Technical Information

RA33

Batch controller
For the batching and dosing of mass and volume

Highlights

- Swift commissioning and easy operation with plain-text display in selectable language
- Valve control for single-stage and two-stage batching
- Automatic after-run correction for constant, extremely accurate results
- Temperature/density compensation as per ASTM D1250–04

Application

- Recording and controlling of batch operations

Typical applications include:
- Food industry
- Chemical industry
- Pharmaceutical industry
- Oil & gas industry

Your benefits

- Standard models are suitable for connecting and supplying all common flow transmitters, temperature sensors and density sensors
- Detailed logging of batch reports and error messages
- Advanced error diagnostics for leakage, fill deviation and "no flow"
- Industry-compliant compact housing for field or wall mounting, panel mounting or top–hat rail mounting
- Remote control option to start and abort batch runs
- Daily, monthly and annual statistics on the batch run size and quantity

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Function and system design

Measuring principle

The Batch Controller RA33 is designed to record flow and control output signals for valves and pumps to ensure the exact dosing of predefined batch quantities. The calculation is based on measuring the current rate of flow and then totalizing or recording the quantity using pulses. The measured volume can be corrected with the temperature/density compensation function. Here, mineral oils can be corrected according to the ASTM D1250-04 standard. The volumes of other media can be corrected using expansion coefficients, or the volume can be converted to mass by measuring the density.
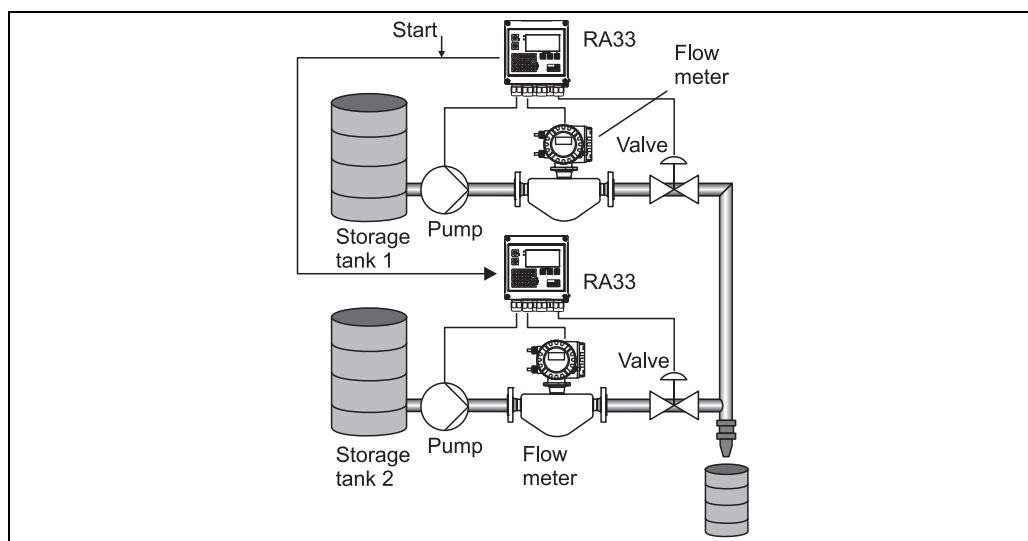
Measuring system
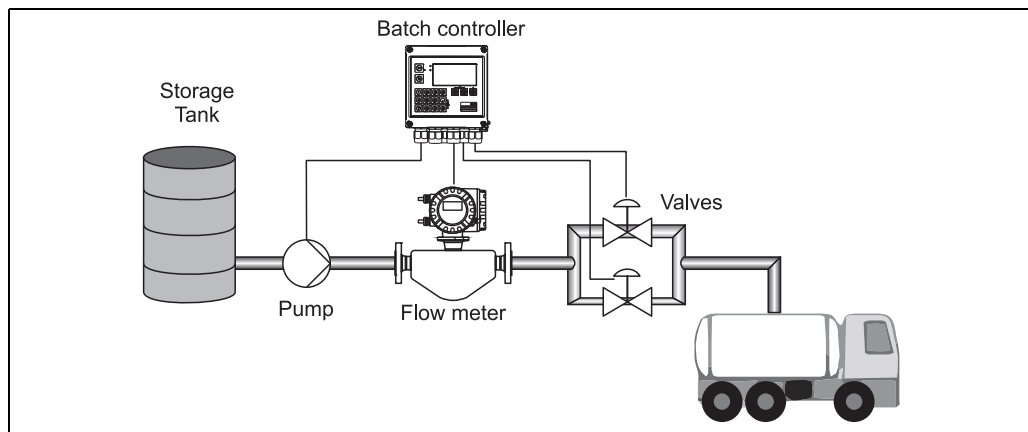
Application: Batch Controller RA33 with 2-stage batching to fill a tank truck
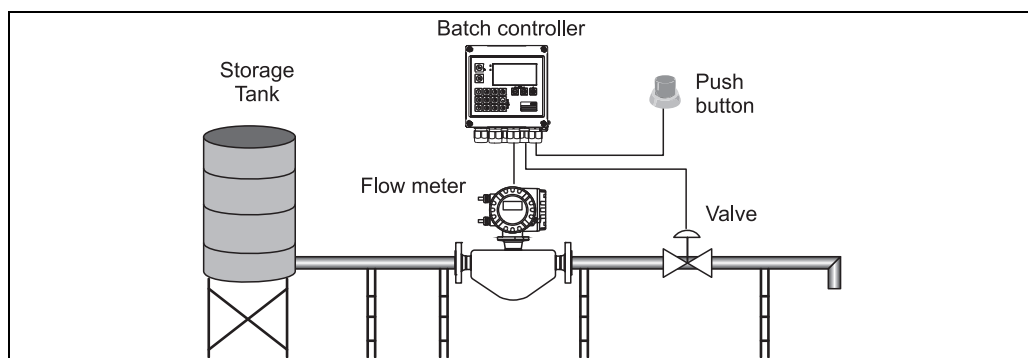
Application: manual batching without a pump with the Batch Controller RA33

