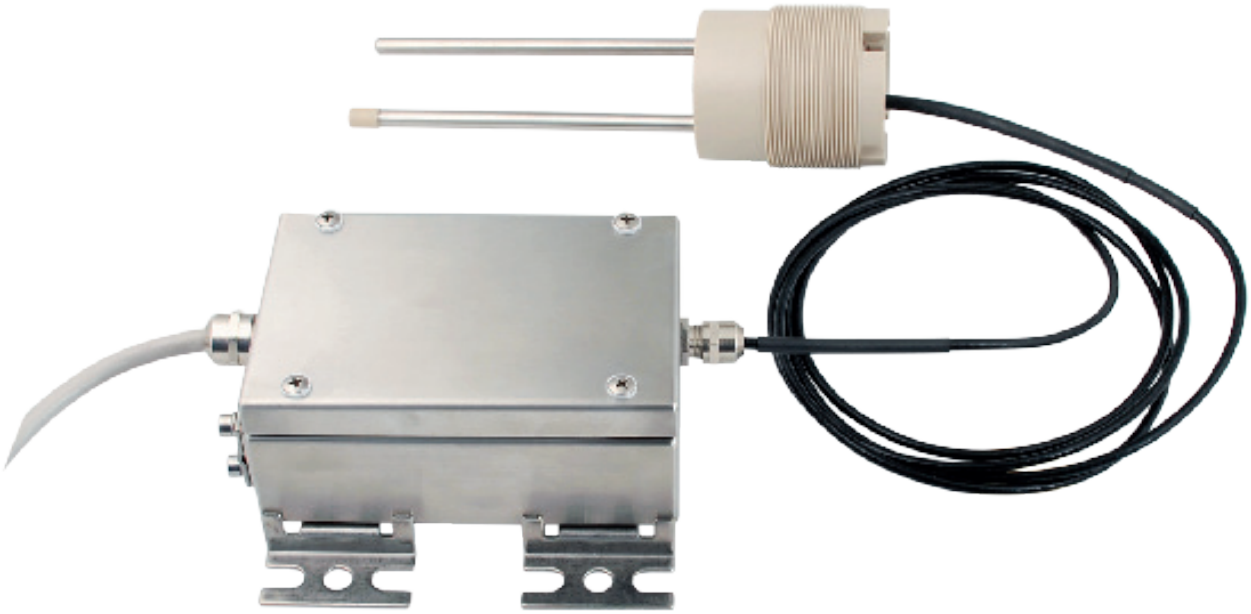
Manual

TRIME®-Ex GWs

ATEX Guideline 2014/34/EU | II 2 D Ex tb IIIC T75°C Db conformable EPS 20 ATEX 1 237 X

More information:
www.imko.de



Moisture Sensor Experts

IMKO

Thank you for purchasing this IMKO product

This manual is an original operating manual of the manufacturer.

The described instructions for use and commissioning are part of the products described and must be kept for future installation or use.

Important!

Please read these instructions carefully to accomplish optimum results with your moisture probe. Please contact your authorized dealer, distributor or service center for troubleshooting, questions or suggestions on your new moisture probe. You may contact IMKO directly, too after exploring your local contact.

We look forward to helping you!

For warranty claims, please contact your local dealer, distributor or service center. The warranty does not include any kind of willful damage to the device or its accessories or an operation outside of the product specification. Please refer to the information in this manual. If you have any questions, please contact IMKO service. Don’t open the device and please do not try to repair the device yourself- the guarantee expires when the device is opened or modified.

In the course of product improvements, we reserve the right to make technical and visual changes to the device.

Inhalt

1 Description

1.1 The patented TRIME® TDR measuring method

The TDR technology (Time Domain Reflectometry) is based on a radar-based dielectric measurement method in which the transit times of electromagnetic pulses for measuring the dielectric constant or the water content are determined.

The TRIME-Ex GWs humidity measuring system consists of a transmitter and an external measuring probe.

The external measuring probe is a 2-rod GR probe

The measuring unit is a stainless-steel housing with an integrated TRIME TDR transmitter. The high-frequency TDR pulse (1 GHz) generated in the TRIME transmitter runs along waveguides and builds up an electromagnetic field around these conductors and therefore in the material around the probe. With the patented measuring method, the transit time of this pulse is measured with a resolution of less than a picosecond (1x10-12) in order to determine humidity and conductivity.

1.2 TRIME® compared to other measuring methods

In contrast to capacitive or microwave measuring methods, the TRIME® technology (**T**ime-**D**omain-**R**eflectometry with Intelligent Micromodule Elements) offers many advantages in humidity measurement.

The TRIME-TDR, for example, works in the optimal frequency range for moisture measurement between 600MHz and 1.2 GHz.

Another great advantage of this technology is that the measuring field, and thus the measuring properties, do not change due to unavoidable abrasive wear on the measuring probes, removing the requirement for regular recalibrations.

1.3 Possible uses of the TRIME-Ex GWs moisture probe

The TRIME-Ex GWs humidity probe is suitable for measuring humidity directly in a dryer for different types of grain. The material to be measured must be free-flowing so that it can easily rest against the rods during pouring movements. We recommend using the TRIME-Ex GWs surface probe for materials that do not flow well.

2 Functionality

2.1 Measured value acquisition with preliminary check, averaging and filtering

TRIME probes measure internally at very high cycle rates in the 10 kHz range, but output the measured value at the analog output with a cycle time of 280 milliseconds. In these 280 milliseconds, a probe-internal preliminary check of the humidity value takes place, i.e. only plausible and already physically checked and somewhat pre-averaged individual measured values are processed, which considerably increases the reliability for the acquisition of the measured values to a downstream control.

The probes can be configured to different measurement modes with external programming devices (SONO-VIEW, or laptop in connection with SM-USB module).

In the CS (Cyclic Successive) measuring mode, there is no further averaging and the cycle time here is 250 milliseconds. In the CA, CF, CH, CC or CK measuring mode, the currently measured individual values are not output immediately, but an average value is formed over an adjustable number of measurements in order to filter out short-term fluctuations in the material flowing past. The TRIME-Ex GWs humidity measuring system is delivered from the factory with standard parameters for the averaging time and a powerful filter function for common applications.

2.2 Material temperature measurement

In the TRIME-Ex GWs probe, a temperature sensor is installed at the tip of one of the two rod tips, which records the material temperature, i.e. the grain temperature. If required, the temperature can be output at analog output 2.

2.3 Temperature compensation when used in higher temperatures (with the SONO-CONFIG app)

TRIME probes generally show a low temperature dependency. However, there are applications that require temperature compensation. TRIME probes offer two options for temperature compensation:

2.3.1 Internal Temperature Compensation of the TRIME® Electronics

Using this temperature adjustment, a possible temperature drift of the TRIME electronics can be compensated for. Since the TRIME electronics generally have little temperature dependency, the standard parameter TempComp = 0.2 is preset in each TRIME probe for "normal" ambient temperature ranges. This TempComp parameter can be set to values up to TempComp = 0.7 for use at high temperatures, depending on the TRIME probe type up to 70°C. However, after changing the TempComp parameter > 0.2, it is advisable to carry out a basic calibration in air and water with the TRIME probe.

The TempComp parameter can be set using the SONO-CONFIG software tool under "Calibrations" in the "Electronic-Temperature-Compensation" menu.

NOTE:

If the TempComp parameter is changed, the basic calibration of the probe changes, which is why a new basic calibration of the TRIME probe would then be required.

2.3.2 Compensation of the temperature of the material to be measured

When used in higher temperature ranges, water and certain materials to be measured show a temperature dependency of the dielectric constant (DC).

The humidity is determined via the dielectric constant, i.e. the DC is the actual measurement parameter when measuring humidity with TRIME probes. If materials to be measured, such as corn, show a very special temperature dependency of the DC (i.e. temperature dependency in only very specific humidity ranges), then it may be necessary to carry out a significantly more complex material temperature compensation, which, however, is associated with considerable laboratory work. For this, in addition to the moisture, the temperature of the measured material must be measured with the temperature sensor built into a TRIME probe.

The parameters t0 to t5 can be set in each of the 15 preprogrammed calibration curves Cal1 to Cal15. If you need this very complex material-specific temperature compensation, please contact the IMKO GmbH service.

2.4 The analog outputs for outputting measured values

The measured values are output as a current signal via the analog output. The TRIME probe can be set to the two versions for 0..20mA or 4..20mA with the help of the SONO-CONFIG app. The SONO-CONFIG app can also be used to variably set the humidity dynamic range for the analog output, e.g. 0-10%, 0-20% or 0-30%.

Output 1: humidity in% (variably adjustable)

Output 2: Conductivity (EC-TRIME) 0..12dS/m or optionally temperature 0..70°C or optionally the standard deviation in the humidity measurement.

There is also the option of dividing analog output 2 into two areas in order to output both conductivity and temperature, in 4..11mA for the temperature and 12..20mA for the conductivity. Analog output 2 automatically switches between these two current windows every 5 seconds. The two analog outputs can be variably adjusted with the SONO-CONFIG app. A 500 Ohm resistor can be used for a 0-10V DC voltage output.

For the analog outputs 1 and 2 there are several setting options for the TRIME probe:

Analog output: selection 0..20mA or 4..20mA

For special controls and applications, the current output can also be set inversely with 20..0mA and 20..4mA

Analog Output Channels: The two analogue outputs of the TRIME probe can be set to one of four possible variations.

