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Operating Instructions
EngyCal RS33

Steam calculator for a measuring point with one pulse/ analog input for flow and two RTD/analog inputs for temperature/pressure

Endress+Hauser
People for Process Automation

Table of contents

1 About this document

1.1 Document function

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

1.2 Symbols

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 potentially dangerous situation. Failure to avoid this situation can result in serious or fatal injury.

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

NOTICE
This symbol alerts you to a potentially harmful situation. Failure to avoid this situation can result in damage to the product or something in its vicinity.

1.2.2 Symbols for certain types of information

Symbol	Meaning
	**Permitted** Procedures, processes or actions that are permitted.
	**Preferred** Procedures, processes or actions that are preferred.
	**Forbidden** Procedures, processes or actions that are forbidden.
	**Tip** 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

1.2.3 Electrical symbols

⎓	Direct current	~	Alternating current
⎓~	Direct current and alternating current	⏚	**Ground connection** A grounded terminal which, as far as the operator is concerned, is grounded via a grounding system.

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

1.3 Documentation

For an overview of the scope of the associated Technical Documentation, refer to the following:
- *Device Viewer* (www.endress.com/deviceviewer): Enter the serial number from the nameplate
- *Endress+Hauser Operations app*: Enter serial number from nameplate or scan matrix code on nameplate.

The following document types are available in the Downloads area of the Endress+Hauser website (www.endress.com/downloads), depending on the device version:

Document type	Purpose and content of the document
Technical Information (TI)	**Planning aid for your device** The document contains all the technical data on the device and provides an overview of the accessories and other products that can be ordered for the device.
Brief Operating Instructions (KA)	**Guide that takes you quickly to the 1st measured value** The Brief Operating Instructions contain all the essential information from incoming acceptance to initial commissioning.

Document type	Purpose and content of the document
Operating Instructions (BA)	**Your reference document** The 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.
Description of Device Parameters (GP)	**Reference for your parameters** The document provides a detailed explanation of each individual parameter. The description is aimed at those who work with the device over the entire life cycle and perform specific configurations.
Safety instructions (XA)	Depending on the approval, safety instructions for electrical equipment in hazardous areas are also supplied with the device. These are an integral part of the Operating Instructions. The nameplate indicates which Safety Instructions (XA) apply to the device.
Supplementary device-dependent documentation (SD/FY)	Always comply strictly with the instructions in the relevant supplementary documentation. The supplementary documentation is a constituent part of the device documentation.

2 Basic 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 steam calculator is a flow computer for calculating the mass and energy flow of steam. The mains-powered device is designed for use in industrial environments.

- The manufacturer accepts no liability for damages resulting from improper or non-intended use. The device must not be converted or modified in any way.
- The device may only be operated when installed.

2.3 Workplace safety

When working on and with the device:
- Wear the required personal protective equipment as per national regulations.

2.4 Operational safety

Damage to the device!
- ▶ Operate the device in proper technical condition and fail-safe condition only.
- ▶ The operator is responsible for the interference-free operation of the device.

Modifications to the device

Unauthorized modifications to the device are not permitted and can lead to unforeseeable dangers!
- ▶ If modifications are nevertheless required, consult with the manufacturer.

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 the repair of an electrical device.
- ▶ Use only original spare parts and accessories.

2.5 Product safety

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

2.6 IT security

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

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

3 Product description

3.1 Product design

The steam calculator is used for recording and billing steam mass and energy flow in systems with saturated or superheated steam. The calculation is based on the process values measured for volume flow, temperature and/or pressure. The calculator is suitable for connecting and supplying all common flow transmitters, temperature sensors and pressure sensors.

The device uses the IAPWS IF97 standard to calculate the mass flow and energy flow of steam. Here, the input variables pressure and temperature are used to calculate the density and enthalpy of steam. The compensation of the differential pressure flow measurement and the electronic adjustment of the temperature sensor (sensor-transmitter matching) with the calculator enable highly accurate and reliable measurements even under dynamic process conditions. Remote reading of the stored data is possible via Ethernet IP, Modbus or M-Bus.

4 Incoming acceptance and product identification

4.1 Incoming acceptance

On receipt of the delivery:

1. Check the packaging for damage.
   ↳ Report all damage immediately to the manufacturer.
   Do not install damaged components.
2. Check the scope of delivery using the delivery note.
3. Compare the data on the nameplate with the order specifications on the delivery note.
4. Check the technical documentation and all other necessary documents, e.g. certificates, to ensure they are complete.

If one of the conditions is not satisfied, contact the manufacturer.

4.1.1 Product identification

The device can be identified in the following ways:
- Nameplate specifications
- Enter the serial number from the nameplate into *Device Viewer* (www.endress.com/deviceviewer): all the information about the device and an overview of the Technical Documentation supplied with the device are displayed.
- Enter the serial number from the nameplate into the *Endress+Hauser Operations App* or scan the 2-D matrix code (QR code) on the nameplate with the *Endress+Hauser Operations App*: all the information about the device and the technical documentation pertaining to the device is displayed.

Nameplate

Do you have the correct device?

The nameplate provides you with the following information on the device:
- Manufacturer identification, device designation
- Order code
- Extended order code
- Serial number
- Tag name (TAG) (optional)
- Technical values, e.g. supply voltage, current consumption, ambient temperature, communication-specific data (optional)
- Degree of protection
- Approvals with symbols
- Reference to Safety Instructions (XA) (optional)

▶ Compare the information on the nameplate with the order.

Name and address of manufacturer

Name of manufacturer:	Endress+Hauser Wetzer GmbH + Co. KG
Address of manufacturer:	Obere Wank 1, D-87484 Nesselwang or www.endress.com

4.1.2 Storage and transport

Storage temperature: −30 to +70 °C (−22 to +158 °F)

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

Pack the device for storage and transportation in such a way that it is reliably protected against impact and external influences. The original packaging provides optimum protection.

Avoid the following environmental influences during storage:
- Direct sunlight
- Proximity to hot objects
- Mechanical vibration
- Aggressive media

5 Mounting

5.1 Mounting requirements

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

Its orientation is determined by the readability 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)

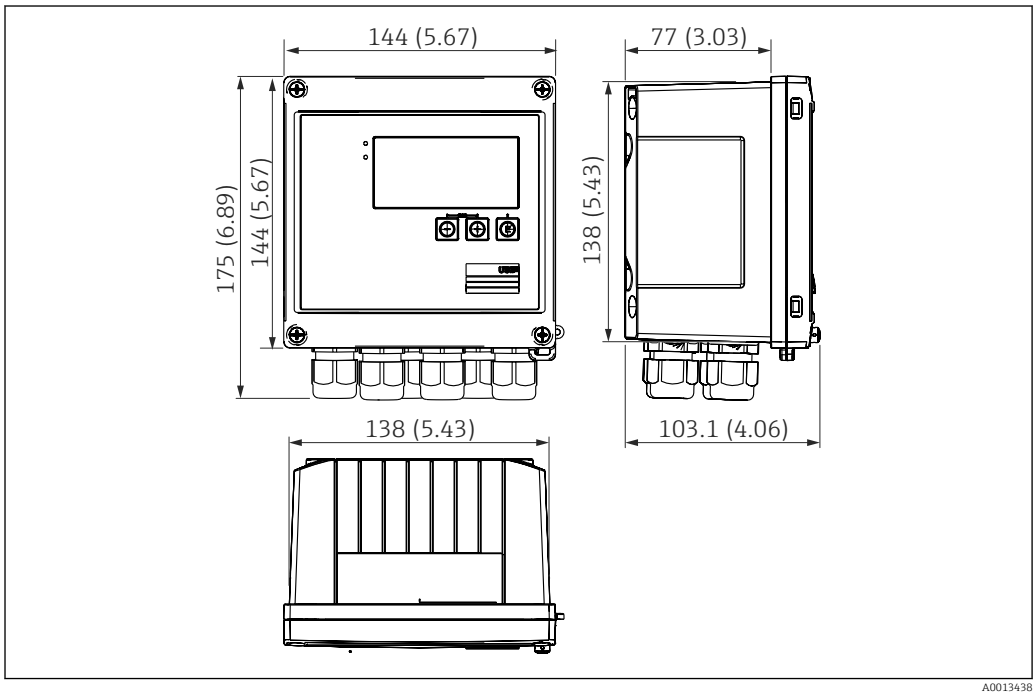
You can find more information in the "Technical data" section.

NOTICE

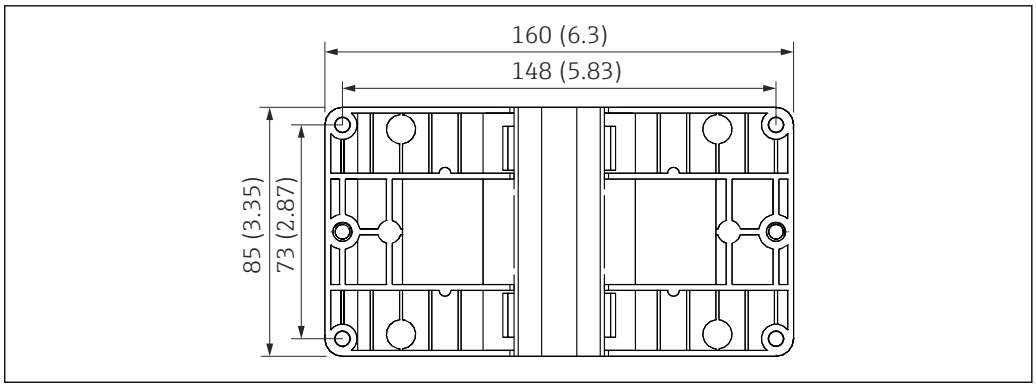
Overheating of the device due to insufficient cooling

▶ 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.

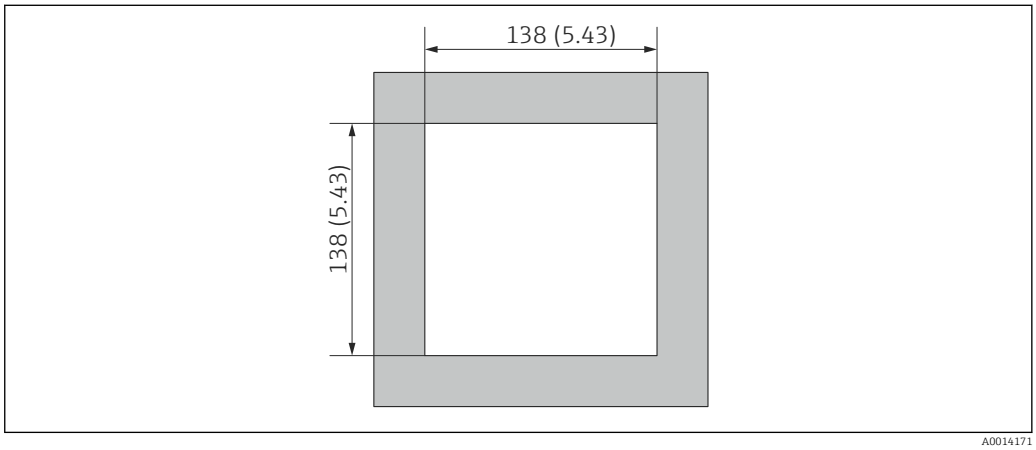
5.2 Dimensions



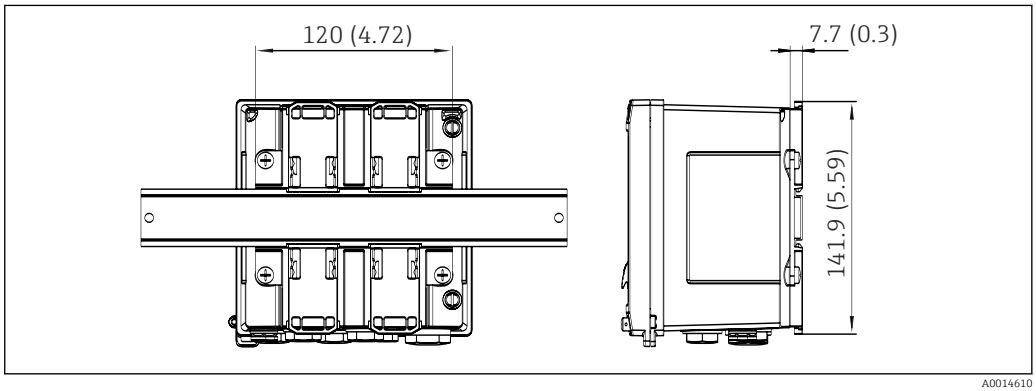
1 *Dimensions of the device in mm (in)*



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



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

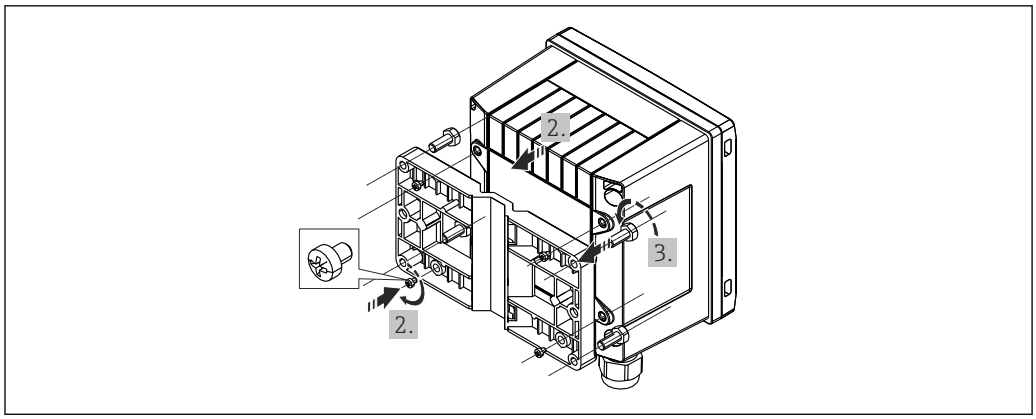


4 *Dimensions of DIN rail adapter in mm (in)*

5.3 Mounting the device

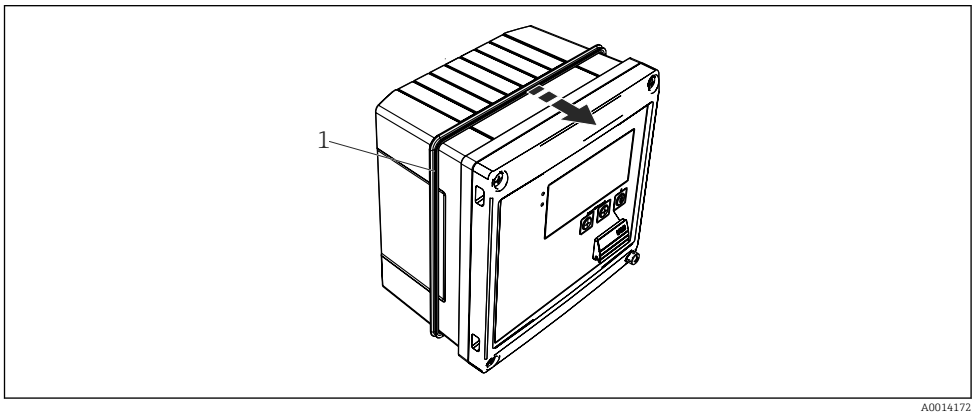
5.3.1 Wall mounting

1. Use the mounting plate as the template for drilled holes, dimensions → 2, 9
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.



