OPTISYS TUR 1050 Handbook

Compact measuring system for turbidity

KROHNE

1.1 Intended use

The OPTISYS TUR 1050 series consists of a white light (WL) version and an infrared (IR) version. Both versions are designed to measure online the turbidity of water. Furthermore the two following different measuring ranges are available: 0.02...100 NTU/FNU or 0.02...1000 NTU/FNU

1.2 Certification

1.2.1 CE

CE marking

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

- Electromagnetic compatibility (EMC) in accordance with:
  EN 61326-1:2006: 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 61010-1:2001, Edition 2.0.

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

1.2.2 ETL

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

- ETL: tested to UL 61010B-1, 1st Edition, January 24th, 2003.
- ETLc: tested to CS C22.2#1010.1-92.

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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1.3.2 Disclaimer

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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.

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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.
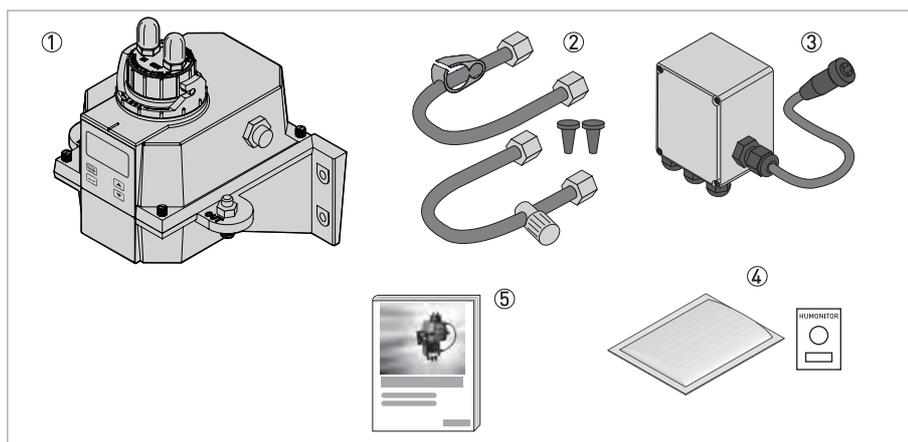
Figure 2-1: Scope of delivery

① Electronic device with flow-through assembly 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
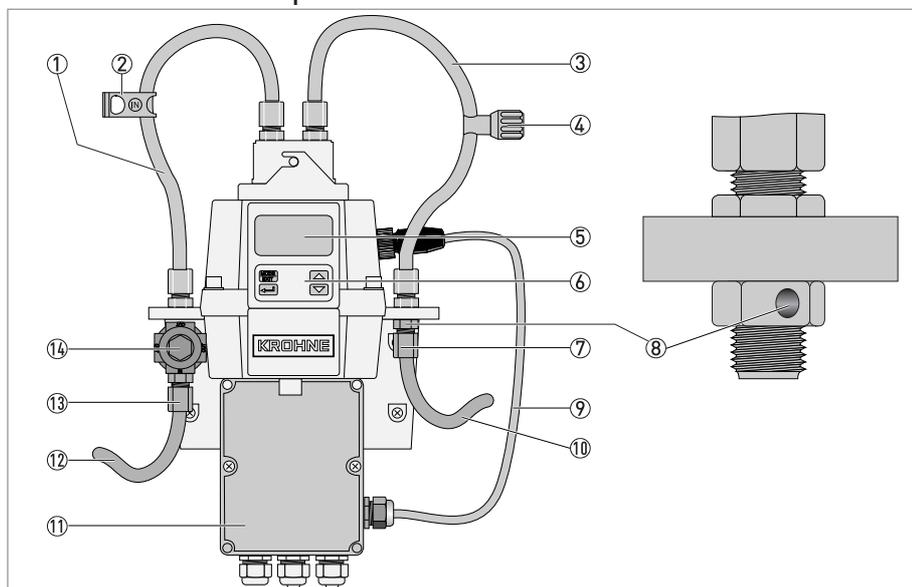
Figure 2-2: Description of the complete device

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 (inner Ø: 4.75 mm / 0.19", outer Ø: 8 mm / 0.31"), 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 (inner Ø: 4.75 mm / 0.19",outer Ø: 8 mm / 0.31"), has to supply the sensor with a dependable sample flow
⑭ Pressure regulator

Ultrasonic cuvette with flow-through holder

Figure 2-3: Description of ultrasonic cuvette with flow-through holder

① Intake tubing
② Drain tubing
③ Bolt
④ Ultrasonic cuvette
⑤ Bottom plate with ultrasonic transducer (at the bottom side)

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 14 bar / 203 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 two other RS 485 modes:

- Online: the device operates as a small SCADA system (Supervisory Control and Data Acquisition) with an optional software package (to get this package contact the manufacturer or your local sales office). This system allows the connection of up to 255 devices which all have to be an OPTISYS TUR 1050. Furthermore this system offers a direct interface with common database and spreadsheet software.
- Simple: 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 version
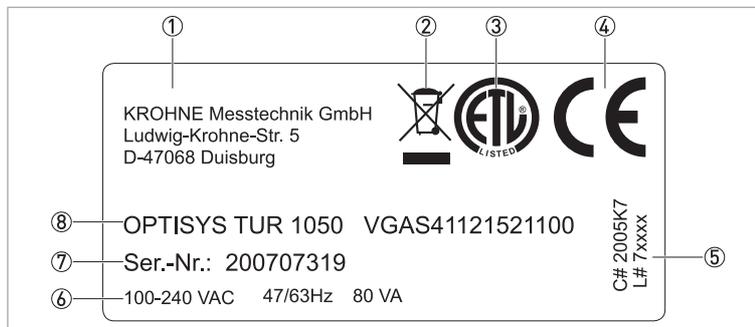
Figure 2-4: Example for nameplate for infrared version

① Manufacturer and address
② WEEE waste bin symbol
③ ETL symbol
④ CE symbol
⑤ Logistics numbers
⑥ Electrical data
⑦ Serial number
⑧ Device designation and order code

White light version
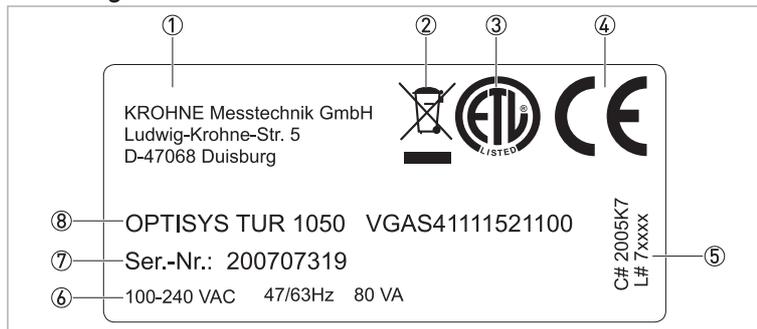
Figure 2-5: Example for nameplate for white light version

① Manufacturer and address
② WEEE waste bin symbol
③ ETL symbol
④ CE symbol
⑤ Logistics numbers
⑥ Electrical data
⑦ Serial number
⑧ Device designation and order code

3.1 General notes on installation

> **ℹ** *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.*

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

> **ℹ** *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

> **ℹ** *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.*

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: 0.07...14 bar / 1...200 psi (built in regulator set at 1 bar / 15 psi)
- Maximum allowable flow rate of the cuvette: 0.1...1 l/min / 0.026...0.26 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:
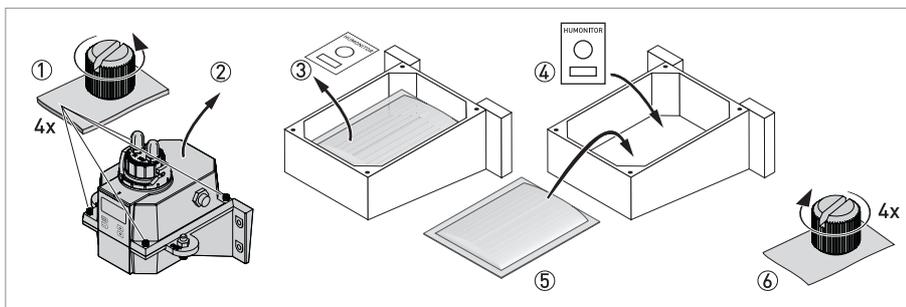
Figure 3-1: Desiccant pack (desiccant pouch with humidity indicator)

