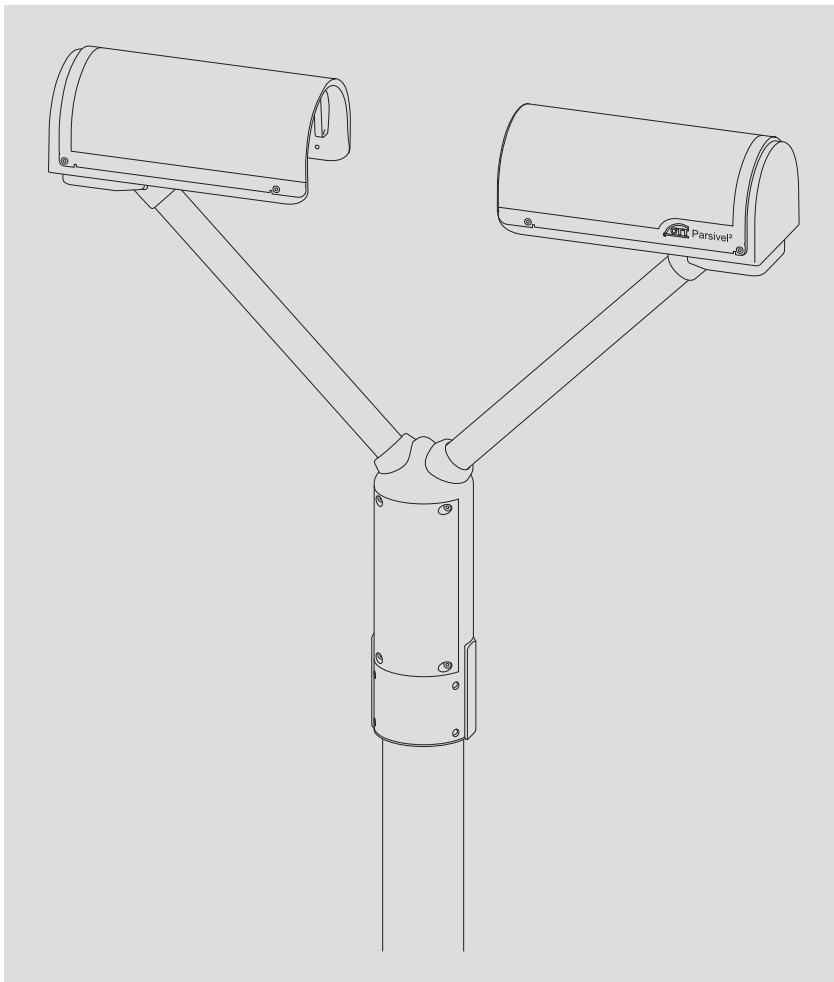


Operating instructions
Present Weather Sensor
OTT Parsivel²



English

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

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1 Scope of supply

- ▶ **OTT Parsivel²** – 1 laser-optical disdrometer consisting of: two sensor heads with splash protection unit grid, tunnel housing with 30 mm wide and 180 mm long light strip, base holder with integrated electronics and 8-pin panel jack for connecting the supply voltage and electrical ports
- 1 installation set, consisting of
 - 1 x cable lug for grounding
 - 1 x flat washer
 - 6 x grub screws M 8 x 16 mm
 - 7 x grub screws M 8 x 25 mm
 - 1 x hex nut M 8
 - 2 x lock washers
 - 1 x Allen key, 4 mm
- 1 USB connection cable. USB connector type A to USB type B, 3 m
- 1 OTT Parsivel PC software "ASDO", basic version
- 1 set of operating instructions

2 Order numbers

▶ OTT Parsivel²	Laser-optical disdrometer	70.210.001.3.0
▶ Accessories	Connection cable, assembled	70.210.409.4.1
	– 8-core, wire cross section 0.25/0.75 mm ²	
	– one end prepared with plug	
	– one open cable end, insulation removed and provided with end sleeves	
	– Length 1 m, 13 m (available on request according to customer requirements)	
	Power supply 24 V DC/100 W; control cabinet version	65.030.003.9.2
	– Protection class IP 20	
	– for top hat rail installation (TS 35)	
	– Input voltage: 100 ... 240 V AC	
	Power supply 24 V DC/100 W; protective housing version	97.850.029.9.5
	– Protection class IP 65	
	– in aluminum protective housing	
	– Input voltage: 100 ... 240 V AC	
	Interface converter	
	– RS-485 / USB; galvanically isolated; electrical supply via USB interface	97.961.091.9.5
	– RS-485 / RS-232; galvanically isolated; external electrical supply 12 ... 24 V required	97.970.041.9.5
	Pedestal 2"	
	– with bottom plate for attachment to a concrete base	
	– with mounting plate for mains adapter (protective housing version)	
	– Laser strip installation height: 1 m (length: 0.53 m)	70.210.420.3.1
	– Laser strip installation height: 2 m (length: 1.53 m)	70.210.421.3.1
	– Laser strip installation height: 3 m (length: 2.53 m)	70.210.422.3.1
	Attachment set for pedestal	99.020.050.9.2
	– for attachment of the pedestal on a concrete base	
	– 4 x anchor rods	
	– 4 x anchor bolt glue cartridges	
	OTT Parsivel PC software "ASDO", full version	56.551.001.9.7
▶ Spare parts	Splash protection unit grid (1 piece)	70.210.410.3.1

3 OTT Parsivel² factory settings

The OTT Parsivel² is a flexibly configurable device with respect to interface activation and parameters and the heating setting, and is supplied with the following factory settings:

Operating mode:	RS-485 2-wire *
Baudrate RS-485:	19,200 baud
RS-485 bus mode:	disabled
Bus address RS-485:	0
SDI-12 interface:	disabled
SDI-12 bus address:	0
Pulse output:	0.1 mm enabled
Heating mode:	mode 1 (50 W)
Data telegram:	OTT telegram (see Chapter 11.4)
Measurement interval:	60 s


The parameters can be set with the OTT Parsivel software ASDO, or alternatively using a terminal software. Notes on setting these parameters can be found in Appendix A "CS command set" or in the "OTT Parsivel software ASDO" Operating instructions.

* The green and yellow wires in the connection cable are configured as an RS-485 interface (alternatively: SDI-12)





4 Safety information



- ▶ These operating instructions contain basic instructions that must be followed during installation, operation and maintenance. Therefore, it is absolutely necessary that they be read by the assembler and by the responsible technical personnel/operator prior to installation and startup!
- ▶ These operating instructions must be accessible at the point of use of the measurement device.
- ▶ Personnel responsible for installation, operation and maintenance must have the appropriate qualifications for this work! Responsibilities, competency and the monitoring of personnel must be closely controlled by the owner. If personnel do not have the required knowledge, it must be provided through training and instruction. If necessary, OTT Hyrdomet can provide this service on a contractual basis for the owner.
- ▶ Non-adherence to these safety instructions can have dangerous consequences for persons as well as for the measurement device!
- ▶ Non-adherence to these safety instructions can result in the loss of any indemnity claims!
- ▶ Please adhere to the safety instructions listed in these operating instructions, to all existing national accident prevention regulations and to any internal work, operating and safety rules as set forth by the owner!
- ▶ The operating safety of the delivered measuring device is only guaranteed when it is used properly! Retrofitting or changing the measuring device is only allowed if authorized by the manufacturer.
- ▶ To ensure safety, buy only original replacement parts and accessories authorized by the manufacturer. Use of other parts can void liability for any consequences arising therefrom!
- ▶ The OTT Parsivel² is a class 1 laser product which complies with IEC/EN 60825-1 A2:2001.
Wavelength: 780 nm; output: max. 0.5 mW.
- ▶ Do not stare into the beam or view directly with optical instruments!



Parsivel²
SN: XXXXXX



CLASS 1 LASER PRODUCT

LASER KLASSE 1

CLASS 1 LASER PRODUCT / LASER KLASSE 1 / 780 nm
DIN EN 60825-1 : 2008-05 / IEC 60825-1 : 2001-08
INVISIBLE LASER RADIATION - DO NOT STARE INTO BEAM
UNSICHTBARE LASERSTRAHLUNG - NICHT DEM STRAHL AUSSETZEN

www.ott.com Made in Germany

5 Introduction

The OTT Parsivel² is a laser-based optical system for complete and reliable measurement of all types of precipitation. The size range of measurable liquid precipitation particles is from 0.2 ... 5 mm, for solid precipitation particles it is from 0.2 ... 25 mm. In the process, precipitation particles can have a velocity of from 0.2 ... 20 m/s. The precipitation particles are categorized as follows:

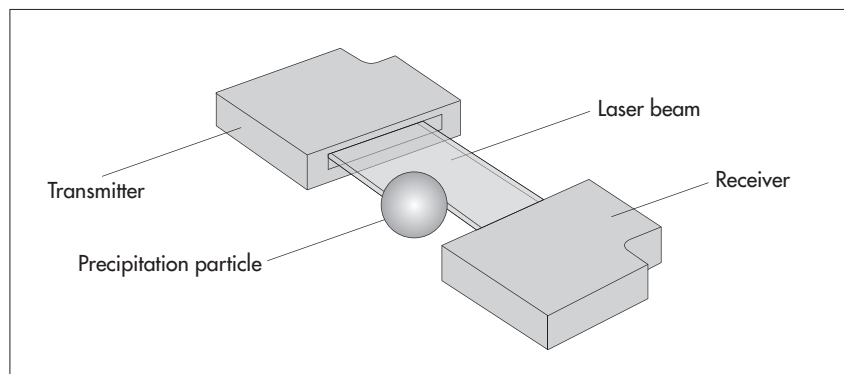
- ▶ Drizzle
- ▶ Drizzle with rain
- ▶ Rain
- ▶ Rain, drizzle with snow
- ▶ Snow
- ▶ Snow grains
- ▶ Freezing rain
- ▶ Hail

The precipitation measurements are carried out using a special sensor head that was developed for this particular purpose. It detects precipitation optically. The data thus determined are processed and stored by a fast digital signal processor. The OTT Parsivel² issues one data telegram every 60 seconds.

5.1 Functional principle

The theory behind the OTT Parsivel² is a laser sensor that produces a horizontal strip of light. The emitter and the receiver are integrated into a single protective housing.

Fig. 1: Functional principle of the OTT Parsivel².



Measurement of particle size

If there are no particles in the laser beam, the maximum voltage is output at the receiver. Precipitation particles passing through the laser beam block off a portion of the beam corresponding to their diameter, thus reducing the output voltage; this determines the particle size.

Measurement of particle speed

To determine the particle speed, the duration of the signal is measured. A signal begins as soon as a precipitation particle enters the light strip and ends when it has completely left the light strip.

The following parameters can be derived from these two determined quantities:

- ▶ Size spectrum
- ▶ Type of precipitation
- ▶ Kinetic energy
- ▶ Intensity of the precipitation
- ▶ Radar reflectivity
- ▶ Visibility

The splash protection attached to the sensor head prevents precipitation particles from deflecting off the housing, falling into the laser beam and thus falsifying the measurements.

5.2 Connection options for the OTT Parsivel²

The OTT Parsivel² can be connected to various devices as shown in the illustration below. Refer to the respective chapters in this regard.

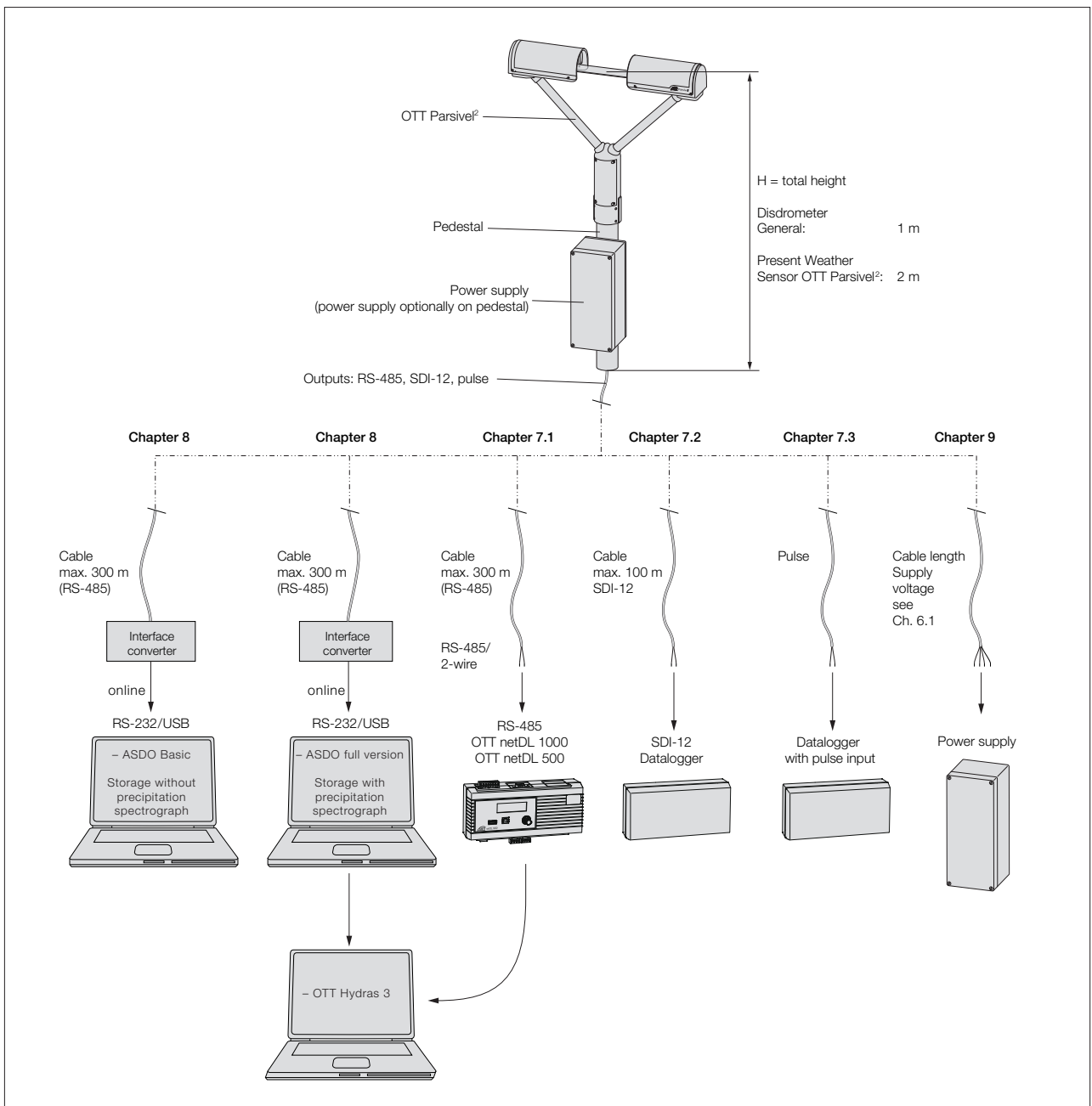


Fig. 2: Connection options for the OTT Parsivel².

