OPTIBAR DP 7060 Technical Datasheet

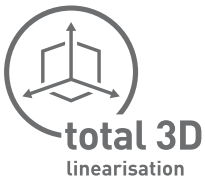
Differential pressure transmitter for measuring flow, level, differential pressure, density and interface

- High accuracy and measurement stability under all process conditions
- Integrated absolute pressure measurement
- Modular converter platform for all applications

1.1 OPTIBAR differential pressure transmitter

The member of the KROHNE OPTIBAR family is unparalleled when it comes to versatility and robustness. The completely newly developed piezoresistive differential pressure measuring device provides not only the exact differential pressure under any operating conditions but also simultaneously measures the static pressure in the process line.

The extremely compact measuring cell has a robust and precise response to temperature changes and with step response times of just 125 ms, it provides enough measurements for reliable and stable process control.



Total 3D linearisation

For a robust and accurate differential pressure measurement, even under changing process conditions, each OPTIBAR DP differential pressure transmitter is linearised in 3 dimensions during calibration: differential pressure, ambient temperature and static pressure are taken into account in combination. Since the full specified operating range is covered, an outmost stable and accurate measurement under all process conditions is guaranteed.

Highlights

- Outstanding temperature stability even under harsh conditions
- Very good repeatability and long-term stability of the measuring signal
- Extremely quick step response times < 125 ms
- Combined DP, SP and T measurements for maximum process reliability
- Measuring ranges down to 10 mbar / 0.145 psi even without electronic spreading
- Turn down up to 100:1, higher on request
- Universal modularity of the entire OPTIBAR process series
- Display and adjustment module with optional bluetooth communication can be used for remote measured value indication, adjustments and diagnostics
- Quick start-up for all applications
- Extensive diagnostic and parameterisation functions on the display module or the user-friendly and free DTM

Industries

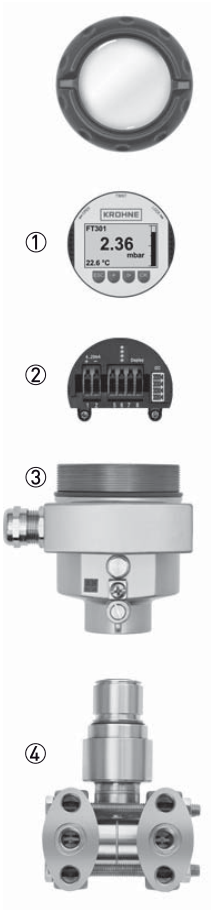
- General process technology
- Power generation
- Chemical and petrochemical
- Environmental technology
- Water and wastewater

Applications

- Pressure monitoring of filters and pumps with overload protection of up to 400 bar / 5800 psi
- Level measurement of liquids in open and pressurised vessels
- Flow measurement of gases, vapours and liquids with differential pressure transmitters
- Measurement of density and interface of liquids in tanks

1.2 Options

The OPTIBAR process pressure series allows free choice of pressure sensors, process connections, electronics and housings - so that each device is perfectly adapted to its measuring task.



① The optional display and adjustment module makes it possible to start-up the converter on site. With double chamber housings it can be installed on the side.

② The converter can be configured using the optional display and adjustment module as well as via PACTware™ or the optionally available USB communicator. Regardless of the selected option, user guidance and navigation are absolutely identical.

There is a variety of converters available, which can be used regardless of the housing or sensor selected. In addition to the standard configuration with 2-wire 4...20 mA and HART® (version 7) signal, Foundation Fieldbus and Profibus PA can be selected depending on the application.

③ Note that not all approvals are available with all housings.

④ The OPTIBAR process pressure series comprises relative and absolute pressure sensors with metallic and ceramic measuring cells as well as a differential pressure measuring cell with metallic diaphragm for any application in industrial process measuring industry.

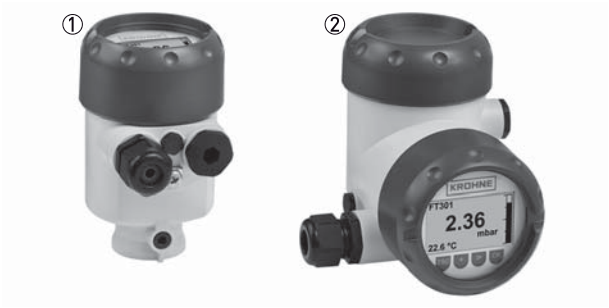


Figure 1-1: Plastic housing

① Single chamber
② Double chamber

The plastic housing is cost-effective and features a low net weight and high chemical resistance in corrosive environments.

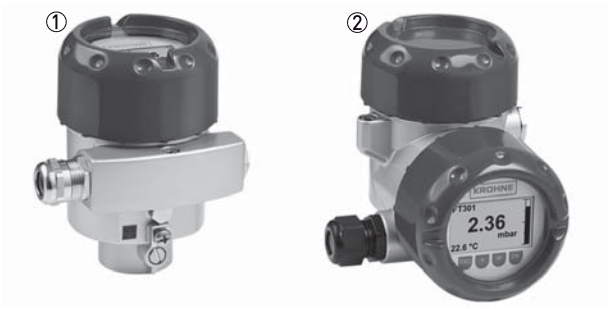


Figure 1-2: Aluminium housing

① Single chamber
② Double chamber

The standard housing for all pressure transmitters – it is perfectly equipped for industrial use and can be used in hazardous areas for all protection types.

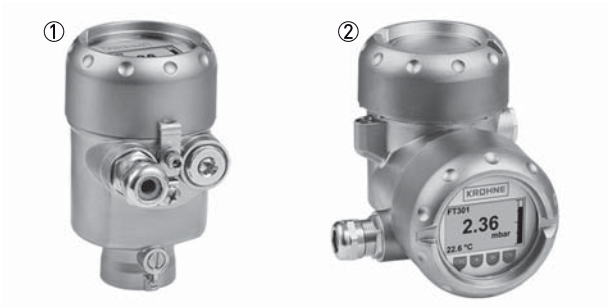


Figure 1-3: Stainless steel housing (precision casting)

① Single chamber
② Double chamber

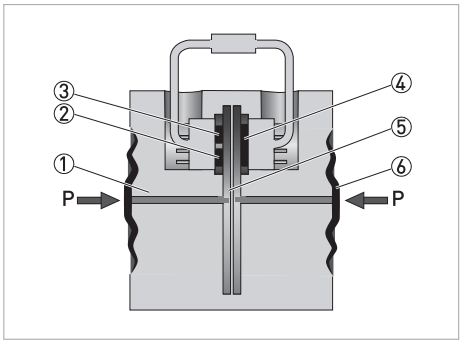
For applications that place particular demands on the mechanical robustness of the converter. These housings can be used with all protection types for hazardous areas.

Figure 1-4: Stainless steel housing (electro-polished)

① Single chamber

Recommended for applications requiring the corrosion resistance of stainless steel but not the mechanical robustness of a stainless steel precision casting housing. Also suitable for hygienic applications that require an IP69K protection class for steam jet cleanings. Converters can only be used in hazardous areas in intrinsically safe operation.

1.3 Measuring principle



① Fill fluid
② Temperature sensor
③ Absolute pressure sensor
④ Differential pressure sensor
⑤ Overload system
⑥ Separating diaphragm

The process pressure is transferred via the separating metallic diaphragms ⑥ of the high and low pressure side and the fill fluid ① to the piezoresistive silicon sensor. Through the prevailing pressure differential, the silicon diaphragm of the differential pressure sensor ④ is deflected and changes the resistance value of the four piezoresistive elements in the bridge circuit. The change in resistance of the bridge circuit is proportional to the differential pressure. Additionally, the measured cell temperature ② and the prevailing static pressure ③ on the low pressure side is measured and then made available to the signal converter for further processing. If the measurement limit is exceeded, the overload system ⑤ restricts the prevailing process pressure at the differential pressure sensor and protects it from damage.

2.1 Technical data

- *The following data is provided for general applications. If you require data that is more relevant to your specific application, please contact us or your local sales office.*
- *Additional information (certificates, special tools, software,...) and complete product documentation can be downloaded free of charge from the website (Downloadcenter).*

Measuring system

Measuring principle	Piezoresistive differential pressure cell
Application range	• Volumetric and mass flow measurement in gases, vapours and liquids • Differential pressure measurement • Level measurement • Density measurement • Interface measurement
Measuring range	10 mbar, 30 mbar, 100 mbar, 500 mbar, 3 bar, 16 bar / 0.145 psi, 0.435 psi, 1.45 psi, 7.25 psi, 43.5 psi, 232.1 psi
Display and User interface	
Local control	• Operation via 4 push buttons on the display and adjustment module
Display and adjustment module	• Indication of measured value or derived measured value such as filling height • Quick start adjustment and extended adjustment of all parameters • Warning and diagnostic information
Remote control	• Bluetooth® via OPTICHECK Pressure Mobile application available in Google Play Store and Apple App Store • PACTware™, incl. Device Type Manager (DTM) • HART® Hand Held Communicator • AMS® from Emerson Process • PDM® from Siemens
Operating and display languages	German, English, French, Spanish, Portuguese, Italian, Dutch, Russian, Turkish, Polish, Czech, Chinese and Japanese
Integrated clock	
Date format	Day / Month / Year
Time format	12 hours / 24 hours
Time zone	CET (Factory setting)
Rate deviation	Maximum 10.5 minutes / year

Measuring accuracy

Differential pressure

Reference conditions acc. to IEC 60770-1

- Ambient temperature (constant): +18...+30°C / +64...+86°F
- Relative humidity (constant): 45...75%
- Ambient pressure (constant): 860...1060 mbar / 86...106 kPa / 12.5...15.4 psi
- Vertical mounting position
- Curve characteristic: Linear
- Measurement start at 0.00 bar / kPa / psi
- Process diaphragm: 316L / 1.4435
- Fill fluid: Silicone oil
- Material of process flanges: 316L / 1.4404
- Power supply: 24 VDC ±3 VDC
- Load for HART®: 250 Ω
- Effect of mounting position ≤ 0.35 mbar per 10° inclination around the transverse axis (a position-dependent zero offset can be corrected)
- Deviation in the current output due to strong, high-frequency electromagnetic fields acc. to EN 61326-1 <± 150 µA

Reference accuracy acc. to DIN EN 61298

Includes the non-linearity, hysteresis and repeatability under reference conditions. Applies to the digital interfaces (HART®, Profibus PA, Foundation Fieldbus) as well as for the analogue 4…20 mA current output. Turn down (TD) is the relation of nominal range/set measuring span. [% of the set span]

	TD < 5:1	TD > 5:1	TD < 10:1	TD > 10:1
10 mbar / 0.145 psi	<± 0.10	<± 0.02 x TD		
30 mbar / 0.435 psi				
100 mbar / 1.45 psi			<± 0.065	<±0.035 + 0.01 x TD
500 mbar / 7.25 psi				<±0.015 + 0.005 x TD
3 bar / 43.5 psi				
16 bar / 232.1 psi				<±0.035 + 0.01 x TD

