Type 202610.0

Two-wire Transmitter
for dissolved oxygen (DO)
and
terminal box/
operating unit

B 202610.0
Operating Instructions

12.05/00394433

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1 Typographical conventions

1.1 Warning signs

Danger

This symbol is used when there may be **danger to personnel** if the instructions are ignored or not followed correctly!

Caution

This symbol is used when there may be **damage to equipment or data** if the instructions are ignored or not followed correctly!

1.2 Note signs

Note

This symbol is used when your **special attention** is drawn to a remark.

Reference

This symbol refers to **further information** in other chapters or sections.

abc[1]

Footnote

Footnotes are remarks that **refer to specific points** in the text. Footnotes consist of two parts:

A marker in the text, and the footnote text.

The markers in the text are arranged as continuous superscript numbers.

✱

Action

This symbol indicates that an **action to be performed** is described.

The individual steps are marked by this asterisk.

Example:

✱ Remove crosspoint screws.

2 General

2.1 Preface

Please read these Operating Instructions before commissioning the instrument. Keep the manual in a place that is accessible to all users at all times.

Please assist us to improve these operating instructions, where necessary.

Your suggestions will be appreciated.

Phone +49 661 6003-0
Fax +49 661 6003-607

All necessary settings are described in this manual. However, if any difficulties should still arise during start-up, please do not carry out any unauthorized manipulations. You could endanger your rights under the instrument warranty!

Please contact the nearest subsidiary or the main factory in such a case.

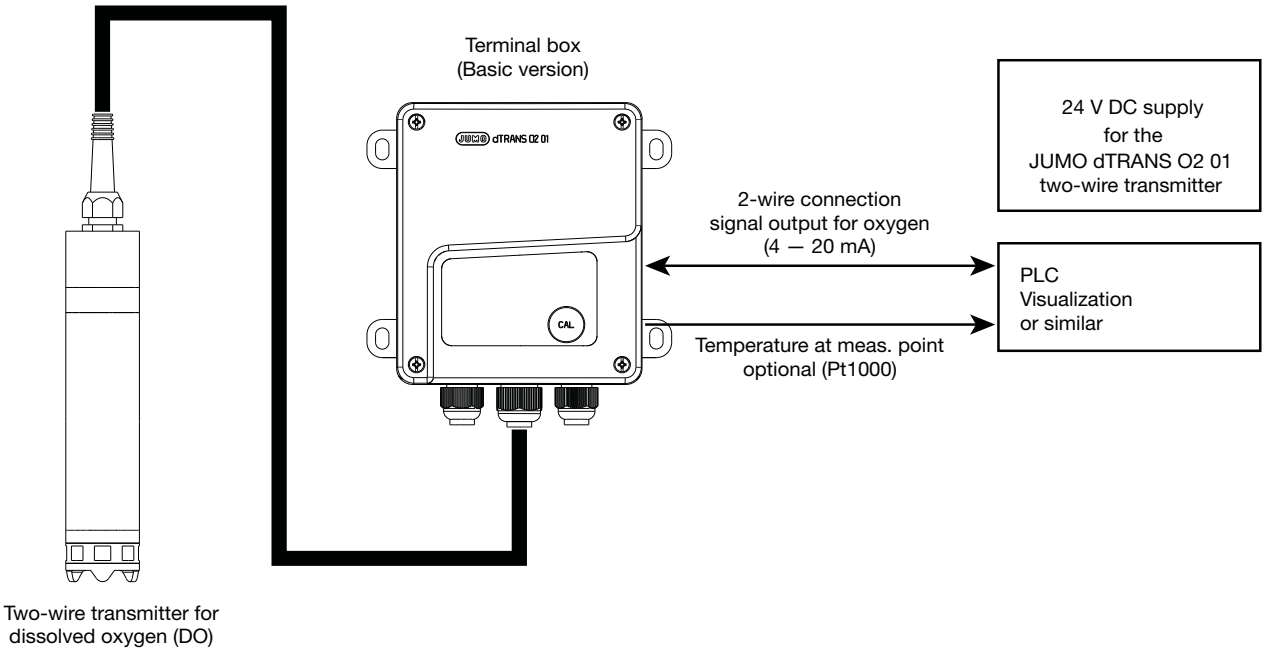
Caution

A sudden failure of a measuring cell may lead to excessive or insufficient dosing of oxygen. This may harm living creatures (fish in ponds or micro-organisms in wastewater-treatment plants).

Appropriate precautionary measures must therefore be taken in such a case.

2.2 Arrangement of the oxygen measuring system

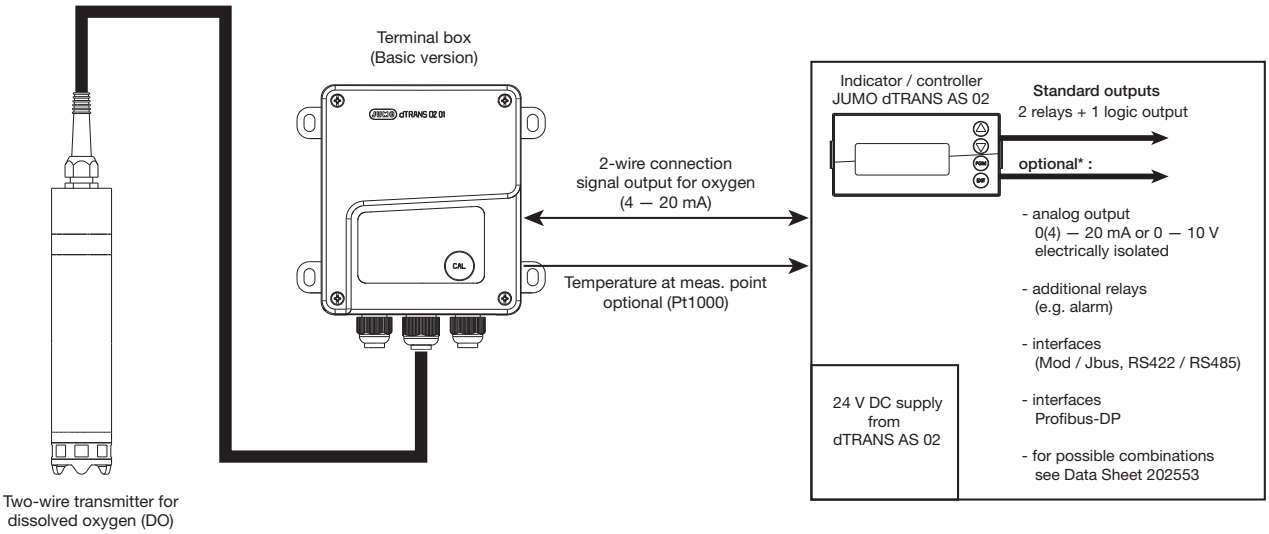
Basic version, type 202610/80...



- Two-wire transmitter JUMO dTRANS O2 01
- 8 m attached cable
- Terminal/operating unit with button for calibration

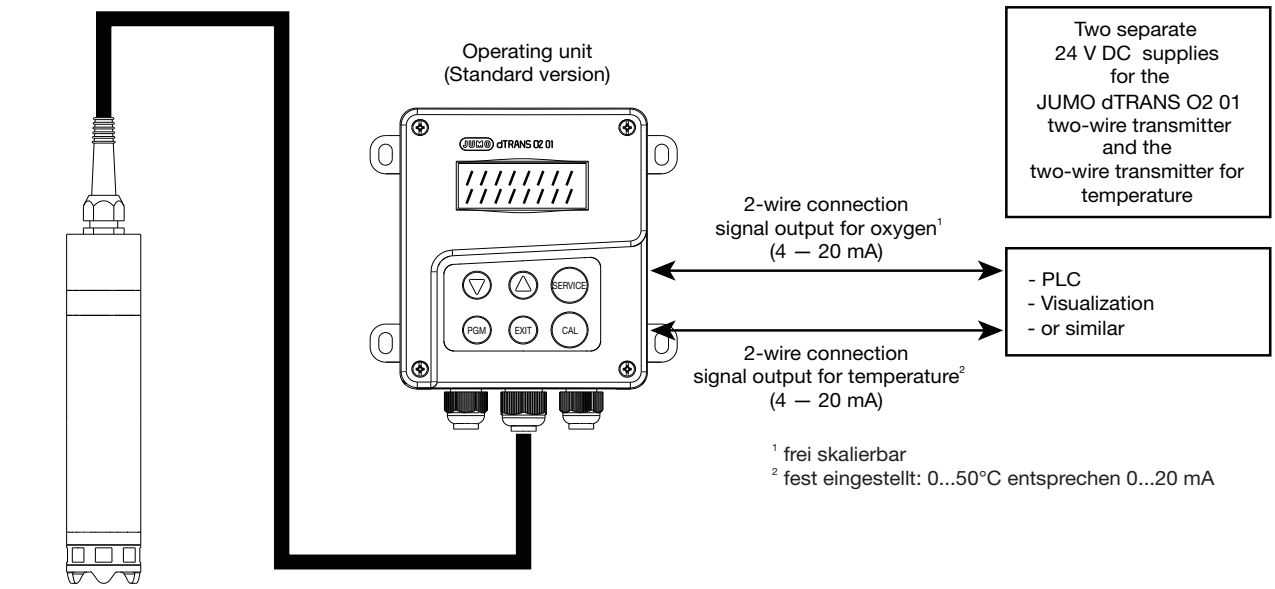
The basic version is designed for direct connection to a PLC or a recorder. The calibration function can be initiated locally. An optional setup program is available for configuring the transmitter. The two-wire transmitter is powered by a separate power supply (optional), e.g. JUMO TN-22, see Data Sheet 95.6024

Basic version, type 202610/80...



The JUMO dTRANS AS 02 (Jumo Data Sheet 202553), bezel size 96 x 48 is a suitable indicator/controller for the basic version. This instrument is recommended where there is no requirement for a direct connection to a PLC or recorder. The JUMO dTRANS AS 02can also provide the 18 V DC supply necessary for the two-wire transmitter. See Data Sheet 202553 for further details.

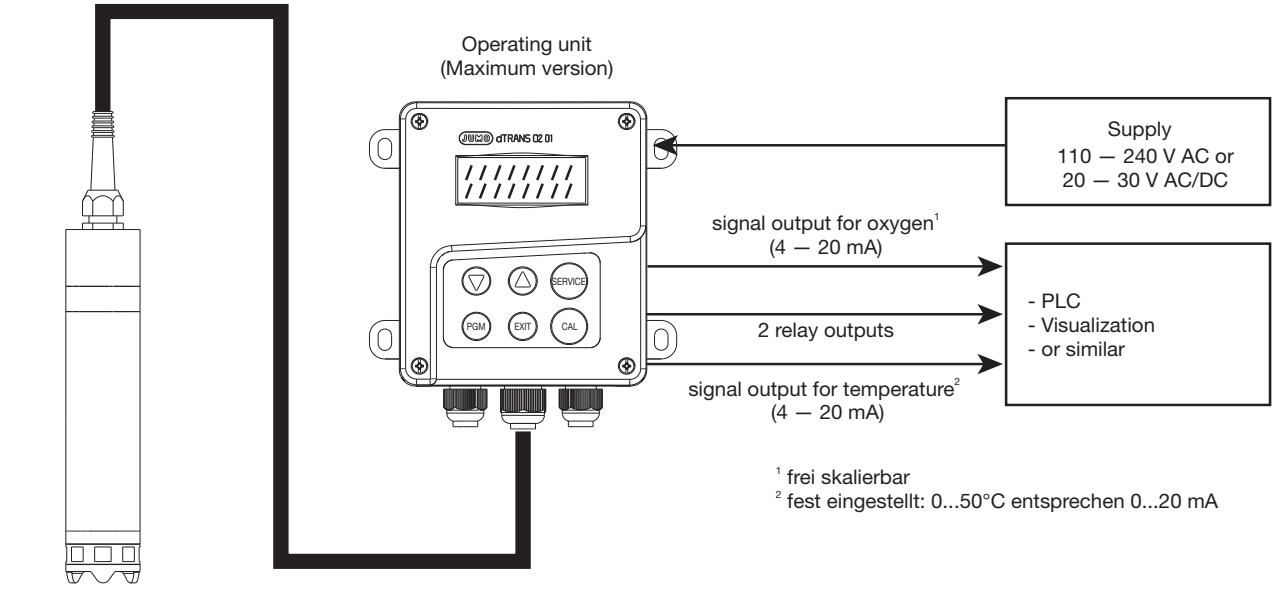
Standard version, type 202610/81...



Two-wire transmitter for dissolved oxygen (DO)

As for the basic version, but with an operating unit (instead of the terminal box) featuring a display and additional operating keys. The two-wire transmitter and the operating unit are powered by a separate power supply (optional), e.g. JUMO TN-22, see Data Sheet 95.6024. A further power supply (e.g. JUMO TN-22) is required for the supply of the additional (optional) two-wire transmitter for temperature. The instrument is operated from the membrane keypad and operator prompting in plain text ensures that operation is straightforward. The instrument is configured via the operating unit.

Full (maximum) version, type 202610/82...



Two-wire transmitter for dissolved oxygen (DO)

As for the standard version (see above). The operating unit has its own power supply to power the two-wire transmitters for oxygen and temperature. The output signal is in each case a 4 — 20 mA standard signal. In addition, this version comes with two freely programmable relays for alarm generation and limit monitoring. The display features backlighting.

3.1 Application

General

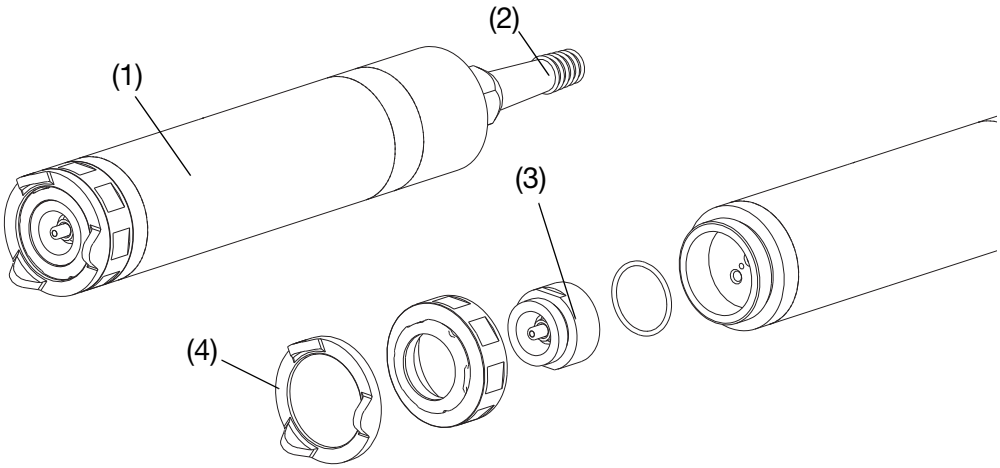
The instrument is suitable for continuous measurement of dissolved oxygen in water.

Typical areas of application

- Measurement of the O_2 content in activation basins. The measurement signal is used here for monitoring, and as a control parameter.
- Check of the O_2 content in the outlet of wastewater-treatment plants.
- Measurement and control of the O_2 content in fish ponds and fish farms (fresh and salt water).
- Monitoring of public water, e.g. rivers, lakes, reservoirs etc.
- O_2 enrichment of drinking water.

3.2 Construction

of the dTRANS O2 01



The oxygen transmitter consists of

- the housing (1) with the transmitter electronics and the connecting cable (2)
- the sensor module (3) and the protection basket (4)
  (optionally with additional protective film)

of the measuring cell

The measuring cell for dissolved oxygen is a membrane-covered galvanic cell with an alkaline electrolyte.

The cell consists of

- the cell body with the two connection contacts to the evaluation unit
- the silver cathode
- the lead anode
- the electrolyte
- the oxygen-permeable (but not porous) Teflon membrane, which constitutes the boundary surface between the inside of the cell and the sample liquid.

The cathode, with which the oxygen diffused through the membrane reacts electrochemically, is in direct contact with the membrane, via a thin electrolyte film.

3.3 Function

of the transmitter

The transmitter operates on the 2-wire principle, i.e. the output is a proportional modulation (4 — 20mA) of the current drawn by the transmitter.

The output signal is electrically isolated from the medium being measured.

of the measuring cell

The cell does **not** need an external supply, since the minimum voltage of about 850 mV that is necessary for oxygen reduction is internally generated through the partial reactions (1) and (2).

(1) $O_2 + 2H_2O + 4e^- \Leftrightarrow 4OH^-$ $E°(O_2) = +401mV$ (cathodic reaction)
(2) $2Pb + 4OH^- \Leftrightarrow 2PbO + 2H_2O + 4e^-$ $E°(Pb) = -576mV$ (anodic reaction)

Sum $O_2 + 2Pb \rightarrow 2PbO$ $E° = 977mV$

If an electrical connection is made between cathode and anode via a working resistance, a current will flow that is linearly proportional to the reduced oxygen and, therefore, to the oxygen dissolved in the sample liquid.