6 Installing the OTT Parsivel²



Please follow Safety instructions (see chapter 4) when installing the OTT Parsivel²!

It is of critical importance to the quality of the measurements that the setup location be selected carefully. Here, wind and vibrations must be minimized (see chapter 13.2 "Disruptions due to convection and vibrations"). If the protection against these influences is not sufficient, virtual drops can be detected.

Prerequisites

The OTT Parsivel² is mounted on a pedestal. The pedestal must have the following specifications:

- ▶ Pedestal diameter 50 ... 62 mm
- ▶ Pedestal consists of an electrically conducting material and is grounded
- ▶ The concrete foundation of the pedestal must have minimum dimensions of 40 x 40 x 80 cm (L x W x H).

Before the OTT Parsivel² can be fastened to the pedestal, the data transmission cable and power supply must be installed.

6.1 Cable selection

The electrical connection of the OTT Parsivel² is made with an 8-core cable, prepared with a plug at the factory (accessory). This connection cable can be supplied with a length of one or 13 meters. The wire cross section is 0.25 mm² (heating power supply: 0.75 mm²). If required, you can extend the cable keeping to the following criteria:

Data transmission cable

The OTT Parsivel² has the following interfaces:

- ▶ RS-485
- ▶ SDI-12
- ▶ Pulse output

A total of two wires are available in the connection cable for the RS-485 and SDI-12 interfaces. The assignment of these wires with the RS-485 or SDI-12 interface is carried out by the OTT Parsivel user software ASDO or with a terminal program (factory setting: RS-485 interface).

We recommend that the data transmission cable has the following characteristics:

- ▶ Twisted-pair cable; unshielded
- ▶ Usage length with RS-485 interface: max. 300 m
- ▶ Usage length with SDI-12 interface: max. 100 m
- ▶ Usage length with pulse output: max. 100 m
- ▶ Wire cross section from a cable length of 25 meter $\geq 0.5 \text{ mm}^2$ (below that: 0.25 mm²)

Power supply cable

Power supply for electronics: Wire cross section up to a cable length of 25 meter 0.25 mm², above that 0.5 mm². Maximum cable length 250 meter (when using an OTT power supply).

Power supply for heating: Maximum resistance of cable: 2 Ω .

The length of the cable is dependent on the wire cross section:

Wire cross section	max. cable length for heating setting*	
	50 W	100 W
0.75 mm ²	42 m	21 m
1.0 mm ²	56 m	28 m
1.5 mm ²	84 m	42 m
2.5 mm ²	140 m	70 m
4.0 mm ²	225 m	112.5 m

* See Chapter 10

6.2 Connecting ground to OTT Parsivel² (recommendation)

To ground the OTT Parsivel², you will need the following parts from the installation set provided:

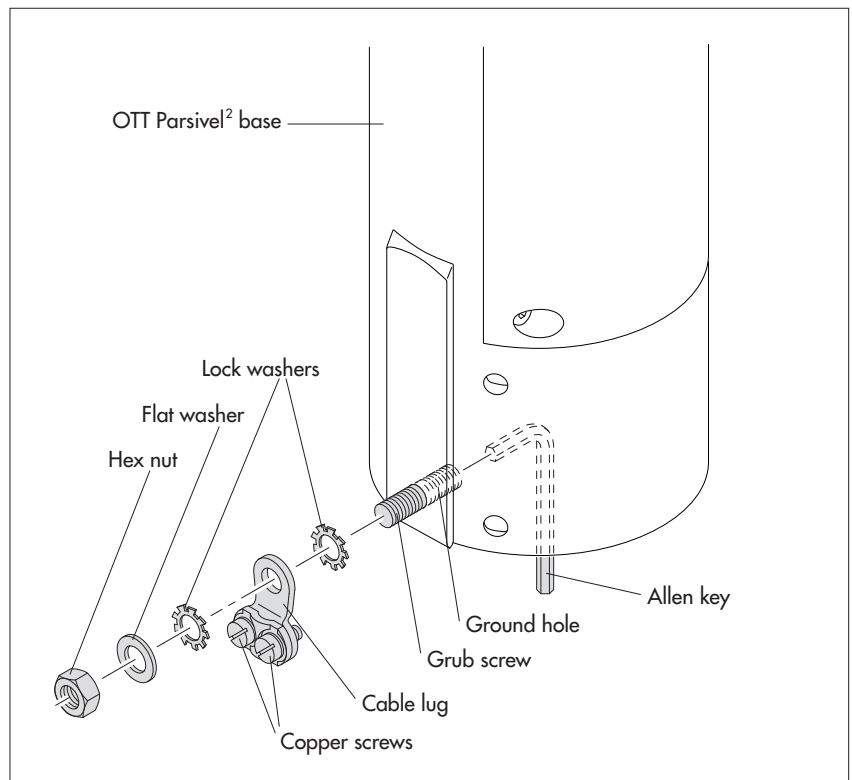
- ▶ 1 hex key 4 mm
- ▶ 1 M 8 x 25 grub screw
- ▶ 2 lock washers
- ▶ 1 cable lug
- ▶ 1 flat washer
- ▶ 1 M 8 hex nut

Also, you will need a grounding cable with a wire cross section of 16 mm².

In order to ground the OTT Parsivel², proceed as follows:

- Rotate the grub screw using the hex key from inside into the grounding hole (see Fig. 3) until the grub screw is flush with the inner wall inside the socket.
- Place the lock washers, cable lug and flat washer as shown in Fig. 3 onto the grub screw from the outside.
- Likewise, screw the hex nut from outside onto the grub screw and tighten it. Hold the grub screw from the inside using the hex key while doing so so that it does not rotate during tightening.
- Loosen the two copper screws of the cable lug by rotating them a few turns.
- Remove the insulation from one end of the grounding cable approximately 2 cm.
- Insert the uninsulated end of the grounding cable between the two plates of the cable lug and retighten the two copper screws. The other end of the cable must be properly grounded near the OTT Parsivel².

Fig. 3: Grounding the OTT Parsivel².
The individual parts to fasten the cable lug are included in the installation kit.

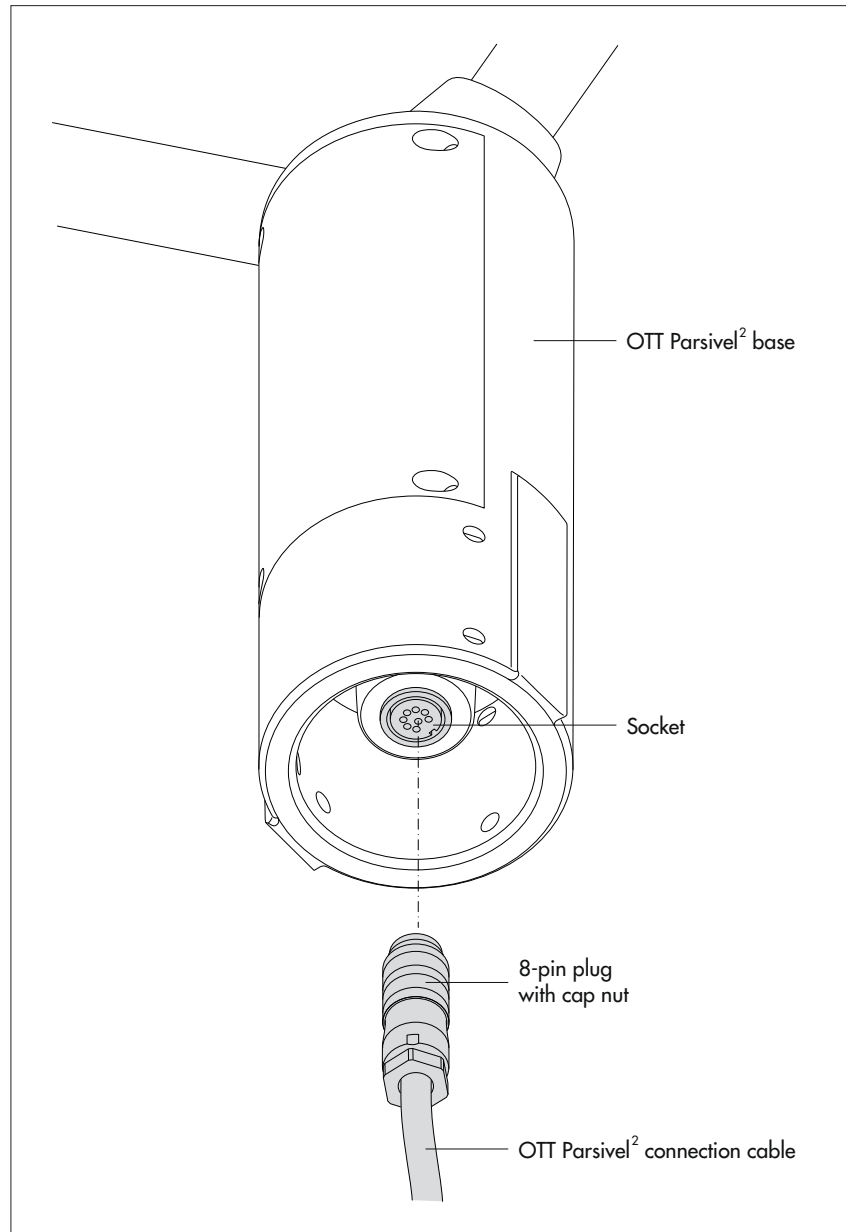


6.3 Installing the OTT Parsivel² on a pedestal

Proceed as follows to install the OTT Parsivel²:

- If necessary: Attach the power supply (protective housing version) to the mounting plate of the pedestal using the bolts and nuts supplied.
- Feed the connection cable with the 8-pin plug from the power supply on the leg or from a control cabinet upwards through the pedestal.
- Connect the plug to the socket in the base of the OTT Parsivel². Tighten the cap nut for the plug by hand.

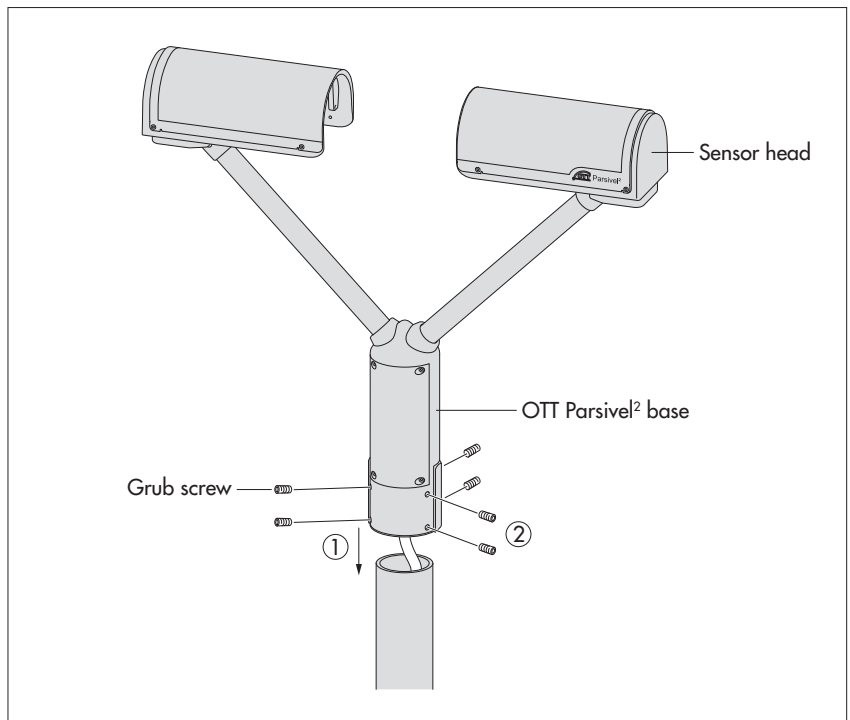
Fig. 4: Connecting the connection cable to the OTT Parsivel² base.



- Slide the connected and grounded OTT Parsivel² onto the pedestal.

- Orient the OTT Parsivel² such that the laser beam is perpendicular to the local main wind direction.
- Evenly tighten the 6 M 8 x 16 grub screws, or M 8 x 25 depending on the diameter of the pedestal, using the 4 mm hex key provided (installation set) so that the sensor heads are horizontal as much as possible.

Fig. 5: Installing the OTT Parsivel² on the pedestal.



