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# Operating Instructions
# **EngyCal RH33**

Universal BTU meter


Endress+Hauser
People for Process Automation

# Table of contents

# 1 About this document

## 1.1 Document function

These Operating Instructions contain all the information that is required in various phases of the life cycle of the device: from product identification, incoming acceptance and storage, to mounting, connection, operation and commissioning through to troubleshooting, maintenance and disposal.

## 1.2 Document conventions

### 1.2.1 Safety symbols

**⚠ DANGER**
This symbol alerts you to a dangerous situation. Failure to avoid this situation will result in serious or fatal injury.

**⚠ WARNING**
This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in serious or fatal injury.

**⚠ CAUTION**
This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in minor or medium injury.

**NOTICE**
This symbol contains information on procedures and other facts which do not result in personal injury.

### 1.2.2 Electrical symbols

| Symbol | Meaning |
|---|---|
|  A0011197 | **Direct current**<br>A terminal to which DC voltage is applied or through which direct current flows. |
|  A0011198 | **Alternating current**<br>A terminal to which alternating voltage is applied or through which alternating current flows. |
|  A0017381 | **Direct current and alternating current**<br>▪ A terminal to which alternating voltage or DC voltage is applied.<br>▪ A terminal through which alternating current or direct current flows. |
|  A0011200 | **Ground connection**<br>A grounded terminal which, as far as the operator is concerned, is grounded via a grounding system. |
|  A0011199 | **Protective ground connection**<br>A terminal which must be connected to ground prior to establishing any other connections. |
|  A0011201 | **Equipotential connection**<br>A connection that has to be connected to the plant grounding system: This may be a potential equalization line or a star grounding system depending on national or company codes of practice. |
|  A0012751 | **ESD - electrostatic discharge**<br>Protect the terminals from electrostatic discharge. Failure to observe this may result in the destruction of parts of the electronics. |

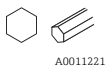
### 1.2.3 Symbols for certain types of information

| Symbol | Meaning |
|---|---|
|  | **Permitted**<br>Procedures, processes or actions that are permitted. |
|  | **Preferred**<br>Procedures, processes or actions that are preferred. |
|  | **Forbidden**<br>Procedures, processes or actions that are forbidden. |
|  | **Tip**<br>Indicates additional information. |
|  | Reference to documentation |
|  | Reference to page |
|  | Reference to graphic |
|  | Notice or individual step to be observed |
| 1., 2., 3... | Series of steps |
|  | Result of a step |
|  | Help in the event of a problem |
|  | Visual inspection |

### 1.2.4 Symbols in graphics

| Symbol | Meaning | Symbol | Meaning |
|---|---|---|---|
| **1, 2, 3,...** | Item numbers | 1., 2., 3... | Series of steps |
| **A, B, C, ...** | Views | **A-A, B-B, C-C, ...** | Sections |
|  | Hazardous area |  | Safe area (non-hazardous area) |

### 1.2.5 Tool symbols

| Symbol | Meaning |
|---|---|
|  A0011220 | Flat-blade screwdriver |
|  A0011219 | Phillips screwdriver |
|  A0011221 | Allen key |
|  A0011222 | Open-ended wrench |
|  A0013442 | Torx screwdriver |

# 2 Safety instructions

Safe operation of the device is only guaranteed if the Operating Instructions have been read and the safety instructions they contain have been observed.

## 2.1 Requirements for the personnel

The personnel for installation, commissioning, diagnostics and maintenance must fulfill the following requirements:
- Trained, qualified specialists must have a relevant qualification for this specific function and task.
- Are authorized by the plant owner/operator.
- Are familiar with federal/national regulations.
- Before starting work, read and understand the instructions in the manual and supplementary documentation as well as the certificates (depending on the application).
- Follow instructions and comply with basic conditions.

The operating personnel must fulfill the following requirements:
- Are instructed and authorized according to the requirements of the task by the facility's owner-operator.
- Follow the instructions in this manual.

## 2.2 Intended use

The BTU meter is a device for measuring energy flow in heating and cooling systems. The mains-powered arithmetic unit can be used universally in industry, long-distance heat and building systems.

- The manufacturer accepts no liability for damages resulting from incorrect use or use other than that designated. It is not permitted to convert or modify the device in any way.
- The device may only be operated when installed.

## 2.3 Workplace safety

For work on and with the device:
- Wear the required personal protective equipment according to national regulations.

If working on and with the device with wet hands:
- Due to the increased risk of electric shock, wear suitable gloves.

## 2.4 Operational safety

Risk of injury.
- Operate the device in proper technical condition and fail-safe condition only.
- The operator is responsible for interference-free operation of the device.

**Conversions to the device**

Unauthorized modifications to the device are not permitted and can lead to unforeseeable dangers.
- If, despite this, modifications are required, consult with Endress+Hauser.

**Repair**

To ensure continued operational safety and reliability,
- Carry out repairs on the device only if they are expressly permitted.
- Observe federal/national regulations pertaining to repair of an electrical device.

- Use original spare parts and accessories from Endress+Hauser only.

## 2.5 Conversion and consequences of conversion

NOTICE

**Repair/conversion/modification results in loss of approval for custody transfer**

- Repair/conversion/modification is possible, but results in the device losing its current custody transfer approval. This means that following repair/conversion/modification, the customer is responsible for ensuring that the instrument is inspected on site by an approved calibration authority (e.g. calibration officer) for the purpose of recalibration.

## 2.6 Product safety

This measuring device is designed in accordance with good engineering practice to meet state-of-the-art safety requirements, has been tested, and left the factory in a condition in which it is safe to operate.

It meets general safety standards and legal requirements. It also complies with the EC directives listed in the device-specific EC Declaration of Conformity. Endress+Hauser confirms this by affixing the CE mark to the device.

Furthermore, the device meets the legal requirements of the applicable UK regulations (Statutory Instruments). These are listed in the UKCA Declaration of Conformity along with the designated standards.

By selecting the order option for UKCA marking, Endress+Hauser confirms a successful evaluation and testing of the device by affixing the UKCA mark.

Contact address Endress+Hauser UK:
Endress+Hauser Ltd.
Floats Road
Manchester M23 9NF
United Kingdom
www.uk.endress.com

## 2.7 IT security

Our warranty is valid only if the device is installed and used as described in the Operating Instructions. The device is equipped with security mechanisms to protect it against any inadvertent changes to the settings.

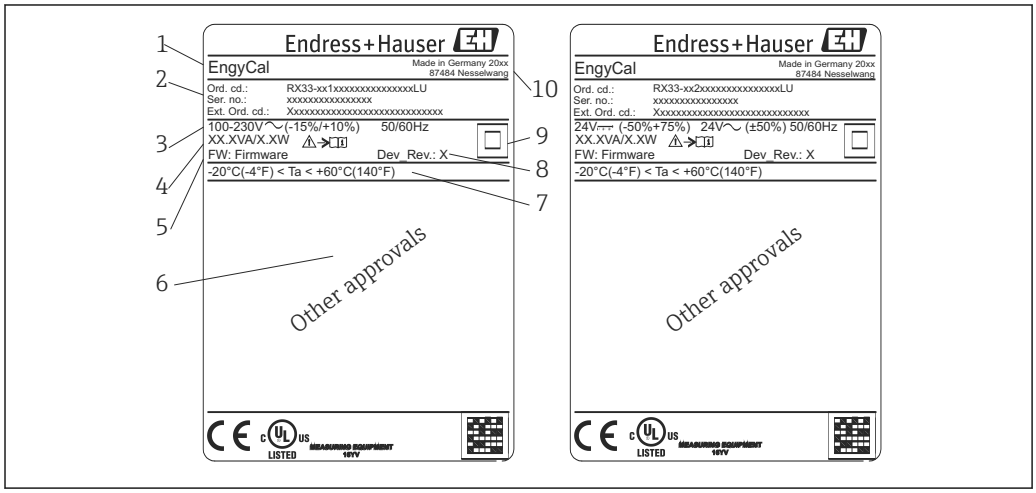
IT security measures, which provide additional protection for the device and associated data transfer, must be implemented by the operators themselves in line with their security standards.

# 3 Identification

## 3.1 Device designation

### 3.1.1 Nameplate

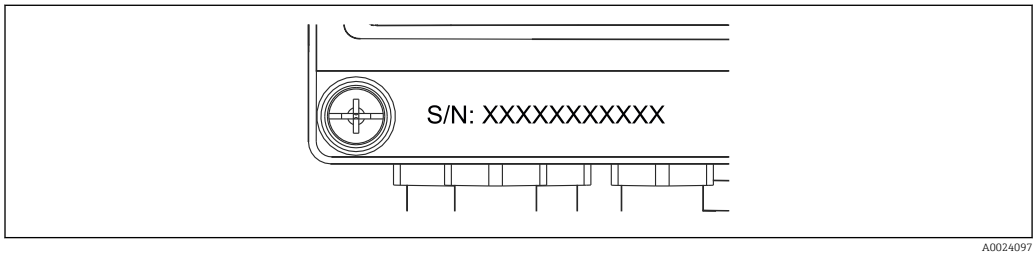
Compare the nameplate on the device with the following diagram:




*1 Device nameplate (example)*

1 *Device tag name*
2 *Order code and serial number*
3 *Supply voltage*
4 *Power consumption*
5 *Firmware version*
6 *Approvals, if available*
7 *Ambient temperature range*
8 *Device revision*
9 *Device protected by double or reinforced seal*
10 *Place and year of manufacture*

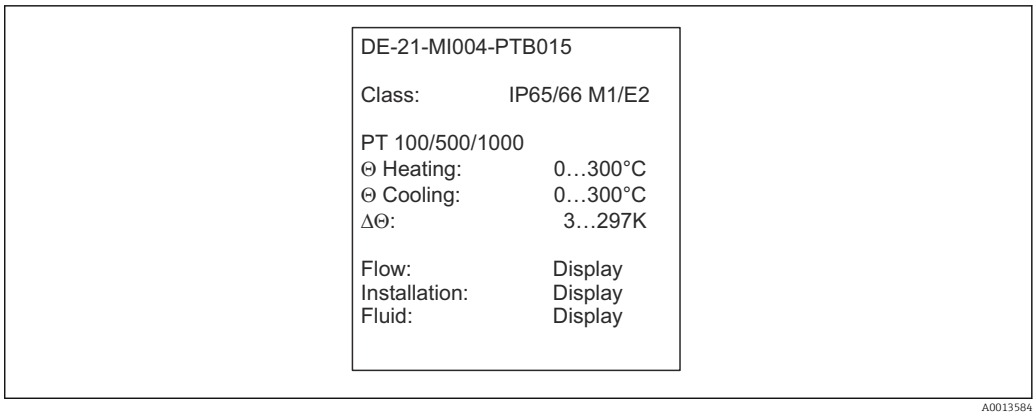
### 3.1.2 Serial number on front of device




*2 Serial number on front of device*

### 3.1.3 Front foil for devices with approval for custody transfer

For devices with the option of approval for custody transfer, the front foil is imprinted with the following information:




3 *Labeling of front foil for devices with approval for custody transfer*

## 3.2 Scope of delivery

The scope of delivery comprises:
- EngyCal (field housing)
- Wall mounting plate
- Hard copy of Brief Operating Instructions
- Optional RTD assembly
- Optional 3 pc. connecting terminal (each 5-pin)
- Optional interface cable in a set with "FieldCare Device Setup" parameterization software
- Optional Field Data Manager software MS20
- Optional mounting hardware for DIN rail, panel mounting, pipe mounting
- Optional overvoltage protection

Please note the device accessories in the "Accessories" section → 60.

## 3.3 Certificates and approvals

The BTU meter and the pair of temperature sensors (optionally available) meet the requirements of Directive 2014/32/EU (L 96/149) (Measurement Instruments Directive, MID) and OIML R75 and EN-1434.

If the arithmetic unit with temperature sensors is to be used in commercial applications, the flow sensor must also have a type approval (incl. conformity assessment) according to MID.

Measuring devices with MID approval have the MID mark on the front foil. → 1, 8. This approval replaces the initial calibration on-site.

The calibrated arithmetic unit can be set individually onsite. Custody transfer-related parameters, such as the pulse value of the flow transmitter, can be changed up to three times. The changes to the custody transfer-related parameters are recorded in a custody transfer logbook. This allows individual defective sensors to be replaced in the field without losing the custody transfer status.

The device also has a national approval as a BTU meter for cooling or for combined heating/cooling applications. The initial calibration of these devices is always carried out on-site by a calibration officer.

### 3.3.1 CE mark

The product meets the requirements of the harmonized European standards. As such, it complies with the legal specifications of the EC directives. The manufacturer confirms successful testing of the product by affixing to it the CE-mark.

# 4 Mounting

## 4.1 Incoming acceptance, transport, storage

Compliance with the permitted environmental and storage conditions is mandatory. The exact specifications for this are provided in the "Technical Information" section → 🖹 73.

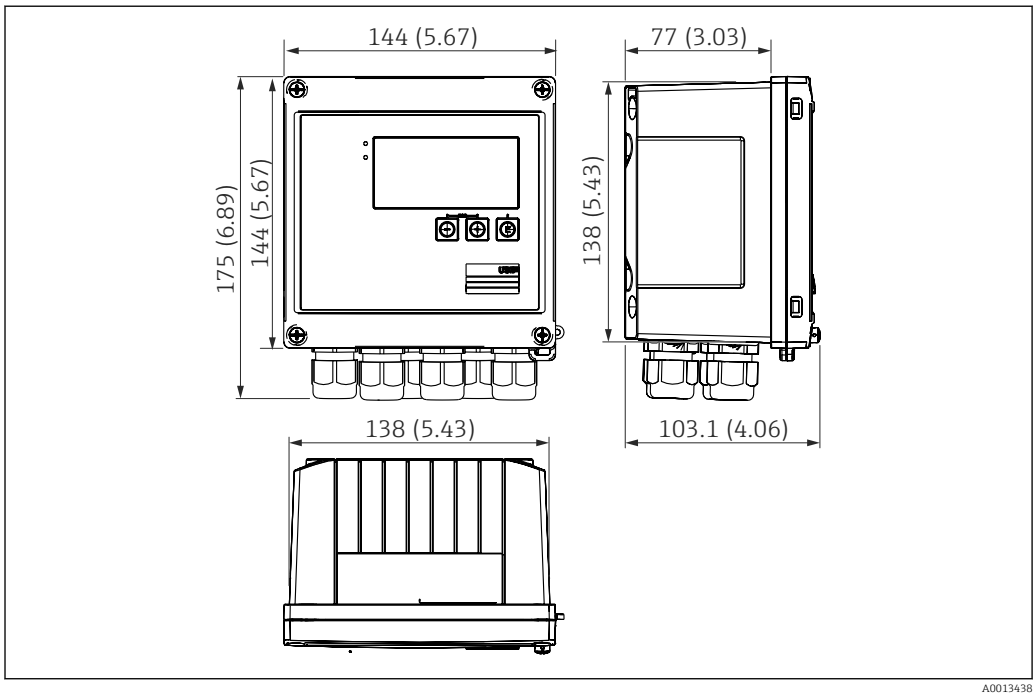
### 4.1.1 Incoming acceptance

On receipt of the goods, check the following points:
- Is the packaging or the content damaged?
- Is the delivery complete? Compare the scope of delivery against the information on your order form.

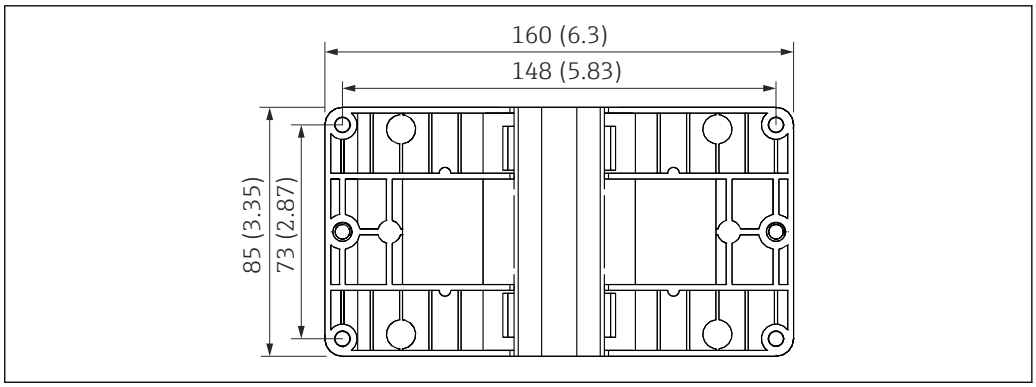
### 4.1.2 Transport and storage

Please note the following:
- Pack the device in such a way as to protect it reliably against impact for storage (and transportation). The original packaging provides optimum protection.
- The permitted storage temperature is −40 to +85 °C (−40 to +185 °F); it is possible to store the device at borderline temperatures for a limited period (48 hours maximum).

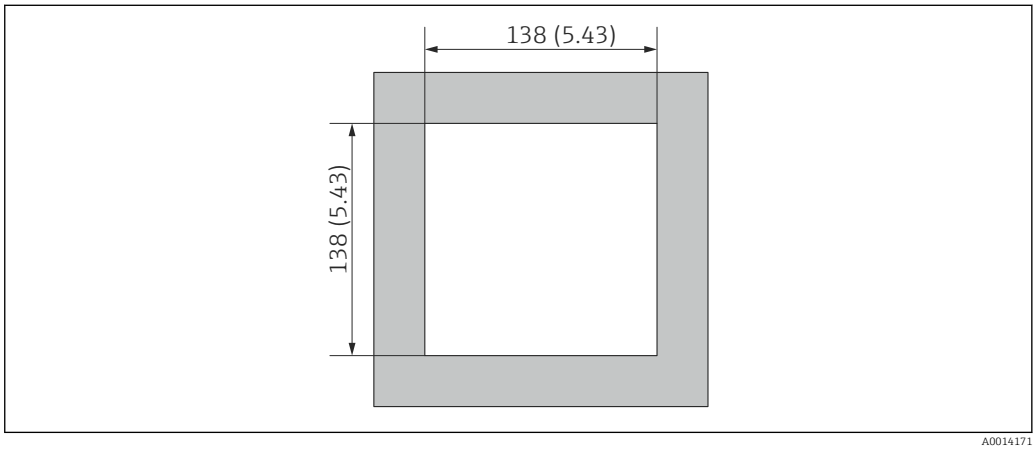
## 4.2 Dimensions



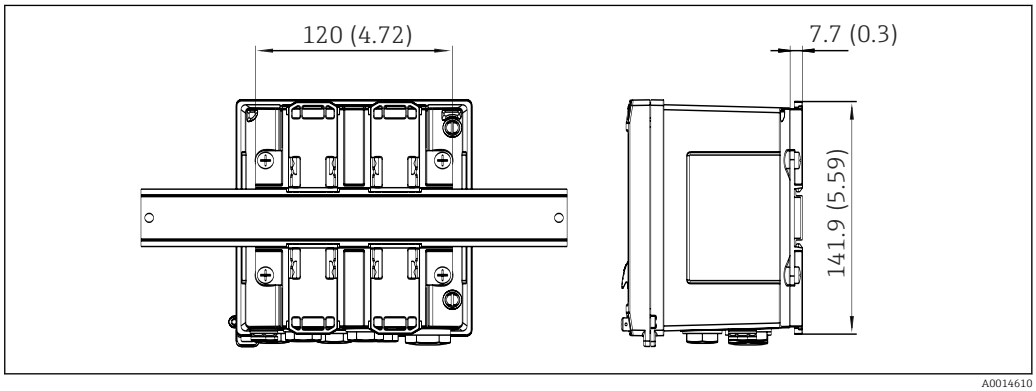

🖹 4 *Dimensions of the device in mm (in)*



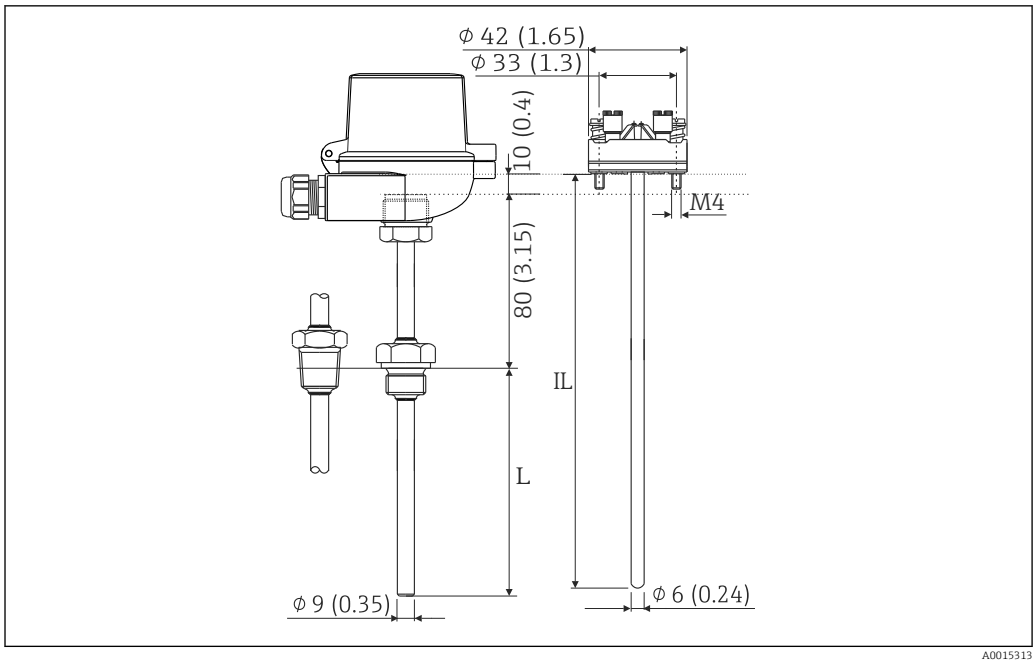

5 *Dimensions of the mounting plate for wall, pipe and panel mounting in mm (in)*




6 *Dimensions of the panel cutout in mm (in)*




7 *Dimensions of DIN rail adapter in mm (in)*




8 *RTD assembly (optional accessory), dimensions in mm (in)*

*L Immersion length, specified when ordered*
*IL Insertion length = L + extension neck length (80 mm (3.15 in)) + 10 mm (0.4 in)*

## 4.3 Mounting requirements

With the appropriate accessories, the device with field housing is suitable for wall mounting, pipe mounting, panel mounting and DIN rail installation.

The orientation is determined by the legibility of the display. Connections and outputs are fed out of the bottom of the device. The cables are connected via coded terminals.

Operating temperature range: –20 to 60 °C (–4 to 140 °F)

You can find more information in the "Technical data" section.

**NOTICE**

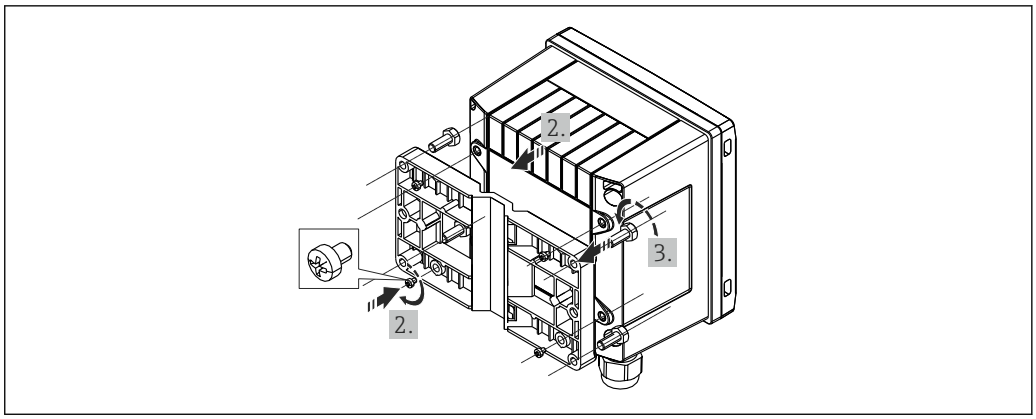
**Overheating of the device due to insufficient cooling**

- To avoid heat buildup, please always ensure that the device is sufficiently cooled. Operating the device in the upper temperature limit range decreases the operating life of the display.

## 4.4 Mounting

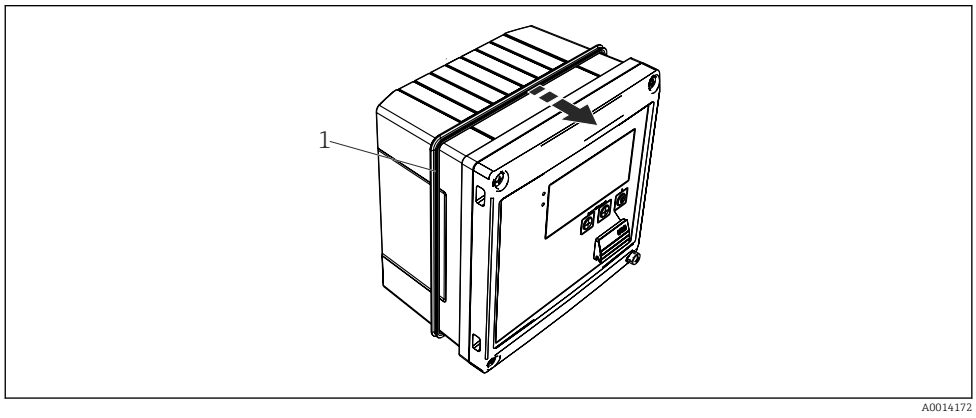
### 4.4.1 Wall mounting

1. Use the mounting plate as the template for drilled holes, dimensions → 5, 11
2. Attach the device to the mounting plate and fasten it in place from the rear using 4 screws.
3. Fasten the mounting plate to the wall using 4 screws.



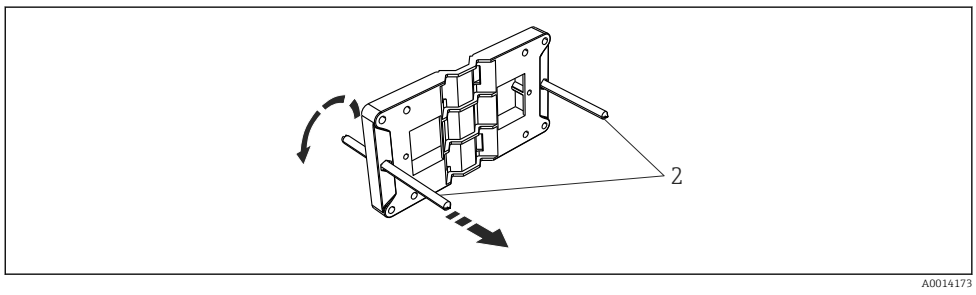

9 *Wall mounting*

### 4.4.2 Panel mounting

1. Make the panel cutout in the required size, dimensions → 6, 11
2. 


10 *Panel mounting*

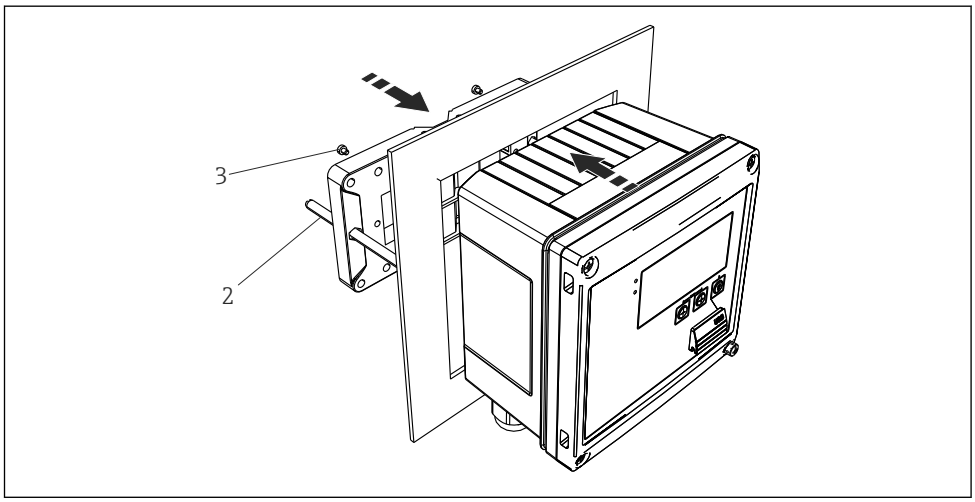
Attach the seal (item 1) to the housing.

3. 


11 *Preparing the mounting plate for panel mounting*

Screw the threaded rods (item 2) into the mounting plate (dimensions → 5, 11).

4.



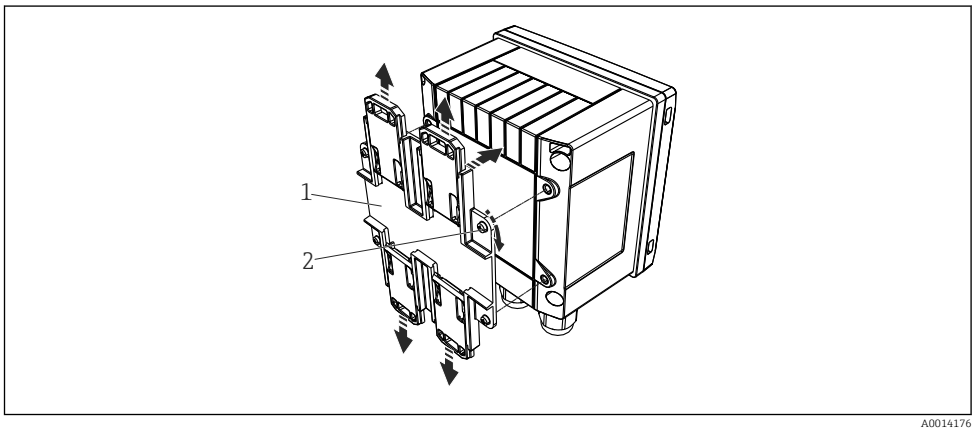

12 *Panel mounting*

Push the device into the panel cutout from the front and attach the mounting plate to the device from the rear using the 4 screws provided (item 3).

