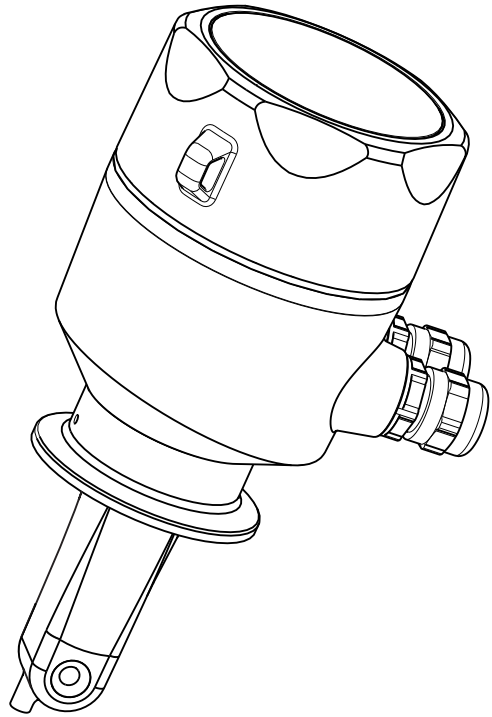
BA01149C/07/EN/05.17
71354508

Operating Instructions
Smartec CLD18

Conductivity measuring system



Endress+Hauser
People for Process Automation

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1 Document information

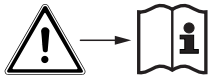
1.1 Warnings

Structure of information	Meaning
⚠ DANGER **Causes (/consequences)** Consequences of non-compliance (if applicable) ▶ Corrective action	This symbol alerts you to a dangerous situation. Failure to avoid the dangerous situation **will** result in a fatal or serious injury.
⚠ WARNING **Causes (/consequences)** Consequences of non-compliance (if applicable) ▶ Corrective action	This symbol alerts you to a dangerous situation. Failure to avoid the dangerous situation **can** result in a fatal or serious injury.
⚠ CAUTION **Causes (/consequences)** Consequences of non-compliance (if applicable) ▶ Corrective action	This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in minor or more serious injuries.
NOTICE **Cause/situation** Consequences of non-compliance (if applicable) ▶ Action/note	This symbol alerts you to situations which may result in damage to property.

1.2 Symbols used

Symbol	Meaning
	Additional information, tips
	Permitted or recommended
	Not permitted or not recommended
	Reference to device documentation
	Reference to page
	Reference to graphic
	Result of a step

1.3 Symbols on device

Symbol	Meaning
	Reference to device documentation

2 Basic safety instructions

2.1 Requirements for the personnel

- Installation, commissioning, operation and maintenance of the measuring system may be carried out only by specially trained technical personnel.
- The technical personnel must be authorized by the plant operator to carry out the specified activities.
- The electrical connection may be performed only by an electrical technician.
- The technical personnel must have read and understood these Operating Instructions and must follow the instructions contained therein.
- Measuring point faults may be repaired only by authorized and specially trained personnel.

Repairs not described in the Operating Instructions provided may only be carried out directly by the manufacturer or by the service organization.

2.2 Designated use

The compact measuring system is used for inductive conductivity measurement in liquids with medium to high conductivity.

Use of the device for any purpose other than that described, poses a threat to the safety of people and of the entire measuring system and is therefore not permitted.

The manufacturer is not liable for damage caused by improper or non-designated use.

NOTICE

Non-designated use

Incorrect measurements, malfunctions and even measuring point failure could result

- ▶ Only use the product in accordance with the product specifications.
- ▶ Pay particular attention to the technical data on the nameplate.

2.3 Occupational safety

As the user, you are responsible for complying with the following safety conditions:

- Installation guidelines
- Local standards and regulations

Electromagnetic compatibility

- The product has been tested for electromagnetic compatibility in accordance with the applicable European standards for industrial applications.
- The electromagnetic compatibility indicated applies only to a product that has been connected in accordance with these Operating Instructions.

2.4 Operational safety

1. Before commissioning the entire measuring point, verify that all connections are correct. Ensure that electrical cables and hose connections are undamaged.
2. Do not operate damaged products, and safeguard them to ensure that they are not operated inadvertently. Label the damaged product as defective.
3. If faults cannot be rectified:

   Take the products out of operation and safeguard them to ensure that they are not operated inadvertently.

2.5 Product safety

The product is designed to meet state-of-the-art safety requirements, has been tested, and left the factory in a condition in which it is safe to operate. The relevant regulations and European standards have been observed.

We only provide a warranty if the device is installed and used as described in the Operating Instructions. The device is equipped with security mechanisms to protect it against any inadvertent changes to the device settings.

IT security measures in line with operators' security standards and designed to provide additional protection for the device and device data transfer must be implemented by the operators themselves.

3 Incoming acceptance and product identification

3.1 Incoming acceptance

1. Verify that the packaging is undamaged.
   ↳ Notify your supplier of any damage to the packaging.
   Keep the damaged packaging until the matter has been settled.
2. Verify that the contents are undamaged.
   ↳ Notify your supplier of any damage to the delivery contents.
   Keep the damaged products until the matter has been settled.
3. Check the delivery for completeness.
   ↳ Check it against the delivery papers and your order.
4. Pack the product for storage and transportation in such a way that it is protected against impact and moisture.
   ↳ The original packaging offers the best protection.
   The permitted ambient conditions must be observed (see "Technical data").

If you have any questions, please contact your supplier or your local sales center.

3.2 Product identification

3.2.1 Nameplate

The nameplate provides you with the following information on your device:
- Manufacturer identification
- Order code
- Extended order code
- Serial number
- Firmware version
- Ambient and process conditions
- Input and output values
- Measuring range
- Safety information and warnings
- Protection class

▶ Compare the data on the nameplate with your order.

3.2.2 Product identification

Product page

www.endress.com/CLD18

Interpreting the order code

The order code and serial number of your product can be found in the following locations:
- On the nameplate
- In the delivery papers

Obtaining information on the product

1. Go to the product page for your product on the Internet.
2. At the bottom of the page, click the link **Online Tools** and then select **Access device specific information**.
   ↳ An additional window opens.
3. Enter the order code from the nameplate into the search field and then select **Show details**.
   ↳ You will receive information on each feature (selected option) of the order code.

Manufacturer's address

Endress+Hauser Conducta GmbH+Co. KG
Dieselstraße 24
D-70839 Gerlingen

3.3 Scope of delivery

The delivery comprises:
- A Smartec CLD18 measuring system in the version ordered
- Operating Instructions BA01149C/07/EN

3.4 Certificates and approvals

3.4.1 Declaration of Conformity

The product meets the requirements of the harmonized European standards. As such, it complies with the legal specifications of the EU directives. The manufacturer confirms successful testing of the product by affixing to it the CE mark.

3.4.2 Hygiene

FDA

All materials in contact with the product are FDA-listed materials (apart from the PVC process connections).

EHEDG

Certified cleanability according to EHEDG Type EL Class I.

When using the sensor in hygienic applications, please note that the cleanability of the sensor also depends on the way the sensor is installed. To install the sensor in a pipe, use the appropriate and EHEDG-certified flow vessels for the particular process connection.

3-A

Certified according to 3-A Standard 74- ("3-A Sanitary Standards for Sensor and Sensor Fittings and Connections Used on Milk and Milk Products Equipment").

