Operating Manual

Inductive Conductivity Sensor

ILM-4

Table of contents

Table of contents **2**

1 Application/intended use **3**

2 Conformity with standards **3**

3 Safety instructions **3**

4 Special features/advantages **4**

5 Options/accessories **4**

6 Installation and connection **4**

6.1 Settings using the MPI-200 programming adapter 6

6.2 Settings using the Simple User Interface 8

6.2.1 Screen display 10

6.2.2 LED configuration 10

6.3 Examples for settings sensors 11

6.3.1 Setting of customer-specific concentration curve via PC software: 11

6.3.2 Example for setting measurement range 1 12

6.3.3 Example for setting temperature coefficient 1 13

7 Dimensions **14**

8 Wiring diagram **15**

9 Repair and maintenance **15**

10 Technical data **16**

1 Application/intended use

- Inductive measurement of specific conductivity and concentration of fluid media in the range of 0...999 mS/cm
- For use in hygienic applications of the food, beverage and pharmaceutical industries
- Not suitable for use in explosive atmospheres
- Not suitable for safety-related unit parts (SIL)

2 Conformity with standards

The basic safety and health requirements are met through fulfillment of:

- 2014/30/EU Electromagnetic Compatibility
- 1935/2004/EU Consumer Goods Ordinance
- Directive (EU) 10/2011 (Articles in Contact with Food)
- EN 61000-6-2:2005 (Interference Immunity)
- EN 61000-6-4:2007 + A1:2011 (Interference Emissions)

3 Safety instructions

These safety instructions must be followed to

- Avoid endangering persons and the environment.
- Avoid damage to the sensors.
- Prevent faulty batches during production.

The electrical connections may only be performed by persons with the necessary technical skills (e.g. certified electricians or persons with technical training in electrics) and by persons with the necessary authorization from the operator.

The power supply and the control circuit inputs and outputs must be professionally wired. The current state-of-the-art of electrical connections must be adhered to. See also **section 8** "Wiring diagram".

The following details must be noted in particular:

- Safety instructions
- Electrical connection data

1. All persons involved with the setup, commissioning, operation, service and maintenance of the sensor must be suitably qualified.
2. This operating manual must be followed closely. The operator must ensure that the personnel has read and fully understood the operating manual.
3. All work must be performed with utmost care and may only be executed by authorized and trained personnel. The applicable national regulations regarding opening and repairing of devices must be complied with.
4. We recommend storing the operating manual in the vicinity of the measuring device in an easily accessible location.
5. The sensor must be de-energized prior to alterations and maintenance.
6. The working area of the operator must offer enough space to minimize the risk of injury.
7. The technical data specified in the operating manual and on the type label must be noted.

Warranty coverage shall not be granted for any damage that can be attributed to improper execution of work on the device.

4 Special features/advantages

- Wear-free, inductive measurement procedure
- In contrast to conductive measurement procedures, there are no problems due to electrode deterioration or polarization.
- Hygienic design with Negele weld-in sleeve
- Individual setting/programming via PC or Simple User Interface
- Two configurable LEDs on the display unit

5 Options/accessories

- Simple User Interface with small display (retrofittable)
- Programming adapter MPI-200 (PC-based)
- Tool for detaching the signal module
- Preassembled PVC cables

PVC cable with M12 coupling of stainless steel 1.4305, IP 69k, unshielded

M12-PVC/4–5 m	PVC cable, 4-pin, 5 m in length
M12-PVC/4-10 m	PVC cable, 4-pin, 10 m in length
M12-PVC/4-25 m	PVC cable, 4-pin, 25 m in length

PVC cable with M12 coupling of nickel-plated brass, IP 67, shielded

M12-PVC/4G–5 m	PVC cable, 4-pin, 5 m in length
M12-PVC/4G–10 m	PVC cable, 4-pin, 10 m in length
M12-PVC/4G–25 m	PVC cable, 4-pin, 25 m in length

6 Installation and connection

Mechanical connection/installation notes

- The device must be installed such that the submersible body is fully surrounded by the medium and no air bubbles can form in the sensor area. It therefore is advisable to install the device in rising pipes.
- The device must be aligned such that the lettering "FLOW" is at the bottom of the device in the direction of flow.
- Very strong vibrations can lead to false measurements (e.g. if installed near a pump).
- Use the Negele **CLEANadapt** system to ensure that the measuring point functions properly.
- When installing the device, adhere to the maximum tightening torque of 20 Nm.
- To correctly install **CLEANadapt** weld-in sleeves, use a suitable welding mandrel. Follow the weld-in and installation instructions in the **CLEANadapt** product information.

The ILM-4 inductive conductivity sensor is set to operate without requiring special adaptations. In isolated instances, some parameters may need to be adjusted. The parameterization may be changed using the PC-based MPI-200 programming adapter or the Simple User Interface directly on the sensor. This can be performed either directly on location or in the office in a dry simulation.

When setting the parameters, please note that a hierarchy of authorization levels exists (0 Monitoring, 1 Adjustment, 2 Setup 3 Calibration and 4 Factory). It is not possible to change the ILM-4 sensor parameters in the lowest **"Monitoring"** level. The parameters can be set/adjusted beginning with the **"Adjustment"** level. The farther up you move in the hierarchy, the more parameters can be changed at the customer site, although it

should be noted that the upper levels, **"Calibration"** and **"Factory"**, are password-protected and access is only possible on request.