⚠ *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 holder (detailed information on page 21).
- Unscrew the four corner thumbscrews of the electronic device manually according to ① in the following drawing (if the screws are too tight, use a screwdriver for slotted grub 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 ③.
- 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 ④ and ⑤.
- Inspect the seal and reseat or replace it if necessary.
- Reassemble everything in reverse order ⑥.
- 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 following 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.
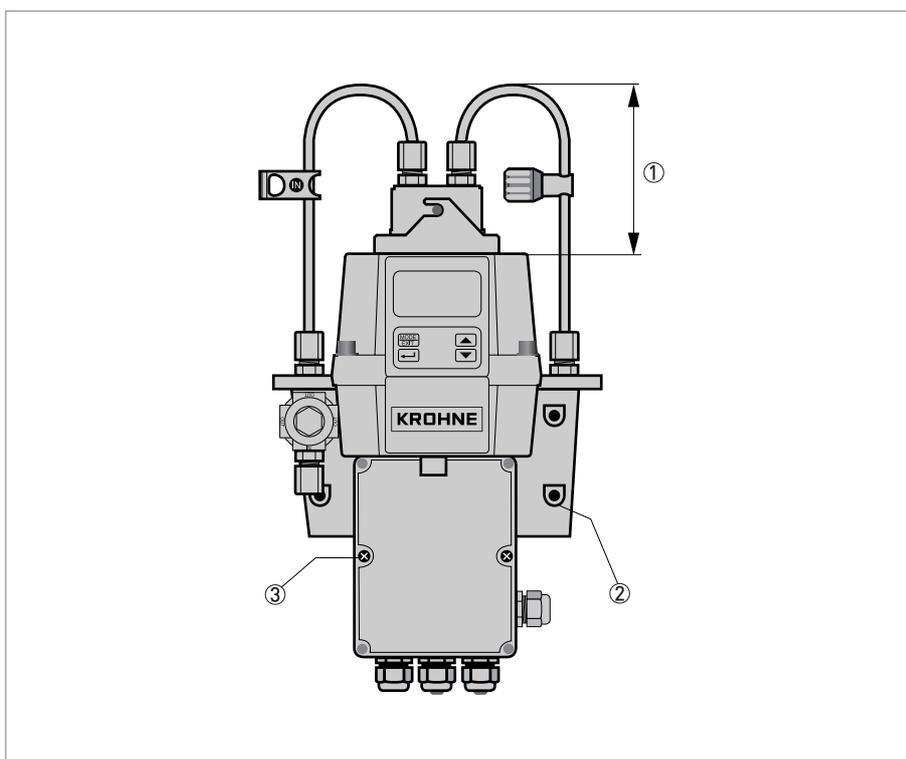
INFORMATION!
The design of the device recommends that the junction box power assembly cradles in a hutch below the electronic device. Therefore the correct procedure is to fix the junction box power assembly first and then mount the electronic device on top of it.

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 drawing on the following page directly as mounting template as the printed dimensions there 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.
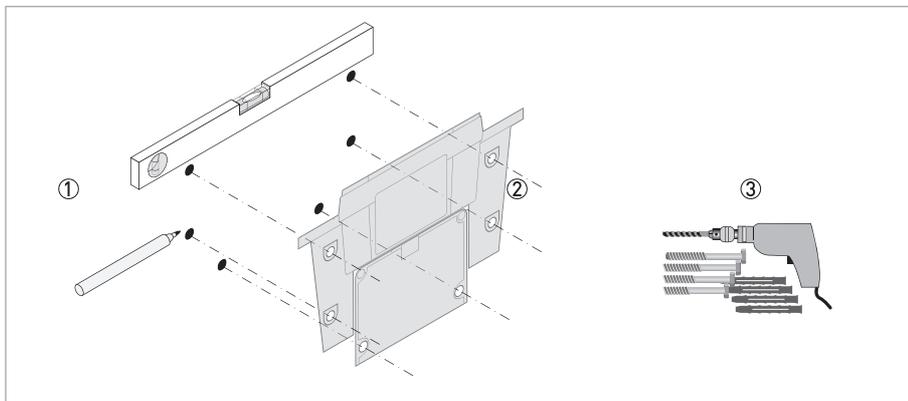
Figure 3-2: Mounting field terminal box

3.4.3 Mounting
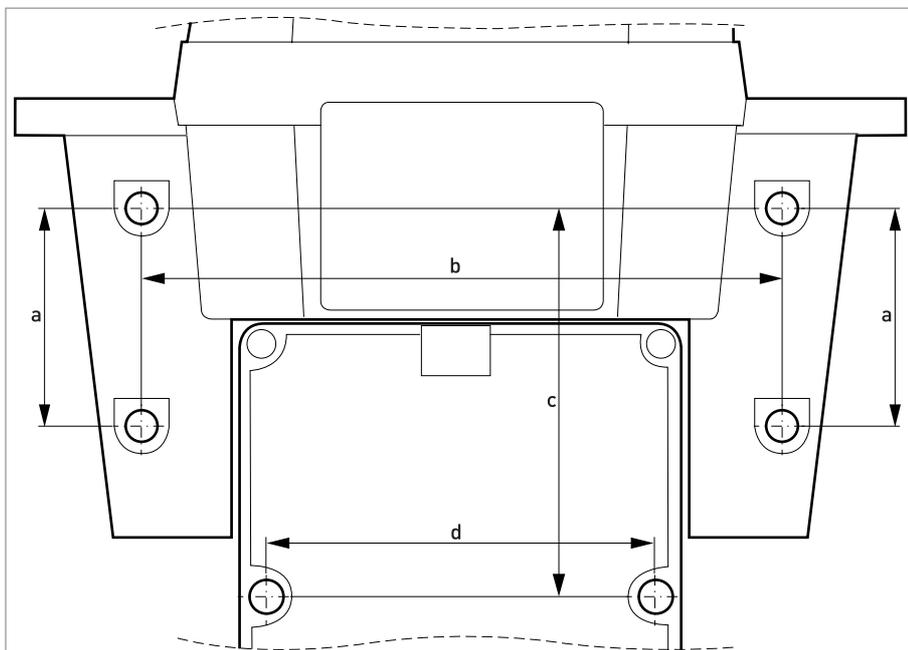
	[mm]	["]
a	51	2.0
b	147	5.79
c	90	3.54
d	87	3.43

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

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 holder 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!
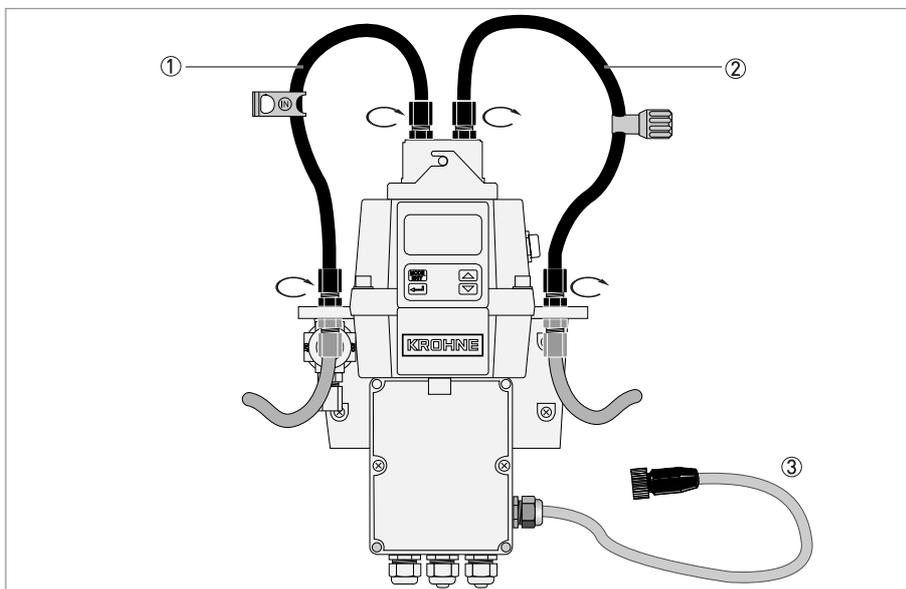
Figure 3-3: Connecting the hoses
① Intake tubing with shut-off clamp
② Drain hose with backpressure valve
③ Sensor interconnect cable

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:

• Inner diameter: 4.75 mm / 3/16".

• Outer diameter: 8 mm / 5/16".

• Flexible and opaque hose material to prevent algae growth if direct sunlight can reach the hose.

