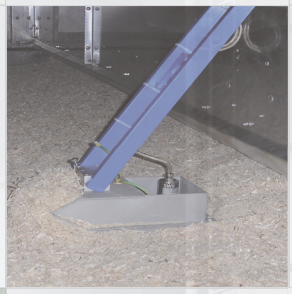
EN

Competence in Solids

SWR engineering

M-Sens 2

Online-Moisture Meter for Solids



Operating Instructions

SWR engineering Messtechnik GmbH

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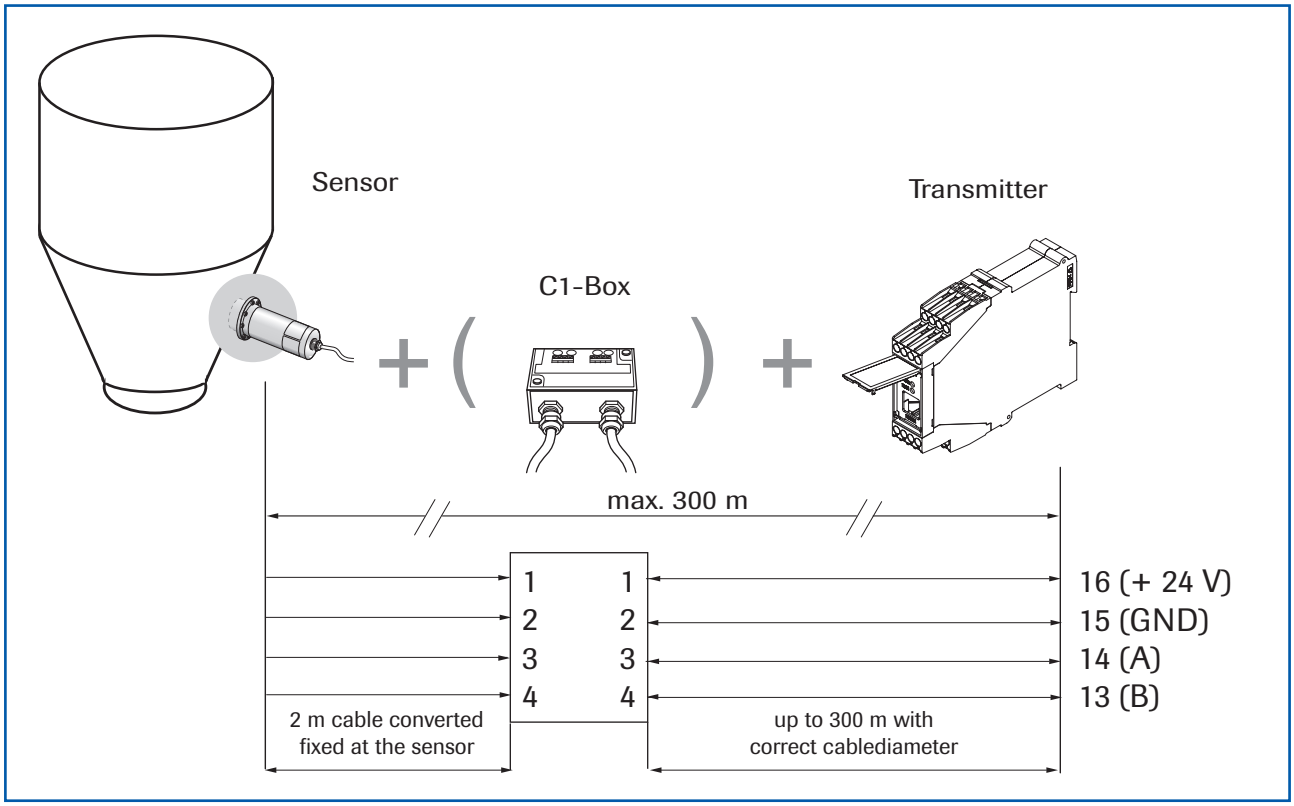
1. System Overview

A complete M-Sens 2 unit consists of the following components:

- 1 welding flange per sensor
- 1 to 3 sensors with 2 m connecting cable
- Transmitter MME 300 up to 3 sensors in a DIN Rail housing
- C1-Box for connecting of sensor and transmitter



The sensor is connected by a shielded, 4-wired cable to the transmitter; the maximal distance between these devices can be at most 300 m.

2. Function

The M-Sens 2 sensor functionality is based on precise high-frequency measurement and direct digitalization of measured values, where from results a high resolution. As the material surface and capillary moisture influences strongly its specific conductive capacity, the moisture can be measured exactly by a constant averaged bulk density. By way of support, any fluctuations of the measuring value caused by the bulk density are balanced through an internal filter function. Temperature-related fluctuations of the measuring value are automatically compensated by the sensor. The calibration of the system can easily be carried out by the operator. On the installed system, the calibration is a matter of pushing a button and entering the humidity reference value.

