

# Brief Operating Instructions

## Solitrend MMP40

Material moisture measurement



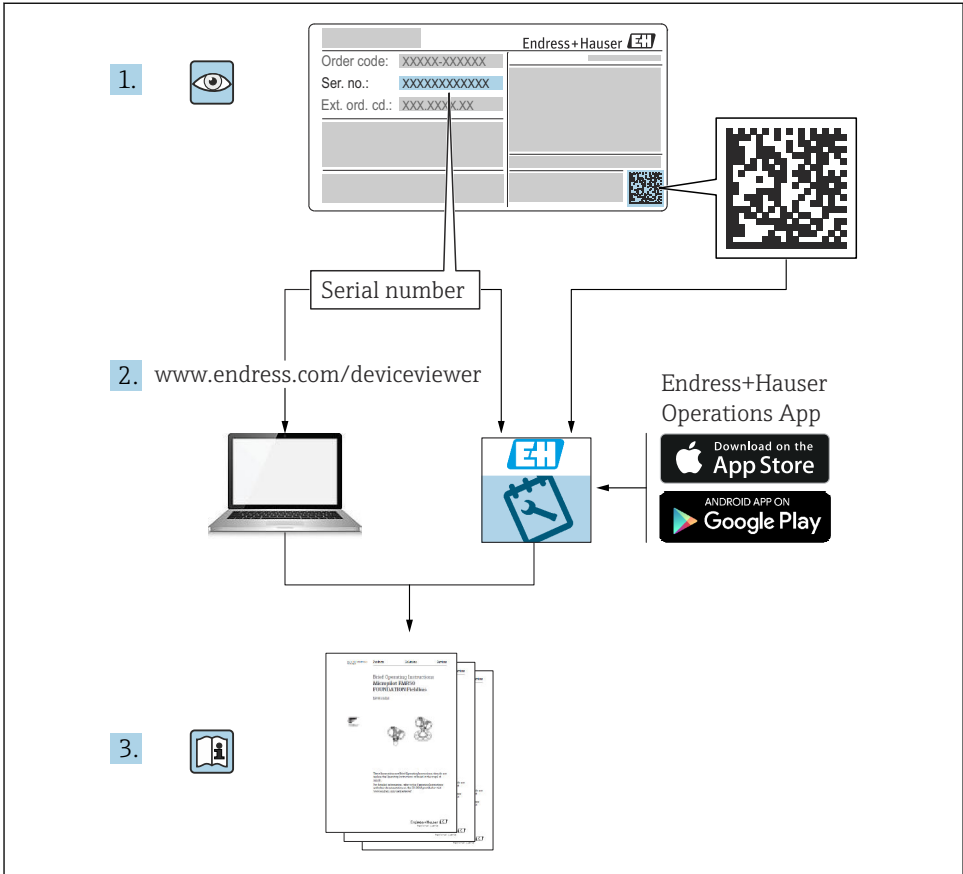
These Brief Operating Instructions are not a substitute for the Operating Instructions pertaining to the device.

Detailed information can be found in the Operating Instructions and the additional documentation.

Available for all device versions via:

- Internet: [www.endress.com/deviceviewer](http://www.endress.com/deviceviewer)
- Smartphone/tablet: Endress+Hauser Operations app

# 1 Associated documentation



## 2 About this document

### 2.1 Symbols used

#### 2.1.1 Safety symbols

** DANGER**

This symbol alerts you to a dangerous situation. Failure to avoid this situation will result in serious or fatal injury.

**⚠ WARNING**

This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in serious or fatal injury.

**⚠ CAUTION**

This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in minor or medium injury.

**ℹ NOTICE**

This symbol contains information on procedures and other facts which do not result in personal injury.

### 2.1.2 Symbols for certain types of information and graphics

**✔ Permitted**

Procedures, processes or actions that are permitted

**✘ Forbidden**

Procedures, processes or actions that are forbidden

**i Tip**

Indicates additional information



Reference to documentation



Reference to graphic



Notice or individual step to be observed



Series of steps



Result of a step

1, 2, 3, ...

Item numbers

A, B, C, ...

Views

## 3 Basic safety instructions

### 3.1 Requirements for personnel

The personnel for installation, commissioning, diagnostics and maintenance must fulfill the following requirements:

- ▶ Trained, qualified specialists must have a relevant qualification for this specific function and task.
- ▶ Personnel must be authorized by the plant owner/operator.

- ▶ Be familiar with federal/national regulations.
- ▶ Before starting work: personnel must read and understand the instructions in the manual and supplementary documentation as well as the certificates (depending on the application).
- ▶ Personnel must follow instructions and comply with general policies.

The operating personnel must fulfill the following requirements:

- ▶ Personnel are instructed and authorized according to the requirements of the task by the facility's owner-operator.
- ▶ Personnel follow the instructions in this manual.

## 3.2 Intended use

### Application and media

The measuring device described in this manual is intended for the continuous moisture measurement of a wide variety of materials. Due to its operating frequency of approx. 1 GHz, the device can also be used outside of closed metal vessels.

If operated outside of closed vessels, the device must be mounted in accordance with the instructions in the "Installation" section. The operation of the devices does not present any health risk. If the limit values specified in the "Technical data" and the conditions listed in the instructions and additional documentation are observed, the measuring device may be used only for the following measurements:

- Measured process variables: material moisture, material conductivity and material temperature

To ensure that the device remains in proper condition throughout the operating period:

- ▶ Use the device only for media to which the process-wetted materials are sufficiently resistant.
- ▶ Observe the limit values in the "Technical data".

### Incorrect use

The manufacturer is not liable for damage caused by using the device incorrectly or for purposes for which it was not intended.

Verification for borderline cases:

- ▶ With regard to special fluids and media used for cleaning, the manufacturer is glad to assist in clarifying the corrosion resistance of materials in contact with the fluid, but does not accept any warranty or liability.

### Residual risks

Due to the transfer of heat from the process and power dissipation within the electronics, the temperature of the electronics housing and the assemblies contained therein may increase to up to 70 °C (158 °F) during operation. When in operation, the sensor can reach a temperature close to the medium temperature.

Danger of burns from contact with surfaces!

- ▶ In the event of high medium temperatures, ensure protection against contact to prevent burns.

### 3.3 Workplace safety

For work on and with the device:

- ▶ Wear the required personal protective equipment according to federal/national regulations.

### 3.4 Operational safety

Risk of injury!

- ▶ Operate the device only if it is in proper technical condition, free from errors and faults.
- ▶ The operator is responsible for interference-free operation of the device.

#### Hazardous area

To eliminate the risk of danger to persons or the facility when the device is used in the approval-related area (e.g. explosion protection, pressure equipment safety):

- ▶ Check the nameplate to verify if the device ordered can be put to its intended use in the approval-related area.
- ▶ Observe the specifications in the separate supplementary documentation that is an integral part of this manual.

### 3.5 Product safety

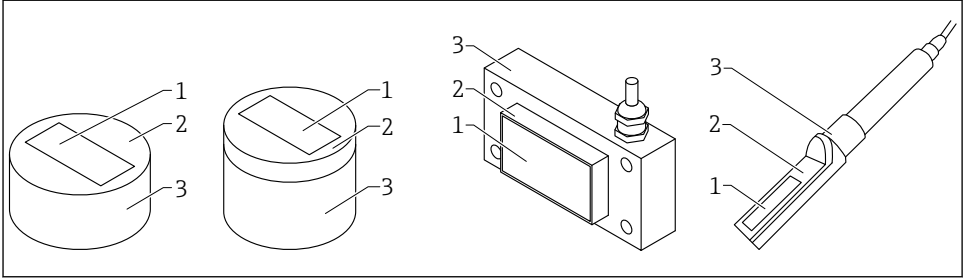
This device is designed in accordance with good engineering practice to meet state-of-the-art safety requirements, has been tested, and left the factory in a condition in which it is safe to operate.

