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71510187
2020-11-27

Operating Instructions
Solitrend MMP42

Material moisture measurement

Endress+Hauser
People for Process Automation

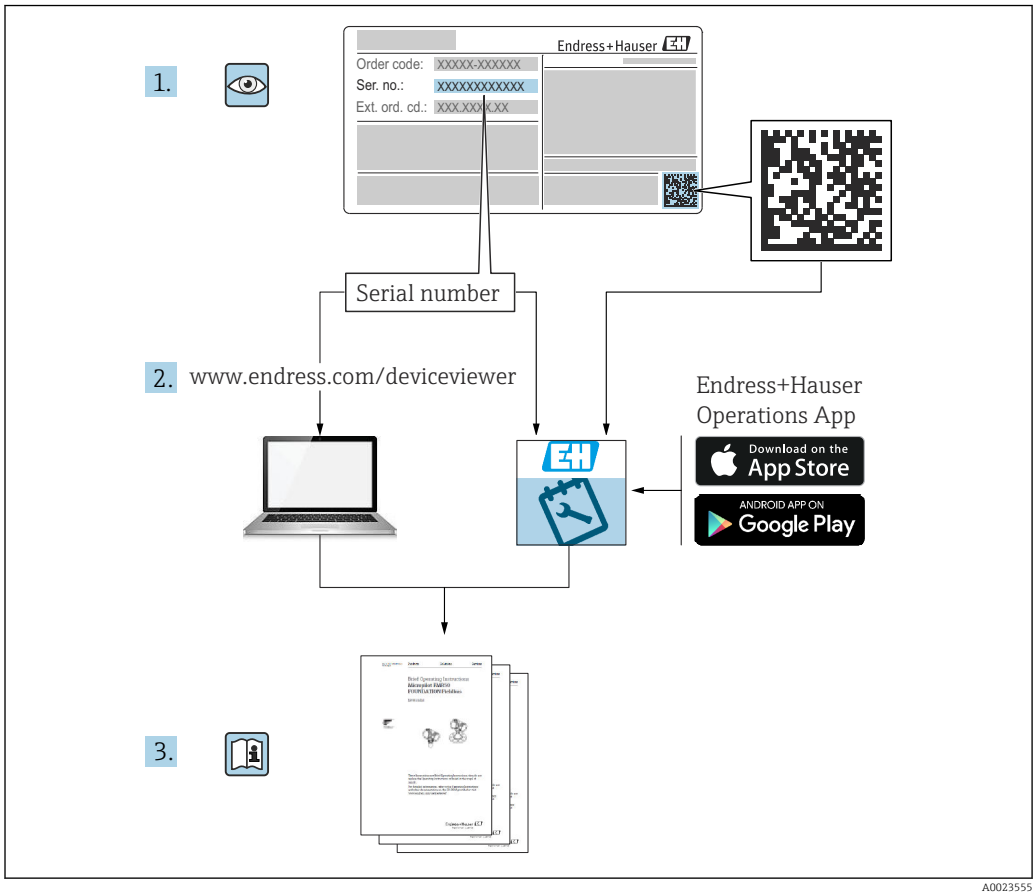

1.
Endress+Hauser
Order code: XXXXX-XXXXXX
Ser. no.: XXXXXXXXXXX
Ext. ord. cd.: XXX XXX XX XX
Serial number
2. www.endress.com/deviceviewer
Endress+Hauser
Operations App
Download on the App Store
ANDROID APP ON Google Play
3.
A0023555

Table of contents

1 About this document

1.1 Document function

These Operating Instructions provide all of the information that is required in various phases of the life cycle of the device including:
- Product identification
- Incoming acceptance
- Storage
- Installation
- Connection
- Operation
- Commissioning
- Troubleshooting
- Maintenance
- Disposal

1.2 Symbols used

1.2.1 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.

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

1.2.2 Symbols for certain types of information and graphics

✓ **Permitted**
Procedures, processes or actions that are permitted

✗ **Forbidden**
Procedures, processes or actions that are forbidden

Tip
Indicates additional information

Reference to documentation

Reference to graphic

▶
Notice or individual step to be observed

1., 2., 3.
Series of steps

↳
Result of a step

1, 2, 3, ...
Item numbers

A, B, C, ...
Views

1.3 Terms and abbreviations

TI
Document type "Technical Information"

PLC
Programmable logic controller (PLC)

1.4 Documentation

The following types of documentation are available in the Download Area of the Endress +Hauser website (www.endress.com/downloads):

For an overview of the scope of the associated Technical Documentation, refer to the following:
- *W@M Device Viewer* (www.endress.com/deviceviewer): Enter the serial number from nameplate
- *Endress+Hauser Operations App*: Enter the serial number from the nameplate or scan the 2D matrix code (QR code) on the nameplate

1.4.1 Technical Information (TI)

Planning aid
The document contains all the technical data on the device and provides an overview of the accessories and other products that can be ordered for the device.

2 Basic safety instructions

2.1 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.

2.2 Designated use

Application and media
The measuring device described in this manual is intended for the continuous moisture measurement of a wide variety of materials. Because of 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 manual and additional documentation are observed, the measuring device may be used for the following measurements only:

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

To ensure that the measuring device remains in proper operating 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 "Technical data".

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

Clarification of borderline cases:
- For special materials and media used for cleaning, the manufacturer is happy to provide assistance in verifying the corrosion resistance of medium-wetted materials, but disclaims any warranty or liability.

Residual risks
Due to heat transfer from the process as well as power dissipation within the electronics, the temperature of the electronics housing and the assemblies contained therein may rise to 70 °C (158 °F) during operation. During operation, the sensor can reach a temperature close to the medium temperature.

Danger of burns from contact with surfaces!
- In the event of elevated medium temperatures, ensure protection against contact to prevent burns.

2.3 Workplace safety

For work on and with the device:
- Wear the required personal protective equipment according to federal/national regulations.

2.4 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.

Modifications to the device

Unauthorized modifications to the device are not permitted and can lead to unforeseeable dangers:
- If modifications are nevertheless required, consult with the manufacturer.

Repair

To ensure continued operational safety and reliability:
- Carry out repairs on the device only if they are expressly permitted.
- Observe federal/national regulations pertaining to the repair of an electrical device.
- Use only original spare parts and accessories from the manufacturer.

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.

2.5 Product safety

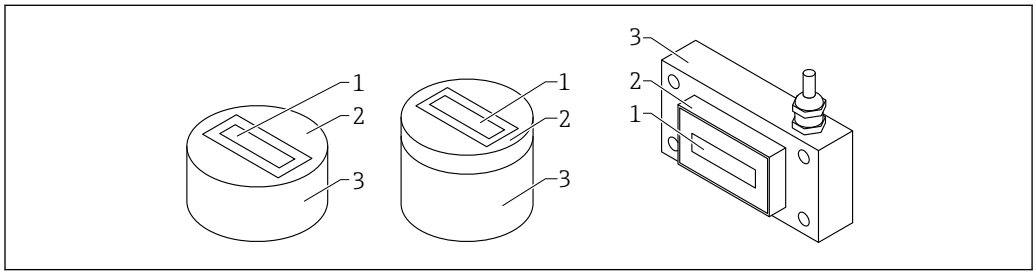
This device is designed in accordance with good engineering practice to meet state-of-the-art safety requirements, has been tested, and left the factory in a condition in which it is safe to operate.

