HUMY 301

Continuous inline moisture measurement of bulk goods

Application

Moisture in solids is an important parameter that influences the quality of a product and the economic efficiency of production. Nevertheless, in many companies, product moisture is only determined in the laboratory. These random sample measurements are time-consuming and the results are only available with a delay.
The HUMY 301 inline moisture measurement system is the better alternative. Its real-time measurement enables an immediate response to moisture changes in the process. The measurement results can be used to control a dryer or automatic humidification or to continuously monitor the process.

Industries

Aluminum
Bakeries
Building materials
Chemical industry
Fertilizer
Power generation
Glass production
Wood industry
Mills
Food industry
Surface cleaning
Paper and pulp
Pharmaceuticals
Steel industry
Cement industry
etc.

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Manual

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Disclaimer

We have checked the contents of the printed document for conformity with the hardware and software described. However, deviations cannot be ruled out, so we cannot guarantee complete conformity. The information in this printed document is checked regularly. Corrections and additions are made in the following version. We are grateful for any suggestions for improvement.

Subject to technical changes

Contents

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1 Safety instructions and installation

Note: Installation, operation and maintenance may only be carried out by qualified personnel.

The applicable safety guidelines (including national safety guidelines), accident prevention regulations and general technical rules must be observed when installing and operating the appliance.

Note: The device's circuits must not be accessed.

Do not repair the appliance yourself, but replace it with an equivalent appliance. Repairs may only be carried out by the manufacturer.

The safety-relevant data can be found in the operating instructions or in other certificates (if required).

2 Classification of safety instructions

These instructions contain information that you must observe for your personal safety and to prevent damage to property. These instructions are highlighted by a triangular warning sign and are shown as follows, depending on the degree of danger.

WARNING

means that death or serious injury can occur if the appropriate precautions are not taken .

CAUTION

with a triangular warning sign means that minor personal injury may occur if the appropriate precautions are not taken .

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CAUTION

without a triangular warning sign means that material damage may occur if the appropriate precautions are not taken.

ATTENTION

means that an undesired result or an undesired state can occur if the corresponding instruction is not followed.

NOTES

indicates important information about the product, the handling of the product or the respective part of the documentation, is intended to draw particular attention to it and must be observed .

In addition to the instructions in this manual, the generally applicable safety and accident prevention regulations must be observed. If the information contained in this document is not sufficient in individual cases, you can obtain further information from our telephone service. Please read these instructions carefully before installation and commissioning.

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3 General instructions

This device left the factory in a technically immaculate condition. To maintain this condition and ensure safe operation of the device, the user must observe the instructions and warnings in these operating instructions.

For reasons of clarity, the manual does not contain all detailed information on all product types and therefore cannot cover every conceivable case with regard to installation, operation and maintenance .

If you require further information or if specific problems arise that are not covered in sufficient detail in the manual, you can obtain the necessary information by telephone.

Furthermore, we would like to point out that the content of this manual is not part of a previous or existing contract, agreement or legal relationship, nor is it intended to modify it. All obligations of Mütec Instruments GmbH arise from the respective purchase contract, which also contains the complete and solely valid warranty provisions. These contractual warranty provisions are neither extended nor restricted by the information contained in the manual.

The content corresponds to the current state of printing technology. We reserve the right to make technical changes in the course of further development .

WARNING

The correct and safe operation of this appliance requires proper transportation, storage, installation and assembly as well as careful operation and maintenance. The appliance may only be used for the purposes specified in these operating instructions .

DISCLAIMER

All modifications to the device are the responsibility of the user, unless expressly stated otherwise in the operating instructions .

VALIDITY

The data sheet is only valid for the HUMY 301 described and the hardware/firmware version specified in the technical data

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QUALIFIED PERSONNEL

Qualified personnel are persons who, due to their training, experience and instruction as well as their knowledge of relevant standards, regulations, accident prevention regulations and operating conditions, have been authorized by the person responsible for the safety of the system to carry out the necessary planning and activities and are able to recognize and avoid potential hazards.

PREREQUISITES

The specialist personnel must have knowledge in the following areas:

- Handling and knowledge of and about security products
- Applicable EMC regulations
- Applicable regulations for occupational safety and accident prevention
- Installation or assembly of the security product
- Commissioning, monitoring and maintenance of the security product
- Knowledge of devices / systems in accordance with safety engineering standards for electrical circuits
- Training or instruction in accordance with safety engineering standards in the care and use of appropriate safety equipment

SAFETY INSTRUCTIONS

The safety regulations of electrical engineering and the employers' liability insurance association must be observed and complied with. Failure to observe the safety regulations may result in death, serious injury or considerable damage to property.

DIRECT / INDIRECT CONTACT

Protection against direct and indirect contact in accordance with VDE 0100 Part 410 must be ensured for all components connected to the system. In the event of a fault, there must be no dangerous voltage carry-over.

INSTALLATION, COMMISSIONING, MODIFICATION

Installation, commissioning, modification and retrofitting may only be carried out by qualified personnel. Before starting work, the appliance must be disconnected from the power supply. The wiring must be carried out and checked in accordance with the intended use. Separate cable routing for the high voltage on the one hand and all other circuits on the other is recommended

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SWAPPING AND REVERSING THE CONNECTIONS

Take measures to avoid mix-ups, reverse polarity or tampering with the connections

DAMAGED DEVICE

If a fault occurs, the device may be damaged. Correct and safe operation is then no longer guaranteed and the device should therefore be replaced. Only the manufacturer or a person authorized by the manufacturer may open the housing and repair the device. Failure to do so will invalidate the warranty.

DECOMMISSIONING AND DISPOSAL

The device must be disposed of in accordance with environmental regulations. It must be ensured that a defective device cannot be reused .

CE mark, declaration of conformity

The devices are built and tested in accordance with the state of the art for operational safety and have left the factory in a technically safe condition. The devices comply with the relevant standards and regulations in accordance with EN 61010 "Safety requirements for electrical equipment for measurement, control and laboratory use". The measuring system described in these operating instructions therefore fulfills the legal requirements of the EC directives. Mütec Instruments confirms the successful testing of the device by affixing the CE mark

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4 Technical data

4.1 Transmitter

General data

Housing

Material:	PBT
Protection class:	IP20
Flammability class:	VO according to UL
Dimensions (WxLxH):	22.5 mm x 114.5 mm x 99 mm without clamps
Weight:	250 g
Design:	Terminal enclosure for mounting rail installation
Mounting/installation position:	any

Limit values

Permissible temperature:	-10 °C ... +60 °C
Storage/transport:	-10 °C ... +70 °C
Perm. humidity during operation:	10 % ... 95 % RF. without condensation

Moisture measurement

Measured value:	0-85% relative humidity (RF) or 15-100% dry matter (TR)
Representation:	Percentage value with max. 3 decimal places
Accuracy:	max. 0.1 %
Average value:	0-999 seconds
Filter value:	0-999.9 seconds
Temperature coefficient	
Maximum:	<0,05 %/K
Typical:	<0,03 %/K
Product memory:	max. 24 product calibration curves

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Energy supply

Supply Voltage:	24 VDC (18..30V)
Power consumption:	max. 2.0 W

Analog output:

Output value:	up to 22 mA / 11 V
Accuracy:	40 uA / 20 mV
Load (mA):	up to 500 Ohm
Burden (V):	up to 50 kOhm
Rise time:	max. 150ms
Separation:	galvanically isolated

Switching outputs

Relay outputs:

Contact:	NO (normally open contact)
Switching voltage:	30 V,AC/DC
Switching voltage:	1 A,DC / 0.3 A,AC
Switching capacity:	30 W / 9 VA,AC

Transistor outputs:

Technology:	open collector
Switching voltage:	28 V
Switching voltage:	50mA
Max. frequency:	200 Hz
Separation:	galvanically isolated

Switching inputs:

Technology:	Optocoupler
Voltage level:	8..30 V
Separation:	galvanically isolated

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Data interfaces

USB interface:

Technology:	USB 2.0, Mini-USB
Speed:	up to 115200 baud
Supply:	galvanically isolated area: from PC
Separation:	galvanically isolated

RS485 interface:

Speed:	up to 115200 baud
Termination:	Software-controlled
Biasing:	None
Supply:	galvanically isolated area: from device
Separation:	galvanically isolated

4.2 Sensor

General data

Housing:

Material	Stainless steel 1.4301 or 1.4307
Protection class:	IP 67 according to EN 60529
Weight:	approx. 1300 g
Connection cable:	Shielded cable, 4-wire, min. 0.5 mm²
cable length:	max. 500 m

Energy supply

Supply voltage:	20 V,DC (option for 24V)
Current consumption:	Typ. 20 mA
Current limitation:	Functional supply current limitation (PTC or transistor)
Separation:	galvanically isolated

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Data connection

Interface:	RS485
Termination:	470R
Biasing:	1k0 between 0 and 5 V
Separation:	galvanically isolated
Baud rate	19200 bps
Device address:	1

Material

FMS410K:	POM
FMS410C:	Ceramic (with POM inner cup)
FMS410T:	PTFE
FMS410S:	Ceramic (with PTFE inner cup; recommended for CIP)

Limit values

Compressive strength:	max. 6 bar, short-term 10 bar
Operating temperature:	FMS410*-C,-K: 0°C to +70°C
	FMS410*-S,-T: 0°C to +80°C
Process temperature:	FMS410*-C,-K: 0°C to +70°C (non-Ex up to 90°C)
	FMS410*-S,-T: 0°C to +90°C
	with protection cap and passive cooling housing up to max. 120°C possible (non-ex)
Storage temperature:	-10 to 80°C

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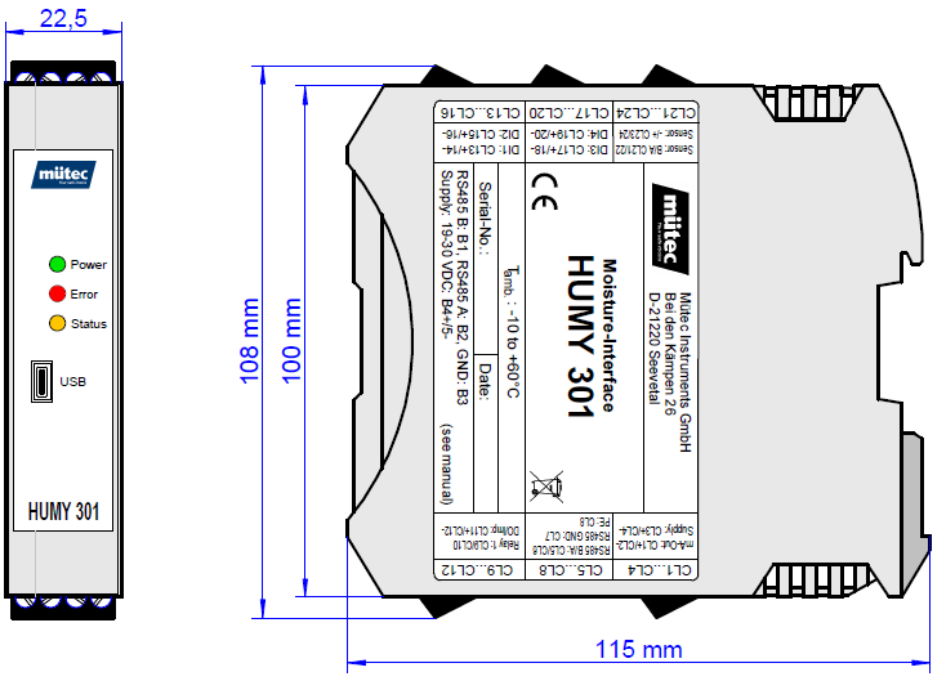
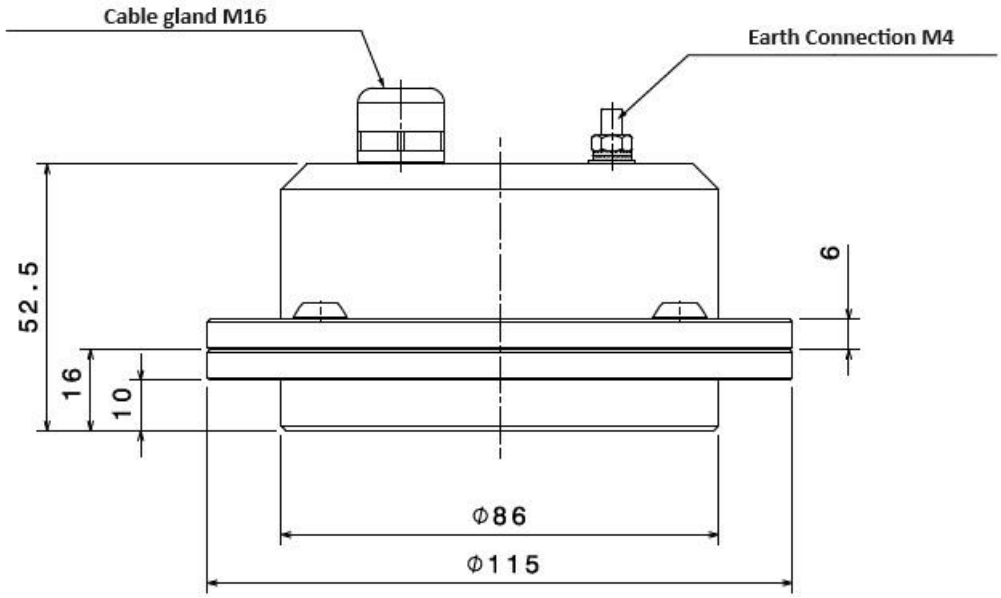
5 Dimensions

5.1 Transmitter



5.2 Sensor



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6 Intended Use

The moisture measuring system consists of the **HUMY 301** control and evaluation unit in a top-hat rail housing and the **FMS 410** moisture sensor. The inline measuring system for process monitoring guarantees trouble-free measurement of the internal product moisture of solids and emulsions. A PC-supported user interface with a clear display of the measurement, alarm and MIN/MAX values, combined with simple editing and parameterization, enables uncomplicated and simple operation.

The sensor surface must be in direct contact with the product. If this is not possible, the HUMY can measure through a separator made of glass or plastic. Air between the material and the separator must be avoided.

A constant product flow across the sensor is important. Static measurements should be avoided. Material height at the measuring point should be constant (e.g. by using a vessel on a conveyor belt). If this is not possible, the material height should be at least 10 cm.

The speed of the material must be constant. The bulk density must be constant or different calibration curves must be created for each product with different bulk density.

Calibration is carried out with the process running and with at least two points (highest and lowest possible moisture content), preferably with up to 5 points. The samples must be taken close to the sensor at the time when the raw value for the calibration point is determined.

7 Measuring principle

The HUMY probe for capacitive moisture measurement is based on the open capacitor principle. The bulk material in front of the measuring surface serves as the dielectric of the measuring capacitor. Electronic measured value processing and temperature compensation in the probe enable reliable data transmission even over long distances.

