BA00300K/09/EN/07.25-00
71744301
2025-09-30

Valid as of version
V01.03.xx (device software)

Operating Instructions
RA33

Batch controller with one current/pulse input for flow, one RTD input for temperature and one current input for density

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
EX	Hazardous area	EX	Safe area (non-hazardous area)

1.2.5 Tool symbols

Symbol	Meaning
 A0011220	Flat-blade screwdriver
 A0011219	Phillips screwdriver
 A0011221	Allen key
 A0011222	Open-end 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.

1.4 Change 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 Bug fixes and internal changes.
No changes to the Operating Instructions.

Date	Firmware version	Software changes	Documentation
09/2010	01.00.xx	Original software	BA00300K/09/EN/13.10
02/2011	01.00.xx	Bug fixing	BA00300K/09/EN/01.11
02/2014	01.00.xx	Bug fixing	BA00300K/09/EN/02.14
10/2014	01.00.xx	Bug fixing	BA00300K/09/EN/03.14
02/2015	01.01.xx	Mass flow input, new Modbus functions	BA00300K/09/EN/04.15
03/2019	01.03.xx	Web server port is configurable, German help text revised	BA00300K/09/EN/05.19
10/2021	01.03.05	Extended Modbus functions, low flow cut off disengageable	BA00300K/09/EN/06.21
05/2025	01.03.xx	Bug fixing	BA00300K/09/EN/07.25

2 Basic safety instructions

Safe and reliable operation of the device is only ensured if the Operating Instructions have been read and the safety instructions contained therein are 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 Batch Controller is a batching and dosing manager for metering any kind of fluid or mineral oil.

- The manufacturer is not liable for harm caused by improper or unintended use. The device must not be converted or modified in any way.
- The device may only be operated when installed.

2.3 Workplace safety

For work on and with the device:
- Wear the required personal protective equipment according to federal/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 Incoming acceptance and product identification

3.1 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.

3.1.1 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

3.1.2 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

4 Installation

4.1 Installation conditions

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

The orientation is determined by the 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)

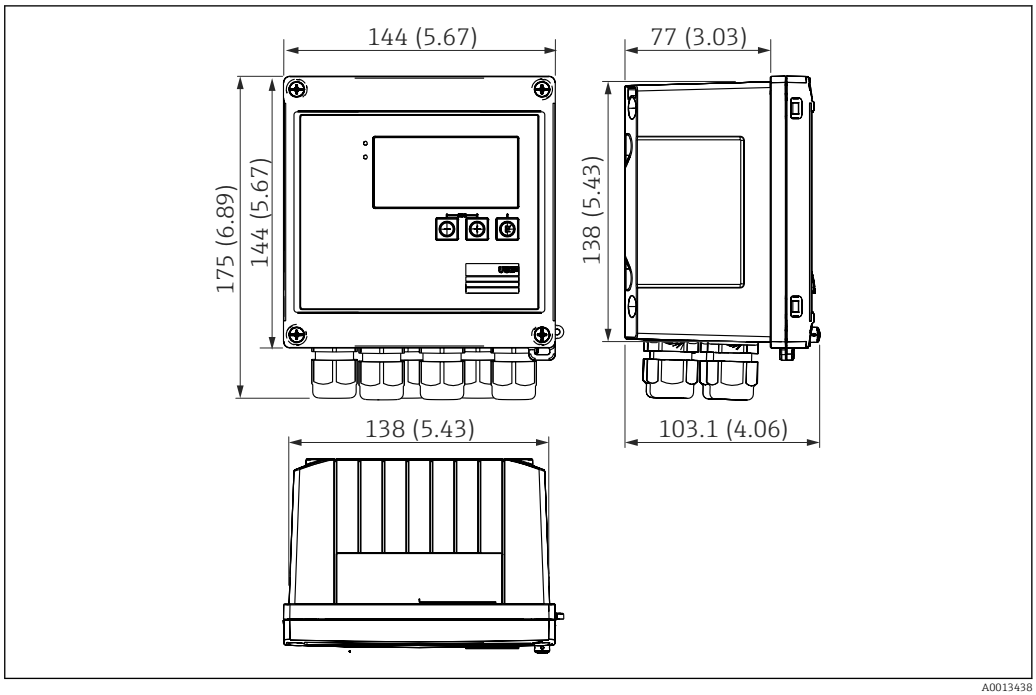
For further information, see the "Technical data" section of the Operating Instructions.

NOTICE

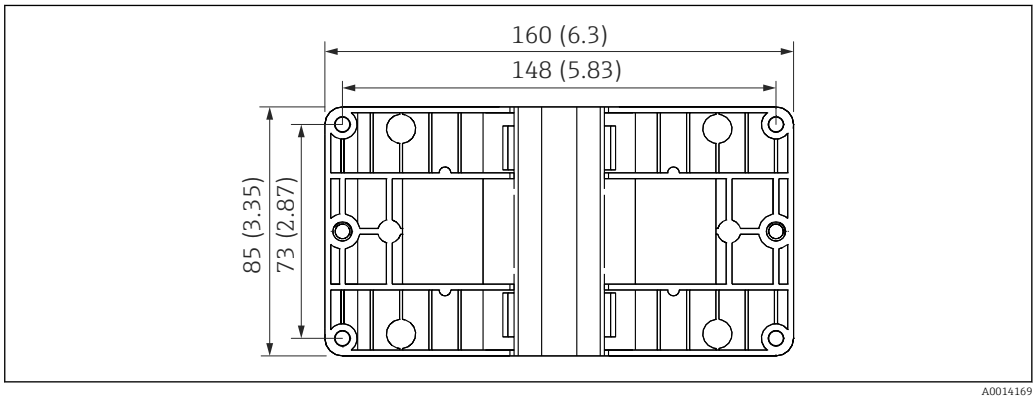
Overheating of the device due to insufficient cooling

▶ Always ensure adequate cooling of the device to prevent heat accumulation. Operating the device in the upper temperature limit range decreases the operating life of the display.

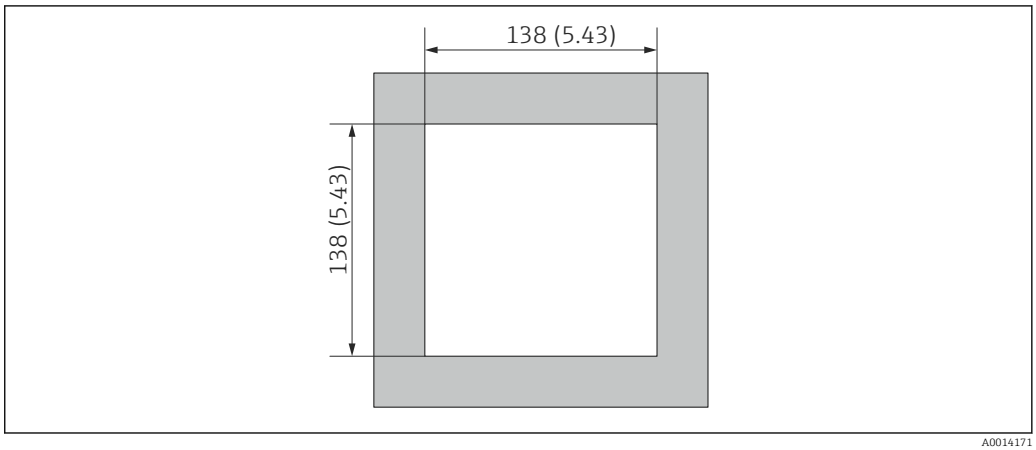
4.2 Dimensions



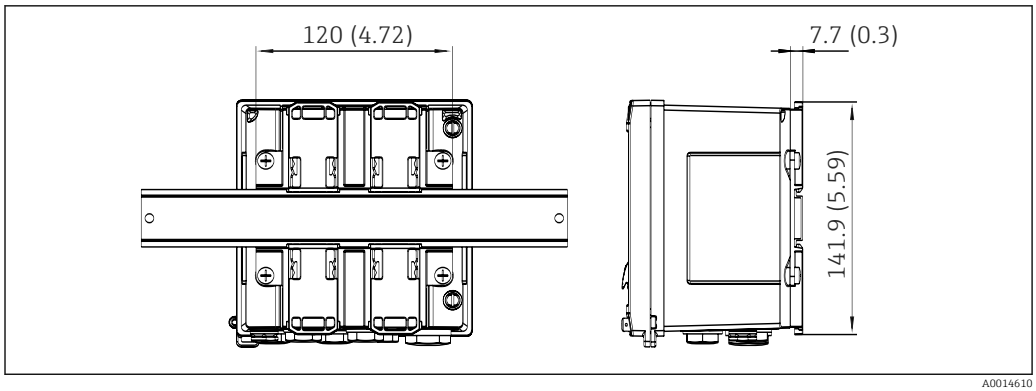
1 *Dimensions of the device in mm (in)*



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



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

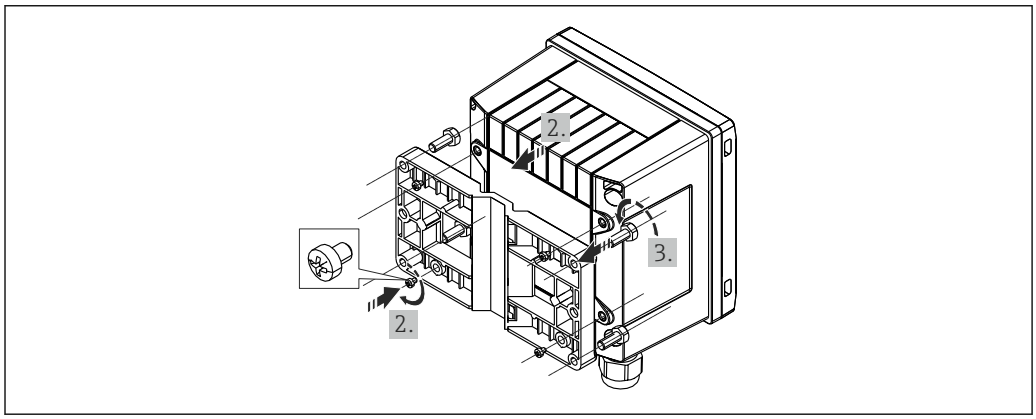


4 Dimensions of DIN rail adapter in mm (in)

4.3 Installing the device

4.3.1 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.

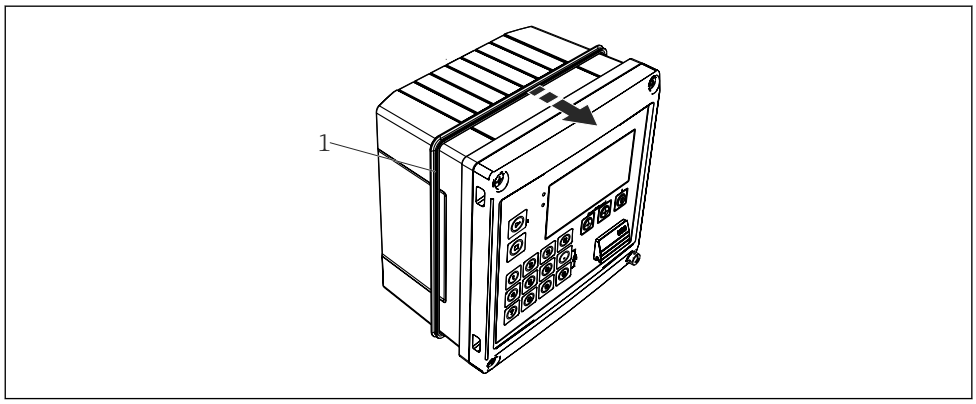


5 Wall mounting

4.3.2 Panel mounting

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

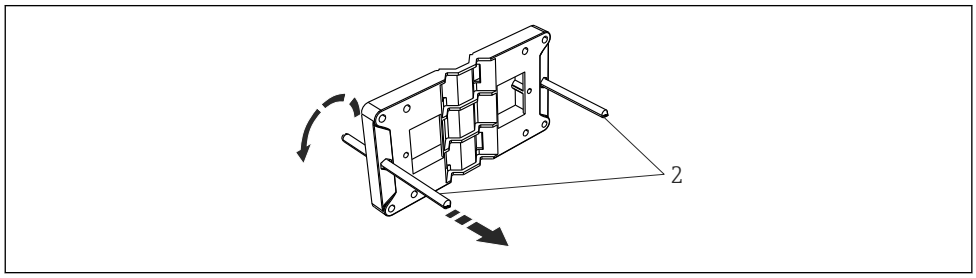
2.



6 *Panel mounting*

Attach the seal (item 1) to the housing.

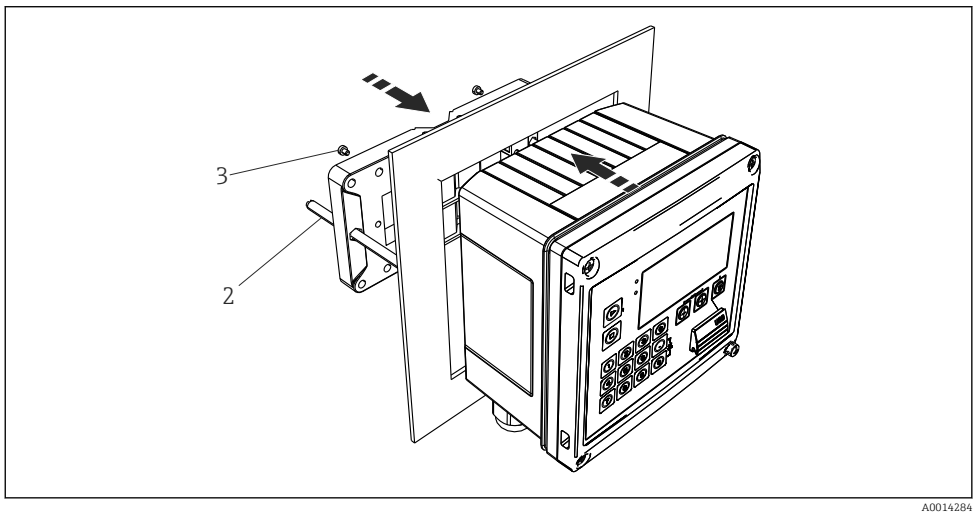
3.



7 *Preparing the mounting plate for panel mounting*

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

4.



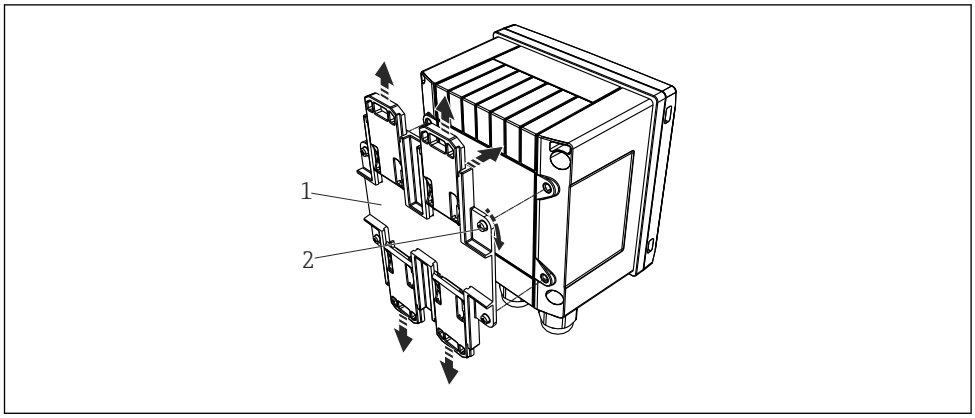
8 *Panel mounting*

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.

4.3.3 Support rail/DIN rail (as per EN 50 022)

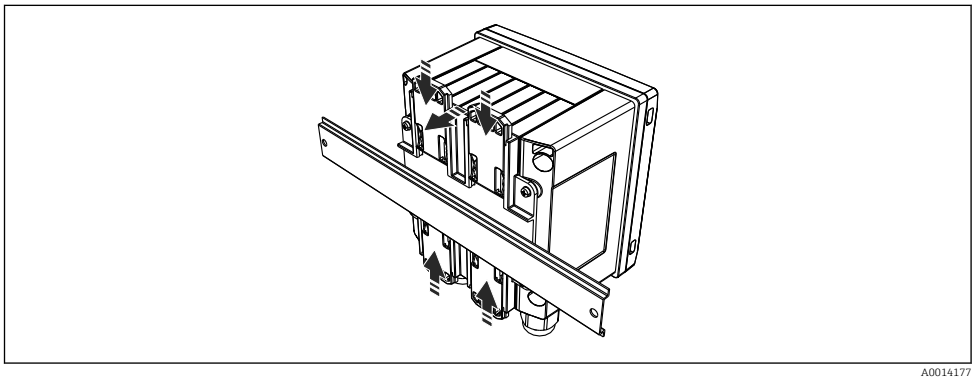
1.



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.

