TI01504D/06/EN/02.24-00
71633387
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Technical Information
Proline Prosonic Flow P 500

Ultrasonic time-of-flight flowmeter

Clamp-on flowmeter for limited spaces in process industries with up to 3 I/Os

Application

- The measuring principle is non-invasive and independent of pressure, density and conductivity
- Bidirectional measurement of various fluids, e.g. liquid hydrocarbons and chemicals

Device properties

- Direct mounting, independent of process temperature
- Wide nominal diameter range: DN 15 to 4000 (½ to 160")
- Medium temperature: −40 to +550 °C (−40 to +1 022 °F)
- Remote version with up to 3 I/Os
- Backlit display with touch control and WLAN access
- Standard volume correction and product identification for liquid hydrocarbons

Your benefits

- Constant accuracy even when mounted with short inlet run thanks to FlowDC
- High safety standards – SIL by design, international hazardous area approvals
- Long-term stable signal – maintenance-free permanent mounting from outside with coupling pads
- Reliable measurement on various pipe materials – sensor for GRP and plastic pipes available
- Full access to process and diagnostic information – numerous, freely combinable I/Os
- Reduced complexity and variety – freely configurable I/O functionality
- Integrated verification – Heartbeat Technology

Endress+Hauser
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.
	**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

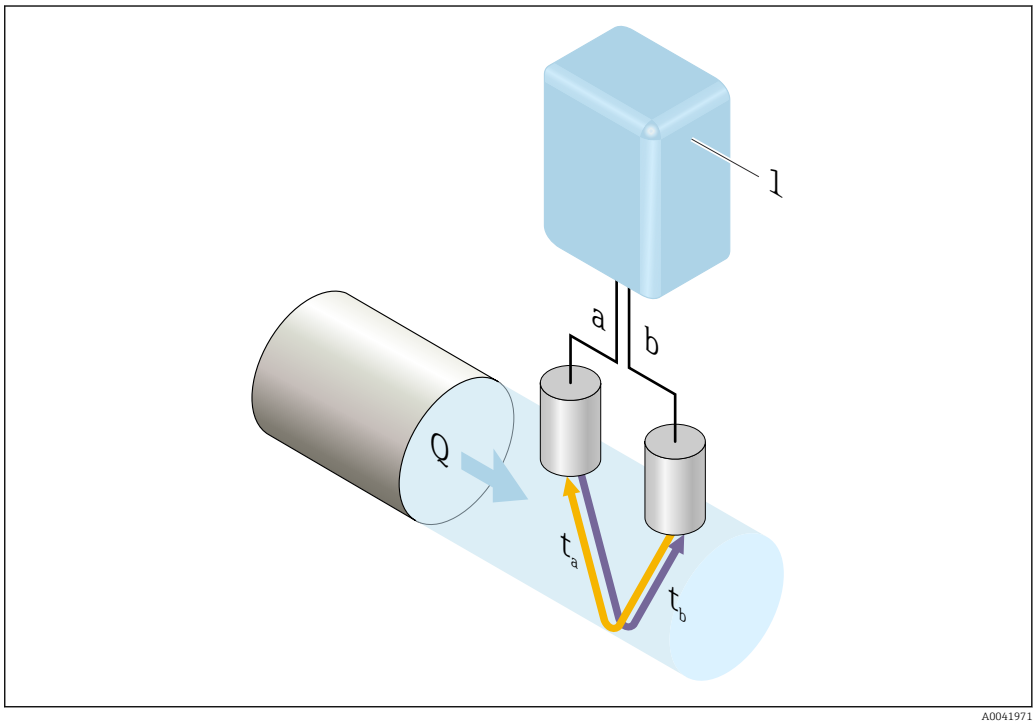
Function and system design

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 $v \sim \Delta t$

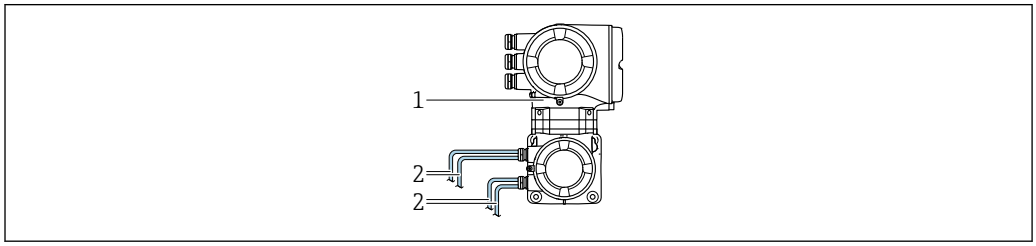
Measuring system

The measuring system consists of a transmitter and two or one 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 → 🖹 8.

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



1 Transmitter with integrated ISEM
2 Sensor cables

- Electronics and ISEM (intelligent sensor electronics module) in the transmitter housing
- Signal transmission: analog
  Order code for "Integrated ISEM electronics", option **B**: transmitter

Sensor cables

Sensor cables can be ordered in various lengths → 🖹 83

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

Ex Zone

Use in: Ex Zone 1 and 2; Class 1, Division 2 and Class 1, Division 1

Housing versions and materials

- Transmitter housing
  - Aluminum, coated: aluminum, AlSi10Mg, coated
  - Cast, stainless: cast, stainless steel, 1.4409 (CF3M) corresponds to the properties of 316L
- Window material: glass

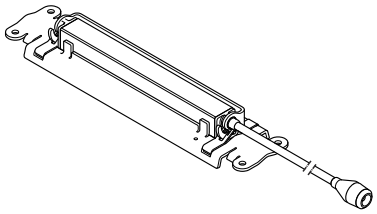
Configuration

- External operation via 4-line, illuminated graphic local display (LCD) with touch control and guided menus ("Make-it-run" wizards) for application-specific commissioning.
- Via service interface or WLAN connection:
  - Operating tools (e.g. FieldCare, DeviceCare)
  - Web server (access via web browser)

Sensor

Prosonic Flow P

DN 15 to 65 (½ to 2½")



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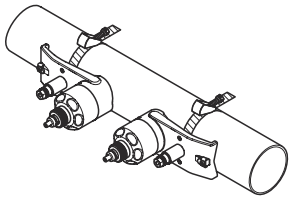
DN 50 to 4000 (2 to 160")



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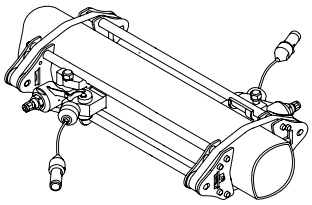
1 *Example: 1 sensor set with 2 traverses*

DN 50 to 4000 (2 to 160")



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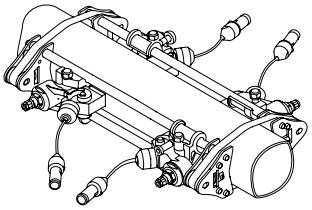
2 *Example: high-temperature sensors comprising 1 sensor set with 1 traverse*

DN 50 to 600 (2 to 24")



A0051732

3 *Example: high-temperature sensors comprising 2 sensor sets with 1 traverse*

- Measurement of:
  - Pure liquids or slightly contaminated liquids
  - Chemicals
  - Solvents
  - Liquid hydrocarbons
  - Acids
  - Alkalis
- Nominal diameter range: DN 15 to 4000 (½ to 160")
- Materials:
  - Sensor holder:
    Stainless steel 1.4301 (304), 1.4404 (316L)
  - Sensor housing:
    Stainless steel 1.4301 (304), 1.4404 (316L)
  - Strapping band/bracket:
    Stainless steel 1.4301 (304), 1.4404 (316L)
  - Sensor contact surface:
    Chemically stable plastic
    Stainless steel 1.4404 (316L)

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.

Order code for "Sensor version", options AG, AH: high-temperature sensors may only be installed on metallic pipes.

Medium		Pipe material		Liner
▪ Water ▪ Seawater ▪ Distilled water ▪ Ammonia NH3 ▪ Benzene ▪ Ethanol	▪ Glycol ▪ Kerosene ▪ 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.

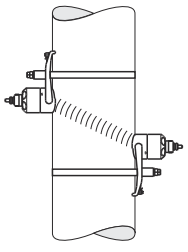
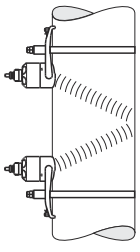
The sensors can be arranged in different ways:

- Mounting arrangement for measurement with 1 sensor set (1 measuring path):
  - The sensors are located on opposite sides of the measuring pipe (offset at 180°): measurement with 1 or 3 traverses.
  - The sensors are located on the same side of the measuring pipe: measurement with 2 or 4 traverses
- Mounting for measurement with 2 sensor sets [1] (2 measuring paths):
  - 1 sensor of each sensor set is located at the opposite side of the measuring pipe (offset by 180°): measurement with 1 or 3 traverses
  - The sensors are located on the same side of the measuring pipe: measurement with 2 or 4 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 1, 2, 3 or 4 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.

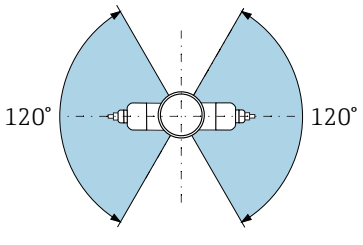
Use of high-temperature sensors
The measuring paths for a high-temperature measurement are preferably mounted with 1 traverse on the pipe. If 2 measuring paths are being used, the individual paths are arranged so they are offset by 180° from each other (X-arrangement).

Single-path measurement (1 sensor set)	
Vertical mounting	
 A0042013	 A0042014
4 *1 traverse*	5 *2 traverses*

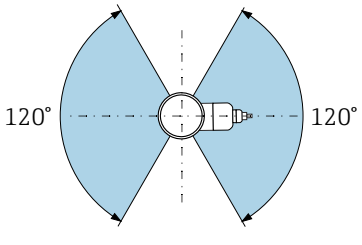
1) Do not swap the sensors of the two sensor sets, as this can affect the measurement performance.

Single-path measurement (1 sensor set)

Horizontal mounting



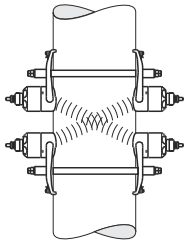
6 *1 traverse*



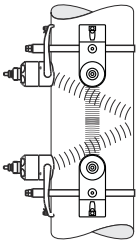
7 *2 traverses*

Two-path measurement (2 sensor sets)

Vertical mounting

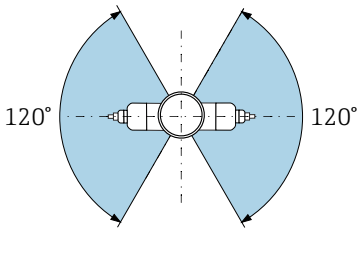


8 *1 traverse*

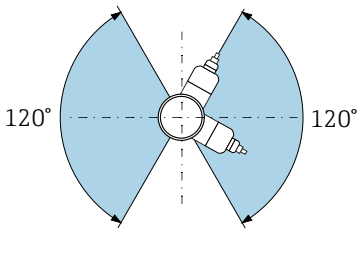


9 *2 traverses*

Horizontal mounting



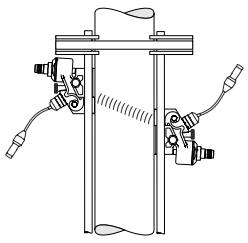
10 *1 traverse*



11 *2 traverses*

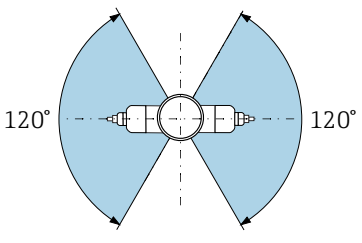
Single-path measurement (1 sensor set) for order code for "Process temperature", option H, I, J

Vertical mounting

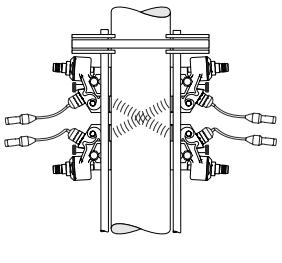
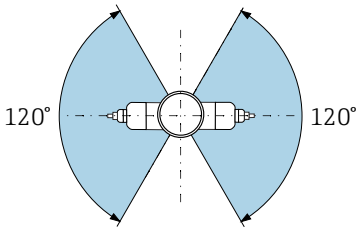


12 *1 traverse*

Horizontal mounting



13 *1 traverse*

Two-path measurement (2 sensor sets) order code for "Process temperature", option H, I, J	
Vertical mounting	**Horizontal mounting**
 A0052539	 A0044304
14 *1 traverse*	15 *1 traverse*

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 → 10
Plastic	< DN 50 (2")	C-500-A
	≥ DN 50 (2")	Table for measuring pipe material: plastic → 11
Glass-fiber reinforced plastic	< DN 50 (2")	C-500-A (with restrictions)
	≥ DN 50 (2")	Table for measuring pipe material: glass-fiber reinforced plastic → 11

Order code for "Sensor version", options AG, AH: To comply with the measurement accuracy specifications of the high-temperature sensors, these sensors may only be installed on metallic pipes!

Further selection criteria are provided in SD03088D (Special Documentation for high-temperature applications).

Measuring pipe material: steel, cast iron

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)]		
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)
> 2.2 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)

2) Recommendation: product sizing in Applicator → 85

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]		
> 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)
> 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)	–	–

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]		
> 500 to 1 000 (20 to 40)	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.

- 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
  - High-temperature applications (>170°C), order code "Process temperature", options H, I, J: configuration and sizing of the measuring point using the Applicator is recommended.

Measuring mode

Two-path measurement with FlowDC [3] (standard configuration)

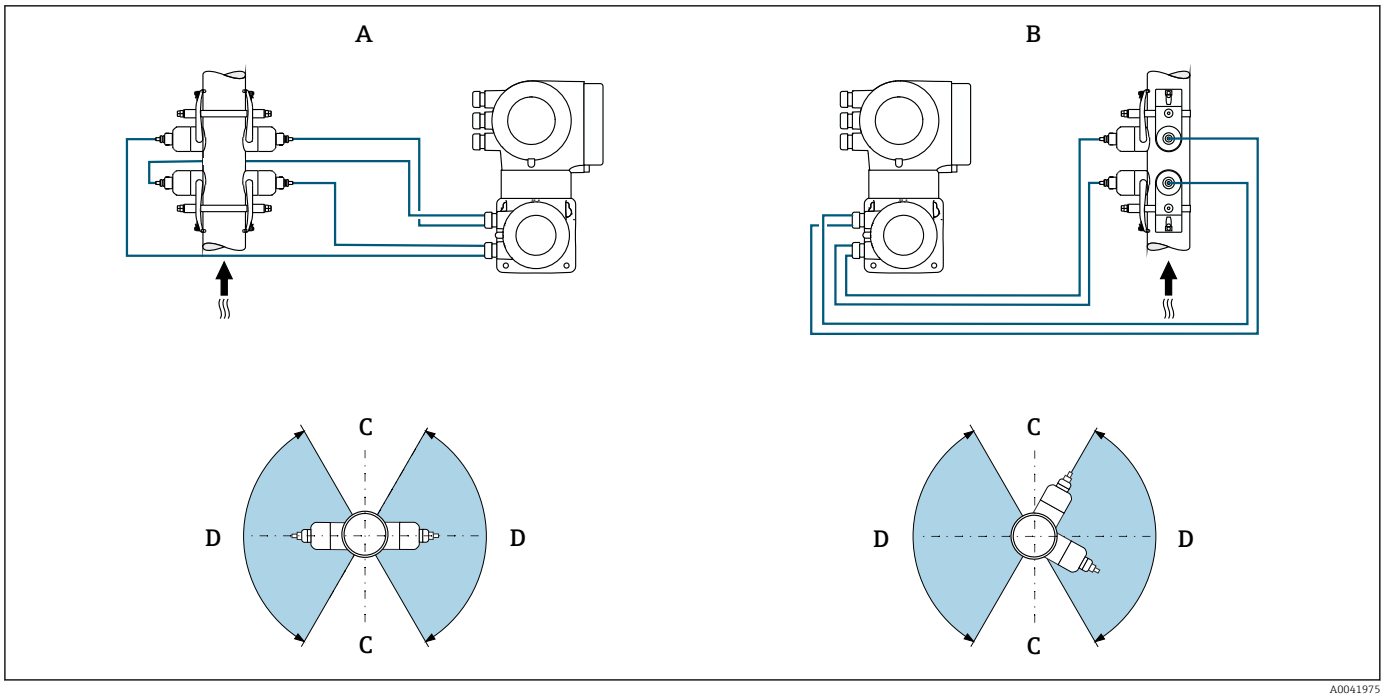
In the case of two-path measurement with FlowDC, the flow is measured by two measurements at the measuring point.

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 specified maximum measurement error and repeatability are maintained even under non-ideal flow conditions (see for example → 33, 42).

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

3) Flow disturbance compensation



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

Single-path measurement (alternative configuration)

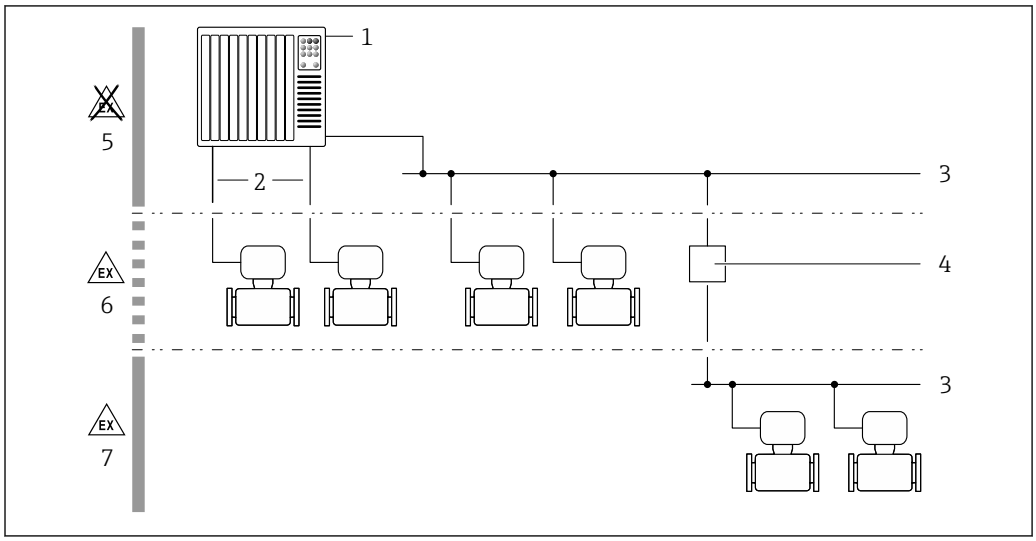
In the case of single-path measurement, the flow is measured at the measuring point without the option of compensation.

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 standard configuration with two sensor sets [4)] with FlowDC is recommended.

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

Equipment architecture



17 *Possibilities for integrating measuring devices into a system*

1 *Control system (e.g. PLC)*
2 *Connecting cable (0/4 to 20 mA HART etc.)*
3 *Fieldbus*
4 *Coupler*
5 *Non-hazardous area*
6 *Hazardous area: Zone 2; Class I, Division 2*
7 *Hazardous area: Zone 1; Class I, Division 1*

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 → 🖹 15	Not enabled	On an individual basis following risk assessment
Access code (also applies to web server login or FieldCare connection) → 🖹 15	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) → 🖹 15	Serial number	Assign an individual WLAN passphrase during commissioning
WLAN mode	Access point	On an individual basis following risk assessment
Web server → 🖹 15	Enabled	On an individual basis following risk assessment
CDI-RJ45 service interface→ 🖹 15	–	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, web browser 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.
- Infrastructure mode
  When the device is operated in infrastructure mode, the WLAN passphrase corresponds to the WLAN passphrase configured on the operator side.

User-specific access code

Write access to the device parameters via the local display, web browser 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.

Infrastructure mode

A connection between the device and WLAN access point is protected by means of an SSID and passphrase on the system side. Please contact the relevant system administrator for access.

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

With the integrated web server, the device can be operated and configured via a web browser. 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.

For detailed information on device parameters, see:
"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.

Transmitters with an Ex de approval may not be connected via the service interface (CDI-RJ45)!

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 → 🖹 85

Operable flow range

Over 150 : 1

Input signal

Output and input variants

→ 🖹 19

External measured values

The measuring device provides optional interface that enable the transmission of externally measured variables (temperature, density) to the measuring device:
- Analog inputs 4-20 mA
- Digital inputs (via HART input or Modbus)

Various temperature measuring devices can be ordered from Endress+Hauser: see "Accessories" section → 🖹 86

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

Current input

The measured values are written from the automation system to the measuring device via the current input → 🖹 17.