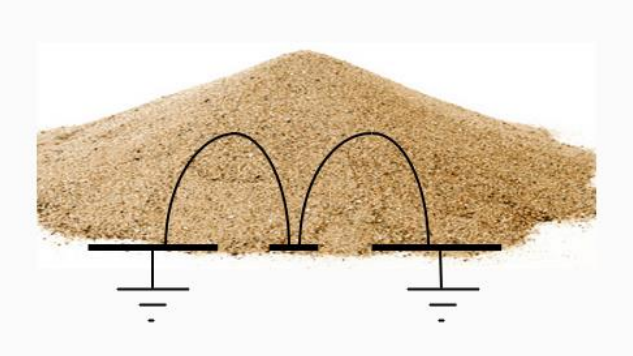

Figure 3: Measuring principle

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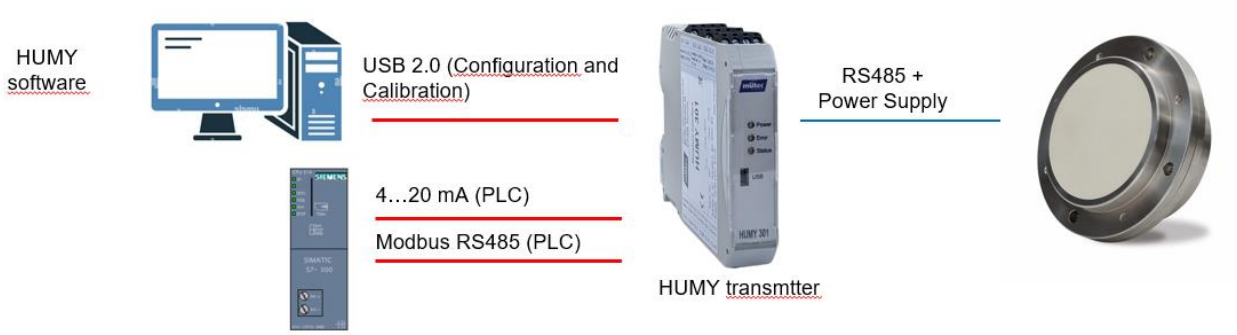
8 Setup of the Sensor

Built into a solid cylindrical stainless steel housing, the probe is largely insensitive to external influences. A special internal encapsulation protects the entire electronics from the ingress of moisture and increases resistance to alkalis, acids and solvents. The electrical connection is made via a fixed cable connection in the probe and guarantees IP67 tightness thanks to the high-quality PG screw connection. The thickness of the dielectric can be between 20 and 100 mm and is determined by the type of bulk material. Electrical conductivity, pH value or surface structure have no influence on the measurement, but the density does. The measuring surface of the sensor is sensitive and must be protected from mechanical influences. For special applications with an increased risk of abrasion, it is reinforced by an attached ceramic disk.



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9 Assembly

9.1 Mounting of transmitter

The ME-MAX housing can be combined with a 5-pole TBUS connector/ DIN rail connector. The RS485 interface and the supply voltage can be conveniently wired through via the TBUS connector snapped into the top-hat rail. The TBUS connection is set up automatically in the grid of the devices involved. Time-consuming pre-planning or reworking of the TBUS connection on site is therefore a thing of the past.

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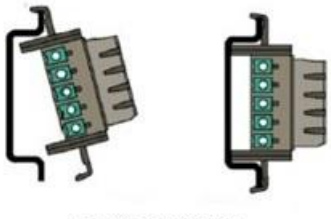
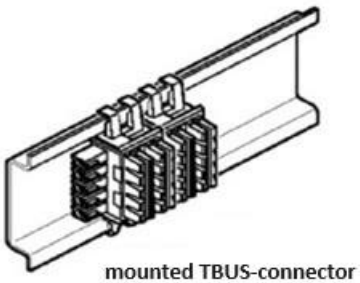
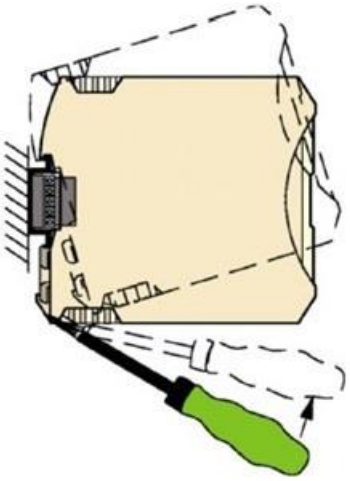


TBUS-connector



mounted TBUS-connector



Assembly and disassembly of the housing

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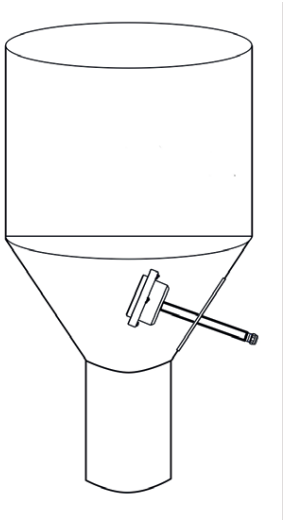
9.2 Mounting of sensor

The HUMY 301 is designed for continuous moisture measurement in the production flow. The prerequisite for correct moisture measurement in bulk materials is always the correct choice of installation location for the moisture probe. With bulk material chutes or conveyor belts, care must also be taken to ensure that the measured material is guided over the probe with as uniform a layer height as possible.

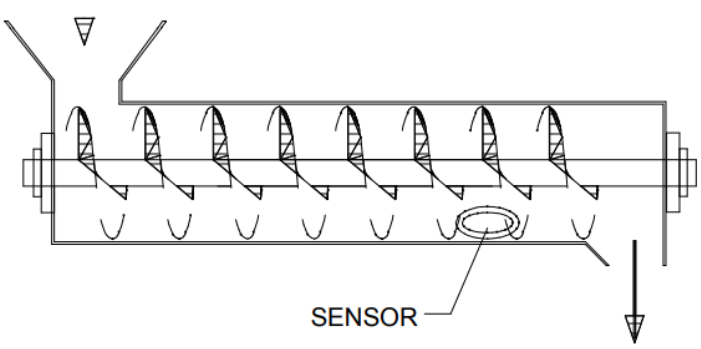
9.2.1 Silo

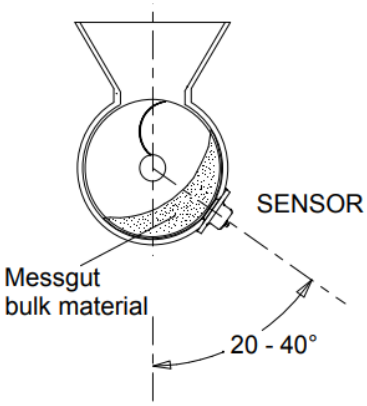
Installation on the discharge hopper of a silo



9.2.2 Screw conveyor

Mounting the moisture sensor at the outlet of a screw conveyor





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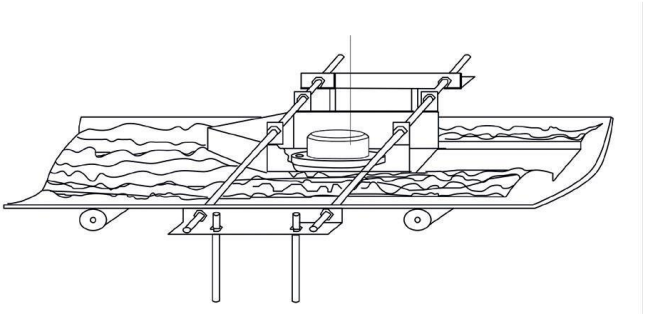
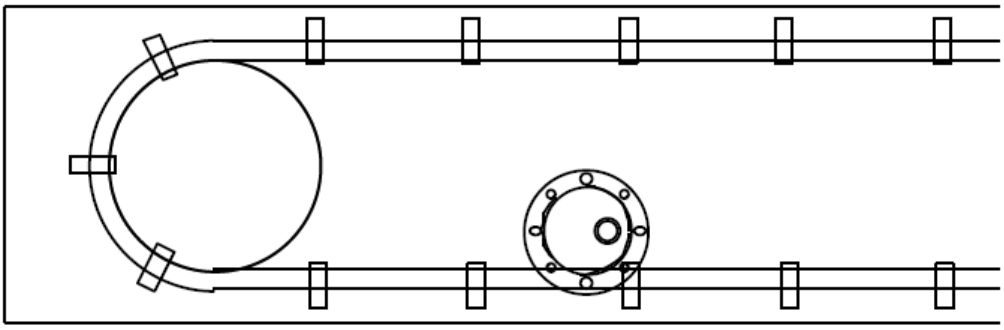
9.2.3 Conveyor belt

Installation on a conveyor belt



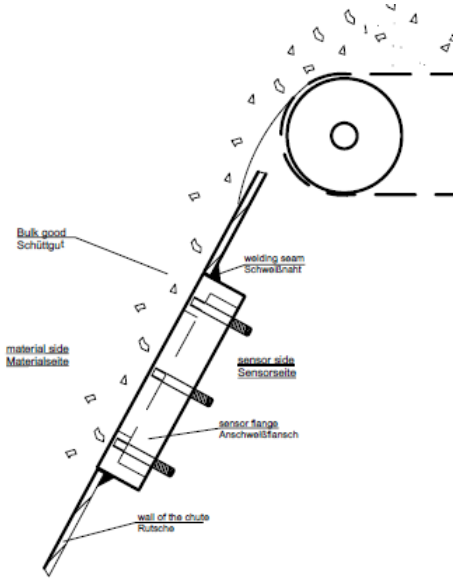
9.2.4 Trough chain conveyor

Installation on a trough chain conveyor



9.2.5 Slide

Installation on a slide



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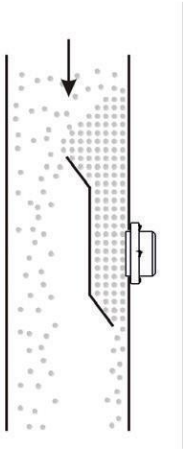
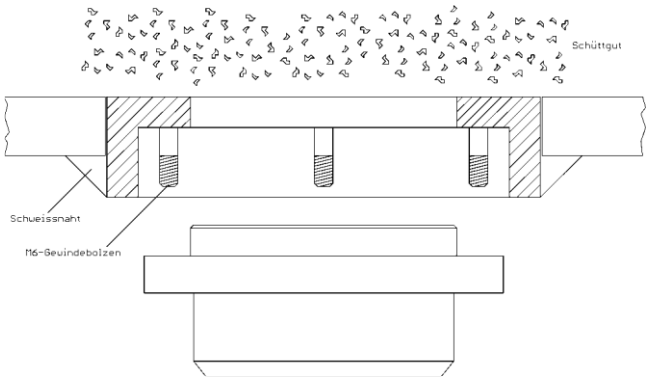
9.2.6 Free-fall tube

Installation in a free-fall application:



9.2.7 Installation with a separating layer

Indirect installation of the HUMY probe is necessary if the wall thickness is 10 mm or more or if the wall is curved. In such cases, the use of a weld-on flange is recommended.



9.2.6 Mounting with a protective cap

The measuring window must be in direct contact with the material to be measured. A neutral separating layer between the probe and the material to be measured is also permissible. The separating layer can, for example, consist of the material to be measured (layer formation on the probe), plastic, glass or similar material. A metallic material as a separating layer or measuring window is not permitted. The separating layer as protection for the probe may be up to 30 mm.

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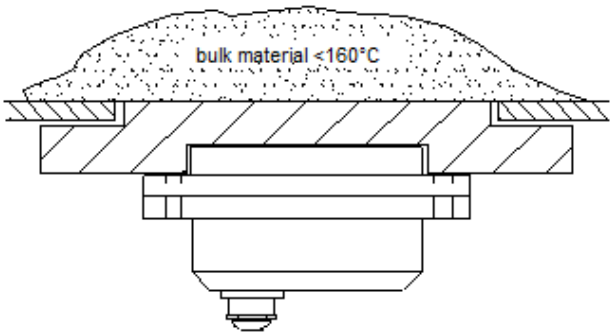

The recommended arrangement for chain conveyors or for measuring media with a temperature of over 80°C up to a maximum of 120°C is the use of a separating layer of 5 to 15 mm. The permissible thickness depends on the material to be measured and the residual water content. The measuring surface of the moisture sensor must always have mechanical contact with the separating layer.

9.3 Outdoor installation

Due to the measuring principle, operation of the sensor at temperatures below 0°C is not possible.

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10 Electrical connection

10.1 Transmitter terminal assignment

Terminal 1	mA out (+)	Terminal 13	DI 1 (+)
Terminal 2	mA out (-)	Terminal 14	DI 1 (-)
Terminal 3	Supply (+)	Terminal 15	DI 2 (+)
Terminal 4	Supply (-)	Terminal 16	DI 2 (-)
Terminal 5	RS 485 (B)	Terminal 17	DI 3 (+)
Terminal 6	RS 485 (A)	Terminal 18	DI 3 (-)
Terminal 7	RS 485 (GND)	Terminal 19	DI 4 (+)
Terminal 8	PE	Terminal 20	DI 4 (-)
Terminal 9	Relay 1	Terminal 21	Sensor B
Terminal 10	Relay 1	Terminal 22	Sensor A
Terminal 11	DO / Imp (+)	Terminal 23	Sensor (-)
Terminal 12	DO / Imp (-)	Terminal 24	Sensor (+)

10.2 Terminal assignment top-hat rail

Terminal B1	RS 485 B
Terminal B2	RS 485 A
Terminal B3	RS 485 GND
Terminal B4	Supply (+)
Terminal B5	Supply (-)

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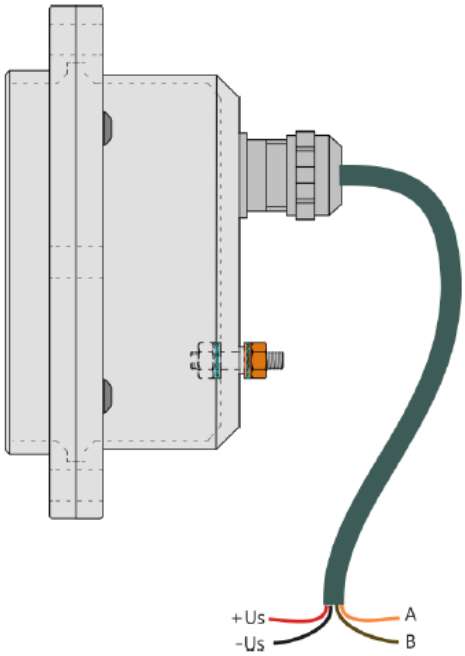

The cable shield is connected to the earthing contact in the probe. If the cable shield is also earthed at the other end of the cable and there is a significant potential difference between the two earthing points, a considerable equalizing current flow across the cable shield can be the result.

Risk of electric shock! Do not install or wire the device under mains voltage. Failure to observe this can also lead to the destruction of parts of the electronics. The device is earthed via the earthing screw on the housing (minimum 4 mm), see **Figure 1.** Ensure that earthing has been completed before wiring! - Compare the label information with the existing supply voltage. Observe the applicable national installation regulations.

10.3 Installing the cables

The sensor is supplied with a 3 m connection cable as standard. The connection cable must be permanently installed for safe operation of the sensor, e.g. in a cable duct.

11 Commissioning

11.1 Switching on the measuring system

1. ensure that all cable connections are made correctly.

2. apply operating voltage.

3. operational readiness is indicated by the green POWER LED on the front panel.

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12 Introduction to the HUconfig software

The **HUconfig-301** configuration software is installed on a Windows PC (Windows 7, 10, 11) and is used to calibrate and parameterize the **Humy 301** inline moisture measurement system and for graphical analysis of the process. The measured values are stored on the hard disk of the connected PC or laptop and can be retrieved later, e.g. for offline calibration.

