

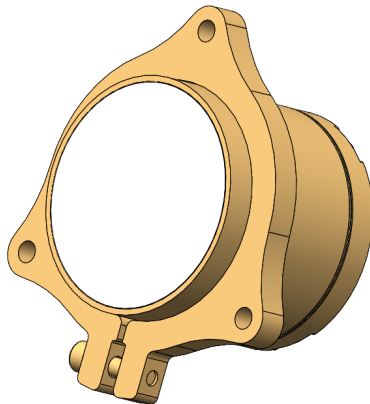


FEUCHTEMESSUNG
MOISTURE MEASUREMENT

Manual

Moisture Measuring Sensor

BMMS



TRANSLATED MANUAL
Rev. 1.3 EN | © ACO

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Preface

Thank you for your decision to use an ACO moisture measurement. The BMMS moisture measuring sensor has been specially developed for measuring moisture in bulk materials and offers reliable and precise measurement for a variety of applications. Please read these instructions carefully so that you can use your ACO product safely and economically. By following the instructions in this manual, your ACO moisture measuring sensor will work reliably over a long service life.

Contents

1	General safety instructions.....	4
1.1	Symbols used	4
1.2	Safety information	5
1.3	Personal protective equipment	6
2	Certificates and approvals	7
3	Purpose of use	8
3.1	Intended Use.....	8
3.2	Area of application.....	8
3.3	Improper use	8
4	Environmental influences	9
5	Technical data.....	10
6	Nameplate	10
7	Dimensions	11
7.1	Dimensions of moisture measuring sensor	11
7.2	Dimensions of connection box (ConBox).....	12
7.3	Dimensions of clamping ring	13
7.4	Overview of sensor cables	14
8	Assembly.....	15
8.1	Assembly process.....	15
8.2	Installation examples.....	16
9	Electrical connection.....	17
9.1	Sensor connection	17
9.2	Power supply	18
10	Functional description	19
11	Preparation for calibration	20
11.1	Operation.....	20
11.2	Functional test	20





11.3	Self-heating	20
12	Maintenance, cleaning and repairs	21
12.1	Maintenance	21
12.2	Cleaning	21
12.3	Repair	21
13	Transport and storage	22
13.1	Transport	22
13.2	Storage	22
14	Disposal	22
15	BMMScontrol calibration software	23
15.1	Installation	23
15.2	Programming cable and drivers	24
15.3	Licensing the BMMScontrol	25
15.4	Structure of the BMMScontrol software	26
15.5	Toolbar menu structure	28
15.6	“Live Data” navigation tab	29
15.7	“Sensor” navigation tab	32
15.8	"Calibration" navigation tab	33
15.9	Additional calibration functions	34
15.10	“Batch“ navigation tab	35
15.11	BMMScontrol settings	37
16	Example calibration	38
17	Warnings, faults and error messages	41
17.1	General faults	41
17.2	Warnings and error messages in BMMScontrol	42

1 General safety instructions

Read the following safety instructions carefully and follow them precisely. They are for your own safety and help you avoid injuries or damages.

This manual is intended for qualified personnel. The contents of this manual must be made accessible and used by qualified personnel.

1.1 Symbols used

	<p>Warning of a danger zone! This sign warns you about work that poses a risk to life and limb. Observe these instructions and behave particularly careful!</p>
	<p>There is danger when working on electrical equipment! Work may therefore only be carried out by qualified electricians and electrically and mechanically instructed persons!</p>
	<p>Important note! This symbol indicates important information. Malfunctions or faults may occur if not observed.</p>
	<p>Note! This symbol indicates tips and special features that will make it easier for you to use the moisture measuring sensor.</p>

1.2 Safety information

- The moisture measuring sensor described is installed as a component in a system.
 - The safety of this system is the responsibility of the manufacturer.
 - The system manufacturer is obliged to carry out a risk assessment and to create documentation in accordance with the legal and normative requirements for the operator and user of the system.
- It is essential that you read these manual before using the sensor for the first time and keep it for the duration of use.
- In addition to the manual, the generally applicable legal and other binding regulations for accident prevention and environmental protection must be observed and instructed.
- Ignoring application instructions or technical information can result in property damage and/or personal injury.
- If required by regulations or otherwise necessary, wear personal protective equipment.
- No changes may be made to the moisture measuring sensor without the approval of ACO. No liability is accepted for modifications made without the approval of ACO and the warranty is void.
- ACO assumes no liability and no warranty for the consequences of incorrect use of the moisture measuring sensor by the operator.
- The moisture measuring sensor and the cable must be effectively protected from damage.



There is danger when working on electrical equipment!
Work may therefore only be carried out by qualified electricians and electrically and mechanically instructed persons!



All work may only be carried out in compliance with the applicable guidelines and associated regulations on occupational safety, operator safety and accident prevention in the operating country.

1.3 Personal protective equipment

Wear your personal protective equipment during all activities.
Depending on the type of work to be carried out or if required by country-specific regulations, you must choose additional protective equipment.



You are responsible for wearing the necessary protective equipment and ensuring that it is maintained in a proper condition.

2 Certificates and approvals

CE	<p>The moisture measuring sensor meets the legal requirements of the applicable EC guidelines. These are listed together with the applied standards in the corresponding EC declaration of conformity.</p> <p>ACO confirms the successful testing of the sensor by affixing the CE mark.</p>
RoHS	<p>The moisture measuring sensor complies with the substance restrictions of the Directive on the Restriction of the Use of Certain Hazardous Substances 2011/65/EU (RoHS 2).</p>
EMC	<p>Electromagnetic compatibility in accordance with all relevant requirements of the following tests:</p> <ul style="list-style-type: none"> - EN 55011:2016+A1:2017+A11:2020 - Radio interference properties - EN IEC 61326-1:2021 - Interference immunity properties

3 Purpose of use

3.1 Intended Use

The BMMS moisture measuring sensor is used to measure material moisture, mainly of bulk materials, in a production process.

The BMMS moisture measuring sensor may only be used in a technically flawless condition, as intended, with an awareness of safety and dangers and in compliance with the manual!

Malfunctions that could affect safety must be eliminated immediately.

3.2 Area of application

- Material moisture: 0...100%
- Temperature: 4...80 °C

3.3 Improper use

- Any structural change.
- Any way of working that endangers operational safety.
- Removing or changing safety and protective devices.
- Changes to the electrical equipment and controls.
- The assembly of unauthorised components.
- The installation of spare parts and the use of operating materials that are not approved by ACO.
- The commissioning of the moisture measuring sensor without acceptance testing if this is required by national laws.
- Commissioning by people who are not authorised by the operator, who do not have the required training, who do not have any training or knowledge of the manual.
- The moisture measuring sensor must not be installed and operated in a potentially explosive area. Furthermore, measuring explosive material is not permitted.
- The measured value of the moisture measuring sensor must not be used to guarantee a safety-relevant function with safety level (SIL).



ACO assumes no liability for personal injury or property damage resulting from improper use. The operator alone bears the risk.

4 Environmental influences

The moisture measuring sensor can determine the water content of free water in a material.

The measuring results also depends on the following influences:

- Temperature
- Pressure
- Material
- Density of the material

Depending on external circumstances, for example pressure, water can become gaseous even at temperatures below 100 °C.

If the material temperature is below 0 °C, the measuring results can be distorted.

The water content cannot be determined in gaseous or frozen water.



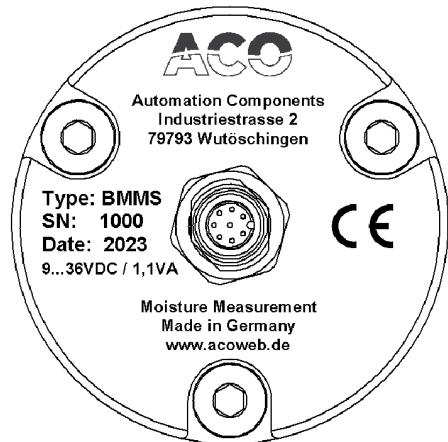
For a reliable moisture measurement, it must be assumed that the material to be measured is brought homogeneously and with a constant density in front of the measuring surface of the moisture measuring sensor. Avoid caking on the measuring surface or material jamming! Constant measuring conditions are absolutely important and the correct installation location is crucial for the quality of the moisture measurement.

