Operating Instructions
RA33

Batch controller
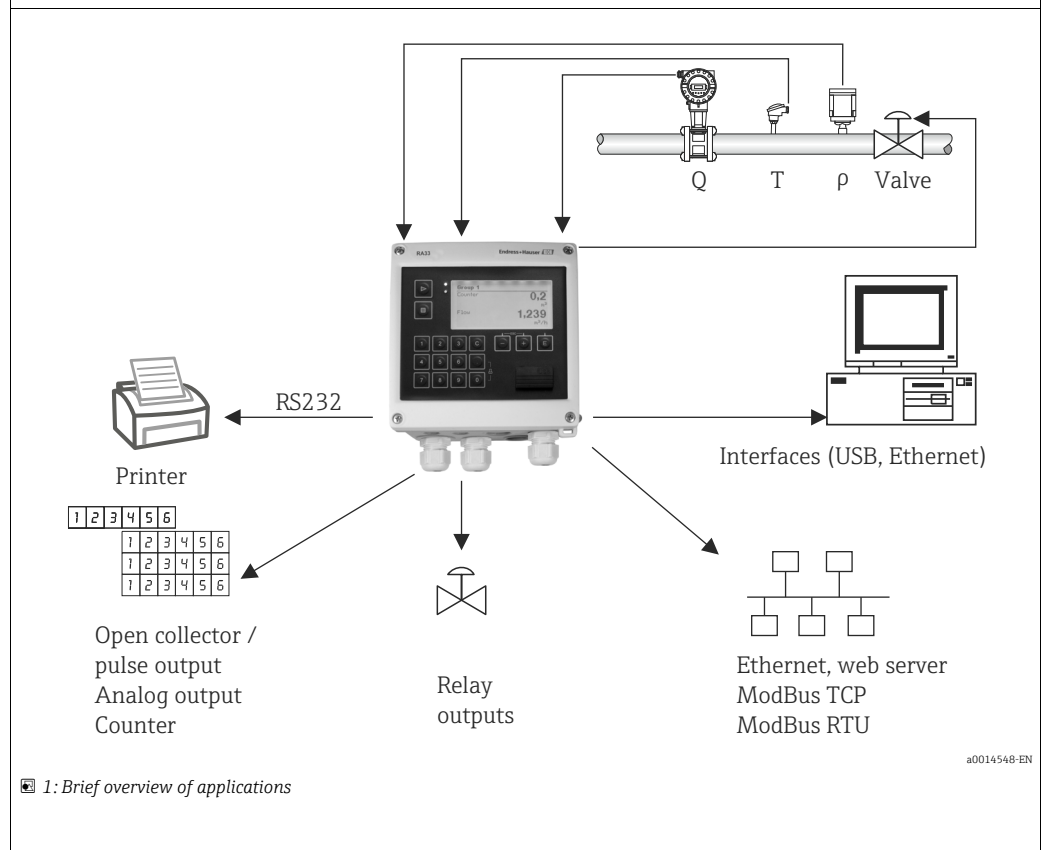

Endress+Hauser [EH]

People for Process Automation
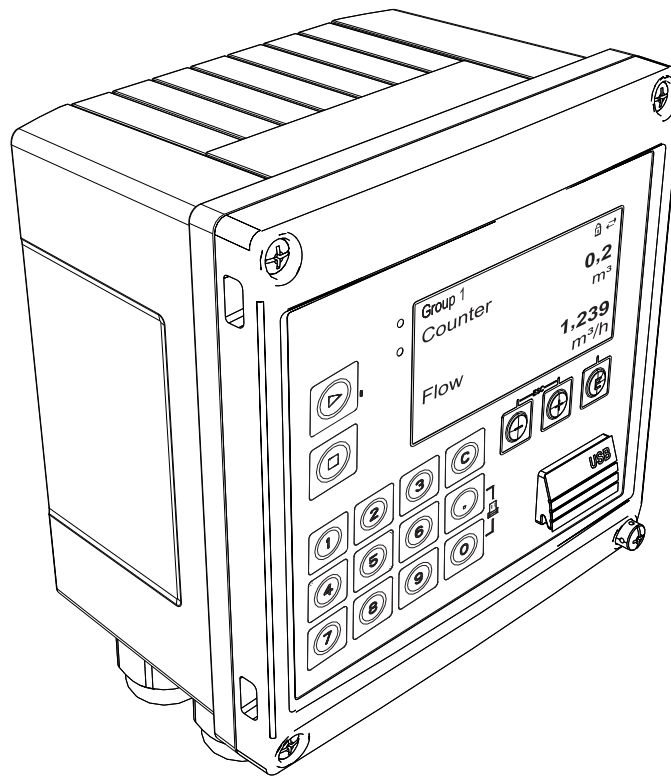
Brief overview

For quick and easy commissioning:

Safety instructions	→ 🖺 6
▾	
Installation	→ 🖺 10
▾	
Wiring	→ 🖺 15
▾	
Display and operating elements	→ 🖺 22
▾	
Commissioning	→ 🖺 26

Applications for the batch controller

Q T ρ Valve

RS232

Printer

Open collector /
pulse output
Analog output
Counter

Relay
outputs

Interfaces (USB, Ethernet)

Ethernet, web server
ModBus TCP
ModBus RTU

a0014548-EN

🖻 *1: Brief overview of applications*

Endress+Hauser

Table of contents

1 Safety instructions

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

1.1 Designated use

The batch controller is a batching and dosing manager for the batching of any media or mineral oils.

– The manufacturer cannot take responsibility for any damage caused by misuse of the device. It is not permitted to make any changes or reconstruction to the device.
– The device may be operated in built-in state only.

1.2 Installation, commissioning and operation

The batch controller is safely manufactured using state-of-the-art technology and complies with the respective regulations and EU Directives. The device could be dangerous if it is incorrectly installed or used.
Installation, wiring and maintenance of the device must be carried out only by trained, skilled personnel authorized to perform such work and instructed by the facility's owner-operator. The skilled personnel must have read and understood these Operating Instructions and it is mandatory for them to follow the instructions they contain. The operator must ensure that the measuring system is correctly wired in accordance with the wiring diagrams. When the housing cover is removed, the shock protection is disabled (danger of electrocution). The housing may be opened by trained skilled personnel only.
The batch controller may be operated in a closed and secure state only.

1.3 Operational safety

Technical improvement
The manufacturer reserves the right to improve and update the technical details. For details of improvements or additions to these instructions, please contact your local sales organization.

1.4 Return

For a return, e.g. in case of repair, the device must be sent in protective packaging. The original packaging offers the best protection. Repairs must only be carried out by your supplier's service organization.

When sending for repair, enclose a note with a description of the error and the application.

1.5 Notes on safety conventions and icons

The safety instructions in these Operating Instructions are labeled with the following safety icons and symbols:

Symbol	Meaning
⚠ **WARNING** A0011190-EN	**WARNING!** This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in serious or fatal injury.
⚠ **CAUTION** A0011191-EN	**CAUTION!** This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in minor or medium injury.
NOTICE A0011192-EN	**NOTE** This symbol contains information on procedures and other facts which do not result in personal injury.
	ESD - Electrostatic discharge Protect the terminals from electrostatic discharge. Failure to observe this may result in destruction or malfunction of parts of the electronics.
ℹ A0011193	Additional information, tip

2 Identification

2.1 Device tag

2.1.1 Nameplate

Compare the nameplate on the device with the following diagram:
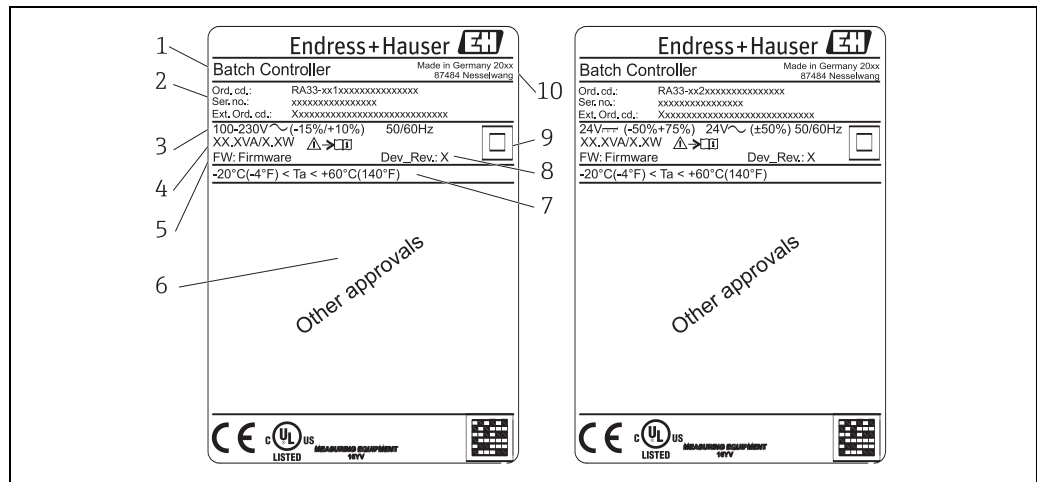
⊡ 2: Nameplate of the batch controller (example)

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

2.2 Scope of delivery

The scope of delivery of the batch controller comprises:

- Batch controller (field housing)
- Wall mountig plate
- Brief Operating Instructions in paper form
- Optional 3 pcs. connection clamps (5 positions apiece)
- Optional interface cable and DVD set with FieldCare Device Setup parameter configuration software
- Optional Field Data Manager software
- Optional mounting hardware for DIN rail, panel mounting, pipe mounting
- Optional overvoltage protection

Please note the device accessories in Section 8 'Accessories'.

2.3   Certificates and approvals

CE mark, Declaration of Conformity
The device is safely built and tested according to state-of-the-art technology and has left the factory in perfect condition as regards technical safety. The device complies with the applicable standards and regulations in accordance with EN 61010-1 "Safety requirements for electrical equipment for measurement, control and laboratory use".
Thus, the device described in these Operating Instructions meets the legal requirements of the EU Directives. The manufacturer confirms successful testing of the device by affixing to it the CE mark.

3 Installation

3.1 Incoming acceptance, transport and storage

The permitted environmental, storage and transportation conditions must be complied with. For detailed specifications, refer to the "Technical data" chapter (→ 🖹 56).

3.1.1 Incoming acceptance

On receipt of the goods, check the following points:
• Are the packaging or contents damaged?
• Are the delivered goods complete? Compare the scope of delivery with your order information.

3.1.2 Transport and storage

Observe the following points:
• Pack the device in such a way as to protect it reliably against impact for storage (and transportation). The original packaging provides optimum protection.
• The permitted storage temperature range is -40 to +85 ℃ (-40 to +185 ℉); storage in the temperature limit ranges is possible for a limited time only (maximum of 48 hours).

3.2 Dimensions
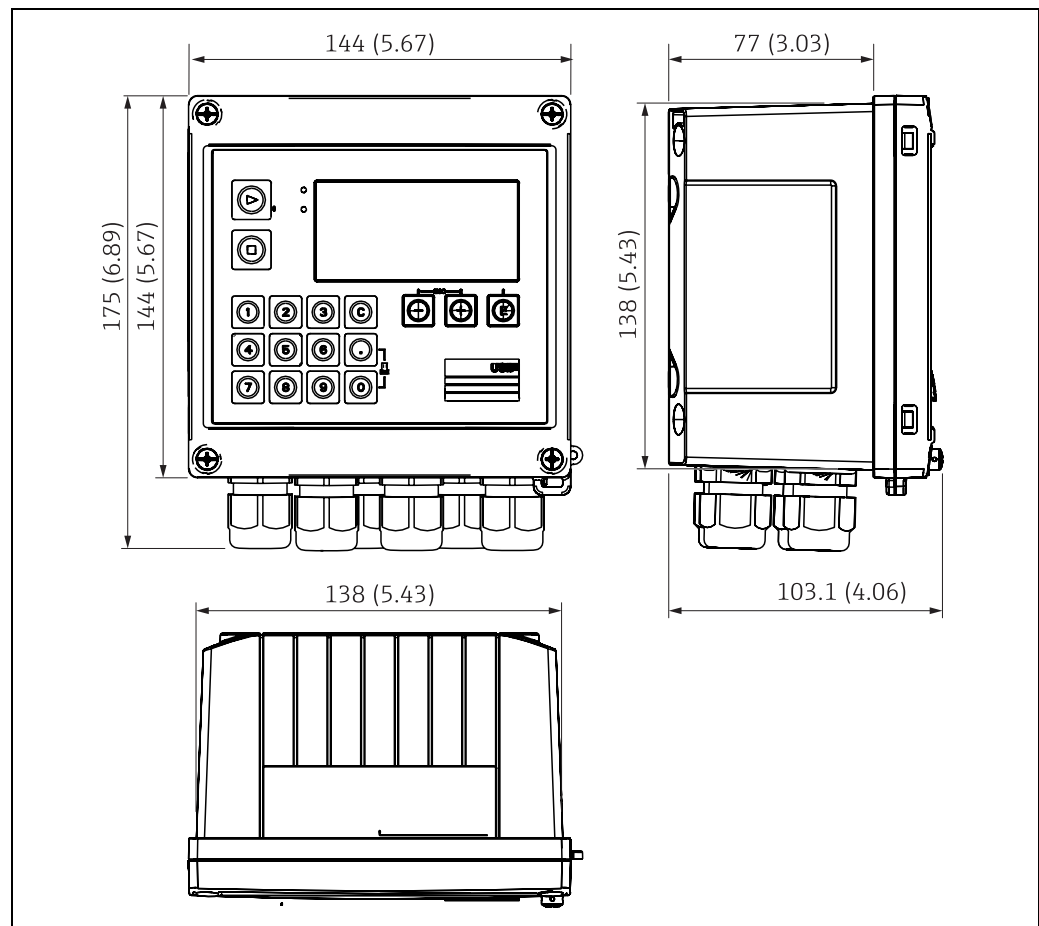
a0014119

🖲 *3: Dimensions of the device in mm (in)*
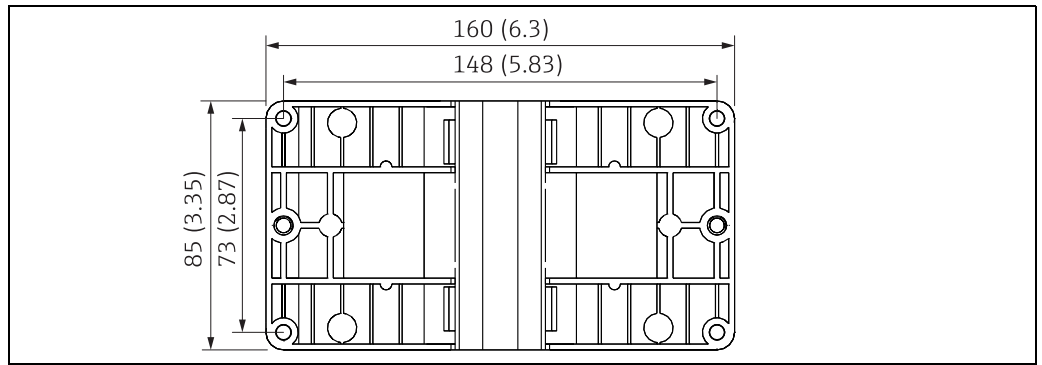
4: Mounting plate for wall, pipe and panel mounting, dimensions in mm (in)
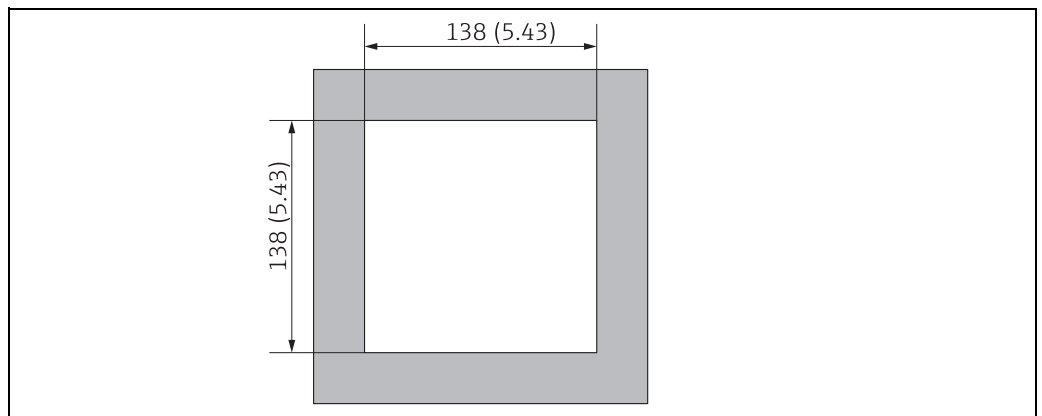
5: Panel cutout, dimensions in mm (in)
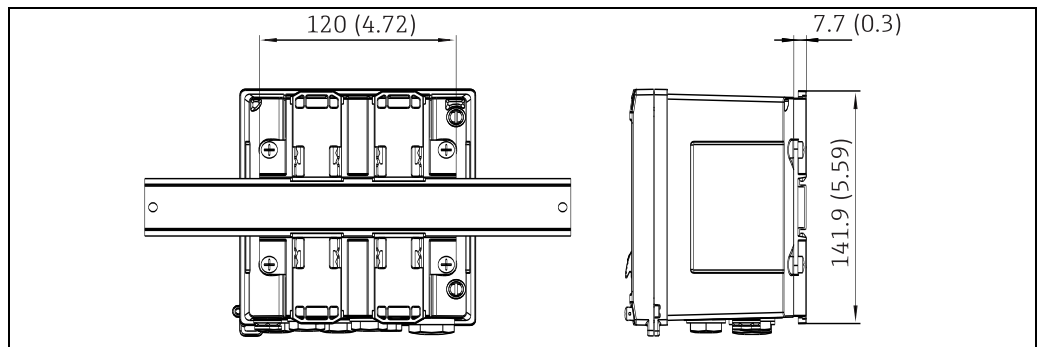
6: Dimensions of the DIN rail adapter in mm (in)

3.3   Installation

With the appropriate accessories → 🖹 46, the device with field housing is suitable for wall mounting, pipe mounting, panel mounting and DIN rail installation.
The orientation is determined by the legibility of the display. Connections and outputs are fed out of the bottom of the device. The pipes are connected via coded clamps.
Operating temperature range:
-20 to 60 ℃ (-4 to 140 ℉)

NOTICE

High temperatures reduce the operating life of the device

▶ To prevent heat build-up, do not expose the device to extreme heat or strong direct sunshine.

