OPTIBAR DP 7060 C Technical Datasheet

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

- High accuracy and measurement stability under all process conditions
- Fast response time
- Modular converter platform for all applications

KROHNE

1.1 OPTIBAR differential pressure transmitter

The newest 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.

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 up to 30 mbar / 0.44 psi even without electronic spreading.
- Light, compact measuring cell with low weight.
- Turn down up to 100:1, higher on request.
- Universal modularity of the entire OPTIBAR process series.
- Quick start-up for all applications.
- Extensive diagnostic and parameterization functions on the display module or the user-friendly and free DTM.

Industries

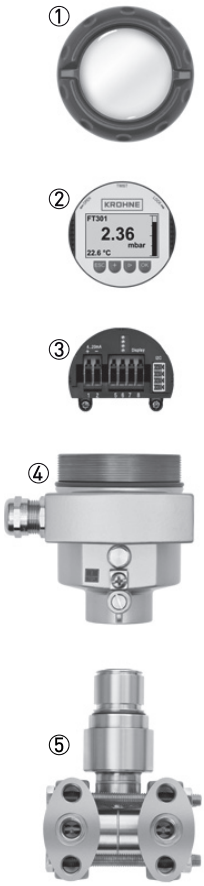
- General process technology
- Power generation
- Chemicals
- Petrochemicals
- Environmental technology
- Water and wastewater

Applications

- Pressure monitoring of filters and pumps with overload protection of up to 160 bar / 2320 psi.
- Level measurements of liquids in pressurised vessels.
- Flow measurement of gases, vapours and liquids with differential pressure transmitters.
- Measurement of density and separating layers 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 each measuring task.



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

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

③ There are a variety of converters available and they can be used regardless of the housing or sensor selected. In addition to the standard configuration with 2-wire 4...20mA and superimposed HART® (Version 7) signal, Foundation Fieldbus and Profibus PA can be selected depending on the application.

④ Note that not all approvals are available with all housings.

⑤ 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 technology.

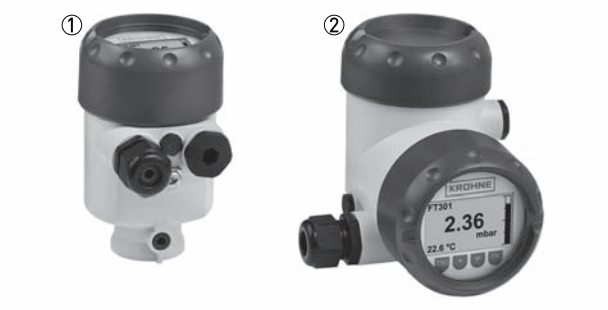


Figure 1-1: Plastic housing

① Single chamber
② Double chamber

The plastic housing is cost-effective and features a low net weight. Converters can only be used in hazardous areas in intrinsically safe operation.

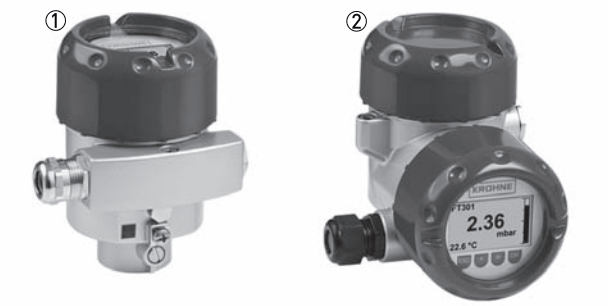


Figure 1-2: Aluminium housing

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.

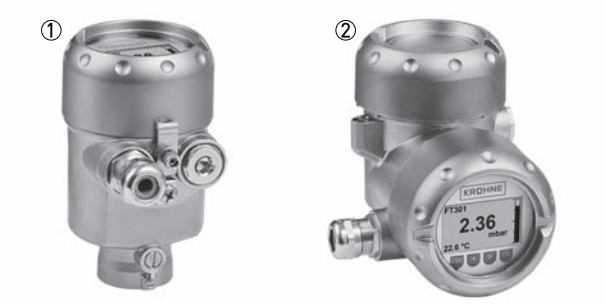


Figure 1-3: Stainless steel housing (precision casting)

① Single chamber
② Double chamber

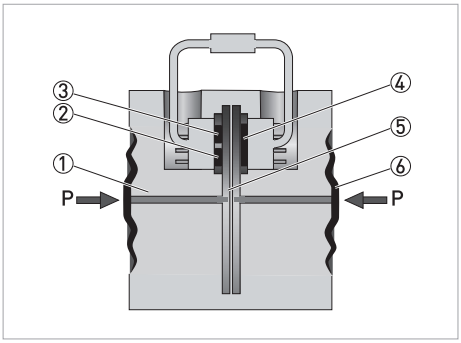
For applications that place particular demands on the mechanical robustness of the converter. These housings can be used with all protection types for hazardous areas.

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 (Download Center).*

Measuring system

Measuring principle	Piezoresistive differential pressure cell
Application range	• Flow measurement (volume or mass flow) with corresponding differential pressure transmitter in gases, vapours and liquids • Differential pressure measurement • Interface and density measurement • Level, volume and mass measurement of liquids
Measuring range	30 mbar...16 bar / 0.44...232 psi
Display and user interface	
Display on signal converter	• Dot-matrix display 45x27 mm / 1.77x1.06", illuminated • Display turnable in 90° steps • Digit size 13x7 mm / 0.51x0.27" • Ambient temperatures below -20°C / -4°F may affect the readability of the display
Display function	• Measured value display or derived measured value such as filling height, density, interface position, volume or mass flow and total counter • Warning and diagnostic information • All parameters are accessible via the operating menu
Operating and display languages	German, English, French, Spanish, Portuguese, Italian, Dutch, Russian, Turkish, Polish and Czech
Operation	Local operation via 4 push buttons on the display and adjustment module
Remote operation	• PACTware™, incl. Device Type Manager (DTM) • HART® Hand Held Communicator from Emerson Process • AMS® from Emerson Process • PDM® from Siemens
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 / 12.5...15.4 psi
- Mounting position: vertical
- Rising characteristics
- Measurement start at 0.00 bar / psi
- Process diaphragm: 316 L / 1.4404
- Fill fluid: silicone oil
- Material of process flanges: 316 L / 1.4404
- Power supply: 24 VDC ±3 VDC
- Load for HART®: 250 Ω

Reference conditions 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.
[% of the set span]

	TD < 5:1	TD > 5:1	TD < 10:1	TD > 10:1
30 mbar / 0.44 psi	< ±0.10%	< ± 0.02% x TD		
100 mbar / 1.5 psi	-	-	< ±0.065%	<±-0.035% + 0.01% x TD
500 mbar / 7.3 psi				<±0.015% + 0.005% x TD
3 bar / 43.51 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®, Profibus PA, Foundation Fieldbus) as well as for the analogue 4…20 mA current output.
[% of the set span]

	up to TD	-10...+60°C / +14...+140°F	-40...+85°C / -40...+185°F
30 mbar / 0.44 psi	30:1	<± 0.10% + 0.10% x TD	<± 0.15% + 0.15% x TD
100 mbar / 1.5 psi	100:1	<± 0.15% + 0.15% x TD	<± 0.15% + 0.20% x TD
500 mbar / 7.3 psi		<± 0.08% + 0.05% x TD	<± 0.12% + 0.06% x TD
3 bar / 43.51 psi			
16 bar / 232.1 psi		<± 0.15% + 0.015% x TD	<± 0.15% + 0.20% x TD

Effect of system pressure

Ambient temperature effect on zero point and span in relation to the set measuring span. Zero point errors can be calibrated out 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]

	up to nominal pressure	on zero	on span
30 mbar / 0.44 psi	40 bar / 580 psi	<± 0.10% x TD	<± 0.10%
100 mbar / 1.5 psi	160 bar / 2320 psi		
500 mbar / 7.3 psi			
3 bar / 43.51 psi			
16 bar / 232.1 psi			

Effect of mounting position

A position-dependent zero offset can be corrected.

