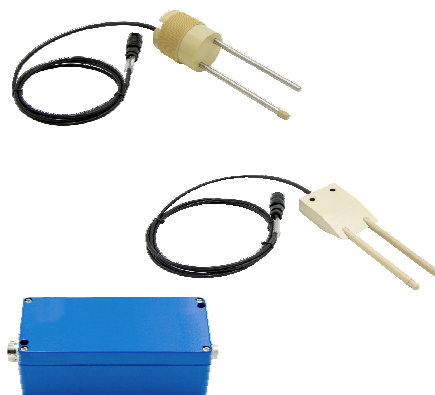


Brief Operating Instructions

Solitrend MMP44

Material moisture measurement



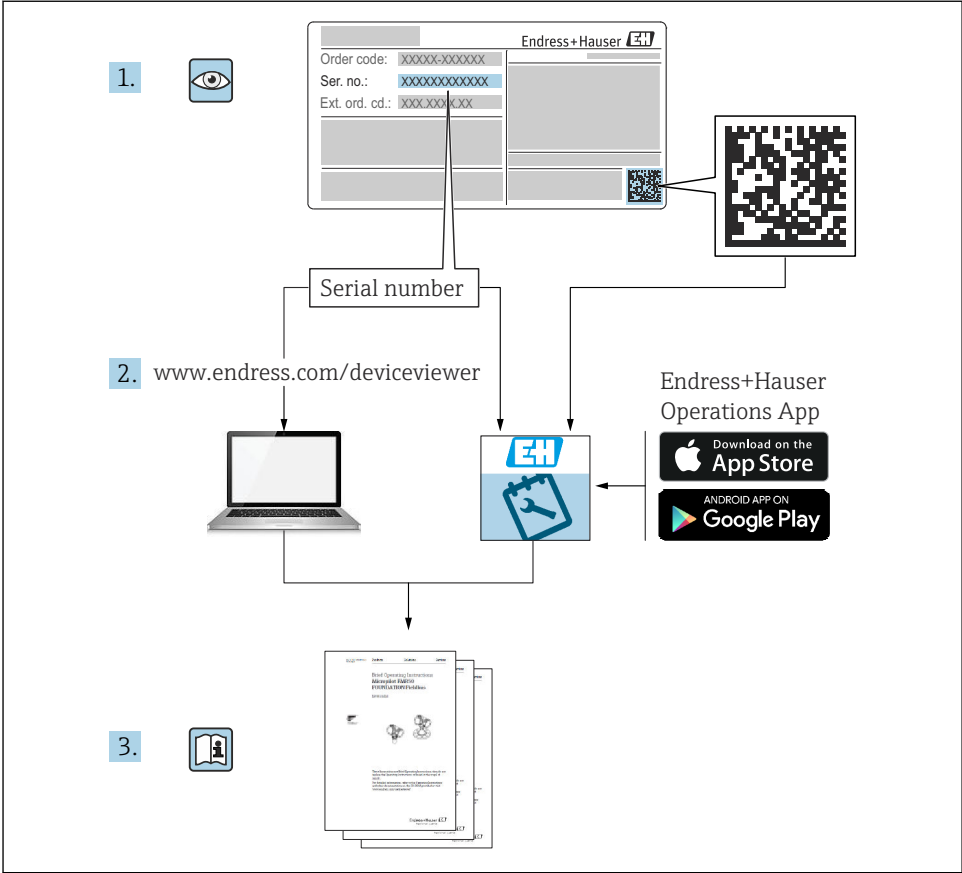
These Brief Operating Instructions are not a substitute for the Operating Instructions pertaining to the device.

Detailed information is provided in the Operating Instructions and other documentation.