5 Technical data

Physical measuring principle:	Capacity determination in high frequency stray field, at 15...23MHz
Measuring range:	0...100% moisture (measuring window adjustable)
Achievable accuracy:	+/- 0.05% moisture (depending on material / installation / calibration)
Measuring type:	Continuous or batch measuring
Temperature:	4...80°C (ambient/material temperature)
Temperature compensation:	Of the Sensor electronics
Measuring depth:	150mm (depending on material / compression)
Dimensions sensor:	Ø = 76mm / H = 70mm (without plug)
Materials:	Stainless steel (1.4305), ceramic zirconium oxide (ZrO ₂ Al ₂ O ₃)
Protection class:	IP68
Assembly:	Use the associated clamping ring / optional installation kits
Supply:	9...36V DC / 1.1VA
Measured value output:	Analogue standard signal, 4...20mA
Calibration:	via BMMSControl software, directly in the process
ConBox:	IP67, aluminium housing, with integrated calibration interface
Sensor cable:	Can be plugged into sensor and junction box, 0.5 / 3 / 5m long, IP68
Sensor weight:	1.1kg
Clamping ring weight:	0.3kg
ConBox weight:	0.5g
Options:	<ul style="list-style-type: none"> • Sensor for measuring in the silo • Sensor for measuring in the mixer • Sensor housing made of acid-resistant stainless steel (1.4462) • Digital interface, RS485 (max. 1,000m cable length)

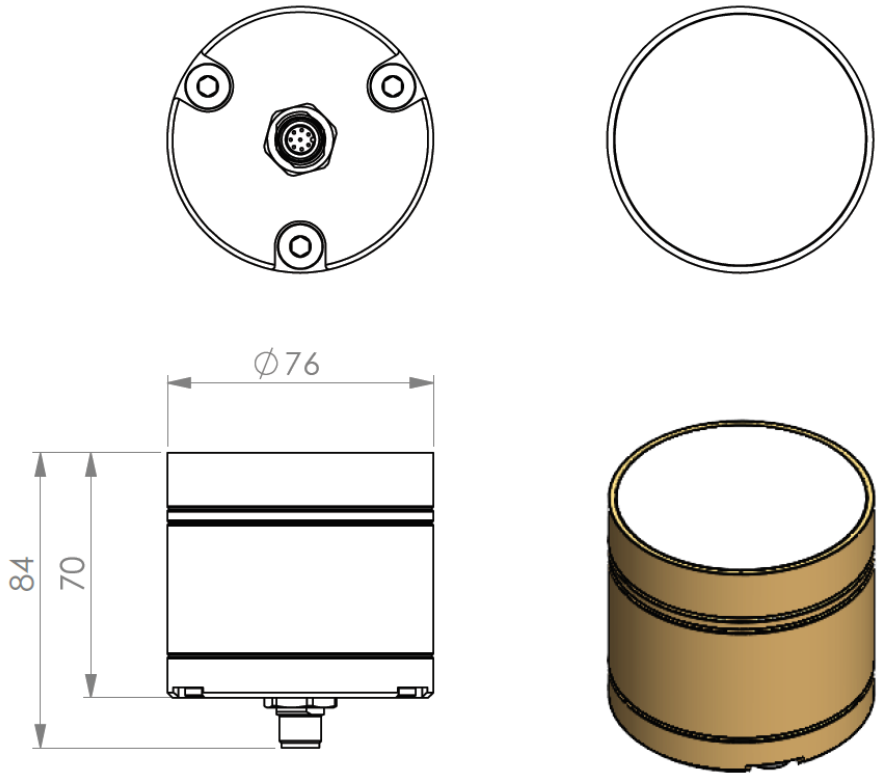
6 Nameplate

The nameplate of the BMMS moisture measuring sensor is permanently marked on the back.

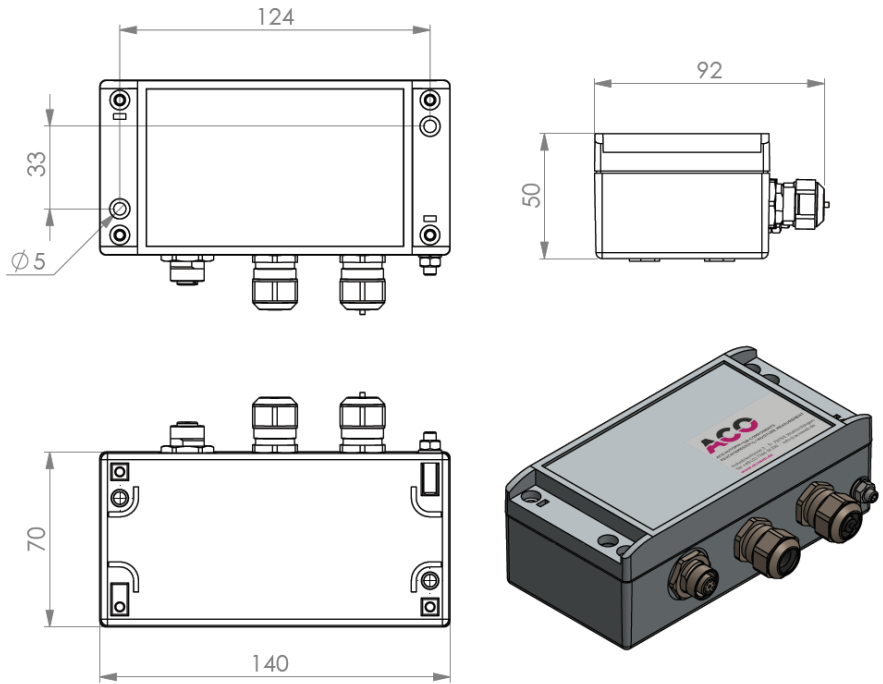


7 Dimensions

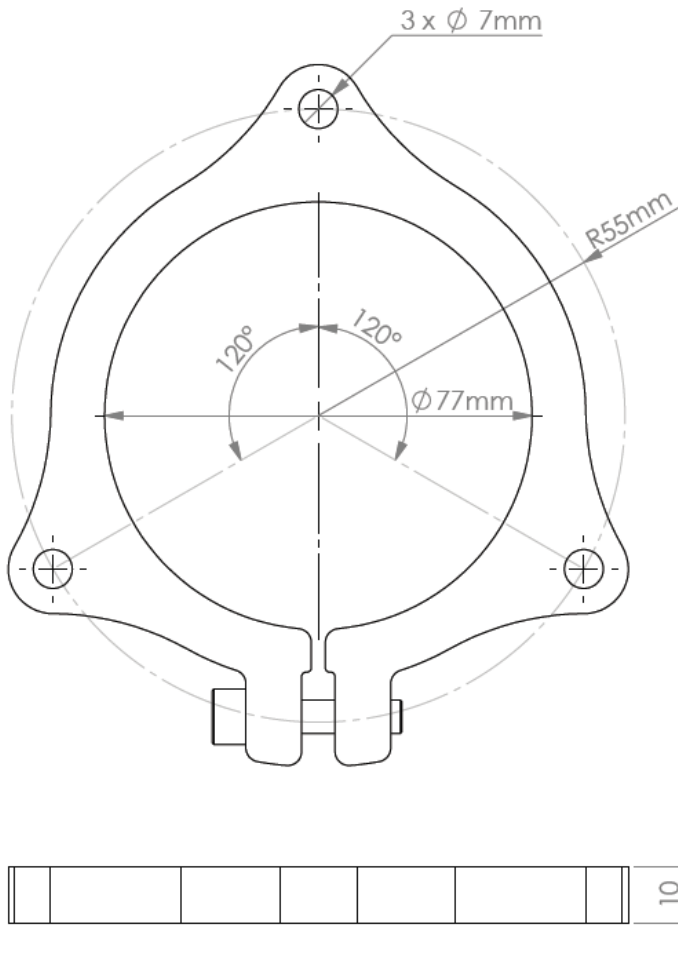
7.1 Dimensions of moisture measuring sensor