▶ Operation in the upper temperature limit range decreases the operating life of the display.

3.4   Installation

3.4.1   Wall mounting

1. Use the mounting plate as the template for drilled holes, dimensions → ⊿ 4, ◻ 11

2. Attach the batch controller 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.
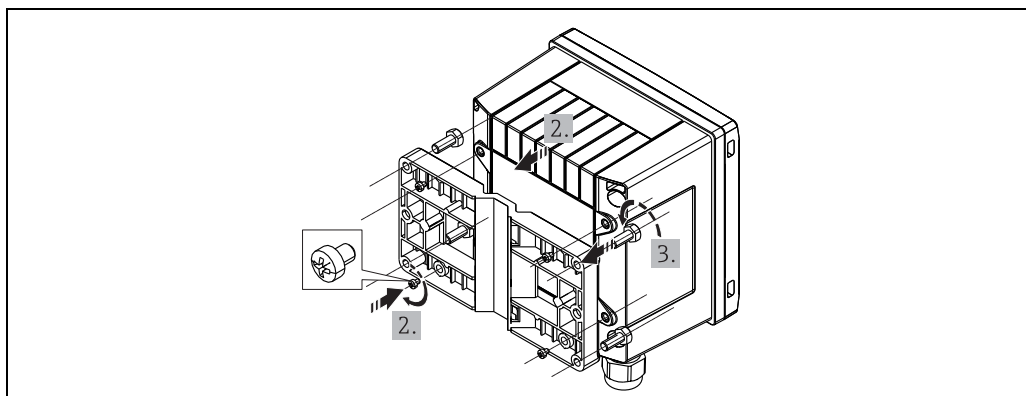
a0014170

◪ *7: Wall mounting*

3.4.2   Panel mounting

1. Make the panel cutout in the required size, dimensions → ⊿ 5, ◻ 11.

2. Attach the seal (item 1) to the housing.
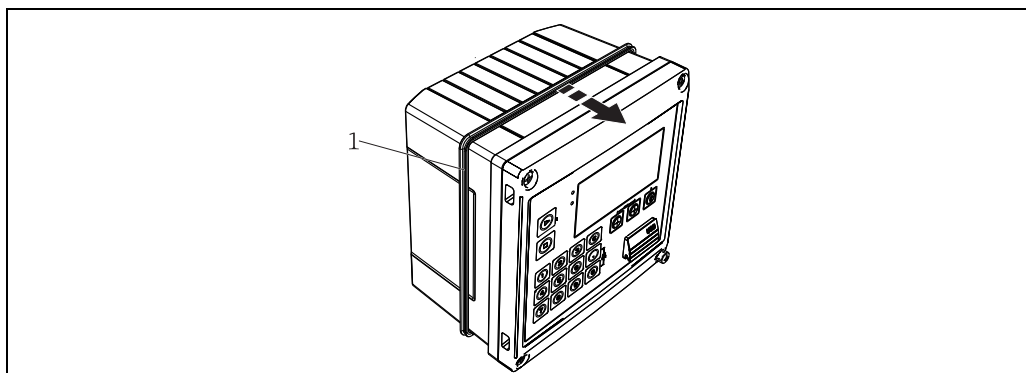
a0014283

◪ *8: Panel mounting*

3. Screw the threaded rods (item 2) into the mounting plate (dimensions → ⊿ 4, ◻ 11).
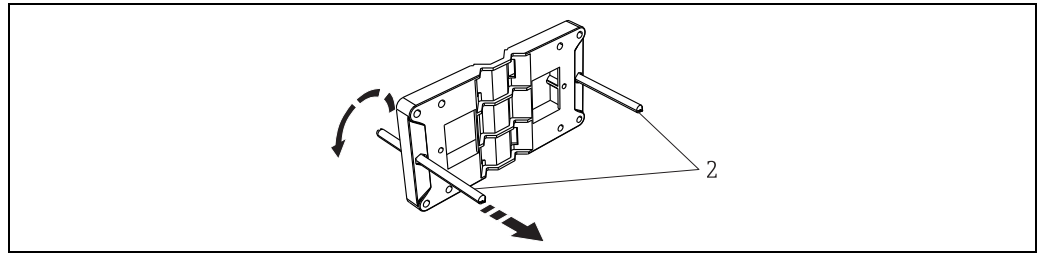
9: Preparing the mounting plate for panel mounting

4. 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.
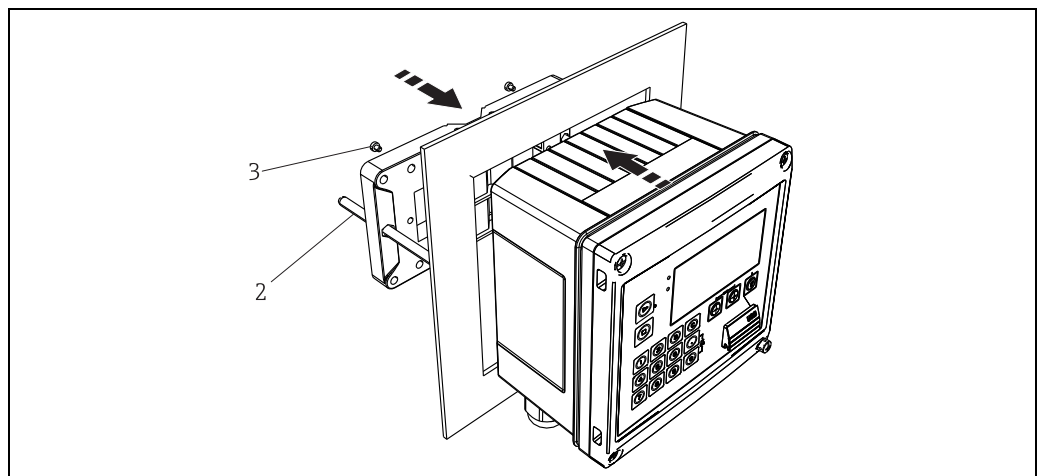
10: Panel mounting

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

1. Fasten the DIN rail adapter (item 1, dimensions → ⬚ 6, 🗎 11) to the device using the screws provided (item 2) and open the DIN rail clips.
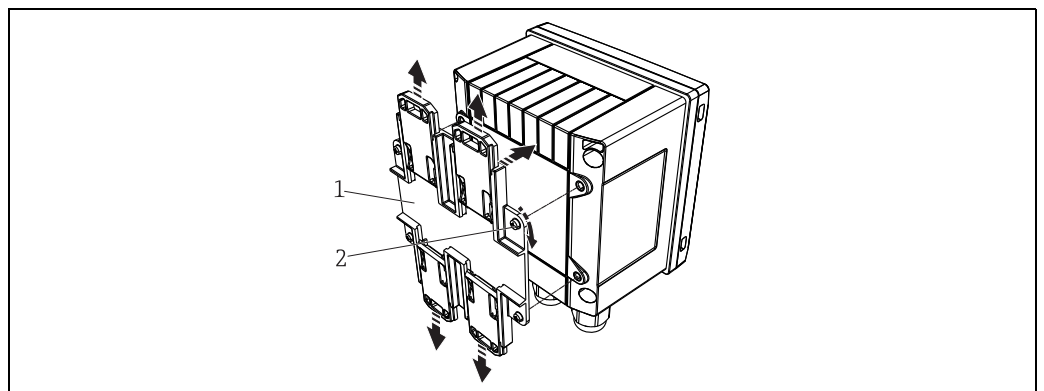
11: Preparing for DIN rail mounting

2. Attach the device to the DIN rail from the front and close the DIN rail clips.
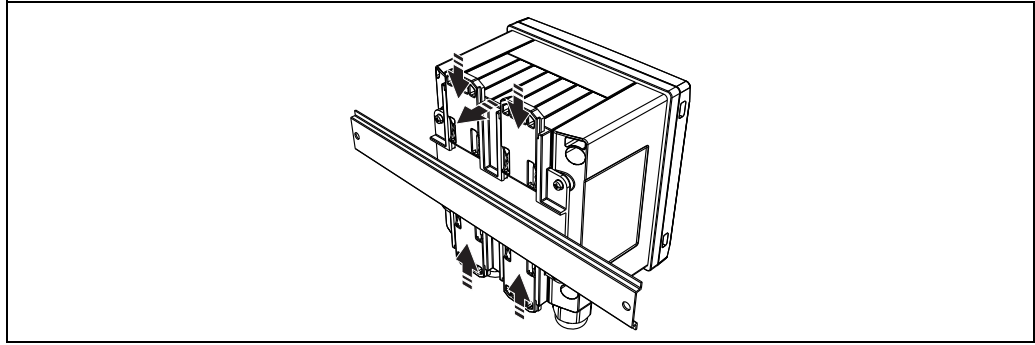
12: DIN rail mounting

3.4.4   Pipe mounting

1.   Pull the steel belts through the mounting plate (dimensions → 🖼 4, 📄 11) and fasten them to the pipe.
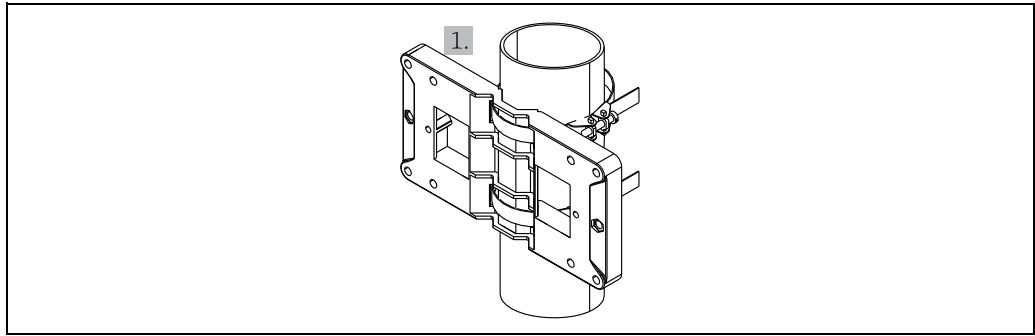
13: Preparing for pipe mounting

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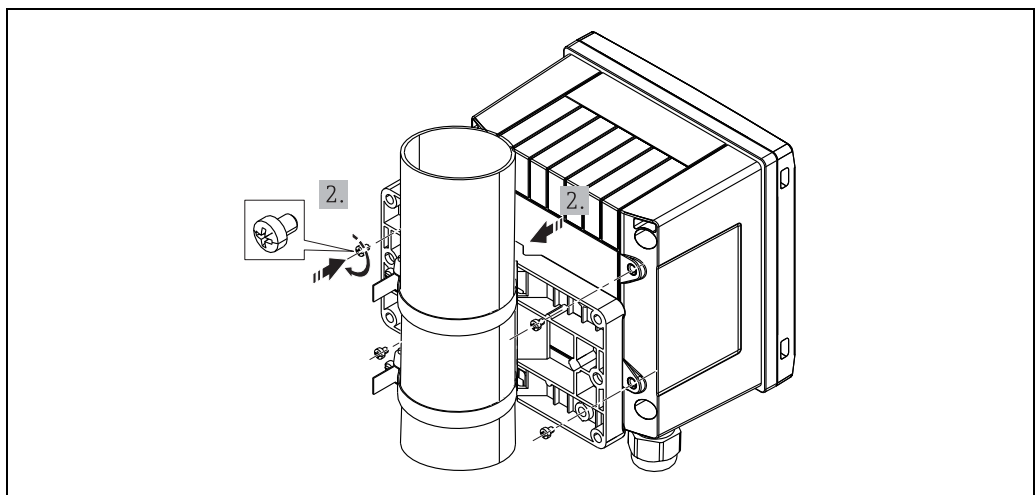
14: Pipe mounting

3.5   Post-installation check

For installing the batch controller and the associated temperature sensors, observe the general installation instructions according to EN 1434 Part 6.

4   Wiring

4.1   Connection requirements

⚠ WARNING
Danger! Electric voltage!
▶ The entire connection of the device must take place while the device is de-energized.

⚠ CAUTION
Incorrect power supply can cause malfunctions
▶ Before commissioning the device, make sure that the supply voltage matches the voltage specifications on the nameplate.
▶ Provide a suitable switch or power-circuit breaker in the building installation. This switch must be installed close to the device (so that it is easily accessible) and marked as a circuit breaker.
▶ An overload protection unit (rated current = 10 A) is required for the power cable.

4.2   Quick wiring guide
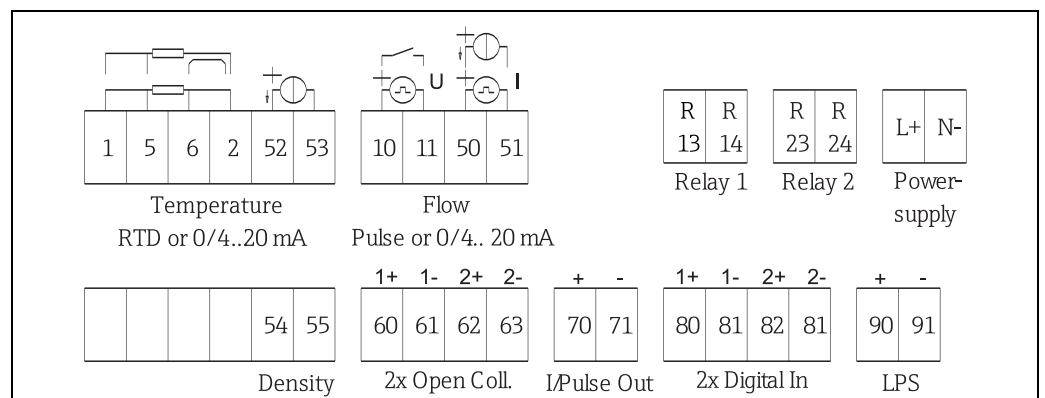
☒ 15: Connection diagram of the batch controller

For the connection of the communication interfaces, see the "Communication" section, → 🖹 20.

Terminal assignment

Terminals	Terminal assignment	Inputs
1	+ RTD power supply	Temperature, → 🖹 19 (Optionally RTD or current input)
2	- RTD power supply	
5	+ RTD sensor	
6	- RTD sensor	
52	+ 0/4 to 20 mA input	
53	Ground for 0/4 to 20 mA input	
54	+ 0/4 to 20 mA input	Density (Current input)
55	Ground for 0/4 to 20 mA input	
10	+ pulse input (voltage or contact)	Flow, → 🖹 17 (Optionally pulse or current input)
11	- pulse input (voltage or contact)	
50	+ 0/4 to 20mA or current pulse (PFM)	
51	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 for end of batch, 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 20mA/pulse output	Current values (e.g. power) or counter values (e.g. energy)
71	0/4 to 20mA/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	24V sensor power supply (LPS)	24 V power supply (e.g. for sensor power supply)
91	Power supply ground	
		Power supply
L/+	L for AC + for DC	
N/-	N for AC - for DC	

4.2.1   Open housing

a0014368
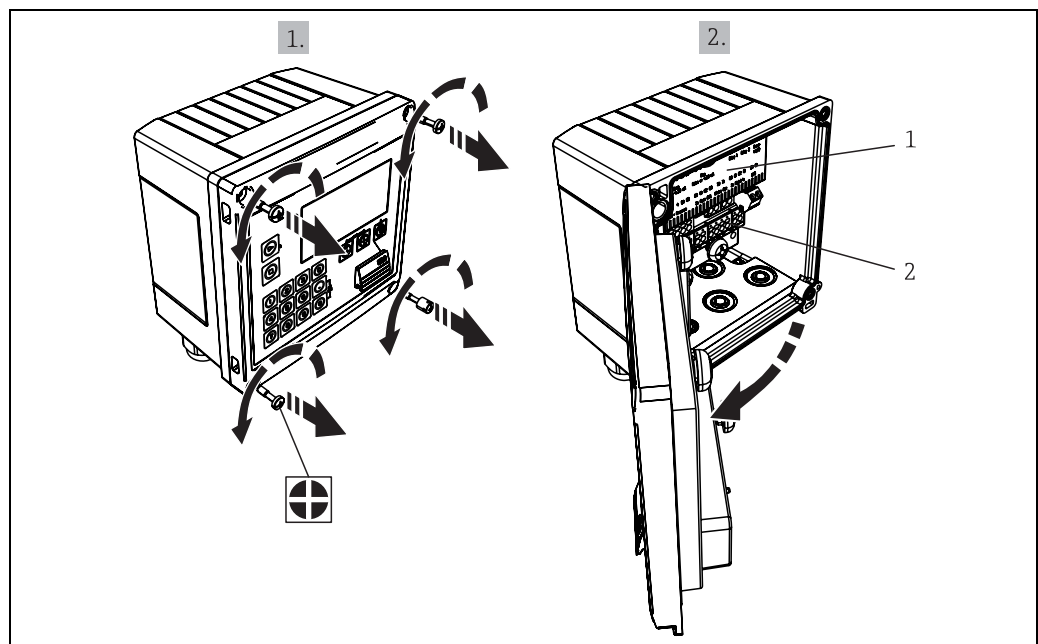
🖾 *16: Opening the housing of the batch controller*

1   Terminal assignment labeling
2   Terminals
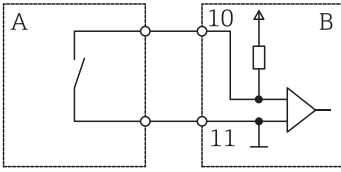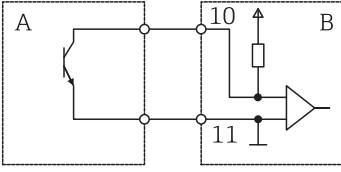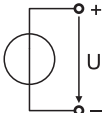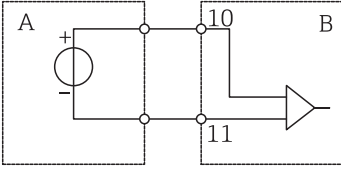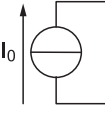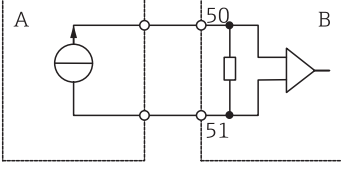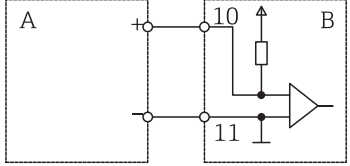
4.3 Connecting the sensors

4.3.1 Flow

Sensors for volume or mass flow measurement can be connected to the batch controller.

