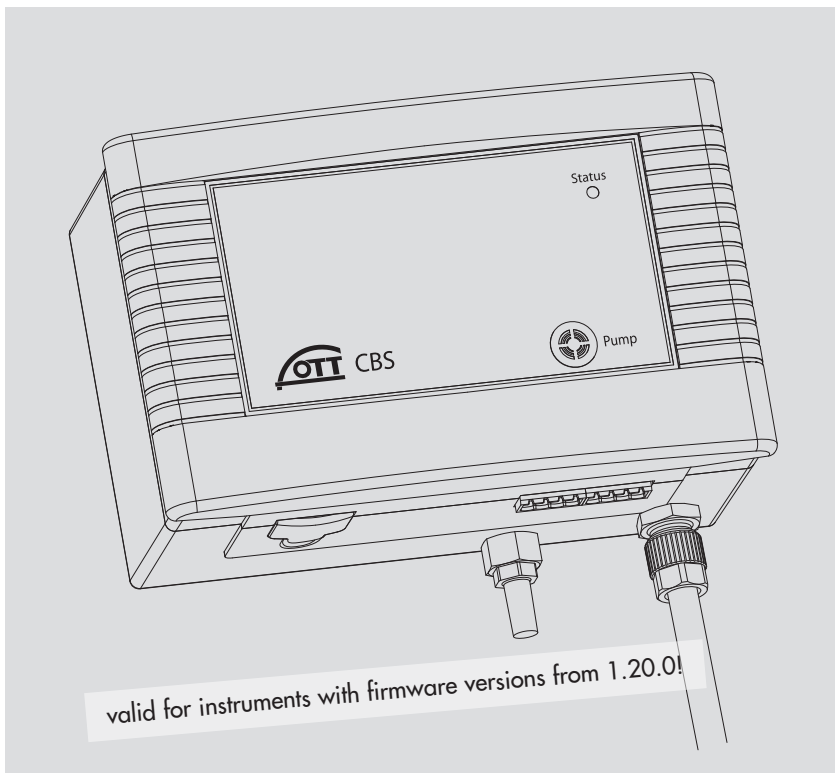


Operating instructions

Bubble Sensor **OTT CBS**



English

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

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1 Scope of supply

- ▶ **OTT CBS**
 - 1 Bubble Sensor OTT CBS with possibility for connecting measuring tubes with 4 mm/2 mm external/internal diameter
 - 1 Installation kit (top hat rail with fastening parts; screw terminal blocks, pin jumpers)
 - 1 Operating Instructions
 - 1 Factory acceptance test (FAT) certificate

2 Order numbers

▶ OTT CBS	Bubble Sensor OTT CBS	63.200.001.9.2
▶ Accessories	Measuring tube 4 mm/2 mm external/internal diameter; transparent PE	
	- 50 m	99.420.050.9.5
	- 100 m	99.420.100.9.5
	Combined measuring tube/ bubble chamber suspension cable black, with kevlar core for length stabilization, measuring tube with 4 mm/2 mm external/internal diameter; transparent PE	
	- 50 m	99.420.009.9.5
	- 100 m	99.420.008.9.5
	Measuring tube 6 mm/4 mm with sheathing Length as requested	20.500.133.5.5
	Measuring tube 6 mm/4 mm without sheathing Length as requested	20.500.302.5.5
	Bubble chamber suspension cable black, with Kevlar core for length stabilization	
	- 50 m	99.000.050.9.5
	- 100 m	99.000.100.9.5
	Bubble chamber for ground water - for observation wells beginning at 2" diameter, 670 gram	55.510.051.4.2
	Bubble Pot EPS 50 for surface water	
	- hose connector 4 mm/2 mm	55.510.048.3.2
	- hose connector 6 mm/4 mm	55.510.049.3.2
	Straight pipe fitting - for connecting measuring tubes with 1/8" internal diameter and 3/8" external diameter	63.200.025.9.2

3 Introduction

The OTT CBS, working on the air bubble principle, can be used for measuring ground water or water levels depending on the bubble chamber used.

To meet the various demands of the station, three different versions of the OTT CBS bubble sensor are available:

"Standard" version:

- ▶ Measuring range 0 ... 15 m or 0 ... 1500 mbar
- ▶ Resolution 1 mm or 0.1 mbar
- ▶ Accuracy ± 5 mm

"USGS specification" version:

- ▶ Measuring range 0 ... 15 m or 0 ... 1500 mbar
- ▶ Resolution 1 mm or 0.1 mbar
- ▶ Accuracy measuring range 0 ... 15 ft: ± 0.01 ft
measuring range 15 ... 50 ft: ± 0.065 % of measured value or ± 0.02 ft, whichever is less

"30 m measuring range" version:

- ▶ Measuring range 0 ... 30 m or 0 ... 3000 mbar
- ▶ Resolution 1 mm or 0.1 mbar
- ▶ Accuracy ± 5 mm

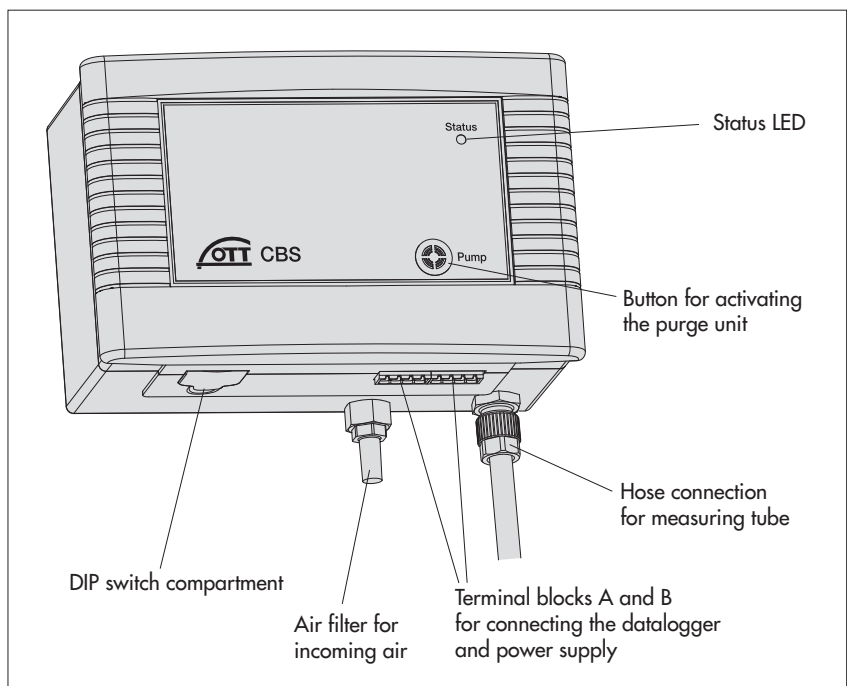
The compressed air produced by a piston pump flows via a measuring tube and the bubble chamber into the water to be measured. The pressure created in the measuring tube is directly proportional to the water column above the bubble chamber. The OTT CBS determines the barometric air and bubble pressure one after the other. By taking the difference between the two signals, the OTT CBS calculates the height of the water level above the bubble chamber.

The power supply can be provided from a mains adapter, battery or solar power.

The OTT CBS contains a purge function. This clears the measuring tube and the bubble chamber of any minor contamination by pumping a large volume of air into the measuring tube.

By using an intelligent pump strategy, no air drying unit is necessary for the measuring range of 0 ... 15 m.

Fig. 1: Overview of OTT CBS.



For the display of any error states that may occur, the OTT CBS has a "Status" LED (see Fig. 1).

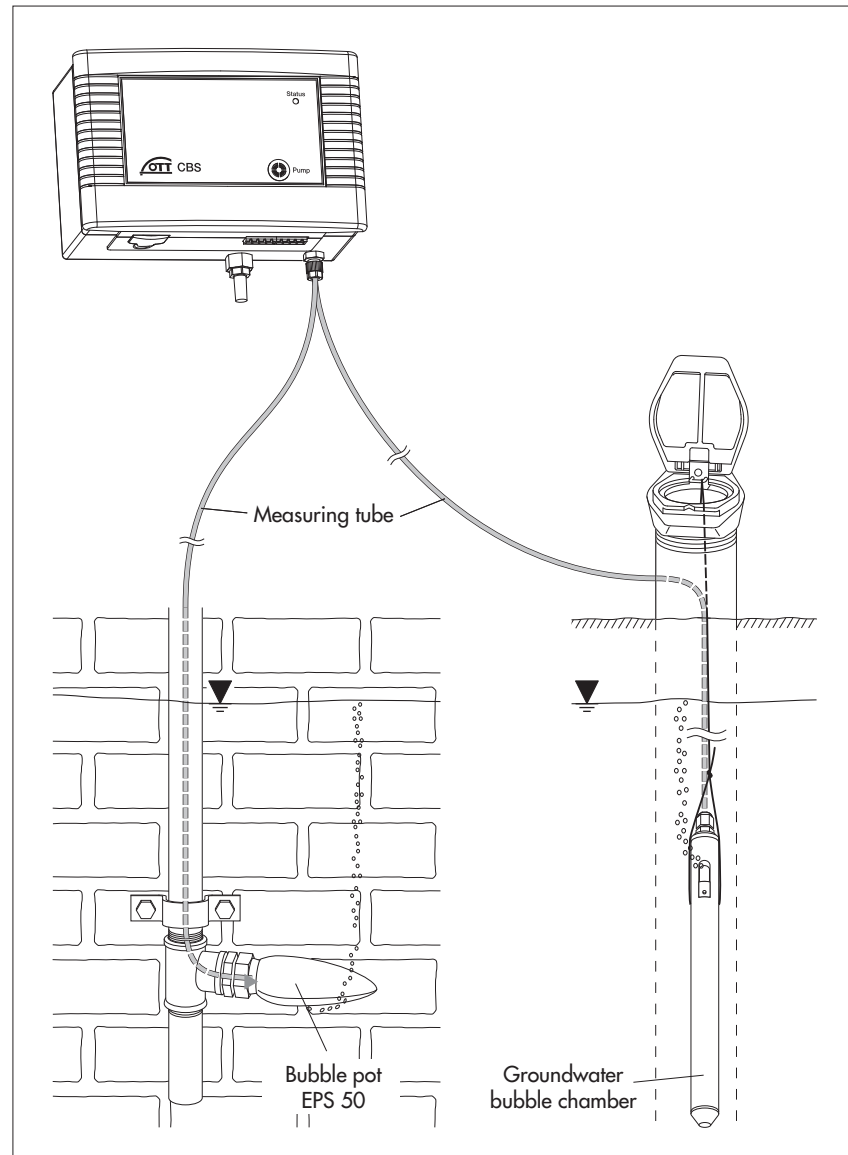
Connection to a data logger can be established via a choice of

- ▶ SDI-12,
- ▶ RS-485 (2-wire; SDI-12- / Modbus protocol) or
- ▶ 4 ... 20 mA (current loop)

interface.