Setting can be made regarding the sensor signal output (4...20 mA signal) and the measurement of conductivity, concentration and temperature. The 2 analog outputs of the sensor for conductivity, concentration and temperature are freely configurable.

Conductivity: Two different conductivities can be set independently of each other. The upper range limit can be freely selected. The temperature compensation and damping can also be set by the customer.

Concentration: The concentration can be select from 2 predefined ranges for common CIP media (NaOH or HNO_3). In addition, up to 8 customer-specific support points (each for conductivity and concentration) can be entered. To define a range, at least 2 points must be entered, and their values must both be > 0. Users can enter these support points in the **"Setup"** level and higher. The temperature compensation, damping and upper range limit can also be set.

Temperature: Output of the temperature of the medium measured at the tip of the PEEK part on the sensor. The temperature unit and response time can be adjusted.

The table below shows the conductivity sensor settings by authorization level:

Parameter	Settings in the **"Adjustment"** level	Settings in the **"Setup"** level	Adjustable range
Conductivity measurement			
Conductivity 1			
	Temperature Compensation	Temperature Compensation	Freely adjustable from 0...100%/K
		Damping 1	Selectable: inactive, 2.5 s, 5 s, 10 s, 20 s
	Upper Range Value	Upper Range Value	Freely adjustable from 0.5...1000 mS/cm (in increments of 0.5)
Concentration			
	Temperature Compensation	Temperature Compensation	Freely adjustable from 0...100%/K
		Damping C	Selectable: inactive, 2.5 s, 5 s, 10 s, 20 s
	Media Concentr. Range	Media Concentr. Range	NaOH 0...10%, HNO_3 0...20% or customer-specific points (beginning with "Setup" level)
	Upper Range Value	Upper Range Value	Freely adjustable from 1...100%
		(+) Customer-specific points, concentration	Up to 8 support points for conductivity and concentration
Conductivity 2			
	Temperature Compensation	Temperature Compensation	Freely adjustable from 0...100%/K
		Damping 2	Selectable: inactive, 2.5 s, 5 s, 10 s, 20 s
	Upper Range Value	Upper Range Value	Freely adjustable from 0.5...1000 mS/cm (in increments of 0.5)
Temperature			
		Unit Temperature	°C or °F
		Response Time	Normal or rapid

Both the PC/MPI-200 and Simple User Interface software is based on a tree structure.

In addition to the advanced options in the Conductivity Measurement branch, the **"Setup"** level also enables access to the Signaling Interface branch. The following parameters for the sensor output signals can be changed in this branch:

- **Signal selection for the 4...20 mA signal:** Selection between conductivity 1 or 2, concentration and temperature
- **Set value for 4 or 20 mA signal:** By default, the lower range limit is used for the 4 mA signal and the upper range limit for the 20 mA signal. This can be adjusted as necessary.
- **"No Media" warning signal:** Current loop signal when the sensor is not immersed in a medium → dry running.
- **"Outside Spec." warning signal:** Current loop signal if an operating state is outside of the specified range. The measurement accuracy can no longer be guaranteed.

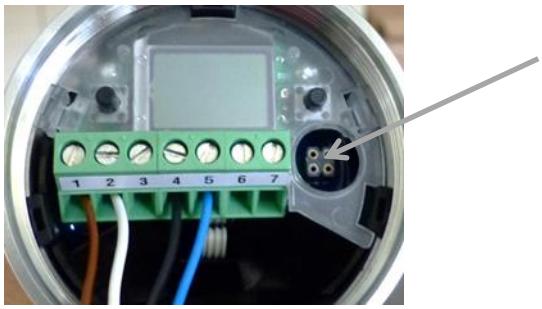
- **"Global Failure" error signal:** Current loop signal if a malfunction occurs, for example if the device fails.
- **Signal limit for underrange and overrange:** Lower or upper limit of the current loop signal that is still valid and linear when output below 4 mA or above 20 mA.
- **"Underflow/overflow" error signal:** Current loop signal is below or above the underrange or overrange limit.
- **Signaling Simulation**: Simulates the current loop signal, where the source value is briefly replaced by the entered parameter value.
- **LED configuration:** These two LEDs can be configured as required. The procedure is described in section **6.3**.

A list of the parameters set in the conductivity sensor is included with the delivery. These parameter values, as well as those changed by the users themselves, can be printed out using the MPI-200 programming adapter via File → Parameter Data → Print and can also be exported as a file to the PC (via File → Parameter Data → Export Data File (*.xml)).

When making the settings, note the help texts in the MPI software for each parameter. They provide useful information on changing the selected parameter.

6.1 Settings using the MPI-200 programming adapter

The MPI-200 programming adapter is connected to the ILM-4 conductivity sensor via the external MPI-200-F adapter piece. It must be ensured that the ILM-4 conductivity sensor is permanently connected to the supply voltage while the parameters are being set.



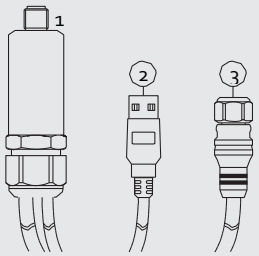
Connection plug for the MPI-200-F adapter as an intermediate plug between the ILM-4 electronics and the MPI-200 connection 3 (see the next figure).