Connecting flow sensors with a pulse output

Pulse output of the flow sensor	Setting at the Rx33	Electrical connection	Notes
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.

Pulse output of the flow sensor	Setting at the Rx33	Electrical connection	Notes
Namur sensor (as per EN60947-5-6)	Pulse ID/IE up to 25 Hz or up to 12.5 kHz	 a0015359 1 = Sensor 2 = Rx33	No monitoring for short circuit or line break takes place.

Flow sensors with external power supply
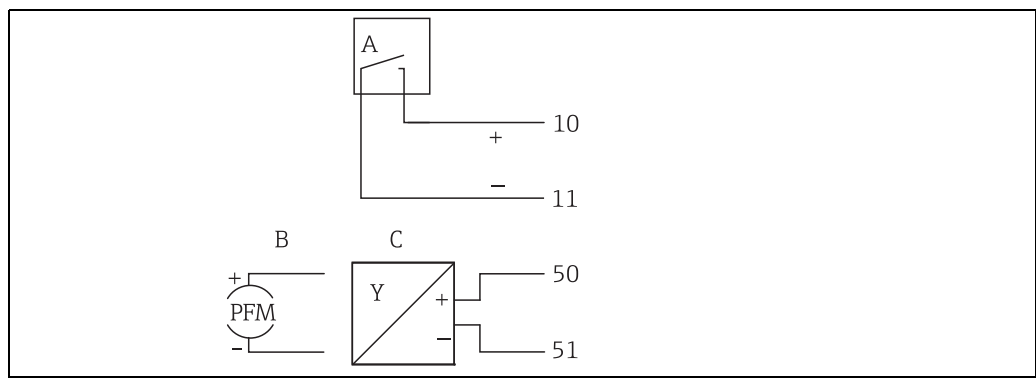
17: Connecting a flow sensor

A　　　Voltage pulses or contact sensors including EN 1434 Type IB, IC, ID, IE
B　　　Current pulses
C　　　0/4 to 20 mA signal

Flow sensors with power supply via the batch controller
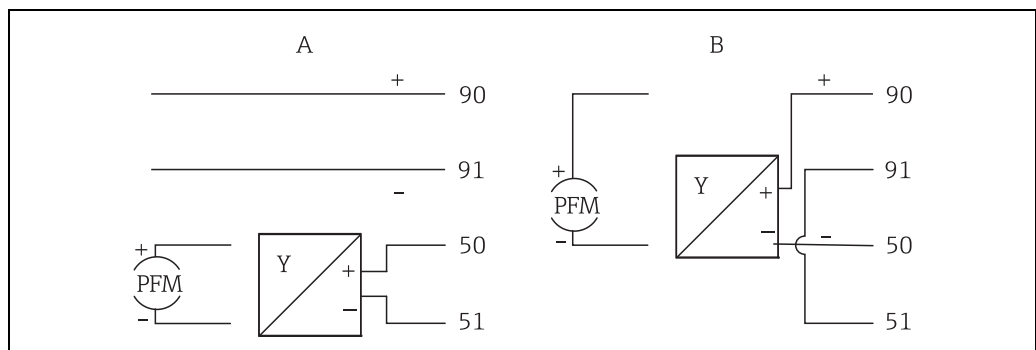
18: Connecting active flow sensors

A　　　4-wire sensor
B　　　2-wire sensor

4.3.2   Temperature

Connecting the RTD sensors	
	A0014529
	A = 2-wire connection, B= 3-wire connection, C = 2-wire connection Terminals 1, 2, 5, 6: temperature
Temperature transmitter connection	
	A0014528
	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

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

Density

Density sensor connection	
	a0015152
	A = without external power supply of the density sensor, B = with external power supply of the density sensor

4.4   Outputs

4.4.1   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. For the terminal assignment, refer to → 🖹 15.

4.4.2   Pulse output (active)

Active voltage pulses are output at the pulse output.
Voltage level:
- 0 to 2 V corresponds to Low level
- 15 to 20 V corresponds to High level

Maximum output current: 22 mA

4.4.3   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

4.5   Communication

ℹ️ 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.

4.5.1   Ethernet TCP/IP (optional)

The Ethernet interface is galvanically isolated (testing voltage: 500 V). A standard patch cable (e.g. CAT5E) can be used to connect the Ethernet interface. A special cable gland is available for this purpose which allows users to guide pre-terminated cables through the housing. Via the Ethernet interface, the device can be connected using a hub or a switch or directly to office equipment.
- Standard: 10/100 Base-T/TX (IEEE 802.3)
- Socket: RJ-45
- Max. line length: 100 m
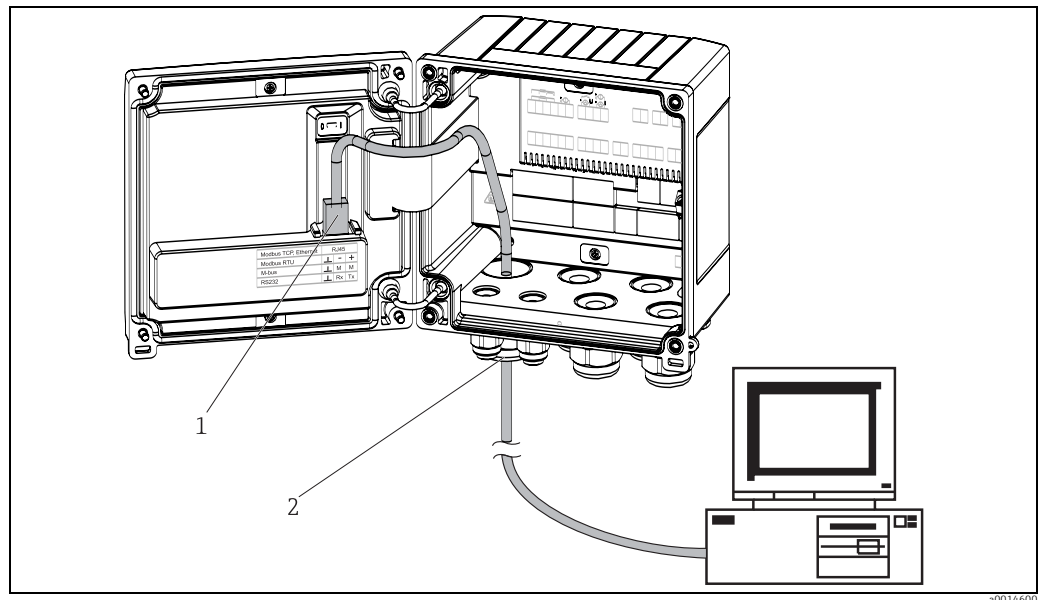
19: Ethernet TCP/IP, Modbus TCP connection

1   Ethernet, RJ45
2   Cable entry for Ethernet cable

4.5.2   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 (→ 🖹 20). Connection → 🖻 19, 🖹 20.

4.5.3   Modbus RTU (optional)

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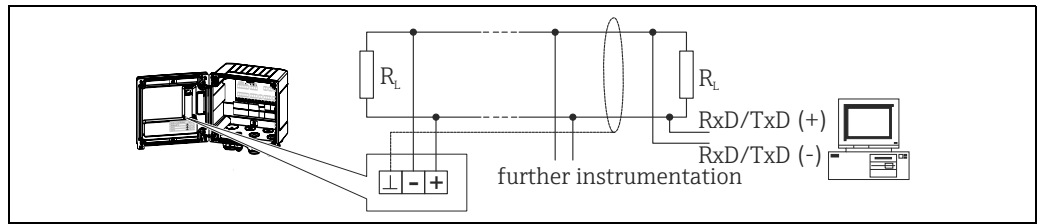
20: Modbus RTU connection

4.5.4 Printer interface / RS232 (optional)

The printer/RS232 interface is galvanically isolated (testing voltage: 500 V) and is used to connect a printer. It is connected via a 3-pin plug-in terminal in the housing cover.
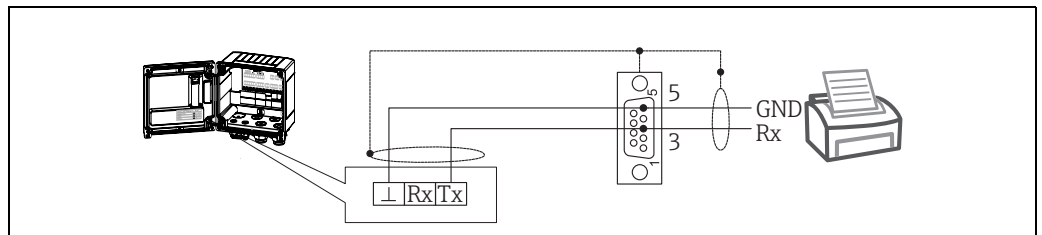
21: Printer connection via RS232

The following printers have been tested with the batch controller:
- GeBE MULDE Mini thermal printer

4.6 Post-connection check

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

Device status and specifications	Notes
Is the device or cable damaged (visual inspection)?	-
Electrical connection	Notes
Does the supply voltage match the specifications on the nameplate?	100 to 230 V AC/DC (±10%) (50/60 Hz) 24 V DC (-50% / +75%) 24 V AC (±50%) 50/60 Hz
Are the mounted cables relieved of tension?	-
Are the power supply and signal cables correctly connected?	See wiring diagram on the housing

5   Operation

5.1   General notes for operation

The batch controller can be configured using keys or using the "FieldCare" operating software.
The operating software, including the interface cable, is available as an order option, i.e. it is not part of the basic scope of delivery.
The configuration is locked if the device is locked by the locking switch (→ 🖹 23) or the user code.

5.2   Display and operating elements
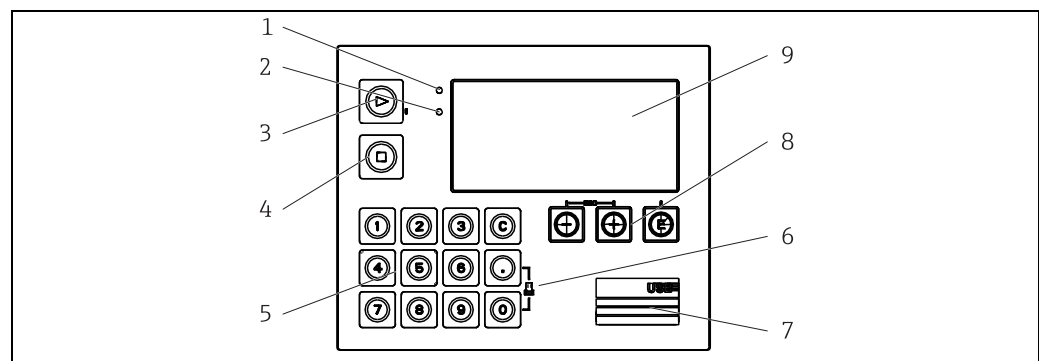
🖻 *22: Display and operating elements of the batch controller*

1   LED green, "Operation"
2   LED red, "Fault indicator"
Function keys:
3   Start
4   Stop
5   Numerical keypad
6   Start printing
Interface:
7   USB connection for configuration
Operating keys:
8   -, +, E
Display:
9160   x80 DOT matrix display

> ℹ️ Green LED for voltage, red LED for alarm/error. Green LED is always illuminated as soon as power is supplied to the device.
> Slow flashing of the red LED (approx. 0.5 Hz): the device has been put into bootloader mode.
> Fast flashing of the red LED (approx. 2 Hz): in normal operation: maintenance required. During firmware update: data transmission active.
> Red LED illuminated constantly: device error.

5.2.1   Operating elements

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

Esc/back function: press "-" and "+" simultaneously.
Enter/confirm entry: press "E"

14 function keys:

Start/stop function: Pressing the "Start" button starts a batching operation. Press the "Stop" button once to pause the batching operation currently in progress. Press "Stop" a second time to abort the batch. Pressing start again restarts the batch cycle.
C function: Press "C" when batching is stopped to reset the counters on the display to their original values.
Print function: Press "0" and "." simultaneously to print out the last batch cycle. The "RS232 printer interface" feature must be purchased to be able to use this function.

Locking switch

a0015168
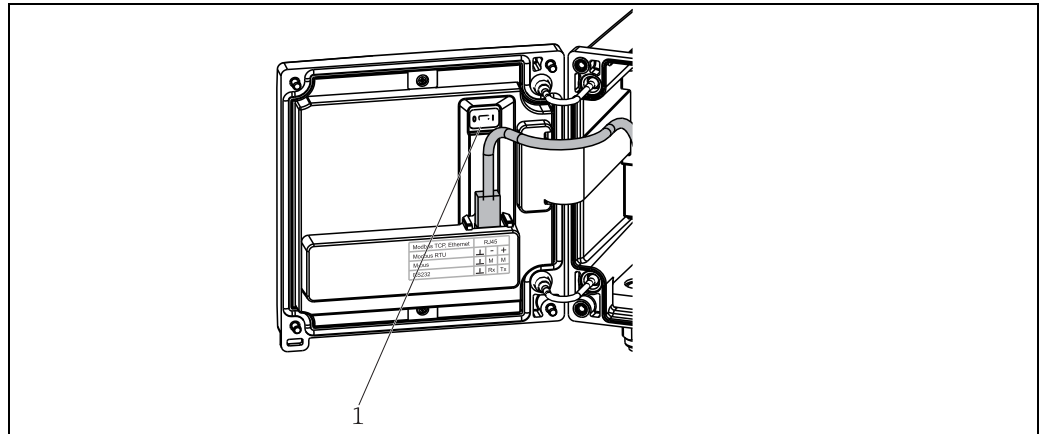
◱ *23: Locking switch*

1   Locking switch on the back of the housing cover

5.2.2   Function for entering a value for the preset counter

A value for the preset counter can be entered any time. This value can either be entered 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.

ℹ️   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.

5.2.3   Display

❶   ❷

a0014551

◱ *24: 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

> A list of the icons is provided in the Appendix, → 🗎 79.

5.2.4 "FieldCare Device Setup" operating software

For configuring the device using the FieldCare Device Setup software, connect the device to your computer via the USB interface.

Establishing a connection

Proceed as follows:

1. Start FieldCare.

2. Connect the device to the computer via USB.

3. Generate project via File/New.

4. Select communication DTM (CDI Communication USB).

5. Add Rx33.

6. Click "Establish connection".

7. Start online configuration.

Carry out the rest of the configuration of the device according to these Operating Instructions for the device. The entire Setup menu, i.e. all parameters listed in these Operating Instructions, is also included in the FieldCare Device Setup.

> During configuration with FieldCare, the device can enter undefined states! This can result in undefined switching of outputs and relays.

5.3 Operating matrix

For a complete overview of the operating matrix including all configurable parameters, → 🗎 65.

Language	Drop-down list with all available operating languages. Select the language of the device.

Display/operation menu	• Select the group for display (automatic change or fixed display group) • Setting for the display brightness and contrast • Display the stored analyses and batch reports • Enter a value for the preset counter • Recipe selection

Setup menu	In this Setup, you can configure the parameters for quick commissioning of the device. Advanced setup includes all important parameters for configuring the instrument 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 be configured via "Expert".

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

Expert menu	The Expert menu offers access to all operating options of the device, including fine tuning and service functions. • Jump directly to parameters via Direct Access (only on the device) • Service code for displaying service parameters (via PC operating software only) • System (settings) • Inputs • Outputs • Application • Diagnostics

6   Commissioning

Make sure that all post-connection checks have been carried out before you commission your device:

- See 'post-installation check', → 🗎 14
- Checklist for 'post-connection check', → 🗎 21

After the operating voltage is applied, the display and the green LED are illuminated. The device is now ready to operate and can be configured via the keys or the "FieldCare Device Setup" parameter configuration software (→ 🗎 24).

> ℹ️ Remove the protective foil from the display, as otherwise legibility is impaired.

6.1   Quick commissioning/make it run

For quick commissioning of the "standard" batch controller application, you only have to enter a few operating parameters in the menu **Setup**.

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 flow (pulse or current)

→ **Unit**: Select the flow unit

→ **Counter unit**: Specify the unit for the flow counter, e.g. m^3, kg

→ **Pulse value, value**: Enter the unit and value for the pulse value of the flow transmitter (for "pulse" signal type)

→ **Meas. range start** and **Meas. range end** (for "current" signal type)

→ **Date/time**: Set the date and time

The device is now operational and ready to control batching.
You can configure device functions, such as data logging, tariff function, bus connection and the scaling of current inputs for flow or temperature, in the "Advanced setup" menu.

