Operating Manual

Relative Turbidity Meter

ITM-51 / ITM-51R

Table of contents

1 Application / intended use

- Relative turbidity measurement of liquid media for mid to high turbidity range (200...300.000 NTU equivalent)
- For use in hygienic applications of the food, beverage and pharmaceutical industries
- Suitable for CIP/ SIP up to 140°C for a maximum of 120minutes
- 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
- 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

- The sensor structure is based on a modular device platform which can be tailored to requirements and is easy to exchange if faulty
- Front flush sensor for easy cleanability
- Optics made of high resistance sapphire
- Independent to reflexions at small diameters or electro-polished surfaces
- Color independent measurement at 860 nm wave length
- Hygienic design with Negele weld-in sleeve
- Individual setting/programming via PC or User Interface
- Two configurable LEDs on the display unit

5 Options / accesories

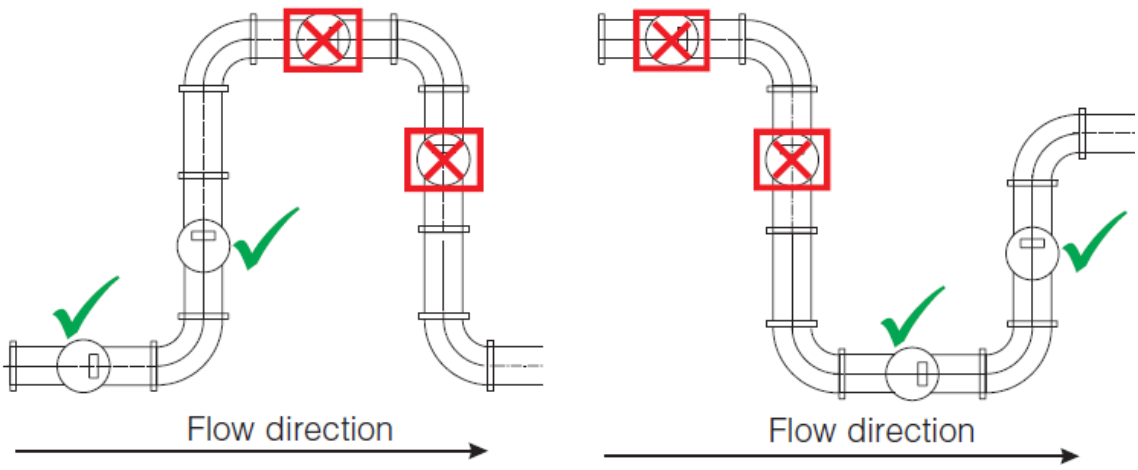
- User Interface with small or large display (retrofittable)
- Programming adapter MPI-200 (PC-based)
- Tool for detaching the signal module
- Full featured remote version (see order matrix for ITM-51R)
- Pre-assembled PVC cables

6 Installation and connection

6.1 Mounting position

Mechanical connection / installation notes

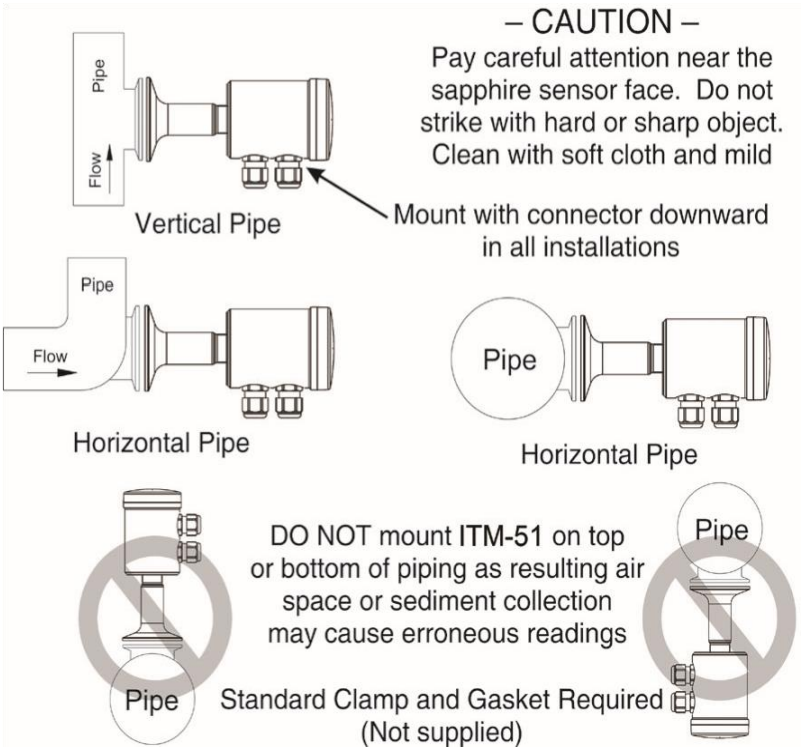
- The sensor must be installed in that way that the sensor tip is entirely washed around by media and no bubbles can occur. It therefore is advisable to install the device in rising pipes. Refer to the drawings below for reference.
- In case an installation from top can't be avoided a sensor with extended sensor tip (process connection SOL or TLx) is recommended to avoid the influence of bubbles to the measuring signal.



6.2 Hygienic installation requirements

Conditions for hygienic installation according 3A and EHEDG

- The ITM-51 / ITM-51R is designed for CIP/SIP cleaning. The sensor can withstand a maximum of 140°C/120min.
- The mounting position must guarantee self-draining properties.
- If mounted with a TC connection the mounting tee, mounting position and gasket need to follow the actual 3A or EHEDG standards and guidelines.



