

Technical Information

Solitrend MMP44

Material moisture measurement



In-line moisture measurement for grains and seeds
Flexible and reliable operation in primarily
continuous drying processes and malting plants

Application

Moisture measurement in grain dryers, grain handling, seeds and malting plants



Your benefits

- Easy commissioning even in challenging processes
- Deep material penetration to 130 mm (5.12 in)
- Large measuring field with a volume of up to 1.5 l
- Optional versions available for higher moisture values, vaporous processes or abrasive media
- Ambient temperature up to 120 °C (248 °F) thanks to remote electronics module
- Broad measuring range of 0 to 100 % vol. moisture
- Factory calibration for maize and wheat for example
- Measurement of surface and capillary moisture



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About this document

Symbols

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.

Symbols for certain types of information and graphics

Tip

Indicates additional information



Reference to graphic

Permitted

Procedures, processes or actions that are permitted

Preferred

Procedures, processes or actions that are preferred

Forbidden

Procedures, processes or actions that are forbidden

1, 2, 3, ...

Item numbers

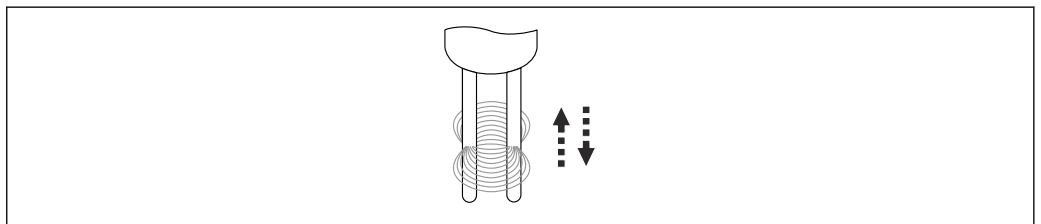
A, B, C, ...


Views

Function and system design

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.



 1 *Two-rod wave guide*

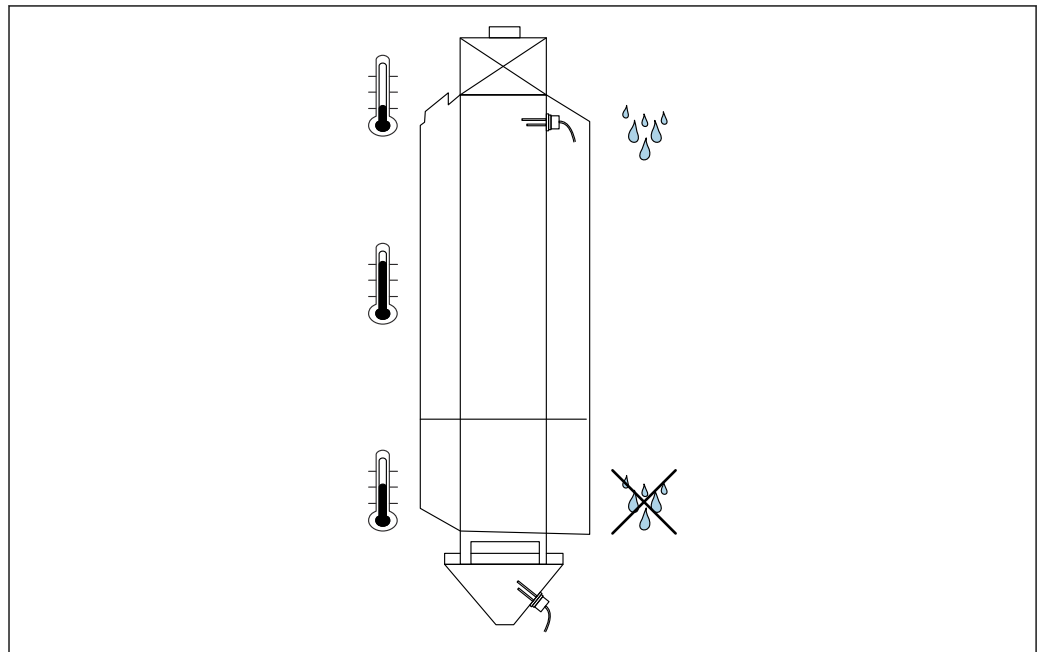
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The TDR method operates in the ideal frequency range between 600 MHz and 1.2 GHz.


With variable sensor designs, the modular TDR technology can be adapted to many applications.

Measuring system

Grain drying



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 2 Application example: grain drying

The device can be used to monitor the moisture of the supplied grain and can also be used to support or automate the grain drying process. A suitable calibration curve must be selected depending on the type of grain to be measured and its bulk density.

Monitoring during grain acceptance

The device makes it possible to continuously measure the moisture of the grain during the grain acceptance process. This produces a moisture profile that can be recorded with a PC, PLC or a recorder. In addition, the current values can be displayed with the remote display unit. This enables better quality control and greater transparency.

Manual or semi-automatic dryer control

In the case of manual or semi-automatic dryer control, the use of the device in conjunction with the remote display can significantly optimize drying results. In addition, by connecting a recorder or PC it is possible to document the drying process. This provides additional optimization potential for the drying process.