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

3 Product description

TDR material moisture sensors for measuring bulk solids and media with material density ratings of 0.3 to 1.0 kg/dm^3 and conductivity values up to 2 mS/cm.

3.1 Product design

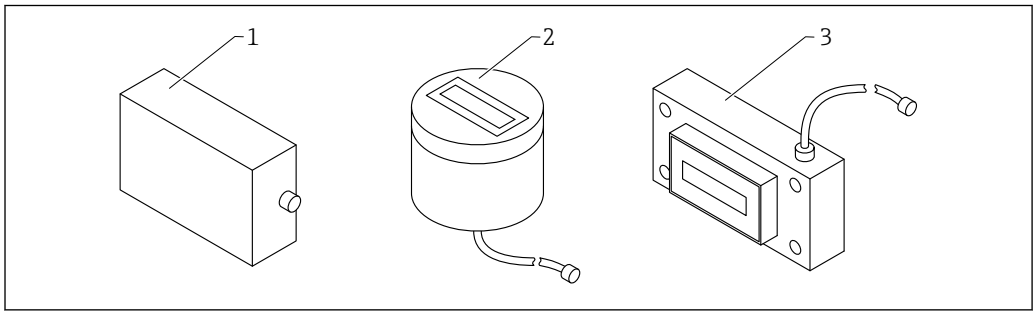


1 Product design

1 Measuring cell; wave guide (1.4301) + ceramic (aluminum oxide)
2 Sensor plate
3 Housing

3.2 Sensor temperature range up to 120 °C (248 °F)

With the "Sensor temperature range up to 120 °C (248 °F)" order option, the electronics unit is always located separately in the separate housing and is connected using the HF cable permanently connected to the sensor (round sensor, middle version or rectangular sensor).



1 Electronics housing
2 Round sensor, middle with HF cable 2.5 m (8.2 ft)
3 Rectangular sensor with HF cable 2.5 m (8.2 ft)

4 Incoming acceptance and product identification

4.1 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.

4.2 Product identification

The following options are available for the identification of the measuring device:
- Nameplate specifications
- Extended order code with breakdown of the device features on the delivery note

- Enter the serial number from the nameplates into *W@M Device Viewer* (www.endress.com/deviceviewer)
  - All the information about the measuring device and the scope of the associated Technical Documentation are displayed.

- Enter the serial number from the nameplate into the *Endress+Hauser Operations App* or use the *Endress+Hauser Operations App* to scan the 2-D matrix code (QR Code) provided on the nameplate
  - All the information about the measuring device and the scope of the associated Technical Documentation are displayed.

4.3 Manufacturer's address

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

4.4 Storage, transport

4.4.1 Storage conditions

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

4.4.2 Transporting the product to the measuring point

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

5 Installation

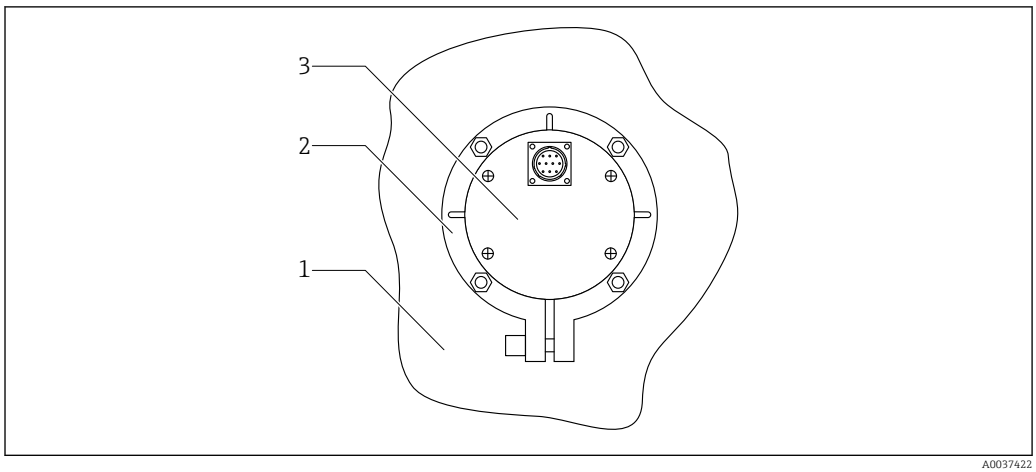
5.1 Installation conditions

- The device must be installed at a point in the process in such a way that ensures a relatively constant material density, as the material density is directly related to 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 material density, over the sensor is relatively constant.
- The measuring field of the device should be completely surrounded by material and the material height must exceed the minimum sensor coverage (depending on sensor type and moisture).
- The flow of material over the surface of the sensor should be relatively continuous. The electronics module offers ways to automatically detect and bridge gaps in material in intervals of seconds.
- No material deposits or buildup may form on the sensor surface, as this would falsify the readings.

Longer averaging times increase the stability of the measured value.

5.2 Round sensor, short / middle

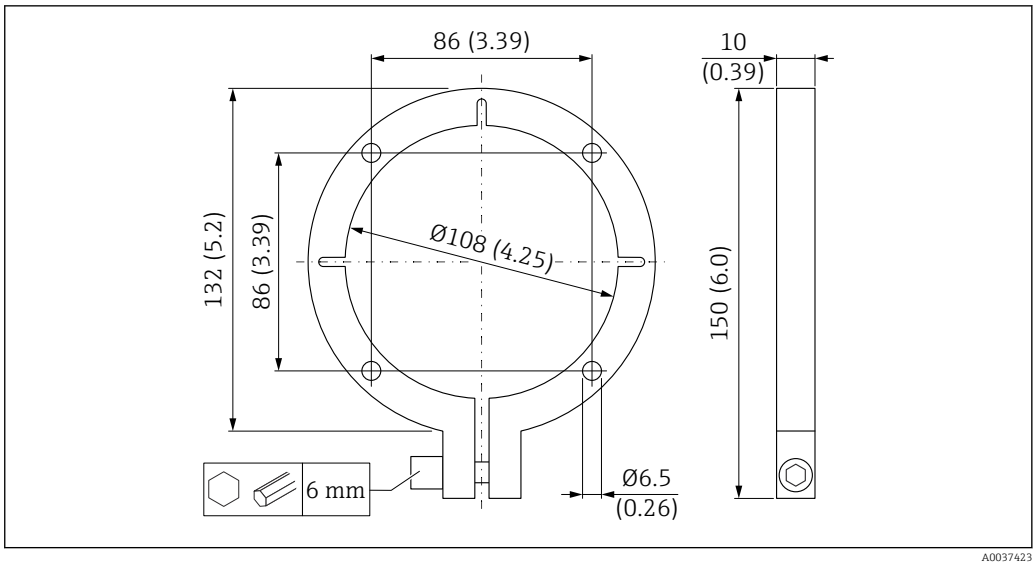
The short / middle round sensor can be installed using a mounting flange.



