Compact measuring system for turbidity
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1.1 Intended use

The OPTISYS TUR 1060 is available in white light and infrared versions. Both versions are designed to measure online the turbidity of water. Furthermore the two following different measuring ranges are available: 0...100 NTU/FNU or 0...1000 NTU/FNU

1.2 Certification

1.2.1 CE

The device fulfils the statutory requirements of the following EU directives:

- Electromagnetic compatibility (EMC) in accordance with:
  EN 61326-1:2013: Emission standard and immunity for industrial environments.
- Low Voltage Directive:
  Safety requirements for electrical equipment for measurement, control and laboratory use in accordance with EN 61010-1:2010, Edition 2.0.

The manufacturer certifies successful testing of the product by applying the CE marking.

1.2.2 LC

The manufacturer tested the device and it fulfils the following LC requirements:

- LC: tested to UL 61010-1 (Ed.3)
- LC: tested to CAN/CSA-C22.2 No. 61010-1-12 (R2017)

1.2.3 US EPA 180.1

The white light version meets the design criteria specified by the US EPA 180.1 on turbidity measurement.

1.2.4 ISO 7027 and DIN 27027

The infrared version meets the design criteria specified in ISO 7027 and DIN 27027 for the measurement of the turbidity of a sample.
1.3 Safety instructions from the manufacturer

1.3.1 Copyright and data protection

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The contents and works in this document are subject to copyright. Contributions from third parties are identified as such. Reproduction, processing, dissemination and any type of use beyond what is permitted under copyright requires written authorisation from the respective author and/or the manufacturer.

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We hereby expressly prohibit the use of the contact data published as part of our duty to publish an imprint for the purpose of sending us any advertising or informational materials that we have not expressly requested.

1.3.2 Disclaimer

The manufacturer will not be liable for any damage of any kind by using its product, including, but not limited to direct, indirect or incidental and consequential damages.

This disclaimer does not apply in case the manufacturer has acted on purpose or with gross negligence. In the event any applicable law does not allow such limitations on implied warranties or the exclusion of limitation of certain damages, you may, if such law applies to you, not be subject to some or all of the above disclaimer, exclusions or limitations.

Any product purchased from the manufacturer is warranted in accordance with the relevant product documentation and our Terms and Conditions of Sale.

The manufacturer reserves the right to alter the content of its documents, including this disclaimer in any way, at any time, for any reason, without prior notification, and will not be liable in any way for possible consequences of such changes.
1.3.3 Product liability and warranty

The operator shall bear responsibility for the suitability of the device for the specific purpose. The manufacturer accepts no liability for the consequences of misuse by the operator. Improper installation or operation of the devices (systems) will cause the warranty to be void. The respective “Standard Terms and Conditions” which form the basis for the sales contract shall also apply.

1.3.4 Information concerning the documentation

To prevent any injury to the user or damage to the device it is essential that you read the information in this document and observe applicable national standards, safety requirements and accident prevention regulations.

If this document is not in your native language and if you have any problems understanding the text, we advise you to contact your local office for assistance. The manufacturer can not accept responsibility for any damage or injury caused by misunderstanding of the information in this document.

This document is provided to help you establish operating conditions, which will permit safe and efficient use of this device. Special considerations and precautions are also described in the document, which appear in the form of icons as shown below.
1.3.5 Warnings and symbols used

Safety warnings are indicated by the following symbols.

**DANGER!**
This warning refers to the immediate danger when working with electricity.

**DANGER!**
This warning refers to the immediate danger of burns caused by heat or hot surfaces.

**DANGER!**
This warning refers to the immediate danger when using this device in a hazardous atmosphere.

**DANGER!**
These warnings must be observed without fail. Even partial disregard of this warning can lead to serious health problems and even death. There is also the risk of seriously damaging the device or parts of the operator’s plant.

**WARNING!**
Disregarding this safety warning, even if only in part, poses the risk of serious health problems. There is also the risk of damaging the device or parts of the operator’s plant.

**CAUTION!**
Disregarding these instructions can result in damage to the device or to parts of the operator’s plant.

**INFORMATION!**
These instructions contain important information for the handling of the device.

**LEGAL NOTICE!**
This note contains information on statutory directives and standards.

**HANDLING**
This symbol designates all instructions for actions to be carried out by the operator in the specified sequence.

**RESULT**
This symbol refers to all important consequences of the previous actions.

1.4 Safety instructions for the operator

**WARNING!**
In general, devices from the manufacturer may only be installed, commissioned, operated and maintained by properly trained and authorized personnel.
This document is provided to help you establish operating conditions, which will permit safe and efficient use of this device.
2.1 Scope of delivery

**INFORMATION!**
Inspect the packaging carefully for damages or signs of rough handling. Report damage to the carrier and to the local office of the manufacturer.

**INFORMATION!**
Do a check of the packing list to make sure that you have all the elements given in the order.

**INFORMATION!**
Look at the device nameplate to ensure that the device is delivered according to your order. Check for the correct supply voltage printed on the nameplate.

**INFORMATION!**
Assembly materials and tools are not part of the delivery. Use the assembly materials and tools in compliance with the applicable occupational health and safety directives.

---

**Figure 2-1: Scope of delivery**

1. Electronic device with flow-through unit and ultrasonic cuvette
2. Tubing kit (drain vent, shut-off clamp, seal screw, backpressure valve, connection tubes with fittings for ultrasonic cuvette assembly)
3. Junction box power assembly
4. Desiccant pack (desiccant pouch with humidity indicator)
5. Documentation
2.2 Device description

Front view of the complete device

Figure 2-2: Description of the complete device

1. Intake tubing
2. Shut-off clamp (stops the intake flow during cuvette cleanings and replacements)
3. Drain tubing
4. Backpressure valve (allows adjustment of the amount of back pressure, which helps to control the flow rate and eliminate small bubbles)
5. Display [LCD]
6. Operation keys
7. Drain hose connection (1/4 inch OD flexible tubing), the hose has to lead to a suitable drain site
8. Drain vent hole
9. Sensor interconnect cable
10. Drain hose
11. Terminal box
12. Intake hose
13. Intake hose connection (1/4 inch OD flexible tubing), has to supply the sensor with a dependable sample flow
14. Pressure regulator
The device is available with a white light source or an infrared light source. There are no visible differences between these versions. Both versions provide the possibility of ultrasonic cleaning. Every device has a pressure regulator for the incoming flow which reduces pressures up to 7 bar / 101.5 psi down to 1 bar / 15 psi.

**Dehumidification system**

The device is equipped with a continuous dehumidification system that works with the help of a replaceable desiccant pouch in the electronic device. While the system heat is used to warm the air, a fan inside the device continuously circulates this heated and by the desiccant pouch dehumidified air around the optical well and the electronic device. This features eliminates the need for a dry purge line.

The device monitors the replaceable desiccant pouch condition continuously. The lower line of the display shows the message “DESC” in the event that you have to replace a saturated desiccant pouch that may cause problems.

**Liquid crystal display (LCD)**

For a better readability in low light or no light conditions the LCD is backlight. The backlight always stays on, but the brightness is adjustable.
RS 485 interface
In addition to the Modbus communication the device can operate in another RS 485 modes:

- Simple mode: the device can provide basic communications with the help of simple programs. Examples for such programs are Hilgraeve hyperterminal (included in most Microsoft Windows packages) or Visual Basic.

Ultrasonic cleaning
This feature helps to clean the ultrasonic cuvette continuously. The system works by sending an ultrasonic frequency through spring connections in the upper part of the device to a piezo transducer at the bottom of the ultrasonic cuvette. The ultrasonic cleaning can increase the time between cleanings significantly. However it cannot substitute the manual cleaning entirely.

2.3 Nameplates

INFORMATION!
Look at the device nameplate to ensure that the device is delivered according to your order. Check for the correct supply voltage printed on the nameplate.

Infrared / White light version

![Nameplate example](image)

Figure 2-4: Example for a nameplate

1. Manufacturer and address
2. Observe the operation and installation instruction, Electronic / electric device waste marking, China RoHs
3. Electrical data
4. Protection category
5. Serial number
6. Order code
7. Device type
8. Part number
3 INSTALLATION

3.1 General notes on installation

**INFORMATION!**
Inspect the packaging carefully for damages or signs of rough handling. Report damage to the carrier and to the local office of the manufacturer.

**INFORMATION!**
Do a check of the packing list to make sure that you have all the elements given in the order.

**INFORMATION!**
Look at the device nameplate to ensure that the device is delivered according to your order. Check for the correct supply voltage printed on the nameplate.

3.2 Storage and transport

- Store and transport the device in a dry, dust-free environment.
- Store and transport the device in an environment with a temperature between -20...+60°C / -4...+176°F.
- The original packing is designed to protect the equipment. It has to be used if the device is transported or sent back to the manufacturer.

3.3 Requirements of the device

**INFORMATION!**
The device must not be heated by radiated heat (e.g. exposure to the sun) to a electronics housing surface temperature above the maximum permissible ambient temperature. If it is necessary to prevent damage from heat sources, a heat protection (e.g. sun shade) has to be installed.

