Technical Information
Proline Promag E 100

Electromagnetic flowmeter

The economical flowmeter with an ultra-compact transmitter

Application

- The measuring principle is practically independent of pressure, density, temperature and viscosity
- Perfectly suitable for basic applications in the chemical and process industry

Device properties
- Nominal diameter: max. DN 600 (24")
- Ex approvals for Zone 2
- PTFE liner
- Robust, ultra-compact transmitter housing
- Local display available

Your benefits

- Low-cost sensor – ideal solution for basic requirements
- Energy-saving flow measurement – no pressure loss due to cross-section constriction
- Maintenance-free – no moving parts
- 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 [EH]

People for Process Automation

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Document information

Symbols used

Electrical symbols

Symbol	Meaning	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.
⏚	**Protective ground connection** A terminal which must be connected to ground prior to establishing any other connections.	▽	**Equipotential connection** A connection that has to be connected to the plant grounding system: This may be a potential equalization line or a star grounding system depending on national or company codes of practice.

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

Function and system design

Measuring principle

Following *Faraday's law of magnetic induction*, a voltage is induced in a conductor moving through a magnetic field.

A0017035
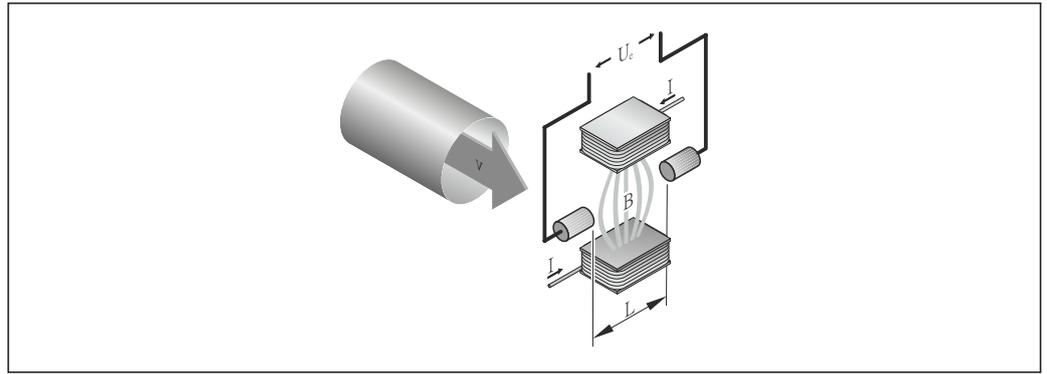
Ue *Induced voltage*
B *Magnetic induction (magnetic field)*
L *Electrode spacing*
I *Current*
v *Flow velocity*

In the electromagnetic measuring principle, the flowing medium is the moving conductor. The voltage induced (U_e) is proportional to the flow velocity (v) and is supplied to the amplifier by means of two measuring electrodes. The flow volume (Q) is calculated via the pipe cross-section (A). The DC magnetic field is created through a switched direct current of alternating polarity.

Formulae for calculation
- Induced voltage $U_e = B \cdot L \cdot v$
- Volume flow $Q = A \cdot v$

| Measuring system | The device consists of a transmitter and a sensor. |

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

Transmitter

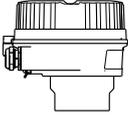| Promag 100	Device versions and materials: Compact, aluminum coated: Aluminum, AlSi10Mg, coated

A0016693	Configuration:
	• Via operating tools (e.g. FieldCare)
	• Additionally for device version with local display:
	  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

Promag E	Nominal diameter range: DN 15 to 600 (½ to 24")

A0017703	Materials:
	• Sensor housing:
	  – Aluminum, AlSi10Mg, coated
	  – DN 15 to 300 (½ to 12"): aluminum, AlSi10Mg, coated
	  – DN 350 to 600 (14 to 24"): carbon steel with protective varnish
	• Measuring tubes [1]: stainless steel, 1.4301/1.4306
	• Liner: PTFE
	• Electrodes: stainless steel, 1.4435 (F316L); Alloy C22, 2.4602 (UNS N06022); tantalum
	• Process connections: carbon steel, A105/FE410WB [2]/HII/S235JRG2/ S275JR; Alloy C22, 2.4602 (UNS N06022)
	• Seals: as per DIN EN 1514-1
	• Ground disks: stainless steel, 1.4435 (316L); Alloy C22, 2.4602 (UNS N06022); tantalum; titanium

1)   For flanges made of carbon steel with Al/Zn protective coating (DN 15 to 300 (½ to 12")) or protective varnish (DN 350 to 600 (14 to 24"))
2)   With Al/Zn protective coating (DN 15 to 300 (½ to 12")) or protective varnish (DN 350 to 600 (14 to 24"))

Equipment architecture
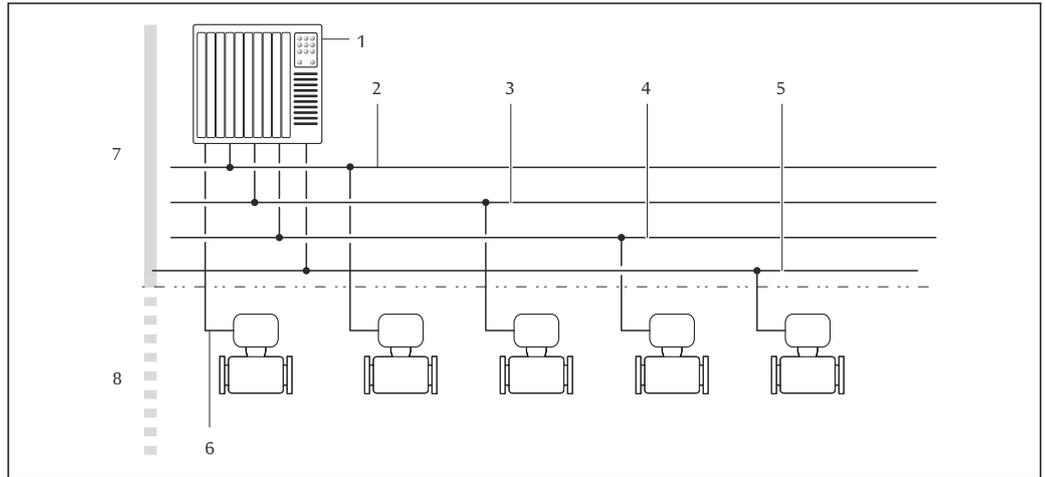
🖼 *1   Possibilities for integrating measuring devices into a system*

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   Non-hazardous area
8   Non-hazardous area and Zone 2/Div. 2

Safety

IT security

We only provide a warranty if the device is installed and used as described in the Operating Instructions. The device is equipped with security mechanisms to protect it against any inadvertent changes to the device settings.

IT security measures in line with operators' security standards and designed to provide additional protection for the device and device data transfer must be implemented by the operators themselves.

Input

Measured variable

Direct measured variables

- Volume flow (proportional to induced voltage)
- Electrical conductivity

Calculated measured variables

- Mass flow
- Corrected volume flow

Measuring range

Typically v = 0.01 to 10 m/s (0.03 to 33 ft/s) with the specified accuracy

Electrical conductivity: ≥ 5 µS/cm for liquids in general

Flow characteristic values in SI units

Nominal diameter		Recommended flow	Factory settings		
		min./max. full scale value (v ~ 0.3/10 m/s)	Current output full scale value [1] (v ~ 2.5 m/s)	Pulse value [1] (~ 2 pulse/s)	Low flow cut off (v ~ 0.04 m/s)
[mm]	[in]	[dm³/min]	[dm³/min]	[dm³]	[dm³/min]
15	½	4 to 100	25	0.2	0.5
25	1	9 to 300	75	0.5	1

Nominal diameter		Recommended flow	Factory settings		
		min./max. full scale value (v ~ 0.3/10 m/s)	Current output full scale value [1] (v ~ 2.5 m/s)	Pulse value [1] (~ 2 pulse/s)	Low flow cut off (v ~ 0.04 m/s)
[mm]	[in]	[dm³/min]	[dm³/min]	[dm³]	[dm³/min]
32	–	15 to 500	125	1	2
40	1 ½	25 to 700	200	1.5	3
50	2	35 to 1 100	300	2.5	5
65	–	60 to 2 000	500	5	8
80	3	90 to 3 000	750	5	12
100	4	145 to 4 700	1 200	10	20
125	–	220 to 7 500	1 850	15	30
150	6	20 to 600 m³/h	150 m³/h	0.03 m³	2.5 m³/h
200	8	35 to 1 100 m³/h	300 m³/h	0.05 m³	5 m³/h
250	10	55 to 1 700 m³/h	500 m³/h	0.05 m³	7.5 m³/h
300	12	80 to 2 400 m³/h	750 m³/h	0.1 m³	10 m³/h
350	14	110 to 3 300 m³/h	1 000 m³/h	0.1 m³	15 m³/h
400	16	140 to 4 200 m³/h	1 200 m³/h	0.15 m³	20 m³/h
450	18	180 to 5 400 m³/h	1 500 m³/h	0.25 m³	25 m³/h
500	20	220 to 6 600 m³/h	2 000 m³/h	0.25 m³	30 m³/h
600	24	310 to 9 600 m³/h	2 500 m³/h	0.3 m³	40 m³/h

1) HART only

Flow characteristic values in US units

Nominal diameter		Recommended flow	Factory settings		
		min./max. full scale value (v ~ 0.3/10 m/s)	Current output full scale value [1] (v ~ 2.5 m/s)	Pulse value [1] (~ 2 pulse/s)	Low flow cut off (v ~ 0.04 m/s)
[in]	[mm]	[gal/min]	[gal/min]	[gal]	[gal/min]
½	15	1.0 to 27	6	0.1	0.15
1	25	2.5 to 80	18	0.2	0.25
1 ½	40	7 to 190	50	0.5	0.75
2	50	10 to 300	75	0.5	1.25
3	80	24 to 800	200	2	2.5
4	100	40 to 1 250	300	2	4
6	150	90 to 2 650	600	5	12
8	200	155 to 4 850	1 200	10	15
10	250	250 to 7 500	1 500	15	30
12	300	350 to 10 600	2 400	25	45
14	350	500 to 15 000	3 600	30	60
16	400	600 to 19 000	4 800	50	60
18	450	800 to 24 000	6 000	50	90

Nominal diameter		Recommended flow	Factory settings		
		min./max. full scale value (v ~ 0.3/10 m/s)	Current output full scale value [1] (v ~ 2.5 m/s)	Pulse value [1] (~ 2 pulse/s)	Low flow cut off (v ~ 0.04 m/s)
[in]	[mm]	[gal/min]	[gal/min]	[gal]	[gal/min]
20	500	1 000 to 30 000	7500	75	120
24	600	1 400 to 44 000	10500	100	180

1)   HART only

To calculate the measuring range, use the *Applicator* sizing tool → 🗎 63

Recommended measuring range

"Flow limit" section → 🗎 44

Operable flow range   Over 1000 : 1

Input signal

External measured values

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

Various pressure transmitters and temperature measuring devices can be ordered from Endress +Hauser: see "Accessories" section → 🗎 64

It is recommended to read in external measured values to calculate the following measured variables: 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 from the automation system to the measuring via:
• PROFIBUS DP
• Modbus RS485
• EtherNet/IP
• PROFINET

Output

Output signal

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	Adjustable: 0.07 to 999 s
Assignable measured variables	• Volume flow • Mass flow • Corrected volume flow • Flow velocity • Conductivity • Corrected conductivity • Electronic temperature

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	Adjustable: 0.05 to 2 000 ms
Maximum pulse rate	10 000 Impulse/s
Pulse value	Adjustable
Assignable measured variables	• Volume flow • Mass flow • Corrected volume flow
Frequency output	
Output frequency	Adjustable: 0 to 10 000 Hz
Damping	Adjustable: 0 to 999 s
Pulse/pause ratio	1:1
Assignable measured variables	• Volume flow • Mass flow • Corrected volume flow • Flow velocity • Conductivity • Corrected conductivity • Temperature • Electronic temperature
Switch output	
Switching behavior	Binary, conductive or non-conductive
Switching delay	Adjustable: 0 to 100 s

Number of switching cycles	Unlimited

Assignable functions	• Off
	• On
	• Diagnostic behavior
	• Limit value:
	  – Off
	  – Volume flow
	  – Mass flow
	  – Corrected volume flow
	  – Flow velocity
	  – Conductivity
	  – Corrected conductivity
	  – Totalizer 1-3
	  – Temperature
	  – Electronic temperature
	• Flow direction monitoring
	• Status
	  – Empty pipe detection
	  – Low flow cut off

PROFIBUS DP

Signal encoding	NRZ code
Data transfer	9.6 kBaud...12 MBaud

Modbus RS485

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

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

4-20 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 • Freely definable value between: 3.59 to 22.5 mA • Actual value • Last valid value

HART

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

Pulse/frequency/switch output

Pulse output	
Failure mode	Choose from: • Actual value • No pulses
Frequency output	
Failure mode	Choose from: • Actual value • 0 Hz • Defined value: 0 to 12 500 Hz
Switch output	
Failure 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	In accordance with "Application Layer protocol for decentral device periphery and distributed automation", 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

Operating tool

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

Plain text display	With information on cause and remedial measures

ℹ Additional information on remote operation → 🖹 55

Web browser

Plain text display	With information on cause and remedial measures

Light emitting diodes (LED)

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

Low flow cut off	The switch points for low flow cut off are user-selectable.
Galvanic isolation	The following connections are galvanically isolated from each other: • Outputs • Power supply
Protocol-specific data	**HART**

Manufacturer ID	0x11
Device type ID	0x3A
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) • Off • Volume flow • Mass flow • Corrected volume flow • Flow velocity • Temperature • Electronic temperature
	Measured variables for SV, TV, QV (secondary, tertiary and quaternary dynamic variable) • Volume flow • Mass flow • Corrected volume flow • Flow velocity • Temperature • Electronic temperature • Totalizer 1 • Totalizer 2 • Totalizer 3
Device variables	Read out the device variables: HART command 9 The device variables are permanently assigned.
	A maximum of 8 device variables can be transmitted: • 0 = volume flow • 1 = mass flow • 2 = corrected volume flow • 3 = flow velocity • 4 = conductivity • 5 = corrected conductivity • 6 = temperature • 7 = electronic temperature • 8 = totalizer 1 • 9 = totalizer 2 • 10 = totalizer 3

PROFIBUS DP

Manufacturer ID	0x11
Ident number	0x1561
Profile version	3.02
Device description files (GSD, DTM, DD)	Information and files under: • www.endress.com On the product page for the device: Documents/Software → Device drivers • www.profibus.org
Output values (from measuring device to automation system)	**Analog input 1 to 4** • Volume flow • Mass flow • Corrected volume flow • Flow velocity • Conductivity • Corrected conductivity • Temperature • Electronic temperature
	Digital input 1 to 2 • Empty pipe detection • Low flow cut off • Verification status
	Totalizer 1 to 3 • Volume flow • Mass flow • Corrected volume flow

Input values (from automation system to measuring device)	**Analog output 1 to 2 (fixed assignment)** • External temperature • External density
	Digital output 1 to 2 (fixed assignment) • Digital output 1: switch positive zero return on/off • Digital output 2: start verification

	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
	  Simplest 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
	  Simplest 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

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	0x103A
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 device	• 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 device
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	56
	T → O configuration:	0x64	32

Exclusive Owner Multicast		Instance	Size [byte]
	Instance configuration:	0x69	-
	O → T configuration:	0x66	56
	T → O configuration:	0x64	32

Input only Multicast		Instance	Size [byte]
	Instance configuration:	0x68	398
	O → T configuration:	0xC7	-
	T → O configuration:	0x64	32

Input only Multicast		Instance	Size [byte]
	Instance configuration:	0x69	-
	O → T configuration:	0xC7	-
	T → O configuration:	0x64	32

Input Assembly	• Current device diagnostics • Volume flow • Mass flow • Corrected volume flow • 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	56
	T → O configuration:	0x65	88
Exclusive Owner Multicast		Instance	Size [byte]
	Instance configuration:	0x69	-
	O → T configuration:	0x66	56
	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	• Volume flow • Corrected volume flow • Mass flow • Electronic temperature • Totalizer 1 to 3 • Flow velocity • Volume flow unit • Corrected volume flow unit • Mass flow unit • Temperature unit • Unit totalizer 1-3 • Flow velocity unit • Verification result • Verification status ⓘ 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 reference density compensation • Activation of temperature compensation • Reset totalizers 1-3 • External density • Density unit • External temperature • Activation verification • Start verification		

