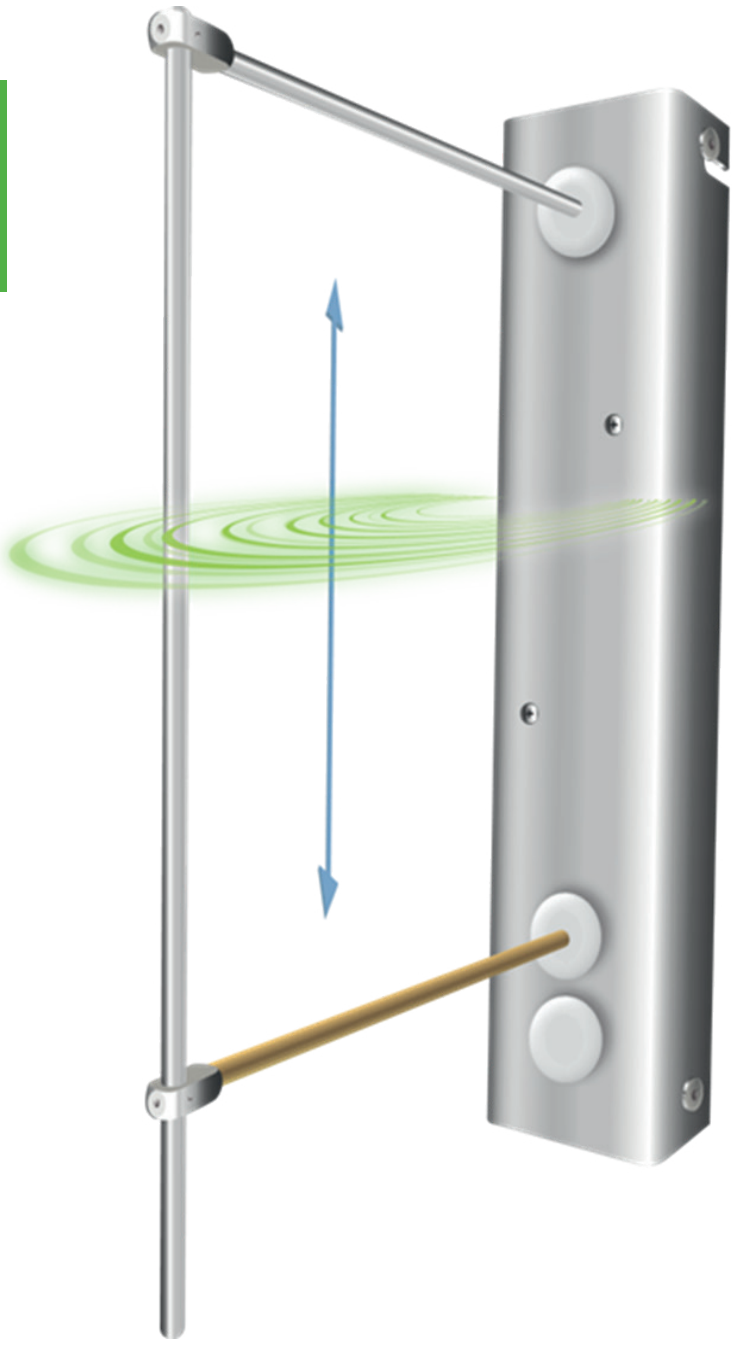
Manual

TRIME®-GW Line

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, to 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 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.

Content

1 Functional Description

1.1 The patented TRIME® TDR-Measuring Method

The TDR technology (**T**ime-**D**omain-**R**eflectometry) is a radar-based dielectric measuring procedure at which the transit times of electromagnetic pulses for the measurement of dielectric constants, respectively the moisture content are determined.

TRIME-GW Line consists of the measurement transformer TRIME-GW casing and the 1-rod-probe head. An integrated TRIME TDR measuring transducer of IMKO´s SONO-series is installed into the TRIME-GW Line casing. A high frequency TDR pulse (1GHz), passes along wave guides and generates an electro-magnetic field around these guides and herewith also in the material surrounding the probe. Using a patented measuring method, the transit time of this pulse is determined with a resolution of <1 picosecond (1x10-12). Due to this high resolution the moisture and the conductivity of the material is measured with a high precission.

The established moisture content, as well as the conductivity, respectively the temperature, can either be uploaded directly into a PLC via two analogue outputs 0(4) ...20 mA or recalled via a serial RS485 interface.

1.2 TRIME® compared to other Measuring Methods

In contrary to conventional capacitive or microwave measuring methods, the TRIME® technology (**T**ime-**D**omain-**R**eflectometry with Intelligent Micromodule Elements) offers precise measurement results which means more reliability at the production.

TRIME-TDR technology operates in the ideal frequency range between 600MHz and 1,2 GHz. Capacitive measuring methods (also referred to as Frequency-Domain-Technology) , depending on the device, operate within a frequency range between 5MHz and 40MHz and are therefore prone to interference due to disturbance such as the temperature and the mineral contents of the measured material. Microwave measuring systems operate with high frequencies >2GHz. At these frequencies, nonlinearities are generated which require very complex compensation. For this reason, microwave measuring methods are more sensitive in regard to temperature variation.

The modular TRIME technology enables a manifold of special applications without much effort due to the fact that it can be variably adjusted to many applications.

1.3 Areas of Application with TRIME-GW Line and the 1-Rod Probe

The TRIME-GW Line with the 1-rod probe is suited for measuring in different materials directly inside a silo. The 1-rod probe requires a good flowability of the measured material in order to ensure that the material lies close to the rods when the material is flowing.

The temperature of the measured material should not be higher than 60°C.

2 Mode of Operation

2.1 Measurement value collection with pre-check, average value and filtering

TRIME-GW Line measures internally at a very high rate of measurements per second and issues the resulting measurement value at a cycle time of up to 200 milliseconds at the analogue output. Within this cycle time of 200 milliseconds a probe-internal pre-check of the moisture values is included. Only plausible and physically pre-averaged measurement values are used for the further data processing. This increases reliability and stability of the measurement output at the interface of the probe.

In the **Measurement Mode CS** (Cyclic-Successive), an average value is not accumulated, and the cycle time here is 200 milliseconds. In the **Measurement Mode CA and CF** (Average), not the momentarily measured individual values are directly issued, but an average value is accumulated via a variable number of measurements in order to filter out temporary variations. These variations can be caused by inhomogeneous moisture distribution of the material. The delivery scope of TRIME-GW Line includes suited parameters for the averaging period and a universally applicable filter function deployable for currently usual applications. The time for the average value accumulation, as well as various filter functions, can be adjusted and customized for special applications.

2.2 Temperature Measurement

A temperature sensor is installed on one stay bar of the 1-rod probe which establishes the measurement of the material temperature. The temperature can optionally be transmitted at the analogue output 2.

2.3 Temperature compensation when working at high temperatures

Because the TRIME-GW Line measurement transformer works in other temperature ranges as the 1-rod-probe inside the dryer, it is necessary to compensate the electronic separately from the 1-rod-probe. TRIME-GW Line offers two possibilities for temperature compensation.

A) Temperature compensation of the internal TRIME-electronic

Despite the TRIME-GW Line electronic shows a generally low temperature drift, it is necessary to compensate a temperature drift in applications for measuring moisture inside a grain dryer. With this method of temperature compensation, a possible temperature drift of the TRIME-electronic can be compensated. For standard applications in grain drying the compensation parameter is pre-set to TempComp = 0.2. For special applications it could be necessary to adjust this parameter. But it is to consider that it is necessary to make a Basic-Balancing of the TRIME-GW Line in air and dry glass beads if the parameter TempComp is changed to another value. The parameter TempComp can be changed with the software tool SONO-CONFIG, in the menu **"Calibration"** and the window **"Temperature-Compensation"**.

B) Temperature compensation for the measured material

Water and special materials like maize, wheat and others, show a dependency of the dielectric permittivity when using TRIME-GW Line at high temperature ranges. The dielectric permittivity is the raw parameter for measuring water content with TRIME-GW Line. If special materials show this temperature drift, it could be necessary to use a more elaborate temperature compensation. TRIME-GW Line offers the possibility to set special temperature compensation parameters for every calibration curve Cal1 of Cal15 (see chapter “Selection of the individual calibration curve”).

2.4 Analogue Outputs

The measurement values are transmitted as a current signal via the analogue output. With the help of the service program **SONO-CONFIG**, the TRIME-GW Line can be set to the two versions for 0..20mA or 4..20mA. Furthermore, it is also possible to variably adjust the moisture dynamic range e.g. to 0-10%, 0-20% or **0-50%**. For a 0-10V DC voltage output, a 500R resistor can be installed in order to reach a 0..10V output.

Analogue Output 1: Moisture in % (0…50%, variable adjustable)

Analogue Output 2: Temperature 0….100°C, variable adjustable

F

For the analogue outputs 1 and 2 there are two adjustable options: Analog Output: (two possible selections)

0..20mA **4..20mA**

Output Channel 1 and 2: (three possible selections)

Moisture Temperature: Analogue output 1 for moisture, output 2 for temperature.

For analogue output 1 and 2 the moisture dynamic range and temperature dynamic range can be variably adjusted. The moisture dynamic range should not exceed 100%

Moisture Range:	**Temp. Range:**
Maximum: e.g. 50 for maize (Set in %)	Maximum: 60°C
Minimum: 0	Minimum: 0°C

2.5 The serial RS485 and IMP-Bus interface

TRIME-GW Line is equipped with a standard RS485 as well as the IMP-Bus interface to set and readout individual parameters or measurement values. An easy to implement data transfer protocol enables the connection of several sensors/probes at the RS485-Interface. In addition, the TRIME-GW Line can be directly connected via the module SM-USB to the USB port of a PC, in order to adjust individual measuring parameters or conduct calibrations.

NOTE:

The initial default setting of the serial interface is pre-set for the IMP-Bus. To operate with the RS485 it is necessary to switch and activate the RS485 interface with help of the modul SM-USB. The transmission protocol of TRIME-GW Line can be requested via “Contact us” on www.imko.de.

2.6 The IMP-Bus as a user friendly network system

With external power supply on site for the SONO probes, a simple 2-wire cable can be used for the networking. By use of 4-wire cables, several probes can be also supplied with power.

Standard RS485-interfaces cause very often problems! They are not galvanically isolated and therefore raises the danger of mass grindings or interferences which can lead to considerably security problems. An RS485 network needs shielded and twisted pair cables, especially for long distances. Depending on the topology of the network, it is necessary to place 100Ohm termination resistors at sensitive locations. In practice this means considerable specialist effort and insurmountable problems.

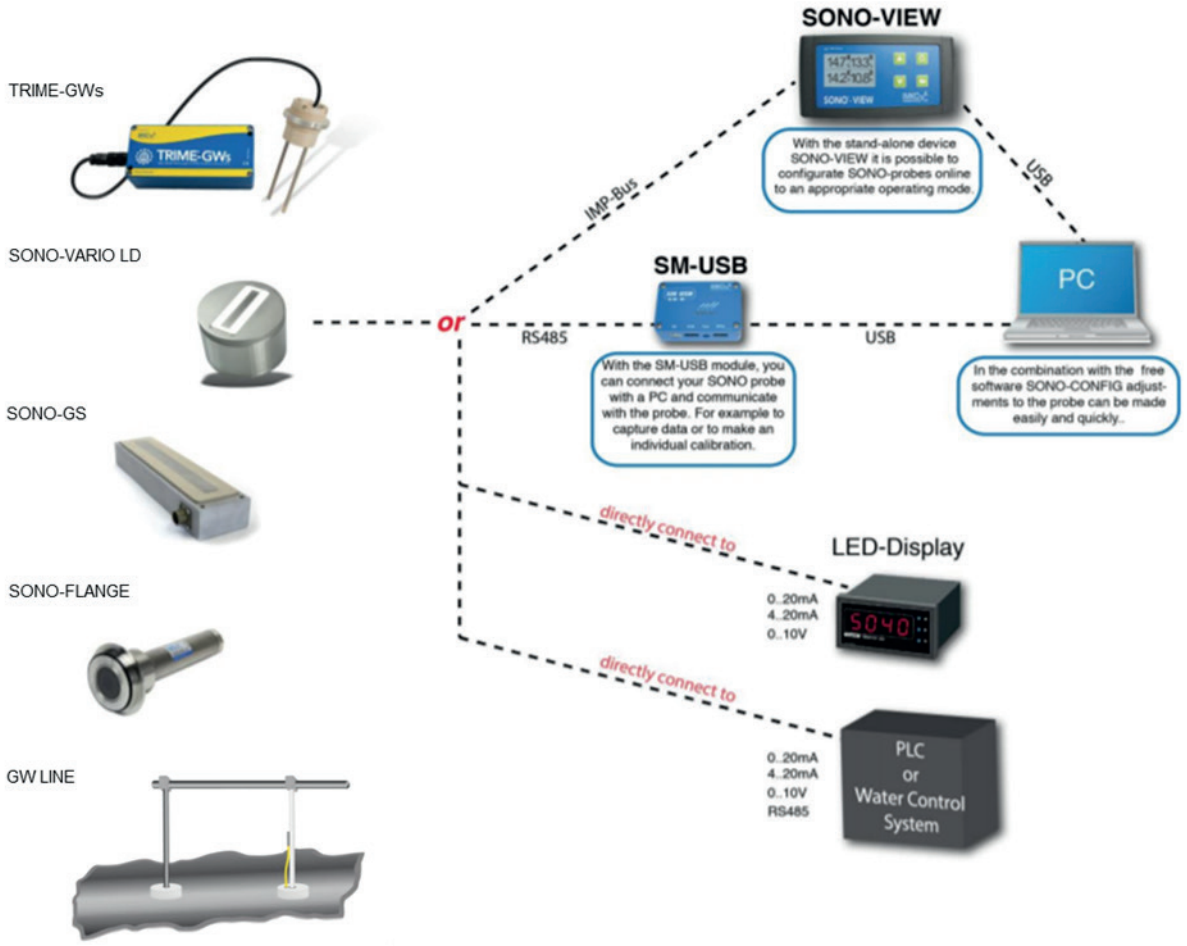
The robust IMP-Bus ensures security. SONO-probes have in parallel to the standard RS485 interface the robust IMP-Bus which is galvanically isolated which means increased safety. The serial data line is isolated from the probe´s power supply and the complete sensor network is therefore independent from single ground potentials and different grid phases. Furthermore, the IMP-Bus transmit its data packets not as voltage signals, but rather as current signals which also works at already existing longer lines. A special shielded cable is not necessary and also stub lines are no problem.

2.7 Error Reports and Error Messages

TRIME-GW Line is very fault-tolerant. This enables failure-free operation. Error messages can be recalled via the serial interface.

3 Connectivity to TRIME-GW Line

Compatible to SONO probes



3.1 How to configure SONO-probes to appropriate operating and calibration parameters?

TRIME-GW Line is initially adjusted for the application for grain drying with the calibration curve Cal14, operation mode CF and 3 seconds average time. The analogue outputs are adjusted to 4..20mA. With this pre-adjustment TRIME-GW Line can be installed direct in the heating zone, without further adjustments. For operation at the discharge hopper where an absolute moisture value is important, TRIME-GW Line has to be adjusted to a suitable calibration curve Cal-x, depending on grain type and possibly to a zero-offset, depending on installation place.

