

Brief Operating Instructions

Solitrend MMP42

Material moisture measurement



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

For detailed information, refer to the Operating Instructions and other documentation.

Available for all device versions via:

- Internet: www.endress.com/deviceviewer
- Smart phone/Tablet: Endress+Hauser Operations App



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Table of contents

1	About this document	4
1.1	Symbols used	4
1.2	Documentation	5
2	Basic safety instructions	5
2.1	Requirements for personnel	5
2.2	Designated use	5
2.3	Workplace safety	6
2.4	Operational safety	6
2.5	Product safety	6
3	Product description	7
3.1	Product design	7
3.2	Sensor temperature range up to 120 °C (248 °F)	7
4	Incoming acceptance and product identification	8
4.1	Incoming acceptance	8
4.2	Product identification	8
4.3	Manufacturer's address	9
4.4	Storage, transport	9
5	Installation	9
5.1	Installation conditions	9
5.2	Round sensor, short / middle	9
5.3	Rectangular sensor	11
5.4	Protection of sensor connector against abrasion	13
5.5	Electronics housing, sensor temperature range up to 120 °C (248 °F)	14
5.6	Post-installation check	15
6	Electrical connection	16
6.1	Connection conditions	16
6.2	Connecting the measuring device	16
6.3	Post-connection check	18
7	Operating options	19
8	Commissioning	19
8.1	Analog outputs for measured value output	19
8.2	Mode	21
8.3	Calibration curve set B for grain	21
8.4	Settings	24
8.5	Special functions	24
9	Diagnostics and troubleshooting	24
9.1	Optimizing the material flow	24
9.2	Difference between measured moisture value and laboratory value too large during initial commissioning	25

1 About this document

1.1 Symbols used

1.1.1 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.

NOTICE

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

1.1.2 Symbols for certain types of information and graphics

Permitted

Procedures, processes or actions that are permitted

Forbidden

Procedures, processes or actions that are forbidden

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

1.2 Documentation

The following documentation types are available in the Downloads section 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

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.

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

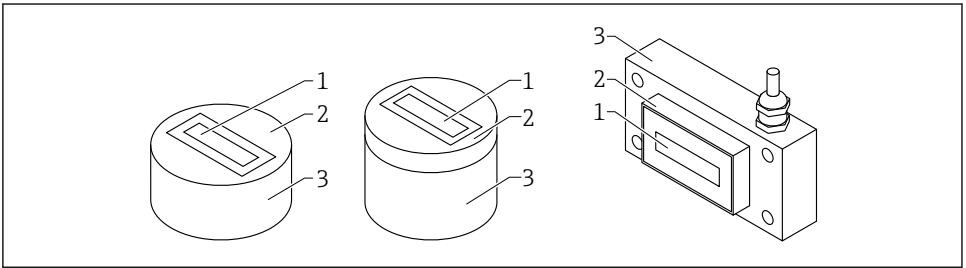
This device is designed in accordance with good engineering practice to meet state-of-the-art safety requirements, has been tested, and left the factory in a condition in which it is safe to operate.

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/dm³ and conductivity values up to 2 mS/cm.

3.1 Product design



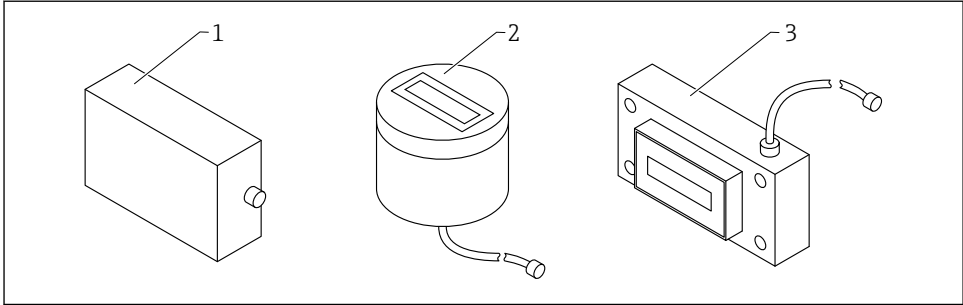
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1 Product design

- 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).