Effect of ambient temperature

Ambient temperature effect on zero and span in relation to the set measuring span. Applies to the digital interfaces (HART®, Foundation Fieldbus, Profibus PA) as well as for the analogue 4...20 mA current output.
[% of the set span per 28°C / 50°F]
All performance characteristics are in conformance with ≥ ± 3-sigma

	-10...+60°C / +14...+140°F	-40...-10°C / -40...+14°F	+60...+85°C / +140...+185°F
10 mbar / 0.145 psi	0.25 x TD + 0.03 Max. 0.2 x TD + 0.15 ①	Max. 0.3 x TD + 0.4 ①	
30 mbar / 0.435 psi	0.08 x TD + 0.08 Max. 0.1 x TD + 0.15 ①	Max. 0.15 x TD + 0.2 ①	
100 mbar / 1.45 psi	0.03 x TD + 0.08 Max. 0.15 x TD + 0.15 ①	Max. 0.2 x TD + 0.15 ①	
500 mbar / 7.25 psi	0.01 x TD + 0.14 Max. 0.05 x TD + 0.15 ①	Max. 0.06 x TD + 0.2 ①	
3 bar / 43.5 psi	0.08 x TD + 0.07 Max. 0.05 x TD + 0.15 ①	Max. 0.06 x TD + 0.2 ①	
16 bar / 232.1 psi	0.03 x TD + 0.12 Max. 0.15 x TD + 0.15 ①	Max. 0.2 x TD + 0.15 ①	

① Maximum value applies for the entire temperature intervall

<table>
<tr><td rowspan="10">Effect of system pressure</td><td colspan="5">System pressure effect on zero and span in relation to the set measuring span. Zero-point offset can be adjusted under operating pressure. Applies to the digital interfaces (HART®, Profibus PA, Foundation Fieldbus) as well as for the analogue 4…20 mA current output.
[% of the set span per 40bar / 580psi for measuring ranges 100mbar-16bar]
[% of the set span per 1bar / 14.5psi for measuring ranges 10mbar and 30mbar]
All performance characteristics are in conformance with ≥ ± 3-sigma</td></tr>
<tr><td colspan="2">Measuring range</td><td colspan="2">on zero (max. 0.1) ①</td><td>on span (max. 0.1) ①</td></tr>
<tr><td colspan="2">10 mbar / 0.145 psi</td><td colspan="2">0.007 x TD</td><td>0.011</td></tr>
<tr><td colspan="2">30 mbar / 0.435 psi</td><td colspan="2">0.005 x TD</td><td>0.01</td></tr>
<tr><td colspan="2">100 mbar / 1.45 psi</td><td colspan="2">0.03 x TD</td><td>0.05</td></tr>
<tr><td colspan="2">500 mbar / 7.25 psi</td><td colspan="2">0.02 x TD</td><td>0.08</td></tr>
<tr><td colspan="2">3 bar / 43.5 psi</td><td colspan="2">0.03 x TD</td><td>0.08</td></tr>
<tr><td colspan="2">16 bar / 232.1 psi</td><td colspan="2">0.02 x TD</td><td>0.06</td></tr>
<tr><td colspan="5">① Maximum value applies for the entire system pressure intervall</td></tr>
<tr><td rowspan="2">Long-term stability acc. to DIN 16086 and IEC 60770-1</td><td colspan="5">Applies to the digital interfaces (HART®, Profibus PA, Foundation Fieldbus) as well as for the analogue 4…20 mA current output.
[% of the set span]</td></tr>
<tr><td colspan="5"><± 0.1 x TD over a period of 5 years</td></tr>
<tr><td rowspan="11">Total performance in accordance with DIN 16086</td><td colspan="5">Total performance at indicated nominal differential pressure, static pressure and temperature.
[% of the set span]</td></tr>
<tr><td>Measuring range</td><td>up to TD</td><td>Nominal pressure</td><td>-10°C / +14°F</td><td>+60°C / +140°F</td><td>+30°C / +86°F</td></tr>
<tr><td>10 mbar / 0.145 psi</td><td rowspan="6">1:1</td><td rowspan="2">20 bar / 290 psi</td><td colspan="2"><± 0.38</td><td><± 0.15</td></tr>
<tr><td>30 mbar / 0.435 psi</td><td colspan="2"><± 0.24</td><td><± 0.144</td></tr>
<tr><td>100 mbar / 1.45 psi</td><td rowspan="4">80 bar / 1160 psi</td><td colspan="2"><± 0.184</td><td><± 0.121</td></tr>
<tr><td>500 mbar / 7.25 psi</td><td colspan="2"><± 0.218</td><td><± 0.122</td></tr>
<tr><td>3 bar / 43.5 psi</td><td colspan="2"><± 0.221</td><td><± 0.122</td></tr>
<tr><td>16 bar / 232.1 psi</td><td colspan="2"><± 0.221</td><td><± 0.122</td></tr>
<tr><td colspan="5">The details of total performance comprise the reference accuracy, the effect of the ambient temperature on the zero point and the measuring span as well as the effect of the static pressure on the measuring span.</td></tr>
<tr><td colspan="5">$E_{perf}=\sqrt{([E_{\Delta TZ}+E_{\Delta TS}]^2+E_{\Delta PS}^2+E_{lin}^2)}$
$E_{\Delta TZ}$= Effect of ambient temperature on the zero point
$E_{\Delta TS}$= Effect of ambient temperature on the measuring span
$E_{\Delta PS}$= Effect of the static pressure on the measuring span
E_{lin} = Reference accuracy</td></tr>
<tr><td colspan="6">Measuring cell temperature</td></tr>
<tr><td colspan="6">The evaluation is made by using the display and adjustment module for indication, the current output and additional current output for analogue signal output and HART®, Profibus PA and Foundation Fieldbus for digital signal output.</td></tr>
<tr><td>Operating temperature / nominal temperature range:</td><td colspan="5">-40...+105 °C / -40...+221°F</td></tr>
<tr><td>Resolution</td><td colspan="5">< 0.2 K</td></tr>
<tr><td>Accuracy at -40…+105°C / -40…+221°F</td><td colspan="5"><± 1 K</td></tr>
</table>

<table>
<tr><td colspan="5">Electronics temperature</td></tr>
<tr><td colspan="5">The evaluation is made by using the display and adjustment module for indication, the current output and additional current output for analogue signal output and HART®, Profibus PA and Foundation Fieldbus for digital signal output.</td></tr>
<tr><td>Operating temperature / nominal temperature range</td><td colspan="4">-40...+85°C / -40...+185°F</td></tr>
<tr><td>Resolution</td><td colspan="4">< 0.1 K</td></tr>
<tr><td>Accuracy at -40…+85 C / -40…+185°F</td><td colspan="4"><± 3 K</td></tr>
<tr><td colspan="5">System pressure</td></tr>
<tr><td>Reference conditions acc. to IEC 60770-1</td><td colspan="4">• Ambient temperature (constant): +18...+30°C / +64...+86°F
• Relative humidity (constant): 45...75%
• Ambient pressure (constant): 860...1060 mbar / 86...106 kPa / 12.5...15.4 psi
• Vertical mounting position</td></tr>
<tr><td rowspan="8">Reference accuracy acc. to DIN EN 61298</td><td colspan="4">Includes the non-linearity, hysteresis and repeatability under reference conditions. Applies to the digital interfaces (HART®, Profibus PA, Foundation Fieldbus) as well as for the analogue 4…20 mA current output.
[% of URL]</td></tr>
<tr><td></td><td colspan="2">up to nominal pressure acc. to URL absolute pressure</td><td>TD 1:1</td></tr>
<tr><td>10 mbar / 0.145 psi</td><td colspan="2" rowspan="2">40 bar / 580 psi</td><td rowspan="6"><± 0.10</td></tr>
<tr><td>30 mbar / 0.435 psi</td></tr>
<tr><td>100 mbar / 1.45 psi</td><td colspan="2" rowspan="4">160 bar / 2320 psi
or
400 bar / 5800 psi</td></tr>
<tr><td>500 mbar / 7.25 psi</td></tr>
<tr><td>3 bar / 43.5 psi</td></tr>
<tr><td>16 bar / 232.1 psi</td></tr>
<tr><td rowspan="8">Effect of ambient temperature</td><td colspan="4">Ambient temperature effect on zero and span. Applies to the digital interfaces (HART®, Foundation Fieldbus, Profibus PA) as well as for the analogue 4…20 mA current output.
[% of URL]</td></tr>
<tr><td></td><td>up to nominal pressure acc. to URL absolute pressure</td><td>-10...+60°C / +14...140°F</td><td>-40...+80°C / -40...+176°F</td></tr>
<tr><td>10 mbar / 0.145 psi</td><td rowspan="2">40 bar / 580 psi</td><td rowspan="6"><± 0.5</td><td rowspan="6"><± 0.5</td></tr>
<tr><td>30 mbar / 0.435 psi</td></tr>
<tr><td>100 mbar / 1.45 psi</td><td rowspan="4">160 bar / 2320 psi
or
400 bar / 5800 psi</td></tr>
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<tr><td>3 bar / 43.5 psi</td></tr>
<tr><td>16 bar / 232.1 psi</td></tr>
<tr><td rowspan="2">Long-term stability acc. to DIN 16086 and IEC 60770-1</td><td colspan="4">Applies to the digital interfaces (HART®, Profibus PA, Foundation Fieldbus) as well as for the analogue 4…20 mA current output.
[% of URL]</td></tr>
<tr><td colspan="4"><± 0.1 over a period of 5 years</td></tr>
</table>

Operating conditions

Temperature		
Process temperature	Measuring cell seal	Standard version
	PTFE	-40...+105°C / -40...+221°F
	EPDM	-40...+105°C / -40...+221°F
	Copper	-40...+105°C / -40...+221°F
	FKM	-20...+105°C / -4...+221°F
Ambient temperature	-40...+80°C / -40...+176°F	
Storage temperature	-40...+80°C / -40...+176°F	
Climate category	4K 4H (air temperature: -20...+55°C / -4...131°F, humidity: 4...100% according to DIN EN 60721-3-4)	

Further operating conditions

Housing material	**Version**	**Protection acc. to IEC 60529**	**Protection acc. to NEMA**
Plastic (PBT)	Single chamber	IP66 / IP67	Type 4X
	Double chamber		
Aluminium	Single chamber	IP66 / IP67	Type 4X
	Double chamber		
Stainless steel (electro-polished)	Single chamber	IP66 / IP67	Type 4X
		IP69K	
Stainless steel (precision casting)	Single chamber	IP66 / IP67	Type 4X
	Double chamber		
Connection of the feeding power supply unit	Networks of overvoltage category III		
Altitude above sea level			
by default	up to 2000 m (6562 ft)		
with connected overvoltage protection	up to 5000 m (16404 ft)		
Pollution degree	2 (when used with fulfilled housing protection)		
Protection rating (IEC/EN 61010-1)	II		
Mechanical stress (depending on the instrument version)			
Reference conditions	• Without mounting bracket • Process flanges 316L / 1.4404 PN 160 • Single chamber housing, aluminium		
Vibration resistance acc. to IEC 60770-1	10...58 Hz, 0.35 mm 58...1000 Hz, 20 m/s^2 1 octave per minute, 10 cycles per axis		
Shock resistant according to IEC 60770-1	500 m/s^2, 6 ms 100 shocks per axis		
Noise according to IEC 60770-1	10...200 Hz, 1 $(m/s^2)^2/Hz$ 200...500 Hz, 0.3 $(m/s^2)^2/Hz$ 4 hours per axis		