Application: blending of 2 liquids when batching with the Batch Controller RA33

Functions	**Batch control**

The function of the Batch Controller RA33 is to control valves and pumps using the measured rate of flow and to fill a precise volume of the medium into a container.
Three different batch modes are available to perform this task:

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

After-run correction

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

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

Outputs (optional)

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

Temperature/density compensation (optional)

The temperature/density compensation enables compensation for various kinds of media.
Compensation via temperature measurement, or temperature and density measurement, can be selected for mineral oils. The values measured are then converted to a compensated volume at 15°C, 20°C or 60°F using the ASTM D1250-04 standard.
The compensation of user-defined media is a second possibility. A volume can be corrected by measuring the temperature and applying an expansion coefficient, or by measuring the density. Volume can also be converted to mass with a density measurement. The preset counter can also be set for this mass unit.

Data logging/logbook

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

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

Batch error messages

In addition to classic sensor errors and device faults, additional batch-specific error types are saved in the device for advanced diagnostics.

- No flow: The "No flow" error is triggered if no flow is detected during an active batch run.
- Fill deviation: The "Fill deviation" error is triggered if the volume of medium actually batched is above or below the limit configured in the setup.
- Leakage: When batching is not active, any detected flow is considered an error and a possible leak.

Communication / printer interface (optional)

Ethernet and Modbus interfaces for communication, as well as an RS232 printer interface for printing, are optionally available for the Batch Controller RA33.
A commercially available serial ASCII printer can be connected via the RS232 interface to print out batching reports directly from the device.

Real time clock (RTC)

The device has a real time clock that can be synchronized via a free digital input or using the Field Data Manager software.
The real time clock continues running even in case of a power failure, the device documents power on and off; the clock switches either automatically or manually from daylight saving to standard time.

Display

To display measured values, counters and calculated values, 6 groups are available. Each group can be assigned up to 3 values or meter readings as desired.

Analyzing the stored data – Field Data Manager software MS20

Via the Field Data Manager software, the stored measured values, alarms and events, as well as the device configuration, are read out from the device (automatically) so that they are tamper-proof and stored securely in an SQL database. The software offers centralized data management with a variety of visualization functions. Using an integrated system service, analyses and reports can be created, printed and stored fully automatically. Security is provided by the FDA-compliant audit trail of the software and the extensive user management. Simultaneous access and analysis of data from various workstations or users is supported (client-server architecture).