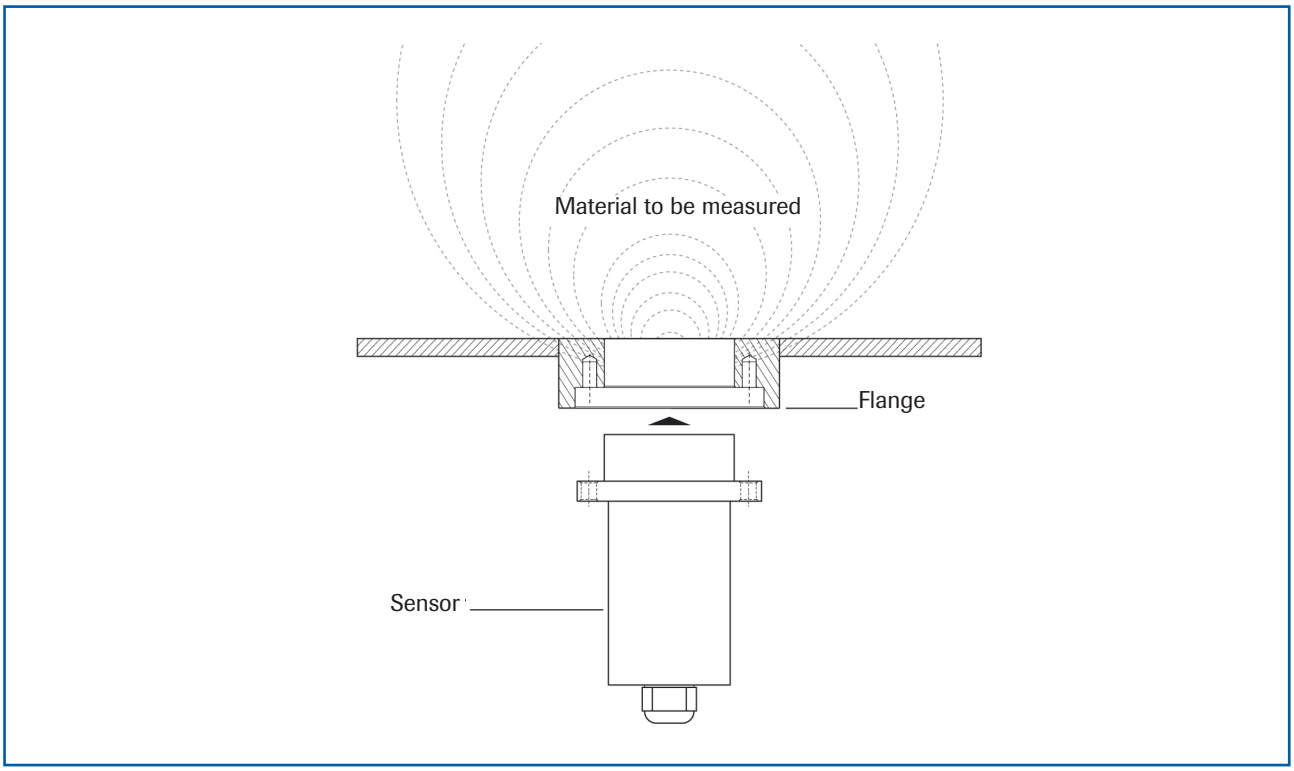


Fig. 2: Coupling and reflection of the high frequency

3. Safety

The measuring system M-Sens 2 designed and built according the latest technology has been tested to be safe and was shipped in safe condition. Nevertheless persons or objects may be endangered by components of the system if these are operated in an inexpert manner.

The operating instructions must therefore be read in its entirety, and the safety instructions must be adhered to. If the device is used in a way that does not adhere to its intended and/or proper use, any liability or warranty on the part of the manufacturer is void.

3.1 Regular Use

- Only original spare parts and accessories of SWR engineering must be used.

3.2 Identification of Dangers

- Possible dangers when using the measuring system are marked by the following symbols in the operating instructions:

Warning!

- This symbol in the operating instructions marks actions, which may represent a danger for life and limb of persons when carried out in an inexpert manner.

Attention!

- All actions which may endanger objects are marked with this symbol in the operating instructions.

3.3 Operational Safety

- The measuring system must be installed by trained and authorised personnel only.
- Switch of the supply voltage for all maintenance, cleaning or inspection works on the tubes or on components of the M-Sens 2. Follow the notes of the chapter maintenance.
- Before hot-work the sensor must be removed from the installation place.
- The components and electrical connections must be checked for damages regularly.
  If a damage is found, it is to repaired before further operation of the instruments.

3.4 Technical Progress

- SWR reserves the right to adapt technical data to the technical progress without particular advance notice. If you have any questions, SWR engineering will be pleased to inform you on possible changes and extensions of the operating instructions.

4. Mounting and Installation

4.1 Delivery Range

- Transmitter in DIN-Rail housing
- Sensor
- Operating instructions
- C1-Box
- Welding flange

4.2 Auxiliary

- Screw driver 2.5 mm
- Allen key 5 mm

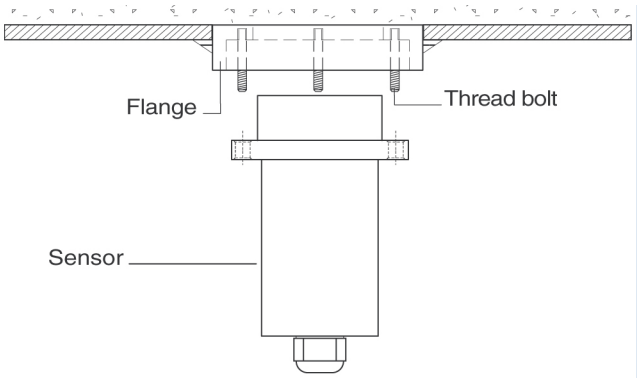
4.3 Mounting of the Sensor

M-Sens 2 is designed for continuous moisture measurement. Most important conditions for correct measurement is the right choice of the mounting place of the sensor. That is, when using chutes or conveyor belts, it is very important to have a almost even material height in front of the sensor window.

- The flange is welded without sensor and dummy plate in the opening at determined mounting place. Sensor and dummy plate are mounting by means of plumbing lubricant. For applications without over-pressure it is possible to renounce the 2 sealing rings.

Attention!

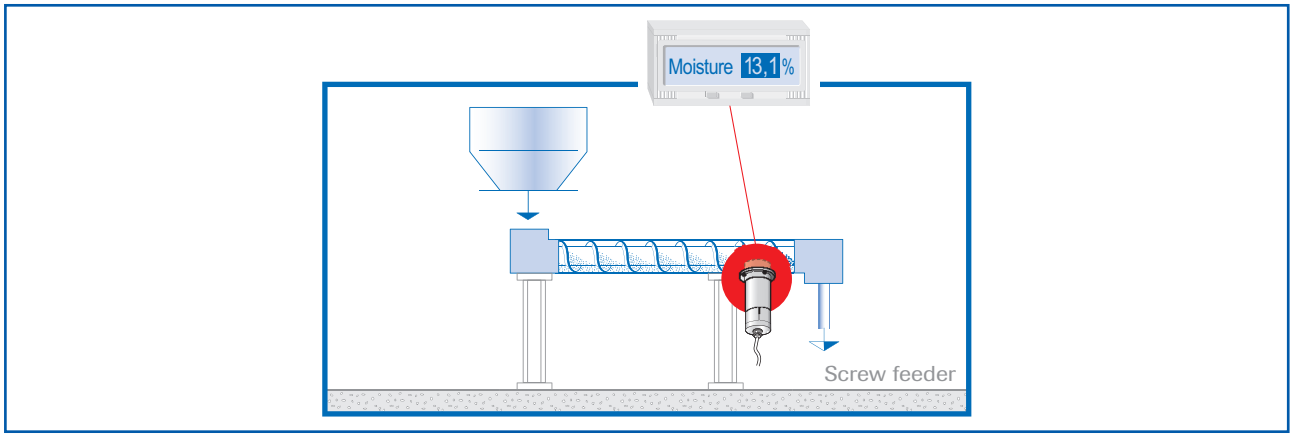
The flange mustn't be welded together with the sensor or dummy plate (incl. the sealing rings).