An additional service interface with eight-position DIP switch can be used to adjust various operating parameters.

Fig. 2: The main layout of a level station with OTT CBS bubble sensor.



4 Installing OTT CBS



4.1 Preparing the OTT CBS for installation

- If required and not yet completed: Adjust operating parameters using service interface (see chapter 8).

4.2 Fastening OTT CBS

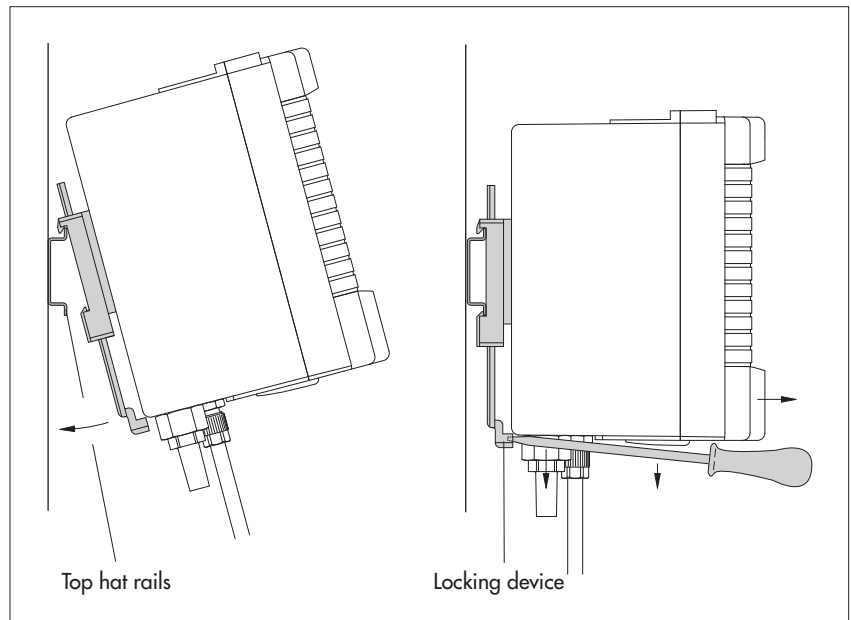
The OTT CBS is designed only to be installed on top hat rails (a section of top hat rail is supplied with the OTT CBS). Choose a dry and dust free location for the installation such as a gage station or control cabinet.

- First attach the OTT CBS on the upper edge of the top hat rail and then press the underside against the top hat rail until it clicks into place.

Demounting OTT CBS

- First press one locking device downwards and pull the OTT CBS slightly forwards at this point. Press the second locking device downwards and remove the OTT CBS upwards from the top hat rail.

Fig. 3: Fastening the CBS on the top hat rail (left)/demounting (right).



4.3 Connecting measuring tube to OTT CBS

To install the measuring tube on the OTT CBS, proceed as follows:

Measuring tube with 2 mm internal diameter

- Cut off the end of the measuring tube square with a sharp knife and push onto the factory fitted connection nipple.

Maximum length of the measuring tube: 100 m.

Measuring tube with 4 mm internal diameter

- Cut off the end of the measuring tube square with a sharp knife.
- Remove cap nut (width across flats: 10) and pull off the (short) factory mounted measuring tube from the connection nozzle.
- Push cap nut over the measuring tube (\varnothing 4 mm).
- Push measuring tube onto the connection nozzle.
- Push the cap nut back onto the connection nozzle and tighten by hand.

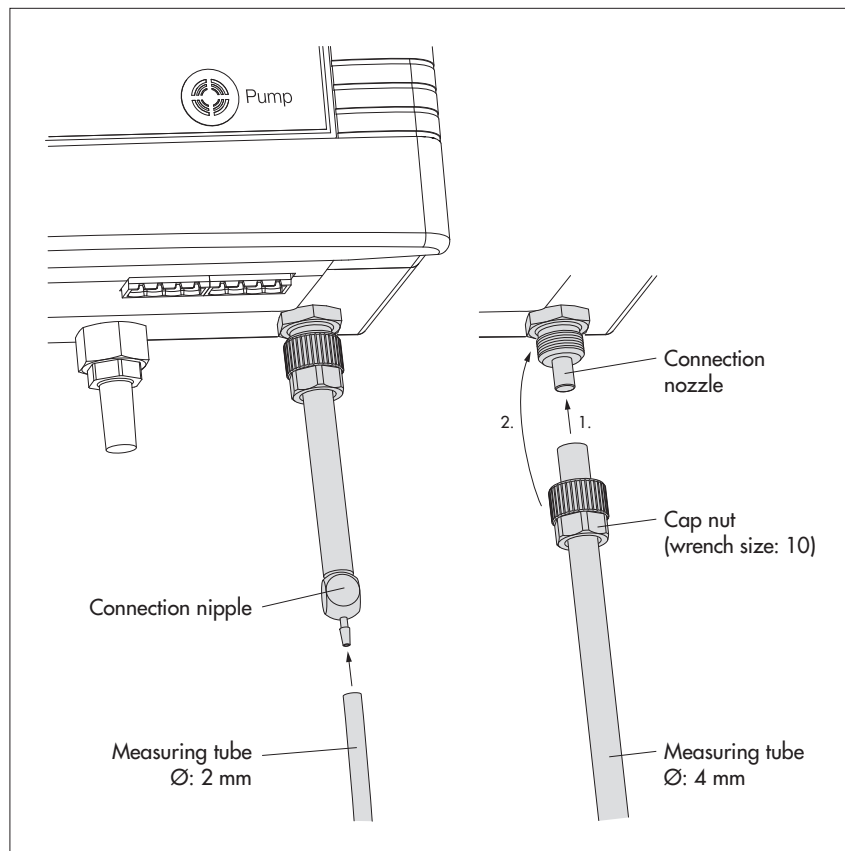
Maximum length of the measuring tube: 75 m.

Measuring tube with 1/8" internal diameter

A special pipe fitting for the 1/8" internal diameter measuring tube is available (accessory). Please follow the instructions delivered with the pipe fitting for installing the pipe.

Maximum length of the measuring tube: 100 m.

Fig. 4: Connecting measuring tube on OTT CBS.

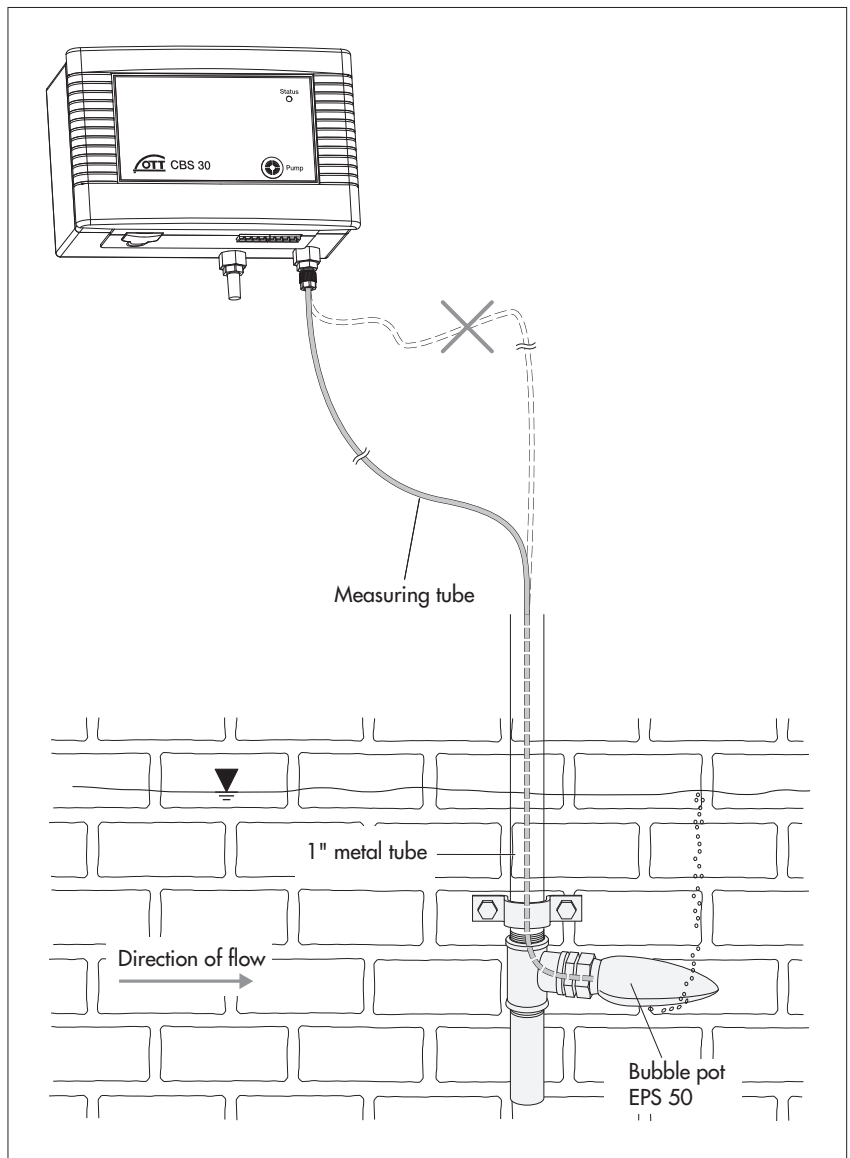


5 Installing bubble chamber

Please ensure the following points are noted during installation:

- ▶ No contamination or moisture may be allowed into the measuring tube.
- ▶ When immersing the bubble chamber (only EPS 50), the OTT CBS must be activated, so that the piston pump is operating during this process.
- ▶ Do not damage or kink the measuring tube during installation.
- ▶ Lay the measuring tube such that there is a continuous drop from the OTT CBS towards the bubble chamber. Otherwise moisture could collect in a "hollow" and potentially block the tube with the formation of drops (see Fig. 5)

Fig. 5: Routing requirements for measuring tube.



5.1 Installing bubble chamber for surface water

We recommend using the Bubble Pot EPS 50 for measurements in surface waters. See "Bubble Pot EPS 50" installation instructions for information on its installation.