The cell has no zero current, which means that when no oxygen is present, there will also be no voltage and, consequently, no measuring current.

3.4 Influence

on the measurement signal

The measurement signal is influenced by the following factors

- the oxygen permeability of the membrane
- the saturation solubility of oxygen in water
- the salinity (salt content) and
- the vapor pressure of the water.

These factors are temperature-dependent.

The oxygen permeability of the membrane is design-specific. It depends on the material, the thickness and the deformation of the membrane.

The remaining factors describe physical phenomena, such as are listed in EN 25 814.

The factors mentioned above, and their dependency on temperature, are taken into account by the microprocessor-controlled evaluation electronics and compensated for.

Pressure fluctuations in the measured medium will affect the output signal!

Influence of the atmospheric pressure

With present-day calibration methods (acquisition of the measurement signal in vapor-saturated air), the atmospheric pressure must be considered, since the tables above refer to the normal atmospheric pressure of 1013 mbar.

When the measuring device is installed either

- the height a.m.s.l. is entered. Since the weather-dependent fluctuations of the atmospheric pressure only slightly influence the measurement variable, they do not have to be automatically taken into account.
- or the present atmospheric pressure is measured and entered on the transmitter.

The dTRANS O2 01 offers both entry options. The entries are made through the setup program, or on the operating unit.

Salinity

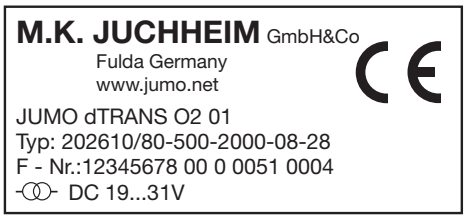
Salinity denotes the content of dissolved salts in water (in weight %).

The relationship between conductivity and salinity is described, for example, on the following Internet page:

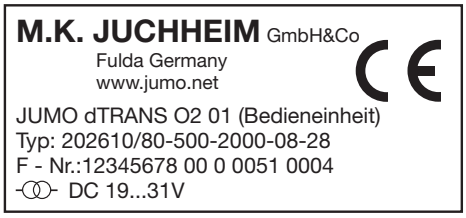
http://ioc.unesco.org/oceanteacher/resourcekit/M3/Converters/SeaWaterEquationOfState/Sea%20Water%20Equation%20of%20State%20Calculator.htm

4 Instrument identification

4.1 Nameplate



on the transmitter



on the terminal box / operating unit

4.2 Type designation

				(1)	**Basic type**
			202610		Two-wire transmitter for dissolved oxygen (DO)
				(2)	**Basic type extensions**
			80		Basic version[1]
			81		Standard version[1]
			82		Maximum version[1]
				(3)	**Output (additional temperature output)**
		X	006		4 — 20 mA (internal supply)
	X		405		4 — 20 mA (external supply)
X	X		500		Resistance output Pt1000
				(4)	**Oxygen range**
X	X	X	2000		0 — 2 to 0 — 50 mg/liter (programmable)
				(5)	**Cable length (transmitter)**
X	X	X	08		8 m
				(6)	**Supply**
		X	23		110 — 240 V AC +10 /-15%, 48 — 63 Hz
		X	25		20 — 53 V AC/DC, 48 — 63 Hz
X	X		28		19 — 31 V DC , +-0% (two-wire transmitter)
				(7)	**Language**
	X	X	1		German (standard)
	X	X	2		English
	X	X	3		French
	X	X	4		Spanish

X = combination is possible

	(1)		**(2)**		**(3)**		**(4)**		**(5)**		**(6)**		**(7)**
Order code	202610	/		-		-	2000	-	08	-		-	
Order example	202610	/	81	-	500	-	2000	-	08	-	28	-	1

[1] Special version: if appreciable fouling is expected, the protection basket of the oxygen transmitter can be supplied with a protective membrane. This membrane will, however, delay the sensor response.

5.1 Technical data of the two-wire transmitter

Supply	19 — 31 V DC; nominal 24 V DC; 8 VA
Permissible ambient temperature	-5 to 50°C
Length of the connecting cable	8 m
Electrical connection	screw terminals
Lightning protection	coarse and fine protection
Electromagnetic compatibility (EMC)	to EN 61 326
Measurement range	0 — 2 to 0 — 50 mg/liter (freely programmable) standard setting: 0 — 20 mg/liter => 4 — 20 mA
Measurement units	mg/liter or % saturation standard setting: mg/liter
Accuracy	±1% of range end (20 mg/liter)
Temperature compensation	0 to +50°C
Atmospheric pressure compensation	via direct input of atmospheric pressure: 500 — 1500 hPa (mbar) via input of height a.m.s.l.: 0 — 3000 m standard setting: 300 m a.m.s.l. or 976 hPa
Salinity (salt content compensation)	0 — 40 g/kg standard setting: 0 g/kg
Output signal	for dissolved oxygen: 4 — 20 mA, freely scalable within the range standard setting: 4 — 20 mA => 0 — 20 mg/liter for temperature: as resistance value Pt1000 (1000 Ω at 0°C, to DIN 45921, Class B) fixed setting: 0 to 50°C corresponding to 0 — 20 mA

Burden	Type 80 (basic version) dissolved oxygen $\leq \frac{U_B - 11\ V}{0.02\ A}$	Type 81 (standard version) dissolved oxygen/temp. $\leq \frac{U_B - 17\ V}{0.02\ A}$	Type 82 (maximum version) dissolved oxygen/temp. ≤ 350 Ohm
Response time	oxygen measurement (at 25°C): $t_{90} < 180$ sec temperature: $t_{90} < 300$ sec		
Flow rate	min. 5 cm/sec		
Safe pressure	max. 6 bar at 20°C		
Enclosure protection	IP68 to EN 60 529		
Housing material	shaft: stainless steel 1.4305 sensor head and protection basket: PVC		
Weight	approx. 700 g		

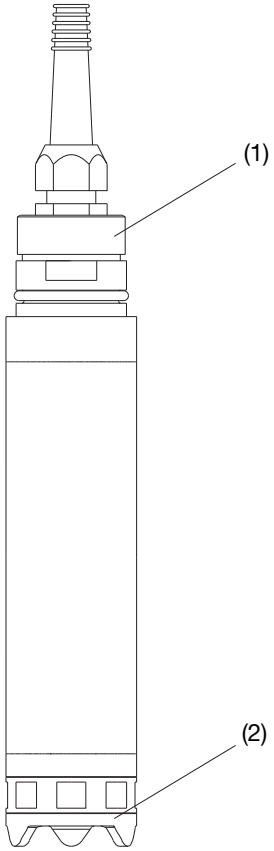
5.2 Technical data for the terminal box / operating unit

Supply	see nameplate on the terminal box / operating unit
Graphics display	visible area: 56 x 21 mm background lighting (on maximum version)
Permissible ambient temperature	basic version: -10 to +70°C standard and maximum version: -10 to +50°C
Electrical connection	pluggable screw terminals
Lightning protection	coarse and fine protection
Electromagnetic compatibility (EMC)	to EN 61 326
Enclosure protection	IP65 to EN 60 529 for panel mounting: IP54 to EN 60 529
Housing material	Macrolon® (polycarbonate, PC)
Weight	approx. 500 g

6.1 Two-wire transmitter

Installation variations

The transmitter type 202610 has a G1 A (1" pipe) thread (1) (underneath the blue cap) and can be screwed into suitable immersion or flow-through fittings.



Operating position

Preferably vertical, with the membrane (2) pointing down.
Alternative transmitter positions are allowed under unfavorable flow conditions, but not beyond the horizontal position. **An upwards orientation of the membrane is not permitted!**

Measurement point

The location for the fitting has to be chosen so as to enable easy access for calibration at a later time. Care has to be taken that the support columns and fittings are safely secured and largely free from vibration. For submerged operation in activation basins, a location has to be chosen that is representative of the typical oxygen concentration.

Pre-assembly

For submerged operation it is advisable, for safety reasons, to pre-assemble the individual modules at some distance from the basin, on a firm surface. Only then can the final assembly be performed at the desired location.

Screwing in and unscrewing the transmitter

The connecting cable must be able to rotate freely!
The cable must not be twisted!

Avoid strong tension on the cable. In particular, avoid tugging on the cable.

6 Assembly

6.2 Flow-through fittings

Application

Flow-through fittings are used to accommodate the dTRANS O2 01 oxygen transmitter. The fittings are installed directly in the pipeline conveying the liquid, or in the bypass. The special construction of the fitting ensures a correct flow past the sensor, thereby avoiding measurement errors.

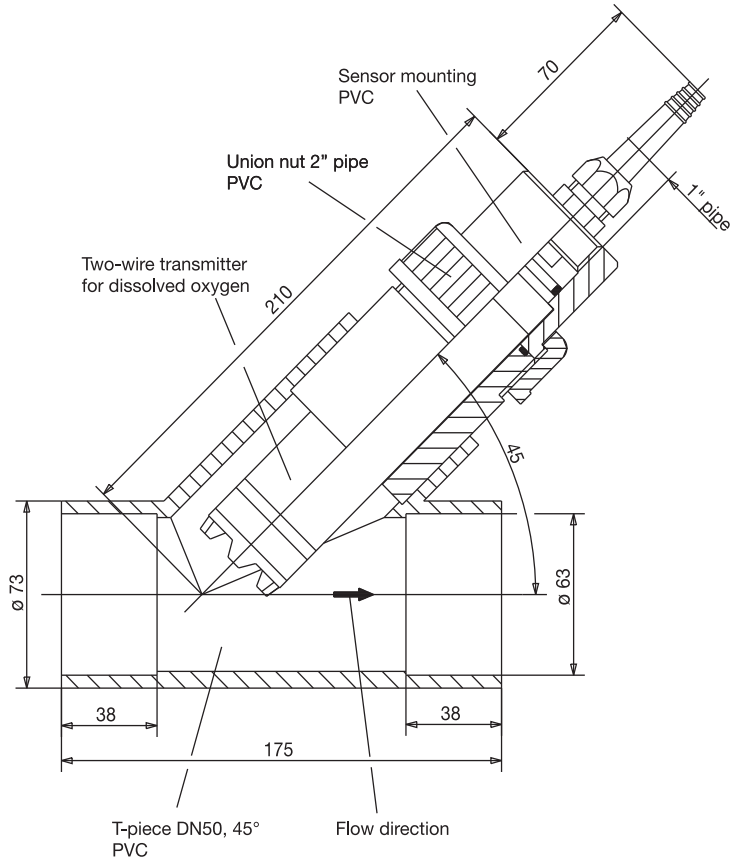
The following points should be noted when planning the pipework layout:

- The fitting must be easily accessible, to allow regular maintenance and cleaning of the transmitter or the fitting itself.
- Bypass measurements are recommended. Shut-off valves should be provided so that the transmitter can be removed.
- Where systems are subject to temperature and / or pressure loading, the fitting and the transmitter must meet the requirements.

The suitability of the materials of the fitting and the transmitter (e.g. chemical compatibility) must be checked by the system designer.

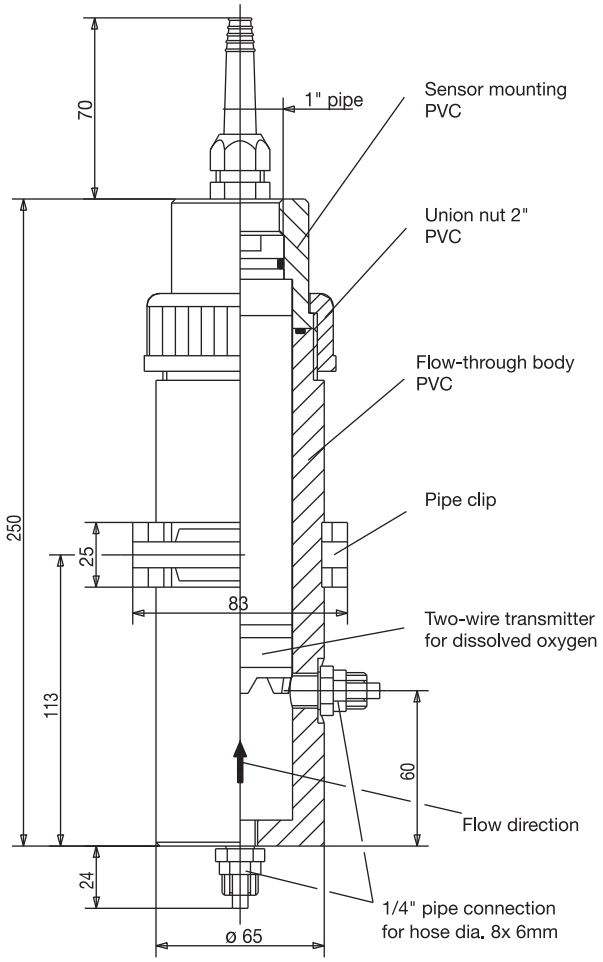
Flow-through fitting, angled seat

Material:	PVC
Permissible temperature:	+5 to +50°C
Safe pressure:	up to 1 bar
Connection:	solvent weld sockets
Process connection:	T-piece DN50, 45°
Part no.	00398137



Flow-through fitting, hose connection

Material:	housing PVC
	pipe clip PP
Permissible temperature:	+5 to +50°C
Safe pressure:	up to 1 bar
Connection:	G1/4 (1/4" pipe) for 8 x 6 mm hose dia.
Part no.	00398142



6 Assembly

6.3 Immersion fittings

Application

Immersion fittings are used to accommodate the dTRANS O2 01 oxygen transmitter. The fittings are installed in open containers or sluices using the pipe clips supplied. Different immersion depths are facilitated by various immersion lengths.

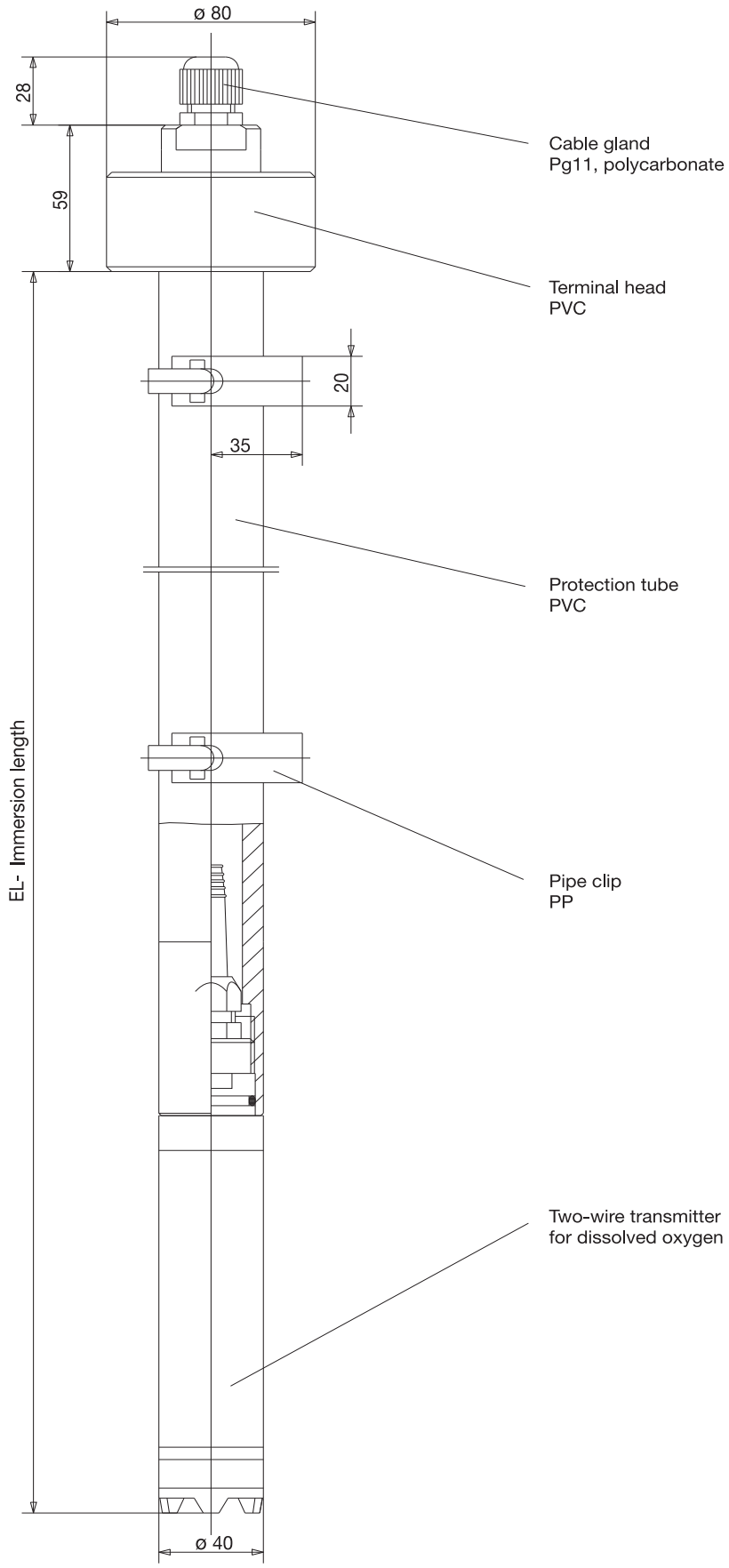
The following points should be noted at the design stage:

- The fitting must be easily accessible, to allow regular maintenance and cleaning of the transmitter or the fitting itself.
- The suitability of the materials of the fitting and the transmitter (e.g. chemical compatibility) must be checked by the system designer.