APPLICATIONS – PRACTICAL EXAMPLES

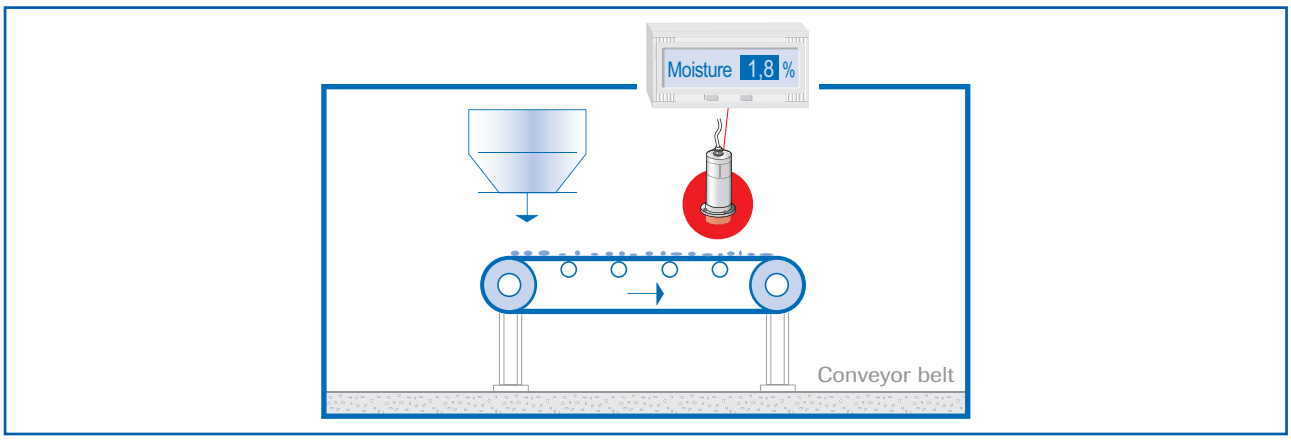
- **Installation in a screw**

  The installation of a moisture sensor in screw feeders proved to be very advantageous, since the material passes by the sensor window in even intervals and with relatively constant bulk density.



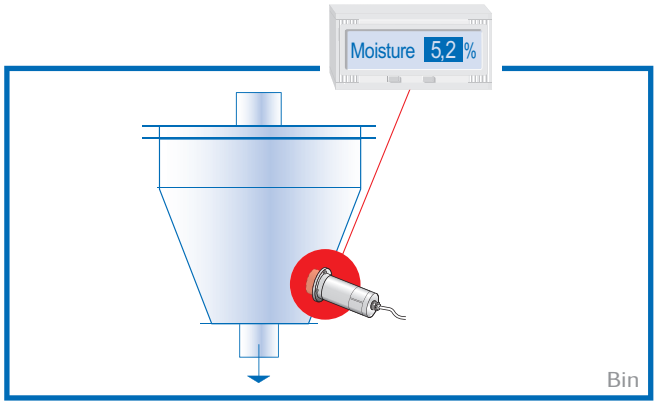
- **Installation on a conveyor belt**

  By means of the online moisture measurement of solids on a conveyor belt, the operator can react in due time if the material is too humid or too dry. In consequence, plugging of subsequent aggregates can be prevented.



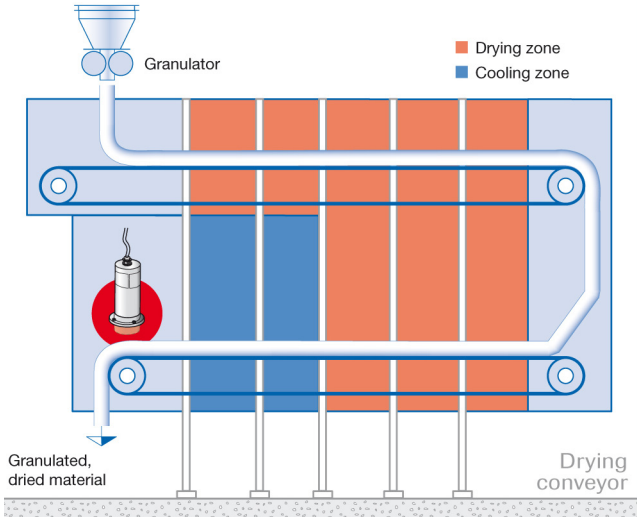
- **Installation in a bin**

  Another installation alternative is to mount a sensor at a bins outlet. Due to constant bulk density in case of a filled bin, the sensor finds an almost unchanging measuring field for monitoring the residual moisture. Thus, M-Sens 2 avoids that too damp material reaches the next production level or arrives into the loading.