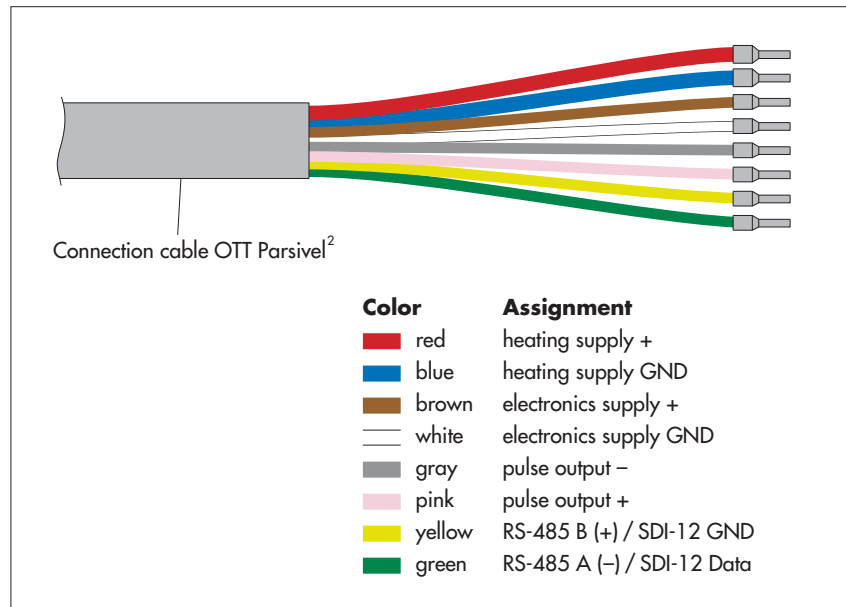
7 Connecting the OTT Parsivel² to a datalogger

The OTT Parsivel² can be connected to the following dataloggers:

- ▶ OTT netDL with RS-485 interface
- ▶ OTT netDL with SDI-12 interface
- ▶ Any datalogger with an SDI-12 interface
- ▶ Datalogger with pulse input

The connection to a datalogger is made with a prepared, 8-core connection cable (accessory). This cable also has 2 wires for the electrical power supply for the electronics and two for the heating of the Parsivel.

Fig. 6: Wiring assignment of the connection cable.



The green and yellow cable is assigned either to the RS-485 or SDI-12 interface. The selection is carried out during setup via the OTT Parsivel user software ASDO or a terminal program. Both of these wires are assigned to the RS-485 interface at the factory.

Parallel operation of the pulse output with either the RS-485 or the SDI-12 interface is possible to a limited extent. With this operating type, the OTT Parsivel² does not send the pulse at intervals of one minute but at the time interval set for sample intervals on the datalogger or PC.

7.1 Connecting the OTT Parsivel² to an OTT netDL IP datalogger using the RS-485 interface

The measured values determined by the OTT Parsivel² can be called and stored via the OTT netDL IP datalogger.

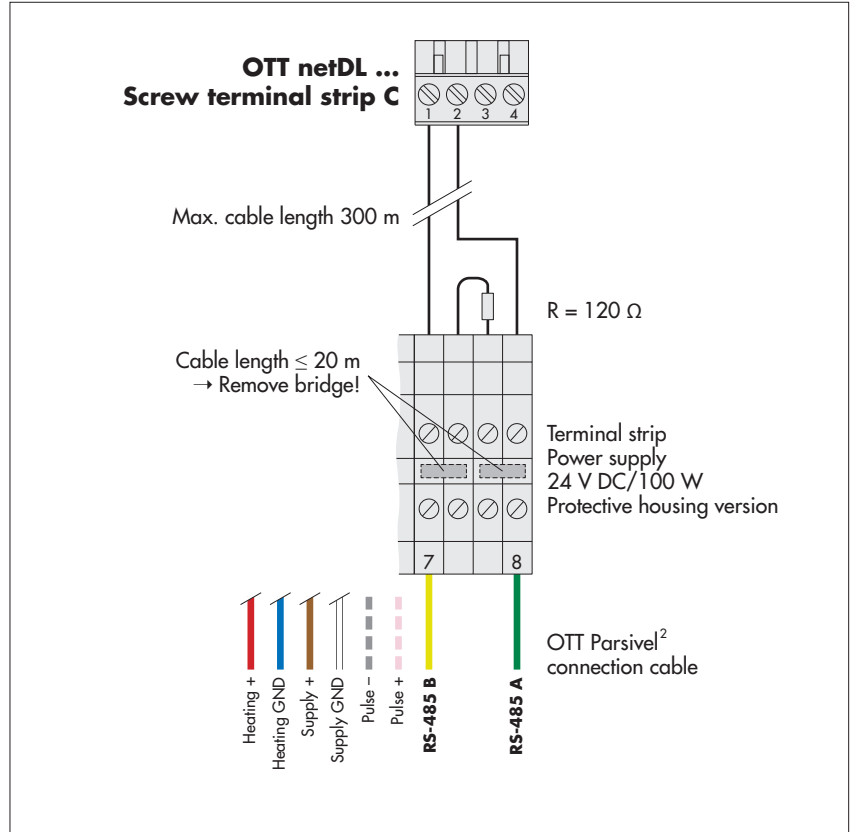
- To do so, connect the OTT Parsivel² as shown in Fig. 7 to the OTT netDL using the RS-485 interface.

Fig. 7: Connecting the OTT Parsivel² to the OTT netDL via the RS-485 interface.

The figure shows the example connection using the terminal strip of an OTT power supply (accessory).

In addition, the four wires of the voltage supply (heating: red + blue; electronics: brown + white) must be connected to the power supply; see Chapter 9.

Likewise connect the two wires of the pulse output to the terminal strip. For this application, however, they are not connected further.

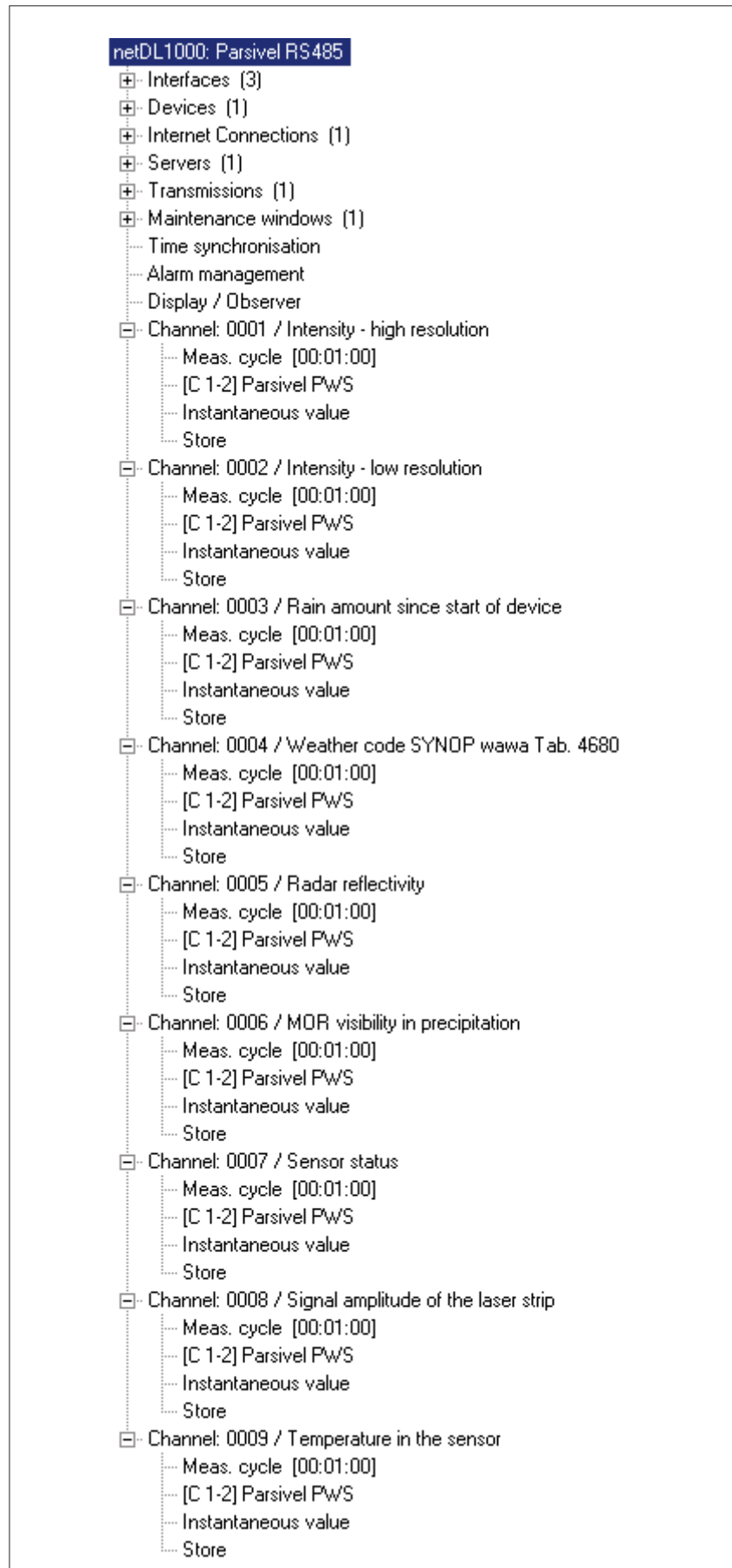


Configuring the OTT netDL IP datalogger for RS-485 communication

To call the data from the OTT Parsivel² with the OTT netDL and to store them, a configuration must be set up in the OTT netDL. Figure 8 shows an OTT netDL example configuration for communication via the RS-485 interface. See also the operating instructions for the "OTT netDL IP datalogger".

Note that the measurement cycle must be set up with the same value in all channels set up in the OTT Parsivel².

Fig. 8: Configuration example of an OTT netDL connected to an RS-485 interface.



7.2 Connecting the OTT Parsivel² to a datalogger via an SDI-12 interface

If a datalogger is used that is connected via an SDI-12 interface, the datalogger functions as a master, and specifies the measurement time and sample interval of the OTT Parsivel². The measurement time must be ≥ 1 min in this case in order for the OTT Parsivel² to collect sufficient data during winter operation as well to allow for the precise assignment of precipitation type.

To make the OTT Parsivel² capable of communicating for an SDI-12 interface, the OTT Parsivel² must first be connected to a PC via the USB interface. The SDI-12 interface can be switched to active through the Parsivel user software ASDO or using a terminal program and the command "CS/S/E/1<CR>" (see operating instructions for OTT Parsivel user software ASDO and Chapter 11 "Operating the OTT Parsivel² with a terminal software").

For a detailed description of SDI-12 commands refer to Annex B.

Connecting the OTT Parsivel² to a datalogger using an SDI-12 interface (general)

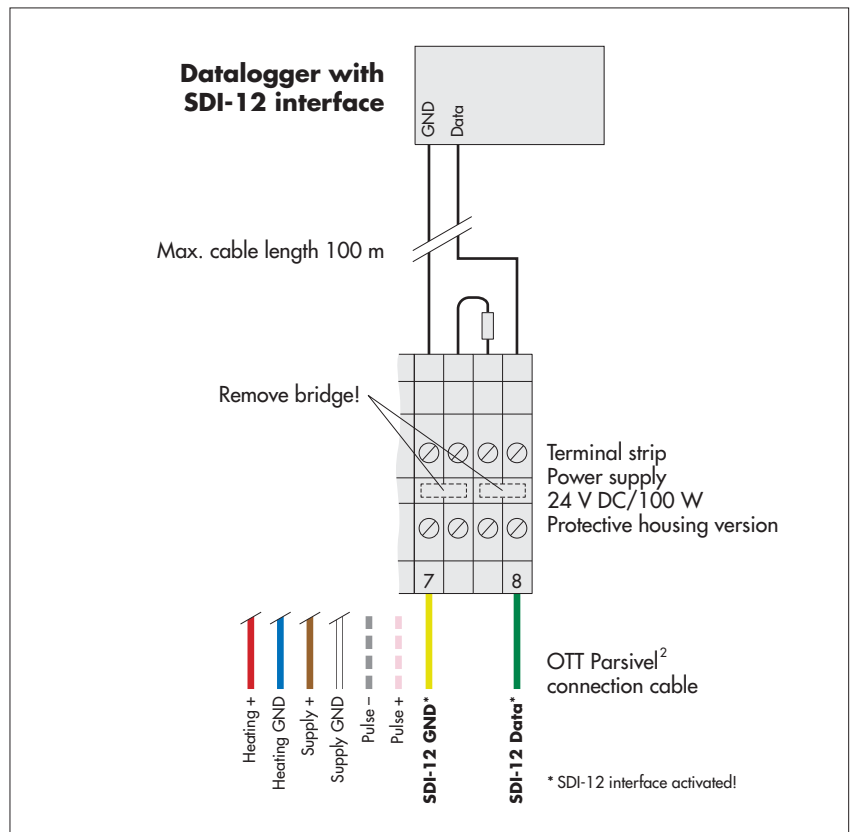
- Connect the OTT Parsivel² to any datalogger as shown in Fig. 10 via the SDI-12 interface.

Fig. 9: Connecting the OTT Parsivel² to a datalogger via the SDI-12 interface.

The figure shows the example connection using the terminal strip of an OTT power supply (accessory).

In addition, the four wires of the voltage supply (heating: red + blue; electronics: brown + white) must be connected to the power supply; see Chapter 9.

Likewise connect the two wires of the pulse output to the terminal strip. For this application, however, they are not connected further.



