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Technical Information
Proline Prosonic Flow W 400

Ultrasonic time-of-flight flowmeter



Clamp-on meter with Heartbeat Technology and web server for the water and wastewater industry

Application

- The measuring principle is non-invasive and independent of pressure, density and conductivity
- Bidirectional measurement for water and wastewater as well as process water and hydropower plants

Device properties

- Mounting without process interruption
- Wide nominal diameter range: DN 15 to 4000 (½ to 160")
- Medium temperature up to +130 °C (+266 °F)
- Transmitter housing made of durable polycarbonate or aluminium
- Remote version for wall mounting
- Integrated data logger: measured values monitoring

Your benefits

- Short inlet run thanks to FlowDC
- Low procurement costs - high cost efficiency with increasing nominal pipe diameter (up to DN 4000/160")
- Long-term stable signal – maintenance-free, permanent external mounting by means of coupling pads
- Reliable measurement on numerous pipe materials - transducers available for GRP and plastic pipes
- Safe operation – no need to open the device thanks to display with touch control, background lighting
- Full remote access – web server
- Integrated diagnostics, verification and monitoring – Heartbeat Technology

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People for Process Automation

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About this document

Symbols

Electrical symbols

Symbol	Meaning
	Direct current
	Alternating current
	Direct current and alternating current
	**Ground connection** A grounded terminal which, as far as the operator is concerned, is grounded via a grounding system.
	**Potential equalization connection (PE: protective earth)** Ground terminals that must be connected to ground prior to establishing any other connections. The ground terminals are located on the interior and exterior of the device: ▪ Interior ground terminal: potential equalization is connected to the supply network. ▪ Exterior ground terminal: device is connected to the plant grounding system.

Communication-specific symbols

Symbol	Meaning
	**Wireless Local Area Network (WLAN)** Communication via a wireless, local network.
	Bluetooth Wireless data transmission between devices over a short distance.
	**LED** Light emitting diode is off.
	**LED** Light emitting diode is on.
	**LED** Light emitting diode is flashing.

Symbols for certain types of information

Symbol	Meaning
	**Permitted** Procedures, processes or actions that are permitted.
	**Preferred** Procedures, processes or actions that are preferred.
	**Forbidden** Procedures, processes or actions that are forbidden.
	**Tip** Indicates additional information.
	Reference to documentation
	Reference to page
	Reference to graphic
	Visual inspection

Symbols in graphics

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

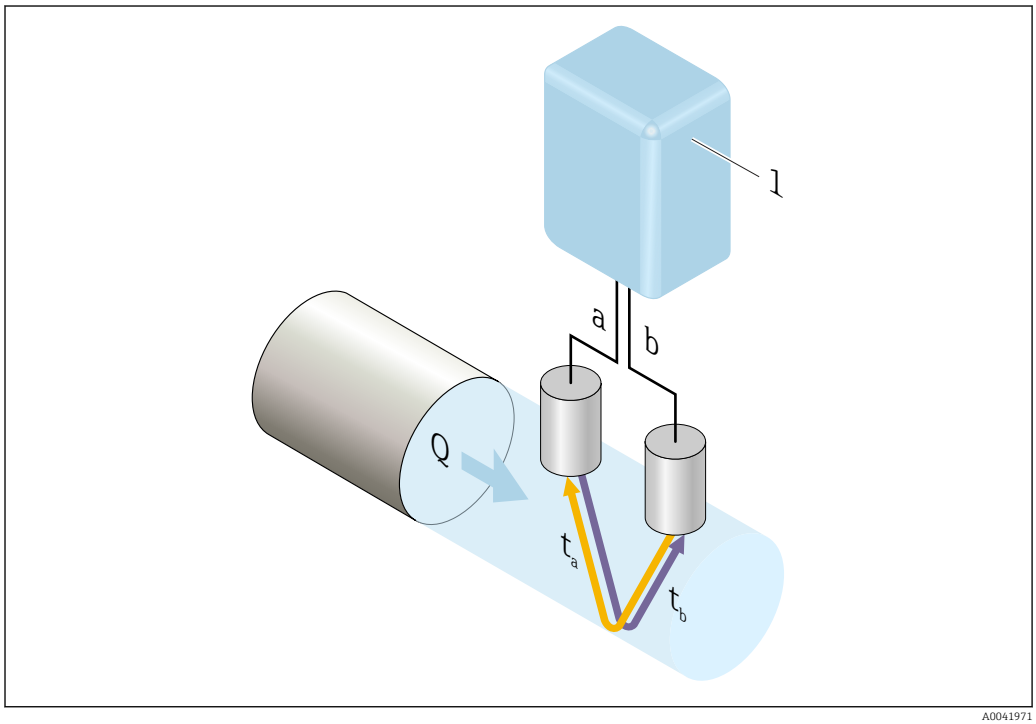
Function and system design

Measuring principle

The measuring system uses a measurement method based on the transit time difference. In this measurement method, acoustic signals (ultrasonic) are transmitted between two sensors. Signal transmission is bidirectional, i.e. the sensor operates as both a sound transmitter and a sound receiver.

As the speed of propagation of the sound waves is slower against the flow direction than in the flow direction, this results in a transit time difference. This transit time difference is directly proportional to the flow velocity.

The measuring system calculates the volume flow of the medium from the measured transit time difference and the pipe cross-sectional area. The sound velocity of the medium is simultaneously measured along with the transit time difference. With this additional measured variable, it is possible to differentiate between different media or monitor the medium quality.



A0041971

1 *Transmitter*
a *Sensor*
b *Sensor*
Q *Volume flow*
Δt *Transit time difference* $\Delta t = t_a - t_b$*; flow velocity* $v \sim \Delta t$

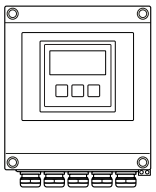
Measuring system

The measuring system consists of a transmitter and one or two sensor sets. The transmitter and sensor sets are mounted in physically separate locations. They are interconnected by sensor cables.

The measuring system uses a measurement method based on the transit time difference. Here, the sensors function as sound generators and sound receivers. Depending on the application and version, the sensors can be arranged for a measurement via 1, 2, 3 or 4 traverses → 🖹 6.

The transmitter serves to control the sensor sets, to prepare, process and evaluate the measuring signals, and to convert the signals to the desired output variable.

Transmitter

Proline 400  A0045222	Device versions and materials: Remote version: wall-mount housing ▪ Polycarbonate plastic ▪ Aluminum, AlSi10Mg, coated Configuration: ▪ External operation via four-line, illuminated local display with touch control and guided menus ("Make-it-run" wizards) for applications ▪ Via operating tools (e.g. FieldCare) ▪ Via Web browser (e.g. Microsoft Internet Explorer)

Sensor cables

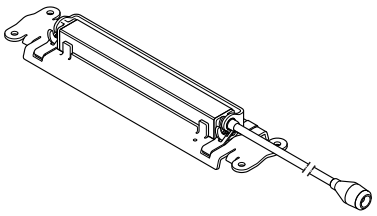
Sensor cables can be ordered in different lengths → 🖹 62

- Length: max. 30 m (90 ft)
- Cable with a common shield and individual shielded cores

Sensor

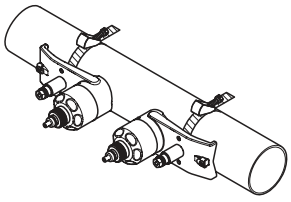
Prosonic Flow W

DN 15 to 65 (½ to 2½")



A0011484

DN 50 to 4000 (2 to 160")



A0013475

1 *Example: 1 sensor set with 2 traverses*

- Measurement of:
  - Pure liquids or slightly contaminated liquids
  - Water, e.g. drinking water, industrial water, saltwater, de-ionized water and cooling and heating water
- Nominal diameter range: DN 15 to 4000 (½ to 160")
- Materials:
  - Sensor holder: Stainless steel 1.4404 (316L)
  - Sensor housing: Stainless steel 1.4404 (316L)
  - Strapping band/bracket: Stainless steel 1.4404 (316L)
  - Sensor contact surface: Chemically stable plastic

Accessories for mounting

The required distances must be determined for the sensors. Information about the medium, the pipe material used and the exact pipe dimensions is necessary to determine these values. The values for the sound velocity of the following media, pipe materials and liner materials are saved in the transmitter.

Medium		Pipe material		Liner
▪ Water ▪ Seawater ▪ Distilled water ▪ Ammonia NH3 ▪ Benzene	▪ Ethanol ▪ Glycol ▪ Milk ▪ Methanol ▪ User-specific liquid	▪ Carbon steel ▪ Graphite cast iron ▪ Stainless steel ▪ 1.4301 (UNS S30400) ▪ 1.4401 (UNS S31600) ▪ 1.4550 (UNS S34700) ▪ Hastelloy C ▪ PVC ▪ PE ▪ LDPE	▪ HDPE ▪ GFR ▪ PVDF ▪ PA ▪ PP ▪ PTFE ▪ Pyrex glass ▪ Asbestos cement ▪ Copper ▪ Unknown pipe material	▪ None ▪ Cement ▪ Rubber ▪ Epoxy resin ▪ Unknown liner material

Sensor set selection and arrangement

If mounting horizontally, always mount the sensor set so that it is offset at an angle of ±30° to the top of the measuring pipe to avoid incorrect measurements caused by gas pockets or bubbles at the top of the pipe.

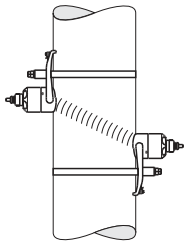
The sensors can be arranged in different ways:
- Mounting arrangement for measurement with one sensor set (one measuring path):
  - The sensors are located on opposite sides of the measuring pipe (offset by 180°): Measurement with one or three traverses
  - The sensors are located on the same side of the measuring pipe: Measurement with two or four traverses
- Mounting for measurement with two sensor sets [1] (two measuring paths):
  - One sensor of each sensor set is located at the opposite side of the measuring pipe (offset by 180°): Measurement with one or three traverses
  - The sensors are located on the same side of the measuring pipe: Measurement with two or four traverses

  The sensor sets are arranged on the measuring pipe, offset by 90°.

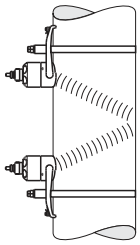
Using 5 MHz sensors
Here, the rails of the two sensor sets are always arranged at an angle of 180° to one another for all measurements with one, two, three or four traverses. The sensor functions are assigned in the two rails via the transmitter electronics unit depending on the selected number of traverses. It is not necessary to swap the cables in the transmitter between the channels.

Single-path measurement (1 sensor set)

Vertical mounting

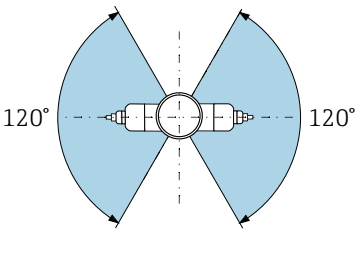


2 *1 traverse*

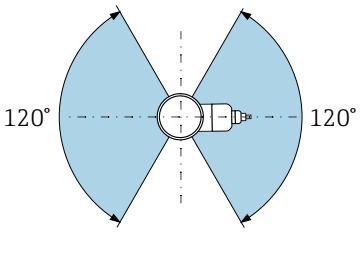


3 *2 traverses*

Horizontal mounting

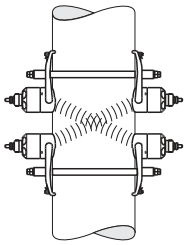
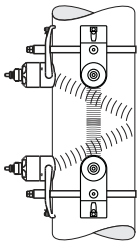
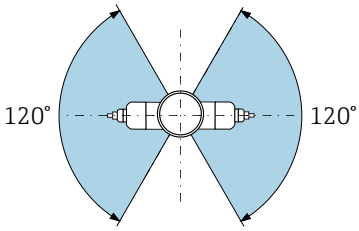
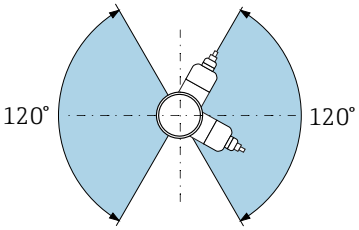


4 *1 traverse*



5 *2 traverses*

1) Do not swap the sensors of the two sensor sets, as this can affect the measurement performance.

Two-path measurement (2 sensor sets)	
Vertical mounting	
 A0042016	 A0042017
6 *1 traverse*	7 *2 traverses*
Horizontal mounting	
 A0044304	 A0046760
8 *1 traverse*	9 *2 traverses*

Operating frequency selection
The sensors of the measuring device are available with adapted operating frequencies. For the resonance behavior of the measuring pipes, these frequencies are optimized for different properties of measuring pipes (material, pipe wall thickness) and media (kinematic viscosity). If these properties are known, an optimum selection can be made according to the following tables [2].

Measuring pipe material	Nominal diameter of measuring pipe	Recommendation
Steel, cast iron	< DN 65 (2½")	C-500-A
	≥ DN 65 (2½")	Table for measuring pipe material: steel, cast iron → 🖹 8
Plastic	< DN 50 (2")	C-500-A
	≥ DN 50 (2")	Table for measuring pipe material: plastic → 🖹 9
Glass-fiber reinforced plastic	< DN 50 (2")	C-500-A (with restrictions)
	≥ DN 50 (2")	Table for measuring pipe material: glass-fiber reinforced plastic → 🖹 9

Measuring pipe material: steel, cast iron

	Kinematic viscosity cSt [mm²/s]		
	0 < ν ≤ 10	10 < ν ≤ 100	100 < ν ≤ 1000
Measuring pipe wall thickness [mm (in)]	Converter frequency (sensor version/number of traverses) [1]		
1.0 to 1.9 (0.04 to 0.07)	2 MHz (C-200 / 2)	2 MHz (C-200 / 1)	2 MHz (C-200 / 1)
> 1.9 to 2.2 (0.07 to 0.09)	1 MHz (C-100 / 2)	1 MHz (C-100 / 1)	1 MHz (C-100 / 1)

2) Recommendation: product sizing in Applicator → 🖹 64

Measuring pipe wall thickness [mm (in)]	Kinematic viscosity cSt [mm²/s]		
	0 < v ≤ 10	10 < v ≤ 100	100 < v ≤ 1000
	Converter frequency (sensor version/number of traverses) [1]		
> 2.2 to 2.8 (0.09 to 0.11)	2 MHz (C-200 / 2)	1 MHz (C-100 / 1)	1 MHz (C-100 / 1)
> 2.8 to 3.4 (0.11 to 0.13)	1 MHz (C-100 / 2)	1 MHz (C-100 / 1)	1 MHz (C-100 / 1)
> 3.4 to 4.2 (0.13 to 0.17)	2 MHz (C-200 / 2)	2 MHz (C-200 / 1)	1 MHz (C-100 / 1)
> 4.2 to 5.9 (0.17 to 0.23)	1 MHz (C-100 / 2)	1 MHz (C-100 / 1)	0.3 MHz (C-030 / 2)
> 5.9 (0.23)	Selection according to table: "Measuring pipe material: steel, cast iron > 5.9 mm (0.23 in)"		

1) Table shows a typical selection: In critical cases (large pipe diameter, liner, gas or solid inclusions) the optimum sensor type may differ from these recommendations.

Measuring pipe material: Steel, cast iron with wall thicknesses > 5.9 mm (0.23 in)

Nominal diameter [mm (")]	Kinematic viscosity cSt [mm²/s]		
	0 < v ≤ 10	10 < v ≤ 100	100 < v ≤ 1000
	Converter frequency (sensor version/number of traverses) [1]		
15 to 50 (½ to 2)	5 MHz (C-500)		
> 50 to 300 (2 to 12)	2 MHz (C-200)	1 MHz (C-100)	1 MHz (C-100)
> 300 to 1 000 (12 to 40)	1 MHz (C-100)	0.3 MHz (C-030)	0.3 MHz (C-030)
> 1 000 to 4 000 (40 to 160)	0.3 MHz (C-030)		

1) Table shows a typical selection: In critical cases (large pipe diameter, liner, gas or solid inclusions) the optimum sensor type may differ from these recommendations.

Measuring pipe material: plastic

Nominal diameter [mm (")]	Kinematic viscosity cSt [mm²/s]		
	0 < v ≤ 10	10 < v ≤ 100	100 < v ≤ 1000
	Converter frequency (sensor version/number of traverses) [1]		
15 to 50 (½ to 2)	5 MHz (C-500 / 2)	5 MHz (C-500 / 2)	5 MHz (C-500 / 2)
> 50 to 80 (2 to 3)	2 MHz (C-200 / 2)	1 MHz (C-100 / 2)	0.3 MHz (C-030 / 2)
> 80 to 150 (3 to 6)	1 MHz (C-100 / 2)	1 MHz (C-100 / 2)	0.3 MHz (C-030 / 2)
> 150 to 200 (6 to 8)	1 MHz (C-100 / 2)	0.3 MHz (C-030 / 2)	0.3 MHz (C-030 / 2)
> 200 to 300 (8 to 12)	1 MHz (C-100 / 2)	0.3 MHz (C-030 / 2)	0.3 MHz (C-030 / 2)
> 300 to 400 (12 to 16)	1 MHz (C-100 / 1)	0.3 MHz (C-030 / 2)	0.3 MHz (C-030 / 1)
> 400 to 500 (16 to 20)	1 MHz (C-100 / 1)	0.3 MHz (C-030 / 1)	0.3 MHz (C-030 / 1)
> 500 to 1 000 (20 to 40)	0.3 MHz (C-030 / 1)	0.3 MHz (C-030 / 1)	–
> 1 000 to 4 000 (40 to 160)	0.3 MHz (C-030 / 1)	–	–

1) Table shows a typical selection: In critical cases (large pipe diameter, liner, gas or solid inclusions) the optimum sensor type may differ from these recommendations.

Measuring pipe material: glass-fiber reinforced plastic

Nominal diameter [mm (")]	Kinematic viscosity cSt [mm²/s]		
	0 < v ≤ 10	10 < v ≤ 100	100 < v ≤ 1000
	Converter frequency (sensor version/number of traverses) [1]		
15 to 50 (½ to 2)	5 MHz (C-500 / 2)	5 MHz (C-500 / 2)	5 MHz (C-500 / 2)
> 50 to 80 (2 to 3)	0.3 MHz (C-030 / 2)	0.3 MHz (C-030 / 2)	0.3 MHz (C-030 / 1)

Nominal diameter [mm (")]	Kinematic viscosity cSt [mm²/s]		
	0 < v ≤ 10	10 < v ≤ 100	100 < v ≤ 1000
	Converter frequency (sensor version/number of traverses) [1]		
> 80 to 150 (3 to 6)	0.3 MHz (C-030 / 2)	0.3 MHz (C-030 / 1)	0.3 MHz (C-030 / 1)
> 150 to 400 (6 to 16)	0.3 MHz (C-030 / 2)	0.3 MHz (C-030 / 1)	–
> 400 to 500 (16 to 20)	0.3 MHz (C-030 / 1)	–	–
> 500 to 1000 (20 to 40)	0.3 MHz (C-030 / 1)	–	–
> 1000 to 4000 (40 to 160)	0.3 MHz (C-030 / 1)	–	–

1) Table shows a typical selection: In critical cases (large pipe diameter, liner, gas or solid inclusions) the optimum sensor type may differ from these recommendations.

- If clamp-on sensors are used, a 2 traverse-type installation is recommended. This is the easiest and most convenient type of installation, particularly for measuring devices whose measuring pipe is difficult to access from one side.
- A 1 traverse installation is recommended for the following installation conditions:
  - Certain plastic measuring pipes with a wall thickness of >4 mm (0.16 in)
  - Measuring pipes made of composite materials (e.g. glass-fiber reinforced plastic)
  - Lined measuring pipes
  - Applications with media with high acoustic damping

Measuring mode

Single-path measurement

In the case of single-path measurement, the flow is measured at the measuring point without the option of compensation.

For this, it is necessary to comply strictly with the specified inlet and outlet runs after the disturbance points (e.g. elbows, extensions, reductions) in the measuring pipe.

To ensure the best possible measurement performance and measurement accuracy, the configuration with two sensor sets [3] with FlowDC is recommended.

Two-path measurement

In the case of two-path measurement, the flow is measured by two measurements (two measuring paths/sensor sets) at the measuring point.

For this purpose, the two sensor sets are installed at a measuring point with one or two traverses. The sensors can generally be arranged in one or two different measuring planes. For installation with two measuring planes, the sensor planes must be rotated by at least 30° in relation to the pipe axis.

The measured values of both sensor sets are averaged. Configuration of the measurement is only performed once and is adopted for both measuring paths.

If extending the measuring point from single-path measurement to two-path measurement, a sensor of the same design must be selected.

Two-path measurement with FlowDC [4]

In the case of two-path measurement with FlowDC, the flow is measured by two measurements at the measuring point.

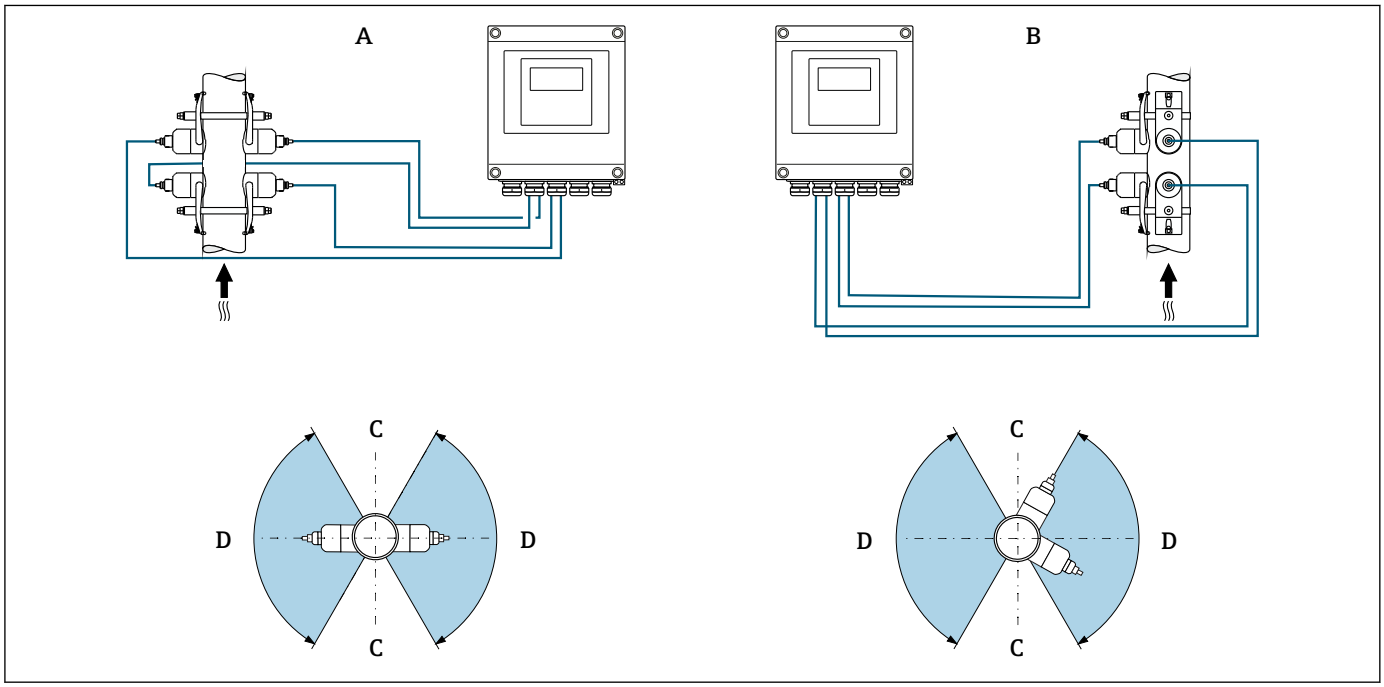
For this, the two sensor sets are installed on the measuring pipe, offset at a specific angle to one another (180° for 1 traverse, 90° for 2 traverses, angle tolerance ±5°). This arrangement is independent of the circumferential position of the two sensor sets on the measuring pipe.