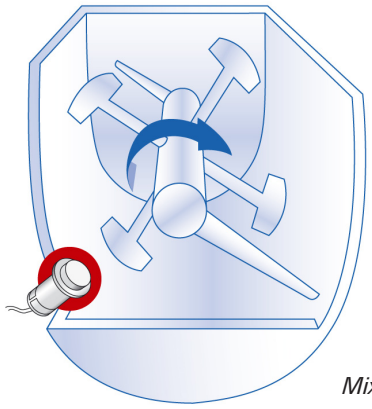
- **Control of dryer by means of moisture measurement**

  After the material, lying on the belt, has passed through the dryer tunnel, it gets withdrawn from the hot air zone. At the end of the belt the dried material falls in a screw conveyor which transports it to the processing.
  The operator queries the following points: Has the material reached really the desired residual moisture value? That is, has he chosen the right cycle time and temperature?
  M-Sens 2 provides accurate and reliable online moisture values for the process control, by which constant moisture in close tolerances of the output material can be met.
  This process optimization enables the operator to manage high savings and quality improvements.



- **Moisture measurement in a mixer**

  M-Sens 2 can be installed, even later on, in all types of mixers. The measuring values logging is done by within the moving material during the mixer procedure.
  With the measured moisture value of the material in the dryer process parameters like detention time and dosage quantity can be controlled.
  For this purpose M-Sens 2 is connected to a PLC or another process control system.



Mixer

4.4 Mounting of the Transmitter

The whole electronic equipment can be installed at a maximum distance of 300 m from the sensor. For assembly in the switching cabinet, the housing is prepared on a top-hat rail in accordance with DIN EN60715 TH35a.

