OPTISENS TUR 2000 Handbook

Sensor for turbidity measurement in water and wastewater

The documentation is only complete when used in combination with the relevant documentation for the signal converter.

KROHNE

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1.1 Intended use

CAUTION!
Responsibility for the use of the measuring devices with regard to suitability, intended use and corrosion resistance of the used materials against the measured fluid lies solely with the operator.

INFORMATION!
This device is a Group 1, Class A device as specified within CISPR11:2009. It is intended for use in industrial environment. There may be potential difficulties in ensuring electromagnetic compatibility in other environments, due to conducted as well as radiated disturbances.

INFORMATION!
The manufacturer is not liable for any damage resulting from improper use or use for other than the intended purpose.

The intended use of OPTISENS TUR 2000 sensors is the measurement of turbidity in water and wastewater applications. The sensor is suitable for connection to the MAC 100 signal converter.

1.2 Certifications

CE marking

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

- EMC Directive 2014/30/EU

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

1.3 Safety instructions from the manufacturer

1.3.1 Copyright and data protection

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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.

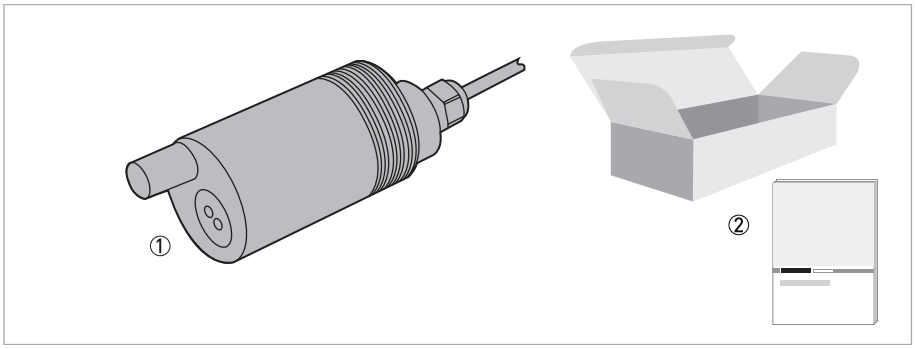


Figure 2-1: Standard scope of delivery

① Ordered sensor
② Documentation

Optional accessories

- SENSOFIT IMM 2000 - Immersion assembly

Consumables / Spare parts available

- Connector for cleaning hose
- Turbidity standards for verification and calibration

INFORMATION!
For further information contact your local sales office.

2.2 Device description

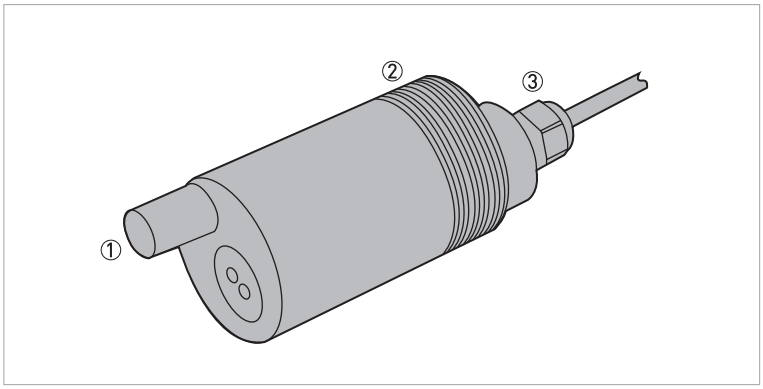


Figure 2-2: Device description

① Cleaning nozzle
② 2" NPT
③ Attached cable

2.3 Nameplate

INFORMATION!
Look at the device nameplate to ensure that the device is delivered according to your order.

The device type is specified on the label of the package and on the device itself.

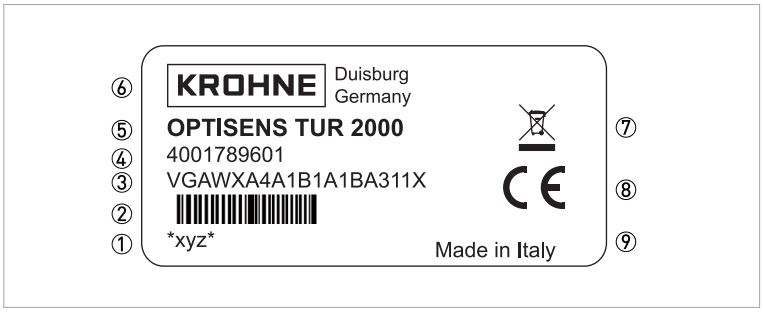


Figure 2-3: Example for a nameplate

① Serial number
② Serial number as barcode
③ Order code
④ Articel number
⑤ Device name
⑥ Manufacturer
⑦ Electronic/electric device waste marking (WEEE dustbin symbol)
⑧ CE marking
⑨ Country of manufacture

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 General installation instructions

The sensor tip must always have full contact with water.

The mounting position of the sensor should be 25°...75° from vertical position (sensor tip pointing downwards). Non-observance might cause air bubbles or dirt/sludge to stick to the sensor tip.

For optimal positioning use an immersion assembly as shown in the following image.

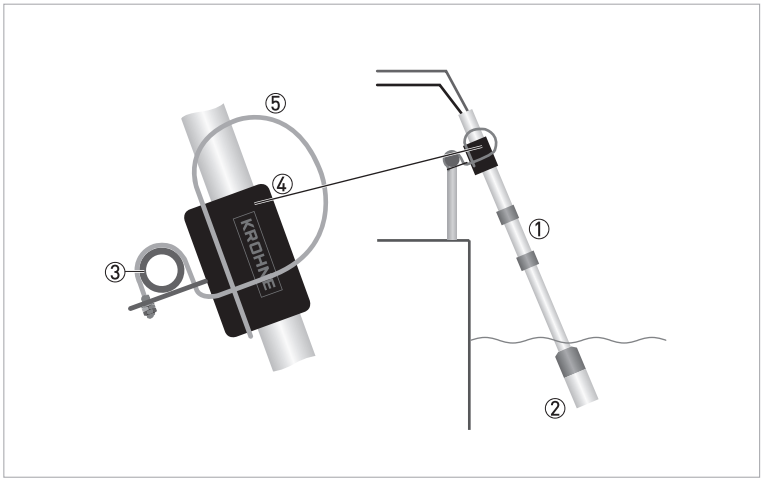


Figure 3-1: Optimal mounting position

① Immersion assembly
② Sensor holder
③ Handrail
④ Rod holder
⑤ Mounting bracket

INFORMATION!
Install the sensor in a light angle to avoid wrong measurement results due to a dirty sensor or trapped air on the sensor.

3.3 Storage and transport

- Store the device in a dry, dust-free location.
- Avoid continuous direct sunlight.
- 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.

3.4 Configuration of a measuring point

The sensor has a 4...20 mA current loop and can be operated with external signal converter or without. If operated without the external converter the converter is needed as configuration and calibration tool.

A complete measuring point consists of at least two or three parts:

- Optional: A signal converter (for configuration only as calibration tool or for operation)
- OPTISENS TUR 2000 sensor (including cable)
- Immersion assembly or other adequate housing

If automatic flushing is installed, an optional solenoid valve is necessary as well.

Examples of typical measuring points are listed in the following sections.

3.5 Pre-installation requirements

CAUTION!