5.2 Installing bubble chamber for ground water

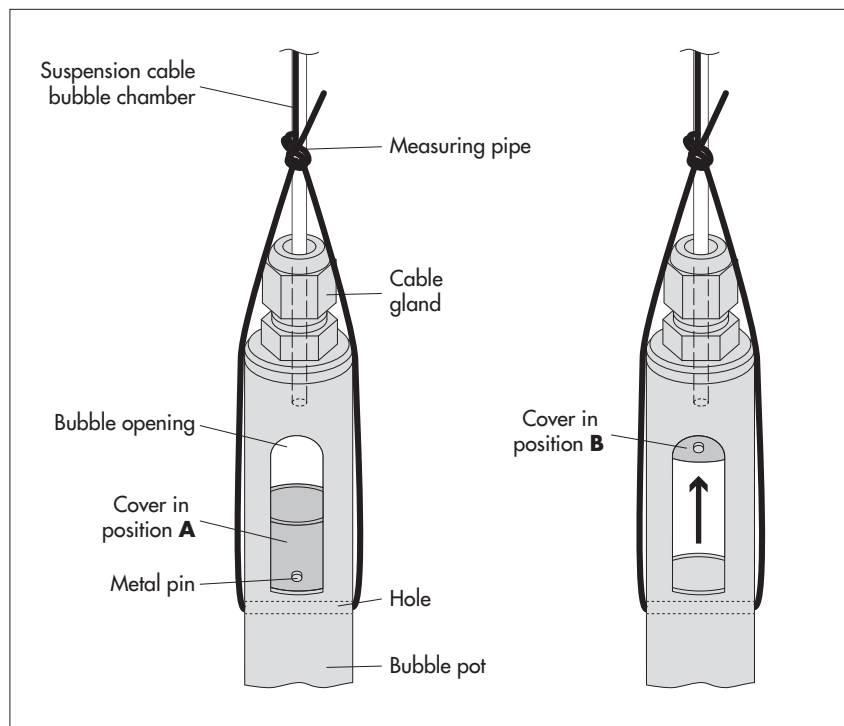
To install the bubble chamber for ground water, proceed as follows:

- Determine depth of the bubble chamber (e.g. using a contact gauge). The bubble chamber must be positioned under the lowest expected water level.
Depth = distance from bubble opening to upper edge of the top cap
- Push the measuring tube into the cable gland of the bubble chamber as far as it goes.
- Tighten the cable gland firmly by hand
- Cut suspension cable to length; **suspension cable length = depth + 125 cm** (to protect the suspension cable from being twisted off, it can be melted, with a cigarette lighter for example).
- Feed the suspension cable through the hole in the bubble chamber as shown in figure 6 and tie firmly.
- Slide cover into position B (upwards), see Fig. 6.

Fig. 6: Installing bubble chamber for ground water.

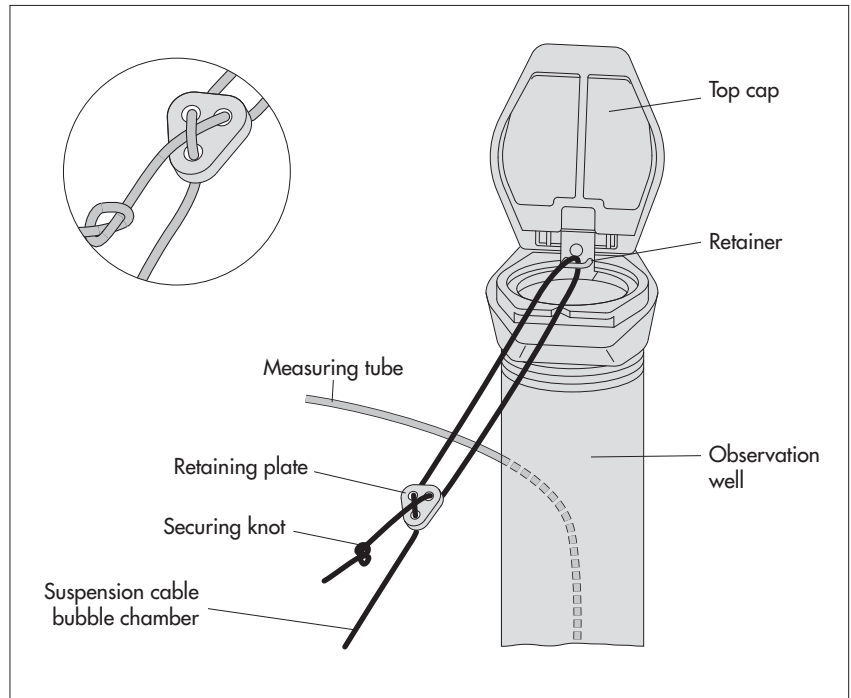
When lowering the bubble chamber, the cover must be in position B! The cover prevents water entering the measuring tube during installation.

During initial startup, over pressure builds up in the measuring tube. As a result, the cover falls back to position A and opens the measuring tube in the process.



- As shown in Fig. 7, attach the suspension cable of the bubble chamber to the retainer on an OTT top cap already mounted. The retaining plate allows a fine height adjustment afterwards.
- Secure the suspension cable against slipping with a knot.
- If top caps without retainers are used, ensure the suspension cable is attached securely.
- Check all knots and attachments for correct position and firmness.
- Lower the bubble chamber slowly into the observation well with the suspension cable.
- Feed the measuring tube out of the observation well through a hole.

Fig. 7: Installing bubble chamber for ground water – attaching suspension cable.



6 Connecting OTT CBS

The OTT CBS has the following interfaces

- ▶ SDI-12
- ▶ RS-485, (2-wire; SDI-12 /Modbus protocol)
- ▶ 4 ... 20 mA (current loop)

as well as a

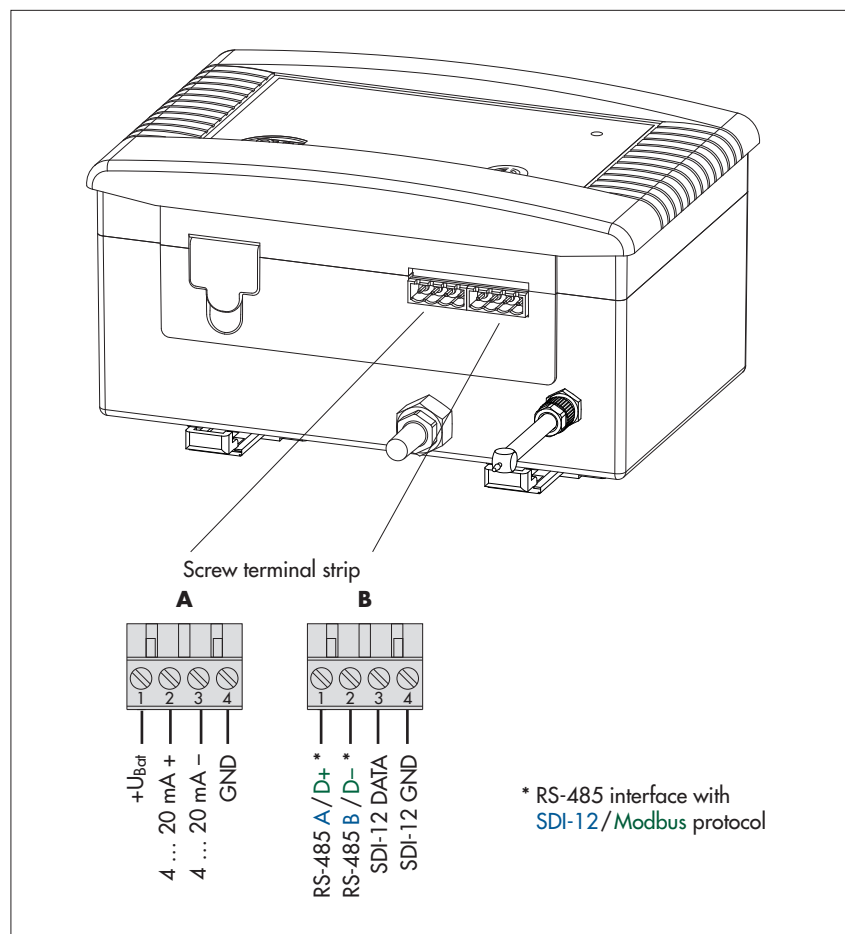
- ▶ connection for the power supply ($U_{Bat} + GND$).

The three interfaces make it possible to connect the OTT CBS both to OTT data loggers and to any data logger by another manufacturer that has the correct interfaces. Note that only one of the interfaces at a time can be used (no parallel operation of interfaces).

The SDI-12 interface meets SDI-12 Standard 1.4.

All electrical connections are made using two screw terminal strips (supplied) at terminal blocks A and B on the underside of the OTT CBS.

Fig. 8: Assignments for the screw terminal strips A and B of the OTT CBS.



6.1 Connect power supply

The OTT CBS requires a power supply of 10 ... 30 V DC, typ. 12/24 V DC (e.g. using batteries or mains connection with galvanically separated low safety voltage).

Please note the following points when dimensioning the power supply:

- ▶ Maximum power consumption per day: 3700 mAh (typ. 320 mAh/day) (with 1 min measurement interval and 100 m measuring tube using the 4 ... 20 mA interface)
- ▶ Peak current consumption: temporary max. 2 A
- ▶ Protect the supply voltage with a microfuse (e.g. 2.5 A, slow-blow)!
- ▶ When using solar panels, we recommend the use of an overvoltage protection device.

To supply the OTT CBS with power, proceed as follows:

- Connect the power supply to screw terminal strip A of the OTT CBS as shown in Fig. 8.

Notes

- ▶ The OTT CBS does not have a switch for switching the unit on and off. As soon as power is supplied, the OTT CBS is ready for operation.
- ▶ Each time the power supply is attached, the piston pump operates for approx. 400 strokes (approx. 5 minutes running time).

6.2 Connecting the OTT CBS to any data logger using the SDI-12 interface

- Connect the OTT CBS to an SDI-12 input of the external data logger. Follow the data logger handbook as you do this. See Fig. 8 for the assignments. The maximum cable length is 100 m*!

* OTT CBS connected to the data logger; no bus operation; otherwise 70 m

6.3 Connecting the OTT CBS to any data logger using the RS-485 interface (SDI-12 / Modbus protocol)

- Connect the OTT CBS to an RS-485 input (SDI-12 or Modbus protocol) on the external data logger. Refer to the data logger manual for more details. The connection assignment can be found in Figure 8. The maximum cable length is
 - SDI-12 protocol: 1000 m
 - Modbus protocol: 100 m

6.4 Connecting the OTT CBS to any data logger using the 4 ... 20 mA interface

- Connect the OTT CBS to a 4 ... 20 mA input of the external data logger. Follow the data logger handbook as you do this as well as chapter 6.5 of these instructions). See Fig. 8 for the assignments.
Maximum cable length: Dependent on the level of supply voltage and the load impedance (load resistance). Make sure that the ohmic resistance of the connecting cable added to any load impedance does not exceed the maximum permitted load resistance (see chapter 6.5 for details). In any case, the upper limit for the cable length is 1000 m.
- With depth measurement: ensure that DIP switch 4 is set to "ON".