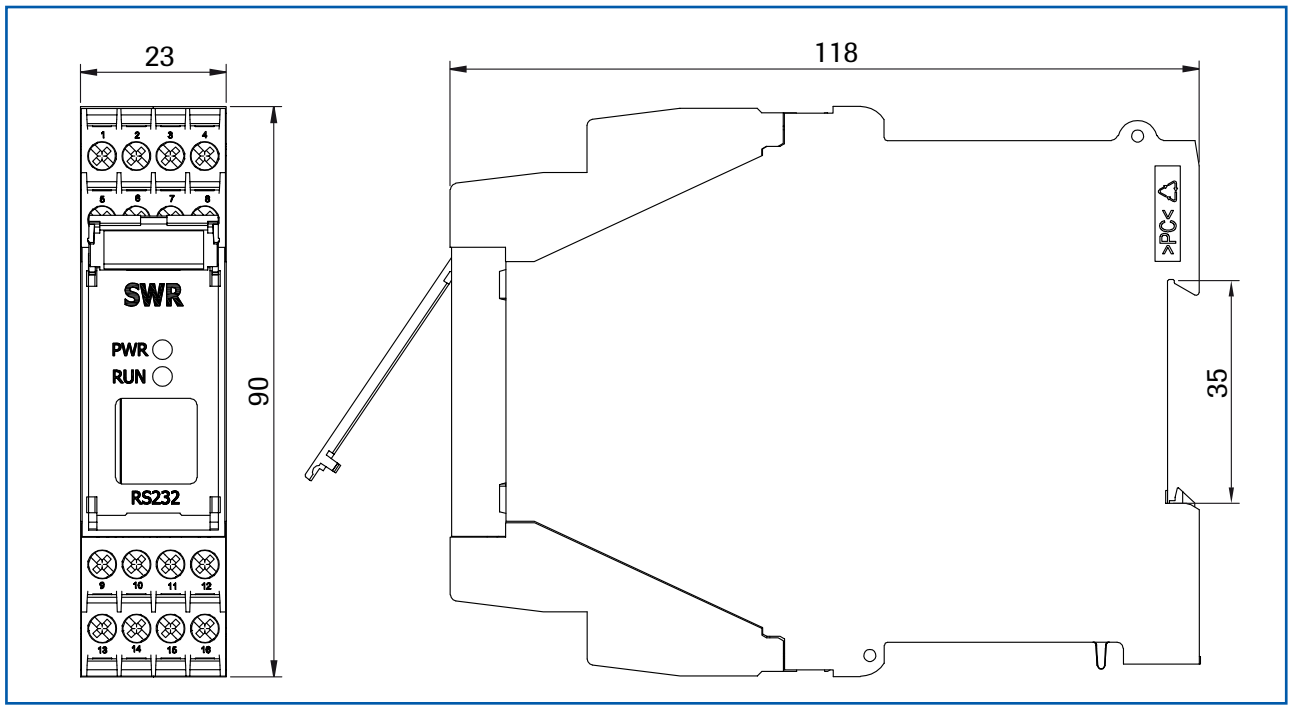


Fig. 9: DIN-Rail housing for the transmitter

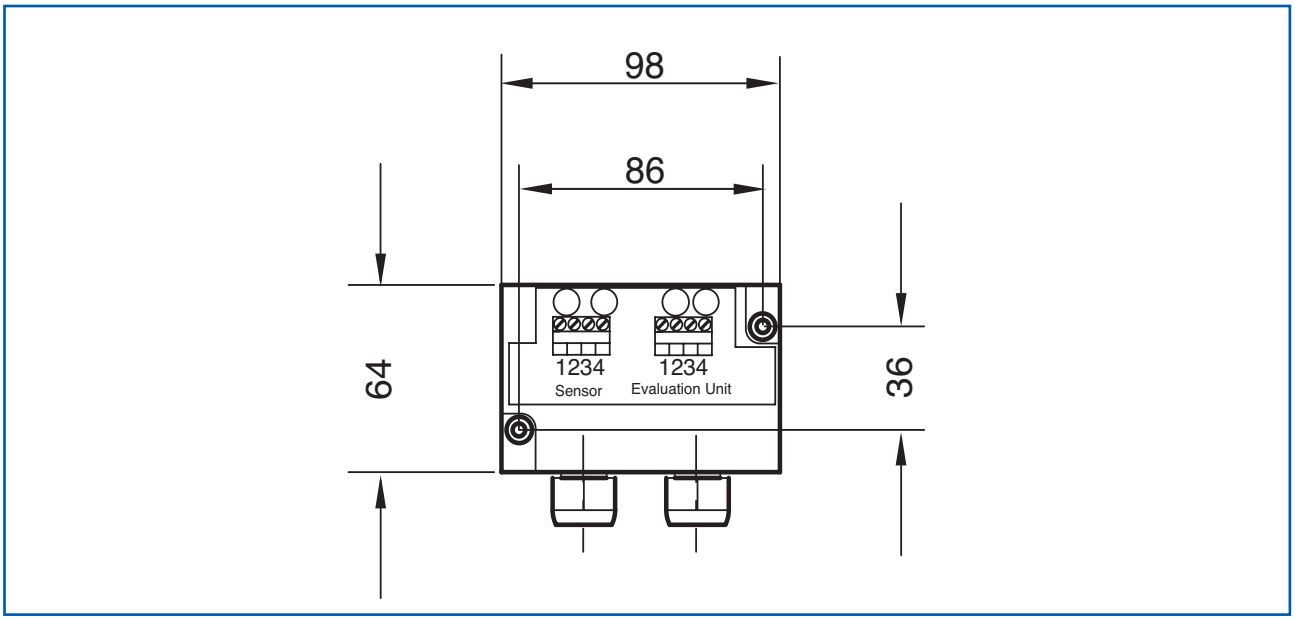


Fig. 10: Field housing for the C1-Box

The C1-Box contains fuses and resistances in order to guarantee the communication by the ModBus between sensor and transmitter.

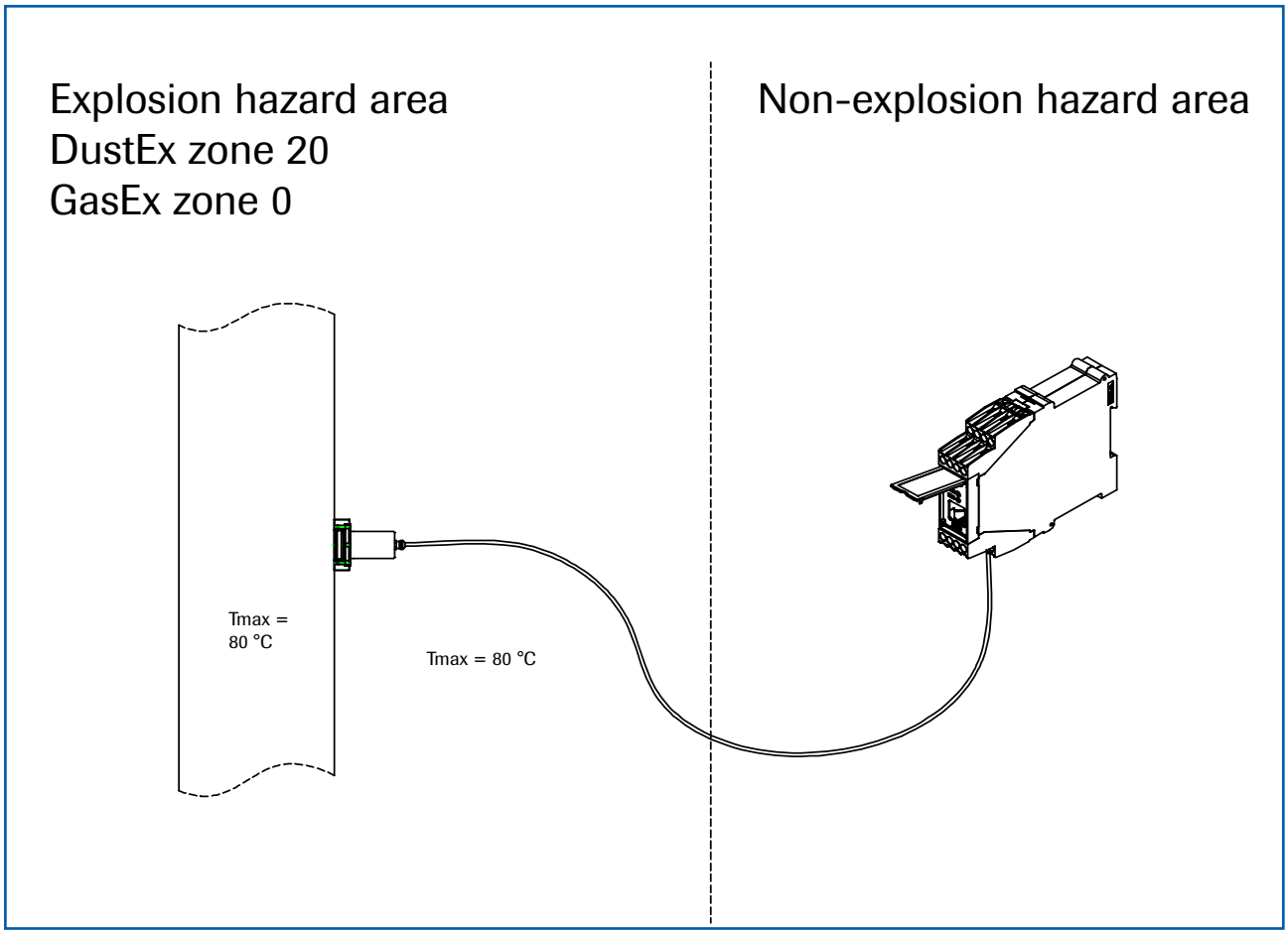
4.5 Use in the explosion hazard area

DustEx labelling: **II 1D Ex maD iaD 20 T120 °C**

- Group of equipment 2
- Equipment category: 1
- Zone 20
- For explosive mixtures of air and flammable dust
- Permissible process temperature 0 ... 80 °C
- Maximum surface temperature 135 °C with Ta = 60 °C

GasEx labelling: **II 1G Ex ma ia CII T4**

- Group of equipment 2
- Equipment category: 1
- Zone 0
- For explosive mixtures of air and flammable gases
- Permissible process temperature 0 ... 80 °C
- Maximum surface temperature 135 °C with Ta = 60 °C



5. Electrical Connection

1 Current output - 4 ... 20 mA	**2** Current output + 4 ... 20 mA	**3** Input supply voltage 0 V DC	**4** Input supply voltage + 24 V DC
5 Not available	**6** Alarm relay NC (Opener)	**7** Alarm relay C	**8** Alarm relay NO (Closer)

