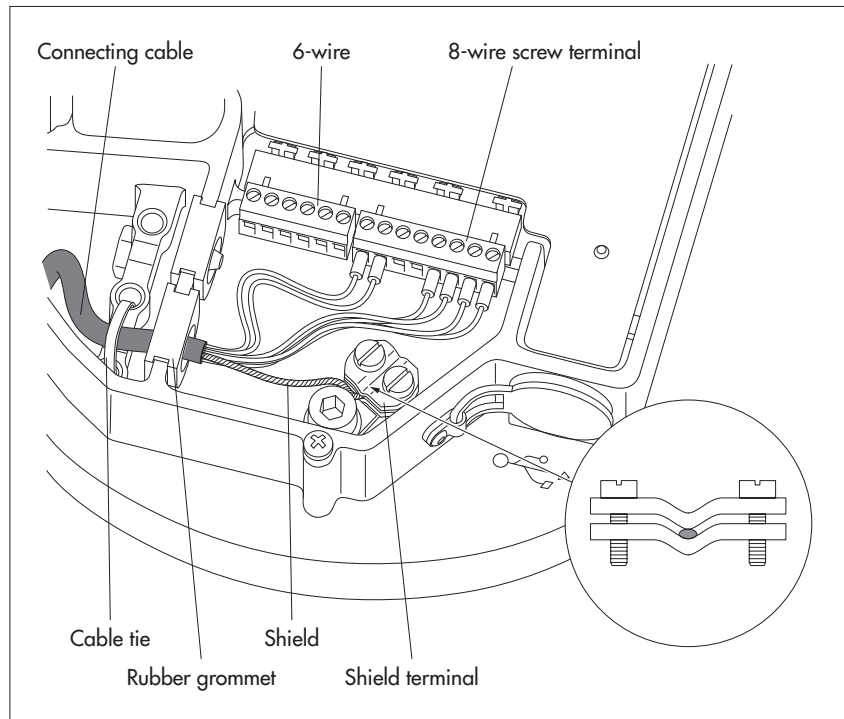


5.7 Connecting the connection cable

- Push rubber grommet with connection cable into the slot.
- Connect 6-wire and 8-wire screw terminal strip to the appropriate PCB sockets.
- Connect the twisted shielding of the cables to the terminal, refer to Fig. 13.
- 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 using the cable tie.

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

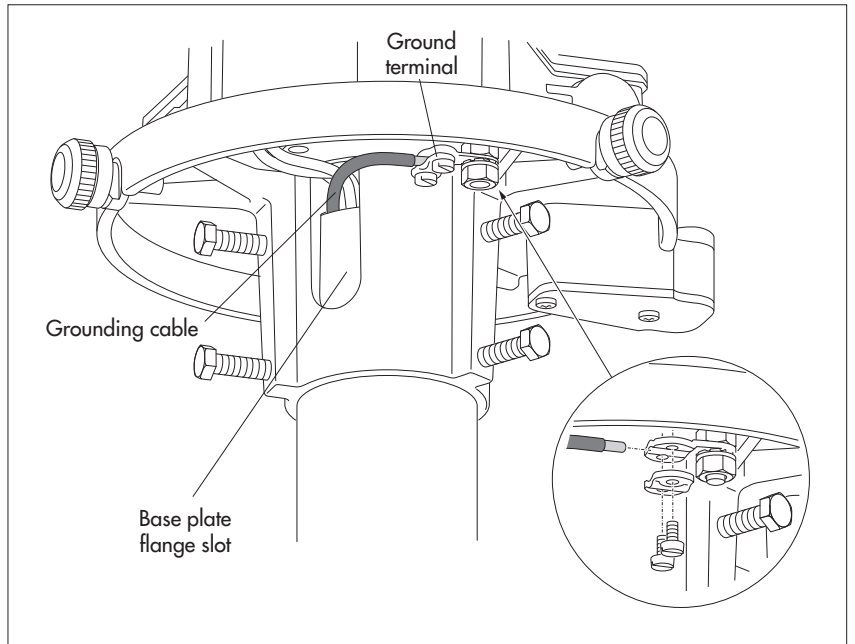
(The Figure shows the example of a standard RS-485 wiring (2-wire) with optional orifice rim heater. The orifice rim heater is supplied separately.)



5.8 Connecting the grounding cable

- Cut the grounding cable (cross-section 10 mm²) to approx. 25 ... 30 cm.
- Strip off approx. 10 mm of the grounding cable insulation and connect to the earth terminal on the base plate underside. For a stranded grounding cable: push on ferrules and crimp using crimping pliers.
- If necessary, pull back the grounding cable and store in pedestal (lift the base plate once more if necessary).
- Connect the other end of the grounding cable to a foundation or earthing rod.

Fig. 14: Connecting the grounding cable.

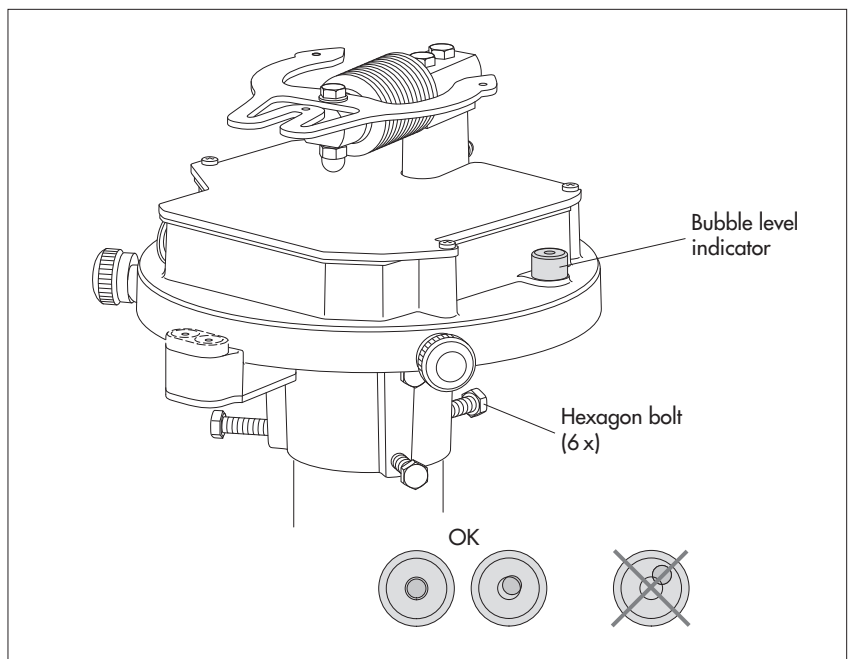


5.9 Aligning the base plate

- First, fix the base plate using the three upper hexagon bolts. Alternately tighten the bolts until they are all contacting the pedestal. Important: Insert all hexagon bolts approximately to the same depth!
- Using the lower hexagon bolts, adjust the base plate so that the air bubble is within the indicator marked ring. Inserting a hexagon bolt will cause the air bubble to move towards this bolt position. In case of large adjustment travel (pedestal is outside the vertical position for several degrees), turn the opposite hexagon bolts counter-clockwise as necessary!
- Alternately tighten all hexagon bolts while avoiding any distortion of the base plate! Maximum torque: 6 Nm.
- Again check bubble level for correct adjustment.

Fig. 15: Levelling the OTT Pluvio² S unit.

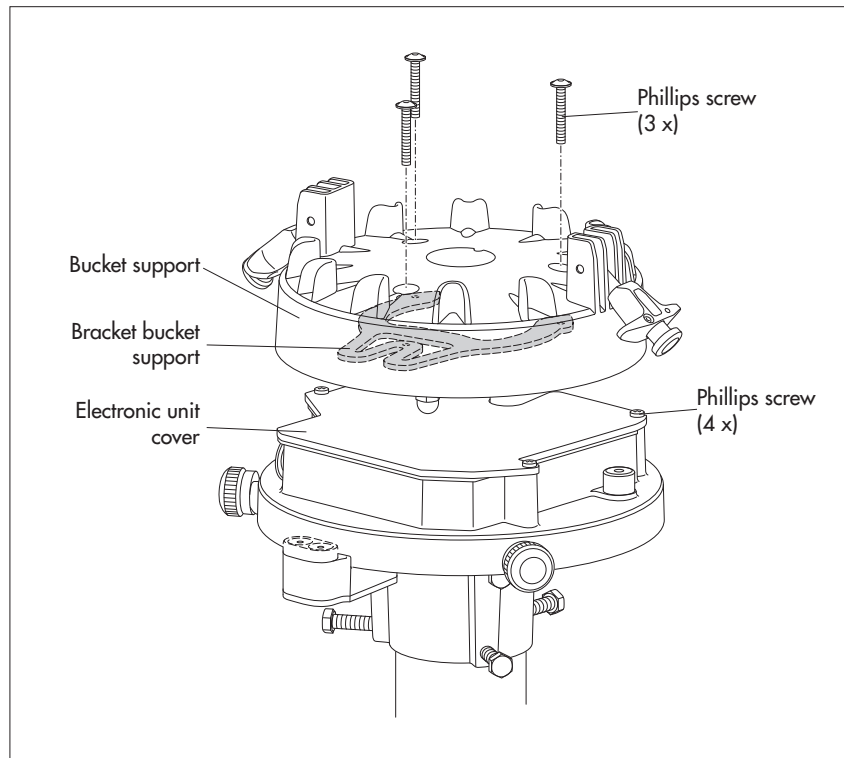
Correct operation of the weighing mechanism is insured only if the base plate is correctly levelled in horizontal direction!



5.10 Performing final work

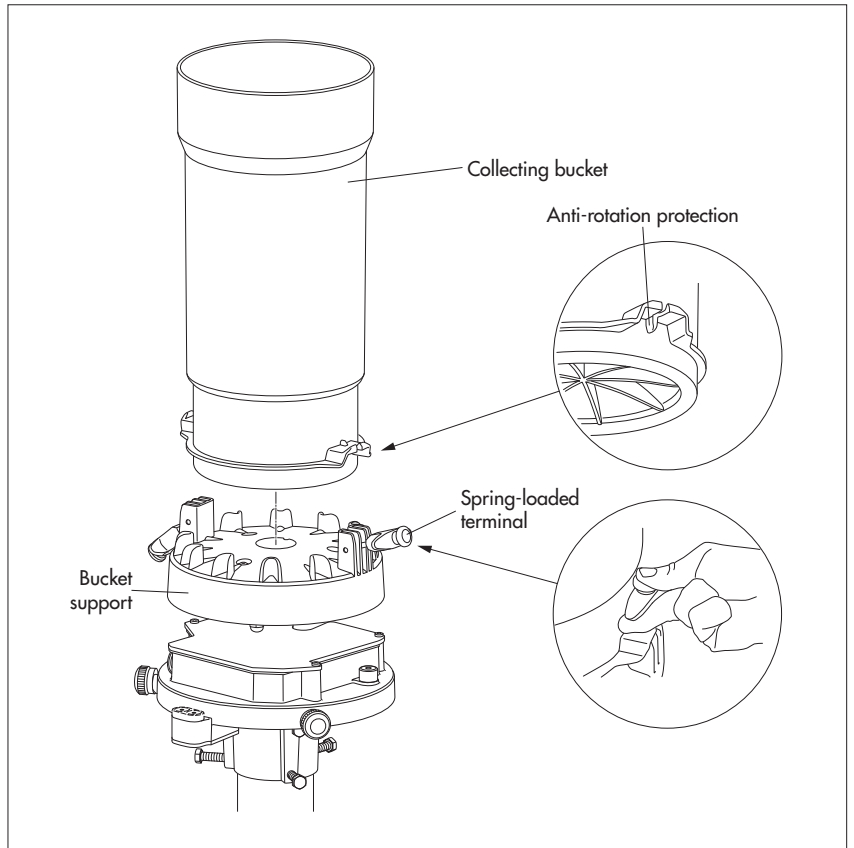
- Replace the electronics unit cover and tighten the four Phillips screws.
- Align the bucket support (refer to decal) and carefully place it onto the bracket for the bucket support.
- Secure the bucket support using three Phillips screws (included in polybag).

