OPTISENS COND Handbook

Conductive conductivity sensors

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

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CONTENTS

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

The intended use of the OPTISENS COND conductivity sensor is the measurement of the electrical conductivity of liquids. The sensor can be operated by any suitable signal converter, e.g. MAC 100 or MAC 300.

1.2 Safety instructions from the manufacturer

1.2.1 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.

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

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.

1.2.3 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.

1.2.4 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 cannot 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.

1.2.5 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.

1.3 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.

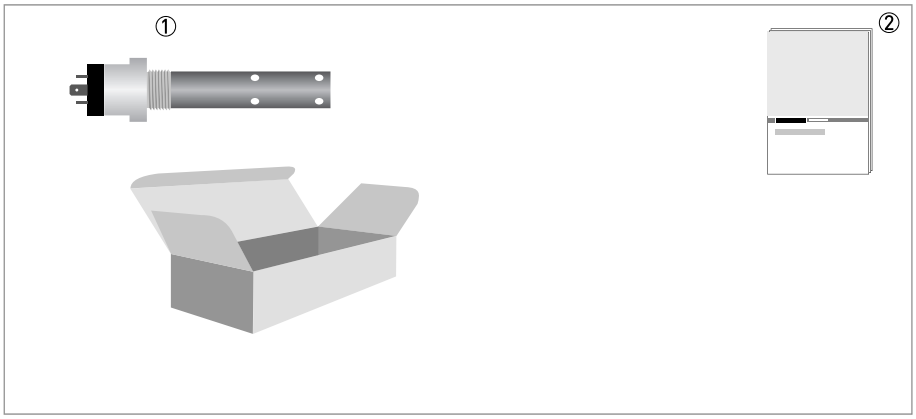


Figure 2-1: Scope of delivery

① Ordered sensor
② Documentation

Optional accessories

- SENSOFIT FLOW 1000 Y Flow-through assembly
- FLOW-cell for panels XGAM010195 / ...196 / ...198
- SENSOFIT IMM 1000 Immersion assembly (for OPTISENS COND 1210)
- OPTISENS COND cables with connector, different lengths

Consumables/Spare parts available

- Standard solution for sensor calibration

2.2 Device description

2.2.1 Conductivity sensor

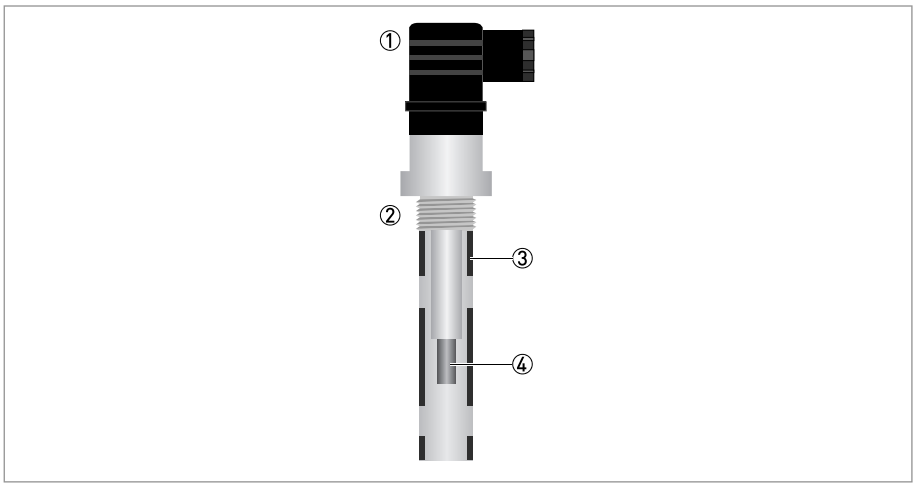


Figure 2-2: Sensor construction

① 4-pin angled plug
② Process connection thread
③ Outer electrode
④ Inner electrode

The OPTISENS COND product family comprises a group of conductive conductivity sensors with integrated temperature sensor (Pt100).

Sensors are available with different designs for insertion and immersion installation. A single sensor always comprises of 2 electrodes that are electrically separated by specific isolating components, e.g. made from PVDF or PEEK.

Different cell constants from c = 0.01 to 1.0 1/cm are available thus covering a wide area of use. All conductivity sensors have a robust design and a long lifespan.

In combination with a signal converter, it is possible to create extremely reliable low-cost measurement systems, which are suitable for a wide range of water analysis measurement tasks.

The conductive measurement principle is characterised by high sensitivity, especially at low conductivity values. For this reason, sensors with low cell constants are perfect for low-contaminated, non-corrosive media such as (ultra)pure water, cooling water, drinking water, as well as surface water.

For waste water, process water or brackish surface water, sensors with higher cell constants and corrosion resistant materials can be used.

The sterilizable OPTISENS COND 7200/7230 sensors meet requirements of the pharmaceutical or food and beverage industry with a surface roughness of <0.8 µm and the test certificate to EN10 204-3.1.

If measuring values exceed 20 mS/cm and in case of heavy soiling or danger of corrosion by the medium, it is highly recommended to make use of sensors or systems based on the inductive measurement prinicple, e.g. OPTISENS IND 1000 or OPTISYS IND 8100.

Sensor types, schematic

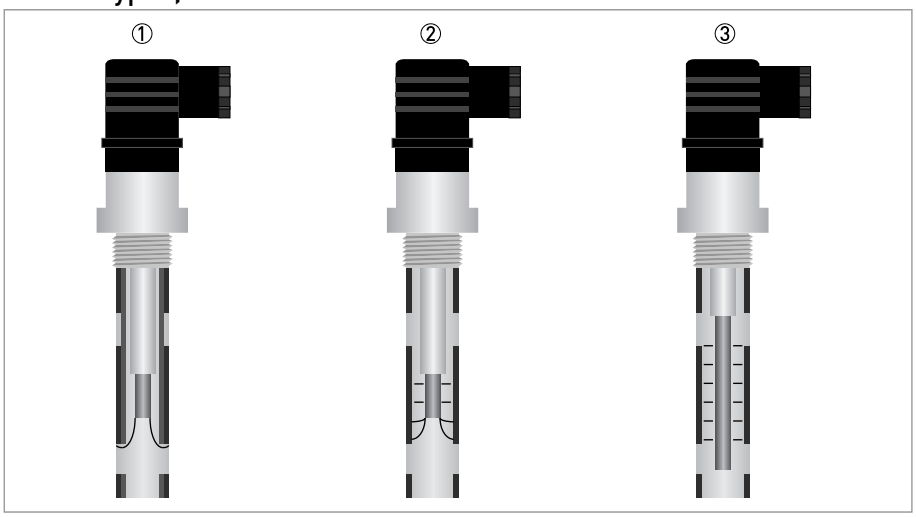


Figure 2-3: Sensors for different conductivity measuring ranges

① high range (c=1.0 1/cm)
② mid range (c=0.1 1/cm)
③ low range (c=0.01 1/cm)

2.3 Nameplate

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

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

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.

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

3.2 Storage and Transport

- Store the sensor in its original packaging in a dry and dust-free location. Keep it away from dirt.
- The original packaging serves as protection of the equipment. Therefore always use it for transport or return to the manufacturer.
- Avoid solar radiation.

3.3 Pre-installation requirements

CAUTION!
- *Do not drop the device! Handle the device with care!*
- *Never touch or scratch the electrodes of the sensor.*
- *Do not make any mechanical modifications to the sensor (electrodes shortened, drilled, bent or scratched). This can result in the loss of proper functionality, as well as the rights under the device warranty.*
- *The sensor must be suitable for the temperature, pressure and medium conditions which are specified (including chemical resistance).*
- *The device must not be heated by radiated heat (e.g. exposure to the sun) to a 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.*

WARNING!
Only for OPTISENS COND 5200 sensors: Check the inner diameter of the process connection at the final measuring location before installing the sensor. For all sensor types with 3/4" thread, a minimum diameter of 24.5 mm / 0.96" is required. Otherwise the sensor cannot be installed or might be damaged.
Recommendation for 3/4 NPT threads:
Make the thread at the final measuring location acc. to standard and wide up lower end to 24.5 mm (lower end thread part is not needed for proper and water-tight installation). Never try to install a sensor in a fitting with less than 24.5 mm inner diameter.

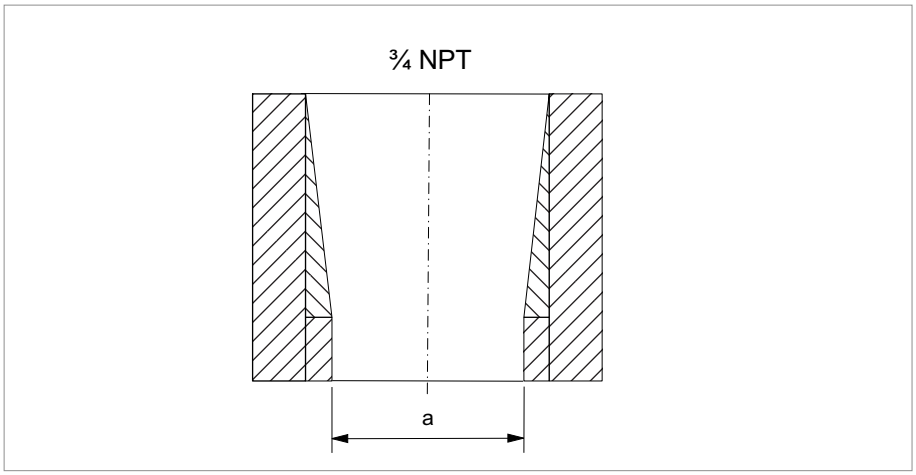


Figure 3-1: OPTISENS COND 5200 process connection (3/4 NPT)

a = min. 24.5mm / 0.96"

3.4 Installation procedure

In order to check functionality and measuring accuracy it is recommended to check the measuring loop by using a standard solution before installing the sensor in its final location. If necessary, perform a calibration.

