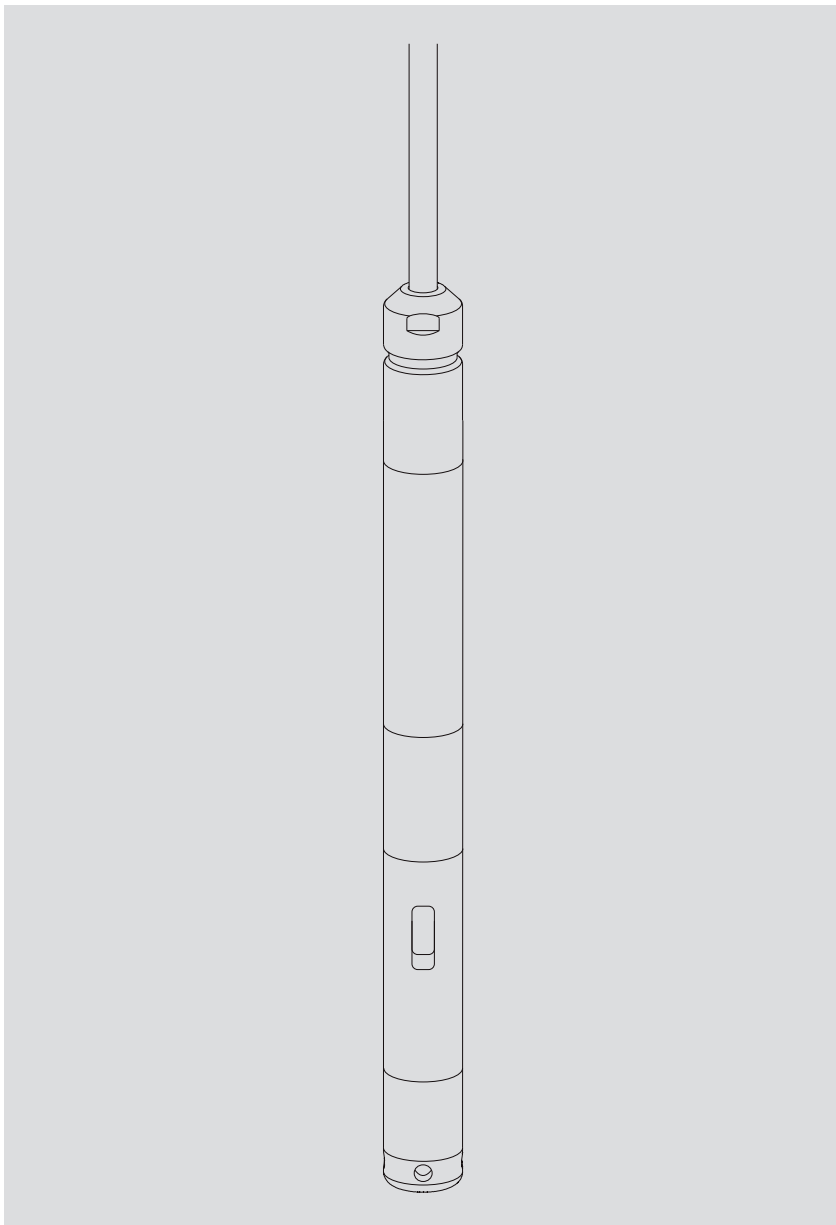




Operating Instructions
**Pressure Probe with
Conductivity Sensor OTT PLS-C**



English

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

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1 Scope of supply

- ▶ **OTT PLS-C**
 - 1 Pressure probe with ceramic, capacitive relative pressure measuring cell and built-in conductivity sensor; fixed pressure probe cable with pressure compensating capillary and Kevlar core for longitudinal stabilization; cable assembly fitted with shipping protection against moisture ingress.
 - 1 Operating instructions
 - 1 Factory acceptance test (FAT) certificate

2 Order numbers and variant code*

| | | |
|----------------------|---|----------------|
| ▶ OTT PLS-C | Pressure probe with conductivity sensor | 63.038.001.9.0 |
| | - Variant including SDI-12 interface | 5* |
| | - Variant including RS-485 interface (SDI-12 protocol) | 4* |
| | Required ordering information | |
| | - Measuring range: 0 ... 4 / 10 / 20 / 40 / 100 m | |
| | - Cable length for SDI-12 interface: 1 ... 100 m | |
| | for RS-485 interface: 1 ... 200 m | |
| ▶ Accessories | OTT FAD 4PF humidity absorber | 63.025.021.4.2 |
| | - Desiccant cartridge in clear container with connecting hose for pressure compensating capillary | |
| | OTT FAD 5 humidity absorber | 63.037.025.3.2 |
| | - Junction box (pressure probe cable ↔ connecting cable for datalogger/power supply) including desiccant cartridge | |
| | Desiccant cartridge | 97.100.066.4.5 |
| | - Replacement cartridge in shipping container | |
| | Cable suspension | 96.140.173.9.5 |
| | Connecting cable | 97.000.040.9.5 |
| | - Twisted pair configuration; LiYY | |
| | - PVC, black | |
| | - 2 x 2 x 0.75 mm ² | |
| | - unshielded | |
| | Connecting cable | 97.000.039.9.5 |
| | - Twisted pair configuration ; FD CP (TP) | |
| | - PVC, grey | |
| | - 2 x 2 x 0.50 mm ² | |
| | - shielded | |
| | Calibration container | 55.445.025.9.2 |
| | OTT USB/SDI-12 interface | 65.050.001.9.2 |
| | - including software "OTT SDI-12 Interface" | |
| | OTT SDI-12 Interface – OTT FAD 5 connecting kit | 97.120.432.3.5 |
| | - for temporary connection the OTT PLS-C and OTT USB/SDI-12 interface within the OTT FAD 5 during conductivity sensor calibration | |
| ▶ Consumables | Conductivity calibration solution | |
| | - 0.1 mS/cm; 1000 ml | 55.495.350.9.5 |
| | - 0.5 mS/cm; 1000 ml | 55.495.351.9.5 |
| | - 1.412 mS/cm; 1000 ml | 55.495.352.9.5 |
| | - 12.856 mS/cm; 1000 ml | 55.495.353.9.5 |
| | - 47.6 mS/cm; 1000 ml | 55.495.354.9.5 |

3 Basic safety information

- ▶ Read these operating instructions before using the OTT PLS-C for the first time! Make yourself completely familiar with installing and operating the OTT PLS-C! Keep these operating instructions for later reference.
- ▶ The OTT PLS-C is used in hydrometry for measuring the water level, temperature, and specific conductivity of ground and surface waters. Only use the OTT PLS-C as described in these operating instructions! For further information → refer to Chapter 4, "Introduction".
- ▶ Note all the detailed safety information given within the individual steps. Any safety information in these operating instructions is identified by the warning symbol shown here.
- ▶ It is essential to comply with the electrical, mechanical and climatic specifications given in the Technical data section. For further information → refer to Chapter 11, "Technical data".
- ▶ Handle the pressure probe cable with care: Do not bend the cable or pull it across sharp edges!
- ▶ Do not make any changes or modifications to the OTT PLS-C! If changes or modifications are made, any warranty will void.
- ▶ Have a faulty OTT PLS-C inspected and repaired by our repair center. Never do any repairs yourself! For further information → refer to Chapter 9, "Repair".
- ▶ After putting the OTT PLS-C out of service, dispose it of properly. Never put the OTT PLS-C into normal household waste. For further information → refer to Chapter 10, "Note about the disposal of used units".



4 Introduction

The OTT PLS-C Pressure Probe with Conductivity Sensor is used for accurately measuring the water level, temperature, and specific electric conductivity of ground and surface waters. Based on the specific conductivity, the OTT PLS-C also calculates the salinity and a TDS value (Total Dissolved Solids).

To determine the water level, the pressure probe measures the hydrostatic pressure of the water column using a relative pressure cell. As a reference, a pressure compensating capillary in the pressure probe cable provides the measuring cell with the current ambient air pressure. Erroneous measurement results due to atmospheric air pressure fluctuations are thus eliminated. The OTT PLS-C measures the specific electric conductivity using a 4-electrode conductivity sensor with built-in temperature sensor. The measurement electrodes are made of graphite.

The temperature compensation process for the conductivity measurement and the reference temperature used can be chosen as well as the salinity calculation method.

The OTT PLS-C is available in various measuring ranges:

- ▶ 0 ... 4 m water column (0 ... 0.4 bar)
- ▶ 0 ... 10 m water column (0 ... 1 bar)
- ▶ 0 ... 20 m water column (0 ... 2 bar)
- ▶ 0 ... 40 m water column (0 ... 4 bar)
- ▶ 0 ... 100 m water column (0 ... 10 bar)

Moreover, the OTT PLS-C may be optionally fitted with SDI-12- or RS-485 interface (using the SDI-12 protocol).