Immersion fitting

Material:	immersion tube PVC
	pipe clip PP
Permissible temperature:	+5 to +50°C
Safe pressure:	up to 1 bar
Cable gland:	Pg11
Protection:	IP65 EN 60 529
Immersion length:	500 mm
Part no.	00398131
Immersion length:	1500 mm
Part no.	00398135

see diagram on next page


ø 80
28
59
20
35
EL - Immersion length
ø 40
Cable gland
Pg11, polycarbonate
Terminal head
PVC
Protection tube
PVC
Pipe clip
PP
Two-wire transmitter
for dissolved oxygen

6 Assembly

6.4 Suspension fittings

Application

Suspension fittings are used to accommodate the dTRANS O2 01 oxygen transmitter. The fittings are primarily employed for measurement in open basins. The fitting can be positioned far from the edge of the basin, suspended from a chain by the shackle, for example. Different immersion depths are facilitated by various immersion lengths.

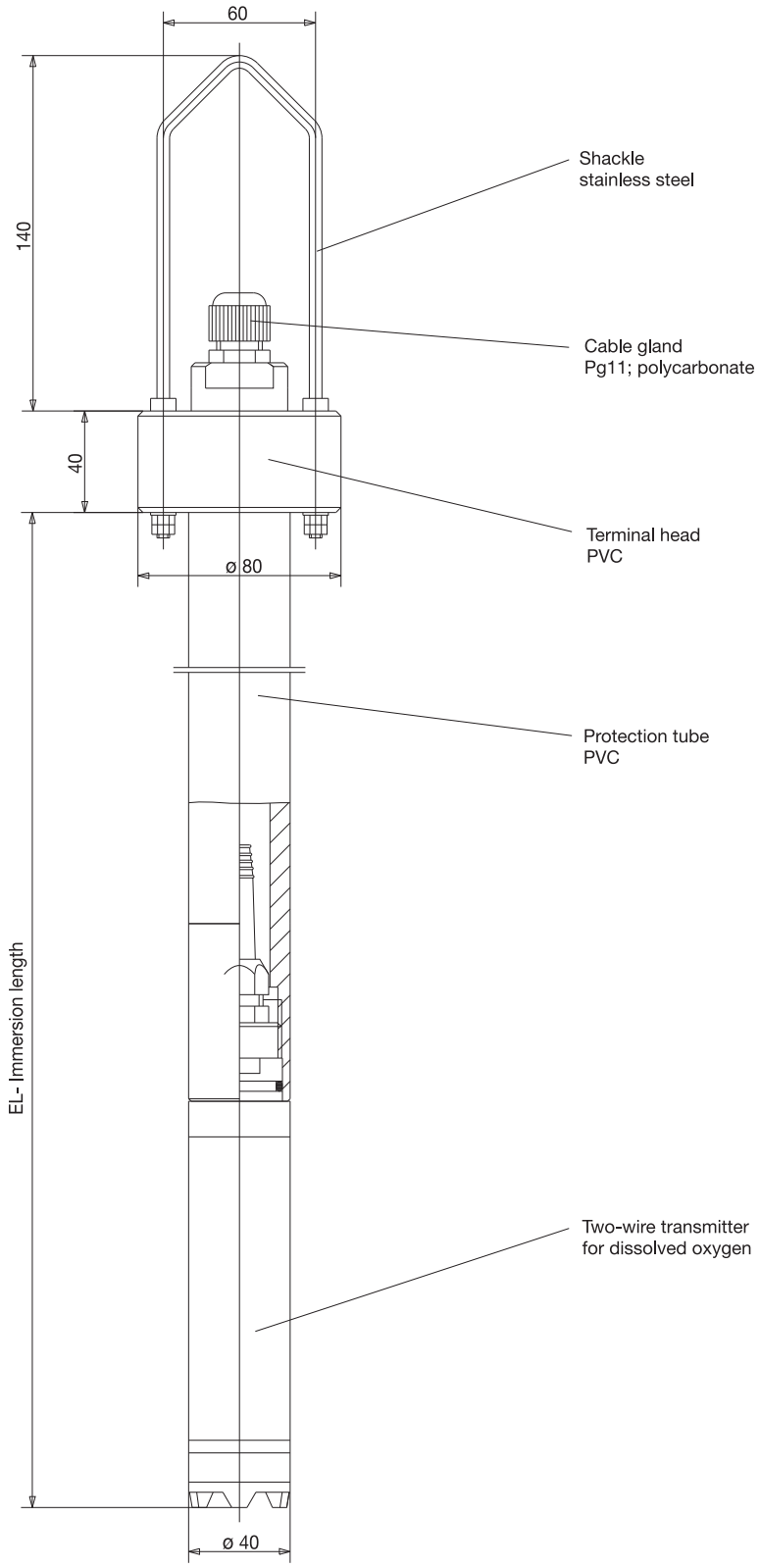
The following points should be noted at the design stage:

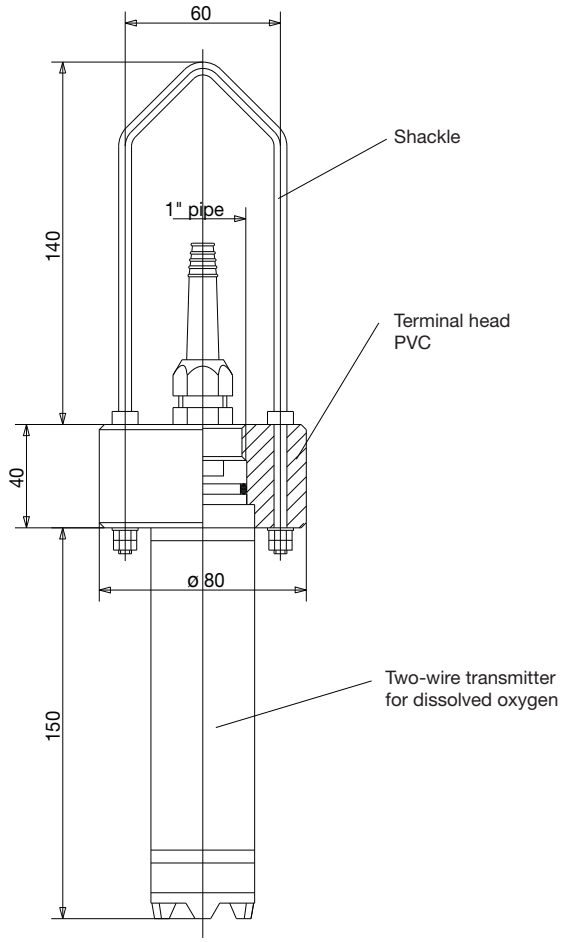
- The fitting must be easily accessible, to allow regular maintenance and cleaning of the transmitter or the fitting itself.
- The fitting (and with it the transmitter) must not strike the side of the basin as a result of pendular movements.
- The suitability of the materials of the fitting and the transmitter (e.g. chemical compatibility) must be checked by the system designer.

Suspension fitting

Material:	immersion tube PVC stainless steel shackle
Permissible temperature:	+5 to +50°C
Safe pressure:	up to 1 bar
Cable gland:	Pg11
Protection:	IP65 EN 60 529
Immersion length:	150 mm
Part no.	00398148
Immersion length:	500 mm
Part no.	00398143
Immersion length:	1500 mm
Part no.	00398144

see diagrams on the following pages


60
140
40
ø 80
ø 40
EL- Immersion length
Shackle
stainless steel
Cable gland
Pg11; polycarbonate
Terminal head
PVC
Protection tube
PVC
Two-wire transmitter
for dissolved oxygen



6.5 Float fittings

Application

Float fittings are used to accommodate the immersion fitting in which the dTRANS O2 01 oxygen transmitter is installed. The fittings are primarily used for measurement in open basins or waterbodies. Different immersion depths are facilitated by various immersion lengths of the fitting.

The following points should be noted at the design stage:

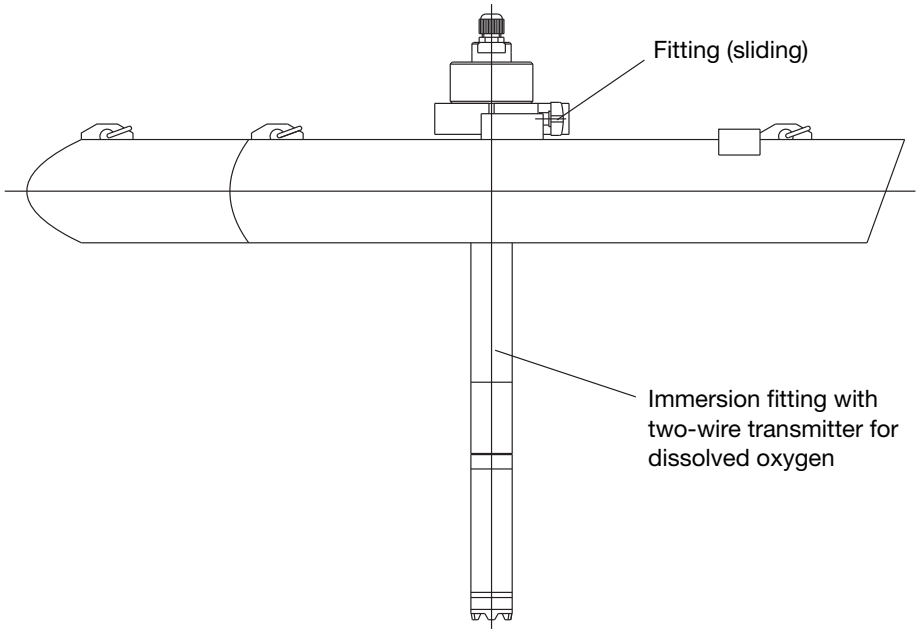
- The fitting must be easily accessible, to allow regular maintenance and cleaning of the transmitter or the fitting itself.
- When the depth of water fluctuates, it must be ensured that the fitting (and with it the transmitter) does not strike the bottom of the basin or waterbody when the water level is low.
- The suitability of the materials of the fitting and the transmitter (e.g. chemical compatibility) must be checked by the system designer.

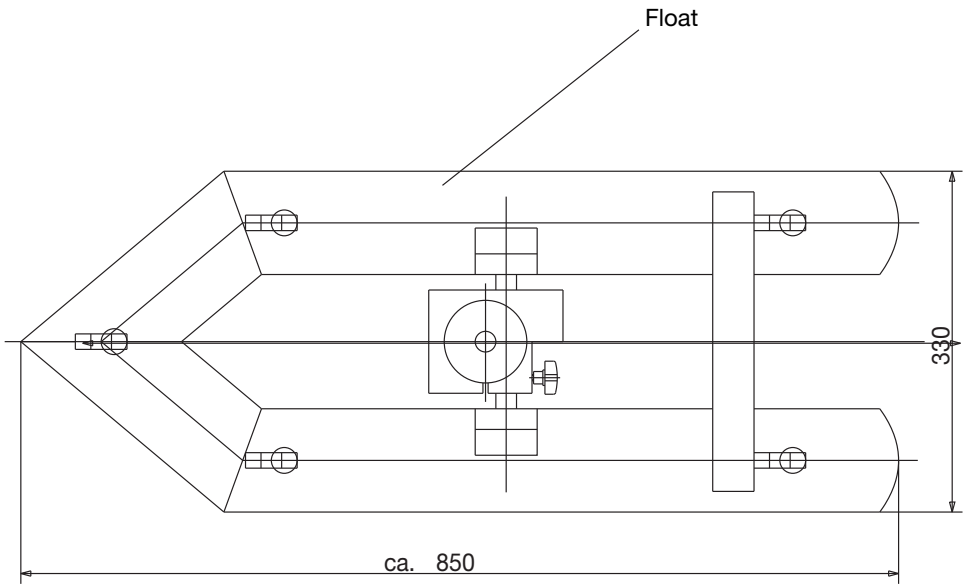
Float fitting

Material:	PVC
Permissible temperature:	+5 to +50°C
Fitting mounting:	40 mm
Part no.	00397483

Suitable immersion fitting

Immersion length:	500 mm
Part no.	00398131
Immersion length:	1500 mm
Part no.	00398135





6 Assembly

6.6 Support column with pedastal base, arm, chain and weather protection canopy

Application

This accessory is intended for installation at the edge of a basin. The dTRANS O2 01 oxygen transmitter is installed in a suspension fitting. Different immersion depths and distances from the edge of the basin are facilitated by the arm and the chain.

The weather protection canopy protects the terminal box or the operating unit from the effects of the weather.

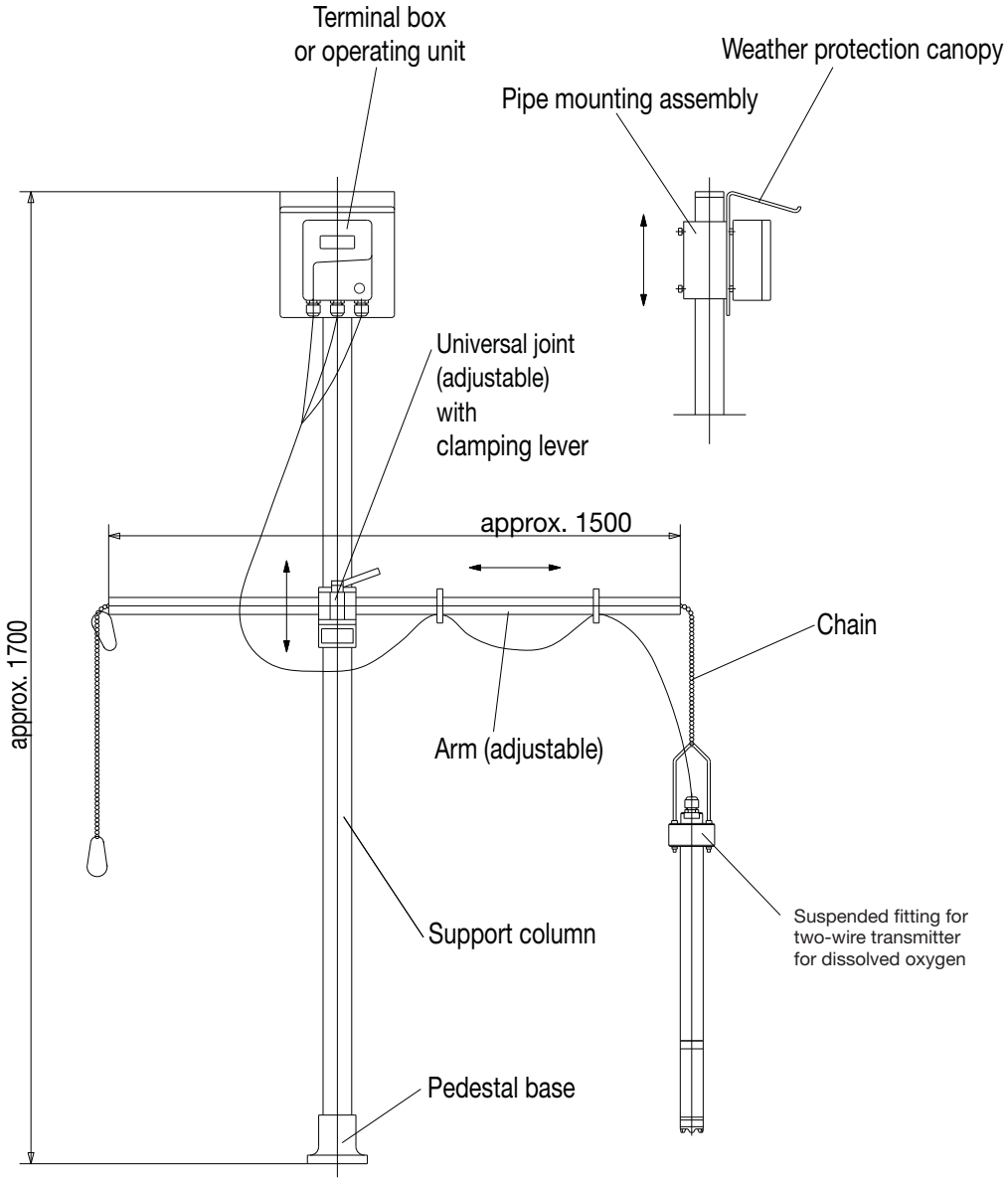
The pipe mounting assembly can be used to mount the terminal box or the operating unit on a pipe (diameter 30 — 50 mm).

