



OPTISENS TSS 3000 Handbook

Suspended solid sensor

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

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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 TSS 3000 sensors is the continuous on-line monitoring of suspended solids in industrial and municipal water and wastewater treatment plants, mining and refining operations. The sensor is suitable for connection to the MAC 300 signal converter.

1.2 Certifications

CE marking



The device meets the essential requirements of the EU directives. The CE marking indicates the conformity of the product with the union legislation applying to the product and providing for CE marking.

For full information of the EU directives and standards and the approved certifications, please refer to the EU declaration on the KROHNE website

1.3 Safety instructions from the manufacturer

1.3.1 Copyright and data protection

The contents of this document have been created with great care. Nevertheless, we provide no guarantee that the contents are correct, complete or up-to-date.

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

The manufacturer tries always to observe the copyrights of others, and to draw on works created in-house or works in the public domain.

The collection of personal data (such as names, street addresses or e-mail addresses) in the manufacturer's documents is always on a voluntary basis whenever possible. Whenever feasible, it is always possible to make use of the offerings and services without providing any personal data.

We draw your attention to the fact that data transmission over the Internet (e.g. when communicating by e-mail) may involve gaps in security. It is not possible to protect such data completely against access by third parties.

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

1.3.2 Disclaimer

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

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

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

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

1.3.3 Product liability and warranty

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

1.3.4 Information concerning the documentation

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

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

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

1.3.5 Warnings and symbols used

Safety warnings are indicated by the following symbols.



DANGER!

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



DANGER!

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



DANGER!

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



DANGER!

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



WARNING!

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



CAUTION!

Disregarding these instructions can result in damage to the device or to parts of the operator's plant.



INFORMATION!

These instructions contain important information for the handling of the device.



LEGAL NOTICE!

This note contains information on statutory directives and standards.



• **HANDLING**

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

➔ **RESULT**

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

1.4 Safety instructions for the operator



WARNING!

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

2.1 Scope of delivery

**INFORMATION!**

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

**INFORMATION!**

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

**INFORMATION!**

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

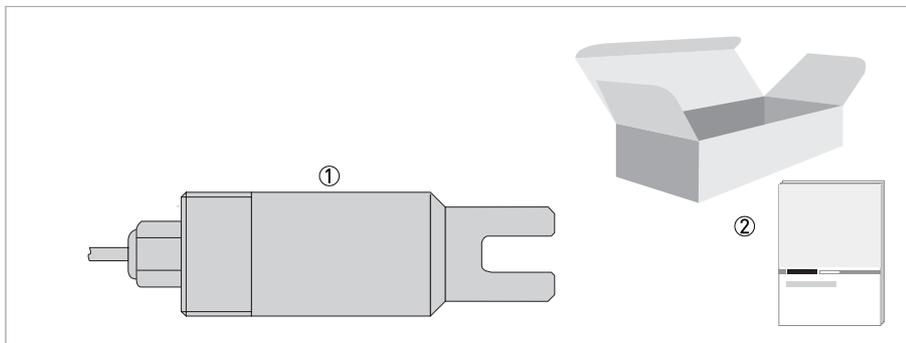


Figure 2-1: Standard scope of delivery

- ① Ordered sensor
- ② Documentation

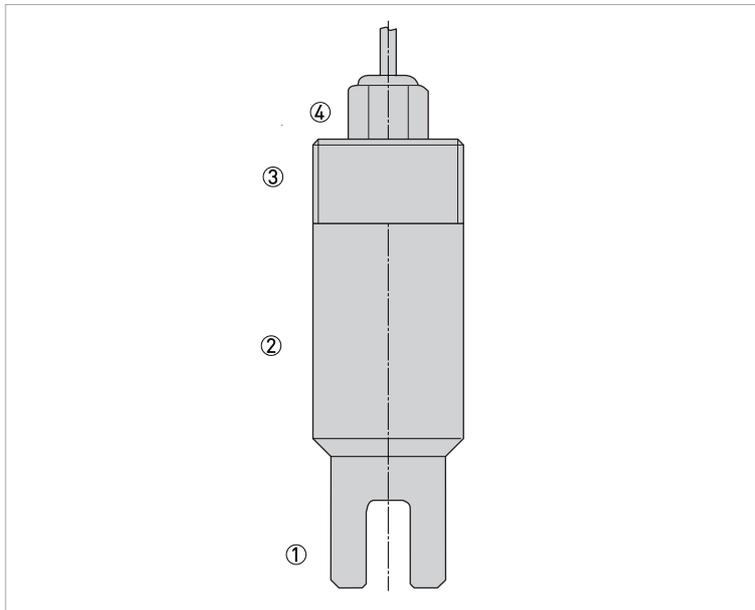
Optional accessories

- SENSOFIT IMM 2000 - Immersion assembly

**INFORMATION!**

For further information contact your local sales office.

2.2 Device description



- ① 2x LED pins, 2x detector pins
- ② PP - Polypropylene body
- ③ 1 1/4" NPT
- ④ 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.

Nameplate

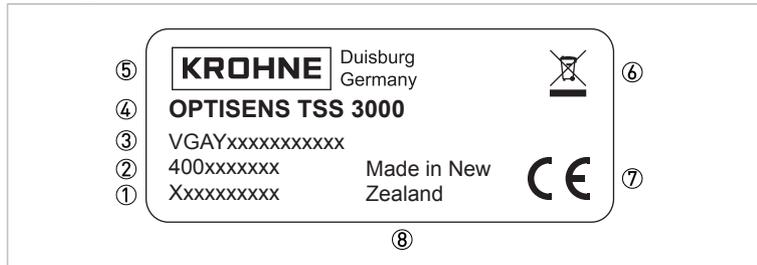


Figure 2-2: Example for a nameplate

- ① Serial number
- ② Article number
- ③ Order code
- ④ Device name
- ⑤ Manufacturer
- ⑥ Electronic/electric device waste marking (WEEE dustbin symbol)
- ⑦ CE marking
- ⑧ 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



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 sensor tip must always have full contact with water.

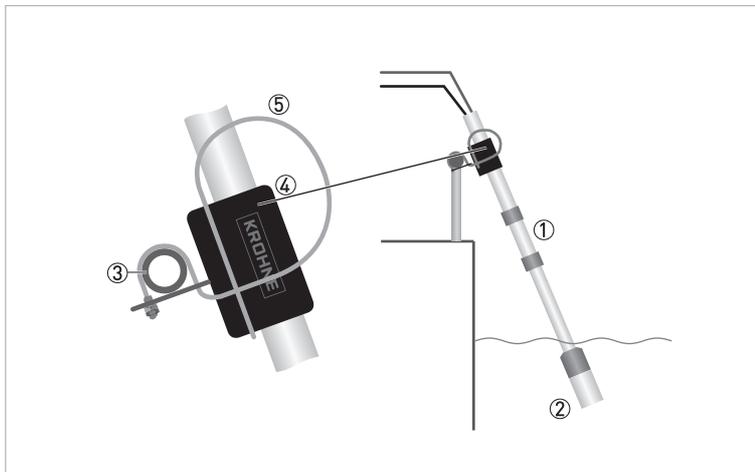


Figure 3-1: Optimal mounting position

- 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.