INFORMATION!
The device was designed to require very low input pressure. Though the device offers a wide pressure range, as it has an integrated pressure regulator:

- Input pressure range: 0.01...7 bar / 14.5...101.5 psi (built in regulator set at 1 bar / 15 psi)
- Maximum allowable flow rate of the cuvette: 0.1...1,5 l/min / 0.026...0.4 gal/min
- Maximum fluid temperature: +50°C / +122°F
3.4 Installation order

**CAUTION!**
Installation, assembly, start-up and maintenance may only be performed by appropriately trained personnel. The regional occupational health and safety directives must always be observed.

To install the device in the correct way, follow the order of the following sections and their instructions.

3.4.1 Placing the desiccant pouch and the humidity indicator

**CAUTION!**
A missing or saturated desiccant pouch affects not only the performance of the whole device, but can also destroy the internal electronics!
If the seal at the device base does not fit properly or is defective, the lifetime of the desiccant decreases. Therefore assure the following items:

- Do not start-up the device with a desiccant pouch missing, replace a saturated pouch!
- Replace the desiccant pouch when the display shows the message "DESC".
- Inspect the enclosure seal each time you replace the desiccant.
- If the seal is not properly seated or damaged, reseat or replace it!

Execute the following steps to insert or replace the desiccant pouch and the humidity indicator (Humonitor® card) or to inspect the seal:

![Figure 3-1: Desiccant pack (desiccant pouch with humidity indicator)](image)

**CAUTION!**
The desiccant degrades prematurely after removing the protective packaging. Therefore do not open the packaging before usage, install the desiccant pouch quickly and close the device as soon as possible.

- Move the lock ring counterclockwise and pull out the ultrasonic cuvette with flow-through unit (detailed information on page 20).
- Unscrew the four corner screws of the electronic device manually according to ① in the drawing (if the screws are too tight, use a screwdriver for slotted screws).
- Remove the upper half of the electronic device ②.
- Prior to installing the desiccant pouch for the first time, remove the shipping support (plastic tube with a red flag reaching outside) within the upper part of the device; after removing you can discard the tube.
• If you want to replace the desiccant pouch and the humidity indicator, take them out at first.
• Take the shrink packed desiccant pouch and the humidity indicator out of the protective packaging.
• Put the humidity indicator on the bottom of the lower part of the electronic device and lay the desiccant pouch on it.
• Inspect the seal and reseat or replace it if necessary.
• Reassemble everything in reverse order.
• To expedite the recognition of the new desiccant, reset the powered device by disconnecting the sensor interconnect cable for two seconds and reconnecting it.

3.4.2 Selecting site and mounting

The preferred way of mounting of the device is wall mounting. If this is not possible, you can mount the device on any suitable level surface. Irrespective of this possibilities always note the following guidelines:

- Choose a location that is easily accessible for operation and service and that is as close as possible to the sampling point to ensure a quick response time (maximum distance: 3 m/10 ft).
- Leave at least 20 cm/8" of free space above the device for easy service (e.g. removal of the flow head and insertion of calibration cuvettes), see position number 1 in the drawing.
- Ensure that the front display rests at eye level.
- Refer to chapter “Dimensions” for the device dimensions.
- Use screws M6/1/4" to fix the electronic device ② and M4/3/16" to fix the junction box power assembly ③.
Mounting procedure

- Take a water-level, a pencil and ruler and use the dimensions in the following drawing to mark the six mounting hole locations on the mounting surface.
  - Note: Do not use the following drawing directly as mounting template because the printed dimensions differ from reality!
- Drill six holes into the mounting surface and insert six screw anchors into them.
- Use screws M4 / 3/16” to fix the junction box power assembly at first.
- Put the electronic device on top of the junction box power assembly and use screws M6 / 1/4” to fix it.

### 3.4.3 Mounting dimensions

**CAUTION!**

Please do not use this directly as mounting template as the printed dimensions here differ from reality!

**INFORMATION!**

Leave at least 20 cm / 8” of free space above the device for easy service (e.g. removal of the flow head and insertion of calibration cuvettes).

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<tr>
<td>c</td>
<td>90</td>
<td>3.54</td>
</tr>
<tr>
<td>d</td>
<td>87</td>
<td>3.43</td>
</tr>
</tbody>
</table>
3.4.4 Connecting the hoses

The scope of delivery contains two tubings with fittings (intake tubing, drain tubing) for the connection between the flow-through unit and the flow intake and flow drain. The intake tubing has a shut-off clamp and the drain tubing has a backpressure valve. Connect the hoses according to the following drawing:

**CAUTION!**
*Do not connect the sensor interconnect cable with the upper part of the device now and regard the installation order in the chapter "Electrical connections"!* The reason is that you will have to do the internal wiring at first and the connection of the sensor interconnect cable afterwards, the reverse order could damage the device!

![Diagram of hose connections](image)

Figure 3-3: Connecting the hoses

1. Intake tubing with shut-off clamp
2. Drain hose with backpressure valve
3. Sensor interconnect cable

The hose for the connection between the sampling point and the device as well as the hose for the flow drain do not belong to the scope of delivery. For this purpose use hoses with the following specifications:

- 1/4 inch OD flexible tubing
- Opaque hose material to prevent algae growth if direct sunlight can reach the hose.

**INFORMATION!**
*To prevent that the drain water causes any damages, assure that the drain hose leads to a suitable drain site.*
3.4.5 Water intake

CAUTION!
Only water which is free of corrosive chemicals or other dangerous substances may be used.

Select a hose diameter of 1/4 inches OD (polyethylene or polypropylene). Make sure that the hose is long enough to connect the drain directly to a suitable location. Ensure that there are no kinks, twists, fractures or damage of any kind in the hoses.

Slide the hose into the Quick Connect fitting on the right-hand side and check that the hose is completely pressed against the stop.

Pull carefully but firmly on the pipe to check if it is secured.

3.4.6 Drain vent

CAUTION!
The device must be routed to a suitable sanitary sewer drain. Do not return the drain sample or any water into the process stream or into any potable water supply.

Select a hose diameter of 1/4 inches OD (polyethylene or polypropylene). Make sure that the hose is long enough to connect the drain directly to a suitable location. Ensure that there are no kinks, twists, fractures or damage of any kind in the hoses.

Slide the hose into the Quick Connect fitting on the right-hand side and check that the hose is completely pressed against the stop.

Pull carefully but firmly on the pipe to check if it is secured.
3.4.7 Inserting and fixing the ultrasonic cuvette with flow-through unit

**CAUTION!**

Never insert a cuvette with visible moisture or water on the glass or the transducer into the upper part of the device, because this could destroy or damage the electronics or the transducer! Always clean and dry the cuvette with a soft cloth just before inserting it. The dehumidification system cannot remove large droplets of water, only residual moisture!

![Figure 3-4: Procedure for inserting and fixing the ultrasonic cuvette with flow-through unit](image)

**INFORMATION!**

Inspect the interior, O-rings and cuvette regularly for damages. If necessary replace the component. Make sure that the cuvette is sealed correctly.

**INFORMATION!**

The device can only detect a new cuvette if it works in the normal operation mode (“AUTO”). If the device operates correctly after inserting a new cuvette, “AUTO” will flash on the display.
4.1 Safety instructions

**DANGER!**
All work on the electrical connections may only be carried out with the power disconnected. Take note of the voltage data on the nameplate!

**DANGER!**
Observe the national regulations for electrical installations!

**WARNING!**
Observe without fail the local occupational health and safety regulations. Any work done on the electrical components of the measuring device may only be carried out by properly trained specialists.

**INFORMATION!**
Look at the device nameplate to ensure that the device is delivered according to your order. Check for the correct supply voltage printed on the nameplate.

4.2 Description of board and cable glands

![Diagram of board and cable glands]

All of the electrical connections to the device run via the junction box power assembly. For shipment the manufacturer inserts plugs into the alarm and the 4...20 mA/RS 485 cable gland to waterproof the device.
4.3 Circuit breaker and specifications of power supply

**DANGER!**
The manufacturer strongly recommends to place a circuit breaker prior to the power connection. Use this circuit breaker to de-energise all cables before starting any installation or service work, otherwise a perilous electric shock can happen.

**CAUTION!**
The device has a switching power supply which demands 100...240 VAC and 47...63 Hz. To avoid damage or destruction of the device always assure that the power supply meets this specifications!

**INFORMATION!**
The power cord does not belong to the scope of delivery.

4.4 Cable specifications

- The power cable glands accept the following cable diameter range: 5.8...10 mm / 0.23...0.39”.
- All terminals accept wires in the range of 12...30 AWG / 0.05...3 mm²
- Stripping of insulation to a length of 6 mm / 1/4”.

4.5 Installation order of the electrical connections

**CAUTION!**
Installation, assembly, start-up and maintenance may only be performed by appropriately trained personnel. The regional occupational health and safety directives must always be observed.

**CAUTION!**
To prevent damage or destruction of all devices, always regard the following items:

- Ensure that the device itself and all devices that should be connected to the outputs are de-energised before establishing a cable connection!
- Before fixing a cable, look on the labels on the board and especially regard polarities!