Available for all device versions via:

- Internet: 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



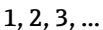
Notice or individual step to be observed



Series of steps



Result of a step



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

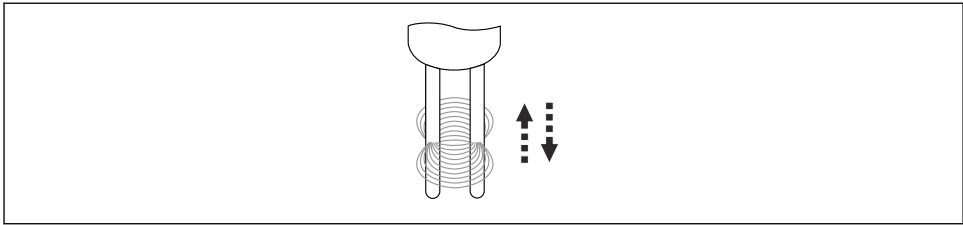
This device is designed in accordance with good engineering practice to meet state-of-the-art safety requirements, has been tested, and left the factory in a condition in which it is safe to operate.

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

4.1 Measuring principle

Time-domain reflectometry (TDR) is a radar-based dielectric measurement method where the transit time of electromagnetic pulses is determined to measure the water content. The sensors consist of a probe body with two stainless steel rods and one transmitter. The high-frequency TDR pulse generated in the transmitter is transmitted to the sensor via a HF cable and is then transmitted along the two-rod wave guide. An electromagnetic field is produced around these two rods/guide and therefore in the material surrounding the sensor. Using a patented measurement method, the transit time of this pulse is measured with a resolution of one picosecond (1×10^{-12}) in order to determine the moisture and temperature.

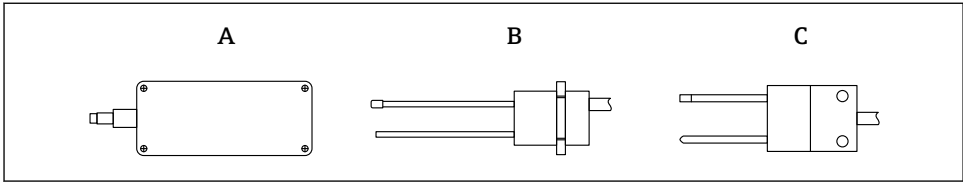


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 1 *Two-rod wave guide*

The TDR method operates in the ideal frequency range between 600 MHz and 1.2 GHz.
With variable sensor designs, the modular TDR technology can be adapted to many applications.

4.2 Product design

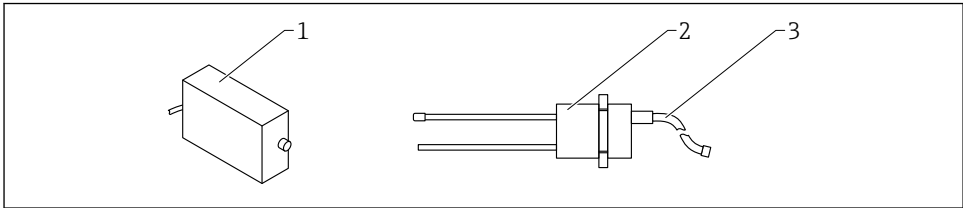


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 2 *Visualization of device designs*

- A *Transmitter*
- B *Two-rod sensor, round design*
- C *Two-rod sensor, wedge-shaped*

4.2.1 ATEX version



A0053311

 3 *Rod sensor, ATEX version*


- 1 *ATEX electronics housing*
- 2 *Two-rod sensor, round design*
- 3 *Cable; UNITRONIC PUR CP*

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)
 - ↳ 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

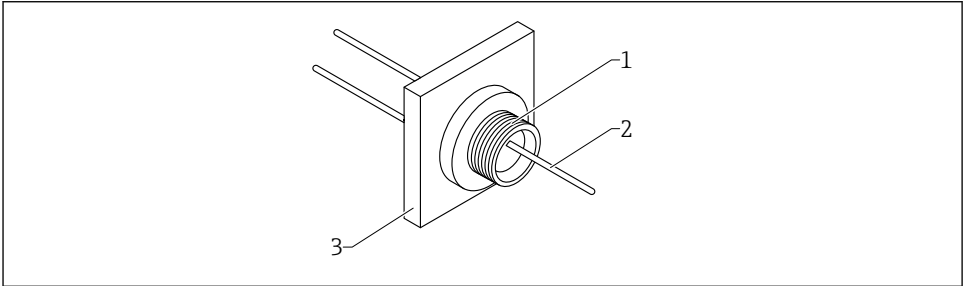
- The device must be installed at a point in the process in such a way that ensures a constant bulk density, as the bulk density directly affects the calculation of the water content. Where necessary, a bypass should be created or structural measures may be needed at the place of installation to ensure that the material flow, and therefore the bulk density, over the sensor rods is constant.
- The flow of material over the sensor rods must be continuous. With the software, it is possible to automatically detect and bridge gaps in material flow in intervals of seconds.
- Material deposit or buildup on the sensor rods falsifies the reading and must therefore be avoided.