5. Fasten the device in place by tightening the threaded rods.

### 4.4.3 Support rail/DIN rail (to EN 50 022)

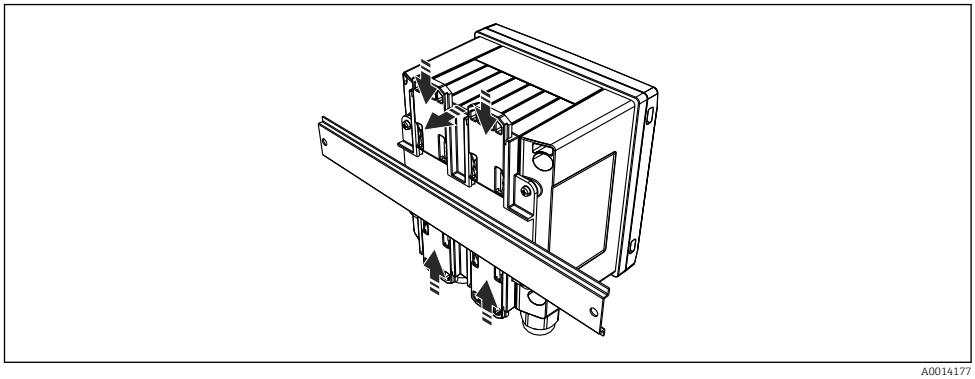
1.




13 *Preparing for DIN rail mounting*

Fasten the DIN rail adapter (item 1) to the device using the screws provided (item 2) and open the DIN rail clips.

2.

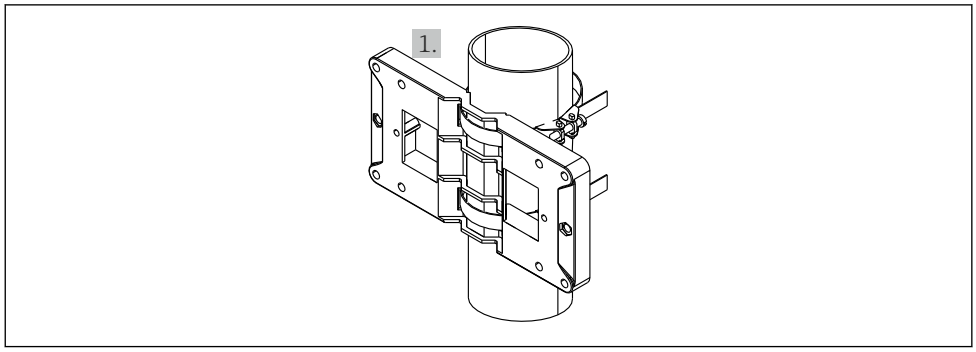



14 *DIN rail mounting*

Attach the device to the DIN rail from the front and close the DIN rail clips.

### 4.4.4 Pipe mounting

1.

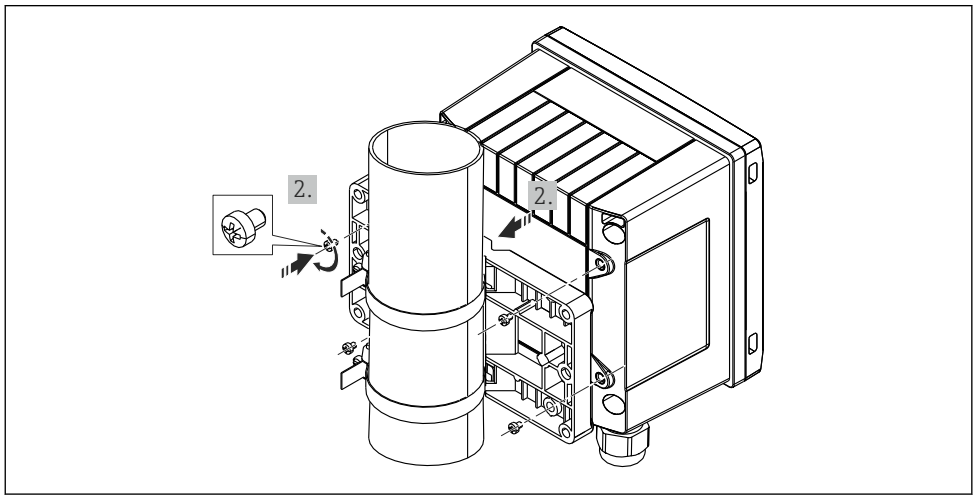



A0014178

15 *Preparing for pipe mounting*

Pull the steel belts through the mounting plate (dimensions → 5, 11) and fasten them to the pipe.

2.

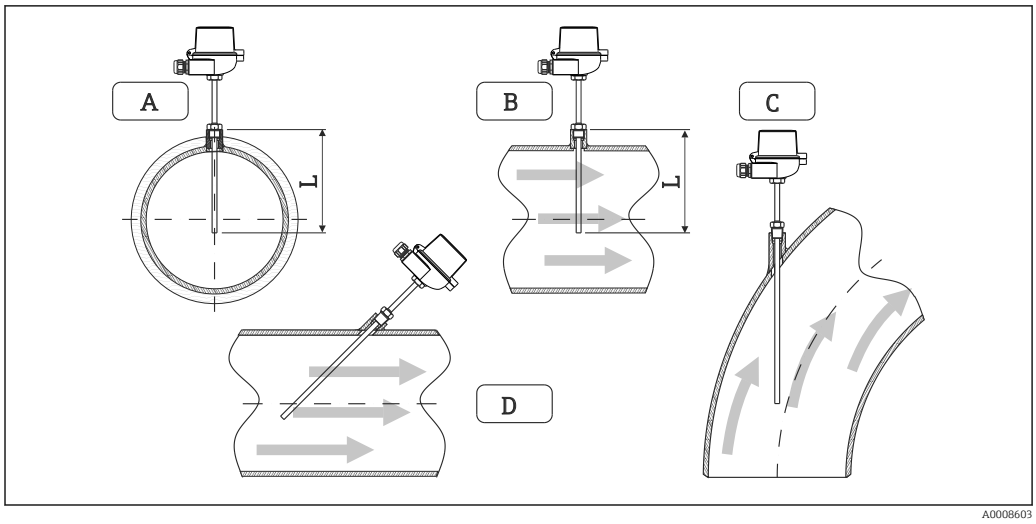



A0014179

16 *Pipe mounting*

Attach the device to the mounting plate and fasten it in place using the 4 screws provided.

## 4.5 Installation instructions for temperature sensor(s)




17 *Installation types for temperature sensors*

*A - B For cables with a small cross-section, the sensor tip must reach to the piping axis or a little farther (=L).*
*C - D Slanted orientation.*

The immersion length of the thermometer influences the accuracy. If the immersion length is too small, errors in the measurement are caused by heat conduction via the process connection and the container wall. For installation in a pipe, therefore, the recommended installation depth ideally corresponds to half of the pipe diameter.

- Installation possibilities: Pipes, tanks or other plant components
- Minimum insertion depth = 80 to 100 mm (3.15 to 3.94 in)
  The insertion depth should be at least 8 times the diameter of the thermowell. Example: Thermowell diameter 12 mm (0.47 in) x 8 = 96 mm (3.8 in). We recommend a standard insertion depth of 120 mm (4.72 in).

For pipes with small nominal diameters, ensure that the tip of the thermowell extends far enough into the process so that it also protrudes past the axis of the pipe (→ 17, 16, item A and B). Another solution may be diagonal installation (→ 17, 16, item C and D). When determining the immersion length or installation depth, all the parameters of the thermometer and of the process to be measured must be taken into account (e.g. flow velocity, process pressure).

Refer also to the installation recommendations EN1434-2 (D), Figure 8.

## 4.6 Requirements for sizing

To avoid systematic errors, the temperature sensors must be installed shortly upstream and shortly downstream from the heat exchanger. If the pressure difference between the temperature measuring points is too large, this can result in an excessively large systematic error, see the table below.

| | Temperature differential in [K] | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Diff in [bar]** | **3** | **5** | **10** | **20** | **30** | **40** | **50** | **60** |
| **0.5** | 0.2 | 0.2 | 0.1 | 0.1 | 0.1 | 0 | 0 | 0 |
| **1** | 0.5 | 0.4 | 0.3 | 0.2 | 0.1 | 0.1 | 0.1 | 0.1 |
| **2** | 0.9 | 0.7 | 0.5 | 0.3 | 0.2 | 0.2 | 0.1 | 0.1 |
| **3** | 1.4 | 1.1 | 0.8 | 0.5 | 0.3 | 0.2 | 0.2 | 0.2 |
| **4** | 1.8 | 1.5 | 1.0 | 0.6 | 0.4 | 0.3 | 0.3 | 0.2 |

| Diff in [bar] | Temperature differential in [K] | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 3 | 5 | 10 | 20 | 30 | 40 | 50 | 60 |
| 5 | 2.3 | 1.9 | 1.3 | 0.8 | 0.5 | 0.4 | 0.3 | 0.3 |
| 6 | 2.7 | 2.2 | 1.5 | 0.9 | 0.6 | 0.5 | 0.4 | 0.3 |
| 7 | 3.2 | 2.6 | 1.9 | 1.1 | 0.7 | 0.6 | 0.5 | 0.4 |
| 8 | 3.6 | 3.0 | 2.0 | 1.2 | 0.9 | 0.7 | 0.5 | 0.4 |
| 9 | 4.1 | 3.3 | 2.3 | 1.4 | 1.0 | 0.7 | 0.6 | 0.5 |
| 10 | 4.5 | 4.0 | 2.5 | 1.5 | 1.1 | 0.8 | 0.7 | 0.5 |

The values are indicated as factors of the maximum permitted error of the BTU meter (with $\Delta\Theta_{min}$ = 3 K (5.4 °F)). The values below the gray line are higher than 1/3 of the maximum permitted error of the BTU meter (with $\Delta\Theta_{min}$ = 3 K (5.4 °F)).

If 2 different heat carriers (e.g. room heating and household hot water) merge shortly upstream from the temperature sensor, the optimum position of this sensor is directly downstream from the flow measuring point.

## 4.7 Post-mounting check

To install the BTU meter and the associated temperature sensors, observe the general installation instructions according to EN 1434 Part 6 and the Technical Guidelines TR-K 9 of the PTB (the German National Metrology Institute). TR-K 9 is available to download from the PTB website.

# 5 Wiring

## 5.1 Connection instructions

**⚠ WARNING**

**Danger! Electric voltage!**

- ▶ The entire connection of the device must take place while the device is de-energized.

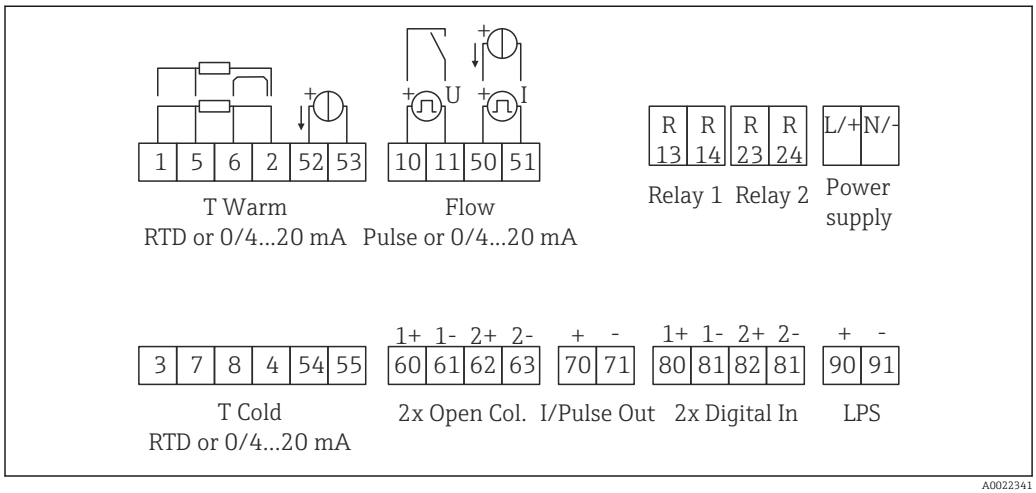
**⚠ CAUTION**

**Pay attention to additional information provided**

- ▶ Before commissioning, ensure that the supply voltage corresponds to the specification on the nameplate.
- ▶ Provide a suitable switch or power-circuit breaker in the building installation. This switch must be provided close to the device (within easy reach) and marked as a circuit breaker.
- ▶ An overload protection element (rated current ≤ 10 A) is required for the power cable.

To install the BTU meter and the associated components, observe the general installation instructions according to EN1434 Part 6.

## 5.2 Quick wiring guide




18 *Connection diagram of the device*

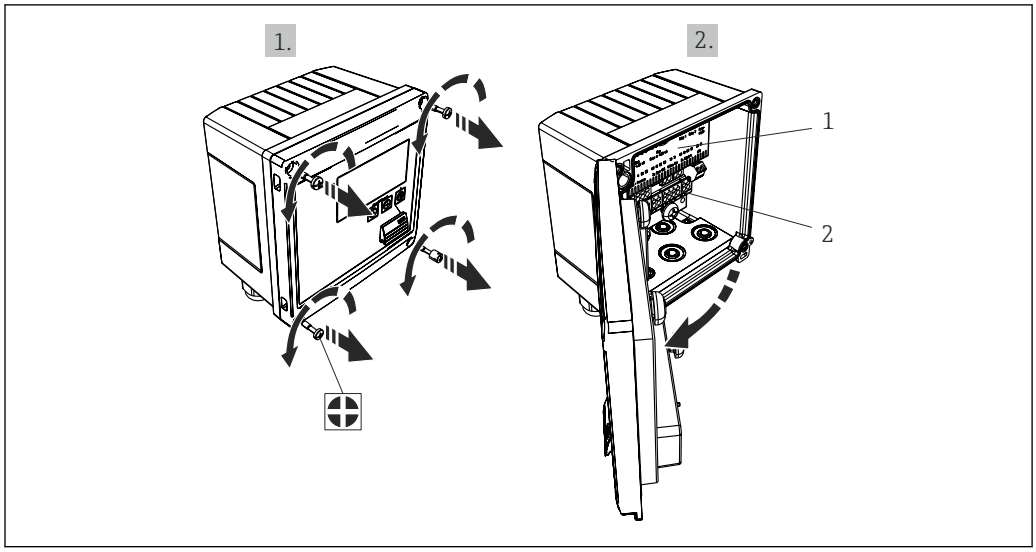
### Terminal assignment

- In the case of heat differential /T, the temperature sensor for T condensate must be connected to the T Warm terminals and the temperature sensor for T steam to the T Cold terminals.
- In the case of heat differential /p, the temperature sensor for T condensate must be connected to the T Warm terminals.

| Terminal | Terminal assignment | Inputs |
|---|---|---|
| 1 | + RTD power supply | Temperature warm (Optionally RTD or current input) |
| 2 | - RTD power supply | |
| 5 | + RTD sensor | |
| 6 | - RTD sensor | |
| 52 | + 0/4 to 20 mA input | |

| | | |
|---|---|---|
| 53 | Ground for 0/4 to 20 mA input | |
| 3 | + RTD power supply | Temperature cold<br>(Optionally RTD or current input) |
| 4 | - RTD power supply | |
| 7 | + RTD sensor | |
| 8 | - RTD sensor | |
| 54 | + 0/4 to 20 mA input | |
| 55 | Ground for 0/4 to 20 mA input | |
| 10 | + pulse input (voltage) | Flow<br>(Optionally pulse or current input) |
| 11 | - pulse input (voltage) | |
| 50 | + 0/4 to 20 mA or current pulse (PFM) | |
| 51 | Ground for 0/4 to 20 mA input flow | |
| 80 | + digital input 1 (switch input) | ▪ Start tariff counter 1<br>▪ Time synchronization<br>▪ Lock device |
| 81 | - digital input (terminal 1) | |
| 82 | + digital input 2 (switch input) | ▪ Start tariff counter 2<br>▪ Time synchronization<br>▪ Lock device<br>▪ Change flow direction |
| 81 | - digital input (terminal 2) | |
| | | **Outputs** |
| 60 | + pulse output 1 (open collector) | Energy, volume or tariff counter. Alternative: limits/ alarms |
| 61 | - pulse output 1 (open collector) | |
| 62 | + pulse output 2 (open collector) | |
| 63 | - pulse output 2 (open collector) | |
| 70 | + 0/4 to 20 mA/pulse output | Current values (e.g. power) or counter values (e.g. energy) |
| 71 | - 0/4 to 20 mA/pulse output | |
| 13 | Relay normally open (NO) | Limits, alarms |
| 14 | Relay normally open (NO) | |
| 23 | Relay normally open (NO) | |
| 24 | Relay normally open (NO) | |
| 90 | 24V sensor power supply (LPS) | 24 V power supply<br>(e.g. for sensor power supply) |
| 91 | Power supply ground | |
| | | **Power supply** |
| L/+ | L for AC<br>+ for DC | |
| N/- | N for AC<br>- for DC | |

### 5.2.1 Opening the housing




A0014071

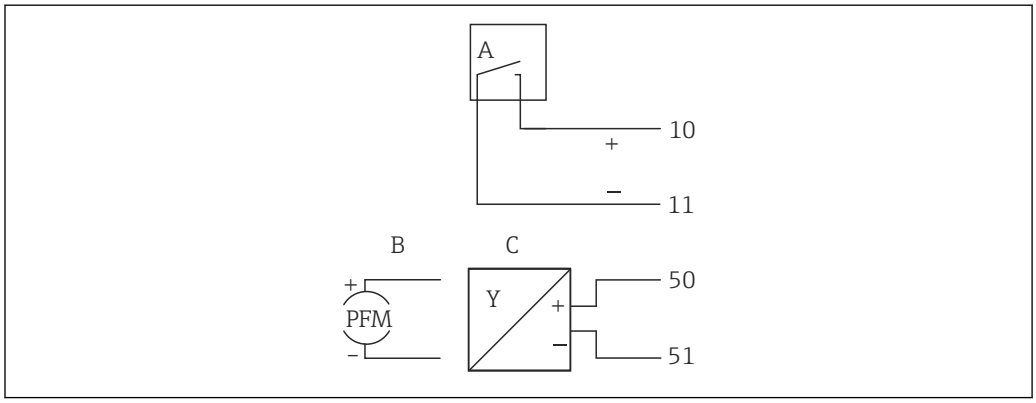
19 *Opening the housing of the device*

*1 Terminal assignment labeling*
*2 Terminals*

## 5.3 Connecting the sensors

### 5.3.1 Flow

**Flow sensors with external power supply**

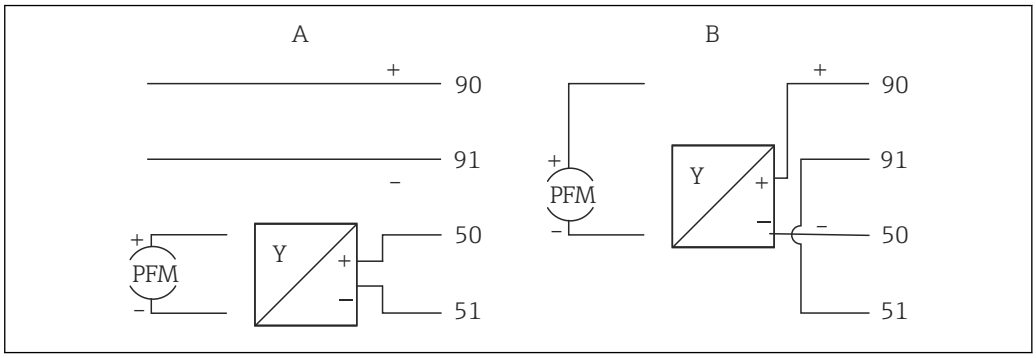



A0013521

20 *Connecting a flow sensor*

*A Voltage pulses or contact sensors including EN 1434 Type IB, IC, ID, IE*
*B Current pulses*
*C 0/4 to 20 mA signal (not in combination with MID approval option)*

### Flow sensors with power supply via the BTU meter

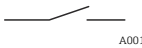
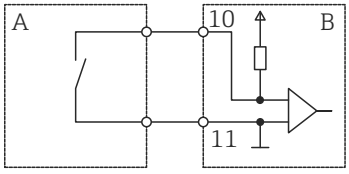
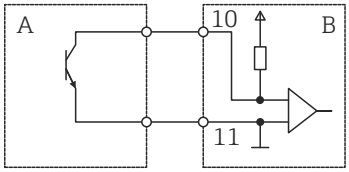
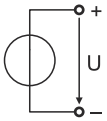
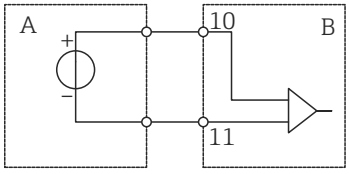


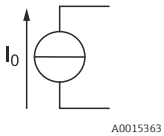
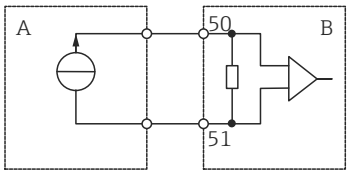
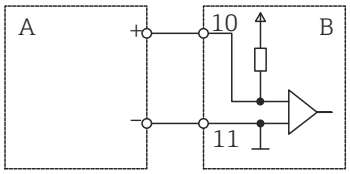

*21 Connecting active flow sensors*

*A 4-wire sensor*
*B 2-wire sensor*

### Settings for flow sensors with pulse output

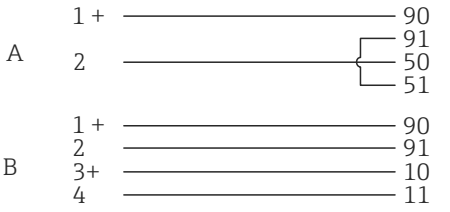
The input for voltage pulses and contact sensors is divided into different types according to EN1434 and provides a supply for switching contacts.

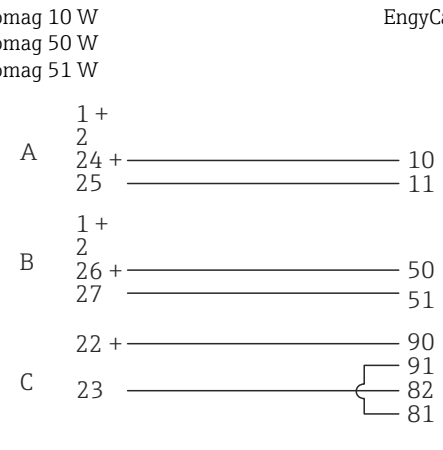
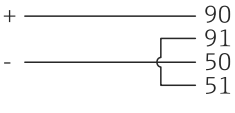
| Pulse output of the flow sensor | Setting at the Rx33 | Electrical connection | Comment |
|---|---|---|---|
| Mechanical contact  A0015360 | Pulse ID/IE up to 25 Hz |  A0015354 *A Sensor* *B Rx33* | As an alternative, it is possible to choose "Pulse IB/IC+U" up to 25 Hz. The current flow via the contact is then lower (approx. 0.05 mA instead of approx. 9 mA). Advantage: lower power consumption, disadvantage: less immunity to interference. |
| Open collector (NPN)  A0015361 | Pulse ID/IE up to 25 Hz or up to 12.5 kHz |  A0015355 *A Sensor* *B Rx33* | As an alternative, it is possible to choose "Pulse IB/IC+U". The current flow via the transistor is then lower (approx. 0.05 mA instead of approx. 9 mA). Advantage: lower power consumption, disadvantage: less immunity to interference. |
| Active voltage  A0015362 | Pulse IB/IC+U |  A0015356 *A Sensor* *B Rx33* | The switching threshold is between 1 V and 2 V |

| Pulse output of the flow sensor | Setting at the Rx33 | Electrical connection | Comment |
|---|---|---|---|
| Active current   A0015363 | Pulse I |   A0015357 *A Sensor* *B Rx33* | The switching threshold is between 8 mA and 13 mA |
| Namur sensor (as per EN60947-5-6) | Pulse ID/IE up to 25 Hz or up to 12.5 kHz |   A0015359 *A Sensor* *B Rx33* | No monitoring for short circuit or line break takes place. |

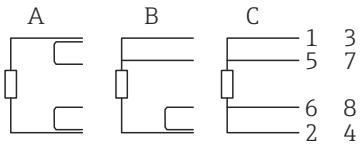
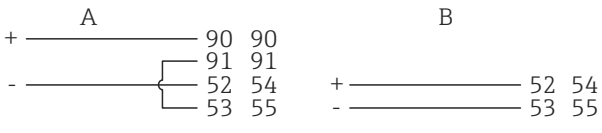
| | | |
|---|---|---|
| Voltage pulses and transmitters according to Class IB and IC (low switching thresholds, small currents) | ≤ 1 V corresponds to Low level<br>≥ 2 V corresponds to High level<br>U max 30 V, U no-load: 3 to 6 V | Floating contacts, reed transmitters |
| Transmitters to Class ID and IE for higher currents and power supplies | ≤ 1.2 mA corresponds to Low level<br>≥ 2.1 mA corresponds to High level<br>U no-load: 7 to 9 V | |

## Endress+Hauser flowmeters

| | |
|---|---|
| Flow sensors with PFM or pulse output:<br>Proline Prowirl 72 and Proline Prosonic Flow 92F | Prowirl 72<br>Prosonic Flow 92F — EngyCal<br>   A0014181<br>A = PFM<br>B = pulse: Terminals 90/91 transmitter power supply, alternatively via external supply unit |

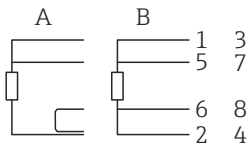
| | |
|---|---|
| Flow sensors with current or pulse output:<br>Proline Promag 10 W<br>Proline Promag 50 W<br>Proline Promag 51W |  <br>A = Pulse input,<br>B = Current input,<br>C = Direction signal via open collector<br>The Promag devices must be powered by an external power supply using terminals 1+ and 2. |
| DP sensors:<br>Deltabar M PMD55,<br>Deltabar S PMD 70/75 |  |

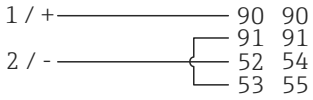
## 5.3.2 Temperature

| | |
|---|---|
| Connecting the RTD sensors |  <br>A = 2-wire connection<br>B = 3-wire connection<br>C = 4-wire connection<br>Terminals 1, 2, 5, 6: T warm<br>Terminals 3, 4, 7, 8: T cold |
| Temperature transmitter connection |  <br>A = without external power supply of the transmitter,<br>B = with external power supply of the transmitter<br>Terminals 90, 91: transmitter power supply<br>Terminals 52, 53: T warm<br>Terminals 54, 55: T cold |

To ensure the highest level of accuracy, we recommend using the RTD 4-wire connection, as this compensates for measurement inaccuracies caused by the mounting location of the sensors or the line length of the connecting cables.

### Endress+Hauser temperature sensors and transmitters

| | |
|---|---|
| Connection of RTD assembly |  <br>A0014187<br>A = 3-wire connection<br>B = 4-wire connection<br>Terminals 1, 2, 5, 6: T warm<br>Terminals 3, 4, 7, 8: T cold |

| | |
|---|---|
| Connection of TMT181, TMT121 temperature transmitter |  <br>A0014188<br>Terminals 90, 91: transmitter power supply<br>Terminals 52, 53: T warm<br>Terminals 54, 55: T cold |

## 5.4 Outputs

### 5.4.1 Analog output (active)

This output can be used either as a 0/4 to 20 mA current output or as a voltage pulse output. The output is galvanically isolated. Terminal assignment, → 18.

### 5.4.2 Relays

The two relays can be switched in case of fault messages or a limit violation.

Relay 1 or 2 can be selected under **Setup** → **Advanced setup** → **System** → **Fault switching**.

Limit values are assigned under **Setup** → **Advanced setup** → **Application** → **Limits**. Possible settings for limit values are described in the "Limits" section, → 39.

### 5.4.3 Pulse output (active)

Voltage level:
- 0 to 2 V corresponds to Low level
- 15 to 20 V corresponds to High level

Maximum output current: 22 mA

### 5.4.4 Open collector output

The two digital outputs can be used as status or pulse outputs. Make the selection in the following menus **Setup** → **Advanced setup** or **Expert** → **Outputs** → **Open collector**

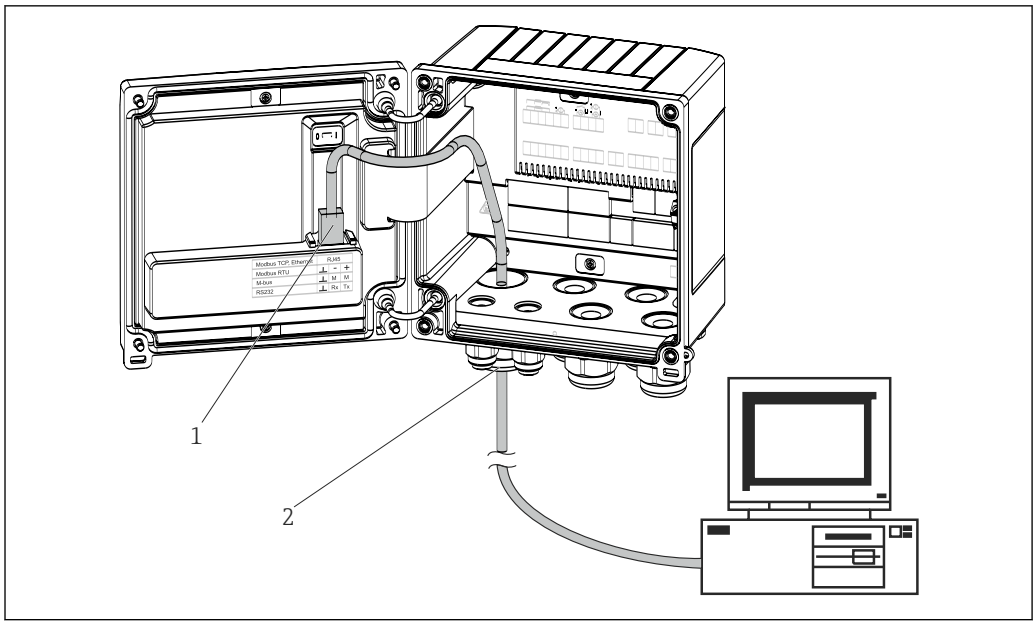
## 5.5 Communication

The USB interface is always active and can be used independently of other interfaces. Parallel operation of multiple optional interfaces, e.g. fieldbus and Ethernet, is not possible.

