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)

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the seals must not be removed or damaged – otherwise the guarantee and the approved application of the instrument are no longer valid!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.

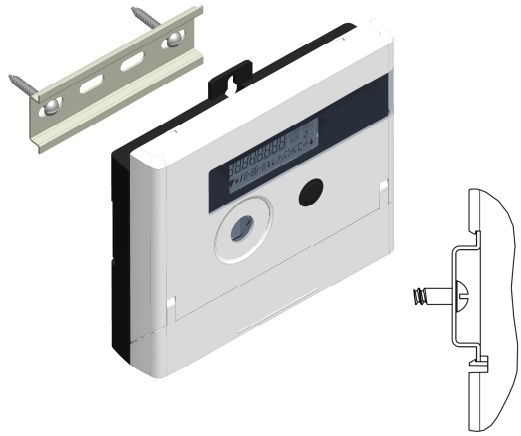
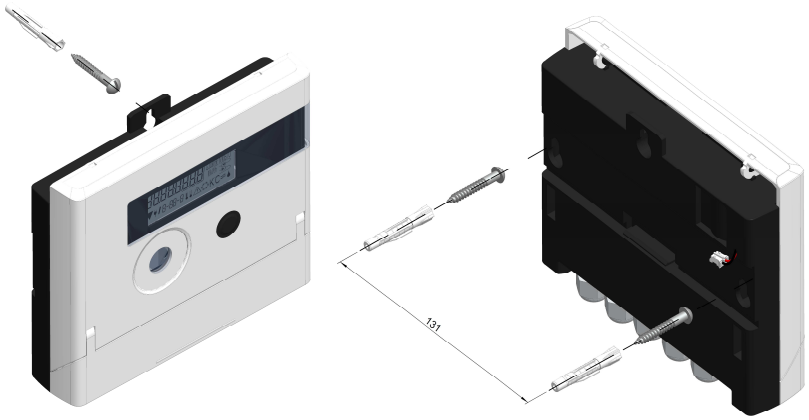
	Installation in outlet flow
	Installation in inlet flow

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.

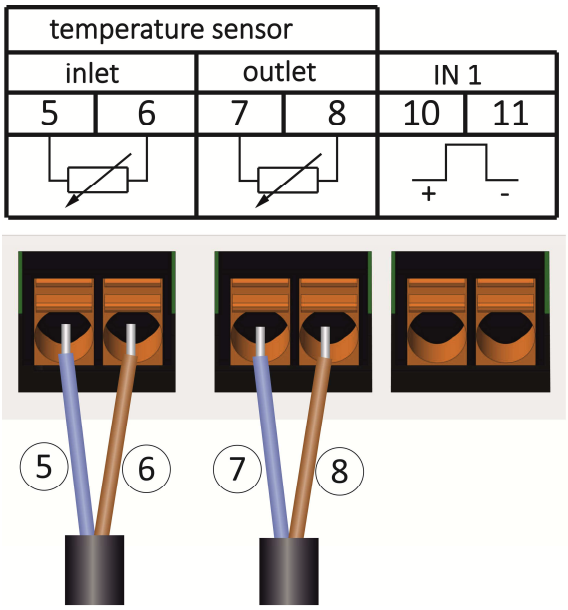
- Sensor cables that are too long should not be rolled up tightly into an ‘air-core coil’. The cables should either be laid out disordered, or rolled up loosely into a wide coil which can be turned and tied into an ‘8’.

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.

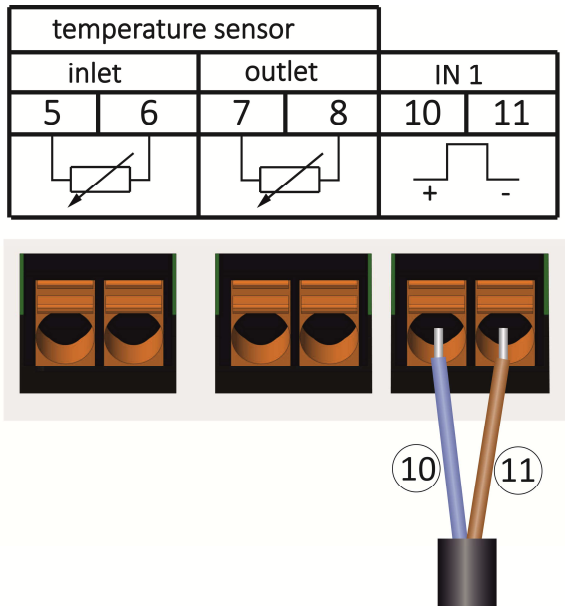
Mounting

- 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 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 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.