There are two ways to configure and adjust a SONO-probe:

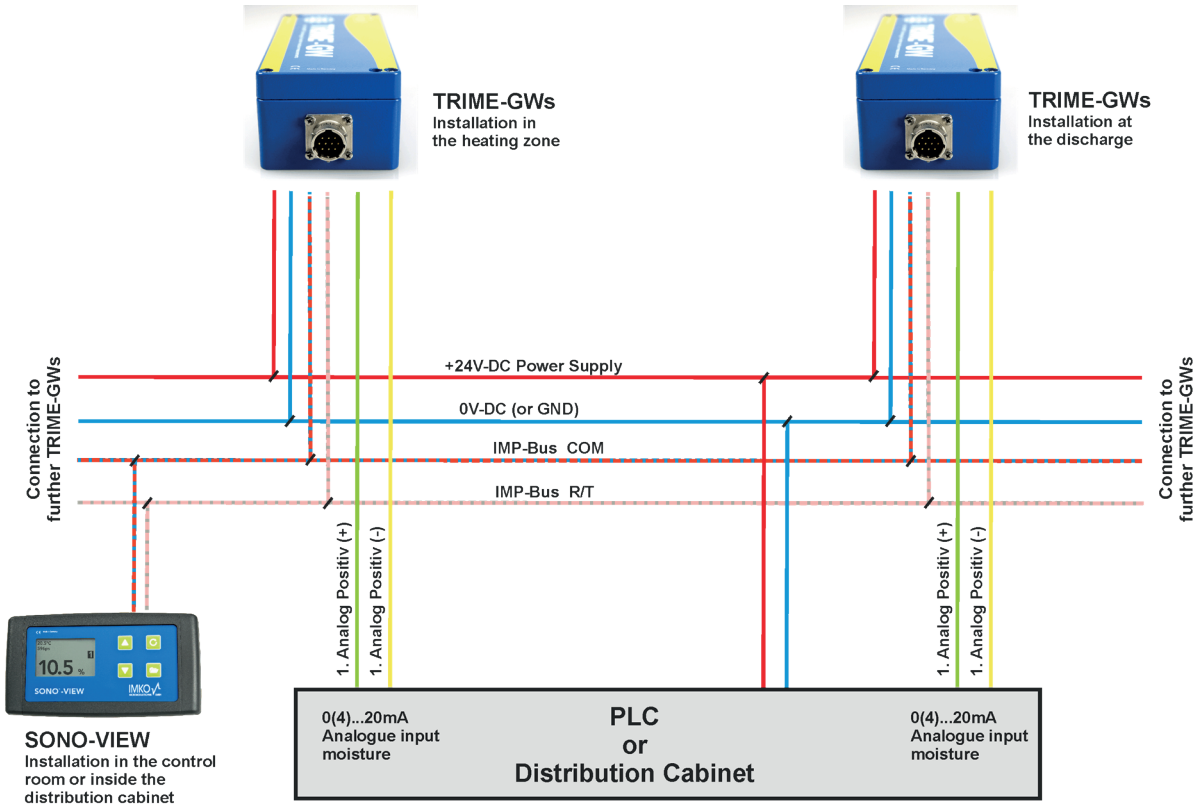
A: Online Configuration via SONO-VIEW

With the stand-alone device SONO-VIEW it is possible to configure SONO-probes online to an appropriate operating mode, without the need to connect the SONO-probe to a PC. The operating mode depends on the application like the moisture measurement under a silo flap, inside a dryer or mixer or on a conveyor belt. The SONO-probe can be adapted via the SONO-VIEW to the appropriate operating mode like cyclic measurement, averaging, filtering, cumulating and other powerful operating parameters. Furthermore, it is possible to select a calibration curve inside a SONO-probe with zero-offset setting. All configuration parameters are stored in a non-volatile memory inside the SONO-probe. This ensures that the analog output (e.g. 4-20mA) of the SONO-probe which could be connected in parallel to a PLC, responds directly to the set configuration parameters.

B: Configuration via SM-USB

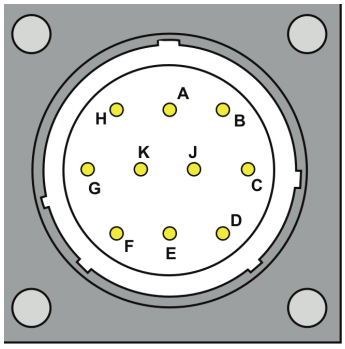
The SONO-probe is connected via the SM-USB and the RS485-interface to a PC. With help of the software tool SONO-CONFIG it is possible to configurate SONO-probes to an appropriate operating mode. The operating mode depends on the application like the moisture measurement under a silo flap, inside a mixer or on a conveyor belt. The SONO-probe can be adapted to the appropriate operating mode like cyclic measurement, averaging, filtering, cumulating and other powerful operating parameters. Furthermore, it is possible to select a calibration curve inside a SONO-probe with zero-offset setting. All configuration parameters are stored in a non-volatile memory inside the SONO-probe. So the analog output (e.g. 4-20mA) of the SONO-probe which could be connected in parallel to a PLC, responds directly to the configuration parameters.

3.2 System Setup with several TRIME-GW Line



3.3 Connection Plug and Plug Pinning

TRIME-GW Line is supplied with a 10-pole MIL flange plug.



Assignment of the 10-pole MIL Plug and sensor cable connections:

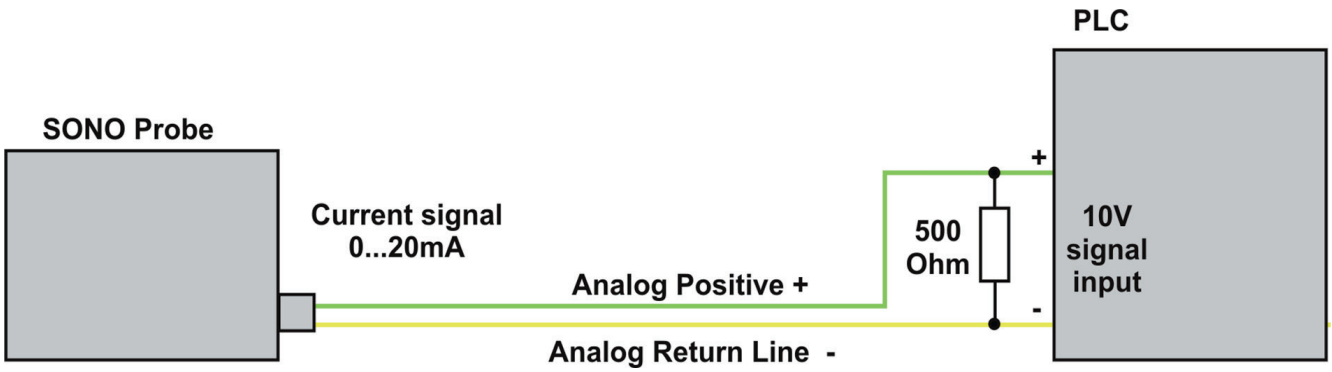
Plug-PIN	Sensor Connections	Lead Colour	Lead Colour
A	+12V....24V Power Supply	**Red**	Red
B	0V Power Supply	**Blue**	Blue
D	1. Analogue Positive (+) Moisture	**Green**	Green
E	1. Analogue Return Line (-) Moisture	**Yellow**	Yellow
F	RS485 A	**Weiß**	White
G	RS485 B	**Brown**	Brown
C	(rt) IMP-Bus	**Grey/Pink**	Grey/Pink
J	(com) IMP-Bus	**Blue/Red**	Blue/ed
K	2. Analogue Positive (+)	**Pink**	Pink
E	2. Analogue Return Line (-)	**Grey**	Grey
H	Screen (is grounded at the sensor. The plant must be properly grounded!)	**Transparent**	Transparent

3.4 Analogue Output 0..10V with a Shunt-Resistor

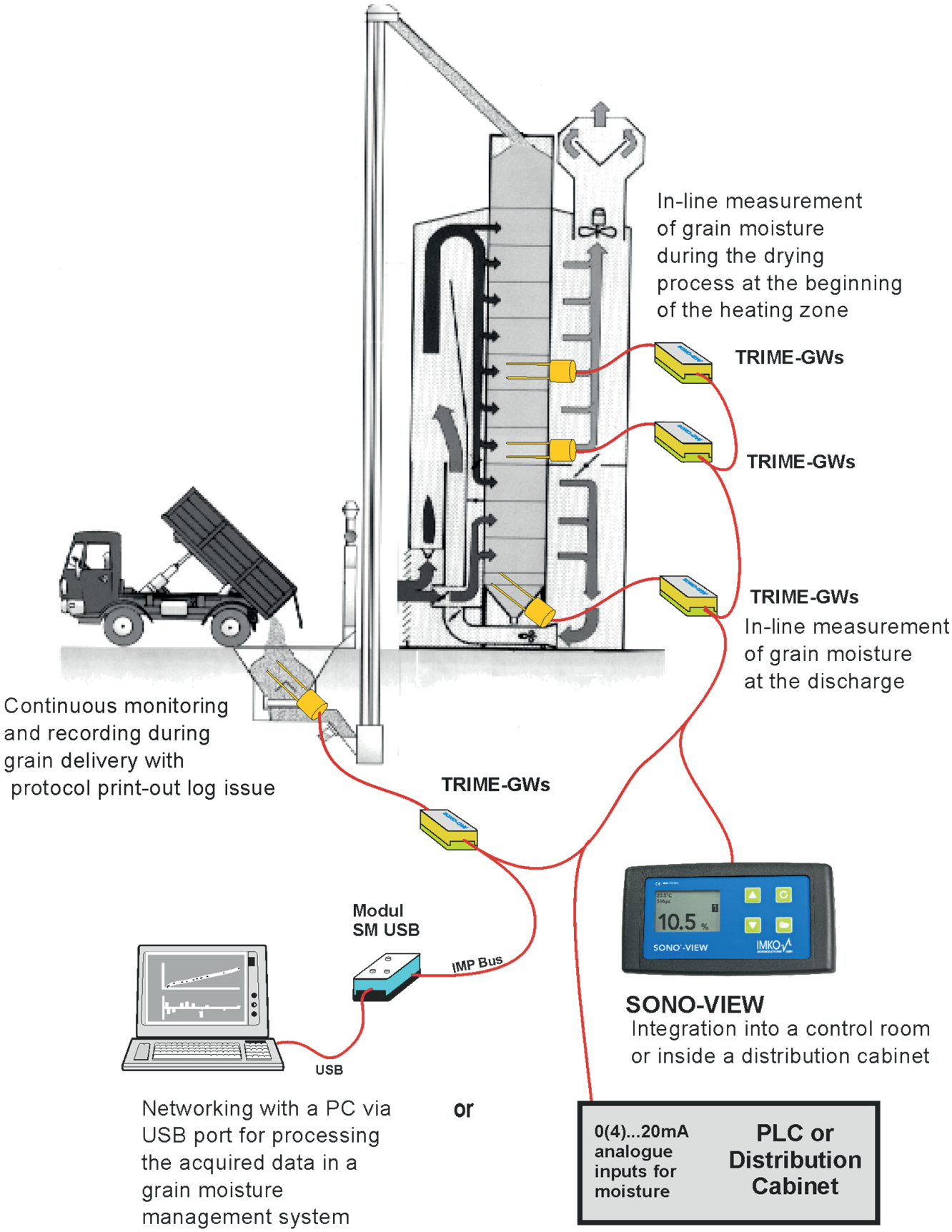
With the help of a shunt resistor with 500 ohm (included in the delivery) 0..10V can be generated from the current signal 0..20mA, in case the local PLC does not handle the recommended 4..20mA. Therefore the 500 Ohm shunt resistor should be placed at the end of the line respectively at the input of the PLC. Following drawing shows the wire connection.

NOTE:

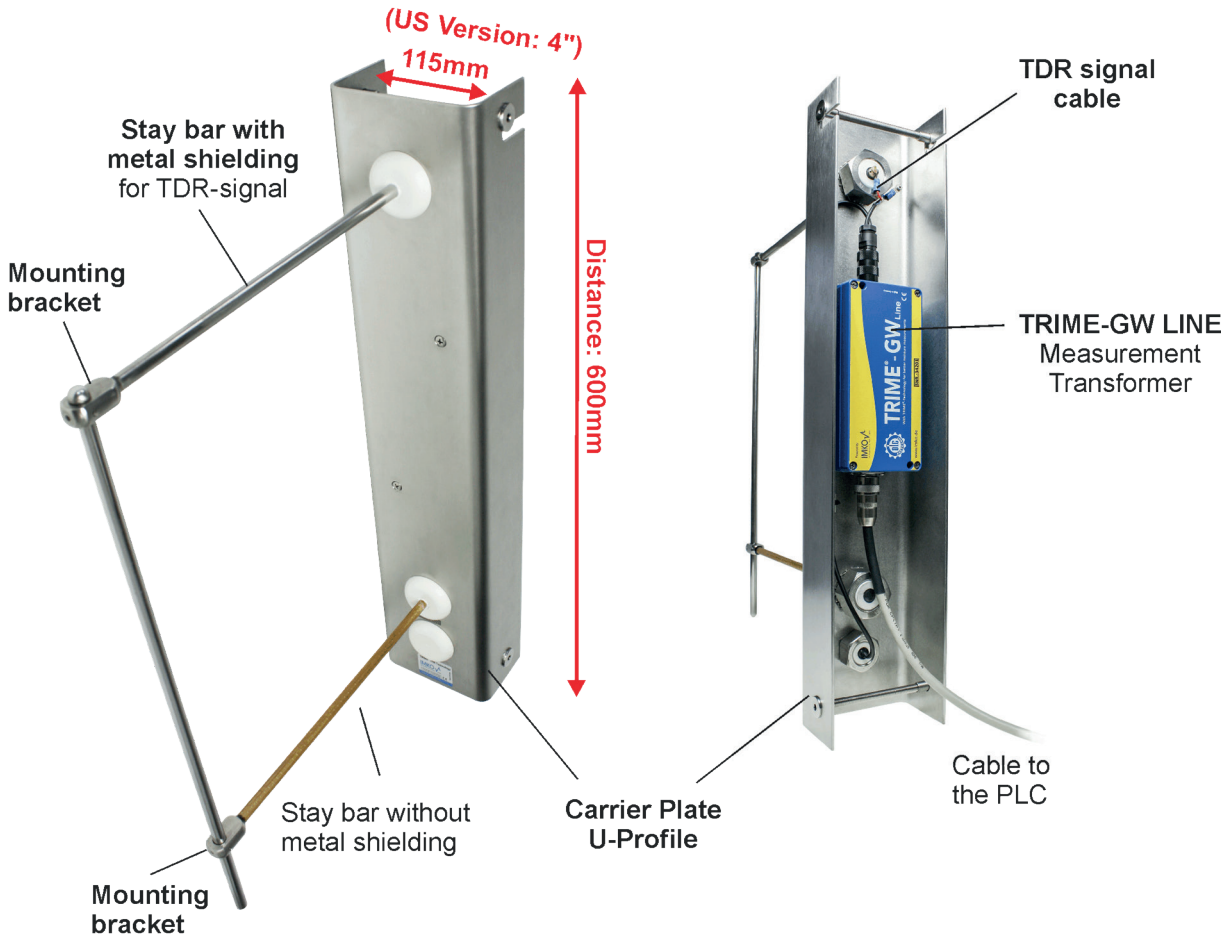
The analogue output of TRIME-GW Line must be set to 0 to 20mA!