- *Never touch or scratch the measurement windows of the sensor.*
- *Make sure that the measurement windows are clean and dust-free. If necessary, clean the measurement windows as described on page 42*
- *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.*

CAUTION!

Do not turn the cable gland on the sensor this might cause a sensor leak and damage the electronics inside. While mounting or dismounting the sensor, the senor cable must not be fixed or trapped as this might loosen the water tight gland connection from the sensor.

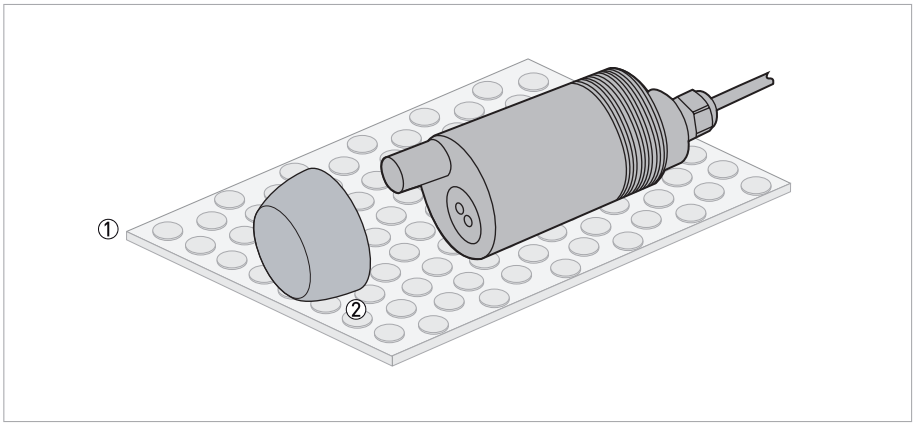


Figure 3-2: Unpacking the sensor

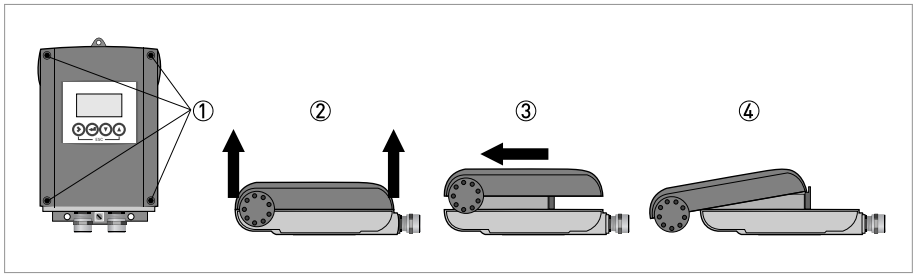
Unpacking the sensor

- Lay the sensor on a soft mat/tissue ①.
- Keep the protection cap ② in the original packaging as long as it is not required.

3.6 Opening the converter housing

INFORMATION!
Clean and grease all threads each time you open the housing. Use only resin-free and acid-free grease. Before closing the cover, ensure that the housing gasket is properly fitted, clean and undamaged.

All installation works on the electrical connections require to open the converter housing:



- Loose the four screws ① with a crosstip screwdriver.
- Lift the housing at the top and bottom at the same time ②.
- Slide the housing cover backward ③.

➲ The housing cover is guided and held by the inside hinge; you have access to the terminal compartment now (see ④ in the previous drawing and next section).

3.7 Installation procedure

A new amperometric dissolved oxygen sensor needs to be calibrated before it is installed into its final measuring location. To install the device in the correct way, follow the order and the following sections and their instructions.

1. Mount the sensor into the immersion assembly. (For further information refer to the manual of the assembly)
2. Connect the sensor to the signal converter or directly to the control system.
3. Configure the measurement range. Calibrate the sensor.
4. Install the sensor into its final measuring location.

3.8 Sensor use without cleaning function

WARNING!
Without a cap on the air line connector the sample might block the cleaning drilling for later use or water might flow into a closed assembly and damage the probe due to later handling.

Before installation and immersion the sensor check the following order:

- Do not install any flexible tubing.
- Install a cap on the air line connector in order to avoid the cleaning drilling to be blocked for later use or water to flow through it into a closed assembly.

3.9 Sensor use with cleaning function

INFORMATION!
Most applications do not require the cleaning function if the sensor is installed correctly in a correct angle.

When the automatic cleaning is required the device can be equipped with a cleaning hose for air cleaning.

Before the device is installed into its final measuring location the following points must be observed

- provide hose (Ø 6.3...9.5 mm / 1/4...3/8") in suitable length
- prepare a connection for the cleaning hose
- push the hose onto the cleaning connector
- put the sensor cable and cleaning hose through the adequate extension pipe of the mounting assembly

The pressurised air is to be provided and must be clean with a max of 3 bar.

The typical cleaning time is 15 seconds and the typical cleaning frequency is 2 times/day, but this will differ from application to application.

3.10 Mounting the sensor into an assembly

DANGER!
All work on the electrical connections may only be carried out with the power disconnected.

CAUTION!
Do not turn the cable gland on the sensor this might cause a sensor leak and damage the electronics inside. While mounting or dismounting the sensor, the senor cable must not be fixed or trapped as this might loosen the water tight gland connection from the sensor.

INFORMATION!
Recalibrate the sensor after each manual cleaning procedure.

For further instructions on installation into an immersion assembly refer to the assembly manual.

Use an assembly that does not fix the sensor cable or require the sensor to be screwed into the assembly. If the sensor needs to be screwed for mounting or dismounting make sure that the sensor cable is turned into the same direction.

Installing procedure

- Insert the sensor cable through the immersion assembly.
- Fasten the sensor to the tip of the telescopic rod by tighteninng the 6 screws of the 2 holding plates.
- Connect the wires either to the control system directly (only 4...20 mA) or to the MAC 100 signal converter. For further information refer to *Connecting the sensor to PC* on page 22, refer to *Connecting the sensor directly to the control system* on page 22 and refer to *Connecting the sensor cable to the signal converter* on page 20.

For removing the sensor, repeat the steps above in reverse order.

Calibrate the sensor before installing it into the assembly. For further information refer to *Calibration* on page 26

4.1 Safety instructions

DANGER!
For devices used in hazardous areas, additional safety notes apply; please refer to the Ex documentation.

DANGER!
All work on the electrical connections may only be carried out with the power disconnected.

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.

4.2 Connecting the power supply to the signal converter MAC 100

DANGER!
The device must be grounded in accordance with regulations in order to protect personnel against electric shocks.

DANGER!
Never install or operate the device in potentially explosive areas, it might cause an explosion that can result in fatal injuries!

CAUTION!
When connecting the power supply, always note the safety regulations of the current state of the art. Also note the following items to avoid fatal injuries, destruction or damage of the device or measuring errors:

- *De-energise the cables of the power supply before you start any installation works!*
- *Always keep the housing of the device well closed if you do not perform any installation works. The function of the housing is to protect the electronic equipment from dust and moisture.*
- *Assure that there is a fuse protection for the infeed power circuit ($I_{nom} \leq 16$ A) and a disconnecting device (switch, circuit breaker) to isolate the signal converter.*
- *Check the nameplate and assure that the power supply meets the voltage and frequency of the device. You can operate the device in the range of 100...230 VAC and 8 VA with a tolerance of -15/+10% while 240 VAC +5% is included in the tolerance range (a version with a power supply of 24 VAC/DC is in preparation). A power supply outside these specifications may destroy the device!*
- *Assure that the protective earth conductor (PE) is longer than the L- and N-conductor.*

INFORMATION!
The manufacturer has designed all creepage distances and clearances according to VDE 0110 and IEC 664 for pollution degree 2. The power supply circuits fulfil the overvoltage category III and the output circuits fulfil the overvoltage category II.