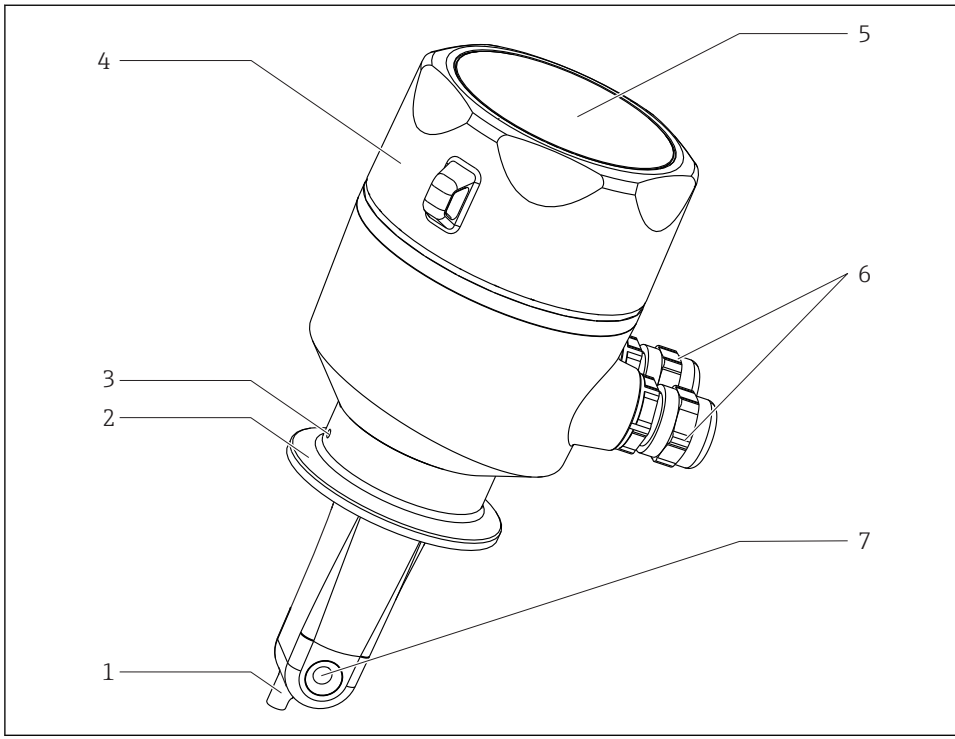
EC Regulation No. 1935/2004

The sensor meets the requirements of EC Regulation No. 1935/2004 on materials and articles intended to come into contact with food.

3.4.3 Pressure approval

Canadian pressure approval for pipes according to ASME B31.3

4 Product description



1 Elements

1 Temperature sensor
2 Process connection
3 Leakage bore (offset by 90° in relation to the flow direction)
4 Removable housing cover
5 Window for display
6 Cable glands (M12)
7 Flow opening of sensor

5 Installation

5.1 Installation conditions

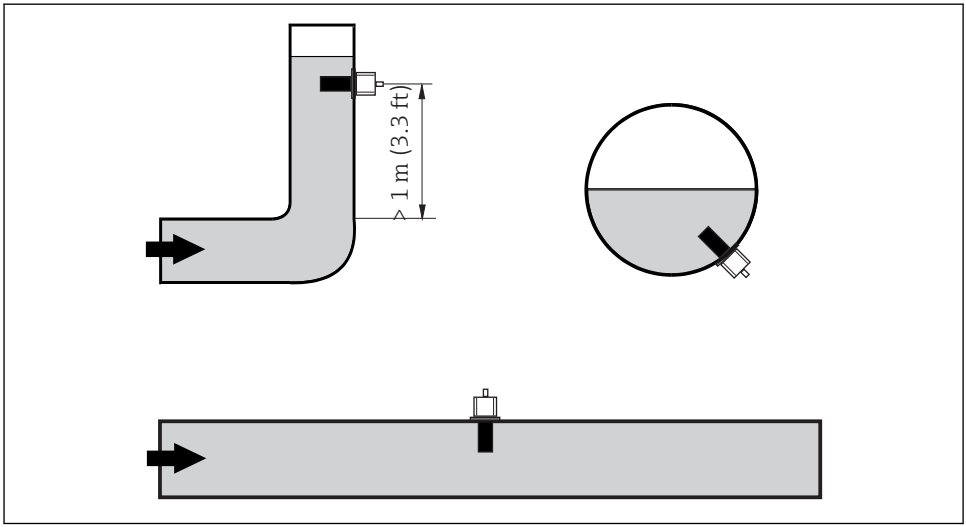
5.1.1 Installation instructions

For a 3-A compliant installation, the following must be noted:

After the instrument is installed its hygienic integrity shall be maintained. The instrument shall be installed with the leakage detection at the lowest point of the assembly. Furthermore all process connections must be 3-A compliant.

Orientations

The sensor must be completely immersed in the medium. Avoid air bubbles in the area of the sensor.

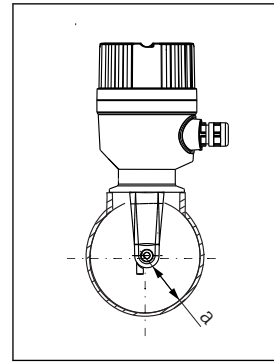


2 *Orientation of conductivity sensors*

If the flow direction changes (after pipe bends), turbulence in the medium can result. Install the sensor at a distance of at least 1 m (3.3 ft) downstream from a pipe bend.

The product should flow along the hole of the sensor (see the arrows on the housing). The symmetrical measuring channel allows flow in both directions.

The ionic current in the liquid is affected by the walls in confined installation conditions. This effect is compensated by what is referred to as the installation factor. The installation factor can be entered in the transmitter for the measurement or the cell constant is corrected by multiplying by the installation factor.
The value of the installation factor depends on the diameter and the conductivity of the pipe nozzle as well as the distance a between the sensor and the wall.
The installation factor can be disregarded (f = 1.00) if the distance to the wall is sufficient (a > 20 mm, from DN 60).
If the distance to the wall is smaller, the installation factor increases for electrically insulating pipes (f > 1) and decreases for electrically conductive pipes (f < 1).
It can be measured using calibration solutions, or a close approximation can be determined from the following diagram.



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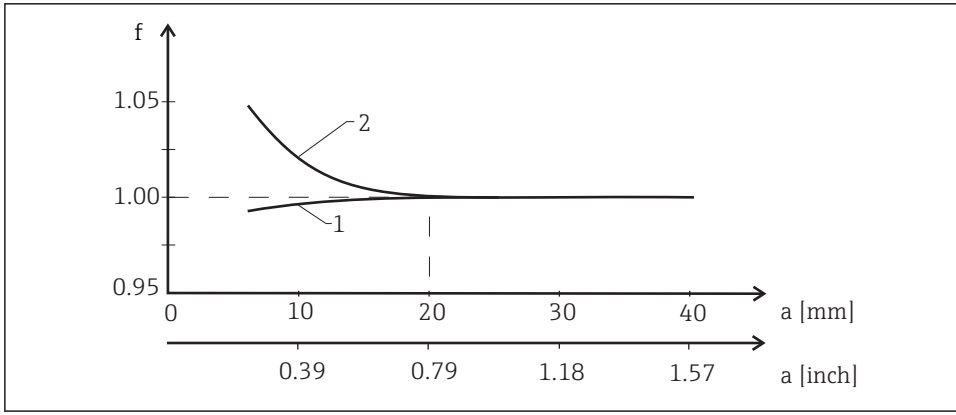
3 *Installation of CLD18*