1. Unpack the sensor.
2. Connect the sensor to the signal converter (see chapter 3.5).
3. Check the sensor performance using a solution with known conductivity fitting to the measuring range of the sensor. Perform a calibration, if necessary (see chapter 4).
4. Install the sensor into its final measuring location.

The required steps are explained in the following sections.

3.5 Electrical connection

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

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.

3.5.1 Connection of the sensor cable

CAUTION!
Moisture on the sensor connector must be avoided! Moisture may cause a short-circuit and a malfunction of the sensor!

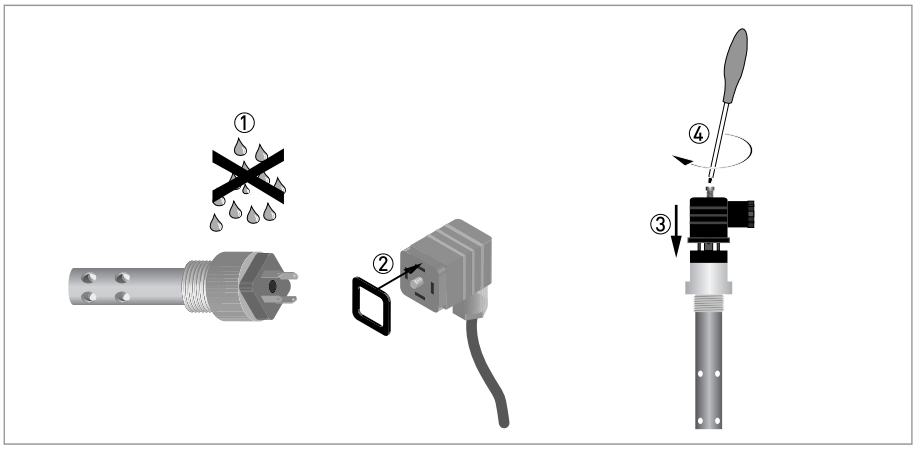


Figure 3-2: Connecting a 4-pin angled plug to the sensor

Ensure that both cable and sensor connector are absolutely dry ① .
Make sure that the seal is positioned on the sensor connector ② in the correct position.
Push the cable connector ③ on the sensor.
Tighten the screw with a screw driver ④ .

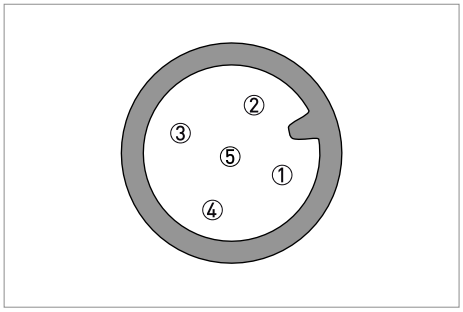


Figure 3-3: M12 sensor connector (OPTISENS COND 7230 only)

Pin	Contact	Colour
1	outer electrode	white
2	inner electrode	brown
3	Pt100	yellow
4	Pt100	green
5	not connected	

Table 3-1: Connector pin assignment M12 (OPTISENS COND 7230 only)

Ensure both cable and sensor connector are absolutely dry.
Make sure that M12 cable connector and sensor plug are aligned.
Push M12 cable connector carefully on the sensor plug.
Seal connection by turning cable connector nut into its final position (hand-tight). Do not use a tool here.

If a small amount of moisture (condensate, deionized water) has entered the connector, dry it with air (e.g. compressed air).
If liquids with higher conductivity (drinking water, process solutions) have entered the junction, it is recommended to replace the sensor. It can be tried to carefully clean the sensor contacts etc. with deionized water to remove conductive components.
Complete drying with compressed air is necessary in any case.
As it is difficult to clean the contacts of the cable plug, it is recommended to replace the sensor cable in this case to ensure full functionality.

3.5.2 Cable connection

CAUTION!
In case that the cable length has to be modified, check the measuring accuracy and re-calibrate the sensor if necessary.

INFORMATION!
The given colours only refer to the delivered cables! When using cables from a different provider, take into account the manufacturer's notes concerning the cable colour and designation.

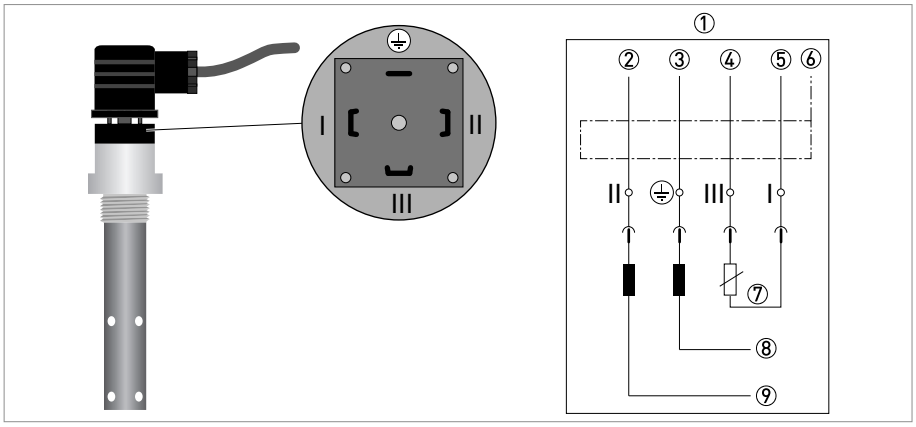


Figure 3-4: Cable assignment of a 4-pin angled plug

① Cable LIYCY 4x0.5 mm^2
② White
③ Brown
④ Yellow
⑤ Green
⑥ Shield
⑦ Pt100 sensor
⑧ Outer electrode
⑨ Inner electrode

3.5.3 Connecting the sensor cable to a 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!

CAUTION!
Make sure that you have read and understood all instructions in the user manual of your signal converter.

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

3.5.4 MAC 100 sensor connection

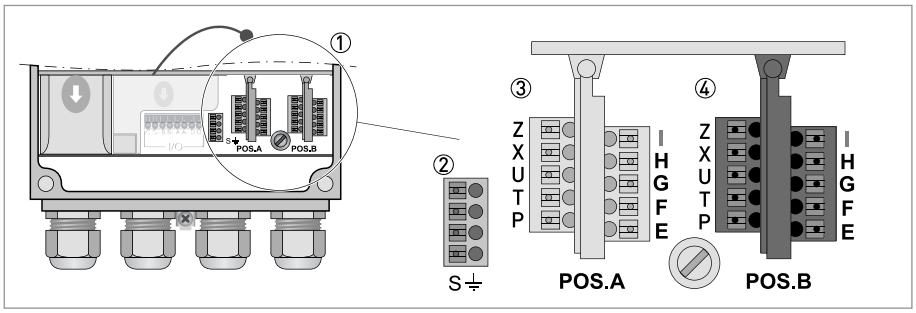


Figure 3-5: MAC 100 sensor connection terminals

① Sensor connection terminals
② Terminal block S (protective earth)
③ Terminal block A: terminals for sensor
④ Terminal block B: terminals for sensor

When ordering the single channel version, only the interface "Pos.A" is populated. In the version with dual channels the interfaces "Pos.A" and "Pos.B" are populated.

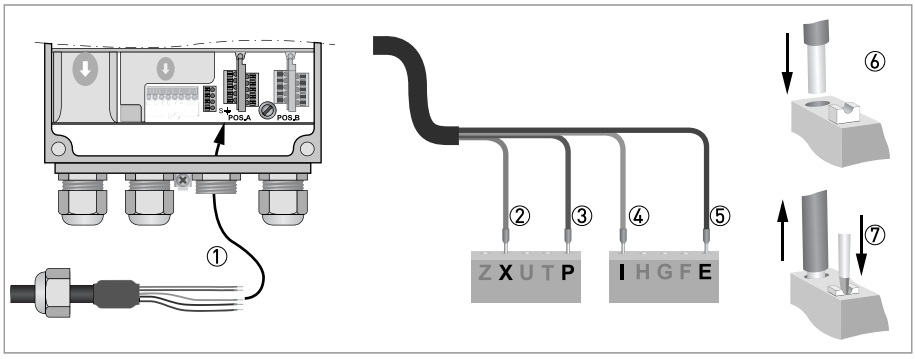


Figure 3-6: Electrical sensor connection to MAC 100

Connecting the sensor cable to the signal converter

- Thread the sensor cable through the middle right cable gland ① .
- Simply push the wires ⑥ into the correct positions of terminal block Pos. A or Pos. B as described in the chart below .

- To remove a cable, press down the white clip ⑦ on the corresponding terminal and pull the cable out.
- Connect the cable shield to terminal block S.

Wire	Terminal block Pos. A / B
Green ②	X
Yellow ③	P
White ④	I
Brown ⑤	E

Table 3-2: Sensor wiring to MAC 100 (4-pin and M12 sensors)

3.5.5 Sensor connection to MAC 300 or other signal converter

For connection and operation of OPTISENS COND sensors using MAC 300 or other signal converter please refer to the user manuals available for the transmitter.

3.6 Calibration check

Before the sensor is installed, it is recommended to check the measuring accuracy with a standard solution. If necessary, make a calibration before installation. For further information refer to *Calibration* on page 28. Then continue with the installation procedure.