1. Moist, Temp	Analog output 1 for humidity, output 2 for material temperature
2. Moist, Conduct	Analog output 1 for humidity, output 2 for conductivity from 0..20dS/m or 50dS / m
3. Moist, Temp/ Conductivity	Analog output 1 for humidity, output 2 for material temperature and EC-TRIME conductivity with automatic current window change
4. Moist / MoistSTdDev	Analog output 1 for humidity, output 2 for the standard deviation in the humidity measurement (for use e.g. in fluidized bed dryers)

The moisture dynamic range and the material temperature output range at analog outputs 1 and 2 can be set variably.

The moisture range must not exceed 100%.

Moisture Range in %	**Temp. Range in °C:**
Maximum: z.B. 20 for sand (Set in %)	Maximum: 70°C
Minimum: 0	Minimum:-10°C
Conductivity Range:	0..20dS/m oder 0..50dS/m

TRIME probes can measure the EC-TRIME pore water conductivity from 5dS/m to 50dS/m, depending on the type of probe and the humidity.

2.5 The serial interfaces RS485 and IMP bus

The TRIME-Ex GWs transmitter has a standard RS485 interface and the IMKO IMP bus to read out individual parameters or measured values serially. A data transfer protocol that is easy to implement enables several probes to be connected to one of the serial interfaces. Furthermore, the TRIME-Ex GWs transmitter can be connected directly to the USB port of a PC via the RS485 or the IMP bus interface and the SM-USB module available from IMKO in order to adjust individual measurement parameters or carry out calibrations.

Please note: TRIME-Ex GWs is delivered with activation of the IMP bus as standard. In order to work with the RS485 interface, the interface must be switched or activated from the IMP bus to the RS485 using the SONO-CONFIG software via the SM-USB module.

The documentation for the data transfer protocol can be downloaded from the download area of the IMKO homepage www.imko.de.

2.6 The IMP bus for practical sensor networking

If the probes are powered externally on site, a 2-wire line is sufficient for networking. When using a 4-wire line, TRIME probes can also be supplied with voltage.

Standard RS485 interfaces may be susceptible to interference in industrial environments. They are not galvanically isolated, i.e. there is always the risk of ground loops or interference pulses, which can lead to considerable safety problems. Furthermore, a shielded and twisted cable must be used for the RS485, especially with longer cable lengths. Depending on the cabling plan (topology) with individual stub lines, a 100 Ohm terminating resistor must then be attached to "sensitive" points in the RS485 network. In practice, this means considerable expert effort and often insurmountable problems.

The robust IMP bus ensures safety. In addition to the standard RS485 interface, TRIME probes also have the robust IMP bus, which is galvanically separated and ensures increased safety. This means that the serial signal line is galvanically separated from the operating voltage of the probes and a sensor network can thus be set up completely independently of individual ground potentials with different network phases. Furthermore, the IMP bus does not send its data packets as voltage pulses but rather as current pulses. This makes the IMP bus extremely robust, a function is ensured even with long cable lengths with existing and laid lines. A shielded cable is not required and stub lines in a wide variety of network topologies are not a problem**.**

2.7 Error output and error messages

TRIME-Ex GWs is very fault-tolerant, enabling trouble-free operation. Error messages can be queried via the serial interface.

3 Installation of the measuring probe

The installation conditions are heavily dependent on the conditions of the respective installation location. The optimal installation location must be determined individually. The following guidelines should be observed.

3.1 Installation instructions

- It must be checked whether the information on the nameplate of the device and in the documentation correspond to the permissible Ex application conditions on site:
  - Explosion Group
  - Device Category
  - Zone
  - Temperature class or the maximum surface temperature
- When installing on the floor and on uneven floors, the probe must be installed at the highest point in the floor. No water must collect on the probe head, otherwise the measurement could be falsified.
- Areas in which there is strong turbulence are not ideal for installation. There should be a continuous flow of material over the probe head.
- The probe should not be installed in the immediate vicinity of sources of electrical interference such as motors.

Attention, risk of explosion!

Earthing / equipotential bonding is mandatory for areas at risk of explosion: To avoid dangerous charges / discharges in areas at risk of explosion, devices e.g. to ground the TRIME-Ex GWs or to include it in the equipotential bonding. The test of the ground leakage resistance (according to TRGS 727 Paragraph 8) must always be measured and recorded before commissioning and after changes to the system. The test is only to be carried out by qualified persons in accordance with TRBS 1203 and TRBS 1203 Part 1. The limit value of the leakage resistance must never exceed 1 MΩ.

Attention, special conditions of use according to EPS 20 ATEX 1 237 X!

The permitted ambient temperature range is-10°C to +70°C. The cable to the housing of the evaluation electronics must be laid permanently. The sensor housing must be installed so that it is protected from UV radiation.

Attention risk of breakage!

The probe head is made of special steel and wear-resistant ceramic to guarantee a long service life for the probe. Despite the stable and wear-resistant structure, the ceramic plate must not be hit because ceramic has a limited fracture resistance.

Risk of overvoltages!

During welding work on the system, all probes must be completely electrically disconnected. TRIME probes require a stabilized supply voltage of 12V DC to a maximum of 24V DC. Unstabilized power supplies run the risk of overvoltages, which is why we strongly advise against using these power supplies.

Risk of malfunction!

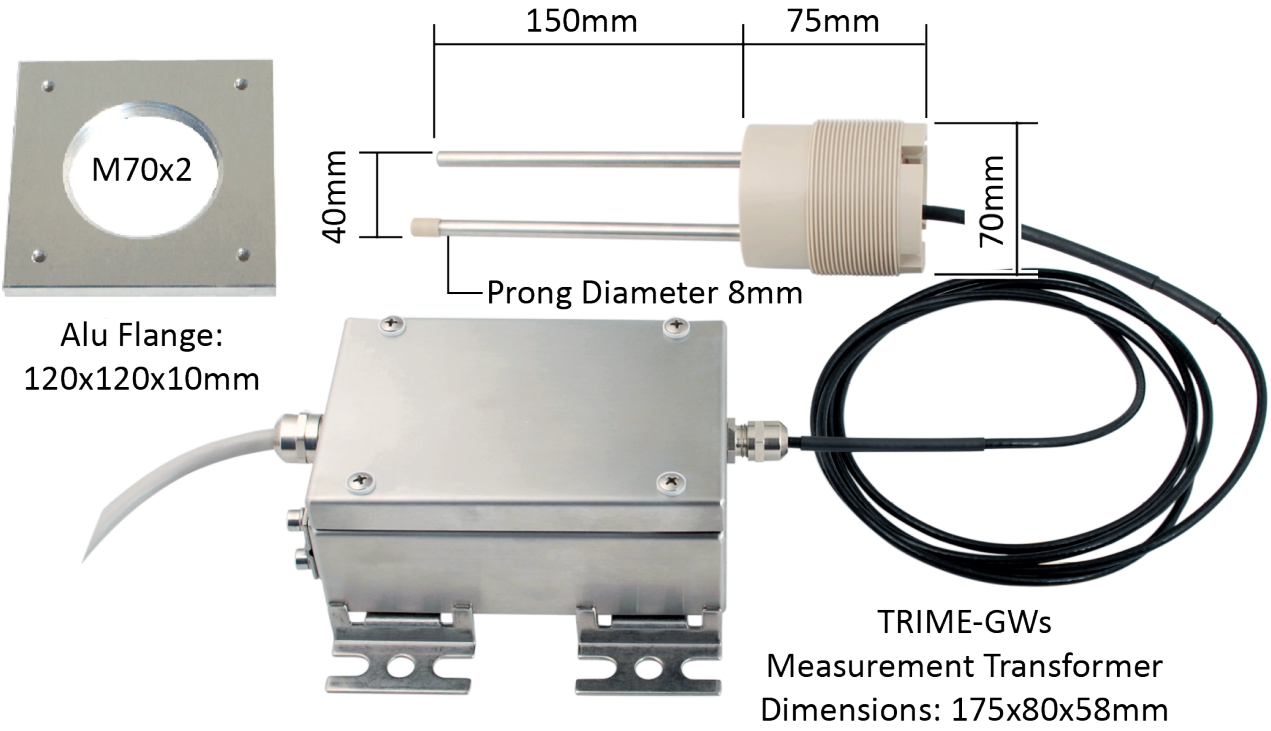
1. There are systems in which the mains voltages can have different ground potentials, which can lead to the analog signal 0 (4) .. 20mA not being correctly measured in a PLC. Here we recommend the use of a galvanically isolated power supply or an isolating coupler for the power supply of the TRIME probes. These are available from IMKO on request.
2. Make sure that there are no other electromagnetic fields in the immediate vicinity of the probe head. E.g. no other humidity probes, in particular microwave probes, should be installed directly next to or opposite TRIME probes.

Damage caused by incorrect installation is not covered by the guarantee!