a Wall distance



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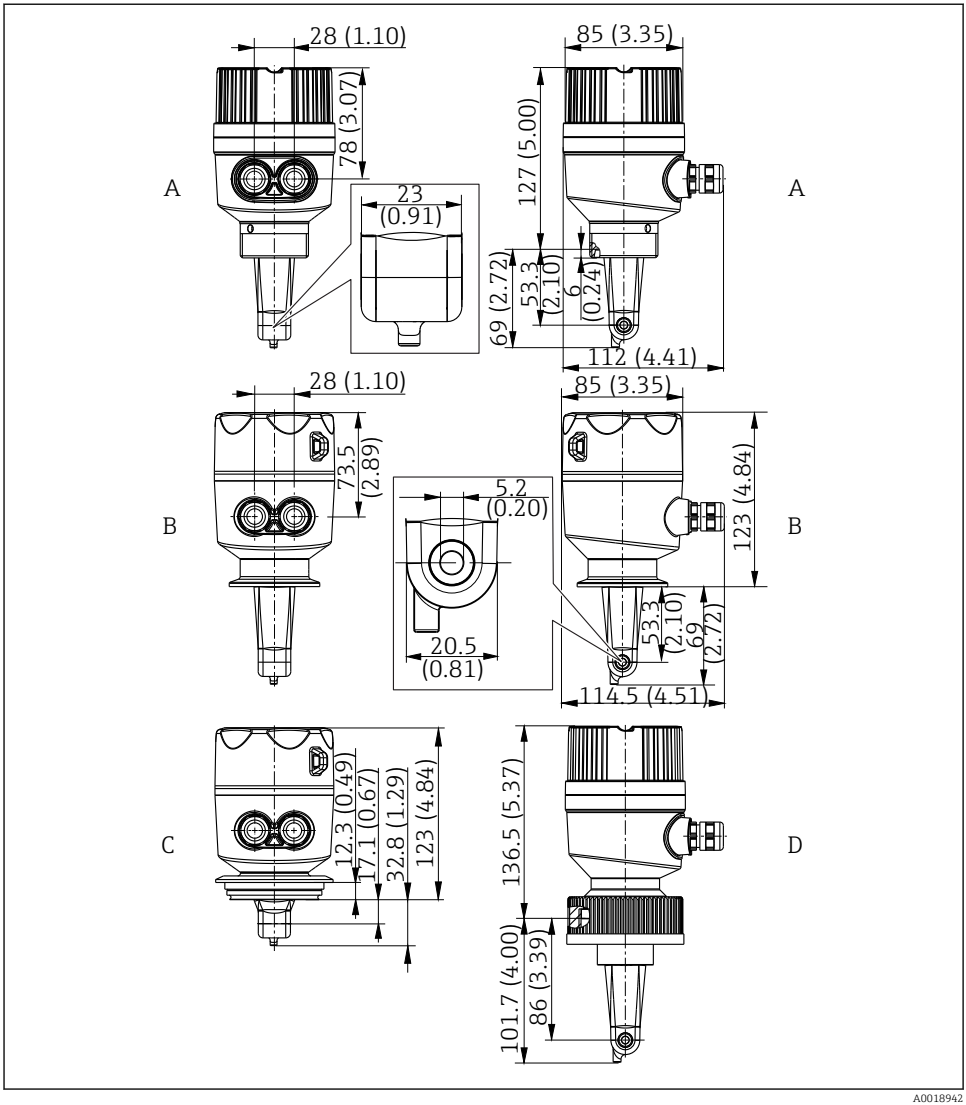
4 *Relationship between installation factor f and wall distance a*

1 Electrically conductive pipe wall
2 Electrically insulating pipe wall

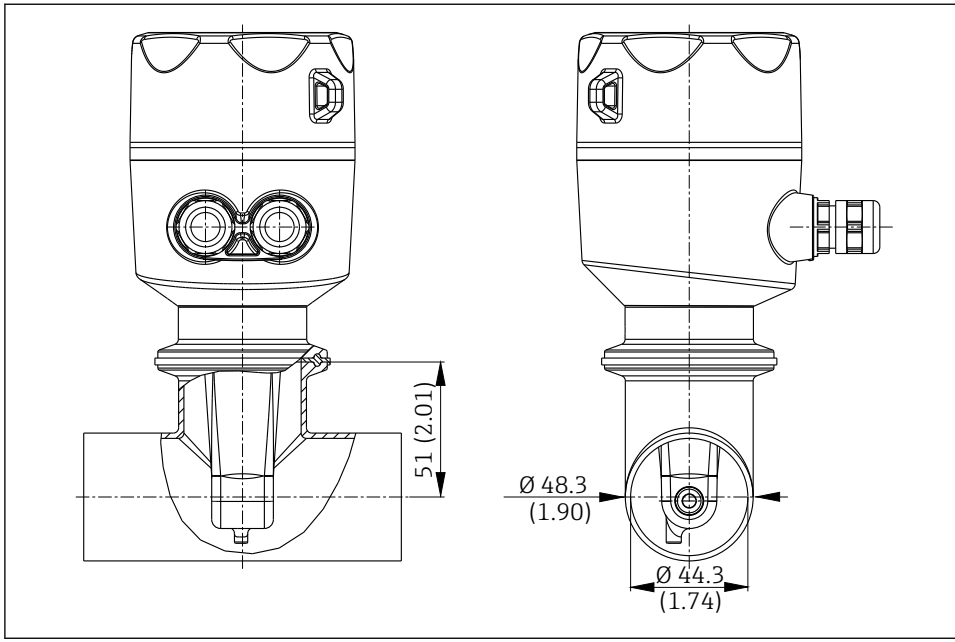
Install the measuring system in such a way that the housing is not exposed to direct sunshine.



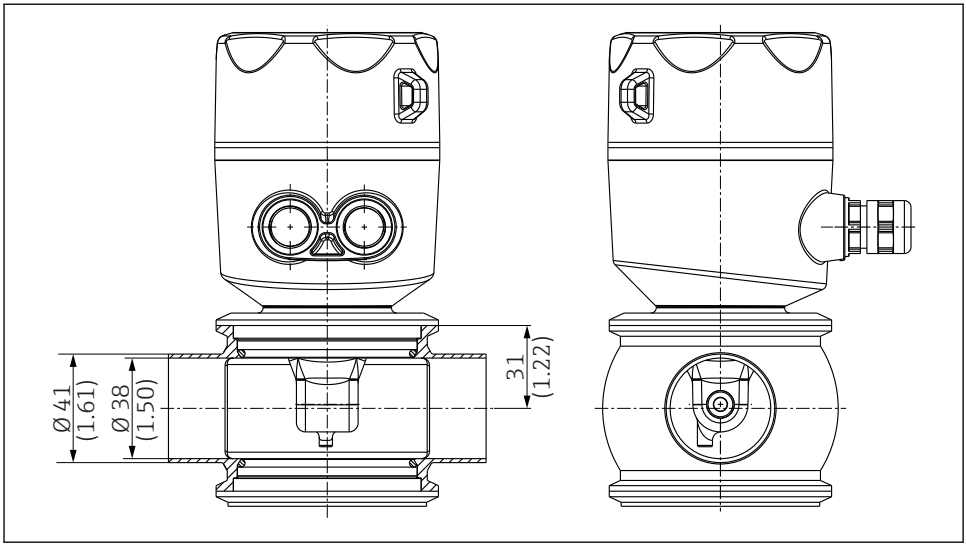
5 Dimensions in mm (inch) and versions (examples)

A Plastic housing with thread G 1½
B Stainless steel housing with ISO 2852 clamp 2"
C Stainless steel housing with Varivent DN 40 to 125
D Plastic housing with coupling nut 2¼" PVC

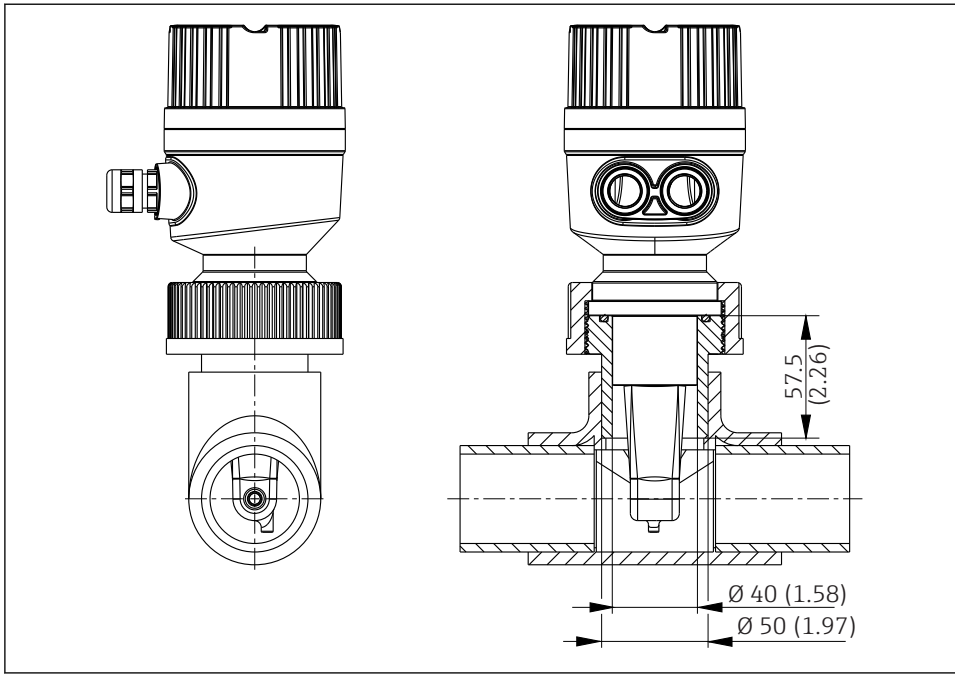
5.1.2 Installation examples



6 Installation in DN 40 pipe with 2" Tri-Clamp process connection, dimensions in mm (inch)



7 Installation in DN 40 pipe with Varivent process connection, dimensions in mm (inch)



8 Installation in DN 40 pipe with coupling nut 2¼" PVC process connection, dimensions in mm (inch)

5.2 Mounting the compact device

Choose the installation depth of the sensor in the medium such that the coil body is completely immersed in the medium.