≤0.1 mbar per 10° inclination

<table>
<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 the set span]</td></tr>
<tr><td colspan="4"><0.1% x TD (Turn Down) over a period of 5 years</td></tr>
<tr><td rowspan="9">Total performance in accordance with DIN 16086</td><td colspan="4">At a temperature change of -10...+60°C / +14...+140°F, up to the indicated nominal pressure.
[% of the set span]</td></tr>
<tr><td></td><td>up to TD</td><td>Nominal pressure</td><td>-10...+60°C / +14...+140°F</td></tr>
<tr><td>30 mbar / 0.44 psi</td><td rowspan="5">1:1</td><td>40 bar / 580 psi</td><td><± 0.24%</td></tr>
<tr><td>100 mbar / 1.5 psi</td><td rowspan="4">160 bar / 2320 psi</td><td><± 0.32%</td></tr>
<tr><td>500 mbar / 7.3 psi</td><td rowspan="3"><± 0.18%</td></tr>
<tr><td>3 bar / 43.51 psi</td></tr>
<tr><td>16 bar / 232.1 psi</td><td><± 0.32%</td></tr>
<tr><td colspan="4">The details of total performance comprise the reference accuracy, the effect of the ambient temperature on the zero signal and the measuring span as well as the effect of the static pressure on the measuring span.</td></tr>
<tr><td colspan="4">$E_{perf}=\sqrt{([E_{\Delta TZ}+E_{\Delta TS}]^2+E_{\Delta PS}^2+E_{lin}^2)}$
$E_{\Delta TZ}$= Effect of ambient temperature on the zero signal
$E_{\Delta TS}$= 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>Dynamic output behaviour</td><td colspan="4">These parameters depend on the filling medium, temperature and, if applicable, the chemical seal.
For more information refer to Dynamic output behaviour on page 21</td></tr>
<tr><td>Damping</td><td colspan="4">63% of the input variable 0…999 seconds, adjustable in 0.1 second steps.</td></tr>
<tr><td colspan="5">Temperature</td></tr>
<tr><td colspan="5">The evaluation is made using the HART® output signal</td></tr>
<tr><td>Resolution</td><td colspan="4">1°C / 1.8°F</td></tr>
<tr><td>Accuracy</td><td colspan="4">± 1°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 / 12.5...15.4 psi
• Mounting position: vertical</td></tr>
<tr><td rowspan="7">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 colspan="2"></td><td>up to nominal pressure acc. to URL absolute pressure</td><td>TD 1:1</td></tr>
<tr><td colspan="2">30 mbar / 0.44 psi</td><td>40 bar / 580 psi</td><td rowspan="6"><± 0.10%</td></tr>
<tr><td colspan="2">100 mbar / 1.5 psi</td><td rowspan="5">160 bar / 2320 psi</td></tr>
<tr><td colspan="2">500 mbar / 7.3 psi</td></tr>
<tr><td colspan="2">3 bar / 43.51 psi</td></tr>
<tr><td colspan="2">16 bar / 232.1 psi</td></tr>
</table>

Effect of ambient temperature	Ambient temperature effect on zero and span. [% of URL]			
		up to nominal pressure acc. to URL absolute pressure	-10...+60°C / +14...140°F	-40...+80°C / -40...+176°F
	30 mbar / 0.44 psi	40 bar / 580 psi	<± 0.10%	<± 0.15%
	100 mbar / 1.5 psi	160 bar / 2320 psi		
	500 mbar / 7.3 psi			
	3 bar / 43.51 psi			
	16 bar / 232.1 psi			
Long-term stability acc. to DIN EN 61298-1	<± 0.1% of URL over a period of 5 years			

Operating conditions

Temperature	
Operating temperature / nominal temperature range	-40...+80°C / -40...+176°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, humidity: 4...100% according to DIN EN 60721-3-4)

Further operating conditions

Ingress protection acc. to IEC 529 / EN 60529			
Plastic (PBT)	Single chamber	IP66 / IP67	NEMA 4X / 6P
	Double chamber	IP66 / IP67	NEMA 4X
Aluminium	Single chamber	IP66 / IP68 (0.2 bar / 2.9 psi)	NEMA 4X / 6P
		IP 68 (1 bar / 14.5 psi)	-
	Double chamber	IP66 / IP67	NEMA 4X
		IP66 / IP68 (0.2 bar / 2.9 psi)	NEMA 4X
Stainless steel (electro-polished)	Single chamber	IP69K	-
	Single chamber	IP66 / IP68 (0.2 bar / 2.9 psi)	NEMA 4X / 6P
Stainless steel (precision casting)	Single chamber	IP66 / IP68 (0.2 bar / 2.9 psi)	NEMA 4X / 6P
		IP 68 (1 bar / 14.5 psi)	NEMA 4X
	Double chamber	IP66 / IP67	NEMA 4X
		IP66 / IP68 (0.2 bar / 2.9 psi)	NEMA 4X
Stainless steel	Sensor for external housing	IP 68 (25 bar / 362.6 psi)	-

Vibration	
Reference conditions	• Without mounting bracket • Process flanges 316 L / 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 resistance acc. to IEC 60770-1	500 m/s^2, 6 ms 100 shocks per axis
Noise acc. 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

Gaskets	
EPDM	-40...+85°C / -40...+185°F
FKM	-15...+85°C / -4...+185°F
PTFE	-40...+85°C / -40...+185°F
NBR	-25...+85°C / -4...+185°F
Filling oil	
Silicone oil	-40...+85°C / -40...+185°F
Wetted parts	
Process connection, screwed flange	316 L / 1.4404
Separating diaphragm	316 L / 1.4404
Drain and vent valves	316 L / 1.4404
Internal transmission fluid	Silicone oil
Non-wetted parts	
Electronics housing	Plastic PBT (Polyester), powder coated die-cast aluminium, 316 L / 1.4404
Housing cover sealing ring	Silicone (aluminium or plastic housing), NBR (stainless steel housing)
Inspection window in housing cover (display, adjustment module)	Polycarbonate (UL746-C listed)
Screws and bolts for the side flanges	PN 160: hexagon screw DIN 931 M8 x 90 A4 70, hexagon nut DIN 934 M8 A4 70
Grounding flange	316 Ti, 316 L / 1.4404

Process connection

Standard	1/4-18 NPT (female)