2 *Round sensor mounted, rear view*

1 Vessel wall
2 Mounting flange
3 Round sensor

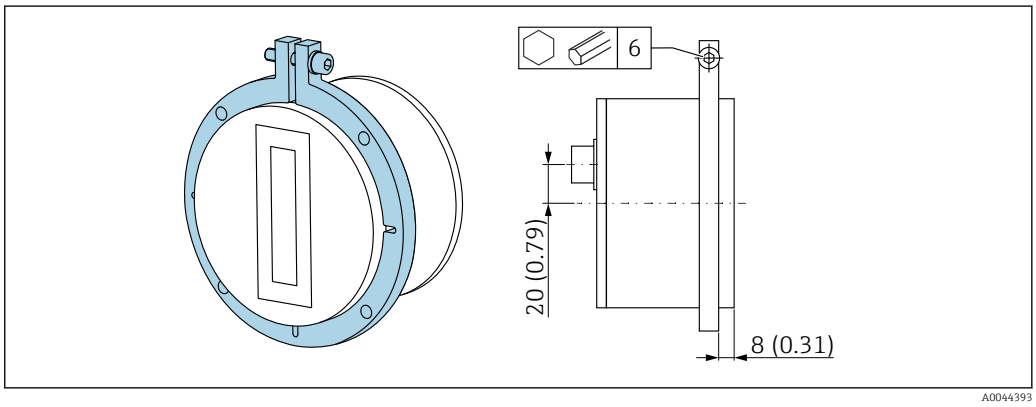
The mounting flange for the round sensor (short or middle version) can be mounted on the bottom or on the side wall of the container.



3 *Mounting flange for round sensor, short version or round sensor, middle version*

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

1. Check the fit between the sensor and mounting flange
2. Make the cut-out in the container

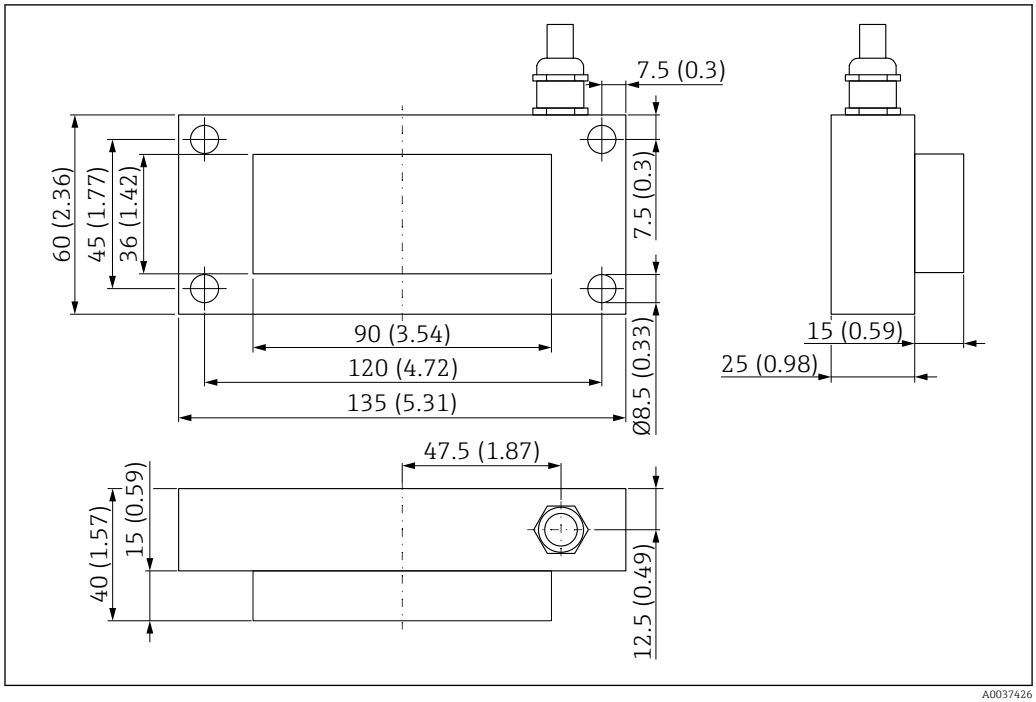


4 *Mounting position, mounting flange and round sensor*

5.3 Rectangular sensor

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

5.3.1 Dimensions

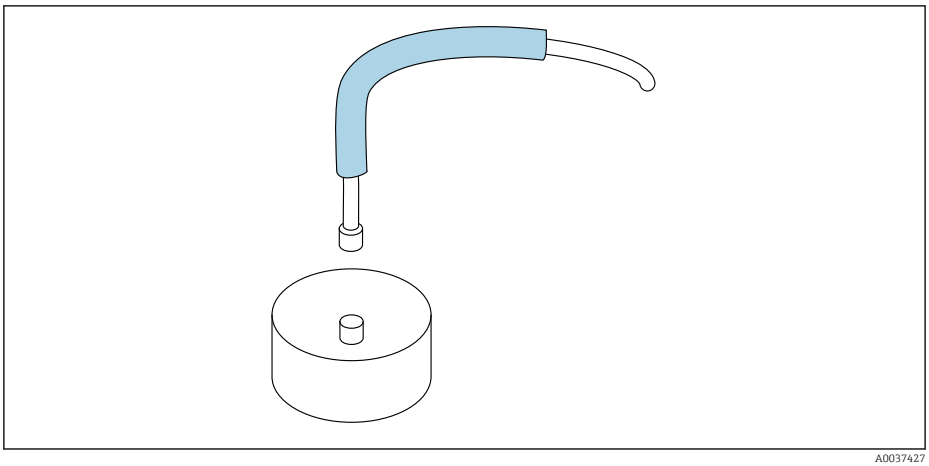


5 Dimensions of rectangular sensor. Unit of measurement mm (in)

5.4 Protection of sensor connector against abrasion

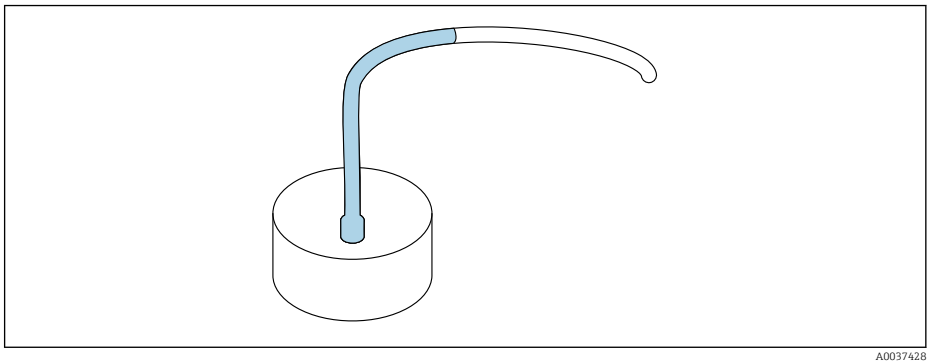
If sand and gravel can come into contact with the sensor connector when they flow over the baffle plate, it is recommended to mount an additional protective guard on the sensor connector.

