Technical Information
Proline Promag D 400

Electromagnetic flowmeter

The flowmeter designed as a compact wafer version and with integrated web server

Application

- The measuring principle is virtually independent of pressure, density, temperature and viscosity
- For basic water applications; optimized for limited space and plastic pipe installations

Device properties
- Short installation length and low weight
- Integrated ground disks made of stainless steel
- International drinking water approvals
- Transmitter housing made of durable polycarbonate
- Same housing concept for compact/remote version
- Integrated data logger: measured values monitoring

Your benefits

- Easy, fast centering of the sensor – innovative housing construction
- Energy-saving flow measurement – no pressure loss due to cross-section constriction
- Maintenance-free – no moving parts
- Safe operation – no need to open the device due to display with touch control, background lighting
- Time-saving local operation without additional software and hardware – integrated web server
- Integrated verification – Heartbeat Technology™

Endress+Hauser
People for Process Automation

Table of contents

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.
ℹ	**Tip** Indicates additional information.
📖	Reference to documentation
📄	Reference to page
🖼	Reference to graphic
👁	Visual inspection

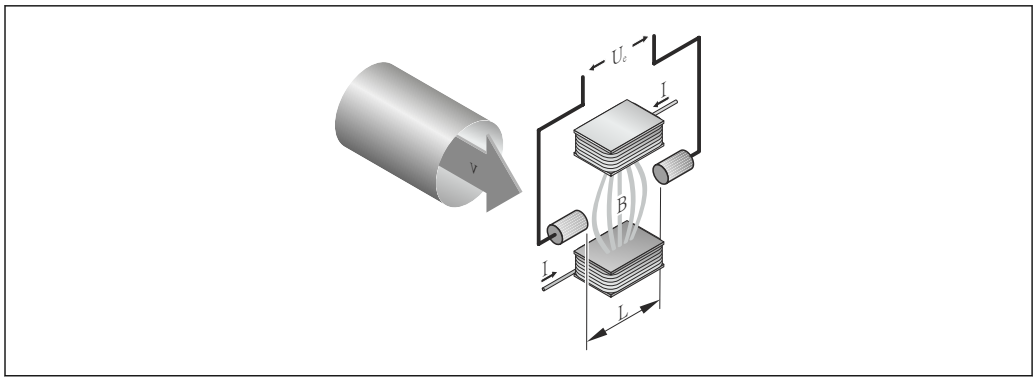
Symbols in graphics

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	EX	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

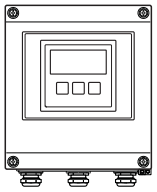
- Induced voltage $U_e = B \cdot L \cdot v$
- Volume flow $Q = A \cdot v$

Measuring system

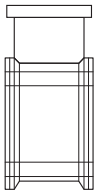
The device consists of a transmitter and a sensor.

Two device versions are available:
- Compact version - the transmitter and sensor form a mechanical unit.
- Remote version – the transmitter and sensor are mounted separately from one another.

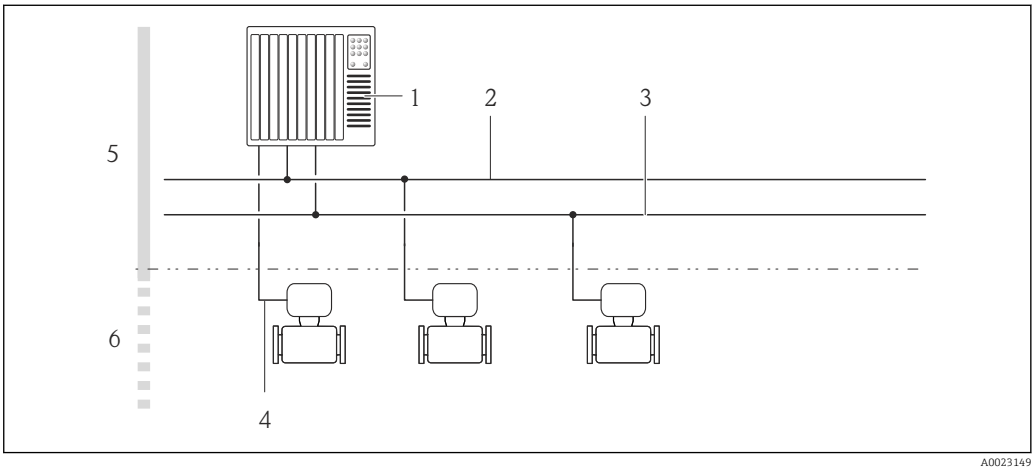
Transmitter

Promag 400  A0017117	Device versions and materials ▪ Compact version: compact housing – Polycarbonate plastic – Aluminum, AlSi10Mg, coated ▪ Remote version: wall-mount housing – Polycarbonate plastic – Aluminum, AlSi10Mg, coated Configuration: ▪ External operation via four-line, illuminated local display with touch control and guided menus ("Make-it-run" wizards) for applications ▪ Via operating tools (e.g. FieldCare) ▪ Via Web browser (e.g. Microsoft Internet Explorer) ▪ Also for device version with EtherNet/IP output: – Via Add-on Profile Level 3 for automation system from Rockwell Automation – Via Electronic Data Sheet (EDS) ▪ Also for device version with PROFIBUS DP output: Via PDM driver for Siemens automation system

Sensor

Promag D  A0017036	Wafer version ▪ Nominal diameter range: DN 25 to 100 (1 to 4") ▪ Materials: – Sensor housing: aluminum, AlSi10Mg, coated – Sensor connection housing: aluminum, AlSi10Mg, coated – Liner: polyamide – O-rings: EPDM – Electrodes: stainless steel, 1.4435 (316L) – Ground disks: stainless steel, 1.4301 (304)

Device architecture



A0023149

1 *Possibilities for integrating measuring devices into a system*

1 *Control system (e.g. PLC)*
2 *EtherNet/IP*
3 *PROFIBUS DP*
4 *4-20 mA HART, pulse/frequency/switch output*
5 *Non-hazardous area*
6 *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)

Calculated measured variables

Mass flow

Measuring range

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

Electrical conductivity: 5 to 10 000 µS/cm

Flow characteristic values in SI units

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

Flow characteristic values in US units

Nominal diameter		Recommended flow	Factory settings		
		min./max. full scale value (v ~ 0.3/10 m/s)	Full scale value current output (v ~ 2.5 m/s)	Pulse value (~ 2 pulse/s)	Low flow cut off (v ~ 0.04 m/s)
[in]	[mm]	[gal/min]	[gal/min]	[gal]	[gal/min]
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
–	65	16 to 500	130	1	2
3	80	24 to 800	200	2	2.5
4	100	40 to 1 250	300	2	4

To calculate the measuring range, use the *Applicator* sizing tool (→ 54)

Recommended measuring range

"Flow limit" section (→ 35)

Operable flow range

Over 1000 : 1

Input signal

External measured values

Various pressure transmitters and temperature measuring devices can be ordered from Endress +Hauser: see "Accessories" section (→ 54)

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

Fieldbuses

The measured values can be written from the automation system to the measuring via:
- PROFIBUS DP
- Modbus RS485
- EtherNet/IP

Status input

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

Output

Output signal

Current output

Current output	Can be set as: ▪ 4-20 mA NAMUR ▪ 4-20 mA US ▪ 4-20 mA HART ▪ 0-20 mA
Maximum output values	▪ DC 24 V (no flow) ▪ 22.5 mA
Load	0 to 700 Ω
Resolution	0.5 µA
Damping	Adjustable: 0.07 to 999 s
Assignable measured variables	▪ Volume flow ▪ Mass flow ▪ Flow velocity ▪ Electronic temperature

Pulse/frequency/switch output

Function	▪ With the order code for "Output; Input", option **H**: output 2 can be set as a pulse or frequency output ▪ With the order code for "Output; Input", option **I**: output 2 and 3 can be set as a pulse, frequency or switch output
Version	Passive, open collector
Maximum input values	▪ DC 30 V ▪ 250 mA
Voltage drop	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
Frequency output	
Output frequency	Adjustable: 0 to 12 500 Hz
Damping	Adjustable: 0 to 999 s
Pulse/pause ratio	1:1
Assignable measured variables	▪ Volume flow ▪ Mass flow ▪ Flow velocity ▪ 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 – Flow velocity – Totalizer 1-3 – 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

Signal on alarm

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

Current output

4-20 mA

Failure mode	Selectable (as per NAMUR recommendation NE 43): ▪ Minimum value: 3.6 mA ▪ Maximum value: 22 mA ▪ Defined value: 3.59 to 22.5 mA ▪ Actual value ▪ Last valid value

0-20 mA

Failure mode	Choose from: ▪ Maximum alarm: 22 mA ▪ Defined value: 0 to 22.5 mA

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 ▪ Defined value: 0 to 12 500 Hz ▪ 0 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

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
- Via service interface

Plain text display	With information on cause and remedial measures

Additional information on remote operation (→ 47)

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

Low flow cut off

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

Galvanic isolation

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

Protocol-specific data

HART

Manufacturer ID	0x11
Device type ID	0x67
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 ▪ Flow velocity ▪ Electronic temperature **Measured variables for SV, TV, QV (secondary, tertiary and quaternary dynamic variable)** ▪ Volume flow ▪ Mass flow ▪ Flow velocity ▪ 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 = conductivity ▪ 3 = flow velocity ▪ 4 = electronic temperature ▪ 5 = totalizer 1 ▪ 6 = totalizer 2 ▪ 7 = totalizer 3

PROFIBUS DP

Manufacturer ID	0x11
Ident number	0x1562
Profile version	3.02
Device description files (GSD, DTM, DD)	Information and files under: ▪ www.endress.com ▪ www.profibus.org
Output values (from measuring device to automation system)	**Analog input 1 to 4** ▪ Mass flow ▪ Volume flow ▪ Flow velocity ▪ Electronic temperature **Digital input 1 to 2** ▪ Empty pipe detection ▪ Low flow cut off ▪ Verification status **Totalizer 1 to 3** ▪ Mass flow ▪ Volume flow

Input values (from automation system to measuring device)	**Analog output 1 (fixed assignment)** 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	▪ 1200 BAUD ▪ 2400 BAUD ▪ 4800 BAUD ▪ 9600 BAUD ▪ 19200 BAUD ▪ 38400 BAUD ▪ 57600 BAUD ▪ 115200 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	0x1067		
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 ▪ 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 ▪ Mass flow ▪ Electronic temperature ▪ Totalizer 1 to 3 ▪ Flow velocity ▪ 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 ▪ Reset totalizers 1-3 ▪ External density ▪ Density unit ▪ 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 ▪ Density unit ▪ Temperature unit ▪ Totalizer 1-3: – Assignment – Unit – Measuring mode – Failure mode ▪ Alarm delay

Power supply

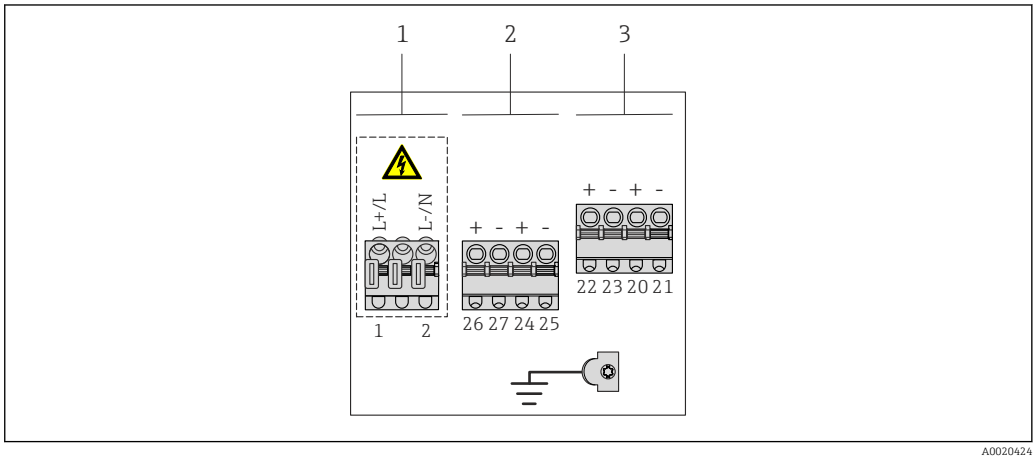
Terminal assignment

Transmitter

0-20 mA/4-20 mA HART connection version with additional outputs and inputs

The sensor can be ordered with terminals.

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



A0020424

1 Supply voltage
2 Output 1 (26/27) and output 2 (24/25)
3 Output 3 (22/23) and input 1 (20/21)

Supply voltage

Order code for "Power supply"	Terminal numbers	
	1 (L+/L)	**2 (L-/N)**
Option **L** (wide range power unit)	AC100 to 240 V	
	AC/DC24 V	

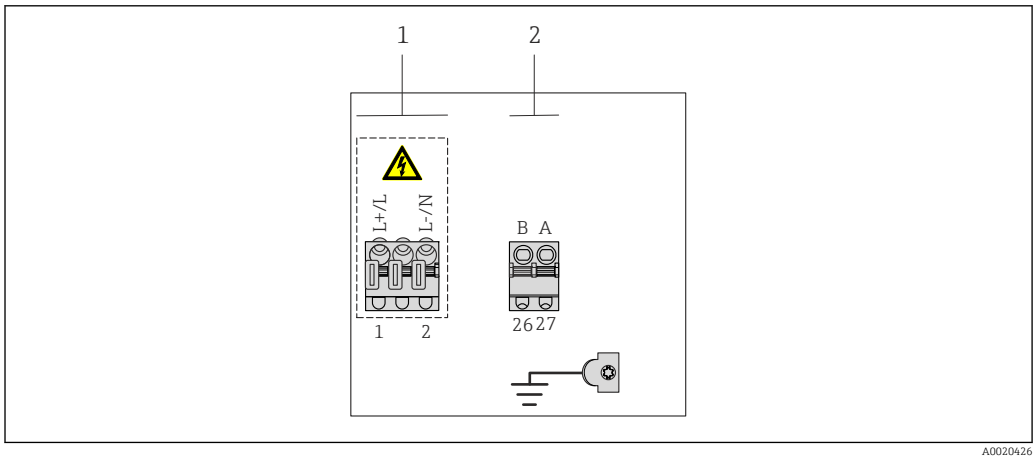
Signal transmission 0-20 mA/4-20 mA HART with additional outputs and inputs

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

PROFIBUS DP connection version

The sensor can be ordered with terminals.