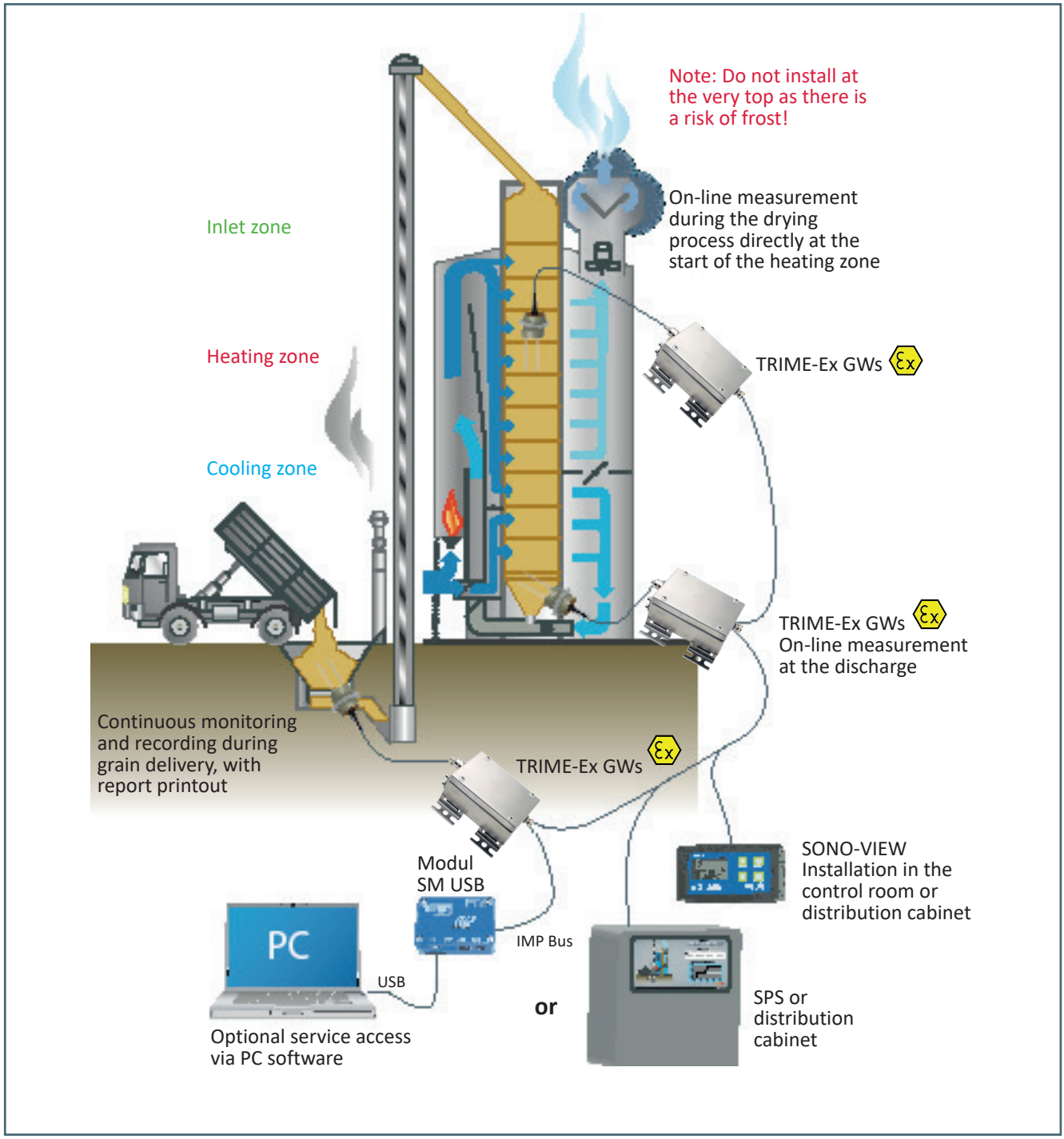
Wear on probe parts is not covered by the guarantee!

3.2 Installation dimensions

The TRIME-Ex GWs probe can be installed with four M8 screws on the floor or on the side wall of a mixer. It should be taken into account that smaller amounts of material can also be used for measurement when installing on the floor.



3.3 Examples of procedural integration



Schematic sketch of the possible uses of TRIME-Ex GWs in a drying plant

There are different areas of application for TRIME-Ex GWs. On the one hand, the system can be used to monitor the moisture content of the delivered grain, and on the other hand, it can be used to support or automate the grain drying process. The appropriate calibration curve must be selected depending on the type of grain to be measured and its density.

Monitoring of grain acceptance

The TRIME-Ex GWs offers the possibility of continuously measuring the moisture when receiving grain. This results in a moisture profile that can be recorded with a PC or a PLC. In addition, the instantaneous values can also be displayed using SONO-VIEW. The TRIME-Ex GWs continuously records the moisture and, by recording the series of measurements, offers a very representative value for the delivered grain moisture. This enables better quality control and greater transparency to be achieved.

Manual control of the grain dryer

With manual or semi-automatic dryer controls, the use of the TRIME-Ex GWs in conjunction with the SONO-VIEW display device can significantly optimize the drying results. As a result, the energy requirement is also brought to a minimum.

Automatic control of the grain dryer

The TRIME-Ex GWs is connected to the actual value input of a controller. Ideally, several TRIME-Ex GWs are used to optimize and coordinate the drying processes in the various dryer zones. The highest drying efficiency can be achieved with automatic control and regulation.

3.3.1 The procedural integration in the continuous dryer

Directly at the dryer entry: In principle, the moisture can be measured here, since the material is freshly filled and, as far as possible, well mixed. In practice, however, there is a risk that frozen material will be introduced at temperatures below zero. Since the system cannot detect frozen water, the measured value could be falsified. Installation at this point is therefore not recommended.

At the transition from the heating zone to the cooling zone: At the end of the heating zone, the drying process is almost complete. Adjustment of the target humidity is possible, but the material arriving at the point is already available with a different humidity. In addition, depending on the type of dryer, the dried material, and the weather, a homogeneous drying result is not guaranteed. In the case of free-standing dryers, for example, a change in the weather can cause the already existing difference in humidity between the supply and exhaust air sides to vary. Installation at this point is therefore not recommended.

At the beginning of the heating zone: Here the conditions are best if the probe is installed a little below the entry. The grain has not yet dried, but the rising warmth ensures that the grain is not frozen even in winter. If you measure the humidity here, you know the amount of water to be removed (current value- target humidity = amount of water to be removed) and you can react to spontaneous changes (jumps) in the input humidity, which, for example, can occur when, the corn is processed in real time and is not temporarily stored in the SILO.

Depending on the type of product such as: corn, wheat, etc., a suitable calibration level can be set in TRIME-Ex GWs. However, at this installation location, the focus is not on displaying the absolute humidity value, but rather using the somewhat balanced relative humidity in this zone as a control parameter. In principle, it is difficult to take samples at this point in the process, and the absolute value is only of secondary importance for the control.

The set calibration curve, if available, should always be selected at this installation location "with TK", so that the measured value of the temperature sensor built into the GR probe rod is included in the correct moisture determination.

In the case of large continuous dryers, it is recommended to attach several probes at the upper end of the heating zone in order to achieve optimal control for obtaining the correct humidity.

In the cooling zone: The problems described above with the type of dryer, dried material, and weather dependency continue in the cooling zone, and therefore there are no uniform conditions here either.

In the discharge funnel: Here, the installation of another TRIME-Ex GWs system is recommended in order to control the final moisture after drying and cooling. If necessary, this measured value can be used to couple it back into the control loop or can be used for documentation. The discharge funnel is particularly suitable because the material falls from the complete drying column into the funnel and is mixed again, so the probe measures the drying result over the entire cross-section of the dryer. If the discharge takes place continuously and the GR probe is permanently covered by grain, then the calibration curve "with TK" must also be set here, if available.

However, if the discharge takes place in batches and the GR probe is not covered with material most of the time, the compensation via the temperature sensor would lead to a falsification of the measured values, since the temperature sensor is influenced more by the ambient temperature than the grain temperature. For this reason, a calibration curve "without TC" should be used for batch discharge.

It is often the case that for budget reasons, a second system is not purchased and only the system in the discharge funnel is used both as a display for the final moisture content and to regulate the moisture content. Provided that the material is very stable in its initial moisture content, this can also lead to success.

However, if there are fluctuations in the input moisture, a single discharge sensor only sees this very late when the material with a different moisture content has run completely through the dryer and then arrives in the hopper. Assuming, for example, that the corn to be dried with an initial moisture content of 25%, then 12% water must be removed with the control in order to achieve the target moisture content of approx. 13%.

If the input moisture were to spontaneously reduce by 5% to 20%, then the control would remove 13% water until the material has completely passed through the dryer once. This would mean that a complete load from the heating zone to the hopper would have been overdried to 7%. For quantities> 20 tons, this can lead to significantly lower yields with higher energy costs due to the weight loss!

The safety aspect should also not be disregarded here, as the burner temperature is usually well above 100°C, which can also be risky if over drying!

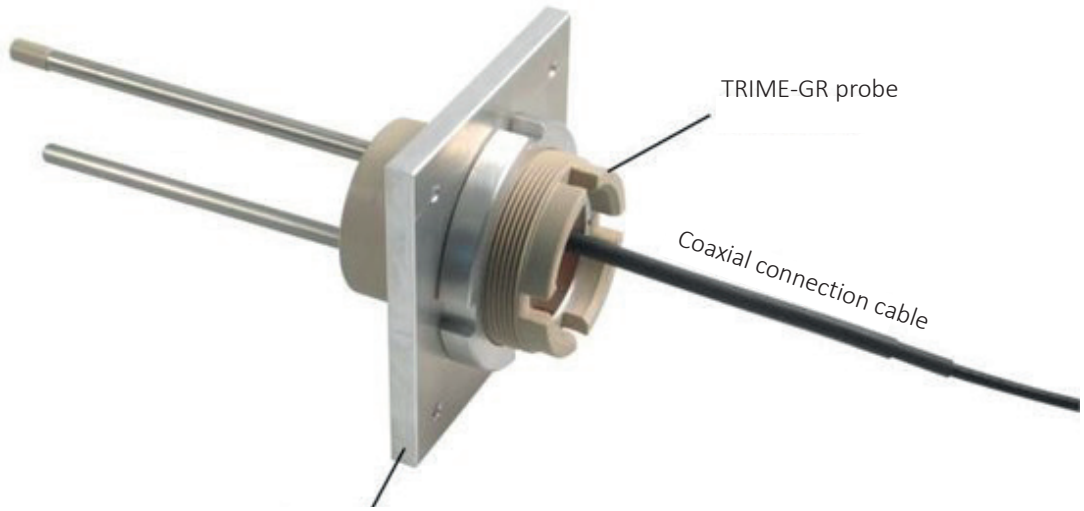
The use of a TRIME-Ex GWs sensor at the beginning of the heating zone is absolutely recommended for larger systems.