7 Parameterisation

The ITM-51 relative turbidity meter 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 User Interface directly on the sensor. This can be performed either directly on location or in the office in a dry simulation.

The sensor is delivered with the following default settings:

Output 1 (terminals 4 and 5): turbidity 1 with measurement range 0...100 %TU

Output 2 (terminals 6 and 7): switching output with 10 %TU set point

The parameter list accompanying the sensor contains the sensor settings for output 1 (terminals 4 and 5) under **X45a** and for output 2 (terminals 6 and 7) under **X67**.

The ITM-51 relative turbidity meter features a modular design with a "tree structure", which can be tailored to meet requirements and can be easily exchanged in the event of a fault.

This tree structure is used by the MPI-200 programming adapter software for the PC and the User Interface in the sensor. The software is subdivided into **Display**, **Electronics (signal interface)** and **Sensor (turbidity measurement)**.

When setting the parameters, please note that a hierarchy of authorization levels exists (0 Monitoring, 1 Adjustment (QuickSetup), 2 Setup 3 Calibration):

0 "Monitoring": The parameter cannot be changed in the ITM-51 sensor.

1 "Adjustment": The main parameters for turbidity measurement can be adjusted/changed.

The farther up you move in the hierarchy, the more parameters can be changed at the customer site.

Sensor (turbidity measurement):

The analog output of the sensor for turbidity can be freely configured.

Turbidity: Two different turbidities can be set here, independently of one another. The upper range limit can be freely selected. Switching between the both ranges can be done with the A53 electronics while using the digital switching input E1. This function is not available with the A42 and A52 electronics.

Switching output (only applicable for A52 and A53 electronics): A setpoint as well as the working direction of the switching output can be selected.

Electronics (Signaling interface):

- **Signal selection for the 4...20 mA signal:** Selection between Turbidity 1 or 2 and the applicable turbidity category
- **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.

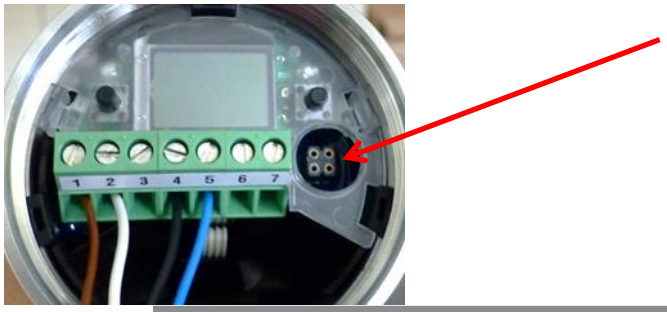
- **Signaling Simulation**: Simulates the current loop signal, where the source value is briefly replaced by the entered parameter value.
- **LED configuration:** These two LEDs can be configured as required. The procedure is described in section **6.2.2**.

A list of the parameters set in the turbidity 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.

7.1 Settings using the MPI-200 programming adapter

The MPI-200 programming adapter is connected to the ITM-51 turbidity meter via the external MPI-200-F adapter piece. It must be ensured that the ITM-51 turbidity meter is permanently connected to the supply voltage while the parameters are being set.



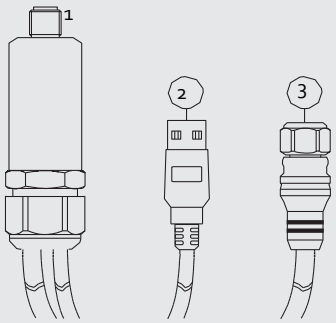
Connection plug for the MPI-200-F adapter as an intermediate plug between the ITM-51 electronics and the MPI-200 connection 3 (see the next figure).

Connection of the MPI-200 programming adapter

1: not neccessary

2: USB port for connecting to a PC

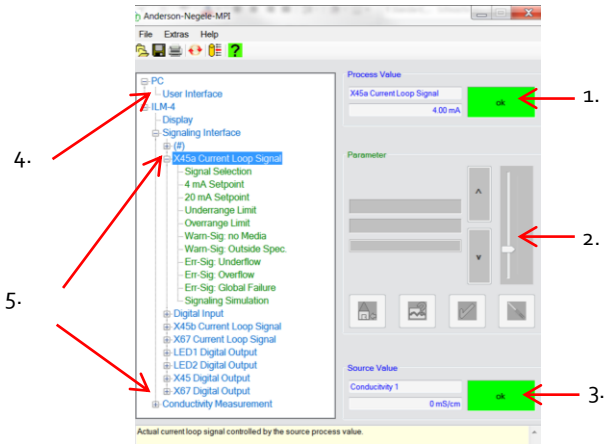
3: Connection cable to adapter for ILM-4



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

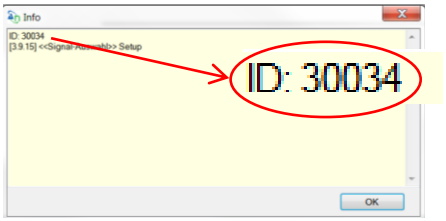
Clicking on the + in the menu opens a submenu in which parameters can be adjusted.