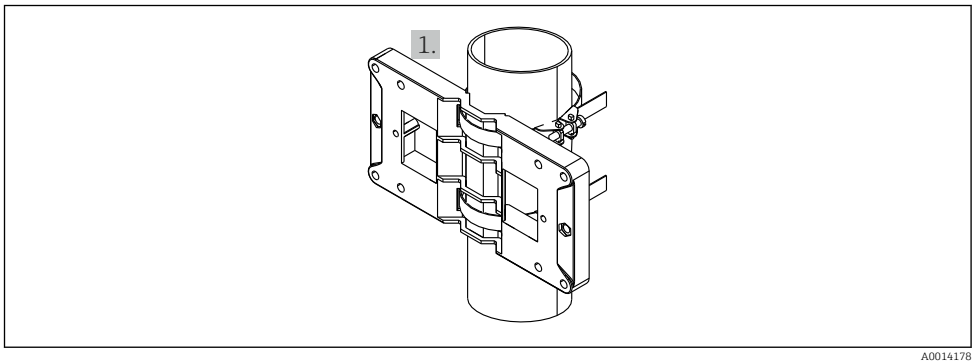


10 *DIN rail mounting*

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

4.3.4 Pipe mounting

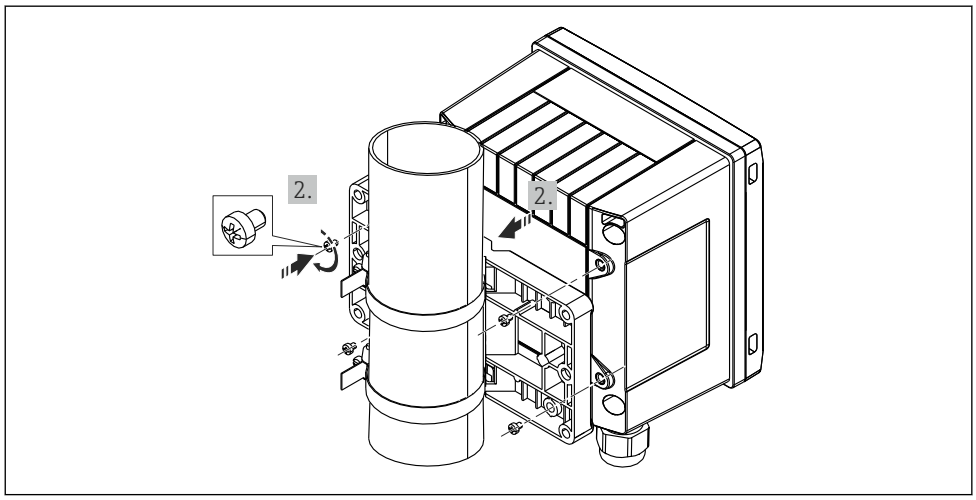
1.



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.

4.4 Post-installation check

Perform the following checks after installing the device:

Device condition and specifications	Notes
Is the device undamaged?	Visual inspection
Is the seal undamaged?	Visual inspection
Is the device fixed securely to the wall or mounting plate?	-
Is the housing cover firmly mounted?	-
Do the ambient conditions match the device specification (e.g. ambient temperature, measuring range etc.)?	See "Technical data" section.

For installation of the Batch Controller and the associated temperature sensors, observe the general installation instructions according to EN 1434 Part 6.

5 Electrical connection

5.1 Connecting requirements

⚠ WARNING

Danger! Electric voltage

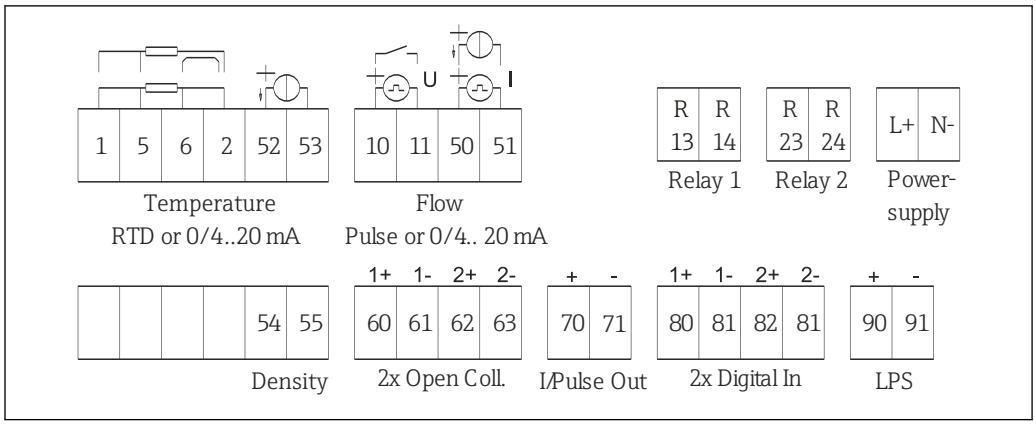
- The entire connection of the device must take place while the device is de-energized.

⚠ CAUTION

Pay attention to additional information provided

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

5.2 Connecting the device



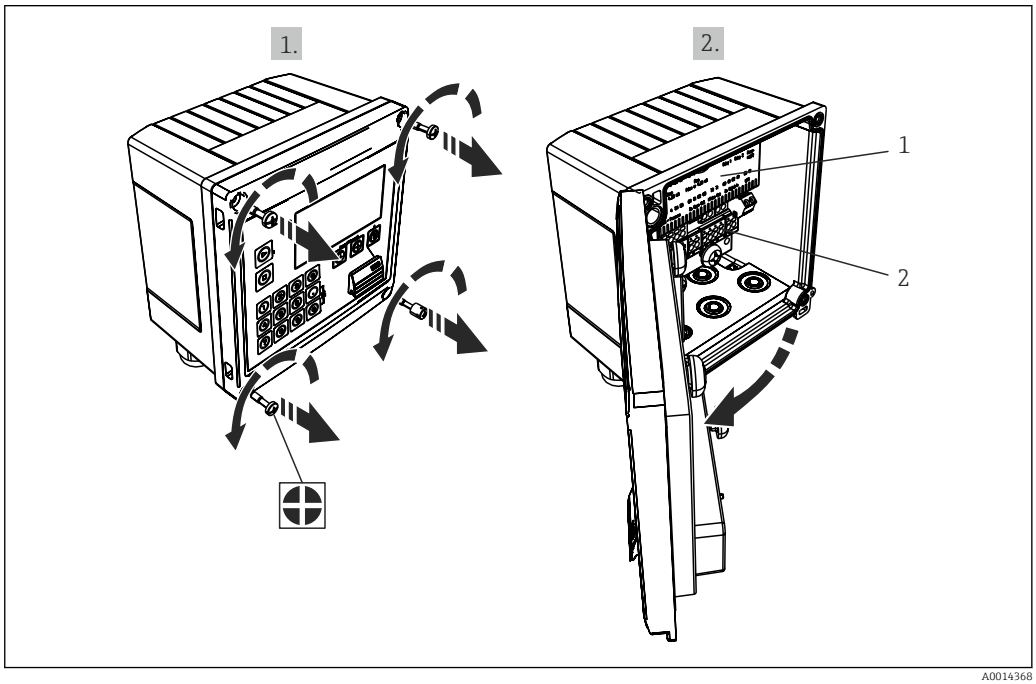
13 *Connection diagram of the device*

Terminal assignment

Terminal	Terminal assignment	Inputs
1	+ RTD power supply	Temperature of 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	
54	+ 0/4 to 20 mA input	Density (current input)
55	Signal ground for 0/4 to 20 mA input	
10	+ pulse input (voltage or contact)	Flow (Optionally pulse or current input)
11	- pulse input (voltage or contact)	
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)	▪ Time synchronization ▪ Start batch ▪ Stop batch ▪ Reset batch
81	- digital input (terminal 1)	
82	+ digital input 2 (switch input)	Time synchronization
81	- digital input (terminal 2)	
		Outputs
60	+ status/pulse output 1 (open collector)	Batch control: pump/valve, volume counter, signal batch ended, fault
61	- status/pulse output 1 (open collector)	
62	+ status/pulse output 2 (open collector)	
63	- status/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 1 normally open (NO)	Batch control: pump/valve, fault
14	Relay 1 normally open (NO)	
23	Relay 2 normally open (NO)	
24	Relay 2 normally open (NO)	

90	24 V 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	

5.2.1 Open the housing



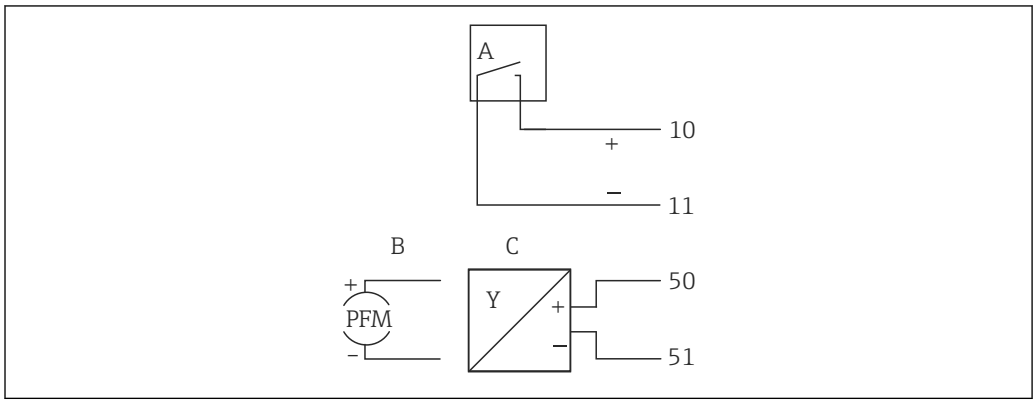
14 Opening the housing of the device

1 Terminal assignment labeling
2 Terminals

5.3 Connecting the sensors

5.3.1 Flow

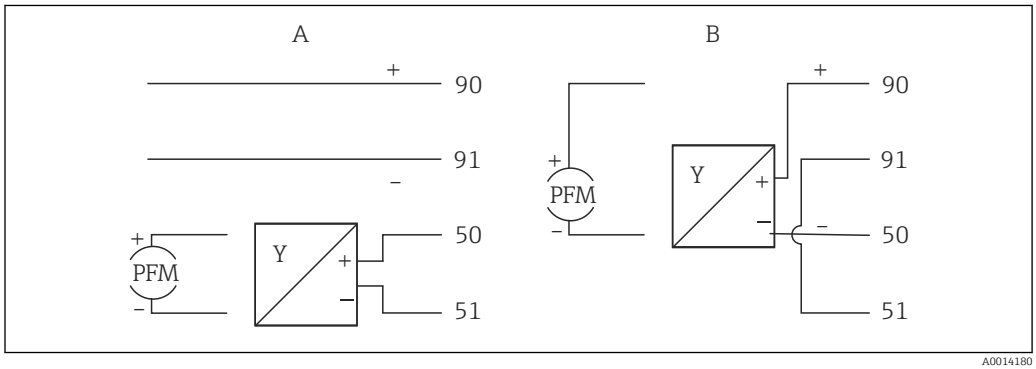
Flow sensors with external power supply



15 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 Batch Controller

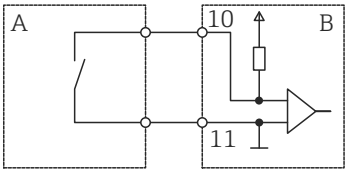
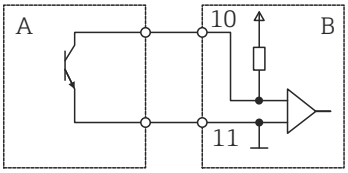
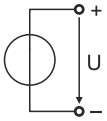
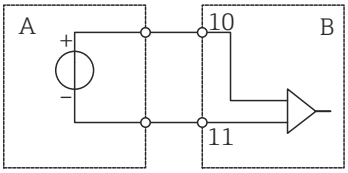
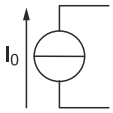
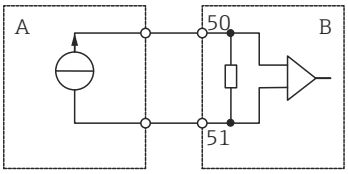
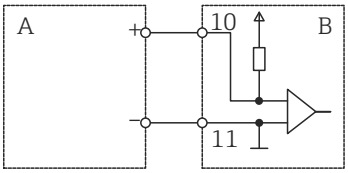


16 Connecting active flow sensors

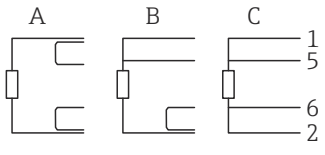
A 4-wire sensor
B 2-wire sensor

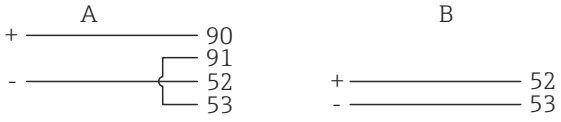
Settings for flow sensors with pulse output

The input for voltage pulses and contact sensors is divided into different types according to EN 1434 and provides a supply for switching contacts.

Pulse output of the flow sensor	Setting at the Rx33	Electrical connection	Comment
Mechanical contact  A0015360	Pulse ID/IE up to 25 Hz	 A0015354 *A Sensor* *B Rx33*	As an alternative, it is possible to choose "Pulse IB/IC+U" up to 25 Hz. The current flow via the contact is then lower (approx. 0.05 mA instead of approx. 9 mA). Advantage: lower power consumption, disadvantage: less immunity to interference.
Open collector (NPN)  A0015361	Pulse ID/IE up to 25 Hz or up to 12.5 kHz	 A0015355 *A Sensor* *B Rx33*	As an alternative, it is possible to choose "Pulse IB/IC+U". The current flow via the transistor is then lower (approx. 0.05 mA instead of approx. 9 mA). Advantage: lower power consumption, disadvantage: less immunity to interference.
Active voltage  A0015362	Pulse IB/IC+U	 A0015356 *A Sensor* *B Rx33*	The switching threshold is between 1 V and 2 V
Active current  A0015363	Pulse I	 A0015357 *A Sensor* *B Rx33*	The switching threshold is between 8 mA and 13 mA
Namur sensor (as per EN 60947-5-6)	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.

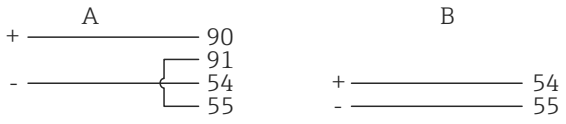
5.3.2 Temperature

Connecting the RTD sensors	 A0047841 A = 2-wire connection B = 3-wire connection C = 4-wire connection Terminals 1, 2, 5, 6: temperature

Temperature transmitter connection	 A0047822 A = without external power supply of the transmitter, B = with external power supply of the transmitter 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.

5.3.3 Density

Density sensor connection	 A0015152 A = without external power supply of the density sensor B = with external power supply of the density sensor

5.4 Outputs

5.4.1 Analog output (active)

This output can be used either as a 0/4 to 20 mA current output or as a voltage pulse output. The output is galvanically isolated. Terminal assignment, → 14.

5.4.2 Pulse output (active)

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

Maximum output current: 22 mA

5.4.3 Open collector output

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

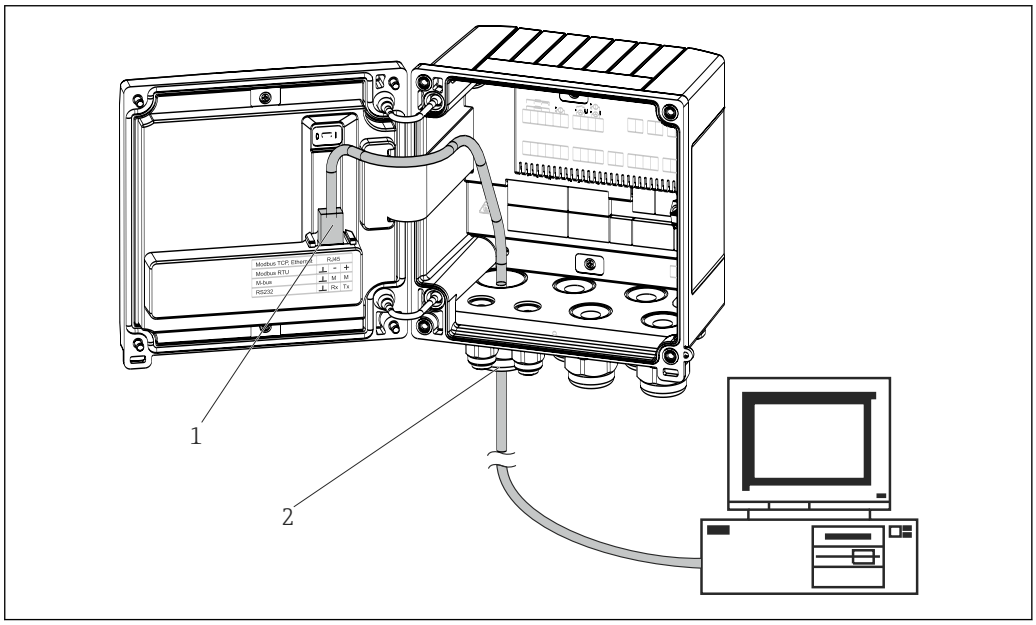
5.5 Communication

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

5.5.1 Ethernet TCP/IP (optional)

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

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



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

1 Ethernet, RJ45
2 Cable entry for Ethernet cable

5.5.2 Modbus TCP (optional)

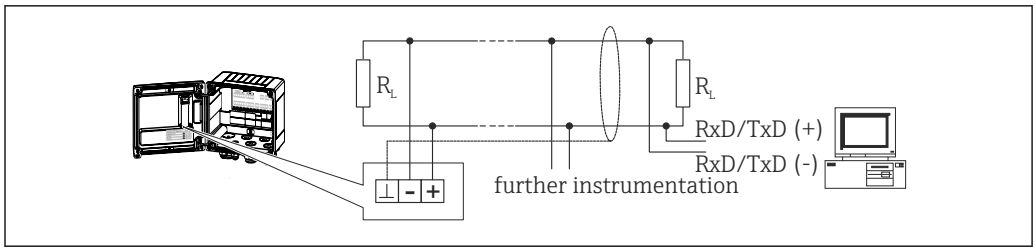
The Modbus TCP interface is used to connect the device to higher-order systems to transmit all measured values and process values. The Modbus TCP interface is physically identical to the Ethernet interface → 17, 19

The device can only be read by a Modbus master.

