TI01104D/06/EN/05.24-00
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2024-11-01

Technical Information
Proline Promass A 100

Coriolis flowmeter

The single-tube measuring instrument for the smallest flow quantities with an ultra-compact transmitter

Application

- Measuring principle operates independently of physical fluid properties such as viscosity or density
- Accurate measurement of smallest quantities of liquids and gases for continuous process control

Device properties
- Nominal diameter: DN 1 to 4 (1/24 to 1/8")
- Process pressure: up to 400 bar (5 800 psi)
- Medium temperature up to +205 °C (+401 °F)
- Robust, ultra-compact transmitter housing
- Highest degree of protection: IP69
- Local display available

Your benefits

- Highest process safety – self-drainable measuring tube design
- Fewer process measuring points – multivariable measurement (flow, density, temperature)
- Space-saving installation – no in-/outlet run needs
- Space-saving transmitter – full functionality on smallest footprint
- Time-saving local operation without additional software and hardware – integrated web server
- Integrated verification – Heartbeat Technology

Endress+Hauser
People for Process Automation

Table of contents

About this document

Symbols

Electrical symbols

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

Symbols for certain types of information

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

Symbols in graphics

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

Function and system design

Measuring principle

The measuring principle is based on the controlled generation of Coriolis forces. These forces are always present in a system when both translational and rotational movements are superimposed.

$F_c = 2 \cdot \Delta m\ (v \cdot \omega)$

F_c = Coriolis force

Δm = moving mass

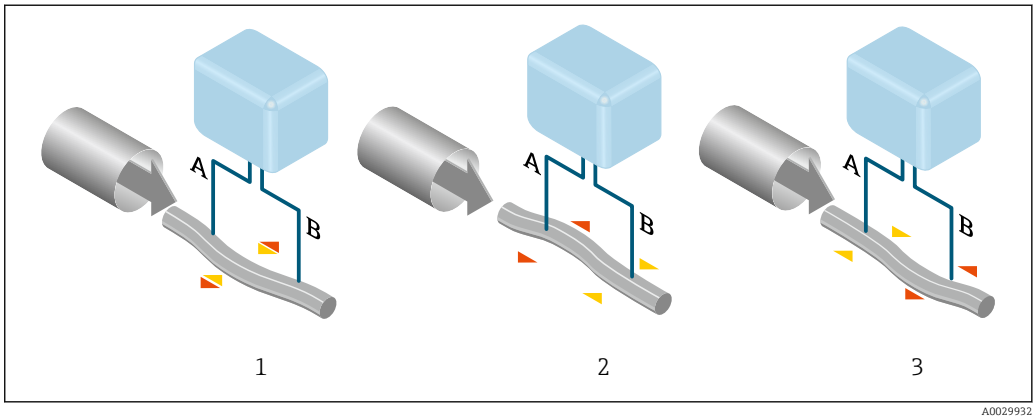
ω = rotational velocity

v = radial velocity in rotating or oscillating system

The amplitude of the Coriolis force depends on the moving mass Δm, its velocity v in the system and thus on the mass flow. Instead of a constant rotational velocity ω, the sensor uses oscillation.

In the sensor, an oscillation is produced in the measuring tube. The Coriolis forces produced at the measuring tube cause a phase shift in the tube oscillations (see illustration):

- If there is zero flow (i.e. when the fluid stands still), the oscillation measured at points A and B has the same phase (no phase difference) (1).
- Mass flow causes deceleration of the oscillation at the inlet of the tubes (2) and acceleration at the outlet (3).



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The phase difference (A-B) increases with increasing mass flow. Electrodynamic sensors register the tube oscillations at the inlet and outlet. System balance is created by exciting an eccentrically arranged swinging mass to antiphase oscillation. The measuring principle operates independently of temperature, pressure, viscosity, conductivity and flow profile.

Density measurement
The measuring tube is continuously excited at its resonance frequency. A change in the mass and thus the density of the oscillating system (comprising measuring tube and fluid) results in a corresponding, automatic adjustment in the oscillation frequency. The resonance frequency is thus a function of the medium density. The microprocessor utilizes this relationship to obtain a density signal.

Volume measurement
Together with the measured mass flow, this is used to calculate the volume flow.

Temperature measurement
The temperature of the measuring tube is determined in order to calculate the compensation factor due to temperature effects. This signal corresponds to the process temperature and is also available as an output signal.

Gas Fraction Handler (GFH)
The Gas Fraction Handler is a Promass software function that improves measurement stability and repeatability. The function continuously checks for the presence of disturbances in single-phase flow, i.e. gas bubbles in liquids or droplets in gas. In the presence of the second phase, flow and density become increasingly unstable. The Gas Fraction Handler function improves measurement stability

with respect to the severity of the disturbances, without any effect under single-phase flow conditions.

The Gas Fraction Handler is only available in device versions with HART, Modbus RS485, PROFINET and PROFINET with Ethernet-APL.

For detailed information on the Gas Fraction Handler, see the Special Documentation for "Gas Fraction Handler"

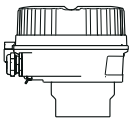
Measuring system

The device consists of a transmitter and a sensor. If a device with Modbus RS485 intrinsically safe is ordered, the Safety Barrier Promass 100 is part of the scope of supply and must be implemented to operate the device.

The device is available as a compact version:
The transmitter and sensor form a mechanical unit.

Transmitter

Proline 100



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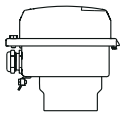

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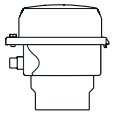

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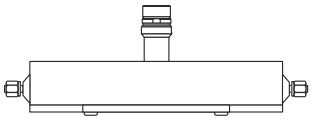
Device versions and materials:
- Compact, aluminum, coated:
  Aluminum, AlSi10Mg, coated
- Compact, hygienic, stainless:
  Hygienic version, stainless steel 1.4301 (304)
- Ultra-compact, hygienic, stainless:
  Hygienic version, stainless steel 1.4301 (304)

Configuration:
- Via operating tools (e.g. FieldCare, DeviceCare)
- Also for device version with local display (LCD):
  Via web browser (e.g. Microsoft Internet Explorer)
- Also for device version with 4-20 mA HART, pulse/frequency/switch output:
  Via web browser (e.g. Microsoft Internet Explorer)
- Also for device version with EtherNet/IP output:
  - Via web browser (e.g. Microsoft Internet Explorer)
  - Via Add-on Profile Level 3 for automation system from Rockwell Automation
  - Via Electronic Data Sheet (EDS)
- Also for device version with PROFINET output:
  - Via web browser (e.g. Microsoft Internet Explorer)
  - Via device master file (GSD)

Sensor

Promass A



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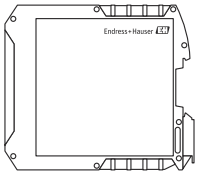
- Bent single-tube system for high-precision measurement of minimum flow rates
- Simultaneous measurement of flow, volume flow, density and temperature (multivariable)
- Immune to process influences
- Nominal diameter range: DN 1 to 4 (1/24 to 1/8 ")
- Materials:
  - Sensor: stainless steel, 1.4301 (304)
  - Measuring tube: stainless steel, 1.4539 (904L); Alloy C22, 2.4602 (UNS N06022)
  - Process connections: stainless steel, 1.4404 (316/316L); stainless steel, 1.4539 (904L); Alloy C22, 2.4602 (UNS N06022)

Safety Barrier Promass 100



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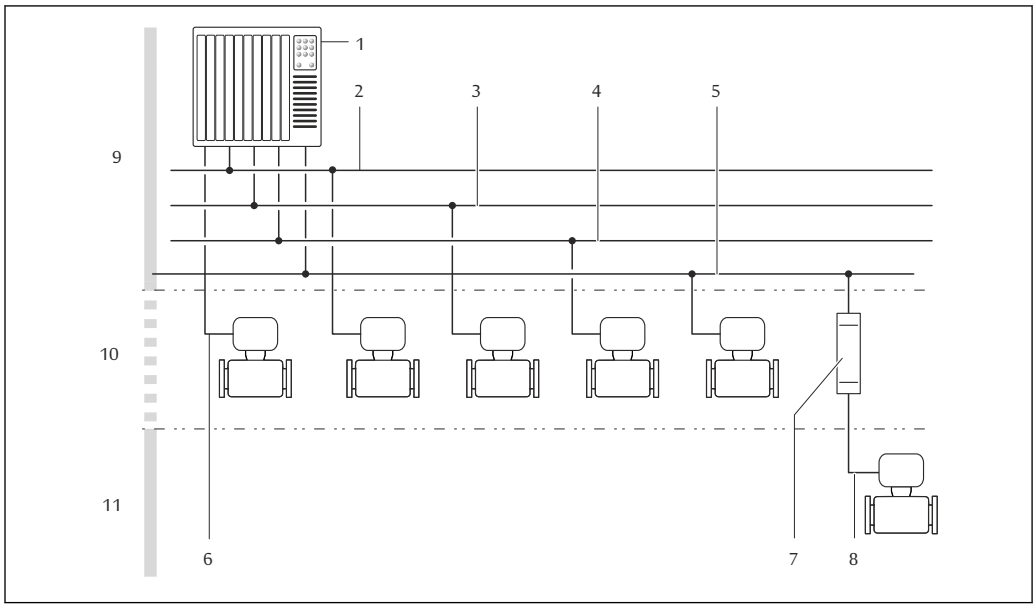
- Dual-channel safety barrier for installation in non-hazardous locations or zone 2/div. 2:
  - Channel 1: DC 24 V power supply
  - Channel 2: Modbus RS485
- In addition to current, voltage and power limitation, it offers galvanic isolation of circuits for explosion protection.
- Easy top-hat rail mounting (DIN 35 mm) for installation in control cabinets

Equipment architecture



1 *Possibilities for integrating measuring devices into a system*

1 Control system (e.g. PLC)
2 EtherNet/IP
3 PROFIBUS DP
4 PROFINET
5 Modbus RS485
6 4-20 mA HART, pulse/frequency/switch output
7 Safety Barrier Promass 100
8 Modbus RS485 intrinsically safe
9 Non-hazardous area
10 Non-hazardous area and Zone 2/Div. 2
11 Hazardous area and Zone 1/Div. 1

Reliability

IT security

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

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

Input

Measured variable

Direct measured variables

- Mass flow
- Density
- Temperature

Calculated measured variables

- Volume flow
- Corrected volume flow
- Reference density

Measuring range

Measuring range for liquids

DN		Measuring range full scale values $\dot{m}_{min(F)}$ to $\dot{m}_{max(F)}$	
[mm]	[in]	[kg/h]	[lb/min]
1	1/24	0 to 20	0 to 0.735
2	1/12	0 to 100	0 to 3.675
4	1/8	0 to 450	0 to 16.54

Measuring range for gases

The full scale value depends on the density and the sound velocity of the gas used. The full scale value can be calculated with the following formulas:

$\dot{m}_{max(G)}$ = Minimum of $(\dot{m}_{max(F)} \cdot \rho_G : x)$ and

$(\rho_G \cdot (c_G/2) \cdot d_i^2 \cdot (\pi/4) \cdot 3600 \cdot n)$

$\dot{m}_{max(G)}$	Maximum full scale value for gas [kg/h]
$\dot{m}_{max(F)}$	Maximum full scale value for liquid [kg/h]
$\dot{m}_{max(G)} < \dot{m}_{max(F)}$	$\dot{m}_{max(G)}$ can never be greater than $\dot{m}_{max(F)}$
ρ_G	Gas density in [kg/m³] at operating conditions
x	Limitation constant for max. gas flow [kg/m³]
c_G	Sound velocity (gas) [m/s]
d_i	Measuring tube internal diameter [m]
π	Pi
n = 1	Number of measuring tubes

DN		x
[mm]	[in]	[kg/m³]
1	1/24	32
2	1/12	32
4	1/8	32

To calculate the measuring range, use the *Applicator* sizing tool → 87

If calculating the full scale value using the two formulas:

1. Calculate the full scale value with both formulas.

2. The smaller value is the value that must be used.

Recommended measuring range

Flow limit → 53

Operable flow range

Over 1000 : 1.

Flow rates above the preset full scale value do not override the electronics unit, with the result that the totalizer values are registered correctly.

Input signal

External measured values

To increase the measurement accuracy of certain measured variables or to calculate the corrected volume flow for gases, the automation system can continuously write different measured values to the measuring instrument:
- Operating pressure to increase measurement accuracy (Endress+Hauser recommends the use of a pressure measuring instrument for absolute pressure, e.g. Cerabar M or Cerabar S)
- Medium temperature to increase measurement accuracy (e.g. iTEMP)
- Reference density for calculating the corrected volume flow for gases

Various pressure transmitters and temperature measuring instruments can be ordered from Endress+Hauser: see "Accessories" section → 87

It is recommended to read in external measured values to calculate the following measured variables:
- Mass flow
- Corrected volume flow

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 by the automation system via:
- PROFIBUS DP
- Modbus RS485
- Ethernet/IP
- PROFINET

Output

Output signal

HART current output

Current output	4-20 mA HART (active)
Maximum output values	▪ DC 24 V (no flow) ▪ 22.5 mA
Load	0 to 700 Ω
Resolution	0.38 µA
Damping	Configurable: 0.07 to 999 s
Assignable measured variables	▪ Mass flow ▪ Volume flow ▪ Corrected volume flow ▪ Density ▪ Reference density ▪ Temperature The range of options increases if the measuring device has one or more application packages.

Pulse/frequency/switch output

Function	Can be set to pulse, frequency or switch output
Version	Passive, open collector
Maximum input values	▪ DC 30 V ▪ 25 mA
Voltage drop	For 25 mA: ≤ DC 2 V
Pulse output	
Pulse width	Configurable: 0.05 to 2 000 ms
Maximum pulse rate	10 000 Impulse/s
Pulse value	Adjustable
Assignable measured variables	▪ Mass flow ▪ Volume flow ▪ Corrected volume flow
Frequency output	
Output frequency	Configurable: 0 to 10 000 Hz
Damping	Configurable: 0 to 999 s
Pulse/pause ratio	1:1
Assignable measured variables	▪ Mass flow ▪ Volume flow ▪ Corrected volume flow ▪ Density ▪ Reference density ▪ Temperature The range of options increases if the measuring device has one or more application packages.
Switch output	
Switching behavior	Binary, conductive or non-conductive
Switching delay	Configurable: 0 to 100 s
Number of switching cycles	Unlimited

Assignable functions	▪ Off
	▪ On
	▪ Diagnostic behavior
	▪ Limit value
	  ▪ Mass flow
	  ▪ Volume flow
	  ▪ Corrected volume flow
	  ▪ Density
	  ▪ Reference density
	  ▪ Temperature
	  ▪ Totalizer 1-3
	▪ Flow direction monitoring
	▪ Status
	  ▪ Partially filled pipe detection
	  ▪ Low flow cut off
	The range of options increases if the measuring device has one or more application packages.

PROFIBUS DP

Signal encoding	NRZ code
Data transfer	9.6 kBaud...12 MBaud
Terminating resistor	Integrated, can be activated via DIP switches

Modbus RS485

Physical interface	In accordance with EIA/TIA-485-A standard
Terminating resistor	▪ For device version used in non-hazardous areas or Zone 2/Div. 2: integrated and can be activated via DIP switches on the transmitter electronics module ▪ For device version used in intrinsically safe areas: integrated and can be activated via DIP switches on the Safety Barrier Promass 100

EtherNet/IP

Standards	In accordance with IEEE 802.3

PROFINET

Standards	In accordance with IEEE 802.3

Signal on alarm

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

Current output 4 to 20 mA

4 to 20 mA

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

Pulse/frequency/switch output

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

PROFIBUS DP

Status and alarm messages	Diagnostics in accordance with PROFIBUS PA Profile 3.02

Modbus RS485

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

EtherNet/IP

Device diagnostics	Device condition can be read out in Input Assembly

PROFINET

Device diagnostics	According to "Application Layer protocol for decentralized periphery", Version 2.3

Local display

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

Status signal as per NAMUR recommendation NE 107

Interface/protocol

- Via digital communication:
  - HART protocol
  - PROFIBUS DP
  - Modbus RS485
  - EtherNet/IP
  - PROFINET
- Via service interface
  CDI-RJ45 service interface

Plain text display	With information on cause and remedial measures

Additional information on remote operation → 77

Web browser

Plain text display	With information on cause and remedial measures

Light emitting diodes (LED)

Status information	Status indicated by various light emitting diodes The following information is displayed depending on the device version: ▪ Supply voltage active ▪ Data transmission active ▪ Device alarm/error has occurred ▪ EtherNet/IP network available ▪ EtherNet/IP connection established ▪ PROFINET network available ▪ PROFINET connection established ▪ PROFINET blinking feature

Ex connection data

These values only apply for the following device version:
Order code for "Output", option M "Modbus RS485", for use in intrinsically safe areas

Safety Barrier Promass 100

Safety-related values

Terminal numbers			
Supply voltage		Signal transmission	
2 (L-)	1 (L+)	26 (B)	27 (A)
U_{nom} = DC 24 V U_{max} = AC 260 V		U_{nom} = DC 5 V U_{max} = AC 260 V	

Intrinsically safe values

Terminal numbers			
Supply voltage		Signal transmission	
20 (L-)	10 (L+)	62 (B)	72 (A)
U_o = 16.24 V I_o = 623 mA P_o = 2.45 W With IIC [1]: L_o = 92.8 µH, C_o = 0.433 µF, L_o/R_o = 14.6 µH/Ω With IIB: L_o= 372 µH, C_o = 2.57 µF, L_o/R_o = 58.3 µH/Ω			
For an overview and for information on the interdependencies between the gas group - sensor - nominal diameter, see the "Safety Instructions" (XA) document for the measuring device			

1) The gas group depends on the sensor and nominal diameter ff.

Transmitter

Intrinsically safe values

Order code "Approval"	Terminal numbers			
	Supply voltage		Signal transmission	
	20 (L-)	10 (L+)	62 (B)	72 (A)
▪ Option **BM**: ATEX II2G + IECEx Z1 Ex ia, II2D Ex tb ▪ Option **BO**: ATEX II1/2G + IECEx Z0/Z1 Ex ia, II2D ▪ Option **BQ**: ATEX II1/2G + IECEx Z0/Z1 Ex ia ▪ Option **BU**: ATEX II2G + IECEx Z1 Ex ia ▪ Option **C2**: CSA C/US IS Cl. I, II, III Div. 1 ▪ Option **85**: ATEX II2G + IECEx Z1 Ex ia + CSA C/US IS Cl. I, II, III Div. 1	U_i = 16.24 V I_i = 623 mA P_i = 2.45 W L_i = 0 µH C_i = 6 nF			
For an overview and for information on the interdependencies between the gas group - sensor - nominal diameter, see the "Safety Instructions" (XA) document for the measuring device				

Low flow cut off

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

Protocol-specific data

HART

Manufacturer ID	0x11
Device type ID	0x4A
HART protocol revision	7
Device description files (DTM, DD)	Information and files under: www.endress.com
HART load	Min. 250 Ω

Dynamic variables	Read out the dynamic variables: HART command 3 The measured variables can be freely assigned to the dynamic variables. **Measured variables for PV (primary dynamic variable)** ▪ Mass flow ▪ Volume flow ▪ Corrected volume flow ▪ Density ▪ Reference density ▪ Temperature **Measured variables for SV, TV, QV (secondary, tertiary and quaternary dynamic variable)** ▪ Mass flow ▪ Volume flow ▪ Corrected volume flow ▪ Density ▪ Reference density ▪ Temperature ▪ Totalizer 1 ▪ Totalizer 2 ▪ Totalizer 3 The range of options increases if the measuring device has one or more application packages. **Heartbeat Technology application package** Additional measured variables are available with the Heartbeat Technology application package: ▪ Carrier pipe temperature ▪ Oscillation amplitude 0
Device variables	Read out the device variables: HART command 9 The device variables are permanently assigned. A maximum of 8 device variables can be transmitted: ▪ 0 = mass flow ▪ 1 = volume flow ▪ 2 = corrected volume flow ▪ 3 = density ▪ 4 = reference density ▪ 5 = temperature ▪ 6 = totalizer 1 ▪ 7 = totalizer 2 ▪ 8 = totalizer 3 ▪ 13 = target mass flow ▪ 14 = carrier mass flow ▪ 15 = concentration

PROFIBUS DP

Manufacturer ID	0x11
Ident number	0x1561
Profile version	3.02
Device description files (GSD, DTM, DD)	Information and files available at: ▪ https://www.endress.com/download On the device product page: PRODUCTS → Product Finder → Links ▪ https://www.profibus.com

Output values (from measuring instrument to automation system)	**Analog input 1 to 8** ▪ Mass flow ▪ Volume flow ▪ Corrected volume flow ▪ Target mass flow ▪ Carrier mass flow ▪ Density ▪ Reference density ▪ Concentration ▪ Temperature ▪ Carrier pipe temperature ▪ Electronics temperature ▪ Oscillation frequency ▪ Oscillation amplitude ▪ Frequency fluctuation ▪ Oscillation damping ▪ Tube damping fluctuation ▪ Signal asymmetry ▪ Exciter current **Digital input 1 to 2** ▪ Partially filled pipe detection ▪ Low flow cut off **Totalizer 1 to 3** ▪ Mass flow ▪ Volume flow ▪ Corrected volume flow

Input values
(from automation system to measuring instrument)
	Analog output 1 to 3 (fixed assignment)
	▪ Pressure
	▪ Temperature
	▪ Reference density
	Digital output 1 to 3 (fixed assignment)
	▪ Digital output 1: switch positive zero return on/off
	▪ Digital output 2: perform zero adjustment
	▪ Digital output 3: switch switch output on/off
	Totalizer 1 to 3
	▪ Totalize
	▪ Reset and hold
	▪ Preset and hold
	▪ Stop
	▪ Operating mode configuration:
	  ▪ Net flow total
	  ▪ Forward flow total
	  ▪ Reverse flow total

Supported functions	▪ Identification & maintenance Straightforward device identification on the part of the control system and nameplate ▪ PROFIBUS upload/download Reading and writing parameters is up to ten times faster with PROFIBUS upload/download. ▪ Condensed status Straightforward and self-explanatory diagnostic information by categorizing diagnostic messages that occur
Configuration of the device address	▪ DIP switches on the I/O electronics module ▪ Via operating tools (e.g. FieldCare)

Modbus RS485

Protocol	Modbus Applications Protocol Specification V1.1
Device type	Slave
Slave address range	1 to 247
Broadcast address range	0

Function codes	▪ 03: Read holding register ▪ 04: Read input register ▪ 06: Write single registers ▪ 08: Diagnostics ▪ 16: Write multiple registers ▪ 23: Read/write multiple registers
Broadcast messages	Supported by the following function codes: ▪ 06: Write single registers ▪ 16: Write multiple registers ▪ 23: Read/write multiple registers
Supported baud rate	▪ 1 200 BAUD ▪ 2 400 BAUD ▪ 4 800 BAUD ▪ 9 600 BAUD ▪ 19 200 BAUD ▪ 38 400 BAUD ▪ 57 600 BAUD ▪ 115 200 BAUD
Data transfer mode	▪ ASCII ▪ RTU
Data access	Each device parameter can be accessed via Modbus RS485. For Modbus register information, see "Description of device parameters" documentation → 88

EtherNet/IP

Protocol	▪ The CIP Networks Library Volume 1: Common Industrial Protocol ▪ The CIP Networks Library Volume 2: Ethernet/IP Adaptation of CIP
Communication type	▪ 10Base-T ▪ 100Base-TX
Device profile	Generic device (product type: 0x2B)
Manufacturer ID	0x49E
Device type ID	0x104A
Baud rates	Automatic $^{10}/_{100}$ Mbit with half-duplex and full-duplex detection
Polarity	Auto-polarity for automatic correction of crossed TxD and RxD pairs
Supported CIP connections	Max. 3 connections
Explicit connections	Max. 6 connections
I/O connections	Max. 6 connections (scanner)
Configuration options for measuring instrument	▪ DIP switches on the electronics module for IP addressing ▪ Manufacturer-specific software (FieldCare) ▪ Add-on Profile Level 3 for Rockwell Automation control systems ▪ Web browser ▪ Electronic Data Sheet (EDS) integrated in the measuring instrument
Configuration of the EtherNet interface	▪ Speed: 10 MBit, 100 MBit, auto (factory setting) ▪ Duplex: half-duplex, full-duplex, auto (factory setting)
Configuration of the device address	▪ DIP switches on the electronics module for IP addressing (last octet) ▪ DHCP ▪ Manufacturer-specific software (FieldCare) ▪ Add-on Profile Level 3 for Rockwell Automation control systems ▪ Web browser ▪ Ethernet/IP tools, e.g. RSLinx (Rockwell Automation)
Device Level Ring (DLR)	No

Fix input			
RPI	5 ms to 10 s (factory setting: 20 ms)		
Exclusive Owner Multicast		Instance	Size [byte]
	Instance configuration:	0x68	398
	O → T configuration:	0x66	64
	T → O configuration:	0x64	44
Exclusive Owner Multicast		Instance	Size [byte]
	Instance configuration:	0x69	-
	O → T configuration:	0x66	64
	T → O configuration:	0x64	44
Input only Multicast		Instance	Size [byte]
	Instance configuration:	0x68	398
	O → T configuration:	0xC7	-
	T → O configuration:	0x64	44
Input only Multicast		Instance	Size [byte]
	Instance configuration:	0x69	-
	O → T configuration:	0xC7	-
	T → O configuration:	0x64	44
Input Assembly	▪ Current device diagnostics ▪ Mass flow ▪ Volume flow ▪ Corrected volume flow ▪ Density ▪ Reference density ▪ Temperature ▪ Totalizer 1 ▪ Totalizer 2 ▪ Totalizer 3		
Configurable Input			
RPI	5 ms to 10 s (factory setting: 20 ms)		
Exclusive Owner Multicast		Instance	Size [byte]
	Instance configuration:	0x68	398
	O → T configuration:	0x66	64
	T → O configuration:	0x65	88
Exclusive Owner Multicast		Instance	Size [byte]
	Instance configuration:	0x69	-
	O → T configuration:	0x66	64
	T → O configuration:	0x65	88
Input only Multicast		Instance	Size [byte]
	Instance configuration:	0x68	398
	O → T configuration:	0xC7	-
	T → O configuration:	0x65	88
Input only Multicast		Instance	Size [byte]
	Instance configuration:	0x69	-
	O → T configuration:	0xC7	-
	T → O configuration:	0x65	88