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



1 Supply voltage (wide range power unit)
2 PROFIBUS DP

Supply voltage

Order code for "Power supply"	Terminal numbers	
	1 (L+/L)	2 (L-/N)
Option **L** (wide range power unit)	AC100 to 240 V	
	AC/DC24 V	

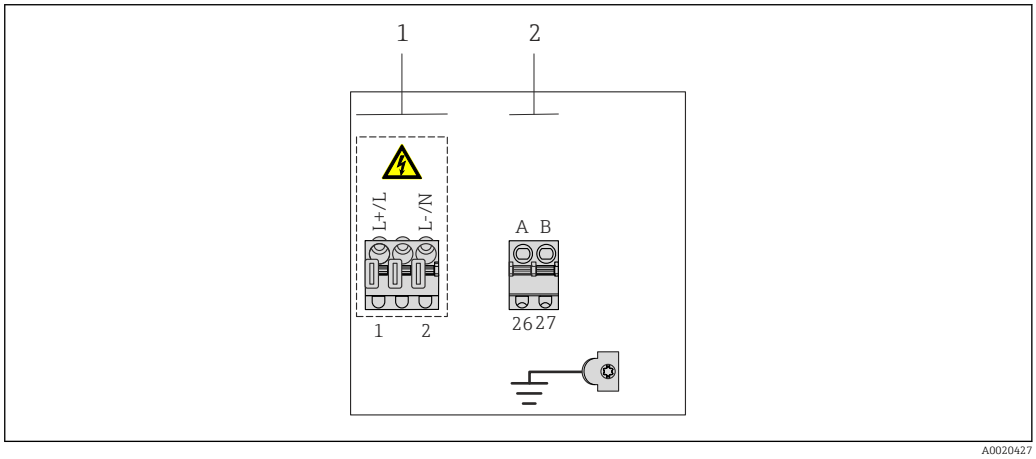
PROFIBUS DP signal transmission

Order code for "Output" and "Input"	Terminal numbers	
	26 (RxD/TxD-P)	27 (RxD/TxD-N)
Option **L**	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

The sensor can be ordered with terminals.

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



A0020427

1 Supply voltage (wide range power unit)
2 Modbus RS485

Supply voltage

Order code for "Power supply"	Terminal numbers	
	1 (L+/L)	2 (L-/N)
Option **L** (wide range power unit)	AC100 to 240 V	
	AC/DC24 V	

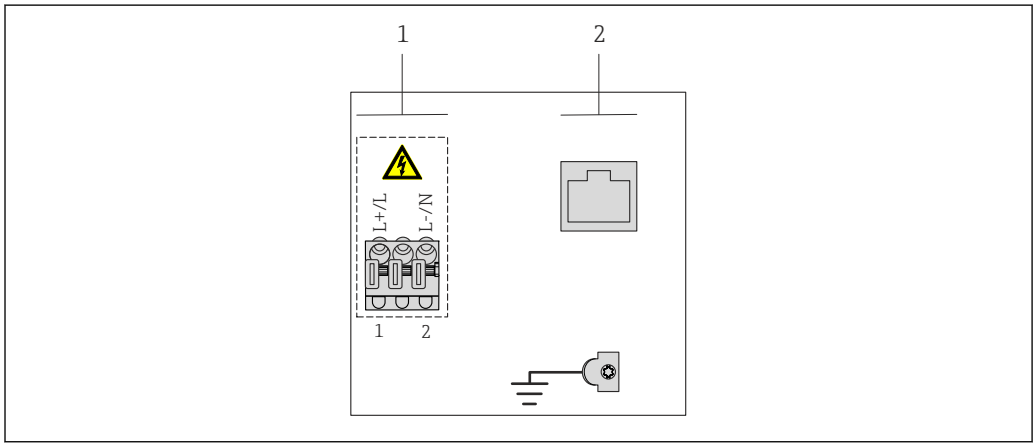
Signal transmission Modbus RS485

Order code for "Output" and "Input"	Terminal numbers	
	26 (+)	27 (-)
Option **M**	A	B

EtherNet/IP connection version

The sensor can be ordered with terminals or a device plug.

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



1 Supply voltage (wide range power unit)
2 EtherNet/IP

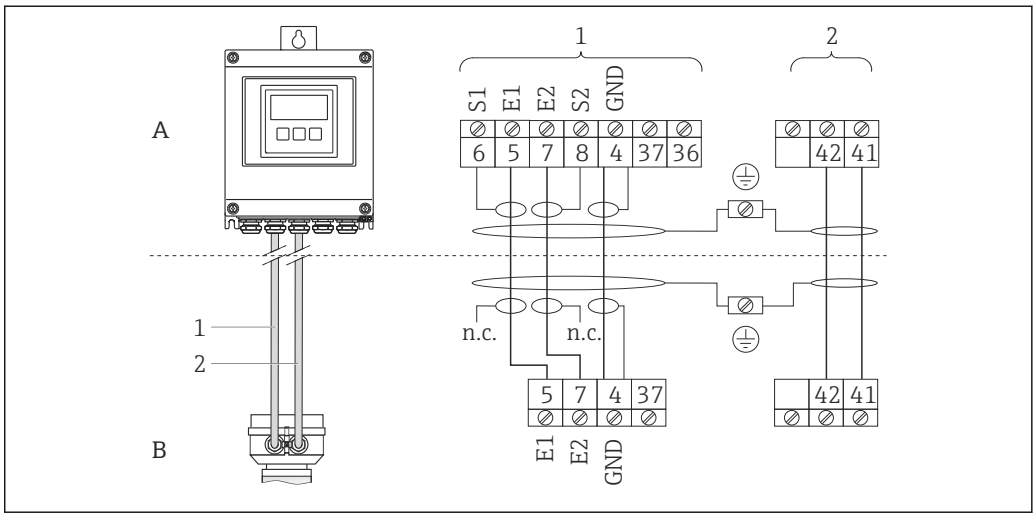
Supply voltage

Order code for "Power supply"	Terminal numbers	
	1 (L+/L)	**2 (L-/N)**
Option **L** (wide range power unit)	AC100 to 240 V	
	AC/DC24 V	

EtherNet/IP signal transmission

Order code for "Output"	Connection via
Option **N**	EtherNet/IP connector

Remote version



2 *Remote version terminal assignment*

A Transmitter wall-mount housing
B Sensor connection housing
1 Electrode cable
2 Coil current cable
n.c. Not connected, insulated cable shields

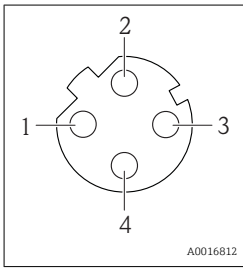
Terminal No. and cable colors: 6/5 = brown; 7/8 = white; 4 = green

Pin assignment, device plug

Order codes for the M12x1 connectors, see the "Order code for electrical connection" column: EtherNet/IP (→ 18)

EtherNet/IP

Device plug for signal transmission (device side)



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

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

Transmitter

Order code for "Power supply"	Terminal voltage	Frequency range
Option **L**	AC100 to 240 V	50/ 60 Hz, ±4 Hz
	AC/DC24 V	50/ 60 Hz, ±4 Hz

Power consumption

Order code for "Output"	Maximum power consumption
Option **H**: 0/4-20mA HART, pulse/frequency/switch output, switch output	30 VA/8 W
Option **I**: 0/4-20mA HART, 2 x pulse/frequency/ switch output, status input	30 VA/8 W
Option **L**: PROFIBUS DP	30 VA/8 W
Option **M**: Modbus RS485	30 VA/8 W
Option **N**: EtherNet/IP	30 VA/8 W

Current consumption

Transmitter

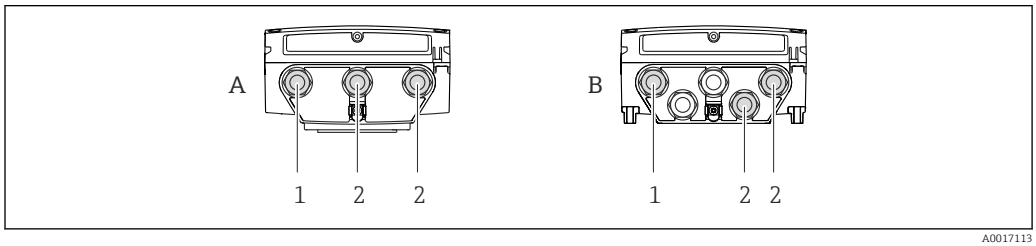
Order code for "Power supply"	Maximum Current consumption	Maximum switch-on current
Option **L**: AC 100 to 240 V	145 mA	25 A (< 5 ms)
Option **L**: AC/DC 24 V	350 mA	27 A (< 5 ms)

Power supply failure

- Totalizers stop at the last value measured.
- Configuration is retained in the plug-in memory (HistoROM DAT).
- Error messages (incl. total operated hours) are stored.

Electrical connection

Connecting the transmitter

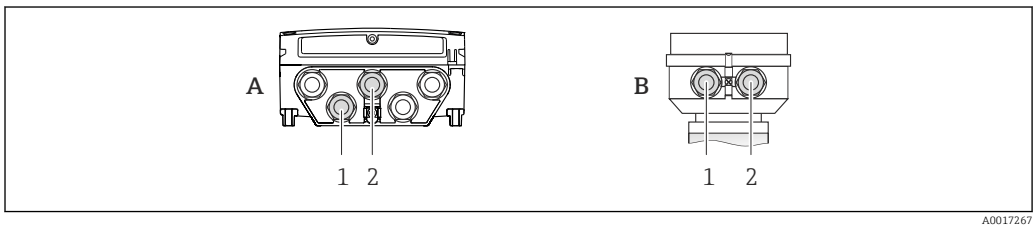


3 Supply voltage and signal transmission connection

A Compact version
B Remote version wall-mount housing
1 Cable entry for supply voltage
2 Cable entry for signal transmission

Remote version connection

Connecting cable



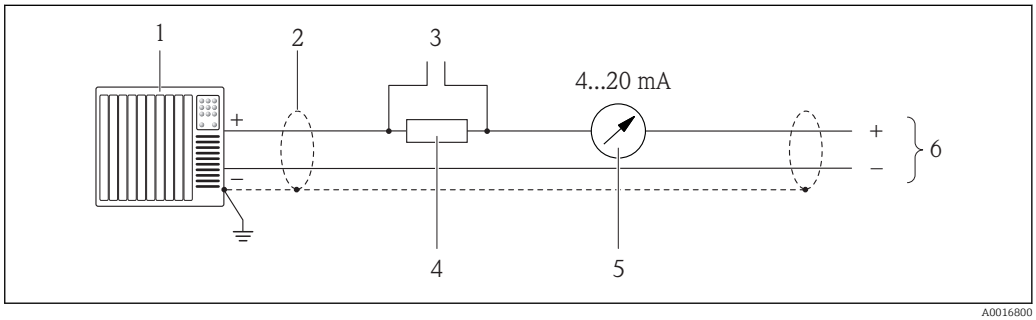
4 Connecting cable connection: electrode and coil current cable

A Transmitter wall-mount housing
B Sensor connection housing
1 Electrode cable
2 Coil current cable

- Fix the cable run or route it in an armored conduit.
  Cable movements can influence the measuring signal especially in the case of low fluid conductivities.
- Route the cable well clear of electrical machines and switching elements.
- Ensure potential equalization between sensor and transmitter .

Connection examples

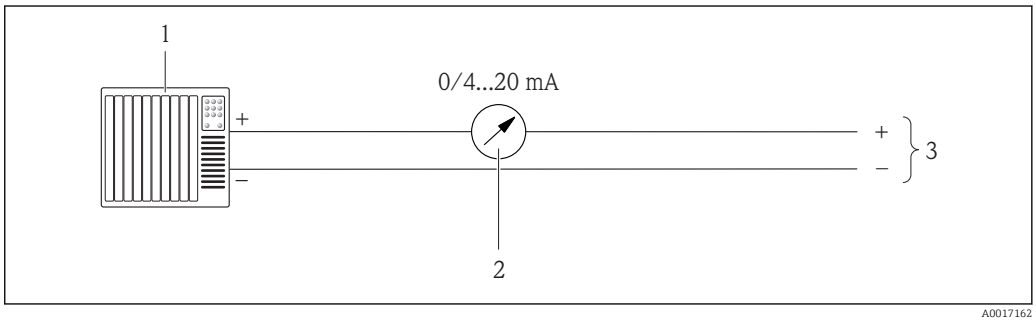
Current output 4-20 mA HART



5 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 (→ 26)
3 Connection for HART operating devices (→ 47)
4 Resistor for HART communication (≥ 250 Ω): observe maximum load (→ 7)
5 Analog display unit: observe maximum load (→ 7)
6 Transmitter

