Zertifiziertes QM-System
DIN EN ISO 9001
Zertifikat-Nr. 01017

Differential Pressure Transmitter

measuring • monitoring • analysing

PAD

- Span: 0.75 … 15 mbar up to 4.137 … 413.7 bar
- Static pressure: max. 310 bar
- t_{max}: +120 °C
- Process connection: ¼ NPT, ½ NPT, various diaphragm seals on request
- Material: stainless steel, HAST-C, Tantalum, Monel
- Various output: 4 ... 20 mA, frequency output
- Sensor input: differential-, gauge-, absolute pressure
- Digital communication with HART® protocol
- ATEX-approval

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Description

The Kobold Differential Pressure Transmitter model PAD is a micro processor-based high performance transmitter, which has flexible pressure calibration and output, automatic compensation of ambient temperature and process variable, configuration of various parameters, communication with HART® protocol. The application is very various, as measuring pressure, flow and level by application method. All data of sensor is to be input, modified and stored in EEPROM.

As an option the Kobold Pressure Transmitter is also available as a flow meter. This flowmeter model PAD-F has added the totalizing function in the PAD transmitter. So it is available to check the flow rate and totalizing flow. It measures the flow rate by using differential pressure without compensation of temperature and static pressure. The shape of the PAD-F is the same as the standard device and it is only the terminal block which is different since there are two more terminals for the read-out of the pulse output.

Features

Superior performance

- High reference accuracy:
  ±0.075 % of calibrated span
  (optional: ±0.04 % of calibrated span)
- Long-term stability (0.125 % URL for 3 years)
- High rangeability (100:1) for range 4-0

Flexibility

- Data configuration with HART® configurator
- Zero point adjustment

Reliability

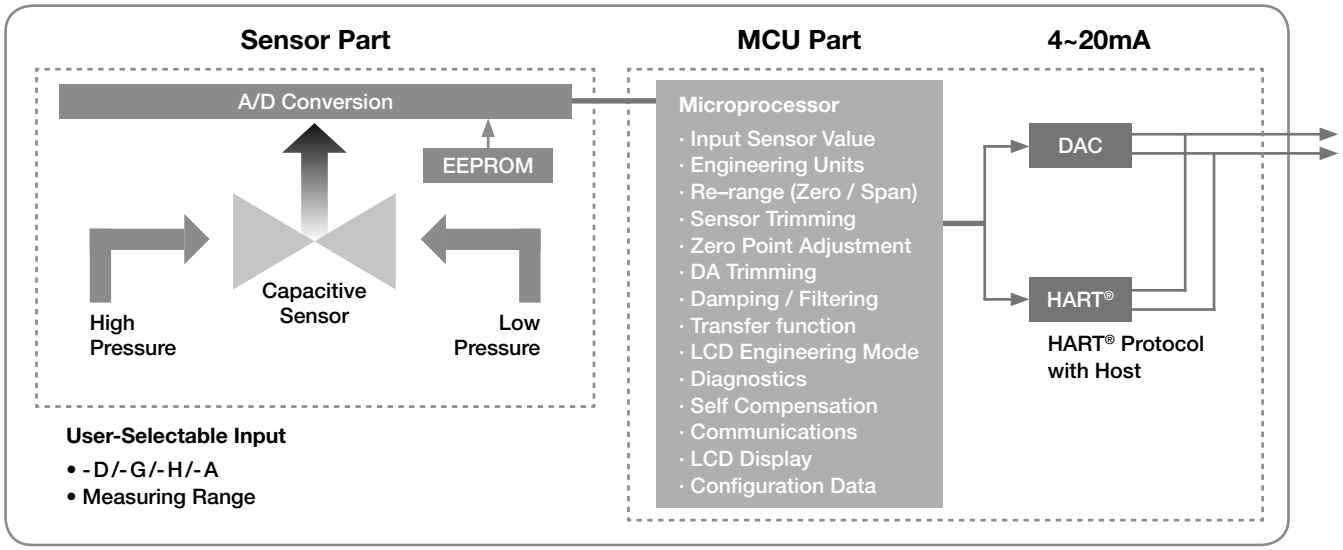
- Continuous self-diagnostic function
- Automatic ambient temperature compensation
- EEPROM write protection
- Fail-mode process function
- CE EMC conformity standards (EN 50081-2, EN 50082-2)

Transmitter Description

Electronics module

The Electronics module consists of a circuit board sealed in an enclosure. There are a MCU module. an analog module, a LCD module and a terminal module in a transmitter. The MCU module acquires the digital value from the analog module and applies correction coefficients selected from EEPROM. The output section of the MCU module converts the digital signal to a 4…20 mA output. The MCU module communicates with the HART®-based configurator or control systems such as DCS. The Power section of MCU module has a DC-to-DC power conversion circuit and an input/output isolation circuit. The LCD module plugs into the MCU module and displays the digital output in a user-configured unit.