3.7 Installing the sensor

3.7.1 General installation instructions

INFORMATION!
To achieve reliable measuring results, note the following items:

- *The sensor must always have full contact with the measuring medium.*

Air /gas bubble trapping must be avoided in any case. Coatings on the electrodes must be avoided. Clean electrode surfaces regularly.

Particle collections in or around the sensor may lead to erratic readings. Install sensor in a way that particles cannot be trapped.

3.7.2 Direct pipe installation

WARNING!
Ensure that the pipe is depressurized and empty before installing or removing a sensor!

INFORMATION!
Shut-off valves should be installed upstream and downstream of the measuring point. This will allow to remove the sensor from the pipe for inspection.

A variety of sensor positions is possible as long as all hints listed in the chapter before are observed.

- For direct pipe installation use an appropriate sealing for the threaded connection.
- Screw in sensor first and check water tightness of the connection.
- Attach sensor cable adjacently.

Installation recommendation

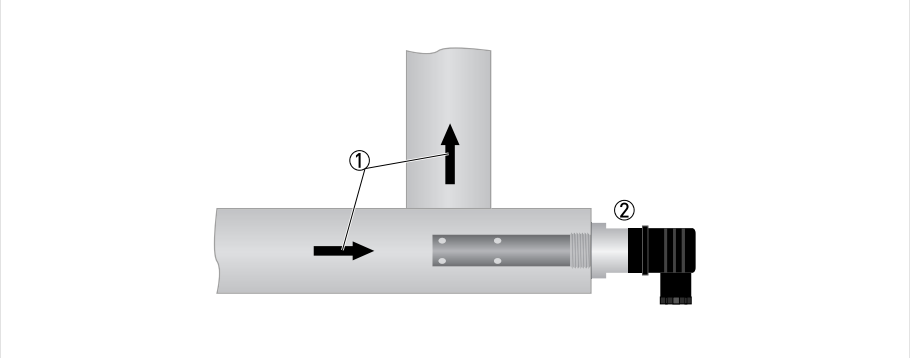


Figure 3-7: Typical installation

① Flow direction
② Ordered sensor

- Installation against the flow to ensure direct exposure of the electrodes.

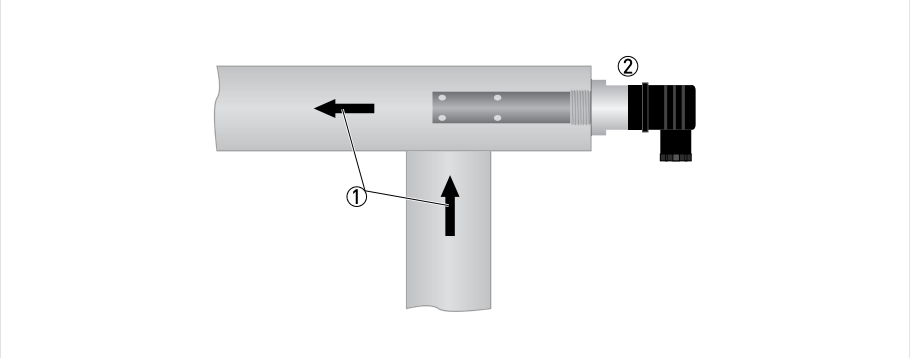


Figure 3-8: Installation for clean water

① Flow direction
② Ordered sensor

- This installation is only recommended if the pipe is completely filled (no air/gas bubbles in the sample).

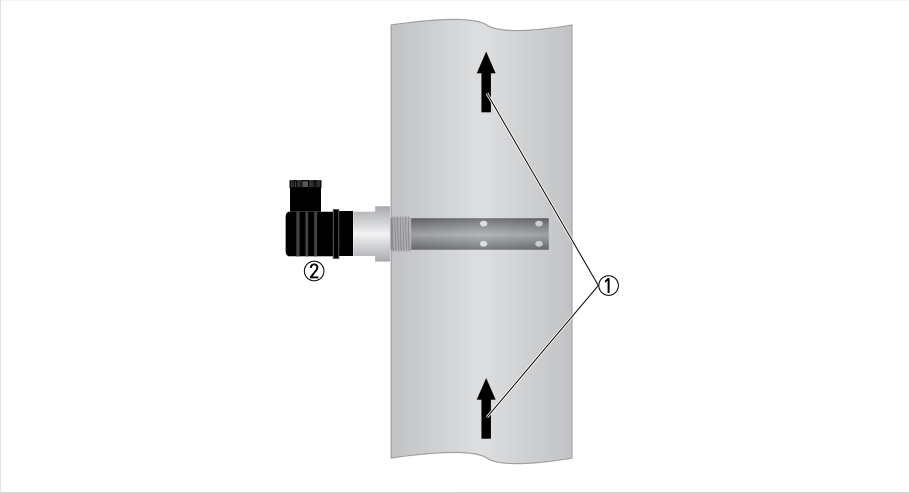


Figure 3-9: Possible installation

① Flow direction
② Ordered sensor

- This installation is only recommended if the pipe is completely filled with liquid.
- Consider the diameter of the pipe, i.e. compare pipe DN with insertion length of the sensor shaft.

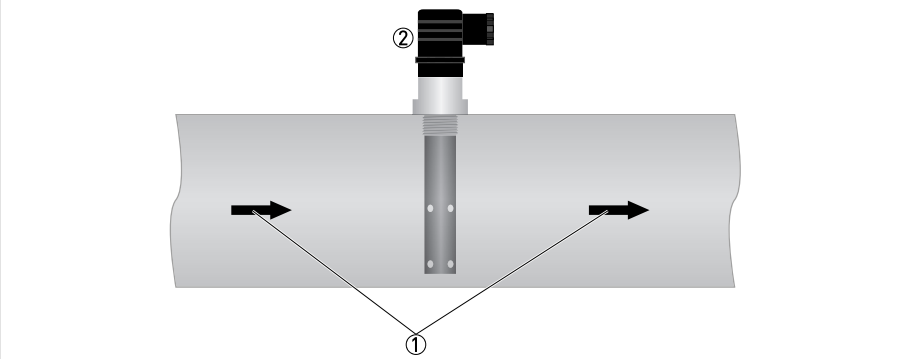


Figure 3-10: Possible installation

① Flow direction
② Ordered sensor

- This installation is only recommended if the pipe is completely filled and if there are no particles or air bubbles in the pipe.

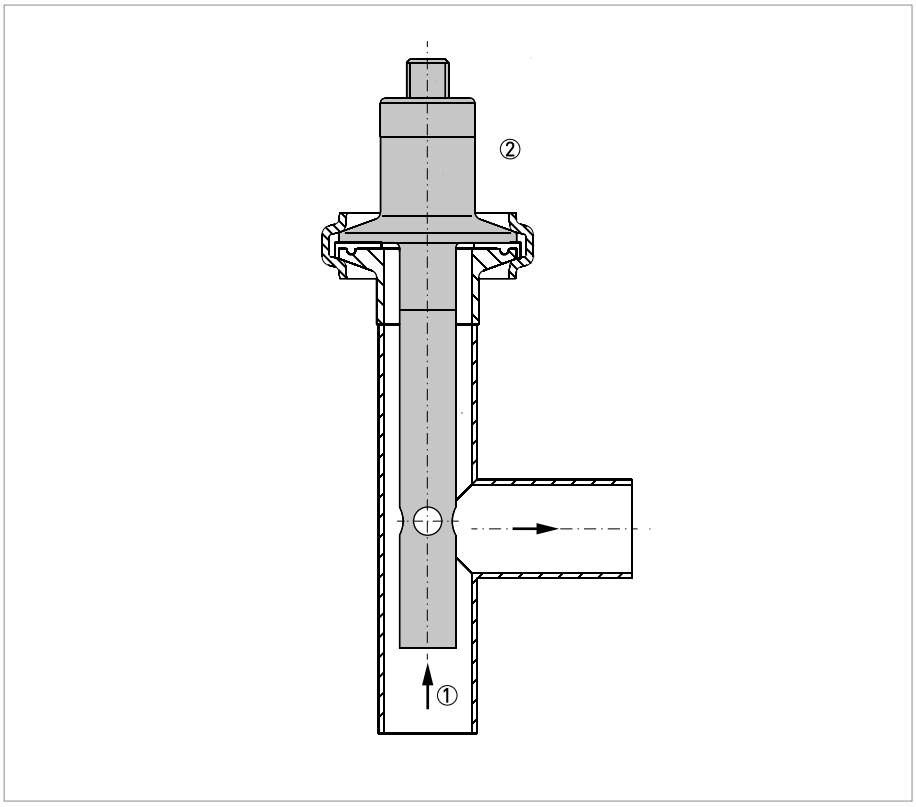


Figure 3-11: Possible installation for an OPTISENS COND 7200/7230 sensor

① Flow direction
② Ordered sensor

- Components for the clamp connection are to be supplied by customer.
- Make sure that the 4 holes in the outer electrode of the sensor are located at the level shown in the drawing. If the holes are located in the upper shaft of the T-piece, incorrect readings will occur.

3.7.3 Flow-through assembly SENSOFIT FLOW 1000 Y

WARNING!
Ensure that the pipe is depressurized and empty before installing or removing a sensor!

INFORMATION!
The flow-through assembly is an optional accessory and not part of the standard scope of delivery. It has to be installed in pump or sample lines or directly in the process.
Make sure that there is sufficient and representative sample flow at the measuring point.

INFORMATION!
OPTISENS COND sensors must be equipped with G 3/4 process connection for use with SENSOFIT FLOW 1000 Y.