It meets the general safety standards and legal requirements. It also complies with the EU directives listed in the device-specific EU Declaration of Conformity. The manufacturer confirms this by affixing the CE mark to the device.

## 4 Product description

TDR material moisture sensors for measuring bulk solids and media with higher material densities and conductivity values up to 20 mS/cm.

### 4.1 Product design

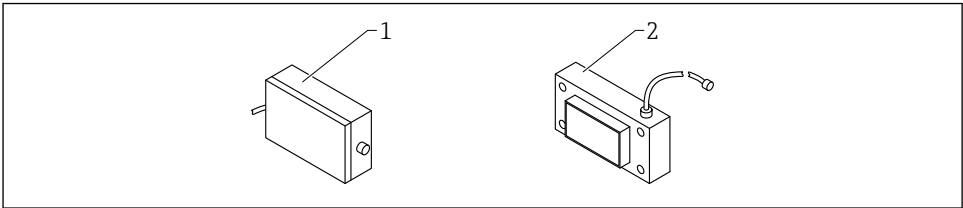


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#### 1 Product design

- 1 Measuring cell; ceramic (silicon nitride)
- 2 Sensor plate
- 3 Housing

### 4.2 ATEX version



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#### 2 Rectangular sensor, ATEX version


- 1 ATEX electronics housing
- 2 Rectangular sensor

## 5 Incoming acceptance and product identification

### 5.1 Incoming acceptance

Check the following during incoming acceptance:

- Are the order codes on the delivery note and the product sticker identical?
- Are the goods undamaged?

- Do the nameplate data match the ordering information on the delivery note?
- If required (see nameplate): Are the safety instructions (XA) provided?
-  If one of these conditions is not met, please contact the manufacturer's sales office.

## 5.2 Product identification

The following options are available for identification of the device:

- Nameplate specifications
- Extended order code with breakdown of the device features on the delivery note
- ▶ Enter serial number from nameplates in *W@M Device Viewer* ([www.endress.com/deviceviewer](http://www.endress.com/deviceviewer))
  - ↳ All of the information on the measuring device and on the scope of the technical documentation pertaining to the device is displayed.
- ▶ Enter the serial number from the nameplate into the *Endress+Hauser Operations App* or scan the 2-D matrix code on the nameplate.
  - ↳ All of the information on the measuring device and on the scope of the technical documentation pertaining to the device is displayed.

## 5.3 Manufacturer's address

Endress+Hauser SE+Co. KG  
Hauptstraße 1  
79689 Maulburg, Germany

## 5.4 Storage, transport

### 5.4.1 Storage conditions

- Permitted storage temperature: -40 to +70 °C (-40 to +158 °F)
- Use original packaging.


### 5.4.2 Transporting the product to the measuring point

Transport the device to the measuring point in the original packaging.

## 6 Mounting

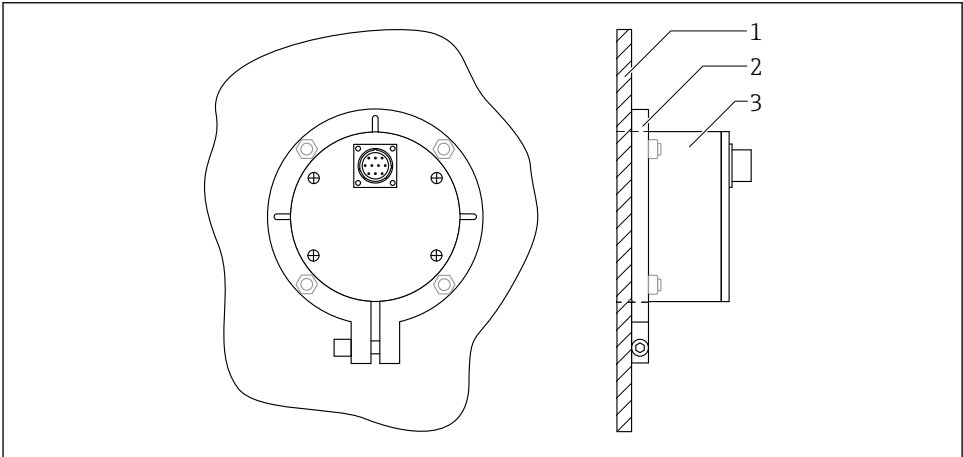
### 6.1 Mounting requirements

- The device must be installed at a point in the process in such a way that ensures a constant bulk density, as the bulk density directly affects the calculation of the water content. Where necessary, a bypass should be created or structural measures may be needed at the place of installation to ensure that the material flow, and therefore the bulk density, over the measurement surface is constant.
- The measuring field of the device must be completely covered by material and the material height must exceed the minimum layer of material covering on the measurement surface (depends on the device type and moisture).
- The flow of material over the measurement surface must be continuous. With the software, it is possible to automatically detect and bridge gaps in material flow in intervals of seconds.
- No material deposits or buildup may form on the measuring cell surface, as this would falsify the readings.


 Longer averaging times increase the stability of the measured value.

### 6.2 Round sensor, short/middle

The round sensor, short / middle version, can be mounted with a mounting flange.



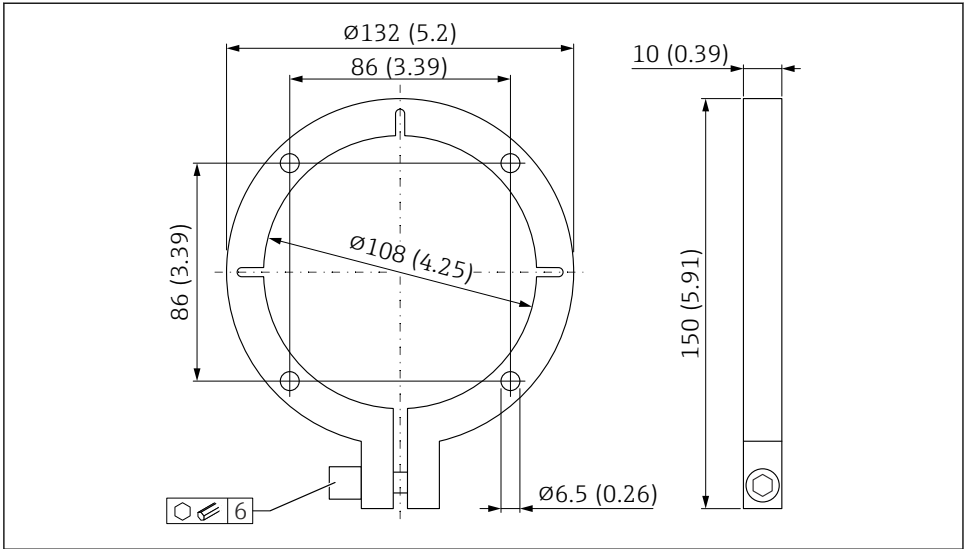
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 3 Round sensor mounted, rear view

- 1 Vessel wall
- 2 Mounting flange
- 3 Round sensor, short / middle

The mounting flange for the round sensor, short version or for the round sensor, middle version can be mounted on the floor or on the side wall of the vessel.