Functional Block Diagram



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Sensor inputs

The models PAD - D, - G, and - H are available in a differential pressure sensor of a capacitance type. The capacitance pressure sensor measures differential and gauge pressure and is commonly used in flow and level applications. Both sides in the capacitance sensor transmit process pressure from the process isolators to the sensor. The model PAD-A is also available in an absolute pressure sensor of a piezoresistive type and measures absolute pressure. The sensor module converts the capacitance or the resistance to the digital value. The MCU module calculates the process pressure based on the digital value.

The sensor modules include the following features

- 0.075 % accuracy
- The software of the transmitter compensates thermal effects, improving performance.
- Precise Input Compensation during operation is achieved with temperature and pressure correction coefficients that are characterized over the range of the transmitter and stored in the sensor module EEPROM memory.
- EEPROM stores sensor information and correction coeficients separately from MCU module, allowing an easy repair, reconfiguration and replacement.

Basic Setups

Following settings can be easily configured from any host that support the HART® protocol:

- Operational parameters
- 4-20 mA points (zero/span)
- Engineering units
- Damping time: 0.25...60 sec
- Tag: 8 alphanumeric characters
- Descriptor: 16 characters
- Message: 32 characters
- Date: day/month/year

Calibration and trimming

- Lower/Upper range (zero/span)
- Sensor zero trimming
- Zero point adjustment
- DAC output trimming
- Transfer function
- Self-compensation

Self-diagnosis and others

- CPU & Analog Module Fault Detection
- Communication Error
- Fail-mode handling
- LCD indication
- Temperature measurement of sensor module

Multi Planar Process Connection

Conventionally, in the case where the pressure transmitter should be vertically installed irrespective of the orientation of the process connection lines, modified flanges (as shown above) are required in addition to the basic flanges. Multiplanar pressure transmitter have been made in an effort to solve the problems occurring in the related art, and an object of this multi planar is to provide a pressure transmitter, capable of being vertically installed without separate adaptor or various types of brackets regardless of the position of the process connection lines.

Process Connection Via Diaphragm Seals

For the connection of the differential pressure transmitter model PAD to all different process connections, diverse diaphragm seal versions are necessary.They can be connected to the differential pressure transmitter by direct mounting or via a capillary tube. Depending on the application different combinations of diaphragm seals, capillary tubes and fill fluids are possible. To clarify those possibilities, the special connections via diaphragm seals are always to be requested separately to the differential pressure transmitter.

Technical Details

Measuring principle:	Capacitance sensor (PAD-D, -F, -G, -H) Piezo-resistive (PAD-A)
Measuring span:	0.75…15 mbar up to 4.137…413.70 bar (depending on instrument version) Zero and span values can be set anywhere within the range limits Span must be greater than or equal to the minimum span
Accuracy:	• for range 2 ±0.25 % of span for 0.1 URL ≤ span ≤ URL ±[0.24 + (0.008 x (URL/span)) % of span for 0.05 URL ≤ span ≤0.1 URL • for range 3 ±0.075 % of span for 0.1 URL ≤ span ≤ URL ±[0.25 + (0.005 x (URL/span))] % of span for 0.02 URL ≤ span ≤0.1 URL • for range 4 to 0 ±0.075 % of span for 0.1 URL ≤ span ≤ URL ±[0.025+(0.005x(URL/span))] % of span for 0.01 URL ≤ span ≤0.1 URL
Turndown ratio:	ranges 4 ~ 0 = 100 : 1 range 3 = 50 : 1 range 2 = 20 : 1
Process temperature:	-40 °C…+120 °C (Approval codes may effect limits. Max. ambiant temperature at LCD = +80 C.)
Ambient temperature:	-30 °C…+80 °C
Storage temperature:	-40 °C…+85 °C (without condensing)
Humidity limit:	5 %...100 % RH

Pressure limits (with silicone oil)