Materials

Wetted parts	
Measuring cell seal	EPDM, PTFE (up to PN160), Copper, FKM
Fill fluid	Silicone oil, halocabon oil
Process connection, screwed flange	316L / 1.4404, NACE MR0175 / MR0103, Hastelloy® C-276, Superduplex
Separating diaphragm	316L / 1.4435, NACE MR0175 / MR0103, Hastelloy® C-276, 316L (1.4435) + 6µm gold
Vent and lock screws	316L / 1.4404, NACE MR0175 / MR0103, Hastelloy® C-276
Non-wetted parts	
Sensor housing	Plastic PBT (Polyester), Aluminium AlSi10Mg low copper content <0.4% (powder-coated, basis: Polyester), 316L
Cable gland	PA, stainless steel, brass
Cable gland: Seal, closure	NBR, PA
Seal, housing lid	Silicone SI 850 R, NBR silicone-free
Inspection window housing cover	Polycarbonate (UL-746-C listed), glass with Aluminium and stainless steel precision casting housing
Ground terminal	316L
Screws and bolts for side flanges	up to PN160: Hexagon screw DIN 931 M8 x 85 A2-70, hexagon nut DIN 934 M8 A2-70
	PN400: Hexagon screw DIN 931 M8 x 85 A2-70, hexagon nut DIN 934 M8 A2-70

Process connection

Process	1/4-18 NPT (Female), IEC 61518 A
Mounting	7/16 UNF, M10 (up to PN160)

Electrical connections

Mechanical - Standard				
Cable entry	M20 x 1.5, 1/2-14 NPT			
Cable gland	M20 x 1.5, 1/2-14 NPT			
Blind plug	M20 x 1.5, 1/2-14 NPT			
Closing cap	M20 x 1.5, 1/2-14 NPT			
Connector option	M12 x 1, Harting HAN 7D, 8D, 7/8" FF			
Material cable gland / Seal insert	Cable diameter			
	5…9 mm / 0.20...0.35"	6…12 mm / 0.24...0.47"	7...12 mm / 0.27...0.47"	10…14 mm / 0.39...0.55"
PA / NBR	X	X	-	X
Brass, nickel-plated / NBR	X	X	-	-
Stainless steel / NBR	-	-	X	-
Wire cross-section (spring-loaded terminals)				
Massive wire, stranded wire	0.2...2.5 mm² (AWG 24...14)			
Stranded wire with end sleeve	0.2...1.5 mm² (AWG 24...16)			

Mechanical - Display and adjustment module		
Display element	Display with backlight turnable in 90° steps	
Measured value indication	5 digits (13x7 mm / 0.51x0.27")	
Adjustment elements	4 keys [OK], [->], [+], [ESC]	
Bluetooth interface (optional)	Bluetooth LE 4.1	
	Max. participants 1	
	Effective range typ. 25 m / 82 ft (depending on the local conditions)	
	Bluetooth Switch [On], [Off]	
Protection rating	Unassembled IP20	
	Mounted in the housing without lid IP40	
Materials	ABS Housing	
	Polyester foil inspection window	
Functional safety	SIL non-reactive	
Ambient temperatures below -20°C / -4°F may affect the readability of the display		
Electrical		
Operating voltage	Non-Ex device: 11...35 VDC	
	Ex ia device: 11...30 VDC	
	Ex d device: 11...35 VDC	
	Background lighting on display from 16 VDC	
Reverse polarity protection	Integrated	
Permissible residual ripple	Non-Ex devices,	for U_n 12 VDC (11 < UB < 14 VDC) ≤ 0.7 V_{eff} (16...400 Hz)
	Ex ia devices	for U_n 24 VDC (18 < UB < 35 VDC) ≤ 1.0 V_{eff} (16...400 Hz)
Load	$R_{L,max}=(U_B-11) / 22$ mA	
Potential connections and electrical separating measures in the instrument	Electronics: Not electrically isolated	
	Conductive connection: Between ground terminal and metallic process connection	
	Reference voltage: 500 V AC (galvanic separation between electronics and metal housing parts)	
Overvoltage category	III	
Protection class	II	

Output signal

Output signal	4...20 mA / HART® version 7.3 3.8...20.5 mA (factory setting acc. to NAMUR recommendation)	
Signal resolution	0.3 µA	
Error signal of current output (adjustable)	High alarm ≥ 21 mA Low alarm ≤ 3.6 mA, last valid measurement Last valid measured value (not possible with SIL)	
Max. output current	21.5 mA	
Switch-on phase	Run-up time with operating voltage U_B:	≥ 12 VDC ≤ 9 s
		< 12 VDC ≤ 22 s
	Starting current:	≤ 10 mA for 5 ms after switching on, then ≤ 3.6 mA

Additional current output (optional)	
Output signal	4…20 mA (passive)
Range of the output signal	3.8…20.5 mA (default setting)
Signal resolution	0.3 µA
Error signal of second current output (adjustable)	High alarm ≥ 21 mA, Low alarm ≤ 3.6 mA, Last valid measured value (not possible with SIL)
Max. output current	21.5 mA
Starting current	≤ 10 mA for 5 ms after switching on, ≤ 3.6 mA
Load	Load resistor, see chapter "Voltage supply"

Approvals and certificates

CE	The device complies with the legal requirements of the EU directive. The manufacturer confirms compliance with these regulations by affixing the CE marking.
Electromagnetic compatibility (EMC)	EN 61326-1:2013 EN 61326-2-3:2013
NAMUR	NE 21 - Electromagnetic compatibility of equipment NE 43 - Signal level for the failure information of digital transmitters NE 53 - Compatibility of field devices and display/adjustment components NE 107 - Self-monitoring and diagnosis of field devices
Classification according to Pressure Equipment Directive (PED 2014/68/EU)	PN160 (2320 psi), PN400 (5800 psi) - For gases of fluid group 1 and liquids of fluid group 1, the requirements are fulfilled according to article 3, paragraph 3 (sound engineering practice).

2.2 Dimensions and weight

The following dimensional drawings represent only an extract of the possible versions. Detailed dimensional drawings can be requested individually.

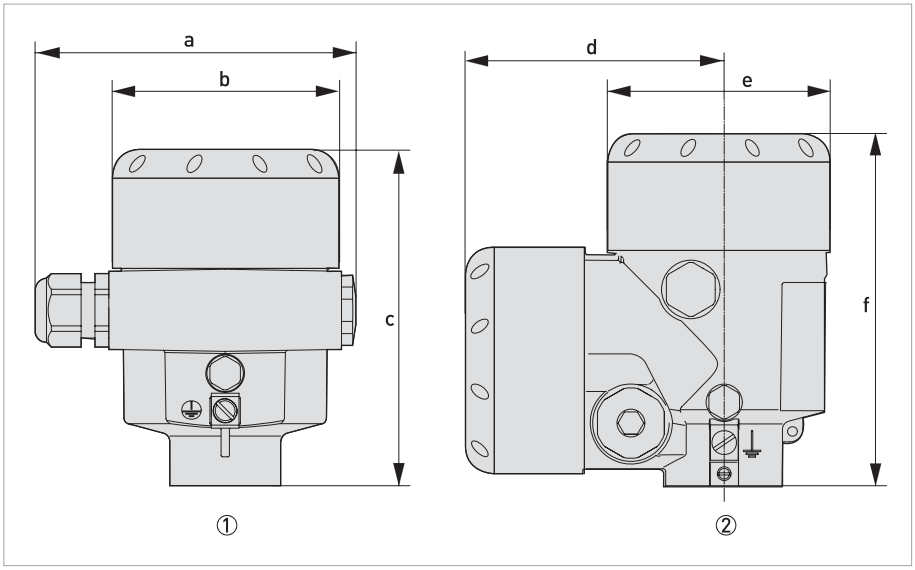


Figure 2-1: Aluminium housing

① Single chamber
② Double chamber

	Dimension [mm]	Dimension [inch]
a	116	4.57
b	86	3.39
c	116	4.57
d	87	3.43
e	86	3.39
f	120	4.72

With integrated display and adjustment module the height of the housing increases by 18 mm / 0.71 inch.

Housing version	Weight [kg]	Weight [lb]
Single chamber, aluminium	0.83	1.84
Double chamber, aluminium	1.24	2.73

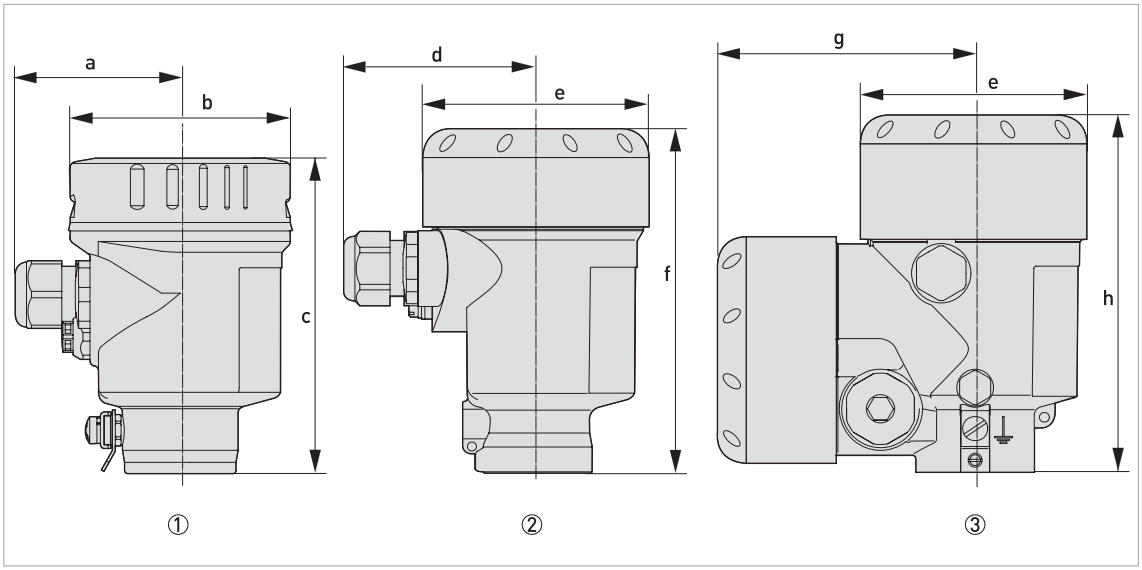


Figure 2-2: Stainless steel housing

① Single chamber, stainless steel (electro-polished)
② Single chamber, precision casting
③ Double chamber, precision casting

	Dimension [mm]	Dimension [inch]
a	59	2.32
b	80	3.15
c	112	4.41
d	69	2.72
e	79	3.11
f	117	4.61
g	87	3.42
h	120	4.72

With integrated display and adjustment module the height of the housing increases by 9 mm / 0.35 inch or 18 mm / 0.71 inch.