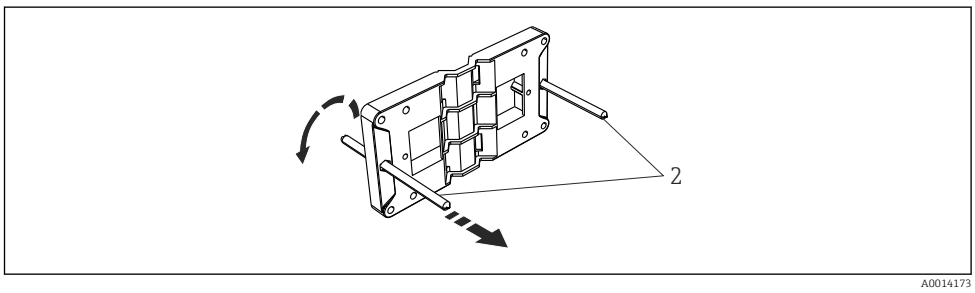
5 *Wall mounting*

5.3.2 Panel mounting

1. Make the panel cutout in the required size, dimensions → 3, 9
2. 

6 *Panel mounting*

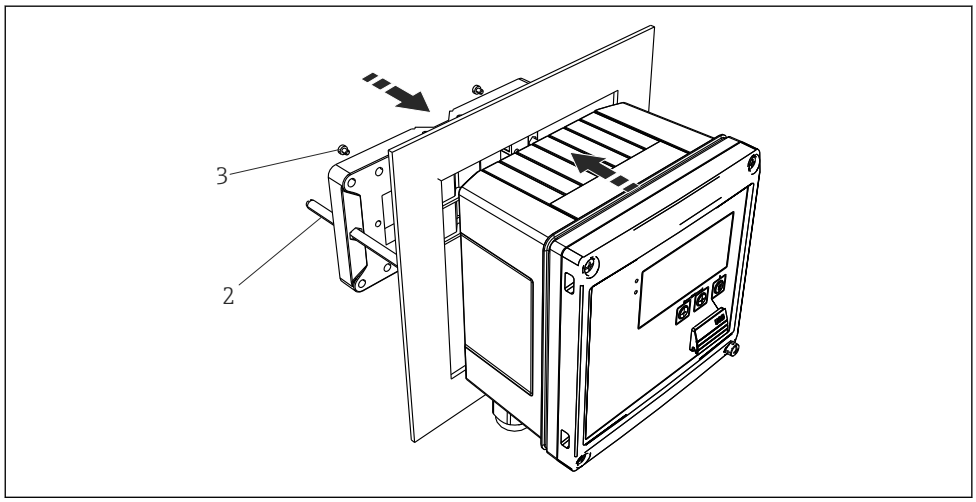
Attach the seal (item 1) to the housing.

3. 

7 *Preparing the mounting plate for panel mounting*

Screw the threaded rods (item 2) into the mounting plate (dimensions → 2, 9).

4.



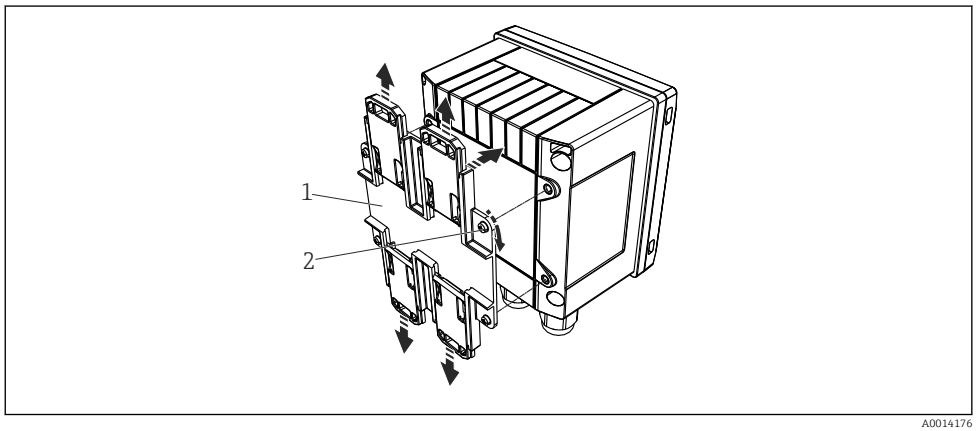
8 *Panel mounting*

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.

5.3.3 Support rail/DIN rail (to EN 50 022)

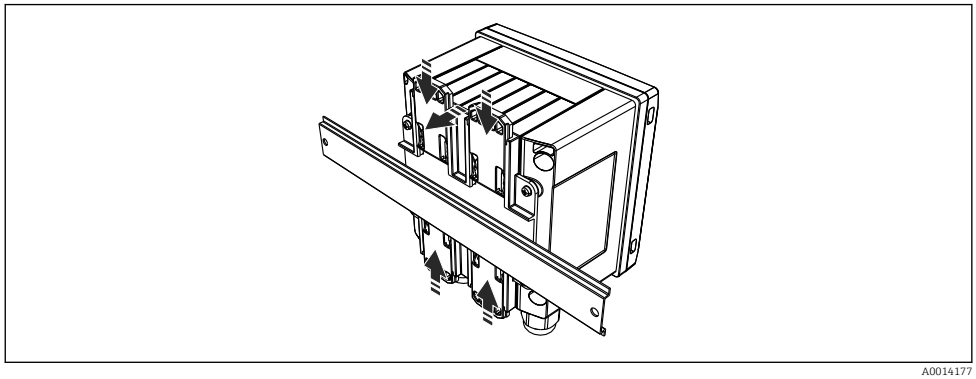
1.



9 *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.

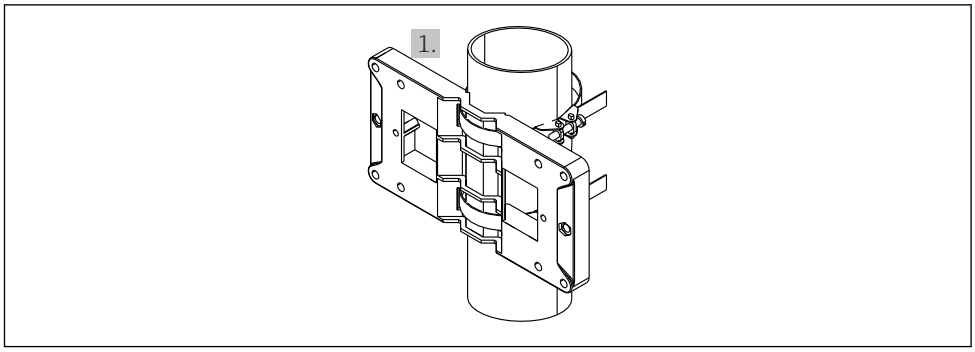


10 *DIN rail mounting*

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

5.3.4 Pipe mounting

1.

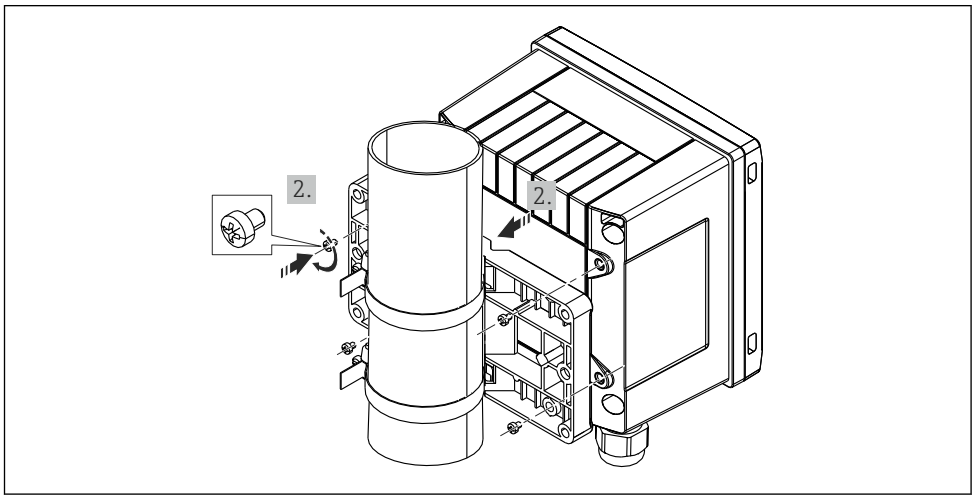


A0014178

11 Preparing for pipe mounting

Pull the steel belts through the mounting plate (dimensions → 2, 9) and fasten them to the pipe.

2.

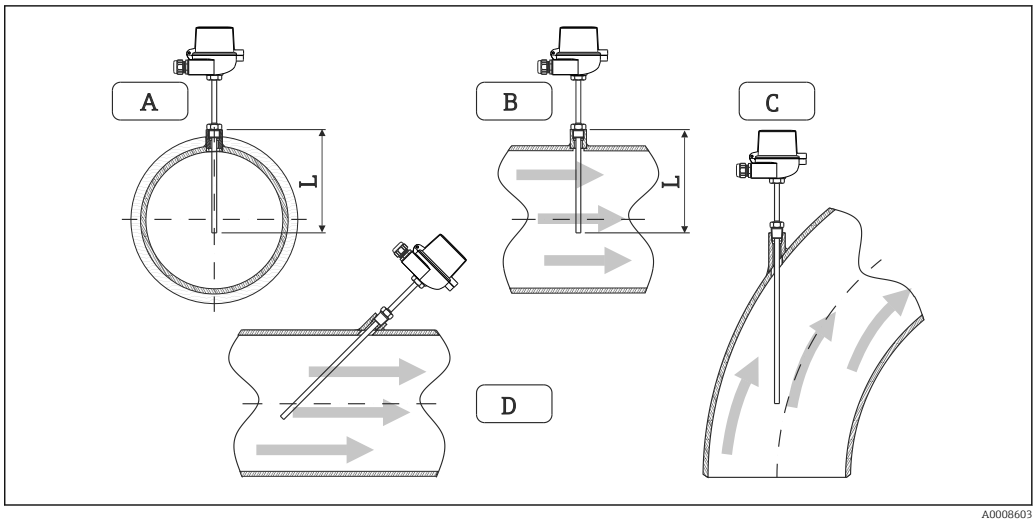


A0014179

12 Pipe mounting

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

5.4 Installation instructions for temperature sensor(s)



13 *Installation types for temperature sensors*

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

The installation depth of the thermometer influences the measurement accuracy. If the installation depth is insufficient, 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.

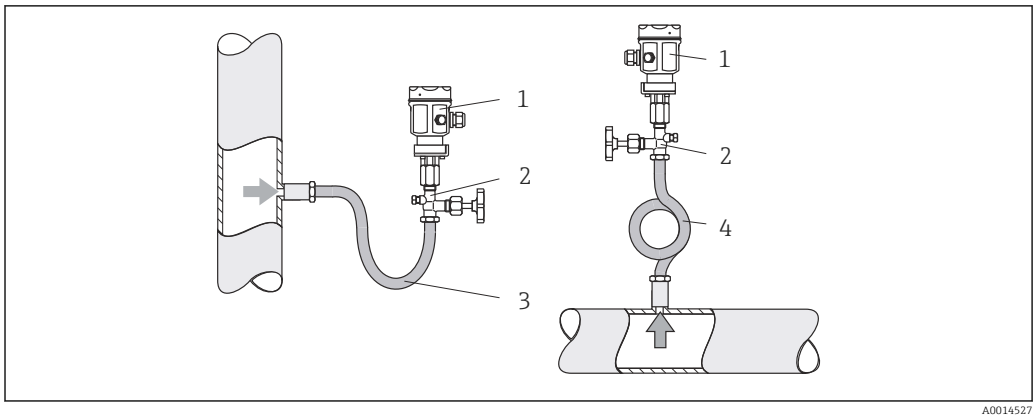
- Installation possibilities: Pipes, tanks or other plant components
- Minimum immersion depth = 80 to 100 mm (3.15 to 3.94 in)
  The immersion depth should correspond to at least 8 times the thermowell diameter. Example: Thermowell diameter 12 mm (0.47 in) x 8 = 96 mm (3.8 in). We recommend a standard immersion 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 (→ 13, 13, item A and B). Another solution may be diagonal installation (→ 13, 13, 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.

Detailed information: BA01915T

5.5 Pressure measuring cell installation instructions



14 *Measuring arrangement for pressure measurement in steams*

1 Pressure measuring cell
2 Shutoff device
3 U-shaped water pocket
4 O-shaped water pocket

- Mount the pressure measuring cell with the siphon above the tapping point. The siphon reduces the temperature to almost ambient temperature.
- Fill the siphon with liquid before commissioning.

6 Electrical connection

6.1 Connecting requirements

⚠ WARNING

Danger! Electric voltage!

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

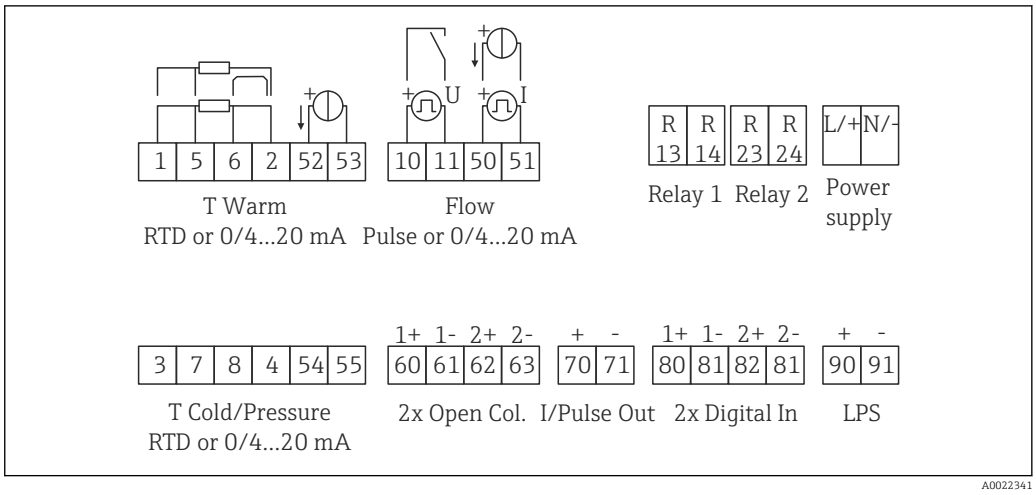
⚠ CAUTION

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 steam calculator and the associated components, observe the general installation instructions according to EN1434 Part 6.