(valid for stand-alone intruments only without assembled diaphragm seals)

Model D and G	0…137.9 bar (for range 2...8)
Model G	0…400 bar (for range 9) 0...750 bar (for range 0)
Model H	0…310 bar (for range 4...7)
Model A	0…5 bar (for range 4) 0…30 bar (for range 5) 0…52 bar (for range 6)

• Burst pressure

Model D, G and H	689 bar 800 bar (for model G, range 0)
Model A	10 bar (for range 4) 40 bar (for range 5) 70 bar (for range 6)

Wetted materials

Isolating diaphragms:	1.4404 (316L st. st), Monel, Tantalum, HAST-C
Drain/Vent valves:	1.4401 (316 st.st), HAST-C
Flanges and adapters:	1.4401 (316 st.st), HAST-C
O-ring:	FPM, PTFE as an option

Non-wetted materials

Fill fluid:	silicone oil or inert fill
Bolts:	stainless steel
Electronics housing:	aluminum, or 316L st.st. (option) flameproof (Ex d) and waterproof (IP67)
Cover o-ring:	NBR
Paint:	epoxy-polyester or polyurethane
Mounting bracket:	for 2-inch pipe, 1.4301 (304 sst), with 1.4301(304 sst) U-bolt
Nameplate:	1.4301 (304 sst)
Process connections:	¼" NPT with 54.0 mm centre distance for standard flanges ½" NPT with process adapter (option)
Mounting position:	upright (process connection more flexible by using multi-planar flange)
Display:	5 Digit LCD
Power supply:	12…45 V_{DC} -operation 17.5…45 V_{DC} -HART® communication
Maximum load:	250 Ω at 17.5 V_{DC} 550 Ω at 24 V_{DC} max. loop resistance = $\frac{(U - 12\ V_{DC})}{0.022\ A}$
Loop load:	0...1500 Ω - operation 250...550 Ω - HART® communication
Failure mode:	fail high: current ≥ 21.1 mA fail low: current ≤ 3.78 mA
Electrical connection:	½" NPT conduit with M4 screw terminals (G½ option)
Output:	• two wire 4…20 mA, userconfigurable for linear or square root output, digital process value superimposed on 4…20 mA signal, available to any host that conforms to the HART® protocol • frequency output for flowmeter model PAD-F with pulse width of 10, 50 or 100 ms (selectable, negative going pulse) output type: open collector, 30 V, 500 mA max. pulse rate: 49 pulses/sec max.
Update time:	0.12 seconds
Turn-On time:	3 seconds
Protection:	IP 67 for Standard (code S)
Weight:	3.9 kg (excluding options) standard 0…750 bar (for range 0) 5.35 kg (st. st. housing - excl. options)
ATEX approval:	⟨Ex⟩ II 2G Exd IIC T6…T5 (option)

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Order Details (Example: **PAD-D EE 2 S 2 N S 0 0**)

Model	Version	Material Body/vent plug/ diaphragm	Calibrated span (Measuring range limits for PAD-D, -F, -G and -H in separate table)
PAD-	**D** = differential pressure transmitter (static pressure 138 bar) **F**[1)] = differential pressure transmitter with pulse output and totalizer especially for flow measurement **H** = differential pressure transmitter for high line pressure (static pressure 310 bar) **G** = gauge pressure transmitter **A** = absolute pressure transmitter	**EE** = 316 st. steel/316 st. steel/316L st. steel **EH** = 316 st. steel/316 st. steel/HAST-C **EM** = 316 st. steel/316 st. steel/Monel **ET** = 316 st. steel/316 st. steel/Tantalum **HH** = HAST-C/HAST-C/HAST-C **HM** = HAST-C/HAST-C/Monel **HT** = HAST-C/HAST-C/Tantalum	**Calibrated span for PAD-D, -F, -G, -H** **2**[3)] = 0.75...15 mbar **3** = 1.5...75 mbar **4** = 3.73...373 mbar **5** = 18.65 mbar...1.865 bar **6** = 69 mbar...6.9 bar **7** = 206.8 mbar...20.68 bar **8**[3)] = 689.5 mbar ...68.95 bar **9**[3)4)] = 2.068...206.80 bar **0**[3)4)] = 4.137...413.70 bar **X**[2)] = special **Calibrated span for PAD-A** **4** = 25 mbar...2.5 bar **5** = 150 mbar...15 bar **6** = 250 mbar...25 bar **X**[2)] = special