### 5.5.1 Ethernet TCP/IP (optional)

The Ethernet interface is galvanically isolated (test voltage: 500 V). A standard patch cable (e.g. CAT5E) can be used to connect the Ethernet interface. A special cable gland is available for this purpose which allows users to guide pre-terminated cables through the housing. Via the Ethernet interface, the device can be connected using a hub or a switch or directly to office equipment.

- Standard: 10/100 Base T/TX (IEEE 802.3)
- Socket: RJ-45
- Max. cable length: 100 m




A0014600

*22 Connection of Ethernet TCP/IP, Modbus TCP*

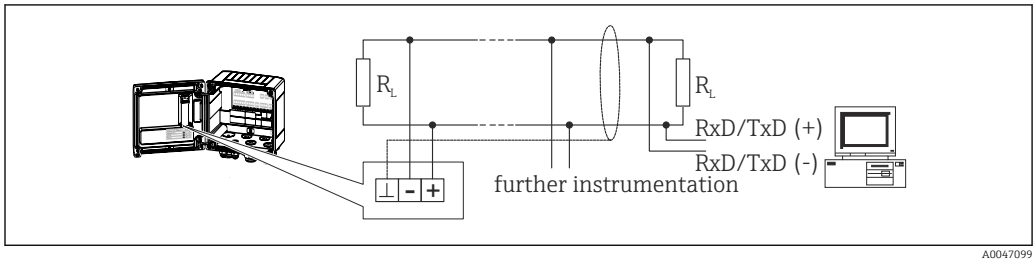
*1 Ethernet, RJ45*
*2 Cable entry for Ethernet cable*

## 5.5.2 Modbus TCP (optional)

The Modbus TCP interface is used to connect the device to higher-order systems to transmit all measured values and process values. The Modbus TCP interface is physically identical to the Ethernet interface → 22, 26

## 5.5.3 Modbus RTU (optional)

The Modbus RTU (RS-485) interface is galvanically isolated (test voltage: 500 V) and used to connect the device to higher-level systems to transmit all measured values and process values. It is connected via a 3-pin plug-in terminal in the housing cover.

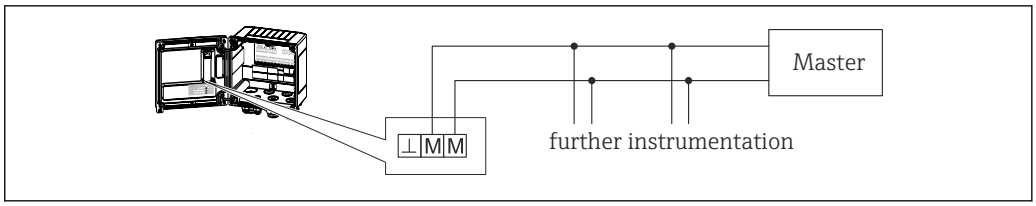



A0047099

*23 Connection of Modbus RTU*

## 5.5.4 M-Bus (optional)

The M-Bus (Meter Bus) interface is galvanically isolated (test voltage: 500 V) and used to connect the device to higher-level systems to transmit all measured values and process values. It is connected via a 3-pin plug-in terminal in the housing cover.




*24 Connection of M-Bus*

## 5.6 Post-connection check

*After completing the device's electrical installation, carry out the following checks:*

| **Device condition and specifications** | **Notes** |
|---|---|
| Is the device or cable damaged (visual inspection)? | - |
| **Electrical connection** | **Notes** |
| Does the supply voltage match the specifications on the nameplate? | 100 to 230 V AC/DC (±10 %) (50/60 Hz)<br>24 V DC (−50 % / +75 %)<br>24 V AC (±50 %) 50/60 Hz |
| Do the cables have adequate strain relief? | - |
| Are the power supply and signal cables correctly connected? | See wiring diagram on the housing |

# 6 Operation

## 6.1 General information regarding operation

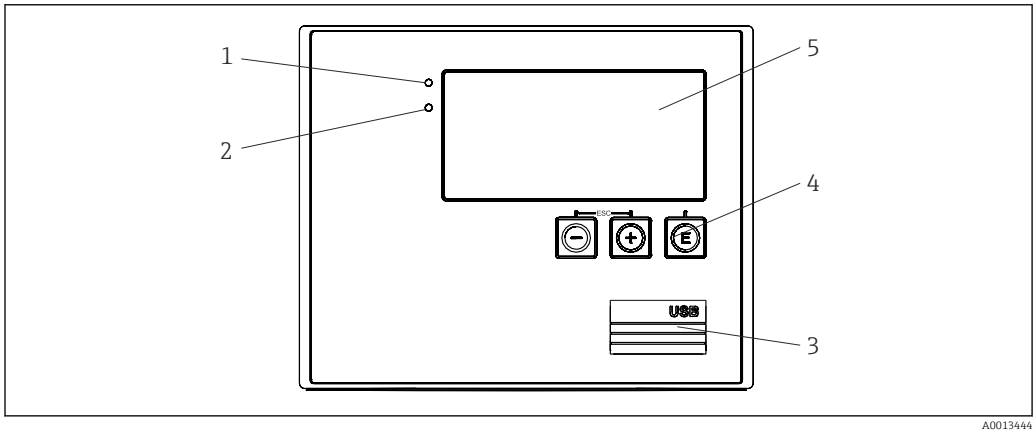
The BTU meter can be configured using operating keys or with the help of the "FieldCare" operating software.

The operating software, including the interface cable, is available as an order option, i.e. it is not included in the basic scope of delivery.

Parameter configuration is locked if the device is locked by the write protection switch → 29, the custody transfer switch, the user code or digital input. For devices locked by the custody switch, custody transfer-related parameters can only be changed a maximum of three times. After that, these parameters can no longer be accessed.

Details, → 43

## 6.2 Display and operating elements




25 *Display and operating elements of the device*

1 *Green LED, "Operation"*
2 *Red LED, "Fault message"*
3 *USB connection for configuration*
4 *Operating keys: -, +, E*
5 *160x80 dot-matrix display*

Green LED if voltage present, red LED in the event of an alarm/error. Green LED is always lit once the device is supplied with power.

Red LED flashing slowly (approx. 0.5 Hz): The device has been set to the bootloader mode.

Red LED flashing quickly (approx. 2 Hz): In normal operation: maintenance required. During firmware update: data transmission in progress.

Red LED remains lit: Device error.

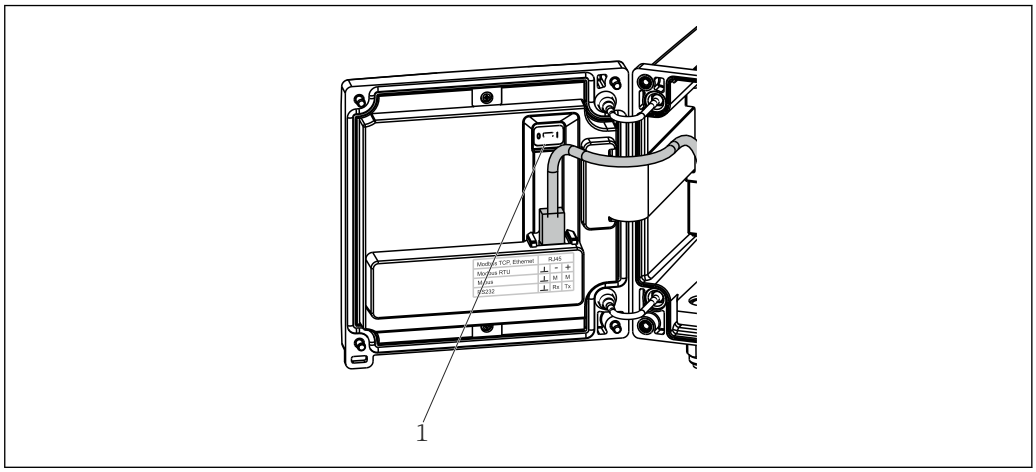
### 6.2.1 Operating elements

**3 operating keys, "-", "+", "E"**

Esc/Back function: Press "-" and "+" simultaneously.

Enter/Confirm entry function: Press "E"

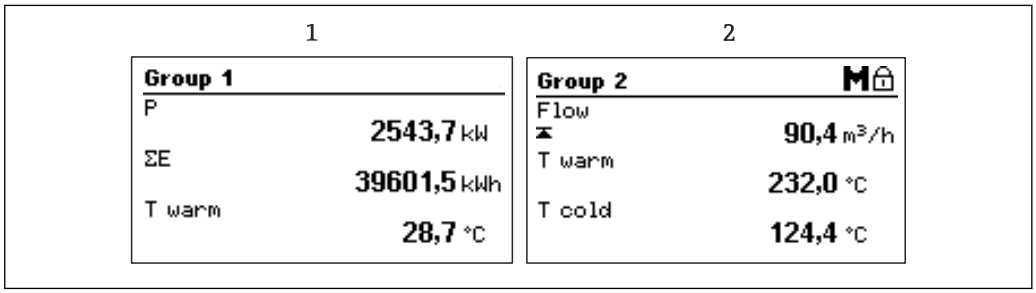
### Write protection switch




*26 Write protection switch*

*1 Write protection switch on rear of housing cover*

## 6.2.2 Display




*27 BTU meter display (example)*

*1 Group 1 display*
*2 Group 2 display, maintenance required, setup is locked, upper limit value for flow was violated*

## 6.2.3 "FieldCare Device Setup" operating software

To configure the device using the FieldCare Device Setup software, connect the device to your PC via the USB interface.

### Establishing a connection

1. Start FieldCare.
2. Connect the device to the PC via USB.
3. Create project in File/New menu.
4. Select Communication DTM (CDI Communication USB).
5. Add device EngyCal RH33.
6. Click Connect.
7. Start parameter configuration.

Continue with device configuration in accordance with these Operating Instructions for the device. The complete Setup menu, i.e. all of the parameters listed in these Operating Instructions, can also be found in the FieldCareDevice Setup.

NOTICE

**Undefined switching of outputs and relays**

- During configuration with FieldCare, the device may assume undefined statuses! This may result in the undefined switching of outputs and relays.

## 6.3 Operating matrix

A complete overview of the operating matrix, incl. all of the configurable parameters, can be found in the appendix, → 📄 85.

| | |
|---|---|
| **Language** | Picklist with all available operating languages. Select the language of the device. |

| | |
|---|---|
| **Display/operation menu** | ▪ Select the group for display (alternate automatically or fixed display group)<br>▪ Configure brightness and contrast of display<br>▪ Display saved analyses (day, month, year, billing date, totalizer) |

| | |
|---|---|
| **Setup menu** | The parameters for quick commissioning of the device can be configured in this setup. The advanced setup contains all of the essential parameters for configuring the device function.<br>▪ Units<br>▪ Pulse value, value<br>▪ Mounting location of flow sensor<br>▪ Date and time<br>Parameters for quick commissioning<br>Advanced setup (settings that are not essential for the basic operation of the device)<br>Special settings can also be configured via the "Expert" menu. |

| | |
|---|---|
| **Diagnostics menu** | Unit information and service functions for a swift unit check.<br>▪ Diagnostic messages and list<br>▪ Event and calibration logbook<br>▪ Device information<br>▪ Simulation<br>▪ Measured values, outputs |

| | |
|---|---|
| **Expert menu** | The Expert menu provides access to all of the operating positions of the device, including fine-turning and service functions.<br>▪ Skip directly to the parameter via Direct Access (on device only)<br>▪ Service code to display service parameters (via PC operating software only)<br>▪ System (settings)<br>▪ Inputs<br>▪ Outputs<br>▪ Application<br>▪ Diagnostics |

# 7 Commissioning

Make sure that all post-connection checks have been carried out before putting your device into operation:
- See 'Post-mounting check' section, → 17.
- Checklist, 'Post-connection check' section, → 27.

After the operating voltage is applied, the display and the green LED are illuminated. The device is now operational and can be configured via the keys or the "FieldCare" parameterization software → 29.

Remove the protective film from the display as this would otherwise affect the readability of the display.

## 7.1 Quick commissioning

For quick commissioning of the "standard" BTU meter application, you only have to enter five operating parameters in the **Setup** menu.

**Prerequisites for quick commissioning:**

- Flow transmitter with pulse output
- RTD temperature sensor, 4-wire direct connection

**Menu/setup**
- **Units**: Select unit type (SI/US)
- **Pulse value**: Select the unit of the pulse value of the flow transmitter
- **Value**: Enter the pulse value of the flow sensor
- **Mounting location**: Determine the mounting location of the flow transmitter
- **Date/time**: Set the date and time

The device is now operational and ready to measure heat energy (cold energy).

You can configure device functions, such as data logging, tariff function, bus connection and the scaling of current inputs for flow or temperature, in the **Advanced setup** menu → 37 or in the **Expert** menu → 52.

- Inputs/flow:
  Select the signal type and enter the start and end of the measuring range (for current signal) or the pulse value of the flow transmitter.
- Inputs/temperature warm
- Inputs/temperature cold

## 7.2 Applications

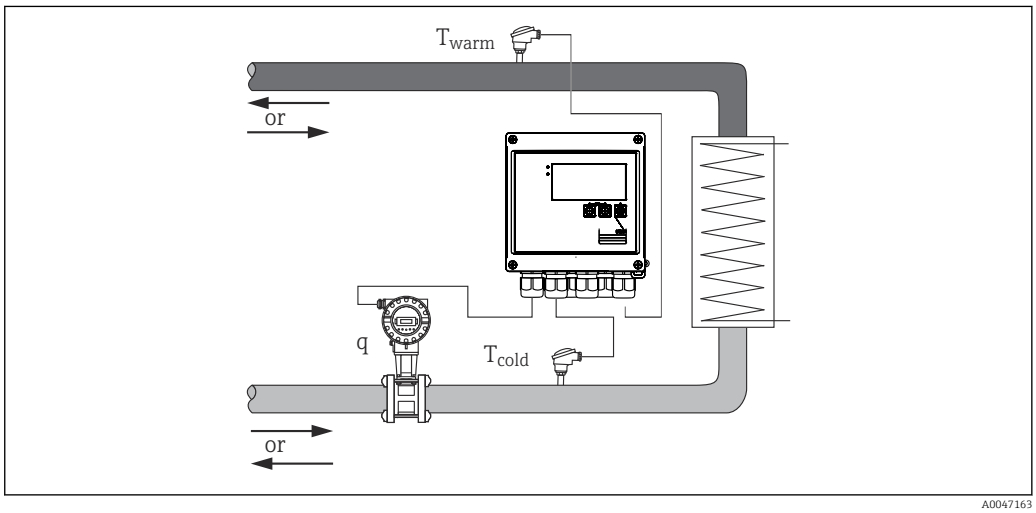
The following is an explanation of the application possibilities, including brief operating instructions for the respective device settings.

The device can be used as:
- BTU meter for heating or cooling applications (heat differential), → 33
- BTU meter for heating/cooling applications (bidirectional heat differential), → 35
- Flow computer, → 36

### 7.2.1 BTU meter for heating or cooling applications (heat differential)

Calculation of the quantity of heat which is given off, or taken in, by a liquid heat carrier in a heat exchanger. Typical application for measuring energy in heating and cooling circuits.

In addition, the heat output at a certain temperature can be determined, e.g. to determine the residual heat in the return pipe of a heat exchanger (see instructions).




*28 Application as BTU meter*

**Input signals:**

Flow, Qv (pulse input or current input)

Temperature on warm side, T warm (RTD or current input)

Temperature on cold side, T cold (RTD or current input)

**Required settings:**

1. Flow input: enter pulse value or measuring range of the 0/4 to 20 mA input (not for MID approval option).
2. Temperature inputs: select the RTD type and temperature range or enter the temperature measuring range for the 4 to 20 mA input (not for MID approval option).
3. If other heat carriers than water are used, in the Application/Medium menu, select "Glycol" or "Liquid table" and enter the glycol concentration or table values for specific heat capacity and density.

**Display variables:**

Power (heat flow), mass flow, volume flow, T warm, T cold, temperature differential, enthalpy, density.

Day, month, year counter, totalizer for energy, volume, mass and deficit. Optional counters: Tariff 1, Tariff 2, Charging power, Discharging power, → 🖹 41

**Miscellaneous notes:**

- The flow transmitter can be installed on the warm or cold side. It is recommended to install the flow transmitter at the point in the heat circuit where the temperature is closer to the ambient temperature (room temperature).
- Tables with data on density and heat capacity of heat carrier used (e.g. coolants or thermal oils) are usually supplied by the manufacturer. These data are entered in the device.
- By way of derogation from EN 1434, which is based on a constant water pressure of 16 bar, in water applications the average operating pressure is calculated based on the measured temperature according to the following table → 🖹 34 and taken into account for the energy calculation. This ensures maximum accuracy for energy calculations even at very high temperatures (large temperature differences).
- To calculate the power (enthalpy) at a certain temperature, e.g. to determine the residual heat in the return pipe of a heat exchanger, only one temperature sensor is connected. The power is calculated relative to 0 °C (32 °F).

**Calculation**

Energy of water:

$E = q * \rho(T_{warm/cold}, p) * [h(T_{warm}) - h(T_{cold})]$

Energy for user-defined liquids:

$E = q * \rho(T_{warm/cold}, p) * c_m * (T_{warm} - T_{cold})$

$c_m = [c(T_1) + c(T_2)]/2$

| | |
|---|---|
| E | Heat quantity |
| q | Operating volume |
| ρ | Density at the mounting location (warm or cold) |
| $T_{warm}$ | Temperature, warm side |
| $T_{cold}$ | Temperature, cold side |
| $c(T_{warm})$ | Specific heat capacity at T warm |
| $c(T_{cold})$ | Specific heat capacity at T cold |
| $c_m$ | Mean specific heat capacity |
| p | Average operating pressure |
| $h(T_{warm})$ | Specific enthalpy of water at T warm |
| $h(T_{cold})$ | Specific enthalpy of water at T cold |

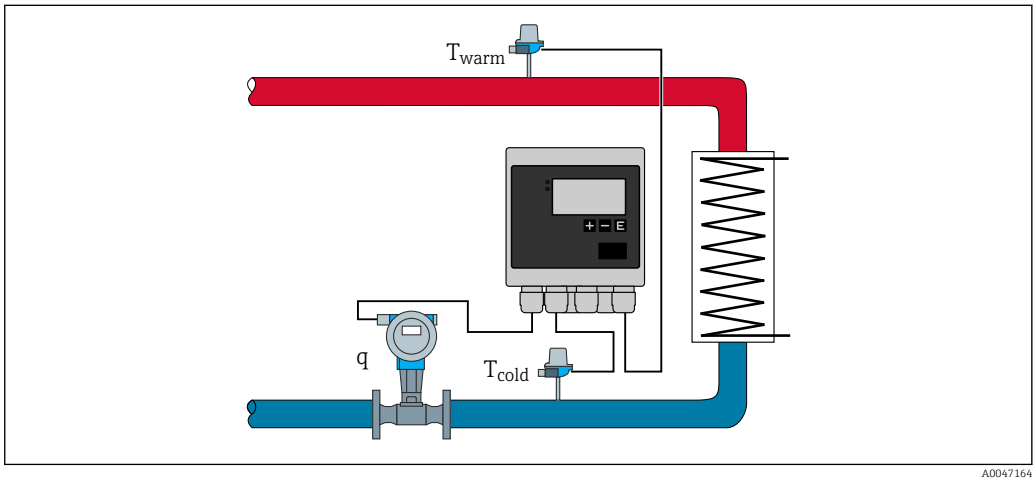
*Calculating the operating pressure from the temperature*

| **Pressure p** | | **Temperature T** | |
|---|---|---|---|
| **[bar]** | **[psi]** | **[°C]** | **[°F]** |
| 10.000 | 145.038 | 179.886 | 355.795 |
| 20.000 | 290.076 | 212.385 | 414.293 |
| 40.000 | 580.181 | 250.358 | 482.644 |
| 60.000 | 870.226 | 275.586 | 528.055 |
| 80.000 | 1 160.302 | 295.009 | 563.016 |
| 100.000 | 1 450.377 | 310.999 | 591.798 |
| 150.000 | 2 175.566 | 342.158 | 647.884 |
| 165.29 | 2 397.329 | 350 | 662 |

### 7.2.2 BTU meter for heating/cooling applications (bidirectional heat differential)

Calculation of the quantity of heat which is given off and taken in by a liquid heat carrier in a heat exchanger. A typical application is measuring energy flows when charging/ discharging a heat accumulator (e.g. geothermal reservoirs).

Bidirectional operation can be implemented depending on the flow direction or temperature differential (with the flow direction remaining the same).




29 *Application as BTU meter, bidirectional*

#### Bidirectional measurement, temperature differential-dependent

If a heat transport circuit is used for both heating and cooling with the flow direction remaining the same, switching from heating to cooling operation takes place depending on the sign of the temperature differential ($T_{warm}$ - $T_{cold}$) and, if selected, a temperature limit (switching temperature). For details, refer to → 54.

#### Bidirectional measurement, flow direction-dependent

If a heat transfer circuit with changing flow direction is used for both heating and cooling purposes, the flow transmitter must output a direction signal in addition to the volume signal output (e. g. MID and ultrasonic flow transmitter). For transmitters without a direction signal output, it is possible to scale a flow measuring range with a negative start of measuring range (e.g. −100 to 100 $m^3/h$).

#### Input signals:

Flow, Qv (pulse input or current input)

Temperature on warm side, T warm (RTD or current input)

Temperature on cold side, T cold (RTD or current input)

Flow direction signal (status) (only for flow direction-dependent operating mode)

#### Required settings:

1. Flow input: enter pulse value or measuring range of the 0/4 to 20 mA input.
2. Temperature inputs: select the RTD type and temperature range or enter the temperature measuring range for the 4 to 20 mA input.
3. If other heat carriers than water are used, in the Application/Medium menu, select "Glycol" or "Liquid table" and enter the glycol concentration or table values for specific heat capacity and density.
4. Application for quantity of heat/bidirectional: Select flow or temperature.

**Display variables**

Power (+/-), mass flow, volume flow, T warm, T cold, temperature differential, enthalpy differential, density.

Charging power, discharging power, energy (the normal energy counter acts as a balance counter, i.e. charging power-discharging power), deficit counter for energy

**Miscellaneous notes:**

- The mounting location of the flow transmitter can be freely selected. For bidirectional operation depending on the temperature differential, the mounting location is applicable relative to the start conditions (i.e. even if the leading sign changes, the same temperature sensor remains assigned to the flow sensor).
- It is recommended to install the flow transmitter at the point in the heat circuit where the temperature is closer to the ambient temperature (room temperature).

**Calculation**

Charging/discharging power of water:

$E = q * \rho(T_{warm/cold}, p) * |h(T_{warm}) - h(T_{cold})|$

Charging/discharging power for user-defined liquids:

$E = q * \rho(T_{warm/cold}, p) * c_m * (T_{warm} - T_{cold})$

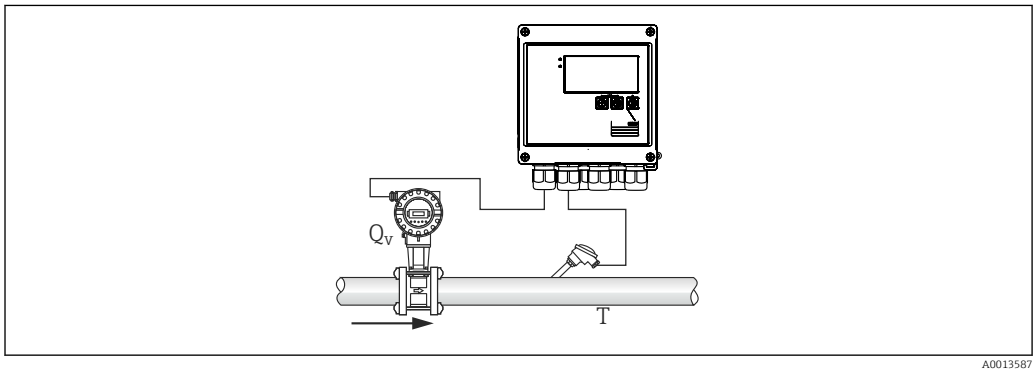
$c_m = |c(T_{warm}) + c(T_{cold})|/2$

Balance power = Charging power - Discharging power

| | |
|---|---|
| E | Heat quantity |
| q | Operating volume |
| ρ | Density at the mounting location (warm or cold) |
| $T_{warm}$ | Temperature, warm side |
| $T_{cold}$ | Temperature, cold side |
| $c(T_{warm})$ | Specific heat capacity at T warm |
| $c(T_{cold})$ | Specific heat capacity at T cold |
| $c_m$ | Mean specific heat capacity |
| p | Average operating pressure → 🖹 34 |
| $h(T_{warm})$ | Specific enthalpy of water at T warm |
| $h(T_{cold})$ | Specific enthalpy of water at T cold |

## 7.2.3 Flow computer (incl. heat content)

Calculating the mass flow based on the volume flow and temperature.




*30 Calculating the mass flow*

**Input signals:**

Flow, Qv (pulse input or current input)

Temperature (RTD or current input)

**Required settings:**

1. Flow transmitter: enter pulse value or scale current input range
2. Temperature input: select RTD type and temperature range
3. If other heat carriers than water are used, in the Application/Medium menu, select "Glycol" or "Liquid table" and enter the glycol concentration or table values for density.

**Display variables:**

Volume flow, mass flow, heat flow (power), temperature, density

Flow sum, mass sum, energy, deficit counter for energy

**Miscellaneous notes:**

No selectable application for flow calculation exists. Calculation of mass flow is part of the standard function of the BTU meter.

## 7.3 Configuring the basic parameters/general device functions

- Inputs, → 37
- Outputs, → 39
- Limits, → 39
- Display/units, → 41
- Data logging, → 42
- Access protection/locking, → 43
- Communication/fieldbus systems, → 47

### 7.3.1 Inputs

**Flow pulse transmitter**

The pulse input can process different current and voltage pulses. The software can switch to different frequency ranges:
- Pulses and frequencies up to 12.5 kHz
- Pulses and frequencies up to 25 Hz (for bounce contacts, max. bounce time: 5 ms)

The input for voltage pulses and contact sensors is divided into different types according to EN1434 and provides a power supply for switching contacts, → 22.

*Pulse value and K-factor*

For all signal types, the pulse value of the flow transmitter has to be entered.

For certified instruments, the pulse value appears on the display and can be changed no more than three times.

The calculation of the current value for the volume flow is floating; therefore, it decreases continuously with slow pulses. After 100 seconds or if the value is less than the low flow cut off, the flow value becomes 0.

The pulse value of flow transmitters is defined differently depending on the transmitter type. As a result, different units can be selected for the pulse value at the device.

- Pulse/volume unit (e.g. pulses/liter), also known as the K-factor (e.g. Prowirl),
- Volume unit/pulses (e.g. liters/pulse, Promag, Prosonic)

### Flow current signal

For flow transmitters with a current signal output, the flow measuring range is scaled in the Advanced setup → 🖹 85.

Configuration of flow measurements according to the differential pressure principle (DP, for example: orifice plate) is described in → 🖹 55.

*Adjustment/calibration of the current input*

To adjust the current inputs, a two-point calibration can be carried out in the Expert menu, for example to correct the long-term drift of the analog input.

Example: flow signal 4 mA (0 $m^3$/h), but the device displays 4.01 mA (0.2 $m^3$/h). If you enter the set point 0 $m^3$/h, actual value: 0.2 $m^3$/h the device "learns" a new 4 mA value. The set point must always be within the measuring range.

*Transmitter mounting location*

In the menu, select the mounting location of the flow transmitter (warm side or cold side). For devices that are suitable for custody transfer measurement, the mounting location is shown on the display as standard.

*Low flow cut off*

Volume flows below the configured low flow cut off value are evaluated as zero (not measured on the counter). This is used to suppress measured values, for example at the lower limit of the measuring range.

For the pulse input, the minimum permitted frequency can be determined from the low flow cut off. Example: low flow cutoff 3.6 $m^3$/h (1 l/s), pulse value of the transmitter: 0.1 l.

1/0.1 = 10 Hz. This means that after 10 s the value "0" is displayed for volume flow and power.

For analog signals, two variants of low flow cut off exist:
- Positive flow measuring range, e.g. 0 to 100 $m^3$/h: values less than the low flow cut off value are valued at zero.
- Negative start of measuring range (bidirectional measurement), e.g. −50 to 50 $m^3$/h: Values around the zero point (+/- low flow cut off value) are valued at zero.