<u>Check the following points:</u>

- 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

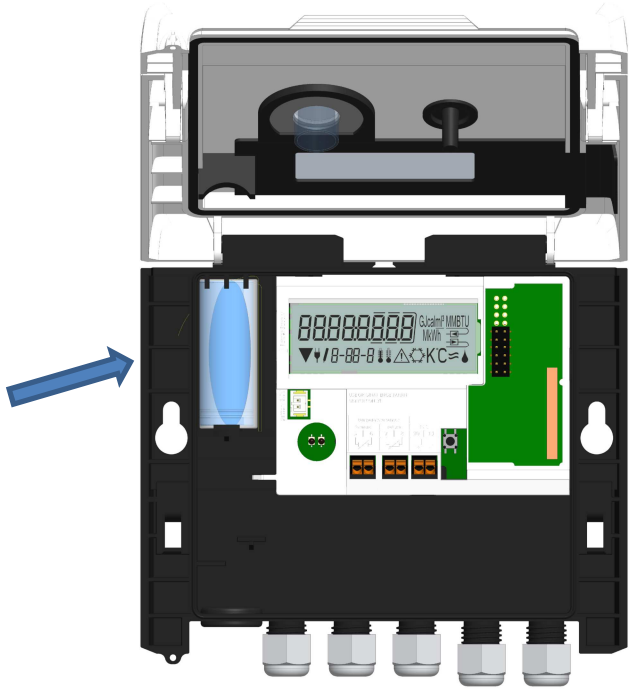
To our calculator further communication interfaces can be added later. You will find the description of our optional interfaces in the operating instructions „Communication Interfaces S3(C)“.

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.

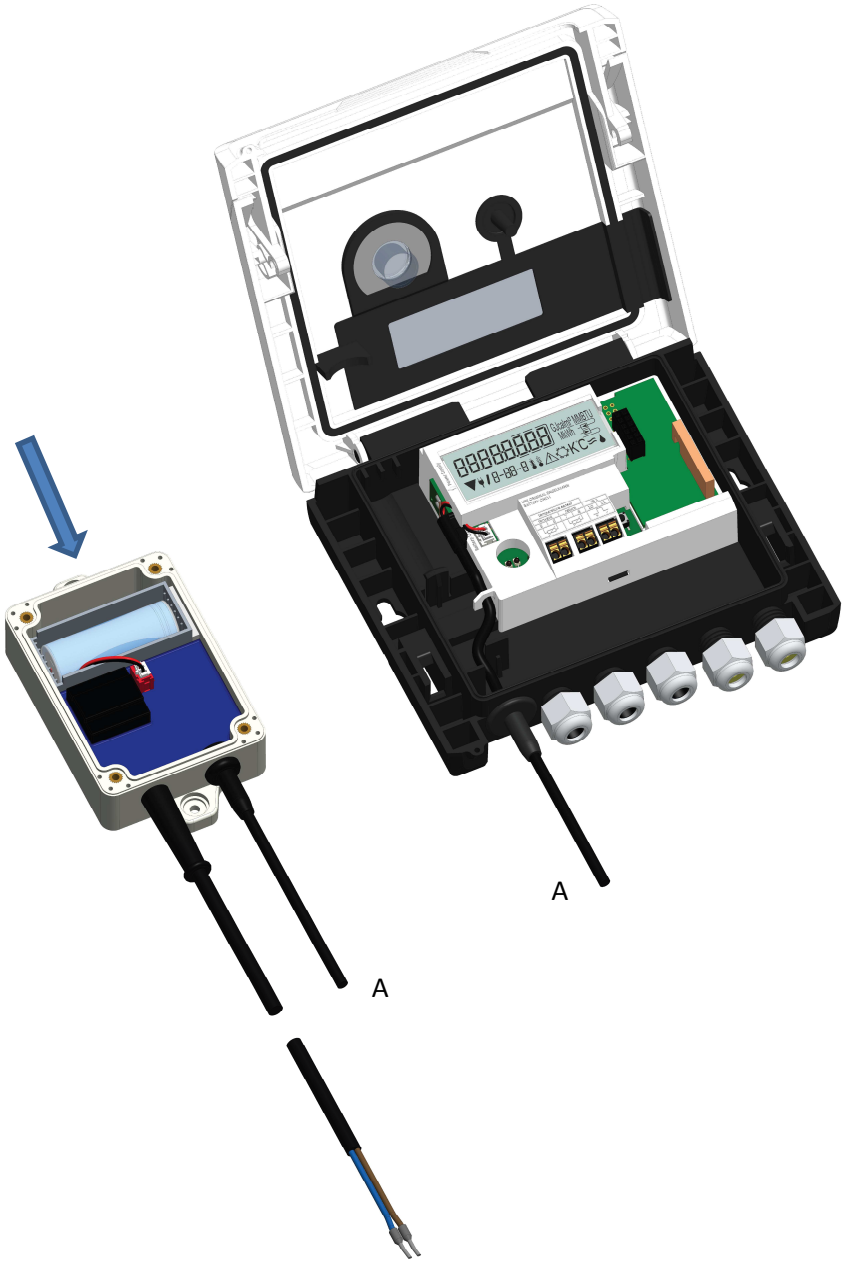
7.3 Exchanging the battery

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.