Configurable Input Assembly	▪ Current device diagnostics ▪ Mass flow ▪ Volume flow ▪ Corrected volume flow ▪ Density ▪ Reference density ▪ Temperature ▪ Totalizer 1 ▪ Totalizer 2 ▪ Totalizer 3 The range of options increases if the measuring device has one or more application packages.
Fix output	
Output Assembly	▪ Activation of reset totalizers 1-3 ▪ Activation of pressure compensation ▪ Activation of reference density compensation ▪ Activation of temperature compensation ▪ Reset totalizers 1-3 ▪ External pressure value ▪ Pressure unit ▪ External reference density ▪ Reference density unit ▪ External temperature ▪ Temperature unit
Configuration	

Configuration Assembly	Only the most common configurations are listed below.
	▪ Software write protection
	▪ Mass flow unit
	▪ Mass unit
	▪ Volume flow unit
	▪ Volume unit
	▪ Corrected volume flow unit
	▪ Corrected volume unit
	▪ Density unit
	▪ Reference density unit
	▪ Temperature unit
	▪ Pressure unit
	▪ Length
	▪ Totalizer 1-3:
	  ▪ Assignment
	  ▪ Unit
	  ▪ Mode of operation
	  ▪ Failure mode
	▪ Alarm delay

PROFINET

Protocol	"Application layer protocol for decentral device periphery and distributed automation", version 2.3
Conformity class	B
Communication type	100 Mbps
Device profile	Application interface identifier 0xF600 Generic device
Manufacturer ID	0x11
Device type ID	0x844A
Device description files (GSD, DTM)	Information and files available at: ▪ https://www.endress.com/download On the device product page: PRODUCTS → Product Finder → Links ▪ https://www.profibus.com
Baud rates	Automatic 100 Mbit/s with full-duplex detection

Periods	From 8 ms
Polarity	Auto-polarity for automatic correction of crossed TxD and RxD pairs
Supported connections	▪ 1 x AR (Application Relation) ▪ 1 x Input CR (Communication Relation) ▪ 1 x Output CR (Communication Relation) ▪ 1 x Alarm CR (Communication Relation)
Configuration options for measuring instrument	▪ DIP switches on the electronics module, for device name assignment (last part) ▪ Manufacturer-specific software (FieldCare, DeviceCare) ▪ Web browser ▪ Device master file (GSD), can be read out via the integrated web server of the measuring instrument
Configuration of the device name	▪ DIP switches on the electronics module, for device name assignment (last part) ▪ DCP protocol
Output values (from measuring instrument to automation system)	**Analog Input module (slot 1 to 14)** ▪ Mass flow ▪ Volume flow ▪ Corrected volume flow ▪ Target mass flow ▪ Carrier mass flow ▪ Density ▪ Reference density ▪ Concentration ▪ Temperature ▪ Carrier pipe temperature ▪ Electronics temperature ▪ Oscillation frequency ▪ Oscillation amplitude ▪ Frequency fluctuation ▪ Oscillation damping ▪ Tube damping fluctuation ▪ Signal asymmetry ▪ Exciter current **Discrete Input module (slot 1 to 14)** ▪ Empty pipe detection ▪ Low flow cut off **Diagnostics Input module (slot 1 to 14)** ▪ Last diagnostics ▪ Current diagnostics **Totalizer 1 to 3 (slot 15 to 17)** ▪ Mass flow ▪ Volume flow ▪ Corrected volume flow **Heartbeat Verification module (fixed assignment)** Verification status (slot 23) The range of options increases if the measuring device has one or more application packages.

Input values
(from automation system to measuring instrument)
	Analog Output module (fixed assignment)
	▪ External pressure (slot 18)
	▪ External temperature (slot 19)
	▪ External reference density (slot 20)
	Discrete Output module (fixed assignment)
	▪ Activate/deactivate positive zero return (slot 21)
	▪ Perform zero adjustment (slot 22)
	Totalizer 1 to 3 (slot 15 to 17)
	▪ Totalize
	▪ Reset and hold
	▪ Preset and hold
	▪ Stop
	▪ Operating mode configuration:
	  ▪ Net flow total
	  ▪ Forward flow total
	  ▪ Reverse flow total
	Heartbeat Verification module (fixed assignment)
	Start verification (slot 23)
	The range of options increases if the measuring device has one or more application packages.

Supported functions	▪ Identification & maintenance
	Simple device identification via:
	  ▪ Control system
	  ▪ Nameplate
	▪ Measured value status
	The process variables are communicated with a measured value status
	▪ Blinking feature via the local display for simple device identification and assignment

Administration of software options

Input/output value	Process variable	Category	Slot
Output value	Mass flow	Process variable	1…14
	Volume flow		
	Corrected volume flow		
	Density		
	Reference density		
	Temperature		
	Electronics temperature		
	Oscillation frequency		
	Frequency fluctuation		
	Oscillation damping		
	Oscillation frequency		
	Signal asymmetry		
	Exciter current		
	Empty pipe detection		
	Low flow cut off		
	Current device diagnostics		
	Previous device diagnostics		
Output value	Target mass flow	Concentration [1)]	1…14
	Carrier mass flow		
	Concentration		
Output value	Carrier pipe temperature	Heartbeat Technology [2)]	1…14

Input/output value	Process variable	Category	Slot
	Oscillation damping 1		
	Oscillation frequency 1		
	Oscillation amplitude 0		
	Oscillation amplitude 1		
	Frequency fluctuation 1		
	Tube damping fluctuation 1		
	Exciter current 1		
Input value	External density	Process monitoring	18
	External temperature		19
	External reference density		20
	Flow override		21
	Zero adjustment		22
	Verification status	Heartbeat Verification [2)]	23

1) Only available with the "Concentration" application package.
2) Only available with the Heartbeat Technology application package.

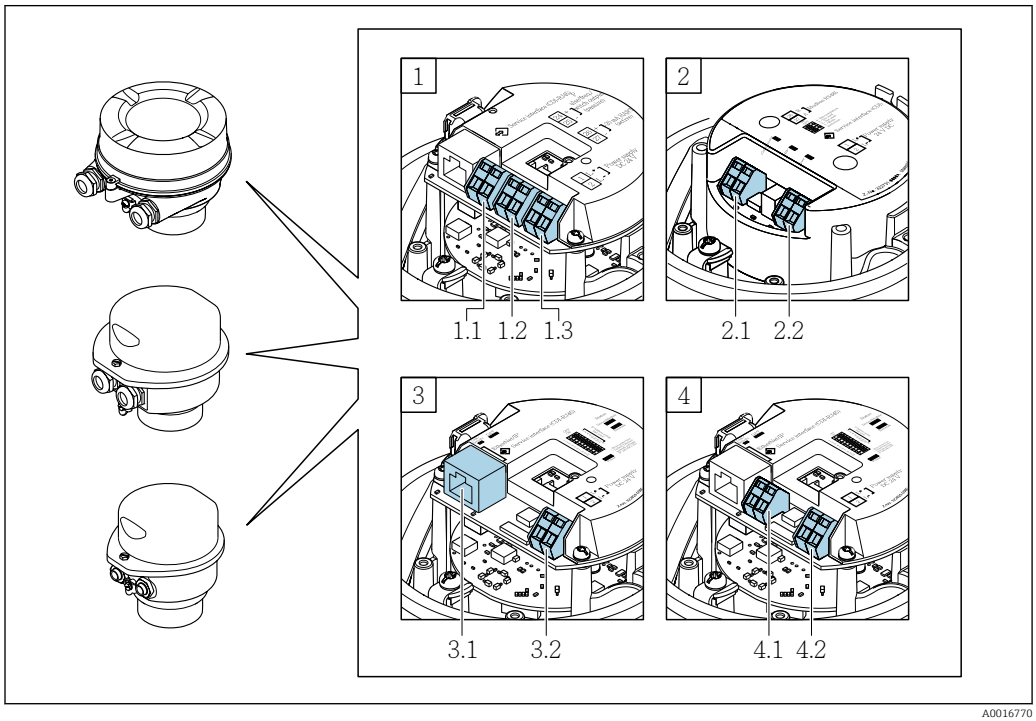
Startup configuration

Startup configuration (NSU)	If startup configuration is enabled, the configuration of the most important device parameters is taken from the automation system and used.
	
	The following configuration is taken from the automation system:
	▪ Management
	  ▪ Software revision
	  ▪ Write protection
	▪ System units
	  ▪ Mass flow
	  ▪ Mass
	  ▪ Volume flow
	  ▪ Volume
	  ▪ Corrected volume flow
	  ▪ Corrected volume
	  ▪ Density
	  ▪ Reference density
	  ▪ Temperature
	  ▪ Pressure
	▪ Concentration application package
	  ▪ Coefficients A0 to A4
	  ▪ Coefficients B1 to B3
	▪ Sensor adjustment
	▪ Process parameters
	  ▪ Damping (flow, density, temperature)
	  ▪ Flow override
	▪ Low flow cut off
	  ▪ Assign process variable
	  ▪ Switch-on/switch-off point
	  ▪ Pressure shock suppression
	▪ Empty pipe detection
	  ▪ Assign process variable
	  ▪ Limit values
	  ▪ Response time
	  ▪ Max. damping
	▪ Corrected volume flow calculation
	  ▪ External reference density
	  ▪ Fixed reference density
	  ▪ Reference temperature
	  ▪ Linear expansion coefficient
	  ▪ Square expansion coefficient
	▪ Measuring mode
	  ▪ Medium
	  ▪ Gas type
	  ▪ Reference sound velocity
	  ▪ Temperature coefficient sound velocity
	▪ External compensation
	  ▪ Pressure compensation
	  ▪ Pressure value
	  ▪ External pressure
	▪ Diagnostic settings
	▪ Diagnostic behavior for diverse diagnostic information

Power supply

Terminal assignment

Overview: housing version and connection versions



A Housing version: compact, aluminum coated
B Housing version: compact, hygienic, stainless
C Housing version: ultra-compact, hygienic, stainless
1 Connection version: 4-20 mA HART, pulse/frequency/switch output
1.1 Signal transmission: pulse/frequency/switch output
1.2 Signal transmission: 4-20 mA HART
1.3 Supply voltage
2 Connection version: Modbus RS485
2.1 Signal transmission
2.2 Supply voltage
3 Connection versions: EtherNet/IP and PROFINET
3.1 Signal transmission
3.2 Supply voltage
4 Connection version: PROFIBUS DP
4.1 Signal transmission
4.2 Supply voltage

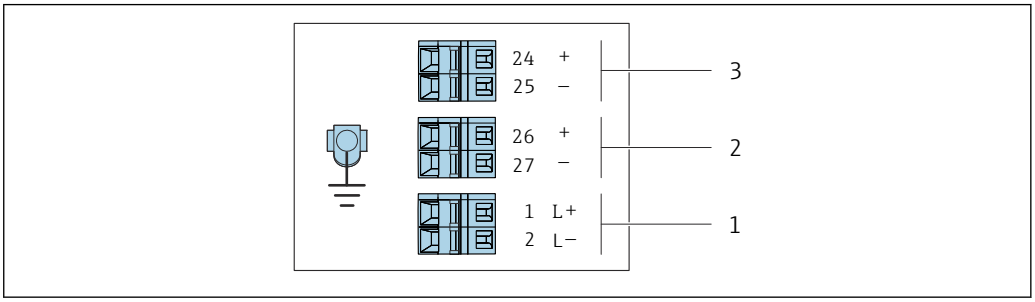
Transmitter

Connection version 4-20 mA HART with pulse/frequency/switch output

Order code for "Output", option **B**

Depending on the housing version, the transmitters can be ordered with terminals or device plugs.

Order code "Housing"	Connection methods available		Possible options for order code "Electrical connection"
	Outputs	Power supply	
Options **A**, **B**	Terminals	Terminals	▪ Option **A**: coupling M20x1 ▪ Option **B**: thread M20x1 ▪ Option **C**: thread G ½" ▪ Option **D**: thread NPT ½"
Options **A**, **B**	Device plugs → 📄 32	Terminals	▪ Option **L**: plug M12x1 + thread NPT ½" ▪ Option **N**: plug M12x1 + coupling M20 ▪ Option **P**: plug M12x1 + thread G ½" ▪ Option **U**: plug M12x1 + thread M20
Options **A**, **B**, **C**	Device plugs → 📄 32	Device plugs → 📄 32	Option **Q**: 2 x plug M12x1
Order code for "Housing": ▪ Option **A**: compact, coated aluminum ▪ Option **B**: compact, hygienic, stainless ▪ Option **C** ultra-compact, hygienic, stainless			



2 Terminal assignment 4-20 mA HART with pulse/frequency/switch output

1 Power supply: DC 24 V
2 Output 1: 4-20 mA HART (active)
3 Output 2: pulse/frequency/switch output (passive)

Order code "Output"	Terminal number					
	Power supply		Output 1		Output 2	
	2 (L-)	1 (L+)	27 (–)	26 (+)	25 (–)	24 (+)
Option **B**	DC 24 V		4-20 mA HART (active)		Pulse/frequency/switch output (passive)	
Order code for "Output": Option **B**: 4-20 mA HART with pulse/frequency/switch output						

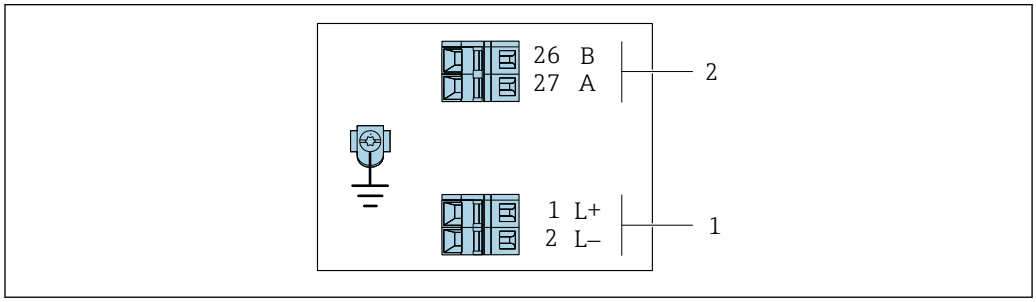
PROFIBUS DP connection version

For use in the non-hazardous area and Zone 2/Div. 2

Order code for "Output", option **L**

Depending on the housing version, the transmitters can be ordered with terminals or device plugs.

Order code "Housing"	Connection methods available		Possible options for order code "Electrical connection"
	Output	Power supply	
Options **A**, **B**	Terminals	Terminals	▪ Option **A**: coupling M20x1 ▪ Option **B**: thread M20x1 ▪ Option **C**: thread G ½" ▪ Option **D**: thread NPT ½"
Options **A**, **B**	Device plug connectors → 32	Terminals	▪ Option **L**: plug M12x1 + thread NPT ½" ▪ Option **N**: plug M12x1 + coupling M20 ▪ Option **P**: plug M12x1 + thread G ½" ▪ Option **U**: plug M12x1 + thread M20
Options **A**, **B**, **C**	Device plug connectors → 32	Device plug connectors → 32	Option **Q**: 2 x plug M12x1
Order code for "Housing": ▪ Option **A**: compact, coated aluminum ▪ Option **B**: compact, hygienic, stainless ▪ Option **C** ultra-compact, hygienic, stainless			



3 PROFIBUS DP terminal assignment

1 Power supply: DC 24 V
2 PROFIBUS DP

Order code "Output"	Terminal number			
	Power supply		Output	
	2 (L-)	1 (L+)	26 (RxD/TxD-P)	27 (RxD/TxD-N)
Option **L**	DC 24 V		B	A
Order code for "Output": Option **L**: PROFIBUS DP, for use in non-hazardous areas and Zone 2/Div. 2				

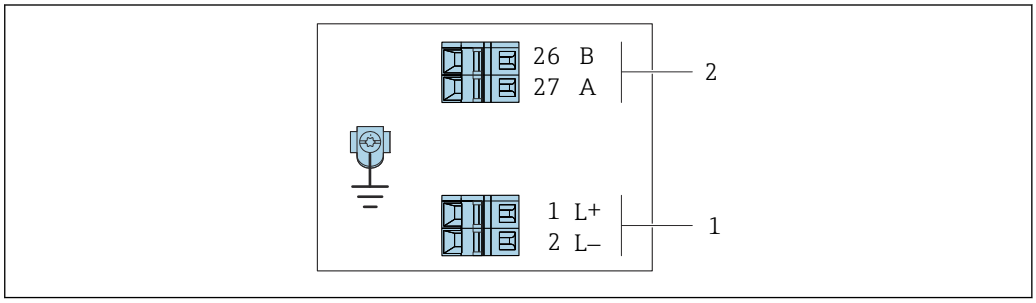
Modbus RS485 connection version

For use in the non-hazardous area and Zone 2/Div. 2

Order code for "Output", option **M**

Depending on the housing version, the transmitters can be ordered with terminals or device plugs.

Order code "Housing"	Connection methods available		Possible options for order code "Electrical connection"
	Output	Power supply	
Options **A**, **B**	Terminals	Terminals	▪ Option **A**: coupling M20x1 ▪ Option **B**: thread M20x1 ▪ Option **C**: thread G ½" ▪ Option **D**: thread NPT ½"
Options **A**, **B**	Device plugs → 🖹 32	Terminals	▪ Option **L**: plug M12x1 + thread NPT ½" ▪ Option **N**: plug M12x1 + coupling M20 ▪ Option **P**: plug M12x1 + thread G ½" ▪ Option **U**: plug M12x1 + thread M20
Options **A**, **B**, **C**	Device plugs → 🖹 32	Device plugs → 🖹 32	Option **Q**: 2 x plug M12x1
Order code for "Housing": ▪ Option **A**: compact, coated aluminum ▪ Option **B**: compact, hygienic, stainless ▪ Option **C**: ultra-compact, hygienic, stainless			



4 *Modbus RS485 terminal assignment, connection version for use in non-hazardous areas and Zone 2/Div. 2*

1 Power supply: DC 24 V
2 Modbus RS485

Order code "Output"	Terminal number			
	Power supply		Output	
	1 (L+)	2 (L-)	26 (B)	27 (A)
Option **M**	DC 24 V		Modbus RS485	
Order code for "Output": Option **M**: Modbus RS485, for use in non-hazardous areas and Zone 2/Div. 2				

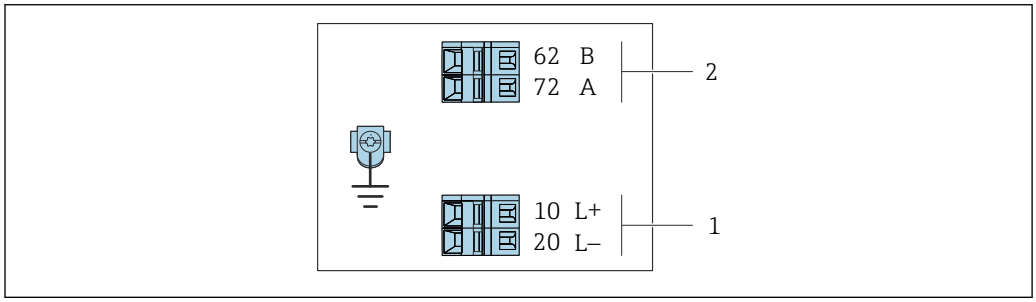
Modbus RS485 connection version

For use in the intrinsically safe area. Connection via Safety Barrier Promass 100.

Order code for "Output", option **M**

Depending on the housing version, the transmitters can be ordered with terminals or device plugs.

Order code "Housing"	Connection methods available		Possible options for order code "Electrical connection"
	Output	Power supply	
Options **A**, **B**	Terminals	Terminals	▪ Option **A**: coupling M20x1 ▪ Option **B**: thread M20x1 ▪ Option **C**: thread G ½" ▪ Option **D**: thread NPT ½"
A, **B**, **C**	Device plugs → 🖹 32		Option **I**: plug M12x1
Order code for "Housing": ▪ Option **A**: compact, coated aluminum ▪ Option **B**: compact, hygienic, stainless ▪ Option **C** ultra-compact, hygienic, stainless			



5 Modbus RS485 terminal assignment, connection version for use in intrinsically safe areas (connection via Safety Barrier Promass 100)

1 Intrinsically safe power supply
2 Modbus RS485

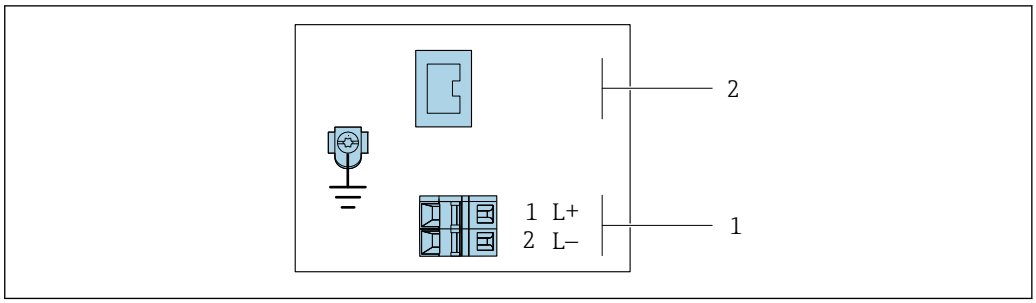
Order code "Output"	10 (L+)	20 (L-)	62 (B)	72 (A)
Option **M**	Intrinsically safe supply voltage		Modbus RS485 intrinsically safe	
Order code for "Output": Option **M**: Modbus RS485, for use in the intrinsically safe area (connection via Safety Barrier Promass 100)				

EtherNet/IP connection version

Order code for "Output", option **N**

Depending on the housing version, the transmitters can be ordered with terminals or device plugs.

Order code "Housing"	Connection methods available		Possible options for order code "Electrical connection"
	Output	Power supply	
Options **A**, **B**	Device plug connectors → 🖹 33	Terminals	▪ Option **L**: plug M12x1 + thread NPT ½" ▪ Option **N**: plug M12x1 + coupling M20 ▪ Option **P**: plug M12x1 + thread G ½" ▪ Option **U**: plug M12x1 + thread M20
Options **A**, **B**, **C**	Device plug connectors → 🖹 33	Device plug connectors → 🖹 33	Option **Q**: 2 x plug M12x1
Order code for "Housing": ▪ Option **A**: compact, coated aluminum ▪ Option **B**: compact, hygienic, stainless ▪ Option **C** ultra-compact, hygienic, stainless			



6 EtherNet/IP terminal assignment

1 Power supply: DC 24 V
2 EtherNet/IP

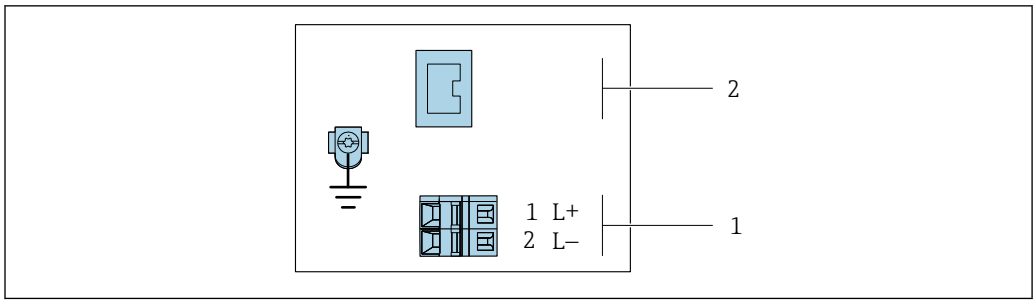
Order code "Output"	Terminal number		
	Power supply		Output
	2 (L-)	1 (L+)	Device plug M12x1
Option **N**	DC 24 V		EtherNet/IP
Order code for "Output": Option **N**: EtherNet/IP			

PROFINET connection version

Order code for "Output", option **R**

Depending on the housing version, the transmitters can be ordered with terminals or device plugs.

