Installation and Operating Instructions

Heat Meter Calculator

Heat/Cooling Meter Calculator

Cooling Meter Calculator

SensoStar C

DE-18-MI004-PTB037 (MID heat)
DE-18-M-PTB-0049 (national German cooling)
CH-T2-18769-00 (national Swiss cooling)

1 Application and Function

The calculator SensoStar C is designed for the measurement of the consumed energy in a closed heating, cooling or heating/cooling system.

2 Contents of the Package

- Calculator
- Installation kit
- Installation and Operating Instructions
- Operating Instructions „Communication Interfaces S3(C)“ (with meters with an optional interface)
- Declaration of Conformity

3 General Information

- Valid standards for the application of calculators for heat metering: EN 1434, parts 1 – 6; the Measuring Instruments Directive 2014/32/EU, Annexes I and MI-004; and the relevant national verification regulations.
- For the selection, installation, commissioning, monitoring and maintenance of the instrument observe the standard EN 1434 part 6, as well as the verification regulations PTB TR K8 + K9 for Germany (and any relevant national verification regulations in other countries).
- National regulations for the consumption measurement of cooling must be observed.
- The technical regulations for electrical installations must be observed.
- This product fulfils the requirements of the European Council Directive on Electromagnetic Compatibility (EMC Directive) 2014/30/EU.
- The identification plate of the instrument and the seals must not be removed or damaged – otherwise the guarantee and the approved application of the instrument are no longer valid!
- The calculator left the factory in conformance with all applicable safety regulations. All maintenance and repair work is to be carried out only by qualified and authorized technical personnel.
- **Instruments with activated radio function are not allowed on air freight.**
- The correct installation point in the system must be chosen: inlet or outlet flow (see item 3.1 ’Pictograms installation point’).
- To clean the calculator (only if necessary) use a slightly moist cloth.
- To protect against damage and dirt the calculator should only be removed from the packaging directly before installation.
- All specifications and instructions listed on the data sheet and in the Application Notes must be adhered to. Further information can be obtained at **www.engelmann.de**.
- The heat meter has a lithium-metal-battery. Do not open the batteries, do not bring the batteries into contact with water or expose them to temperatures above 80 °C. Do not charge them or short-circuit them.
- Instruments which have been replaced or exchanged must be disposed of according to relevant environmental regulations.
- The display is deactivated and can be activated for two minutes by pushing the button.
- **Unit of energy and installation point (outlet flow / inlet flow) can be set on location, only once, before start of operation by pushing the button or alternatively using the „Device Monitor“ software.**
- **Type and concentration of glycol in the medium of those calculator types designed to be used with glycol can be set on location at any time using the „Device Monitor“ software (see item 8.1 for details).**

3.1 Pictograms installation point of calculator (in the information loops)

On the right in the calculator display in all information loops you will find one of the following two pictograms. The pictogram indicates in which pipe the calculator is to be mounted.

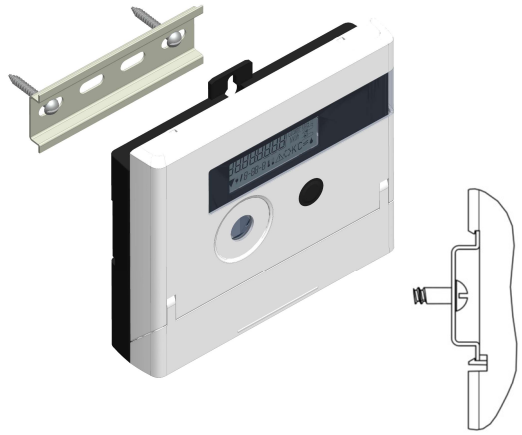
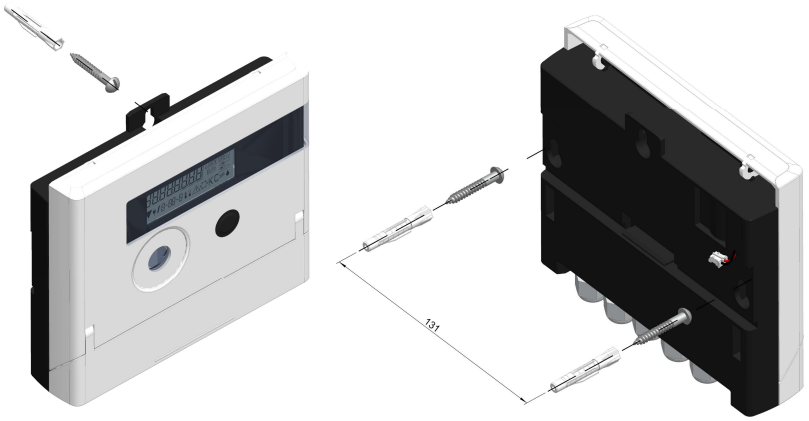
	Installation in outlet flow
	Installation in inlet flow

3.2 Pictograms type of calculator (on type identification label)

	Heat meter calculator
	Cooling meter calculator

4 Wall Mounting the Calculator

You can open the calculator by pulling the clamping bracket at the upper housing´s leading edge up.
Before mounting, check to make sure that the cable lengths of the instruments to be connected are correct for the individual installation situation.
The center to center drill hole separation for the direct screw mounting is in the following picture 131 mm.

With commonly available mounting rail	**Direct screw mounting**
	

5 Connecting the Components

Important: First mount the temperature sensors and then connect the flow meter to the calculator. This way unnecessary error messages can be avoided.

At delivery, the display shows „H 05“ until temperature sensors have been attached. This message disappears as soon as temperature sensors have been connected and the first temperature measurement is carried out (every 15 minutes without flow).
The calculator connections have been designed to meet the valid standard EN1434-2. All terminal strips have been labelled according to this standard.
The terminal strips are located under the cover of the calculator housing.

5.1 Mounting the temperature sensors

Please note the following points:

- The temperature sensors must have the type of Pt suitable for the calculator (Pt 500). The calculator identifies the temperature sensors automatically and shows the type of Pt in loop 2.
- The temperature sensors (up to DN 100) must be installed against the flow direction.
- The temperature sensors are not to be installed within the influence of other sources of heat.
- The temperature sensor cables must not be kinked, lengthened or shortened.

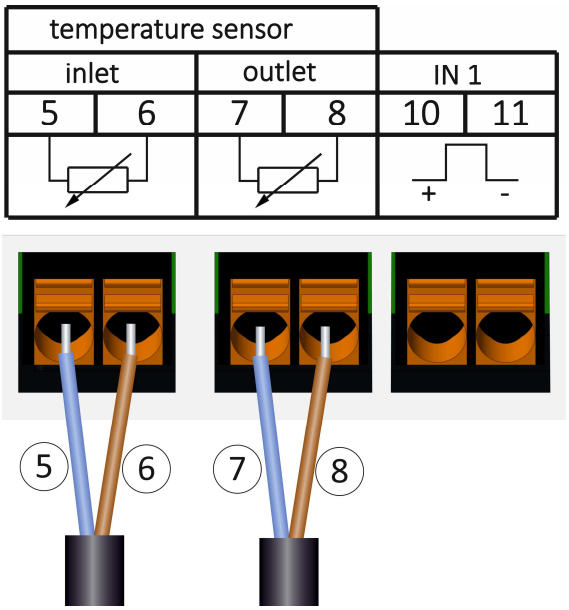
- Sensor cables that are too long should not be rolled up tightly into an ‘air-core coil’. The cables should either be laid out disordered, or rolled up loosely into a wide coil which can be turned and tied into an ‘8’.

Mounting

- Loosen the two cable glands without blind plugs and glide them over the sensor cables.
- Feed the temperature sensors through the appropriate openings of the cable glands into the terminal box.
- Clamp the wires (see identification label temperature sensors) as shown in the illustration:

The inlet flow temperature sensor must always be connected to clamp 5 and 6 (inlet).
The outlet flow temperature sensor must always be connected to clamp 7 and 8 (outlet).
The color of the wires does not matter.

- Check that the connections are tight.
- Screw the cable glands tight by hand.



5.2 Mounting the flow meter

The pulse output of the flow meter to be connected to the calculator must be identical to the calculator input pulse value. Check the technical data of the flow meter and compare it to the specifications on the calculator.

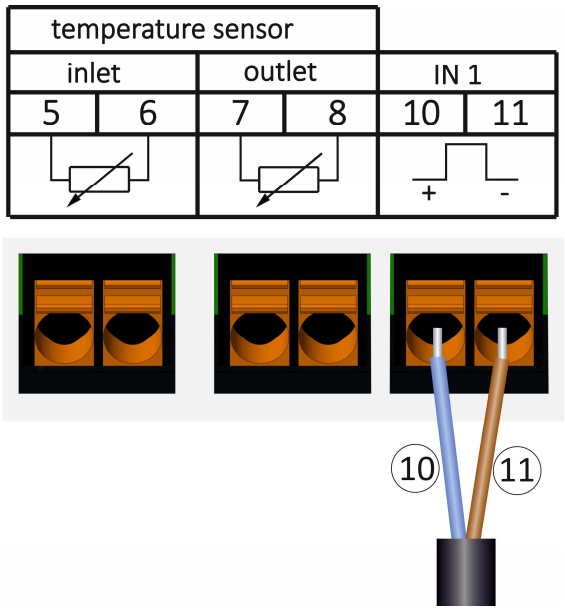
Mounting

- Loosen the middle cable gland and glide it over the flow meter cable.
- Remove the blind plug in the cable gland opening. Feed the pulse cable of the flow meter through the opening into the terminal box.
- Clamp 10 and 11 are used for the connection to the flow meter.
- Clamp on the wires as shown in the illustration.