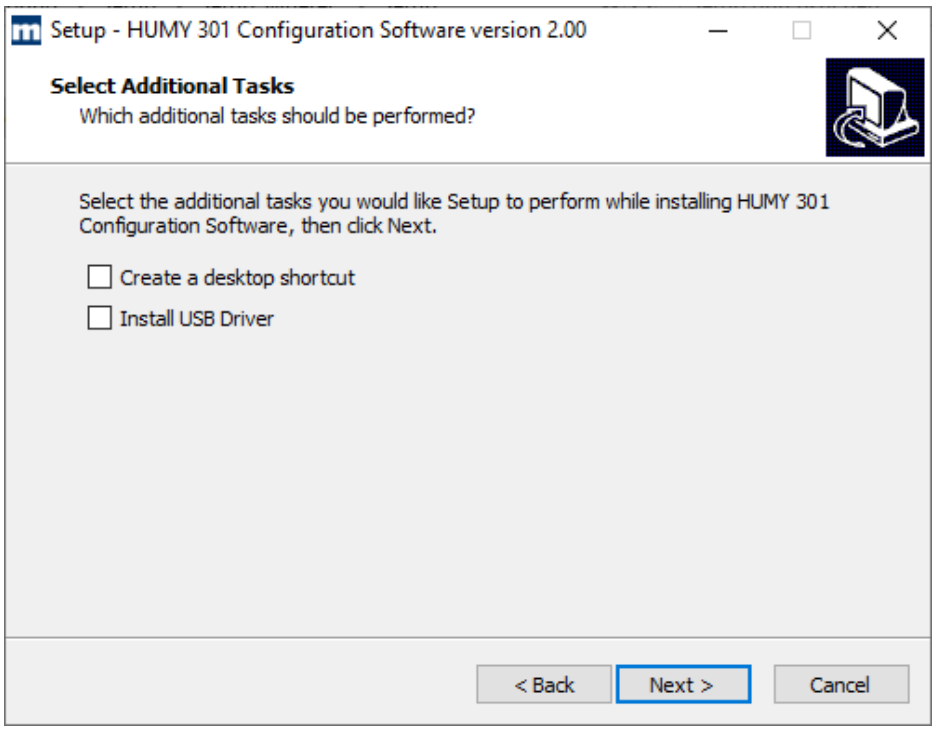
The software can manage up to 8 Humy301/FMS410 measuring systems. Switching between the pre-calibrated products with the help of the software is done later via the digital inputs of the transmitter (e.g. with a binary coded switch) or via a Modbus RTU command using a connected PLC.

In order to be able to make settings in the HUMY-301 transmitter, all electrical connections must be in place.

Before starting the **HUconfig-301** program, the transmitter is connected to a PC via the USB interface on the front.

13 Installing and configuring the software

The setup wizard for installing the software on the laptop/PC is started with the file "*Humy 301 Configuration Setup.exe*". After selecting the installation directory, it is possible to install the driver for the USB connection automatically (only necessary if there was no connection to a Mütec transmitter or other device with a USB interface before):



The software starts automatically after completing the setup wizard or can be started manually in the selected installation directory by double-clicking on the "*Huconfig.exe*" file.

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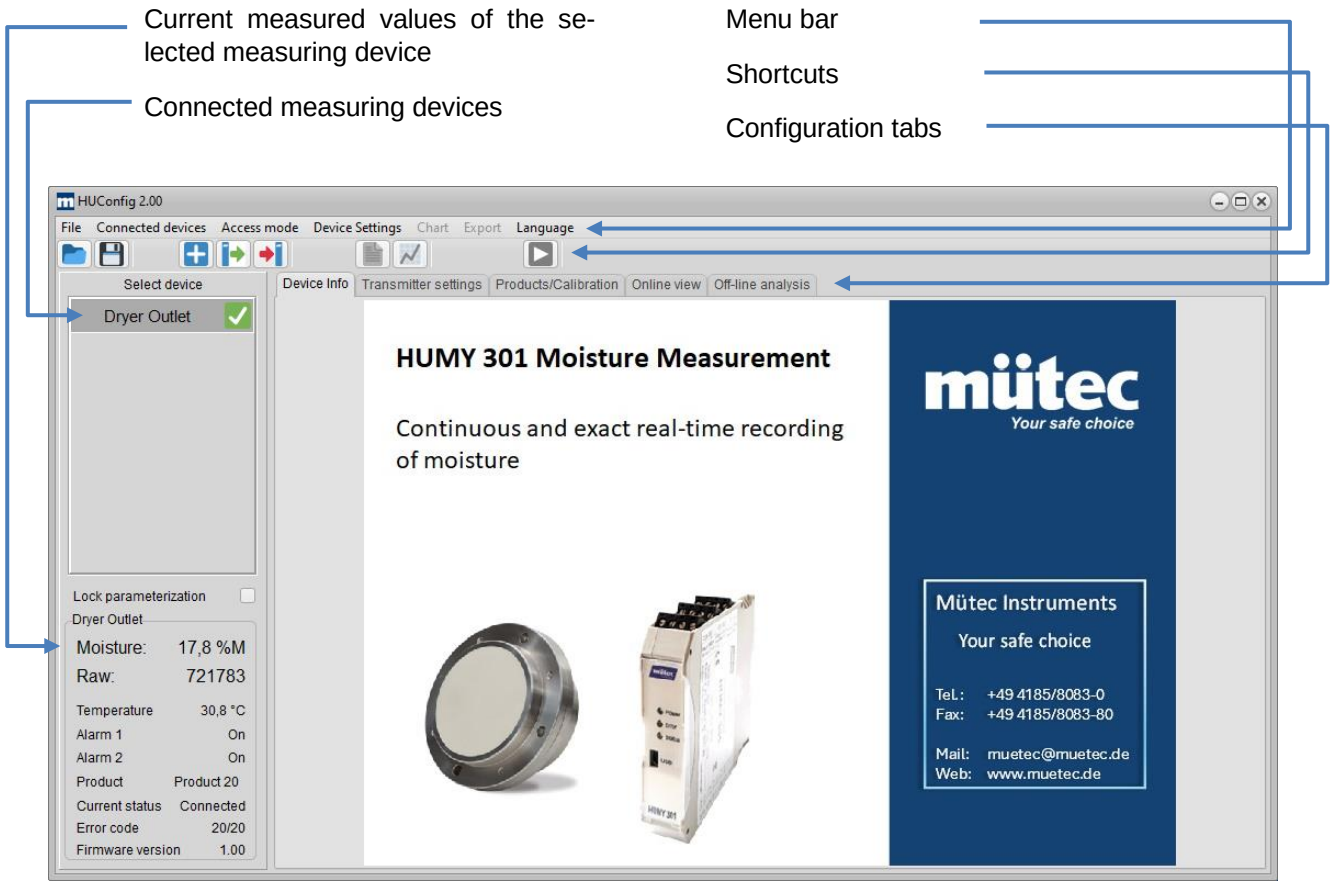
13.1 The start screen

After starting the software, the connected measuring systems (left) and the configuration menu (right) with the most recently edited configuration folder are displayed.



13.2 Selecting the language

The software package contains the language files 'German_Muetec.lngpack' and 'English_Muetec.lngpack'. The files can be translated into different languages. After restarting the software, all available language files appear in the 'Language' menu. Please contact your Mütec sales team for the implementation of new language files.

Selecting the access mode

In general, two different modes are available in the software:

1. Standard mode (for all essential basic settings)
2. Expert mode (for experienced users)

These are selected via the "Access mode" menu.

The software always starts in standard mode.

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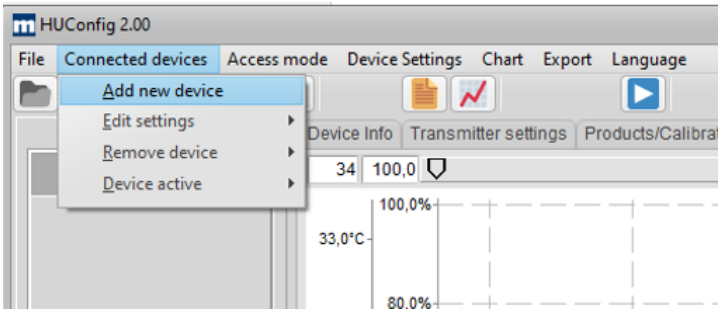
13.3 Connect Humy 301 transmitter to PC

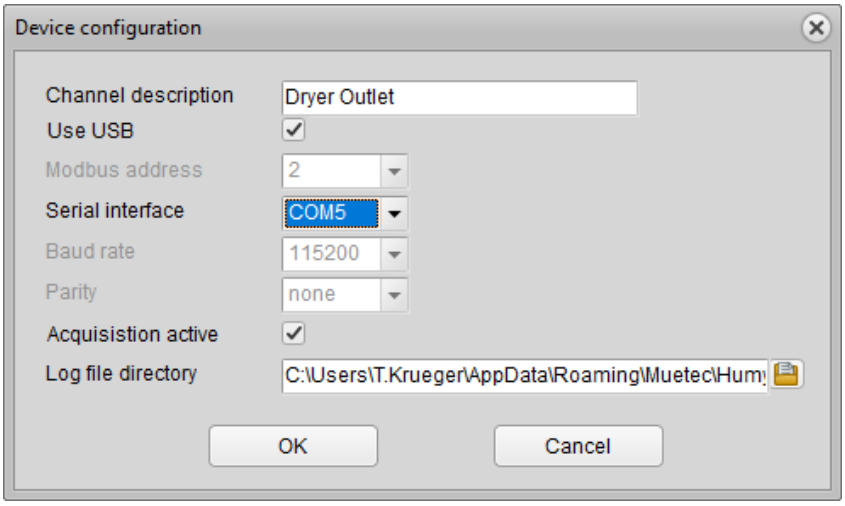
A physical connection to the laptop/PC must be available to configure the transmitter. If the transmitter is successfully connected, a virtual COM port is created in the Windows Device Manager. If this is not the case, please install the supplied USB driver manually. You will find the driver in the selected installation directory in the DRIVER folder.

Up to 8 HUMY 301s can be displayed and configured via the software. A USB hub can be used when connecting several Humy 301 transmitters.

Add the new measuring system in the menu bar via '*Device management*' ► '*Add new device*', by right-clicking in the "Select device" field or via the icon 



A window for configuring the measuring system and the COM port appears:



Channel description:	Designation of the measuring point (freely configurable)
Use USB:	Activate this field if the transmitter is connected via USB. The baud rate is then automatically set to 115 k baud. Alternatively, communication can also take place via the additional RS485 interface (terminals CL5 ... CL7).
Serial interface:	COM port of the transmitter (connected COM ports are automatically recognized by the software)
Data acquisition active:	Activation of the data query from the transmitter to the PC
Log file directory:	Selection of the Windows directory for saving the measured values

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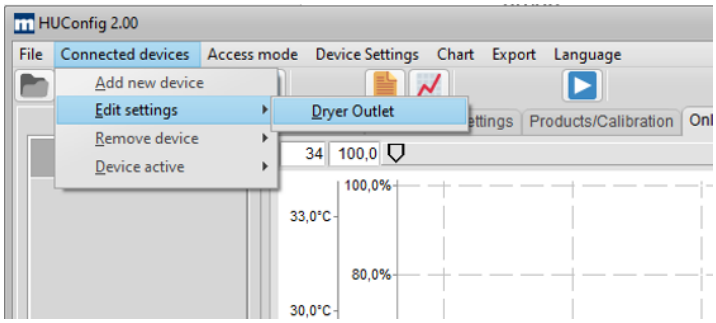
The settings and the selection of the directory for data storage can be changed in the menu via '*Device management*' ► '*Edit settings*' ► *"Name of the device":*

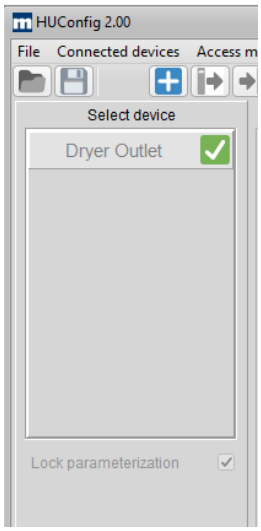


If the connection to the transmitter is successful, a green tick appears next to the device. displayed.

13.4 Selecting and activating the Humy 301 transmitter

For parameterization and calibration, the parameters are loaded by clicking on the device. The current measured values (raw value, scaled humidity value, sensor temperature) and the status of the transmitter are displayed in the status field.

The parameters can be locked by clicking on the 'Lock parameterization' checkbox to prevent any incorrect parameterization of the active device:



In 'Lock parameterization' mode, the connection to the transmitter is still active and recording of the measurement data continues.

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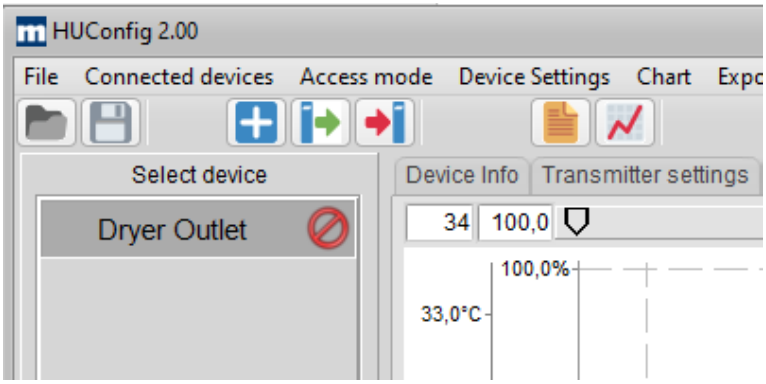
13.5 Deactivate transmitter

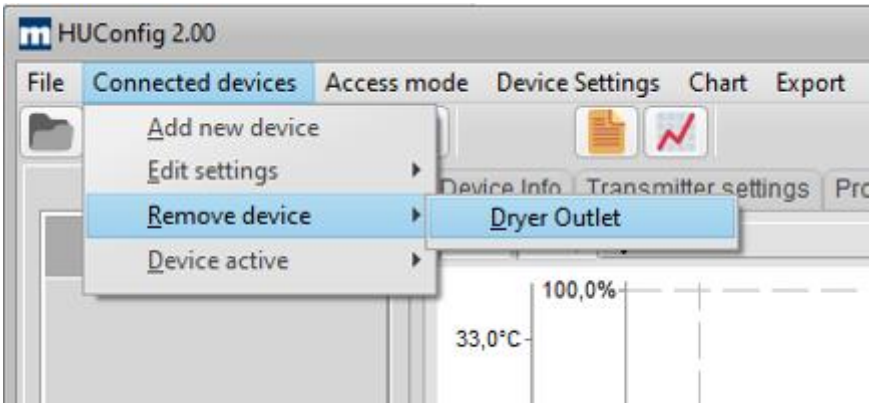
To reduce the data rate when several transmitters are connected, the connection can be disconnected via the menu item 'Device management' ► 'Device active' ► "*Name of device*" or by right-clicking on the device:

A deactivated device is symbolized with a red circle and data recording for the device is interrupted:



13.6 Remove device

A measuring system can be removed from the workspace via the menu bar or by right-clicking on the device to be deleted:



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14 Parameterization of the measuring system

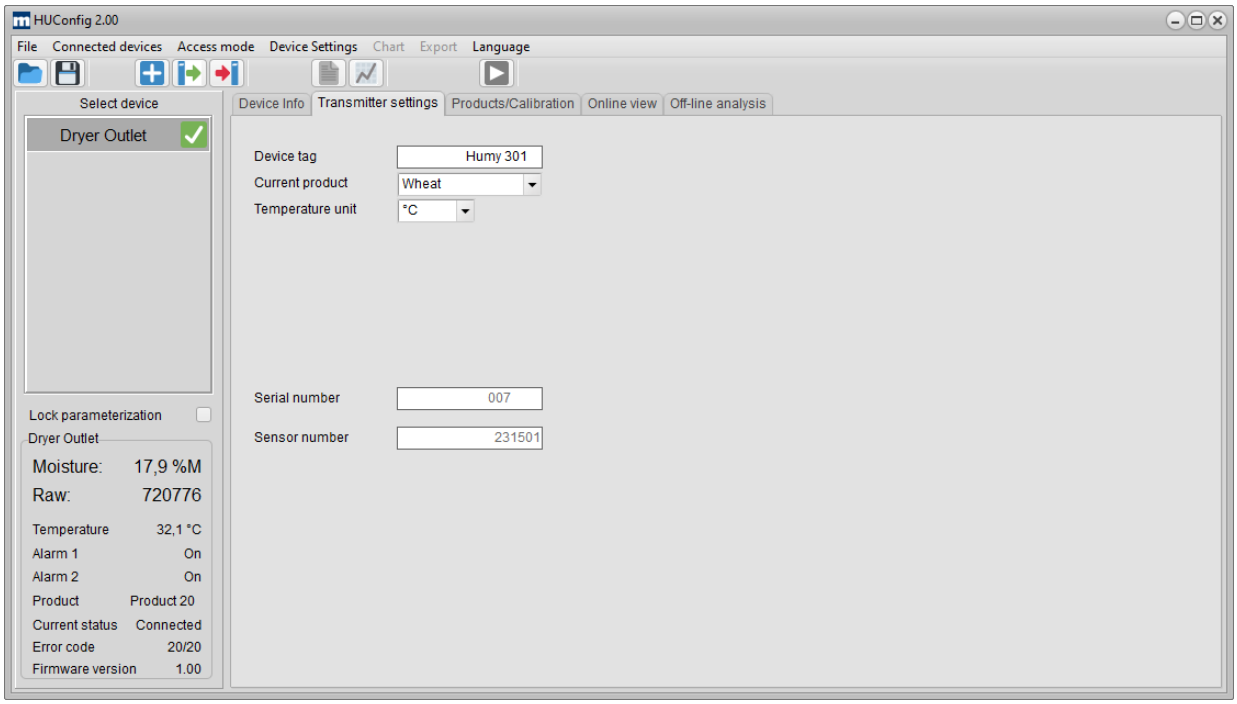
14.1 Parameterization in standard mode

The basic settings of the moisture measurement system can be made in standard mode. Standard mode is set via the '*Access mode*' ► '*User'* menu. Parameterization and calibration are carried out via the configuration tabs.