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- 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

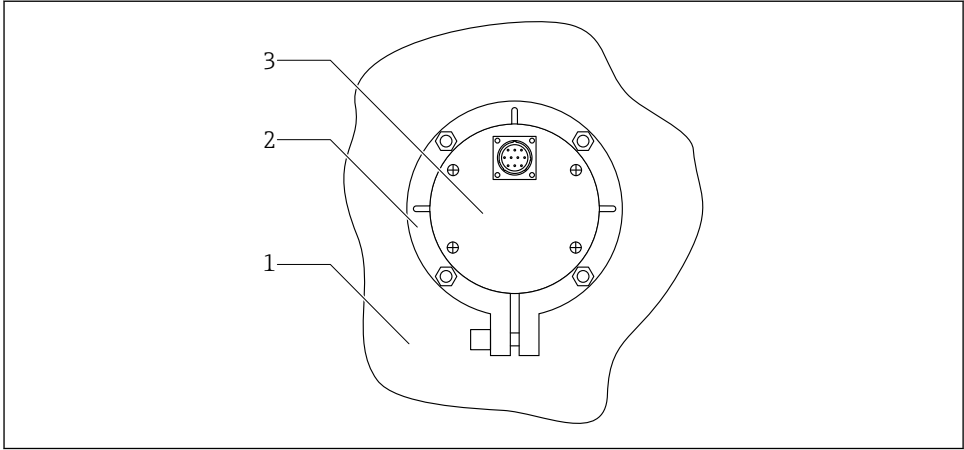
- The device must be installed at a point in the process in such a way that ensures a relatively constant material density, as the material density is directly related to the water content. Where necessary, a bypass should be created or structural measures may be needed at the place of installation to 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

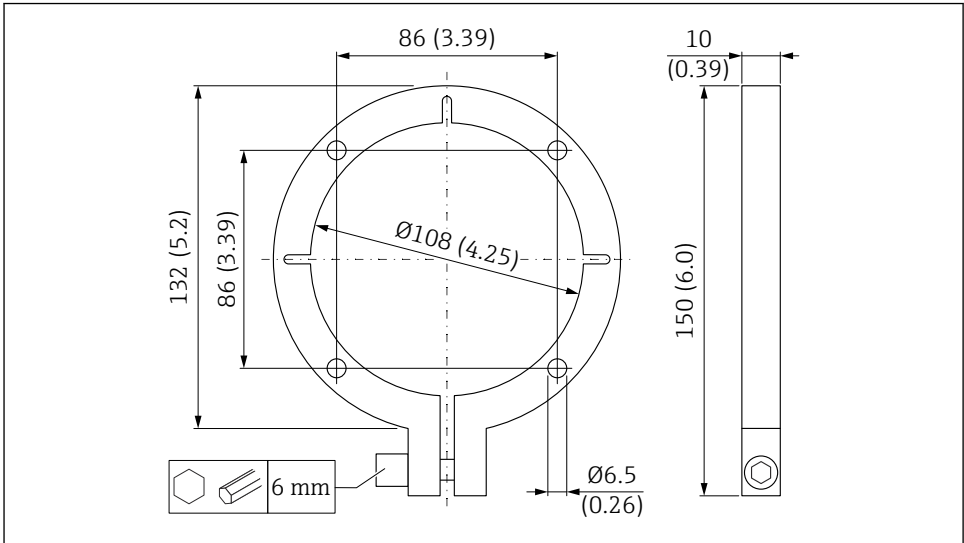
The short / middle round sensor can be installed using a mounting flange.



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- 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.

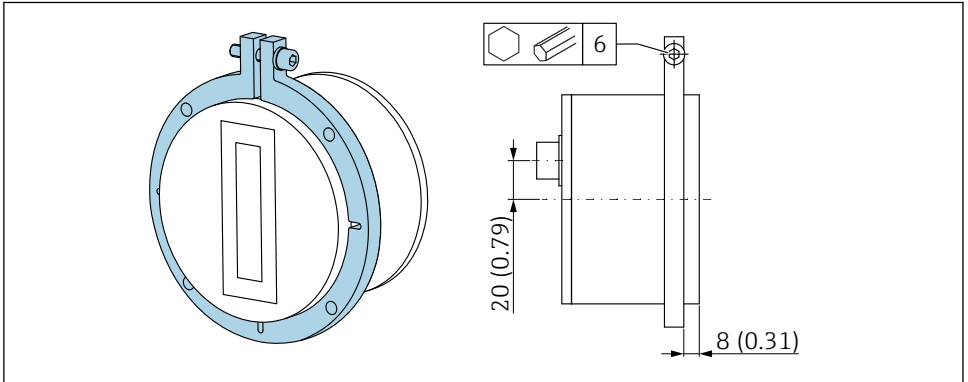


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- 3 Mounting flange for round sensor, short version or round sensor, middle version