Keep a free zone around the sensor tip: All sensors have a "Keep Clear" zone that has to be maintained free from objects, walls and floors. The zone is of a spherical shape with a recommended minimum radius of 50 mm (2") for insertion installation and 75 mm (3") if immersion installation is applied. Also avoid having reflective material near the "Keep clear" zone, presence of such material will cause fluctuations in the sensor reading.

Pipe installation: The minimum pipe diameter is 75 mm (3") for the 10 mm and 20 mm sensor versions and 100 mm (4") is recommended for the 40 mm sensor version. Make sure to install the sensor in such a way that it does not see entrained air due to turbulences as this can influence the output signal of the sensor making it unpredictable. Work to ensure the chance of entrained air is eliminated. For this reason it is recommend that the sensor should be mounted in a straight pipe where there is 10 pipe diameters upstream and 5 pipe diameters downstream that are free from valves and bends.

It is preferable that the sensor is installed at a location where the flow is upwards. This ensures that the pipe is always full. A downwards flow is not recommended as the solution would have some turbulence which would result in an unstable reading. 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. The sensor should not be installed at the top as the pipe may not always be full. The bottom is avoided as it could have dirt or higher than normal concentration of solids.

To assist in sensor cleaning by the flow of the solution, the sensor can be mounted at a 80° angle to the pipe with flow direction (not against). A sample line should be added after the sensor. It should not be at the same point as the sensor or immediately before it.

For Immersion sensors the pipe neck is terminated with a flange. A matting flange with a 1 1/4" NPT (female) thread should be used to hold the sensor. This installation should not be used in hygienic applications.

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 requires the external signal converter MAC 300 for setup, calibration and operation.

A complete measuring point consists of at least three parts:

- MAC 300 signal converter
- OPTISENS TSS 3000 sensor
- Immersion assembly or other adequate housing

3.5 Installation procedure

The 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. Connect the sensor to the signal converter.
2. Calibrate the sensor.
3. Mount the sensor into the immersion assembly. (For further information refer to the manual of the assembly.)
4. Install the sensor into its final measuring location.

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 Connecting the power supply to the signal converter MAC 300



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 ($I_{nom} \leq 16 \text{ A}$) 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.
Universal 80-265 V AC or DC, 15 W max.
Low voltage option 18– 32 V AC or DC, 20 W max.
- Assure that the protective earth conductor (PE) is longer than the L- and N-conductor.

Wall mount (85-265V AC/DC)

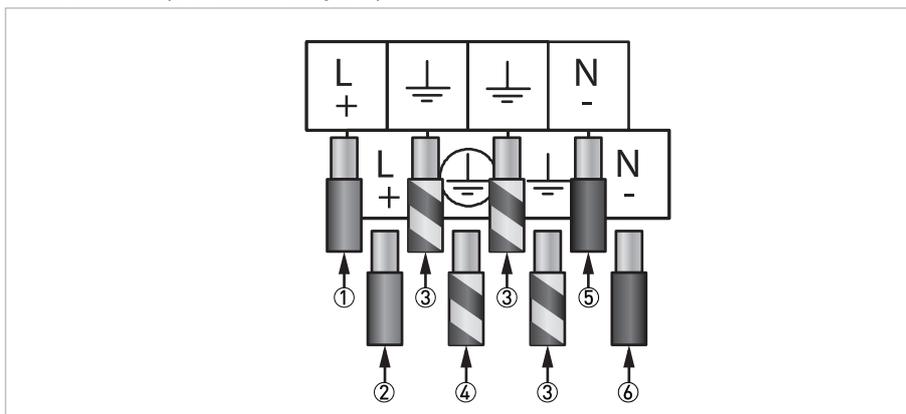


Figure 4-1: Power connector MAC 300 W

- ① Power supply "Live" out (for daisy chaining)
- ② Power supply "Live" in
- ③ Earth
- ④ Protective Earth (Must be connected)
- ⑤ Power supply "Neutral" out (for daisy chaining)
- ⑥ Power supply "Neutral" in

Wall mount (18-32V AC/DC)

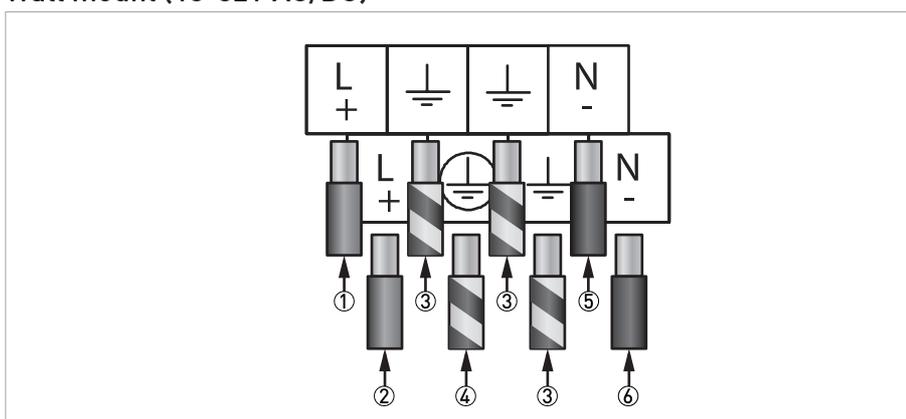


Figure 4-2: Power connector MAC 300 W

- ① Power supply "+" out (for daisy chaining)
- ② Power supply "+" in
- ③ Earth
- ④ Protective earth (Must be connected)
- ⑤ Power supply "-" out (for daisy chaining)
- ⑥ Power supply "-" in

Rack mount (85-265V AC/DC)

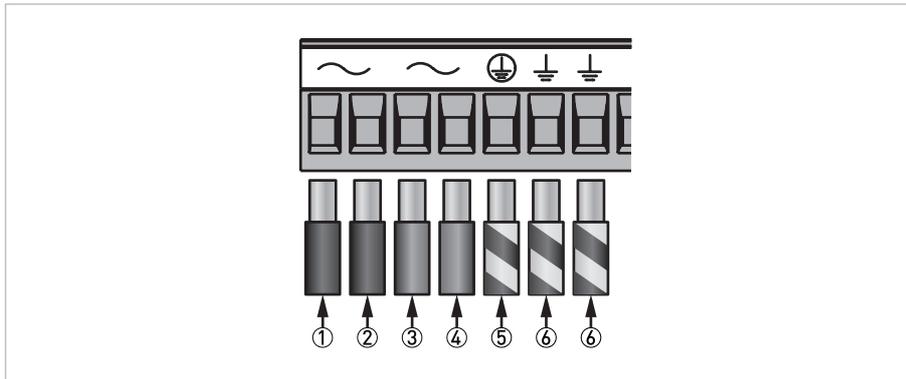


Figure 4-3: Main power connector MAC 300 R

- ① Power supply "Live" in
- ② Power supply "Live" out (for daisy chaining)
- ③ Power supply "Neutral" in
- ④ Power supply "Neutral" out (for daisy chaining)
- ⑤ Protective earth (must be connected)
- ⑥ Earth

Rack mount (18-32V AC/DC)