6.5 Determining the maximum load resistance at the 4 ... 20 mA interface

The load resistance connected to the OTT CBS (load impedance + ohmic resistance of connecting cable) must not exceed a specific maximum value. This value depends on the level of the supply voltage of the OTT CBS. If the load resistance is greater, the loop current* can no longer be evaluated. Smaller load resistances are allowed.

* Current at 4 ... 20 mA interface fed in (controlled) by OTT CBS ($\hat{=}$ measured value)

- Read off the maximum load resistance for your power supply from the following diagram. Alternatively, you can calculate the maximum load resistance using the following formula:

$$R_{\text{Load (max)}} = (U_{\text{supply}} - 7.75 \text{ V}) / 0.02275 \text{ A}$$

Example: Power supply 18 Volt \rightarrow max. load resistance 450 Ohm.

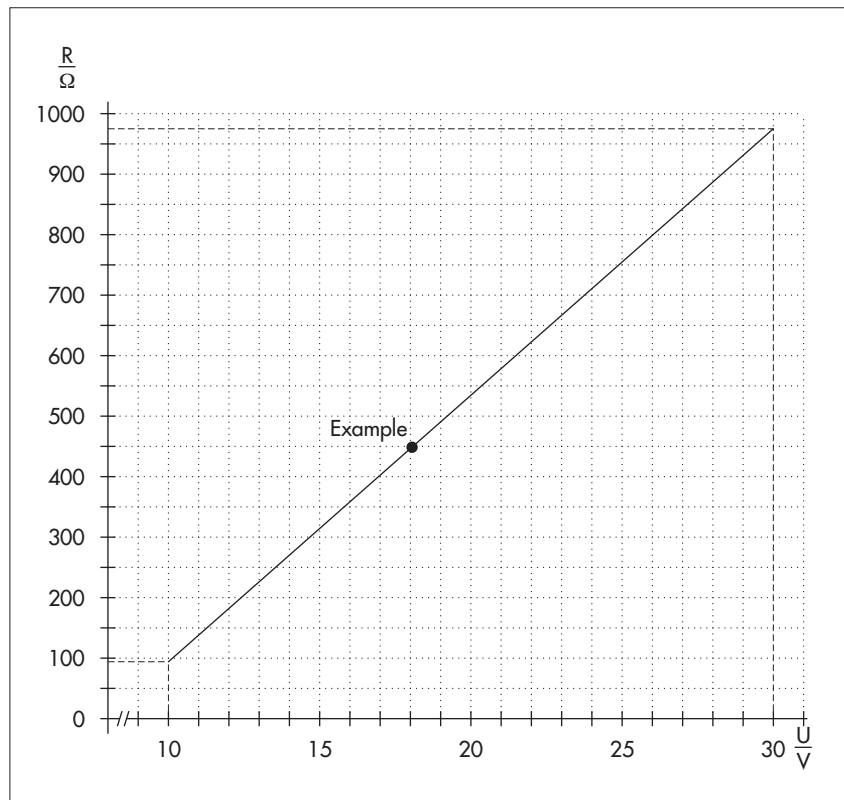
The OTT CBS delivers a loop current corresponding to the measured value for a load resistance of up to 450 Ohm.

- Dimension the connected electrical circuit accordingly. Check the input resistance of the connected peripheral device for this purpose.

Fig. 9: Diagram to determine the maximum load resistance as a function of the power supply.

Minimum power supply: 10 V
Maximum power supply: 30 V

Resistor tolerance: 0.1 %/15 ppm.

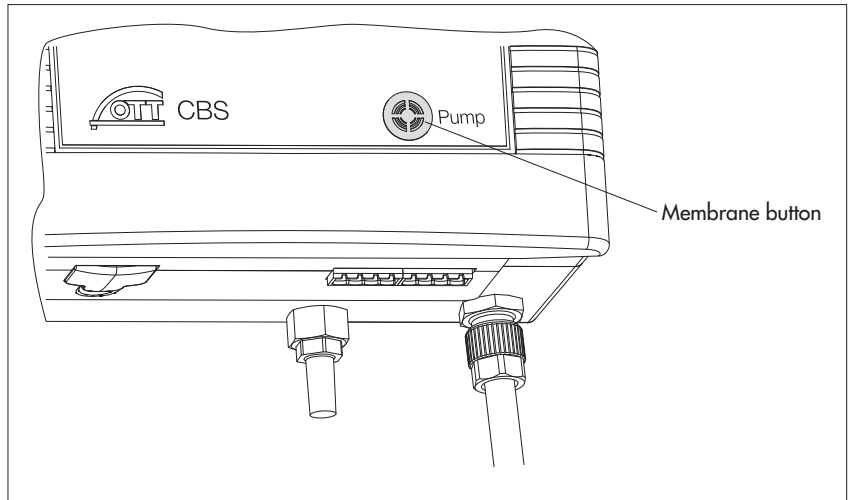


7 Activating the purge function

On the front of the OTT CBS there is a "Pump" membrane button (see Fig. 10). Pressing the button activates the purge function for as long as it is pressed. The "Status" LED lights for approx. 2 seconds. With an activated purge function, the CBS pumps a large amount of air through the measuring tube for the required time period (see also chapter 11). The purge function can also be activated via an SDI-12 command.

Note: Press the membrane button for at least one second as otherwise the error memory is called and displayed at the "Status" LED.

Fig. 10: Activating purge function manually on the OTT CBS with membrane button.



8 Adjusting operating parameters using the service interface

The OTT CBS has a service interface with an eight-position DIP switch. This is located behind a cover on the base of the OTT CBS (see Figure 1). The following operating parameters can be set with them:

- ▶ DIP 1, 2, 3 Set serial interface type (SDI-12 / RS-485)
- ▶ DIP 4 Setting measurement type as level or depth measurement*
- ▶ DIP 5 + 6 Scaling measuring range *
- ▶ DIP 7 Setting metric or imperial system (m/mbar or feet/psi) *
- ▶ DIP 8 Setting measurement type as water level or pressure measurement *

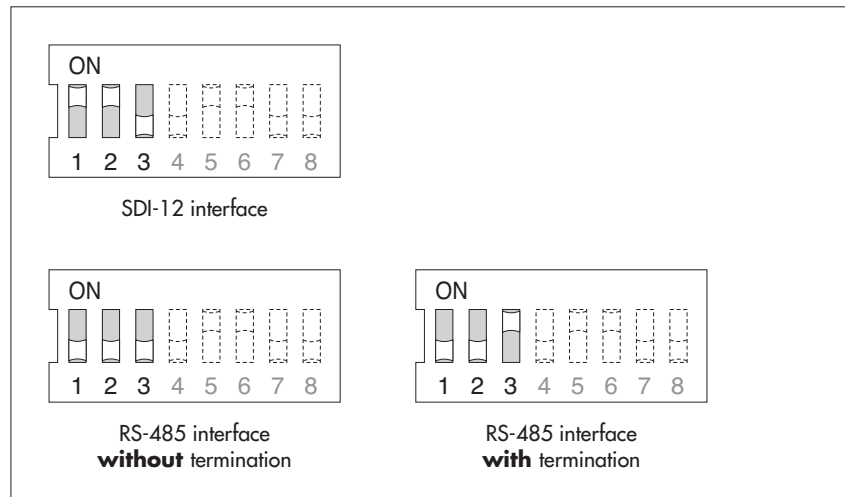
* these settings only affect the 4 ... 20 mA interface.

8.1 Setting the serial interface type

With DIP 1 ... 3 select the type of SDI-12 interface of the OTT CBS (screw terminal strip B; contacts 1 to 4). Note that only one of the interfaces at a time can be used (4 ... 20 mA, SDI-12 or RS-485; no parallel operation of interfaces).

Fig. 11: Setting the type of SDI-12 interface of the OTT CBS.

On the RS-485 interface **with** termination, there is an internal 120 Ohm terminating resistor between the two RS-485 connections.



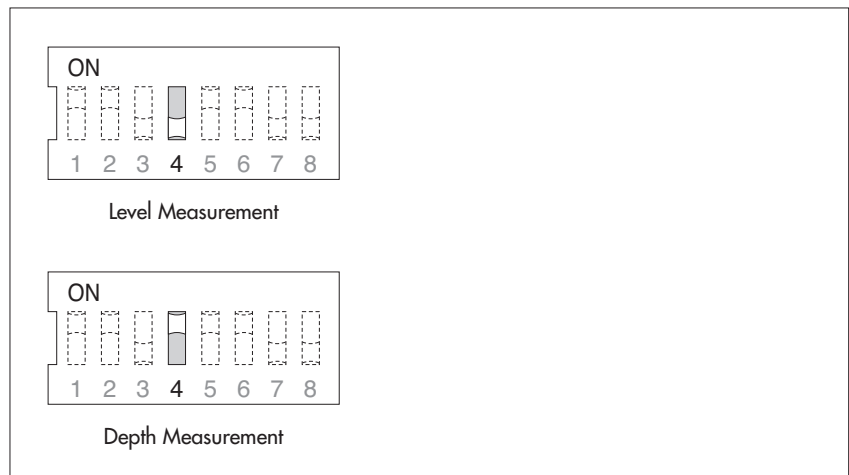
Possible serial interface types

- ▶ SDI-12 interface (SDI-12 protocol)
- ▶ RS-485 interface **without** termination (SDI-12 protocol / Modbus protocol)
Use this setting if multiple OTT CBS are connected in parallel to one RS-485 cable (bus operation) for all OTT CBS except the last device at the end of the bus.
- ▶ RS-485 interface **with** termination (SDI-12 protocol / Modbus protocol)
Use this setting if
 - multiple OTT CBS are connected in parallel to the RS-485 cable (bus operation) for the last device at the end of the bus, or if
 - only one OTT CBS is connected to the RS-485 cable.

Note: When using the 4 ... 20 mA interface, the setting of DIP 1 ...3 is not relevant. (Exception: If default settings on the OTT CBS are to be changed using the SDI-12 interface during service.)

8.2 Setting measurement type of the 4 ... 20 mA interface to level or depth measurement

Fig. 12: Setting measurement type level or depth measurement of the OTT CBS (4 ... 20 mA interface).