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



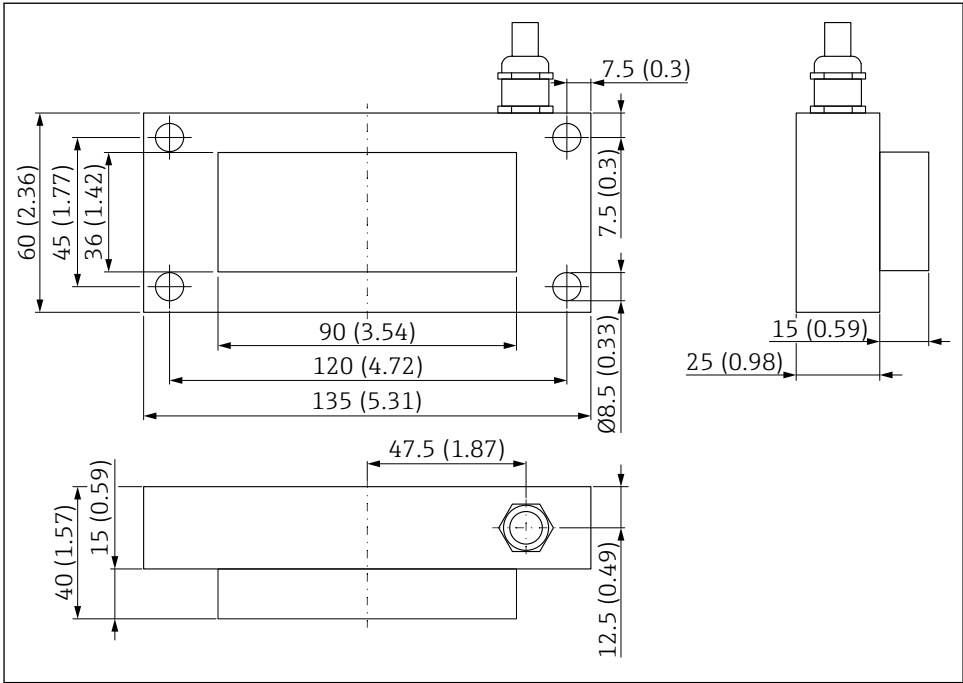
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4 *Mounting position, mounting flange and round sensor*

5.3 Rectangular sensor

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

5.3.1 Dimensions



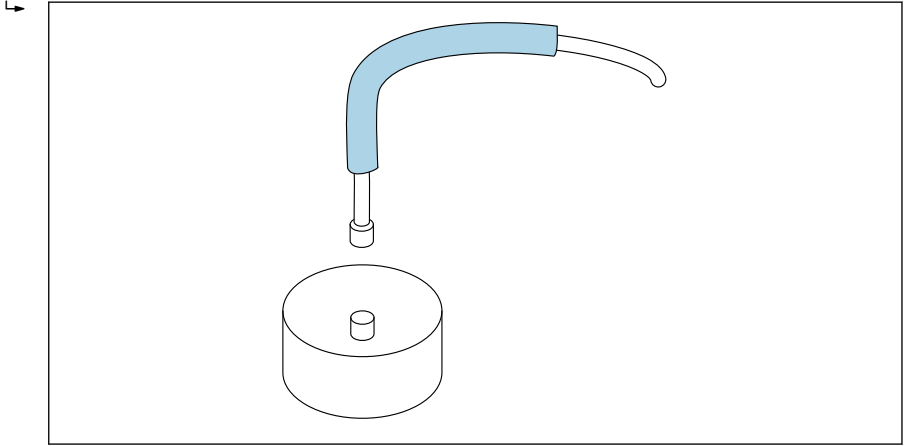
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5 Dimensions of rectangular sensor. Unit of measurement mm (in)

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.