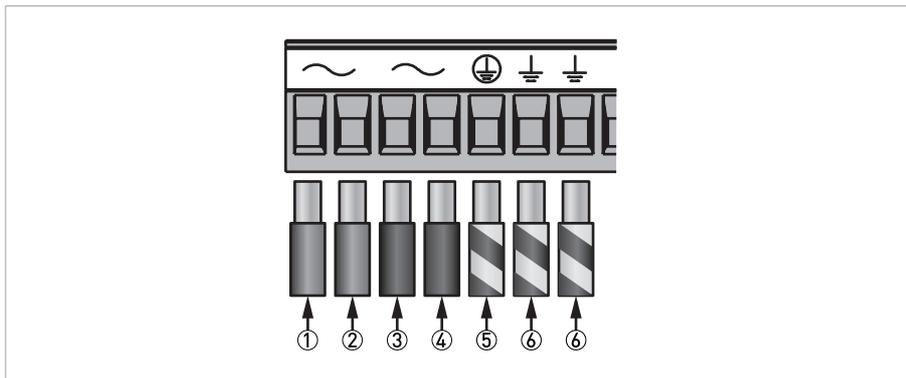


Figure 4-4: Main power connector MAC 300 R

- ① Power supply "+" in
- ② Power supply "+" out (for daisy chaining)
- ③ Power supply "-" in
- ④ Power supply "-" out (for daisy chaining)
- ⑤ Protective earth
- ⑥ Earth



INFORMATION!

To prevent destruction or damage, never operate the device outside of its permissible mechanical, thermal or chemical limits.

The power supply should be taken from an isolated spur and fused to a maximum of 3 Amps. If the relays require greater current, then a separate 5A fuse will be required. The incoming earth connection must be connected to the "Protective Earth" terminal.

5.1 Menu overview



INFORMATION!

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

When the instrument is switched on it will complete a configuration check that will take approximately 20 seconds after this it will default to the front screen. The user interface is arranged in two ways, the first is a quick configuration overview which is accessible by scrolling left or right from the front screen.

↔	4...20 mA OUTPUTS SETUP	↔	DIGITAL INPUTS SETUP	↔	ERROR MESSAGES	↔	Front screen	↔
↔	CURRENT OUTPUT BARGRAPH	↔	LIVE TRENDS 1,2&3	↔	CHANNELS SETUP	↔	SETPOINT / RELAYS SETUP	↔

The second menu is accessible by pressing the menu button on the front screen. This brings up the main menu from which the user can access the instruments settings.

Within the Front Screen modus press the "MENU" Button to enter the "MAIN MENU".

Menu overview

Main menu	Submenu	Parameter
CHANNELS	← CHANNEL 1 → SUSPENDED SOLIDS	← For further information see function tables.
	CALCULATION 1	
	CALCULATION 2	
	SIMULATE CHANNELS	
CALIBRATION	CHANNEL 1 → SUSPENDED SOLIDS	
	4...20 mA OUTPUTS	
	RESET USER CALIBRATION	
SETPOINT / RELAYS	SETPOINT 1 → DISABLED	
	SETPOINT 2 → DISABLED	
4...20 mA OUTPUTS	4...20 mA OP A → DISABLED	
DIGITAL INPUTS	DIG IP 1 → DISABLED	
	DIG IP 2 → DISABLED	
	DIG IP 3 → DISABLED	
	DIG IP 4 → DISABLED	
	DIG IP 5 → DISABLED	
CONFIGURATION	LANGUAGE	
	TIME / DATE	
	SETUP FRONT SCREEN	
	SETUP MENU HEADER	
	SERVICE ALARMS	
	CHANGE DISPLAY CONTRAST	
	SOFTWARE STATUS	
	UNLOCK SOFTWARE	
	UPDATE SOFTWARE	
	FORMAT SD CARD	
ACCESS CODE MANAGEMENT	CHANGE USER ACCESS CODE	
SAVE / RESTORE	SAVE SETUP	
	RESTORE SAVED SETUP	
	DELETE SAVED SETUP	
	RESET SETUP	
ERRORS	UNIT ERRORS	
	NO ERRORS	
↓↑	↓↑	↓↑

The main menu is split into two main sections. The top shows the current time & date, the unit status and the instrument's current readings. The bottom section shows the current options for that menu which may be selected by moving the cursor with the arrow buttons and pressing the enter button. The exit button is used to return to the previous menu or alternatively if held down for 3 seconds will take the instrument straight back to the front screen. If no buttons are pressed after 2 minutes the instrument will default back to the front screen. To the right of the menu screen arrows will indicate if there are further menu pages above or below the current one.

When changing a setting an option pop-up will appear from which the user can select an option or alternatively enter in a value. When looking at a list of options an arrow in the top right or bottom right corner of the pop-up indicates further options above or below the ones currently shown.

Security access pop-up

To protect the instrument setup from unauthorised or accidental tampering, a security access code system is present. This is implemented via the instruments' menu system which operates in two modes, "locked" as indicated by a padlock symbol and "unlocked" as indicated by a key symbol.

The default Access Code is: 1000

5.2 Function tables - Parameter TSS

Depending on the submenu the Security code is queried. The standard code is 1000. Function tables will vary depending on installed measurement card and the measured parameter.

Menu - Channels

Menu	Submenu	Sub-Submenu
CHANNELS ↓ CHANNEL 1 → SUSPENDED SOLIDS	← ENABLED	← YES or NO
	MODE	ON-LINE or OFF-LINE
	UNITS	NTU, FNU mg/l, g/l ppt, ppm EBC,OD % PS (Sensor Signal)
	RANGE	9.999 99.99 999.9 9999
	LINEARISATION SOURCE	CURVE A CURVE B
	SETUP CURVE A	NUMBER OF POINTS: 1-10 SETUP ALL POINTS: enter the concentration for each calibration point
	INPUT FILTER	OUT 1 SEC 2 SEC 4 SEC 8 SEC 16 SEC 32 SEC
CALCULATION 1	CALCULATION 1:	OFF or ON
CALCULATION 2	CALCULATION 2:	OFF or ON
SIMULATE CHANNELS	ENTER ACCESS CODE with the help of ↑ or ↓	

Menu - Calibration

Menu	Submenu	Submenu
CALIBRATION ↓ CHANNEL 1 → SUSPENDED SOLIDS 4-20 mA OUTPUTS RESET USER CALIBRATION	← MODE:	← ON-LINE or OFF-LINE
		Adjust the value with the help of ↑ or ↓
		Adjust the value with the help of ↑ or ↓
		History of the channel is listed
		YES or NO
		YES or NO
		Adjust the value with the help of ↑ or ↓
		RESET SS CAL: YES or NO
		4-20 mA OUTPUT A: YES or NO ALL 4-20 mA OUTPUTS: YES or NO
		YES or NO
	← SENSOR ZERO ADJ:	
	← SENSOR SPAN ADJ:	
	← CALIBRATION HISTORY:	
	← FRONT CAL ACCESS:	
	← CALIBRATION REMINDER:	
	← 4-20 mA OUTPUT A	
	← RESET CHANNEL 1 → CALIB: [SS]	
	← RESET 4-20 mA OUTPUTS	
	← RESET ENTIRE UNIT	