Connecting the OTT Parsivel² to an OTT netDL IP datalogger via the SDI-12 interface

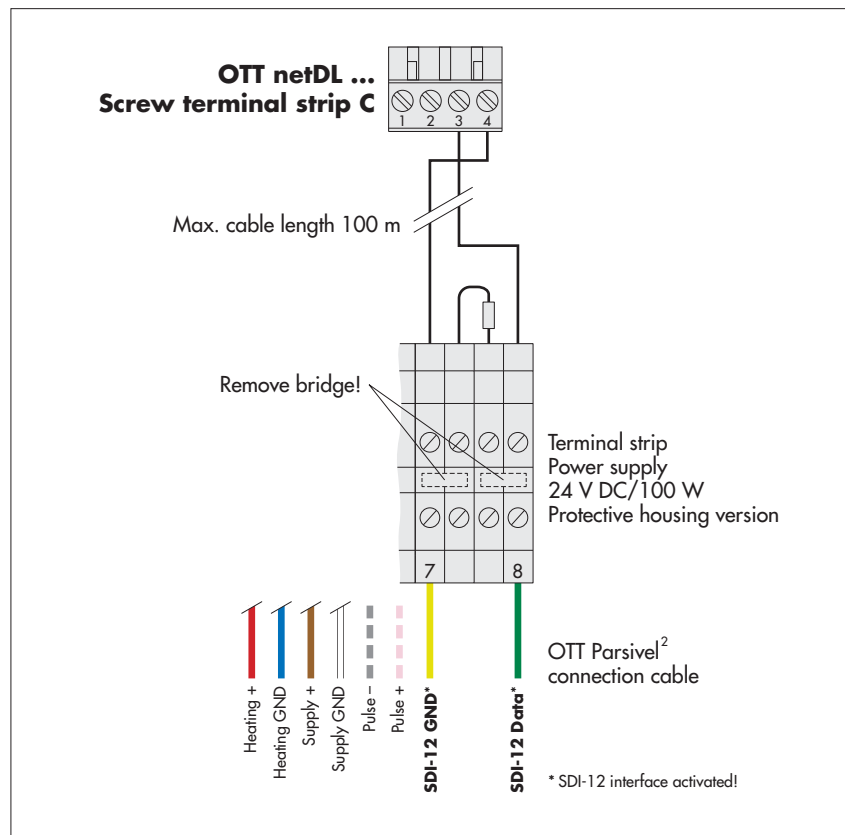
- Connect the OTT Parsivel² as shown in Fig. 10 to the OTT netDL using the SDI-12 interface:

Fig. 10: Connecting the OTT Parsivel² to an OTT netDL via the SDI-12 interface.

The figure shows the example connection using the terminal strip of an OTT power supply (accessory).

In addition, the four wires of the voltage supply (heating: red + blue; electronics: brown + white) must be connected to the power supply; see Chapter 9.

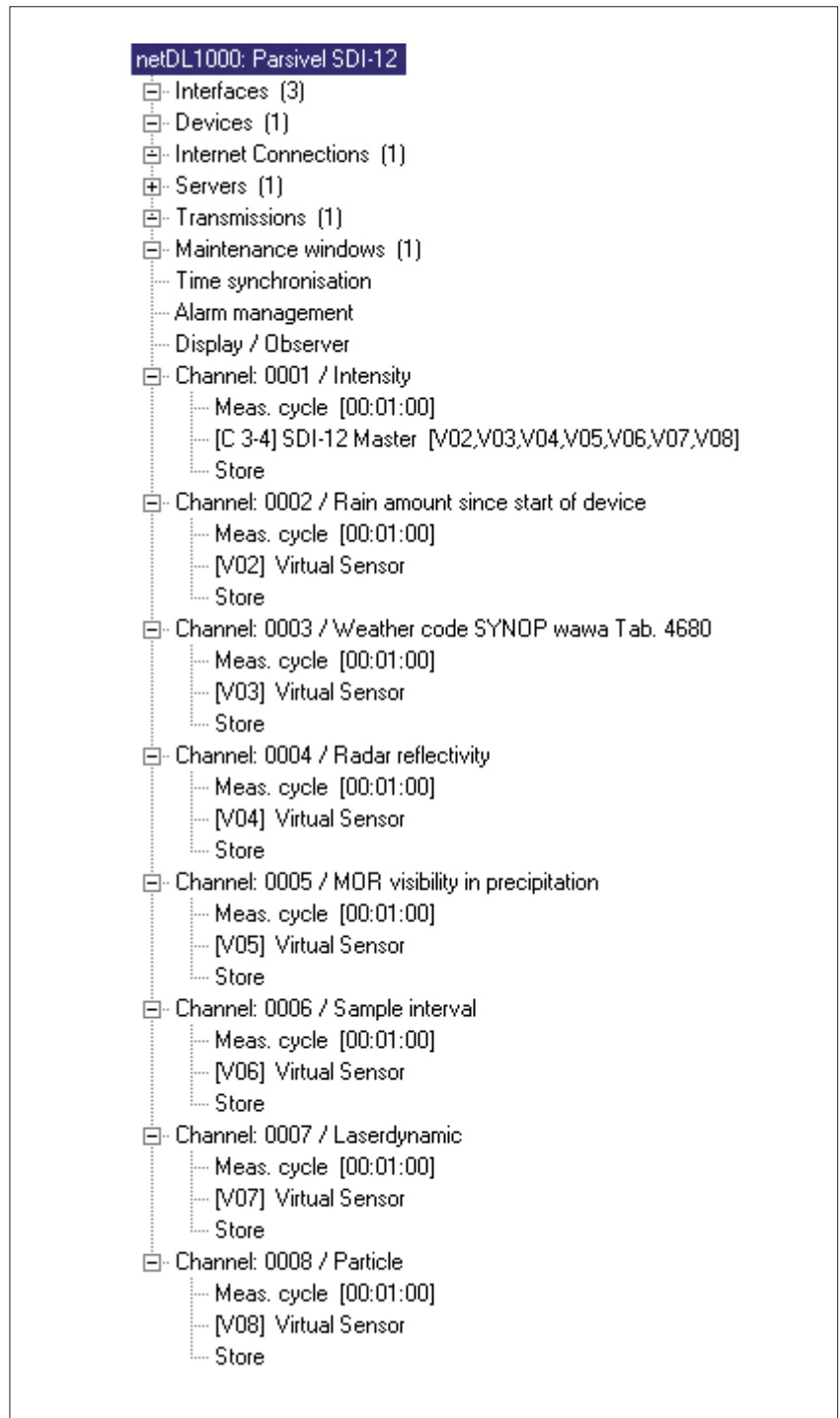
Likewise connect the two wires of the pulse output to the terminal strip. For this application, however, they are not connected further.



Configuring the OTT netDL IP datalogger for SDI-12 communication

To call the data from the OTT Parsivel² with the OTT netDL and to store them, a configuration must be set up in the OTT netDL. Figure 11 shows an OTT netDL example configuration for communication via the SDI-12 interface. See also the operating instructions for the "OTT netDL IP datalogger ...". Note that the measurement cycle must be set up with the same value in all channels set up in the OTT Parsivel², and that no "instantaneous value" can be stored in any of the channels of the OTT netDL configuration, as false measurements can arise otherwise.

Fig. 11: Configuration example of an OTT netDL connected to an SDI-12 interface.



7.3 Connecting the OTT Parsivel² to a datalogger with pulse input

Pulse input

The rainfall amount can be detected in a manner similar to rain collectors according to the tipping bucket principle using pulse input to a datalogger. For the pulse output of the OTT Parsivel², the following values apply:

- Pulse output duration: 250/25 ms
- Pulse voltage: 0 V (max. 100 mA)
- Open circuit voltage: 5 ... 28 V
- Resolution: 0.1 mm/pulse, output frequency 2 Hz
0.01 mm/pulse, output frequency 20 Hz

You can set the resolution with the OTT Parsivel software ASDO or alternatively using a terminal software. Notes on setting these parameters can be found in Appendix A "CS command set" or in the "OTT Parsivel software ASDO" operating instructions.

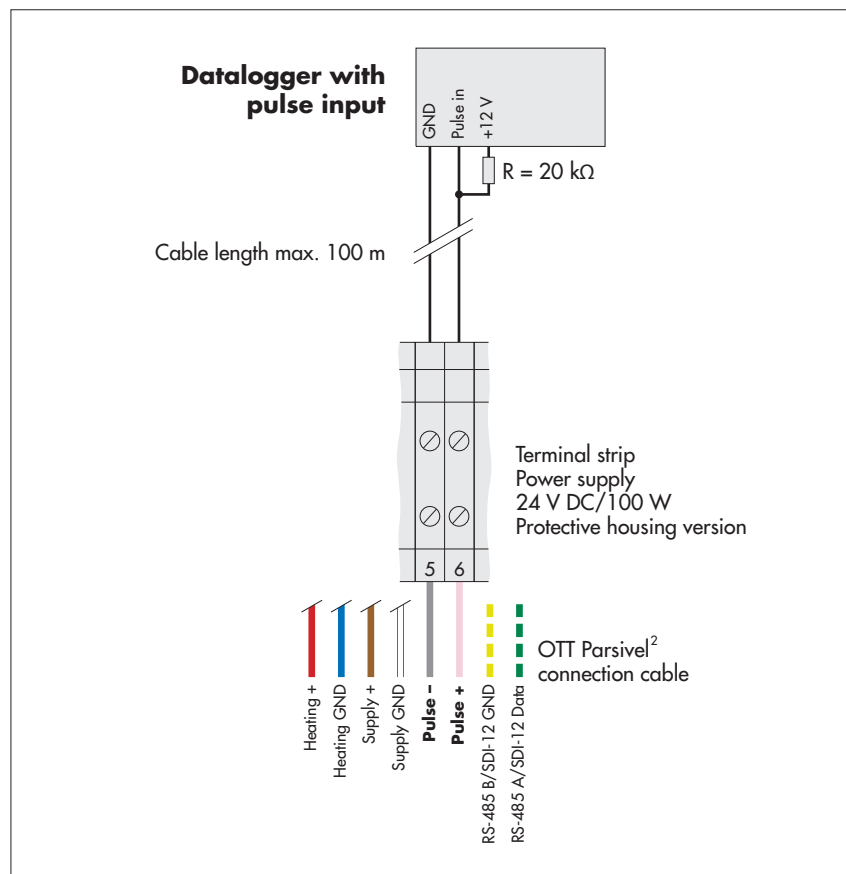
- Connect the OTT Parsivel 2 as follows to the datalogger with pulse input:

Fig. 12: Connecting the OTT Parsivel² to the datalogger with pulse input.

The figure shows the example connection using the terminal strip of an OTT power supply (accessory).

In addition, the four wires of the voltage supply (heating: red + blue; electronics: brown + white) must be connected to the power supply; see Chapter 9.

Likewise connect the two wires of the RS-485/SDI-12 interface to the terminal strip. For this application, however, they are not connected further.



8 Connecting the OTT Parsivel² to a PC

The OTT Parsivel² contains an RS-485 interface. Depending on whether your PC has an RS-232 or USB interface, a corresponding interface converter must be used that provides automatic conversion between the OTT Parsivel² and the PC. Here we recommend using one of the two interface converters from our list of accessories.

To connect the OTT Parsivel² to your PC, proceed as follows:

- Connect the RS-485 interface of the OTT Parsivel² to the interface converter used (see Chapter 8.1, 8.2 or 8.3).
- Connect the interface converter to the PC.
- Start the OTT Parsivel software ASDO or a terminal program on the PC (such as "Hyperterminal").
- Configure and operate the OTT Parsivel² with the OTT Parsivel software ASDO (see also manual "OTT Parsivel software ASDO") or alternatively with a terminal software (see also Chapter 11 "Operating the OTT Parsivel² with a terminal software").

8.1 Connecting the OTT Parsivel² to the RS-485/RS-232 interface converter

The RS-485/RS-232 interface converter (accessory) can be set up for 2-wire communication as well as to 4-wire communication.

Setting the dip switches at the interface converter

- Set the internal dip switches at the interface converter as follows:

Operating mode	1	2	3	4	5	6	7	8
RS-485, 2-wire without echo, automatic control, without bus termination	on	on	off	on	off	off	off	off

2-wire communication

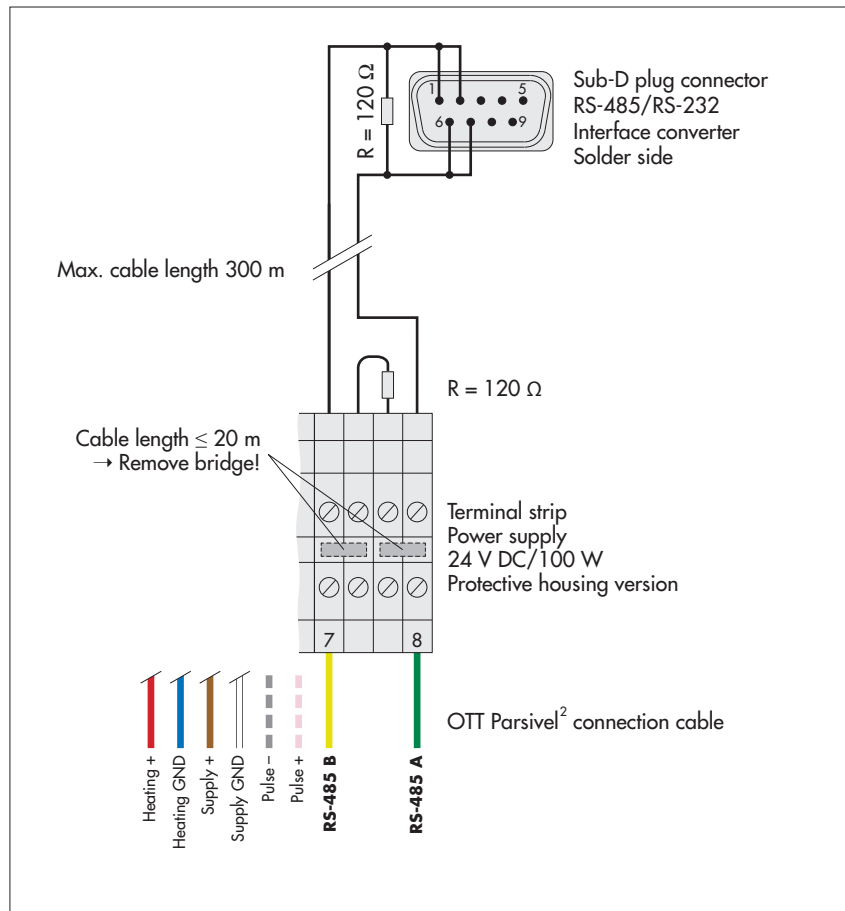
- Connect the OTT Parsivel² as follows to a 9-pin Sub-D socket (female):

Fig. 13: Connecting the OTT Parsivel² to an RS-485/RS-232 interface converter.

The figure shows the example connection using the terminal strip of an OTT power supply (accessory).

In addition, the four wires of the voltage supply (heating: red + blue; electronics: brown + white) must be connected to the power supply; see Chapter 9.