### Temperature inputs

To measure the temperature, RTD sensors can be connected directly or via transmitter (4 to 20 mA). For the direct connection, sensors of types PT 100/500/1000 can be used. For PT 100 sensors, users can choose from different measuring ranges for high and low temperature differences to ensure maximum accuracy:

Menu **Setup** → **Advanced setup** → **Inputs** → **Temperature warm** or **Temperature cold** → **Range**.

The measuring range can be scaled individually if a current signal is used:

Menu **Setup** → **Advanced setup** → **Inputs** → **Temperature warm** or **Temperature cold** → **Range start** and **Meas. range end**.

NOTICE

**Restrictions for custody transfer applications**

▶ For custody transfer applications, only RTD Pt100 and Pt500 temperature sensors are permitted according to the relevant type approval.

**Digital inputs**

Two digital inputs are available: Depending on the options of the device, the following functions can be controlled via the digital inputs:

| Digital input 1 | Digital input 2 |
|---|---|
| Activate tariff counter 1<br>Time synchronization<br>Lock device | Activate tariff counter 2<br>Change flow direction<br>Time synchronization<br>Lock device |

## 7.3.2 Outputs

**Universal output (active current and pulse output)**

The universal output can be used as a current output to output a current value (e.g. power, volume flow) or as an active pulse output to output counter values (e.g. volume).

**Open collector outputs**

The two open collector outputs can be used as a pulse output to output counter values or as a status output to output alarms (e. g. instrument error, limit value violation).

**Relays**

The two relays can be switched in case of fault messages or a limit violation.

Relay 1 or 2 can be selected under **Setup** → **Advanced setup** → **System** → **Fault switching**.

Limit values are assigned under **Setup** → **Advanced setup** → **Application** → **Limits**. Possible settings for limit values are described in the "Limits" section.

## 7.3.3 Limits

To monitor the process and/or the device, events and limits can be defined. Off-limit conditions are entered in the event log and the data archive. You can also assign different limits (alarms) to one relay.

The following operating modes are available for the limit function:

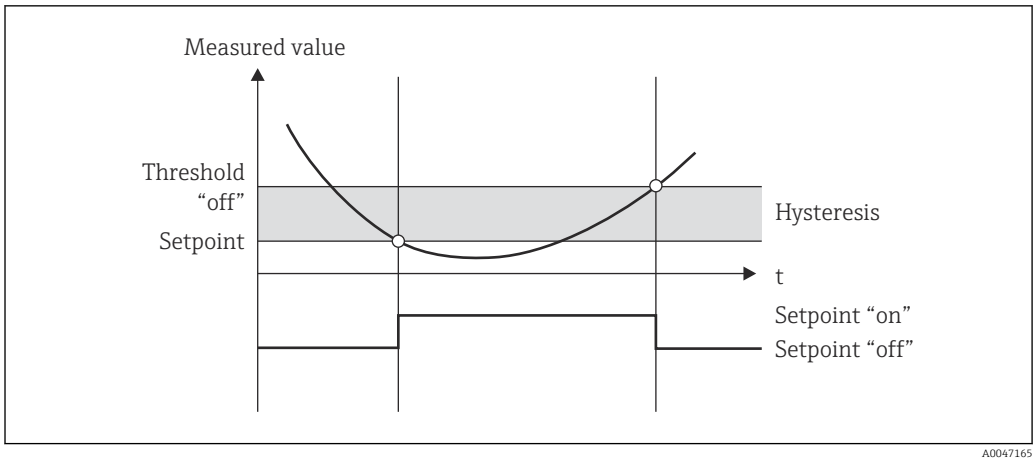
**Off**

No action is triggered. The assigned output is always in the normal operating state.

**Lower set point (SP lower)**

The limit value is active if the configured value is undershot. The limit value is disabled if the value, including hysteresis, exceeds the limit value.

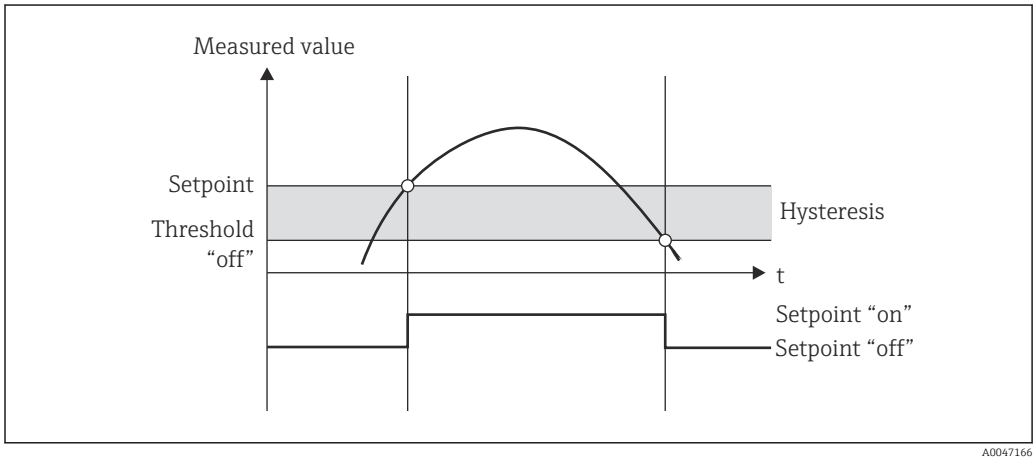
Example: Limit value 100 °C (212 °F), hysteresis 1 °C (1.8 °F) → Limit value on = 100 °C (212 °F), Limit value off = 101 °C (213.8 °F)).




*31 "SP lower" operating mode*

### Upper set point (SP upper)

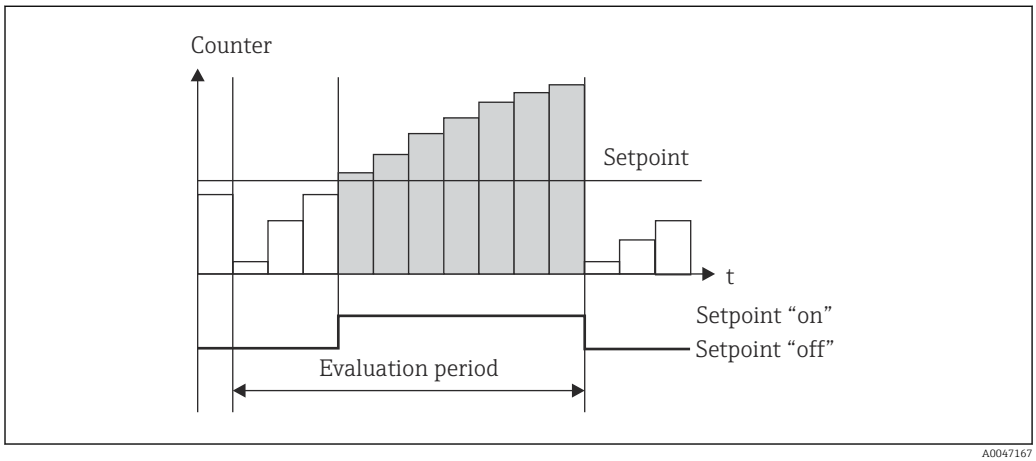
The limit value is active if the value exceeds the configured value. The limit value is switched off if the limit value, including hysteresis, is undershot.



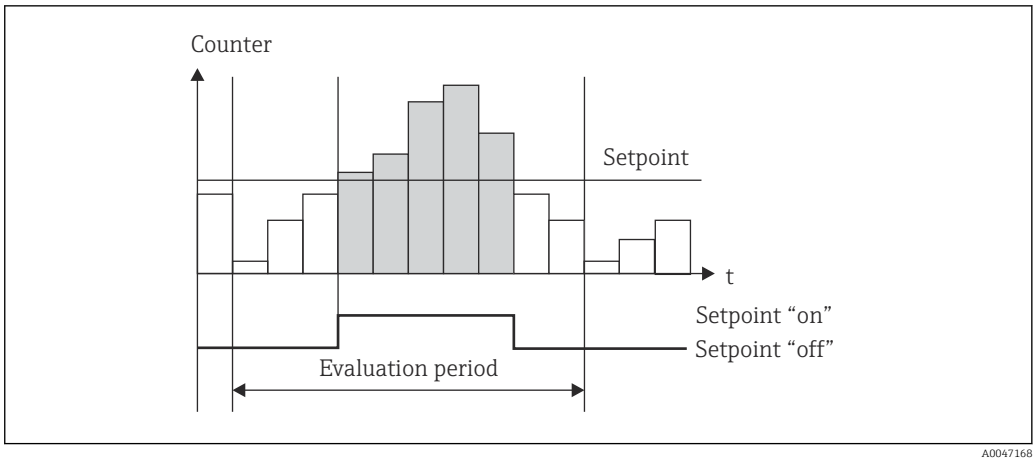

*32 "SP upper" operating mode*

### Counters (day/month/year/billing date counter)

The limit value alarm is triggered if the value exceeds the configured counter value. The limit value alarm is deactivated at the end of the evaluation period (e.g. 1 day for daily counter) or if the counter reading is undershot (e.g. for bidirectional operation).




*33 Limit value for counters*




34 *Limit value for counters*

## 7.3.4 Display settings and units

### Display settings

In the **Setup** → **Advanced setup** → **Application** → **Display groups** menu, select which process values are shown on the display. For this purpose, 6 display groups are available. A group can be assigned up to 3 values. For a three-line display, the values are displayed in a smaller font size. A user-defined name can be assigned to each group (max. 10 characters). This name is displayed in the header. When the device is delivered, the display groups are preconfigured according to the following table.

| Group | Value 1 | Value 2 | Value 3 |
|---|---|---|---|
| 1 | Power | Energy | User-defined |
| 2 | Volume flow | Temperature warm | Temperature cold |
| 3 | Pulse value Q | Mount location Q | Calibration date[1)] |
| 4 | Tariff 2[2)]/Discharging power[3)] | Tariff 1[2)]/Charging power[3)] | T switchover/ΔT lim.[3)] or user-defined |
| 5 | User-defined | User-defined | User-defined |
| 6 | Actual date | Actual time | User-defined |

1) Only with approval for custody transfer option
2) Only with tariff option
3) Only with bidirectional option

For custody transfer devices, Groups 1 to 3 (and also Group 4 with the option of bidirectional measurement) cannot be edited, i.e. only Groups 5 and 6, and Group 4 depending on the option selected) can be configured freely by the user.

### Display mode

The display mode is selected in the Display/operation menu. You configure the brightness, contrast and the switching mode of the display, i.e. whether switching between the display groups takes place automatically or by pressing a button. In this menu, you can also call up the current values for data recording (interval, day, month and billing date counter) under "stored values". (For details → 42, "Data logging")

### Hold function – "freezing" the display

The operating option is visible only if the device is not locked by custody transfer switch.

The entire measured value acquisition can be "frozen" using an operating option, i.e. the input variables remain at the last measured value and the counter readings are not incremented any higher. The measured values during Hold mode are ignored for data logging. The hold function is enabled/disabled in the Diagnostics menu and stopped automatically if no button is pressed for 5 minutes.

**No. of Sums/counter overflow**

Counters are limited to max. 8 digits before the decimal point (for counters that require signs, to 7 characters). If the counter reading exceeds this value (overflows), it is reset to zero. The number of overflows for each counter is recorded on overflow counters. A counter overflow is shown on the display with the "^" icon. The number of overflows can be called up in the **Display/operation** → **Stored values** menu.

**Units**

The units for scaling and displaying the process variables are configured in the respective submenus (e.g. the unit for displaying the temperature is configured under Inputs/ Temperature).

To make device setting easier, the unit system is selected at the beginning of device commissioning.

- EU: SI units
- USA: imperial units

This setting sets the units in the individual submenus to a certain value (default), e.g. SI: $m^3/h$, °C, kWh.

If a unit is converted subsequently, no automatic conversion of the associated (scaled) value takes place!

For custody transfer devices, the selection of units is limited.

For information on the conversion of units, see the appendix → 📄 103.

### 7.3.5 Data logging

The device stores relevant measured values and counter data at defined times. The averages for volume flow, power, warm side temperature and cold side temperature are calculated and stored in an adjustable interval (1 min – 12 h). Daily, monthly and annually, an average calculation for volume flow, power, warm side temperature and cold side temperature is carried out. In addition, the min/max values are determined and stored together with the counter values. In addition, two user-defined billing dates can be used to define a time frame for measuring energy, e.g. for semiannual billing.

Current day, monthly and billing date counters can be called up in the **Display/operation** → **Stored values** menu. In addition, all counters can be shown as a display value (can be allocated to a display group).

The entire data archive, i.e. all stored values, can be read out using the "Field Data Manager Software" only.

Specifically, the following data are stored in the device:

| Analysis | Calculation |
|---|---|
| Interval | Calculating and storing the average for:<br>▪ Temperature warm<br>▪ Temperature cold<br>▪ Volume flow<br>▪ Power |
| Day | Calculation of min, max and average as well as stored counters.<br>The min and max value are calculated from the instantaneous min/max values. The average is calculated from the averages of the interval evaluation.<br>Min, max and average values are determined for:<br>▪ Volume flow<br>▪ Power<br>▪ Temperature warm<br>▪ Temperature cold<br>Counters are determined for:<br>▪ Operating volume<br>▪ Heat (energy)<br>▪ Tariff 1 / Charging power<br>▪ Tariff 2 / Discharging power<br>▪ Deficit counter<br>For counters, the cumulative counter and the totalizer are stored.<br>For min and max, the time is also stored. |
| Month | Similar to day, but with average calculation from the daily averages. |
| Year | Similar to day, but with average calculation from the monthly averages. |
| Billing date | The following counters are determined:<br>▪ Operating volume<br>▪ Heat (energy)<br>▪ Tariff 1 / Charging power<br>▪ Tariff 2 / Discharging power<br>▪ Deficit counter<br>The evaluation always takes place from billing date to billing date. |

### General notes for data logging

The time of data logging (start time of the logging intervals) can be configured and/or synchronized via the time of day.

The current evaluations (min/max/average, counter) can be reset to zero individually or completely via setup. The archived values (completed evaluations) can no longer be changed! To clear these out, the entire measured value memory must be deleted.

### Storage capacity

The device should be read out regularly using the "Field Data Manager Software" to ensure seamless data logging. Depending on the storage depth, the interval, daily, monthly and annual counters are overwritten after a certain time, see the table below.

| Analysis | No. of analyses |
|---|---|
| Interval | Approx. 875 |
| Day | 260 days |
| Month/year/billing date | 17 years |
| Events | At least 1600 (depending on the length of the message text) |

## 7.3.6 Access protection

To prevent tampering, the device can be protected using a hardware switch in the device → 29, an operating code, lead seal and/or locking via a digital input.

### Protection by code

The entire local operation can be protected by a 4-digit code (default is 0000, i.e. no protection). After 600 s without operation, the device is locked again automatically.

### Custody transfer lock

If the custody transfer switch is closed, the device is locked and changes can be carried out only as described in the following.

| | |
|---|---|
| Setup (on the device or via PC software) | O Parameters can be changed up to three times |
| Group settings | O |
| Read out measured values | O |
| Measured value simulation/test functions/device check | X |
| Firmware update | X |
| Hold function | X |
| Clear memory | X |
| Retrofit software options | X |
| Reset counters | X |
| Time synchronization | Depends on the time difference (30 s) |
| Date/time | X (exception: Goldcap battery empty, i.e. date/time invalid, can be changed up to 3x) |
| Reset operating hours counter<br><br>O = open<br>X = locked | X |

### Custody transfer-related parameters

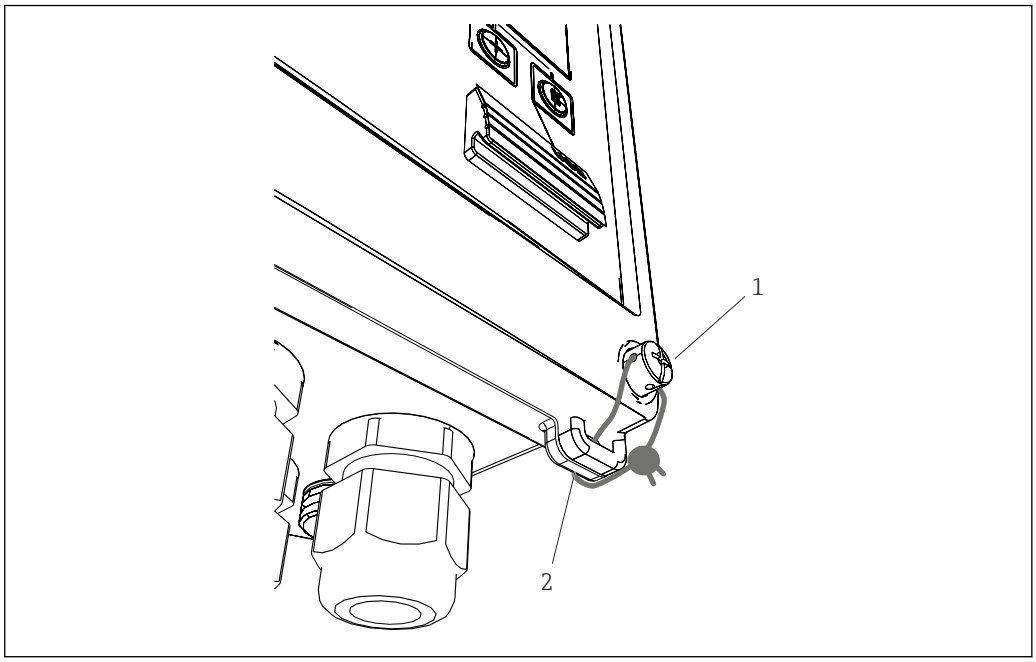
The custody transfer-related parameters are identified in the overview of operating parameters in the appendix, → 🖹 85.

NOTICE

**If the custody seal is broken the approval for custody transfer is no longer valid**

- To recalibrate an instrument, the instrument must be inspected on site by an approved calibration authority (e.g. calibration officer).

### Lead sealing on the device




35 *Lead sealing of the device*

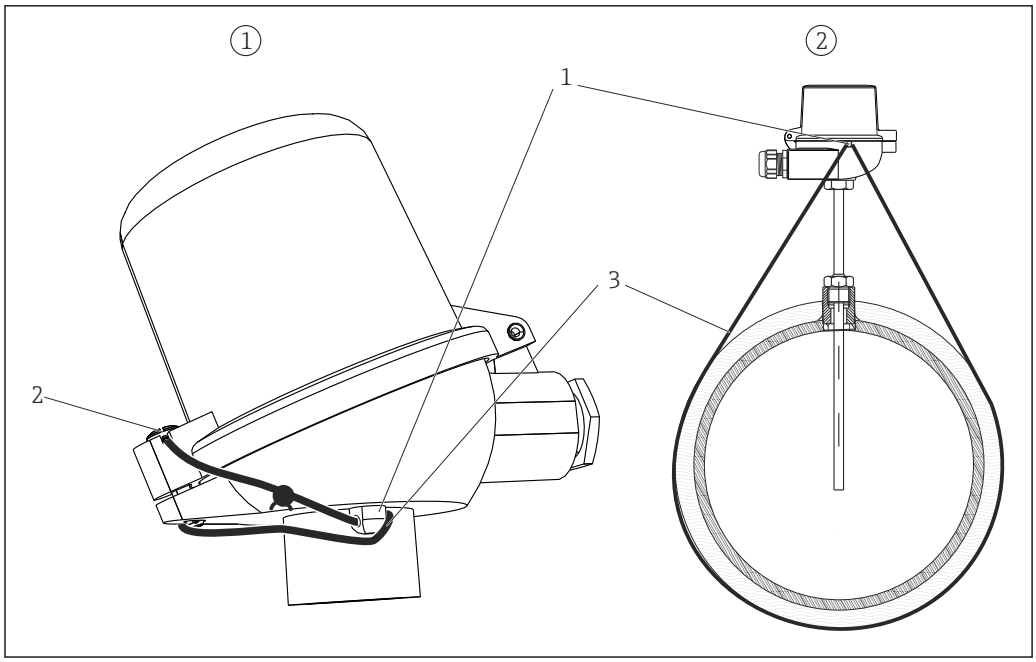
*1 Lead sealing screw*
*2 Housing eyelet*

For lead sealing of the device, a lead sealing screw (item 1) and an eyelet (item 2) are available on the device.

### Lead sealing of the optional RTD assembly

The optional RTD assemblies can be protected against tampering by fitting them with lead seals.

The installation of a lead seal prevents the head from being opened and the thermometer removed, → 36, 46.




*36 Options for lead sealing on the optional RTD assembly: 1. Terminal head, 2. Thermometer at mounting location, illustration is an example*

*1 Eyelet on the housing of the terminal head*
*2 Lead sealing screw*
*3 Lead sealing wire*

### Complete locking

If you want to prevent any and all access to the device, the entire device can be locked by applying a signal at the digital input. The data can still be read out via an interface.

## 7.3.7 Logbooks

Changes to the setup are recorded in entries in the event logbook and in the custody transfer logbook.

### Event logbook

The event logbook stores events such as alarms, off-limit conditions, setup changes, etc. with the date and time specified. The memory is sufficient for at least 1600 messages (however, depending on the text length, it is possible for more messages to be stored). If the memory is full, the oldest messages are overwritten. The logbook can be read out via the Field Data Manager software or on the device. To exit the logbook quickly, press the +/- keys simultaneously.

### Custody transfer logbook

After the custody transfer switch is locked, custody transfer-related parameters (→ 🖹 85, appendix) can be changed up to three times. For example, the pulse value of the flow sensor can be entered on site into the EngyCal if the flow sensor type was not known when the arithmetic unit was ordered. Defective sensors can also be replaced without invalidating the custody transfer status of the measurement.

The custody transfer logbook can be called up on the device only. All events of the custody transfer-related logbook are also visible in the event logbook.

The custody transfer-related logbook is deleted automatically if the custody transfer switch is opened and closed again.

The following events are stored in this logbook:
- Custody transfer-related logbook deleted
- Changes to custody transfer-related parameters (entry of the new value).

### 7.3.8 Communication/fieldbus systems

#### General information

The device has (optional) fieldbus interfaces for reading out all process values. Values can be written to the device only in the context of device configuration (via the FieldCare operating software and USB or Ethernet interface). Process values such as flow cannot be transmitted to the device via the bus interfaces.

Depending on the bus system, alarms or faults occurring during data transmission are displayed (e.g. status byte).

The process values are transmitted in the same units that are used to display the values on the device. Only for the M-Bus are units converted, if a unit that is not defined in the bus protocol is used for display.

Only the counter readings of the most recently completed storage period (day, month, year, billing date) can be read out of the memory.

If counter readings are large, the number of decimal places is truncated (e.g. 1234567.1234 → 1234567 or 234567.1234 → 234567.1).

The device can be read out via the following interfaces:
- M-Bus
- Modbus RTU
- Ethernet/Modbus TCP

#### M-Bus

The M-Bus interface is configured in the **Setup** → **Advanced setup** → **Application** → **M-Bus** menu.

| Menu position | Parameter | Description |
|---|---|---|
| Baud rate | **300**/2400/9600 | Transmission rate |
| Unit address | 1-250 | Primary address |
| ID number | 00000000 | The identification number is part of the secondary address (see below) |
| Manufacturer | EAH | EAH (stands for Endress And Hauser), cannot be changed |
| Version | 01 | Cannot be changed |
| Medium | 0E | 0E (=Bus/System), cannot be changed |
| Number | 0-30 | Number of values to be transferred |
| Value | Volume flow, T warm, etc. | Selection of values to be transferred. |

Data format:
- No automatic baud rate detection
- 8 data bits, EVEN parity (not selectable)

Timeout:

The device waits 11 bit times before answering after having received a request.

Operating mode:

Generally, Mode 1 is used, i.e. LSB is transferred first.

Control characters:
- Start character: 10h (short block) or 68h (long block)
- End character: 16h

*Primary address*

| | |
|---|---|
| 0 | New Device (default) |
| 1...250 | Freely available |
| 251...252 | Reserved (must not be configured) |
| 253 | Addressing via secondary addressing |
| 254 | Broadcast address, all respond (only for point-to-point) |
| 255 | Broadcast address, none responds |

*Secondary addressing*

The identification number, manufacturer ID, version and medium together make up the secondary address. If a device (slave) is addressed by the master via this address, its secondary address is sent with the primary address 253. The device (slave) whose secondary address matches the sent secondary address responds with E5h and is now connected to the master via primary address 253. Further responses from the device (slave) are sent via address 253. A RESET command or the selection of a different bus device (slave) causes the device (slave) to be deselected. This breaks the connection to the master.

The identification number (for secondary addressing) is a unique, 8-digit number within the device that is factory assigned and is generated from the CPU number. This number can be modified on the unit, though not via M-BUS.

The identification number can be configured in the setup function.

The manufacturer ID, version and medium can be displayed in the setup only; they cannot be changed.

Addressing is also possible using wildcards. For the identification number, this is "Fhex" and for the manufacturer ID, version and medium, it is "FFhex".

For the M-Bus, the measured value is transmitted along with the unit (as per EN1434-3). Units that are not supported by M-Bus are transmitted as an SI unit.

### Modbus RTU/(TCP/IP)

The device can be connected to a Modbus system via RS485 or Ethernet interface. The general settings for the Ethernet connection are configured in the **Setup** → **Advanced setup** → **System** → **Ethernet** menu, → 📄 50. Modbus communication is configured in the **Setup** → **Advanced setup** → **System** → **Modbus** menu.

| Menu position | RTU | Ethernet |
|---|---|---|
| Device address: | **1** to 247 | IP address manual or automatic |
| Baud rate: | 2400/4800/9600/**19200**/38400 | - |
| Parity: | **Even**/Odd/None | - |
| Port | - | 502 |
| Reg | Register | Register |
| Value | Value to be transmitted | Value to be transmitted |

*Transfer of values*

The actual Modbus TCP protocol is located between layer 5 to 6 in the ISO/OSI model.

To transmit a value, 3 registers of 2 bytes each are used (2 bytes status + 4-byte float). In the setup, you can configure which register is to be written with which value. The most important/most common values are already preconfigured.

| | |
|---|---|
| Register 000 | Status of first measured value (16-bit integer, high byte first) |
| Register 001 to 002 | First measured value (32-bit float, high byte first) |

Validity and limit value information are encoded in the status byte.

| 16 | | 6 | 5 | 4 | 3 | 2 | 1 | |
|---|---|---|---|---|---|---|---|---|
| | Not used | | | 0 | 0 | 0 | 0 | ok |
| | | | | 0 | 0 | 0 | 1 | Open circuit |
| | | | | 0 | 0 | 1 | 0 | Over range |
| | | | | 0 | 0 | 1 | 1 | Under range |
| | | | | 0 | 1 | 0 | 0 | Invalid measured value |
| | | | | 0 | 1 | 1 | 0 | Replacement value |
| | | | | 0 | 1 | 1 | 1 | Sensor error |
| | | | 1 | | | | | Lower limit value violated |
| | | 1 | | | | | | Upper limit value violated |
| 1 | | | | | | | | Counter overflow |

During the request from the master, the desired start register and the number of registers to be read are sent to the device. Because a measured value always requires three registers, the start register and the number must be divisible by 3.

From the master to the BTU meter:

ga fk r1 r0 a1 a0 c1 c2

| | |
|---|---|
| ga | Slave address (1..247) |
| fk | Function, always 03 |
| r1 r0 | Start register (high byte first) |
| a1 a0 | Number of registers (high byte first) |
| c0 c1 | CRC checksum (low byte first) |

Response from BTU meter for successful request:

ga fk az s1 s0 w3 w2 w1 w0 s1 s0 w3 w2 w1 w0 . . . . . s1 s0 w3 w2 w1 w0 c1 c0

| | |
|---|---|
| ga | Unit address |
| fk | Function, always 03 |
| az | Number of bytes of all subsequent measured values |
| s1 s0 | Status of first measured value (16-bit integer, high byte first) |
| w3 w2 w1 w0 | First measured value in 32-bit float format, high byte first |
| s1 s0 | Status of second measured value (16-bit integer, high byte first) |
| w3 w2 w1 w0 | Second measured value (32-bit float, high byte first) |
| s1 s0 | Status of last measured value (16-bit integer, high byte first) |
| w3 w2 w1 w0 | Last measured value (32-bit float, high byte first) |
| c0 c1 | CRC checksum, 16-bit (low byte first) |

Response from BTU meter for unsuccessful request:

ga fk fc c0 c1

| | |
|---|---|
| ga | Slave address (1..247) |
| fk | Requested function + 80hex |

| | |
|---|---|
| fc | Error code |
| c0 c1 | CRC checksum, 16-bit (low byte first) |

Error code:

01 : Function unknown
02 : Start register invalid
03 : Number of registers to be read invalid

For checksum or parity errors in the request from the master, the BTU meter does not respond.

For large counter readings, the decimal points are truncated.

Additional information on the Modbus is provided in BA01029K.

### Ethernet/Web server (TCP/IP)

**Setup** → **Advanced setup** → **System** → **Ethernet**

The IP address can be entered manually (fixed IP address) or assigned automatically using DHCP.

The port for the data communication is set by default to 8000. The port can be changed in the **Expert** menu.

The following functions are implemented:
- Data communication to PC software (Field Data Manager Software, FieldCare, OPC server)
- Web server
- Modbus TCP → 48

Up to 4 connections can be opened simultaneously, e.g. Field Data Manager software, Modbus TCP and 2x Web server.

However, only one data connection via Port 8000 is possible.