3.3.2 Process integration in the rotary dryer

It is recommended to install it on the hopper, where the circulating grain is transported upwards again and the GR probe is permanently covered with material or grain.

3.4 Installation of the GR probe

The installation conditions are heavily dependent on the conditions of the system. The optimal installation location must be determined individually. The following guidelines are intended to serve as a guide. The rod probe GR consists of a cylindrical probe head made of heat-resistant special plastic, which is provided with a screw thread for fastening in a silo or housing wall. In this GR probe head, two parallel steel rods are attached, which represent the actual measuring sensor. The area relevant for moisture measurement is around the rods. In order to be able to measure the grain temperature precisely without being influenced by the container wall, a temperature sensor is attached to the tip of the rod of the GR probe.

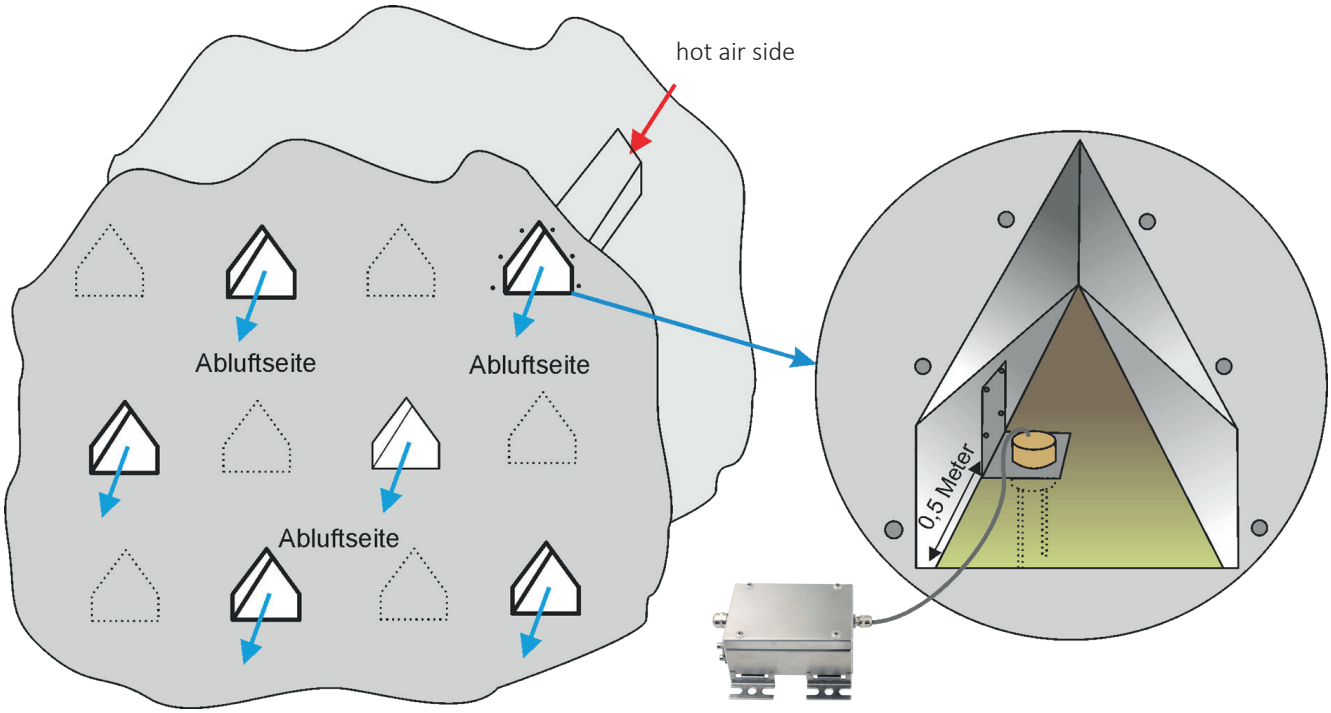


3.5 Installation of the GR probe in the exhaust air side of the dryer wall

In principle, it can be installed directly on the exhaust air side of the dryer wall. However, this installation location has several disadvantages:

- The temperature conditions directly on the wall may differ slightly from those further inside the dryer. Therefore, the grain moisture may not be accurate here.
- Plant residues can stick to the rods of the GR probe protruding transversely into the dryer, which can lead to problems with the flow of material and even blockages, making a measurement impossible.
- Metal surfaces near and along the GR rods can influence the measurement.

3.6 Installation directly in the exhaust duct of a roof dryer



Schematic sketch of a roof dryer with a built-in probe on the exhaust air side

An installation of the GR probe directly inside the exhaust air duct has a beneficial effect:

- Installation at a distance of 0.3 to 0.5 meters from the exhaust air side of the dryer wall ensures that the grain moisture is measured representatively inside the dryer.
- No plant residues can get stuck on the rods of the GR probe pointing vertically downwards.
- Furthermore, an accumulating flow of material directly under the exhaust air duct has a positive effect.

A suitable bracket is available for this installation location if required.

3.7 Installation in circulation dryers

In the case of circulating dryers and in reception areas, the probe should be installed where the grain has the lowest transport speed, since disadvantageous turbulence can form around the measuring rods of the GR probe at high transport speeds. It is recommended to install it in the storage container or near the discharge on the hopper, where the circulating grain is conveyed back up and the GR probe is permanently covered with material or grain.

The probe installation can be done in the following steps:

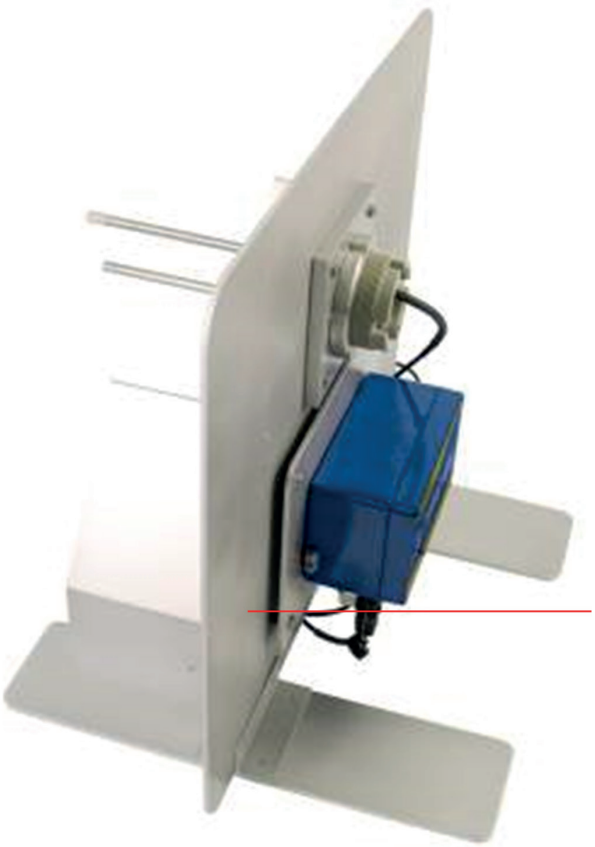
1. A hole with a diameter of approx. 72 mm is drilled or a square cut-out is flexed into the container wall.
2. The aluminum flange is attached to the wall with four M5 screws (cut the M5 thread in the wall).
3. The probe is screwed into the flange as far as possible.
4. With the aid of the locknut, the probe must be fixed in such a way that the rods are vertically slightly offset from the perpendicular (10° to 15°).

3.8 Device installation of the TRIME-Ex GWs transmitter

The TRIME-Ex GWs transmitter must be installed near the probe, as the probe cable length is 5 meters. However, the ambient temperature should not exceed 70°C. The ideal installation location is on the exhaust air side, outside wall of the dryer. The device can be fastened to a suitable location with screws through two diagonally made holes in the housing. An aluminum mounting plate is also available as an accessory.