Fig. 16: Placing and securing the bucket support.



- Take the collecting bucket out of the pipe housing and remove all shaped foam parts.
- Align the collecting bucket and place it onto the bucket support taking into account the anti-rotation protection, refer to Fig. 17!
- Use the two spring-loaded terminals to secure the collecting bucket.

Fig. 17: Placing the collecting bucket onto bucket support.



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

Factory settings:

- SDI-12 sensor address 0
- serial interface SDI-12
- temperature unit of measurement °C
- intensity unit of measurement mm/h
- pulse factor 0.1
- pulse output rate 5 Hz
- orifice rim heater* on
- heating mode* 1, continuously on
- orifice rim heater target temperature* +4 °C

* version with ring heater option

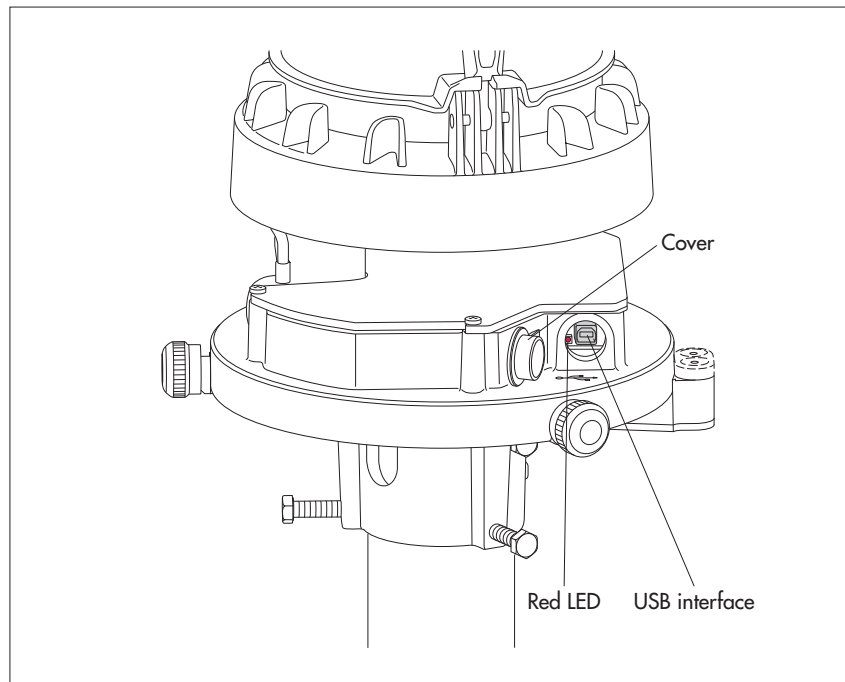
- For temperatures below 0 °C, add antifreeze; for details, refer to Chapter 7.2.
- Connect the free cable end of the connecting cable to the data collection device and the power supply.
- When using a separate connecting cable for the optional orifice rim heater: Connect the cable for the orifice rim heater to the power supply.
- Configure the data collection device. For this, refer to the manual for the data collection device. SDI-12 commands and responses used: refer to Chapter 6.



Please note: Connect the shield of the connection cables **also** at the data collection device/power supply!

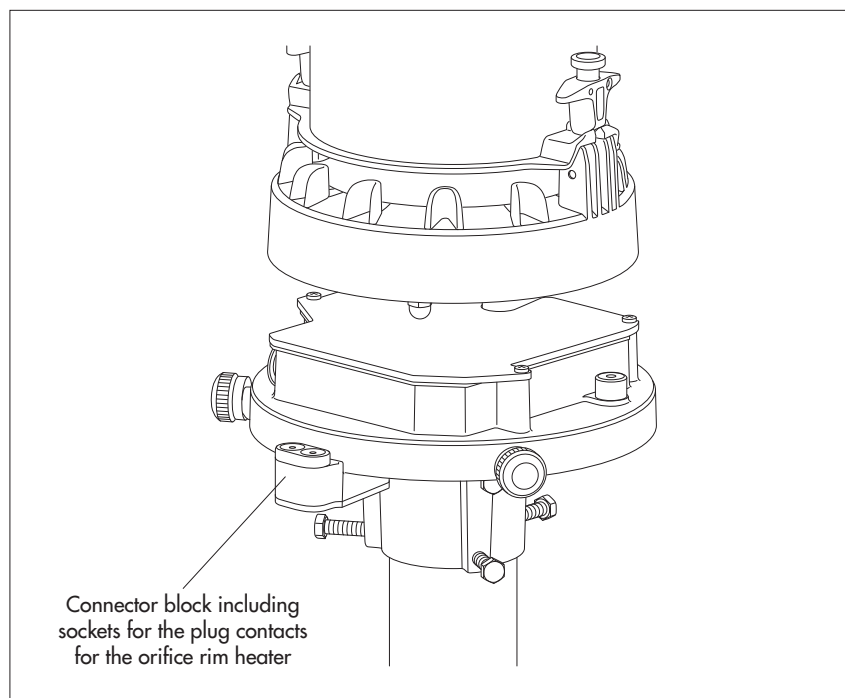
- Carry out functional check: Remove cover of the USB interface → red LED must briefly flash every two seconds.
- Replace cover.

Fig. 18: Carrying out the functional check.



- Align the pipe housing and place it onto the base plate. The pipe housing must completely seat on the base plate (refer to the detail drawing in Fig. 20)!
OTT Pluvio² S with orifice rim heater: Ensure that the sockets in the connection block are not contaminated.

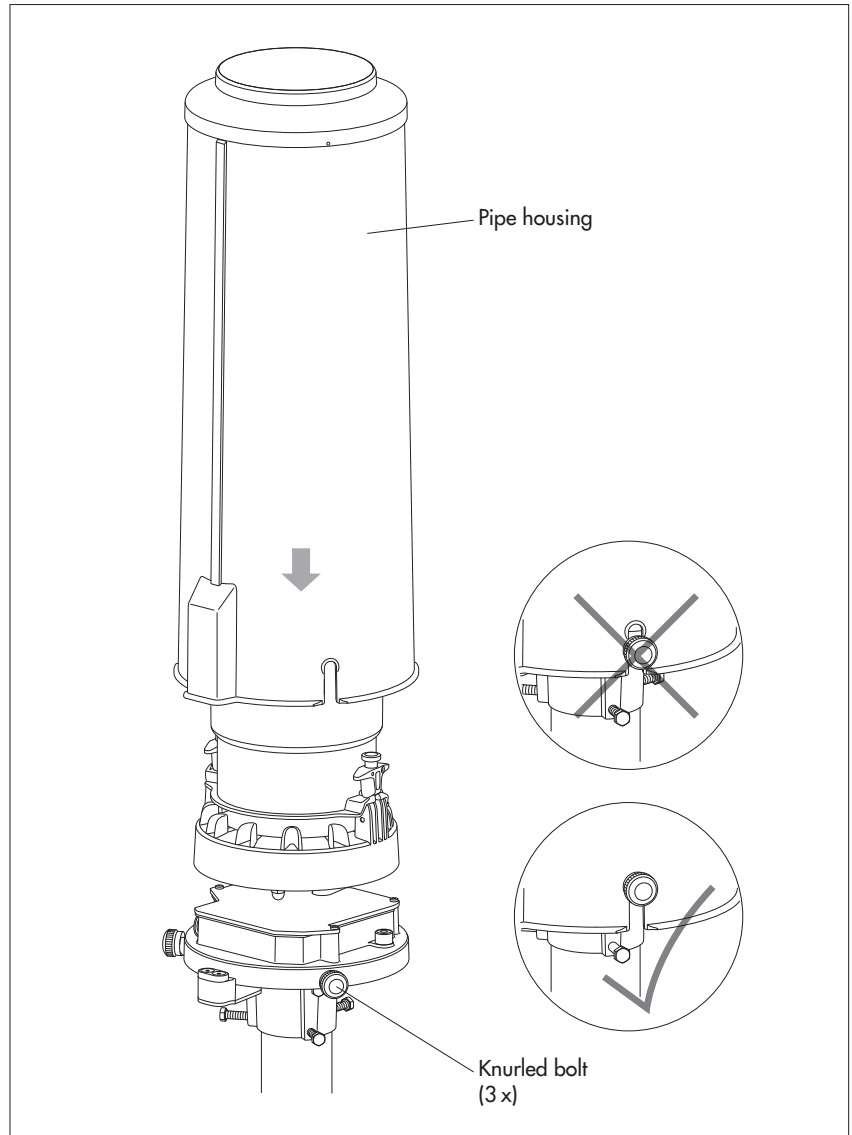
Abb. 19: Connection block for the plug contacts for the orifice rim heater.



■ Tighten three knurled bolts.

Fig. 20: Fitting the pipe housing and tightening the knurled screws.

Please note: Always place and remove the pipe housing of the OTT Pluvio² S with orifice rim heater straightly!