Digital communication

The measured values can be written by the automation system via:
Modbus RS485

Current input 0/4 to 20 mA

Current input	0/4 to 20 mA (active/passive)
Current span	▪ 4 to 20 mA (active) ▪ 0/4 to 20 mA (passive)
Resolution	1 µA
Voltage drop	Typically: 0.6 to 2 V for 3.6 to 22 mA (passive)
Maximum input voltage	≤ 30 V (passive)
Open-circuit voltage	≤ 28.8 V (active)
Possible input variables	▪ Temperature ▪ Density

Status input

Maximum input values	▪ DC −3 to 30 V ▪ If status input is active (ON): R_i >3 kΩ
Response time	Configurable: 5 to 200 ms
Input signal level	▪ Low signal: DC −3 to +5 V ▪ High signal: DC 12 to 30 V
Assignable functions	▪ Off ▪ Reset the individual totalizers separately ▪ Reset all totalizers ▪ Flow override

Output

Output and input variants

Depending on the option selected for output/input 1, different options are available for the other outputs and inputs. Only one option can be selected for each output/input 1 to 3. The following tables must be read vertically (↓).

Example: If the option BA "4–20 mA HART" was selected for output/input 1, one of the options A, B, D, E, F, H, I or J is available for output 2 and one of the options A, B, D, E, F, H, I or J is available for output 3.

Output/input 1 and options for output/input 2

Options for output/input 3 → 20

Order code for "Output; input 1" (020) →	Possible options			
Current output 4 to 20 mA HART	**BA**			
Current output 4 to 20 mA HART Ex i passive	↓	**CA**		
Current output 4 to 20 mA HART Ex i active		↓	**CC**	
Modbus RS485				**MA**
Order code for "Output; input 2" (021) →	↓	↓	↓	↓
Not used	**A**	**A**	**A**	**A**
Current output 4 to 20 mA	**B**			**B**
Current output 4 to 20 mA Ex i passive		**C**	**C**	
User-configurable input/output [1]	**D**			**D**
Pulse/frequency/switch output	**E**			**E**
Pulse output, phase-shifted [2]	**F**			**F**
Pulse/frequency/switch output Ex i passive		**G**	**G**	
Relay output	**H**			**H**
Current input 0/4 to 20 mA	**I**			**I**
Status input	**J**			**J**

1) A specific input or output can be assigned to a user-configurable input/output → 25.
2) If "pulse output, phase-shifted" (F) is selected for output/input 2 (021), only the "pulse output, phase-shifted" (F) option is available for selection for output/input 3 (022).

Output/input 1 and options for output/input 3

Options for output/input 2 → 19

Order code for "Output; input 1" (020) →	Possible options			
Current output 4 to 20 mA HART	**BA**			
Current output 4 to 20 mA HART Ex i passive	↓	**CA**		
Current output 4 to 20 mA HART Ex i active		↓	**CC**	
Modbus RS485				**MA**
Order code for "output; input 3" (022) → →	↓	↓	↓	↓
Not used	**A**	**A**	**A**	**A**
Current output 4 to 20 mA	**B**			**B**
Current output 4 to 20 mA Ex i passive		**C**	**C**	
User-configurable input/output	**D**			**D**
Pulse/frequency/switch output	**E**			**E**
Pulse output, phase-shifted	**F**			**F**
Pulse/frequency/switch output Ex i passive		**G**	**G**	
Relay output	**H**			**H**
Current input 0/4 to 20 mA	**I**			**I**
Status input	**J**			**J**

Output signal

Current output 4 to 20 mA HART

Order code	"Output; input 1" (20): Option BA: current output 4 to 20 mA HART
Signal mode	Can be set to: ▪ Active ▪ Passive
Current range	Can be set to: ▪ 4 to 20 mA NAMUR ▪ 4 to 20 mA US ▪ 4 to 20 mA ▪ 0 to 20 mA (only if the signal mode is active) ▪ Fixed current
Open-circuit voltage	DC 28.8 V (active)
Maximum input voltage	DC 30 V (passive)
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.

Current output 4 to 20 mA HART Ex i

Order code	"Output; input 1" (20) choose from: ▪ Option CA: current output 4 to 20 mA HART Ex i passive ▪ Option CC: current output 4 to 20 mA HART Ex i active
Signal mode	Depends on the selected order version.
Current range	Can be set to: ▪ 4 to 20 mA NAMUR ▪ 4 to 20 mA US ▪ 4 to 20 mA ▪ 0 to 20 mA (only if the signal mode is active) ▪ Fixed current
Open-circuit voltage	DC 21.8 V (active)
Maximum input voltage	DC 30 V (passive)
Load	▪ 250 to 400 Ω (active) ▪ 250 to 700 Ω (passive)
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.

Modbus RS485

Physical interface	RS485 in accordance with EIA/TIA-485 standard
Terminating resistor	Integrated, can be activated via DIP switches

Current output 4 to 20 mA

Order code	"Output; input 2" (21)or "Output; input 3" (022): Option B: current output 4 to 20 mA
Signal mode	Can be set to: ▪ Active ▪ Passive
Current range	Can be set to: ▪ 4 to 20 mA NAMUR ▪ 4 to 20 mA US ▪ 4 to 20 mA ▪ 0 to 20 mA (only if the signal mode is active) ▪ Fixed current
Maximum output values	22.5 mA
Open-circuit voltage	DC 28.8 V (active)
Maximum input voltage	DC 30 V (passive)
Load	0 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.

Current output 4 to 20 mA Ex i passive

Order code	"Output; input 2" (21), "Output; input 3" (022): Option C: current output 4 to 20 mA Ex i passive
Signal mode	Passive
Current range	Can be set to: ▪ 4 to 20 mA NAMUR ▪ 4 to 20 mA US ▪ 4 to 20 mA ▪ Fixed current
Maximum output values	22.5 mA
Maximum input voltage	DC 30 V
Load	0 to 700 Ω
Resolution	0.38 µA
Damping	Configurable: 0 to 999 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	Can be configured as pulse, frequency or switch output
Version	Open collector Can be set to: ▪ Active ▪ Passive
Maximum input values	DC 30 V, 250 mA (passive)
Open-circuit voltage	DC 28.8 V (active)
Voltage drop	For 22.5 mA: ≤ DC 2 V
Pulse output	
Maximum input values	DC 30 V, 250 mA (passive)
Maximum output current	22.5 mA (active)
Open-circuit voltage	DC 28.8 V (active)
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 The range of options increases if the measuring device has one or more application packages.
Frequency output	
Maximum input values	DC 30 V, 250 mA (passive)
Maximum output current	22.5 mA (active)
Open-circuit voltage	DC 28.8 V (active)
Output frequency	Configurable: end value frequency 2 to 10 000 Hz(f_{max} = 12 500 Hz)
Damping	Configurable: 0 to 999.9 s
Pulse/pause ratio	1:1
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.
Switch output	
Maximum input values	DC 30 V, 250 mA (passive)
Open-circuit voltage	DC 28.8 V (active)
Switching behavior	Binary, conductive or non-conductive
Switching delay	Configurable: 0 to 100 s

Number of switching cycles	Unlimited

Assignable functions	▪ Disable
	▪ On
	▪ Diagnostic behavior
	▪ Limit
	  ▪ Volume flow
	  ▪ Mass flow
	  ▪ Flow velocity
	  ▪ Electronics temperature
	  ▪ Sound velocity
	  ▪ Totalizer 1-3
	▪ Flow direction monitoring
	▪ Status
	Low flow cut off
	The range of options increases if the measuring device has one or more application packages.

Pulse output, phase-shifted

Function	Pulse output, phase-shifted
Version	Open collector Can be set to: ▪ Active ▪ Passive ▪ Passive NAMUR
Maximum input values	DC 30 V, 250 mA (passive)
Open-circuit voltage	DC 28.8 V (active)
Voltage drop	For 22.5 mA: ≤ DC 2 V
Output frequency	Configurable: 0 to 1000 Hz
Damping	Configurable: 0 to 999 s
Pulse/pause ratio	1:1
Assignable measured variables	▪ Volume flow ▪ Mass flow The range of options increases if the measuring device has one or more application packages.

Relay output

Function	Switch output
Version	Relay output, galvanically isolated
Switching behavior	Can be set to: ▪ NO (normally open), factory setting ▪ NC (normally closed)

Maximum switching capacity (passive)	▪ DC 30 V, 0.1 A ▪ AC 30 V, 0.5 A

Assignable functions	▪ Disable
	▪ On
	▪ Diagnostic behavior
	▪ Limit
	  ▪ Volume flow
	  ▪ Mass flow
	  ▪ Flow velocity
	  ▪ Electronics temperature
	  ▪ Sound velocity
	  ▪ Totalizer 1-3
	▪ Flow direction monitoring
	▪ Status
	Low flow cut off
	The range of options increases if the measuring device has one or more application packages.

User-configurable input/output

One specific input or output is assigned to a user-configurable input/output (configurable I/O) during device commissioning.

The following inputs and outputs are available for assignment:
- Choice of current output: 4 to 20 mA (active), 0/4 to 20 mA (passive)
- Pulse/frequency/switch output
- Choice of current input: 4 to 20 mA (active), 0/4 to 20 mA (passive)
- Status input

The technical values correspond to those of the inputs and outputs described in this section.

Signal on alarm

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

HART current output

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

Modbus RS485

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

Current output 0/4 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: ▪ Maximum alarm: 22 mA ▪ Definable value between: 0 to 20.5 mA

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: 2 to 12 500 Hz
Switch output	
Fault mode	Choose from: ▪ Current status ▪ Open ▪ Closed

Relay output

Failure mode	Choose from: ▪ Current status ▪ Open ▪ Closed

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 → 73

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

Load

Output signal → 🖹 21

Ex connection data

Safety-related values

Order code "Output; input 1"	Output type	Safety-related values "Output; input 1"	
		26 (+)	27 (–)
Option **BA**	Current output 4 to 20 mA HART	U_N = 30 V_{DC} U_M = 250 V_{AC}	
Option **MA**	Modbus RS485	U_N = 30 V_{DC} U_M = 250 V_{AC}	

Order code "Output; input 2"; "Output; input 3"	Output type	Safety-related values			
		Output; input 2		Output; input 3	
		24 (+)	25 (–)	22 (+)	23 (–)
Option **B**	Current output 4 to 20 mA	U_N = 30 V_{DC} U_M = 250 V_{AC}			
Option **D**	User-configurable input/ output	U_N = 30 V_{DC} U_M = 250 V_{AC}			
Option **E**	Pulse/frequency/switch output	U_N = 30 V_{DC} U_M = 250 V_{AC}			
Option **F**	Pulse output, phase-shifted	U_N = 30 V_{DC} U_M = 250 V_{AC}			
Option **H**	Relay output	U_N = 30 V_{DC} I_N =100 mA_{DC}/500 mA_{AC} U_M = 250 V_{AC}			
Option **I**	Current input 4 to 20 mA	U_N = 30 V_{DC} U_M = 250 V_{AC}			
Option **J**	Status input	U_N = 30 V_{DC} U_M = 250 V_{AC}			

Intrinsically safe values

Order code "Output; input 1"	Output type	Intrinsically safe values "Output; input 1"	
		26 (+)	27 (–)
Option **CA**	Current output 4 to 20 mA HART Ex i passive	U_i = 30 V I_i = 100 mA P_i = 1.25 W L_i = 0 µH C_i = 6 nF	
Option **CC**	Current output 4 to 20 mA HART Ex i active	**Ex ia** [1] U_0 = 21.8 V I_0 = 90 mA P_0 = 491 mW L_0 = 4.1 mH (IIC)/15 mH (IIB) C_0 = 160 nF (IIC)/ 1 160 nF (IIB) U_i = 30 V I_i = 10 mA P_i = 0.3 W L_i = 5 µH C_i = 6 nF	

1) Only available for Proline 500 transmitter Zone 1; Class I, Division 1.

Order code "Output; input 2"; "Output; input 3"	Output type	Intrinsically safe values or NIFW values			
		Output; input 2		Output; input 3	
		24 (+)	25 (–)	22 (+)	23 (–)
Option C	Current output 4 to 20 mA Ex i passive	U_i = 30 V I_i = 100 mA P_i = 1.25 W L_i = 0 C_i = 0			
Option G	Pulse/frequency/switch output Ex-i passive	U_i = 30 V I_i = 100 mA P_i = 1.25 W L_i = 0 C_i = 0			

Low flow cut off

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

Galvanic isolation

The outputs are galvanically isolated:
- from the power supply
- from one another
- from the potential equalization (PE) terminal

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. Not applicable to order code for "Sensor version", options AG, AH.

Protocol-specific data

HART

Manufacturer ID	0x11
Device type ID	0x5D (93)
HART protocol revision	7
Device description files (DTM, DD)	Information and files under: www.endress.com
HART load	Min. 250 Ω
System integration	Information on system integration: Operating Instructions → 🖹 86. ▪ Measured variables via HART protocol ▪ Burst Mode functionality

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	▪ 1 200 BAUD ▪ 2 400 BAUD ▪ 4 800 BAUD ▪ 9 600 BAUD ▪ 19 200 BAUD ▪ 38 400 BAUD ▪ 57 600 BAUD ▪ 115 200 BAUD
Data transmission mode	▪ ASCII ▪ RTU
Data access	Each device parameter can be accessed via Modbus RS485. For Modbus register information → 86
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: supply voltage, input/outputs

HART

Supply voltage		Input/output 1		Input/output 2		Input/output 3	
1 (+)	2 (–)	26 (+)	27 (–)	24 (+)	25 (–)	22 (+)	23 (–)
		The terminal assignment depends on the specific device version ordered .					

Modbus RS485

Supply voltage		Input/output 1		Input/output 2		Input/output 3	
1 (+)	2 (–)	26 (B)	27 (A)	24 (+)	25 (–)	22 (+)	23 (–)
		The terminal assignment depends on the specific device version ordered .					

Transmitter and sensor connection housing: connecting cable

The sensor and transmitter, which are mounted in separate locations, are interconnected by a connecting cable. The cable is connected via the sensor connection housing and the transmitter housing.

Terminal assignment and connection of the connecting cable:
Proline 500 → 31

Available device plugs

Device plugs may not be used in hazardous areas!

Device plug for connecting to the service interface:
Order code for "Accessory mounted"
Option **NB**, RJ45 M12 adapter (service interface) → 30

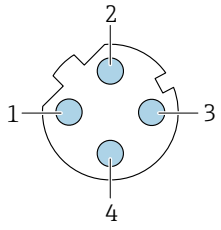
Order code for "Accessory mounted", option NB "Adapter RJ45 M12 (service interface)"

Order code "Accessory mounted"	Cable entry/coupling → 🖹 31	
	Cable entry 2	Cable entry 3
NB	Plug M12 × 1	–

Pin assignment, device plug

Service interface for

Order code for "Accessories mounted", option **NB**: Adapter RJ45 M12 (service interface)



Pin		Assignment
1	+	Tx
2	+	Rx
3	-	Tx
4	-	Rx
Coding		**Plug/socket**
D		Socket

Recommended plug:
- Binder, series 763, part no. 99 3729 810 04
- Phoenix, part no. 1543223 SACC-M12MSD-4Q

Supply voltage

Order code "Power supply"	Terminal voltage		Frequency range
Option **D**	DC 24 V	±20%	–
Option **E**	AC 100 to 240 V	−15…+10%	50/60 Hz, ±4 Hz
Option **I**	DC 24 V	±20%	–
	AC 100 to 240 V	−15…+10%	▪ 50/60 Hz ▪ 50/60 Hz, ±4 Hz

Power consumption

Transmitter

Max. 10 W (active power)

switch-on current	Max. 36 A (<5 ms) as per NAMUR Recommendation NE 21

Current consumption

Transmitter

- Max. 400 mA (24 V)
- Max. 200 mA (110 V, 50/60 Hz; 230 V, 50/60 Hz)

Power supply failure

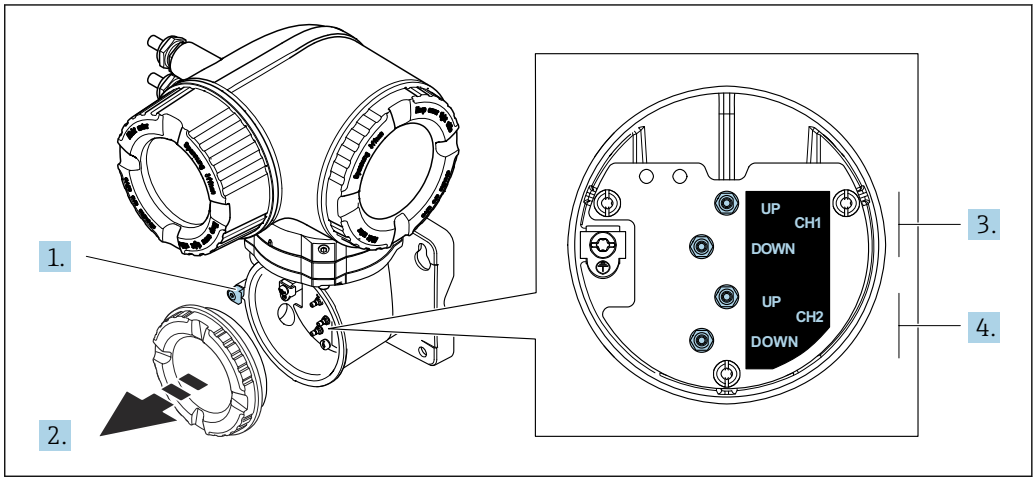
- Totalizers stop at the last value measured.
- Depending on the device version, the configuration is retained in the device memory or in the pluggable data memory (HistoROM DAT).
- Error messages (incl. total operated hours) are stored.

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

Connection of the connecting cable: Proline 500

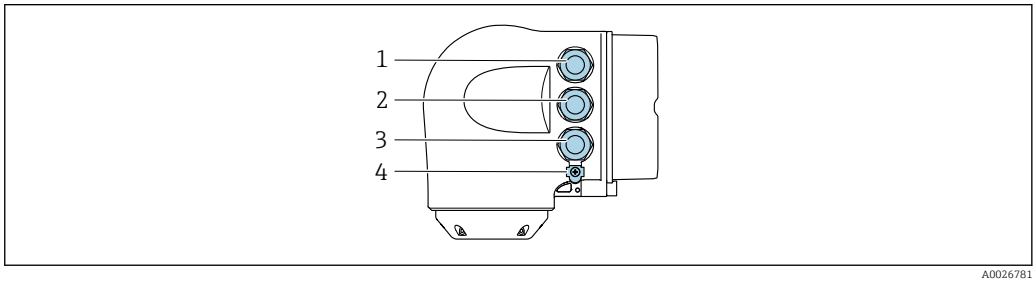


1 *Securing clamp*
2 *Connection compartment cover: sensor cable connection*
3 *Channel 1 UP: upstream/DOWN: downstream*
4 *Channel 2 UP: upstream/DOWN downstream*

Transmitter connection

- Terminal assignment → 29
- Device plug pin assignment → 30

Connecting the transmitter: Proline 500



1 *Terminal connection for supply voltage*
2 *Terminal connection for signal transmission, input/output*
3 *Terminal connection for signal transmission, input/output or terminal for network connection (DHCP client) via service interface (CDI-RJ45; non-Ex); optional: connection for external WLAN antenna*
4 *Terminal connection for potential equalization (PE)*

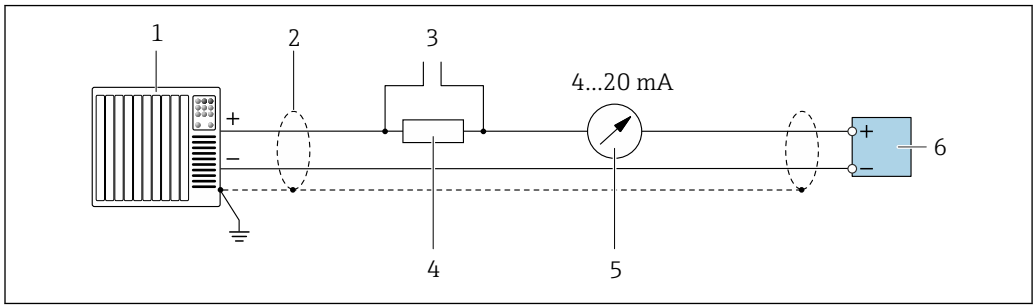
An adapter for the RJ45 to the M12 plug is optionally available:
Order code for "Accessories", option **NB**: "Adapter RJ45 M12 (service interface)"

The adapter connects the service interface (CDI-RJ45; non-Ex) to an M12 plug mounted in the cable entry. The connection to the service interface can thus be established via an M12 plug without opening the device.