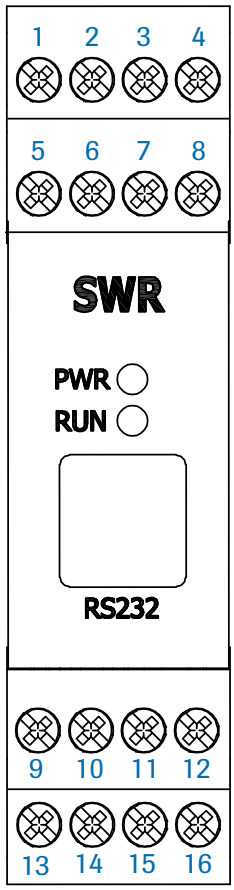


Fig. 12: Electrical connection of the transmitter

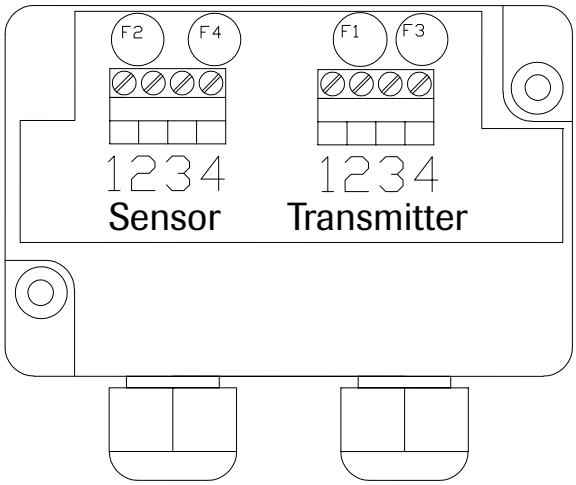


Fig. 13: Electrical connection of the C1-Box

9 Not available	**10** Not available	**11** RS 485- interface data B	**12** RS 485- interface data A
13 **Sensor connection Cable 4** RS 485 Data B	**14** **Sensor connection Cable 3** RS 485 Data A	**15** **Sensor connection Cable 2** Power supply 0 V	**16** **Sensor connection Cable 1** Power supply + 24 V

6. Commissioning

At the first commissioning of the M-Sens 2 it is necessary to calibrate the sensor.

Please consider:

- Correct connection between sensor, C1-Box and transmitter.
- Correct installation of the sensor in respect to the wall thickness.

In case of negative results in spite of consideration of the points as stated above, please contact SWR.

Commissioning of the M-Sens 2

After the delivery the sensor is **not calibrated to the product(s),** so each calibration and parameterization has to be executed during the commissioning. Therefore it is necessary to assign the measured moisture to the desired display and to the initial value. The menu functions are very self-explanatory. In the following a short introduction to the menu overview:

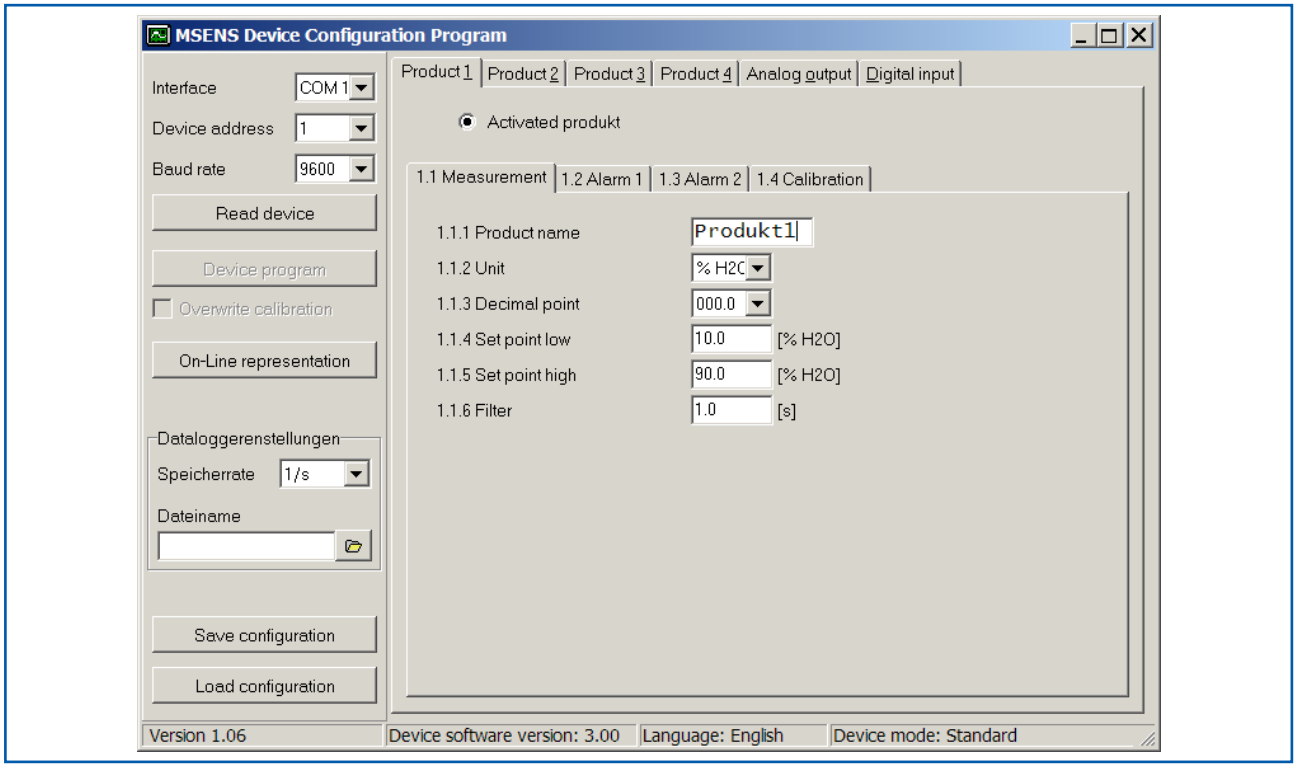
Put the installation CD in the computer and follow the installation menu. The program is compatible with Windows operating systems 98, NT, XP. The connection can take place via the RS 232C interface (jack in the front plate) using the supplied cable, or via the integrated RS 485 interface (bus-compatible) on the screw terminals 11 and 12. By allocating different addresses to the analysis unit, the devices can be addressed individually in the bus using the ModBus protocol. A brief introduction follows to serve as an overview.
All changed values are adopted by leaving the menu level and confirming the save function.