6.2   Applications

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

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

- Batch controller with flow measurement and 1-stage batching, → 🗎 27
- Batch controller with flow measurement and 2-stage batching, → 🗎 28
- Batch controller with API temperature compensation, → 🗎 29
- Batch controller with API temperature/density compensation, → 🗎 30
- Batch controller with mass calculation, → 🗎 31
- Batch controller with volume calculation, → 🗎 32
- Manual batching, → 🗎 33

6.2.1 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 such a way that the specified quantity of medium is batched precisely.
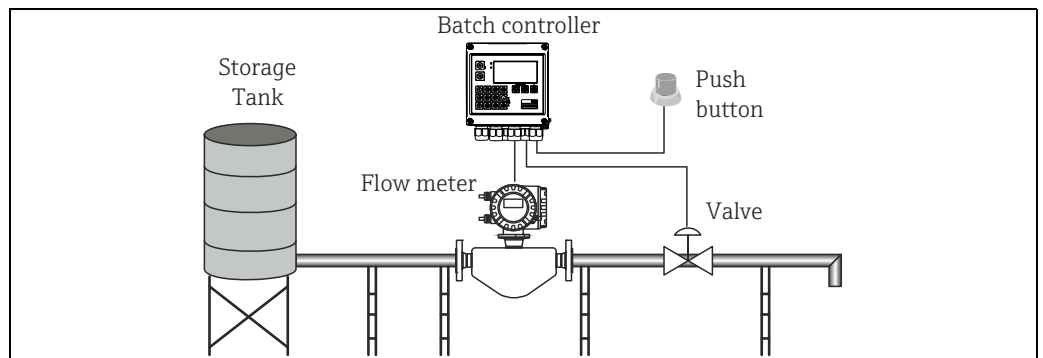
25: Batch controller with flow measurement and 1-stage batching

Input signals:

Flow, (pulse input or current input)

Output signals:

Valve control (relay or open collector)

Required settings:

a. Flow input: Enter pulse value or measuring range of the 0/4 to 20 mA input.

b. Valve control: Set the choice of filling stages to 1-stage. Assign the selected output to control the filling stage.

c. Preset counter: Before starting a batch for the first time, a value must be entered for the preset counter (→ 🖹 23). 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 to be used is stored in the device and applied for new batching operations until the value is changed.

d. After-run correction: The first time the automatic after-run correction function of the Batch Controller RA33 is used, the controller first has to learn what the after-run quantity is. The after-run quantity is the volume of medium that still flows between the time the control output switches to the time no more flow is recorded. The after-run quantity thus depends on the switching delay and valve closing time. The batch controller tries to correct the switch output by this amount to ensure that the batching result 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 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.

6.2.2   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 fast filling and is closed earlier so that the device can then dose more precisely with the second valve.
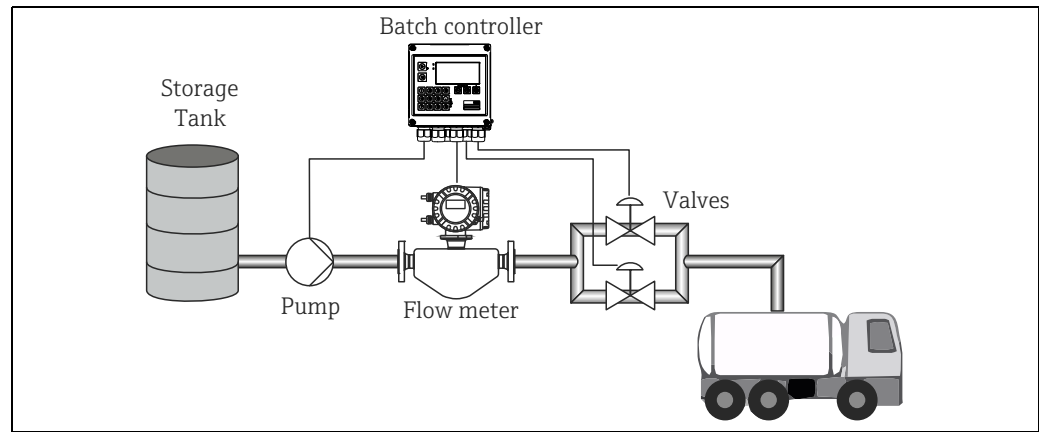
26: Batch controller with flow measurement and 2-stage batching

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:

a.   Flow input: Enter pulse value or measuring range of the 0/4 to 20 mA input.

b.   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 (→ 🖹 23). 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.

6.2.3　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 density. The first application example describes the measurement process using temperature compensation only. The volume can be corrected with any flow unit (volume flow or mass flow).
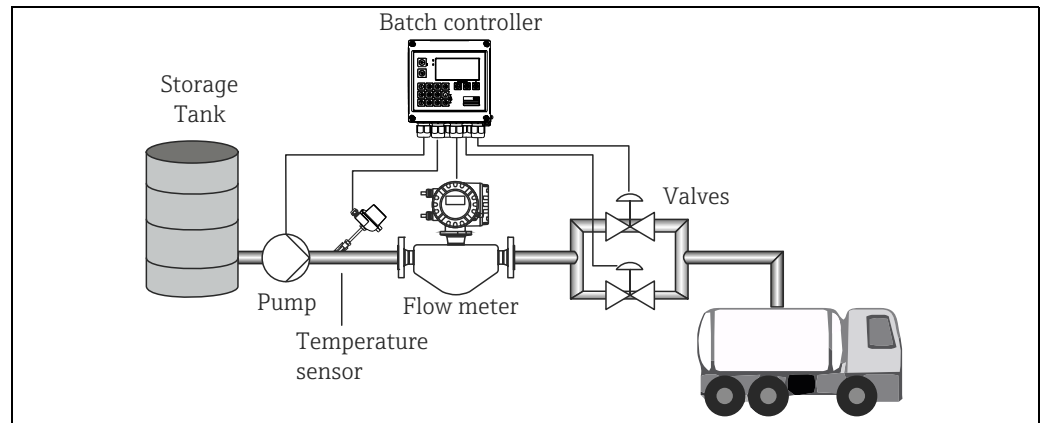
27: Batch controller with flow measurement, temperature compensation and 2-stage batching

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:

a.　Flow input: Enter pulse value or measuring range of the 0/4 to 20 mA input.

b.　Temperature input: Select the RTD type and temperature range or enter temperature measuring range for the 4-20 mA input.

c.　Select the product group of the mineral oil.

d.　Select the type of density measurement: Since the density is not measured, the "Operating density" parameter has to be set to "Calculated".

e.　Select the reference density: The reference conditions of the corrected volume must be assigned for the reference density. Here, the volumes at 15 ℃, 20 ℃ and 60 ℉ can be selected.

f.　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.

g.　Pressure: If the relative pressure differs from the ambient pressure, you must enter a pressure at which the flow is measured.

h.　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 ambient pressure. Since 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.

6.2.4   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).
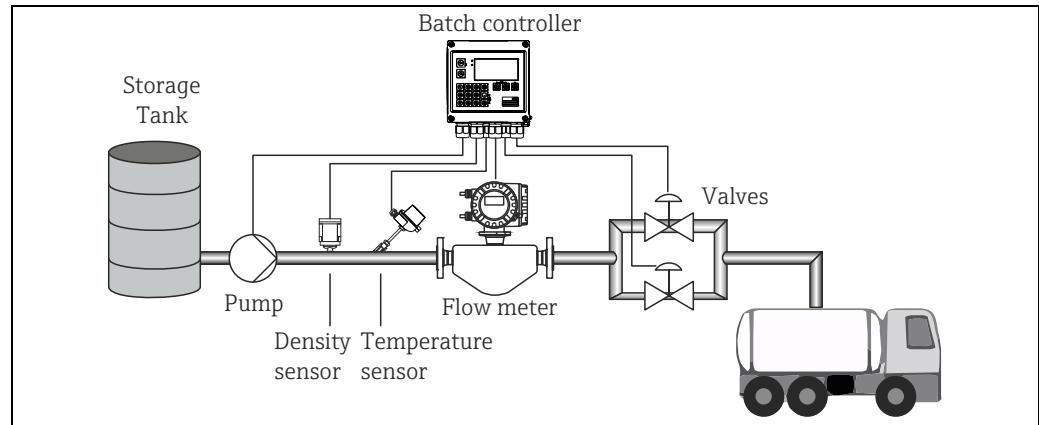
⊞ *28: Batch controller with flow measurement, temperature compensation, density compensation and 2-stage batching*

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:

a. Flow input: Enter pulse value or measuring range of the 0/4 to 20 mA input.

b. Temperature input: Select the RTD type and temperature range or enter temperature measuring range for the 4-20 mA input.

c. Select the product group of the mineral oil.

d. Select the type of density measurement: The "Operating density" is set to "Measured" since a density meter is used in this application example.

e. Select the reference density: The reference conditions of the corrected volume must be assigned for the reference density. Here, the volumes at 15 °C, 20 °C and 60 °F can be selected.

f. 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.

6.2.5   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 enabled, then the volume is converted to mass and the counter and preset counter are also available in the selected mass units.
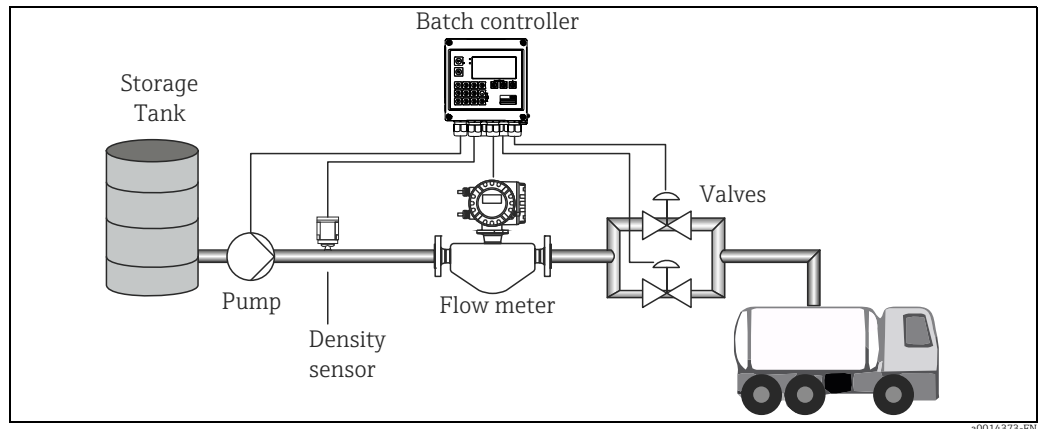
⊠ 29: Batch controller with mass calculation

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:

a.   Flow input: Enter pulse value or measuring range of the 0/4 to 20 mA input.

b.   Set the product group to "User-defined".

c.   Select the type of density measurement: The "Operating density" is set to "Measured" since a density meter is used in this application example.

d.   Set the "The result is" parameter to "Mass" to enable the calculation of the mass.

e.   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.

6.2.6 Batch controller with volume calculation

If a flow sensor is used for mass flow measurement, it is possible to calculate the volume batched. 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.
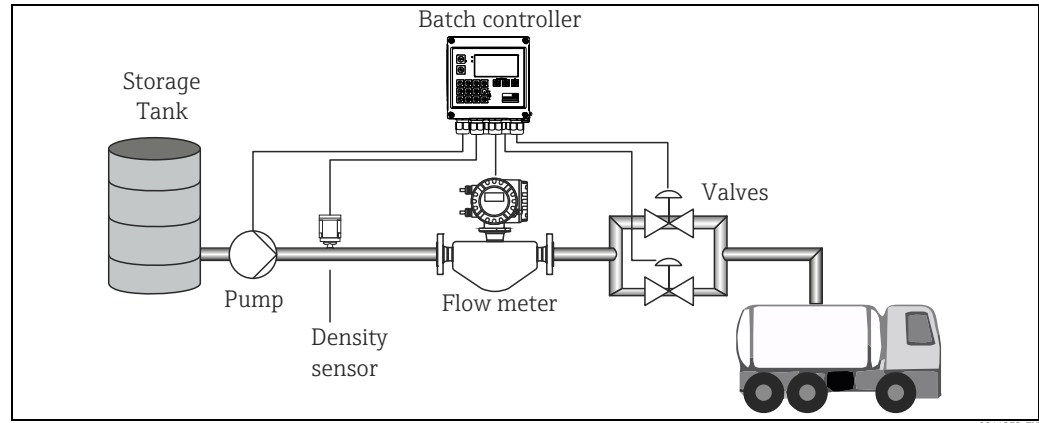
30: Batch controller with volume calculation

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:

a. Flow input: Enter pulse value or measuring range of the 0/4 to 20 mA input.

b. Set the product group to "User-defined".

c. Select the type of density measurement: The "Operating density" is set to "Measured" since a density meter is used in this application example.

d. Set the "The result is" parameter to "Volume" to enable the calculation of the volume.

e. 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.

6.2.7   Manual batching

In addition to batching based on a value entered for the preset counter beforehand, the device can also be used as a volume counter or mass counter (depending on the type of flow sensor) with manual control. This allows batching to be started and stopped locally on sight, for example, or via the stop signal of an external signal transmitter.
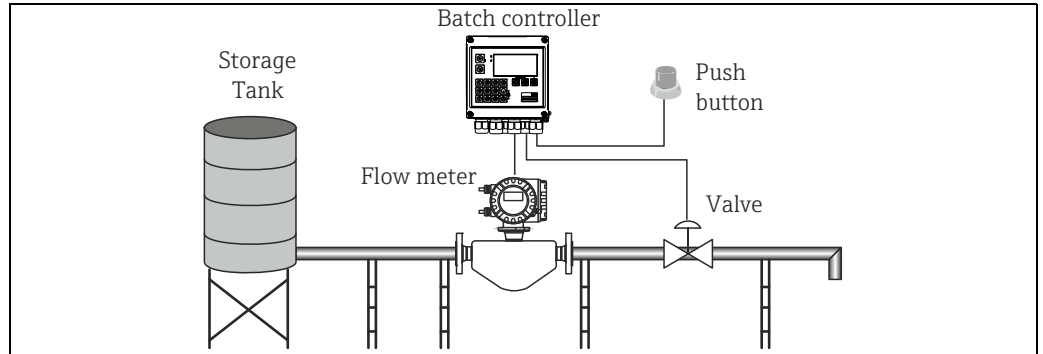
⊞ 31: Manual batching with the batch controller

Input signals:

Flow, (pulse input or current input)
Remote control (digital input)

Output signals:

Valve control (relay or open collector)

Required settings:

a.   Flow input: Enter pulse value or measuring range of the 0/4 to 20 mA input.

b.   Set the batch controller to "Manual" mode.

c.   The digital inputs must be assigned a Start/stop function for remote control.

d.   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.

6.3 Configuring the basic parameters/general device functions

- Inputs (→ 🖹 34)
- Outputs (→ 🖹 35)
- Application (→ 🖹 37)
- Data logging (→ 🖹 38)
- Access protection (→ 🖹 39)
- Logbooks (→ 🖹 39)
- Communication/fieldbuses (→ 🖹 40)

6.3.1 Inputs

Flow pulse transmitter

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

The input for voltage pulses and contact sensors is divided into different types according to EN1434 and provides a 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...9 V	

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 summed up 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 required flow unit must first be selected in the flow settings.

Flow current signal

For flow transmitters with current signal output, the flow measuring range is scaled in Advanced setup (→ 🖹 66).

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 is 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 cut off 3.6 m^3/h (1 l/s), pulse value of the transmitter: 0.1 liter.

1/0.1 = 10 Hz. This means that after 10 seconds 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 m³/h: values less than the low flow cut off value are valued at zero.
- Negative start of measuring range (bidirectional measurement), e.g. -50 to 50 m³/h: values around the zero point (+/- low flow cut off value) are valued at zero.

Temperature (optional)

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

The measuring range can be scaled individually if a current signal is used (menu **Setup→Advanced setup→Inputs→Temperature**).

Refer also to Compensation, → 🖺 45.

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 set. This is suitable for media whose composition is known.

Refer also to Compensation, → 🖺 45.

Digital inputs

Two digital inputs are available: Depending on the options of the device, 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 kickstart 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 no.	The batch number, which is automatically increased, is reset to the start value specified in 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.

6.3.2   Outputs

Relay

The two relays can be switched to control the filling stages and to signal fault commessages. They can be assigned to the relevant filling stages of the batch under **Setup → Advanced setup → Application → Batch settings → Switches fill phase 1/2**.

> ℹ️ The service life of the relays is specified as 10^5 switching cycles at least. In the case of 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. If used as status outputs, they serve to control the filling stages of the batch and to signal fault messages. Counters and the signal to indicate the end of a batch can be output as pulses.