The measured values of both sensor sets are averaged. The resulting measurement error is compensated based on the type of interference, the distance from the measuring point to the disturbance point, and the Reynolds number. The error-compensated average thus ensures that the

3) Order code for "Mounting type", option A2 "Clamp-on, 2-channel, 2-sensor sets"
4) Flow disturbance compensation

specified maximum measurement error and repeatability are maintained even under non-ideal flow conditions (see for example → 28).

The configuration of the two measuring paths is only performed once and is adopted for both measuring paths.



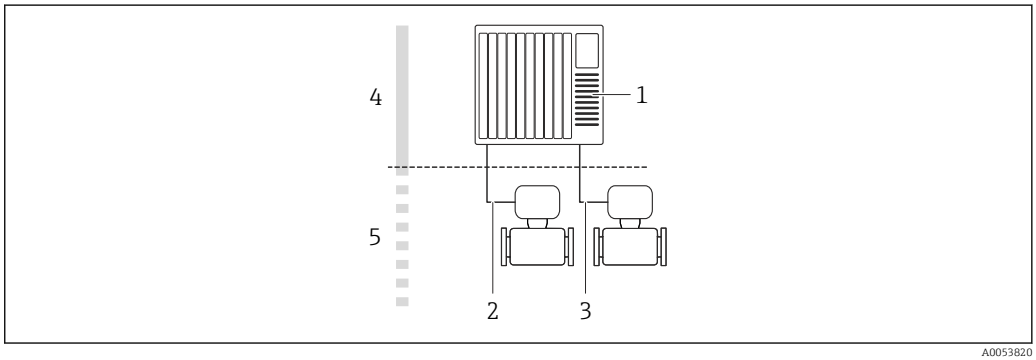
A0044944

10 *Two-path measurement: examples of the horizontal arrangement of the sensor sets at a measuring point*

A Installation of the sensor sets for measurement via 1 traverse
B Installation of the sensor sets for measurement via 2 traverses
C For horizontal orientation: non-recommended installation range (60°)
D For horizontal orientation: recommended installation range max. 120°

If no FlowDC is used, the specified inlet and outlet runs after disturbance points in the measuring pipe (e.g. elbows, extensions, reductions) must be observed precisely to obtain accurate flow measured values.

Device architecture



A0053820

11 *Possibilities for integrating measuring devices into a system*

1 Automation system (e.g. PLC)
2 4 to 20 mA HART, pulse/frequency/switch output
3 Modbus RS485
4 Non-hazardous area
5 Non-hazardous area and Zone 2/Div. 2

Dependability

IT security

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

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

Device-specific IT security

The device offers a range of specific functions to support protective measures on the operator's side. These functions can be configured by the user and guarantee greater in-operation safety if used correctly. The following list provides an overview of the most important functions:

Function/interface	Factory setting	Recommendation
Write protection via hardware write protection switch → 🖹 12	Not enabled	On an individual basis following risk assessment
Access code (also applies to web server login or FieldCare connection) → 🖹 12	Not enabled (0000)	Assign a customized access code during commissioning
WLAN (order option in display module)	Enabled	On an individual basis following risk assessment
WLAN security mode	Enabled (WPA2-PSK)	Do not change
WLAN passphrase (Password) → 🖹 12	Serial number	Assign an individual WLAN passphrase during commissioning
WLAN mode	Access point	On an individual basis following risk assessment
Web server → 🖹 13	Enabled	On an individual basis following risk assessment
CDI-RJ45 service interface→ 🖹 13	–	On an individual basis following risk assessment

Protecting access via hardware write protection

Write access to the parameters of the device via the local display or operating tool (e.g. FieldCare, DeviceCare) can be disabled via a write protection switch (DIP switch on the main electronics module). When hardware write protection is enabled, only read access to the parameters is possible.

Hardware write protection is disabled when the device is delivered.

Protecting access via a password

Different passwords are available to protect write access to the device parameters or access to the device via the WLAN interface.

- User-specific access code
  Protect write access to the device parameters via the local display, web browser or operating tool (e.g. FieldCare, DeviceCare). Access authorization is clearly regulated through the use of a user-specific access code.
- WLAN passphrase
  The network key protects a connection between an operating unit (e.g. notebook or tablet) and the device via the WLAN interface which can be ordered as an option.

User-specific access code

Write access to the device parameters via the local display or operating tool (e.g. FieldCare, DeviceCare) can be protected by the modifiable, user-specific access code.

WLAN passphrase: Operation as WLAN access point

A connection between an operating unit (e.g. notebook or tablet) and the device via the WLAN interface, which can be ordered as an optional extra, is protected by the network key. The WLAN authentication of the network key complies with the IEEE 802.11 standard.

When the device is delivered, the network key is pre-defined depending on the device. It can be changed via the **WLAN settings** submenu in the **WLAN passphrase** parameter.

General notes on the use of passwords

- The access code and network key supplied with the device should be changed during commissioning for safety reasons.
- Follow the general rules for generating a secure password when defining and managing the access code and network key.
- The user is responsible for the management and careful handling of the access code and network key.

Access via web server

The device can be operated and configured via a web browser with the integrated web server. The connection is established via the service interface (CDI-RJ45) or the WLAN interface.

The web server is enabled when the device is delivered. The web server can be disabled via the **Web server functionality** parameter if necessary (e.g., after commissioning).

The device and status information can be hidden on the login page. This prevents unauthorized access to the information.

Detailed information on the device parameters:
"Description of device parameters" document .

Access via service interface (CDI-RJ45)

The device can be connected to a network via the service interface (CDI-RJ45). Device-specific functions guarantee the secure operation of the device in a network.

The use of relevant industrial standards and guidelines that have been defined by national and international safety committees, such as IEC/ISA62443 or the IEEE, is recommended. This includes organizational security measures such as the assignment of access authorization as well as technical measures such as network segmentation.

Input

Measured variable

Direct measured variables

- Volume flow
- Flow velocity
- Sound velocity

Calculated measured variables

Mass flow

Measuring range

v = 0 to 15 m/s (0 to 50 ft/s)

Measuring range depending on the sensor version.

To calculate the measuring range, use the *Applicator* sizing tool → 64

Operable flow range

Over 150 : 1

Input signal

External measured values

The measuring device has an optional interface via which an externally measured variable (temperature) can be transmitted to the measuring device: digital input (via HART input or Modbus)

Various pressure transmitters can be ordered from Endress+Hauser: see "Accessories" section → 65

HART protocol

The measured values are written from the automation system to the measuring device via the HART protocol. The temperature and density measuring device must support the following protocol-specific functions:
- HART protocol
- Burst mode

Status input

Maximum input values	▪ DC 30 V ▪ 6 mA
Response time	Configurable: 5 to 200 ms
Input signal level	▪ Low signal (low): DC −3 to +5 V ▪ High signal (high): DC 12 to 30 V
Assignable functions	▪ Off ▪ Reset totalizers 1-3 separately ▪ Reset all totalizers ▪ Flow override

Output

Output signal

Current output

Current output	Can be set as: ▪ 4 to 20 mA NAMUR ▪ 4 to 20 mA US ▪ 4 to 20 mA HART ▪ 0 to 20 mA
Maximum output values	▪ DC 24 V (when idle) ▪ 22.5 mA
Load	250 to 700 Ω
Resolution	0.38 µA
Damping	Configurable: 0 to 999.9 s
Assignable measured variables	▪ Volume flow ▪ Mass flow ▪ Sound velocity ▪ Flow velocity ▪ Electronics temperature The range of options increases if the measuring device has one or more application packages.

Pulse/frequency/switch output

Function	▪ With the order code for "Output; Input", option **H**: output 2 can be set as a pulse or frequency output ▪ With the order code for "Output; Input", option **I**: output 2 and 3 can be set as a pulse, frequency or switch output
Version	Passive, open collector
Maximum input values	▪ DC 30 V ▪ 250 mA
Voltage drop	At 25 mA: ≤ DC 2 V
Pulse output	
Pulse width	Configurable: 0.05 to 2 000 ms

Maximum pulse rate	10 000 Impulse/s
Pulse value	Configurable
Assignable measured variables	▪ Volume flow ▪ Mass flow
Frequency output	
Output frequency	Configurable: 0 to 12 500 Hz
Damping	Configurable: 0 to 999 s
Pulse/pause ratio	1:1
Assignable measured variables	▪ Volume flow ▪ Mass flow ▪ Sound velocity ▪ Flow velocity ▪ Electronics temperature
Switch output	
Switching behavior	Binary, conductive or non-conductive
Switching delay	Configurable: 0 to 100 s
Number of switching cycles	Unlimited

Assignable functions	▪ Off
	▪ On
	▪ Diagnostic behavior
	▪ Limit value
	  ▪ Volume flow
	  ▪ Mass flow
	  ▪ Sound velocity
	  ▪ Flow velocity
	  ▪ Totalizer 1-3
	  ▪ Electronics temperature
	▪ Flow direction monitoring
	▪ Status
	  Low flow cut off

Modbus RS485

Physical interface	In accordance with EIA/TIA-485-A standard
Terminating resistor	Integrated, can be activated via DIP switch on the transmitter electronics module

Signal on alarm

Depending on the interface, failure information is displayed as follows:

Current output 4 to 20 mA

4 to 20 mA

Failure mode	Choose from: ▪ 4 to 20 mA in accordance with NAMUR recommendation NE 43 ▪ 4 to 20 mA in accordance with US ▪ Min. value: 3.59 mA ▪ Max. value: 22.5 mA ▪ Definable value between: 3.59 to 22.5 mA ▪ Actual value ▪ Last valid value

0 to 20 mA

Failure mode	Choose from: ▪ Max. alarm: 22 mA ▪ Definable value between: 0 to 22.5 mA

HART current output

Device diagnostics	Device condition can be read out via HART Command 48

Pulse/frequency/switch output

Pulse output	
Fault mode	Choose from: ▪ Actual value ▪ No pulses
Frequency output	
Fault mode	Choose from: ▪ Actual value ▪ 0 Hz ▪ Definable value between: 0 to 12 500 Hz
Switch output	
Fault mode	Choose from: ▪ Current status ▪ Open ▪ Closed

Modbus RS485

Failure mode	Choose from: ▪ NaN value instead of current value ▪ Last valid value

Local display

Plain text display	With information on cause and remedial measures
Backlight	Red lighting indicates a device error.

Status signal as per NAMUR recommendation NE 107

Interface/protocol

- Via digital communication:
  - HART protocol
  - Modbus RS485
- Via service interface
  - CDI-RJ45 service interface
  - WLAN interface

Plain text display	With information on cause and remedial measures

Additional information on remote operation → 55

Web browser

Plain text display	With information on cause and remedial measures

Light emitting diodes (LED)

Status information	Status indicated by various light emitting diodes The following information is displayed depending on the device version: ▪ Supply voltage active ▪ Data transmission active ▪ Device alarm/error has occurred

Low flow cut off

The switch points for low flow cut off are user-selectable.

Galvanic isolation

The following connections are galvanically isolated from each other:
- Inputs
- Outputs
- Power supply

DN 50 to 4000 (2 to 160") and non-hazardous area: The clamp-on sensors can also be mounted on cathodically protected pipes. Solution available on request.

Protocol-specific data

HART

Manufacturer ID	0x11
Device type ID	0x5B
HART protocol revision	7
Device description files (DTM, DD)	Information and files available at: www.endress.com
HART load	Min. 250 Ω
Dynamic variables	Read out the dynamic variables: HART command 3 The measured variables can be freely assigned to the dynamic variables. **Measured variables for PV (primary dynamic variable)** ▪ Off ▪ Volume flow ▪ Mass flow ▪ Sound velocity ▪ Flow velocity ▪ Electronics temperature **Measured variables for SV, TV, QV (secondary, tertiary and quaternary dynamic variable)** ▪ Volume flow ▪ Mass flow ▪ Sound velocity ▪ Flow velocity ▪ Electronics temperature ▪ Totalizer 1 ▪ Totalizer 2 ▪ Totalizer 3
Device variables	Read out the device variables: HART command 9 The device variables are permanently assigned. A maximum of 8 device variables can be transmitted: ▪ 0 = volume flow ▪ 1 = mass flow ▪ 2 = sound velocity ▪ 3 = flow velocity ▪ 4 = electronic temperature ▪ 5 = totalizer 1 ▪ 6 = totalizer 2 ▪ 7 = totalizer 3

Modbus RS485

Protocol	Modbus Applications Protocol Specification V1.1
Response times	▪ Direct data access: typically 25 to 50 ms ▪ Auto-scan buffer (data range): typically 3 to 5 ms
Device type	Slave
Slave address range	1 to 247
Broadcast address range	0
Function codes	▪ 03: Read holding register ▪ 04: Read input register ▪ 06: Write single registers ▪ 08: Diagnostics ▪ 16: Write multiple registers ▪ 23: Read/write multiple registers
Broadcast messages	Supported by the following function codes: ▪ 06: Write single registers ▪ 16: Write multiple registers ▪ 23: Read/write multiple registers
Supported baud rate	▪ 1200 BAUD ▪ 2400 BAUD ▪ 4800 BAUD ▪ 9600 BAUD ▪ 19200 BAUD ▪ 38400 BAUD ▪ 57600 BAUD ▪ 115200 BAUD
Data transmission mode	▪ ASCII ▪ RTU
Data access	Each device parameter can be accessed via Modbus RS485. For Modbus register information
System integration	Information regarding system integration: Operating Instructions . ▪ Modbus RS485 information ▪ Function codes ▪ Register information ▪ Response time ▪ Modbus data map

Power supply

Terminal assignment

Transmitter: 0 to 20 mA/4 to 20 mA HART

The sensor can be ordered with terminals.

Connection methods available		Possible options for order code "Electrical connection"
Outputs	**Power supply**	
Terminals	Terminals	▪ Option **A**: coupling M20x1.5 ▪ Option **B**: thread M20x1.5 ▪ Option **C**: thread G ½" ▪ Option **D**: thread NPT ½"

Supply voltage

Order code "Power supply"	Terminal numbers	terminal voltage		Frequency range
Option **L** (wide range power unit)	1 (L+/L), 2 (L-/N)	DC 24 V	±25%	–
		AC 24 V	±25%	50/60 Hz, ±4 Hz
		AC 100 to 240 V	−15 to +10%	50/60 Hz, ±4 Hz

Signal transmission current output 0 to 20 mA/4 to 20 mA HART and additional outputs and inputs

Order code for "Output" and "Input"	Terminal numbers							
	Output 1		Output 2		Output 3		Input	
	26 (+)	27 (-)	24 (+)	25 (-)	22 (+)	23 (-)	20 (+)	21 (-)
Option **H**	Current output ▪ 4 to 20 mA HART (active) ▪ 0 to 20 mA (active)		Pulse/frequency output (passive)		Switch output (passive)		-	
Option **I**	Current output ▪ 4 to 20 mA HART (active) ▪ 0 to 20 mA (active)		Pulse/frequency/ switch output (passive)		Pulse/frequency/ switch output (passive)		Status input	

Transmitter: Modbus RS485

The sensor can be ordered with terminals.

Connection methods available		Possible options for order code "Electrical connection"
Outputs	Power supply	
Terminals	Terminals	▪ Option **A**: coupling M20x1 ▪ Option **B**: thread M20x1 ▪ Option **C**: thread G ½" ▪ Option **D**: thread NPT ½"

Supply voltage

Order code "Power supply"	Terminal numbers	terminal voltage		Frequency range
Option **L** (wide range power unit)	1 (L+/L), 2 (L-/N)	DC 24 V	±25%	–
		AC 24 V	±25%	50/60 Hz, ±4 Hz
		AC 100 to 240 V	−15 to +10%	50/60 Hz, ±4 Hz

Signal transmission Modbus RS485 and additional outputs

Order code for "Output" and "Input"	Terminal numbers							
	26 (+)	27 (-)	24 (+)	25 (-)	22 (+)	23 (-)	20 (+)	21 (-)
Option **M**	Modbus		-		-		-	
	B	A						
Option **O**	Current output 4 to 20 mA (active)		Pulse/frequency/ switch output (passive)		Pulse/frequency/ switch output (passive)		Modbus	
							B	A

Supply voltage

Transmitter

Order code for "Power supply"	terminal voltage		Frequency range
Option **L**	DC 24 V	±25%	–
	AC 24 V	±25%	50/60 Hz, ±4 Hz
	AC 100 to 240 V	−15 to +10%	50/60 Hz, ±4 Hz

Power consumption

Order code for "Output"	Maximum power consumption
Option **H**: 4-20mA HART, pulse/frequency output, switch output	30 VA/8 W
Option **I**: 4-20mA HART, 2 x pulse/frequency/switch output, status input	30 VA/8 W
Option **M**: Modbus RS485	30 VA/8 W
Option **O**: Modbus RS485, 4-20mA, 2 x pulse/ frequency/switch output	30 VA/8 W

Current consumption

Transmitter

Order code for "Power supply"	Maximum Current consumption	Maximum switch-on current
Option **L**: AC 100 to 240 V	145 mA	25 A (< 5 ms)
Option **L**: AC/DC 24 V	350 mA	27 A (< 5 ms)

Device fuse

Fine-wire fuse (slow-blow):
- DC 24 V: T1A
- AC 100 to 240 V: T1A

Power supply failure

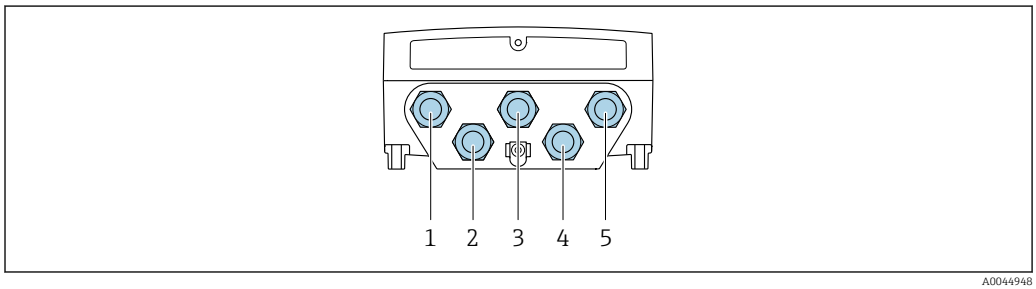
- Totalizers stop at the last value measured.
- Depending on the device version, the configuration is retained in the device memory or in the pluggable data memory (HistoROM DAT).
- Error messages (incl. total operated hours) are stored.

Overcurrent protection element

The device must be operated with a dedicated circuit breaker, as it does not have an ON/OFF switch of its own.
- The circuit breaker must be easy to reach and labeled accordingly.
- Permitted nominal current of the circuit breaker: 2 A up to maximum 10 A.

Electrical connection

Terminal connection for transmitter

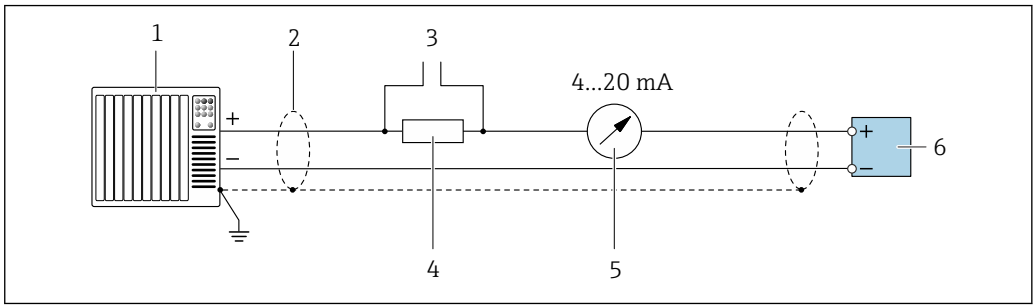


12 Wall-mount housing, remote version: connection of supply voltage and signal transmission

1 Cable entry for supply voltage
2 Cable entry for sensor cable
3 Cable entry for sensor cable
4 Cable entry for signal transmission
5 Cable entry for signal transmission

Connection examples

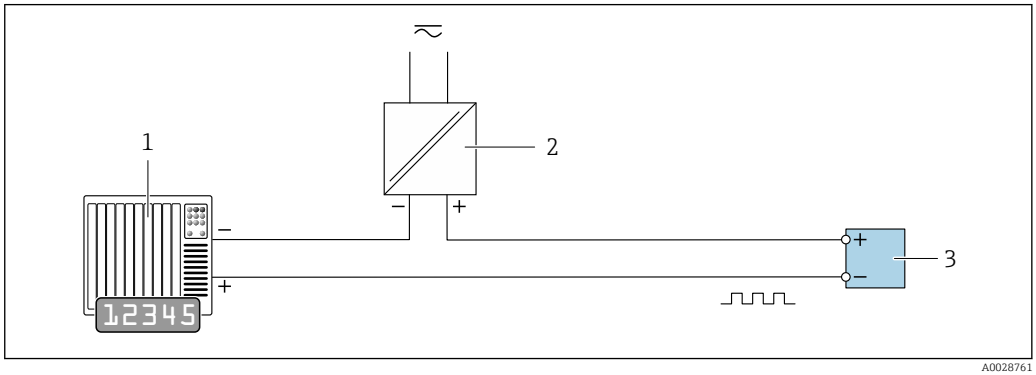
Current output 4 to 20 mA HART



13 *Connection example for 4 to 20 mA HART current output (active)*

1 *Automation system with current input (e.g. PLC)*
2 *Ground cable shield at one end. The cable shield must be grounded at both ends to comply with EMC requirements; observe cable specifications*
3 *Connection for HART operating devices → 55*
4 *Resistor for HART communication (≥ 250 Ω): observe maximum load → 14*
5 *Analog display unit: observe maximum load → 14*
6 *Transmitter*

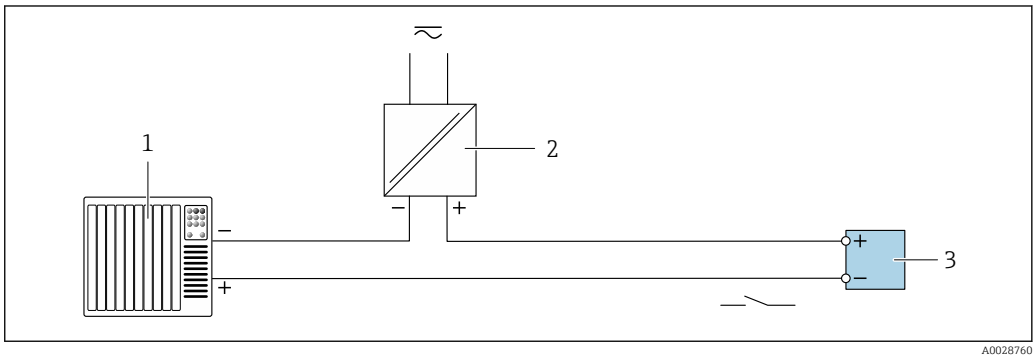
Pulse/frequency output



14 *Connection example for pulse/frequency output (passive)*

1 *Automation system with pulse/frequency input (e.g. PLC with 10 kΩ pull-up or pull-down resistor)*
2 *Power supply*
3 *Transmitter: observe input values → 14*