Before you start to connect the power supply cables, note the following drawing with the function of the terminals:

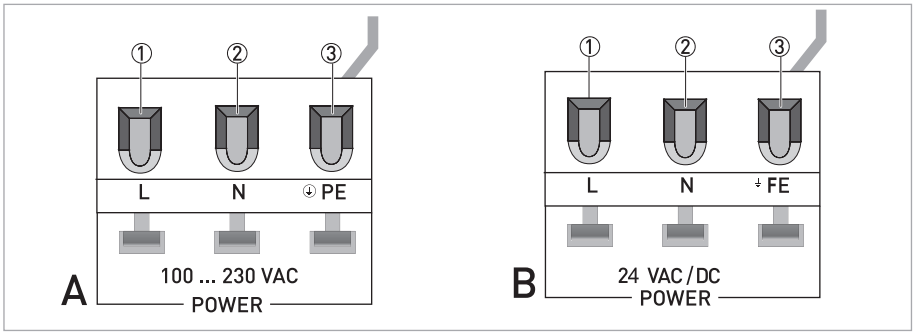
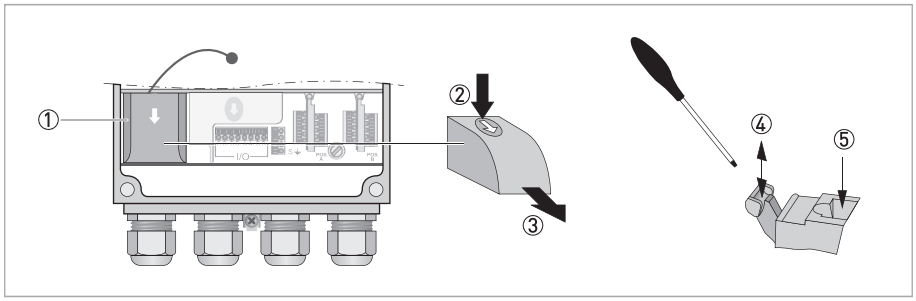


Figure 4-1: A - 100...230 VAC / B- 24 VAC/DC

① Live (L)
② Neutral (N)
③ Protective Earth (PE) or Functional Earth (FE)

Afterwards connect the power supply cables accordingly:

CAUTION!
The manufacturer strongly recommends to use a slotted screwdriver with a tip of 3.5 x 0.5 mm / 0.14 x 0.02" to push down the lever! Otherwise you could damage the lever.



- De-energise the power supply cables with the help of a disconnecting device (switch, circuit breaker)!
- Open the converter housing (refer to *Opening the converter housing* on page 14).
- Remove the cover of the power supply terminal (①) by pressing it down and pulling forwards at the same time (② and ③), be careful and do not disrupt the retaining band (it prevents the cover from getting lost)!
- Use a slotted screwdriver with a tip of 3.5 x 0.5 mm / 0.14 x 0.02" to push down the lever, connect the wires to the terminals and pull up the levers again (④ and ⑤).
- Refasten the cover of the power supply terminal, close the converter housing and tighten all screws of the housing.

4.3 Connecting the sensor cable to the signal converter

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!

INFORMATION!
Look at the device nameplate to ensure that the device is delivered according to your order.

Connect the dissolved oxygen sensor to the MAC100 for optimal configurability and process control due to following features:

- scale selection flexibility
- digital input to hold signals during cleaning process
- easy calibration via zero point and sensitivity adjustment
- set minimum and maximum for alarm relays
- galvanic isolated 4...20 mA outputs
- error current

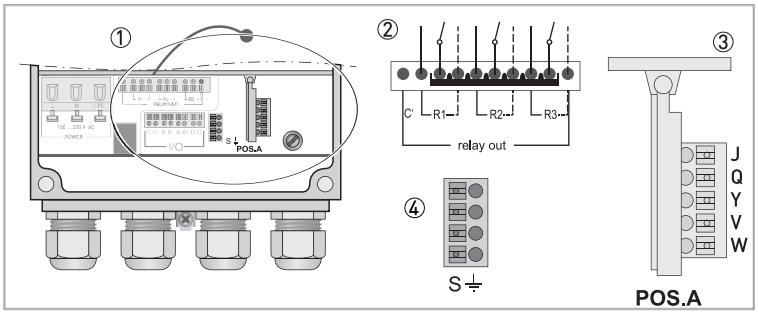


Figure 4-2: Sensor connection terminals on the signal converter MAC 100

① Sensor connection terminal
② Relays
③ Terminal block A: terminals for sensors
④ Terminal block S (protective earth)

Wire	Terminal block Pos.A
White	J
Green	Q
Yellow	Y
Grey	V
None	W
brown	not connected

Wire	Terminal S
Metal (non isolated cable)	S

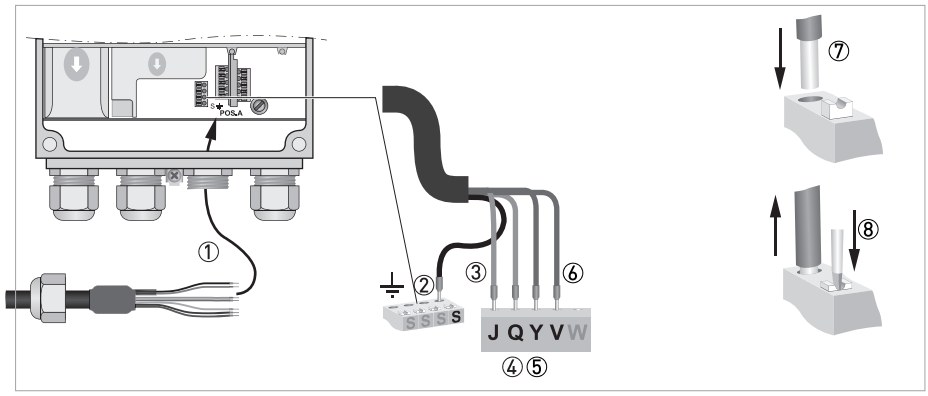


Figure 4-3: Connecting the sensor cable

The following instructions describe the connection of the sensor cable.

Connecting the sensor cable to the signal converter

- Remove the terminal cover.
- Thread the sensor cable through the middle right cable gland ①.
- Push the wires ⑦ into terminal J ③, Q ④, Y⑤, V ⑥ and S ②.
- To remove a wire, press down the white clip ⑧ on the corresponding terminal and pull the wire out.

4.4 Connecting the sensor directly to the control system

CAUTION!
Avoid cable interruptions. If necessary use adequate junction box. Keep the cable far away from power cables inside of the switch board.

The device is loop powered and can be connected directly onto the control system via any junction box.

Wire	Function
Green	+ current loop
White	- current loop
Metal	shield

The normal operation needs just the connection of the green and white wires, which are protected against accidental inversion. The shield is not connected to the probe but it must be connected to the ground.

4.5 Connecting the sensor to PC

CAUTION!
Avoid cable interruptions. If necessary use adequate junction box. Keep the cable far away from power cables inside of the switch board.