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.
Furthermore, 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 issued at the current output if a batch is not active.
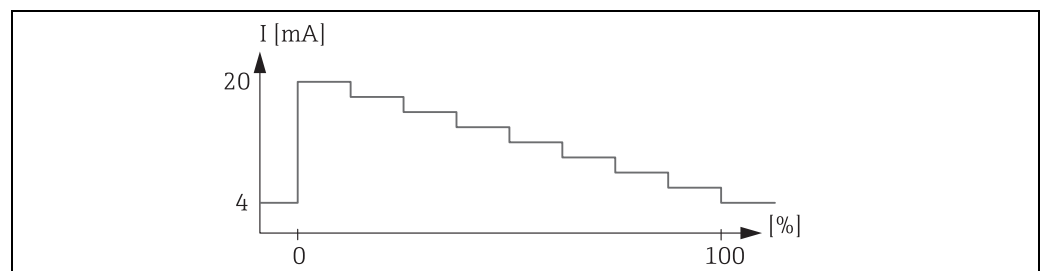
⊠ *32: Batch progress diagram*

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

Curve
The current value at the output is 0/4 mA if batching has stopped. 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.", specified in Setup. The current value at the current output then remains 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 issued at the current output if a batch is not active.
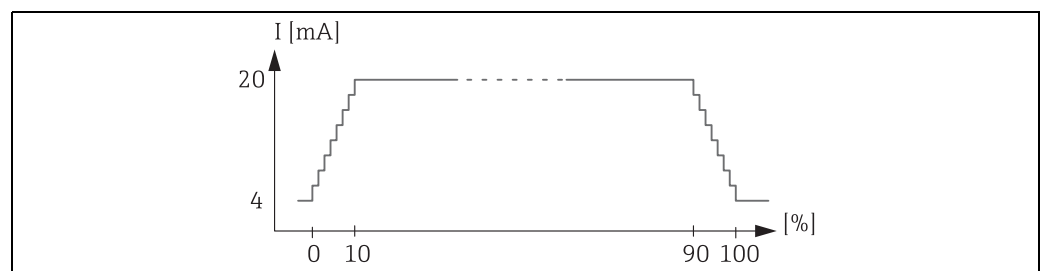
⊠ *33: Curve diagram*

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

Endress+Hauser

6.3.3   Application

Batch settings

All batching and control-related settings for batching must be made in Batch settings.

Batch mode

The main setting for batching functionality is to select the batch mode. It consists of the following modes: "Standard", "Automatic restart" and "Manual".

Function	Description
Standard	"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. 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 next new batch is started. A batch can be started via control output or by pressing a button. It continues until the value on the preset counter is reached or if the batch is first paused by means of a stop command (button or control input). From this paused state, the batch can either be restarted by means of a start command or aborted entirely by means of another stop command.
Automatic restart	"Automatic restart" functions like Standard mode with one addition, however; a batch sequence is started which is restarted after a configurable restart delay time. This continues until the batch sequence is paused and ended.
Manual	In manual mode, a preset counter is not required. The batch is started and stopped by pressing a button 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 direction of counting in which the preset counter is displayed. The options for selection are forwards, in which case a totalizer is displayed, or backwards, whereby the remaining quantity of the current batch is displayed.

Filling stages

The device has options for 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 beginning 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 achieved faster. 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 recommended to use after-run correction due to system response times. The command to close the valves is thus given earlier to compensate for the response time. This enables maximum batching accuracy.
Fixed after-run correction value is the basis. A fixed value can be specified and flow is stopped in advance by this value.
Automatic after-run correction can be enabled in addition to fixed. It calculates the new correction value based on the actual measured error of the last batch runs. This ensures precise batching results permanently.

> 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.

Maximum preset counter

Inputting the maximum preset counter value permitted reduces the risk of incorrect entries. During operation, if a preset counter value is entered that is greater than the maximum permitted value, the batch is not started and a message is output.

Batch information

All parameters for displaying and identifying stored batches are saved in batch information. Batches are identified by means of 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 as well as the current number reset to this value.

Display groups

Display settings

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

Display mode

The display mode is selected in the Display/operation menu. You configure the brightness, contrast and the switching mode of the display, i.e. whether switching between the display groups takes place automatically or by pressing a button. In this menu, you can also call up the current values for data recording (batch reports, day, month and annual counter and totalizer) under "stored values". (For details, refer to Data logging, → 🖹 38)

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/operat.** → **Stored values** menu.

Units

The units for scaling and displaying the process variables are configured in the respective submenus (e.g. the unit for displaying the temperature is configured under Inputs/ Temperature). To make device setting easier, the unit system is selected at the beginning of device commissioning.
- EU: SI units
- USA: imperial units

This setting sets the units in the individual submenus to a certain value (default), e.g. SI: m³/ h, °C, kWh. If a unit is converted subsequently, no automatic conversion of the associated (scaled) value takes place! Conversion of the units, → 🖹 81.

6.3.4 Data logging

The device stores relevant measured values and counter data at defined times.
Daily, monthly and annually, an analysis is stored with the number of batch cycles, error-free batch cycles and 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 provides permanently reliable data logging, which guarantees the security of data even after a power failure.
Current day, monthly and annual counters can be called up in the Display/operat → Stored values menu. In addition the totalizer and the counter for the current batch 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 error-free batches completed

General notes for data logging

The time of data logging (start time of the logging intervals) can be configured and/or synchronized via the time of day.
The current counter can be reset to zero via setup. The archived values (completed evaluations) can no longer be changed! To clear these out, the entire measured value memory must be deleted.

Storage capacity

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

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

6.3.5   Access protection

The device can be locked to protect it against tampering by means of a user code or device hardware switch (→ 🖹 23).

Protection using code

The entire local operation can be protected by a 4-digit code (default is 0000, i.e. no protection). If the device is not operated for 600s, it is locked again automatically.
It is still possible to enter a value for the preset counter.

6.3.6   Logbooks

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

Event logbook

The event logbook stores events such as alarms, setup changes etc. with date and time. The memory is sufficient for at least 1600 messages (however, depending on the text length, it

is possible for more messages to be stored). If the memory is full, the oldest messages are overwritten. The logbook can be read out via the FDM data management software or on the device. To exit the logbook quickly, press the +/- keys simultaneously.

6.3.7 Communication/fieldbuses

General notes

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) only. Process values such as flow cannot be transmitted to the device via the bus interfaces.
Batch commands can be sent to the device via Modbus, for details, refer to "Modbus RTU".
Depending on the bus system, alarms or faults are displayed as part of data transmission (e.g. status byte).
The process values are transmitted in the units that are also used for display on the device. Only the counter readings of the most recently completed storage period (day, month, year) can be read out of the memory.
For large counter readings, the places after the decimal point 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)

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 Expert / System / Ethernet menu, → 🖹 42. Modbus communication is configured in Setup / Advanced setup / System / ModBus or Expert / System / Modbus.

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

Transmission of values

The actual Modbus TCP protocol is between Layers 5 and 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
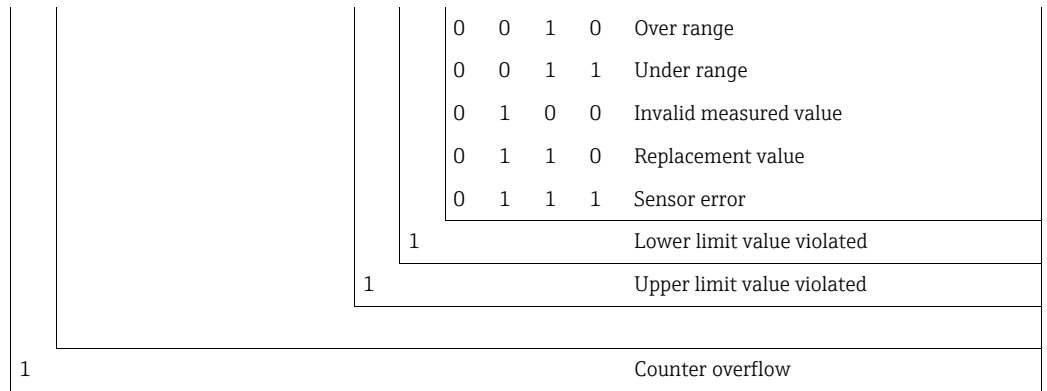
On receipt of the request from the master, the required start register and the number of registers to be read are sent to the batch controller. Because a measured value always requires three registers, the start register and the number must be divisible by 3.
From the master to batch controller:
ga fk r1 r0 a1 a0 c1 c2

ga	Slave address (1 to 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 the batch controller for successful request:
ga fk az s1 s0 w3 w2 w1 w0 s1 s0 w3 w2 w1 w0 . . . . . s1 s0 w3 w2 w1 w0 c1 c0

ga	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 Batch Controller for unsuccessful request:
ga fk fc c0 c1

ga	Device address
fk	Requested function + 80hex
fc	Error code
c0 c1	CRC checksum, 16-bit (low byte first)

Error code:

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

For checksum or parity errors in the request from the master, the batch controller does not respond.

For large counter readings, the decimal points are truncated.

Transmission of batch commands to the batch controller/Reading 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 16 (Write Registers), 06 (Write Single Register).**

The byte order must be followed according to the setting in the batch controller.

Ethernet/Web server (TCP/IP)

Configuration in the menu Setup → Advanced setup → System → Ethernet or
Expert → System → Ethernet
The IP address can be entered manually (fixed IP address) or assigned automatically via DHCP.
The port for the data communication is set by default to 8000. The port can be changed in the Expert menu.
The following functions are implemented:
• Data communication to PC software (Field Data Manager Software, FieldCare, OPC server)
• Web server
• Modbus TCP (→ 🖹 40)

Up to 4 connections can be opened simultaneously, e.g. Field Data Manager software, Modbus TCP and 2x Web server.
However, only one data connection via Port 8000 is possible.
As soon as the max. number of connections is reached, new connection attempts are blocked until an existing connection is terminated.

Web server

If the device is connected via Ethernet, you have the ability to read out the display values over the Internet via Web server.
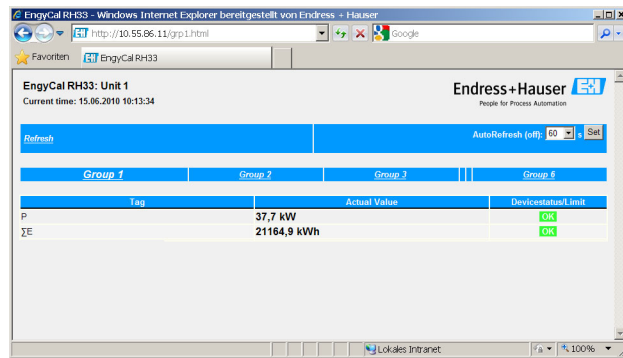
a0014191

※ 34: Display values in the Web browser

Just as in the display, you can switch between the display groups in the Web server. The measured values are updated automatically (direct via "link": off/5s/15s/30s/60s). In addition to the measured values, status/limit value flags are also displayed.
The data can be read out via the Webserver in HTML or XML format.
When using an Internet browser, it suffices to enter the address http://<IP address> to display the information as HTML in the browser. In addition, two versions of the XML format are available. These versions can be integrated into additional systems as required. The two XML versions contain all the measured values which are assigned to any group.

The decimal separator is always displayed as a period in the XML file. All times are given in UTC. The time difference is indicated in minutes in the subsequent 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. Strings such as digital status information 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 in the XML file is explained below:

```
<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>
```

Day	Description
tag	Channel ident.
v1	Measured value of the channel as a decimal value
u1	Unit of the measured value.
vstslv1	Status of the measured value
	0 = OK, 1 = warning, 2= error
hlsts1	Error description
	OK, OC = cable open circuit, Inv: invalid, ErV: error value, OR: over range, UR: under range, ErS: error sensor
vtime	Date and time
man	Manufacturer

Web server settings

Setup→Advanced setup→System→Ethernet→Web server→ Yes or
Expert→System→Ethernet→Web server→ Yes
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.
No provision is made for authentication via ID/password.

Printer interface

The device can print a batch report directly on a connected ASCII printer via the RS232
interface.