Housing version	Weight [kg]	Weight [lb]
Single chamber, stainless steel (electro-polished)	0.73	1.61
Single chamber, precision casting	1.31	2.89
Double chamber, precision casting	2.86	6.31

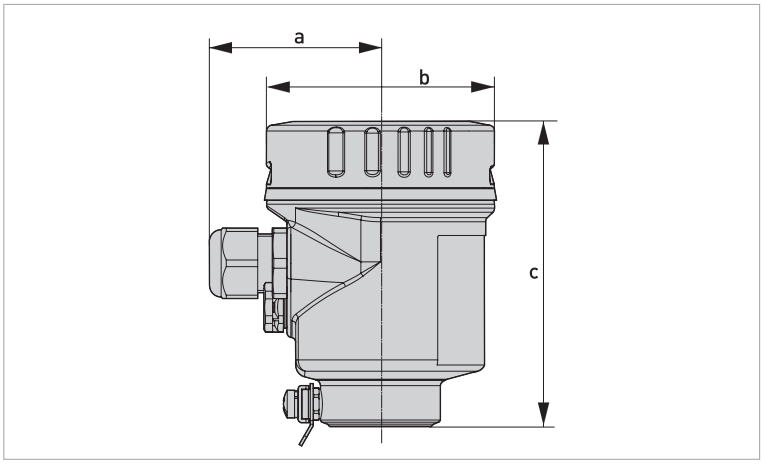


Figure 2-3: Stainless steel (electro-polished) IP69K version

	Dimension [mm]	Dimension [inch]
a	59	2.32
b	80	3.15
c	104	4.10

With integrated display and adjustment module the height of the housing increases by 9 mm / 0.35 inch.

Housing version	Weight [kg]	Weight [lb]
Single chamber, stainless steel (electro-polished)	0.73	1.61

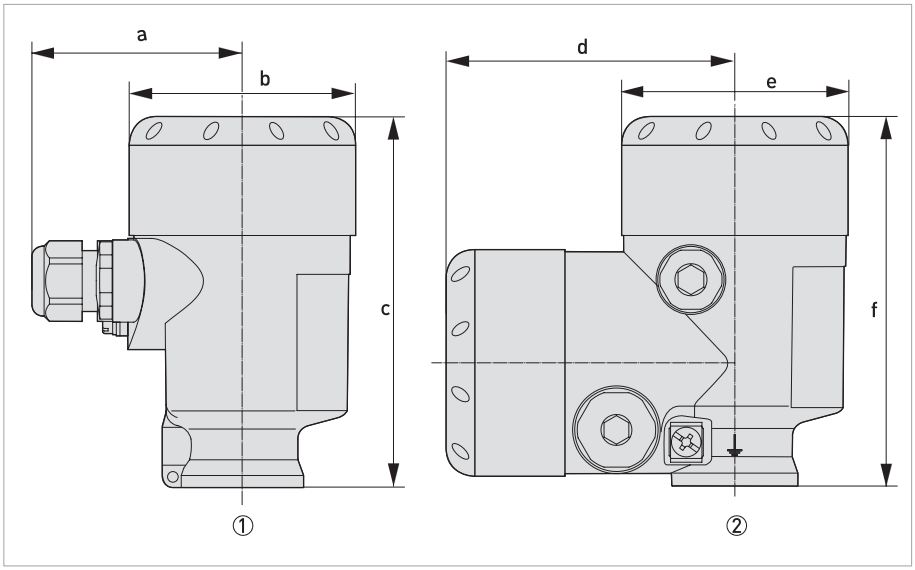


Figure 2-4: Plastic housing

① Single chamber
② Double chamber

	Dimension [mm]	Dimension [inch]
a	69	2.72
b	79	3.11
c	112	4.41
d	84	3.31
e	79	3.11
f	112	4.41

With integrated display and adjustment module the height of the housing increases by 9 mm / 0.35 inch.

Housing version	Weight [kg]	Weight [lb]
Single chamber, plastic	0.40	0.88
Double chamber, plastic	0.51	1.13

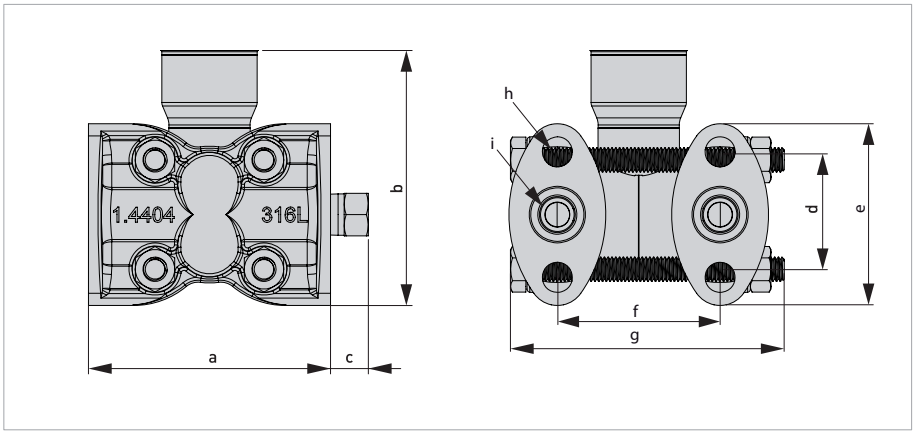


Figure 2-5: 1/4-18 NPT Process connection without venting (S0)

	Dimension [mm]	Dimension [inch]
a	80	3.15
b	84	3.3
c	13	0.51
d	41	1.61
e	60	2.36
f	54	2.13
g	91	3.58
h	7/16 UNF or M10	
i	1/4-18 NPT	

Overall height of the differential pressure transmitter = b (process connection) + overall height of the respective housing

	Weight [kg]	Weight [lb]
Process connection	1.48	3.26

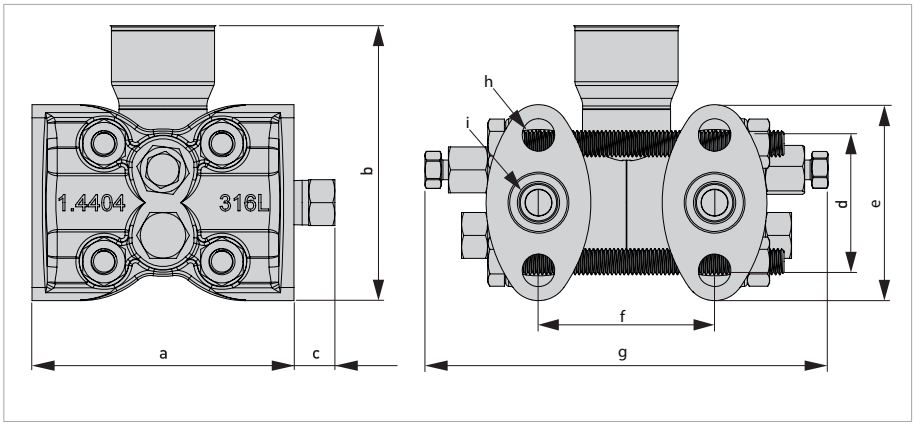


Figure 2-6: 1/2 NPT with side vent (SD)

	Dimension [mm]	Dimension [inch]
a	80	3.15
b	84	3.3
c	13	0.51
d	41	1.61
e	60	2.36
f	54	2.13
g	125	4.92
h	7/16 UNF	
i	1/4-18 NPT according to IEC 61518 A	

Overall height of the differential pressure transmitter = b (process connection) + overall height of the respective housing

	Weight [kg]	Weight [lb]
Process connection, side vent	0.73	1.61

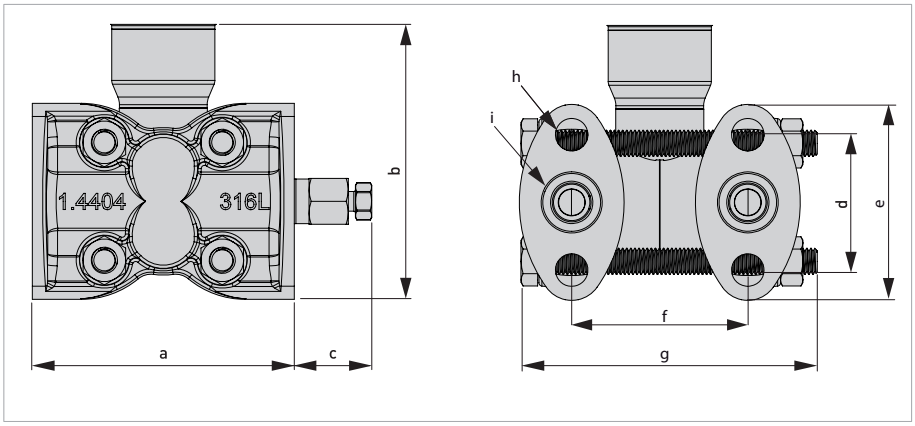


Figure 2-7: 1/4 NPT venting on the process axis (SR)

	Dimension [mm]	Dimension [inch]
a	80	3.15
b	84	3.3
c	13	0.51
d	41	1.61
e	60	2.36
f	54	2.13
g	125	4.92
h	7/16 UNF	
i	1/4-18 NPT according to IEC 61518 A	

Overall height of the differential pressure transmitter = b (process connection) + overall height of the respective housing.

	Weight [kg]	Weight [lb]
Process connection, side vent	1.5	3.31

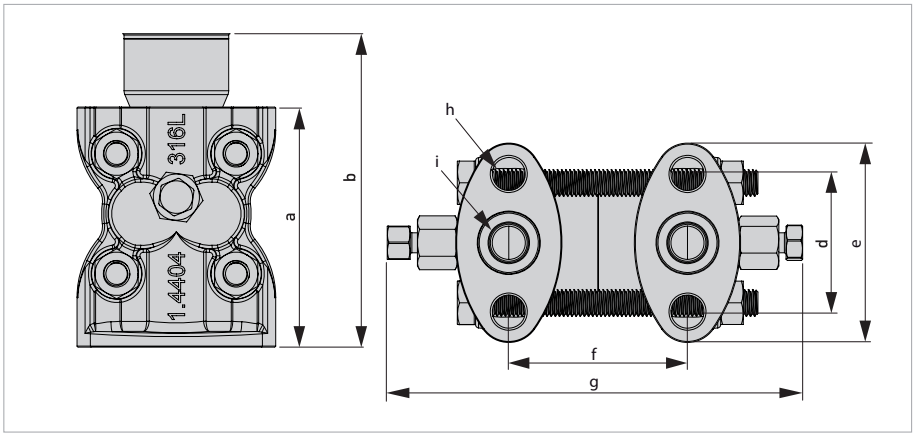


Figure 2-8: 90° vertical 1/4-18 Process connection, side vent (VD)

	Dimension [mm]	Dimension [inch]
a	72	2.83
b	94	3.7
d	41	1.61
e	60	2.36
f	54	2.13
g	125	4.92
h	7/16 UNF	
i	1/4-18 NPT according to IEC 61518 A	

Overall height of the differential pressure transmitter = b (process connection) + overall height of the respective housing.