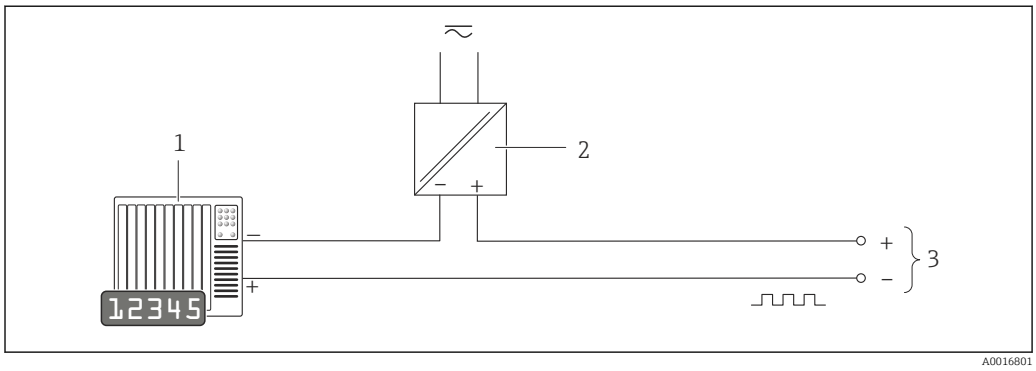
Current output 4-20 mA



6 Connection example for 0-20 mA current output (active) and 4-20 mA current output (active)

1 Automation system with current input (e.g. PLC)
2 Analog display unit: observe maximum load (→ 7)
3 Transmitter

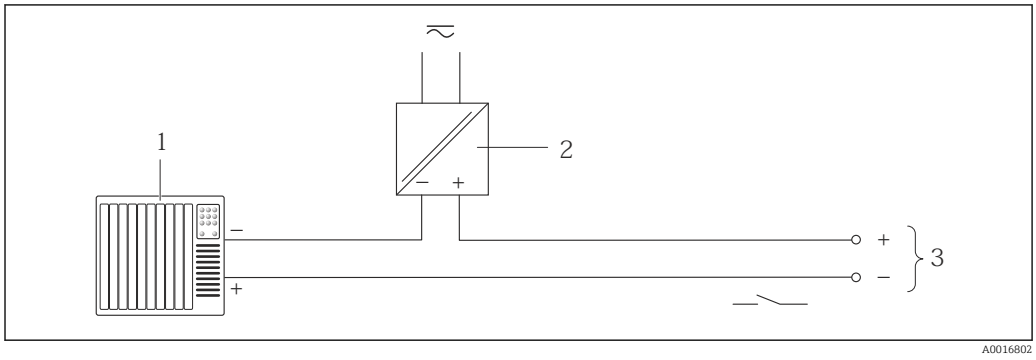
Pulse/frequency output



7 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 (→ 8)

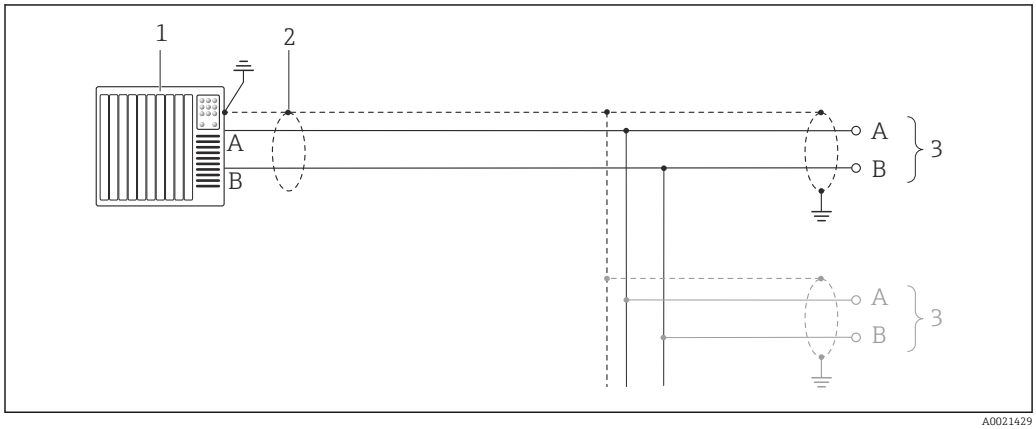
Switch output



8 Connection example for switch output (passive)

1 Automation system with switch input (e.g. PLC)
2 Power supply
3 Transmitter: observe input values (→ 8)

PROFIBUS DP

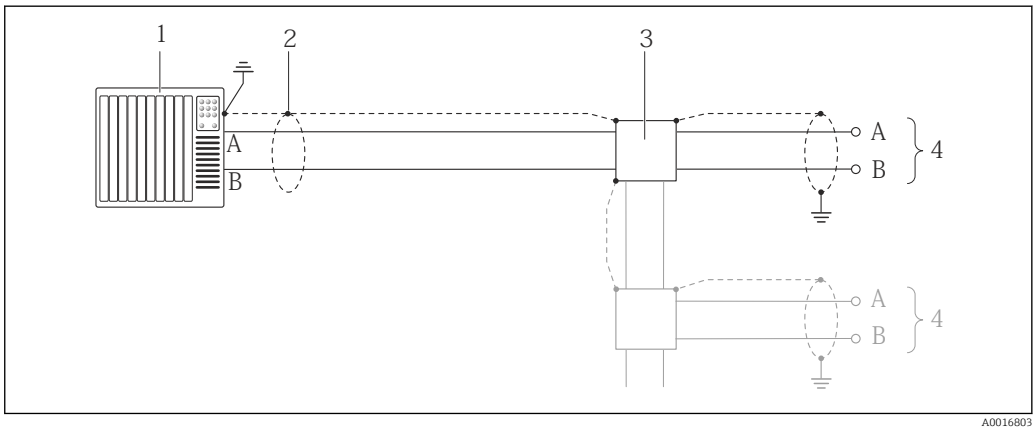


9 Connection example for PROFIBUS DP, non-hazardous area and Zone 2/Div. 2

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 (→ 26)
3 Transmitter

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

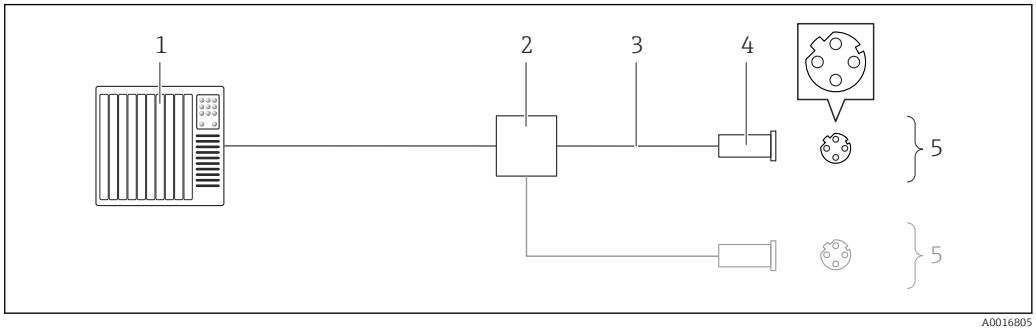
Modbus RS485



10 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 (→ 26)*
3 *Distribution box*
4 *Transmitter*

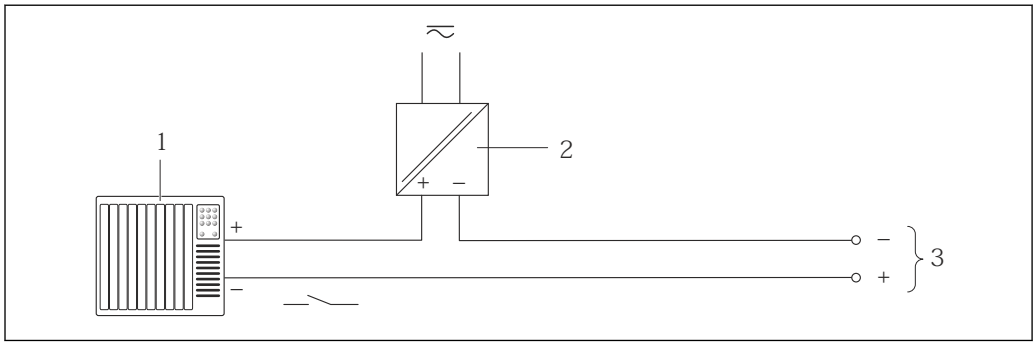
EtherNet/IP



11 Connection example for EtherNet/IP

1 *Control system (e.g. PLC)*
2 *Ethernet switch*
3 *Observe cable specifications (→ 27)*
4 *Device plug*
5 *Transmitter*

Status input



12 *Connection example for status input*

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

Potential equalization

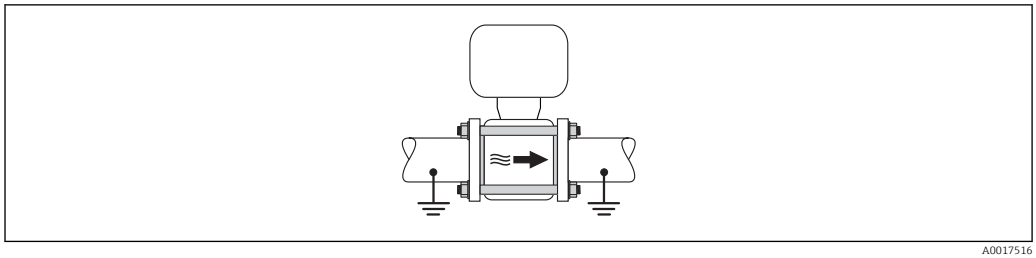
Requirements

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

Connection examples for standard situations

Metal, grounded pipe

This connection method also applies:
- For plastic pipes
- For pipes with insulating liner

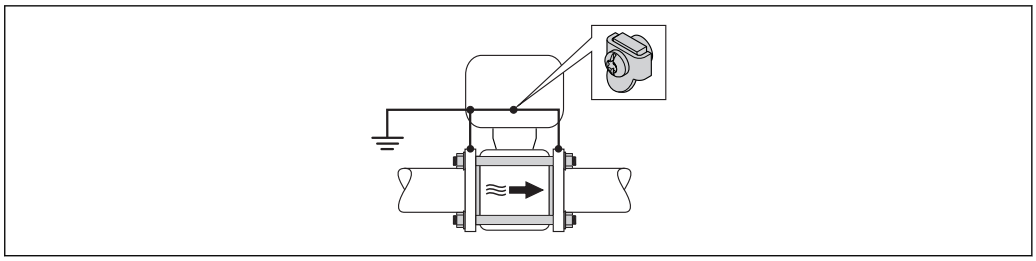


Connection example in special situations

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 least6 mm^2 (0.0093 in^2)



A0017517

Note the following when installing:
- Connect both pipe flanges to one another 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. Mount the ground cable directly on the conductive flange coating of the pipe with the flange screws.

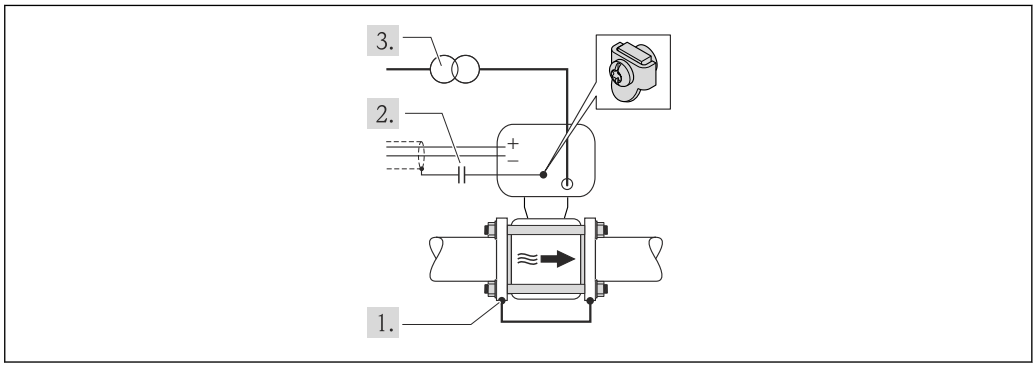
For remote device versions, the ground terminal in the example always refers to the sensor and **not** to the transmitter.

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

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 least6 mm^2 (0.0093 in^2)



A0017518

Prerequisite: The sensor is installed in the pipe in a way that provides electrical insulation.

1. Connect the two flanges of the pipe to one another via a ground cable.
2. Guide the shield of the signal lines through a capacitor.
3. Connect the measuring device to the power supply such that it is floating in relation to the protective ground (isolation transformer).

For remote device versions, the ground terminal in the example always refers to the sensor and **not** to the transmitter.

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

Terminals

Transmitter
- Supply voltage cable: plug-in spring terminals for wire cross-sections 0.5 to 2.5 mm^2 (20 to 14 AWG)
- Signal cable: plug-in spring terminals for wire cross-sections 0.5 to 2.5 mm^2 (20 to 14 AWG)
- Electrode cable: spring terminals for wire cross-sections 0.5 to 2.5 mm^2 (20 to 14 AWG)
- Coil current cable: spring terminals for wire cross-sections 0.5 to 2.5 mm^2 (20 to 14 AWG)

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

Cable entries

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

Cable gland
- For standard cable: M20 × 1.5 with cable Φ6 to 12 mm (0.24 to 0.47 in)
- For reinforced cable: M20 × 1.5 with cable Φ9.5 to 16 mm (0.37 to 0.63 in)

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

Cable specification

Permitted temperature range
- −40 °C (−40 °F) to +80 °C (+176 °F)
- Minimum requirement: cable temperature range ≥ ambient temperature +20 K

Power supply cable

Standard installation cable is sufficient.

Signal cable

Current output
- For 0-20 mA and 4-20 mA: standard installation cable is sufficient.
- For 4-20 mA HART: Shielded cable recommended. Observe grounding concept of the plant.

Pulse/frequency/switch output

Standard installation cable is sufficient.

Status input

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
Shielding	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 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
Shielding	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.

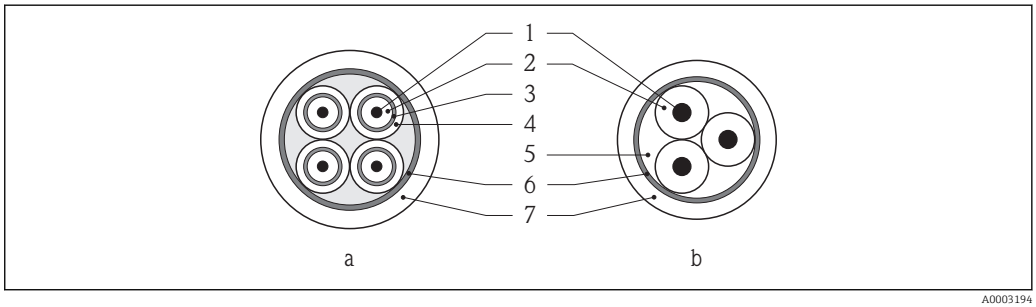
Connecting cable for remote version

Electrode cable

Standard cable	3 ×0.38 mm² (20 AWG) with common, braided copper shield (ϕ ~7 mm (0.28 in) and individual shielded cores
Conductor resistance	≤50 Ω/km (0.015 Ω/ft)
Capacitance: core/shield	≤420 pF/m (128 pF/ft)
Operating temperature	–20 to +80 °C (–68 to +176 °F)

Coil current cable

Standard cable	2 ×0.75 mm² (18 AWG) with common, braided copper shield (ϕ ~ 7 mm (0.28")) and individually shielded cores
Conductor resistance	≤37 Ω/km (0.011 Ω/ft)
Capacitance: core/core, shield grounded	≤120 pF/m (37 pF/ft)
Operating temperature	–20 to +80 °C (–68 to +176 °F)
Test voltage for cable insulation	≤ AC 1433 V r.m.s. 50/60 Hz or ≥ DC 2026 V



13 Cable cross-section

a Electrode cable
b Coil current cable
1 Core
2 Core insulation
3 Core shield
4 Core jacket
5 Core reinforcement
6 Cable shield
7 Outer jacket

Operation in zones of severe electrical interference

The measuring system meets the general safety requirements (→ 🖹 51) and EMC specifications (→ 🖹 35).