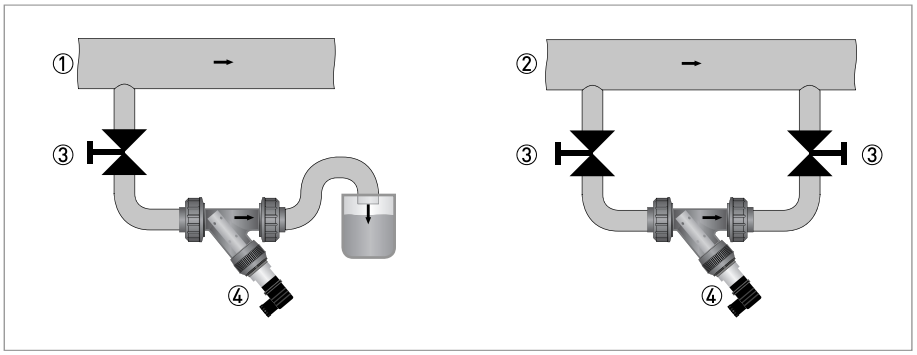


Figure 3-12: Possible mounting positions of the flow-through assembly

① Mounting in an outlet pipe
② Mounting in a bypass pipe
③ Shut-off valve
④ Sensor installed in flow through assembly

OPTISENS COND 1200 sensors can be installed in an arbitrary, also vertical position (refer to *General installation instructions* on page 16 and observe the mentioned hints). As the insertion lengths of OPTISENS COND 3200 and 5200 sensors are shorter, a horizontal position is recommended to ensure complete electrode wetting by the sample and optimum measuring results.

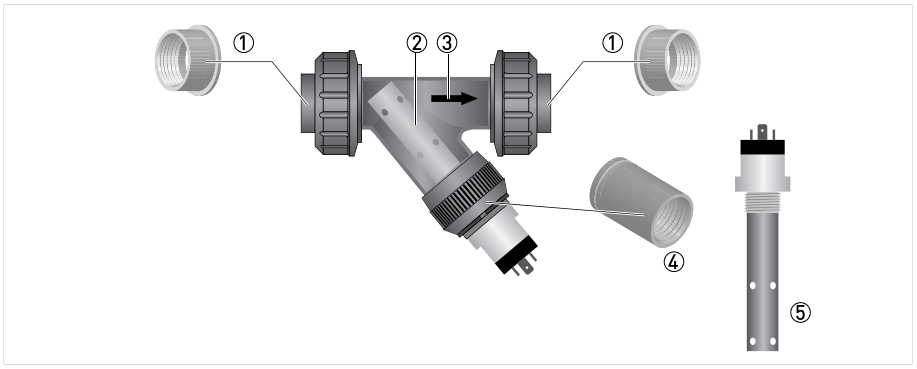


Figure 3-13: Installing the sensor into the flow-through assembly

① Process connection
② Outer electrode
③ Flow direction
④ Female thread
⑤ Sensor

- Apply a sealing ring suitable in size and material between sensor and assembly.
- Screw the sensor into the female thread ④ of the flow through assembly. Tighten the sensor by hand.
- Connect the cable plug to the sensor and tighten the screw.

3.7.4 Immersion assembly SENSOFIT IMM 1000

OPTISENS COND 1210 immersion style sensors can be used with SENSOFIT IMM 1000 immersion assemblies, or appropriate customer supplied components.

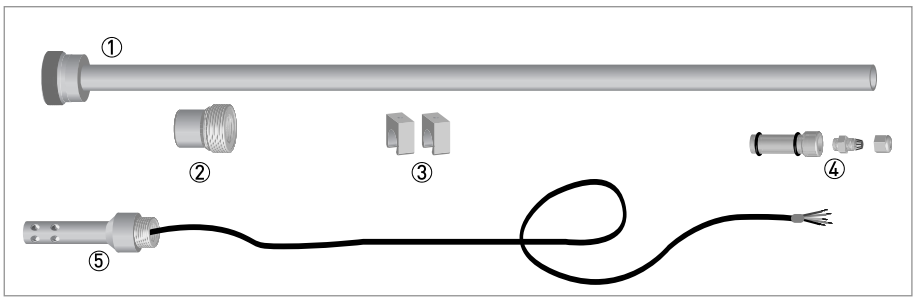


Figure 3-14: SENSOFIT IMM 1000

① Support pipe
② Sensor holder
③ Mounting brackets
④ Closing plug with cable gland
⑤ Sensor OPTISENS COND 1210 immersion style with G 1/2" thread and fix cable

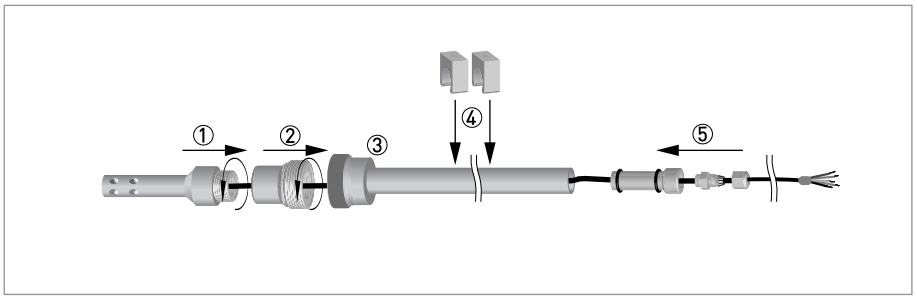


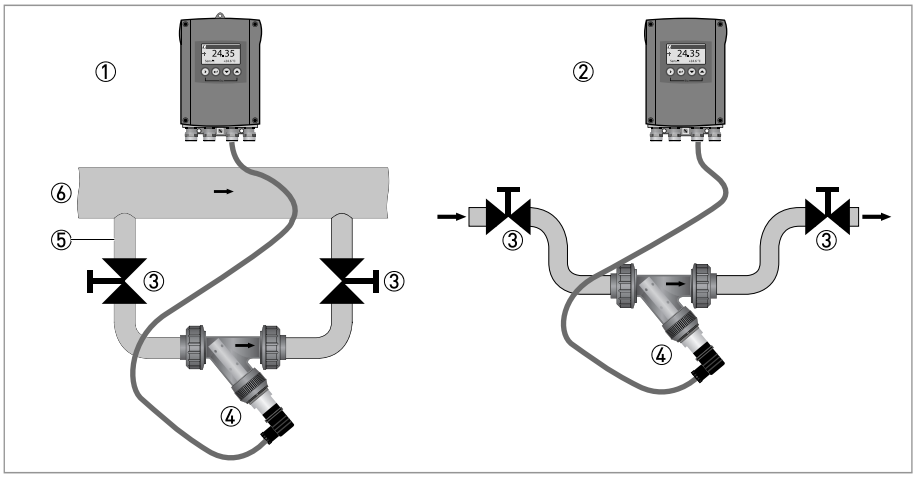
Figure 3-15: Mounting of the sensor with immersion assembly

① Sensor with attached cable
② Sensor holder
③ Support pipe
④ Mounting brackets onto support pipe
⑤ Closing plug with cable gland

- Pull the closing plug with cable gland ⑤ off the support pipe ③
- Push the sensor cable through the sensor- holder ② , the support pipe ③ and the closing plug with cable gland ⑤ .
- Screw the sensor holder ② into the support pipe ③ . Then screw the sensor ① into the sensor- holder ② .
- Push the closing plug with cable gland ⑤ into the support pipe again ③ . Tighten the cable gland.

3.8 Examples of a typical measuring point

The following examples each show the signal converter, a sensor with integrated temperature sensor, and the flow-through or immersion assembly.



① Bypass measurement
② In-line measurement
③ Shut-off valve
④ Flow-through assembly with sensor
⑤ Bypass pipe
⑥ Main pipe

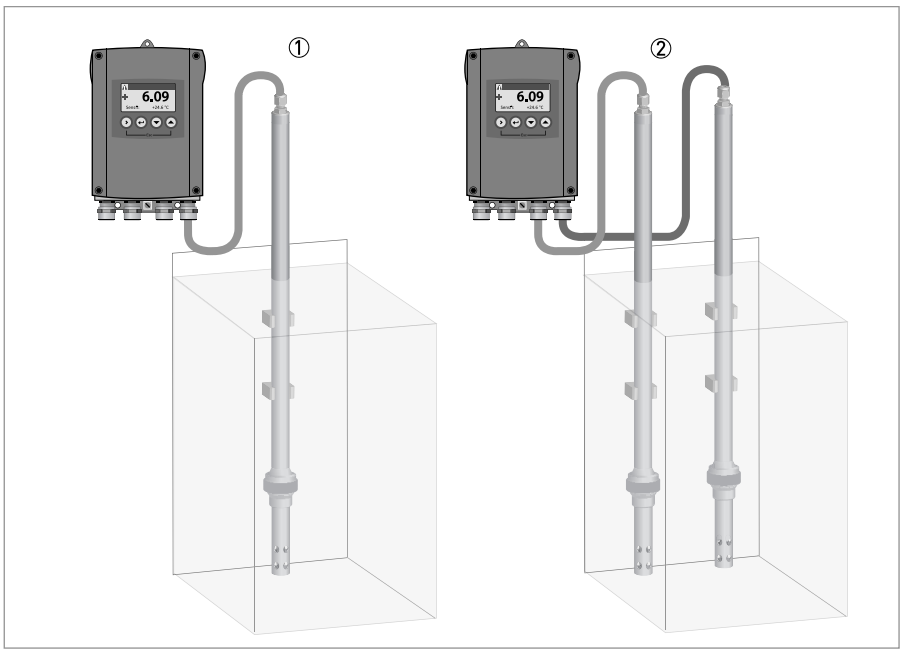


Figure 3-16: Installation with signal converter

① Single channel version
② Dual channel version

4.1 MAC 100 operation

4.1.1 MAC 100 - Menu structure

INFORMATION!
The following table just presents an overview. When programming the device, always consult the function tables additionally as they contain further information!
Only the sensor relevant menus are shown in the following tables. For detailed information about the general setting refer to the signal converter manual.