Automatic control of the grain dryer

The device is connected to the actual value input of a controller. Ideally, several devices are used. The efficiency of the drying process can be maximized with automatic control.

Calibration

The sensor is supplied with factory calibrations for fast commissioning. 15 storage locations are available in the memory for the calibrations.




It is only possible to modify the calibration with the remote display (optional).

Operating mode	<p>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.</p> <ul style="list-style-type: none"> ▪ 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) <ul style="list-style-type: none"> ▪ Standard averaging for fast but continuous measurement processes, with simple filtering and an accuracy of up to $\pm 0.3\%$ ▪ 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) <ul style="list-style-type: none"> ▪ Floating average for very slow and continuous measurement processes, with simple filtering and an accuracy of up to $\pm 0.3\%$ ▪ 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
Communication	Serial interface with databus protocol implemented as standard for the connection and networked operation of multiple sensors.

Input

Measured variable	<ul style="list-style-type: none"> ▪ Channel 1 Material moisture in % (variable setting) ▪ Channel 2 Conductivity or temperature
Measuring range	<ul style="list-style-type: none"> ▪ Material moisture 0 to 100 % volumetric water content ▪ Temperature 0 to 120 °C (32 to 248 °F) ▪ Material conductivity 0 to 2 mS/cm

Output

Analog	<ul style="list-style-type: none"> ▪ 2 × 0 to 20 mA ▪ 2 × 4 to 20 mA ▪ 2 × 0 to 10 V, 500 Ω <p> The following analog output versions can be configured:</p> <ul style="list-style-type: none"> ▪ Moisture, temperature Output 1 = moisture Output 2 = temperature ▪ Moisture, conductivity Output 1 = moisture Output 2 = conductivity ▪ Moisture, temperature/conductivity; presetting Output 1 = moisture Output 2 = alternating (conductivity/temperature)
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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

15 different calibration curves can be selected and saved via the remote display (optional).
Customer-specific calibrations can also be created and saved via the display.

Power supply

Terminal assignment

The device is normally supplied with a 10-pin MIL plug.



The sensor is connected to the transmitter with a 2.5 m (8.2 ft) HF connecting cable.

Supply voltage

12 to 24 V_{DC}

**Overvoltage**

- ▶ Only use stabilized power units

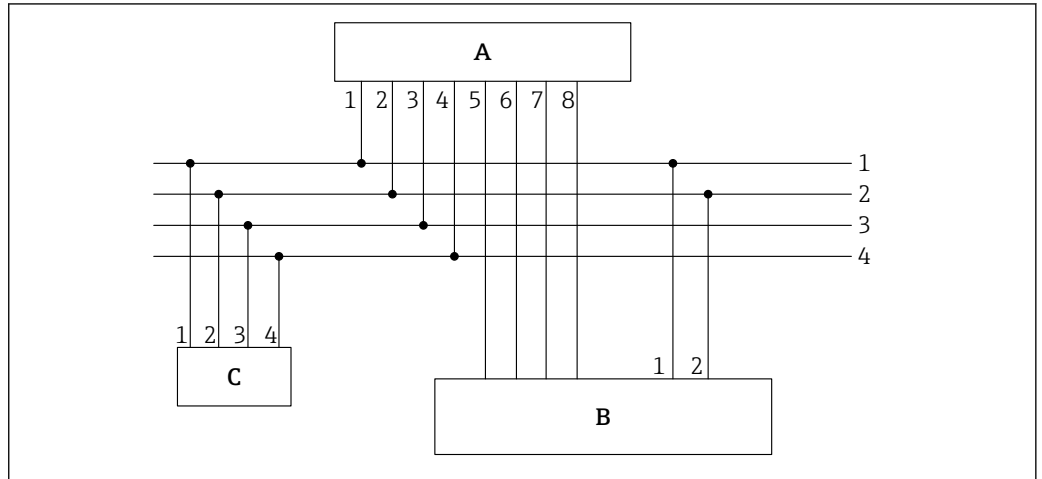
Power consumption

<3 W

Power supply failure

The configuration is retained in the device.

Electrical connection



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3 Connection example, transmitter with 10-pin socket

- 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)

i 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).

Potential equalization

The shield is grounded at the transmitter.

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.

Performance characteristics

Reference operating conditions

The following reference conditions apply to the performance characteristics:

- Ambient temperature: 24 °C (75 °F) ±5 °C (±9 °F)
- Ideal installation conditions:
 - Constant bulk density
 - Sufficient material volume flow through the measuring field
 - No buildup

Measured value resolution

Measuring field propagation

The measuring field propagates along the length of the sensor rods. The diameter of the measuring field is about twice the diameter of the sensor housing and has a volume of approx. 1.5 l.

Material moisture

Measuring range up to 100 % vol.

Conductivity

The conductivity value determined - as a characteristic value depending on the mineral concentration - is uncalibrated and is primarily used to characterize the material being measured. The conductivity range is reduced in material moisture measurement ranges > 50 %.