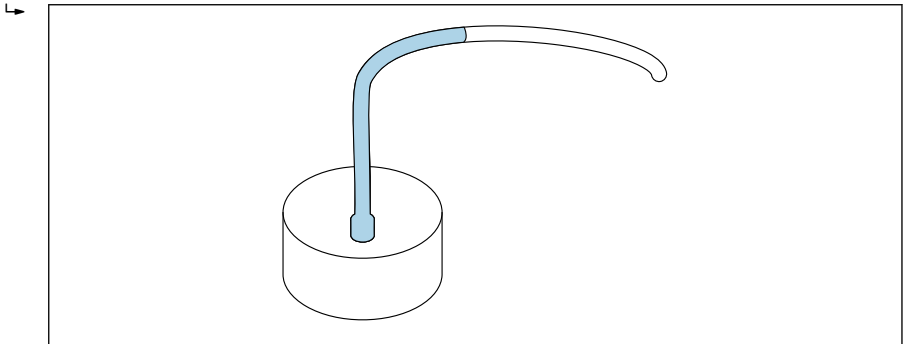
1. The heat-shrink tube supplied with the cable can be used to provide this protection.



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6 Example of round sensor

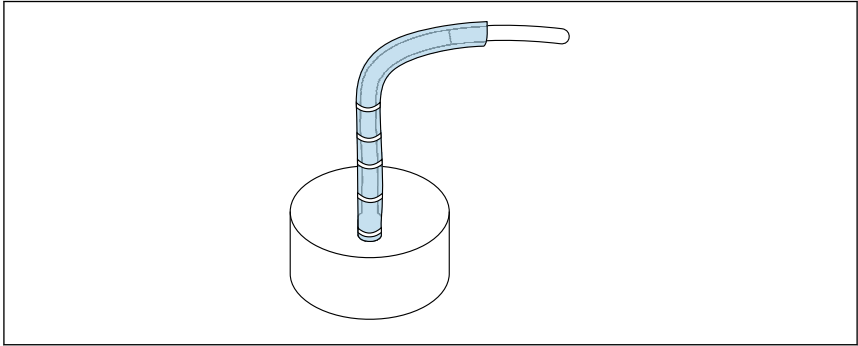
2. Once the sensor has been installed and the sensor cable connected, the heat-shrink tube can be shrunk onto the connector and cable with a hot air blower




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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)



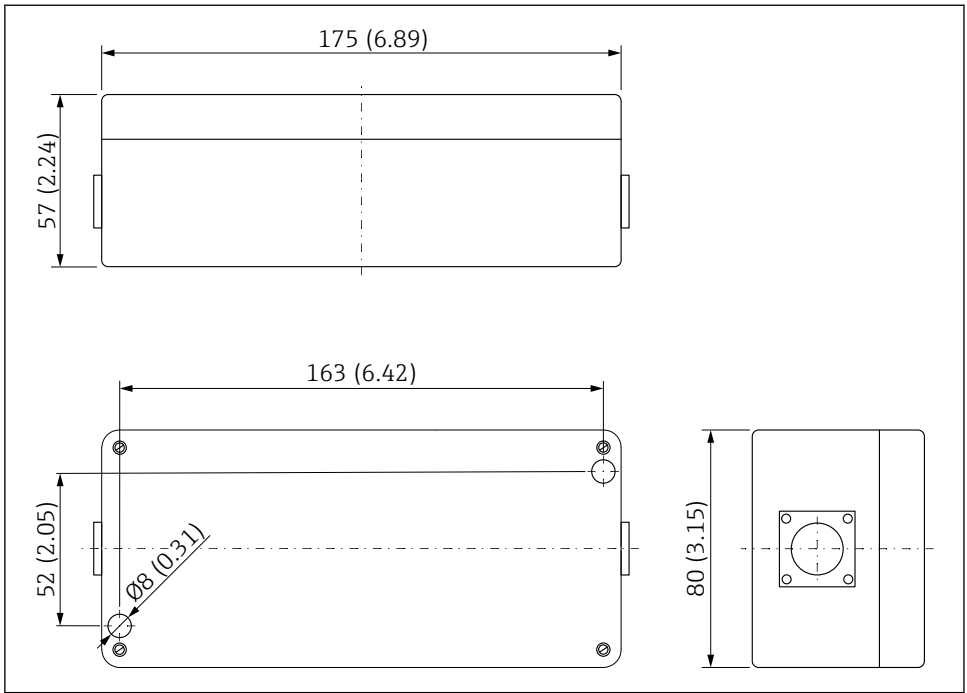
A0037429

 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



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- 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 $6 \times 2 \times 0.25 \text{ mm}^2$, 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.