Menu item	Description
Printout	You can initiate printing manually on-site if it is set to "Manual". If it is set to "Automatic", the configured number of printouts are additionally printed after every batch cycle.
Baudrate	Select the baudrate that is compatible with the printer.
Number of copies	Use this option to specify the number of printouts for automatic printing at the end of the batch.
Characters/line	Use this option to enter the number of characters per line supported by the printer.
Number of headers	Use this option to select the required number of lines for user-defined text at the beginning of the printout.
Header line 1 to 4	Use this option to enter the free text.
Number of footers	Use this option to select the required number of lines for user-defined text at the end of the printout.
Header line 1 to 4	Use this option to enter the free text.
Blank rows at end	Use this option to enter the required blank rows at the end of a printout, e.g. to allow sufficient space for tearing off.
Print direction	Use this option to select whether printing should start at the first line or the last line.
Test print	Use this option to initiate 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
```

a0014552

⊡ *35: Batch controller test report*

6.4   Optional device settings/special functions

- Compensation → 📄 45
- Batch printout → 📄 46

6.4.1   Compensation

Measured volumes can be corrected or converted to mass, or measured mass can be converted to volume, 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 oils	Corrected volume	Calculated	Required	Not required
		Measured	Required	Required

Mass flowmeter (conversion to volume)

Product group	"Operating density" setting	Temperature sensor	Density sensor
User-defined	-	Not required	Not required
Mineral oils	Calculated	Required	Not required
	Measured	Required	Required

> ℹ️ Volume correction via temperature measurement and/or density measurement is possible for both product groups. The advantage of an additional density measurement is that the system reacts to fluctuations in the medium independently. If the correction is based on temperature measurement alone, the density value of the medium must be checked at reference operating conditions where necessary and adjusted.

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 options available for selection are 15 ℃, 20 ℃ or 60 ℉.
The value that must be entered in the reference density parameter is the density of the medium under the selected reference operating conditions. When using the density unit API° and Gravity (G), 60 ℉ 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/℃ or 1/℉ depending on the reference conditions. According to this, a reference condition in ℃ gives rise to an expansion coefficient also in 1/℃. 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. The relative pressure, in relation to the ambient pressure at which the flow of the medium is measured, must be entered in Setup. Direct measurement is not required as the influence of pressure is relatively low. Entering the approximate pressure is adequate for the level of accuracy required. Pressure compensation can be disabled by entering a value of 0 for pressure.

6.4.2   Batch printout

Refer to the section on the printer interface, → 🖹 44.

7   Maintenance

No special maintenance work is required for the device.

8   Accessories

Various accessories are available for the device, and these can be ordered with the device or at a later stage from Endress+Hauser. Detailed information on the order code in question is available from your local Endress+Hauser Sales Center or on the product page of the Endress+Hauser website: **www.endress.com**

8.1   Device-specific accessories

Accessories	Description
Weather protection cover	Is used to protect the measuring device from the effects of the weather: e.g. rainwater, excess heating from direct sunlight or extreme cold in winter. For details, see Installation Instructions SD00333F
Pipe mounting set	Dimensions (→ 🖻 4, 🖹 11) and installation instructions (→ 🖹 14)
DIN rail mounting set	Dimensions (→ 🖻 6, 🖹 11) and installation instructions (→ 🖹 13)
Panel mounting set	Dimensions (→ 🖻 5, 🖹 11) and installation instructions (→ 🖹 12)

8.2   Communication-specific accessories

Accessories	Description
RXU10-G1	USB cable and FieldCare Device Setup calibration software incl. DTM library
Field Data Manager software MS20	Visualization software and SQL-based database
Commubox FXA195 HART	For intrinsically safe HART communication with FieldCare via the USB interface. For details, see "Technical Information" TI00404F

Accessories	Description
HART Loop Converter HMX50	Is used to evaluate and convert dynamic HART process variables to analog current signals or limit values. For details, see "Technical Information" TI00429F and Operating Instructions BA00371F
WirelessHART adapter SWA70	Is used for the wireless connection of field devices. The WirelessHART adapter can be easily integrated into field devices and existing infrastructures, offers data protection and transmission safety and can be operated in parallel with other wireless networks with minimum cabling complexity.
Fieldgate FXA320	Gateway for the remote monitoring of connected 4-20 mA measuring devices via a Web browser. For details, see "Technical Information" TI00025S and Operating Instructions BA00053S
Fieldgate FXA520	Gateway for the remote diagnostics and remote configuration of connected HART measuring devices via a Web browser. For details, see "Technical Information" TI00025S and Operating Instructions BA00051S
Field Xpert SFX100	Compact, flexible and robust industry handheld terminal for remote configuration and for obtaining measured values via the HART current output (4-20 mA). For details, see Operating Instructions BA00060S

8.3   Service-specific accessories

Accessories	Description
Applicator	Software for selecting and sizing Endress+Hauser measuring devices: • Calculation of all the necessary data for identifying the optimum flowmeter: e.g. nominal diameter, pressure loss, accuracy or process connections. • Graphic illustration of the calculation results Management, documentation and access to all the project-related data and parameters over the entire lifetime of a project. Applicator is available: • Via the Internet: https://wapps.endress.com/applicator • On CD-ROM for local PC installation.
W@M	FDT-based plant asset management tool from Endress+Hauser. It can configure all smart field units in your system and helps you manage them. By using the status information, it is also a simple but effective way of checking their status and condition.
FieldCare	For details, see Operating Instructions BA00027S and BA00059S

8.4   System components

Accessories	Description
Memograph M graphic display recorder	The Memograph M graphic data manager provides information on all the relevant process variables. Measured values are recorded correctly, limit values are monitored and measuring points analyzed. The data are stored in the 256 MB internal memory and also on a SD card or USB stick. For details, see "Technical Information" TI00133R and Operating Instructions BA00247R

Accessories	Description
Over voltage protector HAW562 DIN rail	Endress+Hauser offers the HAW562 surge arrester for DIN rail mounting to protect against overvoltage in the power supply, signal cables and communication cables. For details, see "Technical Information" TI01012K
Over voltage protector HAW569 field mounting	Endress+Hauser offers the HAW562 surge arrester for field mounting to protect against overvoltage in the power supply, signal cables and communication cables. For details, see "Technical Information" TI01013K
RN221N	Active barrier with power supply for safe separation of 4-20 mA standard signal circuits. Offers bidirectional HART transmission. For details, see "Technical Information" TI00073R and Operating Instructions BA00202R
RNS221	Supply unit for powering two 2-wire measuring devices solely in the non-Ex area. Bidirectional communication is possible via the HART communication jacks. For details, see "Technical Information" TI00081R and Brief Operating Instructions KA00110R

9　Troubleshooting

9.1　Instrument diagnostics and troubleshooting

The Diagnostics menu is used to analyze the device functions and offers comprehensive help for troubleshooting. To find the causes for device errors or alarm messages, follow these basic procedures.

General procedure for troubleshooting
1. Open diagnosis list: Lists the 10 most recent diagnostic messages. From this, you can tell which errors/faults are currently pending or if one of them has occurred multiple times.

2. Open measured value display diagnostics: Verify the input signals by displaying the raw values (mA, Hz, Ohm) or the scaled measuring ranges. To verify calculations, call up calculated auxiliary variables if necessary.

3. Steps 1 and 2 remedy most causes of errors. If the error persists, observe the troubleshooting instructions for the error types from Chapter 9.2 of the Operating Instructions.

4. If this is not successful, contact service. For service inquiries, please always have the error number and the information from the Device information/ENP (program name, Serial Number etc.) available.

9.2   Error messages

Error	Description	Remedial action
F041	Open circuit Input current ≤ 2 mA • Incorrect wiring • Full scale value of the measuring range configured incorrectly • Sensor defective	• Check wiring • Enlarge measuring range (change scaling) • Replace sensor
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)
F104	Sensor error Input current > 2 to ≤ 3.6 mA or ≥ 21mA (or 22mA for 0 to 20 mA signal) • Incorrect wiring • Full scale value of the measuring range configured incorrectly • Sensor defective Pulse input >12.5 kHz or > 25 Hz	• Check wiring • Enlarge measuring range (change scaling) • Replace sensor • Select a larger value for pulse value
F201	Device error (operating system error)	Contact service
F261	System error (miscellaneous hardware errors)	Contact service
F301	Setup defective	Reconfigure the device. If the error recurs, contact service
M302	Setup has been loaded from backup.	No effect on operation. To be safe, check setup (configuration) and adjust if necessary
F303	Device data defective	Contact service
M304	Device data defective. The system continues working with backup data.	No action required.
F305	Counters defective	Counter value is reset automatically to 0
M306	Counter defective, but system could continue working with backup.	Check plausibility of the counter reading (compare to last stored counter reading)
F307	Customer preset values defective	Save configuration parameters.
F309	Invalid date/time (e.g. GoldCap was empty)	Device was switched off too long. Date/time must be reconfigured.
F310	Setup could not be stored	Contact service
F311	Device data could not be stored	Contact service
F312	Calibration data could not be stored	Contact service
M313	FRAM has been defragmented	No action required.
F314	Activation code is no longer correct (serial number/program name is incorrect).	Enter new code
M315	No IP address could be obtained from the DHCP server!	Check network cable, contact network administrator.
M316	No MAC-Address or incorrect address	Contact service

Error	Description	Remedial action
F431	Calibration data missing	Contact service
F501	Invalid configuration	Check setup
M502	Device is locked! - e.g. for firmware update attempt	Check the hardware switch on the device
F900	Input variable(s) outside the calculation limits (see Technical data, → 📄 56)	• Check plausibility of the measured input values • Check scaling of device inputs/sensor outputs • Check system/process
M908	Analog/pulse output error	Check process values and scaling of the output, select larger full scale value (or pulse value) if necessary.
F910	Firmware for this device not released.	Install correct firmware.
M918	Preset counter may not be 0!	Enter value for preset counter.
M919	Flow rate greater than low flow cut off!	Check sensors, valves or pumps.
M920	Batch aborted. No flow!	Check sensors, valves or pumps.
M921	Fill deviation exceeded!	
M922	Fill deviation undershot!	

9.2.1 Troubleshooting for MODBUS

• Are the device and the master using the same baud rate and parity?
• Is the wiring of the interface OK?
• Does the device address sent by the master match the configured device address of the transmitter?
• Do all slaves on the MODBUS have different device addresses?

9.2.2 Device error/alarm relay

There is a global "alarm relay" (the user can either assign the relay or one of the open collectors in the setup).
This "alarm relay" switches if errors or type "F" (Failure) occur, i.e.:
Errors of type "M" (Maintenance required) do not switch the alarm relay.
For errors of type F, the color of the backlighting of the display also switches from white to red.

9.3 Diagnosis list

Refer also to error messages, → 📄 50.
The device has a diagnostic list in which the last 10 diagnostic messages (messages with error numbers from type Fxxx or Mxxx) are stored.
The diagnosis list is designed as a ring memory, i.e. if the memory is full, the oldest messages are overwritten automatically (without message).

The following information is stored:
• Date/time
• Error number
• Fault Text

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

The following fall under Fxxx or Mxxx:
- Open circuit
- Sensor error
- Invalid meas.val.

9.4 Output function test

In the Diagnostics/Simulation menu, the user can output certain signals at the outputs (function text).
The simulation is ended automatically if the user has not pressed any buttons for 5 minutes or has switched off the function explicitly.

Relay tests

The user can switch the relay manually.

Analog output

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

Pulse outputs (Pulse / OC)

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

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

Status of the outputs

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

9.5   Spare parts

When ordering spare parts, please specify the serial number of the device. The spare part comes with Installation Instructions.
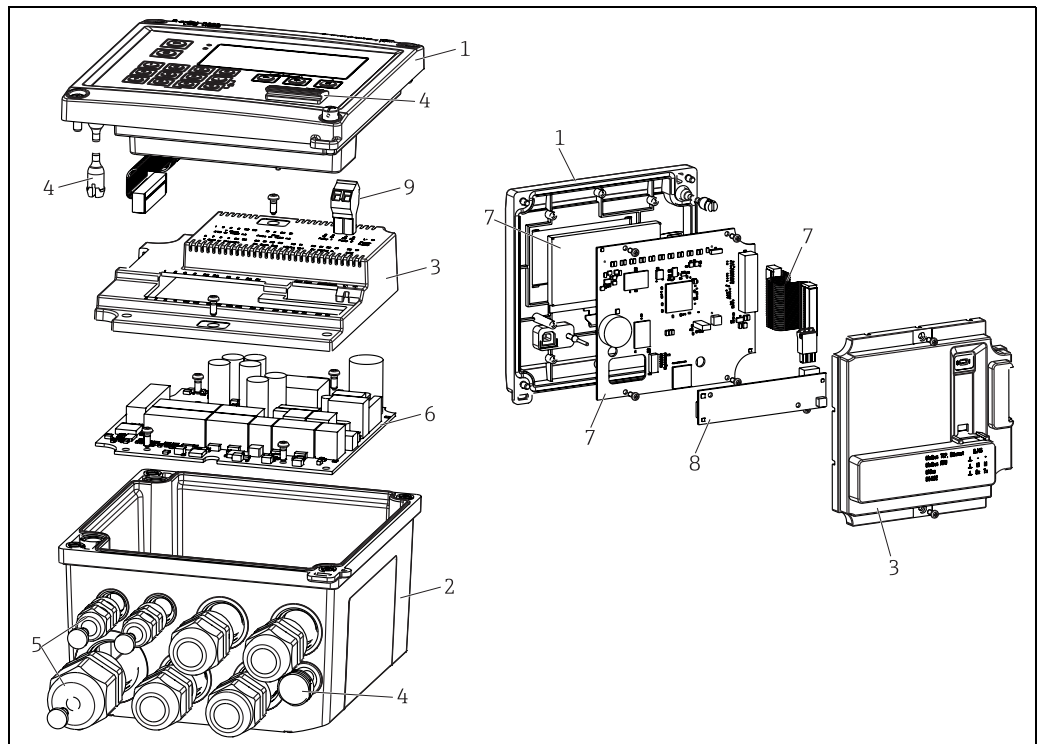
36: Batch controller spare parts

Item No.	Description	Order Code		
1	Housing front RA33 incl. front foil	XPR0001-FA		
2	Housing base (lasered) incl. threaded plate (specify serial number)	XPR0001-UT		
3	Cover electronic internal for RA33 incl. screws (for Mainboard + CPU card)	XPR0001-CB		
4	Set of small parts Hinge pins, pressure compensation element, USB cover, panel seal	XPR0001-SP		
5	Cable insertion set for panel mounting 4xM20, 2xM12, 1xM25	XPR0001-SK		
6	Mainboard	XPR0003-		
		Approval	AA	Non-hazardous area
			CP	CSA General Purpose
		Supply voltage	1	100-230V (AC: -15%/ +10%,50/60 Hz)
			2	24V (DC: -50%/+75%; AC: +/-50%,50/60 Hz)
		Output	B1	1x analog/pulses (active), 2x open collector

7	CPU card + LCD + ribbon cable	XPR0002-		
		Device type	C	RA33
		Display operating language	AA	English
			AB	German
			AC	French
			AD	Spanish
			AE	Italian
			AF	Dutch
			AG	Portuguese
			AH	Polish
			AI	Russian
			AR	Czech
8	Communication card USB	XPR0001-KA		
	Communication card USB + Ethernet	XPR0001-KB		
	Communication card USB + ModBus RTU (RS485)	XPR0001-KC		
	Communication card USB + RS232	XPR0001-KE		
9	Plug-in terminal, 2-pin RM5.0	71084277		
W/O Item No.	Pipe mounting set	XPR0001-RM		
	Wall mounting set	XPR0001-WM		
	DIN rail mounting set	XPR0001-DM		
	Panel mounting set incl. panel seal	XPR0001-SM		
	Plug-in terminal, 3-pin. FMC1.5/3-ST-3.5 for digital I/O and RS485	51009210		

9.6   Return

For a return, e.g. in case of repair, the device must be sent in protective packaging. The original packaging offers the best protection. Repairs must only be carried out by your supplier's service organization.

> When sending for repair, please enclose a note with a description of the error and the application.

9.7   Disposal

The device contains electronic components and must, therefore, be disposed of as electronic waste in the event of disposal. Please also observe local regulations governing disposal.

10 Technical data

10.0.1 Input

Current/pulse input

This input can be used either as a current input for 0/4 to 20 mA signals or as a pulse or frequency input.
The input is galvanically isolated (500 V testing voltage towards all other inputs and outputs).

Cycle time

The cycle time is 125 ms.

Reaction time

In the case of analog signals, the reaction 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	Reaction 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	≤ 440
Pulse input	Relay/digital output	≤ 250

Current input

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

Pulse/frequency input

The pulse/frequency input can be configured for different frequency ranges:
- Pulses and frequencies up to 0.3 Hz to 12.5 kHz
- Pulses and frequencies up to 0.3 Hz to 25 Hz (filters out 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 V to 6 V
Current limiting resistance in the power supply
(pull-up at input):   50 kΩ to 2 MΩ
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 V to 9 V
Current limiting resistance in the power supply (pull-up at input): (Not suitable for active input voltages)	562 Ω to 1 kΩ

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 resistance temperature detector (RTD = resistance thermometer) inputs. 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 the 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 % over range
Accuracy:	0.1 % of full scale value
Temperature drift:	0.01 %/K of full scale value
Loading capacity:	Max. 50 mA, max. 2.5 V
Input impedance (load):	50 Ω
A/D converter resolution:	24 bit

HART® signals are not affected.

RTD input

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

Measuring ranges:	
Pt100_exact:	-200 ℃ to 300 ℃ (-328 to 572 ℉)
Pt100_wide:	-200 ℃ to 600 ℃ (-328 to 1112 ℉)
Pt500:	-200 ℃ to 300 ℃ (-328 to 572 ℉)
Pt1000:	-200 ℃ to 300 ℃ (-328 to 572 ℉)
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 ℉))
Temperature drift:	0.01 %/K (0.0056 %/℉) 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 % over range
Accuracy:	0.1 % of full scale value
Temperature drift:	0.01 %/K of full scale value
Loading capacity:	Max. 50 mA, max. 2.5 V
Input impedance (load):	50 Ω
A/D converter resolution:	24 bit

HART® signals are not affected.

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 also 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)

10.0.2 Output

Current/pulse output (optional)

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 % over range
Load:	0 to 600 Ω (according to IEC 61131-2)
Accuracy:	0.1 % of full scale value
Temperature drift:	0.01 %/K (0.056 %/°F) of full scale value
Inductive load:	Max. 10 mH
Capacitance load:	Max. 10 μF
Ripple:	Max. 12 mVpp on 600 Ω for frequencies < 50 kHz
D/A converter resolution:	14 bit

Pulse output (active)

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

2 x relay output

The relays are designed as NO contacts. The output is galvanically isolated (1500 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 (optional)

The two digital outputs are galvanically isolated from one another and from all the other inputs and outputs (testing voltage: 500 V). The digital outputs can be used as status or pulse outputs. The open collector outputs are particularly suitable for a high number of switching cycles since, in contrast to relays, these outputs are non-wearing.

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.	

10.0.3   Power supply

Terminal assignment
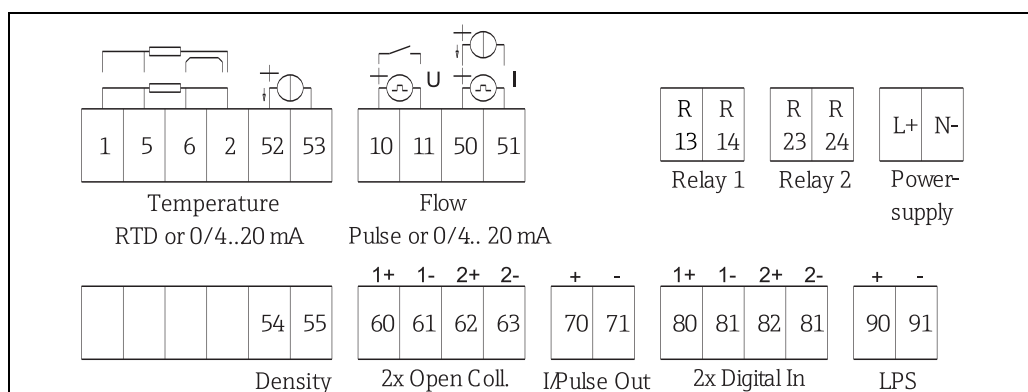
🖼 37: Terminal assignment of RA33.

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

10.0.4   Communication interfaces

A USB interface (with CDI protocol), and optionally 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 PTB-A 50.1.

USB device

Connection:	Type B socket
Specification:	USB 2.0
Speed:	Full speed (max. 12 MBit/sec.)
Max. cable length:	3 m

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 for this purpose which allows users to guide pre-terminated cables through the housing. Via the Ethernet interface, the device can be connected to office equipment using a hub or a switch.

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

RS232 printer interface