Temperature

Measuring range: 0 to 100 °C (32 to 212 °F)

The temperature is measured in the sensor rod tip and can be output at analog output 2.

Maximum measured error

Accuracy up to ±0.3 %_{abs} under ideal, constant installation and material conditions.

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

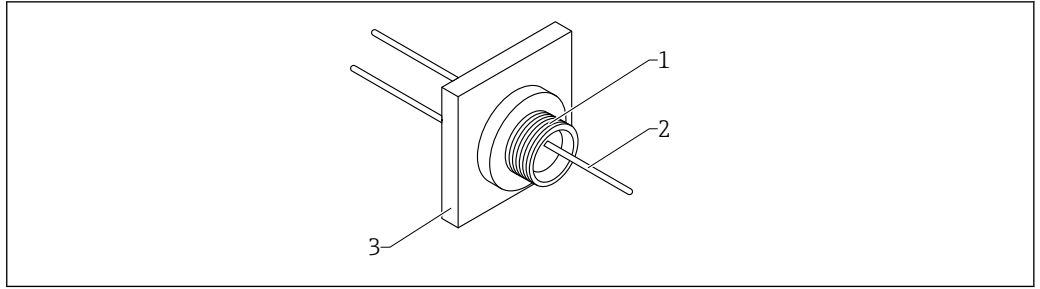
Mounting

Mounting location

- 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.

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.



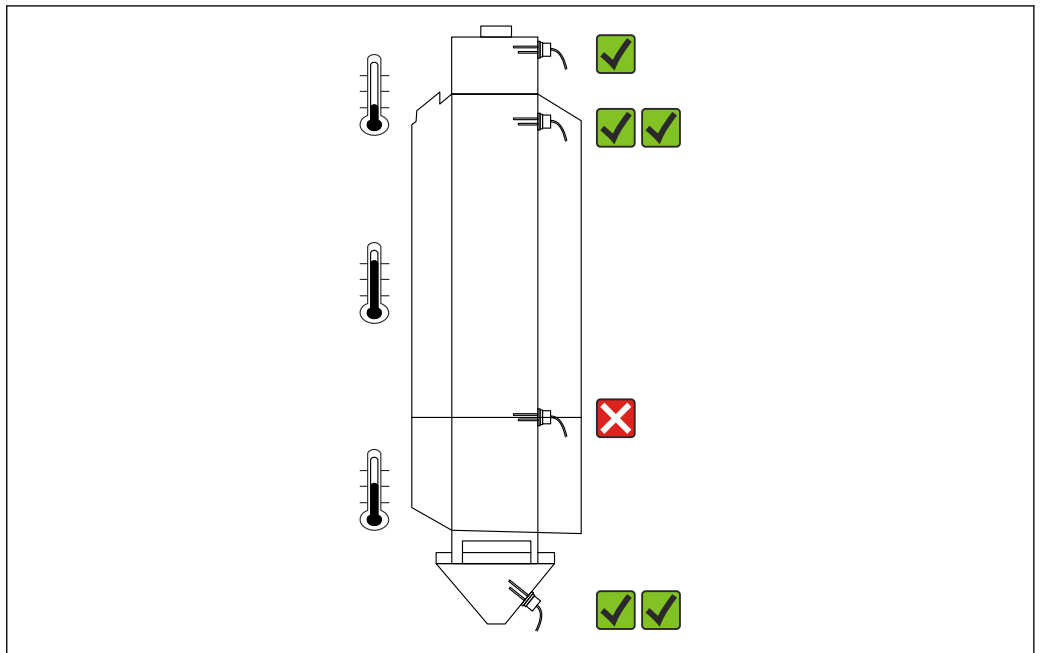
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4 Mounting example with mounting plate

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

Orientation

Continuous flow dryer



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5 Installation positions in a continuous flow dryer

At dryer entry point/inlet

Installation only recommended under certain conditions ✓

- In theory, it is possible to measure the moisture directly at the dryer entry point, as the material is fed in here and is mixed thoroughly to the extent possible.
- At temperatures below zero, frozen material could be fed in at this point.
- Frozen water is not detected and therefore the measured value is falsified.

At the start of the heating zone

Installation is recommended ✓✓

- The installation below the entry point ensures that sufficient regulation time is available
- Rising heat ensures that the material is not (or no longer) frozen
- A calibration curve with temperature compensation enables precise moisture measurement taking the temperature into consideration