	Weight [kg]	Weight [lb]
Process connection, side vent	0.63	1.39

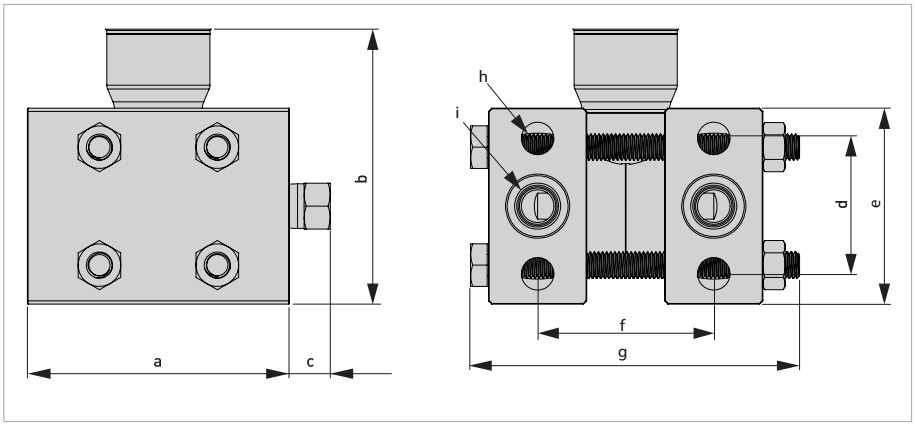


Figure 2-9: 1/4 NPT without venting, Process connection in Hastelloy® C-276 (H0)

	Dimension [mm]	Dimension [inch]
a	80	3.15
b	84	3.3
c	13	0.51
d	41	1.61
e	59	2.32
f	54	2.13
g	101	3.98
h	7/16 UNF	
i	1/4-18 NPT according to IEC 61518 A	

Overall height of the differential pressure transmitter = b (process connection) + overall height of the respective housing.

	Weight [kg]	Weight [lb]
Process connection in Hastelloy® C-276	2.29	5.05

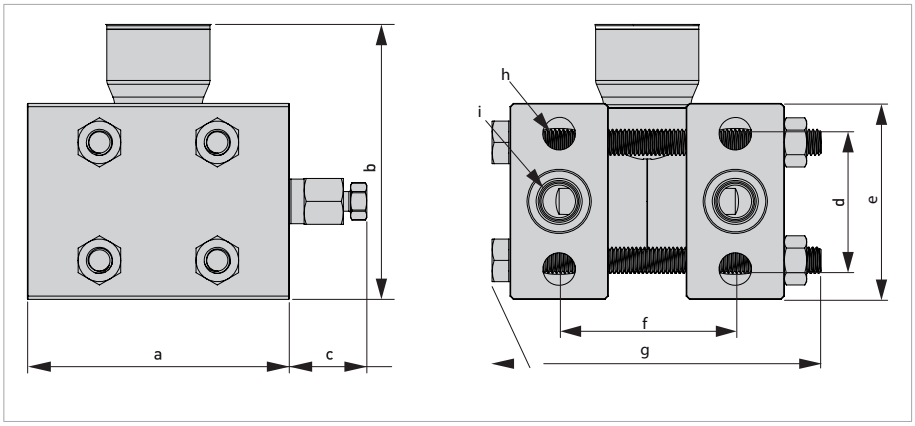


Figure 2-10: 1/4 NPT Process connection in Hastelloy C-276 with venting on the process axis (HR)

	Dimension [mm]	Dimension [inch]
a	80	3.15
b	84	3.3
c	25	0.98
d	41	1.61
e	60	2.36
f	54	2.13
g	101	3.98
h	7/16 UNF	
i	1/4-18 NPT according to IEC 61518 A	

Overall height of the differential pressure transmitter = b (process connection) + overall height of the respective housing.

	Weight [kg]	Weight [lb]
Process connection in Hastelloy, side vent	2.31	5.1

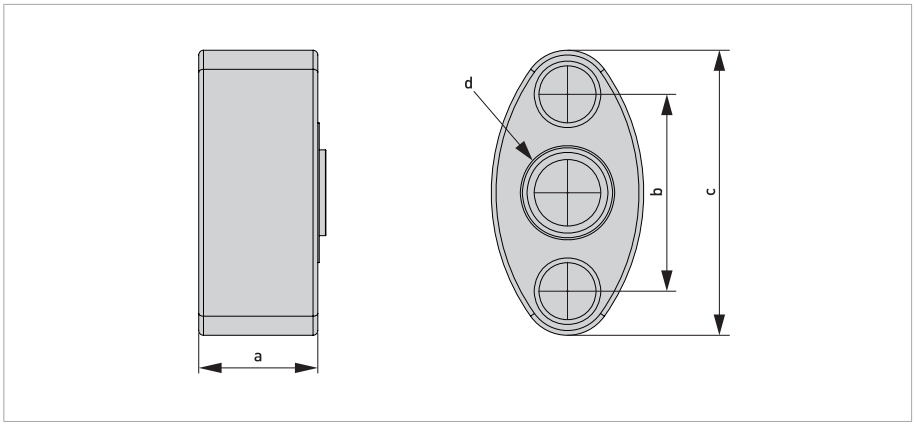


Figure 2-11: Oval flange adapter (Ax)

	Dimension [mm]	Dimension [inch]
a	25	0.98
b	41	1.61
c	60	2.36
d		1/2 NPT

Overall height of the differential pressure transmitter = b (process connection) + overall height of the respective housing.

	Weight [kg]	Weight [lb]
Mounting bracket	0.2	0.44

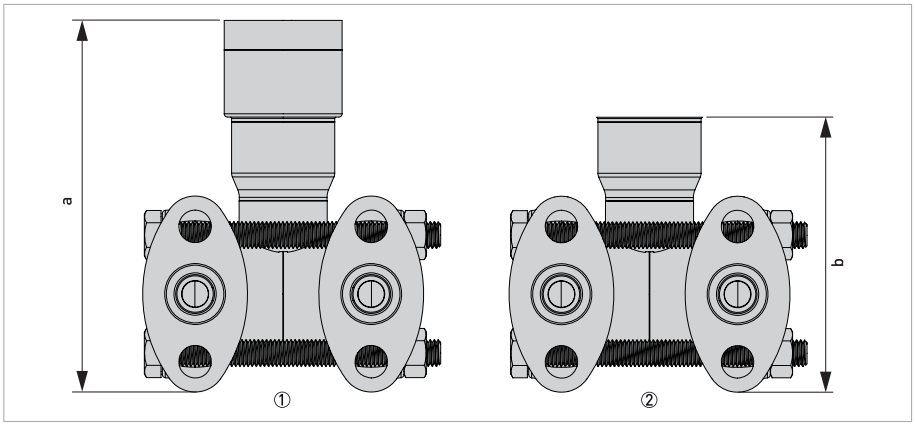


Figure 2-12: Adapter versions

① Adapter for versions with protection type "flameproof enclosure" Ex d
② Adapter for all versions with the exception of "flameproof enclosure" Ex d

	Dimension [mm]	Dimension [inch]
a	113	4.45
b	84	3.31

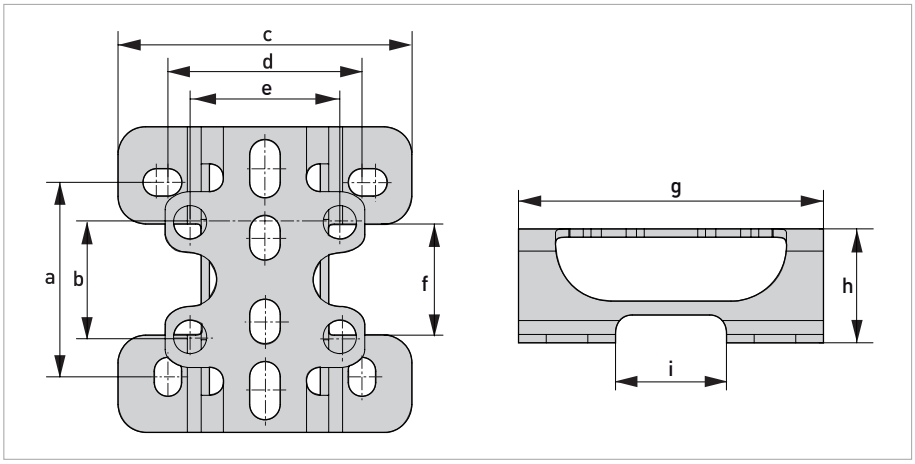


Figure 2-13: Mounting bracket (pipe and wall mounting 2" / 50.8 mm)

	Dimension [mm]	Dimension [inch]
a	70	2.76
b	41	1.61
c	106	4.17
d	70	2.76
e	54	2.13
f	40	1.57
g	110	4.33
h	41	1.61
i	40	1.57

	Weight [kg]	Weight [lb]
Mounting bracket	0.33	0.73

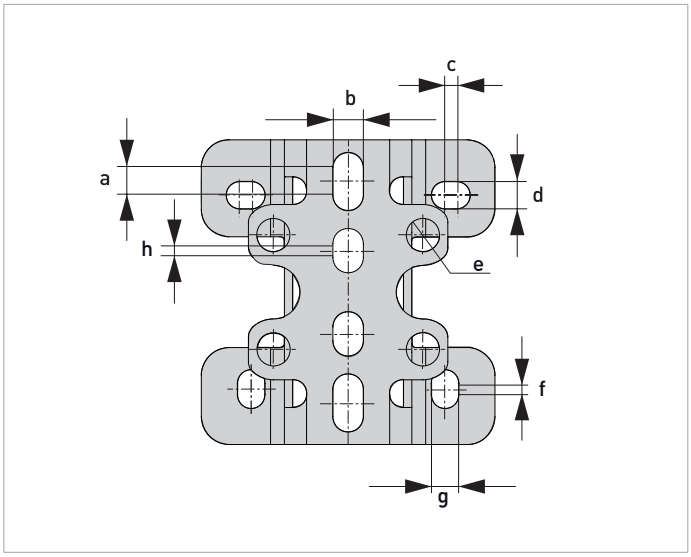


Figure 2-14: Mounting bracket (pipe and wall mounting 2" / 50.8 mm)

	Dimension [mm]	Dimension [inch]
a	10	0.39
b	11	0.43
c	4	0.16
d	10	0.39
e	4x Ø12	4x Ø0.47
f	4	0.16
g	10	0.39
h	5	0.2

2.3 Pressure ranges

Min. / Max. adjustment:
Percent value: -10...110%
Pressure value: -20...120%

Zero/Span adjustment
Zero: -95...+95%
Span: -120...+120%

Difference between zero and span: max. = 120% of the nominal range.
Maximum allowed turn down = unlimited (recommended 20:1)

Recommended maximum Turn Down (TD): 20:1 (no limit)

Nominal ranges and overload capacity

This information is provided as an overview and refers to the measuring cell. Limitations due to the material and design of the process connection are possible. The information given on the nameplate applies. Data on overload capability apply for reference temperature.