Detailed information for Modbus register assignment: www.endress.com

5.5.3 Modbus RTU (optional)

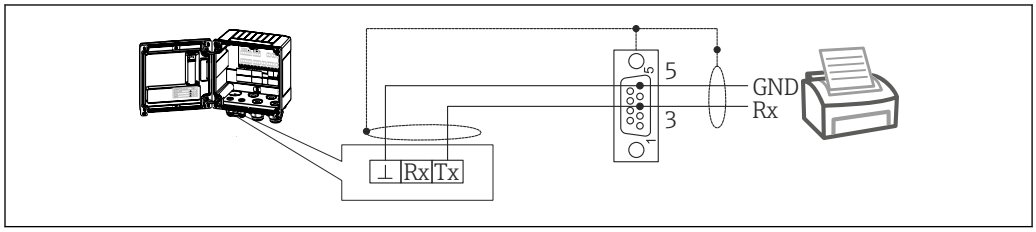
The Modbus RTU (RS-485) interface is galvanically isolated (test voltage: 500 V) and used to connect the device to higher-level systems to transmit all measured values and process values. The connection is made via a 3-pole pluggable terminal in the housing cover.



18 Connection of Modbus RTU

5.5.4 Printer interface/RS232 (optional)

The printer/RS232 interface is galvanically isolated (test voltage: 500 V) and is used to connect a printer. The connection is made via a 3-pole pluggable terminal in the housing cover.



19 Printer connection via RS232

The following printers have been tested with the Batch Controller:

GeBE MULDE Mini thermal printer

5.6 Post-connection check

Perform the following checks after completing electrical installation of the device:

Device conditions 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 strain-relieved?	-
Are the power supply and signal cables connected correctly?	See wiring diagram on the housing

6 Operation options

6.1 Overview of operation options

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

The operating software, including interface cable, is available as an order option.

Parameter configuration is locked if the device is locked by the write protection switch → 23 or the user code.

For details, see "Access protection" in the "Commissioning" section of the Operating Instructions.

6.2 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.

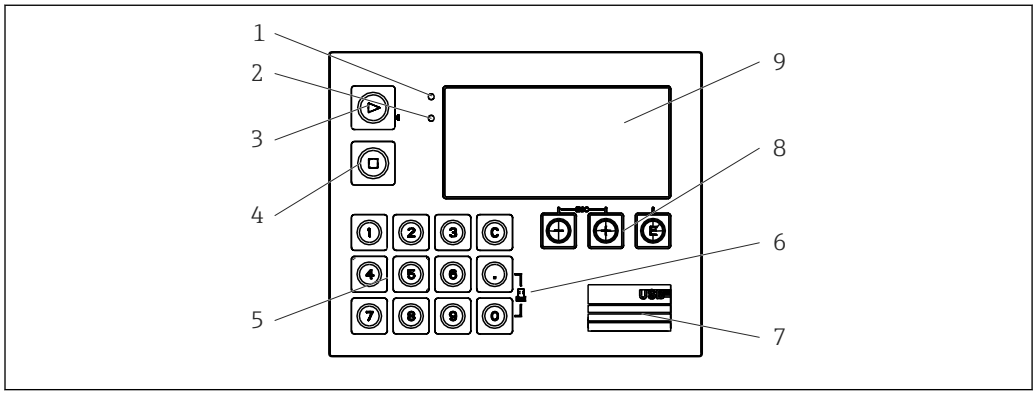
Display/operation menu	▪ Select the group for display (alternate automatically or fixed display group) ▪ Configure brightness and contrast of display ▪ Display saved analyses and batch reports ▪ Enter a value for the preset counter ▪ Recipe selection

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 ▪ Signal type ▪ Pulse value, value (for pulse signal type) or ▪ Start of measuring range (for current signal type) ▪ End of measuring range (for current signal type) ▪ Unit ▪ Counter unit ▪ Date and time Parameters for quick commissioning Advanced setup (settings that are not essential for 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 ▪ Diagnostic

6.3 Display and operating elements



20 *Display and operating elements of the device*

1 *Green LED, "Operation"*
2 *Red LED, "Fault message"*
3 *Start (function key)*
4 *Stop (function key)*
5 *Numeric keyboard (function key)*
6 *Start printout (function key)*
7 *USB connection for configuration (interface)*
8 *-, +, E (operating keys)*
9 *160x80 dot-matrix display*

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

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

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

Red LED remains lit: Device error.

6.3.1 Operating elements

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

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

Enter/Confirm entry function: Press "E"

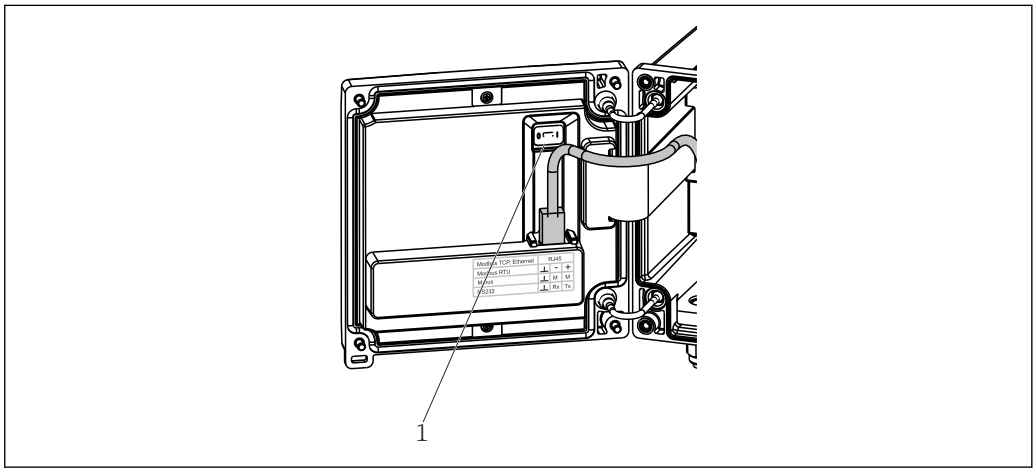
14 function keys

Start / stop function: Press "Start" to start a batching process. Press "Stop" to pause the batch that is currently running. Press "Stop" again to cancel the batch, press "Start" again to resume the batch run.

Function C: Press "C" when a batch is stopped to reset the counters on the display to their initial values.

Print function: Press "0" and "." simultaneously to initiate a printout for the last batch run. To avail of this functionality, the "RS232 printer interface" option must be purchased.

Write protection switch



21 Write protection switch

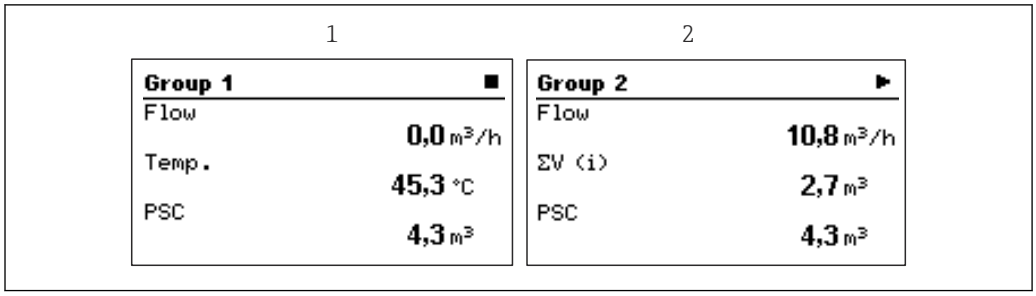
1 Write protection switch on rear of housing cover

6.3.2 Preset counter entry function

A value for the preset counter can be entered any time. This value can be entered either in the **Display** menu or by pressing one of the keys 0-9 or period. It does not matter whether a batching process is currently active when you enter the value. The new preset counter value is used when the next batching process is started.

If the preset counter is part of a display group, the preset counter value which is valid for the current batch is always displayed. If the value is changed when the batching process is stopped, the new value appears immediately on the display. However, if the value is changed during an active batching operation, the old value of the preset counter, which still applies for the current batch run, is displayed until this batching operation is finished. The new value, which is valid for the next batching operation, is displayed directly afterwards.

6.3.3 Display



22 *Display of the Batch Controller (example)*

1 Display group 1, no batch active. Flow, temperature, preset counter
2 Display group 2, batch active. Flow, volume counter, preset counter

6.4 Access to the operating menu via "FieldCare Device Setup"

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

Establishing the connection

1. Start FieldCare.
2. Connect the device to the PC via USB.
3. Create project in File/New menu.
4. Select Communication DTM (CDI Communication USB).
5. Add device EngyCal RA33.
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 Commissioning

7.1 Post-installation check

Perform the following checks prior to commissioning the device:
- See "Post-installation check" section, → 13.
- Post-connection check using the checklist in the "Post-connection check" section, → 20.

7.2 Switching on the device

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

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

7.3 Quick commissioning

For quick commissioning of the "standard" Batch Controller application, only a few operating parameters must be entered in the **Setup** menu.

Prerequisites for quick commissioning:

RTD temperature sensor, 4-wire direct connection

Menu/setup
- **Units**: Select unit type (SI/US)
- **Signal type**: Select the signal type for the flow (pulse or current)
- **Unit**: Select the flow unit
- **Unit counter**: Define the unit for the flow counter, e.g. m^3, kg
- **Pulse value, value**: Enter the unit and value of the pulse value for the flow transmitter (for the pulse signal type)
- **Start of measuring range** and **end of measuring range** (for the current signal type)
- **Date/time**: Set the date and time

The device is now operational and ready to control batches.

The device functions—such as data logging, tariff function, bus integration, and the scaling of current inputs for flow or temperature are configured in the **Advanced setup** menu → 33 or in the **Expert** menu.

7.4 Applications

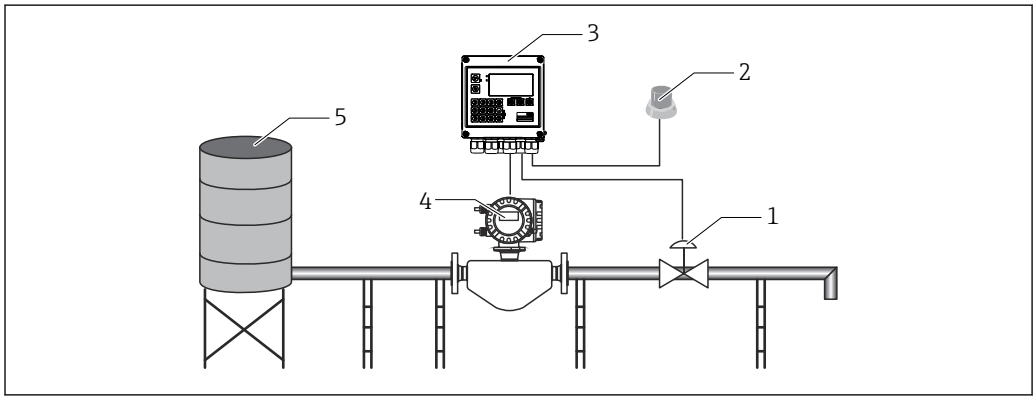
The device is suitable for the automatic control of slow batch processes that last longer than 10 seconds.

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:
- Batch Controller with flow measurement and 1-stage batching, → 26
- Batch Controller with flow measurement and 2-stage batching, → 27
- Batch Controller with API temperature compensation, → 28
- Batch Controller with API temperature/density compensation, → 29
- Batch Controller with mass calculation, → 31
- Batch Controller with volume calculation, → 32
- Manual batching, → 33

7.4.1 Batch Controller with flow measurement and 1-stage batching

This application describes the standard application of the Batch Controller RA33. It is presented as a metering instrument in this application. The flow is measured and the valve is controlled in a way that ensures that precisely the desired volume is batched.



23 Batch Controller with flow measurement and 1-stage batching

1 Valve
2 Start button
3 Batch Controller
4 Flowmeter
5 Supply tank

Input signals:

Flow (pulse input or current input)

Output signals:

Valve control (relay or open collector)

Required settings:

1. Flow input:
   Enter the pulse value or measuring range of the 0/4 to 20 mA input.
2. Valve control:
   Set the choice of filling stages to 1-stage. Assign the selected output to control the filling stage.

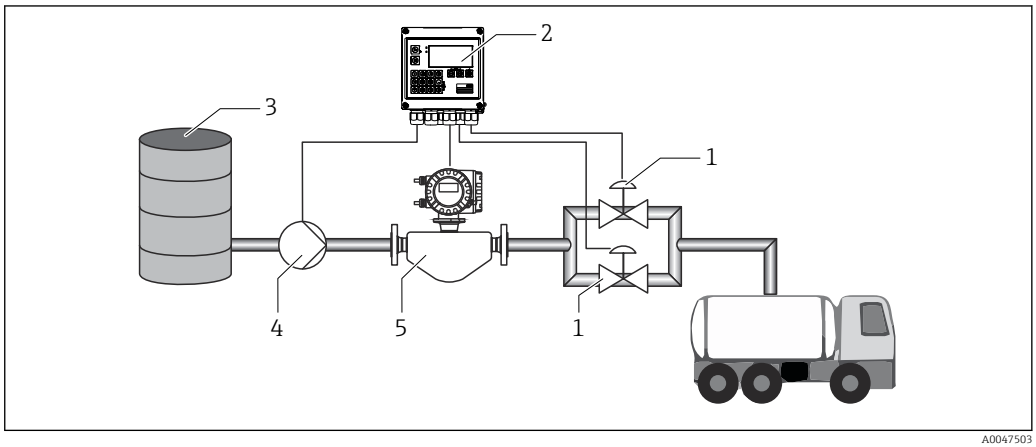
3. Preset counter:
   Before starting a batch for the first time, a value must be entered for the preset counter , as otherwise batching cannot commence. The preset counter defines the quantity of medium which the Batch Controller RA33 batches as precisely as possible. The last preset counter value that was used is stored in the device and applied for new batching operations until the value is changed.
4. After-run correction:
   The first time the automatic after-run correction function of the Batch Controller RA33 is used, the user must first teach the Controller what the after-run quantity is. The after-run quantity refers to the volume of medium that still flows between the time the control output switches and the time no more flow is recorded. The after-run quantity therefore encompasses the switching delay and the valve closing time, for example. The Batch Controller tries to correct the switch output by this amount in order to achieve a batching result that is as accurate as possible. To keep excess amounts to a minimum during these initial runs, it is advisable to enter a value for the manual after-run quantity and to teach the device gradually with smaller test quantities as medium overflow can be expected.

Display variables:

Preset counter, batch counter, flow, daily, monthly and annual counters and totalizer for batched quantity, number of batches.

7.4.2 Batch Controller with flow measurement and 2-stage batching

This application describes the standard application of the Batch Controller. It describes two-stage batching with two valves. This application uses one valve with a higher rate of flow and another valve with a lower rate of flow to dose the medium. The valve with the higher rate of flow is used for faster filling and is closed earlier so that the device can then dose more precisely with the second valve.



24 *Batch Controller with flow measurement and 2-stage batching*

1 Valves
2 Batch Controller
3 Supply tank
4 Pump
5 Flowmeter

Input signals:

Flow (pulse input or current input)

Output signals:

Valve control (relay or open collector)

Pump control (analog output, relay or open collector)

Required settings:

1. Flow input:
   Enter the pulse value or measuring range of the 0/4 to 20 mA input.
2. Valve control:
   Set the choice of filling stages to 2-stage. Assign the selected outputs to control the filling stages.

Display variables:

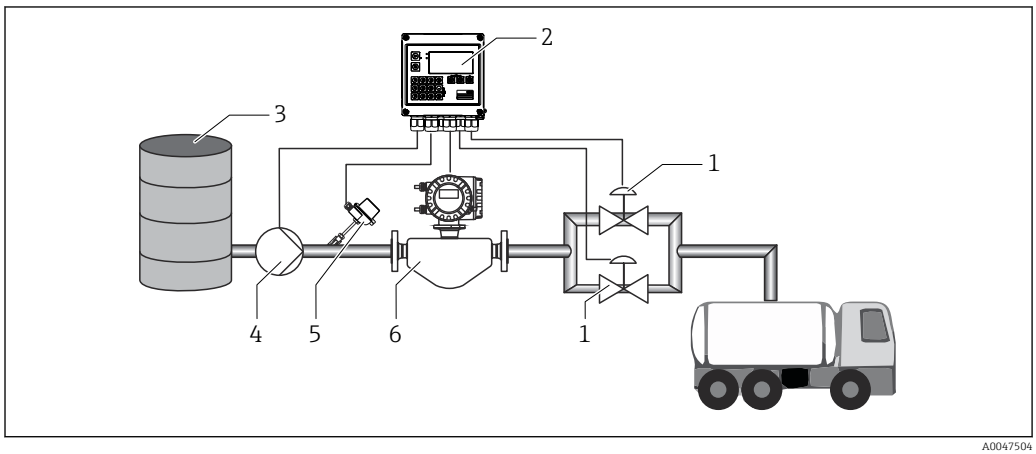
Preset counter, batch counter, flow, daily, monthly and annual counters and totalizer for batched quantity, number of batches.