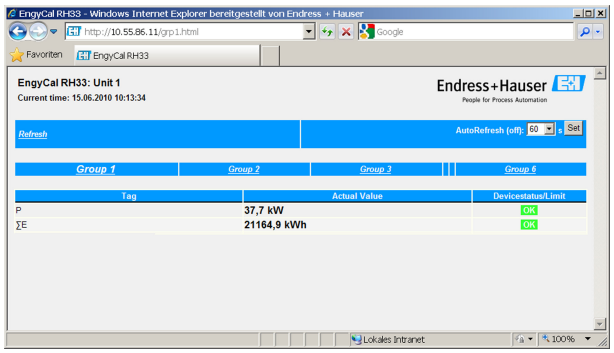
As soon as the max. number of connections is reached, new connection attempts are blocked until an existing connection is terminated.

*Web server*

If the device is connected via Ethernet, it is possible to export the display values via the internet using a Web server.

The Web server port is preset to 80. The port can be changed in the **Expert** → **System** → **Ethernet** menu.

If the network is protected by a firewall, the port may need to be activated.




37 *Display values shown in the Web browser (using the example of the EngyCal RH33)*

As in the case of the display, you can alternate between the display groups in the Web server. The measured values are updated automatically (directly via "link": off/5s/15s/30s/60s). In addition to the measured values, status and limit value flags are displayed.

Data can be exported via the Web server in HTML or XML format.

When using an Internet browser, it suffices to enter the address http://<IP address> to display the information as HTML in the browser. In addition, two versions of the XML format are available. These versions can be integrated into additional systems as required. The two XML versions contain all the measured values which are assigned to any group.

The decimal separator is always displayed as a period in the XML file. All times are given in UTC. The time difference in minutes is noted in the following entry.

*Version 1:*

The XML file is available in ISO-8859-1 (Latin-1) encoding at the address http://<IP address>/index.xml (alternatively: http://<IP address>/xml). However, this encoding cannot display some special characters such as the sum sign. Texts such as digital statuses are not transmitted.

*Version 2:*

A UTF-8 encoded XML file can be retrieved at the address http://<IP address>/main.xml All the measured values and the special characters can be found in this file.

The structure of the channel values for the XML file is explained as follows:

```
<device      id="ID0104" tag="Flow" type="INTRN">
             <v1>12.38</v1>
             <u1>m3/h</u1>
             <vstslv1>2</vstslv1>
             <hlsts1>ErS</hlsts1>
             <vtime>20120105-004158</vtime>
             <man>Endress+Hauser</man>
             <param />
</device>
```

| Tag | Description |
|---|---|
| tag | Channel identifier |
| v1 | Measured value of channel as a decimal value |
| u1 | Unit of measured value |
| vstslv1 | Status of the measured value<br>0 = OK, 1 = warning, 2 = error |
| hlsts1 | Error description<br>OK, OC = cable open circuit, Inv = invalid, ErV = error value, OR = over range, UR = under range, ErS = error sensor |
| vtime | Date and time |
| MAN | Manufacturer |

*Web server settings*

Menu **Setup** → **Advanced setup** → **System** → **Ethernet** → **Web server** → **Yes** or menu **Expert** → **System** → **Ethernet** → **Web server** → **Yes**

If default port 80 is not available in your network you can change the port in the **Expert** menu.

Enter the address for retrieval in the Web browser: http://<IP address>

The following Web browsers are supported:
- MS Internet Explorer 6 and higher
- Mozilla Firefox 2.0 and higher
- Opera 9.x and higher

The operating language for the Web server is English. No other languages are offered.

The device makes the data available in HTML or XML format (for the Fieldgate Viewer).

No provision is made for authentication via ID/password.

## 7.4 Optional device settings/special functions

- "Expert" menu (fine-tuning of the device) → 52
- Fault mode → 52
- Tariff counter → 53
- Bidirectional measurement → 54
- User-defined heat carrier → 54
- Temperature sensor matching (CVD) → 55
- DP Flow calculation (e.g. orifice plate) → 55

### 7.4.1 "Expert" menu (fine-tuning of the device)

The Expert menu offers access to functions for fine-tuning to adapt the device optimally to the application conditions. The user interface corresponds to the Setup/Advanced settings menu plus a few special tuning or service functions, such as adjusting the current inputs and resetting the device to the order configuration.

Access to the Expert menu requires an access code. The factory default code is "0000".

#### Adjusting the current inputs

As part of a "2-point correction", the characteristic of the sensor can be adjusted, e.g. to correct the long-term drift of the current input (current output of a sensor) or to calibrate the input signal with display devices or sensors. For this purpose, the actual value and a correction value (set point) are configured for the beginning and end of the measurement range. By default, the offset is disabled, i.e. the set point and actual value are the same for each.

The set point must always be within the measuring range.

### 7.4.2 Fault mode

In the Expert menu, you can configure the fault mode for each input individually.
- In the position "Namur NE 43", the signal range limits for a current input are defined (the current value at which the "Open circuit" or "Sensor error" alarm is triggered). The NAMUR guideline defines error limits for the sensors. For details, refer to table.
- The "On error" field defines whether the calculation is stopped (invalid) or whether a replacement value (error value) is to be used to calculate the energy quantity during the alarm. The deficit counter is used to record the deficit. For more information, refer to the table.

The fault mode affects the display, counters and outputs as follows.

| | Measuring range | | | | |
|---|---|---|---|---|---|
| **Display** | - - - - - | - - - - - | Measured value | Measured value | Measured value |
| **Status** | F | F | | | |
| **Diagnostic message** | Open circuit | Sensor error | Under range | Over range | |
| **0 to 20 mA** | | ≥ 22 mA | | | 0 to 22 mA |
| **4 to 20 mA as per Namur NE 43** | ≤ 2 mA | ≥ 21 mA or > 2 mA to ≤ 3.6 mA | > 3.6 mA to ≤ 3.8 mA | ≥ 20.5 mA to < 21 mA | > 3.8 mA to < 20.5 mA |
| **4 to 20 mA without Namur** | ≤ 2 mA | ≥ 22 mA | | | > 2 mA to < 22 mA |

| | Measuring range | | | | |
|---|---|---|---|---|---|
| **RTD** | T outside measuring range | | | | |
| **Result** | Configurable in setup:<br>▪ No further calculation and failure current at output<br>▪ Further calculation with replacement value, normal counter and tariff counter do not move, deficit counter runs, calculated value at output. Value output via buses obtains status byte "invalid value"<br>The "fault" relay/OC switches. | | Normal calibration.<br>The "fault" relay/OC is not switched. | | |

### 7.4.3 Tariff counter

The tariff function serves to measure the energy on separate counters (registers) when a certain event takes place. For example, the energy can be counted on two separate tariff counters at a power above and below 100 kW.

The function of the standard energy counter is independent of the tariff counters, i.e. it continues running.

The two tariff counters can be activated independently of each other by the following events (tariff models):

| Tariff model | Necessary inputs |
|---|---|
| Power (heat flow) | Upper or lower set point (min/max) |
| Volume flow | |
| Temperature warm | |
| Temperature cold | |
| Delta T | |
| Power, warm side* | |
| Power, cold side* | |
| Energy | ▪ Limit value<br>▪ The counter to which the set point pertains: Interval/Day/Month/Year/Billing date |
| Digital input | In the digital input, assign the "Start tariff" function<br>Tariff 1 can be controlled via digital input 1 only, Tariff 2 via digital input 2. |
| Time | Time "From" and "To" in the format HH:MM (HH:MM AMPM) |
| Charging power** | As for Heat (energy) |
| Discharge energy** | As for Heat (energy) |

*) Power, warm side = Volume * Density * $h_{warm}$,
Power, cold side = Volume * Density * $h_{cold}$

**) If "bidirectional measurement" is enabled in the Application menu, the Charging power and Discharging power tariff models are used automatically to measure the hot or cold energy.

The tariff counter is an energy counter! The unit is identical to the "normal" energy counter.

In the event of an alarm, the tariff counters behave like the standard counters → 52.

If the tariff type is changed, the counter reading is reset to zero! → 52

### 7.4.4 Bidirectional measurement

Bidirectional measurement can be configured in the **Setup** → **Advanced setup** → **Application** → **Bidirectional** menu.

*There are three forms of bidirectional operation:*

| Form / operating mode | Condition | Function |
|---|---|---|
| Changing flow direction, displayed by scaling the flow input (start value negative, full scale value positive) | | Charging power / discharging power (heat) is accumulated depending on the sign of the flow |
| Changing flow direction, shown by digital input (flow direction signal from flow transmitter) | | Charging power / discharging power (heat) is accumulated depending on the status of the digital input |
| Changing temperature differential | | |
| Consider $T_{switchover}$ (switchover temperature parameter = "Yes") | $T_{warm} > T_{switchover}$ | Charging power (heat) is accumulated |
| | $T_{warm} < T_{switchover}$ | Discharging power (heat) is accumulated |
| Do not consider $T_{switchover}$ (switchover temperature parameter = "No") | $\Delta T > \Delta T_{lim.}$ | Charging power (heat) is accumulated |
| | $\Delta T < -\Delta T_{lim.}$ | Discharging power (heat) is accumulated |
| $T_{switchover}$ is the switching temperature for switching from hot to cold operation.<br>$\Delta T_{lim.}$: Low flow cut off (hysteresis), maximum limit 0.5 K (0.9 °F) | | |

The "normal" counter acts as the balance power counter, i.e. the energy is added or subtracted based on the direction.

The calculated heat flow is displayed with leading sign, i.e. positive sign when charging the heat accumulator (heating), negative sign when discharging the heat accumulator (cooling).

The current operating status (heating or cooling) can be output via Relay/Open collector (Menu/Output/Set point).

The switching temperature ($T_{switchover}$) and the temperature differential ($\Delta T_{lim.}$) can be shown on the display (Group 4).

For the combination of the Bidirectional and MID function (if these are ordered together), the Bidirectional/Temperature function is fixed. The operating mode can be changed only by breaking the custody transfer seal and pressing the custody transfer switch.

The custody transfer approval for the BTU meter for heating/cooling applications (bidirectional measurement depending on the temperature) takes place in the field. For changing the parameters after the custody transfer switch is locked, the same information applies as for the MID approval described in this document.

Combining the operating modes is not possible or leads to undefined device states.

### 7.4.5 User-defined heat carriers

Heat carriers in refrigerating circuits usually consist of glycol/water mixtures. Mixtures for the following glycols are already predefined in the EngyCal:

- Ethylene-glycol
- Antifrogen N
- Glycosol N
- Propylene glycol

For these glycol-water mixtures it is possible to enter the glycol concentration for accurate calculations.

If other heat carriers (e.g. thermal oils, refrigerants) are used, the liquid data have to be stored in the device. For this purpose, tables are available for entering the density and heat

capacity (max. 10 support points). For devices with the "DP flow measurement" option, another table is available with two support points for entering the viscosity data.

The units for the tables cannot be configured explicitly; the units for the respective process variables apply, e.g. those configured under "Setup/Application/Units....".

The values between or outside of the support points are determined by interpolation or extrapolation.

### 7.4.6 Temperature calibration (CVD)

The temperature calibration function enables you to store the individual characteristics of temperature sensors in the device. In this way, any desired temperature sensors can be paired electronically, which ensures highly accurate measurement of process temperature, temperature differential and energy.

The electronic pairing of the sensors makes the use of paired sensors (selected sensors with a similar characteristic) unnecessary and enables individual replacement of sensors, even for custody transfer applications (without impairing the accuracy of the differential temperature measurement).

As part of the temperature sensor calibration (electronic pairing), what are known as Callendar von Dusen coefficients of the general cubic temperature function equation (IEC751) are replaced by sensor-specific A, B and C coefficients.

To store the curves, select the signal type "Platinum RTD (CVD)" in the Inputs/Temperature warm (cold) menu. Entry of the coefficients takes place in the Inputs/Temperature warm (cold)/Linearization CvD menu.

Linearizing equations as per Callendar van Dusen

| | |
|---|---|
| Range −200 °C (−328 °F) to < 0 °C (32 °F) | $Rt = R0 * [1 + A * t + B * t^2 + (t - 100) * C * t^3]$ |
| Range ≥ 0 °C (32 °F) | $Rt = R0 * (1 + A * t + B * t^2)$ |

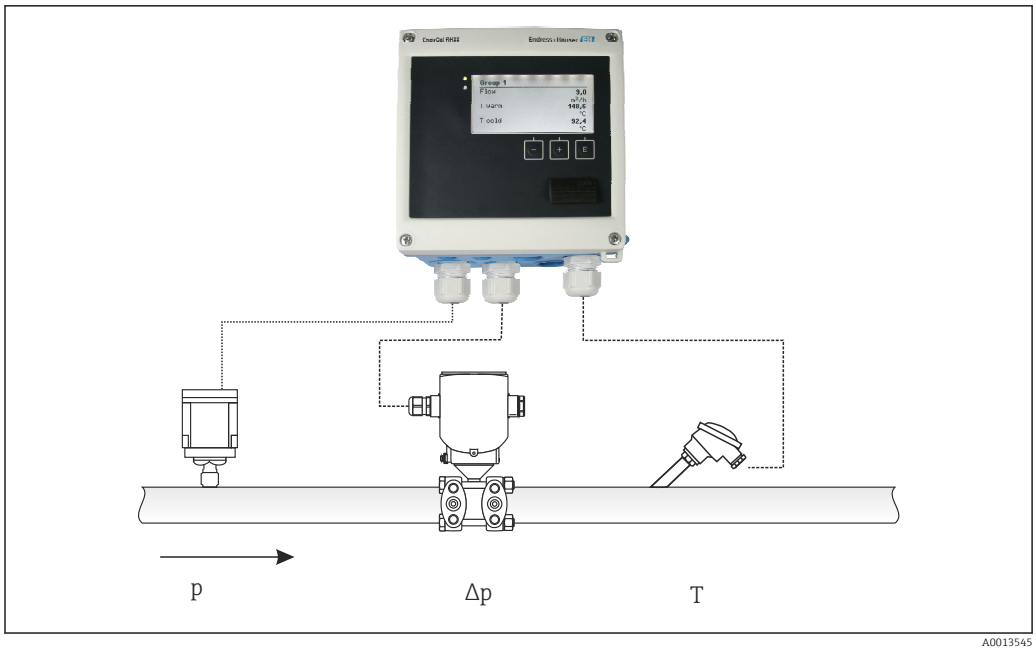
| Operating options | Description/remarks |
|---|---|
| R0 | See equation. Input in ohms. Range: 40.000 to 1 050.000 Ohm |
| A, B, C | CvD coefficients. Input in Exp format (x,yyE±zz) |

### 7.4.7 DP flow calculation (flow measurement according to active pressure method)

#### General information

The BTU meter calculates the flow according to the differential pressure method as per the ISO5167 standard.

Unlike conventional differential pressure measurement methods, which provide accurate results at the design point only, the device calculates the coefficients of the flow equation (flow coefficient, velocity approach factor, expansion number, density etc.) continuously and iteratively. This ensures that the flow is always computed with the greatest of accuracy, even with fluctuating process conditions and completely independently of the design conditions (temperature and pressure in the sizing parameters).




A0013545

38 *DP flow calculation*

*General ISO 5167 equation for orifice plates, nozzles, Venturi tube*

$$Qm = f \cdot c \cdot \sqrt{\frac{1}{1-\beta^4}} \cdot \varepsilon \cdot d^2 \frac{\pi}{4} \cdot \sqrt{2 \cdot \Delta p \cdot \rho}$$

A0013547

*Pitot tube*

$$Qm = k \cdot d^2 \frac{\pi}{4} \cdot \sqrt{2 \cdot \Delta p \cdot \rho}$$

A0013548

*Gilflo, V-Cone (other DP flowmeters)*

$$Qm = Qm(A) \cdot \sqrt{\frac{\rho_B}{\rho_A}}$$

A0013549

*Legend*

| | |
|---|---|
| Qm | Mass flow (compensated) |
| k | Blockage factor |
| ρ | Density in operating mode |
| Δp | Differential pressure |
| Qm(A) | Mass flow in design parameter |
| $\rho_A$ | Density in design parameter |
| $\rho_B$ | Density in operating mode |

**Parameter configuration for differential pressure measurement**

To configure the DP flow measurement, make the following menu selection: Menu/Flow/ Signal: 4 to 20 mA (DP). For additional parameter configuration, the following data

(according to the design sheet or nameplate of the differential pressure measuring device) are required.

- Device type and material of the throttle device, e.g. orifice plate, nozzle
- Differential pressure measuring range
- Internal diameter of pipe at 20 °C (68 °F)
- Diameter of the throttle device (or K-factor for Pitot tubes) at 20 °C (68 °F)
- Density in design parameter (for V-Cone and Gilflo only)

For selecting the characteristic for the flow signal

| EngyCal | DP transmitter (output) |
|---|---|
| Linear characteristic | Characteristic of DP linear transmitter, scaled to mbar or inchH20 |
| Curve square law | Characteristic of DP transmitter square root, scaled to kg/h, t/h, $ft^3/h$, etc. |

Preferably, use the linear characteristic, as this attains higher accuracy for flow calculation in the lower range.

To check the calculation, the following values are displayed in Menu/Diagnostics.
- Flow coefficient c
- Expansion number β
- Differential pressure (DP)

## 7.5 Data analysis and visualization with the Field Data Manager software (accessories)

FDM is a software application which offers central data administration with visualization for recorded data.

This enables the data of a measuring point to be fully archived, e.g.:
- Measured values
- Diagnostic events
- Protocols

FDM saves the data in an SQL database. The database can be operated locally or in a network (client / server).

The following databases are supported:
- PostgreSQL [1)]
  You can install and use the free PostgreSQL database which is supplied with the FDM-CD.
- Oracle [1)]
  Version 8i or higher. To set up user login, please contact your database administrator.
- Microsoft SQL server [1)]
  Version 2005 or higher. To set up user login, please contact your database administrator.

### 7.5.1 Installation of the Field Data Manager software

Insert the Field Data Manager software CD into your CD/DVD drive. Installation starts automatically.

An installation assistant guides you through the necessary installation steps.

Details on installing and operating the Field Data Manager software are provided in the Getting Started Guide supplied with the software and in the Operating Instructions which are available online at www.products.endress.com/ms20.

1) The product names are registered trademarks of the individual manufacturers.

You can import data from the device using the software's user interface. Use the USB cable, which is available as an accessory, or the Ethernet port of the device, → 50.

# 8 Maintenance

No special maintenance work is required for the device.

## 8.1 Calibration

Endress+Hauser issues only the initial approval for the EngyCal RH33 in accordance with the MID (Measurement Instruments Directive).

Periodic recalibration of certified instruments is mandatory according to national calibration law.

Calibration periods are regulated at national level. In many EU states, the calibration period is five years. The BTU meter issues a warning (M911/M912, see attachment) two months before the calibration period elapses.

To recalibrate an instrument, the instrument must be inspected on site by an approved calibration authority (e.g. calibration officer). If a recalibration is not performed, the instrument must be replaced with a new device once the calibration period has elapsed. BTU meters for cooling applications or combined BTU meters for heating and cooling applications are subject to national law and can only be inspected on site by an authorized person.

The meter readings are reset to zero during recalibration.

Follow the recalibration test instructions when recalibrating/inspecting instruments. To verify the measured values on the device, the following values are displayed with five decimals places when in calibration mode.
- Flow rate (scaled value)
- Hot and cold temperature (scaled value)
- Density
- Enthalpy
- Power

The unit is not displayed in the case of very high readings.

Calibration mode is exited automatically after 5 minutes.

## 8.2 Adjustment

To adjust the inputs and outputs, a two-point offset is used. The sensors can be adjusted only in the Expert menu. See "Adjusting the current inputs", → 52.

## 8.3 Cleaning

The front of the housing can be cleaned with a soft, dry cloth.

# 9 Accessories

Various accessories, which can be ordered with the device or subsequently from Endress +Hauser, are available for the device. Detailed information on the order code in question is available from your local Endress+Hauser sales center or on the product page of the Endress+Hauser website: www.endress.com.

## 9.1 Device-specific accessories

### 9.1.1 For the transmitter

| Accessories | Description |
|---|---|
| Weather protection cover | Is used to protect the measuring device from the effects of the weather: e.g. rainwater, excess heating from direct sunlight or extreme cold in winter.<br>For details, see Installation Instructions SD00333F |
| Pipe mounting set | Mounting plate for pipe mounting<br>For dimensions → 5, 11 and installation instructions → 15, see the "Mounting" section |
| DIN rail mounting set | DIN rail adapter for DIN rail mounting<br>For dimensions → 7, 11 and installation instructions → 14, see the "Mounting" section |
| Panel mounting set | Mounting plate for panel mounting<br>For dimensions → 6, 11 and installation instructions → 13, see the "Mounting" section |

### 9.1.2 For the sensor

| Accessories | Description |
|---|---|
| Heating jacket | Is used to stabilize the temperature of the fluids in the sensor.<br>Water, water vapor and other non-corrosive liquids are permitted for use as fluids.<br>If using oil as a heating medium, please consult with Endress+Hauser.<br>Heating jackets cannot be used with sensors fitted with a rupture disk.<br>For details, see Operating Instructions BA00099D |

## 9.2 Communication-specific accessories

| | |
|---|---|
| FDM software | Visualization software and SQL-based database "Field Data Manager software (FDM)" MS20<br>For details, see "Technical Information" TI01022R |
| RXU10-G1 | USB cable and FieldCare Device Setup configuration software incl. DTM library |
| Commubox FXA195 HART | For intrinsically safe HART communication with FieldCare via the USB interface.<br>For details, see "Technical Information" TI00404F |
| HART Loop Converter HMX50 | Is used to evaluate and convert dynamic HART process variables to analog current signals or limit values.<br>For details, see "Technical Information" TI00429F and Operating Instructions BA00371F |

| | |
|---|---|
| Wireless HART adapter SWA70 | Is used for the wireless connection of field devices.<br>The WirelessHART adapter can be easily integrated into field devices and existing infrastructures, offers data protection and transmission safety and can be operated in parallel with other wireless networks with minimum cabling complexity.<br>For details, see Operating Instructions BA061S |
| Fieldgate FXA320 | Gateway for the remote monitoring of connected 4-20 mA measuring devices via a Web browser.<br>For details, see "Technical Information" TI00025S and Operating Instructions BA00053S |
| Fieldgate FXA520 | Gateway for the remote diagnostics and remote configuration of connected HART measuring devices via a Web browser.<br>For details, see "Technical Information" TI00025S and Operating Instructions BA00051S |
| Field Xpert SFX100 | Compact, flexible and robust industry handheld terminal for remote configuration and for obtaining measured values via the HART current output (4-20 mA).<br>For details, see Operating Instructions BA00060S |

## 9.3 Service-specific accessories

| Accessories | Description |
|---|---|
| Applicator | Software for selecting and sizing Endress+Hauser measuring devices:<br>▪ Calculation of all the necessary data for identifying the optimum flowmeter: e.g. nominal diameter, pressure loss, accuracy or process connections.<br>▪ Graphic illustration of the calculation results<br>Administration, documentation and access to all project-related data and parameters over the entire life cycle of a project.<br>Applicator is available:<br>▪ Via the Internet: https://wapps.endress.com/applicator<br>▪ On CD-ROM for local PC installation. |
| W@M | Life cycle management for your plant<br>W@M supports you with a wide range of software applications over the entire process: from planning and procurement, to the installation, commissioning and operation of the measuring devices. All the relevant device information, such as the device status, spare parts and device-specific documentation, is available for every device over the entire life cycle.<br>The application already contains the data of your Endress+Hauser device. Endress +Hauser also takes care of maintaining and updating the data records.<br>W@M is available:<br>▪ Via the Internet: www.endress.com/lifecyclemanagement<br>▪ On CD-ROM for local PC installation. |
| FieldCare | FDT-based plant asset management tool from Endress+Hauser.<br>It can configure all smart field units in your system and helps you manage them. By using the status information, it is also a simple but effective way of checking their status and condition.<br>For details, see Operating Instructions BA00027S and BA00059S |

## 9.4 System components

| Accessories | Description |
|---|---|
| Memograph M graphic data manager | The Memograph M graphic data manager provides information on all the relevant process variables. Measured values are recorded correctly, limit values are monitored and measuring points analyzed. The data are stored in the 256 MB internal memory and also on a SD card or USB stick.<br>For details, see "Technical Information" TI00133R and Operating Instructions BA00247R |
| Overvoltage protection HAW562 DIN rail | To protect against overvoltage in the power supply and signal/communication cables, Endress+Hauser provides a surge arrester HAW562 for DIN rail mounting.<br>For details, see "Technical Information" TI01012K |
| Overvoltage protection HAW569 field housing | To protect against overvoltage in the power supply and signal/communication cables, Endress+Hauser provides a surge arrester HAW562 for field mounting.<br>For details, see "Technical Information" TI01013K |
| RN221N | Active barrier with power supply for safe separation of 4-20 mA standard signal circuits. Offers bidirectional HART transmission.<br>For details, see "Technical Information" TI00073R and Operating Instructions BA00202R |
| RNS221 | Supply unit for powering two 2-wire measuring devices solely in the non-Ex area. Bidirectional communication is possible via the HART communication jacks.<br>For details, see "Technical Information" TI00081R and Brief Operating Instructions KA00110R |

# 10 Troubleshooting

## 10.1 Instrument diagnostics and troubleshooting

The Diagnostics menu is used for the analysis of the device functions and offers comprehensive assistance during troubleshooting. To find the causes for device errors or alarm messages, follow these basic procedures.

**General troubleshooting procedure**

1. Open diagnosis list: Lists the 10 most recent diagnostic messages. This can be used to determine which errors are currently present and whether an error has repeatedly occurred.
2. Open measured value display diagnostics: Verify the input signals by displaying the raw values (mA, Hz, Ohm) or the scaled measuring ranges. To verify calculations, call up calculated auxiliary variables if necessary.
3. Most errors can be rectified by performing steps 1 and 2. If the error persists, observe the troubleshooting instructions for the error types from Chapter 9.2 of the Operating Instructions.
4. If this does not rectify the problem, contact the Service Department. The contact details of your Endress+Hauser representative can be found on the Internet at www.endress.com/worldwide. For service inquiries, please always have the error number and the information from the Device information/ENP (program name, Serial Number etc.) available.

The contact details of your Endress+Hauser representative can be found on the Internet at **www.endress.com/worldwide**.

### 10.1.1 Hold function – "freezing" the display values

The hold function freezes the entire measured value acquisition, including the counter readings. As part of troubleshooting, e.g. for rewiring, this function is recommended for suppressing error messages so that the diagnostics and events list are not filled with unnecessary entries.

The measured values during Hold mode are ignored for data logging. The hold function is enabled/disabled in the Diagnostics menu and stopped automatically if no button is pressed for 5 minutes.

The operating option is visible only if the device is not locked by custody transfer switch. Activating the hold function is stored in the event logbook.

### 10.1.2 Troubleshooting for M-BUS

If communication with the EngyCal does not materialize via the M-Bus, check the following:
- Does the device address in the device match the master?
- Are the device and the master using the same baud rate?
- Is there more than one device with the same device address attached to the M-Bus?
- Is the M-Bus connected to the device correctly?

### 10.1.3 Troubleshooting for MODBUS

- Do the device and master have the same baudrate and parity?
- Is the interface correctly wired?
- Does the device address sent by the master match the configured address of the device?
- Do all slaves on the MODBUS have different device addresses?

### 10.1.4 Device error/alarm relay

There is a global "alarm relay" (the user can either assign the relay or one of the open collectors in the setup).

This "alarm relay" switches if "F"-type errors occur (F = failure), i.e. "M"-type errors (M= Maintenance required) do not switch the alarm relay.

For errors of type F, the color of the backlighting of the display additionally switches from white to red.