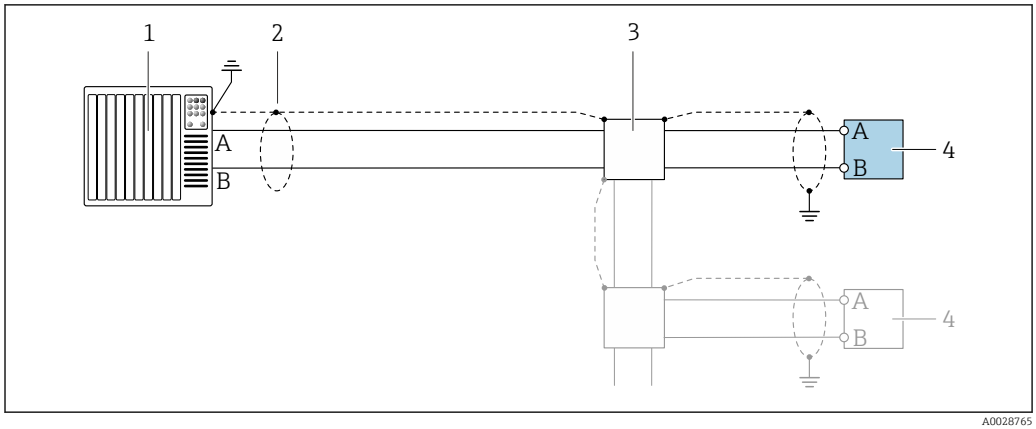
Switch output



15 *Connection example for switch output (passive)*

1 *Automation system with switch input (e.g. PLC with a 10 kΩ pull-up or pull-down resistor)*
2 *Power supply*
3 *Transmitter: observe input values → 14*

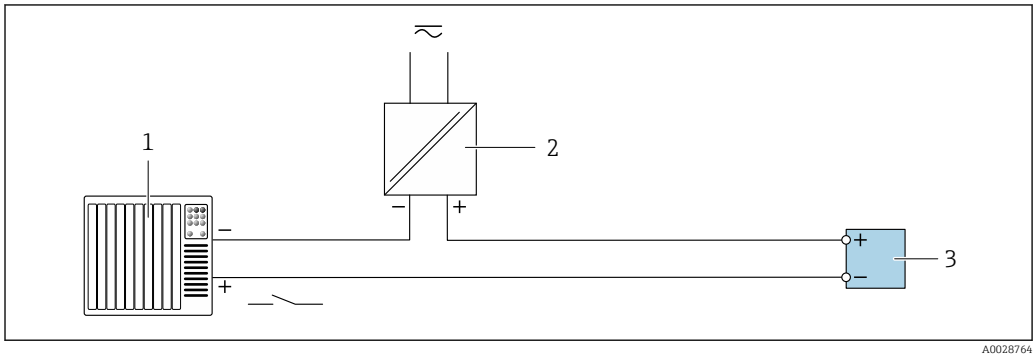
Modbus RS485



16 Connection example for Modbus RS485, non-hazardous area and Zone 2/Div. 2

1 *Control system (e.g. PLC)*
2 *Ground cable shield at one end. The cable shield must be grounded at both ends to comply with EMC requirements; observe cable specifications*
3 *Distribution box*
4 *Transmitter*

Status input



17 Connection example for status input

1 *Automation system with status output (e.g. PLC)*
2 *Power supply*
3 *Transmitter*

Potential equalization

Requirements

For potential equalization:
- Pay attention to in-house grounding concepts
- Take account of operating conditions like the pipe material and grounding
- Connect the sensor and transmitter to the same electric potential [5)]
- Use a ground cable with a minimum cross-section of 6 mm² (10 AWG) and a cable lug for potential equalization connections

Terminals

Transmitter

Supply voltage cable: plug-in spring terminals for wire cross-sections 0.5 to 2.5 mm² (20 to 14 AWG)

Cable entries

Cable entry thread
- M20 x 1.5
- Via adapter:
  - NPT ½"
  - G ½"

5)

Cable gland
M20 × 1.5 with cable Φ 6 to 12 mm (0.24 to 0.47 in)

If metal cable entries are used, use a grounding plate.

Cable specification

Permitted temperature range

- The installation guidelines that apply in the country of installation must be observed.
- The cables must be suitable for the minimum and maximum temperatures to be expected.

Power supply cable (incl. conductor for the inner ground terminal)

Standard installation cable is sufficient.

Signal cable

Current output 0/4 to 20 mA

Standard installation cable is sufficient.

Current output 4 to 20 mA HART

A shielded cable is recommended. Observe grounding concept of the plant.

Pulse /frequency /switch output

Standard installation cable is sufficient.

Status input

Standard installation cable is sufficient.

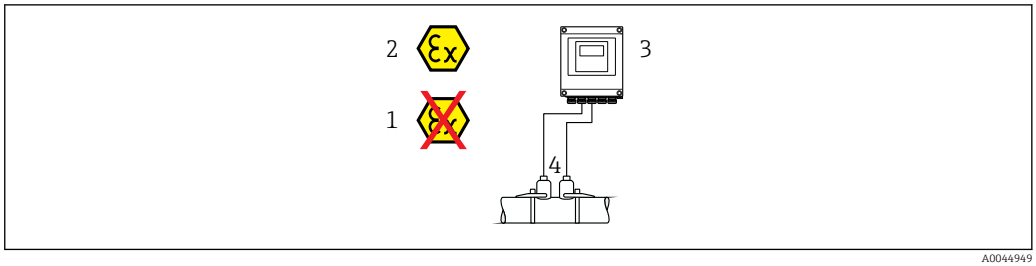
Modbus RS485

The EIA/TIA-485 standard specifies two types of cable (A and B) for the bus line which can be used for every transmission rate. Cable type A is recommended.

Cable type	A
Characteristic impedance	135 to 165 Ω at a measuring frequency of 3 to 20 MHz
Cable capacitance	< 30 pF/m
Wire cross-section	> 0.34 mm² (22 AWG)
Cable type	Twisted pairs
Loop resistance	≤110 Ω/km
Signal damping	Max. 9 dB over the entire length of the cable cross-section
Shield	Copper braided shielding or braided shielding with foil shield. When grounding the cable shield, observe the grounding concept of the plant.

Connecting cable between the transmitter and sensor

Sensor cable for sensor - transmitter



A0044949

Standard cable	▪ TPE: -40 to +80 °C (-40 to +176 °F) ▪ TPE halogen-free: -40 to +80 °C (-40 to +176 °F) ▪ PTFE: -40 to +130 °C (-40 to +266 °F)
Cable length (max.)	30 m (90 ft)
Cable lengths (available for order)	5 m (15 ft), 10 m (30 ft), 15 m (45 ft), 30 m (90 ft)
Operating temperature	Depends on the device version and how the cable is installed: Standard version: ▪ Cable - fixed installation [1]: minimum −40 °C (−40 °F) ▪ Cable - movable installation: minimum −25 °C (−13 °F)

1) Compare details under the row "Standard cable"

Overvoltage protection

Mains voltage fluctuations	→ 🖹 20
Overvoltage category	Overvoltage category II
Short-term, temporary overvoltage	Between cable and ground up to 1200 V, for max. 5 s
Long-term, temporary overvoltage	Between cable and ground up to 500 V

Performance characteristics

Reference operating conditions

- Maximum permissible error according to ISO/DIN 11631
- Specifications as per measurement report
- Accuracy information is based on accredited calibration rigs that are traced to ISO 17025.

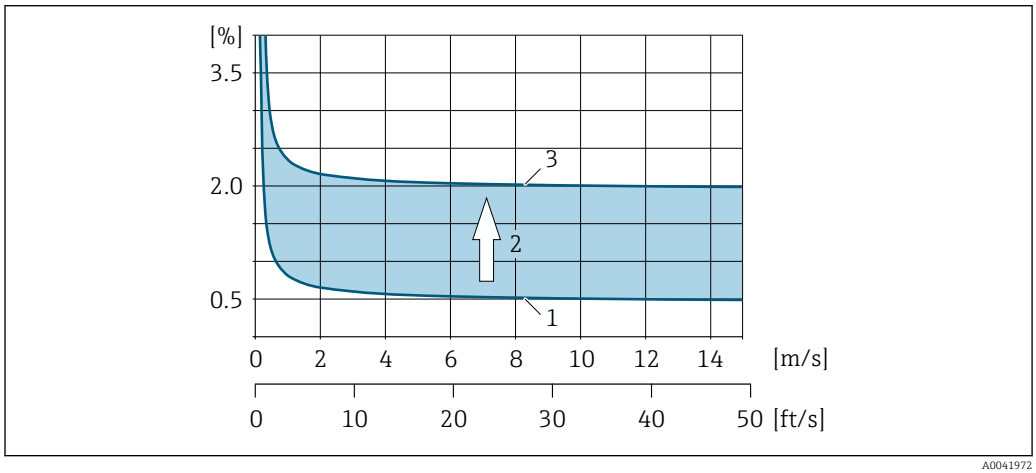
To obtain measured errors, use the *Applicator* sizing tool → 🖹 64

Maximum measurement error

o.r. = of reading

The measurement error depends on a number of factors. A distinction is made between the measurement error of the device (0.5% o.r.) and an additional installation-specific measurement error (typically 1.5% o.r.) that is independent of the device.

The installation-specific measurement error depends on the installation conditions on site, such as the nominal diameter, wall thickness, real pipe geometry or medium. The sum of the two measurement errors is the measurement error at the measuring point.



18 Example of the measurement error in a pipe with a nominal diameter DN > 200 (8")

1 Measurement error of measuring device: 0.5% o.r. ± 3 mm/s (0.12 in/s)
2 Measurement error due to installation conditions: typically 1.5% o.r.
3 Measurement error at the measuring point: 0.5% o.r. ± 3 mm/s (0.12 in/s) + 1.5% o.r. = 2% o.r. ± 3 mm/s (0.12 in/s)

Measurement error at the measuring point

The measurement error at the measuring point is made up of the measurement error of the device (0.5% o.r.) and the measurement error resulting from the installation conditions on site. With a flow velocity > 0.3 m/s (1 ft/s) and a Reynolds number > 10 000, the following are typical error limits:

Nominal diameter	Maximum permissible errors for device	+	Installation-specific maximum permissible errors (typical)	→	Maximum permissible errors at the measuring point (typical)	Field calibration [1]
DN 15 (½")	±0.5% o.r. ± 5 mm/s (0.20 in/s)	+	±2.5% o.r.	→	±3% o.r. ± 5 mm/s (0.20 in/s)	±0.5% o.r. ± 5 mm/s (0.20 in/s)
DN 25 to 200 (1 to 8")	±0.5% o.r. ± 7.5 mm/s (0.30 in/s)	+	±1.5% o.r.	→	±2% o.r. ± 7.5 mm/s (0.30 in/s)	±0.5% o.r. ± 7.5 mm/s (0.30 in/s)
> DN 200 (8")	±0.5% o.r. ± 3 mm/s (0.12 in/s)	+	±1.5% o.r.	→	±2% o.r. ± 3 mm/s (0.12 in/s)	±0.5% o.r. ± 3 mm/s (0.12 in/s)

1) Adjustment in relation to a reference value with correction values written back to the transmitter

Measurement report

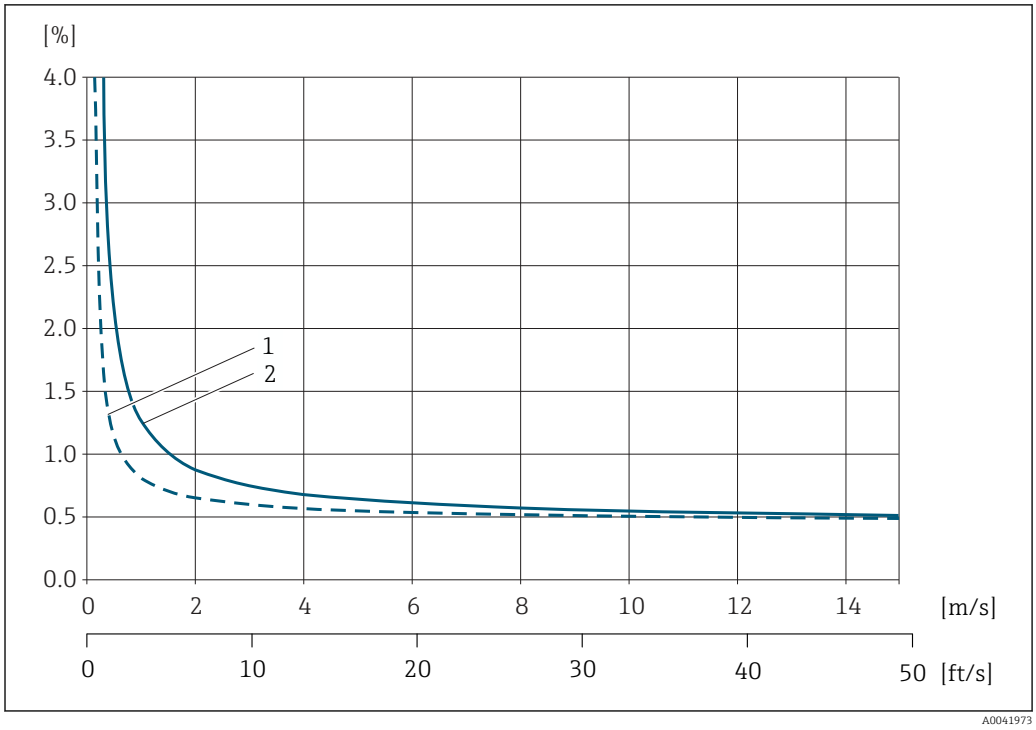
If required, the device can be supplied with a factory measurement report. A measurement is performed under reference conditions to verify the performance of the device. Here, the sensors are mounted on a pipe with a nominal diameter of DN 50 (2") or DN 100 (4").

With a flow velocity of > 0.3 m/s (1 ft/s) and a Reynolds number > 10 000, the following error limits are guaranteed with the measurement report:

Nominal diameter	Maximum permissible errors for device
50 (2")	±0.5% o.r. ± 5 mm/s (0.20 in/s)
100 (4")	±0.5% o.r. ± 7.5 mm/s (0.30 in/s)

The specification applies to Reynolds numbers Re ≥ 10 000. Larger measurement errors may occur for Reynolds numbers Re < 10 000.

Example of max. measurement error (volume flow)



19 Example of max. measurement error (volume flow) in % o.r.

1 Pipe diameter < DN 100 (4")
2 Pipe diameter ≥ DN 100 (4")

Accuracy of outputs

The outputs have the following base accuracy specifications.

Current output

Accuracy	Max. ±5 µA

Pulse/frequency output

o.r. = of reading

Accuracy	Max. ±50 ppm o.r. (over the entire ambient temperature range)

Repeatability

o.r. = of reading

±0.3% for flow velocities >0.3 m/s (1 ft/s)

Influence of ambient temperature

Current output

o.r. = of reading

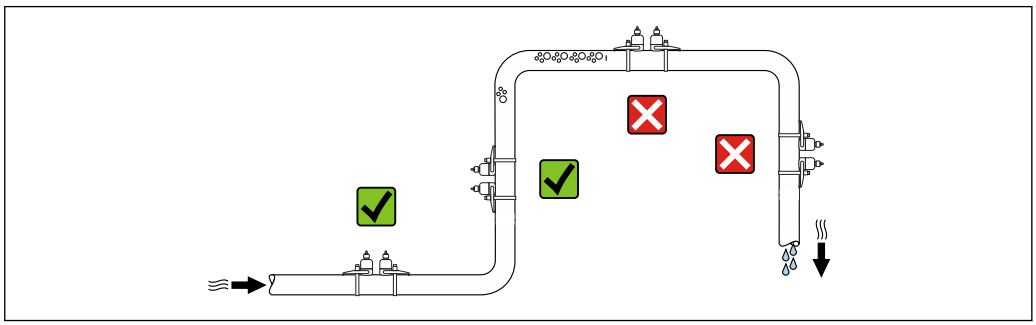
Temperature coefficient	Max. ±0.005 % o.r./°C

Pulse/frequency output

Temperature coefficient	No additional effect. Included in accuracy.

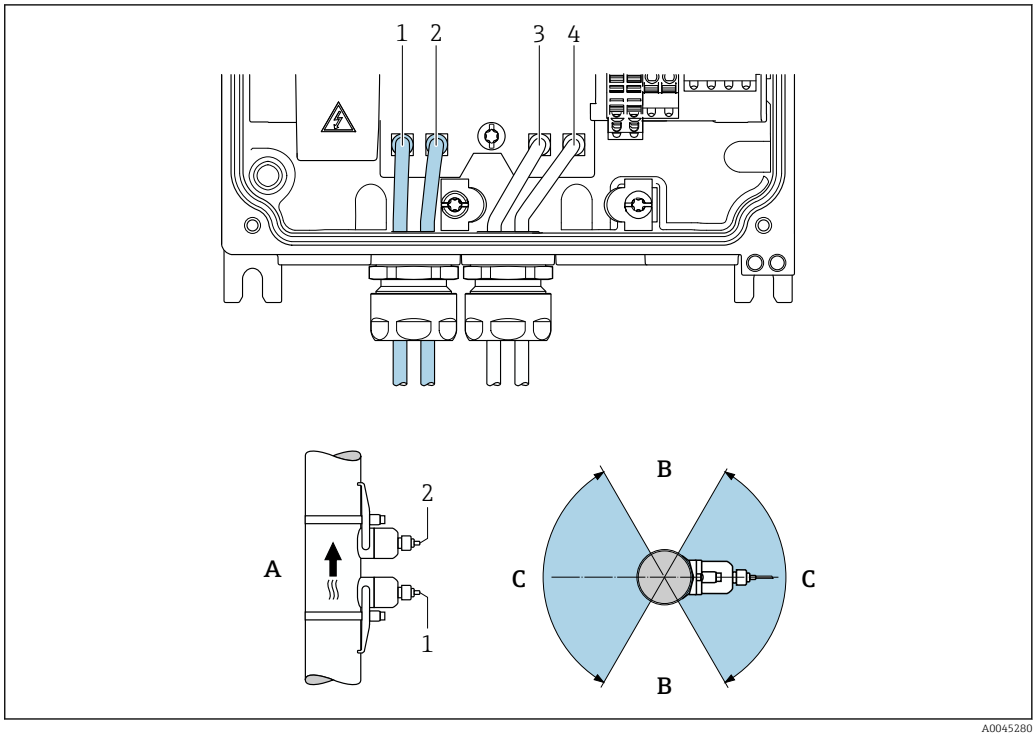
Mounting procedure

Mounting location



To prevent measuring errors arising from accumulation of gas bubbles in the measuring pipe, avoid the following mounting locations in the piping:
- Highest point of a pipeline.
- Directly upstream of a free pipe outlet in a down pipe.

Orientation



20 *Orientation views*

1 Channel 1 upstream
2 Channel 1 downstream
3 Channel 2 upstream
4 Channel 2 downstream
A Recommended orientation with upward flow direction
B Non-recommended installation range with horizontal orientation (60°)
C Recommended installation range max. 120°

Vertical

Recommended orientation with upward flow direction (view A) With this orientation, entrained solids sink and gases rise away from the sensor area when the medium is not flowing. In addition, the pipe can be completely drained and protected against the buildup of deposits.

Horizontal

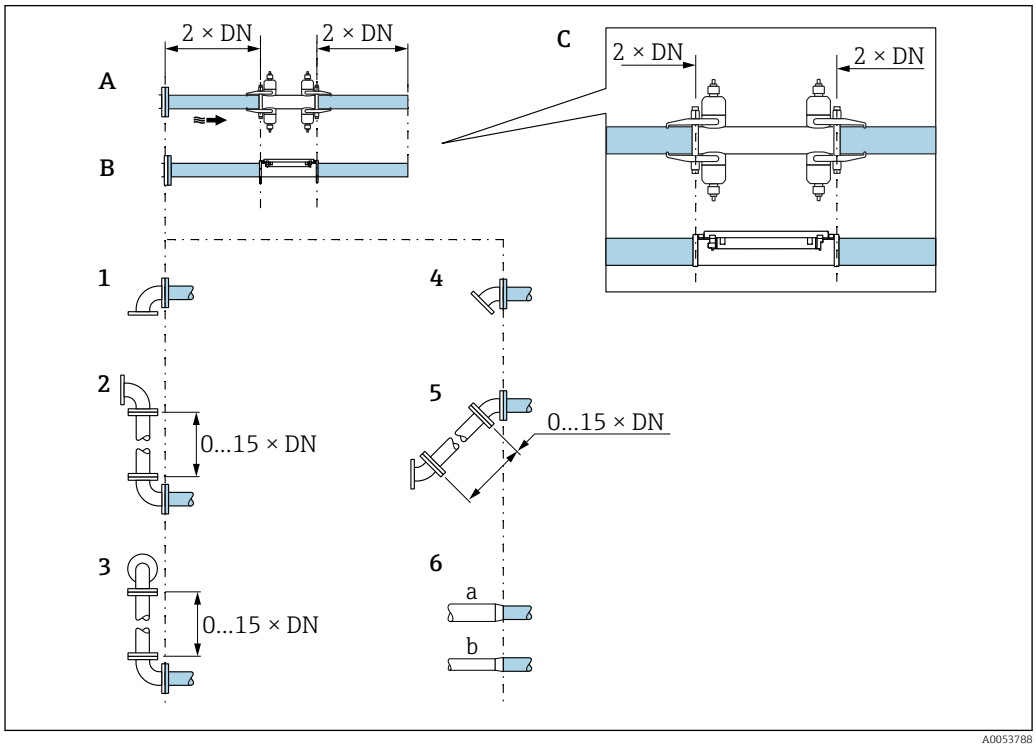
In the recommended installation range with a horizontal orientation (View B), gas and air accumulations at the top of the pipe and inteference from deposit buildup at the bottom of the pipe can influence the measurement to a lesser degree.

Inlet and outlet runs

If possible, install the sensors upstream of assemblies such as valves, T-pieces, elbows, and pumps. If this is not possible, the specified measurement accuracy of the measuring device is achieved by observing the specified minimum inlet and outlet runs with optimum sensor configuration. If there are several flow obstructions, the longest specified inlet run must be taken into account.