Miscellaneous notes:

- Before starting a batch for the first time, a value must be entered for the preset counter , as otherwise batching cannot commence. Afterwards, the last preset counter value to be used is stored in the device.
- To ensure that the after-run quantity is kept to a minimum during the first run even if the automatic after-run correction function is activated (this function requires an initial measurement), it is advisable to enter a measured value as the manual after-run correction value, or to teach the device gradually with a small test quantity.

7.4.3 Batch Controller with API temperature compensation

This application describes the use of the Batch Controller with mineral oils and volume correction. The volume can be corrected by simply measuring the temperature, or by measuring the temperature and the density. The first application example describes the measurement using temperature compensation only. The volume can be corrected with any flow unit (volume flow or mass flow).



25 Batch Controller with flow measurement, temperature compensation and 2-stage batching

1 Valves
2 Batch Controller
3 Supply tank
4 Pump
5 Temperature sensor
6 Flowmeter

Input signals:

Flow (pulse input or current input)

Temperature (RTD or current input)

Output signals:

Valve control (relay or open collector)

Pump control (analog output, relay or open collector)

Required settings:

1. Flow input:
   Enter the pulse value or measuring range of the 0/4 to 20 mA input.
2. Temperature input:
   Select the RTD type and temperature range or enter the temperature measuring range for the 4 to 20 mA input.
3. Select the product group of the mineral oil.
4. Select the type of density measurement:
   As the density is not measured, the "Operating density" parameter must be set to "Calculated".
5. Select the reference density:
   The reference conditions of the corrected volume must be determined for the reference density. Here, the volumes at 15 °C, 20 °C and 60°F can be selected.
6. Reference density value:
   In addition to the reference operating conditions, the actual density value of the medium under the selected reference operating conditions must be specified here.
7. Pressure:
   If the event of gauge pressure deviation, you must enter a pressure at which the flow is measured.
8. Valve control:
   Set the choice of filling stages to 2-stage. Assign the selected output to control the filling stage.

Display variables:

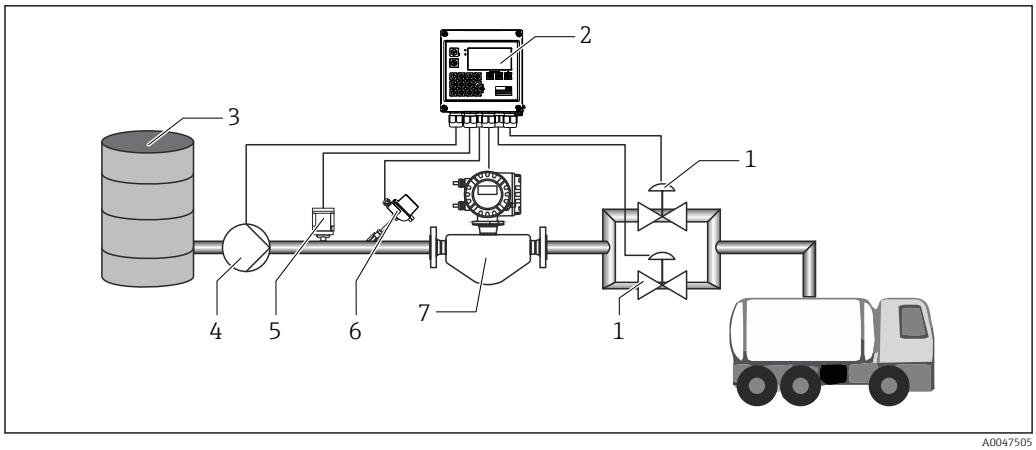
Preset counter (corrected volume), batch counter (corrected volume), volume flow, daily, monthly and annual counters and totalizer for batched quantity, number of batches.

Miscellaneous notes:

The pressure is entered relative to the environment. As the pressure only has a marginal effect on liquids, for the sake of efficiency it suffices to specify a value instead of measuring the pressure.

7.4.4 Batch Controller with API temperature/density compensation

This application describes the use of the Batch Controller with mineral oils and volume correction. The second volume correction application describes the process for correcting the volume by measuring both the temperature and the density. The volume can be corrected with any flow unit (volume flow or mass flow).



26 Batch Controller with flow measurement, temperature compensation, density compensation and 2-stage batching

1 Valves
2 Batch Controller
3 Supply tank
4 Pump
5 Density sensor
6 Temperature sensor
7 Flowmeter

Input signals:

Flow (pulse input or current input)

Temperature (RTD or current input)

Density (current input)

Output signals:

Valve control (relay or open collector)

Pump control (analog output, relay or open collector)

Required settings:

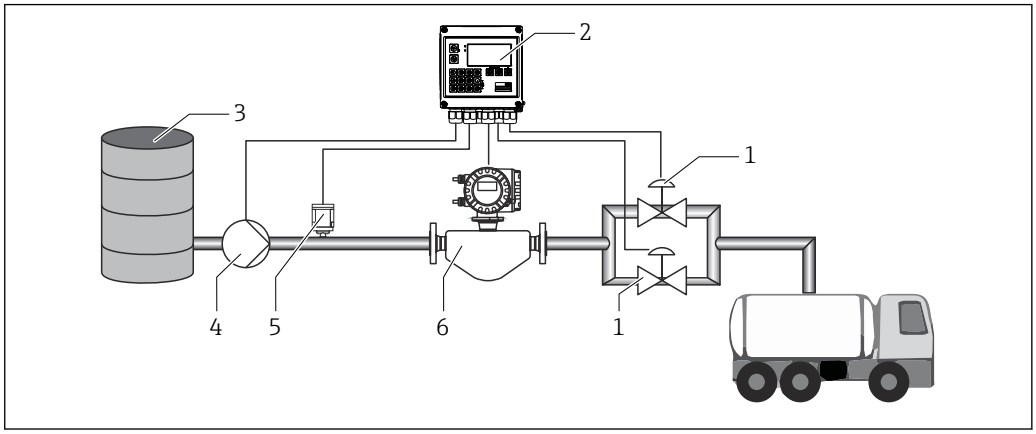
1. Flow input:
   Enter the pulse value or measuring range of the 0/4 to 20 mA input.
2. Temperature input:
   Select the RTD type and temperature range or enter the temperature measuring range for the 4 to 20 mA input.
3. Select the product group of the mineral oil.
4. Select the type of density measurement:
   The "Operating density" is set to "Measured" since a density meter is used in this application example.
5. Select the reference density:
   The reference conditions of the corrected volume must be determined for the reference density. Here, the volumes at 15 °C, 20 °C and 60°F can be selected.
6. Valve control:
   Set the choice of filling stages to 2-stage. Assign the selected output to control the filling stage.

Display variables:

Preset counter (corrected volume), batch counter (corrected volume), volume flow, daily, monthly and annual counters and totalizer for batched quantity, number of batches.

7.4.5 Batch Controller with mass calculation

In addition to performing volume correction for mineral oils, the mass of any medium can also be calculated. If this function is activated, the volume is converted to mass and the counter and preset counter are also available in the selected mass units.



27 *Batch Controller with mass calculation*

1 Valves
2 Batch Controller
3 Supply tank
4 Pump
5 Density sensor
6 Flowmeter

Input signals:

Flow (pulse input or current input)

Density (current input)

Output signals:

Valve control (relay or open collector)

Pump control (analog output, relay or open collector)

Required settings:

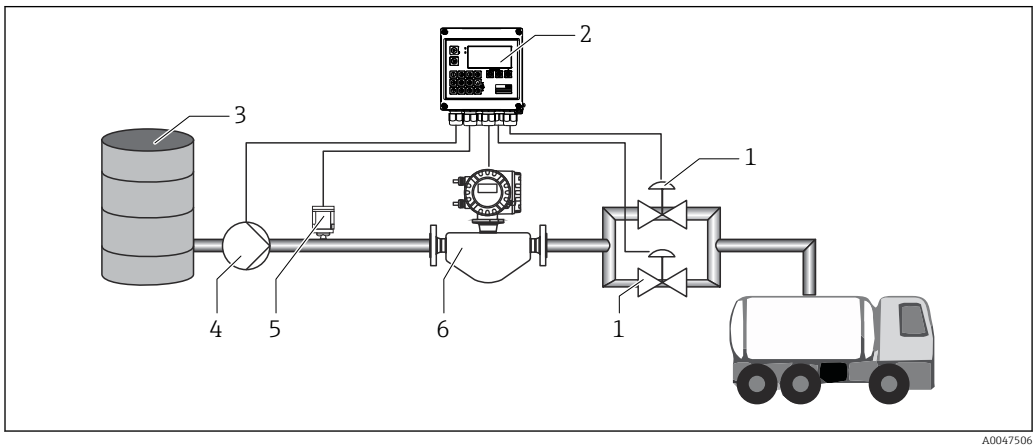
1. Flow input:
   Enter the pulse value or measuring range of the 0/4 to 20 mA input.
2. Set the product group to "User-defined".
3. Select the type of density measurement:
   The "Operating density" is set to "Measured" since a density meter is used in this application example.
4. Set the "The result is" parameter to "Mass" to enable the calculation of the mass.
5. Valve control:
   Set the choice of filling stages to 2-stage. Assign the selected output to control the filling stage.

Display variables:

Preset counter (mass), batch counter (mass), volume flow, daily, monthly and annual counters and totalizer for batched quantity, number of batches.

7.4.6 Batch Controller with volume calculation

If a flow sensor is used for mass flow measurement, it is possible to calculate the batched volume. This requires a density measurement (alternatively: a fixed density value is specified or the temperature is measured and this information is used to calculate the operating density internally on the basis of the reference conditions, reference density and expansion coefficient). If this function is enabled, then the mass is converted to volume and the counter and preset counter are also available in the selected volume units.



28 *Batch Controller with mass calculation*

1 *Valves*
2 *Batch Controller*
3 *Supply tank*
4 *Pump*
5 *Density sensor*
6 *Flowmeter*

Input signals:

Flow (pulse input or current input)

Density (current input)

Output signals:

Valve control (relay or open collector)

Pump control (analog output, relay or open collector)

Required settings:

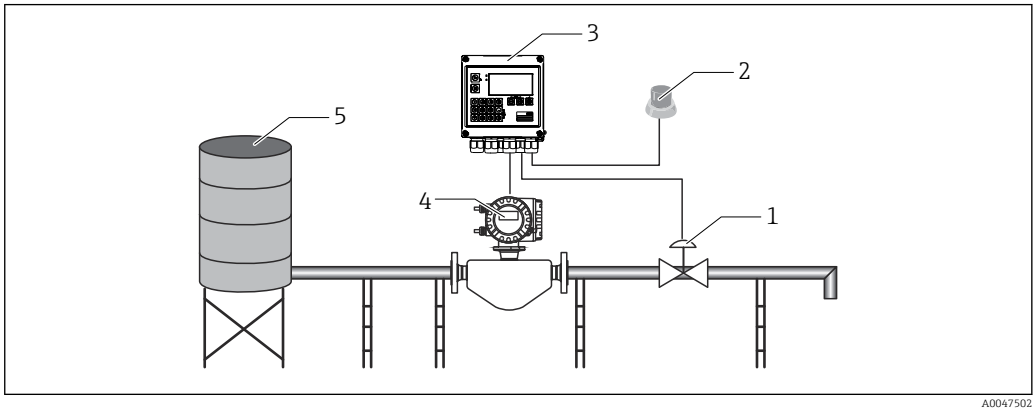
1. Flow input:
   Enter the pulse value or measuring range of the 0/4 to 20 mA input.
2. Set the product group to "User-defined".
3. Select the type of density measurement:
   The "Operating density" is set to "Measured" since a density meter is used in this application example.
4. Set the "The result is" parameter to "Volume" to enable the calculation of the volume.
5. Valve control:
   Set the choice of filling stages to 2-stage. Assign the selected output to control the filling stage.

Display variables:

Preset counter (volume), batch counter (volume), mass flow, daily, monthly and annual counters and totalizer for batched quantity, number of batches.

7.4.7 Manual batching

In addition to batching based on a preset counter selected beforehand, it is also possible to use the device as a volume counter or mass counter (depending on the type of flow sensor) with manual control. This enables batching on the basis of visual control, for example, or via the stop signal of an external signal transmitter.



29 *Manual batching with the Batch Controller*

1 *Valve*
2 *Start button*
3 *Batch Controller*
4 *Flowmeter*
5 *Supply tank*

Input signals:

Flow (pulse input or current input)

Remote control (digital input)

Output signals:

Valve control (relay or open collector)

Required settings:

1. Flow input:
   Enter the pulse value or measuring range of the 0/4 to 20 mA input.
2. Set the Batch Controller to "Manual" mode.
3. The digital inputs must be assigned a Start/stop function for remote control.
4. Valve control:
   Set the choice of filling stages to 1-stage. Assign the selected output to control the filling stage.

Display variables:

Preset counter, batch counter, flow, daily, monthly and annual counters and totalizer for batched quantity/mass, number of batches.

7.5 Configuring the basic parameters/general device functions

- Inputs, → 34
- Outputs, → 35
- Application, → 37
- Data logging, → 39

- Access protection, → 39
- Logbooks, → 40
- Communication/fieldbus systems, → 40

7.5.1 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 EN 1434 and provides a supply for switching contacts.

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 High level ≥ 2.1 mA corresponds to Low level U no-load: 7 to 9 V	

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 batching and statistics counters are totaled from the individual pulse values. The current flow can also be calculated from the counters so that it can be shown on the display. The desired flow unit must first be selected in the flow settings.

Flow current signal

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

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 below the low flow cut off value are treated as zero.
- Negative lower range limit (bidirectional measurement), e.g. −50 to 50 m^3/h: Values around the zero point (+/- low flow cut off value) are evaluated as zero.

Temperature inputs

To measure the temperature, RTD sensors can be connected directly or via transmitter (4 to 20 mA). For direct connection, Pt100/500/1000-type sensors can be used. For Pt100 sensors, different measuring ranges are available to ensure the highest accuracy for both small and large temperature differences:

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**. → 47

Density (optional)

To measure the density, a density sensor can be connected to the current input marked "Density" via 0/4 to 20 mA. In addition a fixed density value can be also be saved. This is suitable for media whose composition is known. → 47

Digital inputs

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

Function	Description
Batch active (high)	A batch is started when there is a switch from low → high. It runs until either the value on the preset counter is reached or the signal drops from high → low. An active batch is aborted and ended if the signal drops. If the value on the preset counter is reached and a new batch should start, a switch must first take place from high → low so that another change from low → high can start the new batch run.
Batch start (edge)	A batch is started when the edge changes from low → high. The function has exactly the same effect as pressing the button locally.
Batch stop (edge)	A batch is paused when the edge changes from low → high and aborted and then stopped with the next change from low → high. The function has exactly the same effect as pressing the button locally.
Reset batch number	The batch number, which is automatically increased, is reset to the start value defined in the Setup when the edge changes from low → high.
Time synchronization	Time synchronization is triggered by an edge change from low → high.
Status	The device remains operational as long as there is a high signal (status=OK). Once the signal drops to low, any batching operation that is currently active is stopped and the device is locked so that it cannot restart. The device remains locked until there is a high signal again, which indicates that the system is operational.

7.5.2 Outputs

Relay

The two relays can be switched to control the filling stages and to signal fault messages.

They can be assigned to the relevant filling stages of the batch under **Setup** → **Advanced setup** → **Application** → **Batch settings** → **Switches fill stage 1/2**.

In the event of more intensive use, it is recommended to use the open collector outputs for batch control.

Open collector outputs (optional)

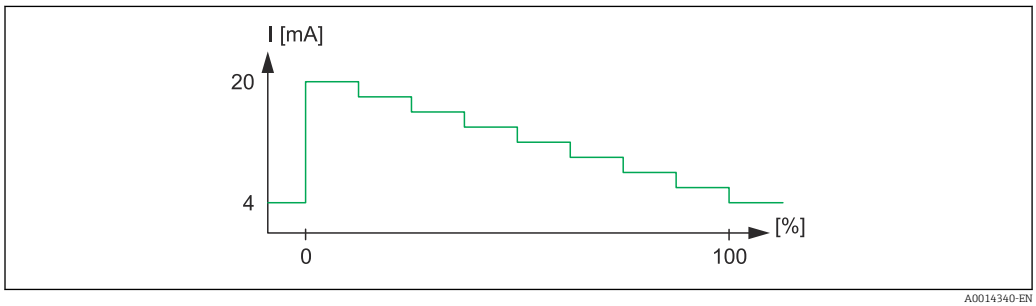
The open collector outputs can be used as status and pulse outputs. As status outputs, they can be used to control the filling stages of the batches and to signal fault messages. As pulse outputs, they can output counter values and signal the end of a batch.

Universal output - current and active pulse output (optional)

The universal output can be used as a pulse output or analog output. It can output the volume flow or the volume/mass counter. In addition, the progress of the batch can be output in linear or curve form.

Batch progress

When the progress of the batch is displayed, the output value starts at 20 mA at the beginning of the batch and moves down linearly until it reaches the lower limit of the current output 0/4 mA at the end of the batch. The output's lower range limit is output at the current output if a batch is not active.