## 10.2 Error messages

| Error | Description | Remedy |
|---|---|---|
| F041 | Cable open circuit:<br>AI1 (flow), AI2 (T warm), AI3 (T cold)<br>Input current ≤ 2 mA<br>▪ Incorrect wiring<br>▪ Full scale value of the measuring range configured incorrectly<br>▪ Sensor defective | ▪ Check wiring<br>▪ Enlarge measuring range (change scaling)<br>▪ Replace sensor |
| F104 | Sensor error<br>Input current > 2 to ≤ 3.6 mA or ≥ 21 mA (or 22 mA for 0 to 20 mA signal)<br>▪ Incorrect wiring<br>▪ Full scale value of the measuring range configured incorrectly<br>▪ Sensor defective<br>Pulse input > 12.5 kHz or > 25 Hz | ▪ Check wiring<br>▪ Enlarge measuring range (change scaling)<br>▪ Replace sensor<br>▪ Select a larger value for pulse value |
| F201 | Device error (operating system error) | Contact the Service Department |
| F261 | System error (miscellaneous hardware errors) | Contact the Service Department |
| F301 | Setup defective | Reconfigure the device. If the error recurs, contact service. |
| F303 | Device data defective | Contact the Service Department |
| F305 | Counters defective | Counter value is reset automatically to 0 |
| F307 | Customer preset value defective | Save configuration parameters. |
| F309 | Invalid date/time (e.g. GoldCap was empty) | Device was switched off too long. The date/time must be set again. |
| F310 | The setup could not be saved | Contact the Service Department |
| F311 | Device data could not be stored | Contact the Service Department |
| F312 | Calibration data could not be stored | Contact the Service Department |
| F314 | Activation code is no longer correct (incorrect serial number/program name). | Enter new code |

| | | |
|---|---|---|
| F431 | Calibration data missing | Contact the Service Department |
| F501 | Invalid configuration | Check setup |
| F900 | Input variable(s) outside the calculation limits (see Technical data, → 🖹 73) | ▪ Check plausibility of the measured input values<br>▪ Check scaling of device inputs/sensor outputs<br>▪ Check system/process |
| F903 | Frost, T water < 0 °C (32 °F), T for glycol concentration too low | ▪ Check plausibility, scaling, physical value (e.g. ohms) of the temperature input/sensor output<br>▪ Check system/process, increase glycol concentration where necessary. |
| M904 | End of frost | |
| F910 | Firmware for this device not released. | Install correct firmware. |
| F914 | Density calculation for DP flow calculation is faulty | Check temperature input and entries in the density table. |
| F915 | Viscosity calculation for DP flow calculation is faulty | Check temperature input and entries in the viscosity table. |
| F916 | Flow < 0 !<br>If the bidirectional flow is controlled via the temperature, the flow must not be negative. | Check process values and settings. |
| M102 | Over range<br>Input current ≥ 20.5 mA to < 21 mA | Enlarge measuring range (change scaling) |
| M103 | Under range<br>Input current > 3.6 mA to ≤ 3.8 mA | Enlarge measuring range (change scaling) |
| M284 | Firmware has been updated | No action required. |
| M302 | Setup has been loaded from backup. | No effect on operation. To be safe, check setup (configuration) and adjust if necessary |
| M304 | Device data defective. The system continues working with backup data. | No action required. |
| M306 | Counter defective, but system could continue working with backup. | Check plausibility of the counter reading (compare to last stored counter reading) |
| M313 | FRAM has been defragmented | No action required. |
| M315 | No IP address could be obtained from the DHCP server! | Check network cable, contact network administrator. |
| M316 | No or incorrect MAC address | Contact the Service Department |
| M502 | Device is locked!<br>- e.g. for firmware update attempt | Check custody transfer switch,<br>locking via digital channel |

| | | |
|---|---|---|
| M905 | Limit value over/under cut | |
| M906 | Limit value violation end | |
| M908 | Analog/pulse output error | Check process values and scaling of the output, select larger full scale value (or pulse value) if necessary. |
| M909 | Negative temperature differential (T warm < T cold) | Check process values and settings of the temperature inputs |
| M911 | Custody transfer date will expire on <Date> (appears 2 months before the expiration date) | Check the approval validity period for the device according to national regulations. If the calibration period elapses, recalibrate the device as soon as possible. |
| M912 | Custody transfer date expired. (default value 5 years) | Check the approval validity period for the device according to national regulations. If the calibration period elapses, recalibrate the device as soon as possible. |
| M913 | DP flow outside ISO 5167, i.e. the input parameters for the calculation are outside the scope of application of the ISO 5167 standard | Check entries for model, pipe diameter, throttle diameter.<br>The calculations continue, but the accuracy as per ISO 5167 is not guaranteed. |

## 10.3 Diagnosis list

See also error messages, → 64.

The device has a diagnostic list in which the last 10 diagnostic messages (messages with error numbers from type Fxxx or Mxxx) are stored.

The diagnosis list is designed as a ring memory, i.e. when the memory is full the oldest messages are automatically overwritten (no message).

The following information is saved:
- Date/time
- Error number
- Error text

The diagnosis list is not read out via PC operating software. However, it can be displayed via FieldCare.

The following fall under Fxxx or Mxxx:
- Open circuit
- Sensor error
- Invalid measured value

## 10.4 Output function test

In the Diagnostics/Simulation menu, the user can output certain signals at the outputs (function text).

The simulation is ended automatically if the user has not pressed any buttons for 5 minutes or has switched off the function explicitly.

### 10.4.1 Relay tests

The user can switch the relay manually.

### 10.4.2 Simulation of outputs

The user can output certain signals at the outputs (function test).

**Analog output**

Allows you to output a current value for test purposes. You can configure fixed values:
- 3.6 mA
- 4.0 mA
- 8.0 mA
- 12.0 mA
- 16.0 mA
- 20.0 mA
- 20.5 mA
- 21.0 mA

**Pulse outputs (Pulse / OC)**

Allows you to output pulse packages for test purposes. The following frequencies are possible:
- 0.1 Hz
- 1 Hz
- 5 Hz
- 10 Hz
- 50 Hz
- 100 Hz
- 200 Hz
- 500 Hz

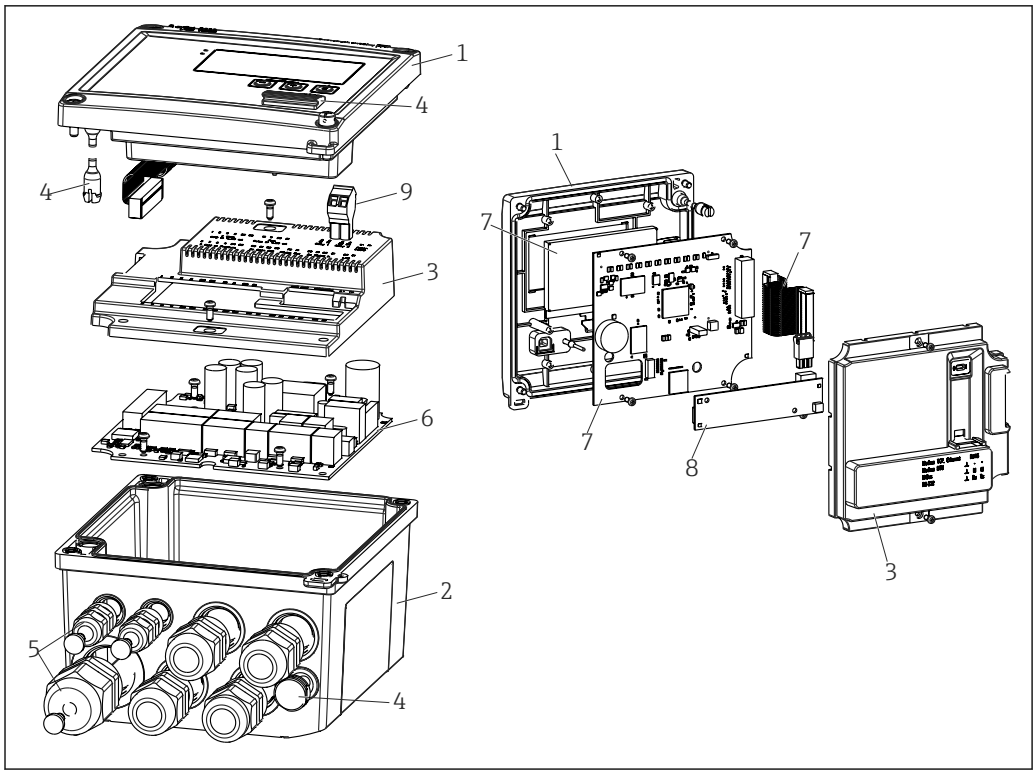
The following simulations are possible for the pulse output only:
- 1 kHz
- 5 kHz
- 10 kHz

### 10.4.3 Status of the outputs

The current status of the relays and open collector outputs can be queried in the "Diagnostics/Outputs" menu (e.g. relay 1: open).

## 10.5 Spare parts

If ordering spare parts, please specify the serial number of the device! Installation instructions are included with the spare part.




*39 Spare parts of the device*

| Item No. | Description | Order number | | |
|---|---|---|---|---|
| 1 | RH33 housing front incl. front foil | XPR0001-FH | | |
| 2 | Housing base (lasered) incl. threaded plate (specify serial number) | XPR0001-UT | | |
| 3 | Internal electronic covers incl. screws (for mainboard + CPU card) | XPR0001-CP | | |
| 4 | Set of small parts<br>Hinge pins, pressure compensation element, USB cover, panel seal | XPR0001-SP | | |
| 5 | Cable insertion set for panel mounting 4xM20, 2xM12, 1xM25 | XPR0001-SK | | |
| 6 | Mainboard | XPR0003- | | |
| | | Approval | AA | Non-hazardous area |
| | | | CP | CSA General Purpose |
| | | Supply voltage | 1 | 100 to 230 V (AC: −15 %/+10 %, 50/60 Hz) |
| | | | 2 | 24 V (DC: −50 %/+75 %; AC: ±50 %, 50/60 Hz) |
| | | Output | B1 | 1x analog/pulses (active), 2x open collector |
| 7 | CPU card + LCD + ribbon cable | XPR0002- | | |
| | | Device type | A | RH33 |
| | | Medium | A | Water |
| | | | B | Glycol + water + other liquids |

| Item No. | Description | Order number | |
|---|---|---|---|
| | | Display operating language | AA English<br>AB German<br>AC French<br>AD Spanish<br>AE Italian<br>AF Dutch<br>AG Portuguese<br>AH Polish<br>AI Russian<br>AR Czech |
| | | Application packages | E2 Tariff function, 2 counters<br>E3 Bidirectional measurement<br>E4 DP flow calculation/ compensation |
| 8 | Communication card USB | XPR0001-KA | |
| | Communication card USB + Ethernet | XPR0001-KB | |
| | Communication card USB + ModBus RTU (RS485) | XPR0001-KC | |
| | Communication card USB + MBus | XPR0001-KD | |
| 9 | Plug-in terminal, 2-pin RM5.0 | 71084277 | |
| W/O Item No. | Pipe mounting set | XPR0001-RM | |
| | Wall mounting set | XPR0001-WM | |
| | DIN rail mounting set | XPR0001-DM | |
| | Panel mounting set incl. panel seal | XPR0001-SM | |
| | Plug-in terminal, 3-pin FMC1.5/3-ST-3.5 for digital I/O and RS485 | 51009210 | |

## 10.6 Software history and overview of compatibility

### Release

The firmware version on the nameplate and in the Operating Instructions indicates the device release: XX.YY.ZZ (example 1.02.01).

XX Change to main version.
No longer compatible. The device and Operating Instructions change.

YY Change to functions and operation.
Compatible. The Operating Instructions change.

ZZ Fixes and internal changes.
No changes to the Operating Instructions.

| Date | Firmware version | Software changes | Documentation |
|---|---|---|---|
| 07/2010 | 01.00.xx | Original software | BA290K/09/en/07.10 |
| 07/2011 | 01.02.xx | Output tariff 1/2 to OC | BA00290K/09/EN/01.11 |
| 09/2011 | 01.03.xx | Web server port is configurable | BA00290K/09/EN/02.11 |
| 12/2013 | 01.04.xx | Switching temperature for bidirectional measurement can be switched off | BA00290K/09/EN/03.13 |

| Date | Firmware version | Software changes | Documentation |
|---|---|---|---|
| 10/2014 | 01.04.xx | - | BA00290K/09/EN/04.14 |
| 03/2016 | 01.04.xx | - | BA00290K/09/EN/05.16 |
| 01/2019 | 01.04.xx | - | BA00290K/09/EN/06.18 |

# 11 Return

The requirements for safe device return can vary depending on the device type and national legislation.

1. Refer to the website for more information:
   http://www.endress.com/support/return-material
2. Return the device if repairs or a factory calibration are required, or if the wrong device was ordered or delivered.

# 12 Disposal

## 12.1 IT security

Observe the following instructions before disposal:

1. Clear data
2. Reset the device
3. Delete/change passwords
4. Delete user
5. Carry out alternative or complementary measures to destroy the storage medium

## 12.2 Removing the measuring device

1. Switch off the device
2. Carry out the mounting and connection steps from the "Mounting the measuring device" and "Connecting the measuring device" sections in reverse order. Observe the safety instructions.

## 12.3 Disposing of the measuring device

If required by the Directive 2012/19/EU on waste electrical and electronic equipment (WEEE), the product is marked with the depicted symbol in order to minimize the disposal of WEEE as unsorted municipal waste. Do not dispose of products bearing this marking as unsorted municipal waste. Instead, return them to Endress+Hauser for disposal under the applicable conditions.

# 13 Technical data

## 13.1 Input

Current/pulse input

This input can be used either as a current input for 0/4 to 20 mA signals (not if the Custody Transfer option was selected) or as a pulse or frequency input.

The input is galvanically isolated (500 V test voltage towards all other inputs and outputs).

### Cycle time

The cycle time is 250 ms or 500 ms when using one or both RTD inputs.

### Response time

In the case of analog signals, the response time is the time between the change at the input and the time when the output signal is equivalent to 90 % of the full scale value. The response time increases by 250 ms if an RTD with 3-wire measurement is connected.

| Input | Output | Reaction time [ms] |
|---|---|---|
| Current | Current | ≤ 600 |
| Current | Relay/digital output | ≤ 600 |
| RTD | Current/ relay/digital output | ≤ 600 |
| Cable open circuit detection | Current/ relay/digital output | ≤ 600 |
| Cable open circuit detection, RTD | Current/ relay/digital output | ≤ 1100 |
| Pulse input | Pulse output | ≤ 600 |

### Current input

| | |
|---|---|
| Measuring range: | 0/4 to 20 mA + 10 % overrange |
| Accuracy: | 0.1 % of full scale value |
| Temperature drift: | 0.01 %/K (0.0056 %/°F) of full scale value |
| Loading capacity: | Max. 50 mA, max. 2.5 V |
| Input impedance (load): | 50 Ω |
| HART® signals | Not affected |
| A/D converter resolution: | 20 bit |

### Pulse/frequency input

The pulse/frequency input can be configured for different frequency ranges:
- Pulses and frequencies up to 12.5 kHz
- Pulses and frequencies up to 25 Hz (filters bounce contacts, max. bounce time: 5 ms)

| **Minimum pulse width:** | |
|---|---|
| Range up to 12.5 kHz | 40 µs |
| Range up to 25 Hz | 20 ms |
| **Maximum permissible contact bounce time:** | |
| Range up to 25 Hz | 5 ms |
| **Pulse input for active voltage pulses and contact sensors as per EN 1434-2, Class IB and IC:** | |
| Non-conductive state | ≤ 1 V |

| | |
|---|---|
| Conductive state | ≥ 2 V |
| No-load supply voltage: | 3 to 6 V |
| Current limiting resistance in the power supply (pull-up at input): | 50 to 2 000 kΩ |
| Maximum permissible input voltage: | 30 V (for active voltage pulses) |
| **Pulse input for contact sensors as per EN 1434-2, Class ID and IE:** | |
| Low-level | ≤ 1.2 mA |
| High-level | ≥ 2.1 mA |
| No-load supply voltage: | 7 to 9 V |
| Current limiting resistance in the power supply (pull-up at input): | 562 to 1 000 Ω |
| Not suitable for active input voltages | |
| **Current/pulse input:** | |
| Low-level | ≤ 8 mA |
| High-level | ≥ 13 mA |
| Loading capacity: | Max. 50 mA, max. 2.5 V |
| Input impedance (load): | 50 Ω |
| **Accuracy during frequency measurement:** | |
| Basic accuracy: | 0.01 % of reading |
| Temperature drift: | 0.01 % of measured value over entire temperature range |

### 2 x current/RTD input

These inputs can be used either as current inputs (0/4 to 20 mA; not if the "Custody transfer approval" option has been selected) or RTD inputs (RTD = Resistance Temperature Detector). It is also possible to configure one input as a current input and the other as an RTD input.

The two inputs are galvanically connected but galvanically isolated from other inputs and outputs (test voltage: 500 V).

*Current input*

| | |
|---|---|
| Measuring range: | 0/4 to 20 mA + 10 % overrange |
| Accuracy: | 0.1 % of full scale value |
| Temperature drift: | 0.01 %/K (0.0056 %/°F) of full scale value |
| Loading capacity: | Max. 50 mA, max. 2.5 V |
| Input impedance (load): | 50 Ω |
| A/D converter resolution: | 24 bit |
| HART® signals are not affected. | |

*RTD input*

Pt100, Pt500 and Pt1000 resistance temperature detectors can be connected to this input.

| | |
|---|---|
| Measuring ranges: | |
| Pt100_exact: | −200 to 300 °C (−328 to 572 °F) |
| Pt100_wide: | −200 to 600 °C (−328 to 1 112 °F) |
| Pt500: | −200 to 300 °C (−328 to 572 °F) |
| Pt1000: | −200 to 300 °C (−328 to 572 °F) |

| | |
|---|---|
| Connection method: | 2-, 3- or 4-wire connection |
| Accuracy: | 4-wire:<br>0.06 % of measuring range<br>3-wire:<br>0.06 % of measuring range + 0.8 K (1.44 °F) |
| Temperature drift: | 0.01 %/K (0.0056 %/°F) |
| Delta T measurement (differential measurement between both RTD inputs): | 0.03 °C (0.054 °F) |
| Characteristic curves: | DIN EN 60751:2008 IPTS-90 |
| Max. cable resistance: | 40 Ω |
| Cable open circuit detection: | Outside the measuring range |

### Digital inputs

Two digital inputs are available for switching the following functions.

| Digital input 1 | Digital input 2 |
|---|---|
| Activate tariff counter 1<br>Time synchronization<br>Lock device (Block set up) | Activate tariff counter 2<br>Change flow direction<br>Time synchronization<br>Lock device (Block set up) |

*Input level:*

As per IEC 61131-2 Type 3:

Logical "0" (corresponds to −3 to +5 V), activation with logical "1" (corresponds to +11 to +30 V)

*Input current:*

Max. 3.2 mA

*Input voltage:*

Max. 30 V (steady-state, without destroying input)

## 13.2 Output

Current/pulse output (option)

This output can be used either as a 0/4 to 20 current output or as a voltage pulse output.

The output is galvanically isolated (500 V test voltage towards all other inputs and outputs).

### Current output (active)

| | |
|---|---|
| Output range: | 0/4 to 20 mA + 10 % overrange |
| Load: | 0 to 600 Ω (as per IEC 61131-2) |
| Accuracy: | 0.1 % of full scale value |
| Temperature drift: | 0.01 %/K (0.0056 %/°F) of full scale value |
| Inductive load: | Max. 10 mH |
| Capacitance load: | Max. 10 µF |
| Ripple: | Max. 12 mVpp on 600 Ω for frequencies < 50 kHz |
| D/A converter resolution: | 14 bit |

**Pulse output (active)**

| | |
|---|---|
| Frequency: | Max. 12.5 kHz |
| Pulse width: | Min. 40 µs |
| Voltage level: | Low: 0 to 2 V<br>High: 15 to 20 V |
| Maximum output current: | 22 mA |
| Short-circuit proof | |

2 x relay output

The relays are designed as NO contacts. The output is galvanically isolated (1 500 V test voltage towards all other inputs and outputs).

| | |
|---|---|
| Max. relay switching capacity: | AC: 250 V, 3 A<br>DC: 30 V, 3 A |
| Minimum contact load: | 10 V, 1 mA |
| Min. switching cycles: | $>10^5$ |

2 x digital output, open collector (option)

The two digital outputs are galvanically isolated from one another and from all other inputs and outputs (test voltage: 500 V). The digital outputs can be used as status or pulse outputs.

| | |
|---|---|
| Frequency: | Max. 1 kHz |
| Pulse width: | Min. 500 µs |
| Current: | Max. 120 mA |
| Voltage: | Max. 30 V |
| Voltage drop: | Max. 2 V in conductive state |
| Maximum load resistance: | 10 kΩ<br>For higher values, the switching edges are flattened. |

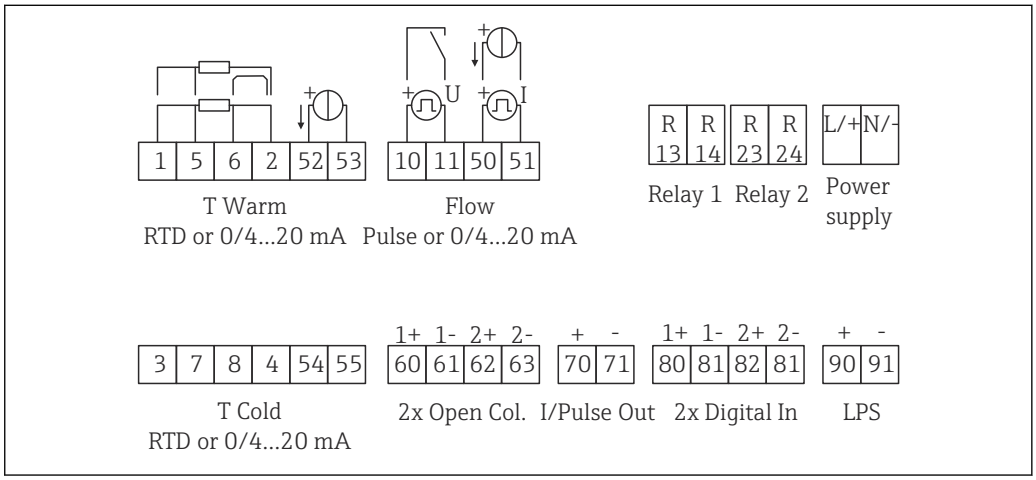
Auxiliary voltage output (transmitter power supply)

The auxiliary voltage output can be used to power the transmitter or control the digital inputs. The auxiliary voltage is short-circuit proof and galvanically isolated (500 V test voltage towards all other inputs and outputs).

| | |
|---|---|
| Output voltage: | 24 V DC ±15 % (not stabilized) |
| Output current: | Max. 70 mA |
| HART® signals are not affected. | |

## 13.3 Power supply

Terminal assignment




*40 Terminal assignment of EngyCal*

Supply voltage

- Low voltage power supply unit: 100 to 230 V AC(−15 % / +10 %) $^{50}/_{60}$ Hz
- Extra-low voltage power unit:
  24 V DC (−50 % / +75 %)
  24 V AC (±50 %) $^{50}/_{60}$ Hz

An overload protection element (rated current ≤ 10 A) is required for the power cable.

Power consumption

15 VA

## 13.4 Communication interfaces

A USB interface (with CDI protocol) and optional Ethernet, are used to configure the device and read out the values. ModBus and M-Bus are optionally available as communication interfaces.

None of the interfaces has a modifying effect on the device in accordance with PTB Requirement PTBA 50.1.

USB device

| | |
|---|---|
| Terminal: | Type B socket |
| Specification: | USB 2.0 |
| Speed: | "Full Speed" (max. 12 MBit/sec) |
| Max. cable length: | 3 m (9.8 ft) |

Ethernet TCP/IP

The Ethernet interface is optional and cannot be combined with other optional interfaces. It is galvanically isolated (testing voltage: 500 V). A standard patch cable (e.g. CAT5E) can be used for the connection. A special cable gland is available for this purpose, which allows users to guide pre-terminated cables through the housing. Via the Ethernet interface, the device can be connected to office equipment using a hub or a switch.

| | |
|---|---|
| standard: | 10/100 Base-T/TX (IEEE 802.3) |
| Socket: | RJ-45 |
| Max. cable length: | 100 m (328 ft) |

**Web server**

If the device is connected via Ethernet, it is possible to export the display values via the internet using a web server.

Data can be exported via the web server to HTML or XML format.

RS485

| | |
|---|---|
| Terminal: | 3-pin plug-in terminal |
| Transmission protocol: | RTU |
| Transmission rate: | 2400/4800/9600/19200/38400 |
| Parity: | choose from none, even, odd |

Modbus TCP

The Modbus TCP interface is optional and cannot be ordered with other optional interfaces. It is used to connect the device to higher-order systems to transmit all measured values and process values. Form a physical point of view, the Modbus TCP interface is identical to the Ethernet interface.

Modbus RTU

The Modbus RTU (RS-485) interface is optional, and cannot be ordered with other optional interfaces.

It is galvanically isolated (testing voltage: 500 V) and is used to connect to higher-order systems to transmit all measured values and process values. It is connected via a 3-pin plug-in terminal.

M-Bus

The M-bus (meter bus) interface is optional and cannot be ordered with other optional interfaces. It is galvanically isolated (testing voltage: 500 V) and is used to connect to higher-order systems to transmit all measured values and process values. It is connected via a 3-pin plug-in terminal.

## 13.5 Performance characteristics

Reference operating conditions

- Power supply 230 V AC ±10 %; 50 Hz ±0.5 Hz
- Warm-up period > 2 h
- Ambient temperature 25 °C ±5 K (77 °F ±9 °F)
- Humidity 39 % ±10 % RH.

Arithmetic unit

| Medium | Variable | Range |
|---|---|---|
| **Water** | Temperature measuring range | 0 to 350 °C (32 to 662 °F) |
| | Temperature differential range ΔT | 0 to 350 K (0 to 630 °F) |
| | Measuring range approved for custody transfer | 0 to 300 °C (32 to 572 °F)<br>ΔT: 3 to 297 K (5.4 to 534.6 °F) |
| | Accuracy | 3 to 20 K (5.4 to 36 °F): < 0.7 % of reading<br>20 to 300 K (36 to 540 °F): < 0.2 % of reading |
| | Accuracy as per EN1434/OIML75 | ± (0.5 + ΔΘmin / ΔΘ) % |
| **Water/glycol** | Glycol concentration | 0 to 60 % |
| | Temperature measuring range | −40 to 350 °C (−40 to 662 °F) |
| | Maximum temperature differential range ΔT | 0 to 390 °C (0 to 702 °F) |
| | Accuracy (0 to 40 % glycol share) | 3 to 20 K (5.4 to 36 °F): < 0.9 % of reading<br>20 to 300 K (36 to 540 °F): < 0.4 % of reading |
| **Liquids** | Temperature measuring range | −200 to 600 °C (−328 to 1 112 °F) |
| | Maximum temperature differential range ΔT | 0 to 390 °C (0 to 702 °F) |
| | Error limit for ΔT | See water |
| **Measurement and calculation interval** | | 500 ms |

## 13.6 Installation

Mounting location

Wall/pipe mounting, panel or DIN rail as per IEC 60715

Installation position

The only factor determining the orientation is the legibility of the display.

## 13.7 Environment

Ambient temperature range

−20 to +60 °C (−4 to +140 °F)

Storage temperature

−30 to +70 °C (−22 to +158 °F)

Climate class

As per IEC 60 654-1 Class B2, as per EN 1434 environment class C

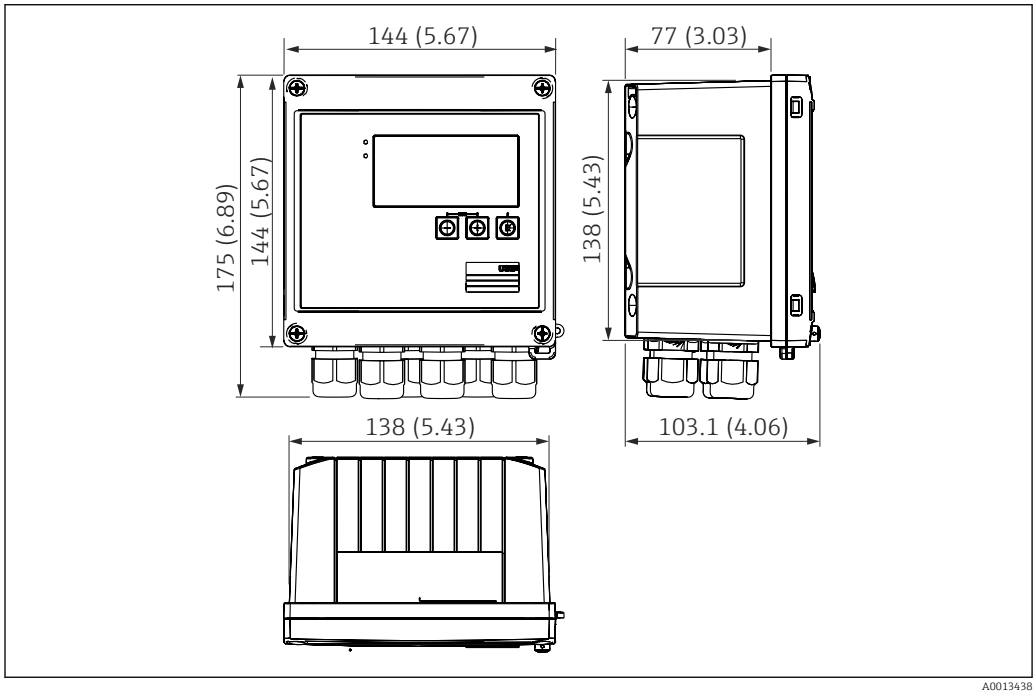
Humidity

Maximum relative humidity 80 % for temperatures up to 31 °C (87.8 °F), decreasing linearly to 50 % relative humidity at 40 °C (104 °F).