Inlet and outlet runs with FlowDC

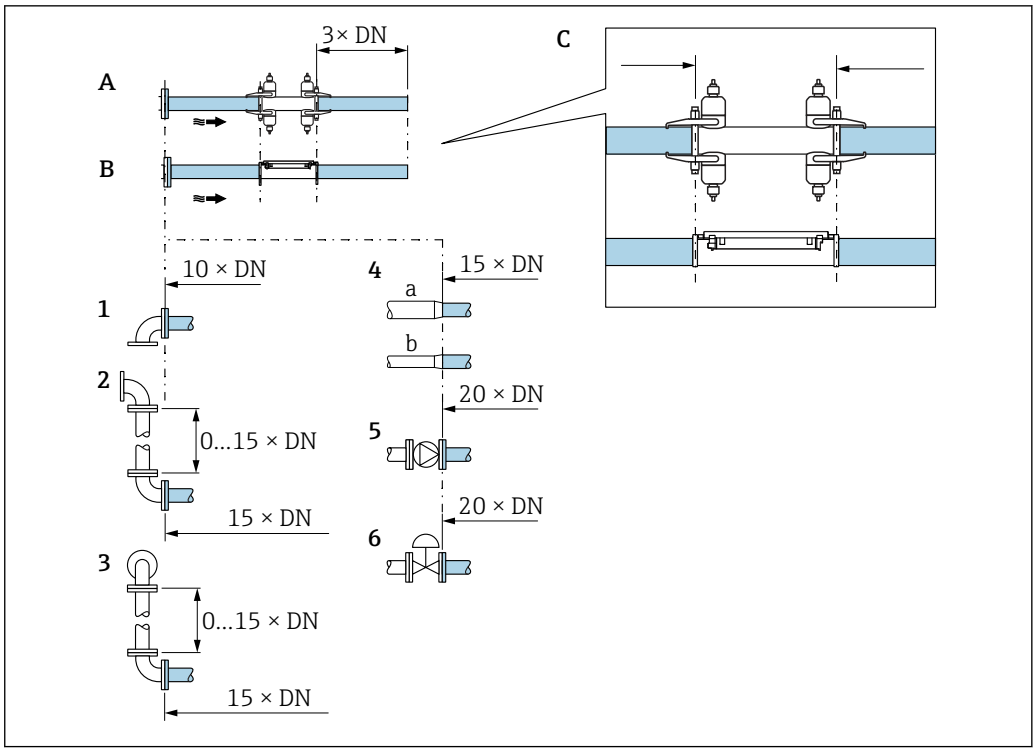
Shorter inlet and outlet runs are possible with the following device versions:
Two-path measurement with 2 sensor sets (order code for "Mounting type", option A2 "Clamp-on, 2-channel, 2-sensor sets") and FlowDC



A Inlet and outlet runs DN 50 to 4000 (2 to 160")
B Inlet and outlet runs DN 15 to 65 (½ to 2½")
C Position of inlet and outlet runs on sensor
1 Single elbow
2 Double elbow (2 × 90° in the same plane, with 0 to 15 x DN between the elbows)
3 Double elbow 3D (2 × 90° in different planes, with 0 to 15 x DN between the elbows)
4 45° bend
5 "2 x 45° bend" option (2 × 45° in the same plane, with 0 to 15 x DN between the elbows)
6a Concentric diameter change (contraction)
6b Concentric diameter change (expansion)

Inlet and outlet runs without FlowDC

Minimum inlet and outlet runs without FlowDC with 1 or 2 sensor sets with different flow obstructions



A Inlet and outlet runs DN 50 to 4000 (2 to 160")
B Inlet and outlet runs DN 15 to 65 (½ to 2½")
C Position of inlet and outlet runs on sensor
1 Pipe elbow 90° or 45°
2 Two pipe elbows 90° or 45° (in one plane, with 0 to 15 x DN between the elbows)
3 Two pipe elbows 90° or 45° (in two planes, with 0 to 15 x DN between the elbows)
4a Reduction
4b Extension
5 Control valve (2/3 open)
6 Pump

Mounting the sensor

WARNING

Risk of injury when mounting sensors and strapping bands!

▶ Suitable gloves and goggles must be worn due to the increased risk of cuts.

Sensor configuration and settings

DN 15 to 65 (½ to 2½")	DN 50 to 4000 (2 to 160")			
Strapping band	Strapping band		Welded bolt	
2 traverses [mm (in)]	1 traverse [mm (in)]	2 traverses [mm (in)]	1 traverse [mm (in)]	2 traverses [mm (in)]
Sensor distance [1]	Sensor distance [1]	Sensor distance [1]	Sensor distance [1]	Sensor distance [1]
–	Wire length → 🖹 37	Measuring rail [1] [2]	Wire length	Measuring rail [1] [2]

1) Depends on the conditions at the measuring point (e.g. measuring pipe, medium). The dimension can be determined via FieldCare or Applicator. See also **Result sensor distance / measuring aid** parameter in **Measuring point** submenu
2) Up to DN 600 (24")

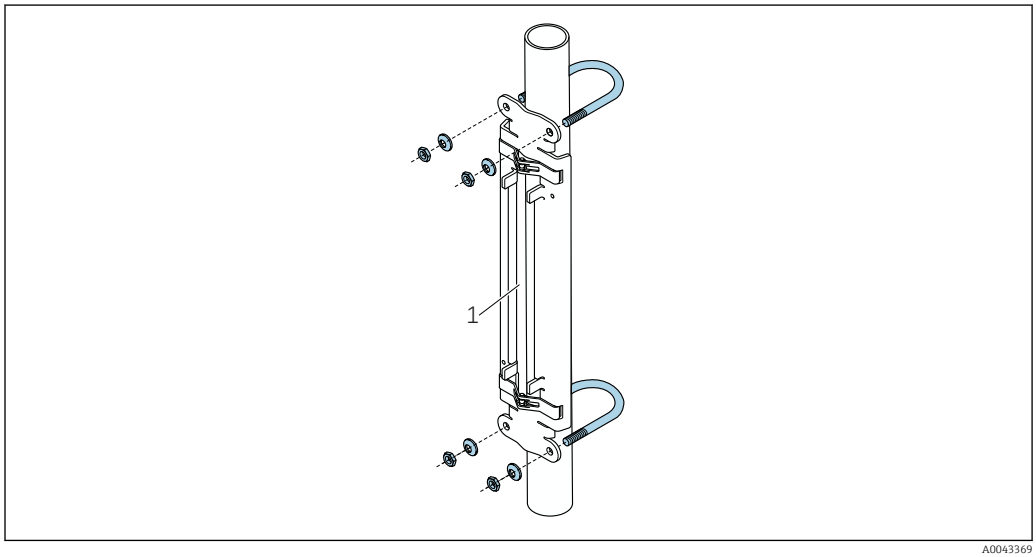
Determining the mounting positions of the sensor

Sensor holder with U-shaped screws)

Can be used for
- Measuring devices with measuring range DN 15 to 65 (½ to 2½")
- Mounting on pipes DN 15 to 32 (½ to 1¼")

Procedure:

1. Disconnect the sensor from the sensor holder.
2. Position the sensor holder on the measuring pipe.
3. Insert the U-shaped screws through the sensor holder and lightly grease the threads.
4. Screw the nuts onto the U-shaped screws.
5. Position the sensor holder exactly and tighten the nuts evenly.



21 Holder with U-shaped screws

1 Sensor holder

CAUTION

Damage to the plastic, copper or glass pipes due to overtightening the nuts of the U-shaped screws!

- The use of a metal half-shell (on the opposite side of the sensor) is recommended for plastic, copper or glass pipes.

To ensure good acoustic contact, the visible measuring pipe surface must be clean and free from flaking paint and/or rust.

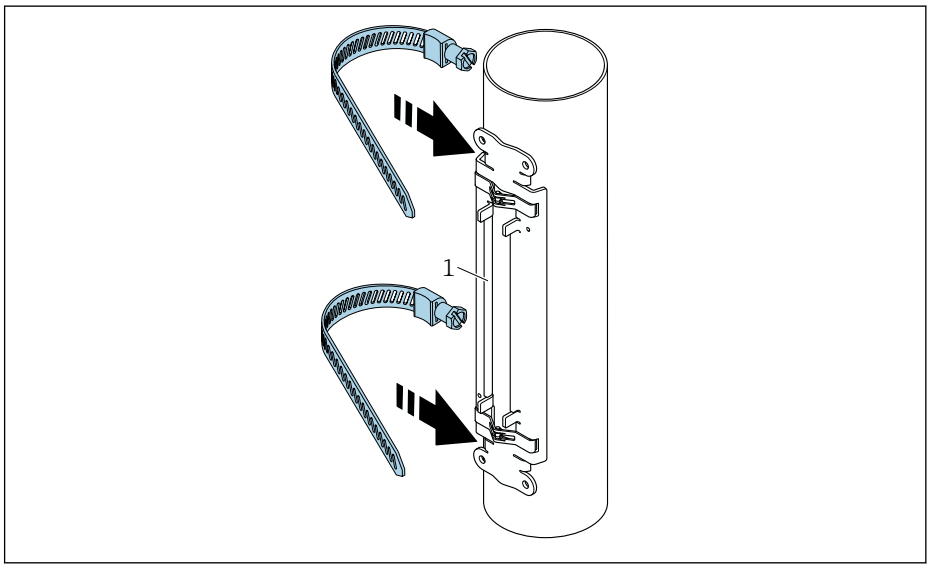
Sensor holder with strapping bands (small nominal diameters))

Can be used for
- Measuring devices with measuring range DN 15 to 65 (½ to 2½")
- Mounting on pipes DN > 32 (1¼")

Procedure:

1. Disconnect the sensor from the sensor holder.
2. Position the sensor holder on the measuring pipe.

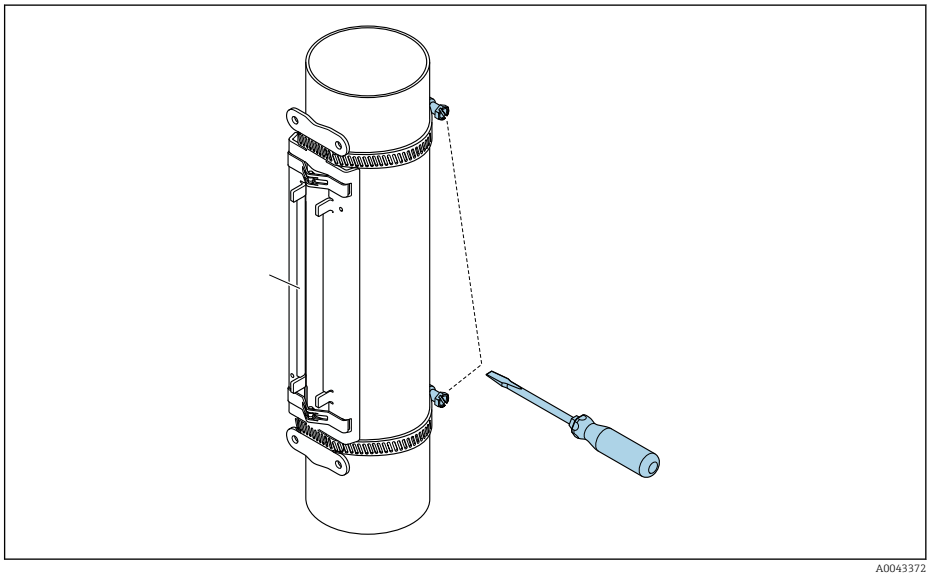
3. Wrap the strapping bands around the sensor holder and measuring pipe without twisting them.



22 *Position the sensor holder and fit the strapping bands.*

1 Sensor holder

4. Guide the strapping bands through the strapping band locks.
5. Tighten the strapping bands as tightly as possible by hand.
6. Align the sensor holder in the desired position.
7. Push down the tensioning screw and tighten the strapping bands so they cannot slip.



23 *Tighten the tensioning screws of the strapping bands.*

8. If necessary, shorten the strapping bands and trim the cut edges.

⚠ WARNING

Risk of injury due to sharp edges!

- ▶ After shortening the strapping bands, trim the cut edges.
- ▶ Wear suitable protective goggles and safety gloves.

To ensure good acoustic contact, the visible measuring pipe surface must be clean and free from flaking paint and/or rust.

Sensor holder with strapping bands (medium nominal diameters))

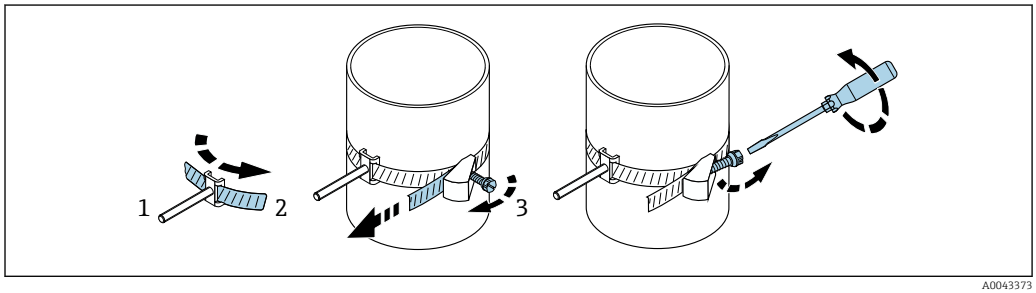
Can be used for
- Measuring devices with measuring range DN 50 to 4000 (2 to 160")
- Mounting on pipes DN ≤ 600 (24")

Procedure:

1. Fit the mounting bolt over strapping band 1.
2. Position strapping band 1 as perpendicular as possible to the measuring pipe axis without twisting it.
3. Guide the end of strapping band 1 through the strapping band lock.
4. Tighten strapping band 1 as tightly as possible by hand.
5. Align strapping band 1 in the desired position.
6. Push down the tensioning screw and tighten strapping band 1 so it cannot slip.
7. Strapping band 2: proceed as for strapping band 1 (steps 1 to 6).
8. Slightly tighten strapping band 2 for final assembly. It must be possible to move strapping band 2 for final alignment.
9. If necessary, shorten the strapping bands and trim the cut edges.

⚠ WARNING

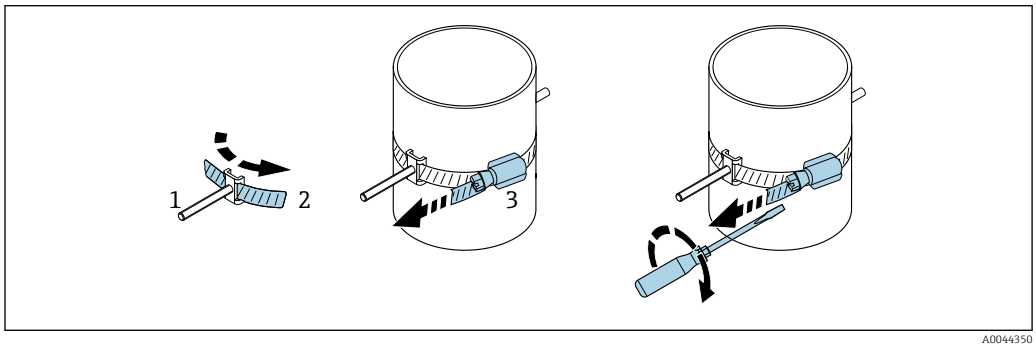
Risk of injury due to sharp edges!
- ▶ After shortening the strapping bands, trim the cut edges.
- ▶ Wear suitable protective goggles and safety gloves.



A0043373

24 Holder with strapping bands (medium nominal diameters), with hinged screw

1 Mounting bolts
2 Strapping band
3 Tensioning screw



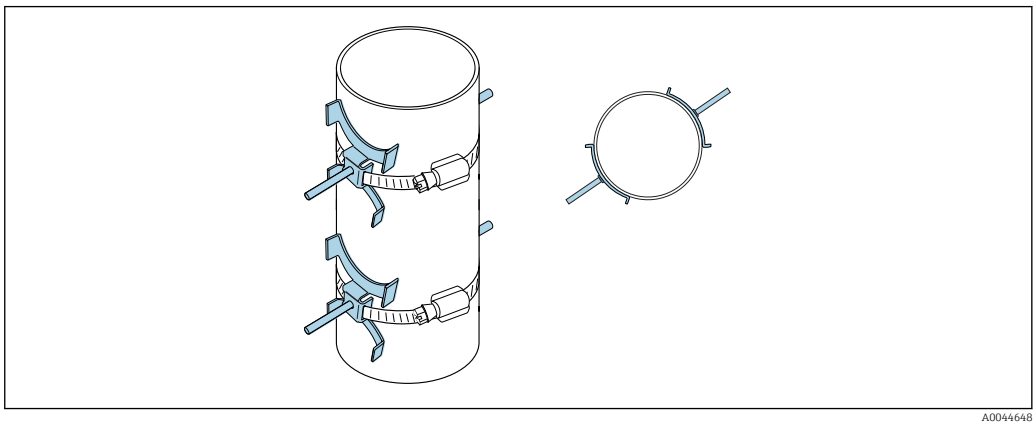
A0044350

25 Holder with strapping bands (medium nominal diameters), without hinged screw

1 Mounting bolts
2 Strapping band
3 Tensioning screw

Sensor holder with strapping bands (large nominal diameters))

Can be used for
- Measuring devices with measuring range DN 50 to 4000 (2 to 160")
- Mounting on pipes DN > 600 (24")
- 1-traverse mounting or 2-traverse mounting with 180° arrangement
- 2-traverse mounting with two-path measurement and 90° arrangement (instead of 180°)



A0044648

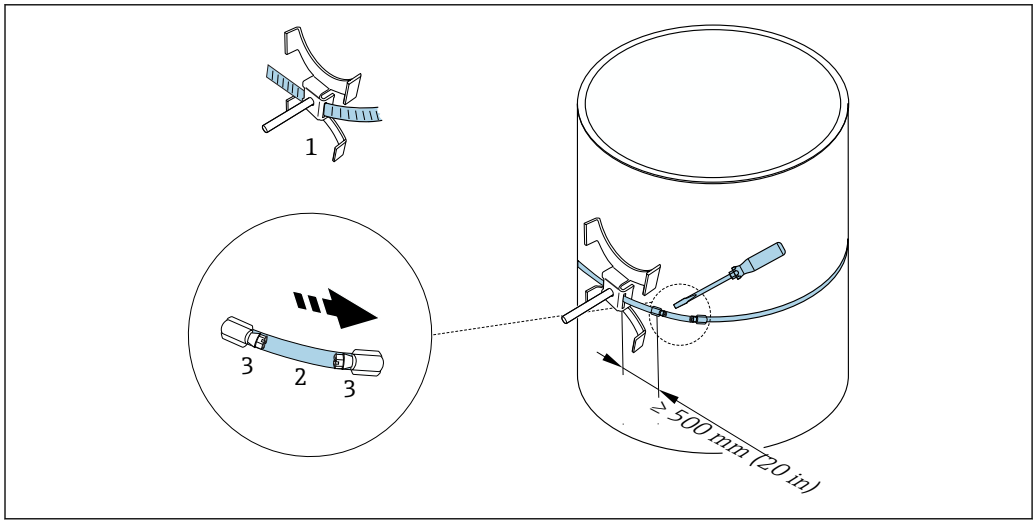
Procedure:

1. Measure the pipe circumference. Note down the full/half or quarter circumference.
2. Shorten the strapping bands to the required length (= measuring pipe circumference + 30 mm (1.18 in)) and trim the cut edges.
3. Select the mounting location of the sensors with the given sensor distance and optimum inlet run conditions,. In doing so, ensure there is nothing impeding sensor mounting over the entire circumference of the measuring pipe.
4. Fit two strap bolts over strapping band 1 and guide approx. 50 mm (2 in) of one of the strapping band ends into one of the two strapping band locks and into the lock. Then guide the protective flap over this strapping band end and lock in place.
5. Position strapping band 1 as perpendicular as possible to the measuring pipe axis without twisting it.
6. Guide the second strapping band end through the strapping band lock that is still free and proceed in the same way as for the first strapping band end. Guide the protective flap over the second strapping band end and lock in place.
7. Tighten strapping band 1 as tightly as possible by hand.
8. Align strapping band 1 in the desired position and place it as perpendicular as possible to the measuring pipe axis.
9. Position the two strap bolts on strapping band 1, arranging them at a half circumference in relation to one another (180° arrangement, e. g. 7:30 o'clock and 1:30 o'clock) or quarter circumference (90° arrangement, e.g. 10 o'clock and 7 o'clock).
10. Tighten strapping band 1 so that it cannot slip.
11. Strapping band 2: proceed as for strapping band 1 (steps 4 to 8).
12. Slightly tighten strapping band 2 for final assembly. It must be possible to move strapping band 2 for final alignment. The distance/offset from the center of strapping band 2 to the center of strapping band 1 is indicated by the sensor distance of the device.
13. Align strapping band 2 so that it is perpendicular to the measuring pipe axis and parallel to strapping band 1.
14. Position the two strap bolts on strapping band 2 on the measuring pipe so they are parallel to one another and offset at the same height/clock position (e. g. 10 o'clock and 4 o'clock) in relation to the two strap bolts on strapping band 1. A line drawn on the measuring pipe wall in parallel with the measuring pipe axis can be helpful here. Now set the distance between the center of the strap bolts at the same level so that it exactly matches the sensor distance. Alternatively, you can use the wire length here → 37.
15. Tighten strapping band 2 so that it cannot slip.

⚠ WARNING

Risk of injury due to sharp edges!

- ▶ After shortening the strapping bands, trim the cut edges.
- ▶ Wear suitable protective goggles and safety gloves.



26 *Holder with strapping bands (large nominal diameters)*

*1 Strap bolt with guide**
*2 Strapping band**
3 Tensioning screw

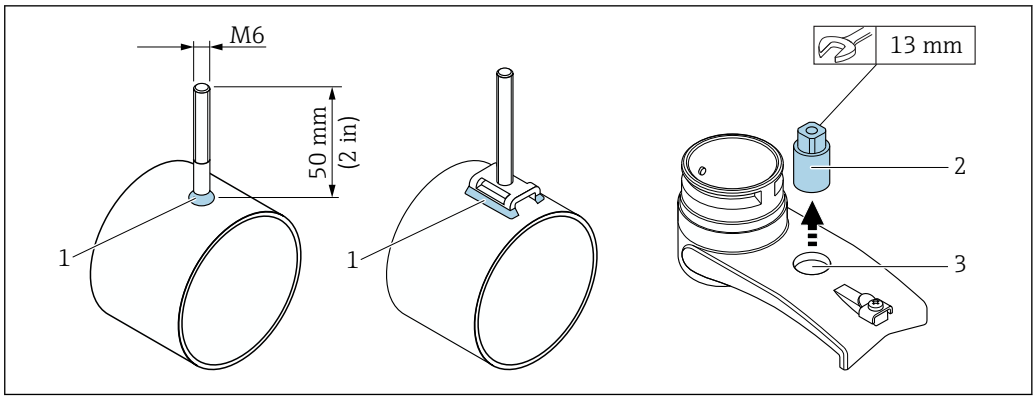
**The distance between the strap bolts and strapping band lock must be at least 500 mm (20 in).*

- For 1-traverse mounting with 180° (opposite) (single-path measurement, A0044304), (two-path measurement, A0043168)
- For 2-traverse mounting (single-path measurement, A0044305), (two-path measurement, A0043309)
- Electrical connection

Sensor holder with welded bolts)

Can be used for
- Measuring devices with measuring range DN 50 to 4000 (2 to 160")
- Mounting on pipes DN 50 to 4000 (2 to 160")

Procedure:
- The welded bolts must be fastened with the same installation distances as the mounting bolts with strapping bands. The following sections explain how to align the mounting bolts, depending on the mounting method and measurement method:
  - Installation for measurement via 1 traverse → 📄 36
  - Installation for measurement via 2 traverses → 📄 39
- The sensor holder is fastened as standard using a locking nut with a metric M6 ISO thread. If a different thread is to be used for fastening, a sensor holder with a detachable locking nut must be used.