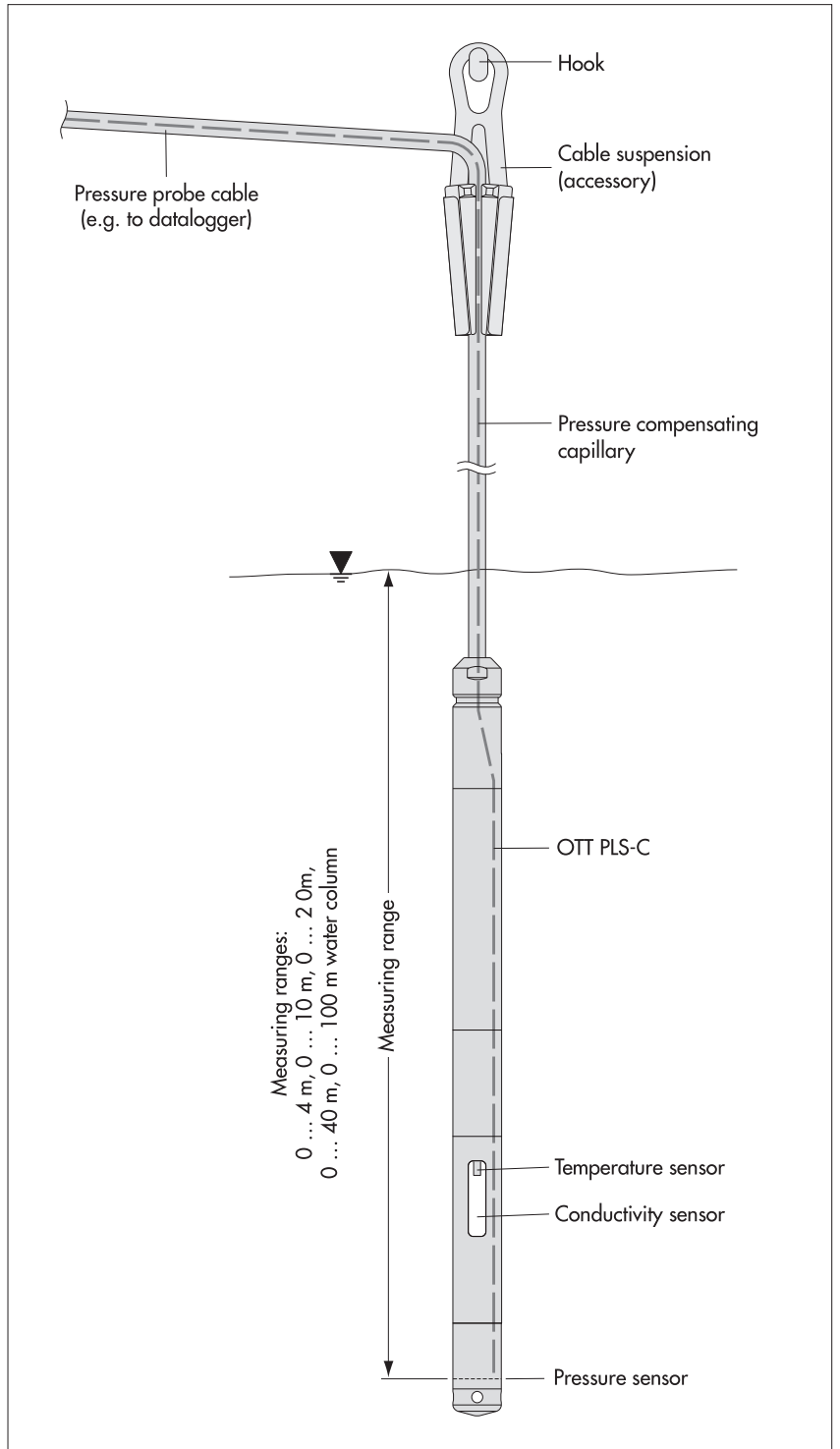
The OTT PLS-C may be configured using the SDI-12 Transparent Mode of a datalogger. Alternatively, this can be done by using the SDI-12 Interface Software in conjunction with an OTT netDL datalogger or USB/SDI-12 Interface. For example, a reference value or offset value can be entered when starting up the device.

A particular feature of the OTT PLS-C is that the unit measures the water temperature as well as the hydrostatic pressure of the water column and thus achieves highly precise and repeatable measurement results by compensating the effects of temperature, specific density of the water and the local gravitational acceleration at the specific station. (For this purpose, the specific density and local gravitational acceleration are to be entered during startup. Alternatively, the OTT PLS-C may dynamically calculate the specific density from the measured temperature and salinity values.) Using a reference value that was input during startup, the OTT PLS-C also provides the measurement results as depth to water values. The measurement intervals (sample intervals) can be preselected as necessary.

At the SDI-12 or RS-485 interface, the OTT PLS-C outputs either the water level (compensated) or hydrostatic pressure as well as the water temperature, specific conductivity, salinity and TDS value. The units for the individual measured values may be set as desired.

A humidity absorber for drying the ambient air that enters the pressure compensating capillary is available as an accessory.

Fig. 1: Basic layout of a water level station using the OTT PLS-C pressure probe with conductivity sensor.



5 Installing the OTT PLS-C

The OTT PLS-C may be used in a variety of ways, for example in observation wells or boreholes from 1" diameter upwards, in shafts, open waterways, and in waterways that do not always hold water.

Please note:

We do not recommend installing the OTT PLS-C in the vicinity of port facilities, industrial waste water discharges or areas that are heavily contaminated by chemicals. The OTT PLS-C is made of high-quality stainless steel and plastic. However, damaging corrosion may occur, depending on the mounting location. For more information on the materials used, refer to Chapter 11, "Technical data".

The OTT PLS-C may be installed in two ways:

- ▶ fixed in an individual protective device (e.g. in a tube, pipe or conduit) to be provided on site by the client, or
- ▶ suspended using the pressure probe cable.

Select the site and type of installation in such a way that the OTT PLS-C may be easily taken out of the water for calibrating the conductivity sensor!

Caution

No moisture should be allowed to enter the pressure compensating capillary of the pressure probe cable during installation! Very high air humidity can also lead to the formation of water droplets in the pressure compensation capillary due to temperature changes. These inevitably lead to unusable measurement results! Therefore, ensure the shipping protection is left on the cable end during the installation of the probe and cable!

Please note:

When exposed to extreme temperature changes during the installation, the PLS-C requires approx. 2 to 3 hours to deliver stable measurements! This happens for instance when the PLS-C is brought into a cold aquifer at high ambient temperatures.

5.1 Installation type A: Fixing the OTT PLS-C in a protective device

In flowing waters or waterways with a swell, the OTT PLS-C must be fixed. With strong currents ($> 0.5 \dots 1$ m/s), the hydrodynamic effects of the station have to be considered when installing the OTT PLS-C. Depending on the model and mounting of the individual components, overpressure or negative pressure can arise that can affect the measurement result.

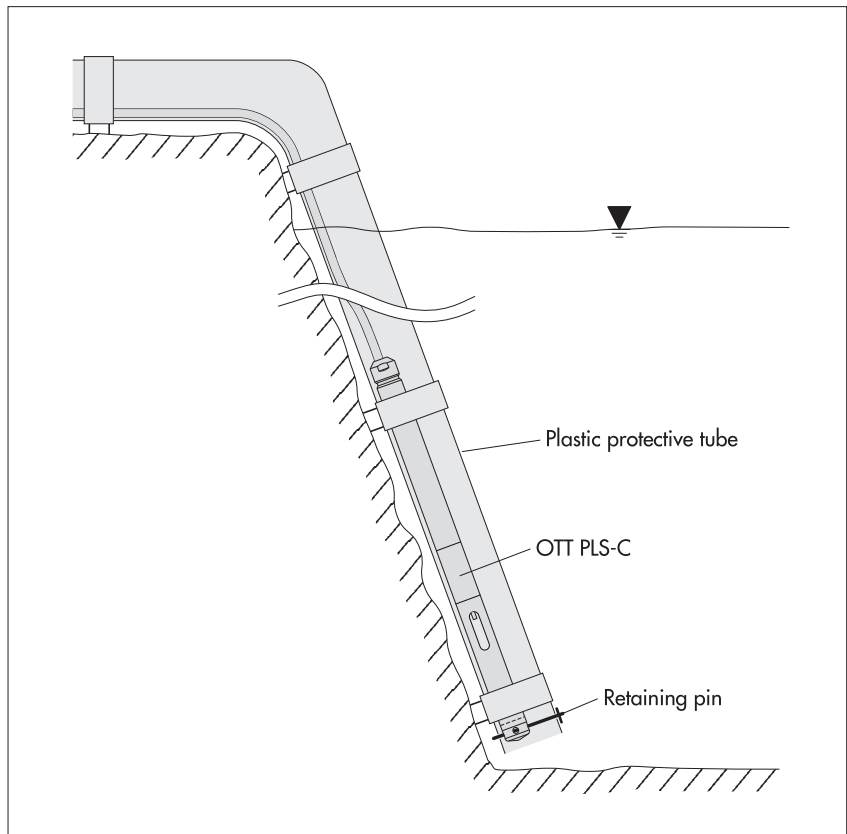
- Determine the minimum and maximum water levels at your station (e.g. staff gauge, contact gauge). Use both values to determine the probe position. The following requirements have to be met:
 - Position the probe below the minimum water level if possible.
 - Difference between max. water level and position of the probe $<$ measuring range of the probe.
- Fix the OTT PLS-C according to your individual requirements in a protective device (e.g. in a tube, pipe or conduit), as shown in Fig. 2.

Note

Fine adjustment of the probe position is carried out, for example, by entering a reference or offset value or using the scaling functionality of the datalogger connected.

Fig. 2: Installation example of the OTT PLS-C in open waterways.

For waterways with currents or swell, a retaining pin is used to securely fasten the probe. Push the fixing pin through the holes in the black protective cap.



5.2 Installation type B: Suspending the OTT PLS-C

See also Figure 1.

- Determine the minimum and maximum water levels at your station (e.g. staff gauge, contact gauge). Use both values to determine the probe position. The following requirements have to be met:
 - Position the probe below the minimum water level if possible.
 - Difference between max. water level and position of the probe < measuring range of the probe.
- Fix the cable attachment (accessory) at a suitably sized attachment point. When the pressure probe cable ends in immediate vicinity of the cable attachment: Additionally fix the Kevlar fibers to a suitable point!
- Carefully lower the OTT PLS-C on the pressure probe cable to the specified depth. There are markings on the cable every 0.25 m to assist in lowering the unit.
- Place the pressure probe cable in the opened clamping jaws of the cable attachment as shown in Figure 1 and secure the pressure probe cable by pushing the clamping jaws together. The mechanical longitudinal stability required is provided by the Kevlar fibers inside the pressure probe cable.

Please note: Maximum suspending depth: 200 m!

Note

Fine adjustment of the probe position is carried out, for example, by entering a reference or offset value or using the scaling functionality of the datalogger connected. It is thus sufficient for many applications to position the probe approximately.