Likewise connect the two wires of the pulse output to the terminal strip. For this application, however, they are not connected further.



8.2 Connecting the OTT Parsivel² to the ADAM-4520 RS-485/RS-232 interface converter

The ADAM-4520 RS-485/RS-232 interface converter (accessory) can only be set for 2-wire communication.

Setting the dip switches at the interface converter

■ Set the internal dip switches at the interface converter as follows:

Switch 1	1	2
10 bits	on	off

Switch 2	1	2	3	4	5	6	7	8	9	10
115.2 Kbps	off	off	off	off	off	off	off	off	on	off

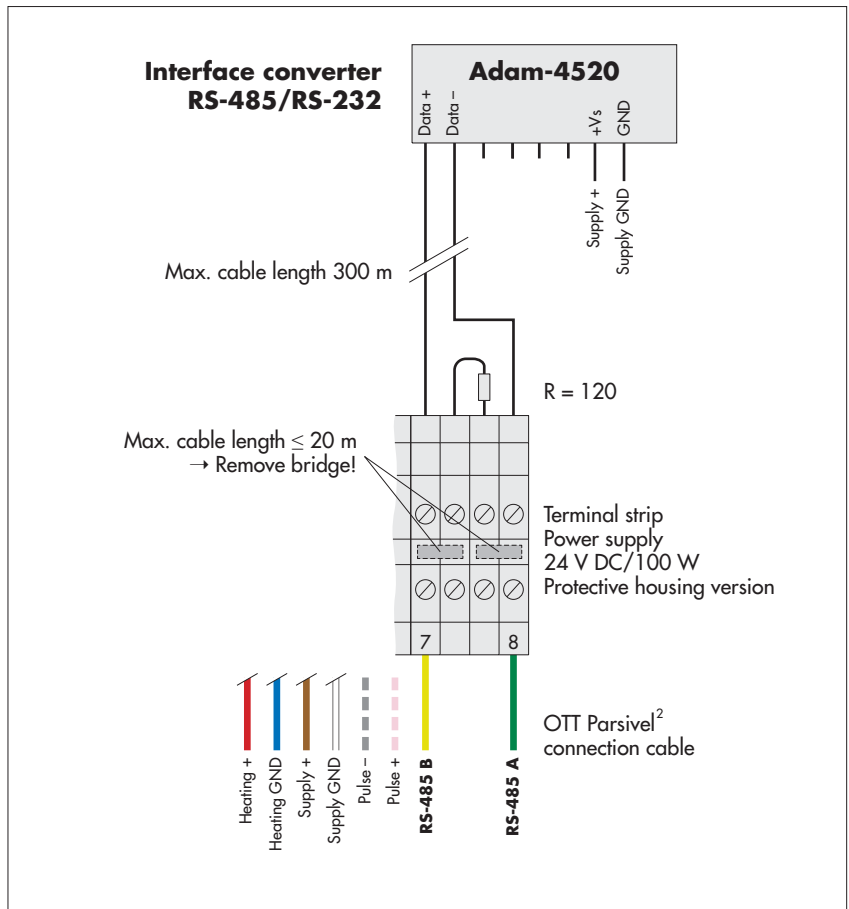
■ Connect the OTT Parsivel² as follows:

Fig. 14: Connecting the OTT Parsivel² to an ADAM-4520 RS-485/RS-232 interface converter.

The figure shows the example connection using the terminal strip of an OTT power supply (accessory).

In addition, the four wires of the voltage supply (heating: red + blue; electronics: brown + white) must be connected to the power supply; see Chapter 9.

Likewise connect the two wires of the pulse output to the terminal strip. For this application, however, they are not connected further.



8.3 Connecting the OTT Parsivel² to the RS-485/USB interface converter

The RS-485/USB interface converter (accessory) can be set for 2-wire communication as well as 4-wire communication.

Setting the dip switches at the interface converter

■ Set the external dip switches at the interface converter as follows:

Operating mode	1	2	3	4
RS-485, 2-wire, without echo, automatic control	off	off	on	on

2-wire communication

■ Connect the OTT Parsivel² as follows to the 6-pin terminal of the interface converter:

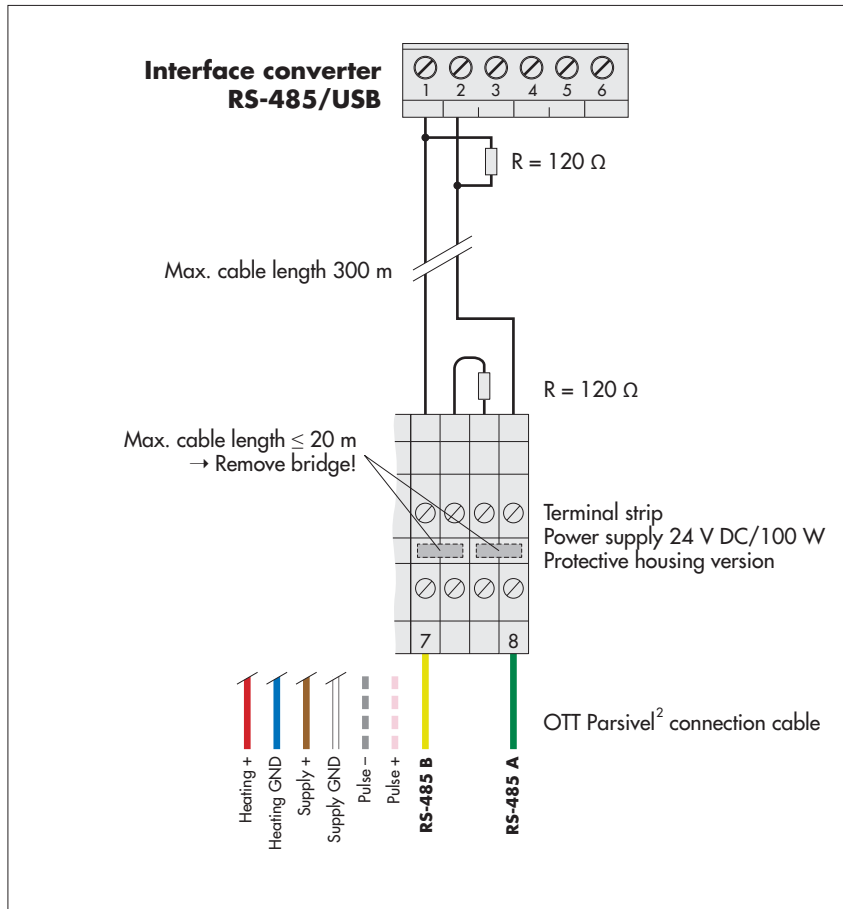
Fig. 15: Connecting the OTT Parsivel² to an RS-485/USB interface converter.

The figure shows the example connection using the terminal strip of an OTT power supply (accessory).

In addition, the four wires of the voltage supply (heating: red + blue; electronics: brown + white) must be connected to the power supply; see Chapter 9.

Likewise connect the two wires of the pulse output to the terminal strip. For this application, however, they are not connected further.

The power supply for the interface converter comes from the USB interface.



8.4 Connecting the OTT Parsivel² to any RS-485 interface converter

When using an interface converter that can not be purchased as an accessory from OTT Hydromet, the following must absolutely be adhered to:

- ▶ Interface converters must be configured in the "automatic send/receive control" mode for 2-wire connections through software commands without hardware handshake cables and "Echo-Off"!
- ▶ The interface converter must be galvanically isolated!

8.5 Connecting the OTT Parsivel² to a PC for configuring using a USB interface

If you do not want to work with the factory settings of the OTT Parsivel² and read out the data only with a datalogger, it is necessary to configure the OTT Parsivel² before its first use using the OTT Parsivel software ASDO Basic or a terminal program. To do so, the OTT Parsivel² is temporarily connected to a PC with a USB interface.

Please note: The OTT Parsivel² is not supplied with power via the USB interface! As in normal measurement operation, the power supply is from an additionally connected power supply (brown and white wire of the connection cable).

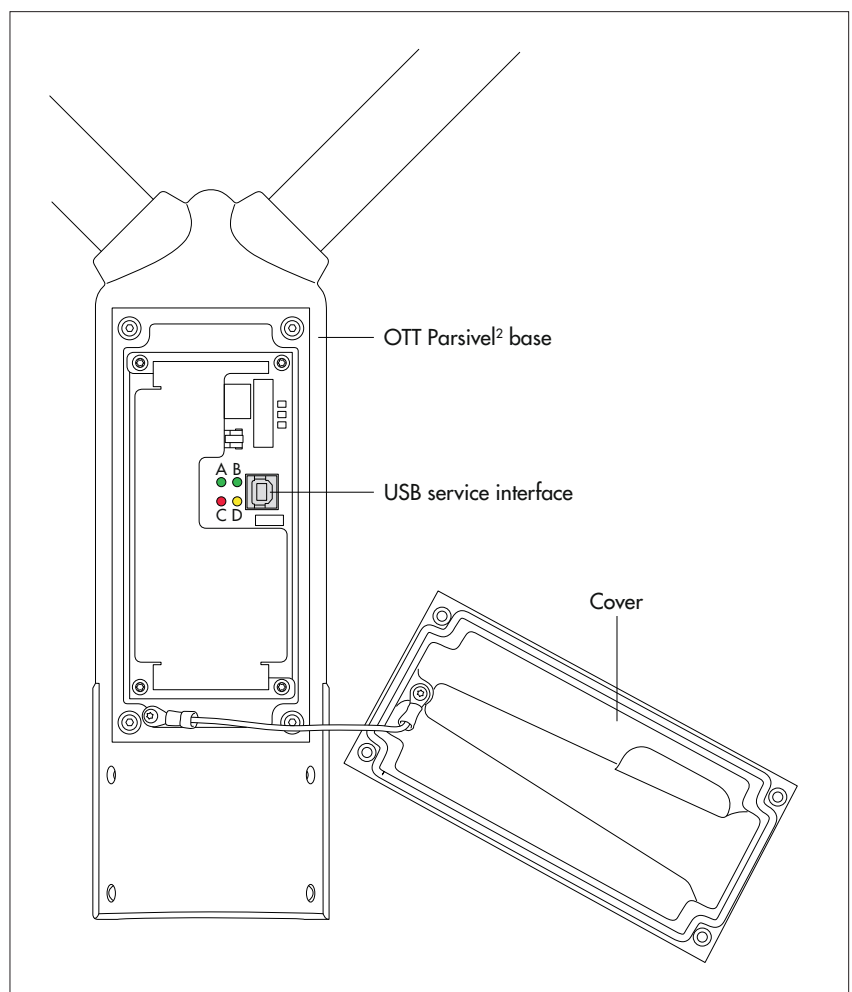
Connecting the OTT Parsivel² to a PC via USB interface:

(Requirements: USB interface drivers are installed; see below)

Fig. 16: Position of the USB service interface in the OTT Parsivel² base.

Meaning of the LEDs:

- A** (green): Communication via RS-485/SDI interface active
- B** (green): USB interface active
- C** (red): an error has occurred
- D** (yellow): particle recognized



- Remove the cover of the OTT Parsivel² base (Allen key, 4 mm).
- Connect the USB cable to a USB interface of the PC (USB plug type A).
- Connect the USB cable to service interface of the OTT Parsivel² (USB plug type B; see Fig. 16).
- Start the OTT Parsivel Software ASDO Basic or terminalsoftware on your PC and make the required settings.
- After completion, disconnect the connection between PC and OTT Parsivel².
- Replace the cover on the OTT Parsivel² base; ensure that you do not kink or jam the cable in the process!

If required: Installing the USB interface driver

For establishing a communication link over the USB interface, the PC requires a dedicated USB interface driver. This USB interface driver must be installed when the communication link is established for the first time.

You may use the USB interface driver on any current standard PC that is fitted with a USB interface and on which a Microsoft 7 or higher operating system is run.

The procedure described here is based on the Microsoft 7 operating system. With minor changes, it applies to the other Windows operating system versions as well.

How to install the USB interface driver:

- Log on to the PC with administrator rights.
- Connect the OTT Parsivel² to a USB interface of the PC, see above → the PC detects the new hardware and displays the message*: "Found New Hardware – OTT Parsivel²" → the "Found New Hardware Wizard" opens.
- Select "No, not this time".
- Select "Next".
- Select "Install from a list or specific location (Advanced)".
- Select "Next".
- Insert the "OTT Parsivel² Software" CD-ROM into PC drive.
- Select "Search for the best driver in these locations" and "Search removable media (CD-ROM, ...)".
- Select "Next".
- The wizard will install the USB interface driver onto the PC.
- After completion of the installation process, the following message will appear: "The wizard has finished installing the software for: OTT PARSIVEL²".
- Select "Next". Now a communication link via the USB interface may be established.

* in the notification area of the taskbar

Note:

- ▶ The USB interface cannot be used as a permanent connection between your PC and the OTT Parsivel².
- ▶ When using the USB interface, the OTT Parsivel² does not send any data via the SDI-12/RS-485 interface or the pulse output.

9 Connecting the OTT Parsivel² to a power supply

OTT Hydromet offers two power supplies (accessory) for the power source:

- ▶ Power supply 24 V DC/100 W; protective housing version
- ▶ Power supply 24 V DC/100 W; control cabinet version

The connection of the power supply is made with an 8-core, prepared connection cable (accessory). If required, you can extend the cable. More information on this can be found in Chapter 6.1 "Cable selection".



Danger of electric shock!

- ▶ Only connect power supplies if you have the required electrical knowledge!
- ▶ For all work on the power supply: Always ensure the mains cables are off-circuit and secure them against switching back on.

- Connect the power supply to the OTT Parsivel² as shown in Figures 17 or 18.

Fig. 17: Connecting power supply control cabinet version to the OTT Parsivel².

Install the power supply in the control cabinet on a standard top hat rail.

For optimum running of the cable, in the area where the cable enters the control cabinet a terminal strip should be used.

When using the RS-485 interface, the total cable length between the OTT Parsivel² and the datalogger may be a maximum of 20 meters! Otherwise, a 120 Ohm terminator is necessary on the OTT Parsivel² between the yellow and green wires!