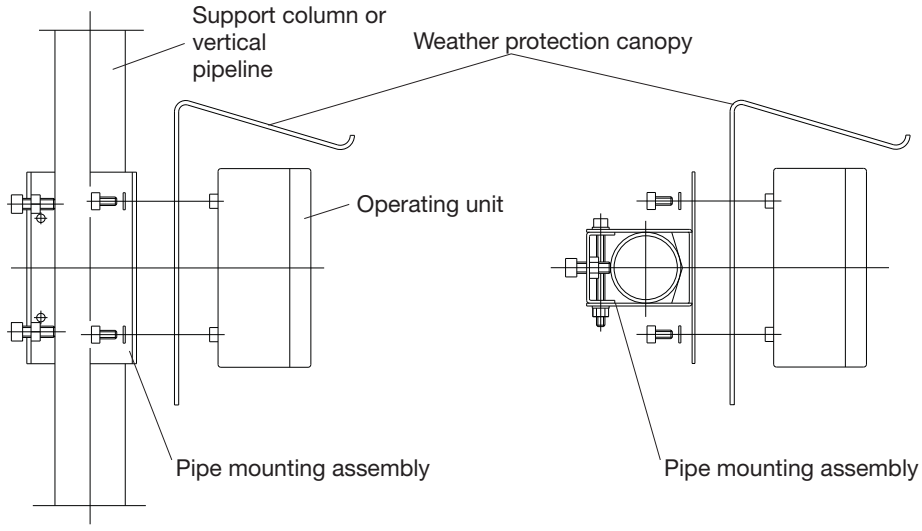
The following points should be noted at the design stage:

- The fitting must be easily accessible, to allow regular maintenance and cleaning of the transmitter or the fitting itself.
- The fitting (and with it the transmitter) must not strike the side of the basin as a result of pendular movements.
- The operating unit must not be exposed to direct sunlight.
- The suitability of the materials of the fitting and the transmitter (e.g. chemical compatibility) must be checked by the system designer.

Support column with pedestal base, arm, chain	Material:	Column	stainless steel
		Pedestal base	die-cast aluminium
		Arm	stainless steel
		Chain	stainless steel
		Universal joint	die-cast aluminium
	Part no.	00398163	
Pipe mounting assembly	Material:	stainless steel	
	Part no.	00398162	
Weather protection canopy	Material:	stainless steel	
	Part no.	00398161	
Suspension fitting	Material:	see previous section	
	Part no.	00398143 or 00398144	

see diagram on next page


Terminal box
or operating unit
Weather protection canopy
Pipe mounting assembly
Universal joint
(adjustable)
with
clamping lever
approx. 1500
approx. 1700
Chain
Arm (adjustable)
Support column
Suspended fitting for
two-wire transmitter
for dissolved oxygen
Pedestal base


Support column or
vertical
pipeline
Weather protection canopy
Operating unit
Pipe mounting assembly
Pipe mounting assembly

6 Assembly

6.7 Terminal box / operating unit

Installation site

- ✱ Make sure that the site is readily accessible, for calibration at a later time.
- ✱ The fixing must be secure and free from vibration.
- ✱ Avoid direct sunlight.

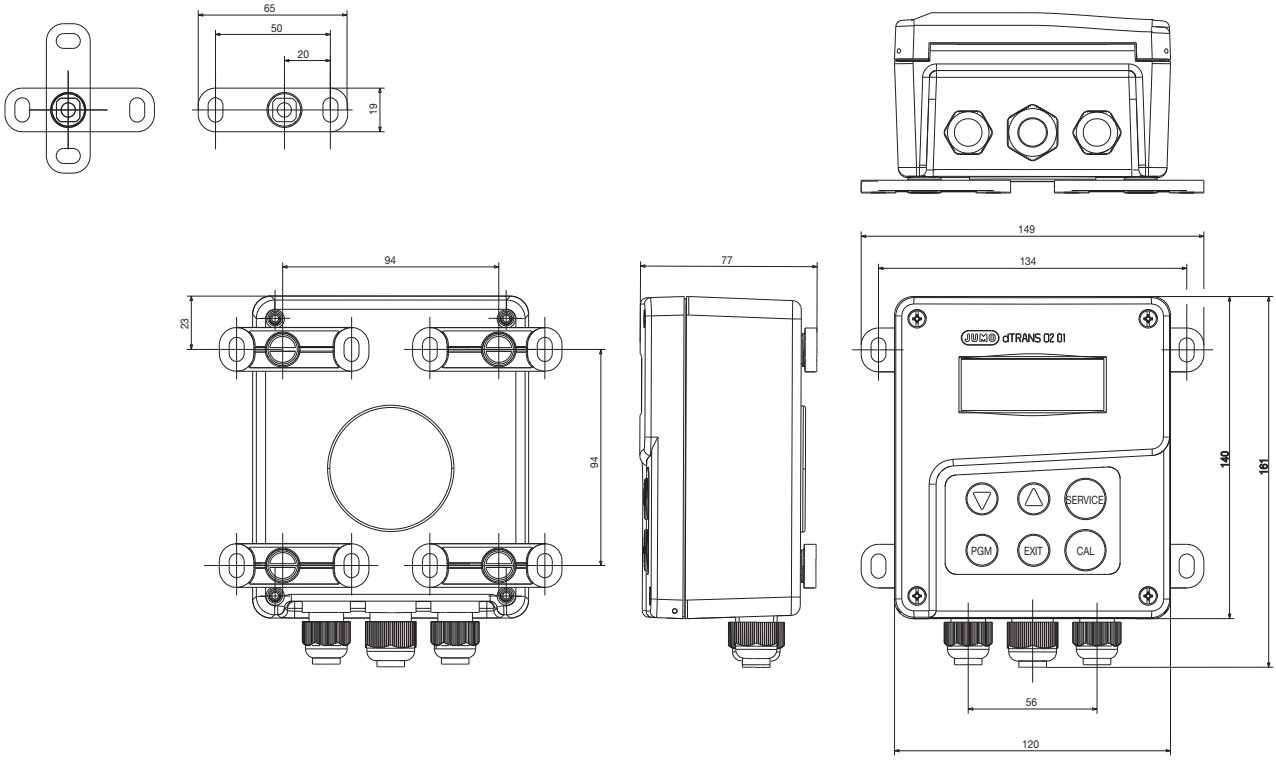
Drilling template

A drilling template is included in these operating instructions (last page), to mark out for wall mounting **without fixing brackets** .

Wall brackets

(included in delivery)

- ✱ Screw the four fixing brackets onto the terminal box / operating unit. The fixing brackets can be rotated in 90° steps.
- ✱ Mount the terminal box / operating unit to a wall or plate by the fixing brackets (using screws, dowels or similar).



Weather protection canopy

(option)

Wall mounting:

The weather protection canopy is mounted between the terminal box / operating unit and the wall.

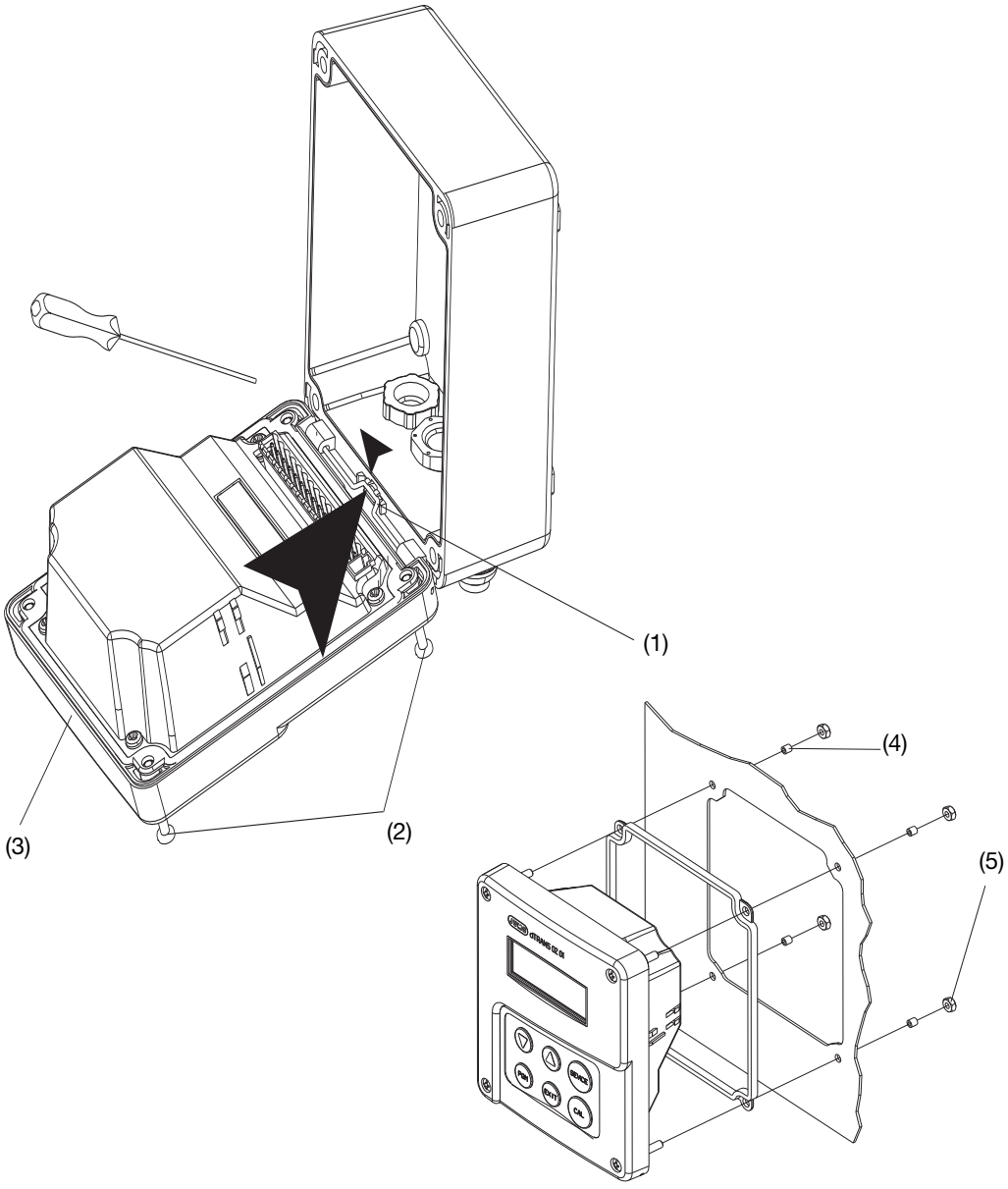
Pipe mounting:

The weather protection canopy is mounted between the terminal box / operating unit and the pipe mounting assembly.

Pipe mounting (option)

Using the pipe mounting assembly, the terminal box / operating unit (and, if required, the weather protection canopy) can be mounted on pipes or railings with diameters from 30 to 50 mm.

Panel mounting For panel mounting, only the the top of the housing is installed.



- ✱ Remove four screws (2) and open cover (3).
- ✱ Lift spring (1) with screwdriver and push it sideways.
- ✱ Tilt cover (3) to one side and push it off the spring (1).
- ✱ Prepare panel cut-out and drilled holes according to the drilling template enclosed.
- ✱ Insert cover (3) in panel and fix it using the screws (2) and the bushes (4) and nuts (5) that are included in the delivery.

7 Installation

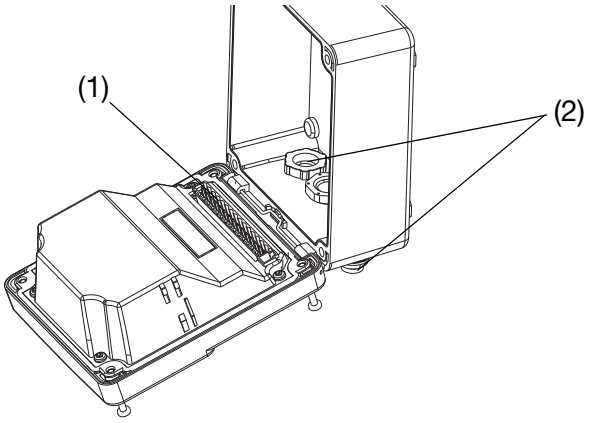
The electrical connection must only be carried out by qualified personnel!

- ❏ The choice of cable, the installation and the electrical connection must conform to the requirements of VDE 0100 “Regulations on the Installation of Power Circuits with Nominal Voltages below 1000 V” or the appropriate local regulations.
- ❏ The electrical connection must only be carried out by properly qualified personnel.
- ❏ If contact with live parts is possible while working on the unit, it must be completely disconnected from the supply.
- ❏ The electromagnetic compatibility conforms to EN 61 326.
- ❏ Run input, output and supply cables separately and not parallel to one another.
- ❏ Sensor and interface cables should be shielded cables with twisted conductors. Do not run them close to current-carrying components or cables. Ground shielding at one end, to the TE terminal on the instrument.
- ❏ The TE terminal on the instrument must be earthed. This cable must have at least the same cross-section as used for the supply cables. Earth cables must be wired in a star configuration to a common earth point that is connected to the protective earth of the supply. Do not loop earth cables, i.e. do not run them from one instrument to another.
- ❏ The instrument is not suitable for use in areas with an explosion hazard (Ex areas).
- ❏ Apart from faulty installation, incorrect settings on the instrument may also affect the proper functioning of the subsequent process or lead to damage.
- ❏ Please observe the national earthing regulations for metallic support columns and fittings!

7.1 General

Opening the terminal box / operating unit

⇨ "Panel mounting", page 29.

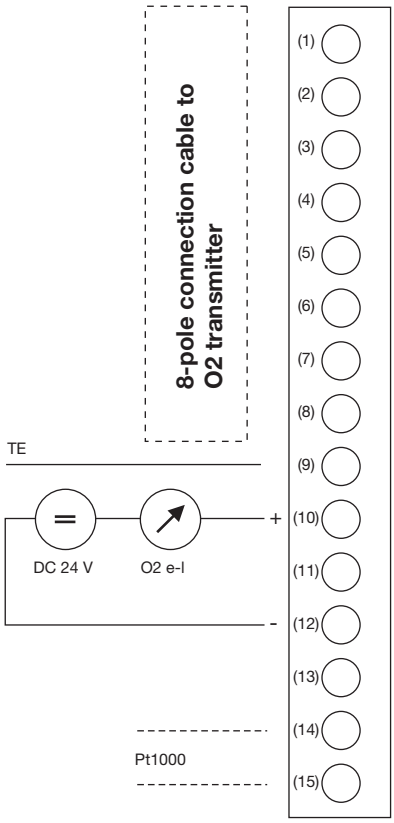


To connect the single conductors, pull off the pluggable screw terminals (1) in the terminal box / operating unit.

Feed the connection cables through the Pg glands (2).