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
	  – Measuring mode
	  – Failsafe mode
	• Alarm delay

PROFINET

Protocol	"Application layer protocol for decentral device periphery and distributed automation", version 2.3
Conformity class	B
Communication type	100 MBit/s
Device profile	Application interface identifier 0xF600 Generic device
Manufacturer ID	0x11
Device type ID	0x843A
Device description files (GSD, DTM)	Information and files under: • www.endress.com On the product page for the device: Documents/Software → Device drivers • www.profibus.org
Baud rates	Automatic 100 Mbit/s with full-duplex detection
Cycle times	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 device	• 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 device
Configuration of the device name	• DIP switches on the electronics module, for device name assignment (last part) • DCP protocol

Output values (from measuring device to automation system)	**Analog Input module (slot 1 to 10)** • Volume flow • Mass flow • Corrected volume flow • Flow velocity • Conductivity • Corrected conductivity • Temperature • Electronic temperature **Discrete Input module (slot 1 to 10)** • Empty pipe detection • Low flow cut off **Diagnostics Input module (slot 1 to 10)** • Last diagnostics • Current diagnosis **Totalizer 1 to 3 (slot 11 to 13)** • Volume flow • Mass flow • Corrected volume flow **Heartbeat Verification module (fixed assignment)** Verification status (slot 17)
Input values (from automation system to measuring device)	**Analog Output module (fixed assignment)** • External density (slot 14) • External temperature (slot 15) **Discrete Output module (fixed assignment)** Activate/deactivate positive zero return (slot 16) **Totalizer 1 to 3 (slot 11 to 13)** • 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 17)
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 onsite 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...10
	Volume flow		
	Corrected volume flow		
	Temperature		
	Conductivity		
	Corrected conductivity		
	Electronic temperature		
	Flow velocity		
	Current device diagnostics		
	Previous device diagnostics		

Input/output value	Process variable	Category	Slot
Input/output value	Totalizer	Totalizer	11...13
Input value	External density	Process monitoring	14
	External temperature		15
	Flow override		16
	Verification status	Heartbeat Verification [1]	17

1)   Only available with the "Heartbeat" application package.
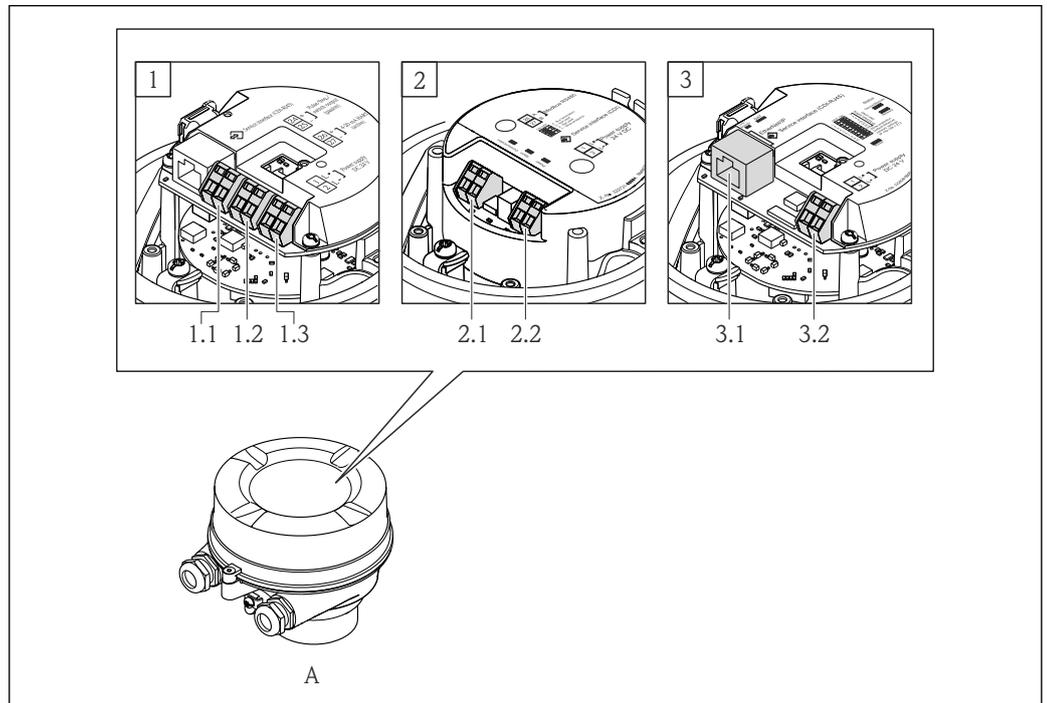
Startup configuration

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 - Temperature - Conductivity - Sensor adjustment - Process param. - Damping (flow, conductivity, temperature) - Flow override - Filter options - 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 - External compensation - Temperature source - Density source - Density value - Diagnostic settings - Diagnostic behavior for diverse diagnostic information

Power supply

Terminal assignment   Overview: housing version and connection versions

A0019825

A   Housing version: compact, aluminum coated
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, PROFIBUS DP
2.1   Signal transmission
2.2   Supply voltage
3   Connection version: EtherNet/IP and PROFINET
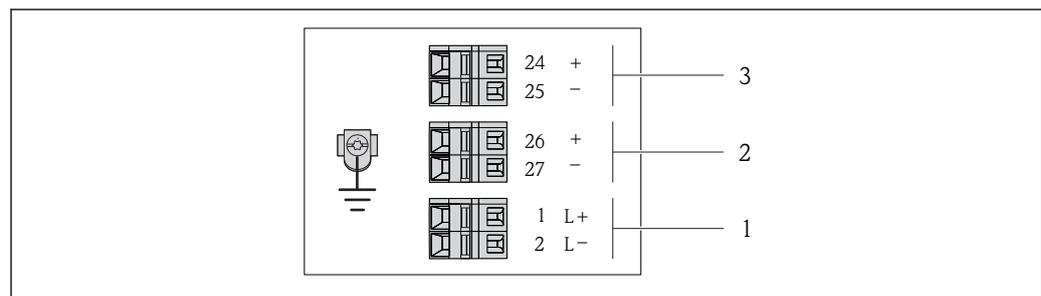*3.1   Signal transmission*
3.2   Supply voltage

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 for "Housing"	Connection methods available		Possible options for order code "Electrical connection"
	Outputs	Power supply	
Option **A**	Terminals	Terminals	• Option **A**: coupling M20x1 • Option **B**: thread M20x1 • Option **C**: thread G ½" • Option **D**: thread NPT ½"
Option **A**	Device plugs → 🖹 26	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
Option **A**	Device plugs → 🖹 26	Device plugs → 🖹 26	Option **Q**: 2 x plug M12x1
Order code for "Housing": Option **A**: compact, coated aluminum			

🖾 *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)

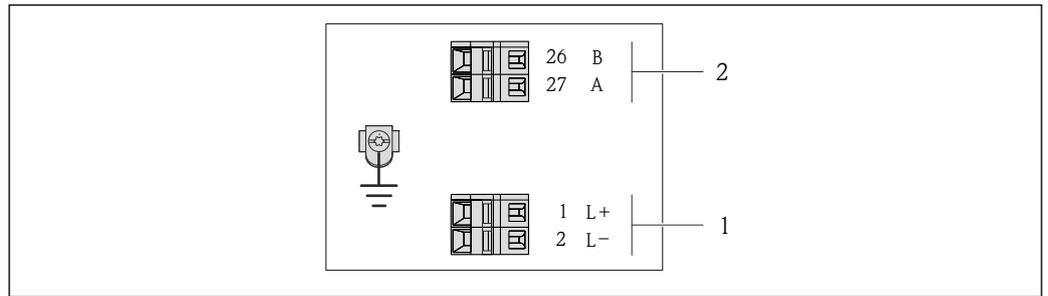| Order code for "Output"	Terminal number					
	Power supply		Output 1		Output 2	
	2 (L-)	1 (L+)	27 (−)	26 (+)	25 (−)	24 (+)
Option **B**	DC 24 V		4-20 mA HART (active)		Pulse/frequency/switch output (passive)	
Order code for "Output": Option **B**: 4-20 mA HART with pulse/frequency/switch output						

PROFIBUS DP connection version

ℹ️ 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 for "Housing"	Connection methods available		Possible options for order code "Electrical connection"
	Output	Power supply	
Option **A**	Terminals	Terminals	• Option **A**: coupling M20x1 • Option **B**: thread M20x1 • Option **C**: thread G ½" • Option **D**: thread NPT ½"
Option **A**	Device plugs → 🕮 26	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
Option **A**	Device plugs → 🕮 26	Device plugs → 🕮 26	Option **Q**: 2 x plug M12x1
Order code for "Housing": Option **A**: compact, coated aluminum			

🖻 3   PROFIBUS DP terminal assignment

1   Power supply: DC 24 V
2   PROFIBUS DP

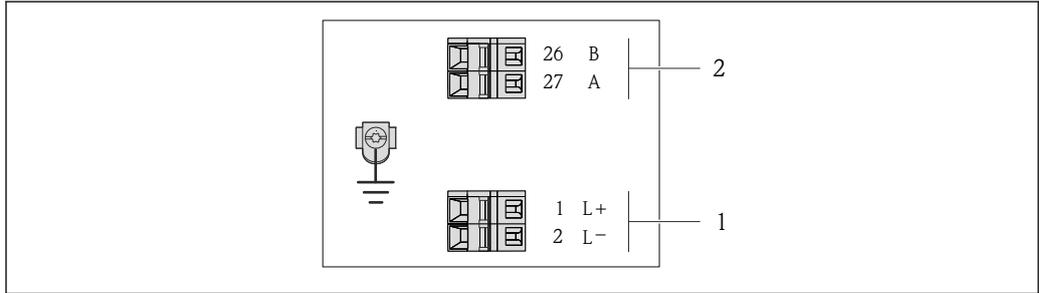| Order code for "Output"	Terminal number			
	Power supply		Output	
	2 (L-)	1 (L+)	26 (RxD/TxD-P)	27 (RxD/TxD-N)
Option **L**	DC 24 V		B	A
Order code for "Output": Option **L**: PROFIBUS DP, for use in non-hazardous areas and Zone 2/div. 2				

Modbus RS485 connection version

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

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

Order code for "Housing"	Connection methods available		Possible options for order code "Electrical connection"
	Output	Power supply	
Option **A**	Terminals	Terminals	• Option **A**: coupling M20x1 • Option **B**: thread M20x1 • Option **C**: thread G ½" • Option **D**: thread NPT ½"
Option **A**	Device plugs → 🖹 26	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
Option **A**	Device plugs → 🖹 26	Device plugs → 🖹 26	Option **Q**: 2 x plug M12x1
Order code for "Housing": Option **A**: compact, coated aluminum			

 4   *Modbus RS485 terminal assignment*

1   Power supply: DC 24 V
2   Modbus RS485

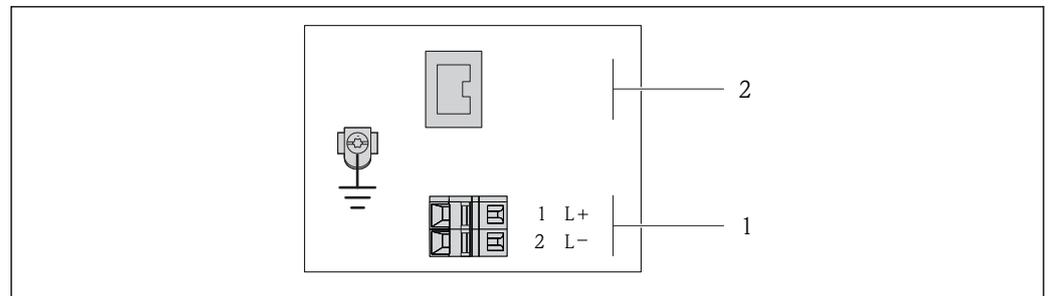| Order code for "Output"	Terminal number			
	Power supply		Output	
	2 (L-)	1 (L+)	27 (B)	26 (A)
Option **M**	DC 24 V		Modbus RS485	
Order code for "Output": Option **M**: Modbus RS485				

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 for "Housing"	Connection methods available		Possible options for order code "Electrical connection"
	Output	Power supply	
Option **A**	Device plugs → 🖹 26	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
Option **A**	Device plugs → 🖹 26	Device plugs → 🖹 26	Option **Q**: 2 x plug M12x1
Order code for "Housing": Option **A**: compact, coated aluminum			

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🖻 *5 EtherNet/IP terminal assignment*

1 Power supply: DC 24 V
2 EtherNet/IP

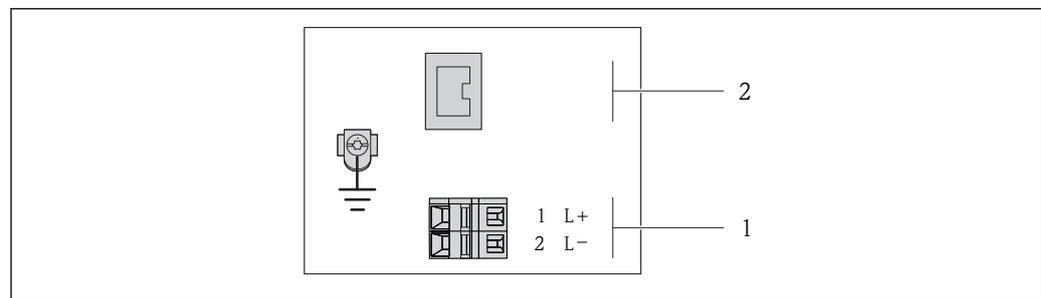| Order code for "Output"	Terminal number		
	Power supply		Output
	2 (L-)	1 (L+)	Device plug M12x1
Option **N**	DC 24 V		EtherNet/IP
Order code for "Output": Option **N**: EtherNet/IP			

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 for "Housing"	Connection methods available		Possible options for order code "Electrical connection"
	Output	Power supply	
Option **A**	Device plugs → 🖹 26	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
Option **A**	Device plugs → 🖹 26	Device plugs → 🖹 26	Option **Q**: 2 x plug M12x1
Order code for "Housing": Option **A**: compact, coated aluminum			

🖻 6   PROFINET terminal assignment

1   Power supply: DC 24 V
2   PROFINET

Order code for "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			

Pin assignment, device plug   ℹ️ Order codes for the M12x1 connectors, see the "Order code for **electrical connection**" column:
• 4-20 mA HART, pulse/frequency/switch output → 🖹 22
• PROFIBUS DP→ 🖹 23
• Modbus RS485 → 🖹 24
• EtherNet/IP → 🖹 25
• PROFINET→ 🖹 26

Supply voltage

For all connection versions (device side)

Pin		Assignment
1	L+	DC 24 V
2		Not assigned
3		Not assigned
4	L-	DC 24 V
5		Grounding/shielding

	Coding	Plug/socket
	A	Plug

ℹ The following is recommended as a socket:
- Binder, series 763, part no. 79 3440 35 05
- Alternatively: Phoenix part no. 1669767 SAC-5P-M12MS
  - 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)

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
Coding		Plug/socket
A		Socket

ℹ - 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

ℹ 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
Coding		Plug/socket
B		Socket

ℹ - 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

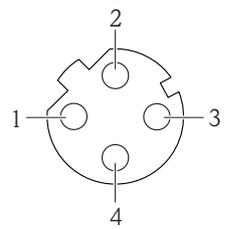*Device plug for signal transmission (device side)*

Pin		Assignment
1		Not assigned
2	A	Modbus RS485
3		Not assigned
4	B	Modbus RS485
5		Grounding/shielding

Coding	Plug/socket
B	Socket

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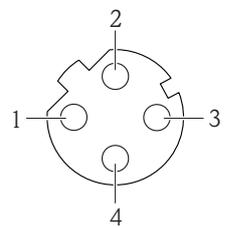• When using the device in a hazardous location, use a suitably certified plug.

EtherNet/IP

Device plug for signal transmission (device side)

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

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ℹ️ 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

A0016812

ℹ️ 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.