Longer averaging times increase the stability of the measured value.

6.2 Wall mounting

The round two-rod sensor features a screw thread to secure it in a silo or housing wall. The area that is relevant for moisture measurement is located around the measuring rods. A temperature sensor is fitted on the tip of a sensor rod and is designed to measure the grain temperature without any influence from the vessel wall.



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4 Mounting example with mounting plate

- 1 Sensor
- 2 HF connecting cable
- 3 Mounting plate

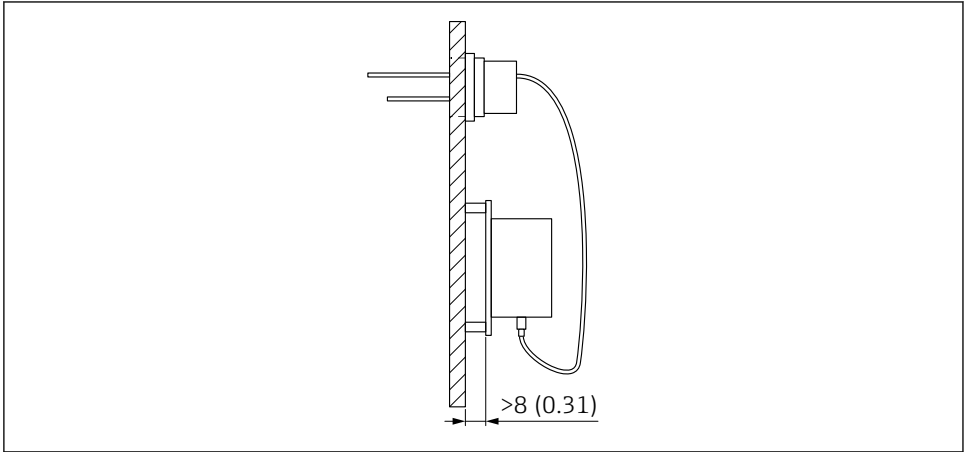
6.3 Mounting the transmitter

For metrological reasons, the sensor cable is only 2.5 m (8.2 ft) long. The transmitter must therefore be mounted near the sensor. The ideal installation location is on the exhaust side of the dryer exterior wall.

The transmitter can be secured in the housing with screws via two holes made diagonally

If the surface temperature of 70 °C (158 °F) is exceeded at the mounting location, the transmitter must be secured with a minimum distance of 8 mm (0.3 in) to prevent the direct transmission of heat (back ventilation).

The use of a weather protection cover is recommended to protect the transmitter from direct sunlight or rain.



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5 Mounting the container wall with higher surface temperatures. Unit of measurement mm (in)

6.4 Two-rod sensor, wedge-shaped

The wedge-shaped two-rod sensor for moisture measurement directly in the malt dryer bed.

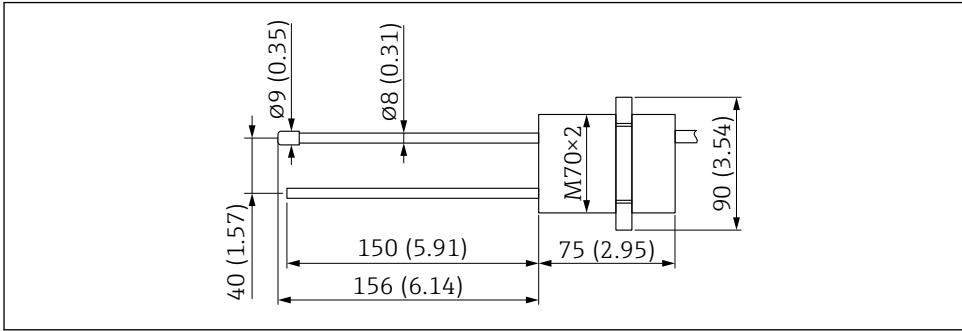
The wedge-shaped two-rod sensor can also be used for higher moisture contents and vaporous environments.