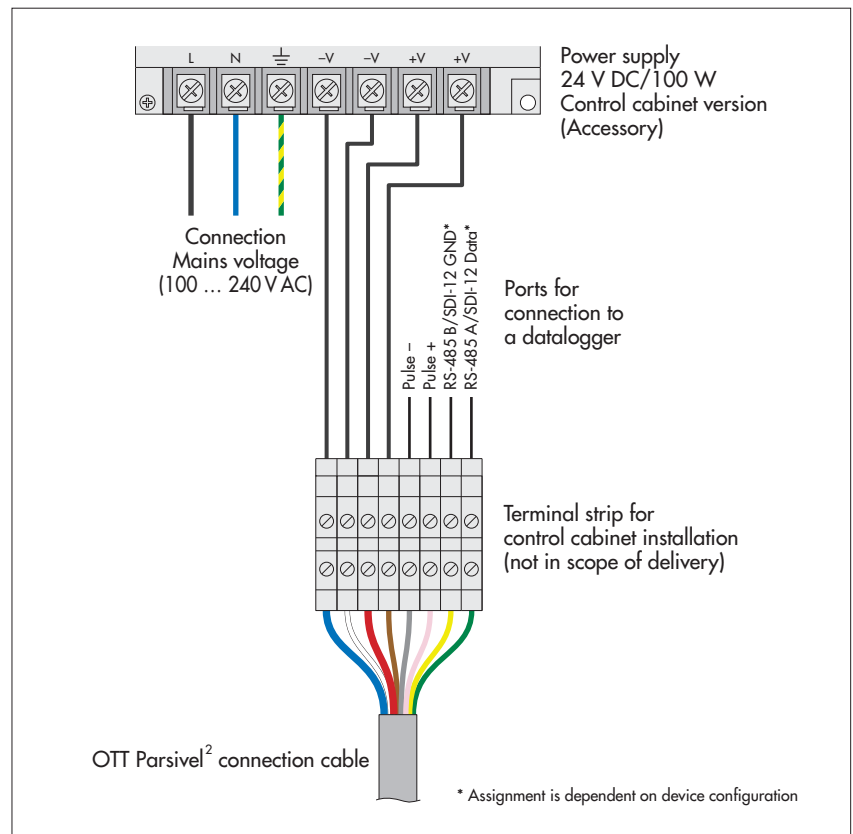
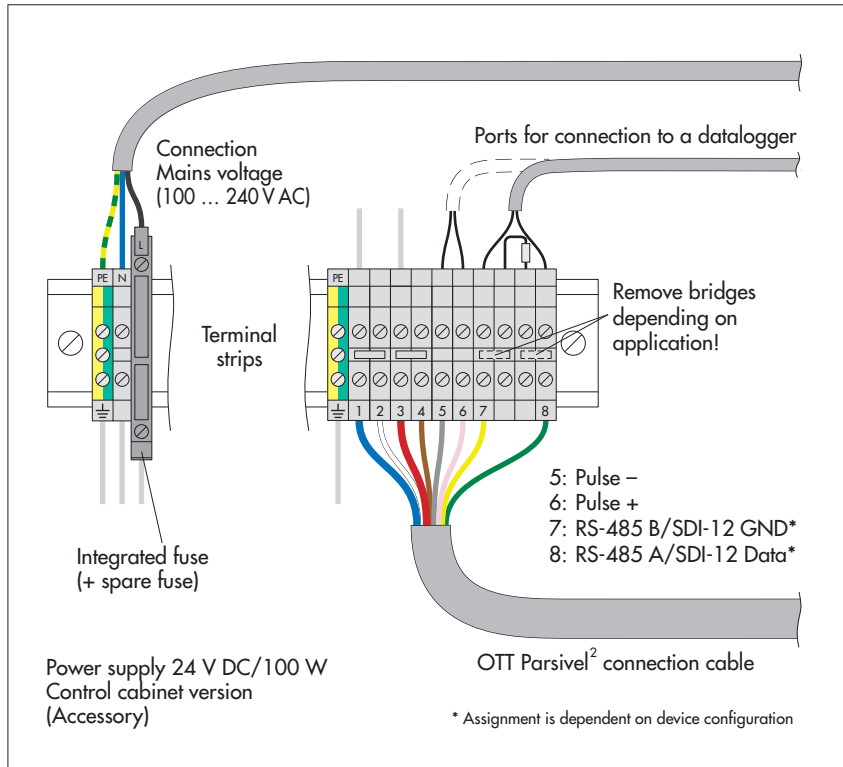


Fig. 18: Connecting power supply protective housing version to the OTT Parsivel².

Install the power supply onto the pedestal of the OTT Parsivel² using the bolts and nuts supplied. In this case, the connection cable has a length of one meter. Feed it through the hole in the leg and one of the three cable connections on the inside of the power supply.



10 Heating the OTT Parsivel² sensor heads

An automatic heating system prevents ice buildup on the sensor heads. A temperature sensor in the sensor head measures the temperature each second. The heating system adjusts according to this value.

The purpose is to hold the sensor heads at a constant temperature of at least 10 °C. If the outside temperature drops below 10 °C, the heating current is switched on until 10 °C is reached again in the sensor heads. The heating control can be adapted to the respective climatic conditions.

Optimum heating output can be guaranteed with a supply voltage of 20 V DC.

Note:

Note that the heating of the sensor heads is set at the factory to 50 watt! Enable the sensor heating in any case if the OTT Parsivel² is used at temperatures below 4 °C! We recommend a power supply of 24V DC and a maximum heating current of 2 A to provide for unlimited heating functionality in all climatic conditions.

You can set the heating performance with the OTT Parsivel software ASDO or alternatively using a terminal software. Notes on setting these parameters can be found in Appendix A "CS command set" or in the "OTT Parsivel software ASDO" operating instructions.

11 Operating the OTT Parsivel² with a terminal software

11.1 Setting up communications between the OTT Parsivel² and the terminal program

The OTT Parsivel² provides a USB interface for communication. This serial interface can be operated at various baudrates. Communication with the sensor is possible with any standard terminal software. Below, operation using the terminal software program "Hyper Terminal" is described since this is a part of Microsoft Windows[®] scope of delivery.

In order to operate OTT Parsivel² using Hyper Terminal, proceed as follows:

- Connect the OTT Parsivel² to your PC as described in Chapter 8 "Connecting the OTT Parsivel² to a PC".
- Start Hyper Terminal.
- After starting Hyper Terminal, the window "Connection Description" opens. Enter a name for the connection, select an arbitrary symbol and confirm your input with "OK". The next window "Connect to" now opens.
- Select the COM interface of your PC and confirm your input with "OK". The next window that opens is "Properties of COM [No.]".
- Enter the following connection settings:

Bits per second:	19200
Databits:	8
Parity:	none
Stopbits:	1
Flow control:	none

After a successful connection with the OTT Parsivel² is made, it sends a "!" as an input prompt after pressing the enter key:

```
BOOTLOADER PARSIVEL
```

after approx. 10 seconds, the following message appears:

```
*** PARSIVEL 2 ***  
OTT HYDROMET GmbH  
Copyright (C) 2013  
Version: V2.02.3
```

Approximately 60 seconds after starting to establish the connection, the OTT Parsivel² starts measuring automatically and outputs the data telegram.

11.2 Measured value numbers

The measurements and status values are output from the OTT Parsivel² in the form of a telegram. To this end, each value that can be output was assigned a measurement number. In addition, the number of digits that the value in the telegram can contain, the form in which this value is output, the covered range and in what unit it is precisely defined. These specifications are listed in the following table:

No.	Description	Digits	Form	Range	Unit
01	Rain intensity (32 bit*)	8	0000.000	0.000 ... 9999.999	mm/h
02	Rain amount accumulated (32 bit*)	7	0000.00	0.00 ... 0300.00	mm
03	Weather code acc. to SYNOP w ₀ w ₀₁ ; Table 4680	2	00	00 ... 99	
04	Weather code acc. to SYNOP ww; Table 4677	2	00	00 ... 99	
05	Weather code METAR/SPECI w'w'; Table 4678	5	+RASN		
06	Weather code according to NWS	4	RLS+		
07	Radar reflectivity (32 bit*)	6	00.000	-9.999 ... 99.999	dBz
08	MOR visibility in precipitation	5	00000	0 ... 20000	m
09	Sample interval	5	00000	0 ... 03600	s
10	Signal amplitude of the laser strip	5	00000	0 ... 99999	1
11	Number of detected particles	5	00000	0 ... 99999	1
12	Temperature in the sensor housing	3	000	-99 ... 100	°C
13	Sensor serial number	6	123456		
14	Firmware IOP version number	6	2.02.3		
15	Firmware DSP version number	6	2.02.3		
16	Heating current	4	0.00	0.00 ... 4.00	A
17	Power supply voltage	4	00.0	0.0 ... 30.0	V
18	Sensor status	1	0	0 ... 3	see Chapt. 12.1
19	Date/time measuring start	19	00.00.0000_00:00:00	DD.MM.YYYY_hh:mm:ss	
20	Sensor time	8	00:00:00	hh:mm:ss	
21	Sensor date	10	00.00.0000	DD.MM.YYYY	
22	Station name	10	XXXXXXXXXX		
23	Station number	4	XXXX		
24	Rain amount absolute (32 bit*)	7	000.000	0.000 ... 999.999	mm
25	Error code	3	000		
26	Temperature PCB	3	000	-99 ... 100	°C
27	Temperature in the right sensor head	3	000	-99 ... 100	°C
28	Temperature in the left sensor head	3	000	-99 ... 100	°C
30	Rain intensity (16 bit*) max. 30.000 mm/h	6	00.000	0.000 ... 30.000	mm/h
31	Rain intensity (16 bit*) max. 1200.0 mm/h	6	0000.0	0.0 ... 1200.0	mm/h
32	Rain amount accumulated (16 bit*)	7	0000.00	0.00 ... 0300.00	mm
33	Radar reflectivity (16 bit*)	5	00.00	-9.99 ... 99.99	dBz
34	Kinetic energy	7	000.000	0.000 ... 999.999	J/(m ² h)
35	Snow intensity	7	0000.00	0.00 ... 9999.99	mm/h
90	Field N (d) 1. Value = average volume equivalent diameter (ved) of the 1. class	223	00.000S	-9.999 ... 99.999	log ₁₀ (1/m ³ mm)
91	Field v (d) 1. Value = average rate of fall (rof) of the 1. class	223	00.000S	0.000 ... 99.999	m/s
93	Raw data 1. Value = number of particles 1. ved/1. rof ... 32. Value = number of particles 32. ved/1. rof; 33. Value = number of particles 1. ved/2. rof ... 64. Value = number of particles 32. ved/2. rof; 65. Value = ...	4095	000S	0 ... 999	1

*depending on which datalogger is used, the measured value number must be selected with the corresponding number of bits. S = Separator

Note: Other values in the telegram which are not included in this list are intended exclusively for service purposes. Please ignore them.

11.3 Defining the formatting string

There are various strings available to tailor the format of the existing data protocol to your individual requirements. These must be individually assigned to each measurement number in the data telegram.

Formatting control codes

String:	Meaning:
/n	Line feed
/r	Return
/s	Start transmission
/e	End transmission

Formatting individual measured values

String:	Meaning:
%04	Output measured value No. 4

Formatting fields

String:	Meaning:
%90;	Output data field no. 90 with ";" as a separator Other signs can be used as well as a separator.

11.4 OTT telegram

The following telegram configuration has been preset at the factory:

```
%13;%01;%02;%03;%07;%08;%34;%12;%10;%11;%18;/r/n
```

According to this configuration, the measurement values are displayed as in the following example:

```
200248;000.000;0000.00;00;-9.999;9999;025;15759;00000;0;
```

According to the table in Chapter 11.2, the data protocol is thus defined as follows:

Meas. value No.	Meas. value	Definition
13	200248	Sensor serial number
01	000.000	Rain intensity
02	0000.00	Rain amount since start of device
03	00	Weather code according to SYNOP $w_o w_a$ (see Appendix D "Categorization of precipitation type by precipitation codes")
07	-9.999	Radar reflectivity
08	9999	MOR visibility in the precipitation
34	000.00	Kinetic energy
12	025	Temperature in the sensor
10	15759	Signal amplitude of the laser strip
11	00000	Number of detected particles
18	0	Sensor status

11.5 Updating OTT Parsivel² firmware

OTT Hydromet provides the latest update versions to OTT software on its internet site at www.ott.com under the rubric "Software updates". The following file is needed to update the OTT Parsivel² firmware:

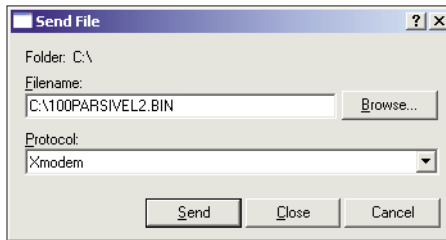
► *IOP.BIN

where * represents the respective version number.

To update the OTT Parsivel² firmware, proceed as follows:

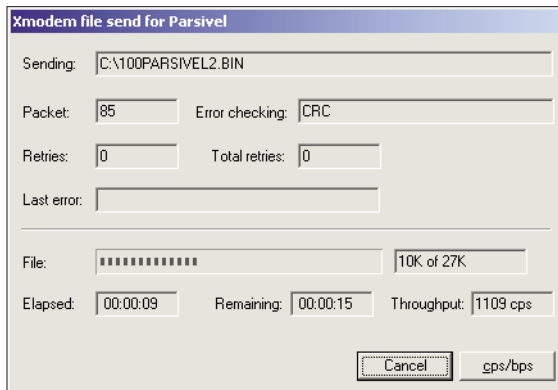
- Connect your PC to the OTT Parsivel² via the corresponding interface converter as described in Chapter 8.
- Load the newest update of the OTT Parsivel² firmware onto your computer from the OTT home page.
- Start a terminal software program on your PC and make the appropriate settings as described in Chapter 11.1 "Setting up communications between the OTT Parsivel² and the terminal software".
- After OTT Parsivel² has started measurement operations and has issued a data telegram, reset the OTT Parsivel² firmware with the command `CS/Z/1<CR>`. OTT Parsivel² answers with "Bootloader OTT Parsivel²".
- Press `<CR>` repeatedly directly after the message. OTT Parsivel² replies with "?".
- Input the command `sup <CR>`. OTT Parsivel² answers with "Start upload Firmware with XMODEM/CRC".
- Select "Transfer | Send file" in the menu bar. The "Send file" window opens:

Fig. 19: "Send file" window.