Electrical connections

Mechanical	
Cable gland	M20 x 1.5 mm
Cable diameter	5...9 mm / 0.20...0.35" 6...12 mm / 0.24...0.47" 10...14 mm / 0.39...0.55"
Cable entry 1/2 NPT	Blind plug: M20 x 1.5 mm, 1/2-14 NPT
	Closing cap: M20 x 1.5 mm, 1/2-14 NPT
	Connector option: M12 x 1, Harting HAN 7D,8D, 7/8 FF
Core cross-section	Solid wire with cords: 0.2 mm...2.5 mm^2 / AWG 24...14
	Cord with wire end sleeve: 0.2 mm...1.5 mm^2 / AWG 24...16
Electrical	
Supply voltage	Non-Ex device: 9.6...35 VDC
	Ex ia device: 9.6...30 VDC
	Ex d device: 9.6...35 VDC
	Ex ia d device: 15...35 VDC
Reverse polarity protection	Integrated
Permissible residual ripple	
Non-Ex devices	for U_n 12 VDC (9.6 < UB < 14 VDC) ≤0.7 V_{eff} (16...400 Hz)
Ex ia devices, Ex ia d devices	for U_n 24 VDC (18 < UB < 35 VDC) ≤1.0 V_{eff} (16...400 Hz)
Load	$R_{L,max}$=(UB-9.6) / 22 mA
Potential connection in device	Electronics: not electrically isolated
	Ground terminal: galvanically connected with process connection
Overvoltage category	III
Protection class	II

Inputs and outputs

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
Max. output current	21.5 mA
Boot-up current	≤10 mA for 5 ms after switching on, then ≤3.6 mA
Damping	0...999 seconds, adjustable

Approvals and certificates

CE	The device fulfils the statutory requirements of the EC directives. The manufacturer certifies that these requirements have been met by applying the CE marking.
Electromagnetic compatibility (EMC)	EMC conformity for EN 61326-1 (05/2006)
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 97/23/EC)	PN160 (MWP 2320 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 weights

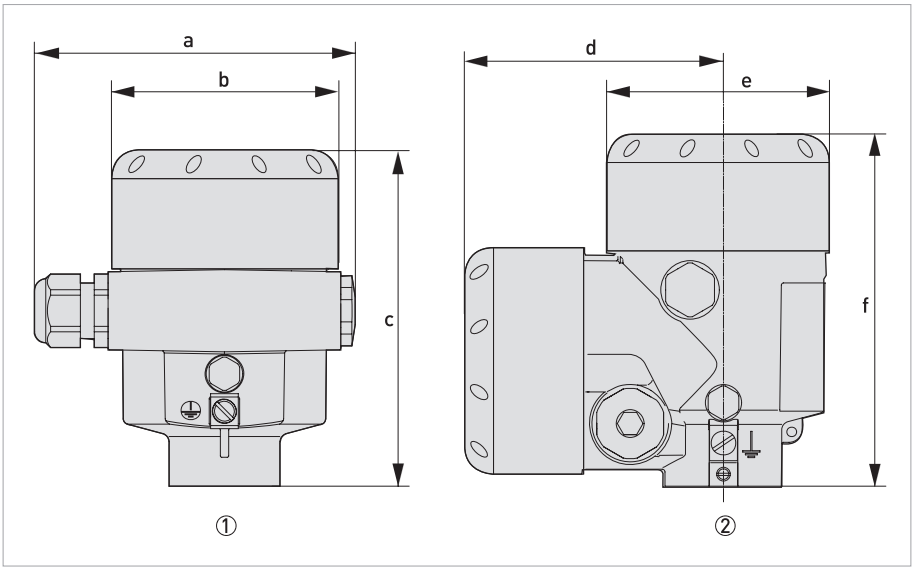


Figure 2-1: Aluminium housing

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

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

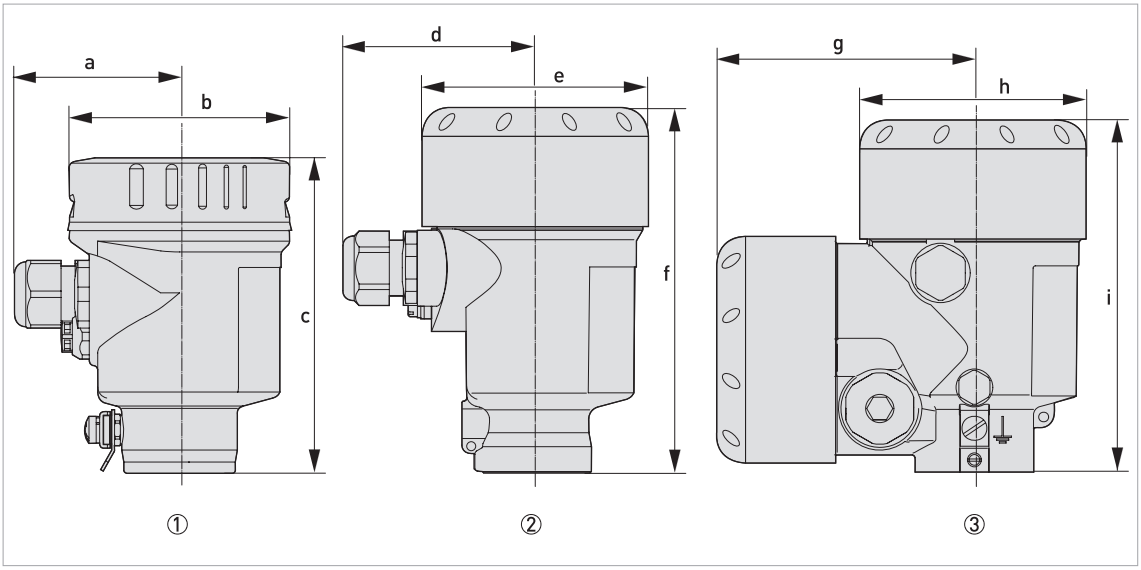


Figure 2-2: Stainless steel housing

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	79	3.11
i	120	4.72

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

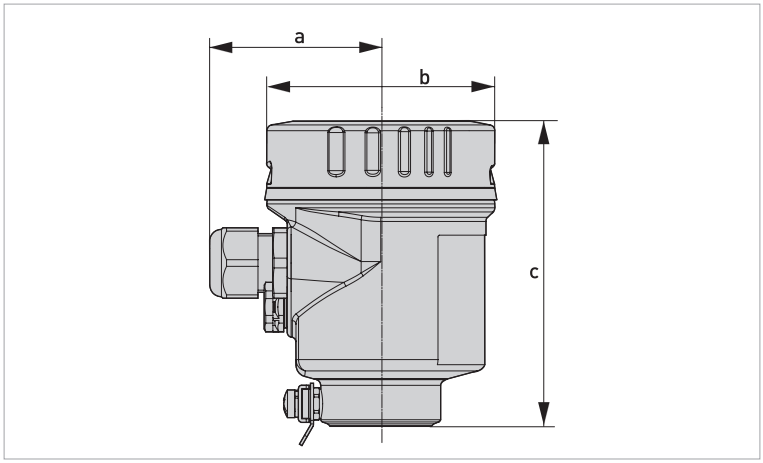


Figure 2-3: IP 69 K, stainless steel (electro-polished)