6.4.1 Installation of the wedge-shaped two-rod sensor in the malt drying system

The installation conditions depend on the conditions in the plant. The optimum installation location must be determined individually.

The two-rod sensor has a wedge-shaped housing. Thanks to this design, several probes can be mounted at different heights on a hydraulic apparatus, which sinks the probes into the germination bed once it has been filled. The wedge-shaped two-rod sensor can be retracted from the bed with the hydraulic system at the end of the germination and drying process, and before the dryer vessel is emptied.

6.5 Two-rod sensor, round design



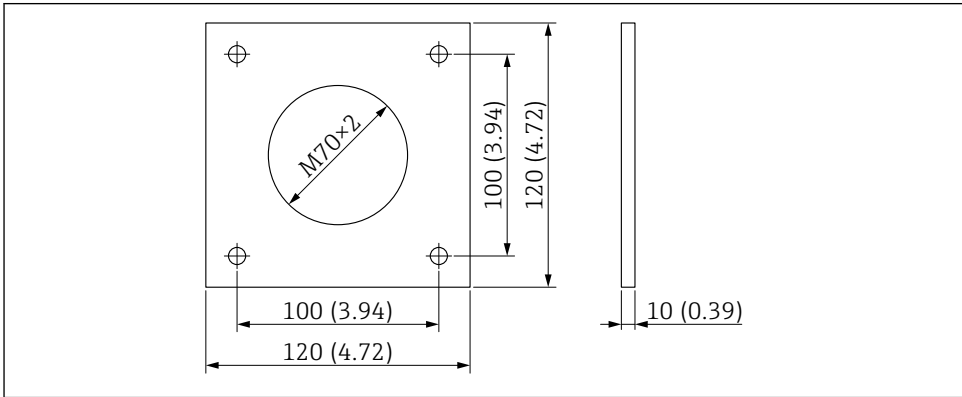
A0040863

6 Dimensions of two-rod sensor, round design. Unit of measurement mm (in)

6.6 Mounting plate

The aluminum mounting plate, which is suitable for the round two-rod sensor, can be ordered via the product structure, "Process connection" feature.

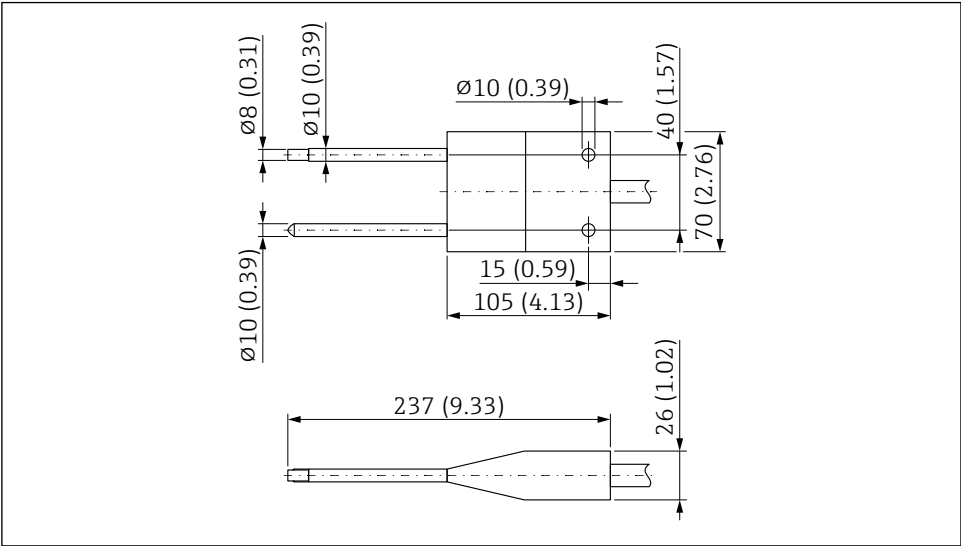
Suitable lock nuts are included in the delivery.



