

# Technical Information

## Proline Prowirl O 200

Vortex flowmeter



Flowmeter optimized to meet requirements of high-pressure mating pipes

### Application

- Preferred measuring principle for wet/saturated/ superheated steam, gases & liquids (also cryogenic)
- The specialist for applications with high process pressure

### Device properties

- Saturated steam mass flow up to PN 250 (Class 1500)
- Full compliance with NACE (MR0175/MR0103)
- Flexible positioning of pressure cell
- Display module with data transfer function
- Robust dual-compartment housing
- Plant safety: worldwide approvals (SIL, Haz. area)

### Your benefits

- Better process control – integrated temperature and pressure measurement for steam and gases
- Increased mechanical integrity for flow measurement – special sensor design
- Same accuracy down to Re 10 000 – most linear Vortex meter body
- Long-term stability – robust drift-free capacitive sensor
- Convenient device wiring – separate connection compartment
- Safe operation – no need to open the device due to display with touch control, background lighting
- Integrated verification – Heartbeat Technology

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## About this document

### Symbols

#### Electrical symbols

Symbol	Meaning
	Direct current
	Alternating current
	Direct current and alternating current
	<b>Ground connection</b> A grounded terminal which, as far as the operator is concerned, is grounded via a grounding system.
	<b>Protective Earth (PE)</b> A terminal which must be connected to ground prior to establishing any other connections.  The ground terminals are situated inside and outside the device: <ul style="list-style-type: none"> <li>▪ Inner ground terminal: Connects the protective earth to the mains supply.</li> <li>▪ Outer ground terminal: Connects the device to the plant grounding system.</li> </ul>

#### Communication symbols




Symbol	Meaning
	<b>Wireless Local Area Network (WLAN)</b> Communication via a wireless, local network.

#### Symbols for certain types of information

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

#### Symbols in graphics

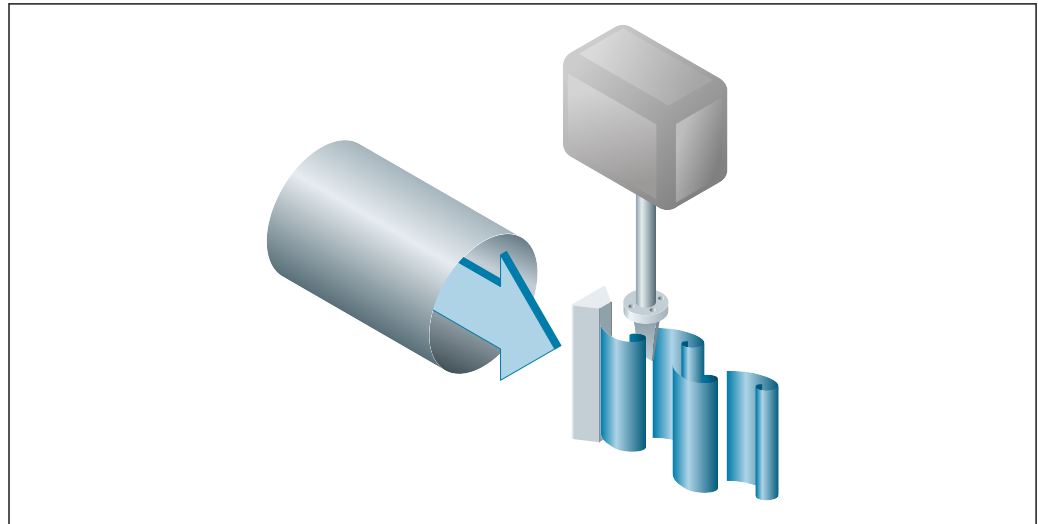
Symbol	Meaning
1, 2, 3, ...	Item numbers
<a href="#">1</a> , <a href="#">2</a> , <a href="#">3</a> , ...	Series of steps
A, B, C, ...	Views
A-A, B-B, C-C, ...	Sections

Symbol	Meaning
	Hazardous area
	Safe area (non-hazardous area)
	Flow direction

## Function and system design

### Measuring principle

Vortex meters work on the principle of the *Karman vortex street*. When fluid flows past a bluff body, vortices are alternately formed on both sides with opposite directions of rotation. These vortices each generate a local low pressure. The pressure fluctuations are recorded by the sensor and converted to electrical pulses. The vortices develop very regularly within the permitted application limits of the device. Therefore, the frequency of vortex shedding is proportional to the volume flow.



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 1 Sample graphic

The calibration factor (K-factor) is used as the proportional constant:

$$\text{K-Factor} = \frac{\text{Pulses}}{\text{Unit Volume [m}^3\text{]}}$$

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Within the application limits of the device, the K-factor only depends on the geometry of the device. It is for  $Re > 10\,000$ :

- Independent of the flow velocity and the fluid properties viscosity and density
- Independent of the type of substance under measurement: steam, gas or liquid

The primary measuring signal is linear to the flow. After production, the K-factor is determined in the factory by means of calibration. It is not subject to long-time drift or zero-point drift.

The device does not contain any moving parts and does not require any maintenance.

### The capacitance sensor

The sensor of a vortex flowmeter has a major influence on the performance, robustness and reliability of the entire measuring system.

The robust DSC sensor is:

- burst-tested
- tested against vibrations
- tested against thermal shock (thermal shocks of 150 K/s)

The measuring device uses the tried-and-tested, capacitance measuring technology from Endress+Hauser, which is already in use in over 450 000 measuring points worldwide. Thanks to its design, the capacitance sensor is also particularly mechanically resistant to temperature shocks and pressure shocks in steam pipelines.

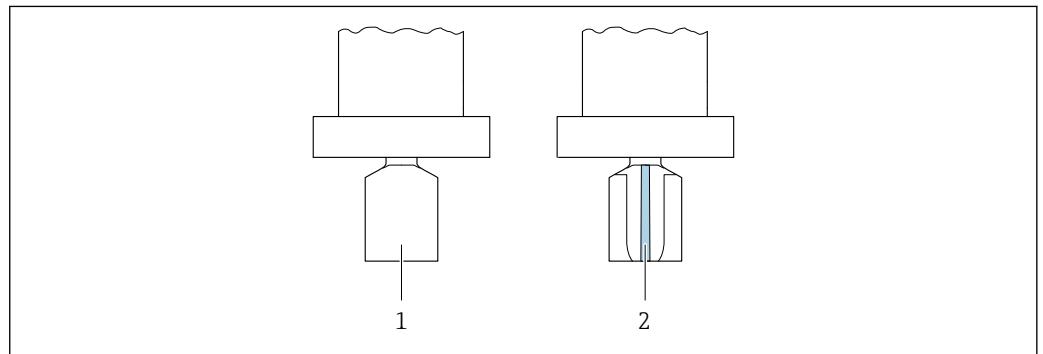
#### Temperature measurement

The "mass" option is available under the order code for "Sensor version". With this option the measuring device can also measure the temperature of the medium.

The temperature is measured via Pt 1000 temperature sensors. These are located in the paddle of the DSC sensor and are therefore in the direct vicinity of the fluid.

Order code for "Sensor version; DSC sensor; measuring tube":

- Option BD "Volume high-temperature; Alloy 718; 316L"
- Option CD "Mass; Alloy 718; 316L (integrated temperature measurement)"



- 1 Order code for "Sensor version", option Volume or Volume high-temperature  
 2 Order code for "Sensor version", option Mass

#### Pressure and temperature measurement

 For order code for "Sensor version; DSC sensor; measuring tube", option DA "Mass steam" and DB "Mass gas/liquid", the following applies:

- Only available for measuring devices with the HART communication protocol
- Oil-free or grease-free cleaning is not possible

The "mass steam" or "mass gas/liquid" options are available under the order code for "Sensor version; DSC sensor; measuring tube". With these options, the measuring device can also measure the pressure and temperature of the fluid.

The temperature is measured via Pt 1000 temperature sensors. These are located in the paddle of the DSC sensor and are therefore in the direct vicinity of the fluid. Pressure measurement is located directly on the meter body at the level of the bluff body. The position of the pressure tapping was chosen so that pressure and temperature could be measured at the same point. This enables accurate density and/or energy compensation of the fluid using pressure and temperature. The measured pressure tends to be somewhat lower than the line pressure. For this reason, Endress+Hauser offers a correction to the line pressure (integrated in the device).

Order code for "Sensor version; DSC sensor; measuring tube":

- Option DC "Mass steam; Alloy 718; 316L (integrated pressure/temperature measurement)"
- Option DD "Mass gas/liquid; Alloy 718; 316L (integrated pressure/temperature measurement)"

#### Lifelong calibration

Experience has shown that recalibrated measuring devices demonstrate a very high degree of stability compared to their original calibration: The recalibration values were all within the original measuring accuracy specifications of the devices. This applies to the measured volume flow, the device's primary measured variable.

Various tests and simulation have shown that once the radii of the edges on the bluff body are less than 1 mm (0.04 in), the resulting effect does not have a negative impact on accuracy.

If the radii of the edges on the bluff body do not exceed 1 mm (0.04 in), the following general statements apply (in the case of non-abrasive and non-corrosive media, such as in most water and steam applications):

- The measuring device does not display an offset in the calibration and the accuracy is still guaranteed.
- All the edges on the bluff body have a radius that is typically smaller in size. As the measuring devices are naturally also calibrated with these radii, the measuring device remains within the specified accuracy rating provided that the additional radius that is produced as a result of wear and tear does not exceed 1 mm (0.04 in).

Consequently, it can be said that the product line offers lifelong calibration if the measuring device is used in non-abrasive and non-corrosive media.

### **Air and industrial gases**

The measuring device enables users to calculate the density and energy of air and industrial gases. The calculations are based on time-tested standard calculation methods. It is possible to automatically compensate for the effect of pressure and temperature via an external or constant value.

This makes it possible to output the energy flow, standard volume flow and mass flow of the following gases:

- Single gas
- Gas mixture
- Air
- User-specific gas



For detailed information on the parameters, see the Operating Instructions. → 89

### **Natural gas**

The device enables users to calculate the chemical properties (gross calorific value, net calorific value) of natural gases. The calculations are based on time-tested standard calculation methods. It is possible to automatically compensate for the effect of pressure and temperature via an external or constant value.

This makes it possible to output the energy flow, standard volume flow and mass flow in accordance with the following standard methods:

Energy can be calculated based on the following standards:

- AGA5
- ISO 6976
- GPA 2172

Density can be calculated based on the following standards:

- ISO 12213-2 (AGA8-DC92)
- ISO 12213-3
- AGA NX19
- AGA8 Gross 1
- SGERG 88



For detailed information on the parameters, see the Operating Instructions. → 89

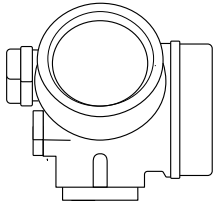
**Measuring system**

The device consists of a transmitter and a sensor.

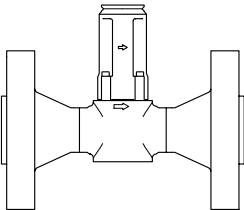
Two device versions are available:

- Compact version – transmitter and sensor form a mechanical unit.
- Remote version - transmitter and sensor are mounted in separate locations.


**Transmitter**

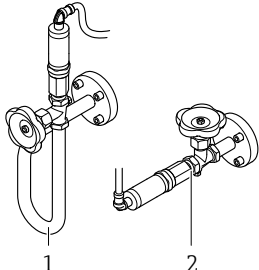
<p><b>Proline 200</b></p>  <p style="text-align: right; font-size: small;">A0013471</p>	<p>Device versions and materials:</p> <ul style="list-style-type: none"> <li>■ Compact or remote version, aluminum coated: Aluminum, AlSi10Mg, coated</li> <li>■ Compact or remote version, stainless: For maximum corrosion resistance: stainless steel CF3M</li> </ul> <p>Configuration:</p> <ul style="list-style-type: none"> <li>■ Via four-line local display with key operation or via four-line, illuminated local display with touch control and guided menus ("Make-it-run" wizards) for applications</li> <li>■ Via operating tools (e.g. FieldCare)</li> </ul>
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**Sensor**

<p><b>Prowirl O</b></p>  <p style="text-align: right; font-size: small;">A0034076</p>	<p>Flanged version:</p> <ul style="list-style-type: none"> <li>■ Nominal diameter range: DN 15 to 300 (½ to 12")</li> <li>■ Materials: <ul style="list-style-type: none"> <li>■ Measuring tubes DN 15 to 300 (½ to 12"): stainless cast steel, CF3M/1.4408</li> <li>■ Flange connections DN 15 to 300 (½ to 12"): stainless steel, triple-certified material, 1.4404/F316/F316L)</li> </ul> </li> </ul>
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**Pressure measuring cell**

-  For order code for "Sensor version; DSC sensor; measuring tube", option DA "Mass steam" and DB "Mass gas/liquid", the following applies:
- Only available for measuring devices with the HART communication protocol
  - Oil-free or grease-free cleaning is not possible

 <p style="text-align: center; font-size: small;">A0034080</p> <p>1 Option DC "Mass steam" 2 Option DD "Mass gas/liquid"</p>	<p>Versions:</p> <p>Pressure components</p> <ul style="list-style-type: none"> <li>■ Pressure measuring cell 40 bar_a</li> <li>■ Pressure measuring cell 100 bar_a</li> <li>■ Pressure measuring cell 160 bar_a</li> </ul> <p>Material</p> <ul style="list-style-type: none"> <li>■ Wetted parts: <ul style="list-style-type: none"> <li>■ Process connection Stainless steel, 1.4404/316L</li> <li>■ Membrane Stainless steel, 1.4435/316L</li> </ul> </li> <li>■ Non-wetted parts: Housing Stainless steel, 1.4404</li> </ul>
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## Input

### Measured variable

#### Direct measured variables

Order code for "Sensor version; DSC sensor; measuring tube"		
Option	Description	Measured variable
BD	Volume high-temperature; Alloy 718; 316L	Volume flow

Order code for "Sensor version; DSC sensor; measuring tube"		
Option	Description	Measured variable
CD	Mass; Alloy 718; 316L (integrated temperature measurement)	<ul style="list-style-type: none"> <li>■ Volume flow</li> <li>■ Temperature</li> </ul>

 For order code for "Sensor version; DSC sensor; measuring tube", option DA "Mass steam" and DB "Mass gas/liquid", the following applies:

- Only available for measuring devices with the HART communication protocol
- Oil-free or grease-free cleaning is not possible

Order code for "Sensor version; DSC sensor; measuring tube"		
Option	Description	Measured variable
DC	Mass steam; Alloy 718; 316L (integrated pressure/temperature measurement)	<ul style="list-style-type: none"> <li>■ Volume flow</li> <li>■ Temperature</li> </ul>
DD	Mass gas/liquid; Alloy 718; 316L (integrated pressure/temperature measurement)	<ul style="list-style-type: none"> <li>■ Pressure</li> </ul>

#### Calculated measured variables

Order code for "Sensor version; DSC sensor; measuring tube"		
Option	Description	Measured variable
BD	Volume high-temperature; Alloy 718; 316L	Under constant process conditions: <ul style="list-style-type: none"> <li>■ Mass flow <sup>1)</sup></li> <li>■ Corrected volume flow</li> </ul> The totalized values for: <ul style="list-style-type: none"> <li>■ Volume flow</li> <li>■ Mass flow</li> <li>■ Corrected volume flow</li> </ul>

1) A fixed density must be entered for calculating the mass flow (**Setup** menu → **Advanced setup** submenu → **External compensation** submenu → **Fixed density** parameter).

Order code for "Sensor version; DSC sensor; measuring tube"		
Option	Description	Measured variable
CD	Mass; Alloy 718; 316L (integrated temperature measurement)	<ul style="list-style-type: none"> <li>■ Corrected volume flow</li> <li>■ Mass flow</li> </ul>
DC	Mass steam; Alloy 718; 316L (integrated pressure/temperature measurement)	<ul style="list-style-type: none"> <li>■ Calculated saturated steam pressure</li> <li>■ Energy flow</li> <li>■ Heat flow difference</li> </ul>
DD	Mass gas/liquid; Alloy 718; 316L (integrated pressure/temperature measurement)	<ul style="list-style-type: none"> <li>■ Specific volume</li> <li>■ Degrees of superheat</li> </ul>

### Measuring range



The measuring range is dependent on the nominal diameter, the fluid and environmental influences.



The following specified values are the largest possible flow measuring ranges ( $Q_{\min}$  to  $Q_{\max}$ ) for each nominal diameter. Depending on the fluid properties and environmental influences, the measuring range may be subject to additional restrictions. Additional restrictions apply to both the lower range value and the upper range value.

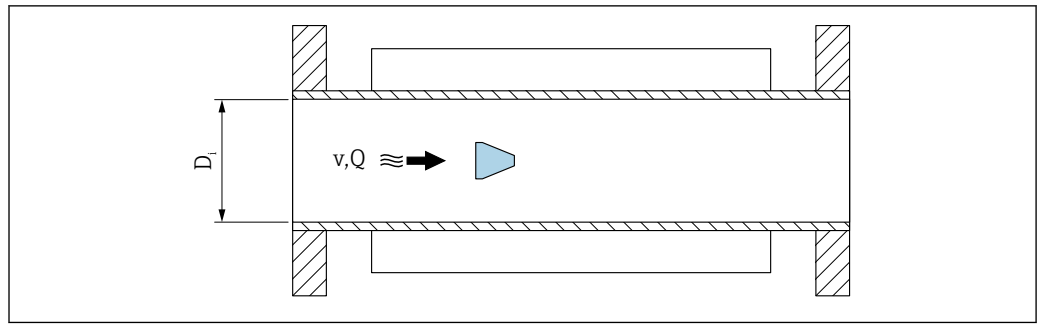
*Flow measuring ranges in SI units*

DN [mm]	Liquids [m <sup>3</sup> /h]	Gas/steam [m <sup>3</sup> /h]
15	0.1 to 4.9	0.52 to 25
25	0.32 to 15	1.6 to 130
40	0.63 to 30	3.1 to 250
50	0.99 to 47	4.9 to 620
80	2.4 to 110	12 to 1500
100	4.1 to 190	20 to 2600
150	9.3 to 440	47 to 5900
200	18 to 760	90 to 10000
250	28 to 1200	140 to 16000
300	40 to 1700	200 to 22000

*Flow measuring ranges in US units*

DN [in]	Liquids [ft <sup>3</sup> /min]	Gas/steam [ft <sup>3</sup> /min]
½	0.061 to 2.9	0.31 to 15
1	0.19 to 8.8	0.93 to 74
1½	0.37 to 17	1.8 to 150
2	0.58 to 28	2.9 to 370
3	1.4 to 67	7 to 900
4	2.4 to 110	12 to 1500
6	5.5 to 260	27 to 3500
8	11 to 450	53 to 6000
10	17 to 700	84 to 9300
12	24 to 1000	120 to 13000

### Flow velocity



A003468

$D_i$  Internal diameter of measuring tube (corresponds to dimension  $K \rightarrow$  54)

$v$  Velocity in measuring tube

$Q$  Flow

**i** The internal diameter of measuring tube  $D_i$  is denoted in the dimensions as dimension  $K \rightarrow$  54.

Calculation of flow velocity:

$$v \text{ [m/s]} = \frac{4 \cdot Q \text{ [m}^3\text{/h]}}{\pi \cdot D_i \text{ [m]}^2} \cdot \frac{1}{3600 \text{ [s/h]}}$$

$$v \text{ [ft/s]} = \frac{4 \cdot Q \text{ [ft}^3\text{/min]}}{\pi \cdot D_i \text{ [ft]}^2} \cdot \frac{1}{60 \text{ [s/min]}}$$

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### Lower range value

A restriction applies to the lower range value due to the turbulent flow profile, which only occurs with Reynolds numbers greater than 5 000. The Reynolds number is dimensionless and indicates the ratio of the inertia force of a fluid to its viscous force when flowing and is used as a characteristic variable for pipe flows. In the case of pipe flows with Reynolds numbers less than 5 000, periodic vortices are no longer generated and flow rate measurement is no longer possible.

The Reynolds number is calculated as follows:

$$Re = \frac{4 \cdot Q \text{ [m}^3\text{/s]} \cdot \rho \text{ [kg/m}^3\text{]}}{\pi \cdot D_i \text{ [m]} \cdot \mu \text{ [Pa} \cdot \text{s]}}$$

$$Re = \frac{4 \cdot Q \text{ [ft}^3\text{/s]} \cdot \rho \text{ [lbm/ft}^3\text{]}}{\pi \cdot D_i \text{ [ft]} \cdot \mu \text{ [lbf} \cdot \text{s/ft}^2\text{]}}$$

A0034291

$Re$  Reynolds number

$Q$  Flow

$D_i$  Internal diameter of measuring tube (corresponds to dimension  $K \rightarrow$  54)

$\mu$  Dynamic viscosity

$\rho$  Density

The Reynolds number, 5 000 together with the density and viscosity of the fluid and the nominal diameter, is used to calculate the corresponding flow rate.

$$Q_{Re = 5000} [\text{m}^3/\text{h}] = \frac{5000 \cdot \pi \cdot D_i [\text{m}] \cdot \mu [\text{Pa} \cdot \text{s}]}{4 \cdot \rho [\text{kg}/\text{m}^3]} \cdot 3600 [\text{s}/\text{h}]$$

$$Q_{Re = 5000} [\text{ft}^3/\text{h}] = \frac{5000 \cdot \pi \cdot D_i [\text{ft}] \cdot \mu [\text{lbf} \cdot \text{s}/\text{ft}^2]}{4 \cdot \rho [\text{lbm}/\text{ft}^3]} \cdot 60 [\text{s}/\text{min}]$$

A0034302

- $Q_{Re = 5000}$  Flow rate is dependent on the Reynolds number
- $D_i$  Internal diameter of measuring tube (corresponds to dimension  $K \rightarrow$  54)
- $\mu$  Dynamic viscosity
- $\rho$  Density

The measuring signal must have a certain minimum signal amplitude so that the signals can be evaluated without any errors. Using the nominal diameter, the corresponding flow can also be derived from this amplitude. The minimum signal amplitude depends on the setting for the sensitivity of the DSC sensor (s), the steam quality (x) and the force of the vibrations present (a). The value mf corresponds to the lowest measurable flow velocity without vibration (no wet steam) at a density of 1 kg/m<sup>3</sup> (0.0624 lbm/ft<sup>3</sup>). The value mf can be set in the range from 6 to 20 m/s (1.8 to 6 ft/s) (factory setting 12 m/s (3.7 ft/s)) with the **Sensitivity** parameter (value range 1 to 9, factory setting 5).

$$v_{\text{AmpMin}} [\text{m}/\text{s}] = \max \left\{ \frac{\text{mf} [\text{m}/\text{s}]}{x^2} \cdot \sqrt{\frac{1 [\text{kg}/\text{m}^3]}{\rho [\text{kg}/\text{m}^3]}} \right.$$

$$v_{\text{AmpMin}} [\text{ft}/\text{s}] = \max \left\{ \frac{\text{mf} [\text{ft}/\text{s}]}{x^2} \cdot \sqrt{\frac{0.062 [\text{lb}/\text{ft}^3]}{\rho [\text{lb}/\text{ft}^3]}} \right.$$

A0034303

- $v_{\text{AmpMin}}$  Minimum measurable flow velocity based on signal amplitude
- mf Sensitivity
- x Steam quality
- $\rho$  Density

$$Q_{\text{AmpMin}} [\text{m}^3/\text{h}] = \frac{v_{\text{AmpMin}} [\text{m}/\text{s}] \cdot \pi \cdot D_i [\text{m}]^2}{4 \cdot \sqrt{\frac{\rho [\text{kg}/\text{m}^3]}{1 [\text{kg}/\text{m}^3]}}} \cdot 3600 [\text{s}/\text{h}]$$

$$Q_{\text{AmpMin}} [\text{ft}^3/\text{min}] = \frac{v_{\text{AmpMin}} [\text{ft}/\text{s}] \cdot \pi \cdot D_i [\text{ft}]^2}{4 \cdot \sqrt{\frac{\rho [\text{lbm}/\text{ft}^3]}{0.0624 [\text{lbm}/\text{ft}^3]}}} \cdot 60 [\text{s}/\text{min}]$$

A0034304

- $Q_{\text{AmpMin}}$  Minimum measurable flow rate based on signal amplitude
- $v_{\text{AmpMin}}$  Minimum measurable flow velocity based on signal amplitude
- $D_i$  Internal diameter of measuring tube (corresponds to dimension  $K \rightarrow$  54)
- $\rho$  Density

The effective lower range value  $Q_{Low}$  is determined using the largest of the three values  $Q_{min}$ ,  $Q_{Re = 5000}$  and  $Q_{AmpMin}$ .

$$Q_{Low} \text{ [m}^3\text{/h]} = \max \begin{cases} Q_{min} \text{ [m}^3\text{/h]} \\ Q_{Re = 5000} \text{ [m}^3\text{/h]} \\ Q_{AmpMin} \text{ [m}^3\text{/h]} \end{cases}$$

$$Q_{Low} \text{ [ft}^3\text{/min]} = \max \begin{cases} Q_{min} \text{ [ft}^3\text{/min]} \\ Q_{Re = 5000} \text{ [ft}^3\text{/min]} \\ Q_{AmpMin} \text{ [ft}^3\text{/min]} \end{cases}$$

A0034313

$Q_{Low}$	Effective lower range value
$Q_{min}$	Minimum measurable flow rate
$Q_{Re = 5000}$	Flow rate is dependent on the Reynolds number
$Q_{AmpMin}$	Minimum measurable flow rate based on signal amplitude

 The Applicator is available for calculation purposes.

### Upper range value

The measuring signal amplitude must be below a certain limit value to ensure that the signals can be evaluated without error. This results in a maximum permitted flow rate  $Q_{AmpMax}$ :

$$Q_{AmpMax} \text{ [m}^3\text{/h]} = \frac{350 \text{ [m/s]} \cdot \pi \cdot D_i \text{ [m]}^2}{4 \cdot \sqrt{\frac{\rho \text{ [kg/m}^3\text{]}}{1 \text{ [kg/m}^3\text{]}}}} \cdot 3600 \text{ [s/h]}$$

$$Q_{AmpMax} \text{ [ft}^3\text{/min]} = \frac{1148 \text{ [ft/s]} \cdot \pi \cdot D_i \text{ [ft]}^2}{4 \cdot \sqrt{\frac{\rho \text{ [lbm/ft}^3\text{]}}{0.0624 \text{ [lbm/ft}^3\text{]}}}} \cdot 60 \text{ [s/min]}$$

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$Q_{AmpMax}$	Maximum measurable flow rate based on signal amplitude
$D_i$	Internal diameter of measuring tube (corresponds to dimension $K \rightarrow$ 54)
$\rho$	Density

For gas applications, an additional restriction applies to the upper range value with regard to the Mach number in the measuring device, which must be less than 0.3. The Mach number  $Ma$  describes the ratio of the flow velocity  $v$  to the sound velocity  $c$  in the fluid.

$$Ma = \frac{v \text{ [m/s]}}{c \text{ [m/s]}}$$

$$Ma = \frac{v \text{ [ft/s]}}{c \text{ [ft/s]}}$$

A0034321

- $Ma$  Mach number
- $v$  Flow velocity
- $c$  Sound velocity

The corresponding flow rate can be derived using the nominal diameter.

$$Q_{Ma=0.3} [\text{m}^3/\text{h}] = \frac{0.3 \cdot c [\text{m}/\text{s}] \cdot \pi \cdot D_i [\text{m}]^2}{4} \cdot 3600 [\text{s}/\text{h}]$$

$$Q_{Ma=0.3} [\text{ft}^3/\text{min}] = \frac{0.3 \cdot c [\text{ft}/\text{s}] \cdot \pi \cdot D_i [\text{ft}]^2}{4} \cdot 60 [\text{s}/\text{min}]$$

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- $Q_{Ma=0.3}$  Restricted upper range value is dependent on Mach number
- $c$  Sound velocity
- $D_i$  Internal diameter of measuring tube (corresponds to dimension  $K \rightarrow$  54)
- $\rho$  Density

The effective upper range value  $Q_{High}$  is determined using the smallest of the three values  $Q_{max}$ ,  $Q_{AmpMax}$  and  $Q_{Ma=0.3}$ .

$$Q_{High} [\text{m}^3/\text{h}] = \min \begin{cases} Q_{max} [\text{m}^3/\text{h}] \\ Q_{AmpMax} [\text{m}^3/\text{h}] \\ Q_{Ma=0.3} [\text{m}^3/\text{h}] \end{cases}$$

$$Q_{High} [\text{ft}^3/\text{min}] = \min \begin{cases} Q_{max} [\text{ft}^3/\text{min}] \\ Q_{AmpMax} [\text{ft}^3/\text{min}] \\ Q_{Ma=0.3} [\text{ft}^3/\text{min}] \end{cases}$$

A0034338

- $Q_{High}$  Effective upper range value
- $Q_{max}$  Maximum measurable flow rate
- $Q_{AmpMax}$  Maximum measurable flow rate based on signal amplitude
- $Q_{Ma=0.3}$  Restricted upper range value is dependent on Mach number

For liquids, the occurrence of cavitation may also restrict the upper range value.



The Applicator is available for calculation purposes.

**Operable flow range**

The value, which is typically up to 49: 1, may vary depending on the operating conditions (ratio between upper range value and lower range value)

**Input signal**

**Current input**

<b>Current input</b>	4-20 mA (passive)
<b>Resolution</b>	1 $\mu\text{A}$
<b>Voltage drop</b>	Typically: 2.2 to 3 V for 3.6 to 22 mA

<b>Maximum voltage</b>	≤ 35 V
<b>Possible input variables</b>	<ul style="list-style-type: none"> <li>▪ Pressure</li> <li>▪ Temperature</li> <li>▪ Density</li> </ul>

### External measured values

To increase the accuracy of certain measured variables or to calculate the corrected volume flow, the automation system can continuously write different measured values to the measuring device:

- Operating pressure to increase accuracy (Endress+Hauser recommends the use of a pressure measuring device for absolute pressure, e.g. Cerabar M or Cerabar S)
- Medium temperature to increase accuracy (e.g. iTEMP)
- Reference density for calculating the corrected volume flow



- Various pressure measuring devices can be ordered as accessories from Endress+Hauser.
- If using pressure measuring devices, pay attention to outlet runs when installing external devices → 47.