At the transition from the heating zone to the cooling zone

Installation is not recommended ✗

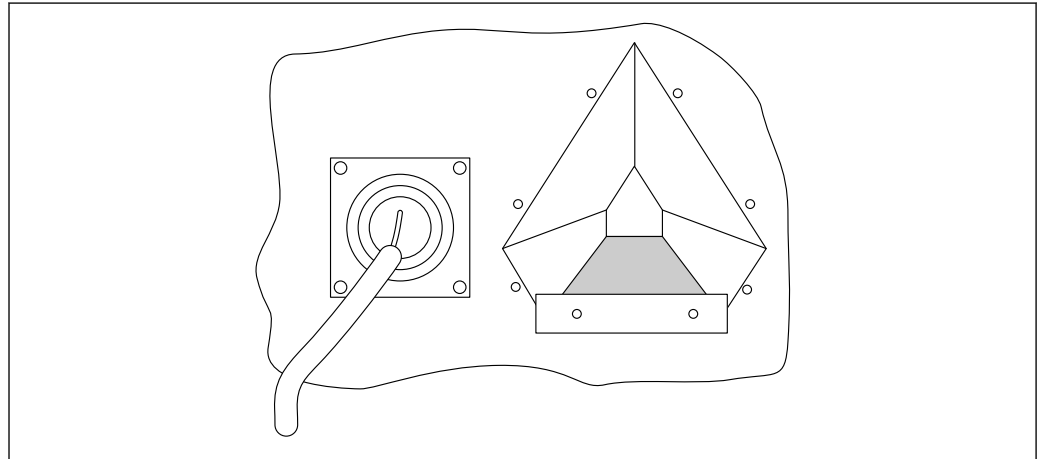
Not enough time to readjust the target moisture

In the discharge hopper

Installation is recommended ✓✓

- Installation location to monitor the target moisture
- The value can be fed back into the control loop
- A calibration curve with temperature compensation enables precise moisture measurement taking the temperature into consideration.

Installation on the exhaust air side of the dryer wall



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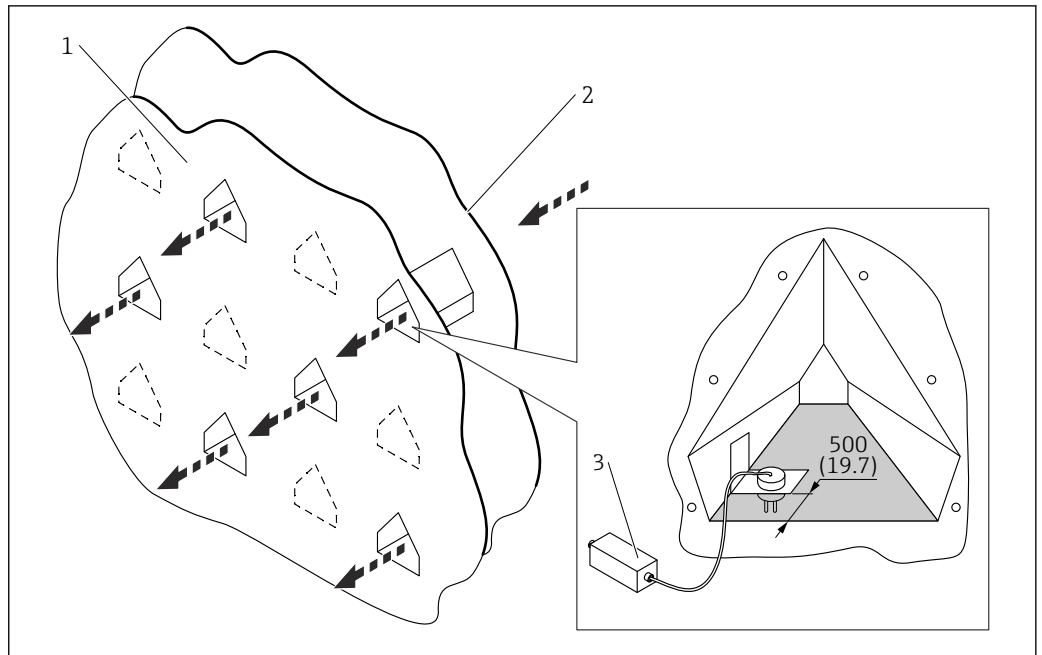
6 Installation example: dryer wall

On the exhaust air side of the dryer wall

Installation only recommended under certain conditions ✓

- The temperature conditions directly at the dryer wall can be different to conditions further inside the dryer. Therefore, the grain moisture content may not be representative here.
- Metal surfaces near and along the sensor rods can affect the measurement.
- Plant residue can stick to the sensor rods that project into the dryer at an angle. This can disturb the flow of material and even cause clogging, making measurement impossible.

Installation directly in the exhaust duct of a roof dryer



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7 Installation example: exhaust duct. Unit of measurement mm (in)