Changes to the parameters only take effect when the parameter set is written to the transmitter using the command '*Device settings*' ► '*Write configuration*'

14.1.1 Transmitter settings

The basic settings of the transmitter are made in this menu item.



Device tag:	Designation of the measuring point (freely configurable)
Current product:	Selection of the current product whose calibration values are currently to be used (24 products can be stored)
Temperature unit:	Temperature display in °C or °F
Serial number:	Serial number of the transmitter (assigned ex works)
Sensor number:	Serial number of the connected FMS410 sensor

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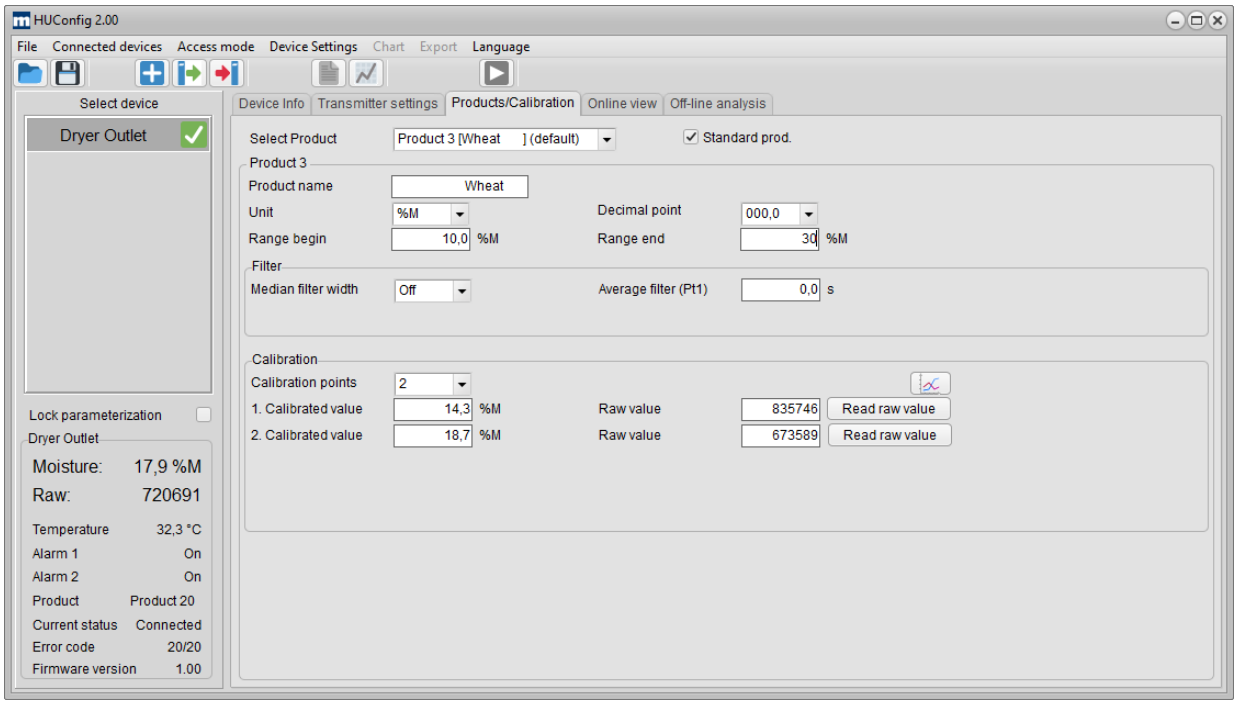
14.1.2 Products/Calibration

Menu for configuring the product-specific parameters and for calibrating the products. Up to 24 different products can be stored.



Select product: Select the product whose parameters or configuration are to be changed.
If the "Current product" checkbox is set, all changes relate to the product currently in use, i.e. the data has an immediate effect on the displayed moisture values after uploading to the transmitter.
If the "Current product" checkbox is not set, other products in the database can be adjusted "offline".

Product name: Definition of the product name (freely configurable)

Unit: Unit of the output value (%M: relative product moisture, H_2O: water content, %DS: dry mass)

Decimal point: Decimal point for the displayed digital value

Range start: Scaling of the analog output to increase the resolution. The specified start value corresponds to the analog output value 4mA

End of range: End value of the measuring range of the analog output. The specified end value corresponds to the analog output value 20mA

Calibration points: Number of measuring points for the calibration curve of a product (2-5 points). At least two measuring points must be used.

Calibrated value: Input of the laboratory value for the product moisture

Raw value: Raw measured value of the sensor during calibration

Record raw value: This integrates the current raw value over the calibration time and calculates and enters the average value

The calibration of the measuring system is described in chapter 6.

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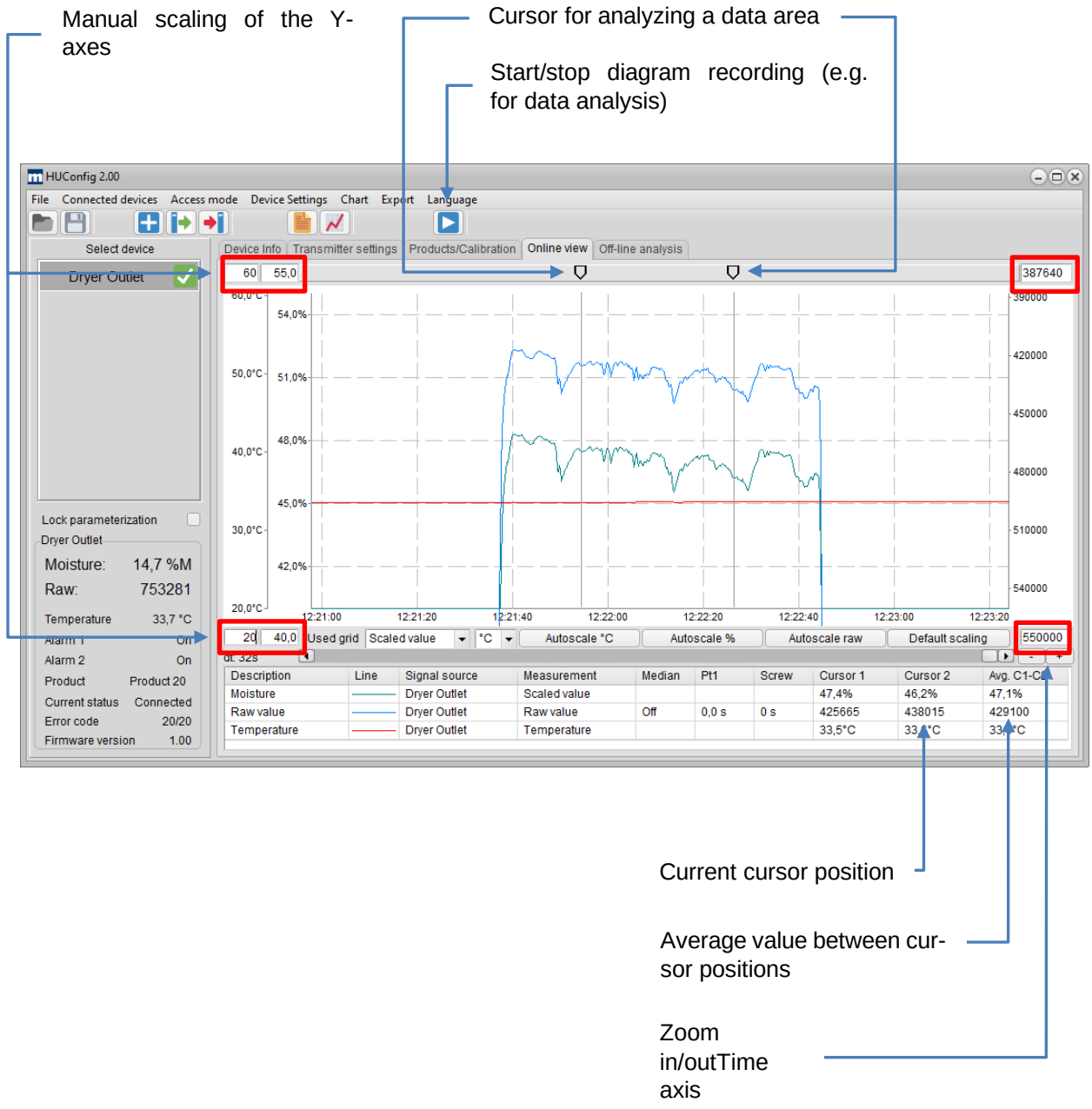
14.1.3 Online view

In the online display, up to 8 measured values from different Humy301 transmitters can be displayed simultaneously. The following measured values can be selected for the online display:

Scaled value:	Moisture value of the selected product (calculated according to the stored calibration curve)
Raw value:	Unfiltered raw value of the measuring probe in digits
Temperature:	Current temperature of the measuring probe
Din1 ... Din4:	Status of the digital inputs (e.g. ext. trigger signals)

The display area can be freely configured with the following control elements:



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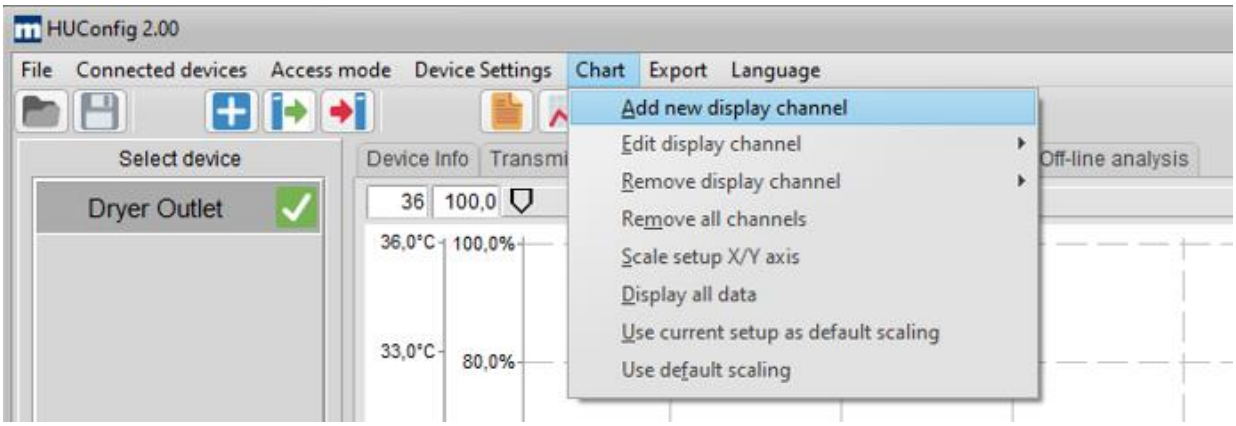
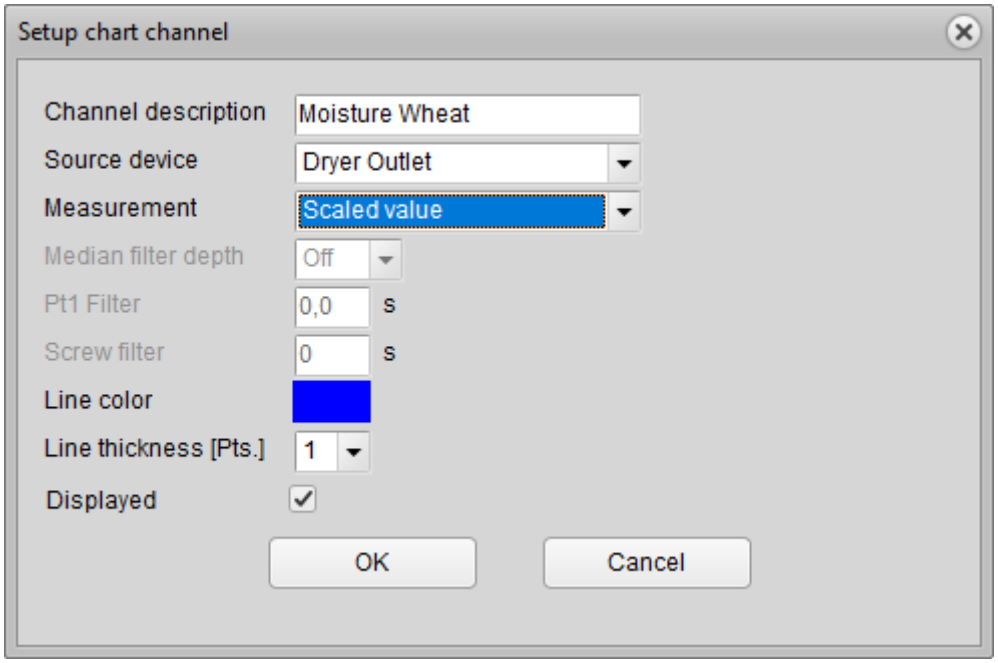
Grid used:	Selection of the measured value to which the grid is related
Autoscaling °C:	Automatic scaling of the temperature axis to the optimum display range. The scaling of the Y-axis changes after pressing the button
Autoscaling %:	Automatic scaling of the Y-axis for the moisture values to the optimum display range
Autoscaling raw:	Automatic scaling of the Y-axis for the raw values to the optimum display range
Standard scaling:	All measured value diagrams are scaled to the preset values in the 'Scaling X/Y axis' menu

Add new display channel:

To display a measured value in the diagram in real time, a new measured value curve is added in the 'Diagram' - 'Add new display channel' menu or by right-clicking in the diagram area.



The configuration window for the new measuring channel appears:



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Description:	Description of the measured value (freely configurable)
Source device:	Selection of the moisture measuring system (max. 8 measuring systems can be managed)
Measurement:	Selection of the measured value for the online display (see above)
Median/Pt1/screw filter:	Setting the measured value filters for the online display (only if 'Raw value' is selected). The filter setting affects the entire signal curve.
Line color:	Selection of the line color of the measured value curve
Line thickness:	Selection of the line thickness of the measured value curve
Display:	The line course is only displayed when activated

The measurement channel is then listed below the display area. To analyze the measured moisture values, the data flow can be interrupted using the 'Pause' button, e.g. to calculate the average value between the cursor positions. The signal can be enlarged for analysis:

Zoom in/out:	Time resolution of the signal with the "+/-" buttons
Free zooming:	By drawing a rectangle around the signal area to be analyzed with the mouse

Edit display channel:

The settings of a channel can be changed in the '*Diagram*' ► *'Edit display channel'* menu (alternatively, the menu is displayed by right-clicking in the diagram area) or by double-clicking on the channel line in the lower area of the diagram.