27 *Holder with welded bolts*

1 Welding seam
2 Locking nut
3 Hole diameter max. 8.7 mm (0.34 in)

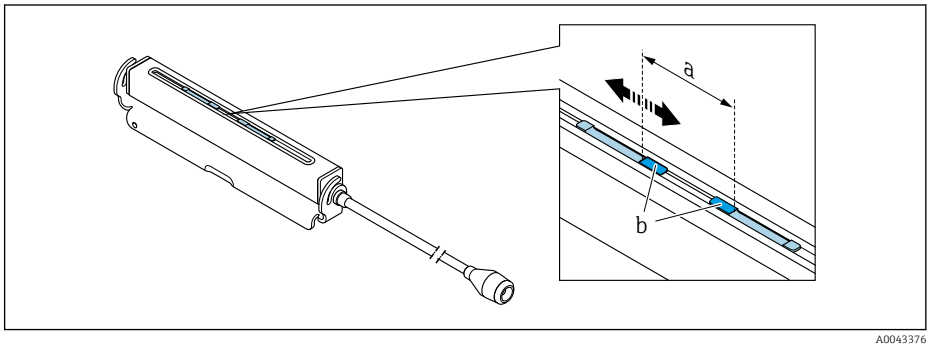
Installing sensor – small nominal diameters DN 15 to 65 (½ to 2½")

Requirements
- The installation distance is known
- Sensor holder is pre-assembled.

Material
The following material is required for mounting:
- Sensor incl. adapter cable
- Sensor cable for connection to the transmitter
- Coupling medium (coupling pad or coupling gel) for an acoustic connection between the sensor and pipe

Procedure:

1. Set the distance between the sensors to the value determined for the sensor distance. Press the movable sensor down slightly to move it.

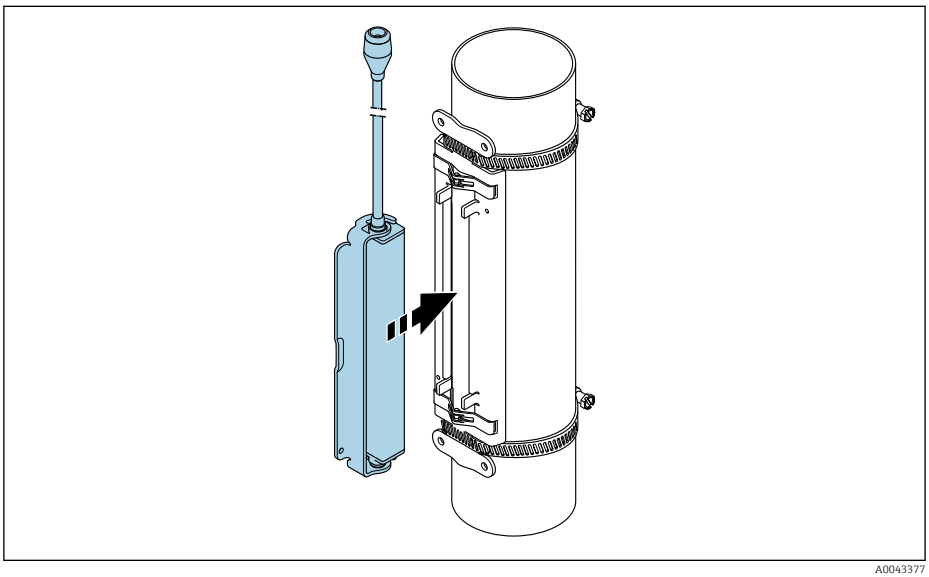


28 *Distance between sensors as per the installation distance*

a Sensor distance (back of sensor must touch the surface)
b Sensor contact surfaces

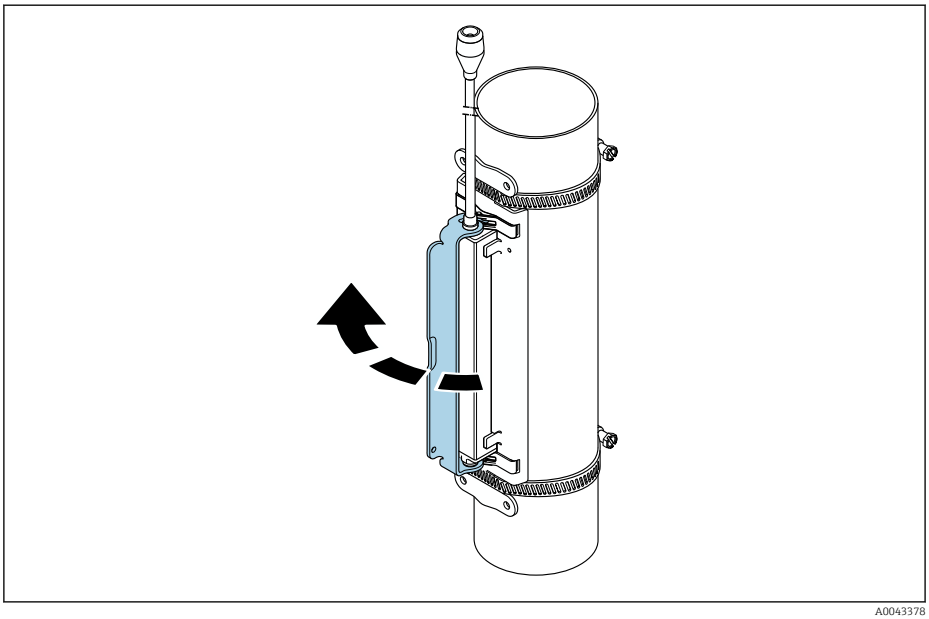
2. Stick the coupling pad under the sensor onto the measuring pipe. Alternatively, coat the contact surfaces of the sensor (b) evenly with coupling gel (approx. 0.5 to 1 mm (0.02 to 0.04 in)).

3. Position the sensor housing on the sensor holder.



29 *Positioning the sensor housing*

4. Attach the sensor housing to the sensor holder by locking the bracket into place.



30 *Fastening the sensor housing*

5. Connect the sensor cable to the adapter cable.
   → This completes the mounting procedure. The sensors can be connected to the transmitter via the connecting cables.

- To ensure good acoustic contact, the visible measuring pipe surface must be clean and free from flaking paint and/or rust.
- If necessary, the holder and sensor housing can be secured with a screw/nut or a lead seal (not supplied).
- The bracket can only be released using an auxiliary tool e.g. screwdriver).

Installing sensors – medium/large nominal diameters DN 50 to 4000 (2 to 160")

Installation for measurement via 1 traverse

Requirements
- The installation distance and wire length are known
- Strapping bands are pre-assembled.

Material

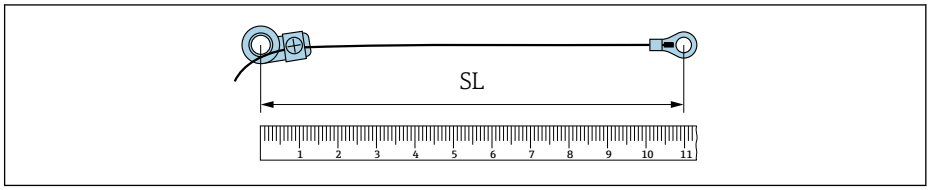
The following material is required for mounting:

- Two strapping bands incl. mounting bolts and centering plates where necessary (already pre-assembled → 32, → 33)
- Two measuring wires, each with a cable lug and a fixer to fix the strapping bands
- Two sensor holders
- Coupling medium (coupling pad or coupling gel) for the acoustic connection between the sensor and pipe
- Two sensors incl. connecting cables

Installation is unproblematic up to DN 400 (16"); as of DN 400 (16") check the distance and angle (180°, ±5°) diagonally with the wire length.

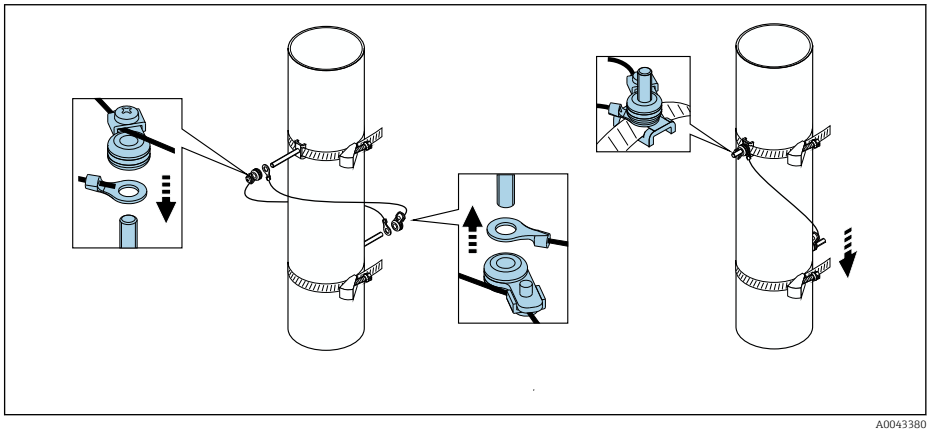
Procedure for using measuring wires:

1. Prepare the two measuring wires: arrange the cable lugs and fixer such that the distance they are apart corresponds to the wire length (SL). Screw the fixer onto the measuring wire.



31 Fixer and cable lugs at a distance that corresponds to the wire length (SL)

2. With measuring wire 1: fit the fixer over the mounting bolt of strapping band 1 that is already securely mounted. Run measuring wire 1 clockwise around the measuring pipe. Fit the cable lug over the mounting bolt of strapping band 2 that can still be moved.
3. With measuring wire 2: fit the cable lug over the mounting bolt of strapping band 1 that is already securely mounted. Run measuring wire 2 counterclockwise around the measuring pipe. Fit the fixer over the mounting bolt of strapping band 2 that can still be moved.
4. Take strapping band 2 (still movable), including the mounting bolt, and move it until both measuring wires are evenly tensioned. Then tighten strapping band 2 so that it cannot slip. Then check the sensor distance from the middle of the strapping bands. If the distance is too small, release strapping band 2 again and position it better. The two strapping bands should be as perpendicular as possible to the measuring pipe axis and parallel to one another.



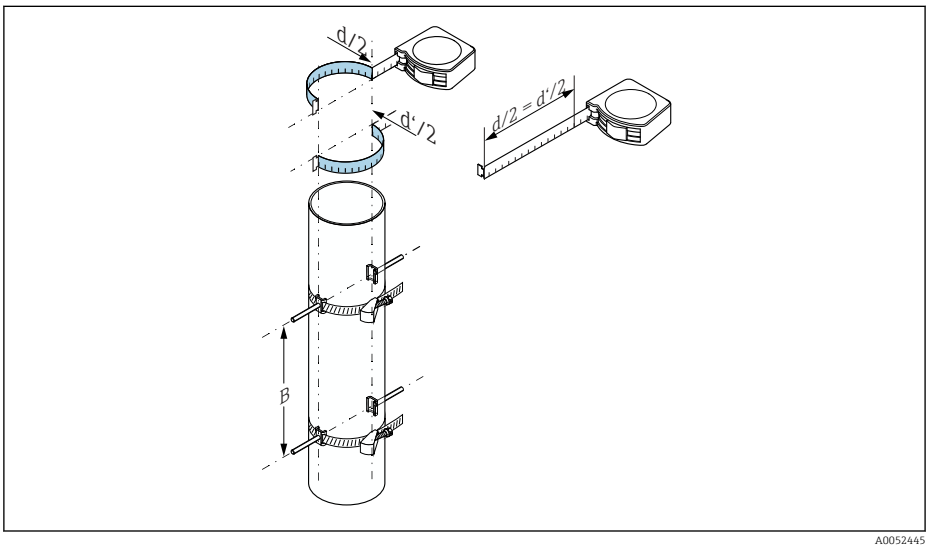
32 Positioning the strapping bands (steps 2 to 4)

5. Loosen the screws of the fixers on the measuring wires and remove the measuring wires from the mounting bolts.

Procedure with a tape measure:

1. Use a tape measure to determine the pipe diameter d.
2. Mount the opposite mounting bolt at d/2 from the front mounting bolt. The distance must be d/2 = d'/2 on both sides.

3. Check distance B.

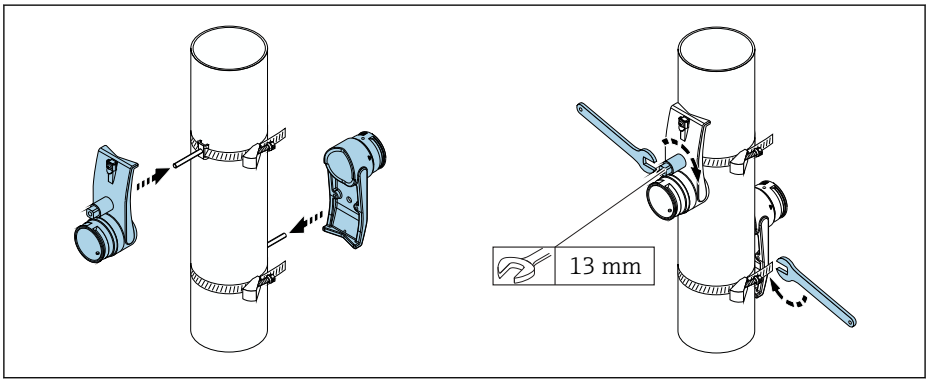


A0052445

33 *Positioning the strapping bands and mounting bolts with a tape measure (steps 2 to 4)*

Fastening the sensors:

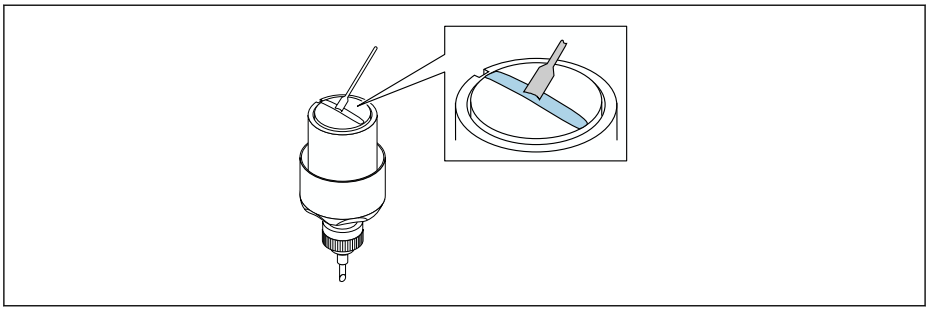
1. Fit the sensor holders over the individual mounting bolts and tighten securely with the locking nut.



A0043381

34 *Mounting the sensor holders*

2. Stick the coupling pad under the sensor → 66. Alternatively, coat the contact surfaces of the sensor evenly with coupling gel (approx. 1 mm (0.04 in)). In doing so, start from the groove through the center to the opposite edge.

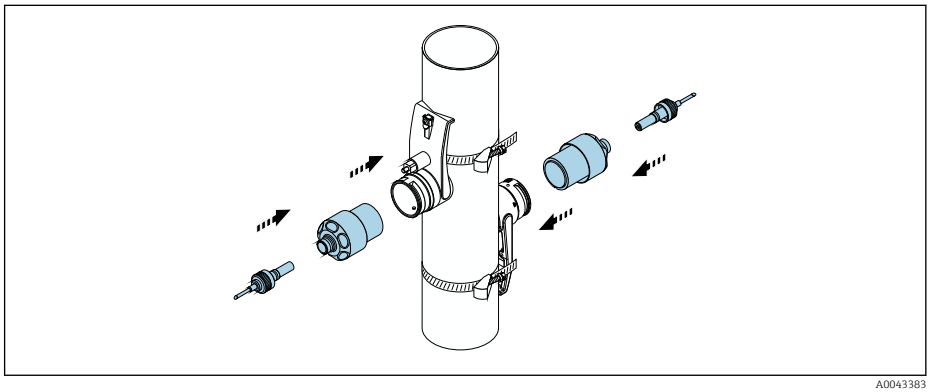


A0043382

35 *Coating the contact surfaces of the sensor with coupling gel (if there is no coupling pad)*

3. Insert the sensor into the sensor holder.
4. Fit the sensor cover on the sensor holder and turn until the sensor cover engages with a click and the arrows (▲ / ▼ "close") are pointing towards one another.

5. Insert the sensor cable into each individual sensor until the end stop.



36 *Mounting the sensors and connecting the sensor cables*

This completes the mounting procedure. The sensors can now be connected to the transmitter via the sensor cables and the error message can be checked in the sensor check function.

- To ensure good acoustic contact, the visible measuring pipe surface must be clean and free from flaking paint and/or rust.
- If the sensor is removed from the measuring pipe, it must be cleaned and new coupling gel applied (if there is no coupling pad).
- On rough measuring pipe surfaces, the gaps in the rough surface must be filled with sufficient amounts of coupling gel if use of the coupling pad does not suffice (installation quality check).

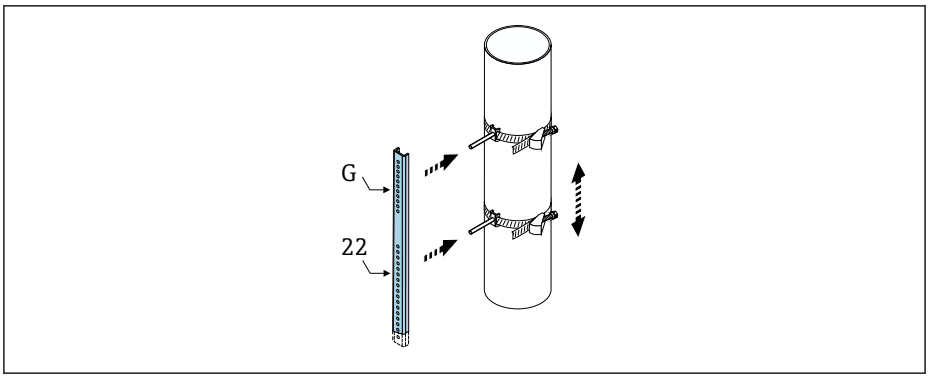
Installation for measurement via 2 traverses

Requirements
- The installation distance is known.
- Strapping bands are pre-assembled.

Material
The following material is required for mounting:
- Two strapping bands incl. mounting bolts and centering plates where necessary (already pre-assembled → 32, → 33)
- A mounting rail to position the strapping bands:
  - Short rail up to DN 200 (8")
  - Long rail up to DN 600 (24")
  - No rail > DN 600 (24"), as distance measured by sensor distance between the mounting bolts
- Two mounting rail holders
- Two sensor holders
- Coupling medium (coupling pad or coupling gel) for an acoustic connection between the sensor and pipe
- Two sensors incl. connecting cables
- Open-ended wrench (13 mm)
- Screw driver

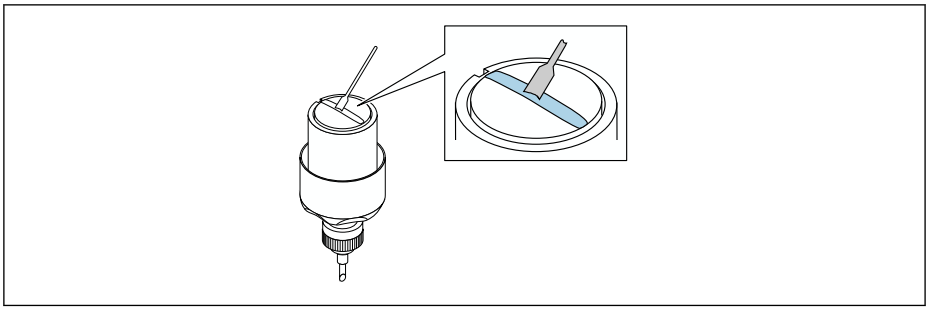
Procedure:

1. Position the strapping bands using the mounting rail [only DN50 to 600 (2 to 24"), for larger nominal diameters, measure the distance between the center of the strap bolts directly]: Fit the mounting rail with the bore identified by the letter (from the **Result sensor distance / measuring aid** parameter) over the mounting bolt of strapping band 1 that is fixed in place. Position the adjustable strapping band 2 and fit the mounting rail with the bore identified by the numerical value over the mounting bolt.



37 Determining the distance in accordance with the mounting rail (e.g. G22).

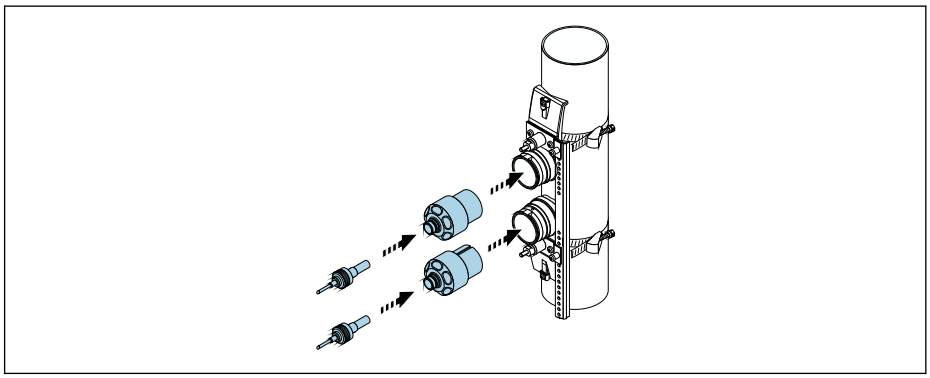
2. Tighten strapping band 2 so that it cannot slip.
3. Remove the mounting rail from the mounting bolt.
4. Fit the sensor holders over the individual mounting bolts and tighten securely with the locking nut.
5. Place the coupling pad under the sensor → 66. Alternatively, coat the contact surfaces of the sensor evenly with coupling gel (approx. 1 mm (0.04 in)). In doing so, start from the groove through the center to the opposite edge.



38 Coating the contact surfaces of the sensor with coupling gel (if there is no coupling pad)

6. Insert the sensor into the sensor holder.
7. Fit the sensor cover on the sensor holder and turn until the sensor cover engages with a click and the arrows (▲ / ▼ "close") are pointing towards one another.

8. Insert the sensor cable into each individual sensor until the end stop and tighten the locking nut.



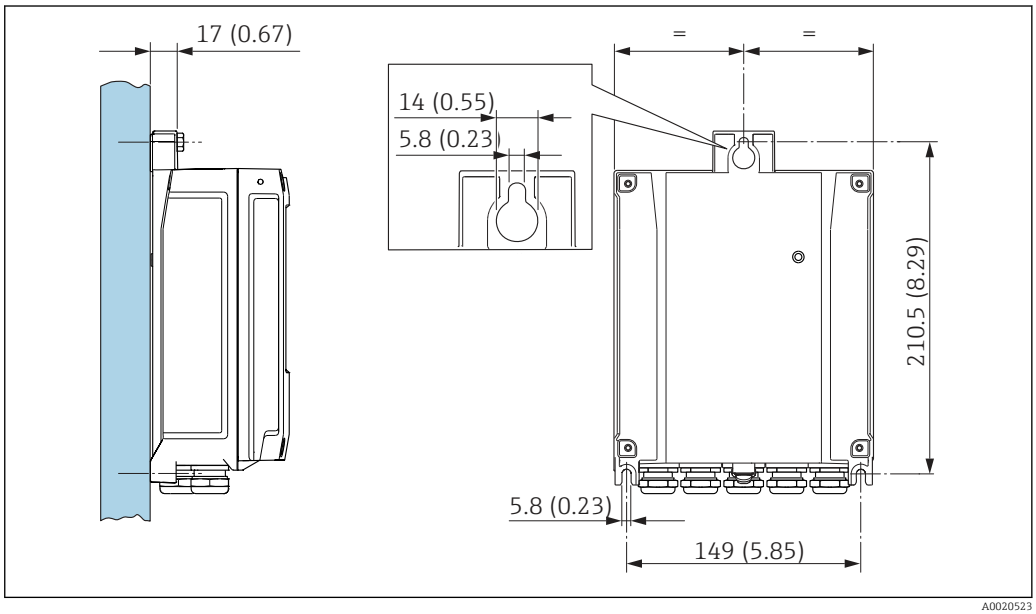
39 *Mounting the sensors and connecting the sensor cables*

This completes the mounting procedure. The sensors can now be connected to the transmitter via the sensor cables and the error message can be checked in the sensor check function.