5.3 Connecting humidity absorber

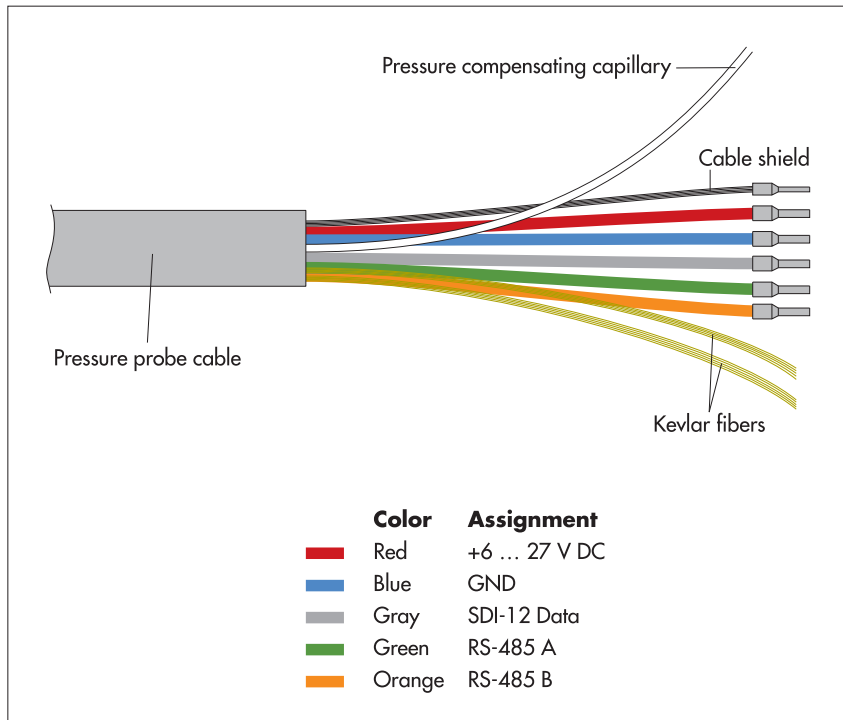
A humidity absorber must be installed for drying the ambient air that enters the pressure compensating capillary of the pressure probe cable! Refer to Appendices B and C.

Caution

Humidity entering the pressure compensating capillary leads to unusable measurement results!

5.4 Wire assignment of the pressure probe cable

Fig. 3: Wire assignment of the OTT PLS-C pressure probe cable.



Provide continuous power supply for the OTT PLS-C! Do not use switched voltage outputs of a datalogger! This assists in regularly calibrating the conductivity sensor. An extremely low power consumption of the OTT PLS-C in Sleep Mode allows this to be implemented.

Please note:

The factory assembled pressure probe cable should only be trimmed using a suitable wire stripping tool! Danger of damaging the cable!

Recommendation: Store excess cable in loops if necessary (loop diameter ≥ 16 cm)!

If necessary, the pressure probe cable may be lengthened. For this purpose, use a suitable terminal box (e.g. OTT FAD 5; it includes a humidity absorber). The maximum cable length for the RS-485 interface is 1,000 m! Recommended cable type for the RS-485 interface: Shielded, twisted pair cable. The wires intended for the power supply may be twisted pair, but do not have to be.

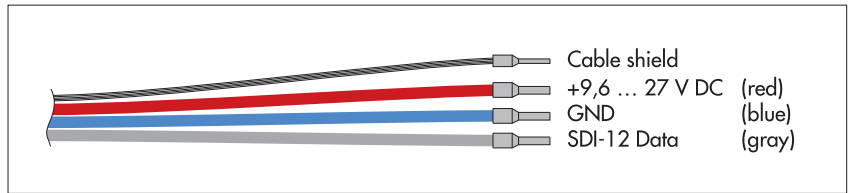
Usable wire sizes

- ▶ Up to 500 m cable length: $2 \times 2 \times 0.50 \text{ mm}^2$ (41 Ohms/1,000 m)
- ▶ 500 to 1,000 m cable length: $2 \times 2 \times 0.75 \text{ mm}^2$ (27 Ohms/1,000 m)

5.5 Connecting the OTT PLS-C to any datalogger using an SDI-12 interface

- Connect the OTT PLS-C to an SDI-12 input of the datalogger. Follow the datalogger manual when doing this. Refer to Figure 4 for the wire assignments of the OTT PLS-C. Wires used: Red, blue, and gray. The maximum cable length is 100 m.

Fig. 4: Wires used with an SDI-12 interface.



The SDI-12 commands and responses used with the OTT PLS-C can be found in Chapter 6, "SDI-12 commands and responses".

5.6 Note on using the RS-485 interface

The RS-485 interface is designed and tested for use with OTT dataloggers! In this case, the transmission protocol via the physical RS-485 interface is the SDI-12 protocol. Connecting OTT PLS-C via the RS-485 interface to the OTT netDL/OTT DuoSens units → see Appendix A, Procedure B.

OTT accepts no functional warranty if you connect the OTT PLS-C via the RS-485 interface to a datalogger of a third-party manufacturer!

6 SDI-12 commands and responses

6.1 Basic commands

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

| Command | Response | Description |
|---------|---|---|
| a! | a<CR><LF> | Acknowledgment active a – Sensor address; factory setting = 0 |
| aI! | a13ccccccmmmmmm vvvxxxxxxxxxx<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) xxxxxxxxx – Serial number Response: OTT PLS-C = 013__OTT__PLS-C0011234567890 |
| 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 5 seconds a<CR><LF> | Start measurement a – Sensor address ttt – Time in seconds until the sensor has determined the measurement result Response: OTT PLS-C = 005 n – Number of measured values Response: OTT PLS-C = 5 a<CR><LF> – Service request |
| aD0! | a<value1><value2><value3>... ...<CR><LF> | Send data a – Sensor address <value1> – Level/pressure value Measured value formats: m → pbbbb.eee cm → pbbbbbbb ft → pbbbb.ee bar → pbbb.eee mbar → pbbbbbb.e psi → pbbbb.eee <value2> – Temperature value Measured value formats: °C and °F → pbbb.ee <value3> – Conductivity Measured value formats: mS → pbbb.ee (0.10 ... 100.00 mS/cm) µS → pbbbb (5 ... 2,000 mS/cm) p – Sign (+,-) b – Number (before decimal point) Output without leading zeros! e – Number after decimal point factory settings are shown in bold letters |

| Command | Response | Description |
|---------|--|--|
| aD1! | a<value4><value5><CR><LF> | <p>a – Sensor address</p> <p><value4> – Salinity Measured value formats: PSU → pbb.ee (0.00* ... 42.00 PSU) ppt → pbb.ee (0.00* ... 60.00 ppt)</p> <p><value5> – TDS Measured value format: g/l → pb.eee</p> <p>p – Sign (+)</p> <p>b – Number (before decimal point) Output without leading zeros!</p> <p>e – Number after decimal point</p> <p>factory settings are shown in bold letters</p> <p>* displayed value range: 0.00 ... ; validity range: 2.00 ...</p> |
| aMC! | atttn<CR><LF> and after 5 seconds a<CR><LF> | <p>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: a<value1><value2><value3><CRC><CR><LF> or a<value4><value5><CRC><CR><LF></p> |
| aC! | atttnn<CR><LF> | <p>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 = 05.</p> |
| aCC! | atttnn<CR><LF> | <p>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 = 05. The responses to the following aD0! and aD1! commands are extended by one CRC value: a<value1><value2><value3><CRC><CR><LF> or a<value4><value5><CRC><CR><LF></p> |
| aM1! | atttn<CR><LF> and immediately afterwards a<CR><LF> | <p>Query status of the last measurement</p> <p>a – Sensor address</p> <p>ttt – Time in seconds until the sensor provides the status Response: OTT PLS-C = 000</p> <p>n – Number of measured values Response: OTT PLS-C = 1</p> <p>a<CR><LF> – Service request</p> |
| aD0! | a<value><CR><LF> | <p>Send data (after aM1!, aMC1!, aC1!, aCC1!)</p> <p>a – Sensor address</p> <p><value> – Status of the last measurement +0 = No hardware fault occurred +128 = Correction table faulty +256 = Watchdog error +512 = Memory faulty +1024 = Pressure cell faulty +2048 = A/D converter faulty</p> |

| Command | Response | Description |
|---------|--|--|
| aMC1! | atttn<CR><LF> and immediately afterwards a<CR><LF> | Query the status of the last measurement and request CRC (Cyclic Redundancy Check). For details, see command aM!. The response to the following aD0! command is extended by one CRC value: a<value><CRC><CR><LF> |
| aC1! | atttnn<CR><LF> | Query the status of the last measurement in concurrent mode (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 = 01. |
| aCC1! | atttnn<CR><LF> | Query the status of the last measurement in concurrent mode (simultaneous measurement with multiple sensors on one single 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 = 01. The response to the following aD0! command is extended by one CRC value: a<value><CRC><CR><LF> |
| aV! | atttn<CR><LF> and immediately afterwards a<CR><LF> | Perform system test a – Sensor address ttt – Time in seconds until the sensor provides the result of the system test Response: OTT PLS-C = 000 n – Number of measured values Response: OTT PLS-C = 1 a<CR><LF> – Service request |
| aD0! | a<value><CR><LF> | Send data (after aV!) a – Sensor address <value> – Result of the system test +0 = No hardware fault occurred +128 = Correction table faulty +256 = Watchdog error +512 = Memory faulty +1024 = Pressure cell faulty +2048 = A/D converter faulty |

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).