Menu - Setpoint / Relays

Menu	Submenu	Submenu
SETPOINT / RELAYS ↓ SETPOINT 1 → DISABLED SETPOINT 2 → DISABLED	← CHANNEL: DISABLED	← DISABLED CHANNEL 1 (SS) UNIT ALARM

Menu - 4-20 mA Outputs

Menu	Submenu	Submenu
4-20 mA OUTPUTS ↓ 4...20 mA OP A → DISABLED	← CHANNEL: DISABLED	← DISABLED CHANNEL 1 (SS) CALCULATION 1

Menu - Digital inputs

Menu	Submenu	Submenu
DIGITAL INPUTS ↓ DIG IP 1 → DISABLED DIG IP 2 → DISABLED DIG IP 3 → DISABLED DIG IP 4 → DISABLED DIG IP 5 → DISABLED DIG IP 6 → DISABLED DIG IP 7 → DISABLED DIG IP 8 → DISABLED	← For example CHANNEL 1 → SUSPENDED SOLIDS	← DISABLED CHANNEL 1 (SS) WHOLE UNIT

Menu - Configuration

Menu	Submenu	Submenu	Submenu
CONFIGURATION ↓ LANGUAGE	← ENGLISH FRANCAIS ESPAÑOL ITALIANO	← Adjust the value with the help of ↑ or ↓	←
TIME / DATE	SET TIME:	Adjust the value with the help of ↑ or ↓	
	SET DATE:	Adjust the value with the help of ↑ or ↓	
	DAYLIGHT SAVING	ENABLED or DISABLED	
	DST START DATE	LAST SUN MAR	
	DST START TIME:	Adjust the value with the help of ↑ or ↓	
	DST END DATE	LAST SUN OCT	
	DST END TIME:	Adjust the value with the help of ↑ or ↓	
SETUP FRONT SCREEN	For example CHANNEL 1 → SUSPENDED SOLIDS CALCULATION 1	CHANNEL SHOWN: YES or NO	YES or NO
		i) PROBE SIGNAL or CLEAR	i) CLEAR or PROBE SIGNAL
		ii) PROBE SIGNAL or CLEAR	ii) CLEAR or PROBE SIGNAL
		CHANNEL LABEL: Adjust the value with the help of ↑ or ↓	CHANNEL LABEL: Adjust the value with the help of ↑ or ↓
SETUP MENU HEADER	i) ii) iii) iv) v) vi)	CLEAR CH1 READING CAL CALCULATION 1 CH1 PS	
SERVICE ALARMS	For example CHANNEL 1 → SUSPENDED SOLIDS	SERVICE REMINDER:	ENTER ACCESS CODE with the help of ↑ or ↓
CHANGE DISPLAY CONTRAST	Adjust the value with the help of ↑ or ↓		
SOFTWARE STATUS	Overview Status of SOFTWARE VERSION: BASE UNIT SERIAL NO: CHANNEL 1 SERIAL NO: CHANNEL 2 SERIAL NO: CHANNEL 3 SERIAL NO: OUTPUT CARD SERIAL NO:		

Menu	Submenu	Submenu
UNLOCK SOFTWARE	DATA LOGGING:	ENTER UNLOCK CODE
UPDATE SOFTWARE	START UPDATE:	START SD card is necessary
FORMAT SD CARD	FORMAT SD CARD:	START SD card is necessary

Menu - Access code management

Menu	Submenu	Security Code
ACCESS CODE MANAGEMENT	← CHANGE USER ACCESS CODE	← ENTER NEW USER ACCESS CODE with the help of ↑ or ↓
		← YES or NO

Menu - Save / Restore

Menu	Submenu	Submenu	Submenu
SAVE / RESTORE	← SAVE SETUP	← For example CHANNEL 1 → SUSPENDED SOLIDS	← SAVE A SAVE B SD CARD A SD CARD B SD CARD C SD CARD D SD CARD E SD CARD F SD CARD G SD CARD H
		ENTIRE UNIT	
	RESTORE SAVED SETUP	For example CHANNEL 1 → SUSPENDED SOLIDS	RESTORE A RESTORE B SD CARD A SD CARD B SD CARD C SD CARD D SD CARD E SD CARD F SD CARD G SD CARD H
		ENTIRE UNIT	
	DELETE SAVED SETUP	For example CHANNEL 1 → SUSPENDED SOLIDS	SAVE A SAVE B SD CARD A SD CARD B SD CARD C SD CARD D SD CARD E SD CARD F SD CARD G SD CARD H
		ENTIRE UNIT	
	RESET SETUP	For example CHANNEL 1 → SUSPENDED SOLIDS	Confirm the Reset with YES or NO
		RESET WHOLE UNIT	

Menu - Errors

Menu	Submenu
ERRORS	← UNIT ERRORS
	← NO ERRORS
	← Press HELP and read the following text
	← Press HELP and read the following text

5.3 Linearisation

With many solutions the rate of infrared absorption is non linear as the solids concentration increases. The purpose of this function is to take the probe signal values from several samples and convert this non-linearity to a straight line output. In many cases this is the only calibration procedure required.

It is recommended that the user should first prepare or obtain from the process a sample, which is as close as possible to the maximum range of suspended solids for which the instrument is to be configured. This will be your 100% point. For a two point linearisation curve the lower point is usually water. Where you want to enter more than two points, dilute your process sample to correspond with, for example, 25%, 50% and 75%. Up to 10 points can be entered, with the more points that are used the more precise the conversion will be.

The MAC 300 provides two methods, automatic and manual, for entering the curve data into the instrument.

Automatic Curve Entry

Automatic Curve Entry allows the user to set the number of points used in the curve. Then for each point define the engineering value and equate it to a live reading taken from the sensor placed in the desired sample. Note that the points can be sampled in any order as they are sorted into ascending probe signal values from within the software.

<ul style="list-style-type: none"> You are on the main menu level. CHANNELS is highlighted. Press ← to enter the chosen menu.
CHANNELS SETUP 1,2 or 3 --> SUSPENDED SOLIDS
Press ↓ or ↑ until the submenu SETUP CURVE A is highlighted.
<ul style="list-style-type: none"> Press ← to enter the chosen menu.
Enter the access code with the help of ↓ or ↑ . The default security access code is 1000 Press ← to enter the chosen menu.
SETUP CURVE A
Number of points <ul style="list-style-type: none"> Press ↓ or ↑ until the submenu NUMBER OF POINTS is highlighted. Press ← to enter. Press ↓ or ↑ to adjust the numbers. Press ← to enter.
Setup all points <ul style="list-style-type: none"> Press ↓ or ↑ until the submenu SETUP ALL POINTS: is highlighted. Press AUTO to start the automatic linearisation routine and setup all curve points. After each point has been set the instrument will sample the sensor and store the observed reading as the equivalent sensor value for that point. Once this value has been stored the instrument will automatically proceed to the next point to be entered.
Setup curve point <ul style="list-style-type: none"> Press ↓ or ↑ to enter the equivalent engineering value for this point. Units and scale depend upon the settings in the channel setup menu. The sensor must be placed in the required sample before pressing the enter button. Press ← to confirm. Automatically the setup curve point 2 can adjust. Up to 10 points can be set. Press EXIT several times to return to the measuring mode.