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. Sensors for volume or mass flow measurement can be connected to the Batch Controller.
The input is galvanically isolated (500 V testing voltage towards all other inputs and outputs).

Cycle time

The cycle time is 125 ms.

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 the 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   562 Ω to 1 kΩ
(pull–up at input):
(Not suitable for active input voltages)
Current/pulse input:
Low–level   ≤ 8 mA
High–level   ≥ 13 mA
Loading capacity: Max. 50 mA, max. 2.5 V

Input impedance (load):	50 Ω

Accuracy during frequency measurement:

Basic accuracy:	0.01 % of measured value
Temperature drift:	0.01 % of measured value over entire temperature range

Temperature input current /RTD

These inputs can be used either as current inputs (0/4 to 20 mA) or as 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 °C to 300 °C (–328 to 572 °F)
Pt100_wide:	–200 °C to 600 °C (–328 to 1112 °F)
Pt500:	–200 °C to 300 °C (–328 to 572 °F)
Pt1000:	–200 °C to 300 °C (–328 to 572 °F)
Connection method:	2-, 3- or 4-wire connection
Accuracy:	4-wire:
	0.06% of measuring range
	3-wire:
	0.06% of the measuring range + 0.8 K (1.44 °F))
Temperature drift:	0.01 %/K (0.0056 %/°F) of the 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.

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

Output range:	0/4 to 20 mA + 10 % over range
Load:	0 to 600 Ω (as per IEC 61131-2)
Accuracy:	0.1 % of full scale value
Temperature drift:	0.01 %/K (0.056 %/°F) of the 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

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 inputs 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

✎ Note!
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.	

Terminal assignment

Electrical connection (circuit diagrams)
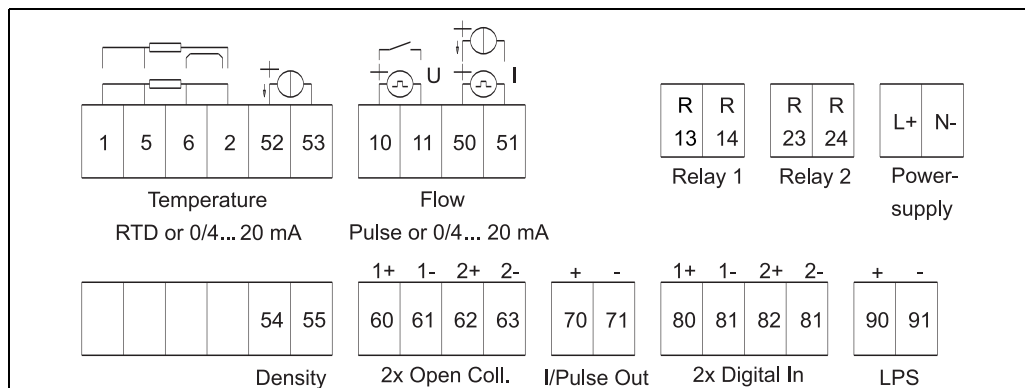
Terminal assignment of RA33.

a0014120

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 unit (rated current ≤ 10 A) is required for the power cable.

Power consumption

15 VA

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.

Performance characteristics

Reference operating conditions	• Power supply 230 V AC ± 10%; 50 Hz ± 0.5 Hz • Warm-up time > 2 h • Ambient temperature 25 °C ± 5 K (77 °F ± 9 °F) • 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.

Installation

Installation instructions	**Mounting location** Wall/pipe mounting, panel or top-hat rail as per IEC 60715[1] **Orientation** The orientation is only determined by the legibility of the display.

Environment

Ambient temperature range	–20 to +60 °C (–4 to +140 °F)
Storage temperature	–30 to +70 °C (–22 to + 158 °F)
Climate class	As per IEC 60 654-1 Class B2, as per EN 1434 ambient class C
Humidity	Maximum relative humidity 80 % for temperatures up to 31 °C (87.8 °F), decreasing linearly to 50 % relative humidity at 40 °C (104 °F).
Electr. safety	As per IEC 61010-1, UL61010-1 and CAN C22.2 No 1010-1. • Protection class II • Overvoltage category II • Pollution degree 2 • Overload protection ≤ 10 A • Operating altitude: up to 2000 m (6560 ft) above MSL

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1) According to UL approval panel or surface mountable only.