Grounding is by means of the ground terminal provided for the purpose inside the connection housing. The stripped and twisted lengths of cable shield to the ground terminal must be as short as possible.

Performance characteristics

Reference operating conditions

In accordance with DIN EN 29104
- Fluid temperature: +28±2 °C (+82±4 °F)
- Ambient temperature range: +22±2 °C (+72±4 °F)
- 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 (→ 🖹 54)

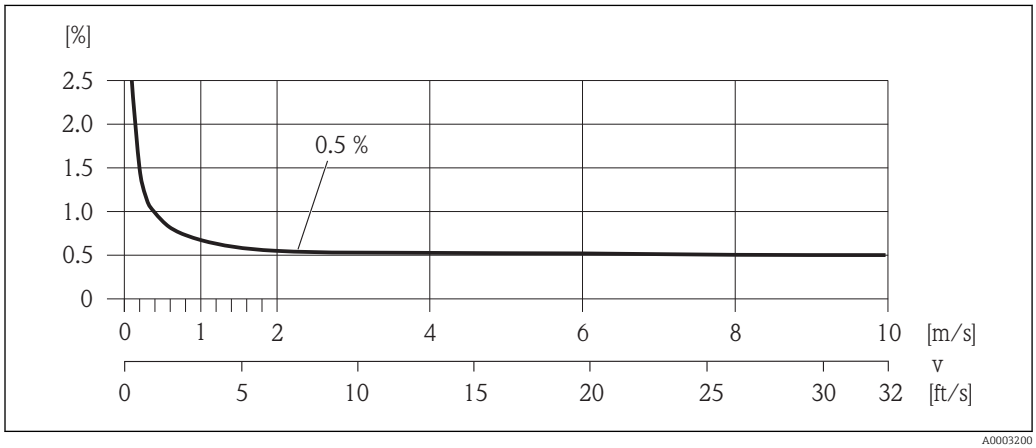
Maximum measured error

Error limits under reference operating conditions

o.r. = of reading

Volume flow
±0.5 % o.r. ± 1 mm/s (0.04 in/s)

Fluctuations in the supply voltage do not have any effect within the specified range.



14 *Maximum measured error in % o.r.*

Accuracy of outputs

o.r. = of reading

The outputs have the following base accuracy specifications.

Current output

Accuracy	Max. ±5 µA

Pulse/frequency output

Accuracy	Max. ±50 ppm o.r. (across the complete ambient temperature range)

Repeatability

o.r. = of reading

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

Influence of ambient temperature

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

Current output

Temperature coefficient	Typically ±50 ppm/°C o.r. or ±1 µA/°C

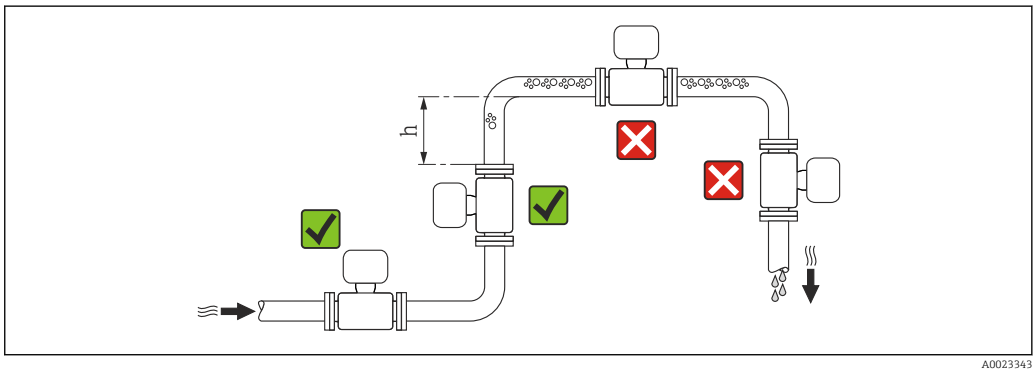
Pulse/frequency output

Temperature coefficient	Max.±0.5 ppm v.M./°C

Installation

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

Mounting location



A0023343

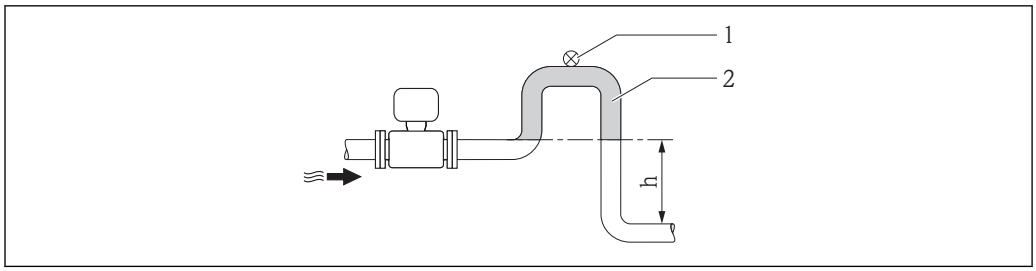
Preferably install the sensor in an ascending pipe, and ensure a sufficient distance to the next pipe elbow: h ≥ 2 × DN

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.

For information on the liner's resistance to partial vacuum (→ 35)



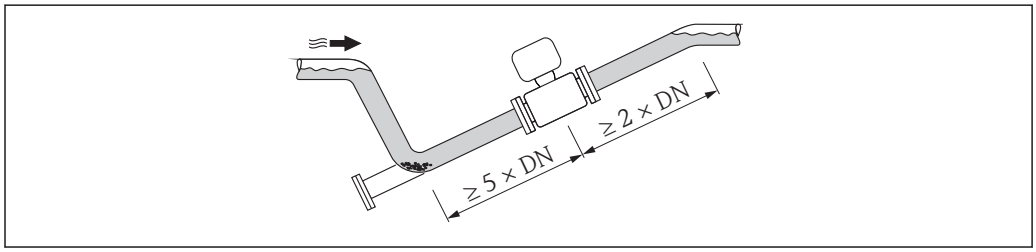
A0017064

15 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.



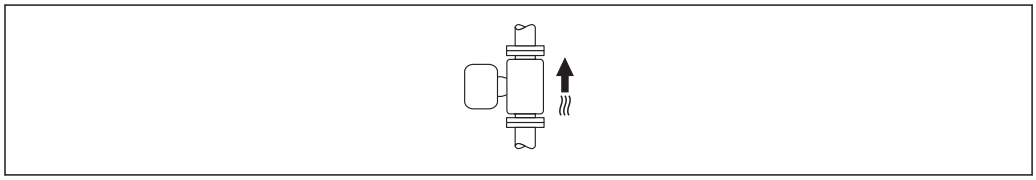
A0017063

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.

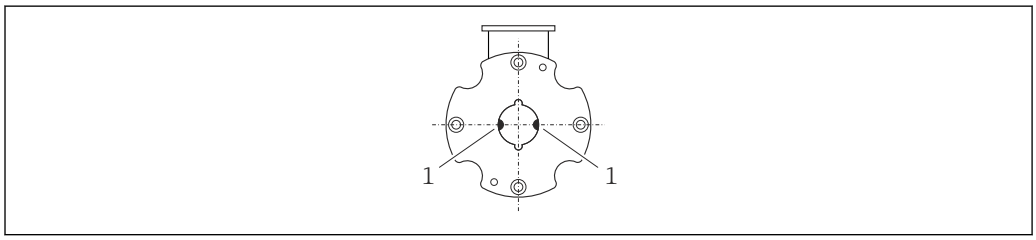
Vertical



A0015591

Optimum for self-emptying pipe systems.

Horizontal



A0017195

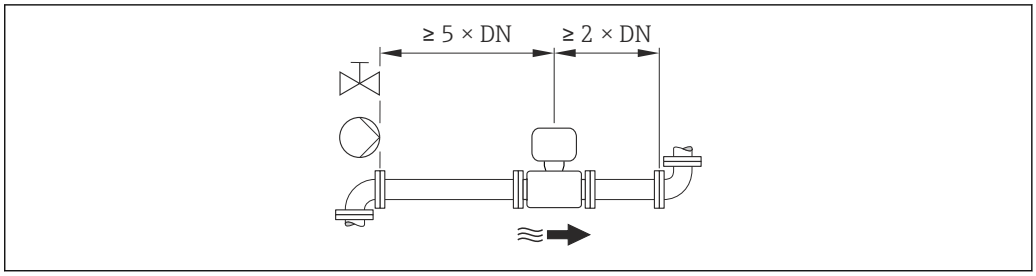
1 Measuring electrodes for signal detection

The measuring electrode plane must be horizontal. This prevents brief insulation of the two measuring electrodes by entrained air bubbles.

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:



A0016275

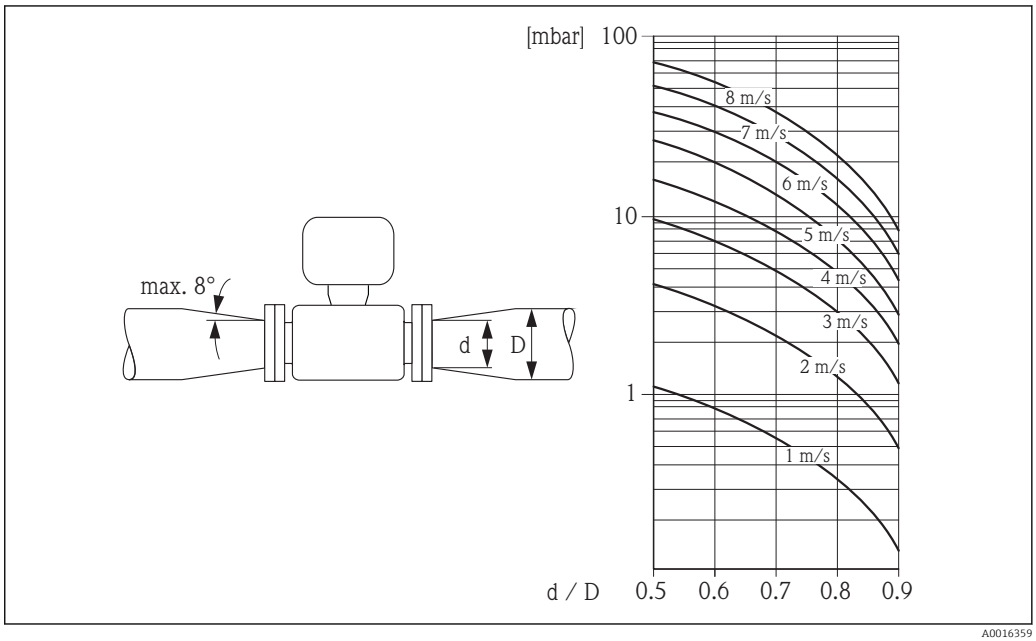
Adapters

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.

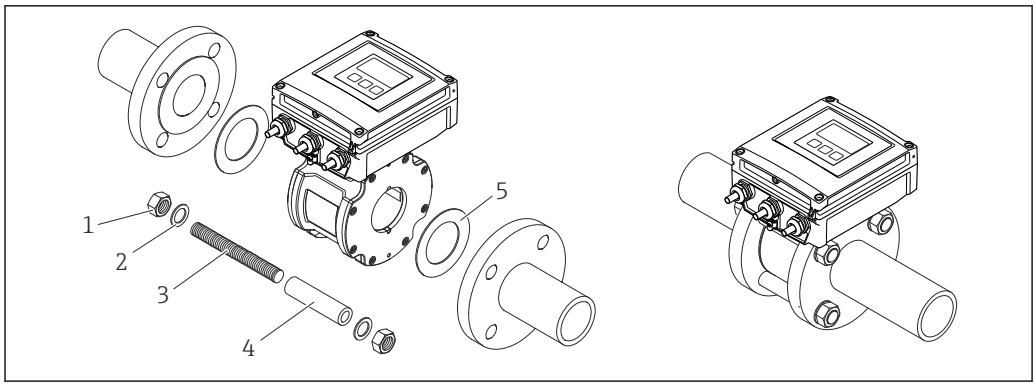


A0016359

Mounting kit

The sensor is installed between the pipe flanges using a mounting kit. The device is centered using the recesses on the sensor. Centering sleeves are also provided depending on the flange standard or the diameter of the pitch circle.

A mounting kit – consisting of mounting bolts, seals, nuts and washers – can be ordered separately (see "Accessories" section (→ 53)).