Assemble the plumbing and connect the hoses according to the following drawing:
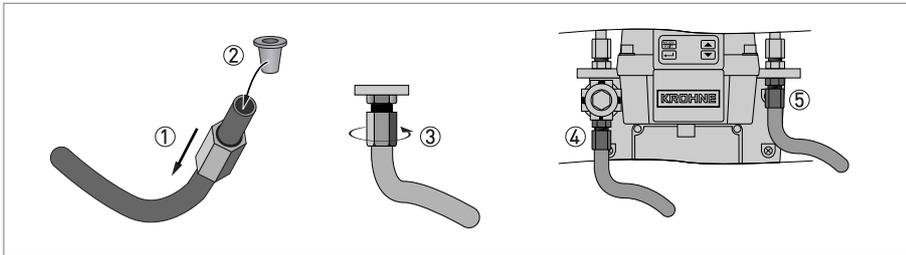
Figure 3-4: Procedure to assemble the plumbing and connect the hoses

- Slip the coupling nut over the hose ①
- Insert spreading ring into the hose ②
- Fix the nut on the thread of the pressure regulator ③
- Intake hose connection ④
- Drain hose connection ⑤

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

3.4.5 Drain vent

CAUTION!
The manufacturer accepts no responsibility for damage caused by the introduction of vapours, fluids or other materials into the device process stream which are not compatible with the device's wetted materials. Always note the list of wetted parts in the technical data table before introducing any media into the device process stream!

The device has a drain vent in the "Out" bulkhead fitting. The drain vent allows atmospheric equalization, thus helping to alleviate bubble formation in the cuvette.

INFORMATION!
During initial flow minor leakage may occur at the drain vent. This will subside once the normal flow is established.

In some pressurised systems there may occur a continuous leakage at the drain vent hole. Therefore the scope of delivery contains a seal screw that you can insert into the vent hole and tighten.

3.4.6 Inserting and fixing the ultrasonic cuvette with flow-through holder

⚠ *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!
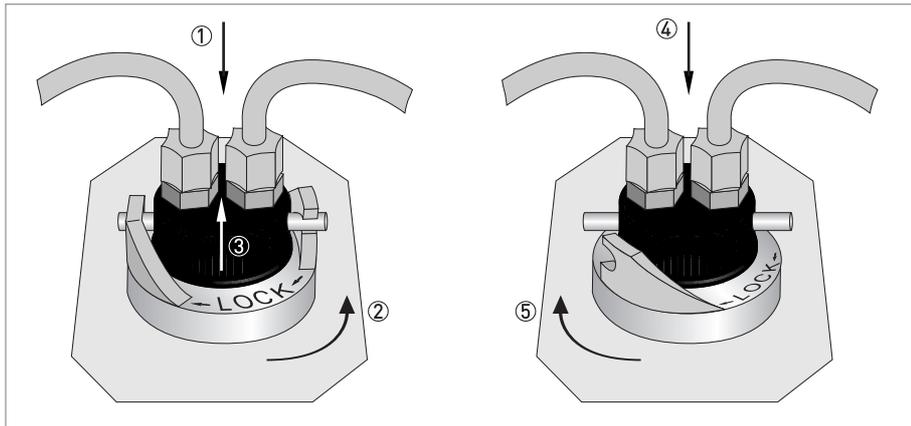
Figure 3-5: Procedure for inserting and fixing the ultrasonic cuvette with flow-through holder

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

ℹ *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 bulkheads
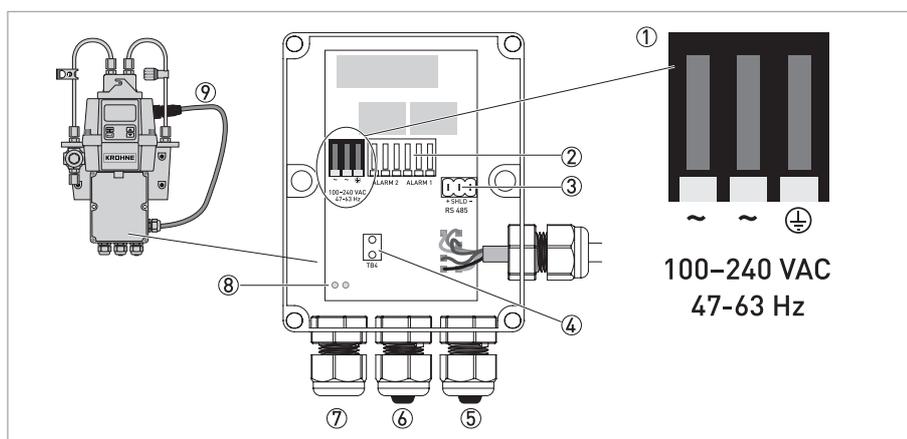
Figure 4-1: Description of board and bulkheads

① Power supply terminal block
② Alarms relay
③ 4...20 mA/RS 485 terminal block
④ Power cable strain relief
⑤ 4...20 mA/RS 485 cable bulkhead
⑥ Alarm cable bulkhead
⑦ Power cable bulkhead
⑧ Holes for strain relief strap
⑨ Sensor interconnect cable

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 bulkhead 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 bulkheads accept the following cable diameter range: 5.8...10 mm / 0.23...0.39".
- All terminals accept wires in the range of 14...28 AWG.
- Stripping of insulation to a length of 6 mm / ¼".

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 meter 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 bulkheads 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 terminal box with a screwdriver.
- Remove the plugs in the cable bulkheads if you want to conduct a cable through them.
- Strip all needed wires to a length of 6 mm / 1/4".
- Fix the cable on the terminal like in the following drawing ① to ⑤.
- Use the strain relief strap to reduce the tension on the power terminals ⑥.
- Close the terminal box and assure that it is properly sealed.

100–240 VAC 47-63 Hz
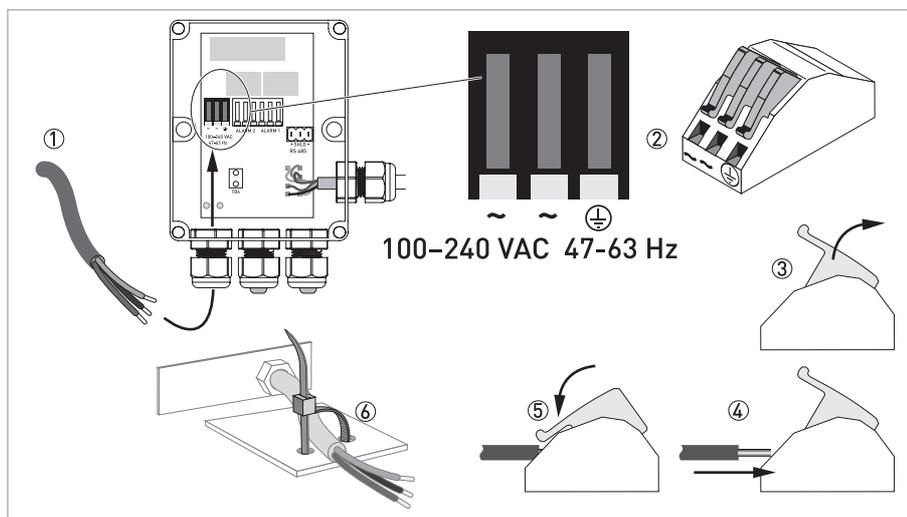
Figure 4-2: Connecting the cables in the junction box power assembly

4.5.2 Alarms terminal (signal output)

The terminals "ALARM 1" and "ALARM 2" are mechanical relays rated at 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 39.

4.5.3 RS 485 or 4...20 mA signal output

INFORMATION!
The installation of the 4...20 mA isolator will render the RS 485 non-operational. Shifting between the 4...20 mA (analog) and the RS 485 (digital) output mode works with the help of the software, for further information refer to Selecting the output on page 36.

INFORMATION!
Transformer isolated outputs are available as a factory installed option.

The 4...20 mA output is energised by a 15 VDC power source and can drive loads up to 600 Ω. 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 plug in 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:
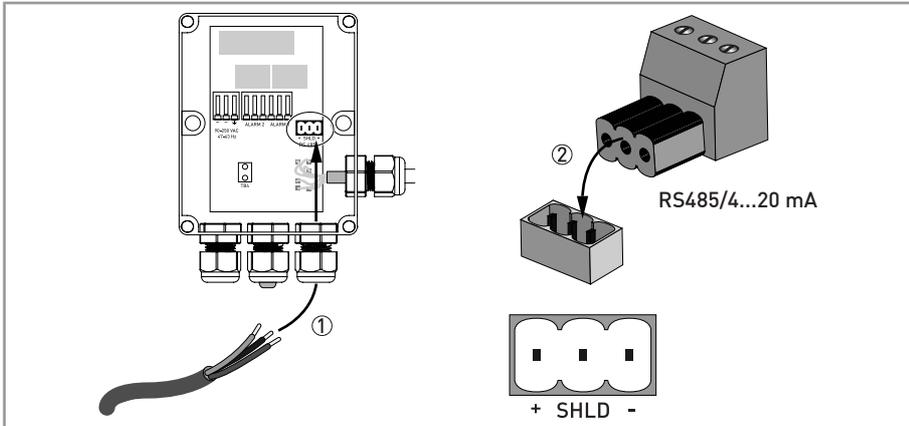
Figure 4-3: Signal output connection