The RS232 interface is optional, and cannot be combined with other optional interfaces.

– 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 used to connect the device to higher-order systems to transmit all measured values and process values. It is connected via a 3-pin plug-in terminal.

10.0.5   Performance characteristics

Reference operating conditions

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

Arithmetic unit

The system has a calculation cycle of 125 ms. The amount of medium that flows in the specified reaction times is reliably measured by the batch Controller but can deviate by this amount from the preset fill quantity. Using the after-run correction function or reducing the flow for 1-stage batching increases the accuracy of the quantity transferred. The use of two batching stages allows for batching that is both fast and precise.

10.0.6   Installation

Mounting location

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

Orientation

The orientation is only determined by the legibility of the display.

10.0.7   Environment

Ambient temperature range

-20 to +60 ℃ (-4 to +140 ℉)

Storage temperature

-30 to +70 ℃ (-22 to + 158 ℉)

Climate class

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

Electr. safety

As per IEC 61010-1, UL61010-1 and CAN C22.2 No 1010-1.
- Class II equipment
- Overvoltage category II
- Pollution degree 2
- Overload protection element ≤ 10 A
- Operating altitude: up to 2000 m above MSL

Degree of protection

- Panel mounting: IP65 front panel, IP20 rear panel
- DIN rail: IP20
- Field housing: IP66, NEMA4x (for cable gland with double seal insert: IP65)

Electromagnetic compatibility

As per EN 1434-4, EN 61326 series and NAMUR NE21

10.0.8   Mechanical construction

Design, dimensions
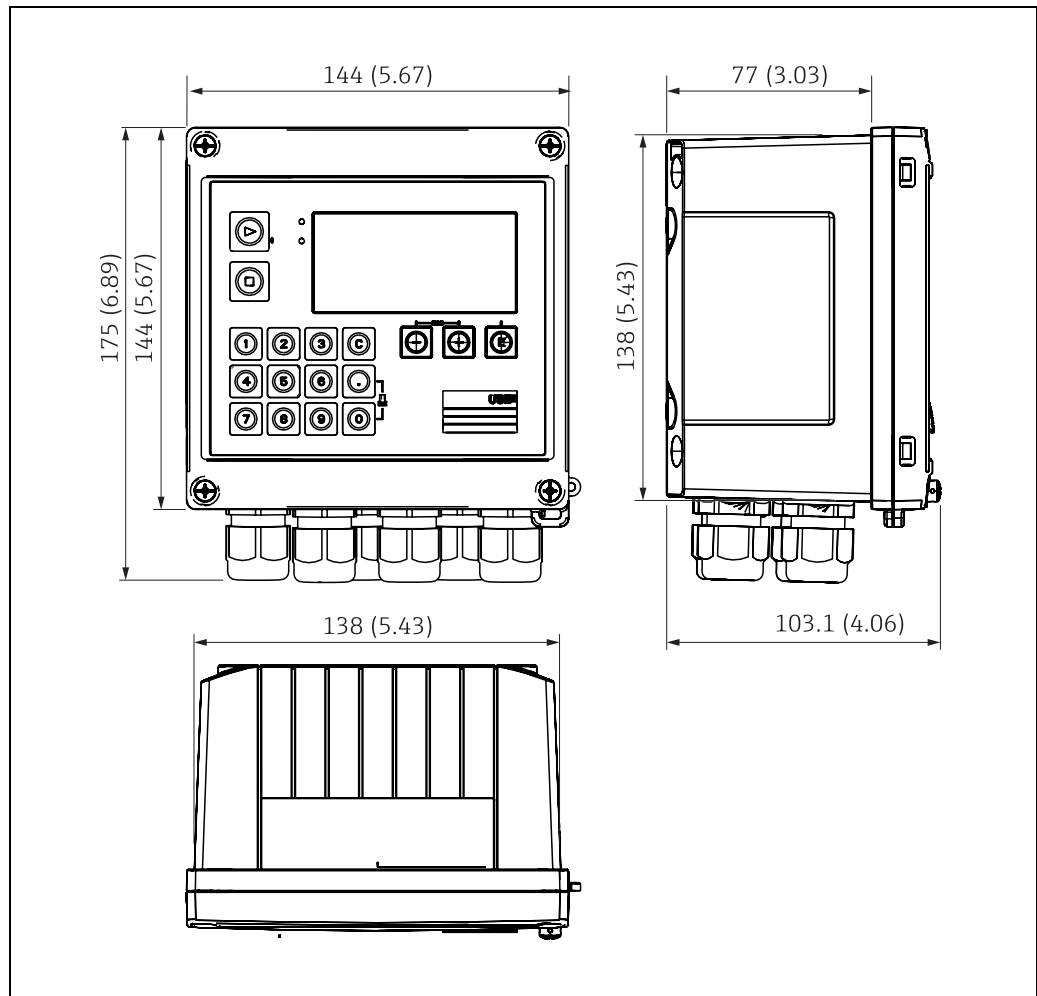
⊡ *38: Dimensions in mm (dimensions in inches in brackets)*

Weight

Approx. 700 g (1.5 lbs)

Materials

Housing: fiber-glass reinforced plastic, Valox 553

Terminals

Spring terminals, 2.5 mm^2 (14 AWG); auxiliary voltage with plug-in screw terminal (AWG 30-12; torque 0.5-0.6 Nm).

10.0.9   Operability

Operating concept

- Display:
  160 x 80 dot matrix LCD with white background, color switches to red in an alarm condition, active display area 70 x 34 mm
- LED status display:

Operation: 1 x green
Fault indication: 1 x red
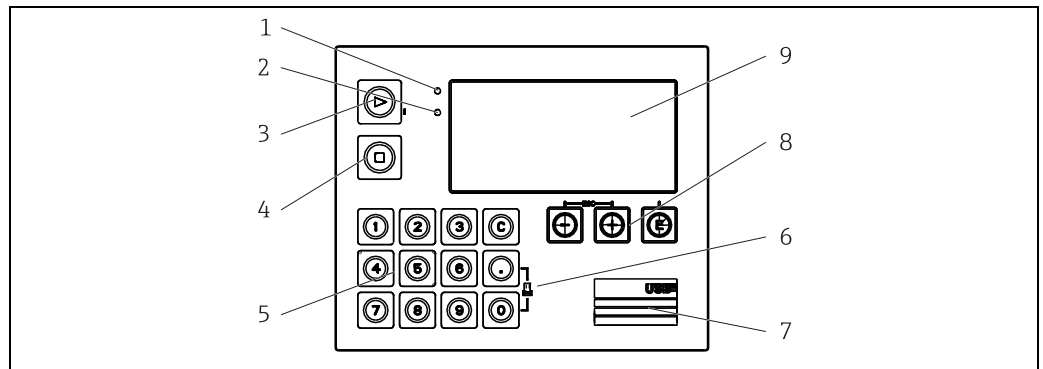
39: Display and operating elements

1   LED green, "Operation"
2   LED red, "Fault indicator"
Function keys:
3   Start batching manually
4   Stop batching manually
5   Numerical keypad
6   Start printing
USB interface
7   USB connection for configuration
Operating keys:
8   -, +, E
Display:
9160   x80 DOT matrix display

Local operation

3 operating keys: "-", "+", "E".
14 function keys:
Start/stop function: Pressing the "Start" button starts a batch run. Press the "Stop" button once to pause the batching operation currently in progress. Press "Stop" a second time to abort the batch. Pressing start again restarts the batch cycle.
C function: Press "C" when batching is stopped to reset the counters on the display to their original values.
Print function: Press "0" and "." simultaneously to print out the last batch cycle. The "RS232 printer interface" feature must be purchased to be able to use this function.

Configuration interface

USB interface, front-panel, optional Ethernet interface: configuration via PC with PC operating software FieldCare Device Setup.

Data logging

Real time clock

▶ Drift: 15 min per year
▶ Power reserve: 1 week

Software

• **Field Data Manager software MS20:** Visualization software and database for analyzing and evaluating the measuring data and calculated values, as well as tamper-proof data logging.

10.0.10 Certificates and approvals

CE mark

The measuring system meets the legal requirements of the EU directives. Endress+Hauser confirms successful testing of the device by affixing to it the CE mark.

Other standards and guidelines

- IEC 60529:
  Degrees of protection provided by enclosures (IP code)
- IEC 61010-1: 2001 cor 2003
  Safety requirements for electrical equipment for measurement, control and laboratory use
- IEC 61326 series:
  Electromagnetic compatibility (EMC requirements)
- NAMUR NE21, NE43
  Association for Standards for Control and Regulation in the Chemical Industry
- ASTM D1250-04 / API MPMS 11.1
  Manual of Petroleum Measurement Standards Chapter 11—Physical Properties Data Section 1.

CSA GP

- CAN/CSA-C22.2 No. 61010-1, 2nd Edition

11   Appendix

11.1   Operating functions and parameters

Direct Access codes are specified for the menu items. In the **Expert** menu, you can jump directly to the respective operating option by entering this code.

11.1.1   Language parameters

German English Español Français Italiano Nederlands Polski Portuguese Russkij ceština	Select the operating language for your device.

11.1.2   Display/operation menu

Selection of the displayed group (measured values), display of signal analyses, etc.

Select recipe		020101	Please select recipe. Only visible if recipe management is activated in Setup/Advanced setup/Application/Batch information.
Preset counter		020100	Please enter preset counter.
Change group			Choose the group which should be displayed. Change automatically between the configured display groups or display one of the 6 display groups (→ 🗎 38)
Display brightness			You can adjust the brightness of the display here. Number: 1-99
Contrast display			You can adjust the contrast of the display here. Number: 20-80
Stored values			Display the analyses stored in the device (→ 🗎 38).
	Display	030000	Choose the data which should 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 using the "Print" option.
	Print		Print the batch report

11.1.3 Setup menu

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

Units		100001-00	Select your unit system (SI or US units). All units are switched to the selected unit system, but configured values are not converted.
Signal type		210000-00	Pulse 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 units of the count input, e.g. gal, cf , ...
Pulse Value		210013-00	Unit for pulse value, e.g. pulse/l or l/pulse
Value		210003-00	Factor which, multiplied by an input impulse, yields the physical value. Example: 1 pulse corresponds to 5 m^3, pulse value 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 beginning of the measuring range here. Example: 0-100 m^3/h of the sensor is transformed 4-20 mA: 0.
Meas. range end		210009-00	Enter the end of the measuring range here, e.g. "100" for a transmitter with 0-100 m^3/h.
Date/time			Show and set date and time.
	UTC time zone	120000-00	Current UTC time zone on (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.
	Change		Change the date and time here.
		UTC time zone	120010-00	
		Date/time	120013-00	
Advanced setup			Additional settings that are not essential for the basic operation of the device.
	System		Basic settings that are needed to operate the device (e.g. date, time, communication settings etc.)
		Access code	100000-00 or 100010-00 (FieldCare)	4-digit number. Using this code, you can protect the setup from unauthorized access. To change parameters, you first have to enter the correct code. Factory setting: "0", i. e. changes are possible at any time. Tip: write down the code and keep it in a place where it is inaccessible to unauthorized persons.
		Device tag	000031-00	Individual name of the device (max. 17 characters).
		Decimal separator	100003-00	Select in which form the decimal separator character is to be displayed
		Units	100001-00	Select your 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. Option: not used, relay 1/2 or open collector 1/2
		Date/time setting		Date/time set-up
			Date format	110000-00	Select in which format the date is to be set and displayed.
			Time format	110001-00	Select in which format the time is to be set and displayed.
			Date/time		Set date/time
				UTC time zone	120000-00	Current UTC time zone on (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.

		Change UTC time zone Date/time	120010-00 120013-00	Change the date and time here.
	NT/ST changeover			NT/ST changeover
		NT/ST changeover	110002-00	Function of the summer (daylight savings) time/standard time switching. Automatic: switching according to valid guidelines of the selected region; manual: configure switching times in the next items; Off: no time switchover.
		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 in fall on which the switch from summer time to standard time takes place, e.g. for the fourth Sunday in October: select 4.
		Day	110012-00	Day of the week on which the switch 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 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).
	Ethernet			Set-up required, if you are using the Ethernet interface of the unit.
		DHCP	150002-00	The device can obtain its Ethernet settings by DHCP. The settings determined are displayed only after the setup is applied. If the leasing time is configured long enough on the DHCP server, the device always obtains the same IP address. The PC software needs the determined IP address to set up the connection.
		IP address	150006-00	If you have configured DHCP = 'No', enter the IP address for the device here. This IP address is assigned by your network administrator. Please contact him or her. If DHCP = 'Yes', the IP address obtained by DHCP is displayed here.
		Subnetmask	150007-00	If you have configured DHCP = 'No', enter the subnet mask (you receive this from your network administrator). If DHCP = 'Yes', the subnet mask obtained by DHCP is displayed here.
		Gateway	150008-00	If you have configured DHCP = 'No', enter the gateway (you receive this from your network administrator). If DHCP = 'Yes', the gateway obtained by DHCP is displayed here.
		Web server	470000-00	Switch the web server function on or off (=factory setting). The current values can be displayed via Internet browser only if the Web server is active. Possible via the Ethernet interface only!
	Modbus			Configure the Modbus settings for the device. For devices with Modbus (optional) only.
		Device address	480000-00	Enter the device address where it should be possible to reach this device in the bus.
		Baudrate	480001-00	Set the transmission rate for communication.
		Parity	480002-00	Please check that settings are compatible with the PC 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. For this reason, it is important to coordinate the addressing method between the master and slave during commissioning. This can be configured here.
	Reg. 0 to 2			Specify which values can be read out.
		Value	500000-00	Choose the value which should be transmitted.
		Analysis	500001-00	Select which counter (e.g. interval, daily counter etc.) is to be transmitted. Only if a counter has been selected for "Value".
	Reg. 3 to 5			Specify which values can be read out.
		Value	500000-01	Choose the value which should be transmitted.
		Analysis	500001-01	Select which counter (e.g. interval, daily counter etc.) is to be transmitted. Only if a counter has been selected for "Value".
	Reg. 6 to 8			Specify which values can be read out.
		Value	500000-02	Choose the value which should be transmitted.
		Analysis	500001-02	Select which counter (e.g. interval, daily counter etc.) is to be transmitted. Only if a counter has been selected for "Value".
	Reg. 9 to 11			Specify which values can be read out.
		Value	500000-03	Choose the value which should be transmitted.
		Analysis	500001-03	Select which counter (e.g. interval, daily counter etc.) is to be transmitted. Only if a counter has been selected for "Value".
	Reg. 12 to 14			Specify which values can be read out.
		Value	500000-04	Choose the value which should be transmitted.
		Analysis	500001-04	Select which counter (e.g. interval, daily counter etc.) is to be transmitted. Only if a counter has been selected for "Value".
	...		...	...
	Reg. 87 to 89			Specify which values can be read out.
		Value	500000-29	Choose the value which should be transmitted.
		Analysis	500001-29	Select which counter (e.g. interval, daily counter etc.) is to be transmitted. Only if a counter has been selected for "Value".
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 signal type connected. 4 to 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: Pulse 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.
		Channel ident.	210001-00	Name of the measuring point connected to this input. Customized text, 6 characters.
		Kind	210014-00	Flow type of the input signal (volume or mass flow).
		Pulse input	210002-00	Define whether the pulse input is a fast (up to 12.5 kHz) or slow (up to 25 Hz) pulse input. Only if Pulse has been selected as the signal type.

	Pulse Value	210003-00	Pulse factor = factor which, multiplied by an input impulse, yields the physical value. Example: 1 pulse corresponds to 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 displayed for selection are adapted to the setting in the "Kind" parameter.	
	Unit	210004-00	Specify the technical (physical) unit for the measuring point connected to this input. The units displayed for selection are adapted to the setting in the "Kind" parameter.	
	Decimal point	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. m^3, kg, etc. The units displayed for selection are adapted to the setting in the "Kind" parameter.	
	Decimal point	210007-00	Number of digits after the decimal point for the counter.	
	Range start		Transmitters convert the physical measured variable into standardized signals. Enter the beginning of the measuring range here. Example: 0-100 m^3/h of the sensor is transformed 4-20 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 0-100 m^3/h. Decimal number, max. 8 digits including decimal separator. Only for 0/4-20 mA.	
	Low flow cut off		If the measured volume flow is below a configured value, these quantities are not added to the counter. If the input is scaled from 0 to y or the pulse input is used, all values less than the configured value are not recorded. If the input is scaled from -x to +y, all values around the zero point (i.e. including 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 signal type connected or set the "Default value".	
	Connection	220001-00	Configure whether RTD is to be connected with 3 or 4 wires. Only for signal type Pt100, Pt500 or Pt1000.	
	Channel ident.	220002-00	Name of the measuring point connected to this input. User-defined text, max. 6 characters.	
	Unit	220003-00	Specify the technical (physical) unit for the measuring point connected to this input.	
	Decimal point	220004-00	Number of places after decimal point for the display.	
	Range	220005-00	Set the desired measuring range. Only for Pt100, Pt500, Pt1000 or Platinum RTD(CvD). A small measuring range increases the accuracy of temperature measurement. Only for Pt100.	
	Range start	220006-00	Transmitters convert the physical measured variable into standardized signals. Enter the beginning of the measuring range here. Only for 0/4 to 20 mA. Decimal number, max. 8 digits including decimal separator.	
	Meas. range end	220007-00	Enter the end of the measuring range here. Only for 0/4 to 20 mA. Decimal number, max. 8 digits including decimal separator.	
	Default value	220009-00	Specify a fixed temperature value with which the device should perform calculations. Only for signal type = default value.	
Density			Settings for the density input	
	Signal type	220000-01	Select the signal type for the density input or set the "Default value".	
	Channel ident.	220002-01	Identifier for the density input. Customized text, 6 characters.	
	Unit	220003-01	Select the density unit.	

	Decimal point	220004-01	Select the number of decimal points that are used for the density input.
	Range start	220006-01	Configure what value corresponds to 0/4 mA. Numerical value, max. 8 digits including decimal separator.
	Meas. range end	220007-01	Configure what value corresponds to 20 mA. Numerical value, max. 8 digits including decimal separator.
	Default value	220009-01	Specify a fixed density value with which the device should perform calculations. Only for signal type = default value.
Digital 1/2			Setting up only required if the digital inputs (e.g. events) are to be used.
	Function	250000-00 250000-01	Select the required function, → 🖹 35. Digital inputs are High active, i.e. the described effect takes place when activated with High. Low = -3 to +5 V High = +12 to +30 V
Outputs			Settings only needed if outputs (e.g. relay or analog outputs) should be used.
Universal output			Settings for the universal output (current or pulse output).
	Signal type	310000-00	Select the output signal for this channel.
	Channel/value	310001-00	Select which channel or calculated value is to be output at the output.
	Start Value	310003-00	Configure what value corresponds to 0/4 mA. Numerical value, max. 8 digits including decimal separator.
	Full scale value	310004-00	Configure what value corresponds to 20 mA. Numerical value, max. 8 digits including decimal separator.
	Damping	310005-00	Time constant of the first order low pass for the output signal. This is used to prevent large fluctuations in the output signal (can only be selected for the signal type 0/4 to 20 mA). 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 move away from the 20 mA value. Only for the setting "Channel/value =Curve".
	Pulse Value	310006-00	The pulse value specifies what quantity an output pulse corresponds to (e.g. 1 pulse = 5 liters). Numerical value, max. 8 digits including decimal separator.
	Pulse width	310007-00	The pulse width limits the max. possible output frequency of the pulse output. Define a fixed or dynamic pulse width.
	Pulse width	310008-00	You can set the pulse width in the range from 0.04 to 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).
	Op. Mode	320001-00 320001-01	Function of the relay: • NC contact: in the quiescent state, the relay is closed (maximum safety). • NO contact: the relay is open in quiescent state.
	Channel/value	320002-00 320002-01	Select which channel/value is to be output at the output. Only for function = pulse output.
	Pulse Value	320004-00 320004-01	The pulse value specifies which quantity an output pulse corresponds to (e.g. 1 pulse = 5 liters).
	Pulse width	320005-00 320005-01	The pulse width limits the max. possible output frequency of the pulse output. Define a fixed or dynamic pulse width.

		Pulse width	320006-00 320006-01	You can set the pulse width in the range from 0.5 to 1000 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
		Op. Mode	330000-00	Function of the relay: • NC contact: in the quiescent state, the relay is closed (maximum safety). • NO contact: the relay is open in quiescent state.
Application				Configure various application-specific settings (e.g. group settings, etc.).
	Batch settings			
		Batch active	400010-00	Specifies whether a status signal should be issued at an output when a batching operation is active
		Batch mode	510000-00	There are three batching modes available. • Batching runs to the end of the preset counter in standard mode. • Automatic restart: In this mode, a sequence is started by the start command and repeats batching until it ends. • A preset counter is not required in manual mode; batching is started and ended locally or via control input.
		Restart delay	510001-00	This time specifies the interval between a completed batch and an automatically restarted one 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 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, smaller flow.
		Switches fill phase 1	510004-00	Specifies the output with which the main filling stage is controlled.
		Switches fill phase 2	510005-00	Specifies which output is used for the filling stage with the additional, larger flow rate.
		Delay phase 2	510006-00	The delay specifies the interval before the second valve with the larger flow rate is switched.
		Pre-stop fill phase 2	510008-00	The advance stop specifies what the remaining quantity is when filling stage 2 is ended and accurate dosing starts.
		Fixed after-run correction	510009-00	Fixed after-run correction is used to compensate for longer valve closing times and response times in order to achieve more accurate batching results. It can also be used when initially teaching the device (even if the automatic after-run correction function is activated) to ensure that the after-run quantity is kept to a minimum.