Pay attention to the information on wall clearance in the "Installation conditions" section.

Mount the compact device directly on a pipe nozzle or tank nozzle via the process connection.

For the 1½" threaded connection, use a Teflon tape to seal the connection and an adjustable pin wrench DIN 1810, flat face, size 45 to 50 mm, to tighten it.

1. When installing, align the compact device in such a way that the medium flows through the flow opening of the sensor in the direction of medium flow. Use the arrow on the nameplate to help you align the device.
2. Tighten the flange.

5.3 Post-installation check

- After installation, check the compact device for damage.
- Ensure that the compact device is protected against direct sunlight.

6 Electrical connection

⚠ WARNING

Device is live

Incorrect connection may result in injury or death

- The electrical connection may be performed only by an electrical technician.
- The electrical technician must have read and understood these Operating Instructions and must follow the instructions contained therein.
- **Prior** to commencing connection work, ensure that no voltage is present on any cable.

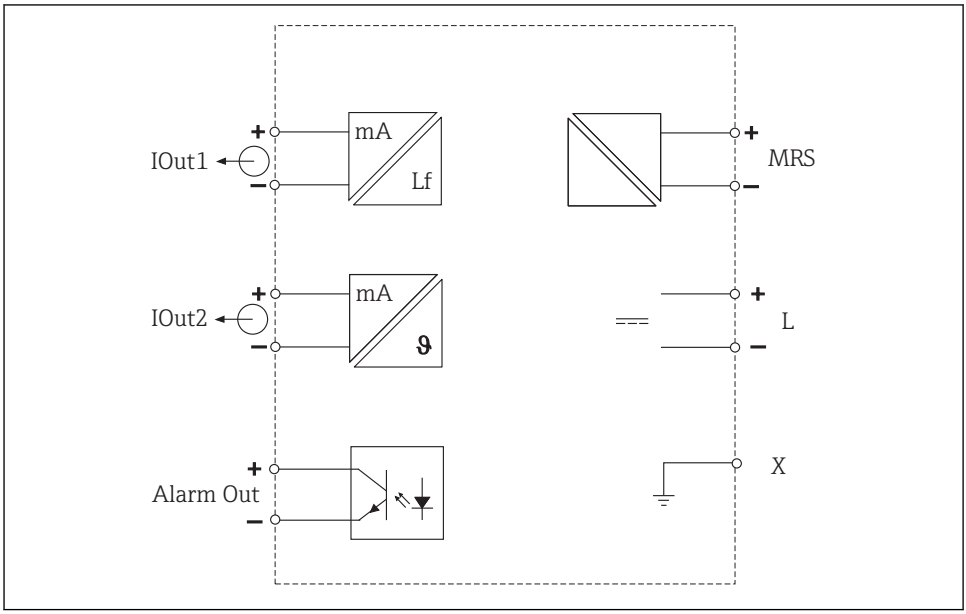
6.1 Electrical connection of the transmitter

⚠ WARNING

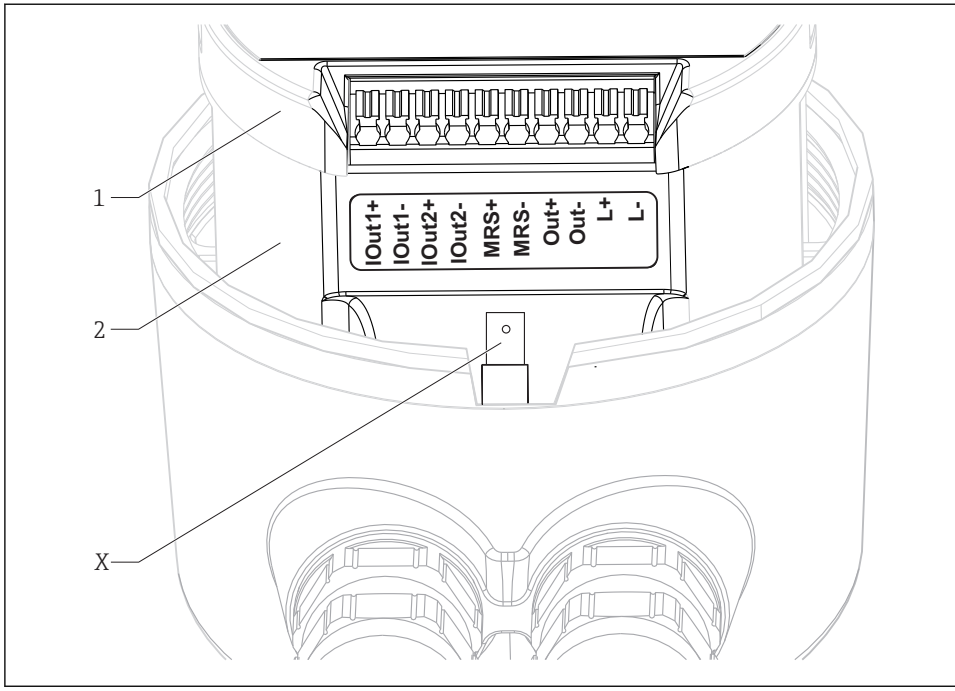
Risk of electric shock!

- At the supply point, the power supply must be isolated from dangerous live cables by double or reinforced insulation in the case of devices with a 24 V power supply.

6.1.1 Direct connection of the cables



9 *Electrical connection*



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10 *Terminal assignment*

IOut1	*Current output conductivity (active)*
IOut2	*Current output temperature (active)*
Out	*Alarm output (open-collector)*
MRS	*Binary input (measuring range switch)*
L+/L-	*Power supply*
X	*Grounding pin (flat male tab 4.8 mm)*
1	*Cover on electronics box*
2	*Electronics box*

NOTICE

Removing the electronics box will destroy the sensor connection!

- ▶ The electronics box must not be removed under any circumstances.
- ▶ Do not open the cover on the electronics box.

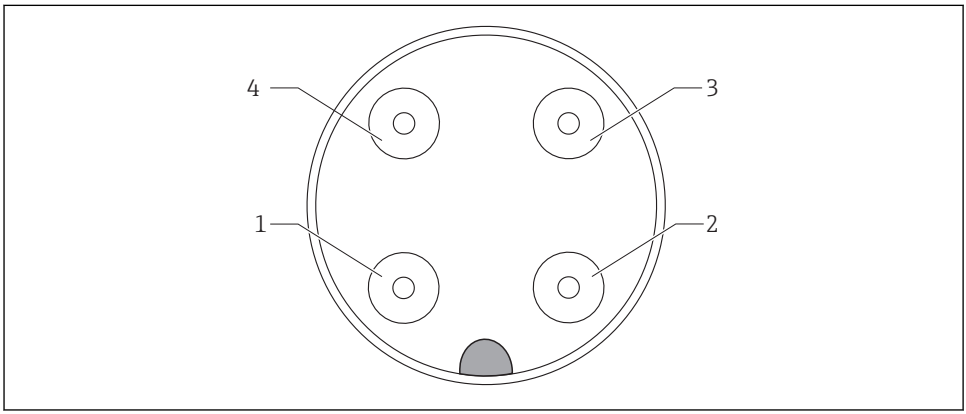
The recommended cable cross-section for the connecting cables is 0.5 mm^2. The maximum cable cross-section is 1.0 mm^2.

Connect the transmitter of the compact device as follows:

1. Unscrew the housing cover.

2. Guide the connecting cables through the cable glands.
3. Connect the cables as per the terminal assignment diagram.
4. Connect the protective ground to the terminal pin for the housing ground.