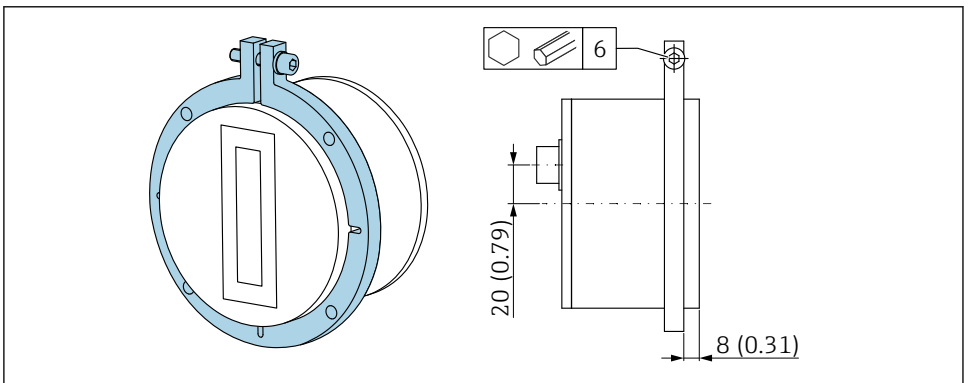


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- 4 *Mounting flange for round sensor, short version or round sensor, middle version. Unit of measurement mm (in)*

The mounting flange serves as a template for the mounting bore holes and the cut-out for the sensor at the mounting location:

1. Check the fit between the sensor and mounting flange
2. Make the cut-out for the sensor at the mounting location
3. Mount the sensor and align it
  - ↳ The surface of the measuring cell is flush-fitted on the material side

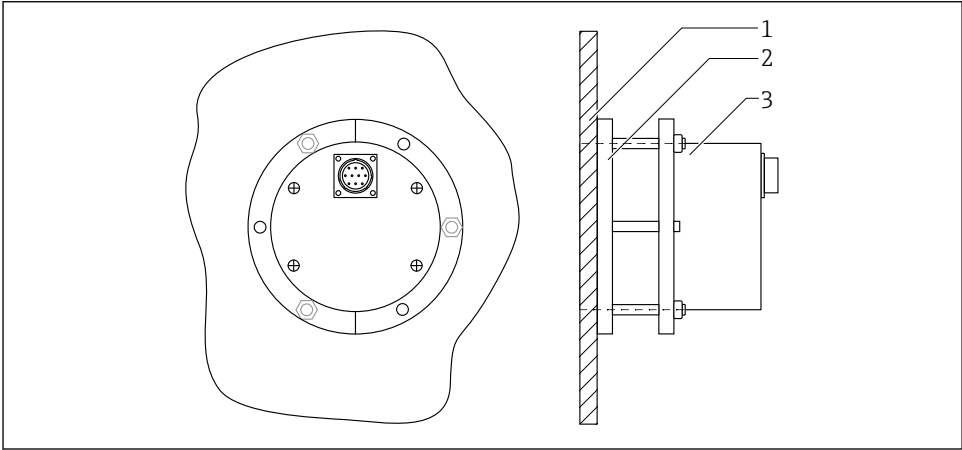


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- 5 *Mounting position, mounting flange and round sensor. Unit of measurement mm (in)*

### 6.3 Round sensor, long

The round sensor, long version, can be mounted with a mounting frame.

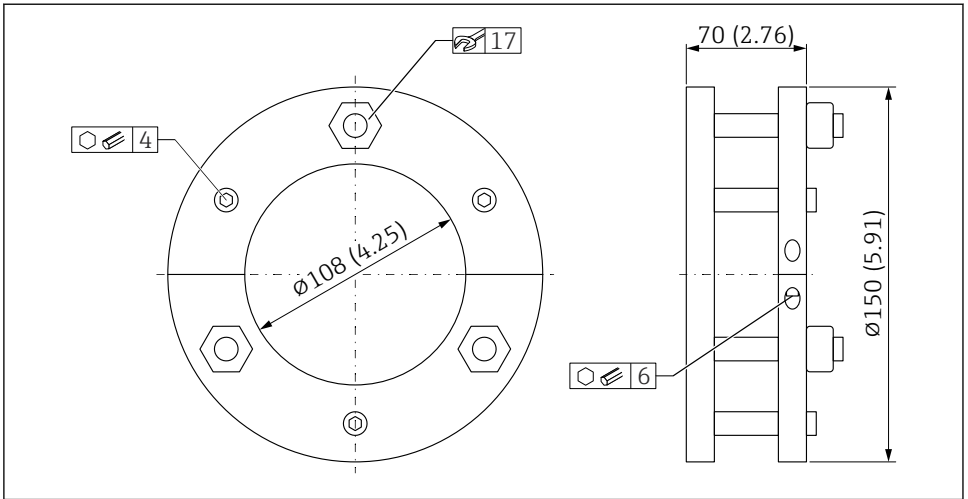



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 6 Round sensor mounted, long version, rear view

- 1 Vessel wall
- 2 Mounting frame with clamping ring
- 3 Round sensor, long

The mounting frame for the round sensor, long version, can be welded onto the floor or side wall of the vessel. At the clamping ring, the sensor can be adjusted to the correct height or position using adjusting screws and nuts.



 7 Mounting frame for round sensor, long version. Unit of measurement mm (in)

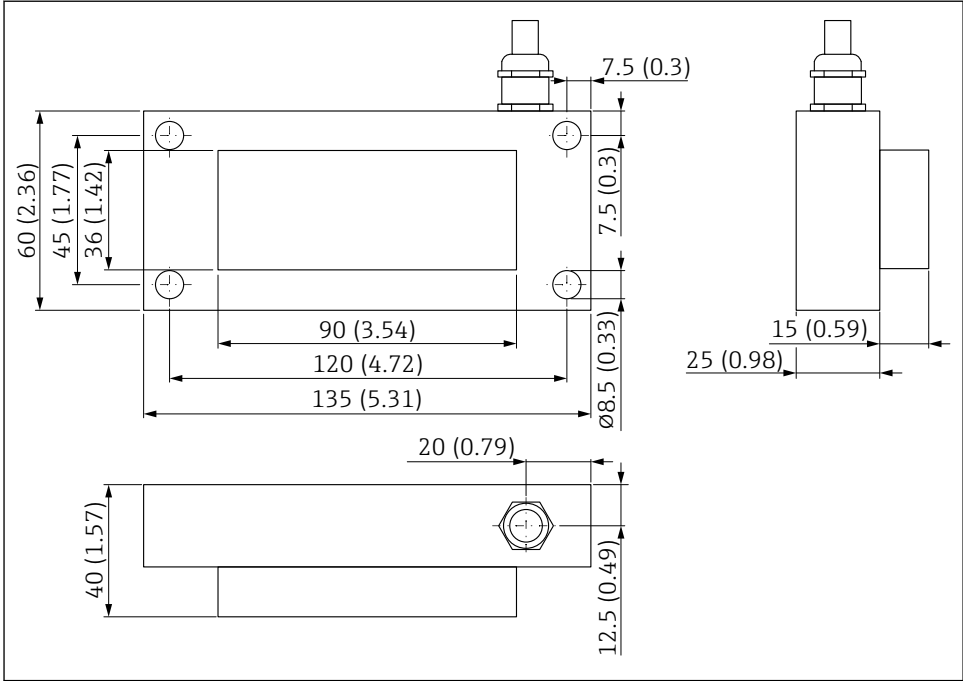
Before welding the mounting flange at the mounting location:

1. Check the fit between the sensor and mounting frame
2. Make the cut-out for the sensor at the mounting location
3. Mount the sensor and align it
  - ↳ The surface of the measuring cell is flush-fitted on the material side

## 6.4 Rectangular sensor

The rectangular sensor can be installed with four screws (M8).

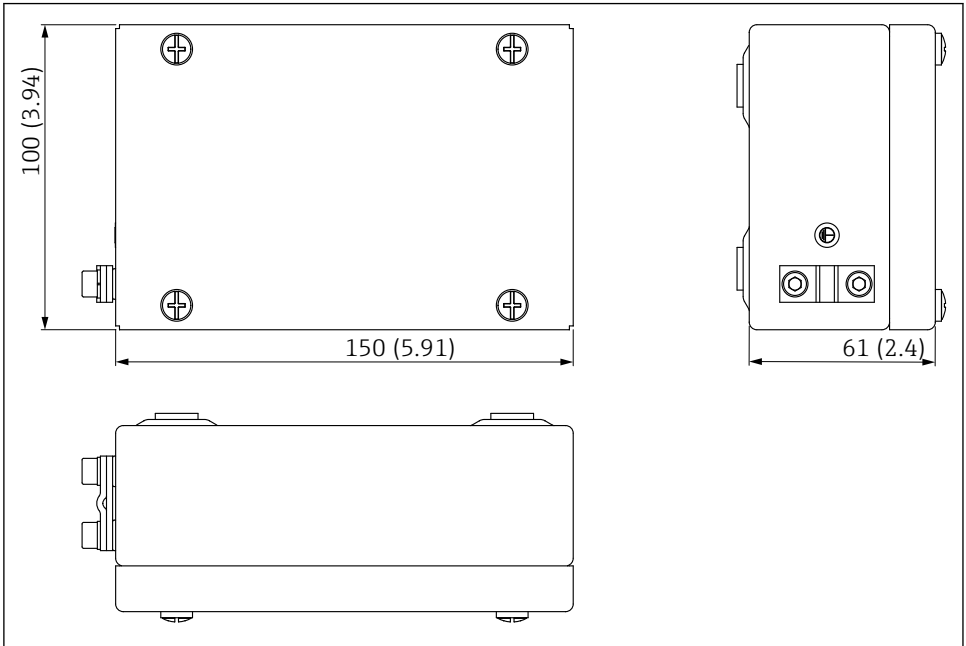
An appropriate cut-out must be created at the place of installation for the measuring cell and bores to secure it.