7.2 Basic version (terminal box)

Connection diagram

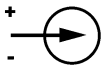
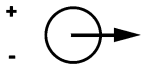


7 Installation

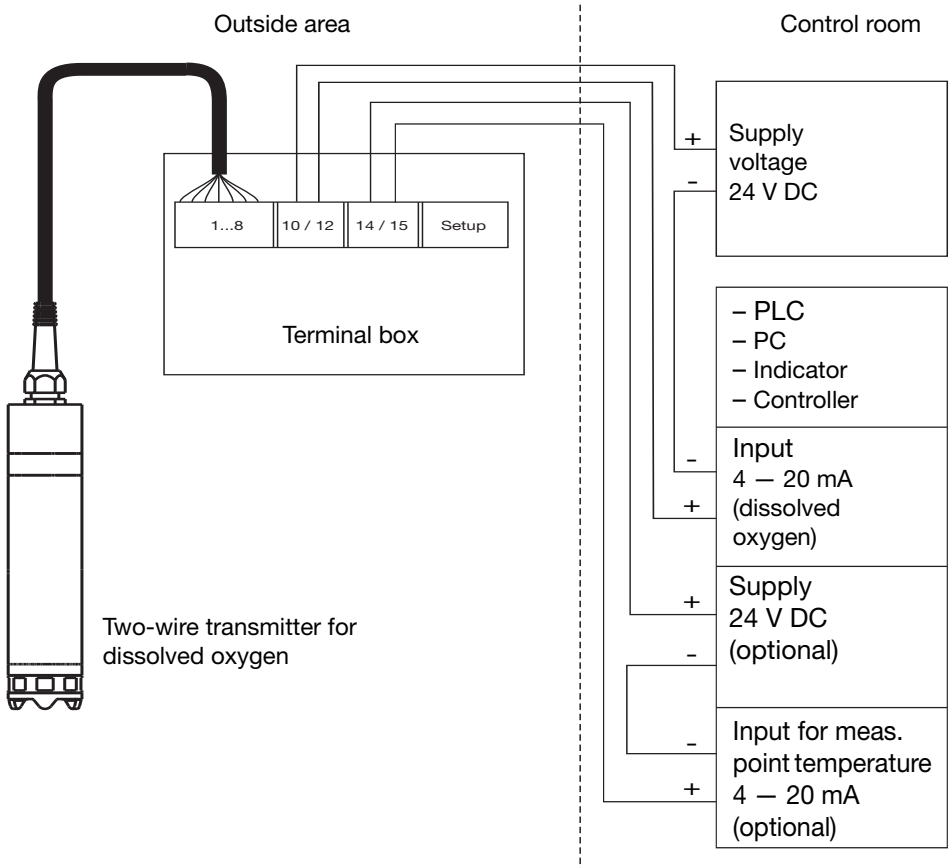
Terminal assignment of the two-wire transmitter

Color	Terminal in terminal box	Signal
Pink	1	RXD
Green	2	GND
Yellow	3	TXD
White	4	b Pt1000
Brown	5	a Pt1000
Red	6	+e / -I
Blue	7	-e / -I
Screen	8	
Gray	11	start CAL

Terminal assignment of the terminal box

Connection	Screw terminals
Supply 19 — 31 V DC 	10 L+ 12 L-
Input (from two-wire transmitter for dissolved oxygen) 	1 2 3 4 5 6 7 8 11
Output (dissolved oxygen) 4 — 20 mA 2-wire Proportional 4 — 20 mA current in supply 	10 L+ 12 L-
Output (measurement point temperature) Pt1000 Resistance signal 	14+ 15-

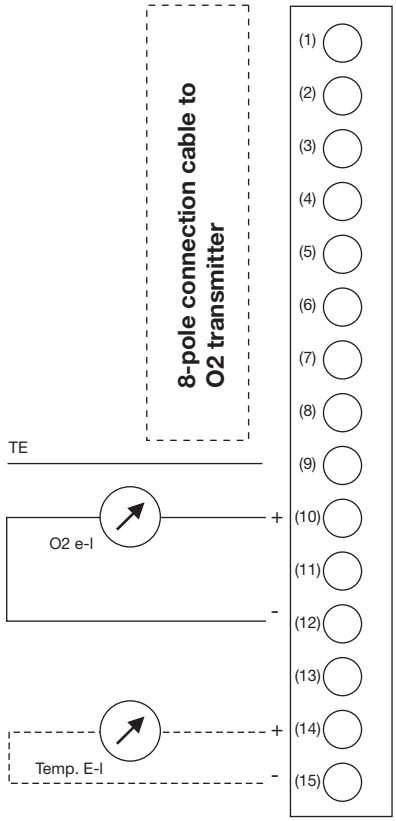
Connection


Outside area
Control room
1...8
10 / 12
14 / 15
Setup
Terminal box
Two-wire transmitter for dissolved oxygen
+
-
Supply voltage 24 V DC
– PLC
– PC
– Indicator
– Controller
-
+
Input 4 — 20 mA (dissolved oxygen)
+
-
Supply 24 V DC (optional)
-
+
Input for meas. point temperature 4 — 20 mA (optional)

7 Installation

7.3 Standard version (operating unit)

Connection diagram



Terminal assignment of the two-wire transmitter

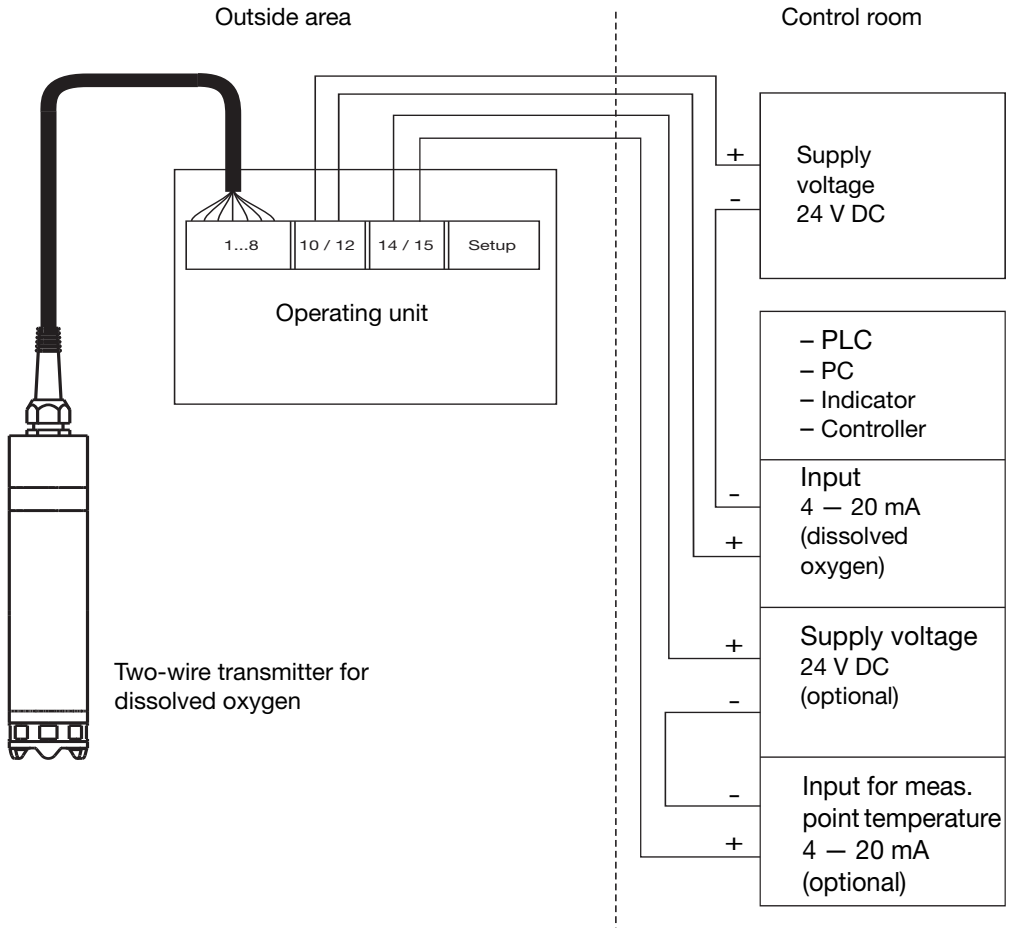
Color	Terminal in operating unit	Signal
Pink	1	RXD
Green	2	GND
Yellow	3	TXD
White	4	b Pt1000
Brown	5	a Pt1000
Red	6	+e / -I
Blue	7	-e / -I
Screen	8	
Gray	open, do not connect to terminal	NC

Terminal assignment of the operating unit

Connection	Screw terminals
Supply 19 — 31 V DC Transmitter for dissolved oxygen	10 L+ 12 L-
Supply (optional) 19 — 31 V DC Transmitter for measurement point temp.	14 L+ 15 L-

Connection	Screw terminals
Input (from two-wire transmitter for dissolved oxygen)	1 2 3 4 5 6 7 8
Output (dissolved oxygen) 4 — 20 mA 2-wire Proportional 4 — 20 mA current in supply	10 L+ 12 L-
Output (measurement point temperature) Proportional 4 — 20 mA current in supply	14+ 15-

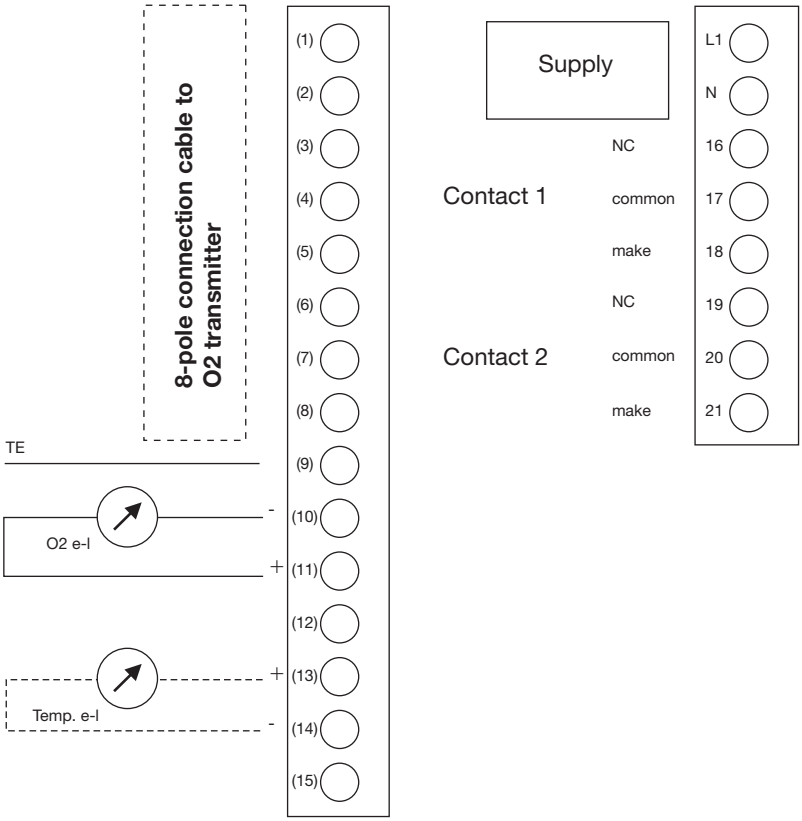
Connection



7 Installation

7.4 Maximum version (operating unit with own PSU)

Connection diagram



Terminal assignment of the two-wire transmitter

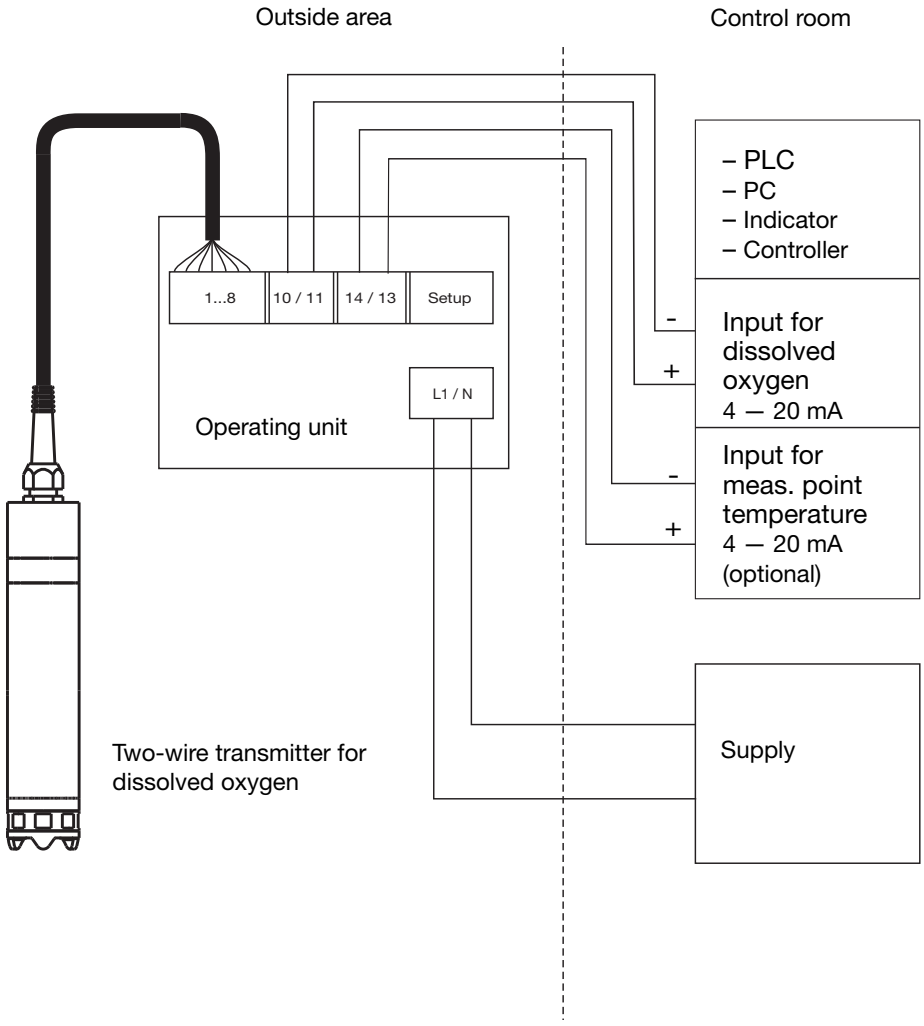
Color	Terminal in operating unit	Signal
Pink	1	RXD
Green	2	GND
Yellow	3	TXD
White	4	b Pt1000
Brown	5	a Pt1000
Red	6	+e / -I
Blue	7	-e / -I
Screen	8	
Gray	open, do not connect to terminal	NC

Terminal assignment of the operating unit

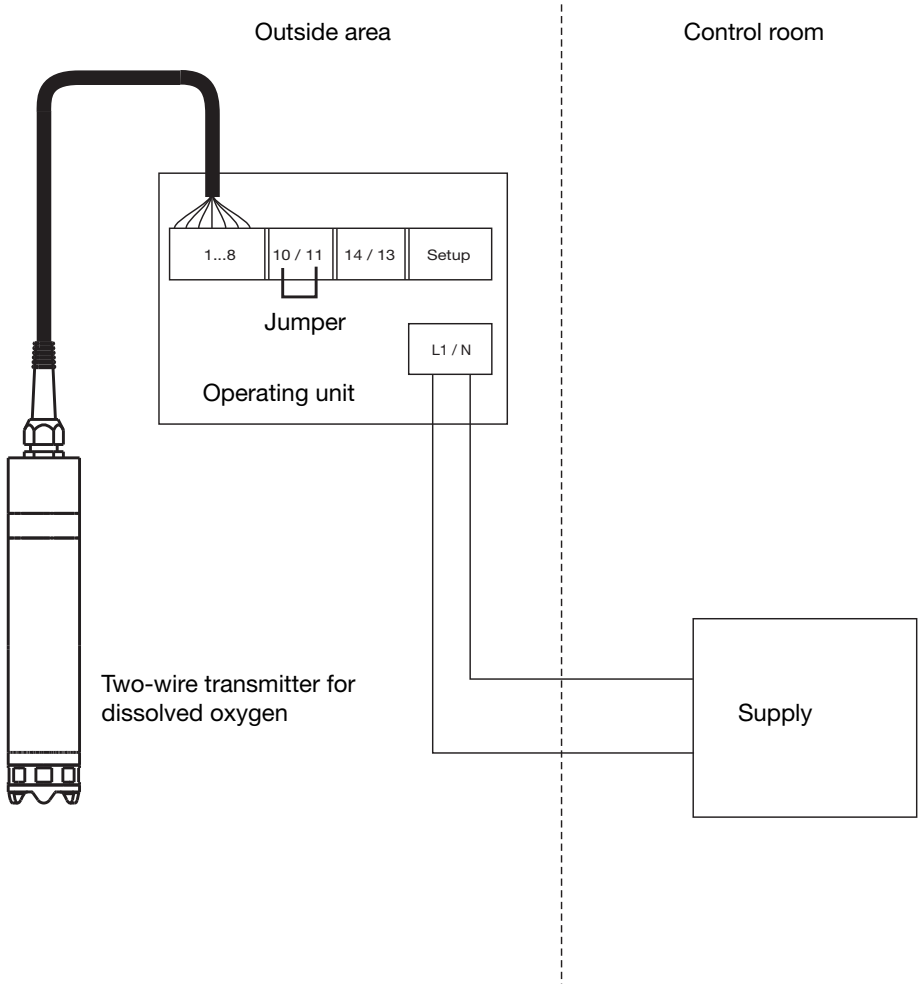
Connection	Screw terminals
Supply 110 — 240 V AC, +10%/-15%, 48 — 63 Hz 20 — 53 V AC/DC, 48 — 63 Hz	L1 N

Connection	Screw terminals
Input (from two-wire transmitter for dissolved oxygen)	1 2 3 4 5 6 7 8
Output (dissolved oxygen) 4 — 20 mA 2-wire The current loop must always be closed; either by means of a recording instrument or similar, or a jumper between the terminals 10 and 11.	10 L- 11 L+
Output (measurement point temperature) 4 — 20 mA 2-wire	13 L+ 14 L-

Connection



Connection (stand alone)



8.1 Function

Configurable parameters

The setup program, which is available as an option, can be used to adapt the transmitter to specific requirements.