7.2 Dimensions of connection box (ConBox)

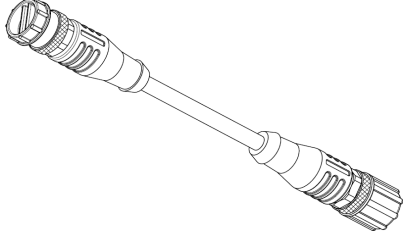
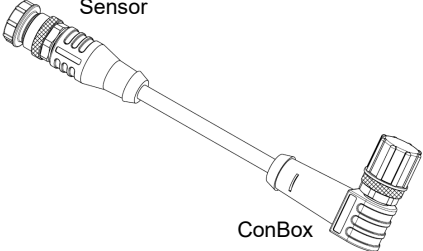
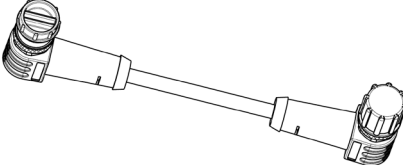
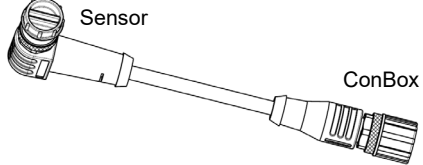


7.3 Dimensions of clamping ring



7.4 Overview of sensor cables

Overview of the available sensor cables between BMMS moisture measuring sensor and ConBox.

	
<p>Straight socket and plug 0.5m → Art no. 1003 3.0m → Art no. 1002 5.0m → Art no. 1008</p>	<p>Straight socket and 90° plug 0.5m → Art no. 1004</p>
	
<p>90° socket and 90° plug 0.5m → Art no. 1005 3.0m → Art no. 1010</p>	<p>90° socket and straight plug 3m → Art no. 1015</p>

8 Assembly

The BMMS moisture measuring sensor is mounted with a clamping ring as standard. The clamping ring is attached to a wall with three M6 screws. The moisture measuring sensor can be moved in the clamping ring over the entire length of the housing and can therefore be individually adapted to the wall thickness.



There is danger when working on electrical equipment! Work may therefore only be carried out by qualified electricians and electrically and mechanically instructed persons!



Warning of a danger zone!
Please note the safety instructions in chapter 1 when working on a production system. Assembly work must only be carried out by qualified personnel.



Important note!
Make sure that the general operating conditions of the moisture measuring sensor are adhered to. Failure to comply will void the warranty.

8.1 Assembly process

- Create a hole for the moisture measuring sensor and a hole pattern for the clamping ring.
- Screw on the clamping ring.
- Position and clamp the moisture measuring sensor.
- Tighten all screws.
- Mount the ConBox within reach of the sensor cable used.

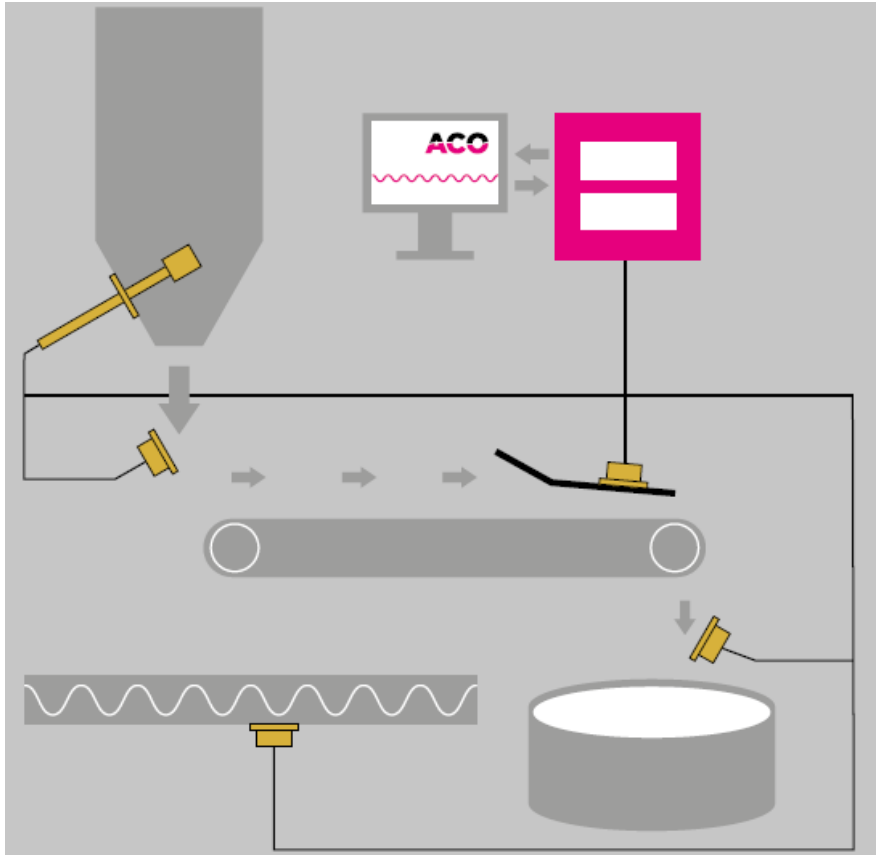


Note!

- Position the moisture measuring sensor in the clamping ring until the measuring surface is flush with the surface of the installation location.
- Make sure that the moisture measuring sensor is not tilted in the clamping ring. The sensor could fall out under stress.
- Observe general tightening torques.

Protect the moisture measuring sensor from severe mechanical influences, for example against stone chips or shear forces.

8.2 Installation examples



Possible installation locations:

- In silo (silo sensor)
- In a chute
- On a conveyor belt
- Under a conveyor belt
- In a screw conveyor
- Any special solutions
- ...

ACO is happy to provide you with a detailed assessment and advice when selecting the respective installation situation.

9 Electrical connection

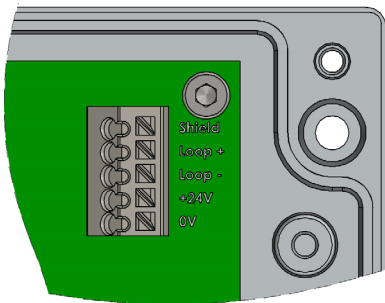
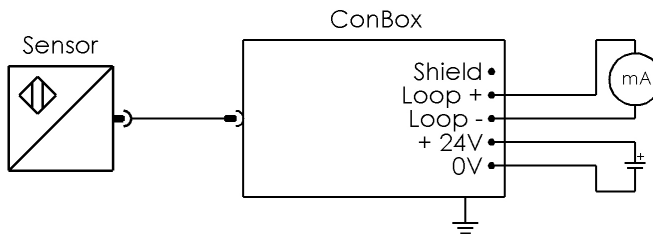
9.1 Sensor connection

The BMMS moisture measuring sensor is connected via the connection box, ConBox. All incoming and outgoing signals and the supply voltage must be connected within the ConBox. The connection between the moisture measuring sensor and ConBox is plugable.



There is danger when working on electrical equipment! Work may therefore only be carried out by qualified electricians and electrically and mechanically instructed persons!

Block diagram and wiring diagram



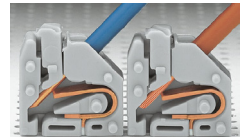
Shield	Shield
Loop+	Analogue signal 4...20mA +
Loop -	Analogue signal 4...20mA -
+24V	Power supply +
0V	Power supply -
PE	Grounding screw on outside of housing

The spring-loaded terminals used in the Conbox are designed for the following cross sections:

Single-wire conductor $0.2...1.5\text{mm}^2$ / 24...16 AWG

Single-wire conductor $0.2...1.5\text{mm}^2$ / 24...16 AWG

Fine-wire conductor; with wire end $0.25...1\text{mm}^2$



Single-wire conductor can be plugged in directly. To insert a fine-wire conductor, the clamping actuator must be pressed in the same way as to remove a conductor.