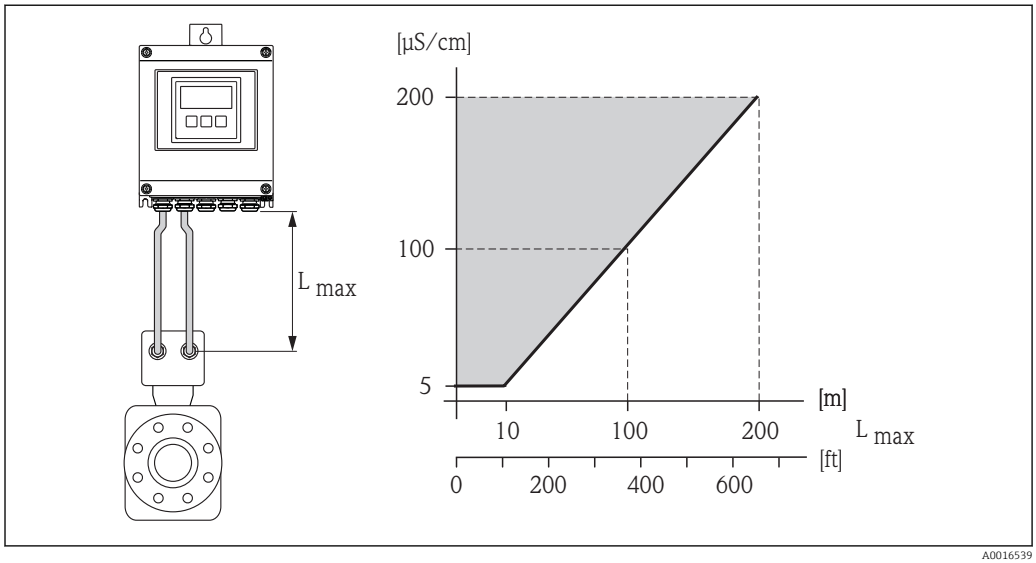
A0018060

16 Mounting the sensor

1 Nut
2 Washer
3 Mounting bolts
4 Centering sleeve
5 Seal

Length of connecting cable

To ensure correct measuring results when using the remote version, observe the maximum permitted cable length L_{max}. This length is determined by the conductivity of the fluid.
If measuring liquids in general: 5 µS/cm



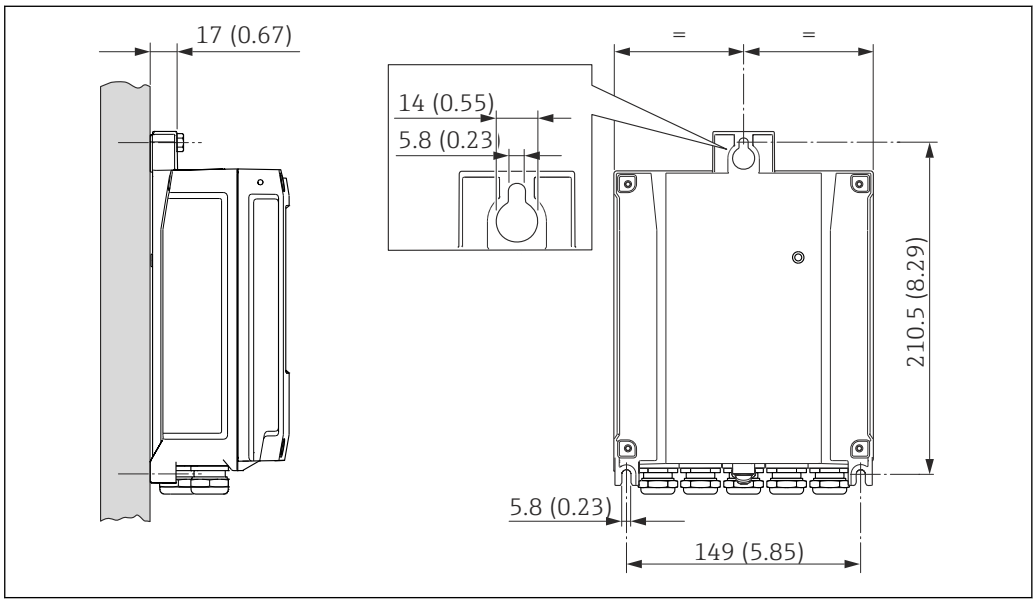
A0016539

17 Permitted length of connecting cable for remote version

Area shaded gray = permitted range
L_{max} = length of connecting cable in [m] ([ft])
[µS/cm] = fluid conductivity

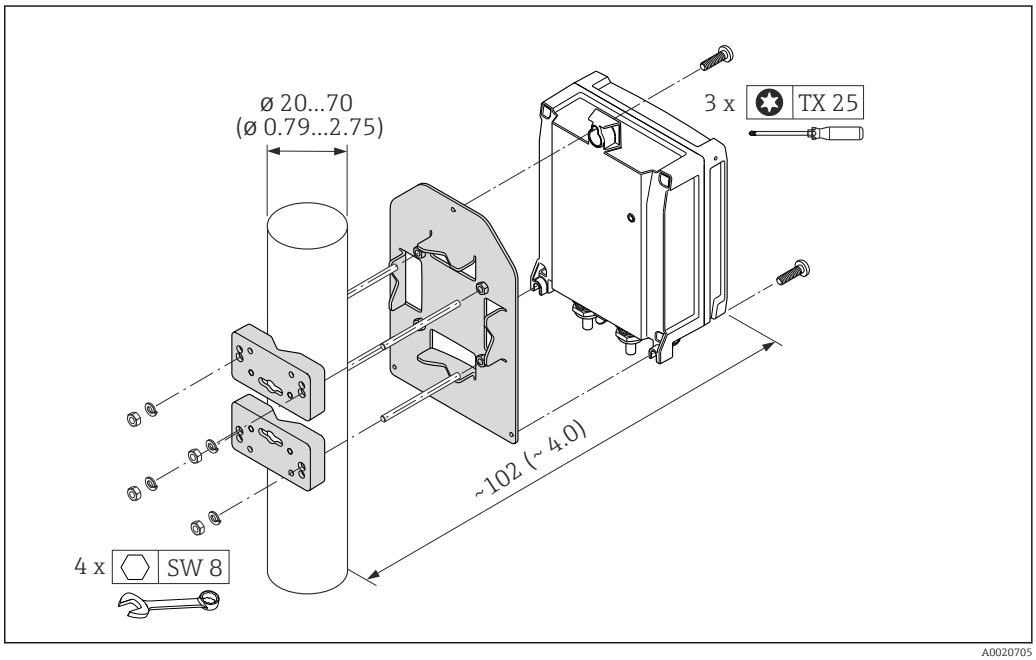
Installing the wall-mount housing

Wall mounting



18 *Engineering unit mm (in)*

Post mounting



19 *Engineering unit mm (in)*

Special mounting instructions

Display protection

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

Environment

Ambient temperature range

Transmitter	−40 to +60 °C (−40 to +140 °F)
Local display	−20 to +60 °C (−4 to +140 °F), the readability of the display may be impaired at temperatures outside the temperature range.
Sensor	−20 to +60 °C (−4 to +140 °F) Mount the transmitter separately from the sensor if both the ambient and fluid temperatures are high.
Liner	Do not exceed or fall below the permitted temperature range of the liner (→ 35).

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.
- Protect the display against impact.
- Protect the display from abrasion by sand in desert areas.

A display protector can be ordered from Endress+Hauser: "Accessories" section (→ 53)

Storage temperature

The storage temperature corresponds to the operating temperature range of the measuring transmitter and the appropriate measuring sensors.

- 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.

Atmosphere

If a plastic transmitter housing is permanently exposed to certain steam and air mixtures, this can damage the housing.

If you are unsure, please contact your Endress+Hauser Sales Center for clarification.

Degree of protection

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

Sensor
As standard: IP66/67, type 4X enclosure

Shock resistance

Compact version
6 ms 30 g, according to IEC 60068-2-27

Remote version
- Transmitter: 6 ms 30 g, according to IEC 60068-2-27
- Sensor: 6 ms 50 g, according to IEC 60068-2-27

Vibration resistance

Compact version
- Vibration sinusoidal, 1 g peak, according to IEC 60068-2-6
- Vibration broad-band random, 1.54 g rms, according to IEC 60068-2-64

Remote version
- Transmitter
  - Vibration sinusoidal, 1 g peak, according to IEC 60068-2-6
  - Vibration broad-band random, 1.54 g rms, according to IEC 60068-2-64
- Sensor:
  - Vibration sinusoidal, 2 g peak, according to IEC 60068-2-6
  - Vibration broad-band random, 2.70 g rms, according to IEC 60068-2-64

Mechanical load

- Protect the transmitter housing against mechanical effects, such as shock or impact; the use of the remote version is sometimes preferable.
- Never use the transmitter housing as a ladder or climbing aid.

Electromagnetic compatibility (EMC)

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

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

For details refer to the Declaration of Conformity.

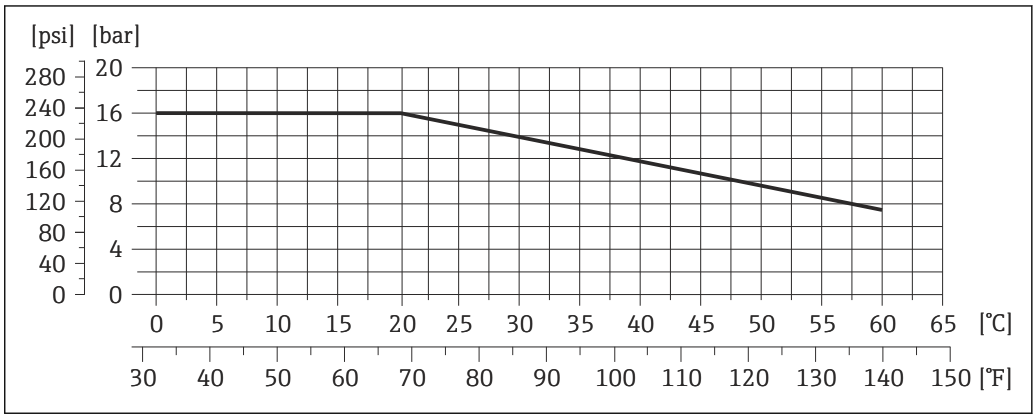
Process

Medium temperature range

0 to +60 °C (+32 to +140 °F) for polyamide

Pressure-temperature ratings

Permitted process pressure



A0021395-EN

Pressure tightness

Measuring tube: 0 mbar abs. (0 psi abs.) at a medium temperature of ≤ +60 °C (+140 °F)

Flow limit

The diameter of the pipe and the flow rate determine the nominal diameter of the sensor. The optimum velocity of flow 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 fluids (e.g. potter's clay, lime milk, ore slurry)
- v > 2 m/s (6.56 ft/s): for fluids producing buildup (e.g. wastewater sludges)

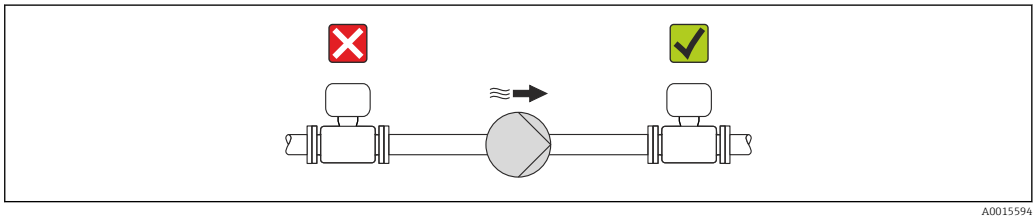
A necessary increase in the flow velocity can be achieved by reducing the sensor nominal diameter.

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

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 (→ 31)

System pressure



A0015594

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 (→ 35)
- Information on the shock resistance of the measuring system (→ 34)
- Information on the vibration resistance of the measuring system (→ 34)

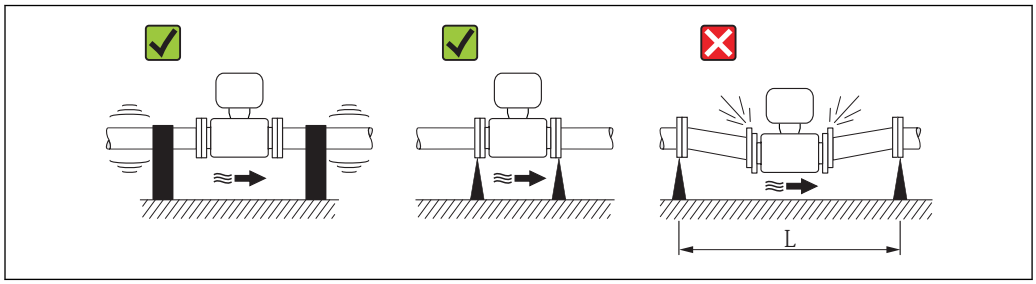
Vibrations

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

It is also advisable to mount the sensor and transmitter separately.

Information on the shock resistance of the measuring system (→ 34)

Information on the vibration resistance of the measuring system (→ 34)



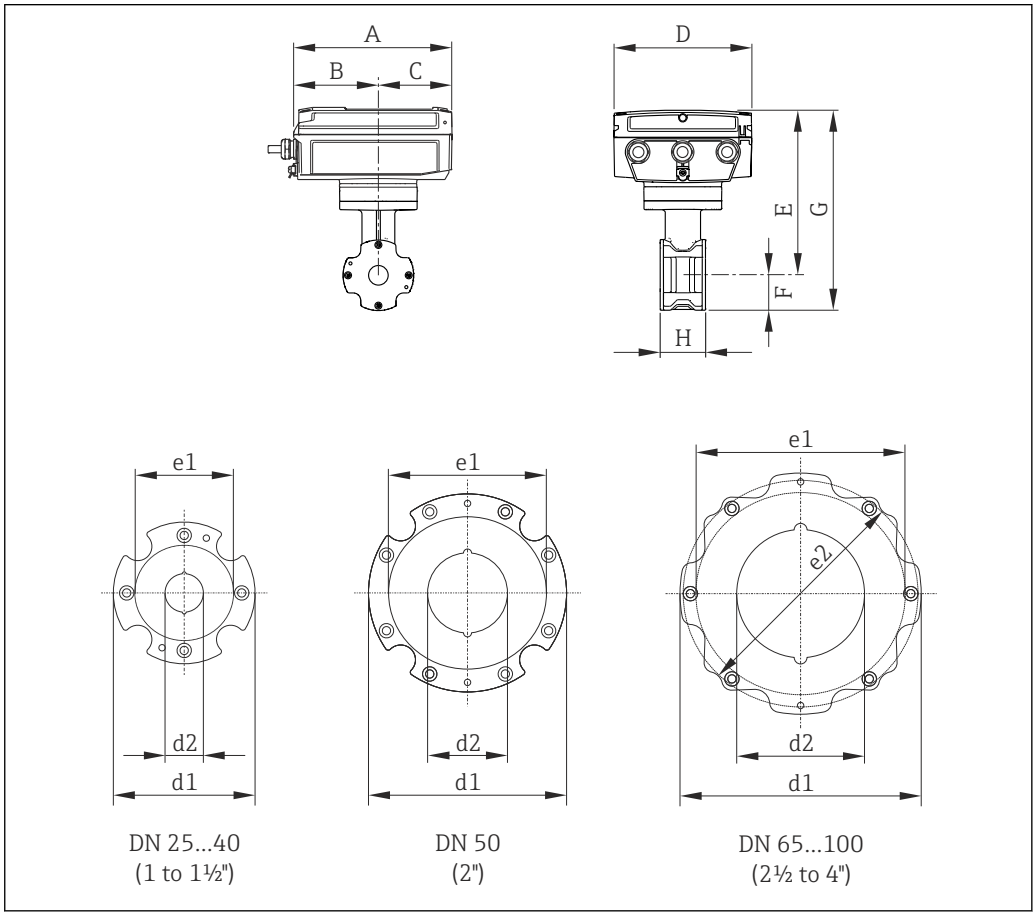
20 Measures to avoid device vibrations (L > 10 m (33 ft))