Note: For flow meters with open collector connections (electronic outputs) make sure the polarity is correct.

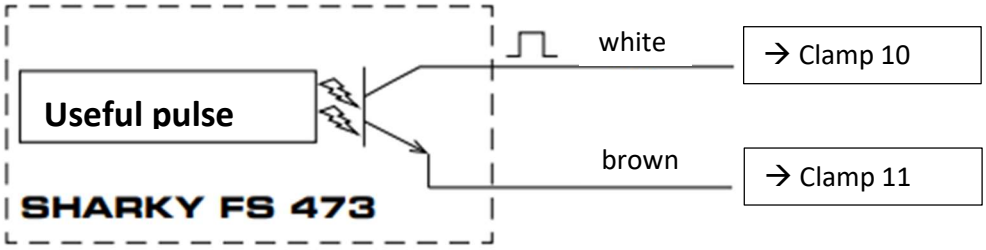
- Check that the connections are tight.
- Screw the cable gland tight by hand.

Please check the unused cable glands to make sure that the necessary blind plugs are inserted and then tighten the cable glands by hand.



5.2.1 Special features when connecting to a Diehl VMT „Sharky FS 473“

For the correct connection of the cables, please note the polarity described in the following drawing:



Important note: The colored marking of the cables corresponds to the scheme shown above.
The white cable (+) is connected to clamp 10, the brown cable (-) to clamp 11.

5.2.2 Calculators with TX version

TX version instruments can be recognized by a special display as long as the pulse value has not been set yet:

Important note: The pulse value will be set permanently after the first input pulses and cannot be changed afterwards. Pay special attention that the flow meter does not register a flow before the correct pulse value has been chosen (factory setting 1 l/pulse).

Set up of pulse value

If the pulse value has not yet been set, follow these steps:

- Choose the desired pulse value by pressing the push-button briefly.
- Confirm the selected pulse value by pressing the push-button longer than 4 seconds. After this the pulse value cannot be changed any longer.

The display format is automatically determined by the pulse value that has been set:

Pulse value [l/pulse]	Display format energy			Display format volume	Display format flow	Display format power
1	0 kWh	0,000 MWh	0,000 GJ	0,000 m³	0,000 m³/h	0,000 kW
2,5	-	0,000 MWh	0,000 GJ	0,000 m³	0,000 m³/h	0,000 kW
10	-	0,00 MWh	0,00 GJ	0,00 m³	0,00 m³/h	0,00 kW

25	-	0,00 MWh	0,00 GJ	0,00 m³	0,00 m³/h	0,00 kW
100	-	0,0 MWh	0,0 GJ	0,0 m³	0,0 m³/h	0,0 kW
250	-	0,0 MWh	0,0 GJ	0,0 m³	0,0 m³/h	0,0 kW
1000	-	0 MWh	0 GJ	0 m³	0 m³/h	0 kW
2500	-	0 MWh	0 GJ	0 m³	0 m³/h	0 kW

6 Start of Operation

- Slowly open the shut-off valves.

Check the following points:

- Is the flow meter of the right size?
- Does the directional arrow on the flow meter match the actual direction of flow?
- Check that there are no leaks.
- Is a flow volume displayed?
- Are all shut-off valves open?
- Is the heating (heating/cooling) system clear (dirt filters not clogged)?
- Is a plausible temperature difference displayed?

When the components are functioning properly, attach the seals to the temperature sensors and the flow meter. Protect the calculator against unauthorized opening using the numbered adhesive seal enclosed. The added bar code label can be used for the purpose of documentation.

7 Interfaces and Options

7.1 Optical (infrared) interface

For communication with the optical interface an optocoupler and the "Device Monitor" software are necessary. The optocoupler and "Device Monitor" are available as accessory equipment.
The optical infrared interface will be activated by automatically sending a header (according to EN 13757-3). Baud rate: 2400 baud. Then you can communicate with the calculator for 4 seconds. After every valid communication the calculator is open for another 4 seconds. Afterwards the display is deactivated.
The number of read-outs per day via the optical interface is limited. During daily read-out at least 4 communications are possible. If read-outs are carried out more rarely, the possible number of communications will increase.

7.2 Retrofitting with an additional communication interface

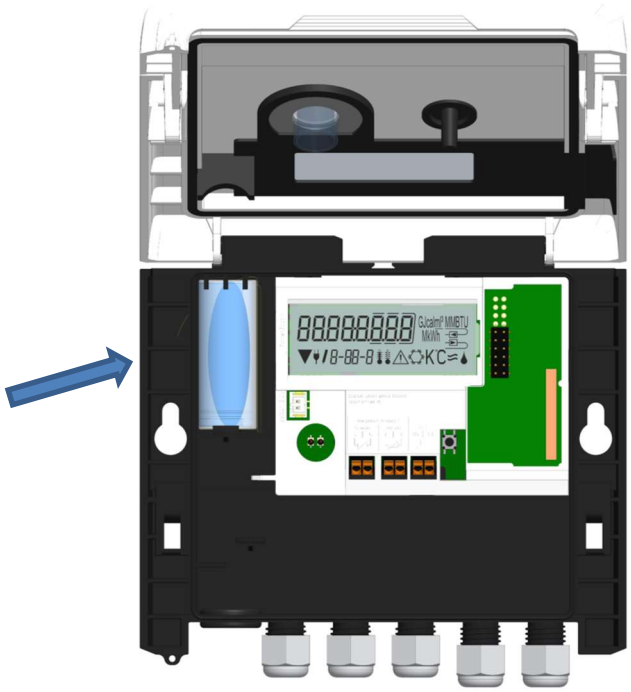
To our calculator further communication interfaces can be added later. You will find the description of our optional interfaces in the operating instructions „Communication Interfaces S3(C)".

During installation of the retrofitting module observe the ESD requirements according to EN 61340-5-1.
This means that on location an antistatic wrist strap with an integrated 1 MΩ resistor has to be used which must be connected to a proper spot: This is either a grounded pipe or – only with an appropriate adapter! – a Schuko plug grounding socket. The antistatic wrist strap must be worn tightly on the skin of the wrist.

Open the calculator by pulling the clamping bracket at the upper housing´s leading edge up.
Plug the interface module on the right side of the PC board. If there are module cables you have to loosen the needed number of cable glands and to glide them over the cables. Remove the blind plugs from the cable gland openings and feed the cables into the calculator.
Protect the calculator against unauthorized opening using one of the numbered adhesive seals enclosed to the modules. The added bar code label can be used for the purpose of documentation.

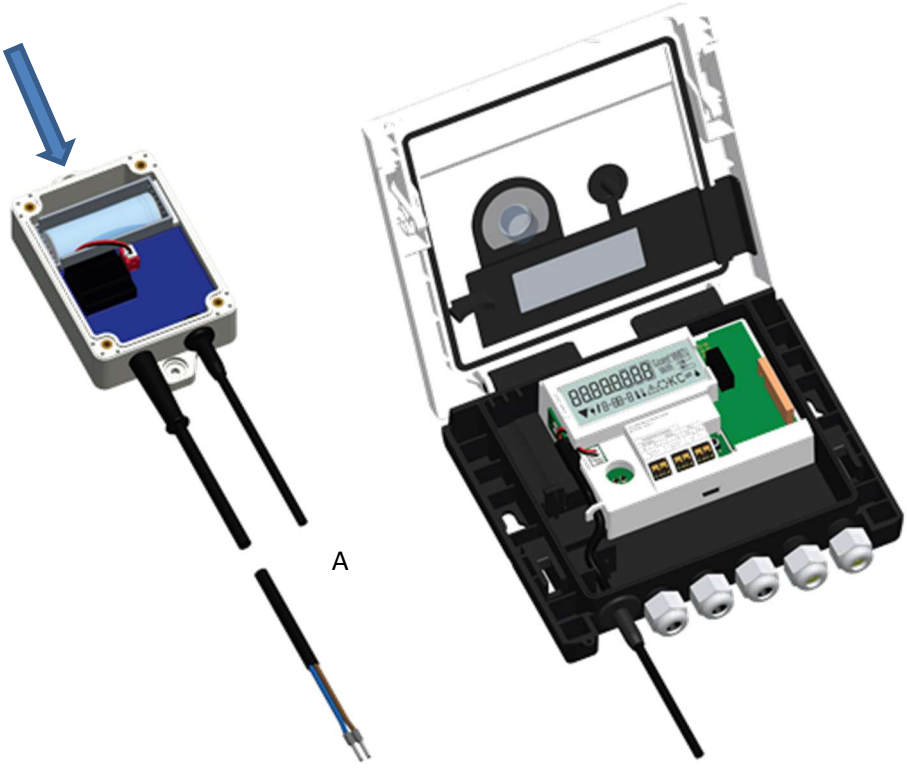
7.3 Exchanging the battery

The calculator´s battery is easy to exchange by authorized technical personnel (our replacements only). Replaced batteries must be disposed of according to relevant environmental regulations.
Open the calculator by pulling the clamping bracket at the upper housing´s leading edge up. Afterwards protect the calculator against unauthorized opening using one of the numbered adhesive seals enclosed to the batteries (stick it upon the seal destroyed). The added bar code label can be used for the purpose of documentation.