Nominal range	10 mbar	30 mbar	100 mbar	500 mbar	3 bar	16 bar
Limit URL (upper)	10 mbar	30 mbar	100 mbar	500 mbar	3 bar	16 bar
Limit LRL (lower)	-10 mbar	-30 mbar	-100 mbar	-500 mbar	-3 bar	-16 bar
Smallest adjustable measuring span	0.5 mbar	1 mbar	1 mbar	5 mbar	30 mbar	160 mbar
Turn down	20:1	30:1	100:1	100:1	100:1	100:1
MWP (maximum system pressure) ①	40 bar	40 bar	160 bar / 400 bar	160 bar / 400 bar	160 bar / 400 bar	160 bar / 400 bar
Minimum system pressure	1 mbar abs (under reference conditions)					

① MWP corresponds to the PS designation in the PED (maximum system pressure)

Nominal range	0.145 psi	0.435 psi	1.45 psi	7.25 psi	43.5 psi	232.1 psi
Limit URL (upper)	0.145 psi	0.435 psi	1.45 psi	7.25 psi	43.5 psi	232.1 psi
Limit LRL (lower)	-0.145 psi	-0.435 psi	-1.45 psi	-7.25 psi	-43.5 psi	-232.1 psi
Smallest adjustable measuring span	0.007 psi	0.015 psi	0.015 psi	0.073 psi	0.435 psi	2.321 psi
Turn down	20:1	30:1	100:1	100:1	100:1	100:1
MWP (maximum system pressure) ①	580 psi	580 psi	2320 psi / 5800 psi	2320 psi / 5800 psi	2320 psi / 5800 psi	2320 psi / 5800 psi
Minimum system pressure	0.015 psi abs (under reference conditions)					

① MWP corresponds to the PS designation in the PED (maximum system pressure)

2.4 Ambient temperature effect on current output

Applies to the analogue 4...20 mA current output and refers to the set span
< 0.05% / 10 K, max. < 0.15%, each case at -40...+80°C / -40...+176°F

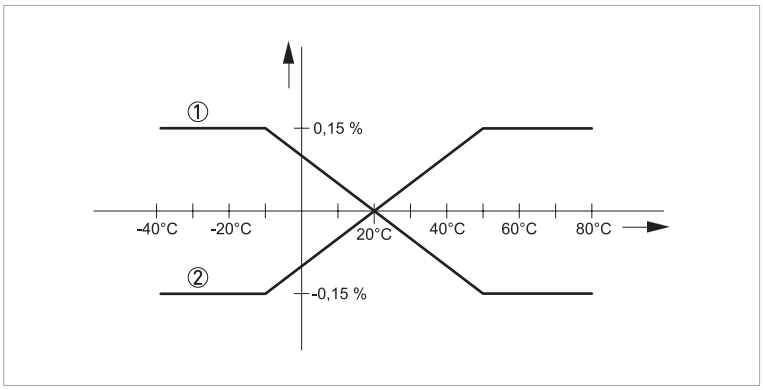


Figure 2-15: Ambient temperature effect on current output

① Falling characteristics
② Rising characteristics

2.5 Dynamic behaviour of the current output

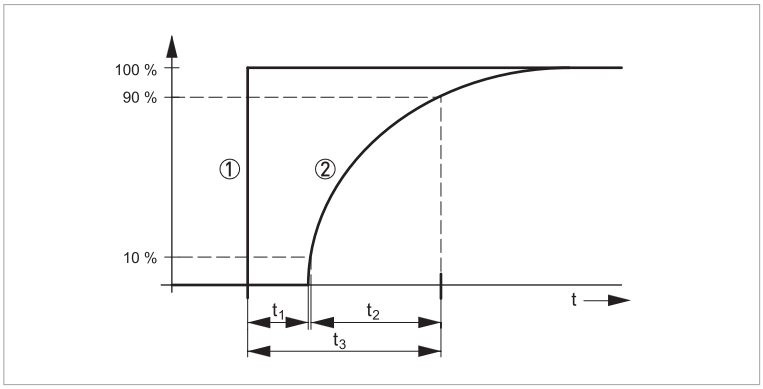


Figure 2-16: Behaviour at an abrupt change in the process variable. t_1 - dead time; t_2 - rise time; t_3 - step response time

① Process variable
② Output signal

	Dead time (t1) [ms]	Rise time 10...90% (t2) [ms]	Step response time (t3) [ms]
10 mbar / 0.145 psi	145	745	890
30 mbar / 0.435 psi	145	115	260
100 mbar / 1.45 psi	125	95	220
500 mbar / 7.25 psi		75	200
3 bar / 43.5 psi	115	60	175
16 bar / 232.1 psi			

Damping (63% of input variable) 0...999 seconds, adjustable in 0.1 second steps

These parameters depend on the fill fluid, temperature and, if applicable, the diaphragm seal system.

3.1 Intended use

For devices used in hazardous areas, additional safety notes apply.

Responsibility for the use of the measuring devices with regard to suitability, intended use and corrosion resistance of the used materials against the measured fluid lies solely with the operator.

This device is a Group 1, Class A device as specified within CISPR11:2009. It is intended for use in industrial environment. There may be potential difficulties in ensuring electromagnetic compatibility in other environments, due to conducted as well as radiated disturbances.

The manufacturer is not liable for any damage resulting from improper use or use for other than the intended purpose.

The OPTIBAR DP 7060 is a differential pressure transmitter suitable for measuring flow, level, differential pressure, density and interface of gases, vapours and liquids. The available measurement ranges and the respective permissible overloads are indicated on the nameplate. To observe the intended use, adhere to the following points:

- Observe the instructions in this document.
- Comply with the technical specifications (for further information refer to *Technical data* on page 8).
- Only suitably qualified personnel may install and operate the device.
- Observe the generally accepted standards of good practice.

3.2 Installation specifications

Observe the relevant directives, ordinances, standards and accident prevention regulations (e.g. VDE/VDI 3512, DIN 19210, VBG, Elex V, etc.).

The accuracy of the measurement is only guaranteed if the transmitter and accompanying impulse line(s), if any, have been correctly installed. In addition, extreme ambient conditions including large fluctuations in temperature, vibrations and shocks should be kept as far away as possible from the measuring equipment.

3.3 Mounting bracket

Scope of delivery

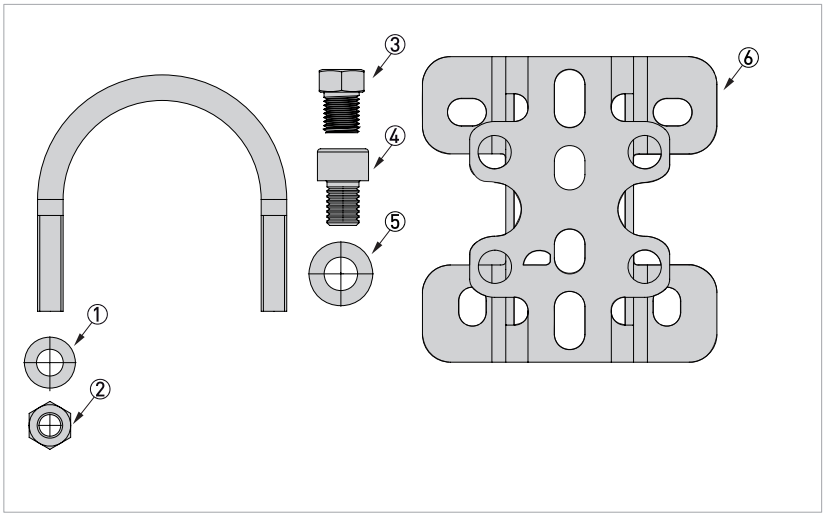


Figure 3-1: Scope of delivery

① 2x Washer M8
② 2x Hexagonal nut M8
③ 4x Hexagonal head screw 7/16-20 UNF
④ 2x Cylinder head screw M10
⑤ 2x Washer M10
⑥ 1x Mounting bracket

Mounting bracket for easy pipe or wall mounting.

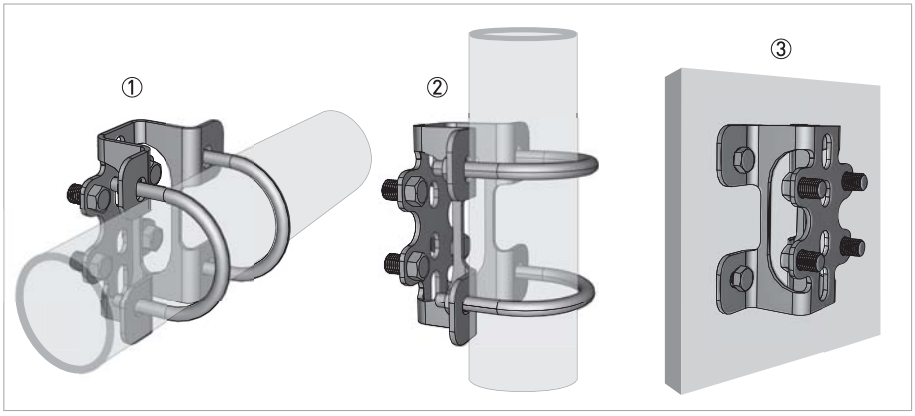


Figure 3-2: Mounting bracket

① Horizontal 2" pipe mounting
② Vertical 2" pipe mounting
③ Wall mount

Mounting bracket for easy valve and pressure transmitter mounting.

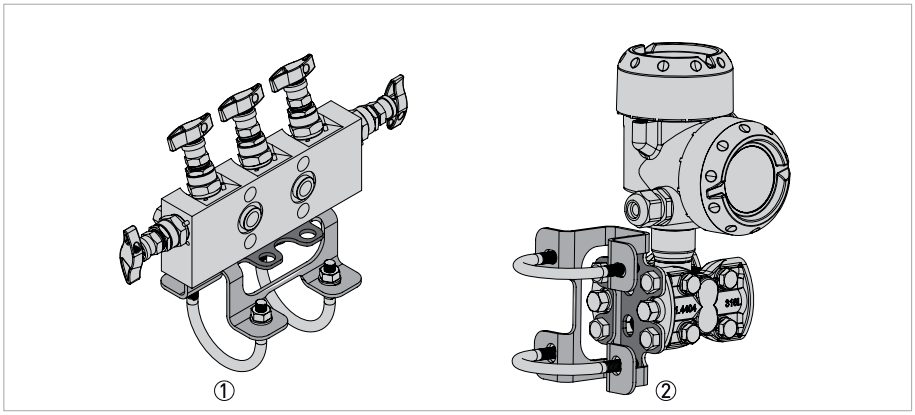


Figure 3-3: Mounting bracket

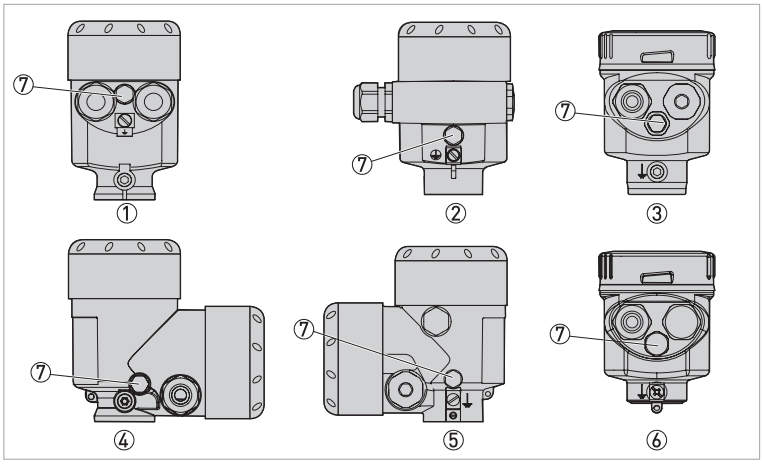
① Mounting bracket on a valve
② Mounting bracket on a pressure transmitter

3.4 Venting

The ventilation for the electronics housing is assured via a filter element in the vicinity of the cable glands, which is permeable to air but moisture-blocking.