Network connection (DHCP client) via service interface (CDI-RJ45) → 75

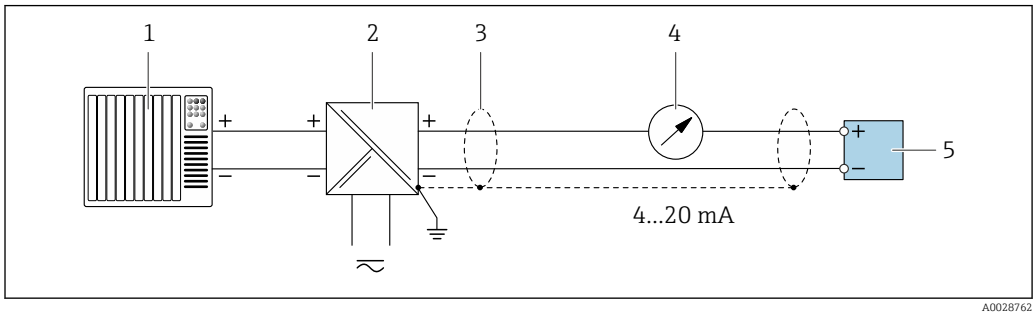
Connection examples

Current output 4 to 20 mA HART



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

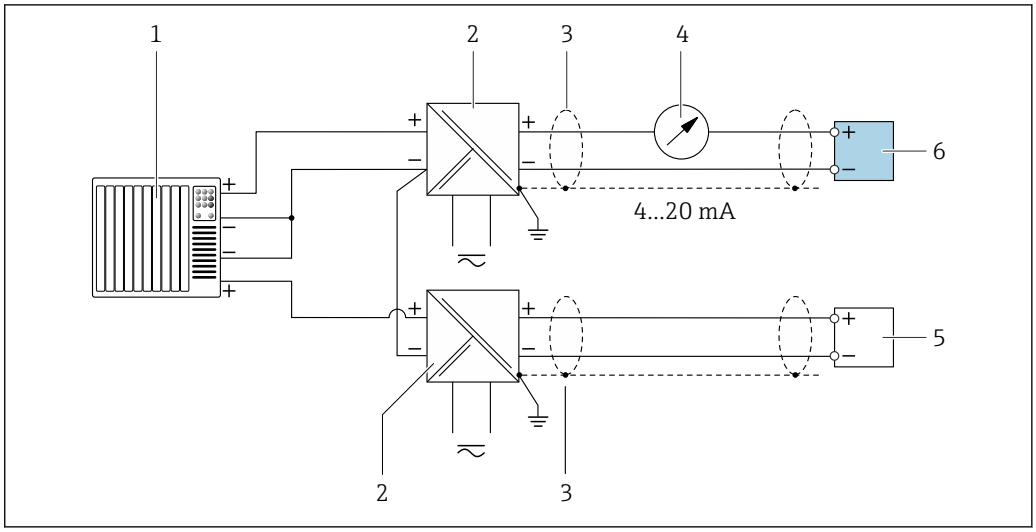
1 *Automation system with current input (e.g. PLC)*
2 *Ground cable shield at one end. The cable shield must be grounded at both ends to comply with EMC requirements; observe cable specifications → 37*
3 *Connection for HART operating devices → 73*
4 *Resistor for HART communication (≥ 250 Ω): observe maximum load → 21*
5 *Analog display unit: observe maximum load → 21*
6 *Transmitter*



19 Connection example for 4 to 20 mA HART current output (passive)

1 *Automation system with current input (e.g. PLC)*
2 *Power supply*
3 *Ground cable shield at one end. The cable shield must be grounded at both ends to comply with EMC requirements; observe cable specifications → 37*
4 *Analog display unit: observe maximum load → 21*
5 *Transmitter*

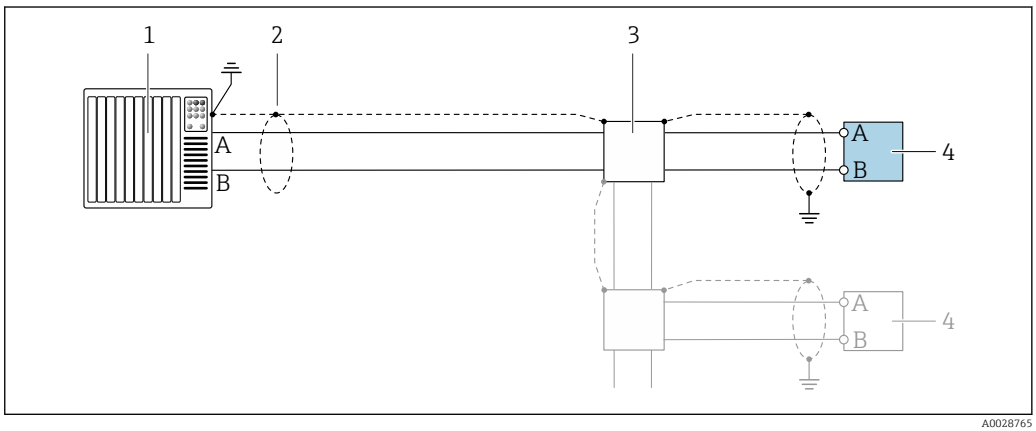
HART input



20 Connection example for HART input with a common negative (passive)

1 *Automation system with HART output (e.g. PLC)*
2 *Active barrier for power supply (e.g. RN221N)*
3 *Ground cable shield at one end. The cable shield must be grounded at both ends to comply with EMC requirements; observe cable specifications*
4 *Analog display unit: observe maximum load → 21*
5 *temperature and density measuring device: observe requirements*
6 *Transmitter*

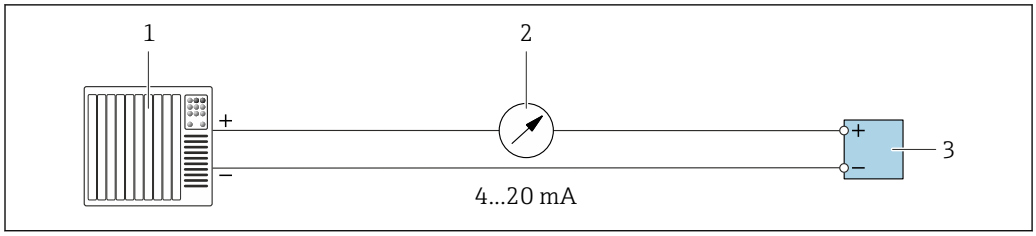
Modbus RS485



21 Connection example for Modbus RS485, non-hazardous area and Zone 2; Class I, Division 2

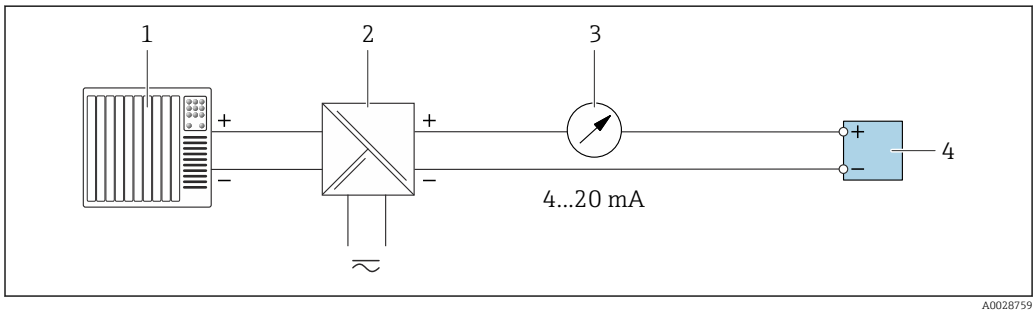
1 *Control system (e.g. PLC)*
2 *Cable shield provided at one end. The cable shield must be grounded at both ends to comply with EMC requirements; observe cable specifications*
3 *Distribution box*
4 *Transmitter*

Current output 4-20 mA



22 Connection example for 4-20 mA current output (active)

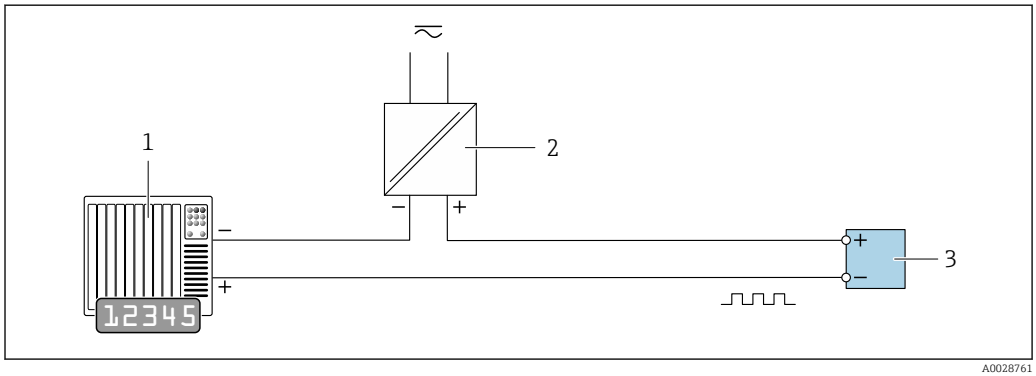
1 Automation system with current input (e.g. PLC)
2 Analog display unit: observe maximum load → 21
3 Transmitter



23 Connection example for 4-20 mA current output (passive)

1 Automation system with current input (e.g. PLC)
2 Active barrier for power supply (e.g. RN221N)
3 Analog display unit: observe maximum load → 21
4 Transmitter

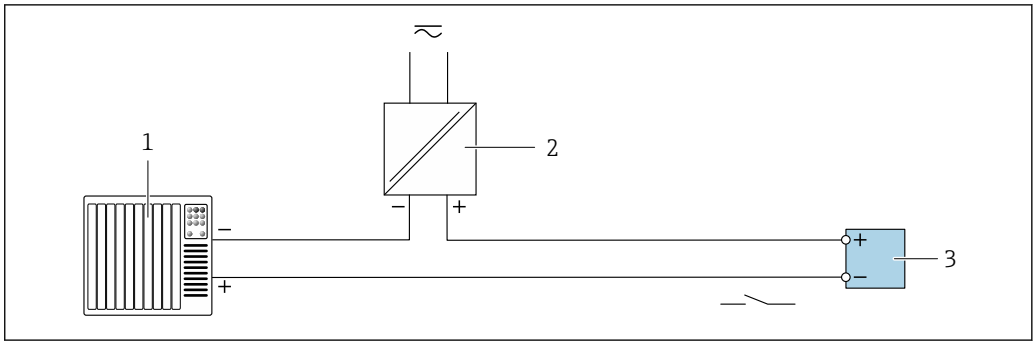
Pulse/frequency output



24 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 → 23

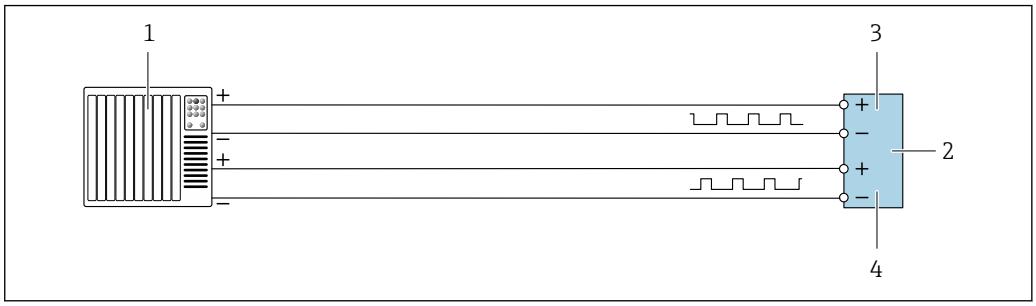
Switch output



25 Connection example for switch output (passive)

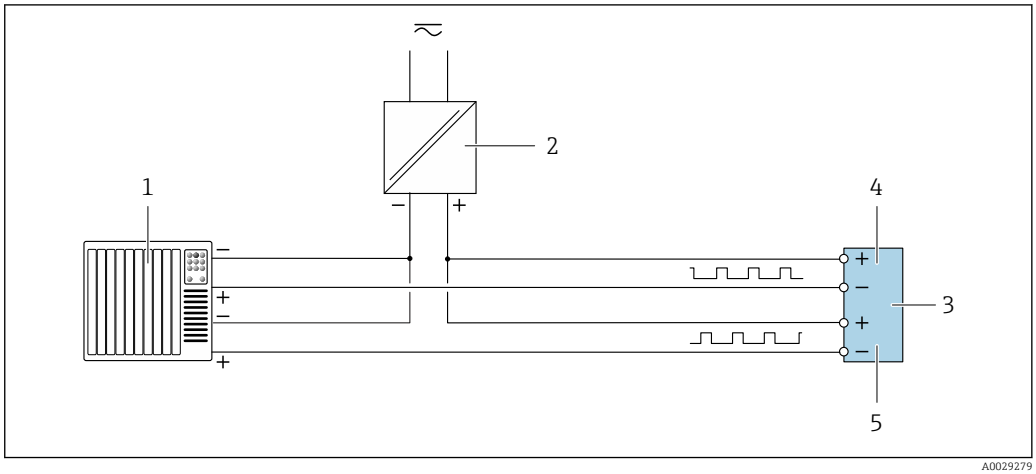
1 Automation system with switch input (e.g. PLC with a 10 kΩ pull-up or pull-down resistor)
2 Power supply
3 Transmitter: observe input values → 23

Pulse output, phase-shifted



26 Connection example for pulse output, phase-shifted (active)

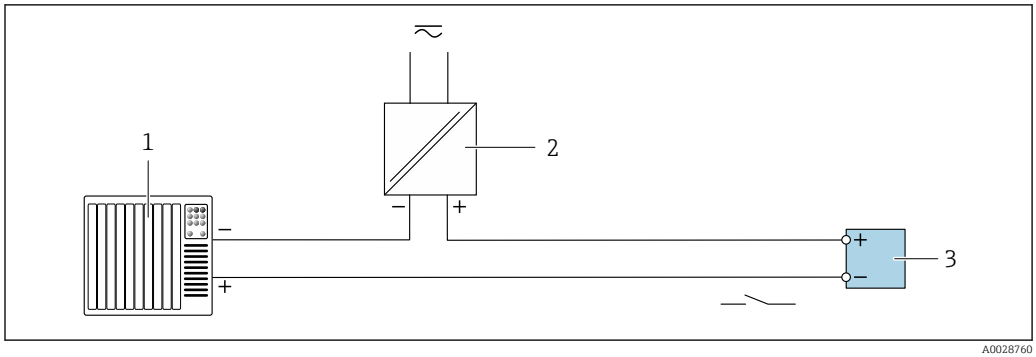
1 Automation system with pulse input, phase-shifted (e.g. PLC)
2 Transmitter: observe input values → 24
3 Pulse output
4 Pulse output (slave), phase-shifted



27 Connection example for pulse output, phase-shifted (passive)

1 Automation system with pulse output, phase-shifted (e.g. PLC)
2 Power supply
3 Transmitter: observe input values → 24
4 Pulse output
5 Pulse output (slave), phase-shifted

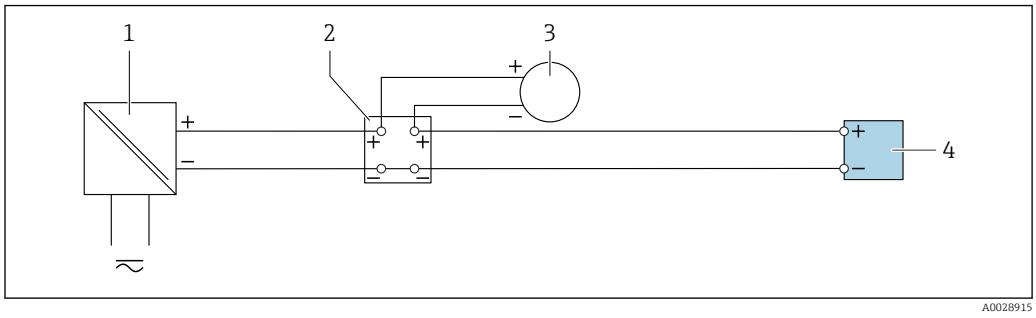
Relay output



28 Connection example for relay output (passive)

1 Automation system with relay input (e.g. PLC)
2 Power supply
3 Transmitter: observe input values → 24

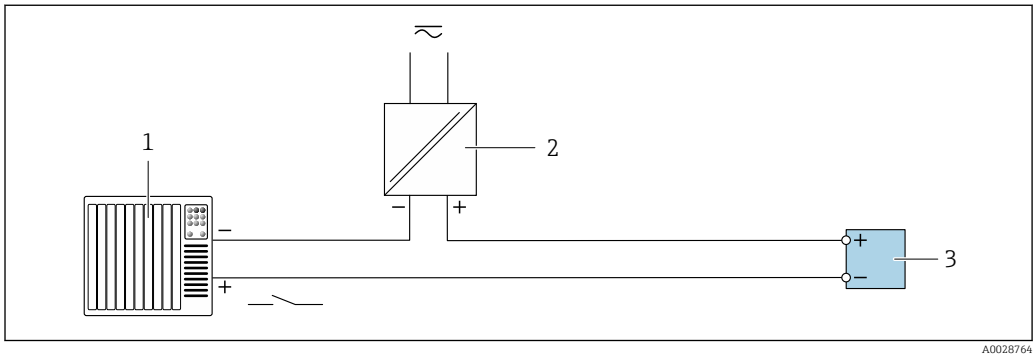
Current input



29 Connection example for 4 to 20 mA current input

1 Power supply
2 Terminal box
3 External measuring device (to read in pressure or temperature, for instance)
4 Transmitter

Status input



30 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
- Medium, 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

Spring-loaded terminals: Suitable for strands and strands with ferrules.
Conductor cross-section 0.2 to 2.5 mm² (24 to 12 AWG).

Cable entries

- Cable gland: M20 × 1.5 with cable Ø 6 to 12 mm (0.24 to 0.47 in)
- Thread for cable entry:
  - NPT ½"
  - G ½"
  - M20
- Device plug for digital communication: M12
  Only available for certain device versions → 🖹 29.

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.

Protective grounding cable for the outer ground terminal

Conductor cross-section < 2.1 mm² (14 AWG)

The use of a cable lug enables the connection of larger cross-sections.

The grounding impedance must be less than 2 Ω.

Signal cable

Current output 4 to 20 mA HART

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

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.

Current output 0/4 to 20 mA

Standard installation cable is sufficient

5)

Pulse /frequency /switch output

Standard installation cable is sufficient

Pulse output, phase-shifted

Standard installation cable is sufficient.

Relay output

Standard installation cable is sufficient.

Current input 0/4 to 20 mA

Standard installation cable is sufficient

Status input

Standard installation cable is sufficient

Connecting cable between the transmitter and sensor

Sensor cable for sensor - transmitter: Proline 500

Standard cable	▪ TPE: -40 to +80 °C (-40 to +176 °F) ▪ TPE armored: -40 to +80 °C (-40 to +176 °F) ▪ TPE halogen-free: -40 to +80 °C (-40 to +176 °F) ▪ PTFE: -50 to +170 °C (-58 to +338 °F) ▪ PTFE armored: -50 to +170 °C (-58 to +338 °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) or −50 °C (−58 °F) ▪ Cable - movable installation: minimum −25 °C (−13 °F)

1) Compare details under the row "Standard cable"

Overvoltage protection

Mains voltage fluctuations	→ 30
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 → 85

Maximum measurement error

o.r. = of reading

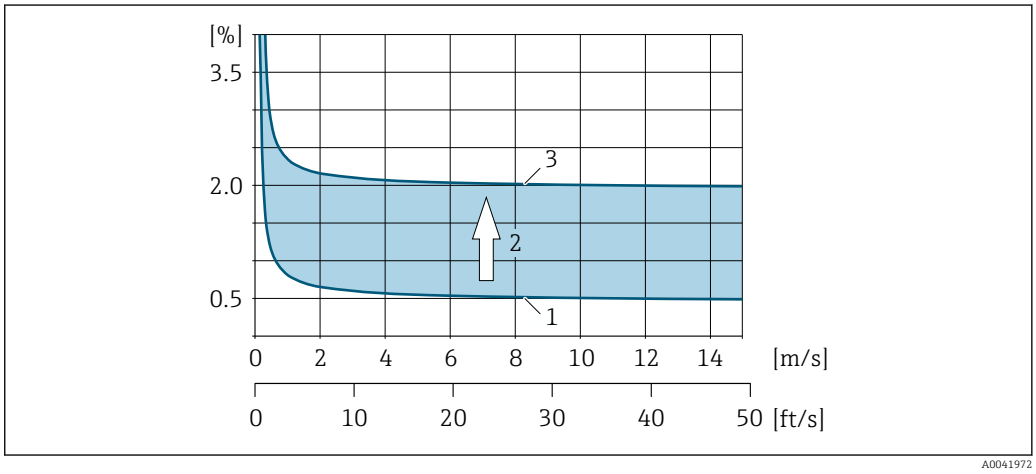
The measurement error depends on a number of factors. A distinction is made between the measurement error of the measuring device and an additional installation-specific measurement error that is independent of the measuring device.

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.

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

The specification applies to Reynolds numbers Re ≥ 10 000 and flow velocities v > 0.3 m/s (1 ft/s). Larger measurement errors may occur for Reynolds numbers Re < 10 000 and flow velocities v < 0.3 m/s (1 ft/s).



31 Example of the absolute value of the measurement error in a pipe with 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 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. The sensors are mounted on an appropriate stainless steel pipe in this case.

The measurement report shows the following maximum permissible errors:

Sensor type	Nominal diameter	Maximum permissible errors for device
C-500 (5 MHz)	DN 50 (2")	±0.5% o.r. ± 5 mm/s (0.20 in/s)
C-200 (2 MHz) C-100 (1 MHz) C-050 (0.5 MHz) CH-100 (1 MHz)	DN 100 (4")	±0.5% o.r. ± 7.5 mm/s (0.30 in/s)
C-030 (0.3 MHz) CH-050 (0.5 MHz)	DN 250 (10")	±0.5% o.r. ± 7.5 mm/s (0.30 in/s)

Accuracy of outputs

The outputs have the following base accuracy specifications.