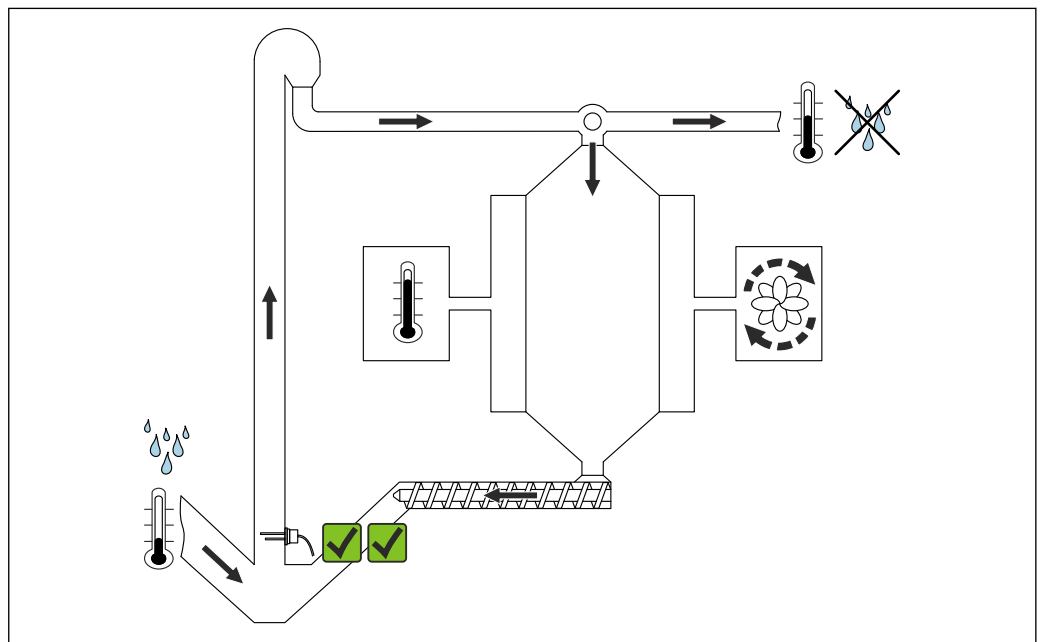
- 1 Exhaust air side
- 2 Hot air side
- 3 Transmitter

Directly inside the exhaust duct

Installation is recommended ✓✓

- Installation at a distance of 0.3 to 0.5 m (0.1 to 1.64 ft) from the exhaust side of the dryer wall ensures a representative measurement of the grain moisture inside the dryer.
- Plant residue cannot get caught on the sensor rods pointing vertically downwards.
- In addition, built-up material flow directly below the exhaust duct has a positive effect on the measuring accuracy.

Recirculating dryer



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8 Installation positions in a recirculating dryer

Storage container or hopper

Installation is recommended ✓✓

Best installation location in the storage container or near the discharge point where the grain circulating in the system is conveyed upwards again and the sensor is permanently covered with material or grain.

i In recirculating dryers and in acceptance areas, install the sensor in places where the material/grain is at the lowest transportation speed. High transportation speeds can cause turbulence around the sensor rods, which can negatively impact the measurement.

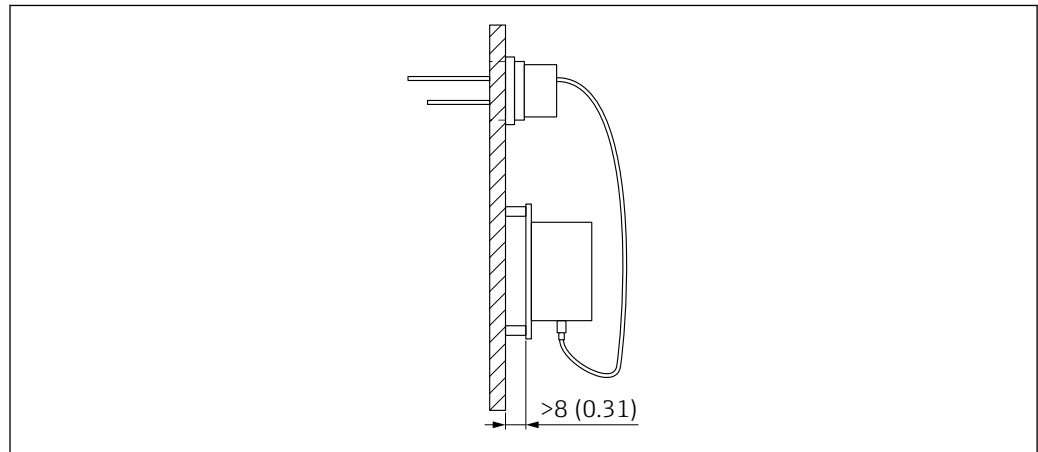
Installation instructions**Mounting the transmitter**

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.



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

Environment

Ambient temperature range At the transmitter: -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

Transmitter

IP65


Probe

IP68 towards the medium with appropriate installation.

Process

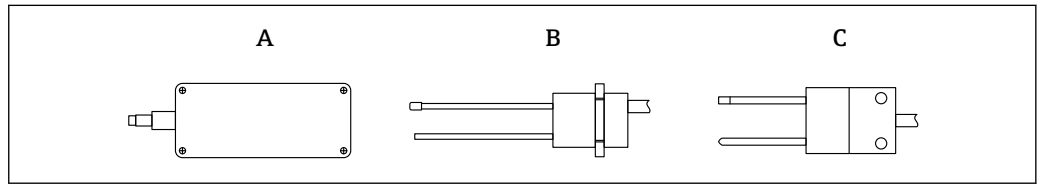
Temperature

Process temperature range
 -40 to +120 °C (-40 to +248 °F)


-  Moisture measurement below 0 °C (32 °F) is not possible.
- Frozen water (ice) cannot be detected.