- To ensure good acoustic contact, the visible measuring pipe surface must be clean and free from flaking paint and/or rust.
- If the sensor is removed from the measuring pipe, it must be cleaned and new coupling gel applied (if there is no coupling pad).
- On rough measuring pipe surfaces, the gaps in the rough surface must be filled with sufficient amounts of coupling gel if use of the coupling pad does not suffice (installation quality check).

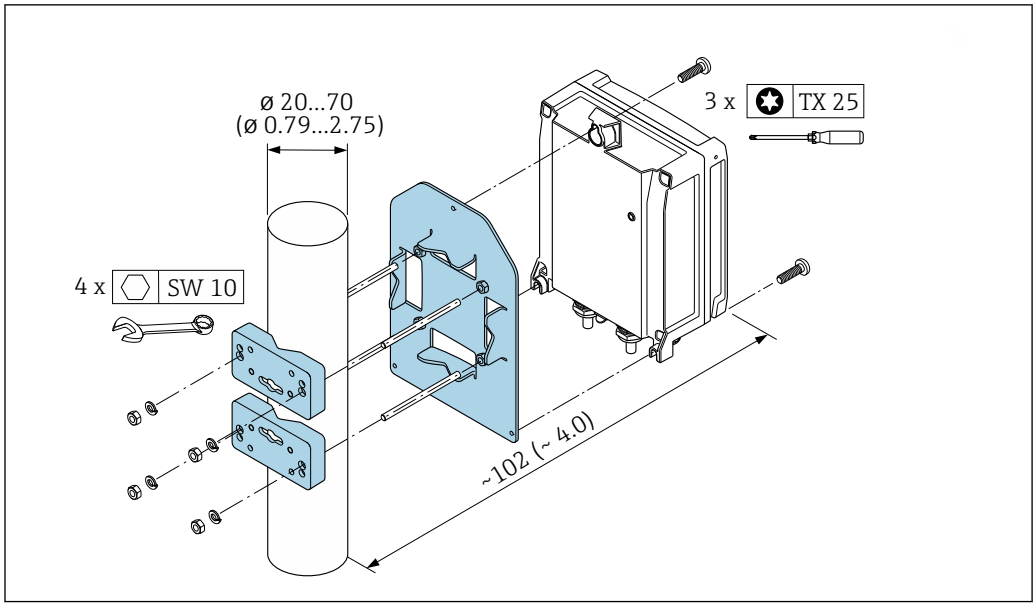
Mounting the transmitter housing

Wall mounting



40 *Unit mm (in)*

Post mounting



41 *Unit mm (in)*

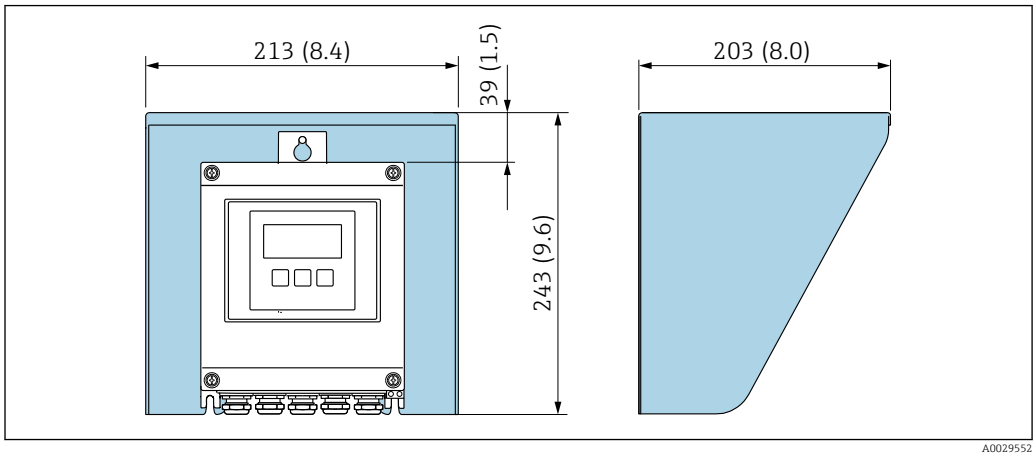
Special mounting instructions

Display guard

To ensure that the display guard can be easily opened, maintain the following minimum head clearance: 350 mm (13.8 in)

Display guard available as an accessory → 62.

Weather protection cover



42 *Weather protection cover; engineering unit mm (in)*

Environment

Ambient temperature range

Transmitter	–40 to +60 °C (–40 to +140 °F)
Readability of the local display	–20 to +60 °C (–4 to +140 °F) The readability of the display may be impaired at temperatures outside the temperature range.

Sensor	DN 15 to 65 (½ to 2½") −40 to +130 °C (−40 to +266 °F) DN 50 to 4000 (2 to 160") ▪ Standard: −20 to +80 °C (−4 to +176 °F) ▪ Optional: −40 to +130 °C (−40 to +266 °F)
Sensor cable (connection between transmitter and sensor)	DN 15 to 65 (½ to 2½") Standard (TPE): −40 to +80 °C (−40 to +176 °F) DN 50 to 4000 (2 to 160") ▪ Standard (TPE halogen-free): −40 to +80 °C (−40 to +176 °F) ▪ Optional (PTFE): −40 to +130 °C (−40 to +266 °F)

In principle, it is permitted to insulate the sensors mounted on the pipe. In the case of insulated sensors, make sure that the process temperature does not exceed or drop below the specified cable temperature.

▶ If operating outdoors:
Avoid direct sunlight, particularly in warm climatic regions.

Storage temperature

The storage temperature for all components (except display modules and order code for "Sensor version", options AG, AH) corresponds to the ambient temperature range→ 42.

Display modules

−40 to +60 °C (−40 to +140 °F)

Relative humidity

The device is suitable for use outdoors and indoors with a relative humidity of 5 to 95 %.

Operating height

According to EN 61010-1
▪ ≤ 2 000 m (6 562 ft)
▪ > 2 000 m (6 562 ft) with additional overvoltage protection (e.g. Endress+Hauser HAW Series)

Degree of protection

Transmitter

▪ IP66/67, type 4X enclosure, suitable for pollution degree 4
▪ When the housing is open: IP20, type 1 enclosure, suitable for pollution degree 2
▪ Display module: IP20, type 1 enclosure, suitable for pollution degree 2

Sensor

▪ Standard: IP66/67, type 4X enclosure, suitable for pollution degree 4
▪ Optionally available: IP68, type 6P enclosure, suitable for pollution degree 4

External WLAN antenna

IP67

Shock and vibration resistance

Vibration sinusoidal, in accordance with IEC 60068-2-6

▪ 2 to 8.4 Hz, 7.5 mm peak
▪ 8.4 to 2 000 Hz, 2 g peak for transmitter, 1 g peak for sensor

Vibration broad-band random, according to IEC 60068-2-64

▪ 10 to 200 Hz, 0.01 g^2/Hz
▪ 200 to 2 000 Hz, 0.003 g^2/Hz
▪ Total: 2.70 g rms

Shock half-sine, according to IEC 60068-2-27

6 ms 50 g

Rough handling shocks according to IEC 60068-2-31

Electromagnetic compatibility (EMC)

- As per IEC/EN 61326 and NAMUR Recommendation 21 (NE 21)
- As per IEC/EN 61000-6-2 and IEC/EN 61000-6-4
- Complies with emission limits for industry as per EN 55011 (Class A)

Details are provided in the Declaration of Conformity.

This unit is not intended for use in residential environments and cannot guarantee adequate protection of the radio reception in such environments.

Process

Medium temperature range

Sensor version	Frequency	Temperature
C-030-A	0.3 MHz	−20 to +80 °C (−4 to +176 °F) −40 to +80 °C (−40 to +176 °F)
C-050-A	0.5 MHz	−20 to +80 °C (−4 to +176 °F)
C-100-A	1 MHz	−20 to +80 °C (−4 to +176 °F)
C-200-A	2 MHz	−20 to +80 °C (−4 to +176 °F)
C-500-A	5 MHz	−20 to +80 °C (−4 to +176 °F) −40 to +80 °C (−40 to +176 °F) 0 to +130 °C (+32 to +266 °F)
C-100-B	1 MHz	−40 to +80 °C (−40 to +176 °F)
C-200-B	2 MHz	−40 to +80 °C (−40 to +176 °F)
C-100-C	1 MHz	0 to +130 °C (+32 to +266 °F)
C-200-C	2 MHz	0 to +130 °C (+32 to +266 °F)

Sound velocity range

600 to 3 000 m/s (1 969 to 9 843 ft/s)

Medium pressure range

No pressure limitation For correct measurement, the static pressure of the medium must be higher than the vapor pressure.

Flow limit

For an overview of the full scale values for the measuring range, see the "Measuring range" section

- The minimum recommended full scale value is approx. 1/20 of the maximum full scale value.
- In most applications, 10 to 50 % of the maximum full scale value can be considered ideal.

Pressure loss

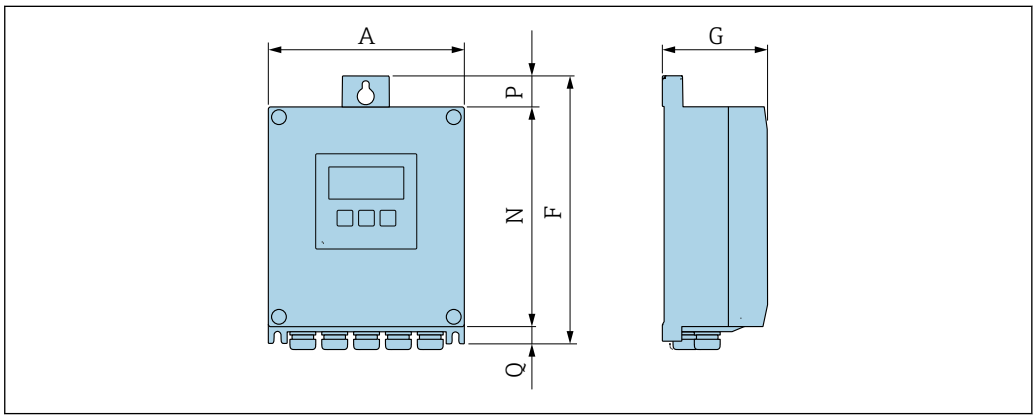
There is no pressure loss.

Mechanical construction

Dimensions in SI units

Transmitter remote version

Order code for "Housing", option N "Remote, polycarbonate" or option P "Remote, aluminum coated"



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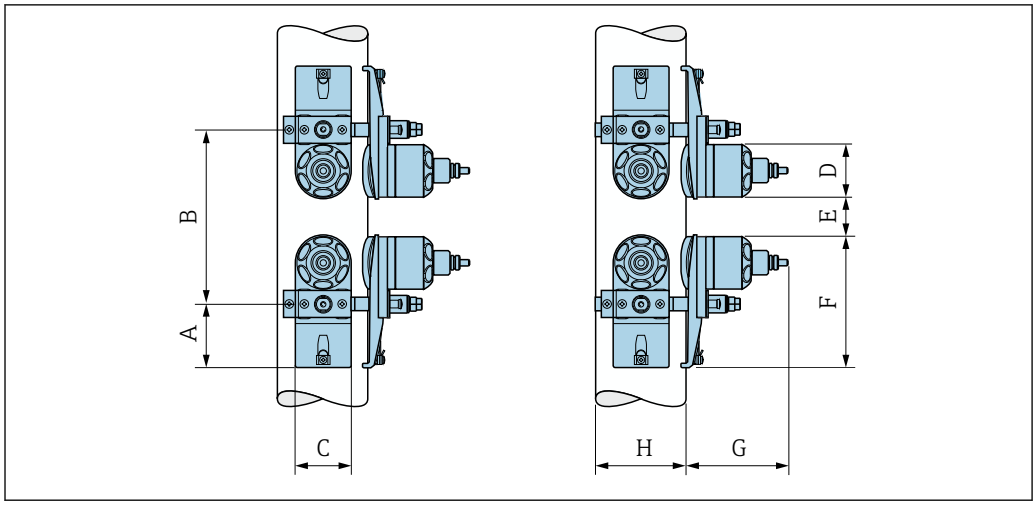
Order code for "Transmitter housing", option P "Remote, aluminum, coated"

A [mm]	F [mm]	G [mm]	N [mm]	P [mm]	Q [mm]
167	232	80	187	24	21

Order code for "Transmitter housing", option N "Remote, polycarbonate"

A [mm]	F [mm]	G [mm]	N [mm]	P [mm]	Q [mm]
177	234	90	197	17	22

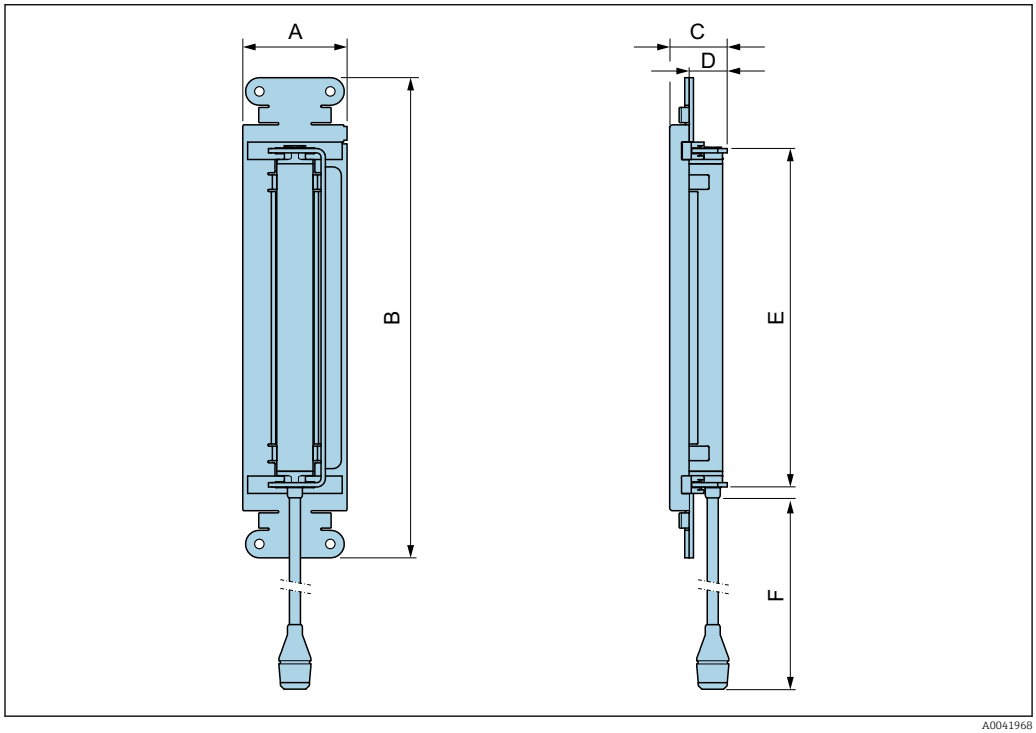
Sensor remote version



43 *DN 50 to 4000: measurement with 2 sensor sets*

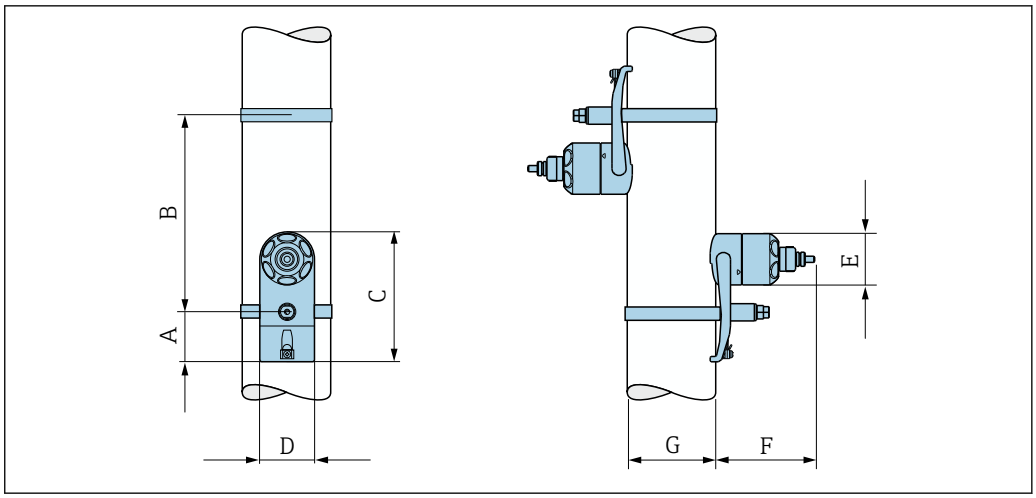
A [mm]	B [mm]	C [mm]	D [mm]	E_{min} [mm]	F [mm]	G [mm]	H [mm]
56	* 1)	62	Ø 58	0.5	145	111	Measuring pipe outer diameter

1) Depends on the conditions at the measuring point (measuring pipe, medium etc.). The dimension can be determined via FieldCare or Applicator.



44 *DN 15 to 65*

A [mm]	B [mm]	C [mm]	D [mm]	E [mm]	F [mm]
72	331	39	28	233	450



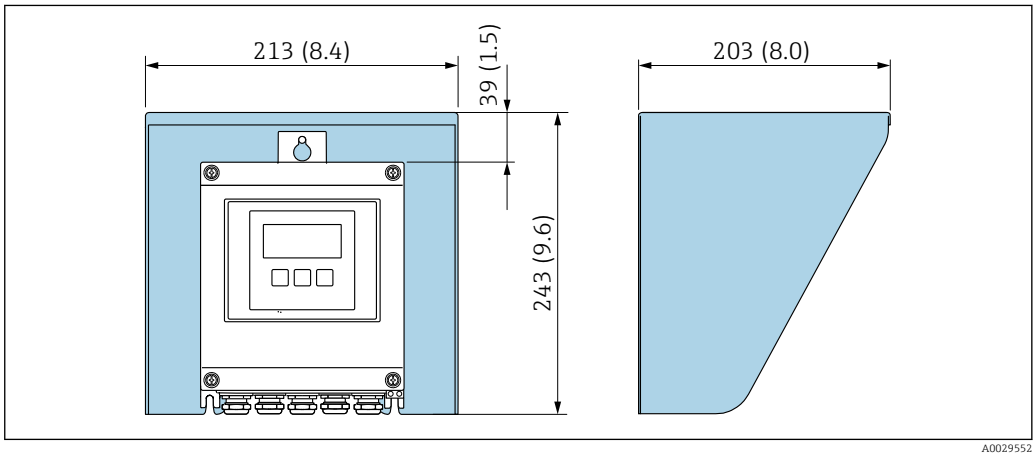
45 *DN 50 to 4000: measurement with 1 sensor set*

A [mm]	B [mm]	C [mm]	D [mm]	E [mm]	F [mm]	G [mm]
56	* 1)	145	62	Ø 58	111	Measuring pipe outer diameter

1) Depends on the conditions at the measuring point (measuring pipe, medium etc.). The dimension can be determined via FieldCare or Applicator.

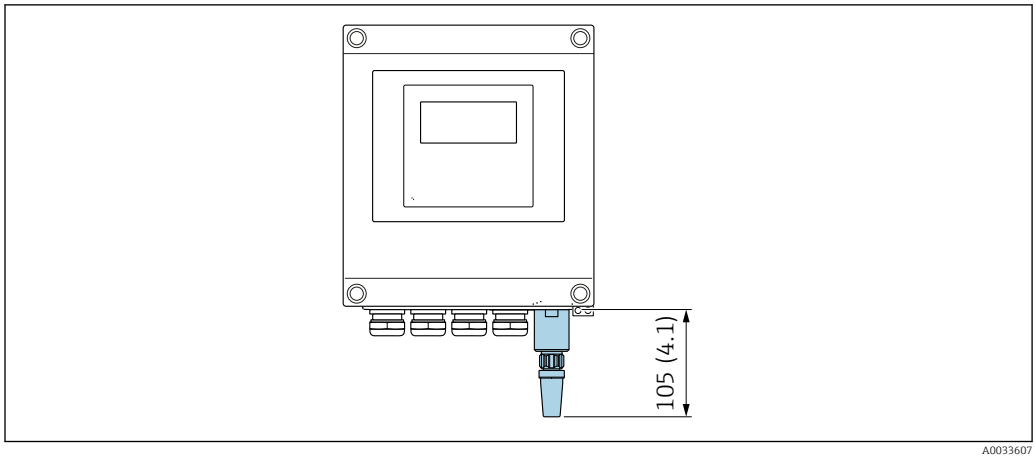
Accessories

Weather protection cover



46 *Weather protection cover; engineering unit mm (in)*

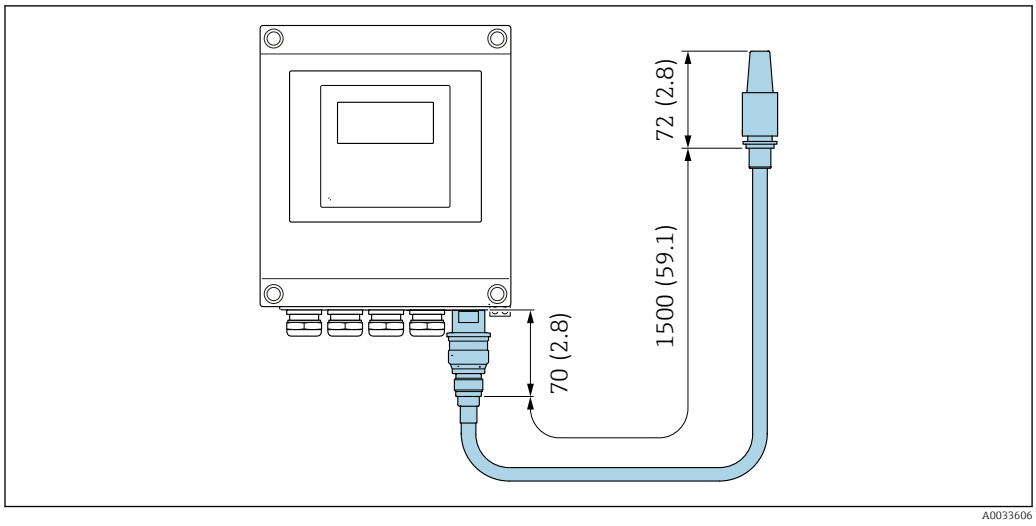
External WLAN antenna mounted on device



47 *Engineering unit mm (in)*

External WLAN antenna mounted with cable

The external WLAN antenna can be mounted separately from the transmitter if the transmission/ reception conditions at the transmitter mounting location are poor.