Connection of the MPI-200 programming

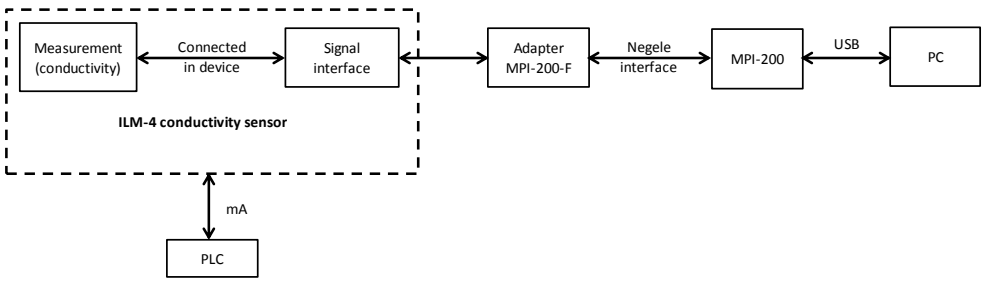
1: Connection for M12 connector

2: USB port for connecting to a PC

3: Connection cable to adapter for ILM-4



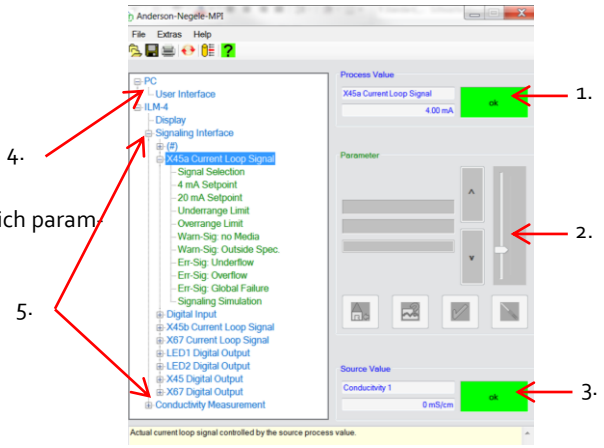
Signal flow during programming



After the sensor is connected to the PC and the user software is opened, the following window appears:

1. Information on the current process value
2. Buttons for changing the parameter setting
3. Information on the current source value
4. Adjustable PC parameters
5. Adjustable sensor parameters

Clicking on the + in the menu opens a submenu in which parameters can be adjusted.

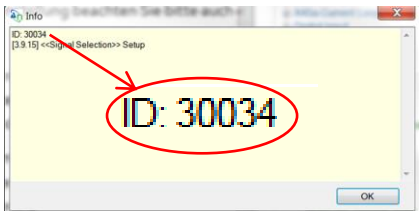


Note:

For further settings, please see also the description in the MPI-200 product information.

To set or change parameters directly in the sensor (see section 6.2 **"Settings using the Simple User Interface"**), you need the ID codes contained in the table below. This table only lists the most important ID codes.

Further ID codes can be found in the user software. To view these, right-click on "Info" by the parameter name. An info box appears with the respective ID (see graphic below):



Because the search number must have 6 digits, an additional digit is always added in front of the five-digit ID (30034 in the graphic above). This digit depends on the node as follows:
4 for changes to the display
3 for changes to the signal interface
0 for changes to the conductivity measurement

Because the signal selection is located in the single interface node, the ID code for the "Signal selection" example above is: 330034.

A list of all ID codes can be printed out via the PC user interface. To do so, click on **File → Parameter Data → Print** to open the corresponding window and print out the complete list of ID codes.

List of important ID codes:

Parameter/ parameter name	Access/setup mode (must be set before the change is made)	Search number (ID number)	Node/ module	Value name
Display				
Contrast User Interface	2 Setup	451020	4 Display	(#)
Backlight	2 Setup	451030	4 Display	(#)
Screensaver delay time	2 Setup	451050	4 Display	(#)
Signaling interface				
Current Loop Signal				
Signal Selection	2 Setup	330031	3 Signal Int	X45a current loop signal
4-mA Setpoint	2 Setup	330111	3 Signal Int	X45a current loop signal