7.4 Mounting a power pack

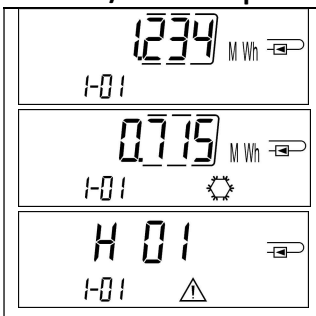
If an external power supply is needed, only the power pack designed for our calculator may be used.
To connect it to the calculator, please open the calculator. First remove the battery from the calculator and plug it into the battery connector in the power pack. Protect the power pack against unauthorized opening using one of the numbered adhesive seals enclosed. The added bar code label can be used for the purpose of documentation. (The battery is a backup in case of a power outage.)
Remove the left blind grommet in the calculator housing and feed the power pack cable (A) through the cable feedthrough. Press the cable grommet into the cable feedthrough. Connect the black service plug with the contact fingers on the left hand side of the calculator's PC board under the display. Plug the white connector into the battery connector on the PC board.
Only authorized technical personnel may connect the power pack to 230 V / 24 V and check it.
When the calculator detects external power supply the pictogram of a mains plug appears in the display.
Protect the calculator against unauthorized opening using one of the numbered adhesive seals enclosed to the power pack. The added bar code label can be used for the purpose of documentation.

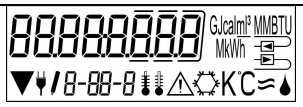


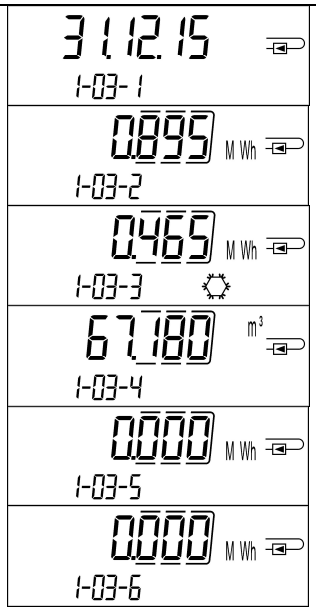
8 Display

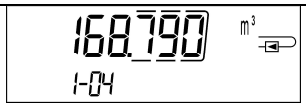
The calculator has a liquid crystal display with 8 digits and special characters. The values that can be shown are divided into five display loops. All data is retrieved using the push-button next to the display.
At the start you are automatically in the main loop (1st level). By pressing the push-button longer than 4 seconds you change to the next display loop. Keep the push-button pressed until you reach the desired information loop. By pressing the push-button briefly each time you can scan all the information within a loop.
After 2 minutes of non-use of the push-button, the display will automatically be deactivated.

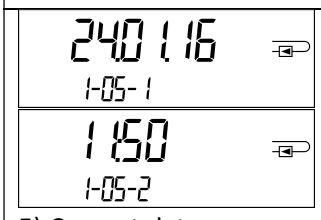
Level 1 / Main Loop:

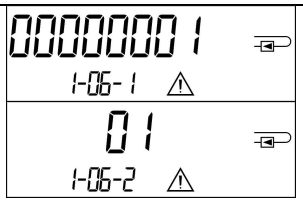
<table>
<tr>
<td> 

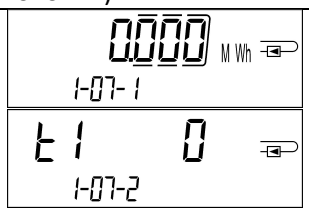
1) Total heat energy since start of operation (standard display); alternating display: total cooling energy (for heat/cooling calculators); information message (if an error was detected)</td>
<td> 

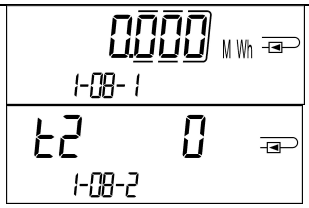
2) Segment test on / off (all segments triggered simultaneously)</td>
<td> 

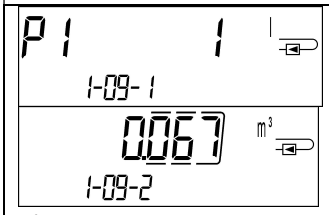
3) Last reading date alternating with heat energy (cooling energy), volume, value tariff register 1, value tariff register 2 at last reading date.[1)] (If the calculator has 3 pulse inputs, their values follow.[2)])</td>
<td> 

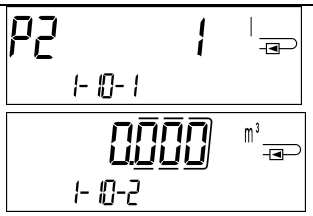
4) Total flow volume in m³</td>
</tr>
<tr>
<td> 

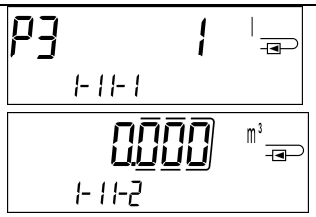
5) Current date alternating with time</td>
<td> 

6) Information message (alternating binary and hexadecimal display)</td>
<td> 

7) Tariff register 1: value alternating with tariff register no. and criteria</td>
<td> 

8) Tariff register 2: value alternating with tariff register no. and criteria</td>
</tr>
<tr>
<td> 

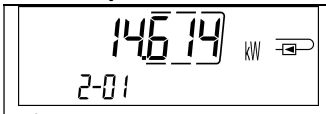
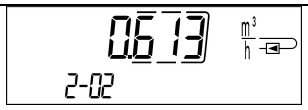
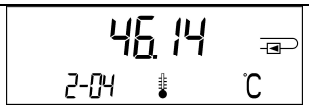
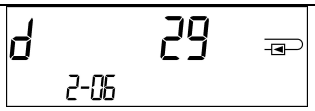
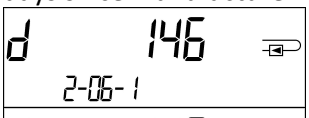
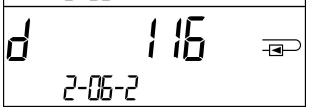
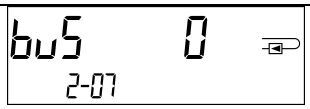
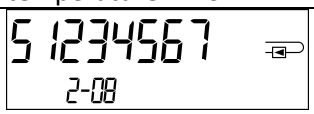
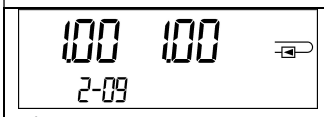
9) Pulse counter 1: pulse value alternating with reading[2)]</td>
<td> 

10) Pulse counter 2: pulse value alternating with reading[2)]</td>
<td> 

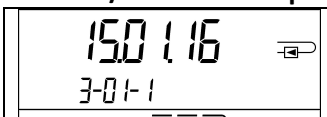
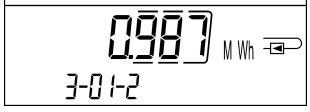
11) Pulse counter 3: pulse value alternating with reading[2)]</td>
<td></td>
</tr>
</table>

[1)] Up to the end of the month / the 15th of the month (for the semimonthly values) the consumption and date will be shown as 0.
[2)] Three pulse inputs are an option. They can be set using the software „Device Monitor“.

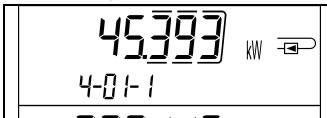
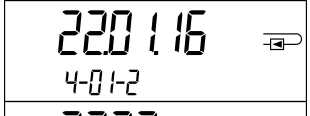
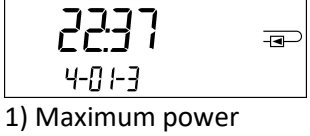
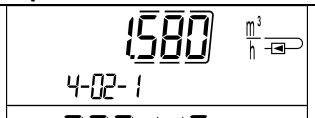
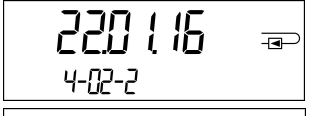
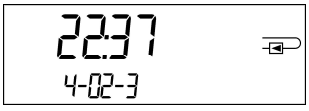
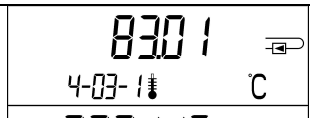
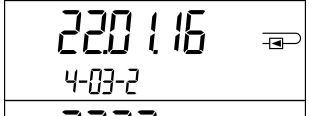
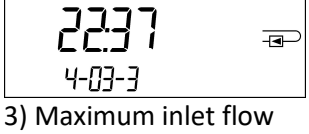
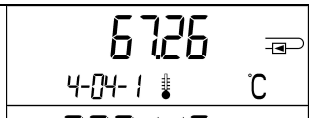
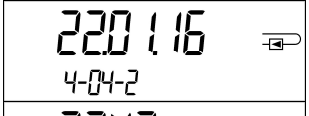
Level 2 / Technician’s Loop:

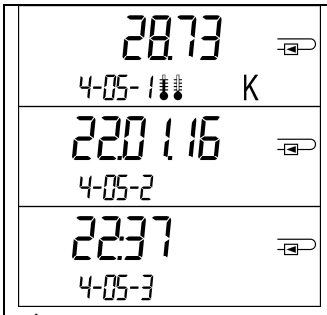
 1) Current power in kW	 2) Current flow in m³/h	 3) Inlet flow temperature in °C	 4) Outlet flow temperature in °C
 5) Temperature difference in K. (Cooling energy: Value is displayed negative.)	 6) Before start of operation: days since manufacture   After start of operation: days since manufacture alternating with days of operation after reaching an energy value > 10 kWh	 7) M-bus address	 8) Serial number
 9) Firmware version	 10) Type of Pt	 11) Pulse value	

Level 3 / Statistics Loop:

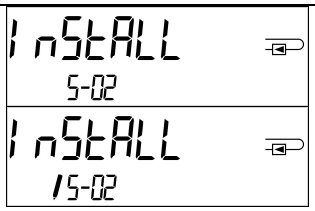
  	  	1) – 30) Semimonthly values: date alternating with heat energy, cooling energy, volume, value tariff register 1, value tariff register 2.[1)] (If the calculator has 3	pulse inputs, their values follow.[2)])

Level 4 / Maximum Values Loop:

   1) Maximum power alternating with date and time	   2) Maximum flow alternating with date and time	   3) Maximum inlet flow temperature alternating with date and time	   4) Maximum outlet flow temperature alternating with date and time

 5) Maximum temperature difference alternating with date and time			

Level 5 / Parametrizing Loop:

 1) Parametrizing „unit of energy“	 2) Parametrizing „installation point“		

8.1 Parametrizing loop

a) The following characteristics of the calculators can be set on location, **only once,** by pushing the button or alternatively using the „Device Monitor“ software:

- **unit of energy** (kWh (only with 1 liter / pulse); MWh; GJ)
- **installation point** (inlet flow; outlet flow).