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



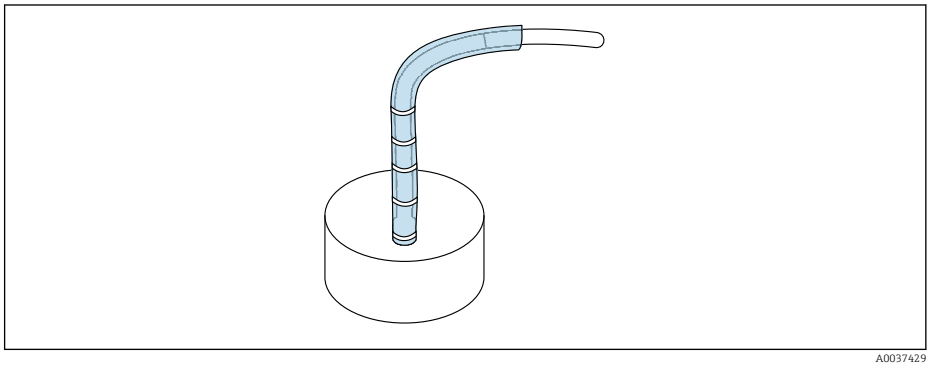
6 Example of round sensor

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



7 *Example of round sensor*

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

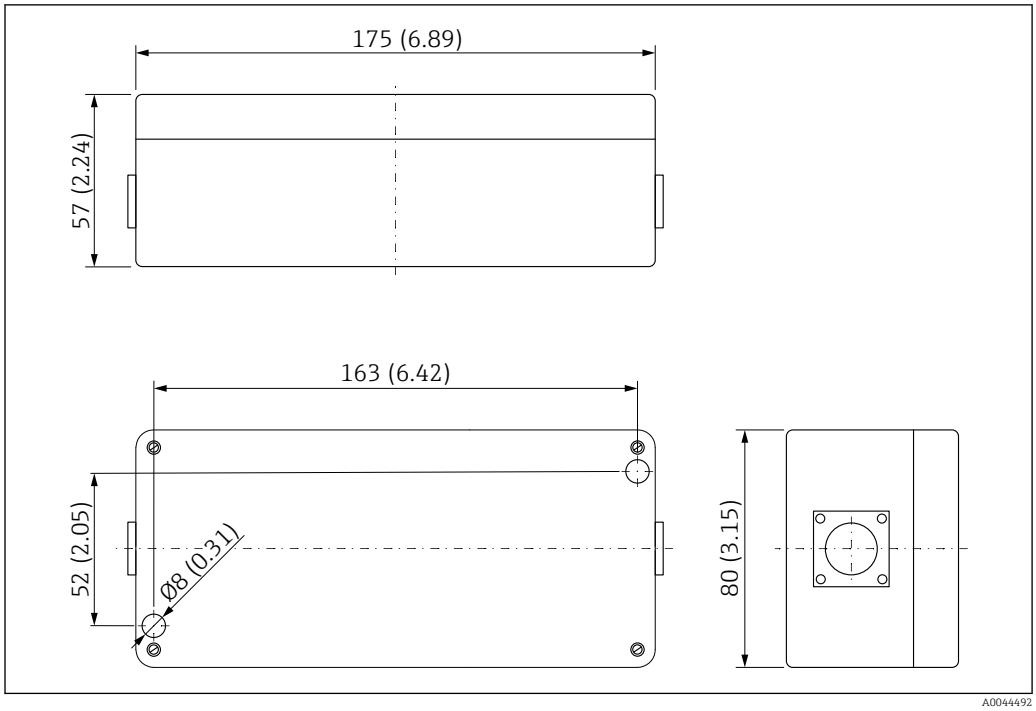


8 *Example of round sensor*

5.5 Electronics housing, sensor temperature range up to 120 °C (248 °F)

The electronics housing, sensor temperature range up to 120 °C (248 °F), can be mounted with two screws (M5).

5.5.1 Dimensions



9 Electronics housing, sensor temperature range up to 120 °C (248 °F). Unit of measurement mm (in)

5.6 Post-installation 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?

❑ Is the device securely seated in the mounting flange (visual inspection)?

❑ Is sufficient material coverage/material flow over the sensor surface ensured?

6 Electrical connection

6.1 Connection conditions

6.1.1 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 × 2 × 0.25 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 × 0.25 mm^2, PUR sheath resistant to oils and chemicals.

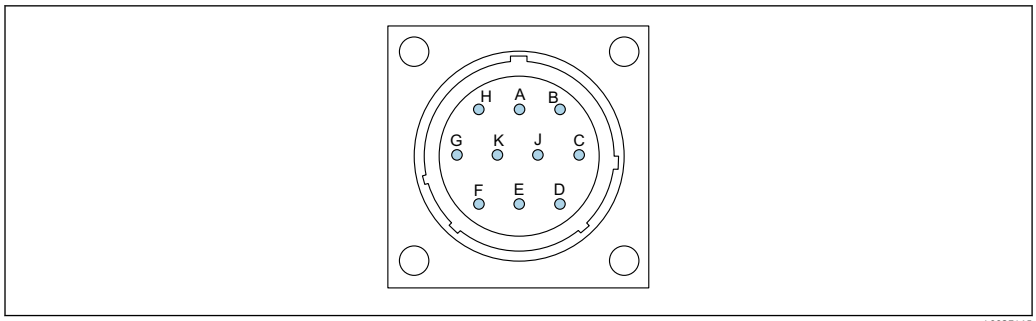
6.2 Connecting the measuring device

6.2.1 Terminal assignment

Round sensors

Round sensors are supplied as standard with a 10-pin connector with IP67 protection.

In the high-temperature version 0 to 120 °C (32 to 248 °F), the sensor is separated from the electronics unit via a HF cable. The electronics housing is equipped on both sides with connectors with IP67 protection.