20-mA Setpoint	2 Setup	330191	3 Signal Int	X45a current loop signal
Underrange Limit	2 Setup	330141	3 Signal Int	X45a current loop signal
Overrange Limit	2 Setup	330211	3 Signal Int	X45a current loop signal
LED 1 digital output				
Signal Selection	2 Setup	330034	3 Signal Int	LED 1 digital output
Warn-S: no Media	2 Setup	331191	3 Signal Int	LED 1 digital output
Warn-S: Outside Spec.	2 Setup	331201	3 Signal Int	LED 1 digital output
Fehler-S: Global Failure	2 Setup	331231	3 Signal Int	LED 1 digital output
Signal-Auswahl	2 Setup	330035	3 Signal Int	LED 2 digital output
LED 2 Digital Output				
Signal Selection	2 Setup	330035	3 Signal Int	LED 2 digital output
Warn-S: no Media	2 Setup	331192	3 Signal Int	LED 2 digital output
Warn-S: Outside Spec.	2 Setup	331202	3 Signal Int	LED 2 digital output
Fehler-S: Global Failure	2 Setup	331232	3 Signal Int	LED 2 digital output
Conductivity Measurement				
Unit of Temperature Comp	2 Setup	013021	0 Measure	(#)
Conductivity 1				
Temp. Compensation 1	2 Setup	013031	0 Measure	Conductivity 1
Damping 1	2 Setup	013041	0 Measure	Conductivity 1
Upper Range Value 1	2 Setup	013091	0 Measure	Conductivity 1
Concentration				
Temp. Compensation C	2 Setup	013032	0 Measure	Concentration C
Damping C	2 Setup	013042	0 Measure	Concentration C
Media Concentr. Range	2 Setup	013061	0 Measure	Concentration C
Upper Range Value C	2 Setup	013092	0 Measure	Concentration C
Conductivity 2				
Temp. Compensation 2	2 Setup	013033	0 Measure	Conductivity 2
Damping 2	2 Setup	013043	0 Measure	Conductivity 2
Upper Range Value 2	2 Setup	013093	0 Measure	Conductivity 2
Temperature				
Unit Temperature	2 Setup	013144	0 Measure	Temperature
Response Time	2 Setup	013145	0 Measure	Temperature

6.2 Settings using the Simple User Interface

The software structure of the Simple User Interface is similar to that of the PC version.

The system is operated using two control buttons to the left and right of the display. These two buttons can be used to navigate through the tree structure of the Simple User Interface to change parameters. The button functions are as follows:

Button	Press briefly	Press and hold
R	Jump to next node, parameter	Edit a node, parameter
L	Jump back to previous node, parameter	Leave editing mode without saving, return to next higher level
R/L	Scroll up and down	
R and L together		Press both buttons for 10 seconds: the menu jumps back to the beginning (attention: this is not a reset)

R right

L left

Note:

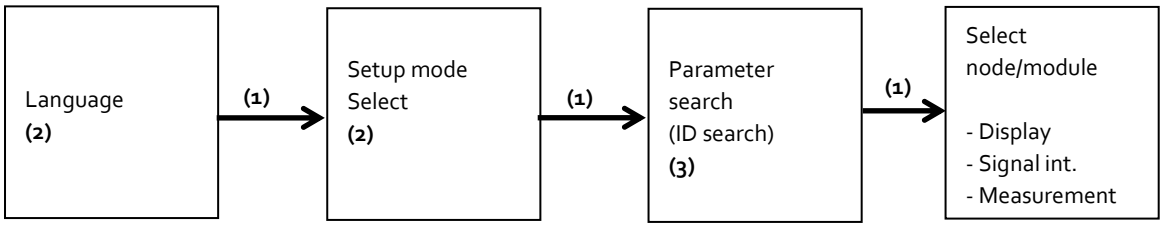
The digits 1), 2) and 3) shown in the graphic below refer to the programming example below.

1) Briefly press the right button.
2) Press and hold the right button, select the required mode (e.g. Setup) and node (e.g. Signalint), scroll through the menu using the right/left buttons and confirm the selection by pressing and holding the right button.
3) Press and hold the right button and then enter the ID number from right to left. Proceed as follows:
   a.) Select the desired position (navigation with the right/left buttons, press the left button: Change the position to the left, press the right button, change the position to the right).
   b.) At the desired position, press and hold the right button until the field becomes gray. Then enter the numerical value using the right/left buttons and confirm by pressing and holding the right button until the gray area disappears. Then enter the next digit.
   c.) After all digits have been entered, move all the way to the left with the left button until the field become gray.