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 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 turbidity 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	Search Number (ID Number)	Value Name
Sensor			
Unit Turb1	Setup	014021	Turbidity1
Damping 1	Setup	014027	Turbidity1
Range Tb.1	Setup	014029	Turbidity1
Unit Turb1	Setup	014022	Turbidity2
Damping 1	Setup	014028	Turbidity2
Range Tb.1	Setup	014030	Turbidity2
X-Pnt 01	Setup	013151	Tu.%Solids
Y-Pnt 01	Setup	013171	Tu.%Solids
Thru	Setup	Thru	Tu.%Solids
X-Pnt 08	Setup	013158	Tu.%Solids
Y-Pnt 08	Setup	013178	Tu.%Solids
Current Loop Signal 1			
Signal Selection	Setup	330031	X45a I-Out
Underrange Limit	Setup	330141	X45a I-Out
Overrange Limit	Setup	330211	X45a I-Out
no Media=	Setup	330121	X45a I-Out
Out Spec.=	Setup	330221	X45a I-Out
Underflow=	Setup	330151	X45a I-Out
Overflow=	Setup	330161	X45a I-Out
Failure=	Setup	330131	X45a I-Out
Simulation	Setup	330201	X45a I-Out
Digital Input			

Direction	Setup	330821	Digital-In
Simul. Inp	Setup	330831	Digital-In
Current Loop Signal 2			
Signal Selection	Setup	330032	X45b I-Out
Underrange Limit	Setup	330142	X45b I-Out
Overrange Limit	Setup	330212	X45b I-Out
no Media=	Setup	330122	X45b I-Out
Out Spec.=	Setup	330222	X45b I-Out
Underflow=	Setup	330152	X45b I-Out
Overflow=	Setup	330162	X45b I-Out
Failure=	Setup	330132	X45b I-Out
Simulation	Setup	330202	X45b I-Out
Digital Output			
Signal Selection	Setup	330037	X67 D-Out
Function	Setup	331114	X67 D-Out
Direction	Setup	331124	X67 D-Out
Inp. Method	Setup	331114	X67 D-Out
Switch Pt.	Setup	331144	X67 D-Out
Hysteresis	Setup	331254	X67 D-Out
ON Delay	Setup	331174	X67 D-Out
OFF Delay	Setup	331114	X67 D-Out
No Media=	Setup	331194	X67 D-Out
Out Spec.=	Setup	331204	X67 D-Out
Underflow=	Setup	331214	X67 D-Out
Overflow=	Setup	331224	X67 D-Out
Failure=	Setup	331234	X67 D-Out

Simulation	Setup	331244	X67 D-Out
Display			
Language	Setup	451010	Set Display
Contrast	Setup	451020	Set Display
Scrs delay	Setup	451050	Set Display
Password	Setup	450103	Set Display

7.2 Settings using the User Interface

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

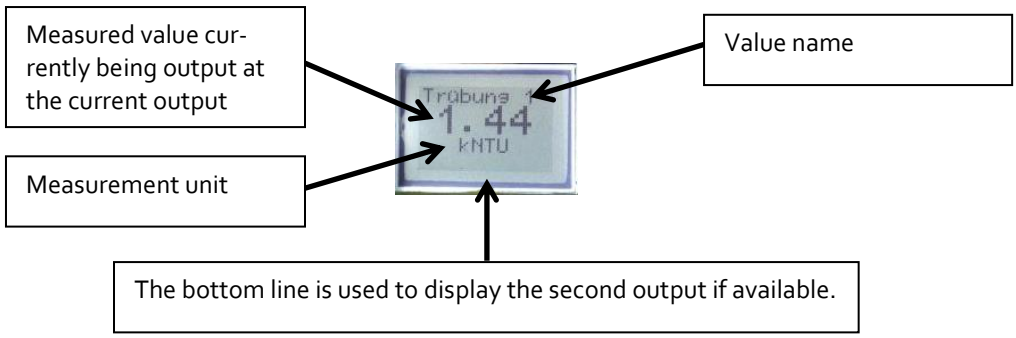
The system is operated using two control buttons to the left and right of the display. These two buttons can be used to navigate through the tree structure of the User Interface to change parameters. The button functions are as follows:

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

7.2.1 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, the main measurement value is shown as described in the picture below. If a second output option is available (only for electronic versions A52, A53) the actual value is shown in the bottom line of the display.



To leave the display mode and create settings on the sensor, press the right button next to the display twice to enter the menu. The sensor then displays the start page, from where the settings can be created.

7.2.2 LED configuration

The display unit features 2 LEDs that can be individually configured. 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: turbidity 1 and 2.
- 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 turbidity sensor is delivered with the following factory settings for the LEDs:

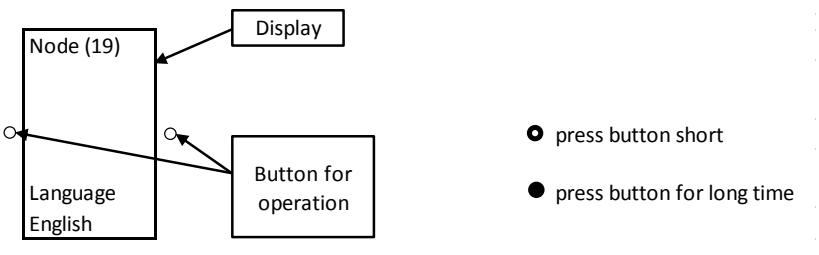
- LED 1 (left LED)
  If the sensor is in a normal state, this LED is off.
  Err-Sig: Overflow: The LED flashes every second if the sensor registers an overrange error. If the sensor is in a normal state, this LED is off.
  Err-Sig: Temperature Error: The LED is permanent on if the sensor registers a medium temperature above 130°C permanent.
  All other errors are indicated while the LED flashes in short intervals.

- LED 2 (right LED)
  Condition of the switching output: LED lights up continuously if the presetted turbidity range is attained. The working direction of the switching output and therefore the behavior of the LED can be changed.