6.2 Advanced SDI-12 commands

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

| Command | Response | Description |
|---|------------------|--|
| ▶ Set/read the unit for level/pressure measured values | | |
| aOSU<value>! | a<value><CR><LF> | Set unit |
| aOSU! | a<value><CR><LF> | Read unit |
| | | a – Sensor address |
| | | <value> – Units for level measurement |
| | | +0 = m; factory setting |
| | | +1 = cm |
| | | +2 = ft |
| | | Level measurement is carried out including compensation for water density, water temperature, and local gravitational acceleration. |
| | | Units for pressure measurement |
| | | +3 = mbar |
| | | +4 = bar |
| | | +5 = psi |
| | | Pressure is measured without compensation! |
| Please note: | | |
| When settings for the "Offset" or "Reference value" parameters have been made before changing the unit, these must be set again! There is no automatic conversion for the parameters set! | | |
| ▶ Set/read the unit for the temperature measured values | | |
| aOST<value>! | a<value><CR><LF> | Set unit |
| aOST! | a<value><CR><LF> | Read unit |
| | | a – Sensor address |
| | | <value> – +0 = °C; factory setting |
| | | +1 = °F |
| ▶ Set/read the unit for the conductivity | | |
| aOSL<value>! | a<value><CR><LF> | Set unit |
| aOSL! | a<value><CR><LF> | Read unit |
| | | a – Sensor address |
| | | <value> – +0 = mS; factory setting |
| | | +1 = µS |
| ▶ Set/read the type of temperature compensation (conductivity) | | |
| aOSC<value>! | a<value><CR><LF> | Set/read the type of temperature compensation |
| aOSC! | a<value><CR><LF> | Read the type of temperature compensation |
| | | a – Sensor address |
| | | <value> – +0 = For freshwater; factory setting |
| | | +1 = For saltwater |
| | | +2 = Acc. to standard method 2510; Reference temperature: 20 °C |
| | | +3 = Acc. to standard method 2510; Reference temperature: 25 °C |
| | | +4 = Acc. to ISO 7888/EN 27888 |
| | | +5 = no compensation |
| | | Mathematical algorithm on which the calculation of the specific conductivity at a defined reference temperature is based. For "standard method 2510", the reference temperature can be selected: 20 °C or 25 °C. |

| Command | Response | Description |
|--|-------------------|--|
| ▶ Set/read the unit for the salinity | | |
| aOSS<value>! | a<value><CR><LF> | Set unit |
| aOSS! | a<value><CR><LF> | Read unit |
| | | <p>a – Sensor address</p> <p><value> – +0 = PSU; factory setting +1 = ppt</p> <p>As the algorithm used for calculating the salinity, the standard method is permanently associated with the "PSU" unit and the "USGS 2311" method is permanently associated with the "ppt" unit.</p> <p>Validity of the algorithm, based on the temperature "t":</p> <ul style="list-style-type: none"> – Standard method (0.00* ... 42.00 PSU) 1.0 °C ≤ t ≤ 35.0 °C – "USGS 2311" method (0.00* ... 60.00 ppt) 0 °C ≤ t ≤ 30.0 °C <p>* displayed value range: 0.00 ... ; validity range: 2.00 ...</p> |
| ▶ Set/read TDS (Total Dissolved Solids) factor | | |
| aOSF<value>! | a<value><CR><LF> | Set TDS factor |
| aOSF! | a<value><CR><LF> | Read TDS factor |
| | | <p>a – Sensor address</p> <p><value> – pb.ee</p> <p>p – Sign (+)</p> <p>b – Number before decimal point</p> <p>e – Number after decimal point</p> <p>Value range: +0.40 ... +0.75</p> <p>Factory setting: +0.64</p> <p>The OTT PLS-C calculates the TDS value from the conductivity measured using the following equation: TDS [ppm] = 0.64 x electrical conductivity [mS/cm]. This equation is valid for a situation in which the measurement medium is affected by sea water. For special applications, you may change the factor in the equation.</p> |
| ▶ Read the cell constant (conductivity) | | |
| aOSK! | a<value><CR><LF> | Read cell constant |
| | | <p>a – Sensor address</p> <p><value> – pb.eeeee</p> <p>p – Sign (+)</p> <p>b – Number before decimal point</p> <p>e – Number after decimal point</p> <p>Value range: +0.30000 ... +0.60000</p> <p>For more information on the cell constant, refer to Chapter 7.2, "Calibrating the conductivity sensor".</p> |
| ▶ Calibrate the conductivity sensor | | |
| aOSA<value1>! | a<value2><CR><LF> | Calibrate the conductivity sensor |
| | | <p>a – Sensor address</p> <p><value1> – Value of the calibration solution in mS (e.g. +1.412) pb.eeee</p> <p><value2> – Newly calculated cell constant pb.eeeee</p> <p>p – Sign (+)</p> <p>b – Number before decimal point</p> |

Command **Response**

▶ Set/read local gravitational acceleration

aOXG<value>! **a<value><CR><LF>**
aOXG! **a<value><CR><LF>**

Description

e – Number after decimal point
 Value range cell constant: +0.30000 ... +0.60000

Please note:

Before calibrating, the **aM!**, **aD0!** and **aD1!** commands are required! Moreover, refer to Chapter 7.x

Set local gravitational acceleration

Read local gravitational acceleration

a – Sensor address

<value> – **pb.eeeee**

p – Sign (+)

b – Number before decimal point

e – Number after decimal point

Value range: 9.50000 ... 9.95000 m/s²

Factory setting = 9.80665 m/s²

The gravitational acceleration at the earth's surface varies between 9.78036 m/s² at the equator and 9.83208 m/s² at the poles. Also, it decreases by 0.003086 m/s² for each kilometer of elevation above sea level.

Formula for the local gravitational acceleration "g" in m/s²:

$$g = 9.780356(1 + 0.0052885 \sin^2 \alpha - 0.0000059 \sin^2 2\alpha) - 0.003086 h$$

α latitude; h = height above sea level in km

(Reference: Jursa, A.S., Ed., Handbook of Geophysics and the Space Environment, 4th ed., Air Force Geophysics Laboratory, 1985, pp. 14-17).

Example

Local gravitational acceleration in Kempten (Germany): At a height above sea level of 669 m and a latitude of 47.71°, a local gravitational acceleration of 9.80659 m/s² results.

Note

The OTT PLS.C is preset to an average value for Germany (Kassel). The measured value deviation caused by gravitational acceleration is ±3mm in Germany (Flensburg – Oberstdorf). This measurement error is compensated by inputting the local gravitational acceleration

▶ Set/read average water density

aOXR<value>! **a<value><CR><LF>**
aOXR! **a<value><CR><LF>**

Set medium water density

Read medium water density

a – Sensor address

<value> – **pb.eeeee**

p – Sign (+)

b – Number before decimal point

e – Number after decimal point

Value range: 0.50000 ... 2.00000 kg/dm³

Factory setting = 0.99997 kg/dm³ (at 3.98 °C)

Using this command, the actual density of the water at your station for level/depth measurement may be set. For example, this is useful for stations in brackish water.

| Command | Response | Description |
|---|------------------|---|
| ▶ Set/read dynamic density compensation | | |
| aOAD<value>! | a<value><CR><LF> | Set dynamic density compensation |
| aOAD! | a<value><CR><LF> | Read dynamic density compensation setting |
| | | a – Sensor address <value> – +0 = Dynamic density compensation disabled +1 = Dynamic density compensation enabled Factory setting = +0 (disabled) |
| ▶ Set/read depth measurement measuring mode | | |
| aOAA<value>! | a<value><CR><LF> | Set depth measurement measuring mode |
| aOAA! | a<value><CR><LF> | Read measuring mode |
| | | a – Sensor address <value> – +0 = Depth measurement measuring mode disabled +1 = Depth measurement measuring mode enabled Factory setting = +0 (disabled) |
| Please note: | | |
| When settings for the "Offset" or "Reference value" parameters have been made before changing the measuring mode, these must be set again! There is no automatic conversion for the parameters set! | | |
| ▶ Set/read level/depth measurement offset | | |
| aOAB<value>! | a<value><CR><LF> | Set offset value based on the last measured value |
| aOAB! | a<value><CR><LF> | Read offset value |
| | | a – Sensor address <value> – pbbbb.eee p – Sign (+,-) b – Number (before decimal point) e – Number after decimal point Input/output without leading zeros! Value range: -9999.999 ... +9999.999 Factory setting = +0.000 |
| | | Using this command, you can add a linear offset (positive/negative) to a level/depth measurement value. Before setting the offset, the aM! , aD0! and aD1! commands should be used to determine the current measured value! |
| Please note: | | |
| This command overwrites any reference value set! | | |
| Example | | |
| | | Measured value = +10.040 m |
| | | Offset = -0.200 m |
| | | Output = +9.840 m |
| Note | | |
| When changing the unit afterwards (aOSU<value>!), a rounding error of ±0.001 may occur. | | |

| Command | Response |
|--|------------------|
| ▶ Set/read level/depth reference value | |
| aOAC<value>! | a<value><CR><LF> |
| aOAC! | a<value><CR><LF> |

| | |
|---|-----------|
| ▶ Reset OTT PLS-C configuration to factory settings | |
| aOOR! | a<CR><LF> |

Description

Set reference value based on the last measured value
Read reference value

a – Sensor address
<value> – pbbbb.eee
p – Sign (+,-)
b – Number (before decimal point)
e – Number after decimal point

Input/output without leading zeros!
Value range: -9999.999 ... +9999.999
Factory setting = **+0.000**

Using this command, you can establish a reference to a level zero, for example, by entering a reference value for level/depth measurement. Before setting the offset, the **aM!**, **aD0!** and **aD1!** commands should be used to determine the current measured value!

Please note:

This command overwrites any offset value set.

Example

Measured value = +2.100 m

Reference value= +1.500 m

Output = +1.500 m

(offset that is calculated by the OTT PLS-C and applied to any other measured values = +0.600 m)

Note

When changing the unit afterwards (**aOSU<value>!**), a rounding error of ± 0.001 may occur.