4 TRIME-GW Line Installation

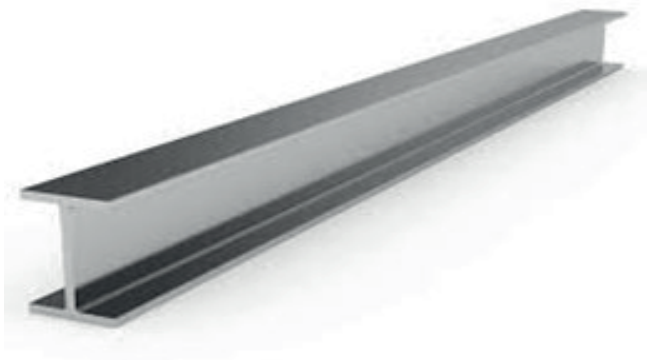


4.1 Schematic Diagram with Carrier Plate U-Profile



4.2 Installation on a steel girder with HEA-profile

TRIME-GW Line is delivered with a carrier plate as U-profile. This carrier plate can be mounted directly on a steel girder which can be installed in silos or drying chambers.

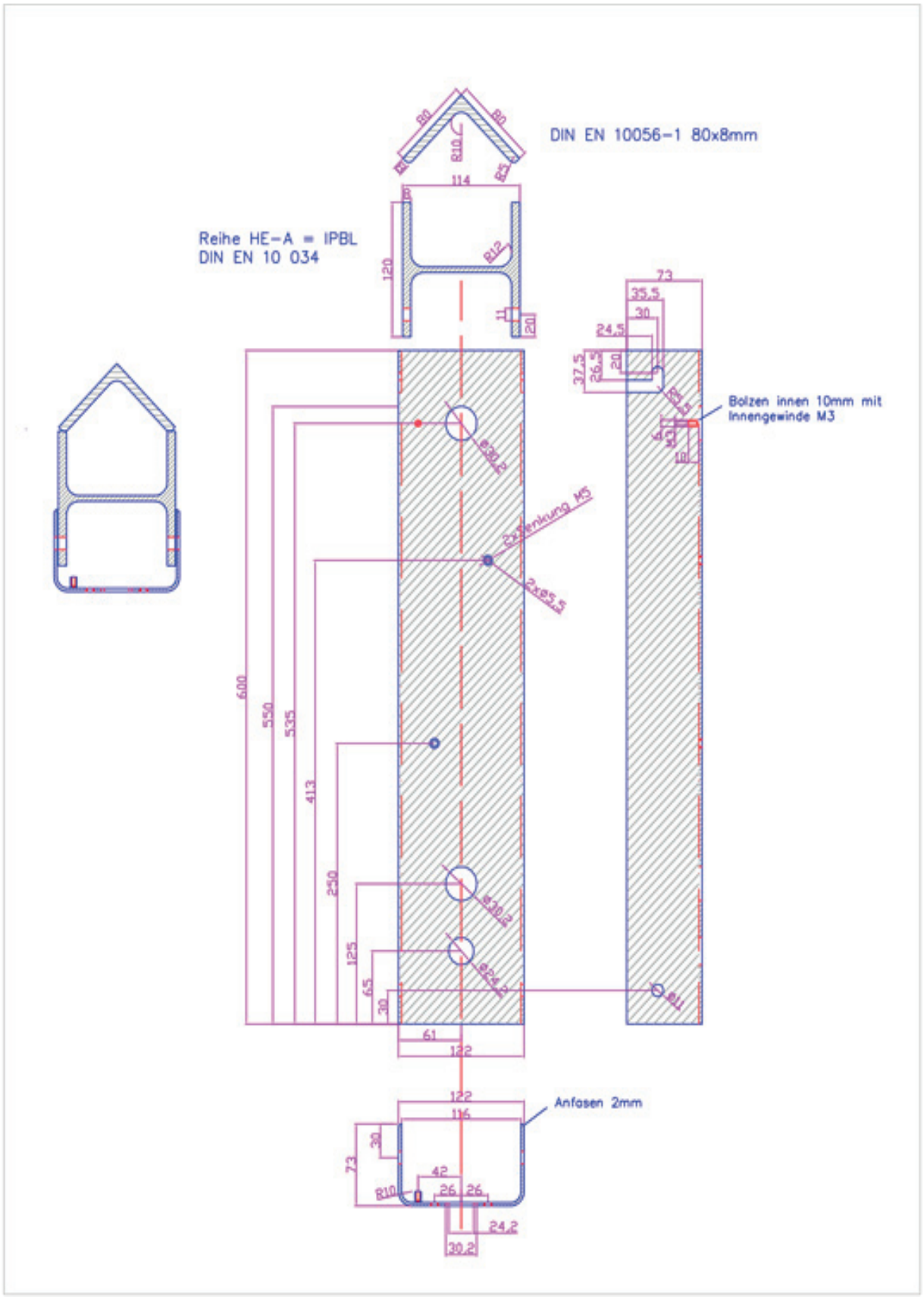


IMKO offers the carrier plate in two possible steel girder dimensions

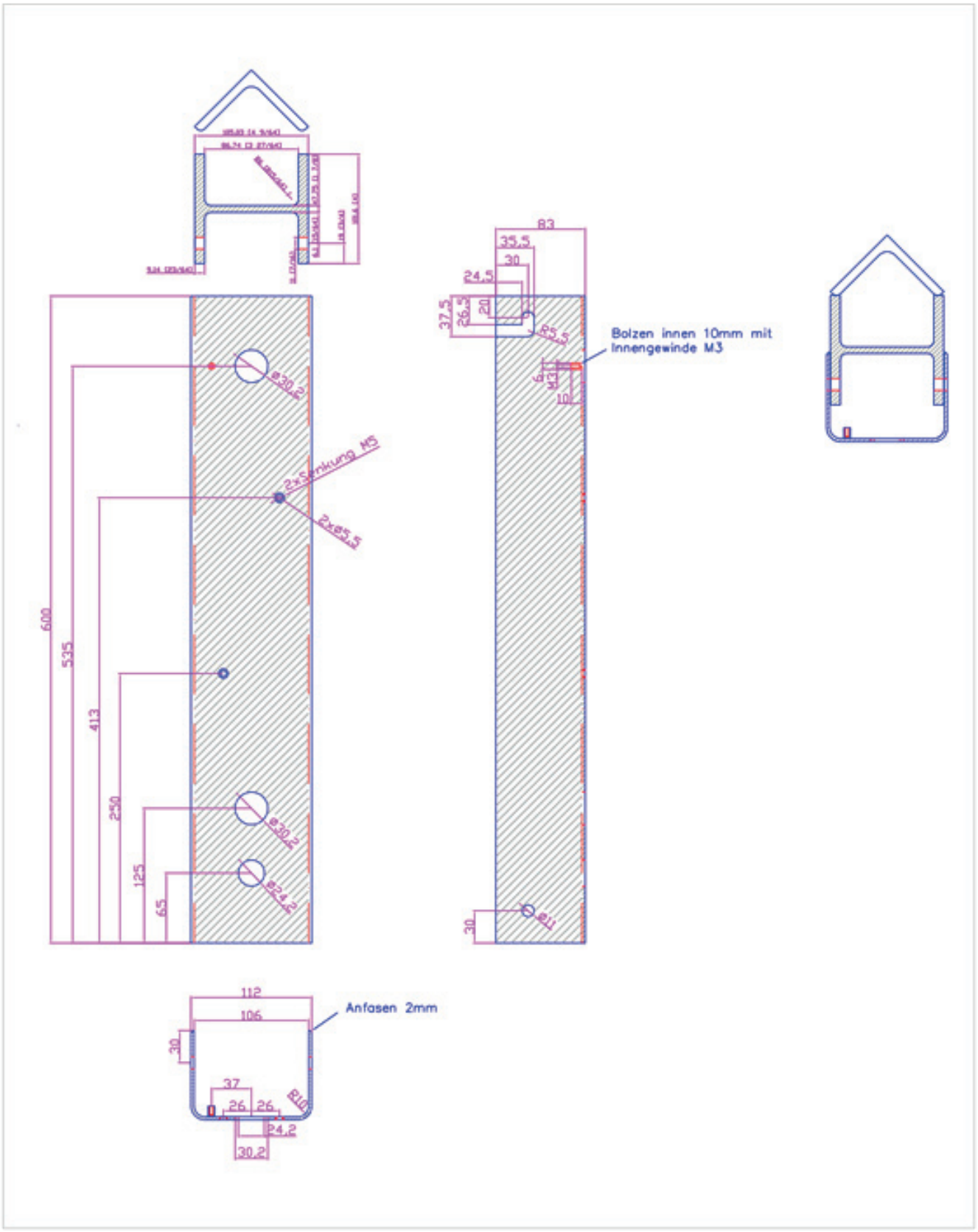
A) With width a = 120mm

B) With width a = 4”

4.3 Carrier plate dimensions for 120mm steel girder

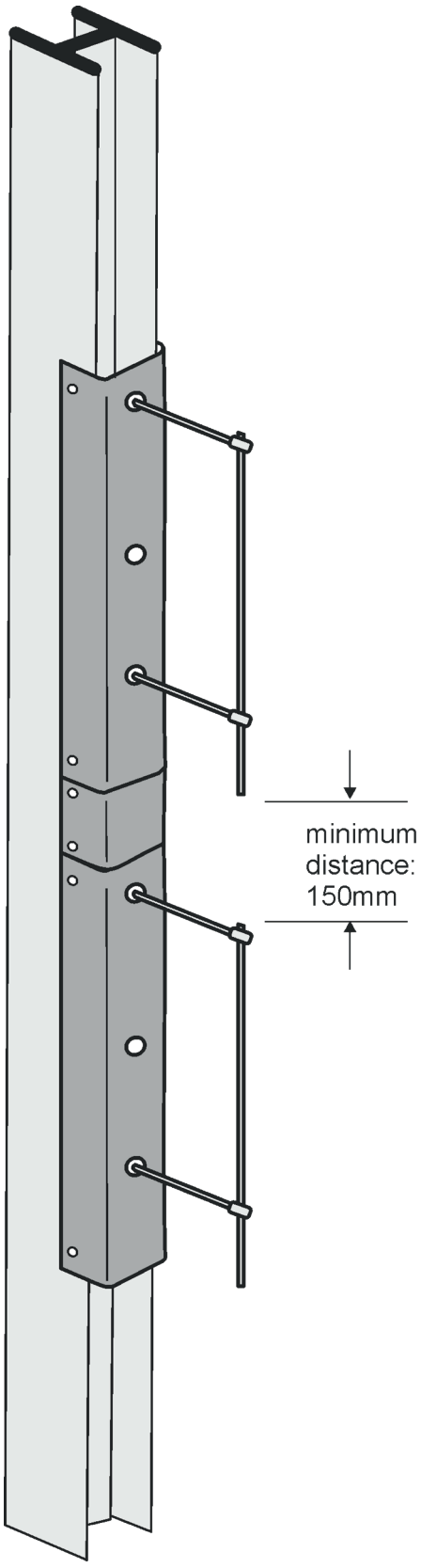


Carrier plate dimensions for 4” steel girder



4.4 Installation of two carrier plates very close to each other

Here it is very important that the two long rods have sufficient distance to one another. This can be achieved with a spacer between the carrier plates.



5 Initial operation and adjustments

5.1 Adjustment Guidelines for Moisture Measurements

Please read the detailed description first and subsequently use these guidelines as a checklist for adjustments.

1. Extract samples from as close as possible to the probe.
2. Select calibration curve with help of SONO-VIEW or via the module SM-USB.
3. **Note: TRIME-GW Line is initially adjusted for the application for grain with the calibration curve Cal2. The analogue outputs are adjusted to 4..20mA. With this pre-adjustment TRIME-GW Line can be installed direct in the silo, without further adjustments.**
4. Determine the difference between the target and the actual value and if necessary adjust the offset of the selected calibration curve.
5. Repeat this procedure for different grain types.

5.2 How to use the Calibration Curves Cal1 to Cal15

Up to 15 different calibration curves (CAL1 ... Cal15) are stored inside the TRIME-GW Line. They can be activated in two ways:

The calibration curve (Cal1. .15) can be activated with the module SONO-VIEW which is working offline or online with a connection via a PC. In the menu "Calibration" and in the window “Material Property Calibration" by selecting the desired calibration curve (Cal1...Cal15) and with using the button “Set Active Calib”. The finally desired and possibly altered calibration curve (Cal1. .15) which is activated after switching on the probes power supply will be adjusted with the button "Set Default Calib”.

The TRIME-GW Line can only be adjusted when installed in the plant as the location and the bulk density of the grain have a significant influence on moisture measurement. Adjustment must be carried out separately for every dried product. Moisture measurement is influenced by the following parameters:

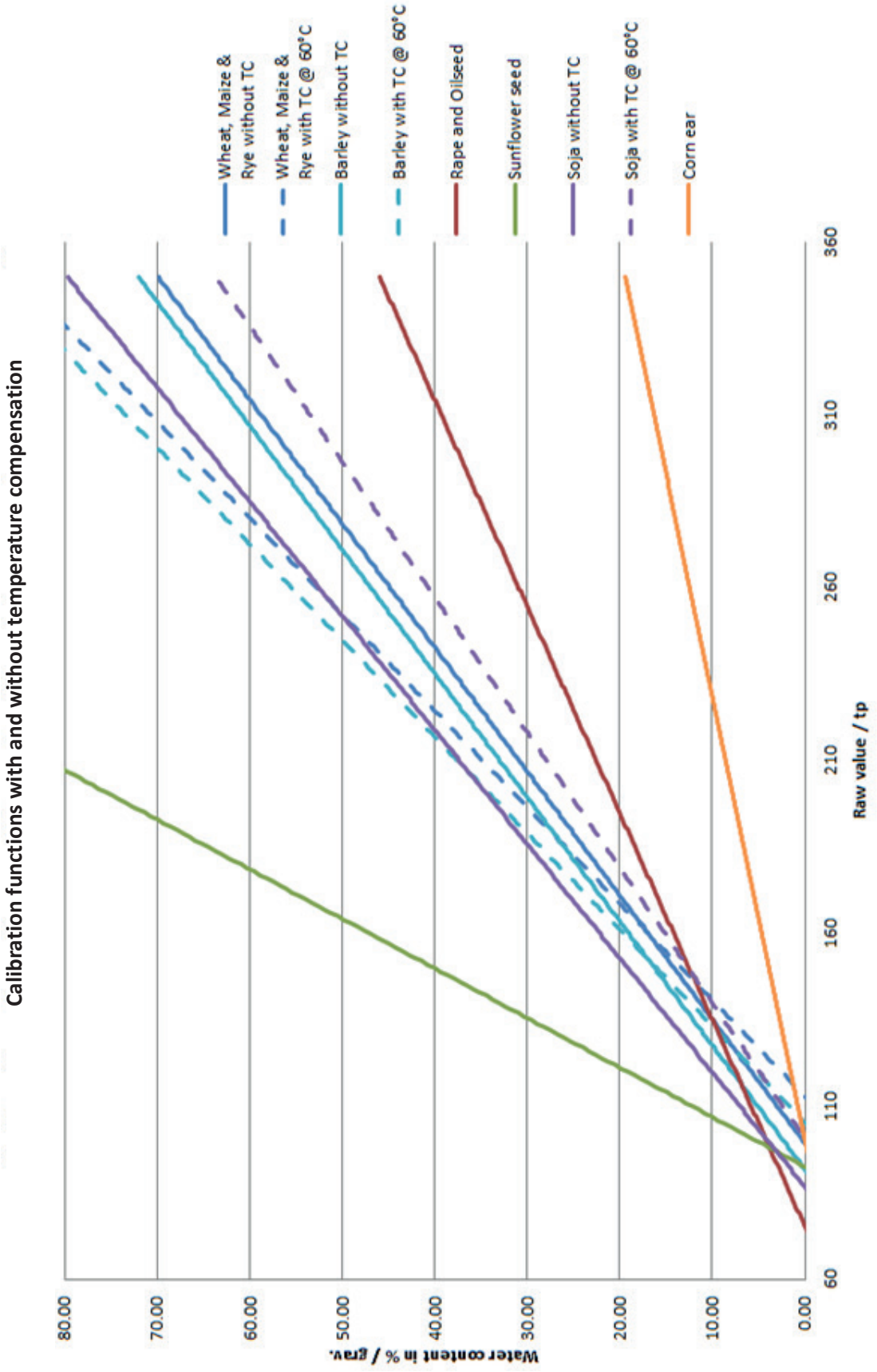
- Location (e.g. metallic objects within the field of measurement)
- Bulk density of the grain (or material)
- Type of grain (material)

As soon as one of these parameters changes, another calibration curve and adjustment must be chosen. If all possible grain types are adjusted, it is only necessary to select the right calibration curve when changing the grain type in the plant.