Mechanical construction

Design, dimensions

Compact version

Order code for "Housing", option M "Compact, Polycarbonate" or option A "Compact, alu, coated"



21 Engineering unit mm (in)

Dimensions in SI units

DN [1] [mm]	A [mm]	B [mm]	C [mm]	D [mm]	E [mm]	F [mm]	G [mm]	H [mm]	d1 [mm]	d2 [mm]	e1 [2] [mm]
25	193	103	90	167	190	43	233	55	86	24	68
40	193	103	90	167	201	52	253	69	104	38	87
50	193	103	90	167	212	62	274	83	124	50	106
65	193	103	90	167	222	70	292	93	139	60	125
80	193	103	90	167	226	75	301	117	151	76	135
100	193	103	90	167	240	89	329	148	179	97	160

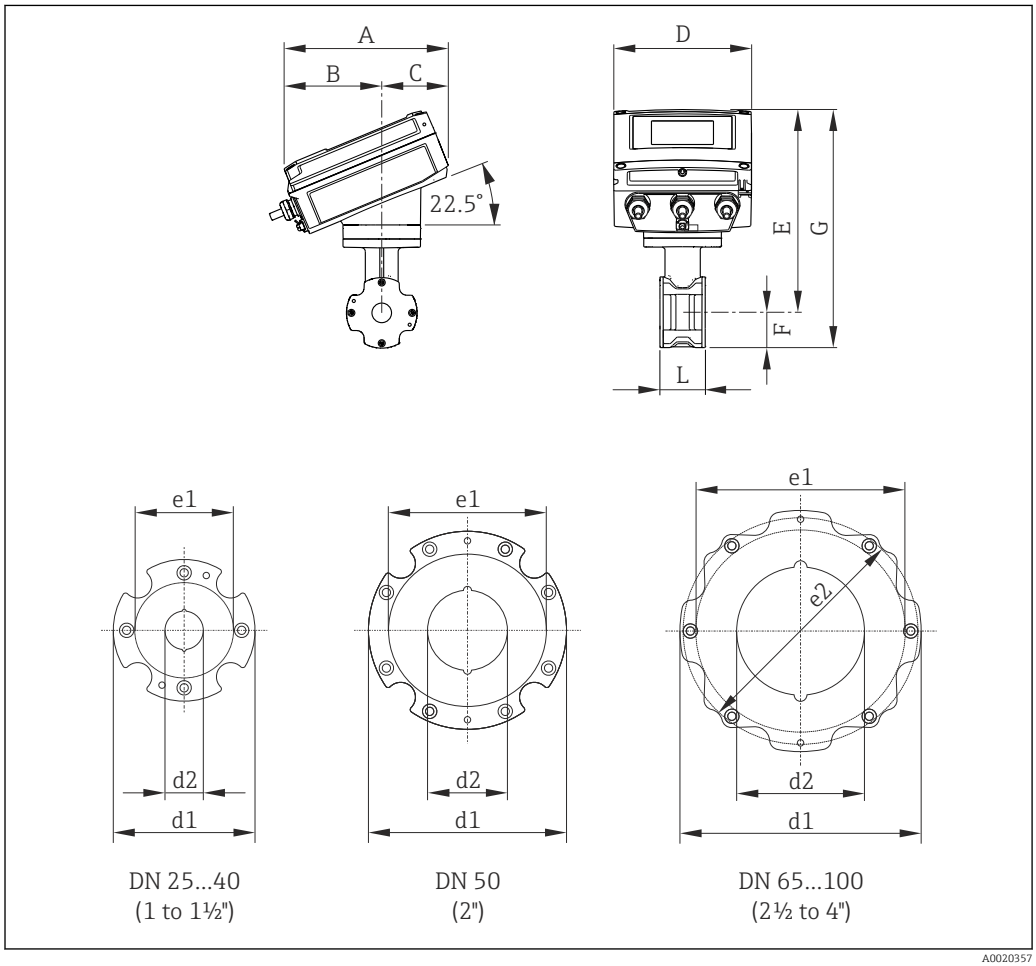
1) EN (DIN), JIS
2) max. Ø seals

Dimensions in US units

DN [1] [in]	A [in]	B [in]	C [in]	D [in]	E [in]	F [in]	G [in]	H [in]	d1 [in]	d2 [in]	e1 [2] [in]	e2 [2] [in]
1	7.60	4.06	3.54	6.57	7.48	1.69	9.17	2.17	3.39	0.94	2.68	–
1 ½	7.60	4.06	3.54	6.57	7.91	2.05	9.96	2.72	4.11	1.50	3.43	–
2	7.60	4.06	3.54	6.57	8.35	2.44	10.8	3.27	4.88	1.97	4.17	–
3	7.60	4.06	3.54	6.57	8.90	2.95	11.9	4.61	5.94	2.99	–	5.43
4	7.60	4.06	3.54	6.57	9.45	3.50	13.0	5.83	7.05	3.82	6.30	–

1) ASME
2) max. Ø seals

Order code for "Housing", option Q "Compact, Polycarbonate, tilted" or option R "Compact, alu, coated, tilted"



22 *Engineering unit mm (in)*

Dimensions in SI units

DN [1] [mm]	A [mm]	B [mm]	C [mm]	D [mm]	E [mm]	F [mm]	G [mm]	H [mm]	d1 [mm]	d2 [mm]	e1 [2] [mm]
25	199	119	80	167	235	43	278	55	86	24	68
40	199	119	80	167	246	52	298	69	104	38	87
50	199	119	80	167	257	62	319	83	124	50	106

DN [1] [mm]	A [mm]	B [mm]	C [mm]	D [mm]	E [mm]	F [mm]	G [mm]	H [mm]	d1 [mm]	d2 [mm]	e1 [2] [mm]
65	199	119	80	167	267	70	337	93	139	60	125
80	199	119	80	167	271	75	346	117	151	76	135
100	199	119	80	167	285	89	374	148	179	97	160

1) EN (DIN), JIS
2) max. Ø seals

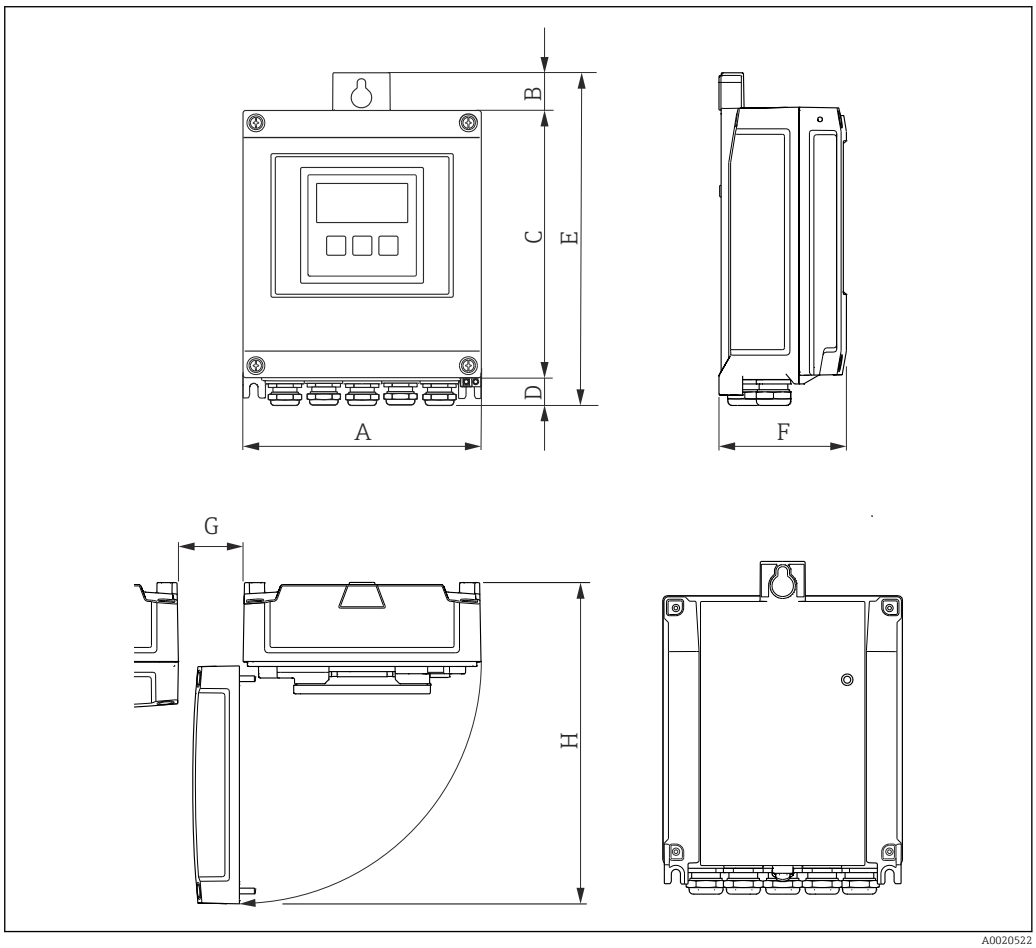
Dimensions in US units

DN [1] [in]	A [in]	B [in]	C [in]	D [in]	E [in]	F [in]	G [in]	H [in]	d1 [in]	d2 [in]	e1 [2] [in]	e2 [2] [in]
1	7.83	4.69	3.15	6.57	9.25	1.69	10.9	2.17	3.39	0.94	2.68	–
1 ½	7.83	4.69	3.15	6.57	9.69	2.05	11.7	2.72	4.11	1.50	3.43	–
2	7.83	4.69	3.15	6.57	10.1	2.44	12.6	3.27	4.88	1.97	4.17	–
3	7.83	4.69	3.15	6.57	10.7	2.95	13.6	4.61	5.94	2.99	–	5.43
4	7.83	4.69	3.15	6.57	11.2	3.50	14.7	5.83	7.05	3.82	6.30	–

1) ASME
2) max. Ø seals

Transmitter remote version

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



A0020522

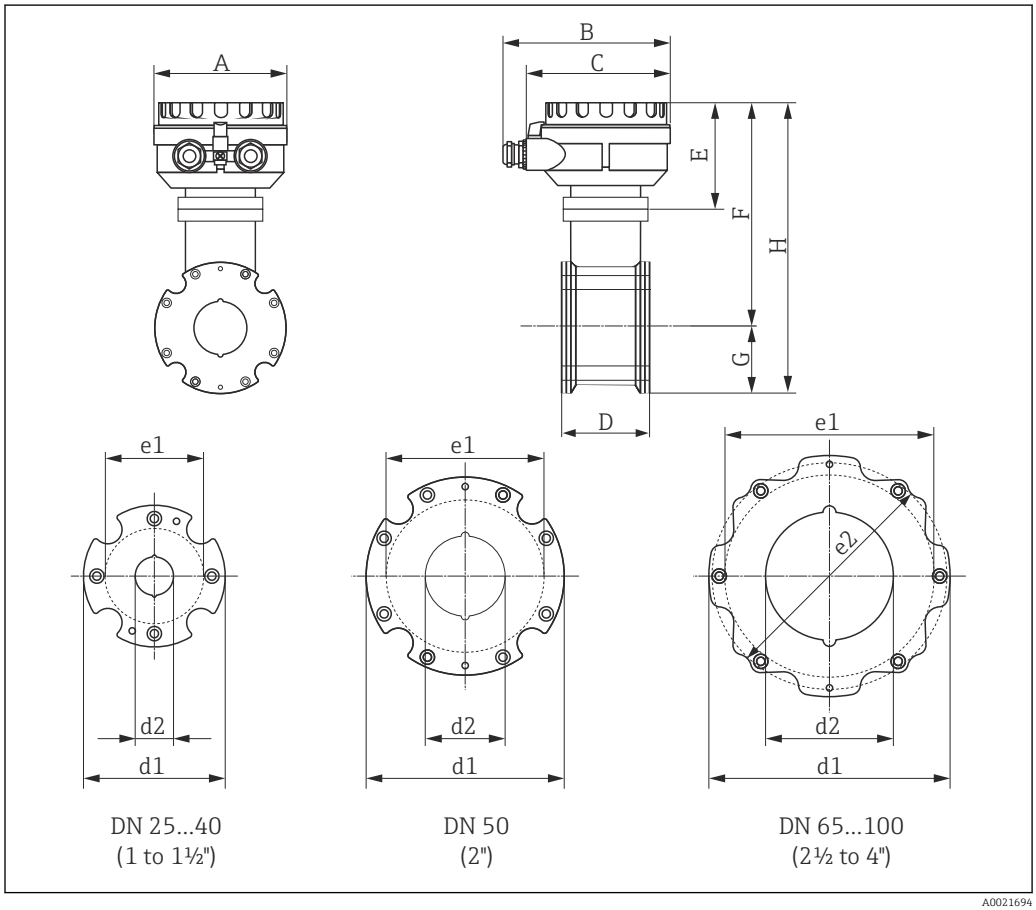
Dimensions in SI units

A [mm]	B [mm]	C [mm]	D [mm]	E [mm]	F [mm]	G [mm]	H [mm]
167	24	187	21	232	80	50	240

Dimensions in US units

A [in]	B [in]	C [in]	D [in]	E [in]	F [in]	G [in]	H [in]
6.57	0.94	7.36	0.83	9.13	3.15	1.97	9.5

Sensor remote version



23 Engineering unit mm (in)

Dimensions in SI units

DN [1] [mm]	A [mm]	B [mm]	C [mm]	D [mm]	E [mm]	F [mm]	G [mm]	H [mm]	d 1 [mm]	d 2 [mm]	e 1 [2] [mm]
25	129	163	143	55	102	192	43	235	86	24	68
40	129	163	143	69	102	203	52	255	104	38	87
50	129	163	143	83	102	214	62	276	124	50	106
65	129	163	143	93	102	224	70	294	139	60	125