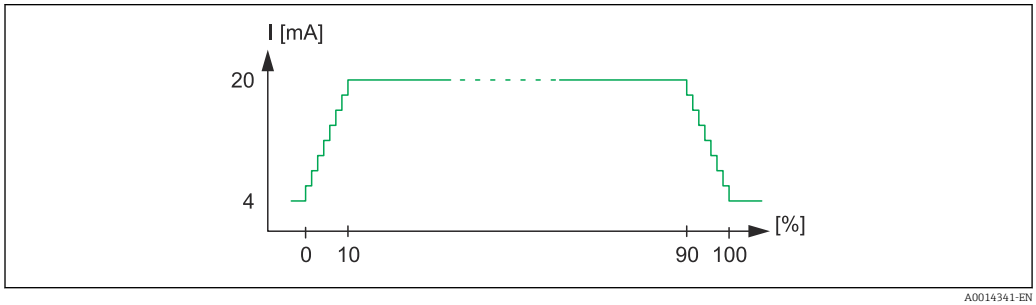


30 Chart displaying batch progress

0 Batch starts at 0 %
100 Quantity reached at 100 %

Curve

If batching has stopped, the current value at the output is 0/4 mA. The output adopts the current defined in "Current start value" directly after a batching operation starts. The current value then moves upwards linearly and reaches the 20 mA current value at a percentage value of the entire batch quantity, "Start max.", that is specified in the Setup. The current value at the current output then remains at 20 mA until the percentage value of the batch quantity specified in "Stop max." is reached. The current value is then adjusted downwards linearly to the output value. The output's lower range limit is output at the current output if a batch is not active.



31 Chart displaying a curve

0 Batch start
10 Start max
90 Stop max
100 Quantity reached

7.5.3 Batch settings

All batching and control-related settings for batch operation must be made in the "Batch settings".

Batch mode

The main setting of the batching functionality is to select the batch mode, which comprises the following modes: "Standard", "Automatic restart" and "Manual"

Function	Description
Standard	In the "Standard mode", a value must be entered for the preset counter after commissioning. This value is then used for all batch cycles until it is changed again. The value for the preset counter can be changed during an active batch or when batching has stopped. This preset counter value is then used when the new batch is started. A batch can be started via the control input or by pressing a button. It continues until the value on the preset counter is reached, or the batch is paused beforehand via a stop command (button or control input). From this paused state, the batch can either be resumed by means of a start command or aborted entirely by means of another stop command.
Automatic restart	The "Automatic restart" mode works like the "Standard" mode but with the addition that a batch sequence is started which is restarted after a configurable restart delay time. This continues until the batch sequence is paused and finished.
Manual	A preset counter is not required in "Manual" mode. The batch is started and stopped by operating keys on the device or via the control input.

Counting direction

The counting direction is another basic setting. It is only relevant for showing values on the display and refers to the counting direction in which the preset counter is displayed.

Counting direction “forward”: displays the totalizer.

Counting direction “backward”: displays the remaining batch quantity.

Filling stages

With this device, the user has the option of 1-stage and 2-stage batching. The main valve is for the first stage. It supplies a lower flow rate and is opened at the start of the batch. It is used for precision dosing at the end of the batch. The second filling stage, with a higher flow rate, is also opened after a specified delay time so that the required batching quantity is reached more quickly. This stage is closed when a remaining pre-stop quantity is reached. The delay time and pre-stop quantity must also be specified in the batch settings.

Fixed and automatic after-run correction

It is advisable to use after-run correction due to system response times. The command to close the valves is thus given early enough to compensate for the response time and to achieve maximum batching accuracy.

Fixed after-run correction value serves as the basis. Here, a fixed value can be specified and flow is stopped earlier by this value.

Automatic after-run correction can be activated in addition. It calculates the new correction value based on the actual measured error of the last batch runs. In this way, consistent batching accuracy can be achieved.

To ensure that the after-run quantity is kept to a minimum during the first run, it is advisable to enter a measured value as the manual after-run correction value, or to teach the device gradually with a small test quantity. The automatic after-run correction can then be activated.

Maximum preset counter

Entering the maximum permitted preset counter value reduces the risk of incorrect entries. If a preset counter value is entered during operation that is greater than the maximum permitted value, the batch is not started and a message is displayed.

7.5.4 Batch information

All parameters for displaying and identifying stored batches are saved in the batch information. Batches are identified by a user-defined name and a batch number, which is automatically incremented after each batch cycle. The start value of the batch number can also be preset and the current number can also be reset to this value.

7.5.5 Display settings and units

Display settings

When **Setup** → **Application/Grouping** is selected, you can define which process values are shown on the display. For this purpose, six display groups are available. A group can be assigned up to three 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:

Display mode

The display mode is selected in the **Display/Operation** menu. You can 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 (batch reports, day, month and annual counter and totalizer) under "stored values". (For details, see "Data logging" → 🖹 39)

No. of Sums/counter overflow

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

Units

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

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

- EU: SI units
- USA: imperial units

Selecting the unit system sets the units in the individual submenus to a specific default value, e.g. SI: m^3/h, °C, kWh.

If a unit is converted afterwards, no automatic conversion of the associated (scaled) value is carried out.

For information on the conversion of units, see the appendix .

7.5.6 Data logging

The device stores relevant measured values and counter data at defined times. An analysis is stored daily, monthly and annually with the number of batch cycles, error-free batch cycles and the batched volume for this time period.

The individual batch cycles are stored with the following details: date, time, batch name, batch number, preset counter and volume counter. The device offers consistent and reliable data logging, which guarantees the security of data even after a power failure.

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
Batch	▪ Date, time ▪ Batch name ▪ Batch number ▪ Preset counter ▪ Volume counter
Daily, monthly and annual analysis	▪ Volume counter for the time period ▪ Number of batches completed ▪ Number of batches completed without error

General notes for data logging

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

The current counter can be reset to zero via the setup. The archived values (completed analyses) can no longer be changed. To delete them, 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 counters are overwritten after a certain time, see the table below.

Data	Number
Batches	Min. 1000
Events	Min. 1500 (messages with an average of 40 characters)
Statistics day/month/year	Min. 800/750/50

7.5.7 Access protection

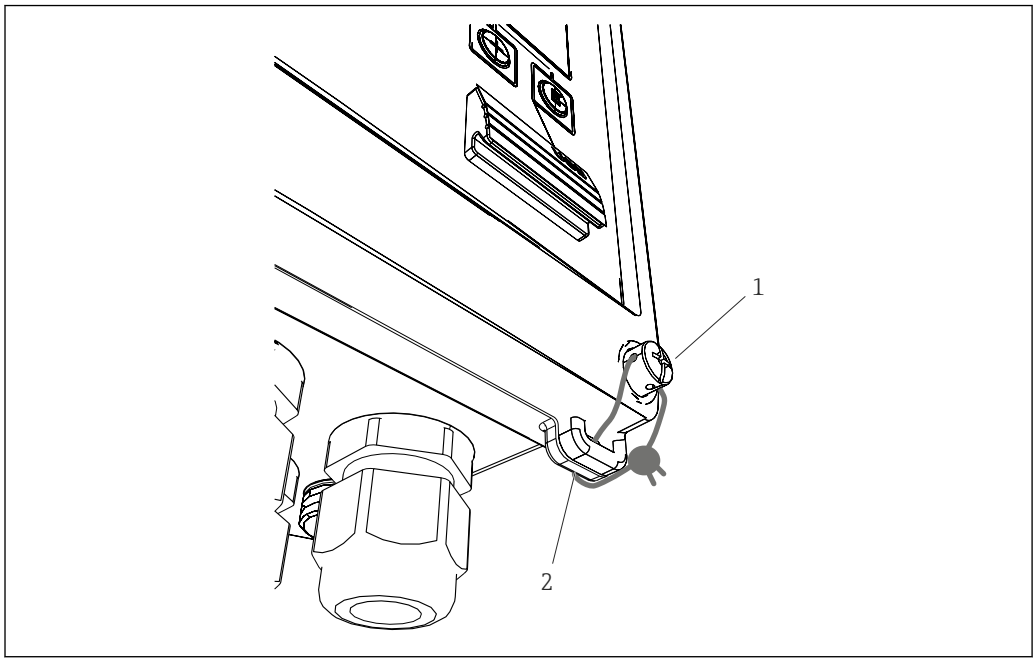
To prevent tampering, the device can be locked by an operating code or by a hardware switch in the device .

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.

It is still possible to enter the preset counter value.

Lead sealing on the device



32 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.

7.5.8 Logbooks

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

Event logbook

The event logbook stores events such as alarms, limit value violations, setup changes, with the date and time specified. The memory holds at least 1600 messages. Depending on the text length, however, more messages may be stored. If the memory is full, the oldest messages are overwritten. The logbook can be read out using the Field Data Manager software or directly on the device. To exit the logbook quickly, press the +/- keys simultaneously.

7.5.9 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 as part of configuration of the device (via FieldCare operating software and USB or Ethernet interface). Process values such as flow cannot be transferred to the device via the bus interfaces.

Batch commands can be sent to the device via Modbus, for details refer to the "Modbus RTU" section.

Depending on the bus system, alarms and 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 the counter readings of the most recently completed storage period (day, month, year, billing date) can be read out of the memory.

For large counter readings, the decimal points are truncated (e.g. 1234567.1234 → 1234567 or 234567.1234 → 234567.1).

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

Modbus RTU/(TCP/IP)

Detailed information for Modbus register assignment: 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 or the **Expert** → **System** → **Ethernet**, menu → 44. Modbus communication is configured in the **Setup** → **Advanced setup** → **System** → **Modbus** menu or the **Expert** → **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 device:

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 device 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 device 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 device does not respond.

For large counter readings, the decimal points are truncated.

For additional information on the Modbus, see Operating Instructions BA01029K.

Transmission of batch commands to the Batch Controller, reading out the batch status

Batch commands can be transmitted to the Batch Controller and the batch status read via Modbus. The following registers are available for this purpose:

Protocol address (base 0)	PLC address (base 1)	Function	Data type	Description
5000	5001	Set preset counter	FLOAT	A new preset counter is set when these registers are written to. **Modbus function 16 (Write Registers)**
5002	5003	Set start/stop	UINT16	If a 1 is written, a batch is started. If a 0 is written, a batch is stopped. **Modbus functions 16 (Write Registers), 06 (Write Single Register).**
5200	5201	Read batch status	UINT16	This register provides the status of the batch: 0: Batch stopped 1: Batch active 2: Batch paused **Modbus functions 03 (Read Holding Register), 04 (Read Input Register)**

The byte order must be followed according to the setting in the Batch Controller.

Set the batch name via Modbus:

Protocol address (base 0)	PLC address (base 1)	Function	Data type	Description
5010-5019	5011-5020	Write batch name	STRING (ASCII)	The batch name is written from register 5010 onwards, Modbus function 16 (Write Registers)

The batch name can only be set before the start of the batch. Register 5200 ->0x0000.

A maximum of 20 characters are accepted.

This functionality is only available if recipe management is switched off, or if no recipe or the first recipe was selected if recipe management is active. Otherwise the device returns Error 04: SLAVE_DEVICE_FAILURE.

2 characters are transferred in each register. Must start from register 5010 (base 0). The end of the text is recognized as follows:

- Register number (maximum 10 -> 20 characters)
- Must end with 0x00 in the event of an uneven number of characters
- Character 0x00

Request from master (byte sequence):

6 characters, register filled	
"ABCDEF" -> 5010-5012	0x41, 0x42, 0x43, 0x44, 0x45, 0x46
6 characters, 2 additional registers, ends with 0x00	
"ABCDEF" -> 5010-5014	0x41, 0x42, 0x43, 0x44, 0x45, 0x46, 0x00, 0x00, 0x00, 0x00
5 characters, last register only 1 character -> ends with 0x00	
"ABCDE"-> 5010-5012	0x41, 0x42, 0x43, 0x44, 0x45, 0x00
4 characters, starting from the 2nd register	

"BCDE" ->5011-5012	0x42, 0x43, 0x44, 0x45 -> Error message 02: Invalid Start Register
22 characters	
"ABCDEFGHIJKLMNOPQRST12" > 5010-5020	0x41, 0x42, ... 0x53, 0x54, 0x31, 0x32 -> The first 20 characters are accepted ("ABCDEFGHIJKLMNIOQRST"), additional characters are ignored. No error message!

Process messages via Modbus:

Protocol address (base 0)	PLC address (base 1)	Function	Data type	Description
5300	5301	Number of active process messages	UINT16	This register provides the number of active process messages: Modbus functions 03 (Read Holding Register), 04 (Read Input Register). e.g. 0x0003
5301	5302	Read out the error code of the process message currently displayed	UINT16	The value has the following structure. Bit 15: "F" Bit 14: "C" Bit 13: "M" Bit 12: "S" Bit 0-11 Error code, Modbus functions 03 (Read Holding Register), 04 (Read Input Register). e.g. "F903" -> 0x8387 -> binary 1000 0011 1000 0111
5302	5303	Acknowledge process messages	UINT16	1: Acknowledge process message currently displayed 2: Acknowledge all process messages, Modbus function 06 (Write Register)

The byte sequence must follow the setting.

Ethernet/web server (TCP/IP)

Setup → **Advanced setup** → **System** → **Ethernet** or **Expert** → **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 → 41

Up to four connections can be opened simultaneously, e.g. Field Data Manager Software, Modbus TCP and two web servers, with only one data connection via Port 8000 being possible at any one time.

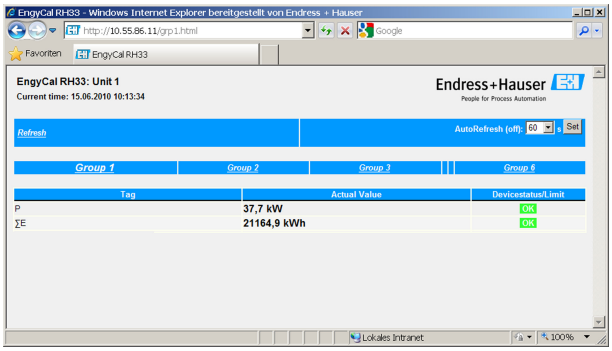
Once the maximum number of four connections has been reached, new connection attempts are blocked until an existing connection has been terminated.

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.



33 *Display values shown in the web browser (using the example of the EngyCal RH33)*

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

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

When using an Internet browser, it is sufficient to enter the address http://<IP address> to display the HTML view 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 status, 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

Tag	Description
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 the 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.

Printer interface

The device can print a batch report directly to a connected ASCII printer via RS232.

Menu item	Description
Printout	With the "manual" setting, a printout can be initiated on site. If the setting is set to "Automatic", the configured number of printouts is additionally printed after every batch cycle.
Baud rate	Select the baud rate that is compatible with the printer.
Number of copies	Select the number of printouts for the automatic printout at the end of the batch.
Characters/line	Enter the number of characters per line supported by the printer.
Number of headers	Select the number of required number of lines for user-defined text at the beginning of the printout.
Header 1-4	Enter the user-defined text for the header line here.
Number of footers	Select the desired number of lines for user-defined text at the end of the printout.
Footer 1-4	Enter the user-defined text for the footer here.
Blank rows at the end	Enter the required number of blank rows at the end of a printout, e.g. to allow sufficient space to tear off the printout.
Print direction	Select whether printing should start with the first line of the printout or with the last line.
Test printout	Trigger a test printout.

```
self definable header information
Company XYZZGSAZGSAZSGZAGSZAGSZGAZSGAZSG
Street ASASOKAOSKAOSOAKSOAKSOK
---------------------------------------

17:07                          03.08.2010
Unit 1                          BatchSimu

No.                                     9
Batch 1                         4.0 m³


---------------------------------------
self definable footer information
Company XYZZGSAZGSAZSGZAGSZAGSZGAZSGAZSG
Street ASASOKAOSKAOSOAKSOAKSOK
```

34 *Batch Controller test printout*

7.6 Optional device settings/special functions

- Compensation → 47
- Batch printout → 48

7.6.1 Compensation

Measured volumes can be corrected or converted to masses, or measured masses can be converted to volumes, using the additional compensation function. Depending on the type of compensation, temperature and density sensors are required for this purpose.

The use of the temperature and density inputs is shown in the table below using the measured product group (mineral oils or other), as are the expected results.

Volume flowmeter (conversion to mass / volume correction)

Product group	Expected result	"Operating density" setting	Temperature sensor	Density sensor
User-defined	Mass	Measured	Not required	Required
	Corrected volume	Calculated	Required	Not required
		Measured	Not required	Required
Mineral oil	Corrected volume	Calculated	Required	Not required
		Measured	Required	Required

For both product groups, volume correction via temperature measurement or density measurement is possible. The advantage of an additional density measurement is that the system reacts to fluctuations in the medium independently. If correction is performed using temperature measurement alone, the density value of the medium must be checked and adjusted under reference conditions.

Product group

The choice of product group determines the calculation standard at the same time. In the case of user-defined media, a volume can be corrected or converted to mass using other parameters. The volume is corrected in accordance with the API MPMS (Chapter 11) standard for the following mineral oil product groups: crude oil, refined products and lubricating oils.

Reference data

The reference condition specifies the ambient conditions at which the correction must be calculated. The user can choose from 15 °C, 20 °C or 60 °F. The value that must be entered in the reference density parameter is the density of the medium under the selected

reference operating conditions. When the API° and Gravity (G) density unit is used, 60 °F is automatically selected as the reference condition.

An expansion coefficient must be specified depending on the calculation and if density measurement does not take place. It must be entered in the unit 1/°C or 1/°F, depending on the reference conditions. Consequently, a reference condition in °C also produces an expansion coefficient in 1/°C. In this case, the expansion coefficient is a factor by which the volume increases if the temperature of the medium is one degree higher than the reference condition.

Pressure specifications

The pressure must be taken into account for a complete correction of the volume. In the Setup, you must enter the gauge pressure in relation to the ambient pressure at which the flow of the medium is measured. Direct measurement is not required as the influence of pressure is relatively low. It suffices to enter the approximate pressure for the required level of accuracy. Pressure compensation can be disabled by entering a pressure value of 0.