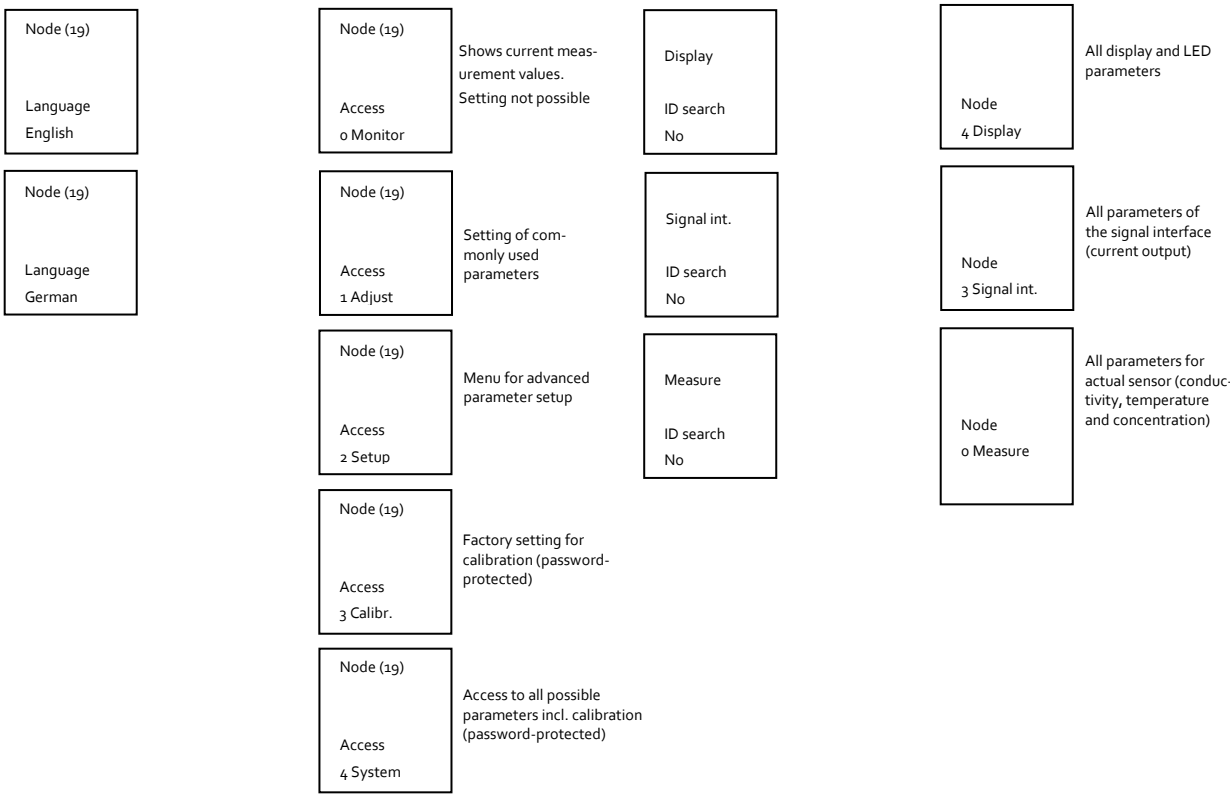
   Then press and hold the right button. The system jumps to the selected parameter, which can now be entered or changed in the same manner. Start by pressing and holding the right button.

   For some system-related parameters, you are asked to confirm that you really wish to make the change. Do this by pressing the left or right button.
   - Press the right button to change the parameter or save the change.
   - Press the left button to leave the setting without making a change.

Menu flowchart to change a parameter

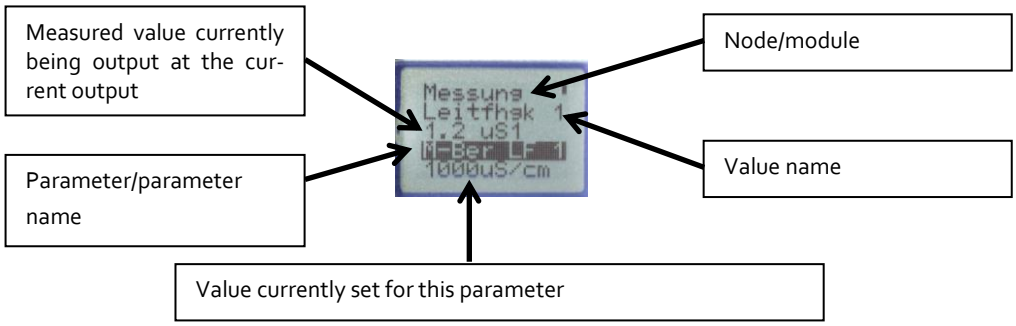


Example of screen display:



6.2.1 Screen display

After the sensor parameters have been adapted/changed, or after the sensor is switched on and no change is made, the sensor switches to the display mode after a certain period. In the display mode, all nodes of the conductivity measurement are run through – conductivity 1, concentration, conductivity 2 and temperature. For each node, the following values/information is displayed:



6.2.2 LED configuration

The display unit features 2 LEDs that can be individually configured. These can be used to visually indicate faults directly on-site. The LED to the left of the display is LED 1 while the one to the right is LED 2.

The following options can be selected when setting the LEDs:

- **Signal Selection**: The following signals can be selected: conductivity 1 and 2, temperature and concentration.
- Output function, direction of action, switch point entry method, switch point, hysteresis
- **Switch ON Delay, Switch OFF Delay:** The digital output is switched on or off with the delay set here. Values can be set between 0...30 s.
- **Warn-S: no Media, Warn-S: Outside Spec., Err-Sig: Underflow, Err-Sig: Overflow, Err-Sig: Global Failure:** The effect of each parameter on the LED display can be set. The following can be selected: "No Effect on Output", Output Fast Blinking" (0.4 s interval), "Output Slowly Blinking" (1 s interval), "Output ON" (LED on continuously) and "Output OFF". "Output" refers to the LED here.
- **Signaling Simulation:** The source value is briefly replaced by the entered parameter value. The following situations can be simulated: "Output OFF", "Output ON", "Output Slowly Blinking" and "Output flashes rapidly". "Output" refers to the LED here.