To establish the electrical connections in the correct way, follow the order of the following sections and their instructions.
4.5.1 Connecting the cables in the junction box power assembly

**DANGER!**
The device involves a line voltage that could endanger life! Only qualified electricians are allowed to perform the electrical installation of the device. Always note all local and government recommendations and methods for installation of electrical connections to and between the device and other peripheral devices.

**DANGER!**
The manufacturer accepts no responsibility that the device is watertight again after the electrical installation. Assure the water tightness after the terminal box was wired for operation. If any of the cable glands does not tighten a cable or plug properly this jeopardises the ratings of the device and may cause a perilous electric shock.

Connection procedure

- Open the junction box with a screwdriver.
- Strip all needed wires to a length of 6 mm / 1/4" ①.
- Fix the cables in the clamp and put the clamp in the terminal like in the following drawing to ②.
- Use the strain relief strap to reduce the tension on the power terminals ③.
- Close the terminal box and assure that it is properly sealed.

![Diagram of connecting the cables in the junction box](image-url)
4.5.2 Alarms terminal (signal output)

The terminal block has spring loaded connections. To open the connection, insert a 3 mm / 1/8 inch flat blade screwdriver into the slot right above the electrical connection. Pulling up slightly on the screwdriver opens the terminal block connection. Removing the screwdriver tightens the connection. There are two stacked rows of connections which are labeled. The alarm connections are on the upper row. The RS-485 and 4-20mA are on the lower row. These connections are rated for a wire size from 12...30 AWG / 0.05...3 mm², either solid or stranded.

The terminals "ALARM 1" and "ALARM 2" are mechanical relays rated at 120 ...240 VAC and 2 A. The abbreviations on the board and below the terminal have the following meanings:

- **NO**: Normally open
- **NC**: Normally closed
- **C**: Common

As the configuration of the alarms is fail-safe, the normal state is a power supplied device and non-active alarms. For detailed information concerning the configuration of the alarms refer to *Configuring the alarm relays* on page 41.

Connections are labeled beneath the large terminal block. These connections are on the upper row.
4.5.3 RS 485 / 4...20 mA signal output

The terminal block has spring loaded connections. To open the connection, insert a 3 mm / 1/8 inch flat blade screwdriver into the slot right above the electrical connection. Pulling up slightly on the screwdriver opens the terminal block connection. Removing the screwdriver tightens the connection. There are two stacked rows of connections which are labeled. The alarm connections are on the upper row. The RS 485 and 4...20 mA are on the lower row. These connections are rated for a wire size from 12...30 AWG / 0.05...3 mm², either solid or stranded.

The 4...20 mA output is energised by a 24 VDC power source and can drive loads up to 1 KΩ. It is isolated from line power and earth ground.

The RS 485 half-duplex digital interface (2-wire) operates with differential levels that are unsusceptible to electrical interferences. This is why the usage of cable lengths up to 900 m / 2950 ft is possible. Independent of the output mode (analog or digital) always note the following items:

- For ease of connecting, remove the label on the terminal block (the labels of the connections are beneath this block).
- Do not run 4...20 mA or RS 485 cables in the same conduit as power as this could lead to signal interferences.
- When using the RS 485 interface, equip the last device on each bus with a 120 Ω terminating resistor to eliminate signal reflection on the line.

The electrical connection is independent of the output mode (analog or digital) and is shown in the following figure:

**Figure 4-3: Signal output connection**

**Connection procedure**

- Open the junction box with a screwdriver.
- Strip all needed wires to a length of 6 mm / 1/4”.
- Fix the cables on the terminal as shown in the drawing ② to ④.
- Use the strain relief strap to reduce the tension on the power terminals.
- Close the terminal box and assure that it is properly sealed.
4.5.4 Connecting the sensor interconnect cable

**CAUTION!**
Always connect the sensor interconnect cable with the upper part of the device last of all! The reason is that if you connect the sensor interconnect cable before the internal wiring, energising the device with power could destroy or damage the device!

![Connecting cable](image.png)

Figure 4-4: Connecting cable
5.1 Start-up

**CAUTION!**
Installation, assembly, start-up and maintenance may only be performed by appropriately trained personnel. The regional occupational health and safety directives must always be observed.

**INFORMATION!**
Inspect the interior, O-rings and cuvette regularly for damages. If necessary replace the component. Make sure that the cuvette is sealed correctly.

Before start-up assure the following adjustments:

- Before first use, the supplied desiccant bag must be inserted.
- The back pressure valve is completely open.
- The hose connected of the device leads to a suitable drain site.
- For continuous measurement the intake hose has to supply the sensor with a dependable sample flow.

**Start-up procedure**

- Check that the circuit breaker is not in a position where it de-energises the device.
- Switch on the power supply.
- Wait until the device has completed its warm-up (1 hour during the initial start-up and typically 45 minutes during all following start-ups), at the same time the fully automatic drying process takes place.

After the warm-up the display shows the measured turbidity, if a continuous process stream is flowing through the cuvette; refer to *Normal operation* on page 28. In addition, the equivalent signal is provided on the analog 4...20 mA output or the digital RS 485 output, depending on the options selected.

- Initial settings like Date and Time must be set now.
5.2 Display and operating keys

Figure 5-1: Description of the display and operating keys

1. Indication of the turbidity levels and user guidance in the customer setting routine
2. Indication of an active access code and operation in offset mode
3. Indication of error messages and user guidance
4. Button to move up or increase
5. Button to move forward
6. Button to move down or decrease
7. Button to accept the change
8. Button to move backward
9. Mode arrows that indicate the current of the three operation modes: AUTO (normal operation), CAL (calibration) or CONFIG (configuration)

5.3 Normal operation

The device can report the turbidity of the process water in Nephelometric Turbidity Units (NTU) or Formazin Nephelometric Units (FNU). Readings above 10 NTU/FNU, 100 NTU/FNU or 1000 NTU/FNU (depending on the specific device measuring range) are outside the range of this device.

During normal operation, the display shows an arrow beside “AUTO” in the upper left corner. Simultaneously the lower row displays the current scale and the upper row the measured reading. The following drawing is an example for a display during normal operation:
5.4 Getting access with activated security access function

The device has a security access function. You can enable and disable this function in the configuration mode (for more information refer to Enabling or disabling the security access on page 43). With the enabled function the following screen appears any time you press the button MODE/EXIT:

![Security Access Screen]

Execute the following steps to enable and disable the security access:

- Use ↑ or ↓ to select “CONFIG” and press ←.
- Use ← or → to select “CODE”.
- Use ↑ or ↓ to select “On” or “OFF”.
- If you choose “OFF”, press ← to get back in the normal measuring mode.
- If you choose “On” first time and press →, the 3 digit security code is set. Using ↑ or ↓ to select each digit. The flashing digit is the number that is currently being adjusted. Press → to move on to the next digit.
- If the code is adjusted, press → to switch to the next item in the menu.

Execute the following steps to get access with an activated security access:

- Press ↑ or ↓ in the normal measuring mode.
- The 3 digit security code is set one digit at a time. Press ↑ or ↓ to select the first number. The flashing digit is the number that is currently being adjusted.
- Press the button → to accept the first number of the code.
  - Now the second number of the code is flashing.
- Repeat the previous step with the second number, confirm the choosen number with the → button.
- Repeat the previous step with the third number and confirm the choosen last number with the ← button.
  - If you have entered the valid code, the main menu with the arrow beside “CAL” appears. If you have entered a wrong code, it returns to the normal measuring mode ("AUTO").
5.5 Change the security access code

To change the access code the current access code is needed.

Execute the following steps to get access with an activated security access and change the security access:

- Press ‹ or › in the normal measuring mode.
- The 3 digit security code is set one digit at a time. Press ‹ or › to select the first number. The flashing digit is the number that is currently being adjusted.
- Press the button › to accept the first number of the code.
- Now the second number of the code is flashing.
- Repeat the previous step with the second number, confirm the chosen number with the button.
- Repeat the previous step with the third number and confirm the chosen last number with the button.
- If you have entered the valid code, the main menu with the arrow beside "CAL" appears. If you have entered a wrong code, it returns to the normal measuring mode ("AUTO").
- Use ‹ or › to select "CONFIG" and press ↵.
- Use ‹ or › to select "CODE", make sure that "CODE" is set "On".
- Use › to see the actual code. Now you can change the code as desired.
- Use ‹ or › to select the number and use ‹ or › to select the digit.
- If the code is adjusted, press ↵ to get back in the normal measuring mode.
5.6 Menu topology

The device has 4 operation modes:

- **Auto (AUTO):** normal measuring mode. This is the default mode when power is applied or restored. The other three modes of operation are limited to 15 minutes with no key presses after which they will return to AUTO mode operation.

- **Calibration (CAL):** mode for physical calibration. All reading outputs and alarms are held while in this mode of operation. The instrument was calibrated and tested prior to leaving the factory. Therefore, it is possible to use the instrument directly out of the box. Under normal conditions, re-calibration is required once every three months. Quarterly calibration ensures performance within accuracy specifications.

- **Configuration (CONFIG):** mode for customer-specific adjustments and preferred operation at any time during normal operation. The CONFIG mode has been split into sub-menus to facilitate instrument configuration. This is also where logged files and calibration logs can be downloaded and where new software, when available, can be uploaded.