- Select the file "*IOP.BIN" under "Filename" using the "Browse" button; you had previously stored this file on your PC.
- Select the "Xmodem" protocol type from the "Protocol" selection window.
- Confirm your input with "Send". The "Xmodem file send for OTT Parsivel²" window opens:

Fig. 20: "Xmodem file send for OTT Parsivel²" window.



The data transfer runs and the window closes automatically after the data transfer has finished.

- After the window has closed, input the command RUN <CR> to start OTT Parsivel². The firmware was successfully updated.

12 Maintenance



Danger of injury to eyes!

When working on the sensor, there is a danger of injury to the eyes due to the laser beam!

- ▶ Never look directly into the laser!
- ▶ During all work on the sensor it must be switched off! If this is not possible, ensure protective goggles are worn!
- ▶ Never open the sensor modules!
- ▶ Observe the safety instructions in Chapter 4!

12.1 Cleaning the laser's protective glass

Depending on the time of year and location, air pollution can lead to contamination of the laser's protective glass. This can result in a drop in the sensor dynamics. The last value (Sensor status) of the OTT telegram provides a reference concerning the current state of the optics, wherein the following error codes are reported:

0 = Everything OK

1 = Laser protective glass is dirty, but measurements are still possible

2 = Laser protective glass is dirty, partially covered. No further usable measurements are possible.

3 = Laser damaged

It is a good idea to clean the laser optics beginning at Status 1. OTT Hydromet recommends that the laser's protective glass be cleaned at least semiannually, regardless of the messages.

To clean the laser's protective glass, proceed as follows:

- Clean the laser's protective glass on both sensor heads from the outside with a soft cloth.

12.2 Keeping the light pathway open



Please follow Safety Instructions (see chapter 4) when keeping the light pathway open!

At regular intervals, remove all impediments, such as leaves, branches or spider webs that are in the way of the light pathway.

12.3 Cleaning the splash protection unit



Danger of injury!

When working on the splash protection unit, there is a danger of injury from sharp edges!

- ▶ Take care when working on the splash protection unit!
- ▶ Wear gloves as necessary!



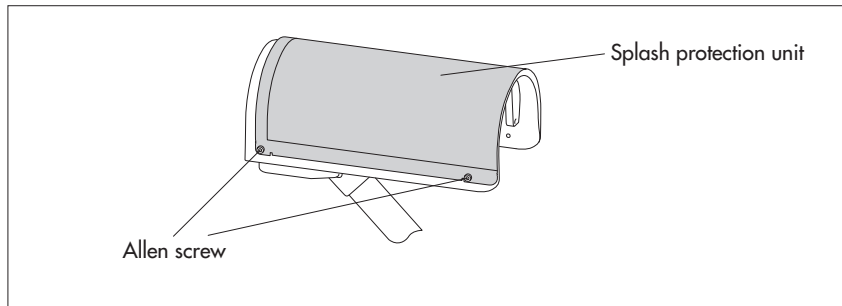
Danger of damaging the device!

The splash protection unit can bend easily!

- ▶ Clean the splash protection unit on a level surface!

A splash protector is attached to each sensor head of the OTT Parsivel². The splash protector has many small holes that break up incident raindrops so that no secondary spectra are detected in the laser beam due to splashing. As soon as the holes are plugged by bird droppings, pollen or similar material, the drops can no longer be broken up and the splash protector has to be cleaned.

Abb. 21: Splash protection unit.



Clean the splash protector as follows:

- Loosen the four hex screws of the respective splash protector using an M4 hex key and remove the splash protector.
- Clean the splash protector using a brush and commercially available household cleanser on both sides under running water.
- Reinstall the splash protector onto the respective sensor head using the hex screws.

If the splash protector can no longer be cleaned or if it is defective, it can be purchased as a replacement part from OTT Hydromet (see Chapter 2 "Part numbers").

13 Functional disruptions and remedies

13.1 OTT Parsivel² does not start

- Check the polarity of the power supply, the A+B connections of the RS-485 cables and the baud rate (see Ch. 6 and 7).
- If this does not work, start any terminal software program on your PC (e.g. Hyper Terminal) and try to make a connection to OTT Parsivel² (see Ch. 11 "Operating the OTT Parsivel² with a terminal software"). The OTT Parsivel² should send a status message of "ok" in response to the "CS/<CR>" command. If this does not happen, contact OTT Hydroservice.

13.2 Disruptions due to convection and vibrations

In rare cases, intense sun can affect the sensor due to the high sensitivity of the device; this is caused by refractive index fluctuations (mirage effects) in connection with wind. The same applies to vibrations. Most of these types of disruptions are recognized and removed through formal analysis of the signals. Nevertheless, some disruption signals cannot be differentiated from the signals of small particles. Further examinations of the particle collective over the respective reporting period help to prevent precipitation reports during good weather for the most part.

14 Note about the disposal of old units



Within the member countries of the European Union

In accordance with the European Union guideline 2002/96/EC, OTT takes back old devices within the member countries of the European Union and disposes of them in an appropriate way. The devices concerned by this are marked with the symbol shown aside. (WEEE registration number: 49590817.)

- 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 guideline 2002/96/EC of your country.

For all other countries

- Dispose of the OTT Parsivel² properly after taking out of service.
- Observe the regulations valid in your country for the disposal of electronic devices.
- Never put the OTT Parsivel² into the normal household waste.

Used materials

see Chapter 15, "Technical Data"

15 Technical data

Optical sensor laser diode	
Wavelength	780 nm
Output power	0.5 mW
Laser class	1 (21 CFR 1040.10 and 1040.11) 1 (IEC/EN 60825-1 A2:2001)
Beam size (W x D)	180 x 30 mm
Measurement surface	54 cm ² , recognition of edge events
Measuring range	
Particle size of liquid precipitation	0.2 ... 5 mm
Particle size of solid precipitation	0.2 ... 25 mm
Particle speed	0.2 ... 20 m/s
Design	32 precipitation size classes 32 speed classes Radar reflectivity Z, kinetic energy
Weather code	Outputs: – SYNOP w ₀ w _a Table 4680, – SYNOP ww Table 4677, – NWS – METAR/SPECI w'w' Table 4678 differentiation of the precipitation types drizzle, rain, hail, snow > 97 % compared to a weather observer
Visibility in precipitation	Measurement range (MOR) 100 ... 5,000 m
Rain rate	
Minimum intensity	0.001 mm/h drizzle rain
Maximum intensity	1,200 mm/h
Accuracy	±5 % (liquid) / ±20 % (solid) ¹⁾
De-icing protection	Microprocessor controlled heating
Power supply	10 ... 28 V DC, reverse polarity protection Optimum heating output of the sensor head heating system can be guaranteed with a power supply voltage of at least 20 V DC.
Current drawn	
Electronics	65 mA at 24 V DC
Heating	2/4 A; 12/24 V DC ²⁾
Interfaces	RS 485 (EIA-485) 1,200 ... 57,600 Baud half-duplex, 2-wire SDI-12 USB OTT Parsivel ² has an output relay for pulse output for precipitation in 0.1 mm/pulse with max. 2 Hz pulse rate
Electromagnetic tolerance	fulfills EN 61000-4-2 to EN 61000-4-6 (10 V/m, 2 kV) for EMC requirements, CE compliant
Lightening protection	integrated
Material	powder-coated aluminum housing
Weight	max. 6.4 kg
Temperature range	–40 ... +70 °C; 0 ... 100 % relative humidity
Protection	IP 65, resistant to salt spray
Size (H x W x D)	670 x 600 x 114 mm

¹⁾ Under laboratory conditions and statistically correlated by OTT calibration system with reference particle calibration of 0.5; 1.0; 2.0 and 4.0 mm

²⁾ Power output ≥ 100 W necessary

Appendix A – CS command set

CS/F/1<CR>

With this command, all factory settings can be recreated.

CS/I/<parameter><CR>

Adjust sample interval and start transfer

In automatic mode, the sample interval can be adjusted in seconds with this command. After confirmation of the command, the first data set is output.

Value range: 0; 10 ... 3600

Standard: 30

If the value "0" is entered for the sample interval, the Polling mode is enabled.

CS/P<CR>

Enabling polling mode

OTT Parsivel² issues a data telegram no later than 500 ms after receiving the command. This command disables the interval-controlled telegram.

CS/PA<CR>

Output all measurement values (in accordance with the table in Chapter 11.2).

This data sequence is necessary for the import into the OTT Parsivel software ASDO.

CS/R<CR>

Repeat polling mode

OTT Parsivel² outputs the data telegram no later than 500 ms after the confirmation of the command.

CS/R/xx<CR>

Output individual measurements

After confirmation of the command, the indicated measurement is output according to the table in Chapter 11.2 "Measured value numbers".

CS/C/R/<parameter><CR>

Adjust baudrate

Warning: Changing the baudrate can lead to loss of the connectivity!

The baudrate can be adjusted from 9600 ... 115200. The baudrate is set at 19200 at the factory.

1200 baud, 8, N, 1	2400 baud, 8, N, 1
4800 baud, 8, N, 1	9600 baud, 8, N, 1
19200 baud, 8, N, 1	38400 baud, 8, N, 1
57600 baud, 8, N, 1	

CS/C/R<CR>

Query baudrate

With this command, the current baudrate setting can be queried.

CS/C/B/<parameter><CR>

Setting up RS-485 bus mode

Warning:

Enabling the bus mode can cause the loss of the connectivity!

With this command, it is possible to operate more than one sensor through one RS-485 interface. The sensors are then operated via the bus address.

Value range: 0 ... 1

Standard: 0

Description: 0 = RS-485 bus mode disabled

1 = RS-485 bus mode enabled

Address query: *<CR>

Answer: <Address><CR><LF>

CS/C/A/<parameter><CR>

Set bus address for RS-485 bus mode

Warning: Changing the bus address can cause the loss of the connectivity!

Value range: 0 ... 9

Standard: 0

CS/T/12:00:00<CR>

Adjust time of day

The time of day of the OTT Parsivel² is set to the time of day of the PC.

CS/D/01.01.2000<CR>

Adjust date

The date of the OTT Parsivel² is set to the calendar of the PC.

CS/S/E/<parameter><CR>

Set SDI-12 mode

Enable or disable the SDI-12 mode.

Value range: 0 ... 1

Standard: 0

Description: 0 = SDI-12 mode disabled

1 = SDI-12 mode enabled

CS/S/A/<parameter><CR>

Set bus address for SDI-12 bus mode

This command sets the bus address for the SDI-12 bus mode.

Value range: 0 ... 9

Standard: 0

CS/K/xxxxxxxxxx<CR>

Input station name

This command allows a user-specific station name to be used. This name can encompass a maximum of 10 characters.

CS/K/PWS00001<CR>

Station name: PWS00001

CS/J/xxxx<CR>

Assign station ID

This command assigns a 4-digit station ID.

CS/M/M/<parameter><CR>

Select data telegram

The data telegram can be input with the parameters 0 ... 1

.

Value range: 0 ... 1

Standard: 0

Description: 0 = OTT telegram

1 = User telegram

CS/M/S/<parameter><CR>

Set formatting string

You can create a data telegram that is optimized according to your needs. This command sets the formatting string. The formatting string is placed in the <parameter> spot (see also Chapter 11.3 "Defining the formatting string").

CS/Z/1<CR>

Restart sensor, reset the rain amount

CS/L<CR>

Output current configuration

CS/?<CR>

This command outputs the command list.

CS/H/M/<parameter><CR>

This command adjusts the operating mode of the heating system.

Value range:	0 ... 3
Standard:	1
Description:	0 = OFF 1 = Automatic 50 W 2 = Automatic 100 W 3 = I _{max} 100 W

CS/H/T/<parameter><CR>

Set minimum temperature of the sensor heater

This command sets the minimum temperature to which the sensor is heated.

Value range:	-40 ... 85 °C
Standard:	10

CS/U/01.01.2011 10:55:11<CR>

Set real time clock

This command sets the real time clock of the OTT Parsivel².

CS/U<CR>

Read out real time clock

With this command the current date and time of the OTT Parsivel² is read out.

Response: 01.01.2011 10:55:11 (example)

CS/*/D/<parameter><CR>

Activate/deactivate "Parsivel¹⁾ Communication Mode"

With this command the OTT Parsivel² telegram (see Chapter 11.2 and 11.4) is set to the format of the previous generation of Parsivel.

This is required if you are using the OTT Parsivel² in a measuring network, together with one/several Parsivel¹⁾ unit/s and the telegram/s of all units has/have to be identical.

Range of values:	0, 1
Factory setting:	0 (→ OTT Parsivel ² telegram)
Description:	0 = Parsivel ¹⁾ Communication Mode deactivated 1 = Parsivel ¹⁾ Communication Mode activated

For a description of the Parsivel* telegram refer to the "Operating instructions Present Weather Sensor Parsivel" (70.200.005.B.E).