Manual curve entry

Manual Curve Entry also allows the user to set the number of points used in the curve. Then for each point the user can define the engineering value and then equate it to a known probe reading previously obtained. Note that the points can be entered in any order as they are sorted into ascending probe signal values from within the software.

If no data is present as the first indication, the "Probe signal Guide" data provided with the sensor can be used. The "Probe Signal Guide" states 5 specific PS values (probe signal values) for: water, milk/water (50/50), milk, milk/cream (50/50) and milk/cream (40/60).

<ul style="list-style-type: none"> You are on the main menu level. CHANNELS is highlighted. Press ← to enter the chosen menu.
CHANNELS SETUP 1,2 or 3 --> SUSPENDED SOLIDS
Press ↓ or ↑ until the submenu SETUP CURVE A is highlighted.
<ul style="list-style-type: none"> Press ← to enter the chosen menu.
Enter the access code with the help of ↓ or ↑ . The default security access code is 1000 Press ← to enter the chosen menu.
SETUP CURVE A
Number of points <ul style="list-style-type: none"> Press ↓ or ↑ until the submenu NUMBER OF POINTS is highlighted. Press ← to enter. Press ↓ or ↑ to adjust the numbers. Press ← to enter.
Manually setup individual curve point <ul style="list-style-type: none"> Press ↓ or ↑ until the 1.Point 1 is highlighted. Press AUTO to start the automatic linearisation routine for this point. Press MAN to start the manual linearisation routine for this point.
Enter curve point data <ul style="list-style-type: none"> Press ↓ or ↑ to enter the equivalent engineering value for this point. Units and scale depend upon the settings in the channel setup menu. The sensor must be placed in the required sample before pressing the enter button. Press ← to confirm. After entering the engineering value the instrument will automatically ask for the equivalent probe reading to be manually entered. Press ← to confirm. Press EXIT several times to return to the measuring mode.

5.4 Calibration



INFORMATION!

Observe the linearisation before you start with the calibration. The calibration may not be used as curve setup (linearization). Calibration is an adjustment of the declared suspended solids curve.

When trying to calibrate an instrument to measure suspended solids it is often difficult to keep the solids in suspension long enough for an accurate calibration to be made. The use of a magnetic stirrer in many cases will improve this. In the linearisation setup menu the probe signals should have been entered from the prepared samples and the output will now be linear with percent solids. In many cases this is all that is required. When the instrument is installed

into the process the indicated readings can be verified by sample analysis in the laboratory. The readings produced from the laboratory may not correlate with the instrument readings. This is more likely in liquids, which have large particles, which separate out easily. For example: yeast, waste water, or white water in the paper industry. To correct for any discrepancies the instrument allows for both a sensor zero adjustment and sensor span 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.

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

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 manual "Off-line" in the first step.



INFORMATION!

Make sure there are no air bubble in front 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 "Off-line" mode

<ul style="list-style-type: none"> You are on the main menu level. CHANNELS is highlighted. Press ← to enter the chosen menu.
<p>CHANNELS SETUP</p> <p>Depending on the installed card select either the input channel you wish to edit Press ↓ or ↑ until the submenu you wish to edit is highlighted. For example CHANNEL 1 → SUSPENDED SOLID CHANNEL 2 → pH CHANNEL 3 → COND SIMULATE CHANNELS</p>
<ul style="list-style-type: none"> Press ← to enter the chosen menu.
<p>CHANNELS SETUP 1,2 or 3 --> SUSPENDED SOLIDS</p> <ul style="list-style-type: none"> Press ↓ or ↑ until the submenu MODE is highlighted. Press ← to enter the chosen menu.
<p>Enter the access code with the help of ↓ or ↑. The default security access code is 1000 Press ← to enter the chosen menu.</p>
<ul style="list-style-type: none"> Press ↓ or ↑ to choose the option OFF-LINE. Press ← to confirm the entered value.
<ul style="list-style-type: none"> Press EXIT several times to return to the measuring mode.

You have activated the **OFF-LINE** mode. **OFF-LINE** will appear in the front screen.

If the message "Cannot Edit Digital Input Has Control" appears, then an associated digital input is currently controlling the on-line / off-line state of the channel.



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 emitter and detector for coating and rinse the sensor with a soft tissue.
- 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 sensor. Otherwise any dirt or product or polymer films are not being removed and interfere with later calibration.

Step 3a Sensor zero adjustment

The sensor zero adjustment will either add or subtract a bias value to the zero point, which will shift the entire curve by this value. The slope of the curve is unchanged.

Zero adjustment

<ul style="list-style-type: none"> • You are on the main menu level. CALIBRATION is highlighted. • Press ← to enter the chosen menu. 	
	<p>CALIBRATION</p> <p>Depending on the installed card select either the input channel you wish to edit Press ↓ or ↑ until the submenu you wish to edit is highlighted. For example CHANNEL 1 → SUSPENDED SOLID 4-20 mA OUTPUTS RESET USER CALIBRATION</p>
<ul style="list-style-type: none"> • Press ← to enter the chosen menu. 	
	<p>CALIBRATE CHANNEL 1</p> <ul style="list-style-type: none"> • Press ↓ or ↑ until the submenu SENSOR ZERO ADJ: is highlighted. • Press ← to enter the chosen menu.
	<p>Enter the access code with the help of ↓ or ↑. The default security access code is 1000 Press ← to enter the chosen menu.</p>
	<ul style="list-style-type: none"> • Press ↓ or ↑ to adjust the sensor reading • Press ← to confirm the entered value. • Press YES or NO to confirm the update cal due date
	<ul style="list-style-type: none"> • Press EXIT several times to return to the measuring mode.

Step 3b Sensor span adjustment

If the zero point of the measuring point is correct but the highest calibration point is incorrect then the sensor span adjustment will shift the end point of the curve up or down. This changes the slope of the output curve. The amount of slope adjustment currently being applied to the sensor as a %. Where 100% equals no adjustment, a slope of greater than 100% equals a steeper slope and a slope of less than 100% equals a shallower slope.

Span adjustment

<ul style="list-style-type: none"> You are on the main menu level. CALIBRATION is highlighted. Press ← to enter the chosen menu. 	
<p>CALIBRATION</p> <p>Depending on the installed card select either the input channel you wish to edit Press ↓ or ↑ until the submenu you wish to edit is highlighted. For example CHANNEL 1 → SUSPENDED SOLID 4-20 mA OUTPUTS RESET USER CALIBRATION</p>	
<ul style="list-style-type: none"> Press ← to enter the chosen menu. 	
<p>CALIBRATE CHANNEL 1</p>	
<ul style="list-style-type: none"> Press ↓ or ↑ until the submenu SENSOR SPAN ADJ: is highlighted. Press ← to enter the chosen menu. 	
<p>Enter the access code with the help of ↓ or ↑. The default security access code is 1000 Press ← to enter the chosen menu.</p>	
<ul style="list-style-type: none"> Press ↓ or ↑ to adjust the sensor reading Press ← to confirm the entered value. Press YES or NO to confirm the update cal due date 	
<ul style="list-style-type: none"> Press EXIT several times to return to the measuring mode. 	



Step 4: switching back to measurement

- Install the sensor in the measuring location.
- Activate the function **ON-LINE**.