A0040862

7 Dimensions of the aluminum mounting plate for the round two-rod sensor. Unit of measurement mm (in)

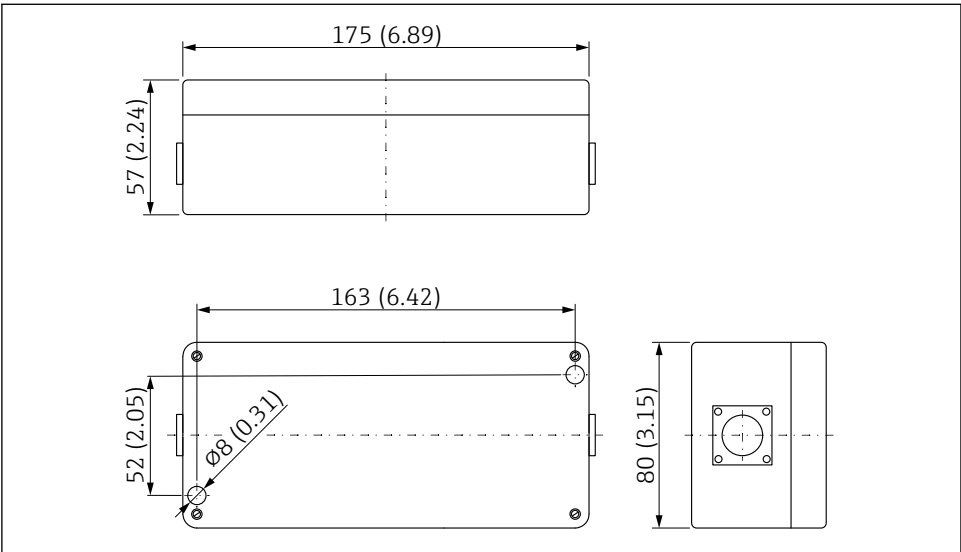
6.7 Two-rod sensor, wedge-shaped design



A0040851

8 Dimensions of the two-rod sensor, wedge-shaped design. Unit of measurement mm (in)

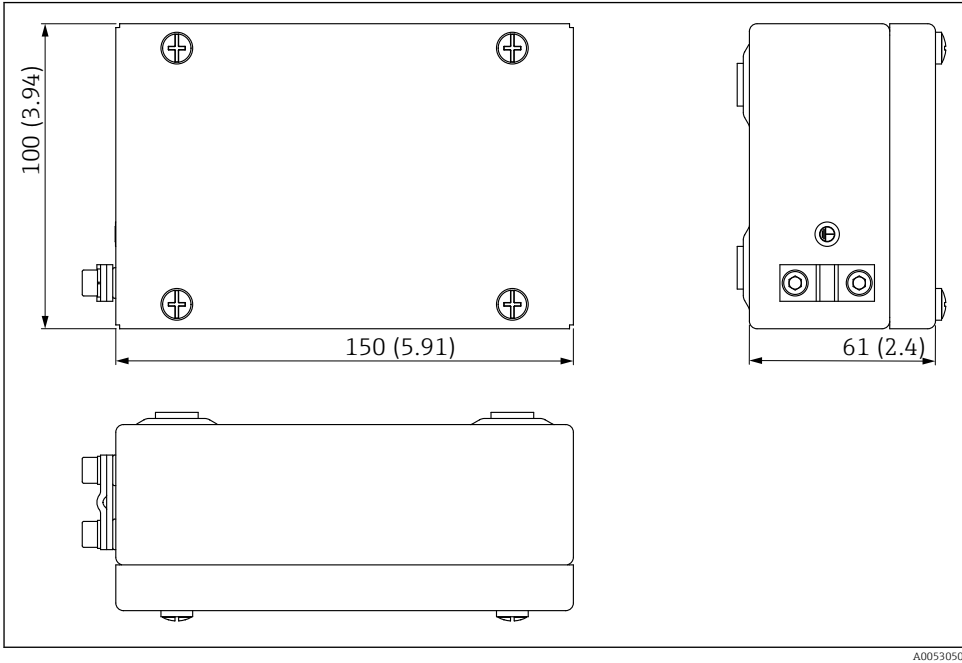
6.8 Transmitter



A0044492

9 Transmitter dimensions. Unit of measurement mm (in)

6.9 ATEX electronics housing



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

6.10 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 sufficient material coverage / material flow over the sensor rods 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 $6 \times 2 \times 0.25 \text{ mm}^2$ (0.01 in²), PUR sheath resistant to oils and chemicals.