The following charts (Cal.1 .. Cal15) show different selectable calibration curves which are stored inside the TRIME-GW Line.

Plotted is on the y-axis the gravimetric moisture (MoistAve) and on the x-axis depending on the calibration curve the associated radar time tpAve in picoseconds. With the software SONO-CONFIG the radar time tpAve is shown on the screen parallel to the moisture value MoistAve (see "Quick Guide for the Software SONO-CONFIG).

5.3 Calibration Curves Cal1 to Cal15



Calibration Curve	Recommended for grain type	Bulk density of grain type	Application
Cal1	Maize, without TC (TC = Temperature Compensation)	0,75	Installation at the discharge hopper. The outfeed is batch by batch and it is not secured, that the 1-rod probe is continually covered with grain.
Cal2	Maize with TC	0,75	Installation inside a silo where the 1-rod probe is continually covered with grain.
Cal3	Wheat without TC	0,75	Pre-installed like Cal1
Cal4	Wheat with TC	0,75	Pre-installed like Cal2
Cal5	Rye without TC	0,72	Pre-installed like Cal1
Cal6	Rye with TC	0,72	Pre-installed like Cal2
Cal7	Barley without TC	0,63	Special calibration curve
Cal8	Barley with TC	0,63	Special calibration curve
Cal9	Rape and oilseeds without TC	0.65	No temperature compensation necessary!
Cal10	Sunflower seeds without TC	0,30	No temperature compensation necessary!
Cal11	Soya without TC	0,65	Special calibration curve
Cal12	Soya with TC	0,65	Special calibration curve
Cal13			
Cal14 (pre-setted after delivery)	Corn ear of maize	0,5	Special calibration curve
Cal15	1/10 tp		Radar time and reference calibration for test

5.4 Selection and application of the reference method

In order to adjust the TRIME-GW Line for precise absolute measurements at the discharge, an off-line measurement method must be available to serve as a reference. It must provide a high degree of absolute precision and function with large sample volumes.

The TRIME-GW Line measures the average value continuously over a large measurement volume. In moving grain, the results of multiple measurement volumes can be accumulated in respect to the chosen avereging time. It therefore requires a lot of time and effort to verify this very representative value with a reference instrument mostly using much more smallersample quantities. The most suitable method for determining the exact moisture of the grain is to use a drying oven. The sample volume is of importance and should be at least 0.5 litres.

For sample extraction and making reference measurements please take the following best practice points into account:

- The samples for the reference measurements should be extracted from as close as possible to the probe
  → The moisture distribution is often very inhomogienius inside the grain dryer
- When using a calibrated instrument with small sample volumes, several samples must be extracted and their arithmetical average calculated
  → The smaller the sample volume, the larger the failures due to e.g. weight measurement
- Please note that calibrated instruments also have measurement faults, depending of the device between 2% in the lower and even 5% in the upper moisture range.
  → An alignment between the TRIME GW Line and the reference measurements should be based on multiple measurements if possible at different moistures.

5.5 Recording measurement data in trial operation

The selection of the calibration curve can only be done in real operation or in realistic trial operation. The following description is based on the implementation of the TRIME-GW Line at the discharge, in the delivery or in the storage area.

As a general rule, only the moisture range close to the reference input is of significance for trial operation, i.e. when determining the switch position for maize at e.g. 15%, calibration should be done at about 15%. It is more important that the TRIME-GW Line is exactly correct in range of the setpoint value, in this example in the lower measurement range. It is of less importance whether TRIME-GW Line measures 26% instead of 28% in the upper measurement range.

When extracting a sample or checking the lower reference input (e.g. 15%), a single sample is of course insufficient. Single samples, possibly even extracted from quite a different point than in the direct vicinity of the probe, are not representative. Several samples must be taken directly at the probe and averaged.

At the start of trial operation, the suitable calibration curve can be set.

When all the preparations for extracting samples and reference measurmentshave been made, the grain dryer can be started up. Now, samples of grain must be taken continuously, ideally every 15 minutes.

The TRIME-GW Line reading and the selected calibration curve are to be noted simultaneously with every extracted sample. This is compared with the appropriate offline-determined reference value, which is also to be noted. As soon as the moisture is near the target moisture, the calibration curve should be set to the best possible value, which is the nearest to the reference value.

In the following you will find a ready-to-use form for entering the measurements.

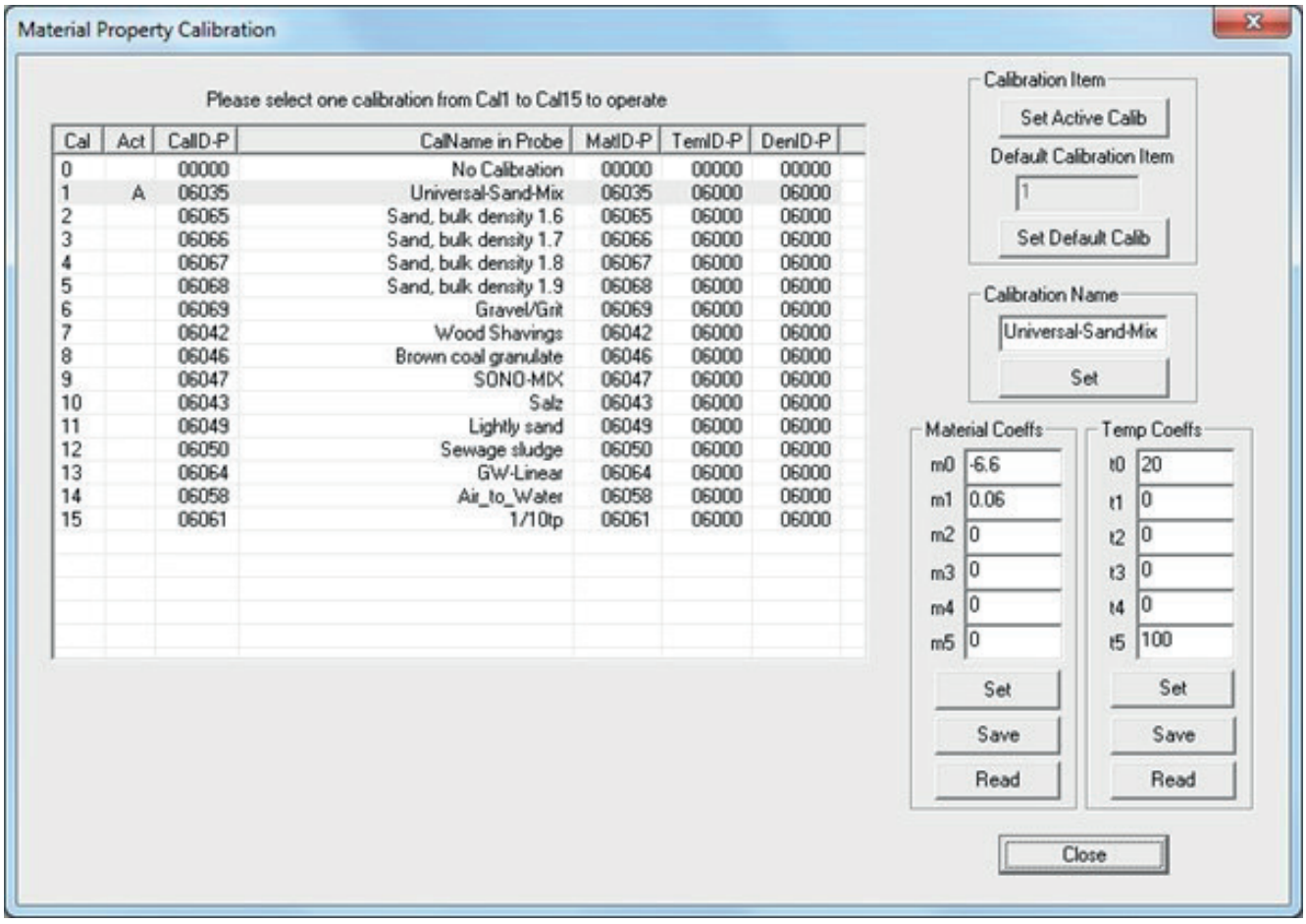
- Where continuous-flow dryers are concerned, at least 10 to 20 measurements should be available in the range between the minimum and maximum permissible moisture content after drying. The measurements from the still very damp discharged grain during the charge phase should be noted but not used for the purposes of adjustment.
- For rotary dryers, only the measurements taken towards the end of the drying process are of relevance to adjustment. Here, too, at least 10 measurements are to have to be documented. Density and moisture distribution effects in the grain can cause too low measurements during the first one to two hours. These values should not be used for the adjustment.

5.6 Setting the calibration curve (adjustment)

The appropriate setting of the calibration curve should be determined on the adjustment protocol. Only the measurements near the target moisture should be taken into account.

5.7 Selection of the individual Calibration Curves

In the menu "Calibration" and the window "Material Property Calibration" the calibration curves CAL1 to Cal15 which are stored in the SONO probe are loaded and displayed on the screen (takes max. 1 minute). With the mouse pointer individual calibration curves can be activated and tested with the SONO-probe by activating the button "Set Active Calib". Furthermore, the individual calibration curves CAL1 to Cal15 can be adapted or modified with the calibration coefficients (see Chapter “Creating a linear calibration curve”).



The desired and possibly altered calibration curve (Cal1. .15) which is activated after switching on the probes power supply can be adjusted with the button **"Set Default Calib”.**

The calibration name can be entered in the window “Calibration Name”.

The coefficients m0 to m1 (for linear curves) and m0 to m5 (for non-linear curves) can be entered and adjusted directly by hand with the buttons **“Set”** and **“Save”**. Possible are non-linear calibration curves with polynomials up to fifth order (m0-m5).

Attention:

Use “dot” as separator not comma, for coefficients m0 to m5!

5.8 Creating a linear Calibration Curve for a specific Material

The calibration curves Cal1 to Cal15 can be easily created or adapted for specific materials with help of SONO-CONFIG. Therefore, two measurement points need to be identified with the probe. Point P1 at dried material and point P2 at moist material where the points P1 and P2 should be far enough apart to get a best possible calibration curve. The moisture content of the material at point P1 and P2 can be determined with laboratory measurement methods (oven drying). It is to consider that sufficient material is measured to get a representative value.

Under the menu "Calibration" and the window "Material Property Calibration" the calibration curves CAL1 to Cal15 which are stored in the SONO probe are loaded and displayed on the screen (takes max. 1 minute). With the mouse pointer individual calibration curves can be tested with the SONO-probe by activating the button "Set Active Calib". The measurement of the moisture value (MoistAve) with the associated radar time tpAve at point P1 and P2 is started using the program SONO-CONFIG in the sub menu "Test" and "Test in Mode CF" (see "Quick Guide for the Software SONO- CONFIG").

Step 1: The radar pulse time tpAve of the probe is measured with dried material. Ideally, this takes place during operation of thedryer in order to take into account possible density fluctuations of the material. It is recommended to detect multiple measurement values for finding a best average value for tpAve. The result is the first calibration point P1 (e.g. 70/0). I.e. 70ps (picoseconds) of the radar pulse time tpAve corresponds to 0% moisture content of the material. But it would be also possible to use a higher point P1´ (e.g. 190/7) where a tpAve of 190ps corresponds to a moisture content of 7%. The gravimetric moisture content of the material, e.g. 7% has to be determined with laboratory measurement methods (oven drying).

Step 2: The radar pulse time tpAve of the probe is measured with moist material. Ideally, this also takes place during operation of the/dryer. Again, it is recommended to detect multiple measurement values of tpAve for finding a best average value. The result is the second calibration point P2 with X2/Y2 (e.g. 500/25). I.e. tpAve of 500ps corresponds to 25% moisture content. The gravimetric moisture content of the material, e.g. 25% has to be determined with laboratory measurement methods (oven drying).

Step 3: With the two calibration points P1 and P2, the calibration coefficients m0 and m1 can be determined for the specific material (see next page).

Step 4: The coefficients m1 = 0.0581 and m0 =-4.05 (see next page) for the calibration curve Cal14 can be entered directly and are stored in the probe by pressing the button “Set”. The name of the calibration curve can also be edited. The selected calibration curve (e.g. Cal14) which is activated after switching on the probes power supply will be adjusted with the button "Set Default Calib”.

Attention:

Use “dot” as separator (0.0581) in SONO-CONFIG, not comma!

5.9 Calculation for a linear 2-point calibration curve

1. Download the Excel-Sheet „SONO 2-Point LinearCalibration_Calculation“ from IMKO´s Homepage /DOWNLOADS/ SOFTWARE.
2. Enter into the Excel-Sheet both TP-values with the respective reference moisture values.
3. Read out both parameters m0 and m1 from the Excel-Sheet.
4. Enter, set and save both parameters m0 and m1 with help of the software „SONO-CONFIG“ in the menu „Calibration“ in the window „Material Property Calibration“ in the selected calibration curve.

5.10 Calculation for a linear 1-point calibration curve

In practice during commissioning of a SONO probe in process, it could be happen that the measured material above the probe is only available with a single moisture value. So a 2-point calibration could not be carried out.

The procedure described below is not as precisely like a 2-point calibration, but it could be a compromise to achieve an acceptable result for a usable calibration curve.