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

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

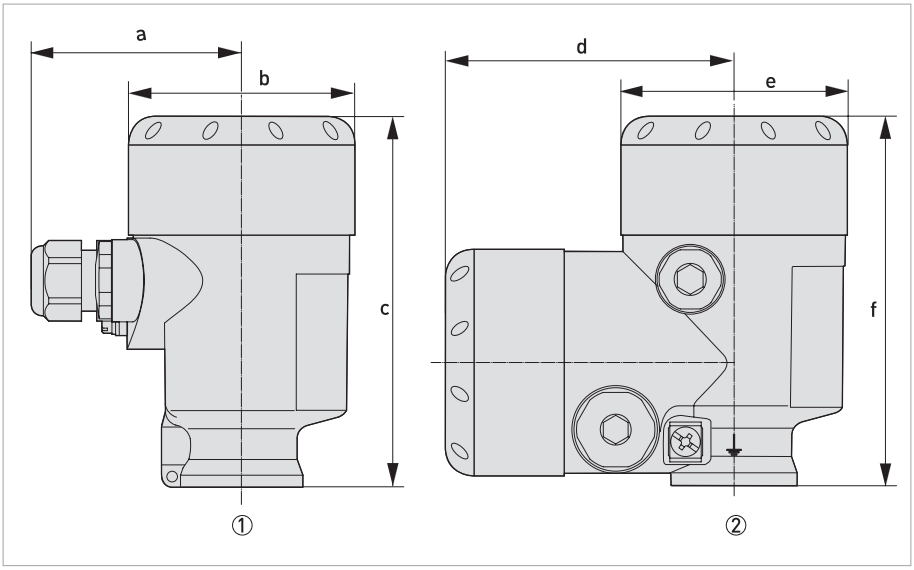


Figure 2-4: Plastic housing

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

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

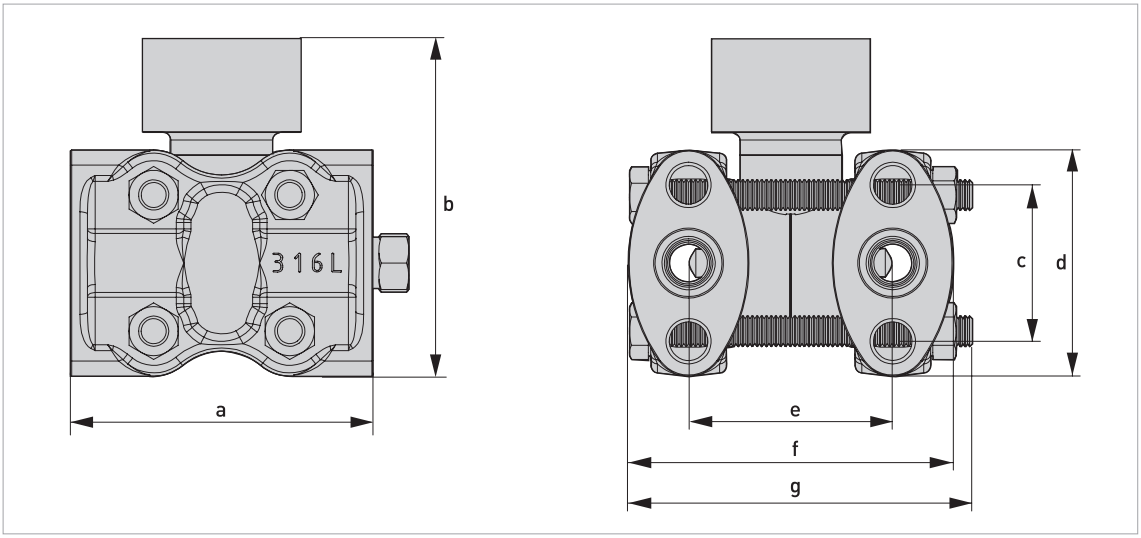


Figure 2-5: 1/4-18 NPT process connection

	Dimension [mm]	Dimension [inch]
a	80	3.15
b	88	3.46
c	41.3	1.63
d	60	2.36
e	54	2
f	86	3.39
g	91	3.58

	Weight [kg]	Weight [lb]
Process connection	2.0	4.41

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

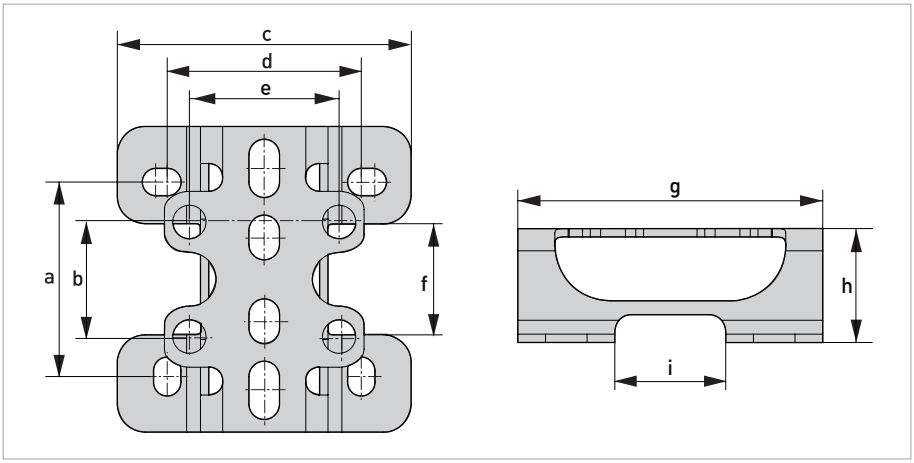


Figure 2-6: Mounting bracket

	Dimension [mm]	Dimension [inch]
a	70	2.76
b	41.3	1.63
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

2.3 Pressure ranges

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

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

Nominal range	0.44 psi	1.50 psi	7.30 psi	43.51 psi	232.1 psi
Limit URL (upper)	0.44 psi	1.50 psi	7.30 psi	43.51 psi	232.1 psi
Limit LRL (lower)	-0.44 psi	-1.45 psi	-7.25 psi	-43.51 psi	-232.1 psi
Smallest adjustable measuring span	0.015 psi	0.015 psi	0.073 psi	0.44 psi	2.32 psi
Turn down	30:1	100:1	100:1	100:1	100:1
MWP (maximum system pressure) ①	580 psi	2321 psi	2321 psi	2321 psi	2321 psi
Minimum system pressure	0.073 psi abs (under reference conditions)				

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

2.4 Dynamic output behaviour

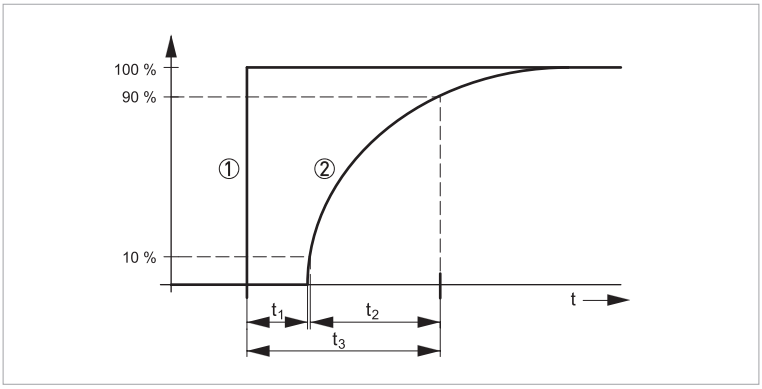


Figure 2-7: Behaviour for an sudden change of the process variable.
t_1 - dead time; t_2 - rise time; t_3 - step response time

① Process variable
② Output signal

These parameters depend on the filling medium, temperature and, if applicable, the chemical seal.