Resets the following parameters of the OTT PLS-C configuration to factory settings:

- Sensor address
- Unit for level/pressure measured values
- Unit for the temperature measured values
- Unit for the conductivity
- Type of temperature compensation (conductivity)
- Unit for the salinity
- TDS (Total Dissolved Solids) factor
- Local gravitational acceleration
- Average water density
- Dynamic density compensation
- Depth measurement measuring mode
- Level/depth measurement offset
- Level/depth reference value.

a – Sensor address

7 Carrying out maintenance operations

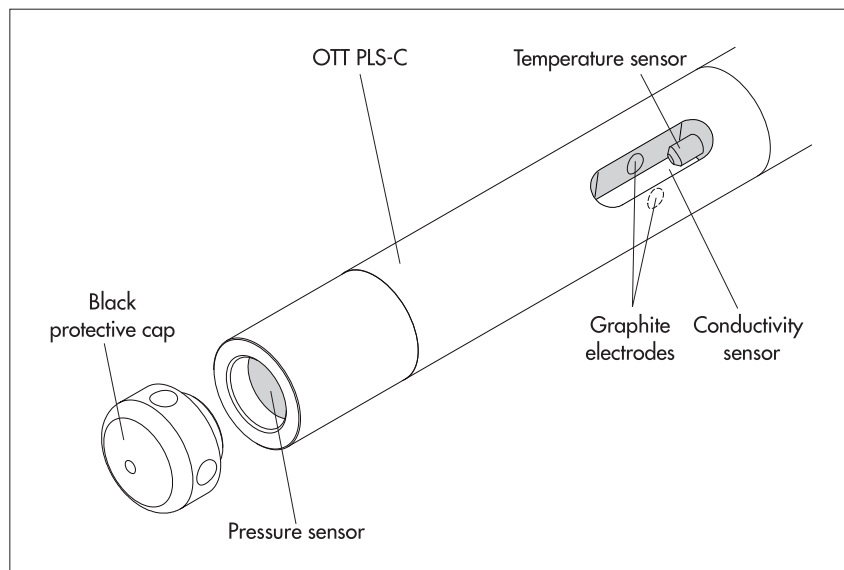
7.1 Cleaning the OTT PLS-C

Recommended interval: Every 12 months
In case of difficult local measuring conditions (heavy deposits): Every 4 to 6 months as necessary.
(Measurements that are inaccurate or not plausible indicate a contaminated pressure sensor.)

How to clean the OTT PLS-C

- Uninstall the OTT PLS-C (refer to Chapter 5).
- Remove the black protective cap.
- Clean the pressure sensor carefully using a brush and water.
Clean graphite electrodes and temperature sensors for the conductivity sensor with soapy water and cotton buds. Lime scale deposits can be removed using a common household scale remover. Make sure to follow the application and safety instructions for the scale remover!
- Reattach the black protective cap.
- Recommendation: Calibrate the conductivity sensor (refer to Chapter 7.1).
- Reinstall the OTT PLS-C (refer to Chapter 5).
- Determine the current level value (SDI-12 basic command "Start Measurement") and compare with reference value (staff gauge, contact gauge) and correct as necessary (position of the OTT PLS-C is not the same before and after calibrating procedure. Use scaling functionality of the datalogger attached to enter the reference/offset value or enter them directly).

Fig. 5: Cleaning the OTT PLS-C.



7.2 Calibrating the conductivity sensor

The goal of the calibration is to determine the so-called "cell constant" for the conductivity sensor. To obtain this value, a conductivity measurement using a standardized calibration solution must be performed.

Above all, the cell constant takes account of the aging process of the electrodes, in addition to the unchanging geometric dimensions, the materials used, and the design of the conductivity sensor.

Recommended interval: Every 12 months (after every cleaning)
in case of difficult local measuring conditions (heavy deposits): Every 4 to 6 months, as required.

Required accessories: – Standardized calibration solution,
– Calibration container.

Additionally, depending on the application:

- OTT USB/SDI-12 Interface interface converter including OTT SDI-12 Interface PC software.
- Connecting kit for temporarily connecting the OTT PLS-C and OTT USB/SDI-12 interface within the OTT FAD 5
- Power supply (6 ... 27 V) for OTT PLS-C (refer to Chapter 2, "Order numbers").

Please note:

- ▶ For an optimum calibration process, the OTT PLS-C and the calibration solution must be at ambient temperature!
- ▶ During the calibration procedure, power must continuously be applied to the OTT PLS-C.

How to calibrate the conductivity sensor

- Uninstall the OTT PLS-C (refer to Chapter 5).
- Thoroughly clean and dry well the OTT PLS-C (refer to Chapter 7.1).

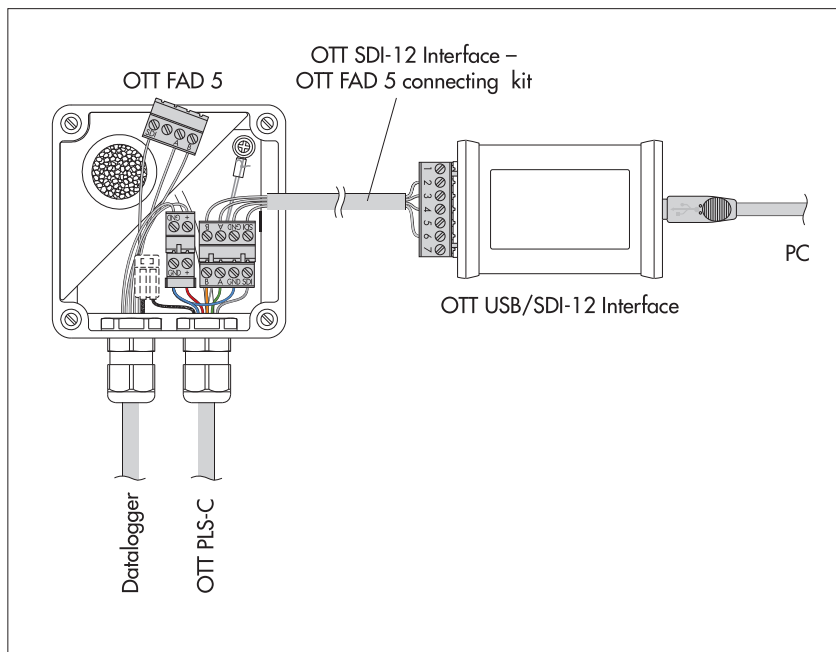
- continue, when using an OTT netDL:

- Establish the PC/OTT netDL communication link.
For detailed information, refer to the OTT netDL Operating Instructions.
- Use the "Tools" menu to start the OTT SDI-12 Interface software.
- Click on "USB Converter" (" Recording only" must be disabled).
- Click on "OK".
- Click on "Calibration".
- Click on "Start Calibration Process".
- Proceed with the calibration process as instructed by software.

- continue, when using any datalogger and the OTT SDI-12 Interface – OTT FAD 5 connecting kit:

- Open the OTT FAD 5 humidity absorber.
- Disconnect the 4-pin connector (screw terminals) within the humidity absorber. When the OTT PLS-C is continuously supplied with power (no switched power), the 2-pin connector may remain connected.
- Connect the connecting cable to the 4-pin connector in the humidity absorber and to the interface converter.
- Connect the interface converter to the PC using the USB cable.
- Start the OTT SDI-12 Interface software.
- Click on "USB Converter" (" Recording only" must be disabled).
- Click on "OK".
- Click on "Calibration".
- Click on "Start Calibration Process".
- Proceed with the calibration process as instructed by software.
- Reconnect the 4-pin connector within the humidity absorber.
- Check the desiccant cartridge (refer to Appendix B).
- Close the OTT FAD 5 humidity absorber.

Fig. 6: Temporarily connecting the OTT PLS-C to a PC using the "OTT SDI-12 Interface – OTT FAD 5 connecting kit" and "OTT USB/SDI-12 Interface".



- continue, when using any datalogger as well as the SDI-12 Transparent Mode

- Establish the datalogger/PC communication link.
For detailed information, refer to the datalogger Operating Instructions.
- Start the Transparent Mode.
- Check zero (conductivity) with "dry" probe using the **aM!** and **aD0** SDI-12 commands (refer to Chapter 6.1).
- Perform calibration procedure using the **aOSK...** and **aOST...** SDI-12 commands (refer to Chapter 6.2).

- continue, when working in laboratory environment

- Connect the OTT PLS-C to the interface converter. For detailed information, refer to the interface converter Operating Instructions.
 - Connect the OTT PLS-C to power supply.
 - Start the OTT SDI-12 Interface software.
 - Click on "USB Converter" (" Recording only" must be disabled).
 - Click on "OK".
 - Click on "Calibration".
 - Click on "Start Calibration Process".
 - Proceed with the calibration process as instructed by software.
- Thoroughly rinse the OTT PLS-C using clear water!
 - Reinstall the OTT PLS-C (refer to Chapters 5.1 and 5.2).
 - Determine the current level value (SDI-12 basic command "Start Measurement") and compare with reference value (staff gauge, contact gauge) and correct as necessary (position of the OTT PLS-C is not the same before and after calibrating procedure) (use scaling functionality of the datalogger attached to enter the reference/offset value or enter them directly).
 - Dispose of the used calibration solution!

Notes

- ▶ Use the calibration solution only once!
- ▶ Always store the calibration solution in a closed container! (The carbon dioxide in ambient air and evaporation may change the conductivity value.)
- ▶ Avoid water entering the calibration solution! Always dry the calibration container well after calibration.
- ▶ Calibration solution may be disposed of in the normal public sewer system!
- ▶ When using an OTT FAD 4PF unit, the interface converter must be temporarily connected via customized wiring.

8 Troubleshooting

Sensor does not respond to the SDI-12 interface

- ▶ Sensor correctly connected to a datalogger with SDI-12 input (master)?
 - Correct connection assignment.
- ▶ Polarity of the supply voltage reversed?
 - Correct connection assignment.
- ▶ Supply voltage <6 V or >27 V?
 - Adjust level of voltage supplied (check the length and cross-section of the connection cable).
- ▶ Is the supply voltage no direct current?
 - Operate sensor on direct current only.
- ▶ Does the sensor address of the OTT PLS-C match the sensor address that the datalogger uses?
 - Correct sensor address.

Measured values are fluctuating, incorrect, or not available

- ▶ Sensor contaminated?
 - Clean sensor carefully, refer to Chapter 7.1, "Cleaning the OTT PLS-C".
- ▶ Sensor installed in stable position (e.g. movement from swell)?
 - Optimize installation.
- ▶ Drops of water in pressure compensating capillary?
 - Replace the OTT PLS-C.
- ▶ Measured conductivity values incorrect
 - Check conductivity sensor for contamination. Clean as necessary and then recalibrate.

Status output at the SDI-12 interface

Refer to SDI-12 command **aM1** !

9 Repair

- In case of device malfunction, use Chapter 8, "Troubleshooting" to see if you can resolve the problem yourself.
- In case of device failure, please contact the OTT repair center:

OTT Hydromet GmbH
Repaircenter
Ludwigstrasse 16
87437 Kempten · Germany
Telephone +49 831 5617-433
Fax +49 831 5617-439
repair@ott.com

Please note: Have a faulty OTT PLS-C checked and repaired only by the OTT repair center. Never attempt to repair the unit yourself! Any repairs or attempted repairs carried out by the client will void any warranty.