Main menu		Submenu	Parameter
A quick setup	A6 analog outputs	A6.1 measurement	For further information see function tables.
		A6.2 spec. conductivity	
B test	B1 sim. process input A	B1.1 temperature	For further information see function tables.
		B1.2 spec. conductivity	
		B1.3 spec. resistance	
	B4 actual values	B4.2 process input A	
		B4.2.1 temperature	
		B4.2.2 spec. conductivity	
		B4.2.3 Meg. Ohm	
		B4.2.8 generator volt.	
		B4.2.9 CPU temp.	
		B4.2.10 range	
		B4.2.11 electrode volt.	
	B6 information	B6.2 process input A	
C setup	C1 process input A	C1.1 parameter	For further information see function tables.
		C1.2 cell constant	
		C1.3 cable resistance	
		C1.14 time constant	
		C1.15 temperature	
		C1.23 cell calibration	

Table 4-1: Overview MAC 100 menu structure

4.2 MAC 100 - Function tables

4.2.1 Menu A, quick setup

INFORMATION!
Note that the appearance of some sub-menus depends on the hardware setting and the used sensor(s). Also only the sensor relevant menus and submenus are shown here in detail. For all other menu functions refer to the MAC 100 signal converter manual.

A 6.1 measurement:

Value used for driving the current outputs. Choose between:

- spec. conductivity
- temperature
- spec. resistance

A 6.2 spec. conductivity

Unit for the current output range. Choose between:

- µS/cm
- mS/cm
- free unit

4.2.2 Menu B, test

INFORMATION!
Note that the appearance of some sub-menus depends on the hardware setting and the used sensor(s). Also only the sensor relevant menus and sub-menus are shown here in detail. For all other menu functions refer to the MAC 100 signal converter manual.

The procedure to start the simulation process is the same for all functions:

- Choose the function with the help of ↓ or ↑ and press ↵ .

➲ You see the two options "set value" (opens the editor to enter the simulation value) and "break" (exits the menu without simulation).

- Choose the desired option with the help of ↑ or ↓ and press ↵ .

➲ If you chose "set value", the device asks "start simulation" and offers the options "no" (exits the menu without simulation) or "yes" (starts the simulation finally).

- Choose the desired option with the help of ↑ or ↓ and press ↵ .

➲ If you chose "yes", the simulation starts.

B1,sim.process inp.A
B2,sim.process inp.B

Level	Designation / function	Settings / descriptions
B1.1	temperature	In this menu the temperature can be simulated.
B1.2	spec. conductivitiy	In this menu the conductivity can be simulated.
B1.3	spec. resistance	In this menu the resistance can be simulated.

Table 4-2: Menu B1 and B2, simulation process

B4, actual values

Level	Designation / function	Settings / descriptions
This menu groups several functions which allow to display the corresponding actual reading. The shown measurements are depending on the device configuration.		
B4.2	process input A	In this menu the measurements from process input A can be read.
B4.3	process input B	In this menu the measurements from process input B can be read. (for 2 channel version only)

Table 4-3: Menu B4, actual values

B6, information

Level	Designation / function	Settings / descriptions
This menu groups several other menus which contain device specific information. The build-up of the display is the same for all menus: • 1st line: ID No. of the circuit board • 2nd line: software version • 3rd line: production date		
B6.2	process input A	Gives information about the electronical part of process input A.
B6.3	process input B	Gives information about the electronical part of process input B.

Table 4-4: Menu B6, information

4.2.3 Menu C, setup

INFORMATION!
The signal converter has a dual process input, A and B. Each process input has an own submenu in this main menu. Process input A is always present, i.e. there is always a board in the interface "Pos.A" in the connection area. The interface of process input B only has a board with the dual channel signal converter. Be aware that the definition which kind of measurement a process input can do is defined when ordering the device. The configuration cannot be changed later.

INFORMATION!
Note that the appearance of some submenus depends on the hardware setting and the used sensor(s).

C1, process input A
C2, process input B

Level	Designation / function	Settings / descriptions
Process input A and B can be either a sensor 1 or a sensor 2. For further information about the type of sensor 1 or 2 please refer to MAC 100 manual "Sensor input combinations". Process input A is always present, process Input B can be present. Note: The exchange of a sensor 1 with a sensor 2, or vice versa, can only be done by the manufacturer! Depending on the sensor which is connected to a slot A or B the menu changes.		
C1.1	parameter (conductivity)	This menu item is for selecting the probe which is connected to process input A/B. The entries of this selection depend on the chosen device configuration. The device configuration is customer specific and set during production.
C1.2	cell constant	Enter cell constant of connected sensor.
C1.3	cable resistance	Enter cable resistance in Ohm
C1.14	time constant	Enter time constant.
C1.15	temperature	Menu for temperature measurement. Available for sensor 1 and sensor 2.
C1.15.1	probe	Options: • manual: used if no internal or external temperature sensor is connected to the signal converter • Pt100/Pt1000: used if a Pt100 or Pt1000 temperature sensor is connected to the signal converter. Select matching Pt type.
C1.15.2	manual	Only available if C1.15.1 is set to "manual". If you have chosen "manual" enter temperature.
C1.15.3	correction	Offset correction for temperature measurement. Not available if C1.15.1 is set to "manual". If you have chosen "Pt100 or Pt1000" enter the temperature correction if necessary.
C1.15.4	limitation	Measuring ranges for temperature measurement. Enter limitation
C1.15.5	temp. comp.	Menu for editing the temperature compensation parameters for the measurement.
		Options: • off • table • ultra pure water • linear (default)
C1.15.6	temp. coefficient	If you have chosen "linear" enter the temperature coefficient (default: 2.1%/K).
C1.15.7	ref. temperature	Enter the reference temperature (default: 25°C).
C1.15.8	Reference points	Only available if C1.15.5 is set to "table". Choose number of reference points: • 2 till 10
C1.15.9	tbl. temperature	Only available if C1.15.5 is set to "table". Enter: • temperature for each reference point
C1.15.10	tbl. conductivity	Only available if C1.15.5 is set to "table". Enter: • uncompensated conductivity for each reference point
C1.23	cell calibration	For detailed information refer to calibration on page 28
C1.23.1	temp. comp.	Menu for temperature compensation during cell calibration.
		Options: • off: temperature measurement is disabled. • manual: temperature value has to be entered manually. • automatic: temperature measurement is performed as configured
C1.23.2	temperature	Only available if C1.23.1 is set to "manual": Enter manually measured temperature of standard solution (must be stable during calibration).

Level	Designation / function	Settings / descriptions
C1.23.3	temp. coefficient	Only available if C1.23.1 is set to "manual": Enter temperature coefficient of standard solution valid for the range between calibration and reference temperature.
C1.23.4	spec. conductivity	Enter the nominal value of the standard solution at the reference temperature set under C 1.15.7 (usually 25°C).
		If temperature compensation for measurement and calibration are set to "OFF", enter nominal value of standard solution at calibration temperature.
C1.23.5	cell constant	Check cell constant after calibration. The displayed value shall be within +/- 10% of the nominal cell constant of the sensor.

Table 4-5: Menu C1 and C2, process input

CAUTION!
Temperature compensation modes for ***measurement****, as set under C 1.15.5, and* ***calibration****, as set under C 1.23.1, must match, as follows:*
If you choose for ***measurement*** *one of the temperature compensation modes under C 1.15.5 (not "OFF"), choose between "automatic" or "manual" for the temperature compensation during* ***calibration****.*
If you choose for ***measurement*** *the temperature compensation "off", choose also "off" for the temperature compensation during* ***calibration****.*

4.3 MAC 100 - Parameter settings

4.3.1 General procedure

After starting-up the signal converter, the measuring screen appears. This is the standard screen which is displayed automatically in the normal operating mode. If this mode is active and any parameter settings have to be adjusted, e.g. the cell constant of the sensor that is connected, the following steps have to be performed:

Changing parameters - general procedure

• 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 **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" and "c1" appears, beneath the submenu **process input A** is highlighted.	
		• Press ▼ or ▲ to select **process input A**.	
		• Press **>** to enter the chosen menu.	
			You are on the second submenu level. In the upper line of the display "process input A" and "c1.1"appears beneath the submenu **parameter** is highlighted.
			• Press ▼ or ▲ to select **cell constant.**
			• Press **>** to enter the cell constant.

Table 4-6: Change of parameters in general

- Now the nominal cell constant as printed on the sensor can be entered.

- Make other settings as necessary and check if temperature compensation settings included in the **temperature** menu match with your requirements.
- If a Pt100 or Pt1000 is connected, you can enter a temperature **correction** in Kelvin so that the signal converter shows the same temperature as the reference thermometer. Press "ENTER" to confirm the entered value. The temperature sensor has been adjusted.
- Select **off , linear , table** or **ultra-pure water** included in the **temp. comp.** menu and "ENTER" to confirm the entered value.

INFORMATION!

- *If you choose **off** for compensation, the measured conductivity will most probably deviate considerably from the actual conductivity. The reason is that the conductivity of a specific medium varies depending on the temperature of the medium.*
- *If you choose **table** you need a data set with uncompensated conductivity readings measured at different temperatures. These can be values available from literature, or taken in a lab with your process solution. The MAC 100 will calculate temperature coefficients from this table. Enter number of reference points first and then the appropriate temperature/conductivity values. It is recommended to list temperature and conductivity values in a spreadsheet first and then transfer the data into the MAC 100.*
- *If you choose **ultra-pure water**, the MAC 100 will use factory-stored values for temperature compensation.*
- *If you choose **linear** enter a temperature coefficient that is representative for your process and the temperature range. Typical values are in the range of 2%/ °C.*

INFORMATION!