Entering the menu	**After starting the M-Sens 2 configuration program, the COM1 to COM8 interface must be selected on the separate PC. Set baud rate to 9600 Bd as a fixed value. Set address of the analysis unit (standard = 1).**
Basic function	For the measurement using the sensor, at least 2 measuring points should be calibrated as a reference point and the corresponding humidity value should be entered. To do this, the reference point measurement is started in the calibration. After the measurement, the analysis device expects the input of the humidity content determined in the lab. While the material is conveyed (in the loading state), the 2nd point is set to a known humidity value and the calibration is also carried out. If only one material humidity value is available, then minor humidity fluctuations and corresponding fluctuations in the humidity values determined in the lab can be used to save at least 2 calibration points.
Adjustment	For the adjustment of user requirements with regard to material, measuring units etc., sub-menu items 1 to 3 are available in menu 1.
Alarms	The user can select operation modes “Fault” or “Alarm” in the menu Alarms (2). A shortfall or exceeding of an adjustable measuring value can be output via the alarm relay as “open” or “close”.

Analog output	is modified in menu 5 and can be adjusted to user requirements here (e.g. 0… 20 mA). The calibration of the starting value takes place in menu items 5.7 and 5.8. Standard MIN = 4 mA MAX = 20 mA The measuring range filter makes it possible to adapt to slower recording devices or continuous output at the analogue output (power output).
Support points	The measurement can be checked for linearity based on varying humidity values. To improve accuracy, these should be determined respectively. In case of deviations, the non-linearity can be corrected through a table of support points. Based on the points that are selected and specified in menus 1.4.2 / 2.4.2 / 3.4.2 / 4.4.2 (a minimum of 2 during first commissioning), a correction value can now be entered for the actual humidity value. (This value can be changed later.) A maximum of 5 support points are available.
Saving changes	After changes are made, they can be saved using the menu item program device. The change is carried out once Overwrite calibration is confirmed.
C1-Box	Is only used when the distance between sensor and analysis unit exceeds 2 m.

In the following there is the menu structure:

7. Menu Structure of M-Sens 2



1.	**Products**		Products 1 to 4
1.1	**Measuring range**		
	1.1.1	**Product name**	Adjust material (8 digits)
	1.1.2	**Unit**	Adjust text, e. g. % H_2O / % TS
	1.1.3	**Decimal point**	Decimal place position
	1.1.4	**Beginning of measuring range**	Range 0 ... 999
	1.1.5	**End of measuring range**	Range 0 ... 999
	1.1.6	**Filter value**	Range 0.1 ... 99.9 s
1.2	**Alarm 1**		
	1.2.1	**Alarm type**	Choose: MIN / MAX
	1.2.2	**Alarm value**	Range 0 ... 100 % in phys. units
	1.2.3	**Alarm dead time**	Range 0.1 ... 99.9 s
	1.2.4	**Alarm hysteresis**	Range 0.1 ... 99.9 %
	1.2.5	**Operation mode**	Choose: Open or closed current principle

1.3.	**Alarm 2**	
1.3.1	**Alarm type**	Choose: MIN / MAX
1.3.2	**Alarm value**	Range 0 ... 100 % in phys. units
1.3.3	**Alarm dead time**	Range 0.1 ... 99.9 s
1.3.4	**Alarm hysteresis**	Range 0.1 ... 99.9 %
1.3.5	**Operation mode**	Choose: Open or closed current principle
1.4	**Calibration**	
1.4.1	**Calibration filter**	Range 0.1 ... 999.9 s
1.4.2	**Number of calibration points**	Range 2 ... 5 base points

When the multisensor function is switched on, up to 3 sensors can be declared!

1.4.3	**Calibration factor for sensor 1**	Rating of sensor signal with several sensors used and **disconnecting of 1 sensor with 0**
1.4.4	**Calibration factor for sensor 2**	Rating of sensor signal with several sensors used and **disconnecting of 1 sensor with 0**
1.4.5	**Calibration factor for sensor 3**	Rating of sensor signal with several sensors used and **disconnecting of 1 sensor with 0**
1.4.6	**Calibration point 1**	Measurement range start and end
1.4.7	**Raw value**	Record of input value
1.4.8	**Calibration point 2**	
1.4.9	**Raw value**	***... (depends on the number of the calibration points)***
1.4.10	**Calibration point N**	Measurement range init and end
1.4.11	**Raw value**	Record of input value

For 2.1 to 2.4 / 3.1 to 3.4 / 4.1 to 4.4 – same way

5. Analog output

5.1	**Beginning of range**	Range 0 ... 22 mA (Standard 4 mA)
5.2	**End of range**	Range 0 ... 22 mA (Standard 20 mA)
5.3	**MIN limit**	Range 0 ... 22 mA (Standard 3 mA)
5.4	**MAX limit**	Range 0 ... 22 mA (Standard 20 mA)
5.5	**Alarm value**	Range 0 ... 22 mA (Standard 3 mA)
5.6	**Filter time**	Range 0.1 ... 999.9 s (Standard 1 s)
5.7	**Calibration: 4 mA**	Adjust current output (calibration to 4 mA)
5.8	**Calibration: 20 mA**	Adjust current output (calibration to 20 mA)

6. No digital inputs present on the top-hat rail device!

7. System

7.1	**Baud rate**	Choose: 4800 / 9600 / 19200 / 38400 Bd
7.2	**ModBus-address**	Range 1 ... 255
7.4	**Language**	Choose: D / F / E

8. Menu Parameters:

1.1 MEASURING RANGE

Product name	Freely selectable symbols of the measuring-medium or -place, max. 8 digits.
Unit	Selection % H2O or % TS
Decimal point	Adjust the digit in the display.
Beginning of measuring range	Enter the respective value of the measuring range you will start with.
End of measuring range	Enter the respective value of the measuring range end.
Filter value	Adjustable damping for the **display** in seconds. Range: 0.1 ... 999.9 s

1.2 ALARM 1

Effect on the relay.