Mechanical construction

Product design

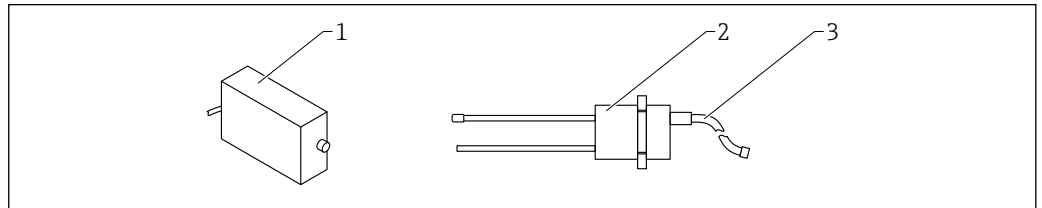


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 10 Visualization of device designs

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

ATEX version



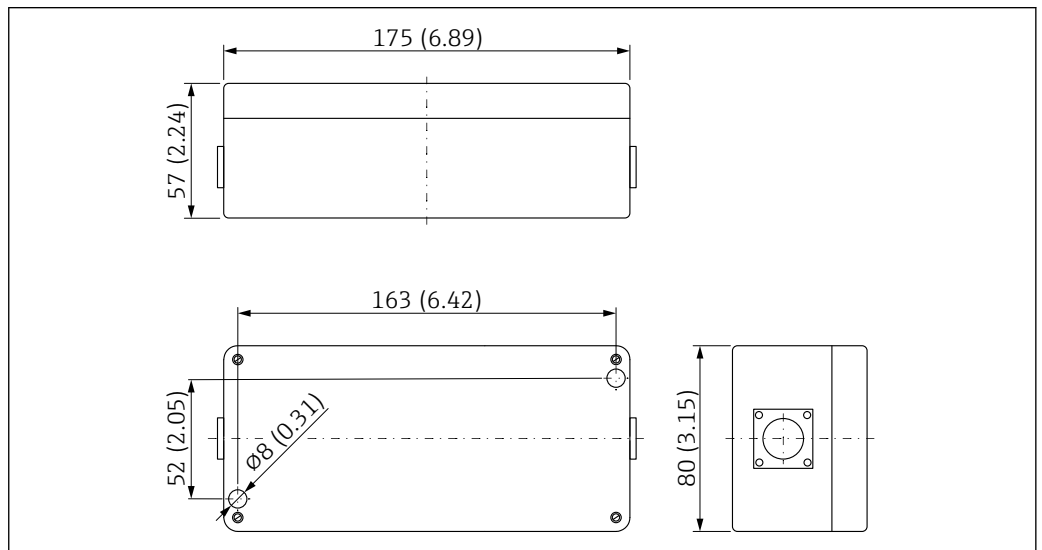
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 11 Rod sensor, ATEX version


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

Dimensions

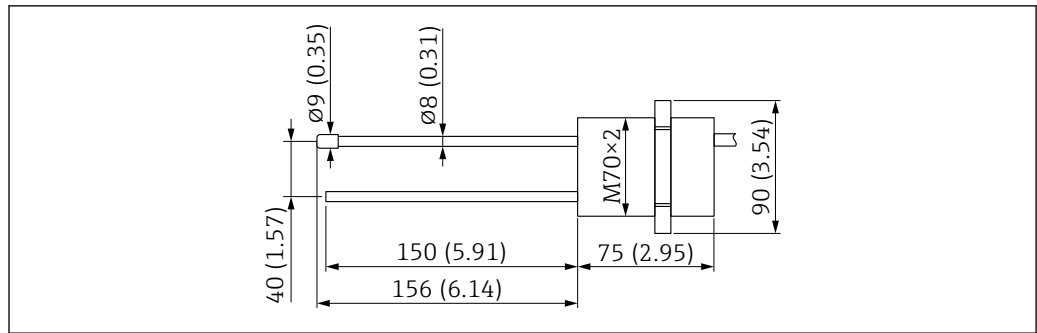
Transmitter



A0044492

 12 Transmitter dimensions. Unit of measurement mm (in)

Two-rod sensor, round design



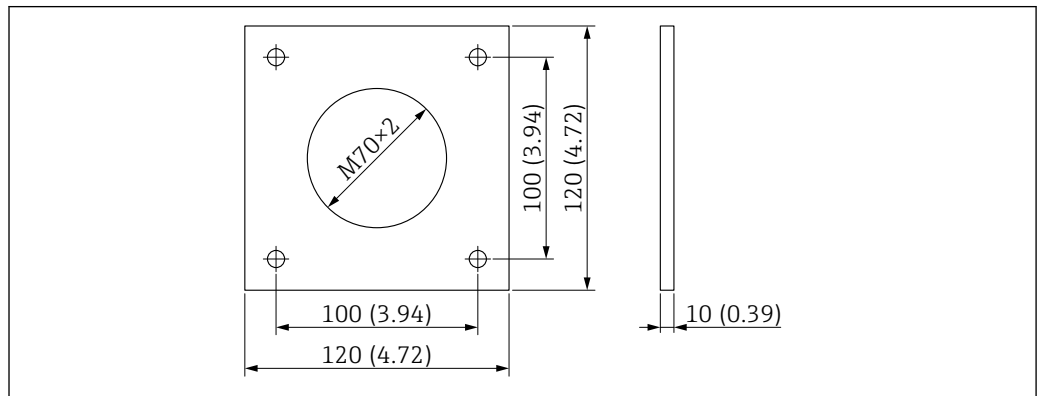
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13 Dimensions of two-rod sensor, round design. Unit of measurement mm (in)

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.