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

Transmitter

For device version with all communication types: 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	3.5 W
Option **N**: EtherNet/IP	3.5 W
Option **R**: PROFINET	3.5 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	90 mA	10 A (< 0.8 ms)
Option **N**: EtherNet/IP	145 mA	18 A (< 0.125 ms)
Option **R**: PROFINET	145 mA	18 A (< 0.125 ms)

| 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 plug-in memory (HistoROM DAT).
• Configuration is retained in the plug-in memory (HistoROM DAT).
• Error messages (incl. total operated hours) are stored. |

| Electrical connection | **Connecting the transmitter** |
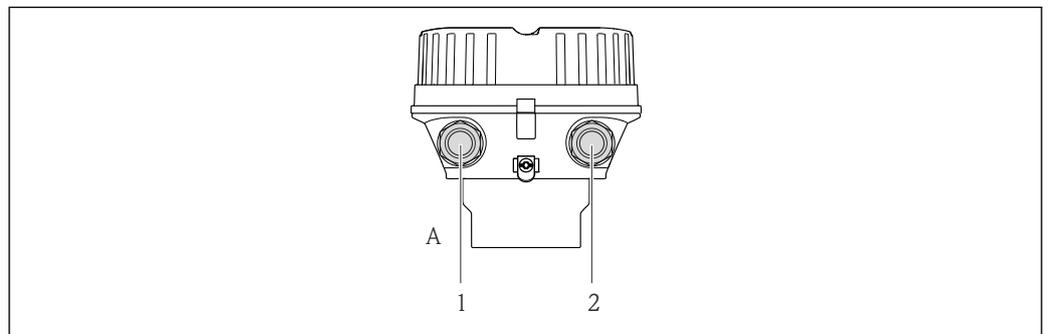
A0019824

A   Housing version: compact, aluminum coated
1   Cable entry or device plug for signal transmission
2   Cable entry or device plug for supply voltage

> • Terminal assignment → 🗎 21
> • Pin assignment, device plug → 🗎 26

> 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.
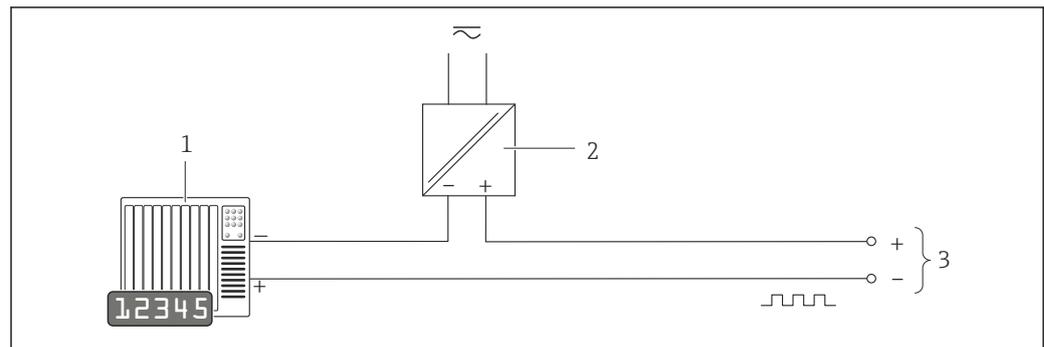
Connection examples

Current output 4-20 mA HART
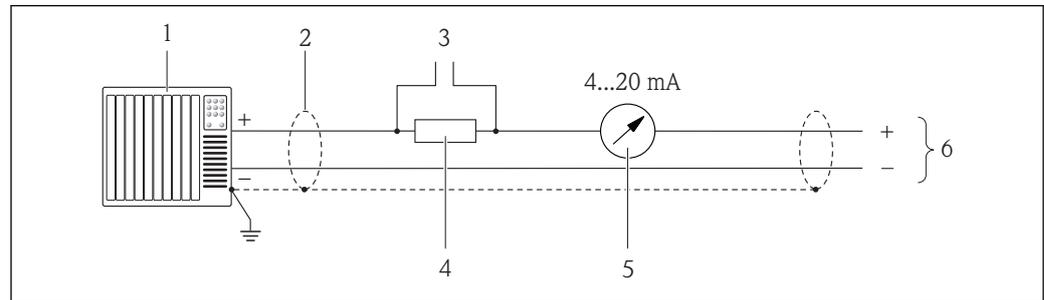
🔲 *7   Connection example for 4-20 mA HART current output (active)*

1   Automation system with current input (e.g. PLC)
2   Cable shield, observe cable specifications
3   Connection for HART operating devices
4   Resistor for HART communication (≥ 250 Ω): observe maximum load
5   Analog display unit: observe maximum load
6   Transmitter

Pulse/frequency output

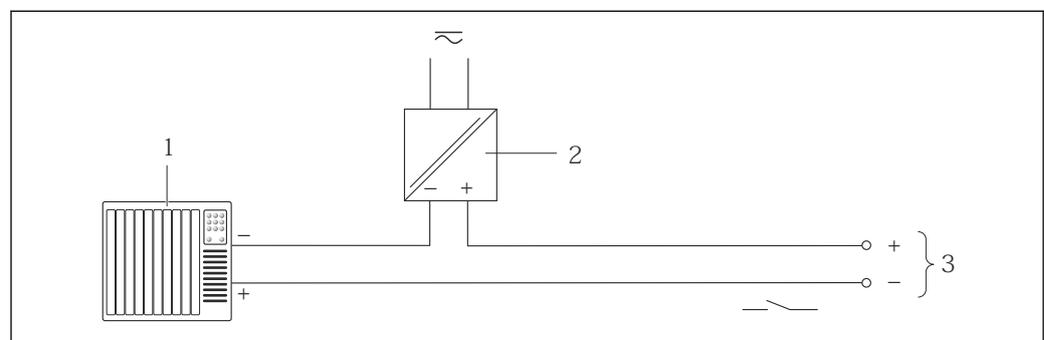🔲 *8   Connection example for pulse/frequency output (passive)*

1   Automation system with pulse/frequency input (e.g. PLC)
2   Power supply
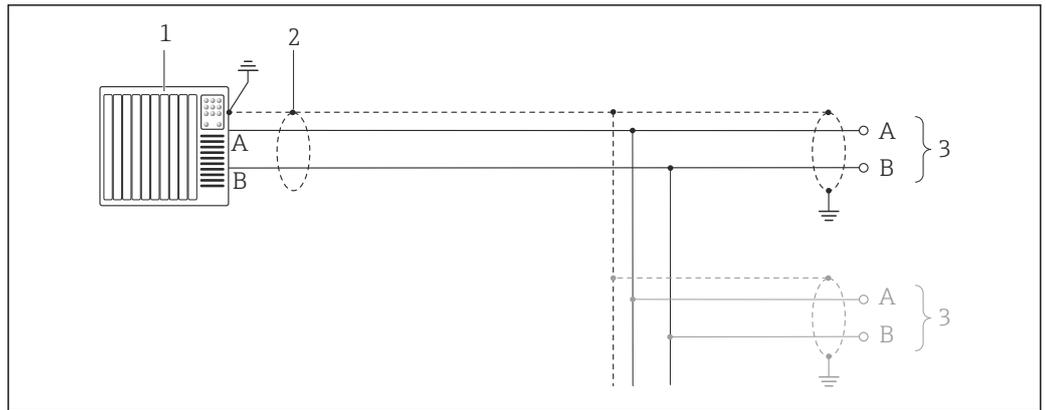*3   Transmitter: observe input values → 🔲 10*

Switch output

🔲 *9   Connection example for switch output (passive)*

1   Automation system with switch input (e.g. PLC)
2   Power supply
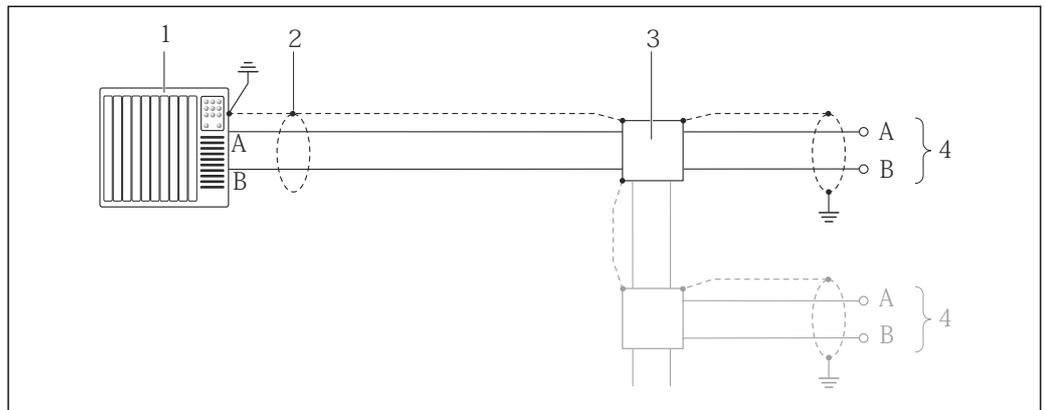*3   Transmitter: observe input values*

PROFIBUS DP

A0021429

⊠ *10   Connection example for PROFIBUS DP, non-hazardous area and Zone 2/Div. 2*

1   Control system (e.g. PLC)
2   Cable shield: the cable shield must be grounded at both ends to comply with EMC requirements; observe cable specifications
3   Transmitter

ℹ️ 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.
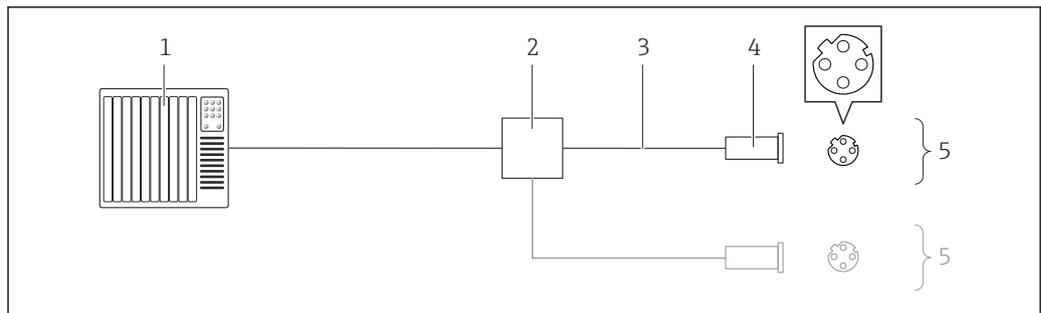
Modbus RS485

A0016803

⊠ *11   Connection example for Modbus RS485, non-hazardous area and Zone 2/Div. 2*

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

EtherNet/IP

⊡ *12   Connection example for EtherNet/IP*

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

PROFINET
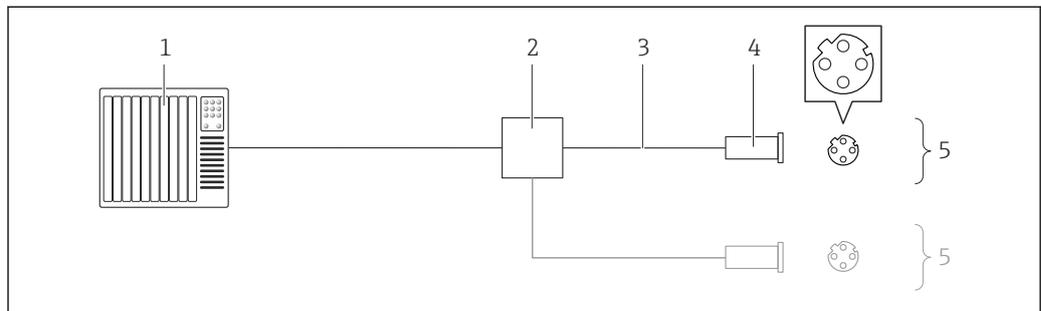
⊡ *13   Connecting cable for PROFINET*

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

HART input
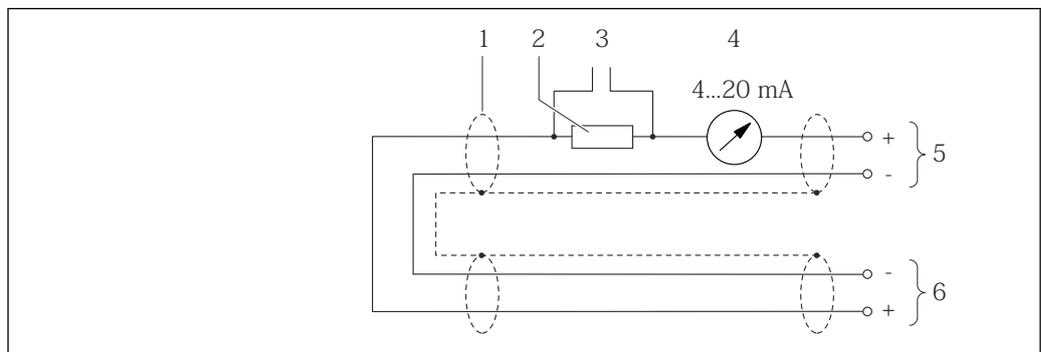
⊡ *14   Connection example for HART input (burst mode) via current output (active)*

1   Cable shield, 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

15   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, 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

Please consider the following to ensure correct measurement:
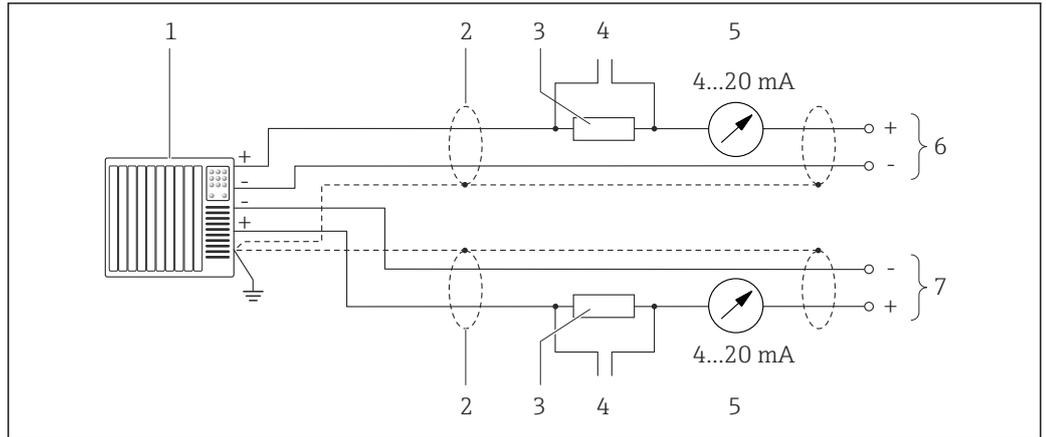- Same electrical potential for the fluid and sensor
- Company-internal grounding concepts
- Pipe material and grounding

For devices intended for use in hazardous locations, please observe the guidelines in the Ex documentation (XA).

Connection example, standard scenario

Metal, grounded pipe
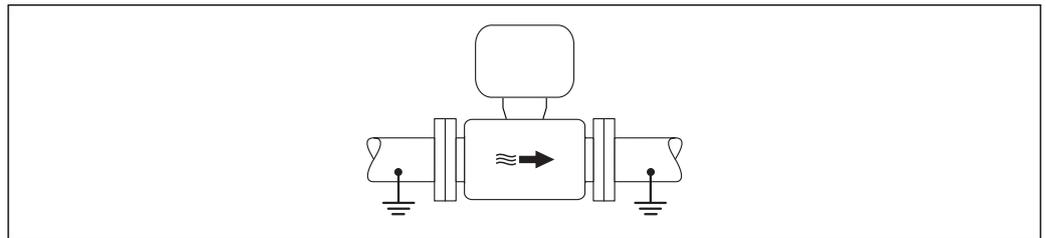
16   Potential equalization via measuring tube

Connection example in special situations

Unlined and ungrounded metal pipe

This connection method also applies in situations where:
- The customary potential equalization is not used
- Equalizing currents are present

Ground cable	Copper wire, at least 6 mm² (0.0093 in²)
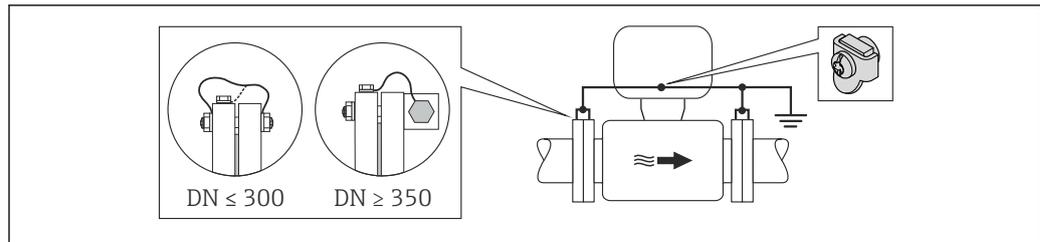
⊠ 17   Potential equalization via ground terminal and pipe flanges

Note the following when installing:
- Connect both sensor flanges to the pipe flange via a ground cable and ground them.
- Connect the connection housing of the transmitter or sensor to ground potential by means of the ground terminal provided for the purpose. To mount the ground cable:
  - If DN ≤ 300 (12"): Mount the ground cable directly on the conductive flange coating of the sensor with the flange screws.
  - If DN ≥ 350 (14"): Mount the ground cable directly on the metal transport bracket.