! **Please note:** After startup, the OTT Pluvio² S 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 SDI-12 Basic commands

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

Conventions applicable to measured value formats:

p – Sign (+,-)

b – Number ahead of the decimal point (Output without leading zeros)

e – Number after the decimal point

Command	Response	Description
a!	a<CR><LF>	Acknowledgment active a – sensor address; factory setting = 0
aI!	allccccccccmmmmmm vvxxxxx<CR><LF>	Send identification a – sensor address 11 – SDI-12 protocol version cccccccc – manufacturer identification (company name) mmmmmm – sensor identification vvv – sensor version (firmware) xxxxxx – serial number OTT Pluvio ² S response = 013OTT HACHPLUV2S100xxxxxx
aAb!	b<CR><LF>	Change sensor address a – old sensor address b – new sensor address
?!	a<CR><LF>	Query sensor address (not possible at SDI-12 bus operation) a – sensor address
aM! / aM1!	atttn<CR><LF>	Start measurement a – sensor address ttt – time in seconds until the sensor has determined the measurement result OTT Pluvio ² S response = 000 n – number of measured values OTT Pluvio ² S response = 9 to aM 3 to aM1!
aMC! / aMC1!	atttn<CR><LF>	Start measurement and request CRC (Cyclic Redundancy Check). For details, see command aM!. The responses to the D0! ... aD2! commands in this case are extended by a CRC value (example): a<value1><value2><value3><CRC><CR><LF>
aC! / aC1!	atttn<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!	atttn<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 D0! ... aD2! commands in this case are extended by a CRC value (example): a<value1><value2><value3><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> <CR><LF>	Send data a – sensor address <value1> – Intensity RT [mm/h]: pbbbb.eee (0.000 ... 3000.000) [mm/min]: pbb.eee (0.000 ... 50.000) [inch/h]: pbbb.eee (0.000 ... 118.110) [inch/min]: pb.eee (0.000 ... 1.969) <value2> – Accu RT-NRT [mm]: pbbb.eee (0.000 ... 500.000) [inch]: pbb.eee (0.000 ... 19.685) <value3> – Accu NRT Format as Accu RT-NRT
aD1!* * after aM!, aMC!, aC!, aCC!	a<value4><value5><value6> <CR><LF>	Send data a – sensor address <value4> – Accu total NRT Format as Accu RT-NRT <value5> – Bucket RT [mm]: pbbb.eee (7.000 ... 400.000) [inch]: pbb.eee (0.276 ... 15.748) <value6> – Bucket NRT Format as Bucket RT
aD2!* * after aM!, aMC!, aC!, aCC!	a<value7><value8><value9> <CR><LF>	Send data a – sensor address <value7> – Temperature of load cell [°C]: pbb.e (-40.0 ... +85.0) [°F]: pbbb.e (-40.0 ... +185.0) <value8> – Heater status pbbb +0 = Orifice rim heater working properly +1 = W: Temp. of orifice ring rim > 40 °C +2 = A: Temp. of orifice ring rim < -20 °C +4 = A: Temperature sensor not connected +8 = A: Temperature sensor short-circuited +16 = A: Communication to rim heater module is defective (the pipe housing may have been removed) +32 = A: Orifice rim heater self-test failed +64 = W: Orifice rim heater temporarily disabled +128 = W: Orifice rim heater disabled or not present W = warning; A = alarm. When the OTT Pluvio ² S unit outputs other values than those indicated here, several events have occurred simultaneously. In such a case, the individual values are added up. Example: "+65" → Sum obtained from warnings "+1" and "+64". The status information output – assuming the cause has been rectified – will be reset the next time the command aM! is used.

- **Note on *Bucket RT* and *Bucket NRT* values:** These level values are not exactly zeroed in case of an empty collecting bucket. Depending on the climatic ambient conditions, they vary by maximum ±10 mm around zero.

Command	Response	Description
(continuation of aD2!)		<p><value9> – Status</p> <p>pbbbb</p> <ul style="list-style-type: none"> +0 = Precipitation gauge working properly +1 = W: Bucket 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 out of range +32 = W: Supply voltage < 7 V +64 = A: Weight measurement unstable +128 = A: Weight measurement incorrect +256 = A: Weight below minimum +512 = A: Weight above maximum +1024 = A: No weight calibration <p>W = warning; A = alarm.</p> <p>When the OTT Pluvio² S unit outputs other values than those indicated here, several events have occurred simultaneously. In such a case, the individual values are added up. Example: "+34" → Sum obtained from warnings "+2" and "+32". The status information output – assuming the cause has been rectified – will be reset the next time the command aM! is used.</p>
<p>aD0!*</p> <p>* after</p> <p>aM1!, aMC1!,</p> <p>aC1!, aCC1!</p>	<p>a<value1><value2><value3> ...</p> <p>... <CR><LF></p>	<p>Send data</p> <p>a – sensor address</p> <p><value1> – Temperature of electronics unit (approximate ambient temperature incl. delay)</p> <p>[°C]: pbb.e (-40.0 ... +85.0)</p> <p>[°F]: pbbb.e (-40.0 ... +185.0)</p> <p><value2> – Supply voltage [V]: pbb.e (+4,5 ... +28.0)</p> <p><value3> – Temperature of orifice ring rim [°C]: pbb.e (-40.0 ... +85.0)</p> <p>[°F]: pbbb.e (-40.0 ... +185.0)</p>

More information on the SDI-12 basic commands can be found in the document *SDI-12: A Serial-Digital Interface Standard for Microprocessor-Based Sensors*, Version 1.4 (see Internet page www.sdi-12.org).

6.2 Advanced SDI-12 commands

All advanced SDI-12 commands start with an "O" for OTT. These commands may be used, for example, to retrieve additional information from an OTT Pluvio² S through the transparent mode of a datalogger or to configure an OTT Pluvio² S.

Command	Response	Description
<p>► Read out firmware version</p> <p>aOOV!</p>	acc.cc.c<CR><LF>	<p>Read out firmware version of the OTT Pluvio² S</p> <p>a – sensor address cc.cc.c – firmware version</p> <p>Example: V1.00.00 (first firmware version supplied)</p>
<p>► Set/read the unit for the temperature measured values</p> <p>aOUTb!</p> <p>aOUT!</p>	<p>ab<CR><LF></p> <p>ab<CR><LF></p>	<p>Set unit</p> <p>Read out unit</p> <p>a – sensor address b – 0 = °C; factory setting 1 = °F</p>
<p>► Set/read unit for the intensity measurements</p> <p>aOUIb!</p> <p>aOUI!</p>	<p>ab<CR><LF></p> <p>ab<CR><LF></p>	<p>Set unit</p> <p>Read out unit</p> <p>a – sensor address b – 0 = mm/min 1 = mm/h; factory setting 2 = inch/min 3 = inch/h</p>
<p>Note: This command changes the units for "Accu ..." and "Bucket ..." at the same time; mm ↔ inch</p>		
<p>► Set/read pulse output rate</p> <p>aOCIB!</p> <p>aOCI!</p>	<p>ab<CR><LF></p> <p>ab<CR><LF></p>	<p>Set pulse output rate</p> <p>Read pulse output rate</p> <p>a – sensor address b – 0 = 5 Hz; factory setting 1 = 2 Hz</p>
<p>► Set/read pulse factor</p> <p>aOSIB!</p> <p>aOSI!</p>	<p>ab<CR><LF></p> <p>ab<CR><LF></p>	<p>Set pulse factor</p> <p>Read pulse factor</p> <p>a – sensor address b – 0 = 0.05 mm 1 = 0.1 mm; factory setting 2 = 0.2 mm 3 = 0.5 mm 4 = 1.0 mm</p>

► Set/read orifice rim heater mode (OTT Pluvio² S with orifice rim heater)

aOCHb!	ab<CR><LF>	Set mode
aOCH!	ab<CR><LF>	Read mode

a – sensor address
b – 0 = Orifice rim heater disabled
 1 = Mode #1; continuously ON
 2 = Mode #2; temperature range control
 3 = Modus 3; NWS Standard
 4 = Modus 4; precipitation events

► Set/read orifice rim heater target temperature (OTT Pluvio² S with orifice rim heater)

aOCHSpb!	apb<CR><LF>	Set target temperature
aOCHS!	apb<CR><LF>	Read target temperature

a – sensor address
p – sign (+)
b – 2 ... 9 (+2 ... +9 °C);
 factory setting +4 °C

► Set/read orifice rim heater lower temperature limit (OTT Pluvio² S with orifice rim heater)
Orifice rim heater mode: #2

aOCHGpbb!	apbb<CR><LF>	Set lower temperature limit
aOCHG!	apbb<CR><LF>	Read lower temperature limit

a – sensor address
p – sign (+,-)
bb – 40 ... 9 (-40 ... +9 °C);
 factory setting -30 °C

► Set/read orifice rim heater on-time/after-run time (OTT Pluvio² S with orifice rim heater)
Orifice rim heater mode: #3, #4

aOCHDbbbb!	abbbb<CR><LF>	Set on-time/after-run time
aOCHD!	abbbb<CR><LF>	Read on-time/after-run time

a – sensor address
bbbb – 1 ... 1440 (1 ... 1440 minutes);
 factory setting 20 minutes

► Set/read orifice rim heater starting time (OTT Pluvio² S with orifice rim heater)
Orifice rim heater mode: #3

aOCHZhh:mm:ss!	ahh:mm:ss<CR><LF>	Set starting time
aOCHZ!	ahh:mm:ss<CR><LF>	Read starting time

a – sensor address
hh:mm:ss – 00:00:00 ... 23:59:59;
 factory setting 14:00:00 Uhr

► Set/read orifice rim heater self-test interval (OTT Pluvio² S with orifice rim heater)
Orifice rim heater mode: #1, #2, #3, #4

aOCHTbbbb!	abbbb<CR><LF>	Set self-test interval
aOCHT!	abbbb<CR><LF>	Read self-test interval

a – sensor address
bbbb – 1 ... 10080 (1 ... 10080 minutes);
 factory setting 60 minutes*

* by OTT Pluvio² operating software adjustable values: 1, 12, 24 hours; 2, 3, 4, 5, 6, 7 days

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

```
aOCLb!          ab<CR><LF>
aOCL!           ab<CR><LF>
```

```
Set serial interface
Read serial interface
```

- a – sensor address
- b – 0 = SDI-12; factory setting
 - 1 = RS-485 2-wire
 - 2 = RS-485 4-wire

▶ Set/read protocol on RS-485 interface

```
aOCMb!          ab<CR><LF>
aOCM!           ab<CR><LF>
```

```
Set protocol
Read protocol
```

- a – sensor address
- b – 0 = SDI-12 protocol; factory setting
 - 1 = ASCII (RS-485 command line mode)
 - 2 = – (special application)
 - 3 = Modbus (RTU)-protocol

▶ Set/read data transmission rate (baudrate) at RS-485 interface using the ASCII/Modbus (RTU)-protocol

```
aOCRb!          ab<CR><LF>
aOCR!           ab<CR><LF>
```

```
Set data transmission rate
Read data transmission rate
```

- a – sensor address
- b – 0 = 1 200 bit/s
 - 1 = 2 400 bit/s
 - 2 = 4 800 bit/s
 - 3 = 9 600 bit/s factory setting
 - 4 = 19 200 bit/s
 - 5 = 57 600 bit/s
 - 6 = 115 200 bit/s

▶ Reset Accu total NRT

```
aOMR!           a<CR><LF>
```

```
Reset Accu total NRT
```

- a – sensor address

6.3 RS-485 interface with Modbus protocol (RTU)

As of firmware version 1.06.0, the OTT Pluvio² S supports the Modbus protocol (RTU) on the RS-485 interface. If required, the precipitation sensor can be individually configured with extended SDI-12 commands for this purpose:

- ▶ Set serial interface ¹⁾

```
aOCLb!          b = 1 → RS-485 2-wire
                  b = 2 → RS-485 4-wire
```
- ▶ Set the protocol on the RS-485 interface


```
aOCM3!          → Modbus protocol (RTU)
```
- ▶ Set data transmission speed ¹⁾

```
aOCRb!          b = 3 → 9 600 bit/s
                  b = 4 → 19 200 bit/s
                  b = 5 → 57 600 bit/s
                  b = 6 → 115 200 bit/s
```

For further configuration parameters ¹⁾ and a detailed description of the supported Modbus registers, refer to the document "Protocol Description Precipitation gauge OTT Pluvio² S/L – RS-485 Interface with Modbus protocol (RTU)"; document number 70.040.001.B.E.