8.3 Scaling the measuring range for the 4 ... 20 mA interface

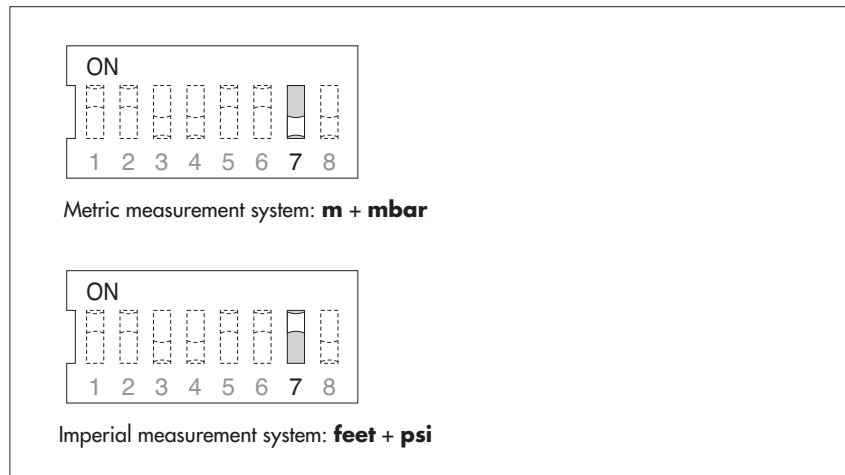
With DIPs 5 and 6 you can scale the available measuring range (15 or 30 m) of an OTT CBS to a smaller range. Where the whole measuring range is not required, this has the advantage that a higher resolution for the 4 ... 20 mA interface can be achieved. Example: For 2 m water level change 16 mA measuring range is available (DIP switches 5 + 6 = OFF).

Fig. 13: Scaling the measuring range of the OTT CBS (4 ... 20 mA interface).

	CBS version	
	Standard + USGS specification	30 m measuring range
	15 m / 50 ft 1.5 bar / 25 psi (not scaled)	30 m / 100 ft 3 bar / 50 psi (not scaled)
	8 m / 25 ft 0.8 bar / 12 psi	15 m / 50 ft 1.5 bar / 25 psi
	4 m / 12 ft 0.4 bar / 6 psi	8 m / 25 ft 0.8 bar / 12 psi
	2 m / 6 ft 0.2 bar / 3 psi	4 m / 12 ft 1.5 bar / 6 psi

8.4 Setting the measuring system for the 4 ... 20 mA interface

Fig. 14: Setting the measuring system of the OTT CBS (4 ... 20 mA interface).



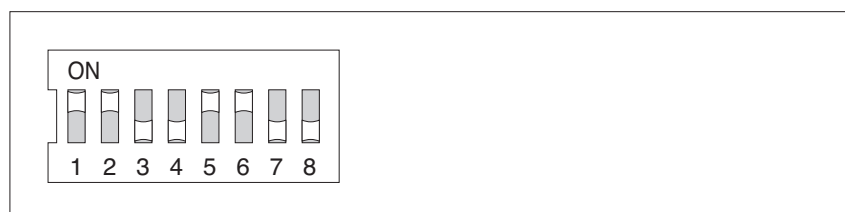
8.5 Setting measurement type of the 4 ... 20 mA interface to water level or pressure measurement

Fig. 15: Setting measurement type to water level or pressure measurement (4 ... 20 mA interface).



8.6 Factory setting of the operating parameters

Fig. 16: Factory setting of the operating parameters.



- SDI-12 interface; level measurement; measuring range not scaled; metric system; water level measurement.

9 SDI-12 commands and responses

Communication with the OTT CBS is carried out using a standardised serial SDI-12 interface. In this technical documentation, you will find a detailed description of the SDI-12 commands implemented in the SDI-12 transfer protocol.

Further information on the SDI-12 standard can be found in the document "SDI-12; A Serial-Digital Interface Standard for Microprocessor-Based Sensors; Version 1.4" (see website "www.sdi-12.org").

All advanced, manufacturer-specific SDI-12 commands on the OTT CBS begin with "o" for OTT. With these commands it is possible to configure the OTT CBS, for example using the "Transparent mode" on a data logger or with the OTT USB/SDI-12 interface accessory.

Conventions for measured value formats

p – Sign (+,-)

b – Figure (before decimal point); output without leading zeroes

e – Figure after the decimal point

a<CR><LF> – Service Request

! – ends a command

9.1 Overview of SDI-12 commands

Standard commands

- ▶ **a!** Acknowledgement active
- ▶ **aI!** Send identification
- ▶ **aAb!** Change sensor address
- ▶ **?!** Query sensor address; factory setting: 0
- ▶ **aM!** Start measurement
- ▶ **aD0!** Send data
- ▶ **aMC!** Start measurement and request CRC (Cyclic Redundancy Check)
- ▶ **aC!** Start concurrent measurement (simultaneous measurement with multiple sensors on one bus line)
- ▶ **aCC!** Start concurrent measurement and request CRC
- ▶ **aV!** Start system test

Meta data commands

- ▶ **aIM!** Determine response to associated **aM!** command (does not start measurement)
 - aIMC!** ... **aMC!**
 - aIC!** ... **aC!**
 - aICC!** ... **aCC!**
- ▶ **aIV!** Determine response to associated **aV!** command (does not start system test)
- ▶ **aIM_001!** Query meta data for measured value 1, 2 and 3; measured value in **aD0!** after **aM!**
 - aIM_002!**
 - aIM_003!**
 - aIMC_001!** ... **aMC!**
 - aIMC_002!**
 - aIMC_003!**
 - aIC_001!** ... **aC!**
 - aIC_002!**
 - aIC_003!**
 - aICC_001!** ... **aCC!**
 - aICC_002!**
 - aICC_003!**
- ▶ **aIV_001!** Query meta data for response to "Perform system test" command

Advanced commands (manufacturer-specific)

- ▶ **aOXM<value>!** Set measuring time
aOXM! Read measuring time
Factory setting: +50 s
- ▶ **aOXC<value>!** Set cycle time
aOXC! Read cycle time
Factory setting: +60 s
- ▶ **aOAA<value>!** Set "level" or "depth" measuring mode
aOAA! Read measuring mode
Factory setting: +0 → "Level" measuring mode
- ▶ **aOAB<value>!** Set offset value for level/depth measurement (SDI-12/RS-485 interface)
aOAB Read offset
Factory setting: +0.000 m
- ▶ **aOAC<value>!** Set reference value for level/depth measurement (SDI-12/RS-485 interface)
aOAC Read reference value
Factory setting: +0.000 m
- ▶ **aOXR<value>!** Set mean water density
aOXR! Read mean water density
Factory setting: +0.999972 kg/dm³
- ▶ **aOXT<value>!** Set mean water temperature
aOXT Read mean water temperature
Factory setting: +3.980000 °C
- ▶ **aOXX<value>!** Set correction factor for pressure/level value
aOXX! Read correction factor for pressure/level value
Factory setting: +1.000000
- ▶ **aOXG<value>!** Set local acceleration due to gravity
OXG! Read local acceleration due to gravity
Factory setting: +9.80665 m/s²
- ▶ **aOPC<Wert>!** Set status of 4 ... 20 mA interface
aOPC! Read status
Factory setting: +0 → 4 ... 20 mA interface disabled
- ▶ **aOSU<value>!** Set unit for level/pressure measured values
aOSU! Read unit
Factory setting: +0 → Unit m
- ▶ **aOST<value>!** Set unit for temperature measured values
aOST! Read unit
Factory setting: +0 → Unit °C
- ▶ **aOOV!** Read firmware version
- ▶ **aOXP<value>!** Activate/deactivate purge function
Factory setting: +0 → Purge function deactivated
- ▶ **aOZY<value>!** Set SDI-12 interface version
aOZY Read version
Factory setting: +1 → Current version activated
- ▶ **aOPF<value>!** Set status of Modbus protocol
aOPF Read status
Factory setting: +0 → Modbus protocol deactivated
- ▶ **aOPG<value>!** Modbus: Set bus address
aOPG Read bus address
Factory setting: +1
- ▶ **aOPH<value>!** Modbus: Set transmission speed
aOPH Read transmission speed
Factory setting: +9600 bit/s

9.2 Standard commands

Command	Response	Description
a!	a<CR><LF>	Acknowledgement active a – Sensor address; factory setting: 0
aI!	allccccccmmmmmm... ...vvvxxxxxx<CR><LF>	Send identification a – Sensor address 11 – SDI-12 protocol version ccccccc – Manufacturer identification (company name) mmmmmm – Sensor designation vvv – Sensor version (in this case Firmware version) xxxxxxx – Additional designation (in this case serial number) OTT CBS response: 0140TT CBS120 xxxxxx
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! ¹⁾	atttn<CR><LF> and after 50 seconds a<CR><LF>	Start measurement a – Sensor address ttt – Time in seconds until the sensor has determined the measured result OTT CBS response: 050 n – Number of measured values OTT CBS response: 3
aMC! ¹⁾	atttn<CR><LF> and after 50 seconds a<CR><LF>	Start measurement and request CRC (Cyclic Redundancy Check); for details see command aM! . The response to the aD0! command is extended with a CRC value in this case: a<value1><value2><value3><CRC><CR><LF>
aC! ¹⁾	atttnn<CR><LF>	Start concurrent measurement (simultaneous measurement with multiple sensors on one busline); for details see command aM! . The number of measured values in the response to this command has two digits (nn): 03.
aCC! ¹⁾	atttnn<CR><LF>	Start concurrent measurement (simultaneous measurement with multiple sensors on one busline) and request CRC (Cyclic Redundancy Check); details see command aM! . The number of measured values in the response to this command has two digits (nn): 03. The response to the aD0! command is extended with a CRC value in this case: a<value1><value2><value3><CRC><CR><LF>

¹⁾ Do not use these commands if the OTT CBS is connected to a data logger using the 4 ... 20 mA interface. This would cause the OTT CBS to interrupt the continuous measurement mode, which is necessary for the 4 ... 20 mA interface.