10 Notes about the disposal of used 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.

- 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

- After having put the OTT PLS-C out of service, properly dispose of it.
- Observe any applicable local regulations for the disposal of electronic devices!
- Never put the OTT PLS-C into the normal household waste!

Materials used

Refer to Chapter 11 "Technical data".

11 Technical data

Water level

| | |
|--|--|
| Measuring range | 0 ... 4 m water column (0 ... 0.4 bar) 0 ... 10 m water column (0 ... 1 bar) 0 ... 20 m water column (0 ... 2 bar) 0 ... 40 m water column (0 ... 4 bar) 0 ... 100 m water column (0 ... 10 bar) |
| Resolution | 0.001 m; 0.1 cm; 0.01 ft; 0.001 bar; 0.1 mbar; 0.001 psi |
| Accuracy (linearity + hysteresis) | ≤ ±0.05 % full scale |
| Long-term stability (linearity + hysteresis) | ≤ ±0.1 %/a full scale |
| Zero drift | ≤ ±0.1 % full scale |
| Units | m, cm, ft, mbar, psi |
| Overload-resistant without permanent mechanical damage (pressure measuring cell) | |
| 0 ... 0.4 bar | 4 bar |
| 0 ... 1 bar | 10 bar |
| 0 ... 2 bar | 15 bar |
| 0 ... 4 bar | 25 bar |
| 0 ... 10 bar | 40 bar |
| Pressure measuring cell | ceramic, temperature-compensated |
| Temperature-compensated operating range | -5 °C ... +45 °C (ice free) |

Temperature

| | |
|--------------------|------------------------------|
| Measuring range | -25 °C ... +70 °C (ice free) |
| Calibrated range | +5 °C ... 45 °C |
| Resolution | 0.01 °C |
| Accuracy | ±0.1 °C |
| Units | °C, °F |
| Temperature sensor | NTC |

Conductivity

| | |
|-----------------------|---|
| Measuring ranges | 5 ... 2,000 µS/cm 0.10 ... 100.00 mS/cm |
| Calibrated range | +5 °C ... 45 °C |
| Resolution | |
| 5 ... 2,000 µS/cm | 1 µS/cm |
| 0.10 ... 100.00 mS/cm | 0.01 mS/cm |
| Accuracy | |
| 5 ... 2,000 µS/cm | ±0.5 % of measured value (at least ±1 µS/cm) |
| 0.10 ... 100.00 mS/cm | ±1.5 % of measured value (at least ±0.01 mS/cm) |
| Units | |
| 5 ... 2,000 µS/cm | µS/cm |
| 0.10 ... 100.00 mS/cm | mS/cm |
| Supply voltage | +6 ... +27 VDC, typically 12/24 VDC |
| Current consumption | |
| SDI-12 Sleep Mode | < 30 µA |
| SDI-12 Active Mode | < 32 mA |
| Interfaces | SDI-12 version 1.3 RS-485 (SDI-12 protocol) |
| Response times | |
| Heat-up time | max. 100 ms |
| Response time | <16 ms |
| Storage temperature | -40 °C ... +85 °C |

Individually configurable functions

- Selection of units
- Pressure/level measurement or depth measurement
- With consideration of the local gravitational acceleration
- Compensate for water density using salinity and temperature
- Temperature compensation for conductivity. Options: freshwater; saltwater; standard method 2510 (reference temperature: 25 °C or 20 °C); ISO 7888 / EN 27888; none
- Dynamic density compensation
- Salinity (standard method or USGS 2311)
- TDS factor

Mechanical data

Dimensions

| | |
|---|--|
| Pressure probe with conductivity sensor L x Ø | 317 mm x 22 mm |
| Cable length for variant with | |
| - SDI-12 interface | 1 ... 100 m |
| - RS-485 interface | 1 ... 200 m (if required extendable to 1000 m) |

Weight

| | |
|---|--------------------|
| Pressure probe with conductivity sensor | approx. 0.43 kg |
| Pressure probe cable | approx. 0.082 kg/m |

Material

| | |
|---|---|
| Housing pressure probe with conductivity sensor | POM, stainless steel 1.4539 (904 L), resistant to sea water |
| Cable jacket | PUR |
| Seals | Viton |
| Separating diaphragm | Ceramic Al ₂ O ₃ ; 96% |
| Degree of protection | IP 68 |

Performance classification

Acc. to DIN EN ISO 4373

| | |
|-------------------------|---------------------|
| Measurement uncertainty | Performance class 1 |
| Temperature range | Temperature class 2 |
| Relative air humidity | Class 1 |

EMC



Meets EC 2004/108/EC
Meets EN 61326-1:2013

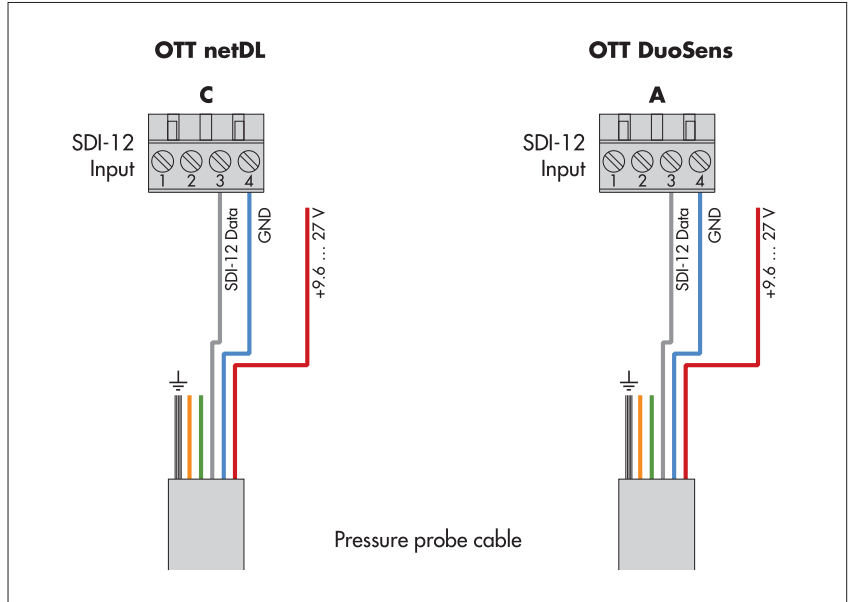
Appendix A – Connecting the OTT PLS-C to an OTT netDL or OTT DuoSens datalogger via SDI-12 or RS-485 interface

Method A: Connecting the OTT PLS-C via the SDI-12 interface (protocol and physical interface: SDI-12). The maximum cable length is 100 m.

- Connect the OTT PLS-C to the OTT netDL IP datalogger or to DuoSens compact datalogger as shown in Figure 7. Also refer to the OTT netDL or OTT DuoSens Operating Instructions.

Fig. 7: Connecting the OTT PLS-C to an OTT netDL or OTT DuoSens via SDI-12 interface.

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

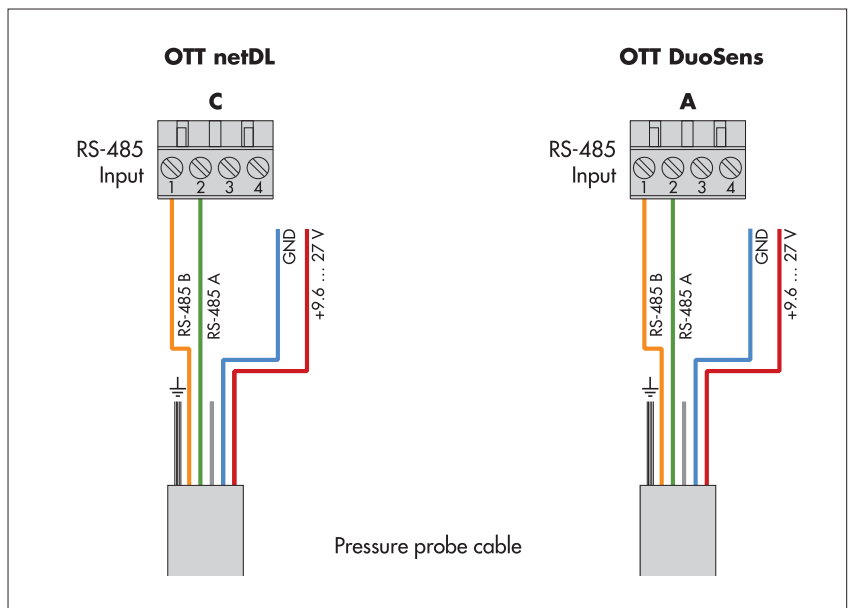


Method B: Connecting the OTT PLS-C using the physical RS-485 interface (SDI-12 protocol via physical RS-485 interface). The maximum cable length is 1,000 m.

- Connect the OTT PLS-C to the OTT netDL IP datalogger or to DuoSens compact datalogger as shown in Figure 8. Also refer to the OTT netDL or OTT DuoSens Operating Instructions.

Fig. 8: Connecting the OTT PLS-C to an OTT netDL or OTT DuoSens using an RS-485 interface (SDI-12 protocol).

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



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

- Create an OTT netDL/OTT DuoSens channel using the "SDI-12 Master" or "OTT SDI RS485" function block ("Serial Sensors" tab).
- Make the following settings:

Fig. 9: Setting the operating parameters of the OTT netDL/OTT DuoSens "SDI-12 Master" function block. The "OTT SDI RS485" function block is to be set in the same way.

- ▶ Terminal block
 - OTT netDL "OTT SDI RS485": C 1-2 (default)
 - OTT netDL "SDI-12 Master": C 3-4 (default)
 - OTT DuoSens SDI-12 Master: A 3-4 (default)
 - OTT DuoSens OTT SDI RS485: A 1-2 (default)
- ▶ Slave address

Terminal block (screw terminal strip) of the OTT netDL/OTT DuoSens to which the OTT PLS-C is connected. SDI-12 bus address. Each slave address may be assigned on an SDI-12 bus line only once. (Check/set: Use the "OTT SDI-12 Interface" tool of the operating program.)