¹⁾ depending on the requirement of the connected Modbus server

6.4 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 datalogger can handle this protocol.

To easily incorporate the OTT Pluvio² S unit into any measuring station infrastructure, a so-called command line mode is implemented in the OTT Pluvio² S. Using an ASCII character format command set, any measured values can be retrieved and various settings made. This command set must be implemented in the data recording device. In the OTT Pluvio² S unit, a number of operating parameters are to be set using the OTT Pluvio² operating software.

Switching to RS-485 command line mode

Communication interface: RS-485 or RS-485 4-wire
RS-485 protocol type: ASCII Text ...

Transmission parameters ... 57 600; 19 200; **9 600**; 4 800; 2 400; 1 200 bd (8 N 1)

Units

Temperature values: °C · °F
Intensity: mm/min · mm/h
inch/min · 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"; "Heater status", "Status", as a sequence of ASCII characters.
After the character **M**, any separator can follow optionally. This character then separates the individual values from each other in the answer from the OTT Pluvio² S. Refer to Chapter 6.1. for a description of measured value formats and status information.

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

MCRC[separator]<CR> request measured values optionally with CRC (Cyclic Redundancy Check)*. In this case, the measured values output are extended by a CRC value.

ECRC[separator]<CR>

RPT<CR> repeats the last command executed; e.g. when CRC-check* is erroneous. In this case the OTT Pluvio² S does not determine new measured values, but displays the buffered measured values repeatedly.

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 intensity, unit temperature, hardware index, PCB number, load cell number

Examples

M;<CR> +0.000 ;+0.000 ;+0.000 ;+0.000 ;+269.280 ;
+269.281 ;+24.5 ;+255 ;+0<CR><LF>

MCRC;<CR> +0.000 ;+0.000 ;+0.000 ;+0.000 ;+269.277 ;
+269.281 ;+24.5 ;+255 ;+0CRC9EFA ;<CR><LF>

E;<CR> +0.000 ;+0.000 ;+0.000 ;+0.000 ;+269.280 ;+269.281 ;
+24.5 ;+255 ;+0 ;+25.4 ;+12.1 ;+99.9CRCC8C8 ;<CR><LF>

R<CR> OK<CR><LF>

W<CR> Heating ON<CR><LF>

S<CR> Heating OFF<CR><LF>

I<CR> 361534 ;v1.03.0 ;200 ;mm/h ; °C ;H1 ;800380210 ;31353651 ;<CR><LF>6

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

* cyclic redundancy check: method for determining a checksum in order to be able to detect errors during data transmission.
(Technical details: CRC-CCITT (CRC-16); CRC order: 16; CRC polynomial: 1021; Initial value: 0; Final XOR value: 0)

7 Performing maintenance operation

CAUTION Risk of burns due to potentially hot orifice rim!



For device versions with orifice rim heater (RH) the orifice rim is heated at low ambient temperatures.

- ▶ Wear protective gloves during maintenance!

To ensure smooth operation of the precipitation gauge, we recommend to perform the following maintenance operations at the intervals given:

- ▶ Emptying: bucket level $\geq 80\%$
- ▶ Add anti-freeze: ambient temperature $< 0\text{ }^{\circ}\text{C}$
- ▶ Visual inspection: once a year
- ▶ Check measurement: once a year

7.1 Emptying the collecting bucket

CAUTION Risk of injury by falling collecting bucket!



A completely filled collecting bucket has a weight of up to 8.5 kg!

- ▶ Be careful when emptying the collecting bucket.
- ▶ As applicable, ask another person to assist.
- ▶ Wear safety shoes when emptying the collecting bucket!

CAUTION Risk of crushing due to pipe housing/knurled screws!



When loosening/tightening the knurled screws and when fitting the pipe housing, there is a risk of fingers being crushed.

- ▶ Wear protective gloves when emptying the collecting bucket!

You may empty the bucket contents at any time, irrespective of the level. Any collecting bucket overflow will result in incorrect measurements, but will not damage the precipitation gauge.

- When to empty?

When the collecting bucket level is 80 % or more ($\cong 320$ mm of precipitation); refer to Bucket RT/Bucket NRT values; Status information includes warning "+1"; response (value 9) to SDI-12 command "aD2!" after "aM!", "aMC!", "aC!" oder "aCC!".

- Interval

Typically once or twice a year;
(more frequently in regions with heavy amount of precipitation).

How to empty the collecting bucket:

- Loosen three knurled screws.
 - Remove the pipe housing upwards.
 - Remove both spring-loaded terminals and carefully remove the collecting bucket.
- ! **Please note:** Proceeding carelessly, e.g. roughly placing the filled collecting bucket on the bucket support, may damage the weighing mechanism.
- Empty the collecting bucket.
 - Place the collecting bucket on the bucket support (note the anti-rotation protection) and secure it using the two spring-loaded terminals, refer to Fig. 17.
 - Align the pipe housing and install it, refer to Fig. 20.
 - Tighten three knurled screws.

7.2 Adding anti-freeze agent for winter operation

CAUTION Risk of eye injuries from anti-freeze agent



The anti-freeze agent contains chemicals that can cause severe eye irritation.

- ▶ Wear protective goggles when filling/emptying the anti-freeze agent!

For temperatures below 0 °C*, we recommend anti-freeze agent be added to the collecting bucket. This anti-freeze causes the collected solid precipitation to gradually thaw in the collecting bucket.

Moreover, it prevents the unit from getting damaged when the collecting bucket is filled for more than 80 % and the content is frozen. Please use the anti-freeze POWERCOOL DC 924-PXL in an aqueous solution, refer to Appendix E (manufacturer: Thermochema GmbH, A-4460 Losenstein; Phone +43 7255 4244-0; www.thermochema.at.)

* temperatures all over the day of continuously < approx. -5 °C. When temperatures of above 0 °C occur for a longer period during the day, adding anti-freeze is not necessary.

How to add anti-freeze agent:

- Preparing the anti-freeze solution: Mix 1 litre of anti-freeze with 0.4 litre of water.
- Carefully add anti-freeze solution to the collecting bucket (the pipe housing does not have to be removed for this).

! **Please note:** Add anti-freeze agent only as an aqueous solution (add 40 % of water)! Never use neat! (POWERCOOL is hygroscopic; this can lead to the output of false precipitation).

• 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 system. 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

Basically, the unit may be operated in the winter season without adding anti-freeze solution. However, this mandatorily requires the collecting bucket to be checked and emptied in regular intervals!

! **Please note: When the accumulated precipitation freezes that has filled the collecting bucket up to 80 %, this may result in permanent damage to the weighing mechanism.**

• Note on third-party anti-freeze solution products

Basically, third-party products may be used provided the following requirements are met:

- ▶ Good solubility in water, low-density (i.e. the anti-freeze agent does not settle below the water).
- ▶ Low evaporation (do not use methanol).
- ▶ Little corrosive effect on aluminium and stainless steel.
- ▶ Low freezing point even with high collecting bucket level.
- ▶ Low hygroscopic properties (absorption of moisture from ambient air, which would affect the measurement results).
- ▶ Note chemical compatibility with collecting bucket (ASA).
- ▶ No gumming after use in open containers for several months.

7.3 Performing the visual inspection

- Check smooth movement of the collecting bucket in all directions at the lower edge of the bucket orifice. The collecting bucket upper edge may not contact the pipe housing!
- If present, carefully remove any contamination (e.g. insects, insect nests, spider webs, etc.), and icing.

7.4 Additional checks in cases of defect

- ▶ Is the collecting bucket distorted?
 - ▶ Is the collecting bucket correctly positioned on the bucket support?
 - ▶ Is the pipe housing correctly positioned and not damaged?
 - ▶ Is the weighing mechanism contacting other components, e.g. caused by contamination?
 - ▶ Is the red LED flashing (refer to Fig. 18)?
 - ▶ Use Chapter 7.5 to isolate the failure.
- If in doubt, perform a Guided Accuracy Test as described in Chapter 7.6.

7.5 Troubleshooting/remedy

Loss of communication through the SDI-12 or RS-485 interfaces

General (both interface types)

- ▶ OTT Pluvio² S is connected to PC/tablet via USB cable (in this case, the OTT Pluvio² S unit disconnects communication over the SDI-12/RS-485 interfaces); red LED flashing once every 2 seconds, green LED permanently lit:
→ disconnect USB cable.
- ▶ Precipitation gauge supply voltage missing, incorrectly connected, or is outside the specified range; red LED is continuously OFF:
→ restore power supply to the unit (replace fuse as necessary);
→ check supply voltage level and adjust as necessary;
→ check supply voltage wiring and correct as necessary.
- ▶ Precipitation gauge and the data recording unit connected are powered by two isolated power sources; GNDs of the two power supplies are not connected to each other:
→ establish connection between the two GNDs.

SDI-12 interface

- ▶ Incorrect configurations of the OTT Pluvio² S and/or of the data recording unit connected:
→ check the SDI-12 sensor address of OTT Pluvio² S and correct as necessary (using the OTT Pluvio² Operating Software);
→ check the "Communication interface" (SDI-12) setting and correct as necessary (using the OTT Pluvio² Operating Software);
→ check the configuration of the data recording unit connected and correct as necessary (refer to the data recording unit Operating Instructions).

RS-485 interface – SDI-12 protocol

- ▶ RS-485 interface wiring is incorrect (pins "Data RS-485 ..."):
 - 2-wire: check pin assignments of "... - A", "... - B" and swap as necessary;
 - 4-wire: check pin assignments of "... TX - A", "... TX - B" as well as of "... RX - A", "... RX - B" and swap as necessary.
- ▶ Incorrect configurations of the OTT Pluvio² S and/or of the data recording unit connected:
 - check the SDI-12 sensor address of OTT Pluvio² S and correct as necessary (using the OTT Pluvio² Operating Software);
 - check the "Communication interface" (RS-485/RS-485 4-wire) setting and correct as necessary (using the OTT Pluvio² Operating Software);
 - check the "RS-485 protocol type" (SDI-12 protocol) setting and correct as necessary (using the OTT Pluvio² Operating Software);
 - check the configuration of the data recording unit connected and correct as necessary (refer to the data recording unit Operating Instructions).
- ▶ When an RS-485 interface converter is used – incorrect settings:
 - check settings and correct as necessary.
- ▶ When terminal software (e.g. for testing) is used – incorrect settings:
 - check settings and correct as necessary.

RS-485 interface – ASCII protocol

- ▶ RS-485 interface wiring is incorrect (pins "Data RS-485 ..."):
 - 2-wire: check pin assignments of "... - A", "... - B" and swap as necessary;
 - 4-wire: check pin assignments "... TX - A", "... TX - B" as well as of "... RX - A", "... RX - B" and swap as necessary.
- ▶ Incorrect configurations of the OTT Pluvio² S and/or of the data recording unit connected:
 - check the "Communication interface" (RS-485/RS-485 4-wire) setting and correct as necessary (using the OTT Pluvio² Operating Software);
 - check the "RS-485 protocol type" (ASCII text ...) setting and correct as necessary; make sure that Baud rate is correct; 1200 ... 57,600 Bd (using the OTT Pluvio² Operating Software);
 - check the configuration of the data recording unit connected and correct as necessary (refer to the data recording unit Operating Instructions).