Alarm type	Upper and lower limit value.
Alarm value	Threshold value Range 0 ... 100 % of the measuring range in phys. units.
Alarm dead time	Threshold value how long the value must be over or under the limit until the alarm relay reacts. Range: 0.1 ... 99.9 s
Alarm hysteresis	Threshold value of the alarm. Range: 0.1 ... 99.9 % of the specified measuring range.
Operation mode	Choice of the contact work or rest NO (working current) - NC (static current)

1.3 ALARM 2 wie ALARM 1

1.4 CALIBRATION

Calibration filter

Attenuation filter to smooth fluctuating signals during calibration. (Has no effect on output.) 0.1 to 999.9 s

Number of calibration points

Input of number of necessary support points.

Calibration point 1 – measuring value

Measuring value to be displayed in physical units.
This is where the actual humidity value is entered as it was determined in the lab based on a material sample.
Range: Start of the measuring range ... end of the measuring range.

Calibration point 1 – calibration

The sensor signal belonging to a measuring value is recorded and the entered measuring value is allocated when the ⇦ area is clicked. The value can also be entered numerically.

The additional points are recorded just like the first one.

Calibration point 2 – measuring value

Measuring value to be displayed in physical units.
Range: Start of the measuring range ... end of the measuring range.

Calibration point 2 – calibration

Input value is recorded and allocated to the measuring value to be displayed.

Calibration point N – measuring value

Measuring value to be displayed in physical units.
Range: Start of the measuring range ... end of the measuring range.

Calibration point N – calibration

Input value is recorded and allocated to the measuring value to be displayed.

For 2.1 to 2.4 / 3.1 to 3.4 / 4.1 to 4.4 same as point 1

5 ANALOG OUTPUT

Start of range

Value to be set for the current output minimum (Standard 4 mA) Range 0 ... 22 mA

End of range

Value to be set for the current output maximum (Standard 20 mA) Range 0 ... 22 mA

MIN limit	Minimum current output value to be set (Standard 3 mA) Range 0 ... 22 mA
MAX limit	Maximum current output value to be set (Standard 20 mA) Range 0 ... 22 mA
MIN limit	Minimum current output value to be set (Standard 3 mA) Range 0 ... 22 mA
Alarm value	Output value to be set for alarm (sensor or internal alarm), at the same time the relay drop. (Standard 3 mA) Range 0 ... 22 mA
Filter time	Filter time to be set for the current output. (Standard 1 s) Range 0.1 ... 999.9 s
Calibration: 4 mA	Setting of the min. starting current. Adjustment to the external measuring system (in case of deviating display). Adjust the current output to 4 mA with the < and > buttons.
Calibration: 20 mA	Setting of the max. starting current. Adjustment to the external measuring system (in case of deviating display). Adjust the current output to 20 mA with the < and > buttons.

9. Maintenance

Warning!

- Electric shock hazard when housing is open!
- Switch off the supply voltage during all maintenance and repair work on the measuring system. The system may not be in operation for a sensor exchange.
- Repair and maintenance work may only be carried out by qualified electricians
- The system is maintenance-free.

10. Warranty

Warranty is granted for one year starting from delivery date under the condition that the operating instructions have been followed, no interventions on the appliances have been made and the components of the system show no mechanical damage or wear resistance.

In case of a defect during the warranty period, defective components are repaired or are replaced free of charge. Replaced parts turn into the property of SWR. If desired by the costumer that the parts should be repaired or replaced in its factory, then the costumer has to take over the costs for the SWR-service staff.

SWR is not responsible for damage, which did not develop at the delivery article; especially SWR is not responsible for escaped profit or other financial damages of the customer.

11. Trouble Shooting

- **Warning!**
  The electrical installation must only be checked by expert personnel.

Problem	Cause	Measure
Measuring system does not work. POW LED off.	Power supply interrupted.	Check the power supply.
	Cable break.	Check the connecting cables for a possible break of a cable.
	Defective fuse.	Exchange the fuse.
	Defective device.	Call SWR for further instructions.
Measuring system does not work. RUN LED off.	Microprocessor does not start.	Power supply switch off and switch on. Program cables remove.
Measuring system outputs wrong values.	Incorrect calibration.	Delete input signal correction, new calibration according to section 6.
	Calibration shifted by abrasion or caking on front end of sensor.	Delete input signal correction, new calibration according to section 6.
Sensor error.	Sensor not properly connected.	Check cable.
	Sensor damaged.	Replace sensor.
	No 24 V DC supply on sensor.	Assure right power supply.
	Voltage drop on the supply line too highly.	Cable cross section check with the help of the length.
Relay flickering.	Hysteresis too small.	Increase hysteresis, check effects caused by external devices.
Do not open, as otherwise the warranty claim expires!		

12. Technical Data

Sensor	
Housing	Stainless steel 1.4571
Sensor surface	Ceramic
Ex-protection	Zone 0 (gas), Zone 20 (dust) - optional
Protection category	IP 67 according to EN 60529
Material ambient temperature	0 ... 120 °C
Working pressure	Max. 10 bar
Power consumption	0.6 W
Response time	0.1 s
Weight	Approx. 1000 g
Measuring range	0 ... 65 % residual moisture (depending on material)
Accuracy	0.1 % absolutely in the calibrated measuring range
Connection cable	Shielded cable 4-wired, 0.25 mm²
Transmitter	
Supply voltage	24 V DC ± 10 %
Power consumption	20 W / 24 V
Current consumption	Max. 1 A at 24 V
Protection category	IP 40 according to EN 60529/10.91
Operating temperature	-10 ... +45 °C
Dimensions	22,8 x 90 x 118 (B x H x T)
Weight	Approx. 350 g
Fixing of the transmitter	DIN 60715 TH35
More data	
Cable cross section	0.2 - 2.5 mm² [AWG 24-14]
Current output signal	4 ... 20 mA (0 ... 20 mA), load < 500 Ω
Switched output measuring alarm	Relay with switching contact - max. 250 V AC, 1 A
Switched output error alarm	Relay NC
Data protection	Flash

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