The necessary ground cable can be ordered from Endress+Hauser .

Plastic pipe or pipe with insulating liner

This connection method also applies in situations where:
- The customary potential equalization is not used
- Equalizing currents are present

Ground cable	Copper wire, at least 6 mm² (0.0093 in²)
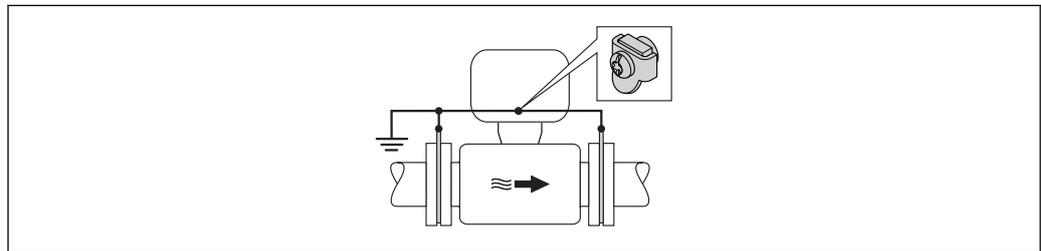
⊠ 18   Potential equalization via ground terminal and ground disks

Note the following when installing:
The ground disks must be connected to the ground terminal via the ground cable and be connected to ground potential.

The ground cable and ground disks can be ordered from Endress+Hauser → 🖺 62.

Pipe with a cathodic protection unit

This connection method is only used if the following two conditions are met:
- Metal pipe without liner or pipe with electrically conductive liner
- Cathodic protection is integrated in the personal protection equipment

Ground cable	Copper wire, at least 6 mm² (0.0093 in²)

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Note the following when installing:
The sensor is installed in the pipe in a way that provides electrical insulation.

The necessary ground cable can be ordered from Endress+Hauser .

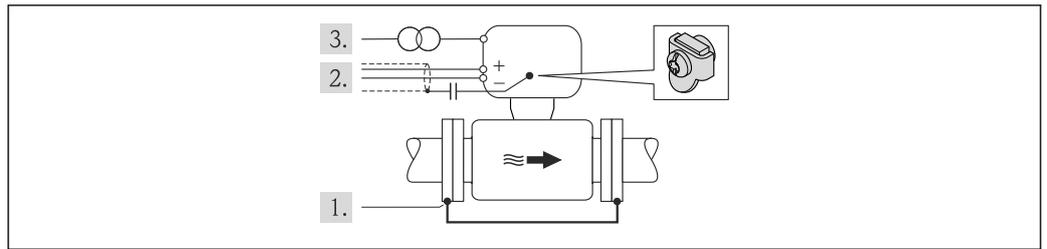|	
Terminals	**Transmitter** Spring terminals for wire cross-sections0.5 to 2.5 mm² (20 to 14 AWG)

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

Cable specification	**Permitted temperature range** • –40 ℃ (–40 ℉) to +80 ℃ (+176 ℉) • Minimum requirement: cable temperature range ≥ ambient temperature +20 K **Power supply cable** Standard installation cable is sufficient. **Signal cable** *Current output* For 4-20 mA HART: Shielded cable recommended. Observe grounding concept of the plant. *Pulse/frequency/switch output* Standard installation cable is sufficient. *PROFIBUS DP* The IEC 61158 standard specifies two types of cable (A and B) for the bus line which can be used for every transmission rate. Cable type A is recommended.

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

Modbus RS485

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

Cable type	A
Characteristic impedance	135 to 165 Ω at a measuring frequency of 3 to 20 MHz
Cable capacitance	<30 pF/m
Wire cross-section	>0.34 mm^2 (22 AWG)
Cable type	Twisted pairs
Loop resistance	≤110 Ω/km
Signal damping	Max. 9 dB over the entire length of the cable cross-section
Shield	Copper braided shielding or braided shielding with foil shield. When grounding the cable shield, observe the grounding concept of the plant.

EtherNet/IP

The standard ANSI/TIA/EIA-568-B.2 Annex specifies CAT 5 as the minimum category for a cable used for EtherNet/IP. CAT 5e and CAT 6 are recommended.

For more information on planning and installing EtherNet/IP networks, please refer to the "Media Planning and Installation Manual. EtherNet/IP" of ODVA Organization

PROFINET

Standard IEC 61156-6 specifies CAT 5 as the minimum category for a cable used for PROFINET. CAT 5e and CAT 6 are recommended.

For more information on planning and installing PROFINET networks, see: "PROFINET Cabling and Interconnection Technology", Guideline for PROFINET

Performance characteristics

Reference operating conditions	**In accordance with DIN EN 29104** • Medium temperature: +28 ± 2 ℃ (+82 ± 4 ℉) • Ambient temperature: +22 ± 2 ℃ (+72 ± 4 ℉) • Warm-up period: 30 min **Installation** • Inlet run > 10 × DN • Outlet run > 5 × DN • Sensor and transmitter grounded. • The sensor is centered in the pipe. To calculate the measuring range, use the *Applicator* sizing tool → 🖹 63
Maximum measured error	**Error limits under reference operating conditions** o.r. = of reading **Volume flow** • ±0.5 % o.r. ± 1 mm/s (0.04 in/s) • Optional: ±0.2 % o.r. ± 2 mm/s (0.08 in/s) Fluctuations in the supply voltage do not have any effect within the specified range.
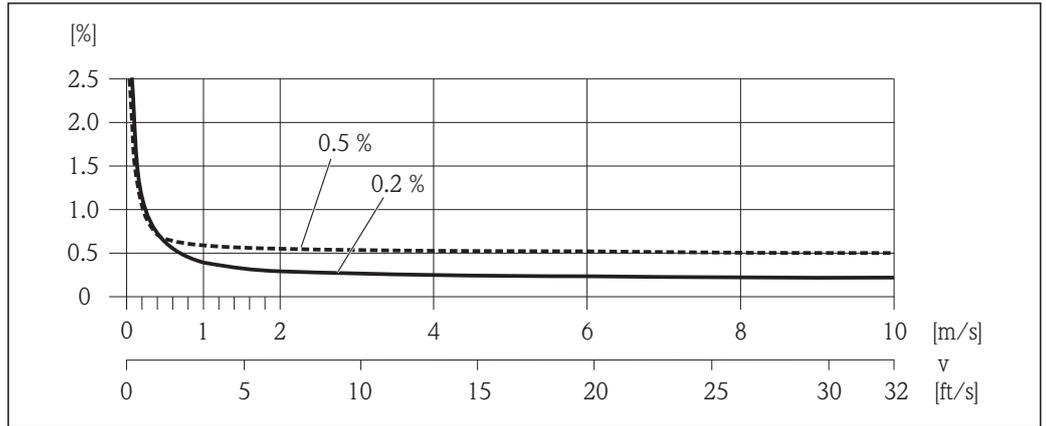
图 19 *Maximum measured error in % o.r.*

Electrical conductivity
Max. measured error not specified.

Accuracy of outputs

ℹ️ In the case of analog outputs, the output accuracy must also be considered for the measured error; in contrast, this need not be considered in the case of 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. (across the entire ambient temperature range)

Repeatability

o.r. = of reading

Volume flow
Max. ±0.1 % o.r. ± 0.5 mm/s (0.02 in/s)

Electrical conductivity
Max. ±5 % o.r.

Temperature measurement response time

T_{90} < 15 s

Influence of ambient temperature

Current output

o.r. = of reading

Temperature coefficient	Max. ±0.005% o.r./℃

Pulse/frequency output

Temperature coefficient	No additional effect. Included in accuracy.

Installation

No special measures such as supports are necessary. External forces are absorbed by the construction of the device.

Mounting location
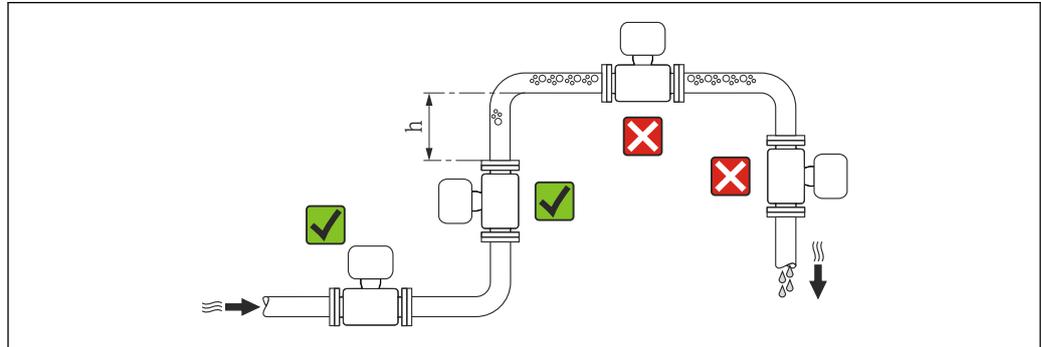
Preferably install the sensor in an ascending pipe, and ensure a sufficient distance to the next pipe elbow: h ≥ 2 × DN

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

Installation in down pipes

Install a siphon with a vent valve downstream of the sensor in down pipes whose length h ≥ 5 m (16.4 ft). This precaution is to avoid low pressure and the consequent risk of damage to the measuring tube. This measure also prevents the system losing prime.

ℹ️ For information on the liner's resistance to partial vacuum
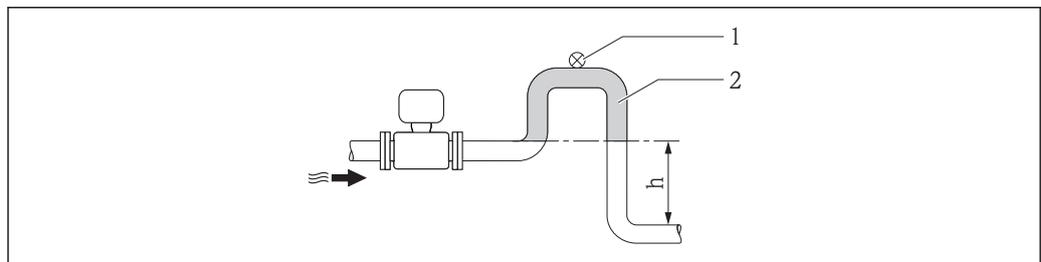
 20   Installation in a down pipe

1   Vent valve
2   Pipe siphon
h   Length of down pipe

Installation in partially filled pipes

A partially filled pipe with a gradient necessitates a drain-type configuration. The empty pipe detection (EPD) function offers additional protection by detecting empty or partially filled pipes.
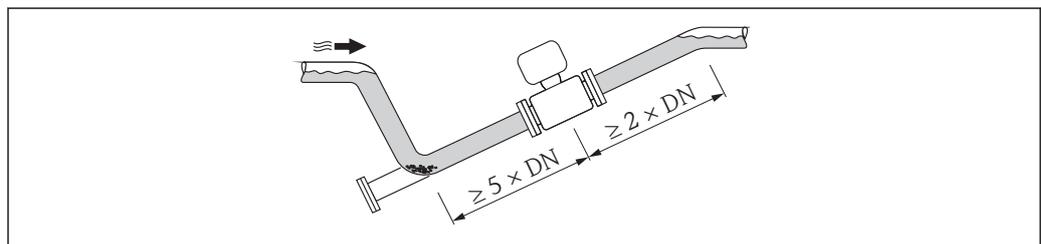
Orientation	The direction of the arrow on the sensor nameplate helps you to install the sensor according to the flow direction (direction of medium flow through the piping).

An optimum orientation position helps avoid gas and air accumulations and deposits in the measuring tube.

The measuring device also offers the empty pipe detection function to detect partially filled measuring pipes in the event of outgassing fluids or variable process pressures.

Vertical
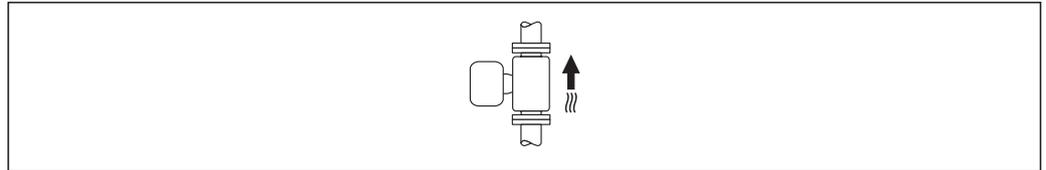
Optimum for self-emptying pipe systems and for use in conjunction with empty pipe detection.

Horizontal
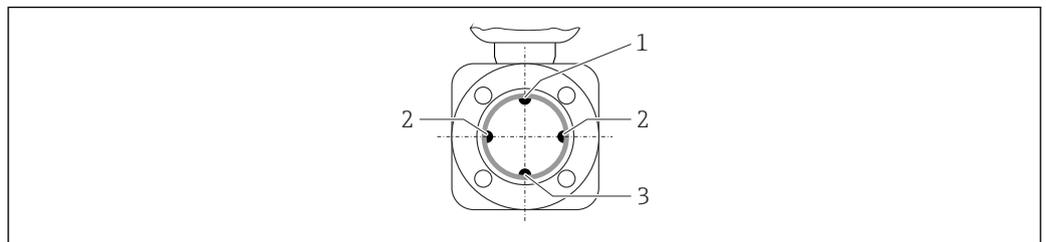
1   EPD electrode for empty pipe detection
2   Measuring electrodes for signal detection
3   Reference electrode for potential equalization

- The measuring electrode plane must be horizontal. This prevents brief insulation of the two measuring electrodes by entrained air bubbles.
- Empty pipe detection only works if the transmitter housing is pointing upwards as otherwise there is no guarantee that the empty pipe detection function will actually respond to a partially filled or empty measuring tube.

Inlet and outlet runs	If possible, install the sensor upstream from fittings such as valves, T-pieces or elbows.

Observe the following inlet and outlet runs to comply with accuracy specifications:
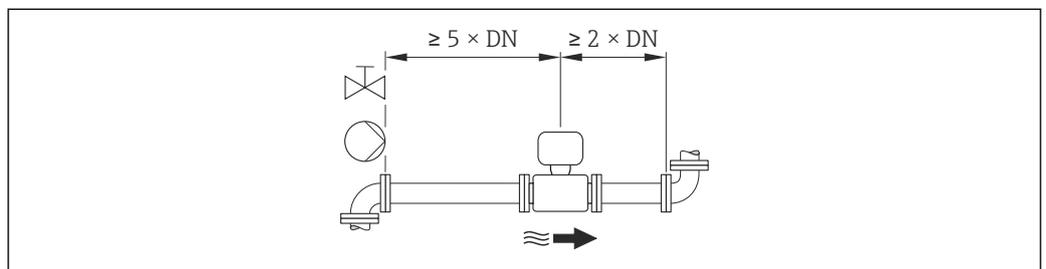
Adapters	Suitable adapters to DIN EN 545 (double-flange reducers) can be used to install the sensor in larger-diameter pipes. The resultant increase in the rate of flow improves measuring accuracy with very slow-moving fluids.

The nomogram shown here can be used to calculate the pressure loss caused by reducers and expanders:
- Calculate the ratio of the diameters d/D.
- From the nomogram read off the pressure loss as a function of flow velocity (downstream from the reduction) and the d/D ratio.