RS-485 interface – Modbus (RTU) protocol

- ▶ Wiring of the RS-485 interface is incorrect (contacts "Data RS-485 ..."):
 - 2-wire: check contact assignment "... - A", "... - B" and change if necessary;
 - 4-wire: check contact assignment "... TX - A", "... TX - B" as well as "... RX - A", "... RX - B" and change if necessary.
- ▶ Configuration of the OTT Pluvio² S and/or the Modbus server is incorrect:
 - Check configuration and correct if necessary (see chapter 6.3 and document "Protocol Description Precipitation gauge OTT Pluvio² S/L – RS-485 Interface with Modbus protocol (RTU)"; document number 70.040.001.B.E).

Loss of communication through the USB interface

- ▶ Connection between OTT Pluvio² L and PC/tablet via USB cable failed; red LED is flashing once in two seconds, green LED is OFF:
 - check connection via USB cable and correct as necessary.
- ▶ USB interface driver on PC/tablet is not or incorrectly installed:
 - (re)install USB interface driver.

No or incorrect pulses available at the pulse outputs

- ▶ Precipitation gauge supply voltage missing, incorrectly connected, or is outside the specified range; red LED is continuously OFF:
 - restore power supply to the unit (replace fuse as necessary);
 - check supply voltage level and adjust as necessary;
 - check supply voltage wiring and correct as necessary.
 - ▶ Supply voltage* for external circuitry connected to the pulse output is missing, incorrectly connected, or limits for U_{max} and I_{max} are exceeded:
 - power external circuitry*;
 - check wiring of the pulse outputs and correct as necessary;
 - check external circuitry and correct as necessary, so that the limits for U_{max} and I_{max} are kept.
- * not required for OTT dataloggers
- ▶ Incorrect configurations of the OTT Pluvio² S and/or of the data recording unit connected:
 - check the "Pulse output frequency" setting and correct as necessary (using the OTT Pluvio² Operating Software);
 - check the "Pulse factor" setting and correct as necessary (using the OTT Pluvio² Operating Software);
 - check the configuration of the data recording unit connected and correct as necessary (refer to the data recording unit Operating Instructions).
- **Note:** The "Pulse status information" output continuously provides pulses (alive signal) when the unit is operating properly. Depending on collecting bucket level, 10 ... 100 pulses per minute are output or, when the OTT Pluvio² S unit is connected to a PC/tablet via USB cable, 120 pulses per minute are output.

Orifice rim heater self-test failed/is not run

- ▶ Orifice rim heater supply voltage is missing, incorrectly connected, or is outside the specified range:
 - restore power supply to the orifice rim heater (replace fuse as necessary);
 - check supply voltage level and adjust as necessary;
 - check wiring of the orifice rim heater and correct as necessary.
- ▶ Pipe housing (including built-in orifice rim heater) is not installed:
 - install the pipe housing.
- ▶ Pipe housing without built-in orifice rim heater of another OTT Pluvio² S is accidentally installed:
 - install the pipe housing with built-in orifice rim heater.
- ▶ No self-test is run:
 - check the "Self-test interval" (Modes 2, 3, 4) setting and correct as necessary (using the OTT Pluvio² Operating Software);
 - force self-test by a "Power-Reset" once.

Orifice rim heater does not work/does not work as expected

- ▶ Orifice rim heater supply voltage is missing, incorrectly connected, or is outside the specified range:
 - restore power supply to the orifice rim heater (replace fuse as necessary);
 - check supply voltage level and adjust as necessary; make sure that output power of power source is sufficient;
 - check orifice rim heater wiring and correct as necessary; make sure that cable cross-section is sufficient;
 - check heater status (using the OTT Pluvio² Operating Software).
- ▶ Pipe housing (including built-in orifice rim heater) is not installed:
 - install the pipe housing.
- ▶ Pipe housing without built-in orifice rim heater of another OTT Pluvio² S is accidentally installed:
 - › install the pipe housing with built-in orifice rim heater.
- ▶ Configuration of the orifice rim heater results in unexpected heater performance:
 - check settings
 - mode of operation
 - orifice rim target temperature (modes #1, #2, #3, #4)
 - lower temperature limit (mode #2)
 - switch-on time (mode #3)
 - on-time (mode #3)
 - after-run time (mode #4)and correct as necessary (using the OTT Pluvio² Operating Software).
- ▶ OTT Pluvio² S system time is incorrect (e.g. after power supply failure):
 - correct system time (using the OTT Pluvio² Operating Software).

No/low precipitation output

- ▶ No precipitation output
 - when USB interface is/was connected,
 - after emptying,
 - start-up/power failure:
 - wait for 5 minutes.
 - ▶ Collecting bucket overflow:
 - empty the collecting bucket.
 - ▶ Evaporation rate is very high (collecting bucket is empty and ambient temperature is high):
 - add approx. 1 to 2 litres of water to the collecting bucket.
 - ▶ Apparently low output for NRT values:
 - wait for 5 minutes (delay caused by filter algorithm).
 - ▶ Increase in weight > approx. 12 mm within 6 seconds:
 - no precipitation output (filter algorithm detects foreign matter), since amount of natural precipitation is exceeded; check precipitation gauge status: Warning "+16" (using the OTT Pluvio² Operating Software).
 - ▶ Precipitation gauge probably failed:
 - perform Guided Accuracy Test (using the OTT Pluvio² Operating Software).
 - ▶ Precipitation gauge is not level:
 - check the bubble level indicator and correct adjustment as necessary.
- **Note:** Check whether measured value used is suited for present application (behaviour over time: Real-time output (RT), Non Real-time output (NRT), or combination value (RT-NRT))! For a description of the individual measured values, refer to Chapter 3.1. Use another measured value as necessary.

Incorrect precipitation output

- ▶ Foreign matter (leaves, insects, ...) have entered the collecting bucket (increase in weight < approx. 12 mm within 6 seconds; any higher increase is detected as foreign matter by the filter algorithm):
 - manually correct the amount of precipitation by deducting a respective amount.
- ▶ Base plate is incorrectly levelled:
 - Rotate the base plate so that the connector block of the orifice rim heater is facing in South direction (North direction on the southern hemisphere)! Refer to Chapter 5.6.
- ▶ Anti-freeze agent without water was added (hygroscopic behaviour):
 - Add anti-freeze agent only as an aqueous solution (add 40 % of water)!
- ▶ ... in the measured values "Intensity RT" + "Accu RT-NRT" at measuring sites exposed to wind¹⁾:
 - alternatively use measured value "Accu NRT". (The measured values "Intensity RT" + "Accu RT-NRT" are more susceptible to wind due to measurement technology.)
- ▶ ... at the pulse output at measuring sites exposed to wind¹⁾:
 - if possible use the SDI-12 interface and the measured value "Accu NRT". (The pulse output is based on the measured value "Accu RT-NRT" which is more susceptible to wind due to measurement technology.)

¹⁾ if necessary, observe time-of-day-dependent wind systems

7.6 Performing the Guided Accuracy Test (check measurement)

CAUTION Risk of injury by falling collecting bucket!



A completely filled collecting bucket has a weight of up to 8.5 kg!

- ▶ Be careful when removing the collecting bucket.
 - ▶ If applicable, ask another person to assist.
 - ▶ Wear safety shoes during the accuracy test!
-

CAUTION Risk of crushing due to pipe housing/knurled screws!



When loosening/tightening the knurled screws and when fitting the pipe housing, there is a risk of fingers being crushed.

- ▶ Wear protective gloves during the accuracy test!
-

The "OTT Pluvio² S Software" flash drive is available as an accessory to the OTT Pluvio² S (refer to Appendix E).

In addition to the Operating Instructions (PDF file), USB interface driver, and OTT datalogger example configurations, this flash drive includes the OTT Pluvio² Operating Software. Alternatively, the individual files are found on our website www.ott.com/resources for free download.

Using the OTT Pluvio² Operating Software, a Guided Accuracy Test may be performed. Using this test, the OTT Pluvio² S can be easily and quickly checked for proper operation on site.

In addition to this feature, other operations are provided by this Operating Software: e.g. modify OTT Pluvio² S basic settings, start measurements, or update the firmware.



Please note: Perform the Accuracy Test on calm days without precipitation! (Otherwise, the test will be affected by wind and unwanted precipitation.) The USB interface also supplies operating voltage to the OTT Pluvio² S. No additional power supply is required. However, if present, it does not have to be removed.

Preparatory work

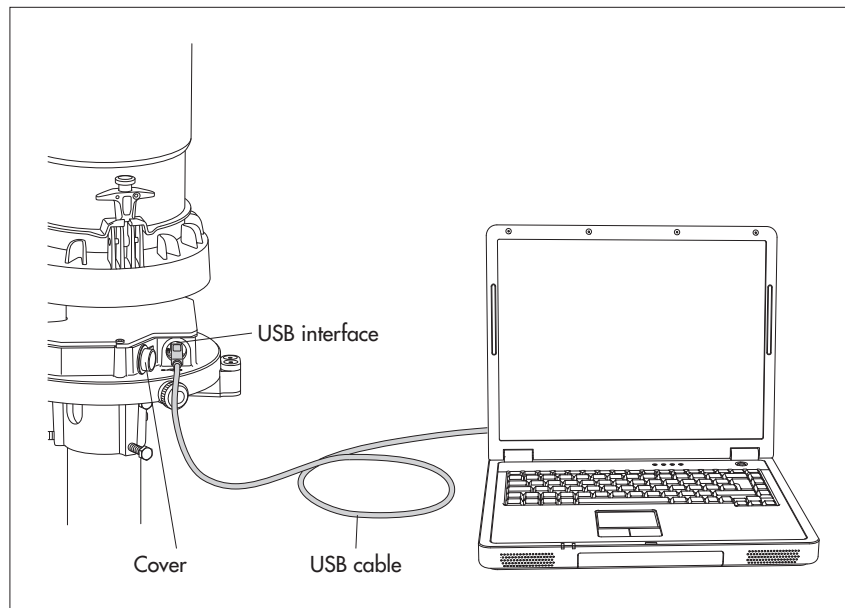
Prerequisite: PC (notebook) running Microsoft Windows 10 or later operating system.

- Log on to the PC as an administrator
- Installing the OTT Pluvio² Operating Software:
 - copy the file “setup.exe” into a directory of the PC;
 - start the file “setup.exe” → the “InstallShield Wizard” (installation program) opens;
 - follow the installation instructions on the screen.
- Installing the USB interface driver (FTDI drivers):
 - copy the file “CDM v2.12.00 WHQL Certified”¹⁾ into a directory of the PC;
 - remove the USB interface cover and connect the OTT Pluvio² S to the PC via the USB cable (included); refer to Fig. 21;
 - complete the device driver installation wizard that is automatically started;
 - start the file “CDM v2.12.00 WHQL Certified”¹⁾.

¹⁾ or higher release

Fig. 21: Connecting the OTT Pluvio² S to the PC using the USB interface.

Once the PC supplies power to the OTT Pluvio² S via the USB interface, a green LED below the USB interface is lit.