Order code "Housing"	Connection methods available		Possible options for order code "Electrical connection"
	Output	Power supply	
Options **A**, **B**	Device plug connectors → 31	Terminals	▪ Option **L**: plug M12x1 + thread NPT ½" ▪ Option **N**: plug M12x1 + coupling M20 ▪ Option **P**: plug M12x1 + thread G ½" ▪ Option **U**: plug M12x1 + thread M20
Options **A**, **B**, **C**	Device plug connectors → 31	Device plug connectors → 31	Option **Q**: 2 x plug M12x1
Order code for "Housing": ▪ Option **A**: compact, coated aluminum ▪ Option **B**: compact, hygienic, stainless ▪ Option **C** ultra-compact, hygienic, stainless			

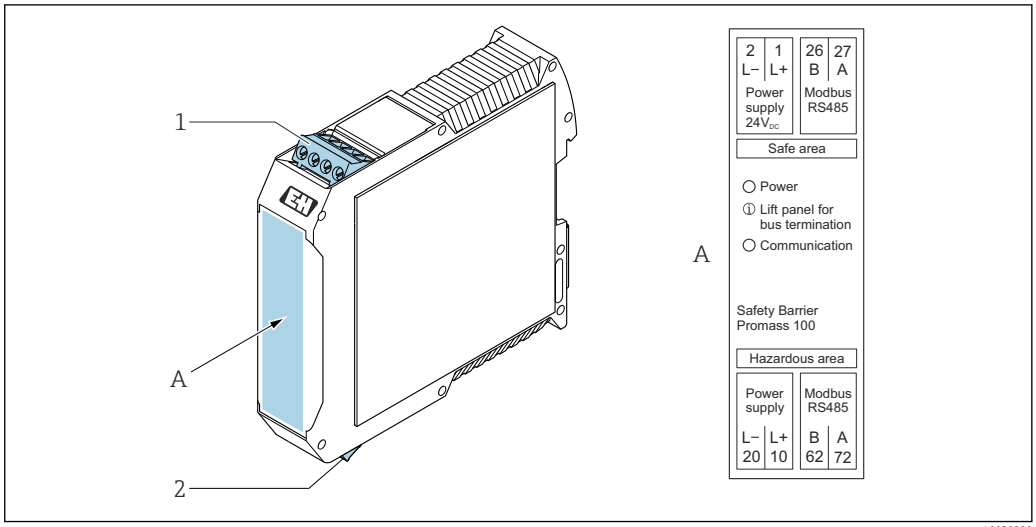


7 PROFINET terminal assignment

1 Power supply: DC 24 V
2 PROFINET

Order code "Output"	Terminal number		
	Power supply		Output
	2 (L-)	1 (L+)	Device plug M12x1
Option **R**	DC 24 V		PROFINET
Order code for "Output": Option **R**: PROFINET			

Safety Barrier Promass 100



8 Safety Barrier Promass 100 with terminals

1 Non-hazardous area, Zone 2, Class I Division 2
2 Intrinsically safe area

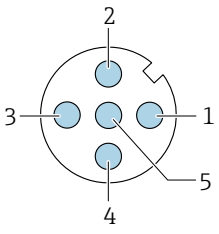
Pin assignment, device plug

Order codes for the M12x1 plugs, see the "Order code for **electrical connection**" column:
- 4-20 mA HART, pulse/frequency/switch output → 📄 24
- PROFIBUS DP→ 📄 26
- Modbus RS485 → 📄 27
- Ethernet/IP → 📄 29
- PROFINET→ 📄 30

Supply voltage

Intrinsically safe for all connection versions except MODBUS RS485 (device side), male connection (plug)

Device plug MODBUS RS485 intrinsically safe with supply voltage → 📄 32



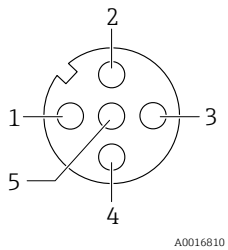
Pin		Assignment
1	L+	DC 24 V
2		Not assigned
3		Not assigned
4	L-	DC 24 V
5		Grounding/shielding [1]
Coding		**Plug/socket**
A		Plug

1) Not assigned for order code for "Housing", option C "Ultra-compact, hygienic, stainless"

The following is recommended as a socket:
- Binder, series 763, part no. 79 3440 35 05
- Alternatively: Phoenix part no. 1682951 SAC-5P-5.0-PUR/M12FS SH
  - With the order code for "Output", option **B**: 4-20 mA HART, pulse/frequency/switch output
  - With the order code for "Output", option **N**: EtherNet/IP
- When using the device in a hazardous location: Use a suitably certified socket.

4-20 mA HART with pulse/frequency/switch output

Device plug for signal transmission (device side), female connection



Pin		Assignment
1	+	4-20 mA HART (active)
2	-	4-20 mA HART (active)
3	+	Pulse/frequency/switch output (passive)
4	-	Pulse/frequency/switch output (passive)
5		Grounding/shielding [1]
Coding		**Plug/socket**
A		Socket

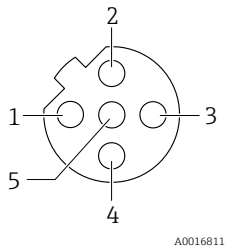
1) Not assigned for order code for "Housing", option C "Ultra-compact, hygienic, stainless"

- Recommended plug: Binder, series 763, part no. 79 3439 12 05
- When using the device in a hazardous location, use a suitably certified plug.

PROFIBUS DP

For use in the non-hazardous area and Zone 2/Div. 2.

Device plug for signal transmission (device side)



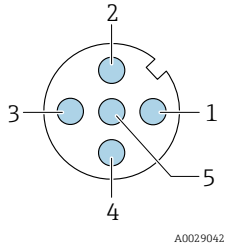
Pin		Assignment
1		Not assigned
2	A	PROFIBUS DP
3		Not assigned
4	B	PROFIBUS DP
5		Grounding/shielding [1]
Coding		**Plug/socket**
B		Socket

1) Not assigned for order code for "Housing", option C "Ultra-compact, hygienic, stainless"

- Recommended plug: Binder, series 763, part no. 79 4449 20 05
- When using the device in a hazardous location, use a suitably certified plug.

MODBUS RS485

Device plug for signal transmission with supply voltage (device side), MODBUS RS485 (intrinsically safe)



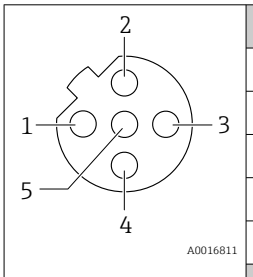
Pin		Assignment
1	L+	Supply voltage, intrinsically safe
2	A	Modbus RS485, intrinsically safe
3	B	
4	L-	Supply voltage, intrinsically safe
5		Grounding/shielding [1]
Coding		**Plug/socket**
A		Plug

1) Not assigned for order code for "Housing", option C "Ultra-compact, hygienic, stainless"

- Recommended socket: Binder, series 763, part no. 79 3439 12 05
- When using the device in a hazardous location: Use a suitably certified socket.

Device plug for signal transmission (device side), MODBUS RS485 (not intrinsically safe)

For use in the non-hazardous area and Zone 2/Div. 2.



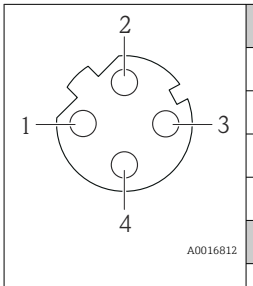
Pin		Assignment
1		Not assigned
2	A	Modbus RS485
3		Not assigned
4	B	Modbus RS485
5		Grounding/shielding [1]
Coding		**Plug/socket**
B		Socket

1) Not assigned for order code for "Housing", option C "Ultra-compact, hygienic, stainless"

- Recommended plug: Binder, series 763, part no. 79 4449 20 05
- When using the device in a hazardous location, use a suitably certified plug.

EtherNet/IP

Device plug for signal transmission (device side)

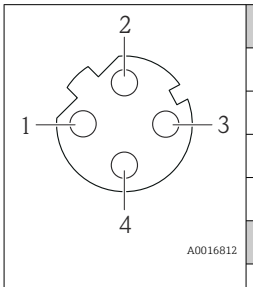


Pin		Assignment
1	+	Tx
2	+	Rx
3	-	Tx
4	-	Rx
Coding		**Plug/socket**
D		Socket

Recommended plug:
- Binder, series 763, part no. 99 3729 810 04
- Phoenix, part no. 1543223 SACC-M12MSD-4Q
- When using the device in a hazardous location, use a suitably certified plug.

PROFINET

Device plug for signal transmission (device side)



Pin		Assignment
1	+	TD +
2	+	RD +
3	-	TD –
4	-	RD –
Coding		**Plug/socket**
D		Socket

Recommended plug:
- Binder, series 825, part no. 99 3729 810 04
- Phoenix, part no. 1543223 SACC-M12MSD-4Q
- When using the device in a hazardous location, use a suitably certified plug.

Supply voltage

The power unit must be tested to ensure it meets safety requirements (e.g. PELV, SELV).

Transmitter

For device version with communication type:
- HART, PROFIBUS DP, EtherNet/IP: DC 20 to 30 V
- Modbus RS485, device version:
  - For use in the non-hazardous area and Zone 2/Div. 2: DC 20 to 30 V
  - For use in the intrinsically safe area: power supply via Safety Barrier Promass 100

Promass 100 safety barrier

DC 20 to 30 V

Power consumption

Transmitter

Order code for "Output"	Maximum Power consumption
Option **B**: 4-20 mA HART with pulse/frequency/switch output	3.5 W
Option **L**: PROFIBUS DP	3.5 W
Option **M**: Modbus RS485, for use in intrinsically safe areas	2.45 W
Option **N**: EtherNet/IP	3.5 W
Option **R**: PROFINET	3.5 W

Promass 100 safety barrier

Order code for "Output"	Maximum Power consumption
Option **M**: Modbus RS485, for use in intrinsically safe areas	4.8 W

Current consumption

Transmitter

Order code for "Output"	Maximum Current consumption	Maximum switch-on current
Option **B**: 4-20mA HART, pul./freq./switch output	145 mA	18 A (< 0.125 ms)
Option **L**: PROFIBUS DP	145 mA	18 A (< 0.125 ms)
Option **M** Modbus RS485, for use in non-hazardous areas and Zone 2/Div. 2	90 mA	10 A (< 0.8 ms)
Option **M**: Modbus RS485, for use in intrinsically safe areas	145 mA	16 A (< 0.4 ms)
Option **N**: EtherNet/IP	145 mA	18 A (< 0.125 ms)
Option **R**: PROFINET	145 mA	18 A (< 0.125 ms)

Promass 100 safety barrier

Order code for "Output"	Maximum Current consumption	Maximum switch-on current
Option **M**: Modbus RS485, for use in intrinsically safe areas	230 mA	10 A (< 0.8 ms)

Device fuse

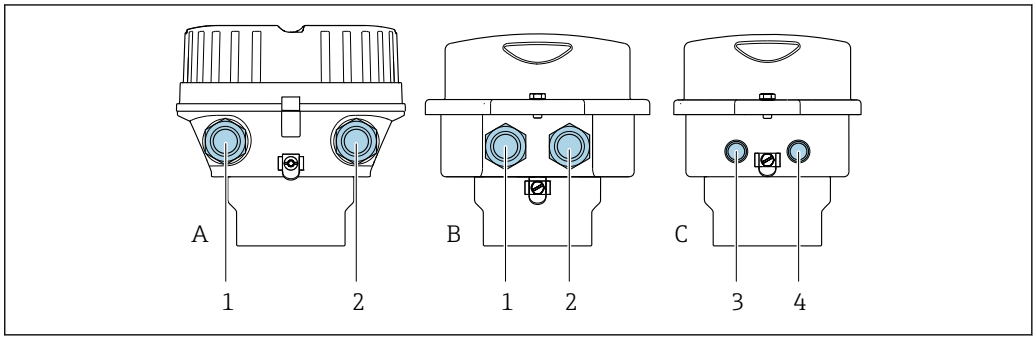
Fine-wire fuse (slow-blow) T2A

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.

Electrical connection

Connecting the transmitter



A0016924

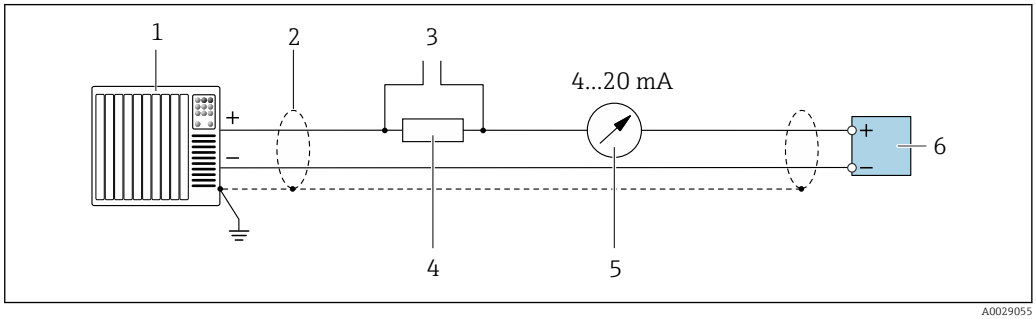
A Housing version: compact, coated, aluminum
B Housing version: compact, hygienic, stainless
1 Cable entry or device plug for signal transmission
2 Cable entry or device plug for supply voltage
C Housing version: ultra-compact, hygienic, stainless, M12 device plug
3 Device plug for signal transmission
4 Device plug for supply voltage

- Terminal assignment→ 24
- Pin assignment, device plug→ 31

In the case of device versions with a connector, the transmitter housing does not need to be opened to connect the signal cable or power supply cable.

Connection examples

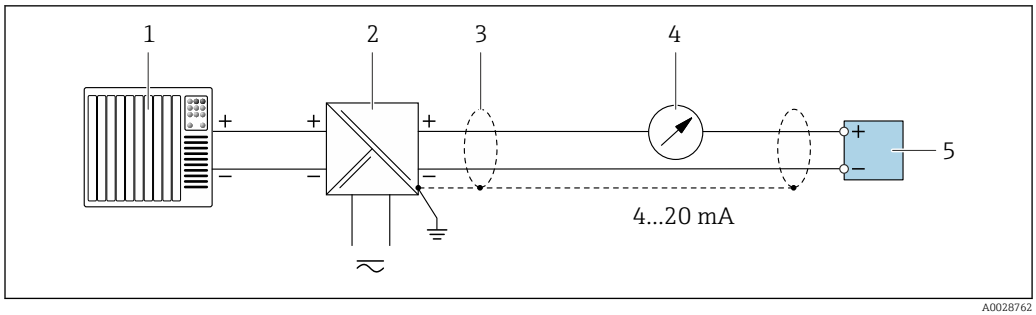
Current output 4 to 20 mA HART



A0029055

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

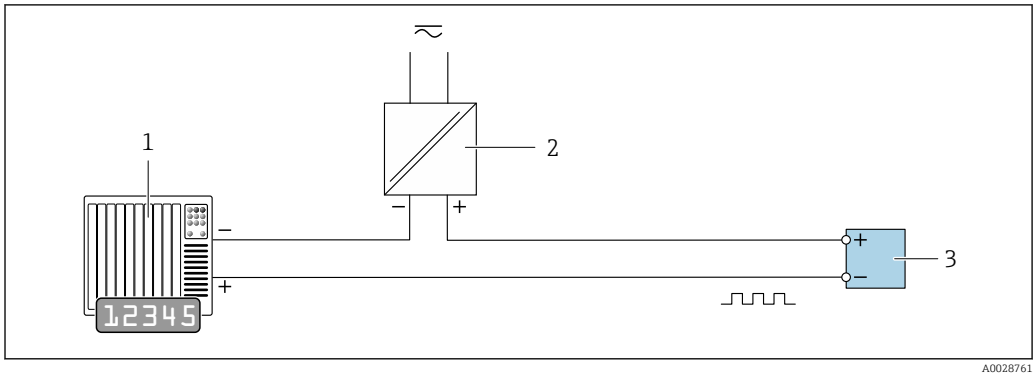
1 Automation system with current input (e.g. PLC)
2 Cable shield provided at one end. The cable shield must be grounded at both ends to comply with EMC requirements; observe cable specifications → 40
3 Connection for HART operating devices → 77
4 Resistor for HART communication (≥ 250 Ω): observe maximum load
5 Analog display unit: observe maximum load
6 Transmitter



10 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 → 40*
4 *Analog display unit: observe maximum load*
5 *Transmitter*

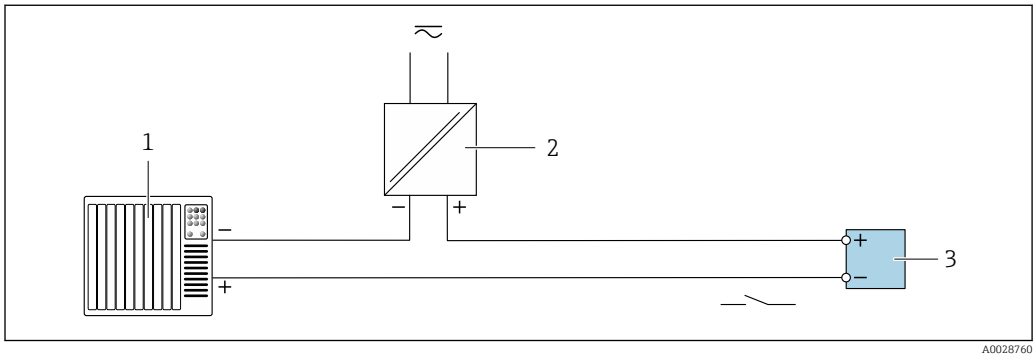
Pulse/frequency output



11 Connection example for pulse/frequency output (passive)

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

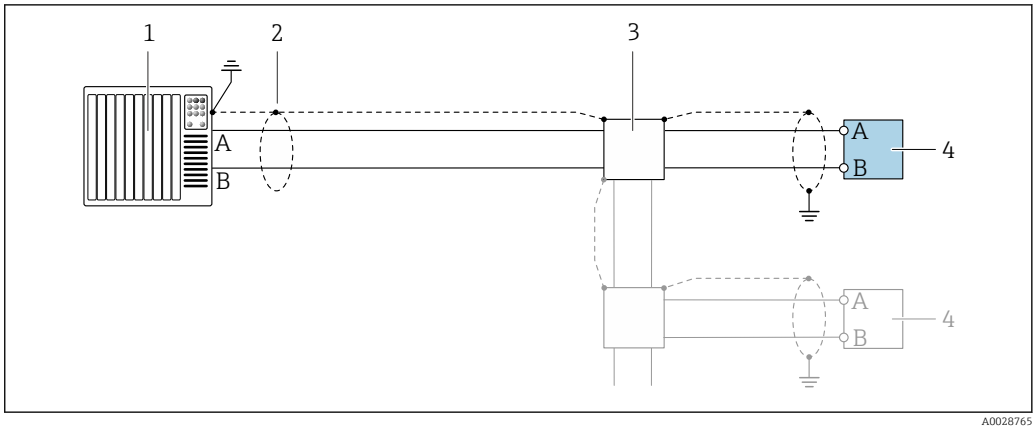
Switch output



12 Connection example for switch output (passive)

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

PROFIBUS DP



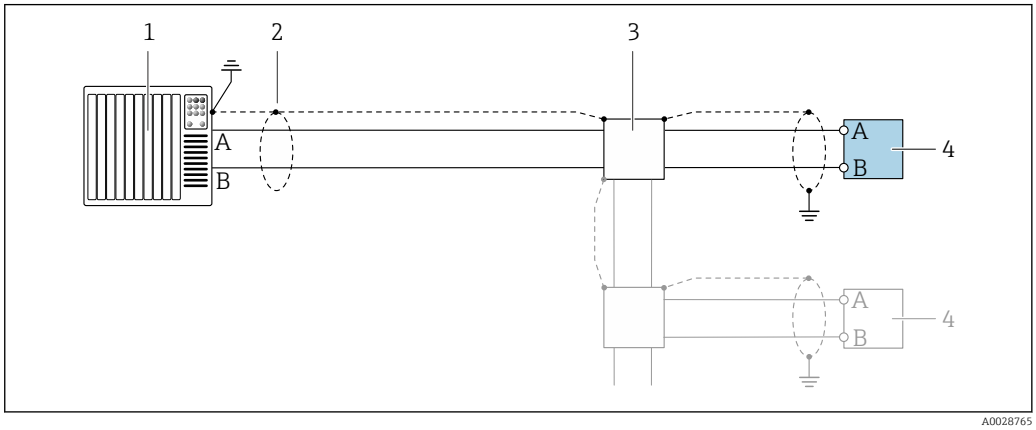
13 Connection example for PROFIBUS DP, non-hazardous area and Zone 2/Div. 2

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

If baud rates > 1.5 MBaud an EMC cable entry must be used and the cable shield must continue as far as the terminal wherever possible.

Modbus RS485

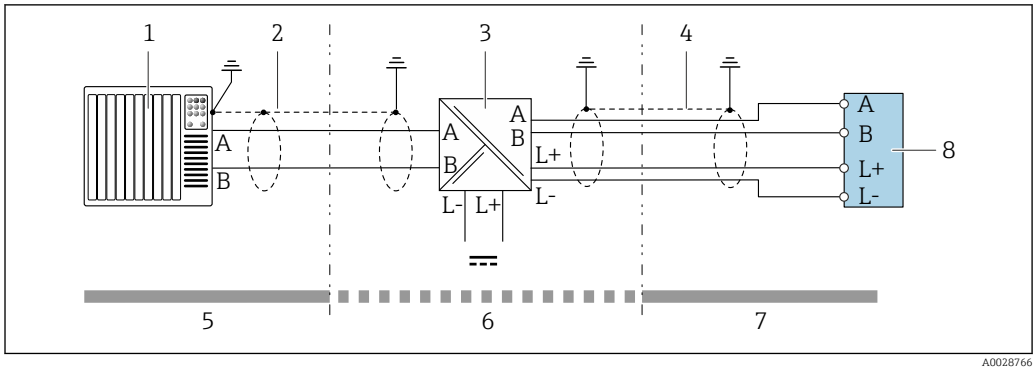
Modbus RS485, non-hazardous area and Zone 2/Div. 2



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

1 Control system (e.g. PLC)
2 Cable shield provided at one end. The cable shield must be grounded at both ends to comply with EMC requirements; observe cable specifications → 40
3 Distribution box
4 Transmitter

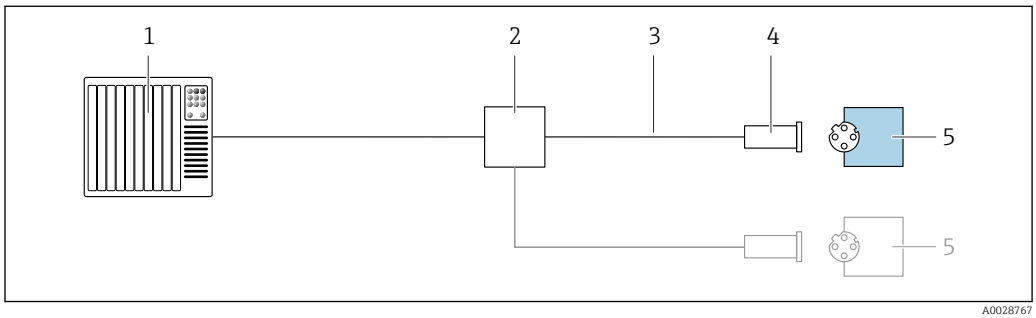
Modbus RS485 intrinsically safe



15 *Connection example for Modbus RS485 intrinsically safe*

1 *Control system (e.g. PLC)*
2 *Cable shield provided at one end. Observe cable specifications*
3 *Safety Barrier Promass 100*
4 *Observe cable specifications*
5 *Non-hazardous area*
6 *Non-hazardous area and Zone 2/Div. 2*
7 *Intrinsically safe area*
8 *Transmitter*

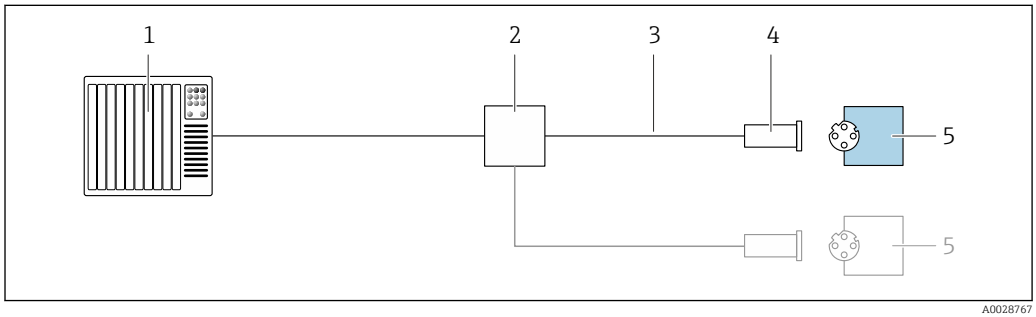
EtherNet/IP



16 *Connection example for EtherNet/IP*

1 *Control system (e.g. PLC)*
2 *Ethernet switch*
3 *Observe cable specifications*
4 *Device plug*
5 *Transmitter*

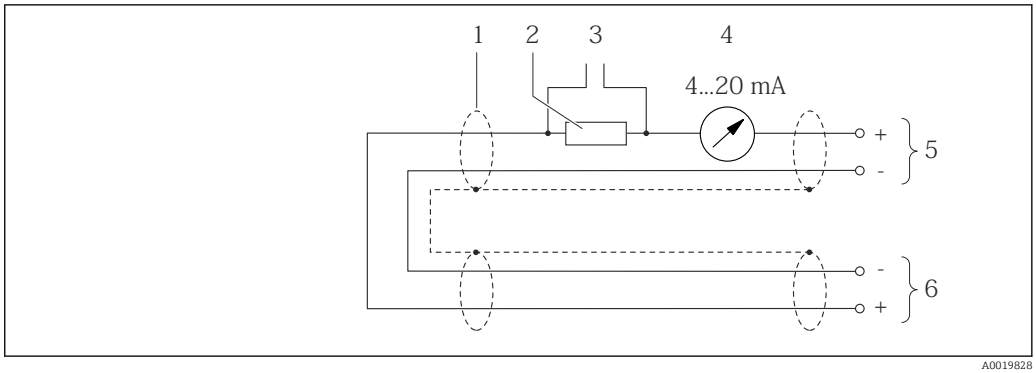
PROFINET



17 *Connection example for PROFINET*

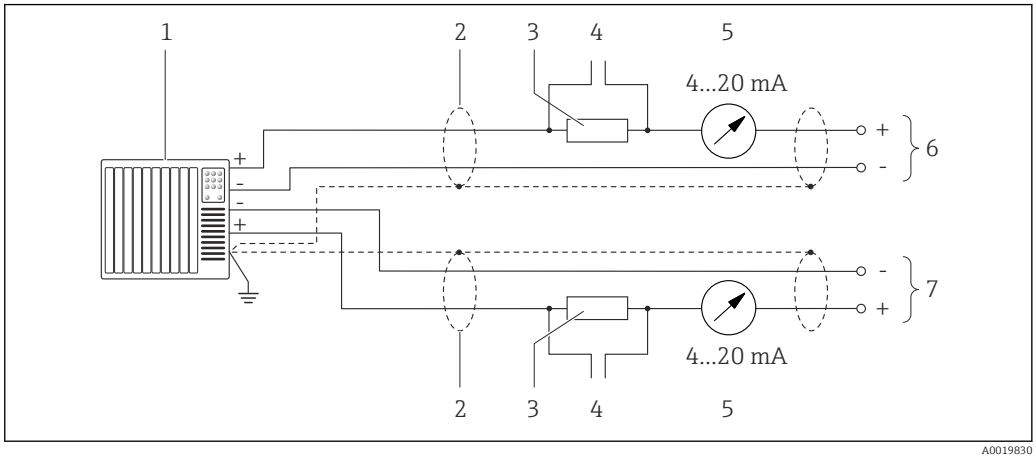
1 *Control system (e.g. PLC)*
2 *Ethernet switch*
3 *Observe cable specifications*
4 *Device plug*
5 *Transmitter*

HART input



18 Connection example for HART input (burst mode) via current output (active)

1 *Cable shield provided at one end. Observe cable specifications*
2 *Resistor for HART communication (≥ 250 Ω): observe maximum load*
3 *Connection for HART operating devices*
4 *Analog display unit*
5 *Transmitter*
6 *Sensor for external measured variable*



19 Connection example for HART input (master mode) via current output (active)

1 *Automation system with current input (e.g. PLC).*
Prerequisite: automation system with HART version 6, HART commands 113 and 114 can be processed.
2 *Cable shield provided at one end. Observe cable specifications*
3 *Resistor for HART communication (≥ 250 Ω): observe maximum load*
4 *Connection for HART operating devices*
5 *Analog display unit*
6 *Transmitter*
7 *Sensor for external measured variable*

Potential equalization

Requirements

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

Terminals

Transmitter

Spring terminals for wire cross-sections0.5 to 2.5 mm² (20 to 14 AWG)

Promass 100 safety barrier

Plug-in screw terminals for wire cross-sections0.5 to 2.5 mm² (20 to 14 AWG)

Cable entries

- Cable gland: M20 × 1.5 with cable Ø 6 to 12 mm (0.24 to 0.47 in)
- Thread for cable entry:
  - M20
  - G ½"
  - NPT ½"

Cable specification

Permitted temperature range

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

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

Standard installation cable is sufficient.