- **HOLD** mode is intended for servicing the instrument and holds the outputs and alarms. During this mode the 4...20 mA and alarms are frozen. This mode can be used to ensure that no changes accidentally are made to the instrument. This mode will time out after 15 minutes and revert back to AUTO mode.

**INFORMATION!**
Each main menu has a set of submenus.

Entering, navigating within and leaving a main menu:

- Press ▲ or ▼ for the desired main menu (in the normal measuring mode: 1 x = CAL, 2 x = CONFIG, 3 x HOLD).
- Press ← to enter one of the 4 main menus.
- Press ◄ or ► to move through the submenu items.
- Press ▲ or ◄ to change the parameter in the submenu.
## 5.7 Menu mode structure

**INFORMATION!**
The following table just presents an overview. When programming the device, always consult the function tables additionally as they contain further information!

<table>
<thead>
<tr>
<th>Main menu</th>
<th>Submenu</th>
<th>Parameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>▶ AUTO - Automatic Operation</td>
<td>◄</td>
<td>This mode is the normal automatic operation. This is the default mode when power is applied or restored.</td>
</tr>
<tr>
<td>▼</td>
<td>100</td>
<td>Calibration starts (wait 30 seconds)</td>
</tr>
<tr>
<td>▼</td>
<td>10</td>
<td>Calibration starts (wait 60 seconds)</td>
</tr>
<tr>
<td>▼</td>
<td>0.02</td>
<td>Calibration starts (wait 30 seconds)</td>
</tr>
<tr>
<td>▼</td>
<td>ABRT</td>
<td>Abort the calibration</td>
</tr>
</tbody>
</table>
## CONFIG - Configure

<table>
<thead>
<tr>
<th>Main menu</th>
<th>Submenu</th>
<th>Parameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>CONFIG</td>
<td>4-20MA - Enable 4-20 mA</td>
<td>On, OFF</td>
</tr>
<tr>
<td></td>
<td>4MA - Setting 4 mA</td>
<td>0.01...100.00, 0.01...1000.00</td>
</tr>
<tr>
<td></td>
<td>20MA - Setting 20 mA</td>
<td>100.00...0.01, 1000.00...0.01</td>
</tr>
<tr>
<td></td>
<td>ERLV - Error Level</td>
<td>0.00, 2.00, 4.00, OFF</td>
</tr>
<tr>
<td></td>
<td>BAUD - Baud Rate</td>
<td>2400, 4800, 9600, 19200</td>
</tr>
<tr>
<td></td>
<td>ADDR - Modbus Address</td>
<td>1...255</td>
</tr>
<tr>
<td></td>
<td>ALM1 - Alarm 1</td>
<td>OFF, HI, LO, Error, S/P Setpoint, DLY - Delay On, Delay OFF</td>
</tr>
<tr>
<td></td>
<td>ALM2 - Alarm 2</td>
<td>OFF, HI, LO, Error, S/P Setpoint, DLY - Delay On, Delay OFF</td>
</tr>
<tr>
<td></td>
<td>OFST - Offset</td>
<td>On, OFF</td>
</tr>
<tr>
<td></td>
<td>CODE - Access Code</td>
<td>On, OFF</td>
</tr>
<tr>
<td></td>
<td>RESP - Signal Averaging</td>
<td>1...60</td>
</tr>
<tr>
<td></td>
<td>RES - Display Resolution</td>
<td>0.0000, 00.000, 000.00, 0000.0</td>
</tr>
<tr>
<td></td>
<td>RESP - Signal Averaging</td>
<td>1...60</td>
</tr>
<tr>
<td></td>
<td>RES - Display Resolution</td>
<td>0.0000, 00.000, 000.00, 0000.0</td>
</tr>
<tr>
<td>Main menu</td>
<td>Submenu</td>
<td>Parameter</td>
</tr>
<tr>
<td>-----------</td>
<td>---------</td>
<td>-----------</td>
</tr>
<tr>
<td><strong>BRT</strong> - LCD Brightness</td>
<td>▲ ▼</td>
<td>1...10</td>
</tr>
<tr>
<td><strong>UNIT</strong> - Display Units</td>
<td>▲ ▼</td>
<td>ntu Fnu</td>
</tr>
<tr>
<td><strong>CLN</strong> - Ultrasonic Cleaning</td>
<td>▲ ▼</td>
<td>On OFF</td>
</tr>
<tr>
<td><strong>PRTY</strong> - Modbus Parity</td>
<td>▲ ▼</td>
<td>nOnE EvEn Odd</td>
</tr>
<tr>
<td><strong>STOP</strong> - Modbus Stop Bits</td>
<td>▲ ▼</td>
<td>1 2</td>
</tr>
<tr>
<td><strong>4MA</strong> - 4 mA Adjust</td>
<td>▲ ▼</td>
<td>-200...200</td>
</tr>
<tr>
<td><strong>20MA</strong> - 20 mA Adjust</td>
<td>▲ ▼</td>
<td>-1000...1000</td>
</tr>
<tr>
<td><strong>ID</strong> - Instrument ID</td>
<td>▲ ▼</td>
<td>0001...9999</td>
</tr>
<tr>
<td><strong>INVL</strong> - Logging Interval</td>
<td>▲ ▼</td>
<td>1...60</td>
</tr>
</tbody>
</table>
## 5.8 Calibration mode (main menu)

The instrument is calibrated for the 0...100 NTU or the 0...1000 NTU range and tested prior to leaving the factory. Therefore you can use the device directly out of the box. Under normal conditions the manufacturer recommends a recalibration every three months. Also be aware of the following device properties:

Relay contacts and the 4...20 mA will be frozen (held at the current state) while the instrument is in the calibration mode. While in the calibration mode, the instrument has a time-out feature that automatically returns to the AUTO mode after 15 minutes of inactivity.

The EPA and ISO recommend that on-line turbidimeters be calibrated with a primary standard at least once every three months if they are to be used for reporting purposes.

### Table: Calibration mode (main menu)

<table>
<thead>
<tr>
<th>Main menu</th>
<th>Submenu</th>
<th>Parameter</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>DOWN</strong> - Download</td>
<td>JAn, Feb, Mar, Apr, May, Jun,</td>
</tr>
<tr>
<td></td>
<td>Logged Files</td>
<td>Jul, Aug, Sep, Oct, Nov, ALL,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CAL, nO</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>MNTH</strong> - Setting</td>
<td>1...12</td>
</tr>
<tr>
<td></td>
<td>Month</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>DAY</strong> - Setting Day</td>
<td>1...31</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Year</strong> - Setting</td>
<td>2017...2100</td>
</tr>
<tr>
<td></td>
<td>Year</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>HOUR</strong> - Setting</td>
<td>0...23</td>
</tr>
<tr>
<td></td>
<td>Hour</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>MIN</strong> - Setting</td>
<td>0...60</td>
</tr>
<tr>
<td></td>
<td>Minutes</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>DST</strong> - Daylight</td>
<td>On</td>
</tr>
<tr>
<td></td>
<td>Saving Time</td>
<td>Off</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>UPDT</strong> - Update</td>
<td>Err</td>
</tr>
<tr>
<td></td>
<td>Software</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>CONFIG HOLD</strong> -</td>
<td></td>
</tr>
<tr>
<td></td>
<td>HOLD</td>
<td></td>
</tr>
</tbody>
</table>
5.8.1 Calibration standards

If you want to use the device over the entire measuring range (0.02...100 NTU/FNU or 0.02...1000 NTU/FNU), a complete calibration with three different calibration liquids is necessary. If you require a device accuracy below 10 NTU/FNU (i.e. with potable water), you can do the calibration with only two liquids (for this purpose the first calibration step can be bypassed).

INFORMATION!
Always note the following items to achieve the best calibration results:

- Use three calibration liquids with turbidities of 0.02, 10.0 and 100 or 1000 NTU/FNU if you want to achieve the full-scale accuracy stated in this document.
- You can use formazin as a primary calibration liquid. Though the manufacturer recommends the own calibration kit as a primary option because this liquids are more stable than formazin and have a minimum shelf life of twelve months (the manufacturer’s calibration kit is purchasable as accessory part).
- Check the expiration dates of the liquids prior to calibration to ensure that they have not expired.

If you want to calibrate the device with formazin, always use a fresh stock suspension. The reason is that diluted formazin is unstable and this can distort the calibration.

For EPA compliant calibration results the agency recommends that a calibration of online devices takes place with primary calibration liquids at least every three months.

5.8.2 Calibration procedure (physical), inclusive indexing

To achieve the highest possible accuracy, the manufacturer recommends to index all calibration cuvettes. Furthermore indexing a calibration cuvette accounts for normal scratches and aberrations in the cuvette glass when performing a calibration. The manufacturer supplies all his optionally available calibration cuvettes with indexing rings (see below).