Order Details continued:

Filling liquid	Process connection	Electrical connection	Approvals for hazardous applications	Manifold valve[6)]	Options
S = silicone **I** = inert filling liquid **X**[2)] = special	**2** = ¼" NPT female (standard) **4** = ½" NPT female (adapter) **X**[2)] = special	**N** = ½" NPT epoxy-polyester painted aluminium **G** = G ½ epoxy-polyester painted aluminium **X**[2)] = special	**S** = standard (waterproof IP67) **F** = ATEX, flameproof, Ex d **E*** = ATEX, intrinsically safe, Ex i ***option E in preparation**	**0** = without **2** = manifold 2-ways (st. steel) **3** = manifold 3-ways (st. steel) **5** = manifold 5-ways (st. steel)	**0** = without **C** = engineering unit (must be chosen when using the differential transmitter as a flowmeter) **D** = teflon o-ring (wetted part) **E** = oil free finish **F** = side vent / drain bottom **G** = side vent / drain top **H** = multi-planar process connection **M** = housing in stainless steel **N**[5)] = mounting of PAD onto diaphragm seal **Y**[2)] = special

[1] specify flow rate engineering unit, Δ p and flow rate
at URV (Upper Range Value), Δ p and flow rate (generally '0')
at LRV (Lower Range Value)
pulse scale (choose only one value from
0.001, 0.01, 0.1, 1, 10, 100, 1000, 10000 m³/pulse) and
pulse width (choose only one value from
10 ms, 50 ms, 100 ms), while ordering so that max.
duty cycle is 49 pulses/sec

[2] Order code X and Y must be specified in writing
[3] not for PAD-H
[4] not for PAD-D and PAD-F
[5] Diaphragm seal model and application data to be speicified in clear text. Application Index on pages 15, 16 to be filled out. For summary of diaphragm seal models and possible ranges, see following page 11 on wards. For dimensional details see DRM data sheet.
[6] Remote type. Option '2' possible only with PAD-G/A...

Order Details Mounting brackets

Description	Order number
Angle type bracket for PAD/PAS vertical pipe mounting for PAS vertical pipe mounting for PAD incl. U-Clamp for 2“ pipe mounting bracket and 2 x mounting nuts/ washers incl. 4 x mounting screws for PAS incl. 4 x mounting screws for PAD	**ZUB-PAD/PAS-K**
Flat type bracket for PAD/PAS horizontal pipe mounting for PAS vertical pipe mounting for PAD incl. U-Clamp for 2“ pipe mounting bracket and mounting nuts/ washers incl. 4 x mounting bolts and washers for PAS incl. 4 x mounting bolts for PAD	**ZUB-PAD/PAS-L**

Measuring Range Limits for PAD-D, -F, -G and -H

Range code	Calibrated span	Lower range limit (LRL)			Upper range limit (URL)
		PAD-D, -F	PAD-G	PAD-H	
2	0.75...15 mbar	- 15 mbar	- 15 mbar	-	15 mbar
3	1.5...75 mbar	-75 mbar	-75 mbar	-	75 mbar
4	3.73...373 mbar	-373 mbar	-373 mbar	-373 mbar	373 mbar
5	18.65 mbar...1.865 bar	-1.865 bar	-1 bar	-1.865 bar	1.865 bar
6	69 mbar...6.9 bar	-6.9 bar	-1 bar	-6.9 bar	6.9 bar
7	206.8 mbar...20.68 bar	-20.68 bar	-1 bar	-20.68 bar	20.68 bar
8	689.5 mbar ...68.95 bar	-68.95 bar	-1 bar	-	68.95 bar
9	2.068...206.80 bar	-	-1 bar	-	206.80 bar
0	4.137...413.70 bar	-	-1 bar	-	413.70 bar

* Special Measuring span with adequate lower and upper range limits on request

Unit Conversion

Range code	bar	kg/cm²	KPa	psi	in H_2O at 4 °C	mm H_2O at 4 °C	in Hg at 0 °C
2	0.015	0.015	1.5	0.217	6	152	0.422
3	0.075	0.076	7.5	1.087	30	765	2.215
4	0.373	0.38	37.3	5.410	149	3804	11.014
5	1.865	1.902	186.5	27.049	749	19018	55.072
6	6.900	7.036	690	100.073	2773	70361	203.750
7	20.681	21.088	2068	299.930	8310	210878	610.660
8	68.950	70.309	6895	1000.009	27708	703097	2036.025
9	206.800	210.876	20680	2999.303	83105	2108781	6106.597
0	413.700	421.856	41370	6000.211	166085	4218566	12216.550