These parametrizing options are only available when the amount of energy is still <= 10 kWh. Make sure that these characteristics are set as needed before starting up the system.
Setup by pushing the button: In order to start the editing mode for parametrizing you must select the respective item in the parametrizing loop and then push the button once again for 2-3 seconds. As an aid, after 2 seconds the „editing pen“ will be displayed bottom left in the LCD (see below picture). As soon as it appears you have to let go of the button. Then the current display will start blinking.

By pressing the push-button briefly you can switch to the next option. By pressing the push-button longer the currently displayed option will be set. If no option is chosen there will be no change and as soon as the LCD goes out the edit mode will end automatically.

b) The following characteristic of those calculator types designed to be used with glycol can be set on location **at any time** using the „Device Monitor“ software:

- **type and concentration of glycol in the medium** (propylene glycol; ethylene glycol; 20 %; 30 %; 40 %; 50%).

8.2 Detection of flow

As long as the calculator detects some flow the following pictogram will be displayed bottom right in the LCD:

	flow detected

8.3 Volume pulses

When a volume pulse is received via the calculator input the following pictogram will be displayed bottom right in the LCD for 1 second:

	volume pulse

9 Application Conditions

Calculator		
Temperature range medium heat	°C	0 – 150
Temperature range medium cooling	°C	0 – 50
Mechanical class		M2
Electromagnetic class		E2
Protection class		IP54
Ambient temperature in the field	°C	5 – 55 at 95 % relative humidity
Transport temperature	°C	-25 – 70 (for maximal 168 h)
Storage temperature	°C	-25 – 55
Pulse input interface		microcontroller CMOS input class IB according to EN 1434-2: 2015
Pulse values	standard	see type identification label
	TX versions	adjustable pulse values will be shown in the display: 1; 2,5; 10; 25; 100; 250; 1000; 2500

Flow meter requirements		
Pulse output device		class OA (reed contact) according to EN 1434-2: 2015; class OC (open collector) according to EN 1434-2: 2015
Point of installation		outlet flow (standard) / inlet flow; calculator can be set on location, only once, before start of operation by pushing the button or alternatively using the „Device Monitor“ software
Maximum input frequency	Hz	10
Pulse length	ms	≥ 25
Pulse pause	ms	≥ 50

Temperature sensor requirements		
Platinum precision resistor		Pt 500
Cable length (unshielded)	m	up to 10 in 2-wire technique
Installation		direct mounted; in temperature pockets
Application heat metering		EU (MID) identification on the temperature sensors
Application cooling metering		national approval as a temperature sensor for cooling meters*)
Application heat/cooling metering		EU (MID) identification and separate national approval as a temperature sensor for cooling meters*)

*) Requirements in countries other than Germany may be different.

10 Information Messages

When the instrument has detected an information message, the message symbol is displayed: ⚠
The specific message can be found at menu item 6 ‘Information message’ in level 1 / main loop (see section 8, Display). The message code is displayed alternately in binary and hexadecimal form.
The instrument recognizes seven message causes, which can also occur in combination with each other.

Hexadecimal display	**Description**	**Binary display**
H 80	Low battery	1 at first place
H 40	Instrument has been reset	1 at second place
H 20	Electronics defective	1 at third place
H 08	Temperature sensor outlet flow short circuit	1 at fifth place
H 04	Temperature sensor outlet flow cable break	1 at sixth place
H 02	Temperature sensor inlet flow short circuit	1 at seventh place
H 01	Temperature sensor inlet flow cable break	1 at eighth place

Example: Temperature sensor inlet cable break

Message	Low battery	Reset	Electronics defective	(Bit will not be used.)	Temperature sensor outlet flow short circuit	Temperature sensor outlet flow cable break	Temperature sensor inlet flow short circuit	Temperature sensor inlet flow cable break	
Bit	7	6	5	4	3	2	1	0	Alternating hexadecimal message displayed (LCD)
Display location	1	2	3	4	5	6	7	8	
Alternating binary message displayed (LCD)									

When a message ⚠ appears in the standard display (total heat energy), with the exception of the messages

- **Low battery (H 80)**
- **Reset (H 40),**

the instrument must be exchanged and sent to the supplier for examination.

10.1 Message description

Display	Message	Effect	Possible cause
H 80	Low battery	No influence on the calculation	Adverse environmental conditions; long operating time
H 40	Reset	No influence on the calculation	EMC, electromagnetic interference
H 20	Electronics defective	No energy calculations are carried out. The register for energy is not being updated.	Defective component, defect on the calculator PC board
H 08 / H 04 / H 02 / H 01	Temperature sensor outlet or inlet flow: short circuit / cable break	As for message „Electronics defective“	Sensor cable damaged

11 Manufacturer

Engelmann Sensor GmbH
Rudolf-Diesel-Str. 24-28
69168 Wiesloch-Baiertal
Germany

Tel: +49 (0)6222-9800-0
Fax:+49 (0)6222-9800-50
E-Mail: info@engelmann.de
www.engelmann.de

Operating Instructions

Communication Interfaces S3(C)

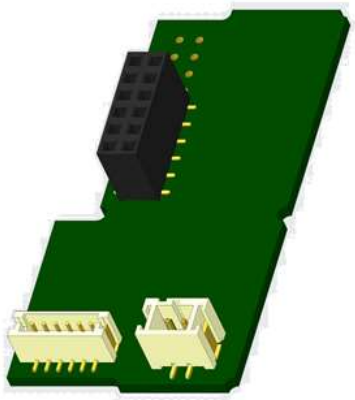
1 Interfaces and Options

1.1 Optical (infrared) interface

For communication with the optical interface an optocoupler and the “Device Monitor” software are necessary. The optocoupler and “Device Monitor” are available as accessory equipment.
The optical infrared interface will be activated by automatically sending a header (according to EN 13757-3). Baud rate: 2400 baud.
Then you can communicate with the meter for 4 seconds. After every valid communication the meter is open for another 4 seconds. Afterwards the display is deactivated.
The number of read-outs per day via the optical interface is limited. During daily read-out at least 4 communications are possible. If read-outs are carried out more rarely, the possible number of communications will increase.

1.2 M-Bus (optional)

The M-Bus is a galvanically isolated interface for the transmission of meter data (absolute values).



General information about the M-Bus interface:
It is important to note that the acknowledged state of the art technology rules and the relevant legal restraints (international and local; see “Relevant Norms / Standards / Literature M-Bus”) are to be observed.
The installation has to be performed by authorized, skilled persons.
If the regulations and the information in the installation and operating instruction manuals are not strictly followed, or if the installation is shown to be faulty, any resulting expenses will be charged to the company responsible for the installation.

Recommended type of cable: Telephone cable J-Y(ST)Y 2x2x0.8mm².
It is important to make sure that the topology of the M-Bus network (cable lengths and cross-sections) is suitable for the **baud rate (2400 Bd)** of the end instruments.

1.2.1 Relevant norms / standards / literature M-Bus

IEC 60364-4-41 (2005-12)	Low-voltage electrical installations - Part 4-41: Protection for safety - Protection against electric shock
IEC 60364-4-44 (2007-08)	Low-voltage electrical installations - Part 4-44: Protection for safety - Protection against voltage disturbances and electromagnetic disturbances
IEC 60364-5-51 (2005-04)	Electrical installations of buildings - Part 5-51: Selection and erection of electrical equipment - Common rules
IEC 60364-5-54 (2011-03)	Low-voltage electrical installations - Part 5-54: Selection and erection of electrical equipment - Earthing arrangements and protective conductors
EN 50310 (2011)	Application of equipotential bonding and earthing in buildings with information technology equipment
EN 13757-1_2015, -2_2004, -3_2013	Communication systems for meters and remote reading of meters
The M-Bus	A Documentation, Version 4.8, M-Bus User group

1.2.2 Additional technical specifications

The installation has to fulfill the requirements of the relevant norms / standards / literature (see paragraph 2.1) and the specifications as follows:

Maximum voltage M-Bus	42 V
Minimum voltage M-Bus	24 V

Maximum ripple voltage	200 mV; EN 13757-2_2004; 4.3.3.6
Maximum voltage potential differences	2 V

1.2.3 Technical data M-Bus

Primary address	0 (factory setting); 1 - 250 (configurable)
Baud rate	2400; 300
Connecting cable length	1 m
Number of possible read-outs	unlimited
Refresh of data	120 s; using a power pack: 2 s

1.3 Modbus RTU (optional)

The Modbus RTU Module is a galvanically isolated interface for the transmission of meter data (absolute values). It is designed for use with S3 heat meter and S3C calculator to connect them to Modbus RTU network using EIA-485 channel.