If the measuring device does not have pressure or temperature compensation <sup>1)</sup>, it is recommended that external pressure measurement values be read in so that the following measured variables can be calculated:

- Energy flow
- Mass flow
- Corrected volume flow

### Integrated pressure and temperature measurement

The measuring device can also directly record external variables for density and energy compensation.

This product version offers the following benefits:

- Measurement of pressure, temperature and flow in a true 2-wire version
- Recording of pressure and temperature at the same point, thus ensuring maximum accuracy of density and energy compensation.
- Continuous monitoring of pressure and temperature, thus enabling complete integration in Heartbeat.
- Easy testing of pressure measurement accuracy:
  - Application of pressure by pressure calibration unit, followed by input into measuring device
  - Automatic error correction performed by device in the event of a deviation
- Availability of calculated line pressure.

### Current input

The measured values are written from the automation system to the measuring device via the current input → 13.

### HART protocol

The measured values are written from the automation system to the measuring device via the HART protocol. The pressure transmitter must support the following protocol-specific functions:

- HART protocol
- Burst mode

### Digital communication

The measured values can be written from the automation system to the measuring via:

- FOUNDATION Fieldbus
- PROFIBUS PA

1) Order code for "Sensor option", option DC, DD


## Output

### Output signal

#### Current output

Current output 1	4-20 mA HART (passive)
Current output 2	4-20 mA (passive)
Resolution	< 1 µA
Damping	Adjustable: 0.0 to 999.9 s
Assignable measured variables	<ul style="list-style-type: none"> <li>▪ Volume flow</li> <li>▪ Corrected volume flow</li> <li>▪ Mass flow</li> <li>▪ Flow velocity</li> <li>▪ Temperature</li> <li>▪ Pressure</li> <li>▪ Calculated saturated steam pressure</li> <li>▪ Total mass flow</li> <li>▪ Energy flow</li> <li>▪ Heat flow difference</li> </ul>

#### Pulse/frequency/switch output

Function	Can be set to pulse, frequency or switch output
Version	Passive, open collector
Maximum input values	<ul style="list-style-type: none"> <li>▪ DC 35 V</li> <li>▪ 50 mA</li> </ul> <p> For information on the Ex connection values → 18</p>
Voltage drop	<ul style="list-style-type: none"> <li>▪ For ≤ 2 mA: 2 V</li> <li>▪ For 10 mA: 8 V</li> </ul>
Residual current	≤ 0.05 mA
<b>Pulse output</b>	
Pulse width	Adjustable: 5 to 2 000 ms
Maximum pulse rate	100 Impulse/s
Pulse value	Adjustable
Assignable measured variables	<ul style="list-style-type: none"> <li>▪ Mass flow</li> <li>▪ Volume flow</li> <li>▪ Corrected volume flow</li> <li>▪ Total mass flow</li> <li>▪ Energy flow</li> <li>▪ Heat flow difference</li> </ul>
<b>Frequency output</b>	
Output frequency	Adjustable: 0 to 1 000 Hz
Damping	Adjustable: 0 to 999 s
Pulse/pause ratio	1:1
Assignable measured variables	<ul style="list-style-type: none"> <li>▪ Volume flow</li> <li>▪ Corrected volume flow</li> <li>▪ Mass flow</li> <li>▪ Flow velocity</li> <li>▪ Temperature</li> <li>▪ Calculated saturated steam pressure</li> <li>▪ Total mass flow</li> <li>▪ Energy flow</li> <li>▪ Heat flow difference</li> <li>▪ Pressure</li> </ul>
<b>Switch output</b>	

<b>Switching behavior</b>	Binary, conductive or non-conductive
<b>Switching delay</b>	Adjustable: 0 to 100 s
<b>Number of switching cycles</b>	Unlimited
<b>Assignable functions</b>	<ul style="list-style-type: none"> <li>▪ Off</li> <li>▪ On</li> <li>▪ Diagnostic behavior</li> <li>▪ Limit value <ul style="list-style-type: none"> <li>▪ Volume flow</li> <li>▪ Corrected volume flow</li> <li>▪ Mass flow</li> <li>▪ Flow velocity</li> <li>▪ Temperature</li> <li>▪ Calculated saturated steam pressure</li> <li>▪ Total mass flow</li> <li>▪ Energy flow</li> <li>▪ Heat flow difference</li> </ul> </li> <li>▪ Pressure</li> <li>▪ Reynolds number</li> <li>▪ Totalizer 1-3</li> <li>▪ Status</li> <li>▪ Status of low flow cut off</li> </ul>

#### FOUNDATION Fieldbus

<b>FOUNDATION Fieldbus</b>	H1, IEC 61158-2, galvanically isolated
<b>Data transfer</b>	31.25 kbit/s
<b>Current consumption</b>	15 mA
<b>Permitted supply voltage</b>	9 to 32 V
<b>Bus connection</b>	With integrated reverse polarity protection

#### PROFIBUS PA

<b>PROFIBUS PA</b>	In accordance with EN 50170 Volume 2, IEC 61158-2 (MBP), galvanically isolated
<b>Data transmission</b>	31.25 kbit/s
<b>Current consumption</b>	16 mA
<b>Permitted supply voltage</b>	9 to 32 V
<b>Bus connection</b>	With integrated reverse polarity protection

#### Signal on alarm

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

#### Current output 4 to 20 mA

*4 to 20 mA*

<b>Failure mode</b>	Choose from: <ul style="list-style-type: none"> <li>▪ 4 to 20 mA in accordance with NAMUR recommendation NE 43</li> <li>▪ 4 to 20 mA in accordance with US</li> <li>▪ Min. value: 3.59 mA</li> <li>▪ Max. value: 22.5 mA</li> <li>▪ Freely definable value between: 3.59 to 22.5 mA</li> <li>▪ Actual value</li> <li>▪ Last valid value</li> </ul>
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**Pulse/frequency/switch output**

Pulse output	
Failure mode	No pulses
Frequency output	
Failure mode	Choose from: <ul style="list-style-type: none"> <li>▪ Actual value</li> <li>▪ 0 Hz</li> <li>▪ Defined value: 0 to 1 250 Hz</li> </ul>
Switch output	
Failure mode	Choose from: <ul style="list-style-type: none"> <li>▪ Current status</li> <li>▪ Open</li> <li>▪ Closed</li> </ul>

**FOUNDATION Fieldbus**


Status and alarm messages	Diagnostics in accordance with FF-891
Failure current FDE (Fault Disconnection Electronic)	0 mA

**PROFIBUS PA**

Status and alarm messages	Diagnostics in accordance with PROFIBUS PA Profile 3.02
Failure current FDE (Fault Disconnection Electronic)	0 mA

**Local display**

Plain text display	With information on cause and remedial measures
Backlight	Additionally for device version with SD03 local display: red lighting indicates a device error.

 Status signal as per NAMUR recommendation NE 107

**Interface/protocol**

- Via digital communication:
  - HART protocol
  - FOUNDATION Fieldbus
  - PROFIBUS PA
- Via service interface
  - CDI service interface

Plain text display	With information on cause and remedial measures
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 Additional information on remote operation →  78

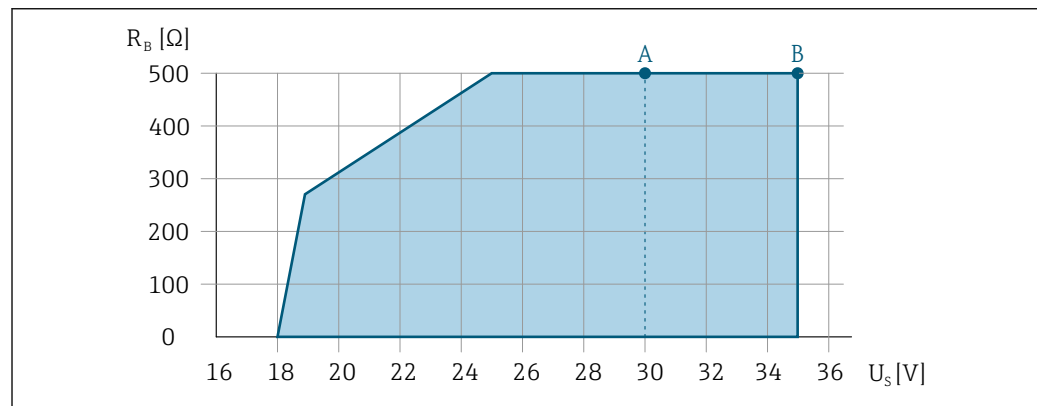
**Load**

Load for current output: 0 to 500 Ω, depending on the external supply voltage of the power supply unit

### Calculation of the maximum load

Depending on the supply voltage of the power supply unit ( $U_S$ ), the maximum load ( $R_B$ ) including line resistance must be observed to ensure adequate terminal voltage at the device. In doing so, observe the minimum terminal voltage

- For  $U_S = 17.9$  to  $18.9$  V:  $R_B \leq (U_S - 17.9 \text{ V}): 0.0036 \text{ A}$
- For  $U_S = 18.9$  to  $24$  V:  $R_B \leq (U_S - 13 \text{ V}): 0.022 \text{ A}$
- For  $U_S \geq 24$  V:  $R_B \leq 500 \Omega$



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- A Operating range for order code for "Output", option A "4-20 mA HART"/option B "4-20 mA HART, pulse/frequency/switch output" with Ex i and option C "4-20 mA HART + 4-20 mA analog"
- B Operating range for order code for "Output", option A "4-20 mA HART"/option B "4-20 mA HART, pulse/frequency/switch output" with non-Ex and Ex d

### Sample calculation

Supply voltage of power supply unit:  $U_S = 19$  V

Maximum load:  $R_B \leq (19 \text{ V} - 13 \text{ V}): 0.022 \text{ A} = 273 \Omega$

### Ex connection data

### Safety-related values

Type of protection Ex d

Order code for "Output"	Output type	Safety-related values
Option A	4-20mA HART	$U_{nom} = \text{DC } 35 \text{ V}$ $U_{max} = 250 \text{ V}$
Option B	4-20mA HART	$U_{nom} = \text{DC } 35 \text{ V}$ $U_{max} = 250 \text{ V}$
	Pulse/frequency/switch output	$U_{nom} = \text{DC } 35 \text{ V}$ $U_{max} = 250 \text{ V}$ $P_{max} = 1 \text{ W}^{1)}$
Option C	4-20mA HART	$U_{nom} = \text{DC } 30 \text{ V}$ $U_{max} = 250 \text{ V}$
	4-20mA analog	
Option D	4-20mA HART	$U_{nom} = \text{DC } 35 \text{ V}$ $U_{max} = 250 \text{ V}$
	Pulse/frequency/switch output	$U_{nom} = \text{DC } 35 \text{ V}$ $U_{max} = 250 \text{ V}$ $P_{max} = 1 \text{ W}^{1)}$
	4 to 20 mA current input	$U_{nom} = \text{DC } 35 \text{ V}$ $U_{max} = 250 \text{ V}$
Option E	FOUNDATION Fieldbus	$U_{nom} = \text{DC } 32 \text{ V}$ $U_{max} = 250 \text{ V}$ $P_{max} = 0.88 \text{ W}$
	Pulse/frequency/switch output	$U_{nom} = \text{DC } 35 \text{ V}$ $U_{max} = 250 \text{ V}$ $P_{max} = 1 \text{ W}^{1)}$

Order code for "Output"	Output type	Safety-related values
Option G	PROFIBUS PA	$U_{nom} = DC 32 V$ $U_{max} = 250 V$ $P_{max} = 0.88 W$
	Pulse/frequency/switch output	$U_{nom} = DC 35 V$ $U_{max} = 250 V$ $P_{max} = 1 W^{1)}$

1) Internal circuit limited by  $R_i = 760.5 \Omega$

*Type of protection Ex ec Ex nA*

Order code for "Output"	Output type	Safety-related values
Option A	4-20mA HART	$U_{nom} = DC 35 V$ $U_{max} = 250 V$
Option B	4-20mA HART	$U_{nom} = DC 35 V$ $U_{max} = 250 V$
	Pulse/frequency/switch output	$U_{nom} = DC 35 V$ $U_{max} = 250 V$ $P_{max} = 1 W^{1)}$
Option C	4-20mA HART	$U_{nom} = DC 30 V$ $U_{max} = 250 V$
	4-20mA analog	
Option D	4-20mA HART	$U_{nom} = DC 35 V$ $U_{max} = 250 V$
	Pulse/frequency/switch output	$U_{nom} = DC 35 V$ $U_{max} = 250 V$ $P_{max} = 1 W$
	4 to 20 mA current input	$U_{nom} = DC 35 V$ $U_{max} = 250 V$
Option E	FOUNDATION Fieldbus	$U_{nom} = DC 32 V$ $U_{max} = 250 V$ $P_{max} = 0.88 W$
	Pulse/frequency/switch output	$U_{nom} = DC 35 V$ $U_{max} = 250 V$ $P_{max} = 1 W$
Option G	PROFIBUS PA	$U_{nom} = DC 32 V$ $U_{max} = 250 V$ $P_{max} = 0.88 W$
	Pulse/frequency/switch output	$U_{nom} = DC 35 V$ $U_{max} = 250 V$ $P_{max} = 1 W$

1) Internal circuit limited by  $R_i = 760.5 \Omega$

*Type of protection XP*

Order code for "Output"	Output type	Safety-related values
Option A	4-20mA HART	$U_{nom} = DC 35 V$ $U_{max} = 250 V$
Option B	4-20mA HART	$U_{nom} = DC 35 V$ $U_{max} = 250 V$
	Pulse/frequency/switch output	$U_{nom} = DC 35 V$ $U_{max} = 250 V$ $P_{max} = 1 W^{1)}$
Option C	4-20mA HART	$U_{nom} = DC 30 V$ $U_{max} = 250 V$

Order code for "Output"	Output type	Safety-related values
	4-20mA analog	
Option D	4-20mA HART	$U_{nom} = DC 35 V$ $U_{max} = 250 V$
	Pulse/frequency/switch output	$U_{nom} = DC 35 V$ $U_{max} = 250 V$ $P_{max} = 1 W^{1)}$
	4 to 20 mA current input	$U_{nom} = DC 35 V$ $U_{max} = 250 V$
Option E	FOUNDATION Fieldbus	$U_{nom} = DC 32 V$ $U_{max} = 250 V$ $P_{max} = 0.88 W$
	Pulse/frequency/switch output	$U_{nom} = DC 35 V$ $U_{max} = 250 V$ $P_{max} = 1 W^{1)}$
Option G	PROFIBUS PA	$U_{nom} = DC 32 V$ $U_{max} = 250 V$ $P_{max} = 0.88 W$
	Pulse/frequency/switch output	$U_{nom} = DC 35 V$ $U_{max} = 250 V$ $P_{max} = 1 W^{1)}$

1) Internal circuit limited by  $R_i = 760.5 \Omega$

### Intrinsically safe values

*Type of protection Ex ia*

Order code for "Output"	Output type	Intrinsically safe values
Option A	4-20mA HART	$U_i = DC 30 V$ $I_i = 300 mA$ $P_i = 1 W$ $L_i = 0 \mu H$ $C_i = 5 nF$
Option B	4-20mA HART	$U_i = DC 30 V$ $I_i = 300 mA$ $P_i = 1 W$ $L_i = 0 \mu H$ $C_i = 5 nF$
	Pulse/frequency/switch output	$U_i = DC 30 V$ $I_i = 300 mA$ $P_i = 1 W$ $L_i = 0 \mu H$ $C_i = 6 nF$
Option C	4-20mA HART	$U_i = DC 30 V$ $I_i = 300 mA$ $P_i = 1 W$ $L_i = 0 \mu H$ $C_i = 30 nF$
	4-20mA analog	

Order code for "Output"	Output type	Intrinsically safe values	
Option D	4-20mA HART	$U_i = DC\ 30\ V$ $I_i = 300\ mA$ $P_i = 1\ W$ $L_i = 0\ \mu H$ $C_i = 5\ nF$	
	Pulse/frequency/switch output	$U_i = DC\ 30\ V$ $I_i = 300\ mA$ $P_i = 1\ W$ $L_i = 0\ \mu H$ $C_i = 6\ nF$	
	4 to 20 mA current input	$U_i = DC\ 30\ V$ $I_i = 300\ mA$ $P_i = 1\ W$ $L_i = 0\ \mu H$ $C_i = 5\ nF$	
Option E	FOUNDATION Fieldbus	STANDARD $U_i = 30\ V$ $I_i = 300\ mA$ $P_i = 1.2\ W$ $L_i = 10\ \mu H$ $C_i = 5\ nF$	FISCO $U_i = 17.5\ V$ $I_i = 550\ mA$ $P_i = 5.5\ W$ $L_i = 10\ \mu H$ $C_i = 5\ nF$
	Pulse/frequency/switch output	$U_i = 30\ V$ $I_i = 300\ mA$ $P_i = 1\ W$ $L_i = 0\ \mu H$ $C_i = 6\ nF$	
Option G	PROFIBUS PA	STANDARD $U_i = 30\ V$ $I_i = 300\ mA$ $P_i = 1.2\ W$ $L_i = 10\ \mu H$ $C_i = 5\ nF$	FISCO $U_i = 17.5\ V$ $I_i = 550\ mA$ $P_i = 5.5\ W$ $L_i = 10\ \mu H$ $C_i = 5\ nF$
	Pulse/frequency/switch output	$U_i = 30\ V$ $I_i = 300\ mA$ $P_i = 1\ W$ $L_i = 0\ \mu H$ $C_i = 6\ nF$	

Type of protection Ex ic

Order code for "Output"	Output type	Intrinsically safe values	
Option A	4-20mA HART	$U_i = DC\ 35\ V$ $I_i = n.a.$ $P_i = 1\ W$ $L_i = 0\ \mu H$ $C_i = 5\ nF$	
Option B	4-20mA HART	$U_i = DC\ 35\ V$ $I_i = n.a.$ $P_i = 1\ W$ $L_i = 0\ \mu H$ $C_i = 5\ nF$	
	Pulse/frequency/switch output	$U_i = DC\ 35\ V$ $I_i = n.a.$ $P_i = 1\ W$ $L_i = 0\ \mu H$ $C_i = 6\ nF$	
Option C	4-20mA HART	$U_i = DC\ 30\ V$ $I_i = n.a.$ $P_i = 1\ W$ $L_i = 0\ \mu H$ $C_i = 30\ nF$	
	4-20mA analog	$U_i = DC\ 30\ V$ $I_i = n.a.$ $P_i = 1\ W$ $L_i = 0\ \mu H$ $C_i = 30\ nF$	

Order code for "Output"	Output type	Intrinsically safe values	
Option D	4-20mA HART	$U_i = DC\ 35\ V$ $I_i = n.a.$ $P_i = 1\ W$ $L_i = 0\ \mu H$ $C_i = 5\ nF$	
	Pulse/frequency/switch output	$U_i = DC\ 35\ V$ $I_i = n.a.$ $P_i = 1\ W$ $L_i = 0\ \mu H$ $C_i = 6\ nF$	
	4 to 20 mA current input	$U_i = DC\ 35\ V$ $I_i = n.a.$ $P_i = 1\ W$ $L_i = 0\ \mu H$ $C_i = 5\ nF$	
Option E	FOUNDATION Fieldbus	STANDARD $U_i = 32\ V$ $I_i = 300\ mA$ $P_i = n.a.$ $L_i = 10\ \mu H$ $C_i = 5\ nF$	FISCO $U_i = 17.5\ V$ $I_i = n.a.$ $P_i = n.a.$ $L_i = 10\ \mu H$ $C_i = 5\ nF$
	Pulse/frequency/switch output	$U_i = 35\ V$ $I_i = 300\ mA$ $P_i = 1\ W$ $L_i = 0\ \mu H$ $C_i = 6\ nF$	
Option G	PROFIBUS PA	STANDARD $U_i = 32\ V$ $I_i = 300\ mA$ $P_i = n.a.$ $L_i = 10\ \mu H$ $C_i = 5\ nF$	FISCO $U_i = 17.5\ V$ $I_i = n.a.$ $P_i = n.a.$ $L_i = 10\ \mu H$ $C_i = 5\ nF$
	Pulse/frequency/switch output	$U_i = 35\ V$ $I_i = 300\ mA$ $P_i = 1\ W$ $L_i = 0\ \mu H$ $C_i = 6\ nF$	

*Type of protection IS*

Order code for "Output"	Output type	Intrinsically safe values	
Option A	4-20mA HART	$U_i = DC\ 30\ V$ $I_i = 300\ mA$ $P_i = 1\ W$ $L_i = 0\ \mu H$ $C_i = 5\ nF$	
Option B	4-20mA HART	$U_i = DC\ 30\ V$ $I_i = 300\ mA$ $P_i = 1\ W$ $L_i = 0\ \mu H$ $C_i = 5\ nF$	
	Pulse/frequency/switch output	$U_i = DC\ 30\ V$ $I_i = 300\ mA$ $P_i = 1\ W$ $L_i = 0\ \mu H$ $C_i = 6\ nF$	
Option C	4-20mA HART	$U_i = DC\ 30\ V$ $I_i = 300\ mA$ $P_i = 1\ W$ $L_i = 0\ \mu H$ $C_i = 30\ nF$	
	4-20mA analog		

Order code for "Output"	Output type	Intrinsically safe values	
Option D	4-20mA HART	$U_i = DC\ 30\ V$ $I_i = 300\ mA$ $P_i = 1\ W$ $L_i = 0\ \mu H$ $C_i = 5\ nF$	
	Pulse/frequency/switch output	$U_i = DC\ 30\ V$ $I_i = 300\ mA$ $P_i = 1\ W$ $L_i = 0\ \mu H$ $C_i = 6\ nF$	
	4 to 20 mA current input	$U_i = DC\ 30\ V$ $I_i = 300\ mA$ $P_i = 1\ W$ $L_i = 0\ \mu H$ $C_i = 5\ nF$	
Option E	FOUNDATION Fieldbus	STANDARD $U_i = 30\ V$ $I_i = 300\ mA$ $P_i = 1.2\ W$ $L_i = 10\ \mu H$ $C_i = 5\ nF$	FISCO $U_i = 17.5\ V$ $I_i = 550\ mA$ $P_i = 5.5\ W$ $L_i = 10\ \mu H$ $C_i = 5\ nF$
	Pulse/frequency/switch output	$U_i = 30\ V$ $I_i = 300\ mA$ $P_i = 1\ W$ $L_i = 0\ \mu H$ $C_i = 6\ nF$	
Option G	PROFIBUS PA	STANDARD $U_i = 30\ V$ $I_i = 300\ mA$ $P_i = 1.2\ W$ $L_i = 10\ \mu H$ $C_i = 5\ nF$	FISCO $U_i = 17.5\ V$ $I_i = 550\ mA$ $P_i = 5.5\ W$ $L_i = 10\ \mu H$ $C_i = 5\ nF$
	Pulse/frequency/switch output	$U_i = 30\ V$ $I_i = 300\ mA$ $P_i = 1\ W$ $L_i = 0\ \mu H$ $C_i = 6\ nF$	


**Low flow cut off** The switch points for low flow cut off are preset and can be configured.

**Galvanic isolation** All inputs and outputs are galvanically isolated from one another.

**Protocol-specific data** **HART**

<b>Manufacturer ID</b>	0x11
<b>Device type ID</b>	0x0038
<b>HART protocol revision</b>	7
<b>Device description files (DTM, DD)</b>	Information and files under: <a href="http://www.endress.com">www.endress.com</a>
<b>HART load</b>	<ul style="list-style-type: none"> <li>▪ Min. 250 <math>\Omega</math></li> <li>▪ Max. 500 <math>\Omega</math></li> </ul>
<b>System integration</b>	For information on system integration, see Operating Instructions. → 89 <ul style="list-style-type: none"> <li>▪ Measured variables via HART protocol</li> <li>▪ Burst Mode functionality</li> </ul>

## FOUNDATION Fieldbus

Manufacturer ID	0x452B48
Ident number	0x1038
Device revision	2
DD revision	Information and files under:
CFF revision	<ul style="list-style-type: none"> <li>▪ <a href="http://www.endress.com">www.endress.com</a></li> <li>▪ <a href="http://www.fieldbus.org">www.fieldbus.org</a></li> </ul>
Device Tester Version (ITK version)	6.2.0
ITK Test Campaign Number	Information: <ul style="list-style-type: none"> <li>▪ <a href="http://www.endress.com">www.endress.com</a></li> <li>▪ <a href="http://www.fieldbus.org">www.fieldbus.org</a></li> </ul>
Link Master capability (LAS)	Yes
Choice of "Link Master" and "Basic Device"	Yes Factory setting: Basic Device
Node address	Factory setting: 247 (0xF7)
Supported functions	The following methods are supported: <ul style="list-style-type: none"> <li>▪ Restart</li> <li>▪ ENP Restart</li> <li>▪ Diagnostic</li> <li>▪ Read events</li> <li>▪ Read trend data</li> </ul>
<b>Virtual Communication Relationships (VCRs)</b>	
Number of VCRs	44
Number of link objects in VFD	50
Permanent entries	1
Client VCRs	0
Server VCRs	10
Source VCRs	43
Sink VCRs	0
Subscriber VCRs	43
Publisher VCRs	43
<b>Device Link Capabilities</b>	
Slot time	4
Min. delay between PDU	8
Max. response delay	Min. 5
System integration	For information on system integration, see Operating Instructions. →  89 <ul style="list-style-type: none"> <li>▪ Cyclic data transmission</li> <li>▪ Description of the modules</li> <li>▪ Execution times</li> <li>▪ Methods</li> </ul>

## PROFIBUS PA

Manufacturer ID	0x11
Ident number	0x1564
Profile version	3.02
Device description files (GSD, DTM, DD)	Information and files under: <ul style="list-style-type: none"> <li>▪ <a href="http://www.endress.com">www.endress.com</a></li> <li>▪ <a href="http://www.profibus.org">www.profibus.org</a></li> </ul>



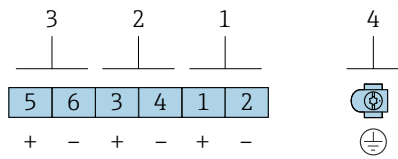
<b>Supported functions</b>	<ul style="list-style-type: none"> <li>▪ Identification &amp; Maintenance Simple device identification via control system and nameplate</li> <li>▪ PROFIBUS upload/download Reading and writing parameters is up to ten times faster with PROFIBUS upload/download</li> <li>▪ Condensed status Simplest and self-explanatory diagnostic information by categorizing diagnostic messages that occur</li> </ul>
<b>Configuration of the device address</b>	<ul style="list-style-type: none"> <li>▪ DIP switches on the I/O electronics module</li> <li>▪ Local display</li> <li>▪ Via operating tools (e.g. FieldCare)</li> </ul>
<b>System integration</b>	<p>For information on system integration, see Operating Instructions. →  89</p> <ul style="list-style-type: none"> <li>▪ Cyclic data transmission</li> <li>▪ Block model</li> <li>▪ Description of the modules</li> </ul>

## Power supply

### Terminal assignment

### Transmitter

#### Connection versions



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<p><i>Maximum number of terminals</i> Terminals 1 to 6: <i>Without integrated overvoltage protection</i></p>	<p><i>Maximum number of terminals for order code for "Accessory mounted", option NA "Overvoltage protection"</i></p> <ul style="list-style-type: none"> <li>▪ Terminals 1 to 4: <i>With integrated overvoltage protection</i></li> <li>▪ Terminals 5 to 6: <i>Without integrated overvoltage protection</i></li> </ul>
<p>1 <i>Output 1 (passive): supply voltage and signal transmission</i>                  2 <i>Output 2 (passive): supply voltage and signal transmission</i>                  3 <i>Input (passive): supply voltage and signal transmission</i>                  4 <i>Ground terminal for cable shield</i></p>	

Order code for "Output"	Terminal numbers					
	Output 1		Output 2		Input	
	1 (+)	2 (-)	3 (+)	4 (-)	5 (+)	6 (-)
Option A	4-20 mA HART (passive)		-		-	
Option B <sup>1)</sup>	4-20 mA HART (passive)		Pulse/frequency/switch output (passive)		-	
Option C <sup>1)</sup>	4-20 mA HART (passive)		4-20 mA analog (passive)		-	
Option D <sup>1) 2)</sup>	4-20 mA HART (passive)		Pulse/frequency/switch output (passive)		4-20 mA current input (passive)	

Order code for "Output"	Terminal numbers					
	Output 1		Output 2		Input	
	1 (+)	2 (-)	3 (+)	4 (-)	5 (+)	6 (-)
Option <b>E</b> <sup>1) 3)</sup>	FOUNDATION Fieldbus		Pulse/frequency/switch output (passive)		-	
Option <b>G</b> <sup>1) 4)</sup>	PROFIBUS PA		Pulse/frequency/switch output (passive)		-	

- 1) Output 1 must always be used; output 2 is optional.
- 2) The integrated overvoltage protection is not used with option D: Terminals 5 and 6 (current input) are not protected against overvoltage.
- 3) FOUNDATION Fieldbus with integrated reverse polarity protection.
- 4) PROFIBUS PA with integrated reverse polarity protection.

### Connecting cable for remote version

#### *Transmitter and sensor connection housing*

In the case of the remote version, the sensor and transmitter are mounted separately from on another and connected by a connecting cable. Connection is performed via the sensor connection housing and the transmitter housing.



How the connecting cable is connected in the transmitter housing depends on the measuring device approval and the version of the connecting cable used.