Connect the device to the converter or directly to the control system as stated in above chapters. The shield is not connected to the probe but it must be connected to the ground.

Wire	Function
Shield	not connected
Yellow	A (+) RS485
Grey	B (-) RS485
Brown	not connected
Green	+ current loop
White	- current loop / COM RS485

5.1 Menu mode structure

INFORMATION!
The following table just presents an overview. Additional levels are accessible from certain menus offering the possibility to change presets.

Measuring mode	Main menu		Submenu			Parameter	
3 or 4 pages, scrolling with ↓ or ↑	> 2.5 s ↵	**A quick setup**	> ↵	A1 language		> ↵	For further information see function tables.
				A2 Tag			
				A3 manual hold			
				A4 set clock			
				A5 reset errors			
				A6 analog outputs	> ↵ A6.1 measurement		
					A6.2 turbidity		
					A6.3 range		
					A6.4 time constant		
				A17 offset			
				A18 temperature offset			
				A19 product cal.			
		↓↑		↓↑			↓↑

Measuring mode	Main menu		Submenu				Parameter	
3 or 4 pages, scrolling with ↓ or ↑	> 2.5 s ↵	**B test**	> ↵	B1 sim.process inp.A	> ↵	B1.1 temperature	> ↵	For further information see function tables.
						B1.4 turbidity		
						Simulation menus input A; existence of the single submenus depends on the selected hardware setting in C setup / C3 I / O. To start a simulation process refer to the MAC 100 manual.		
				B3 simulation I/O		B3.6 simulation R3 To start a simulation process refer to the MAC 100 manual.		
				B4 actual values		B4.1 operating hours		
						B4.2 process input A		
						Menus which show the corresponding actual reading; existence of the single submenus depends on the hardware setting and the used sensor.		
				B5 logbooks		B5.1 status log		
						B5.2 calibration log		
				B6 information		B6.1 C number		
						B6.2 process input A		
						B6.4 SW.REV. MS		
						B6.5 SW.REV. UIS		
						B6.6 Electronic Revision ER		
		↓↑		↓↑		↓↑		↓↑

Measuring mode	Main menu		Submenu				Parameter	
3 or 4 pages, scrolling with ↓ or ↑	> 2.5 s ↵	**C setup**	> ↵	C1 process input A	> ↵	Menus for the setup of the corresponding process input; existence of the single submenus depends on the hardware setting and the used sensor.	> ↵	For further information see function tables.
						C1.1 parameter		
						C1.25 range		
						C1.27 offset		
						C1.28 temperature offset		
						C1.29 product cal.		
				C3 I/O		C3.1 hardware		
						C3.8 current R3		
				C5 device		C5.1 device info		
						C5.2 display		
						C5.3 1 meas.page		
						C5.4 2 meas.page		
						C5.5 graphic page		
						C5.6 special functions		
						C5.7 units		
		↓↑		↓↑		↓↑		↓↑
	D service: This menu is password protected and contains functions to be used by service personnel only.							

5.2 Calibration

Optical components such as LED and photodiodes can have a small drift during their lifetime. The windows between the measuring light source/detector and medium to be measured will age as well due to scratches and more.

INFORMATION!
Insure that the sensor is clean and free from any deposits on the measurement windows. Please clean with clear water and a soft cloth as some deposits can be clear and be visible for the measurement electronics due to infrared operation, but not visible to our eye.

5.2.1 Calibration with a signal converter

The sensor requires a 2-point calibration. The sensor is factory calibrated by means of standard solution and it is ready for use. The operator can perform the field calibration via controller by means of the sensitivity and zero adjustment.

INFORMATION!
It is suggested to verify the sensor periodically and calibrate in case of need to get the requested accuracy on the specific application.

CAUTION!
- *Never touch or scratch the measurement windows of the sensor.*
- *Make sure that the measurement windows are clean and dust-free. If necessary, clean the measurement windows as described on page 42*
- *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.*

To avoid alarms on the distributed control system (DCS) when temporarily removing the sensor (i.e. for maintenance), the signal converter has a hold function. This function "freezes" all outputs (i.e. the display and the current outputs) of the last measured value.

INFORMATION!
As an indication that the manual hold function is active, the warning sign in the upper left corner of the display appears. Meanwhile the status messages show ***checks in progress****. For more details about how to select the manual hold function refer to the signal converter manual.*

After starting-up the signal converter, the measuring screen appears. This is the standard screen which is displayed automatically in the normal operating mode. In this mode the calibration can be started. Activate the **hold function** in the first step.

INFORMATION!
Make sure there are no air bubble infront of the optics as they will be causing measurement signals due to reflection and light scattering effects and such might cause a wrong reading.

Step 1: Activating the hold function

- Press **>** for more than 2.5 seconds, then release the button. You are on the main menu level.
- Press ▼ or ▲ until the main menu **quick setup** is highlighted.

MAIN MENU
> A quick setup B test C setup D service
• Press **>** to enter the chosen menu.
You are on the first submenu level. In the upper line of the display **quick setup** appears, beneath the submenu **language** is highlighted.
• Press ▼ or ▲ until the submenu **manual hold** is highlighted. • Press **>** to enter the chosen menu.
You are on the second submenu level. In the upper line of the display **manual hold** appears, beneath the option **off** is highlighted.
• Press ▼ or ▲ to choose the option **on**.
• Press ↵ to confirm the entered value.

- You have activated the **manual hold** function. Go to the next step and prepare the calibration procedure. You have to return to the measuring mode.
- Press ↵ until you reach the measuring mode again.

Step 2: Preparing the calibration procedure

- For re-calibration, remove the sensor from the process.
- If you calibrate a sensor, make sure that the sensor is correctly connected to the signal converter.
- Check the sensor for damages, check the measurement windows for coating and rinse the sensor tip with tap water and gently swipe it with a soft tissue.
- Do not touch or scratch the windows.
- Repeat the cleaning step twice to make sure that the sensor is clean as well from deposits we can not detect with human eye (e.g. polymer film).

INFORMATION!
Use a soft tissue to wipe the window clean. Otherwise the polymer films are not being removed and interfere with later calibration.

INFORMATION!
*Before proceding with **product cal.** make sure that the **offset** is set to 0.000 NTU*

Step 3a: Accessing the calibration menu via the main menu **setup**

- Press **>** for more than 2.5 seconds, then release the button. You are on the main menu level.
- Press ▼ or ▲ until the main menu **setup** is highlighted.

MAIN MENU

A quick setup
B test
> C setup
D service

- Press **>** to enter the chosen menu.

You are on the first submenu level. In the upper line of the display **setup** appear. Press ▼ or ▲ until the submenu **process input A** is highlighted.

- Press **>** to enter the chosen menu.

You are on the second submenu level. In the upper line of the display **process input A** appear. Press ▼ or ▲ until the submenu **product cal.** is highlighted.

- Press **>** to enter the chosen menu.

The actual measured value is displayed.

Step 3b: accessing the calibration menu via the main menu **quick setup**

- Press **>** for more than 2.5 seconds, then release the button. You are on the main menu level.
- Press ▼ or ▲ until the main menu **quick setup** is highlighted.

MAIN MENU

> A quick setup
B test
C setup
D service

- Press **>** to enter the chosen menu.

You are on the first submenu level. In the upper line of the display **quick setup** appear. Press ▼ or ▲ until the submenu **product cal.** is highlighted.