Command	Response	Description
aD0!* * after aM!, aMC!, aC!, aCC!	a,<value1>,<value2>, <value3>;<CRC><CR><LF>	Send data a – Sensor address <value1> – Level/depth/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 → pbbb.ee °F → pbbb.ee <value3> – Status ; see command aV! <CRC> – CRC value (only after aMC!, aCC!)
aV!	atttn<CR><LF>	Start system test a – Sensor address ttt – Time in seconds until the sensor has determined the measured result OTT CBS response: 001 n – Number of measured values OTT CBS response: 1
aD0!* * after aV!	a<value><CR><LF>	Send data a – Sensor address <value> – Status of last measurement +0 → No error +1 → Level too low +2 → Excess pressure +4 → Supply voltage too low (< 9.6 V) +8 → Overload +16 → General software error +32 → Motor malfunction +64 → Valve malfunction +256 → Memory defective +512 → Data bus defective +1024 → Analog converter defective +2048 → Pressure measuring cell defective

9.3 Meta data commands

Command	Response	Description
aIM! aIMC! aIC! aICC!	atttn<CR><LF> atttn<CR><LF> atttnn<CR><LF> atttnn<CR><LF>	The response is identical to the associated measuring command (aM!, aMC!, aC!, aCC!). These commands do not start any measurements. For a description of the responses, see commands aM!, aMC!, aC!, aCC!.
aIV!	atttn<CR><LF>	The response is identical to the associated "Start system test" (aV!) command. This command does not start a system test! For a description of the response, see command aV!.
aIM_001! aIC_001! aIMC_001! aICC_001!	a,<Field1>,<Field2>, <Field3>;<CRC><CR><LF>	<p>The OTT CBS sends meta data for the associated measured value <value1>¹⁾ in the form of three data fields. These commands do not start any measurements!</p> <p>a – Sensor address <Field1> – Measured value code LE (level) · DW (distance to water) PH (hydrostatic pressure) <Field2> – Unit meter · cm · ft · mbar · bar · psi <Field3> – Text description water level · distance to water hydrostatic pressure <CRC> – CRC value (only for aIMC_001!, aICC_001!)</p> <p>Examples: 0,LE,cm,water level;<CR><LF> 3,PH,mbar,hydrostatic pressure;GQa<CR><LF></p>
aIM_002! aIC_002! aIMC_002! aICC_002!	a,<Field1>,<Field2>, <Field3>;<CRC><CR><LF>	<p>The OTT CBS sends meta data for the associated measured value <value2>¹⁾ in the form of three data fields. These commands do not start any measurements!</p> <p>a – Sensor address <Field1> – Measured value code CU <Field2> – Unit degrees C · degrees F <Field3> – Text description average air temperature <CRC> – CRC value (only for aIMC_001!, aICC_001!)</p> <p>Example: 0,CU,degrees C,average air temperature;<CR><LF></p>
aIM_003! aIC_003! aIMC_003! aICC_003!	a,<Field1>,<Field2>, <Field3>;<CRC><CR><LF>	<p>The OTT CBS sends meta data for the associated measured value <value3>¹⁾ in the form of three data fields. These commands do not start any measurement!</p> <p>a – Sensor address <Field1> – Measured value code DS <Field2> – Unit (No unit, space output) <Field3> – Text description device status <CRC> – CRC value</p> <p>Example: 0,DS, ,device status;<CR><LF></p>

¹⁾ Part of the response to the command aD0! (after aM!, aMC!, aC!, aCC!)

Command	Response	Description
aIV_001!	a,<Field1>,<Field2>, <Field3>;<CR><LF>	The OTT CBS sends meta data for the associated "Start system test" command (aV!) in the form of three data fields. For a description of the meta data, see command aIM_003!.

9.4 Advanced SDI-12 commands

Command	Response	Description
▶ Set/read measuring time		
aOXM<value>! aOXM!	a<value><CR><LF> a<value><CR><LF>	Set measuring time Read measuring time a – Sensor address <value> – Measuring time in seconds pbbbb Value range: +30 ... +300 s Factory setting: +50 s Duration over which the OTT CBS determines an average measured value.
▶ Set/read cycle time		
aOXC<value>! aOXC!	a<value><CR><LF> a<value><CR><LF>	Set cycle time Read cycle time a – Sensor address <value> – Cycle time in seconds pbbbb Value range: +30 ... +7200 s Factory setting: +60 s With active 4 ... 20 mA interface (aOPC! → +1) or active Mobus protocol (aOPF! → +1): Time interval in which the OTT CBS starts measurements. With the 4 ... 20 mA interface, the OTT CBS adjusts the loop current when the measured result is available. The condition "Cycle time ≥ Measuring time" must be met. If it is not, the OTT CBS automatically adjusts the measuring time to the cycle time.
▶ Set/read level or depth measuring mode		
aOAA<value>! aOAA!	a<value><CR><LF> a<value><CR><LF>	Set measuring mode Read measuring mode a – Sensor address <value> – +0 = "Level" measuring mode activated (water level relative to level zero point) +1 = "Depth" measuring mode activated (reference point ↔ water surface) Factory setting: +0 Please note If entries have already been made for the "Offset" or "Reference value" parameters before changing the measuring mode, you must reset them. There is no automatic conversion of the parameters entered.

Command	Response	Description
▶ SDI-12-/RS-485 interface – Set/read offset for level/depth measurement		
aOAB<value>!	a<value><CR><LF>	Set offset value
aOAB!	a<value><CR><LF>	Read offset value
		<p>a – Sensor address</p> <p><value> – pbbbb.eee m *</p> <p>– pbbbb cm *</p> <p>– pbbbb.ee ft *</p> <p>Input/output without leading zeroes.</p> <p>Value range: –9999.999 ... +9999.999 *</p> <p>Factory setting: +0.000</p> <p>You can use this command to apply a linear offset (positive/negative) to the level/depth measured value (basis: current measurement).</p> <p>Please note</p> <p>A measurement must have taken place directly before the setting. This command overwrites any reference value set.</p> <p>Example</p> <p>Measured value = +10.040 m</p> <p>Offset = –0.200 m</p> <p>Output = +9.840 m</p> <p>Note</p> <p>If the unit is subsequently changed (aOSU<value>!) you must reset the offset value.</p>
▶ SDI-12/RS-485 interface - Set/read reference value for level/depth measurement		
aOAC<value>!	a<value><CR><LF>	Set reference value
aOAC!	a<value><CR><LF>	Read reference value
		<p>a – Sensor address</p> <p><value> – pbbbb.eee m *</p> <p>– pbbbb cm *</p> <p>– pbbbb.ee ft *</p> <p>Input/output without leading zeroes.</p> <p>Value range: –9999.999 ... +9999.999 *</p> <p>Factory setting: +0.000</p> <p>You can use this command with level/depth measurement to create a reference to a level zero point by entering a reference value (basis: current measurement).</p> <p>Please note</p> <p>A measurement must have taken place directly before the setting. This command overwrites any offset value set.</p> <p>Example</p> <p>Measured value = +2.100 m</p> <p>Reference value = +1.500 m</p> <p>Output = +1.500 m</p> <p>(Offset calculated by OTT CBS and applied to all other measured values = +0,600 m)</p> <p>Note</p> <p>If the unit is subsequently changed (aOSU<value>!) you must reset the offset value</p> <p>* Depends on the set unit (aOSU<value>!)</p>

Command	Response	Description
▶ Set/read average water density		
aOXR<value>!	a<value><CR><LF>	Set average water density
aOXR!	a<value><CR><LF>	Read average water density
		a – Sensor address <value> – pb.eeeeeee Value range: +0.500000 ... +2.000000 kg/dm ³ Factory setting: +0.999972 kg/dm ³ (at 3.98 °C)
		You can use this command to set the actual density of the water at your measuring point for level/depth measurement. For example, this is useful at stations with brackish water.
▶ Set/read average water temperature		
aOXT<value>!	a<value><CR><LF>	Set average water temperature
aOXT!	a<value><CR><LF>	Read average water temperature
		a – Sensor address <value> – pbb.eeeeeee Value range: -20.000000 ... +55.000000 °C Factory setting: +3.980000 °C
		You can use this command to set the actual average water temperature at your measuring point for level/depth measurement. This is useful at measuring points with a very low/high water temperature, for example.
▶ Set/read correction factor for pressure/level value		
aOXX<value>!	a<value><CR><LF>	Set correction factor for pressure/level value
aOXX!	a<value><CR><LF>	Read correction factor for pressure/level value
		a – Sensor address <value> – pb.eeeeeee Value range: +0.500000 ... +2.000000 Factory setting: +1.000000
		You can use this command to correct the pressure/level value. The OTT CBS multiplies the measured values by the correction factor.
▶ Set/read local acceleration due to gravity		
aOXG<value>!	a<value><CR><LF>	Set local acceleration due to gravity
aOXG!	a<value><CR><LF>	Read local acceleration due to gravity
		a – Sensor address <value> – pb.eeeee Value range: +9.50000 ... 9.95000 m/s ² Factory setting: +9.80665 m/s ²
		Gravity on the earth's surface fluctuates between 9.78036 m/s ² at the equator and 9.3208 m/s ² at the poles. It also decreases by 0.003086 m/s ² for every kilometre of altitude above sea level.

Command	Response	Description
		<p>Formula for local acceleration due to gravity "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</p> <p>(Source: Jursa, A.S., Ed., Handbook of Geophysics and the Space Environment, 4th ed., Air Force Geophysics Laboratory, 1985, pp. 14-17).</p> <p>Example Local acceleration due to gravity in Kempten: At a height above sea level of 669 m and a latitude of 47.71° the local acceleration due to gravity is 9.80659 m/s².</p> <p>Note The OTT CBS is preset to an average value for Germany (Kassel). The measured value variation caused by acceleration due to gravity in Germany is ±3 mm (Flensburg – Oberstdorf). This measured value error can be compensated by entering the local acceleration due to gravity.</p>
▶ Set/read unit for level/depth/pressure measured values		
aOSU<value>!	a<value><CR><LF>	Set unit
aOSU!	a<value><CR><LF>	Read unit
		<p>a – Sensor address</p> <p><value> – Units for level/depth measurement +0 = m; factory setting +1 = cm +2 = ft The level/depth measurement is performed with compensation for water density, average water temperature and local acceleration due to gravity</p> <p>Units for pressure measurement +3 = mbar +4 = bar +5 = psi The pressure measurement is carried out without compensation.</p>
		<p>Please note: If settings have already been made for the "Offset" or "Reference value" parameters before changing the unit, you must reset them. There is no automatic conversion of the set parameters.</p>
▶ Set/read unit for temperature measured values		
aOST<value>!	a<value><CR><LF>	Set unit
aOST!	a<value><CR><LF>	Read unit
		<p>a – Sensor address</p> <p><value> – +0 = °C; factory setting +1 = °F</p>
▶ Read firmware version		
aOOV!	accccccc<CR><LF>	Read OTT CBS firmware version
		<p>a – Sensor address</p> <p>accccccc – Firmware version; example: V1.20.0</p>