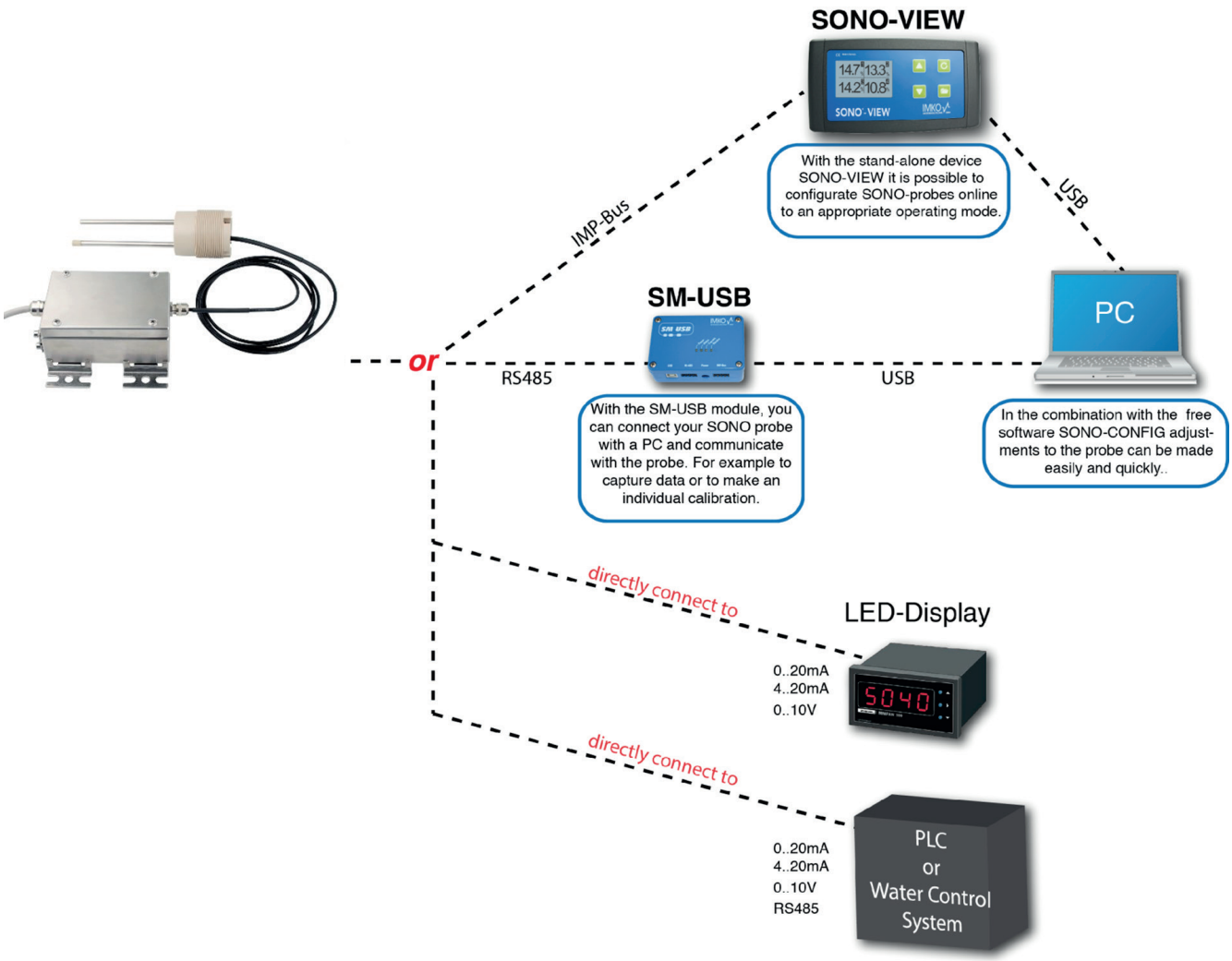
If the device is to be mounted on a wall whose temperature exceeds 70°C, TRIME-Ex GWs must be attached to spacer bolts for rear ventilation (at least 8 mm) in order to avoid direct heat transfer from the wall to the device housing.

Despite the degree of protection IP66, the device should not be permanently exposed to direct precipitation. For outdoor use, it is recommended to mount it under a protective roof, e.g. a sheet mounted horizontally above the device.



Mounting position of the mounting plate must consider a minimum clearance of 8mm
(mounting plate to cladding)

4 Electronic Integration



4.1 Pin assignment of the probe

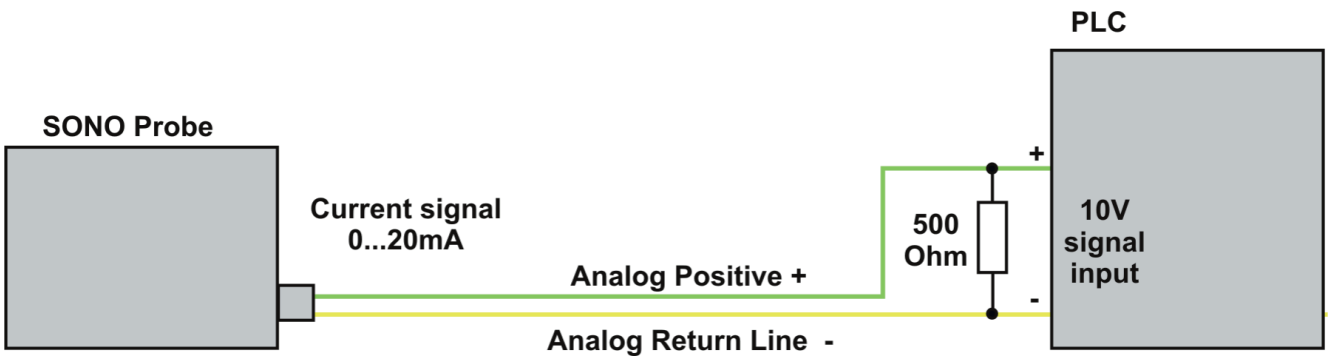
TRIME-Ex GWs is delivered with a 10-pole permanently installed cable.

Assignment of the 10-pin cable

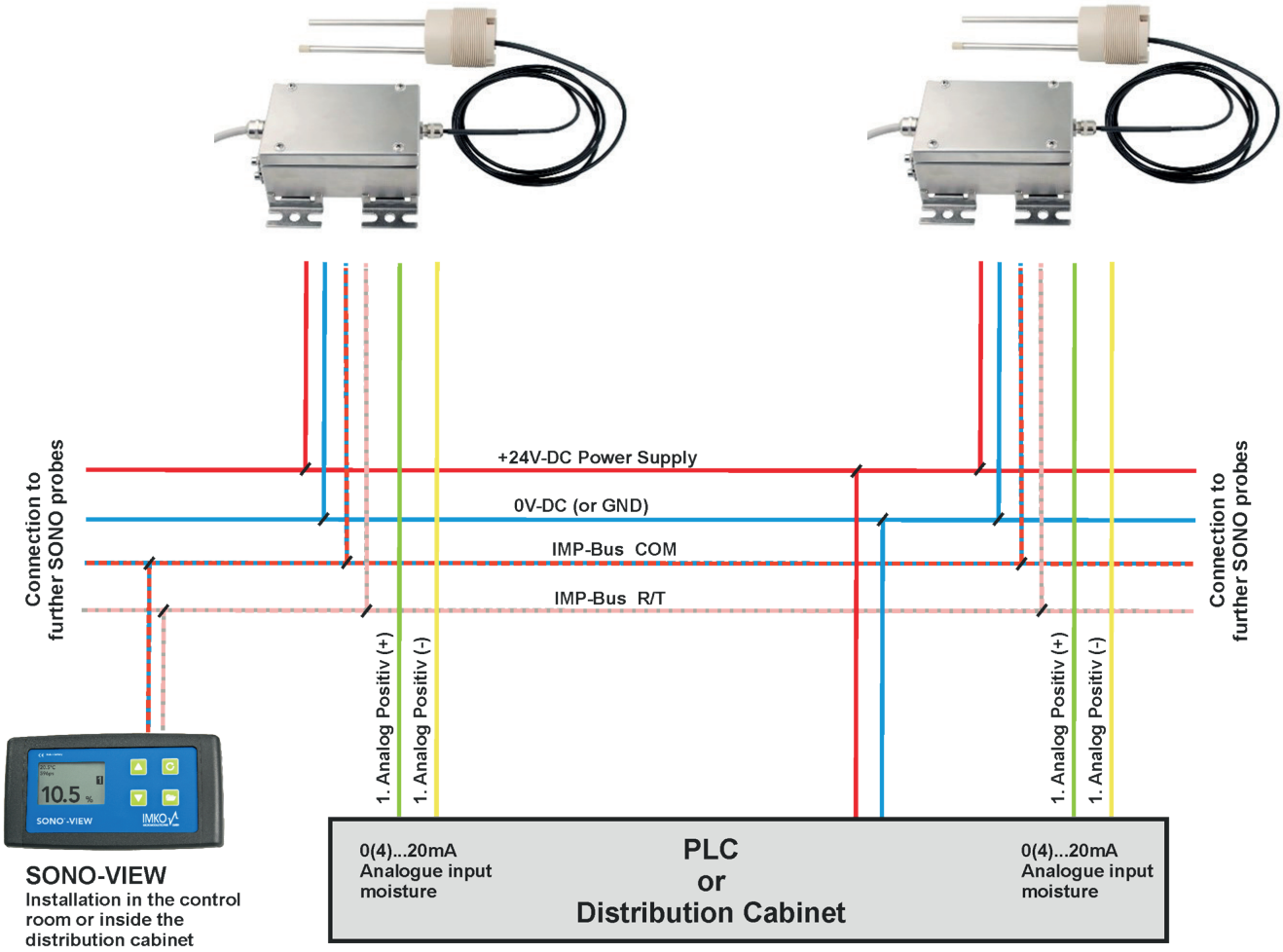
Plug-PIN	Sensor connections	Conductor color	Conductor color
A	+12V..24V DC Power supply	**Red**	Red
B	0V Power supply	**Blue**	Blue
D	1. Analog positive (+) humidity	**Green**	Green
E	1. Analog return line (-) humidity	**Yellow**	Yellow
F	RS485 A (must be activated)	**White**	White
G	RS485 B (must be activated)	**Brown**	Brown
C	IMP-Bus RT	**Grey** / **Pink**	Grey / Pink
J	IMP-Bus COM	**Blue** / **Red**	Blue / Red
K	2. Analog positive (+)	**Pink**	Pink
E	2. Analog return line (-)	**Grey**	Grey
H	Shielding (is grounded at the sensor. The system must be properly grounded!)	**Transparent**	Transparent

4.2 Analog output 0..10V with shunt resistor

There are controls which do not have a current input 0..20mA but a voltage input 0..10V. With the use of a 500 Ohm shunt resistor (included in the scope of delivery), a 0..10V voltage signal can be generated from a 0..20mA current signal. The 500 Ohm shunt resistor should be attached to the end of the line or to the control input. The following sketch shows the circuit principle.