In the following versions, only terminals can be used for connection in the transmitter housing:

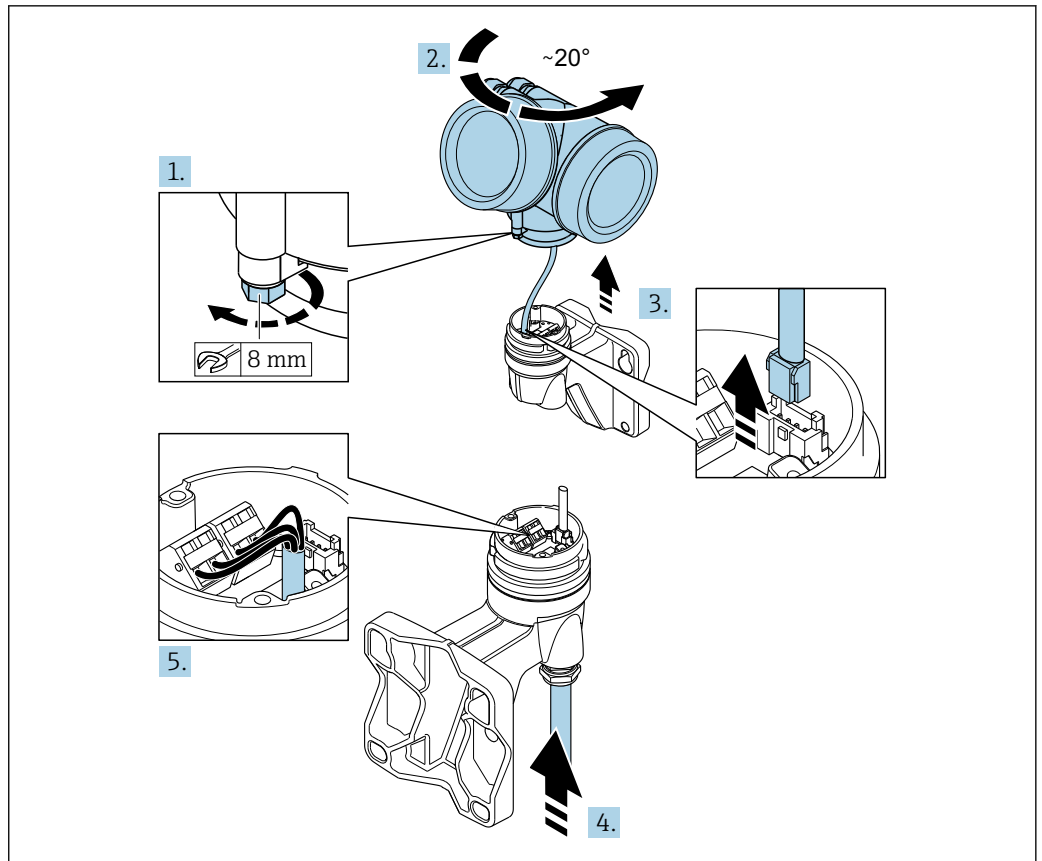
- Order code for "Electrical connection", option B, C, D
- Certain approvals: Ex nA, Ex ec, Ex tb and Division 1
- Use of reinforced connecting cable
- Order code for "Sensor version; DSC sensor; measuring tube", option DC, DD

In the following versions, an M12 device connector is used for connection in the transmitter housing:

- All other approvals
- Use of connecting cable (standard)

Terminals are always used to connect the connecting cable in the sensor connection housing (tightening torques for screws for cable strain relief: 1.2 to 1.7 Nm).

#### *Connection via terminals*







1. Loosen the securing clamp of the transmitter housing.
2. Turn the transmitter housing clockwise by approx. 20°.
3. **NOTICE**

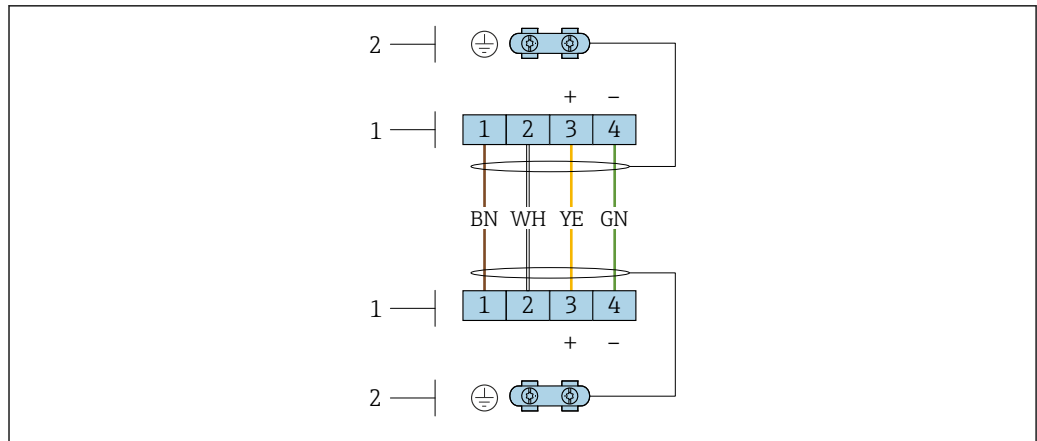
**The connection board of the wall housing is connected to the electronics board of the transmitter via a signal cable!**

- ▶ Pay attention to the signal cable when lifting the transmitter housing!

Lift the transmitter housing, plug the signal cable out of the connection board of the wall holder and remove the transmitter housing.

4. Release the cable gland and insert the connecting cable (use the shorter stripped end of the connecting cable).
5. Wire the connecting cable →  2,  28 →  3,  28.
6. Reverse the removal procedure to reassemble the transmitter housing.
7. Firmly tighten the cable gland.

*Connecting cable (standard, reinforced)*



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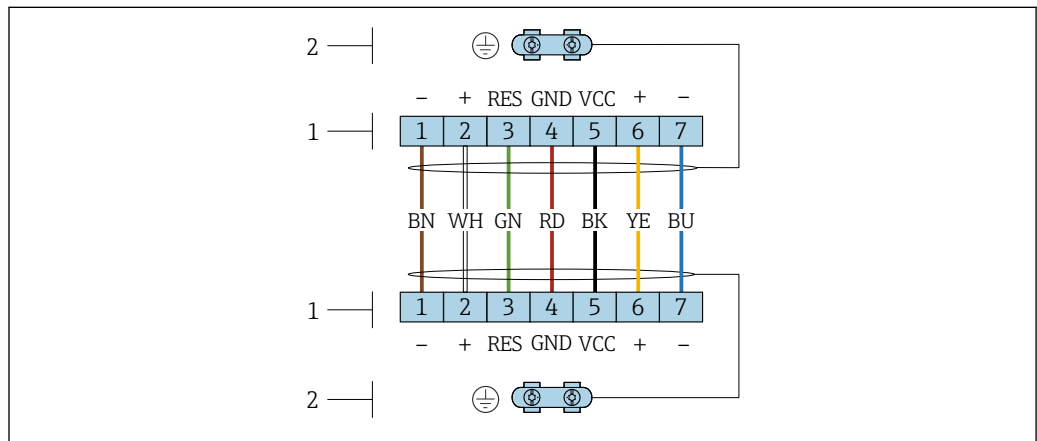
2 Terminals for connection compartment in the transmitter wall holder and the sensor connection housing

- 1 Terminals for connecting cable
- 2 Grounding via the cable strain relief

Terminal number	Assignment	Cable color Connecting cable
1	Supply voltage	Brown
2	Grounding	White
3	RS485 (+)	Yellow
4	RS485 (-)	Green

Connecting cable (option "mass pressure-/temperature-compensated")

Order code for "Sensor version; DSC sensor; measuring tube", option DC, DD



A0033471

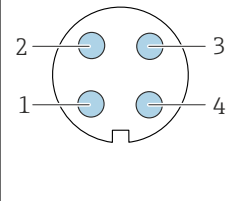
3 Terminals for connection compartment in the transmitter wall holder and the sensor connection housing

- 1 Terminals for connecting cable
- 2 Grounding via the cable strain relief

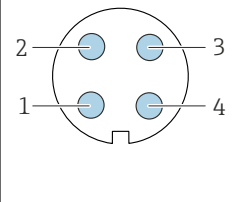
Terminal number	Assignment	Cable color Connecting cable
1	RS485 (-) DPC	Brown
2	RS485 (+) DPC	White
3	Reset	Green
4	Supply voltage	red

Terminal number	Assignment	Cable color Connecting cable
5	Grounding	Black
6	RS485 (+)	Yellow
7	RS485 (-)	Blue

**Pin assignment, device plug PROFIBUS PA**

	Pin	Assignment	Coding	Plug/socket	
	1	+			PROFIBUS PA +
	2				Grounding
	3	-			PROFIBUS PA -
	4				Not assigned

**FOUNDATION Fieldbus**

	Pin	Assignment	Coding	Plug/socket	
	1	+			Signal +
	2	-			Signal -
	3				Grounding
	4				Not assigned

**Supply voltage Transmitter**

An external power supply is required for each output.

Supply voltage for a compact version without a local display <sup>1)</sup>



Order code for "Output; input"	Minimum terminal voltage <sup>2)</sup>	Maximum terminal voltage
Option A: 4-20 mA HART	≥ DC 12 V	DC 35 V
Option B: 4-20 mA HART, pulse/frequency/switch output	≥ DC 12 V	DC 35 V
Option C: 4-20 mA HART + 4-20 mA analog	≥ DC 12 V	DC 30 V
Option D: 4-20 mA HART, pulse/frequency/switch output, 4-20 mA current input <sup>3)</sup>	≥ DC 12 V	DC 35 V
Option E: FOUNDATION Fieldbus, pulse/frequency/switch output	≥ DC 9 V	DC 32 V
Option G: PROFIBUS PA, pulse/frequency/switch output	≥ DC 9 V	DC 32 V



- 1) In event of external supply voltage of the power supply unit with load, the PROFIBUS DP/PA coupler or FOUNDATION Fieldbus power conditioners
- 2) The minimum terminal voltage increases if local operation is used: see the following table
- 3) Voltage drop 2.2 to 3 V for 3.59 to 22 mA

*Increase in minimum terminal voltage*

Order code for "Display; operation"	Increase in minimum terminal voltage
Option C: Local operation SD02	+ DC 1 V
Option E: Local operation SD03 with lighting (backlighting not used)	+ DC 1 V
Option E: Local operation SD03 with lighting (backlighting used)	+ DC 3 V

Order code for "Sensor version; DSC sensor; measuring tube"	Increase in minimum terminal voltage
Option DC: Mass steam; Alloy 718; 316L (integrated pressure/temperature measurement)	+ DC 1 V
Option DD: Mass gas/liquid; Alloy 718; 316L (integrated pressure/temperature measurement)	+ DC 1 V

 For information about the load see →  17

 Various power supply units can be ordered from Endress+Hauser: →  88

 For information on the Ex connection values →  18


**Power consumption****Transmitter**

Order code for "Output; input"	Maximum power consumption
Option A: 4-20 mA HART	770 mW
Option B: 4-20 mA HART, pulse/frequency/switch output	<ul style="list-style-type: none"> <li>▪ Operation with output 1: 770 mW</li> <li>▪ Operation with output 1 and 2: 2 770 mW</li> </ul>
Option C: 4-20 mA HART + 4-20 mA analog	<ul style="list-style-type: none"> <li>▪ Operation with output 1: 660 mW</li> <li>▪ Operation with output 1 and 2: 1 320 mW</li> </ul>
Option D: 4-20 mA HART, pulse/frequency/switch output, 4-20 mA current input	<ul style="list-style-type: none"> <li>▪ Operation with output 1: 770 mW</li> <li>▪ Operation with output 1 and 2: 2 770 mW</li> <li>▪ Operation with output 1 and input: 840 mW</li> <li>▪ Operation with output 1, 2 and input: 2 840 mW</li> </ul>
Option E: FOUNDATION Fieldbus, pulse/frequency/switch output	<ul style="list-style-type: none"> <li>▪ Operation with output 1: 512 mW</li> <li>▪ Operation with output 1 and 2: 2 512 mW</li> </ul>
Option G: PROFIBUS PA, pulse/frequency/switch output	<ul style="list-style-type: none"> <li>▪ Operation with output 1: 512 mW</li> <li>▪ Operation with output 1 and 2: 2 512 mW</li> </ul>

 For information on the Ex connection values →  18


**Current consumption****Current output**

For every 4-20 mA or 4-20 mA HART current output: 3.6 to 22.5 mA

 If the option **Defined value** is selected in the **Failure mode** parameter : 3.59 to 22.5 mA

**Current input**

3.59 to 22.5 mA

 Internal current limiting: max. 26 mA

**FOUNDATION Fieldbus**

15 mA

**PROFIBUS PA**

15 mA

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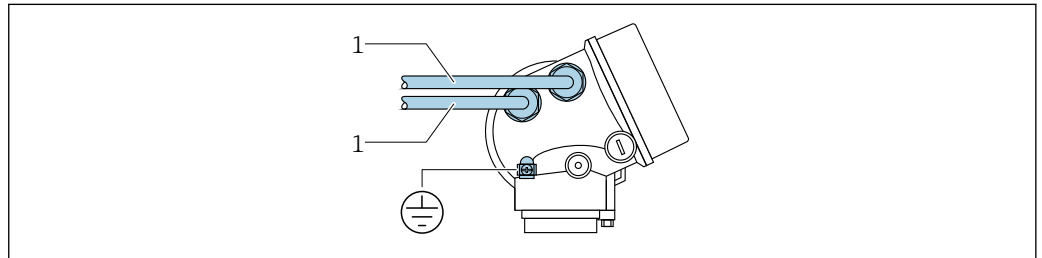
**Power supply failure**

- 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.

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**Electrical connection**

**Connecting the transmitter**

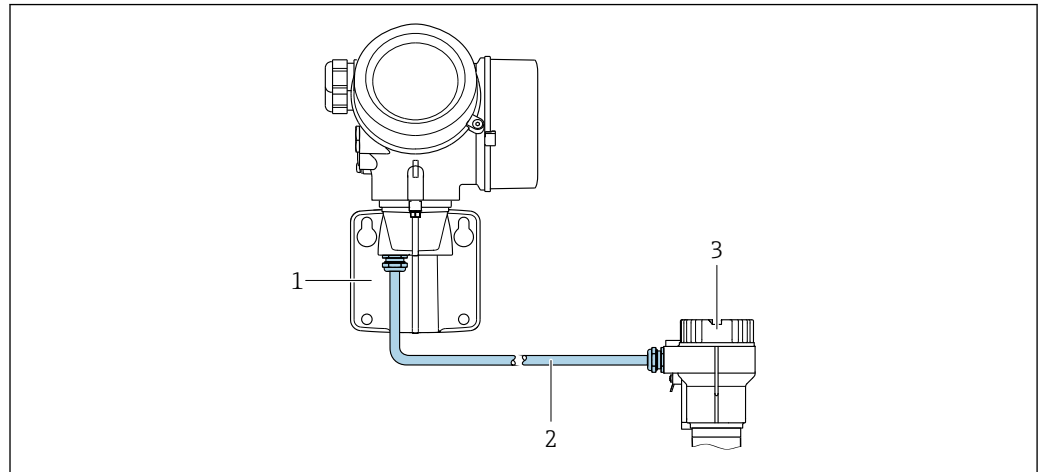


1 Cable entries for inputs/outputs

A0033480

## Remote version connection

### Connecting cable



**4** Connecting cable connection

- 1 Wall holder with connection compartment (transmitter)
- 2 Connecting cable
- 3 Sensor connection housing

**i** How the connecting cable is connected in the transmitter housing depends on the measuring device approval and the version of the connecting cable used.

In the following versions, only terminals can be used for connection in the transmitter housing:

- Order code for "Electrical connection", option B, C, D
- Certain approvals: Ex nA, Ex ec, Ex tb and Division 1
- Use of reinforced connecting cable
- Order code for "Sensor version; DSC sensor; measuring tube", option DC, DD

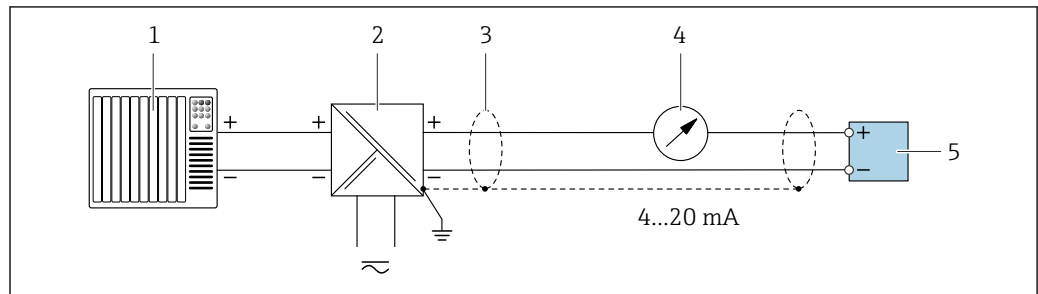
In the following versions, an M12 device connector is used for connection in the transmitter housing:

- All other approvals
- Use of connecting cable (standard)

Terminals are always used to connect the connecting cable in the sensor connection housing (tightening torques for screws for cable strain relief: 1.2 to 1.7 Nm).

## Connection examples

### Current output 4-20 mA HART

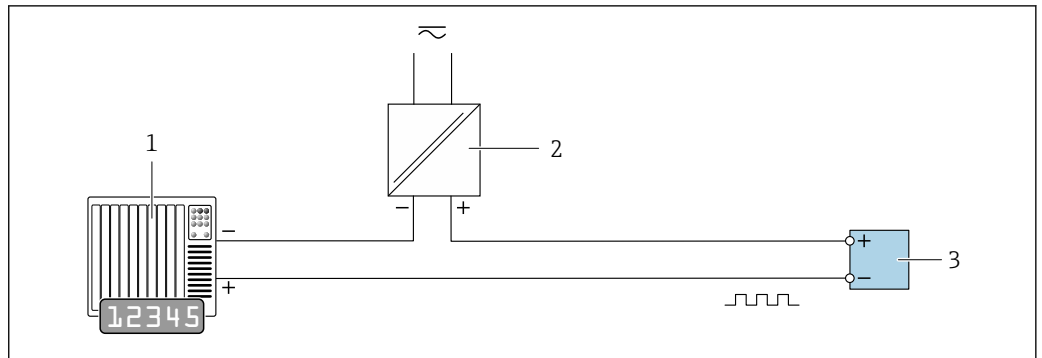


**5** Connection example for 4 to 20 mA HART current output (passive)

- 1 Automation system with current input (e.g. PLC)
- 2 Power supply
- 3 Cable shield provided 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
- 5 Transmitter



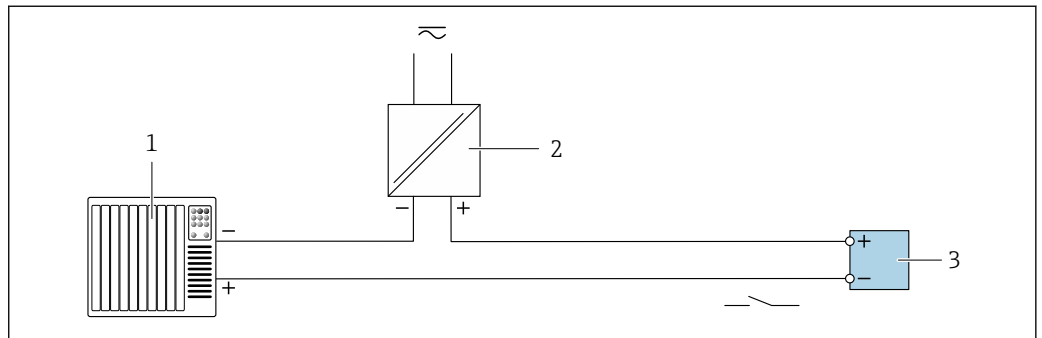
Pulse/frequency output



A0028761

- 6 Connection example for pulse/frequency output (passive)
- 1 Automation system with pulse/frequency input (e.g. PLC)
  - 2 Power supply
  - 3 Transmitter: Observe input values

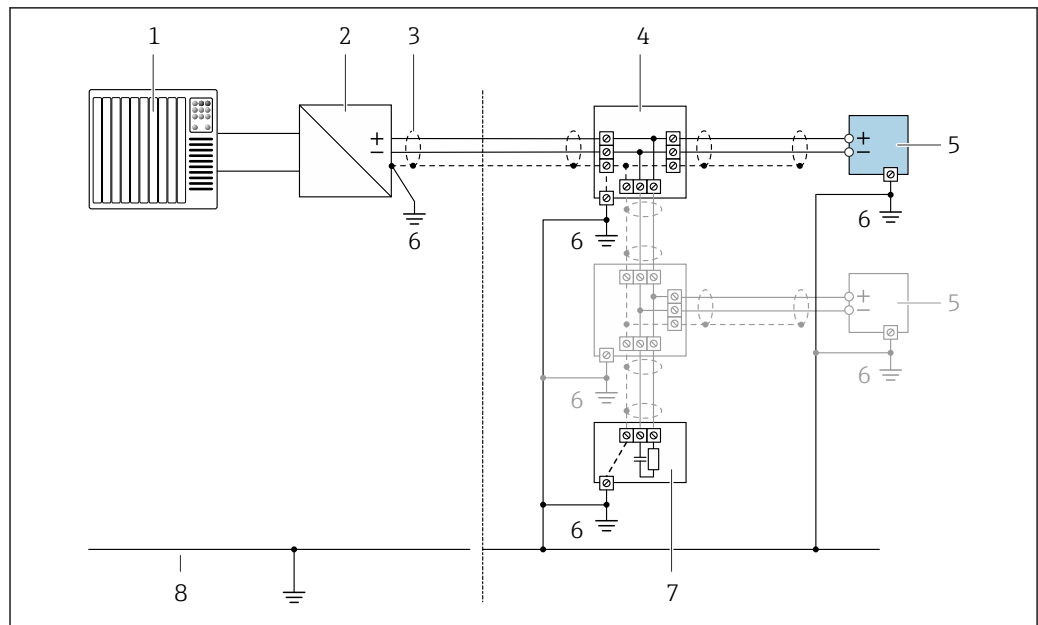
Switch output



A0028760

- 7 Connection example for switch output (passive)
- 1 Automation system with switch input (e.g. PLC)
  - 2 Power supply
  - 3 Transmitter: Observe input values

## FOUNDATION Fieldbus

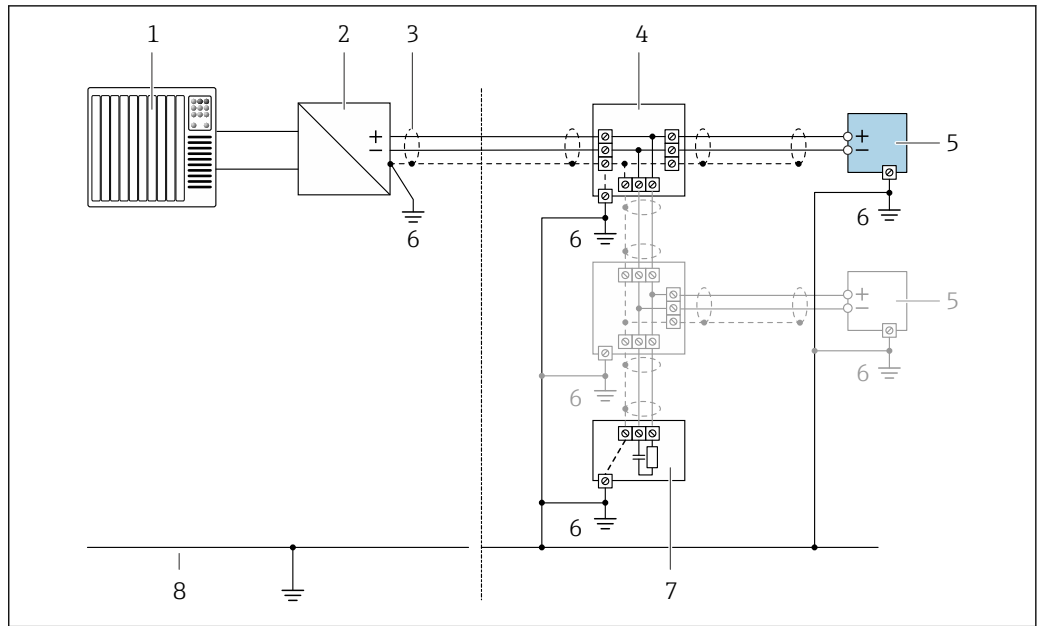


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8 Connection example for FOUNDATION Fieldbus

- 1 Control system (e.g. PLC)
- 2 Power Conditioner (FOUNDATION Fieldbus)
- 3 Cable shield provided at one end. The cable shield must be grounded at both ends to comply with EMC requirements; observe cable specifications
- 4 T-box
- 5 Measuring device
- 6 Local grounding
- 7 Bus terminator
- 8 Potential matching line

PROFIBUS PA

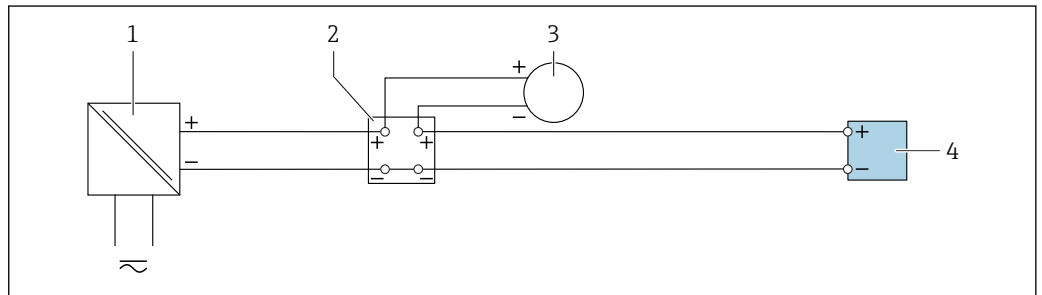


A0028768

9 Connection example for PROFIBUS PA

- 1 Control system (e.g. PLC)
- 2 PROFIBUS PA segment coupler
- 3 Cable shield provided at one end. The cable shield must be grounded at both ends to comply with EMC requirements; observe cable specifications
- 4 T-box
- 5 Measuring device
- 6 Local grounding
- 7 Bus terminator
- 8 Potential matching line

Current input

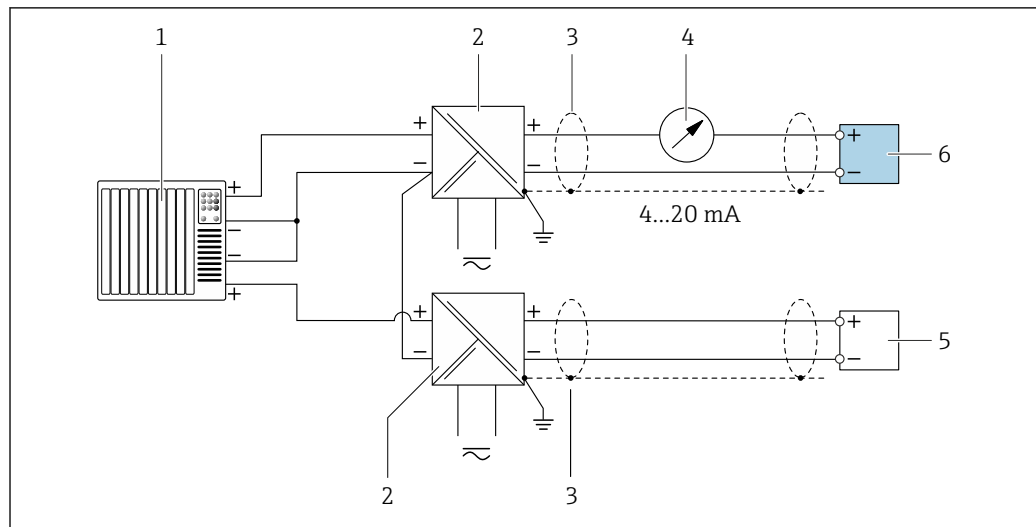


A0028915

10 Connection example for 4-20 mA current input

- 1 Active barrier for power supply (e.g. RN221N)
- 2 Terminal box
- 3 External measuring device (to read in pressure or temperature, for instance)
- 4 Transmitter

## HART input



A0028763

11 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 Cable shield provided 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
- 5 Pressure measuring device (e.g. Cerabar M, Cerabar S): see requirements
- 6 Transmitter

## Potential equalization

## Requirements

Please consider the following to ensure correct measurement:

- Same electrical potential for the fluid and sensor
- Remote version: same electrical potential for the sensor and transmitter
- Company-internal grounding concepts
- Pipe material and grounding

## Terminals

- For device version without integrated overvoltage protection: plug-in spring terminals for wire cross-sections 0.5 to 2.5 mm<sup>2</sup> (20 to 14 AWG)
- For device version with integrated overvoltage protection: screw terminals for wire cross-sections 0.2 to 2.5 mm<sup>2</sup> (24 to 14 AWG)

## Cable entries

- Cable gland (not for Ex d): M20 × 1.5 with cable  $\varnothing$  6 to 12 mm (0.24 to 0.47 in)
- Thread for cable entry:
  - For non-hazardous and hazardous areas: NPT 1/2"
  - For non-hazardous and hazardous areas (not for XP): G 1/2"
  - For Ex d: M20 × 1.5

## 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.

## Signal cable

Current output 4 to 20 mA HART

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

Current output 4 to 20 mA

Standard installation cable is sufficient.

Pulse/frequency/switch output


Standard installation cable is sufficient.

*Current input*

Standard installation cable is sufficient.


*FOUNDATION Fieldbus*

Twisted, shielded two-wire cable.

-  For further information on planning and installing FOUNDATION Fieldbus networks see:
- Operating Instructions for "FOUNDATION Fieldbus Overview" (BA00013S)
  - FOUNDATION Fieldbus Guideline
  - IEC 61158-2 (MBP)

*PROFIBUS PA*

Twisted, shielded two-wire cable. Cable type A is recommended .

-  For further information on planning and installing PROFIBUS networks see:
- Operating Instructions "PROFIBUS DP/PA: Guidelines for planning and commissioning" (BA00034S)
  - PNO Directive 2.092 "PROFIBUS PA User and Installation Guideline"
  - IEC 61158-2 (MBP)

**Connecting cable for remote version**

*Connecting cable (standard)*

<b>Standard cable</b>	2 × 2 × 0.5 mm <sup>2</sup> (22 AWG) PVC cable with common shield (2 pairs, pair-stranded) <sup>1)</sup>
<b>Flame resistance</b>	According to DIN EN 60332-1-2
<b>Oil-resistance</b>	According to DIN EN 60811-2-1
<b>Shielding</b>	Galvanized copper-braid, opt. density approx.85 %
<b>Cable length</b>	5 m (16 ft), 10 m (32 ft), 20 m (65 ft), 30 m (98 ft)
<b>Operating temperature</b>	When mounted in a fixed position: -50 to +105 °C (-58 to +221 °F); when cable can move freely: -25 to +105 °C (-13 to +221 °F)

- 1) UV radiation may cause damage to the outer jacket of the cable. Protect the cable from exposure to sun as much as possible.