Current output

Accuracy	±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

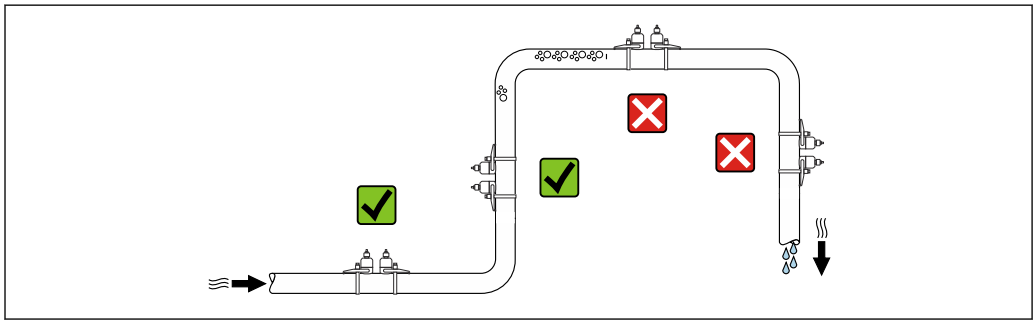
Temperature coefficient	Max. 1 µA/°C

Pulse/frequency output

Temperature coefficient	No additional effect. Included in accuracy.

Mounting procedure

Mounting location



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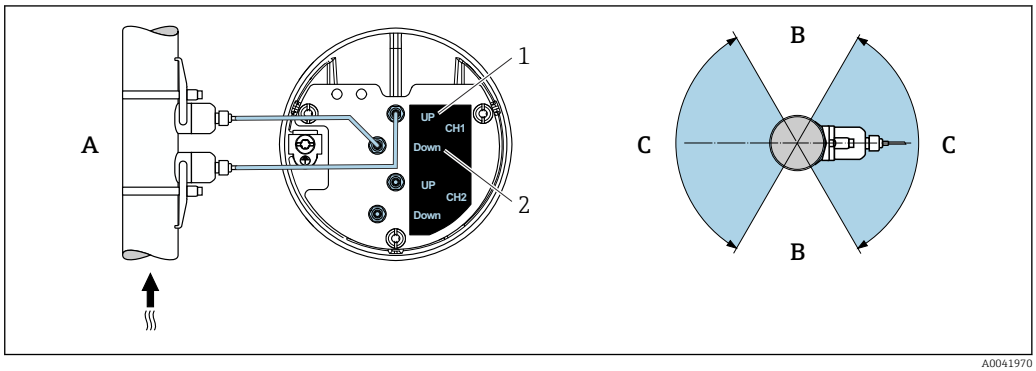
To prevent measuring errors arising from accumulation of gas bubbles in the measuring pipe, avoid the following mounting locations in the piping:
- Highest point of a pipeline.
- Directly upstream of a free pipe outlet in a down pipe.

Orientation



32 *Orientation views*

1 Channel 1 upstream
2 Channel 1 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.

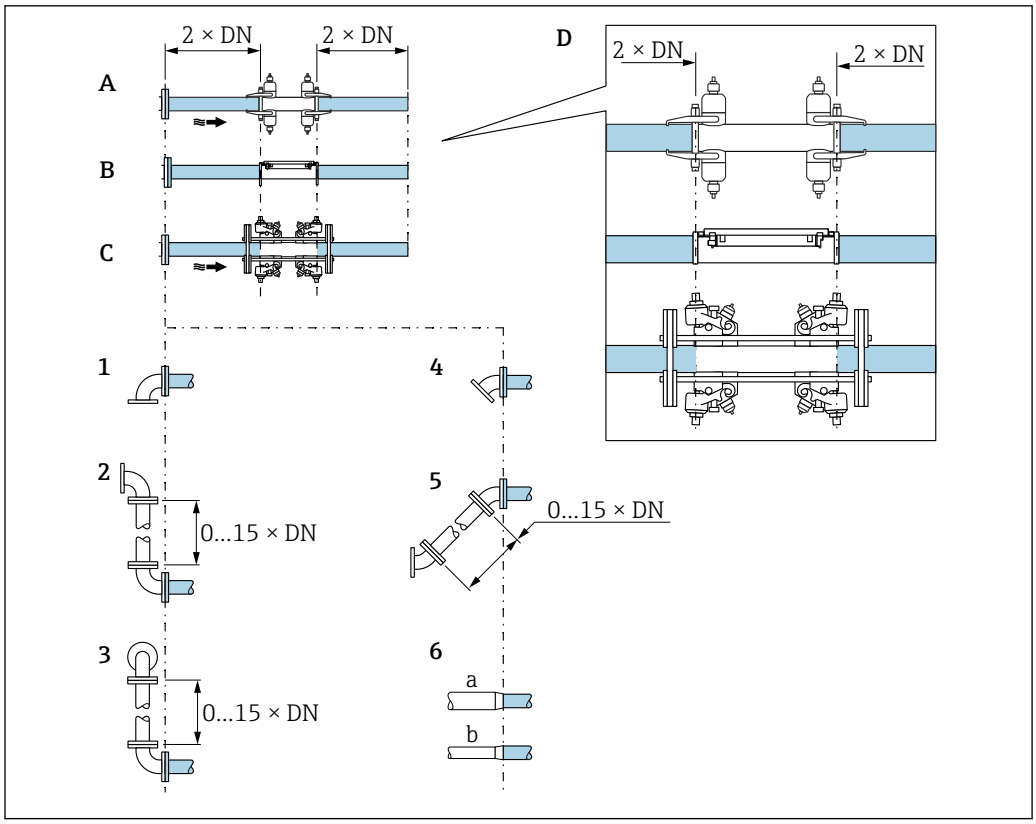
Inlet and outlet runs

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

For additional information on FlowDC, see the Special Documentation for the device → 87

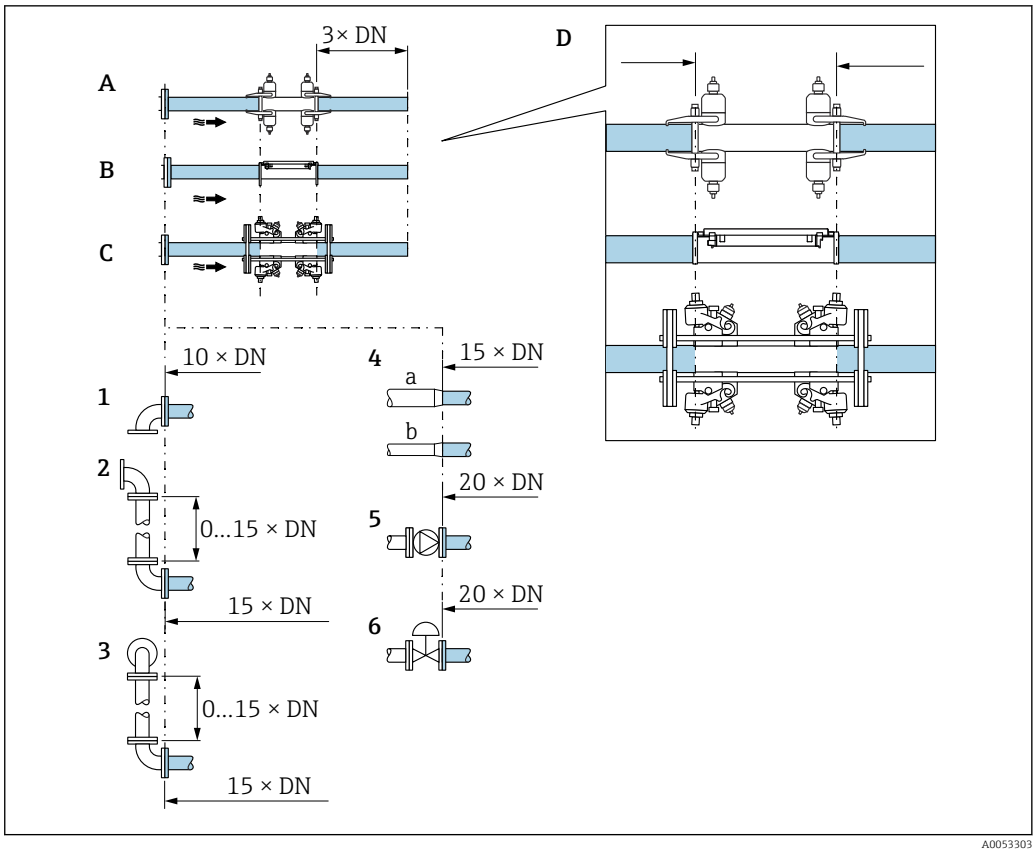


33

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 Inlet and outlet runs for high-temperature sensors
D 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



34

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 Inlet and outlet runs for high-temperature sensors
D 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.

DANGER

Risk of burns from hot surfaces!

- Wear suitable protective equipment such as temperature-resistant protective gloves, clothing or protective visors.
- Before commencing work: allow the system and measuring device to cool to a touch-safe temperature.

High-temperature applications (> 170°C)

- Order code for "Process temperature", options H, I, J
- Installation for high-temperature applications may only be performed by Endress+Hauser staff or by individuals authorized and trained by Endress+Hauser.

Notes on mounting

Mounting the high-temperature sensors CH-050/CH-100

For detailed information on mounting the CH-050/CH-100 high-temperature sensors (order code for "Sensor version", options AG, AH), see Special Documentation on "High-temperature applications → 87".

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 → 52	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")

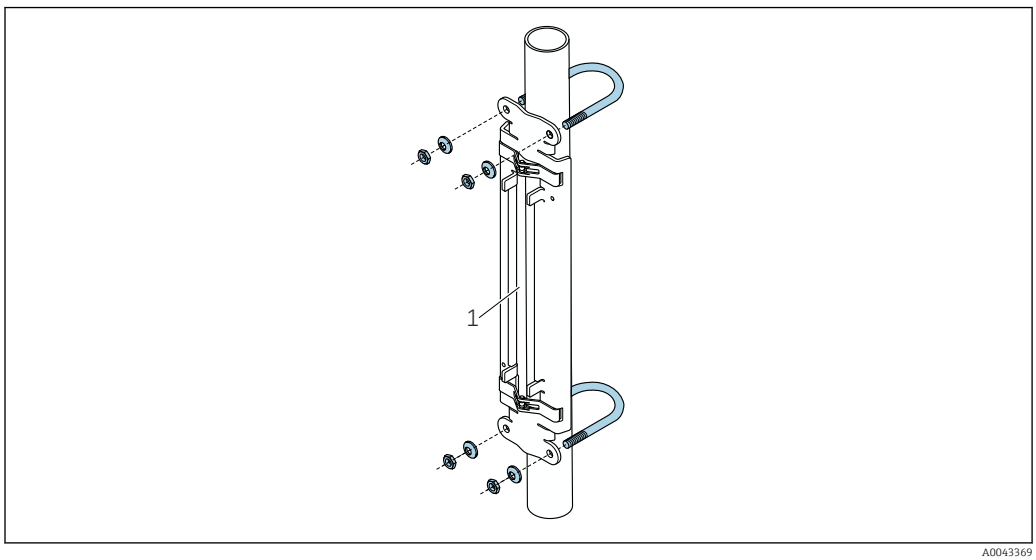
Determining the mounting positions of the sensor

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.



35 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.

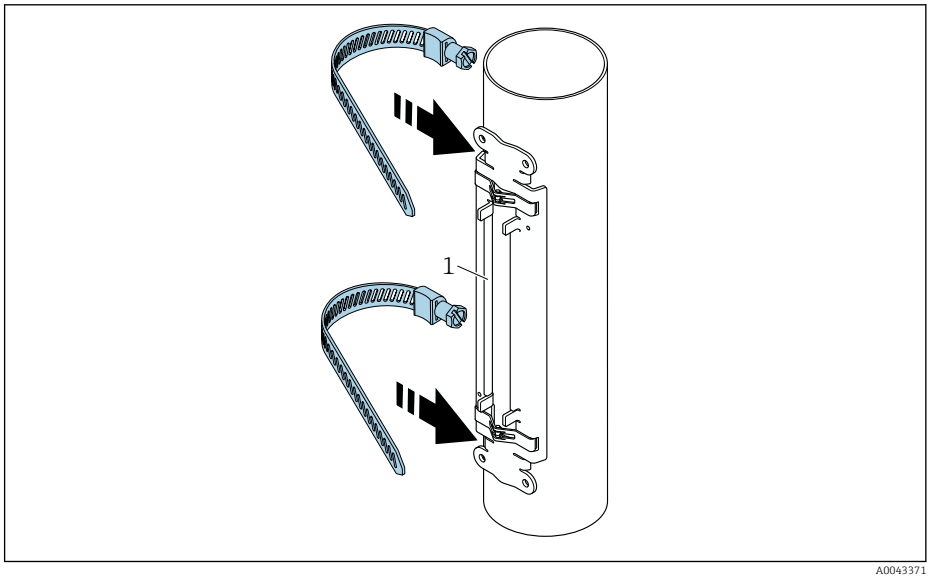
To ensure good acoustic contact, the visible measuring pipe surface must be clean and free from flaking paint and/or rust.

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.

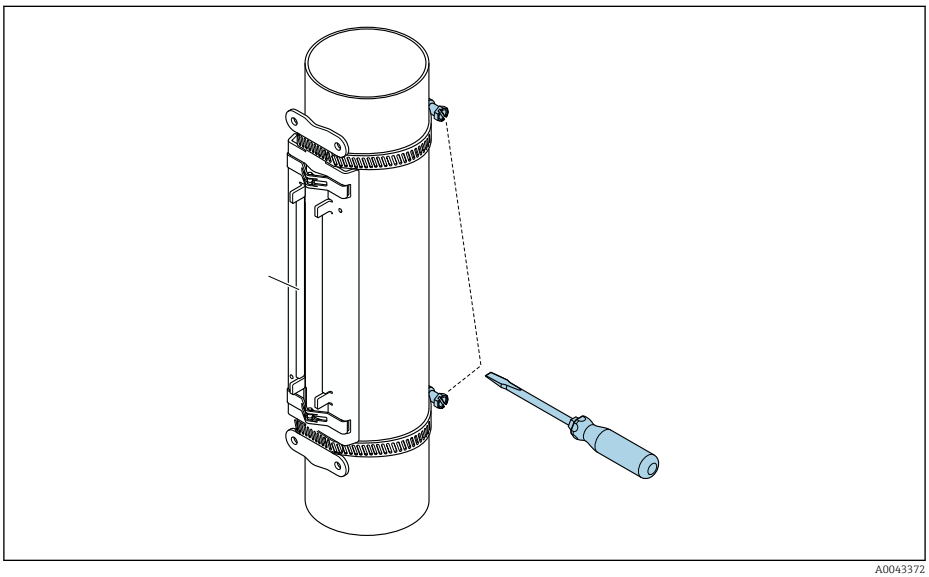


36 Position the sensor holder and fit the strapping bands.

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.



37 *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")

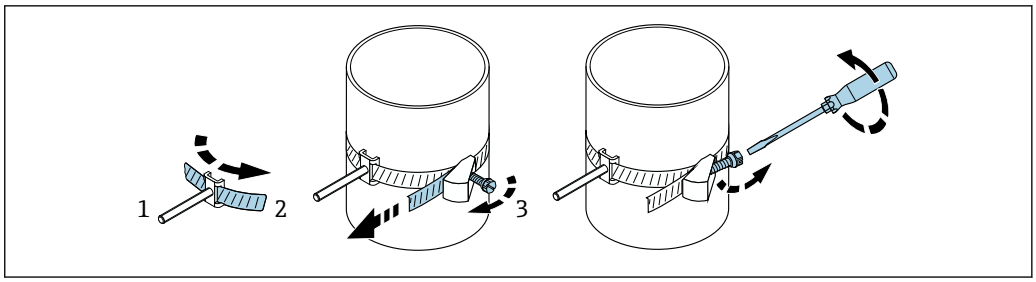
Procedure:

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

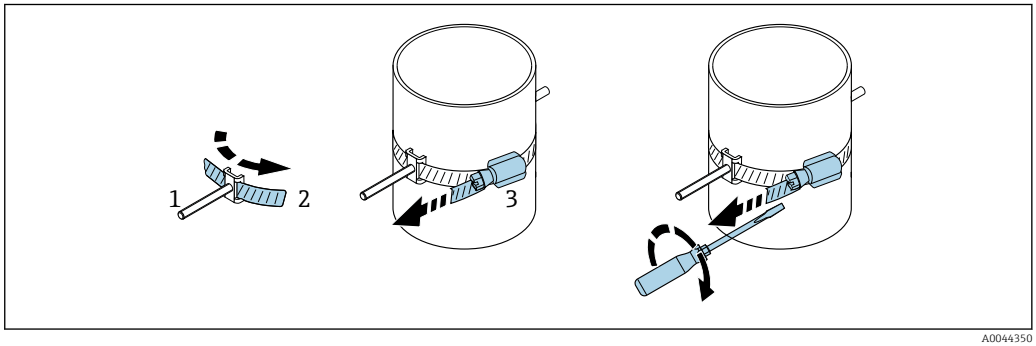
Risk of injury due to sharp edges!

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



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

1 Mounting bolts
2 Strapping band
3 Tensioning screw

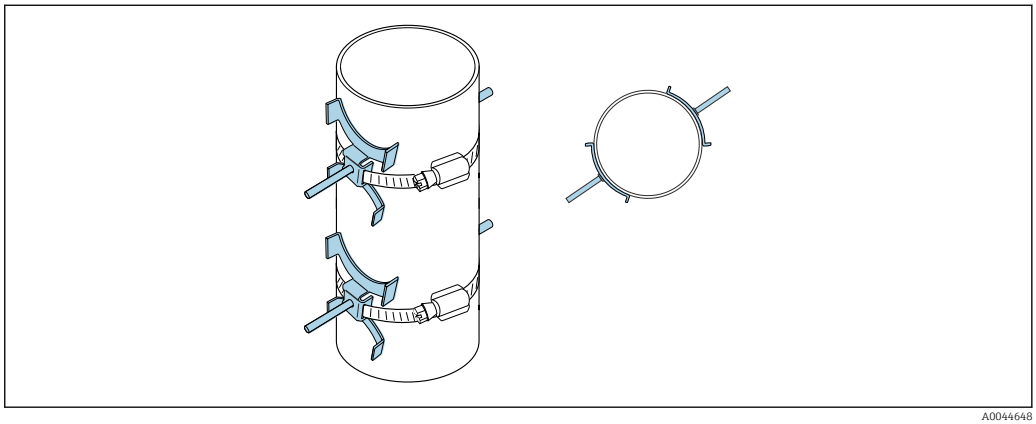


39 Holder with strapping bands (medium nominal diameters), without hinged screw

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°)



Procedure:

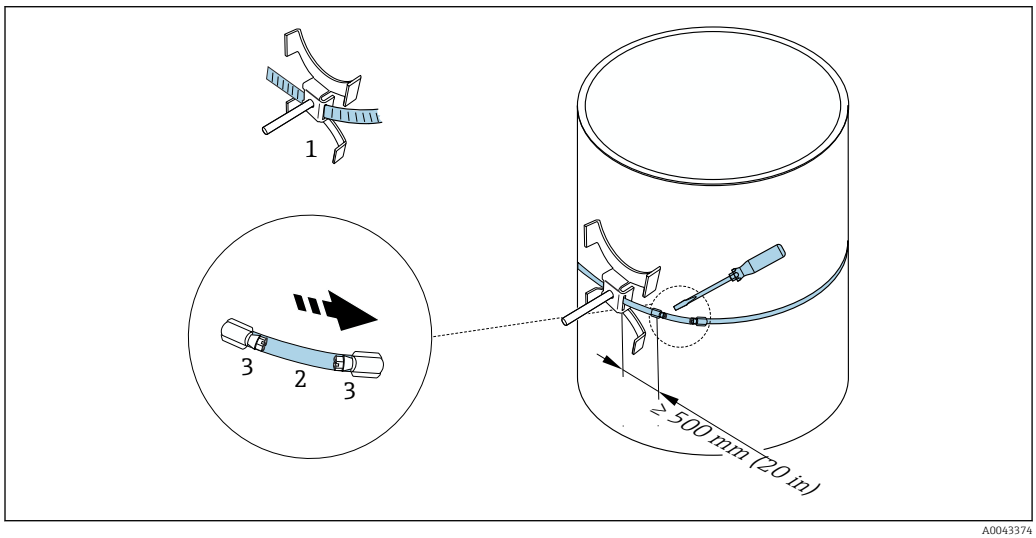
1. Measure the pipe circumference. Note down the full/half or quarter circumference.
2. Shorten the strapping bands to the required length (= measuring pipe circumference + 30 mm (1.18 in)) and trim the cut edges.

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 that is parallel to 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 → 52.
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.