Degree of protection	▪ Panel mounting: IP65 front panel, IP20 rear panel (not evaluated by UL) ▪ Top–hat rail: IP20 ▪ Field housing: IP66, NEMA4x (for cable gland with double seal insert: IP65) (not evaluated by UL)
Electromagnetic compatibility	As per EN 1434-4, EN 61326 series and NAMUR NE21

Mechanical construction

Design, dimensions
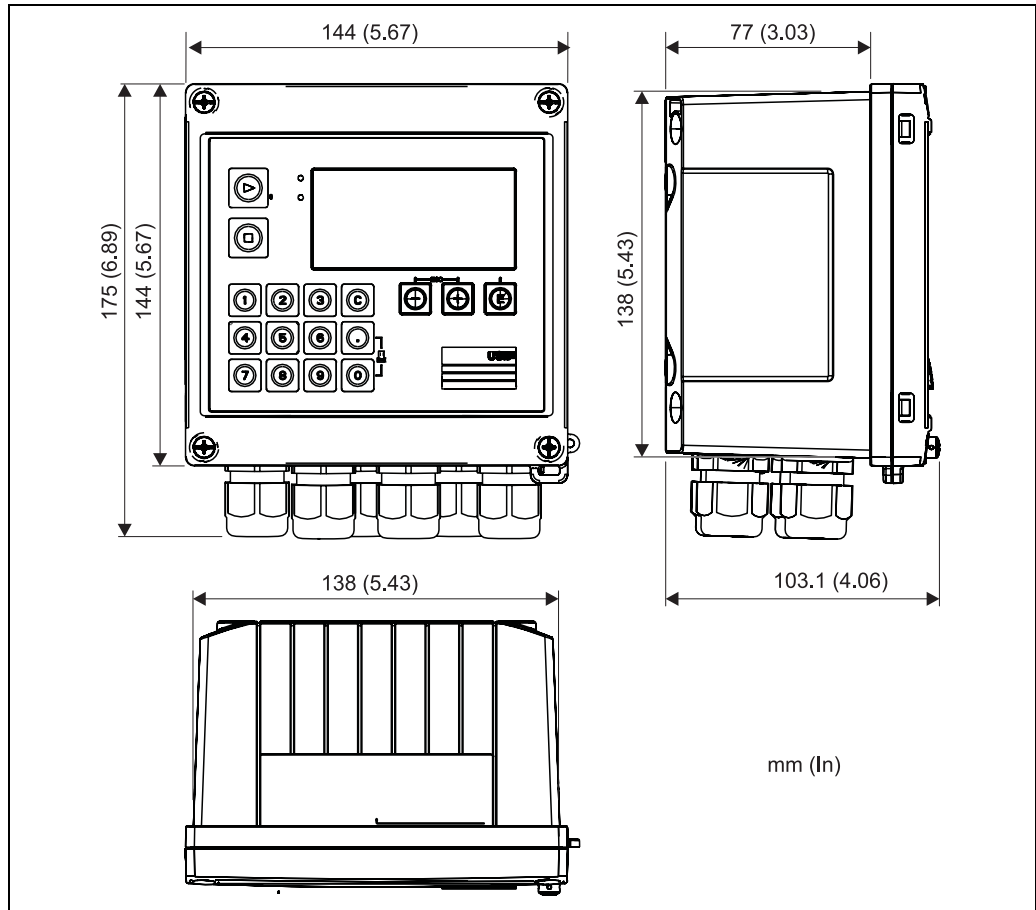
Dimensions of the batch controller
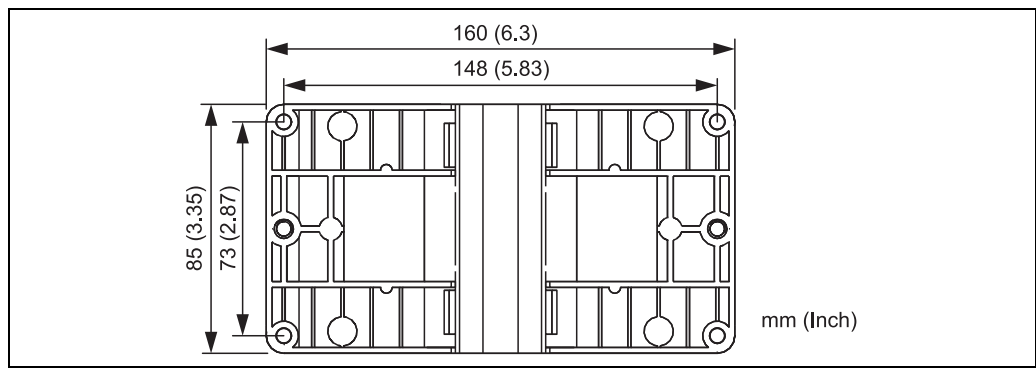
Mounting plate for wall, pipe and panel mounting
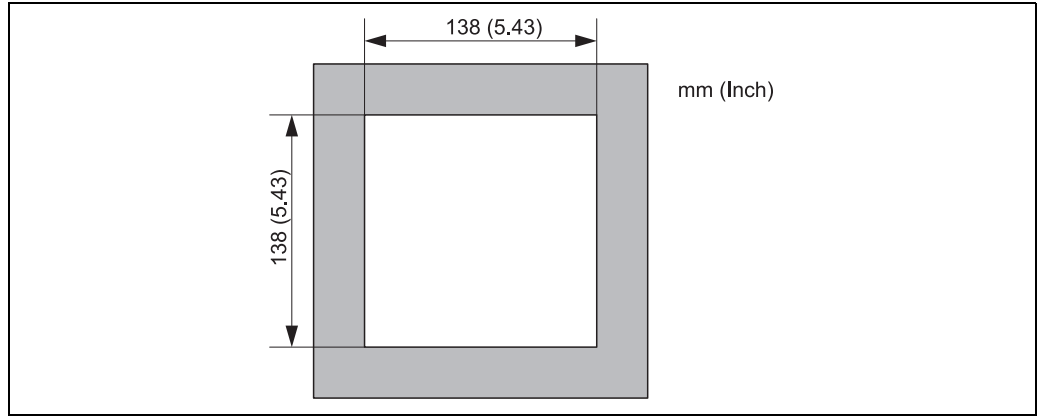
Panel cutout
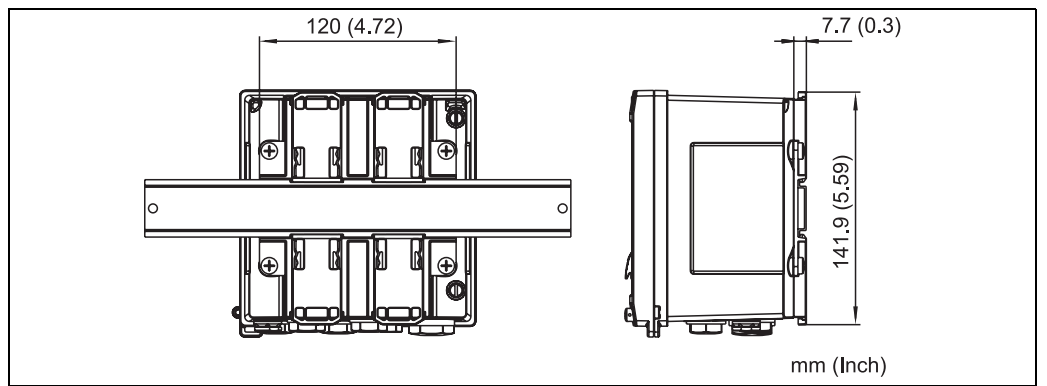
Dimensions of the top hat rail adapter