The nomogram only applies to liquids with a viscosity similar to that of water.
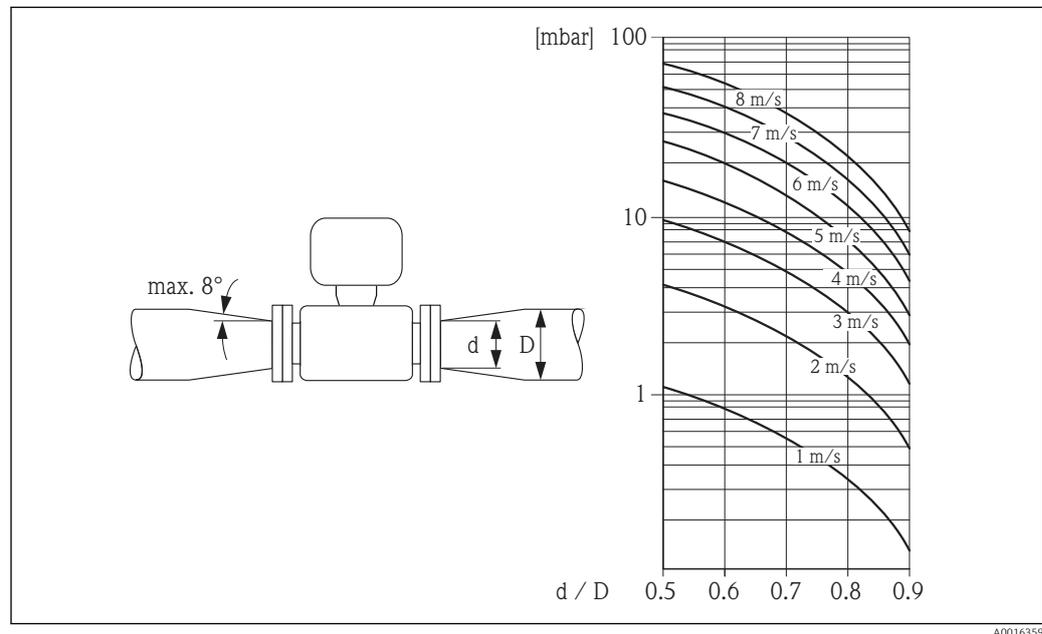
A0016359

Environment

Ambient temperature range	Transmitter	−40 to +60 ℃ (−40 to +140 ℉)
	Local display	−20 to +60 ℃ (−4 to +140 ℉), the readability of the display may be impaired at temperatures outside the temperature range.
	Sensor	Process connection material, carbon steel: −10 to +60 ℃ (+14 to +140 ℉)
	Liner	Do not exceed or fall below the permitted temperature range of the liner .

If operating outdoors:
- Install the measuring device in a shady location.
- Avoid direct sunlight, particularly in warm climatic regions.
- Avoid direct exposure to weather conditions.

Temperature tables

The following interdependencies between the permitted ambient and fluid temperatures apply when operating the device in hazardous areas:

Ex nA, cCSAUS NI

SI units

Ta [°C]	T6 [85 °C]	T5 [100 °C]	T4 [135 °C]	T3 [200 °C]	T2 [300 °C]	T1 [450 °C]
30	50	95	130	150	150	150
50	–	95	130	150	150	150
60	–	95	110	110	110	110

US units

Ta [°F]	T6 [185 °F]	T5 [212 °F]	T4 [275 °F]	T3 [392 °F]	T2 [572 °F]	T1 [842 °F]
86	122	203	266	302	302	302
122	–	203	266	302	302	302
140	–	203	230	230	230	230

Storage temperature	The storage temperature corresponds to the operating temperature range of the measuring transmitter and the appropriate measuring sensors.→ 🖻 40 • Protect the measuring device against direct sunlight during storage in order to avoid unacceptably high surface temperatures. • Select a storage location where moisture cannot collect in the measuring device as fungus or bacteria infestation can damage the liner. • If protection caps or protective covers are mounted these should never be removed before installing the measuring device.
Degree of protection	**Transmitter and sensor** • As standard: IP66/67, type 4X enclosure • When housing is open: IP20, type 1 enclosure • Display module: IP20, type 1 enclosure
Shock resistance	As per IEC/EN 60068-2-31
Vibration resistance	Acceleration up to 2 g based on IEC 60068-2-6
Mechanical load	• Protect the transmitter housing against mechanical effects, such as shock or impact. • Never use the transmitter housing as a ladder or climbing aid.

Electromagnetic compatibility (EMC)	• Depends on the communication protocol:
	   – HART, PROFIBUS DP, Modbus RS485, EtherNet/IP:
	     As per IEC/EN 61326 and NAMUR Recommendation 21 (NE 21)
	   – PROFINET: 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
	
	 ℹ️ 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.
	
	 📖 For details, refer to the Declaration of Conformity.

Process

Medium temperature range	−10 to +110 °C (−4 to +230 °F)
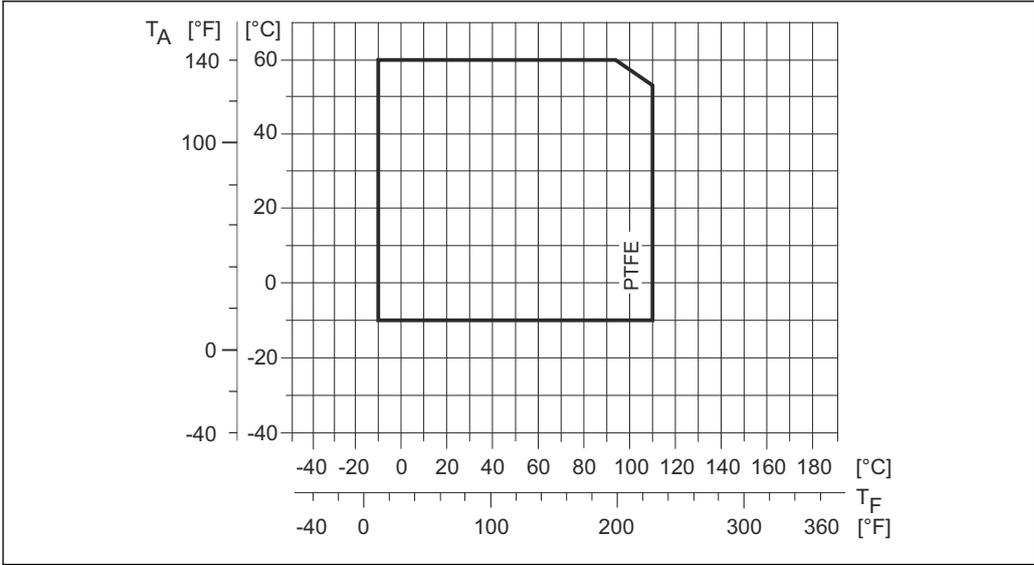
T_A   Ambient temperature range

T_F   Medium temperature

Conductivity   ≥ 5 µS/cm for liquids in general

Pressure-temperature ratings   The following pressure-temperature ratings refer to the entire device and not just the process connection.

Process connection: flange according to EN 1092-1 (DIN 2501)
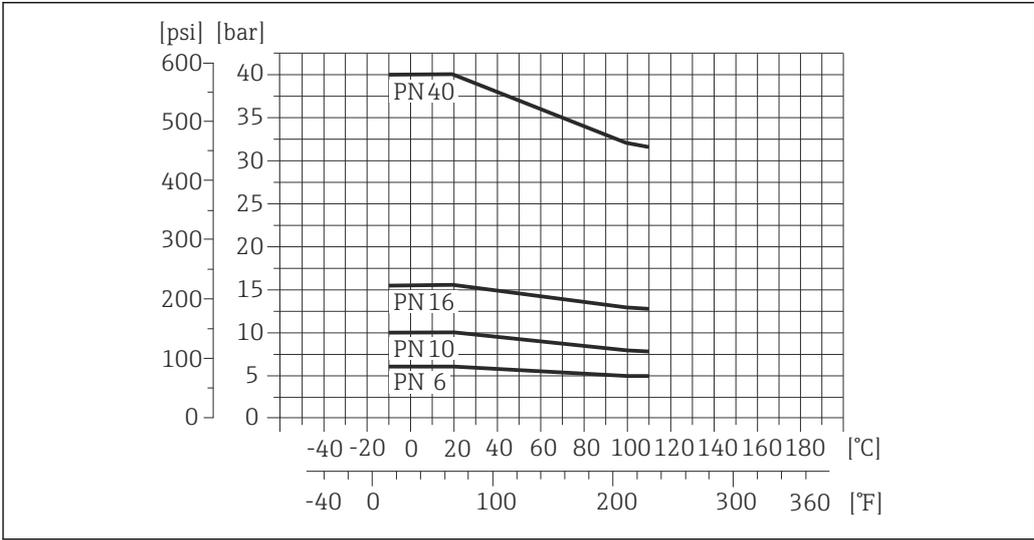
🔲 *21   Process connection material: carbon steel, FE410WB/S235JRG2*

Process connection: flange according to ASME B16.5
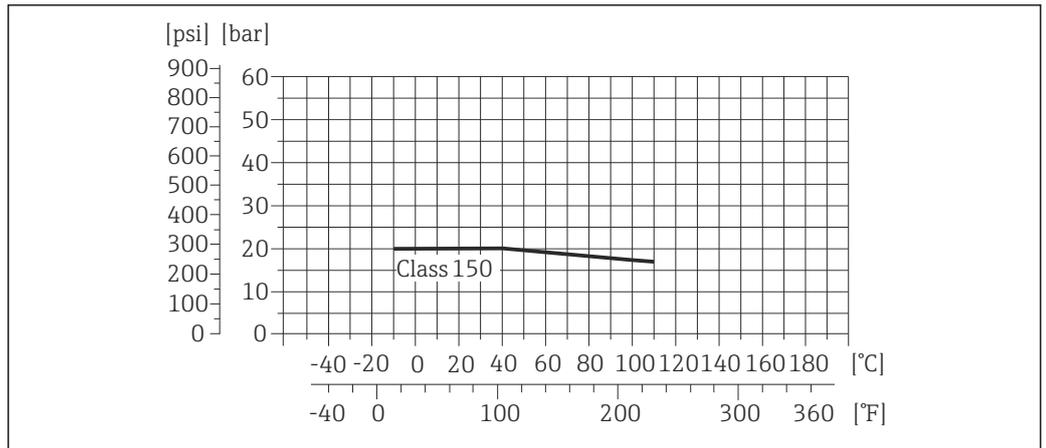
A0022939-EN

 22   Process connection material: carbon steel, A105

Process connection: flange according to JIS B2220
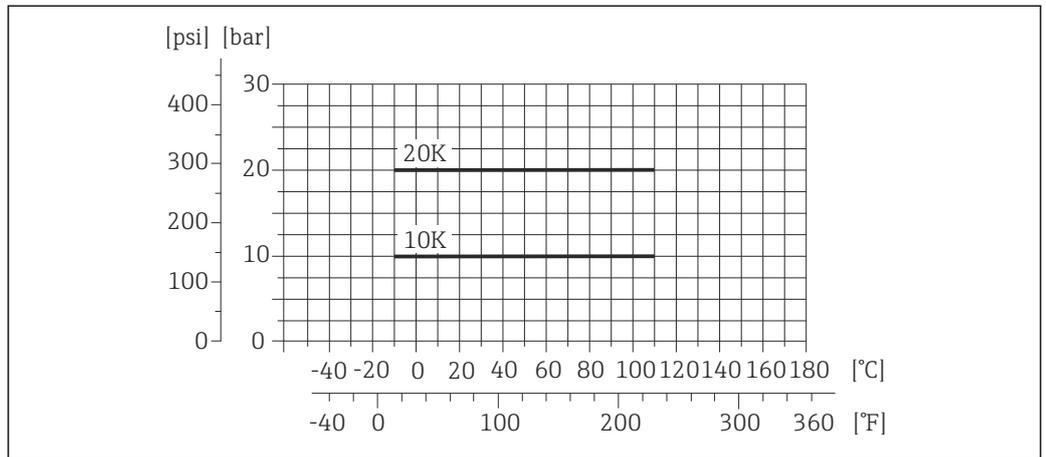
A0022940-EN

 23   Process connection material: carbon steel, S235JRG2/HII

Pressure tightness   "–" = no specifications possible

Liner: PTFE

Nominal diameter		Limit values for absolute pressure in [mbar] ([psi]) for fluid temperatures:			
[mm]	[in]	+25 °C (+77 °F)	+80 °C (+176 °F)	+100 °C (+212 °F)	+110 °C (+230 °F)
15	½	0 (0)	0 (0)	0 (0)	100 (1.45)
25	1	0 (0)	0 (0)	0 (0)	100 (1.45)
32	–	0 (0)	0 (0)	0 (0)	100 (1.45)
40	1 ½	0 (0)	0 (0)	0 (0)	100 (1.45)
50	2	0 (0)	0 (0)	0 (0)	100 (1.45)
65	–	0 (0)	–	40 (0.58)	130 (1.89)
80	3	0 (0)	–	40 (0.58)	130 (1.89)
100	4	0 (0)	–	135 (1.96)	170 (2.47)
125	–	135 (1.96)	–	240 (3.48)	385 (5.58)
150	6	135 (1.96)	–	240 (3.48)	385 (5.58)
200	8	200 (2.90)	–	290 (4.21)	410 (5.95)

Nominal diameter		Limit values for absolute pressure in [mbar] ([psi]) for fluid temperatures:			
[mm]	[in]	+25 ℃ (+77 ℉)	+80 ℃ (+176 ℉)	+100 ℃ (+212 ℉)	+110 ℃ (+230 ℉)
250	10	330 (4.79)	–	400 (5.80)	530 (7.69)
300	12	400 (5.80)	–	500 (7.25)	630 (9.14)
350	14	470 (6.82)	–	600 (8.70)	730 (10.6)
400	16	540 (7.83)	–	670 (9.72)	800 (11.6)
450	18	No negative pressure permitted!			
500	20				
600	24				

Flow limit

The diameter of the pipe and the flow rate determine the nominal diameter of the sensor. The optimum flow velocity is between 2 to 3 m/s (6.56 to 9.84 ft/s). Also match the velocity of flow (v) to the physical properties of the fluid:
• v < 2 m/s (6.56 ft/s): For abrasive media (e.g. potter's clay, lime milk, ore slurry)
• v > 2 m/s (6.56 ft/s): For media that produce buildup (e.g. wastewater sludges)

A necessary increase in the flow velocity can be achieved by reducing the sensor nominal diameter.

For an overview of the full scale values for the measuring range, see the "Measuring range" section → 🖹 7

Pressure loss

• No pressure loss occurs if the sensor is installed in a pipe with the same nominal diameter.
• Pressure losses for configurations incorporating adapters according to DIN EN 545 → 🖹 39

System pressure
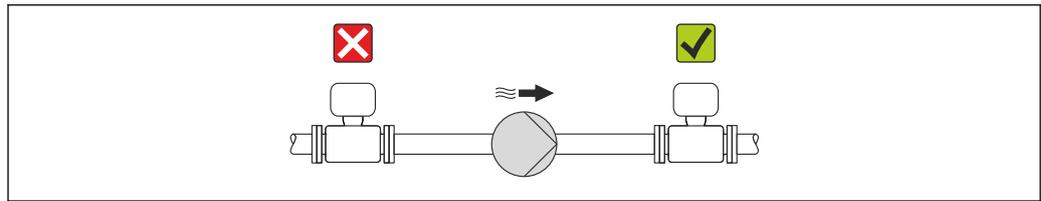
Never install the sensor on the pump suction side in order to avoid the risk of low pressure, and thus damage to the liner.

Furthermore, install pulse dampers if reciprocating, diaphragm or peristaltic pumps are used.

• For information on the liner's resistance to partial vacuum → 🖹 43
• For information on the shock resistance of the measuring system → 🖹 41
• For information on the vibration resistance of the measuring system → 🖹 41

Vibrations

In the event of very strong vibrations, the pipe and sensor must be supported and fixed.