9.2 Power supply

For optimal operation of moisture measuring sensor, we recommend a single-phase power supply that delivers an unearthed, stabilised and galvanically isolated SELV/PELV/ES1 output voltage with 24V DC and approx. 1.5A.

We also recommend that the power supply meets the requirements for a limited power source according to NEC CLASS 2 and is subject to protection class II.



ACO article number: → 230-24



There is danger when working on electrical equipment!
Work may therefore only be carried out by qualified electricians and electrically and mechanically instructed persons!

10 Functional description

The moisture measuring sensor type BMMS is a compact moisture measuring sensor with completely digital measuring technology and integrated evaluation via microprocessor.

During operation, the moisture measuring sensor requires nothing other than a power supply but a display or a controller that waits for the measuring signal. The BMMS moisture measuring sensors are designed for applications in which multi-part systems are not to be used and the highest precision is still required. Through calibration in the process, all influences resulting from sensor installation are directly compensated. The calibration is carried out conveniently using the BMMScontrol software. The measuring signal is output as an analogue 4...20mA standard signal and optionally in digital form (RS485).

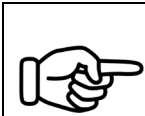
- Purely capacitive measuring principle
- Microprocessor controlled
- Integrated calibration data memory
- Continuous or batch measurement
- Temperature measurement
- Temperature compensation of the electronics

Moisture measuring sensors of the BMMS type enable full reproducibility of the data when replacing the sensor. Recalibration is not necessary.

11 Preparation for calibration

The BMMS moisture measuring sensors use the purely capacitive measuring principle, i.e. an indirect method for determining material moisture. Each moisture measuring sensor must therefore be calibrated individually to the material to be measured and the measuring application.

The BMMS moisture measuring sensor is put into operation using the BMMScontrol software and calibrated within the process.



Note:

The quality and reproducibility of the measurement depends largely on the installation situation and the calibration. A poorly performed calibration is directly reflected in the measuring result.

11.1 Operation

The moisture measuring sensor is active immediately after switching on the power supply. The selected calibration curve and the settings for the 4...20mA standard signal are applied. The standard signal is output according to these settings.

11.2 Functional test

When not installed and without damping of the measuring surface (measurement against air), the moisture measuring sensor has a low analog output signal. The "Counts" value in the BMMScontrol software is approx. 0.00 counts.

By placing the flat of your hand on the measuring surface, the measured value increases significantly.

11.3 Self-heating

To achieve optimal calibration, the moisture measuring sensor should be connected to the recommended power supply for at least 15 minutes before the actual calibration process. This leads to the measuring circuit's own heating and creates comparable operating conditions.

12 Maintenance, cleaning and repairs

12.1 Maintenance

Check the moisture measuring sensor at regular intervals for deposits, caking and damage to the housing and the measuring surface. If damaged, the sensor must be replaced.



The maintenance schedule must be determined by the operator of the moisture measuring sensor according to actual process conditions.

12.2 Cleaning

Clean the moisture measuring sensor with mild cleaning agents and a soft cleaning cloth.



Do not use aggressive cleaning agents or solvents.
No cleaning with a high-pressure water jet!

If cleaned improperly, the moisture measuring sensor can be damaged!

12.3 Repair

The moisture measuring sensor can only be repaired by the manufacturer. Please contact ACO.

13 Transport and storage

13.1 Transport

Use suitable packaging for transport and secure and pad the moisture measuring sensor and all components in such a way that damage is prevented during transport.



When returning the moisture measuring sensor, ensure that the sensor is free of contamination, especially dangerous and toxic substances (decontaminated).

13.2 Storage

Clean the moisture measuring sensor and store it in sturdy packaging in a dry and clean environment.

14 Disposal

After use/life cycle, dispose of the moisture measuring sensor in an environmentally friendly manner in accordance with applicable national regulations.

Take the device directly to a specialised recycling company and do not use the municipal collection points for this.



You are also welcome to send the moisture measuring sensor back to ACO. We take care of the proper disposal.

15 BMMScontrol calibration software

15.1 Installation

Installing the BMMScontrol software on your Windows PC is a simple process. It allows you easily to put the BMMS moisture measuring sensor into operation or calibrate.

Take the installation file from the included USB stick. Double-click the installation file to start the installation process. Follow the on-screen instructions and select the installation location. Click "Install" to start the installation.

15.2 Programming cable and drivers

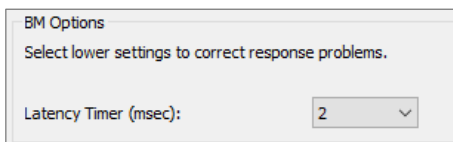
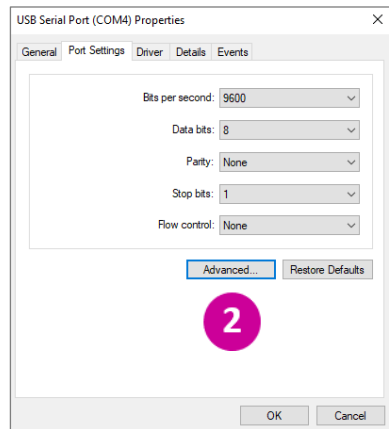
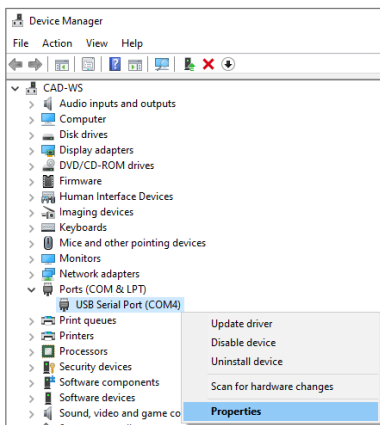
The BMMScable is required to establish a connection between the Windows PC and the BMMS moisture measuring sensor with ConBox A. The parameterisation cable is a USB cable with an integrated RS485 interface. There is a USB A plug on the PC side and a Mini DIN plug on the sensor side.

When connecting to the PC, the programming cable is in most cases recognised directly and the device driver is installed via the Windows driver library. If this is not the case, the driver can be installed manually. To do this, use the driver file in the “BMMS” installation directory. For further information please contact ACO.

Depending on the PC configuration, the connection settings of the generated COM port must be set to ensure stable communication between the PC and the moisture measuring sensor.

To do this, proceed as follows:

Open Device Manager and go to Connections (COM & LPT)→ USB Serial Port (COM xx)→ Properties→ Port Settings→ Advanced→ BM Options→ Set Latency Timer (msec) to **2 – 4** and confirm with “OK”.

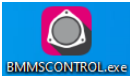


15.3 Licensing the BMMScontrol

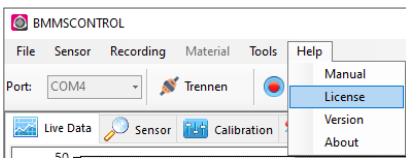
To operate the BMMScontrol software, a licence is required, which is included with every software purchase. The license is hardware-bound and non-transferable.

After installing the software, the license must be requested from ACO using the automatically generated request code.

Please proceed as follows:



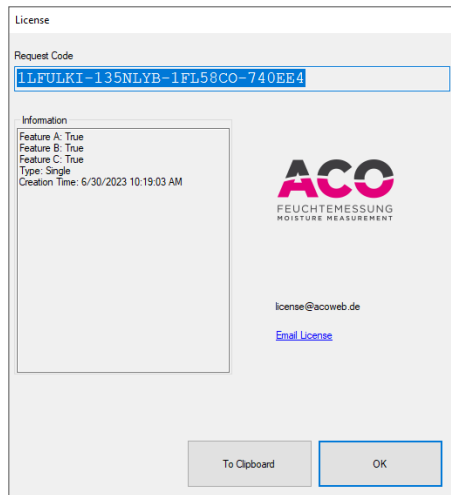
Open the BMMScontrol software and open the “License” sub-item in the “Help” toolbar.