Signal cable

For custody transfer, all signal lines must be shielded cables (tinned copper braiding, optical coverage ≥ 85 %). The cable shield must be connected on both sides.

Current output 4 to 20 mA HART

Shielded twisted-pair cable.

See https://www.fieldcommgroup.org "HART PROTOCOL SPECIFICATIONS".

Pulse /frequency /switch output

Standard installation cable is sufficient.

PROFIBUS DP

Shielded twisted-pair cable. Cable type A is recommended.

See https://www.profibus.com "PROFIBUS Installation Guidelines".

Modbus RS485

Shielded twisted-pair cable.

See https://modbus.org "MODBUS over Serial Line Specification and Implementation Guide".

EtherNet/IP

Twisted-pair Ethernet CAT 5 or better.

See https://www.odva.org"EtherNet/IP Media Planning & Installation Manual".

PROFINET

Only PROFINET cables.

See https://www.profibus.com "PROFINET Planning guideline".

Connecting cable between Safety Barrier Promass 100 and measuring device

Cable type	Shielded twisted-pair cable with 2x2 wires. When grounding the cable shield, observe the grounding concept of the plant.
Maximum cable resistance	2.5 Ω, one side

Comply with the maximum cable resistance specifications to ensure the operational reliability of the measuring device.

The maximum cable length for individual wire cross-sections is specified in the table below. Observe the maximum capacitance and inductance per unit length of the cable and connection values for hazardous areas .

Wire cross-section		Maximum cable length	
[mm²]	[AWG]	[m]	[ft]
0.5	20	70	230
0.75	18	100	328
1.0	17	100	328
1.5	16	200	656
2.5	14	300	984

Performance characteristics

Reference operating conditions

- Error limits based on ISO 11631
- Water
  - +15 to +45 °C (+59 to +113 °F)
  - 2 to 6 bar (29 to 87 psi)
- Data as indicated in the calibration protocol
- Accuracy based on accredited calibration rigs according to ISO 17025

To obtain measured errors, use the *Applicator* sizing tool → 87

Maximum measurement error

o.r. = of reading; 1 g/cm³ = 1 kg/l; T = medium temperature

Base accuracy

Design fundamentals → 44

Mass flow and volume flow (liquids)

±0.10 % o.r.

Mass flow (gases)

±0.50 % o.r.

Density (liquids)

Under reference conditions [g/cm³]	Standard density calibration [1] [g/cm³]	Wide-range Density specification [2] [3] [g/cm³]
±0.0005	±0.001	±0.002

1) For devices with the order code "Measuring tube material, wetted surface", option HB "Alloy C22, high pressure, not polished", the standard density calibration ±0.002 g/cm³
2) Valid range for special density calibration: 0 to 2 g/cm³, +5 to +80 °C (+41 to +176 °F)
3) order code for "Application package", option EE "Special density"

Temperature

±0.5 °C ± 0.005 · T °C (±0.9 °F ± 0.003 · (T − 32) °F)

Zero point stability

DN		Zero point stability	
[mm]	[in]	[kg/h]	[lb/min]
1	1/24	0.0010	0.000036
2	1/12	0.0050	0.00018
4	1/8	0.0225	0.0008

Flow values

Flow values as turndown parameters depending on nominal diameter.

SI units

DN [mm]	1:1 [kg/h]	1:10 [kg/h]	1:20 [kg/h]	1:50 [kg/h]	1:100 [kg/h]	1:500 [kg/h]
1	20	2	1	0.4	0.2	0.04
2	100	10	5	2	1	0.2
4	450	45	22.5	9	4.5	0.9

US units

DN [inch]	1:1 [lb/min]	1:10 [lb/min]	1:20 [lb/min]	1:50 [lb/min]	1:100 [lb/min]	1:500 [lb/min]
1/24	0.735	0.074	0.037	0.015	0.007	0.001
1/12	3.675	0.368	0.184	0.074	0.037	0.007
1/8	16.54	1.654	0.827	0.331	0.165	0.033

Accuracy of outputs

The output accuracy must be factored into the measurement error if analog outputs are used; but can be ignored for fieldbus outputs (e.g. Modbus RS485, EtherNet/IP).

The outputs have the following base accuracy specifications.

Current output

Accuracy	Max. ±5 µA

Pulse/frequency output

o.r. = of reading

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

Repeatability

o.r. = of reading; 1 g/cm³ = 1 kg/l; T = medium temperature

Base repeatability

Design fundamentals → 🖹 44

Mass flow and volume flow (liquids)

±0.05 % o.r.

Mass flow (gases)

±0.25 % o.r.

Density (liquids)

±0.00025 g/cm³

Temperature

±0.25 °C ± 0.0025 · T °C (±0.45 °F ± 0.0015 · (T−32) °F)

Response time

The response time depends on the configuration (damping).

Influence of ambient temperature

Current output

o.r. = of reading

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

Pulse/frequency output

Temperature coefficient	No additional effect. Included in accuracy.

Influence of medium temperature

Mass flow

o.f.s. = of full scale value

If there is a difference between the temperature during zero adjustment and the process temperature, the additional measurement error of the sensors is typically ±0.0002 %o.f.s./°C (±0.0001 % o. f.s./°F).

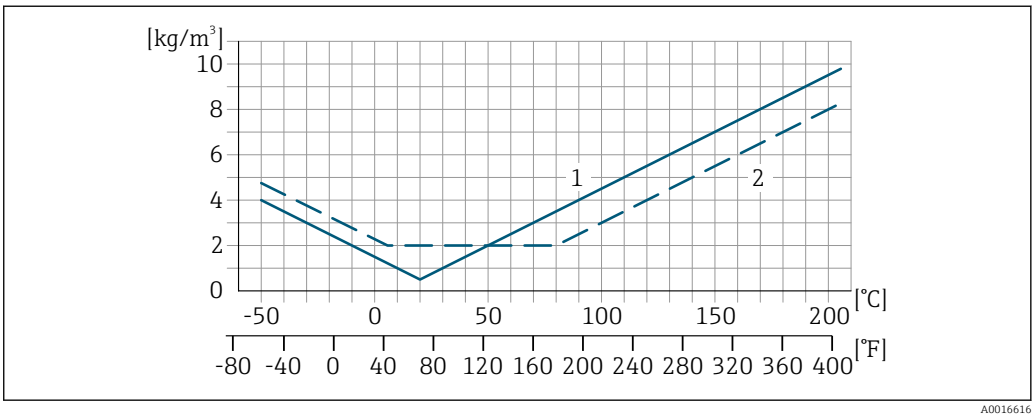
The influence is reduced when the zero adjustment is performed at process temperature.

Density

If there is a difference between the density calibration temperature and the process temperature, the measurement error of the sensors is typically ±0.00005 g/cm³/°C (±0.000025 g/cm³/°F). Field density adjustment is possible.

Wide-range density specification (special density calibration)

If the process temperature is outside the valid range (→ 41) the measurement error is ±0.00005 g/cm³ /°C (±0.000025 g/cm³ /°F)



1 Field density adjustment, for example at +20 °C (+68 °F)
2 Special density calibration

Temperature

±0.005 · T °C (± 0.005 · (T − 32) °F)

Influence of medium pressure

A difference between the calibration pressure and process pressure does not affect accuracy.

Influence of process density

If there is a difference in density between the calibration density and the process density, the measurement error for the measured density is typically:
- ±0.6% for nominal diameter DN 4 (1/24 in)
- ±1.4% for nominal diameter DN 2 (1/12 in)
- ±2.0% for nominal diameter DN 1 (1/12 in) and for devices with order code for "Measuring tube material, wetted surface:", option HB "Alloy C22, high pressure, not polished"

A field density adjustment is possible.

Design fundamentals

o.r. = of reading, o.f.s. = of full scale value

BaseAccu = base accuracy in % o.r., BaseRepeat = base repeatability in % o.r.

MeasValue = measured value; ZeroPoint = zero point stability

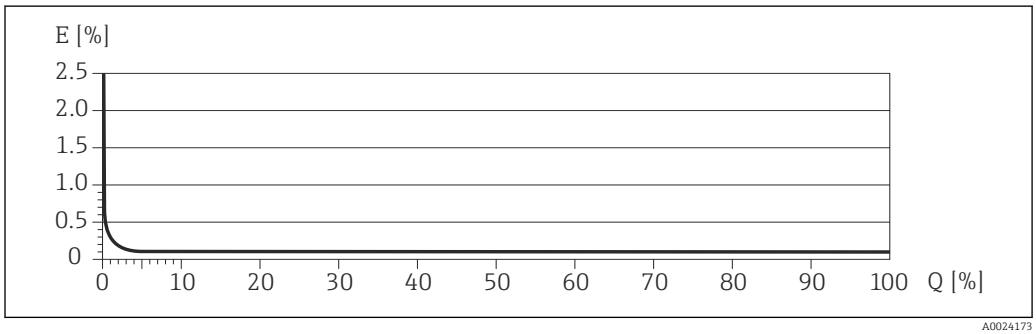
Calculation of the maximum measured error as a function of the flow rate

Flow rate	Maximum measured error in % o.r.
$\geq \frac{\text{ZeroPoint}}{\text{BaseAccu}} \cdot 100$ A0021332	$\pm$ BaseAccu A0021339
$< \frac{\text{ZeroPoint}}{\text{BaseAccu}} \cdot 100$ A0021333	$\pm \frac{\text{ZeroPoint}}{\text{MeasValue}} \cdot 100$ A0021334

Calculation of the maximum repeatability as a function of the flow rate

Flow rate	Maximum repeatability in % o.r.
$\geq \frac{½ \cdot \text{ZeroPoint}}{\text{BaseRepeat}} \cdot 100$ A0021335	$\pm$ BaseRepeat A0021340
$< \frac{½ \cdot \text{ZeroPoint}}{\text{BaseRepeat}} \cdot 100$ A0021336	$\pm ½ \cdot \frac{\text{ZeroPoint}}{\text{MeasValue}} \cdot 100$ A0021337

Example of maximum measurement error



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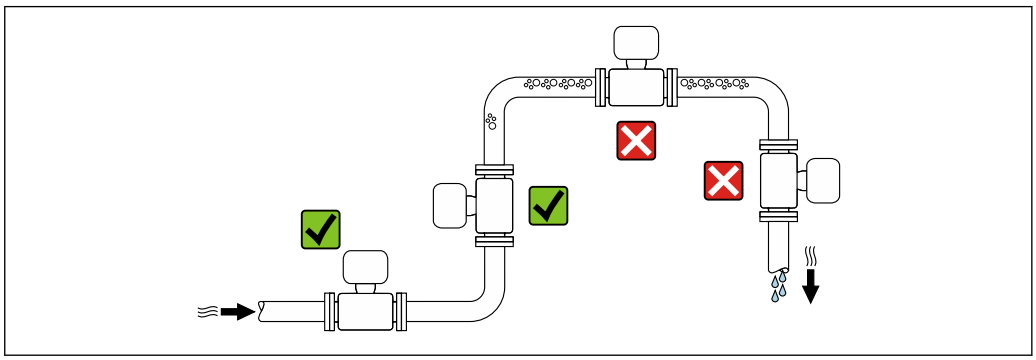
E Maximum measurement error in % o.r. (example)
Q Flow rate in % of maximum full scale value

Installation

Installation point



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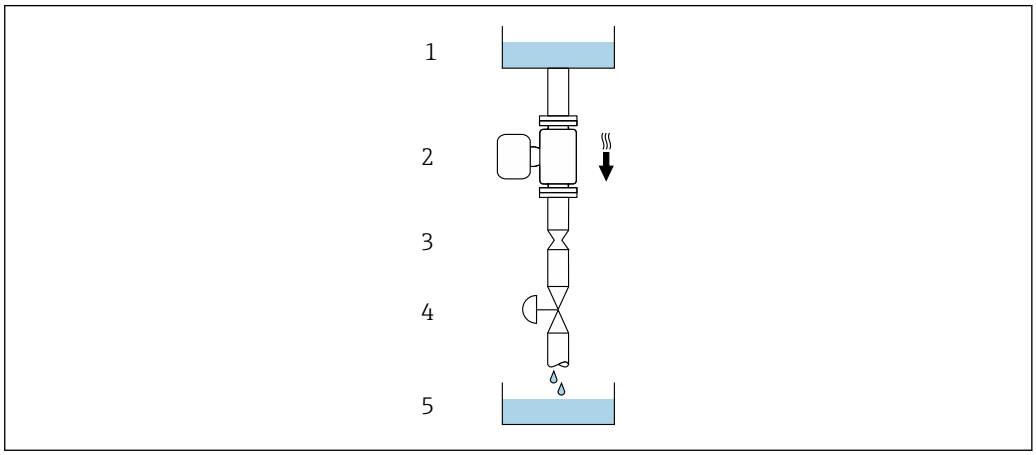
To prevent measuring errors arising from accumulation of gas bubbles in the measuring pipe, avoid the following mounting locations in the piping:
- Highest point of a pipeline.
- Directly upstream of a free pipe outlet in a down pipe.

Installation in down pipes

However, the following installation suggestion allows for installation in an open vertical pipeline. Pipe restrictions or the use of an orifice with a smaller cross-section than the nominal diameter prevent the sensor running empty while measurement is in progress.



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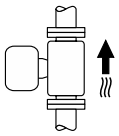
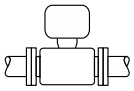
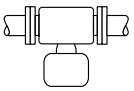
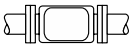
20 *Installation in a down pipe (e.g. for batching applications)*

1 *Supply tank*
2 *Sensor*
3 *Orifice plate, pipe restriction*
4 *Valve*
5 *Filling vessel*

DN		Ø orifice plate, pipe restriction	
[mm]	[in]	[mm]	[in]
1	1/24	0.8	0.03
2	1/12	1.5	0.06
4	1/8	3.0	0.12

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).

Orientation			Recommendation
A	Vertical orientation	 A0015591	✓✓ 1)
B	Horizontal orientation, transmitter at top	 A0015589	✓✓ 2)
C	Horizontal orientation, transmitter at bottom	 A0015590	✓✓ 3)
D	Horizontal orientation, transmitter at side	 A0015592	✗

1) This orientation is recommended to ensure self-draining.
2) Applications with low process temperatures may reduce the ambient temperature. To maintain the minimum ambient temperature for the transmitter, this orientation is recommended.
3) Applications with high process temperatures may increase the ambient temperature. To maintain the maximum ambient temperature for the transmitter, this orientation is recommended.

If a sensor is installed horizontally with a curved measuring tube, match the position of the sensor to the fluid properties.

Inlet and outlet runs

No special precautions need to be taken for fittings that create turbulence, such as valves, elbows or T-pieces, as long as no cavitation occurs → 🖹 53.

Special installation instructions

Hygienic compatibility

When installing in hygienic applications, please refer to the information in the "Certificates and approvals/hygienic compatibility" section → 🖹 83

Rupture disk

Process-related information: → 🖹 53.

⚠ WARNING

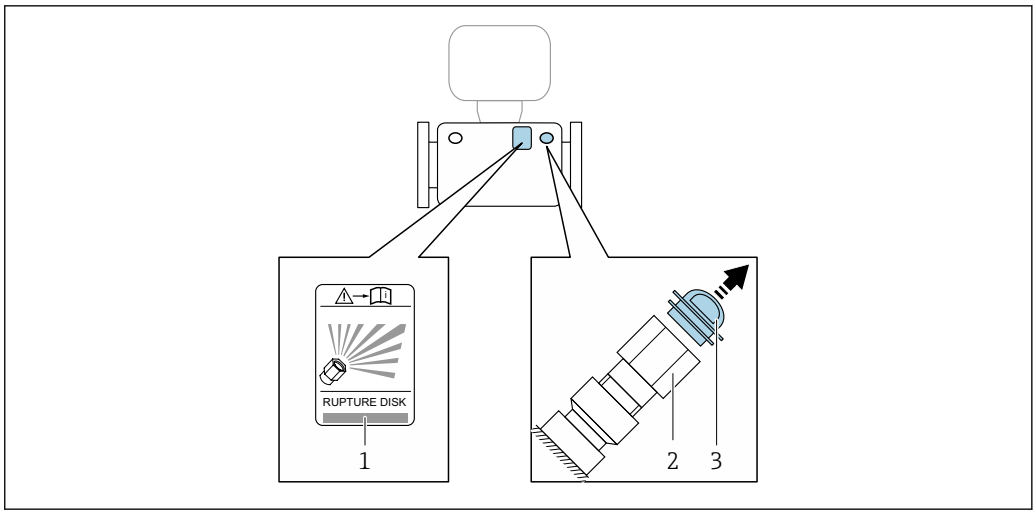
Danger from medium escaping!
Medium escaping under pressure can cause injury or material damage.
- ▶ Take precautions to prevent danger to persons and damage if the rupture disk is actuated.
- ▶ Observe the information on the rupture disk sticker.
- ▶ Make sure that the function and operation of the rupture disk is not impeded through the installation of the device.
- ▶ Do not use a heating jacket.
- ▶ Do not remove or damage the rupture disk.

The position of the rupture disk is indicated by a sticker affixed beside it.

The transportation guard must be removed.

The existing connecting nozzles are not intended for the purpose of rinsing or pressure monitoring, but instead serve as the mounting location for the rupture disk.

In the event of a failure of the rupture disk, a drain device can be screwed onto the internal thread of the rupture disk in order to drain off any escaping medium.



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1 *Rupture disk label*
2 *Rupture disk with 1/2" NPT internal thread and 1" width across flats*
3 *Transportation guard*

For information on the dimensions, see the "Mechanical construction" section (accessories).

Zero verification and zero adjustment

All measuring instruments are calibrated in accordance with state-of-the-art technology. Calibration takes place under reference conditions → 41. Therefore, a zero adjustment in the field is generally not required.

Experience shows that zero adjustment is advisable only in special cases:
- To achieve maximum measurement accuracy even with low flow rates.
- Under extreme process or operating conditions (e.g. very high process temperatures or very high-viscosity fluids).
- For gas applications with low pressure

For information on checking the zero point and performing a zero adjustment, see the Operating Instructions for the device.

To achieve the highest possible measurement accuracy at low flow rates, the installation must protect the sensor from mechanical stresses during operation.

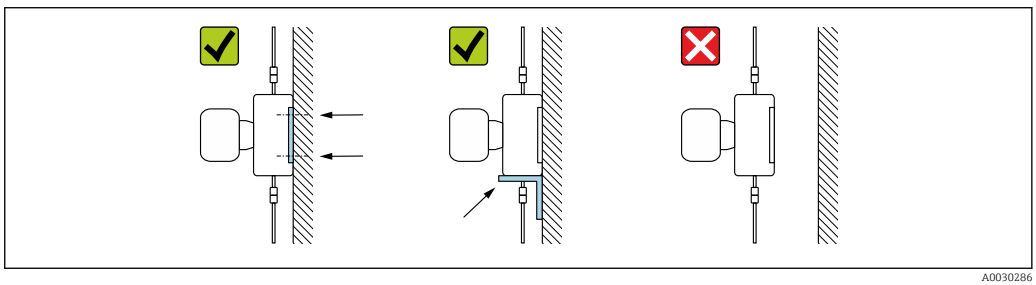
Wall mounting

WARNING

Incorrect sensor mounting
Risk of injury if measuring tube breaks
- ▶ The sensor should never be installed in a pipe in a way that it is freely suspended
- ▶ Using the base plate, mount the sensor directly on the floor, wall or ceiling.
- ▶ Support the sensor on a securely mounted support base (e.g. angle bracket).

The following mounting versions are recommended for the installation.

Vertical
- Mounted directly on a wall using the base plate, or
- Device supported on an angle bracket mounted on the wall



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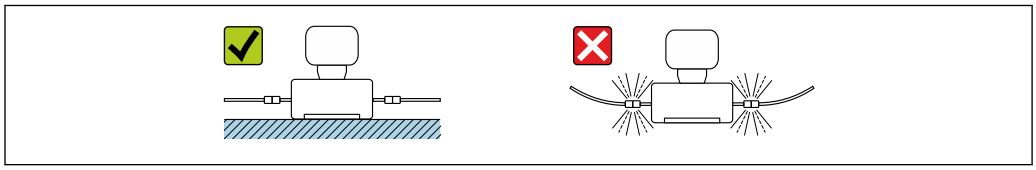
Horizontal
Device standing on a solid support base



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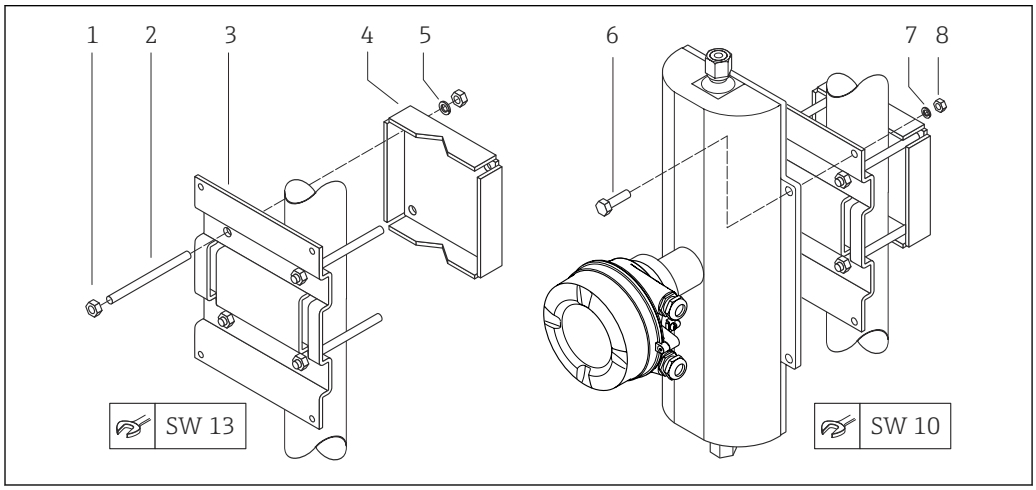
Post retainer

The post retainer mounting kit is used to secure the device to a pipe or post (order code for "Accessories", option PR).



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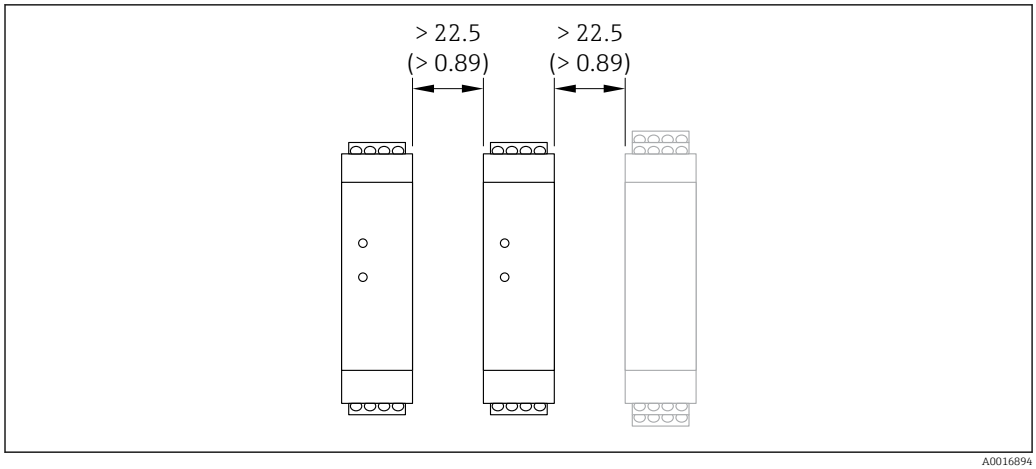
21 Post retainer mounting kit

1 8 x hexagonal nut M8 × 0.8
2 4 x threaded bolt M8 × 150
3 1 x post retaining plate
4 1 x post securing plate
5 4 x spring washer for M8
6 4 x hexagon bolt M6 × 20
7 4 x spring washer for M6
8 4 x hexagonal nut M6 × 0.8

Installing the Safety Barrier Promass 100



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22 Minimum distance between additional Safety Barrier Promass 100 or other modules. Engineering unit mm (in)

Environment

Ambient temperature range

Measuring device	▪ −40 to +60 °C (−40 to +140 °F) ▪ Order code for "Test, certificate", option JM: −50 to +60 °C (−58 to +140 °F)
Safety barrier Promass 100	−40 to +60 °C (−40 to +140 °F)

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

Storage temperature

−40 to +80 °C (−40 to +176 °F), preferably at +20 °C (+68 °F) (standard version)

−50 to +80 °C (−58 to +176 °F) (Order code for *"Test, certificate"*, option JM)

Climate class

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

Degree of protection

Transmitter and sensor
- Standard: IP66/67, Type 4X enclosure, suitable for pollution degree 4
- With the order code for "Sensor options", option CM: IP69 can also be ordered
- When the housing is open: IP20, Type 1 enclosure, suitable for pollution degree 2
- Display module: IP20, Type 1 enclosure, suitable for pollution degree 2

Safety Barrier Promass 100
IP20

Shock and vibration resistance

Vibration sinusoidal, in accordance with IEC 60068-2-6
- 2 to 8.4 Hz, 3.5 mm peak
- 8.4 to 2 000 Hz, 1 g peak

Vibration broad-band random, according to IEC 60068-2-64
- 10 to 200 Hz, 0.003 g^2/Hz
- 200 to 2 000 Hz, 0.001 g^2/Hz
- Total: 1.54 g rms

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

6 ms 30 g

Rough handling shocks according to IEC 60068-2-31

Internal cleaning
- CIP cleaning
- SIP cleaning

Options
Oil- and grease-free version for wetted parts, without declaration
Order code for "Service", option HA [1)]

1) The cleaning refers to the measuring instrument only. Any accessories supplied are not cleaned.