*Connecting cable (armored)*

<b>Cable, armored</b>	2 × 2 × 0.34 mm <sup>2</sup> (22 AWG) PVC cable with common shield (2 pairs, pair-stranded) and additional steel-wire braided sheath <sup>1)</sup>
<b>Flame resistance</b>	According to DIN EN 60332-1-2
<b>Oil-resistance</b>	According to DIN EN 60811-2-1
<b>Shielding</b>	Galvanized copper-braid, opt. density approx. 85%
<b>Strain relief and reinforcement</b>	Steel-wire braid, galvanized
<b>Cable length</b>	5 m (16 ft), 10 m (32 ft), 20 m (65 ft), 30 m (98 ft)
<b>Operating temperature</b>	When mounted in a fixed position: -50 to +105 °C (-58 to +221 °F); when cable can move freely: -25 to +105 °C (-13 to +221 °F)

- 1) UV radiation may cause damage to the outer jacket of the cable. Protect the cable from exposure to sun as much as possible.

*Connecting cable (option "mass pressure-/temperature-compensated")*

Order code for "Sensor version; DSC sensor; measuring tube", option DC, DD

<b>Standard cable</b>	$[(3 \times 2) + 1] \times 0.34 \text{ mm}^2$ (22 AWG)PVC cable with common shield (3 pairs, pair-stranded) <sup>1)</sup>
<b>Flame resistance</b>	According to DIN EN 60332-1-2
<b>Oil-resistance</b>	According to DIN EN 60811-2-1
<b>Shielding</b>	Galvanized copper-braid, opt. density approx. 85%
<b>Cable length</b>	10 m (32 ft), 30 m (98 ft)
<b>Operating temperature</b>	When mounted in a fixed position: -50 to +105 °C (-58 to +221 °F); when cable can move freely: -25 to +105 °C (-13 to +221 °F)

- 1) UV radiation may cause damage to the outer jacket of the cable. Protect the cable from exposure to sun as much as possible.

#### Connecting cable (option "mass pressure-/temperature-compensated")

Order code for "Sensor version; DSC sensor; measuring tube", option DC, DD


<b>Standard cable</b>	$[(3 \times 2) + 1] \times 0.34 \text{ mm}^2$ (22 AWG)PVC cable with common shield (3 pairs, pair-stranded) <sup>1)</sup>
<b>Flame resistance</b>	According to DIN EN 60332-1-2
<b>Oil-resistance</b>	According to DIN EN 60811-2-1
<b>Shielding</b>	Galvanized copper-braid, opt. density approx. 85%
<b>Cable length</b>	10 m (32 ft), 30 m (98 ft)
<b>Operating temperature</b>	When mounted in a fixed position: -50 to +105 °C (-58 to +221 °F); when cable can move freely: -25 to +105 °C (-13 to +221 °F)

- 1) UV radiation may cause damage to the outer jacket of the cable. Protect the cable from exposure to sun as much as possible.

#### Overvoltage protection

The device can be ordered with integrated overvoltage protection for diverse approvals:

*Order code for "Accessory mounted", option NA "Overvoltage protection"*

<b>Input voltage range</b>	Values correspond to supply voltage specifications →  29 <sup>1)</sup>
<b>Resistance per channel</b>	$2 \cdot 0.5 \Omega$ max.
<b>DC sparkover voltage</b>	400 to 700 V
<b>Trip surge voltage</b>	< 800 V
<b>Capacitance at 1 MHz</b>	< 1.5 pF
<b>Nominal discharge current (8/20 µs)</b>	10 kA
<b>Temperature range</b>	-40 to +85 °C (-40 to +185 °F)

- 1) The voltage is reduced by the amount of the internal resistance  $I_{\min} \cdot R_i$



Depending on the temperature class, restrictions apply to the ambient temperature for device versions with overvoltage protection.





For detailed information on the temperature tables, see the "Safety Instructions" (XA) for the device.

## Performance characteristics

### Reference operating conditions

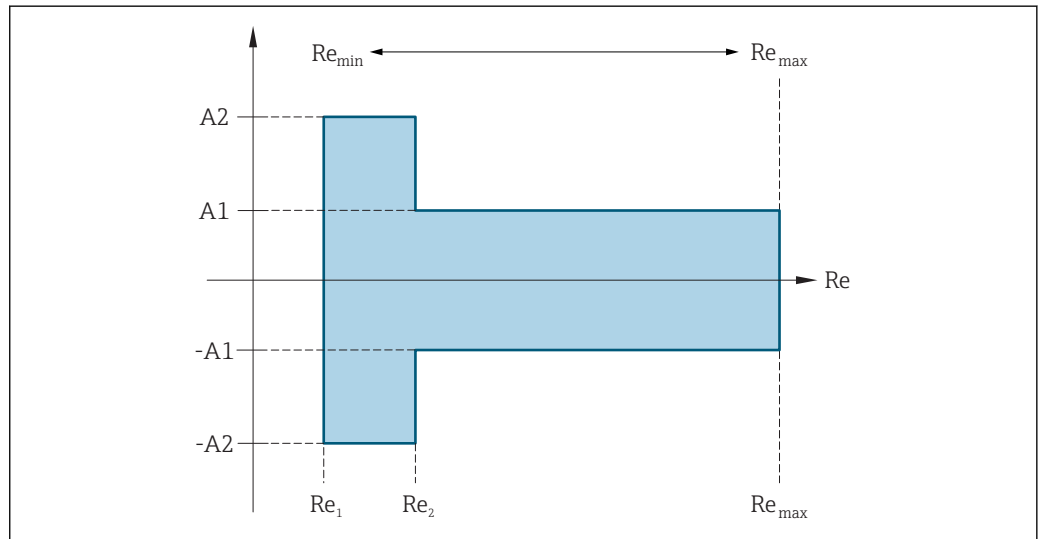
- Error limits following ISO/DIN 11631
- +20 to +30 °C (+68 to +86 °F)
- 2 to 4 bar (29 to 58 psi)
- Calibration system traceable to national standards
- Calibration with the process connection corresponding to the particular standard

 To obtain measured errors, use the *Applicator* sizing tool →  88



### Maximum measured error

### Base accuracy

o.r. = of reading



A0034077

Reynolds number	
Re <sub>1</sub>	5 000
Re <sub>2</sub>	10 000
Re <sub>min</sub>	Reynolds number for minimum permitted volume flow in measuring tube
	Standard
	$Q_{AmpMin} [m^3/h] = \frac{v_{AmpMin} [m/s] \cdot \pi \cdot D_i [m]^2}{4 \cdot \sqrt{\frac{\rho [kg/m^3]}{1 [kg/m^3]}}} \cdot 3600 [s/h]$ $Q_{AmpMin} [ft^3/min] = \frac{v_{AmpMin} [ft/s] \cdot \pi \cdot D_i [ft]^2}{4 \cdot \sqrt{\frac{\rho [lbm/ft^3]}{0.0624 [lbm/ft^3]}}} \cdot 60 [s/min]$
	A0034304
Re <sub>max</sub>	Defined by internal diameter of measuring tube, Mach number and maximum permitted velocity in measuring tube
	$Re_{max} = \frac{\rho \cdot 4 \cdot Q_{High}}{\mu \cdot K}$
	A0034339
	 Further information on effective upper range value Q <sub>High</sub> →  12

*Volume flow*

Medium type		Incompressible	Compressible
Reynolds number range	Measured value deviation	Standard	Standard
Re <sub>2</sub> to Re <sub>max</sub>	A1	< 0.75 %	< 1.0 %
Re <sub>1</sub> to Re <sub>2</sub>	A2	< 5.0 %	< 5.0 %

*Temperature*

- Saturated steam and liquids at room temperature, if T > 100 °C (212 °F):  
< 1 °C (1.8 °F)
- Gas: < 1 % o.r. [K]
- Volume flow: 70 m/s (230 ft/s): 2 % o.r.
- Rise time 50 % (stirred under water, following IEC 60751): 8 s

*Pressure*

Order code for "Pressure component" <sup>1)</sup>	Nominal value [bar abs.]	Pressure ranges and measured errors <sup>2)</sup>	
		Pressure range [bar abs.]	Maximum measured error
Option E Pressure measuring cell 40 bar_a	40	0.01 ≤ p ≤ 8 8 ≤ p ≤ 40	0.5 % of 8 bar abs. 0.5 % o.r.
Option F Pressure measuring cell 100 bar_a	100	0.01 ≤ p ≤ 20 20 ≤ p ≤ 100	0.5 % of 20 bar abs. 0.5 % o.r.
Option G Pressure measuring cell 160 bar_a	160	0.01 ≤ p ≤ 40 40 ≤ p ≤ 160	0.5 % of 40 bar abs. 0.5 % o.r.

- 1) The "mass" sensor version (integrated pressure/temperature measurement) is available only for measuring devices in HART communication mode.
- 2) The specific measured errors refer to the position of the measurement in the measuring tube and do not correspond to the pressure in the pipe connection line upstream or downstream from the measuring device. No measured error is specified for the measured error for the "pressure" measured variable that can be assigned to the outputs.

*Mass flow saturated steam*

Sensor version				Mass (integrated temperature measurement)	Mass (integrated pressure/temperature measurement) <sup>1)</sup>
Process pressure [bar abs.]	Flow velocity [m/s (ft/s)]	Reynolds number range	Measured value deviation	Standard	Standard
> 4.76	20 to 50 (66 to 164)	Re <sub>2</sub> to Re <sub>max</sub>	A1	< 1.7 %	< 1.5 %
> 3.62	10 to 70 (33 to 230)	Re <sub>2</sub> to Re <sub>max</sub>	A1	< 2.0 %	< 1.8 %
In all cases not specified here, the following applies: < 5.7 %					

- 1) Sensor version available only for measuring devices in HART communication mode.



Mass flow of superheated steam/gases<sup>2)</sup>

Sensor version				Mass (integrated pressure/temperature measurement) <sup>1)</sup>	Mass (integrated temperature measurement) + external pressure compensation <sup>2)</sup>
Process pressure [bar abs.]	Flow velocity [m/s (ft/s)]	Reynolds number range	Measured value deviation	Standard	Standard
< 40	All velocities	Re <sub>2</sub> to Re <sub>max</sub>	A1	< 1.5 %	< 1.7 %
< 120		Re <sub>2</sub> to Re <sub>max</sub>	A1	< 2.4 %	< 2.6 %
In all cases not specified here, the following applies: < 6.6 %					

- 1) Sensor version available only for measuring devices in HART communication mode.
- 2) The use of a Cerabar S is required for the measured errors listed in the following section. The measured error used to calculate the error in the measured pressure is 0.15 %.

Water mass flow

Sensor version				Mass (integrated temperature measurement)	
Process pressure [bar abs.]	Flow velocity [m/s (ft/s)]	Reynolds number range	Measured value deviation	Standard	
All pressures	All velocities	Re <sub>2</sub> to Re <sub>max</sub>	A1	< 0.85 %	
		Re <sub>1</sub> to Re <sub>2</sub>	A2	< 2.7 %	

Mass flow (user-specific liquids)

To specify the system accuracy, Endress+Hauser requires information about the type of liquid and its operating temperature or information in table form about the dependency between the liquid density and the temperature.


Example

- Acetone is to be measured at fluid temperatures from +70 to +90 °C (+158 to +194 °F).
- For this purpose, the **Reference temperature** parameter (7703) (here 80 °C (176 °F)), **Reference density** parameter (7700) (here 720.00 kg/m<sup>3</sup>) and **Linear expansion coefficient** parameter (7621) (here 18.0298 × 10<sup>-4</sup> 1/°C) must be entered in the transmitter.
- The overall system uncertainty, which is less than 0.9 % for the example above, is comprised of the following measurement uncertainties: uncertainty of volume flow measurement, uncertainty of temperature measurement, uncertainty of the density-temperature correlation used (including the resulting uncertainty of density).

Mass flow (other media)

Depends on the selected fluid and the pressure value, which is specified in the parameters. Individual error analysis must be performed.

Diameter mismatch correction

 The measuring device is calibrated according to the ordered process connection. This calibration takes account of the edge at the transition from the mating pipe to the process connection. If the mating pipe used deviates from the ordered process connection, a diameter mismatch correction can compensate for the effects. The difference between the internal diameter of the ordered process connection and the internal diameter of the mating pipe used must be taken into consideration.

The measuring device can correct shifts in the calibration factor which are caused, for example, by a diameter mismatch between the device flange (e.g. ASME B16.5/Sch. 80, DN 50 (2")) and the mating pipe (e.g. ASME B16.5/Sch. 40, DN 50 (2")). Only apply diameter mismatch correction within the following limit values (listed below) for which test measurements have also been performed.

2) single gas, gas mixture, air: NEL40; natural gas: ISO 12213-2 contains AGA8-DC92, AGA NX-19, ISO 12213-3 contains SGERG-88 and AGA8 Gross Method 1

**Flange connection:**

- DN 15 (½"): ±20 % of the internal diameter
- DN 25 (1"): ±15 % of the internal diameter
- DN 40 (1½"): ±12 % of the internal diameter
- DN ≥ 50 (2"): ±10 % of the internal diameter

If the standard internal diameter of the ordered process connection differs from the internal diameter of the mating pipe, an additional measuring uncertainty of approx. 2 % o.r. must be expected.

**Example**

Influence of the diameter mismatch without using the correction function:

- Mating pipe DN 100 (4"), Schedule 80
- Device flange DN 100 (4"), Schedule 40
- This installation position results in a diameter mismatch of 5 mm (0.2 in). If the correction function is not used, an additional measuring uncertainty of approx. 2 % o.r. must be expected.
- If the basic conditions are met and the feature is enabled, the additional measuring uncertainty is 1 % o.r.



For detailed information on the parameters for diameter mismatch correction, see the Operating Instructions → 89

**Accuracy of outputs**

The outputs have the following base accuracy specifications.

*Current output*

<b>Accuracy</b>	±10 µA
-----------------	--------

*Pulse/frequency output*

o.r. = of reading

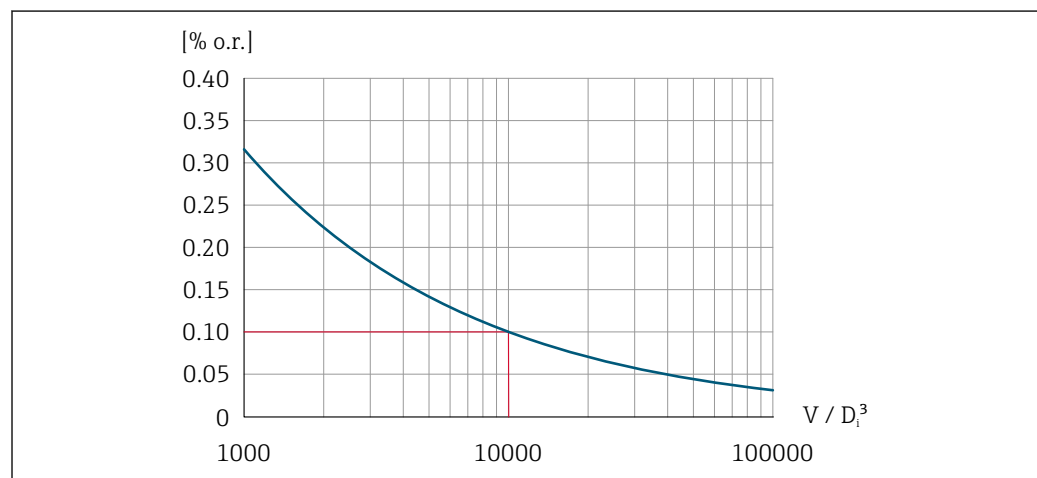
<b>Accuracy</b>	Max. ±100 ppm o.r.
-----------------	--------------------

**Repeatability**

o.r. = of reading

$$r = \left\{ \frac{100 \cdot D_i^3}{V} \right\}^{1/2} \% \text{ o.r.}$$

A0042121-EN



A0042123-EN

12 Repeatability = 0.1 % o.r. with a measured volume [m³] of V = 10 000 · D<sub>i</sub><sup>3</sup>

The repeatability can be improved if the measured volume is increased. Repeatability is not a device characteristic but a statistical variable that is dependent on the boundary conditions indicated.

**Response time**

If all the configurable functions for filter times (flow damping, display damping, current output time constant, frequency output time constant, status output time constant) are set to 0, in the event of vortex frequencies of 10 Hz and higher a response time of  $\max(T_v, 100 \text{ ms})$  can be expected.

In the event of measuring frequencies  $< 10 \text{ Hz}$ , the response time is  $> 100 \text{ ms}$  and can be up to 10 s.  $T_v$  is the average vortex period duration of the flowing fluid.

**Influence of ambient temperature**

**Current output**

o.r. = of reading

Additional error, in relation to the span of 16 mA:

Temperature coefficient at zero point (4 mA)	0.02 %/10 K
Temperature coefficient with span (20 mA)	0.05 %/10 K

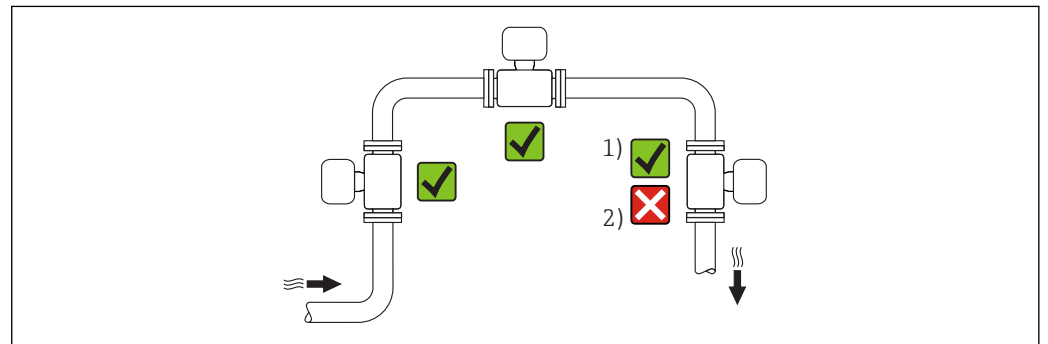
**Pulse/frequency output**

o.r. = of reading

Temperature coefficient	Max. $\pm 100 \text{ ppm o.r.}$
-------------------------	---------------------------------

## Installation

**Mounting location**

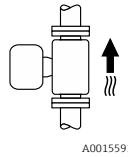
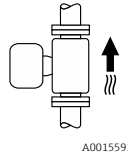
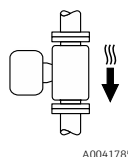
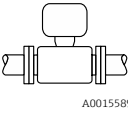
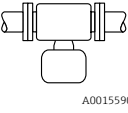



- 1 Installation suitable for gases and steam
- 2 Installation not suitable for liquids

**Orientation**

The direction of the arrow on the sensor nameplate helps you to install the sensor according to the flow direction (direction of medium flow through the piping).

Vortex meters require a fully developed flow profile as a prerequisite for correct volume flow measurement. Therefore, please note the following:

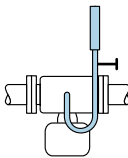
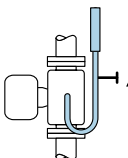
Orientation		Recommendation		
		Compact version	Remote version	
A	Vertical orientation (liquids)	 A0015591	✓✓ <sup>1)</sup>	✓✓
A	Vertical orientation (dry gases)	 A0015591   A0041785	✓✓	✓✓
B	Horizontal orientation, transmitter head up	 A0015589	✓✓ <sup>2) 3)</sup>	✓✓
C	Horizontal orientation, transmitter head down	 A0015590	✓✓ <sup>4)</sup>	✓✓
D	Horizontal orientation, transmitter head at side	 A0015592	✓✓	✓✓

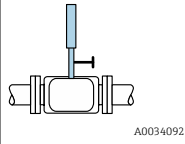
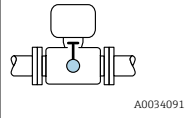
- 1) In the case of liquids, there should be upward flow in vertical pipes to avoid partial pipe filling (Fig. A). Disruption in flow measurement!
- 2) Danger of electronics overheating! If the fluid temperature is  $\geq 200\text{ °C}$  ( $392\text{ °F}$ ), orientation B is not permitted for the wafer version (Prowirl D) with nominal diameters of DN 100 (4") and DN 150 (6").
- 3) In the case of hot media (e.g. steam or fluid temperature (TM)  $\geq 200\text{ °C}$  ( $392\text{ °F}$ ): orientation C or D
- 4) In the case of very cold media (e.g. liquid nitrogen): orientation B or D

**i** For order code for "Sensor version; DSC sensor; measuring tube", option DA "Mass steam" and DB "Mass gas/liquid", the following applies:

- Only available for measuring devices with the HART communication protocol
- Oil-free or grease-free cleaning is not possible

*Pressure measuring cell*

Steam pressure measurement		Option DC
E	<ul style="list-style-type: none"> <li>▪ With the transmitter installed at the bottom or at the side</li> <li>▪ Protection against rising heat</li> </ul>	 A0034057
F	<ul style="list-style-type: none"> <li>▪ Reduction in temperature to almost ambient temperature due to siphon<sup>1)</sup></li> </ul>	 A0034058

Gas pressure measurement			Option DD
<b>G</b>	<ul style="list-style-type: none"> <li>Pressure measuring cell with shutoff device above tapping point</li> <li>Discharge of any condensate into the process</li> </ul>		✓✓
Liquid pressure measurement			Option DD
<b>H</b>	Device with shutoff device at the same level as tapping point		✓✓

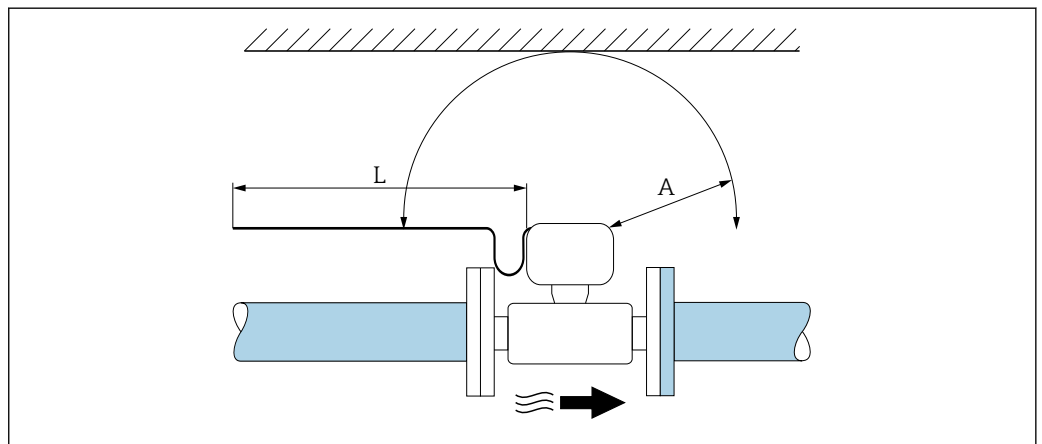
1) Note max. permitted ambient temperature of transmitter → 49.

**Minimum spacing and cable length**

Order code for "Sensor version", option "mass" DC, DD

**i** For order code for "Sensor version; DSC sensor; measuring tube", option DA "Mass steam" and DB "Mass gas/liquid", the following applies:

- Only available for measuring devices with the HART communication protocol
- Oil-free or grease-free cleaning is not possible



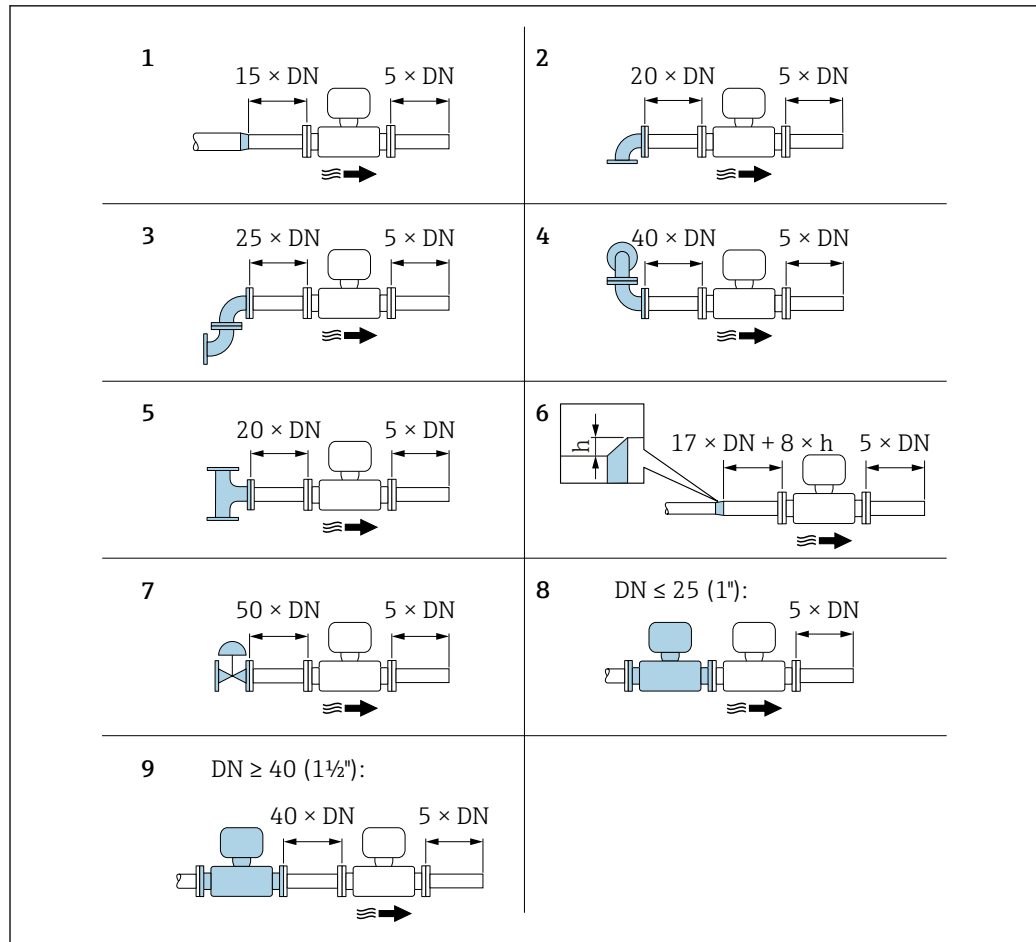
A Minimum spacing in all directions  
 L Required cable length

The following dimensions must be observed to guarantee problem-free access to the device for service purposes:

- A = 100 mm (3.94 in)
- L = L + 150 mm (5.91 in)

**Inlet and outlet runs**

To attain the specified level of accuracy of the measuring device, the inlet and outlet runs mentioned below must be maintained at the very minimum.



A0019189

13 Minimum inlet and outlet runs with various flow obstructions

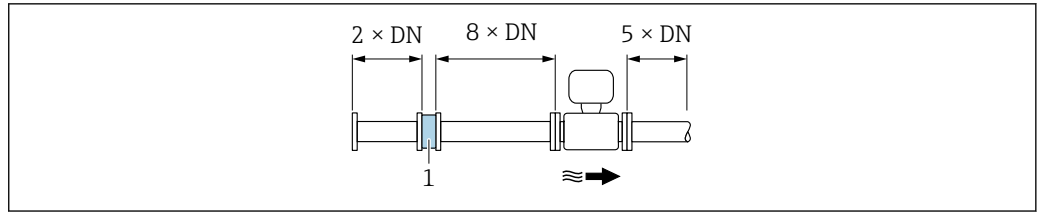
- h* Difference in expansion  
 1 Reduction by one nominal diameter size  
 2 Single elbow (90° elbow)  
 3 Double elbow (2 × 90° elbows, opposite)  
 4 Double elbow 3D (2 × 90° elbows, opposite, not on one plane)  
 5 T-piece  
 6 Expansion  
 7 Control valve  
 8 Two measuring devices in a row where  $DN \leq 25$  (1''): directly flange on flange  
 9 Two measuring devices in a row where  $DN \geq 40$  (1½''): for spacing, see graphic

- i** ■ If there are several flow disturbances present, the longest specified inlet run must be maintained.  
 ■ If the required inlet runs cannot be observed, it is possible to install a specially designed flow conditioner → 46.

#### Flow conditioner

If the inlet runs cannot be observed, the use of a flow conditioner is recommended.

The flow conditioner is fitted between two pipe flanges and centered by the mounting bolts. Generally this reduces the inlet run needed to  $10 \times DN$  with full accuracy.



A0019208

1 Flow conditioner

The pressure loss for flow conditioners is calculated as follows:  $\Delta p \text{ [mbar]} = 0.0085 \cdot \rho \text{ [kg/m}^3\text{]} \cdot v^2 \text{ [m/s]}$

Example for steam

$p = 10 \text{ bar abs.}$

$t = 240 \text{ }^\circ\text{C} \rightarrow \rho = 4.39 \text{ kg/m}^3$

$v = 40 \text{ m/s}$

$\Delta p = 0.0085 \cdot 4.39 \cdot 40^2 = 59.7 \text{ mbar}$

Example for H<sub>2</sub>O condensate (80 °C)

$\rho = 965 \text{ kg/m}^3$



$v = 2.5 \text{ m/s}$

$\Delta p = 0.0085 \cdot 965 \cdot 2.5^2 = 51.3 \text{ mbar}$

$\rho$  : density of the process medium

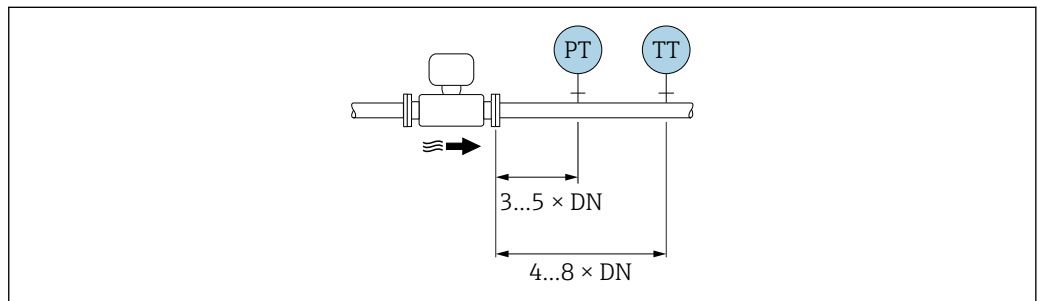
$v$ : average flow velocity

abs. = absolute

 A specially designed flow conditioner is available from Endress+Hauser: →  62

**Outlet runs when installing external devices**

If installing an external device, observe the specified distance.