Command	Response	Description
▶ Activate/deactivate purge function		
aOXP<value>!	a<CR><LF>	Activate/deactivate purge function
		a – Sensor address <value> – +0 = Purge function deactivated +1 = Purge function activated
		With the purge function activated, the OTT CBS pumps a greater volume of air through the bubble tube over a given period. For further information, see chapter 7 and 11.1.
▶ Set/read SDI-12 interface version		
aOZY<value>!	a<value><CR><LF>	Set version
aOZY!	a<value><CR><LF>	Read version
		a – Sensor address <value> – +0 = Previous version active; (up to OTT CBS firmware version V1.15.6) +1 = Current version active; factory setting (up to OTT CBS firmware version V1.20.0)
		For example, the previous version of the SDI-12 interface is required if the OTT CBS is to be fitted in an existing installation as a replacement device. This does not require a change in the configuration of the existing data logger.
		If required, you can find a description of the previous version of the SDI-12 interface in the OTT CBS operating manual, "04-0211".
▶ Set/read Modbus protocol (RS-485 interface)		
aOPF<value>!	a<value><CR><LF>	Activate/deactivate Modbus protocol
aOPF!	a<value><CR><LF>	Read Modbus protocol status
		a – Sensor address <value> – +0 = Modbus protocol deactivated; factory setting – +1 = Modbus protocol activated
		The Modbus protocol must be activated if the OTT CBS is connected to a programmable logic controller, for example.
▶ Modbus: Set/read bus address (RS-485 interface)		
aOPG<value>!	a<value><CR><LF>	Set bus address
aOPG!	a<value><CR><LF>	Read bus address
		a – Sensor address <value> – pbbb
		Value range: +1 ... +255 Factory setting: +1
▶ Modbus: Set/read transmission speed (RS-485 interface)		
aOPH<value>!	a<value><CR><LF>	Set transmission speed (Baud rate)
aOPH!	a<value><CR><LF>	Read transmission speed (Baud rate)
		a – Sensor address <value> – +9600 +19200
		Factory setting: +9600 bit/s

10 Carrying out maintenance work

The OTT CBS bubble sensor itself is maintenance free. We recommend that the measuring tube and bubble chamber are checked at regular intervals as described below and cleaned as required:

10.1 Activating purge function

Activate the purge function of the OTT CBS quarterly by pressing the membrane button "Pump" (see also Fig. 10) and checking whether air bubbles rise out of the bubble chamber. If not, check whether the bubble chamber is blocked, and/or whether the measuring tube is leaking or blocked.

10.2 Cleaning bubble chamber

Check the bubble chamber quarterly for sand buildup and weed infiltration. For light sand buildup, clean the bubble chamber using the purge function, and for heavier buildup or weed infiltration clean the bubble chamber carefully manually (do not change the position of the bubble chamber).

10.3 Testing the measuring tube

After 15 years' operation, test the measuring tube for tightness/pressure resistance roughly every 2 years.



Never open the housing of the OTT CBS! There are no adjustment or control elements inside the housing!

In the case of device defects, contact the OTT Repaircenter:

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

11 "Status" LED

For the display of any error states that may occur, the OTT CBS has a "Status" LED on the front of the device (see Fig. 1).

The following error states can arise:

▶ level too low (< 5 cm)	1 x flash
▶ overload (measuring range exceeded)	2 x flash
▶ power supply voltage too low	3 x flash
▶ pump motor overloaded	4 x flash
▶ watchdog error	5 x flash
▶ data memory defective	6 x flash
▶ data bus defective	7 x flash
▶ analog converter defective	8 x flash
▶ measuring cell defective	9 x flash

The OTT CBS shows an error state when it arises and for approximately 2 minutes after pressing the "Pump" membrane button.

The "... defective" error states signify hardware problems that can only be rectified by the OTT Repaircenter (see chapter 10). The "watchdog error" error state means that the OTT CBS has been restarted. No intervention is necessary.

Any error states arising can be displayed as follows:

- Press "Pump" membrane button briefly (< 1 second; otherwise the purge function is called) → the LED "Status" lights once for a longer period as confirmation → Pause → 1st error state arising (e.g. flashing once) → Pause → 2nd error state arising (e.g. flashing three times) → Pause → The OTT CBS repeats all error states arising for approx. two minutes.

Notes

- ▶ Interrupt displaying error states: press membrane button briefly.
- ▶ If no error state has arisen: the LED "Status" lights once for a longer period as confirmation.

12 Note about the disposal of old devices



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 about the return procedure, please contact your local sales contact. You will find the addresses of all sales partners in the internet on „www.ott-hydrometry.com“. Please take into consideration also the national implementation of the EU guideline 2002/96/EC of your country.

13 Technical Data

Measuring ranges	
"Standard" + "USGS specification" version	0 ... 15 m or 0 ... 1500 mbar 0 ... 50 ft or 0 ... 25 psi
"30 m measuring range" version	0 ... 30 m or 0 ... 3000 mbar 0 ... 100 ft or 0 ... 50 psi
Resolution	1 mm or 0.1 mbar 0.01 ft or 0.001 psi
Accuracy SDI-12 interface	
"Standard" + "30 m measuring range" version	±5 mm ±0.02 ft
"USGS specification" version	measuring range 0 ... 15 ft: ±0.01 ft measuring range 15 ... 50 ft: ±0.065 % of measured value or ±0.02 ft, whichever is less
Accuracy 4 ... 20 mA interface	±0.1 % FS; TC 10 ppm/°C (at 20 °C)
Measuring dynamics (max. level change)	1 m/min
Units	m or ft; bar or PSI
Interfaces	4 ... 20 mA, SDI-12, SDI-12 via RS-485
Power supply	10 ... 30 V _{DC} , typ. 12/24 V _{DC}
Current consumption	
Query interval 1 min	typ. 320 mAh/day (max. 3700 mAh/day)
Query interval 15 min	typ. 25 mAh/day (max. 300 mAh/day)
Dimensions L x W x H	165 mm x 205 mm x 115 mm
Operating/display elements	
DIP switches	Setting operating parameters (eight)
"Pump" membrane button	Call purge function; display error status using LED
"Status" LED	Display operating state/error status
Weight	approx. 1.500 g
Housing material	ABS
Type of protection	IP 43
Temperature range	
Operation	-20 ... +60 °C
Storage	-40 ... +85 °C
Relative humidity	10 ... 95 % not condensing
Measuring tube	
Internal diameter	Connection possibilities for 2 mm, 4 mm, 1/8"
Length	2 mm, 1/8": max. 100 m 4 mm: max. 75 m

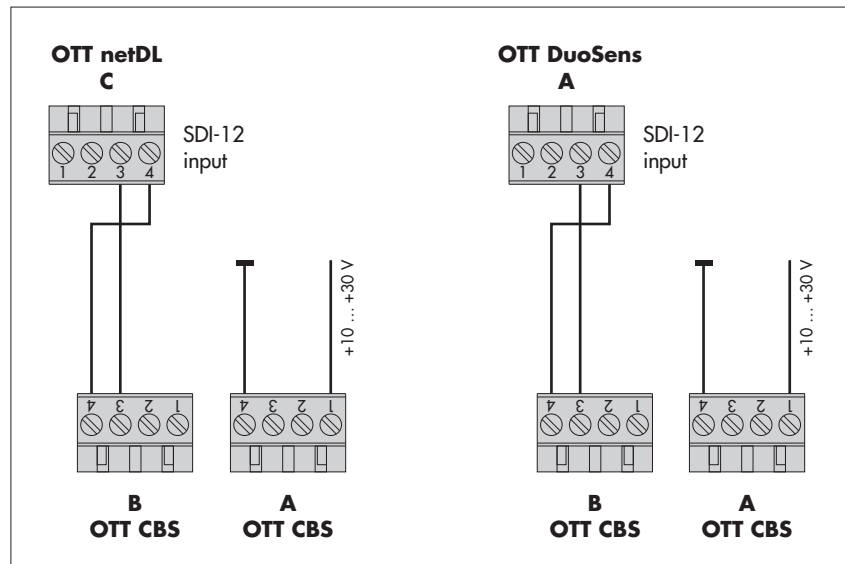
Appendix A – Connecting the OTT CBS to OTT netDL or OTT DuoSens using the SDI-12/RS-485 interface

Method A: Connect the OTT CBS via the SDI-12 interface (protocol and physical interface: SDI-12). The maximum length of the cable is 70 m. Recommended cable cross-section: 0.5 mm²:

- Connect the OTT CBS as shown in Figure 17 to the OTT netDL IP data logger or to the OTT DuoSens Compact data logger. Take note of the operating instructions for the OTT netDL/OTT DuoSens.

Fig. 17: Connecting the OTT CBS to OTT netDL or OTT DuoSens using the SDI-12 interface.

The letters above/below the screw terminal strip identify the possible connections on the OTT netDL/OTT DuoSens/CBS.



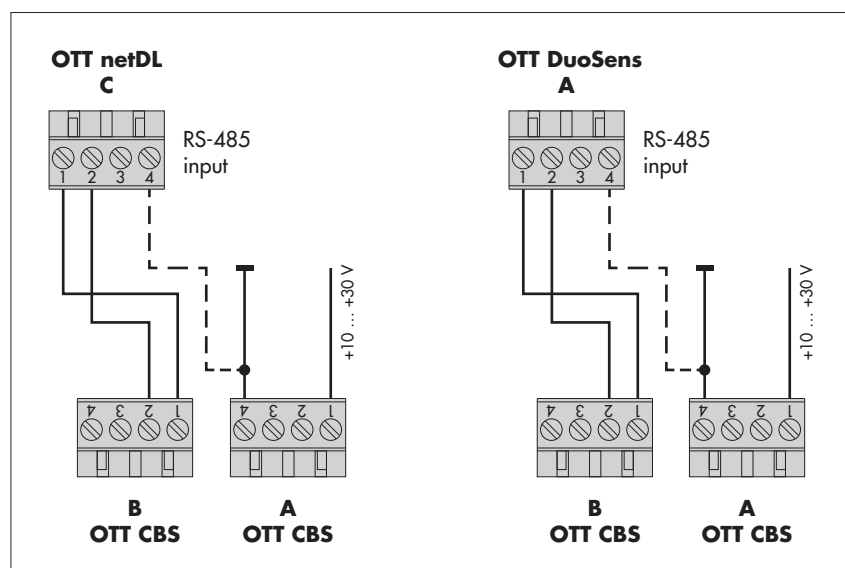
Method B: Connect OTT CBS using the physical RS-485 interface (SDI-12 protocol via physical RS-485 interface). The maximum length of the cable is 1.500 m. Recommended cable type: Unshielded twisted-pair cable; recommended cable cross-section: 0.5 mm² (above 500 m: 0.75 mm²)

- Connect the OTT CBS as shown in Figure 18 to the OTT netDL IP data logger or to the OTT DuoSens Compact data logger. Take note of the operating instructions for the OTT netDL/OTT DuoSens.

Fig. 18: Connecting the OTT CBS to OTT netDL or OTT DuoSens using the RS-485 interface (SDI-12 protocol).

The letters above/below the screw terminal strip identify the possible connections on the OTT netDL/OTT DuoSens/CBS.

The dotted connection is necessary if the OTT netDL and the OTT CBS are supplied from different voltage sources.



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

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

Fig. 19: Adjusting the operating parameters of the OTT netDL/OTT DuoSens "SDI-12 Master" function block.