7.1.2 Cable specification for HF sensor connection

HF cable between the transmitter and wedge-shaped two-rod sensor / round two-rod sensor

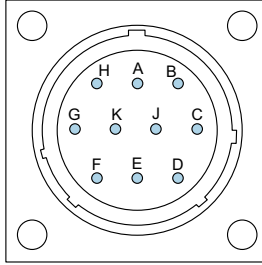
- Length: 2.5 m (8.2 ft)
- Temperature: max. 127 °C (261 °F)
- Material: PTFE

7.2 Connecting the measuring device

7.2.1 Terminal assignment

Transmitter

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



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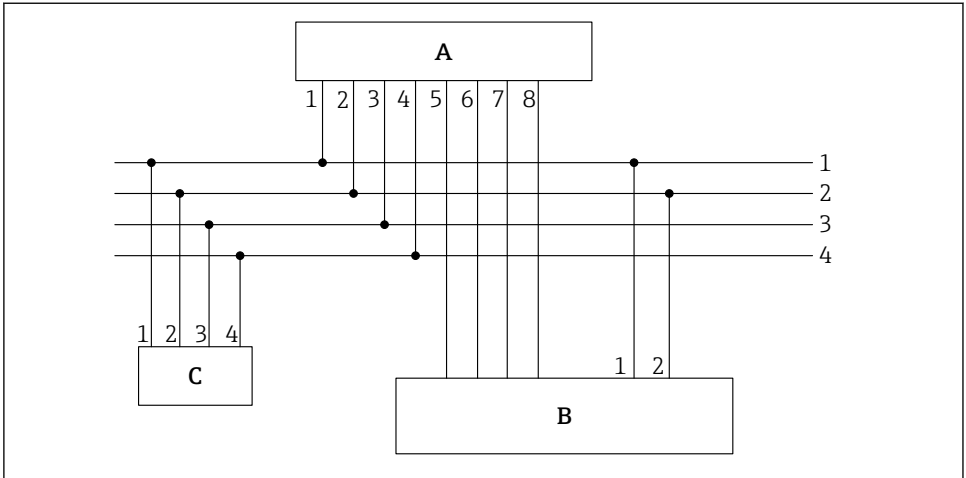
11 Assignment of the 10-pin connector

- 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


Potential equalization

The shield is grounded at the transmitter.


7.2.2 Connection example of 10-pin socket



A0037418

 12 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)

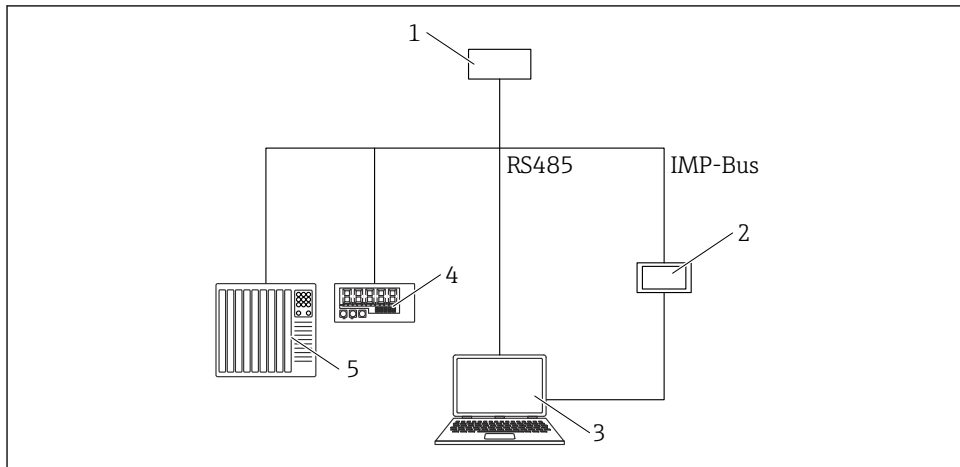
 The moisture content determined and the conductivity/temperature can either be fed directly into a PLC via analog outputs 0 to 20 mA/4 to 20 mA or queried via the serial interface (IMP-Bus) using the display (optional).