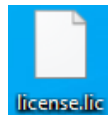
Use the “Email License” link to go directly to your standard mailing program. Please send us your request code.

Or copy the request code and send it and your contact details to the following address:

license@acoweb.de



After verifying your data, we will generate your license, which you can use to unlock your copy of the software. The license file must be copied into the BMMScontrol installation directory. The software can then be started without restrictions.



15.4 Structure of the BMMScontrol software

The software is clearly structured and user-friendly. It allows the user to easily navigate through the sensor settings via tabs.

The toolbar is visible at the top, the current sensor values are visible at the right edge and the most important settings are visible in footer.

Toolbar and navigation tabs

Current measurements

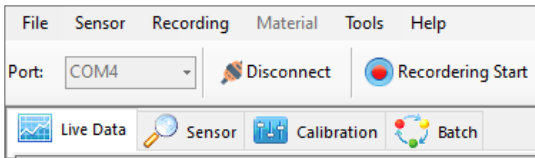
The screenshot shows the BMMSCONTROL software interface. The window title is "BMMSCONTROL". The menu bar includes "File", "Sensor", "Recording", "Material", "Tools", and "Help". The toolbar shows "Port: COM4", "Disconnect", "Reconnecting Start", "Live Data", "Sensor", "Calibration", and "Batch". The main area contains two line graphs: "Counts" (green line at 0) and "Moisture %" (blue line at 0). On the right, a panel shows "Counts: 0.00", "Moisture: 0.00", "Current [mA]: 4.000", and "Temp [°C]: 25.0". The footer displays "Sensor: Connected", "Recording: Off", "SN: 1000", "Firmware: 20230511", "Filter: Off", "Batch: Off", "Material: 1", and "EN".


Footer with status information and language switch


Depending on the selected navigation tab, you will find the respective configuration interface for the moisture sensor in the centre of the software window. You can switch between the following tabs.

- Live Data
- Sensor
- Calibration
- Batch

The toolbar, the connection options and the navigation tab are shown in the software header.



In order to establish a connection to the moisture measuring sensor, select the port (COM xx) created in the PC after plugging in and installing the driver of the USB programming cable. The sensor data is loaded by clicking on “Connect” .

With the “Recording Start”  button, a recording of the measured values can be started as a csv file.

As soon as there is a connection between the moisture measuring sensor and the software, the current sensor values “Counts”, “Moisture” according to the stored calibration and set filter settings, “Current” and “Temp” of the temperature sensor are displayed on the right edge of the software.

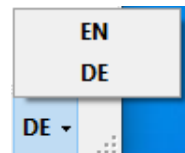
The temperature sensor is located directly behind the ceramic disc.

Counts:	0.00
Moisture:	0.00
Current [mA]	4.000
Temp [°C]:	24.0

In the footer you can find status information about the moisture measuring sensor, as well as plain text information about ongoing software actions, such as connection status or error messages.

Sensor: Connected	Recording: Off	SN: 1000	Firmware: 20230511	Filter: Off	Batch: Off	Material: 1	Data From Sensor Loaded!
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The language switch DE/EN is located on the right in the footer. The language can be switched directly during operation and the moisture measuring sensor is connected. A software restart is not required.



15.5 Toolbar menu structure

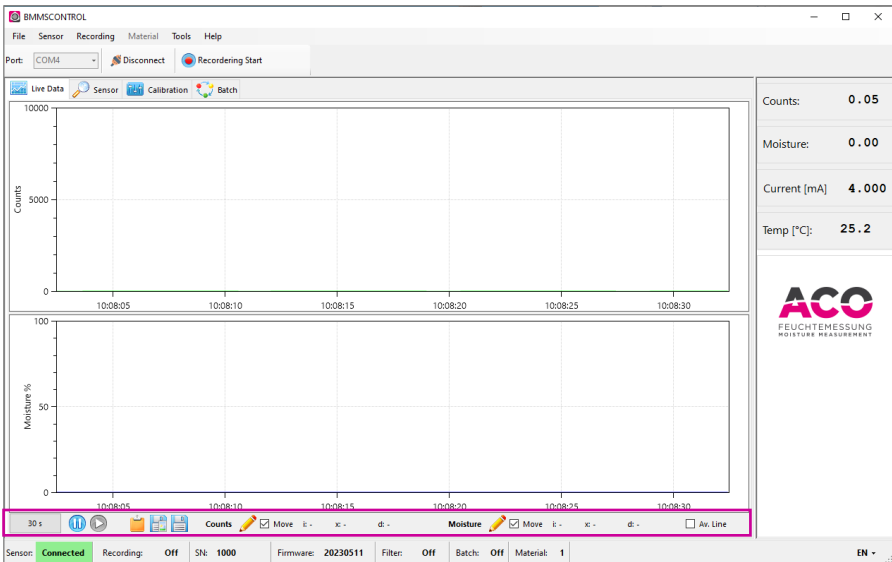
File	Sensor	Recording	Material	Tools	Help
------	--------	-----------	----------	-------	------

Menu	Function	Task
File	New	Creates a new configuration file
	Open	Opens a configuration file
	Save	Save configuration data on the PC
	Close	Exits the software
Sensor	Connect	Connect with sensor
	Disconnect	Disconnect from the sensor
	Reset	Restart sensor
	Factory Settings	Resets the sensor to factory settings
Recording	Start	Starts recording measuring values
	Stop	Stops recording measuring values
Material	Copy	Copy calibration curve
	Insert	Insert calibration curve
	Offset	Move calibration curve parallel
	Coefficients	Shows the coefficients of the selected curve
Tools	Ruler	Evaluation aid for counts and moisture
	Language	Language switching
	Settings	Settings for the PC software
Help	Instructions	Open manual
	License	Generate license request
	Version	Information about the PC software
	About	Information about ACO

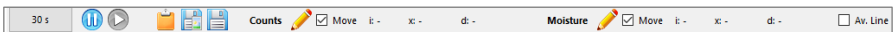
15.6 “Live Data” navigation tab

After connecting, all data from the BMMS moisture measuring sensor will be loaded. Meanwhile, the measured values are already available on the right and in the graphs.

In the upper graph are the “Counts” and in the lower graph is the “Moisture”, shown according to the stored calibration and filter setting. With their convenient recording and evaluation options, the two graphs are mainly used to determine the calibration points and observe the process.





Toolbar



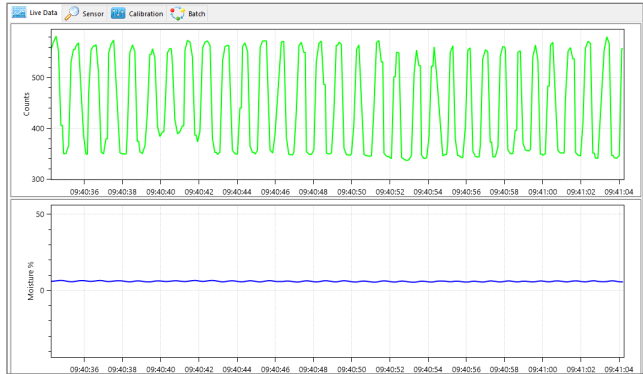
The toolbar contains functions for evaluating and documenting the “Counts” and “Moisture” graphs.


On the far left, you can switch the display area of both graphs from 30 seconds to 30 minutes by clicking on the “Display Time” ... button.

Similarly, the graphs can be paused or resumed with the "Pause" and "Continue" buttons.