- *Make all settings from C1.1 to C1.15.10 as shown in table C1 as required. The new configuration must be saved, otherwise changes will be lost. You will be asked to save any changes when you try to return to the normal measuring mode.*
- *Do not start a calibration before having stored the new parameter settings!*

4.3.2 Calibration

WARNING!
Make sure that all parameter settings are stored before starting a calibration.

INFORMATION!
Before starting a calibration, it is useful to check the sensor performance in air and in a solution with a known conductivity value, fitting to the measuring range. If the accuracy is sufficient for your needs, a calibration is not necessary.

Calibration can be necessary in regular intervals or when installing a new sensor.

When calibrating a conductivity measurement, keep in mind that the measuring system as a whole is calibrated, and not only the sensor.

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) to the last measured value.

INFORMATION!
As an indication that the 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 documentation.

Step 1: activating the hold function

• 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 **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" and A1" appears, beneath the submenu **language** is highlighted.	
		• Press ▼ or ▲ until the submenu **hold function** 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.

Table 4-7: Calibration, activating the hold function

- You have activated the hold function. To 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

- If you calibrate a new sensor, make sure that the sensor is correctly connected to the signal converter.
- Check the sensor for damages or dirt deposits.
- Provide a suitable standard solution for your sensor and measuring range.

After activating the hold function and the preparative measures, you can get access to the calibration procedure from the measuring mode via the main menu **setup** (step 3a).

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. In the upper line of the display "A" appears, beneath the main menu **quick setup** is highlighted. • 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" and "c1" appears, beneath the submenu **process input A** is highlighted.	
		• Press ▼ or ▲ to select **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" and "C1.1" appears, beneath the submenu **parameter** is highlighted.
			• Press ▼ or ▲ until the submenu **cell calibration** is highlighted.
			• Press **>** to enter the chosen menu.

Table 4-8: Calibration, accessing the calibration menu via the main menu setup

- You can start the calibration procedure now as described in "Step 4".

Step 4: calibration procedure

- After choosing the submenu **cell calibration** (step 3a) in the previous steps, continue by pressing **>**.

➲ The signal converter demands to choose the kind of temperature compensation. You have the options **off**, **automatic** and **manual**. Please select the same kind of temperature compensation for the calibration as for the measurement (refer to *Menu C, setup* on page 25).
automatic: the signal converter will automatically compensate temperature influences using the information of a Pt100 or Pt1000 temperature sensor.
manual: the signal converter will compensate temperature influences using a manually entered value; this option only makes sense if the temperature of the standard solution is constant.
off: temperature compensation is disabled.

- If you chose **automatic**, just press ↲ . If you chose **manual**, first enter the temperature and the temperature coefficient of the measured medium using ▼ or ▲ and then press ↲ .

➲ On the screen the message **spec.conductivity** appears.

- Enter the nominal value of the standard solution at the reference temperature set under C 1.15.7 (usually 25°C; e.g. 1.413 mS/cm for a KCl standard). If temperature compensation for measurement and calibration are set to "OFF", enter nominal value of standard solution at calibration temperature. Press ↲ .
- The signal converter now performs a measurement which takes 25 seconds.

➲ After completion, a new cell constant is calculated and displayed. The difference between nominal and calibrated cell constant shall be lower than 10%.

- Press ↲ .

➲ The signal converter now asks "store cal. value?"

- Choose **yes** to store the calibration values. Choose **no** to discard the results, if the difference is >10%. Repeat calibration after having checked for air bubbles, dirt on the sensor and correct standard solution. .
- Press ↲ to confirm.
- If you want to return to the measuring mode, press ↲ several times until you reach this mode.

➲ Prior to returning to the measuring display, you are asked if the configuration should be stored.

- Choose **yes** using ▼ or ▲ to store the new calibration values.

➲ You have completed the calibration.

INFORMATION!
The "stored value" is a calculated value based on the actual measurement. The signal converter calculates this value depending on the compensation methods (temperature compensation) chosen for the calibration. Do not change the compensation method in the time between the measurement of the "stored value" and the input of the reference value. Otherwise this could result in a wrong calibration.

Step 5: re-installing the sensor

- After the calibration procedure, rinse the sensor with tap water or ultra-pure water, depending on the application..
- Reinstall the sensor into its assembly, refer to *Installing the sensor* on page 16.

Step 6: switching back to measurement

- Deactivate the function "hold function " again.

4.3.3 Calibration log

INFORMATION!
In order to show the history of the calibrations, the 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.		
		You are on the first submenu level. In the upper line of the display "test" and "B1" appears, beneath the submenu **sim.process input A** is highlighted.	
		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 "B5.1" appears, beneath the submenu **status log** is highlighted.
			Press ▼ or ▲ until the submenu **calibration log** is highlighted.
			Press **>** to enter the chosen menu.

Table 4-9: Accessing the calibration log

- 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.

5.1 Maintenance

5.1.1 Cleaning

- Clean the sensor surface with pure water.
- Slight dirt residues or dust: Rinse the sensor with tap water and clean it with a soft tissue.
- Oily and greasy coatings: Remove with a warm soap solution and rinse with water.
- Hardness deposits or metal hydroxide deposits: Remove with 10% citric acid or hypochloric acid and rinse with water.

INFORMATION!
Timer control for automated spray cleaning is provided by transmitters MAC 100 (up from ER 1.1.11) and MAC 300. Components for spray cleaning are to be supplied by the user.

5.1.2 Aging and re-calibration

Damages or non-removable coatings may lead to a significant difference between calibrated and nominal cell constant (>15%). In this case, it is recommended to replace the sensor.

5.2 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.

5.3 Availability of services

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

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

5.4 Returning the device to the manufacturer

5.4.1 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.

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.*

5.4.2 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:
Telephone number: Fax number:		Email address:
Manufacturer order number or serial number:		
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 caused by any residual media contained in this device when it is returned.		
Date:		Signature:
Stamp:		

5.5 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):

According to the directive 2012/19/EU or UK Regulation 2013 No. 3113, 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.

6.1 Measuring principle

6.1.1 Conductivity measurement

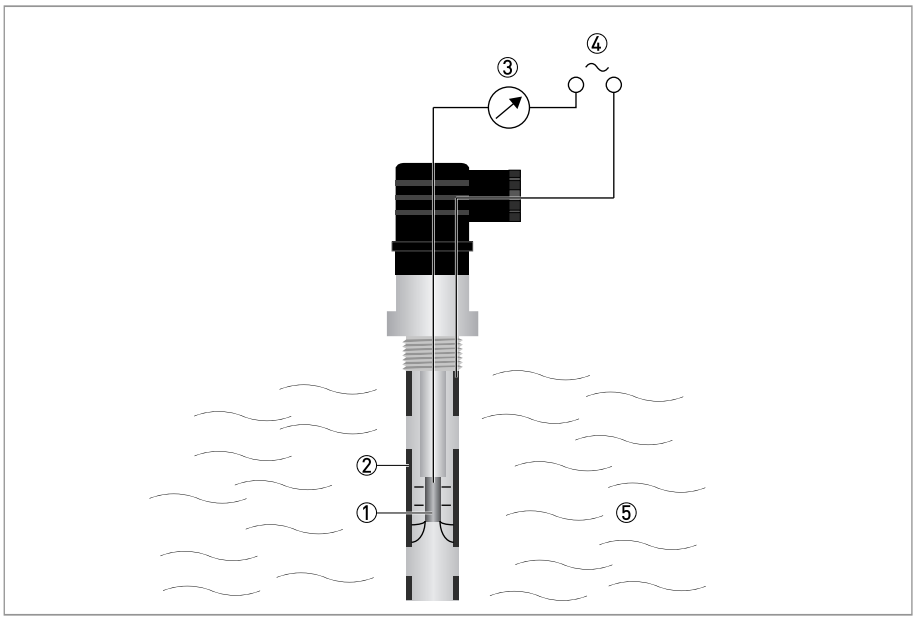


Figure 6-1: Measuring principle for conductivity measurement

① Inner electrode
② Outer electrode
③ Current measurement
④ Power supply
⑤ Measuring medium

The principle of conductivity measurement is based on the capacity of a solution to conduct an electrical current between two electrodes. In a solution, the current flows by ion transport. The higher the ion concentration, the more current can flow. Using Ohm's law: Resistance = Voltage/Current, the resistance of a liquid can be determined by measuring the current while keeping the voltage constant. Specific conductivity is defined by 1/resistivity. The unit of measurement is Siemens/meter and is normally expressed in µS/cm.
An important criterion for the measuring range of conductivity cells is the geometry of the electrodes. There are two rules which are characteristic for conductivity measurement:

1. The larger the distance between the two electrodes, the larger the resistance.
2. The larger the electrode surface, the lower the resistance.

The surface area (A) and the distance (L) must be correctly matched to the desired measuring range. This is called the "cell constant" defined as c=L/A.