6.2 Connecting the device



15 *Connection diagram of the device*

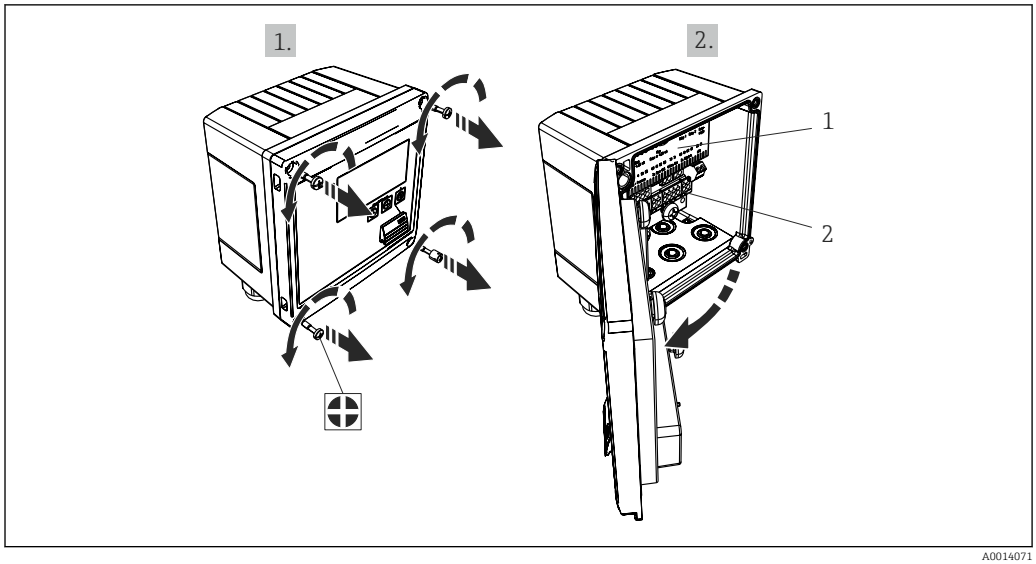
Terminal assignment

- 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 steam (Optionally RTD or current input)
2	- RTD power supply	
5	+ RTD sensor	
6	- RTD sensor	
52	+ 0/4 to 20 mA input	
53	Signal ground for 0/4 to 20 mA input	
3	+ RTD power supply	Pressure (steam)
4	- RTD power supply	
7	+ RTD sensor	
8	- RTD sensor	
54	+ 0/4 to 20 mA input	
55	Signal ground for 0/4 to 20 mA input	
10	+ pulse input (voltage)	Flow (Optionally pulse or current input)
11	- pulse input (voltage)	
50	+ 0/4 to 20 mA or current pulse (PFM)	
51	Signal ground for 0/4 to 20 mA input flow	
80	+ digital input 1 (switch input)	▪ Start tariff counter 1 ▪ Time synchronization ▪ Lock device
81	- digital input (terminal 1)	
82	+ digital input 2 (switch input)	▪ Start tariff counter 2 ▪ Time synchronization ▪ Lock device
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 (e.g. for sensor power supply)
91	Power supply ground	
		Power supply
L/+	L for AC + for DC	
N/-	N for AC - for DC	

6.2.1 Opening the housing



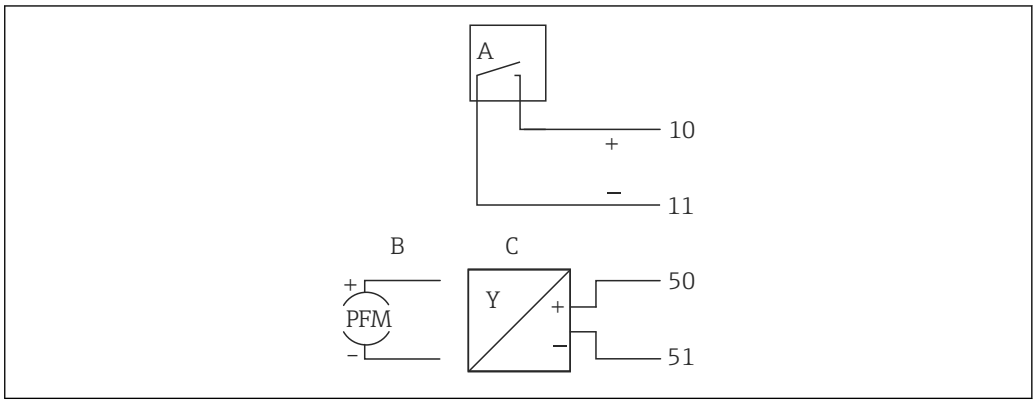
16 Opening the housing of the device

1 Terminal assignment labeling
2 Terminals

6.3 Connecting the sensors

6.3.1 Flow

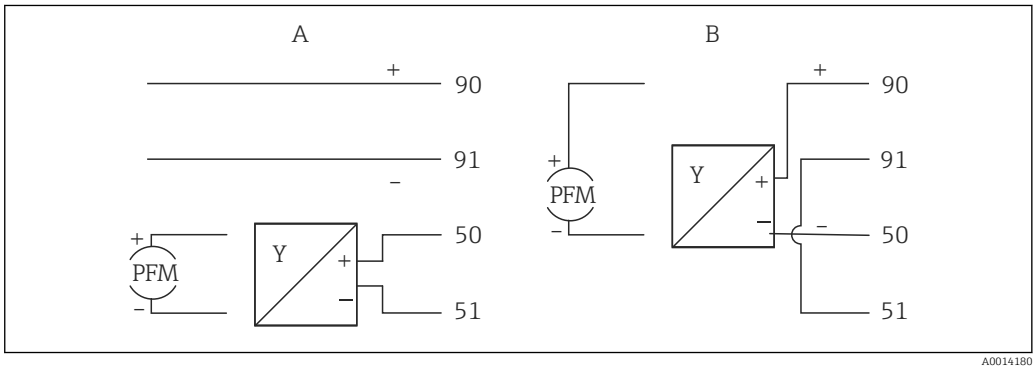
Flow sensors with external power supply



17 *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

Flow sensors with power supply via the steam calculator

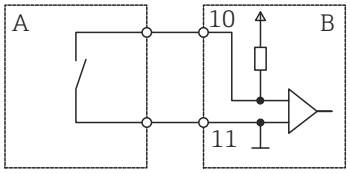
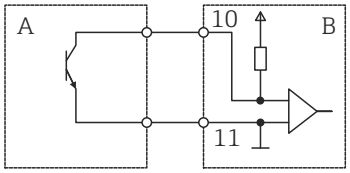
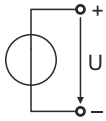
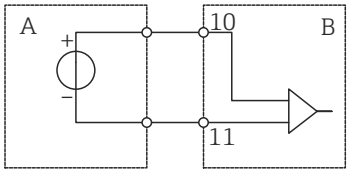
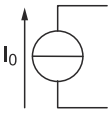
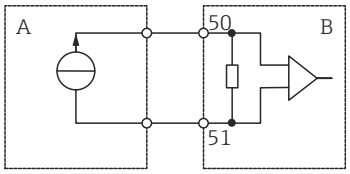
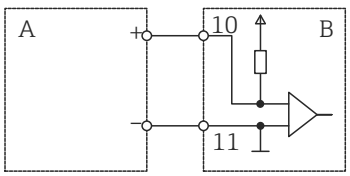


18 *Connecting active flow sensors*

A 4-wire sensor
B 2-wire sensor

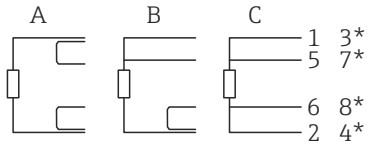
Settings for flow sensors with pulse output

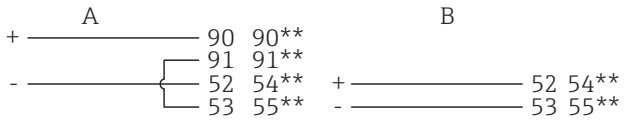
The input for voltage pulses and contact sensors is divided into different types according to EN1434 and provides a power supply for switching contacts.

Pulse output of the flow sensor	Setting at the Rx33	Electrical connection	Note
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
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 ≥ 2 V corresponds to High level 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 ≥ 2.1 mA corresponds to High level U no-load: 7 to 9 V	

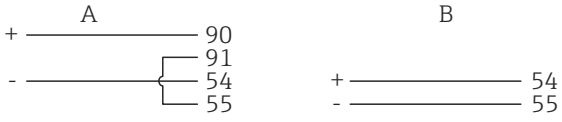
6.3.2 Temperature

Connecting the RTD sensors	 A0014529 A = 2-wire connection B = 3-wire connection C = 4-wire connection * only use in event of energy calculation with heat differential /T, temperature sensor in steam Terminals 1, 2, 5, 6: temperature Terminals 3, 4, 7, 8: temperature

iTEMP temperature transmitter connection	 A0014528 A = without external power supply of the transmitter, B = with external power supply of the transmitter ** only use in event of energy calculation with heat differential /T, temperature sensor in steam Terminals 90, 91: transmitter power supply Terminals 52, 53: temperature input

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

6.3.3 Pressure

Pressure measuring cell connection	 A0015152 A = 2-wire sensor with power supply via the steam calculator B = 4-wire sensor with external power supply Terminals 90, 91: transmitter power supply Terminals 54, 55: pressure

6.4 Outputs

6.4.1 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, → 15.

6.4.2 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, → 34.

6.4.3 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

6.4.4 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**

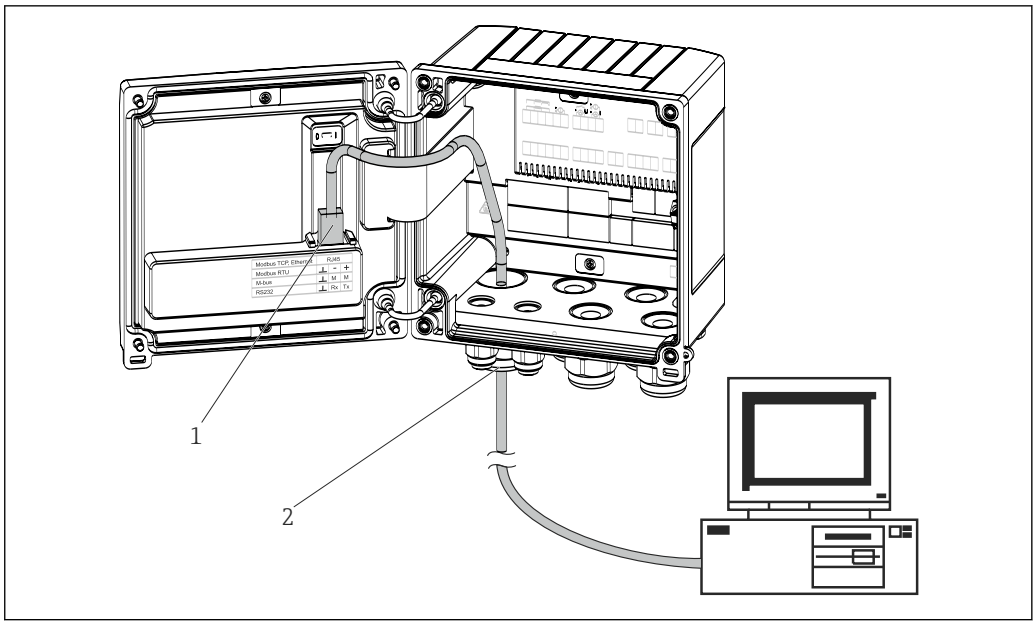
6.5 Communication

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.

6.5.1 Ethernet TCP/IP (optional)

The Ethernet interface is galvanically isolated (testing 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



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

1 Ethernet, RJ45
2 Cable entry for Ethernet cable

6.5.2 Modbus TCP (optional)

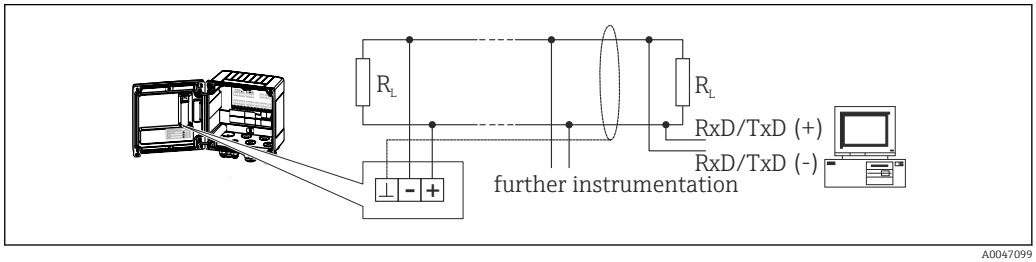
The Modbus TCP interface is used to connect the device to higher-order systems to transmit all measured values and process values. The Modbus TCP interface is physically identical to the Ethernet interface → 19, 21

The device can only be read from a Modbus master.

Detailed information for the Modbus register map: www.endress.com

6.5.3 Modbus RTU (optional)

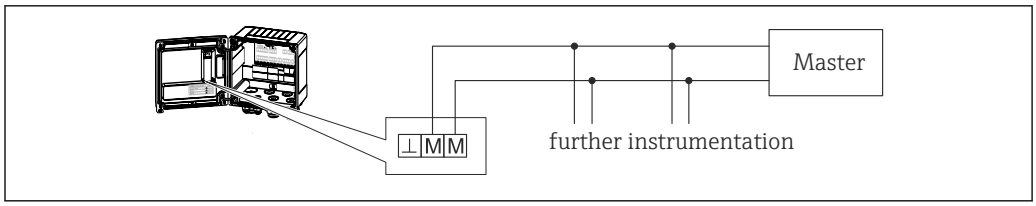
The Modbus RTU (RS-485) interface is galvanically isolated (testing voltage: 500 V) and used to connect the device to higher-level systems to transmit all measured values and process values. It is connected via a 3-pin plug-in terminal in the housing cover.



20 *Connection of Modbus RTU*

6.5.4 M-Bus (optional)

The M-Bus (Meter Bus) interface is galvanically isolated (testing 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.