7.3 Examples of sensor settings

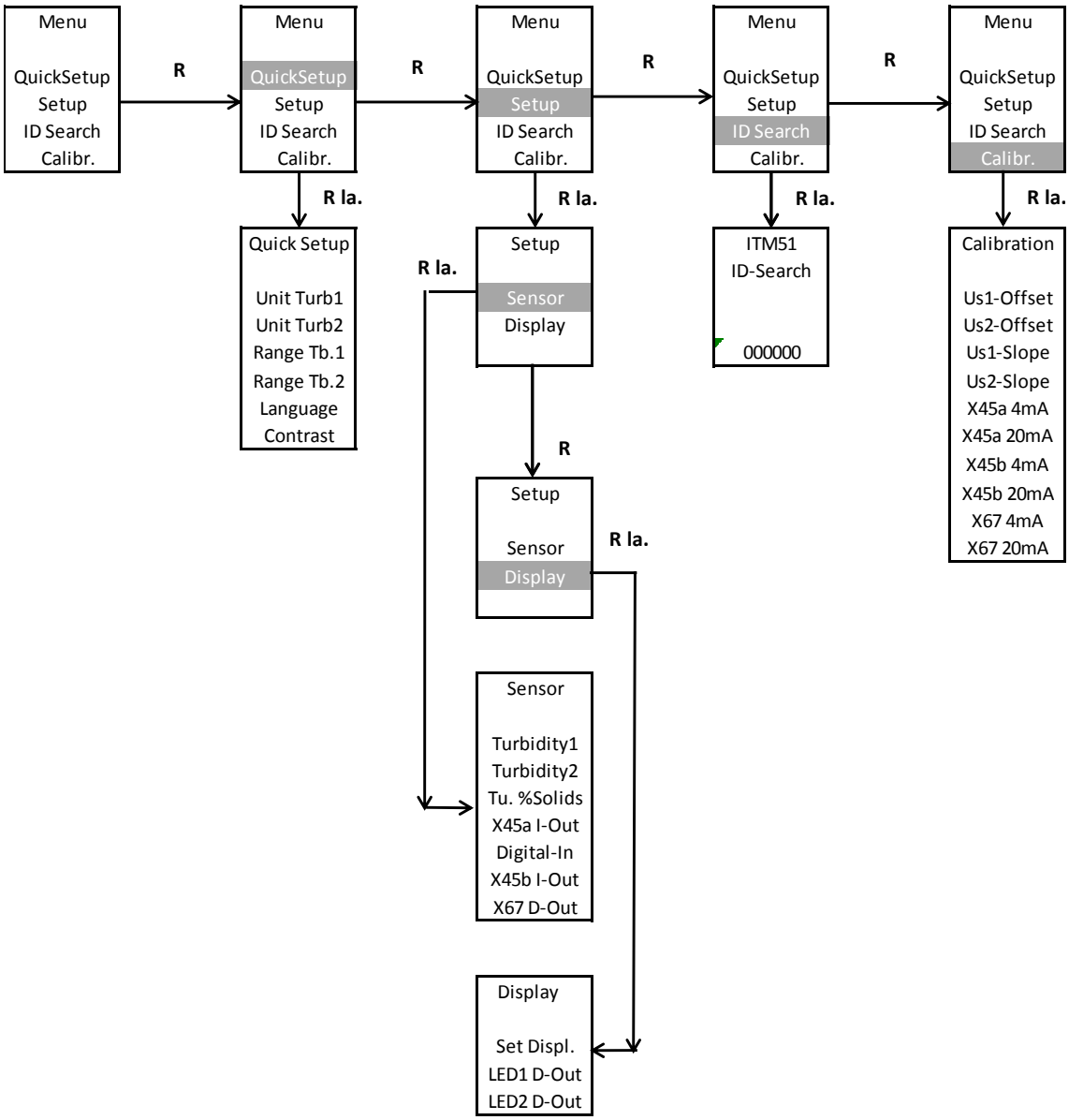
Several examples of settings that can be created on the User Interface or on the user interface of the PC follow.

The device is operated using two operating buttons on the left and right next to the display. When the sensor is in display mode, the right button must be pressed short to leave the display mode. To reach the start page of the menu the right button needs to be pressed long. The buttons function as follows:

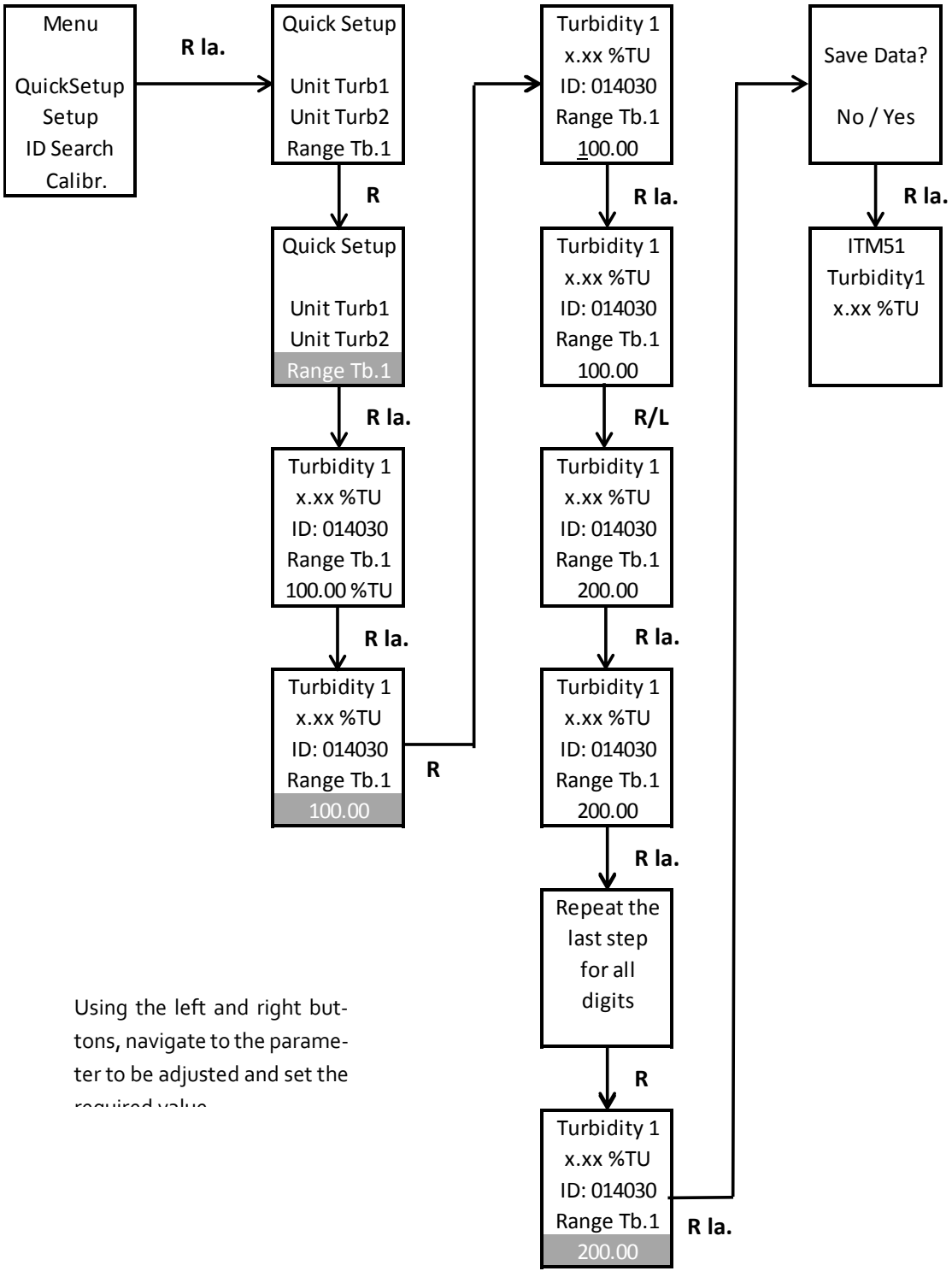


7.3.1 Menu structure User Interface

In the following flow-chart the parameter setup of the second level is shown.



7.3.2 Example for setting turbidity 1 range without an ID code:



Alternative to entering the measurement range as described above, the measurement range can also be adjusted by entering an ID code.

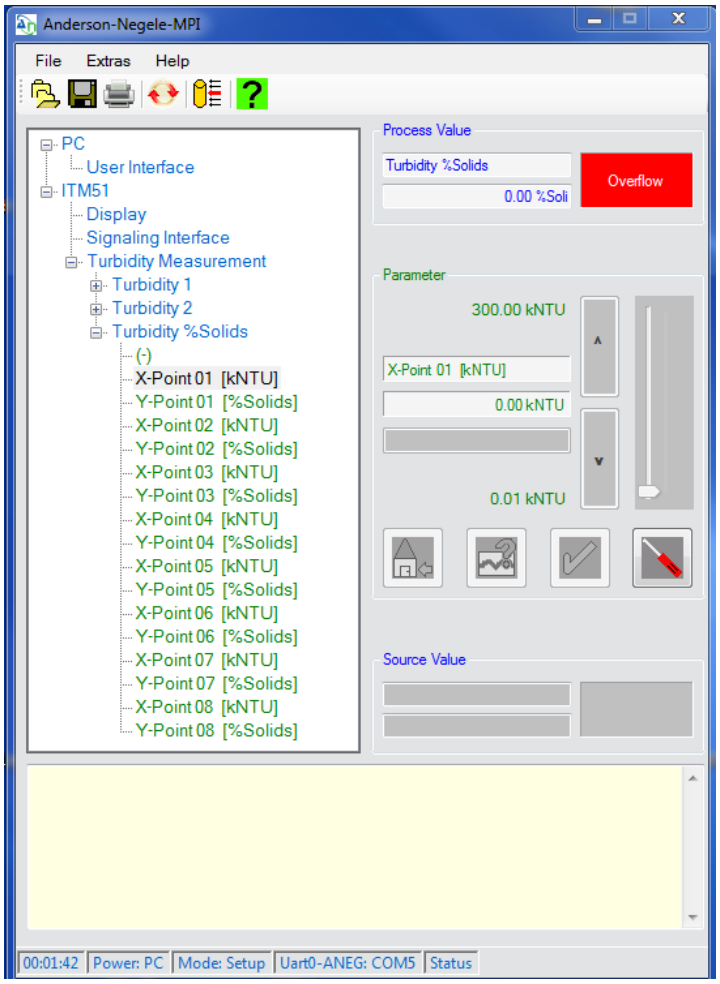
To do so, go to "**YES**" on the ID search page and enter the ID code using the buttons. After the code is confirmed, the sensor display shows the menu in which the parameter can be adjusted.

7.3.3 Setting of customer-specific turbidity / %solids curve via PC software:

After the PC software is started, a customer-specific curve for the turbidity can be entered via the following node: Turbidity Measurement → % solids → (+). 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 turbidity (X) and % solids (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 de-activated.