The conductivity sensor is delivered with the following factory settings for the LEDs:

- LED 1 (left LED)
  Err-Sig: Overflow: The LED flashes every second if the sensor registers an overrange error. If the sensor is in a normal state, this LED is off.
- LED 2 (right LED)
  Power ON Signal – Err-Sig: Global Failure: LED lights up continuously in normal mode as long as the device is supplied with power. If a device failure occurs, this LED flashes rapidly (approx. 0.4 s interval)

6.3 Examples for settings sensors

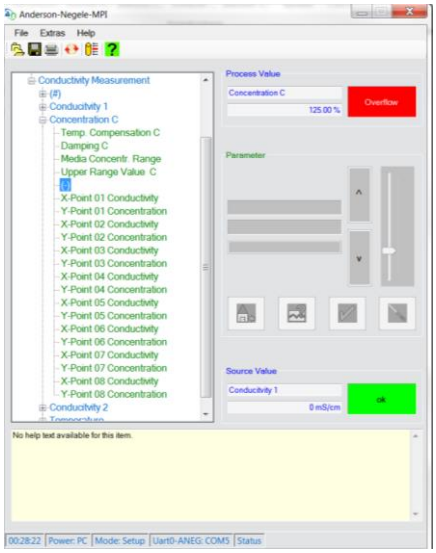
This section contains some examples that illustrate how the sensor can be set via the PC user interface or the Simple User Interface:

6.3.1 Setting of customer-specific concentration curve via PC software:

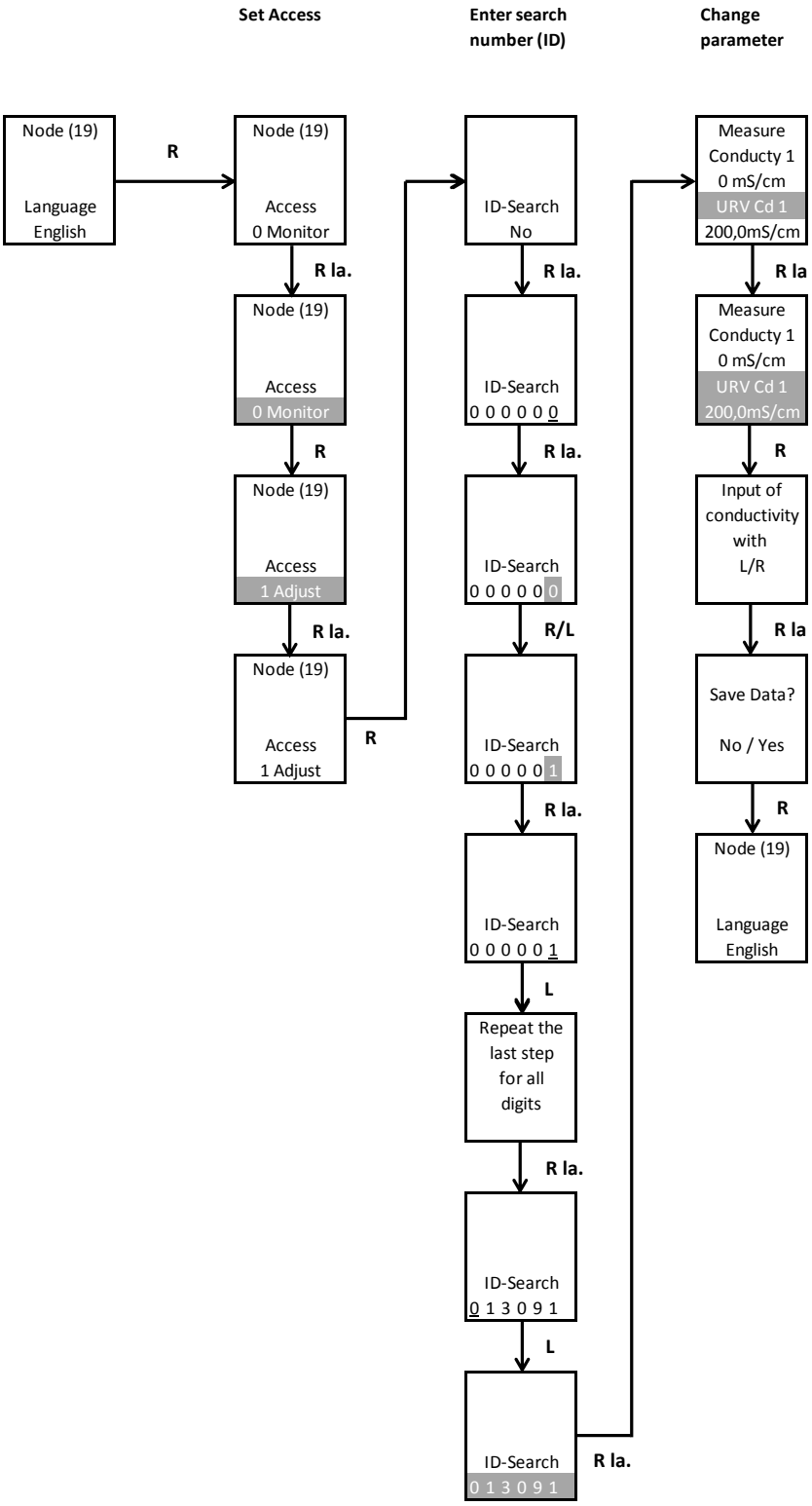
After the PC software is started, a customer-specific curve for the concentration can be entered via the following node: Conductivity Measurement → Concentration C → (+). Values need to be entered for at least 2 X and Y points. Up to 8 support points for X and the associated Y values can be entered to establish the relationship between conductivity (X) and concentration (Y). The Y values together with the associated X values form coordinates that act as support points for the linearization curve. If 0 is entered for any of these points, that support point is deactivated.

X-Point 01…X-Point 08 (Conductivity): This parameter is used to define the customer-specific measurement range of the conductivity. Values can be entered from 0…1000 mS/cm.