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8 Dimensions. Unit of measurement mm (in)

## 6.5 ATEX electronics housing

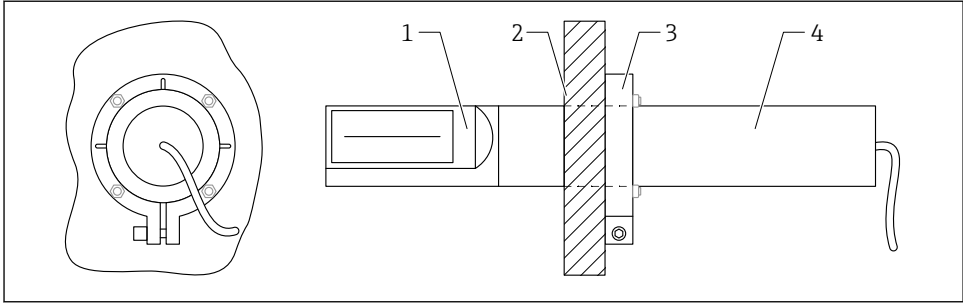


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9 Dimension of ATEX electronics housing. Unit of measurement mm (in)

## 6.6 Rod sensor

The rod sensor can be installed using a mounting flange and a 200 mm (7.87 in) long installation pipe (additional mounting accessories are optionally available).



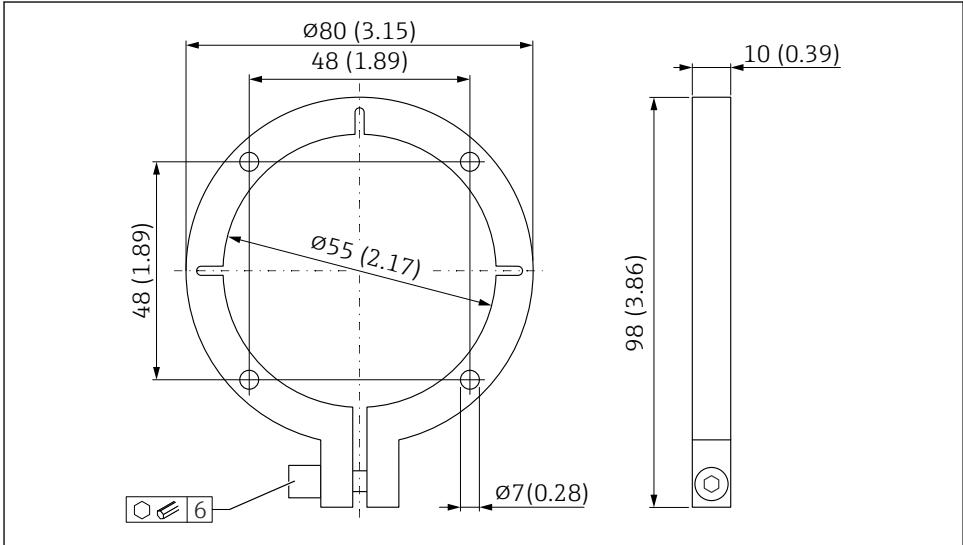
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10 Rod sensor mounted, rear view

- 1 Rod sensor
- 2 Vessel wall
- 3 Mounting flange
- 4 Installation pipe / extension / adapter (accessories)

### 6.6.1 Mounting flange $\varnothing 55$ mm (2.17 in)

The mounting flange for the rod sensor can be mounted on the vessel wall.



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11 Mounting flange for the rod sensor. Unit of measurement mm (in)

The mounting flange serves as a template for the mounting bore holes and the cut-out for the sensor in the vessel:

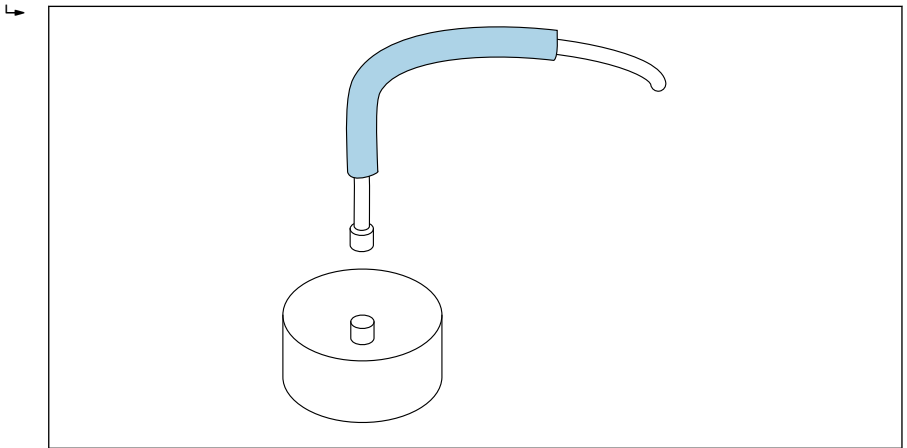
1. Check the fit between the sensor and mounting flange

2. An installation pipe must first be mounted on the sensor before the mounting flange can be fixed. It is available in two different lengths and can be ordered together with the device via the "Accessory mounted" or "Accessory enclosed" section of the product order structure.
3. Make the cut-out in the vessel
4. Mount the sensor and align it


## 6.7 Protection of sensor connector against abrasion

If sand and gravel can come into contact with the sensor connector when they flow over the baffle plate, it is recommended to mount an additional protective guard on the sensor connector.

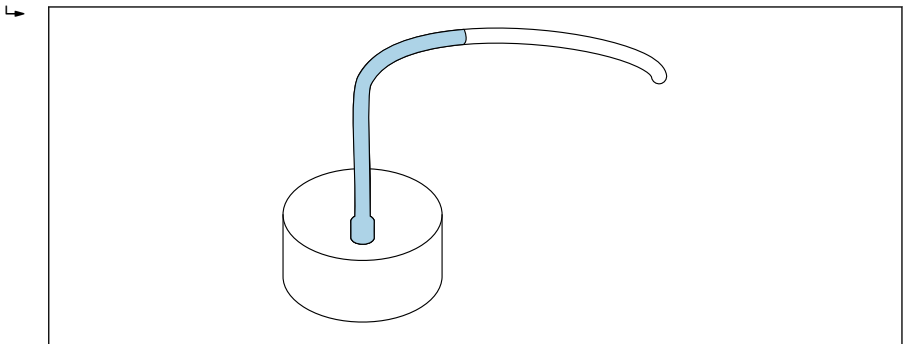
1. The heat-shrink tube supplied with the cable can be used to provide this protection.