Delete display channel:

A channel can be deleted from the diagram in the '*Diagram*' ► '*Remove display channel'* menu (alternatively, the menu is displayed by right-clicking in the diagram area). All channels are deleted from the diagram in the '*Diagram*' ► '*Remove all channels'* menu.

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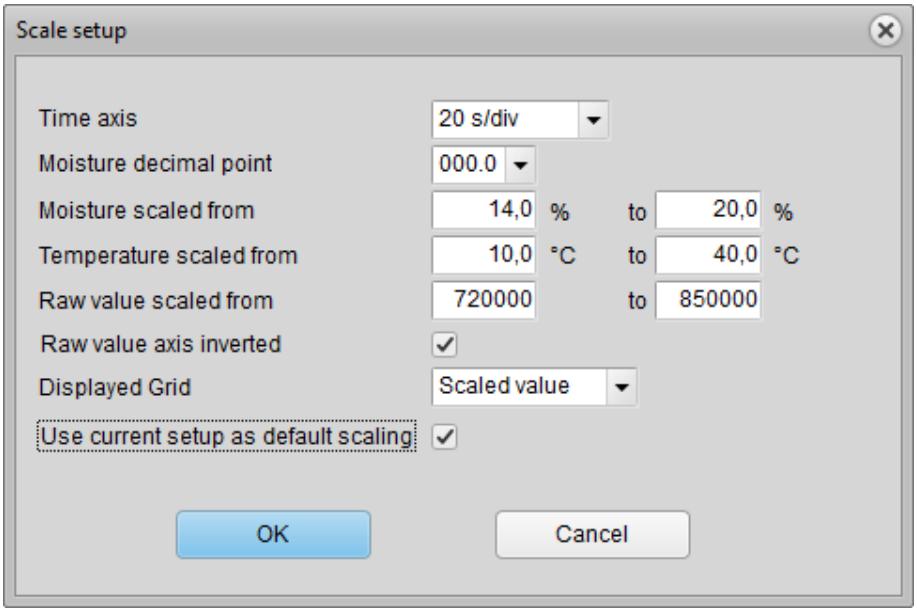
Scaling of the measured values:

Basic settings for manual scaling of the measured values and the time axis can be made in the '*Scaling*' ► '*Scaling X/Y axis'* menu.



By activating the *'Use default scaling'* option, the settings for the diagram are saved. If a diagram section is changed using the zoom function, the saved scaling setting can be restored in the '*Diagram'* menu ► '*Use default scaling*' or by clicking on the '*Default scaling*' button below the diagram area.

Alternatively, the scaling can be automatically adopted from the diagram. The current scaling settings for the X and Y axes are saved in the '*Diagram*' ► '*Use current setting as default scaling*' menu.

The '*Diagram'* function ► '*Show all data*' displays all measured values since the start of recording in a diagram.

Take over raw value for calibration

High-performance moisture measurement requires precise calibration under constant process conditions. The diagram module offers the option of marking the most stable measured value range with the cursor and saving the average value between the cursors as a calibration point.

First optimize the filter settings and then position the cursor on the desired range. Right-click on the measured value 'Avg. C1-C2' of the raw value and select the desired calibration point.

In the following example, the moisture value of the measurement sample was determined in the laboratory at 14.3%. Select 'Dryer output - Calibration point 1 - 14.3%' to take over the raw value for the calibration. The second calibration point can be determined graphically in the same way.

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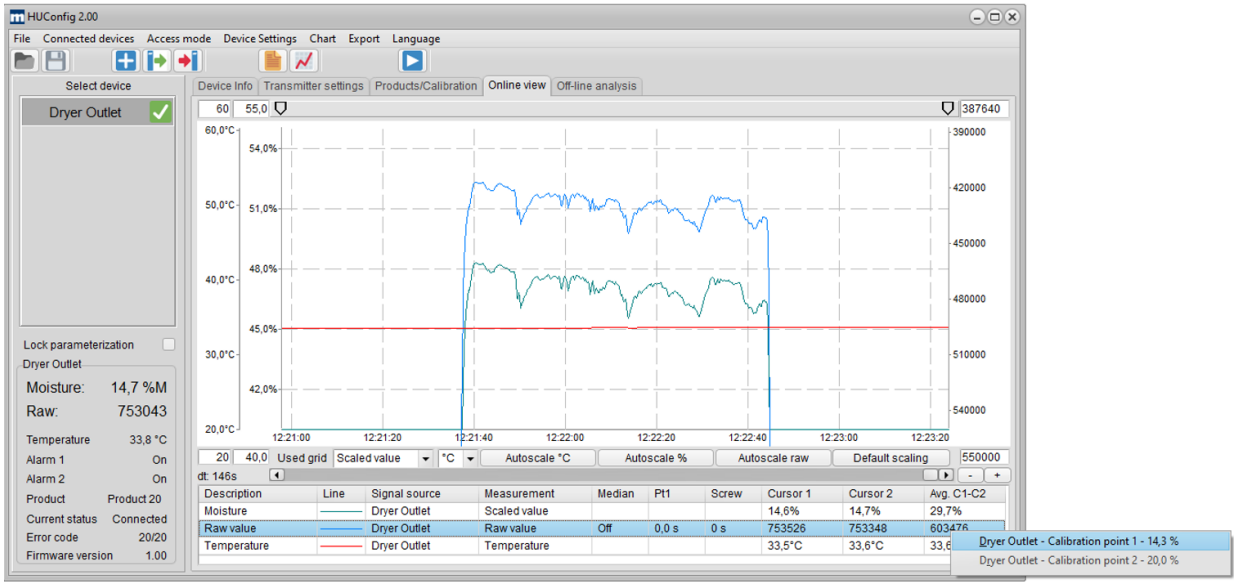

Export measured values

The displayed measured values can be exported as a csv file or as a bitmap for documentation purposes.

Export as csv file: In the menu '*Export*' ► '*Export displayed data (.csv)'* or via the button 

Export as bitmap: In the menu *'Save diagram as bitmap'* or via the button 

Settings for csv-export: Choose decimal point (. or ,) and delimiter for the evaluation in Excel

14.1.4 Offline analysis

Stored measured values can be displayed and evaluated in the offline view. All measured values of a device are saved in a file. One file is created per day and device and saved in the selected file directory. The data is saved on the hard disk of the PC or laptop connected to the transmitter.

To analyze the stored data, a new display channel is first created by selecting the log file. The name of the log file consists of the device name, the serial number of the transmitter and the date of the recording.

Example:

The measured moisture value from 16.05.2024 is to be analyzed for the "Dryer output" measuring point. To do this, define the name of the measuring channel in the '*Diagram'* ► '*Add new display channel'* menu and select the 'Dryer *output_008_20240516'* file. All measurement data from 16.05.2024 are available. To display the measured moisture value, the '*Scaled value'* parameter is selected under '*Measurement'.*

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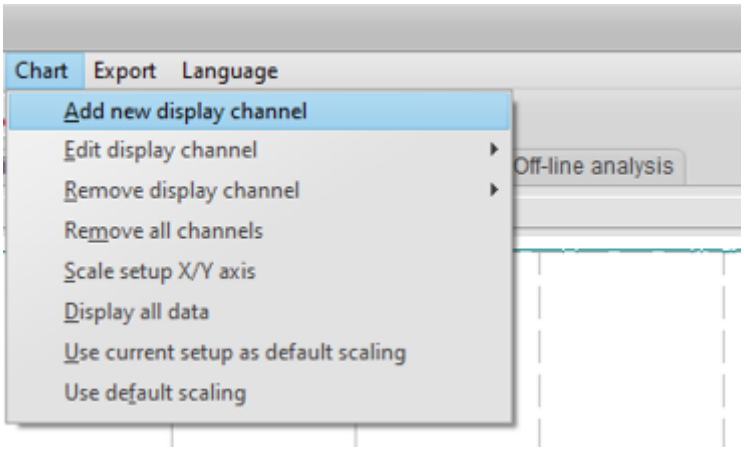
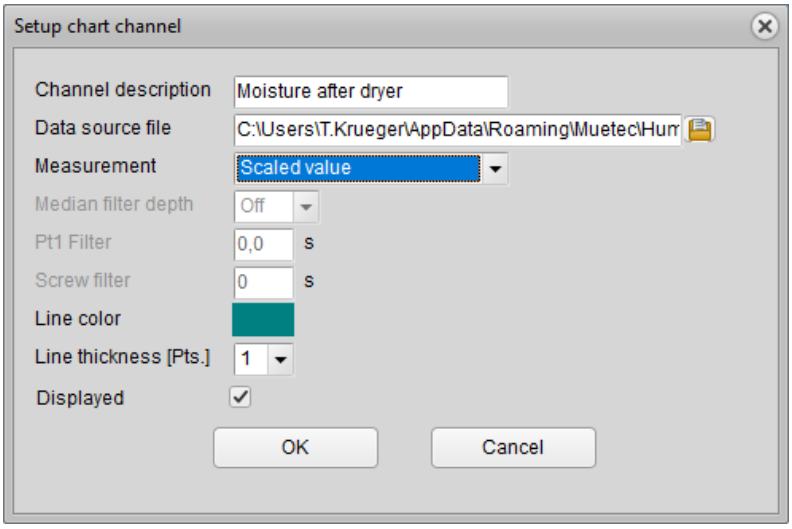


The following window appears:



Description:	Description of the measured value (freely configurable)
Log file directory:	Selection of a log file for analyzing the measured values. The file name contains the device name, the serial number of the transmitter and the date (yyyymmdd). Example: Dryer output_007_20240619.hlog. The directory for the log file is defined in the configuration of the device (see menu *'Device management'* ► *'Edit setting'* ► *"Name of the device*").
Measurement:	Selection of the measured value for the offline analysis
Median/Pt1/snail filter:	Setting the measured value filters for the offline analysis (only if 'Raw value' is selected). The filter setting affects the entire signal curve.
Line color:	Selection of the line color of the measured value curve
Line thickness:	Selection of the line thickness of the measured value curve
Display:	The route is only displayed when activated

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The directory for the log file is defined in the configuration of the device (see menu *'Device management'* ► *'Edit setting'* ► *"Name of the device*").

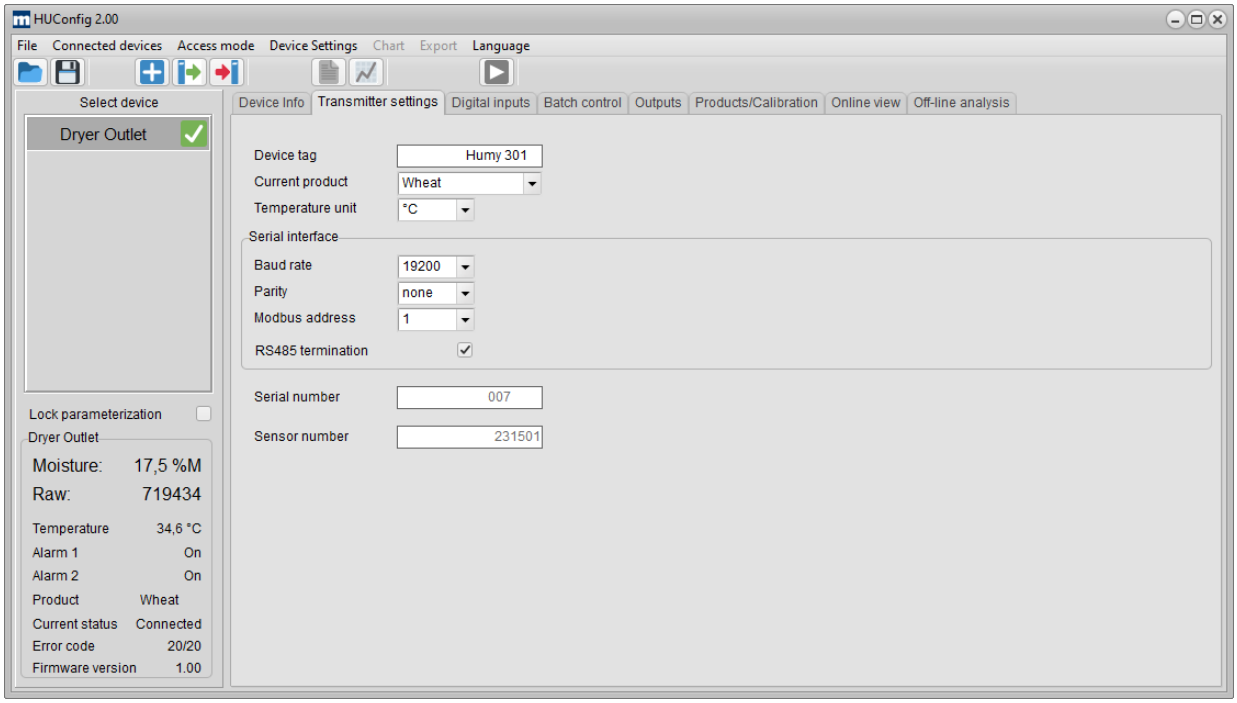
The operation and functions of the graphical user interface are identical to those of the online view.

14.2 Parameterization in expert mode

Additional functions and tabs are activated in expert mode. Expert mode is set via the '*Access mode'* ► *'Expert'* menu.

14.2.1Settings of the transmitter (additional functions)

In expert mode, the menu for configuring the RS485 serial interface for communication with an external PLC appears



RS485 interface:	Configuration of the RS485 interface for communication with an external PLC. Communication takes place with 8 data bits and one stop bit.
Baud rate:	Transmission speed to the PLC (max. 115200 baud)
Parity:	Setting the parity bit (E: Even, O: Odd, N: None)
Modbus address:	Address of the Humy301 transmitter. If several transmitters communicate via an RS485 bus, the transmitters must be assigned different addresses
RS485 termination:	Terminating resistor for terminating the RS485 bus when communicating with several participants (the first and last participant are terminated with a terminating resistor)

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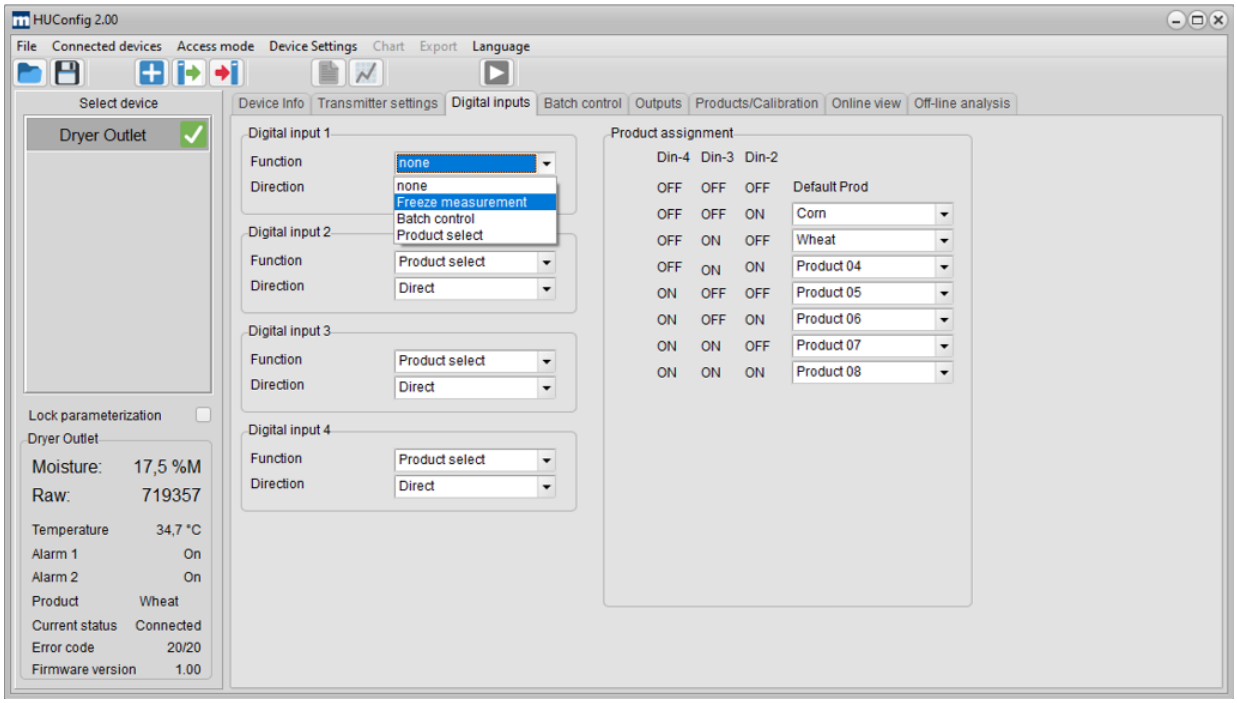
14.2.2 Digital inputs

Configuration of the digital inputs. The Humy301 transmitter is equipped with 4 digital inputs with different functions.