Weight	Approx. 700 g (1.5 lbs)
Material	Housing: fiber-glass reinforced plastic, Valox 553
Terminals	Spring terminals, 2.5 mm^2 (14 AWG); auxiliary voltage with plug-in screw terminal (30–12 AWG; torque 0.5–0.6 Nm).

Human interface

Display elements

- 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 (2.76 x 1.34 in)
- LED status display:
  Operation: 1 x green
  Fault indication: 1 x red
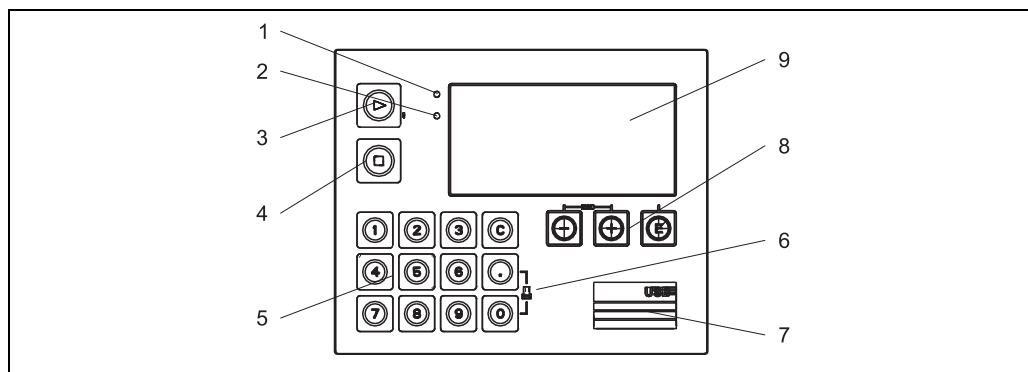
Display and operating elements

1   LED green, "Operation"
2   LED red, "Fault indicator"
Function keys:
3   Start batching manually
4   Stop batching manually
5   Numeric keypad
6   Start printing
USB interface
7   USB connection for configuration
Operating keys:
8   -, +, E
Display:
9   160x80 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 a 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 run. 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 Field-Care 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

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 guide-lines	■ 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-22.2 No. 61010-1, 2nd Edition
UL approval	■ UL 61010-1, 2nd Edition

Ordering information

Product structure

RA33	Batch Controller in compact field housing for batching volumes and masses. Inputs: 1x analog/pulse (flow), 1x RTD/analog (temperature), 1 x analog (density), 2x digital inputs 2x relay outputs (limit / alarm) 3-key operation, PC USB interface, text display in selectable language.

	Approval:	
AA	Non-hazardous area
CP	CSA General Purpose

		Power Supply:	
	1	100-230V (AC: -15%/+10%,50/60 Hz)
	2	24V (DC: -50%/+75%; AC: +/-50%,50/60 Hz)

RA33–			⇐ **Order code** (part 1; 1 feature per category must be selected.)

Additional selection (as option; no selection or multiple selection is possible)

											Operation Language Display:	
										AA	English
										AB	German
										AC	French
										AD	Spanish
										AE	Italian
										AF	Dutch
										AG	Portuguese
										AH	Polish
										AI	Russian
										AR	Czech

Output:	
B1	1x analog/puls (active), 2x open collector

Communication:	
D1	Ethernet TCP/IP, Modbus
D2	Modbus RTU RS485
D4	RS232 Printerconnection

Application Package:	
E5	Density/Temperature compensation + 1x RTD + 1x analog input

Calibration:	
F1	Works calib. certificate 5-point fixed

Service:	
H1	Application specific pre-configured
HY	Special version, TSP-no. to be spec

Additional Approval:	
LU	UL listed
LW	CoC Certificate of Compliance

Accessory Enclosed:	
P1	Pipe mounting kit
P2	DIN rail mounting kit
P3	Panel mounting kit
R1	Cable + configuration software
R2	... Piece, HAW569 surge arrester field housing
R3	..... Piece, HAW562 surge arrester DIN rail

Marking:	
Z1	Tagging (TAG), metal
Z2	Tagging (TAG), on device
Z3	Commissioning label, paper
Z5	Bus address
Z6	Tagging (TAG), by customer
ZA	Tagging (TAG), Descriptor

RA33–		**+**									⇐ **Order code complete**

Accessories

Software and communication
- USB cable and FieldCare Device Setup calibration software incl. DTM library
  – RXU10-G1
- Visualization software and SQL-based database Field Data Manager software MS20

Overvoltage protection

Overvoltage protection for sensors and devices:
HAW562 Surge arrester for top hat rail according to IEC 60715.
HAW569 Surge arrester for field installation.

Documentation

- Operating Instructions 'RA33 Batch Controller' (BA00300K/09)
- Technical Information 'Surge arrester HAW562' (TI01012K/09)
- Technical Information 'Surge arrester HAW569' (TI01013K/09)

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