6.1.2 Connection via M12 connector



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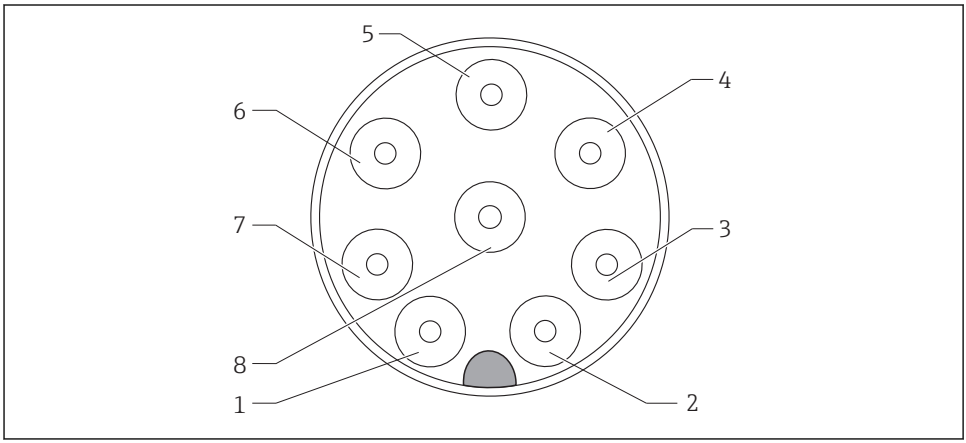
11 *View of connector, 4-pin, data cable (at device)*

1	*IOUT1+*	*Conductivity*	*3*	*IOUT2-*	*Temperature*
2	*IOUT2+*	*Temperature*	*4*	*IOUT1-*	*Conductivity*



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12 *View of connector, 8-pin, power supply/controller (at device)*

1	*L+*	*Power supply*	*5*	*Out+*	*Alarm output+*
2	*L-*	*Power supply*	*6*	*Out-*	*Alarm output-*
3	*MRS+*	*Binary input*	*7*	*GND*	*Functional ground*
4	*MRS-*	*Binary input*	*8*	*GND*	*Functional ground*

6.2 Ensuring the degree of protection

Guarantee the degree of protection as follows:

1. Check that the O-ring is seated correctly in the housing cover.
2. Screw down the housing cover as far as it will go.
3. Tighten the cable glands.

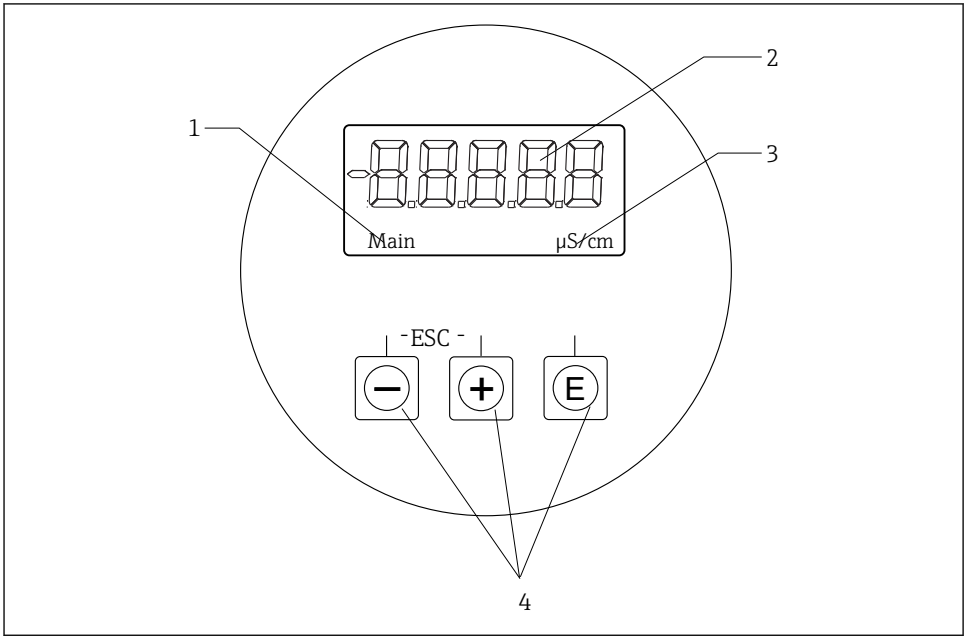
6.3 Post-connection check

Carry out the following checks once you have made the electrical connection:

Instrument status and specifications	Notes
Are the transmitter and cables free from damage on the outside?	Visual inspection

Electrical connection	Notes
Are the installed cables strain-relieved and not twisted?	
Is the cable run correct, without loops and cross-overs?	
Are the signal cables correctly connected as per the wiring diagram?	
Are all the cable entries fitted, tightened and leak-proof?	
Are the PE distributor blocks grounded (if present)?	Grounding is carried out at the point of installation.

7 Operation options



13 *Display and keys of the CLD18*

1 Parameters
2 Measured value
3 Unit
4 Operating keys

The ASTN display (Advanced Super Twisted Nematic) is split into two sections. The segment section displays the measured value. The dot-matrix section displays the parameter and unit. The operating texts are displayed in English.

In the event of an error the device automatically alternates between displaying the error and the measured value.

7.1 Operating keys

 A0029236	▪ Open the Configuration menu ▪ Confirm the entry ▪ Select a parameter or submenu
 A0029235	Within the Configuration menu: ▪ Gradually select the menu items / characters for the parameter ▪ Change the selected parameter Outside the Configuration menu: Display enabled and calculated channels, as well as minimum and maximum values, for all the active channels.
	Press both keys simultaneously (< 3 s) to quit the setup without saving any changes.

You can always quit menu items / submenus at the end of the menu via "x Back".

Symbols in the editing mode:

 A0020597	Accept entry. If this symbol is selected, the entry is applied at the position specified by the user, and you quit editing mode.
 A0020598	Reject entry. If this symbol is selected, the entry is rejected and you quit editing mode. The previously set text remains.
 A0020599	Jump one position to the left. If this symbol is selected, the cursor jumps one position to the left.
 A0020600	Delete backwards. If this symbol is selected, the character to the left of the cursor position is deleted.
 A0020601	Delete all. if this symbol is selected, the entire entry is deleted.

7.2 Menus

The operating functions of the compact measuring device are divided into the following menus:

Display	Settings for the device display: contrast, brightness, time for alternating measured values on the display
Setup	Device settings
Calibration	Perform sensor calibration*
Diagnostics	Device information, diagnostics logbook, sensor information, simulation

* The air set and the correct cell constant have already been configured at the factory for Smartec CLD18 devices. A sensor calibration is not necessary during commissioning.

8 Commissioning

8.1 Switching on the device

Familiarize yourself with the operation of the transmitter before it is first switched on. After power-up, the device performs a self-test and then goes to the measuring mode.

If you are commissioning the device for the first time, program the setup as described in the following sections of the Operating Instructions.

8.2 Display settings (Display menu)

Press the 'E'-key to call up the main menu. The "Display" menu appears on the display. Press the 'E'-key again to open the menu. Use the "x Back" option, which can be found at the bottom of each menu, to move up a level in the menu structure.

Parameters	Possible settings	Description
Contrast	1 to 7 Default: **5**	Setting for the contrast
Brightness	1 to 7 Default: **5**	Setting for the brightness of the display
Alternating time	0, 3, 5, 10 s Default: **5**	Alternating time between the two measured values 0 means that the values do not alternate on the display

8.3 Device configuration (Setup menu)

Press the 'E'-key to call up the main menu. Navigate through the available menus with the '+' and '–' keys. Press the 'E'-key to open the desired menu. Use the "x Back" option, which can be found at the bottom of each menu, to move up a level in the menu structure. Default settings are in bold.

Parameters	Possible settings	Description
Current range	**4-20 mA** 0-20 mA	Select current range
Out1 0/4 mA	0 to 2000000 µS/cm **0 µS/cm**	Use this parameter to enter the measured value at which the min. current value (0/4 mA) is present at the transmitter output.
Out1 20 mA	0 to 2000000 µS/cm **0 µS/cm**	Use this parameter to enter the measured value at which the max. current value (20 mA) is present at the transmitter output.
Out2 0/4 mA	-50 to 250 °C **0.0 °C**	Use this parameter to enter the measured value at which the min. current value (0/4 mA) is present at the transmitter output.
Out2 20 mA	-50 to 250 °C **100.0 °C**	Use this parameter to enter the measured value at which the max. current value (20 mA) is present at the transmitter output.
Damping main	0 ... 60 s **0 s**	Damping value for the conductivity measured value
Extended setup		Advanced settings The functions are described in the following section.
Manual hold	**Off**, On	Function for freezing the current and alarm outputs

8.4 Extended setup (Extended Setup menu)

Press the 'E'-key to call up the main menu. Navigate through the available menus with the '+' and '–' keys. Press the 'E'-key to open the desired menu. Use the "x Back" option, which can be found at the bottom of each menu, to move up a level in the menu structure. Default settings are in bold.