Electromagnetic compatibility (EMC)

- Depends on the communication protocol:
  - As per IEC/EN 61326 and NAMUR Recommendation 21 (NE 21)
  - As per IEC/EN 61000-6-2 and IEC/EN 61000-6-4
  - As per IEC/EN 61326
- Complies with emission limits for industry as per EN 55011 (Class A)
- Device version with PROFIBUS DP: Complies with emission limits for industry as per EN 50170 Volume 2, IEC 61784

The following applies for PROFIBUS DP: If baud rates > 1.5 MBaud, an EMC cable entry must be used and the cable shield must continue as far as the terminal wherever possible.

Details are provided in the Declaration of Conformity.

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

Process

Medium temperature range

−50 to +205 °C (−58 to +401 °F)

Seals

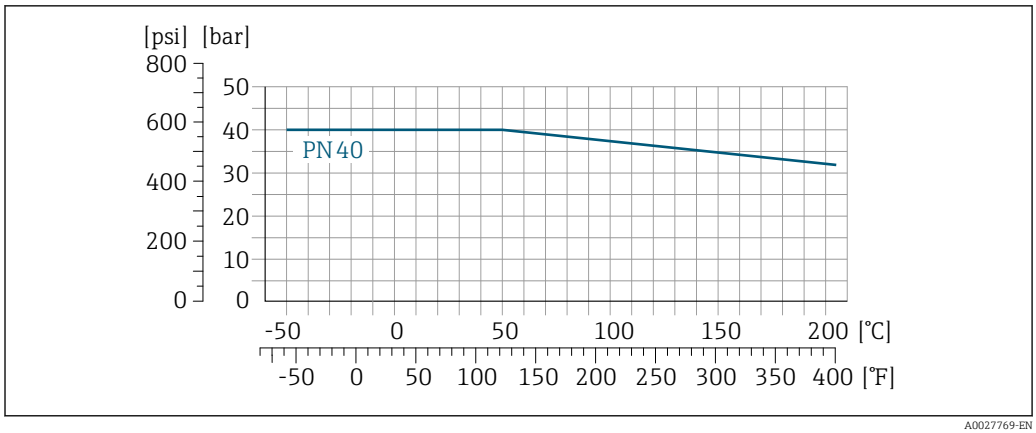
For mounting sets with screwed-on connections:
- Viton: −15 to +200 °C (−5 to +392 °F)
- EPDM: −40 to +160 °C (−40 to +320 °F)
- Silicone: −60 to +200 °C (−76 to +392 °F)
- Kalrez: −20 to +275 °C (−4 to +527 °F)

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.

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

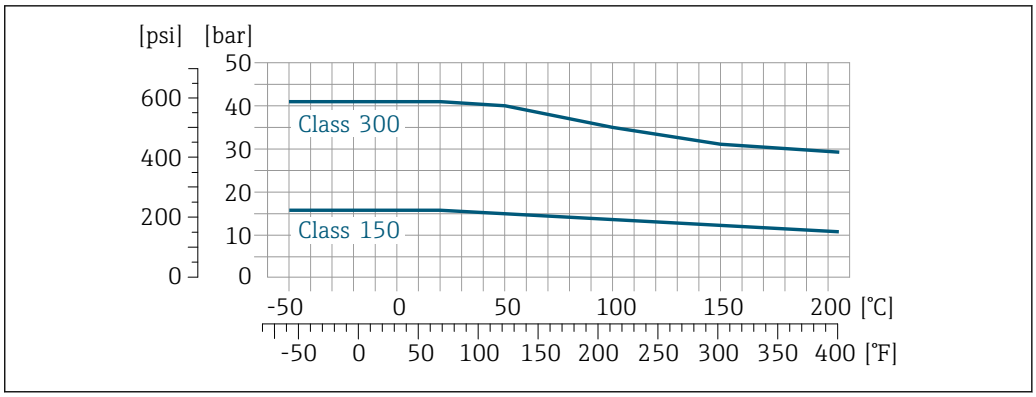
Order code for "Mounting kit", option PE, PM, PN, PO



23 With flange material: 1.4539 (904L), Alloy C22; lap joint flanges (not wetted): 1.4404 (F316L)

Flange connection according to ASME B16.5

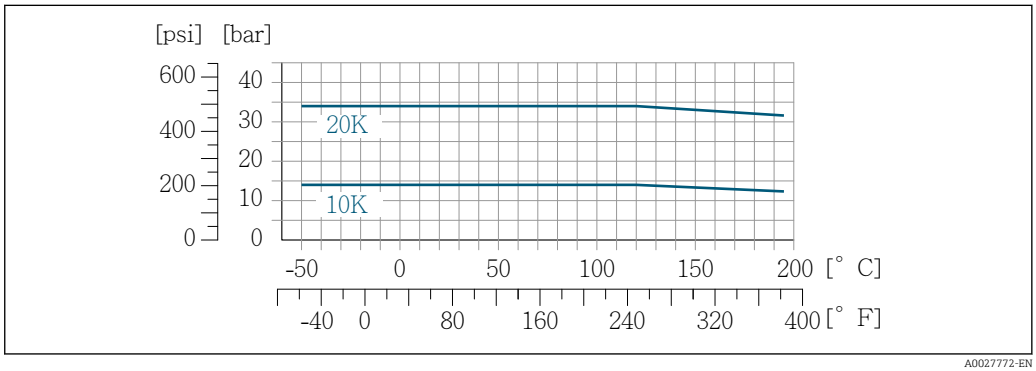
Order code for "Mounting kit", option PF, PP, PG, PQ



24 *With flange material: 1.4539 (904L), Alloy C22; lap joint flanges (not wetted): 1.4404 (F316L)*

Flange connection according to JIS B2220

Order code for "Mounting kit", option PH, PS, PT, PU

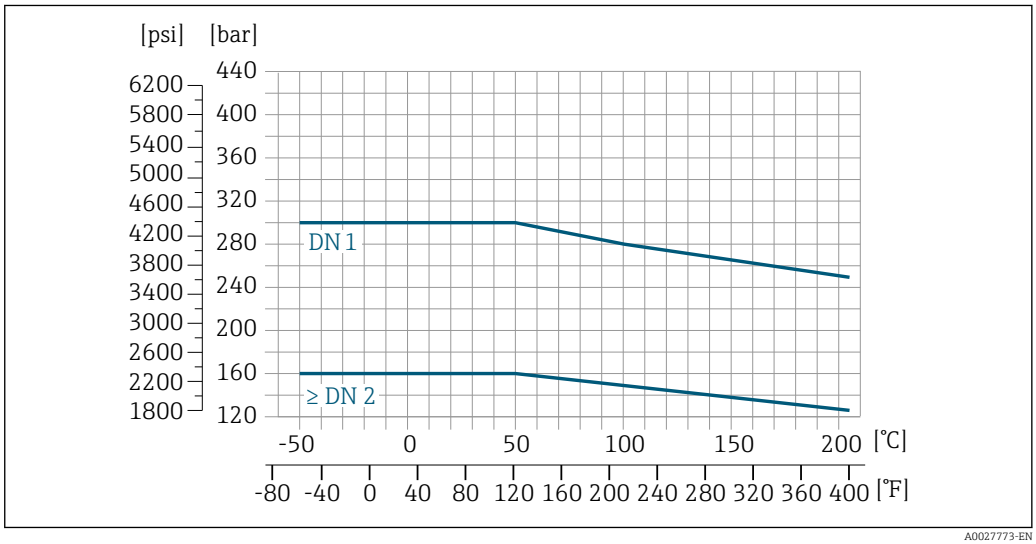


25 *With flange material: 1.4539 (904L), Alloy C22; lap joint flanges (not wetted): 1.4404 (F316L)*

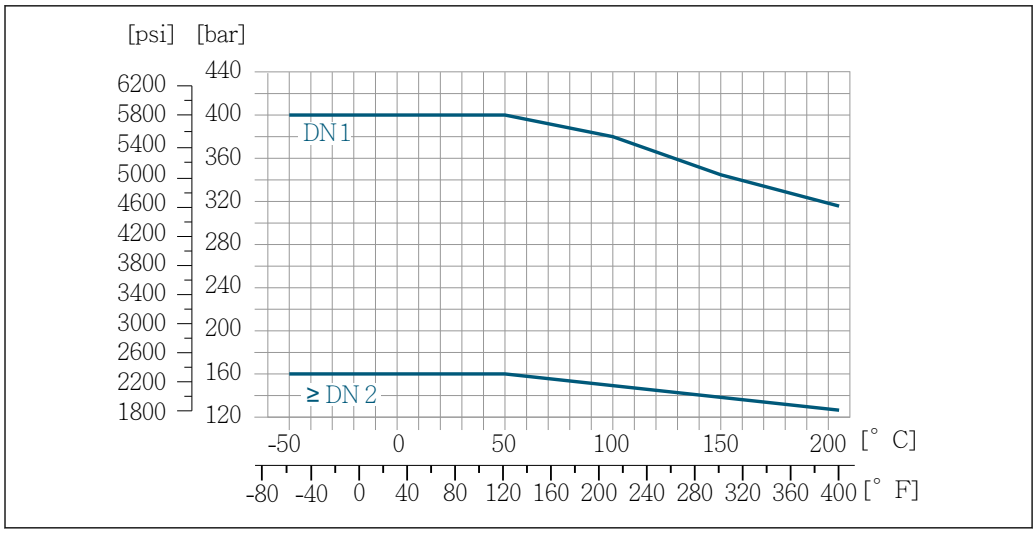
Tri-Clamp process connection

The clamp connections are suitable up to a maximum pressure of 16 bar (232 psi). The operating limits of the clamp and seal used must be observed, as they may be under 16 bar (232 psi). The clamp and seal are not included in the scope of supply.

Process connection 4-VCO-4, NPT ¼", SWAGELOK

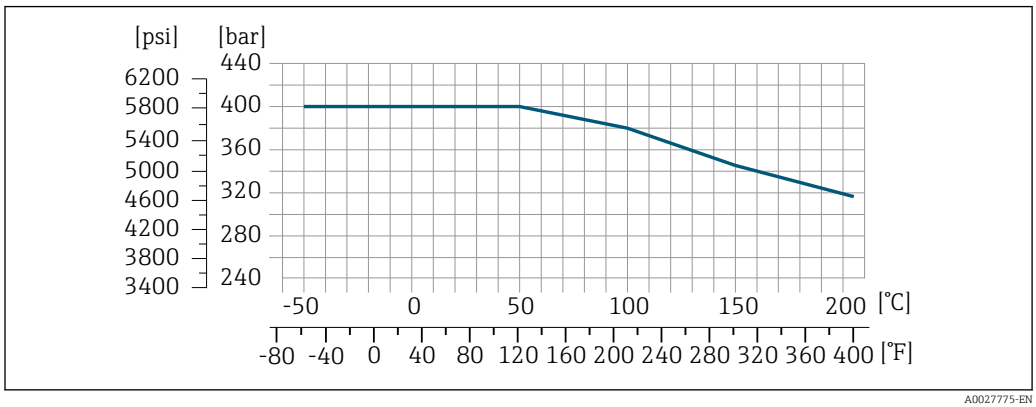


26 *With flange connection 4-VCO-4 coupling: 1.4539 (904L); ¼ NPT threaded adapter: 1.4539 (904L); ¼" or ⅛" SWAGELOK coupling: 1.4401 (316)*



27 *With flange connection 4-VCO-4 coupling: Alloy C22; ¼ NPT threaded adapter: Alloy C22; ¼" or ⅛" SWAGELOK coupling: 1.4401 (316)*

Process connections for high-pressure version (DN 2, 4)



28 *With flange connection 4-VCO-4 coupling: 1.4539 (904L); ¼ NPT threaded adapter: 1.4539 (904L); ¼" or ⅛" SWAGELOK coupling: 1.4401 (316)*

Sensor housing

The sensor housing is filled with dry nitrogen gas and protects the electronics and mechanics inside.

If a measuring tube fails (e.g. due to process characteristics like corrosive or abrasive fluids), the fluid will initially be contained by the sensor housing.

In the event of a tube failure, the pressure level inside the sensor housing will rise according to the operating process pressure. If the user judges that the sensor housing burst pressure does not provide an adequate safety margin, the device can be fitted with a rupture disk. This prevents excessively high pressure from forming inside the sensor housing. Therefore, the use of a rupture disk is strongly recommended in applications involving high gas pressures, and particularly in applications in which the process pressure is greater than 2/3 of the sensor housing burst pressure.

If there is a need to drain the leaking medium into a discharge device, the sensor should be fitted with a rupture disk. Connect the discharge to the additional threaded connection → 65.

If the sensor is to be purged with gas (gas detection), it should be equipped with purge connections.

Do not open the purge connections unless the containment can be filled immediately with a dry, inert gas. Use only low pressure to purge.

Maximum pressure: 5 bar (72.5 psi)

Burst pressure of the sensor housing

The following sensor housing burst pressures are only valid for standard devices and/or devices equipped with closed purge connections (not opened/as delivered).

If a device fitted with purge connections (order code for "Sensor option", option CH "Purge connection") is connected to the purge system, the maximum pressure is determined by the purge system itself or by the device, depending on which component has the lower pressure classification.

If the device is fitted with a rupture disk (order code for "Sensor option", option CA "Rupture disk"), the rupture disk trigger pressure is decisive .

The sensor housing burst pressure refers to a typical internal pressure which is reached prior to mechanical failure of the sensor housing and which was determined during type testing. The corresponding type test declaration can be ordered with the device (order code for "Additional approval", option LN "Sensor housing burst pressure, type test").

DN		Sensor housing burst pressure	
[mm]	[in]	[bar]	[psi]
1	1/24	175	2 538
2	1/12	155	2 248
4	1/8	130	1 885

For information on the dimensions: see the "Mechanical construction" section

Rupture disk

To increase the level of safety, a device version with a rupture disk with a trigger pressure of 10 to 15 bar (145 to 217.5 psi)can be used (order code for "Sensor option", option "rupture disk").

The use of rupture disks cannot be combined with the separately available heating jacket.

For information on the dimensions: see the "Mechanical construction" section (accessories) → 65

Flow limit

Select the nominal diameter by optimizing between the required flow range and permissible pressure loss.

For an overview of the full scale values for the measuring range, see the "Measuring range" section → 9

- The minimum recommended full scale value is approx. 1/20 of the maximum full scale value
- In most applications, 20 to 50 % of the maximum full scale value can be considered ideal
- A low full scale value must be selected for abrasive media (such as liquids with entrained solids): flow velocity < 1 m/s (< 3 ft/s).
- For gas measurement the following rules apply:
  - The flow velocity in the measuring tubes should not exceed half the sound velocity (0.5 Mach).
  - The maximum mass flow depends on the density of the gas: formula

To calculate the flow limit, use the *Applicator* sizing tool → 87

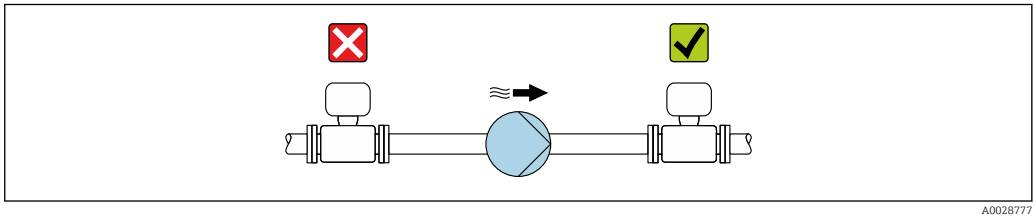
Pressure loss

To calculate the pressure loss, use the *Applicator* sizing tool → 87

Static pressure

It is important that cavitation does not occur, or that gases entrained in the liquids do not outgas. This is prevented by means of a sufficiently high static pressure.

For this reason, the following mounting locations are recommended:
- At the lowest point in a vertical pipe
- Downstream from pumps (no danger of vacuum)



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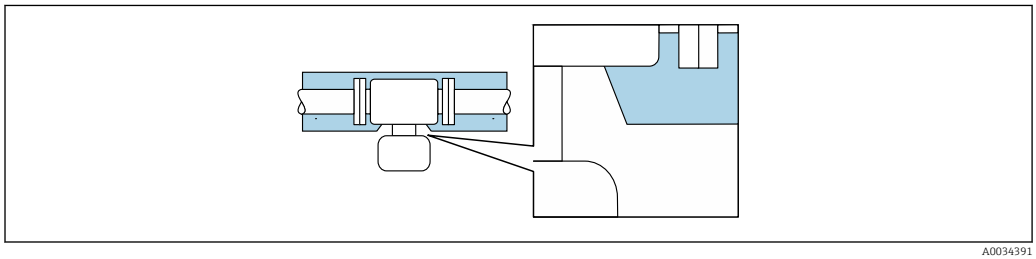
Thermal insulation

In the case of some fluids, it is important to keep the heat radiated from the sensor to the transmitter to a low level. A wide range of materials can be used for the required insulation.

NOTICE

Electronics overheating on account of thermal insulation!

- ▶ Recommended orientation: horizontal orientation, transmitter housing pointing downwards.
- ▶ Do not insulate the transmitter housing .
- ▶ Maximum permissible temperature at the lower end of the transmitter housing: 80 °C (176 °F)
- ▶ Regarding thermal insulation with an exposed extended neck: We advise against insulating the extended neck to ensure optimal heat dissipation.



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29 Thermal insulation with exposed extended neck

Heating

Some fluids require suitable measures to avoid loss of heat at the sensor.

Heating options

- Electrical heating, e.g. with electric band heaters [2)]
- Via pipes carrying hot water or steam
- Via heating jackets

Heating jackets for the sensors can be ordered as accessories from Endress+Hauser → 86.

NOTICE

Danger of overheating when heating

- ▶ Ensure that the temperature at the lower end of the transmitter housing does not exceed 80 °C (176 °F).
- ▶ Ensure that sufficient convection takes place at the transmitter neck.
- ▶ Ensure that a sufficiently large area of the transmitter neck remains exposed. The uncovered part serves as a radiator and protects the electronics from overheating and excessive cooling.
- ▶ When using in potentially explosive atmospheres, observe the information in the device-specific Ex documentation. For detailed information on the temperature tables, see the separate document entitled "Safety Instructions" (XA) for the device.
- ▶ Consider the "830 ambient temperature too high" and "832 electronics temperature too high" process diagnostics if overheating cannot be ruled out based on a suitable system design.

Vibrations

The high oscillation frequency of the measuring tubes ensures that the correct operation of the measuring system is not influenced by plant vibrations.

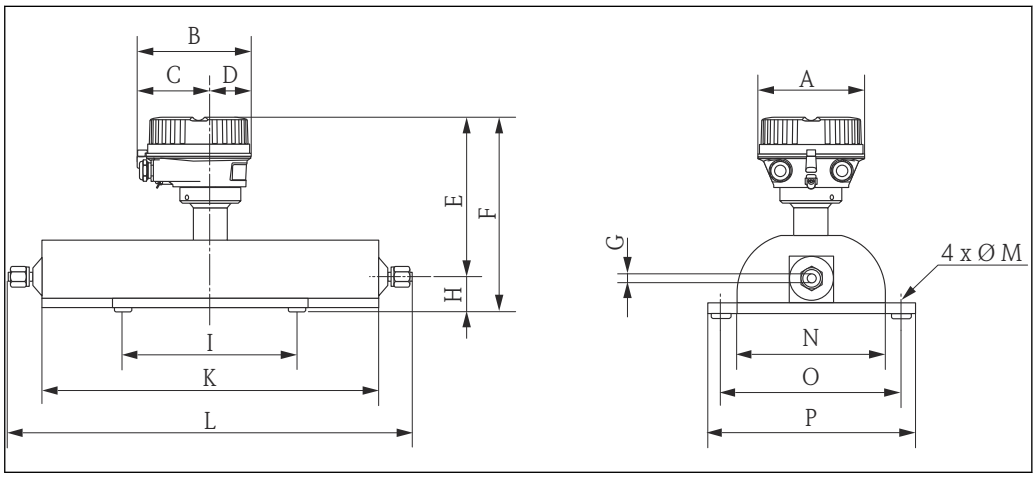
2) The use of parallel electric band heaters is generally recommended (bidirectional electricity flow). Particular considerations must be made if a single-wire heating cable is to be used. Additional information is provided in the document EA01339D "Installation instructions for electrical trace heating systems" → 89

Mechanical construction

Dimensions in SI units

Compact version

Order code for "Housing", option A "Compact coated aluminum"



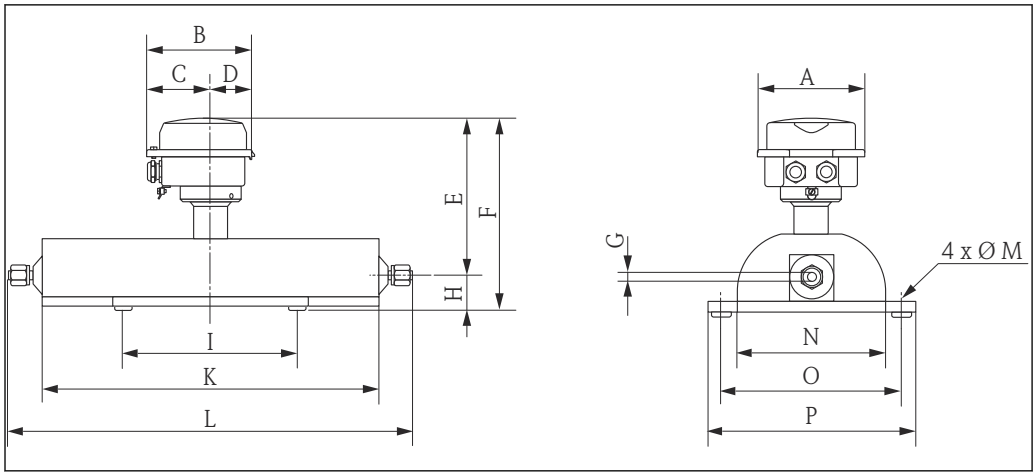
DN [mm]	A [mm]	B [mm]	C [mm]	D [mm]	E [1] [mm]	F [1] [mm]	G [mm]	
1	136	147.5	93.5	54	184	216	1.1	–
2	136	147.5	93.5	54	184	216	1.8	1.41 [2]
4	136	147.5	93.5	54	194	226	3.5	3.02 [2]

1) If using a display, order code for "Display; Operation", option B: values + 28 mm
2) High-pressure version: order code for "Measuring tube material", option SG, SH, SI

DN [mm]	H [mm]	I [mm]	K [mm]	L [mm]	M [mm]	N [mm]	O [mm]	P [mm]
1	32	160	228	[1]	4 × Ø6.5	120	145	165
2	32	160	310	[1]	4 × Ø6.5	120	145	165
4	32	220	435	[1]	4 × Ø6.5	150	175	195

1) Depends on the particular process connection

Order code for "Housing", option B "Compact, hygienic, stainless"



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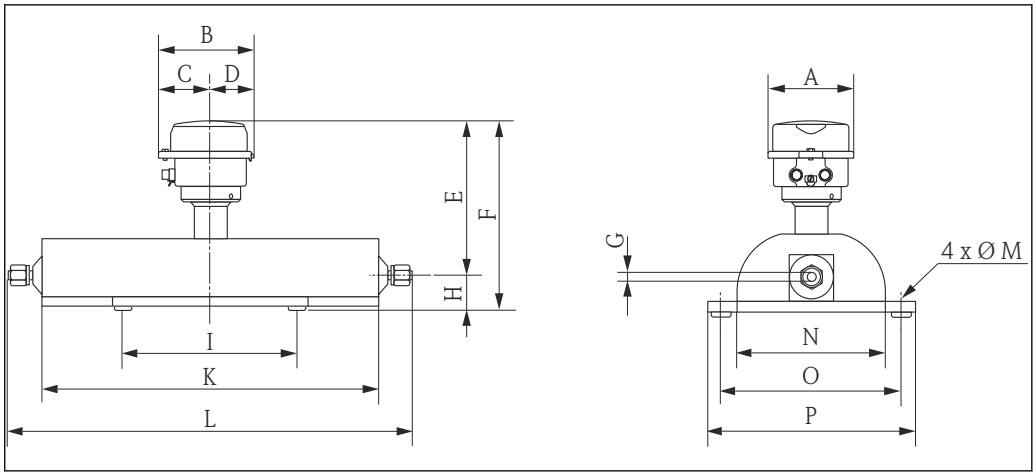
DN [mm]	A [mm]	B [mm]	C [mm]	D [mm]	E [1] [mm]	F [1] [mm]	G [mm]	
1	133.5	136.8	78	58.8	179	211	1.1	–
2	133.5	136.8	78	58.8	179	211	1.8	1.41 [2]
4	133.5	136.8	78	58.8	189	221	3.5	3.02 [2]