	Dead time (t1) [ms]	T90% (t2) [ms]	Step response time (t3) [ms] ①
30 mbar / 0.44 psi	90	115	205
100 mbar / 1.50 psi	60	95	155
500 mbar / 7.3 psi		75	135
3 bar / 43.51 psi		60	120
16 bar / 232.1 psi			

① Step response time is the sum of dead time and T90%

3.1 Intended use

For devices used in hazardous areas, additional safety instructions 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.

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

The OPTIBAR DP 7060 C 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.).

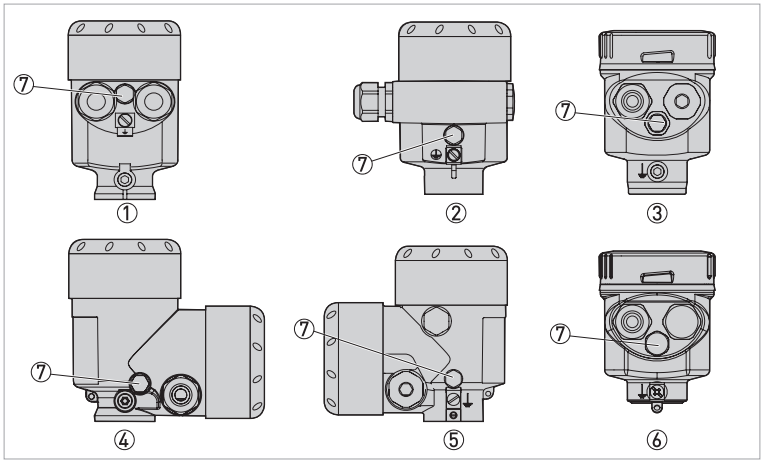
The accuracy of the measurement is only guaranteed if the transmitter and accompanying impulse line(s), if any, have been correctly installed. In addition, extreme ambient conditions including large fluctuations in temperature, vibrations and shocks should be kept as far away as possible from the measuring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

3.3 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 water-absorbent.

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, electro-polished stainless steel
④ Double chamber housing, plastic
⑤ Double chamber housing, aluminium
⑥ Single chamber housing IP69k
⑦ Filter element

3.4 Measurement setup for flow measurement

3.4.1 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.

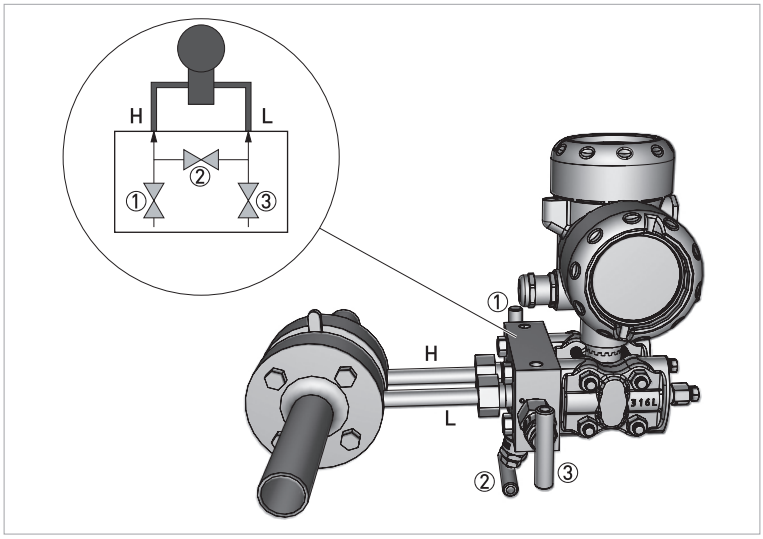


Figure 3-1: Application example

① Shut-off valve
② Equalizing valve
③ Shut-off valve

3.4.2 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.

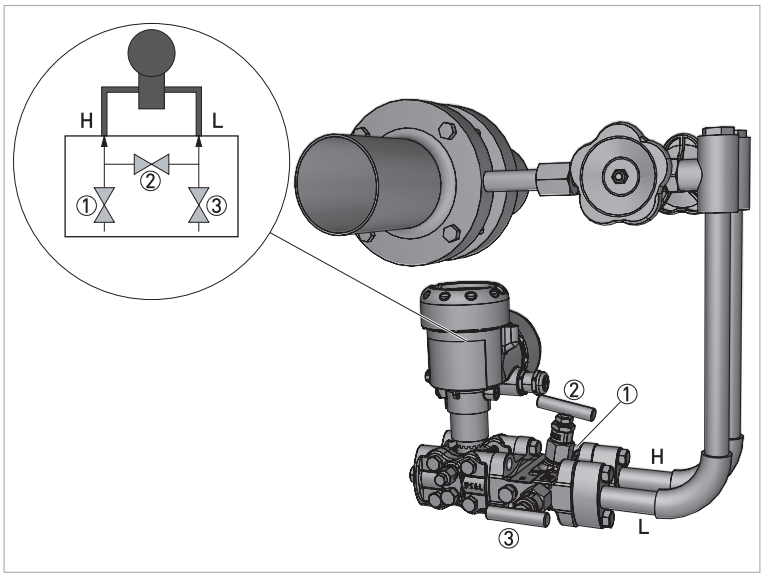


Figure 3-2: Application example

① Shut-off valve
② Equalizing valve
③ Shut-off valve

3.5 Measurement setup for level measurement

3.5.1 In open vessels with impulse line

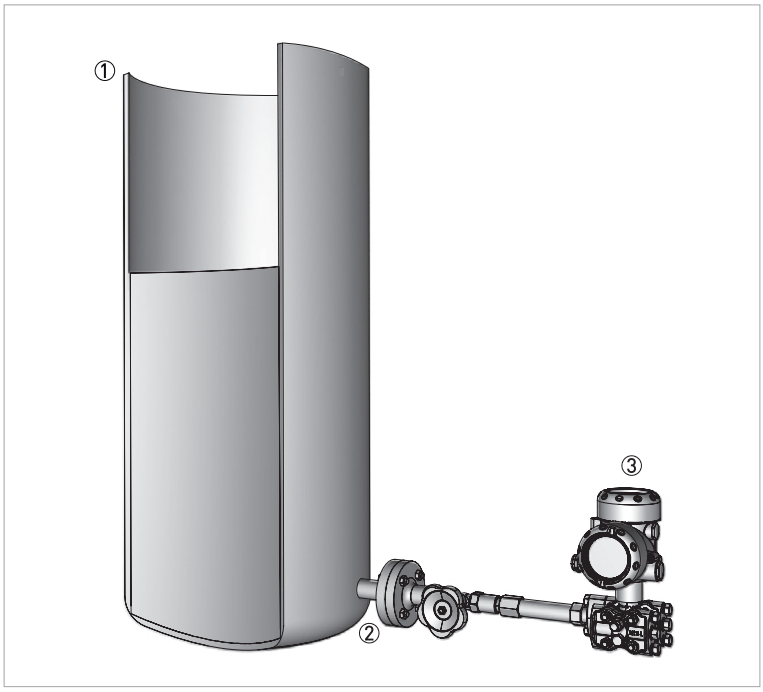


Figure 3-3: Application example

① Tank
② Impulse line
③ 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 in products with solid content, the installation of separators and drain valves is recommended to enable collection and removal of debris and sediment.