X-Point 01…X-Point 08 (Turbidity): This parameter is used to define the customer-specific measurement range of the turbidity. Values can be entered from 0…300 kNTU.

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



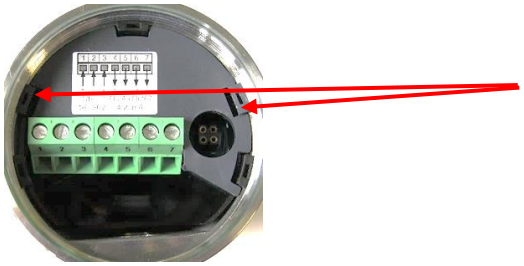
8 Installation of the „Large User Interface" (LUI)

1. Remove the plastic cover (continue with step 4), or remove the puck with the mounted small display (continue with step 2)
2. Remove the small display
3. Install the puck in the sensor head
4. Mount the large display

Hot-plug function: The large display can be installed while the sensor is energized, but this requires the usual precautionary measures when working with electronic components.

If the display is being installed while energized, it is necessary to press both buttons simultaneously for > 10 s after the display is installed to activate the display.

8.1 Retrofitting the display if a display was not yet installed



Remove the plastic cover: To do so, bend the tabs slightly inwards with a screwdriver to be able to remove the cover easily.

After removing the plastic cover, the large display can be inserted in the head of the sensor. The tabs (Fig. 2) must be inserted in the appropriate openings on the puck (Fig. 1). Then the display can be easily pressed onto the puck. No wiring is required.

Note: After the Large User Interface is mounted, the sensor can only be operated on this display since the display conceals the connector for the MPI-200 adapter. If operating the sensor using the programming software is preferred, the display must be removed. Then the connector of the programming adapter can be plugged in

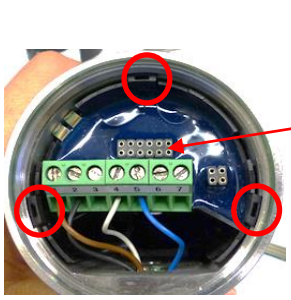


Abb. 1

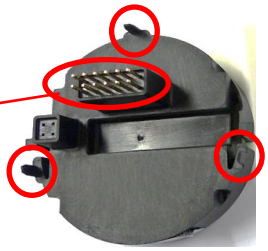


Abb. 2

Attention: The connector of the programming adapter (Fig. 3) must be connected in the correct direction → the green spacer must face the cable exit (M12 connector or PG).

Abb. 3

8.2 Retrofitting the display if a small display (SUI) was already installed

First the puck with the mounted display needs to be removed using the puck puller tool (Fig. 1). To do so, detach the wires from the cable terminal. Then insert the five arms of the puck puller in the plastic tabs of the puck (Fig. 2).

Fig. 1

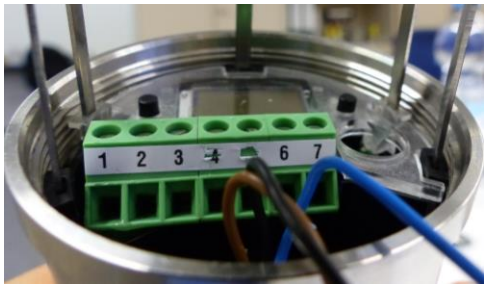
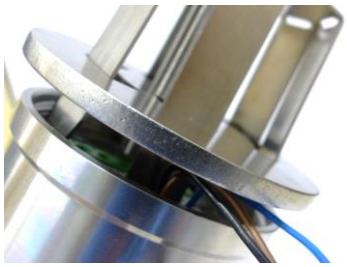


Fig. 2

Push the puck puller all the way into the sensor head and push the disk as far as possible toward the sensor head so that the arms of the puck puller firmly grasp the puck.
Pull the puck with the display out of the sensor housing and pull the small display off of the puck.



Now the puck without the display can be properly positioned and installed back in the sensor head and the wiring can be reconnected to the cable terminal. Then the large display can be mounted → see "**Retrofitting the display if a display was not yet installed**".

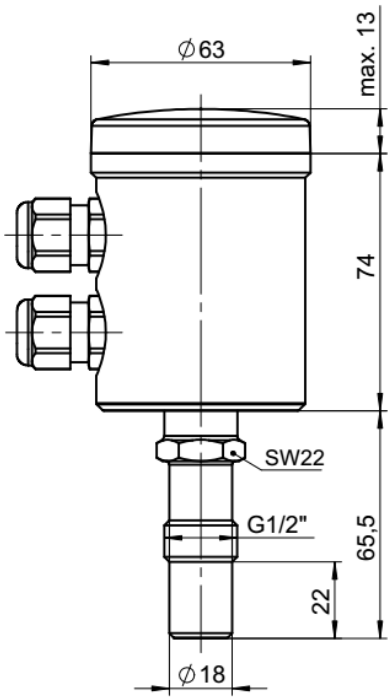
8.3 Operating the large display

The large display (LUI) is operated in the same way as the small display (SUI). It is operated using two operating buttons below the display:

After the sensor is started, the screen saver appears in which the process values of the sensor are displayed one after the other. To reach the start page from here, press one of the two buttons briefly. Further information on operating the display can be found in the quick start manual and in the operating manual for the modular sensors (ITM-51, ILM-4,...).