4.3 Connection diagram to the PLC and use of SONO-VIEW



5 Settings, operating modes and calibration levels

5.1 Factory settings and configuration options

When delivered, TRIME-Ex GWs is preset to calibration level Cal1, operating mode CF with an averaging time of 3 seconds and analog output 4..20mA for use in grain dryers. With this setting, TRIME-Ex GWs can be used directly in the discharge for the grain type maize without further adjustments. The corresponding calibration level must be selected for other types of grain. For applications for humidity measurement in the heating zone, TRIME-Ex GWs must be adjusted to the calibration level of the respective grain type and, depending on the installation location, possibly with a zero point offset.

There are two ways to configure or adjust TRIME-Ex GWs:

5.1.1 Online-Konfiguration via SONO-VIEW

With the stand-alone display device, SONO-VIEW, it is possible to set suitable configuration parameters directly during operation without being connected to a PC. SONO-View adapts its LCD dynamically to the number of connected TRIME-Ex GWs (See manual SONO-View).

The SONO-VIEW display device is connected to the TRIME-Ex GWs via the IMP bus.

5.1.2 Configuration using the SM-USB module

TRIME-Ex GWs can be connected to a PC via the external SM-USB module and the serial interface. With the SONO-CONFIG software tool, TRIME-Ex GWs can be set to the appropriate operating mode with individual parameters. The operating mode can be set depending on different applications.

As with SONO-VIEW, it is also possible to set one of the 15 calibration curves. A zero-point correction can also be carried out with SONO-CONFIG.

All configured configuration parameters are saved in non-volatile memory in TRIME-Ex GWs. The set parameters have a direct effect on the analog output 0 (4)..20mA, which is brought out in parallel to a PLC.

5.2 Adjustment of the TRIME-Ex GWs

Please read this manual carefully first.

The humidity measurement is influenced by the following parameters:

- Installation location (e.g. metallic objects in the measuring area)
- Bulk density of the grain
- Type of grain

The installation location and the bulk density of the grain at the installation location can lead to an offset in the measurements. The respective grain type requires an individual calibration curve.

The following parameters can be set and adjusted on the TRIME-Ex GWs:

- The calibration curve can be selected depending on the type of grain
- Depending on the installation location, a zero point offset correction of the set calibration curve can be carried out

The following chapters describe the procedure for setting the probe(s) under the respective requirements and boundary conditions.

The use of SONO-VIEW is recommended for adjustment. The TRIME-Ex GWs can only be adjusted when it is installed in the system, as the installation location and the storage density of the grain influence the moisture measurement. The adjustment must be carried out separately for each type of grain.

With the help of the selection of the factory-set grain-specific calibration, the correct function is first set. Depending on the individual installation location, a zero-point offset correction of the calibration curve set under point A can be carried out.

NOTE:

TRIME-Ex GWs is preset to calibration level Cal1 on delivery and can be used without further changes in the heating zone for corn, but also for wheat or rye, since the humidity measurement in the heating zone is about precise relative measurements and the absolute value humidity measurement is not in the foreground.

5.2.1 Relative humidity measurement (in front of the heating zone in the dryer column)

To control the system, only the relative fluctuations in the measured humidity are usually necessary.

Proceed in the following steps:

1. Choose a sampling location as close as possible to the probe.
2. Select the correct calibration level according to the calibration table and set it using SONO-VIEW or the SM-USB.
3. Start the dryer for a test run, continuously take reference samples every half hour at the sampling point and enter both the measured values and the reference values in the adjustment report.
4. Determine the difference between the setpoint and the actual value and set the offset for the corresponding calibration level.
5. Repeat the process for the different types of grain.

Once the TRIME-Ex GWs has been adjusted for all types of grain used, these parameters remain non-volatile in the TRIME-Ex GWs. If the type of grain and the fixed installation location are changed, then only the corresponding calibration level has to be selected during operation, because the influence of the installation location remains constant and the bulk density is also largely the same within a product.

5.2.2 Adjustment for the Absolute Value Humidity Measurement

If you want to carry out an absolute value measurement with an accuracy of ±0.3% with the TRIME-Ex GWs, please proceed as follows:

6. Sampling takes place at the installation site of the probe.
7. Select the correct calibration level according to the calibration table and set it using SONO-VIEW or the SM-USB.
8. Start the dryer for a test run, continuously take reference samples every half hour at the sampling point and enter both the measured values and the reference values in the adjustment report.
9. Determine the difference between the setpoint and the actual value and set the offset for the corresponding calibration level.
10. Repeat the process for the different types of grain.

If the material, installation location or bulk density at the installation location changes, the adjustment must be carried out again if the humidity is to be measured as an absolute humidity value.

Once the TRIME-Ex GWs has been adjusted for all types of grain used, these parameters remain non-volatile in the TRIME-Ex GWs. If the type of grain and the fixed installation location are changed, then only the corresponding calibration level has to be selected during operation. This is due to the influence of the installation location remains constant and the bulk density is also largely the same within a product.

5.2.3 Adjustment for systems with several TRIME-Ex GWs

Due to the influence of the individual installation situations, it may be necessary in systems with several TRIME-Ex GWs to correct the deviations of the TRIME-Ex GWs from one another. This measure is only necessary if the TRIME-Ex GWs are to deliver an absolute humidity value. If the constant deviations of ±1-2% that are possible due to the installation situation are acceptable, it is sufficient to just adjust the control probe, e.g. at the discharge.

To carry out the extended adjustment for all TRIME-Ex GWs, proceed in three steps:

1. First of all, the most important measuring point for the operation must be selected. For example, it could be the probe at the discharge. In any case, it must be possible to take samples directly at this probe installation location.
2. This TRIME-Ex GWs is to be adjusted with sampling. At the same time, the measurement data must also be determined for all other devices. The sampling should be as close as possible to the probes.
3. On the basis of the measured value differences between the devices, the individual TRIME-Ex GWs are adjusted by means of an offset correction.

5.3 The calibration level selection Cal1 to Cal15

TRIME-Ex GWs is delivered with several calibrations as standard. A maximum of 15 different calibrations (Cal1.. Cal15) can be saved in the TRIME transmitter.

Measuring point at the beginning of the heating zone:

The TRIME-Ex GWs can be installed with the preset parameters with little effort for relative measurements in the heating zone. It can measure changes in humidity with a relative accuracy of up to ±0.3%. Depending on the type of product such as corn, wheat, etc., the appropriate calibration level is set in TRIME-Ex GWs.

Measuring point in the heating zone:

For use in the heating zone where precise relative humidity measurement with an accuracy of ±0.3% is required, almost all types of grain with the Cal2 (with TK) calibration curve can be used with TRIME-Ex GWs.

The focus here is not on the display of the absolute humidity value, but rather on correctly measuring the relative humidity in this zone with the temperature compensation TK set. The set calibration curve should therefore always be selected "with TK".

Measuring point in or on the discharge funnel:

The setting of a suitable calibration level depending on the grain type must be considered here, so that the final moisture content is correctly displayed as an absolute moisture value. If the discharge takes place continuously and the probe rods are always covered by grain, then a calibration curve "with TK" must also be set here. However, if the discharge takes place in batches and the GR probe is temporarily not covered with material, the built-in temperature sensor of the probe adjusts to the air temperature and not to the grain temperature.

This leads to measurement errors, so we recommend setting a calibration curve "without TC" in the case of batch discharge. In order to precisely carry out and display absolute humidity measurements at the discharge, the respective calibration level must be correctly set and adjusted.

The following table gives an overview of all preset calibration curves.

The calibration curves Cal1 / Cal2, Cal3 / Cal4 and Cal 5 / Cal6 are for measuring corn, wheat and rye, each with and without temperature compensation (TC).