A0019205


PT Pressure

TT Temperature device

**Length of connecting cable**

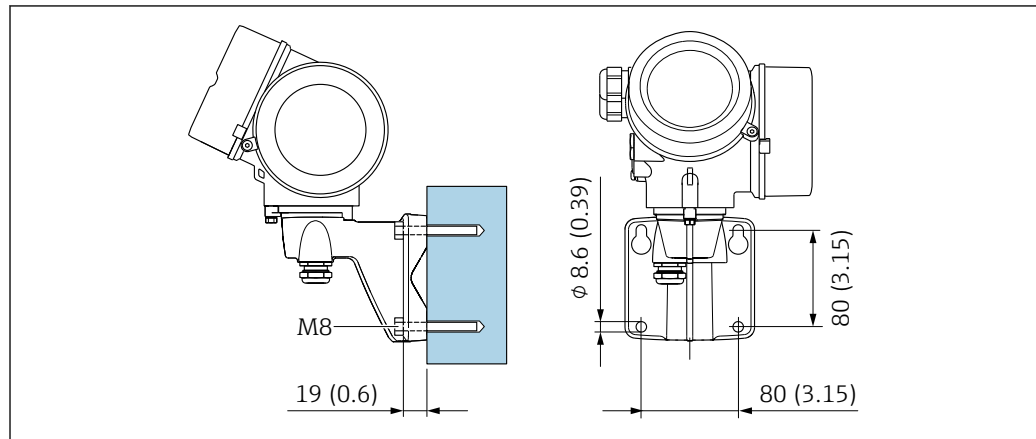
To ensure correct measuring results when using the remote version,

- observe the maximum permitted cable length:  $L_{\text{max}} = 30 \text{ m (90 ft)}$ .
- The value for the cable length must be calculated if the cable cross-section differs from the specification.

 For detailed information about calculating the length of the connecting cable, refer to the Operating Instructions for the device on the CD-ROM provided

## Mounting the transmitter housing

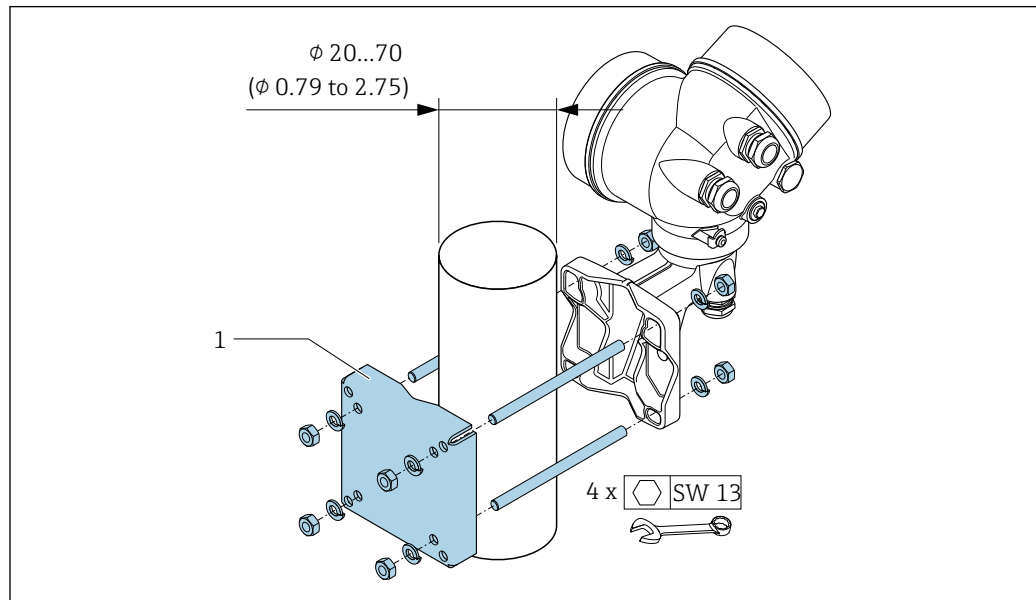
### Wall mounting



A0033464

■ 14 mm (in)

### Post mounting



A0033466

■ 15 mm (in)

## Special mounting instructions

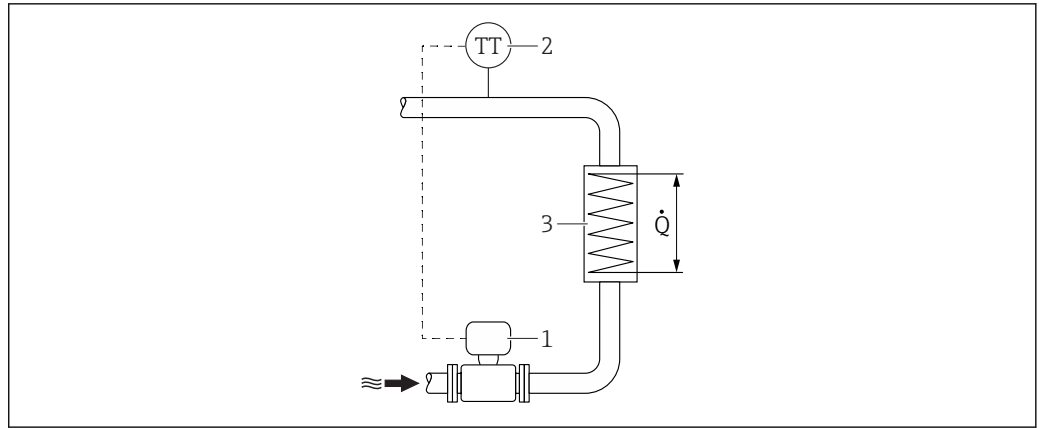
### Installation for delta heat measurements

- Order code for "Sensor version", option CD "mass; Alloy 718; 316L (integrated temperature measurement), -200 to +400 °C (-328 to +750 °F)"
- Order code for "Sensor version", option DC "mass steam; Alloy 718; 316L (integrated pressure/temperature measurement), -200 to +400 °C (-328 to +750 °F)"
- Order code for "Sensor version", option DD "mass gas/liquid; Alloy 718; 316L (integrated pressure/temperature measurement), -40 to +100 °C (-40 to +212 °F)"

The second temperature measurement is taken using a separate temperature sensor. The measuring device reads in this value via a communication interface.

- In the case of saturated steam delta heat measurements, the measuring device must be installed on the steam side.
- In the case of water delta heat measurements, the device can be installed on the cold or warm side.





A0019209

16 Layout for delta heat measurement of saturated steam and water

- 1 Measuring device
- 2 Temperature sensor
- 3 Heat exchanger
- Q Heat flow

**Protective cover**

Observe the following minimum head clearance: 222 mm (8.74 in)

For information on the weather protection cover, see → 86

## Environment

**Ambient temperature range** *Compact version*

<b>Measuring device</b>	Non-hazardous area:	-40 to +80 °C (-40 to +176 °F) <sup>1)</sup>
	Ex i, Ex nA, Ex ec:	-40 to +70 °C (-40 to +158 °F) <sup>1)</sup>
	Ex d, XP:	-40 to +60 °C (-40 to +140 °F) <sup>1)</sup>
	Ex d, Ex ia:	-40 to +60 °C (-40 to +140 °F) <sup>1)</sup>
<b>Local display</b>		-40 to +70 °C (-40 to +158 °F) <sup>2) 1)</sup>

- 1) Additionally available as order code for "Test, certificate", option JN "Transmitter ambient temperature - 50 °C (-58 °F)".
- 2) At temperatures < -20 °C (-4 °F), depending on the physical characteristics involved, it may no longer be possible to read the liquid crystal display.



*Remote version*

<b>Transmitter</b>	Non-hazardous area:	-40 to +80 °C (-40 to +176 °F) <sup>1)</sup>
	Ex i, Ex nA, Ex ec:	-40 to +80 °C (-40 to +176 °F) <sup>1)</sup>
	Ex d:	-40 to +60 °C (-40 to +140 °F) <sup>1)</sup>
	Ex d, Ex ia:	-40 to +60 °C (-40 to +140 °F) <sup>1)</sup>
<b>Sensor</b>	Non-hazardous area:	-40 to +85 °C (-40 to +185 °F) <sup>1)</sup>
	Ex i, Ex nA, Ex ec:	-40 to +85 °C (-40 to +185 °F) <sup>1)</sup>
	Ex d:	-40 to +85 °C (-40 to +185 °F) <sup>1)</sup>

	Ex d, Ex ia:	-40 to +85 °C (-40 to +185 °F) <sup>1)</sup>
<b>Local display</b>		-40 to +70 °C (-40 to +158 °F) <sup>2) 1)</sup>

- 1) Additionally available as order code for "Test, certificate", option JN "Transmitter ambient temperature - 50 °C (-58 °F)".
- 2) At temperatures < -20 °C (-4 °F), depending on the physical characteristics involved, it may no longer be possible to read the liquid crystal display.

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

 You can order a weather protection cover from Endress+Hauser. →  86.

**Storage temperature** All components apart from the display modules:  
-50 to +80 °C (-58 to +176 °F)

#### Display modules

All components apart from the display modules:  
-50 to +80 °C (-58 to +176 °F)

Remote display FHX50:  
-50 to +80 °C (-58 to +176 °F)

**Climate class** DIN EN 60068-2-38 (test Z/AD)

**Degree of protection**

**Transmitter**

- As standard: IP66/67, type 4X enclosure
- When housing is open: IP20, type 1 enclosure
- Display module: IP20, type 1 enclosure

**Sensor**  
IP66/67, type 4X enclosure

**Connector**  
IP67, only in screwed situation

**Vibration- and shock-resistance**

**Vibration sinusoidal, according to IEC 60068-2-6**

Order code for "Housing", option B "GT18 dual compartment, 316L, compact" and order code for "Sensor version; DSC sensor; Meas. tube", option DC "Mass steam; 316L; 316L (integrated pressure/temp. measurement)" or option DD "Mass gas/liquid; 316L; 316L (integrated pressure/temp. measurement)"

- 2 to 8.4 Hz, 3.5 mm peak
- 8.4 to 500 Hz, 1 g peak

Order code for "Housing", option C "GT20 dual compartment, alu, coated, compact" or option J "GT20 dual compartment, alu, coated, remote" or option K "GT18 dual compartment, 316L, remote"

- 2 to 8.4 Hz, 7.5 mm peak
- 8.4 to 500 Hz, 2 g peak

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

Order code for "Housing", option B "GT18 dual compartment, 316L, compact" and order code for "Sensor version; DSC sensor; Meas. tube", option DC "Mass steam; 316L; 316L (integrated pressure/temp. measurement)" or option DD "Mass gas/liquid; 316L; 316L (integrated pressure/temp. measurement)"

- 10 to 200 Hz, 0.003 g<sup>2</sup>/Hz
- 200 to 500 Hz, 0.001 g<sup>2</sup>/Hz
- Total: 0.93 g rms

Order code for "Housing", option C "GT20 dual compartment, alu, coated, compact" or option J "GT20 dual compartment, alu, coated, remote" or option K "GT18 dual compartment, 316L, remote"

- 10 to 200 Hz, 0.01 g<sup>2</sup>/Hz
- 200 to 500 Hz, 0.003 g<sup>2</sup>/Hz
- Total: 1.67 g rms

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

- Order code for "Housing", option B "GT18 dual compartment, 316L, compact" and order code for "Sensor version; DSC sensor; Meas. tube", option DC "Mass steam; 316L; 316L (integrated pressure/temperature measurement)" or option DD "Mass gas/liquid; 316L; 316L (integrated pressure/temp. measurement)"  
6 ms 30 g
- Order code for "Housing", option C "GT20 dual compartment, alu, coated, compact" or option J "GT20 dual compartment, alu, coated, remote" or option K "GT18 dual compartment, 316L, remote"  
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)



Details are provided in the Declaration of Conformity.


**Process**

**Medium temperature range**

*DSC sensor<sup>1)</sup>*

Order code for "Sensor version; DSC sensor; measuring tube"		
Option	Description	Medium temperature range
BD	Volume high-temperature; Alloy 718; 316L	-200 to +400 °C (-328 to +752 °F), PN 63 to 160/Class 600
CD	Mass; Alloy 718; 316L	-200 to +400 °C (-328 to +752 °F)
Special version for very high fluid temperatures (on request)		-200 to +440 °C (-328 to +824 °F), version for hazardous areas

1) Capacitance sensor

Order code for "Sensor version; DSC sensor; measuring tube"		
Option	Description	Medium temperature range
	For order code for "Sensor version; DSC sensor; measuring tube", option DA "Mass steam" and DB "Mass gas/liquid", the following applies: <ul style="list-style-type: none"> <li>■ Only available for measuring devices with the HART communication protocol</li> <li>■ Oil-free or grease-free cleaning is not possible</li> </ul>	
DC	Mass steam; Alloy 718; 316L	-200 to +400 °C (-328 to +752 °F), stainless steel <sup>1) 2)</sup>
DD"	Mass gas/liquid; Alloy 718; 316L	-40 to +100 °C (-40 to +212 °F), stainless steel <sup>2)</sup>

- 1) Siphon enables use for extended temperature range (up to +400 °C (+752 °F)).
- 2) In steam applications, in conjunction with the siphon, the steam temperature may be higher (up to +400 °C (+752 °F)) than the permitted temperature of the pressure measuring cell. Without a siphon, the gas temperature is restricted due to the maximum permitted temperature of the pressure measuring cell. This applies regardless of whether or not a stop cock is present.

*Pressure measuring cell*

Order code for "Pressure component"		
Option	Description	Medium temperature range
E	Pressure measuring cell 40bar/580psi abs	-40 to +100 °C (-40 to +212 °F)
F	Pressure measuring cell 100bar/1450psi abs	
G	Pressure measuring cell 160bar/2320psi abs	

## Seals

Order code for "DSC sensor seal"		
Option	Description	Medium temperature range
A	Graphite (standard)	-200 to +400 °C (-328 to +752 °F)
B	Viton	-15 to +175 °C (+5 to +347 °F)
C	Gylon	-200 to +260 °C (-328 to +500 °F)
D	Kalrez	-20 to +275 °C (-4 to +527 °F)

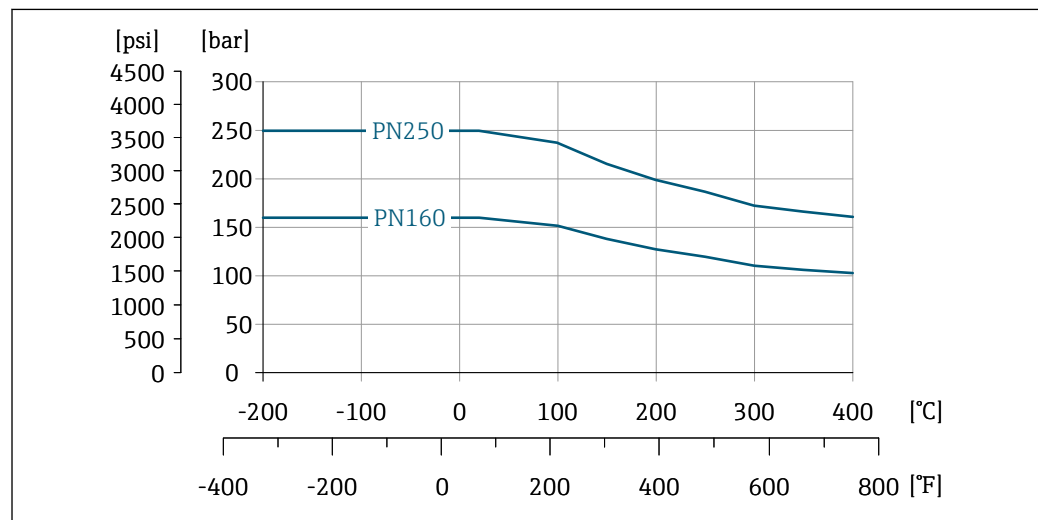
### Pressure-temperature ratings

The following pressure/temperature diagrams apply to all pressure-bearing parts of the device and not just the process connection. The diagrams show the maximum permissible medium pressure depending on the specific medium temperature.

The pressure-temperature rating for the specific measuring device is programmed into the software. If values exceed the curve range a warning is displayed. Depending on the system configuration and sensor version, the pressure and temperature are determined by entering, reading in or calculating values.

**i** Integral mass vortex: The permitted pressure for the measuring device can be less than indicated in this section, depending on the selected pressure measuring cell. → 53

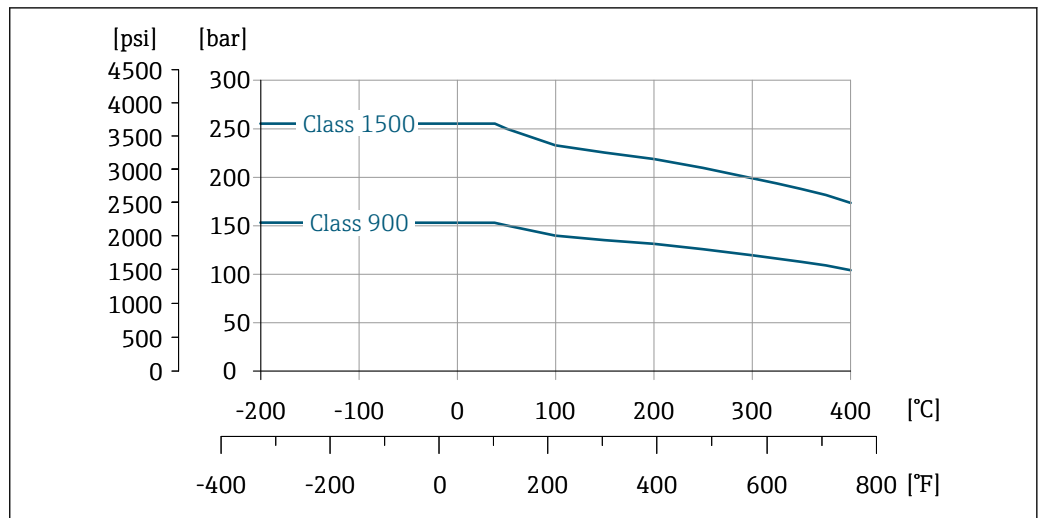
#### Flange connection: flange according to EN 1092-1 (DIN 2501)



**17** Flange connection material: stainless cast steel, multiple certifications, 1.4404/F316/F316L

A0034048-EN

**Flange connection: flange according to ASME B16.5**



A0034049-EN

18 Flange connection material: stainless steel, multiple certifications, 1.4404/F316/F316L

**Nominal pressure of sensor**

The following overpressure resistance values apply to the sensor shaft in the event of a membrane rupture:

Sensor version; DSC sensor; measuring tube	Overpressure, sensor shaft in [bar a]
Volume high-temperature	375
Mass (integrated temperature measurement)	375
Mass steam (integrated pressure/temperature measurement) Mass gas/liquid (integrated pressure/temperature measurement)	375

**Pressure specifications**

**i** For order code for "Sensor version; DSC sensor; measuring tube", option DA "Mass steam" and DB "Mass gas/liquid", the following applies:

- Only available for measuring devices with the HART communication protocol
- Oil-free or grease-free cleaning is not possible

The OPL (over pressure limit = sensor overload limit) for the measuring device depends on the lowest-rated element, with regard to pressure, of the selected components, i.e. the process connection has to be taken into consideration in addition to the measuring cell. Also observe pressure-temperature dependency. For the appropriate standards and further information → 40. The OPL may only be applied for a limited period of time.

The MWP (maximum working pressure) for the sensors depends on the lowest-rated element, with regard to pressure, of the selected components, i.e. the process connection has to be taken into consideration in addition to the measuring cell. Also observe pressure-temperature dependency. For the appropriate standards and further information → 40. The MWP may be applied at the device for an unlimited period. The MWP can also be found on the nameplate.


**⚠ WARNING**

**The maximum pressure for the measuring device depends on the lowest-rated element with regard to pressure.**

- ▶ Note specifications regarding pressure range → 40.
- ▶ The Pressure Equipment Directive (2014/68/EU) uses the abbreviation "PS". The abbreviation "PS" corresponds to the MWP of the device.
- ▶ MWP: The MWP is indicated on the nameplate. This value refers to a reference temperature of +20 °C (+68 °F) and may be applied to the device for an unlimited time. Note temperature dependence of MWP.
- ▶ OPL: The test pressure corresponds to the over pressure limit of the sensor and may be applied only temporarily to ensure that the measurement is within the specifications and no permanent damage occurs. In the case of sensor range and process connection combinations where the OPL of the process connection is less than the nominal value of the sensor, the device is set at the factory, at the very maximum, to the OPL value of the process connection. If using the entire sensor range, select a process connection with a higher OPL value.

Sensor	Maximum sensor measuring range		MWP	OPL
	Lower (LRL)	Upper (URL)		
	[bar (psi)]	[bar (psi)]	[bar (psi)]	[bar (psi)]
40 bar (600 psi)	0 (0)	+40 (+600)	100 (1 500)	160 (2 400)
100 bar (1 500 psi)	0 (0)	+100 (+1 500)	100 (1 500)	160 (2 400)
160 bar (2 300 psi)	0 (0)	+160 (+2 300)	400 (6 000)	600 (9 000)

**Pressure loss**

For a precise calculation, use the Applicator →  88.

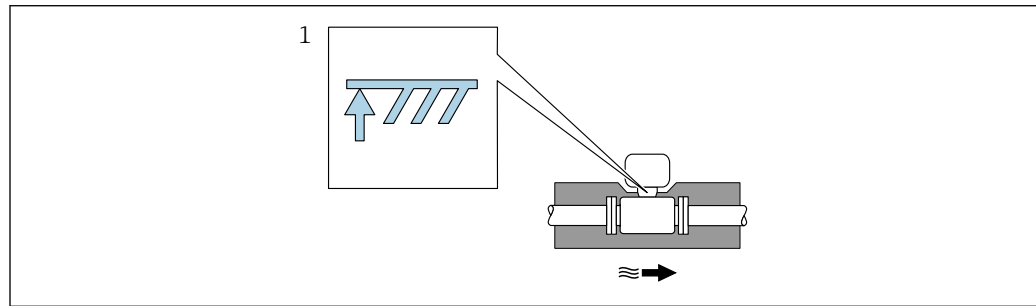
**Thermal insulation**

For optimum temperature measurement and mass calculation, heat transfer at the sensor must be avoided for some fluids. This can be ensured by installing thermal insulation. A wide range of materials can be used for the required insulation.

This applies for:

- Compact version
- Remote sensor version

The maximum insulation height permitted is illustrated in the diagram:



A0019212


1 Maximum insulation height

- When insulating, ensure that a sufficiently large area of the housing support remains exposed.

The uncovered part serves as a radiator and protects the electronics from overheating and excessive cooling.

## Mechanical construction

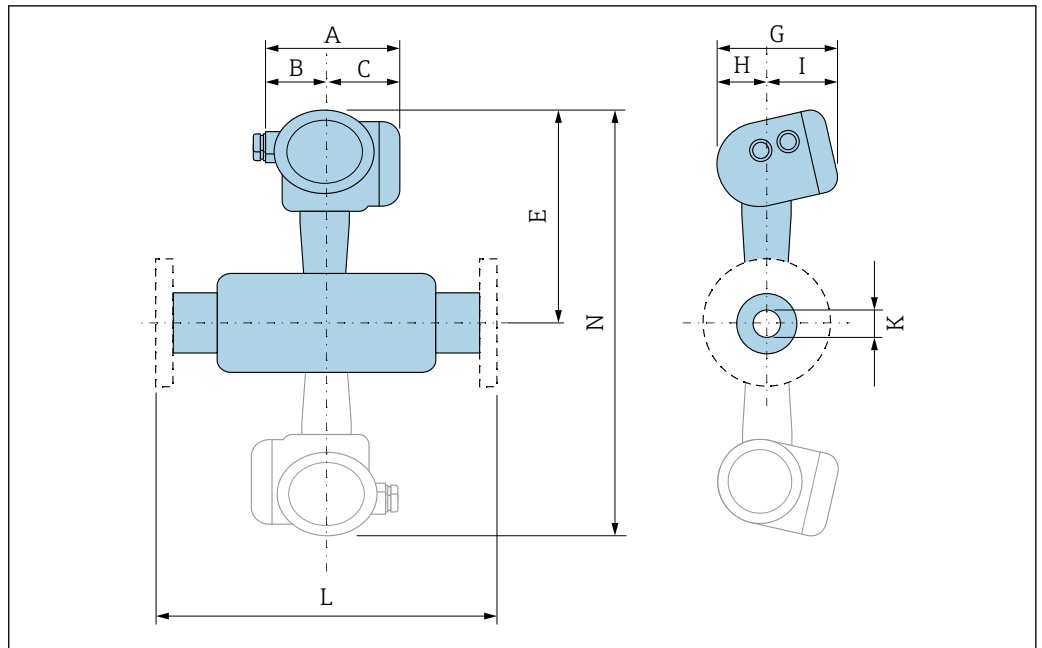
**Dimensions in SI units**

Pay attention to the information on diameter mismatch correction →  41.

**Compact version**

Order code for "Housing", option B "GT18 dual compartment, 316L, compact"; option C "GT20 dual compartment, aluminum, coated, compact"

Standard version



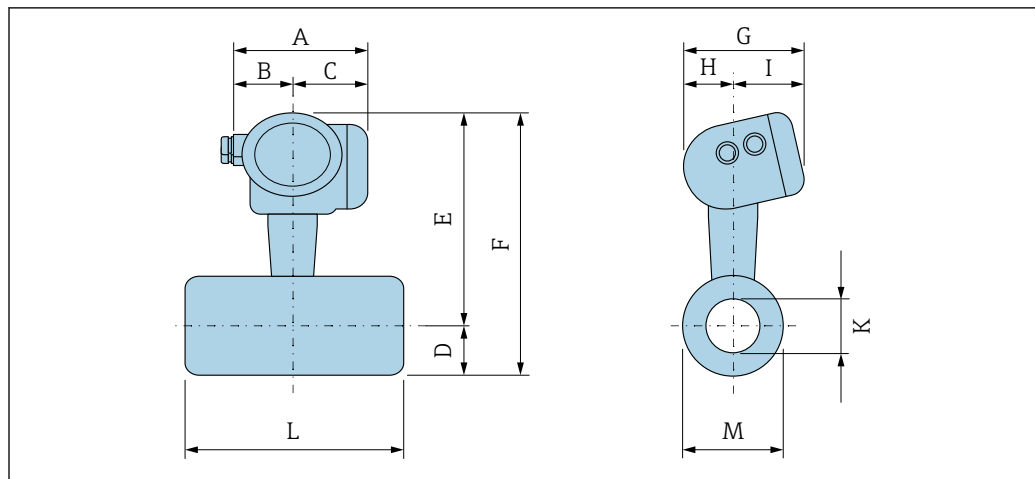
A0033794

19 Grayed out: Dualsens version

Order code for "Process connection", option D5W/D6W/ADS/ADT/AES/AET										
DN [mm]	A <sup>1)</sup> [mm]	B [mm]	C <sup>1)</sup> [mm]	E <sup>2)</sup> [mm]	G [mm]	H [mm]	I <sup>3)</sup> [mm]	K (D <sub>i</sub> ) [mm]	L [mm]	N <sup>4)</sup> [mm]
15	140.2	51.7	88.5	294	159.9	58.2	101.7	13.9	<sup>5)</sup>	<sup>6)</sup>
25	140.2	51.7	88.5	300	159.9	58.2	101.7	24.3	<sup>5)</sup>	<sup>6)</sup>
40	140.2	51.7	88.5	306	159.9	58.2	101.7	34	<sup>5)</sup>	612
50	140.2	51.7	88.5	310	159.9	58.2	101.7	42.9	<sup>5)</sup>	620
80	140.2	51.7	88.5	323	159.9	58.2	101.7	66.7	<sup>5)</sup>	645
100	140.2	51.7	88.5	334	159.9	58.2	101.7	87.3	<sup>5)</sup>	667
150	140.2	51.7	88.5	362	159.9	58.2	101.7	131.8	<sup>5)</sup>	724
200 <sup>7)</sup>	140.2	51.7	88.5	383	159.9	58.2	101.7	182.6	<sup>5)</sup>	765
250 <sup>7)</sup>	140.2	51.7	88.5	413	159.9	58.2	101.7	230.1	<sup>5)</sup>	825
300 <sup>7)</sup>	140.2	51.7	88.5	440	159.9	58.2	101.7	273	<sup>5)</sup>	879

- 1) For version with overvoltage protection: values + 8 mm
- 2) For version without local display: values - 10 mm
- 3) For version without local display: values - 7 mm
- 4) For version without local display: values - 20 mm
- 5) Dependent on respective flange connection
- 6) Not available as a Dualsens version
- 7) Available only for PN160/Class 900

## Butt-weld version



A0034573

**Butt-weld version according to EN (DIN): PN 250**  
**Order code for "Process connection", option D6B**

DN	A <sup>1)</sup>	B	C <sup>1)</sup>	D	E <sup>2)</sup>	F <sup>2)</sup>	G	H	I <sup>3)</sup>	K (D <sub>i</sub> )	L	M
[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]
15	140.2	51.7	88.5	33.3	294	348.5	159.9	58.2	101.7	16.1	248 <sup>4)</sup>	21.3
25	140.2	51.7	88.5	32.3	300	347.5	159.9	58.2	101.7	26.5	248 <sup>4)</sup>	33.4
40	140.2	51.7	88.5	32.2	306	351.5	159.9	58.2	101.7	38.3	278 <sup>5)</sup>	48.3
50	140.2	51.7	88.5	32.2	310	342.5	159.9	58.2	101.7	47.7	288 <sup>5)</sup>	60
80	140.2	51.7	88.5	64.3	323	380.5	159.9	58.2	101.7	79.6	325 <sup>5)</sup>	102
100	140.2	51.7	88.5	77.1	334	405.5	159.9	58.2	101.7	98.6	394 <sup>5)</sup>	127
150	140.2	51.7	88.5	101.9	362	446.2	159.9	58.2	101.7	142.8	566 <sup>5)</sup>	178