21 Connection of M-Bus

6.6 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 information on the nameplate?	100 to 230 V AC/DC (±10 %) (50/60 Hz) 24 V DC (−50 % / +75 %) 24 V AC (±50 %) 50/60 Hz
Are the mounted cables relieved of tension?	-
Are the power supply and signal cables connected correctly?	See wiring diagram on the housing

7 Operation options

7.1 Overview of operation options

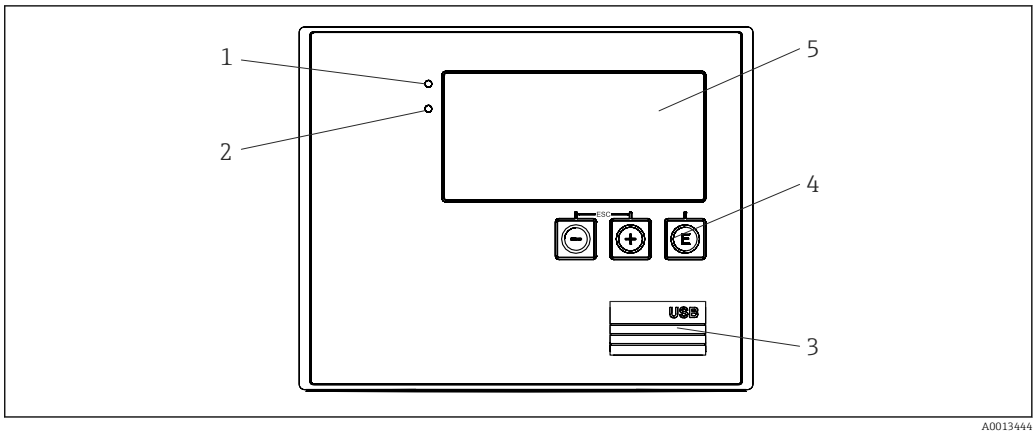
The steam calculator can be configured using operating keys or with the help of the "FieldCare" operating software.

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 → 24, the user code or digital input.

For details, see → 38

7.2 Display and operating elements



22 *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.

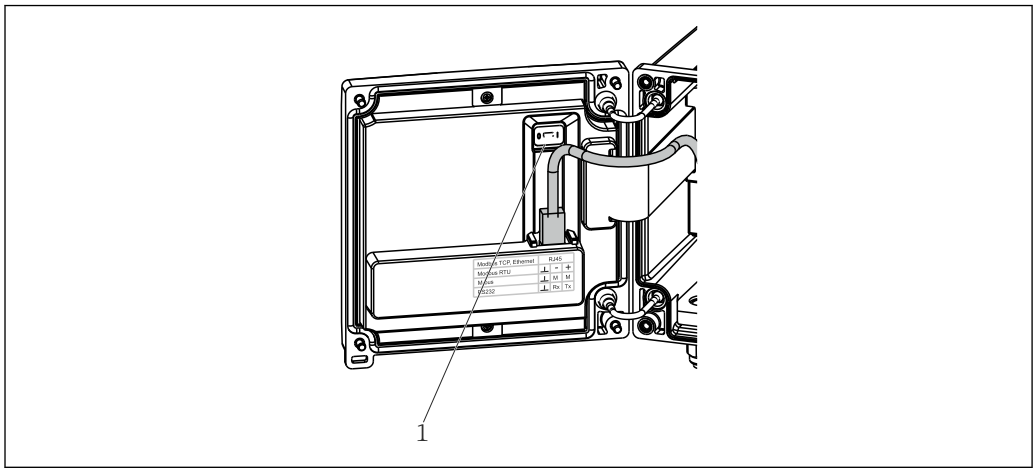
7.2.1 Operating elements

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

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

Enter/Confirm entry function: Press "E"

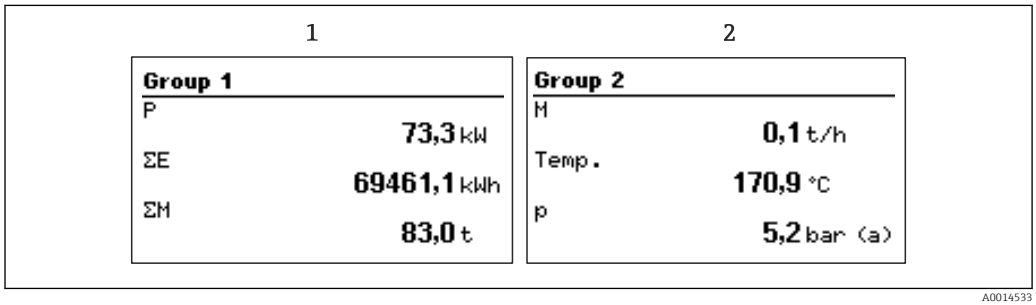
Write protection switch



23 Write protection switch

1 Write protection switch on rear of housing cover

7.2.2 Display



24 Steam calculator display (example)

1 Group 1 display
2 Group 2 display

7.2.3 "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.

Connecting the device

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 RS33.
6. Click Connect.
7. Start parameter configuration.

Continue with device configuration in accordance with the 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 FieldCare Device 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.

7.3 Structure and function of the operating menu

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

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) ▪ Configure brightness and contrast of display ▪ 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. ▪ Units ▪ Pulse value, value ▪ Date and time ▪ Pressure Parameters for quick commissioning Advanced setup (settings that are not essential for the basic operation of the device) Special settings can also be configured via the "Expert" menu.

Diagnostics menu	Device information and service functions for a quick device check. ▪ Diagnostic messages and list ▪ Event logbook ▪ Device information ▪ Simulation ▪ Measured values, outputs

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

8 Commissioning

Perform the following checks before commissioning the device:
Perform the post-connection check using the 'Post-connection check' section, → 22.

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 operating keys or the "FieldCare" parameter configuration software → 24.

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

8.1 Quick commissioning

The standard application for steam mass/energy is commissioned in just a few moments by simply configuring 5 operating parameters in the **Setup** menu.

Prerequisites for quick commissioning:

- Flow transmitter with pulse output
- RTD temperature sensor, 4-wire direct connection
- Absolute pressure measuring cell with current output 4 to 20 mA

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
- **Date/time**: Set the date and time
- **Pressure**: Set the measuring range for the pressure measuring cell

The device is now operational and ready to measure the steam mass and heat 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 → 32 or in the **Expert** menu→ 44.

Here, you can also find the settings for the inputs (e.g. when connecting a gauge pressure measuring cell, flow transmitter with a current output etc.).

- 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:
  Select the signal type and enter the type of connection or the start and end of the measuring range (for current signals).
- Inputs/pressure:
  Select the signal type and the pressure unit (absolute or gauge) and enter the start and end of the measuring range.

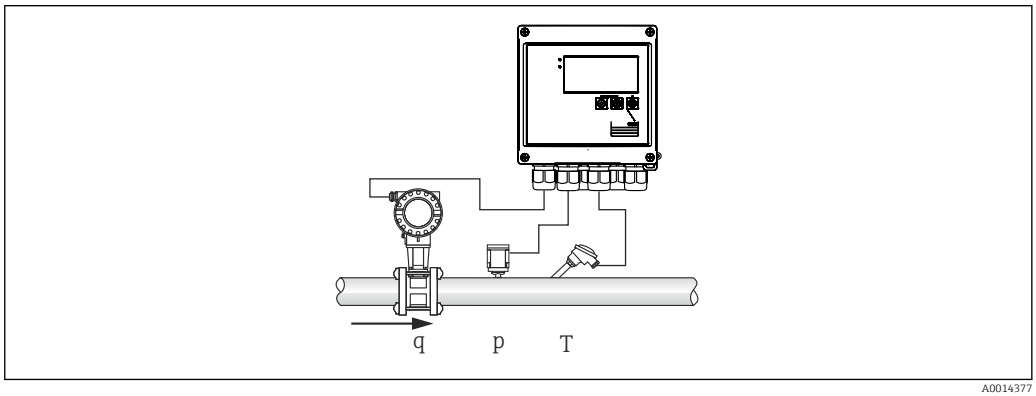
8.2 Applications

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

The device can be used for the following applications:
- Steam mass and energy, → 27
- Tariff counter for steam mass and energy flow, → 31

8.2.1 Steam mass and energy

Calculation of the mass flow and the quantity of heat it contains at the output of a steam generator or for individual consumers.



25 *Steam mass and energy application*

Input signals:

Flow, Qv (pulse input or current input)

Temperature (RTD or current input)

Pressure (current input)

Users can choose not to perform pressure or temperature measurement when measuring saturated steam (see "Miscellaneous notes").

The pressure and temperature must be measured in order to measure superheated steam.

Required settings:

1. Flow transmitter: enter pulse value or scale current input range
2. Temperature input: select RTD type and temperature range or scale the temperature range
3. Pressure input: Select the type of pressure measuring cell (gauge or absolute pressure measuring cell) and scale the measuring range. If gauge pressure is selected, check the value for the atmospheric pressure and change it if necessary.

Display variables:

Mass flow, power (heat flow), volume flow, temperature, pressure, enthalpy, density.

Counters: mass, energy, volume, deficit counter, (optional tariff counter, → 31, → 35).

Miscellaneous notes:

Wet steam alarm

You can configure how the device reacts when a wet steam alarm occurs. A wet steam alarm is triggered if the measured temperature reaches or drops below the condensate temperature (saturated steam temperature) calculated on the basis of the pressure. The wet steam alarm indicates that increased steam condensation can be expected. In the event of a wet steam alarm, the saturated steam condition is determined on the basis of the measured pressure and the calculated quantities of steam are totalized by either the "normal" counter, the wet steam counter (tariff counter1) or the deficit counter. For details, see the "Failure mode" section, → 🖹 44.

Saturated steam measurements

You do not require the pressure or temperature sensor to measure the saturated steam. The missing variable (P or T) is determined using the saturated steam curve stored in the system. However, for reasons of safety and to ensure maximum accuracy, it is advisable to measure the flow, pressure and temperature for every steam application. This is the only way to monitor the steam condition closely and ensure a "wet steam alarm" is issued when the condensate temperature of the steam is reached. In addition, this reliably monitors whether pressure and temperature measurement return implausible values and whether the sensors are not operating correctly. Any inaccuracies in the temperature measurement (e.g. caused by installation errors) are easily detected and corrected.

Example: During ongoing operation, the measured temperature is below the saturated steam temperature which would mean that pure water is flowing through the steam pipes. By entering an offset value, the temperature measurement can be adjusted to a value slightly above (approx. 1-2 °C (1.8-3.6 °F)) the saturated steam temperature. This ensures that steam measurement works correctly and that a wet steam alarm is only issued when real measurement errors or process errors occur.

Energy calculation:

The heat content of steam - also known as the enthalpy - is calculated with reference to 0 °C (32 °F). However, the reference temperature for calculating the enthalpy can be changed from 0 °C (32 °F) to another value.

Example: You want to calculate the energy needed to generate steam (in a steam boiler). Here, the reference value for calculating the energy is the feedwater temperature, e.g. 100 °C (212 °F), and not 0 °C (32 °F). Alternatively you can also calculate the energy consumption in a heat exchanger by setting the average condensate temperature as the reference temperature.

The reference temperature can be set in the Expert/Application/Feedwater Temperature menu.

Calculation

$E = q * \rho(T, p) * [h_D(T, p)]$

E	Heat quantity
q	Operating volume
ρ	Density
T	Temperature
p	Pressure
h_D	Enthalpy of steam

8.2.2 Steam heat differential

Calculation of the quantity of heat given off when the steam condenses in a heat exchanger.

Alternatively, also calculation of the quantity of heat (energy) which is used to generate steam.

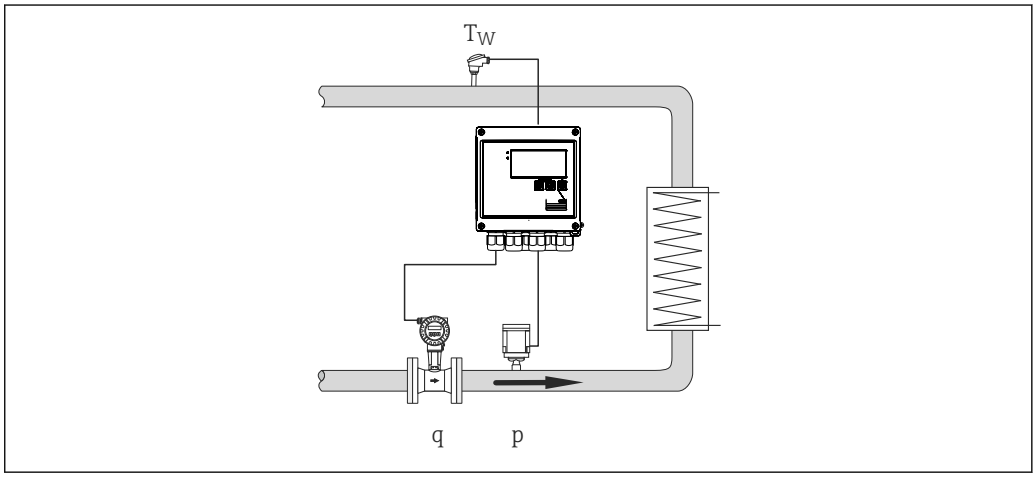
The quantity of heat can be calculated in a variety of ways with the RS33. Various combinations of input signals and installation locations can be selected for this purpose.

The various calculation methods can be found in the Setup:

Menu Setup → Advanced setup → Application → Op. mode steam

Heat differential/p

The energy is calculated from the difference between enthalpy (steam) and enthalpy (condensate temperature). The condensate pressure is calculated from the condensate temperature, while the steam temperature is calculated from the steam pressure (saturated steam curve).



Input signals:

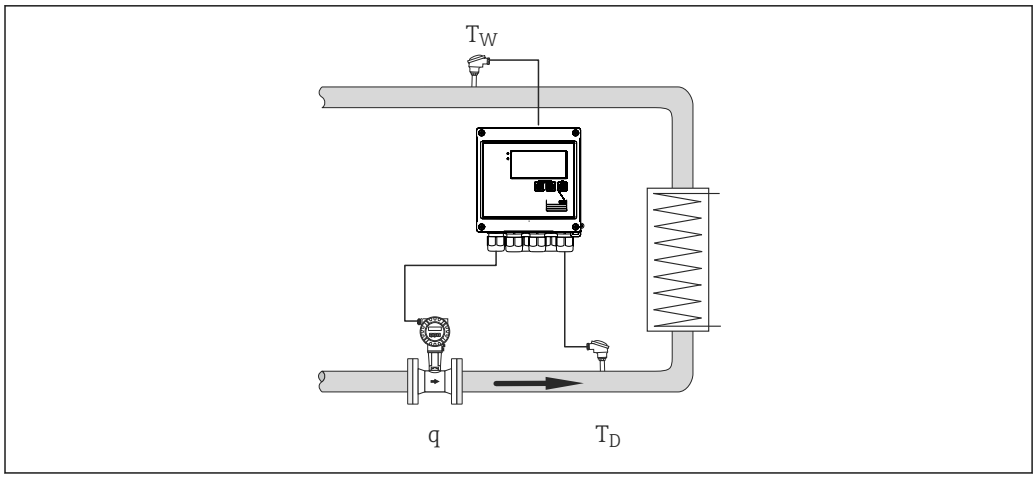
Flow, Qv (pulse input or current input)

Condensate temperature (RTD or current input)

Steam pressure (current input)

Heat differential/T

The energy is calculated from the difference between enthalpy (steam) and enthalpy (condensate temperature). The condensate pressure is calculated from the condensate temperature, while the steam pressure is calculated from the steam temperature (saturated steam curve).