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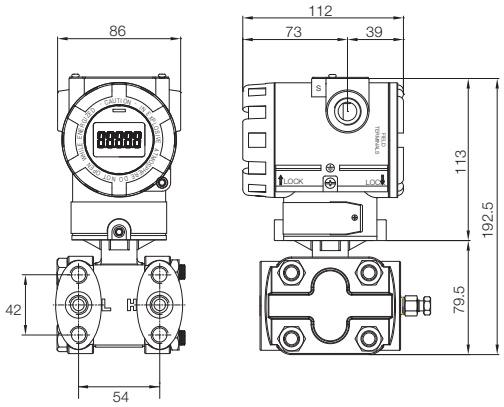
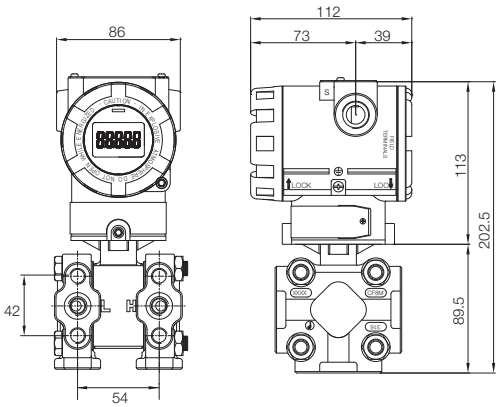
Dimensions