• For information on the shock resistance of the measuring system → 🖹 41
• For information on the vibration resistance of the measuring system → 🖹 41
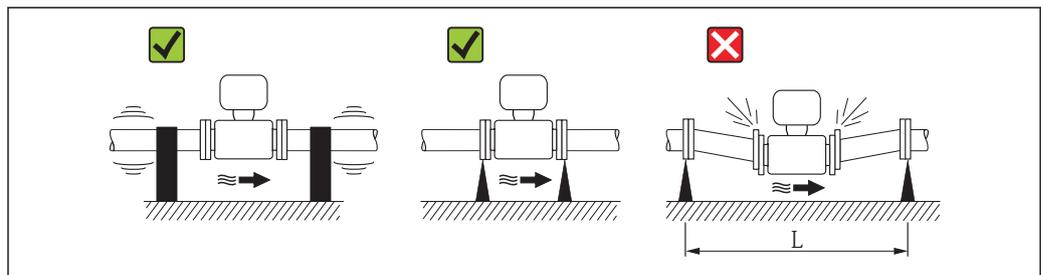
🖻 24   *Measures to avoid device vibrations (L > 10 m (33 ft))*

Mechanical construction

Design, dimensions

Compact version

Order code for "Housing", option A "Compact, coated aluminum"
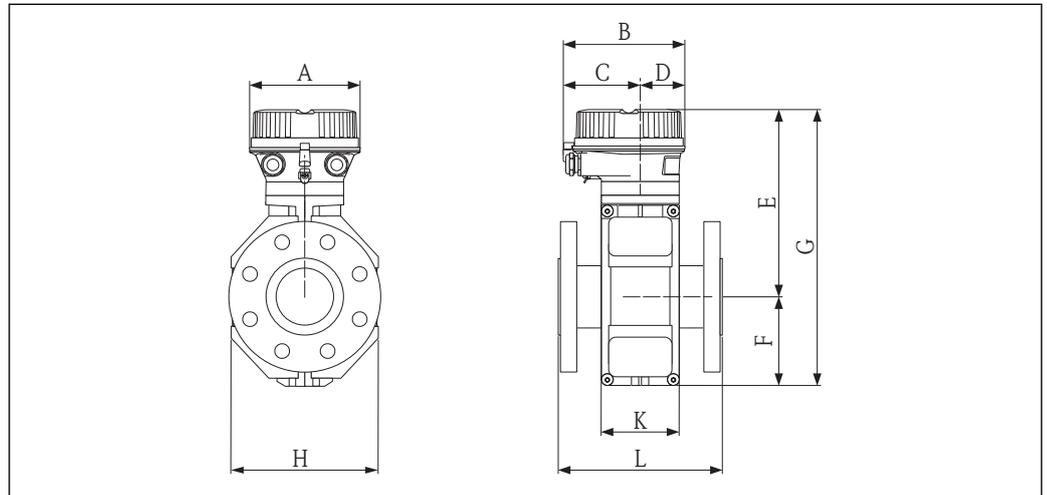
A0019491

DN	L [1]	A	B	C	D	E [2]	F	G [2]	H	K
[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]
15	200	136	147.5	93.5	54	197	84	281	120	94
25	200	136	147.5	93.5	54	197	84	281	120	94
32	200	136	147.5	93.5	54	197	84	281	120	94
40	200	136	147.5	93.5	54	197	84	281	120	94
50	200	136	147.5	93.5	54	197	84	281	120	94
65	200	136	147.5	93.5	54	222	109	331	180	94
80	200	136	147.5	93.5	54	222	109	331	180	94
100	250	136	147.5	93.5	54	222	109	331	180	94
125	250	136	147.5	93.5	54	262	150	412	260	140
150	300	136	147.5	93.5	54	262	150	412	260	140
200	350	136	147.5	93.5	54	287	180	467	324	156
250	450	136	147.5	93.5	54	312	205	517	400	166
300	500	136	147.5	93.5	54	337	230	567	460	166

1) The length (L) is always the same, irrespective of the selected pressure rating.
2) If using a display, order code for "Display; Operation", option B: values + 28 mm
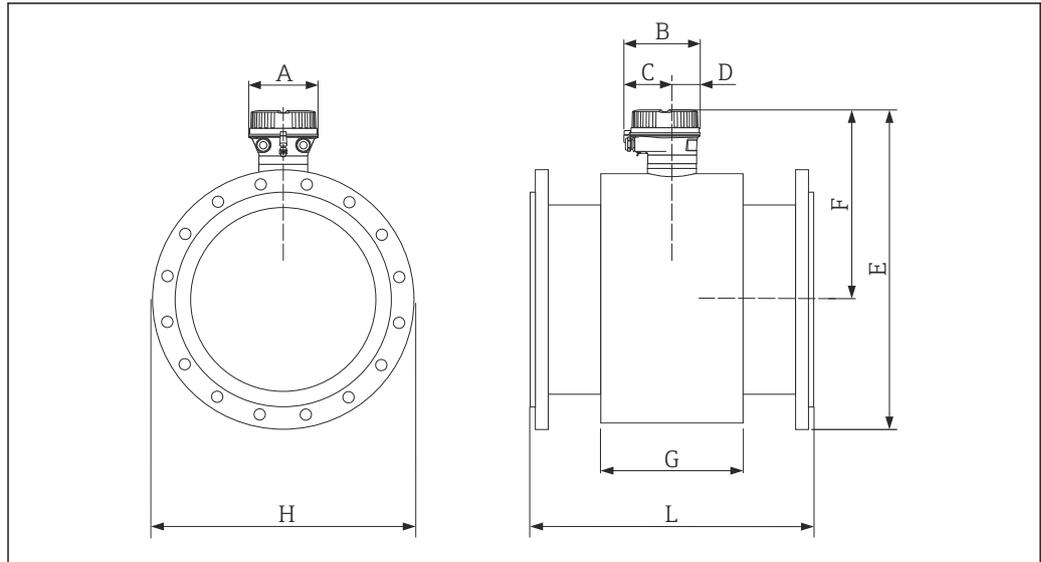
A0023368

DN	L [1]	A	B	C	D	F [2]	G
[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]
350	550	136	147.5	93.5	54	399	290
400	600	136	147.5	93.5	54	425	290
450	600	136	147.5	93.5	54	450	290
500	600	136	147.5	93.5	54	476	290
600	600	136	147.5	93.5	54	528	290

1) The length (L) is always the same, irrespective of the selected pressure rating.
2) If using a display, order code for "Display; Operation", option B: values + 28 mm

DN	E [1] for pressure rating				H for pressure rating			
	PN 6	PN 10	PN 16	ASME	PN 6	PN 10	PN 16	ASME
[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]
350	644	651	659	665	490	505	520	533
400	695	707	715	723	540	565	580	597
450	747	757	770	767	595	615	640	635
500	798	811	833	825	645	670	715	699
600	905	918	948	934	755	780	840	813

1) If using a display, order code for "Display; Operation", option B: values + 28 mm

Accessories

Ground disk for flange connection
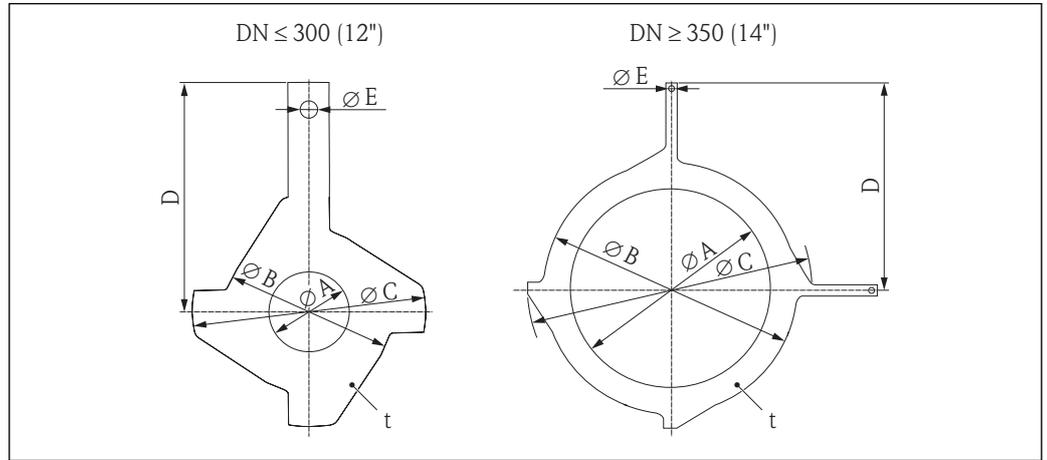
A0003221

DN [1] EN (DIN), JIS [mm]	A PTFE [mm]	B [mm]	C [mm]	D [mm]	E [mm]	t [mm]
15	16	43	61.5	73	6.5	2
25	26	62	77.5	87.5	6.5	2
32	35	80	87.5	94.5	6.5	2
40	41	82	101	103	6.5	2
50	52	101	115.5	108	6.5	2
65	68	121	131.5	118	6.5	2
80	80	131	154.5	135	6.5	2
100	104	156	186.5	153	6.5	2
125	130	187	206.5	160	6.5	2
150	158	217	256	184	6.5	2
200	206	267	288	205	6.5	2
250	260	328	359	240	6.5	2
300 [2]	312	375	413	273	6.5	2
300 [3]	310	375	404	268	6.5	2
350 [2]	343	433	479	365	9.0	2
400 [2]	393	480	542	395	9.0	2
450 [2]	439	538	583	417	9.0	2
500 [2]	493	592	650	460	9.0	2
600 [2]	593	693	766	522	9.0	2

1) Ground disks DN 15 to 250 (½ to 10") can be used for all available flange standards/pressure ratings.
2) PN 10/16
3) JIS 10K/20K

Design, dimensions

Compact version

Order code for "Housing", option A "Compact, coated aluminum"
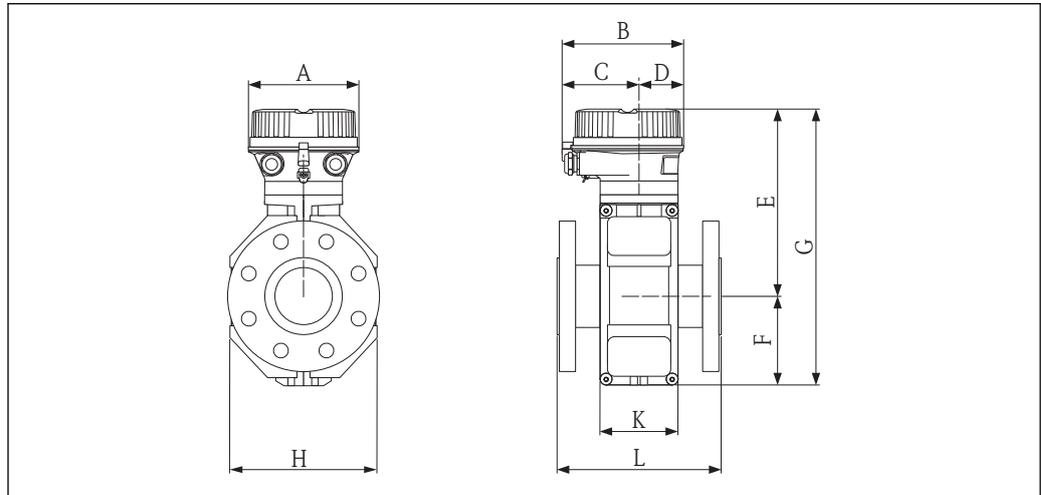
A0019491

| DN	L [1]	A	B	C	D	E [2]	F	G [2]	H	K
[in]	[in]	[in]	[in]	[in]	[in]	[in]	[in]	[in]	[in]	[in]
½	7.87	5.35	5.81	3.68	2.13	7.76	3.31	11.1	4.72	3.70
1	7.87	5.35	5.81	3.68	2.13	7.76	3.31	11.1	4.72	3.70
1 ½	7.87	5.35	5.81	3.68	2.13	7.76	3.31	11.1	4.72	3.70
2	7.87	5.35	5.81	3.68	2.13	7.76	3.31	11.1	4.72	3.70
3	7.87	5.35	5.81	3.68	2.13	8.74	4.29	13.0	7.09	3.70
4	9.84	5.35	5.81	3.68	2.13	8.74	4.29	13.0	7.09	3.70
6	11.8	5.35	5.81	3.68	2.13	10.3	5.91	16.2	10.2	5.51
8	13.8	5.35	5.81	3.68	2.13	11.3	7.09	18.4	12.8	6.14
10	17.7	5.35	5.81	3.68	2.13	12.3	8.07	20.4	15.8	6.54
12	19.7	5.35	5.81	3.68	2.13	13.3	9.06	22.3	18.1	6.54

1) The length (L) is always the same, irrespective of the selected pressure rating.
2) If using a display, order code for "Display; Operation", option B: values + 1.1 in
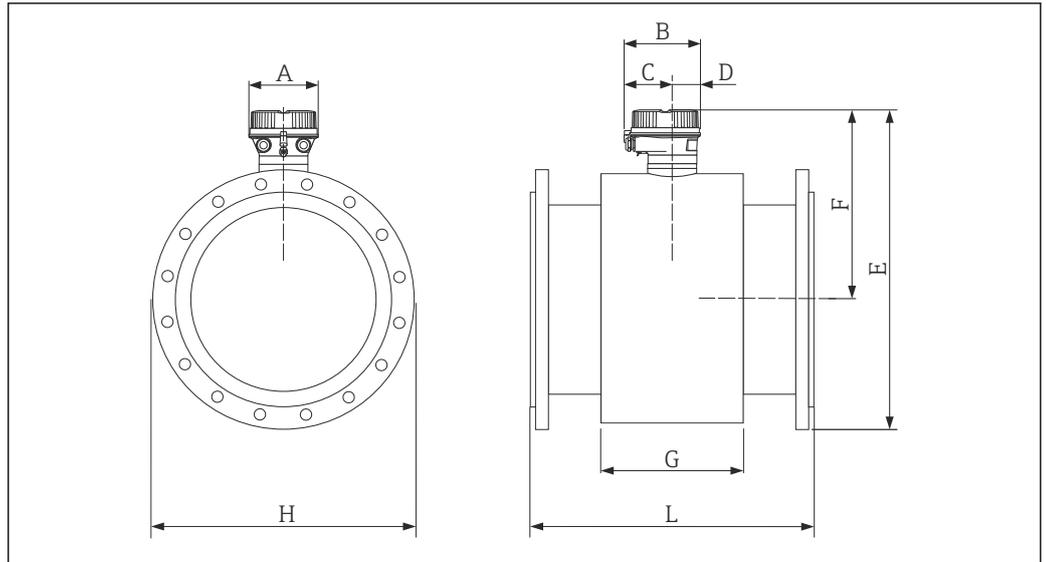
A0023368

DN	L [1]	A	B	C	D	F [2]	G
[in]	[in]	[in]	[in]	[in]	[in]	[in]	[in]
14	21.6	5.35	5.81	3.68	2.13	15.7	11.4
16	23.6	5.35	5.81	3.68	2.13	16.7	11.4
18	23.6	5.35	5.81	3.68	2.13	17.7	11.4
20	23.6	5.35	5.81	3.68	2.13	18.7	11.4
24	23.6	5.35	5.81	3.68	2.13	20.8	11.4

1) The length (L) is always the same, irrespective of the selected pressure rating.
2) If using a display, order code for "Display; Operation", option B: values + 1.1 in

DN	E [1] for pressure rating				H for pressure rating			
	PN 6	PN 10	PN 16	ASME	PN 6	PN 10	PN 16	ASME
[in]	[in]	[in]	[in]	[in]	[in]	[in]	[in]	[in]
14	25.4	25.6	25.9	26.2	19.3	19.9	20.5	21.0
16	27.4	27.8	28.2	28.5	21.3	22.2	22.8	23.5
18	29.4	29.8	30.3	30.2	23.4	24.2	25.2	25.0
20	31.4	31.9	32.8	32.5	25.4	26.4	28.2	27.5
24	35.6	36.1	37.3	36.8	29.7	30.7	33.1	32.0

1) If using a display, order code for "Display; Operation", option B: values + 1.1 in

Accessories

Ground disk for flange connection
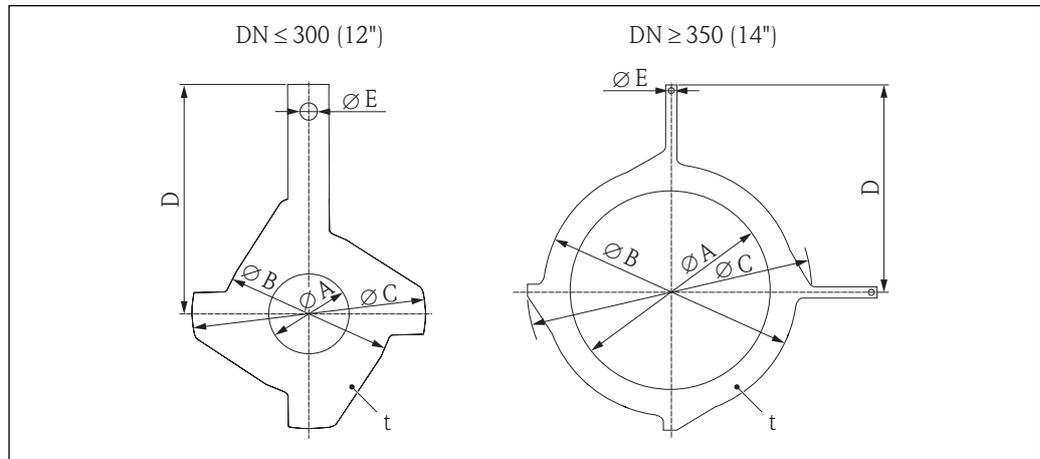
DN [1) ASME [in]	A PTFE [in]	B [in]	C [in]	D [in]	E [in]	t [in]
½	0.63	1.69	2.42	2.87	0.26	0.08
1	1.02	2.44	3.05	3.44	0.26	0.08
1 ½	1.61	3.23	3.98	4.06	0.26	0.08
2	2.05	3.98	4.55	4.25	0.26	0.08
3	3.15	5.16	6.08	5.31	0.26	0.08
4	4.09	6.14	7.34	6.02	0.26	0.08
6	6.22	8.54	10.08	7.24	0.26	0.08
8	8.11	10.51	11.34	8.07	0.26	0.08
10	10.24	12.91	14.13	9.45	0.26	0.08
12	12.28	14.76	16.26	10.75	0.26	0.08
14	13.50	17.05	18.86	14.37	0.35	0.08
16	15.47	18.90	21.34	15.55	0.35	0.08
18	17.28	21.18	22.95	16.42	0.35	0.08
20	19.41	23.31	25.59	18.11	0.35	0.08
24	23.35	27.28	30.16	20.55	0.35	0.08

1)   Ground disks can be used for all available pressure ratings.