A0022322

Input signals:

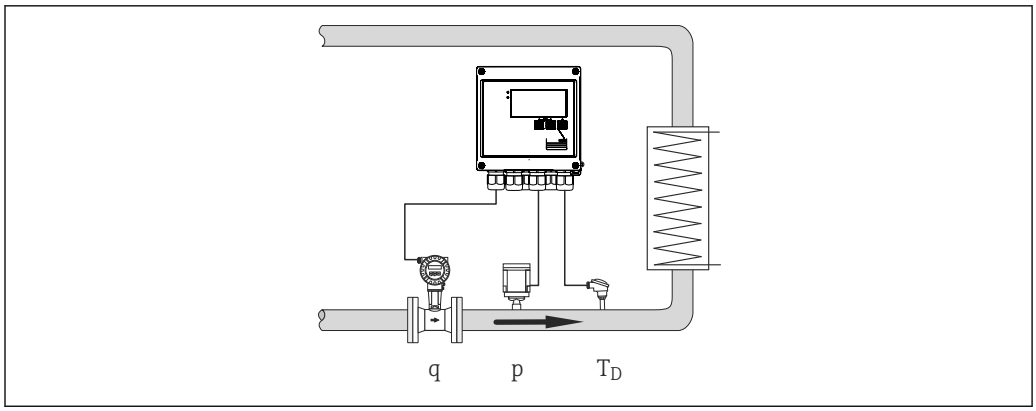
Flow, Qv (pulse input or current input)

Condensate temperature (RTD or current input)

Steam temperature (RTD or current input)

Heat differential/p+T

The energy is calculated from the difference between enthalpy (steam) and enthalpy (condensate temperature). It is presumed that the pressure in the condensate corresponds to the pressure in the steam. The condensate pressure is calculated from the condensate temperature, while the steam pressure is calculated from the steam temperature (saturated steam curve).



A0022323

Input signals:

Flow, Qv (pulse input or current input)

Steam temperature (RTD or current input)

Steam pressure (current input)

Display variables for all 3 calculation methods:

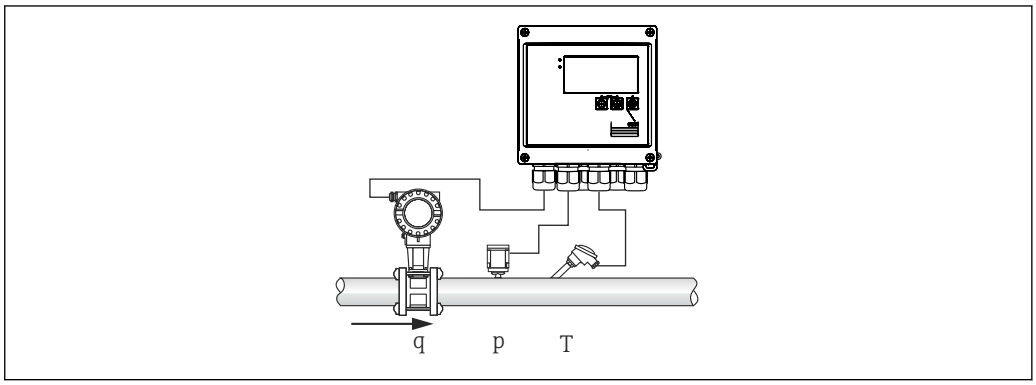
Power (heat flow), mass flow, volume flow, temperature, pressure, enthalpy, density.

Totalizer: mass, energy, volume, deficit counter

8.2.3 Tariff counter for steam mass and energy flow (option)

This is used for calculating the steam mass flow and the heat quantity it contains. The mass or energy are calculated on different counters depending on specific events. For example, the quantity of steam can be recorded separately and invoiced differently depending on the time of day or the level of consumption.

Similarly bidirectional flow and energy can be recorded on the tariff counters.



26 *Using the tariff counter for steam mass and energy flow (option)*

Input signals:

Flow, Qv (pulse input or current input)

Pressure (current input)

Temperature (RTD or current input)

Users can choose not to perform pressure or temperature measurement when measuring saturated steam (see "Miscellaneous notes").

Required settings:

1. Flow transmitter: enter pulse value or scale current input range
2. Temperature input: select RTD type and temperature range or scale the temperature range
3. Pressure input: Select the type of pressure measuring cell (gauge or absolute pressure measuring cell) and scale the measuring range. If gauge pressure is selected, check the value for the atmospheric pressure and change it if necessary.
4. Select the tariff model and make the tariff settings. Set under: Setup → Application → Tariff

Display variables:

Power, volume flow, temperature, enthalpy difference, density.

Counters: mass, energy, volume, energy deficit counter, tariff counter.

Miscellaneous notes

- For notes on the wet steam alarm and saturated steam measurements, → 27.
- The tariff counter can be used to record the quantity of steam during a wet steam alarm ("Wet steam" tariff model).

The tariff counters are activated via the digital inputs or a limit value (e.g. mass flow 0 kg/h) to record the amounts in bidirectional mode.

Calculation

$E = q * \rho(T, p) * [h_D(T, p)]$

E	Heat quantity
q	Operating volume
ρ	Density
T	Temperature
p	Pressure
h_D	Enthalpy of steam

8.3 Configuring the basic parameters/general device functions

- Inputs, → 32
- Outputs, → 33
- Limits, → 34
- Display/units, → 35
- Data logging, → 36
- Access protection/locking, → 38
- Communication/fieldbus systems, → 39

8.3.1 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, → 19.

Pulse value and K-factor

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

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 → 67.

Configuration of flow measurements according to the differential pressure principle (DP, for example: orifice plate) is described in → 46.

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.

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** → **Range**.

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

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

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 Time synchronization Lock device	Activate tariff counter 2 Time synchronization Lock device

8.3.2 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.

8.3.3 Limit values

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:

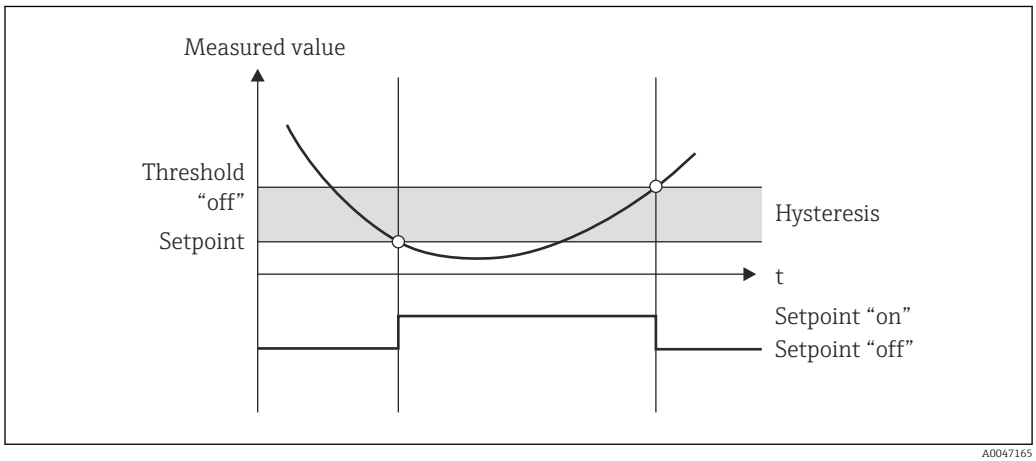
Off

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.

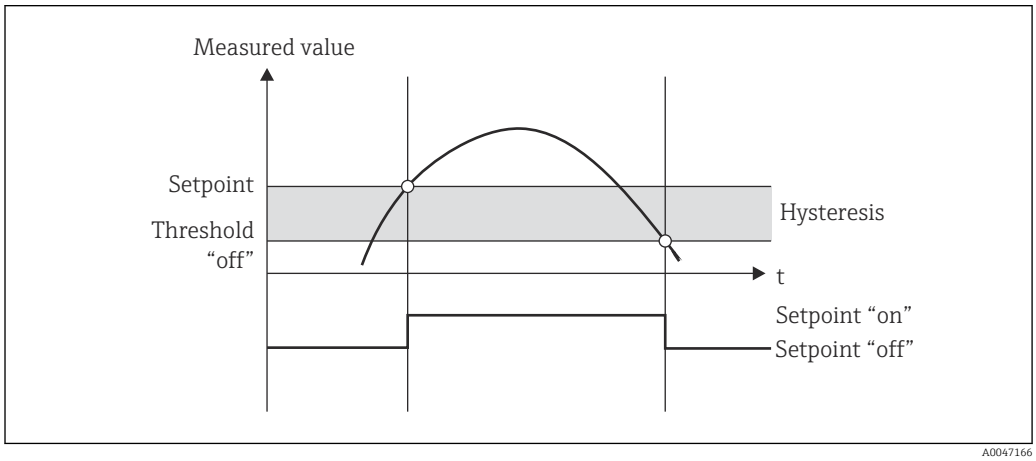
Example: Limit value 100 °C (212 °F), hysteresis 1 °C (1.8 °F) → Limit value on = 100 °C (212 °F), Limit value off = 101 °C (213.8 °F)).



27 "SP lower" operating mode

Upper set point (SP upper)

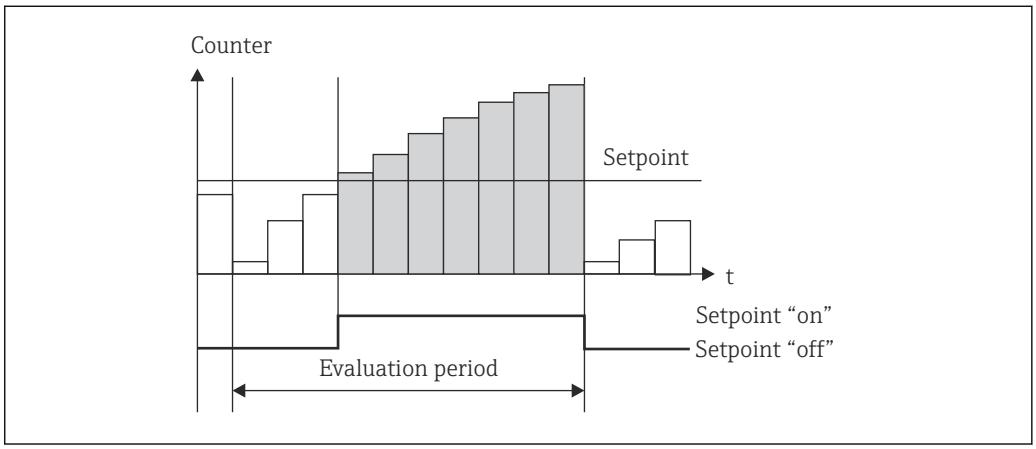
The limit value is active if the value exceeds the configured value. The limit value is switched off if the limit value, including hysteresis, is undershot.



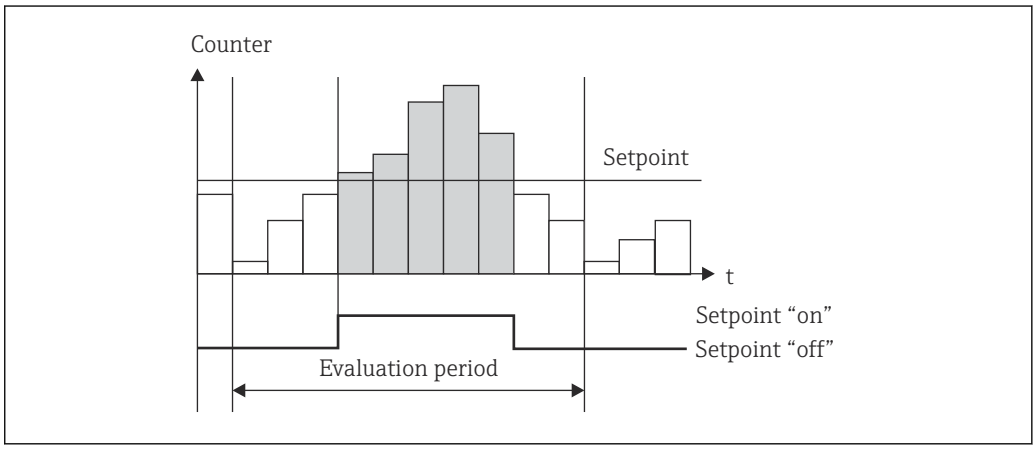
28 "SP upper" operating mode

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).



29 *Limit value for counters*



30 *Limit value for counters*

8.3.4 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	Mass flow	Temperature	Pressure
3	Pulse value. Q	User-defined	User-defined
4	User-defined	User-defined	User-defined

Group	Value 1	Value 2	Value 3
5	User-defined	User-defined	User-defined
6	Current date	Current time	User-defined

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, see → 🖹 36 "Data logging")

Hold function – "freezing" the display

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 configuration 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 information on the conversion of units, see the appendix → 🖹 83.

8.3.5 Data logging

The device stores relevant measured values and counter data at defined times. The averages for volume flow, power, temperature and pressure are calculated and stored in an adjustable interval (1 min – 12 h). The average values for volume flow, power, temperature and pressure are calculated daily, monthly and annually. 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: ▪ Temperature ▪ Pressure ▪ Mass flow ▪ Power
Day	Calculation of min, max and average as well as stored counters. The min and max value are calculated from the instantaneous min/max values. The average is calculated from the averages of the interval evaluation. Min, max and average values are determined for: ▪ Mass flow ▪ Power ▪ Temperature ▪ Pressure Counters are determined for: ▪ Operating volume ▪ Heat (energy) ▪ Tariff 1 ▪ Tariff 2 ▪ Deficit counter For counters, the cumulative counter and the totalizer are stored. 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: ▪ Operating volume ▪ Heat (energy) ▪ Tariff 1 ▪ Tariff 2 ▪ Deficit counter 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 delete these, the entire measured value memory must be cleared.