7.6.2 Batch printout

See the "Printer interface" section, → 46

7.7 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)]
  The supplied free PostgreSQL database can be installed and used.
- Microsoft SQL server [1)]
  Contact your database administrator to set up a login.

Data can be imported from the device via the software's user interface. To do this, use the USB cable available as an accessory or the Ethernet port of the device→ 44.

For details on installing and operating the Field Data Manager software:
See online at: www.produkte.endress.com/ms20

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

8 Diagnostics and troubleshooting

8.1 Instrument diagnostics and troubleshooting

The Diagnostics menu is used for the analysis of the device functions and offers comprehensive assistance during troubleshooting. Proceed as follows to locate the cause of device errors or alarms:

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 the diagnostic measured value display: Check the input signals by viewing the raw values (mA, Hz, Ohm) or the scaled measuring ranges. To verify calculations, call up calculated auxiliary variables if necessary.
3. Most faults can be rectified by performing steps 1 and 2. If the fault persists, follow the troubleshooting instructions for the fault types from Section 9.2 of the Operating Instructions.
4. If this does not rectify the problem, contact the Service Department. For service inquiries, please always have the diagnostic number and the information from the Device information/ENP (program name, serial number etc.) available.

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

8.1.1 Troubleshooting for Modbus

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

8.1.2 Device error/alarm relay

There is a global "alarm relay". In the setup, either the relay or the open collector can be assigned to this function.

This "alarm relay" switches if "F" type errors occur (F = failure). "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.

8.2 Error messages

Fault	Description	Remedy
F041	Open circuit: Input current ≤ 2 mA ▪ Incorrect wiring ▪ Full scale value of the measuring range configured incorrectly ▪ Sensor defective	▪ Check the wiring ▪ Enlarge measuring range (change scaling) ▪ Replace sensor

F104	Sensor error Input current > 2 … ≤ 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 the wiring ▪ Enlarge measuring range (change scaling) ▪ Replace sensor ▪ Select a larger value for pulse value
F201	Device error (operating system error)	Contact the Service Team.
F261	System error (miscellaneous hardware errors)	Contact the Service Team.
F301	Setup defective	Reconfigure the device. If the error recurs, contact service.
F303	Device data defective	Contact the Service Team.
F305	Counters defective	Counter value is reset automatically to 0.
F307	Customer preset value defective	Save configuration parameters.
F309	Invalid date/time (e.g. GoldCap was empty)	Device was switched off too long. The date/time must be set again.
F310	The setup could not be saved	Contact the Service Team.
F311	Device data could not be stored	Contact the Service Team.
F312	Calibration data could not be stored	Contact the Service Team.
F314	Activation code is no longer correct (incorrect serial number/program name).	Enter new code.
F431	Calibration data missing	Contact the Service Team.
F501	Invalid configuration	Check setup.
F900	Input variable(s) outside the calculation limits (see Technical data, → 🖹 57)	▪ 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.
F918	Inputs not configured. The application requires an additional input. This is not configured. Example: Compensation: "Yes" requires a temperature input.	▪ Configure the necessary input. ▪ Set the application differently, e.g. Compensation: "No" ▪ Restart the device following the change.
F919	Flow rate greater than low flow cut off!	Check sensors, valves or pumps.
F921	Fill deviation exceeded!	

F922	Fill deviation undershot!	
M102	Over range Input current ≥ 3.6 mA to < 3.8 mA	Enlarge measuring range (change scaling).
M103	Under range Input current > 20.5 mA to ≤ 21 mA	Enlarge measuring range (change scaling).
M302	Setup has been loaded from backup.	No effect on operation. As a precaution, check and adjust setup settings.
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 the plausibility of the counter reading (compare to the 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 Team.
M502	Device is locked! - e.g. during an attempt to update the firmware	Check the hardware switch in device.
M908	Analog/pulse output error	Check process values and scaling of the output, select full scale value or pulse value.
M918	Preset counter may not be 0!	Enter value for preset counter.
M920	Batch aborted. No flow!	Check sensors, valves or pumps.

8.3 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. When the memory is full, the oldest messages are automatically overwritten without generating a message.

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

The diagnostic list is not read out via the PC operating software, but can be displayed via FieldCare.

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

8.4 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.

8.4.1 Relay tests

The user can switch the relay manually.

8.4.2 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 only available for the pulse output:
- 1 kHz
- 5 kHz
- 10 kHz

8.4.3 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 Maintenance

No special maintenance work is required for the device.

9.1 Cleaning

9.1.1 Cleaning of surfaces not in contact with the medium

- Recommendation: Use a lint-free cloth that is either dry or slightly dampened using water.
- Do not use any sharp objects or aggressive cleaning agents that corrode the surfaces (displays, housing, for example) and seals.
- Do not use high-pressure steam.
- Observe the degree of protection of the device.

The cleaning agent used must be compatible with the materials of the device configuration. Do not use cleaning agents with concentrated mineral acids, bases or organic solvents.

9.1.2 Cleaning of surfaces in contact with the medium

Note the following for cleaning and sterilization in place (CIP/SIP):
- Use only cleaning agents to which the materials in contact with the medium are sufficiently resistant.
- Observe the permitted maximum medium temperature.

10 Repair

10.1 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.

10.1.1 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.

10.2 Spare parts

Product spare parts that are currently available can be found online at:
www.endress.com/onlinetools

10.3 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
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 provides the best protection.

10.4 Disposal

10.4.1 IT security

Observe the following instructions before disposal:

1. Delete the data
2. Reset the device

10.4.2 Removing the measuring instrument

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

10.4.3 Disposing of the measuring instrument

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.

11 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**.

11.1 Device-specific accessories

11.1.1 Accessories enclosed

Accessories	Description
Pipe mounting set	Mounting plate for pipe mounting For dimensions and installation instructions, see the "Installation" section.
DIN rail mounting set	DIN rail adapter for DIN rail mounting For dimensions and installation instructions, see the "Installation" section.
Panel mounting set	Mounting plate for panel mounting For dimensions and installation instructions, see the "Installation" section.

11.2 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

11.3 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

11.4 Online tools

Product information about the entire life cycle of the device is available at:
www.endress.com/onlinetools

11.5 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

Process indicators from the RIA product family

Easily readable process indicators with various functions: loop-powered indicators for displaying 4-20mA values, display of up to four HART variables, process indicators with control units, limit value monitoring, sensor power supply, and galvanic isolation.

Universal application thanks to international hazardous area approvals, suitable for panel mounting or field installation..

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

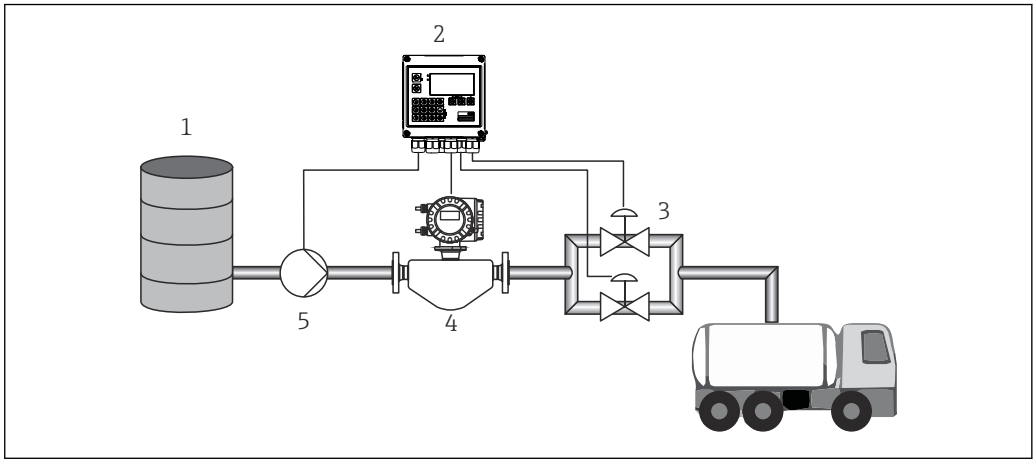
12 Technical data

12.1 Function and system design

Measuring principle

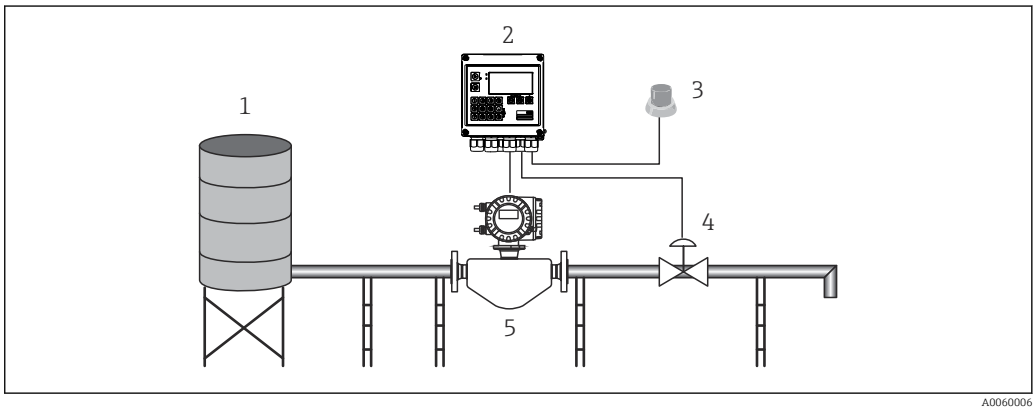
The Batch Controller RA33 is designed to record flow and control output signals for valves and pumps to ensure the exact dosing of predefined batch quantities. The calculation is based on measuring the current rate of flow and then totalizing or recording the quantity using pulses. The measured volume can be corrected with the temperature/density compensation function. Mineral oils can be corrected in accordance with the ASTM D1250-04 standard. The volume of other media can be converted using expansion coefficients, or from their mass, using a density measurement.

Measuring system



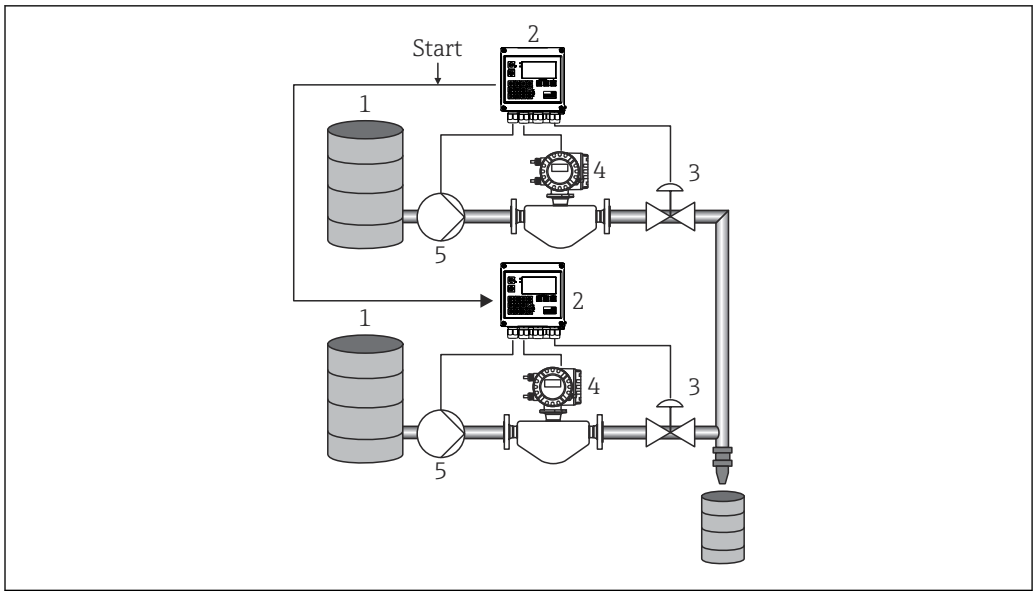
35 *Application: Batch Controller RA33 with two-stage batching to fill a tank truck*

1 *Supply tank*
2 *Batch Controller RA33*
3 *Valves*
4 *Flowmeter*
5 *Pump*



36 *Application: manual batching without a pump with the Batch Controller RA33*

1 *Supply tank*
2 *Batch Controller RA33*
3 *Start button*
4 *Valve*
5 *Flowmeter*



37 *Application: blending of two liquids when batching with the Batch Controller RA33*

1 *Supply tank*
2 *Batch Controller RA33*
3 *Valve*
4 *Flowmeter*
5 *Pump*

Functions

Batch control

The function of the Batch Controller RA33 is to control valves and pumps using the measured rate of flow and to fill a precise volume of the medium into a container.

Three different batch modes are available to perform this task:
- Standard mode: A value for the preset counter must be entered before batching commences. Batching can then be started by pressing the start button or via the digital input. The flow is measured, the counter calculates the volume and the pumps and valves are stopped as soon as the specified volume is reached. The value on the preset counter remains for the next run but can be changed manually.
- Automatic restart: In this scenario, the system repeatedly fills the selected fill quantity until the sequence ends. It is also possible to define an interval between the individual fill quantities. For added safety, a control input can also be assigned a blocking function which prevents the batching operation from restarting automatically.
- Manual mode: In the manual mode, it is possible to perform batching without a preset counter. The device registers the total flow between the start and end of a batch. The batch must be started and ended by pressing a button or via the control input.

The device is suitable for the automatic control of slow batch processes with a duration of longer than 10 seconds..

After-run correction

The after-run correction is a volume that is determined by the system response time. On the basis of this volume, the stop command from the batch control system is executed earlier in order to achieve maximum batching accuracy. Two correction capabilities, which build on one another, are implemented in the device.

- Fixed after-run correction: A fixed value can be specified if the system response time is known, or in order to keep the after-run quantity as low as possible when initially teaching the device and configuring it for the automatic correction function.
- Automatic after-run correction: It is advisable to enable automatic after-run correction. It complements manual correction and constantly optimizes the lead time before the valve is closed and the pump is switched off in order to permanently obtain precise batching results, and to compensate for possible system changes brought about by aging or external influencing factors.

Outputs (optional)

The additional output package comprises two more digital outputs (open collector) and a pulse/analog output. These digital outputs are non-wearing and are thus suitable for a high number of switching cycles. Furthermore, a counter, a flow or a user-definable ramp function to indicate the progress of the batching can be output with the additional pulse/analog output.

Temperature/density compensation (optional)

The temperature/density compensation enables compensation for various kinds of media. For mineral oils, compensation can be selected via temperature measurement or via density measurement. The values measured are then converted to a compensated volume at 15 °C, 20 °C or 60 °F using the ASTM D1250-04 standard.

The compensation of user-defined media is a second possibility. A volume can be corrected by measuring the temperature and applying an expansion coefficient, or by measuring the density. Volume can also be converted to mass with a density measurement. The preset counter can also be set for this mass unit.

Data logging/logbook

Data logging comprises three specific areas. Batching reports, daily, monthly and annual statistics, and a logbook of events are stored in the device.

- Batch report: A batch report is created for each batch run. This report contains any error messages that might have occurred. The preset counter value, the volume actually filled, the batch name and number, as well as the date and time are saved in every report.
- Statistics: Daily, monthly and annual statistics are generated internally. They contain information on the number of batches executed, the number of batches without errors, and the total amount.
- Event logbook: All the relevant device events are logged in the event logbook. These include setup changes, power outages, sensor errors and firmware updates.

Real-time clock (RTC)

The device has a real-time clock that can be synchronized via a free digital input or using the Field Data Manager software MS20.

The real-time clock continues running even in case of a power outage, the device documents power on and off; the clock switches either automatically or manually from daylight saving to standard time.

Display

To display measured values, counters and calculated values, six groups are available. Each group can be assigned up to 3 values or counter readings as desired.

Analyzing the stored data–Field Data Manager software MS20

The Field Data Manager software allows the saved measured values, alarms and events, as well as the device configuration to be read out from the device (automatically) and backed up securely in an SQL database in such a way that they are tamper-proof. The software

offers centralized data management with a variety of visualization functions. Using an integrated system service, analyses and reports can be compiled, printed and saved fully automatically. Security is guaranteed by the FDA-compliant audit trail of the software and by the extensive user management functionality. Simultaneous access to and analysis of data from different workstations or different users is supported (client-server architecture).

Communication interfaces

A USB interface (with CDI protocol), and optional Ethernet, are used to configure the device and read out the values.

ModBus is optionally available as a communication interface.

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

USB device

Connection:	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 to connect the Ethernet interface. A special cable gland is available that allows pre-terminated cables to be routed 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)

RS232 printer interface

The RS232 interface is optional and cannot be combined with other optional interfaces. A commercially available serial ASCII printer can be connected via the RS232 interface to print out batching reports directly from the device.

Connection:	3-pin plug-in terminal
Transmission protocol:	serial
Transmission rate:	300/1200/2400/4800/9600/19200/38400/57600/76800

RS485

Connection:	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. The Modbus TCP interface is physically 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-level systems to transmit all measured values and process values. It is connected via a 3-pin plug-in terminal.

12.2 Input

Current/pulse input

This input can be used either as a current input for 04 to 20 mA signals or as a pulse/ frequency input. Sensors for volume or mass flow measurement can be connected to the Batch Controller.

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

Cycle time

The cycle time is 125 ms.

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.