Weight

Compact version

- Including the transmitter (1.8 kg (4.0 lb))
- Weight specifications excluding packaging material

Weight in SI units

Nominal diameter		EN (DIN)				ASME	JIS
		PN 6	PN 10	PN 16	PN 40	Class 150	10K
[mm]	[in]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]
15	½	–	–	–	4.9	4.9	4.9
25	1	–	–	–	5.7	5.7	5.7
32	–	–	–	–	6.4	–	5.7
40	1 ½	–	–	–	7.8	7.8	6.7
50	2	–	–	–	9.0	9.0	7.7
65	–	–	–	10.4	–	–	9.5
80	3	–	–	12.4	–	12.4	10.9
100	4	–	–	14.4	–	14.4	13.1
125	–	–	–	19.9	–	–	19.4
150	6	–	–	23.9	–	23.9	22.9
200	8	–	43.4	44.4	–	43.4	40.3
250	10	–	63.4	68.4	–	73.4	67.8
300	12	–	68.4	79.4	–	108.4	70.7
350	14	75.8	86.8	97.8	–	135.8	–
400	16	87.8	102.8	118.8	–	166.8	–
450	18	97.8	110.8	131.8	–	189.8	–
500	20	112.8	130.8	180.8	–	226.8	–
600	24	153.8	160.8	258.8	–	300.8	–

Weight in US units

Nominal diameter		ASME
[mm]	[in]	Class 150
		[lbs]
15	½	10.8
25	1	12.6
40	1 ½	17.2
50	2	19.9
80	3	27.3
100	4	31.8
150	6	52.7
200	8	95.7
250	10	161.9
300	12	239.0
350	14	299.4
400	16	367.8
450	18	418.5
500	20	500.1
600	24	663.3

Measuring tube specification	Nominal diameter		Pressure rating			Process connection internal diameter	
			EN (DIN)	ASME	JIS	PTFE	
	[mm]	[in]	[bar]	[psi]	[bar]	[mm]	[in]
	15	½	PN 40	Class 150	20K	14	0.55
	25	1	PN 40	Class 150	20K	26	1.02
	32	–	PN 40	–	20K	34	1.34
	40	1 ½	PN 40	Class 150	20K	40	1.57
	50	2	PN 40	Class 150	10K	51	2.01
	65	–	PN 16	–	10K	67	2.64
	80	3	PN 16	Class 150	10K	79	3.11
	100	4	PN 16	Class 150	10K	103	4.06
	125	–	PN 16	–	10K	128	5.04
	150	6	PN 16	Class 150	10K	155	6.10
	200	8	PN 10/16	Class 150	10K	203	7.99
	250	10	PN 10	–	10K	257	10.1
	250	10	PN 16	Class 150	10K	255	10.0
	300	12	PN 16	Class 150	10K	302	11.9
	350	14	PN 6/10	–	–	338	13.3
	350	14	PN 16	Class 150	–	336	13.2
	400	16	PN 6/10	–	–	388	15.3
	400	16	PN 16	–	–	386	15.2
	400	16	–	Class 150	–	384	15.1
	450	18	PN 6/10	–	–	440	17.3
	450	18	PN 16	–	–	438	17.2
	450	18	–	Class 150	–	436	17.2
	500	20	PN 6/10	–	–	491	19.3
	500	20	PN 16	–	–	487	19.2
	500	20	–	Class 150	–	485	19.1
	600	24	PN 6	–	–	592	23.3
	600	24	PN 10	–	–	590	23.2
	600	24	PN 16	–	–	588	23.2
	600	24	–	Class 150	–	586	23.1

Materials

Transmitter housing

- Order code for "Housing", option **A** "Compact, aluminum coated":
  Aluminum, AlSi10Mg, coated
- Window material for optional local display (→ 🖺 54):
  For order code for "Housing", option **A**: glass

Cable entries/cable glands

A0020640
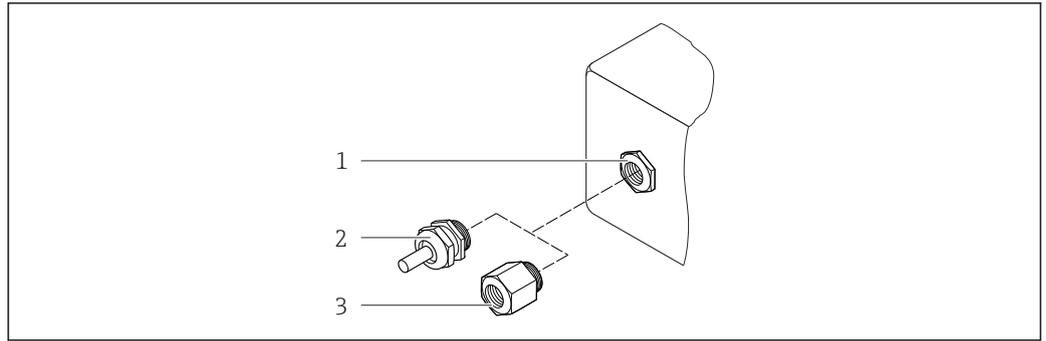
🖾 *25 Possible cable entries/cable glands*

1 Cable entry in transmitter housing with internal thread M20 x 1.5
2 Cable gland M20 x 1.5
3 Adapter for cable entry with internal thread G ½" or NPT ½"

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

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"	

Device plug

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

Sensor housing

- DN 15 to 300 (½ to 12"): coated aluminum AlSi10Mg
- DN 350 to 600 (14 to 24"): carbon steel with protective varnish

Measuring tubes

Stainless steel, 1.4301/304/1.4306/304L; for flanges made of carbon with Al/Zn protective coating (DN 15 to 300 (½ to 12")) or protective varnish (DN 350 to 600 (14 to 24"))

Liner

PTFE

Process connections

EN 1092-1 (DIN 2501)
Carbon steel, FE410WB [1]/S235JRG2; Alloy C22, 2.4602 (UNS N06022)

ASME B16.5
Carbon steel, A105

JIS B2220
Carbon steel, S235JRG2/HII

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[1] DN 15 to 300 (½ to 12") with Al/Zn protective coating; DN 350 to 600 (14 to 24") with protective varnish

Electrodes

Stainless steel, 1.4435 (F316L); Alloy C22, 2.4602 (UNS N06022); tantalum

Seals

In accordance with DIN EN 1514-1

Accessories

Ground disks

Stainless steel, 1.4435 (F316L); Alloy C22, 2.4602 (UNS N06022); tantalum; titanium

Fitted electrodes	Measuring electrodes, reference electrodes and electrodes for empty pipe detection: Standard: stainless steel, 1.4435 (F316L); Alloy C22, 2.4602 (UNS N06022); tantalum
Process connections	• EN 1092-1 (DIN 2501): DN ≤ 300 (12") form A, DN ≥ 350 (14") flat face; dimensions as per DIN 2501, DN 65 PN 16 and DN 600 (24") PN 16 only as per EN 1092-1 • ASME B16.5 • JIS B2220
Surface roughness	Stainless steel electrodes, 1.4435 (F316L); Alloy C22, 2.4602 (UNS N06022); tantalum: ≤ 0.3 to 0.5 μm (11.8 to 19.7 μin) (All data relate to parts in contact with fluid)

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" 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; lit, 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 ℃ (−4 to +140 ℉). The readability of the display may be impaired at temperatures outside the temperature range.

Remote operation **Via HART protocol**

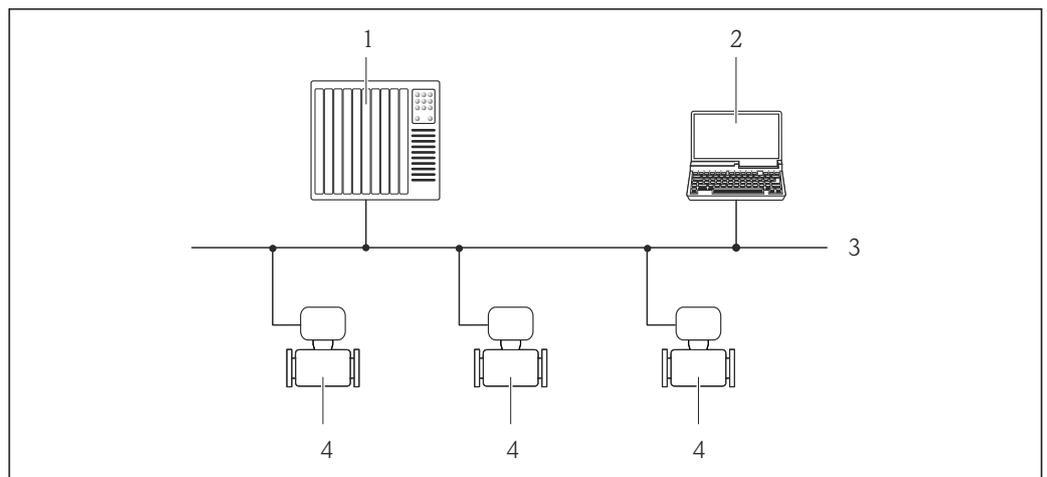This communication interface is available in device versions with a HART output.

A0016948
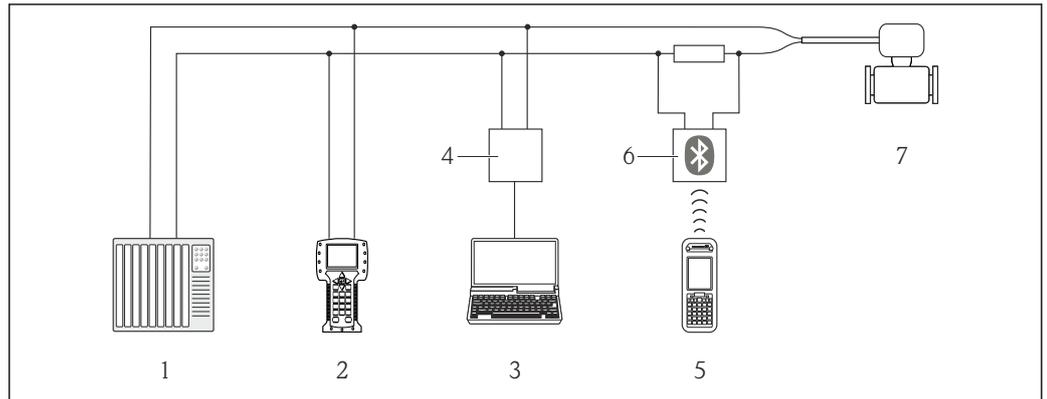
 26   Options for remote operation via HART protocol

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   VIATOR Bluetooth modem with connecting cable
7   Transmitter

Via PROFIBUS DP network

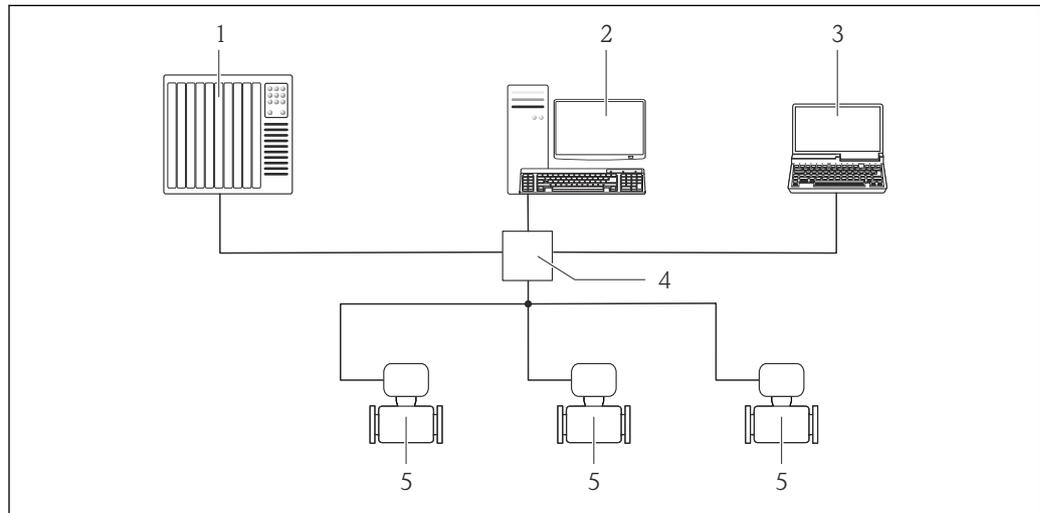This communication interface is available in device versions with PROFIBUS DP.

A0020903

 27   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-based fieldbus

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

A0016961

⊠ 28   Options for remote operation via Ethernet-based fieldbus

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

Via PROFINET network

This communication interface is available in device versions with PROFINET.
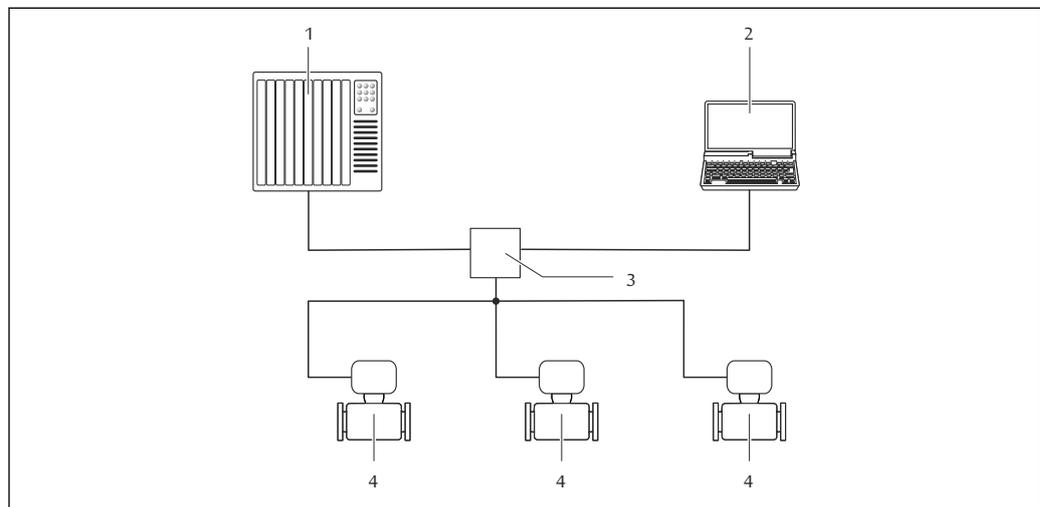
A0026545