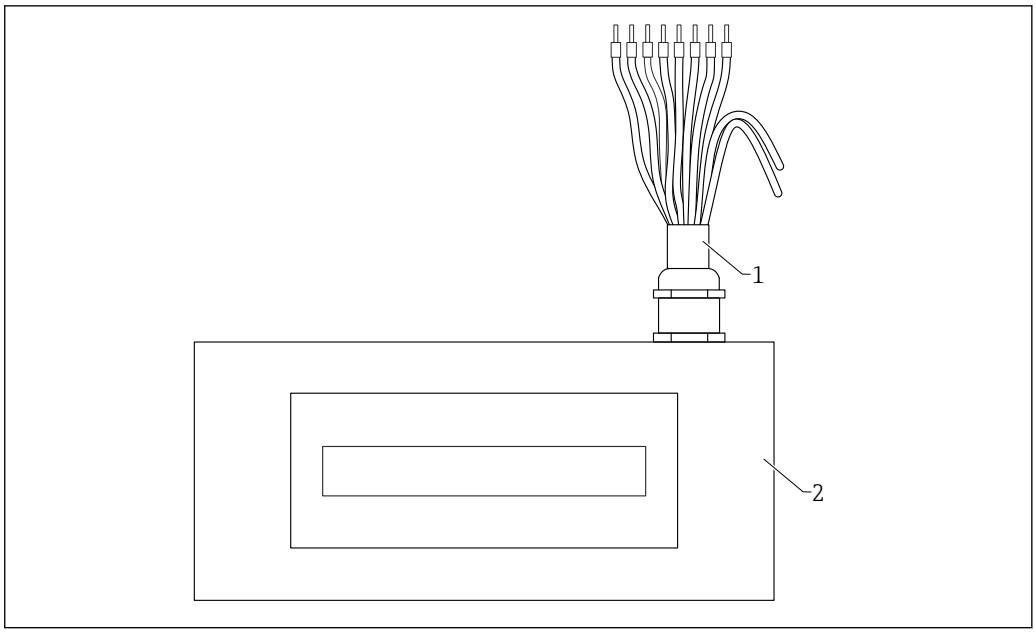
10 *Assignment of the 10-pin connector*

A *12 to 24 V_{DC} stabilized power supply*
Wire color: red (RD)
B *0 V_{DC} 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 (10-pin)
- The cable is firmly connected to the sensor
- The other end of the cable is fitted with ferrules

In the high-temperature version 0 to 120 °C (32 to 248 °F), the sensor is separated from the electronics unit via a HF cable. The electronics housing is equipped on both sides with connectors with IP67 protection.

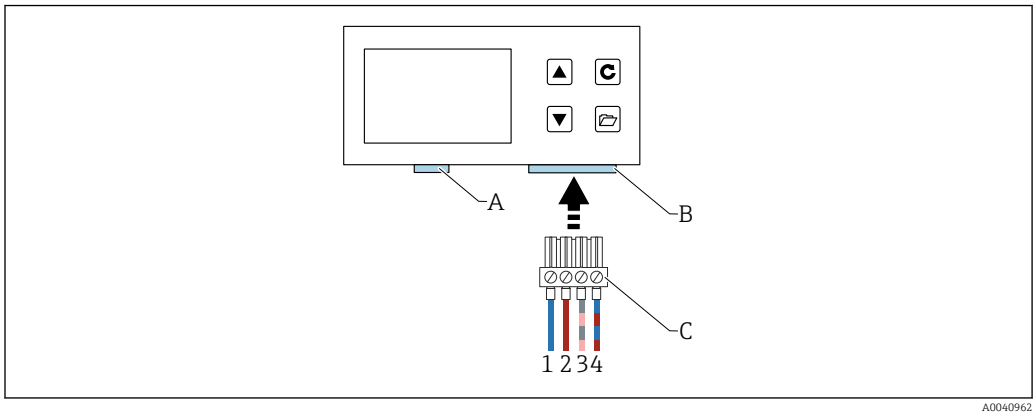


11 Rectangular sensor (standard version) with 10-pin cable assignment

1 10-pin cable with ferrules
- *12 to 24 V_{DC} stabilized power supply*
  Wire color: white (WH)
- *0 V_{DC} 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

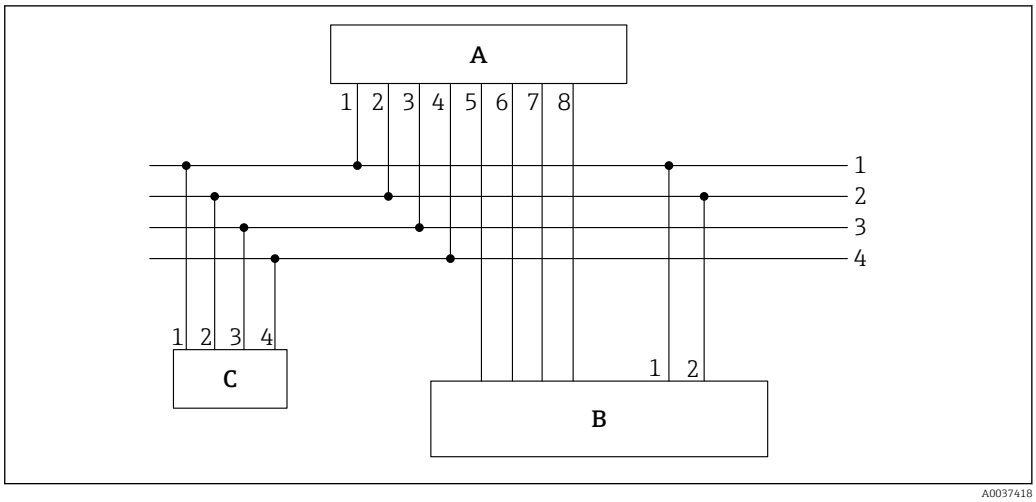
Connection to a remote display (optional)



12 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_{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)

6.3 Connection example of 10-pin socket



13 *Electrical connection example, sensor cable with 10-pin socket (sensor side) and ferrules at the end of the cable*

A Sensor
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 analog positive (+), material moisture
Wire color: green (GN)
6 1st analog return line (-), material moisture
Wire color: yellow (YE)
7 2nd analog positive (+)
Wire color: pink (PK)
8 2nd analog return line (-)
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).

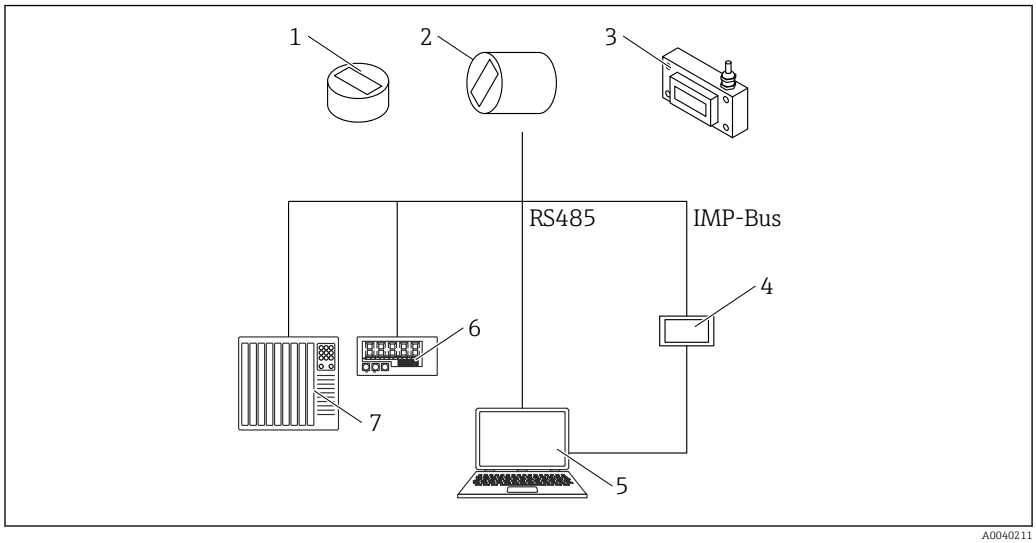
6.4 Post-connection check

☐ 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?