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!
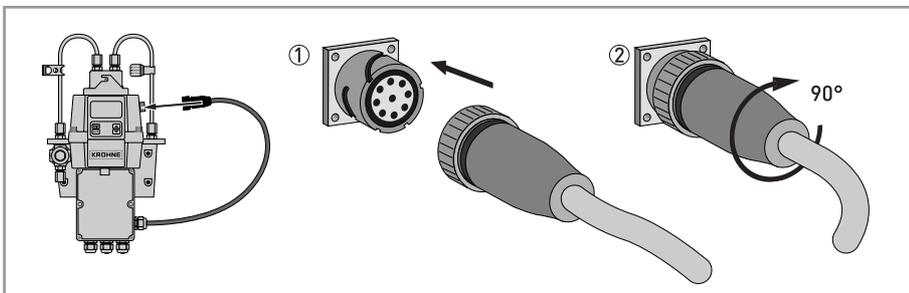
Figure 4-4: Connecting cable

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:

• The drain vent is open for gravity-feed and open-drain systems. In pressurised systems it has to be plugged with a seal screw (the manufacturer ships the device with the seal screw in the drain vent).
• The back pressure valve is completely open.
• The hose connected with drain connection 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.

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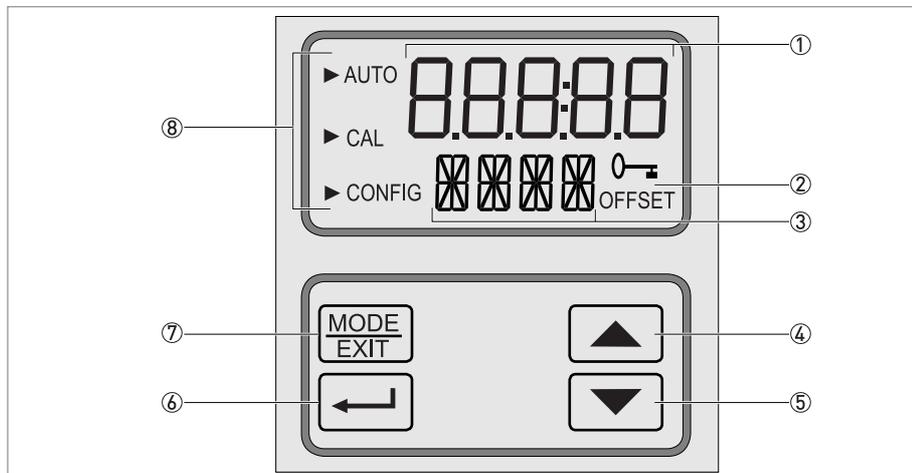
Figure 5-1: Description of the display and operating keys

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 down or decrease
⑥ Button to enter the option or mode that is chosen
⑦ Button to cycle between the three operation modes
⑧ 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 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 that you can enable and disable in the configuration mode (for more information refer to *Enabling or disabling the security access* on page 41). With the enabled function the following screen appears any time you press the button MODE/EXIT:
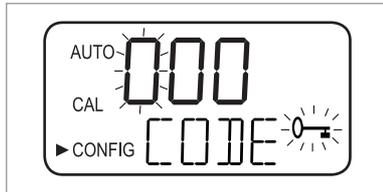
INFORMATION!
The only valid security code is 333, it cannot be changed.

Execute the following steps to get access to the menus CAL or CONFIG with an activated security access:

- • If you have not already pressed the button MODE/EXIT, press it now (in the normal measuring mode: 1 x = CAL, 2 x = CONFIG).
- ➡ You see the display like in the drawing above with the first number of the access code in the upper row flashing.

- • Use the buttons ↑ or ↓ to select the first number of the code (i.e. "3").
- • Press the button ↵ to accept the first number of the code.
- ➡ Now the second number of the code is flashing.

- • Repeat the previous steps with the second and third number (always enter "3"), always confirm the chosen number with the ↵ button.
- ➡ If you have entered the valid code, the device directly goes to calibration or configuration main menu. If you have entered a wrong code, it returns to the normal measuring mode ("AUTO").

5.5 Menu topology

The device has three operation modes:

- **Auto (AUTO):** normal measuring mode
- **Calibration (CAL):** mode for physical calibration
- **Configuration (CONFIG)** mode for customer-specific adjustments and offset calibration

You can enter the calibration mode and the configuration mode with the help of the correspondent main menus. Each main menu has a set of submenus.

Entering, navigating within and leaving a main menu:

- Press the button MODE/EXIT until the arrow on the left side of the display appears in front of the abbreviation of the desired main menu (in the normal measuring mode: 1 x = CAL, 2 x = CONFIG).
- ➲   You are now in one of the two main menus.

- You can move through the submenu items by pressing ↵, in the submenu you can choose the different options.
- You can always leave the submenu level and go back to the normal operation mode by pressing the button MODE/EXIT.

INFORMATION!
Note that you can change settings, i.e. values and options, with the help of ↑ or ↓ upwards and downward. But you can only move through the menus in one direction. If you want to go back, you have to leave the main menu by pressing MODE/EXIT and enter it again as described above.

5.6 Calibration mode (main menu)

The manufacturer calibrates and tests every device before it leaves 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:

INFORMATION!
- *During calibration the fan inside the device does not run to extend the life of the desiccant; the fan turns on again during each calibration countdown, after returning to the normal operation mode ("AUTO") or after 5 minutes, whichever comes first.*
- *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.*

CAUTION!
The desiccant pouch may become prematurely saturated if the measurement chamber is permanently uncovered; therefore keep the chamber covered during calibration and replace the ultrasonic cuvette immediately thereafter.

5.6.1 Calibration liquids

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.

5.6.2 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:

- Press the button MODE/EXIT 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.
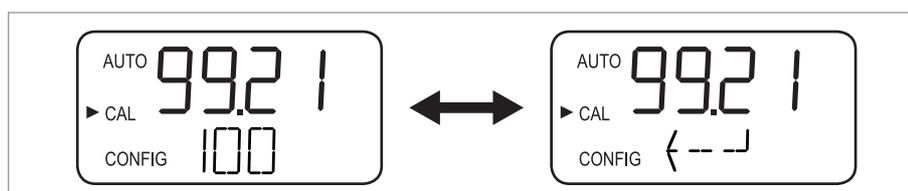
- Remove the ultrasonic cuvette and insert the 100 NTU/FNU or 1000 NTU/FNU calibration cuvette according to the following drawing (if you do not need the full-scale accuracy, press ↓ alternatively to bypass this calibration step and go directly to the 10 NTU/FNU calibration step).
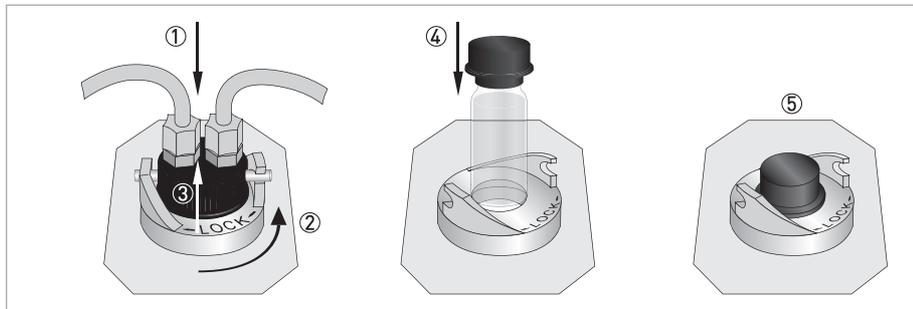
- If you need the 100 NTU/FNU or 1000 NTU/FNU calibration step, slowly rotate the calibration cuvette one complete revolution (i.e. 360°), observe the measured turbidity on the display during rotation and locate the position with the lowest measured turbidity.
- After one complete rotation return the 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.
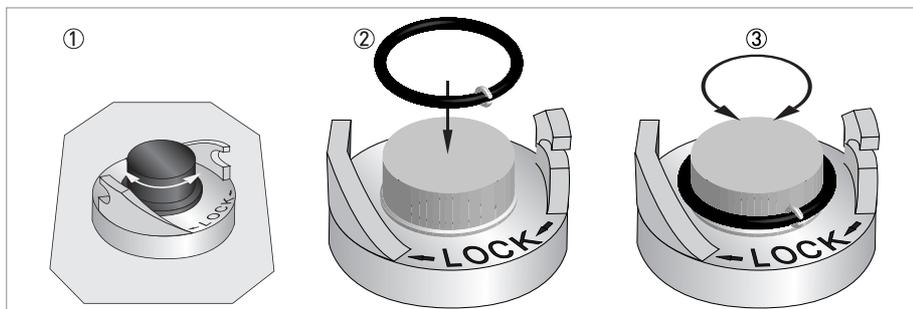
- After finding out the lowest measured value of the 100 NTU/FNU or 1000 NTU/FNU calibration cuvette and indexing it, press ↵ to accept the 100 NTU/FNU or 1000 FNU/NTU calibration.
➲ The lower line of the display counts down the progress of the calibration step, afterwards the device requests the next calibration step by showing 10 and ↵ alternating.