DN [1] [mm]	A [mm]	B [mm]	C [mm]	D [mm]	E [mm]	F [mm]	G [mm]	H [mm]	d 1 [mm]	d 2 [mm]	e 1 [2] [mm]
80	129	163	143	117	102	228	75	303	151	76	135
100	129	163	143	148	102	242	89	331	179	97	160

1) EN (DIN), JIS
2) max. Ø seals

Dimensions in US units

DN [1] [in]	A [in]	B [in]	C [in]	D [in]	E [in]	F [in]	G [in]	H [in]	d 1 [in]	d 2 [in]	e 1 [2] [in]	e 2 [2] [in]
1	5.08	6.42	5.63	2.17	4.02	7.56	1.69	9.25	3.39	0.94	2.68	–
1 ½	5.08	6.42	5.63	2.72	4.02	7.99	2.05	10.0	4.11	1.50	3.43	–
2	5.08	6.42	5.63	3.27	4.02	8.43	2.44	10.9	4.88	1.97	4.17	–
3	5.08	6.42	5.63	4.61	4.02	8.98	2.95	11.9	5.94	2.99	–	5.43
4	5.08	6.42	5.63	5.83	4.02	9.53	3.50	13.0	7.05	3.82	6.30	–

1) ASME
2) max. Ø seals

Weight

Compact version

Weight data:
- Including the transmitter
  - Order code for *"Housing"*, option M, Q: 1.3 kg (2.9 lbs)
  - Order code for *"Housing"*, option A, R: 2.0 kg (4.4 lbs)
- Excluding packaging material

Weight in SI units

EN 1092-1 (DIN 2501), JIS B2220		
DN [mm]	Weight [kg]	
	Order code for "Housing", option M, Q: Polycarbonate plastic	Order code for "Housing", option A, R: Aluminum, AlSi10Mg, coated
25	2.50	3.20
40	3.10	3.80
50	3.90	4.60
65	4.70	5.40
80	5.70	6.40
100	8.40	9.10

Weight in US units

ASME B16.5		
DN [in]	Weight [lbs]	
	Order code for "Housing", option M, Q: Polycarbonate plastic	Order code for "Housing", option A, R: Aluminum, AlSi10Mg, coated
1	5.51	7.06
1½	6.84	8.40
2	8.60	10.1

ASME B16.5		
DN [in]	Weight [lbs]	
	Order code for "Housing", option M, Q: Polycarbonate plastic	Order code for "Housing", option A, R: Aluminum, AlSi10Mg, coated
3	12.6	14.1
4	18.5	20.1

Transmitter remote version

Wall-mount housing

Depends on the material of the wall-mount housing:
- Polycarbonate plastic: 1.3 kg (2.9 lb)
- Aluminum, AlSi10Mg, coated: 2.0 kg (4.4 lb)

Sensor remote version

Weight data:
- Including sensor connection housing
- Excluding the connecting cable
- Excluding packaging material

Weight in SI units

EN 1092-1 (DIN 2501), JIS B2220	
DN [mm]	Weight [kg]
25	2.5
40	3.1
50	3.9
65	4.7
80	5.7
100	8.4

Weight in US units

ASME B16.5	
DN [in]	Weight [lbs]
1	5.5
1½	6.8
2	8.6
3	12.6
4	18.5

Measuring tube specification

Pressure rating EN (DIN)

Pressure rating PN 16								
DN		Mounting bolts			Length Centering sleeves		internal diameter Measuring tube	
[mm]	[in]		[mm]	[in]	[mm]	[in]	[mm]	[in]
25	1	4 × M12 ×	145	5.71	54	2.13	24	0.94
40	1 ½	4 × M16 ×	170	6.69	68	2.68	38	1.50
50	2	4 × M16 ×	185	7.28	82	3.23	50	1.97
65 [1]	–	4 × M16 ×	200	7.87	92	3.62	60	2.36
65 [2]	–	8 × M16 ×	200	7.87	– [3]	–	60	2.36
80	3	8 × M16 ×	225	8.86	116	4.57	76	2.99
100	4	8 × M16 ×	260	10.24	147	5.79	97	3.82

1) EN (DIN) flange: 4-hole → with centering sleeves
2) EN (DIN) flange: 8-hole → without centering sleeves
3) A centering sleeve is not required. The device is centered directly via the sensor housing.

ASME pressure rating

Pressure rating Class 150								
DN		Mounting bolts			Length Centering sleeves		internal diameter Measuring tube	
[mm]	[in]		[mm]	[in]	[mm]	[in]	[mm]	[in]
25	1	4 × UNC ½" ×	145	5.70	– [1]	–	24	0.94
40	1 ½	4 × UNC ½" ×	165	6.50	–	–	38	1.50
50	2	4 × UNC 5/8" ×	190.5	7.50	–	–	50	1.97
80	3	8 × UNC 5/8" ×	235	9.25	–	–	76	2.99
100	4	8 × UNC 5/8" ×	264	10.4	147	5.79	97	3.82

1) A centering sleeve is not required. The device is centered directly via the sensor housing.

Pressure rating JIS

Pressure rating 10K								
DN		Mounting bolts			Length Centering sleeves		internal diameter Measuring tube	
[mm]	[in]		[mm]	[in]	[mm]	[in]	[mm]	[in]
25	1	4 × M16 ×	170	6.69	54	2.13	24	0.94
40	1 ½	4 × M16 ×	170	6.69	68	2.68	38	1.50
50	2	4 × M16 ×	185	7.28	– [1]	–	50	1.97
65	–	4 × M16 ×	200	7.87	–	–	60	2.36
80	3	8 × M16 ×	225	8.86	–	–	76	2.99
100	4	8 × M16 ×	260	10.24	–	–	97	3.82

1) A centering sleeve is not required. The device is centered directly via the sensor housing.

Materials

Transmitter housing

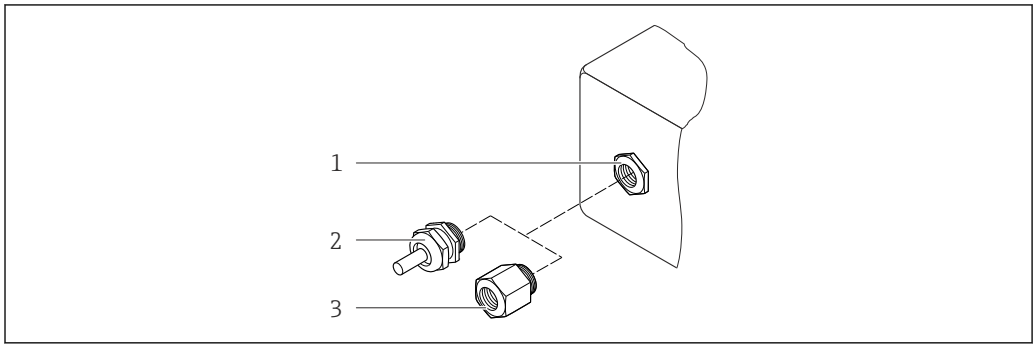
Order Code for "Housing"

- Compact version, standard:
  - Option **A**: aluminum, AlSi10Mg, coated
  - Option **M**: polycarbonate plastic
- Compact version, inclined:
  - Option **Q**: polycarbonate plastic
  - Option **R**: aluminum, AlSi10Mg, coated
- Remote version (wall-mount housing):
  - Option **N**: polycarbonate plastic
  - Option **P**: aluminum, AlSi10Mg, coated

Window material

Transmitter housing material	Window material
Polycarbonate plastic	Plastic
Aluminum, AlSi10Mg, coated	Glass

Cable entries/cable glands



24 *Possible cable entries/cable glands*

1 *Cable entry in transmitter housing, wall-mount housing or connection 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"*

Compact and remote versions and sensor connection housing

Cable entry/cable gland	Material
Cable gland M20 × 1.5	Plastic
Remote version: cable gland M20 × 1.5 Option of reinforced connecting cable	▪ Sensor connection housing: Nickel-plated brass ▪ Transmitter wall-mount housing: Plastic
Adapter for cable entry with internal thread G ½" or NPT ½"	Nickel-plated brass

Device plug

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

Connecting cable for remote version

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

Sensor housing

Aluminum, AlSi10Mg, coated

Sensor connection housing

Aluminum, AlSi10Mg, coated

Sensor cable entries

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

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

Electrical connection	Material
Cable gland M20 × 1.5	Nickel-plated brass
Thread G ½" via adapter	Nickel-plated brass
Thread NPT ½" via adapter	Nickel-plated brass

Liner

Polyamide

Electrodes

Stainless steel, 1.4435/F316L

Process connections

- EN 1092-1 (DIN 2501)
- ASME B16.5
- JIS B2220

List of all available process connections

Seals

O-rings made from EPDM

Accessories

Display protection

Stainless steel, 1.4301 (304L)

Ground disks

Stainless steel ,1.4301/304

Mounting bolts

Tensile strength
- Galvanized steel mounting bolts: strength category 5.6 or 5.8
- Stainless steel mounting bolts: strength category A2–70

Fitted electrodes

2 measuring electrodes made of 1.4435 (316L)

Process connections

- EN 1092-1 (DIN 2501)
- ASME B16.5
- JIS B2220

For information on the materials of the process connections (→ 45)

Operability

Operating concept

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

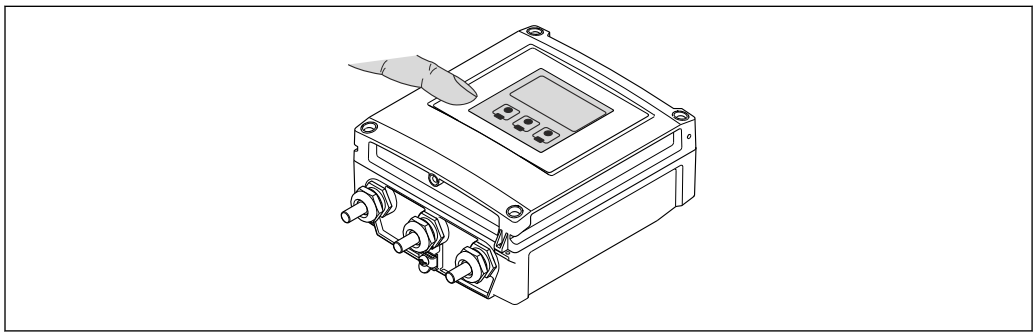
Quick and safe commissioning
- Guided menus ("Make-it-run" wizards) for applications
- Menu guidance with brief explanations of the individual parameter functions

Reliable operation
- Operation in the following languages:
  - Via local display:
    English, German, French, Spanish, Italian, Dutch, Portuguese, Polish, Russian, Turkish, Chinese, Japanese, Bahasa (Indonesian), Vietnamese, Czech
  - Via "FieldCare" operating tool:
    English, German, French, Spanish, Italian, Chinese, Japanese
  - Via Web browser:
    English, German, French, Spanish, Italian, Dutch, Portuguese, Polish, Russian, Turkish, Chinese, Japanese, Bahasa (Indonesian), Vietnamese, Czech
- Uniform operating philosophy applied to device, 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.

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

Local operation

Via display module



A0020538

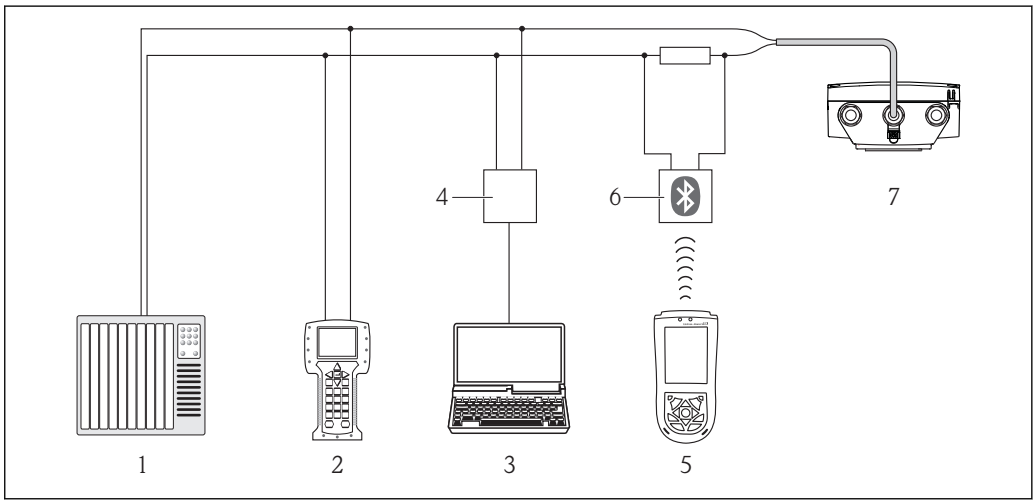
Display elements
- 4-line display
- White background lighting; switches to red in event of device errors
- Format for displaying measured variables and status variables can be individually configured
- Permitted ambient temperature for the display: −20 to +50 °C (−4 to +122 °F)
  The readability of the display may be impaired at temperatures outside the temperature range.