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 event text)

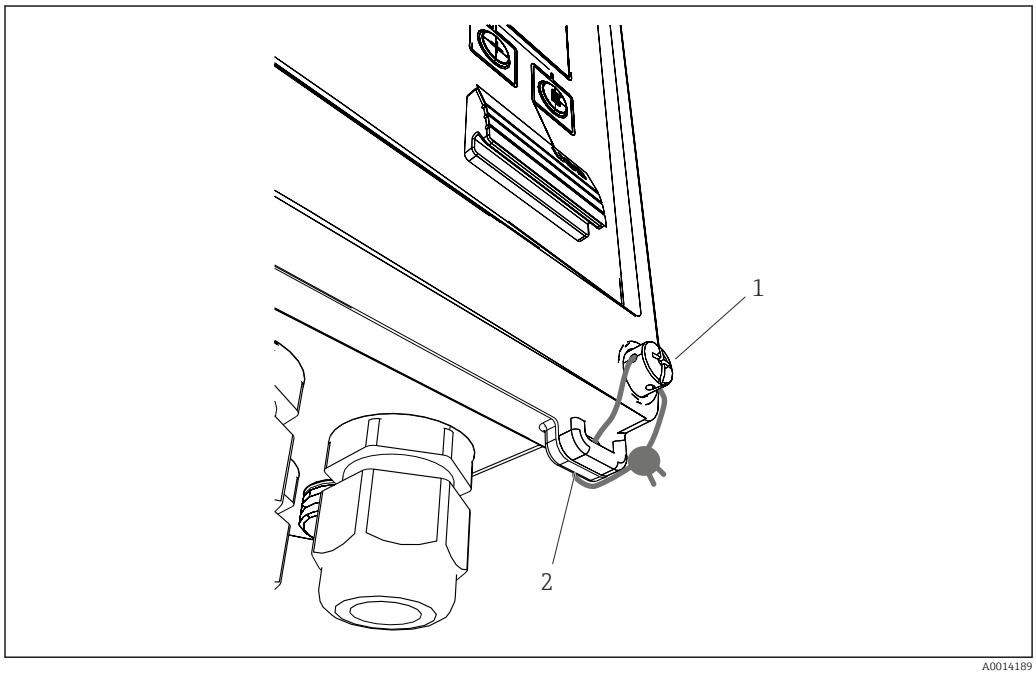
8.3.6 Access protection

To prevent tampering, the device can be protected using a hardware switch in the device → 24, an operating code, lead sealing and/or locking via a digital input.

Protection by code

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

Lead sealing on the device



31 *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.

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.

8.3.7 Logbooks

Changes to the setup are recorded in entries in the event 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.

8.3.8 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 item	Parameter	Description
Baud rate	**300**/2400/9600	Transmission rate
Device 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)

Detailed information for the Modbus register map: www.endress.com

The device can be connected to a Modbus system via RS485 or Ethernet interface. The general settings for the Ethernet connection are made in the **Setup** → **Advanced setup** → **System** → **Ethernet** menu, → 42. Modbus communication is configured in the **Setup** → **Advanced setup** → **System** → **Modbus** menu.

Menu item	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 steam calculator:

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 steam calculator in event of 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	Device 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 steam calculator in event of 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

In the event of checksum or parity errors in the request from the master, the steam calculator 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 → 40

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.

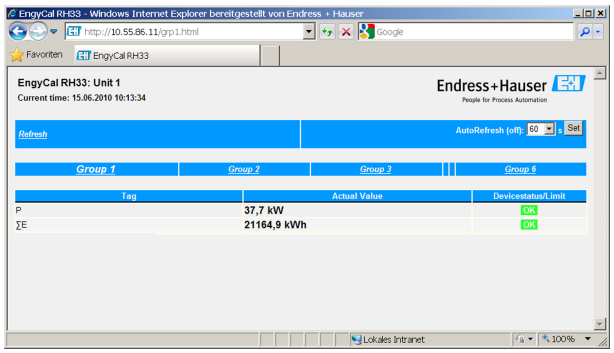
As soon as the max. number of connections is reached, new connection attempts are blocked until an existing connection is terminated.

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.



32 *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 in HTML or XML format via the Web server.

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 0 = OK, 1 = warning, 2 = error
hlsts1	Error description 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.

8.4 Optional device settings/special functions

- "Expert" menu (fine-tuning of the device) → 44
- Failure mode → 44
- Tariff counter → 45
- Temperature sensor matching (CVD) → 45
- DP flow calculation (e.g. orifice plate) → 46

8.4.1 "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.

8.4.2 Failure mode

In the Expert menu, you can configure the failure 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 maximum permissible errors 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 failure mode affects the display, counters and outputs as follows.

	Measurement 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

	Measurement range				
RTD	T outside measuring range				
Effect	Configurable in setup: ▪ No further calculation and failure current at output ▪ 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" The "fault" relay/OC switches.		Normal calibration. The "fault" relay/OC is not switched.		

8.4.3 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	
Mass flow	
Temperature	
Pressure	
Energy	▪ Limit value ▪ 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 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)
Wet steam	Counter type: Energy or mass

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 → 44.

If the tariff type is changed, the counter reading is reset to zero! → 44

8.4.4 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.

As part of the temperature sensor calibration (electronic pairing), what are known as Callendar-Van 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 menu. Entry of the coefficients takes place in the Inputs/Temperature/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) $Rt = R0 * (1 + A * t + B * t^2)$

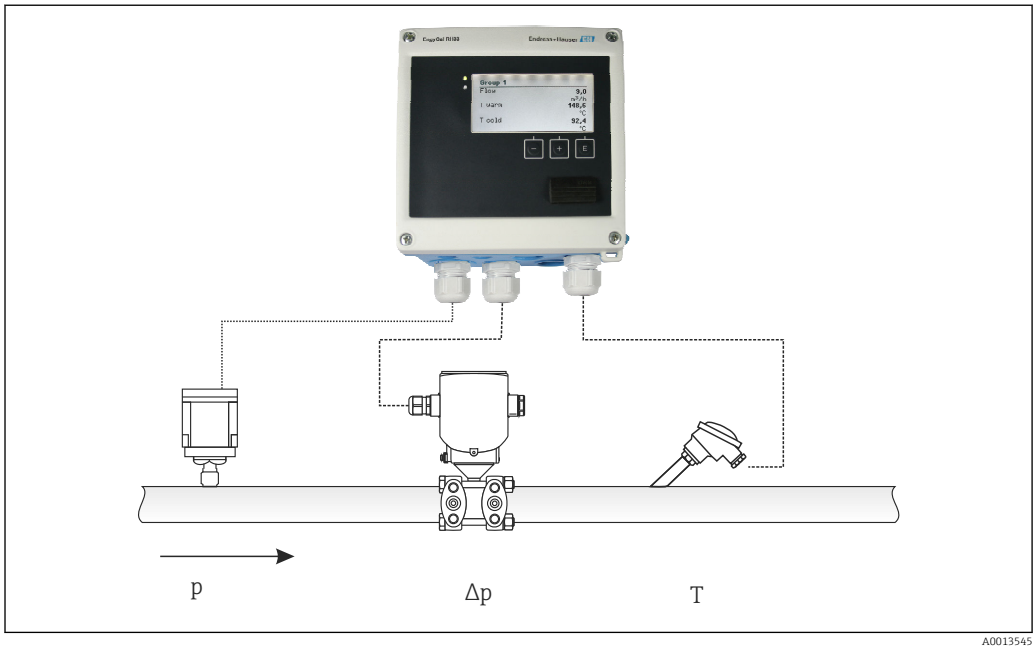
Operating options	Description/remarks
R0	See equation. Input in ohms. Range: 40.000 to 1 050.000 Ohm
A, B, C	CvD coefficients. Input in Exp format (x,yyE±zz)

8.4.5 DP flow calculation (flow measurement according to the differential pressure method)

General information

The steam calculator calculates the flow according to the differential pressure method as per the ISO5167 standard.

Unlike conventional differential pressure measurement methods, which provide accurate results only under design conditions, the device calculates the coefficients of the flow equation (flow coefficient, velocity of approach factor, expansion number, density etc.) iteratively on a continuous basis. 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).



33 *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 under operating conditions
Δp	Differential pressure
Qm(A)	Mass flow under design conditions
ρ_A	Density under design conditions
ρ_B	Density under operating conditions

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)

8.5 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.

8.5.1 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.

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, → 42.

9 Diagnostics and troubleshooting

9.1 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 diagnostic 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.

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

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**.

9.1.1 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.

9.1.2 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?

9.1.3 Troubleshooting for MODBUS

- Do the device and master have the same baud rate 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?

9.1.4 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.

9.2 Error messages

Error	Description	Remedy

F041	Open circuit: AI1 (flow), AI2 (temperature), AI3 (pressure). Input current ≤ 2 mA ▪ Incorrect wiring ▪ Full scale value of the measuring range configured incorrectly ▪ Sensor defective	▪ Check wiring ▪ Enlarge measuring range (change scaling) ▪ Replace sensor
F104	Sensor error Input current > 2 to ≤ 3.6 mA or ≥ 21 mA (or 22 mA for 0 to 20 mA signal) ▪ Incorrect wiring ▪ Full scale value of the measuring range configured incorrectly ▪ Sensor defective Pulse input > 12.5 kHz or > 25 Hz	▪ Check wiring ▪ Enlarge measuring range (change scaling) ▪ Replace sensor ▪ 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	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, → 🖹 56)	▪ Check plausibility of the measured input values ▪ Check scaling of device inputs/sensor outputs ▪ Check system/process
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 ! If the bidirectional flow is controlled via the temperature, the flow must not be negative.	Check process values and settings.
M102	Over range Input current ≥ 20.5 mA to < 21 mA	Enlarge measuring range (change scaling)
M103	Under range 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! - e.g. for firmware update attempt	locking via digital channel
M905	Limit value violation	
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.
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. The calculations continue, but the measurement accuracy as per ISO 5167 is not guaranteed.

9.3 Diagnostic list

See also error messages, → 49.

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

The diagnostic 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
- Diagnostic number
- Error text

The diagnostic 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

9.4 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.

9.4.1 Relay tests

The user can switch the relay manually.

9.4.2 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

9.4.3 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).

9.5 Firmware history

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	BA294K/09/en/07.10
07/2011	01.02.xx	Output tariff 1/2 to OC	BA00294K/09/EN/01.11
09/2011	01.03.xx	Web server port is configurable	BA00294K/09/EN/02.11
12/2013	01.04.xx	Switching temperature for bidirectional measurement can be switched off	BA00294K/09/EN/03.13
10/2014	01.04.xx	-	BA00294K/09/EN/04.14
01/2019	01.04.xx	-	BA00294K/09/EN/05.18
02/2024	01.05.01	Units MJ/h, GJ/h, kPa added	BA00294K/09/EN/06.24

10 Maintenance

No special maintenance work is required for the device.

10.1 Cleaning

A clean, dry cloth can be used to clean the device.

11 Repair

11.1 General information

The device has a modular design and repairs can be carried out by the customer's electrotechnical personnel. For more information on service and spare parts, contact the supplier.

11.1.1 Repair of Ex-certified devices

- Only specialist personnel or the manufacturer may undertake repairs on Ex-certified devices.
- The prevailing standards, national hazardous area regulations, safety instructions and certificates must be observed.
- Only use original spare parts from the manufacturer.
- When ordering spare parts, check the device designation on the nameplate. Parts may only be replaced by identical parts.
- Carry out repairs according to the instructions. On completion of the repair, carry out the routine test specified for the device.
- A certified device may only be converted to another certified device version by the manufacturer only.
- Document all repairs and modifications.

11.2 Spare parts

For spare parts currently available for the product, see online at:
https://www.endress.com/deviceviewer (→ Enter serial number)

11.3 Return

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

1. Refer to the web page for information:
   https://www.endress.com/support/return-material
   ↳ Select the region.
2. If returning the device, pack the device in such a way that it is reliably protected against impact and external influences. The original packaging offers the best protection.

11.4 Disposal

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 the manufacturer for disposal under the applicable conditions.

12 Accessories

The accessories currently available for the product can be selected at www.endress.com:

1. Select the product using the filters and search field.
2. Open the product page.
3. Select **Spare parts & Accessories**.

12.1 Device-specific accessories

12.1.1 For the transmitter

Accessories	Description
Pipe mounting set	Mounting plate for pipe mounting For dimensions → 2, 9 and installation instructions → 12, see the "Mounting" section
DIN rail mounting set	DIN rail adapter for DIN rail mounting For dimensions → 4, 9 and installation instructions → 11, see the "Mounting" section
Panel mounting set	Mounting plate for panel mounting For dimensions → 3, 9 and installation instructions → 10, see the "Mounting" section

12.1.2 For the sensor

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

12.2 Service-specific accessories

Commubox FXA291

Connects Endress+Hauser field devices with a CDI interface (= Endress+Hauser Common Data Interface) and the USB port of a computer or laptop.

For more information, please refer to: www.endress.com

RXU10-G1

USB cable and FieldCare Device Setup configuration software incl. DTM library

For more information, please refer to: www.endress.com

FieldCare SFE500
FieldCare is a configuration tool for Endress+Hauser and third-party field devices based on DTM technology.
The following communication protocols are supported: HART, WirelessHART, PROFIBUS, FOUNDATION Fieldbus, Modbus, IO-Link, EtherNet/IP, PROFINET and PROFINET APL.

Technical Information TI00028S

www.endress.com/sfe500

12.3 Communication-specific accessories

Field Data Manager (FDM) analysis software MS20, MS21

- Field Data Manager (FDM) is a software which provides central data management and visualization. This enables the continuous, tamper-free archiving of process data, e.g. measured values and diagnostic events. "Live data" from connected devices is available. FDM saves the data in an SQL database.
- Supported databases: PostgreSQL (included in the delivery), Oracle or Microsoft SQL server.
- MS20 single-user license: Installing the software on a computer.
- MS21 multi-user license: Several simultaneous users, dependent on the number of available licenses.

Technical Information TI01022R

www.endress.com/ms20

www.endress.com/ms21

12.4 Online tools

Product information over the entire life cycle of the device: www.endress.com/onlinetools

12.5 System components

Data Manager of the RSG product family

Data Managers are flexible and powerful systems to organize process values. Up to 20 universal inputs and up to 14 digital inputs for direct connection of sensors, optionally with HART, are available as an option. The measured process values are clearly presented on the display and logged safely, monitored for limit values and analyzed. The values can be forwarded via common communication protocols to higher-level systems and connected to one another via individual plant modules.

For more information, please refer to: www.endress.com

Surge arrester modules from the HAW product family

Surge arrester modules for DIN rail and field device mounting, for the protection of plants and measuring instruments with power supply and signal/communication lines.

More detailed information: www.endress.com

RN series active barrier

Single- or two-channel active barrier for safe separation of 0/4 to 20 mA standard signal circuits with bidirectional HART transmission. In the signal duplicator option, the input signal is transmitted to two galvanically isolated outputs. The device has one active and one passive current input; the outputs can be operated actively or passively.

For more information, please refer to: www.endress.com

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 or as a pulse or frequency input.

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

Cycle time

The cycle time is 250 ms when using the RTD input.