Basic steps:

1. Measure the radar travel time Tp in the running process while the material lies or flows through the TRIME GW Line measuring field. Tp can be measured with help of the module SM-USB or with the display module SONO-VIEW.
2. Determine the reference moisture M in % of the measured material. Unless the material moisture is already known, the reference moisture can be determined with an infrared- or microwave oven in the laboratory.
3. Determine the bulk density D of the material in kg per dm3. Unless the bulk density is already known this can be done by weighing of exactly 1 liter volume of the material.
4. Download the Excel-Sheet „SONO 1-Point LinearCalibration_Calculation“ from IMKO´s Homepage /DOWNLOADS/SOFTWARE. Enter the three determined parameters Tp (Radar travel time), M (Moisture) und D (bulk density) into the Excel-Sheet. As result you get the two calibration curve coefficients m0 and m1.
5. Enter, set and save both parameters m0 and m1 with help of the software „SONO-CONFIG“ in the menu „Calibration“ in the window „Material Property Calibration“ in the selected calibration curve. The three parameters Tp, M and D can be also entered without a PC with the module SONO-VIEW (see manual SONO-VIEW).

5.11 Calculation for a non-linear calibration curve

SONO probes can work also with non-linear calibration curves with polynomials up to 5th grade.

For a non-linear calibration it is necessary to calibrate with 4...8 different calibration points with different Tp values and the related moisture values in %. To calculate nonlinear coefficients for polynomials up to 5th grade, an EXCEL software tool from IMKO can be used.

1. Download the Excel-Sheet „SONO_NonlinearCalibration_Calculation“ from IMKO´s Homepage /DOWNLOADS/SOFTWARE.
2. Enter the TP-values with the respective reference moisture values into the Excel-Sheet.
3. Read out the parameters m0 to m5 from the Excel-Sheet.
4. Enter, set and save the parameters m0 to m5 in the selected calibration curve with help of the software „SONO-CONFIG“ in the menu „Calibration“ under the window „Material Property Calibration“.

5.12 Configuration of the Measuring Mode

TRIME-GW Line is pre-adjusted in the factory before delivery to mode CF. A process-related later new adjustment of this device-internal setting is possible with the help of the service program SONO-CONFIG or directly online with SONO-VIEW. For all activities regarding parameter setting and calibration the probe can be directly connected via the RS485 interface to the PC via a RS485 USB-Module which is available from IMKO.

The following settings of TRIME-GW Line can be amended with the service program SONO-CONFI.

Measurement-Mode and Parameters:

- Measurement Mode A-On-Request (only in network operation for the retrieval of measurement values via the RS485 interface).
- Measurement Mode C Cyclic:
- TRIME-GW Line is supplied with suited parameters in Mode CF with 3 second average time for bulk goods.

Mode CS: (Cyclic-Successive) For very short measuring processes (e.g. 5…20 seconds) without floating average, with internal up to 100 measurements per second and a cycle time of around 200 milliseconds at the analogue output. Measurement mode CS can also be used for getting raw data from the TRIME-GW Line without averaging and filtering.

Mode CA: (Cyclic-Average-Filter) For relative short measuring processes with continual average value, filtering and an accuracy of up to 0.1%

Mode CF: (Cyclic-Float-Average) for continual average value with filtering and an accuracy of up to 0.1% for very slow measuring processes, e.g. in fluidized bed dryers, conveyor belts, etc.

Mode CK: (Cyclic-Kalman-Filter) Standard setting for SONO-MIX probes for use in fresh concrete mixer with continual average value with special dynamic Kalman filtering and an accuracy of up to 0.1%.

Mode CC: (Cyclic Cumulated) with automatic summation of a moisture quantity during one batch process.

- Precision of a single TDR radar pulse measurement (see in chapter „Software tool SONO-CONFIG“ under point „Setting the precision of a single value measurement”.
- Calibration (if completely different materials are deployed)

Each of these settings will be preserved after shut down of the probe. All parameters are stored on a permanent basis.

Parameters in the Measurement Mode CA, CF, CC, CH and CK	Function
Average-Time Standard Setting: 2s Setting Range: 1…20 **Unit: Seconds**	**CA/CF:** Time (in seconds) for the generation of the average value can be set with this parameter. **CC/CH/CK:** Setting of the time for calculation of the trend or expectation value for the Boost & Offset function.
Filter-Upper-Limit-Offset Standard Setting: 25% Setting Range: 1…20 **Unit: % Absolut**	**CA/CC/CF/CH/CK:** Too high measurement values generated due to metal wipers or blades are filtered out. The offset value in % is added to the dynamically calculated upper limit.
Filter-Lower-Limit-Offset Standard Setting: 25% Setting Range: 1…20! **Unit: % Absolut**	**CA/CC/CF/CH/CK:** Too low measurement values generated due to insufficient material at the probe head are filtered out. The offset value in % is subtracted from the dynamically calculated lower limit with the negative sign.
Upper-Limit-Keep-Time Standard Setting: 10 Setting Range: 1...100 **Unit: % Absolut**	**CA/CC/CF/CH/CK:** The maximum duration (in seconds) of the filter function for Upper-Limit-failures (too high measurement values) can be set with this parameter
Lower-Limit-Keep-Time Standard Setting: 10 Setting Range: 1...100s **Unit: Seconds**	**CA/CC/CF/CH/CK:** The maximum duration (in seconds) of the filter function for Lower-Limit-failures (too low measurement values) for longer-lasting "material gaps", ie the time where no material is located on the probe´s surface can be bridged.
Moisture Threshold (start threshold in %-moisture) Standard Setting: 0.1% Setting Range: 0....100% **Unit: % Absolut**	**CA/CF/CK:** inactive **CC/CH:** The accumulation of moisture values starts above the „Moisture Threshold“ and from here the analogue signal is outputted. The accumulation pauses and will be frozen if the moisture level is below the threshold value. The **No-Material-Delay** time starts and material gaps (disturbance) can be eliminated.

Parameters in the Measurement Mode CA, CF, CC, CH and CK	Function
No-Material-Delay (period time) Standard Setting: 10s Setting Range: 1…100s **Unit: Seconds**	**CA/CF/CK:** inactive **CC/CH:** The accumulation stopps if the moisture value is below the Moisture Threshold. The accumulation pauses for the period of the setted delay time and will be frozen if the moisture level is below the threshold value. The SONO probes starts again in a new batch with a new accumulation after the setted time span of the **No-Material-Delay** is completely exceeded.
Boost Standard Setting: 35nn Setting Range: 1…100nn **Unit: without unit!**	**CA/CF:** inactive **CC/CH/CK:** Defines, how strong single measurement values are weighted dependent on deviation to the current expected average value. With e.g. Boost = 35, a single measurement value is weighted with only 65% (100-35) for a new average value.
Offset Standard Setting: 0.5% Setting Range: 0 …5% **Unit: % Absolut**	**CA/CF:** inactive **CC/CH/CK:** Non-linearities in the process can be compensated by higher weighting of higher values. Can be used e.g. in fluid bed dryers or under silo flaps where non-linearities can occur due to changes in the material density during process. “Offset” works together with the parameter “Average-time”.
Weight Standard Setting: 5 values Setting Range: 0 …50 **Unit: Measurement Values**	**CA/CF/CK:** inactive **CH:** Smoothing factor for analog output setting. This parameter influences the reaction/response time with factor 3. E.g. 15 values responds to a reaction time of 15/3 = 5 seconds. **CK:** The reaction/response time works nearly 1:1. E.g. 15 values responds to a reaction time of 15 seconds.
Invalid Measure Count Standard Setting: 2 values Setting Range: 0…10 **Unit: Measurement Values** with 3 single values per second.	**CA/CF/CK:** inactive **CC/CH:** Number of discarded (poor) measurement values after the start of a new batch, when „No-Material-Delay“ has triggered. The first measurement values will be rejected, e.g. due to dripping water.
Moisture Std. Deviation Count Standard Setting: 5 values Setting Range: 0…20 **Unit: Measurement Values** with 3 single values per second.	**CA/CC/CF/CH/CK:** If the parameters Temperature or EC-TRIME (RbC) are not needed, the analogue output 2 can be setted tot he mode Moist/Moist Std. Deviation. In this mode the standard deviation of all single moisture values can be outputted. With this function the homogeneity of the single measurement values can be determined and it is possible to control a regulating process, e.g. pressure regulation.
Quick und Quick-Precision With Meas Time (no. values) **Unit: without unit!** See in chapter „Software tool SONO-CONFIG“ under point „Setting the precision of a single value measurement”.	**CA/CC/CF/CH/CK/CS:** Recommended is Quick Precision with Meas Time = 2 where the TDR pulse is detected precisely. For still a little better accuracies, Meas Time can be increased, however the single measurement cycle is increased by 60 milliseconds per step (e.g. from 280ms to 340ms). Older SONO probe versions do not have this Quick Precision function!

5.13 Operation Mode CA and CF at non-continuous Material Flow

For mode CA and CF the TRIME-GW Line are supplied with suited parameters for the averaging time.

The setting options and special functions of TRIME-GW Line depicted in this chapter are only rarely required. It is necessary to take into consideration that the modification of the settings or the realisation of these special functions may lead to faulty operation of the probe!

For applications with non-continuous material flow, there is the option to optimise the control of the measurement process via the adjustable filter values Filter-Lower-Limit, Filter-Upper-Limit and the time constant No-Material-Keep-Time. The continual/floating averaging can be set with the parameter Average-Time.

Average Time in the measurement mode CA and CF

TRIME-GW Line establishes every 200 milliseconds a new single measurement value which is incorporated into the continual averaging and issues the respective average value in this timing cycle at the analogue output. The averaging time therefore accords to the “memory” of the TRIME-GW Line. The longer this time is selected, the more inert is the reaction rate, if differently moist material passes the probe. A longer averaging time results in a more stable measurement value. This should in particular be taken into consideration, if the TRIME-GW Line is deployed in different applications in order to compensate measurement value variations due to differently moist materials.

At the point of time of delivery, the Average Time is set to 4 seconds. This value has proven itself to be useful for many types of applications. At applications which require a faster reaction rate, a smaller value can be set. Should the display be too “unstable”, it is recommended to select a higher value.

5.14 Filtering at material gaps in mode CA and CF

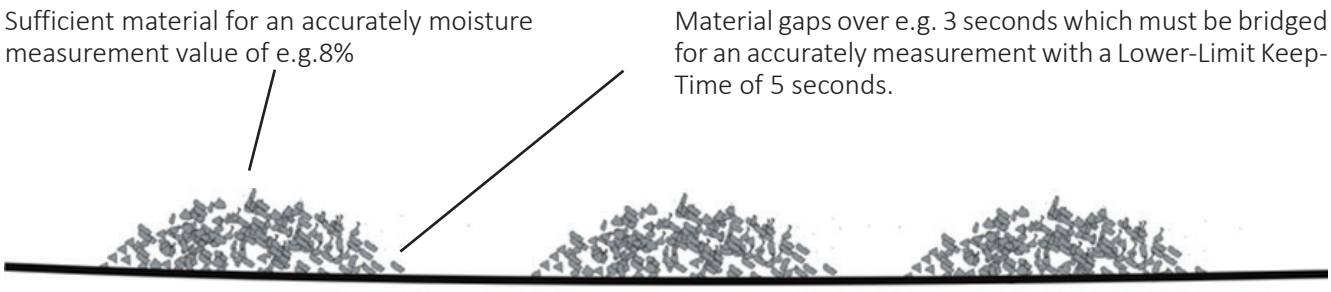
A TRIME-GW Line is able to identify, if temporarily no or less material is at the probe head and can filter out such inaccurate measurement values (Filter-Lower-Limit). Particular attention should be directed at those time periods in which the measurement area of the probe is only partially filled with material for a longer time, i.e. the material temporarily no longer completely fills the probe measuring field. During these periods (Lower-Limit-Keep-Time), the probe would establish a value that is too low. The Lower-Limit-Keep-Time sets the maximum possible time where the probe could determine inaccurate (too low) measurement values.

Furthermore, the passing of metal blades or wipers through the measuring field can lead to too high measurement values (Filter-Upper-Limit). The Upper-Limit-Keep-Time sets the maximum possible time where the probe would determine inaccurate (too high) measurement values.

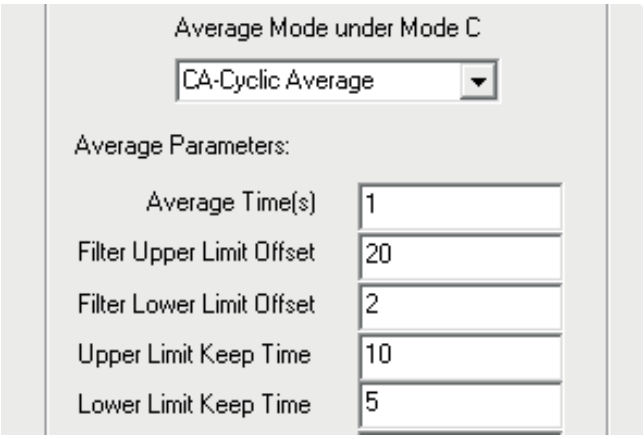
Using a complex algorithm, TRIME-GW Line are able to filter such faulty individual measurement values. The standard settings in the Measurement Mode CA and CF for the filter functions depicted in the following have proven themselves to be useful for many applications and should only be altered for special applications.

It is appropriate to bridge material gaps in mode CA with Upper- and Lower-Limit Offsets and Keep-Time. For example the Lower-Limit Offset could be adjusted with 2% with a Lower-Limit Keep-Time of 5 seconds.

If the TRIME-GW Line determines a moisture value which is 2% below the average moisture value with e.g. 8%, than the average moisture value will be frozen at this value during the Lower-Limit Keep-Time of 5 seconds. In this way the material gap can be bridged. This powerful function inside the TRIME-GW Line works here as a highpass filter where the higher moisture values are used for building an average value, and the lower or zero values are filtered out. In the following this function is described with SONO parameters.



The following parameter setting in mode CA fits a high pass filtering for bridging material gaps.



The Filter Upper-Limit is here deactivated with a value of 20, the Filter Lower-Limit is set to 2%. With a Lower-Limit Keep-Time of 5 seconds the average value will be frozen for 5 seconds if a single measurement value is below the limit of 2% of the average value. After 5 seconds the average value is deleted and a new average value building starts. The Keep-Time function stops if a single measurement value lies within the Limit values.

5.15 Mode CC – automatic summation of a moisture quantity during one batch process

Simple PLCs are often unable to record moisture measurement values during one batch process with averaging and data storage. Furthermore, there are applications without a PLC, where accumulated moisture values of one batch process should be displayed to the operating staff for a longer time.

TRIME-GW Line works in mode CC with automatic summation. This increases the reliability for the moisture measurement during one complete batch process. Due to precise moisture measurement also in the lower moisture range, ‚TRIME-GW Line can record, accumulate and store moisture values during a complete batch process without an external switching or trigger signal.

The TRIME-GW Line “freezes” the analogue signal as long as a new batch process starts. So the PLC has time enough to read in the “freezed” moisture value of the batch. For applications without a PLC the “freezed” signal of the TRIME-GW Line can be used for displaying the moisture value to a simple 7-segment unit as long as a new batch process starts.