Default setting: "0" (only one OTT PLS-C is connected to the terminal block with no bus operation).
- ▶ Value no.

Identifies which measured value the OTT PLS-C is recording on this channel.

 - In "M!" Measuring Mode: Water level = 1, temperature = 2, conductivity = 3, salinity = 4, or TDS = 5.
 - In "M1!" Measuring Mode: Status of the last measurement = 1.
- ▶ Measuring Mode
 - "M!" for the water level, temperature, conductivity, salinity, and TDS measured valued, or
 - "M1!" for the status of the last measurement.
- ▶ Concurrent Mode*

: Uses the Concurrent Measuring Mode (C!, C1!) instead of the SDI-12 default Measuring Mode (M!, M1!). This allows simultaneous measurement using multiple sensors connected to a bus line (the sensors respond to a measurement command without service request). The sensors must support version 1.2 or later of the SDI-12 Standard. For further information on the Concurrent Mode, please refer to the SDI-12-Standard (please visit www.sdi-12.org). This mode is helpful when multiple sensors are connected to one single bus line and a longer measuring time and the same query interval are used for the sensors.

* Only in combination with an OTT netDL.

- ▶ Instantaneous value* : Upon an instantaneous value request (via LCD display and jog shuttle), the OTT netDL sends a command to the OTT PLS-C to start a measurement. Until this measurement is complete, the LCD display uses to the last measured value (or the instantaneous value last displayed, whichever is the most recent). On the display, this is identified by an "s" to the right of the channel number (sensor number). After completing the measurement, the new measured value appears without additional identification.
: Shows the last measured value of the sensor (measured value of the last query interval) for an instantaneous value request. On the display, this is identified by an "s" to the right of the channel number (sensor number), also refer to the OTT netDL IP Datalogger Operating Instructions, Chapter 9.1). This setting is helpful for sensors for which a longer measuring period and shorter query interval is used.
- ▶ Value no./ Virtual Terminal ID Allocation of the additional measured values of the OTT PLS-C that are not recorded in this channel to the virtual terminals (for the "M1" Measuring Mode only).

* Only in combination with an OTT netDL.

- In the appropriate "Channel" function blocks, set the required units and number of decimal places (m: 3; cm: 0; ft: 2, mbar: 1; bar: 3, psi: 3; mS: 2; μ S: 0, PSU: 2, ppt: 2, g/l: 3; °C: 2, °F: 2; Status: 0).

Notes:

- ▶ To record the five measured values of an OTT PLS-C, five channels in the OTT netDL/ OTT DuoSens are therefore required. The first channel contains the function block "SDI-12 Master" or "OTT SDI RS485" as an input signal. Each of the other channels contains a "Virtual Sensor" function block (V02 to V05) as an input signal. Of course, only one single measured value may be re-recorded. In this case, no entry is required in the "Virtual terminal no." box ("---"). When the status of the last measurement is to be recorded as well, an additional channel including the "SDI-12 Master" or "OTT SDI RS485" function block and the "M1!" Measuring Mode are required.
- ▶ Further information on the SDI-12 commands and responses used can be found in Chapter 6, "SDI-12 commands and responses".
- ▶ The OTT PLS-C provides the measurement result for retrieval 5 seconds after the SDI-12 command "M!".
- ▶ Note the maximum value range of the OTT netDL/OTT DuoSens! These dataloggers have a value range of maximum ± 32750 (alternatively: 0 ... +65500). When the "Depth" Measuring Mode is used and/or an offset/reference value is set, the OTT PLS-C provides measured values that may exceed this value range.

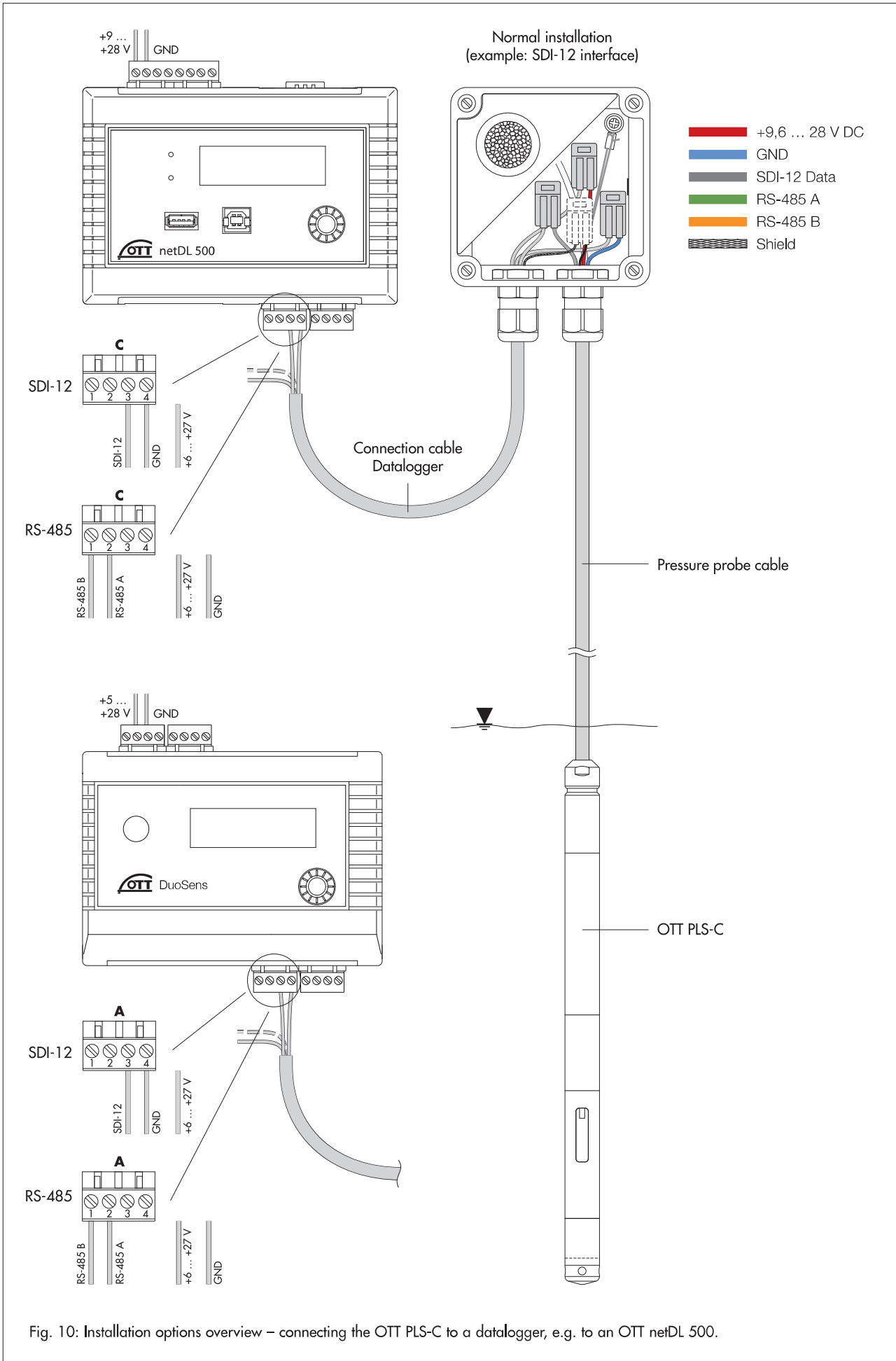


Fig. 10: Installation options overview – connecting the OTT PLS-C to a datalogger, e.g. to an OTT netDL 500.

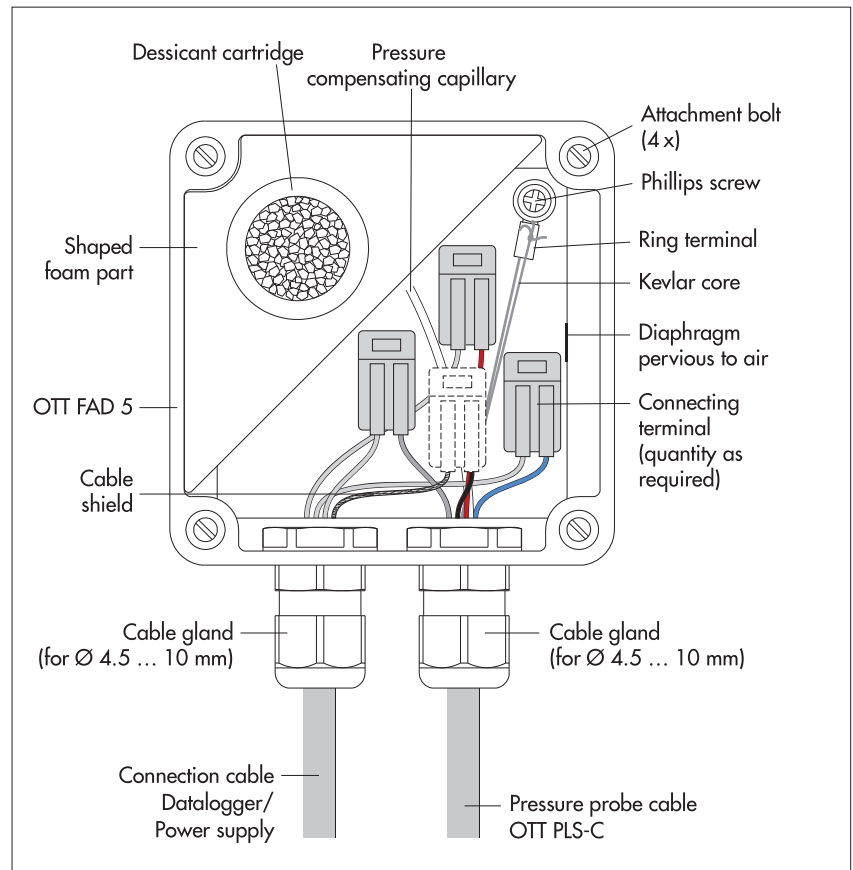
Appendix B – Installing the OTT FAD 5 humidity absorber

The OTT FAD 5 humidity absorber as an accessory to the OTT PLS-C fulfills multiple functions:

- ▶ Drying the air that has entered the pressure compensating capillary;
- ▶ Connecting the pressure probe cable with a connection cable to the datalogger/power supply via several two-wire terminals;
- ▶ For short pressure probe cables (< 5 m): It may be used as a fixing point for suspending the OTT PLS-C.