No function:
The digital input is deactivated

Freeze measured value:
The measured value is frozen when a rising edge is detected (direction of the signal can be set via "*Direction*") and does not change. In a batch measurement, for example, the last current measured value can be frozen by detecting a trigger signal and output at the analog output.

Batch control:
Activation of the batch measurement. The measurement is started when a rising edge is detected (trigger sensor); when the falling edge is detected, the average value of the measured value is output over the batch time (definition of batch mode: see following menu item)

Product selection:
Up to 16 different products can be selected via an external hardware signal (e.g. PLC or with a BCD switch). The switching of the products is binary coded according to the adjacent table. In the example above, the product "Corn" is selected by connecting inputs 3 and 4 with 0V voltage level and input 2 with 24V input level.

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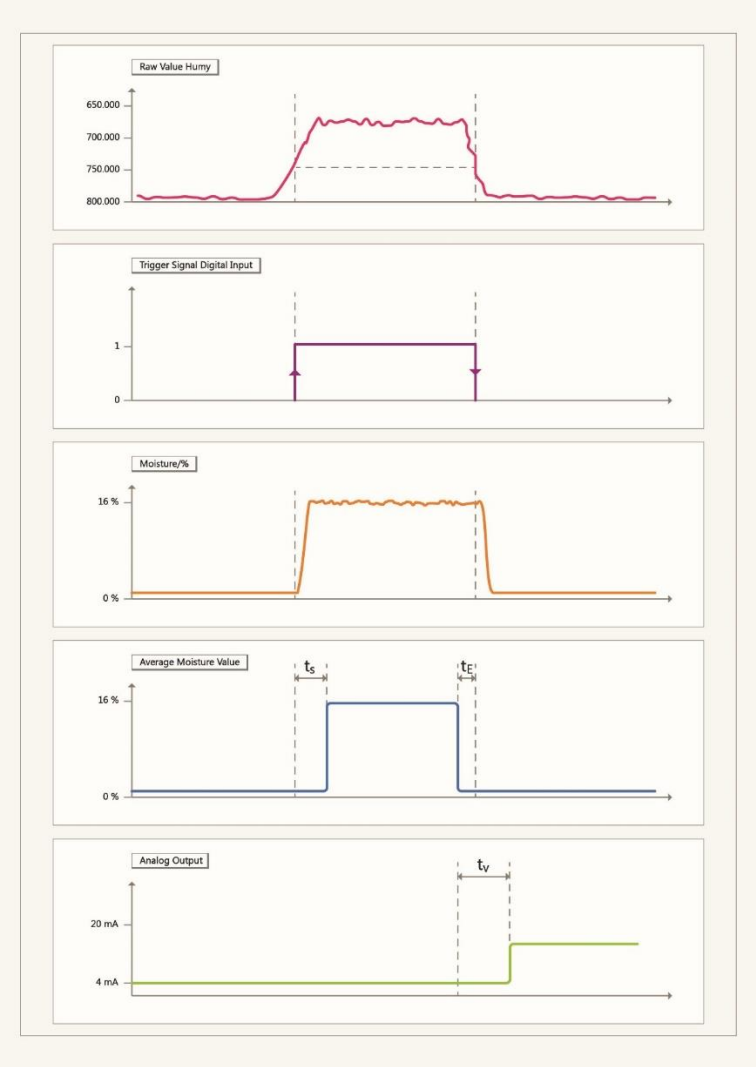
14.2.3 Batch control

In certain processes, the product is conveyed in batches. The product moisture can then only be measured over a short period of time. To ensure that the measured value is not influenced by unstable process conditions at the beginning and end of the batch (e.g. different pouring height or bulk density, sensor not covered with product), the product inlet and outlet can be blanked out when using a trigger sensor (e.g. capacitive sensor). The times for blanking can be determined and freely configured in the graphic display.



t_s :Delay time after detection of the trigger signal (rising edge)
t_E :Delay time after detection of the falling edge
t_V :Delay time for the output of the analog value

With batch measurement, the measured values are recorded after the delay time ts has elapsed. When the falling edge minus the delay time t_E is detected, the measurement is stopped. The average value of the recorded measured values is calculated and output at the analog output after the delay time t_V

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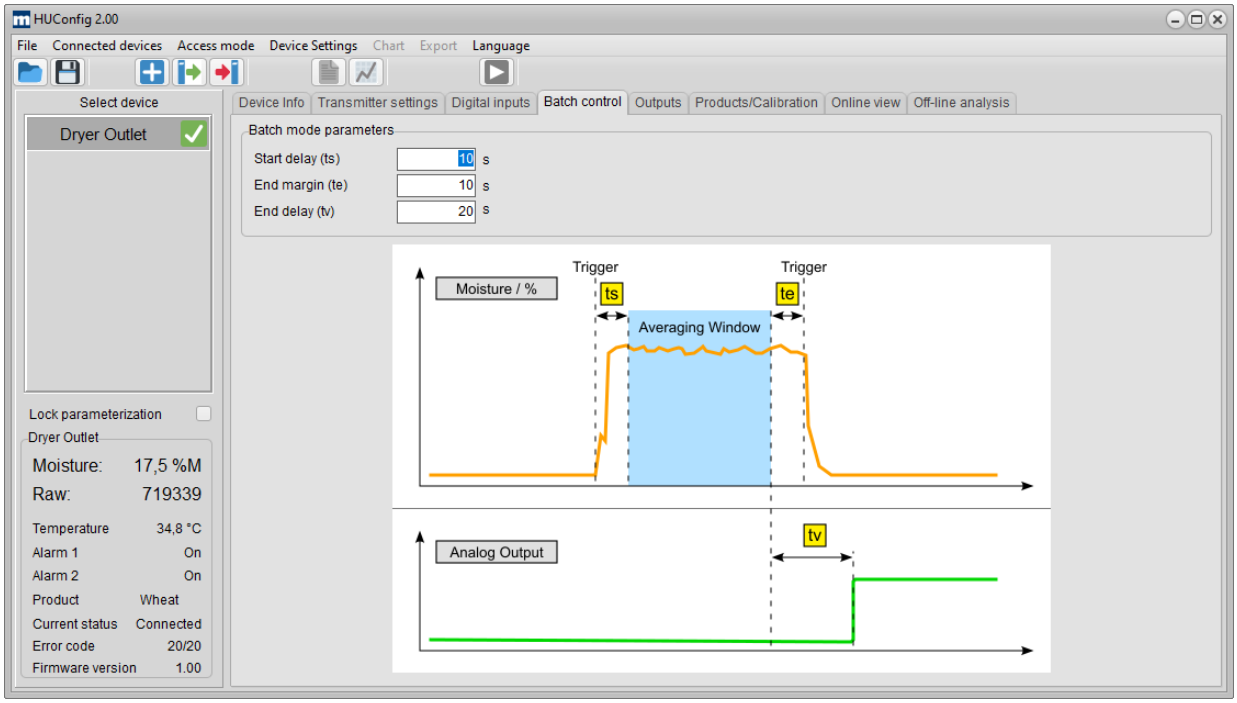
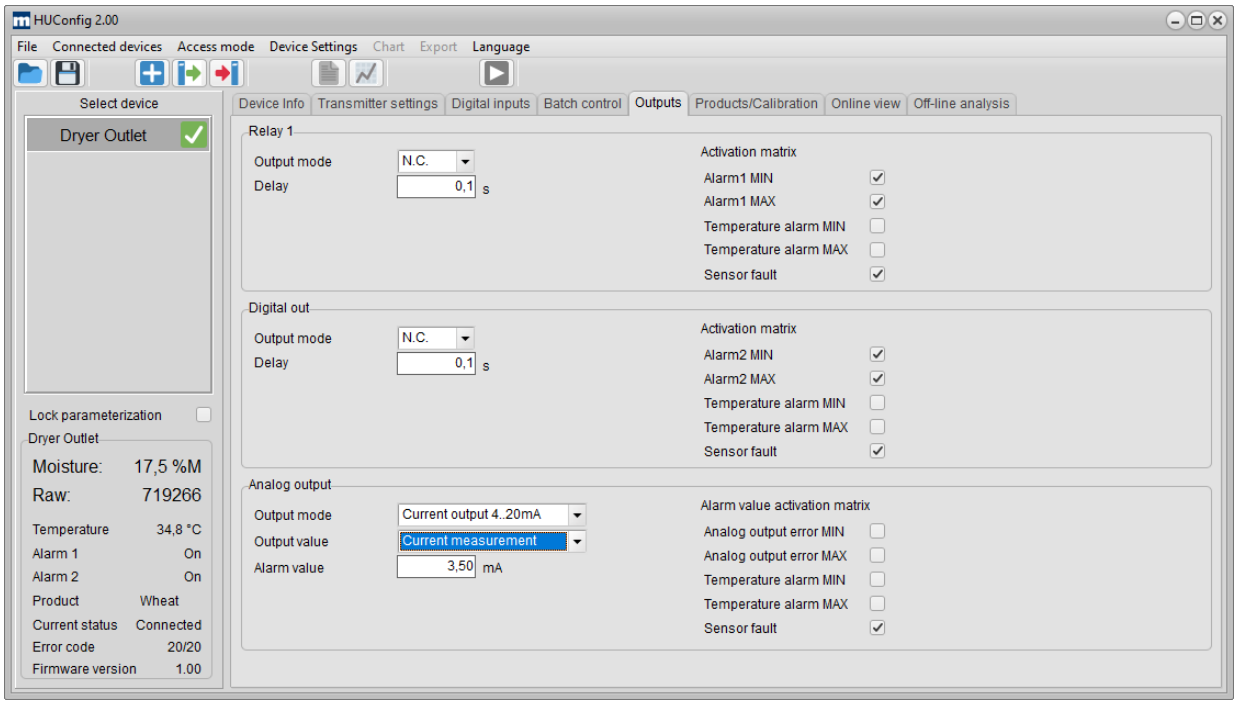


14.2.3 Outputs

The alarm outputs and the analog output for data transmission to a PLC are configured in the "*Outputs*" menu.
A relay and a transistor output are available for outputting the alarm values. Alarm values can also be output as an analog value. The output value in the event of an alarm is freely configurable.



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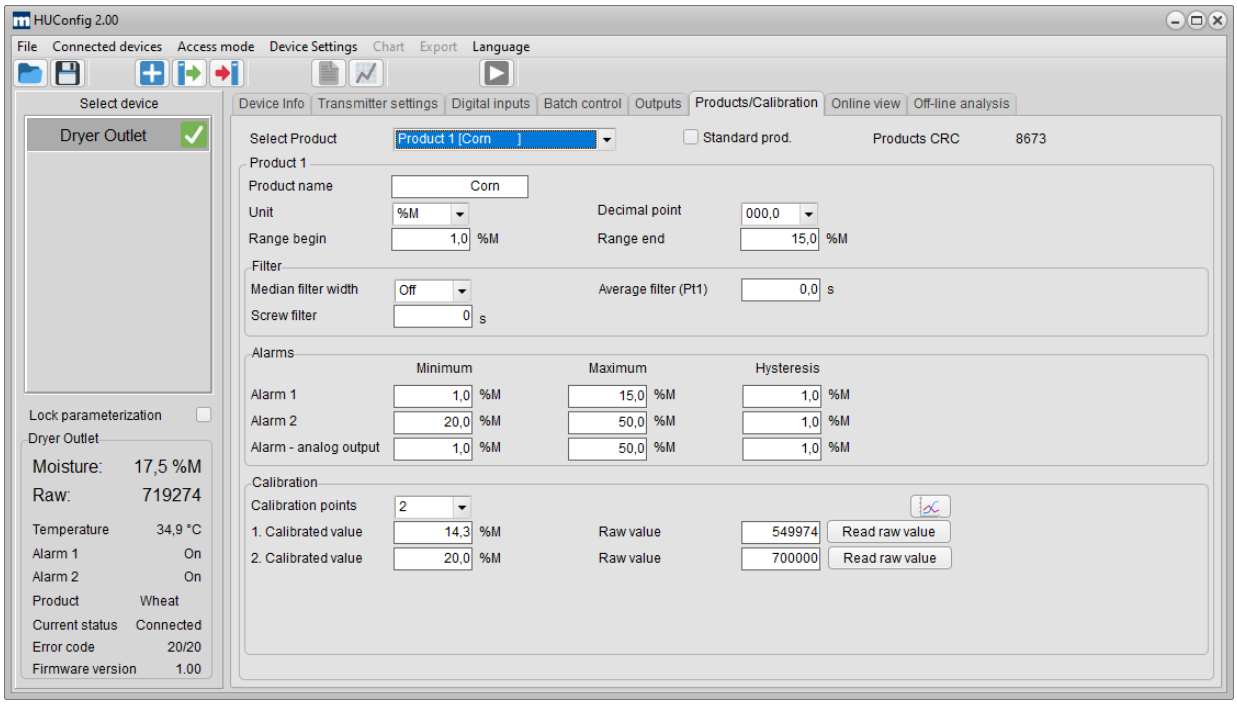
Output mode:	Effective direction of the alarm output
Delay:	Switching delay time of the output value
Activation matrix:	Selection of the available alarm value (moisture value min/max, over/under temperature of the sensor, sensor error)
Analog output:	Configuration of the analog output
Output mode:	Selection of current (4...20mA) or voltage output (0...10V)
Output value:	Select continuous measurement or batch mode
Alarm value:	Definition of the output value when an alarm is detected
Alarm value Activation matrix:	Configuration of the alarm states for the analog output (moisture value min/max, over/under temperature of the sensor, sensor error). In the event of an alarm, the configured alarm value is output

14.2.4 Products/Calibration (additional functions)

The following additional functions are activated in expert mode:



Screw filter:	Special filter for the elimination of periodic interference peaks (0...10s)
Alarms	The alarm thresholds can be set individually for each product.
Alarm 1/2 Minimum:	Measuring range lower limit for critical product moisture in relation to digital output value
Alarm 1/2 Minimum:	Measuring range upper limit for critical product moisture in relation to digital output value
Alarm-Analog output Min:	Measuring range lower limit for critical product moisture in relation to analog output value
Alarm-Analog output Max:	Measuring range upper limit for critical product moisture in relation to analog output value
Hysteresis:	Adjustable hysteresis in relation to the switching point