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	Response 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 measured value
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) or as RTD inputs (RTD = Resistance Temperature Detector). Here, one input is provided for the temperature signal, the other for the pressure signal.

The two inputs are galvanically connected but galvanically isolated from other inputs and outputs (testing 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: 0.06 % of measuring range 3-wire: 0.06 % of measuring range + 0.8 K (1.44 °F)
Temperature drift:	0.01 %/K (0.0056 %/°F) of measuring range

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 Time synchronization Lock device (Block set up)	Activate tariff counter 2 Time synchronization 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 mA current output or as a voltage pulse output.

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

Max. relay switching capacity:	AC: 250 V, 3 A 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 (testing 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 For higher values, the switching edges are flattened.

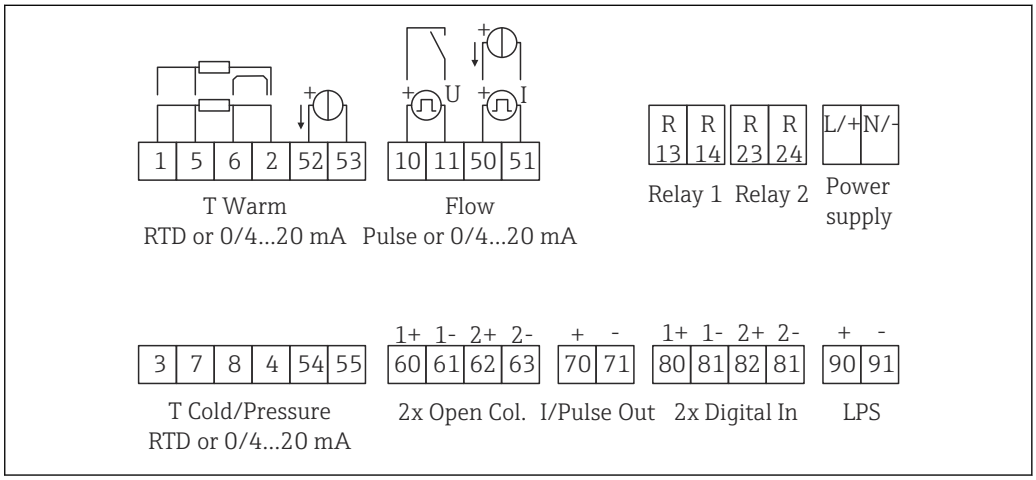
Auxiliary voltage output (transmitter power supply)

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 testing 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



34 *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	Size	Range
Steam	Temperature measuring range	0 to 800 °C (32 to 1472 °F)
	Pressure measuring range	0 to 1000 bar (0 to 14500 psi)
	Measurement and calculation interval	500 ms

Calculation standard IAPWS IF97

Typical accuracy of steam mass and energy measurement in a complete steam measuring point: approx. 1.5 % (e.g., ModuLine, Cerabar, Prowirl)

13.6 Installation

Mounting location

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

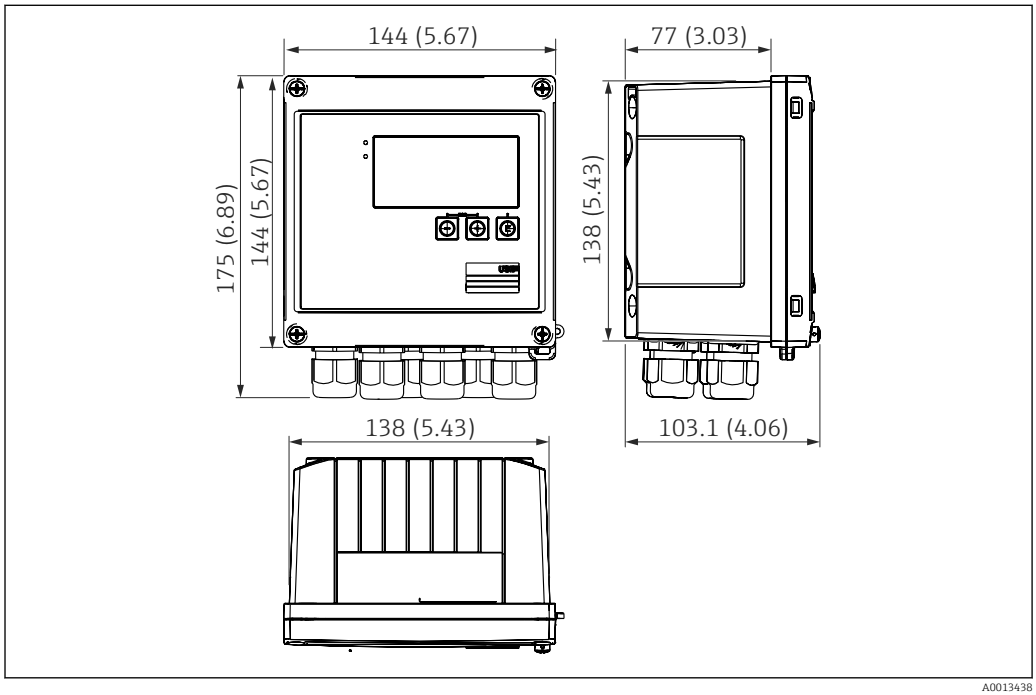
Installation position	The only factor determining the orientation is the legibility of the display.

13.7 Environment

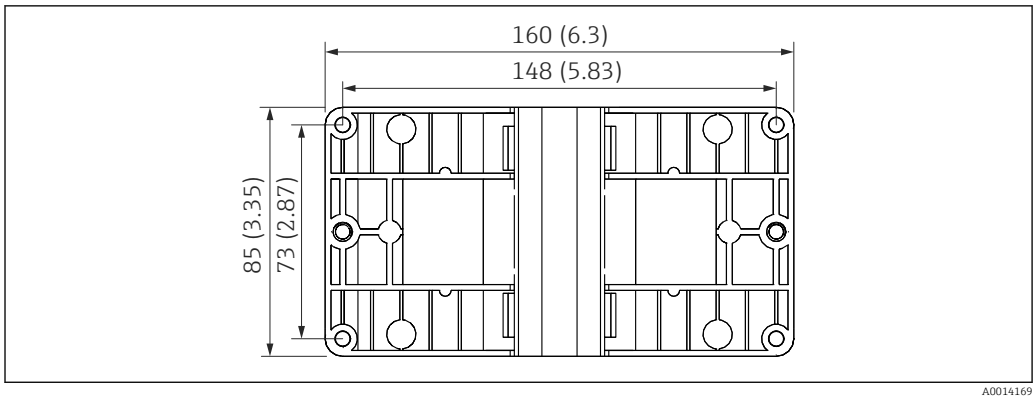
Ambient temperature range	−20 to +60 °C (−4 to +140 °F)
Storage temperature	−30 to +70 °C (−22 to +158 °F)
Climate class	As per IEC 60 654-1 Class B2, as per EN 1434 environment class C
Humidity	Maximum relative humidity 80 % for temperatures up to 31 °C (87.8 °F), decreasing linearly to 50 % relative humidity at 40 °C (104 °F).
Electrical safety	As per IEC 61010-1 and CAN C22.2 No 1010-1. ▪ Class II equipment ▪ Overvoltage category II ▪ Pollution level 2 ▪ Overcurrent protection ≤ 10 A ▪ Operating altitude: up to 2 000 m (6 560 ft.) above MSL
Degree of protection	▪ Panel mounting: IP65 at front, IP20 at rear ▪ DIN rail: IP20 ▪ 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

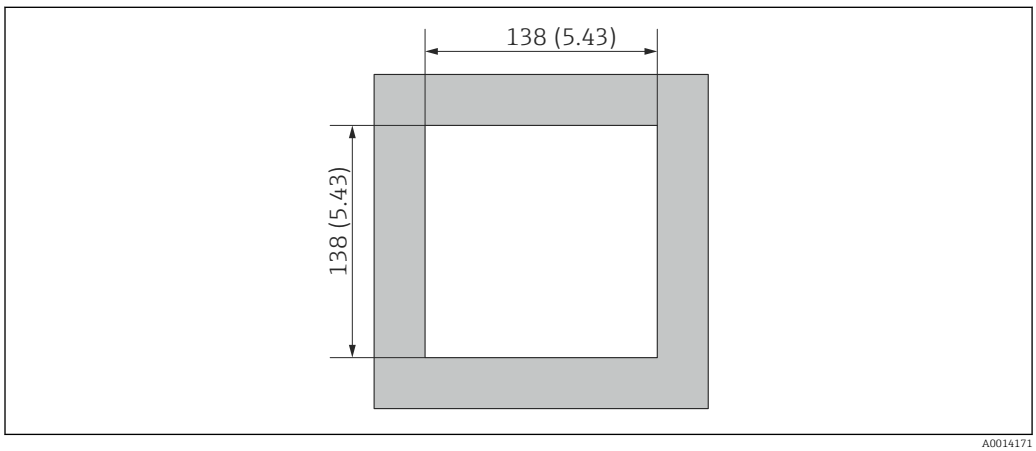
Design, dimensions



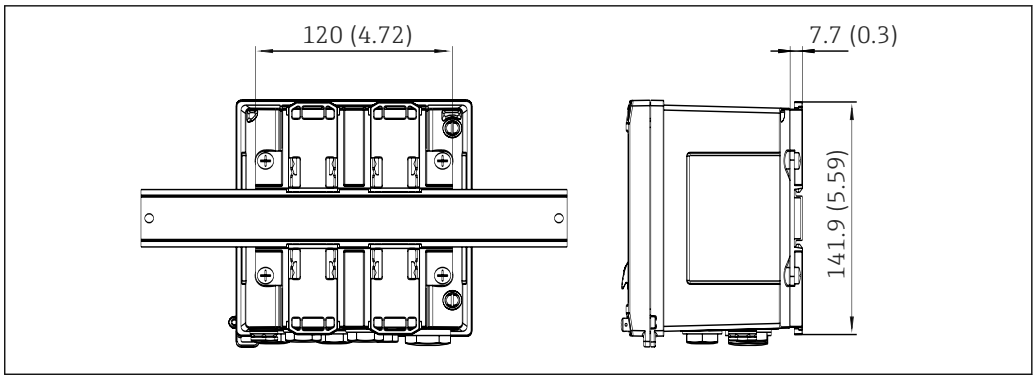
35 *EngyCal housing; dimensions in mm (in)*



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



37 *Panel cutout in mm (in)*

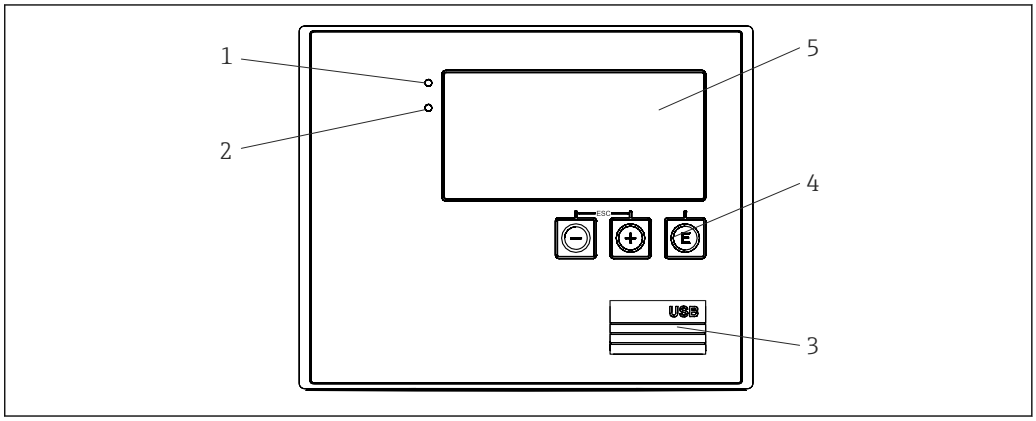


38 *Dimensions of DIN rail adapter in mm (in)*

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) .

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



39 *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** ▪ Deviation: 15 min per year ▪ 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. ▪ **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

Current certificates and approvals for the product are available at www.endress.com on the relevant product page:

1. Select the product using the filters and search field.
2. Open the product page.
3. Select **Downloads**.

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 English Español Français Italiano Nederlands Polski Portuguese Russkij ceština	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 → 🖹 35

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 → 🖹 36.
	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".

Units			100001-00	Select your unit system (SI or US units). ℹ All units are switched to the selected unit system, but configured values are not converted.
Pulse value			210013-00	Unit for the pulse value, e.g. pulse/l, l/pulse...
Value			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. Decimal number, 8 digits including leading sign and decimal separator.
Date/time				Set date/time.
	UTC time zone			Current UTC time zone (UTC = coordinated universal time).
	Actual date			Actual date. Format as configured under date format.
	Actual time			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	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. 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. ℹ 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 the format in which 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. 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	120013-00	Set your current date and your current time.
			NT/ST changeover			Settings for summer time changeover
				NT/ST changeover	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	110003-00	Selects the regional settings for summer/normal time changeover.
				Begin summer time		
				Occurrence	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	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	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	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	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	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	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	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		100001-00	Select your unit system (SI or US units). 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 places		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 places		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 places	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 places	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 places	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 places	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. ▪ The settings determined are displayed only after the setup is applied. ▪ 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 contact him or her. 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). 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). If DHCP = 'Yes', the gateway obtained by DHCP is displayed here.
			Web server	470000-00	Switch the Web server function on or off (= factory setting). The instantaneous values can only be displayed using an Internet browser when the Web browser is activated. Only possible using the Ethernet interface!
			Port	470001-00	The Web server communicates through this communication port. 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. 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. For devices with M-Bus (optional) only.
			Device 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. 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. Only if a counter has been set for "Value".
		Device options				Hardware and software options.
			Optional outputs		990000-00	
			Communication		990001-00	
			Protocol		990007-00	
			DP flow		990003-00	
			Tariff		990005-00	
			Callendar v. Dusen		990004-00	
	Inputs					Settings for the analog and digital inputs.