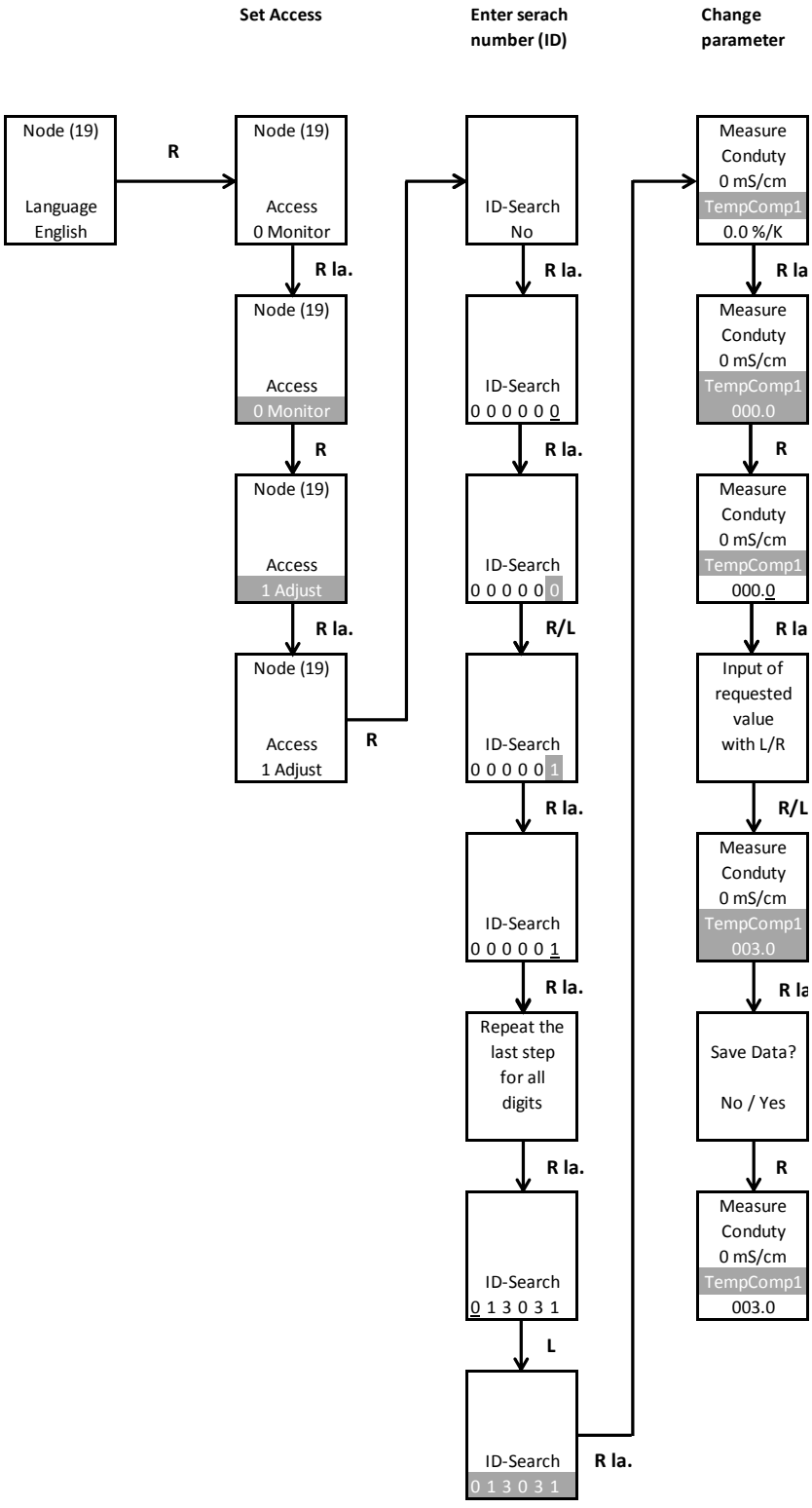
Y-Point 01…Y-Point 08 (Concentration): This parameter is used to define the customer-specific measurement range of the concentration. Values can be entered from 0…100%.



6.3.2 Example for setting measurement range 1

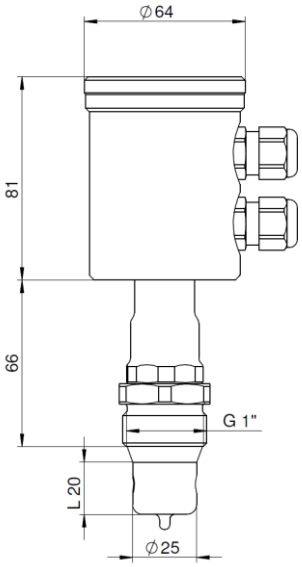


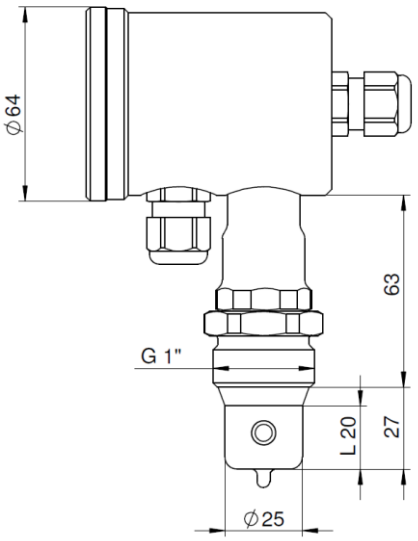
6.3.3 Example for setting temperature coefficient 1