With the parameter Moisture Threshold the TRIME-GW Line can be configured to the start moisture level where the summation starts automatically. Due to an automatic recalibration of TRIME-GW Line, it is ensured that the zero point will be precisely controlled. The start level could be variably set dependent to the plant. Recommended is a level with e.g. 0.5% to 1%.

With the parameter No-Material-Delay a time range can be set, where the TRIME-GW Line is again ready to start a new batch process. Are there short material gaps during a batch process which are shorter than the “No-Material-Delay”, with no material at the probes surface, then the TRIME-GW Line pauses shortly with the summation. Is the pause greater as the “No-Material-Delay” then the probe is ready to start a new batch process.

How can the mode CC be used, if the TRIME-GW Line cannot detect the „moisture threshold“ by itself, e.g. if there is constantly material above the probe over a longer time: In this case, a short interrupt of the probe´s power supply, e.g for about 0.5 seconds with the help of a relay contact of the PLC, can restart the TRIME-GW Line at the beginning of the material transport. After this short interrupt the TRIME-GW Line starts immediately with the summarizing and averaging.

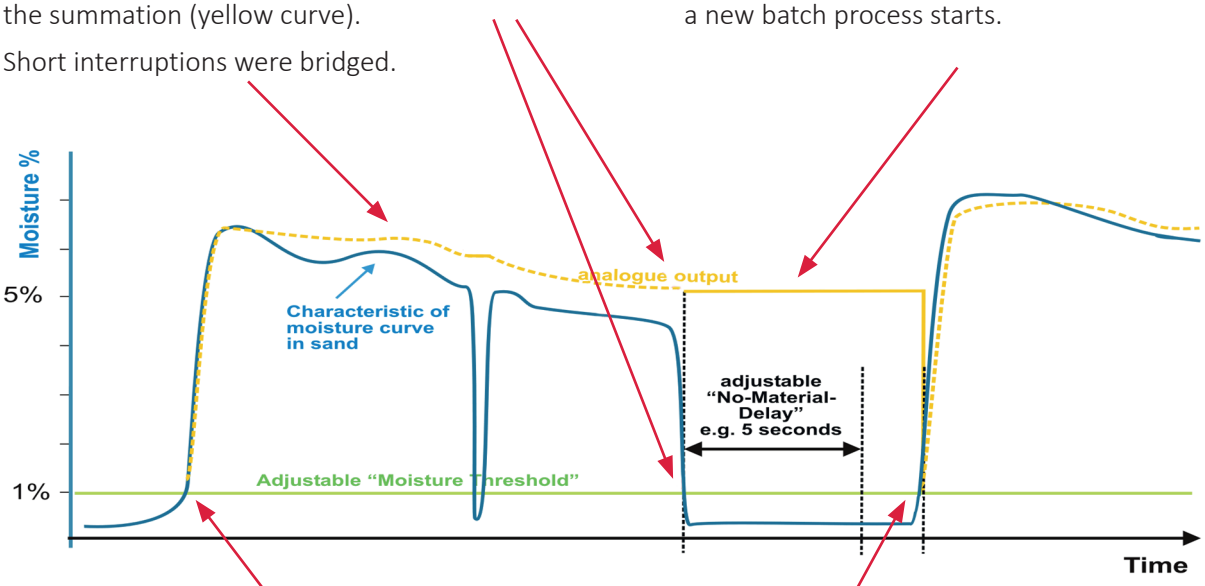
Following possible parameter settings in mode CC inside the TRIME-GW Line can be set:

Parameter in mode CC	Function
Moisture Threshold (in %-moisture) Standard Setting: 1 Setting Range: 1...20	The accumulation of moisture values starts above the „Moisture Threshold“ and the analogue signal is output. The accumulation pauses if the moisture level is below the threshold value.
No-Material-Delay (in seconds) Standard Setting: 5 Setting Range: 1...20	The accumulation stopps if the moisture value is below the moisture threshold. The TRIME-GW Line starts again in a new batch with a new accumulation after the time span of the “No-Material-Delay” is exceeded.

The first batch process stops. The SONO-probe recognizes that the measurement value is below the moisture threshold of 1% and the probe stops automatically with the summation (yellow curve).

Short interruptions were bridged.

The last freezed summerized and averaged moisture value is freezed at the analogue output, until the "No-Material-Delay" time of e.g. 5 seconds has expired and a new batch process starts.



Start of first batch process. The SONO-probe recognizes that the adjustable moisture threshold of e.g. 1% has been exceeded and the probe starts automatically with the continuous accumulation of measurement values (yellow curve).

Start of second batch process. After the period of "No-Material-Delay" (e.g. 5 seconds) the SONO-probe recognizes, that the threshold of 1% has been exceeded. The previously stored measurement value is cleared and the probe starts again automatically with the continuous accumulation of measurement values (yellow curve).

6 Serial Connection to the SM-USB Module

The SM-USB provides the ability to connect a SONO probe either to the standard RS485 interface or to the IMP-Bus from IMKO. In fact that the IMP-Bus is more robust and enables the download of a new firmware to the SONO probe, the SONO probes are preset to the IMP-Bus. It is recommended to use the IMP-Bus for a serial communication. Both connector ports are shown in the drawing below.

The SM-USB is signalling the status of power supply and the transmission signals with 4 LED´s. When using a dual-USB connector on the PC, it is possible to use the power supply for the SONO probe directly from the USB port of the PC without the use of the external AC adapter.

Connection to the Probe:

RS485 Connector

Pin B: 0V Power Supply

Pin A: +12VDC Power Supply

Pin G: RS485A Lead Colour "white"

Pin F: RS485A Lead Colour "white"

+12VDC

IMP-Bus Connector

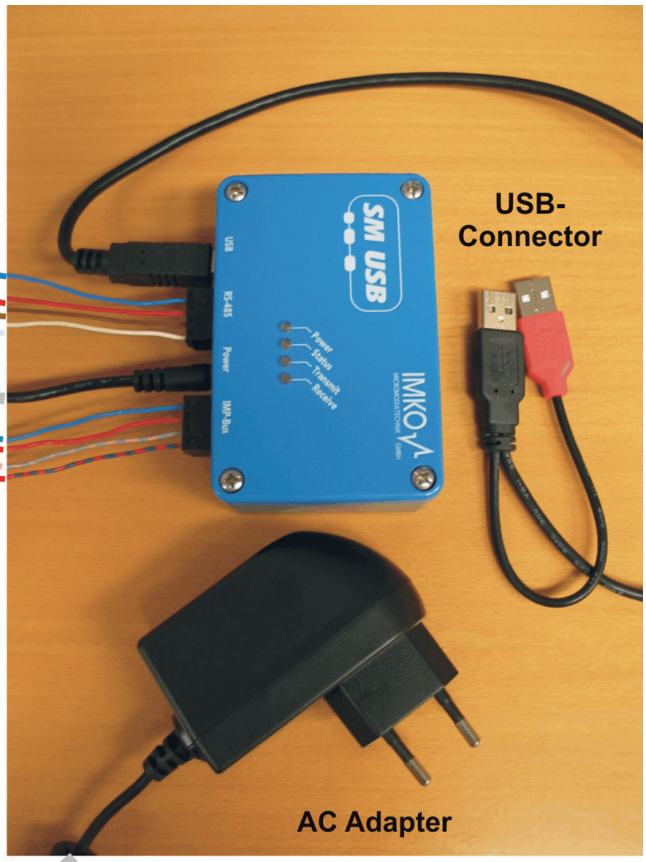
With the option accomplish a download of the firmware for the SONO probe

Pin B: 0V Power Supply

Pin A: +12VDC Power Supply

Pin C: (rt) Lead Colour "grey/pink"

Pin J: (com) Lead Colour "blue/red"



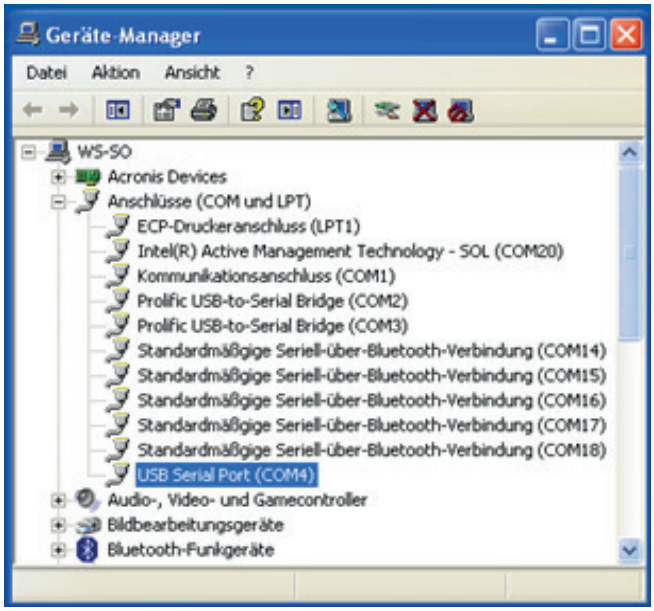
How to start with the SM-USB module from IMKO

- Install USB-Driver from USB-Stick.
- Connect the SM-USB to the USB-Port of the PC and the installation will be accomplished automatically.
- Install Software SONOConfig-SetUp.msi from USB-Stick.
- Connection of the SONO probe to the SM-USB, with 4 wires for power supply and serial interface.
- Check the setting of the COM-Ports in the Device-Manager und setup the specific COM-Port with the Baudrate of 9600 Baud in SONO-CONFIG with the button "Bus" and "Configuration" (COM1-COM15 is possible).
- Start “Scan probes” in SONO-CONFIG.
- The SONO probe logs in the window „Probe List“ after max. 30 seconds with its serial number.

NOTE:

In the Device-Manager passes it as follows:

Control Panel → System → Hardware → Device-Manager

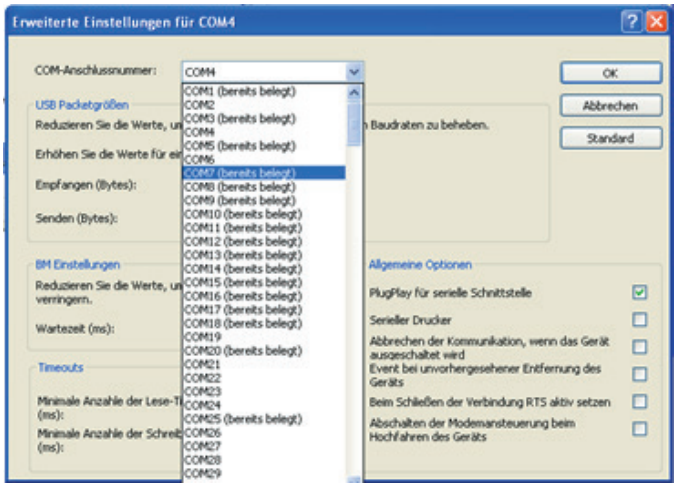


Under the entry “Ports (COM & LPT) now the item “USB Serial Port (COMx)” is found.

COMx set must be between COM1….COM9 and it should be ensured that there is no double occupancy of the interfaces.

In case of a conflict when the serial port or the USB-SM has been found in a higher COM-port, the COM port number can be adjusted manually:

By double clicking on "USB Serial Port" you can go into the properties menu, where you see "connection settings" – with "Advanced" button, the COM port number can be switched to a free number.

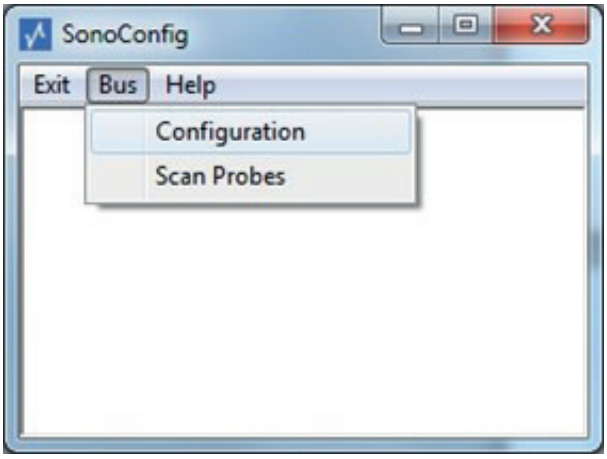


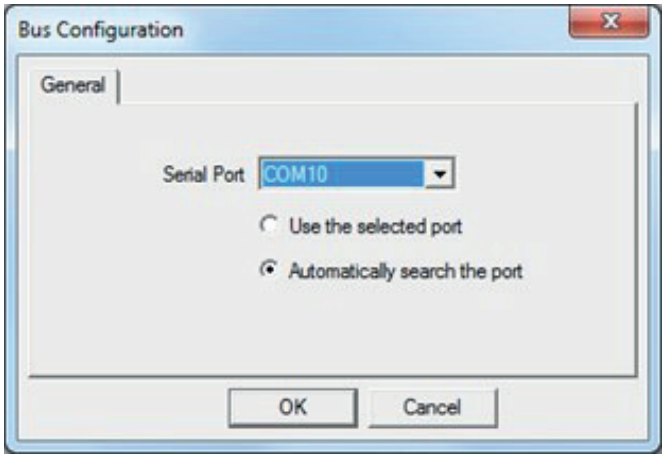
After changing the COMx port settings, SONO-CONFIG must be restarted.

7 QuickGuidefortheCommissioningSoftwareSONO-CONFIG

With SONO-CONFIG it is possible to make process-related adjustments of individual parameters of the SONO probe. Furthermore, the measurement values of the SONO probe can be read from the probe via the serial interface and displayed on the screen.

In the menu "Bus" and the window "Configuration" the PC can be configured to an available COMx-port with the Baudrate of 9600 Baud.