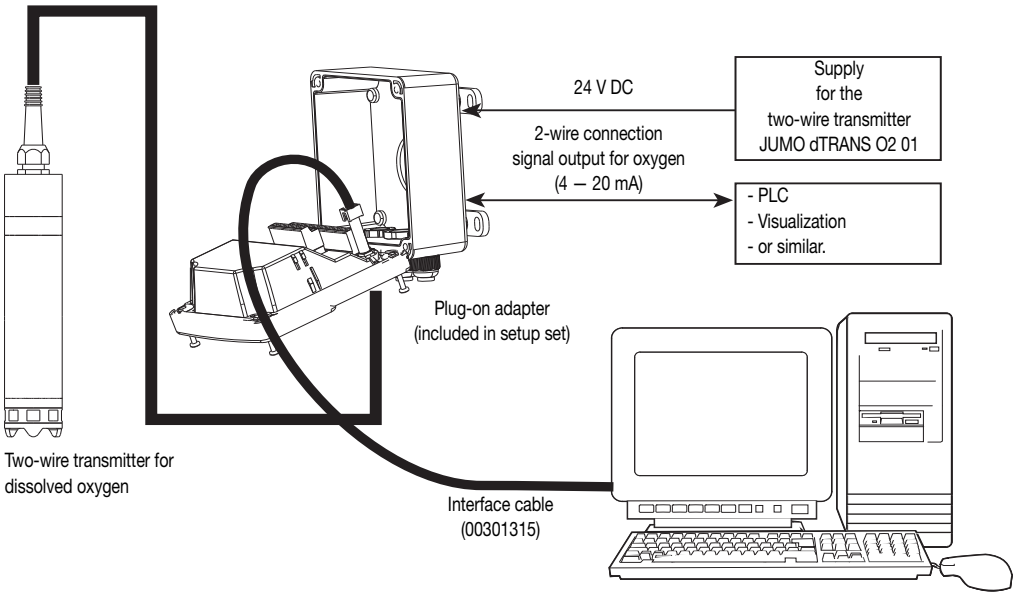
- Setting the measurement unit (mg/liter or %).
- Setting the mean atmospheric pressure or the height a.m.s.l.
- Setting the salinity (salt content)
- Setting the range limits
- Setting the response of the output to out-of-range
- Description of the measurement point (19-character TAG number).
- Setting the functions of the limit comparators (lk).
- Setting the digital filter.
- Setting or checking the slope of the sensor module.
- etc.

Data transmission from or to the transmitter can only take place when it is connected to the supply ⇨ Chapter 7 “Installation”, page 30ff.

Connection

The setup interface and the analog output are electrically isolated. When connecting the PC interface cable, it is absolutely essential to ensure that either the supply of the transmitter or of the PC is **not** galvanically coupled to the earth (e.g. use a battery-powered notebook).

If no power supply (supply isolator) is available, the two-wire transmitter can be configured using a 9 V battery as a power source.



9 Commissioning

9.1 Starting up

The transmitter has been tested in the factory for fault-free functioning and is delivered ready for operation.

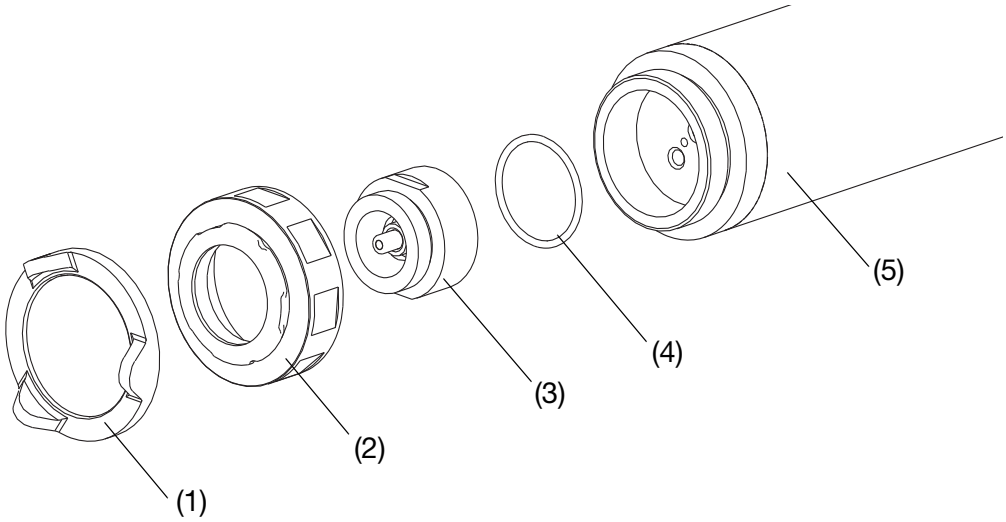
The membrane (3) must not be touched or made dirty!

In the course of normal operation, a grayish-white deposit may form on the anode of the sensor module. This deposit does **not** affect the proper functioning of the measuring cell.

Pressure fluctuations in the measured medium will affect the output signal!

Preparing for calibration

* Unscrew ring (2) with protection basket (1) from transmitter (5).
* Take sensor module (3) out of the packaging and mount it on the transmitter (5). Note the seal (4)!
* Screw ring (2) with protection basket (1) onto transmitter (5).



* Connect supply,
  ⇨ Chapter 7 “Installation”, page 30ff.
* Wait for the sensor module to run in (approx. 2hrs)
  If the measurement is carried out in an area of low oxygen concentration, the run-in time may be considerably longer, since the excess oxygen in the electrolyte of the cell has to be used up first.

Oxygen cells must be "run in" before calibration. This means that the cell is connected to the transmitter and then continuously operated in air that is saturated with water vapor until the reading no longer changes.

Note: The vapor-saturated air is several centimeters above the water surface. The oxygen cell should be as close as possible to the surface of the water but **must not** get wet !

Calibrating only makes sense when the measurement has sufficiently stabilized. If an oxygen cell is calibrated that has not been completely run in, then an incorrect slope will be used for the subsequent calculation of the measurements. To prevent this from happening, the transmitter monitors the signal stability of the oxygen cell during calibration. If the signal drift is too large during calibration, or when a sensor slope of more than 150% is calculated, an error message will be generated and the calibration canceled.

Depending on the age, pretreatment and storage conditions, the oxygen cells, in their original packaging, may require different run-in times. This is **not** a defect.

While the oxygen cell is being run in, the oxygen, which reaches the cathode from the electrolyte, will be used up by the reduction at the cathode. Afterwards, only the oxygen will be acquired that has reached the sensor cathode from the sample medium. During the run-in time, the oxygen cell will measure an excessive oxygen concentration. Under unfavorable circumstances, running in may take several hours.

If, after the end of the calibration, the instrument calculates a sensor slope of more than 150%, the calibration will be considered as unsuccessful and the result discarded.
The run-in time should be extended until a constant measurement is displayed.

Temperature	Oxygen content in water with an air ressure of 101.325 kPA
0°C	14.62 mg/l
0°C	12.77 mg/l
10°C	11.29 mg/l
15°C	10.08 mg/l
20°C	9.09 mg/l
25°C	8.26 mg/l
30°C	7.56 mg/l
35°C	6.94 mg/l
40°C	6.41 mg/l

✱ Calibrate instrument,
⇨ Chapter 10 “Calibration”, page 42ff.

✱ For high-precision measurements, repeat calibration after 24 hrs.

10 Calibration

10.1 General

When to calibrate?

- during commissioning
- when the sensor module is replaced
- after lengthy breaks in operation without supply voltage

Application-specific calibration cycles

- drinking water: 1 to 6 months
- monitoring of waterbodies (river or lakes): 1 to 4 months
- municipal effluents: 2 weeks up to 3 months
- industrial effluents: 1 week to 2 months

In many cases, it will be sufficient to clean the transmitter head,
⇨ "Cleaning", page 58.
Pressure fluctuations in the measured medium will affect the output signal!

10.2 Calibrating

General

The transmitter is matched to the specific characteristics of the sensor module during calibration.

Since the measuring system of this transmitter does not require zero-point calibration, calibration is performed as single-point calibration.

Calibration can generally be carried out in two ways:

- in vapor-saturated air, i.e. in close proximity to the water surface. The sensor **must**, however, remain **dry**!
- in air-saturated water. For this, the water is aerated until it is saturated with air.

Air calibration

As it is rather involved to produce air-saturated water and difficult to reproduce, the simpler method of air calibration is recommended for industrial measurements.

Preconditions

- Transmitter, terminal box / operating unit and indicator must be connected and powered.
  ⇨ Chapter 7 “Installation”, page 30ff.
- The sensor module (membrane and/or the optional protective film) is **clean and dry** on the outside.
- The transmitter is in the air, as close as possible to the water surface.

The sensor **must** remain **dry** during calibration!

Calibrating

The membrane must not be damaged!

The measurement signal may change during calibration! Control devices or PLCs operated by the transmitter may react in an undesirable manner! The output signal will be set to the value (normally 18 mA) that has been defined as the service current.

* Remove transmitter from the sample liquid.
* Clean the transmitter externally with a moist cloth or sponge, then dry it (particularly the membrane). Likewise, remove any dirt or moisture between the sensor module and the protective membrane.
* Position the transmitter just above the surface of the water and wait for the transmitter temperature-compensation time (about 20 minutes) to elapse. Avoid direct sunlight.
* After removal of the transmitter from pressurized systems, wait for the output signal to stabilize.
* When the **output signal has stabilized**, start calibration by pressing the CAL key. Keep the key pressed down for more than 2 seconds. The output signal will be set to the value (normally 18 mA) that has been defined as the service current. The calibration procedure is performed automatically, takes up to 15 minutes and ends automatically.

The transmitter for dissolved oxygen switches over to saturation measurement (%) during the calibration procedure.

The LC display (on the standard or maximum version) shows CALIB.

If the setup program is active at the same time, the measurement display will change from mg/l to %. At the end of the calibration, 100% will not necessarily be indicated, since the old value for the slope is active during calibration.

Successful calibration for the version without display

When the calibration has been completed successfully, the two-wire transmitter for dissolved oxygen goes into the measurement mode (mg/l). At a water temperature of 20°C, an oxygen content of about 9 mg/l will be displayed. The output signal for the measurement range (where 0 — 20 mg/l corresponds to 4 — 20 mA) will be approx. 11.2 mA.

Successful calibration for the version with display

* Press PGM - the freshly determined sensor slope is accepted and the calibration is completed.

Pressing EXIT will cancel the calibration; the original value for the sensor slope is retained.

10 Calibration

Calibration unsuccessful

If no stable value is produced within 15 minutes after pressing the CAL key, the two-wire transmitter for dissolved oxygen will remain in the service mode. The output current will remain at the value defined as the service current (factory-set to 18 mA).

Basic version:

* Press CAL key briefly (about 1 sec). The old calibration data will be restored and the two-wire transmitter for dissolved oxygen will again go into the measurement mode (with the old calibration data).

Standard and maximum versions:

The LC display signals ERROR.

* Keep the EXIT pressed down. The old calibration data will be restored and the two-wire transmitter for dissolved oxygen will go into the measurement mode again.
* Restart the calibration by pressing the CAL key. Keep the key pressed down for more than 2 seconds. The output signal will be set to the value (normally 18 mA) that has been defined as the service current.
* After repeated unsuccessful calibration, the sensor module will have to be replaced.
  ⇨ Chapter 12.2 “Replacing the sensor module”, page 59.

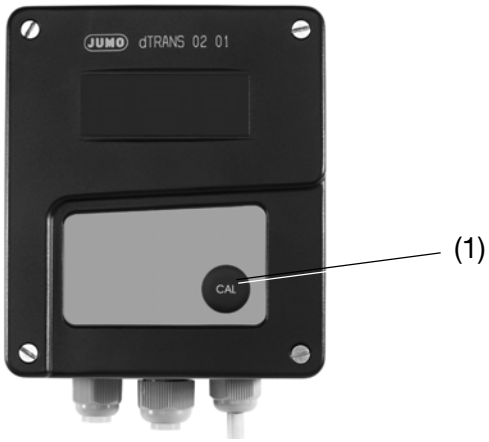
Cancel calibration

Only possible on the standard and maximum versions.

* Press the EXIT key.

11.1 Function

Front view of basic version



(1) CAL key, to start calibration

Front view of standard / maximum version

(1) PGM key
Confirm entries / step on with parameters

(2) EXIT key
cancel entry without saving; cancel calibration

(3) DOWN key
decrease value / step on with selection

(4) UP key
increase value / step on with selection

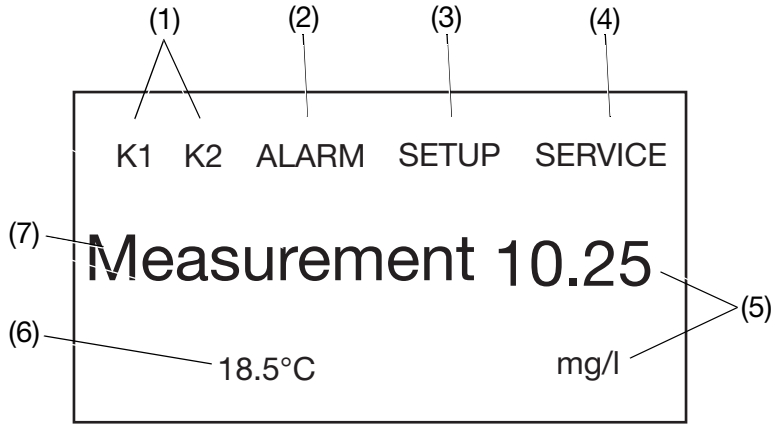
(5) LC display

(6) SERVICE key
call up service function

(7) CAL key
start calibration

11 Operation

11.2 Display in measurement mode



(1) Status display of configured contacts K1 and K2.
If the characters are visible, the corresponding contact is activated.

(2) Indicates present alarm states (e.g. calibration alarm, measurement out-of-range).

(3) Signals that the setup cable is connected.

If DATA appears here, only the transmitter and the PC are communicating. There is no communication between transmitter and operating unit.

In the SETUP or DATA status, the measurements are not updated in the LC display.

(4) The instrument is in the service mode. The output current for dissolved oxygen has reached the value that was previously configured and is kept constant.

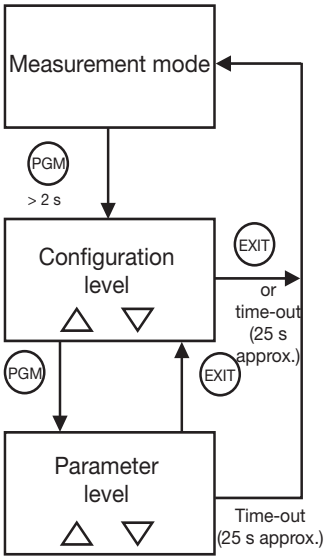
(5) The measurement and the unit are shown here.

(6) In this area, the measured temperature of the medium and the unit are shown.

(7) The present operational state of the transmitter (measurement or calibration) is shown here.

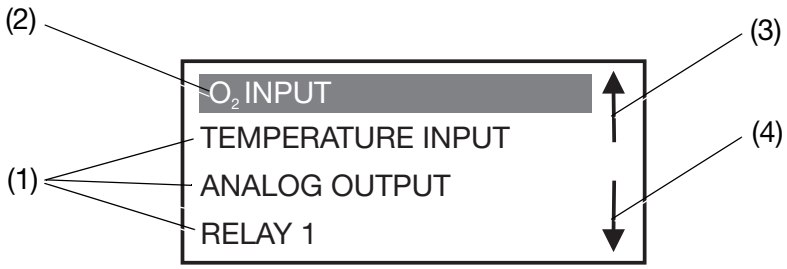
11.3 Principle of operation

Operation within levels



11.4 Configuration level

Operation



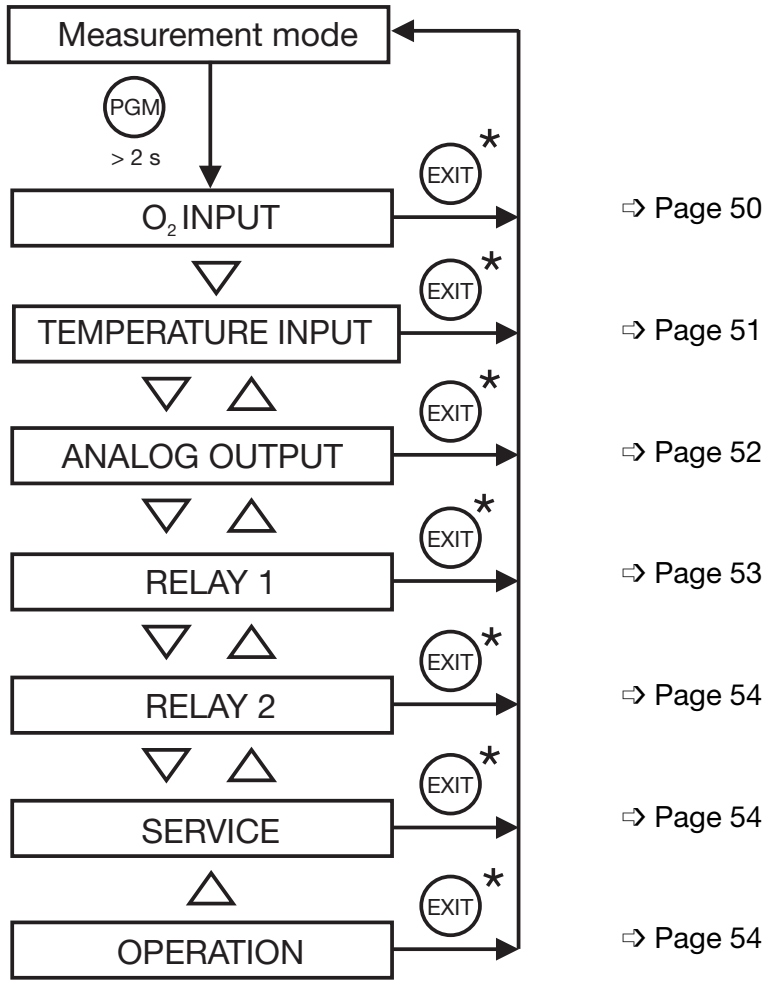
(1) Additional parameters that can be selected

(2) Configuration parameter whose settings can be selected via the PGM key and then altered (inverse display).