- Press **>** to enter the chosen menu.

The actual measured value is displayed.

Step 4: Preparing the zero point calibration

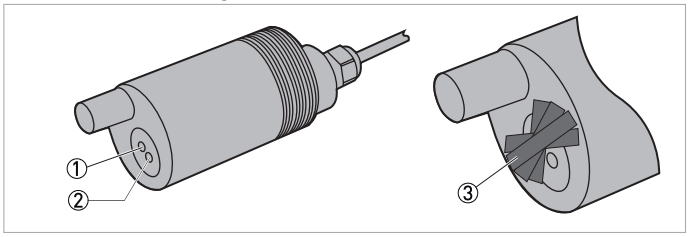


Figure 5-1: Preparing the zero calibration

① Detector
② Ermitter
③ Black electrical isolation tape

- Tape three to four layers of new black electrical isolation tape across the detector window.
- While taping you will notice that the measuring value decreases.
- Make sure that the detector is absolutely sealed from light sources.

Step 5: Zero point calibration

		Please wait till the measured value is stable. • Press ↵ to confirm.
		Press ▼ or ▲ to change the value and press > to move to the next digit in the displayed value. To select the standard value (e.g. 0.000 NTU) confirm with ↵. The sensor default is 0.020 NTU
		The submenu **calibrate zero? start calib.**is displayed.
		• Press ↵ to start the calibration.
		The message **zero calibration successful** is displayed. • Press ↵ to confirm.
		The actual measured value is displayed.

INFORMATION!
The zero calibration value is allowed to deviate a maximum of 0.4 NTU from 0.0. The sensitivity calibration value is allowed to be within 70-130% of calculated signal strength.

Step 6: Preparing the sensitivity calibration

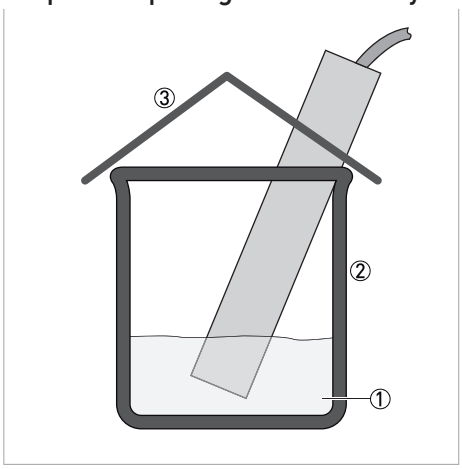


Figure 5-2: Sensitivity calibration

① Standard solution (e.g. 100,00 NTU)
② Dark beaker
③ Opaque cover

- Position the sensor in a cup or bucket out of a material which has little to none light reflecting characteristics.
- Pour in the standard solution making sure that the complete sensor optics is submersed in it.
- The sensor shall not stand vertical, but at a light angle to reduce any influences due to reflection.
- Cover the setup with a cloth to shut out any interfering sun light.

Step 7: Sensitivity calibration

		Please wait till the measured value is stable. • Press ↵ to confirm.
		Press ▼ or ▲ to change the value and press **>** to move to the next digit in the displayed value. To select the standard value (e.g. 100.00 NTU) confirm with ↵.
		The submenu **sensitivity calibration start calib.**is displayed.
		• Press ↵ to start the calibration.
		The message **sensitivity calibration successful** is displayed. • Press ↵ to proceed.
		If **calibration successful** is highlighted, press ↵ several times to save the calibration and to return to main menu level.

INFORMATION!

- *If an error occurs during the calibration procedure, the display shows an error message.*
- *If the calibration was not successful please start again and follow the steps mentioned in this chapter.*
- *If the calibration was unsuccessful refer to Troubleshooting on page 40*

Step 8: switching back to measurement

- Deactivate the function **manual hold** again.
- Install the sensor in the measuring location.

5.2.2 Calibration log

INFORMATION!
In order to show the history of the calibrations, the signal converter has a calibration logbook function. Up to 64 entries of the calibration history are stored including date and time.

Accessing the calibration log

- Press **>** for more than 2.5 seconds, then release the button. You are on the main menu level. In the upper line of the display "A" appears, beneath the main menu **quick setup** is highlighted.
- Press ▼ or ▲ until the main menu **test** is highlighted.

MAIN MENU A quick setup **> B test** C setup D service			
Press **>** to enter the chosen menu.			
	Press ▼ or ▲ until the submenu **logbooks** is highlighted.		
	Press **>** to enter the chosen menu.		
		You are on the second submenu level. In the upper line of the display "logbooks" and "B5/B5.1" appears, beneath the submenu **status log** is highlighted.	
		Press ▼ or ▲ until the submenu **calibration log** and **B5.2** is highlighted.	
		Press **>** to enter the chosen menu.	

- You are on the data level and you see the calibration history. With the help of ▼ or ▲ you can scroll through the different entries.
- If you want to return to the measuring mode press ↵ several times until you reach this mode.

5.2.3 Calibration with PC

In addition to the calibration with converter the device can be calibrated via computer using standard RS485 communication modules and a standard terminal program (such as hyperterminal). For this matter the sensor needs to be powered with 24 VDC (9/36 VDC). Neither communication module nor terminal program are products from **KROHNE**.

Please be aware that the device is factory configured for analog mode operation. After 2 seconds from switching on, the current loop will provide 8 seconds a fixed current value depending of the selected scale. If during this 8 seconds interval digital activity is detected on the RS485 line it will switch to digital communication. Else it will remain in analog operation.

The calibration and programming via PC gives additional possibilities concerning the signal calibration and is straight forward.

5.2.4 Communication protocol

Through the RS485 it is possible to connect the probe to a PC for the data handling and the calibration and the configuration of the probe. It is necessary to use a RS485 / RS232 or RS485 / USB converter. It is possible to use the hyperterminal of a PC.

The protocol is product specific and not a standard protocol.

Standard baud rate 9600.

Transmission mode

Characters	ASCII
Bits per characters	
start bits	1
data bits	8
parity	none
stop bits	1
Errors verifying (just command A)	BCC

Commands format

2 byte for ID (01-32)
1 byte for command
n byte data to insert if required by the command
1 byte <cr> (carriage return), end of the command

The probe responds to the command with the individual ID or 00.

Do not use the ID 00 if the probe is in a network in order to avoid conflicts.

INFORMATION!
The probe do not answer if configured for different baud rate.

5.2.5 Sensor mode options

As factory setting the sensor is configured in analog operating mode (current loop 4...20mA). This is within the programming: digital mode = 0.

Analog mode

After 2 seconds from switching the sensor on, the current will provide for 8 seconds a fixed current value depending of the selected scale:

8 mA for 4.000 NTU scale

12 mA for 40.00 NTU scale

20 mA for 400.0 NTU scale

If during this 8 second interval no activity on the RS485 line is detected the sensor will keep the analog operating mode. If during this 8 second interval activity on the RS485 is detected the sensor will switch to digital operating mode (digital mode=1). In this mode the current value will be 8/12/20 mA depending of the scale and it will increase during transmission. Within the digital mode the operator is able to perform the calibration and to configure the sensor via the RS485 connection. The digital mode will be maintained until the next time the sensor is switched on.

INFORMATION!
Make sure to switch the sensor off and on if you changed the from digital mode =1 to 0 for the analog mode to become effective.