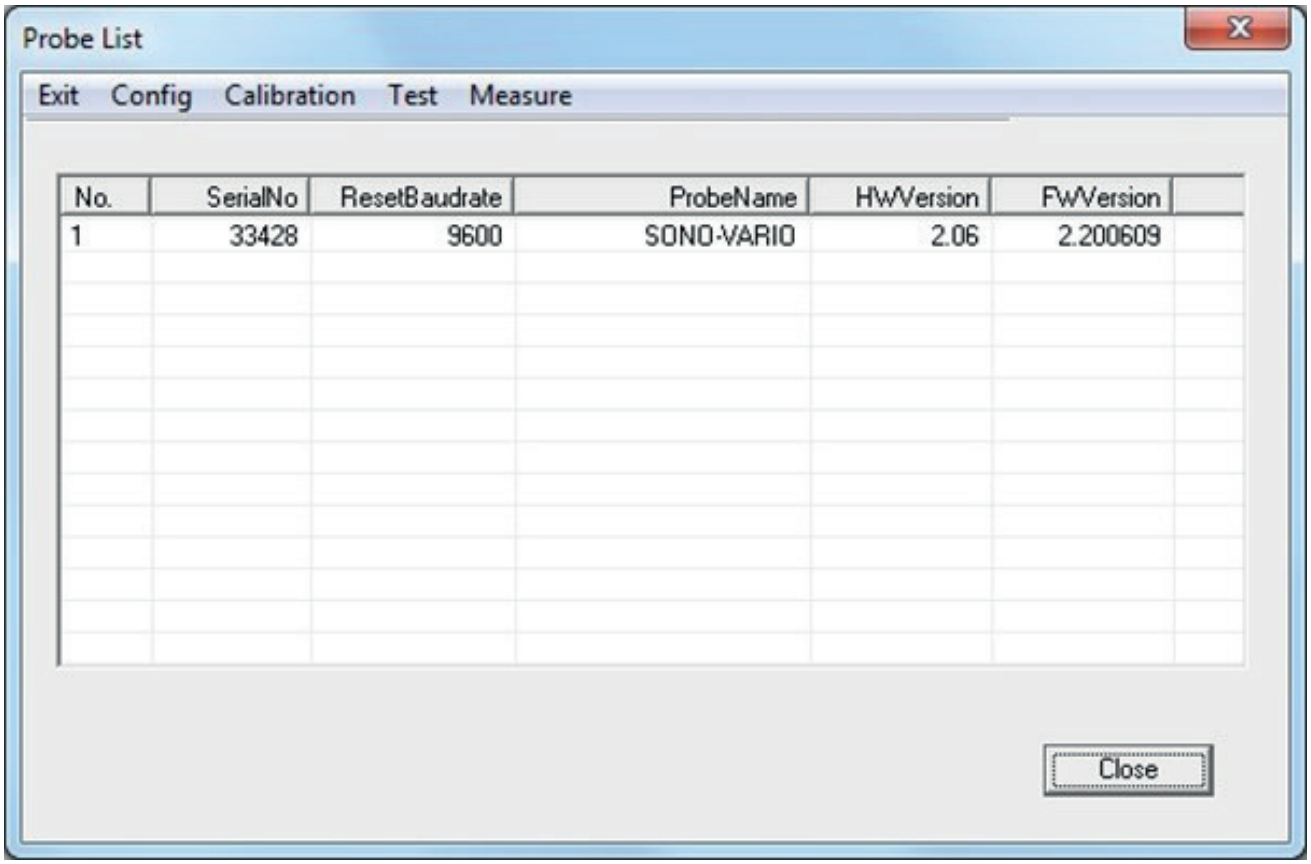




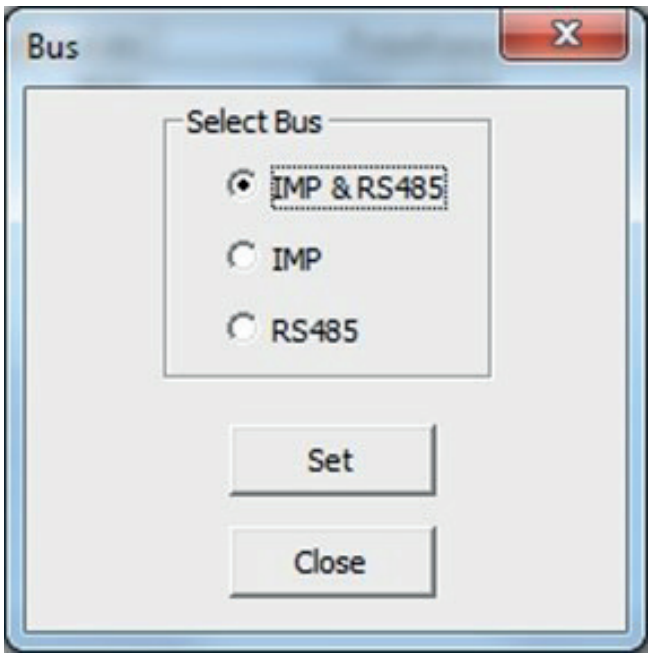
7.1 Scan of connected SONO probes on the serial interface

In the menu "Bus" and the window "Scan Probes" the serial bus can be scanned for attached SONO probes (this takes max. 30 seconds).

SONO-CONFIG reports one or more connected and founded SONO probes with its serial number in the window “Probe List“. One SONO probe can be selected.



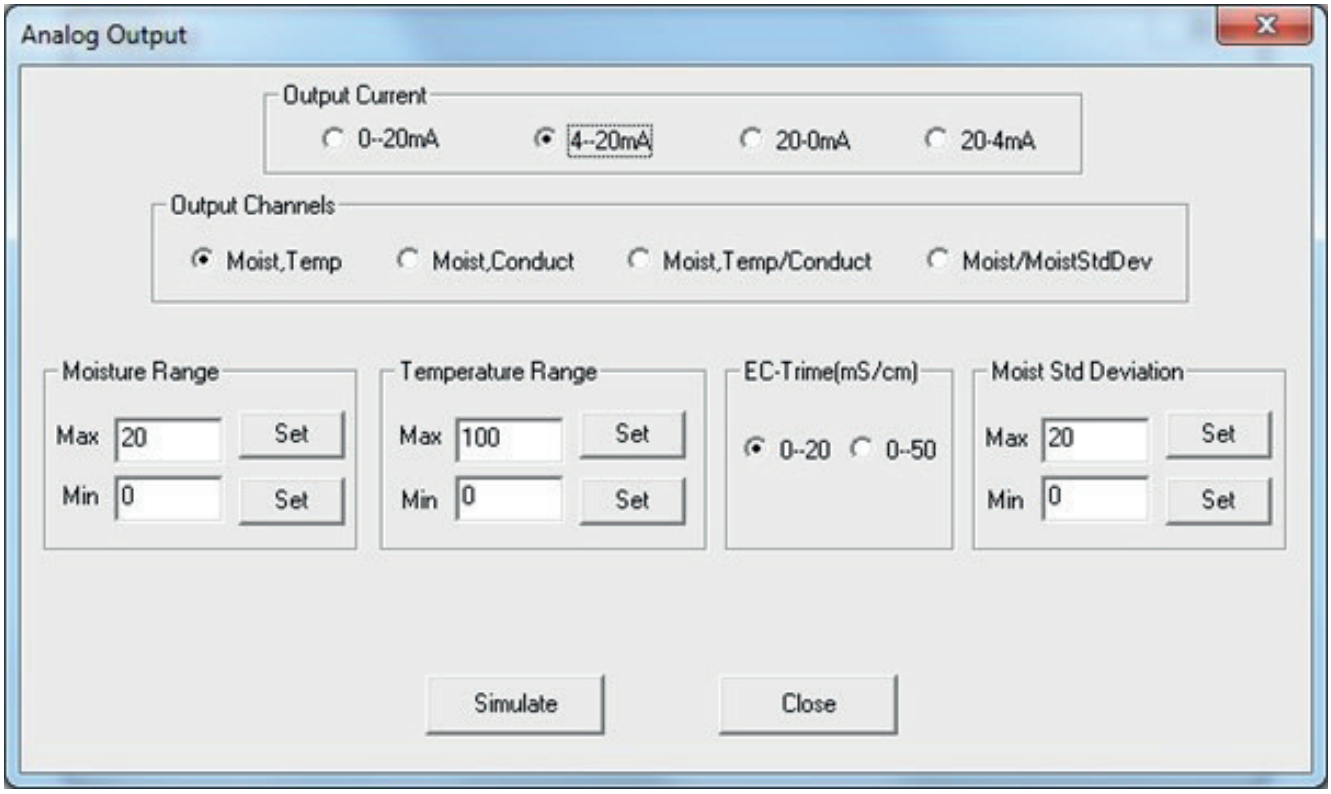
7.2 Configuration of serial SONO-interface



The serial interface inside the SONO probe can be selected to IMP-Bus or RS485. Due to very robust behavior it is recommended to select the IMP-Bus.

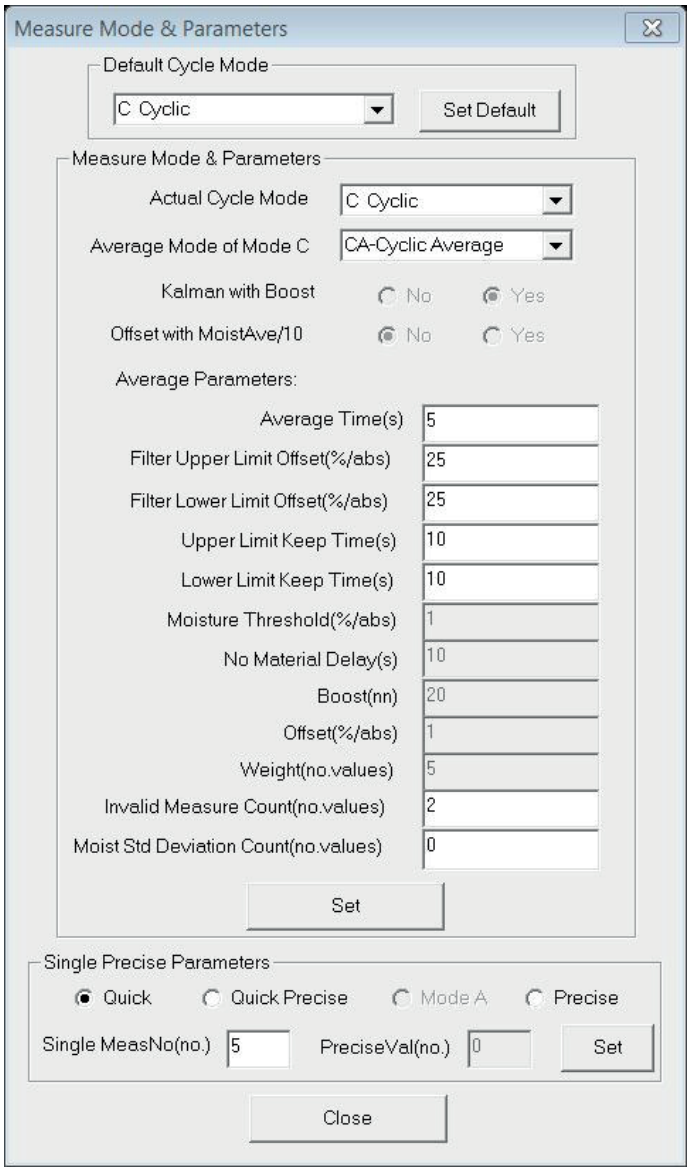
7.3 Set analogue outputs of the SONO probe

In the menu "Config" and the window "Analog Output" the two analogue outputs of the SONO probe can be configured (see Chapter “Analogue outputs”).



7.4 Configuration of Measure Mode

In **"Probe List"** with **"Config"** and **"Measure Mode & Parameters"** the SONO probe can be adjusted to the desired measure mode CA, CF, CS, CK, CC or CH (see Chapter "Configuration Measure Mode).



By selecting the operating mode, the SONO probe can be set up to different measurement modes, e.g. for averaging values from several single measurement values, for performing a filtering or performing other functions (see chapter **"Measurement mode configuration"** in this manual).

Furthermore, a SONO probe can be set to a special required precision of the single value measurement with **"Single Precise Parameters"**. It is about settings, how the TDR radar pulse is executed and evaluated during one measurement cycle.

The next chapter describes how this can be done.

7.5 Setting the precision of a single value measurement cycle

The SONO probe can be adjusted to the precision of a single value measurement via **"Single Precise Parameters"**. First of all, the more accurate the SONO probe has to measure, the longer the time required for a single value measurement with a TDR radar pulse evaluation. There are applications where the SONO probe under a silo valve has only 2 to 4 seconds to perform several measurements with average value building.

Here, a precise single value measurement would take too long, which is why the setting "Quick" with a short measuring time of 280 ms is recommended. Especially since the fluctuating flow of material under a silo valve cannot lead to constant conditions anyway in order to be able to carry out a highly precise individual measurement.

However, there are applications where it is necessary to achieve measuring accuracies up to +-0.05% moisture content which is only possible with very constant material conditions. E.g. in liquids with fractions of water in oil or in emulsions.

The following table provides an overview of the possible settings in the SONO probe for a single TDR radar pulse evaluation.

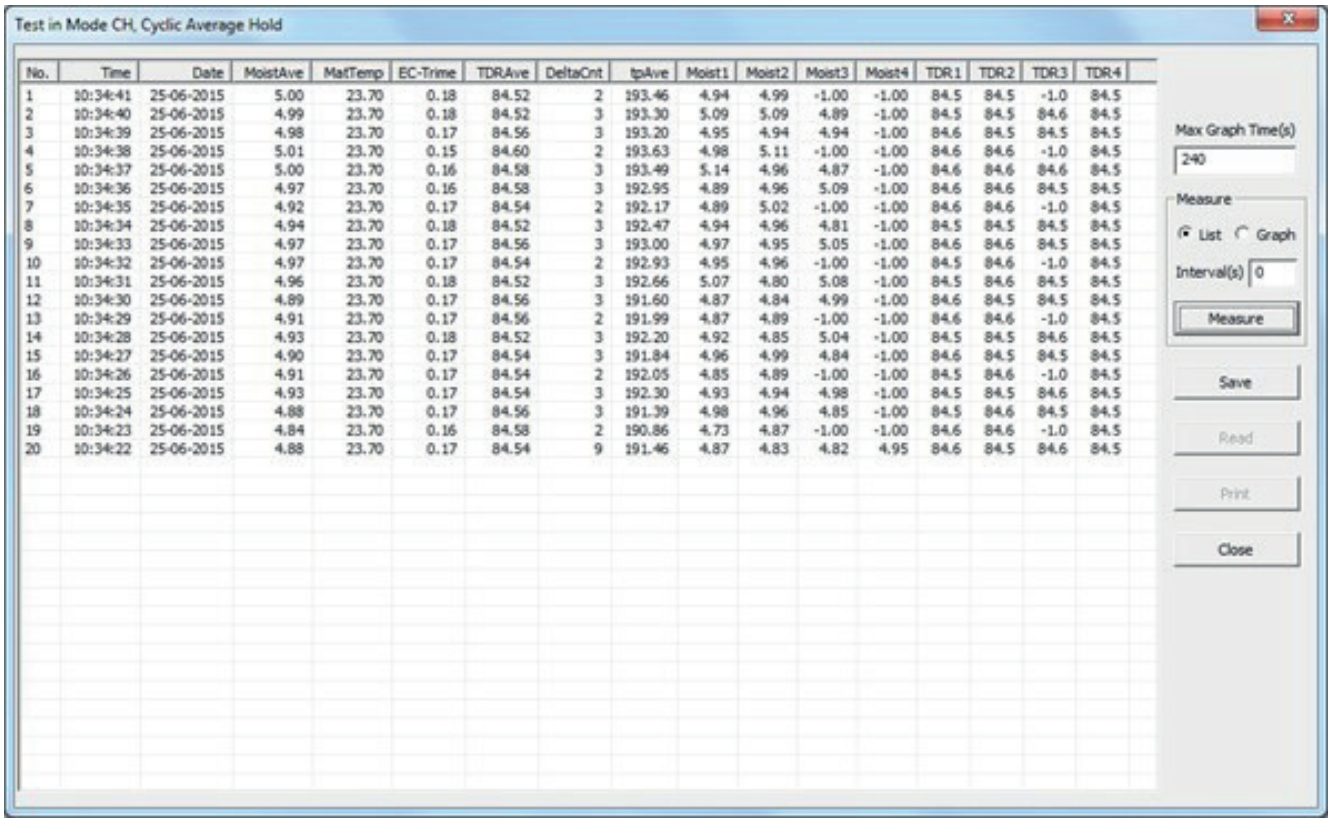
Parameter Setting	Measure-Mode	Function of the parameter	Application
Quick:	Mode C e.g. CS, CH, CF, etc.	Quick TDR pulse search and very quick measurement within 280 ms.	e.g. under a silo flap with only 2-4 seconds measurement time.
Quick Precise:	Mode C e.g. CS, CH, CF, etc.	Quick and precise TDR pulse search and precise measurement within 350ms.	Similar to „Quick“ but with a little longer reaction time in process measurements.
Mode A:	Mode A	Mode A only with measurements via serial interface of the sensor. E.g. for calibrations.	Mode A for mobile moisture probes with hand measurement device HD2 or SONO-DIS.
Precise: **PreciseVal:** Input value: 1…4	Mode C and Mode A	Most precise single value measurement with precise TDR radar pulse triggering and pulse analysis. The higher the value 1 to 4 the higher the precision but the longer the measurement time.	Only in process environment where a continuously material flow is guaranteed and a very high precision is necessary.
Single MeasNo Default value: 4 Input value max. 10	Mode C and Mode A	Additional averaging of the single value measurement. Please consider: when 10 is entered, one single measurement can take up to one second.	Only in process environment where a continuously material flow is guaranteed and a very high precision is necessary.