1.3.1 Technical data Modbus

Connector A	PowerSupply 12 V – 24V DC ± 10% (SELV power supply only)
Connector B	Modbus Network
Maximum power consumption	500 mW
Communication protocol	Modbus RTU
Channel	EIA-485 (galvanically isolated)
Baud rate	1200, 2400, 4800, 9600, 14400, 19200, 38400, 56000, 57600, 115200

1.3.2 Default factory settings

Communication parameters	9600 bps, 8N1 data format (8 data bits, none parity, 1 stop bit)
Update Rate Data from Meter	600 s
Modbus Slave ID*	1
Automatic Slave ID**	0 (deactivated)

* Acceptable values: 1 … 247

** If the automatic Slave ID is activated (set to = 1), the M-Bus address which is set in the meter is used for communication.

1.4 Wireless Interfaces

Engelmann offers the following radio interfaces:

- wireless M-Bus interface EN 13757-3, -4 (see chapter 1.4.1)
- LoRaWAN communication interface (see chapter 1.4.2)

General information about the radio interface:

Installation of radio components between or behind heating pipes, or the presence of other bulky metallic obstacles directly over or in front of the housing must be avoided.

The transmission quality (range, telegram processing) of radio components can be negatively influenced by instruments or equipment with electromagnetic emissions, such as telephones (particularly LTE mobile radio standard), wi-fi routers, baby monitors, remote control units, electric motors, etc.

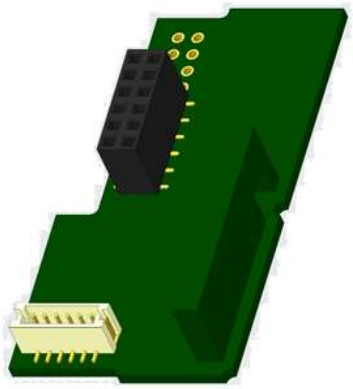
In addition, the construction of the building has a strong influence on the transmission range and coverage. Furthermore, when using installation boxes (substations) they must be equipped with non-metallic covers or doors.

The factory-setting of the clock in the meter is standard (winter) Central European Time (GMT +1). There is no automatic changeover to daylight savings (summer) time.

The radio function is deactivated upon delivery (factory-setting). See chapter 1.4.1.3 & 1.4.2.3 regarding the a**ctivation of the radio interface.**

1.4.1 Radio interface wireless M-Bus EN 13757-3, -4 (optional)

The radio interface transmits meter data (absolute values).



1.4.1.1 Technical data radio

Frequency	868 MHz
Transmission power	up to 12 dBm
Protocol	wireless M-Bus based on EN 13757-3, -4
Selectable modes	S1 / T1 (Frame Format A) C1 (Frame Format B)
Telegrams	- short telegram in conformity to AMR (OMS-Spec_Vol2_Primary_v301 and _v402): energy (heat/cooling energy, pulse input 1 to pulse input 3), total volume, flow, power, information message, outlet flow temperature, temperature difference - long telegram for walk-by read-out: energy (heat/cooling energy, pulse input 1 to pulse input 3), total volume, information message, 15 monthly or 30 semimonthly values (compact mode)
Encryption	AES: Advanced Encryption Standard; key length: 128 bits

1.4.1.2 Radio configuration

Parameter	**Possible settings**
Mode	S1 / T1 / C1; unidirectional
Transmission period	00:00 - 24:00; any time period in the day
Transmission interval	10 seconds - 240 minutes
Weekdays	Monday – Sunday (any weekday)
Weeks in a month	1 – 4 (4: uninterrupted, incl. a possible 5th week)
Months	1 - 12
Radio activation date	01.01. - 31.12. (day. month)

AES-128-Encryption	- not encrypted;
	- encrypted according to MODE 5 or MODE 7:
	  - Master Key
	  - key per instrument

Type of telegram	- short telegram in conformity to AMR (OMS-Spec_Vol2_Primary_v301 and _v402) - long telegram for walk-by read-out

1.4.1.3 Activation of the radio interface

The radio interface **leaves the factory deactivated**. It can be activated as follows:

a) The radio function can be activated by pressing the push-button.
Press the push-button until you change to the display loop “6” (module loop). Then change with a brief keystroke to the 2nd item “rad(io) off“ (see picture).
In order to start the editing mode you afterwards must press the push-button once again for 2-3 seconds. As an aid, after 2 seconds the “editing pen“ will be displayed bottom left in the LCD. As soon as it appears you have to let go of the button. Now the display shows “rad(io) on“ and in all display loops a black triangle (see picture).

b) The radio function can also be activated using the software “Device Monitor”.

This software can be ordered separately as an option.

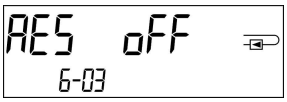
The radio function can only be deactivated using the software “Device Monitor”.

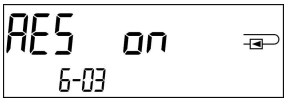
After activation of the radio function or modification of the radio parameters the meter remains in installation mode for 60 minutes. During this time he sends telegrams in a 36-seconds-interval.

If using the **compact mode**, after activation the meter transmits during installation mode format telegrams and compact telegrams alternately.
During installation mode at least one meter of the version being installed (inlet or outlet flow, heat or heat/cooling, pulse inputs, display units) must be read out with the Engelmann “Read-out Software walk-by”. The format of the telegram will be stored locally in the PC in an .xml file.
After completion of the installation mode only compact telegrams will be transmitted.

1.4.1.4 Later activation of the radio encryption

The AES encryption can also be activated later. It can be activated as follows:
a) The encryption can be activated by pressing the push-button.
Press the push-button until you change to the display loop “6” (module loop). Then change with a brief keystroke to the 3rd item “AES off“ (see picture).
In order to start the editing mode you afterwards must press the push-button once again for 2-3 seconds. As an aid, after 2 seconds the “editing pen“ will be displayed bottom left in the LCD. As soon as it appears you have to let go of the button. Now the display shows “AES on“ (see picture).

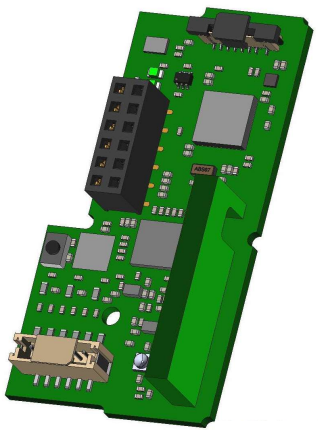




b) The encryption can also be activated using the software “Device Monitor”. This software can be ordered separately as an option.
The encryption can only be deactivated using the software “Device Monitor”.

1.4.2 LoRaWAN interface

The LoRaWAN interface transmits meter data (absolute values).



1.4.2.1 Technical data

Radio characteristics

Frequency 868 MHz	Frequency 868 MHz
Output power 14 dBm	Output power 14 dBm
Receiver sensitivity -135 dBm	Receiver sensitivity -135 dBm

LoRaWAN characteristics

Device class	Class A, Bi-directional
LoRa version	1.0.2 Rev B
Activation	OTAA* or ABP*
Data rate	DR0-DR5 (250 bit/s-5470 bit/s)

*OTAA = Over-the-air activation
** ABP = Activation by personalization

1.4.2.2 LoRa module configuration

The module can be configurated by using the Device Monitors or the OTC App.

Parameter	Possible settings	Factory setting
Power mode	Active Inactive	Inactive
Configuration Lock	Open Locked	Open
Synchronize meter time	on off	off
Activation type	OTAA ABP	OTAA
EcoMode	off 6 years 10 years	EcoMode 10 years
Transmit interval *[Min.]	5 … 1440	60
Message format**	Standard Engelmann Compact JSON Scheduled - daily redundant Scheduled - extended Combined heat/cooling	Standard
Pulse input selection	Choice between 0-3 pulse inputs	0

* The actual transmission interval depends on the type of telegram and the current data rate. The transmission interval is adjusted accordingly in order to guarantee the set battery life (Eco Mode 10 or 6 years). You can find more information in the „Manual LoRa Module“.

** For pulse input option, the telegram type „Engelmann“ must be selected.

1.4.2.3 Activation of the radio interface

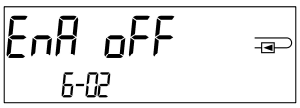
The radio interface is deactivated by default and can be activated in one of the three following ways:

a) **NTC interface - via Elvaco OTC App**; further information is available in the operating instructions of the Elvaco OTC App: https://www.elvaco.se/Image/GetDocument/en/269/elvaco-otc-app-manual-english.pdf

b) **Optical interface - via the Engelmann configuration software Device Monitor** – from version 2.22; further information is available in the operating instructions of the Device Monitor. The software can be ordered separately.

c) **Via the heat meter menu;**

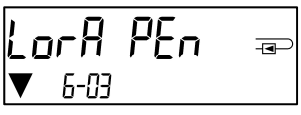
Press and hold the button to switch to display loop "6" (= module loop; see Chapter 3 Display in the Module Loop (Optional)). Then switch to the second loop with a short press of the button – 6-02 – „EnA oFF“ (see image).



In order to start the edit mode, you must then press the key press once more for 2-3 seconds. As an aid, an “editing pen” symbol appears in the lower left corner of the LCD after 2 seconds. As soon as it can be seen, you must release the button. The display now shows „EnA on“ and a black triangle in all display loops (see image).

1.4.2.3 Connection to the LoRaWAN Network

To check whether the meter has already connected to the LoRaWAN network, change from loop 6-02 to loop 6-03 by briefly pressing the button. As long as the meter is searching for the LoRaWAN network, „LorA Pen“ appears in the LCD; the time between each connection attempt is gradually reduced to at least once a day.