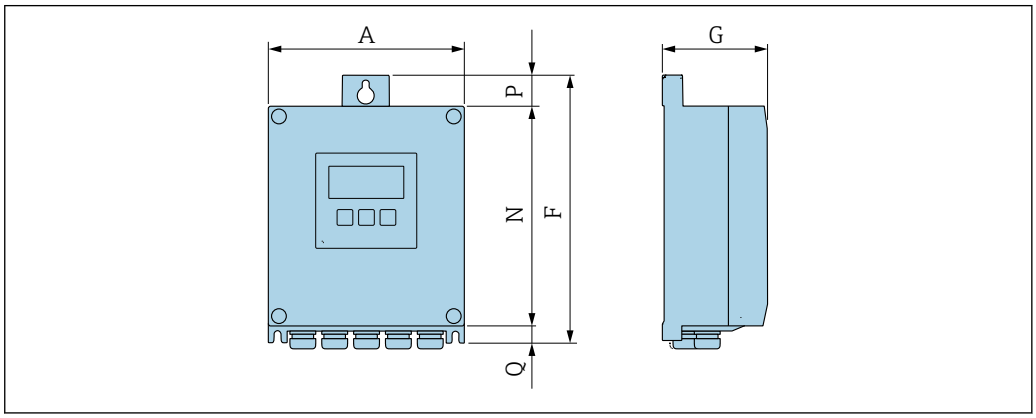


48 *Engineering unit mm (in)*

Dimensions in US units

Transmitter remote version

Order code for "Housing", option N "Remote, polycarbonate" or option P "Remote, aluminum coated"



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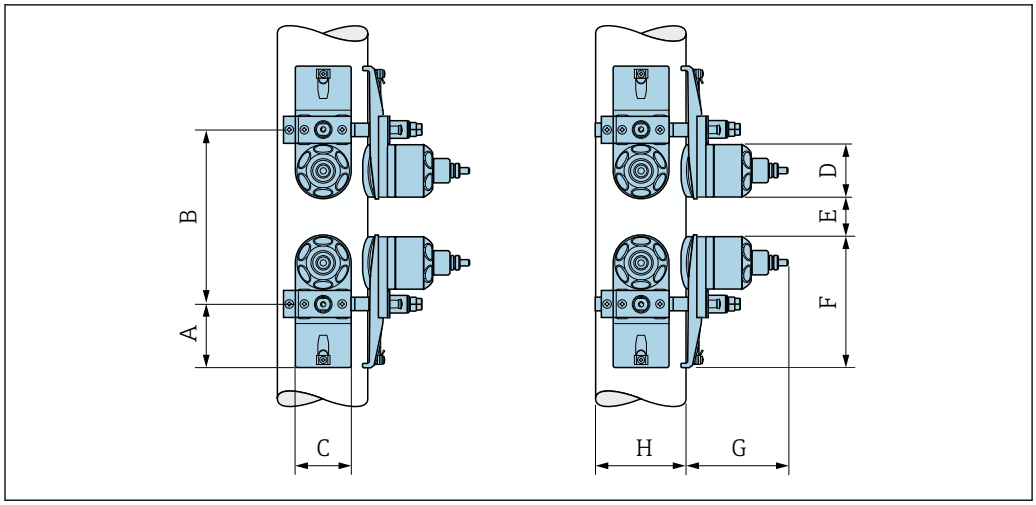
Order code for "Transmitter housing", option P "Remote, aluminum, coated"

A [in]	F [in]	G [in]	N [in]	P [in]	Q [in]
6.57	9.13	3.15	7.36	0.94	0.83

Order code for "Transmitter housing", option N "Remote, polycarbonate"

A [in]	F [in]	G [in]	N [in]	P [in]	Q [in]
6.97	9.21	3.54	7.76	0.67	0.87

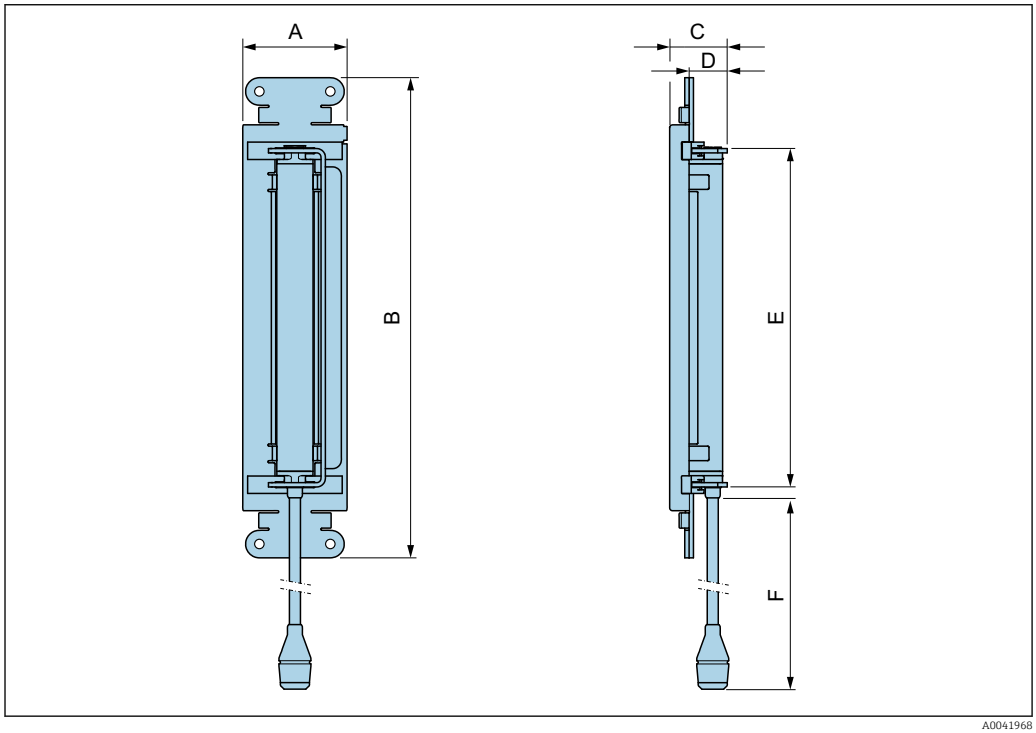
Sensor remote version



49 *DN 2 to 160": measurement with 2 sensor sets*

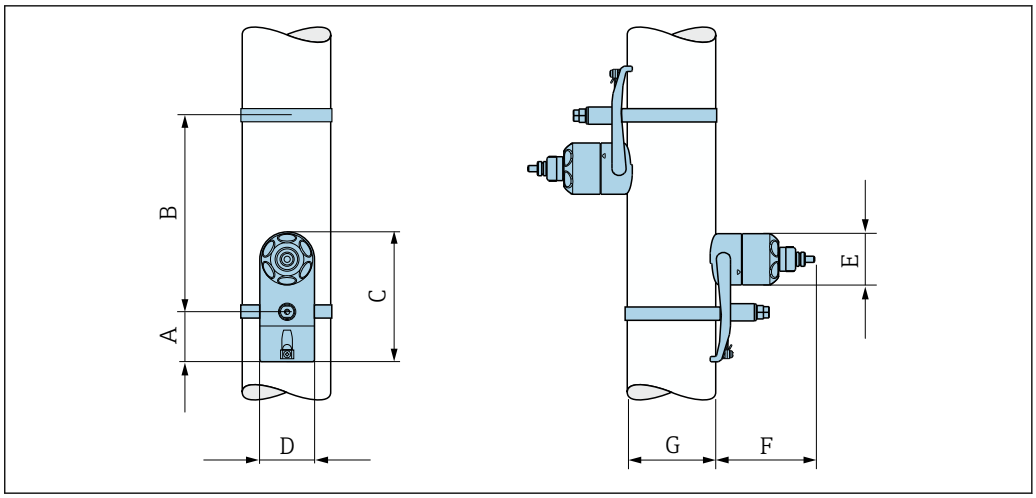
A [in]	B [in]	C [in]	D [in]	E_{min} [in]	F [in]	G [in]	H [in]
2.20	* 1)	2.44	ø 2.28	0.20	5.71	4.37	Measuring pipe outer diameter

1) Depends on the conditions at the measuring point (measuring pipe, medium etc.). The dimension can be determined via FieldCare or Applicator.



50 *DN ½ to 2½"*

A [in]	B [in]	C [in]	D [in]	E [in]	F [in]
2.83	13.0	1.54	1.10	9.17	17.7



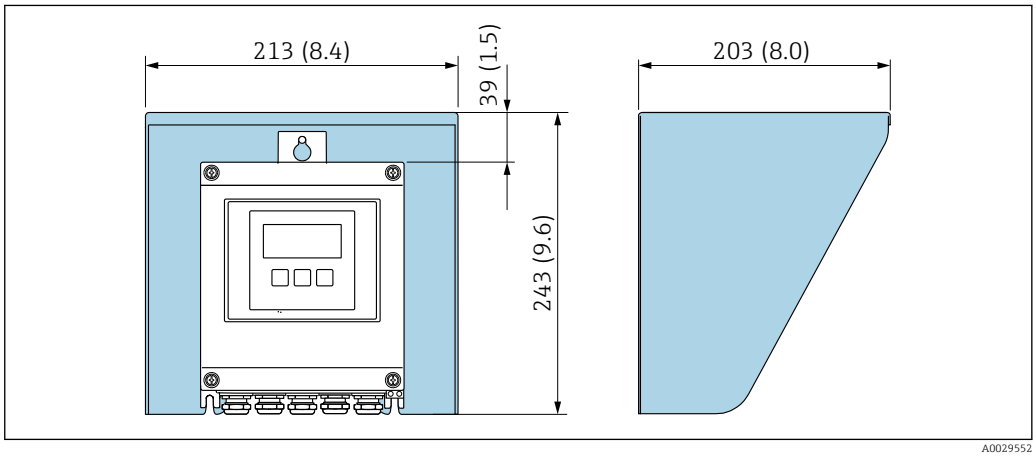
51 *DN 2 to 160": measurement with 1 sensor set*

A [in]	B [in]	C [in]	D [in]	E [in]	F [in]	G [in]
2.20	* 1)	5.71	2.44	Ø 2.28	4.37	Measuring pipe outer diameter

1) Depends on the conditions at the measuring point (measuring pipe, medium etc.). The dimension can be determined via FieldCare or Applicator.

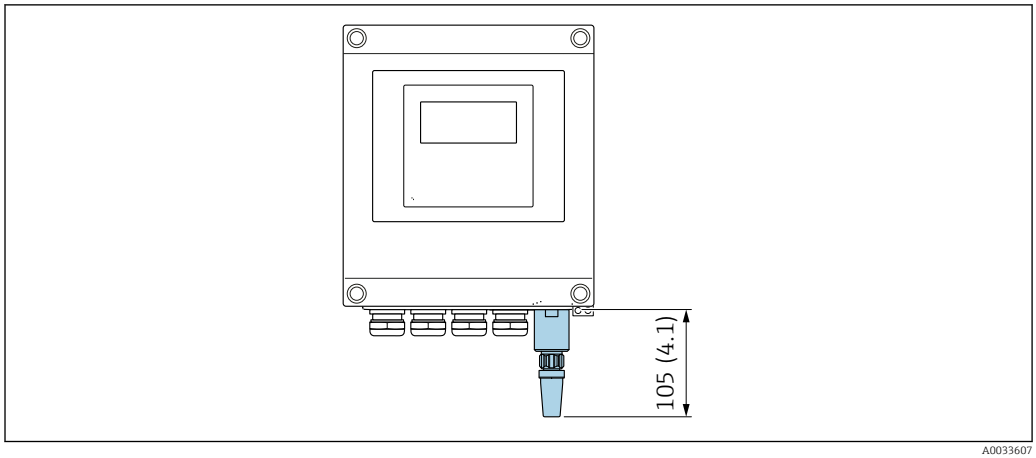
Accessories

Weather protection cover



52 *Weather protection cover; engineering unit mm (in)*

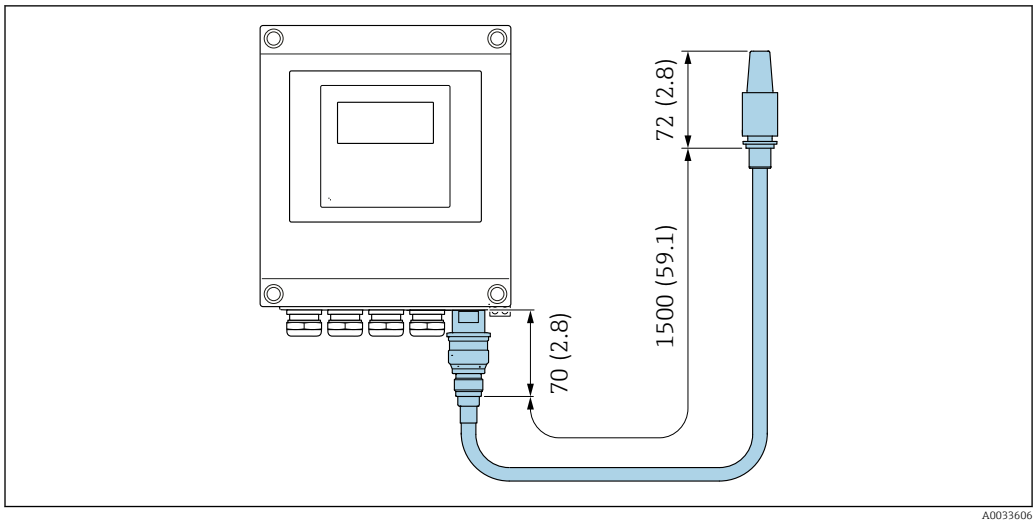
External WLAN antenna mounted on device



53 *Engineering unit mm (in)*

External WLAN antenna mounted with cable

The external WLAN antenna can be mounted separately from the transmitter if the transmission/ reception conditions at the transmitter mounting location are poor.



54 *Engineering unit mm (in)*

Weight

Weight specifications exclusive of packaging material.

Transmitter

- Proline 400 polycarbonate plastic: 1.2 kg (2.65 lb)
- Proline 400 aluminum, coated: 6.0 kg (13.2 lb)

Sensor

Including mounting material

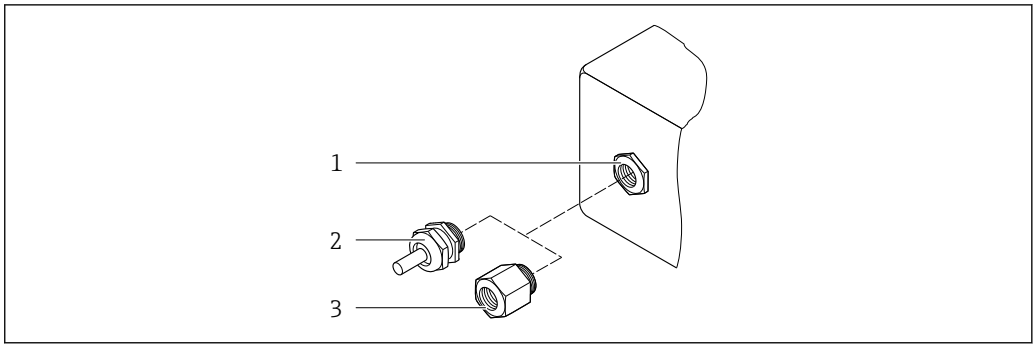
- DN 15 to 65 (½ to 2½"): 1.2 kg (2.65 lb)
- DN 50 to 4000 (2 to 160"): 2.8 kg (6.17 lb)

Materials

Remote version (wall-mount housing)

- Order code for "Housing", option **P** "Remote, alu, coated": Aluminum, AlSi10Mg, coated
- Order code for "Housing", option **N**: polycarbonate plastic
- Window material:
  - For order code for "Housing", option **P**: glass
  - For order code for "Housing", option **N**: plastic

Cable entries/cable glands



55 *Possible cable entries/cable glands*

1 Female thread M20 × 1.5
2 Cable gland M20 × 1.5
3 Adapter for cable entry with female thread G ½" or NPT ½"

remote version

Cable entry/cable gland	Material
Cable gland M20 × 1.5	▪ Plastic ▪ Nickel-plated brass
Cable gland of sensor cable	Nickel-plated brass
Power cable gland	Plastic
Adapter for cable entry with female thread G ½" or NPT ½"	Nickel-plated brass

Sensor - transmitter cable

UV rays can impair the cable outer sheath. Protect the cable from exposure to sun as much as possible.

DN 15 to 65 (½ to 2½"):
Sensor cable: TPE
- Cable sheath: TPE
- Cable plug: nickel-plated brass

DN 50 to 4000 (2 to 160"):
- Sensor cable, TPE halogen-free
  - Cable sheath: TPE halogen-free
  - Cable plug: nickel-plated brass
- Sensor cable PTFE
  - Cable sheath: PTFE
  - Cable plug: stainless steel 1.4301 (304), 1.4404 (316L)

Ultrasonic transducer

- Holder: stainless steel 1.4301 (304), 1.4404 (316L)
- Housing: stainless steel 1.4301 (304), 1.4404 (316L)
- Strapping bands/bracket: stainless steel 1.4301 (304), 1.4404 (316L)
- Contact surfaces: chemically stable plastic

Coupling pads

- −40 to +100 °C (−40 to +212 °F): silicon-based thermal pad H48.2 (0.5 mm (0.02 in))
- +80 to +170 °C (+176 to +338 °F): VMQ-silicone-rubber (vinyl methyl silicone) (0.5 mm (0.02 in))

Coupling paste

Coupling grease

Accessories

External WLAN antenna

- Antenna: ASA plastic (acrylonitrile styrene acrylate) and nickel-plated brass
- Adapter: Stainless steel and nickel-plated brass
- Cable: Polyethylene
- Plug: Nickel-plated brass
- Angle bracket: Stainless steel

Display and user interface

Operation concept

Operator-oriented menu structure for user-specific tasks
- Commissioning
- Operation
- Diagnosis
- Expert level

Quick and safe commissioning
- Guided menus ("Make-it-run" wizards) for applications
- Menu guidance with brief descriptions of the individual parameter functions
- Access to the device via web server
- WLAN access to the device via mobile handheld terminal, tablet or smart phone

Reliable operation
- Operation in local language
- Uniform operating philosophy applied to device and operating tools
- If replacing electronic modules, transfer the device configuration via the integrated memory (HistoROM backup) which contains the process and measuring device data and the event logbook. No need to reconfigure.

Efficient diagnostics increase measurement reliability
- Troubleshooting measures can be called up via the device and in the operating tools
- Diverse simulation options, logbook for events that occur and optional line recorder functions

Installation quality

To optimize the sensor mounting positions, real-time display of:
- Installation status (good, bad, acceptable)
- Signal strength
- Signal to noise ratio
- Sound velocity

Languages

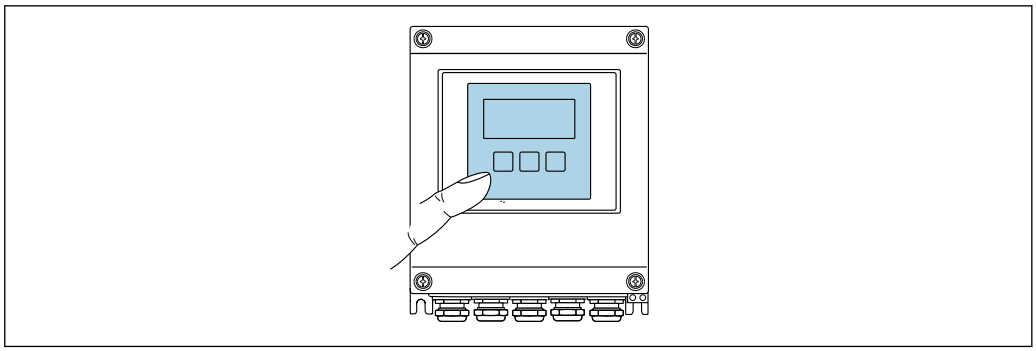
Can be operated in the following languages:
- Via local operation:
  English, German, French, Spanish, Italian, Dutch, Portuguese, Polish, Russian, Turkish, Chinese, Japanese, Bahasa (Indonesian), Vietnamese, Czech, Swedish
- Via "FieldCare", "DeviceCare" operating tool:
  English, German, French, Spanish, Italian, Chinese, Japanese
- Via Web browser (only available for device versions with HART, PROFIBUS DP and EtherNet/IP):
  English, German, French, Spanish, Italian, Dutch, Portuguese, Polish, Russian, Turkish, Chinese, Japanese, Bahasa (Indonesian), Vietnamese, Czech, Swedish

Onsite operation

Via display module

Features:
- Standard features 4-line, illuminated, graphic display; touch control
- Order code for "Display; operation", option G "4-line, illuminated; touch control +WLAN" offers standard equipment features in addition to access via web browser

Information about WLAN interface → 56



56 *Operation with touch control*

Display elements

- 4-line, illuminated, graphic display
- White background lighting; switches to red in event of device errors
- Format for displaying measured variables and status variables can be individually configured

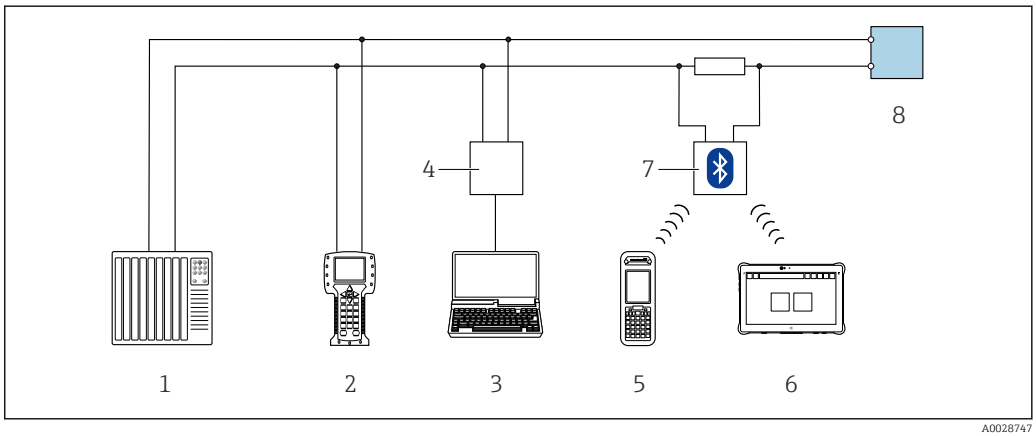
Operating elements

- External operation via touch control (3 optical keys) without opening the housing: ⊞, ⊟, Ⓔ
- Operating elements also accessible in the various zones of the hazardous area

Remote operation

Via HART protocol

This communication interface is available in device versions with a HART output.

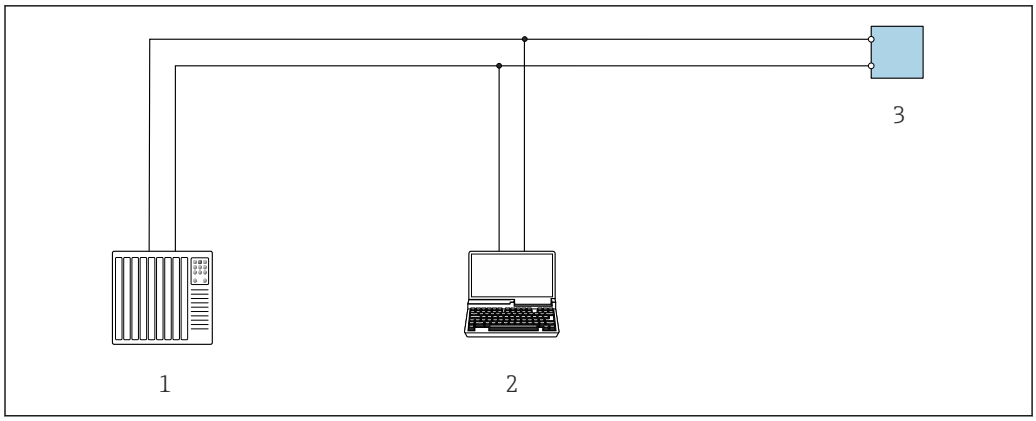


57 *Options for remote operation via HART protocol*

1 *Control system (e.g. PLC)*
2 *Field Communicator 475*
3 *Computer with operating tool (e.g. FieldCare, AMS Device Manager, SIMATIC PDM)*
4 *Commubox FXA195 (USB)*
5 *Field Xpert SFX350 or SFX370*
6 *Field Xpert SMT70*
7 *VIATOR Bluetooth modem with connecting cable*
8 *Transmitter*

Via Modbus RS485 protocol

This communication interface is available in device versions with a Modbus RS485 output.