(3) Arrow pointing up; appears when the UP key can be used to select additional parameters above the ones shown.

(4) Arrow pointing down; appears when the DOWN key can be used to select additional parameters beneath the ones shown.

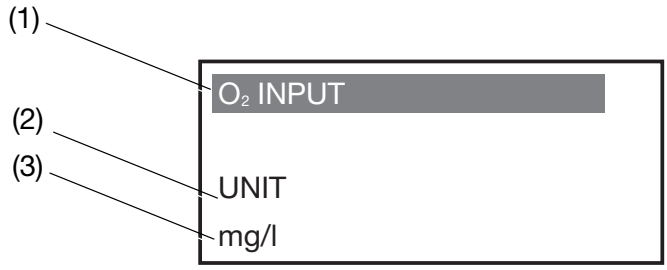
Settings at the configuration level



* or time-out (about 25 sec)

11.5 Parameter level

Operation

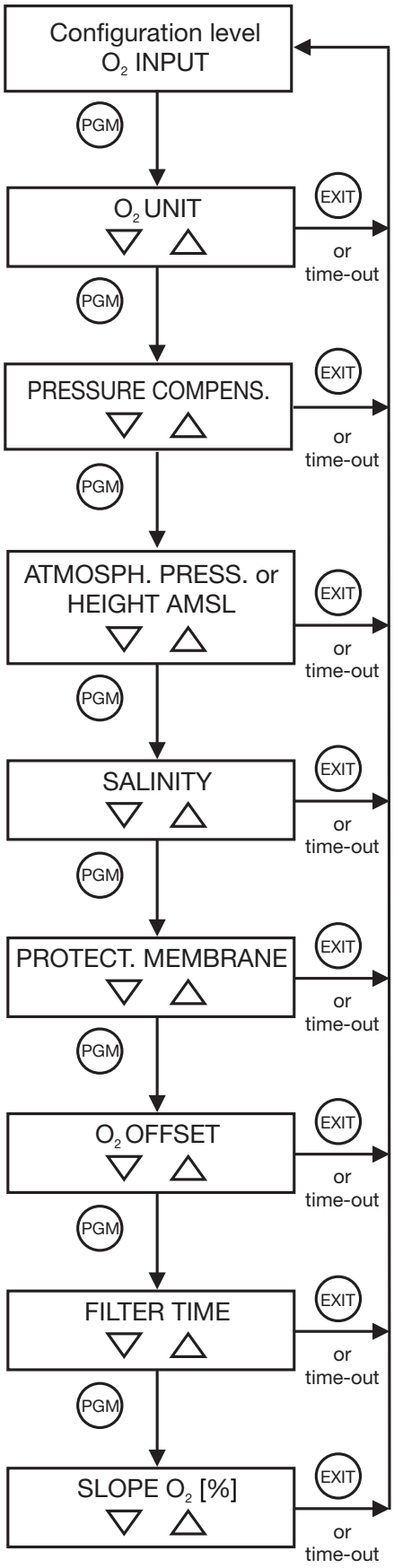


(1) The parameter that was selected at the configuration level

(2) The parameter that can be altered at the parameter level.
Step on to the next parameter with PGM

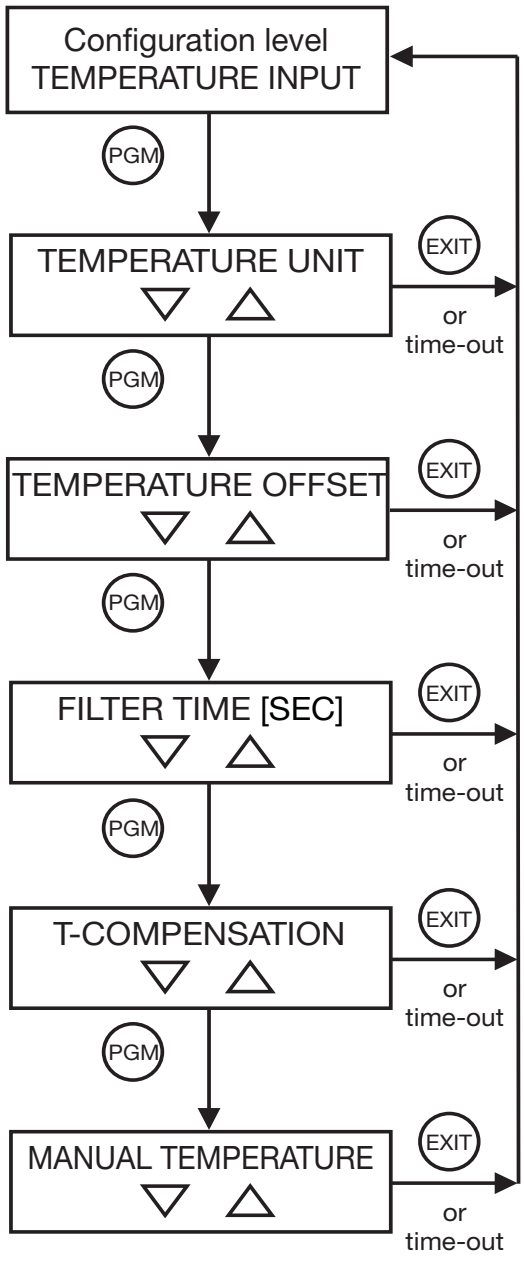
(3) Selection option between different settings or alterations of values using the UP or DOWN key. Confirm with PGM.

Settings at the parameter level O_2 INPUT



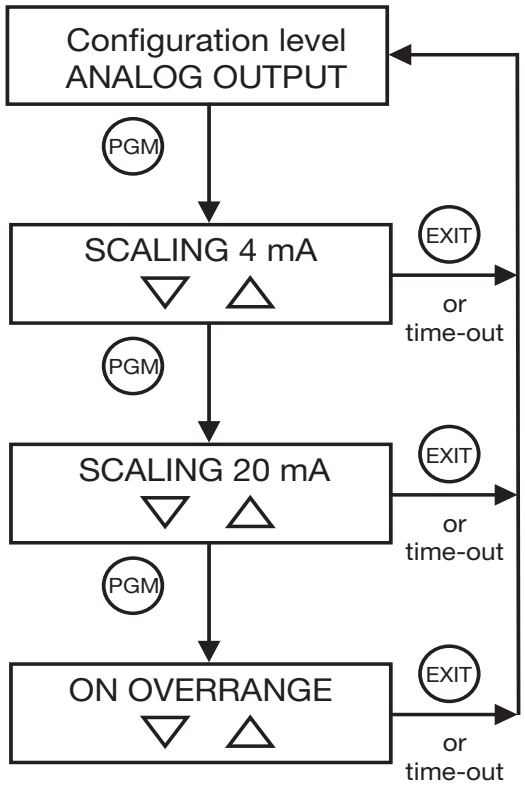
	Selection / value range	Standard
O_2 UNIT	mg/l or %	mg/l
PRESSURE COMPENS.	ATMOSPHERIC PRESSURE or HEIGHT a.m.s.l.	ATMOSP. PRESS-URE
ATMOSPH. PRESS. or HEIGHT AMSL	500 — 1500 hPa or 0 — 3000 m	976 hPa or 300 m
SALINITY	0 — 100%	0
PROTECT. MEMBRANE	NO or YES	NO
O_2 OFFSET	-5.0 — 5.0	0.0
FILTER TIME	0.0 — 100.0	3.0
SLOPE O_2 [%]	50.0 — 200.0	100.0

Settings at the parameter level TEMPERATURE INPUT



	Selection / value range	Standard
TEMPERATURE UNIT	°C or °F	°C
TEMPERATURE OFFSET	-5.0 to 5.0 °C	0.0
FILTER TIME [SEC]	0.0 — 100.0	1.0
T-COMPENSATION	AUTOMATIC or CONSTANT	AUTO-MATIC
MANUAL TEMPERATURE	-10.0 to 60.0°C	18.0

Settings at the parameter level ANALOG OUTPUT

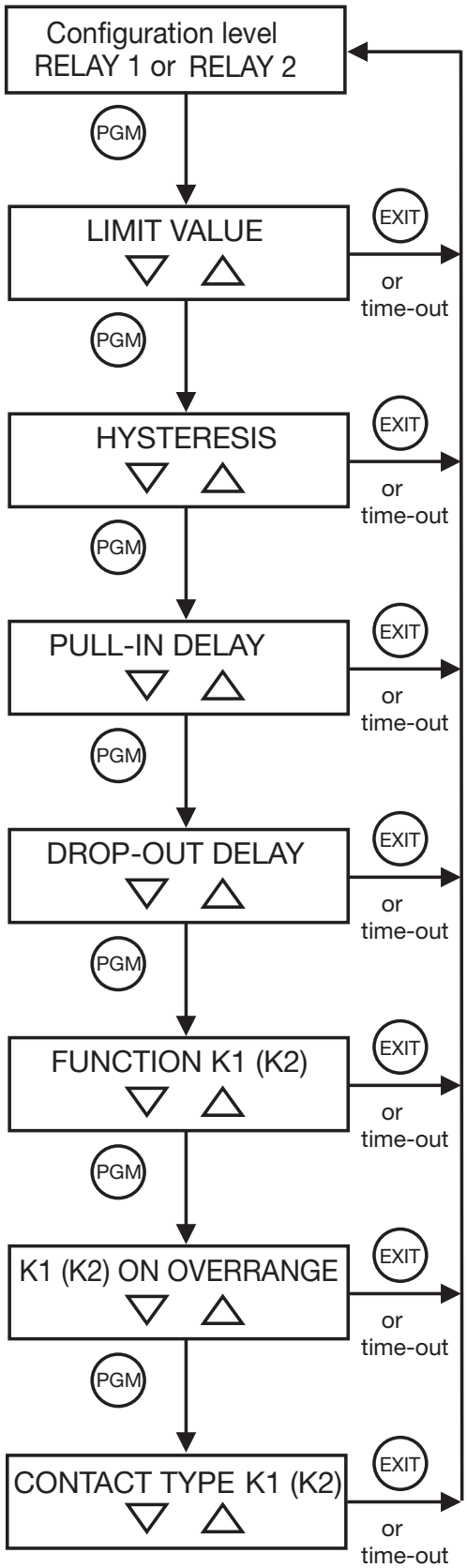


	Selection / Value range	Standard
SCALING 4 mA	-199.9 — 199.9	0.0 mg/l
SCALING 20 mA	-199.9 — 199.9	20.0 mg/l
ON OVERRANGE	3.6 or 22.0 mA	22.0

Temperature output

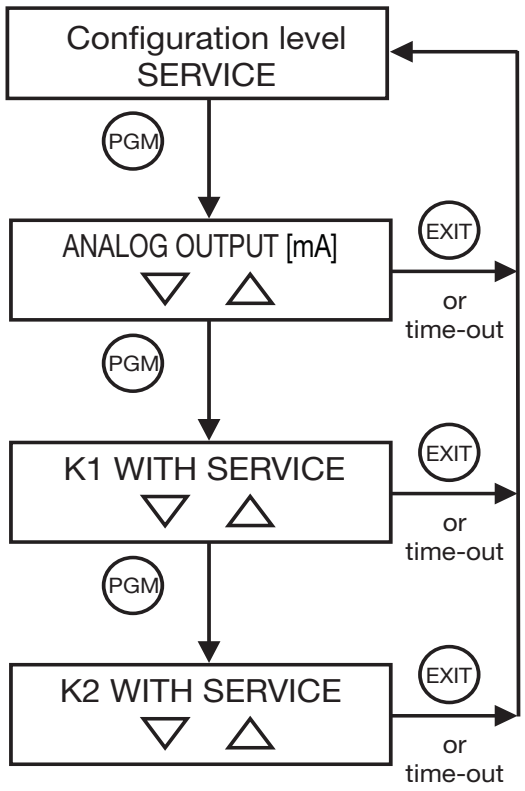
Depending on the version:
resistance signal Pt1000 or
fixed setting: 0 to 50°C corresponding to 4 — 20 mA

Settings at the parameter level RELAY 1 or RELAY 2



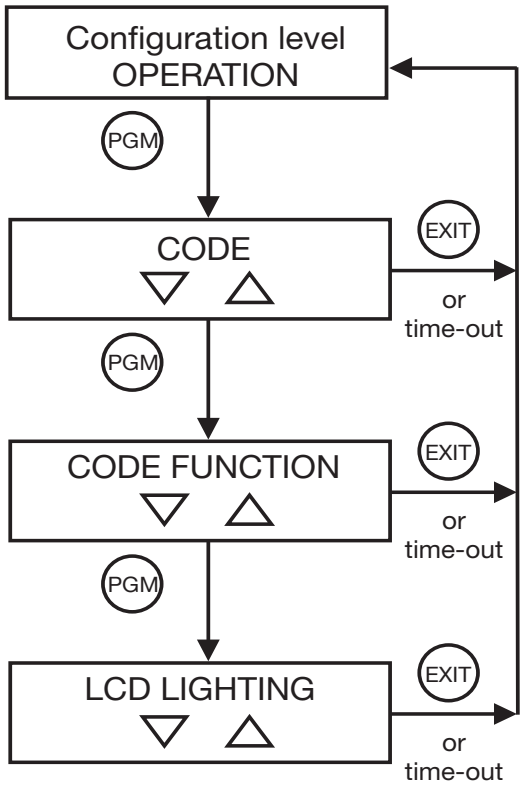
	Selection / value range	Standard
LIMIT VALUE	-199.9 — 199.9	0.0
HYSTERESIS	0.01 — 99.9	0.01
PULL-IN DELAY	0.0 — 999.9 s	0.0
DROP-OUT DELAY	0.0 — 999.9 s	0.0
FUNCTION K1 (K2)	NONE x > w O_2 x < w O_2 x > w TEMP. x < w TEMP.	NONE
K1 (K2) ON OVERRANGE	ACTIVE or INACTIVE	ACTIVE
CONTACT TYPE K1 (K2)	MAKE or BREAK	MAKE

Settings at the parameter level SERVICE



	Selection / value range	Standard
ANALOG OUTPUT [mA]	3.6 — 21.0	18.0
K1 WITH SERVICE	ACTIVE or INACTIVE	ACTIVE
K2 WITH SERVICE	ACTIVE or INACTIVE	ACTIVE

Settings at the parameter level OPERATION



	Selection / value range	**Standard**
CODE	0 — 999.9	0
CODE FUNCTION	ACTIVE or INACTIVE	INACTIVE
LCD LIGHTING	ALWAYS ON ALWAYS OFF IN OPERATION	On the basic and standard versions: ALWAYS OFF On the maximum version: IN OPERATION

11 Operation

11.6 Special functions

Time-out

If no key is pressed for about 25 sec, the transmitter jumps back to the measurement mode.

Exception:

During the “SERVICE function” and “Calibration” procedures, the time-out function is not active.

SERVICE

This function can be used to prevent undefined reactions in connected systems while inspecting or cleaning the transmitter or sensor.

Activation by pressing the SERVICE key for more than 2 seconds.

Depending on the programming, the signal output is set to a constant value (factory setting: 18 mA).

⇨ "Settings at the parameter level SERVICE”, page 54.

Deactivate by pressing the SERVICE key again.

CALIBRATION

Pressing the CAL key for more than 2 seconds will start the calibration procedure.

The output signal will be set to the value (normally 18 mA) that has been defined as the service current.

The calibration procedure is performed automatically, lasts up to 15 minutes and ends automatically. ⇨ "Calibration”, page 42ff.