Required for the Guided Accuracy Test: test weight kit (refer to Appendix E)

Performing the Guided Accuracy Test

- Loosen the three knurled screws at the pipe housing.
- Remove the pipe housing upwards.
- Remove both spring-loaded terminals and carefully remove the collecting bucket.
- Remove the USB interface cover and connect the OTT Pluvio² S to the PC via the USB cable (included); refer to Fig. 21.
- Start the OTT Pluvio² S Operating Software.
- Select the “Connect” button → the Operating Software will establish a connection to the OTT Pluvio² S unit and retrieves different status information.
- Select the “Guided Accuracy Test” button → a wizard will guide you through the accuracy test. Make sure you follow all the steps and notes shown on the display!
- After completing the accuracy test, remove the USB cable.
- Replace the USB interface cover.
- Empty the collecting bucket as necessary, reinstall it and secure it using the two spring-loaded terminals; refer to Fig. 17.
- Align the pipe housing and install it, refer to Fig. 20.
- Retighten three knurled screws.



Please note: After attaching the USB interface, the OTT Pluvio² S disconnects communication over the other interfaces!

8 Repair

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

OTT Hydromet GmbH
Repaircenter
Ludwigstrasse 16
87437 Kempten · Germany
Phone +49 831 5617-433
Fax +49 831 5617-489
repair@ott.com



Please note: Only have a defective OTT Pluvio² S checked and repaired by the OTT repair center. Never attempt to repair the unit yourself! On no account carry out repairs yourself! Only a qualified repair followed by a factory final test ensures the specified measurement accuracy. 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 by replacement of components on their own. For more information, please contact the OTT HydroService department.

9 Notes about the disposal of used units



Within the member countries of the European Union

In accordance with the European Union Directive 2012/19/EC, OTT takes old devices back within the member countries of the European Union and disposes of them properly. The devices concerned by this are marked with the symbol shown aside.

- For further information on the return procedure, please contact your local 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 directive 2002/96/EC of your country.

For all other countries

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

Materials used

Base plate: stainless steel/aluminium
Collecting bucket: ASA
Bucket support: 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. 12 V _{DC} ; reverse-polarity protected
Current consumption	typ. 9.2 mA (measuring + communication) at 12 V _{DC}
Power consumption	≤ 110 mW (without heater)
Recordable precipitation	liquid, solid, mixed
Recordable precipitation amount	400 mm
Resolution	
Intensity	0,001 mm/min or mm/h
Amount of precipitation	0,001 mm
Accuracy	refer to limits/accuracy
Measuring range	
Bucket content	400 mm \triangleq 8 l
Collecting area	200 cm ² (\varnothing 159.6 \pm 0,1 mm)
Sampling interval (Poll)	1 minute ... 60 minutes
Output delay	
Real time	< 1 minute
Non-real-time (filtered values)	5 minutes (max. collecting period is 60 minutes)
Interfaces	
USB	Version 2.0 (only for service purposes – no overload protection)
SDI-12	Version 1.3
RS-485 (2- or 4-wire)	SDI-12 protocol and RS-485 command line mode; transfer speed factory setting (RS-485): 9600 Baud; 8 N 1
Pulse output	2 or 5 Hz
Measured values/status values output	Intensity RT, Accu RT/NRT, Accu NRT, Accu total NRT, Bucket RT, Bucket NRT, Temperature of load cell, OTT Pluvio2 S status, Heater status
Supply voltage for orifice rim heater	12 ... 28 V _{DC} ; typ. 12/24 V _{DC} ; reverse-polarity protected (no isolation of the power supply for the orifice rim heating and the precipitation gauge necessary)
Heater current consumption	max. 2,2 A
Heater power	at 12 V*: 12,5 Watt at 24 V: 50 Watt * Temperature ramp of the orifice rim temperature restricted to 12 K (wind speed 0 m/s each)
Operating range of the orifice rim heater (ambient temperature)	-40 ... +60 °C
Measuring range of orifice rim temperature	-40 ... +85 °C
Target temperature for orifice ring rim	+2 ... +9 °C; factory setting +4 °C
Accuracy of target temperature	\pm 1 °C
LED displays	
red LED (left of USB interface)	flashing 1 x every 2 seconds (0.5 Hz): normal operation
green LED (under the USB interface)	permanently lit: supply voltage < 5.5 Volt permanently lit: OTT Pluvio ² S connected to PC via USB interface
Dimensions \varnothing x h	288 mm x 651 mm
Weight (empty)	approx. 7,8 kg
Housing material	
Base plate	stainless steel/aluminium
Collecting bucket	ASA, UV resistant
Bucket support	ASA, UV resistant
Pipe housing	ASA, UV resistant
Degree of protection	
Pipe housing closed	IP 65
Pipe housing open	IP 63
Load cell	IP 67

Temperature range	
Operation	-40 ... +60 °C
Storage	-40 ... +70 °C
Temperature compensation	-25 ... +45 °C
Max. wind speed without device damage	50 m/s
Relative humidity	0 ... 100 %, non-condensing

Product certifications

CE (EU)

This device complies with the essential requirement of the 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 conditions:

- the equipment must not cause harmful interference;
- the equipment must accept any interference received, including interference that may cause undesired operation.

IC (CA)

Canadian Radio Interference-Causing Equipment.

This Class B digital device meets all requirements of the Canadian Regulation, ICES-003, Class B Interference-Causing Equipment Regulations.

Measured value	Unit	Measuring range	Threshold	Resolution	Accuracy absolute	Accuracy relative	Output delay
SDI-12/RS-485 interface							
▲ Intensity RT	mm/h mm/min	0.000 ... 3000.000 0.000 ... 50.000	6.000 0.100	0.60 0.001	±6 ±0.1	±1 % ±1 %	<1 <1
▲ Accu RT/NRT	mm	0.000 ... 500.000	0.030	0.001	±0.1	±1 %	1 ... 65
▲ Accu NRT	mm	0.000 ... 500.000	0.030	0.001	±0.1	±1 %	5 ... 65
▲ Accu total NRT	mm	0.000 ... 500.000	0.030	0.001	±0.1	±1 %	5 ... 65
▲ Bucket RT	mm	7.000 ... 400.000		0.001	±0.1	±0.2 %	<1
▲ Bucket NRT	mm	7.000 ... 400.000		0.001	±0.1	±0.2 %	5
▲ Temperature of load cell	°C	-40.0 ... +85.0		0.1	±1		<1
▲ Heater status		0 ... 128		1			<1
▲ OTT Pluvio ² status		0 ... 1024		1			<1
▲ Temp. of electronics unit	°C	-40.0 ... +85.0		0.1	±1		<1
▲ Power supply	V	+5.5 ... +28.0		0.1	±0.5		<1
▲ Temp. of orifice ring rim	°C	-40.0 ... +85.0		0.1	±1		<1
Pulse outputs							
▲ Pulse status information		0 ... 128	1			<1	
▲ Pulse-Accu RT-NRT	mm	0.05 ... 6.0* / 0.1 ... 12.0** / 0.2 ... 24.0*** 0.05 ... 15.0* / 0.1 ... 30.0** / 0.2 ... 60.0***		0.1/0.2 0.1/0.2	±0.1/0.2 ±0.1/0.2	±1 % ±1 %	<1 <1

** Pulse factor: 0.05 ** Pulse factor: 0.1 *** Pulse factor: 0.2

the larger value in each case counts

minutes

Appendix A – Connecting the OTT Pluvio² S to an OTT datalogger

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

There are two ways to connect the OTT Pluvio² S:

- ▶ Variant A: via SDI-12 interface
(protocol and physical interface: SDI-12)
- ▶ Variant B: via RS-485 interface
(SDI-12 interface via physical RS-485 interface)

Recommended: Variant B (greater range, higher interference immunity)

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

- Connect the OTT Pluvio² S to the OTT netDL IP datalogger as shown in Figure A1 (on the left). Also refer to the OTT netDL Operating Instructions.

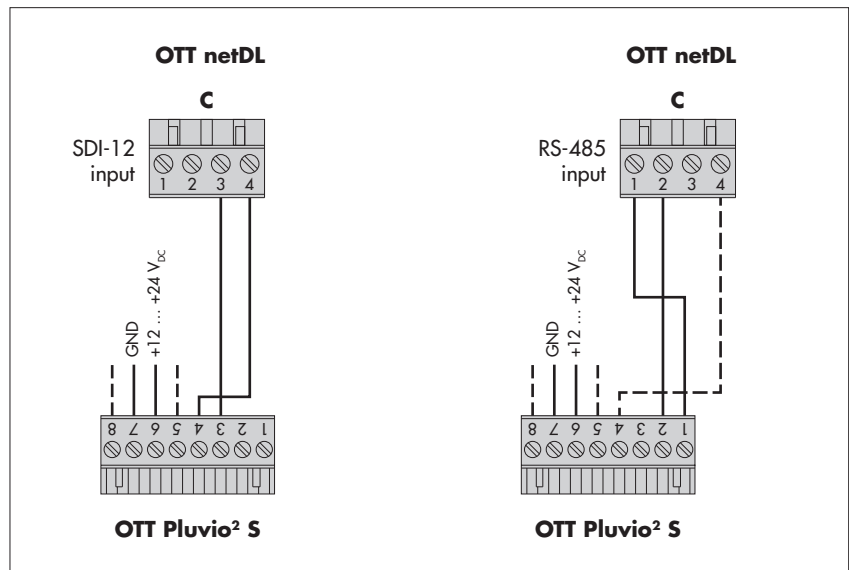
Method B: Connect the OTT Pluvio² S using the physical RS-485 interface (SDI-12 protocol via physical RS-485 interface). The maximum cable length is 1000 m.

- Connect the OTT Pluvio² S to the OTT netDL IP datalogger as shown in Figure A1 (on the right). Also refer to the OTT netD Operating Instructions.

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

The letters above the screw terminal strips identify the connectivity options available on the OTT netDL. Only the 8-pole screw terminal strip is required for this application.

The dashed GND connection is only necessary if the OTT Pluvio² S and the OTT netDL are supplied by separate power supplies.



Configuring the OTT netDL for the OTT Pluvio² S with SDI-12 interface

- Create a OTT netDL channel with "SDI-12 Recorder" or "OTT SDI RS485" function block ("Serial sensors" tab).
- Make the following settings:

Fig. A2: Setting the operating parameters of the OTT netDL SDI-12 Recorder function block.