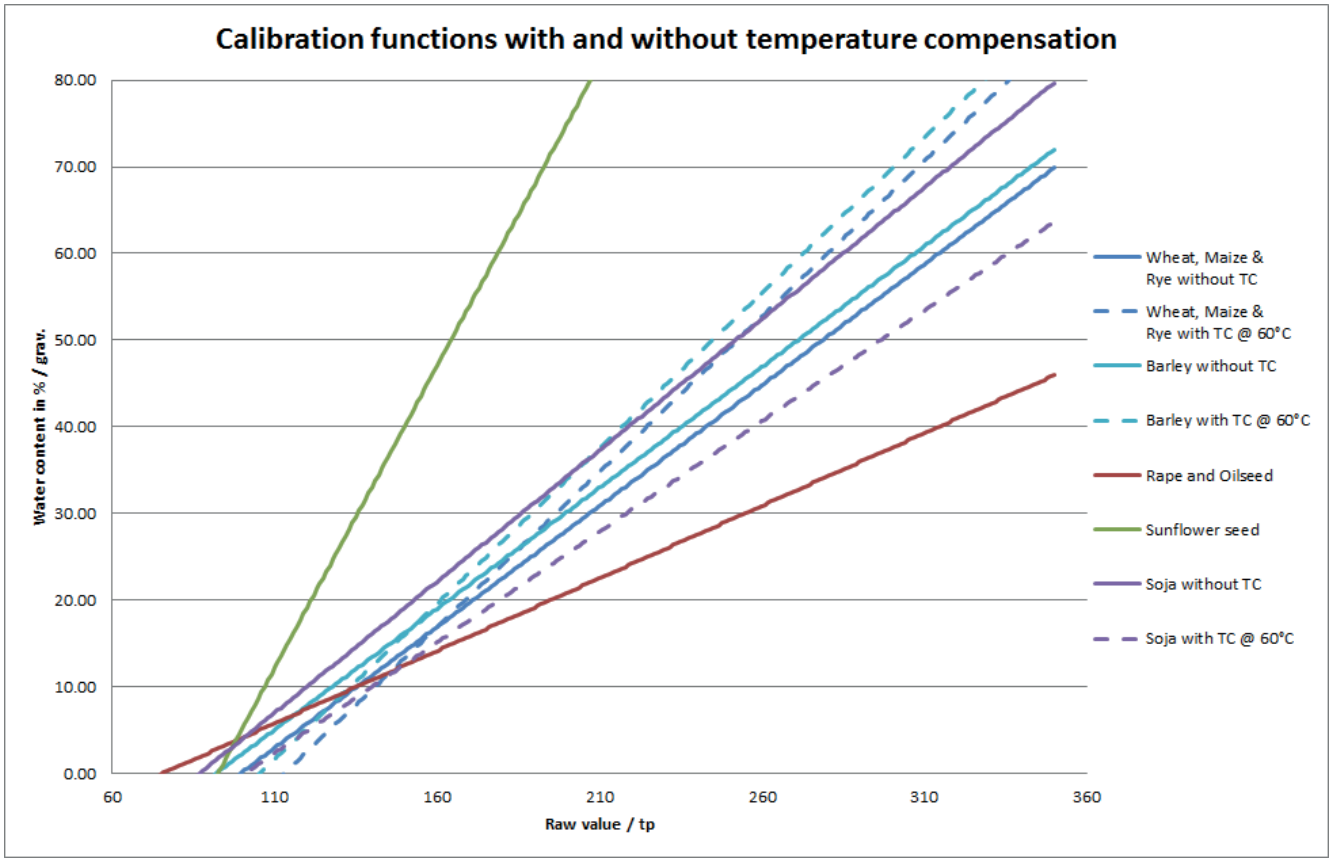
For absolute moisture measurements at the discharge, with an accuracy requirement of ±0.3%, each calibration curve must be set individually depending on the installation location

.

Calibration Curve	Recommended for	Bulk Density	Application
Cal1 (factory setting)	Corn without TK	0,75	Installation e.g. on the discharge funnel with batch discharge, if the GR probe is not continuously covered with material..
Cal2	Corn with TK	0,75	- Installation in the heating zone when the GR probe is continuously covered with material. - Installation on the discharge funnel with continuous discharge, if the GR probe is constantly covered with material.
Cal3	Wheat without TK	0,75	Installation e.g. on the discharge funnel with batch discharge, if the GR probe is not continuously covered with material.
Cal4	Wheat with TK	0,75	- Installation in the heating zone when the GR probe is continuously covered with material. - Installation on the discharge funnel with continuous discharge, if the GR probe is constantly covered with material.
Cal5	Rye without TK	0,72	Installation e.g. on the discharge funnel with batch discharge, if the GR probe is not continuously covered with material.
Cal6	Rye with TK	0,72	- Installation in the heating zone when the GR probe is continuously covered with material. - Installation on the discharge funnel with continuous discharge, if the GR probe is constantly covered with materia.
Cal7	Barley without TK	0,63	Installation e.g. on the discharge funnel with batch discharge, if the GR probe is not continuously covered with material.
Cal8	Barley with TK	0,63	- Installation in the heating zone when the GR probe is continuously covered with material. - Installation on the discharge funnel with continuous discharge, if the GR probe is constantly covered with material.
Cal9	Rape-/ Oil seeds without TK	0.60	No temperature compensation required!
Cal10	Sunflower seeds without TK	0,30	No temperature compensation required!
Cal11	Soybeans without TK	0,65	Installation e.g. on the discharge funnel with batch discharge, if the GR probe is not continuously covered with material.
Cal12	Soybeans with TK	0,65	- Installation in the heating zone when the GR probe is continuously covered with material. - Installation on the discharge funnel with continuous discharge, if the GR probe is constantly covered with material.
Cal13			
Cal14			
Cal15	1/10 tp		Radar transit time, reference calibration for test

TK = temperature compensation

The following diagram shows the calibration curves listed in the table. The gravimetric humidity is shown on the y-axis, and the corresponding pulse transit time in picoseconds depending on the calibration curve on the x-axis. In air, TRIME probes usually measure 60 picoseconds pulse transit time, in dry glass beads 145 picoseconds.



5.4 Selection and application of the reference measurement method

Note:

In order to be able to adjust the TRIME-Ex GWs Inline precisely for absolute value measurements at the discharge, an offline measurement method must be available as a reference. This must have a high level of absolute accuracy and work with a large sample volume. Most commercially available grain moisture meters show major weaknesses in both points!

The TRIME-Ex GWs measures the mean value continuously over a measuring volume of 1-2 liters. With moving grain, the measurement volume recorded in the averaging time increases many times over. In addition, the TRIME-Ex GWs is largely insensitive to fluctuations in the conductivity of the material due to the TDR measurement method. The measuring method and the measuring volume recorded by the averaging time lead to a very representative measured value.

When checking with a reference device, its suitability and measurement errors must be carefully considered in advance. Commercially available measuring devices often measure material samples in the milliliter range and thus detect inhomogeneities if necessary. Cross-sensitivities to the electrical conductivity of the material are also known.

The most suitable method for determining the exact moisture content of the grain is therefore to use a drying oven. The sample volume is also decisive here and should be at least 0.5 liters.

The following points must be observed when taking samples and making reference measurements:

- The samples for the reference measurements should be taken as close as possible to the probe. The moisture distribution in the grain dryer can be very different.
- When using a calibrated device with a small sample volume, several samples must be taken and the mean value calculated from them.
- Please note that even calibrated devices have measurement errors that can amount to up to 2% in the lower and even 5% in the upper humidity range.

5.4.1 Measurement data acquisition in trial operation

The calibration curve can only be set in practical operation or by means of a practical trial run. The following description relates to the use of the TRIME-Ex GWs at the discharge or in the reception or storage area.

Basically, only the humidity range close to the setpoint is important for the trial run. This means that when determining the switch position for corn, the check should be carried out at approx. 15% moisture. It is more important that the TRIME-Ex GWs is precisely adjusted in this lower humidity measuring range, it is less important whether the TRIME-Ex GWs in the dryer measures 26% instead of 28% in the dryer. When sampling or checking the lower target value (e.g. 15%), several representative samples must be taken and measured. An individual sample, perhaps taken at a point far away from the installation site, cannot give any representative comparative values. Samples must be taken several times directly at the installation site of the probe and the determined humidity averaged.

The appropriate calibration curve must be set at the beginning of the trial run.

When all preparations for taking and measuring the samples have been made, the grain dryer can be started up. Now a grain sample must be taken continuously, ideally every quarter of an hour. For each sample, the TRIME-Ex GWs measured value and the number of the calibration curve must be noted at the same time. The reference value determined off-line is compared to this measured value and also noted. As soon as the humidity approaches the target humidity, the most favorable position of the calibration curve must be set so that the measured value comes closest to the reference value.

Below you will find a ready-made form for entering the measured values.

- With the continuous dryer (roof dryer) at least 10 to 20 measured values should be available, which are in the range between the minimum and the maximum permissible humidity after drying. The measured values of the still very moist grain during the running-in phase should be documented but not used for the adjustment.
- With the rotary dryer, only the measured values towards the end of drying are relevant for the adjustment. Here, too, at least 10 measured values should have been documented. Density and moisture distribution effects of the grain can lead to reduced readings within the first one to two hours. Therefore, these values should not be used for the adjustment.

The most favorable setting of the calibration curve is selected on the basis of the adjustment protocol created in this way. The setting should be based solely on the measured values in the target humidity range.

5.4.2 Example for the adaptation of a wheat calibration curve

TRIME-Ex GWs at the discharge should be adjusted for wheat. A TRIME-Ex GWs is installed, the probe of which is in the immediate vicinity of the discharge. First the calibration curve Cal3 (without TC) is set.

The dryer starts up and the measurement values are recorded. Only when the humidity at the discharge falls below around 18% are the measured values relevant and can be used for adjustment. From this point on, the setting of the calibration curve is checked with each measurement and, if necessary, corrected by offset correction with SONO-VIEW.

Adjustment protocol

Reference Measurement	Display SONO VIEW	Setting the Offset
17,9%	19,5%	-1,6%
15.5	15.7	-0,2%
14.3	14,4	Waiting
13,8	14,0	Waiting
13,5	13,8	Waiting
13,6	13,8	-0,2%

However, the adjustment only relates to the case that the measurement is carried out in a known medium with a suitable calibration. If a new material is to be measured, the measured values should always be collected in calibration level Cal1.

Furthermore, the temperature determined by TRIME-Ex GWs and displayed in the SONO-VIEW must also be recorded for each measured value and reference value. It is only with these three values that it is possible to distinguish the influence of the measured values by humidity or temperature and thus to create a calibration.

For further information, please contact us at info@imko.de

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6 Commissioning and handling

The installation conditions are heavily dependent on the conditions of the respective system. The optimal installation location must be determined individually. The following guidelines should be observed.