Groove type 22 as per DIN 2559

- 1) For version with overvoltage protection: values + 8 mm
- 2) For version without local display: values - 10 mm
- 3) For version without local display: values - 7 mm
- 4) +1.5 to -2.0 mm
- 5) ±3.5 mm

**Butt-weld version according to ASME: Class 600/900/1500, Schedule 80/160**  
**Order code for "Process connection", option A6B/A6C**

DN	A <sup>1)</sup>	B	C <sup>1)</sup>	D	EI <sup>2)</sup>	F <sup>2)</sup>	G	H	I <sup>3)</sup>	K (D <sub>i</sub> )	L	M
[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]
15	140.2	51.7	88.5	33.3	294	348.5	159.9	58.2	101.7	13.9	248 <sup>4)</sup>	21.3
25	140.2	51.7	88.5	32.3	300	347.5	159.9	58.2	101.7	24.3	248 <sup>4)</sup>	33.4
40	140.2	51.7	88.5	32.2	306	351.5	159.9	58.2	101.7	34.1	278 <sup>5)</sup>	48.3
50	140.2	51.7	88.5	32.2	310	342.5	159.9	58.2	101.7	42.9	288 <sup>5)</sup>	60.3
80	140.2	51.7	88.5	64.3	323	380.5	159.9	58.2	101.7	66.7	325 <sup>5)</sup>	88.9
100	140.2	51.7	88.5	77.1	334	405.5	159.9	58.2	101.7	87.3	394 <sup>5)</sup>	114.3

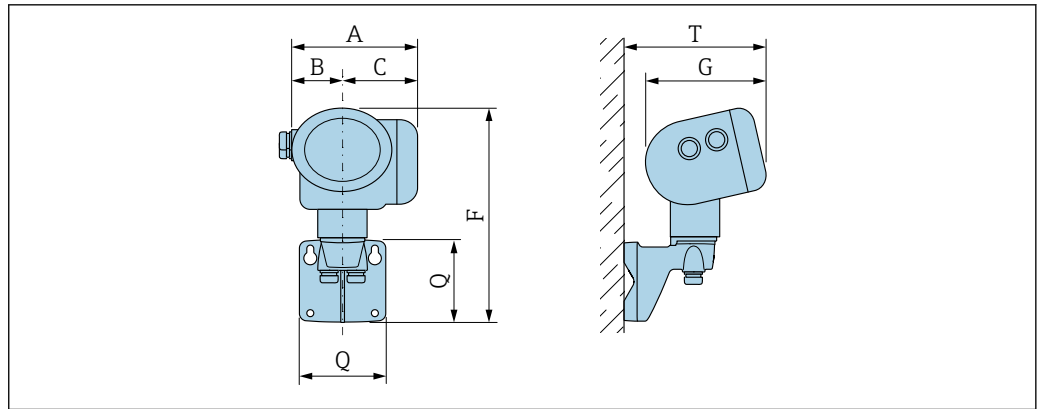


Butt-weld version according to ASME: Class 600/900/1500, Schedule 80/160												
Order code for "Process connection", option A6B/A6C												
DN	A <sup>1)</sup>	B	C <sup>1)</sup>	D	EI <sup>2)</sup>	F <sup>2)</sup>	G	H	I <sup>3)</sup>	K (D <sub>i</sub> )	L	M
[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]
150	140.2	51.7	88.5	101.9	362	446.2	159.9	58.2	101.7	131.8	566 <sup>5)</sup>	168.3
Groove type 22 as per DIN 2559												

- 1) For version with overvoltage protection: values + 8 mm
- 2) For version without local display: values - 10 mm
- 3) For version without local display: values - 7 mm
- 4) +1.5 to -2.0 mm
- 5) ±3.5 mm

**Transmitter remote version**

Order code for "Housing", option J "GT20 two-chamber, aluminum, coated, remote"; option K "GT18 two-chamber, 316L, remote"



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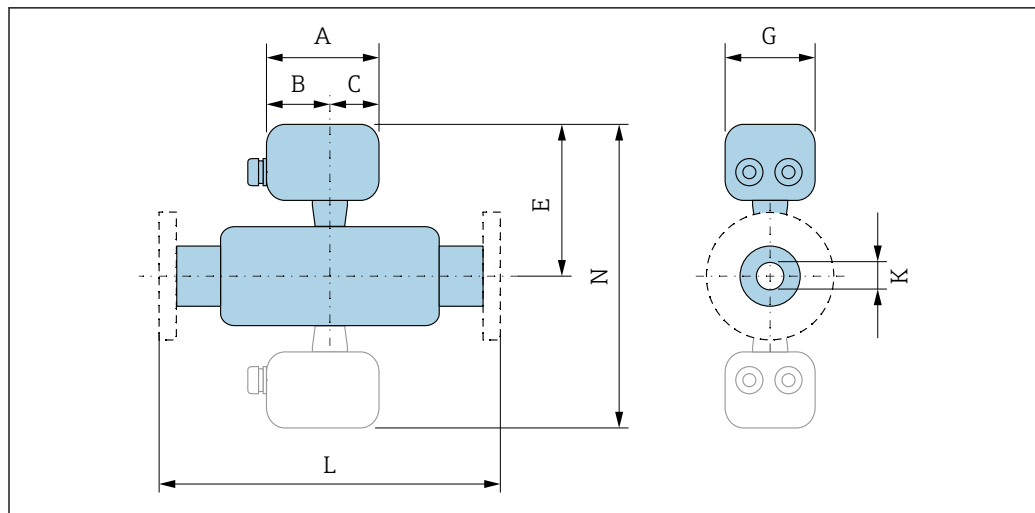
A <sup>1)</sup>	B	C <sup>1)</sup>	F <sup>2)</sup>	G <sup>3)</sup>	Q	T <sup>3)</sup>
[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]
140.2	51.7	88.5	254	159.9	107	191

- 1) For version with overvoltage protection: value + 8 mm
- 2) For version without local display: value - 10 mm
- 3) For version without local display: value - 7 mm

**Sensor remote version**

Order code for "Housing", option J "GT20 dual compartment, aluminum, coated, remote"; option K "GT18 dual compartment, 316L, remote"

## Standard version



20 Grayed out: Dualsens version

Order code for "Process connection", option D5W/D6W/ADS/ADT/AES/AET										
DN	A <sup>1)</sup>	B	C <sup>1)</sup>	E	G	H	I	K (D <sub>i</sub> )	L	N
[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]
15	107.3	60	47.3	267	94.4	58.2	101.7	13.9	<sup>2)</sup>	<sup>3)</sup>
25	107.3	60	47.3	273	94.4	58.2	101.7	24.3	<sup>2)</sup>	<sup>3)</sup>
40	107.3	60	47.3	279	94.4	58.2	101.7	34.0	<sup>2)</sup>	558
50	107.3	60	47.3	283	94.4	58.2	101.7	42.9	<sup>2)</sup>	566
80	107.3	60	47.3	296	94.4	58.2	101.7	66.7	<sup>2)</sup>	591
100	107.3	60	47.3	307	94.4	58.2	101.7	87.3	<sup>2)</sup>	613
150	107.3	60	47.3	335	94.4	58.2	101.7	131.8	<sup>2)</sup>	670
200 <sup>4)</sup>	107.3	60	47.3	356	94.4	58.2	101.7	182.6	<sup>2)</sup>	711
250 <sup>4)</sup>	107.3	60	47.3	386	94.4	58.2	101.7	230.1	<sup>2)</sup>	771
300 <sup>4)</sup>	107.3	60	47.3	413	94.4	58.2	101.7	273.0	<sup>2)</sup>	825

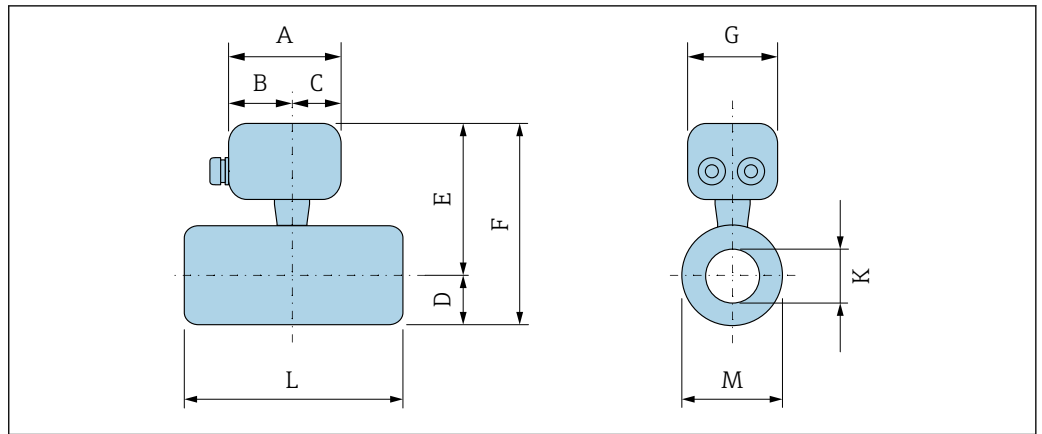
1) For version with overvoltage protection: values + 8 mm

2) Dependent on respective flange connection

3) Not available as a Dualsens version

4) Available only for PN160/Class 900

Butt-weld version



A0034667

Butt-weld version according to EN (DIN): PN 250												
Order code for "Process connection", option D6B												
DN	A <sup>1)</sup>	B	C <sup>1)</sup>	D	E	F	G	H	I	K (D <sub>i</sub> )	L	M
[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]
15	107.3	60	47.3	33.3	267	348.5	94.4	58.2	101.7	16.1	248 <sup>2)</sup>	21.3
25	107.3	60	47.3	32.3	273	347.5	94.4	58.2	101.7	26.5	248 <sup>2)</sup>	33.4
40	107.3	60	47.3	32.2	279	351.5	94.4	58.2	101.7	38.3	278 <sup>3)</sup>	48.3
50	107.3	60	47.3	32.2	283	342.5	94.4	58.2	101.7	47.7	288 <sup>3)</sup>	60.0
80	107.3	60	47.3	64.3	296	380.5	94.4	58.2	101.7	79.6	325 <sup>3)</sup>	102.0
100	107.3	60	47.3	77.1	307	405.5	94.4	58.2	101.7	98.6	394 <sup>3)</sup>	127.0
150	107.3	60	47.3	101.9	335	446.2	94.4	58.2	101.7	142.8	566 <sup>3)</sup>	178.0
Groove type 22 as per DIN 2559												

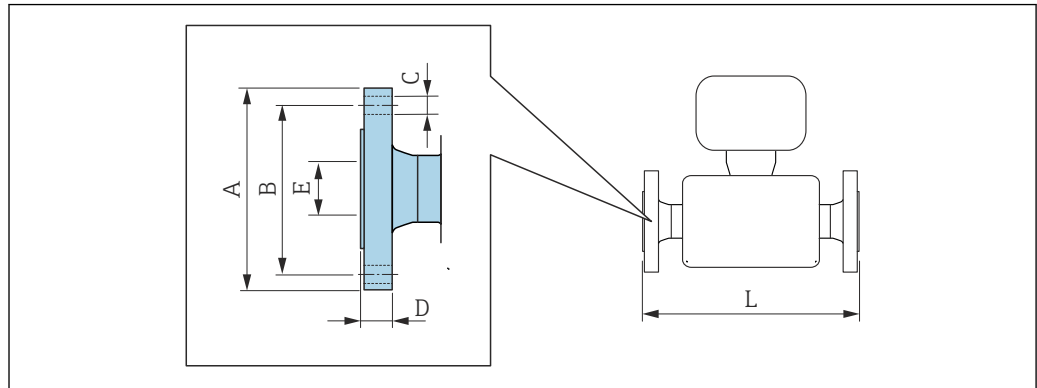
- 1) For version with overvoltage protection: values + 8 mm
- 2) +1.5 to -2.0 mm
- 3) ±3.5 mm

Butt-weld version according to ASME: Class 600/900/1500, Schedule 80/160												
Order code for "Process connection", option A6B/A6C												
DN	A <sup>1)</sup>	B	C <sup>1)</sup>	D	E	F	G	H	I	K (D <sub>i</sub> )	L	M
[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]
15	107.3	60	47.3	33.3	294	348.5	94.4	58.2	101.7	13.9	248 <sup>2)</sup>	21.3
25	107.3	60	47.3	32.3	300	347.5	94.4	58.2	101.7	24.3	248 <sup>2)</sup>	33.4
40	107.3	60	47.3	32.2	306	351.5	94.4	58.2	101.7	34.1	278 <sup>3)</sup>	48.3
50	107.3	60	47.3	32.2	310	342.5	94.4	58.2	101.7	42.9	288 <sup>3)</sup>	60.3
80	107.3	60	47.3	64.3	323	380.5	94.4	58.2	101.7	66.7	325 <sup>3)</sup>	88.9
100	107.3	60	47.3	77.1	334	405.5	94.4	58.2	101.7	87.3	394 <sup>3)</sup>	114.3
150	107.3	60	47.3	101.9	362	446.2	94.4	58.2	101.7	131.8	566 <sup>3)</sup>	168.3
Groove type 22 as per DIN 2559												

- 1) For version with overvoltage protection: values + 8 mm
- 2) +1.5 to -2.0 mm
- 3) ±3.5 mm

## Flange connections

## Flange



A0015621

- i** Length tolerance for dimension L in mm:  
 DN ≤ 25: +1.5 to -2.0 mm  
 DN ≥ 40: ±3.5 mm

**Flange connection dimensions according to DIN EN 1092-1: PN 160**  
 Triple-certified material, 1.4404/F316/F316L  
 Order code for "Process connection", option D5W

DN [mm]	A [mm]	B [mm]	C [mm]	D [mm]	E [mm]	L [mm]
15 <sup>1)</sup>	105	75	4 × Ø 14	20	17.3	205
25 <sup>1)</sup>	140	100	4 × Ø 18	24	27.9	250
40	170	125	4 × Ø 22	28	41.1	252
50	195	145	4 × Ø 26	30	52.3	273
80	230	180	8 × Ø 26	36	76.3	295
100	265	210	8 × Ø 30	40	98.3	337
150	355	290	12 × Ø 33	50	146.3	403
200	430	360	12 × Ø 36	60	182.6	492
250	515	430	12 × Ø 42	68	230.1	528
300	585	500	16 × Ø 42	78	273	587

Raised face according to DIN EN 1092-1 Form B1: Ra 3.2 to 12.5 µm

- 1) Not available as a Dualsens version

**Flange connection dimensions according to DIN EN 1092-1: PN 250**  
 Triple-certified material, 1.4404/F316/F316L  
 Order code for "Process connection", option D6W

DN [mm]	A [mm]	B [mm]	C [mm]	D [mm]	E [mm]	L [mm]
15	130	90	4 × Ø 18	26	16.1	235
25	150	105	4 × Ø 22	28	26.5	264
40	185	135	4 × Ø 26	34	38.1	284
50	200	150	8 × Ø 26	38	47.7	293
80	255	200	8 × Ø 30	46	79.6	327
100	300	235	8 × Ø 33	54	98.6	377

Flange connection dimensions according to DIN EN 1092-1: PN 250 Triple-certified material, 1.4404/F316/F316L Order code for "Process connection", option D6W						
DN [mm]	A [mm]	B [mm]	C [mm]	D [mm]	E [mm]	L [mm]
150	390	320	12 × Ø36	68	142.8	467

Raised face according to DIN EN 1092-1 Form B1: Ra 3.2 to 12.5 µm

Flange connection dimensions according to ASME B16.5: Class 900, Schedule 80/160 Triple-certified material, 1.4404/F316/F316L Order code for "Process connection", option ADS/ADT <sup>1)</sup>						
DN [mm]	A [mm]	B [mm]	C [mm]	D [mm]	E [mm]	L [mm]
15	120	82.6	4 × Ø 22.2	29.3	13.9	249
25	150	101.6	4 × Ø 25.4	35.6	24.3	294
40	180	123.8	4 × Ø 28.6	38.8	34.1	304
50	215	165.1	8 × Ø25.4	45.1	42.9	341
80	241.3	190.5	8 × Ø25.4	38.1	73.7	341
100	292.1	234.9	8 × Ø31.7	44.4	97.3	379
150	381.0	317.5	12 × Ø31.7	55.6	131.8	441
200	470	393.7	12 × Ø31.8	70.5	182.6	548
250	545	496.9	16 × Ø31.8	76.9	230.1	598
300	610	533.4	20 × Ø31.8	86.4	273	647

Raised face according to ASME 16.5: Ra 3.2 to 6.3 µm

1) Option ADT: DN 40 to 150

Flange connection dimensions according to ASME B16.5: Class 900, Schedule 120 Triple-certified material, 1.4404/F316/F316L Order code for "Process connection", option ADR						
DN [mm]	A [mm]	B [mm]	C [mm]	D [mm]	E [mm]	L [mm]
200	470	393.7	12 × Ø31.8	70.5	182.6	548
250	545	496.9	16 × Ø31.8	76.9	230.1	598
300	610	533.4	20 × Ø31.8	86.4	273	647

Raised face according to ASME 16.5: Ra 3.2 to 6.3 µm

Flange connection dimensions according to ASME B16.5: Class 1500, Schedule 80 Triple-certified material, 1.4404/F316/F316L Order code for "Process connection", option AES						
DN [mm]	A [mm]	B [mm]	C [mm]	D [mm]	E [mm]	L [mm]
15	120.6	82.5	4 × Ø 22.3	22.3	14.0	249
25	149.3	101.6	4 × Ø 25.4	28.4	24.3	294
40	177.8	123.9	4 × Ø 28.4	31.7	38.1	304
50	215.9	165.1	8 × Ø25.4	38.1	49.3	341
80	266.7	203.2	8 × Ø31.7	47.7	73.7	371
100	311.1	241.3	8 × Ø35.0	53.8	97.3	399

Flange connection dimensions according to ASME B16.5: Class 1500, Schedule 80  
 Triple-certified material, 1.4404/F316/F316L  
 Order code for "Process connection", option AES

DN [mm]	A [mm]	B [mm]	C [mm]	D [mm]	E [mm]	L [mm]
150	393.7	317.5	12 × Ø38.1	82.5	146.3	503

Raised face according to ASME 16.5: Ra 3.2 to 6.3 µm

Flange connection dimensions according to ASME B16.5: Class 1500, Schedule 160  
 Triple-certified material, 1.4404/F316/F316L  
 Order code for "Process connection", option AET

DN [mm]	A [mm]	B [mm]	C [mm]	D [mm]	E [mm]	L [mm]
40	180	123.8	4 × Ø28.4	31.7	38.1	304
50	215	165.1	8 × Ø25.4	38.1	49.3	341
80	265	203.2	8 × Ø31.7	47.7	73.7	371
100	310	241.3	8 × Ø35.0	53.8	97.3	399
150	395	317.5	12 × Ø38.1	82.5	146.3	503

Raised face according to ASME 16.5: Ra 3.2 to 6.3 µm

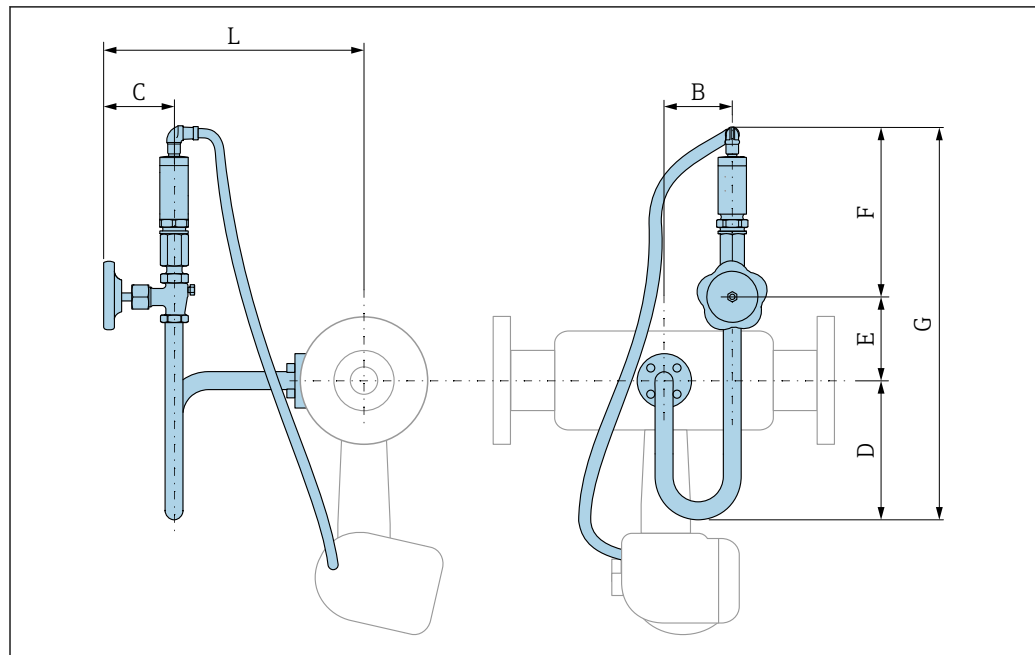
## Accessories

### Pressure measuring cell

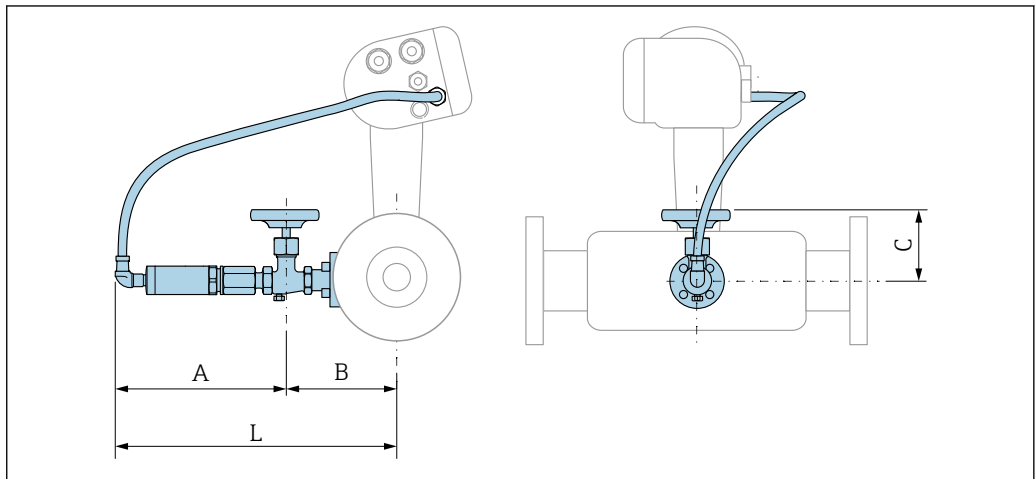


For order code for "Sensor version; DSC sensor; measuring tube", option DA "Mass steam" and DB "Mass gas/liquid", the following applies:

- Only available for measuring devices with the HART communication protocol
- Oil-free or grease-free cleaning is not possible





Order code for "Sensor version; DSC sensor; measuring tube": Option DC "Mass steam; Alloy 718; 316L (integrated pressure/temperature measurement)"							
DN [mm]	B [mm]	C [mm]	D [mm]	E [mm]	F [mm]	G [mm]	L [mm]
25	76	78.8	155	60.8	190.5	407	321
40	76	78.8	155	60.8	190.5	407	319
50	76	78.8	155	60.8	190.5	407	327
80	76	78.8	155	60.8	190.5	407	333
100	76	78.8	155	60.8	190.5	407	344
150	76	78.8	155	60.8	190.5	407	371
200	76	78.8	155	60.8	190.5	407	396
250	76	78.8	155	60.8	190.5	407	423
300	76	78.8	155	60.8	190.5	407	449



A0034024

Order code for "Sensor version; DSC sensor; measuring tube": Option DD "Mass gas/liquid; Alloy 718; 316L (integrated pressure/temperature measurement)"				
DN [mm]	A [mm]	B [mm]	C [mm]	L [mm]
25	191	147	79	338
40	191	145	79	336
50	191	153	79	344
80	191	159	79	350
100	191	170	79	361
150	191	198	79	388
200	191	223	79	413
250	191	250	79	440
300	191	276	79	466

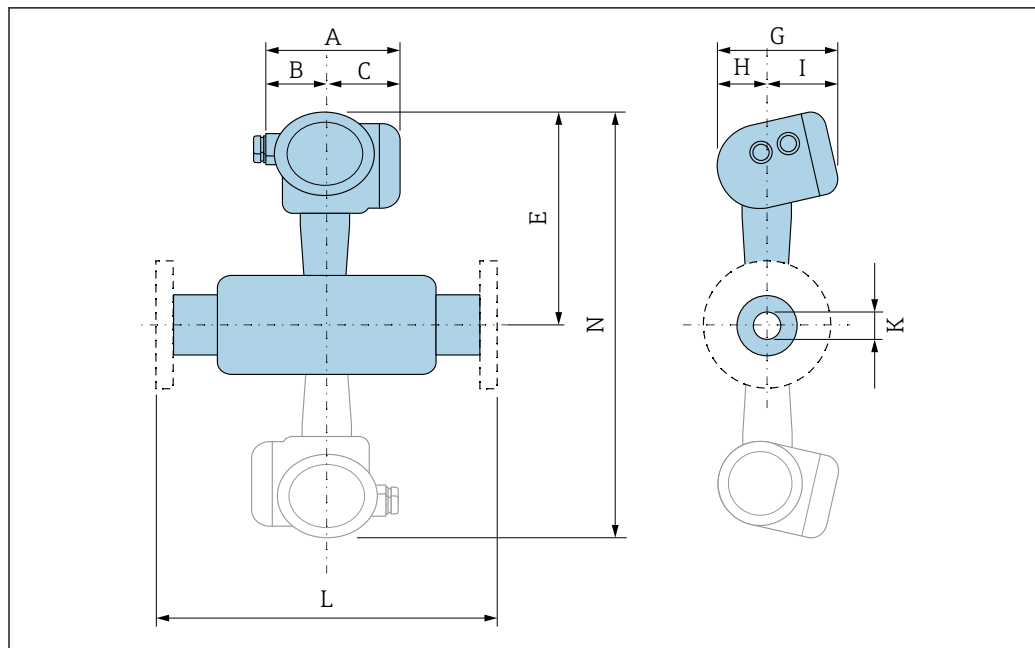
**Dimensions in US units**

 Pay attention to the information on diameter mismatch correction →  41.