- If the display does not show 10 and ↵ alternating, press ↑ or ↓ 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").

5.6.3 Calibration procedure (offset calibration)

Under certain circumstances an offset calibration is more suitable than a physical calibration as described in the previous chapter. 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 turbiditymeter 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:

- In the normal measuring mode (AUTO), press the button MODE/EXIT twice.
- ➲ The device switches in the configuration mode and the arrow in the display appears in front of "CONFIG".

- Press ↵ several times until "OFST" appears in the lower row of the display.
- ➲ While the lower row shows "OFST", the upper row indicates the status of the offset function ("ON" or "OFF", default setting is "OFF")

- Change the status of the offset function by pressing ↓ or ↑, see following drawing.
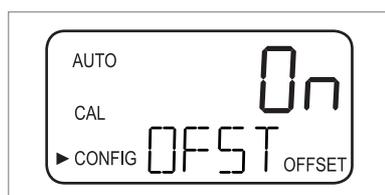
• Press ↵ to accept the new operational status.
⮑ The display now shows the set offset value (default setting is 0.00).

• Select the desired offset value by pressing ↑ or ↓ (regard the example below).
• Press ↵ 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 MODE/EXIT.

INFORMATION!
Whenever the measurement rests upon an offset value, the information "OFFSET" appears in the lower right corner of the display (even in the normal operation mode).

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.

5.6.4 Calibration error

If the following information is shown on the display, the internal diagnostic function has determined an error during the calibration procedure:
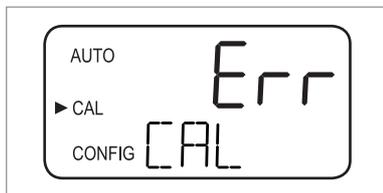
The reason for this error message is that either the calibration liquids were bad or they were inserted in the wrong order. You may find a remedy with the following options:

- 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 *Restoring the factory settings* on page 47.

INFORMATION!
If the device reports a calibration error, you cannot use it for measuring purposes without performing a recalibration or restoring the factory settings.

5.7 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:

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 MODE/EXIT. The device automatically saves all changes.*
- *The order of the following sections and subsections represents the menu topology.*

As described in the section "Menu topology", you have to press the button MODE/EXIT twice to switch to the configuration mode. Thereafter you are always in the first submenu, i.e. "Selecting the output".

5.7.1 Selecting the output

After switching to the configuration mode, the first submenu is always the selection of the output. At first you see the following display:
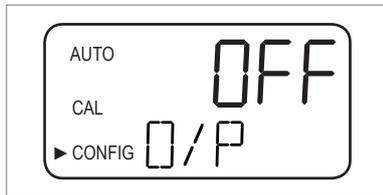
- Select the desired output by using ↓ or ↑ (options: 4-20 for the 4…20 mA output, 485 for the RS 485 output, OFF if you do not need outputs) or leave the setting.

The displays for the two possible outputs look like the following drawings:
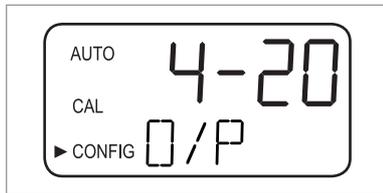
- Accept your selection by pressing ↵.
- ➲ If you chose or leave the setting "OFF", the device switches to the submenu "Error level"; if you chose or leave one of the outputs, the device switches to a submenu for the settings of the chosen output (see one of the next two sections).

5.7.2 Setting the 4...20 mA output inclusive error level

If you selected or left the 4...20 mA output in the previous step (for detailed information refer to *Selecting the output* on page 36), the device automatically switches to this submenu. At first you see the following display:

```
 ┌──────────────────────────────┐
 │ AUTO      0.02               │
 │ CAL                          │
 │ ► CONFIG  4MA                │
 └──────────────────────────────┘
```

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 or leave the setting.
- Accept your selection by pressing ↵.
- ➲   The device switches to the next menu item, i.e. the setting of the upper limit.

```
 ┌──────────────────────────────┐
 │ AUTO      1.00               │
 │ CAL                          │
 │ ► CONFIG  20MA               │
 └──────────────────────────────┘
```
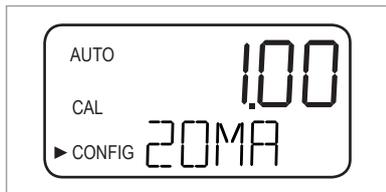
- Use the buttons ↑ and ↓ to define the upper turbidity limit which is assigned to the 20 mA output level or leave the setting.
- Accept your selection by pressing ↵.
- ➲   The device switches to the last menu item of this submenu, i.e. "Error level".

```
 ┌──────────────────────────────┐
 │ AUTO      OFF                │
 │ CAL                          │
 │ ► CONFIG  ERLV               │
 └──────────────────────────────┘
```
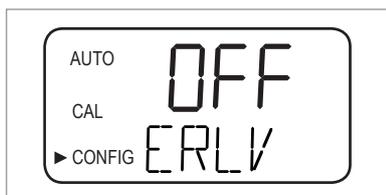
In case of an error the 4...20 mA output can be used to indicate the problem. That means the device can set the current either to 4.00 mA, 2.00 mA, 0 mA or to "OFF" ("OFF" is the default setting and effects that the 4...20 mA output is unaffected by any error condition):

- Use the buttons ↑ or ↓ to choose the desired setting for the error level or leave the setting.
- Accept your selection by pressing ↵.
- ➲   The device switches to the submenu "Configuring the alarm relays".

5.7.3 Configuring the RS 485 port

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

If you selected the RS 485 output (for detailed information refer to *Selecting the output* on page 36), the device automatically switches to this submenu. It allows to configure the RS 485 output and starts with the baud rate:

```
AUTO     9600
CAL
► CONFIG BAUD
```

- Use the buttons ↑ and ↓ to select one of the predefined baud rates or leave the setting (options: 1200, 2400, 4800, 9600 or 19200 baud).
- Accept your selection by pressing ↵.
➲ The device switches to the next menu item, i.e. the setting of the device address.

```
AUTO        1
CAL
► CONFIG ADDR
```

- Use the buttons ↑ and ↓ to select the desired device address or leave the setting (options: 1...255).
- Accept your selection by pressing ↵.
➲ The device switches to the last menu item of this submenu, i.e. "Modbus mode".

```
AUTO      rtu
CAL
► CONFIG MBUS
```
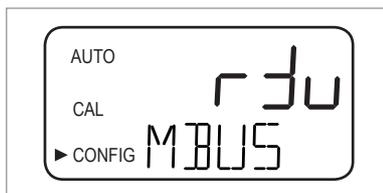
- Use the buttons ↑ and ↓ to select the options "RTU" or "ASCII" or leave the setting.
- Accept your selection by pressing ↵.
➲ The device switches to the submenu "Configuring the alarm relays".

INFORMATION!
For further information concerning the Modbus mode contact the manufacturer.

5.7.4 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.
- **OFF:** this option completely deactivates the alarm functions.
- **ERROR:** the relay changes state when an internal error occurs.