7 Operating options



14 Overview

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

8 Commissioning

8.1 Analog outputs for measured value output

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

Output 1 can be scaled at the factory, or can be subsequently scaled individually (user-defined setting) using the remote display (optionally available), e.g. 0 to 10 %, 0 to 20 % or 0 to 30 %

- Output 1: moisture in % (variably adjustable)
- Output 2: conductivity 0 to 20 mS/cm or temperature 0 to 100 °C (32 to 212 °F), this also applies for the high-temperature version.

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 temperature and the 12 to 20 mA range for conductivity. Output 2 automatically switches between these two windows every 5 seconds.

8.1.1 Possible settings for analog outputs

Therefore, there are several possible settings for analog outputs 1 and 2:

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 changeover.

Moisture range

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

The moisture range may not exceed 100 %.

- **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 sensors can measure conductivity in the range from 0 to 2 mS/cm, depending on the sensor type and moisture. The output is set to 0 to 20 mS/cm at the factory.

8.2 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 A - OnRequest (only in network mode for calling up measured values via the serial interface for calibration purposes).
- 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

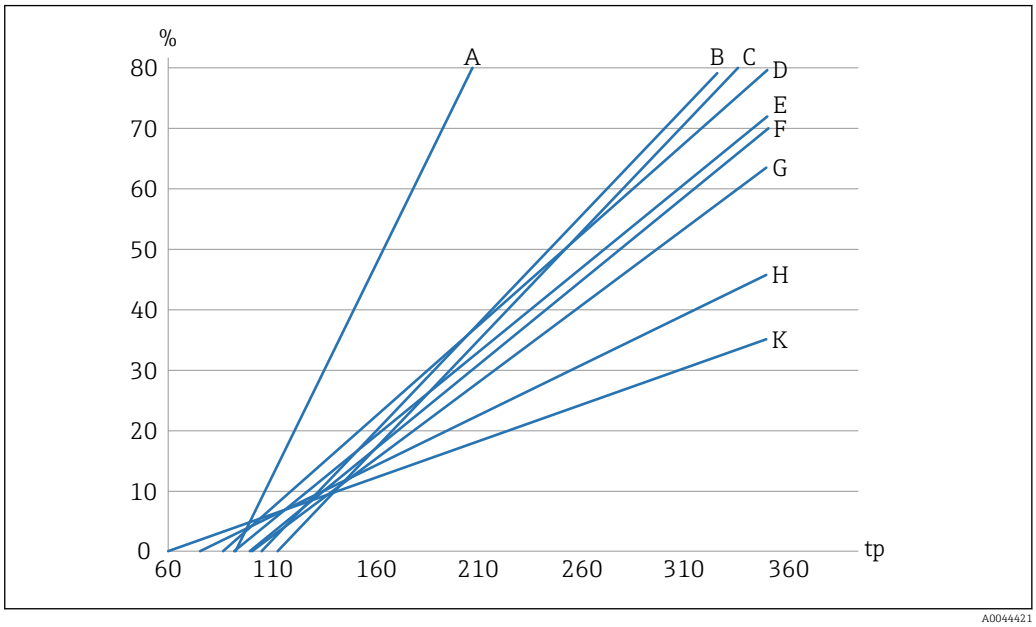
Each of these settings is retained even after the sensor is switched off, i.e. the setting is saved to the non-volatile memory of the sensor.

8.2.1 Operating mode

The sensor is supplied from the factory 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 seconds) 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 subsequently be able to analyze the measured data and identify the best 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 as low as 2 s 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.

8.3 Calibration curve set B for grain

For the measurement of different types of grain, special calibration curves for maize, rye, wheat, barley, soy, etc. can be saved in the sensor and can be activated via the remote display.



15 *Linear calibration curves*

H Gravimetric moisture; %
tp Raw value (radar transit time)

Assignment of the calibration curve to the material to be measured
- **A**: Sunflower seeds
- **B**: Barley with temperature compensation at 60 °C (140 °F)
- **C**: Wheat, maize, rye; with temperature compensation at 60 °C (140 °F)
- **D**: Soy without temperature compensation
- **E**: Barley without temperature compensation
- **F**: Wheat, maize, rye; without temperature compensation
- **G**: Soy with temperature compensation at 60 °C (140 °F)
- **H**: Rape and oilseeds
- **K**: Cal14 (air/water 0 to 100 %)

The graphic shows the linear calibration curves (A to K) for various types of grain. These curves are saved in the sensor and can be selected by the user. The gravimetric moisture is indicated as a % on the y-axis, and the associated radar transit time (tp) in picoseconds is displayed on the x-axis. This depends on the specific calibration curve. The radar transit time is displayed simultaneously with the moisture value during moisture measurement. In air, the sensors measure approx. 60 picoseconds radar transit time, and 145 picoseconds in dry glass beads.

Calibration curve set A for general bulk solid applications (e.g. sand, gravel, grit, wood chips) is available on request.

SD02333M **remote display** - description of operation and material calibration.

8.3.1 Installation in or at the discharge hopper

With this type of installation, it is important to set the right calibration curve to match the grain type so that the final moisture is displayed correctly as an absolute moisture value.

If product is continuously discharged and the sensor plate is permanently covered by grain, a calibration curve with temperature compensation must also be set here.

However, if the product is discharged intermittently in batches and the sensor plate is not covered most of the time, the integrated temperature sensor would adapt to the air temperature and not to the grain temperature, which would cause errors in the measurements.

Therefore, a calibration curve without temperature compensation is the recommended setting for intermittent discharge.

To precisely measure and display absolute moisture readings at the discharge point, the calibration curve must be correctly set and fine-adjusted.

Once the device is fine-adjusted for all possible types of grain, these parameters are stored in the device in the non-volatile memory. If the type of material to be measured is changed, the user only needs to select the relevant calibration curve during operation, as the influence of the installation location remains constant and the bulk density within a product is also largely the same.

Possible settings
- The grain calibration curve can be set depending on the type, as described in Section 8.3.
- Depending on the installation location, a zero point offset correction can be performed for the selected calibration curve

The use of the remote display is recommended to perform the fine-adjustment. The device can only be fine-adjusted when it is installed in the system, as the installation location and the bulk density of the grain has a considerable influence on moisture measurement.

The fine-adjustment must be performed separately with each type of grain.

Absolute moisture measurement depends on the following parameters:
- Installation location (e.g. metal objects in the field of measurement)
- Bulk density of the material

Another calibration curve must be selected as soon as one of these parameters changes if you want to display the moisture as an absolute moisture value.

8.4 Settings

8.4.1 Material calibration

Different calibrations are saved in the sensor depending on the intended application of the sensor.

In the "Material calibration" menu item, the necessary calibration can be selected via the optional remote display, depending on the application. In this way, one sensor can cover a variety of applications.