6.2 Technical data

OPTISENS COND – conductive conductivity sensors with integral Pt100 temperature sensor

	COND 1200	COND 1210	COND 3200	COND 3220	COND 5200	COND 7200	COND 7230
Cell constant* ①	C = 0.05 cm^{-1}: 0.1...200 µS/cm C = 0.2 cm^{-1}: 1...2000 µS/cm C = 1.0 cm^{-1}: 0.1...20 mS/cm	C = 0.2 cm^{-1}: 1...2000 µS/cm C = 1.0 cm^{-1}: 0.1...20 mS/cm	C = 0.01 cm^{-1}: 0.05...10 µS/cm C = 0.1 cm^{-1}: 0.001...1 mS/cm	C = 0.1 cm^{-1}: 0.001...1 mS/cm	C = 1.0 cm^{-1}: 0.01...15 mS/cm	C = 0.01 cm^{-1}: 0.05...10 µS/cm C = 0.1 cm^{-1}: 0.001...1 mS/cm	C = 0.01 cm^{-1}: 0.05...10 µS/cm C = 0.1 cm^{-1}: 0.001...1 mS/cm
Body material	PVDF	PP	PVDF or Stainless steel (1.4571 / 316Ti)	Stainless steel (1.4404 /316L) PEEK	PVDF / PES	Stainless steel (1.4435 /316L)	Stainless steel (1.4435 /316L)
Electrode material	Stainless steel (1.4571 / 316Ti)	Stainless steel (1.4571 / 316Ti)	Stainless steel (1.4571 / 316Ti); or Titanium (with PVDF body)	Stainless steel (1.4404 /316L)	Graphite	Stainless steel (1.4435 /316L)	Stainless steel (1.4435 /316L)
Process connection	G ¾	G ½ (at sensor rear end, immersion style)	G ½ G ¾ G 1 ¾ NPT	¾ NPT	G ¾ G 1 ¾ NPT	Clamp DN 25	Clamp DN 25
Insertion length	100 mm / 3.94"	100 mm / 3.94"	60 mm / 2.36"	45 mm / 1.77"	60 mm / 2.36"	60 mm / 2.36"	115mm / 4.53";
Diameter	20 mm / 0.79"	20 mm / 0.79"	16 mm / 0.63"; 22 mm / 0.87"	19 mm / 0.75"	23.5 mm / 0.93"	22 mm / 0.87"	16 mm / 0.63"
Temperature range	0...+135°C / +32...+275°F	0...+90°C / +32...194°F	0...+135°C / +32...+275°F	0...+200°C / +32...+392°F	0...+130°C / +32...+266°F	0...+135°C / +32...+275°F	0...+135°C / +32...+275°F
Max. operating pressure	16 bar at 25°C / 232psi at 77°F	16 bar at 25°C / 232psi at 77°F	16 bar at 25°C / 232psi at 77°F	40 bar at 25°C, 17 bar at 200°C / 580 psi at +77°F, 246 psi at +392°F	16 bar at 25°C / 232psi at 77°F	16 bar at 25°C / 232psi at 77°F	16 bar at 25°C / 232psi at 77°F
Sensor cable connection	4-pin angled connector	10 m / 33 ft. fix cable	4-pin angled connector	4-pin angled connector	4-pin angled connector	4-pin angled connector	M12 connector

Table 6-1: Different sensor types OPTISENS COND

① Nominal cell constant values; actual value may vary by +/-10% and range

Connection cables for all sensors with 4-pin angled connector:

Cable length	3m / 9.8 ft
	5m / 16.5 ft
	10 m / 33 ft
	15 m / 49 ft
	20 m / 65 ft
	30 m / 98 ft

Table 6-2: Cable lengths for all sensors with 4-pin angled connector

Connection cables for sensor with M12 connector:

Cable length	10m / 33 ft
	25m / 82 ft

Table 6-3: Cable lengths for sensors with M12 connector

All cables are equipped with core end sleeves at the controller side.

6.3 Dimensions

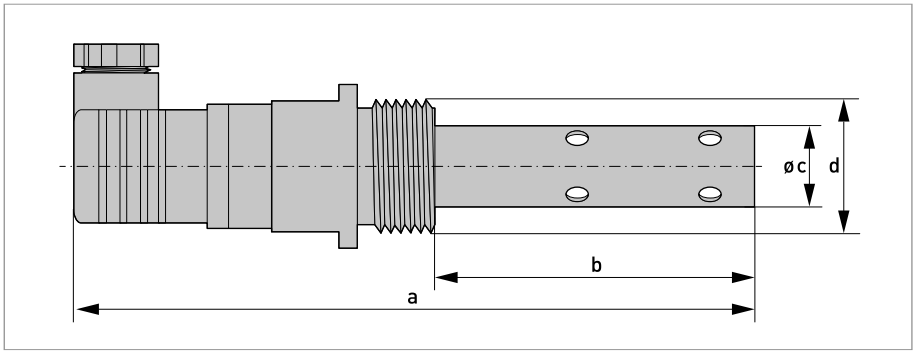


Figure 6-2: OPTISENS COND 1200

	Dimensions [mm]	Dimensions [inch]
a	186	7.32
b	100	3.94
c	Ø 20 mm	Ø 0.79
d	G3/4	

Table 6-4: Dimensions OPTISENS COND 1200

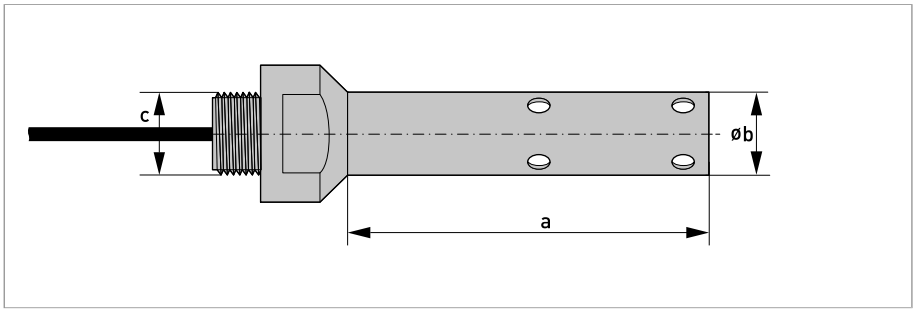


Figure 6-3: OPTISENS COND 1210 immersion version

	Dimensions [mm]	Dimensions [inch]
a	100	3.94
b	Ø 20	Ø 0.79
c	G1/2	

Table 6-5: Dimensions OPTISENS COND 1210

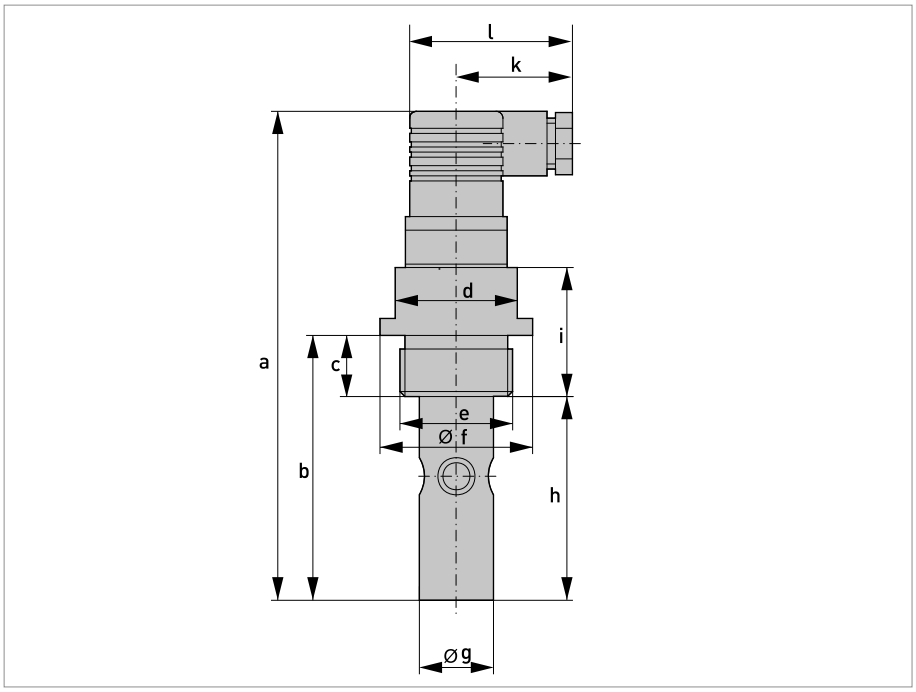


Figure 6-4: OPTISENS COND 3200

Dimension in mm										
a	b	c	d	e	f	g	h	i	k	l
145	80	20	36	3/4 NPT	45	22	60	38	37	50
	78	18		G1		22				
	76	16		G3/4		22				
	74	14		G1/2		16				

Table 6-6: Dimensions OPTISENS COND 3200

Dimension in inch										
a	b	c	d	e	f	g	h	i	k	l
5.71	3.15	0.79	1.42	3/4 NPT	1.77	0.87	2.36	1.5	1.46	1.97
	3.07	0.71		G1		0.87				
	3	0.63		G3/4		0.87				
	2.91	0.55		G1/2		0.63				