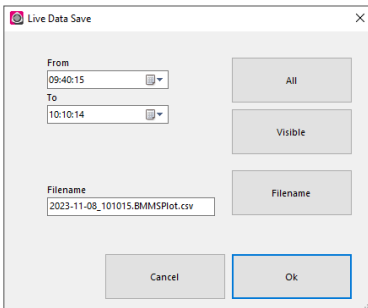
The two graphs can be copied to the clipboard or saved as an image by using the “Copy” and “Save”   buttons. The file path can be selected under “Settings”.

Example: Saved screenshot/image.

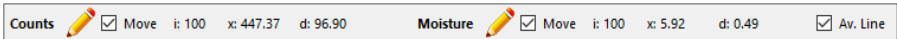


For documentation purposes, the individual measured values of the two current graphs can be saved as a .csv file in the “Live Data” tab. To do this, click on the “Live Data Save”  button.

Before saving the measured values, a dialog window opens where the data range, storage location, and name of the .csv file are set. Clicking on “OK” creates the file.



The counts and moisture can be evaluated directly in the respective graphs.



To do this, pause the graphs by clicking on the “Pause” button, then click on the “Pen” button to delimit the area to be measured with two vertical lines. The following three values are determined within the boundaries.

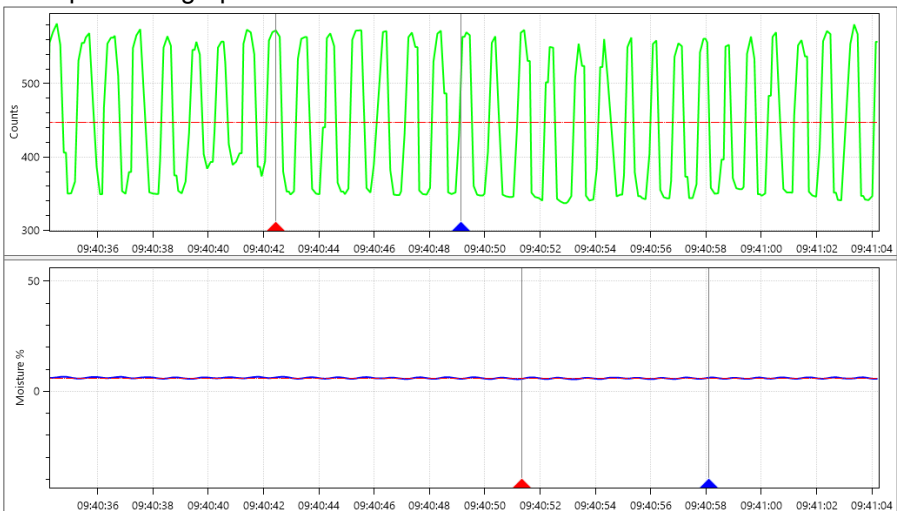
- i = Number of individual measuring points
- x = Mean value
- d = Standard deviation

The “Counts” and “Moisture” graphs can be evaluated completely independently of each other.

The checkbox Move allows the boundaries to move with the graph or be fixed.

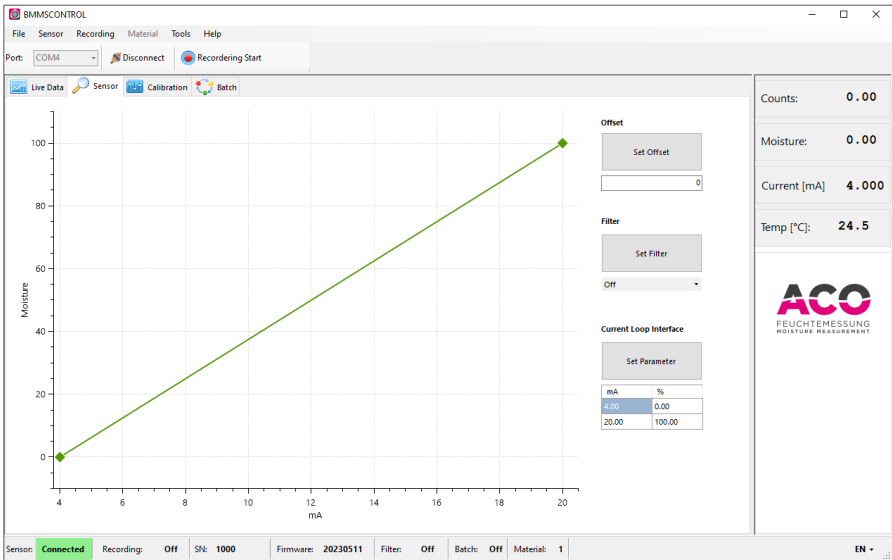
The checkbox Mittellinie is used to display the centreline formed from the data within the limits.

Example: Both graphs with set boundaries and centreline



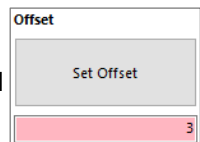
15.7 “Sensor” navigation tab

The Offset, Filter and Current Loop Interface settings are made in the “Sensor” navigation tab.



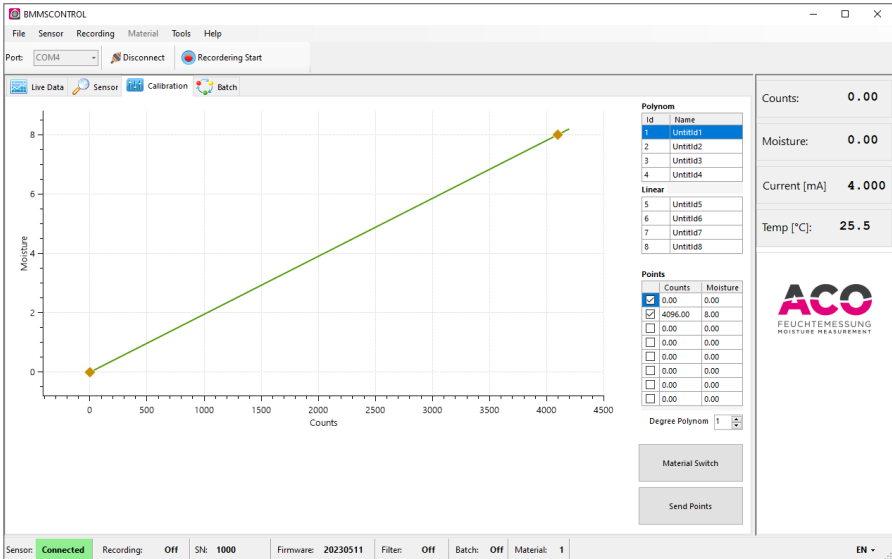
<p>Offset</p> <p>Set Offset</p> <p>-0.6</p>	<p>With the input field "Offset," the moisture sensor is calibrated to 0.00 Counts in the removed state and with the measuring surface exposed to air. E.g.: Display value: 0.6 → Offset: -0.6 → Sensor value: 0.00 Counts</p>						
<p>Filter</p> <p>Set Filter</p> <p>Off</p> <p>Weak</p> <p>Medium</p> <p>Strong</p>	<p>For damping and smoothing the output signal, four filter settings are available. Practical experience shows that the most sensible setting is made after calibration and after observing the measured values. The currently activated filter is displayed in the footer.</p>						
<p>Current Loop Interface</p> <p>Set Parameter</p> <table border="1"> <thead> <tr> <th>mA</th> <th>%</th> </tr> </thead> <tbody> <tr> <td>4.00</td> <td>0.00</td> </tr> <tr> <td>20.00</td> <td>100.00</td> </tr> </tbody> </table>	mA	%	4.00	0.00	20.00	100.00	<p>Here the analogue output (4...20mA) is normalised to the desired measuring range. The setting is displayed graphically in the left coordinate system.</p>
mA	%						
4.00	0.00						
20.00	100.00						

Changes that were made in the software but were not transferred to the moisture measuring sensor with the associated “click” are highlighted in pink. This applies to all changeable parameters and input fields



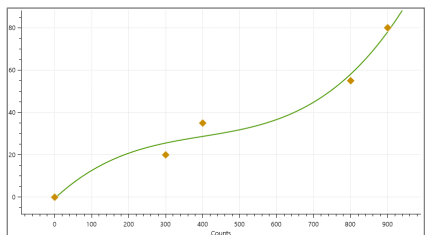
15.8 "Calibration" navigation tab

Calibration and material switching are carried out in the "Calibration" navigation tab.