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

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

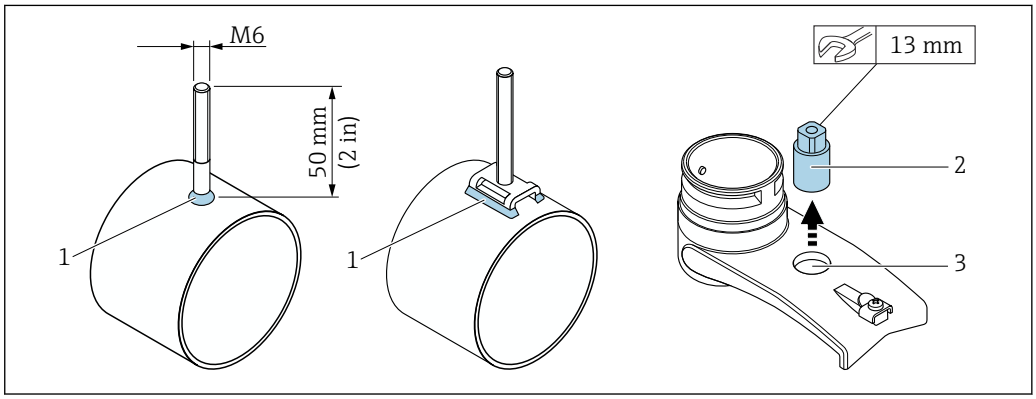
*The distance between the strap bolts and strapping band lock must be at least 500 mm (20 in).

- For 1-traverse mounting with 180° (opposite) → 6, 9 (single-path measurement, A0044304), → 10, 9(two-path measurement, A0043168)
- For 2-traverse mounting → 7, 9 (single-path measurement, A0044305), → 11, 9(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 → 51
  - Installation for measurement via 2 traverses → 54
- 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.



41 *Holder with welded bolts*

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

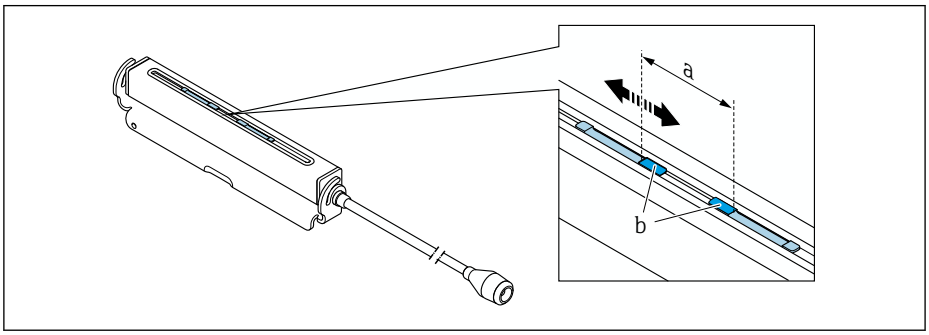
Installing sensor – small nominal diameters DN 15 to 65 (½ to 2½")

Requirements
- The installation distance is known. → 44
- 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.

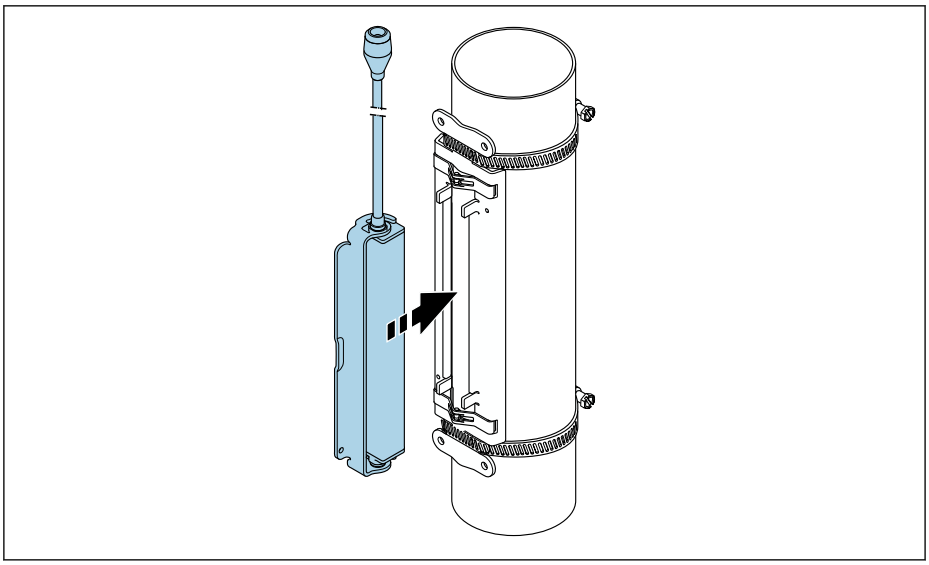


42 *Distance between sensors as per the installation distance* → 44

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

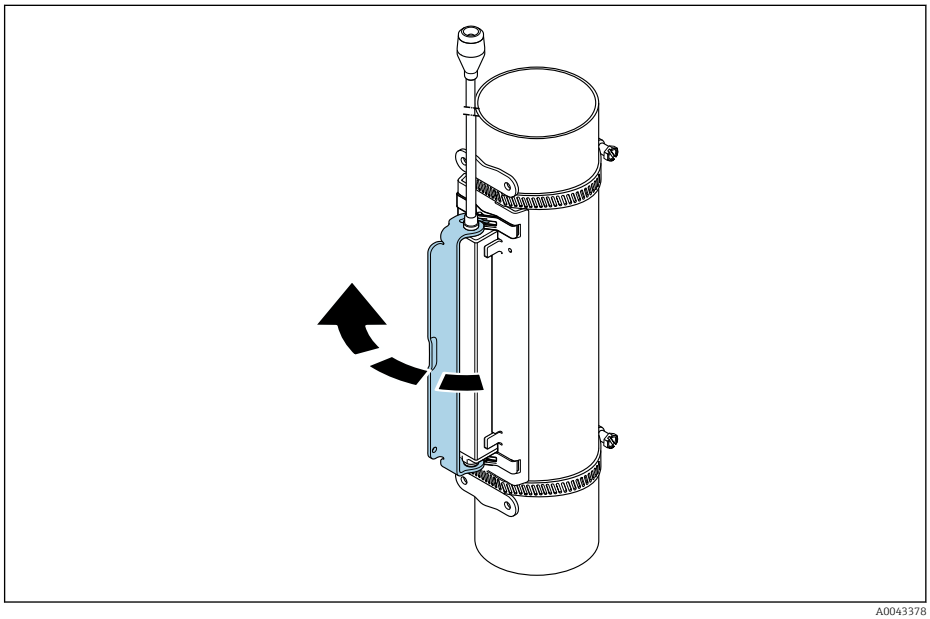
2. Stick the coupling pad under the sensor onto the measuring pipe. Alternatively, coat the contact surfaces of the sensor (b) evenly with coupling gel (approx. 0.5 to 1 mm (0.02 to 0.04 in)).

3. Position the sensor housing on the sensor holder.



43 *Positioning the sensor housing*

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



44 *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

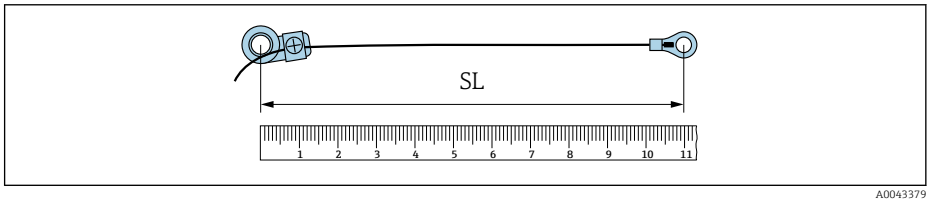
Requirements
- The installation distance and wire length are known → 44
- Strapping bands are pre-assembled

Material
The following material is required for mounting:
- Two strapping bands incl. mounting bolts and centering plates where necessary (already pre-assembled → 46, → 47)
- 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.

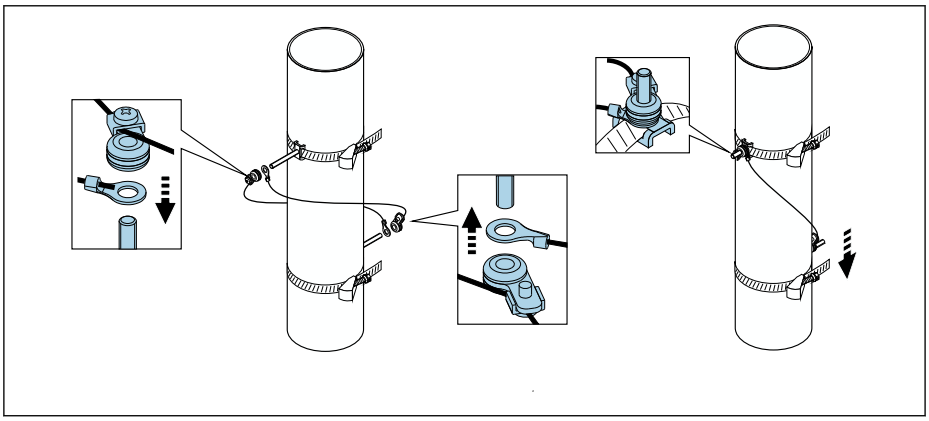
Procedure for using measuring wires:

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.
   ↳



45 *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, which can still be moved.
4. Take the still movable strapping band 2, including the mounting bolt, and move it until both measuring wires are evenly tensioned and 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.

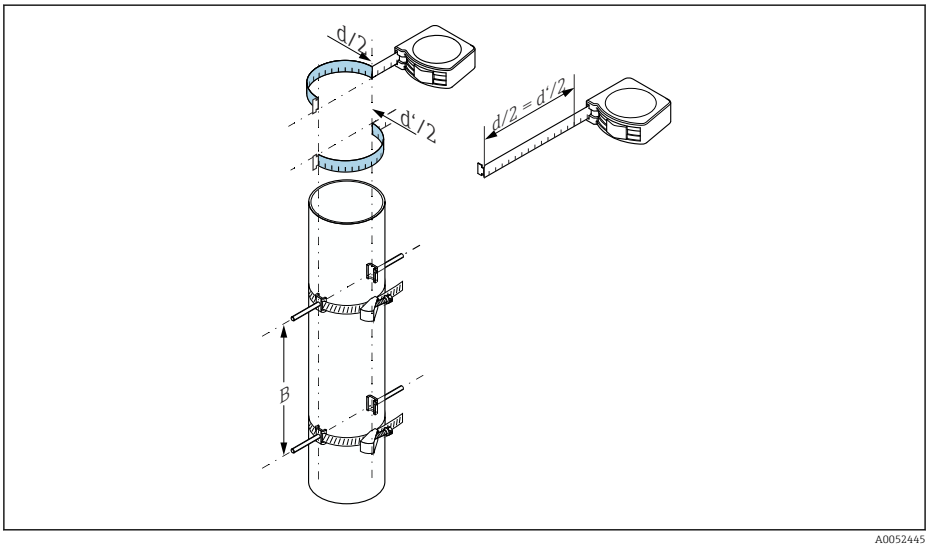


46 *Positioning the strapping bands (steps 2 to 4)*

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:

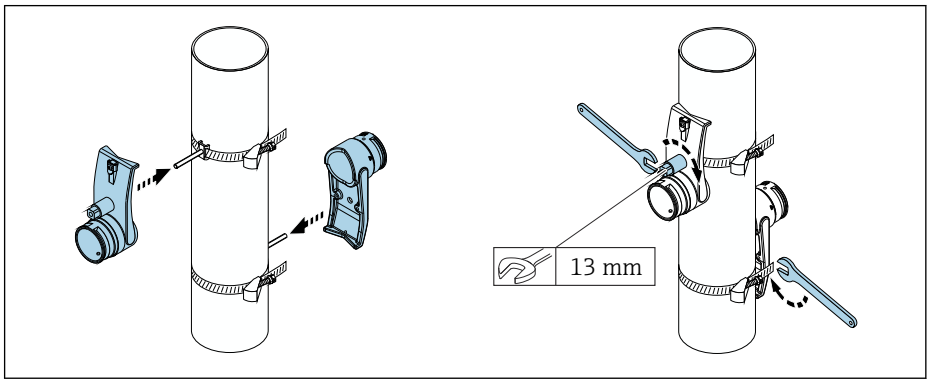
1. Use a tape measure to determine the pipe diameter d.
2. Mount the opposite mounting bolt at d/2 from the front mounting bolt. The distance must be d/2 = d'/2 on both sides.
3. Check distance B.



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

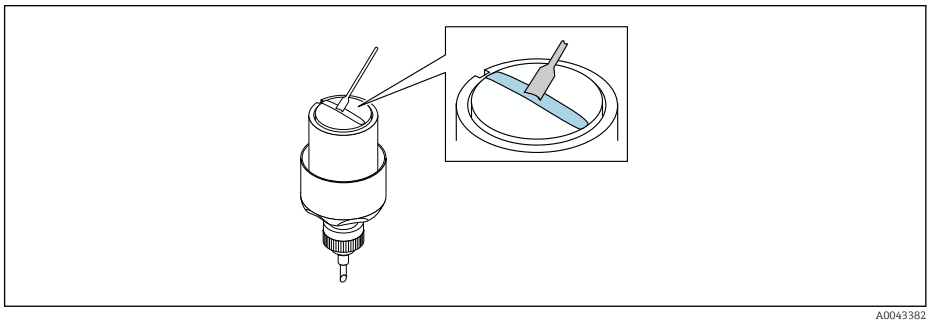
Fastening the sensors:

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



48 Mounting the sensor holders

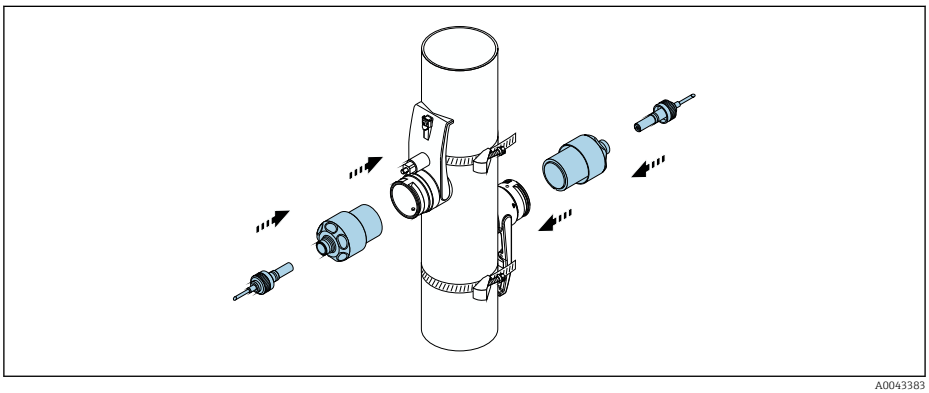
2. Stick the coupling pad under the sensor → 87. Alternatively, coat the contact surfaces of the sensor evenly with coupling gel (approx. 1 mm (0.04 in)). In doing so, start from the groove through the center to the opposite edge.



49 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.



50 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).

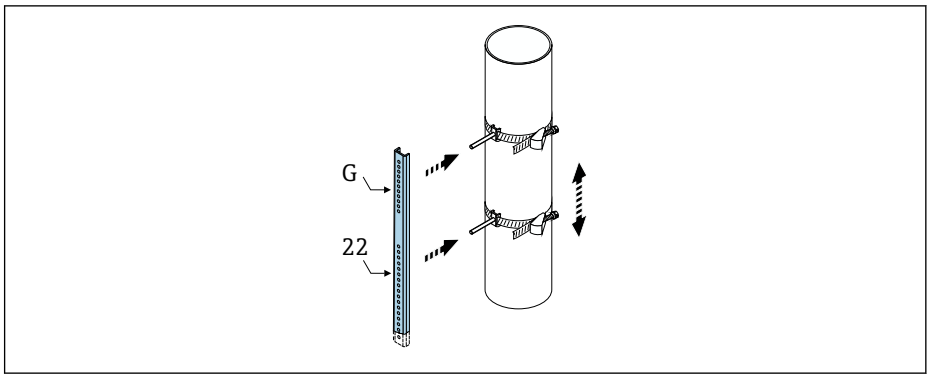
Installation for measurement via 2 traverses

Requirements
- The installation distance is known. → 44
- 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 → 46, → 47)
- 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

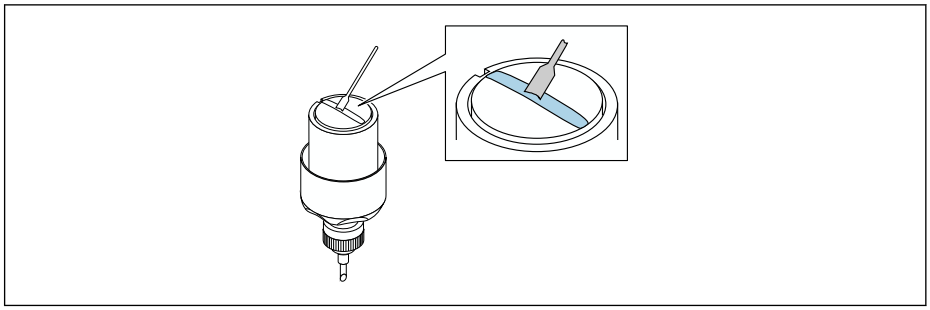
Procedure:

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.



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

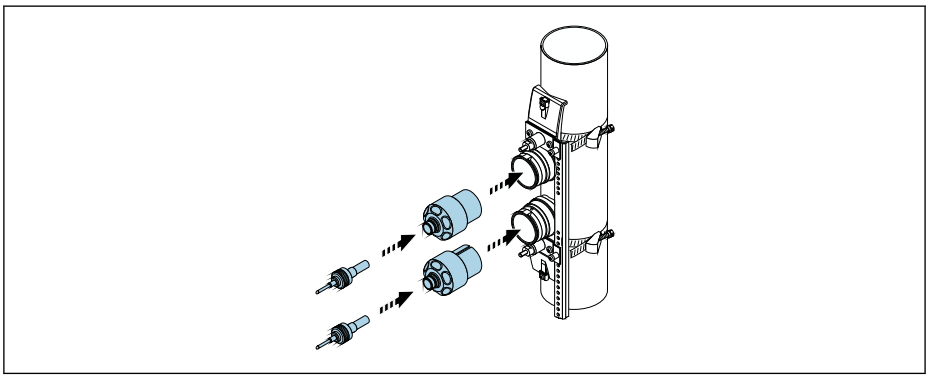
2. Tighten strapping band 2 so that it cannot slip.
3. Remove the mounting rail from the mounting bolt.
4. Fit the sensor holders over the individual mounting bolts and tighten securely with the locking nut.
5. Place the coupling pad under the sensor → 87. Alternatively, coat the contact surfaces of 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.



52 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.



53 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

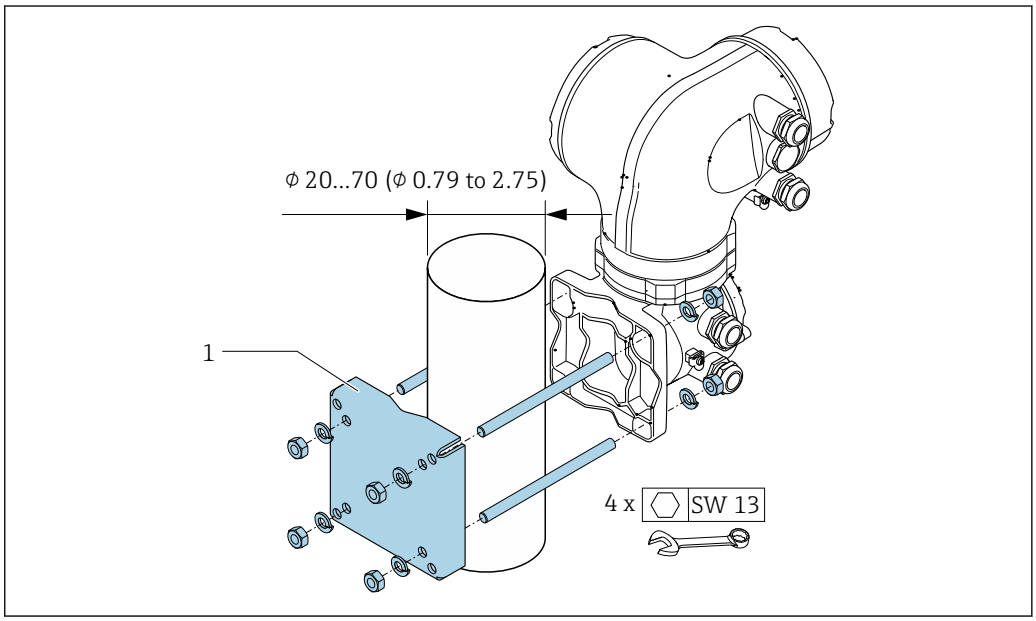
Proline 500 transmitter

Pipe mounting

Required tools
Open-ended wrench AF 13

⚠ WARNING

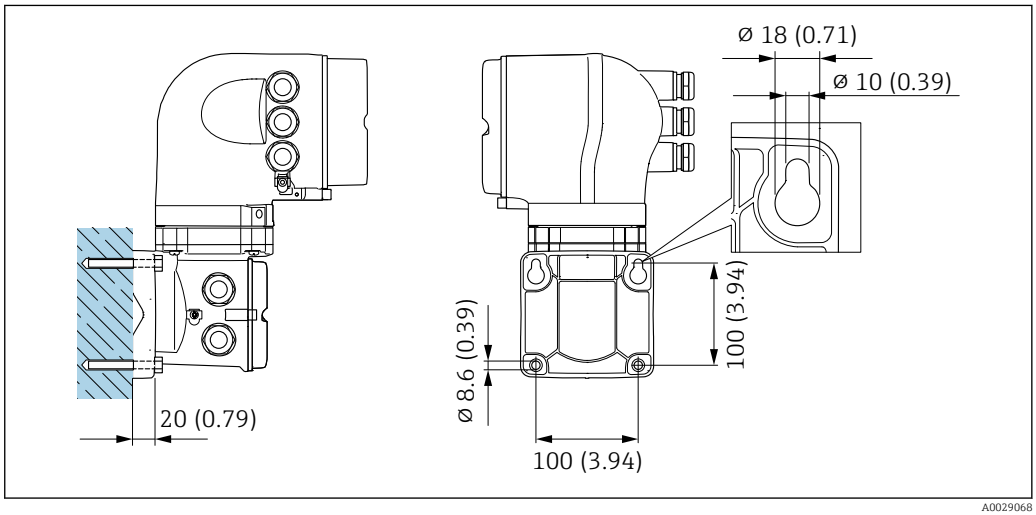
Order code for "Transmitter housing", option L "Cast, stainless": cast transmitters are very heavy.
They are unstable if they are not mounted on a secure, fixed post.
- ▶ Only mount the transmitter on a secure, fixed post on a stable surface.