1. It must be checked whether the information on the nameplate of the device and in the documentation correspond to the permissible Ex operating conditions on site:
    a. Explosion Group
    b. Device Category
    c. Zone
    d. Temperature class or the maximum surface temperature

Attention, danger of overvoltages!

During welding work on the system, all probes must be completely electrically disconnected

TRIME probes require a stabilized supply voltage of 12V DC to max. 24V DC. Unstabilized power supplies run the risk of overvoltages, which is why we strongly advise against using these power supplies.

Caution, risk of malfunction

1. There are systems in which the mains voltages can have different ground potentials, which can lead to the analog signal 0(4)..20mA not being correctly measured in a PLC. Here we recommend the use of a galvanically isolated power supply or an isolating coupler for the power supply of the TRIME probes. Available from IMKO on request.
2. Make sure that there are no other electromagnetic fields in the immediate vicinity of the probe head. E.g. no other humidity probes, especially microwave probes, should be installed directly next to or opposite TRIME probes

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7 Technical specifications

Power supply:	12V..24V DC 3W
Power consumption:	Depending on the supply voltage: 12V to 24V DC bei 125..250mA Power consumption
Measuring range:	5 bis 45 Gew.% based on the wet mass (Depending on the material to be measured)
Standard deviation:	Area 5..20 Gew.%: ±0,6 Gew.% Area 20..45 Gew.%: ±1 Gew.% (Depending on the material to be measured)
Repeatability:	±0,3 Gew.% (Depending on the material to be measured)
Transmitter temperature range TRIME-Ex GWs:	-10 till +70°C
Temperature range GR probe:	-10 till +70°C
Measurement interval:	Flowing averaging over an adjustable period of time (0.5s to 20min)
Interface:	IMP-Bus and RS485
Analog output:	0(4)..20mA = 0..100 Gew.% (Maximum load: 500 Ω)
Probe cable length:	Standard 5m
Enclosure protection class:	Stainless steel case IP66
Degree of protection GR probe:	IP68 potted waterproof

EXPLOSION PROTECTION

II 2 D Ex tb IIIC T75°C Db

SPECIAL CONDITIONS

The permitted ambient temperature range is-10°C to +70°C

The cable to the housing of the evaluation electronics must be laid permanently.

8 Safety instructions

In this documentation, text passages that require special attention are highlighted accordingly.

Attention:

The warning triangle with the exclamation mark warns you of personal injury or property damage.

Intended Use

Sensors and measuring systems from IMKO GmbH may only be used for the purpose described within their technical boundaries. Improper use is not permitted. The function and operational safety of a sensor or measuring system can only be guaranteed if the generally applicable safety precautions, national regulations and the special safety instructions in these operating instructions are observed.

The humidity sensors and measuring systems from IMKO GmbH are used to measure humidity according to the measuring purpose and measuring range defined and specified in the technical data. Only compliance with the instructions described in the manual is considered intended use. The manual describes the connection, use and care of the IMKO sensors and IMKO measuring systems.

Read the manual before connecting and operating a sensor or measuring system.

The manual is part of the product and must be kept ready to hand near the sensor or measuring system.

Impairment of security

The sensor or the measuring system has been built and tested in accordance with the safety regulations for electronic measuring devices applicable in Germany and left the factory in a perfectly safe condition. If the sensor or the measuring system can no longer be operated safely, it must be put out of operation and secured with a label before further commissioning. In cases of doubt, the sensor or the measuring system must be sent to the manufacturer or his contractual partner for repair or maintenance.

Changes

For safety reasons, it is not permitted to make modifications or changes to the sensor or the measuring system without the consent of the manufacturer.

Opening the sensor or hand-held measuring device, adjustment and repair work as well as all maintenance work except the work described in the manual may only be carried out by a specialist authorized by us. The sensor or the measuring system must be disconnected from the power supply before installation or maintenance work.

The hand-held measuring device and the power supply unit must not be opened or repaired!

Hazard warnings

Danger from improper operation.

The sensor or the measuring system may only be operated by trained personnel. The operating personnel must have read and understood the instructions for use.

Attention:

The warning triangle with the exclamation mark warns you of personal injury or property damage.

Electricity hazard

The hand-held measuring device must not be immersed in water or other liquids. The sensor is insensitive to moisture contained in the products typically measured.

Only connect the hand-held measuring device to a properly installed socket with the supplied power supply cable, the voltage of which corresponds to the technical data. Use only the adapter that is suitable for your socket outlet.

Only operate the measuring device with the original accessories included in the scope of delivery. Contact the manufacturer if you need additional accessories or replacements.

Do not use the meter:

- if the measuring device, sensor, plug-in power supply unit or accessories are damaged,
- the sensor or the measuring system does not work as intended,
- the power cord or plug is damaged,
- the sensor or the measuring system has fallen.

Pull the plug-in power supply unit out of the socket:

- if you do not use the sensor or the measuring system for a longer period of time,
- before you clean, pack away or move the sensor or the measuring system,
- when you carry out work on the sensor or measuring device, e.g. connecting devices,
- if a malfunction obviously occurs during operation,
- during a thunderstorm.

Caution - property damage

Make sure that there is a sufficiently large distance from strong heat sources such as heating plates, heating pipes.

Disconnect the sensor or hand-held measuring device from other devices before moving or transporting it. Pull out the plug on the device.

Do not use any aggressive chemical cleaning agents, scouring agents, hard sponges or the like for cleaning. The operator must ensure that he is not statically charged. Should a display error occur due to static discharge, please restart the device.

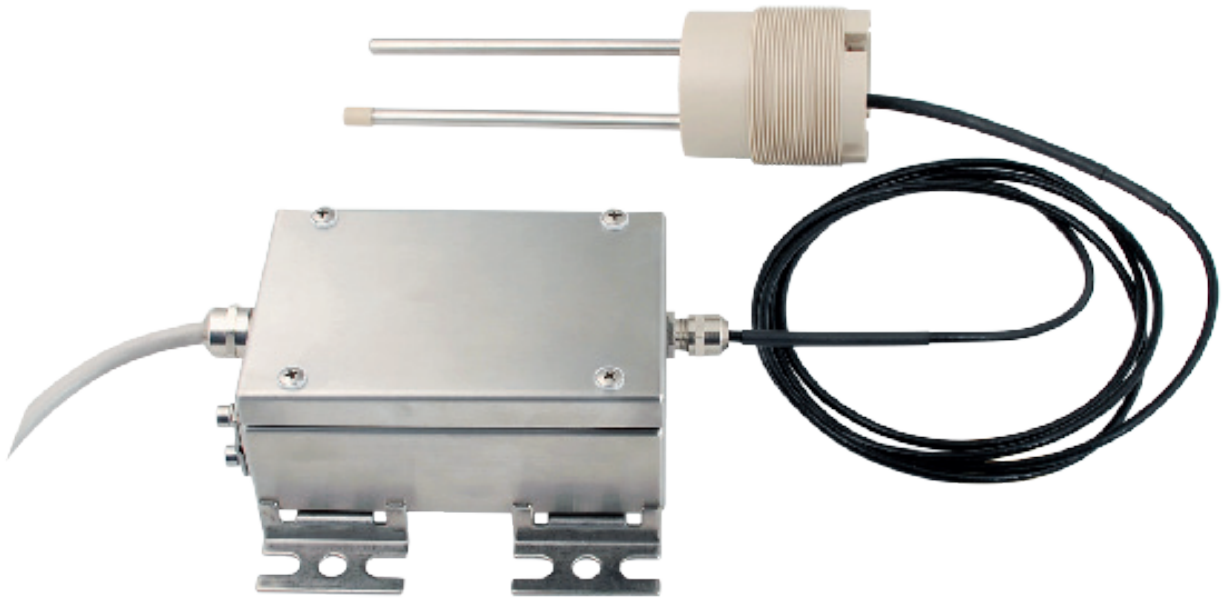
Attention

The device is not intended for use in residential areas and, in rare cases, may interfere with radio reception.

9 Certificate and approvals

CE-mark	The measuring system fulfills the legal requirements of the applicable EC directives. These are listed together with the applied standards in the corresponding EC Declaration of Conformity. IMKO Micromodultechnik GmbH confirms the successful testing of the device by affixing the CE mark.
RoHS	The measuring system complies with the substance restrictions of the directive on the restriction of the use of certain hazardous substances 2011/65/EU (RoHS2).
Radio Approval	Meets "Part 15" of the FCC regulations for an 'Unintentional Radiator'. All probes meet the requirements of a "Class A Digital Device".
Electromagnetic Compatibility	Electromagnetic compatibility according to all relevant requirements of the EN 61326 series. Details can be found in the declaration of conformity. Maximum measurement deviation during EMC tests: < 3.0% of the span When installing the probes in metal and concrete containers and when using a coaxial probe • Emitted interference according to EN 61326-x series, equipment of the class B • Interference immunity according to EN 61326-series requirements for industrial areas When installing without a shielding / metallic wall, e.g. in plastic and wooden silos, the measured value can be influenced by the effects of strong electromagnetic fields • Emitted interference according to EN – 61326 series, Equipment Class A • Interference immunity: the measured value can be influenced by the effects of strong electromagnetic fields.
Explosion Protection (ATEX)	Directive conformity with 2014/34/EU is confirmed by the EU type examination certificate EPS 20 ATEX 1 237 X

10 Product images



Transmitter in stainless steel housing with TRIME-GR probe

11 Note

Contact

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