5.3 Commands for operation via RS485

Through the Help command is possible to get a list of commands implemented in the probe

5.3.1 Help

Command Format: ID + H ↵
For example, if ID = 14, type 14H ↵ or 00H ↵
By sending the command 'H' the probe responds with a list of available commands with a brief description

```
------------------------------------------------------------------------
HELP MENU, COMMAND LIST      TUR KROHNE GmbH
------------------------------------------------------------------------
TU8x25 TURBIDITY PROBE 4.000/40.00/400.0 NTU Rev.fw:1.01  S/N:123456

00H  <cr>  Help menu
00A  <cr>  Acquisition
00Mx <cr>  Digital mode:     0000          (0=analog mode 1=digital mode)
00Ox <cr>  Analog out 4/20mA: 0003          (1=4.000 2=40.00 3=400.0 NTU)
00Vx <cr>  Standard zero NTU: 0.020 NTU      (0.000-400.0 NTU)
00Tx <cr>  Standard sens.NTU: 400.0 NTU      (0.000-400.0 NTU)
00Z  <cr>  Zero  calibration: not done   0.0  (0.4 NTU max)(00ZR reset zero)
00S  <cr>  Sens. calibration: not done  100.0% (70-130%)   (00SR reset sens)
00C  <cr>  Check signal cal.: not done  100.0% (50-200%)   (00CR reset check)
00Kx <cr>  Check enable:     0000          (0=off 1=on)
00Fx <cr>  Check fouling:    0010          (0-100%)
00Yx <cr>  Check dry:        0200          (100-200%)
00Dx <cr>  Last cal date:                  (max 8 characters)
00Ix <cr>  ID value:   Actual 0002 Config 0002 (01-32)
00Bx <cr>  Baud rate:  Actual 0003 Config 0003 (1=2400 2=4800 3=9600 4=19200)

Type ID number or 00 before command. Example, if ID=15 type 15A or 00A <cr>
Use 00A <cr> if only one probe is connected
------------------------------------------------------------------------
```

Figure 5-3: Help menu - List of all available commands

5.3.2 Acquisition

Command Format: ID + A ↵
For example, if ID = 14, type 14A ↵ or 00A ↵

By sending the command 'A' (00A), the probe responds by sending a data record containing the code, ID, date, time, and the value of all measurements.

```
TU8x25  2 0.0 01/01/01 00:00:00    0.7NTU   220.0%     19.8øC      10%
200%        2err    34.7%        0err        FF
```

Figure 5-4: Record format

The transmission of the measured parameter followes the format:
Measuring field - Sign of the measurement (if positive it sents one space) - Value of the measurement (6 characters – aligned on the right)

Measurement unit field – Measurement unit of the parameter (4 ch. – aligned on the left) - 1 space (ASCII 32)

± 100.0 NTU	Turbidity value
± 100.0%	Ceck signal value
± 20.0°C	Temperature
± 10%	Check fouling
± 200%	Check dry cell
± 0err	Check error 0=no error, 1= fouling error, 2= dry error
± 36.0%	Average signal generated by the external light
± 0err	Light error 0=no error, 1= external light error

At the end of the record the probe sends the data of the last calibration, than 2 bytes with the BCC.

XX/XX/XX	Last calibrate date
XX:	2 byte BCC

The transmission is ended with a carriage return <cr> and line feed <lf> sequence.

BCC calculation

The BCC is calculated as XOR of all bytes of the message (excluded <cr> and <lf>) and divided in 2 nibble. The 2 nibble are then transformed in ASCII codes.

5.3.3 Digital mode

Command Format: ID + M + x ↵
For example, if ID = 14, and analog out = ppm type 14M1 ↵ or 00M1 ↵

Probe response:	ID + M + x	command executed correctly
Probe response:	none	command does not run properly

The probe can be configured for digital mode (digital mode=1) or analog 4...20 mA (digital mode=0).

INFORMATION!
For this Command and for all the following Commands shown in this manual, the answer of the probe will be a replica of the received Command with <lf> line feed at the beginning and at the end of the answer.

5.3.4 Analog ouput

Command Format: ID + O + x ↵
For example, if ID = 14, and analog out = ppm type 14O1 ↵ or 00O1 ↵

Probe response:	ID + M + x	command executed correctly
Probe response:	none	command does not run properly

The analog output 4...20 mA can be linked to the following scales:
Set the parameter x=1 for the scale 4.000 NTU
x=2 for the scale 40.00 NTU
x=3 for the scale 400.0 NTU

5.3.5 Zero standard setting

Command Format: ID + V + x ↵ For example, if ID = 14, and value of the turbidity standard = 0.02 NTU, type 14T0.02 ↵ or 00T0.02 ↵

Probe response:	ID + V + x	command executed correctly
Probe response:	none	command does not run properly

In order to verify if the inserted value has been accepted, digit the command H

INFORMATION!
We suggest to use zero standards close to zero NTU value even if a small adjustment is possible for high reading values as well.

5.3.6 Sensitivity standard setting

Command Format: ID + T + x ↵
For example, if ID = 14, and value of the turbidity standard = 100 NTU, type 14T100 ↵ or 00T100↵

Probe response:	ID + T + x	command executed correctly
Probe response:	none	command does not run properly

In order to verify if the inserted value has been accepted, digit the command H.

5.3.7 Zero calibration

Command Format: ID + Z ↵
For example, if ID = 14, type 14Z ↵ or 00Z ↵

Probe response:	ID + Z + x	command executed correctly
Probe response:	none	command does not run properly

The zero calibration must be done possibly before the sensitivity calibration and in a zero standard solution.
The standard solution value has to be inserted by following the procedure. For further information refer to *Zero standard setting* on page 35.
The zero calibration is automatically performed in all the scales starting from the lower scale.

In order to verify the zero calibration, send the command ID + A, the reading must be close to Zero standard solution value.

Send the command ID + H to control the line “Zero calibration: ok /error” If the calibration is not performed (error), the probe will maintain the previous zero value.
Verify if the standard solution and check the surface of the lens and eventually clean by using soft tissue / cloth.
The message “Zero calibration: not done” means that the parameter is turned to the default value by means of the command ID + ZR

5.3.8 Zero Reset

Command Format: ID + ZR ↵
For example, if ID = 14, type 14Z ↵ or 00Z ↵

Probe response:	ID + ZR + x	command executed correctly
Probe response:	none	command does not run properly

This command sets zero as default.
Verify the result by means of the command ID + H and check the line “Zero calibration: not done”

5.3.9 Sensitivity calibration

Command Format: ID + S ↵
For example, if ID = 14, type 14S ↵ or 00S ↵

Probe response:	ID + S + x	command executed correctly
Probe response:	none	command does not run properly

This calibration must be done in a Formazine solution or similar standard solution. The standard solution value has to be inserted. For further information refer to *Sensitivity standard setting* on page 36.

The calibration is done on the selected scale and the new sensitivity value will be applied to the other scales as well. Verify the result by means of the command ID + A and check the readout value corresponding to the standard solution value.
Send the command ID + H and check the line “Sens. calibration: ok / error”.

If the error message appears, check if the probe has been fully immersed in the standard solution. Check the surface of the lens and clean with soft tissue / cloth.

In case of error signal the probe will maintain the previous sensitivity value.

The message “Sens. Calibration: not done” means the sensitivity has turned to the default value through the command ID + SR.