In order to ensure effective ventilation, the filter element must be always free of deposits.

Do not use a high-pressure cleaner to clean the housing. The filter element may become damaged and as a result moisture can penetrate into the housing. The exception to this is the IP69K single chamber housing.



① Single chamber housing, plastic, stainless steel precision casting
② Single chamber housing, aluminium
③ Single chamber housing, stainless steel electro-polished
④ Double chamber housing, plastic
⑤ Double chamber housing, aluminium
⑥ Single chamber housing IP69k
⑦ Filter element

3.5 Measurement setup for flow measurement

3.5.1 In gases and liquids with solids content

- Include the pressure tapping points above or to the side on the process line.
- The device must be mounted above the chosen tapping point.

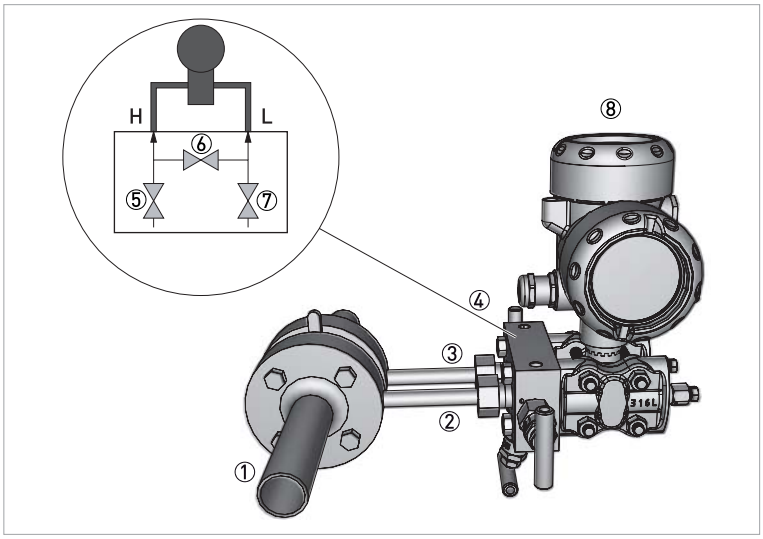


Figure 3-4: Application example

① Pipeline with primary element
② Low-pressure line (L)
③ High-pressure line (H)
④ 3-valve manifold
⑤ Shut-off valve
⑥ Equalizing valve
⑦ Shut-off valve
⑧ Pressure transmitter

3.5.2 In vapours and pure liquids

- Include the pressure tapping points to the side on the process line.
- The device must be mounted at the same height or underneath the tapping points.
- In steam applications, fill the impulse lines and/or condensate vessels with an appropriate liquid.

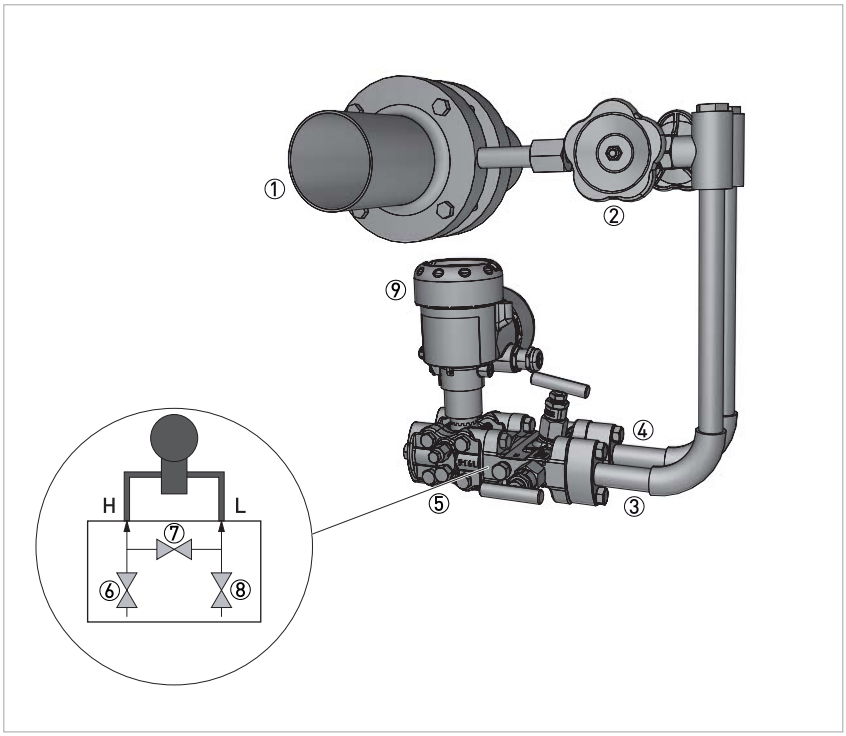


Figure 3-5: Application example

① Pipeline with primary element
② Primary shut-off valve
③ Low-pressure line (L)
④ High-pressure line (H)
⑤ 3-valve manifold
⑥ Shut-off valve
⑦ Equalizing valve
⑧ Shut-off valve
⑨ Pressure transmitter

3.6 Measurement setup for level measurement

3.6.1 In open vessels with impulse line

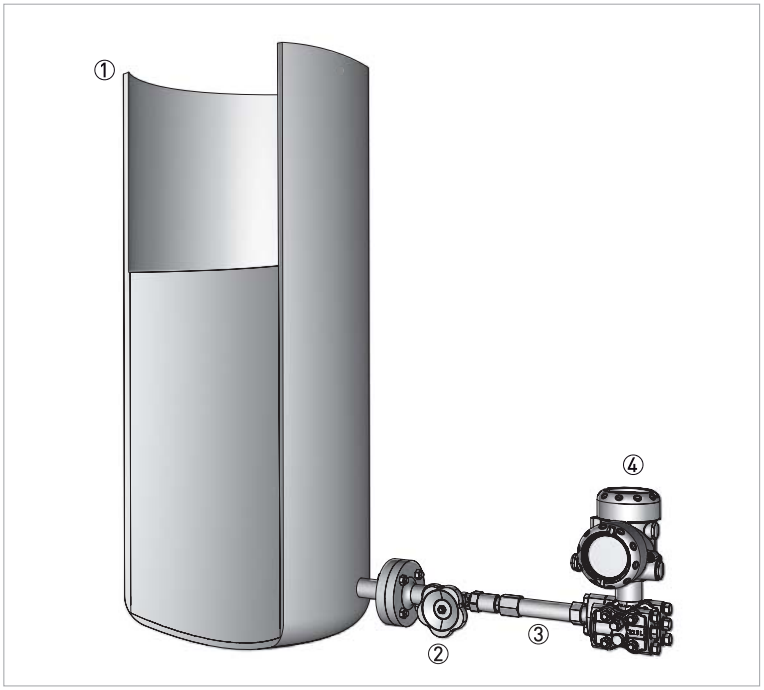


Figure 3-6: Application example

① Tank
② Shut-off valve
③ Impulse line
④ Differential pressure transmitter

The following points should be observed in this application:

- Mount the differential pressure transmitter below the lower process connection so that the impulse lines are always filled with liquid.
- The low-pressure side (L) is open to atmospheric pressure.
- For measurements of fluids with solid content, the installation of separators and drain valves is recommended to enable collection and removal of debris and sediment.

3.6.2 In closed vessels with gas-filled impulse lines

Figure 3-7: Application example

① Tank
② Shut-off valve
③ Low-pressure line (L)
④ High-pressure line (H)
⑤ Differential pressure transmitter

The following points should be observed in this application:

- Mount the differential pressure transmitter below the lower process connection so that the impulse line is always filled with liquid.
- The low-pressure side (L) must always be connected above the maximum level.
- For measurements of fluids with solid content, the installation of separators and drain valves is recommended to enable collection and removal of debris and sediment.

3.6.3 In closed vessels with liquid / condensate filled impulse lines

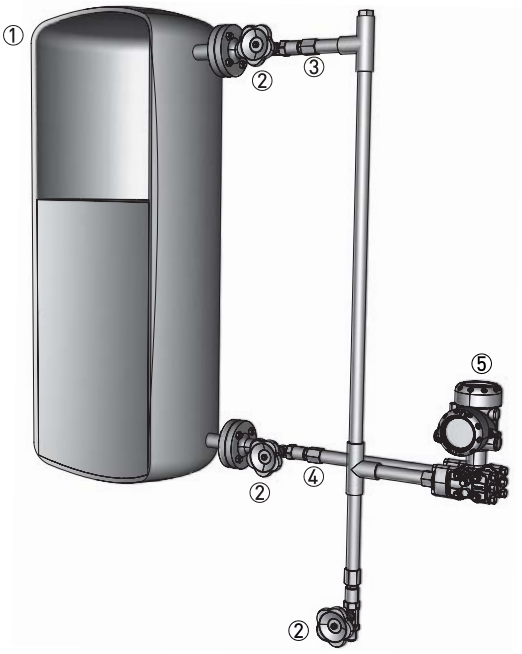


Figure 3-8: Application example

① Tank
② Shut-off valve
③ Low-pressure line (L)
④ High-pressure line (H)
⑤ Differential pressure transmitter

The following points should be observed in this application:

- Mount the differential pressure transmitter below the lower process connection so that the impulse lines are always filled with liquid.
- The low-pressure side (L) must always be connected above the maximum level.
- For measurements of fluids with solid content, the installation of separators and drain valves is recommended to enable collection and removal of debris and sediment.

4.1 Safety instructions

All work on the electrical connections may only be carried out with the power disconnected. Take note of the voltage data on the nameplate!

Observe the national regulations for electrical installations!

Observe without fail the local occupational health and safety regulations.
Any work done on the electrical components of the measuring device may only be carried out by properly trained specialists.

Look at the device nameplate to ensure that the device is delivered according to your order. Check for the correct supply voltage printed on the nameplate.

4.2 Notes for electrical cables

The device must be grounded to a spot in accordance with regulations in order to protect personnel against electric shocks.

Cables may only be connected when the power is switched off! Since the transmitter has no switch-off elements, overcurrent protection devices, lightning protection and/or energy isolating devices need to be provided by the customer.

Metric thread M16 x 1.5 mm
The cable glands with metric threads are screwed in by the factory. They are sealed using plastic plugs to protect them during transport. Remove these plugs prior to establishing an electrical connection.

4.2.1 Requirements for signal cables supplied by the customer

If the signal cable was not ordered, it is to be provided by the customer. The following requirements regarding the electrical specifications of the signal cable must be observed:

Specifications for standard signal cables

- Test voltage: ≥ 500 VAC RMS (750 VDC)
- Temperature range: -40...+105°C / -40...+221°F
- Capacity: ≤ 200 pF/m / 61 pF/ft
- Inductance: ≤ 0.7 µH/m / 0.2 µH/ft
- Use cable with round cross section.
- We generally recommend the use of a shielded cable for HART® multidrop mode.