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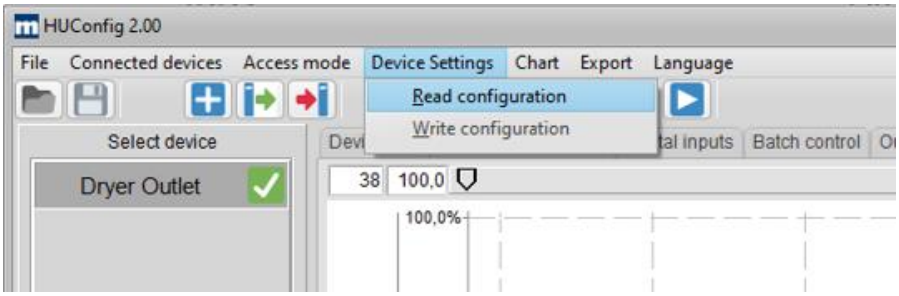
14.3 Read/write parameters

Changes to parameters or calibration curves are initially saved temporarily and must be written to the transmitter memory after each change in the '*Device settings*' ► '*Write configuration*' menu or by clicking on the symbol must be written:



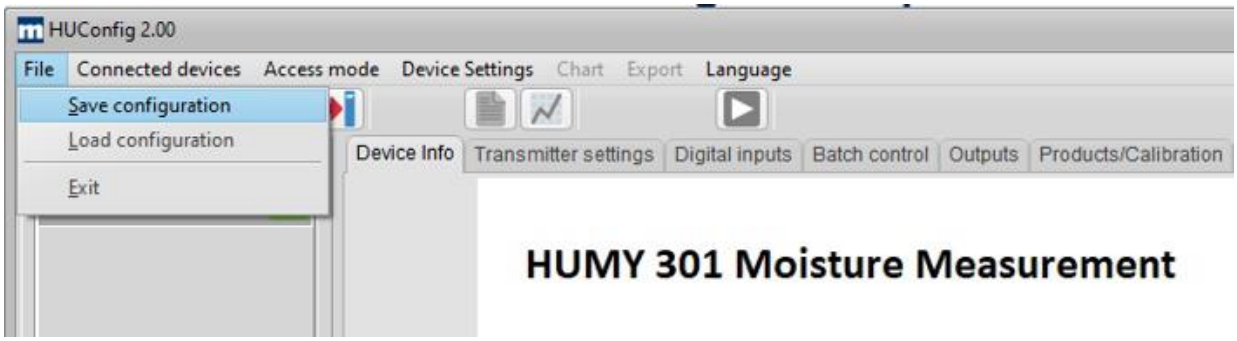
After changing parameters and switching to another menu or exiting the program, you will be prompted to save the parameters.

Device parameters are transferred to the PC in the '*Device settings*' ► '*Load configuration*' menu or by clicking on the icon and can then be changed

14.4 Save/load software configuration

When replacing a transmitter or for service purposes, the parameters of the transmitter can be saved on the PC and loaded into another transmitter.

The current configuration is saved in the '*File'* menu ► '*Save configuration*' or with the floppy disk symbol to save it:



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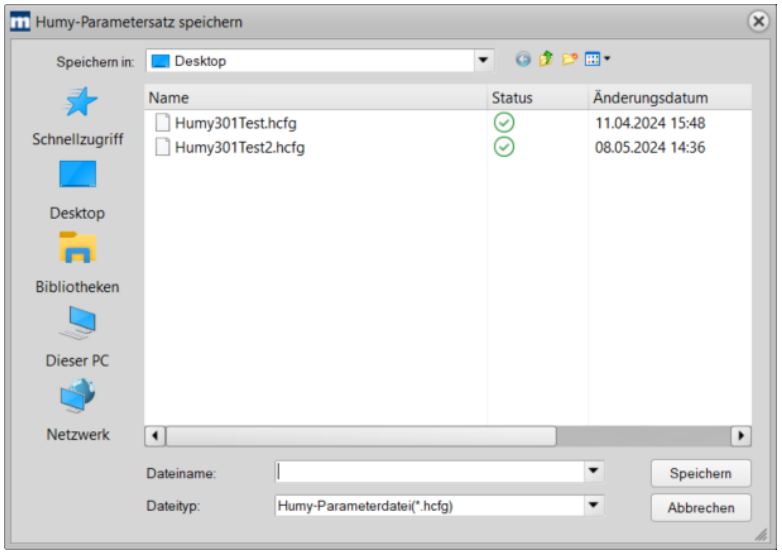
An existing configuration is loaded in the 'File' menu ► 'Load configuration' or with the folder symbol  loaded.



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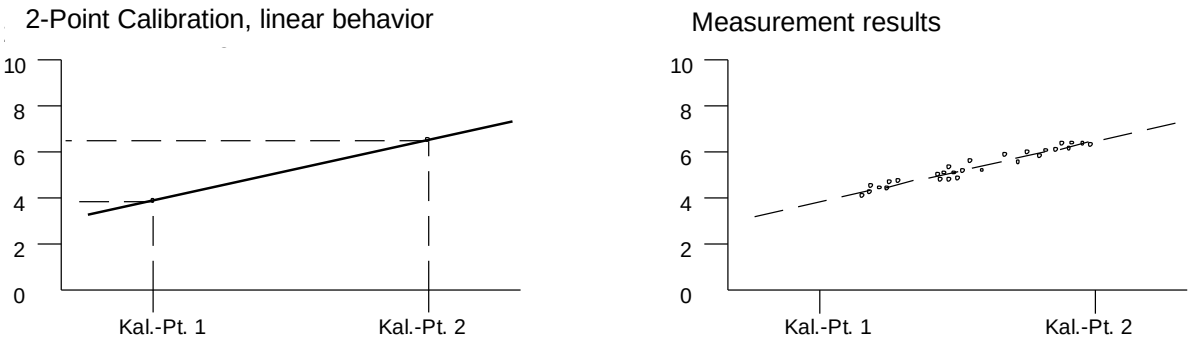
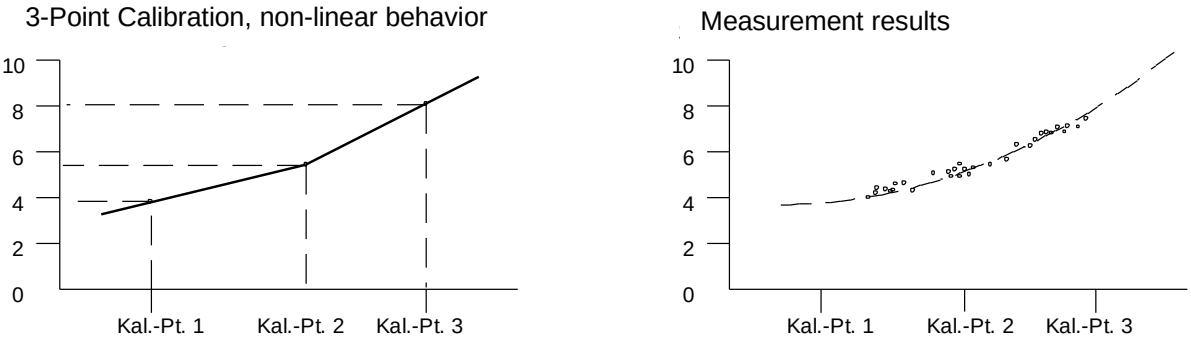
15 Calibration

A good and precise calibration is essential to achieve a high level of measurement accuracy. The number of calibration points must be determined first. In most cases, 2 calibration points are sufficient, in which case linear behavior is assumed. A maximum of 5 calibration points can be selected.

Example of a successful 2-point calibration with linear product behavior



Example of a successful 3-point calibration with non-linear product behavior



The calibration time (time in which raw values are recorded) varies depending on the process. A long calibration time can be selected for stable processes. The measured values scanned by the sensor are integrated during the calibration time, the mean value of the integrated values is saved as the raw value for the calibration point.

15.1 Product selection for calibration

Up to 24 products can be stored in the transmitter. An individual calibration curve can be stored for each product.

First select a product from the 'Select product' list and select the unit for the moisture display. The name of the product can be freely defined. By activating the 'Standard product' checkbox, the moisture value is calculated using the stored calibration curve.

The resolution of the analog output is increased by limiting the moisture range.

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Example:

The expected moisture range is between 10 and 15%. Recommended setting for scaling the analog output: 5% (range start 4mA) - 20% (range end 20mA).

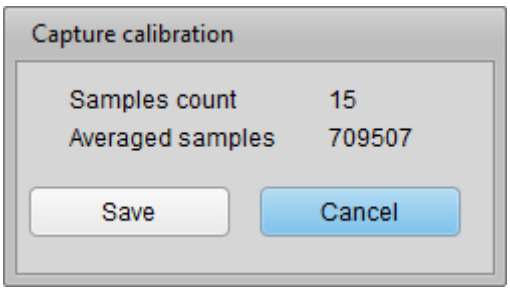
15.2 Number of calibration points

A calibration curve can be created with a minimum of 2 to a maximum of 5 calibration points, depending on the accuracy requirement. In most cases, a 2-point calibration is sufficient. The calibration menu is described in **section 15.1.2.**

15.3 Starting the calibration

Once the number of calibration points has been determined and the process is stable (constant pouring height, bulk density and conveying speed), the actual calibration can begin.

Start the calibration by pressing the '*Read raw value'* button in the *'Calibration'* section. The window below opens and calibration begins:



During calibration, a material sample must be taken close to the sensor for moisture analysis in the laboratory. It is recommended to analyze at least 3 samples and calculate the average of the measurements as the corresponding moisture value.

The recording of the raw value for the first calibration point is completed by pressing the '*Save*' button and the average value is saved. The result of the laboratory analysis can be entered at a later time. A minimum recording time of 30 seconds is recommended. When measuring in screw conveyors, an acquisition time of up to 60 seconds can be selected.

The parameters must be saved after each calibration (shortcut button )

The second calibration point is determined as described under 'The 1st calibration point'.

Plausibility check:

By clicking on the button  an X/Y diagram of the calibration values opens. This allows the calibration to be checked for plausibility.

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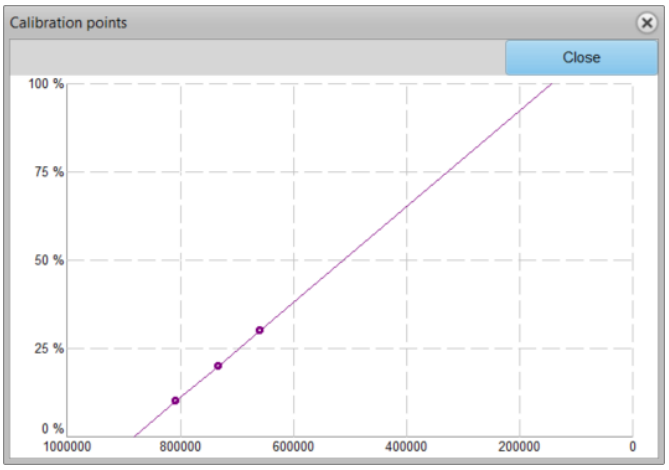
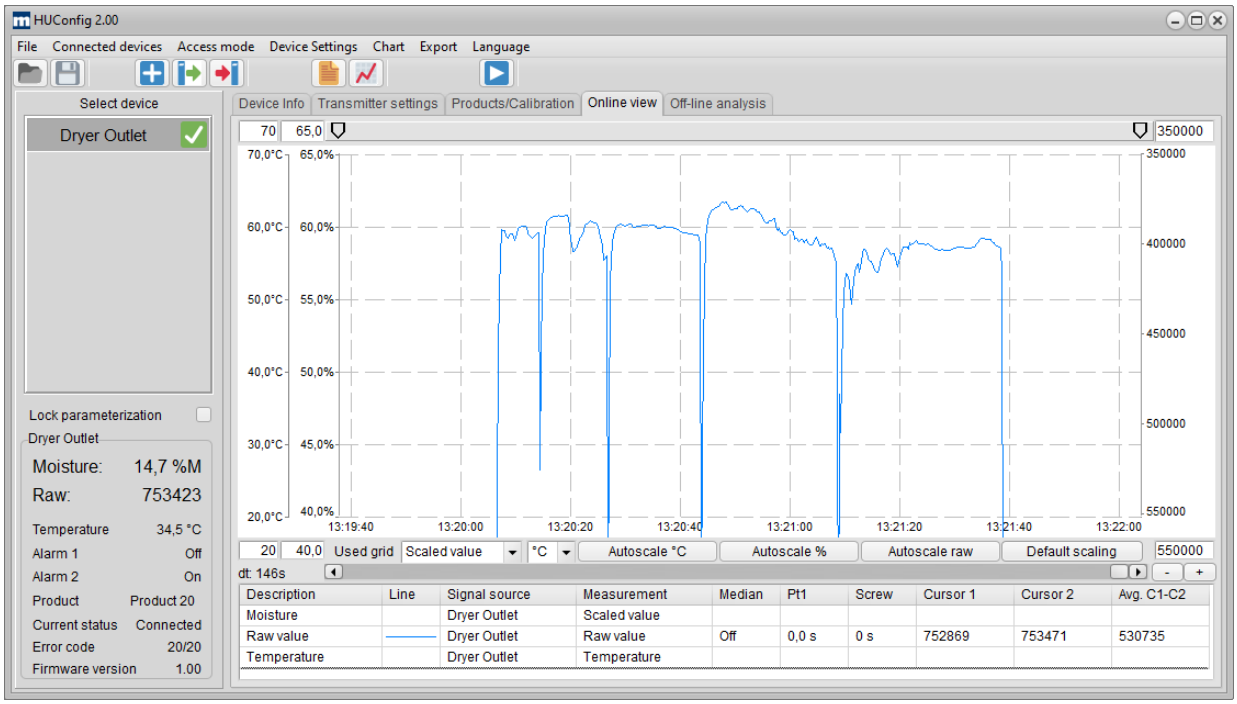


15.4 Determining the optimum filter value

The software offers various filter algorithms for smoothing the digital output signal. A combination of median filter for eliminating outliers and Pt1 average filter for smoothing the signal is recommended. The filter values can be changed in the online view and the effect on the signal can be tested directly.

For static measurements, a median filter value of 3 measured values and an average value of 2s is usually sufficient to minimize the noise of the digital value.