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 Operating options



A0046938

- 1 Transmitter
- 2 Remote display
- 3 Computer
- 4 LED display
- 5 PLC or water dosing computer

9 Commissioning

9.1 General notes

NOTICE

Danger of overvoltage!

- ▶ When carrying out welding work on the system, make sure that the electrical connections are removed from all the probes
- ▶ Use a stabilized power supply of 12 to 24 V_{DC}
- ▶ Use a galvanically isolated power supply
- ▶ Line voltages must have the same ground potential to ensure a correct measurement
- ▶ Avoid electromagnetic fields in the immediate vicinity of the probes

NOTICE**Damage to the electronics**

- ▶ The probe must not be connected to the transmitter during installation

9.2 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: moisture in % (variable setting)
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 %, etc.
- Output 2: conductivity 0 to 5 mS/cm or temperature 0 to 70 °C (32 to 158 °F) or optionally the standard deviation during moisture measurement

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.

The two analog outputs can be adapted individually. For a 0 to 10 V DC voltage output, a 500 Ω resistor can be used on the controller side.

9.2.1 Possible settings for analog outputs

Several settings are therefore possible for analog outputs 1 and 2:

Analog outputs**Selection:**

- 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, or 0 to 50 mS/cm

Moisture, temperature/conductivity

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

Moisture, moisture standard deviation

Output 1 for moisture, output 2 for standard deviation of moisture measurement (for use in fluidized bed dryers, for example).

Moisture range

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

- **Moisture range in %**
 - Maximum: e.g. 100 % volumetric or in relation to the total mass
 - Minimum: 0 %
- **Temperature range in °C**
 - Maximum: 100 °C
 - Minimum: 0 °C
- **Conductivity in mS/cm**
 - Maximum 20 mS/cm, or 0 to 50 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.

9.3 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



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.

9.3.1 Operating mode

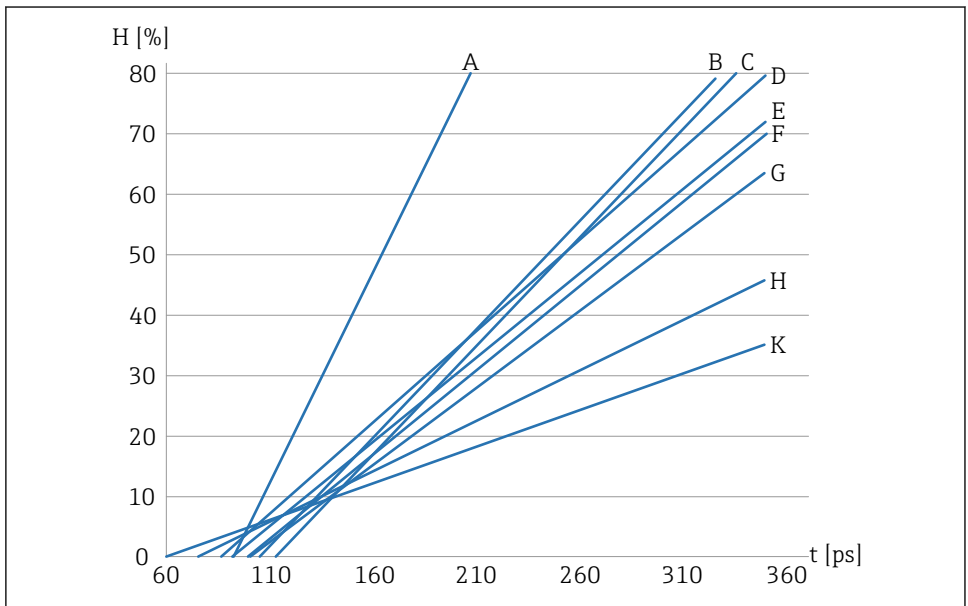
The sensor is supplied from the factory with the **CA** mode for general process applications. 6 different operating modes are available depending on the application.