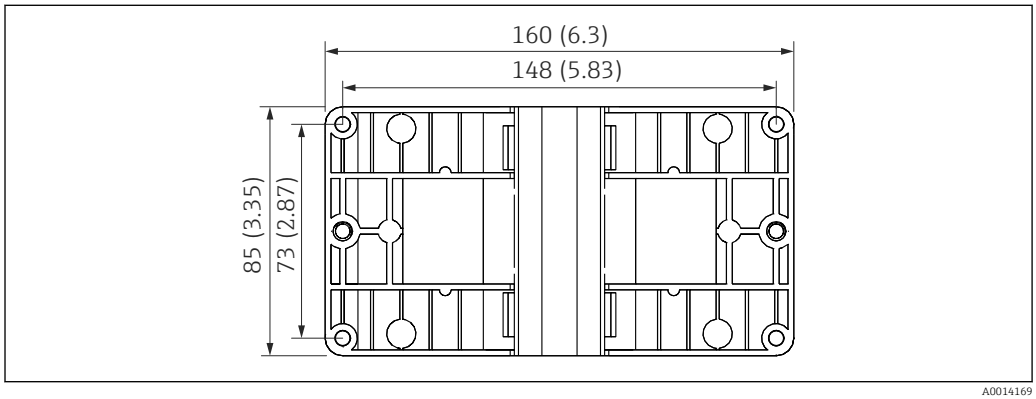
| | |
|---|---|
| Electrical safety | As per IEC 61010-1 and CAN C22.2 No 1010-1.<br>▪ Class II equipment<br>▪ Overvoltage category II<br>▪ Pollution level 2<br>▪ Overcurrent protection ≤ 10 A<br>▪ Operating altitude: up to 2 000 m (6 560 ft.) above MSL |
| Degree of protection | ▪ Panel mounting: IP65 at front, IP20 at rear<br>▪ DIN rail: IP20<br>▪ Field housing: IP66, NEMA4x (for cable gland with double seal insert: IP65) |
| Electromagnetic compatibility | As per EN 1434-4, EN 61326 and NAMUR NE21 |

## 13.8 Mechanical construction

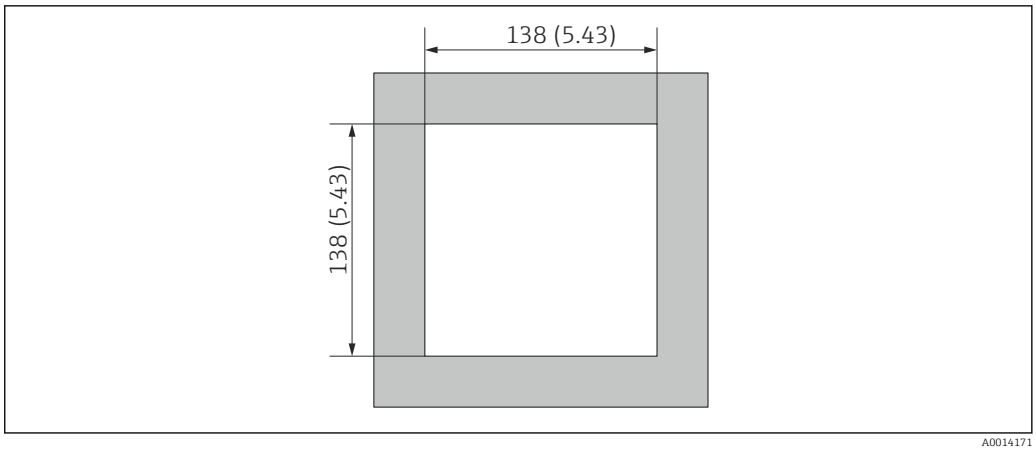
Design, dimensions



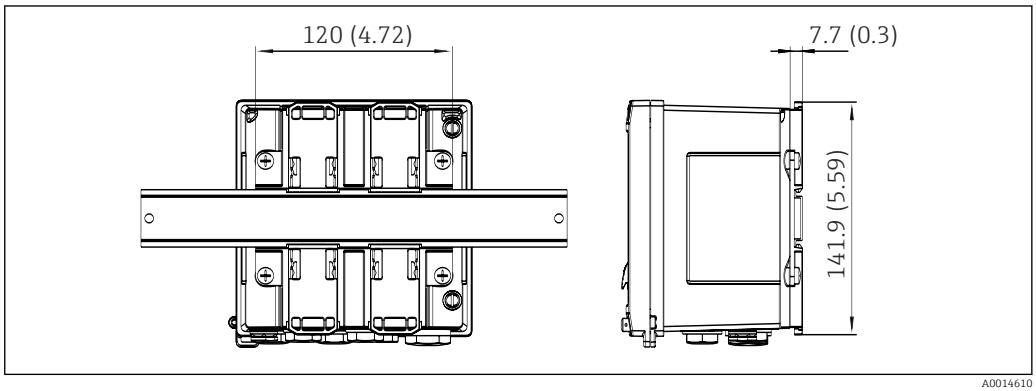

41 *EngyCal housing; dimensions in mm (in)*




42 *Mounting plate for wall, pipe and panel mounting; dimensions in mm (in)*



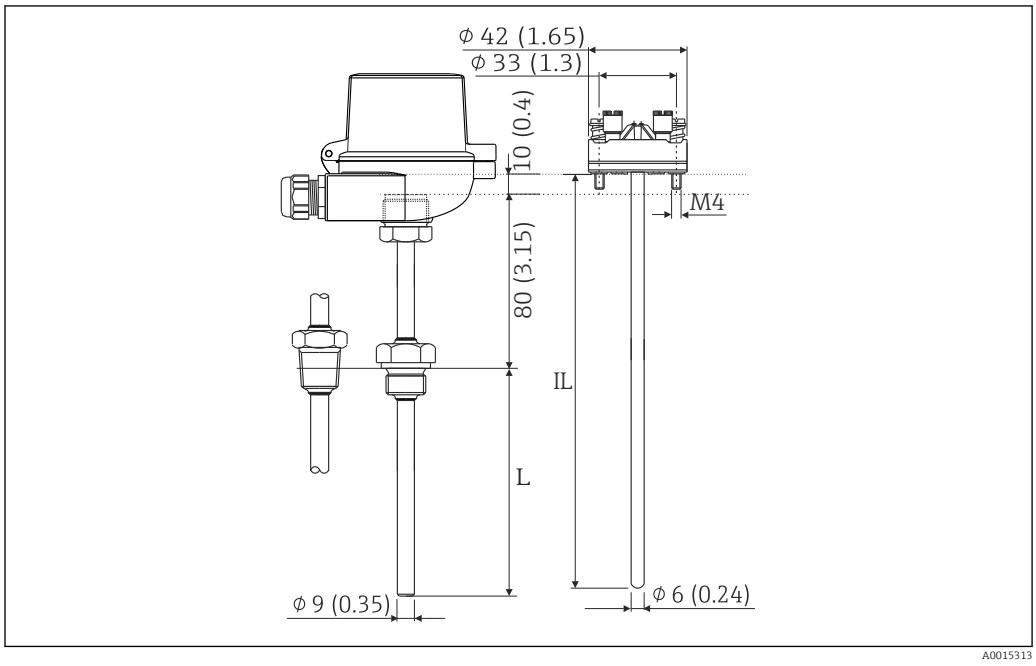

43 *Panel cutout in mm (in)*




44 *Dimensions of DIN rail adapter in mm (in)*

| | |
|---|---|
| Weight | Approx. 700 g (1.5 lbs) |
| Materials | Housing: fiber-glass reinforced plastic, Valox 553 |
| Terminals | Spring terminals, 2.5 mm² (14 AWG); auxiliary voltage with plug-in screw terminal (30-12 AWG; torque 0.5 to 0.6 Nm) . |

RTD assembly (option)

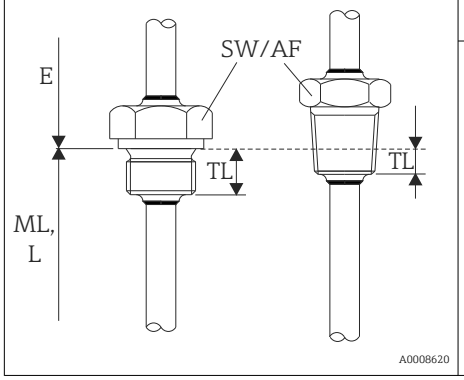



45 *Optional RTD assembly; dimensions in mm (in)*

*IL Insertion length*
*L Immersion length*

More technical data for the RTD assembly can be found in the Technical Information for the device. This document is available for download at www.de.endress.com/download.

RTD assembly process connection (option)

| Process connection | | Version | | Thread length TL |
|---|---|---|---|---|
| Cylindrical | Conical | | | |
|  | | G | G1/2" | 15 mm (0.6 in) |
| | | NPT | NPT1/2" | 8 mm (0.32 in) |



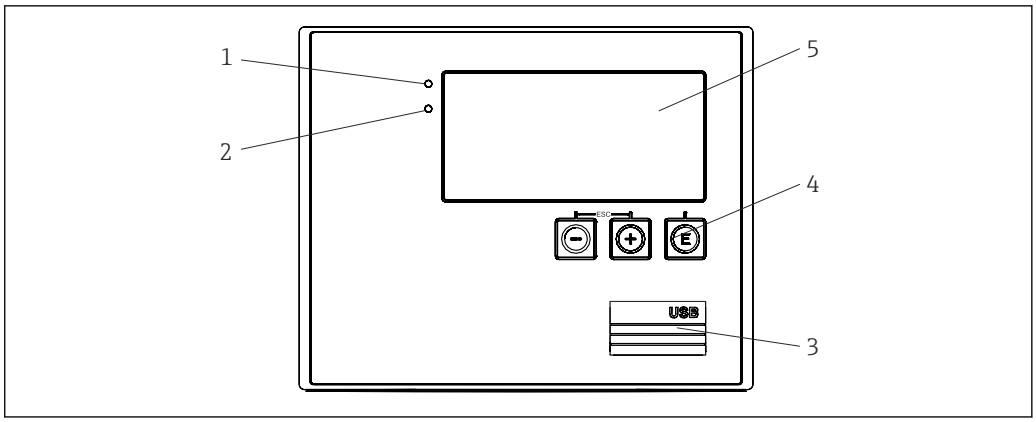
## 13.9 Operability

Languages

You can choose from one of the following operating languages on the device: English, German, French, Spanish, Italian, Dutch, Portuguese, Polish, Russian, Czech

Display elements

- Display:
  160 x 80 dot-matrix LCD with white backlighting, color changes to red in the event of an alarm, active display area 70 x 34 mm (2.76" x 1.34")
- LED status display:
  Operation: 1 x green
  Fault message: 1 x red




*46 Display and operating elements*

*1 Green LED, "Operation"*
*2 Red LED, "Fault message"*
*3 USB connection for configuration*
*4 Operating keys: -, +, E*
*5 160x80 dot-matrix display*

| | |
|---|---|
| Local operation | 3 keys, "-", "+", "E". |
| Configuration interface | USB interface at front, optional Ethernet: configuration via PC with FieldCare Device Setup configuration software. |
| Data logging | **Real-time clock**<br>▪ Deviation: 15 min per year<br>▪ Power reserve: 1 week |
| Software | ▪ **Field Data Manager software MS20**: visualization software and database for analyzing and evaluating the measured data and calculated values as well as tamper-proof data logging.<br>▪ **FieldCare Device Setup**: The device can be configured with the FieldCare PC software. FieldCare Device Setup is included in the scope of delivery for RXU10-G1 (see "Accessories") or can be downloaded free of charge from www.produkte.endress.com/fieldcare. |

## 13.10 Certificates and approvals

| | |
|---|---|
| Approval for custody transfer | as per MID 2014/32/EU (L 96/149), EN1434 (water/liquids) and OIML R75 |
| CE mark | The product meets the requirements of the harmonized European standards. As such, it complies with the legal specifications of the EC directives. The manufacturer confirms successful testing of the product by affixing to it the CE-mark. |

| | |
|---|---|
| Other standards and guidelines | ▪ IEC 60529:<br>Degrees of protection provided by enclosures (IP code)<br>▪ IEC 61010-1: 2001 cor 2003<br>Protection Measures for Electrical Equipment for Measurement, Control, Regulation and Laboratory Procedures<br>▪ IEC 61326 series:<br>Electromagnetic compatibility (EMC requirements)<br>▪ NAMUR NE21, NE43:<br>Association for Standards for Control and Regulation in the Chemical Industry<br>▪ IAPWS-IF 97:<br>Internationally applicable and recognized calculation standard (since 1997) for steam and water. Issued by the International Association for the Properties of Water and Steam (IAPWS).<br>▪ OIML R75:<br>International design and test recommendation for heat meters for water applications issued by the International Organization of Legal Metrology.<br>▪ EN 1434<br>▪ EN ISO 5167<br>Measurement of fluid flow by means of pressure differential devices |
| CSA GP | CAN/CSA-C22.2 No. 61010-1, 2nd edition |

# 14 Appendix

## 14.1 Operating functions and parameters

If a number in the form XXXXXX-XX is specified in a table row next to a parameter, the parameter can be accessed directly.

For this purpose go to the menu **Expert** → **Direct Access** and enter the number specified.

### 14.1.1 Language menu

| | |
|---|---|
| Deutsch<br>English<br>Español<br>Français<br>Italiano<br>Nederlands<br>Polski<br>Portuguese<br>Russkij<br>čeština | Select the operating language of the device from the list. |

### 14.1.2 Display/operation menu

| | |
|---|---|
| Change group | Choose the group which should be displayed. Change automatically between the configured display groups or display one of the 6 display groups → 41 |
| Display brightness | You can adjust the brightness of the display here. Number: 1-99 |
| Display contrast | You can adjust the contrast of the display here. Number: 20-80 |
| Stored values | Display the analyses stored in the device → 42. |
| Display | Choose the data which should be displayed. |

### 14.1.3 Setup menu

In this setup, you can select only the most common/important operating options. Special settings can also be configured via "Expert".

Some parameters are marked as follows in the tables:
- 1) Custody transfer-related. Cannot be changed if the device is locked by the custody transfer switch.
- 2) Custody transfer-related, but can be changed 3x

| | | |
|---|---|---|
| Units[2)] | 100001-00 | Select your unit system (SI or US units).<br>All units are switched to the selected unit system, but configured values are not converted. |
| Pulse value[2)] | 210013-00 | Unit for the pulse value, e.g. pulse/l, l/pulse... |
| Value[2)] | 210003-00 | Pulse factor = factor which, multiplied by an input impulse, yields the physical value. Example: 1 pulse corresponds to 5 $m^3$, pulse value is set to "$m^3$/pulse" → enter "5" here.<br>Decimal number, 8 digits including leading sign and decimal separator. |
| Mounting location Q[2)] | 210012-00 | Specify where the flow sensor is installed (Temperature warm or Temperature cold).<br>This is important so that the correct temperature is used for density calculation. |
| Date/time | | Set date/time |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | UTC time zone | | | | | | 120000-00 | Current UTC time zone (UTC = coordinated universal time). |
| | Actual date | | | | | | 120001-00 | Actual date. Format as configured under date format. |
| | Actual time | | | | | | 120002-00 | Actual time. HH:MM, 12/24-hour as configured in the time format. |
| | Changing | | | | | | | You can change the date and time here. |
| | | UTC time zone | | | | | 120010-00 | |
| | | Date/time[2)] | | | | | 120013- 00 | |
| Advanced setup | | | | | | | | Additional settings that are not essential for the basic operation of the device. |
| | System | | | | | | | Basic settings that are needed to operate the device (e.g. date, time, communication settings etc.) |
| | | Access code | | | | | 100000-00 | 4-digit number.<br>Using this code, setup access can be protected from unauthorized persons. In order to change any parameter the correct code must be entered. Factory setting: "0", i.e. changes can be made at any time.<br>Make a note of the code and store in a safe place. |
| | | Device tag | | | | | 000031-00 | Individual name of the device (max. 17 characters). |
| | | Decimal separator | | | | | 100003-00 | Select in which form the decimal separator character is to be displayed. |
| | | Fault switching | | | | | 100002-00 | If the device detects a system error (e.g. hardware defect) or a fault (e.g. cable open circuit), the selected output switches.<br>Selection: Relay 1/2 or OpenCollector 1/2 |
| | | Date/time setting | | | | | | Date/time set-up |
| | | | Date format | | | | 110000-00 | Select in which format the date is to be set and displayed. |
| | | | Time format | | | | 110001-00 | Select in which format the time is to be set and displayed. |
| | | Date/time | | | | | | Set date/time |
| | | | UTC time zone | | | | 120000-00 | Current UTC time zone (UTC = coordinated universal time). |
| | | | Actual date | | | | 120001-00 | Actual date. Format as configured under date format. |
| | | | Actual time | | | | 120002-00 | Actual time. HH:MM, 12/24-hour as configured in the time format. |
| | | | Changing | | | | | You can change the date and time here. |
| | | | | UTC time zone | | | 120010-00 | Set your UTC time zone (UTC = universal time coordinated). |
| | | | | Date/time[2)] | | | 120013-00 | Set your current date and your current time. |
| | | | NT/ST changeover | | | | | Settings for summer time changeover |
| | | | | NT/ST changeover[2)] | | | 110002-00 | Function for summer/normal time changeover. Automatic: Changes to the local regional regulations; Manual: Changeover times can be set in the following addresses ; Off: No changeover times required. |
| | | | | NT/ST region[2)] | | | 110003-00 | Selects the regional settings for summer/normal time changeover. |
| | | | | Begin summer time | | | | |
| | | | | Occurrence[2)] | | | 110005-00 | Day in spring on which the switch from standard time to summer time takes place, e.g. for the fourth Sunday in March: select 4. |
| | | | | Day[2)] | | | 110006-00 | Day of the week on which the switch from standard time to summer time takes place in spring, e.g. for the fourth Sunday in March: select Sunday. |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | | Month[2)] | 110007-00 | Month on which the switch from standard time to summer time takes place in spring, e.g. for the fourth Sunday in March: select March. |
| | | | | Date | 110008-00 | Day, when in the spring a change from normal to summer time occurs. |
| | | | | Time[2)] | 110009-00 | Time when the clocks go forward one hour on the day the time changes from standard time to summer time (format: hh:mm). |
| | | | | End summer time | | |
| | | | | Occurrence[2)] | 110011-00 | Day on which the switch back from summer time to standard time takes place in fall, e.g. for the fourth Sunday in October: select 4. |
| | | | | Day[2)] | 110012-00 | Day of the week on which the switch back from summer time to standard time takes place in fall, e.g. for the fourth Sunday in October: select Sunday. |
| | | | | Month[2)] | 110013-00 | Month in which the switch back from summer time to standard time takes place in fall, e.g. for the fourth Sunday in October: select October. |
| | | | | Date | 110014-00 | Day, when in the autumn a change from summer to normal time occurs. |
| | | | | Time[2)] | 110015-00 | Time when the clocks go back one hour on the day the time changes from summer time to standard time (format: hh:mm). |
| | | Units | | | | You can set the unit of your calculated variables here. |
| | | | Units[2)] | | 100001-00 | Select your unit system (SI or US units).<br>All units are switched to the factory settings for the selected unit system, but configured values are not converted. |
| | | | Mass flow | | 410000-00 | Set the desired unit in which this variable should be output/saved. |
| | | | Decimal point | | 410001-00 | Number of decimal places for displaying the mass flow. |
| | | | Power | | 410002-00 | Set the desired unit in which this variable should be output/saved. |
| | | | Decimal point | | 410003-00 | Number of decimal places for displaying the heat flow rate. |
| | | | Density | | 410006-00 | Set the desired unit in which this variable should be output/saved. |
| | | | Decimal point | | 410007-00 | Number of decimal places for displaying the density. |
| | | | Enthalpy | | 410008-00 | Set the desired unit in which this variable should be output/saved. |
| | | | Decimal point | | 410009-00 | Number of decimal places for displaying the enthalpy. |
| | | | Mass counter | | 410010-00 | Set the desired unit in which this variable should be output/saved. |
| | | | Decimal point | | 410011-00 | Number of decimal places for displaying the mass. |
| | | | Energy | | 410012-00 | Set the desired unit in which this variable should be output/saved. |
| | | | Decimal point | | 410013-00 | Number of decimal places for displaying the heat. |
| | | Ethernet | | | | Set-up required, if you are using the Ethernet interface of the unit. |
| | | | DHCP | | 150002-00 | The device can get its Ethernet settings through DHCP.<br>▪ The settings determined are displayed only after the setup is applied.<br>▪ Note: The unit always gets the same IP address if the leasing time is set long enough on the DHCP server. The PC software needs the IP address determined to establish a connection! |
| | | | IP address | | 150006-00 | If you have configured DHCP = 'No', enter the IP address for the device here. This IP address is assigned by your network administrator. Please talk to your network administrator about this.<br>If DHCP = 'Yes', the IP address obtained by DHCP is displayed here. |

| | | | | | |
|---|---|---|---|---|---|
| | | | Subnetmask | 150007-00 | If you have configured DHCP = 'No', enter the subnet mask (you receive this from your network administrator).<br>If DHCP = 'Yes', the subnet mask obtained by DHCP is displayed here. |
| | | | Gateway | 150008-00 | If you have configured DHCP = 'No', enter the gateway (you receive this from your network administrator).<br>If DHCP = 'Yes', the gateway obtained by DHCP is displayed here. |
| | | | Web server | 470000-00 | Switch the Web server function on or off (= factory default). The instantaneous values can only be displayed using an Internet browser when the Web browser is activated.<br>Only possible using the Ethernet interface! |
| | | | Port | 470001-00 | The Web server communicates through this communication port.<br>If your network is protected by a firewall, this port may have to be enabled. Please contact your network administrator if this is the case. Only visible if Web server = yes. |
| | | Modbus | | | Configure the Modbus settings for the device.<br>Only visible for devices with Modbus (option). |
| | | | Port | 480004-00 | Port via which the Modbus protocol can be addressed. |
| | | | Byte sequence | 480005-00 | Byte addressing, i.e. the transmission sequence of the bytes, is not specified in the MODBUS specification. For this reason, it is important to coordinate the addressing method between the master and slave during commissioning. This can be configured here. |
| | | | Reg. 0 to 2 | | Specify which values can be read out. |
| | | | | Value | 500000-00 | Choose the value which should be transmitted. |
| | | | | Analysis | 500001-00 | Select which counter (e.g. interval, daily counter, etc.) is to be transmitted. Only if a counter has been set for "Value". |
| | | | Reg. 3 to 5 | | Specify which values can be read out. |
| | | | | Value | 500000-01 | Choose the value which should be transmitted. |
| | | | | Analysis | 500001-01 | Select which counter (e.g. interval, daily counter, etc.) is to be transmitted. |
| | | | Reg. 6 to 8 | | Specify which values can be read out. |
| | | | | Value | 500000-02 | Choose the value which should be transmitted. |
| | | | | Analysis | 500001-02 | Select which counter (e.g. interval, daily counter, etc.) is to be transmitted. |
| | | | ... | ... | ... |
| | | | Reg. 87 to 89 | | Specify which values can be read out. |
| | | | | Value | 500000-29 | Choose the value which should be transmitted. |
| | | | | Analysis | 500001-29 | Select which counter (e.g. interval, daily counter, etc.) is to be transmitted. |
| | | M-Bus | | | Configure the M-Bus settings for the device.<br>For devices with M-Bus (optional) only. |
| | | | Unit address | 490001-00 | Enter the device address where it should be possible to reach this device in the bus. |
| | | | Baud rate | 490000-00 | Set the transmission rate for communication. |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | ID number | | 490002-00 | The identification number (for secondary addressing) is an 8-digit unique number. This number can be modified on the unit, though not via M-BUS. |
| | | | Manufacturer | | 490003-00 | Manufacturer ID |
| | | | Version | | 490004-00 | Displays the M-Bus version. |
| | | | Medium | | 490005-00 | The medium is always 0E (= bus/system) |
| | | | Number | | 490006-00 | Number of values that are to be read out via the M-Bus. |
| | | | Value 1 | | | Specify which values can be read out. |
| | | | | Value | 500000-00 | Choose the value which should be transmitted. |
| | | | | Analysis | 500001-00 | Choose which counter of the value should be transmitted.<br>Only if a counter has been set for "Value". |
| | | | ... | | ... | ... |
| | | | Value 5 | | | Specify which values can be read out. |
| | | | | Value | 500000-04 | Choose the value which should be transmitted. |
| | | | | Analysis | 500001-04 | Choose which counter of the value should be transmitted.<br>Only if a counter has been set for "Value". |
| | | Device options | | | | Hardware and software options. |
| | | | Optional outputs[1)] | | 990000-00 | |
| | | | Communication[1)] | | 990001-00 | |
| | | | Protocol[1)] | | 990007-00 | |
| | | | CT approval[1)] | | 990002-00 | |
| | | | DP Flow[1)] | | 990003-00 | |
| | | | Medium[1)] | | 990006-00 | |
| | | | Tariff[1)] | | 990005-00 | |
| | | | Bidirectional[1)] | | 990008-00 | |
| | | | Callendar v.Dusen[1)] | | 990004-00 | |
| | Inputs | | | | | Settings for the analog and digital inputs. |
| | | Flow | | | | Settings for the flow input. |

| | | | | | |
|---|---|---|---|---|---|
| | | | Signal type[2)] | 210000-00 | Select the signal type connected.<br>▪ 4 to 20 mA:<br>Current input<br>Not for devices with MID approval.<br>▪ 4 to 20 mA (DP flow):<br>Input for flow measurements based on the differential pressure method (e.g. orifice plate)<br>Not for devices with MID approval.<br>▪ 0 to 20 mA:<br>Current input<br>Not for devices with MID approval.<br>▪ Pulse U+IB+IC:<br>Input for active voltage pulses and contact sensors as per EN 1434-2, Class IB + IC.<br>▪ Pulse Cl. ID+IE:<br>Pulse input for contact sensors as per EN 1434-2, Class ID + IE.<br>▪ Pulse I:<br>Current pulse input: ≤ 8 mA Low level, ≥ 13 mA High level. |
| | | | Design | 210070-00 | Configure the transmitter type used.<br>Only for "Signal type" = "4-20 mA (DP-Flow)" |
| | | | Channel identifier | 210001-00 | Name of the measuring point connected to this input. Customized text, 6 characters. |
| | | | Pulse input[2)] | 210002-00 | Specify whether the pulse input is a fast (up to 12.5 kHz) or slow (up to 25 Hz) input.<br>Only if Pulse has been selected as the signal type. |
| | | | Pulse value[2)] | 210003-00 | Pulse factor = factor which, multiplied by an input impulse, yields the physical value. Example: 1 pulse equals 5 $m^3$ → enter a "5". Decimal number, max. 8 digits including decimal separator.<br>Only if Pulse has been selected as the signal type. |
| | | | Unit[2)] | 210004-00 | Specify the technical (physical) unit for the measuring point connected to this input. |
| | | | Decimal point | | Number of places after decimal point for the display.<br>E.g. measured value: 20.12348 l/s<br>The following can be displayed:<br>▪ None: 20 l/s<br>▪ One: 20.1 l/s<br>▪ Two: 20.12 l/s<br>▪ Three: 20.123 l/s<br>The value is rounded where necessary. |
| | | | Counter unit[2)] | 210005-00 | Technical unit of the count input, e.g. gal, cf, ... . |
| | | | Decimal point | 210007-00 | Number of digits after the decimal point for the counter. |
| | | | DP unit | 210072-00 | Unit of the differential pressure.<br>Only for signal type = 4 to 20 mA (DP-Flow) |
| | | | Range start | | Transmitters convert the physical measured variable into standardized signals. Enter the start of the measuring range here.<br>Example: 0 to 100 $m^3/h$ of the sensor converted to 4 to 20 mA : 0.<br>Decimal number, max. 8 digits including decimal separator.<br>Only for 0/4-20 mA. |
| | | | Meas. range end | | Enter the end of the measuring range here, e.g. "100" for a transmitter with 0 to 100 $m^3/h$.<br>Decimal number, max. 8 digits including decimal separator.<br>Only for 0/4-20 mA. |
| | | | Decimal point | 410005-00 | Decimal places for displaying the differential pressure.<br>Only for 4-20 mA (DP-Flow). |

| | | | | | |
|---|---|---|---|---|---|
| | | | Low flow cut off[2] | | If the volume flow recorded is below the set value, these quantities are not added to the counter.<br>If the input is scaled from 0 to y, or if the pulse input is used, all values that are smaller than the set value are not recorded.<br>If the input is scaled from -x to +y, all values around the zero point (e.g. also negative values) are not recorded.<br>Decimal number, max. 8 digits including decimal separator. |
| | | | Characteristic | | Select the flow characteristic depending on the settings at the output of your differential pressure transmitter.<br>Linear: if the output of the DP transmitter is scaled in mbar/inH2O (characteristic at the DPT output is linear).<br>Square: if the output of the DP transmitter is scaled in mass or volume units e.g. kg/h, ton/h, $m^3$/h (characteristic at the DPT output is squared).<br>Only for 4-20 mA (DP-Flow). |
| | | | Diameter unit | 210076-00 | Unit of the internal diameter of the pipe.<br>Only for signal type = 4 to 20 mA (DP-Flow) |
| | | | D at 20 °C | 210077-00 | Pipe inner diameter (D) under design conditions at 20 °C (68 °F).<br>Decimal number, max. 8 digits including decimal separator.<br>Only for signal type = 4 to 20 mA (DP-Flow) |
| | | | d at 20 °C | 210078-00 | Primary element bore diameter (d) under design conditions at 20 °C (68 °F).<br>Decimal number, max. 8 digits including decimal separator.<br>Only for signal type = 4 to 20 mA (DP-Flow) |
| | | | K-factor | 210079-00 | Set the K-factor (blockage factor) of the Pitot tube (see nameplate of the probe or E+H Applicator).<br>Decimal number, max. 8 digits including decimal separator.<br>Only for signal type = 4 to 20 mA (DP-Flow) and device type= Pitot tube |
| | | | Design density | 210080-00 | Density under design conditions (at design pressure/temperature).<br>Decimal number, max. 8 digits including decimal separator.<br>Only for signal type = 4 to 20 mA (DP-Flow) and device type = V-Cone or Gilflo |
| | | | Sensor material | 210081-00 | Material of the sensor.<br>Only for signal type = 4 to 20 mA (DP-Flow) and device type = Orifice plate, Nozzle, Venturi nozzle, Venturi tube |
| | | | Pipe material | 210082-00 | Material of the pipe.<br>Only for signal type = 4 to 20 mA (DP-Flow) and device type = Orifice plate, Nozzle, Venturi nozzle, Venturi tube, Pitot tube |
| | | | Mounting location Q[2] | 210012-00 | Specify where the flow sensor is installed. This is important so that the correct temperature is used for density calculation. |
| | | Temperature warm/cold | | | Settings for the temperature input warm/cold. |
| | | | Signal type[2] | T warm: 220000-00<br>T cold: 220000-01 | Select the signal type connected. |
| | | | Connection type[1] | T warm: 220001-00<br>T cold: 220001-01 | Configure whether RTD assembly is to be connected with 3 or 4 wires.<br>Only for signal type Pt100, Pt500 or Pt1000. |
| | | | Channel identifier | T warm: 220002-00<br>T cold: 220002-01 | Name of the measuring point connected to this input.<br>Customized text, max. 6 characters. |
| | | | Unit[2] | T warm: 220003-00<br>T cold: 220003-01 | Specify the technical (physical) unit for the measuring point connected to this input. |