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

- ▶ Terminal block OTT netDL "SDI-12 Recorder": C 3-4 (specified)
OTT netDL "OTT SDI RS485": C 1-2 (specified)
Terminal block used (screw terminal strip) of the OTT netDL
- ▶ Sensor address SDI-12 bus address. Each sensor address may be assigned on an SDI-12 bus line only once. (Check/set: refer to OTT netDL Operating Instructions, Chapter SDI-12 Transparent Mode.)
Typical setting: "0" (only one OTT Pluvio² S is connected to the terminal block, no bus operation).
- ▶ Value no. identifies which value (the xth of n values + status information) of the OTT Pluvio² S is recorded in this channel. Typical setting: "1" (first one of nine ("M!" Measuring Mode) or three ("M1!" Measuring Mode) measured values)
- ▶ Measuring mode "M!" or "M1!" (for allocating the measured values, refer Chapter 6, "SDI-12 commands and responses")
- ▶ Value no./ Virtual Terminal ID allocating the additional measured values of the OTT Pluvio² S to virtual terminals (for allocating the measured values, refer to Chapter 6, "SDI-12 commands and responses").
- ▶ Concurrent mode refer to the operating program online help; the OTT Pluvio² S does not support Concurrent Mode!
- ▶ Instantaneous value refer to the operating program online help.
- In the respective Channel function blocks, set the required units and number of digits after the decimal place; see responses to SDI-12 commands **aD0!** ... **aD2!**, Chapter 6.1 (status values: unit:-; decimal places: 0)

Notes:

- ▶ For recording all the 12 measured values + status information for an OTT Pluvio² S, 12 channels in the OTT netDL are thus necessary. The first channel contains the function block "SDI-12 Recorder" or "OTT SDI RS485" as the input signal. The other channels each contain a function block "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 S makes the measurement results available for retrieval immediately after the **aM!** and **aM1!** SDI-12 commands.

Fig. A3: Example configuration of an OTT netDL with 6 values recorded.

Additional configuration examples can be found on the flash drive OTT Pluvio² S software.

```
netDL 1000: 0000004590 / Airport FMM
> · Interfaces (3)
> · Devices (1)
> · Connections IP (1)
> · Servers (1)
> · Transmissions (1)
> · Maintenance windows (1)
  · External IP Devices (0)
  · Time synchronisation
  · Action management (1)
  · Display / Observer
  · Channel: 1010 / Intensity RT [mm/min]
    · Meas. cycle internal [00:01:00]
    · [C 3-4 /0/M!] SDI-12 Recorder [V02,V03,V04,V05,V06]
    · Virtual Terminal [V01]
    · Storage delta
    · Store
  · Channel: 1011 / Intensity RT Instantaneous Value [mm/min]
    · Meas. cycle internal [00:01:00]
    · [V01] Virtual Sensor
    · Instantaneous value
  · Channel: 1020 / Accu RT-NRT [mm]
    · Meas. cycle internal [00:01:00]
    · [V02] Virtual Sensor
    · Storage delta
    · Instantaneous value
    · Store
  · Channel: 1021 / Accu NRT [mm]
    · Meas. cycle internal [00:01:00]
    · [V03] Virtual Sensor
    · Total [00:15:00]
    · Storage delta
    · Instantaneous value
    · Store
  · Channel: 1022 / Accu total NR [mm]
    · Meas. cycle internal [00:01:00]
    · [V04] Virtual Sensor
    · Instantaneous value
    · Store
  · Channel: 1030 / Bucket RT [mm]
    · Meas. cycle internal [00:01:00]
    · [V05] Virtual Sensor
    · Scaling y=ax+b
    · Instantaneous value
    · Store
  · Channel: 1031 / Bucket NRT
    · Meas. cycle internal [00:01:00]
    · [V06] Virtual Sensor
    · Scaling y=ax+b
    · Instantaneous value
    · Store
```

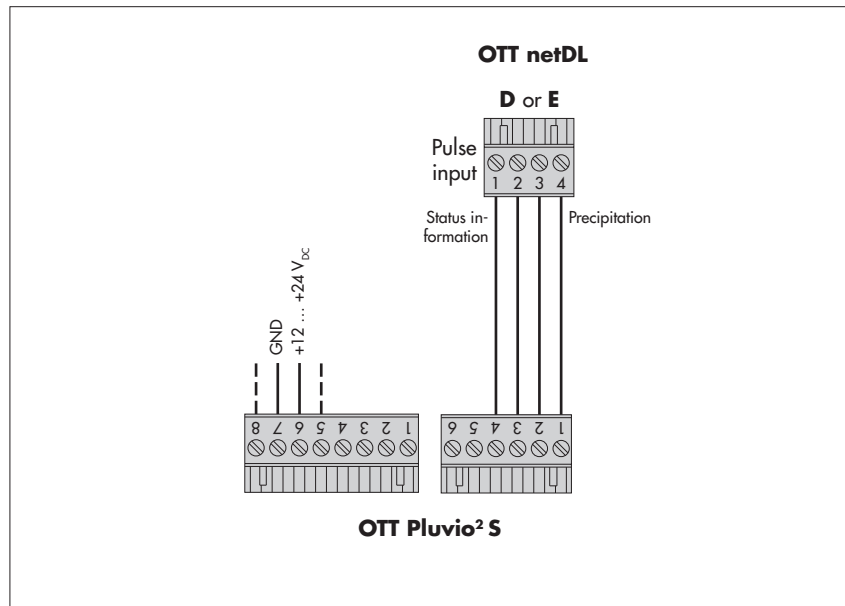
A.2 Connecting the OTT Pluvio² S to an OTT netDL via the pulse output

- Connect the OTT Pluvio² S to the OTT netDL IP datalogger or to the OTT DuoSens Compact Datalogger as shown in Figure A4. Also refer to the OTT netDL Operating Instructions. Maximum cable length: 1000 m.

Fig. A4: Connecting the OTT Pluvio² S to an OTT netDL via the pulse output.

The letters above the screw terminal strip identify the connectivity options available on the OTT netDL.

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



Configuring OTT netDL for OTT Pluvio² S with pulse output

- Create two OTT netDL channels with function block "Pulse input" ("Digital sensors" tab). (When you only want to record the amount of precipitation, one function block is sufficient.)
- Make the following settings:

Fig. A5: Setting the operating parameters of the OTT netDL Pulse input function block.

Pulse input	
Terminal block	D 1-2
Pulse factor	0.1
Debounce delay [ms]	8

- ▶ Terminal block D 1-2, D 3-4, E 1-2 or E 3-4
- ▶ Pulse factor – amount of precipitation: 0.05 · 0.1 · 0.2 · 0.5 · 1.0
(one pulse corresponds to 0.05 mm, 0.1 mm, 0.2 mm, 0.5 mm or 1.0 mm of precipitation.)
- ▶ Debounce delay [ms] – status information: 1
time in milliseconds during which the pulse input is disabled after recording a pulse. This prevents the OTT netDL from recording unwanted pulses caused by bouncing switch contacts. Set 8 ms for the OTT Pluvio² S.



Please note:

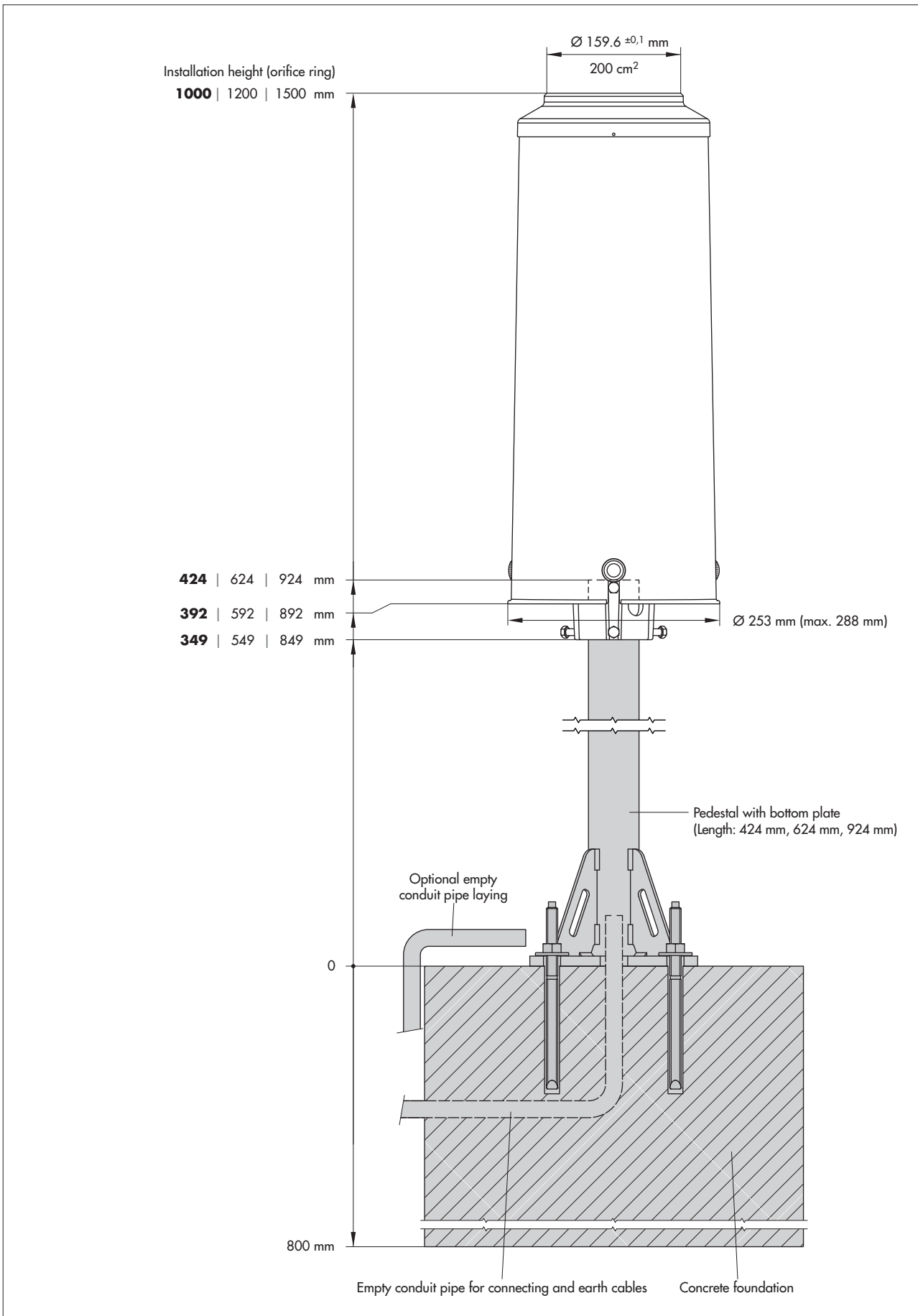
- ▶ Always position a pulse input at the beginning (top) of the function tree.
- ▶ After changing the pulse factor, a data reset (reset the OTT netDL) is necessary!
- In the “Channel” function block, set the required unit (accu: mm; status: –) and the number of digits (accu: 0 · 1 · 2; status: 0).

Fig. A6: Example configuration of an OTT netDL with 2 values recorded.