Alarm set point

This is the level at which an alarm activates. 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:

- Use the buttons ↑ and ↓ to select the desired work mode (HI, LO, OFF, ERROR) or leave the setting.
- Accept your selection by pressing ↵.
- ➲ If you chose "OFF" or "ERROR", a prompt appears to set up the alarm for the second relay (see below in this section). If you chose one of the other options, a prompt appears to set up the alarm set point.

```
┌─────────────────────────────┐
│  ┌────────────────────────┐ │
│  │ AUTO        ┌─┐ ┌─┐    │ │
│  │             │_│.│_││   │ │
│  │ CAL          _  _  _   │ │
│  │ ►CONFIG     5/P        │ │
│  └────────────────────────┘ │
└─────────────────────────────┘
```
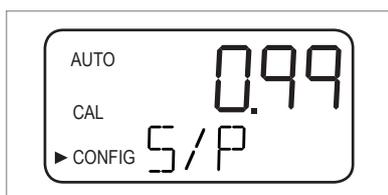
- Use the buttons ↑ and ↓ to select the desired alarm set point in the upper row or leave the setting.
- Accept your selection by pressing ↵.
- ➲ A prompt appears to set up the alarm delay times starting with "Delay on". Thus an arrow pointing upward appears to the right of "DLY" in the lower row while the upper row shows the preset number of seconds.
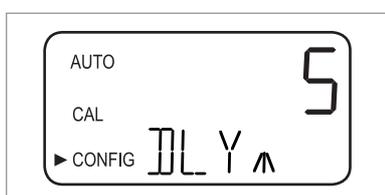
```
┌─────────────────────────────┐
│  ┌────────────────────────┐ │
│  │ AUTO              ┌─┐  │ │
│  │                   └─┤  │ │
│  │ CAL                _│  │ │
│  │ ►CONFIG   DLY  ⋀        │ │
│  └────────────────────────┘ │
└─────────────────────────────┘
```

- 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) or leave the setting.
- 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". Thus an arrow pointing downward appears to the right of "DLY" in the lower row while the upper row again shows the preset number of seconds.
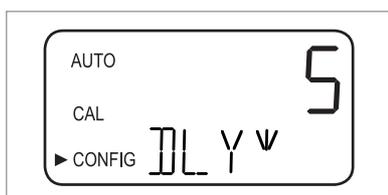
```
┌─────────────────────────────┐
│  ┌────────────────────────┐ │
│  │ AUTO              ┌─┐  │ │
│  │                   └─┤  │ │
│  │ CAL                _│  │ │
│  │ ►CONFIG   DLY  ⋁        │ │
│  └────────────────────────┘ │
└─────────────────────────────┘
```

- Use the buttons ↑ and ↓ to select the desired number of seconds for the time after which the alarm has to be "OFF" or leave the setting.
- 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 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.

If you choose another work mode than "OFF" for the second alarm relay, you have to go through the described procedure of defining the set point and the delay times for this relay. After defining "Delay off" for the second alarm relay and pressing ↵, the device switches to the next submenu (i. e. enabling or disabling the security access). The same happens if you choose the work mode "OFF" for the second alarm relay and press ↵.

5.7.5 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 33.

5.7.6 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).

INFORMATION!
The only valid security code is 333, it cannot be changed.

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.
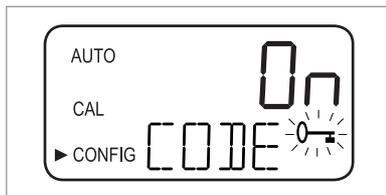
- Accept your selection by pressing ↵.
  ⮕ The device switches to the last submenu of the configuration mode ("Extended settings").

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

5.7.7 Extended settings

"Extended settings" is the last submenu of the configuration mode. A couple of settings are grouped together in this submenu to prevent them form being adjusted by mistake. The default setting is "OFF", as shown in the following drawing:
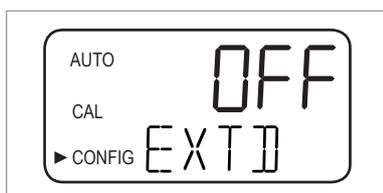
You can leave the default setting or, if the setting is "ON", disable the extended settings again by pressing ↑ or ↓.

INFORMATION!
If you disable the extended settings, i.e. choose the setting "OFF", the device stores all adjustments for every menu item of the extended settings submenu. The manufacturer recommends to disable the extended settings again after all adjustments to prevent adjustments by mistake.

Any time you press ↵ while the extended settings are disabled, the device switches back to the normal measuring mode and saves all settings. If you enabled the extended settings with the buttons ↑ or ↓ (i.e. "ON" appears in the upper row of the display) and press ↵, the device switches to the first menu item of the extended settings submenu (speed of response). The procedure of changing a setting and switching to the next item is the same for every item of the extended settings:

Changing a setting and switching to the next item

- Use the buttons ↑ or ↓ to change the setting.
- Accept your selection by pressing ↵.
- ➲   The device switches to the next item of the extended settings. Pressing ↵ after reaching the last item (i.e. the 20 mA adjustment) will switch the device back to the normal measuring mode (AUTO), all settings are saved.

Speed of response

```
┌─────────────────────────┐
│  AUTO            ╷╺╸     │
│                  ╵╹      │
│  CAL                     │
│                          │
│ ► CONFIG  RESP           │
└─────────────────────────┘
```

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.

Resolution of the measured value

```
 AUTO   0.0001
 CAL
►CONFIG  RES
```
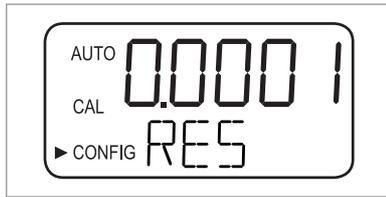
The device can display from one up to four digits to the right of the decimal place. The default setting are two decimal places. Four digits right to the decimal point are only possible for measuring results below 10 NTU/FNU. Each decade upwards decreases the digits right to the decimal place by one.

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.

Display backlight brightness

```
 AUTO          7
 CAL
►CONFIG  BRT
```
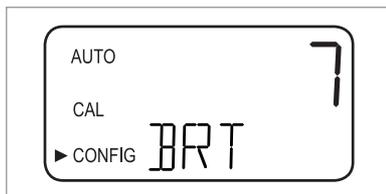
The display backlight brightness is of particular interest if multiple devices are located in the same area. If all of them should have the same clearness of display, then you might have to adjust the backlight brightness of particular devices. The default setting is 8, ten levels are available.

Setting the units

```
 AUTO    nЈu
 CAL
►CONFIG  UNIT
```
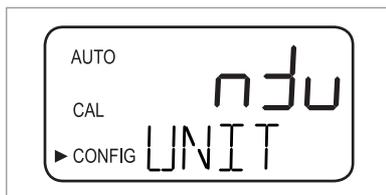
The most common unit of the measured value and the default setting is NTU (Nephelometric Turbidity Units), but FNU (Formazin Nephelometric Units) is also available.

Ultrasonic cleaning

```
┌─────────────────────────┐
│  AUTO                    │
│              ┌─┐  ┌─     │
│  CAL         │ │  │ │    │
│              └─┘  │ │    │
│ ► CONFIG  ┌ ┌ │\│        │
│           │ │ │ │\│      │
└─────────────────────────┘
```
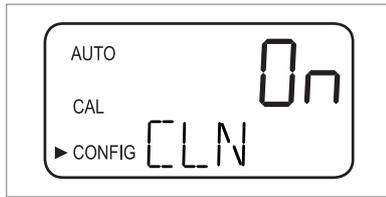
With the help of this function you turn the ultrasonic cleaning on or off (default is "On").

RS 485 parameters

The RS 485 parameters are only adjustable and so appear if the RS 485 interface is enabled (for detailed information refer to *Selecting the output* on page 36). In this case you can change the parameters "BITS", "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:
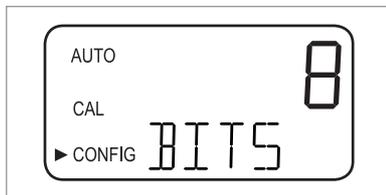
```
┌─────────────────────────┐
│  AUTO                    │
│                   ┌─┐    │
│  CAL              │─┤    │
│                   └─┘    │
│ ► CONFIG  ┌ │ ┌┐ ┌       │
│           └ │ │ └─┐      │
└─────────────────────────┘
```

- Use ↑ or ↓ to select the desired number of bits or leave the setting, accept your selection by pressing ↵.
- Use ↑ or ↓ to select the desired parity or leave the setting, accept your selection by pressing ↵.
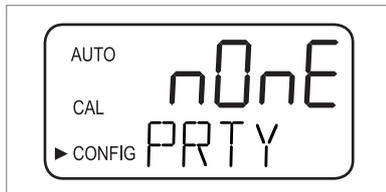
```
┌─────────────────────────┐
│  AUTO                    │
│           ┌┐┌┐┌┐┌─       │
│  CAL      │││││││├─      │
│           └┘└┘└┘└─       │
│ ► CONFIG  ┌┐┌┐┌┐┌ │      │
│           ├┘├┤ │ └┘      │
└─────────────────────────┘
```

- Use ↑ or ↓ 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 extended settings (desiccant alarm).

```
┌─────────────────────────┐
│  AUTO                    │
│                    │     │
│  CAL               │     │
│                    │     │
│ ► CONFIG  ┌─┐┌┐┌─┐┌─     │
│           └─┘ ││ │├┘     │
└─────────────────────────┘
```

In the communication mode "Simple" the following information is exchanged between the master computer and the device:

Enquiries of master computer	Answer of device
Byte 1: attention character ":" in ASCII or 3A Hex	The same attention character ":" in ASCII or 3A Hex
Byte 2: address of the device being enquired	Address of the device
Byte 3/4: CR/LF or 0D 0A in Hex	3: Measured value
	4: Unit (NTU or FNU)
Example (master requesting a report from address No. 1): 1 CRLF	**Example** (response of the device set to address No. 1): 001 0.0249 NTU