7.6 Test run in the respective Measurement Mode

In the menu "Test" and the window "Test in Mode CA to CF" the measured moisture values “MoistAve” (Average) of the SONO probe are displayed on the screen and can be parallel saved in a file. In the menu "Test" and the window "Test in Mode CS" the measured single measurement values “Moist” (5 values per second) of the SONO probe are displayed on the screen and parallel stored in a file. In „Test in Mode A“ single measurement values (without average) are displayed on the screen and can also be stored in a file.

Attention:

For a test run in mode CA, CH, CC, CF, CS or A it must be ensured that the SONO probe was also set to this mode (Measure Mode CA, CF, CS, A). If this is not assured, the probe returns zero values.



No.	Time	Date	MoistAve	MatTemp	EC-Trime	TDRAve	DeltaCnt	tpAve	Moist1	Moist2	Moist3	Moist4	TDR1	TDR2	TDR3	TDR4
1	10:34:41	25-06-2015	5.00	23.70	0.18	84.52	2	193.46	4.94	4.99	-1.00	-1.00	84.5	84.5	-1.0	84.5
2	10:34:40	25-06-2015	4.99	23.70	0.18	84.52	3	193.30	5.09	5.09	4.89	-1.00	84.5	84.5	84.6	84.5
3	10:34:39	25-06-2015	4.98	23.70	0.17	84.56	3	193.20	4.95	4.94	4.94	-1.00	84.6	84.5	84.5	84.5
4	10:34:38	25-06-2015	5.01	23.70	0.15	84.60	2	193.63	4.98	5.11	-1.00	-1.00	84.6	84.6	-1.0	84.5
5	10:34:37	25-06-2015	5.00	23.70	0.16	84.58	3	193.49	5.14	4.96	4.87	-1.00	84.6	84.6	84.6	84.5
6	10:34:36	25-06-2015	4.97	23.70	0.16	84.58	3	192.95	4.89	4.96	5.09	-1.00	84.6	84.6	84.5	84.5
7	10:34:35	25-06-2015	4.92	23.70	0.17	84.54	2	192.17	4.89	5.02	-1.00	-1.00	84.6	84.6	-1.0	84.5
8	10:34:34	25-06-2015	4.94	23.70	0.18	84.52	3	192.47	4.94	4.96	4.81	-1.00	84.5	84.5	84.5	84.5
9	10:34:33	25-06-2015	4.97	23.70	0.17	84.56	3	193.00	4.97	4.95	5.05	-1.00	84.6	84.6	84.5	84.5
10	10:34:32	25-06-2015	4.97	23.70	0.17	84.54	2	192.93	4.95	4.96	-1.00	-1.00	84.5	84.6	-1.0	84.5
11	10:34:31	25-06-2015	4.96	23.70	0.18	84.52	3	192.66	5.07	4.80	5.08	-1.00	84.5	84.6	84.5	84.5
12	10:34:30	25-06-2015	4.89	23.70	0.17	84.56	3	191.60	4.87	4.84	4.99	-1.00	84.6	84.5	84.5	84.5
13	10:34:29	25-06-2015	4.91	23.70	0.17	84.56	2	191.99	4.87	4.89	-1.00	-1.00	84.6	84.6	-1.0	84.5
14	10:34:28	25-06-2015	4.93	23.70	0.18	84.52	3	192.20	4.92	4.85	5.04	-1.00	84.5	84.5	84.6	84.5
15	10:34:27	25-06-2015	4.90	23.70	0.17	84.54	3	191.84	4.96	4.99	4.84	-1.00	84.6	84.5	84.5	84.5
16	10:34:26	25-06-2015	4.91	23.70	0.17	84.54	2	192.05	4.85	4.89	-1.00	-1.00	84.5	84.6	-1.0	84.5
17	10:34:25	25-06-2015	4.93	23.70	0.17	84.54	3	192.30	4.93	4.94	4.98	-1.00	84.5	84.5	84.6	84.5
18	10:34:24	25-06-2015	4.88	23.70	0.17	84.56	3	191.39	4.98	4.96	4.85	-1.00	84.5	84.6	84.5	84.5
19	10:34:23	25-06-2015	4.84	23.70	0.16	84.58	2	190.86	4.73	4.87	-1.00	-1.00	84.6	84.6	-1.0	84.5
20	10:34:22	25-06-2015	4.88	23.70	0.17	84.54	9	191.46	4.87	4.83	4.82	4.95	84.6	84.5	84.6	84.5

Following measurement values are displayed on the screen:

MoistAve	Moisture Value in % (Average)
MatTemp	Temperature
EC-TRIME	Radar-based-Conductivity EC-TRIME in dS/m (or mS/cm)
TDRAve	TDR-Signal-Level for special applications.
DeltaCount	Number of single measurements which are used for the averaging.
tpAve	Radar time (average) which corresponds to the respective moisture value.

By clicking **„Save“** the recorded data is saved in a text file in the following path:

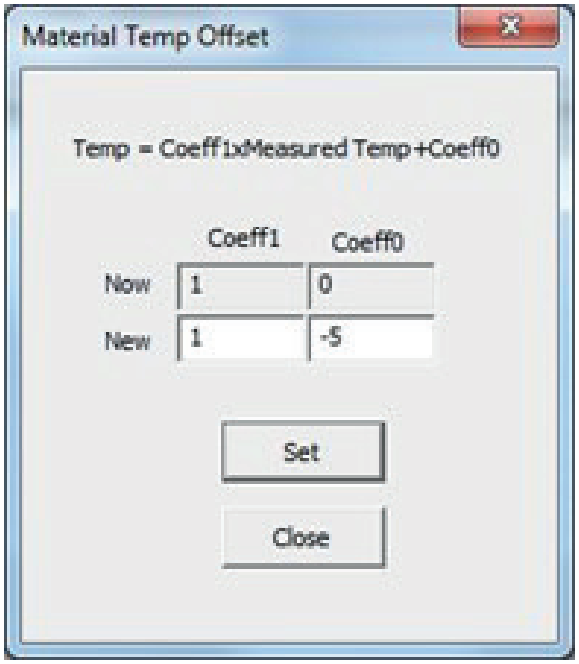
\SONO-CONFIG.exe-Pfad\MD\Dateiname.

The name of the text file **Statis+SN+yyyymmddHHMMSS.sts** is assigned automatically with the serial number of the probe (SN) and date and time. The data in the text file can be evaluated with Windows-EXCEL.

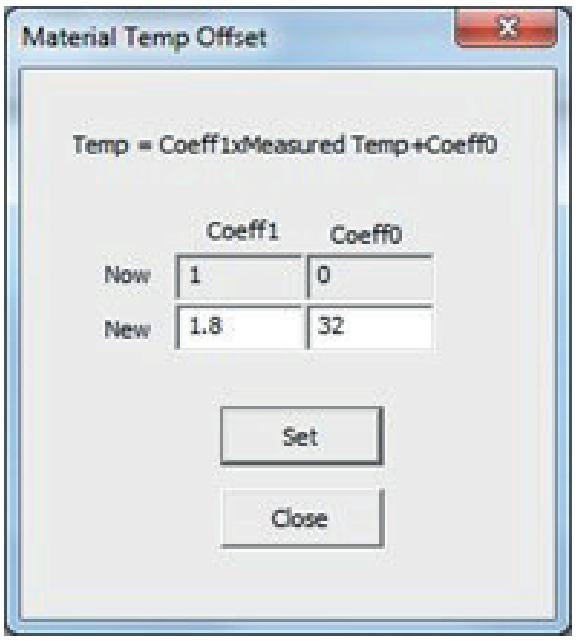
7.7 “Measure” Run in Datalogging-Operation

In the menu **"Datalogging"** it is possible to aquire and store measurement data from several SONO probes with variable and longer cycle rates in a datalogger-operation, e.g. to store measurement data during a long-term drying cycle.

7.8 Offsetting the material temperature sensor

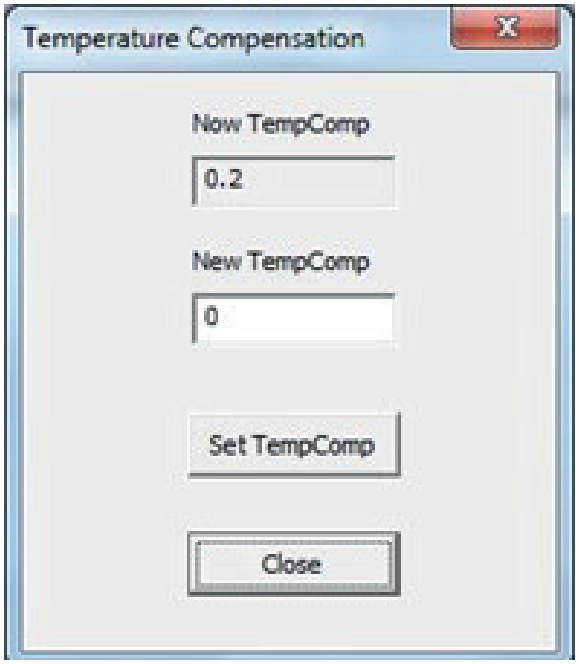


In the menu „Calibration“ and the window „Material Temp Offset“, a zero point offset can be adjusted for the material temperatur sensor which is installed inside the SONO probe. In this example a temperature deviation of +5° C is produced by inside self-warming of the SONO probe. The correction value -5 can be setted in the Coeff0 window.



The example shows the parameters for displaying the temperature in the unit: Degree Fahrenheit.

7.9 Compensation of the electronic temperature



With this method of temperature compensation, a possible temperature drift of the SONO-electronic can be compensated. Because the SONO-electronic shows a generally low temperature drift, SONO probes are presetted at delivery for standard ambient conditions with the parameter TempComp=0.2. Dependent on SONO probe type, this parameter TempComp can be adjusted for higher temperature ranges (up to 120°C for special high temperature version) to values up to TempComp=0.75. But it is to consider that it is necessary to make a Basic-Balancing of the SONO probe in air and water, if the parameter TempComp is changed to another value as TempComp=0.2. The parameter TempComp can be changed with the software tool SONO-CONFIG, in the menu "Calibration" and the window "Electronic-Temperature-Compensation"

Attention:

When changing the TempComp parameter, a new basic balancing of the SONO probe is necessary!

8 Technical Data TRIME-GW Line

Power supply:	12V..24V-DC 3W
Power consumption:	Dependent on the power supply:12V to 24V DC 200mA consumption
Measuring range:	3..45% by weight (b.w.) on a wet mass basis (depends on the used material)
Standard deviation:	Range 3..20 % b.w.: 0.6 % b.w. Range 20..45 % b.w.: 1 % b.w. (depends on the used material)
Repeatability:	± 0.2 % b.w. (depends on the measured material)
Measurement transformer temperature range:	-10..60 °C, extended range on request
Probe temperature range:	0..60°C
Measuring period / -interval:	Floating average with adjustable time interval
Interface:	RS485 and IMP-Bus
Analogue output:	0(4)...20 mA = 0 .. 100% gravimetric moisture (max. load: 500 Ω)
Cable length for probe connection:	Standard 350mm
Housing protection:	Aluminium diecasting IP65
1-Rod Probe protection:	IP67 watertight

9 Safty Notes

In this documentation, text points are highlighted, which require special attention.

DANGER:

The Warning Triangle with the exclamation mark warns you against personal in-jury or property damage.

Intended Use

Sensors and measuring systems of IMKO GmbH may only be used for the purpose described, taking into account the technical data. Misuse and use of the equipment other than for its intended purpose are not eligible. The function and operational safety of a sensor or measuring system can only be guaranteed if the general safety precautions, national regulations and the special safety instructions in this operating manual are observed during use.

The moisture sensors and measuring systems of IMKO GmbH are used to measure moisture according to the measuring purpose and measuring range defined and defined in the technical data. Only adherence to the instructions described in the manual is regarded as intended use. The manual describes the connection, use and maintenance of 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 close to the sensor or measuring system.

Impairment of safety

The sensor or the measuring system has been designed and tested in accordance with EN 61010 safety regulations for electronic measuring instruments and has left the factory in a safe and safe condition. If the sensor or the measuring system can no longer be operated safely, it must be put out of operation and secured by means of marking before further commissioning. In case of doubt, the sensor or the measuring system must be sent to the manufacturer or his contractual partner for repair or maintenance.

Modifications

For safety reasons, it is not permitted to carry out any modifications or modifications to the sensor or the measuring system without the consent of the manufacturer. The opening of the sensor or hand-held meter, adjustment and repair work, as well as all maintenance work other than the work described in the manual may only be carried out by a specialist authorized by IMKO. The sensor or the measuring system must be disconnected from the power supply before installation or maintenance work. Do not open or repair the hand-held unit and the power supply!

Hazard Warnings

Danger due to improper operation. The sensor or the measuring system may only be operated by instructed personnel. The operating personnel must have read and understood the operating instructions.

Danger by electricity

The hand-held meter must not be immersed in water or other liquids. The sensor is insensitive to moisture contained in the typically measured products. Only connect the hand-held meter to a properly installed outlet with the supplied voltage supply cable, the voltage of which corresponds to the technical data. Make sure that the power outlet is well accessible, so that you can unplug the power supply quickly if necessary. Use only the adapter that is suitable for your outlet.

Only operate the meter with the supplied original accessories. If you need additional accessories or replacement, please contact the manufacturer.

Do not use the meter in following case:

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

Unplug the power supply from the wall outlet in following case:

- if you do not use the sensor or the measuring system for an extended period of time,
- before cleaning, unpacking or changing the sensor or the measuring system,
- if you are working inside the sensor or measuring instrument, e.g. connect devices,
- if a fault occurs during operation,
- during thunderstorms.

Caution - Property damage

Ensure that there is a sufficient distance to strong heat sources such as heating plates, heating pipes. Disconnect the sensor or handheld device from other devices before relocating or transporting it. Disconnect the connectors on the device.

Do not use aggressive chemical cleaning agents, scouring agents, hard sponges or the like.

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