6.2 Connecting the measuring device

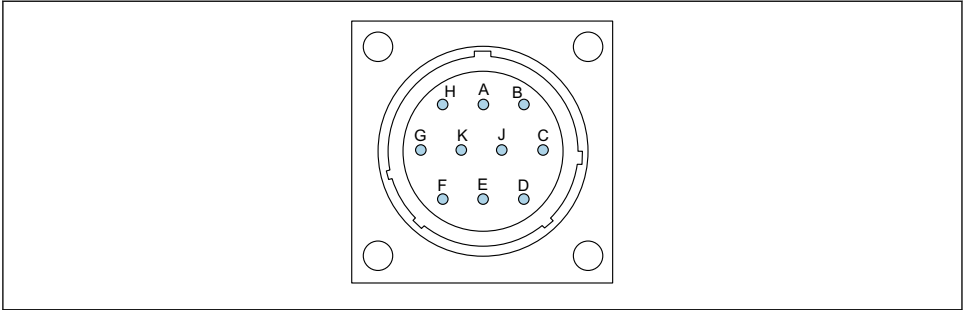
6.2.1 Terminal assignment

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.



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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

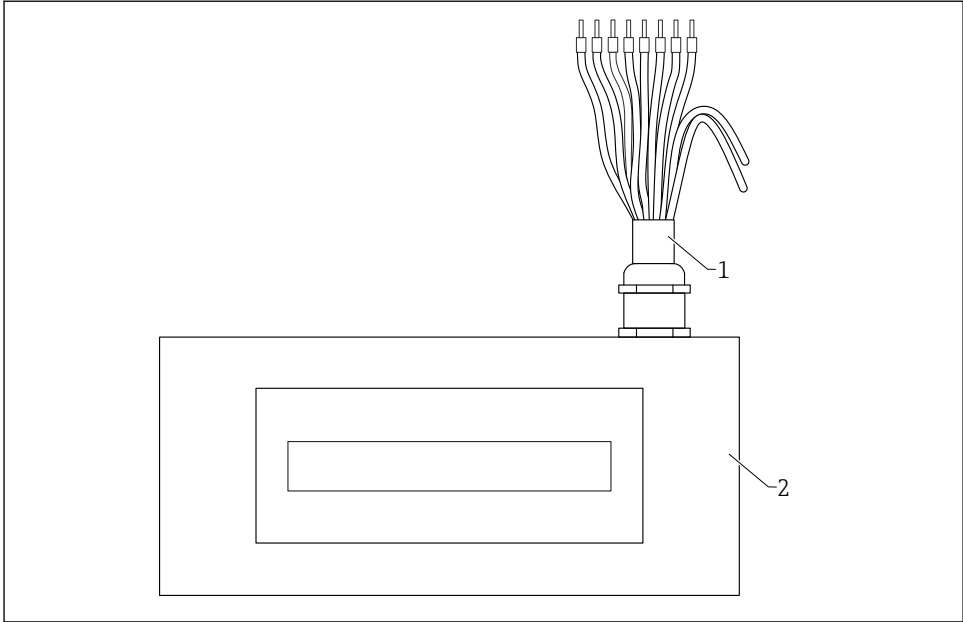
Rectangular sensors

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 sensor housing is equipped on both sides with connectors with IP67 protection.



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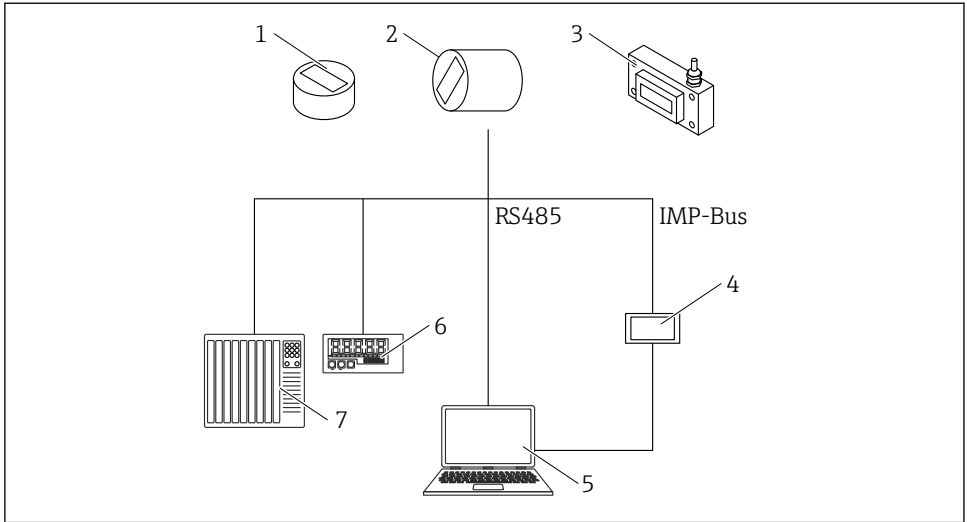
▣ 11 Rectangular sensor (standard version) with 10-pin cable assignment