Raw signal without filter settings:



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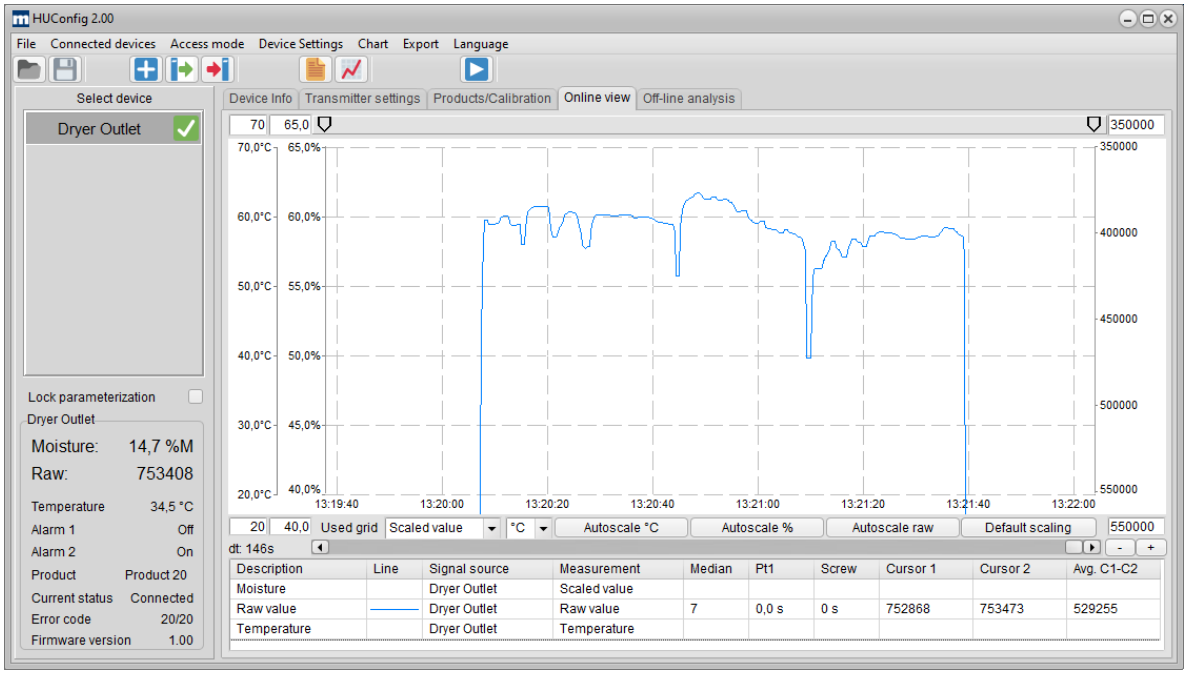
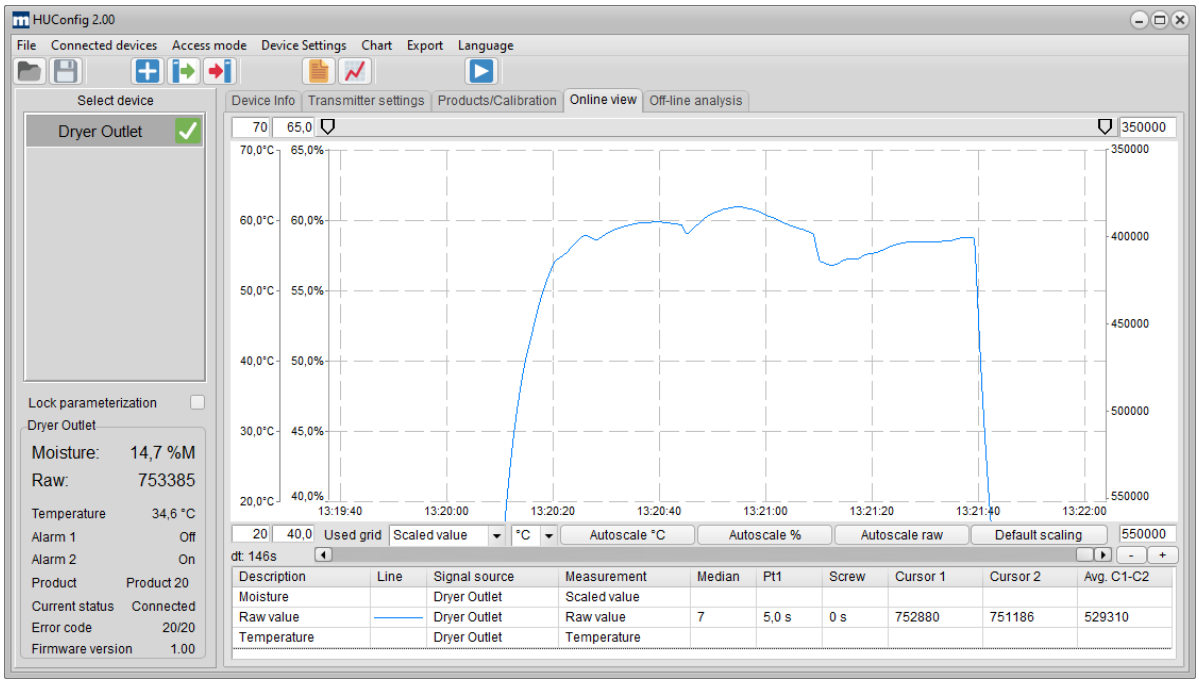
Raw signal with activated median filter over 7 measured values:



Raw signal with activated median filter over 7 measured values and mean value filter PT1 (filter length 5s):



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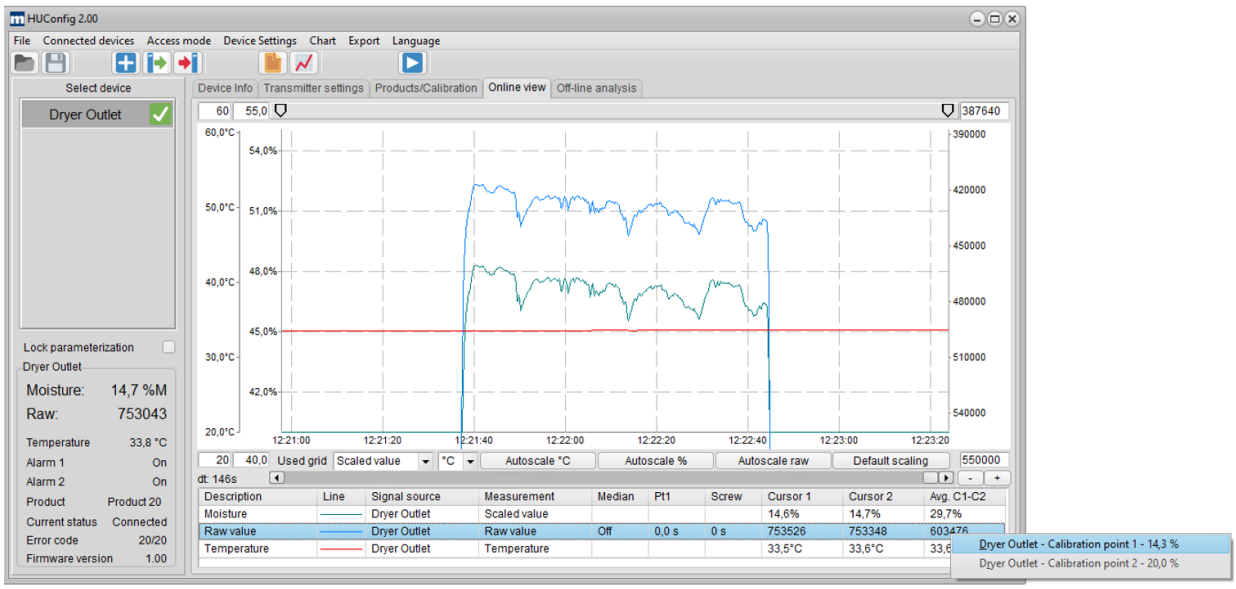
A large time constant of the mean value filter leads to optimum smoothing of the signal, but abruptly changing signal curves are registered with a time offset. A combination of median filter and subsequent smoothing using a PT1 mean value filter is therefore recommended.
For static measurements, a median filter value of 3 measured values and a mean value of 2s is usually sufficient to smooth out the noise of the digital value. For dynamic measurements (e.g. on a belt conveyor), a median filter of 3 or 5 measured values combined with an average filter of up to 30 seconds is recommended.

The filter values only have an active effect on the analog output after the parameters have been programmed on the transmitter (butto)

15.5 Graphical determination of a calibration point

As an alternative to automatically recording the raw value, a calibration point can also be determined graphically in the online view. To do this, position the cursor on the desired value range. Right-click on the measured value 'Avg. C1-C2' of the raw value and select the desired calibration point.

In the following example, the moisture value of the measurement sample in the laboratory was determined to be 15.3%. The average value between the cursors is 424948 digits. Select '*Dryer output - Calibration point 1 - 15.3%*' to accept the raw value for the calibration. The second calibration point can be determined graphically in the same way.



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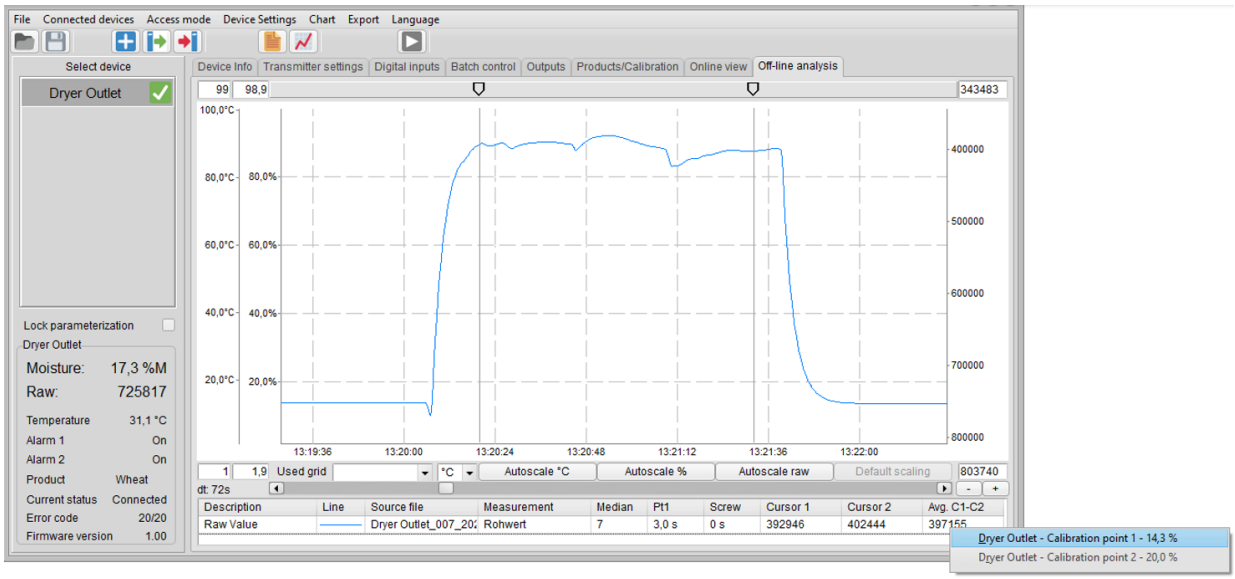
15.6 Offline calibration

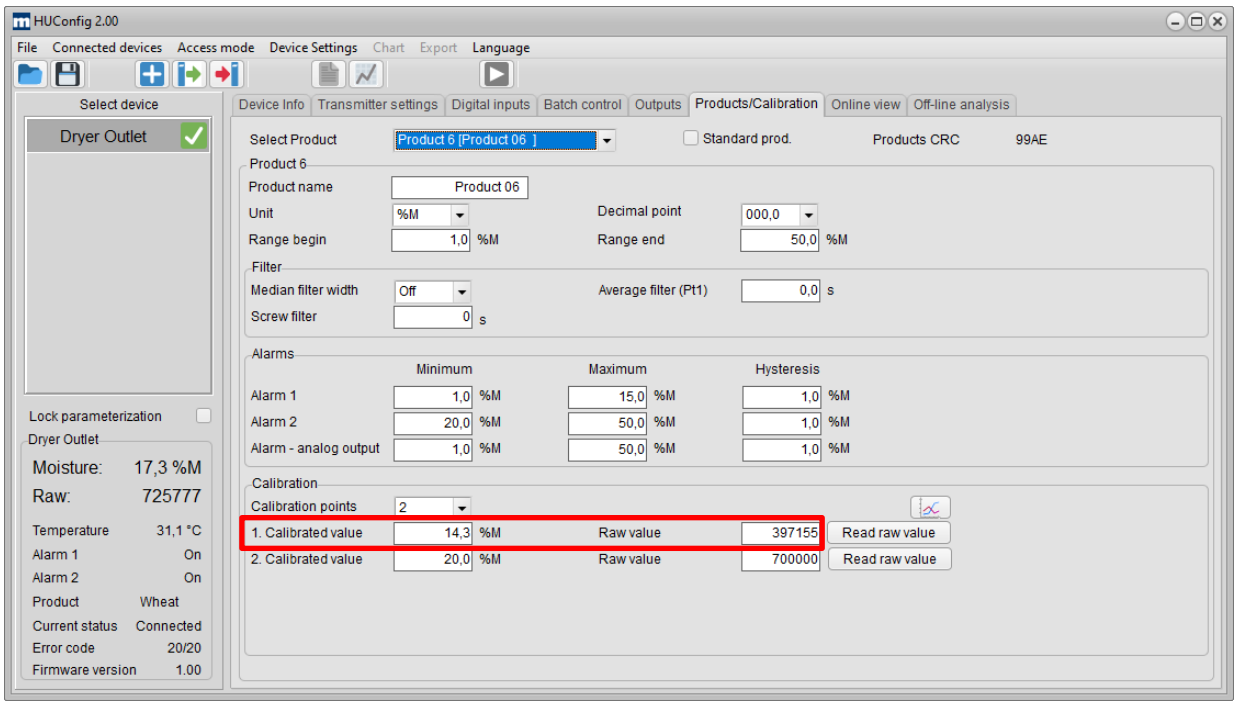
Similar to the graphical determination of a calibration point, calibration can also be carried out using historical data. This means that a laboratory sample can be taken and analyzed at any time during the process, which is then later assigned to a historical raw value.

Example:

A laboratory sample was analyzed on 15.05.2024 at 15:05. In the offline analysis, a new measurement channel is created with the raw values from 15.05.2024 and the cursor is placed in the corresponding time range. The mean value between the cursors can be transferred directly from the diagram as a calibration point.



The determined raw value, which is assigned to the moisture value, appears in the "Products/Calibration" configuration tab.



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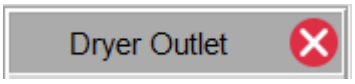
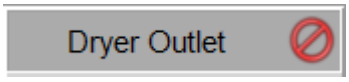
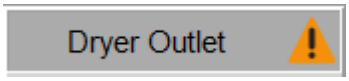
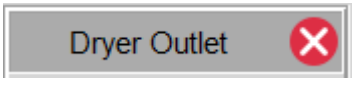
16 Troubleshooting

The following table contains a list of possible causes of errors when using the moisture measurement system. If the error has not been rectified, please contact Mütec Instruments technical support:

16.1 Software or hardware-related error causes

Error image	Possible cause	Measure
Parameters are not displayed, device is grayed out, data is recorded. Software signaling: 	Parameters not loaded after starting the software	Select and click on the device to be parameterized
Measured value is not displayed, no data recording, yellow status LED on the transmitter does not light up. Software signaling: 	Communication between PC and transmitter interrupted	Check the USB connection to the transmitter, check the interface parameters, check the virtual COM port in the Device Manager. Reinstall driver for virtual COM port
Measured value is not displayed, no data recording, yellow status LED on the transmitter does not light up. Software signaling: 	Device not active	Activate device in the menu (Device management ► Device active ► "Name of the device"
Measured value is not updated, red LED on transmitter lights up, software signaling: 	Connection from sensor to transmitter interrupted	Check connection cable from sensor and wiring
Measured value is not displayed, no data recording, yellow status LED and green power LED on the transmitter do not light up. Software signaling: 	Power supply interrupted	Check power supply

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Analog output remains at max. value	Current humidity value is greater than end of range in the product menu	Check the scaling of the current output in the "Products/Calibration" menu
Measured value is not displayed in the PLC	- Analog output defective - PLC analog input card incorrectly configured	- Measure analog output value with multimeter on transmitter

16.2 Process-related causes of errors

Error image	Possible cause	Measure
Measuring system outputs incorrect value	- Calibration not correct - Excessive build-up on the sensor surface	- Recalibrate system - Incorrect calibration curve used - Check whether calibration points are plausible ("Products/Calibration" menu -> Press button for plausibility check) - Remove buildup on the sensor
Measured value does not change (raw value > approx. 700,000 digits)	Sensor surface not covered with product	- Silo not filled - Sensor not in contact with the product
Strong fluctuations in measured values with constant product moisture	- Product speed changes - Bulk density changes (air inclusions, large particles) - Dump height changes	- Measurement at constant product speed - Use individual calibration curves for different products - Keep pouring heights <100mm constant
Incorrect measured values at low process temperatures	Ice formation in the product	Avoid ice formation

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