| | | | | | |
|---|---|---|---|---|---|
| | | | Decimal point | T warm: 220004-00<br>T cold: 220004-01 | Number of places after decimal point for the display. |
| | | | Range[1] | T warm: 220005-00<br>T cold: 220005-01 | Set the desired measuring range.<br>Can only be set for Pt100 or platinum RTD (CvD).<br>A small measuring range increases the accuracy of temperature measurement. |
| | | | Range start[2] | T warm: 220006-00<br>T cold: 220006-01 | Transmitters convert the physical measured variable into standardized signals.<br>Enter the start of the measuring range here.<br>Only for 0/4 to 20 mA.<br>Decimal number, max. 8 digits including decimal separator. |
| | | | Meas. range end[2] | T warm: 220007-00<br>T cold: 220007-01 | Enter the end of the measuring range here.<br>Only for 0/4 to 20 mA.<br>Decimal number, max. 8 digits including decimal separator. |
| | | | Default value | T warm: 220009-00<br>T cold: 220009-01 | Specify a fixed temperature value with which the device should perform calculations.<br>Only for signal type = default value |
| | | | Linearization CvD | | Describe the temperature curve of the connected resistance thermometer by entering the Callendar van Dusen (CvD) coefficients (sensor calibration temperature).<br>Only for signal type = Platinum RTD(CvD) |
| | | | | R0 coefficient[2] | T warm: 220070-00<br>T cold: 220070-01 | Enter the R0 coefficient as per the calibration datasheet.<br>Decimal number, max. 8 digits including decimal separator. |
| | | | | A coefficient[2] | T warm: 220071-00<br>T cold: 220071-01 | Enter the A coefficient as per the calibration datasheet.<br>Decimal number, max. 8 digits including decimal separator. |
| | | | | B coefficient[2] | T warm: 220072-00<br>T cold: 220072-01 | Enter the B coefficient as per the calibration datasheet.<br>Decimal number, max. 8 digits including decimal separator. |
| | | | | C coefficient[2] | T warm: 220073-00<br>T cold: 220073-01 | Enter the C coefficient as per the calibration datasheet.<br>Decimal number, max. 8 digits including decimal separator. |
| | | Digital 1/2 | | | Setting up only required if the digital inputs (e.g. events) are to be used. |
| | | | Function | DI 1: 250000-00<br>DI 2: 250000-01 | Select the required function, → 39. Digital inputs are High active; this means the described effect is achieved by a high input.<br>Low = −3 to +5 V<br>High = +12 to +30 V |
| | Outputs | | | | Settings only required if outputs (e.g. relays or analog outputs) are to be used. |
| | | Universal output | | | Settings for the universal output (current or pulse output). |
| | | | Signal type | 310000-00 | Select the output signal for this channel. |
| | | | Channel/value | 310001-00 | Select which channel or calculated value is to be output at the output. |
| | | | Start value | 310003-00 | Configure what value corresponds to 0/4 mA.<br>Numerical value, max. 8 digits including decimal separator (can only be selected for the 0/4 to 20 mA signal type). |

| | | | | | |
|---|---|---|---|---|---|
| | | | Full scale value | 310004-00 | Configure what value corresponds to 20 mA.<br>Numerical value, max. 8 digits including decimal separator (can only be selected for the 0/4 to 20 mA signal type). |
| | | | Damping | 310005-00 | Time constant of the first order low pass for the output signal. This is used to prevent severe fluctuations in the output signal (can only be selected for the 0/4 to 20 mA signal type).<br>Numerical value, max. 8 digits including decimal separator. |
| | | | Pulse value | 310006-00 | The pulse value specifies what quantity an output pulse corresponds to (e.g. 1 pulse = 5 liters).<br>Numerical value, max. 8 digits including decimal separator. |
| | | | Pulse width | 310007-00 | The pulse width limits the max. possible output frequency of the pulse output.<br>Define a fixed or dynamic pulse width. |
| | | | Pulse width | 310008-00 | You can set the pulse width in the range from 0.04 to 1 000 ms here.<br>Numerical value, max. 8 digits including decimal separator.<br>Visible only if a user-defined pulse width was selected. |
| | | Open Collector 1/2 | | | Settings for the open collector output (pulse or status). |
| | | | Function | OC 1:<br>320000-00<br>OC 2:<br>320000-01 | Specify what the open collector output should output (pulses or status). |
| | | | Operating mode | 320001-00<br>320001-01 | Function of the open collector:<br>▪ NC contact: The contact is closed in its quiescent state (maximum safety).<br>▪ NO contact: The contact is open in its quiescent state. |
| | | | Channel/value | 320002-00<br>320002-01 | Select which channel/value is to be output at the output.<br>Only for function = pulse output. |
| | | | Pulse value | 320004-00<br>320004-01 | The pulse value specifies which quantity an output pulse corresponds to (e.g. 1 pulse = 5 liters).<br>Only for function = pulse output. |
| | | | Pulse width | 320005-00<br>320005-01 | The pulse width limits the max. possible output frequency of the pulse output.<br>Define a fixed or dynamic pulse width.<br>Only for function = pulse output. |
| | | | Pulse width | 320006-00<br>320006-01 | You can set the pulse width in the range from 0.5 to 1 000 ms here.<br>Numerical value, max. 8 digits including decimal separator.<br>Visible only if a user-defined pulse width was selected. |
| | | Relay | | | Setup for the selected relay |
| | | | Operating mode | Relay 1:<br>330000-00<br>Relay 2:<br>330000-01 | Relay function:<br>▪ NC contact: The relay is closed in its quiescent state (maximum safety).<br>▪ NO contact: The relay is open in its quiescent state. |
| | Application | | | | Configure various application-specific settings (e.g. group settings, limit values, etc.). |
| | | Medium[2)] | | 400000-00 | For selecting the medium.<br>If the medium you are using does not appear in the list, use the liquid table. |
| | | Concentration[2)] | | 400001-00 | Concentration of the water/glycol mixture in vol % (0-60 %).<br>Not if medium = water or liquid table |
| | | Liquid table | | | Tables for entering the data of the liquid used.<br>Only if medium = liquid table |
| | | | Temperature unit[2)] | 400099-00 | Set the temperature unit in which the subsequent support points are entered. |
| | | | Density | | Enter the data for the density of your refrigerant/heat transfer medium. |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | | No. support points[2)] | 420000-00 | Number of support points in the density table.<br>Whole number; possible values: 2-10 |
| | | | | Support point 1 to x[2)] | Temp.:<br>420001- 00...xx<br>Density:<br>420002- 00...xx | Enter a temperature/density value pair for each support point. |
| | | | Heat capacity | | | Enter the data for the density of your refrigerant/heat transfer medium. |
| | | | | Heat capacity[2)] | 420013-00 | Set the desired unit in which this variable should be output/saved. |
| | | | | No. support points[2)] | 420010-00 | Number of support points in the thermal capacity table.<br>Whole number; possible values: 2-10 |
| | | | | Support point 1 to x[2)] | Temp.:<br>420011- 00...xx<br>Heat c.:<br>420012- 00...xx | Enter a temperature/heat capacity value pair for each support point. |
| | | | Viscosity | | | If the flow is measured based on the differential pressure method (DP Flow), please enter the data for the viscosity of your refrigerant/heat transfer medium. Input is always in [cp]. |
| | | | | Support point 1 to x | Temp.:<br>420020- 00...xx<br>Visc.:<br>420021-00...xx | Enter a temperature/viscosity value pair. |
| | | Bidirectional | | | | Settings for bidirectional measurement. |
| | | | Bidirectional[1)] | | 400002-00 | Bidirectional measurement, i.e. separate measurement of heating and cooling power, can be implemented in two ways:<br>▪ Flow direction: the change of flow direction is controlled by a digital signal or detected via the scaling (-/+).<br>▪ Temperature: the operating mode is detected by the change of the sign of the temperature differential. |
| | | | Switching temperature [2)] | | 400006-00 | Choose whether a switching temperature should be taken into consideration for "Temperature" bidirectional measurement.<br>If "Yes" is selected the switching point must be set in the "T switchover" parameter.<br>If "No" is selected, the measurement of the heating/cooling power only depends on the sign of the temperature differential. |
| | | | Temperature unit[2)] | | 400003-00 | Set the temperature unit in which the T switchover is entered.<br>Only if bidirectional = temperature<br>ΔT limit is always in the unit K. |
| | | | T switchover[2)] | | 400004-00 | Point system switches over between counting heat and cold.<br>Only if bidirectional = temperature and switching temperature = yes |
| | | | ΔT limit[2)] | | 400005-00 | Low flow cut off If the temperature differential is smaller than ΔT limit, no energy is accumulated on the counters.<br>Only if bidirectional = temperature<br>Always specified in K. |
| | | Tariff 1/2 | | | | Tariff counters for recording the energy during specific process conditions or statuses.<br>The tariff counters have no effect on the "normal" counter. |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | Tariff model[2)] | | Tariff 1: 430000-00 Tariff 2: 430000-01 | Define the parameters in dependence on which the tariff counter is to work. The deficit counter totalizes the energy during an error (e.g. open circuit). To calculate the deficits, the error values for the temperatures are used. |
| | | | Limit[2)] | | 430001-00 430001-01 | Depending on which variable is the tariff counter to be enabled? Example: The amount of energy should be recorded on the tariff counter when a power rating of 100 kW is exceeded → Set "Upper limit value". |
| | | | Value[2)] | | 430002-00 430002-01 | Enter the limit value at which the tariff counter is activated, i.e. when the energy flow is totalized. Numerical value, max. 15 digits including decimal separator. |
| | | | Unit[2)] | | 430003-00 430003-01 | Enter the unit for the tariff. Customized text, max. 9 characters. |
| | | | From[2)] | | 430004-00 430004-01 | Enter the time at which the tariff counter is activated, i.e. when the quantity is totalized (format: HH:MM). Visible only if Time has been selected as the tariff model. |
| | | | To[2)] | | 430005-00 430005-01 | Enter the time at which the tariff counter is deactivated (format: HH:MM). Visible only if Time has been selected as the tariff model. |
| | | Data logging | | | | Settings for signal analysis (saving). |
| | | | Synchron. time[2)] | | 440001-00 | Time for completing the signal analysis. If, for example, 07:00 is set up, then the daily analysis will run from 07:00 of the actual day until 07:00 of the following day. Format: HH:MM |
| | | | Interval[2)] | | 440000-00 | Define the interval at which signal analyses are to be stored. Min, max and average values of the daily and monthly evaluations, etc. are determined from the averages of the interval. |
| | | | Billing date[2)] | | 440002-00 | Specify how many billing date analyses should take place each year. |
| | | | Billing date 1/2 | | | Specify when the billing date analysis should take place. |
| | | | | Day[2)] | 440003-00 440003-01 | Enter the date on which this billing date analysis is to be created (1-31). |
| | | | | Month[2)] | 440004-00 440004-01 | Enter the month on which this billing date analysis is to be created (picklist). |
| | | Limits | | | | Limit values can monitor the measured values. A relay, for example, can be switched if a limit value is violated. |
| | | | Set point 1 to 3 | | | View or change the setup for the selected alarm set point. |
| | | | | Channel/value | 450000-00 450000-01 450000-02 | Select which input/calculated value the limit value refers to. |
| | | | | Type | 450001-00 450001-01 450001-02 | Type of limit value (depends on the input variable). |
| | | | | Limit | 450002-00 450002-01 450002-02 | Limit value in the set process unit, e.g. in °C, $m^3/h$ |
| | | | | Hysteresis (abs.) | 450004-00 450004-01 450004-02 | The alarm condition is only canceled when the signal has changed into the normal operation range by the preset value. |
| | | | | Switches | 450005-00 450005-01 450005-02 | Switches the selected output in a limit condition. |

| | | | | | | |
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| | | Display groups | | | | Put the inputs/calculated values into groups such that you can call up the information you need at the touch of a button during operation. |
| | | | Group 1 to 6 | | | Various general settings for the groups for measured value display of the device.<br>For the MID option, groups 1 to 3 cannot be edited.<br>For the MID option and bidirectional, group 4 also cannot be edited. |
| | | | | Identifier | 460000-00<br>-01, -02,<br>-03, -04,<br>-05 | Enter a name for these groups. |
| | | | | Value 1 | 460001-00<br>-01, -02,<br>-03, -04,<br>-05 | Select which input/which calculated variable in this group is to be displayed. |
| | | | | Value 2 | 460003-00<br>-01, -02,<br>-03, -04,<br>-05 | Select which input/which calculated variable in this group is to be displayed. |
| | | | | Value 3 | 460005-00<br>-01, -02,<br>-03, -04,<br>-05 | Select which input/which calculated variable in this group is to be displayed. |
| | | | | Display | | If you select a counter in "Value 1 to 3", in "Display", you can configure which data of the counter are to be displayed. |

### 14.1.4 Diagnostics menu

| | | | | |
|---|---|---|---|---|
| Actual diagnos. | | | 050000-00 | Displays the current diagnosis message. |
| Last diagnostics | | | 050005-00 | Displays the last diagnosis message. |
| Last restart | | | 050010-00 | Information as to when the device was last restarted (e.g. due to a power failure). |
| CT expiry date | | | 980101-00 | CT expiry date |
| Diagnosis list | | | | All pending diagnosis messages are output. |
| Event logbook | | | | Events such as alarm set point infringement and power failure are listed in the correct time sequence. |
| CT logbook | | | | All changes relevant to custody transfer are saved in the custody transfer logbook. |
| Device information | | | | Displays important device information. |
| | Device tag | | 000031-00 | Individual device tag name/unit identifier (max. 17 characters). |
| | Serial number | | 000027-00 | Please send these details with any questions about the unit. |
| | Order number | | 000029-00 | Please send these details with any questions about the unit. |
| | Order identifier | | 000030-00 | Please send these details with any questions about the unit. |
| | Firmware version | | 000026-00 | Please send these details with any questions about the unit. |
| | ENP version | | 000032-00 | Please send these details with any questions about the unit. |
| | ENP device name | | 000020-00 | Please send these details with any questions about the unit. |
| | Device name | | 000021-00 | Please send these details with any questions about the unit. |
| | Manufacturer ID | | 000022-00 | Please send these details with any questions about the unit. |
| | Manufacturer name | | 000023-00 | Please send these details with any questions about the unit. |
| | Firmware | | 009998-00 | Please send these details with any questions about the unit. |
| | Hardware | | | Information on the hardware components. |
| | | Device running time | 010050-00 | Indicates how long the device was in operation. |
| | | Fault hours | 010051-00 | Indicates how long the device experienced a fault. |
| | | Ethernet | | Information about the Ethernet interface of the device.<br>Only for devices with Ethernet interface. |
| | | | Firmware version | 010026-00 | Firmware version of Ethernet card. Please send these details with any questions about the unit. |
| | | | Serial number | 010027-00 | Serial number of Ethernet card. Please send these details with any questions about the unit. |
| | Device options | | | Hardware and software options of the device. |
| | | Optional outputs | 990000-00 | |
| | | Communication | 990001-00 | |
| | | Protocol | 990007-00 | |

| | | | | |
|---|---|---|---|---|
| | | Custody transfer approval | 990002-00 | |
| | | DP flow | 990003-00 | |
| | | Medium | 990006-00 | |
| | | Tariff | 990005-00 | |
| | | Bidirectional | 990008-00 | |
| | | Callendar v. Dusen | 990004-00 | |
| Measured values | | | | Display of current measured values of device.<br>For displaying on the device. |
| | Hold | | 060000-00 | Stops the entire measured value acquisition/storage.<br>Select "No" to exit the hold function.<br>The hold function is exited automatically after 5 minutes. |
| | CT mode | | 060005-00 | Custody transfer-related values are displayed with 5 decimal points.<br>Does not have any effect on the storage or group display. |
| | Display | | 060010-00 | Display of a measured value / calculated value.<br>Grouping of 3 measured values for display in the PC operating software.<br>The device always shows only one value. |
| | Status | | 060015-00 | Status of the measured value. |
| | Value | | 060020-00 | Current measured value/calculated value. |
| | Signal value | | 060035-00 | Displays the physical measured value (mA, Ohm, etc) |
| Outputs | | | | Current status of outputs (if used). |
| | Universal output | | 060120-00 | Value currently output at the universal output. |
| | Relay 1/2 | | 060100-00<br>060105-00 | Current relay state. |
| | Open Collector 1/2 | | 060110-00<br>060115-00 | Current state of the open collector output. |
| Simulation | | | | Various functions/signals can be simulated for test purposes here.<br>In Simulation mode normal recording of the measured values is interrupted and the intervention is logged in the event log. |
| | Universal output | | 050200 | Choose the value which should be output.<br>Select "Switched off" to exit the simulation.<br>The simulation is exited automatically after 5 minutes.<br>The simulation is NOT exited automatically when exiting the menu. |
| | Open Collector 1/2 | | 050205-00<br>050210-00 | Choose the value which should be output.<br>Select "Switched off" to exit the simulation.<br>The simulation is exited automatically after 5 minutes.<br>The simulation is NOT exited automatically when exiting the menu. |
| | Relay 1/2 | | 050215-00<br>050220-00 | Manual activation of the selected relay.<br>The simulation is exited automatically after 5 minutes.<br>The simulation is NOT exited automatically when exiting the menu. |

### 14.1.5 Expert menu

In the Expert menu, all parameters and settings of the device can be changed.

The menu contains all parameters / settings from the Setup menu in addition to those described below.

Some parameters are marked as follows in the tables:
- 1) Custody transfer-related
- 2) Custody transfer-related, but can be changed 3x

| | | | | |
|---|---|---|---|---|
| Direct access | | | | Direct access to parameters (rapid access). |
| Service code | | | 010002-00 | Please enter service code to make service parameter visible.<br>For PC operating software only. |
| System | | | | Basic settings that are needed to operate the device (e.g. date, time, communication settings etc.). |
| | Language | | 010000-00 | Select the operating language of the device. |
| | PRESET[1)] | | | Resets all parameters to the factory settings!<br>Can be changed via the service code only. |
| | Clear memory[1)] | | 059000-00 | Delete internal memory |
| | Reset[1)] | | 059100-00 | Reset analysis to 0. |
| | Ethernet | | | Set-up required, if you are using the Ethernet interface of the unit. |
| | | MAC address | 150000-00 | MAC address of the device |
| | | Port | 150001-00 | The system communicates with the PC software through this communication port.<br>Default: **8000**<br>If your network is protected by a firewall, this port may have to be enabled. Please contact your network administrator if this is the case. |
| | | Port | 470001-00 | The Web server communicates through this communication port.<br>Default: **80**<br>If your network is protected by a firewall, this port may have to be enabled. Please contact your network administrator if this is the case. |
| | Device options | | | Hardware and software options of the device. |
| | | Activation code[1)] | 000057-00 | Here, you can enter a code to enable the device options. |
| Inputs | | | | Settings for the analog and digital inputs. |
| | Damping | | 210010-00 | Fast changes in the measured value or an irregular pulse input are attenuated at the input. Result: The measured values on the display, or values relayed via digital communication, change more slowly and measured value spikes are avoided. This damping does not affect the counter.<br>Decimal number, max. 5 digits incl. decimal separator.<br>Factory setting: 0.0 s. |
| | Flow | | | |
| | | Meas.val. corrct. | | Determining the correction values to balance measurement tolerances.<br>Proceed as follows:<br>- Measure the current value at the lower measurement range.<br>- Measure the current value at the upper measurement range.<br>- Enter the lower and upper target and actual value. |

| | | | | | |
|---|---|---|---|---|---|
| | | | Range start | | Lower correction value. |
| | | | Target value | 210051-00 | Enter the setpoint at the start of the measuring range here (e.g. measuring range 0 l/h to 100 l/h: 0 l/h). |
| | | | Actual value | 210052-00 | Enter the value actually measured here (e.g. measuring range 0 l/h to 100 l/h: measured 0.1 l/h). |
| | | | Meas. range end | | Upper correction value. |
| | | | Target value | 210054-00 | Enter the setpoint at the end of the measuring range here (e.g. measuring range 0 l/h to 100 l/h: 100 l/h100l/h). |
| | | | Actual value | 210055-00 | Enter the value actually measured here (e.g. measuring range 0 l/h to 100 l/h: measured 99.9 l/h). |
| | | | Damping | 210010-00 | Fast changes in the measured value or an irregular pulse input are attenuated at the input. Result: The measured values on the display, or values relayed via digital communication, change more slowly and measured value spikes are avoided. This damping does not affect the counter.<br>Decimal number, max. 5 digits incl. decimal separator.<br>Factory setting: 0.0 s |
| | | Fault mode | | | Settings that define how this channel is to react under fault conditions (e.g. cable open circuit, over range). |
| | | | NAMUR NE 43 | 210060-00 | Activate/deactivate the 4 to 20 mA loop monitoring as per NAMUR recommendation NE 43.<br>The following error ranges apply when NAMUR NE43 is switched on:<br>▪ ≤ 3.8 mA: under range<br>▪ ≥ 20.5 mA: over range<br>▪ ≤ 3.6 mA or ≥ 21.0 mA: sensor error<br>▪ ≤ 2mA: cable open circuit |
| | | | On error | 210061-00 | Configure what value the device should continue working with (for calculations) if the measured value is not valid (e.g. cable open circuit). |
| | | | Error value | 210062-00 | Only if the setting "Error value" has been selected under "On error".<br>The device continues calculating with this value in the event of an error. The calculated values are recorded in the deficit counter.<br>The normal counter remains unchanged (does not run). |
| | Temp warm/cold | | | | Settings for the temperature input warm/cold. |
| | | Damping[1)] | | T warm: 220008-00<br>T cold: 220008-01 | Factory setting: 0.0 s. The more unwanted interference is superimposed over the measuring signal, the higher the value should be set. Result: Fast changes are dampened/suppressed.<br>Decimal number, max. 5 digits incl. decimal separator. |
| | | Meas.val. corrct. | | | Determining the correction values to balance measurement tolerances.<br>Proceed as follows:<br>▪ Measure the current value at the lower measurement range.<br>▪ Measure the current value at the upper measurement range.<br>▪ Enter the lower and upper target and actual value. |
| | | | Offset[1)] | 220050-00<br>220050-01 | Factory setting "0". This offset is only effective on the analog input signal (no maths / bus channels). Only for RTD.<br>Decimal number, max. 8 digits including decimal separator. |
| | | | Range start | | Lower correction value<br>Only for 0/4 to 20 mA. |
| | | | Target value | 220052-00<br>220052-01 | Enter the lower setpoint here (e.g. measuring range 0 °C to 100 °C: 0 °C).<br>Decimal number, max. 8 digits including decimal separator.<br>Only for 0/4 to 20 mA. |

| | | | | | |
|---|---|---|---|---|---|
| | | | Actual value | 220053-00<br>220053-01 | Enter the lower value actually measured here (e.g. measuring range 0 °C to 100 °C: measured 0.5 °C).<br>Decimal number, max. 8 digits including decimal separator.<br>Only for 0/4 to 20 mA. |
| | | | Meas. range end | | Upper correction value<br>Only for 0/4 to 20 mA. |
| | | | Target value | 220055-00<br>220055-01 | Enter the upper setpoint here (e.g. measuring range 0 °C to 100 °C: 100 °C).<br>Decimal number, max. 8 digits including decimal separator.<br>Only for 0/4 to 20 mA. |
| | | | Actual value | 220056-00<br>220056-01 | Enter the upper value actually measured here (e.g. measuring range 0 °C to 100 °C: measured 99.5 °C).<br>Decimal number, max. 8 digits including decimal separator.<br>Only for 0/4 to 20 mA. |
| | | Fault mode | | | Settings that define how this channel is to react under fault conditions (e.g. cable open circuit, over range). |
| | | | NAMUR NE 43 | 220060-00<br>220060-01 | Activate/deactivate the 4 to 20 mA loop monitoring as per NAMUR recommendation NE 43.<br>The following error ranges apply when NAMUR NE43 is switched on:<br>▪ ≤ 3.8 mA: under range<br>▪ ≥ 20.5 mA: over range<br>▪ ≤ 3.6 mA or ≥ 21.0 mA: sensor error<br>▪ ≤ 2 mA: cable open circuit |
| | | | On error | 220061-00<br>220061-01 | Configure what value the device should continue working with (for calculations) if the measured value is not valid (e.g. cable open circuit). |
| | | | Error value | 220062-00<br>220062-01 | Only if the setting "Error value" has been selected under "On error".<br>The device continues calculating with this value in the event of an error. The calculated values are recorded in the deficit counter.<br>The normal counter remains unchanged (does not run). |
| Outputs | | | | | Settings only required if outputs (e.g. relays or analog outputs) are to be used. |
| | Universal output | | | | Settings for the universal output (current or pulse output). |
| | | Failure current | | 310009-00 | Set the current to be output in the event of an error (e.g. cable open circuit at the input).<br>Numerical value, max. 8 digits including decimal separator. |
| | | Meas.val. corrct. | | | Here, you can correct the output current value (necessary only if the device that carries out the further processing cannot compensate for any measurement section tolerances).<br>Proceed as follows:<br>▪ On the connected device, read out the displayed value in both the upper and lower measuring range.<br>▪ Enter the lower and upper target and actual value. |
| | | | Start value | | Lower correction value. |
| | | | Target value | 310051-00 | Enter the lower setpoint here. |
| | | | Actual value | 310052-00 | Here, enter the lower actual value which is displayed at the connected device. |
| | | | Full scale value | | Upper correction value |
| | | | Target value | 310054-00 | Enter the upper setpoint here. |
| | | | Actual value | 310055-00 | Here, enter the upper actual value which is displayed at the connected device. |
| Diagnostics | | | | | Device information and service functions for swift device check.<br>This information can also be found in the Diagnostics / Device information menu |

| | | | |
|---|---|---|---|
| | ENP device name | 000020-00 | Please send these details with any questions about the unit. |
| | Device name | 000021-00 | Please send these details with any questions about the unit. |
| | Serial number | 000027-00 | Please send these details with any questions about the unit. |
| | Order number | 000029-00 | Please send these details with any questions about the unit. |
| | Order identifier | 000030-00 | Please send these details with any questions about the unit. |

## 14.2 Symbols

| Symbol | Description |
|---|---|
| 🔒 | Device locked |
| F | Fault<br>For example, error in a channel not displayed in the current group. |
| M | Maintenance required<br>For example, maintenance required in a channel not displayed in the current group. |
| ⇄ | External communication, e.g. fieldbus |
| SIM | Simulation |
| ⧗ | Hold |
| ▼ | Low value |
| ▲ | High value |
| ^ | Counter overflow |
| **Name of the inputs and process values** | |
| C (DP) | C (DP Flow) |
| DI 1 | Digital input 1 |
| DI 2 | Digital input 2 |
| ε | Epsilon (DP Flow) |
| Flow | Volume flow |
| h | Enthalpy |
| M | Mass flow |
| Δp | Differential pressure |
| P | Power |
| Q inst | Mount location Q |
| Q pv | Pulse value Q |
| ρ | Density |
| Σ1, Σ1 (i), Σ1 (d), Σ1 (m), Σ1 (y), Σ1 (1) | Tariff 1, charging energy: total, interval, day, month, year, billing date |

| | |
|---|---|
| Σ2, Σ2 (i), Σ2 (d), Σ2 (m), Σ2 (y), Σ2 (1) | Tariff 2, discharging energy: total, interval, day, month, year, billing date |
| ΣE, ΣE (i), ΣE (d), ΣE (m), ΣE (y), ΣE (1) | Energy counter: total, interval, day, month, year, billing date |
| ΣM, ΣM (i), ΣM (d), ΣM (m), ΣM (y), ΣM (1) | Mass counter: total, interval, day, month, year, billing date |
| ΣV, ΣV (i), ΣV (d), ΣV (m), ΣV (y), ΣV (1) | Volume counter: total, interval, day, month, year, billing date |
| Σx, Σx (i), Σx (d), Σx (m), Σx (y), Σx (1) | Deficit counter: total, interval, day, month, year, billing date |
| T warm | Temperature warm |
| T cold | Temperature cold |
| ΔT | Temperature differential |
| Tu/ΔTg | Information on bidirectional operation |
| Valid | Custody transfer expiry date (only for devices with approval for custody transfer) |

## 14.3 Definition of important system units

| | |
|---|---|
| **Volume** | |
| bl<br>Device display "bbl" | 1 barrel (general liquids), corresponds to 119.24047 l |
| gal | 1 US gallon, corresponds to 3.7854 l |
| Igal | Imperial gallon, corresponds to 4.5609 l |
| l | 1 liter = 1 $dm^3$ |
| hl | 1 hectoliter = 100 l |
| $m^3$ | Corresponds to 1 000 l |
| $ft^3$ | Corresponds to 28.37 l |
| **Temperature** | |
| | Conversion:<br>▪ 0 °C = 273.15 K<br>▪ °C = (°F - 32)/1.8 |
| **Pressure** | |
| | Conversion:<br>1 bar = 100 kPa = 100 000 Pa = 0.001 mbar = 14.504 psi |
| **Mass** | |
| ton (US) | 1 US ton, corresponds to 2 000 lbs (= 907.2 kg) |
| ton (long) | 1 long ton, corresponds to 2 240 lbs (= 1 016 kg) |
| **Power (heat flow)** | |
| ton | 1 ton (refrigeration) corresponds to 200 Btu/min |
| Btu/s | 1 Btu/s corresponds to 1.055 kW |
| **Energy (heat quantity)** | |
| therm | 1 therm, corresponds to 100 000 Btu |

| | |
|---|---|
| tonh | 1 tonh, corresponds to 1 200 Btu |
| Btu | 1 Btu corresponds to 1.055 kJ |
| kWh | 1 kWh corresponds to 3 600 kJ corresponds to 3 412.14 Btu |

# Index


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