⊠ 29   Options for remote operation via PROFINET network

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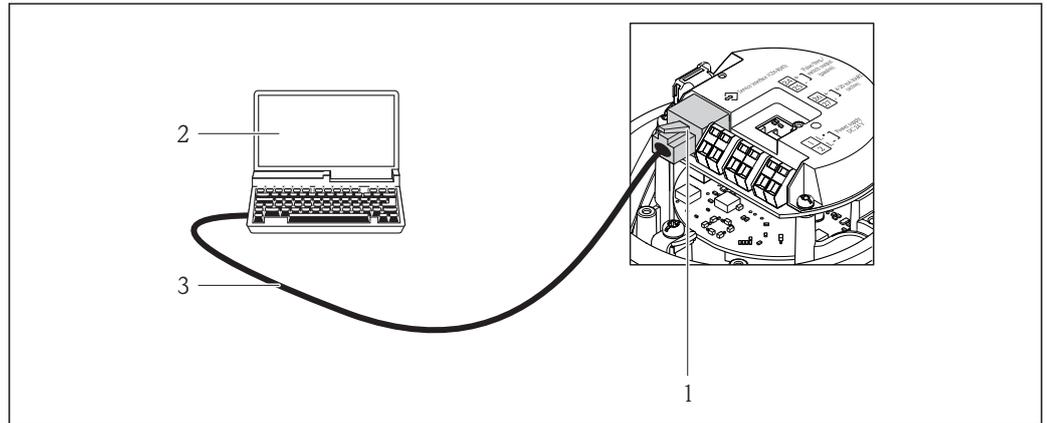*4   Measuring device*

| 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
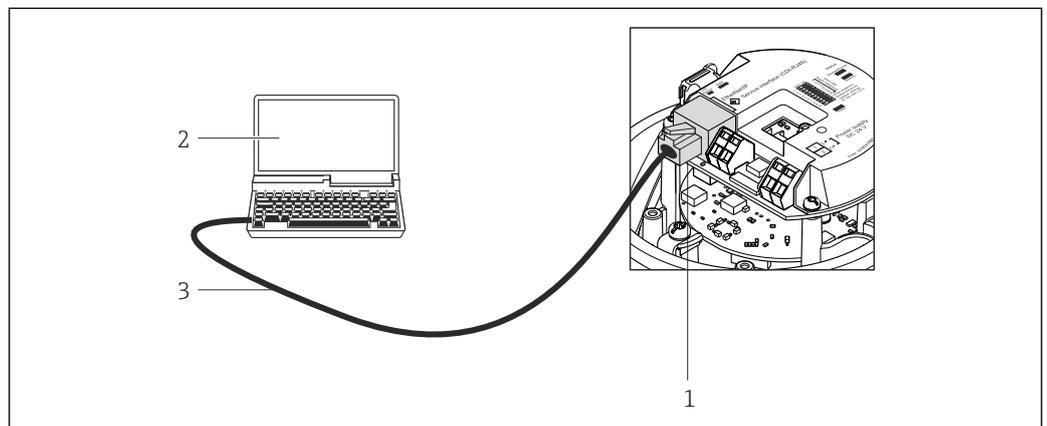
HART

A0016926

■ *30   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 device Web server or with "FieldCare" operating tool with COM DTM "CDI Communication TCP/IP"
3   Standard Ethernet connecting cable with RJ45 plug

PROFIBUS DP

A0021270

■ *31   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 device Web server or with "FieldCare" operating tool with COM DTM "CDI Communication TCP/IP"
3   Standard Ethernet connecting cable with RJ45 plug

EtherNet/IP

A0016940

⊡ *32   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 device Web server or with "FieldCare" operating tool with COM DTM "CDI Communication TCP/IP"
3   Standard Ethernet connecting cable with RJ45 plug

PROFINET

A0016940

⊡ *33   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 device Web server or with "FieldCare" operating tool with COM DTM "CDI Communication TCP/IP"
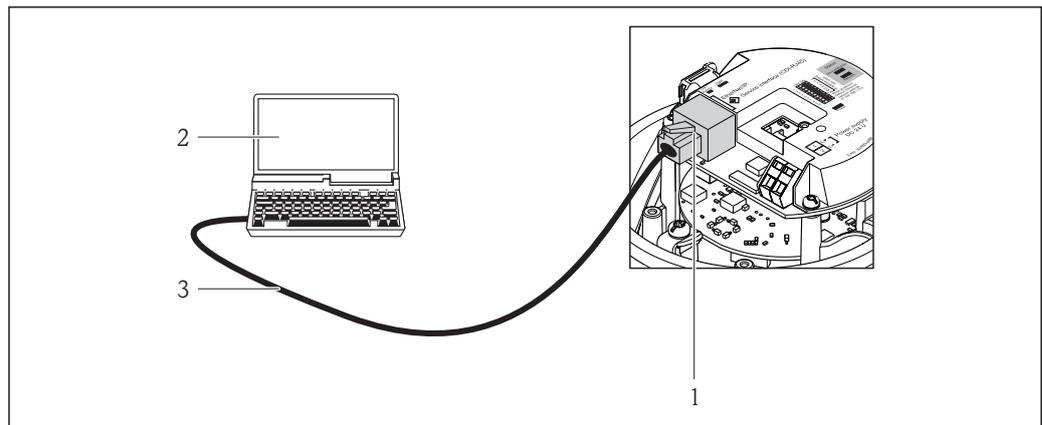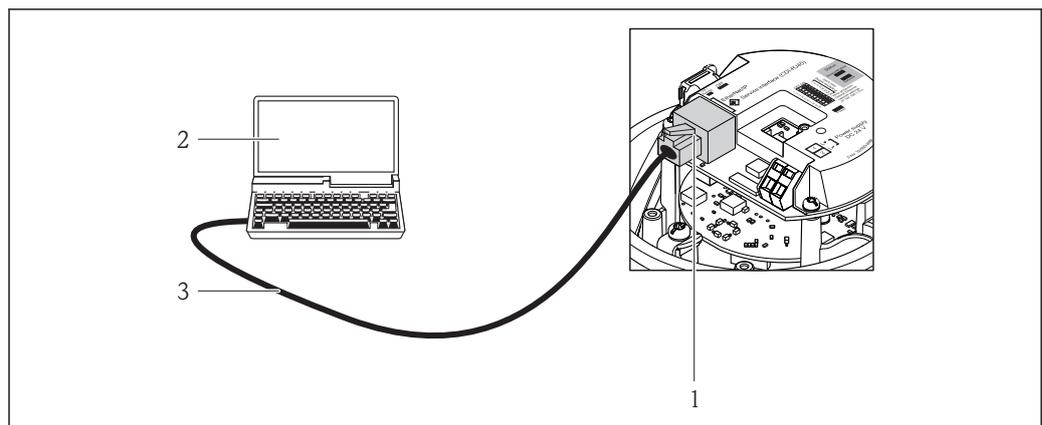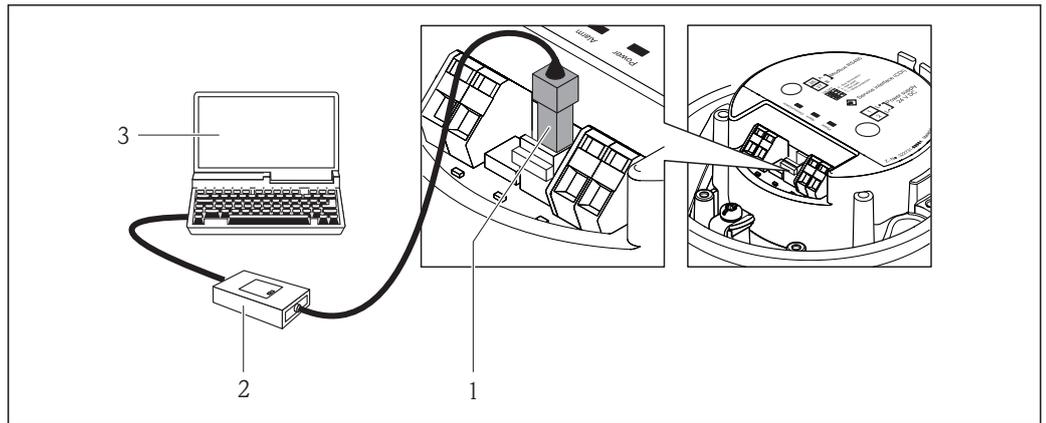*3   Standard Ethernet connecting cable with RJ45 plug*

Via service interface (CDI)

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

Modbus RS485

A0016925

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

Certificates and approvals

CE mark

The measuring system is in conformity with the statutory requirements of the applicable EC Directives. These are listed in the corresponding EC Declaration of Conformity along with the standards applied.

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

C-Tick symbol

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 nA

Category	Type of protection
II3G	Ex nA IIC T6-T1 Gc

INMETRO

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

...

Category	Type of protection
...	...

NEPSI

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

...

Category	Type of protection
...	...

Functional safety

The measuring device can be used for flow monitoring systems (min., max., range) up to SIL 2 (single-channel architecture) and SIL 3 (multichannel architecture with homogeneous redundancy) and is independently evaluated and certified by the TÜV in accordance with IEC 61508.

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

ℹ️ Functional Safety Manual with information on the SIL device

HART certification

HART interface

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

Certification PROFIBUS

PROFIBUS interface

The measuring device is certified and registered by the PROFIBUS User Organization (PNO). The measuring system meets all the requirements of the following specifications:
• Certified in accordance with PROFIBUS PA Profile 3.02
• The device can also be operated with certified devices of other manufacturers (interoperability)

Modbus RS485 certification

The measuring device meets all the requirements of the MODBUS/TCP conformity test and has the "MODBUS/TCP Conformance Test Policy, Version 2.0". The measuring device has successfully passed all the test procedures carried out and is certified by the "MODBUS/TCP Conformance Test Laboratory" of the University of Michigan.

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)

Certification PROFINET

PROFINET interface

The measuring device is certified and registered by the PNO (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 – Net load test
• The device can also be operated with certified devices of other manufacturers (interoperability)

Additional certification

PWIS-free

PWIS = paint-wetting impairment substances

PWIS-free pending.

ℹ️ For more information on PWIS-free certification, see "Test specification" document TS01028D

Pressure Equipment Directive	• With the PED/G1/x (x = category) marking on the sensor nameplate, Endress+Hauser confirms compliance with the "Essential Safety Requirements" specified in Annex I of the Pressure Equipment Directive 97/23/EC. • Devices bearing this marking (PED) are suitable for the following types of medium: Media in Group 1 and 2 with a vapor pressure greater than, or smaller and equal to 0.5 bar (7.3 psi) • Devices not bearing this marking (PED) are designed and manufactured according to good engineering practice. They meet the requirements of Art.3 Section 3 of the Pressure Equipment Directive 97/23/EC. The range of application is indicated in tables 6 to 9 in Annex II of the Pressure Equipment Directive.
Other standards and guidelines	• EN 60529 Degrees of protection provided by enclosures (IP code) • EN 61010-1 Safety requirements for electrical equipment for measurement, control and laboratory use - general requirements • IEC/EN 61326 Emission in accordance with Class A requirements. Electromagnetic compatibility (EMC requirements). • NAMUR NE 21 Electromagnetic compatibility (EMC) of industrial process and laboratory control equipment • NAMUR NE 32 Data retention in the event of a power failure in field and control instruments with microprocessors • NAMUR NE 43 Standardization of the signal level for the breakdown information of digital transmitters with analog output signal. • NAMUR NE 53 Software of field devices and signal-processing devices with digital electronics • NAMUR NE 105 Specifications for integrating fieldbus devices in engineering tools for field devices • NAMUR NE 107 Self-monitoring and diagnosis of field devices • NAMUR NE 131 Requirements for field devices for standard applications

Ordering information

Detailed ordering information is available from the following sources:
• In the Product Configurator on the Endress+Hauser website: www.endress.com → Select your country → Products → Select measuring technology, software or components → Select the product (picklists: measurement method, product family etc.) → Device support (right-hand column): Configure the selected product → The Product Configurator for the selected product opens.
• From your Endress+Hauser Sales Center: www.addresses.endress.com

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

Application packages

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

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

Cleaning

Package	Description
Electrode cleaning circuit (ECC)	The electrode cleaning circuit (ECC) function has been developed to have a solution for applications where magnetite (Fe_3O_4) deposits frequently occur (e.g. hot water). Since magnetite is highly conductive this build up leads to measuring errors and ultimately to the loss of signal. The application package is designed to AVOID build up of highly conductive matter and thin layers (typical of magnetite).

Heartbeat Technology

Package	Description
Heartbeat Verification +Monitoring	**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 (such as 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. **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.

Accessories

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

Device-specific accessories

For the transmitter

Accessories	Description
Ground cable	Set, consisting of two ground cables for potential equalization.

For the sensor

Accessories	Description
Ground disks	Are used to ground the fluid in lined measuring tubes to ensure proper measurement. 📖 For details, see Installation Instructions EA00070D

Communication-specific accessories

Accessories	Description
Commubox FXA195 HART	For intrinsically safe HART communication with FieldCare via the USB interface. 📖 For details, see "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. 📖 For details, see the "Technical Information" document TI405C/07

HART Loop Converter HMX50	Is used to evaluate and convert dynamic HART process variables to analog current signals or limit values.
	For details, see "Technical Information" TI00429F and 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.
	For details, see Operating Instructions BA00061S
Fieldgate FXA320	Gateway for the remote monitoring of connected 4-20 mA measuring devices via a Web browser.
	For details, see "Technical Information" TI00025S and Operating Instructions BA00053S
Fieldgate FXA520	Gateway for the remote diagnostics and remote configuration of connected HART measuring devices via a Web browser.
	For details, see "Technical Information" TI00025S and Operating Instructions BA00051S
Field Xpert SFX350	Field Xpert SFX350 is a mobile computer for commissioning and maintenance. It enables efficient device configuration and diagnostics for HART and FOUNDATION Fieldbus devices in the **non-Ex area**.
	For details, see Operating Instructions BA01202S
Field Xpert SFX370	Field Xpert SFX370 is a mobile computer for commissioning and maintenance. It enables efficient device configuration and diagnostics for HART and FOUNDATION Fieldbus devices in the **non-Ex area** and the **Ex area**.
	For details, see Operating Instructions BA01202S

Service-specific accessories

Accessories	Description
Applicator	Software for selecting and sizing Endress+Hauser measuring devices: • Calculation of all the necessary data for identifying the optimum flowmeter: e.g. nominal diameter, pressure loss, accuracy or process connections. • Graphic illustration of the calculation results Administration, documentation and access to all project-related data and parameters throughout the entire life cycle of a project. Applicator is available: • Via the Internet: https://wapps.endress.com/applicator • On CD-ROM for local PC installation.
W@M	Life cycle management for your plant W@M supports you with a wide range of software applications over the entire process: from planning and procurement, to the installation, commissioning and operation of the measuring devices. All the relevant device information, such as the device status, spare parts and device-specific documentation, is available for every device over the entire life cycle. The application already contains the data of your Endress+Hauser device. Endress+Hauser also takes care of maintaining and updating the data records. W@M is available: • Via the Internet: www.endress.com/lifecyclemanagement • On CD-ROM for local PC installation.
FieldCare	FDT-based plant asset management tool from Endress+Hauser. It can configure all smart field units in your system and helps you manage them. By using the status information, it is also a simple but effective way of checking their status and condition.
	For details, see Operating Instructions BA00027S and BA00059S

DeviceCare	Tool for connecting and configuring Endress+Hauser field devices.
	🔖 For details, see Innovation brochure IN01047S
Commubox FXA291	Connects Endress+Hauser field devices with a CDI interface (= Endress+Hauser Common Data Interface) and the USB port of a computer or laptop.
	🔖 For details, see "Technical Information" TI00405C

System components

Accessories	Description
Memograph M graphic display recorder	The Memograph M graphic display recorder provides information on all 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.
	🔖 For details, see "Technical Information" TI00133R and Operating Instructions BA00247R

Supplementary documentation

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

Standard documentation

Brief Operating Instructions

🔖 Brief Operating Instructions containing all the important information for standard commissioning is enclosed with the device.

Operating Instructions

Measuring device	Documentation code				
	HART	PROFIBUS DP	Modbus RS485	EtherNet/IP	PROFINET
Promag E 100	BA01305D	BA01307D	BA01306D	BA01308D	BA01423D

Description of device parameters

Measuring device	Documentation code				
	HART	PROFIBUS DP	Modbus RS485	EtherNet/IP	PROFINET
Promag 100	GP01038D	GP01039D	GP01040D	GP01041D	GP01042D

Supplementary device-dependent documentation

Safety Instructions

Contents	Documentation code
ATEX/IECEx Ex nA	XA01090D

Special Documentation

Contents	Documentation code
Information on the Pressure Equipment Directive	SD01056D
Modbus RS485 Register Information	SD01148D
Heartbeat Technology	SD01149D

Installation Instructions

Contents	Documentation code
Installation Instructions for spare part sets	Specified for each individual accessory

Registered trademarks

HART®
Registered trademark of the HART Communication Foundation, Austin, USA

PROFIBUS®
Registered trademark of the PROFIBUS User Organization, Karlsruhe, Germany

Modbus®
Registered trademark of SCHNEIDER AUTOMATION, INC.

EtherNet/IP™
Trademark of ODVA, Inc.

PROFINET®
Registered trademark of the PROFIBUS User Organization, Karlsruhe, Germany

Microsoft®
Registered trademark of the Microsoft Corporation, Redmond, Washington, USA

Applicator®, FieldCare®, DeviceCare ®, Field Xpert™, HistoROM®, Heartbeat Technology™
Registered or registration-pending trademarks of the Endress+Hauser Group

Endress+Hauser [EH]

People for Process Automation

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