**Compact version**

Order code for "Housing", option B "GT18 dual compartment, 316L, compact"; option C "GT20 dual compartment, aluminum, coated, compact"

## Standard version



A0033794

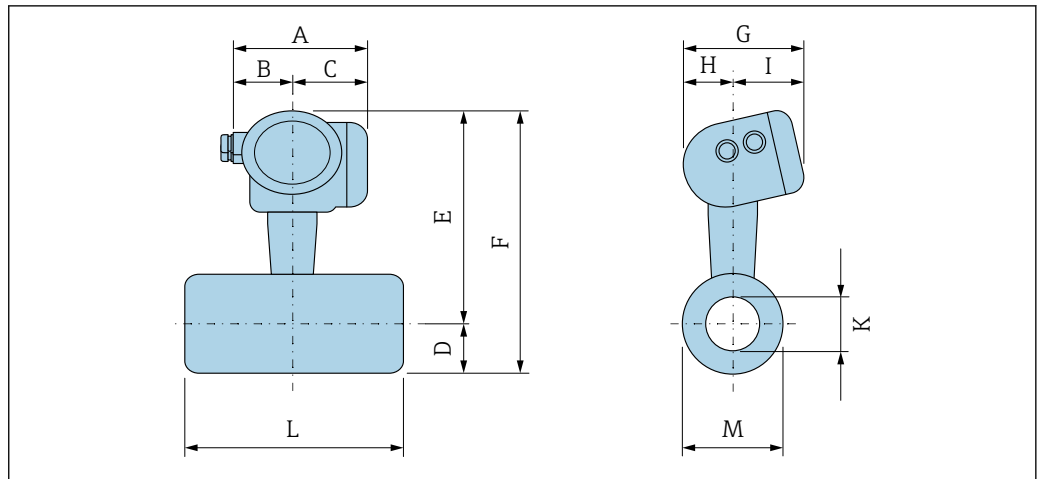
21 Grayed out: Dualsens version

Order code for "Process connection", option D5W/D6W/ADS/ADT/AES/AET										
DN	A <sup>1)</sup>	B	C <sup>1)</sup>	E <sup>2)</sup>	G	H	I <sup>3)</sup>	K (D <sub>f</sub> )	L	N
[in]	[in]	[in]	[in]	[in]	[in]	[in]	[in]	[in]	[in]	[in]
½	5.52	2.04	3.48	11.6	6.3	2.29	4	0.55	<sup>4)</sup>	<sup>5)</sup>
1	5.52	2.04	3.48	11.8	6.3	2.29	4	0.96	<sup>4)</sup>	<sup>5)</sup>
1½	5.52	2.04	3.48	12	6.3	2.29	4	1.34	<sup>4)</sup>	24.1
2	5.52	2.04	3.48	12.2	6.3	2.29	4	1.69	<sup>4)</sup>	24.4
3	5.52	2.04	3.48	12.7	6.3	2.29	4	2.63	<sup>4)</sup>	25.4
4	5.52	2.04	3.48	13.1	6.3	2.29	4	3.44	<sup>4)</sup>	26.3
6	5.52	2.04	3.48	14.3	6.3	2.29	4	5.19	<sup>4)</sup>	28.5
8	5.52	2.04	3.48	15.1	6.3	2.29	4	7.19	<sup>4)</sup>	30.1
10	5.52	2.04	3.48	16.3	6.3	2.29	4	9.06	<sup>4)</sup>	32.5
12	5.52	2.04	3.48	17.3	6.3	2.29	4	10.7	<sup>4)</sup>	34.6

- 1) For version with overvoltage protection: values + 0.31 in
- 2) For version without local display: values - 0.39 in
- 3) For version without local display: values - 0.28 in
- 4) Dependent on respective flange connection
- 5) Not available as a Dualsens version



Butt-weld version



A0034573

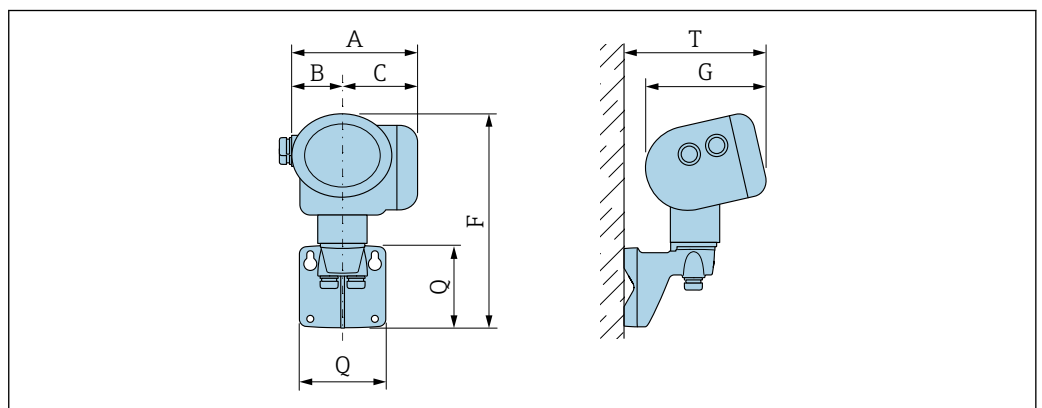
Butt-weld version according to ASME: Class 600/900/1500, Schedule 80/160												
Order code for "Process connection", option A6B/A6C												
DN	A <sup>1)</sup>	B	C <sup>1)</sup>	D	E <sup>2)</sup>	F <sup>2)</sup>	G	H	I <sup>3)</sup>	K (D <sub>i</sub> )	L	M
[in]	[in]	[in]	[in]	[in]	[in]	[in]	[in]	[in]	[in]	[in]	[in]	[in]
½	5.52	2.04	3.48	1.31	11.6	13.7	6.3	2.29	4	0.55	9.76 <sup>4)</sup>	0.84
1	5.52	2.04	3.48	1.27	11.8	13.7	6.3	2.29	4	0.96	9.76 <sup>4)</sup>	1.31
1½	5.52	2.04	3.48	1.27	12	13.8	6.3	2.29	4	1.34	10.9 <sup>5)</sup>	1.9
2	5.52	2.04	3.48	1.27	12.2	13.5	6.3	2.29	4	1.69	11.3 <sup>5)</sup>	2.37
3	5.52	2.04	3.48	2.53	12.7	15	6.3	2.29	4	2.63	12.8 <sup>5)</sup>	3.5
4	5.52	2.04	3.48	3.04	13.1	16	6.3	2.29	4	3.44	15.5 <sup>5)</sup>	4.5
6	5.52	2.04	3.48	4.01	14.3	17.6	6.3	2.29	4	5.19	22.3 <sup>5)</sup>	6.63

Groove type 22 as per DIN 2559

- 1) For version with overvoltage protection: values + 0.31 in
- 2) For version without local display: values - 0.39 in
- 3) For version without local display: values - 0.28 in
- 4) +0.06 to -0.08 in
- 5) ±0.14 in

Transmitter remote version

Order code for "Housing", option J "GT20 two-chamber, aluminum, coated, remote"; option K "GT18 two-chamber, 316L, remote"



A0033796

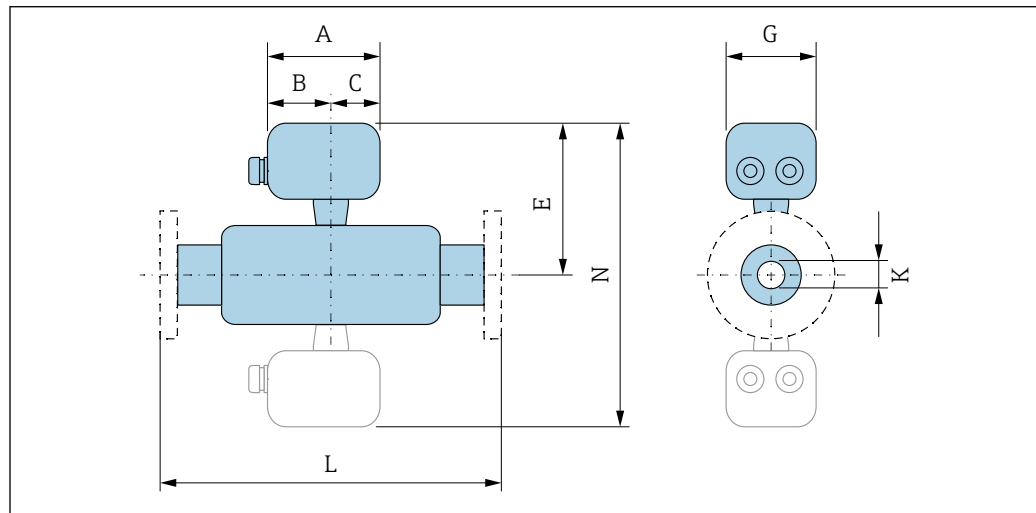
A <sup>1)</sup> [in]	B [in]	C <sup>1)</sup> [in]	F <sup>2)</sup> [in]	G <sup>3)</sup> [in]	Q [in]	T <sup>3)</sup> [in]
5.52	2.04	3.48	10	6.3	4.21	7.52

- 1) For version with overvoltage protection: value + 0.31 in
- 2) For version without local display: value - 0.39 in
- 3) For version without local display: value - 0.28 in

**Sensor remote version**

Order code for "Housing", option J "GT20 dual compartment, aluminum, coated, remote"; option K "GT18 dual compartment, 316L, remote"

*Standard version*



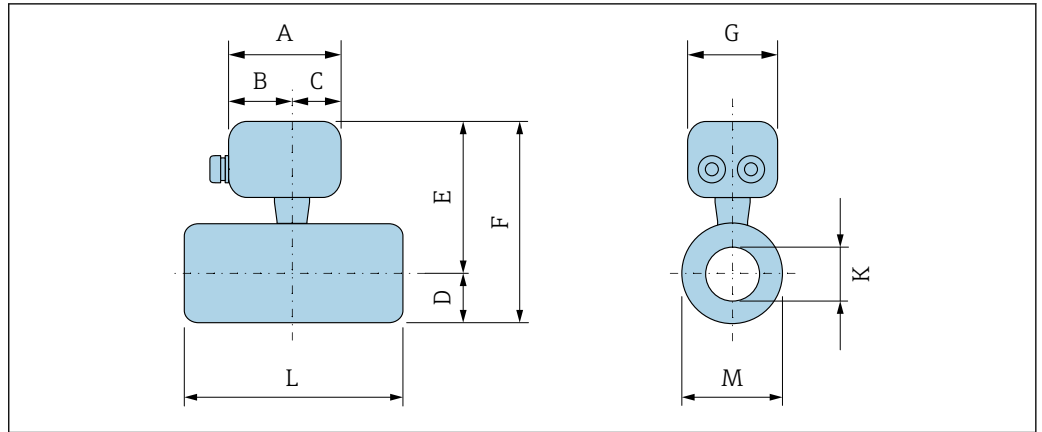
A0033797

22 Grayed out: Dualsens version

Order code for "Process connection", option ADS/AES/ADT/AET										
DN [in]	A <sup>1)</sup> [in]	B [in]	C [in]	E [in]	G [in]	H [in]	I [in]	K (D <sub>i</sub> ) [in]	L [in]	N [in]
½	4.22	2.36	1.86	10.5	3.72	2.29	4	0.55	<sup>2)</sup>	<sup>3)</sup>
1	4.22	2.36	1.86	10.7	3.72	2.29	4	0.96	<sup>2)</sup>	<sup>3)</sup>
1½	4.22	2.36	1.86	11.0	3.72	2.29	4	1.34	<sup>2)</sup>	22.0
2	4.22	2.36	1.86	11.1	3.72	2.29	4	1.69	<sup>2)</sup>	22.3
3	4.22	2.36	1.86	11.7	3.72	2.29	4	2.63	<sup>2)</sup>	23.3
4	4.22	2.36	1.86	12.1	3.72	2.29	4	3.44	<sup>2)</sup>	24.1
6	4.22	2.36	1.86	13.2	3.72	2.29	4	5.19	<sup>2)</sup>	26.4
8	4.22	2.36	1.86	14.0	3.72	2.29	4	7.19	<sup>2)</sup>	28.0
10	4.22	2.36	1.86	15.2	3.72	2.29	4	9.06	<sup>2)</sup>	30.4
12	4.22	2.36	1.86	16.3	3.72	2.29	4	10.7	<sup>2)</sup>	32.5

- 1) For version with overvoltage protection: values + 0.31 in
- 2) Dependent on respective flange connection
- 3) Not available as a Dualsens version

Butt-weld version



A0034667

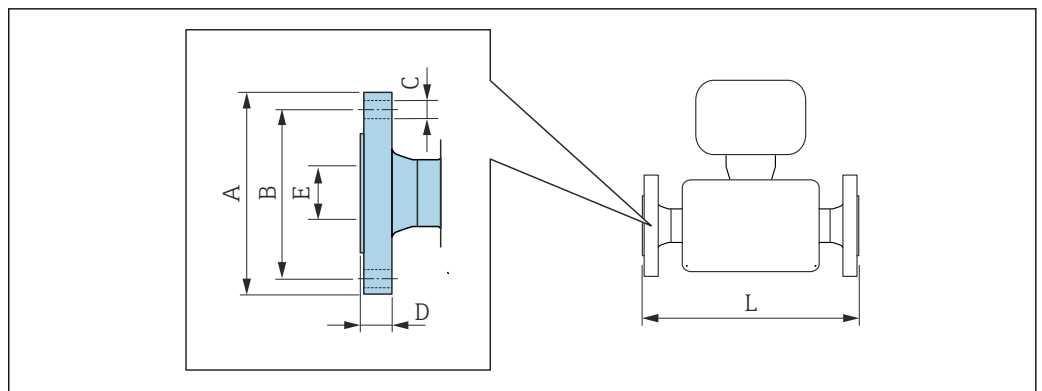
Butt-weld version according to ASME: Class 600/900/1500, Schedule 80/160 Order code for "Process connection", option A6B/A6C												
DN [in]	A [in]	B [in]	C [in]	D [in]	E [in]	F [in]	G [in]	H [in]	I [in]	K (D <sub>i</sub> ) [in]	L [in]	M [in]
½	4.22	2.36	1.86	1.31	11.6	13.7	3.72	2.29	4	0.55	9.76 <sup>1)</sup>	0.84
1	4.22	2.36	1.86	1.27	11.8	13.7	3.72	2.29	4	0.96	9.76 <sup>1)</sup>	1.31
1½	4.22	2.36	1.86	1.27	12.0	13.8	3.72	2.29	4	1.34	10.9 <sup>2)</sup>	1.90
2	4.22	2.36	1.86	1.27	12.2	13.5	3.72	2.29	4	1.69	11.3 <sup>2)</sup>	2.37
3	4.22	2.36	1.86	2.53	12.7	15.0	3.72	2.29	4	2.63	12.8 <sup>2)</sup>	3.50
4	4.22	2.36	1.86	3.04	13.1	16.0	3.72	2.29	4	3.44	15.5 <sup>2)</sup>	4.50
6	4.22	2.36	1.86	4.01	14.3	17.6	3.72	2.29	4	5.19	22.3 <sup>2)</sup>	6.63

Groove type 22 as per DIN 2559

- 1) +0.06 to -0.08 in
- 2) ±0.14 in

Flange connections

Flange



A0015621

- i** Length tolerance for dimension L in inch:  
 DN ≤ 1": +0.06 to -0.08 in  
 DN ≥ 1½": ±0.14 in

Flange connection dimensions according to ASME B16.5: Class 900, Schedule 80/160 Triple-certified material, 1.4404/F316/F316L Order code for "Process connection", option ADS/ADT <sup>1)</sup>						
DN [in]	A [in]	B [in]	C [in]	D [in]	E [in]	L [in]
½	4.72	3.25	4 × Ø 0.87	1.15	0.55	9.80
1	5.91	4.00	4 × Ø 1.00	1.40	0.96	11.6
1½	7.09	4.87	4 × Ø 1.13	1.53	1.34	12.0
2	8.46	6.50	8 × Ø1.00	1.78	1.69	13.4
3	9.50	7.50	8 × Ø1.00	1.50	2.90	13.4
4	11.5	9.25	8 × Ø1.25	1.75	3.83	14.9
6	15	12.5	12 × Ø1.25	2.19	5.19	17.4
8	18.5	15.5	12 × Ø1.25	2.78	7.19	21.6
10	21.5	19.6	16 × Ø1.25	3.03	9.06	23.5
12	24	21	20 × Ø1.25	3.40	10.7	25.5
Raised face according to ASME 16.5: Ra 125 to 250µin						

1) Option ADT: DN 1½ to 6

Flange connection dimensions according to ASME B16.5: Class 900, Schedule 120 Triple-certified material, 1.4404/F316/F316L Order code for "Process connection", option ADR						
DN [in]	A [in]	B [in]	C [in]	D [in]	E [in]	L [in]
8	18.5	15.5	12 × Ø1.25	2.78	7.19	21.6
10	21.5	19.6	16 × Ø1.25	3.03	9.06	23.5
12	24	21	20 × Ø1.25	3.40	10.7	25.5
Raised face according to ASME 16.5: Ra 125 to 250µin						

Flange connection dimensions according to ASME B16.5: Class 1500, Schedule 80 Triple-certified material, 1.4404/F316/F316L Order code for "Process connection", option AES						
DN [in]	A [in]	B [in]	C [in]	D [in]	E [in]	L [in]
½	4.75	3.25	4 × Ø 0.88	0.88	0.55	9.80
1	5.88	4.00	4 × Ø 1.00	1.12	0.96	11.6
1½	7.00	4.88	4 × Ø 1.12	1.25	1.50	12.0
2	8.50	6.50	8 × Ø1.00	1.50	1.94	13.4
3	10.5	8.00	8 × Ø1.25	1.88	2.90	14.6
4	12.2	9.50	8 × Ø1.38	2.12	3.83	15.7
6	15.5	12.5	12 × Ø1.50	3.25	5.76	19.8
Raised face according to ASME 16.5: Ra 125 to 250µin						

Flange connection dimensions according to ASME B16.5: Class 1500, Schedule 160 Triple-certified material, 1.4404/F316/F316L Order code for "Process connection", option AET						
DN [in]	A [in]	B [in]	C [in]	D [in]	E [in]	L [in]
1½	7.09	4.87	4 × Ø 1.12	1.25	1.50	12.0
2	8.46	6.50	8 × Ø 1.00	1.50	1.94	13.4
3	10.4	8.00	8 × Ø 1.25	1.88	2.90	14.6
4	12.2	9.50	8 × Ø 1.38	2.12	3.83	15.7
6	15.6	12.5	12 × Ø 1.50	3.25	5.76	19.8

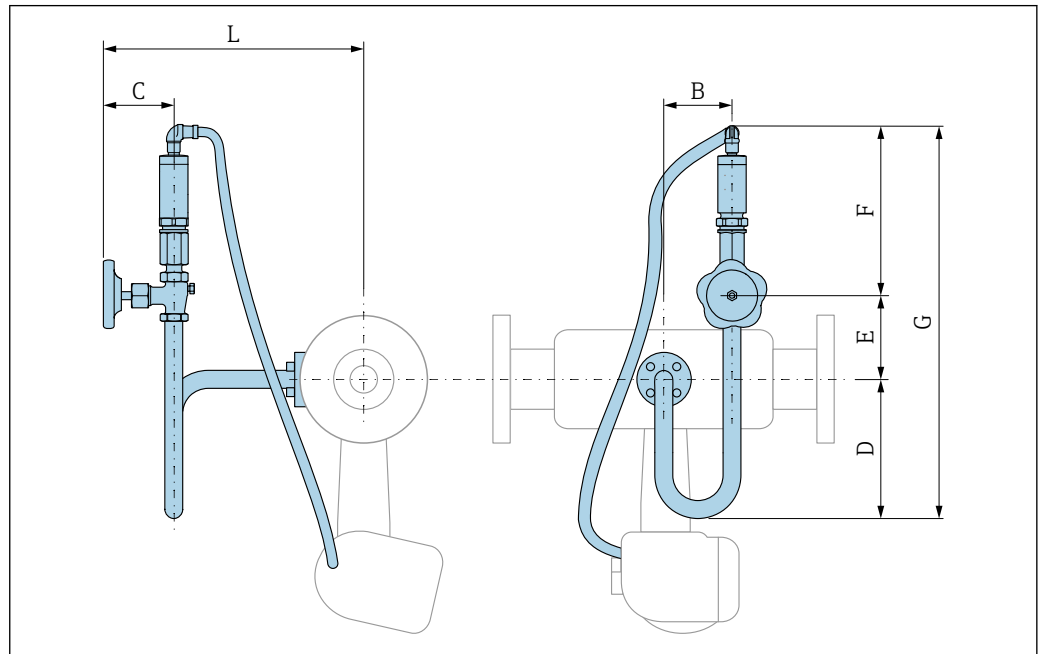
Raised face according to ASME 16.5: Ra 125 to 250µin

**Accessories**

*Pressure measuring cell*

**i** For order code for "Sensor version; DSC sensor; measuring tube", option DA "Mass steam" and DB "Mass gas/liquid", the following applies:

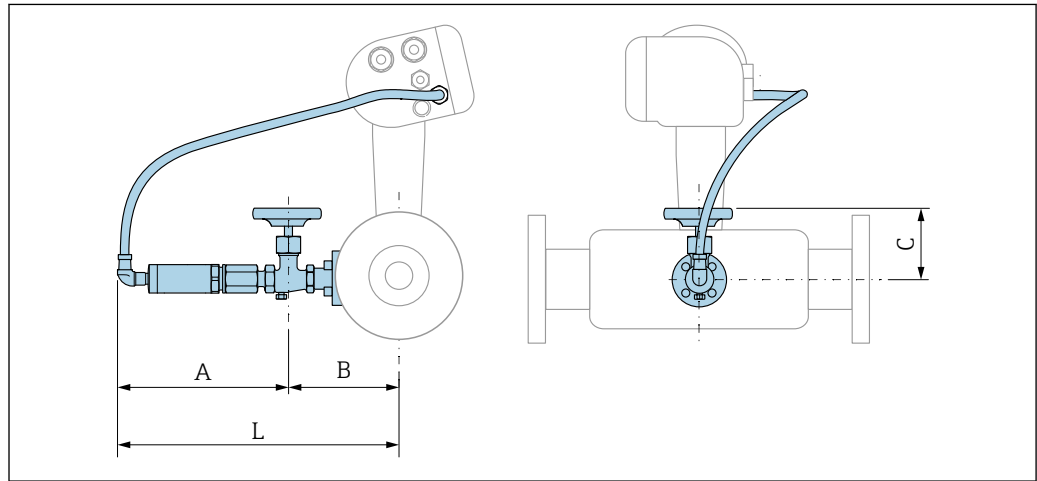
- Only available for measuring devices with the HART communication protocol
- Oil-free or grease-free cleaning is not possible



A0033851

Order code for "Sensor version; DSC sensor; measuring tube": Option DC "Mass steam; Alloy 718; 316L (integrated pressure/temperature measurement)"							
DN [in]	B [in]	C [in]	D [in]	E [in]	F [in]	G [in]	L [in]
1	2.99	3.1	6.1	2.39	7.5	16.02	12.64
1½	2.99	3.1	6.1	2.39	7.5	16.02	12.56
2	2.99	3.1	6.1	2.39	7.5	16.02	12.87
3	2.99	3.1	6.1	2.39	7.5	16.02	13.11
4	2.99	3.1	6.1	2.39	7.5	16.02	13.54
6	2.99	3.1	6.1	2.39	7.5	16.02	14.61
8	2.99	3.1	6.1	2.39	7.5	16.02	15.59

Order code for "Sensor version; DSC sensor; measuring tube": Option DC "Mass steam; Alloy 718; 316L (integrated pressure/temperature measurement)"							
DN [in]	B [in]	C [in]	D [in]	E [in]	F [in]	G [in]	L [in]
10	2.99	3.1	6.1	2.39	7.5	16.02	16.65
12	2.99	3.1	6.1	2.39	7.5	16.02	17.68



Order code for "Sensor version; DSC sensor; measuring tube": Option DD "Mass gas/liquid; Alloy 718; 316L (integrated pressure/temperature measurement)"				
DN [in]	A [in]	B [in]	C [in]	L [in]
1	7.52	5.79	3.11	13.31
1½	7.52	5.71	3.11	13.23
2	7.52	6.02	3.11	13.54
3	7.52	6.26	3.11	13.78
4	7.52	6.69	3.11	14.21
6	7.52	7.8	3.11	15.28
8	7.52	8.78	3.11	16.26
10	7.52	9.84	3.11	17.32
12	7.52	10.87	3.11	18.35

**Weight**

**Compact version**

Weight data:

- Including the transmitter:
  - Order code for "Housing", option C "GT20, two-chamber, aluminum, coated, compact" 1.8 kg (4.0 lb):
  - Order code for "Housing", option B "GT18 two-chamber, 316L, compact" 4.5 kg (9.9 lb):
- Excluding packaging material

*Weight in SI units*

All values (weight) refer to devices with EN (DIN), PN 250 flanges. Weight information in [kg].

DN [mm]	Weight [kg]	
	Order code for "Housing", option C "GT20 two-chamber, aluminum, coated, compact"	Order code for "Housing", option B "GT18 two-chamber, 316L, compact"
15	15.1	17.8
25	16.1	18.8
40	21.1	23.8
50	23.1	2..8
80	41.1	43.8
100	64.1	66.8
150	152.1	154.8

*Weight in US units*

All values (weight) refer to devices with ASME B16.5, Class 1500/Sch. 80 flanges. Weight information in [lbs].

DN [in]	Weight [lbs]	
	Order code for "Housing", option C "GT20 two-chamber, aluminum, coated, compact"	Order code for "Housing", option B "GT18 two-chamber, 316L, compact"
½	29.0	34.9
1	37.8	43.7
1½	44.4	50.3
2	66.5	72.4
3	108.3	114.3
4	156.8	162.8
6	381.7	387.7

**Transmitter remote version**

*Wall-mount housing*

Dependent on the material of wall-mount housing:

- Order code for "Housing" option J "GT20 two-chamber, aluminum, coated, remote" 2.4 kg (5.2 lb):
- Order code for "Housing", option K "GT18 two-chamber, 316L, remote" 6.0 kg (13.2 lb):

**Sensor remote version**

Weight data:

- Including sensor connection housing:
  - Order code for "Housing" option J "GT20 two-chamber, aluminum, coated, remote" 0.8 kg (1.8 lb):
  - Order code for "Housing", option K "GT18 two-chamber, 316L, remote" 2.0 kg (4.4 lb):
- Excluding the connecting cable
- Excluding packaging material

*Weight in SI units*

All values (weight) refer to devices with EN (DIN), PN 250 flanges. Weight information in [kg].

DN [mm]	Weight [kg]	
	sensor connection housing Order code for "Housing", option J "GT20 two-chamber, aluminum, coated, remote"	sensor connection housing Order code for "Housing", option K "GT18 two-chamber, 316L, remote"
15	14.1	15.3
25	15.1	16.3

DN [mm]	Weight [kg]	
	sensor connection housing Order code for "Housing", option J "GT20 two-chamber, aluminum, coated, remote"	sensor connection housing Order code for "Housing", option K "GT18 two-chamber, 316L, remote"
40	20.1	21.3
50	22.1	23.3
80	40.1	41.3
100	63.1	64.3
150	151.1	152.3

*Weight in US units*

All values (weight) refer to devices with ASME B16.5, Class 1500/Sch. 80 flanges. Weight information in [lbs].

DN [in]	Weight [lbs]	
	sensor connection housing Order code for "Housing", option J "GT20 two-chamber, aluminum, coated, remote"	sensor connection housing Order code for "Housing", option K "GT18 two-chamber, 316L, remote"
½	26.6	29.4
1	35.4	38.2
1½	42.0	44.8
2	64.1	66.8
3	105.9	108.7
4	154.5	157.2
6	379.3	382.1

**Accessories***Flow conditioner**Weight in SI units*

DN <sup>1)</sup> [mm]	Pressure rating	Weight [kg]
15	PN 63	0.05
25	PN 63	0.2
40	PN 63	0.4
50	PN 63	0.6
80	PN 63	1.4
100	PN 63	2.4
150	PN 63	7.8

1) EN (DIN)

DN <sup>1)</sup> [mm]	Pressure rating	Weight [kg]
15	40K	0.06
25	40K	0.1
40	40K	0.3



DN <sup>1)</sup> [mm]	Pressure rating	Weight [kg]
50	40K	0.5
80	40K	1.3
100	40K	2.1
150	40K	6.2

1) JIS

## Materials

### Transmitter housing

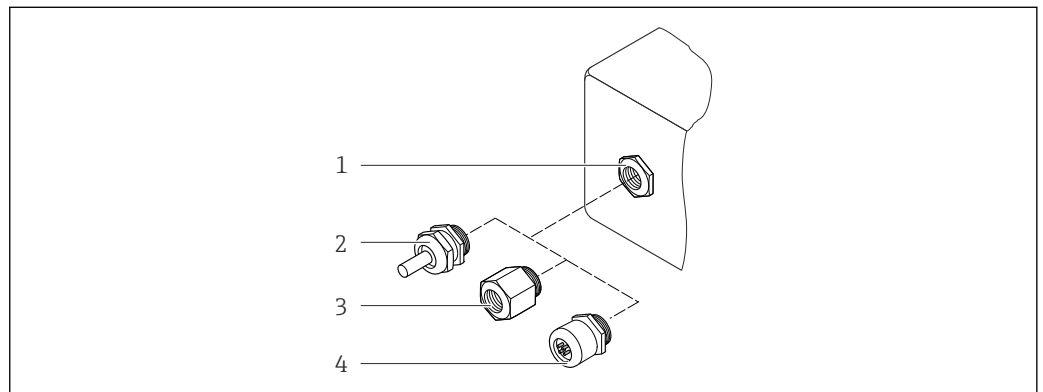
#### Compact version

- Order code for "Housing", option B "GT18 two-chamber, 316L, compact":  
Stainless steel, CF3M
- Order code for "Housing", option C "GT20, two-chamber, aluminum, coated, compact":  
Aluminum, AlSi10Mg, coated
- Window material: glass

#### Remote version

- Order code for "Housing" option J "GT20 two-chamber, aluminum, coated, remote":  
Aluminum, AlSi10Mg, coated
- Order code for "Housing", option K "GT18 two-chamber, 316L, remote":  
For maximum corrosion resistance: Stainless steel, CF3M
- Window material: glass

### Cable entries/cable glands



A0028352


23 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"
- 4 Device plugs

Order code for "Housing", option B "GT18 dual compartment, 316L, compact" option K "GT18 dual compartment, 316L, remote"

Cable entry/cable gland	Type of protection	Material
Cable gland M20 × 1.5	<ul style="list-style-type: none"> <li>■ Non-hazardous area</li> <li>■ Ex ia</li> <li>■ Ex ic</li> <li>■ Ex nA, Ex ec</li> <li>■ Ex tb</li> </ul>	Stainless steel ,1.4404
Adapter for cable entry with female thread G ½"	Non-hazardous area and hazardous area (except for XP)	Stainless steel, 1.4404 (316L)
Adapter for cable entry with female thread NPT ½"	Non-hazardous area and hazardous area	

Order code for "Housing": option C "GT20 dual compartment, aluminum, coated, compact", option J "GT20 dual compartment, aluminum, coated remote"


 Applies also to the following device versions in combination with HART communication mode: Order code for "Sensor version; DSC sensor; measuring tube", option DC "Mass steam; Alloy 718; 316L", option DD "Mass gas/liquid; Alloy 718; 316L"

Cable entry/cable gland	Type of protection	Material
Cable gland M20 × 1.5	<ul style="list-style-type: none"> <li>■ Non-hazardous area</li> <li>■ Ex ia</li> <li>■ Ex ic</li> </ul>	Plastic
	Adapter for cable entry with female thread G ½"	Nickel-plated brass
Adapter for cable entry with female thread NPT ½"	Non-hazardous area and hazardous area (except for XP)	Nickel-plated brass
Thread NPT ½" via adapter	Non-hazardous area and hazardous area	

#### Connecting cable for remote version

- Standard cable: PVC cable with copper shield
- Reinforced cable: PVC cable with copper shield and additional steel wire braided jacket

#### Connecting cable, pressure measuring cell

 For order code for "Sensor version; DSC sensor; measuring tube", option DA "Mass steam" and DB "Mass gas/liquid", the following applies:

- Only available for measuring devices with the HART communication protocol
- Oil-free or grease-free cleaning is not possible

Standard cable: PVC cable with copper shield

#### Sensor connection housing

The material of the sensor connection housing is dependent on the material selected for the transmitter housing.