Table 6-7: Dimensions OPTISENS COND 3200

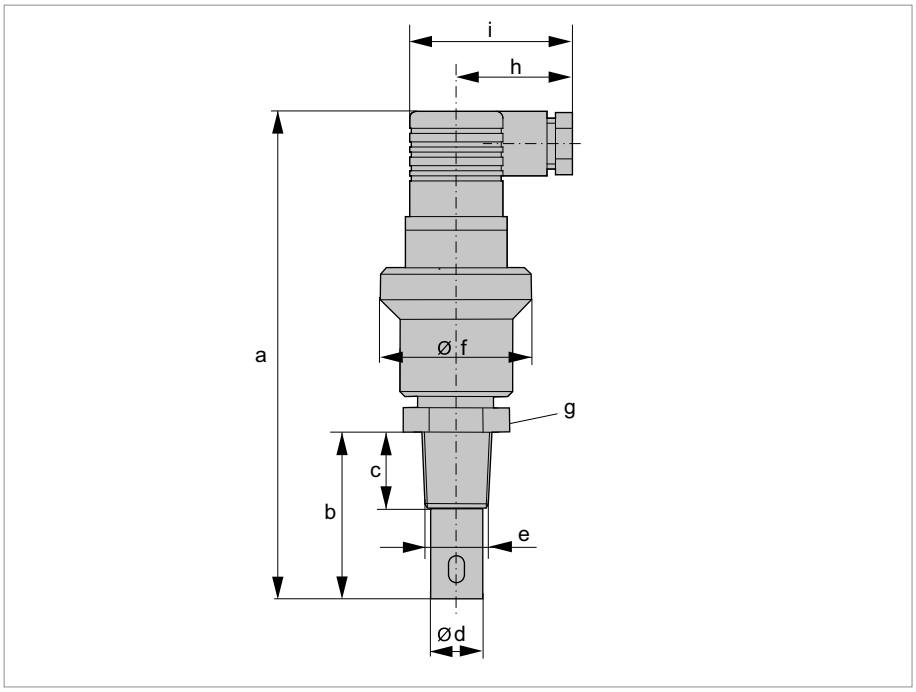


Figure 6-5: OPTISENS COND 3220

Dimension in mm								
a	b	c	d	e	f	g*	h	i
143	45	19	19	3/4 NPT	45	29	37	50

Table 6-8: Dimensions OPTISENS COND 3220

* Wrench size

Dimension in inch								
a	b	c	d	e	f	g*	h	i
5.63	1.77	0.75	0.75	3/4 NPT	1.77	1.14	1.46	1.97

Table 6-9: Dimensions OPTISENS COND 3220

* Wrench size

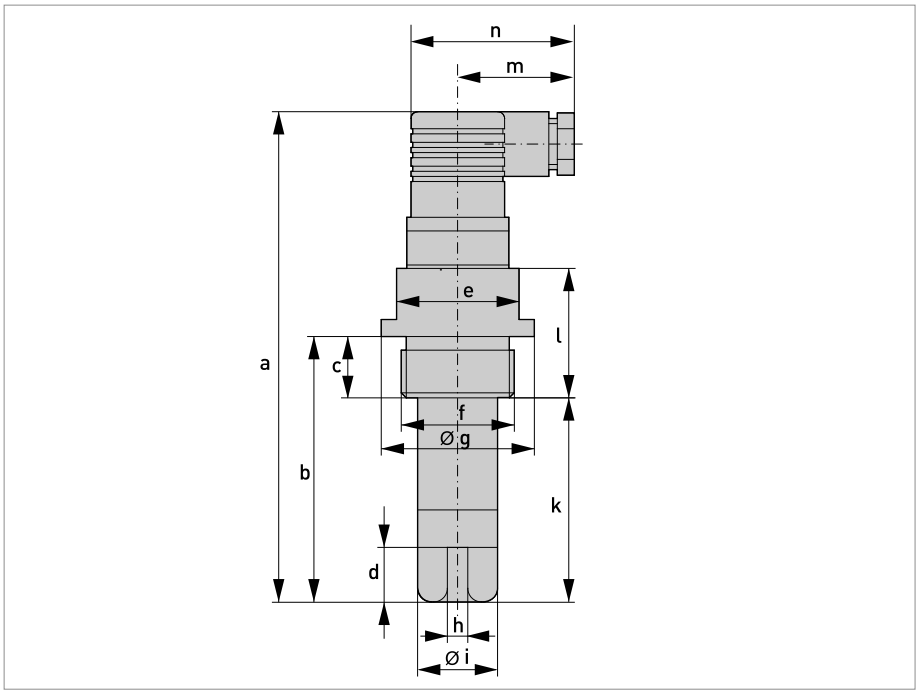


Figure 6-6: OPTISENS COND 5200

Dimension in mm												
a	b	c	d	e	f	g	h	i*	k	l	m	n
145	80	20	16	36	3/4 NPT	45	6	23.5	60	38	37	50
	78	18			G1							
	76	16			G3/4							

Table 6-10: Dimensions OPTISENS COND 5200

* Minimum inner diameter of 24.5 mm / 0.96" required for installation, refer to *Pre-installation requirements* on page 11 for details

Dimension in inch												
a	b	c	d	e	f	g	h	i*	k	l	m	n
5.71	3.15	0.79	1.42	1.42	3/4 NPT	1.77	0.24	0.93	2.36	1.5	1.46	1.97
	3.07	0.71			G1							
	3	0.63			G3/4							

Table 6-11: Dimensions OPTISENS COND 5200

* Minimum inner diameter of 24.5 mm / 0.96" required for installation, refer to *Pre-installation requirements* on page 11 for details

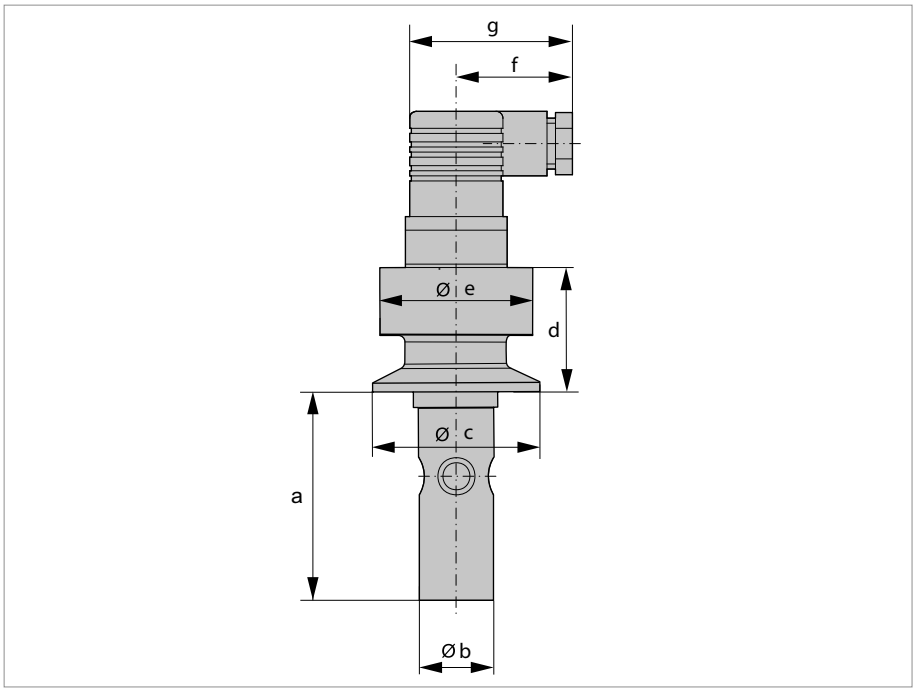


Figure 6-7: OPTISENS COND 7200

Dimension in mm						
a	b	c	d	e	f	g
60	22	50.5	38	45	37	50

Table 6-12: Dimensions OPTISENS COND 7200

Dimension in inch						
a	b	c	d	e	f	g
2.36	0.87	1.99	38	1.50	1.46	1.97

Table 6-13: Dimensions OPTISENS COND 7200

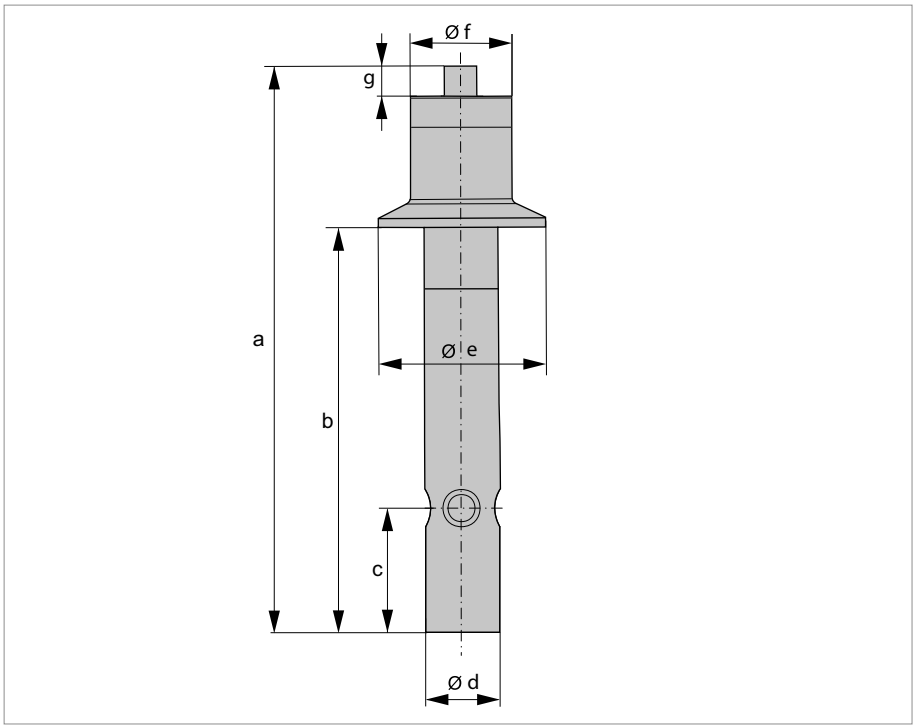


Figure 6-8: OPTISENS COND 7230

Dimension in mm						
a	b	c	d	e	f	g
167	115	36	16	50.5	27	11

Table 6-14: Dimensions OPTISENS COND 7230

Dimension in inch						
a	b	c	d	e	f	g
6.55	4.53	1.42	0.63	1.99	1.06	0.43

Table 6-15: Dimensions OPTISENS COND 7230

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