Execute the following steps to make a physical calibration inclusive indexing the calibration cuvettes:

- Use the buttons ▲ and ◄ once to switch into the calibration mode.
- The arrow in the display appears beside “CAL”, the lower display line shows alternating “100” (turbidity value of the first calibration liquid in NTU/FNU) and ◄, the upper line shows the real-time reading.
• Remove the ultrasonic cuvette and insert the 100 NTU/FNU or 1000 NTU/FNU calibration cuvette according to the following drawing (if you do not need the full-scale accuracy, press ▼ alternatively to bypass this calibration step and go directly to the 10 NTU/FNU calibration step).

![Diagram](image)

• If you need the 100 NTU/FNU or 1000 NTU/FNU calibration step, slowly rotate the calibration cuvette one complete revolution (i.e. 360°), observe the measured turbidity on the display during rotation and locate the position with the lowest measured turbidity.
• After one complete rotation return the cuvette to the position with the lowest measured turbidity.
• Pull the indexing ring over the cap of the calibration cuvette according to the following drawing, the ring should face directly forward.
  ➤ The cuvette is indexed now. When using it in future, insert it so that the pointer of the indexing ring faces directly forward. For fine adjustment slowly rotate the calibration cuvette about 5° clockwise and counterclockwise to find the lowest measured turbidity.

![Diagram](image)

• After finding out the lowest measured value of the 100 NTU/FNU or 1000 NTU/FNU calibration cuvette and indexing it, press ← to accept the 100 NTU/FNU or 1000 FNU/NTU calibration.
  ➤ The lower line of the display counts down the progress of the calibration step, afterwards the device requests the next calibration step by showing 10 and ← alternating.
• If the display does not show 10 and ← alternating, press ▲ and ▼ until the display does so.
• Insert the 10 NTU/FNU calibration cuvette (contrary to the 100 NTU/FNU or 1000 NTU/FNU calibration step you cannot leave out this step and the 0.02 NTU/FNU step).
• Repeat the procedure above and finally press ← to accept the 10 NTU/FNU calibration.
  ➤ The lower line of the display counts down the progress of the calibration step, afterwards the device requests the next calibration step by showing 0.02 and ← alternating.
• Repeat the procedure above and finally press ← to accept the 0.02 NTU/FNU calibration.
  ➤ The lower line of the display counts down the progress of the calibration step, afterwards the device returns to the normal operation mode (“AUTO”).
5.8.3 Calibration procedure (offset calibration)

Under certain circumstances an offset calibration is more suitable than a physical calibration. This might be the case if the process application contains a number of devices so that a regular physical calibration is not possible.

**INFORMATION!**
*Be aware that an offset calibration does not offer the accuracy of a physical calibration. An offset calibration makes the device accurate only at turbidity levels in the immediate vicinity of the grab sample’s value and not in the full measuring range!*

The maximum offset value is ±1 NTU/FNU. If the deviation goes beyond this value, a physical calibration is necessary. An offset calibration always starts with a comparison of samples:

- Collect a grab sample of the process water with the optional grab sample cuvette.
- Measure the turbidity with the help of the device.
- Take a second grab sample and measure its turbidity using a turbidimeter for laboratory use (the manufacturer’s service department can give you examples of suitable devices).
- Compare the turbidity values of both samples. If they are very close, then an offset calibration is not required and you can stop the procedure at this step.

If both samples differ substantially (but less than 1 NTU/FNU), continue with the actual offset calibration. The following steps make the turbidity reading of the device agree with the value of turbidity meter for laboratory use:

- Use ← or → to select "CONFIG" and press ↓.
- Use ← or → to select "OFST", make sure that "OFST" is set "On".
- Use → to see the actual value. Default setting is 0.00
- Use ← or → to select the desired offset.
- Use → to accept the chosen offset value.
- The offset calibration is complete and the device goes to the next submenu in the configuration main menu.
- If you want to return to the normal measuring mode, press ↓.
Example of finding out the offset value
The correct offset value is the difference between the value measured with the turbidity meter for laboratory use and the value measured with the actual meter. After you have entered an offset value, the meter adds or subtracts this value from its own measured value (depending on the algebraic sign of the difference).

If the actual meter measures 0.28 NTU/FNU in the grab sample and the meter for laboratory use measures 0.04 NTU in the same sample, than the correct offset value is -0.24. After entering the offset value the device subtracts 0.24 from its own measured value of 0.28 NTU/FNU and displays a measuring result of 0.04 NTU/FNU.

5.8.4 Calibration error
If the following information is shown on the display, the internal diagnostic function has determined an error during the calibration procedure:

The reason for this error message is that either the calibration liquids were bad or they were inserted in the wrong order. You may find a remedy with the following options:

- Check of the calibration liquids (e.g. the expiration date), afterwards restoring the factory calibration or performing a recalibration.
- To recalibrate execute a calibration as described in the previous sections.
- To restore the factory calibration refer to Reset to factory calibration on page 50.

5.9 Configuration mode (main menu)
The device has the ability to customise it according to your specific needs any time during normal operation with the help of the configuration mode. Be aware of the following device properties:
5.9.1 Setting the 4...20 mA output inclusive error level

- Use the buttons ▲ and ◄ to select “CONFIG” and press►.
- Use ◄ or ► to select “4-20”.

Use the buttons ▲ and ◄ to set “ON” and press►.

Your task is now to set the lower and the upper turbidity limits:

- Use the buttons ▲ and ◄ to define the lower turbidity limit which is assigned to the 4 mA output level and press►.
  - The device switches to the next menu item, i.e. the setting of the upper limit.

- Use the buttons ▲ and ◄ to define the upper turbidity limit which is assigned to the 20 mA output level and press►.
  - The device switches to the next menu item, i.e. “Error level”.

INFORMATION!
- While in calibration or configuration mode, the device has a time-out function; it automatically returns the device to the normal operation mode (“AUTO”) after a 15 minute period of inactivity.
- While in the calibration or configuration mode, the relay contacts hold at the last valid condition and will not change state.
- You can leave the configuration mode at any time and menu by pressing the button ◄. The device automatically saves all changes.
- The order of the following sections and subsections represents the menu topology.
In case of an error the 4...20 mA output can be used to indicate the problem. That means the device can set the current either to 4.00 mA, 2.00 mA, 0 mA or to “OFF” (“OFF” is the default setting and effects that the 4...20 mA output is unaffected by any error condition):

- Use the buttons ▲ and ▼ to choose the desired setting for the error level and press ▶.
- The device switches the next menu item, “Baud rate”

### 5.9.2 Baud rate

**INFORMATION!**

The default communication parameters of the RS 485 port are: 8 bits, no parity and 1 stop bit.

Select the desired baud rate (2400, 4800, 9600, or 19200) for operation of the I/O port.

- Use the buttons ▲ and ▼ to select one of the predefined baud rates (options: 2400, 4800, 9600 or 19200) and press ▶.
- The device switches to the next menu item.

**INFORMATION!**

For further information concerning the Modbus mode contact the manufacturer.

### 5.9.3 Configuring the alarm relays

The device has two alarm relays that operate as two independent programmable alarms. To fully program each alarm, you have to input the work mode of the alarm function, the alarm set point and the delay time for the alarm.
Work mode of the alarm function

- **HI**: the relay changes state when the measured turbidity level is higher than the programmed alarm level for the chosen alarm delay time.
- **LO**: the relay changes state when the measured turbidity level is lower than the programmed alarm level for the chosen alarm delay time.
- **ERROR**: the relay changes state when an internal error occurs.
- **OFF**: this option completely deactivates the alarm functions. If a system error occurs a message will appear on the lower row of the screen describing the problem.

Alarm set point

This is the level at which an alarm activates. On the instrument, the alarm set point is designated as “S/P”. You can adjust the alarm set point to any valid turbidity level over the range of the device in steps of 0.01 NTU/FNU.

Alarm delay times

The alarm delay time prevents activating the alarm when the measured turbidity level exceeds or falls below the alarm set point just for a short time. There are two options:

- **Delay on**: with this option you can define a time period; the turbidity level must exceed the alarm set point for this time period before the alarm starts. Example: if you selected an alarm set point of 50 NTU/FNU and an alarm delay time of 5 seconds, then the measured turbidity must exceed 50 NTU/FNU for at least 5 seconds to start the alarm.
- **Delay off**: similar to the option “Delay on” you can define a time period; the turbidity level must not fall below the alarm set point for this time period before the alarm stops. Example: if you selected an alarm set point of 50 NTU/FNU and an alarm delay time of 5 seconds, then the measured turbidity must fall below 50 NTU/FNU for at least 5 seconds to stop the alarm.

If you have completed all settings for the output as described in the previous sections, the device moves to the submenu for the alarm configuration. At first you see the following display:

![Display](image)

- Use the buttons ▲ and ▼ to select the desired work mode (HI, LO, OFF, ERROR).
- Accept your selection by pressing ▶.
  - If you choose "HI", "LO" or "Error" a prompt appears to set up the alarm set point.

![Display](image)

- Use the buttons ▲ and ▼ to select the desired alarm set point in the upper row.
- Accept your selection by pressing ▶.
A prompt appears to set up the alarm delay times starting with “Delay on”. The upper row shows the preset number of seconds.

- Use the buttons ↑ and ↓ to select the desired number of seconds for the time after which the alarm has to be ”On” (options: 1...30).
- Accept your selection by pressing →.