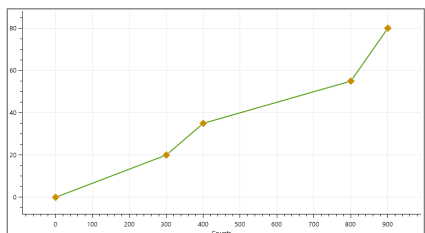


The BMMS moisture measuring sensor can store eight calibration curves. Each of these calibration curves can be named with 8 ASCII characters. A calibration curve can consist of a maximum of eight points.

Calibration curves 1...4 are based on a polynomial calculation basis. Polynomial degrees ranging from 1...4 can be selected or switched.



Calibration curves 5...8 are based on a list of points in which the points entered are connected.



<p>Material Switch</p>	<p>With the "Material Switch" button you can alternate between the eight individual materials during operation. The material that is currently active is displayed in the footer.</p>
<p>Send Points</p>	<p>With the "Send Points" button, changes to the calibration are transferred to the moisture measuring sensor. Only the data from the selected calibration curve is sent to the moisture measuring sensor.</p>

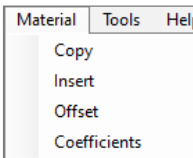
The "checkboxes" are used to set or deselect measuring points for creating the calibration function. Likewise, if a value is changed, the "Old Value" is still displayed as a tooltip.

Points		
	Counts	Moisture
<input checked="" type="checkbox"/>	0.00	0.00
<input checked="" type="checkbox"/>	300.00	20.00
<input checked="" type="checkbox"/>	500.00	35.00
<input type="checkbox"/>	800.00	Last Value: 400
<input type="checkbox"/>	900.00	0.00
<input type="checkbox"/>	0.00	0.00
<input type="checkbox"/>	0.00	0.00
<input type="checkbox"/>	0.00	0.00

Degree Polynom

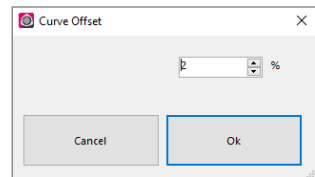
Changes made in the software but not transferred to the moisture measuring sensor with the "Send Points" **Send Points** button are highlighted in pink. This applies to all changeable parameters and input fields.

15.9 Additional calibration functions



As soon as the "Calibration" navigation tab is selected, the "Material" menu item is activated in the toolbar. In this submenu, a calibration curve can be copied and pasted elsewhere.

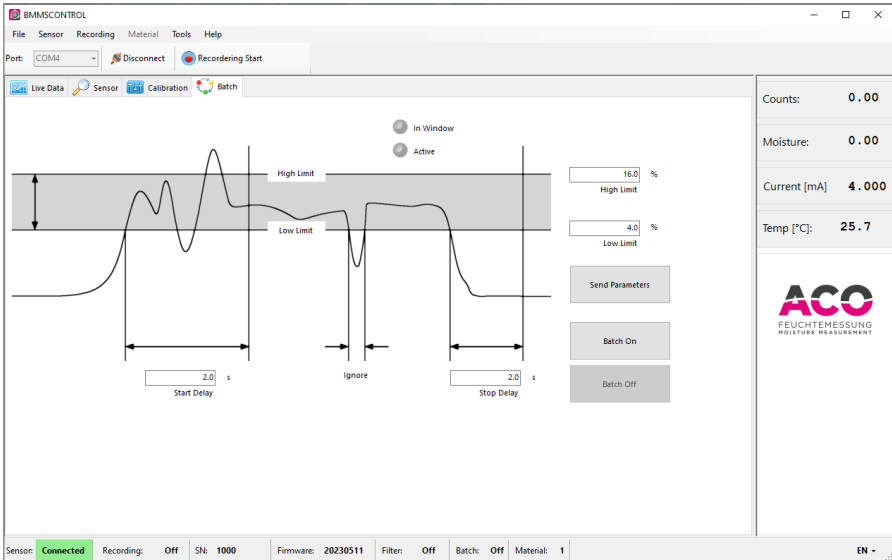
In addition, with the "Curve Offset" function, the calibration curve can be shifted in parallel, positively, or negatively.



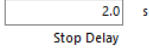


By selecting the "Coefficients" function, a window is opened that displays the coefficients of the polynomial function.

15.10 “Batch“ navigation tab

The “Batch” navigation tab is used to activate batch mode and set the required parameters. If the batch mode is active, material batches are automatically recorded based on the measured values and the average calculation is started and stopped. The moisture measuring sensor exits continuous measuring mode.



<p>Batch On</p> <p>Batch Off</p>	<p>Batch mode is activated or deactivated using the “Batch On” and “Batch Off” buttons. Whether batch measuring is activated or not is displayed in the footer.</p>
<p>Send Parameters</p>	<p>The “Send Parameters” button is used to set parameters for the batch mode and send them to the moisture measuring sensor.</p>
<p>16.0 % High Limit</p> <p>4.0 % Low Limit</p>	<p>The two fields “High Limit” and “Low Limit” define the measuring window of the batch measuring where the expected material batch is located. The moisture measuring sensor only starts the batch measuring if the material batch is in this range and the starting conditions are met.</p>
<p>2.0 s Start Delay</p>	<p>The “Start Delay” field is used to set the time after which the batch measuring starts, provided the measured value is in the measuring window. This is a minimum time; fluctuations in the material flow or interruptions can extend the start delay.</p>

	<p>The “Stop Delay” field is used to set the time after which the batch measuring stops. The batch measuring stops after the measured value has left the measuring window and the time has expired. Fluctuations and interruptions that are smaller than the set time are ignored.</p>
	<p>These two indicators serve to visualise or provide an overview of which phase the batch measuring is currently in.</p>
	<p>“Batch On” in the footer indicates that the moisture measuring sensor is in batch mode. If the batch mode is active and the moisture measuring sensor is currently carrying out a measuring, this is signalled by a green background behind “Batch On”.</p>

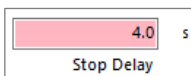
Sequence of batch measuring operations

1. The moisture measuring sensor constantly checks whether the moisture value is within the specified measuring window.
2. Once the moisture value is within the measuring window and the set "Start Delay" has elapsed, the calculation begins. Short interruptions in the material flow are hidden or are not taken into account in the average calculation.
3. The calculation of the measured value continues until the moisture value runs out of the measuring window for the set “Stop Delay” time. The batch measuring is then stopped and the average value for the entire batch is output as a moisture value.

The measured value of the completed measuring remains until the new measuring starts.

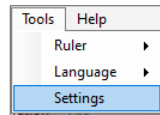
A new batch measuring is started as soon as the starting conditions are met again.

Changes made in the software but not transferred to the moisture measuring sensor with the “Send Parameters” [Send Parameters](#) button are highlighted in pink. This applies to all changeable parameters and input fields.



15.11 BMMScontrol settings

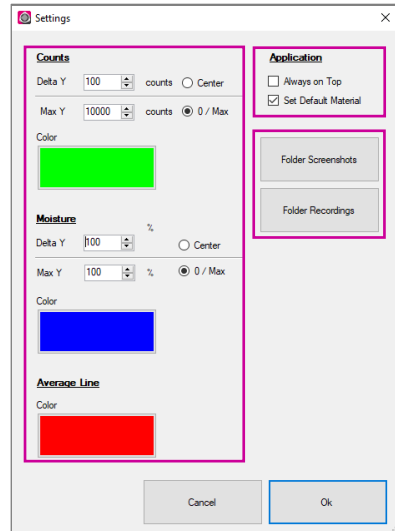
The settings window opens via the “Tools” toolbar and the “Settings” menu entry. Basic settings for the BMMScontrol software are made here.



In the first section, settings for the graphic area in the "Live Data" navigation tab can be configured. The Y-axes for counts and moisture can be scaled.