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 12 Example of round sensor

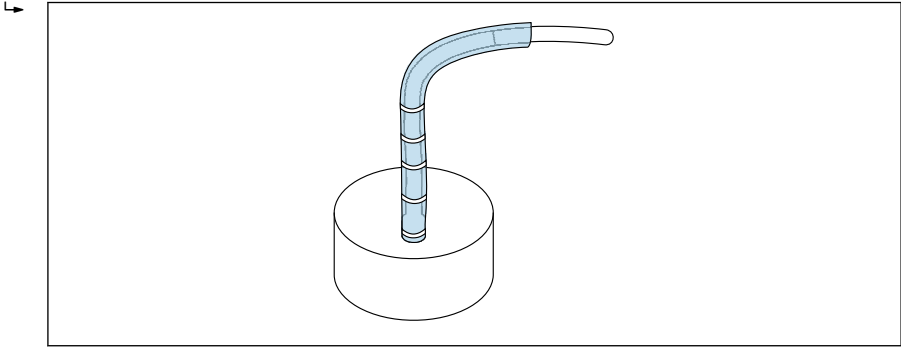
2. Once the sensor has been installed and the sensor cable connected, the heat-shrink tube can be shrunk onto the connector and cable with a hot air blower



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 13 Example of round sensor

3. In addition, the sensor and ground cable can be protected with a silicone tube (not included in the delivery)



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14 Example of round sensor

## 6.8 Post-mounting check

Perform the following checks after mounting the device:

- Is the device undamaged (visual inspection)?
- If provided: are the measuring point number and labeling correct?
- Are the connections established correctly and protected against mechanical influences?
- If used: is the device securely positioned in the mounting flange / mounting frame (visual inspection)?
- Is the device securely mounted and is the measuring cell surface flush on the material side (visual inspection)?
- Is sufficient material coverage / material flow over the measurement surface ensured?



## 7 Electrical connection

### 7.1 Connecting requirements

#### 7.1.1 Cable specification

Connecting cables are available in different versions and lengths (depending on design).

##### **Device with 10-pin connector**

Connecting cables with a pre-assembled 10-pin socket on the device side are available in different standard lengths:

- 4 m (13 ft)
- 10 m (32 ft)
- 25 m (82 ft)

**UNITRONIC PUR CP** shielded cable, twisted pairs  $6 \times 2 \times 0.25 \text{ mm}^2$ , PUR sheath resistant to oils and chemicals.

##### **Rectangular sensors**

Standard lengths (fixed cable):

- 5 m (16 ft)
- Cable lengths of 1 to 100 m (3 to 328 ft) are possible upon request

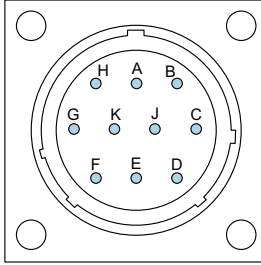
**UNITRONIC PUR CP** shielded cable,  $10 \times 0.25 \text{ mm}^2$ , PUR sheath resistant to oils and chemicals.

### 7.2 Connecting the measuring instrument

#### 7.2.1 Terminal assignment

##### **Round sensors**

Round sensors are supplied with a 10-pin MIL plug as standard.



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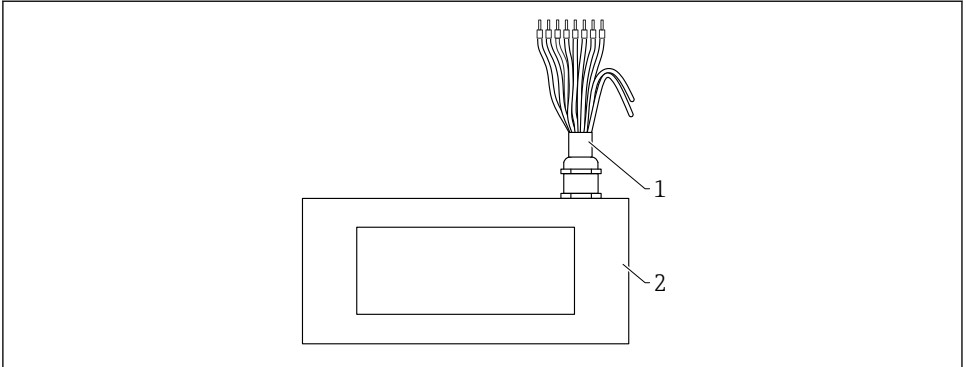
### 15 Assignment of the 10-pin plug

- A 12 to 24 V<sub>DC</sub> stabilized power supply  
Wire color: red (RD)
- B 0 V<sub>DC</sub> power supply  
Wire color: blue (BU)
- D 1st analog positive (+), material moisture  
Wire color: green (GN)
- E 1st analog return line (-), material moisture  
Wire color: yellow (YE)
- F RS485 A (must be enabled)  
Wire color: white (WH)
- G RS485 B (must be enabled)  
Wire color: brown (BN)
- C IMP-Bus RT  
Wire color: gray (GY)/pink (PK)
- J IMP-Bus COM  
Wire color: blue (BU)/red (RD)
- K 2nd analog positive (+)  
Wire color: pink (PK)
- E 2nd analog return line (-)  
Wire color: gray (GY)
- H Shield (is grounded at the sensor. The installation must be grounded correctly!)  
Wire color: transparent

## Rectangular sensors

Standard version of rectangular sensor:

- Cable length: 5 m (16 ft) (10-pin)
- The cable is firmly connected to the sensor
- The other end of the cable is fitted with ferrules



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▣ 16 Rectangular sensor (standard version) with 10-pin cable assignment

- 1 10-pin cable with ferrules
- 12 to 24 V<sub>DC</sub> stabilized power supply  
Wire color: white (WH)
- 0 V<sub>DC</sub> power supply  
Wire color: brown (BN)
- 1st analog positive (+), material moisture  
Wire color: green (GN)
- 1st analog return line (-), material moisture  
Wire color: yellow (YE)
- IMP-Bus RT  
Wire color: pink (PK)
- IMP-Bus COM  
Wire color: gray (GY)
- 2nd analog positive (+)  
Wire color: blue (BU)
- 2nd analog return line (-)  
Wire color: violet (VT)
- 2 Rectangular sensor

## ATEX rectangular sensors

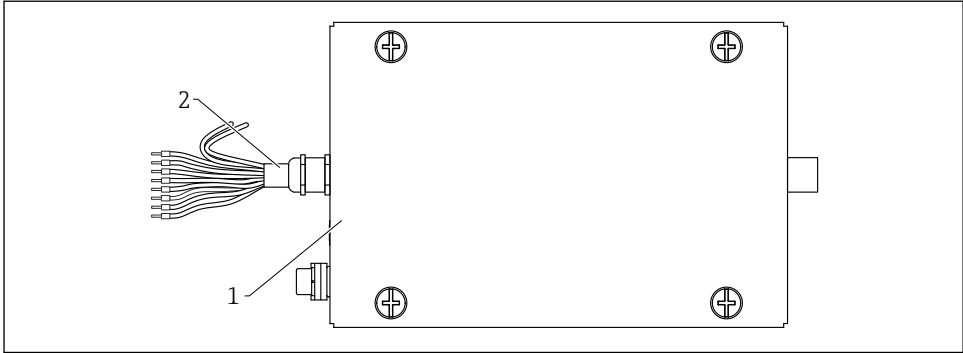
### ATEX version

Rectangular sensor

- Cable length between sensor and ATEX electronics housing 5 m (16 ft)
- Cable firmly connected to the sensor with plug to the ATEX electronics housing

### ATEX electronics housing

- Cable length: 5 m (16 ft) (10-pin)
- The cable is firmly connected to the electronics housing
- The other end of the cable is fitted with ferrules