5.5 Troubleshooting

Problem	Remedy
Instrument appears dead	Check that power is available to the unit. Using a voltmeter, set to AC or DC, check the power supply voltage at the connector. The design allows the unit to accept from 85 to 250 V AC or DC; an alternative option allows operation from 18 to 32 V AC or DC, check the name plate for voltage specification. Check that the power cable is securely and correctly attached. There are no user serviceable fuses fitted within this unit.
Access code does not work	It is probable that the access code has either been changed or the operator does not recall the code correctly. Contact KROHNE or your local distributor should this problem arise.
Input reading is constantly over-range, under-range or incorrect	Ensure that the sensor input is correctly connected (see Installation Section) and that the transmitter is not faulty or damaged. Check that linearisation curve has been correctly entered within the Channel Setup menu Check the sensor for fouling or damage. Check the raw sensor signal reading in a high and low sample. If the sensor signal is not reading as expected contact a service engineer for guidance. Try resetting the offset and slope calibration and re-calibrate the sensor in high and low samples. Where extension cables have been used, try connecting the sensor directly to the instrument.
Sensor reading is incorrect	Ensure the sensor is mounted properly, that there is at least 25 mm (1") of clearance around the head of the probe. Establish that the sensor is specified to work within the range that is being monitored.
Current output is incorrect or noisy	Check that the unit is "On-Line" Check that the maximum load for the current loop has not been exceeded. (750 Ω). Check that the terminals have been wired correctly. Check that the cable screen is attached to Earth at one end and that the cable does not pass too close to a power cable. Check that the current output has been configured properly.
Relays appear to malfunction	Check that the unit is "On-Line" Check that the set point configuration is correct (see setpoints, current outputs and digital input configuration) If the relays are vibrating or "chattering" as they pass the set point, check the hysteresis setting and increase if necessary. Ensure that the relays are connected properly and that the voltage/current levels are not exceeding 5 A at 30 V DC or 5 A at 250 V AC. Check that the instrument input cables are not picking up excessive noise.
Sensor readings are fluctuating	Check if there is enough space around the sensor (minimum 25 mm, recommended 50 mm insertion and 75 mm immersion installation). Check if too close to reflecting surfaces. If immersion installation check that the sunlight can not influence reading and the sensor is immersed far enough (around 1 m).

6.1 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.

6.2 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.

6.3 Repairs

Repairs must be carried out exclusively by the manufacturer or the manufacturer authorised specialist companies.

6.4 Returning the device to the manufacturer

6.4.1 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.*

6.5 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:			

6.6 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

The 4 beam alternating light principle compensates for variations in both light intensity and detector sensitivity. It features 2 light sources (LED's) which are switched on and off alternately and 2 detector.

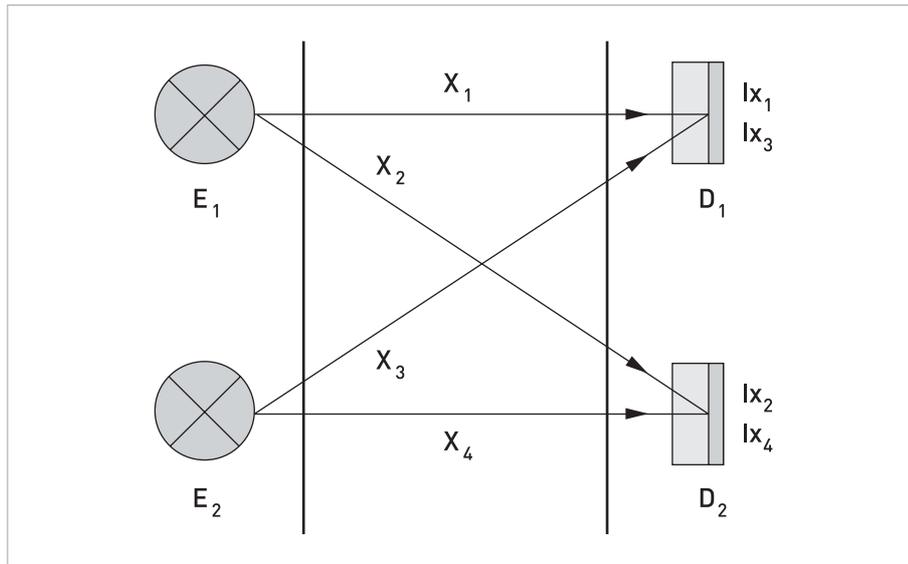


Figure 7-1: 2 lights and 2 detectors alternating light principle

When E_1 is turned 'ON' light is transmitted through the process media and each photodetector (D_1 and D_2) receives the light via paths X_1 and X_2 respectively. D_1 and D_2 generate signals based on the amplitude of light each photodetector receives. A ratio (R_a) is created by comparing these results.

$$R_a = I_{x_1}/I_{x_2} = 80\mu\text{A}/40\mu\text{A} = 2$$

Because any change in the characteristics of E_1 (due to age or contamination) will, affect D_1 and D_2 equally, this ratio will remain constant. For example, if the light output of E_1 is reduced by 25 %, the signals generated by D_1 and D_2 will both be reduced accordingly, but the ratio will remain the same. This eliminates the effects of contamination on E_1 .

$$R_a = I_{x_1}/I_{x_2} = 60\mu\text{A}/30\mu\text{A} = 2$$

The same procedure is performed using E_2 , across paths X_3 and X_4 and a similar ratio (R_b) is created. This eliminates the effects of contamination on E_2 .

$$R_b = I_{x_3}/I_{x_4} = 30\mu\text{A}/60\mu\text{A} = 0.5$$

To eliminate the effects of contamination or component aging on the detectors, a ratio comparing R_a and R_b is made.

$$R_a/R_b = 2/0.5 = 4$$

Because a change in the sensitivity of D_1 or D_2 (due to age or contamination) will reduce the light received from E_1 and E_2 equally, this ratio remains constant even if the characteristics of D_1 or D_2 change. For example if dirt covers 25% of D_1 , light received from both E_1 and E_2 will be reduced by 25 % but the ratio will remain the same.

$$R_a = I_{x_1}/I_{x_2} = 60\mu\text{A}/40\mu\text{A} = 1.5$$

$$R_b = I_{x_3}/I_{x_4} = 22.5\mu\text{A}/60\mu\text{A} = 0.375$$

$$R_a/R_b = 1.5/0.375 = 4$$

By using these ratios, rather than the direct output from D_1 and D_2 , the effects of contamination and component aging are eliminated.

Ambient light is detected by D_1 and D_2 while E_1 and E_2 are off. The resulting "offset" signal is used to correct the measurement. All signals are linearised and combined to produce a reliable 0/4...20mA output signal which is proportional to solids concentration.

By using single wavelength diodes with 880 nm which are outside the visible light spectrum the sensors are also insensitive to colour. KROHNE designs sensors of different sensitivity and measuring range by changing the distances between the sensor's light sources and detectors. When they are far apart, the sensor is more sensitive to suspended solids because the longer optical path lengths increase the sensor's ability to detect small changes in suspended solids concentration. However, because an increase in distance reduces the amount of detected light intensity, optical path length also determines the measuring range. For example, in two sensors with identical light sources, the sensor with longer path lengths will detect less light therefore it reaches the upper limit of its measuring range at a lower concentration and has a smaller measuring range. The sensor with shorter path lengths can measure higher concentrations and has a larger measuring range.