¹⁾ predecessor model of OTT Parsivel²

Annex B – SDI-12 commands and responses

B.1 Basic commands

All SDI-12 basic commands are implemented in the OTT Parsivel². The following SDI-12 basic commands are relevant for the operation of the OTT Parsivel²:

Command	Response	Description
a!	a<CR><LF>	Acknowledgement active a – Sensor address; factory setting = 0
aI!	a13cccccccmmmmmmm vvvvxxxxxx<CR><LF>	Send identification a – Sensor address 13 – SDI-12 protocol version ccccccc – Manufacturer's identification (company name) mmmmmm – Sensor identification vvv – Sensor version (firmware) xxxxxx – Serial number Response OTT Parsivel ² = 013OTT____PARS_2202123456
aAb!	b<CR><LF>	Change sensor address a – Old sensor address b – New sensor address
?!	a<CR><LF>	Query sensor address a – Sensor address
aM!	atttn<CR><LF> and after 9 seconds a<CR><LF>	Start measurement a – Sensor address ttt – Time in seconds until the sensor has determined the measurement result Response OTT Parsivel ² = 009 n – Number of measured values Response OTT Parsivel ² = 8 a<CR><LF> – Service request
aD0!	a<value1><value2><value3> <value4><value5><value6> <CR><LF>	Send data – Part 1 (after aM! , aMC! , aC! , aCC!) a – Sensor address <value1> – Rain intensity [mm/h] Measured value format: pbbbb.eee Range: +0.000 ... +9999.999 mm/h <value2> – Rain amount accumulated [mm] Measured value format: pbbb.ee Range: +0.00 ... +300.00 mm <value3> – Weather code according to SYNOP $w_a w_a$ Table 4680 Measured value format: pbb [1] Range: +00 ... +99 <value4> – Radar reflectivity [dBz] Measured value format: pb.eee Range: -9.999 ... +9.999 dBz <value5> – MOR visibility in precipitation [m] Measured value format: pbbbbbb Range: +0 ... +20000 m <value6> – Sample interval [s] Measured value format: pbbbb Range: +0 ... +3600 s p – Sign (+,-) b – Number (before decimal point) Output without leading zeros! e – Number after decimalpoint

Command	Response	Description
aD1!	a<value7><value8><CR><LF>	Send data – Part 2 (after aM!, aMC!, aC!, aCC!) <value7> – Signal amplitude of the laser strip [1] Measured value format: pbbbb Range: +0 ... +99999 <value8> – Number of detected particles [1] Measured value format: pbbbb Range: +0 ... +99999 p – Sign (+) b – Number (before decimal point) Output without leading zeros! e – Number after decimal point
aMC!	atttn<CR><LF> and after 9 seconds a<CR><LF>	Start measurement and request CRC (Cyclic Redundancy Check); for details see command aM!. The responses to the following aD0! and aD1! commands are extended by one CRC value: <value1><value2><value3><value4><value5> <value6><CRC><CR><LF> or a<value7><value8><CRC><CR><LF>
aC!	atttnn<CR><LF>	Start concurrent measurement (simultaneous measurement with multiple sensors on one single bus line); for details see command aM!. The number of measured values in the response to this command has two digits: nn = 02.
aCC!	atttnn<CR><LF>	Start concurrent measurement (simultaneous measurement with multiple sensors on one single bus line) and request CRC (Cyclic Redundancy Check); for details see command aM!. The number of measured values in the response to this command has two digits: nn = 02. The responses to the following aD0! and aD1! commands are extended by on CRC value: a<value1><value2><value3><value4><value5>... ... <value6><CRC><CR><LF> or a<value7><value8><CRC><CR><LF>
aM1!	atttn<CR><LF> and after 9 seconds a<CR><LF>	Start additional measurement a – Sensor address ttt – Time in seconds until the sensor has determined the measurement result Response OTT Parsivel ² = 009 n – Number of measured values Response OTT Parsivel ² = 8 a<CR><LF> – Service request
aD0!	a<value1><value2><value3> <value4><value5><value6> <CR><LF>	Send data – Part 1 (after aM1!, aMC1!, aC1!, aCC1!) a – Sensor address <value1> – Kinetic energy [J/(m ² h)] Measured value format: pbbb.eee Range: +0.000 ... +999.999 J/(m ² h) <value2> – Snow intensity [mm/h] Measured value format: pbbbb.ee Range: +0.00 ... +9999.99 mm/h <value3> – Weather code according to SYNOP ww Table 4677 Measured value format: pbb [1] Range: +00 ... +99 <value4> – Temperature PCB [°C] Measured value format: pbbb Range: -99 ... +100 °C

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Command	Response	Description
		<p><value5> – Temperature in the right sensorhead [°C] Measured value format: pbbb Range: -99 ... +100 °C</p> <p><value6> – Temperature in the left sensorhead [°C] Measured value format: pbbb Range: -99 ... +100 °C</p> <p>p – Sign (+,-) b – Number (before decimal point) Output without leading zeros! e – Number after decimal point</p>
aD1!	a<value7><value8> <value9><CR><LF>	<p>Send data – Part 2 (after aM1!, aMC1!, aC1!, aCC1!)</p> <p><value7> – Sensor status [1] (see Chapt. 12.1) Measured value format: pb Range: +0 ... +3</p> <p><value8> – Heating current [A] Measured value format: pb.ee Range: +0.00 ... +4.00 A</p> <p><value9> – Power supply voltage [V] Measured value format: pbb.e Range: +0.0 ... +30.0 V</p> <p>p – Sign (+) b – Number (before decimal point) Output without leading zeros! e – Number after decimal point</p>
aMC1!	atttn<CR><LF> and after 9 seconds a<CR><LF>	<p>Start additional measurement and request CRC (Cyclic Redundancy Check); for details see command aM1!. The responses to the following aD0! and aD1! commands are extended by one CRC value: a<value1><value2><value3><value4><value5> <value6><CRC><CR><LF> or a<value7><value8><value9><CRC><CR><LF></p>
aC1!	atttnn<CR><LF>	<p>Start concurrent measurement (simultaneous measurement with multiple sensors on one single bus line); for details see command aM1!. The number of measured values in the response to this command has two digits: nn = 02.</p>
aCC1!	atttnn<CR><LF>	<p>Start concurrent measurement (simultaneous measurement with multiple sensors on one bus line) and request CRC (Cyclic Redundancy Check); for details see command aM1!. The number of measured values in the response to this command has two digits: nn = 02. The responses to the following aD0! and aD1! commands are extended by one CRC value: a<value1><value2><value3><value4><value5> <value6><CRC><CR><LF> or a<value7><value8><value9><CRC><CR><LF></p>

Command	Response	Description
aV!	atttn<CR><LF>	Perform system test a – Sensor address ttt – Time in seconds until the sensor provides the result of the system test Response OTT Parsivel ² = 000 n – Number of measured values Response OTT Parsivel ² = 0 a<CR><LF> – Service request
aD0!	a0<CR><LF>	Send data (after aV!) a – Sensor address 0 – no system test performed

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 1.3* (refer to website www.sdi-12.org).

B.2 Advanced SDI-12 commands

All advanced SDI-12 commands are preceded by "O" which stands for OTT. Using these commands, the OTT Parsivel² may be configured from the Transparent Mode of a datalogger.

Command	Response	Description
▶ Set/read the unit for level/pressure measured values		
aOSE<value>!	a<value><CR><LF>	Activate SDI-12 mode a – Sensor address <value> – +0 = SDI-12 mode deactivated; factory setting +1 = SDI-12 mode activated

Appendix C – Classification of precipitation types

After determining the volume equivalent diameter (D) and the particle speed (V), the OTT Parsivel² subdivides the particles into appropriate classes. The scale of this classification is smaller for small, slow particles than for large and fast particles.

C.1 Class limits

The measured particles are subdivided into D and V classes in a two-dimensional field, wherein there are 32 different D and V classes so that there are a total of $32 \times 32 = 1024$ classes.

Classification according to volume-equivalent diameter

Class number	Mid-value of class [mm]	Class spread [mm]
1	0.062	0.125
2	0.187	0.125
3	0.312	0.125
4	0.437	0.125
5	0.562	0.125
6	0.687	0.125
7	0.812	0.125
8	0.937	0.125
9	1.062	0.125
10	1.187	0.125
11	1.375	0.250
12	1.625	0.250
13	1.875	0.250
14	2.125	0.250
15	2.375	0.250
16	2.750	0.500
17	3.250	0.500
18	3.750	0.500
19	4.250	0.500
20	4.750	0.500
21	5.500	1.000
22	6.500	1.000
23	7.500	1.000
24	8.500	1.000
25	9.500	1.000
26	11.000	2.000
27	13.000	2.000
28	15.000	2.000
29	17.000	2.000
30	19.000	2.000
31	21.500	3.000
32	24.500	3.000

Note:

Class 1 and class 2 are limits and are not evaluated at the current time in measurements using the OTT Parsivel² since they are outside the measurement range of the device.

Classification according to speed

Class number	Mid-value of class [m/s]	Class spread [m/s]
1	0.050	0.100
2	0.150	0.100
3	0.250	0.100
4	0.350	0.100
5	0.450	0.100
6	0.550	0.100
7	0.650	0.100
8	0.750	0.100
9	0.850	0.100
10	0.950	0.100
11	1.100	0.200
12	1.300	0.200
13	1.500	0.200
14	1.700	0.200
15	1.900	0.200
16	2.200	0.400
17	2.600	0.400
18	3.000	0.400
19	3.400	0.400
20	3.800	0.400
21	4.400	0.800
22	5.200	0.800
23	6.000	0.800
24	6.800	0.800
25	7.600	0.800
26	8.800	1.600
27	10.400	1.600
28	12.000	1.600
29	13.600	1.600
30	15.200	1.600
31	17.600	3.200
32	20.800	3.200

Appendix D – Categorization of precipitation type by precipitation codes

From the classification of precipitation particles, the OTT Parsivel² calculates the rain rate. The type of precipitation is based on the number of particles within the measurement range, and the precipitation code is determined from the precipitation intensity R (in mm/h of an equivalent amount of water).

D.1 Precipitation code according to SYNOP

The definitions of the precipitation codes below are listed according to the following tables:

- ▶ SYNOP $w_o w_a$ Table 4680
- ▶ SYNOP w_w Table 4677

No precipitation		Tab. 4680	Tab. 4677
		00	00

Drizzle		Tab. 4680	Tab. 4677
Intensity	Rain rate [mm/h]		
light	≤ 0.2	51	51
moderate	0.2 ... 0.5	52	53
heavy	≥ 0.5	53	55

Drizzle with rain		Tab. 4680	Tab. 4677
Intensity	Rain rate [mm/h]		
light	≤ 0.2	57	58
moderate	0.2 ... 0.5	58	59
heavy	≥ 0.5	58	59

Rain		Tab. 4680	Tab. 4677
Intensity	Rain rate [mm/h]		
light	≤ 0.5	61	61
moderate	0.5 ... 4.0	62	63
heavy	≥ 4.0	63	65

Rain, drizzle with snow		Tab. 4680	Tab. 4677
Intensity	Rain rate [mm/h]		
light	≤ 0.5	67	68
moderate	> 0.5	68	69

Snow		Tab. 4680	Tab. 4677
Intensity	Rain rate [mm/h]		
light	≤ 0.5	71	71
moderate	0.5 ... 4.0	72	73
heavy	≥ 4.0	73	75

Snow grains		Tab. 4680	Tab. 4677
Intensity	Rain rate [mm/h]		
light	≤ 0.5	77	77
moderate	0.5 ... 4.0	77	77
heavy	≥ 4.0	77	77

Freezing rain		Tab. 4680	Tab. 4677
Intensity	Rain rate [mm/h]		
light	≤ 0.4	87	87
moderate	> 0.4	88	88

Hail		Tab. 4680	Tab. 4677
Intensity	Rain rate [mm/h]		
light	≤ 7.5	89	89
moderate	≥ 7.5	89	90

D.2 Precipitation code according to the NWS and METAR/SPECI w'w', Table 4678

The definitions of the precipitation codes below are listed according to the following tables:

- ▶ NWS
- ▶ METAR/SPECI w'w' Table 4678

No precipitation		NWS	Tab. 4678
		C	NP

Drizzle		NWS	Tab. 4678
Intensity	Rain rate [mm/h]		
light	≤ 0.2	L-	-DZ
moderate	0.2 ... 0.5	L	DZ
heavy	≥ 0.5	L+	+DZ

Drizzle with rain		NWS	Tab. 4678
Intensity	Rain rate [mm/h]		
light	≤ 0.2	RL-	-RADZ
moderate	0.2 ... 0.5	RL	RADZ
heavy	≥ 0.5	RL+	+RADZ

Rain		NWS	Tab. 4678
Intensity	Rain rate [mm/h]		
light	≤ 0.5	R-	-RA
moderate	0.5 ... 7.5	R	RA
heavy	≥ 7.5	R+	+RA

Rain, drizzle with snow		NWS	Tab. 4678
Intensity	Rain rate [mm/h]		
light	≤ 0.5	RLS-	-RASN
moderate	> 0.5	RLS	RASN
heavy		RLS+	+RASN

Snow		NWS	Tab. 4678
Intensity	Rain rate [mm/h]		
light	≤ 0.5	S-	-SN
moderate	0.5 ... 2.5	S	SN
heavy	≥ 2.5	S+	+SN

Snow grains		NWS	Tab. 4678
Intensity	Rain rate [mm/h]		
light	≤ 0.5	SG	-SG
moderate	0.5 ... 4.0	SG	SG
heavy	≥ 4.0	SG	+SG

Freezing rain		NWS	Tab. 4678
Intensity	Rain rate [mm/h]		
light	≤ 0.4	SP	-GS
moderate	> 0.4	SP	GS
heavy		SP	+GS

Hail		NWS	Tab. 4678
Intensity	Rain rate [mm/h]		
light	≤ 7.5	A	GR
moderate	≥ 7.5	A	GR



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Klasse/ class/ classe 1

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Dr. Anton Felder
(CEO)

OTT Hydromet GmbH
Postfach 21 40 · 87411 Kempten
Ludwigstraße 16 · 87437 Kempten
Tel.: +49 831 5617-0
Fax: +49 831 56 17-209
info@ott.com
www.ott.com

Geschäftsführer: Dr.-Ing. Anton Felder, Jörg Mayer, Ronald Marcel Peters
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OTT Hydromet GmbH

Ludwigstrasse 16
87437 Kempten · Germany

Tel. +49 831 5617-0

Fax +49 831 5617-209

info@ott.com · www.ott.com