Desiccant alarm

The device can output a humidity alarm if the detected humidity could cause condensation. The default setting of the humidity alarm is "OFF", like in the following drawing:

If you enabled the desiccant alarm and the humidity detector determines a problematic value, the device activates the alarms and sets the 4...20 mA output to the selected error level. In the normal measuring mode you see the measured value in the upper row and "DESC" in the lower row:

4 mA and 20 mA adjustment

If you enabled the 4...20 mA output (for detailed information refer to *Selecting the output* on page 36) 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 settings 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: ± 0.2 mA or ± 200 counts
- 20 mA: ± 1 mA or ± 1000 counts

After accepting your selection for the desiccant alarm by pressing ↵ and while the 4...20 mA output is enabled, you see the following display:

```
AUTO      -40
CAL
►CONFIG   4MA
```
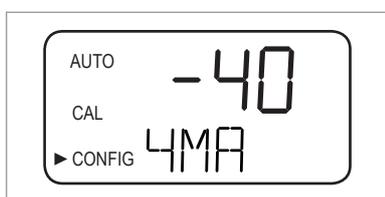
- Use ↑ or ↓ to make your adjustment.
- Press ↵ to switch to the adjustment of the 20 mA output:

```
AUTO      - 152
CAL
►CONFIG   20MA
```

After accepting the adjustment for the 20 mA output by pressing ↵ the device switches back to the normal measuring mode (AUTO). All settings are saved.

5.8 Restoring the factory settings

INFORMATION!
The restore function affects not only the configuration settings, but also the calibration settings. Executing this functions means that both return to the default which was defined by the manufacturer. Furthermore the device works with reduced accuracy!

INFORMATION!
Be aware that if the reason for restoring the factory settings was a hardware defect (e.g. a sensor lamp with a low output), the original problem still exists thereafter. Before an accurate operation you have to determine and correct the original problem.

Irrespective of the reason for restoring you always have to execute the following steps if you want the configuration and calibration settings to return to the default:

• Press and hold the button ↑.
• Press the button ↵ and release it.
• Release the button ↑
➲   Factory configuration and calibration settings have been restored.

5.9 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

A warning is simply an indication of a problem, i.e. the device does not activate any alarms. If for example the desiccant becomes saturated and the desiccant alarm is disabled, the warning "DESC" appears on the display.

Errors

The cause of an error message can usually be corrected by the operator. If the device detects an error, it activates both alarm relays and sets the 4...20 mA output to the selected error level. In this case the device may still display measuring results, but with an uncertain accuracy:

A message of a calibration error, i.e. the calibration is deficient, differs from the other error messages and looks like the following:

```
┌─────────────────────────┐
│  AUTO        Err        │
│ ► CAL                   │
│  CONFIG   CAL           │
└─────────────────────────┘
```
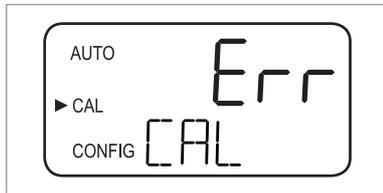
Failures

A failure is a complete malfunction, i.e. the device does not function properly. Failures cannot be corrected by the operator, but the device has to be returned to the manufacturer. They concern internal systems such as the CPU, the A/D converter or the EEPROM chip. In the case of a failure detection, the display shows the message "FAIL". Furthermore the device activates both alarm relays and helds the 4...20 mA output at the selected error level.

```
┌─────────────────────────┐
│  AUTO                   │
│  CAL                    │
│  CONFIG   FAIL          │
└─────────────────────────┘
```

Apart from the faults shown before there are problems that do not have a specific message in the display (e.g. extremely alternating measuring results). The following table contains both kinds of problems:

Fault chart

Fault message / problem	Category	Cause	Measurement
CAL (bottom row of display)	Error	Deficient calibration or calibration impossible.	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.
CLN (bottom row of display)	Error	Ultrasonic transducer has no contact to the spring connections or transducer itself is damaged.	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.
		Ultrasonic cuvette has been removed or wrong cuvette is used.	Insert correct ultrasonic cuvette and pay attention to the correct procedure (details on page 21).
DESC (bottom row of display, only if desiccant alarm disabled)	Warning	Desiccant in the pouch is saturated or bad.	Change desiccant pouch (details on page 51).
FAIL (bottom row of display)	Failure	Complete malfunction of an internal system.	Return the device to the manufacturer.
FLOW (bottom row of display, only if flow switch is installed)	Error	Sample flow stopped.	Restore sample flow, contact manufacturer for further information.
LAMP (bottom row of display)	Error	Light source fails.	A service employee of the manufacturer has to replace the lamp, do not do it on your own!
MA (bottom row of display)	Error	4...20 mA loop open.	Check wiring of the current output (details on page 25).
Measuring result blinks (i.e. value in the upper row of the display)	-	Exceeding of measuring range, i.e. turbidity is too high.	Take a sample and check the turbidity in a laboratory.
Measuring result alternates extremely	-	Bubbles in the measured medium.	Ensure that the drain vent hole is open and not blocked.
			Apply backpressure with the help of the backpressure valve.
			In case of severe bubble formation use a stilling chamber (available as accessory part).
		Debris in the ultrasonic cuvette.	Remove cuvette (details on page 50) and clean it with a soft cloth.
Measuring result is higher than expected	-	Bubbles in the measured medium.	See above in this table.
		Condensate or dirt in the ultrasonic cuvette	Remove cuvette (details on page 50) and clean it with a soft cloth.
		Leaky ultrasonic cuvette.	Check for leakages and replace devices if necessary.
		Improper calibration.	Recalibrate the device (details on page 30).
Measuring result is lower than expected	-	Improper calibration.	Recalibrate the device (details on page 30).

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.

ℹ 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.

ℹ 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!

ℹ 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 holder execute the following steps:

- Shut-off the intake flow with the help of the shutoff clamp.
- Move the lock ring counterclockwise and remove the ultrasonic cuvette with flow-through holder (details on page 21).
- Turn the cuvette counterclockwise to remove it from the ultrasonic cuvette with flow-through holder.
- 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 an 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 to 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

Spare or accessory part	Order code
Desiccant pack (desiccant pouch with humidity indicator)	XGA M 010000
Flow regulator	XGA M 010010
Flow-through assembly	XGA M 010015
Pressure regulator	XGA M 010020
Junction box power assembly	XGA M 010025
Ultrasonic cuvette	XGA M 010030
Lamp assembly WL	XGA M 010040
Lamp assembly IR	XGA M 010050
Tubing kit: (1 drain vent, 1 shut-off clamp, 1 backpressure valve, 2 connection tubes with fittings for flow-through assembly	XGA M 010060
Stilling chamber	XGA M 010070
Grab sample cuvette, 10 pack	XGA M 010080
Software for data collection and reporting	XGA M 010090
Solid validation standard (cuvette)	XGA M 010100
Calibration kit (0.02, 10, 100 NTU/FNU)	XGA M 010150
Calibration kit (0.02, 10, 1000 NTU/FNU)	XGA M 010160
Electronic service device IR	XGA M 010200
Electronic service device WL	XGA M 010210

CAUTION!
The spare part "Electronic service device IR (XGAM010200)" or "Electronic service device WL (XGAM010210) is labelled with a spare part number. In case you change the electronic device, please keep the original device label with the complete order code of the device. Only with the original label the manufacturer can draw conclusions from the exact device type and specific configuration. This is also important in case the device has still warranty.

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.

⚠️ *CAUTION!*
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.*

⚠️ *CAUTION!*
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 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.