As soon as the meter has connected to the LoRaWAN network, “LorA Con” appears in the LCD.

1.5 Three additional pulse inputs (optional; only in conjunction with M-Bus or radio)

With this option, additional instruments with pulse outputs can be read out via optical interface, M-Bus or radio.

General information about pulse inputs:

It is important to note that the acknowledged state of the art technology rules and the relevant legal restraints (international and local; see “Relevant Norms / Standards / Literature Pulse Inputs”) are to be observed.

The installation has to be performed by authorized, skilled persons.

If the regulations and the information in the installation and operating instruction manuals are not strictly followed, or if the installation is shown to be faulty, any resulting expenses will be charged to the company responsible for the installation.

1.5.1 Relevant norms / standards / literature pulse inputs

IEC 60364-4-41 (2005-12)	Low-voltage electrical installations – Part 4-41: Protection for safety – Protection against electric shock
IEC 60364-4-44 (2007-08)	Low-voltage electrical installations – Part 4-44: Protection for safety – Protection against voltage disturbances and electromagnetic disturbances
IEC 60364-5-51 (2005-04)	Electrical installations of buildings – Part 5-51: Selection and erection of electrical equipment – Common rules
IEC 60364-5-54 (2011-03)	Low-voltage electrical installations – Part 5-54: Selection and erection of electrical equipment – Earthing arrangements and protective conductors
EN 50310 (2011)	Application of equipotential bonding and earthing in buildings with information technology equipment
EN 1434-2 (2016)	Heat Meters – Part 2: Constructional requirements

1.5.2 Technical data pulse inputs

Pulse input class	IB according to EN 1434-2:2016
Connecting cable length	1 m
Voltage supply	+ 3 V DC
Source current	= 1,5 µA
High level input threshold	U ≥ 2 V
Low level input threshold	U ≤ 0,5 V
Pull-up resistor	2 MΩ
Pulse length	≥ 100 ms
Pulse frequency	≤ 5 Hz

1.5.3 Possible combinations of the different input (class IB) and output (class OA) devices

	Class IA	**Class IB**	**Class IC**	**Class ID**	**Class IE**
Class OA	yes	yes	no	yes	no
Class OB	yes	no	no	yes	yes
Class OC	no	yes	yes	no	no
Class OD	no	no	yes	no	no
Class OE	no	no	no	no	yes

1.5.4 Setting up the three additional pulse inputs

The optional pulse inputs 1 + 2 + 3 for external meters can be set up using the “Device Monitor” configuration software. You can configure serial number, manufacturer, version (0 … 255), medium code, input pulse value, unit and starting value of the external meters.

1.5.5 Set-up possibilities

Pulse value	Units
1	liters / kWh / pulse without unit
2,5	liters / kWh / pulse without unit
10	liters / kWh / pulse without unit
25	liters / kWh / pulse without unit
100	liters / kWh / pulse without unit
250	liters / kWh / pulse without unit
1000	liters / kWh / pulse without unit

Installation notes for pulse inputs:
It is important that the pulse cables not be affected by (or exposed to) an external voltage!
Check the polarity of pulse generators with “open collector“ outputs.
The cable wires must not touch each other during installation, otherwise pulses will be counted in the instrument.
When setting up the meter it may be necessary to adjust the meter reading of the instruments connected and the pulse value using the “Device Monitor” software.

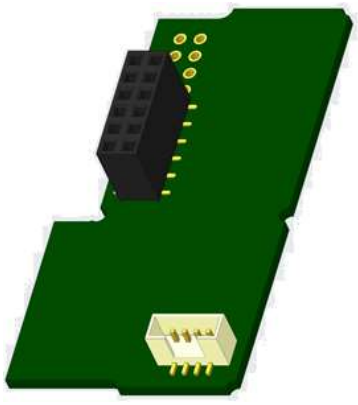
For transmitting the values of the pulse inputs via radio, transmission must be set using the “Device Monitor” software, if the meters were not already ordered with the transmission of these values set.
Select the menu item „Parameterization of the module“ in the software. Set the radio transmission in the menu item „Transmission of values for the pulse inputs“. (The transmission of these values via M-Bus is always set in the factory setting.)

1.5.6 Pin assignments 6-wire cable

Color	Connection
Pink	IE1+
Grey	IE1⊥
Yellow	IE2+
Green	IE2⊥
Brown	IE3+
White	IE3⊥

1.6 One potential-free pulse output (optional)

Important note: This module can be used for the compact heat meter S3 from firmware version 1.03 on, for the calculator S3C from firmware version 1.00 on.
The potential-free pulse output provides counting pulses of the meter.
The pulse output closes corresponding to the pulse value, see item „pulse value pulse output 1“ in display loop “6” (module loop).



	Heat meter	Cooling meter	Heat/cooling meter
Possible settings pulse output 1	heat energy (factory setting) or volume	cooling energy (factory setting) or volume	heat energy (factory setting) or volume

From firmware version 1.03 (S3) and 1.00 (S3C) on the meter recognizes nominal size and unit of energy and autonomously sets the pulse values for energy and volume according to the following notes.

S3 - pulse output for energy:

	Display shows kWh / MWh	Display shows Gcal	Display shows GJ	Display shows MMBTU
q_p 0,6 m^3/h	1 kWh/pulse	1 Mcal/pulse	10 MJ/pulse	10 MMBTU/pulse
q_p 1,5 m^3/h	1 kWh/pulse	1 Mcal/pulse	10 MJ/pulse	10 MMBTU/pulse
q_p 2,5 m^3/h	1 kWh/pulse	1 Mcal/pulse	10 MJ/pulse	10 MMBTU/pulse
q_p 3,5 m^3/h	10 kWh/pulse	10 Mcal/pulse	10 MJ/pulse	10 MMBTU/pulse
q_p 6 m^3/h	10 kWh/pulse	10 Mcal/pulse	10 MJ/pulse	10 MMBTU/pulse
q_p 10 m^3/h	10 kWh/pulse	10 Mcal/pulse	10 MJ/pulse	10 MMBTU/pulse

S3 - pulse output for volume:
The pulse value for volume is always determined as follows: Display shows m^3 -> pulse value: 100 l/pulse (0,1 m^3/pulse).

S3C - pulse output for energy:
The pulse value for energy is always determined by **the second-to-last place** of the energy display.
Examples:
Display: 0 kWh -> pulse value: 10 kWh/pulse
Display: 0,000 MWh -> pulse value: 0,01 MWh/pulse
Display: 0,000 GJ -> pulse value: 0,01 GJ/pulse.

S3C - pulse output for volume:
The pulse value for volume is always determined by **the third-to-last place** of the volume display. Examples:
Display: 0,000 m^3 -> pulse value: 100 l/pulse (0,1 m^3/pulse)
Display: 0 m^3 -> pulse value: 100 m^3/pulse.

1.6.1 Pin assignments 4-wire cable

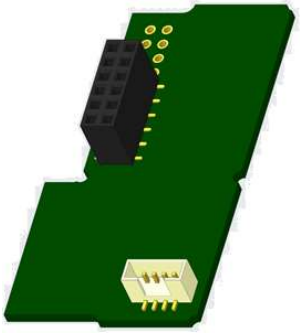
Color	Connection
Yellow	IA1
Green	IA1
Brown / White	not reserved

1.6.2 Technical data for one pulse output and two pulse outputs

Pulse outputs class	OA (electronic switch) according to EN 1434-2:2016
Connecting cable length	1 m
Switching voltage, maximum	30 V
Switching current, maximum	27 mA
Contact resistance (on) max.	74 Ω
Contact resistance (off) min.	6 MΩ
Closure time	100 ms
Interval between pulses	100 ms

1.7 Two potential-free pulse outputs (optional)

The potential-free pulse outputs provide counting pulses of the meter.
The pulse outputs close corresponding to the pulse value, see items „pulse value pulse output 1“ and „pulse value pulse output 2“ in display loop “6” (module loop).



	Heat meter	Cooling meter	Heat/cooling meter
Pulse output 1	heat energy	cooling energy	heat energy
Pulse output 2	volume	volume	cooling energy

Pulse outputs for energy:
The pulse value for energy is always determined by **the last place** of the energy display.
Examples:
Display: 0 kWh -> pulse value: 1 kWh/pulse
Display: 0,000 MWh -> pulse value: 0,001 MWh/pulse
Display: 0,000 GJ -> pulse value: 0,001 GJ/pulse

Pulse outputs for volume:
The pulse value for volume is always determined by **the second-to-last place** of the volume display.
Example:
Display: 0,000 m³ -> pulse value: 10 l/pulse (0,01 m³/pulse)