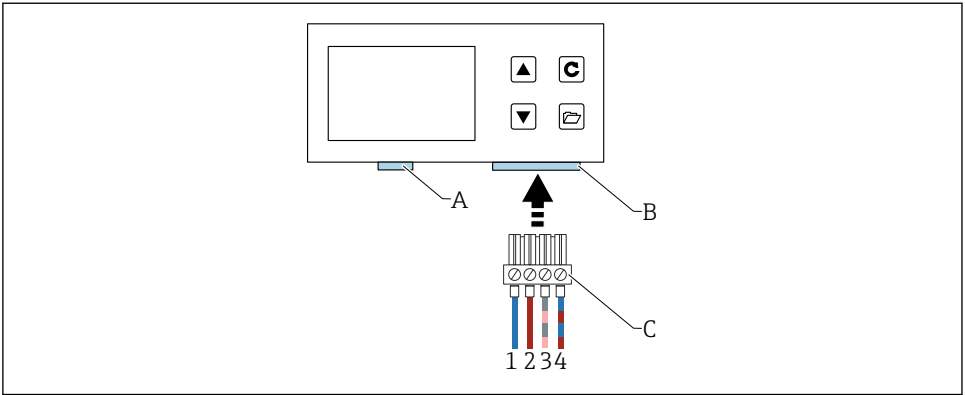


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17 ATEX electronics housing with assignment of the 10-pin cable

- 1 10-pin cable with ferrules
- 12 to 24 V<sub>DC</sub> stabilized power supply  
Wire color: red (RD)
  - 0 V<sub>DC</sub> power supply  
Wire color: blue (BU)
  - 1st analog positive (+), material moisture  
Wire color: green (GN)
  - 1st analog return line (-), material moisture  
Wire color: yellow (YE)
  - IMP-Bus RT  
Wire color: gray/pink (GY/PK)
  - IMP-Bus COM  
Wire color: blue/red (BU/RD)
  - 2nd analog positive (+)  
Wire color: pink (PK)
  - 2nd analog return line (-)  
Wire color: gray (GY)
- 2 Rectangular sensor

## Connection to a remote display (optional)

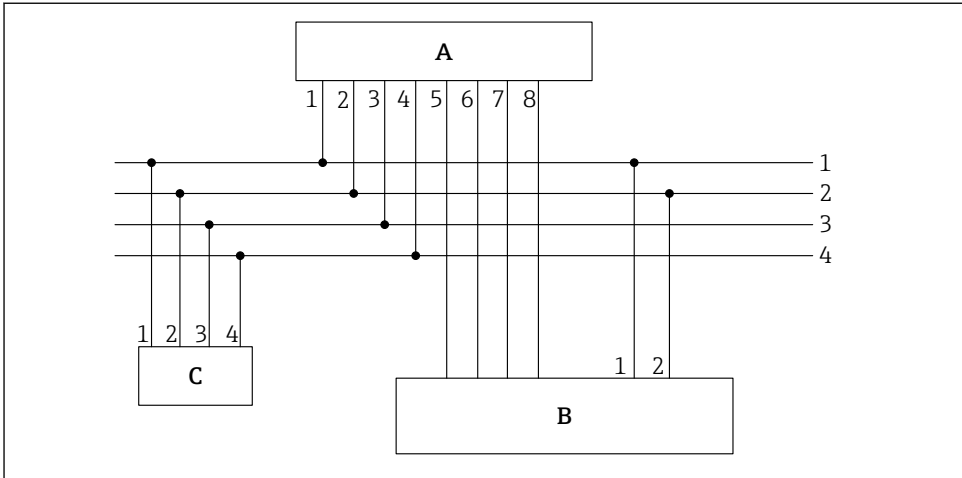


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### 18 Connection to a remote display

- A USB (Mini B type), USB-IMP-Bridge, firmware update (only for service purposes)
- B Socket for supply voltage and bus interface
- C Connector for supply voltage and bus interface (included in the delivery for "remote display")
- 1 0 V<sub>DC</sub> power supply  
Wire color: blue (BU)
- 2 12 to 24 V<sub>DC</sub> stabilized power supply  
Wire color: red (RD)
- 3 IMP-Bus (RT)  
Wire color: gray (GY) / pink (PK)
- 4 IMP-Bus (COM)  
Wire color: blue (BU) / red (RD)


## 7.2.2 Connection example of 10-pin socket



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- 19 Connection example, cable with 10-pin socket (on device side) and wire end ferrules at the cable end

- A Transmitter  
 B PLC/distribution box  
 C Remote display (optional)
- 1  $0 V_{DC}$  power supply  
Wire color: blue (BU)
  - 2  $12$  to  $24 V_{DC}$  stabilized power supply  
Wire color: red (RD)
  - 3 IMP-Bus RT  
Wire color: gray (GY)/pink (PK)
  - 4 IMP-Bus COM  
Wire color: blue (BU)/red (RD)
  - 5 1st current output (+), analog  
Wire color: green (GN)
  - 6 1st current output (-), analog  
Wire color: yellow (YE)
  - 7 2nd current output (+), analog  
Wire color: pink (PK)
  - 8 2nd current output (-), analog  
Wire color: gray (GY)

 The moisture content determined and the conductivity/temperature can either be fed directly into a PLC via analog outputs 0 to 20 mA/4 to 20 mA or queried via the serial interface (IMP-Bus) using the display (optional).

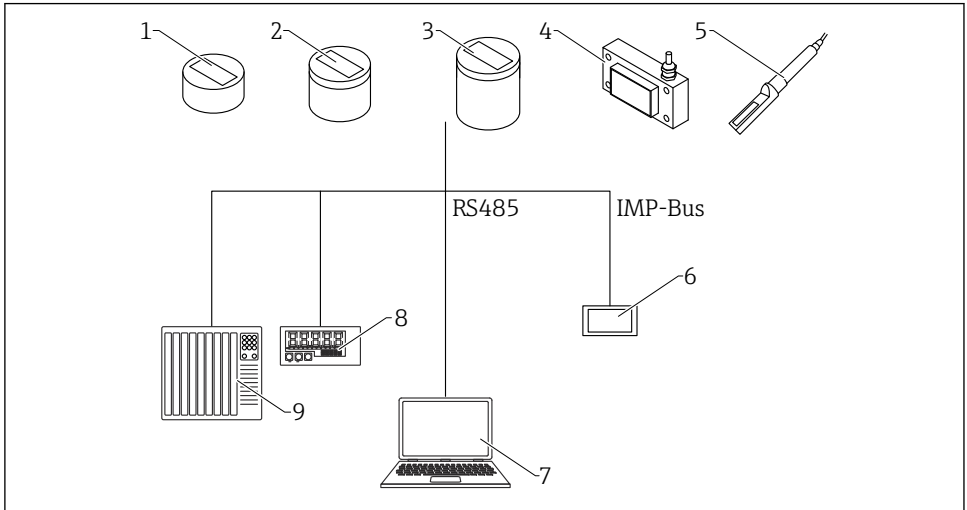
## 7.3 Post-connection check

- Is the device or cable undamaged (visual inspection)?

- Does the supply voltage match the specifications on the nameplate?
- Are the connections established correctly and protected against mechanical influences?

## 8 Operation options

### 8.1 Overview of operation options



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#### 20 Operation options

- 1 Round sensor, short
- 2 Round sensor, middle
- 3 Round sensor, long
- 4 Rectangular sensor
- 5 Rod sensor
- 6 Remote display
- 7 Computer
- 8 LED display
- 9 PLC or water dosing computer

## 9 Commissioning

### 9.1 Analog outputs for measured value output

The measured values are output as a current signal via the analog output. The device can be set to 0 to 20 mA or 4 to 20 mA.

 The current output can also be set inversely to 20 to 0 mA or 20 to 4 mA for special controllers and applications.

The analog outputs can be set differently to the following possible options:

#### Moisture, temperature

- Output 1: moisture in % (variable setting)
- Output 2: material temperature 0 to 100 °C (32 to 212 °F), this also applies for the high-temperature version.


#### Moisture, conductivity

- Output 1: moisture in % (variable setting)
- Output 2: conductivity 0 to 20 mS/cm(factory setting)

#### Moisture, temperature/conductivity

- Output 1: moisture in % (variable setting)
- Output 2: material temperature 0 to 100 °C (32 to 212 °F) and conductivity 0 to 20 mS/cm with automatic window switching.

It is also possible to divide output 2 into two ranges to output both the conductivity and the temperature, namely the 4 to 11 mA range for the temperature and the 12 to 20 mA range for the conductivity. Output 2 automatically switches between these two windows every 5 s.