The desired number of seconds for the time after which the alarm has to be “On” is set. The display switches to the input of the value for “Delay off”. The upper row again shows the preset number of seconds.

- Use the buttons ↑ and ↓ to select the desired number of seconds for the time after which the alarm has to be ”OFF” (options: 1...30).
- Accept your selection by pressing →.

The desired number of seconds for the time after which the alarm has to be “OFF” is set. The display switches back to the selection of the desired work mode, but this time for the second alarm relay.

- Repeat the procedure described in this section for the second alarm relay, starting again with the work mode.

After the settings for Alarm 1 have been completed, prompts will allow for the set-up of the information on Alarm 2.

### 5.9.4 Offset calibration

The offset calibration is a submenu item in the configuration mode. That means despite of its function, it is not accessible via the calibration mode. For detailed information concerning the offset calibration procedure refer to Calibration procedure (offset calibration) on page 38.

### 5.9.5 Enabling or disabling the security access

With an enabled security access the user has to enter a valid code to get to any mode other than normal operation (AUTO).

Execute the following steps to change the setting of the function:

- Use the buttons ↑ or ↓ to enable (upper row: ON) or disable (upper row: OFF) the security access or leave the setting.
If you enabled the security access, the security key icon will be visible and flashing on the display in all working modes of the device (AUTO, CAL, CONFIG) and their submenus.

- Accept your selection by pressing .
- The device switches to the next item of the menu.

For further information refer to Getting access with activated security access function on page 29.

5.9.6 Speed of response (Signal Averaging)

Changing a setting and switching to the next item

- Use the buttons ▲ and ▼ to change the setting.
- Accept your selection by pressing .
- The device switches to the next item of the menu.

With the help of this function you can adjust the speed of response for both the displayed NTU/FNU value and the output values (i.e. of the RS 485 or the 4...20 mA output). The default setting is 10, the adjustable range is 1...100.

Note that the displayed speed of response in the upper row of the display is a relative number and not the real speed of response in seconds. You can calculate the approximate response time in seconds by multiplying the number in the upper row by 5.

Select the slowest speed of response (i.e. the highest number) if you want to avoid disturbances of the reading by air and other anomalies. Select the fastest speed (i.e. the lowest number) if you need to monitor rapid changes.

5.9.7 Resolution of the measured value

Changing a setting and switching to the next item

- Use the buttons ▲ and ▼ to change the setting.
- Accept your selection by pressing .
- The device switches to the next item of the menu.
The device can display from one up to four digits to the right of the decimal place. The default setting are two decimal places. Four digits right to the decimal point are only possible for measuring results below 10 NTU/FNU. Each decade upwards decreases the digits right to the decimal place by one.

If the last or the last two digits right of the decimal place are not stable, you can reduce the resolution (i.e. the amount of digits right to the decimal place) to hide these digits and get a stable reading.

5.9.8 Display backlight brightness

Changing a setting and switching to the next item
• Use the buttons ↑ and ↓ to change the setting.
• Accept your selection by pressing →.
⇒ The device switches to the next item of the menu.

The display backlight brightness is of particular interest if multiple devices are located in the same area. If all of them should have the same clearness of display, then you might have to adjust the backlight brightness of particular devices. The default setting is 8, ten levels are available.

5.9.9 Setting the units

Changing a setting and switching to the next item
• Use the buttons ↑ and ↓ to change the setting.
• Accept your selection by pressing →.
⇒ The device switches to the next item of the menu.

The most common unit of the measured value and the default setting is NTU (Nephelometric Turbidity Units), but FNU (Formazin Nephelometric Units) is also available.
5.9.10 Ultrasonic cleaning

Changing a setting and switching to the next item
• Use the buttons ▲ and ▼ to change the setting.
• Accept your selection by pressing ▶.
• The device switches to the next item of the menu.

With the help of this function you turn the ultrasonic cleaning on or off (default is “On”).

5.9.11 RS 485 parameters (Modbus)

Changing a setting and switching to the next item
• Use the buttons ▲ and ▼ to change the setting.
• Accept your selection by pressing ▶.
• The device switches to the next item of the menu.

The RS 485 parameters are only adjustable and so appear if the RS 485 interface is enabled. In this case you can change the parameters “PRTY” (parity) and “STOP” (stop bit). After choosing a setting for the ultrasonic cleaning in the previous step you see the following display at first:

• Use ▲ and ▼ to select the desired Modbus parity, accept your selection by pressing ▶.
• The device switches to the next item of the menu.

• Use ▲ and ▼ to select the desired number of bits or leave the setting, accept your selection by pressing ▶.
• The device switches to the next item of the menu.
5.9.12 4 mA and 20 mA adjustment

Changing a setting and switching to the next item

- Use the buttons \( \uparrow \) and \( \downarrow \) to change the setting.
- Accept your selection by pressing \( \rightarrow \).
- The device switches to the next item of the menu.

If you enabled the 4...20 mA output you can adjust the 4 mA and the 20 mA output separately (if the 4...20 mA output is disabled this item does not appear in the extended settings). This means that you can increase or decrease the current output slightly until you see exactly 4 mA or 20 mA at your multimeter or control system. This setting will be slightly different on each device as the manufacturer sets them to 4.00 mA and 20 mA before shipping. The limits are:

- 4 mA: \( \pm 0.2 \) mA or \( \pm 200 \) counts
- 20 mA: \( \pm 1 \) mA or \( \pm 1000 \) counts

5.9.13 Instrument ID

Changing a setting and switching to the next item

- Use \( \uparrow \) and \( \downarrow \) to make your adjustment.
- Press \( \rightarrow \) to switch to the adjustment of the 20 mA output:

After accepting the adjustment for the 20 mA output by pressing \( \leftarrow \) the device switches back to the normal measuring mode (AUTO). All settings are saved.
This menu provides the instrument with a unique ID up to 4 digits. This ID can be used when logged data is downloaded. This enables the data to be associated with a particular instrument or location.

5.9.14 Logging Interval

This menu determines how often readings are logged. The setting is in minutes. This can be set from 1 minute to 60 minutes.

Changing a setting and switching to the next item
- Use the buttons ↑ and ↓ to change the setting.
- Accept your selection by pressing →.
- The device switches to the next item of the menu.

5.9.15 Download logged file

This menu is used to download CSV files to a flash drive. The selections are: No download (NO), Calibration file only (CAL), All Files (ALL) or individual month (Jan, Feb...). Once the data stick is inserted in the USB slot on the right side of the instrument push the button ↓. If no data stick is inserted you will get an Error (Err). The upper display will flash while the download is taking place and show "dOnE" when complete.

Changing a setting and switching to the next item
- Use the buttons ↑ and ↓ to change the setting.
- Accept your selection by pressing →.
- The device switches to the next item of the menu.

5.9.16 Date and time

The MTOL+ has a displayed date (month / day / year) and time (hour / minute / Daylight Savings) that must be set upon initial installation/setup. The next five menus are used for this setup.
Changing a setting and switching to the next item

- Use the buttons ▲ and ▼ to change the setting.
- Accept your selection by pressing ▶.
- The device switches to the next item of the menu.

5.9.17 Daylight saving time

"DST" (Daylight saving time) is valid for use in the USA, Canada, Europe and other countries or locations that follow an Energy Savings Act.

Changing a setting and switching to the next item

- Use the buttons ▲ and ▼ to change the setting.
- Accept your selection by pressing ▶.
- The device switches to the next item of the menu.

5.9.18 Update software

The software version can be determined by pressing and holding down the ▲ and ▼ buttons for about 1 second. The first number shown is the version and second number displayed is the model number. This can be performed anytime during AUTO Mode.

Changing a setting and switching to the next item

- Use the buttons ▲ and ▼ to change the setting.
- Accept your selection by pressing ▶.
- The device switches to the next item of the menu.

Software updates can only be made if a USB flash drive is installed with a newer version of software than the one currently installed in the device. If either a flash drive is not installed or a newer version of software is not detected this error screen will appear.
Once a flash drive with valid files are found, select the desired range to update using the ▲ and ▼ buttons.

While the system is updating, the word “busy” appears as it performs a self-check of the software installation.

If the device finds a flash drive with a previous version of software it will show the word FILE. You will need an updated file on the flash drive.

Once installed the system will automatically turn off and restart. The entire process takes about 60 seconds to complete.

**INFORMATION!**
Be certain to check the configuration as changes may have taken place either with new software or a new range.

### 5.10 Reset to factory calibration

**CAUTION!**
Make sure that only authorised and trained personnel perform changes to the calibration.

**INFORMATION!**
Incorrect settings in the parameters may result in the output of incorrect measured values and switching points.

Proceed as follows to reset the device to the factory calibration and delete possible user calibrations:

1. Press the ← and the ▲ button for 2 seconds to get access to the reset function.
The following screen will appear.

![Screen with options](image)

1. Use the buttons ▲ and ▼ to choose No or Yes.
2. Press the ← button to confirm.
3. After 2 seconds the device returns to the normal operation mode.