1) If using a display, order code for "Display; Operation", option B: values + 14 mm
2) High-pressure version: order code for "Measuring tube material", option SG, SH, SI

DN [mm]	H [mm]	I [mm]	K [mm]	L [mm]	M [mm]	N [mm]	O [mm]	P [mm]
1	32	160	228	[1]	4 × Ø6.5	120	145	165
2	32	160	310	[1]	4 × Ø6.5	120	145	165
4	32	220	435	[1]	4 × Ø6.5	150	175	195

1) Depends on the particular process connection

Order code for "Housing", option C "Ultra-compact, hygienic, stainless"



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DN [mm]	A [mm]	B [mm]	C [mm]	D [mm]	E [1] [mm]	F [1] [mm]	G [mm]	
1	111.4	123.6	67.7	55.9	179	211	1.1	–
2	111.4	123.6	67.7	55.9	179	211	1.8	1.41 [2]
4	111.4	123.6	67.7	55.9	189	221	3.5	3.02 [2]

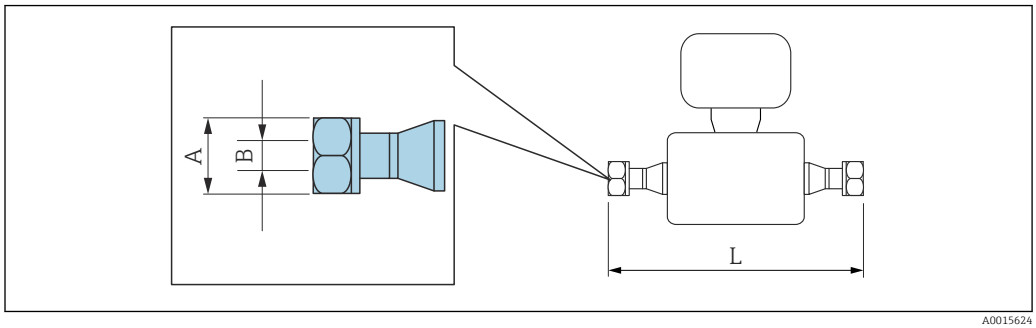
1) If using a display, order code for "Display; Operation", option B: values + 14 mm
2) High-pressure version: order code for "Measuring tube material", option SG, SH, SI

DN [mm]	H [mm]	I [mm]	K [mm]	L [mm]	M [mm]	N [mm]	O [mm]	P [mm]
1	32	160	228	[1]	4 × Ø6.5	120	145	165
2	32	160	310	[1]	4 × Ø6.5	120	145	165
4	32	220	435	[1]	4 × Ø6.5	150	175	195

1) Depends on the particular process connection

Glands

VCO coupling



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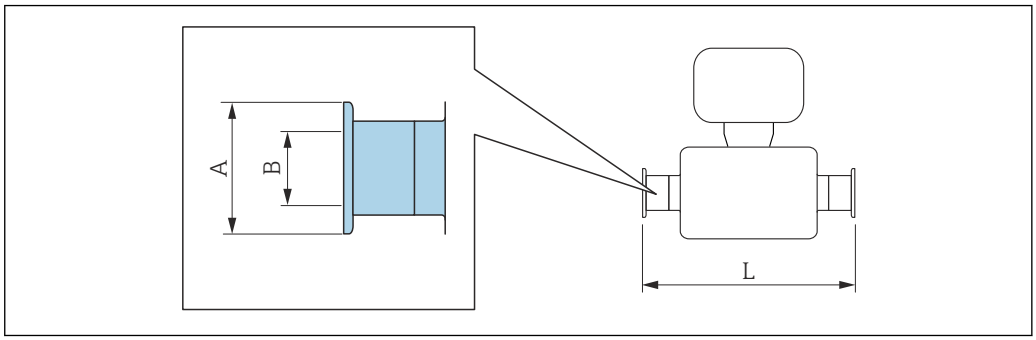
Length tolerance for dimension L in mm:
+1.5/−2.0

4-VCO-4 **1.4404 (316L):** *order code for "Process connection", option* **HAW** **Alloy C22:** *order code for "Measuring tube material", option* **HA**				
DN [mm]	**A [in]**	**B [mm]**		**L [mm]**
1	AF $^{11}/_{16}$	1.1	–	290
2	AF $^{11}/_{16}$	1.8	1.4 [1)]	372
4	AF $^{11}/_{16}$	3.5	3.0 [1)]	497
3A version available (Ra ≤ 0.76 µm/150 grit, Ra ≤ 0.38 µm/240 grit) for order code for "Process connection", option **HAW** (1.4539 (904L)): Order code for "Measuring tube material", option **SE, SF, SH, SI** in combination with order code for "Additional approval", option **LP**				

1) High-pressure version: order code for "Measuring tube material", option SG, SH, SI

Clamp connections

Tri-Clamp



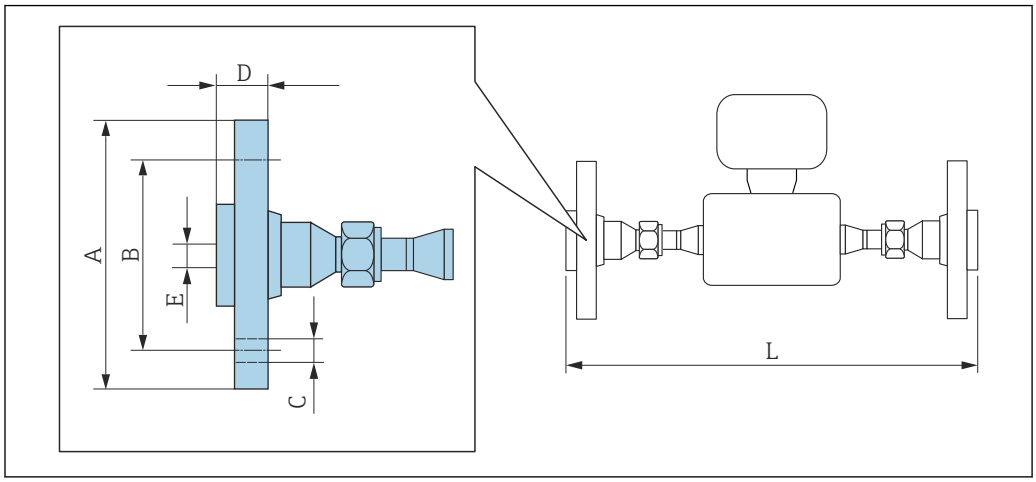
A0015625

Length tolerance for dimension L in mm:
+1.5/−2.0

½" Tri-Clamp **1.4539 (904L)** *Order code for "Process connection", option* **FBW**			
DN **[mm]**	**A** **[mm]**	**B** **[mm]**	**L** **[mm]**
1	25	9.4	296
2	25	9.4	378
4	25	9.4	503
3A version available (Ra ≤ 0.76 µm/150 grit, Ra ≤ 0.38 µm/240 grit): Order code for "Measuring tube material", option **SE, SF, SH, SI** in combination with order code for "Additional approval", option **LP**			

Adapter

Adapter, DN 15 flange to 4-VCO-4



Length tolerance for dimension L in mm:
+1.5/−2.0

Flange according to EN 1092-1 (DIN 2501): PN 40 **1.4539 (904L):** *order code for "Accessories", option* **PE** **Alloy C22:** *order code for "Accessories", option* **PM**						
DN [mm]	**A [mm]**	**B [mm]**	**C [mm]**	**D [mm]**	**E [mm]**	**L [mm]**
1	95	65	4 × Ø14	28	17.3	393
2	95	65	4 × Ø14	28	17.3	475
4	95	65	4 × Ø14	28	17.3	600
Lap joint flanges (not wetted) made of stainless steel 1.4404 (F316L) Sealing sets: order code for "Accessory enclosed", option **P1** (Viton), **P2** (EPDM), **P3** (silicone), **P4** (Kalrez)						

Flange according to ASME B16.5: Class 150 **1.4539 (904L):** *order code for "Accessories", option* **PF** **Alloy C22:** *order code for "Accessories", option* **PP**						
DN [mm]	**A [mm]**	**B [mm]**	**C [mm]**	**D [mm]**	**E [mm]**	**L [mm]**
1	90.0	60.3	4 × Ø15.7	17.7	15.7	393
2	90.0	60.3	4 × Ø15.7	17.7	15.7	475
4	90.0	60.3	4 × Ø15.7	17.7	15.7	600
Lap joint flanges (not wetted) made of stainless steel 1.4404 (F316L) Sealing sets: order code for "Accessory enclosed", option **P1** (Viton), **P2** (EPDM), **P3** (silicone), **P4** (Kalrez)						

Flange according to ASME B16.5: Class 300 **1.4539 (904L):** *order code for "Accessories", option* **PG** **Alloy C22:** *order code for "Accessories", option* **PQ**						
DN [mm]	**A [mm]**	**B [mm]**	**C [mm]**	**D [mm]**	**E [mm]**	**L [mm]**
1	95.2	66.5	4 × Ø15.7	20.7	15.7	393
2	95.2	66.5	4 × Ø15.7	20.7	15.7	475

Flange according to ASME B16.5: Class 300
1.4539 (904L): *order code for "Accessories", option* **PG**
Alloy C22: *order code for "Accessories", option* **PQ**

DN [mm]	A [mm]	B [mm]	C [mm]	D [mm]	E [mm]	L [mm]
4	95.2	66.5	4 × Ø15.7	20.7	15.7	600

Lap joint flanges (not wetted) made of stainless steel 1.4404 (F316L)
Sealing sets: order code for "Accessory enclosed", option **P1** (Viton), **P2** (EPDM), **P3** (silicone), **P4** (Kalrez)

Flange JIS B2220: 10K
1.4539 (904L): *order code for "Accessories", option* **PH**
Alloy C22: *order code for "Accessories", option* **PS**

DN [mm]	A [mm]	B [mm]	C [mm]	D [mm]	E [mm]	L [mm]
1	95	70	4 × Ø15	28	15.0	393
2	95	70	4 × Ø15	28	15.0	475
4	95	70	4 × Ø15	28	15.0	600

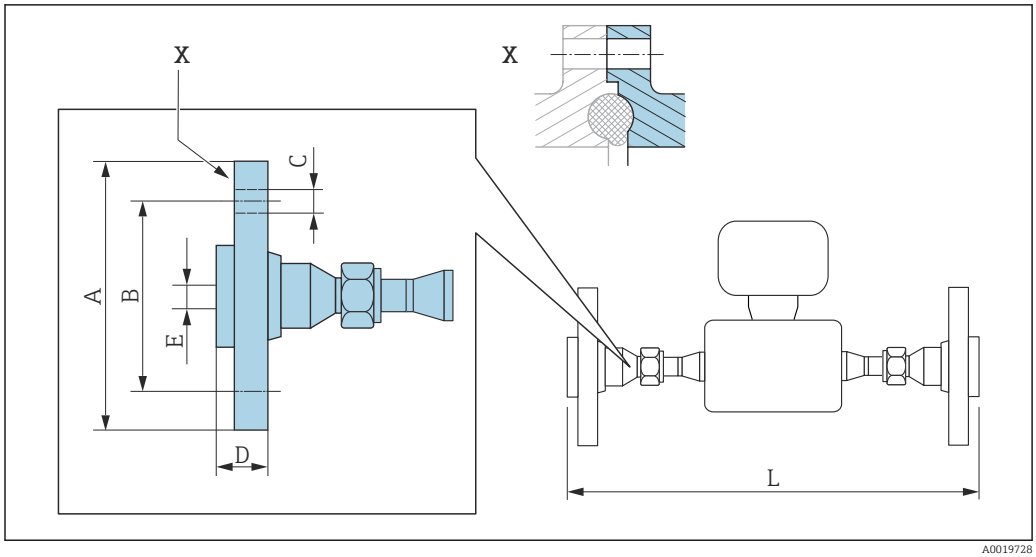
Lap joint flanges (not wetted) made of stainless steel 1.4404 (F316L)
Sealing sets: order code for "Accessory enclosed", option **P1** (Viton), **P2** (EPDM), **P3** (silicone), **P4** (Kalrez)

Flange JIS B2220: 20K
1.4539 (904L): *order code for "Accessories", option* **PT**
Alloy C22: *order code for "Accessories", option* **PU**

DN [mm]	A [mm]	B [mm]	C [mm]	D [mm]	E [mm]	L [mm]
1	95	70	4 × Ø15	14	15.0	393
2	95	70	4 × Ø15	14	15.0	475
4	95	70	4 × Ø15	14	15.0	600

Lap joint flanges (not wetted) made of stainless steel 1.4404 (F316L)
Sealing sets: order code for "Accessory enclosed", option **P1** (Viton), **P2** (EPDM), **P3** (silicone), **P4** (Kalrez)

Adapter, DN 15 female to 4-VCO-4

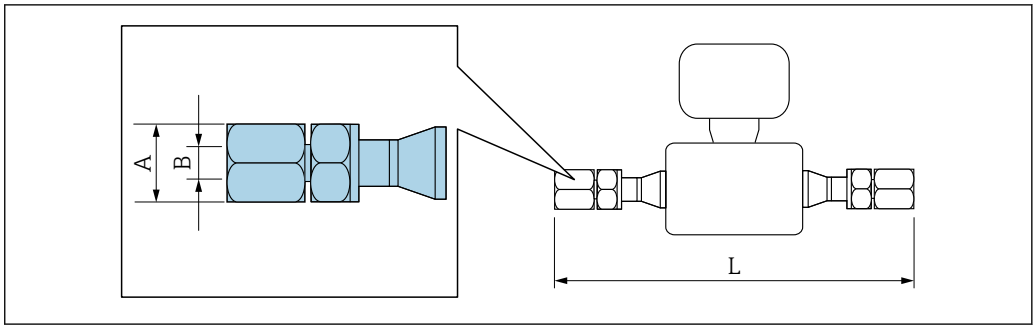


30 Detail X: Asymmetrical process connection; the part shown in blue is provided by the supplier.

Length tolerance for dimension L in mm:
+1.5/−2.0

Female according to EN 1092-1 (DIN 2501): PN 40 **1.4539 (904L):** *order code for "Accessories", option* **PN** **Alloy C22:** *order code for "Accessories", option* **PO**						
DN [mm]	**A [mm]**	**B [mm]**	**C [mm]**	**D [mm]**	**E [mm]**	**L [mm]**
1	95	65	4 × Ø14	28	17.3	393
2	95	65	4 × Ø14	28	17.3	475
4	95	65	4 × Ø14	28	17.3	600
Lap joint flanges (not wetted) made of stainless steel 1.4404 (F316L) Sealing sets: order code for "Accessory enclosed", option **P1** (Viton), **P2** (EPDM), **P3** (silicone), **P4** (Kalrez)						

Adapter, NPT to 4-VCO-4

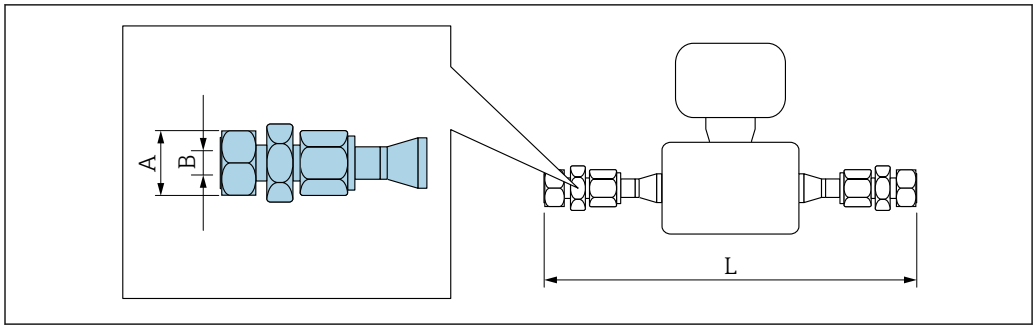


Length tolerance for dimension L in mm:
+1.5/−2.0

¼" NPT **1.4539 (904L):** *order code for "Accessories", option* **PI** **Alloy C22** [1]**:** *order code for "Accessories", option* **PJ**			
DN **[mm]**	**A** **[in]**	**B** **[in]**	**L** **[mm]**
1	AF ¾	¼ NPT	361
2	AF ¾	¼ NPT	443
4	AF ¾	¼ NPT	568
Sealing sets: order code for "Accessory enclosed", option **P1** (Viton), **P2** (EPDM), **P3** (silicone), **P4** (Kalrez)			

1) Not available as high-pressure version

Adapter, SWAGELOK to 4-VCO-4



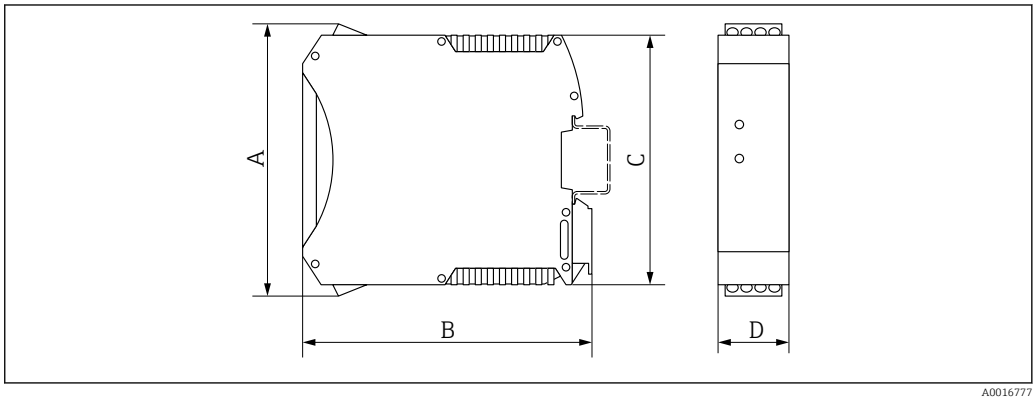
Length tolerance for dimension L in mm:
+1.5/−2.0

SWAGELOK adapter **1.4401 (316)** *Order code for "Accessories", ⅛" option* **PK** *Order code for "Accessories", ¼" option* **PL**			
DN **[mm]**	**A** **[in]**	**B** **[in]**	**L** **[mm]**
1	AF 7/16	⅛ NPT	361
1	AF 9/16	¼ NPT	364.6
2 [1]	AF 7/16	⅛ NPT	441.6
2 [1]	AF 9/16	¼ NPT	446.6
4 [1]	AF 9/16	¼ NPT	571.6
Sealing sets: order code for "Accessory enclosed", option **P1** (Viton), **P2** (EPDM), **P3** (silicone), **P4** (Kalrez)			

1) Also available as high-pressure version

Safety Barrier Promass 100

Top-hat rail EN 60715:
- TH 35 x 7.5
- TH 35 x 15



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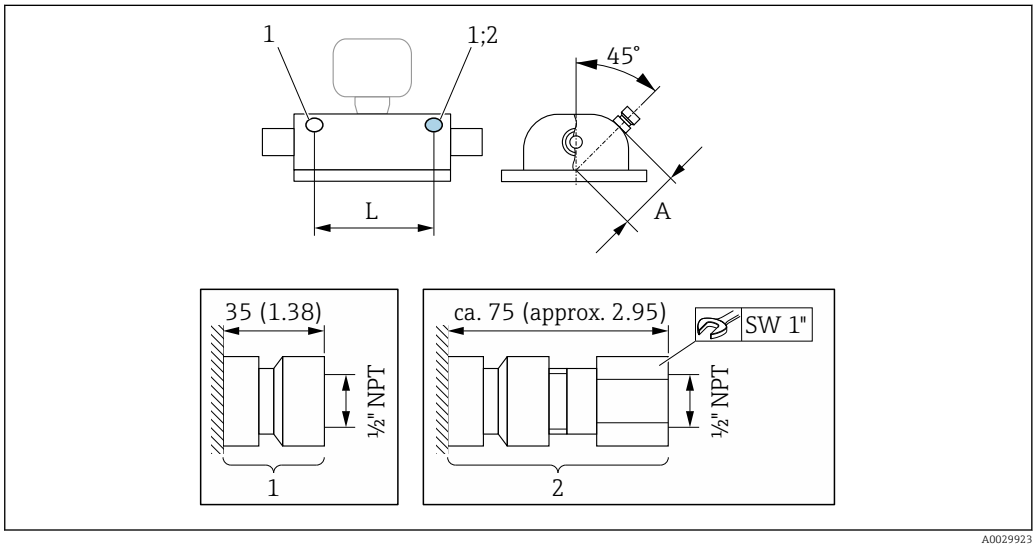
A	B	C	D
[mm]	[mm]	[mm]	[mm]
108	114.5	99	22.5

Accessories

Rupture disk/purge connections



A0029923

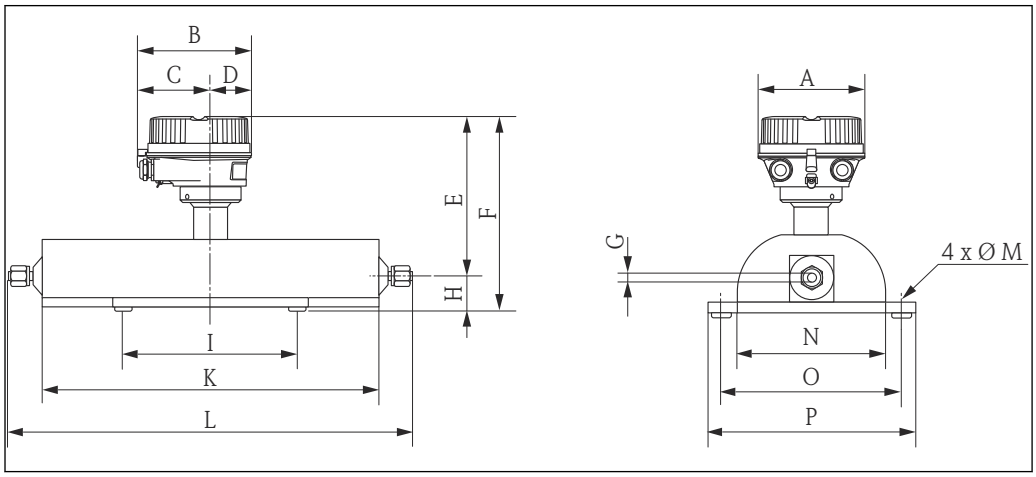
1 Connection nipple for purge connections: order code for "Sensor options", option CH "Purge connection"
2 Connection nipple with rupture disk: order code for "Sensor option", option CA "Rupture disk"

DN [mm]	A [mm]	L [mm]
1	47.0	178
2	47.0	260
4	59.5	385

Dimensions in US units

Compact version

Order code for "Housing", option A "Compact coated aluminum"



A0019424

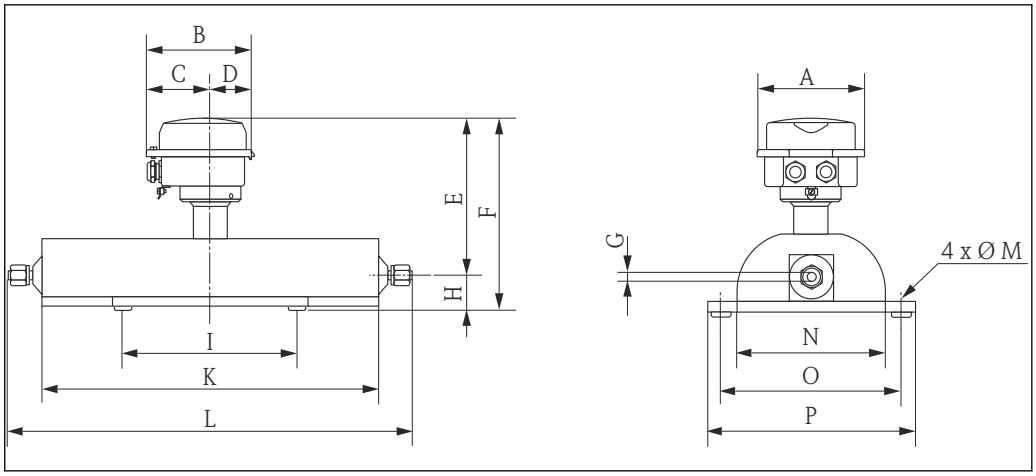
DN [in]	A [in]	B [in]	C [in]	D [in]	E [1] [in]	F [1] [in]	G [in]	
1/24	5.35	5.81	3.68	2.13	7.24	8.5	0.043	–
1/12	5.35	5.81	3.68	3.68	7.24	8.5	0.071	0.055 [2]
1/8	5.35	5.81	3.68	3.68	7.64	8.9	0.14	0.12 [2]

1) If using a display, order code for "Display; Operation", option B: values + 1.1 in
2) High-pressure version: order code for "Measuring tube material", option SG, SH, SI

DN [in]	H [in]	I [in]	K [in]	L [in]	M [in]	N [in]	O [in]	P [in]
1/24	1.26	6.3	8.98	[1]	4 × Ø0.26	4.72	5.71	6.5
1/12	1.26	6.3	12.2	[1]	4 × Ø0.26	4.72	5.71	6.5
1/8	1.26	8.66	17.13	[1]	4 × Ø0.26	5.91	6.89	7.68

1) Depends on the particular process connection

Order code for "Housing", option B "Compact, hygienic, stainless"