54 *Engineering unit mm (in)*

Wall mounting

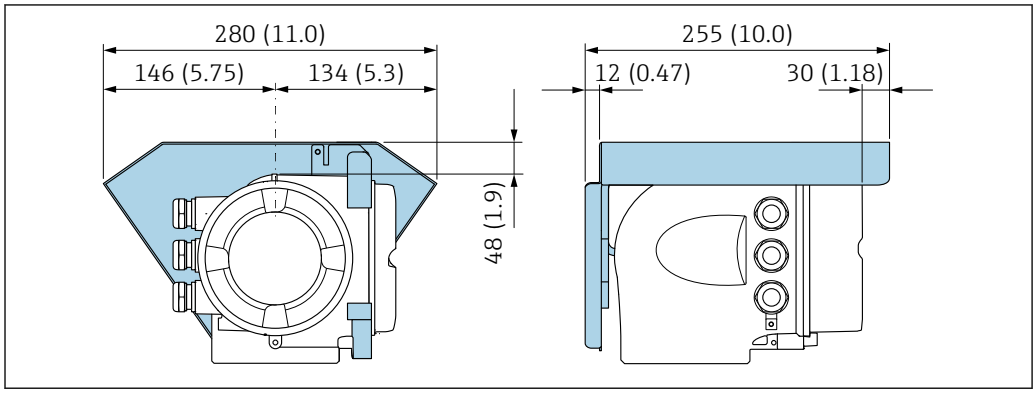
Required tools
Drill with drill bit Ø 6.0 mm



55 *Engineering unit mm (in)*

Special mounting instructions

Weather protection cover



56 *Weather protection cover for Proline 500; engineering unit mm (in)*

Environment

Ambient temperature range

Transmitter	▪ Standard:−40 to +60 °C (−40 to +140 °F) ▪ Optional order code for "Test, certificate", option JN: −50 to +60 °C (−58 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 +150 °C (−40 to +302 °F) DN 50 to 4000 (2 to 160") ▪ Standard:−40 to +80 °C (−40 to +176 °F) ▪ Optional: 0 to +170 °C (+32 to +338 °F) DN 50 to 600 (2 to 24") High temperature: +150 to +550 °C (+302 to +1022 °F)
Sensor cable (connection between transmitter and sensor)	DN 15 to 65 (½ to 2½") Standard (TPE [1]): −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 [1]): −50 to +170 °C (−58 to +338 °F)

1) Armored version also available for order

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

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.

For notes on insulation for high-temperature sensors, see the Special Documentation on high-temperature applications for the device → 87

You can order a weather protection cover from Endress+Hauser. → 83.

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→ 58.

Order code for "Sensor version", options AG, AH: −50 to +80 °C (−58 to +176 °F)

Display modules

−40 to +80 °C (−40 to +176 °F)

Relative humidity

The device is suitable for use in outdoor and indoor areas with a relative humidity of 5 to 40%.

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

Order code for "Sensor version", options AA, AB, AC, AD, AE:
- IP68, Type 6P enclosure, suitable for pollution degree 4
- For the operation of the device under water
- Operating duration at a maximum depth of:
  - 3 m (10 ft): permanent use
  - 10 m (30 ft): maximum 48 hours

Order code for "Sensor version", options AG, AH:
IP66/67, Type 4X enclosure, suitable for pollution degree 4

When the housing is open: IP20, Type 1 enclosure, suitable for pollution degree 2

Optional

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

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) and 43 (NE43)

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.

For detailed information on high-temperature sensors CH-050 / CH-100 (order code for "Sensor version", options AG, AH), see Special Documentation "High-temperature" → 87.

Process

Medium temperature range

Sensor version	Frequency	Temperature
C-030-A	0.3 MHz	−40 to +100 °C (−40 to +212 °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	−40 to +150 °C (−40 to +302 °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 +170 °C (+32 to +338 °F)
C-200-C	2 MHz	0 to +170 °C (+32 to +338 °F)
CH-050-A	0.5 MHz	▪ +150 to +220 °C (302 to +428 °F): Order code for "Process temperature", option H ▪ +210 to +370 °C (410 to +698 °F): Order code for "Process temperature", option I ▪ +350 to +550 °C (+662 to +1022 °F): Order code for "Process temperature", option J
CH-100-A	1 MHz	▪ +150 to +220 °C (302 to +428 °F): Order code for "Process temperature", option H ▪ +210 to +370 °C (410 to +698 °F): Order code for "Process temperature", option I ▪ +350 to +550 °C (+662 to +1022 °F): Order code for "Process temperature", option J

Sound velocity range

600 to 3000 m/s (1969 to 9843 ft/s)

Medium pressure range

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

Pressure loss

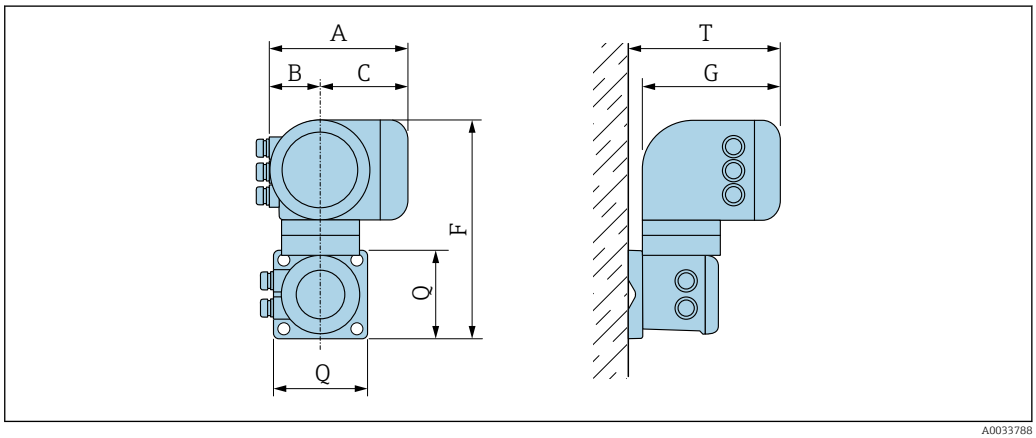
There is no pressure loss.

Mechanical Construction

Dimensions in SI units

Housing of Proline 500 transmitter

Non-hazardous area or hazardous area: Zone 2; Class I, Division 2 or Zone 1; Class I, Division 1



A0033788

Order code for "Transmitter housing", option A "Aluminum, coated" and order code for "Integrated ISEM electronics", option B "Transmitter"

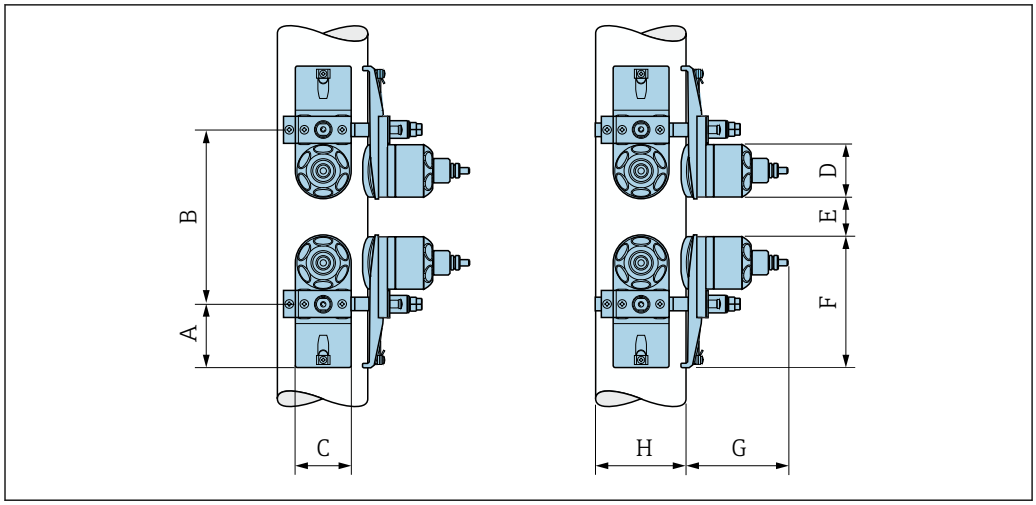
A [mm]	B [mm]	C [mm]	F [1] [mm]	G [2] [mm]	Q [mm]	T [2] [mm]
188	85	103	318	217	130	239

1) Non-hazardous area: values - 38 mm
2) Non-hazardous area: values - 10 mm

Order code for "Transmitter housing", option L "Cast, stainless" and order code for "Integrated ISEM electronics", option B "Transmitter"

A [mm]	B [mm]	C [mm]	F [mm]	G [mm]	Q [mm]	T [mm]
188	85	103	295	217	130	239

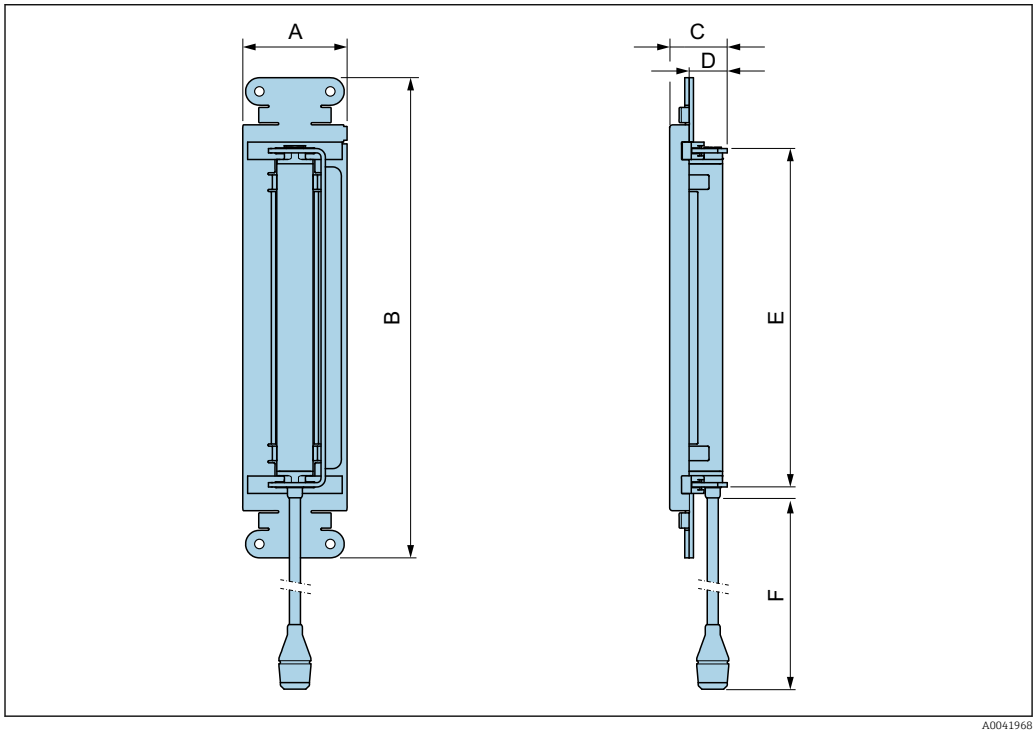
Sensor remote version



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

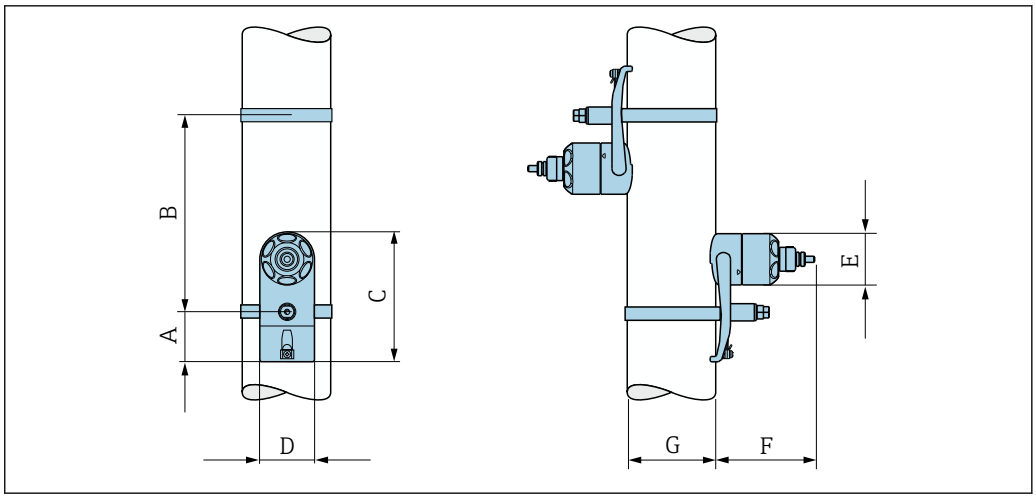
A [mm]	B [mm]	C [mm]	D [mm]	E_{min} [mm]	F [mm]	G [mm]	H [mm]
56	* 1)	62	Ø 58	0.5	145	111	Measuring pipe outer diameter

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



58 *DN 15 to 65*

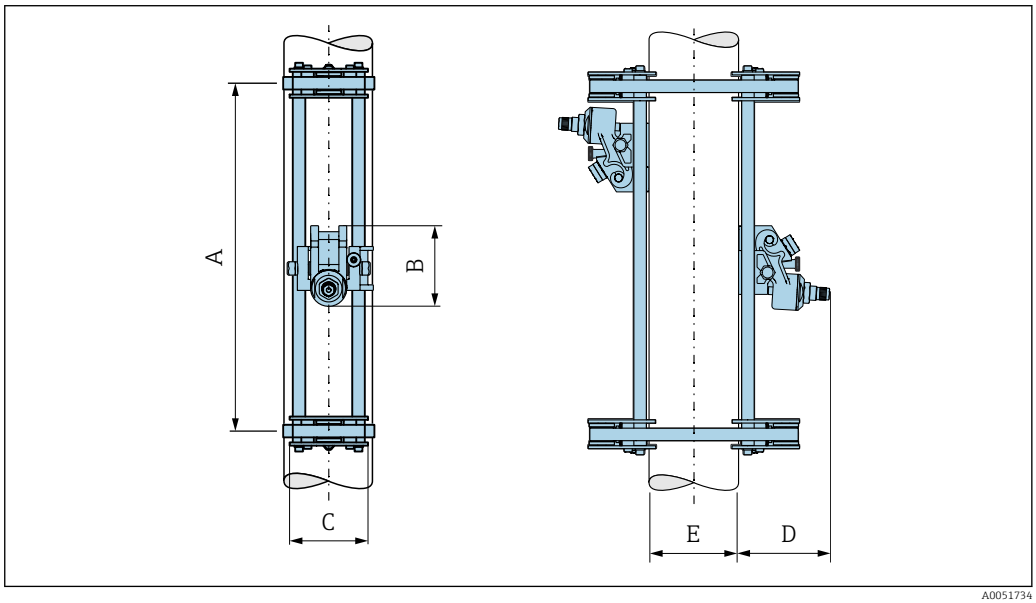
A [mm]	B [mm]	C [mm]	D [mm]	E [mm]	F [mm]
72	331	39	28	233	450



59 *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.

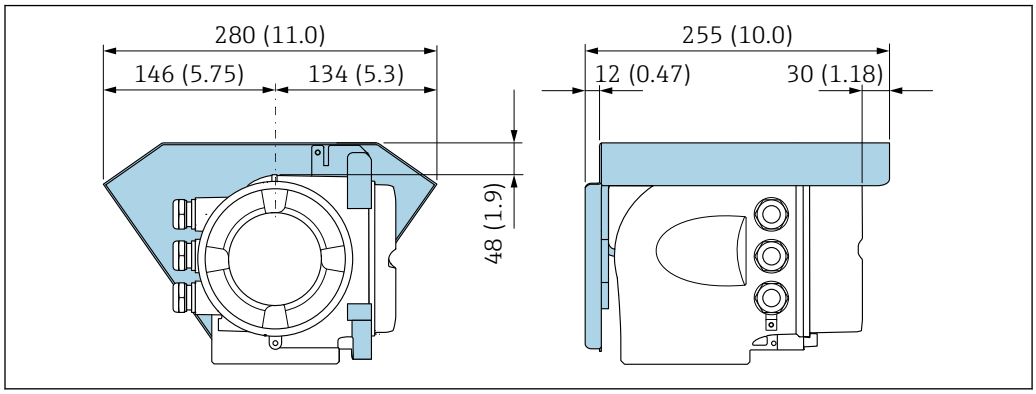


A [mm]	B [mm]	C [mm]	D [mm]	E [mm]
494/664 1)	100	100	130	Measuring pipe outer diameter

1) DN 300 to 600

Accessories

Weather protection cover

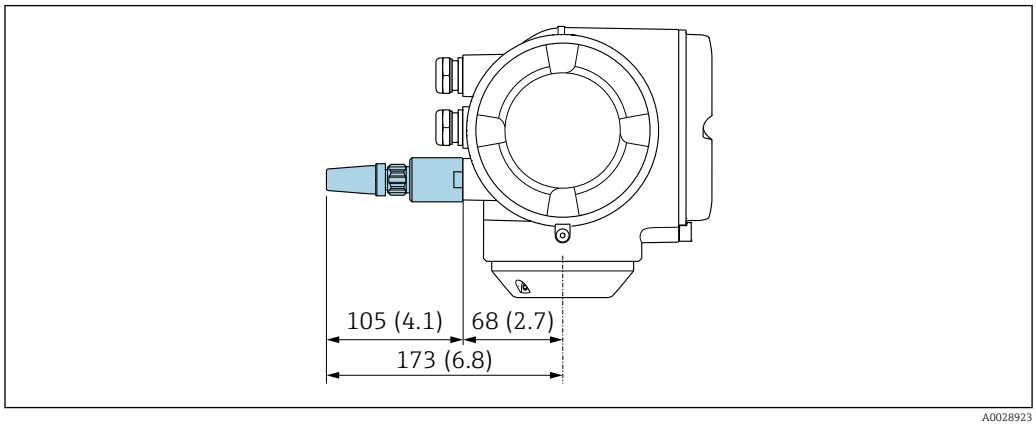


60 Weather protection cover for Proline 500; engineering unit mm (in)

External WLAN antenna

Proline 500

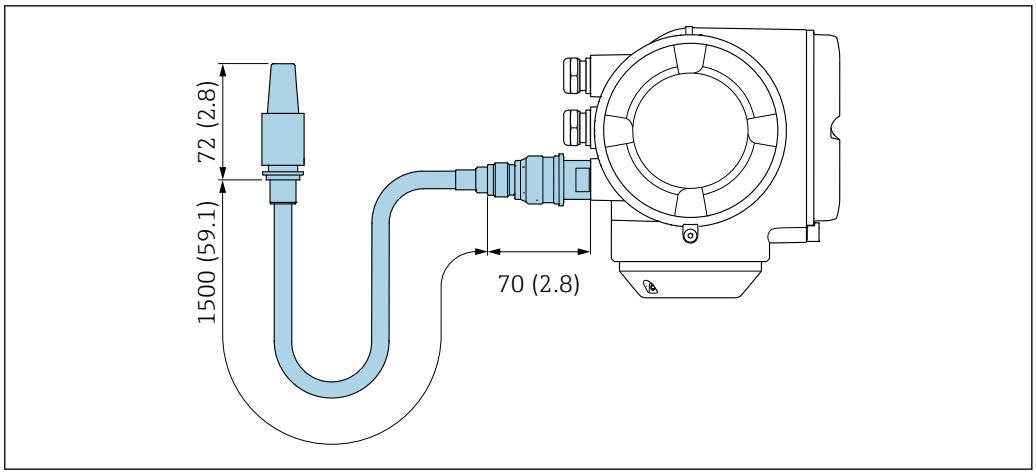
External WLAN antenna mounted on device



61 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.