11.7 CODE

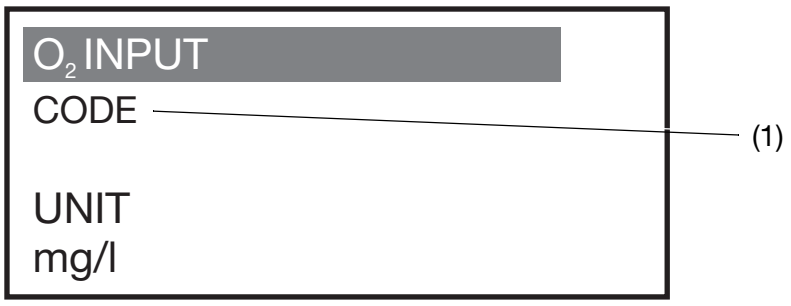
Inhibit

The transmitter as a whole can be protected against unauthorized operation by activating the CODE function.

⇨ "”, page 54.

With active CODE function, no action can be performed apart from deactivating the CODE function.

Example of display with active CODE function



(1) Indicates that the CODE function is active

Activating the CODE function

Point of departure is the measurement mode.

- Press the PGM key for more than 2 seconds (start configuration)
- Step on to the configuration item OPERATION by repeatedly pressing the DOWN key.
- Select the OPERATION configuration item using the PGM key.
- By repeatedly pressing the PGM key, select the parameter CODE FUNCTION.
- Switch from INACTIVE to ACTIVE by pressing the UP or DOWN key.
- Press the PGM key (confirm the ACTIVE selection). The CODE function is now active.
- Switch back to the measurement mode by repeatedly pressing the EXIT key.

Unlocking CODE - enabling entries

Point of departure is the measurement mode.

- Call up configuration by pressing the PGM key for more than 2 seconds.
- Step on to the configuration item OPERATION by repeatedly pressing the DOWN key.
- Select the OPERATION configuration item using the PGM key.
- By pressing the PGM key, step on to the parameter **CODE**.
- Use the UP or DOWN key to select the value **300**.
- Confirm the value 300 with the PGM key. Full operation is now possible.
- Switch back to the measurement mode by repeatedly pressing the EXIT key.
- (temporarily) briefly.

Locking CODE - inhibiting entries

When a wrong CODE is entered (all values except 0 and 300), or when the supply is switched off and on, the transmitter is inhibited.

Follow procedure as described above: “Unlocking CODE - enabling entries”.

Deactivating the CODE function

Point of departure is the measurement mode.

- Press the PGM key for more than 2 seconds (start configuration)
- Step on to the configuration item OPERATION by repeatedly pressing the DOWN key.
- Select the OPERATION configuration item using the PGM key.
- By repeatedly pressing the PGM key, select the parameter CODE FUNCTION.
- Switch from ACTIVE to INACTIVE by pressing the UP or DOWN key.
- Press PGM (confirm the INACTIVE selection). Now the CODE function is not active.
- Switch back to the measurement mode by repeatedly pressing the EXIT key.

12 Maintenance

12.1 Two-wire transmitter for dissolved oxygen

Do not touch the membrane or the (optional) protective film with sharp or pointed objects! Do not damage the membrane or the (optional) protective film!

The measurement signal may change during maintenance work! Control devices or PLCs operated by the transmitter may react in an undesirable manner!

General

In order to simplify maintenance, a change of the electrolyte and / or the membrane is not envisaged. After the end of their operating life (usually after the electrolyte has been exhausted), they are replaced altogether.

During measurement operation, the maintenance work described below has to be carried out at regular intervals.

It is advisable to enter the maintenance schedule in a logbook or calendar in advance.

The intervals are given by the degree of fouling or pollution.

Cleaning

Dirt deposits on the membrane may introduce measurement errors.

In the course of normal operation, a grayish-white deposit may form on the anode of the sensor module. This deposit does **not** affect the proper functioning of the measuring cell.

- ✱ Clean the transmitter **housing** in a bucket with drinking water using a suitable brush. **Do not brush the membrane or the protective film!**
- ✱ Clean the membrane, or the optional protective film, in a bucket with drinking water using a soft sponge.
- ✱ Remove salt deposits (if necessary):
  Immerse transmitter in drinking water or in a 1-5% hydrochloric acid solution (only for up to 10 minutes). Then rinse thoroughly with drinking water.

Simple testing of the measurement function

- ✱ Clean membrane and dry it.
- ✱ Wait for about 45 minutes - the instrument should now indicate approx. 9.09 mg/liter at 20°C and 1013 hPa, or a saturation concentration of approx. 100 %.
  Values for additional temperatures can be taken from EN 25 814.

Recalibration

⇨ Chapter 10 “Calibration”, page 42ff.

12.2 Replacing the sensor module

The maximum theoretical life of the sensor module with air saturation and at 20°C is 5 years.

A grayish-white deposit may form on the anode of the sensor module. This deposit does **not** affect the functioning of the measuring cell.

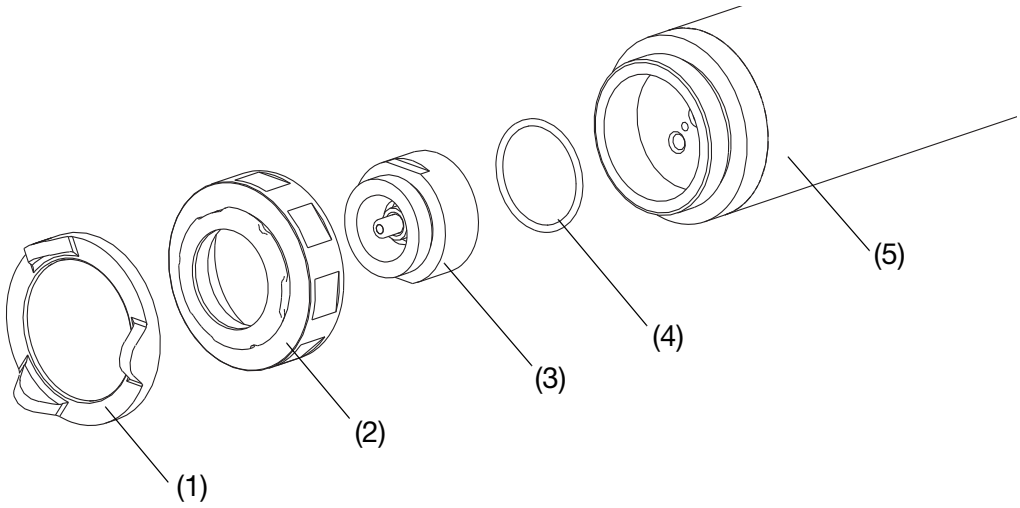
After the sensor module has been replaced, the two-wire transmitter for dissolved oxygen has to be calibrated.
⇨ Chapter 10 “Calibration”, page 42ff.

After the sensor module has been plugged on, wait for at least 30 minutes before starting to calibrate.
Reasons: The excess oxygen in the electrolyte has to be reduced at the cathode first. The temperature has to be compensated.

When to replace?

- when the membrane is damaged
- when repeated calibration has failed to produce correct calibration results.

Replacing



(1) Protection basket (with optional protective film, if required)
(2) Union nut
(3) Sensor module
(4) Seal
(5) Transmitter

Removal

✱ Screw off protection basket (1) (1/3 ccw turn to the notch) and remove.

✱ Unscrew union nut (2).

✱ Pull out sensor module (3) from transmitter (5), keeping it straight.

Installation

* Insert sensor module (3) into transmitter (5), keeping it straight. Make sure that the seal (4) is seated correctly.
* Screw on union nut (2) finger tight.

* Screw on protection basket (1) (1/3 cw turn to the notch).

Fault / malfunction	Possible cause	Elimination	Precautionary measures
No reading No sensor reaction	No supply	Check supply voltage. ⇨ "Installation", page 30ff.	
		Check electrical connection. ⇨ "Installation", page 30ff.	
	Jumper is missing.	Check electrical connection. ⇨ Chapter 7 "Installation", page 30	
	No flow	Check flow and restore, if necessary.	⇨ Chapter 5.1 "Technical data of the two-wire transmitter", page 15.
	Deposits on membrane	Clean membrane. ⇨ "Cleaning", page 58.	
	Sensor damaged	Replace sensor. ⇨ "Replacing the sensor module", page 59. Then recalibrate. ⇨ "Calibration", page 42ff.	
Indicated value is too high		Clean cell membrane ⇨ "Cleaning", page 58 and / or: wait for stable output signal, then recalibrate. ⇨ "Calibration", page 42ff.	
	Sensor damaged	Replace sensor. ⇨ "Replacing the sensor module", page 59. Then recalibrate. ⇨ "Calibration", page 42ff.	

13 Eliminating faults and malfunctions

Fault / malfunction	Possible cause	Elimination	Precautionary measures
Indicated value too low		Clean cell membrane ⇨ "Cleaning", page 58 and / or: wait for stable output signal, then recalibrate. ⇨ "Calibration", page 42ff.	
	No flow	Check flow and restore, if necessary.	⇨ Chapter 5.1 "Technical data of the two-wire transmitter", page 15.
Indicated value fluctuates appreciably	Sensor damaged	Replace sensor. ⇨ "Replacing the sensor module", page 59. Then recalibrate. ⇨ "Calibration", page 42ff.	
	Noise interference on measurement cable		Route measurement and control cables separately from supply cables.
Response time too large		Check installation site.	
		Reduce filter time (time constant) O_2 using the setup program.	
		Remove protective membrane. ⇨ "Replacing the sensor module", page 59. Note: The protective membrane additionally protects the sensor module from mechanical damage.	

Fault / malfunction	Possible cause	Elimination	Precautionary measures
When measuring in areas of low oxygen concentration: the indicated value is too high, the expected measured value is not reached, the reading drops unexpectedly after calibration.	The run-in time was too short. The electrolyte in the cell still contains excess oxygen that is used up at the cathode during the run-in phase.	Extend the run-in time, then recalibrate.	Select a run-in time that is sufficiently long. Only calibrate when the indicated value is constant.

14 Appendix

14.1 Before configuration

If a number of instrument parameters have to be modified in the instrument, then it is advisable to note them in the table below, and then modify these parameters in the sequence given.

The following list shows the maximum number of parameters that can be altered.

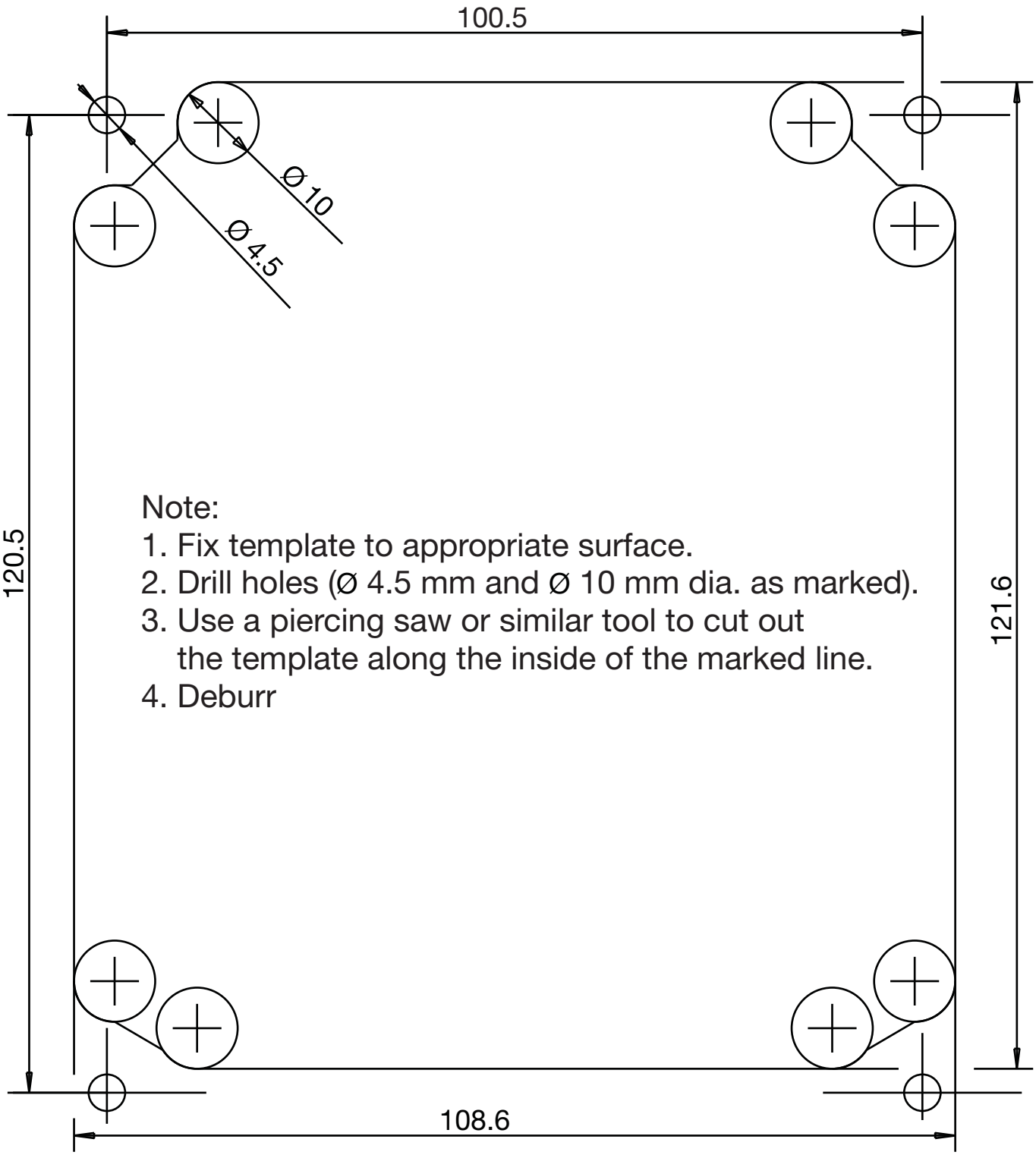
Depending on the type and configuration, your instrument may not show some of the listed parameters.

Code words to unlock the individual levels,
⇨ "CODE", page 56.

Parameter	Selection / value range	Factory setting	New setting	see page
O_2 INPUT				
O_2 UNIT	mg/l or %	mg/l		48
PRESSURE COMPENS.	HEIGHT AMSL or ATMOSPH. PRESSURE	HEIGHT AMSL		
HEIGHT AMSL	0 — 3000 m	300		
ATMOSPH. PRESSURE	500 — 1500 hPa	976		
SALINITY	0 — 100%	0		
PROTECT. MEMBRANE	YES or NO	NO		
O_2 OFFSET	-5.0 — 5.0	0.0		
FILTER TIME	0.0 — 100.0	3.0		
SLOPE O_2	50.0 — 200.0%	100.0		
TEMPERATURE INPUT				
TEMPERATURE UNIT	°C or °F	°C		49
TEMPERATURE OFFSET	-5.0 — 5.0	0.0		
FILTER TIME	0.0 — 100.0 s	1.0		
T-COMPENSATION	AUTOMATIC or CONSTANT	AUTO		
MANUAL TEMPERATURE	-10.0 to 60.0°C	18.0		
ANALOG OUTPUT				
SCALING 4 mA	-199.9 — 199.9	0.0		49
SCALING 20 mA	-199.9 — 199.9	20.0		
ON OVERRANGE	3.6 or 22.0 mA	22.0		
RELAY 1 or 2				
LIMIT VALUE	-199.9 — 199.9	0.0		51
HYSTERESIS	0.01 — 99.9	0.01		
PULL-IN DELAY	0.0 — 999.9	0.0		
DROP-OUT DELAY	0.0 — 999.9	0.0		

Parameter	Selection / value range	Factory setting	New setting	see page
FUNCTION K1 or FUNCTION K2	NONE x > w O_2 x < w O_2 x > w TEMP x < w TEMP	NONE		51
K1or K2 ON OVERRANGE	ACTIVE or INACTIVE	ACTIVE		
CONTACT TYPE K1or K2	MAKE or BREAK	MAKE		
SERVICE				
ANALOG OUTPUT	3.6 — 21.0	18.0		52
K1 WITH SERVICE	ACTIVE or INACTIVE	ACTIVE		
K2 WITH SERVICE	ACTIVE or INACTIVE	ACTIVE		
OPERATION				
CODE	0 — 999.9	0		53
CODE FUNCTION	ACTIVE or INACTIVE	INACTIVE		
LCD LIGHTING	ALWAYS ON ALWAYS OFF IN OPERATION	Basic and standard versions: ALWAYS OFF Maximum version: IN OPER-ATION		

15 Drilling diagram



Note:
1. Fix template to appropriate surface.
2. Drill holes (Ø 4.5 mm and Ø 10 mm dia. as marked).
3. Use a piercing saw or similar tool to cut out the template along the inside of the marked line.
4. Deburr