5.3.10 Sensitivity reset

Command Format: ID + SR ↵
For example, if ID = 14, type 14S ↵ or 00S ↵

Probe response:	ID + SR + x	command executed correctly
Probe response:	none	command does not run properly

The Command turn the sensitivity to the default 100% value.
Verify the result by means of the command ID + H and check the line “Sens. calibration: not done”

5.3.11 Check signal calibration

Command Format: ID + C ↵
For example, if ID = 14, type 14S ↵ or 00S ↵

Probe response:	ID + C + x	command executed correctly
Probe response:	none	command does not run properly

This function is for check signal calibration at 100%.
Verify the lens surface and the air bubble absence first, eventually clean by using a soft tissue / cloth.
The “Check signal cal.: not done” message will mean the parameter is turned to the default value through the Command ID + CR

5.3.12 Check signal reset

Command Format: ID + CR ↵
For example, if ID = 14, type 14CR ↵ or 00CR ↵

Probe response:	ID + CR + x	command executed correctly
Probe response:	none	command does not run properly

This function is for turning the check signal to the default value 100%.
The “Check signal cal.: not done” message will mean the parameter is turned to the default value through the Command ID + H

5.3.13 Check enable

Command Format: ID + K + x ↵
For example, if ID = 14, type 14K1 ↵ or 00K1 ↵

Probe response:	ID + K + x	command executed correctly
Probe response:	none	command does not run properly

The enable check signal allow to have information about:

- dirty or damaged lens surfaces
- the probe is not well immersed into the sample or air bubbles close to the lens
- the ambient light is too high to saturate the turbidity signal.

In the analog operating mode the violation of the fouling or dry alarm limits or the high external light is signaled by the current loop flashing at 3.80 mA and 21.0 mA every 16 seconds. The sequence is ended when all the alarm condition are not present.

5.3.14 Check fouling

Command Format: ID + F + x ↵ For example, if ID = 14, and we need to set the alarm for dirty cell to 10% of the check signal, type 14F10 ↵ or 00F10 ↵

Probe response:	ID + F + x	command executed correctly
Probe response:	none	command does not run properly

The Command is for setting the alarm limit of the dirty or damaged lens surface.

The Command sets the alarm limit of the dirty or damaged lens surface.

5.3.15 Check dry

Command Format: ID + Y + x ↵
For example, if ID = 14, and we need to set the alarm for dry cell to 150 % of the check signal, type 14Y150 ↵ or 00Y150 ↵

Probe response:	ID + Y + x	command executed correctly
Probe response:	none	command does not run properly

The Command is for setting the alarm limit of the dry cell or air bubble presence near the lens.

5.3.16 Last calibration date

Command Format: ID + D + cccccccc ↵
For example, if ID = 14, and we need to set the date 13/11/10, type 14D13/11/10 ↵ or 00D13/11/10 ↵

Probe response:	ID + D + cccccccc	command executed correctly
Probe response:	none	command does not run properly

The Command is for memorising the last calibration date.
The operator can use the 8 characters as he likes better (no syntaxes limitation).

5.3.17 ID value

Command Format: ID + I + x ↵
For example, if ID = 14, and we need to set the ID at 07, type 14I07 ↵ or 00I07 ↵

Probe response:	ID + I + x	command executed correctly
Probe response:	none	command does not run properly

The new ID will be available from the next start up of the probe.

5.3.18 Baud rate

Command Format: ID + B + x ↵
For example, if ID = 14, and we need to set the speed 2=4800 baud, type 14B2 ↵ or 00B2 ↵

Probe response:	ID + B + x	command executed correctly
Probe response:	none	command does not run properly

The new baud rate will be available from the next switching on of the probe.

5.4 Troubleshooting

Problem	Possible cause	Remedy
No values are displayed	No power supply available or sensor cable not connected.	Check electrical connection
No sensor reaction	Deposits on the measurement element	Clean the measurement window of the sensor
	Window is damaged	Calibrate and if outside of specification, replace the sensor and send to manufacturer for repair
Indicated values are too high	Deposits on the window	Clean the measurement window, verifiy and in case of need recalibrate
	Window is damaged	Calibrate and if outside of specification, replace the sensor and send to manufacturer for repair
Indicated values fluctuate	Entrained air/air bubbles	Install a bubble trap upstream of measurement or move measurement location by a few centimeters
Sensor reads zero where it should not	Measurement windows totally covered so that no scattered light come back	Clean the sensor
Sensor does read too high in a 1 NTU standard	Reflection from cup used	Use different bucket, tilt sensor at an angle and cover cup/bucket
No connection between PC and sensor within 8 seconds	Terminal program was connected before sensor	Power up sensor and connect terminal program
Sensor does not answer via RS485 but is connected the correct way (2400/4800/9600 or 19200 bits)	Baud rate programmed wrong	Try with different baud rate
Dry error on signal converter or via RS485	The sensor is not well immersed into the sample	Put the sensor into the water
	Air bubbles are trapped on the lense	Check the mounting position
Foul error on signal converter or via RS485	Dirty or damaged lens surface	Clean the sensor
External light error on signal converter or via RS485	The ambient light is too high to saturate the turbidity signal	Install the sensor that less light can be reflected into the measurement window

5.5 Function tables

Measurement setting	Setting options or allowed values	Default value
Possibles scales	0.000...4.000 / 40.00 / 400.0 NTU	400.0 NTU
Zero adjustment	± 0.400 NTU on all scales	0 NTU
Sensitivity adjusement	70...130%	100%
Zero standard solution	0.000...400.0 NTU	0.020 NTU
Sensitivity standard solution	0.000...400.0 NTU	400.0 NTU

Measurement setting	Setting options or allowed values	Default value

Current loop settings

Scale ID (analog mode)	scale 4.000 NTU	8 mA switched on for 8 seconds
	scale 40.00 NTU	12 mA switched on for 8 seconds
	scale 400.0 NTU	20 mA switched on for 8 seconds
Alarm sequence (analog mode)	loop at 3.80 mA for 16 seconds	
	loop at 21.0 mA for 16 seconds	
Alarm signals (digital mode)	Check error: 0err 0=no error, 1 = fouling error, 2 = dry error	
	Light error: 0err 0=no error, 1 = external light error	
Check signals		
Scale	0.0%...200.0%	
Over range	220%	
Sensitivity	50.0...200.0%	100%
Alarm from check signal and if external light too high	On / Off	On
Min. alarm (fouling or LED damage)	0.0%...100.0%	10.0%
Max alarm (dry cell)	100.0%...200.0%	200.0%
Alarm indications	Analog mode: loop sequence 3.80 mA and 21.0 mA	
	Digital mode: check error command "A"	

Temperature

Internal sensor	Pt100 for optical efficiency	

External light evaluation

Scale	0.0...100.0%	
Alarm	On / Off	On

Serial interface

Interface	RS485 not terminated Isolated from the sample Not isolated from the loop power supply	
Distance	1000 / 500 / 250 / 125 meter	
Baud rate	2400 / 4800 / 9600 bits	9600 bit
Probes in network	up to 32	
Protocol	ASCII	

Power supply

Voltage	8...36 VDC	
Current	22 mA max.	

6.1 Maintenance

6.1.1 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.

6.1.2 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.

6.1.3 Cleaning

- Dirt deposits on the measurement window may lead to erroneous results.
- Rinse the device thoroughly with tap water and only use a soft tissue to carefully remove deposits from the measurement window.
- The sensor housing may be cleaned by scrubbing it with a suitable brush. Make sure you do not touch or scratch the measurement window.