		Automatic after-run correction	510010-00	Automatic after-run correction works in addition to fixed after-run correction and automatically corrects the accuracy to compensate for possible system changes brought about, e.g., by valve aging.
		Max. preset counter	510012-00	Defines the maximum preset counter value that can be entered in order to prevent the entry of incorrect, high 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 thus be preset for various batches and selected during operation without setup access.
		Number	510101-00	Enter the number of required, preconfigurable recipes here. Possible values: 1-30
		Batch name	510105-00	Use this option to enter the batch identifier which will then be stored in the batch report.
		Batch no. start value	510110-00	Use this option to enter the start value of the current batch number.
		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	Use this option to enter the batch identifier which will then 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 after-run correction	510109-00 ...-29	Fixed after-run correction is used to compensate for longer valve closing times and response times in order to achieve more accurate batching results. It can also be used when initially teaching the device (even if the automatic after-run correction function is activated) to ensure that the after-run quantity is kept to a minimum.
	Compensation			This menu contains all of the settings for correcting the volume or converting to mass using additional measured variables.
		Compensation	530000-00	Activate this option to correct the flow volume or to calculate the mass (only if Inputs/Flow/Kind = "Volume flow"). A density or temperature sensor is required for the compensation. When using a temperature sensor, the density is calculated on the basis of the reference condition and reference density.
		Product group	530001-00	Use this option to select your product group. The user-defined option allows the correction of any medium using density or temperature measurement or the calculation of the mass using a density sensor. The mineral oil options initiate volume correction based on temperature and another, optional density sensor.
		The result is	530008-00	Select "Corrected volume" here to perform volume correction. Select "Mass" here to convert the measured volume into mass. The mass unit is set in the parameter "Mass unit". Only visible if Inputs/Flow/Kind = "Volume flow".
		Mass unit	530009-00	Use this option to specify the required mass unit, into which the volume should be converted. The counter value then appears on the display and in the analyses in this mass unit. The preset counter must also be entered in this unit. Only visible if Inputs/Flow/Kind = "Volume flow" and The result is = "Mass".
		Volume unit	530009-00	Use this option to specify the required unit for the calculated volume. The counter value then appears on the display and in the analyses in this unit. The preset counter must be entered in this unit. Only visible if Inputs/Flow/Kind = "Mass flow".
		Density unit	530002-00	Use this option to select your preferred density unit, in which the subsequent values must be entered.
		Operating density	530003-00	Select "measured" if you wish to use a density sensor for measurement. If you calculate the density internally, you only require a temperature sensor and can select "calculated".
		Reference condition	530004-00	Use this option to select the required reference operating condition for volume correction.
		Reference density	530005-00	Use this option to enter the density of the medium under the reference operating conditions selected previously.
		Pressure unit	530007-00	Use this option to select your preferred pressure unit, in which the 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. It is sufficient to enter a relative pressure value of 0 to switch off compensation based on the pressure value.
		Expansion coeff. unit	530011-00	
		Expansion coeff.	530010-00	The thermal expansion coefficient describes the expansion of a medium at 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	Use this option to activate printing. You can also choose whether printing can be initiated manually on-site, or whether a printout should also take place at the end of every batch.
		Baudrate	510214-00	Set the transmission rate for communication.
		Number of copies	510201-00	Use this option to set the required number (0-5) of automatic printouts.
		Characters/line	510212-00	Use this option to specify the maximum number of characters per line.
		Number of headers	510202-00	Use this option to specify the number (0-5) of required lines for user-defined text at the beginning of the batch report.
		Header x	510203-00 ...06-00	Use this option to enter the user-defined text for printing on the batch report.
		Number of footers	510207-00	Use this option to enter the number of lines for user-defined text at the end of the batch report.
		Footer x	510208-00 ...11-00	Use this option to enter the user-defined text for printing on the batch report.

		Blank rows at end	510215-00		Use this option to enter the number of blank rows required at the end of the report to allow sufficient space for tearing off.
		Print direction	510213-00		Use this option to select the print direction based on the properties of the printer you are using (starting from the first line or starting from the last line).
		Test print	510216-00		Use this option to start printing in order to check your settings.
	Display groups				Put the inputs/calculated values into groups such that you can call up the information you need at the touch of a button during operation.
		Group 1-6			Various general settings for displaying the device measured value.
			Identifier	460000-00 ...-05	Enter a name for these groups.
			Value 1	460001-00 ...-05	Select which input/which calculated variable in this group is to be displayed.
			Display	460002-00 ...-05	Please select what data from the selected channel should be displayed.
			Value 2	460003-00 ...-05	Select which input/which calculated variable in this group is to be displayed.
			Display	460004-00 ...-05	Please select what data from the selected channel should be displayed.
			Value 3	460005-00 ...-05	Select which input/which calculated variable in this group is to be displayed.
			Display	460006-00 ...-05	Please select what data from the selected channel should be displayed.

11.1.4 Diagnostics menu

Actual diagnos.	050000-00	Displays the current diagnosis message.
Last diagnostics	050005-00	Displays the last diagnosis message.
Last restart	050010-00	Information as to when the device was last restarted (e.g. due to a power failure).
Diagnosis list		All pending diagnosis messages are output.
Event logbook		Events such as alarm set point infringement and power failure are listed in the correct time sequence.
Device information		Displays important device information.
Device tag	000031-00	Individual device tag name/unit identifier (max. 17 characters).
Serial Number	000027-00	Please send these details with any questions about the device.
Order Code	000029-00	Please send these details with any questions about the device.
Order Identifier	000030-00	Please send these details with any questions about the device.
Firmware Version	000026-00	Please send these details with any questions about the device.
ENP version	000032-00	Please send these details with any questions about the device.
ENP device name	000020-00	Please send these details with any questions about the device.
Device name	000021-00	Please send these details with any questions about the device.
Manufacturer ID	000022-00	Please send these details with any questions about the device.
Manufacturer name	000023-00	Please send these details with any questions about the device.
Firmware	009998-00	Please send these details with any questions about the device.
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		Set-up required, if you are using the Ethernet interface of the unit. Only for devices with Ethernet interface.
Firmware Version	010026-00	Firmware version of Ethernet card. Please send these details with any questions about the device.
Serial Number	010027-00	Serial number of Ethernet card. Please send these details with any questions about the device.
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.
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 the 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. During simulation operation, normal measured value recording is interrupted and the intervention is logged in the event logbook.
Universal output	050200-00	Choose the value which should be output. Select "Switched off" to exit the simulation. The simulation is exited automatically after 5 minutes.
Open Collector 1/2	050205-00 050210-00	Select the frequency which should be output. Select "Switched off" to exit the simulation. The simulation is exited automatically after 5 minutes.

Relay 1/2		050215-00 050220-00	Manual activation of the selected relay. The simulation is exited automatically after 5 minutes.

11.1.5 Expert menu

In the Expert menu, all parameters and settings of the device can be changed.
The menu contains all parameters / settings from the Setup menu in addition to those described below.

Direct Access				Direct access to parameters (rapid access).
Service code			010002-00	Please enter service code to make service parameter visible. For PC operating software only.
System				Basic settings that are needed to operate the device (e.g. date, time, communication settings etc.)
	Language		010000-00	Select unit operating language.
	PRESET		000044-00	Resets all 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			Set-up required, if you are using the Ethernet interface of the unit.
		MAC-Address	150000-00	MAC-Address
		Port	150001-00	Communication with the PC software takes place via this communication port. If your network is protected by a firewall, you may need to enable the port. In this case, contact your network administrator.
	Device options			Hardware and software options of the device.
		Activation code	000057-00	You can enter a code for activating the device options here.
Inputs				Settings for the analog and digital inputs.
	Flow			
		Damping	210010-00	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.
		Meas.val. corrct.		Determines the correction values used to compensate for measurement section tolerances. Proceed as follows: 1. Measure the current measured value at the lower measuring range. 2. Measure the current measured value at the upper measuring range. 3. Enter the upper and lower target value and actual value.
			Range start	Lower correction value.
			Target value	210051-00	Enter the setpoint at the start of the measuring range here (e.g. measuring range 0l/h to 100l/h: 0l/h).
			Actual value	210052-00	Enter the actual measured value here (e.g. measuring range 0l/h to 100l/h: 0.1l/h).
			Meas. range end	Upper correction value.
			Target value	210054-00	Enter the target value at the end of the measuring range here (e.g. measuring range 0l/h to 100l/h: 100 l/h).
			Actual value	210055-00	Enter the actual measured value here (e.g. measuring range 0l/h to 100l/h: 99.9l/h).
		Fault mode		Settings that define how this channel is to react under fault conditions (e.g. cable open circuit, over range).
			NAMUR NE 43	210060-00	Switch on/off monitoring of the 4 to 20 mA range as per NAMUR Recommendation NE 43. The following fault ranges apply when NAMUR NE43 is enabled: ■ ≤ 3.8 mA: Under range ■ ≥ 20.5 mA: Over range ■ ≤ 3.6 mA or ≥ 21.0 mA: Sensor error ■ ≤ 2mA: Open circuit
			On error	210061-00	Configure what value the device should continue working with (for calculations) if the measured value is not valid (e.g. cable open circuit).

		Error value	210062-00	Only if the setting "Error value" has been selected under "On error". The device continues calculating with this value in the event of an error. The calculated values are recorded in the deficit counter. The normal counter remains unchanged (does not run).
	Temperature			Settings for the temperature input.
		Damping	220008-00	Factory setting: 0.0 s. The more unwanted interference is superimposed over the measuring signal, the higher the value should be set. Result: Fast changes are dampened/suppressed. Decimal number, max. 5 digits incl. decimal separator.
		Meas.val. corrct.		Determines the correction values used to compensate for measurement section tolerances. Proceed as follows: 1. Measure the current measured value at the lower measuring range. 2. Measure the current measured value at the upper measuring range. 3. Enter the upper and lower target value and actual value.
			Offset	220050-00	Factory setting is "0". The configured value is added to the real measured input signal for further use (display, storage, limit value monitoring). Only for RTD. Decimal number, max. 8 digits including decimal separator.
			Range start		Lower correction value
			Target value	220052-00	Enter the setpoint at the start of the measuring range here (e.g. measuring range 0 ℃ to 100 ℃: 0 ℃). Only for 0/4 to 20 mA. Decimal number, max. 8 digits including decimal separator.
			Actual value	220053-00	Enter the lower value actually measured here (e.g. measuring range 0 ℃ to 100 ℃: measured value 0.5 ℃). Only for 0/4 to 20 mA. Decimal number, max. 8 digits including decimal separator.
			Meas. range end		Upper correction value Only for 0/4 to 20 mA.
			Target value	220055-00	Enter the target value at the end of the measuring range here (e.g. measuring range 0 ℃ to 100 ℃: 100 ℃). Only for 0/4 to 20 mA. Decimal number, max. 8 digits including decimal separator.
			Actual value	220056-00	Enter the upper value actually measured here (e.g. measuring range 0 ℃ to 100 ℃: measured value 99.5 ℃). Only for 0/4 to 20 mA. 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	220060-00	Switch on/off monitoring of the 4 to 20 mA range as per NAMUR Recommendation NE 43. The following fault ranges apply when NAMUR NE43 is enabled: • ≤ 3.8 mA: Under range • ≥ 20.5 mA: Over range • ≤ 3.6 mA or ≥ 21.0 mA: Sensor error • ≤ 2mA: Open circuit
			On error	220061-00	Configure what value the device should continue working with (for calculations) if the measured value is not valid (e.g. cable open circuit).
			Error value	220062-00	Only if the setting "Error value" has been selected under "On error". The device continues calculating with this value in the event of an error. The calculated values are recorded in the deficit counter. The normal counter remains unchanged (does not run).
	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.		Determines the correction values used to compensate for measurement section tolerances. Proceed as follows: 1. Measure the current measured value at the lower measuring range. 2. Measure the current measured value at the upper measuring range. 3. Enter the upper and lower target value and actual value.
			Range start		Lower correction value
			Target value	220052-01	Enter the lower setpoint here. Decimal number, max. 8 digits including decimal separator.

		Actual value	220053-01	Enter the lower value actually measured here. Decimal number, max. 8 digits including decimal separator.	
		Meas. range end		Upper correction value	
		Target value	220055-01	Enter the upper setpoint here. Decimal number, max. 8 digits including decimal separator.	
		Actual value	220056-01	Enter the upper value actually measured here. Decimal number, max. 8 digits including decimal separator.	
	Fault mode			Settings that define how this channel is to react under fault conditions (e.g. cable open circuit, over range).	
		NAMUR NE 43	220060-01	Switch on/off monitoring of the 4 to 20 mA range as per NAMUR Recommendation NE 43. The following fault ranges apply when NAMUR NE43 is enabled: • ≤ 3.8 mA: Under range • ≥ 20.5 mA: Over range • ≤ 3.6 mA or ≥ 21.0 mA: Sensor error • ≤ 2mA: Open circuit	
		On error	220061-01	Configure what value the device should continue working with (for calculations) if the measured value is not valid (e.g. cable open circuit).	
		Error value	220062-01	Only if the setting "Error value" has been selected under "On error". The device continues calculating with this value in the event of an error. The calculated values are recorded in the deficit counter. The normal counter remains unchanged (does not run).	
Outputs				Settings only needed if outputs (e.g. relay or analog outputs) should be used.	
	Universal output			Settings for the universal output (current or pulse output).	
		Failure current	310009-00	Set the current to be output in the event of an error (e.g. cable open circuit at the input). Numerical value, max. 8 digits including decimal separator.	
		Meas.val. corrct.		Here, you can correct the output current value (necessary only if the device that carries out the further processing cannot compensate for any measurement section tolerances). Proceed as follows: 1. On the connected device, read out the displayed value in both the upper and lower measuring range. 2. Enter the upper and lower target value and actual value.	
			Start Value		Lower correction value.
			Target value	310051-00	Enter the lower setpoint here.
			Actual value	310052-00	Here, enter the lower actual value which is displayed at the connected device.
			Full scale value		Upper correction value
			Target value	310054-00	Enter the upper setpoint here.
			Actual value	310055-00	Here, enter the upper actual value which is displayed at the connected device.
Application				Configure 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 system must wait once a valve has closed so as to steady the system and therefore increase accuracy. This time must first elapse before a new batch can be started.	
		Timeout "No 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 fail response	510016	The "Power fail 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.	
Diagnostics				Device information and service functions for swift device check.	
	ENP device name		000020-00	Please send these details with any questions about the device.	
	Device name		000021-00	Please send these details with any questions about the device.	
	Serial Number		000027-00	Please send these details with any questions about the device.	

Order Code	000029-00	Please send these details with any questions about the device.
Order Identifier	000030-00	Please send these details with any questions about the device.

11.2   Icons

Symbol	Description
🔒	Device locked
F	Error For example, error in a channel not displayed in the current group.
M	Maintenance required. For example, maintenance required in a channel not displayed in the current group.
⇄	External communication, e.g. fieldbus
SIM	Simulation
▼	Lower limit value
▲	Upper limit value
^	Counter overflow
▶	Batch active
■	No batch active
‖	Pause in batching
↻	Batching in automatic restart mode
Name of the 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
ρ	Density
ρ ref	Reference density
ΣM	Mass counter, total
ΣM (i)	Mass counter, current batch
ΣV	Volume counter, total
ΣV (i)	Volume counter, current batch
Σx	Deficit counter
T	Temperature
VCF	Volume correction factor

11.3   Units used in the device

Parameter	Units	
Mass flow	kg/s kg/min kg/h t/s t/min t/h	lb/s lb/min lb/h ton/s ton/min ton/h
Density	kg/m^3	lb/ft^3
Mass counter	kg t	lb klb ton
Flow	l/s l/min l/h m^3/s m^3/min m^3/h	ft^3/s ft^3/min ft^3/h gal/s gal/min gal/h igal/s igal/min igal/h bbl/s bbl/min bbl/h
Flow counter	l m^3	ft^3 gal kgal Mgal igal bbl gal*1000 gal*10000
Temperature	°C K	°F
Pressure	bar (a) bar (g) MPa (a) MPa (g)	psi (a) psi (g) inH2O (a) inH2O (g)

11.4 Definition of important system units

Volume	
bbl	1 barrel, corresponds to 115.6271 liters
gal	1 US gallon, corresponds to 3.7854 liters
igal	Imperial gallon, corresponds to 4.5609 liters
l	1 liter = 1 dm^3
m^3	corresponds to 1000 liters
ft^3	corresponds to 28.37 liters
Temperature	
	Conversion: • 0 °C = 273.15 K • °C = (°F - 32)/1.8
Pressure	
	Conversion: 1 bar = 100 kPa = 100000 Pa = 0.001 mbar = 14.504 psi
Mass	
ton (US)	1 US ton, corresponds to 2000 lbs (= 907.2 kg)
ton (long)	1 long ton, corresponds to 2240 lbs (= 1016 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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