Input	Output	Response time [ms]
Current	Current	≤ 440
Current	Relay/digital output	≤ 250
RTD	Current/ relay/digital output	≤ 440
Cable open circuit detection	Current/ relay/digital output	≤ 440
Cable open circuit detection, RTD	Current/ relay/digital output	≤ 1100
Pulse input	Pulse output	≤ 600
Pulse input	Relay/digital output	≤ 250

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 0.3 Hz to 12.5 kHz
- Pulses and frequencies 0.3 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

Temperature input current/RTD

These inputs can be used either as current inputs (0/4 to 20 mA) or as RTD inputs (RTD = Resistance Temperature Detector). It is also possible to configure one input as a current input and the other as an RTD input.

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

Cycle time

The cycle time of the temperature measurement is 500 ms.

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
No influence from HART signals.	

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
Characteristic curves:	DIN EN 60751:2008 IPTS-90
Max. cable resistance:	40 Ω
Cable open circuit detection:	Outside the measuring range

Density input

Cycle time

The cycle time of the density measurement is 125 ms.

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
No influence from HART signals.	

Digital inputs

The digital inputs can be used for external control. A batch run can be started or stopped via these inputs, or the inputs can prevent a new batch from starting. In addition, the time can be synchronized.

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)

12.3 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 upper range value
Temperature drift:	0.01 %/K (0.0056 %/°F) of upper range value
Inductive load:	Max. 10 mH
Capacitance load:	Max. 10 µF
Ripple:	max. 12 mVpp at 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 normally-open 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.

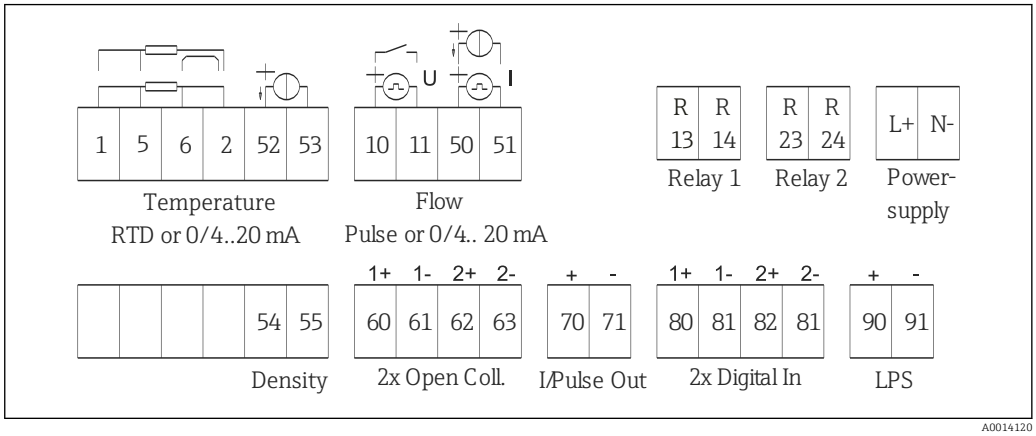
Auxiliary voltage output (transmitter power supply)

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.	

12.4 Electrical connection

Terminal assignment



38 Terminal assignment of RA33

Supply voltage

- Low-voltage power 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

12.5 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

The system operates with a calculation cycle of 125 ms. The flow at the specified response times is reliably recorded by the Batch Controller, but may deviate by this amount from the preset filling quantity. By using the after-run correction or reducing the flow rate in single-

stage batching, the accuracy of the fill volume is increased. Using two filling stages enables both fast and highly accurate batching.

12.6 Installation

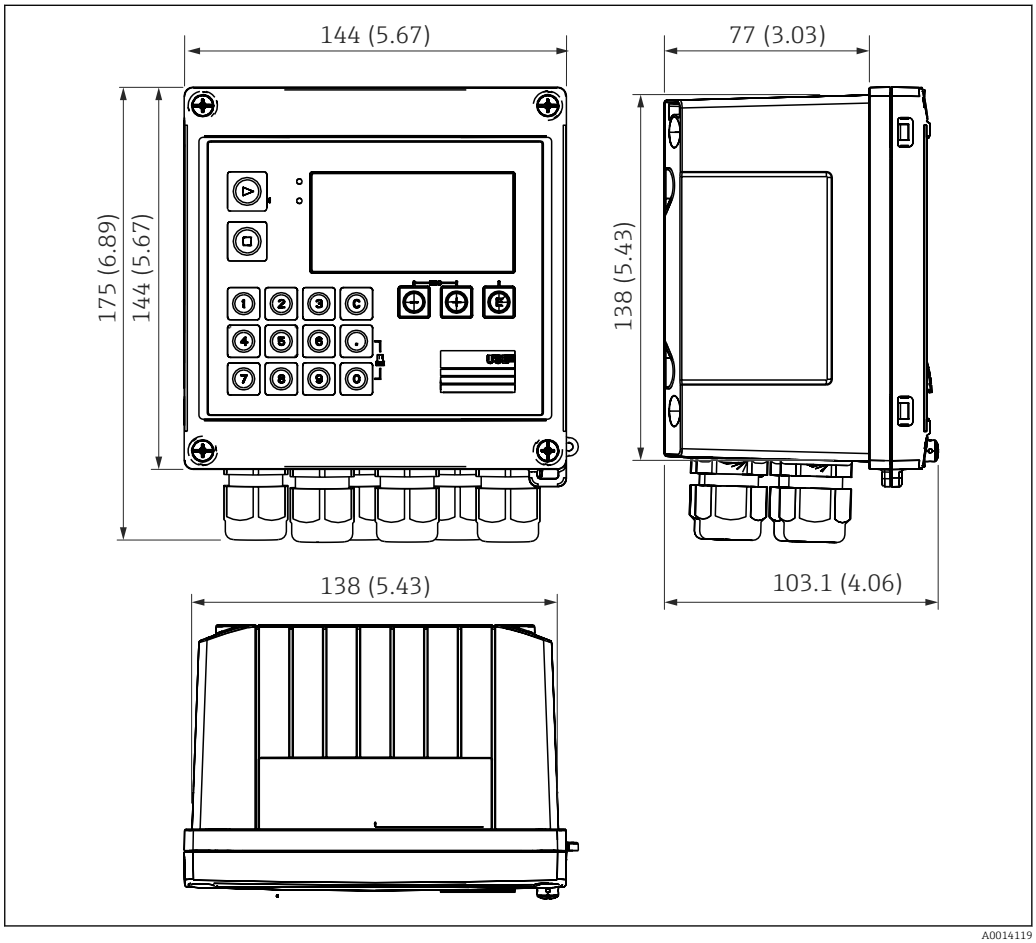
Installation location	Wall/pipe mounting, panel or DIN rail as per IEC 60715
Orientation	The orientation is determined by the readability of the display.

12.7 Environment

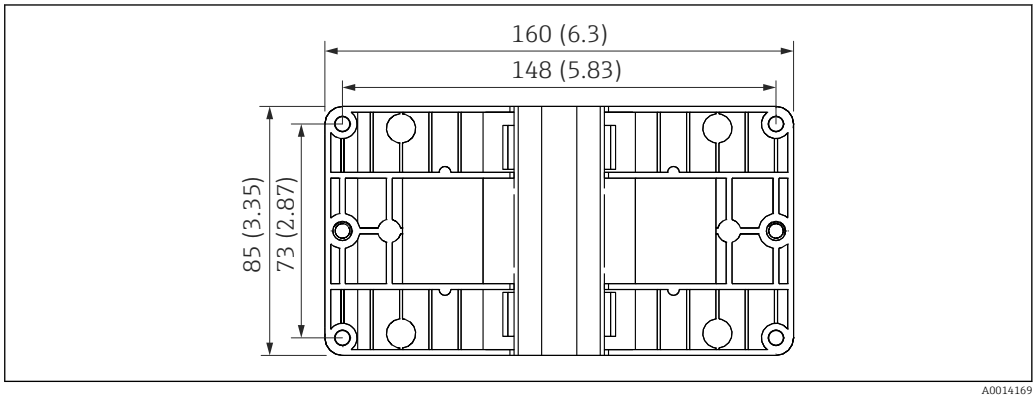
Ambient temperature range	−20 to +60 °C (−4 to +140 °F)
Storage temperature	−30 to +70 °C (−22 to +158 °F)
Climate class	As per IEC 60 654-1 Class B2, as per EN 1434 environment class C
Humidity	Maximum relative humidity 80 % for temperatures up to 31 °C (87.8 °F), decreasing linearly to 50 % relative 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

12.8 Mechanical construction

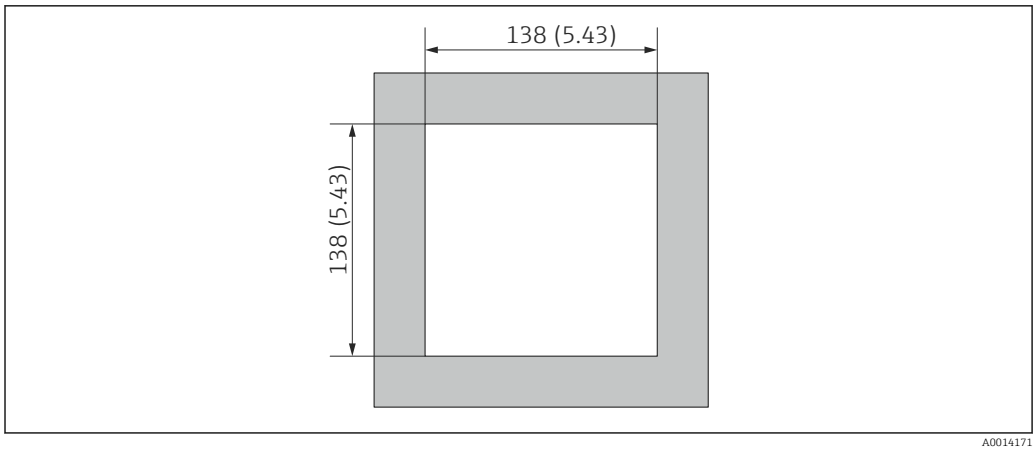
Design and dimensions



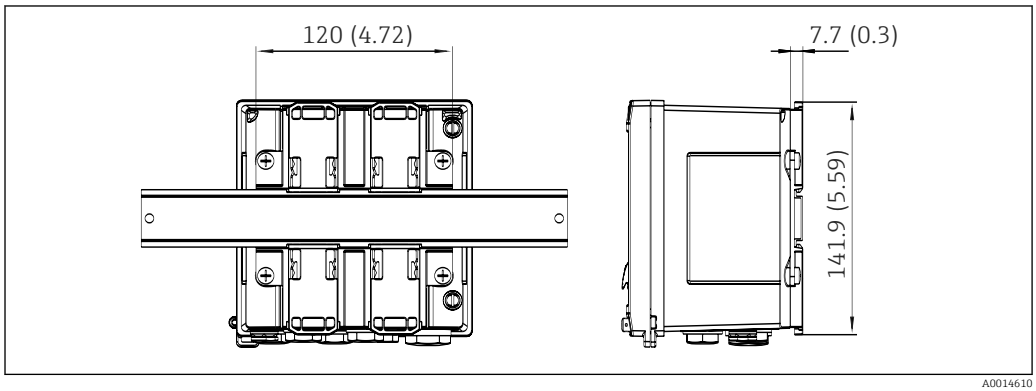
39 *Batch Controller housing; dimensions in mm (in)*



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



41 Panel cutout in mm (in)

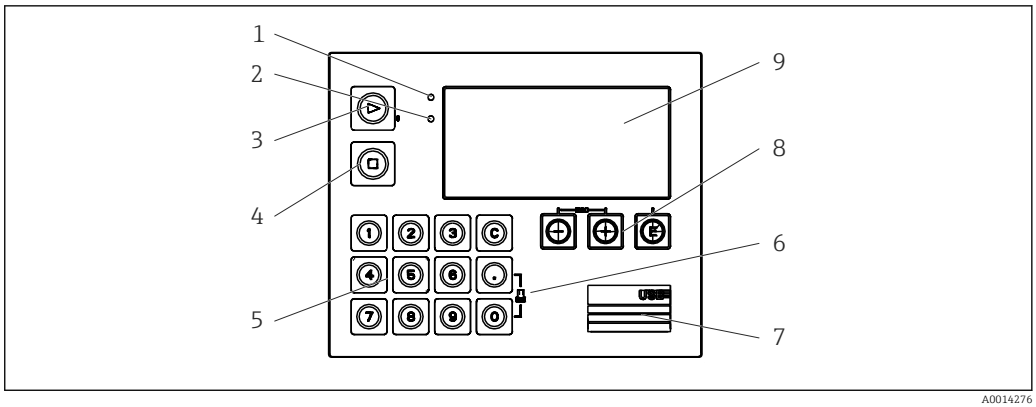


42 Dimensions of DIN rail adapter in mm (in)

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) .

12.9 User interface

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



43 *Display and operating elements*

1 Green LED, "Operation"
2 Red LED, "Fault message"
Function keys:
3 Start batch manually
4 Stop batch manually
5 Numeric keypad
6 Start printout
7 USB connection for configuration
8 Operating keys: -, +, E
9 Display: 160x80 dot-matrix display

Local operation

3 keys, "-", "+", "E".

14 function keys:
- Start / stop function: Press the "Start" button to start a batch run. Press "Stop" to pause the batch that is currently running. Press "Stop" again to abort the batch; press "Start" to resume the batch run.
- Reset counters: Press "C" when a batch is stopped to reset the counters on the display to their initial values.
- Printout: Press "0" and "." simultaneously to trigger a printout of the last batch run. To avail of this functionality, the "RS232 printer interface" option must be purchased.

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 delivery with the RXU10-G1 (see "Accessories") or can be downloaded free of charge from www.endress.com/fieldcare .

12.10 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**.

13 Appendix

13.1 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.

13.1.1 Language menu

Deutsch English Español Français Italiano Nederlands Polski Portuguese Russkij ceština	Select the operating language of the device from the list.

13.1.2 Display/operation menu

Select recipe		Select a recipe for use. Only visible if recipe management is activated in **Setup** → **Advanced setup** → **Application** → **Batch information**.
Preset counter		Enter value for preset counter.
Change group		Select a group to be displayed. Automatic change between the configured display groups or display one of the 6 display groups
Display brightness		Adjust brightness of the display. Number: 1-99
Display contrast		Adjust the contrast of the display. Number: 20-80
Stored values		Display the analyses stored in the device .
	Display	Select data to be displayed. The following information is displayed, depending on the configured display value: ▪ Status ▪ Start time ▪ End time ▪ Duration ▪ Batch name ▪ Batch number ▪ Preset counter ▪ Quantity ▪ Number The batch report can be printed with the "Print" option.
	Print	Print out the batch report

13.1.3 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 the unit system (SI or US units). All units are switched to the selected unit system, but configured values are not converted.
Signal type		210000-00	Input for contact sensors as per EN 1434-2, Class ID + IE. Pulse (current): Current pulse input: = 8 mA Low level, = 13 mA High level.
Unit		210004-00	Specify the technical (physical) unit for the measuring point connected to this input.
Counter unit		210005-00	Technical unit of the count input, e.g. liter, m^3 etc.
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.
Range start		210008-00	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.
Meas. range end		210009-00	Enter the end of the measuring range here, e.g. "100" for a transmitter with 0 to 100 m^3/h.
Date/time			Show and set date and 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		The date and time can be changed 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 or 100010-00 (FieldCare)	4-digit number. This code can be used to protect the setup from unauthorized access. In order to change any parameter the correct code must be entered. Factory default is "0", this means changes can be done at any time. Make a note of the code and store in a safe place.
		Device tag name	000031-00	Individual device tag name (max. 17 characters).
		Decimal separator	100003-00	Use this function to select the decimal separator to represent a number.
		Units	100001-00	Select the unit system. All units are switched to the factory settings, but configured values are not converted.

		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 settings
			Date format		110000-00	Select the date format.
			Time format		110001-00	Select time format.
		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			The date and time can be changed here.
				UTC time zone	120010-00	Selection of the UTC time zone (UTC = coordinated universal time).
				Date/time	120013-00	Set the current date and 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				Setting of the unit of calculated variables

					100001-00	Use this function to select the 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.
		Ethernet				Settings that are required if the Ethernet interface of the device is to be used
			DHCP		150002-00	The device can get its Ethernet settings through DHCP. ▪ The determined settings are displayed only after the setup has been 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 DHCP = 'No', enter the IP address for the device here. This is assigned by the network administrator. If DHCP = 'Yes', the IP address obtained by DHCP is displayed here.
			Subnet mask		150007-00	If DHCP = 'No', enter the subnet mask here. This is assigned by the network administrator. If DHCP = 'Yes', the subnet mask obtained by DHCP is displayed here.
			Gateway		150008-00	If DHCP = 'No', enter the gateway here. This is assigned by the network administrator. If DHCP = 'Yes', the gateway obtained by DHCP is displayed here.
			Web server		470000-00	Activation and deactivation of web server functionality The instantaneous values can only be displayed using an Internet browser when the web server is activated. Only possible via the Ethernet interface.
		Modbus				Configure the Modbus settings for the device. Only visible for devices with Modbus (option).
			Device address		480000-00	Enter the device address under which this device should be reachable on the bus.
			Baud rate		480001-00	Select the transmission speed used for Modbus communication.
			Parity		480002-00	Make sure the settings are compatible with the PC software settings.
			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. It is therefore important to coordinate and align the addressing method between the master and the slave during commissioning. This can be configured here.
			Reg. 0 to 2			Specify which values can be read out.
				Value	500000-00	Use this function to select which value should be transferred.
				Analysis	500001-00	Select which counter value (e.g. interval, daily counter) 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	Use this function to select which value should be transferred.
				Analysis	500001-01	Select which counter value (e.g. interval, daily counter) is to be transmitted.
			Reg. 6 to 8			Specify which values can be read out.
				Value	500000-02	Use this function to select which value should be transferred.
				Analysis	500001-02	Select which counter value (e.g. interval, daily counter) is to be transmitted.