A0019425

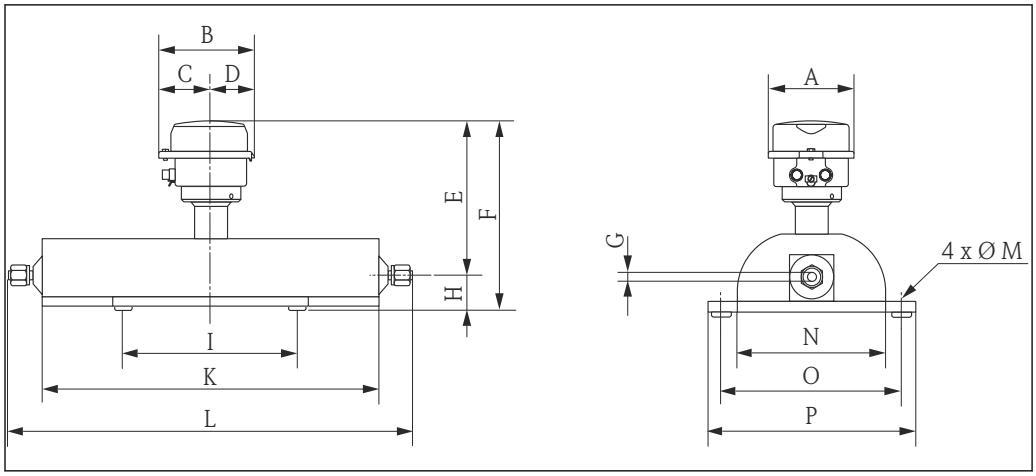
DN [in]	A [in]	B [in]	C [in]	D [in]	E [1] [in]	F [1] [in]	G [in]	
1/24	5.26	5.39	3.07	2.31	7.05	8.31	0.043	–
1/12	5.26	5.39	3.07	2.31	7.05	8.31	0.071	0.055 [2]
1/8	5.26	5.39	3.07	2.31	7.44	8.7	0.14	0.12 [2]

1) If using a display, order code for "Display; Operation", option B: values + 0.55 in
2) High-pressure version: order code for "Measuring tube material", option SG, SH, SI

DN [in]	H [in]	I [in]	K [in]	L [in]	M [in]	N [in]	O [in]	P [in]
1/24	1.26	6.3	8.98	[1]	4 × Ø0.26	4.72	5.71	6.5
1/12	1.26	6.3	12.2	[1]	4 × Ø0.26	4.72	5.71	6.5
1/8	1.26	8.66	17.13	[1]	4 × Ø0.26	5.91	6.89	7.68

1) Depends on the particular process connection

Order code for "Housing", option C "Ultra-compact, hygienic, stainless"



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Dimensions – US units

DN	A [in]	B [in]	C [in]	D [in]	E [1] [in]	F [1] [in]	G [in]	
1/24	4.39	4.87	2.67	2.2	7.05	8.31	0.043	–
1/12	4.39	4.87	2.67	2.2	7.05	8.31	0.071	0.055 [2]
1/8	4.39	4.87	2.67	2.2	7.44	8.7	0.14	0.12 [2]

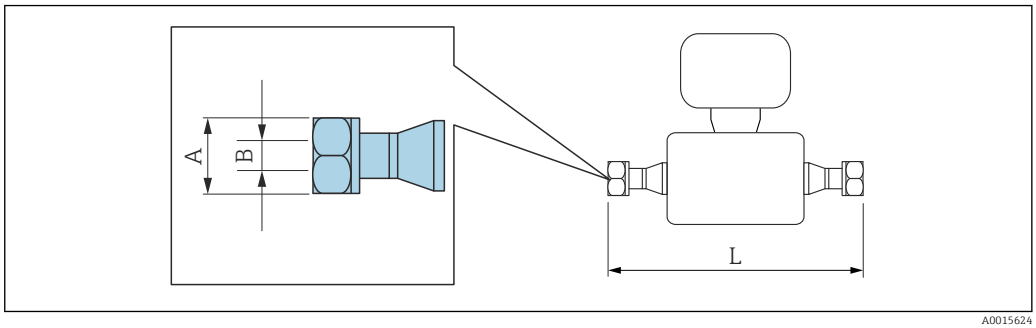
1) If using a display, order code for "Display; Operation", option B: values + 0.55 in
2) High-pressure version: order code for "Measuring tube material", option SG, SH, SI

DN [in]	H [in]	I [in]	K [in]	L [in]	M [in]	N [in]	O [in]	P [in]
1/24	1.26	6.3	8.98	[1]	4 × Ø0.26	4.72	5.71	6.5
1/12	1.26	6.3	12.2	[1]	4 × Ø0.26	4.72	5.71	6.5
1/8	1.26	8.66	17.13	[1]	4 × Ø0.26	5.91	6.89	7.68

1) Depends on the particular process connection

Glands

VCO coupling



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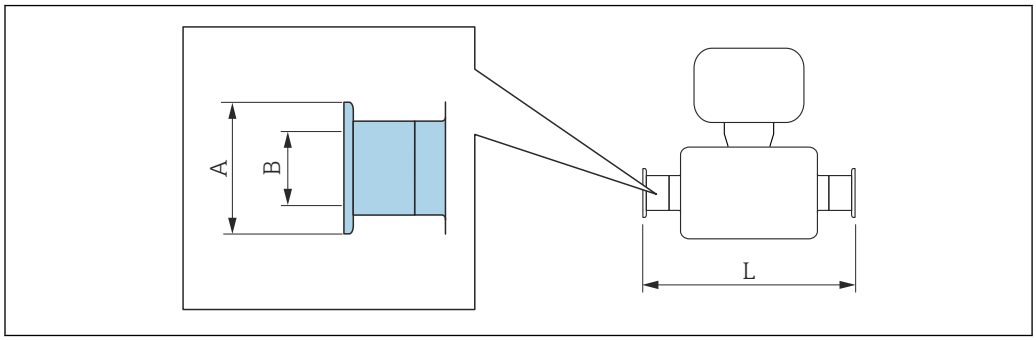
Length tolerance for dimension L in inches:
+0.06/−0.08

4-VCO-4 **1.4404 (316/316L):** *order code for "Process connection", option* **HAW** **Alloy C22:** *order code for "Measuring tube material", option* **HA**				
DN [in]	**A [in]**	**B [in]**		**L [in]**
1/24	AF 11/16	0.043	–	11.4
1/12	AF 11/16	0.071	0.055 [1)]	14.6
1/8	AF 11/16	0.14	0.12 [1)]	19.6
3A version available (Ra ≤ 32 µin/150 grit, Ra ≤ 16 µin/240 grit) for order code for "Process connection", option **HAW** (1.4539 (904L)): Order code for "Measuring tube material", option **SE, SF, SH, SI** in combination with order code for "Additional approval", option **LP**				

1) High-pressure version: order code for "Measuring tube material", option SG, SH, SI

Clamp connections

Tri-Clamp



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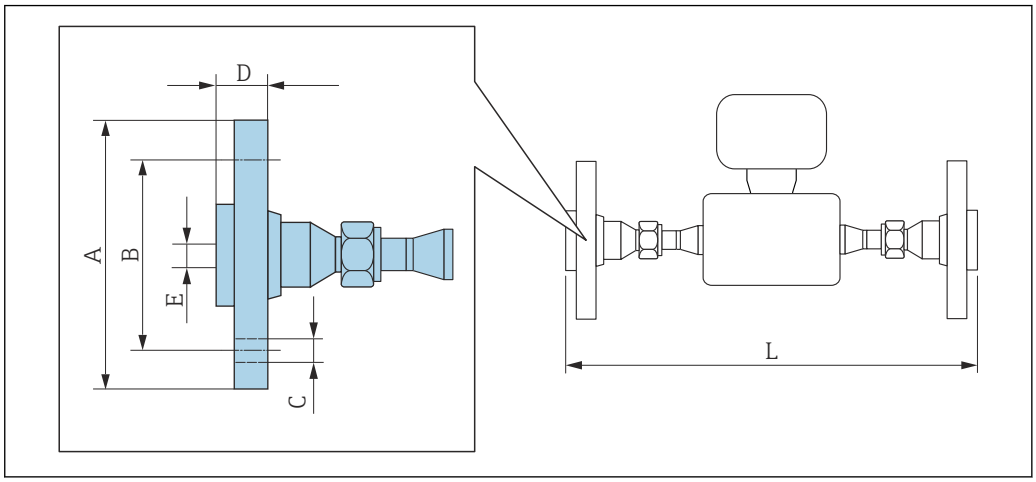
Length tolerance for dimension L in inches:
+0.06/−0.08

½" Tri-Clamp **1.4539 (904L)** *Order code for "Process connection", option* **FBW**			
DN **[in]**	**A** **[in]**	**B** **[in]**	**L** **[in]**
1/24	0.98	0.37	11.7
1/12	0.98	0.37	14.9
1/8	0.98	0.37	19.8
3A version available (Ra ≤ 32 µin/150 grit, Ra ≤ 16 µin/240 grit): Order code for "Measuring tube material", option **SE, SF, SH, SI** in combination with order code for "Additional approval", option **LP**			

Adapter

Adapter, DN 15 flange to 4-VCO-4



Length tolerance for dimension L in inches:
+0.06/−0.08

Flange according to ASME B16.5: Class 150
1.4539 (904L): *order code for "Accessories", option* **PF**
Alloy C22: *order code for "Accessories", option* **PP**

DN [in]	A [in]	B [in]	C [in]	D [in]	E [in]	L [in]
1/24	3.54	2.37	4 × Ø0.62	0.7	0.62	15.5
1/12	3.54	2.37	4 × Ø0.62	0.7	0.62	18.7
1/8	3.54	2.37	4 × Ø0.62	0.7	0.62	23.6

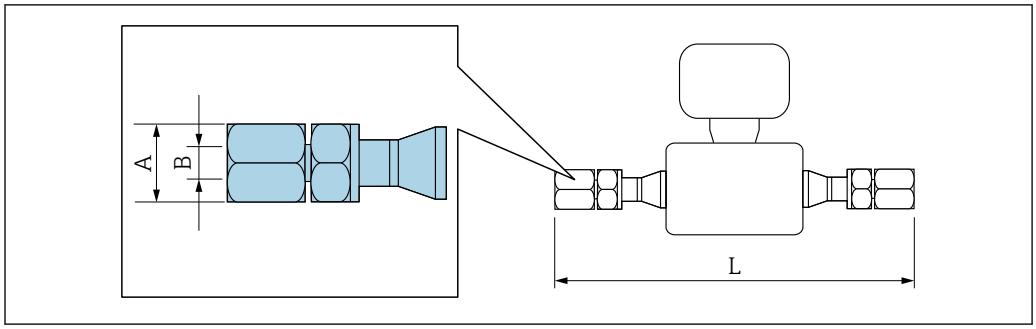
Lap joint flanges (not wetted) made of stainless steel 1.4404 (F316L)
Sealing sets: order code for "Accessory enclosed", option **P1** (Viton), **P2** (EPDM), **P3** (silicone), **P4** (Kalrez)

Flange according to ASME B16.5: Class 300
1.4539 (904L): *order code for "Accessories", option* **PG**
Alloy C22: *order code for "Accessories", option* **PQ**

DN [in]	A [in]	B [in]	C [in]	D [in]	E [in]	L [in]
1/24	3.75	2.62	4 × Ø0.62	0.81	0.62	15.5
1/12	3.75	2.62	4 × Ø0.62	0.81	0.62	18.7
1/8	3.75	2.62	4 × Ø0.62	0.81	0.62	23.6

Lap joint flanges (not wetted) made of stainless steel 1.4404 (F316L)
Sealing sets: order code for "Accessory enclosed", option **P1** (Viton), **P2** (EPDM), **P3** (silicone), **P4** (Kalrez)

Adapter, NPTF to 4-VCO-4 coupling

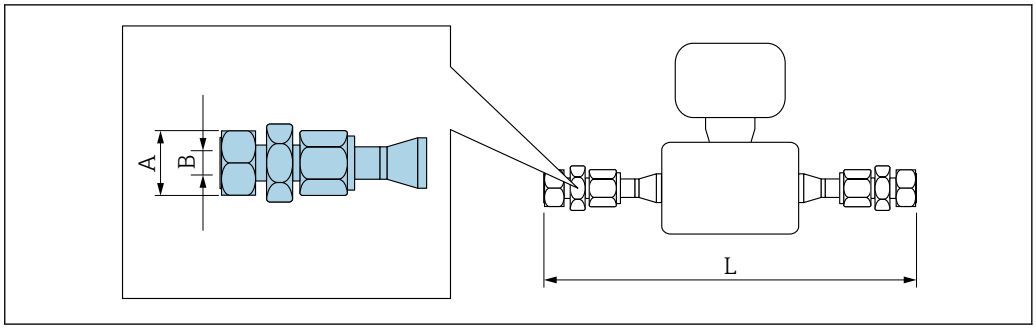


Length tolerance for dimension L in inches:
+0.06/−0.08

¼" NPT **1.4539 (904L):** *order code for "Accessories", option* **PI** **Alloy C22** [1]**:** *order code for "Accessories", option* **PJ**			
DN **[in]**	**A** **[in]**	**B** **[in]**	**L** **[in]**
1/24	AF ¾	¼ NPT	14.2
1/12	AF ¾	¼ NPT	17.4
⅛	AF ¾	¼ NPT	22.4
Sealing sets: order code for "Accessory enclosed", option **P1** (Viton), **P2** (EPDM), **P3** (silicone), **P4** (Kalrez)			

1) Not available as high-pressure version

Adapter, SWAGELOK to 4-VCO-4 coupling



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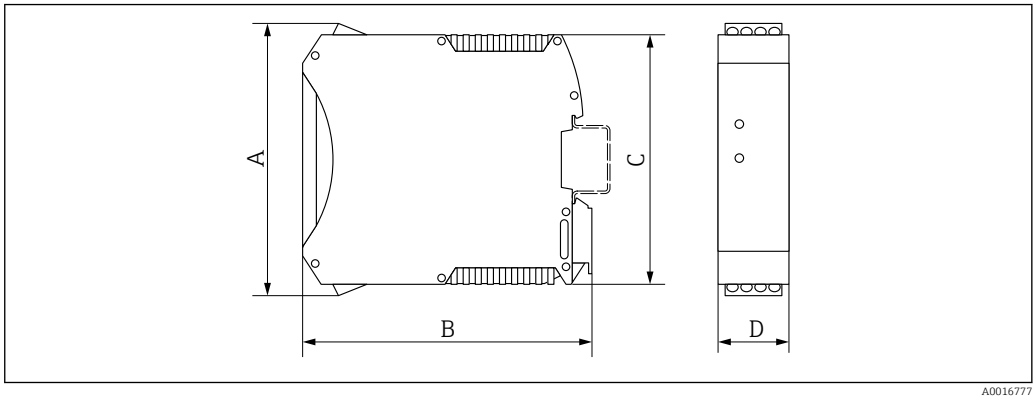
Length tolerance for dimension L in inches:
+0.06/−0.08

SWAGELOK **1.4401 (316)** *Order code for "Accessories", ⅛" option* **PK** *Order code for "Accessories", ¼" option* **PL**			
DN **[in]**	**A** **[in]**	**B** **[in]**	**L** **[in]**
1/24	AF 7/16	1/8 NPT	14.2
1/24	AF 9/16	1/4 NPT	14.4
1/12 1)	AF 7/16	1/8 NPT	17.4
1/12 1)	AF 9/16	1/4 NPT	17.6
1/8 1)	AF 9/16	1/4 NPT	22.5
Sealing sets: order code for "Accessory enclosed", option **P1** (Viton), **P2** (EPDM), **P3** (silicone), **P4** (Kalrez)			

1) Also available as high-pressure version

Safety Barrier Promass 100

Top-hat rail EN 60715:
- TH 35 x 7.5
- TH 35 x 15



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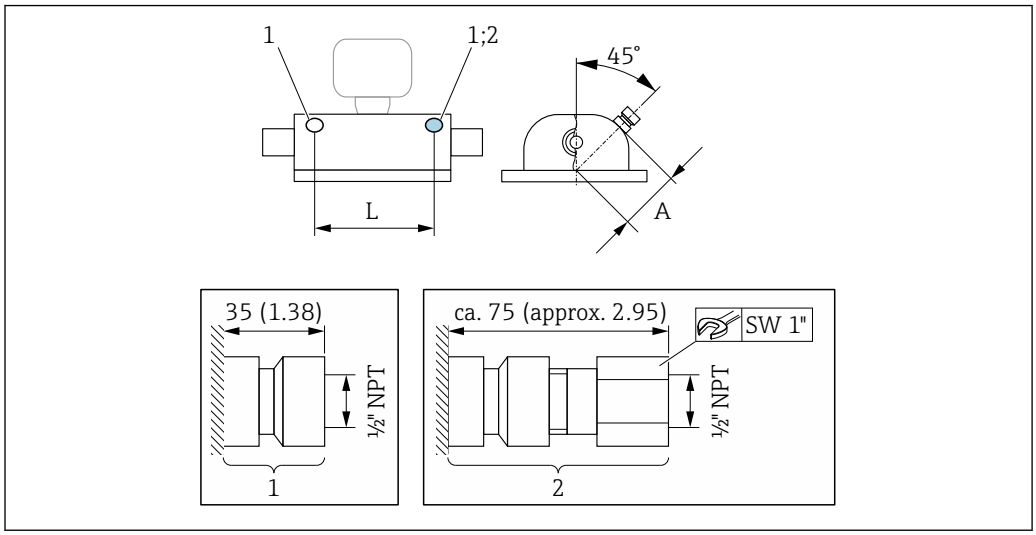
A	B	C	D
[in]	**[in]**	**[in]**	**[in]**
4.25	4.51	3.9	0.89

Accessories

Rupture disk/purge connections



1 Connection nipple for purge connections: order code for "Sensor options", option CH "Purge connection"
2 Connection nipple with rupture disk: order code for "Sensor option", option CA "Rupture disk"

DN [in]	A [in]	L [in]
1/24	1.85	7.01
1/12	1.85	10.24
1/8	2.34	15.16

Weight

All values (weight exclusive of packaging material) refer to devices with EN/DIN PN 40 flanges. Weight specifications including transmitter: order code for "Housing", option A "Compact, aluminum coated".

Weight in SI units

DN [mm]	Weight [kg]
1	8
2	9
4	13

Weight in US units

DN [in]	Weight [lbs]
1/24	18
1/12	20
1/8	29

Safety Barrier Promass 100

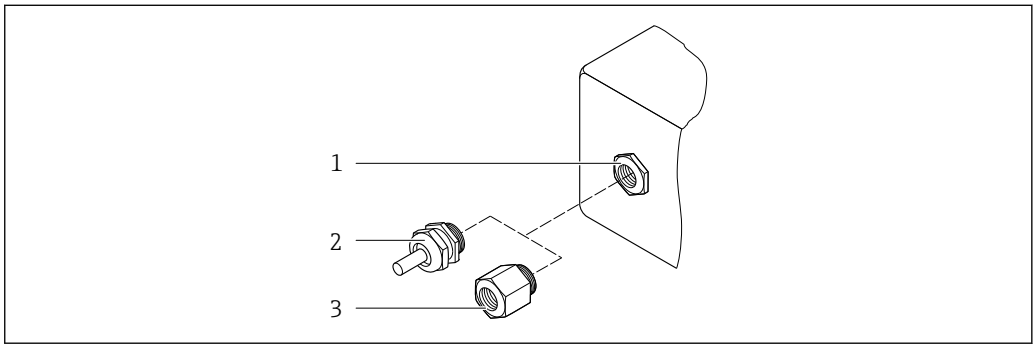
49 g (1.73 ounce)

Materials

Transmitter housing

- Order code for "Housing", option **A** "Compact, aluminum coated":
  Aluminum, AlSi10Mg, coated
- Order code for "Housing", option **B** "Compact, hygienic, stainless":
  Hygienic version, stainless steel 1.4301 (304)
- Order code for "Housing", option **C** "Ultra-compact, hygienic, stainless":
  Hygienic version, stainless steel 1.4301 (304)
- Window material for optional local display (→ 77):
  - For order code for "Housing", option **A**: glass
  - For order code for "Housing", option **B** and **C**: plastic

Cable entries/cable glands



31 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"

Order code for "Housing", option A "Compact, aluminum, coated"

The various cable entries are suitable for hazardous and non-hazardous areas.

Cable entry/cable gland	Material
Cable gland M20 × 1.5	Nickel-plated brass
Adapter for cable entry with internal thread G ½"	
Adapter for cable entry with internal thread NPT ½"	

Order code for "Housing", option B "Compact, hygienic, stainless"

The various cable entries are suitable for hazardous and non-hazardous areas.

Cable entry/cable gland	Material
Cable gland M20 × 1.5	Stainless steel, 1.4404 (316L)
Adapter for cable entry with internal thread G ½"	
Adapter for cable entry with internal thread NPT ½"	

Device plug

Electrical connection	Material
Plug M12x1	▪ Socket: Stainless steel, 1.4404 (316L) ▪ Contact housing: Polyamide ▪ Contacts: Gold-plated brass

Sensor housing

- Acid and alkali-resistant outer surface
- Stainless steel 1.4301 (304)

Measuring tubes

Stainless steel, 1.4539 (904L); Alloy C22, 2.4602 (UNS N06022)

Process connections

VCO coupling
- Stainless steel, 1.4404 (316/316L)
- Alloy C22, 2.4602 (UNS N06022)

Tri-clamp
Stainless steel, 1.4539 (904L)

Adapter, flanges as per EN 1092-1 (DIN 2501), ASME B16.5, JIS B2220
- Stainless steel, 1.4539 (904L)
- Alloy C22, 2.4602 (UNS N06022)

Adapter, lap joint flanges as per EN 1092-1 (DIN 2501), ASME B16.5, JIS B2220
Stainless steel, 1.4404 (F316L)

SWAGELOK adapter
Stainless steel, 1.4401 (316)

Adapter, NPT
- Stainless steel, 1.4539 (904L)
- Alloy C22, 2.4602 (UNS N06022)

Available process connections→ 76

Seals

Welded process connections without internal seals

Seals for mounting kit
- Viton
- EPDM
- Silicone
- Kalrez

Accessories

Protective cover

Stainless steel, 1.4404 (316L)

Safety Barrier Promass 100

Housing: Polyamide

Process connections

- Fixed flange connections:
  - EN 1092-1 (DIN 2501) flange
  - EN 1092-1 (DIN 2512N) flange
  - ASME B16.5 flange
  - JIS B2220 flange
- Clamp connections:
  Tri-Clamp (OD tubes), DIN 11866 series C
- VCO connections:
  4-VCO-4
- Adapter for VCO connections:
  - Flange EN 1092-1 (DIN 2501)
  - Flange ASME B16.5
  - Flange JIS B2220
  - SWAGELOK
  - NPT
  - NPT

Process connection materials

Surface roughness

All data refer to parts in contact with the medium.

The following surface roughness categories can be ordered:
- Not polished
- Ra ≤ 0.76 µm (30 µin)
- Ra ≤0.38 µm (15 µin)

Operability

Operating concept

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

Quick and safe commissioning
- Individual menus for applications
- Menu guidance with brief explanations of the individual parameter functions

Reliable operation
- Operation in the following languages:
  - Via "FieldCare", "DeviceCare" operating tool:
    English, German, French, Spanish, Italian, Chinese, Japanese
  - Via integrated Web browser(only available for device versions with HART, PROFIBUS DP, PROFINET and EtherNet/IP):
    English, German, French, Spanish, Italian, Dutch, Portuguese, Polish, Russian, Turkish, Chinese, Japanese, Bahasa (Indonesian), Vietnamese, Czech, Swedish, Korean
- Uniform operating philosophy applied to operating tools and Web browser
- If replacing the electronic module, transfer the device configuration via the plug-in memory (HistoROM DAT) which contains the process and measuring device data and the event logbook. No need to reconfigure.
  For devices with Modbus RS485, the data recovery function is implemented without the plug-in memory (HistoROM DAT).

Efficient diagnostics increase measurement availability
- Troubleshooting measures can be called up via the operating tools and web browser
- Diverse simulation options
- Status indicated by several light emitting diodes (LEDs) on the electronic module in the housing compartment

Local display

A local display is only available for device versions with the following communication protocols: HART, PROFIBUS-DP, PROFINET, EtherNet/IP

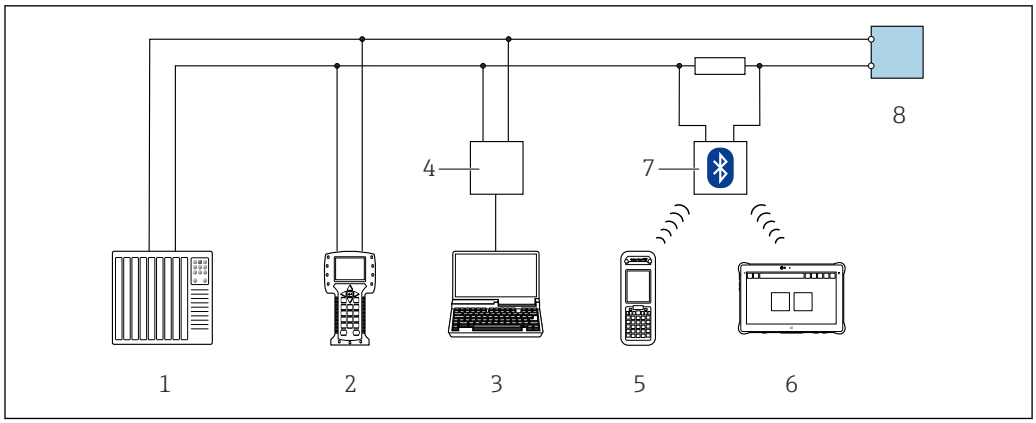
The local display is only available with the following device order code:
Order code for "Display; operation", option **B**: 4-line; illuminated, via communication

Display element
- 4-line liquid crystal display with 16 characters per line.
- 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.