3.5.2 In closed vessels with gas-filled impulse lines

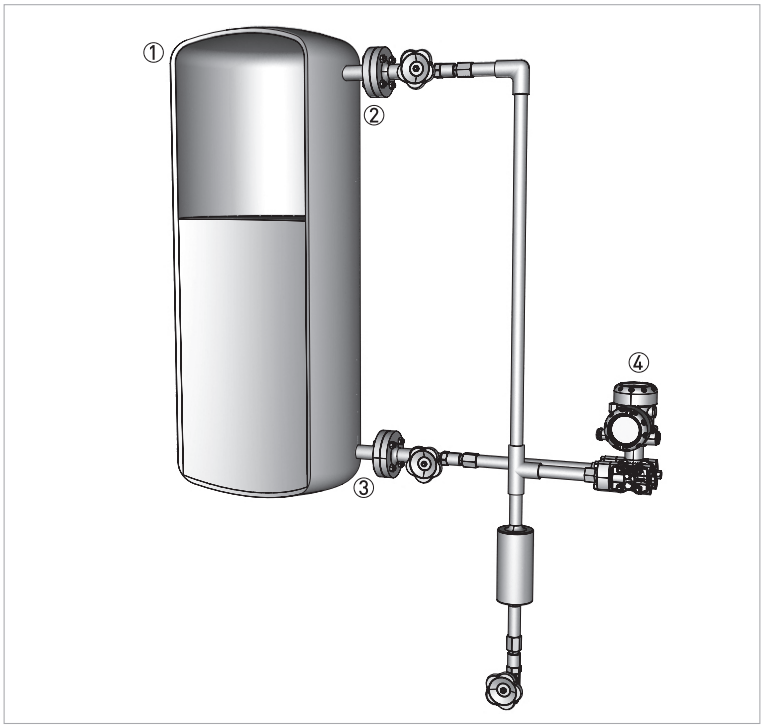


Figure 3-4: Application example

① Tank
② Low-pressure line (L)
③ High-pressure line (H)
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 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.

3.5.3 In closed vessels with liquid / condensate filled impulse lines

Figure 3-5: Application example

① Tank
② Low-pressure line (L)
③ High-pressure line (H)
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) 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 must be provided by the customer.

4.2.1 Requirements for signal cables provided 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.
- A cable outer diameter of 5...9 mm / 0.2 ... 0.35" ensures the seal effect of the cable gland. If you are using cable with a different diameter or cross-section, exchange the seal or use a suitable cable gland.
- We generally recommend the use of a shielded cable for HART® multidrop mode.

4.2.2 Laying electrical cables correctly

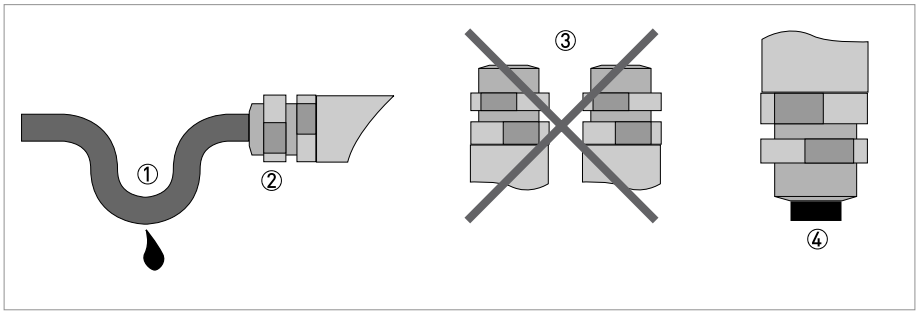


Figure 4-1: Protect housing from dust and water

① Lay the cable in a loop just before the housing.
② Tighten the screw connection of the cable entry securely.
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.

- 5...9 mm / 0.20...0.35" (standard)
- 6...12 mm / 0.24...0.47" (optional)
- 10...14 mm / 0.40...0.55" (optional)

The terminals in the terminal compartment are designed for wire cross-sections of up to 1.5 mm². To ensure a proper connection, you should strip the cable 40...50 mm / 1.6...2".

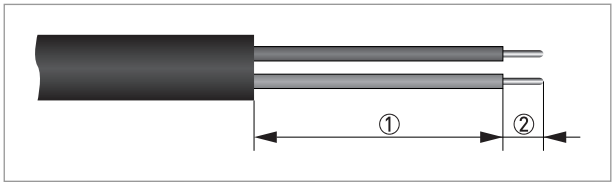


Figure 4-2: Stripping the cable

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. For further information about max. torque for all housings refer to *Technical data* on page 8.

4.2.5 Connector pin assignment

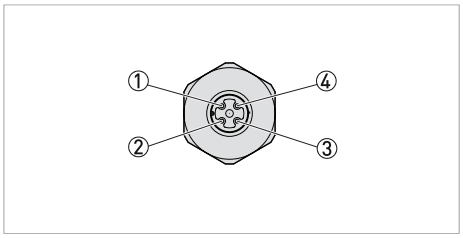


Figure 4-3: Connector M12 x 1, 4-pin

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

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

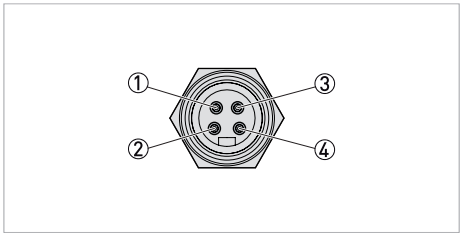


Figure 4-4: 7/8 connector, Foundation Fieldbus (FF)

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

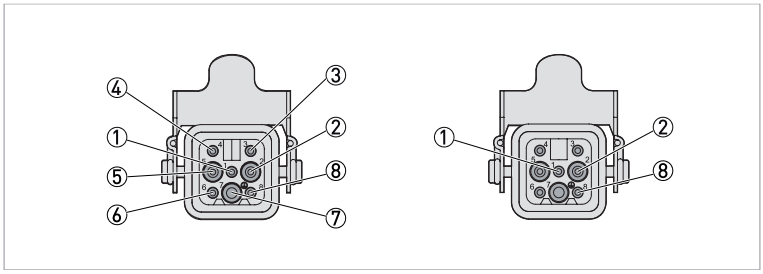


Figure 4-5: Connector, Harting HAN 8D (left) and Harting HAN 7D (right)

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

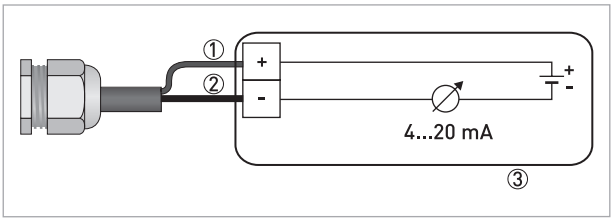


Figure 4-6: Connection to the power supply

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 connection of the power supply and the signal output is carried out via spring-loaded terminals in the housing. The display and adjustment module is connected via contact pins with the interface adapter.