			...		...	...
			Reg. 87 to 89			Specify which values can be read out.
				Value	500000-29	Use this function to select which value should be transferred.
				Analysis	500001-29	Select which counter value (e.g. interval, daily counter) is to be transmitted.
		Device options				Hardware and software options
			Optional outputs		990000-00	
			Communication		990001-00	
			Protocol		990007-00	
			Compensation+RTD		990009-00	
	Inputs					Settings for the analog and digital inputs
		Flow				Settings for the flow input.
			Signal type		210000-00	Select the type of signal connected. ▪ 4-20 mA (DP flow): Input for flow measurements based on the differential pressure method (e.g. orifice plate) ▪ 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.
			Channel identifier		210001-00	Name of the measuring point connected to this input. Customized text, 6 characters.
			Type		210014-00	Flow type of the input signal (volume flow or mass flow).
			Pulse input		210002-00	Specify whether the pulse input is a fast input (up to 12.5 kHz) or slow input (up to 25 Hz). 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 "5" here. Decimal number, max. 8 digits including decimal separator. Only if Pulse has been selected as the signal type. The pulse values available for selection are displayed depending on the setting in the "Type" parameter.
			Unit		210004-00	Specify the technical (physical) unit for the measuring point connected to this input. The pulse values available for selection are displayed depending on the setting in the "Type" parameter.
			Decimal places		210006-00	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, etc. The pulse values available for selection are displayed depending on the setting in the "Type" parameter.
			Decimal places	210007-00	Number of digits after the decimal point for the counter.
					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.
			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.
		Temperature			Settings for the temperature input.
			Signal type	220000-00	Select the type of signal connected.
			Type of connection	220001-00	Specify whether 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 preferred 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 to be used by the device for calculations. Only for signal type = default value
		Density			Settings for the density input
			Signal type	220000-01	Select the signal type for the density input or "Default value".
			Channel identifier	220002-01	Identifier for the density input. Customized text, 6 characters.
			Unit	220003-01	Select the unit of density.
			Decimal places	220004-01	Select the number of decimal places for the density input.

			Range start	220006-01	Configure which value corresponds to 0/4 mA. Numerical value, max. 8 digits including decimal separator.
			Meas. range end	220007-01	Configure which value corresponds to 20 mA. Numerical value, max. 8 digits including decimal separator.
			Default value	220009-01	Specify a fixed density value to be used by the device for calculations. Only for signal type = default value.
		Digital 1/2			Settings only required if digital inputs (e.g. events) are to be used.
			Function	DI 1: 250000-00 DI 2: 250000-01	Select the required function, . 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 which 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 which 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.
			Current start value	310022-00	Current that should be output at the start of the batch. Only for the setting "Channel/value =Curve".
			Start max	310020-00	Two points are defined for the actuator curve. This is the percentage value to reach the 20 mA value. Only for the setting "Channel/value =Curve".
			Stop max	310021-00	Two points are defined for the actuator curve. This is the percentage value to leave the 20 mA value. Only for the setting "Channel/value =Curve".
			Pulse value	310006-00	The pulse value defines which quantity corresponds to an output pulse (e.g. 1 pulse = 5 liters). Numerical value, max. 8 digits including decimal separator.
			Pulse width	310007-00	The pulse width limits the maximum possible output frequency of the pulse output. Define a fixed or dynamic pulse width.
			Pulse width	310008-00	You can set the pulse width within the range 0.04 to 1000 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).

			Mode of operation	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 defines which quantity corresponds to an output pulse (e.g. 1 pulse = 5 liters). Only for function = pulse output.
			Pulse width	320005-00 320005-01	The pulse width limits the maximum 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 within the range 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
			Mode of operation	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				Definition of various application-specific settings (e.g. group settings, limit values etc.).
		Batch settings			
			Batch active	400010-00	Defines whether a status signal should be output at an output when a batching operation is active.
			Batch mode	510000-00	Three batch modes are available: ▪ In the standard mode batching runs to the end of the preset counter. ▪ In the automatic restart mode, a sequence is started by the start command that repeats batching until it ends. ▪ In the manual batch mode, a preset counter is not required; batching is started and ended locally or via control input.
			Restart delay	510001-00	This time defines the interval between a completed batch and an automatically restarted batch in the "Autom. restart" batching mode.
			Counting direction	510002-00	The counting direction determines the way the preset counter is shown on the display. If the direction is forwards, the counter is increased from 0 to the preset counter value; if it is backwards, it is decreased from the preset counter value to 0.
			Filling stages	510003-00	Two filling stages can be used for more accurate dosing of a batch. A larger-quantity flow rate can be stopped earlier and the total quantity can be dosed with more accuracy until the preset counter value is reached using another, lower flow rate.
			Switches fill stage 1	510004-00	Specifies the output used to control the main filling stage.
			Switches fill stage 2	510005-00	Specifies which output is used for the filling stage with the additional, larger flow rate.
			Delay stage 2	510006-00	The delay specifies the time after which the second valve with the larger flow rate is activated.
			Pre-stop fill stage 2	510008-00	The pre-stop specifies what the remaining quantity is when filling stage 2 is ended and fine-dosing starts.

			Fixed correction	510009-00	Fixed after-run correction is used to compensate for longer valve closing times and response times and to achieve more accurate batching results. It can also be used to keep incorrect quantities to a minimum when initially teaching the system even if the automatic after-run correction function is activated.
			Autom. correction	510010-00	Automatic after-run correction complements the fixed correction function and automatically corrects the accuracy to compensate for system variations caused, for example, by valve aging.
			Max. preset counter	510012-00	The maximum preset counter defines the maximum value that can be entered as the preset counter value in order to prevent the entry of large incorrect values.
		Batch information			The **Batch information** menu is used to manage identifiers and recipes.
			Recipe management	510100-00	Recipe management can be activated. The identifier, manual after-run correction and preset counter can be preconfigured for different batches and selected during operation without setup access.
			Number	510101-00	Enter the desired number of preconfigurable recipes here. Possible values: 1-30
			Batch name	510105-00	Enter the batch identifier which will be stored in the batch report.
			Batch no. start value	510110-00	Enter the start value of the current batch number here.
			Reset batch no.	510111-00	Use this option to reset the current number to the start value.
			Recipe 1 to 30		
				Batch name	510102-00 ...-29	Enter the batch identifier which will be stored in the batch report.
				Preset counter	510104-00 ...-29	This preset counter represents the preconfigured preset counter value, which is used when the recipe is selected but can still be modified.
				Fixed correction	510109-00 ...-29	Fixed after-run correction is used to compensate for longer valve closing times and response times and to achieve more accurate batching results. It can also be used to keep incorrect quantities to a minimum when initially teaching the system even if the automatic after-run correction function is activated.
		Compensation			The **Compensation** menu contains all of the settings for correcting the volume or converting to mass using additional measured variables.
			Compensation	530000-00	Activation of the compensation function to correct the flow volume or to calculate the mass (only if Inputs/flow/type = "Volume flow"). A density sensor or temperature sensor is required for the compensation. When a temperature sensor is used, the density is calculated on the basis of the reference condition and reference density.
			Product group	530001-00	Selection of the product group. The "User-defined" option allows the correction of any medium using density or temperature measurement or calculation of the mass using a density sensor. The mineral oil options initiate volume correction based on a temperature sensor and an optional, additional density sensor.
			The result is	530008-00	Select "corrected volume" to perform volume correction. If "Mass" is selected, the measured volume is converted to mass. The mass unit is set in the "Mass unit" parameter. Only visible if "Inputs/flow/type" = "Volume flow".
			Mass unit	530009-00	The desired mass unit into which the volume is to be converted. The counter value then appears on the display and in the analyses in this unit. The preset counter must also be entered in this unit. Only visible if "Inputs/flow/type" = "Volume flow" and "The result is" = "Mass".
			Volume unit	530009-00	Desired unit for the calculated volume The counter value then appears on the display and in the analyses in this unit. The preset counter must also be entered in this unit. Only visible if "Inputs/flow/type" = "Mass flow".
			Density unit	530002-00	Preferred density unit in which the subsequent values must be entered.

			Operating density	530003-00	If a density sensor is used for measurement, select "Measured" here. If the density is calculated internally, select "Calculated" here and connect a temperature sensor.
			Reference condition	530004-00	Select the desired reference condition for volume correction.
			Reference density	530005-00	Density of the medium for the previously selected reference conditions
			Pressure unit	530007-00	Preferred pressure unit in which subsequent values must be entered.
			Pressure	530006-00	Use this option to enter the pressure at which the medium flow is measured. This value is also taken into account when calculating volume correction. To disable compensation based on the pressure value, you simply need to enter a relative pressure value of 0.
			Expansion unit	530011-00	
			Expansion coeff.	530010-00	The thermal expansion coefficient describes the expansion of a medium in the event of a temperature change of 1 °C/°F starting from the temperature set in the reference condition.
		Batch printout			All of the relevant parameters to print out a batch report can be defined here.
			Printout	510200-00	The printout can be activated here. The printout can be started manually via local operation, or automatically at the end of each batch.
			Baud rate	510214-00	Select the transmission speed used for printer communication.
			Number of copies	510201-00	Desired number (0-5) of automatic printouts.
			Characters/line	510212-00	Maximum number of characters per line
			Number of headers	510202-00	Number (0-5) of desired lines for user-defined text at the start of the batch report.
			Header x	510203-00 ... 06-00	Enter the user-defined text for the header to be printed on the batch report.
			Number of footers	510207-00	Number of user-defined lines desired at the end of the batch report
			Footer x	510208-00 ... 11-00	Enter the user-defined text for the footer to be printed on the batch report.
			Blank rows at the end	510215-00	Number of blank lines required at the end of the printout to provide a gap making it easier to tear off.
			Print direction	510213-00	Select the print direction according to the properties of the printer used (start of first line or start of last line).
			Test printout	510216-00	Test printout for checking the settings
		Display groups			Group together inputs and calculated values. This allows important information to be retrieved in consolidated form during operation.
			Group 1 to 6		Various general settings for the groups for measured value display of the device.
				Identifier	460000-00 -01, -02, -03, -04, -05	Identifier for the groups
				Value 1	460001-00 -01, -02, -03, -04, -05	Choose which input/calculated variable is to be displayed in this group.

				Value 2	460003-00 -01, -02, -03, -04, -05	Choose which input/calculated variable is to be displayed in this group.
				Value 3	460005-00 -01, -02, -03, -04, -05	Choose which input/calculated variable is to be displayed in this group.
				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.

13.1.4 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).
Diagnostic 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 name		000031-00	Individual device tag name (max. 17 characters).
	Serial number		000027-00	Please send these details with any questions about the unit.
	Order code		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	
		Compensation	990009-00	
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.
Outputs			Current status of outputs (if used).
	Universal output	060120-00	Value currently output at the universal 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 logbook.
	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.

13.1.5 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	Service code for displaying the service parameters 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				000044-00	Resets all the parameters to the factory settings. Can be changed via the service code only.
	Clear memory				059000-00	Delete internal memory.
	Reset				059100-00	Reset analysis to 0.
	Ethernet					Settings required to use the Ethernet interface
		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 the network is protected by a firewall, this port may have to be enabled. In this case, contact your network administrator.
	Device options					Hardware and software options of the device.
		Activation code			000057-00	Enter a code to enable device options.
Inputs						Settings for the analog and digital inputs
	Flow					
		Meas.val. corrct.				Determining the correction values to balance measurement tolerances. Procedure: ▪ Measure the current measured value at the lower measuring range. ▪ Measure the current measured value at the upper measuring range. ▪ Enter the lower and upper set point and actual values in each case.
			Range start			Lower correction value
			Target value		210051-00	Enter the set point at the lower range limit (e.g. measuring range 0 l/h up to 100 l/h: 0 l/h).
			Actual value		210052-00	Enter the value actually measured (e.g. measuring range 0 l/h up to 100 l/h: measured 0.1 l/h).
			Meas. range end			Upper correction value
			Target value		210054-00	Enter the set point at the upper range limit (e.g. measuring range 0 l/h up to 100 l/h: 100 l/h100 l/h).
			Actual value		210055-00	Enter the value actually measured (e.g. measuring range 0 l/h up 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 has no effect on the counter. Decimal number, max. 5 digits incl. decimal separator. Factory setting: 0.0 s
		Fault mode			Settings that define how this channel behaves under fault conditions (e.g. open circuit, overrange).
			NAMUR NE 43	210060-00	Activate/deactivate monitoring of the 4 to 20 mA range 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
			In the event of an error	210061-00	Specify the value the device is to use in calculations if the measured value is invalid (e.g. 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. Procedure: ▪ Measure the current measured value at the lower measuring range. ▪ Measure the current measured value at the upper measuring range. ▪ Enter the lower and upper set point and actual values in each case.
			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 lower set point (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 (e.g. measuring range 0 °C up 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 set point (e.g. measuring range 0 °C up 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 (e.g. measuring range 0 °C up 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 behaves under fault conditions (e.g. open circuit, overrange).
			NAMUR NE 43	220060-00	Activate/deactivate monitoring of the 4 to 20 mA range 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
			In the event of an error	220061-00	Specify the value the device is to use in calculations if the measured value is invalid (e.g. 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).
	Density				Settings for the temperature input.
		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. Procedure: ▪ Measure the current measured value at the lower measuring range. ▪ Measure the current measured value at the upper measuring range. ▪ Enter the lower and upper set point and actual values in each case.
			Range start		Lower correction value
			Target value	220052-01	Enter lower set point. Decimal number, max. 8 digits including decimal separator.
			Actual value	220053-01	Enter the lower value actually measured. Decimal number, max. 8 digits including decimal separator.
			Meas. range end		Upper correction value
			Target value	220055-01	Enter upper set point. Decimal number, max. 8 digits including decimal separator.
			Actual value	220056-01	Enter the upper value actually measured. 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
			In the event of an error	220061-01	Specify the value the device is to use in calculations if the measured value is invalid (e.g. 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 that should be output in the event of an error (e.g. open circuit at input). Numerical value, max. 8 digits including decimal separator.
		Meas.val. corrct.				The output current value can be corrected here. This is only necessary if the downstream device cannot compensate for possible measurement section tolerances. Procedure: ▪ On the connected device, read out the displayed value in both the upper and lower measuring range. ▪ Enter the lower and upper set point and actual values in each case.
			Start value			Lower correction value
			Target value		310051-00	Enter lower set point.
			Actual value		310052-00	Enter the lower actual value that is displayed on the connected device.
			Full scale value			Upper correction value
			Target value		310054-00	Enter upper set point.
			Actual value		310055-00	Enter the upper actual value that is displayed on the connected device.
Application						Various application-specific settings (e.g. group settings, limit values etc.).
		Batch settings				Batching-related parameters are defined in the **Batch settings** menu.
			Max. fill deviation		510013	This percentage value defines a percentage limit by which the actual amount may deviate from the desired amount before a message is displayed.
			Wait at batch end		510011	This parameter defines the time that the device must wait once a valve has closed so that the system settles down and therefore measurement accuracy is increased. This time must first elapse before a new batch can be started. The setting 999s allows the user to switch off leak monitoring during a batch and if a batch in inactive. The "Wait at batch end" function is then permanently set to 0 seconds.
			Timeout flow		510015	This parameter defines the period of time within which flow must occur when a batching process is started. A message is displayed if this time elapses and no quantifiable flow is measured.
			Power failure response		510016	The "Power failure response" parameter defines the startup behavior following a power failure during active batching. Batching is either started with the status "paused" and can then be resumed or canceled, or batching is resumed automatically.
Diagnostic						Device information and service functions for swift device check. This information is also available in the **Diagnostics/Device information** menu.
	ENP device name				000020-00	Please specify these details if you have any questions about the device.
	Device name				000021-00	Please specify these details if you have any questions about the device.
	Serial number				000027-00	Please specify these details if you have any questions about the device.
	Order code				000029-00	Please specify these details if you have any questions about the device.
	Order identifier				000030-00	Please specify these details if you have any questions about the device.

13.2 Symbols

Symbol	Description
🔒	Device locked.
F	Fault For example, a channel that is not displayed in the current group is faulty.
M	Maintenance required For example, maintenance required in a channel not displayed in the current group.
⇄	External communication, e.g. Fieldbus
SIM	Simulation
▼	Low value
▲	High value
^	Counter overflow
▶	Batch active
■	No batch active
⏸	Batch paused
↻	Batch in automatic restart mode
Name of the inputs and process values	
Count	Number of batches
DI 1	Digital input 1
DI 2	Digital input 2
Good	Number of successful batches
Name	Batch name
No.	Batch number, PSC preset counter
PSC	Preset counter
ρ	Density
ρ ref	Reference density
ΣM	Mass counter, total
ΣM (i)	Mass counter, current batch
ΣM	Volume counter, total
ΣV (i)	Volume counter, current batch
Σx	Deficit counter
Temp.	Temperature
VCF	Volume correction factor

13.3 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)
Density	
kg/m^3	1 kg/m^3 corresponds to 0.0624 lb/ft^3
lb/ft^3	1 lb/ft^3 corresponds to 16.018 kg/m^3

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