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

- ▶ Terminal block
OTT netDL "OTT SDI RS485": C 1-2 (specified)
OTT netDL "SDI-12 Master": C 3-4 (specified)
OTT DuoSens "SDI-12 Master": A 3-4 (specified)
OTT DuoSens "OTT SDI RS485": A 1-2 (specified)
Terminal block (screw terminal strip) on the OTT netDL/OTT DuoSens, to which the OTT CBS is connected.
- ▶ Slave address
SDI-12 bus address. Each slave address may only be allocated once to an SDI-12 bus line. (Check/set: Using the "OTT SDI-12 Interface" tool in the operating program.) Factory setting: "0".
- ▶ Value no.
Indicates which measured value the OTT CBS will record on this channel. Level/depth/pressure = 1, Temperature = 2, Status = 3
- ▶ Measurement mode
"M!" (C!); for level/depth/pressure measured values, temperature and status
- ▶ Concurrent Mode*
: Uses instead of SDI-12 standard measuring mode (M!) concurrent mode (C!).
This allows simultaneous measurement with multiple sensors on a bus line (the sensors respond to a measurement command without a service request). The sensors must support version 1.2 or higher of the SDI-12 standard. Further information about Concurrent Mode can be found in the SDI-12 standard; see "www.sdi-12.org". This mode is useful if several sensors with a longer measuring time and identical sample interval are connected to a bus line.

* Only in conjunction with an OTT netDL

- ▶ Instantaneous value* : For an instantaneous value request (using LCD display and jog shuttle), the OTT netDL sends a command to start a current measurement to the OTT CBS. Until this measurement is complete, the LCD display uses the last measured value (or the last instantaneous value displayed if this is more recent). This is indicated by an "s" after the channel number (sensor number) in the display. After completion of the measurement, the new measured value appears with no additional indication.
- : For an instantaneous value request, shows the last measured value from the sensor (measured value from last sample interval). This is indicated by an "s" after the channel number (sensor number) in the display (see also "OTT netDL IP data logger" operating manual, chapter 9.1). This setting is useful for sensors with a longer measuring time and a short sample interval.
- ▶ Value no./ Virtual Terminal ID Assignment of further measured values from the OTT CBS – that are not recorded on this channel – to a virtual terminal.
- Set the units and the number of decimal places in the relevant "Channel" function blocks (m: 3 · cm: 0 · ft: 2; bar: 3 · mbar: 1 · psi: 3; °C: 2 · °F: 2; Status: 0).

Note:

- ▶ Therefore, three channels on the OTT netDL/OTT DuoSens are required to record the two measured values and the status of an OTT CBS. The first channel contains the "SDI-12 Master" or "OTT SDI RS485" function block as the input signal. The other channels each contain a "Virtual sensor" function block (V02 to V03) as the input signal. Of course, it is also possible to record only individual channels. In this case, fewer entries are necessary in the "Measured value no. / Virtual terminal no." field.
- ▶ Further information on the SDI-12 commands and responses used can be found in chapter 6 "SDI-12 commands and responses".

Please note: The measuring time must be at least 30 seconds; the factory setting is 50 seconds.

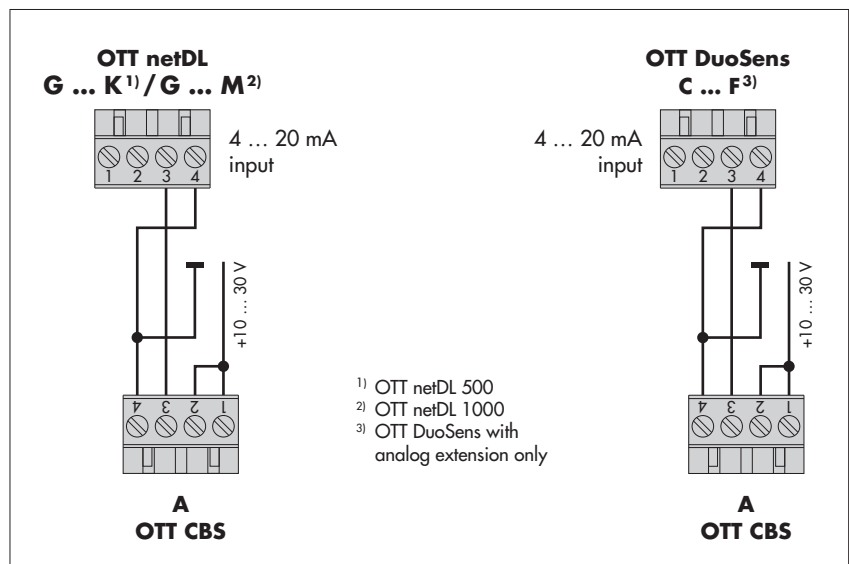
Appendix B – Connecting the OTT CBS to an OTT netDL or OTT DuoSens using the 4 ... 20 mA interface

- Connect the OTT CBS to the OTT netDL IP data logger or to the OTT DuoSens compact data logger as shown in Figure 20. Take note of the operating instructions for the OTT netDL/OTT DuoSens. Maximum cable length: Depending on the level of the supply voltage and the wire cross-section used. Make sure that the ohmic resistance of the connecting cable does not exceed the maximum permitted load resistance (see chapter 6.5 for details). In any case, the upper limit for the cable length is 1000 m.

Fig. 20: Connecting the OTT CBS to OTT netDL or OTT DuoSens using a 4 ... 20 mA interface.

The letters above/below the screw terminal strip identify the possible connections on the OTT netDL/OTT DuoSens/OTT CBS.

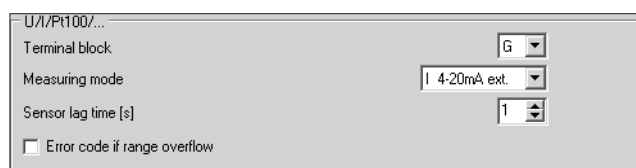
In the shown application the supply of the current loop will occur via the OTT CBS.



Configuring the OTT netDL/OTT DuoSens for OTT CBS with 4 ... 20 mA interface

- Create a OTT netDL/OTT DuoSens channel with function block "U/I/Pt100/..." ("Analog sensors" tab).
- Apply the following settings:

Fig. 21: Setting operating parameters of the OTT netDL/OTT DuoSens "U/I/Pt100/..." function block.



- ▶ Terminal block
- ▶ Measuring mode
- ▶ Sensor lag time (s)

OTT net DL 500 G ... K
OTT netDL 1000: G ... M
OTT DuoSens: C ... F
terminal block used (screw terminal strip) of the OTT netDL/OTT DuoSens.
Set to "I 4-20 mA ext".
switches on the OTT netDL/OTT DuoSens input x seconds before the actual measurement process; set to "1"

- ▶ Error code if range overflow if required: record error codes if range overflow
- Insert a function block "2-point scaling" into this channel and set the appropriate water levels for the electrical values measured (e. g. for an OTT CBS with 15 m measuring range and level measurement (DIP switches 5 + 6 = ON): Point 1: 4 → 0; Point 2: 20 → 15). Ensure you note here the settings of DIP switches 5 + 6!
- With depth measurement: ensure that DIP switch 4 is set to ON or carry out the inversion of the value via function "2-point scaling" (e. g. for an OTT CBS with 15 m measuring range and depth measurement (DIP switches 5 + 6 = ON): Point 1: 4 → 15; Point 2: 20 → 0).

With the "2-point-scaling" function it is also possible to reference a level zero at the same time.

Appendix C – RS-485 interface with Modbus protocol (RTU)

C.1 Prerequisites

- ▶ Connection using RS-485 interface (2-wire, half duplex, with termination), see chapter 6
- ▶ Service interface setting DIP 1, 2 and 3: OFF OFF ON, see chapter 8.3
- ▶ Modbus protocol activated Factory setting: deactivated SDI-12 command: aOPF<value>!
- ▶ Bus address correctly set Factory setting: +1 SDI-12 command: aOPG<value>!
- ▶ Transmission speed correctly set Factory setting: +9600 SDI-12 command: aOPH<value>!

C.2 "Read Holding Register" function (0x03)

Register name	Register-number	Type	Value	Factory Setting	Access-mode	Unit
▶ Bus address	0000	unsigned word	1 ... 247	1	R/W	–
▶ Baud rate	0001	unsigned word	9600 · 19200	9600	R/W	Bit/s
▶ Parity	0002	unsigned word	0 ...2 0 → None 1 → Odd 2 → Even	0	R/W	–
▶ Serial number	0003	unsigned word	10 Byte; ASCII-Format	–	R	–
▶ Firmware version	0008	unsigned word	10 Byte; ASCII-Format	–	R	–
▶ Cycle time	0013	unsigned word	30 ... 7200	60	R/W	s
▶ Level/pressure/ measured value unit	0014	unsigned word	0 ... 5	0	R/W	0 → m 1 → cm 2 → ft 3 → mbar 4 → bar 5 → psi
▶ Temperature mea- sured value unit	0015	unsigned word	0 ...1	0	R/W	0 → °C 1 → °F
▶ Level/depth measuring mode	0016	unsigned word	0 ...1 0 → Depth 1 → Level		R/W	–
▶ Local acceleration due to gravity	0018	float ¹⁾	9.50000 ... 9.95000	9.80665	R/W	m/s ²
▶ Mean water temperature	0020	float ¹⁾	–20.00 ... +55.00	+3.98	R/W	°C
▶ Mean water density	0022	float ¹⁾	0.500000 ... 2.000000	0.999972	R/W	kg/dm ³
▶ Level/depth measure- ment offset value	0024	float ¹⁾	–9999.999 ... +9999.999	0.000	R/W	m · cm · ft
▶ Level/depth measure- ment reference value	0026	float ¹⁾	–9999.999 ... +9999.999	0.000	R/W	m · cm · ft

¹⁾ Byte-sequence: CD AB (Big Endian – Word Swap)

C.3 "Read Input Register" function (0x04)

Register name	Register number	Type	Access mode	Unit
Level/depth/pressure measured value	0000	float ¹⁾	R	m · cm · ft mbar · bar · psi ²⁾
Temperature measured value	0002	float ¹⁾	R	°C · °F ¹⁾
Status of last measurement ³⁾	0004	float ¹⁾	R	–
Operating hours	0006	float ¹⁾	R	–

¹⁾ Byte sequence: CD AB (Big Endian – Word Swap)

²⁾ Depending on the set unit; see function "Read Holding Register" (0x03), register number 0014 and 0015

³⁾ For a description of the potential output values, see chapter 9.2, SDI-12 command **aD0!** after **aV!**

Appendix D – Note on the declaration of conformity

If required, you can download the current version of the declaration of conformity for the OTT CBS from our website as a PDF file: "www.ott.com/resources".



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