- 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

6.3 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?

7 Operating options



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12 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.

i 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.

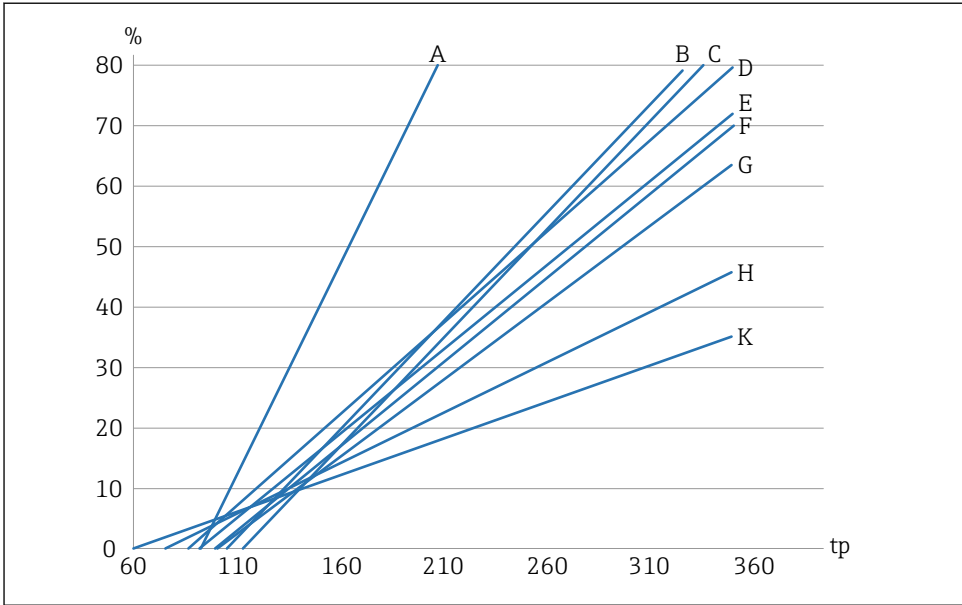
8.2.1 Operating mode

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.



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13 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

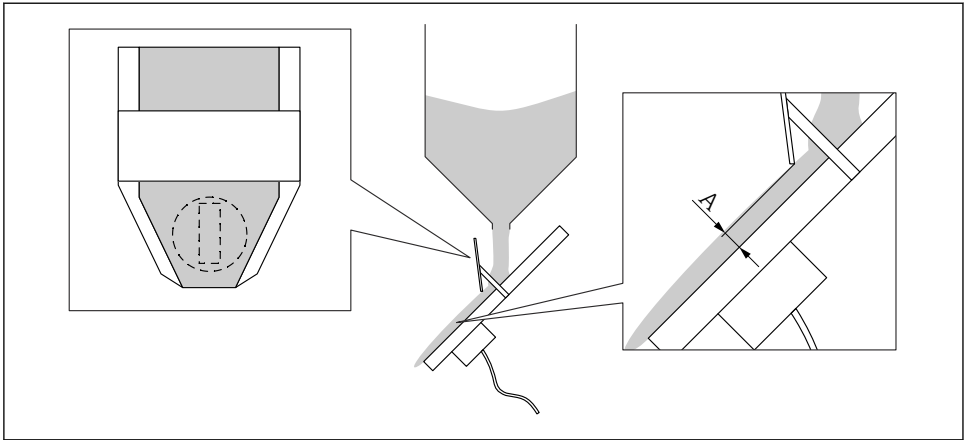
Special functions that are available are described in the Operating Instructions pertaining to the device.

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.



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14 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.



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