1.7.1 Pin assignments 4-wire cable

Color	Connection
Yellow	IA1
Green	IA1
Brown	IA2
White	IA2

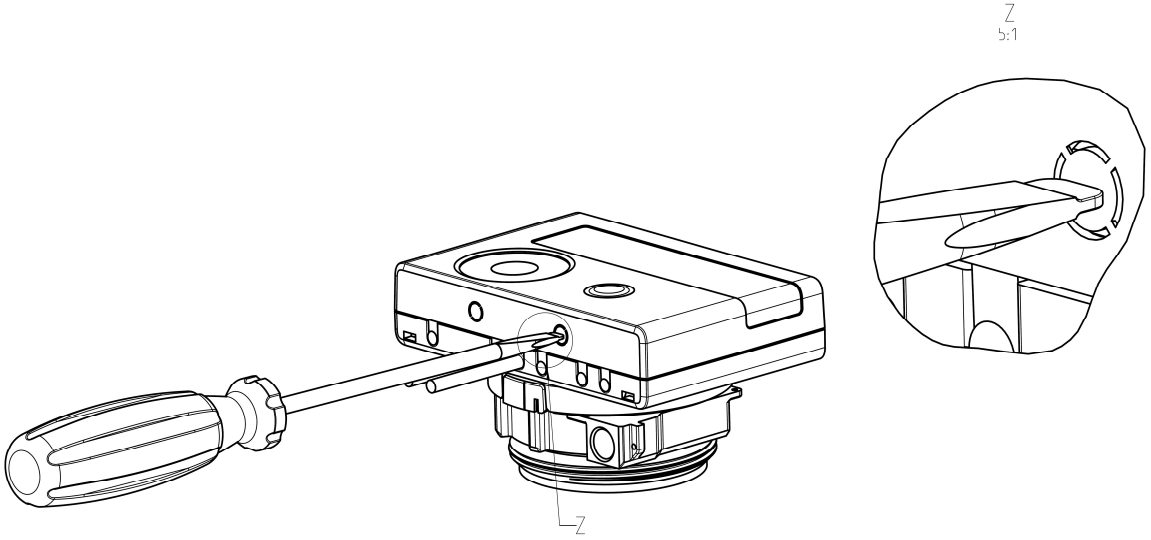
2 Retrofitting with an Additional Communication Interface

During installation of the retrofitting module observe the ESD requirements according to EN 61340-5-1.
This means that on location an antistatic wrist strap with an integrated 1 MΩ resistor has to be used which must be connected to a proper spot: This is either a grounded pipe or – only with an appropriate adapter! – a Schuko plug grounding socket. The antistatic wrist strap must be worn tightly on the skin of the wrist.

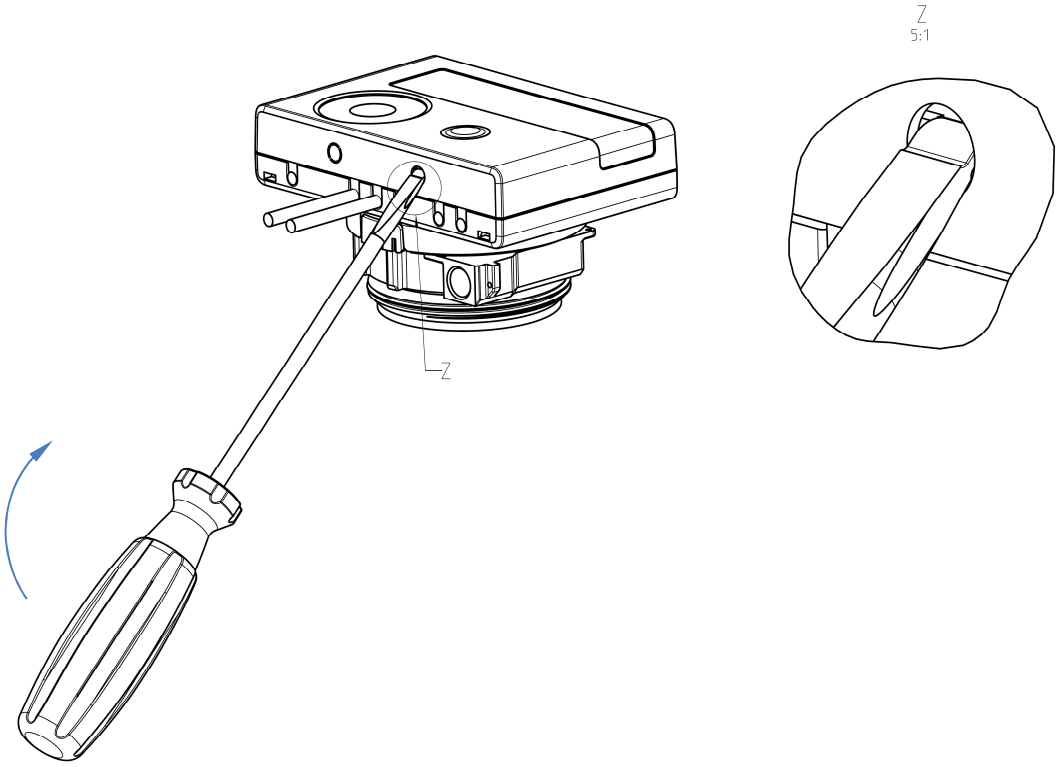
2.1 Retrofitting S3 with an additional communication interface (optional)

We also offer a retrofittable meter to which communication interfaces can be added later.

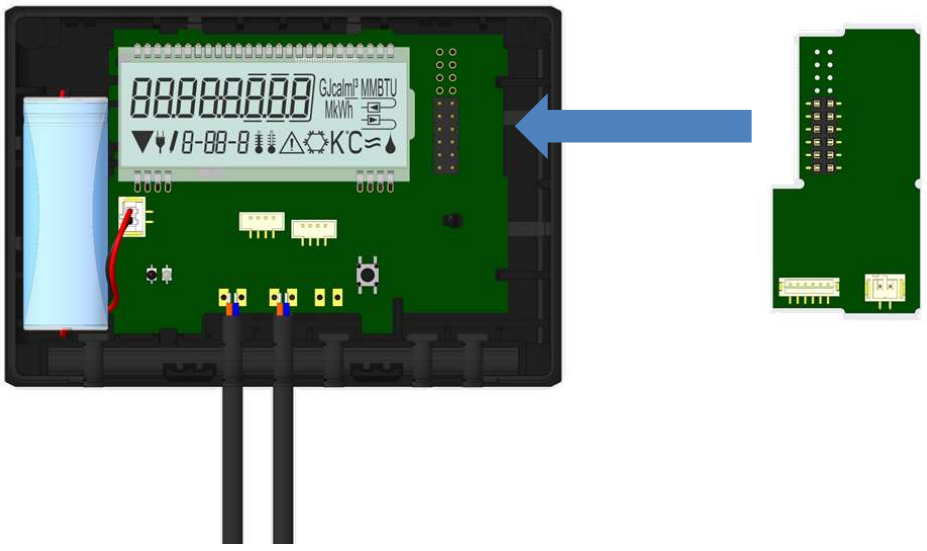
To retrofit such a meter with an additional communication interface the calculator´s adhesive seal has to be destroyed and the device´s calculator to be opened. Use a screwdriver with a wide tip (4 - 5 mm) and carefully press in the two round predetermined breaking points above the cable feedthroughs (see picture 1).



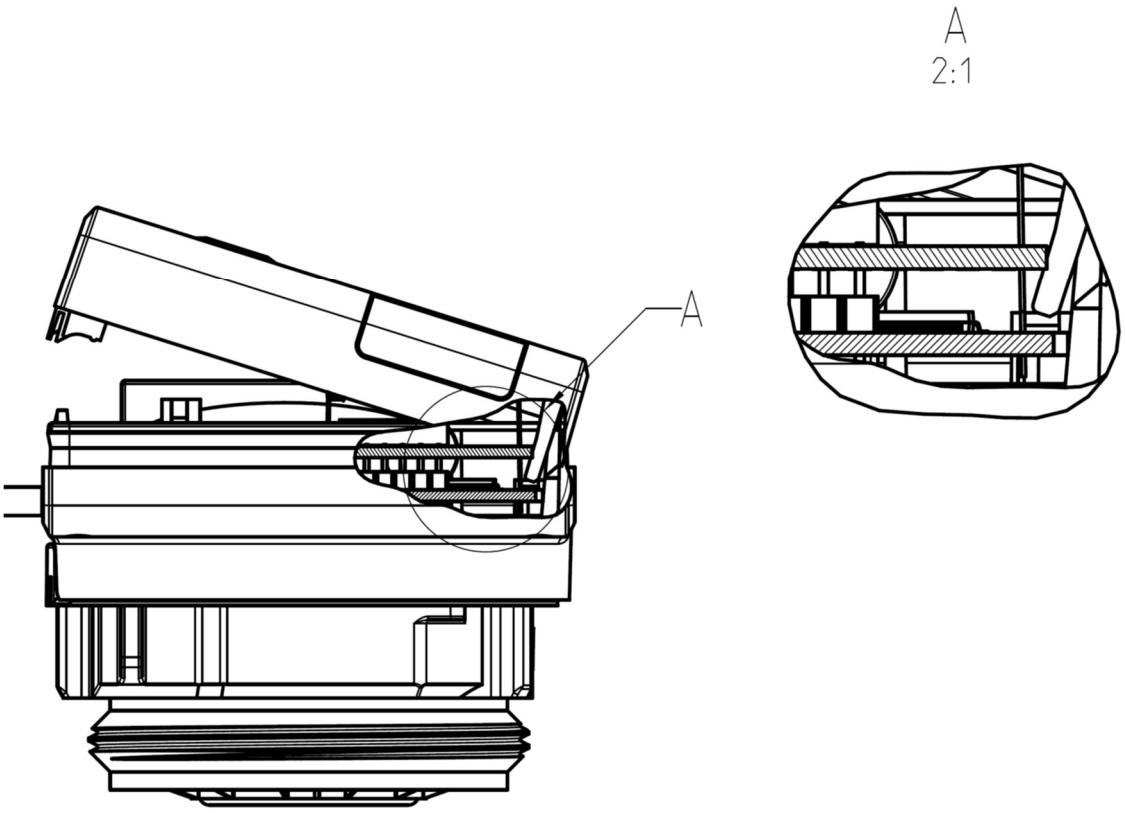
Then insert the screwdriver into one of the two openings at an angle of approx. 45° and carefully lift the handle up to approx. 90° (see picture 2). The upper housing piece of the calculator is then no longer latched on this side. Repeat this with the other opening. Now the upper housing piece can be taken off.