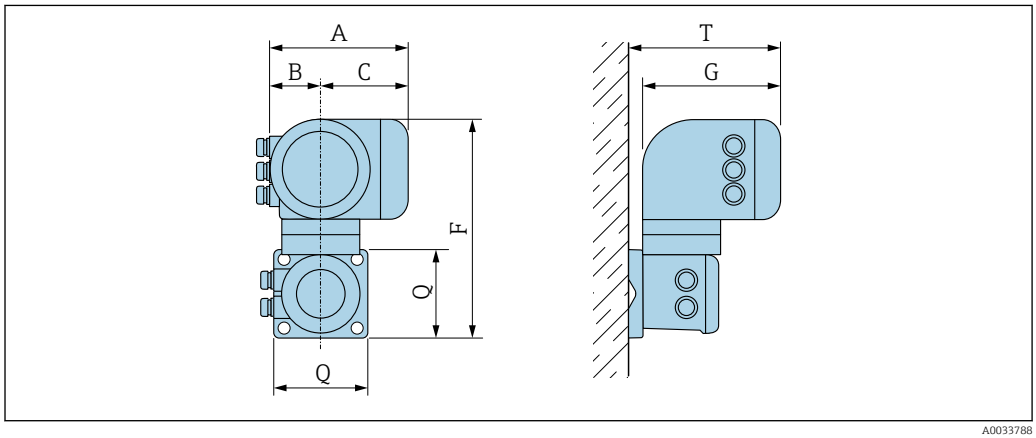


62 *Engineering unit mm (in)*

Dimensions in US units

Housing of Proline 500 transmitter

Non-hazardous area or hazardous area: Zone 2; Class I, Division 2 or Zone 1; Class I, Division 1



A0033788

Order code for "Transmitter housing", option A "Aluminum, coated" and order code for "Integrated ISEM electronics", option B "Transmitter"

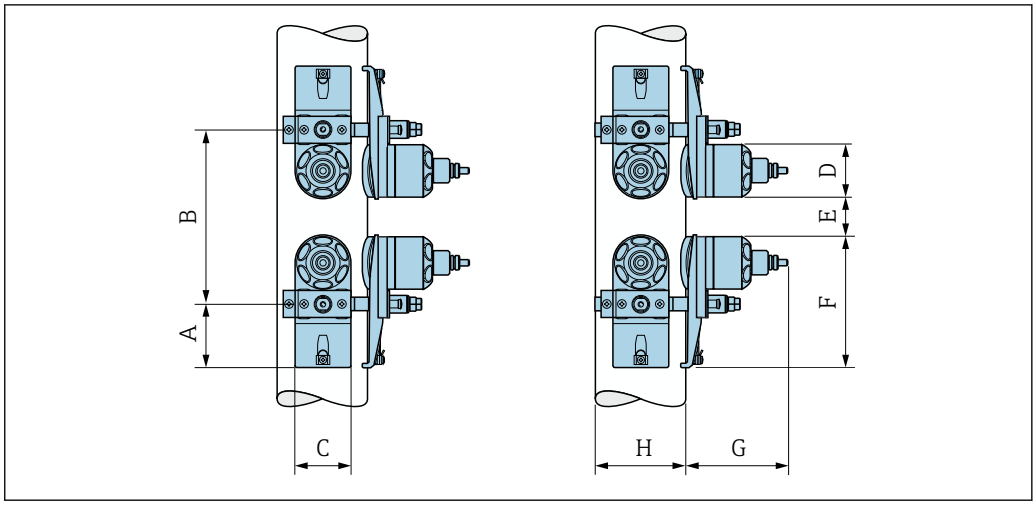
A [in]	B [in]	C [in]	F [1] [in]	G [2] [in]	Q [in]	T [2] [in]
7.40	3.35	4.06	12.5	8.54	5.12	9.41

1) Non-hazardous area: values - 1.5 in
2) Non-hazardous area: values - 0.39 in

Order code for "Transmitter housing", option L "Cast, stainless" and order code for "Integrated ISEM electronics", option B "Transmitter"

A [in]	B [in]	C [in]	F [in]	G [in]	Q [in]	T [in]
7.40	3.35	4.06	11.6	8.54	5.12	9.41

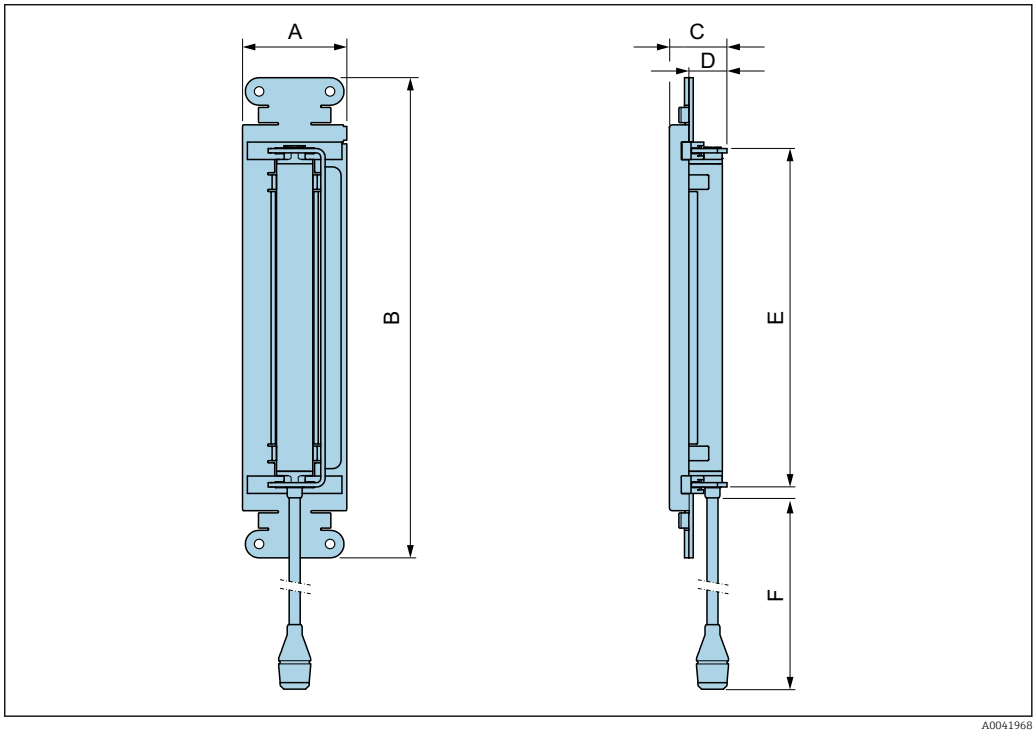
Sensor remote version



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

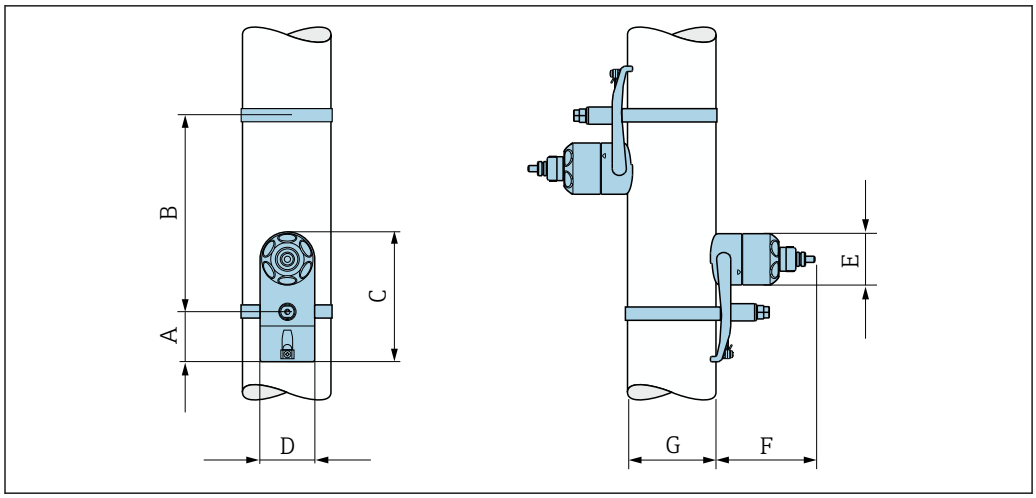
A [in]	B [in]	C [in]	D [in]	E_{min} [in]	F [in]	G [in]	H [in]
2.20	* 1)	2.44	Ø 2.28	0.20	5.71	4.37	Measuring pipe outer diameter

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



64 *DN ½ to 2½"*

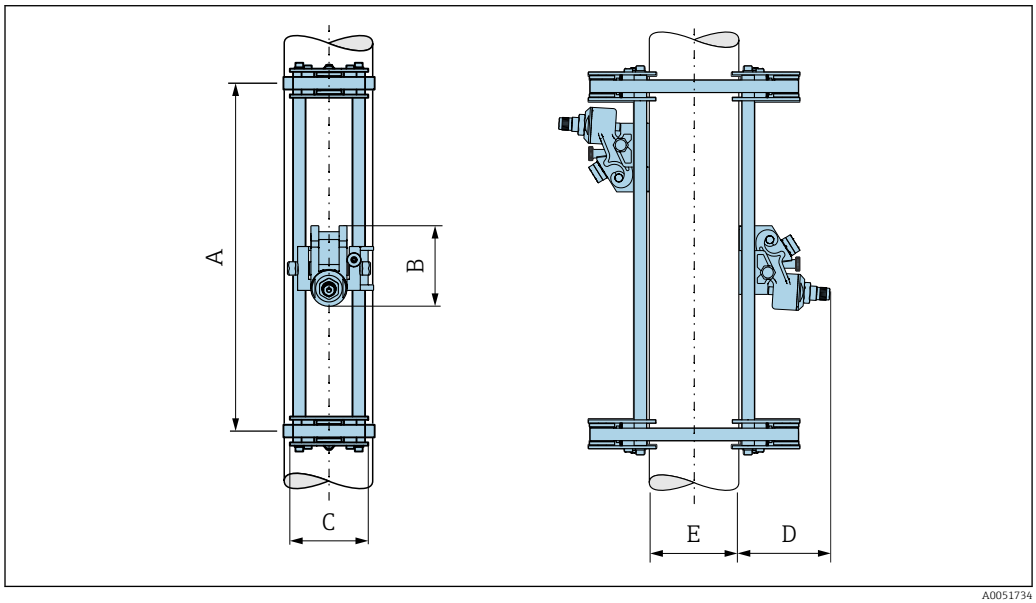
A [in]	B [in]	C [in]	D [in]	E [in]	F [in]
2.83	13.0	1.54	1.10	9.17	17.7



65 *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.

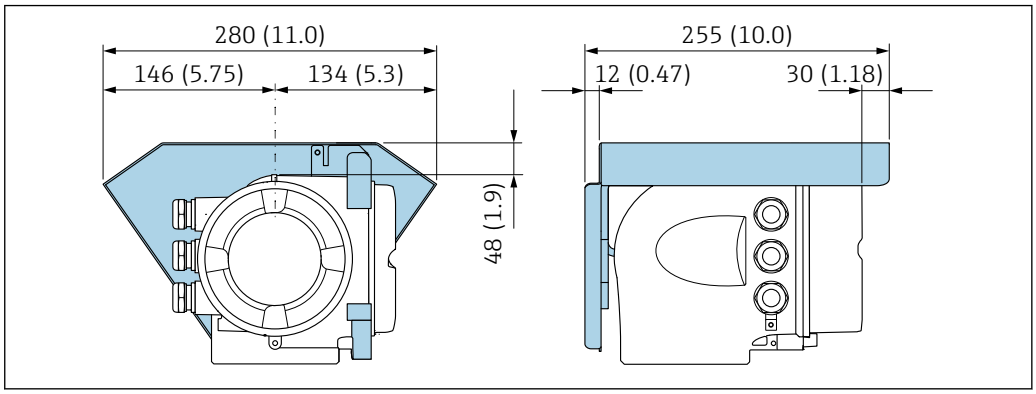


A [in]	B [in]	C [in]	D [in]	E [in]
19.45/26.14 1)	3.94	3.94	5.12	Measuring pipe outer diameter

1) DN 12 to 24 "

Accessories

Weather protection cover

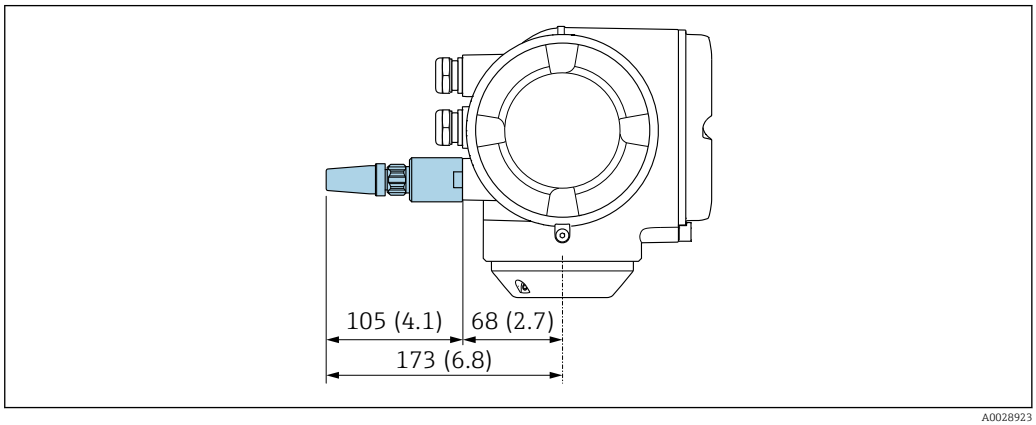


66 *Weather protection cover for Proline 500; engineering unit mm (in)*

External WLAN antenna

Proline 500

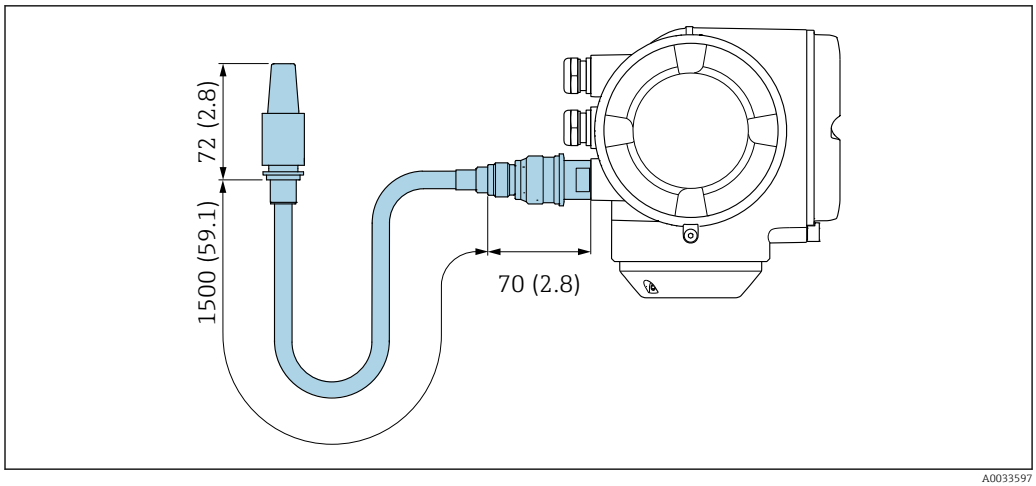
External WLAN antenna mounted on device



67 *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.



68 Engineering unit mm (in)

Weight

Weight specifications exclusive of packaging material.

Transmitter
- Proline 500 aluminum: 6.5 kg (14.3 lbs)
- Proline 500 cast, stainless: 15.6 kg (34.4 lbs)

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)
- DN 50 to 600 (2 to 24") order code for "Sensor version", options AG, AH
  - 9.8 kg (21.6 lb)
  - Long rail (DN 300 to 600 (12 to 24)): 10.7 kg (23.6 lb)

Materials

Transmitter housing

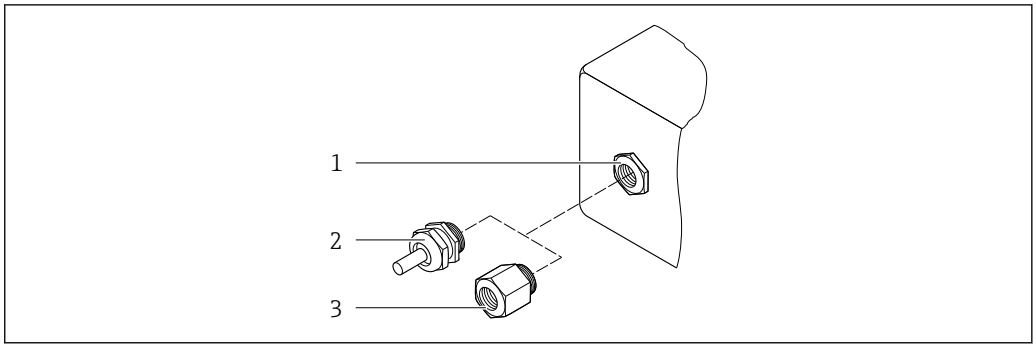
Housing of Proline 500 transmitter

Order code for "Transmitter housing":
- Option **A** "Aluminum coated": aluminum, AlSi10Mg, coated
- Option **L** "Cast, stainless": cast, stainless steel, 1.4409 (CF3M) corresponds to the properties of 316L

Window material

Order code for "Transmitter housing":
- Option **A** "Aluminum, coated": glass
- Option **L** "Cast, stainless": glass

Cable entries/cable glands



69 *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"

Cable entries and adapters	Material
Cable gland of sensor cable	Brass or stainless steel 1.4404
Power cable gland	Plastic
▪ Adapter for cable entry with female thread G ½" ▪ Adapter for cable entry with female thread NPT ½" Only available for certain device versions: Order code for "Transmitter housing": Option A "Aluminum, coated"	Nickel-plated brass
▪ Adapter for cable entry with female thread G ½" ▪ Adapter for cable entry with female thread NPT ½" Only available for certain device versions: Order code for "Transmitter housing": Option L "Cast, stainless"	Stainless steel, 1.4404 (316L)

Sensor cables

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

Sensor cable for sensor - Proline 500 transmitter

DN 15 to 65 (½ to 2½"):
Sensor cable: TPE [6]
- Cable sheath: TPE
- Cable plug: stainless steel 1.4301 (304), 1.4404 (316L), nickel-plated brass

DN 50 to 4000 (2 to 160"):
- Sensor cable, TPE halogen-free
  - Cable sheath: TPE halogen-free
  - Cable connector: nickel-plated brass
- PTFE sensor cable [6]
  - 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

6) Also available in optional armored version (316L)

Coupling pads

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

Coupling foil

- 150 to 220 °C (302 to 428 °F): tin
- 210 to 370 °C (410 to 698 °F): zinc
- 350 to 550 °C (662 to 1022 °F): aluminum

Coupling paste

Coupling grease

Accessories

Protective cover

Stainless steel, 1.4404 (316L)

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

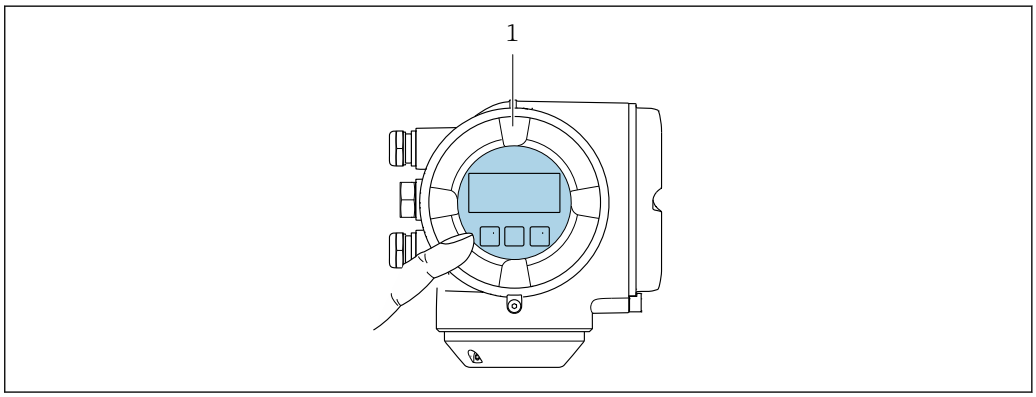
Can be operated in the following languages:
- Via local operation
  English, German, French, Spanish, Italian, Dutch, Portuguese, Polish, Russian, Turkish, Chinese, Japanese, Korean, Vietnamese, Czech, Swedish
- Via web browser
  English, German, French, Spanish, Italian, Dutch, Portuguese, Polish, Russian, Turkish, Chinese, Japanese, Vietnamese, Czech, Swedish
- Via "FieldCare", "DeviceCare" operating tool: English, German, French, Spanish, Italian, Chinese, Japanese

Local operation

Via display module

Equipment:
- Order code for "Display; operation", option F "4-line, illuminated, graphic display; touch control"
- Order code for "Display; operation", option G "4-line, illuminated, graphic display; touch control + WLAN"