- **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 fast but continuous measurement processes, with simple filtering and an accuracy of up to ± 0.3 %
 - The CA mode is also used to record raw values, without averaging and filtering, for subsequent analysis and determination of the optimum operating mode
 - Maximum averaging time 25 s
- **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 ± 0.3 %
 - Maximum averaging time 255 s

- **CK** mode (Cyclic Kalman with Boost Filter)
For complex applications in mixers and dryers
- **CC** mode (Cyclic Cumulated)
With automatic totalizing of moisture volume measurement in a batch process, without PLC controller
- **CH** mode (Cyclic Hold)
Moisture volume measurement with automatic filter function, ideal for short batch processes with batch times of up to 2 s, for use without PLC controller

9.4 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.



A0044421

13 Calibration curve set B (Cal.A, Cal.B, Cal.C, Cal.D, Cal.E, Cal.F, Cal.G, Cal.H, Cal.K)

H Gravimetric moisture; %

t Radar transit time; picoseconds

A Cal.A, sunflower seeds

B Cal.B, barley with temperature compensation at 60 °C (140 °F)

C Cal.C, wheat, maize, rye; with temperature compensation at 60 °C (140 °F)

D Cal.D, soy without temperature compensation

E Cal.E, barley without temperature compensation

F Cal.F, wheat, maize, rye; without temperature compensation

G Cal.G, soy with temperature compensation at 60 °C (140 °F)

H Cal.H, canola seed and oilseeds

K Cal.K (Cal.14), air/water 0 to 100 %

The graphic shows the linear calibration curves (Cal.A to Cal.K) for various types of grain 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 at a radar transmit time of approx. 60 ps, and 145 ps 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.

9.4.1 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 measuring surface is always permanently covered with grain, a calibration curve with temperature compensation must be set in the event of large variations in the process temperature.

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

Once the device has been fine-tuned for all possible grain types, these parameters are permanently stored in the device. If the type of material to be measured changes, during operation all the user needs to do is simply select the relevant calibration curve, 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 configured depending on the type
- 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.

9.5 Settings

9.5.1 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.

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



SD02333M **Remote display** - Description of operation and material calibration.

9.6 Special functions

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

10 Diagnostics and troubleshooting

The device is normally precalibrated with calibration set B and Cal.14 (air/water 0 to 100 %) upon delivery.

Fine-tuning to achieve an accuracy of ± 0.3 % in relation to the laboratory value can be performed via a PLC or the remote display (optional).

Fine-tuning with the PLC

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.).

- ▶ Perform a parallel shift / offset in the PLC
 - ↳ Contact the PLC manufacturer

Fine-tuning with the remote display

- ▶ Perform fine-tuning / parallel shift in the device via the **Offset** parameter

10.1 Different moisture value

If the moisture value of the device deviates by more than ± 0.3 % from the laboratory value during initial commissioning, this may be due to the following:

Incorrect installation in the material flow

The measurement surface must be sufficiently covered. A good, stable flow of material **must** be guaranteed.

- ▶ Correct the installation or material flow
 - ↳ A video of the material flow during the batch process can be helpful for analysis purposes.

The wrong calibration curve is set

The device is delivered with calibration curve Cal.14 (air / water 0 to 100 %).

- ▶ Select a suitable calibration curve.

Moisture scaling set incorrectly in the PLC

In the device, 0 to 20 % moisture corresponds to the current output of 0 to 20 mA or 4 to 20 mA.

- ▶ Enter the 0 to 20 % moisture scaling in the PLC.
 - ↳ Contact the PLC manufacturer

The calibration curves that are saved do not match the material

In the case of materials where the slope does not roughly correspond to a calibration curve saved in the device, 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

Incorrect data processing

In the event of inaccurate data processing, check the moisture value displayed in the PLC.

1. Connect the device to the remote display
2. Compare the moisture value shown in the PLC with the moisture value shown on the display
3. For a test run, set the **CS** operating mode in the device
4. After the test run, set the operating mode back to **CA**

Start/stop conditions are not correct

- Start condition: time in seconds or kg in the scales
- Stop condition: usually % of target weight
- ▶ Check the start/stop conditions in the PLC
 - ↳ Contact the PLC manufacturer



If the solutions described here do not rectify the problem, contact the manufacturer's Service Department.



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www.addresses.endress.com