### 5.11 Faults: reasons and remedies

The device continuously performs an internal fault detection. If a fault occurs, a description in form of a queue appears in the bottom row of the display. Altogether there are three types of fault messages:

**Warnings**
If the desiccant becomes saturated, only a screen warning of DESC will appear. Other warnings are ALM1 or ALM2 will be displayed if an alarm is set and the threshold is exceeded.

**Errors**
If any of these errors occur DO NOT rely on displayed readings. These errors effect accuracy and reliability of instruments readings.

**Failures**
A failure is a system fault. This is NOT a problem that the operator can correct, and the unit must be returned to the factory for service. These failures consist of failures in the CPU, A/D, EEPROM or other devices internal to the instrument. The word FAIL will display on the lower row.
## Fault chart

<table>
<thead>
<tr>
<th>Fault message / problem</th>
<th>Category</th>
<th>Cause</th>
<th>Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CAL</strong> (bottom row of display)</td>
<td>Error</td>
<td>Deficient calibration or calibration impossible.</td>
<td>Ensure that you use a proper calibration liquid (the best way is to use the calibration cuvettes of the manufacturer), if the calibration fails nonetheless, check the output of the sensor lamp and clean it or replace. After you remedied the problem, you have to recalibrate the device.</td>
</tr>
<tr>
<td><strong>CLN</strong> (bottom row of display)</td>
<td>Error</td>
<td>Ultrasonic transducer has no contact to the spring connections or transducer itself is damaged.</td>
<td>Rotate ultrasonic cuvette slightly to improve the spring connection; if message persists, the transducer itself is damaged and you have to replace the whole cuvette.</td>
</tr>
<tr>
<td><strong>DESC</strong> (bottom row of display)</td>
<td>Warning</td>
<td>Desiccant in the pouch is saturated or bad.</td>
<td>Change desiccant pouch [details on page 54].</td>
</tr>
<tr>
<td><strong>FAIL</strong> (bottom row of display)</td>
<td>Failure</td>
<td>Complete malfunction of an internal system.</td>
<td>Return the device to the manufacturer.</td>
</tr>
<tr>
<td><strong>FLOW</strong> (bottom row of display, only if flow switch is installed)</td>
<td>Error</td>
<td>Sample flow stopped.</td>
<td>Restore sample flow, contact manufacturer for further information.</td>
</tr>
<tr>
<td><strong>LAMP</strong> (bottom row of display)</td>
<td>Error</td>
<td>Light source fails.</td>
<td>A service employee of the manufacturer has to replace the lamp, do not do it on your own!</td>
</tr>
<tr>
<td><strong>MA</strong> (bottom row of display)</td>
<td>Error</td>
<td>4...20 mA loop open.</td>
<td>Check wiring of the current output [details on page 25].</td>
</tr>
<tr>
<td>Measuring result blinks (i.e. value in the upper row of the display)</td>
<td>Error</td>
<td>Exceeding of measuring range, i.e. turbidity is too high.</td>
<td>Take a sample and check the turbidity in a laboratory.</td>
</tr>
<tr>
<td>Measuring result alternates extremely</td>
<td>Error</td>
<td>Bubbles in the measured medium.</td>
<td>Ensure that the drain vent hole is open and not blocked.</td>
</tr>
<tr>
<td>Measuring result is higher than expected</td>
<td>Error</td>
<td>Bubbles in the measured medium.</td>
<td>See above in this table.</td>
</tr>
<tr>
<td>Measuring result is lower than expected</td>
<td>Error</td>
<td>Improper calibration.</td>
<td>Recalibrate the device [details on page 35].</td>
</tr>
</tbody>
</table>
6.1 Service admonitions

**CAUTION!**
Installation, assembly, start-up and maintenance may only be performed by appropriately trained personnel. The regional occupational health and safety directives must always be observed.

**INFORMATION!**
Each time a housing cover is opened, the thread should be cleaned and greased. Use only resin-free and acid-free grease. Ensure that the housing gasket is properly fitted, clean and undamaged.

**INFORMATION!**
Assembly materials and tools are not part of the delivery. Use the assembly materials and tools in compliance with the applicable occupational health and safety directives.

6.2 Maintenance

6.2.1 Replacing or cleaning cuvette

**CAUTION!**
Never insert a cuvette with visible moisture or water on the glass or the transducer into the upper part of the device! Otherwise this cuvette could destroy or damage the electronics or the transducer! Always clean and dry the cuvette with a soft cloth just before inserting it. The dehumidification system cannot remove large droplets of water, only residual moisture!

**INFORMATION!**
Measurement cuvettes used for both grabbing a sample and continuous flow measurement have to be clean and free of marks or scratches. Otherwise the device cannot detect a proper measuring result.

To remove the glass cuvette from the ultrasonic cuvette with flow-through unit execute the following steps:

- Shut-off the intake flow with the help of the shutoff clamp.
- Turn the lock ring counterclockwise and remove the ultrasonic cuvette with flow-through unit [details on page 20].
- Turn the cuvette counterclockwise to remove it from the flow-through unit.
- Take a new cuvette or clean the old one (clean the interior and exterior of the cuvette by washing up with a detergent solution usual in trade at first, afterwards rinse the interior and exterior with distilled or de-ionised water usual in trade).
- Reassemble everything in reverse order.
After installing a new cuvette, the dehumidification system becomes active to remove all moisture from the ultrasonic transducer. The drying process may last up to 30 minutes, during this time "DRY" appears in the lower row of the screen and the ultrasonic cleaning cannot run. Also be aware of the following items:

- The drying process is not an alarm condition and therefore no alarm is active.
- The duration of the process depends on the amount of moisture detected by the dehumidification system and thus it may vary.
- If you remove the ultrasonic cuvette assembly during the drying process, the message "CLN" does not appear in the lower row of the display; in the normal case the message indicates that the spring connection has no contact, but the drying process deactivates this function.
- All seals and the desiccant pack have to be in a good condition (i.e. that the message "DESC" does not appear in the display); otherwise, the dehumidification system cannot function properly.
- If the drying process is unsuccessful (e.g. because of too much moisture or water on the cuvette), the message "DESC" appears on the display.

**INFORMATION!**
Check after installation and maintenance works, that the cuvette is sealed correctly. Periodically inspect the interior and inspect the O-rings / cuvette for damages and if necessary replace.

### 6.2.2 Replacing desiccant pouch and humidity indicator

**INFORMATION!**
Contact the manufacturer or your local sales office if you need a new, shrinkpacked desiccant pouch, a new humidity indicator or a new seal.

The device monitors the replaceable desiccant pouch condition continuously. The lower line of the display shows the message "DESC" in the event that you have to replace a saturated desiccant pouch that may cause problems. The desiccant has a long lifetime, however its replacement is necessary from time to time. In this case, refer to *Placing the desiccant pouch and the humidity indicator* on page 15 and use a new desiccant pouch and humidity indicator.

### 6.2.3 Replacing the source lamp

The source lamps in the device have a long lifetime. The manufacturer has rated the infrared lamp for ten years and the white light lamp for seven years.

**CAUTION!**
To prevent the device from damages, do not try to replace the lamp on your own! If you need to replace a lamp, contact the manufacturer or your local sales office.
6.3 Availability of services

The manufacturer offers a range of services to support the customer after expiration of the warranty. These include repair, maintenance, technical support and training.

INFORMATION!
For more precise information, please contact your local sales office.

6.4 Spare parts availability

The manufacturer adheres to the basic principle that functionally adequate spare parts for each device or each important accessory part will be kept available for a period of 3 years after delivery of the last production run for the device.

This regulation only applies to spare parts which are subject to wear and tear under normal operating conditions.

6.5 Spare or accessory parts

<table>
<thead>
<tr>
<th>Spare or accessory part</th>
<th>Order code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Desiccant pack (desiccant pouch with humidity indicator)</td>
<td>XGAM 010000</td>
</tr>
<tr>
<td>Flow regulator</td>
<td>XGAM 010010</td>
</tr>
<tr>
<td>Flow-through assembly</td>
<td>XGAM 010015</td>
</tr>
<tr>
<td>Pressure regulator</td>
<td>XGAM 010020</td>
</tr>
<tr>
<td>Junction box power assembly</td>
<td>XGAM 010026</td>
</tr>
<tr>
<td>Ultrasonic cuvette</td>
<td>XGAM 010030</td>
</tr>
<tr>
<td>Lamp assembly WL</td>
<td>XGAM 010040</td>
</tr>
<tr>
<td>Lamp assembly IR</td>
<td>XGAM 010050</td>
</tr>
<tr>
<td>Tubing kit: 1 drain vent, 1 shut-off clamp, 1 backpressure valve, 2 connection tubes with fittings for flow-through assembly</td>
<td>XGAM 010060</td>
</tr>
<tr>
<td>Bubble trap</td>
<td>XGAM 010070</td>
</tr>
<tr>
<td>Grab sample cuvette, 10 pack</td>
<td>XGAM 010080</td>
</tr>
<tr>
<td>Solid validation standard (cuvette)</td>
<td>XGAM 010100</td>
</tr>
<tr>
<td>Calibration kit [0.02, 10, 100 NTU/FNU]</td>
<td>XGAM 010150</td>
</tr>
<tr>
<td>Calibration kit [0.02, 10, 1000 NTU/FNU]</td>
<td>XGAM 010160</td>
</tr>
</tbody>
</table>
6.6 Returning the device to the manufacturer

6.6.1 General information

This device has been carefully manufactured and tested. If installed and operated in accordance
with these operating instructions, it will rarely present any problems.