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	Suspended solids
Measuring principle	Transmitted light absorption principle; pulsed NIR 880 nm; with reference measurement. Reflection and absorption of light on suspended solids and sludge particles. The light passes the measured particles between the emitter and the detector in a straight line.

Design

Measuring scale	0...25 g/L with the path length 10 mm (Type 1)
	0...10 g/L with the path length 20 mm (Type 2)
	0...2.5 g/L with the path length 40 mm (Type 3)
Sensor thread	1 1/4" NPT

Operating conditions

Temperature range	0...85°C / +32...185°F
Pressure range	10 bar at 25°C / 145 psi at 77°F
Accuracy	± 2% of reading
Repeatability	± 1% of reading
Air pressure cleaning (Optional)	10 bar / 145 psi

Installation conditions

Ingress conditions	IP68
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Materials

Sensor body	PP - Polypropylene
Wetted material	
Cable gland sealing	NBR
Cable gland	PA
Cable	PU

Electrical connection

Cable	10 meter / 32.8 ft. (other lengths available)
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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.
For full information of the EU directives and standards and the approved certifications, please refer to the EU declaration or the website of the manufacturer

7.3 Dimensions

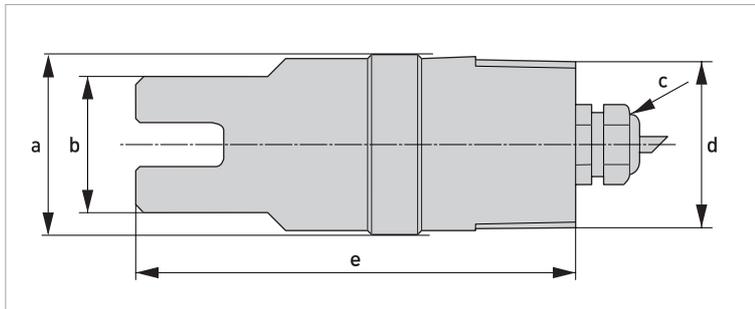


Figure 7-2: Dimensions

Type 1 (path length 10 mm)

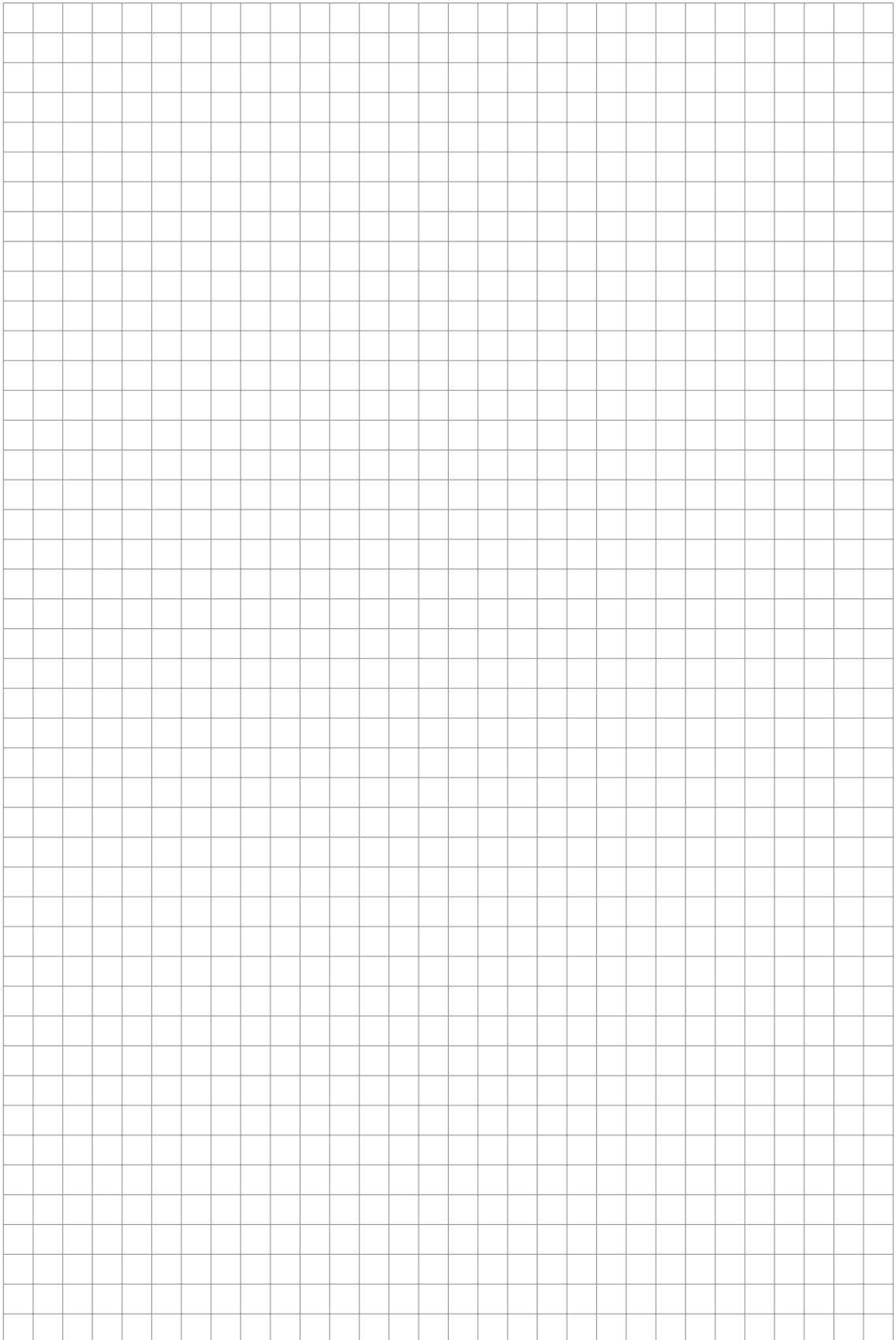
	Dimensions [mm]	Dimensions [inch]
a	45 Max.	1.77 Max.
b	34	1.43
c		M20 x 1.5
d		1 1/4 NPT
e	110	4.33