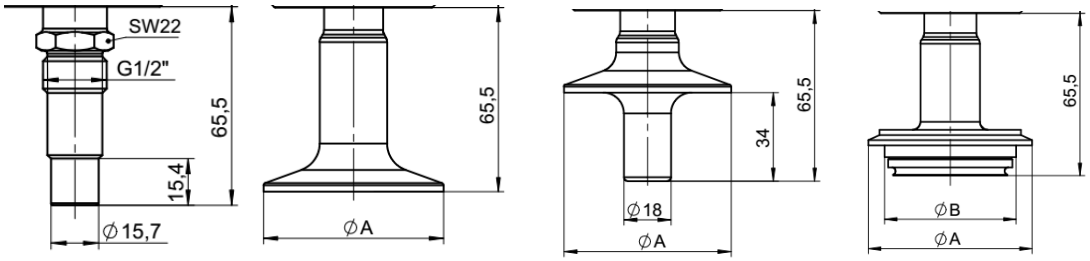
9 Dimensions

ITM-51 with vertical head orientation.



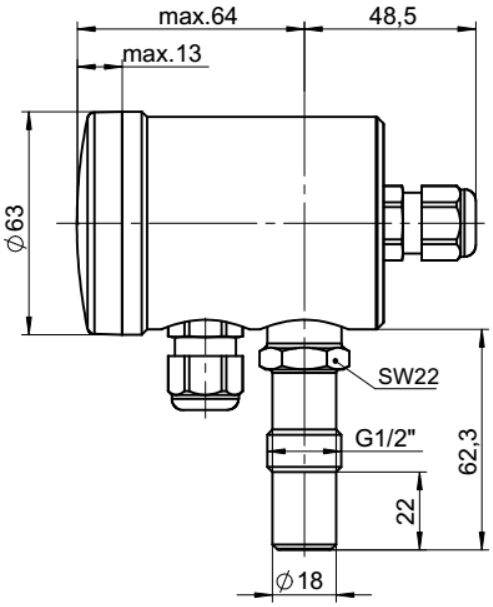
Process Connection

SOL TCx TLx Vxx



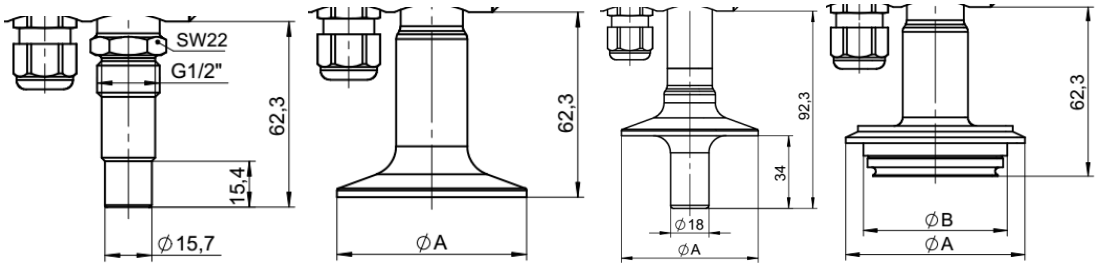
TriClamp size			**Varivent size**		
Type	Ø A		Type	Ø A	Ø B
TC1 / TL1	50,5 mm		V25	66,00 mm	57,00 mm
TC2 / TL2	64,00 mm		V40	84,00 mm	75,00 mm
T25 / TL5	77,50 mm				
TC3 / TL3	91,00 mm				

ITM-51 with horizontal head orientation.



Process connection

SOL TCx TLx Vxx



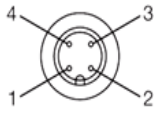
10 Wiring diagram

Electrical connection with M12-connector

Version N (Electronic A53)

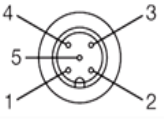
M12 connector top (4 pin)

1: out 1+
2: out - / D out
3: out + / D out
4: out 1-



M12 connector bottom (5 pin)

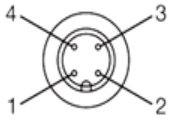
1: power supply +24 VDC
2: not connected
3: not connected
4: power supply -
5: Digital input (nb bei A52)



Version M (Electronic A42)

M12 Stecker oben (4 pin)

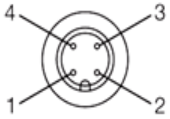
1: power supply +24 VDC
2: out +
3: out -
4: power supply -



Version A (Electronic A53)

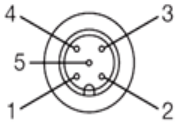
M12 connector top (4 pin)

1: out -
2: out +
3: power supply +24 VDC
4: power supply -



M12 connector bottom (5 pin)

1: out - / D out
2: not connected
3: not connected
4: out + / D out
5: Digital input (nb bei A52)



Connection of cables to the connecting terminal plate: required if puck is extended from the sensor.

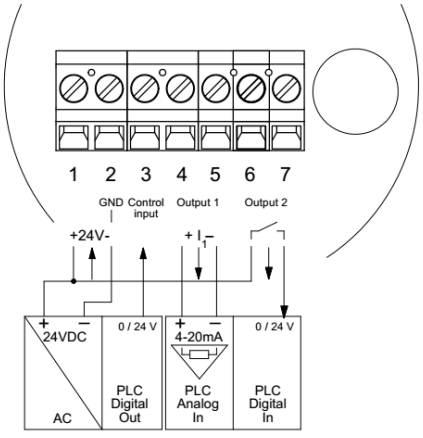
Version N (Electronics A53)

Connector 1: 5-pin connector brown
Connector 2: 5-pin connector black
Connector 3: 5- pin connector grey
Connector 4: 4- pin connector brown
Connector 5: 4- pin connector black
Connector 6: 4- pin connector blue
Connector 7: 4- pin connector white

Version M (Electronics A42)