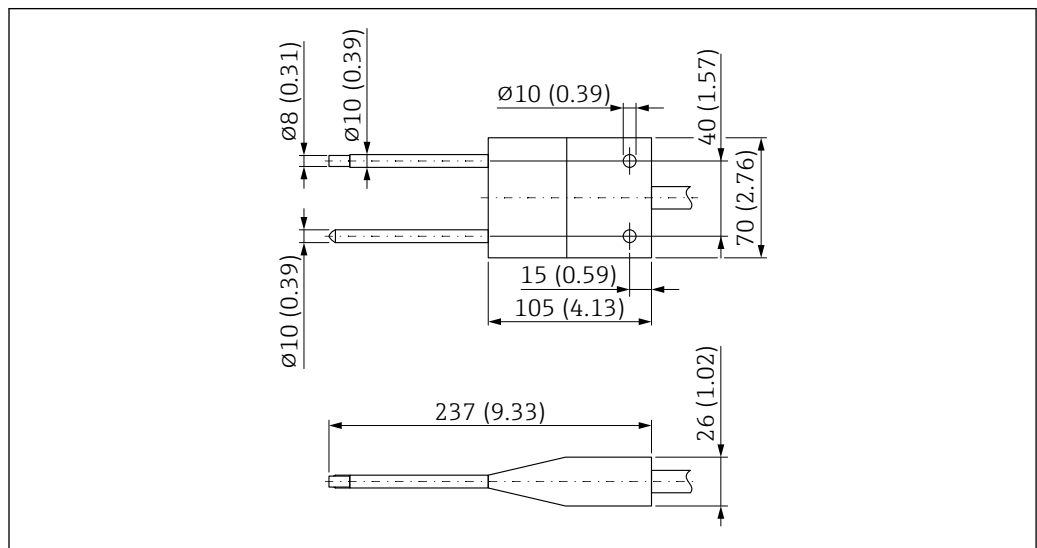
Suitable lock nuts are included in the delivery.



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

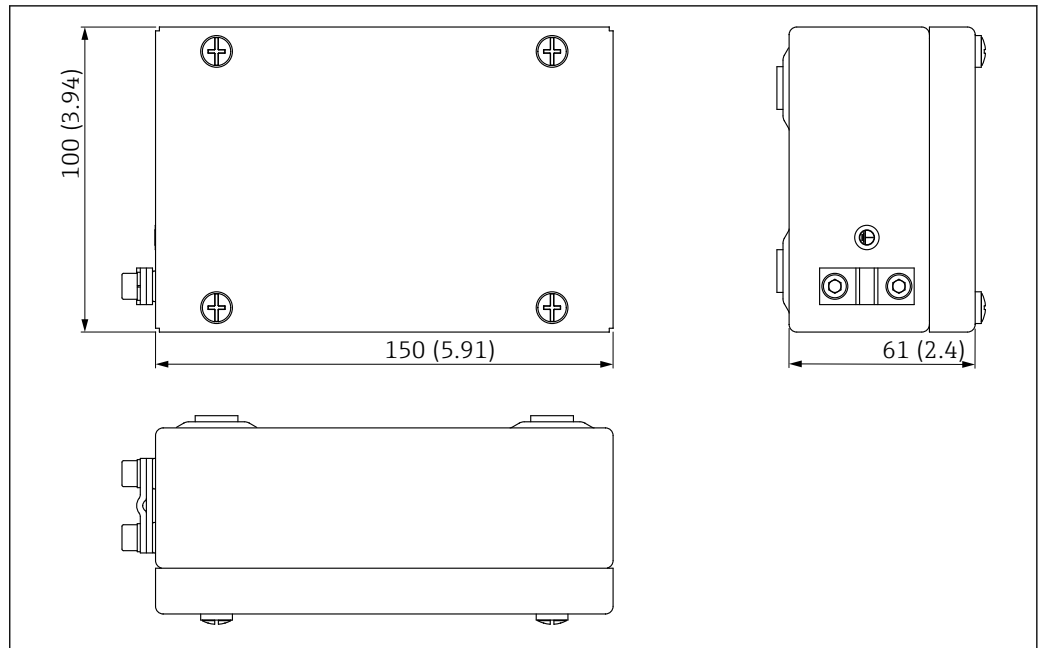
Two-rod sensor, wedge-shaped design



A0040851

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

ATEX electronics housing



A0053050

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

Weight

Transmitter

Weight without packaging and accessories:
1 kg (2.2 lb)

Two-rod sensor, round design

Weight without packaging and accessories:
0.3 kg (0.66 lb)

Two-rod sensor, wedge-shaped design

Weight without packaging and accessories:
0.25 kg (0.55 lb)