4.3.1 Connection in the terminal compartment

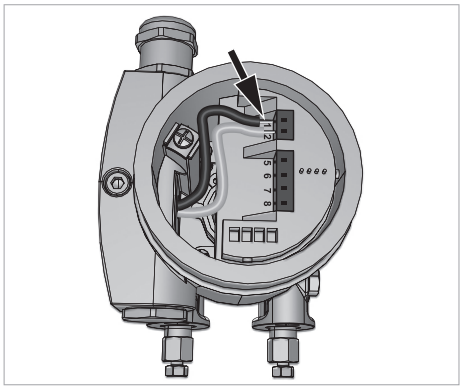


Figure 4-7: Terminal compartment from above

Procedure

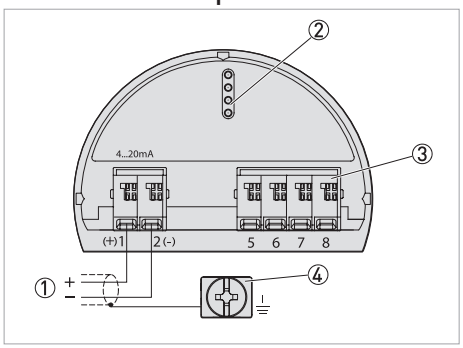
- Unscrew the housing cover.
- If present, remove the display and adjustment module by turning it to the left.
- Loosen union nut of the cable gland.
- For preparation of connection cable refer to *Cable preparation* on page 30.
- Push the cable through the cable gland into the terminal compartment.
- Insert the wire ends into the open terminals according to the wiring plan. Flexible cores with cable 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 Ex ia, the Ex d and the Ex d ia version.

Electronics compartment



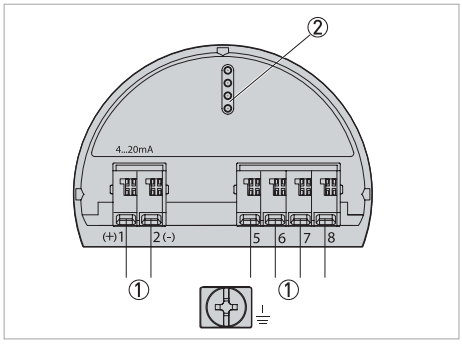
① Power supply / signal output
② Interface adapter for the display and adjustment module
③ Digital interface
④ Ground terminal for connection of the cable shield

4.3.3 Double chamber housing

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

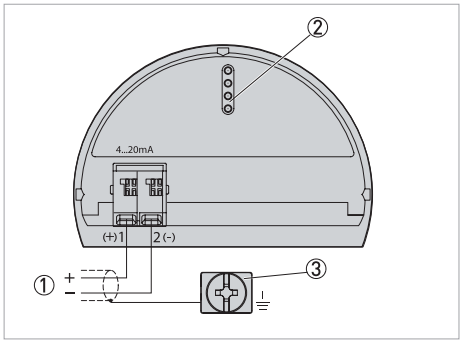
The following illustration applies to both the non-Ex as well as the the Ex ia, and the Ex d version.

Electronics compartment



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

Terminal compartment

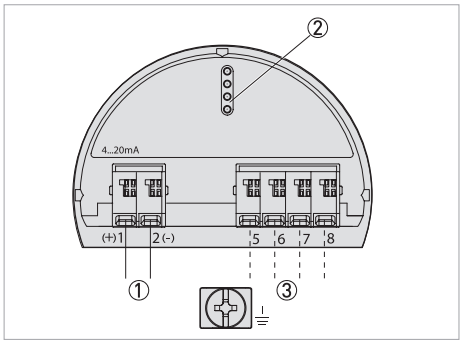


① Power supply / signal output
② Interface adapter for the display and adjustment module
③ Ground terminal for connection of the cable shield

4.3.4 Double chamber housing Ex d ia

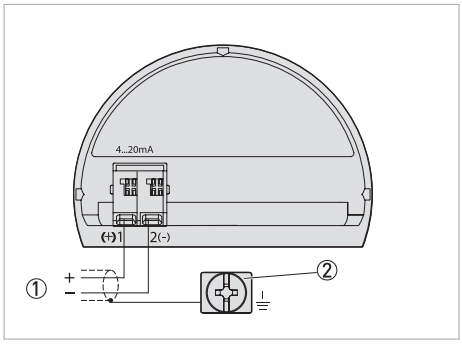
For devices used in hazardous areas, additional safety notes apply; please refer to the Ex documentation.

Electronics compartment



① Power supply / signal output
② Interface adapter for the display and adjustment module
③ Digital interface

Terminal compartment



① Power supply / signal output
② Ground terminal for connection of the cable shield

5.1 Order code

The characters of the order code highlighted in light grey describe the standard.

OPTIBAR DP 7060

VGK7	4	Approval											
		AX	Ex-free zone Europe				WX	Ex-free zone International					
		AC	ATEX II 1G, 1/2G, 2G Ex ia IIC T6				WC	IEC Ex ia IIC T6					
		AD	ATEX II 1/2G, 2G Ex d ia IIC T6				WD	IEC Ex d ia IIC T6					
		AE	ATEX II 1/2G, 2G Ex d IIC T6				WE	IEC Ex d IIC T6					
		AR	ATEX II 1D, 1/2D,1/3D,2D IP66				WR	IEC Ex t IIIC T... IP66					
		AH	ATEX II 1G, 1/2G 2G Ex ia IIC + II 1D, 1/2D, 1/3D, 2D IP66				WH	IEC Ex ia IIC T6 + IEC Ex t IIIC T... IP66					
		AT	ATEX II 1G, 1/2G, 2G Ex ia IIC + 1/2/-D Ex t IIIC IP67/66				W1	IEC Ex d ia IIC T6 + IEC Ex t IIIC T... IP66					
		A1	ATEX II 1/2G, 2G Ex d ia IIC + II 1D, 1/2D, 1/3D, 2D IP66				WL	IEC Ex d IIC T6 + IEC Ex t IIIC T... IP66					
		AL	ATEX II 1/2G, 2G Ex d IIC + II 1D, 1/2D, 1/3D, 2D IP66										
		AS	ATEX II 1/2/-D Ex t IIIC IP67/66 T.. Da/Db/-										
			Material / Process connection / Venting										
			S0	316 L; 1/4-18NPT; UNF 7/16; without									
			SR	316 L; 1/4-18 NPT; UNF7/16; on process axis									
			SD	316 L; 1/4-18 NPT; UNF7/16; at side									
			A0	316 L; Adpt. 1/2-14 NPT; UNF7/16; without									
			AR	316 L; Adpt. 1/2-14 NPT; UNF7/16; on process axis									
			AD	316 L; Adpt. 1/2-14 NPT; UNF7/16; at side									
			DY	Prepared for diaphragm seals									
				Diaphragm / Filling oil									
				S	1.4404 (AISI 316 L), silicone oil								
					Gasket								
					E	EPDM							
					F	FKM							
					N	NBR							
					P	PTFE							
						Measuring range / PN							
						2	30 mbar / 0.43 psi; 40 bar / 580 psi						
						3	100 mbar / 1.45 psi; 160 bar / 2400 psi						
						4	500 mbar / 7.25 psi; 160 bar / 2400 psi						
						5	3 bar / 43.5 psi; 160 bar / 2400 psi						
						6	16 bar / 232 psi; 160 bar / 2400 psi						