Make sure that the cable used features the required temperature resistance and fire safety for the maximum possible ambient temperature.

4.2.2 Laying electrical cables correctly

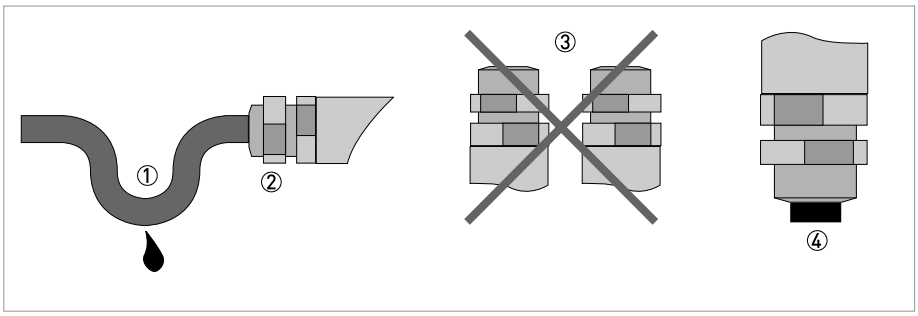


Figure 4-1: Protect housing from dust and water

① Lay the cable in a loop just before the housing.
② Tighten the screw connections of the cable entry.
③ Never mount the housing with the cable entries facing upwards.
④ Seal cable entries that are not needed with a plug.

4.2.3 Cable preparation

The device is connected with standard two-wire cable without shielding. If electromagnetic interference is expected which is above the test values of EN 61326-1 for industrial areas, a shielded cable should be used.

Check which outer diameter is suitable for the cable gland in order to ensure the sealing effect according to the specified IP protection class.

- 4.5...10 mm / 0.18...0.39" (standard)
- 4...11 mm / 0.16...0.43" (optional)

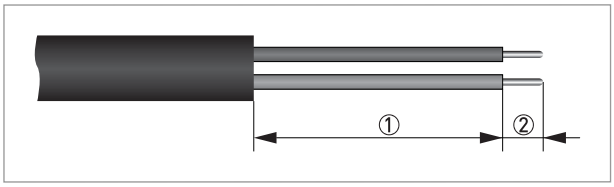


Figure 4-2: Stripping the cable

① 40...50 mm / 1.6...2"
② 5 mm / 0.2"

4.2.4 Cable entry 1/2-14 NPT (female)

With plastic housings, the NPT cable gland or the conduit steel tube must be screwed without grease into the thread.

4.2.5 Connector pin assignment

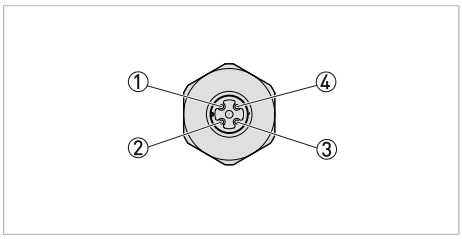


Figure 4-3: Connector M12 x 1, 4-pin, A-coding

① Shield
② Not used
③ VS-
④ VS+

Contact pin	Colour of cable	Electronic insert for terminal
Pin ①	Brown	1
Pin ④	Blue	2

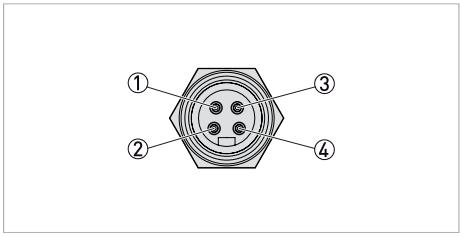


Figure 4-4: 7/8 connector, Foundation Fieldbus (FF)

① VS-
② VS+
③ Not connected
④ Cable shield

Contact pin	Colour of cable	Electronic insert for terminal
Pin ①	Blue	1
Pin ②	Brown	2
Pin ④	Green / yellow	Grounding

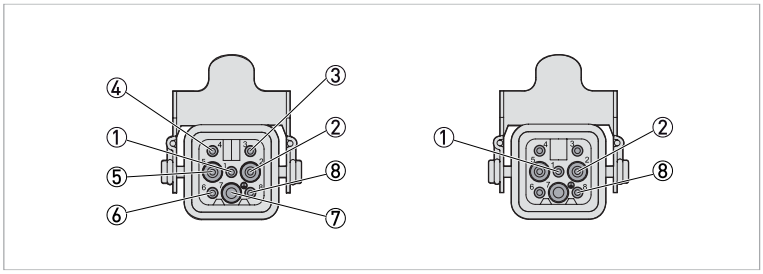


Figure 4-5: Connector, Harting HAN 8D (left) and Harting HAN 7D (right)

① VS-
② VS+

Contact pin	Colour of cable	Electronic insert for terminal
Pin ①	Black	1
Pin ②	Blue	2
Pin ⑧	Green / yellow	Grounding

4.2.6 Connection to the power supply

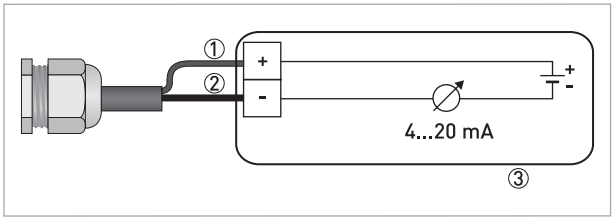


Figure 4-6: Connection to the power supply

① Red
② Black
③ Power supply with load

4.2.7 Cable shield and grounding

If a shielded cable is necessary, connect the cable shield on both ends to the grounding potential.

In the device, the cable shield must be connected directly to the internal ground terminal.

The ground terminal outside on the housing must be connected to the grounding potential with low impedance.

In hazardous areas, the grounding is carried out according to the installation instructions.

Significant potential differences exist inside galvanization plants as well as on vessels with cathodic corrosion protection. A two-sided shield grounding can cause unacceptably high shield currents as a result.

The metallic and wetted parts (process connection, cap flange, measuring cell and separating diaphragm etc.) are conductive connected with the inner and outer ground terminal on the housing.

4.3 Electrical connection

The power supply and signal output are connected via screw terminals in the housing. The display and adjustment module is connected to the interface adapter via contact pins.

4.3.1 Connection in the terminal compartment

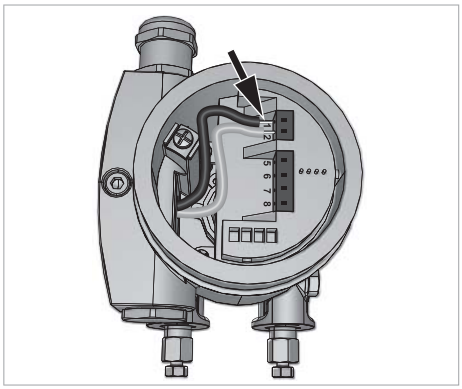


Figure 4-7: Terminal compartment from above

Procedure

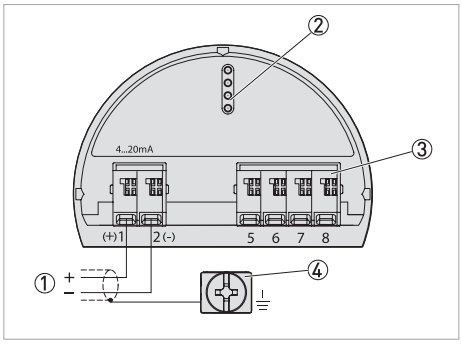
- Unscrew the housing cover.
- If present, remove the display and adjustment module by turning it to the left.
- Loosen union nut of the cable gland.
- For preparation of connection cable refer to *Cable preparation* on page 42.
- Push the cable through the cable gland into the terminal compartment.
- Insert the wire ends into the open terminal connection according to the wiring plan. Flexible cores with wire end sleeves as well as solid cores can be inserted directly into the terminal openings. In case of flexible cores, press the spring terminal with a small screwdriver to open the terminal opening.
- Check the proper hold of the wires in the terminals by lightly pulling on them.
- Connect the cable shield to the internal ground terminal, connect the outer ground terminal to the customer/plant equipotential bonding.
- Tighten the union nut of the cable gland. The sealing ring must completely enclose the cable.
- Screw the housing cover back on.

4.3.2 Single chamber housing

For devices used in hazardous areas, additional safety notes apply; please refer to the Ex documentation.

The following illustration applies to both the non-Ex as well as the the Ex ia, and the Ex d version.

Electronics compartment



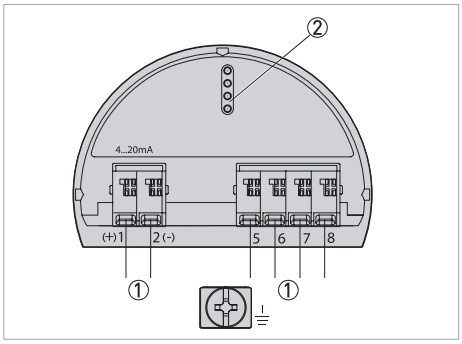
① Power supply / signal output
② Interface adapter for the display and adjustment module
③ Digital interface
④ Ground terminal for connection of the cable shield

4.3.3 Double chamber housing

For devices used in hazardous areas, additional safety notes apply; please refer to the Ex documentation.

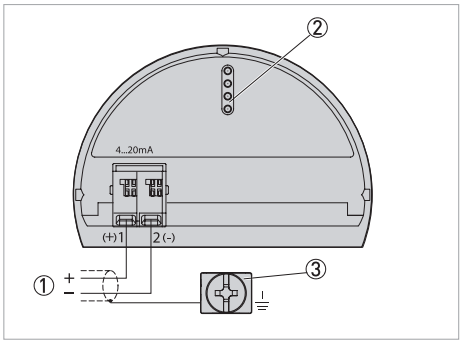
The following illustration applies to both the non-Ex as well as the Ex ia, and the Ex d version.

Electronics compartment



① Internal connection to terminal compartment
② Interface adapter for the display and adjustment module

Terminal compartment: Standard



① Power supply / signal output
② Interface adapter for the display and adjustment module
③ Ground terminal for connection of the cable shield

Terminal compartment: Additional current output

To make a second measured value available for use, you can use the supplementary electronics "Additional current output". Both current outputs are passive and need a power supply.

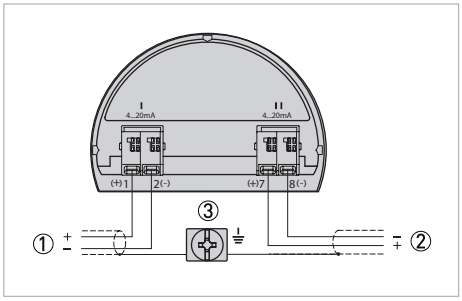


Figure 4-8: Additional current output

① First current output (I) - Voltage supply and signal output, sensor (HART®)
② Additional current output (II) - Voltage supply and signal output (without HART®)
③ Ground terminal for connection of the cable screening

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Head Office KROHNE Messtechnik GmbH
Ludwig-Krohne-Str. 5
47058 Duisburg (Germany)
Tel.: +49 203 301 0
Fax: +49 203 301 10389
info@krohne.com

The current list of all KROHNE contacts and addresses can be found at:
www.krohne.com