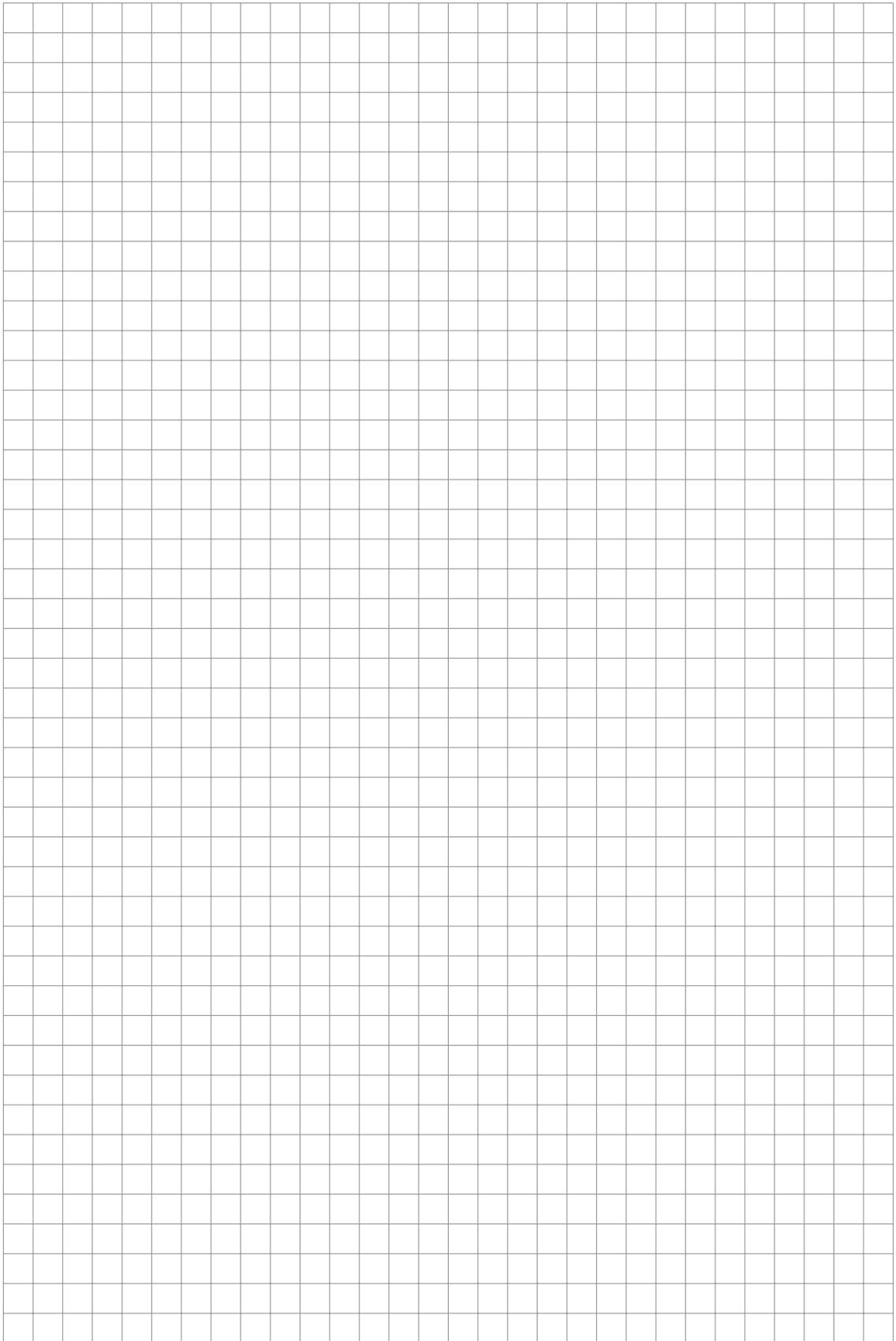
Type 2 (path length 20 mm)

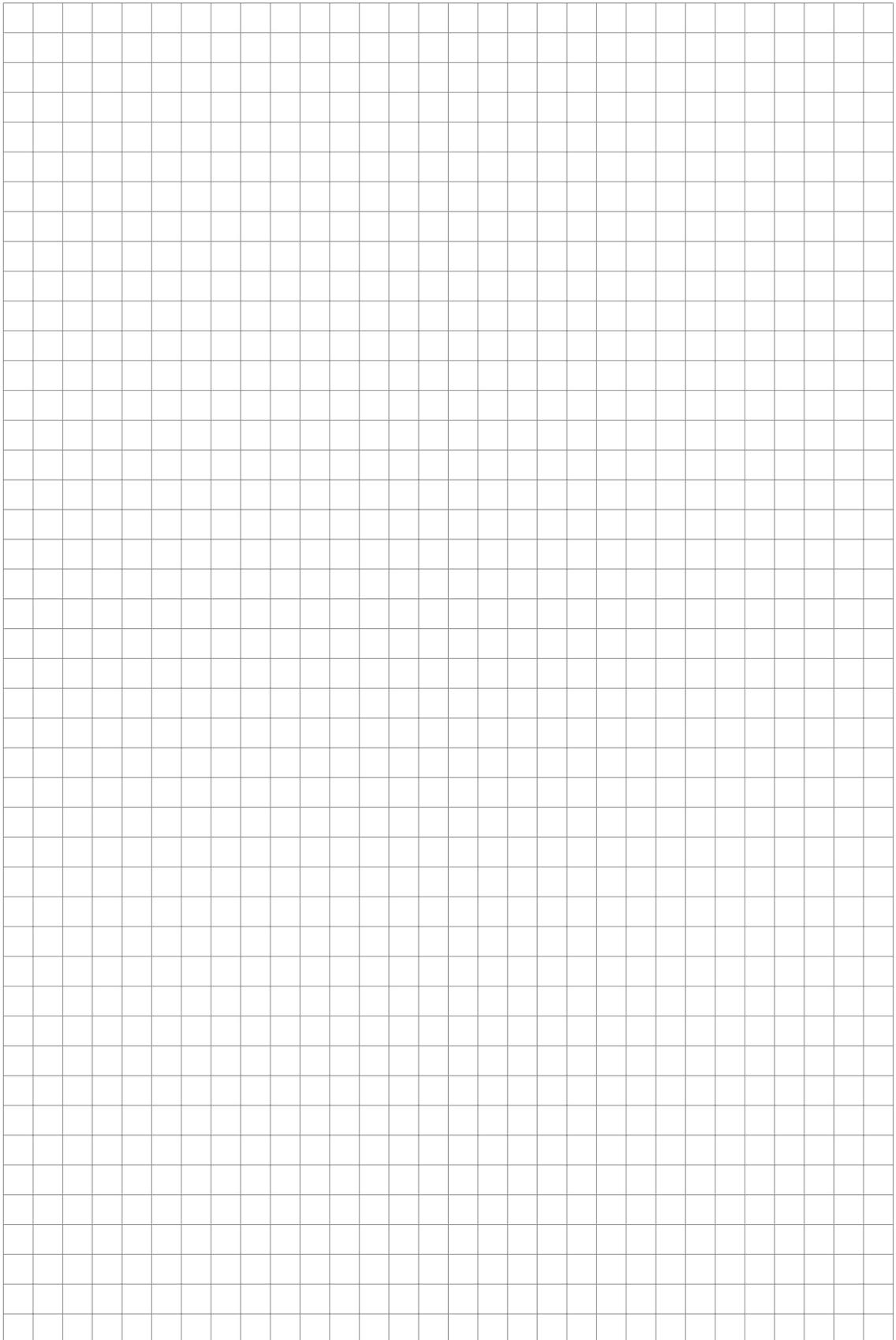
	Dimensions [mm]	Dimensions [inch]
a	45 Max.	1.77 Max.
b	43	1.69
c		M20 x 1.5
d		1 1/4 NPT
e	110	4.33

Type 3 (path length 40 mm)

	Dimensions [mm]	Dimensions [inch]
a	72 Max.	2.83 Max.
b	64	2.52
c		M20 x 1.5
d		1 1/4 NPT
e	122.3	4.81









KROHNE – Process instrumentation and measurement solutions

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- Level
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- Process Analysis
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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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