Company:	Address:
Department:	Name:
Tel. no.:	Fax no. and/or Email address:

Manufacturer's order no. or serial no.:	

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

⚠️ *CAUTION!*
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)
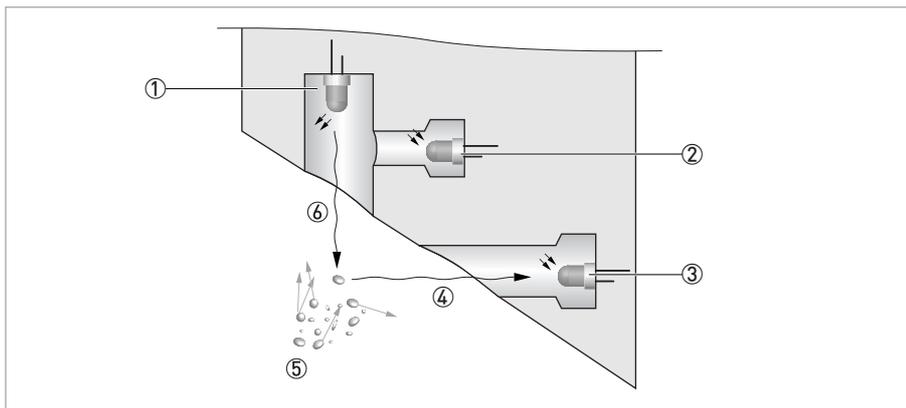- FNU (Formazin Nephelometric Unit)

Figure 7-1: Measuring principle for turbidity measurement

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

Measuring principle	90° scattered light method
Application range	Turbidity measurement of liquids according to ISO 7027 and US EPA 180.1
Measuring range	0.02...100 NTU/FNU or 0.02...1000 NTU/FNU

Design

The measurement system consists of a sensor and a signal converter and is only available as compact version.	
Display and user interface	
Display	Multi-line liquid crystal backlight display
Operating and display language	English
Other properties	
Response time	Min. 5 seconds, adjustable
Alarms	Two programmable, 120...240 VAC, 2A form C relay

Measuring accuracy

Reference conditions	+1...+50°C / +33.8...+122°F
	95% relative humidity
	Altitude up to 2000 m / 6600 ft
Accuracy	< 40 NTU/FNU: ±2% of reading or ±0.02 NTU/FNU whichever is greater
	> 40 NTU/FNU: ±5% of reading
Resolution	0.0001 NTU/FNU (below 10 NTU/FNU) selectable

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	0.07...14 bar / 1...200 psi (built-in regulator set at 1 bar / 15 psi)
Ambient pressure	Atmospheric, altitude up to 2000 m / 6600 ft
Flow velocity	
Minimum	0.1 l/min / 0.026 gal/min
Maximum	1 l/min / 0.26 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 58.
Weights	Shipping weight: 2.5 kg / 5.5 lbs

Materials

| Sensor housing	ABS
Wetted parts	Nylon, borosilicate glass, silicon, polypropylene, stainless steel AISI 304

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)
	Option: transformer isolated current output
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 600 Ω
Modbus	Bi-directional, RS-485 Modbus RTU/ASCII
Relays	2 x relay 120...240 VAC, freely programmable

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.
ETL	Listed to UL 61010B-1 and certified to CSA 22.2 No. 1010.1-92

7.3 Dimensions and weight
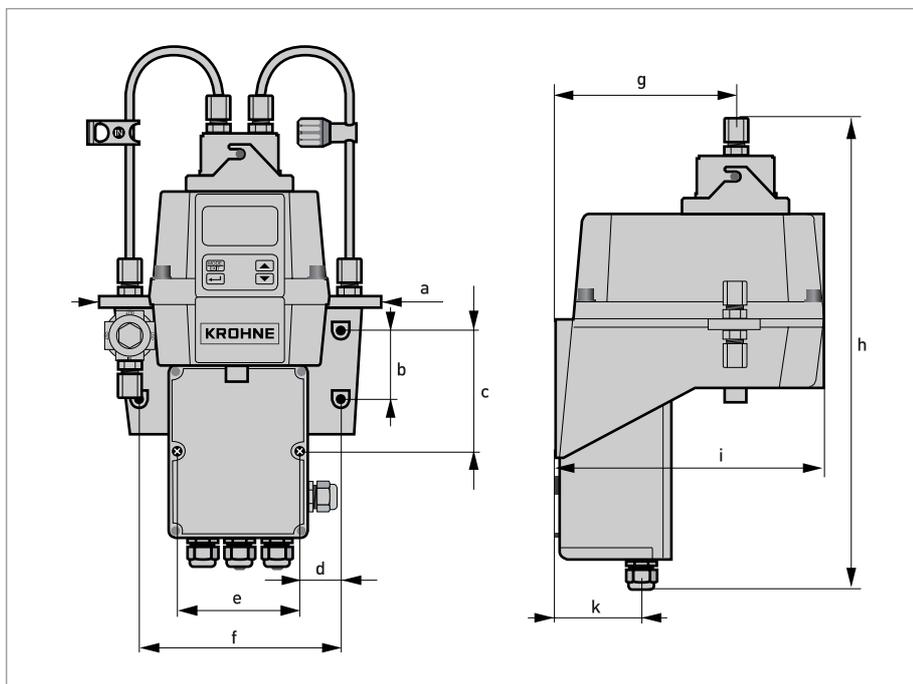
	Dimensions	
	[mm]	["]
a	208	8.19
b	51	2.0
c	90	3.54
d	30	1.18
e	87	3.43
f	148	5.83
g	131	5.16
h	347	13.66
i	197	7.76
k	62	2.44

Shipping weight: 2.5 kg / 5.5lbs
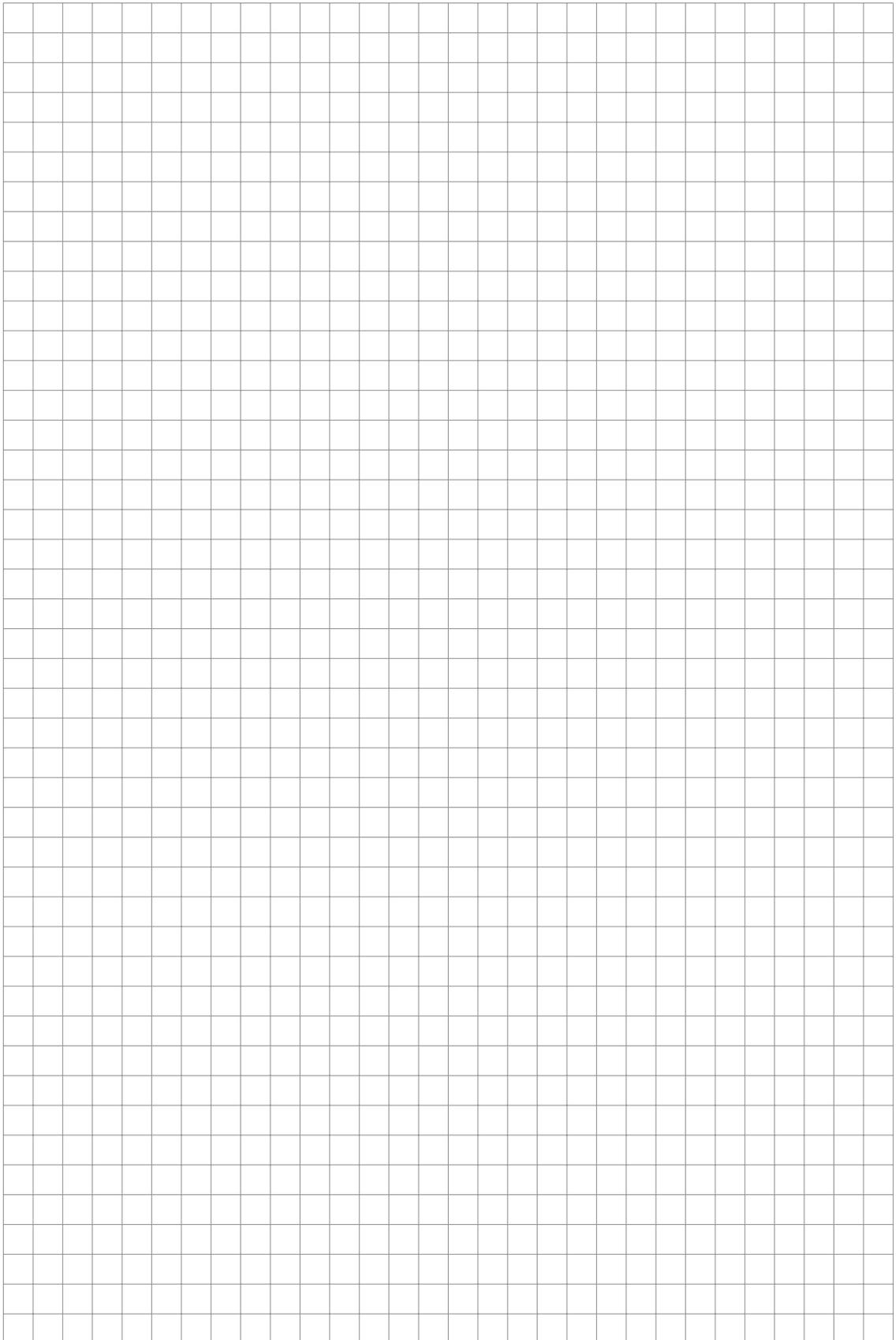
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Head Office KROHNE Messtechnik GmbH
Ludwig-Krohne-Str. 5
47058 Duisburg (Germany)
Tel.: +49 203 301 0
Fax: +49 203 301 10389
info@krohne.com

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

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