It is also possible to perform your own calibrations and overwrite an existing calibration curve.

SD02333M **remote display** - description of operation and material calibration.

8.5 Special functions

8.5.1 Determining the mineral concentration

With the radar-based measurement method, it is not only possible to measure moisture but also 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 2 mS/cm, depending on the moisture content.

8.5.2 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 is output at analog output 2 as standard. As the sensor electronics use approx. 3 W of power, the sensor housing heats up slightly. Therefore a very precise measurement of the material temperature is not possible, or is only possible to a certain degree.

8.5.3 Material temperature compensation

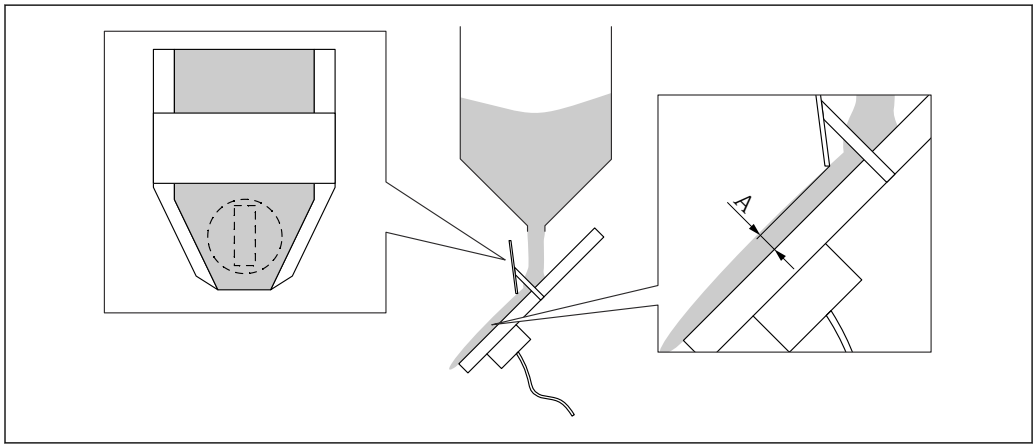
When used in higher temperature ranges, the dielectric constant (ε_r) of water and certain materials being measured show a temperature dependency. Moisture is determined using the dielectric constant, i.e. the dielectric constant is the actual parameter measured during moisture measurement. If materials being measured show a very special dielectric constant temperature dependency, such as a temperature dependency only in very specific moisture ranges, it may be necessary to perform a material-specific temperature compensation. If necessary, contact the manufacturer's Service Department for this material-specific temperature compensation.

9 Diagnostics and troubleshooting

9.1 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 60 mm (2.36 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.



16 *Example: "Concentration of material"*

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.

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

The sensor is delivered pre-calibrated with calibration set B and Cal14 (air/water 0 to 100 %) as standard.

The sensor can be fine-adjusted in a variety of ways to an accuracy of +/-0.1 % in relation to the laboratory value.

- 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 displayed by the sensor deviates from the laboratory value by more than +/-1 % during initial commissioning, this can be caused by the following:

- The sensor is not correctly installed in the material flow. The sensor surface must be covered sufficiently. Good and stable material flow **must** be ensured. A video of the material flow during the batch process can be helpful for analysis purposes.
- The wrong calibration curve is configured in the sensor. The sensor is delivered with calibration curve Cal14 (air/water 0 to 100 %).
- Incorrect moisture scaling is configured in the PLC. In the sensor, 0 to 20 % moisture corresponds to the 0 to 20 mA or 4 to 20 mA current output. The 0 to 20 % moisture scaling must also be entered in the PLC.
  Please contact the PLC manufacturer for more information.
- In the case of materials where the slope does not roughly correspond to a calibration curve saved in the sensor, a 2-point calibration (dry and wet material sample) may be necessary in the PLC or sensor.
  SD02333M **remote display** - description of operation and material calibration.
- In the case of coarse-grained or hydrophobic materials, water can escape directly onto the measuring cell and therefore cause a high moisture value. In this case, limits must be entered in the PLC.
  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 **"CA"** operating mode in the sensor must then be set to the **"CS"** mode for a test run, and then switched back to **"CA"** again 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.

10 Maintenance

No special maintenance work is required.

10.1 Exterior cleaning

When cleaning the exterior, always use cleaning agents that do not corrode the surface of the sensor and housing.

11 Repair

11.1 General information

11.1.1 Repair concept

Under the Endress+Hauser repair concept for the device, the device can be repaired by the Endress+Hauser Service Department.

For more information, please contact the Service Department at Endress+Hauser.

11.2 Return

The requirements for safe device return vary depending on the device type and national legislation.

For information on device return, please see:
http://www.endress.com/support/return-material

11.3 Disposal

If required by the Directive 2012/19/EU on waste electrical and electronic equipment (WEEE), the product is marked with the depicted symbol in order to minimize the disposal of WEEE as unsorted municipal waste. Do not dispose of products bearing this marking as unsorted municipal waste. Instead, return them to Endress+Hauser for disposal under the applicable conditions.

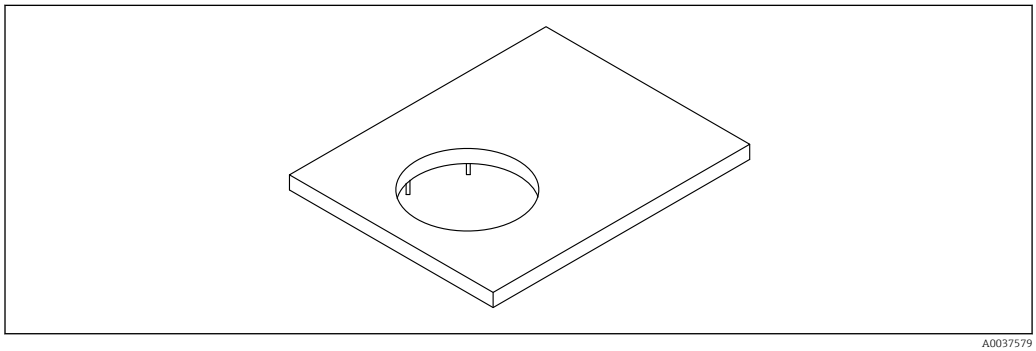
12 Accessories

12.1 Device-specific accessories

12.1.1 Baffle plate for round sensor

With sensor cut-out Ø108 mm

The baffle plate for the round sensor can be ordered together with the device via the "Accessory enclosed" section of the product order structure.