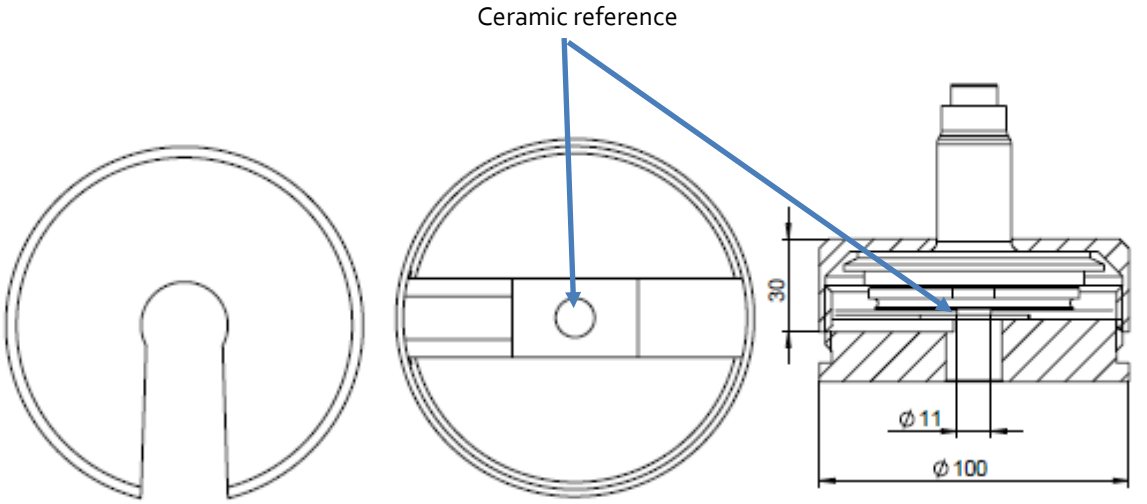
Connector 1: 4- pin connector brown
Connector 2: 4- pin connector white
Connector 3: not connected
Connector 4: 4- pin connector blue
Connector 5: 4- pin connector black

Electrical connection with cable gland



11 Repair and maintenace

The turbidity sensor described here is maintenance-free. However, it is recommended to check the calibration of the turbidity sensor once a year. For this check the ITM-51-CU calibration check tool is recommended.



ITM-51-CU-cap ITM-51-CU-bottom ITM-51-V40 placed in ITM-51 CU

The ITM-51-CU unit is used as below:

1. Cleaning the lens. The lens must be free of residues and scratches.
2. Changing the measurement category to NTU
3. Setting the upper range limit to 300K NTU
4. Placing the ceramic reference plate in the bottom piece according to the ITM-51 process connection. Fitting types TLx and Sox are placed from bottom and centered automatically. Fitting type TCx and Vxx are placed on top as shown in the drawing above. The centering is done while screwing the cap on to the bottom piece.
5. Checking the displayed NTU value and compare with the reference value printed on the label of ITM-51-CU. The value needs to be within the range of ±6% as printed on the label as well.
6. If the displayed value is outside the limits it is recommended to send back the ITM-51 for recalibration.

12 Technical data

<table>
<tr><td>Measurement category</td><td>The measurement category can be selected</td><td>%TU, NTU, EBC, %solids (customized)</td></tr>
<tr><td>Measurement range</td><td>The measurement range is freely adjustable</td><td>0…300.000 NTU equivalent
0…200 %TU
0…75.000 EBC</td></tr>
<tr><td>Process connection</td><td></td><td>CLEANadapt G1/2" hygienic
TriClamp 1.5", 2", 2.5", 3"
Varivent DN 25 (type F) DN 40/50 (type N)</td></tr>
<tr><td>Process pressure</td><td></td><td>-1…20 bar</td></tr>
<tr><td>Tightening torque</td><td></td><td>20 Nm (CLEANadapt system)</td></tr>
<tr><td>Materials</td><td>Connecting head
Sensor
Lens
Plastic cover/sight glass</td><td>Stainless steel 1.4308
Stainless steel 1.4404 (316L)
Sapphire
Polycarbonate</td></tr>
<tr><td>Temperature ranges</td><td>Ambient
Process
CIP/SIP</td><td>-10…60°C
-10…130°C
Up to 140°C max. 120 min</td></tr>
<tr><td>Reproducibility</td><td>of turbidity</td><td>≤ 1% of upper range limit</td></tr>
<tr><td>Resolution/measure-ment range</td><td>the resolution is dependent on the selected measure-ment range</td><td><table><tr><td>range/ NTU</td><td>resolution/ NTU</td></tr><tr><td>< 1 000</td><td>15</td></tr><tr><td>1 000…10 000</td><td>30</td></tr><tr><td>10 000…100 000</td><td>100</td></tr></table></td></tr>
<tr><td>Accuracy</td><td>0…9.999 NTU
10.000…300.000 NTU</td><td>±3 % from measurement value; ±50 NTU offset
±5 % from measurement value</td></tr>
<tr><td>Long-term stability</td><td>±0,2 %</td><td>from measurement value</td></tr>
<tr><td>Response time</td><td>for turbidity measurement</td><td>0,75 s</td></tr>
<tr><td>Measurement principle</td><td>infrared backscatter</td><td>wave length 860 nm</td></tr>
<tr><td>Electrical connection</td><td>Cable gland
Cable connection
Supply voltage
Protection class</td><td>2 x M16 x 1.5
2 x M12 connector 1.4305
18…36 V DC max. 190 mA
IP 69K</td></tr>
</table>

Output	1 analog outputs 1 switching output	4…20 mA (scaled to measurement range) potential free switching output
Weight		750 g

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