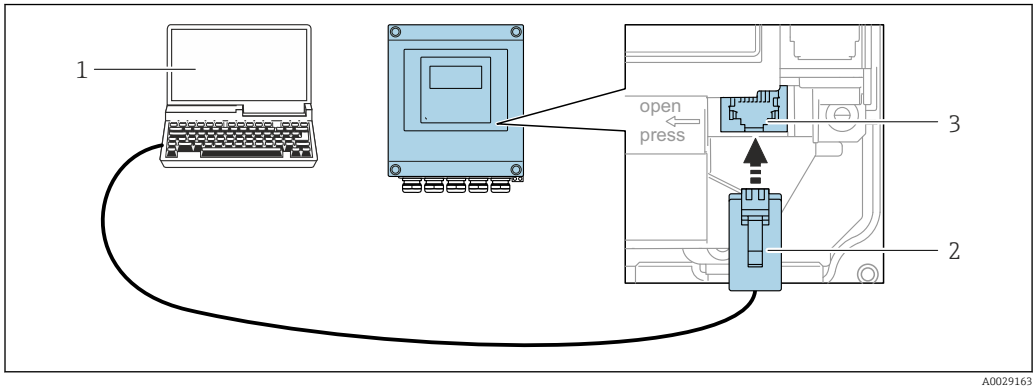
58 *Options for remote operation via Modbus RS485 protocol (active)*

1 Control system (e.g. PLC)
2 Computer with web browser (e.g. Microsoft Edge) to access the integrated device web server or with operating tool (e.g. FieldCare, DeviceCare) with COM DTM "CDI Communication TCP/IP" or Modbus DTM
3 Transmitter

Service interface

Via service interface (CDI-RJ45)

This communication interface is present in the following device version:
- Order code for "Output", option **H**: 4 to 20 mA HART, pulse/frequency output, switch output
- Order code for "Output", option **I**: 4 to 20 mA HART, 2 x pulse/frequency/switch output, status input
- Order code for "Output", option **M**: Modbus RS485
- Order code for "Output", option **O**: Modbus RS485, 4 to 20 mA, 2 x pulse/frequency/switch output

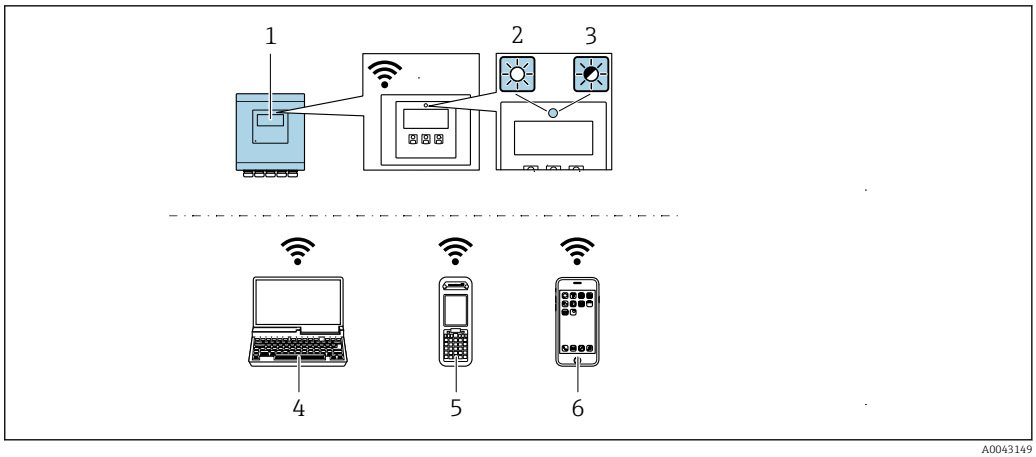


59 *Connection via service interface (CDI-RJ45)*

1 Computer with web browser (e.g. Microsoft Internet Explorer, Microsoft Edge) for accessing the integrated device web server or with operating tool "FieldCare", "DeviceCare" with COM DTM "CDI Communication TCP/IP" or Modbus DTM
2 Standard Ethernet connecting cable with RJ45 plug
3 Service interface (CDI-RJ45) of the measuring device with access to the integrated web server

Via WLAN interface

The optional WLAN interface is available on the following device version:
Order code for "Display; operation", option G "4-line, illuminated; touch control + WLAN"



A0043149

1 *Transmitter with integrated WLAN antenna*
2 *LED lit constantly: WLAN reception is enabled on measuring device*
3 *LED flashing: WLAN connection established between operating unit and measuring device*
4 *Computer with WLAN interface and web browser (e.g. Microsoft Internet Explorer, Microsoft Edge) for accessing the integrated device web server or with operating tool (e.g. FieldCare, DeviceCare)*
5 *Mobile handheld terminal with WLAN interface and web browser (e.g. Microsoft Internet Explorer, Microsoft Edge) for accessing the integrated device web server or operating tool (e.g. FieldCare, DeviceCare)*
6 *Smart phone or tablet (e.g. Field Xpert SMT70)*

Function	WLAN: IEEE 802.11 b/g (2.4 GHz) ▪ Access Point with DHCP server (factory setting) ▪ Network
Encryption	WPA2-PSK AES-128 (in accordance with IEEE 802.11i)
Configurable WLAN channels	1 to 11
Degree of protection	IP67
Available antenna	Internal antenna
Range	Typically 10 m (32 ft)

Supported operating tools

Different operating tools can be used for local or remote access to the measuring device. Depending on the operating tool used, access is possible with different operating units and via a variety of interfaces.

Supported operating tools	Operating unit	Interface	Additional information
Web browser	Notebook, PC or tablet with web browser	▪ CDI-RJ45 service interface ▪ WLAN interface	Special Documentation for device
DeviceCare SFE100	Notebook, PC or tablet with Microsoft Windows system	▪ CDI-RJ45 service interface ▪ WLAN interface ▪ Fieldbus protocol	→ 📄 64
FieldCare SFE500	Notebook, PC or tablet with Microsoft Windows system	▪ CDI-RJ45 service interface ▪ WLAN interface ▪ Fieldbus protocol	→ 📄 64

Supported operating tools	Operating unit	Interface	Additional information
Field Xpert	SMT70/77/50	▪ All Fieldbus protocols ▪ WLAN interface ▪ Bluetooth ▪ CDI-RJ45 service interface	Operating Instructions BA01202S Device description files: Use update function of handheld terminal
SmartBlue app	Smart phone or tablet with iOs or Android	WLAN	→ 🖹 64

Other operating tools based on FDT technology with a device driver such as DTM/iDTM or DD/EDD can be used for device operation. These operating tools are available from the individual manufacturers. Integration into the following operating tools, among others, is supported:

- FactoryTalk AssetCentre (FTAC) from Rockwell Automation → www.rockwellautomation.com
- Process Device Manager (PDM) from Siemens → www.siemens.com
- Asset Management Solutions (AMS) from Emerson → www.emersonprocess.com
- FieldCommunicator 375/475 from Emerson → www.emersonprocess.com
- Field Device Manager (FDM) from Honeywell → www.process.honeywell.com
- FieldMate from Yokogawa → www.yokogawa.com
- PACTWare → www.pactware.com

The related device description files are available: www.endress.com → Download Area

Web server

With the integrated web server, the device can be operated and configured via a web browser service interface (CDI-RJ45) or WLAN interface. The structure of the operating menu is the same as for the local display. In addition to the measured values, status information on the device is displayed and can be used to monitor device health. Furthermore the device data can be managed and the network parameters can be configured.

A device that has a WLAN interface (can be ordered as an option) is required for the WLAN connection: order code for "Display", option G "4-line illuminated; touch control +WLAN". The device acts as an access point and enables communication by computer or a mobile handheld terminal.

Supported functions
Data exchange between the operating unit (such as a notebook, for example,) and measuring device:
- Upload the configuration from the measuring device (XML format, configuration backup)
- Save the configuration to the measuring device (XML format, restore configuration)
- Export event list (.csv file)
- Export parameter settings (.csv file or PDF file, document the measuring point configuration)
- Export the Heartbeat verification report (PDF file, only available with the **Heartbeat Verification** → 🖹 61 application package)
- Flash firmware version for device firmware upgrade, for example
- Download driver for system integration
- Visualize up to 1000 saved measured values (only available with the **Extended HistoROM** application package→ 🖹 61)

HistoROM data management

The measuring device features HistoROM data management. HistoROM data management comprises both the storage and import/export of key device and process data, making operation and servicing far more reliable, secure and efficient.

Additional information on the data storage concept

There are different types of data storage units in which device data are stored and used by the device:

	HistoROM backup	T-DAT	S-DAT
Available data	▪ Event logbook, e.g. diagnostic events ▪ Device firmware package	▪ Measured value logging ("Extended HistoROM" order option) ▪ Current parameter data record (used by firmware at run time) ▪ Indicator (minimum/maximum values) ▪ Totalizer value	▪ Sensor data: e.g. ▪ Serial number ▪ Device configuration (e.g. SW options, fixed I/O or multi I/O)
Storage location	Fixed on the user interface PC board in the connection compartment	Can be plugged into the user interface PC board in the connection compartment	Fixed on the sensor connection board

Data backup

Automatically
- The most important device data (sensor and transmitter) are automatically saved in the DAT modules.
- If the transmitter or measuring device is replaced: Once the T-DAT containing the previous device data has been exchanged, the new measuring device goes into operation immediately, without any errors.
- If the sensor is replaced: Once the S-DAT has been replaced with new device data, the measuring device goes into operation immediately, without any errors.

Data transmission

Manual
Transfer of a device configuration to another device using the export function of the specific operating tool, e.g. with FieldCare, DeviceCare or Web server: to duplicate the configuration or to store in an archive (e.g. for backup purposes)

Event list

Automatic
- Chronological display of up to 20 event messages in the events list
- If the **Extended HistoROM** application package (order option) is enabled: up to 100 event messages are displayed in the events list along with a time stamp, plain text description and remedial measures
- The events list can be exported and displayed via a variety of interfaces and operating tools e.g. DeviceCare, FieldCare or Web server

Data logging

Manual
If the **Extended HistoROM** application package (order option) is enabled:
- Recording of 1 to 4 channels of up to 1 000 measured values (up to 250 measured values per channel)
- User configurable recording interval
- Export the measured value log via a variety of interfaces and operating tools e.g. FieldCare, DeviceCare or web server

Certificates and approvals

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

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

CE mark

The device meets the legal requirements of the applicable EU Directives. These are listed in the corresponding EU Declaration of Conformity along with the standards applied.

Endress+Hauser confirms successful testing of the device by affixing to it the CE mark.

UKCA marking

The device meets the legal requirements of the applicable UK regulations (Statutory Instruments). These are listed in the UKCA Declaration of Conformity along with the designated standards. By selecting the order option for UKCA marking, Endress+Hauser confirms a successful evaluation and testing of the device by affixing the UKCA mark.

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

RCM marking

The measuring system meets the EMC requirements of the "Australian Communications and Media Authority (ACMA)".

Ex-approval

The devices are certified for use in hazardous areas and the relevant safety instructions are provided in the separate "Control Drawing" document. This is referenced on the nameplate.

HART certification

HART interface

The measuring device is certified and registered by the FieldComm Group. The measuring system meets all the requirements of the following specifications:
- Certified according to HART 7
- The device can also be operated with certified devices of other manufacturers (interoperability)

Modbus RS485 certification

The measuring device meets all the requirements of the MODBUS RS485 conformity test and has the "MODBUS RS485 Conformance Test Policy, Version 2.0". The measuring device has successfully passed all the test procedures carried out.

Radio approval

The measuring device has radio approval.

For detailed information on the radio approval, see the Special Documentation → 66

External standards and guidelines

- EN 60529
  Degrees of protection provided by enclosure (IP code)
- EN 61010-1
  Safety requirements for electrical equipment for measurement, control and laboratory use - general requirements
- IEC/EN 61326-2-3
  Emission in accordance with Class A requirements. Electromagnetic compatibility (EMC requirements).
- ANSI/ISA-61010-1 (82.02.01)
  Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use - Part 1 General Requirements
- CAN/CSA-C22.2 No. 61010-1-12
  Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use - Part 1 General Requirements
- NAMUR NE 21
  Electromagnetic compatibility (EMC) of industrial process and laboratory control equipment
- NAMUR NE 32
  Data retention in the event of a power failure in field and control instruments with microprocessors
- NAMUR NE 43
  Standardization of the signal level for the breakdown information of digital transmitters with analog output signal.
- NAMUR NE 53
  Software of field devices and signal-processing devices with digital electronics
- NAMUR NE 105
  Specifications for integrating fieldbus devices in engineering tools for field devices
- NAMUR NE 107
  Self-monitoring and diagnosis of field devices

- NAMUR NE 131
  Requirements for field devices for standard applications
- ETSI EN 300 328
  Guidelines for 2.4 GHz radio components.
- EN 301489
  Electromagnetic compatibility and radio spectrum matters (ERM).

Ordering information

Detailed ordering information is available from your nearest sales organization www.addresses.endress.com or in the Product Configurator at www.endress.com:

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

Product Configurator - the tool for individual product configuration
- Up-to-the-minute configuration data
- Depending on the device: Direct input of measuring point-specific information such as measuring range or operating language
- Automatic verification of exclusion criteria
- Automatic creation of the order code and its breakdown in PDF or Excel output format
- Ability to order directly in the Endress+Hauser Online Shop

Application packages

Many different application packages are available to enhance the functionality of the device. Such packages might be needed to address safety aspects or specific application requirements.

The application packages can be ordered with the device or subsequently 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.

Detailed information on the application packages:
Special Documentation → 66

Diagnostic functionality

Order code for "Application package", option EA "Extended HistoROM"

Comprises extended functions concerning the event log and the activation of the measured value memory.

Event log:
Memory volume is extended from 20 message entries (standard version) to up to 100 entries.

Data logging (line recorder):
- Memory capacity for up to 1000 measured values is activated.
- 250 measured values can be output via each of the 4 memory channels. The recording interval can be defined and configured by the user.
- Measured value logs can be accessed via the local display or operating tool e.g. FieldCare, DeviceCare or Web server.

For detailed information, see the Operating Instructions for the device.

Heartbeat Technology

Order code for "Application package", option EB "Heartbeat Verification + Monitoring"

Heartbeat Verification
Meets the requirement for traceable verification to DIN ISO 9001:2008 Chapter 7.6 a) "Control of monitoring and measuring equipment".
- Functional testing in the installed state without interrupting the process.
- Traceable verification results on request, including a report.
- Simple testing process via local operation or other operating interfaces.
- Clear measuring point assessment (pass/fail) with high test coverage within the framework of manufacturer specifications.
- Extension of calibration intervals according to operator's risk assessment.

Heartbeat Monitoring
Continuously supplies data, which are characteristic of the measuring principle, to an external condition monitoring system for the purpose of preventive maintenance or process analysis. These data enable the operator to:
- Draw conclusions - using these data and other information - about the impact the measuring application has on the measuring performance over time.
- Schedule servicing in time.
- Monitor the process or product quality, e.g. gas pockets .

For detailed information, see the Special Documentation for the device.

Accessories

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

Device-specific accessories

For the transmitter

Accessories	Description
Transmitter Prosonic Flow 400	Transmitter for replacement or storage. Use the order code to define the following specifications: ▪ Approvals ▪ Output / input ▪ Display/operation ▪ Housing ▪ Software For details, see Installation Instructions EA00104D
Post mounting kit	Post mounting kit for transmitter.
Weather protection cover	Is used to protect the measuring device from the effects of the weather: e.g. rainwater, excess heating from direct sunlight. Order number: 71343504 Installation Instructions EA01191D

External WLAN antenna	External WLAN antenna with 1.5 m (59.1 in) connecting cable and two angle brackets. Order code for "Accessory enclosed", option P8 "Wireless antenna wide area". ▪ The external WLAN antenna is not suitable for use in hygienic applications. ▪ Additional information regarding the WLAN interface → 🖹 56. Order number: 71351317 Installation Instructions EA01238D
Sensor cable Proline 400 Sensor – transmitter	The sensor cable can be ordered directly with the measuring device (order code for "Cable") or as an accessory (order number DK9017). The following cable lengths are available: ▪ Temperature: –40 to +80 °C (–40 to +176 °F) ▪ Option AA: 5 m (15 ft) ▪ Option AB: 10 m (30 ft) ▪ Option AC: 15 m (45 ft) ▪ Option AD: 30 m (90 ft) ▪ Temperature: –40 to +130 °C (–40 to +266 °F) ▪ Option FA: 5 m (15 ft) ▪ Option FB: 10 m (30 ft) ▪ Option FC: 15 m (45 ft) ▪ Option FD: 30 m (90 ft) Possible cable length for a Proline 400 sensor cable: max. 30 m (90 ft)

For the sensor

Accessories	Description
Sensor set (DK9018)	▪ Sensor set 0.3 MHz (C-030) ▪ Sensor set 0.5 MHz (C-050) ▪ Sensor set 1 MHz (C-100) ▪ Sensor set 2 MHz (C-200) ▪ Sensor set 5 MHz (C-500)
Sensor holder set (DK9014)	▪ Sensor holder set 0.3 to 2 MHz ▪ Sensor holder set 5 MHz
Installation set (DK9015)	▪ Installation set, DN15-DN32, 1/2-1 1/4" ▪ Installation set, DN32-DN65, 1 1/4-2 1/2" ▪ Installation set, DN50-DN150, 2"-6" ▪ Installation set, DN150-DN200, 6"-8" ▪ Installation set, DN200-DN600, 8"-24" ▪ Installation set, DN600-DN2000, 24"-80" ▪ Installation set, DN2000-DN4000, 80"-160"
Conduit adapter set (DK9003)	▪ Conduit adapter M20x1.5 + sensor cable gland ▪ Conduit adapter NPT1/2" + sensor cable gland ▪ Conduit adapter G1/2" + sensor cable gland
Coupling medium (DK9CM)	▪ Coupling pad ▪ Coupling foil ▪ Coupling gel

Communication-specific accessories

Accessories	Description
Commubox FXA195 HART	For intrinsically safe HART communication with FieldCare via the USB port Technical Information TI00404F
Commubox FXA291	Connects Endress+Hauser field devices with a CDI interface (= Endress+Hauser Common Data Interface) and the USB port of a computer or laptop. Technical Information TI405C/07

HART Loop Converter HMX50	Is used to evaluate and convert dynamic HART process variables to analog current signals or limit values. ▪ Technical Information TI00429F ▪ Operating Instructions BA00371F
Wireless HART 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. Operating Instructions BA00061S
Fieldgate FXA42	Transmission of the measured values of connected 4 to 20 mA analog measuring devices, as well as digital measuring devices ▪ Technical Information TI01297S ▪ Operating Instructions BA01778S ▪ Product page: www.endress.com/fxa42
Field Xpert SMT50	The Field Xpert SMT50 table PC for device configuration enables mobile plant asset management. It is suitable for commissioning and maintenance staff to manage field instruments with a digital communication interface and to record progress. This tablet PC is designed as an all-in-one solution with a preinstalled driver library and is an easy-to-use, touch-sensitive tool which can be used to manage field instruments throughout their entire life cycle. ▪ Technical Information TI01555S ▪ Operating Instructions BA02053S ▪ Product page: www.endress.com/smt50
Field Xpert SMT70	The Field Xpert SMT70 tablet PC for device configuration enables mobile plant asset management in hazardous and non-hazardous areas. It is suitable for commissioning and maintenance staff to manage field instruments with a digital communication interface and to record progress. This tablet PC is designed as an all-in-one solution with a preinstalled driver library and is an easy-to-use, touch-sensitive tool which can be used to manage field instruments throughout their entire life cycle. ▪ Technical Information TI01342S ▪ Operating Instructions BA01709S ▪ Product page: www.endress.com/smt70
Field Xpert SMT77	The Field Xpert SMT77 tablet PC for device configuration enables mobile plant asset management in areas categorized as Ex Zone 1. ▪ Technical Information TI01418S ▪ Operating Instructions BA01923S ▪ Product page: www.endress.com/smt77

Service-specific accessories

Accessories	Description
Applicator	Software for selecting and sizing Endress+Hauser measuring devices: ▪ Choice of measuring devices for industrial requirements ▪ Calculation of all the necessary data for identifying the optimum flowmeter: e.g. nominal diameter, pressure loss, flow velocity and accuracy. ▪ Graphic illustration of the calculation results ▪ Determination of the partial order code, administration, documentation and access to all project-related data and parameters over the entire life cycle of a project. Applicator is available: ▪ Via the Internet: https://portal.endress.com/webapp/applicator ▪ As a downloadable DVD for local PC installation.
Netilion	IIoT ecosystem: Unlock knowledge Endress+Hauser 's Netilion IIoT ecosystem enables you to optimize your plant performance, digitize workflows, share knowledge and improve collaboration. Based on decades of experience in process automation, Endress+Hauser offers the process industry an IIoT ecosystem that enables you to gain useful insights from data. This knowledge can be used to optimize processes, leading to higher plant availability, efficiency and reliability, and ultimately to a more profitable plant. www.netilion.endress.com

Accessories	Description
FieldCare	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. Operating Instructions BA00027S and BA00059S
DeviceCare	Tool to connect and configure Endress+Hauser field devices. Innovation brochure IN01047S
Commubox FXA291	Connects Endress+Hauser field devices with a CDI interface (= Endress +Hauser Common Data Interface) and the USB port of a computer or laptop. Technical Information TI00405C

System components

Accessories	Description
Memograph M graphic data manager	The Memograph M graphic data manager provides information on all the relevant measured 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. ▪ Technical Information TI00133R ▪ Operating Instructions BA00247R

Supplemental documentation

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

Standard documentation

Supplementary information on the semi-standard options is available in the relevant Special Documentation in the TSP database.

Brief operating instructions

Brief Operating Instructions for the sensor

Measuring device	Documentation code
Proline Prosonic Flow W	KA01512D

Brief operating instructions for transmitter

Measuring device	Documentation code	
	HART	Modbus RS485
Proline 400	KA01510D	KA01660D

Operating instructions

Measuring device	Documentation code	
	HART	Modbus RS485
Prosonic Flow W 400	BA02086D	BA02302D

Description of device parameters

Measuring device	Documentation code	
	HART	Modbus RS485
Prosonic Flow W 400	GP01167D	GP01207D

Device-dependent additional documentation

Special documentation

Content	Documentation code	
	HART	Modbus RS485
Radio approvals for WLAN interface for A309/A310 display module	SD01793D	
FlowDC	SD02691D	
Heartbeat Technology	SD02712D	SD03132D

Installation instructions

Contents	Note
Installation instructions for spare part sets and accessories	Documentation code: specified for each individual accessory → 62.

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Modbus®
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