WARNING!
Should you nevertheless need to return a device for inspection or repair, please pay strict
attention to the following points:
• Due to statutory regulations on environmental protection and safeguarding the health and
  safety of the personnel, the manufacturer may only handle, test and repair returned devices
  that have been in contact with products without risk to personnel and environment.
• This means that the manufacturer can only service this device if it is accompanied by the
  following certificate [see next section] confirming that the device is safe to handle.

WARNING!
If the device has been operated with toxic, caustic, radioactive, flammable or water-endangering
products, you are kindly requested:
• to check and ensure, if necessary by rinsing or neutralising, that all cavities are free from
  such dangerous substances,
• to enclose a certificate with the device confirming that it is safe to handle and stating the
  product used.
6.6.2 Form (for copying) to accompany a returned device

CAUTION!
To avoid any risk for our service personnel, this form has to be accessible from outside of the packaging with the returned device.

<table>
<thead>
<tr>
<th>Company:</th>
<th>Address:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Department:</td>
<td>Name:</td>
</tr>
<tr>
<td>Tel. no.:</td>
<td>Fax no. and/or Email address:</td>
</tr>
<tr>
<td>Manufacturer’s order no. or serial no.:</td>
<td></td>
</tr>
</tbody>
</table>

The device has been operated with the following medium:

This medium is:
- radioactive
- water-hazardous
- toxic
- caustic
- flammable

We checked that all cavities in the device are free from such substances.

We have flushed out and neutralized all cavities in the device.

We hereby confirm that there is no risk to persons or the environment through any residual media contained in the device when it is returned.

Date: 
Signature: 
Stamp:

6.7 Disposal

LEGAL NOTICE!
Disposal must be carried out in accordance with legislation applicable in your country.

Separate collection of WEEE (Waste Electrical and Electronic Equipment) in the European Union:

According to the directive 2012/19/EU, the monitoring and control instruments marked with the WEEE symbol and reaching their end-of-life must not be disposed of with other waste. The user must dispose of the WEEE to a designated collection point for the recycling of WEEE or send them back to our local organisation or authorised representative.
7.1 Measuring principle

According to the US EPA definition, turbidity is the cloudy appearance of water caused by the presence of suspended and colloidal matter. In the waterworks field, a turbidity measurement is used to indicate the clarity of water. Technically, turbidity is an optical property of the water based on the amount of light reflected by suspended particles and colloidal matter.

According to ISO 7027 turbidity values below < 40 NTU are measured with the 90° scattered light method. Light source and receiver are positioned in a 90° angle to each other. The light transmitted from the source is directed in equal strength to the reference receiver and into the medium. The light is reflected from the particles and fractions of the scattered light are received by the detector, which is positioned in a 90° angle. The meter compares the light from reference and scattered light receiver and calculates the turbidity value.

The measuring units for the turbidity are:

- NTU (Nephelometric Turbidity Unit)
- FNU (Formazin Nephelometric Unit)

![Figure 7-1: Measuring principle for turbidity measurement](image)

1. Light source
2. Reference sensor
3. Sensor
4. Reflected light beam
5. Particles
6. Emitted light beam
7.2 Technical data table

**INFORMATION!**
- The following data is provided for general applications. If you require data that is more relevant to your specific application, please contact us or your local sales office.
- Additional information (certificates, special tools, software,...) and complete product documentation can be downloaded free of charge from the website [Downloadcenter].

### Measuring system

<table>
<thead>
<tr>
<th>Measuring principle</th>
<th>90° scattered light method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Application range</td>
<td>Turbidity measurement of liquids according to ISO 7027 and US EPA 180.1</td>
</tr>
<tr>
<td>Measuring range</td>
<td>0...100 NTU/FNU and 0...1000 NTU/FNU factory configured</td>
</tr>
</tbody>
</table>

### Design

The measurement system consists of a sensor and a signal converter and is only available as compact version.

<table>
<thead>
<tr>
<th>Display and user interface</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Display</strong></td>
</tr>
<tr>
<td>Multi-line liquid crystal backlight display</td>
</tr>
<tr>
<td><strong>Operating and display language</strong></td>
</tr>
<tr>
<td>English</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Other properties</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Response time</strong></td>
</tr>
<tr>
<td>Adjustable 1...60 seconds</td>
</tr>
<tr>
<td><strong>Alarms</strong></td>
</tr>
<tr>
<td>Two programmable, 120...240 VAC, 2A form C relay</td>
</tr>
</tbody>
</table>

### Measuring accuracy

<table>
<thead>
<tr>
<th>Reference conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>+1...+50°C / +33.8...+122°F</td>
</tr>
<tr>
<td>95% relative humidity</td>
</tr>
<tr>
<td>Altitude up to 2000 m / 6600 ft</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 40 NTU/FNU: ±2% of reading or ±0.02 NTU/FNU whichever is greater (0...100 or 0...1000 NTU/FNU range)</td>
</tr>
<tr>
<td>&gt; 40 NTU/FNU: ±5% of reading (0...100 or 0...1000 NTU/FNU range)</td>
</tr>
<tr>
<td>±2% of reading or ±0.02 NTU/FNU (0...10 NTU/FNU range)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Resolution</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0001 NTU/FNU (below 10 NTU/FNU) selectable</td>
</tr>
</tbody>
</table>
Operating conditions

**Note: the device is not appropriate for outdoor use!**

**Temperature**
- Process and ambient temperature: +1...+50°C / +34...+122°F
- Storage temperature: -20...+60°C / -4...+140°F

**Pressure**
- Process pressure: 1...7 bar / 14.5...101.5 psi (built-in regulator set at 1 bar / 14.5 psi)
- Ambient pressure: Atmospheric, altitude up to 2000 m / 6600 ft

**Flow velocity**
- Minimum: 0.1 l/min / 0.026 gal/min
- Maximum: 1.5 l/min / 0.40 gal/min

**Other conditions**
- Humidity: Display and operating unit: up to 95% relative humidity (non-condensing)
- Protection category: Enclosure is designed to meet IP 66 / NEMA 4X

Installation conditions

**Dimensions**
For detailed information refer to Dimensions and weight on page 61.

**Weights**
- Instrument weight: 1.8 kg / 4.0 lbs
- Shipping weight: 2.8 kg / 6.17 lbs

**Materials**
- Sensor housing: ABS
- Wetted parts: Nylon, borosilicate glass, silicon, polypropylene, stainless steel AISI 304, Viton, Acetyl

**Electrical connections**
- Galvanic insulation: Double insulated, pollution degree 2, over voltage category II (all in- and outputs are electrically isolated from each other and from power and earth ground)
- Power supply
  - Voltage: 100...240 VAC, 47...63 Hz
  - Power consumption: 80 VA
- Outputs
  - Current output: 1 x 4...20 mA, active, 15 VDC power source, max. load 1 kΩ
  - Modbus: Bi-directional, RS-485 Modbus RTU/ASCII
  - Relays: 2 x relay 120...240 VAC, 2 A, freely programmable

**Software**
- Data storage: Upgradeable via USB flashdrive
  - 16 GB via USB flashdrive

**Approvals and certifications**
- CE: This device fulfils the statutory requirements of the EC directives. The manufacturer certifies successful testing of the product by applying the CE mark.
- LC: Listed to UL 61010-1 [Ed.3] and certified to CAN/CSA 22.2 No. 61010-1-12 [R2017]
7.3 Dimensions and weight

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>[mm]</th>
<th>[&quot;]</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>208</td>
<td>8.19</td>
</tr>
<tr>
<td>b</td>
<td>51</td>
<td>2.0</td>
</tr>
<tr>
<td>c</td>
<td>88.77</td>
<td>3.5</td>
</tr>
<tr>
<td>d</td>
<td>30</td>
<td>1.18</td>
</tr>
<tr>
<td>e</td>
<td>87</td>
<td>3.43</td>
</tr>
<tr>
<td>f</td>
<td>148</td>
<td>5.83</td>
</tr>
<tr>
<td>g</td>
<td>133.71</td>
<td>5.26</td>
</tr>
<tr>
<td>h</td>
<td>350</td>
<td>13.79</td>
</tr>
<tr>
<td>i</td>
<td>198</td>
<td>7.8</td>
</tr>
<tr>
<td>k</td>
<td>62</td>
<td>2.44</td>
</tr>
</tbody>
</table>

Shipping weight: 2.8 kg / 6.17lbs
KROHNE – Process instrumentation and measurement solutions

- Flow
- Level
- Temperature
- Pressure
- Process Analysis
- Services

Head Office KROHNE Messtechnik GmbH
Ludwig-Krohne-Str. 5
47058 Duisburg (Germany)
Tel.: +49 203 301 0
Fax: +49 203 301 10389
info@krohne.com

The current list of all KROHNE contacts and addresses can be found at:
www.krohne.com