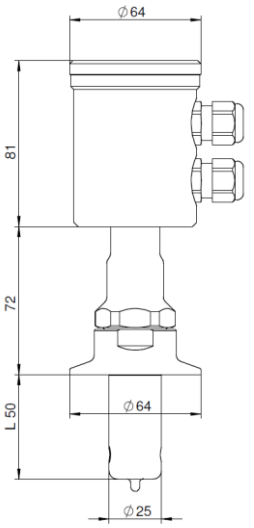


7 Dimensions

For all process connections, the conductivity sensor can be ordered with a submersion length of L20 (20 mm) or L50 (50 mm).





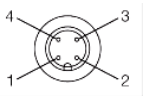


8 Wiring diagram

2 x M12 plug connection

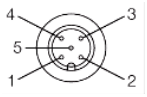
M12
connector, top
(4-pin)

1:	Output 1 +
2:	Output 2 +
3:	Output 2 -
4:	Output 1 -



M12
connector,
bottom (5-pin)

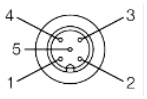
1:	Power supply +24 VDC
2:	Not assigned
3:	Not assigned
4:	Power supply -
5:	Digital input E1



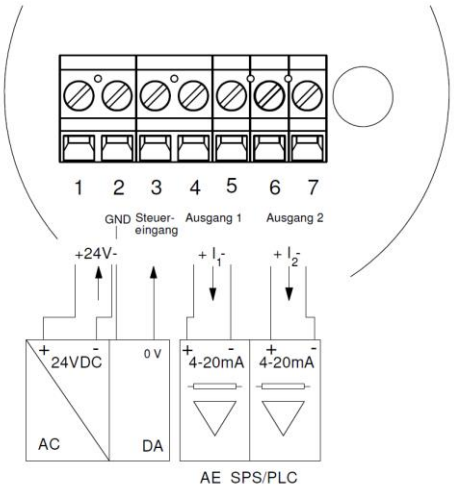
1 x M12 plug connection

M12 connector
(5-polig)

1:	Power supply +24 VDC
2:	Output +
3:	Output -
4:	Power supply -
5:	Digital input E1



Electrical connection with cable gland



9 Repair and maintenance

The conductivity sensor described here is maintenance-free. However, if it should become necessary to calibrate the sensor, the offset (zero point) and the span of the sensor can be set in the "Calibration " mode (via the software).

For this purpose, navigate to the following window via the user interface (for example, for conductivity 1): **"Conductivity Measurement → Conductivity 1 → Offset Conductivity 1"** (for offset) or **"Conductivity Measurement → Conductivity 1 → Slope Conductivity"** (for span). For the offset, the set value is added to the calibrated conductivity value set at the factory. For the span, the set factor is multiplied with the calibrated conductivity value set at the factory. This method can also be applied to concentration, conductivity 2 and temperature (offset only).

The adjustable ranges are:

- Offset conductivity: half of the set measurement range, e.g. -50...50 mS/cm in measurement range 0...200 mS/cm
- Slope Conductivity: 75%...125%.

The setting can also be made via the Simple User Interface directly on the sensor using the ID codes 013071 for the zero-point conductivity and 013081 for the conductivity slope.

We recommend always using a reference solution and a reference device for calibration.

10 Technical data

Submersion length	Product-contacting	L20: 20 mm L50: 50 mm
Measurement range	The measurement range is freely adjustable	0…0.5 mS/cm to 0…1000 mS/cm in half-steps
Process connection	Thread	CLEANadapt G1" hygienic TriClamp 1.5", 2", 2.5", 3" DN 25 (type F) DN 40/50 (type N)
Process pressure		Max. 16 bar
Tightening torque		20 Nm (CLEANadapt system)
Materials	Connecting head Threaded connector Submersible body Plastic cover/sight glass	Stainless steel 1.4308 Edelstahl 1.4305, 36 mm PEEK (FDA approval: 21 CFR 177 2415) Polycarbonate
Temperature ranges	Ambient Process CIP/SIP	-10…70°C -10…130°C 150°C max. 60 min
Reproducibility	of conductivity	≤ 1% of measurement value
Resolution/measurement range	< 10 mS/cm 10…100 mS/cm 100…999 mS/cm	1 µS/cm 10 µS/cm 100 µS/cm
Accuracy	Slope Offset	± 2% of measurement value ± 20 µS/cm
Long-term stability		≤ 0.5% of upper range limit
Accuracy of temperature output	≤ 100°C 100…150°C	Max. 0.5°C Max. 1.0 °C
Response time t90		< 100 ms
Electrical connection	Cable gland Cable connection Supply voltage Protection class	2 x M16 x 1.5 2 x M12 connector 1.4305 18…36 V DC max. 190 mA IP 69K
Output	2 outputs	Freely configurable, conductivity 1 or 2, temperature or concentration
Weight		850 g