Parameters		Possible settings	Description
System			General settings
	Device tag	Customized text Max. 16 characters	Enter the device designation
	Temp. unit	**°C** °F	Setting for the temperature unit
	Hold release	0 to 600 s **0 s**	Prolongs the device hold when the hold condition no longer applies
	Alarm delay	0 to 600 s **0 s**	Time that delays when an alarm is output. This suppresses alarm conditions that are present for a period that is shorter than the alarm delay time.
Input			Setting for the inputs
	Cell const.	Read only	Displays the cell constant

Parameters	Possible settings	Description
Inst. factor	0.1 to 5.0 **1.0**	The affect of the distance from the wall can be corrected with the installation factor (see the "Installation factor" section).
Unit	**auto**, µS/cm, mS/cm	Unit of conductivity "auto" automatically switches between µS/cm and mS/cm.
Damping main	0 ... 60 s **0 s**	Setting for the damping
Temp. comp.	**Off**, linear	Setting for temperature compensation
Alpha coeff.	1.0 to 20.0 %/K **2.1 %/K**	Coefficient for linear temperature compensation
Ref. temp	+10 to +50 °C **25 °C**	Enter the reference temperature
Process check		The process check checks the measuring signal for stagnation. An alarm is triggered if the measuring signal does not change over a specific period (several measured values).
Function	On, **Off**	Switch the process check on or off
Duration	1 to 240 min **60 min**	The measured value must change within this time as otherwise an error message is triggered.
Observation width	1 to 20 % **0.0 %**	Bandwidth for the process check
Analog outputs		Setting for analog outputs
Current range	**4-20 mA** 0-20 mA	Current range for analog output
Out1 0/4 mA	0 to 2000000 µS/cm **0 µS/cm**	Use this parameter to enter the measured value at which the min. current value (0/4 mA) is present at the transmitter output.
Out1 20 mA	0 to 2000000 µS/cm **0 µS/cm**	Use this parameter to enter the measured value at which the max. current value (20 mA) is present at the transmitter output.
Out2 0/4 mA	-50 to 250 °C **0.0 °C**	Use this parameter to enter the measured value at which the min. current value (0/4 mA) is present at the transmitter output.
Out2 20 mA	-50 to 250 °C **100.0 °C**	Use this parameter to enter the measured value at which the max. current value (20 mA) is present at the transmitter output.
MRS		Setting for measuring range switching (see "MRS (Measuring range switch)" section)
Out1 0/4 mA	0 to 2000000 µS/cm **0 µS/cm**	Use this parameter to enter the measured value at which the min. current value (0/4 mA) is present at the transmitter output.
Out1 20 mA	0 to 2000000 µS/cm **0 µS/cm**	Use this parameter to enter the measured value at which the max. current value (20 mA) is present at the transmitter output.
Out2 0/4 mA	-50 to 250 °C **0.0 °C**	Use this parameter to enter the measured value at which the min. current value (0/4 mA) is present at the transmitter output.
Out2 20 mA	-50 to 250 °C **100.0 °C**	Use this parameter to enter the measured value at which the max. current value (20 mA) is present at the transmitter output.

Parameters		Possible settings	Description
	Damping main	0 ... 60 s **0 s**	Setting for the damping
	Alpha coeff.	1.0 to 20 %/K **2.1 %/K**	Coefficient for linear temperature compensation
Factory default			Factory settings
	Please confirm	**no** no, yes	

8.4.1 Installation factor

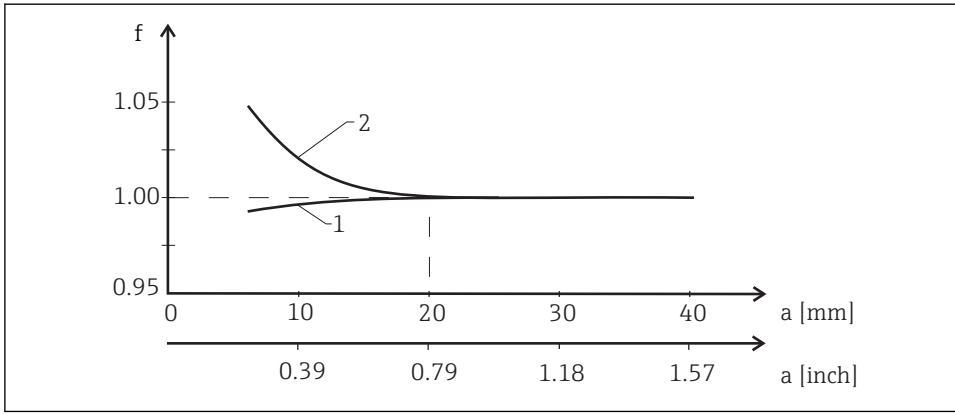
In confined installation conditions, the conductivity measurement is affected by the pipe walls. The installation factor compensates for this effect. The cell constant is corrected by multiplying by the installation factor.

The value of the installation factor depends on the diameter and the conductivity of the pipe nozzle as well as the sensor's distance to the wall.

The installation factor f (f = 1.00) can be disregarded if the distance to the wall is sufficient (a>20 mm (0.79"), from DN60).

If the distance from the wall is small, the installation factor increases for electrically insulating pipes (f > 1), and decreases for electrically conductive pipes (f < 1).

It can be measured using calibration solutions, or a close approximation determined from the following diagram.



14 Relationship between the installation factor (f) and the distance from wall (a)

1 Electrically conductive pipe wall
2 Electrically insulating pipe wall

8.4.2 Temperature compensation

The conductivity of a liquid depends heavily on the temperature, as the mobility of the ions and the number of dissociated molecules are temperature-dependent. In order to compare measured values, they must be referenced to a defined temperature. The reference temperature is 25 °C (77 °F).

The temperature is always specified when the conductivity is specified. $k(T_0)$ represents the conductivity measured at 25 °C (77 °F) or referenced back to 25 °C (77 °F).

The temperature coefficient α represents the percentage change in the conductivity per degree of temperature change. The conductivity k at the process temperature is calculated as follows:

$$\kappa(T) = \kappa(T_0) \cdot (1 + \alpha \cdot (T - T_0))$$

A0009163

Where
$k(T)$ = conductivity at process temperature T
$k(T_0)$ = conductivity at process temperature T_0
The temperature coefficient depends on both the chemical composition of the solution and on the temperature, and is between 1 and 5 % per °C. The electrical conductivity of the majority of diluted saline solutions and natural waters changes in a close-to-linear fashion.

Typical values for the temperature coefficient α:

Natural waters	Approx. 2 %/K
Salts (e.g. NaCl)	Approx. 2.1 %/K
Alkali (e.g. NaOH)	Approx. 1.9 %/K
Acids (e.g. HNO_3)	Approx. 1.3 %/K

8.4.3 Measuring range switch (MRS)

Measuring range switching involves a parameter set changeover for two substances:
- in order to cover a large measuring range
- in order to adjust temperature compensation in the event of a product change

The two analog outputs can each be configured with two parameter sets.
- Parameter set 1:
  - The parameters for the current outputs and the damping can be set in the Setup menu.
  - The alpha coefficient for temperature compensation can be set in the Setup/Extended Setup/Input menu.
  - Parameter set 1 is active if the "MRS" binary input is LOW.
- Parameter set 2:
  - The parameters for the current outputs, the damping and the alpha coefficient for temperature compensation can be set in the Setup/Extended Setup/Remote Switch menu.
  - Parameter set 2 is active if the "MRS" binary input is HIGH.

The settings for parameter set 1 are also listed in the Extended Setup/Analog Outputs menu.

The LOW and HIGH specifications are described in the "Technical data" section.

8.5 Calibration (Calibration menu)

The air set and the correct cell constant have already been configured at the factory for Smartec CLD18 devices. A sensor calibration is not necessary during commissioning.