Additional configuration examples can be found on the flash drive OTT Pluvio² S software.

```
netDL 1000: 0000004598 / Airport FMM
> Interfaces (3)
> Devices (1)
> Connections IP (1)
> Servers (1)
> Transmissions (1)
> Maintenance windows (1)
External IP Devices (0)
Time synchronisation
Action management (1)
Display / Observer
v Channel: 1120 / Pulse-Accu RT-NRT [mm]
  Meas. cycle internal [00:01:00]
  [D 1-2] Pulse input
  Instantaneous value
  Store
v Channel: 1171 / Pulse-Status
  Meas. cycle internal [00:01:00]
  [D 3-4] Pulse input
  Instantaneous value
  Store
```

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



Appendix C – Dimensions of pedestal with bottom plate

Dimensions A

Installation height **1.0 m**: 424 mm ¹⁾

Installation height **1.2 m**: 624 mm ²⁾

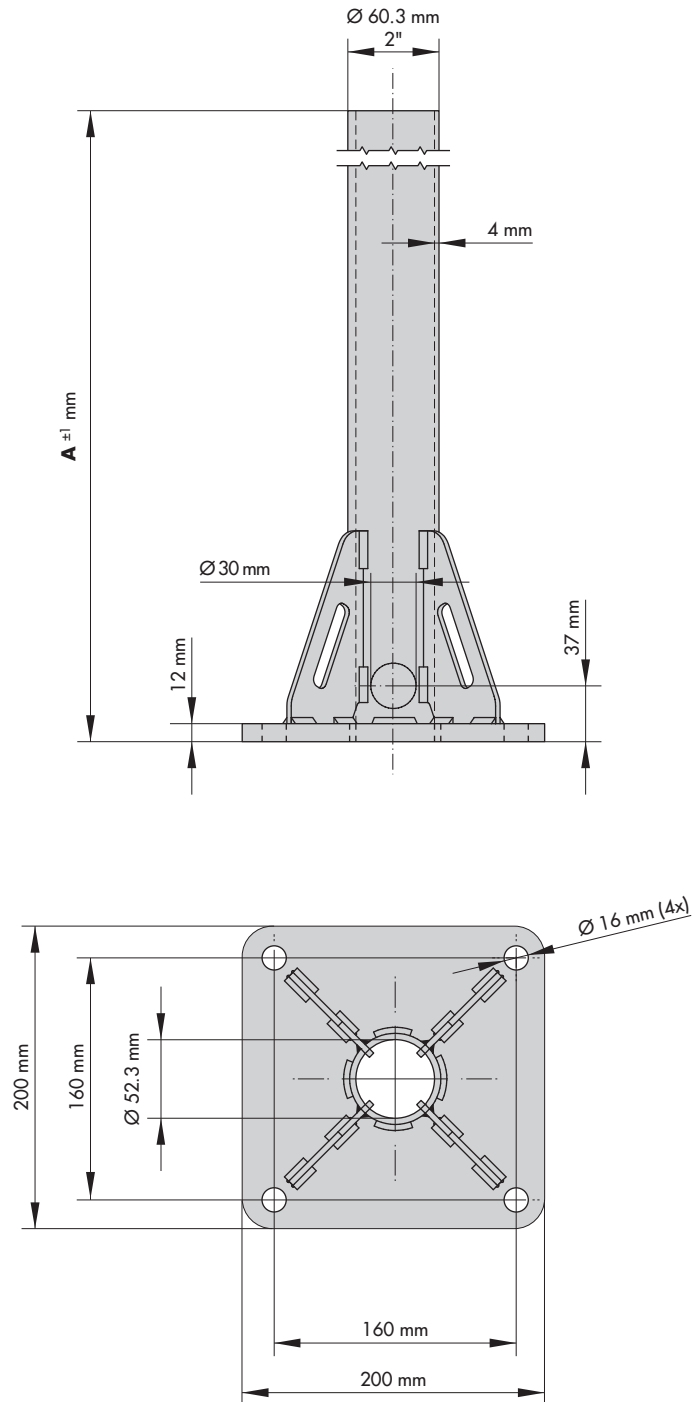
Installation height **1.5 m**: 924 mm ³⁾

Order numbers

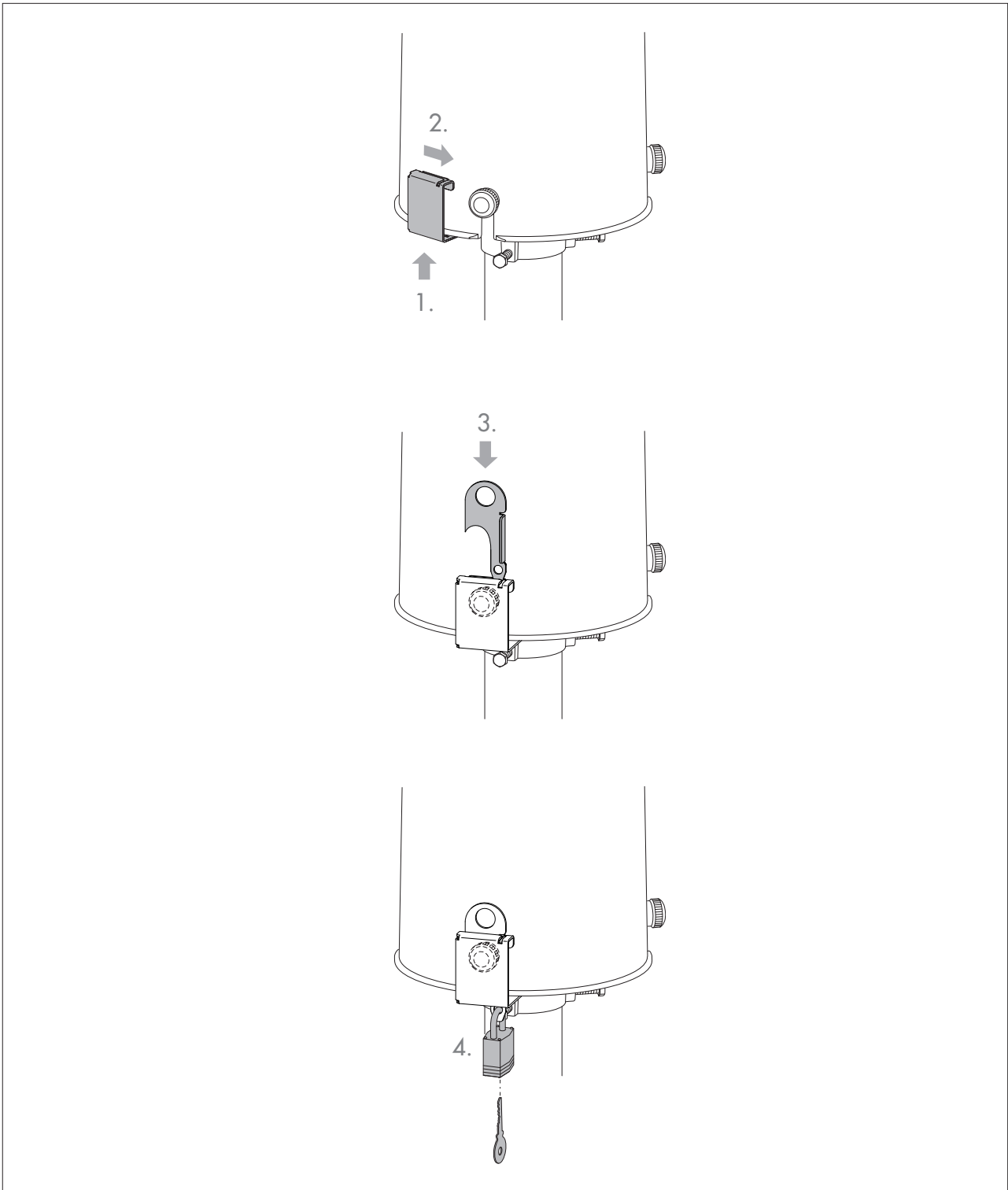
¹⁾ 70.030.033.9.2

²⁾ 70.030.034.9.2

³⁾ 70.030.035.9.2



Appendix D - Installing the anti-theft protection



Appendix E – Accessories/replacement parts

► Accessories	2"-pedestal with bottom plate for 1.0 m installation height	
	– length 424 mm	70.030.033.9.2
	– incl. bottom plate for attaching to a concrete foundation	
	– installation height (height of orifice ring): 1.0 m	
	2"-pedestal with bottom plate for 1.2 m installation height	
	– length 624 mm	70.030.034.9.2
	– incl. bottom plate for attaching to a concrete foundation	
	– installation height (height of orifice ring): 1.2 m	
	2"-pedestal with bottom plate for 1.5 m installation height	
	– length 924 mm	70.030.035.9.2
	– incl. bottom plate for attaching to a concrete foundation	
	– installation height (height of orifice ring): 1.5 m	
	Mounting kit for 2" pedestal	99.020.083.9.2
	– for attaching the 2" pedestal to a concrete foundation	
	– 4x compound anchor cartridge	
	– 4x anchor rod M 12	
	– 4x hexagon nut M 12 + washer	
	Wind shield OTT PWS ...	
	– ... 100 for 1.0 m installation height	70.035.020.1.2
	– ... 120 for 1.2 m installation height	70.035.021.1.2
	– ... 150 for 1.5 m installation height	70.035.022.1.2
	Wind shield mounting kit OTT PWS ...	99.020.081.9.2
	– for attaching the wind shield to a concrete foundation	
	– 4x compound anchor cartridge	
	– 4x anchor rod M 10	
	– 4x hexagon nut M 10 + washer	
	OTT POD 100 platform	70.035.030.2.2
	– for use with OTT PWS 100 or OTT PWS 150 wind shields	
	for OTT Pluvio ² S installation heights of 2.0 or 2.5 m	
	– height: 1 m	
	Mounting kit for OTT POD 100 platform	99.020.082.9.2
	– for attaching the platform to a concrete foundation	
	– 4x compound anchor cartridge	
	– 4x anchor rod M 16	
	– 4x hexagon nut M 16 + washer	
	24 V_{DC} power supply for C-rail mounting	
	– 50 W	65.030.001.9.2
	– degree of protection: IP 20	
	– for C-rail mounting	
	– input voltage: 90 ... 260 V _{AC}	
	24 V_{DC} power supply in separate protective casing	
	– 50 W	97.850.012.9.5
	– degree of protection: IP 65	
	– aluminium protective casing	
	– input voltage: 90 ... 260 V _{AC}	
	Cable for OTT Pluvio² S without heater	97.000.039.9.5
	– twisted pair configuration	
	– PUR, gray	
	– 2 x 2 x 0.50 mm ²	
	– shielded	
	Cable for OTT Pluvio² S with heater	97.000.038.9.5
	– special PUR, gray	
	– 7 x 0.75 mm ²	
	– shielded	

	OTT Pluvio² S software flash drive	56.575.001.9.7
	– incl. USB interface drivers	
	– incl. OTT Pluvio ² operating software	
	– incl. example configurations for the OTT datalogger	
	Anti-freeze	0.929.002.002
	– POWERCOOL DC 924-PXL	
	– package size: 10 litre canister	
	Bird repellent ring for OTT Pluvio² S	70.020.085.9.2
	– prevents birds sitting on the orifice rim	
	Anti-theft protection for OTT Pluvio² S	70.030.040.9.2
	U-lock (weather-resistant) for anti-theft protection	99.000.083.9.5
	Test weight kit	70.020.071.9.2
	– tare weigh 2.5 kg ± 100 g	
	– test weight 200 g M1	
	– DKD certificate for test weigh	
	– in transport box	
► Replacement parts	Collecting bucket	70.030.401.1.1
	USB cable	97.970.065.9.5
	– USB connector type A to USB type B, 3 m	

Document number
70.030.001.B.E 05-0324



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