6.1.4 Recalibration

It is recommended to check the sensor in regular intervals. For this use a turbidity standard and verify the sensor. In case of the sensor is not reaching the standard stated value within 5% do a calibration. For further information refer to *Calibration* on page 26.

INFORMATION!
The life time expectation of the sensor depends heavily on the application and if something that might scratch the measurement window or something chemical aggressive is in the water (medium) to be monitored.

6.2 Returning the device to the manufacturer

6.2.1 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.*

6.2.2 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:		

6.3 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

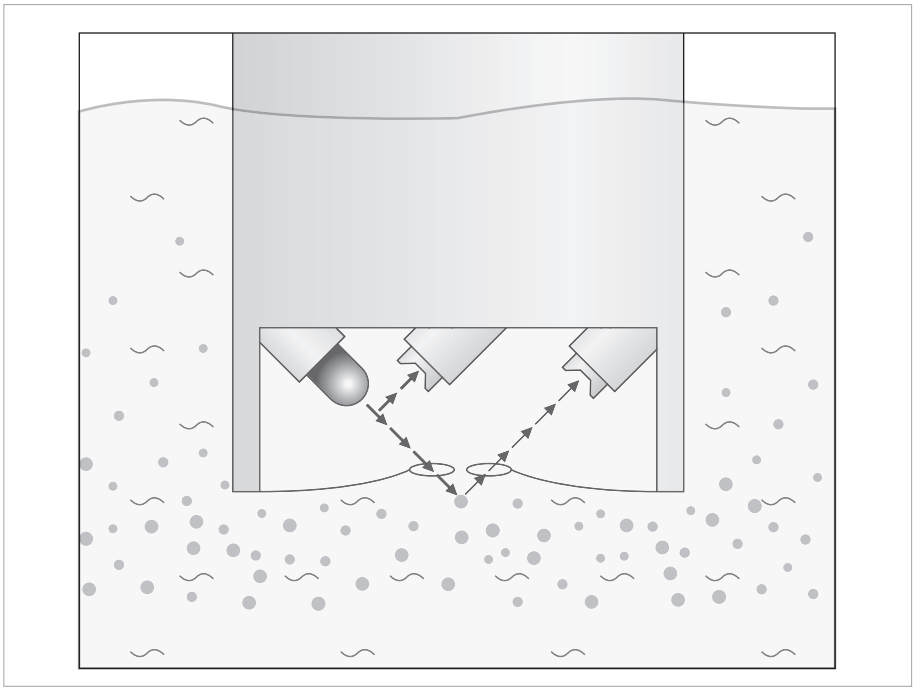


Figure 7-1: Measuring principle for turbidity measurement

Turbidity is an optical property of water based on the amount of light scattered and absorped by collodial and suspended particles. The turbidity value measured in FNU, FTU, NTU etc. is the quantitative statement of this qualitative phenomenon.
The goal of measuring turbidity is to get an indication for the concentration of scattering particles in a medium. This can be done by determination of the light loss of the transmitted beam or the measurement of the light scattered sideways. Both methods deliver proportional data to particle concentration and are therefore suitable for measuring turbidity. They however differ in application and concentration levels. Scattered light measurement principle is more suitable for the detection of lower concentrations, while transmission (reflection or absorption) measurement is used for higher concentrations.

The device measures scatted light at 90° which is according to ISO 7027 / DIN EN 27027 to be used for turbidity values below 40 NTU.The NIR 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 detector and into the medium. Light is scattered from the particles and the portion which is scattered at a 90° angle is received by the detector. The meter now compares the light from the reference detector and scattered light receiver and calculates the turbidity value.

The measurement unit for the turbidity measured at a 90° angle varies depending on country in and is according to ISO 7027 Formazine Nephelometric Unit (FNU), but the more commonly used terminology is Nephelometric Turbidity Unit (NTU) stated within the US EPA 180.1. Both units compare 1 to 1.

The advantage of the using NIR as light source as stated in the ISO 7027 is that this sensor is not affected by colour of the medium measured.

7.2 Technical data

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

Parameter	Turbidity
Measuring principle	90° scattered light

Design

Measuring principle	Nephelometric
Measuring scale	0...4.000 NTU / FNU
	0...40.00 NTU / FNU
	0...400.0 NTU / FNU (default)
Sensitivity NTU	70...130% NTU
Zero NTU	± 0.400 NTU all scales
Sensor type	Installation with MAC 100 signal converter or directly to control system via 4...20 mA
Shaft diameter	60 mm / 2.36"
Shaft length	166 mm / 6.5"
Sensor thread	2" NPT
Hose diameter	6.3...9.5 mm / 1/4...3/8"

Operating conditions

Temperature range	-5...50°C / +23...122°F
Pressure range	Max. 1 bar at 25°C / 14.5 psi at 77°F
Measuring range	< 1% of end of measurement scale
Response time	t_{90} < 120 seconds (small signal < 3%fs), < 40 seconds (high signal > 3%fs)
Measuring cycle	2 seconds
Relative humidity	0...95% non condensing
Air pressure cleaning	max. 3 bar / 43.51 psi
Units displayed sensor	NTU (= FNU)

Installation conditions

Ingress conditions	IP68
Weight	Body 420 g / 0.93 lb 10 meter cable 760 g / 1.41 lb

Materials

Sensor body	PVC

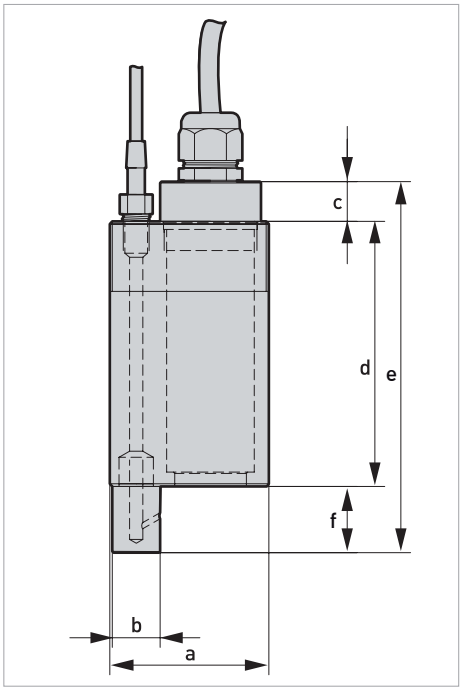
Electrical connection

Cable	10 meter / 32.8 ft. 20 meter / 65.62 ft. 30 meter / 98.43 ft.
Voltage	9...36 VDC
Analog output	4...20 mA loop powered isolated
Load	600 Ohm max. at 24 VDC
Digital output	RS485

Approvals and certifications

CE	This device fulfils the statutory requirements of the EC directive. The manufacturer certifies successful testing of the product by applying the CE mark.
Electromagnetic compatibility	EMC Directive 2004/108/EC (valid until 2016/04/19) or EMC Directive 2014/30/EU (valid from 2016/04/20) EN 61326-2-3:2013 EN 55011:2009+A1:2010

7.3 Dimensions and weight



	Dimensions [mm]	Dimensions [inch]
a	60	2,4
b	18	0,71
c	15	0,6
d	100	3,94
e	140	5,51
f	25	0,98

KROHNE – Process instrumentation and measurement solutions

- Flow
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- Process Analysis
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