							Adjustment (customer specific measuring range)					
							0	Nominal range %				
							1	Nominal range mbar				
							2	Nominal range bar				
							3	Nominal range psi				
							4	Nominal range Pa				
							5	Nominal range kPa				
							6	Nominal range Mpa				
							7	Nominal range mmH20				
							8	Nominal range inH20				
							A	Nominal range mmHG				
							B	Nominal range inHG				
							C	Nominal range mm (density 1)				
							D	Nominal range cm (density 1)				
							E	Nominal range m (density 1)				
							F	Nominal range in (density 1)				
							G	Nominal range ft (density 1)				
							L	Customer specific adjustment for level measurement				
							S	Customer specific adjustment for flow measurement				
							Y	Customer specific adjustment for pressure measurement				
								Accuracy class				
								M	0.065%			
									Electronics			
									H	2-wire 4...20 mA / HART®		
									A	2-wire 4...20 mA / HART® with SIL (in preparation)		
									F	Foundation Fieldbus		
									P	Profibus PA		
										Supplementary electronics		
										X	without	
											Housing	
											K	Plastic (PBT), DIN single chamber
											R	Plastic (PBT), DIN double chamber
											A	Aluminium, DIN single chamber
											D	Aluminium, DIN double chamber
											8	316 L (electro-polished), DIN single chamber
											V	316 L, DIN single chamber
											W	316 L, DIN double chamber
												Housing version / Ingress protection
												1 compact, IP 66 / 67, NEMA 6P

	Electrical connection / Material
M	M20 x 1.5, plastic, black, 5...9 mm / 0.20...0.35"
S	M20 x 1.5, plastic, black, 6...12 mm / 0.24...0.47"
T	M20 x 1.5, plastic, black, 10...14 mm / 0.39...0.55"
K	M20 x 1.5, plastic, blue, 5...9 mm / 0.20...0.35"
U	M20 x 1.5, plastic, blue, 6...12mm / 0.24...0.47"
V	M20 x 1.5, plastic, blue, 10...14mm / 0.39...0.55"
0	M20 x 1.5, nickel-plated brass, 4...8.5 mm / 0.16...0.33"
L	M20 x 1.5, 316 L, 6...12 mm / 0.24...0.47"
D	M20 x 1.5, blind plug
F	M20 x 1.5, connector HAN7D, straight
G	M20 x 1.5, connector HAN7D, 90°
H	M20 x 1.5, connector HAN8D, straight
W	M20 x 1.5, connector HAN8D, 90°
N	1/2-14 NPT, blind plug
7	1/2-14 NPT, plastic, black, 5...9 mm / 0.2...0.35"
P	1/2-14 NPT, nickel-plated brass, 4...8.5 mm / 0.16...0.33"
Z	1/2-14 NPT, connector 7/8-14 NPT

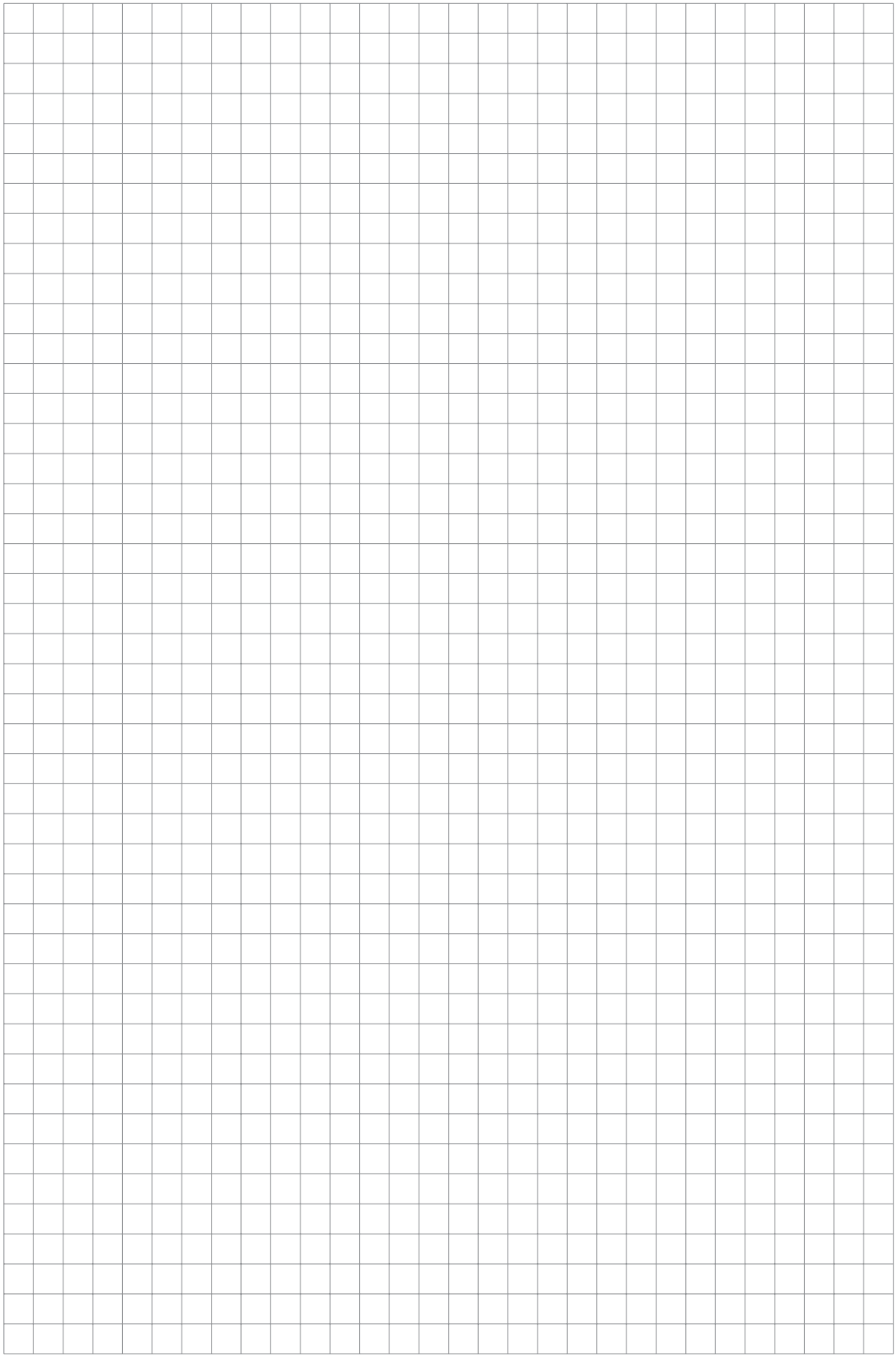
		Display / Adjustment module
	X	without
	A	mounted (top)
	B	mounted (side)
	F	without, lid with sight window

		Language – Display
	D	DE - German
	E	EN - English
	1	JP - Japanese
	C	CN - Chinese
	F	FR - French
	N	NL - Dutch
	P	PT - Portuguese
	R	RU - Russian
	S	ES - Spanish
	T	IT - Italian

		Language – Manual
	D	DE - German
	E	EN - English
	F	FR - French

		Additional process barrier
	0	without
	S	with secondary process barrier

																		Identification tag			
																		0	without		
																		F	Foil (40 x 20 mm)		
																		S	Stainless steel (40 x 20 mm)		
																			Device settings		
																			0	without	
																				Certificates	
																				X	without
																				M	Observe VZPA / B code
VGK7	**4**																				



KROHNE product overview

- Electromagnetic flowmeters
- Variable area flowmeters
- Ultrasonic flowmeters
- Mass flowmeters
- Vortex flowmeters
- Flow controllers
- Level meters
- Temperature assemblies
- Pressure transmitters
- Analysis products
- Products and systems for the oil & gas industry
- Measuring systems for the marine industry

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