		Flow			Settings for the flow input.
			Signal type	210000-00	Select the signal type connected. ▪ 4 to 20 mA: Current input ▪ 4 to 20 mA (DP flow): Input for flow measurements based on the differential pressure method (e.g. orifice plate) ▪ 0 to 20 mA: Current input ▪ Pulse U+IB+IC: Input for active voltage pulses and contact sensors as per EN 1434-2, Class IB + IC. ▪ Pulse Cl. ID+IE: Input for contact sensors as per EN 1434-2, Class ID + IE. ▪ Pulse I: Current pulse input: ≤ 8 mA Low level, ≥ 13 mA High level.
			Design	210070-00	Configure the transmitter type used. 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	210002-00	Specify whether the pulse input is a fast (up to 12.5 kHz) or slow (up to 25 Hz) input. Only if Pulse has been selected as the signal type.
			Pulse value	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. Only if Pulse has been selected as the signal type.
			Unit	210004-00	Specify the technical (physical) unit for the measuring point connected to this input.
			Decimal places		Number of places after decimal point for the display. E.g. measured value: 20.12348 l/s The following can be displayed: ▪ None: 20 l/s ▪ One: 20.1 l/s ▪ Two: 20.12 l/s ▪ Three: 20.123 l/s The value is rounded where necessary.
			Counter unit	210005-00	Technical unit of the count input, e.g. liter, m^3, ...
			Decimal places	210007-00	Number of digits after the decimal point for the counter.
			DP unit	210072-00	Unit of the differential pressure. 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. Example: 0 to 100 m^3/h of the sensor converted to 4 to 20 mA : 0. Decimal number, max. 8 digits including decimal separator. 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. Decimal number, max. 8 digits including decimal separator Only for 0/4-20 mA.
			Decimal places	410005-00	Decimal places for displaying the differential pressure. Only for 4-20 mA (DP-Flow).

			Low flow cut off		If the volume flow recorded is below the set value, these quantities are not added to the counter. 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. If the input is scaled from -x to +y, all values around the zero point (e.g. also negative values) are not recorded. 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. Linear: if the output of the DP transmitter is scaled in mbar/inH2O (characteristic at the DPT output is linear). 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). Only for 4-20 mA (DP-Flow).
			Diameter unit	210076-00	Unit of the internal diameter of the pipe. 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). Decimal number, max. 8 digits including decimal separator. Only for signal type = 4 to 20 mA (DP-Flow)
			d at 20 °C	210078-00	Pipe inner diameter of the primary element (d) under design conditions at 20 °C (68 °F). Decimal number, max. 8 digits including decimal separator. 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). Decimal number, max. 8 digits including decimal separator. 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). Decimal number, max. 8 digits including decimal separator. 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. 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. Only for signal type = 4 to 20 mA (DP-Flow) and device type = Orifice plate, Nozzle, Venturi nozzle, Venturi tube, Pitot tube
		Temperature			Settings for the temperature input.
			Signal type	220000-00	Select the signal type connected.
			Connection type	220001-00	Configure whether an RTD assembly is connected with 3 or 4 wires. Only for signal type Pt100, Pt500 or Pt1000.
			Channel identifier	220002-00	Name of the measuring point connected to this input. Customized text, max. 6 characters.
			Unit	220003-00	Specify the technical (physical) unit for the measuring point connected to this input.
			Decimal places	220004-00	Number of places after decimal point for the display.
			Range	220005-00	Set the desired measuring range. Can only be set for Pt100 or platinum RTD (CvD). A small measuring range increases the accuracy of temperature measurement.

			Range start		220006-00	Transmitters convert the physical measured variable into standardized signals. Enter the start of the measuring range here. Only for 0/4 to 20 mA. Decimal number, max. 8 digits including decimal separator.
			Meas. range end		220007-00	Enter the end of the measuring range here. Only for 0/4 to 20 mA. Decimal number, max. 8 digits including decimal separator.
			Default value		220009-00	Specify a fixed temperature value with which the device should perform calculations. 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). Only for signal type = Platinum RTD(CvD)
				R0 coefficient	220070-00	Enter the R0 coefficient as per the calibration datasheet. Decimal number, max. 8 digits including decimal separator.
				A coefficient	220071-00	Enter the A coefficient as per the calibration datasheet. Decimal number, max. 8 digits including decimal separator.
				B coefficient	220072-00	Enter the B coefficient as per the calibration datasheet. Decimal number, max. 8 digits including decimal separator.
				C coefficient	220073-00	Enter the C coefficient as per the calibration datasheet. Decimal number, max. 8 digits including decimal separator.
		Pressure				Settings for the pressure input
			Signal type		220000-01	Select the signal type connected or select the "Default value". The default value is set in the "Default value" menu item.
			Channel identifier		220002-01	Name of the measuring point connected to this input. Customized text, max. 6 characters.
			Unit		220003-01	Specify the technical (physical) unit for the measuring point connected to this input.
			Decimal places		220004-01	Number of places after decimal point for the display.
			Default value		220009-01	Specify a fixed value with which the device should perform calculations. Only for signal type = default value.
		Digital 1/2				Setting up only required if the digital inputs (e.g. events) are to be used.
			Function		DI 1: 250000-00 DI 2: 250000-01	Select the required function, → 🖹 33. Digital inputs are High active; this means the described effect is achieved by a high input. Low = −3 to +5 V 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. 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. 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). 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). 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. 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. Numerical value, max. 8 digits including decimal separator. 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: 320000-00 OC 2: 320000-01	Specify what the open collector output should output (pulses or status).
			Operating mode	320001-00 320001-01	Function of the open collector: ▪ NC contact: The contact is closed in its quiescent state (maximum safety). ▪ NO contact: The contact is open in its quiescent state.
			Channel/value	320002-00 320002-01	Select which channel/value is to be output at the output. Only for function = pulse output.
			Pulse value	320004-00 320004-01	The pulse value specifies which quantity an output pulse corresponds to (e.g. 1 pulse = 5 liters). Only for function = pulse output.
			Pulse width	320005-00 320005-01	The pulse width limits the max. possible output frequency of the pulse output. Define a fixed or dynamic pulse width. Only for function = pulse output.
			Pulse width	320006-00 320006-01	You can set the pulse width in the range from 0.5 to 1 000 ms here. Numerical value, max. 8 digits including decimal separator. Visible only if a user-defined pulse width was selected.
		Relay			Setup for the selected relay
			Operating mode	Relay 1: 330000-00 Relay 2: 330000-01	Relay function: ▪ NC contact: The relay is closed in its quiescent state (maximum safety). ▪ NO contact: The relay is open in its quiescent state.
	Application				Configure various application-specific settings (e.g. group settings, limit values, etc.).
		Op. mode steam		400014-00	Calculation of the heat quantity using different calculation methods: ▪ Heat quantity (temperature + pressure in steam) ▪ Heat differential /p (temperature in condensate, pressure in steam) ▪ Heat differential /T (temperature in condensate, temperature in steam) ▪ Heat differential /p+T (temperature in steam, pressure in steam)
		Wet steam alarm		400010-00	Behavior for wet steam alarm (in event of partial condensation of the steam).
		Switches		400011-00	Action for wet steam alarm.
		Tariff 1/2			Tariff counters for recording the energy or mass during specific process conditions or statuses. The tariff counters have no effect on the "normal" counter.

			Tariff model		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 or mass during an error (e.g. open circuit). To calculate the deficits, the error values for temperature and pressure are used.
			Limit		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		430002-00 430002-01	Enter the limit value at which the tariff counter is activated, i.e. when the energy or mass flow is totalized. Numerical value, max. 15 digits including decimal separator.
			Unit		430003-00 430003-01	Enter the unit for the tariff. Customized text, max. 9 characters.
			From		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		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.
			Counter type		430006-00 430006-01	Specify whether an energy or mass unit is used for the tariff counter.
		Data logging				Settings for signal analysis (saving).
			Synchron. time		440001-00	Time for completing the signal analysis. If, for example, 07:00 is entered, then the daily analysis will run from 07:00 of one day until 07:00 of the following day. Format: HH:MM
			Interval		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		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	440003-00 440003-01	Enter the date on which this billing date analysis is to be created (1-31).
				Month	440004-00 440004-01	Enter the month on which this billing date analysis is to be created (picklist).
		Limit values				Limit values can monitor the measured values. A relay, for example, can be switched if a limit value is violated.
			Limit value 1 to 3			View or change the settings for the selected limit value.
				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.
		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.
				Designation	460000-00 -01, -02, -03, -04, -05	Enter a name for these groups.
				Value 1	460001-00 -01, -02, -03, -04, -05	Select which input/which calculated variable in this group is to be displayed.
				Value 2	460003-00 -01, -02, -03, -04, -05	Select which input/which calculated variable in this group is to be displayed.
				Value 3	460005-00 -01, -02, -03, -04, -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 diagnostic message.
Last diagnostics			050005-00	Displays the last diagnostic message.
Last restart			050010-00	Information as to when the device was last restarted (e.g. due to a power failure).
Diagnostics list				All pending diagnostic messages are listed.
Event logbook				Events such as a limit value violation and power failure are listed in the correct time sequence.
Device information				Displays important device information.
	Device tag		000031-00	Individual device tag name (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. 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	
		DP flow	990003-00	
		Tariff	990005-00	
		Callendar v. Dusen	990004-00	

Measured values			Displays the current measured values of the device. For displaying on the device.
	Hold	060000-00	Stops the entire measured value acquisition/storage. Select "No" to exit the hold function. The hold function is exited automatically after 5 minutes.
	Display	060010-00	Display of a measured value / calculated value. Grouping of 3 measured values for display in the PC operating software. 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 060105-00	Current relay state.
	Open Collector 1/2	060110-00 060115-00	Current state of the open collector output.
Simulation			Various functions/signals can be simulated for test purposes here. 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. Select "Switched off" to exit the simulation. The simulation is exited automatically after 5 minutes. The simulation is NOT exited automatically when exiting the menu.
	Open Collector 1/2	050205-00 050210-00	Choose the value which should be output. Select "Switched off" to exit the simulation. The simulation is exited automatically after 5 minutes. The simulation is NOT exited automatically when exiting the menu.
	Relay 1/2	050215-00 050220-00	Manual activation of the selected relay. The simulation is exited automatically after 5 minutes. 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 the parameters / settings from the **Setup** menu in addition to those described below.

Direct access				Direct access to parameters (rapid access).
Service code			010002-00	Please enter service code to make service parameter visible. 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			Resets all parameters to the factory settings! Can be changed via the service code only.
	Clear memory		059000-00	Clear internal memory
	Reset		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. Default: **8000** 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. Default: **80** 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	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. Decimal number, max. 5 digits incl. decimal separator. Factory setting: 0.0 s.
	Flow			
		Meas.val. corrct.		Determining the correction values to balance measurement tolerances. Proceed as follows: ▪ Measure the current value at the lower measurement range. ▪ Measure the current value at the upper measurement range. ▪ 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. Decimal number, max. 5 digits incl. decimal separator. 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. The following error ranges apply when NAMUR NE43 is switched on: ▪ ≤ 3.8 mA: under range ▪ ≥ 20.5 mA: over range ▪ ≤ 3.6 mA or ≥ 21.0 mA: sensor error ▪ ≤ 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". The device continues calculating with this value in the event of an error. The calculated values are recorded in the deficit counter. The normal counter remains unchanged (does not run).
	Temperature				Settings for the temperature input.
		Damping		220008-00	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. Decimal number, max. 5 digits incl. decimal separator.
		Meas.val. corrct.			Determining the correction values to balance measurement tolerances. Proceed as follows: ▪ Measure the current value at the lower measurement range. ▪ Measure the current value at the upper measurement range. ▪ Enter the lower and upper target and actual value.
			Offset	220050-00	Factory setting "0". This offset is only effective on the analog input signal (no maths / bus channels). Only for RTD. Decimal number, max. 8 digits including decimal separator.
			Range start		Lower correction value Only for 0/4 to 20 mA.
			Target value	220052-00	Enter the lower setpoint here (e.g. measuring range 0 °C to 100 °C: 0 °C). Decimal number, max. 8 digits including decimal separator. Only for 0/4 to 20 mA.
			Actual value	220053-00	Enter the lower value actually measured here (e.g. measuring range 0 °C to 100 °C: measured 0.5 °C). Decimal number, max. 8 digits including decimal separator. Only for 0/4 to 20 mA.
			Meas. range end		Upper correction value Only for 0/4 to 20 mA.

			Target value	220055-00	Enter the upper setpoint here (e.g. measuring range 0 °C to 100 °C: 100 °C). Decimal number, max. 8 digits including decimal separator. Only for 0/4 to 20 mA.
			Actual value	220056-00	Enter the upper value actually measured here (e.g. measuring range 0 °C to 100 °C: measured 99.5 °C). Decimal number, max. 8 digits including decimal separator. 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	Activate/deactivate the 4 to 20 mA loop monitoring as per NAMUR recommendation NE 43. The following error ranges apply when NAMUR NE43 is switched on: ▪ ≤ 3.8 mA: under range ▪ ≥ 20.5 mA: over range ▪ ≤ 3.6 mA or ≥ 21.0 mA: sensor error ▪ ≤ 2 mA: cable open circuit
			On error	220061-00	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	220062-00	Only if the setting "Error value" has been selected under "On error". The device continues calculating with this value in the event of an error. The calculated values are recorded in the deficit counter. The normal counter remains unchanged (does not run).
	Pressure				
		Damping		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. Decimal number, max. 5 digits incl. decimal separator.
		Meas.val. corrct.			Determining the correction values to balance measurement tolerances. Proceed as follows: ▪ Measure the current value at the lower measurement range. ▪ Measure the current value at the upper measurement range. ▪ Enter the lower and upper target and actual value.
			Range start		Lower correction value
			Target value	220052-01	Enter the lower setpoint here. Decimal number, max. 8 digits including decimal separator.
			Actual value	220053-01	Enter the lower value actually measured here. Decimal number, max. 8 digits including decimal separator.
			Meas. range end		Upper correction value
			Target value	220055-01	Enter the upper setpoint here. Decimal number, max. 8 digits including decimal separator.
			Actual value	220056-01	Enter the upper value actually measured here. Decimal number, max. 8 digits including decimal separator.
		Fault mode			Settings that define how this channel is to react under fault conditions (e.g. cable open circuit, over range).
			NAMUR NE 43	220060-01	Activate/deactivate monitoring as per NAMUR recommendation NE 43. The following error ranges apply when NAMUR NE43 is switched on: ▪ ≤ 3.8 mA: under range ▪ ≥ 20.5 mA: over range ▪ ≤ 3.6 mA or ≥ 21.0 mA: sensor error ▪ ≤ 2 mA: cable open circuit

			On error	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	220062-01	Only if the setting "Error value" has been selected under "On error". The device continues calculating with this value in the event of an error. The calculated values are recorded in the deficit counter. 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). 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). Proceed as follows: ▪ On the connected device, read out the displayed value in both the upper and lower measuring range. ▪ 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. 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 For example, error in a channel not displayed in the current group.
M	Maintenance required 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 pv	Pulse value Q
ρ	Density
Σ1, Σ1 (i), Σ1 (d), Σ1 (m), Σ1 (y), Σ1 (1)	Tariff 1: total, interval, day, month, year, billing date
Σ2, Σ2 (i), Σ2 (d), Σ2 (m), Σ2 (y), Σ2 (1)	Tariff 2: 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
Temp.	Temperature

14.3 Definition of important system units

Volume	
bl 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: ▪ 0 °C = 273.15 K ▪ °C = (°F - 32)/1.8
Pressure	
	Conversion: 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

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