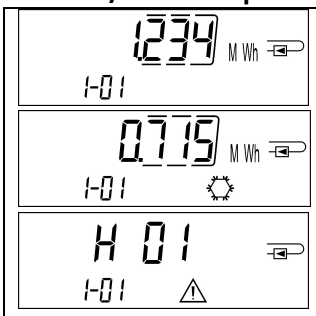


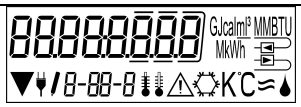
8 Display

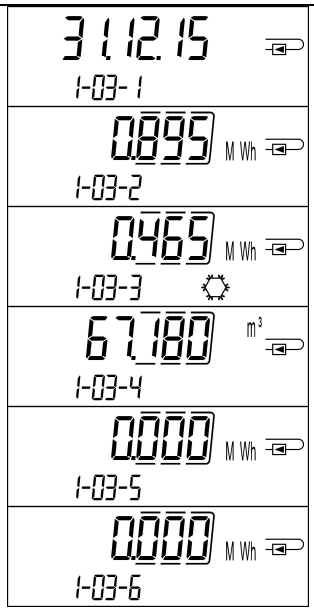
The calculator has a liquid crystal display with 8 digits and special characters. The values that can be shown are divided into five display loops. All data is retrieved using the push-button next to the display.

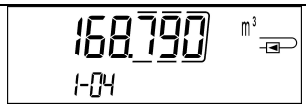
At the start you are automatically in the main loop (1st level). By pressing the push-button longer than 4 seconds you change to the next display loop. Keep the push-button pressed until you reach the desired information loop. By pressing the push-button briefly each time you can scan all the information within a loop.
After 2 minutes of non-use of the push-button, the display will automatically be deactivated.

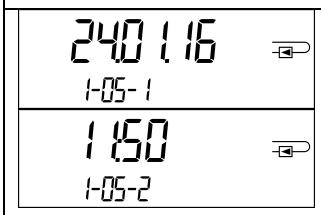
Level 1 / Main Loop:

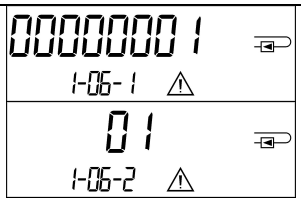
<table>
<tr>
<td> 

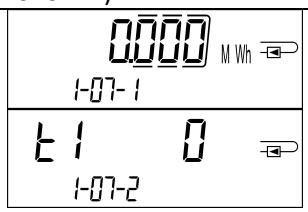
1) Total heat energy since start of operation (standard display); alternating display: total cooling energy (for heat/cooling calculators); information message (if an error was detected)</td>
<td> 

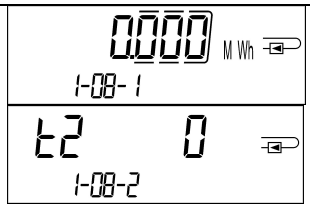
2) Segment test on / off (all segments triggered simultaneously)</td>
<td> 

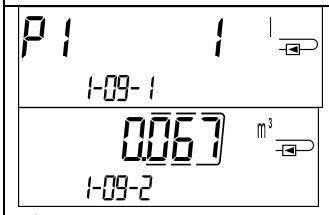
3) Last reading date alternating with heat energy (cooling energy), volume, value tariff register 1, value tariff register 2 at last reading date.[1)] (If the calculator has 3 pulse inputs, their values follow.[2)])</td>
<td> 

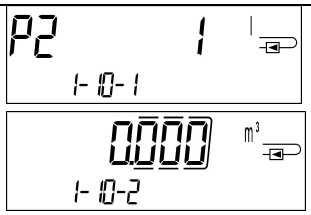
4) Total flow volume in m³</td>
</tr>
<tr>
<td> 

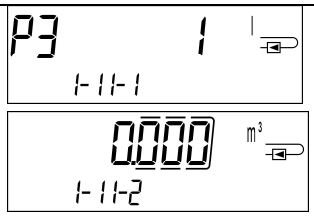
5) Current date alternating with time</td>
<td> 