8.5.1 Types of calibration

The following types of calibration are possible:
- Cell constant with calibration solution
- Air set (residual coupling)

8.5.2 Cell constant

General

A conductivity measuring system is generally calibrated in such a way that the exact cell constant is determined or checked using suitable calibration solutions. This process is described in the standards EN 7888 and ASTM D 1125, for example, and the method for producing a number of calibration solutions is explained.

Calibrating the cell constant

You enter a reference value for the conductivity with this type of calibration. In the result, the device calculates a new cell constant for the sensor.

First switch off the temperature compensation:

1. Select the "Setup" / "Extended setup" / "Input" / "Temp. comp:" menu.
2. Select "Off".
3. Return to the "Setup" menu.

Perform the calculation of the cell constant as follows:

1. Select the "Calibration" / "Cell const." menu.
   ↳ Select "Cond. ref." and enter the value of the standard solution.
2. Insert the sensor into the medium (Insert sensor in med.).
3. Start the calibration.
   ↳ "Wait calib." - Wait for the calibration to be completed - the new value is displayed after the calibration.
4. Press the Plus key.
   ↳ "Save calib data?"
5. Select "Yes".
   ↳ "Calib successful"
6. Switch the temperature compensation back on.

8.5.3 Air set (residual coupling)

While the calibration line goes through zero for physical reasons in the case of conductive sensors (a current flow of 0 corresponds to a conductivity of 0), when working with inductive sensors, the residual coupling between the primary coil (transmitter coil) and secondary coil (receiver coil) must be taken into account or compensated for. The residual coupling is not only caused by the direct magnetic coupling of the coils but also by crosstalk in the supply cables.

The cell constant is then determined using a precise calibration solution, as is the case with the sensors.

To perform an airset, the sensor must be dry.

Perform an airset as follows:

1. Select "Calibration" / "Airset".
   ↳ The current value is displayed.
2. Press the Plus key.
   ↳ "Keep sensor in air"
3. Keep the dried sensor in air and press the Plus key.
   ↳ "Wait calib." - Wait for the calibration to be completed - the new value is displayed after the calibration.
4. Press the Plus key.
   ↳ "Save calib data?"
5. Select "Yes".
   ↳ "Calib successful"
6. Press the Plus key.
   ↳ The device switches back to measuring mode.

9 Diagnostics and troubleshooting

9.1 Trouble shooting instructions

Press the 'E'-key to call up the main menu. Navigate through the available menus with the '+' and '–' keys. Press the 'E'-key to open the desired menu. Use the "x Back" option, which can be found at the bottom of each menu, to move up a level in the menu structure.

Parameters		Possible settings	Description
Current diag.		Read only	Displays the current diagnostic message
Last diag		Read only	Displays the last diagnostic message
Diagnost logbook		Read only	Displays the last diagnostic messages
Device info		Read only	Displays device information
Sensor info		Read only	Displays sensor information
Simulation			
	Analog out 1	**Off** 0 mA, 3.6 mA, 4 mA, 10 mA, 12 mA, 20 mA, 21 mA	Outputs a corresponding value at "analog out 1".
	Analog out 2	**Off** 0 mA, 3.6 mA, 4 mA, 10 mA, 12 mA, 20 mA, 21 mA	Outputs a corresponding value at "analog out 2".
	Alarm out	**Off** Active Inactive	
Reset device			

9.2 Trouble shooting instructions

User interface	Cause	Solution
No measured value displayed	No power supply connected	Check the power supply of the device.
	Power is supplied, device is defective	The device must be replaced.
Diagnostic message is displayed	The list of diagnostic messages is provided in the following section.	

9.3 Diagnostic messages

The diagnostic message consists of a diagnostic code and a message text. The diagnostic code consists of the error category as per Namur NE 107 and the message number.

Error category (letter in front of the message number)
- F = Failure. A malfunction has been detected.
  The measured value of the affected channel is no longer reliable. The cause of the malfunction is to be found in the measuring point. Any controller connected should be set to manual mode.
- M = Maintenance required. Action may have to be taken soon.
  The device still measures correctly. Immediate measures are not necessary. However, proper maintenance efforts would prevent a possible malfunction in the future.
- C = Function check, waiting (no error)
  Maintenance work is being performed on the device. Wait until the work has been completed.
- S = Out of specification. The measuring point is being operated outside specifications. Operation is still possible. However, you run the risk of increased wear, shorter operating life or lower measurement accuracy. The cause of the problem is to be found outside the measuring point.

Diagnostic code	Message text	Description
F61	Sensor elec.	Sensor electronics defective Remedy: Contact the Service Department
F62	Sens. Connect	Sensor connection Remedy: Contact the Service Department
F100	Sensor comm.	Sensor not communicating Possible reasons: No sensor connection Remedy: Contact the Service Department
F130	Sensor supply	Sensor check No conductivity displayed Possible reasons: ▪ Sensor in air ▪ Sensor defective Remedy: ▪ Check sensor installation ▪ Contact the Service Department
F143	Self-test	Sensor self-test error Remedy: Contact the Service Department

Diagnostic code	Message text	Description
F152	No airset	Sensor data No calibration data available Remedy: Perform an air set
F523	Cell const.	Sensor calibration warning Invalid cell constant, max. range reached Remedy: ▪ Enter cell constant as per factory specifications ▪ Contact the Service Department
F524	Cell const.	Sensor calibration warning Min. possible cell constant is undershot Remedy: ▪ Enter cell constant as per factory specifications ▪ Contact the Service Department
F845	Device ID	Incorrect hardware configuration
F847	Couldn't save param	Parameter incorrect
F848	Calib AO1	Incorrect calibration values for analog output 1
F849	Calib AO2	Incorrect calibration values for analog output 2
F904	Process check	Process check system alarm Measuring signal has not changed for a long time Possible reasons: ▪ Contaminated sensor, or sensor in air ▪ No flow to sensor ▪ Sensor defective ▪ Software error Remedy: ▪ Check electrode system ▪ Check sensor ▪ Restart device

Diagnostic code	Message text	Description
C107	Calib. active	Sensor calibration is active Remedy: Wait for calibration to be finished
C154	No calib. data	Sensor data No calibration data available, factory settings are used Remedy: ▪ Check the calibration information of the sensor ▪ Contact the Service Department
C850	Simu AO1	Simulation of analog output 1 is active
C851	Simu AO2	Simulation of analog output 2 is active

Diagnostic code	Message text	Description
S844	Process value	Measured value outside the specified range Possible reasons: ▪ Sensor in air ▪ Incorrect flow to sensor ▪ Sensor defective Remedy: ▪ Increase process value ▪ Check electrode system

Diagnostic code	Message text	Description
M500	Not stable	Sensor calibration aborted Main measured value fluctuating Possible reasons: ▪ Sensor in air ▪ Sensor fouled ▪ Incorrect flow to sensor ▪ Sensor defective Remedy: ▪ Check sensor ▪ Check installation
M526	Cell const.	Sensor calibration warning Invalid cell constant, max. range reached Remedy: ▪ Repeat the calibration ▪ Enter cell constant as per factory specifications ▪ Contact the Service Department
M528	Cell const.	Sensor calibration warning Min. possible cell constant is undershot Remedy: ▪ Repeat the calibration ▪ Enter cell constant as per factory specifications ▪ Contact the Service Department

10 Maintenance

WARNING

Risk of injury if medium escapes!

- ▶ Before performing any maintenance work, make sure that the process pipe is unpressurized, empty and has been rinsed.

The electronics box does not contain any parts that the user must maintain.
- The cover on the electronics box may be opened only by Endress+Hauser Service staff.
- The electronics box may be removed only by Endress+Hauser Service staff.

10.1 Cleaning the housing

Clean the front of the housing using commercially available cleaning agents only.

The front of the housing is resistant to the following in accordance with DIN 42 115:
- Ethanol (for a short time)
- Diluted acids (max. 2% HCl)
- Diluted alkaline solutions (max. 3% NaOH)
- Soap-based household cleaning agents

When performing any work on the device, bear in mind any potential impact this may have on the process control system or on the process itself.

NOTICE

Prohibited cleaning agents

Damage to the housing surface or housing seal

- ▶ Never use concentrated mineral acids or alkaline solutions for cleaning.
- ▶ Never use organic cleaners such as benzyl alcohol, methanol, methylene chloride, xylene or concentrated glycerol cleaner.
- ▶ Never use high-pressure steam for cleaning purposes.