17 *Baffle plate with sensor cut-out Ø108 mm*

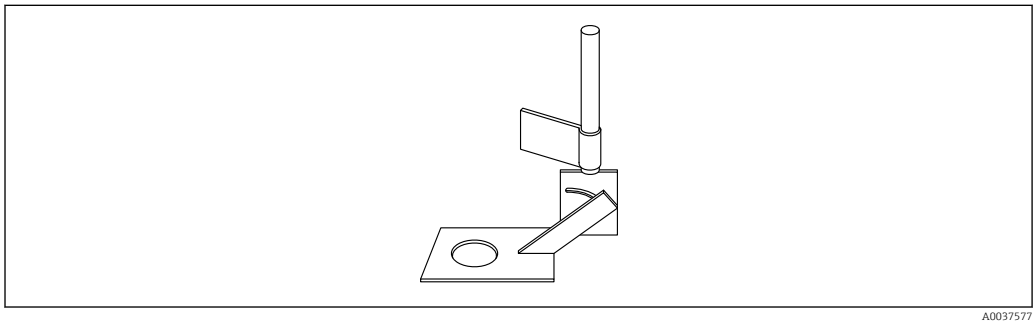
Material
1.4301

Dimensions
- Length: 300 mm (11.81 in)
- Width: 200 mm (7.87 in)
- Height: 8 mm (0.31 in)

12.1.2 Universal holder with tilt mechanism for round sensor

The universal holder for the round sensor can be ordered together with the device via the "Accessory enclosed" section of the product order structure.

Tilt mechanism with retaining head. For installing the device beneath a silo hatch or above a conveyor belt.

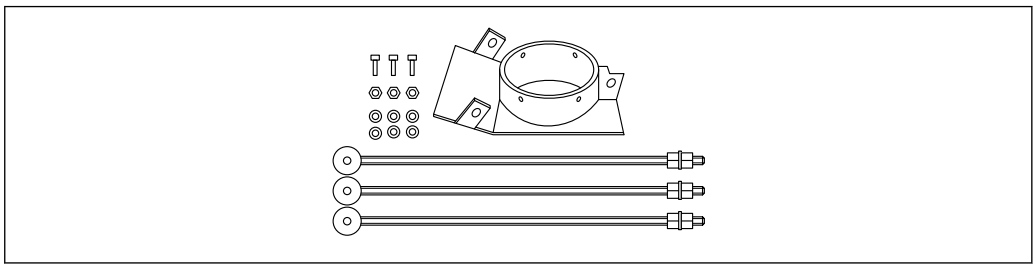


18 *Universal holder for round sensor with tilt mechanism for retaining head*

Material
1.4301

12.1.3 Sliding carriage, for round sensor

The sliding carriage for the round sensor can be ordered together with the device via the "Accessory enclosed" section of the product order structure.



A0037578

19 *Sliding carriage*

Material

- Fastening:
  1.4301
- Sliding carriage:
  1.4301
- Sliding surface:
  1.4301, uncoated
- 3 × threaded bolts for fastening

For installation on conveyor belts.

13 Technical data

13.1 Input

Measured variable

- **Channel 1**
  Material moisture in % (variably adjustable)
- **Channel 2**
  Conductivity 0 to 2 mS/cm or temperature 0 to 100 °C (32 to 212 °F), this also applies for the high-temperature version.

Measuring range

- **Material moisture**
  The material moisture can be determined with a water content ranging from 0 to 100 %
- **Temperature sensor**
  The temperature can be determined in the range from 0 to 100 °C (32 to 212 °F), this also applies for the high-temperature version.
- **Material conductivity**
  Material conductivity can be determined up to a maximum value of 2 mS/cm

13.2 Output

Analog

- Channel 1 (material moisture):
  0 to 20 mA/ 4 to 20 mA
- Channel 2 (material conductivity or material temperature):
  0 to 20 mA/4 to 20 mA

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

Moisture, temperature
Analog output 1 for moisture, output 2 for material temperature.

Moisture, conductivity
Analog output 1 for moisture, output 2 for conductivity of 0 to 20 mS/cm (factory setting)

Moisture, temperature/conductivity
Analog output 1 for moisture, output 2 for material temperature and conductivity with automatic window changeover.

Starting time

The first stable measured value is present at the analog output after approx. 1 s.

Digital

- Serial interface, RS485 standard
- IMP-Bus
  - Signal cable and operating voltage are galvanically isolated
  - Data transmission rate 9 600 Bit/s

Linearization

Up to 15 different calibration curves can be used in the sensor. Linear and non-linear curves with polynomials of up to degree 5 can be used. The calibration curve can be selected via the remote display.

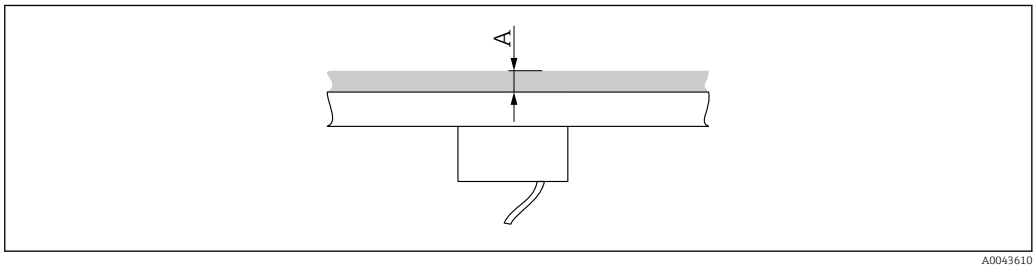
13.3 Performance characteristics

Reference operating conditions

The following reference conditions apply to the performance characteristics:
Ambient temperature: 24 °C (75 °F) ±5 °C (9 °F)

Measured value resolution

Sensor coverage / material height
For accurate measurement, the material on top of the sensor must be of a sufficient height.
Minimum sensor coverage (A): 60 mm (2.36 in) (moisture-dependent)



20 Height of material on top of sensor

A Minimum sensor coverage

Measuring field propagation
≥ 50 mm (1.97 in) depending on material and moisture

Material moisture
Measuring range up to 100 % vol.

Conductivity
- The device delivers a characteristic value depending on the mineral concentration
- The conductivity range in which a stable measurement can be performed is reduced in material moisture measurement ranges >50 %
- The conductivity value determined is uncalibrated and is primarily used to characterize the material being measured

Temperature
Measuring range: 0 to 100 °C (32 to 212 °F)
The temperature is measured 3 mm below the sensor surface in the housing and can be output at analog output 2. As the electronics use approx. 3 W of power, the housing heats up slightly. Therefore the precise measurement of the material temperature is only possible to a certain degree. The material temperature can be determined following an external calibration and compensation of the sensor's internal heating.

Maximum measured error

Accuracy: up to ±0.1 %

The measured error depends on the operating mode and on the flow of material over the measurement surface. The longer the averaging time and the more stable the material density over the measurement surface, the lower the measured error.

Heterogeneous bulk solids with varying grain size require a continuous flow of material over the surface of the sensor.

13.4 Environment

Ambient temperature range

At the housing: −40 to +70 °C (−40 to +158 °F)

Storage temperature	−40 to +70 °C (−40 to +158 °F)
Operating altitude	Up to 2 000 m (6 600 ft) above sea level
Degree of protection	IP67

13.5 Process

Process temperature range	▪ Standard, 0 to 70 °C (32 to 158 °F) ▪ High-temperature version (electronics unit in separate housing), 0 to 120 °C (32 to 248 °F) (not available for the short round sensor) Moisture measurement below 0 °C (32 °F) is not possible. The water content of ice (frozen water) cannot be determined.

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