Remote operation

Via HART protocol

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

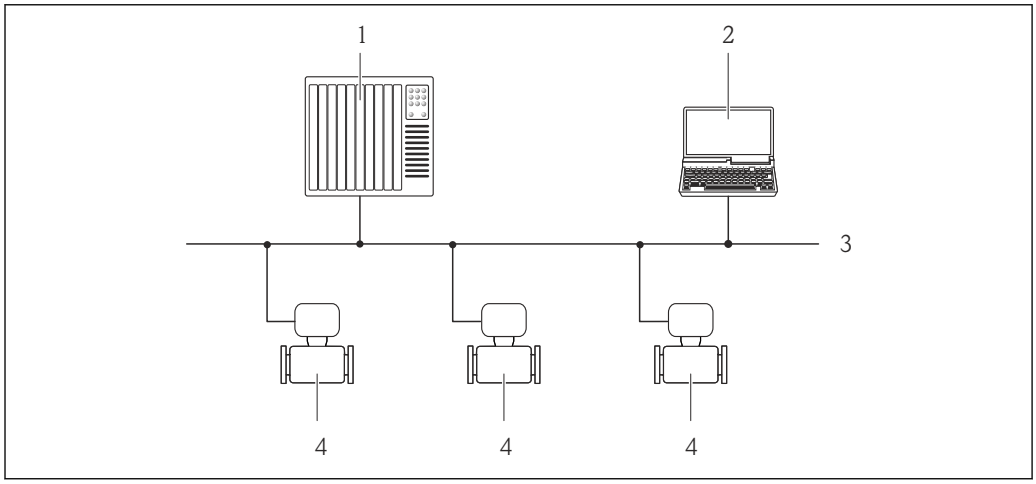


32 *Options for remote operation via HART protocol*

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

Via PROFIBUS DP network

This communication interface is available in device versions with PROFIBUS DP.



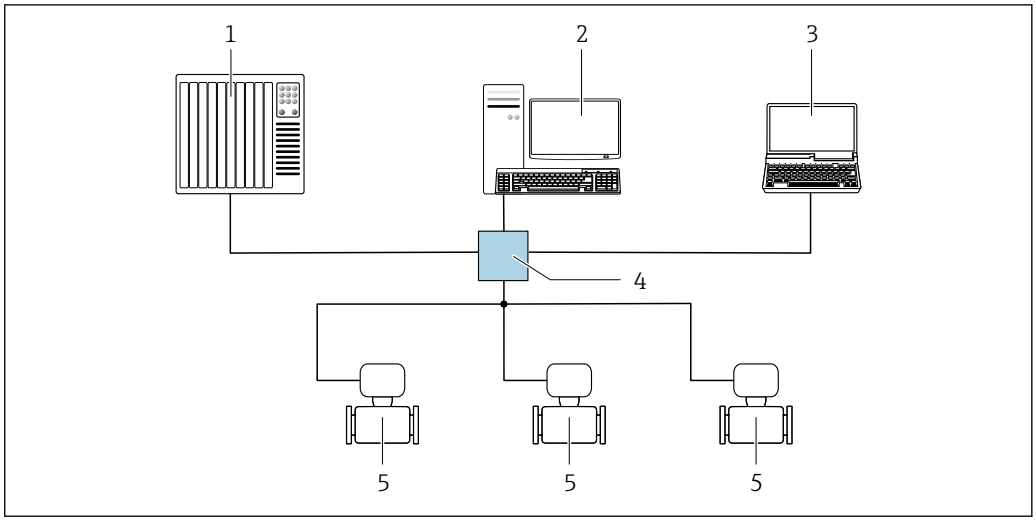
33 *Options for remote operation via PROFIBUS DP network*

1 *Automation system*
2 *Computer with PROFIBUS network card*
3 *PROFIBUS DP network*
4 *Measuring device*

Via EtherNet/IP network

This communication interface is available in device versions with EtherNet/IP.

Star topology



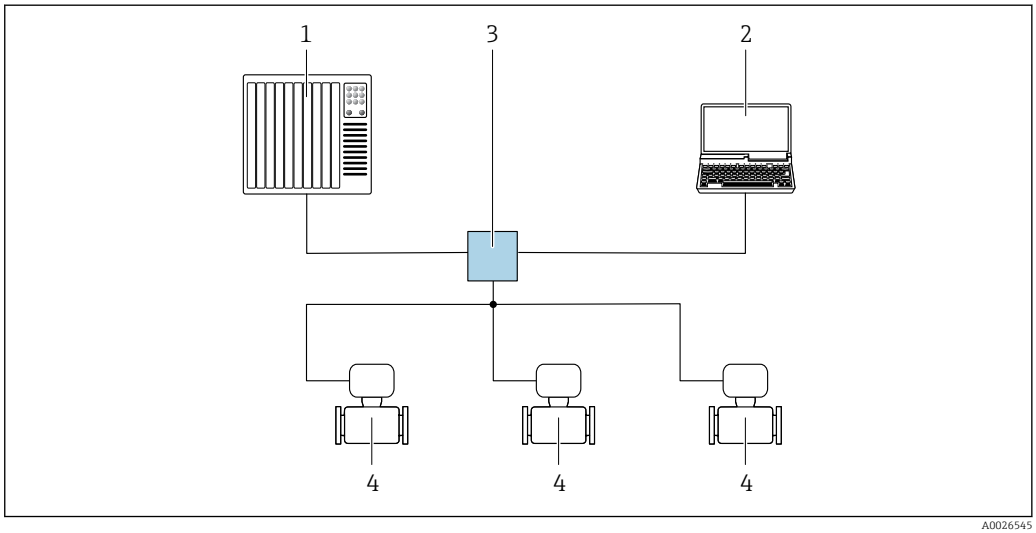
34 Options for remote operation via EtherNet/IP network: star topology

1 Automation system, e.g. "RSLogix" (Rockwell Automation)
2 Workstation for measuring device operation: with Custom Add-On Profile for "RSLogix 5000" (Rockwell Automation) or with Electronic Data Sheet (EDS)
3 Computer with Web browser (e.g. Internet Explorer) for accessing the integrated Web server or computer with operating tool (e.g. FieldCare, DeviceCare) with COM DTM "CDI Communication TCP/IP"
4 Standard Ethernet switch, e.g. Scalance X204 (Siemens)
5 Measuring device

Via PROFINET network

This communication interface is available in device versions with PROFINET.

Star topology



35 Options for remote operation via PROFINET network: star topology

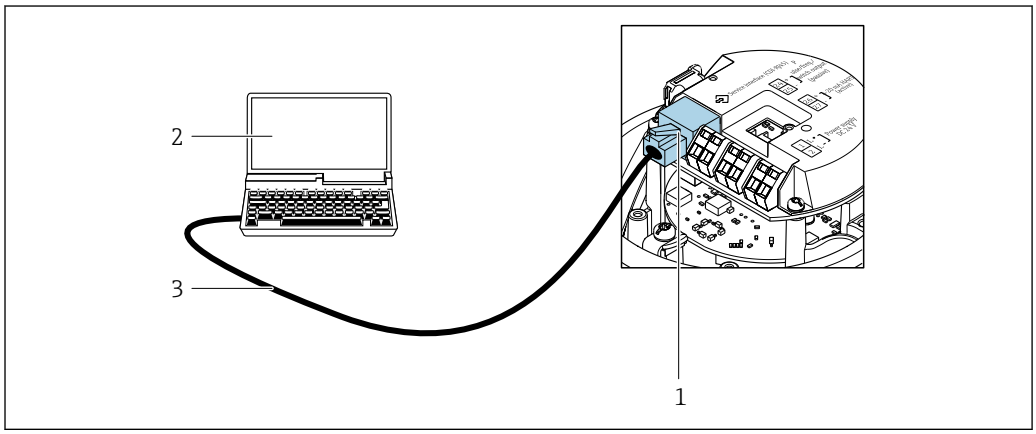
1 Automation system, e.g. Simatic S7 (Siemens)
2 Computer with Web browser (e.g. Internet Explorer) for accessing the integrated Web server or computer with operating tool (e.g. FieldCare, DeviceCare, SIMATIC PDM) with COM DTM "CDI Communication TCP/IP"
3 Standard Ethernet switch, e.g. Scalance X204 (Siemens)
4 Measuring device

Service interface

Via service interface (CDI-RJ45)

This communication interface is present in the following device version:
- Order code for "Output", option **B**: 4-20 mA HART, pulse/frequency/switch output
- Order code for "Output", option **L**: PROFIBUS DP
- Order code for "Output", option **N**: EtherNet/IP
- Order code for "Output", option **R**: PROFINET

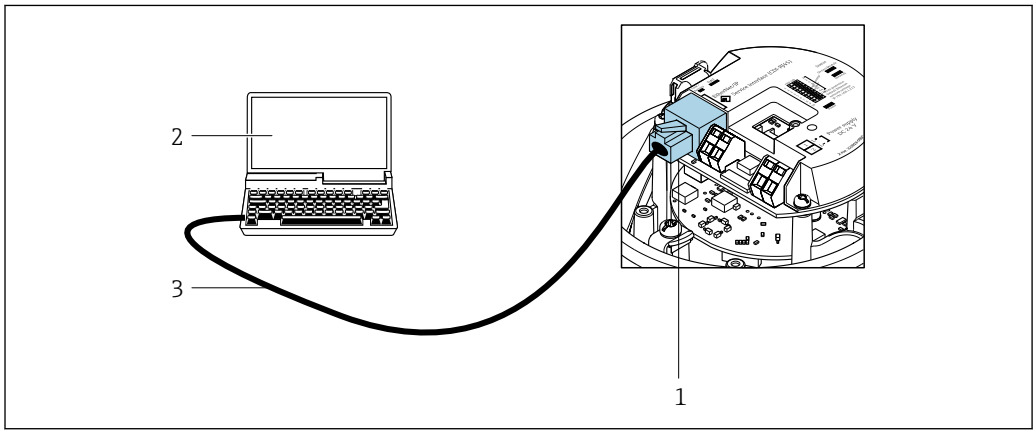
HART



36 Connection for the order code for "Output", option B: 4-20 mA HART, pulse/frequency/switch output

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

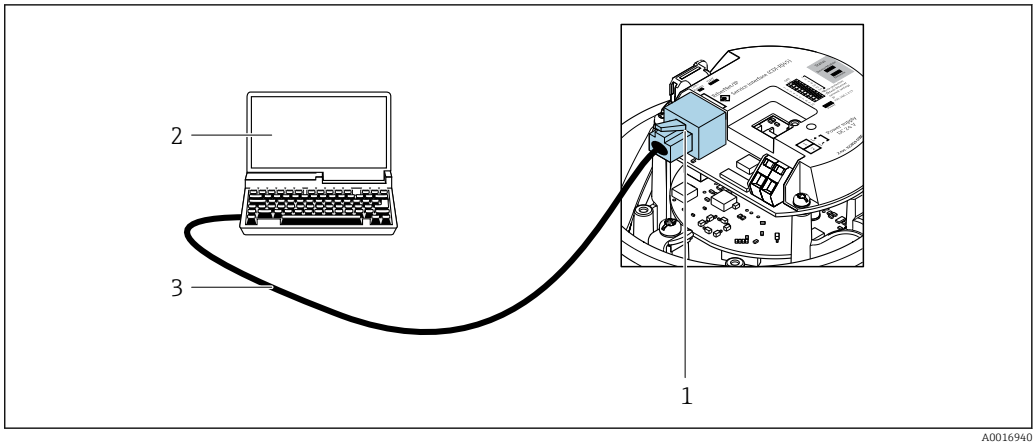
PROFIBUS DP



37 Connection for order code for "Output", option L: PROFIBUS DP

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

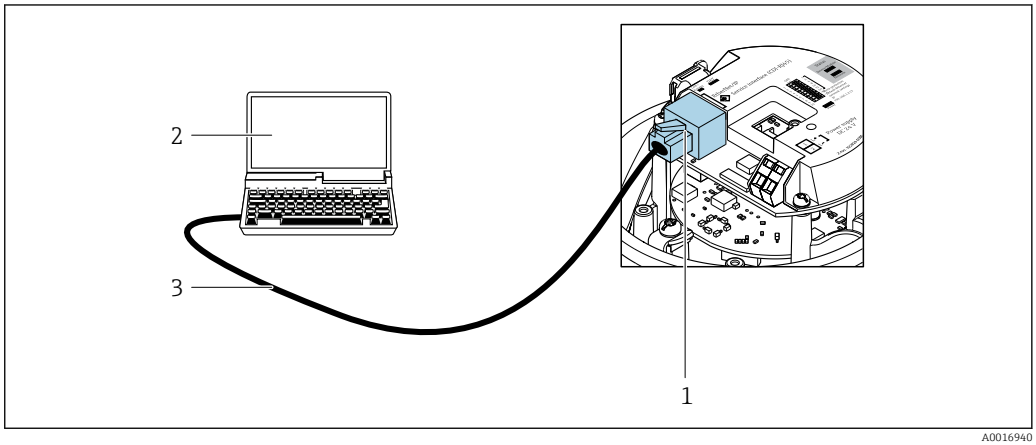
EtherNet/IP



38 Connection for order code for "Output", option N: EtherNet/IP

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

PROFINET



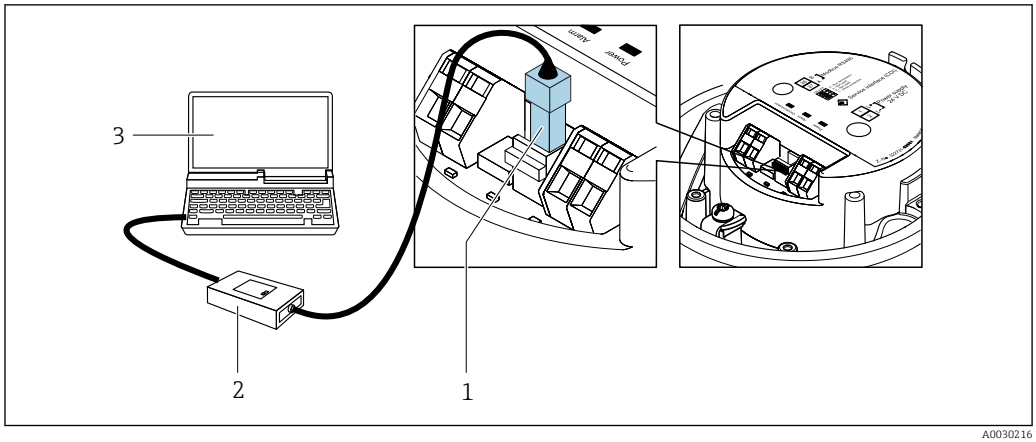
39 Connection for order code for "Output", option R: PROFINET

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

Via service interface (CDI)

This communication interface is present in the following device version:
Order code for "Output", option **M**: Modbus RS485

Modbus RS485



1 Service interface (CDI) of measuring device
2 Commubox FXA291
3 Computer with "FieldCare" operating tool with COM DTM "CDI Communication FXA291"

Certificates and approvals

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

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

CE mark

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

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

UKCA marking

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

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

RCM marking

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

Ex approval

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

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

ATEX/IECEx

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

Ex ia

Category (ATEX)	Type of protection
II2G, II2D	Ex ia IIC T6...T1 Gb Ex tb IIIC Txx °C Db
II2G	Ex ia IIC T6...T1 Gb

Ex nA

Category (ATEX)	Type of protection
II3G	Ex nA IIC T6...T1 Gc or Ex nA IIC T5-T1 Gc

$_{C}CSA_{US}$

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

IS (Ex i)
- Class I Division 1 Groups ABCD
- Class II Division 1 Groups EFG and Class III

NI (Ex nA)
Class I Division 2 Groups ABCD

Hygienic compatibility

3-A approval
- Only measuring instruments with the order code for "Additional approval", option LP "3A" have 3-A approval.
- The 3-A approval refers to the measuring instrument.
- When installing the measuring instrument, ensure that no liquid can accumulate on the outside of the measuring instrument.
  A remote display module must be installed in accordance with the 3-A Standard.
- Accessories (e.g. heating jacket, weather protection cover, wall holder unit) must be installed in accordance with the 3-A Standard.
  Each accessory can be cleaned. Disassembly may be necessary under certain circumstances.

Observe the special installation instructions

HART certification

HART interface

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

Certification PROFIBUS

PROFIBUS interface

The measuring device is certified and registered by the PNO (PROFIBUS Nutzerorganisation e.V./ PROFIBUS User Organization). The measuring system meets all the requirements of the following specifications:
- Certified according to PA Profile 3.02
- The device can also be operated with certified devices of other manufacturers (interoperability)

Certification PROFINET

PROFINET interface

The measuring device is certified and registered by the PNO (PROFIBUS Nutzerorganisation e.V. / PROFIBUS User Organization). The measuring system meets all the requirements of the following specifications:
- Certified according to:
  - Test specification for PROFINET devices
  - PROFINET Security Level 1– Netload Class 2 0 Mbps
- The device can also be operated with certified devices of other manufacturers (interoperability)
- The device supports PROFINET S2 system redundancy.

EtherNet/IP certification

The measuring device is certified and registered by the ODVA (Open Device Vendor Association). The measuring system meets all the requirements of the following specifications:
- Certified in accordance with the ODVA Conformance Test
- EtherNet/IP Performance Test
- EtherNet/IP PlugFest compliance
- The device can also be operated with certified devices of other manufacturers (interoperability)

Modbus RS485 certification

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

External standards and guidelines

- EN 60529
  Degrees of protection provided by enclosures (IP code)
- IEC/EN 60068-2-6
  Environmental influences: Test procedure - Test Fc: vibrate (sinusoidal).
- IEC/EN 60068-2-31
  Environmental influences: Test procedure - Test Ec: shocks due to rough handling, primarily for devices.
- EN 61010-1
  Safety requirements for electrical equipment for measurement, control and laboratory use - general requirements
- EN 61326-1/-2-3
  EMC requirements for electrical equipment for measurement, control and laboratory use
- 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
- NAMUR NE 132
  Coriolis mass meter
- ETSI EN 300 328
  Guidelines for 2.4 GHz radio components.
- EN 301489
  Electromagnetic compatibility and radio spectrum matters (ERM).

Ordering information

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

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

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

Application packages

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

The application packages can be ordered with the device or subsequently from Endress+Hauser. Detailed information on the order code in question is available from your local Endress+Hauser sales center or on the product page of the Endress+Hauser website: www.endress.com.

Detailed information on the application packages:
Special Documentation → 88

Heartbeat Technology

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

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

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

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

Concentration measurement

Order code for "Application package", option ED "Concentration"

Calculation and outputting of fluid concentrations.

The measured density is converted to the concentration of a substance of a binary mixture using the "Concentration" application package:
- Choice of predefined fluids (e.g. various sugar solutions, acids, alkalis, salts, ethanol etc.).
- Common or user-defined units (°Brix, °Plato, % mass, % volume, mol/l etc.) for standard applications.
- Concentration calculation from user-defined tables.

The measured values are output via the digital and analog outputs of the device.

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

Special density

Order code for "Application package", option EE "Special density"

Many applications use density as a key measured value for monitoring quality or controlling processes. The measuring instrument measures the density of the fluid as standard and makes this value available to the control system.

The "Special Density" application package offers high-precision density measurement over a wide density and temperature range particularly for applications subject to varying process conditions.

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

Accessories

Various accessories, which can be ordered with the device or subsequently from Endress+Hauser, are available for the device. Detailed information on the order code in question is available from your

local Endress+Hauser sales center or on the product page of the Endress+Hauser website: www.endress.com.

Device-specific accessories

For the sensor

Accessories	Description
Heating jacket	Is used to stabilize the temperature of the fluids in the sensor. Water, water vapor and other non-corrosive liquids are permitted for use as fluids. If using oil as a heating medium, please consult with Endress+Hauser. Heating jackets cannot be used with sensors fitted with a rupture disk. ▪ If ordered together with the measuring device: Order code for "Accessory enclosed" ▪ Option RB "Heating jacket, G 1/2" female thread" ▪ Option RC "Heating jacket, G 3/4" female thread" ▪ Option RD "Heating jacket, NPT 1/2" female thread" ▪ Option RE "Heating jacket, NPT 3/4" female thread" ▪ If ordered subsequently: Use the order code with the product root DK8003. Special Documentation SD02155D

Communication-specific accessories

Accessories	Description
Commubox FXA195 HART	For intrinsically safe HART communication with FieldCare via the USB port. Technical Information TI00404F
Commubox FXA291	Connects Endress+Hauser field devices with a CDI interface (= Endress+Hauser Common Data Interface) and the USB port of a computer or laptop. Technical Information TI00405C
HART loop converter HMX50	Is used to evaluate and convert dynamic HART process variables to analog current signals or limit values. ▪ Technical Information TI00429F ▪ Operating Instructions BA00371F
Wireless HART adapter SWA70	Is used for the wireless connection of field devices. The WirelessHART adapter can be easily integrated into field devices and existing infrastructures, offers data protection and transmission safety and can be operated in parallel with other wireless networks with minimum cabling complexity. Operating Instructions BA00061S
Fieldgate FXA42	Transmission of the measured values of connected 4 to 20 mA analog measuring instruments, as well as digital measuring instruments ▪ Technical Information TI01297S ▪ Operating Instructions BA01778S ▪ Product page: www.endress.com/fxa42
Field Xpert SMT50	The Field Xpert SMT50 tablet PC for device configuration enables mobile plant asset management in the non-hazardous areas. It is suitable for commissioning and maintenance staff to manage field instruments with a digital communication interface and to record progress. This tablet PC is designed as an all-in-one solution with a preinstalled driver library and is an easy-to-use, touch-sensitive tool which can be used to manage the field instruments throughout their entire life cycle. ▪ Technical Information TI01555S ▪ Operating Instructions BA02053S ▪ Product page: www.endress.com/smt50

Field Xpert SMT70	The Field Xpert SMT70 tablet PC for device configuration enables mobile plant asset management in hazardous and non-hazardous areas. It is suitable for commissioning and maintenance staff to manage field instruments with a digital communication interface and to record progress. This tablet PC is designed as an all-in-one solution with a preinstalled driver library and is an easy-to-use, touch-sensitive tool which can be used to manage the field instruments throughout their entire life cycle. ▪ Technical Information TI01342S ▪ Operating Instructions BA01709S ▪ Product page: www.endress.com/smt70
Field Xpert SMT77	The Field Xpert SMT77 tablet PC for device configuration enables mobile plant asset management in areas categorized as Ex Zone 1. ▪ Technical Information TI01418S ▪ Operating Instructions BA01923S ▪ Product page: www.endress.com/smt77

Service-specific accessories

Accessories	Description
Applicator	Software for selecting and sizing Endress+Hauser measuring instruments: ▪ Choice of measuring instruments for industrial requirements ▪ Calculation of all the necessary data for identifying the optimum flowmeter: e.g. nominal diameter, pressure loss, flow velocity and measurement accuracy. ▪ Graphic display of the calculation results ▪ Determination of the partial order code, administration, documentation and access to all project-related data and parameters over the entire life cycle of a project. Applicator is available: Via the Internet: https://portal.endress.com/webapp/applicator
Netilion	IIoT ecosystem: Unlock knowledge With the Netilion IIoT ecosystem,Endress+Hauser allows you to optimize your plant performance, digitize workflows, share knowledge, and enhance collaboration. Drawing upon decades of experience in process automation, Endress+Hauser offers the process industry an IIoT ecosystem designed to effortlessly extract insights from data. These insights allow process optimization, leading to increased plant availability, efficiency, and reliability - ultimately resulting in a more profitable plant. www.netilion.endress.com
FieldCare	FDT-based plant asset management tool from Endress+Hauser. It can configure all intelligent field units in your system and helps you manage them. By using the status information, it is also a simple but effective way of checking their status and condition. Operating Instructions BA00027S and BA00059S
DeviceCare	Tool to connect and configure Endress+Hauser field devices. Innovation brochure IN01047S

System components

Accessories	Description
Memograph M graphic data manager	The Memograph M graphic data manager provides information on all the relevant measured variables. Measured values are recorded correctly, limit values are monitored and measuring points analyzed. The data are stored in the 256 MB internal memory and also on a SD card or USB stick. ▪ Technical Information TI00133R ▪ Operating Instructions BA00247R
iTEMP	The temperature transmitters can be used in all applications and are suitable for the measurement of gases, steam and liquids. They can be used to read in the medium temperature. "Fields of Activity" document FA00006T

Supplementary documentation

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

Standard documentation

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

Brief Operating instructions

Brief Operating Instructions for the sensor

Measuring instrument	Documentation code
Proline Promass A	KA01282D

Brief operating instructions for transmitter

Measuring instrument	Documentation code		
	HART PROFIBUS DP	Modbus RS485	EtherNet/IP PROFINET
Proline Promass 100	KA01333D	KA01335D	KA01336D

Operating Instructions

Measuring device	Documentation code				
	HART	PROFIBUS DP	Modbus RS485	EtherNet/IP	PROFINET
Promass A 100	BA01187D	BA01246D	BA01179D	BA01182D	BA01424D

Description of device parameters

Measuring device	Documentation code				
	HART	PROFIBUS DP	Modbus RS485	EtherNet/IP	PROFINET
Promass 100	GP01033D	GP01034D	GP01035D	GP01036D	GP01037D

Supplementary device-dependent documentation

Safety Instructions

Content	Documentation code
ATEX/IECEx Ex i	XA00159D
ATEX/IECEx Ex nA	XA01029D

Content	Documentation code
cCSAus IS	XA00160D
INMETRO Ex i	XA01219D
INMETRO Ex nA	XA01220D
NEPSI Ex i	XA01249D
NEPSI Ex nA	XA01262D

Special Documentation

Content	Documentation code
Information on the Pressure Equipment Directive	SD00142D
Modbus RS485 Register Information	SD00154D
Concentration measurement	SD01152D
Concentration measurement	SD01503D
Heartbeat Technology	SD01153D
Heartbeat Technology	SD01493D
Web server	SD01820D
Web server	SD01821D
Web server	SD01822D
Web server	SD01823D

Installation instructions

Contents	Note
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 Nutzerorganisation e.V. (PROFIBUS User Organization), Karlsruhe, Germany

Modbus®
Registered trademark of SCHNEIDER AUTOMATION, INC.

EtherNet/IP™
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TRI-CLAMP®
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People for Process Automation