11 Repairs

The O-ring is defective if medium escapes from the leakage hole. Contact the E+H Service Department to replace the O-ring.

11.1 Return

The product must be returned if repairs or a factory calibration are required, or if the wrong product was ordered or delivered. As an ISO-certified company and also due to legal regulations, Endress+Hauser is obliged to follow certain procedures when handling any returned products that have been in contact with medium.

To ensure swift, safe and professional device returns, please read the return procedures and conditions at www.endress.com/support/return-material.

11.2 Disposal

The device contains electronic components and must therefore be disposed of in accordance with regulations on the disposal of electronic waste.

Observe the local regulations.

12 Accessories

The following are the most important accessories available at the time this documentation was issued. For accessories not listed here, please contact your service or sales office.

12.1 Calibration solutions

Conductivity calibration solutions CLY11
Precision solutions referenced to SRM (Standard Reference Material) by NIST for qualified calibration of conductivity measuring systems in accordance with ISO 9000

- CLY11-C, 1.406 mS/cm (reference temperature 25 °C (77 °F)), 500 ml (16.9 fl.oz)
  Order No. 50081904
- CLY11-D, 12.64 mS/cm (reference temperature 25 °C (77 °F)), 500 ml (16.9 fl.oz)
  Order No. 50081905
- CLY11-E, 107.00 mS/cm (reference temperature 25 °C (77 °F)), 500 ml (16.9 fl.oz)
  Order No. 50081906

Technical Information TI00162C

13 Technical data

13.1 Input

13.1.1 Measured variable

Conductivity

Temperature

13.1.2 Measuring range

Conductivity:	Recommended range: 200 µS/cm to 1000 mS/cm (uncompensated)
Temperature:	−10 to +130 °C (+14 to +266 °F)

13.1.3 Temperature measurement

Pt 1000

13.1.4 Binary input

The binary input is used for measuring range switching.

Voltage range	0 V to 30 V
Voltage HIGH min.	12 V
Voltage LOW max.	9.0 V
Current consumption at 24 V	30 mA
Undefined voltage range	9.0 to 12 V

13.2 Output

13.2.1 Output signal

Conductivity:	0 / 4 to 20 mA, galvanically isolated
Temperature:	0 / 4 to 20 mA, galvanically isolated

13.2.2 Load

Max. 500 Ω

13.2.3 Characteristic

Linear

13.2.4 Signal resolution

Resolution:	> 13 bit
Accuracy:	± 20 µA

13.2.5 Alarm output

The alarm output is implemented as an "open collector".

Max. current	200 mA
Max. voltage	30 V DC

Error or device without supply voltage	Alarm output blocked (0 mA)
No error	Alarm output open (up to 200 mA)

13.3 Power supply

13.3.1 Supply voltage

24 V DC ±20 %, protected against reverse polarity

13.3.2 Power consumption

3 W

13.3.3 Cable specification

Recommendation	0.5 mm^2
max.	1.0 mm^2

13.4 Performance characteristics

13.4.1 Response time

Conductivity:	t_{95} < 1.5 s
Temperature:	t_{90} < 50 s

13.4.2 Maximum measured error

Conductivity:	± (2.0 % of measured value + 20 µS/cm)
Temperature:	± 1.5 K
Signal outputs	± 50 µA

13.4.3 Repeatability

Conductivity:	max. 0.5 % of measured value ± 5 µS/cm ± 2 digits

13.4.4 Cell constant

11.0 cm^{-1}

13.4.5 Temperature compensation

Range	−10 to +130 °C (+14 to +266 °F)
Types of compensation	▪ None ▪ Linear with user-configurable temperature coefficient

13.4.6 Reference temperature

25 °C (77 °F)

13.5 Environment

13.5.1 Ambient temperature range

Stainless steel process connection: -20 to +60 °C (-4 to +140 °F)
PVC process connection: -10 to +60 °C (14 to 140 °F)

13.5.2 Storage temperature

Stainless steel process connection: -25 to +80 °C (-13 to +176 °F)
PVC process connection: -10 to +60 °C (14 to 140 °F)

13.5.3 Humidity

≤ 100 %, condensating

13.5.4 Climate class

Climate class 4K4H as per EN 60721-3-4

13.5.5 Degree of protection

IP 69k as per EN 40050:1993

Degree of protection NEMA TYPE 6P as per NEMA 250-2008

13.5.6 Shock resistance

Complies with IEC 61298-3, certified up to 5 g

13.5.7 Vibration resistance

Complies with IEC 61298-3, certified up to 5 g

13.5.8 Electromagnetic compatibility

Interference emission as per EN 61000-6-3:2007 + A1:2011 and EN 55011:2009 + A1:2010

Interference immunity as per EN 61326-1:2013

13.6 Process

13.6.1 Process temperature

Stainless steel process connection:

-10 to +110 °C (14 to 230 °F)

Max.130 °C (266 °F) up to 60 minutes

PVC process connection:

-10 to +60 °C (14 to 140 °F)

13.6.2 Absolute process pressure

Stainless steel process connection:

13 bar (188.5 psi), abs to up to 50 °C (122 °F)

7.75 bar (112 psi), abs at 110 °C (230 °F)

6.0 bar (87 psi), abs at 130 °C (266 °F) max. 60 minutes

1 to 6 bar (14.5 to 87 psi), abs in CRN environment tested with 50 bar (725 psi)

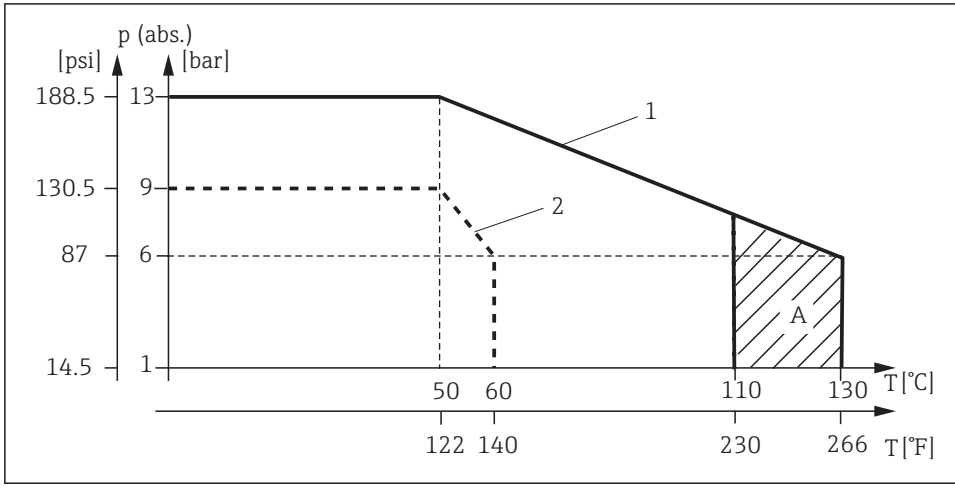
PVC process connection:

9 bar (130.5 psi), abs to up to 50 °C (122 °F)

6.0 bar (87 psi), abs at 60 °C (140 °F)

1 to 6 bar (14.5 to 87 psi), abs in CRN environment tested with 50 bar (725 psi)

13.6.3 Pressure-temperature ratings



15 Pressure-temperature ratings

1 Stainless steel process connection
2 PVC process connection
A Process temperature increased briefly (max. 60 minutes)

13.6.4 Flow velocity

max. 10 m/s (32.8 ft/s) for low-viscosity media in pipe DN 50

13.7 Mechanical construction

13.7.1 Dimensions

→ Section "Installation"

13.7.2 Weight

Stainless steel housing:	up to 1.870 kg (4.12 lbs)
Plastic housing:	up to 1.070 kg (2.36 lbs)

13.7.3 Materials

In contact with medium

Sensor:	PEEK (polyetheretherketone)
Process connection:	Stainless steel 1.4435 (AISI 316 L), PVC-U
Seal:	EPDM

Not in contact with medium

Stainless steel housing:	Stainless steel 1.4308 (ASTM CF-8, AISI 304)
Plastic housing:	PBT GF20, PBT GF10
Seals:	EPDM
Window:	PC
Cable glands:	PA, TPE

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