- Order code for "Housing" option J "GT20 two-chamber, aluminum, coated, remote": Coated aluminum AlSi10Mg
- Order code for "Housing", option K "GT18 two-chamber, 316L, remote": Stainless cast steel, 1.4408 (CF3M)  
Compliant with:
  - NACE MR0175
  - NACE MR0103

### Measuring tubes

#### DN 15 to 300 (½ to 12"), pressure ratings PN160/250, Class 900/1500:

Stainless cast steel, CF3M/1.4408

Compliant with:

- NACE MR0175
- NACE MR0103
- DN15 to 150 (½ to 6"): AD2000, permitted temperature range -10 to +400 °C (+14 to +752 °F) restricted)

### DSC sensor

Order code for "Sensor version; DSC sensor; measuring tube", option **BD, CD, DC, DD**

#### Pressure ratings PN 160/250, Class 900/1500:

Parts in contact with medium (marked as "wet" on the DSC sensor flange):

- UNS N07718 similar to Alloy 718/2.4668
- Compliant with:
  - NACE MR01752003
  - NACE MR01032003

Parts not in contact with medium:

Stainless steel 1.4301 (304)

### Pressure measuring cell

 For order code for "Sensor version; DSC sensor; measuring tube", option DA "Mass steam" and DB "Mass gas/liquid", the following applies:

- Only available for measuring devices with the HART communication protocol
- Oil-free or grease-free cleaning is not possible
- Wetted parts:
  - Process connection  
Stainless steel, 1.4404/316L
  - Membrane  
Stainless steel, 1.4435/316L
- Non-wetted parts:
  - Housing  
Stainless steel, 1.4404



Order code for "Sensor version; DSC sensor; measuring tube", option DC, DD

- Siphon<sup>3)</sup>  
Stainless steel, 1.4571
- Adjusting nut  
Stainless steel, 1.4571
- Pressure gauge valve  
Stainless steel, 1.4571
- Welded connection on meter body  
Stainless steel, multiple certifications 1.4404/316/316L
- Seals  
Copper

### Process connections

#### Pressure ratings PN 160/250, Class 900/1500:

Stainless steel, triple-certified material, 1.4404/F316/F316L

 Available process connections →  76

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3) Only with order code for "Sensor version; DSC sensor; measuring tube", option DC available.

**Seals**

- Graphite (standard)  
Sigraflex foil™ (BAM-tested for oxygen applications, "high-grade in the context of TA-Luft Clean Air Guidelines")
- FPM (Viton™)
- Kalrez 6375™
- Gylon 3504™ (BAM-tested for oxygen applications, "high-grade in the context of TA-Luft clean air guidelines")

Order code for "Sensor version; DSC sensor; measuring tube", option DC, DD  
Copper

**Housing support**

Stainless steel, 1.4408 (CF3M)

**Screws for DSC sensor**

- Order code for "Sensor version", option BD, CD, DC, DD  
Stainless steel, A2-80 according to ISO 3506-1 (304)
- On request  
Stainless steel, 1.4980 according to EN 10269 (Gr. 660 B)

**Accessories***Protective cover*

Stainless steel, 1.4404 (316L)

*Flow conditioner*

- Stainless steel, multiple certifications, 1.4404 (316, 316L)
- Compliant with:
  - NACE MR0175-2003
  - NACE MR0103-2003

**Flange connections**

Flange connection dimensions and raised face in accordance with:

- DIN EN 1092-1
- ASME B16.5
- JIS B2220



For information on the different materials used in the flange connections → 75

## Operability

**Operating concept****Operator-oriented menu structure for user-specific tasks**

- Commissioning
- Operation
- Diagnostics
- Expert level

**Quick and safe commissioning**

- Guided menus ("Make-it-run" wizards) for applications
- Menu guidance with brief explanations of the individual parameter functions

**Reliable operation**

- Operation in the following languages:
  - Via local display: English, German, French, Spanish, Italian, Dutch, Portuguese, Polish, Russian, Swedish, Turkish, Chinese, Japanese, Korean, Bahasa (Indonesian), Vietnamese, Czech
  - Via "FieldCare" operating tool: English, German, French, Spanish, Italian, Chinese, Japanese
- Uniform operating philosophy applied to device and operating tools
- If replacing the electronic module, transfer the device configuration via the integrated memory (integrated HistoROM) which contains the process and measuring device data and the event logbook. No need to reconfigure.

**Efficient diagnostics increase measurement availability**

- 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

**Languages**

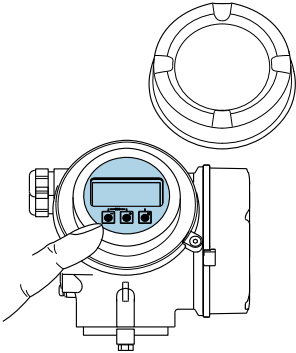
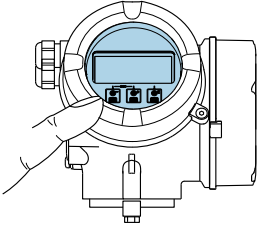
Can be operated in the following languages:

- Via local display: English, German, French, Spanish, Italian, Dutch, Portuguese, Polish, Russian, Swedish, Turkish, Chinese, Japanese, Korean, Bahasa (Indonesian), Vietnamese, Czech
- Via "FieldCare" operating tool: English, German, French, Spanish, Italian, Chinese, Japanese

**Local operation**

**Via display module**

Two display modules are available:

Order code for "Display; Operation", option C "SD02"	Order code for "Display; Operation", option E "SD03"
	
1 Operation with pushbuttons	1 Operation with touch control

*Display elements*

- 4-line, illuminated, graphic display
- White background lighting; switches to red in event of device errors
- Format for displaying measured variables and status variables can be individually configured
- Permitted ambient temperature for the display: -20 to +60 °C (-4 to +140 °F)  
The readability of the display may be impaired at temperatures outside the temperature range.

*Operating elements*

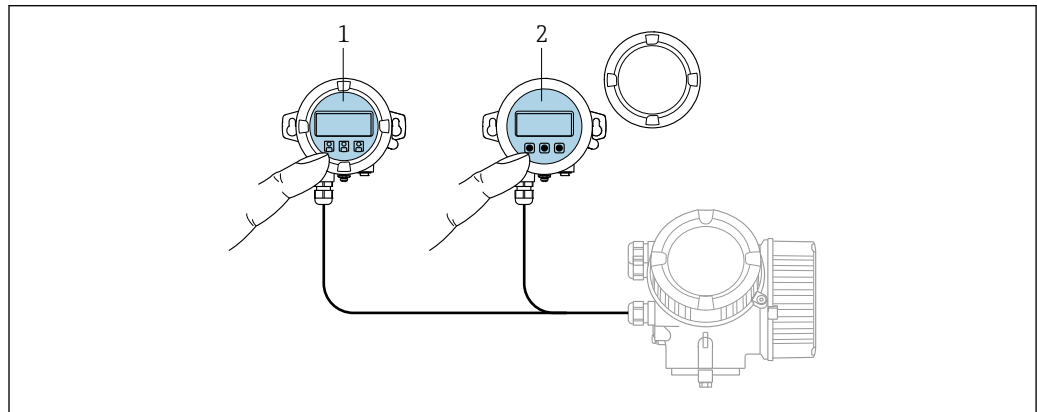
- Operation with 3 push buttons with open housing: ⊕, ⊖, ⊞  
or
- External operation via touch control (3 optical keys) without opening the housing: ⊕, ⊖, ⊞
- Operating elements also accessible in the various zones of the hazardous area

*Additional functionality*

- Data backup function  
The device configuration can be saved in the display module.
- Data comparison function  
The device configuration saved in the display module can be compared to the current device configuration.
- Data transfer function  
The transmitter configuration can be transmitted to another device using the display module.

**Via remote display FHX50**

- The remote display FHX50 can be ordered as an optional extra → 86.
- The remote display FHX50 cannot be combined with the order code for "Sensor version; DSC sensor; measuring tube", option DC "mass steam" or option DD "mass gas/liquid".



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24 FHX50 operating options

- 1 SD02 display and operating module, push buttons: cover must be opened for operation
- 2 SD03 display and operating module, optical buttons: operation possible through cover glass

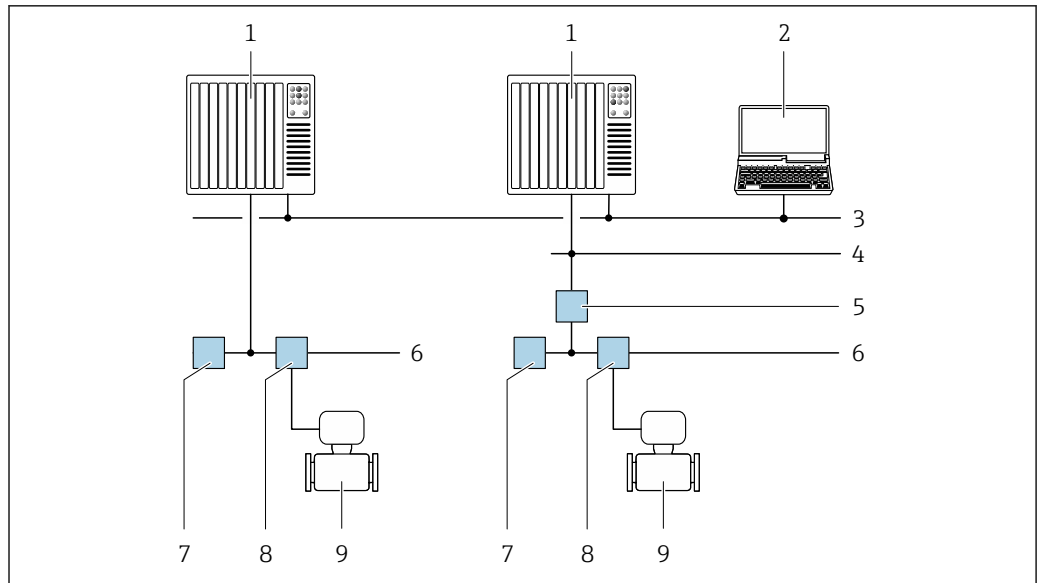
*Display and operating elements*

The display and operating elements correspond to those of the display module .

**Remote operation****Via HART protocol**

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





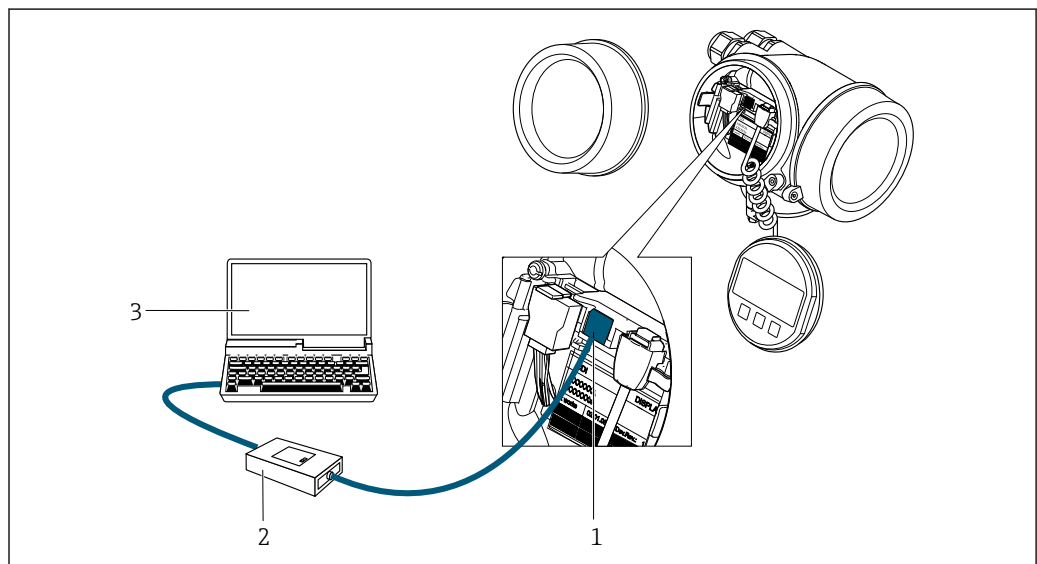
A0028837

27 Options for remote operation via FOUNDATION Fieldbus network

- 1 Automation system
- 2 Computer with FOUNDATION Fieldbus network card
- 3 Industry network
- 4 High Speed Ethernet FF-HSE network
- 5 Segment coupler FF-HSE/FF-H1
- 6 FOUNDATION Fieldbus FF-H1 network
- 7 Power supply FF-H1 network
- 8 T-box
- 9 Measuring device

Service interface

Via service interface (CDI)



A0034056

- 1 Service interface (CDI = Endress+Hauser Common Data Interface) of the measuring device
- 2 Commubox FXA291
- 3 Computer with FieldCare operating tool with COM DTM CDI Communication FXA291

## Certificates and approvals

**i** Currently available certificates and approvals can be called up via the product configurator.



<b>CE mark</b>	<p>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.</p> <p>Endress+Hauser confirms successful testing of the device by affixing to it the CE mark.</p>
<b>RCM-tick symbol</b>	<p>The measuring system meets the EMC requirements of the "Australian Communications and Media Authority (ACMA)".</p>
<b>Ex approval</b>	<p>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.</p>

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

**ATEX, IECEx**

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

*Ex d*

Category	Type of protection
II2G/Zone 1	Ex d[ia] IIC T6 ... T1
II1/2G/Zone 0/1	Ex d[ia] IIC T6 ... T1

*Ex ia*

Category	Type of protection
II2G/Zone 1	Ex ia IIC T6 ... T1
II1G/Zone 0	Ex ia IIC T6 ... T1
II1/2G/Zone 0/1	Ex ia IIC T6 ... T1

*Ex ic*

Category	Type of protection
II3G/Zone 2	Ex ic IIC T6 ... T1
II1/3G/Zone 0/2	Ex ic[ia] IIC T6 ... T1

*Ex Ec*

Category	Type of protection
II3G/Zone 2	Ex ec IIC T6 ... T1

*Ex tb*

Category	Type of protection
II2D/Zone 21	Ex tb IIIC Txxx

**cCSAus**

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

*XP*

Category	Type of protection
Class I, II, III, Division 1 for Group A-G	XP (Ex d Flameproof version)

*IS*

Category	Type of protection
Class I, II, III, Division 1 for Group A-G	IS (Ex i Intrinsically safe version)

*NI*

Category	Type of protection
Class I, Division 2 for Group ABCD	NI (Non-incendive version), NIFW-Parameter*

\*= Entity and NIFW parameters according to control drawings

**NEPSI**

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

*Ex d*

Category	Type of protection
Zone 1	Ex d ia  IIC T1 ~ T6 Ex d ia Ga  IIC T1 ~ T6
Zone 0/1	Ex d ia  IIC T1 ~ T6 DIP A21 Ex d ia Ga  IIC T1 ~ T6 DIP A21

*Ex ia*

Category	Type of protection
Zone 1	Ex ia IIC T1 ~ T6
Zone 0/1	Ex ia IIC T1 ~ T6 DIP A21

*Ex ic*

Category	Type of protection
II3G/Zone 2	Ex ic IIC T1 ~ T6
II1/3G/Zone 0/2	Ex ic ia Ga  IIC T1 ~ T6

*Ex nA*

Category	Type of protection
Zone 2	Ex nA IIC T1 ~ T6 Ex nA ia Ga  IIC T1 ~ T6

**INMETRO**

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

*Ex d*

Category	Type of protection
-	Ex d ia  IIC T6 ... T1

*Ex ia*

Category	Type of protection
-	Ex ia IIC T6 ... T1

Ex nA

Category	Type of protection
IIBG/Zone 2	Ex nA IIC T6 ... T1

EAC

Ex d

Category	Type of protection
Zone 1	1Ex d [ia Ga] IIC T6 ... T1 Gb
	Ga/Gb Ex d [ia Ga] IIC T6 ... T1



Ex nA

Category	Type of protection
Zone 2	2Ex nA [ia Ga] IIC T6 ... T1 Gc

**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 (multichannel architecture with homogeneous redundancy) and is evaluated and certified in accordance with IEC 61508.

The following types of monitoring in safety equipment are possible:

 Functional Safety Manual with information on the SIL device →  89

**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
- The device can also be operated with certified devices of other manufacturers (interoperability)

**FOUNDATION Fieldbus certification**

**FOUNDATION Fieldbus interface**

The measuring device is certified and registered by the FieldComm Group. The measuring system meets all the requirements of the following specifications:

- Certified in accordance with FOUNDATION Fieldbus H1
- Interoperability Test Kit (ITK), revision version 6.2.0 (certificate available on request)
- Physical Layer Conformance Test
- The device can also be operated with certified devices of other manufacturers (interoperability)

**Certification PROFIBUS**

**PROFIBUS interface**

The measuring device is certified and registered by the PNO (PROFIBUS User Organization Organization). The measuring system meets all the requirements of the following specifications:

- Certified in accordance with PROFIBUS PA Profile 3.02
- The device can also be operated with certified devices of other manufacturers (interoperability)

**Pressure Equipment Directive**

The devices can be ordered with or without a PED approval. If a device with a PED approval is required, this must be explicitly stated in the order.

- With the identification PED/G1/x (x = category) on the sensor nameplate, Endress+Hauser confirms conformity with the "Essential Safety Requirements" specified in Appendix I of the Pressure Equipment Directive 2014/68/EU.
- Devices bearing this marking (PED) are suitable for the following types of medium: Media in Group 1 and 2 with a vapor pressure greater than, or smaller and equal to 0.5 bar (7.3 psi)
- Devices not bearing this marking (PED) are designed and manufactured according to good engineering practice. They meet the requirements of Article 4 paragraph 3 of the Pressure Equipment Directive 2014/68/EU. The range of application is indicated in tables 6 to 9 in Annex II of the Pressure Equipment Directive 2014/68/EU.

**Experience**

The Prowirl 200 measuring system is the official successor to Prowirl 72 and Prowirl 73.

**Other standards and guidelines**

- EN 60529  
Degrees of protection provided by enclosures (IP code)
- DIN ISO 13359  
Measurement of conductive liquid flow in closed conduits - Flanged-type electromagnetic flowmeters - Overall length
- EN 61010-1  
Safety requirements for electrical equipment for measurement, control and laboratory use - general requirements
- IEC/EN 61326  
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

## Ordering information

Detailed ordering information is available as follows:

- In the Product Configurator on the Endress+Hauser website: [www.endress.com](http://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](http://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

**Product generation index**

Release date	Product root	On change
01.09.2013	702B	TI01085D
01.11.2017	702C	TI01334D



More information is available from your Sales Center or at:

[www.service.endress.com](http://www.service.endress.com) → Downloads

## 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](http://www.endress.com).



Detailed information on the application packages:  
Special Documentation for the device

**Diagnostics functions**

Package	Description
Extended HistoROM	<p>Comprises extended functions concerning the event log and the activation of the measured value memory.</p> <p>Event log: Memory volume is extended from 20 message entries (standard version) to up to 100 entries.</p> <p>Data logging (line recorder):</p> <ul style="list-style-type: none"> <li>▪ Memory capacity for up to 1000 measured values is activated.</li> <li>▪ 250 measured values can be output via each of the 4 memory channels. The recording interval can be defined and configured by the user.</li> <li>▪ Measured value logs can be accessed via the local display or operating tool e.g. FieldCare, DeviceCare or Web server.</li> </ul>

**Heartbeat Technology**







Package	Description
Heartbeat Verification	<p><b>Heartbeat Verification</b></p> <p>Meets the requirement for traceable verification to DIN ISO 9001:2008 Chapter 7.6 a) "Control of monitoring and measuring equipment".</p> <ul style="list-style-type: none"> <li>▪ Functional testing in the installed state without interrupting the process.</li> <li>▪ Traceable verification results on request, including a report.</li> <li>▪ Simple testing process via local operation or other operating interfaces.</li> <li>▪ Clear measuring point assessment (pass/fail) with high test coverage within the framework of manufacturer specifications.</li> <li>▪ Extension of calibration intervals according to operator's risk assessment.</li> </ul>



## 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](http://www.endress.com).

## Device-specific accessories

## For the transmitter








Accessories	Description
Prowirl 200 transmitter	<p>Transmitter for replacement or storage. Use the order code to define the following specifications:</p> <ul style="list-style-type: none"> <li>■ Approvals</li> <li>■ Output, Input</li> <li>■ Display/operation</li> <li>■ Housing</li> <li>■ Software</li> </ul> <p> Installation Instructions EA01056D</p> <p> (Order number: 7X2CXX)</p>
Remote display FHX50	<p>FHX50 housing for accommodating a display module .</p> <ul style="list-style-type: none"> <li>■ FHX50 housing suitable for: <ul style="list-style-type: none"> <li>■ SD02 display module (push buttons)</li> <li>■ SD03 display module (touch control)</li> </ul> </li> <li>■ Length of connecting cable: up to max. 60 m (196 ft) (cable lengths available for order: 5 m (16 ft), 10 m (32 ft), 20 m (65 ft), 30 m (98 ft))</li> </ul> <p>The measuring device can be ordered with the FHX50 housing and a display module. The following options must be selected in the separate order codes:</p> <ul style="list-style-type: none"> <li>■ Order code for measuring device, feature 030: Option L or M "Prepared for FHX50 display"</li> <li>■ Order code for FHX50 housing, feature 050 (device version): Option A "Prepared for FHX50 display"</li> <li>■ Order code for FHX50 housing, depends on the desired display module in feature 020 (display, operation): <ul style="list-style-type: none"> <li>■ Option C: for an SD02 display module (push buttons)</li> <li>■ Option E: for an SD03 display module (touch control)</li> </ul> </li> </ul> <p>The FHX50 housing can also be ordered as a retrofit kit. The measuring device display module is used in the FHX50 housing. The following options must be selected in the order code for the FHX50 housing:</p> <ul style="list-style-type: none"> <li>■ Feature 050 (measuring device version): option B "Not prepared for FHX50 display"</li> <li>■ Feature 020 (display, operation): option A "None, existing displayed used"</li> </ul> <p> The FHX50 remote display cannot be combined with the order code for "Sensor version; DSC sensor; measuring tube":</p> <ul style="list-style-type: none"> <li>■ option DC "Mass steam; Alloy 718; 316L (integrated pressure/temperature measurement), -200 to +400 °C (-328 to +750 °F)"</li> <li>■ option DD "Mass gas/liquid; Alloy 718; 316L (integrated pressure/temperature measurement), -40 to +100 °C (-40 to +212 °F)"</li> </ul> <p> Special Documentation SD01007F</p> <p>(Order number: FHX50)</p>
Overvoltage protection for 2-wire devices	<p>Ideally, the overvoltage protection module should be ordered directly with the device. See product structure, feature 610 "Accessory mounted", option NA "Overvoltage protection". Separate order necessary only if retrofitting.</p> <ul style="list-style-type: none"> <li>■ OVP10: For 1-channel devices (feature 020, option A):</li> <li>■ OVP20: For 2-channel devices (feature 020, options B, C, E or G)</li> </ul> <p> Special Documentation SD01090F</p> <p>(Order number OVP10: 71128617) (Order number OVP20: 71128619)</p>
Protective cover	<p>Is used to protect the measuring device from the effects of the weather: e.g. rainwater, excess heating from direct sunlight or extreme cold in winter.</p> <p> Special Documentation SD00333F</p> <p>(Order number: 71162242)</p>

Accessories	Description
Connecting cable for remote version	<ul style="list-style-type: none"> <li>■ Connecting cable available in various lengths:                             <ul style="list-style-type: none"> <li>■ 5 m (16 ft)</li> <li>■ 10 m (32 ft)</li> <li>■ 20 m (65 ft)</li> <li>■ 30 m (98 ft)</li> </ul> </li> <li>■ Armored cables available on request.</li> </ul> <p> Standard length: 5 m (16 ft) Is always supplied if no other cable length has been ordered.</p>
Post mounting kit	<p>Post mounting kit for transmitter.</p> <p> The post mounting kit can only be ordered together with a transmitter.</p> <p>(Order number: DK8WM-B)</p>



**For the sensor**

Accessories	Description
Flow conditioner	<p>Is used to shorten the necessary inlet run.</p> <p>(Order number: DK7ST)</p>




**Communication-specific accessories**

Accessories	Description
Commubox FXA195 HART	<p>For intrinsically safe HART communication with FieldCare via the USB interface.</p> <p> Technical Information TI00404F</p>
Commubox FXA291	<p>Connects Endress+Hauser field devices with a CDI interface (= Endress+Hauser Common Data Interface) and the USB port of a computer or laptop.</p> <p> Technical Information TI405C/07</p>
HART Loop Converter HMX50	<p>Is used to evaluate and convert dynamic HART process variables to analog current signals or limit values.</p> <p> <ul style="list-style-type: none"> <li>■ Technical Information TI00429F</li> <li>■ Operating Instructions BA00371F</li> </ul> </p>
Wireless HART adapter SWA70	<p>Is used for the wireless connection of field devices.</p> <p>The WirelessHART adapter can be easily integrated into field devices and existing infrastructures, offers data protection and transmission safety and can be operated in parallel with other wireless networks with minimum cabling complexity.</p> <p> Operating Instructions BA00061S</p>
Fieldgate FXA42	<p>Is used to transmit the measured values of connected 4 to 20 mA analog measuring devices, as well as digital measuring devices</p> <p> <ul style="list-style-type: none"> <li>■ Technical Information TI01297S</li> <li>■ Operating Instructions BA01778S</li> <li>■ Product page: <a href="http://www.endress.com/fxa42">www.endress.com/fxa42</a></li> </ul> </p>
Field Xpert SMT70	<p>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.</p> <p>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.</p> <p> <ul style="list-style-type: none"> <li>■ Technical Information TI01342S</li> <li>■ Operating Instructions BA01709S</li> <li>■ Product page: <a href="http://www.endress.com/smt70">www.endress.com/smt70</a></li> </ul> </p>
Field Xpert SMT77	<p>The Field Xpert SMT77 tablet PC for device configuration enables mobile plant asset management in areas categorized as Ex Zone 1.</p> <p> <ul style="list-style-type: none"> <li>■ Technical Information TI01418S</li> <li>■ Operating Instructions BA01923S</li> <li>■ Product page: <a href="http://www.endress.com/smt77">www.endress.com/smt77</a></li> </ul> </p>


## Service-specific accessories

Accessories	Description
Applicator	<p>Software for selecting and sizing Endress+Hauser measuring devices:</p> <ul style="list-style-type: none"> <li>Choice of measuring devices for industrial requirements</li> <li>Calculation of all the necessary data for identifying the optimum flowmeter: e.g. nominal diameter, pressure loss, flow velocity and accuracy.</li> <li>Graphic illustration of the calculation results</li> <li>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.</li> </ul> <p>Applicator is available:</p> <ul style="list-style-type: none"> <li>Via the Internet: <a href="https://portal.endress.com/webapp/applicator">https://portal.endress.com/webapp/applicator</a></li> <li>As a downloadable DVD for local PC installation.</li> </ul>
W@M	<p>W@M Life Cycle Management</p> <p>Improved productivity with information at your fingertips. Data relevant to a plant and its components is generated from the first stages of planning and during the asset's complete life cycle.</p> <p>W@M Life Cycle Management is an open and flexible information platform with online and on-site tools. Instant access for your staff to current, in-depth data shortens your plant's engineering time, speeds up procurement processes and increases plant uptime.</p> <p>Combined with the right services, W@M Life Cycle Management boosts productivity in every phase. For more information, visit <a href="http://www.endress.com/lifecyclemanagement">www.endress.com/lifecyclemanagement</a></p>
FieldCare	<p>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.</p> <p> Operating Instructions BA00027S and BA00059S</p>
DeviceCare	<p>Tool to connect and configure Endress+Hauser field devices.</p> <p> Innovation brochure IN01047S</p>

## System components

Accessories	Description
Memograph M graphic data manager	<p>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.</p> <p> <ul style="list-style-type: none"> <li>Technical Information TI00133R</li> <li>Operating Instructions BA00247R</li> </ul> </p>
RN221N	<p>Active barrier with power supply for safe separation of 4-20 mA standard signal circuits. Offers bidirectional HART transmission.</p> <p> <ul style="list-style-type: none"> <li>Technical Information TI00073R</li> <li>Operating Instructions BA00202R</li> </ul> </p>
RNS221	<p>Supply unit for powering two 2-wire measuring devices solely in the non-hazardous area. Bidirectional communication is possible via the HART communication jacks.</p> <p> <ul style="list-style-type: none"> <li>Technical Information TI00081R</li> <li>Brief Operating Instructions KA00110R</li> </ul> </p>

## Supplementary documentation

-  For an overview of the scope of the associated Technical Documentation, refer to the following:
- W@M Device Viewer* ([www.endress.com/deviceviewer](http://www.endress.com/deviceviewer)): Enter the serial number from nameplate
  - Endress+Hauser Operations App*: Enter the serial number from the nameplate or scan the 2D matrix code (QR code) on the nameplate



**Standard documentation**

**Brief Operating Instructions**

*Brief Operating Instructions for the sensor*

Measuring device	Documentation code
Prowirl O 200	KA01324D

*Brief Operating Instructions for transmitter*

Measuring device	Documentation code		
	HART	FOUNDATION Fieldbus	PROFIBUS PA
Proline 200	KA01326D	KA01327D	KA01328D

**Operating Instructions**

Measuring device	Documentation code		
	HART	FOUNDATION Fieldbus	PROFIBUS PA
Prowirl O 200	BA01687D	BA01695D	BA01691D

**Description of Device Parameters**

Measuring device	Documentation code		
	HART	FOUNDATION Fieldbus	PROFIBUS PA
Prowirl 200	GP01109D	GP01111D	GP01110D

**Supplementary device-dependent documentation**

**Safety instructions**

Content	Documentation code
ATEX/IECEX Ex d, Ex tb	XA01635D
ATEX/IECEX Ex ia, Ex tb	XA01636D
ATEX/IECEX Ex ic, Ex ec	XA01637D
cCSA <sub>US</sub> XP	XA01638D
cCSA <sub>US</sub> IS	XA01639D
NEPSI Ex d	XA01643D
NEPSI Ex i	XA01644D
NEPSI Ex ic, Ex nA	XA01645D
INMETRO Ex d	XA01642D
INMETRO Ex i	XA01640D
INMETRO Ex nA	XA01641D
EAC Ex d	XA01684D
EAC Ex nA	XA01685D
JPN Ex d	XA01766D

**Special documentation**

Contents	Documentation code
Information on the Pressure Equipment Directive	SD01614D
Functional Safety Manual	SD02025D

Contents	Documentation code		
	HART	FOUNDATION Fieldbus	PROFIBUS PA
Heartbeat Technology	SD02029D	SD02030D	SD02031D

### Installation Instructions

Contents	Comment
Installation instructions for spare part sets and accessories	Documentation code: specified for each individual accessory → 86.

## Registered trademarks

### HART®

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

### PROFIBUS®

Registered trademark of the PROFIBUS User Organization, Karlsruhe, Germany

### FOUNDATION™ Fieldbus

Registration-pending trademark of the FieldComm Group, Austin, Texas, USA

### KALREZ®, VITON®

Registered trademarks of DuPont Performance Elastomers L.L.C., Wilmington, DE USA

### GYLON®

Registered trademark of Garlock Sealing Technologies, Palmyra, NY, USA

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