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> 

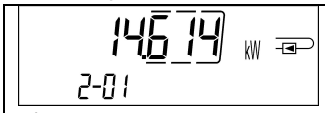
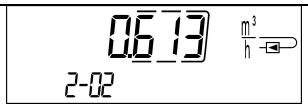
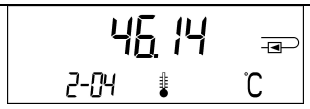
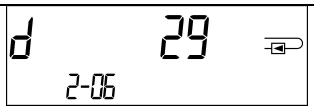
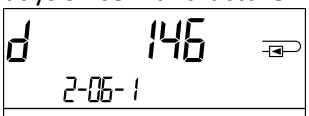
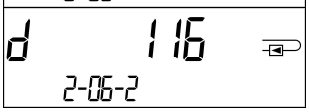
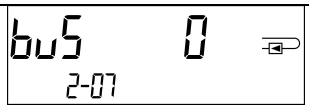
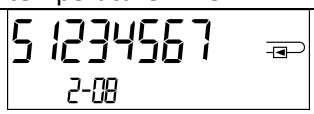
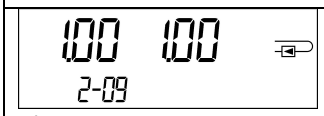
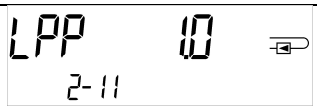
10) Pulse counter 2: pulse value alternating with reading[2)]</td>
<td> 

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

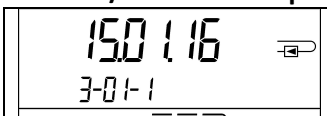
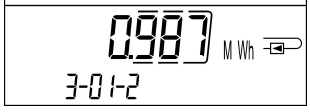
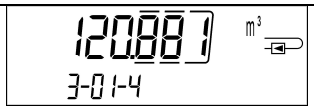
[1)] Up to the end of the month / the 15th of the month (for the semimonthly values) the consumption and date will be shown as 0.

[2)] Three pulse inputs are an option. They can be set using the software „Device Monitor“.

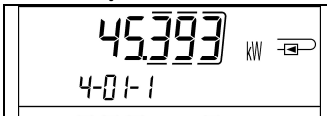
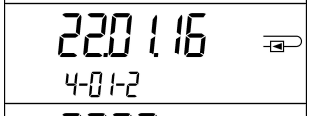
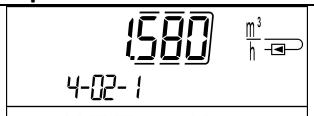
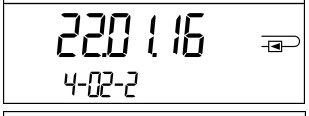
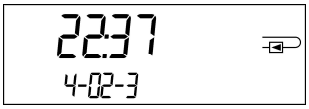
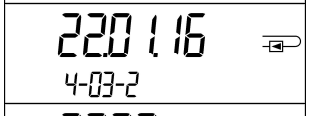
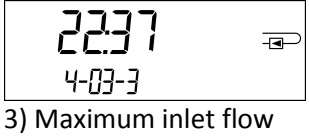
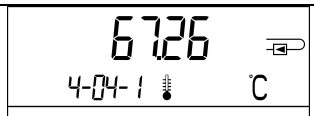
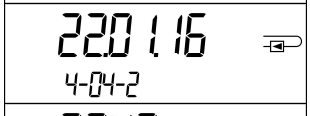
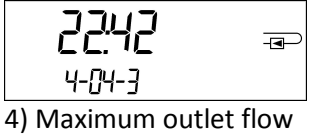
Level 2 / Technician's Loop:

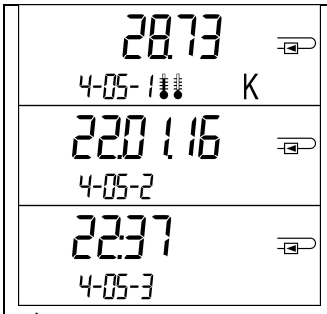
 1) Current power in kW	 2) Current flow in m³/h	 3) Inlet flow temperature in °C	 4) Outlet flow temperature in °C
 5) Temperature difference in K. (Cooling energy: Value is displayed negative.)	 6) Before start of operation: days since manufacture   After start of operation: days since manufacture alternating 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:

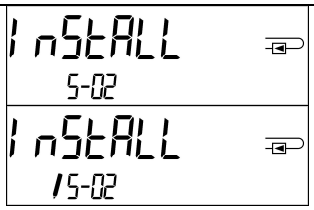
  	  	1) – 30) Semimonthly values: date alternating with heat energy, cooling energy, volume, value tariff register 1, value tariff register 2.[1)] (If the calculator has 3	pulse inputs, their values follow.[2)])

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*)

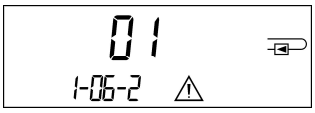
*) Requirements in countries other than Germany may be different.

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	Alternating hexadecimal message displayed (LCD)
Bit	7	6	5	4	3	2	1	0	
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

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