Fig. 11: Installing the OTT FAD 5 humidity absorber: Normal installation using an OTT netDL IP datalogger.

The cable shield may be optionally continued.
(Housing lid removed.)



Requirements for the installation location

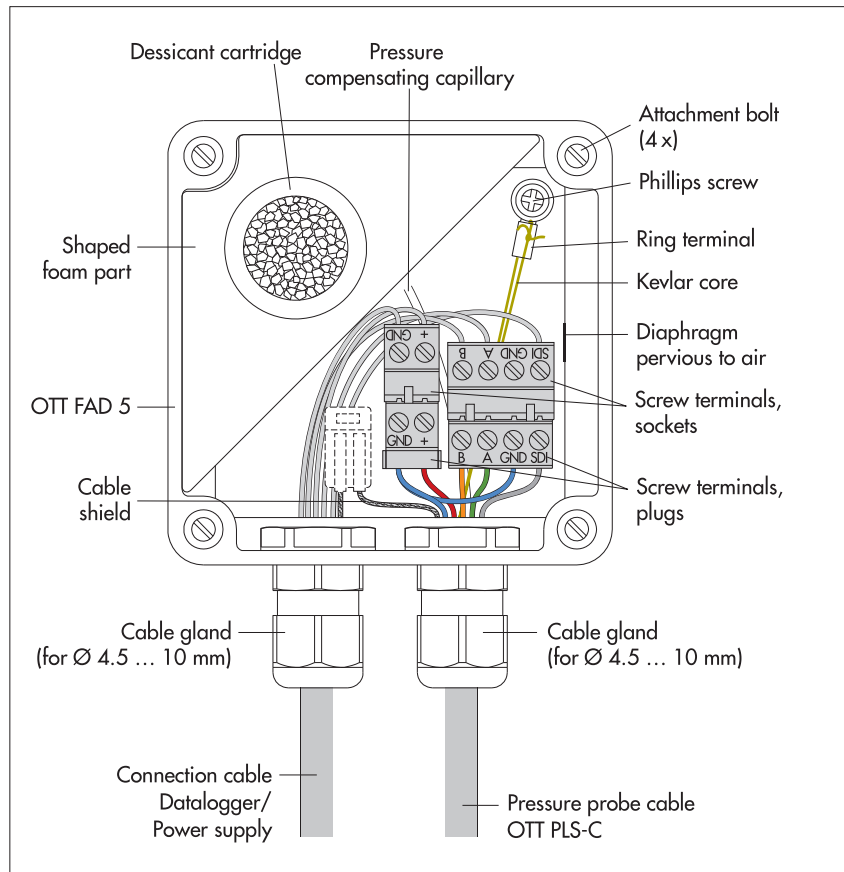
- ▶ The installation location must be protected from humidity as much as possible.
- ▶ When the installation location is in a control cabinet: There must be a pressure compensation into the surroundings (no hermetically sealed enclosure)!
- ▶ The only allowable installation position is shown in Figure 11.
- ▶ OTT FAD 5 to be used as a fixing point: Attach the humidity absorber above the station so that the OTT PLS-C is suspended freely (OTT PLS-C cable length < 5 m).

How to attach the OTT FAD 5:

- Unscrew the four captive screws on the housing lid and remove it.
- Secure the humidity absorber to a solid surface using four screws. Hole spacing: 79 mm. (select the screws according to the surface: e.g. wood screws with plugs, machine screws with nuts, Ø 4 mm.)

Fig. 12: Installing the OTT FAD 5 humidity absorber: Special case when using the "OTT SDI-12 Interface – OTT FAD 5 connecting kit".

The cable shield may be optionally continued.
(Housing lid removed.)



How to connect the cables to the FAD 5:

Please note:

- ▶ Remove the shipping protection for the pressure probe cable immediately before connecting!
- ▶ Do not damage the pressure compensating capillary, do not plug it, and protect it from contamination and humidity!
- Feed the pressure probe cable through a cable gland of the OTT FAD 5.
- Only when the OTT FAD 5 is used as the fixing point for suspending the OTT PLS-C: Secure the ring terminal using the Phillips screw supplied and put the pressure probe cable under tension.
- Firmly tighten the cable gland by hand.
- Remove approx. 80 ... 100 mm of the insulation of the datalogger connection/ power supply cable.
- Feed the connection cable through the second cable gland on the OTT FAD 5 unit and firmly tighten the cable gland by hand.

- Connect the respective wires of both cables to each other:
 - Normal installation ¹⁾: To do this, completely open the terminals (raise orange lever by approx. 90°), insert wires with 10 mm insulation removed, close lever. Size range 0.08 ... 2.5 mm². Fine-wired conductors do not require ferrules.
 - Special case when using the "OTT SDI-12 Interface – OTT FAD 5 connecting kit" ²⁾: Connect the wires to the plug-in screw terminals as shown in Figure 12. The jumper between the 2-wire and 4-wire screw terminals is already factory-installed.

For wire assignment, see sticker on the housing lid of the OTT FAD 5.

¹⁾ Connection to the dataloggers OTT netDL or OTT DuoSens by using the 2-wire terminals (included in the OTT FAD 5 scope of delivery)

²⁾ Connection to dataloggers of third-party manufacturers by using the „OTT SDI-12 Interface – OTT FAD 5 connecting kit “. In combination with the „OTT USB/SDI-12 Interface“ this enables easy commissioning and calibration of the conductivity sensor.

How to insert and check the desiccant cartridge:

- Insert the desiccant cartridge into the shaped foam part. The colored indicator must be orange (desiccant cartridge is dry and able to absorb humidity)!
- Immediately replace the housing lid and secure using the four captive screws.
- Check the color of the colored indicator at regular intervals.
The intervals are heavily dependent on the atmospheric humidity present.
Recommendation: After initial installation, check at monthly intervals. Afterwards, the intervals can be adapted to the local conditions. Take seasonal climate changes into account.
- Follow the directions on the slip enclosed with the desiccant cartridge to regenerate the desiccant cartridge.

Information on the functional principle of the desiccant cartridges:

The air entering the humidity absorber through an air-permeable diaphragm in the side wall of the OTT FAD 5 is dried by the desiccant cartridge. This prevents humid air from entering the pressure compensating capillary as a result of temperature and air variations. Humidity could block the pressure compensating capillary due to the formation of condensation and lead to inaccurate measurement results.

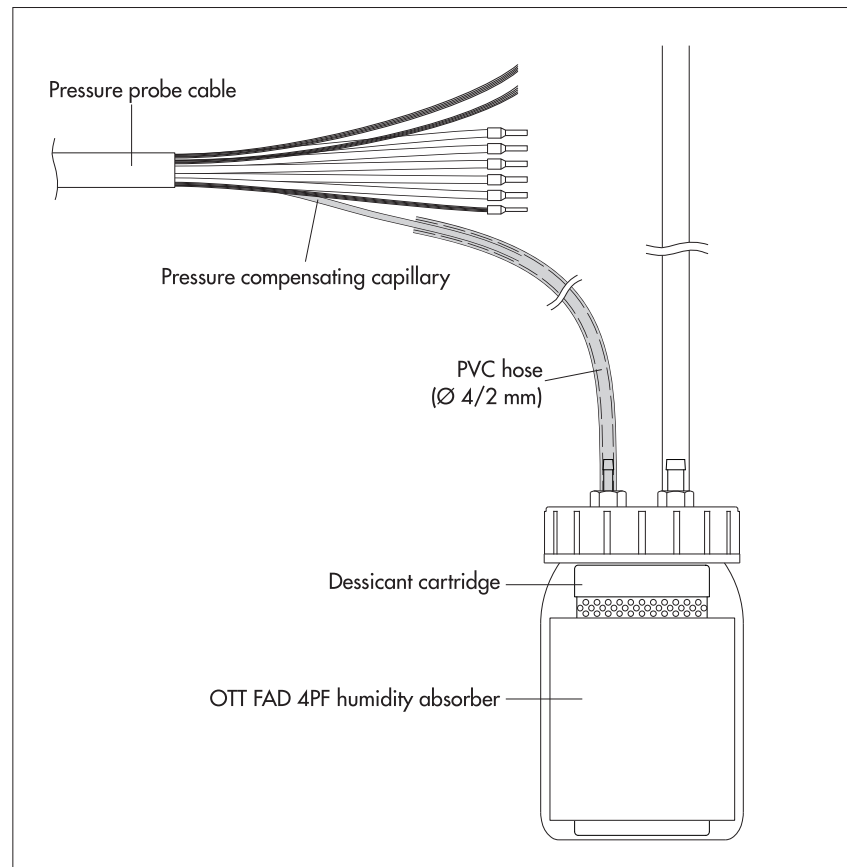
The desiccant cartridge contains silica gel with a colored indicator. It extracts water from the surrounding air and is therefore used for drying air that is contained in a device. Due to the colored indicator, the silica gel is orange when dry and white when wet. Once the silica gel has become white, it can no longer keep the air dry and must be exchanged for a desiccant cartridge with orange silica gel.

Appendix C – Installing the OTT FAD 4PF humidity absorber

The OTT FAD 4PF humidity absorber dries the surrounding air that enters the pressure compensating capillary.

- Mount the humidity absorber at the driest position possible (e.g. using double-sided tape). If this is in a control cabinet, it is important that there is pressure compensation to the surroundings (no hermetically sealed enclosure!).
- Insert the pressure compensating capillary at least 5 cm into the PVC tube of the humidity absorber as shown in Figure 13.

Fig. 13: Installing the OTT FAD4 PF humidity absorber.



- Check the color of the colored indicator at regular intervals. The intervals are heavily dependent on the atmospheric humidity present. Recommendation: After initial installation, check at monthly intervals. Afterwards, the intervals can be adapted to the local conditions. Take seasonal climate changes into account.
- Please note the instruction leaflet supplied with the OTT FAD 4PF for regenerating the desiccant cartridge.



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