ATEX electronics housing

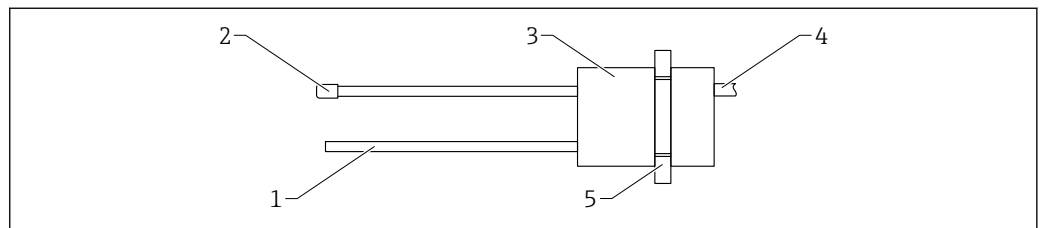
Weight without packaging and accessories:
1.8 kg (3.97 lb)

Materials

Transmitter housing

Cast aluminum

Two-rod sensor, round design

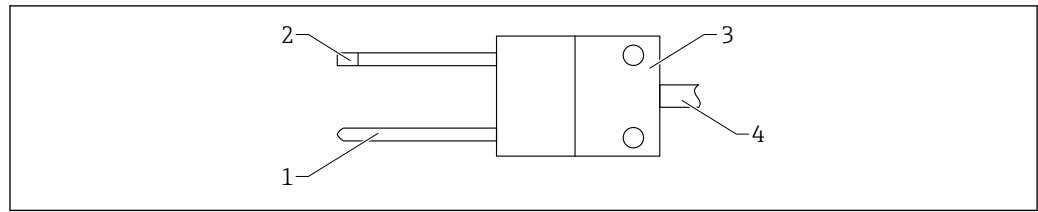


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17 Material of two-rod sensor, round design

- 1 Measuring rod = V2A
- 2 Temperature sensor, PEEK coated
- 3 Probe body = PEEK
- 4 Cable; UNITRONIC PUR CP
- 5 Gland = aluminum

Two-rod sensor, wedge-shaped

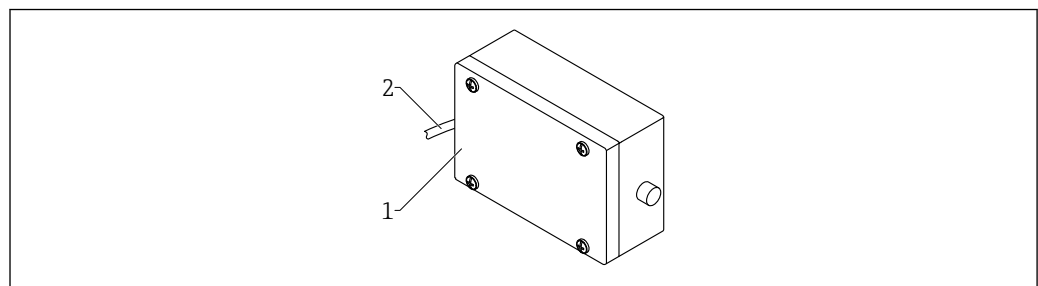


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18 Material of two-rod sensor, wedge-shaped design

- 1 Probe rods = V2A, PEEK coated
- 2 Temperature sensor, PEEK coated
- 3 Probe head = PEEK
- 4 Cable; UNITRONIC PUR CP

ATEX electronics housing



A0053051

19 Material of ATEX electronics housing

- 1 Housing; 1.4404
- 2 Cable; UNITRONIC PUR CP

Certificates and approvals

Current certificates and approvals for the product are available at www.endress.com on the relevant product page:

1. Select the product using the filters and search field.
2. Open the product page.
3. Select **Downloads**.

Ordering information

Detailed ordering information is available from your nearest sales organization www.addresses.endress.com or in the Product Configurator at www.endress.com:

1. Select the product using the filters and search field.
2. Open the product page.
3. Select **Configuration**.

Product Configurator - the tool for individual product configuration

- Up-to-the-minute configuration data
- Depending on the device: direct input of information specific to the measuring point, such as the measuring range or operating language
- Automatic verification of exclusion criteria
- Automatic creation of the order code and its breakdown in PDF or Excel output format
- Ability to order directly in the Endress+Hauser Online Shop

Accessories

Device-specific accessories Temperature sensor protection cap, 1.4301
Application: rice, abrasive bulk solids

Documentation

The following document types are available in the Downloads 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:

- *Device Viewer* (www.endress.com/deviceviewer): Enter the serial number from the nameplate
- *Endress+Hauser Operations app*: Enter serial number from nameplate or scan matrix code on nameplate.

Brief Operating Instructions (KA) **Guide that takes you quickly to the 1st measured value**
The Brief Operating Instructions contain all the essential information from incoming acceptance to initial commissioning.

Operating Instructions (BA) **Your reference guide**
These Operating Instructions contain all the information that is required in various phases of the life cycle of the device: from product identification, incoming acceptance and storage, to mounting, connection, operation and commissioning through to troubleshooting, maintenance and disposal.



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