Information about WLAN interface → 75



70 Operation with touch control

1 Proline 500

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

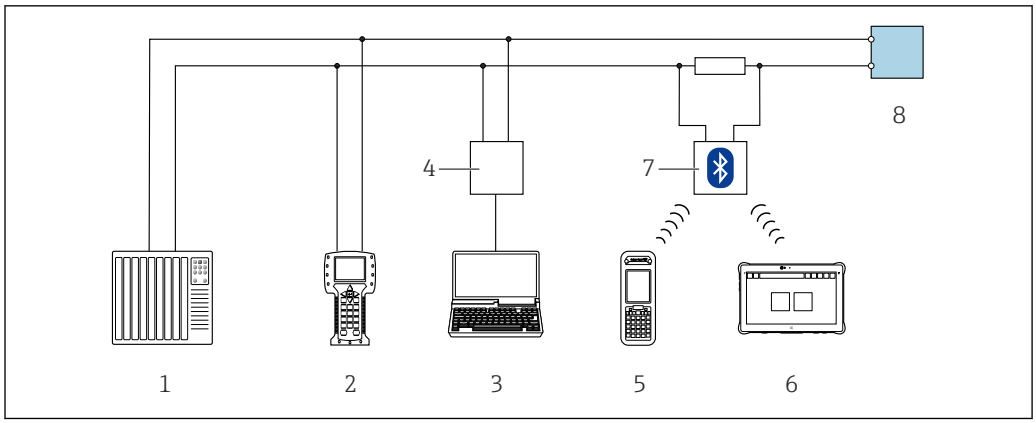
Operating elements

- 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

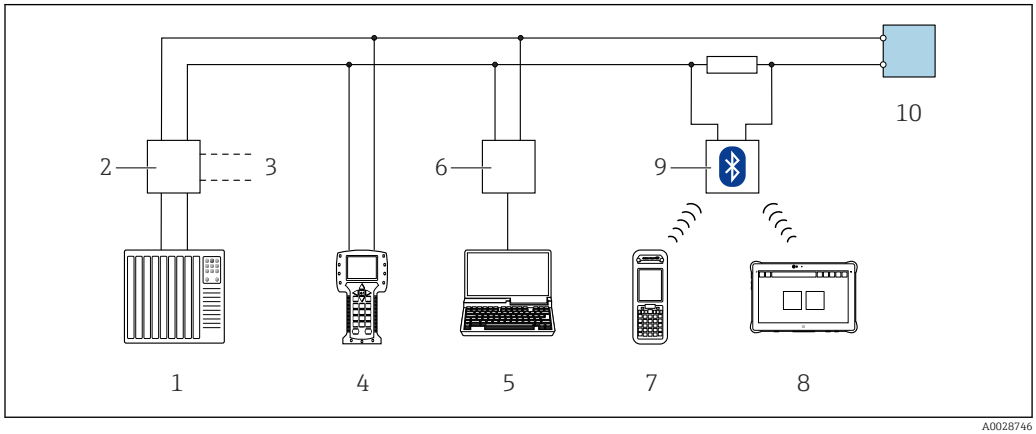
Via HART protocol

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



71 Options for remote operation via HART protocol (active)

1 *Control system (e.g. PLC)*
2 *Field Communicator 475*
3 *Computer with web browser (e.g. Microsoft Edge) to access the integrated device web server or computer with operating tool (e.g. FieldCare, DeviceCare, AMS Device Manager, SIMATIC PDM) with COM DTM "CDI Communication TCP/IP"*
4 *Commubox FXA195 (USB)*
5 *Field Xpert SFX350 or SFX370*
6 *Field Xpert SMT70*
7 *VIATOR Bluetooth modem with connecting cable*
8 *Transmitter*

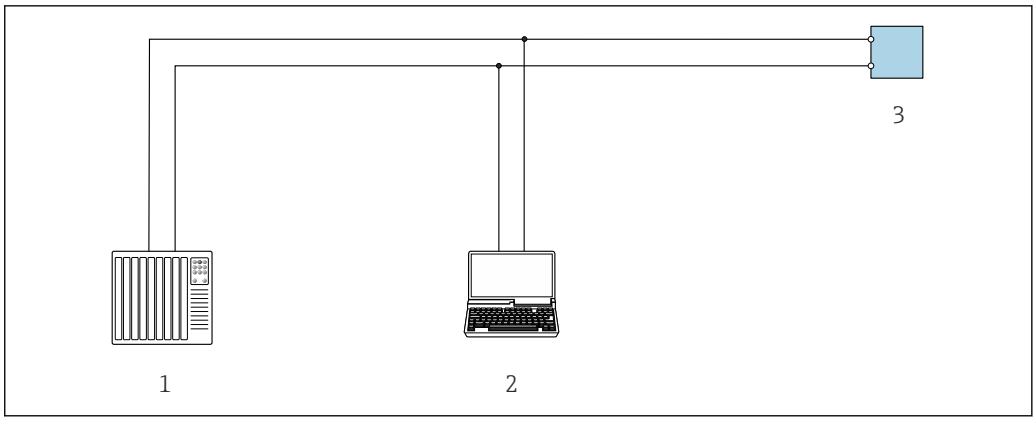


72 Options for remote operation via HART protocol (passive)

1 *Control system (e.g. PLC)*
2 *Transmitter power supply unit, e.g. RN221N (with communication resistor)*
3 *Connection for Commubox FXA195 and Field Communicator 475*
4 *Field Communicator 475*
5 *Computer with web browser (e.g. Microsoft Edge) to access the integrated device web server or computer with operating tool (e.g. FieldCare, DeviceCare, AMS Device Manager, SIMATIC PDM) with COM DTM "CDI Communication TCP/IP"*
6 *Commubox FXA195 (USB)*
7 *Field Xpert SFX350 or SFX370*
8 *Field Xpert SMT70*
9 *VIATOR Bluetooth modem with connecting cable*
10 *Transmitter*

Via Modbus RS485 protocol

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



73 *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

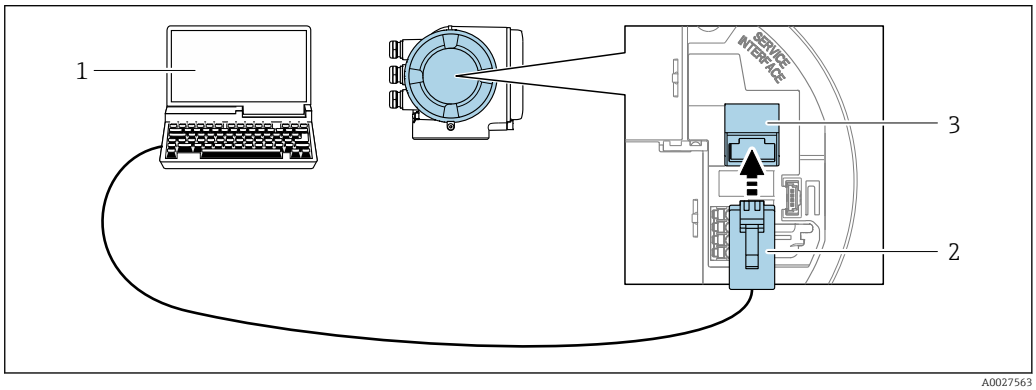
Via service interface (CDI-RJ45)

A point-to-point connection can be established to configure the device on site. With the housing open, the connection is established directly via the service interface (CDI-RJ45) of the device.

An adapter for the RJ45 to the M12 plug is optionally available for the non-hazardous area:
Order code for "Accessories", option **NB**: "Adapter RJ45 M12 (service interface)"

The adapter connects the service interface (CDI-RJ45) to an M12 plug mounted in the cable entry. The connection to the service interface can be established via an M12 plug without opening the device.

Proline 500 transmitter

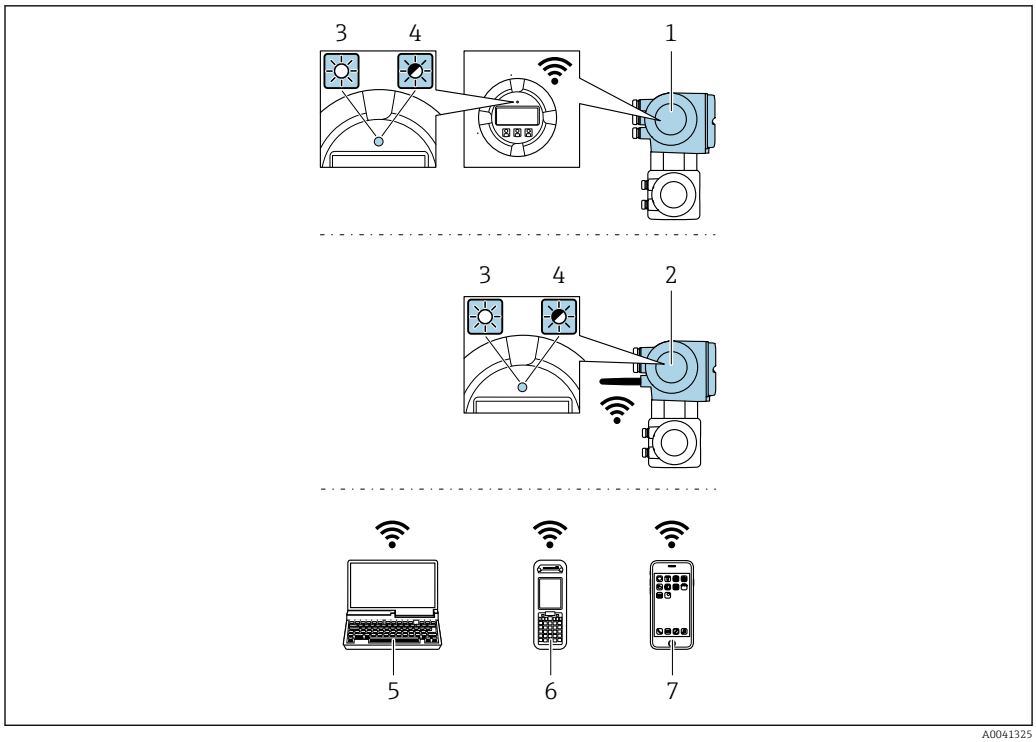


74 *Connection via service interface (CDI-RJ45)*

1 Computer with web browser (e.g. Microsoft Internet Explorer, Microsoft Edge) to access the integrated web server or with an 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"



A0041325

1 *Transmitter with integrated WLAN antenna*
2 *Transmitter with external WLAN antenna*
3 *LED lit constantly: WLAN reception is enabled on measuring device*
4 *LED flashing: WLAN connection established between operating unit and measuring device*
5 *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)*
6 *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)*
7 *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 antennas	▪ Internal antenna ▪ External antenna (optional) In the event of poor transmission/reception conditions at the place of installation. Available as an accessory . Only 1 antenna is active at any one time!
Range	▪ Internal antenna: typically 10 m (32 ft) ▪ External antenna: typically 50 m (164 ft)
Materials (external 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

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	→ 🖹 85
FieldCare SFE500	Notebook, PC or tablet with Microsoft Windows system	▪ CDI-RJ45 service interface ▪ WLAN interface ▪ Fieldbus protocol	→ 🖹 85
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	→ 🖹 85

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; operation", 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** → 🖹 82 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→ 🖹 82)

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.

When the device is delivered, the factory settings of the configuration data are stored as a backup in the device memory. This memory can be overwritten with an updated data record, for example after commissioning.

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 ▪ Parameter data record backup ▪ 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. measuring point configuration ▪ 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	In the sensor plug in the transmitter neck part

Data backup

Automatic

- 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 is ready for operation again immediately without any errors
- If the sensor is replaced: once the sensor has been replaced, new sensor data are transferred from the S-DAT in the measuring device and the measuring device is ready for operation again immediately without any errors
- If exchanging the electronics module (e.g. I/O electronics module): Once the electronics module has been replaced, the software of the module is compared against the current device firmware. The module software is upgraded or downgraded where necessary. The electronics module is available for use immediately afterwards and no compatibility problems occur.

Manual

Additional parameter data record (complete parameter settings) in the integrated device memory HistoROM backup for:

- Data backup function
  Backup and subsequent restoration of a device configuration in the device memory HistoROM backup
- Data comparison function
  Comparison of the current device configuration with the device configuration saved in the device memory HistoROM backup

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 measuring device is certified for use in hazardous areas and the relevant safety instructions are provided in the separate "Safety Instructions" (XA) document. Reference is made to this document on the nameplate.

The separate Ex documentation (XA) containing all the relevant explosion protection data is available from your Endress+Hauser sales center.

Proline 500

ATEX/IECEx

Currently, the following versions for use in hazardous areas are available:

Ex db ia

Transmitter		Sensor	
Category	Type of protection	Category	Type of protection
–	–	II2G	Ex db ia IIC T6...T1 Gb
II3G	Ex ec nC IIC T5...T4 Gc	II2G	Ex db ia IIC T6...T1 Gb

Ex ec

Transmitter		Sensor	
Category	**Type of protection**	**Category**	**Type of protection**
–	–	II3G	Ex ec ic IIC
II3G	Ex ec nC IIC T5...T4 Gc	II3G	Ex ec ic IIC

Ex tb

Transmitter		Sensor	
Category	**Type of protection**	**Category**	**Type of protection**
–	–	II2D	Ex ia tb IIIC T** °C Db

$_{C}CSA_{US}$

Currently, the following versions for use in hazardous areas are available:

IS

Transmitter	Sensor
Class I Division 2 Groups A - D	Class I, II, III Division 1 Groups A-G

NI

Transmitter	Sensor
Class I Division 2 Groups A - D	Class I Division 2 Groups A - D

Ex i

Transmitter	Sensor
Class I Zone 2, AEx/Ex nA nC IIC T5...T4 Gc	Class I Zone 1, AEx/Ex d ia IIC T6...T1 Gb

Ex nA

Transmitter	Sensor
Class I Zone 2, AEx/Ex nA nC IIC T5...T4 Gc	Class I Zone 2, AEx/Ex nA ic IIC T6...T1 Gc

Ex tb

Transmitter	Sensor
–	Zone 21, AEx/Ex ia tb IIIC T** °C Db

Functional safety

The measuring device can be used for flow monitoring systems (min., max., range) up to SIL 2 (single-channel architecture; order code for "Additional approval", option LA) and SIL 3 (multi-channel architecture with homogeneous redundancy) and is independently evaluated and certified in accordance with IEC 61508.

The following types of monitoring in safety equipment are possible:
Volume flow

Functional safety manual with information for the SIL device

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)
Radio approval	The measuring device has radio approval. For detailed information on the radio approval, see the Special Documentation → 87
Additional certification	**Tests and certificates** ▪ Ambient temperature −50 °C (−58 °F) (order code for "Test, certificate", option JN) ▪ EN10204-2.1 confirmation of compliance with the order and EN10204-2.2 test report
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). ▪ 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 as follows:
- In the Product Configurator on the Endress+Hauser website: www.endress.com -> Click "Corporate" -> Select your country -> Click "Products" -> Select the product using the filters and search field -> Open product page -> The "Configure" button to the right of the product image opens the Product Configurator.
- From your Endress+Hauser Sales Center:www.addresses.endress.com

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 → 87

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 total test coverage within the framework of manufacturer specifications.
- Extension of calibration intervals according to operator's risk evaluation.

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.

Petroleum

Order code for "Application package", option EJ "Petroleum"

The most important parameters for the Oil & Gas Industry can be calculated and displayed with this application package.

- Corrected volume flow and calculated reference density in accordance with the "API Manual of Petroleum Measurement Standards, Chapter 11.1"
- A temperature measurement is required to calculate the corrected volume. The measured values can be read in via the 4-20 mA input on the device, for example.
  As a temperature measuring device, the resistance thermometer TST602 is recommended. TMT82 is recommended for use in hazardous areas.

For detailed information, see the Special Documentation for the device. → 87.

Petroleum & Product identification

Order code for "Application package", option EQ "Petroleum& Product identification"

The most important parameters for the Oil & Gas Industry can be calculated and displayed with this application package. It is also possible to identify the product based on the sound velocity or the reference density.

- Corrected volume flow and calculated reference density in accordance with the "API Manual of Petroleum Measurement Standards, Chapter 11.1"
- A temperature measurement is required to calculate the corrected volume. The measured values can be read in via the 4-20 mA input on the device, for example.
  As a temperature measuring device, the resistance thermometer TST602 is recommended. TMT82 is recommended for use in hazardous areas.

For detailed information, see the Special Documentation for the device. → 87.

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 Proline 500	Transmitter for replacement or storage. Use the order code to define the following specifications: ▪ Approvals ▪ Output ▪ Input ▪ Display/operation ▪ Housing ▪ Software Proline 500 transmitter: Order number: 9X5BXX-*********B Proline 500 transmitter for replacement: It is essential to specify the serial number of the current transmitter when ordering. On the basis of the serial number, the device-specific data of the replaced device can be used for the new transmitter. Proline 500 transmitter: Installation Instructions EA01152D
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 → 75. Order number: 71351317 Installation Instructions EA01238D
Pipe mounting set	Pipe mounting set for transmitter. Installation Instructions EA01195D Proline 500 transmitter Order number: 71346428

Weather protection cover Transmitter Proline 500	Is used to protect the measuring device from the effects of the weather: e.g. rainwater, excess heating from direct sunlight. Proline 500 transmitter Order number: 71343505 Installation Instructions EA01191D
Sensor cables Proline 500 Sensor – Transmitter	The sensor cable can be ordered directly with the measuring device (order code for "Cable") or as an accessory (order number DK9012). 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: −50 to +170 °C (−58 to +338 °F) ▪ Option BA: 5 m (15 ft) ▪ Option BB: 10 m (30 ft) ▪ Option BC: 15 m (45 ft) ▪ Option BD: 30 m (90 ft) ▪ Armored; temperature: −40 to +80 °C (−40 to +176 °F) ▪ Option CA: 5 m (15 ft) ▪ Option CB: 10 m (30 ft) ▪ Option CC: 15 m (45 ft) ▪ Option CD: 30 m (90 ft) ▪ Armored; temperature: −50 to +170 °C (−58 to +338 °F) ▪ Option DA: 5 m (15 ft) ▪ Option DB: 10 m (30 ft) ▪ Option DC: 15 m (45 ft) ▪ Option DD: 30 m (90 ft) Possible cable length for a Proline 500 sensor cable: max. 30 m (100 ft)

For the sensor

Accessories	Description
Sensor set (DK9013)	▪ Sensor set 0.3 MHz (C-030) ▪ Sensor set 0.5 MHz (C-050, CH-050) ▪ Sensor set 1 MHz (C-100, CH-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, high-temperature version 0.5 to 1 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" ▪ Installation set, high-temperature version, DN50-DN80, 2"-3" ▪ Installation set, high-temperature version, DN80-DN200, 3"-8" ▪ Installation set, high-temperature version, DN200-DN300, 8"-12" ▪ Installation set, high-temperature version, DN300-DN600, 12"-24"
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
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
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 With the Netilion IIoT Ecosystem, Endress+Hauser enables you to optimize your plant performance by digitizing workflows, creating knowledge and establishing new levels of collaboration. Building decades of expertise in process automation, Endress+Hauser provides the process industry with an IIoT Ecosystem that allows data-driven insights. These insights can be applied to optimize processes resulting in increased plant up-time, efficiency, reliability – and ultimately, 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

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
iTEMP	The temperature transmitters can be used in all applications and are suitable for the measurement of gases, steam and liquids. They can be used to read in the medium temperature. "Fields of Activity" document FA00006T

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 P	KA01474D

Brief Operating Instructions for the transmitter

Measuring device	Documentation code	
	HART	Modbus RS485
Proline 500	KA01475D	KA01476D

Operating Instructions

Measuring device	Documentation code	
	HART	Modbus RS485
Prosonic Flow P 500	BA02025D	BA02026D

Description of Device Parameters

Measuring device	Documentation code	
	HART	Modbus RS485
Prosonic Flow P 500	GP01147D	GP01148D

Supplementary device-dependent documentation

Safety Instructions

Safety instructions for electrical equipment for hazardous areas.

Contents	Documentation code
ATEX/IECEx Ex ia	XA02091D
ATEX/IECEx Ex ec	XA02092D
cCSAus Ex ia	XA02093D
cCSAus Ex ec	XA02094D
cCSAus XP	XA02095D
EAC Ex ia	XA03018D
EAC Ex nA	XA03019D
JPN Ex d	XA02617D
KCs Ex d	XA03194D
INMETRO Ex ia	XA02650D
INMETRO Ex ec	XA02651D
NEPSI Ex ia	XA02652D
NEPSI Ex nA	XA02653D
UKEX Ex ia	XA02578D
UKEX Ex ec	XA02579D

Functional Safety Manual

Contents	Documentation code
Proline Prosonic Flow P 500	FY02647D

Special Documentation

Contents	Documentation code	
	HART	Modbus RS485
Radio approvals for WLAN interface for A309/A310 display module	SD01793D	
High-temperature sensors	SD03088D	
FlowDC	SD02660D	SD02674D
Heartbeat Technology	SD02593D	SD02594D
Petroleum & product identification	SD03081D	SD03108D
Web server	SD02603D	SD02604D

Installation Instructions

Contents	Comment
Installation instructions for spare part sets and accessories	Documentation code: specified for each individual accessory → 83.

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Registered trademark of the FieldComm Group, Austin, Texas, USA

Modbus®
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