 Output 1 can be scaled at the factory or subsequently scaled as required (variably) using the remote display (optionally available), e.g. 0 to 10 %, 0 to 20 % or 0 to 30 %

#### 9.1.1 Possible settings

There are several possible settings for the analog outputs:

#### Analog outputs

##### Options:

- 0 to 20 mA
- 4 to 20 mA

 The current output can also be set inversely for special controllers and applications.

- 20 to 0 mA
- 20 to 4 mA



## Channels of the analog outputs



The analog outputs can be set differently to the following possible options:

### **Moisture, temperature**

Output 1 for moisture, output 2 for material temperature.

### **Moisture, conductivity**

Output 1 for moisture, output 2 for conductivity in the range from 0 to 20 mS/cm (factory setting)

### **Moisture, temperature/conductivity**

Output 1 for moisture, output 2 for material temperature and conductivity with automatic window switching.

## Moisture range

The moisture range and the temperature range at outputs 1 and 2 can be individually configured.

- **Moisture range in %**
  - Maximum: e.g. 20 %
  - Minimum: 0 %
- **Temperature range in °C**
  - Maximum: 100 °C, this also applies for the high-temperature version.
  - Minimum: 0 °C
- **Conductivity in mS/cm**
  - Maximum 20 mS/cm
  - Minimum 0 mS/cm



The devices can measure the conductivity depending on the device type and the moisture. The output is set to 0 to 20 mS/cm at the factory.

## 9.2 Operating mode

The sensor configuration is preset at the factory before the sensor is delivered. This device setting can then be optimized to suit the process.

### **Measure mode and parameters:**

The following sensor settings can be changed

- Measure mode C - Cyclic (default setting for sensors with cyclic measurement).
- Average time, reaction speed of the measured values
- Calibration (when different materials are used)
- Filter function
- Precision of a single value measurement

## Operating mode

The sensors are supplied from the factory with the CH mode for applications in the construction industry, and with the CA mode for general process applications. Six different operating modes are available in the C mode, depending on the application

- **CS mode** (Cyclic-Successive)

For very short measurement cycles in the seconds range (e.g. 1 to 10 s) without averaging and without filter functions, and with up to 100 measurements per second internally and a cycle time of 250 ms at the analog output.

- **CA mode** (Cyclic Average Filter)

Standard averaging for relatively fast but continuous measurement processes, with simple filtering and an accuracy of up to 0.1%. The CA operating mode is also used to record raw values, without averaging and filtering, to be able to subsequently analyze the measured data and determine the optimum operating mode.

- **CF mode** (Cyclic Floating Average with Filter)

Floating average for very slow and continuous measurement processes, with simple filtering and an accuracy of up to 0.1 %. Suitable for applications on a conveyor belt etc.

- **CK mode** (Cyclic with Boost Filter)

For complex applications in mixers and dryers

- **CC mode** (Cyclic Cumulated)

With automatic totalization of moisture quantity measurements in one batch process if no PLC controller is used

- **CH mode** (Cyclic Hold)

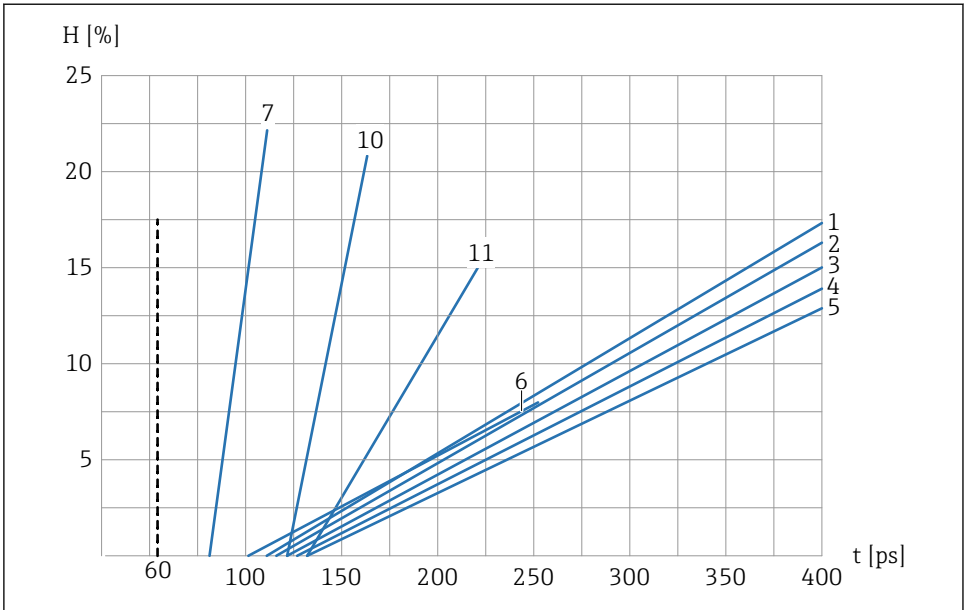
Standard operating mode for applications in the construction industry. Similar to the CC mode, but with filtering and without totalization. The CH mode is ideal for very short batch times down to 2 seconds if the sensor has been installed under the silo discharge hatch. The CH mode performs filtering automatically. This allows drip water that forms in the silo to be filtered out of the measured value, for example.



Each of these settings is retained even after the sensor is switched off, i.e. the setting is saved to the non-volatile memory of the sensor.

## 9.3 Calibration curve set A for general bulk solids applications

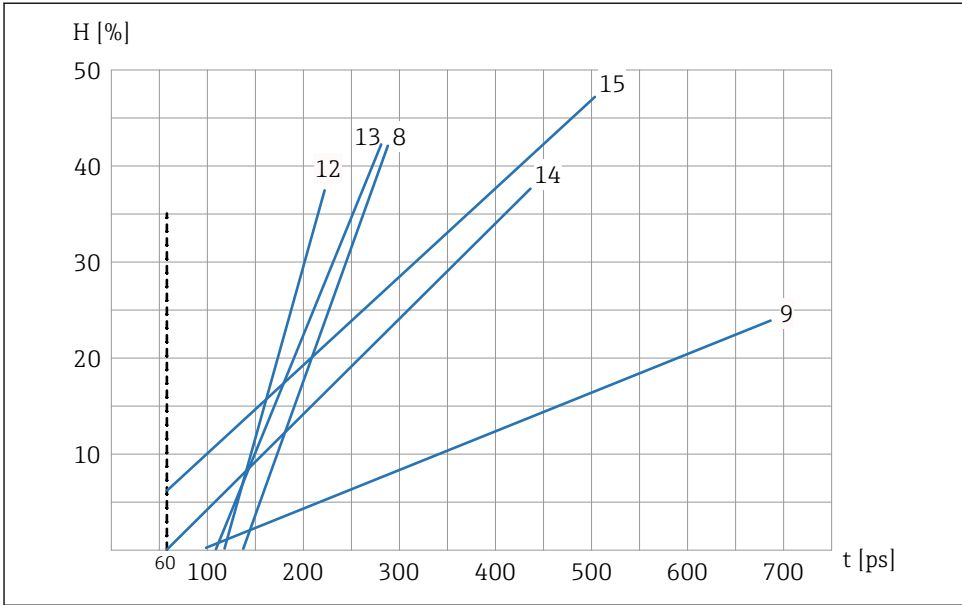
The devices are supplied with a suitable calibration. A maximum of 15 different calibrations can be saved in the device and can be activated and adjusted via the remote display. To pre-test the compatibility of a calibration curve, the user can select individual calibration curves (Cal.1 to Cal.15) in the **Material cal.** menu item, test the curve with the material to be measured and activate it. The desired calibration curve - which may have been modified - is active once the operating voltage is switched on.