Plug the interface module on the right side of the PC board (see picture 3). The cables are to be fed through the rightmost cable feedthroughs into the calculator after removing the blind grommets. Close the calculator. Protect the calculator against unauthorized opening using one of the numbered adhesive seals enclosed to the modules (stick it upon the seal destroyed). The added bar code label can be used for the purpose of documentation.



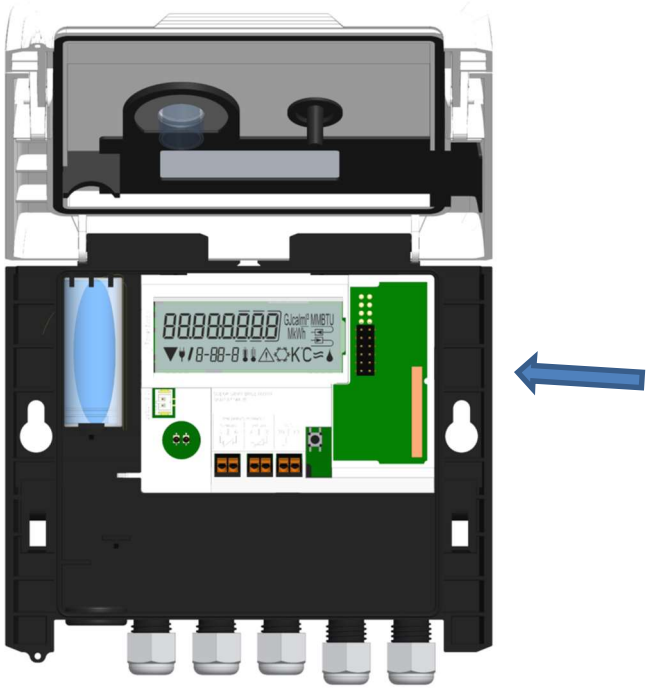
To remove a module the upper housing piece must be carefully pressed against the rear panel of the lower housing piece during opening the calculator. Thus the two rear snap-fits of the upper housing piece lever out the module of the PC board (see picture 4).



2.2 Retrofitting S3C with an additional communication interface

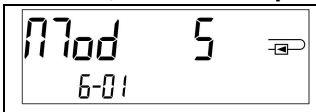
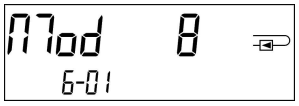
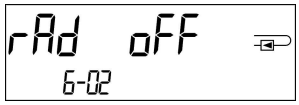
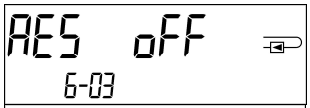
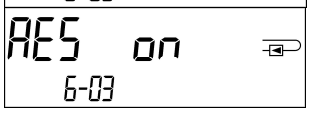
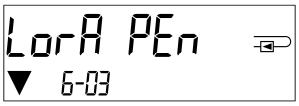
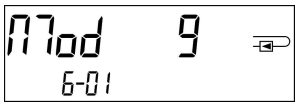
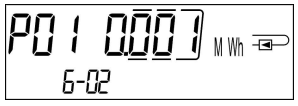
To our calculator further communication interfaces can be added later.

Open the calculator by pulling the clamping bracket at the upper housing´s leading edge up.
Plug the interface module on the right side of the PC board. If there are module cables you have to loosen the needed number of cable glands and to glide them over the cables. Remove the blind plugs from the cable gland openings and feed the cables into the calculator.
Protect the calculator against unauthorized opening using one of the numbered adhesive seals enclosed to the modules (stick it upon the seal destroyed). The added bar code label can be used for the purpose of documentation.



3 Display in the Module Loop (Optional)

Level 6 / Module Loop:

		
	  or:  	  or:  
		
		
1) Display of plugged module (alternatively):	**2) Display depending on plugged module and setup:**	**3) Display depending on plugged module and setup:**
5 = 1 pulse output		
8 = wireless M-Bus + 3 pulse inputs	wireless M-Bus (radio) off/ wireless M-Bus (radio) on; LoRa on/ LoRa off	radio encryption (AES) off; radio encryption (AES) on; LoRa pending/ LoRa connected
9 = M-Bus + 3 pulse inputs; 9 = Modbus		
10 = 2 pulse outputs	pulse value / pulse output 1	pulse value / pulse output 2

4 Imprint

Engelmann Sensor GmbH
Rudolf-Diesel-Str. 24-28
69168 Wiesloch-Baiertal
Germany

E-Mail: info@engelmann.de

www.engelmann.de

EG-Konformitätserklärung
EC-Declaration of Conformity

Für das Produkt *For the product*	
Rechenwerk *Calculator*	**S3C**
EG-Baumusterprüfbescheinigung *EC examination certificate no.*	**DE-18-MI004-PTB037**
Metrologiekennzeichnung *Metrology Marking*	CE **M XX 0102** XX = Jahreszahl *year*
Benannte Stelle, Modul, Zertifikat *notified body number, modul, certificate*	**0102, Physikalisch-Technische Bundesanstalt, D-38166 Braunschweig, Modul D, DE-M-AQ-PTB015**
bestätigen wir als Hersteller *we confirm as the manufacturer*	**Engelmann Sensor GmbH, Rudolf-Diesel-Straße 24-28, D-69168 Wiesloch-Baiertal**

dass das Produkt die Anforderungen erfüllt, die in den folgenden Richtlinien der Europäischen Gemeinschaft genannt werden, soweit diese Anwendung auf das Produkt finden:
that the product meets the requirements according to the following directives of the European Parliament as far as these are applied on the product:

Messgeräte-Richtlinie 2014/32/EU vom 26.02.2014 (ABl. L 96/149 29.3.2014), zuletzt geändert durch die Berichtigung vom **20.01.2016 (ABl. L 13 S. 57)**	*Measuring Instruments Directive 2014/32/EU*
RoHS-Richtlinie 2011/65/EU vom 08.06.2011 (ABl. L 174/88 1.7.2011)	*RoHS Directive 2011/65/EU*
EMV-Richtlinie 2014/30/EU vom 26.02.2014 (ABl. L 96/79 29.3.2014)	*EMC Directive 2014/30/EU*
Zusätzlich für Geräte mit Funk: *Additionally for devices with radio communication:*	
Funkanlagen-Richtlinie 2014/53/EU vom 16.04.2014 (ABl. L 153/62 22.5.2014)	*Radio Equipment Directive 2014/53/EU*

Weiterhin entspricht das Produkt den folgenden harmonisierten Normen, normativen Dokumenten, Technischen Richtlinien und sonstigen Rechtsvorschriften, soweit diese Anwendung auf das Produkt finden:
Furthermore, the product complies with the following harmonised standards, normative documents, technical guidelines and other regulations as far as these are applied on the product:

DIN EN 1434 (2015)	**EN 13757-2, -3 (2005)**	**EN 61000-4-4 (2004+A1:2010)**
OIML R75 (2002/2006)	**EN 60751 (2009)**	**EN 61000-4-6 (2014)**
EN 301489-1 V2.2.3 (2019-11)	**EN 62479 (2010)**	**EN 61000-4-8 (2010-11)**
EN 301489-3 V2.1.1 (2019-03)	**DIN EN 60529 (2000)**	**PTB-Richtlinie K 7.1 (2006)**
EN 300220-2 V3.1.1 (2017-02)	**EN 61000-4-3 (2006+A1:2008+A2:2010)**	

Der Hersteller trägt die alleinige Verantwortung für die Ausstellung der Konformitätserklärung.
The manufacturer is solely responsible for issuance of the declaration of conformity.

Wiesloch-Baiertal, 01.12.2022
Engelmann Sensor GmbH

R. Tischler / CE-Beauftragter *CE Manager*

Konformitätserklärung
für Geräte, die nicht europäischen Vorschriften unterliegen

Für das Produkt	
Rechenwerk	**S3C**
Baumusterprüfbescheinigung	**DE-18-M-PTB-0049**
Metrologiekennzeichnung	**DE-M XX 0102** XX = Jahreszahl
Benannte Stelle, Modul	**0102, Physikalisch-Technische Bundesanstalt, D-38116 Braunschweig, Modul D**
bestätigen wir als Hersteller	**Engelmann Sensor GmbH, Rudolf-Diesel-Straße 24-28, D-69168 Wiesloch-Baiertal**

dass das Produkt die Anforderungen erfüllt, die im **Mess- und Eichgesetz (MessEG vom 25.07.2013 (BGBl. I S. 2722))**, zuletzt geändert durch Artikel 1 des Gesetzes vom **09.06.2021 (BGBl. I S. 1663)** sowie in der sich darauf stützenden **Mess- und Eichverordnung (MessEV vom 11.12.2014 (BGBl. I S. 2010))**, zuletzt geändert durch die **dritte Verordnung zur Änderung der Mess- und Eichverordnung vom 26. Oktober 2021 (BGBl. I S. 4742)**, genannt werden.

Weiterhin entspricht das Produkt den folgenden harmonisierten Normen, normativen Dokumenten, Technischen Richtlinien und sonstigen Rechtsvorschriften, soweit diese Anwendung auf das Produkt finden:

DIN EN 1434 (2015)	**EN 60751 (2009)**
OIML R75 (2002/2006)	**PTB-Richtlinie K 7.1, K7.2 (2006)**

Der Hersteller trägt die alleinige Verantwortung für die Ausstellung der Konformitätserklärung.

Wiesloch-Baiertal, 01.12.2022
Engelmann Sensor GmbH

R. Tischler / Metrologie-Beauftragter