Operating elements
External operation via touch control; 3 optical keys: ⊕, ⊖, Ⓔ

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

Remote operation

Via HART protocol

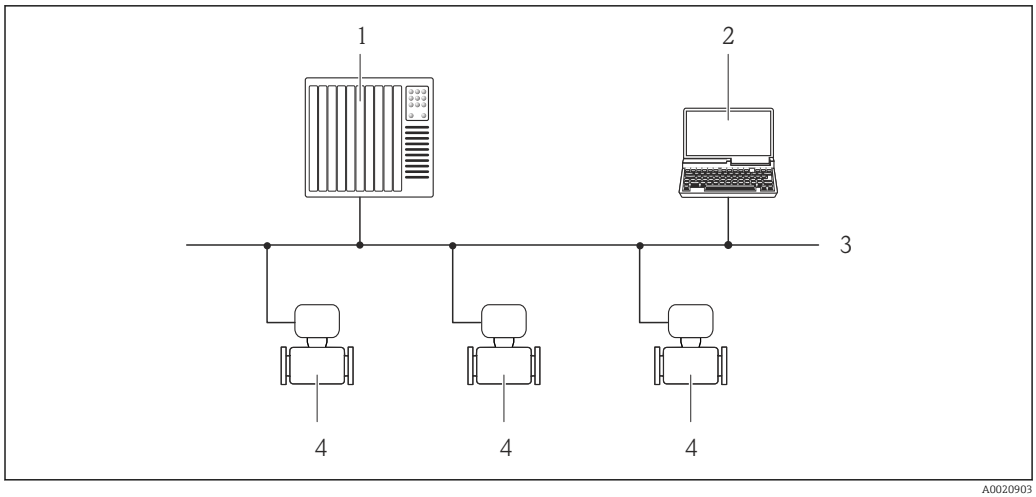


25 Options for remote operation via HART protocol

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

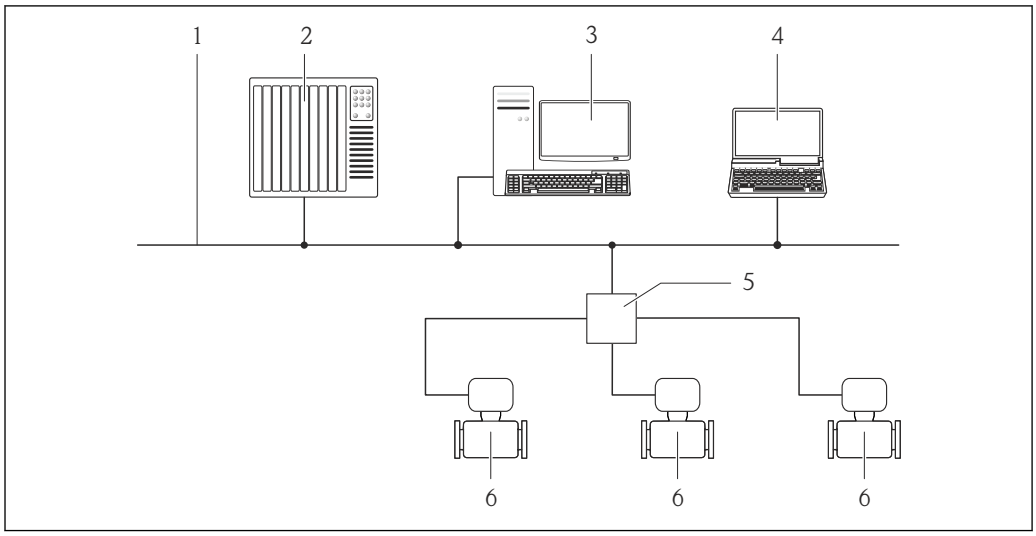
This communication interface is present in the following device version:
Order code for "Output", option **L**: PROFIBUS DP



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

Via Ethernet-based fieldbus

This communication interface is present in the following device version:
Order code for "Output", option **N**: EtherNet/IP



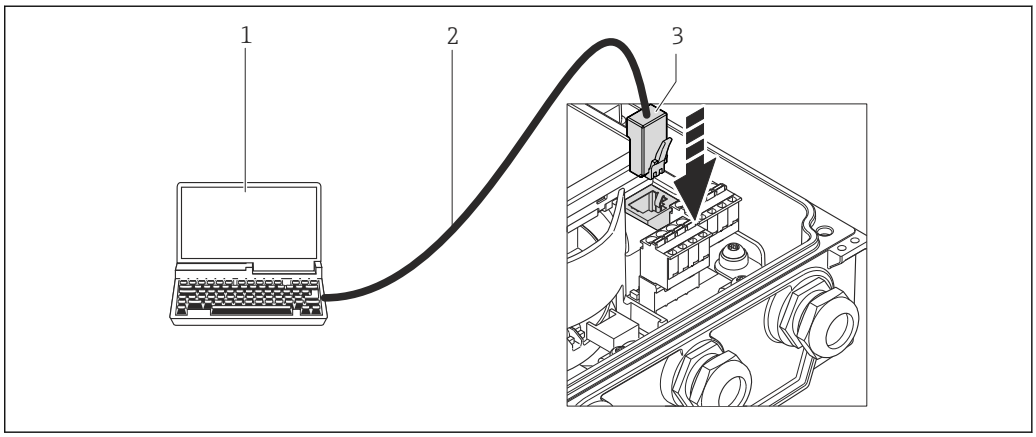
1 Ethernet network
2 Automation system, e.g. "RSLogix" (Rockwell Automation)
3 Workstation for measuring device operation: with Add-on Profile Level 3 for "RSLogix 5000" (Rockwell Automation) or with Electronic Data Sheet (EDS)
4 Computer with Web browser (e.g. Internet Explorer) for accessing the integrated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

Service interface

Service interface (CDI-RJ45)

This communication interface is present in the following device version:
- Order code for "Output", option **H**: 4-20/0-20 mA HART, pulse/frequency/switch output
- Order code for "Output", option **I**: 4-20/0-20 mA HART, pulse/frequency/switch output, status input
- Order code for "Output", option **L**: PROFIBUS DP
- Order code for "Output", option **N**: EtherNet/IP
- Order code for "Output", option **M**: Modbus RS485

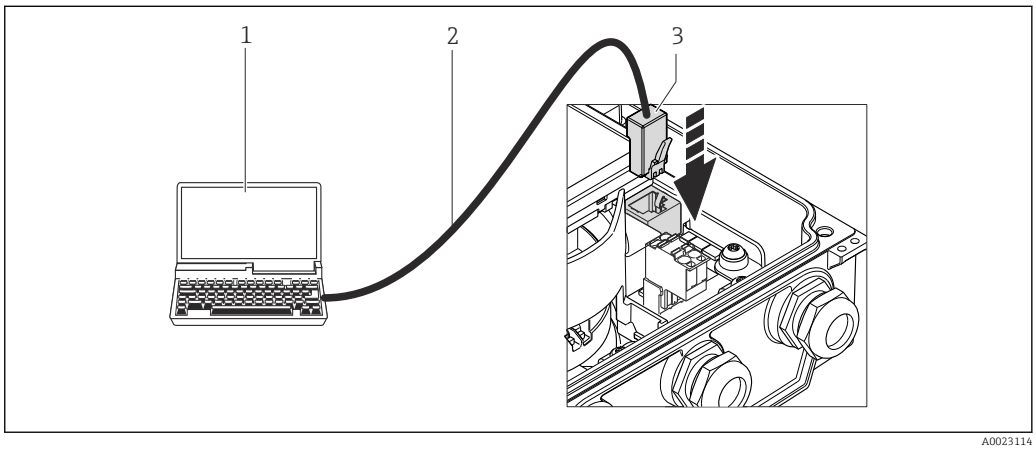
HART



A0020481

1 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"
2 Standard Ethernet connecting cable with RJ45 plug
3 Service interface (CDI -RJ45) of the measuring device with access to the integrated Web server

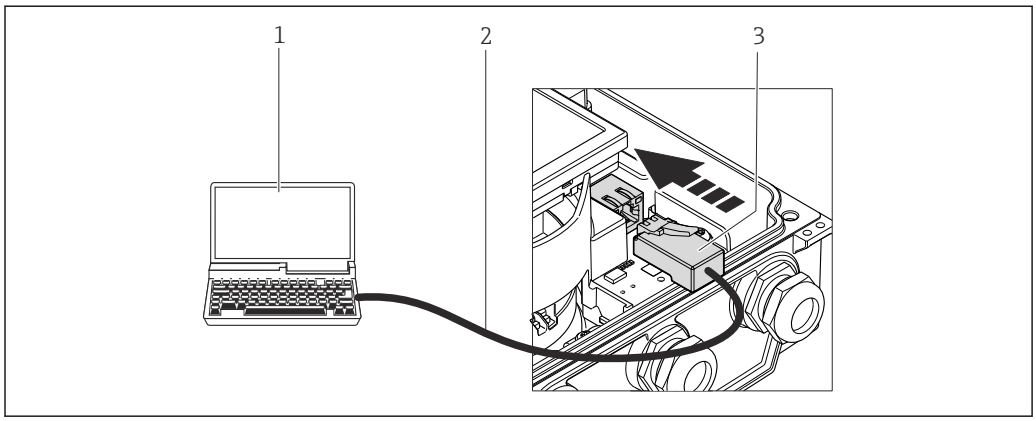
PROFIBUS DP



A0023114

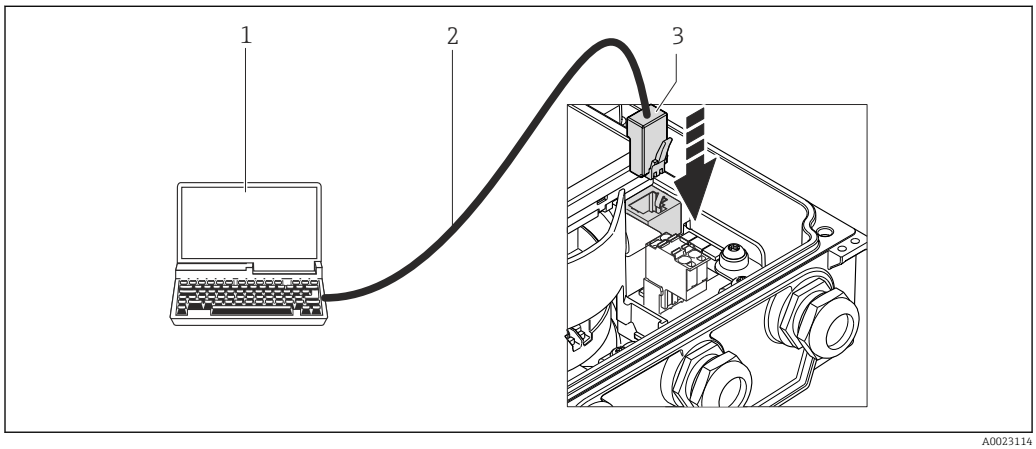
1 Computer with Web browser (e.g. Internet Explorer) for accessing the integrated device Web server or with "FieldCare" operating tool with COM DTM "CDI Communication TCP/IP"
2 Standard Ethernet connecting cable with RJ45 plug
3 Service interface (CDI -RJ45) of the measuring device with access to the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

EtherNet/IP



1 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"
2 Standard Ethernet connecting cable with RJ45 plug
3 Service interface (CDI -RJ45) of the measuring device with access to the integrated Web server

Modbus RS485



1 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"
2 Standard Ethernet connecting cable with RJ45 plug
3 Service interface (CDI -RJ45) of the measuring device with access to the integrated Web server

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)".

Drinking water approval

- ACS
- KTW/W270
- NSF 61
- WRAS BS 6920

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)
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 ▪ IEC/EN 61326 Emission in accordance with Class A requirements. Electromagnetic compatibility (EMC requirements). ▪ ANSI/ISA-61010-1 (82.02.01): 2004 Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use - Part 1 General Requirements ▪ CAN/CSA-C22.2 No. 61010-1-04 Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use - Part 1 General Requirements ▪ NAMUR NE 21 Electromagnetic compatibility (EMC) of industrial process and laboratory control equipment ▪ NAMUR NE 32 Data retention in the event of a power failure in field and control instruments with microprocessors ▪ NAMUR NE 43 Standardization of the signal level for the breakdown information of digital transmitters with analog output signal. ▪ NAMUR NE 53 Software of field devices and signal-processing devices with digital electronics ▪ NAMUR NE 105 Specifications for integrating fieldbus devices in engineering tools for field devices ▪ NAMUR NE 107 Self-monitoring and diagnosis of field devices ▪ NAMUR NE 131 Requirements for field devices for standard applications

Ordering information

Detailed ordering information is available from the following sources:
- In the Product Configurator on the Endress+Hauser web site: www.endress.com → Choose your country → Products → Select measuring technology, software or components → Select product (picklists: measurement method, product family etc.) → Device support (right-hand column): Configure the selected product → The Product Configurator for the selected product is opened.
- 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 from Endress+Hauser either directly with the device or subsequently. 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.

Diagnostics functions

Package	Description
HistoROM extended function	Comprises extended functions concerning the event log and the activation of the measured value memory. Event log: Memory volume is extended from 20 message entries (basic version) to up to 100 entries. Data logging (line recorder): ▪ Memory capacity for up to 1000 measured values is activated. ▪ 250 measured values can be output via each of the 4 memory channels. The recording interval can be defined and configured by the user. ▪ Data logging is visualized via the local display or FieldCare.

Heartbeat Technology

Package	Description
Heartbeat Verification +Monitoring	**Heartbeat Monitoring:** Continuously supplies monitoring data, which are characteristic of the measuring principle, for an external condition monitoring system. This makes it possible to: ▪ Draw conclusions - using these data and other information - about the impact the measuring application has on the measuring performance over time. ▪ Schedule servicing in time. ▪ Monitor the product quality, e.g. gas pockets. **Heartbeat Verification:** Makes it possible to check the device functionality on demand when the device is installed, without having to interrupt the process. ▪ Access via onsite operation or other operating interfaces, such as FieldCare for instance. ▪ End-to-end, traceable documentation of the verification results, including report. ▪ Makes it possible to extend calibration intervals in accordance with 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
Display protection	Is used to protect the display against impact or scoring from sand in desert areas. For details, see Special Documentation SD00333F
Connecting cable for remote version	Coil current and electrode cables, various lengths, reinforced cables available on request.
Post mounting kit	Post mounting kit for transmitter.
Compact → remote conversion kit	For converting a compact device version to a remote device version.

For the sensor

Accessories	Description
Mounting kit	Consists of: ▪ 2 process connections ▪ Threaded fasteners ▪ Seals

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
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
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

For an overview of the scope of the associated Technical Documentation, refer to the following:
- The CD-ROM provided for the device (depending on the device version, the CD-ROM might not be part of the delivery!)
- 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

Measuring device	Documentation code
Promag D 400	KA01112D

Operating Instructions

Measuring device	Documentation code			
	HART	PROFIBUS DP	Modbus RS485	EtherNet/IP
Promag D 400	BA01061D	BA01232D	BA01229D	BA01212D

Supplementary device-dependent documentation

Special Documentation

Contents	Documentation code
Modbus RS485 Register Information	SD01379D
Heartbeat Technology	SD01183D

Installation Instructions

Contents	Documentation code
Installation Instructions for spare part sets	Specified for each individual accessory (→ 52)

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.

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

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

www.addresses.endress.com

Endress+Hauser

People for Process Automation