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21 Calibration curve set A (Cal.1, Cal.2, Cal.3, Cal.4, Cal.5, Cal.6, Cal.7, Cal.10, Cal.11)

- H* Gravimetric moisture; %  
*t* Radar transit time; picoseconds  
 1 Cal.1, Universal; sand/gravel/grit  
 2 Cal.2, Sand 1.6  
 3 Cal.3, Sand 1.7  
 4 Cal.4, Sand 1.8  
 5 Cal.5, Sand 1.9  
 6 Cal.6, Gravel/grit  
 7 Cal.7, Wood chips  
 10 Cal.10, Grains of wheat  
 11 Cal.11, Light sand



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22 Calibration curve set A (Cal.8, Cal.9, Cal.12, Cal.13, Cal.14, Cal.15)

*H* Gravimetric moisture; %

*t* Radar transit time; picoseconds

8 Cal.8, Lignite

9 Cal.9, Basic calibration

12 Cal.12, Sewage sludge

13 Cal.13, Cereals (linear)

14 Cal.14, Air/water 0 to 100 %

15 Cal.15, Raw data calibration ( $1/_{10}$  of average radar transit time)

The graphics show the linear calibration curves (Cal.1 to Cal.15) for various materials that are saved and can be selected in the device. The gravimetric moisture (*H*) is indicated as a percentage on the y-axis, and the associated radar transit time (*t*) in picoseconds is indicated on the x-axis. The radar transit time is displayed simultaneously with the moisture value during moisture measurement. In air, the devices measure approx. 60 ps radar transit time, and 1 000 ps in water.

## 9.4 Special functions

### 9.4.1 Determining the mineral concentration

With the radar-based measurement method, it is possible to draw conclusions about the conductivity or mineral concentration. Here, the device determines the attenuation of the radar pulse in the measured volume of a material. This method delivers a characteristic value

depending on the mineral concentration. The conductivity measuring range of the sensors here is up to 20 mS/cm, depending on the moisture content.

#### **9.4.2 Material temperature measurement**

The sensor contains an integrated temperature sensor, which determines the housing temperature 3 mm below the surface of the sensor head. The temperature can optionally be output at analog output 2. Due to the internal heating of the sensor electronics, the precise measurement of the material temperature is only possible to a limited extent.

#### **9.4.3 Material temperature compensation**

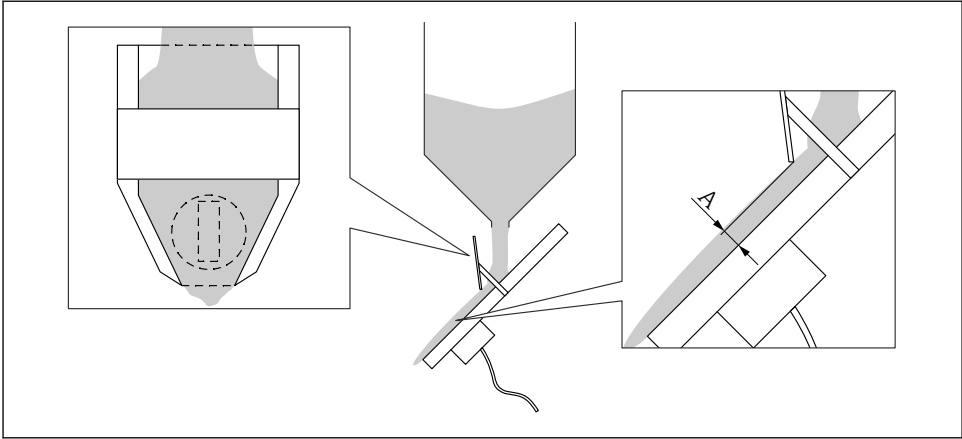
When used in higher temperature ranges, the dielectric constant ( $\epsilon_r$ ) of water and certain materials being measured show a temperature dependency. Moisture is determined using the dielectric constant, i.e. the dielectric constant is the actual parameter measured during moisture measurement. If materials being measured, such as maize, display a very special temperature dependency of the dielectric constant, such as a temperature dependency only in very specific moisture ranges, it may be necessary to perform complex material temperature compensation. This involves a considerable amount of work in the laboratory, however. In addition to the measurement of the moisture, this also requires the temperature of the material to be measured with the temperature sensor integrated in a sensor. Parameters  $t_0$  to  $t_5$  can be set in each of the 15 calibration stages Cal1 to Cal15 (see the "Selecting the individual calibrations" section). If necessary, contact the manufacturer's Service Department if you require assistance with this very complex material-specific temperature compensation process.

## **10 Diagnostics and troubleshooting**

### **10.1 Optimizing the material flow**

For accurate measurement results, certain limits must be respected with regard to the installation and environmental conditions, and the associated bulk density of the material being measured. Furthermore, there must be a sufficiently thick layer of material covering the sensor.

If the material flow is too fast, the level of material above the surface of the sensor can be too low. A hopper chute with guide plates can concentrate and increase the level of material above the sensor head. Ideally - particularly in the case of wet sand - the guide plates have a PTFE coating so that no material can stick to them. The sensor requires a layer of material of at least 35 mm (1.38 in). There are installations where the amount of material is too low or too spread out to ensure sufficient material flow over the sensor. In such cases it may be necessary to "concentrate" the material flow so that material accumulates above the sensor as it flows. The diagram below shows an example of a possible unit where the material is concentrated at the side of the sensor and above the sensor.



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■ 23 Example: "Concentration of material"

A Minimum sensor coverage 35 mm (1.38 in)

In addition, in the case of non-homogeneous material flow it is possible to use the filter functions, with upper and lower limits, that are implemented in the sensor to filter out "wrong" measured values.

## 10.2 Difference between measured moisture value and laboratory value too large during initial commissioning

The sensor is usually precalibrated with Cal14 (air/water 0 to 100 %) upon delivery. In the case of sand and gravel applications, the sensor is precalibrated upon delivery (if the application is known and specified beforehand) with the Cal1 calibration curve (universal calibration curve for sand/gravel).

**During initial commissioning, the measured moisture value should match the laboratory value, which is determined using another method, with an accuracy of at least  $\pm 1$  %.**

If this is the case, the sensor can then be fine-tuned to achieve an accuracy of  $\pm 0.1$  % in relation to the laboratory value in a variety of ways.

- Depending on the PLC, it is possible to perform a parallel shift/offset in the PLC. The parameter has different names depending on the PLC (e.g. initial load, zero point, offset, measuring range, etc.).  
Please contact the PLC manufacturer for more information.
- With the remote display, a fine adjustment or parallel shift in the sensor can be performed using the "Offset" parameter.

**If the moisture value of the sensor deviates by more than  $\pm 1$  % from the laboratory value during initial commissioning, this may be due to the following:**

- The sensor is not correctly installed under the silo discharge hatch. The surface of the sensor must be completely covered with sand/gravel when the hatch opens. A good, stable flow of material **must** be guaranteed. A video of the batch process can be helpful for analysis purposes.
- The wrong calibration curve is configured in the sensor. The sensor is supplied with the universal calibration curve Cal1 for sand and gravel.
- Incorrect moisture scaling is configured in the PLC. In the sensor, 0 to 20 % moisture corresponds to the current output of 0 to 20 mA or 4 to 20 mA. The 0 to 20 % moisture scaling must also be entered in the PLC.  
Please contact the PLC manufacturer for more information.
- A 2-point calibration in the PLC or the sensor may be required for special sands (e.g. fine sand).
- In the case of gravel and grit, limits must be set in the PLC, as running water in the gravel or grit results in an excessively high moisture value in the sensor.  
Please contact the PLC manufacturer for more information.
- Due to inaccurate data processing, it may be necessary to check the moisture value displayed in the PLC. For this purpose, connect the sensor to the remote display and check/compare the moisture value shown in the PLC with the moisture value shown on the display.

**Caution:**

The "**CH**" operating mode in the sensor must then be set to the "**CC**" mode for a test run, and then switched back to "**CH**" afterwards.

- Check the start/stop conditions in the PLC
  - Start condition: time in seconds or kg in the scales
  - Stop condition: usually % of target weight
  - Please contact the PLC manufacturer for more information



If the solutions outlined here do not rectify the problem → contact the manufacturer's Service Department.



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