You can choose whether the graphs should start from zero (0 / Max) or whether the measured value is automatically displayed in the middle of the graph (middle).

The colour of the graphs, as well as the centre line, can be selected here.



At the top right, in the Application area, the “Always on Top” checkbox can be set and ensures that the BMMScontrol software cannot be hidden by other windows.


The “Set Default Material” checkbox can be used to determine which calibration curve should be used when the sensor is restarted. The checkbox is activated by default and therefore the material last activated in the moisture measuring sensor is active even after a restart.

If the checkbox is not activated when a calibration curve is saved, it is not automatically saved as the default curve. This means that the calibration curve for which the checkbox was last active is activated as the default curve.

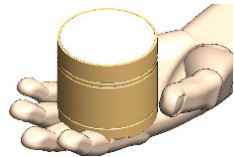
The respective storage paths can be customised using the “Folder Screenshots” and “Folder Recordings” buttons.

16 Example calibration

Put the moisture measuring sensor into operation properly as described in chapters 8 and 9. Also install the BMMScontrol calibration software on your PC.


	<p>For a reliable moisture measuring, it must be assumed that the material to be measured is brought homogeneously and with a constant density in front of the measuring surface of the moisture measuring sensor. Avoid caking on the measuring surface or material jamming! Constant measuring conditions are absolutely important and the correct installation location is crucial for the quality of the moisture measurement.</p>
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1. Open the “BMMScontrol” software
2. Connect to the moisture measuring sensor and load all sensor data. By default, the moisture measuring sensor will be in continuous measuring mode. Batch measuring must be activated separately.
3. Open the “Sensor” tab and set the offset of the moisture measuring sensor. To do this, hold the moisture measuring sensor with the measuring surface against air and compensate the measured value to 0.00 counts.



Set Offset
-3.5

Example: Measured value against air: 3.50 counts
 → Offset: -3.50 = measured value 0.00 counts

	<p>Setting the offset before calibration makes sensor replacement easier.</p>
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
4. Set moisture value of analogue output in the “Sensor” tab.

Example: 4.00mA $\hat{=}$ 0.00%
 20.00mA $\hat{=}$ 100.00%

Set Parameter	
mA	%
4.00	0.00
20.00	100.00




- Switch to the “Calibration” tab and decide whether a point-to-point calibration (material 5...8) or a polynomial calibration (1...4) is required.
Name the selected calibration curve.

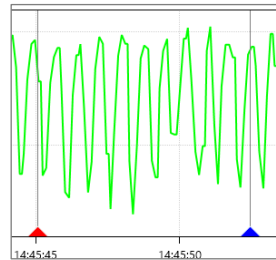
Polynom	
Id	Name
1	UntitId1
2	UntitId2
3	UntitId3
4	UntitId4
Linear	
5	Sand
6	UntitId6
7	UntitId7
8	UntitId8

Activate the selected curve using the “Material Switch”  button.






The simplest form of calibration is a 2-point calibration. At least one dry and one wet material sample is required.

- Evaluate the “Counts” displayed under “Live Data”. To do this, use the toolbar by pausing the graph in the desired measuring window with the “Pause”  button and setting two limits with the “Pen”  button. The results of the measuring window are displayed directly in the toolbar. By clicking the “Continue”  button, the graph will resume.



Counts  Move i: 100 x: 447.37 d: 96.90 Moisture  Move i: 100 x: 5.92 d: 0.49 Av. Line



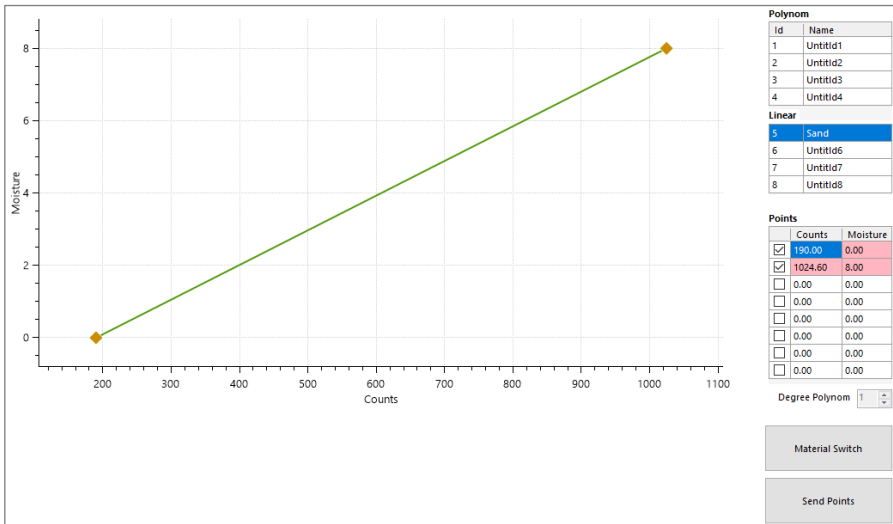
The measuring data can be easily archived via clipboard, screenshot or .csv file. To do this, select from the three buttons   .

Take a material sample from the process and evaluate it. The most common method for this is drying out in laboratory device. To rule out incorrect measurements, we recommend repeating the laboratory measurement.



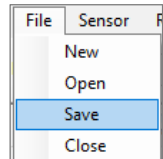
Make sure that the material sample was taken at the same time that the measured values were evaluated to avoid measuring errors.

- If there are at least two calibration points, you can enter the sensor readings and the laboratory readings in the points table. The calibration curve is shown graphically on the left.



Transfer the calibration points into the moisture measuring sensor using the “Send Points” [Send Points](#) button. The pink background switches and signals that the calibration points have been transferred.

- Check the calibration settings for plausibility.
- After calibration is complete, save your sensor data on a PC by creating a configuration file under “File” and “Save”. This can also be opened and viewed offline or written to a BMMS moisture measuring sensor.



Check the measuring results regularly using laboratory samples.

17 Warnings, faults and error messages

A malfunction of the BMMS moisture measuring sensor can have various causes and can occur on the hardware or software side.

17.1 General faults

Fault	Cause	Remedy
Operation via BMMSControl not possible	Communication between moisture measuring sensor and PC interrupted or faulty.	Briefly disconnect the moisture measuring sensor from the power supply and restart the PC.
		Check settings for calibration cable BMMScale (see 15.2).
Moisture measuring sensor delivers incorrect readings	Measuring surface dirty	Clean measuring surface.
	Measuring surface damaged	Contact ACO.
	Incorrect calibration selected	Select a different calibration or create a specific calibration.
	Incorrect operating mode	Check whether continuous or batch measuring is activated.

17.2 Warnings and error messages in BMMScontrol

In the footer on the right, plain text information about ongoing actions such as establishing a connection or instructions is displayed.

No more connection EN - ...

Errors and messages from the moisture measuring sensor are also displayed as numbers on the far right in the footer.

10 EN - ...

Code	Cause	Remedy
01	Internal temperature has fallen below -5°C. Temperature compensation no longer works reliably. Incorrect measurements possible.	Operate the sensor within the permissible temperature range.
02	Internal temperature has exceeded 85°C. Specification of the sensor electronics exceeded. This can result in total sensor failure.	
03	Temperature on ceramic disc has fallen below -12°C. End of temperature measurement.	
04	Temperature on ceramic disc has exceeded 85°C. End of temperature measurement.	
05	Internal temperature and temperature on ceramic disc have fallen below -12°C. End of temperature measurement and compensation.	
06	Internal temperature and temperature on ceramic disc have exceeded 85°C. This can result in total sensor failure.	
10	4...20mA NAMUR saturation fell below 3.8mA. Measured value cannot be output and remains at 3.8mA.	Check the current loop interface parameters.
40	4...20mA NAMUR Saturation 20.5mA exceeded. Measured value cannot be output and remains at 20.5mA.	



If you have any questions about troubleshooting, the ACO team is available to help you at any time.



FEUCHTEMESSUNG
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