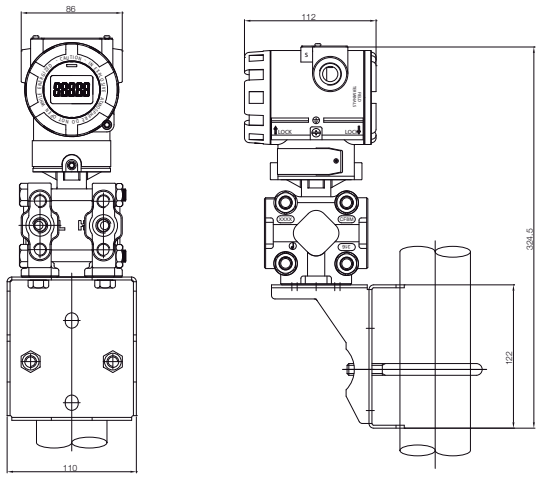
PAD standard*



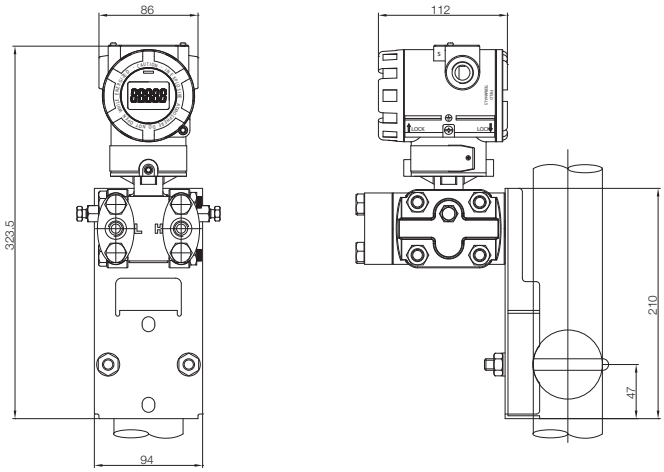
PAD multi planar process connection*



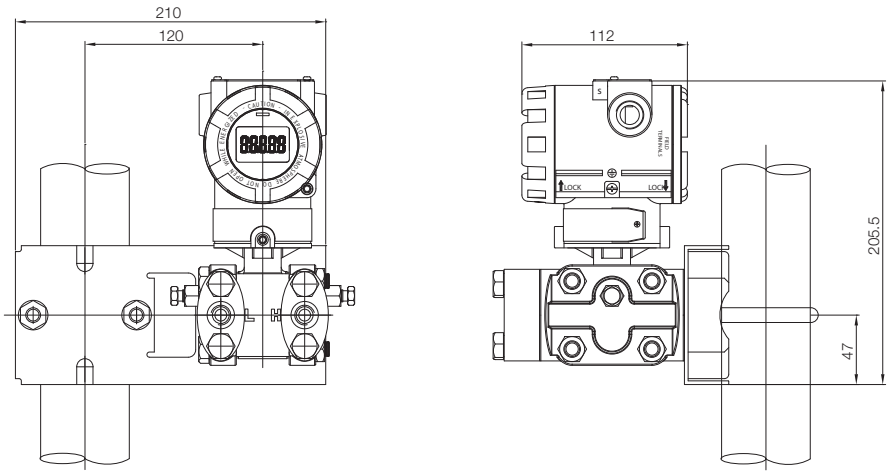
PAD with multi planar flange and angle type bracket*



PAD standard with flat type bracket (vertical mounted)*

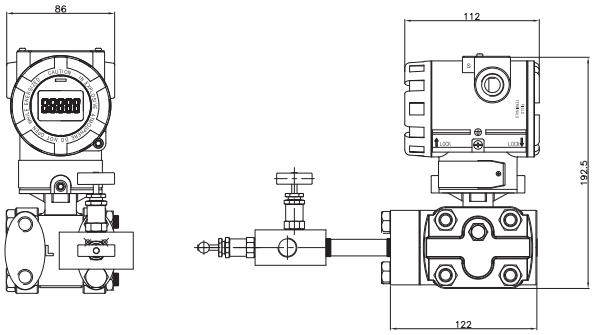


PAD standard with flat type bracket (horizontal mounted)*



* For PAD-G/A, the low pressure port 'L' is always closed

PAD-G/A mounted with 2-way manifold valve*



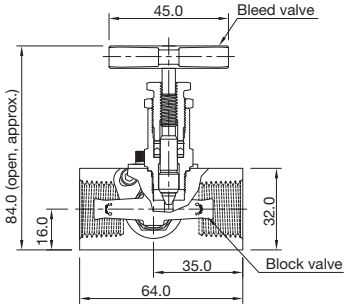
* For PAD-G/A, the low pressure port 'L' is always closed

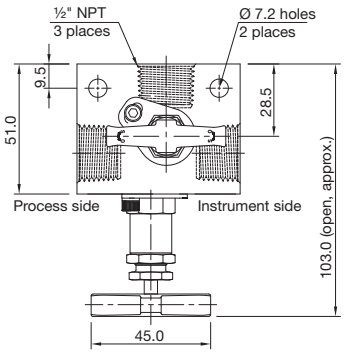
Manifold valves (remote type)

Technical Specifications:

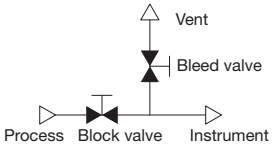
Material: 316SS
Connection & Size: ½" NPT (F)
Pressure rating: 6,000 psig at 38 °C (≈410 bar)
Temperature range: -54 °C ... +232 °C

2-way Manifold valve

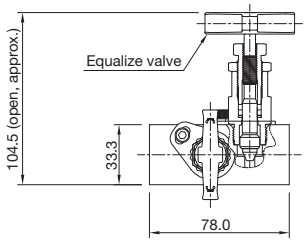


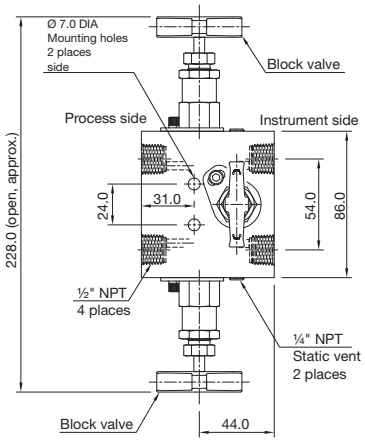


Weight: 0.8 kg

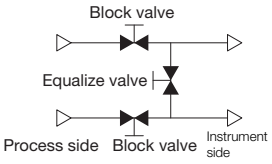


3-way Manifold valve

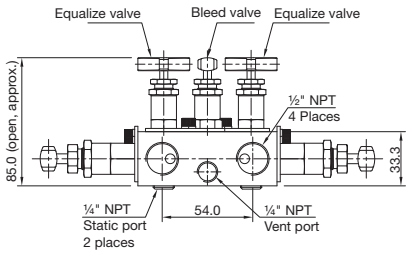


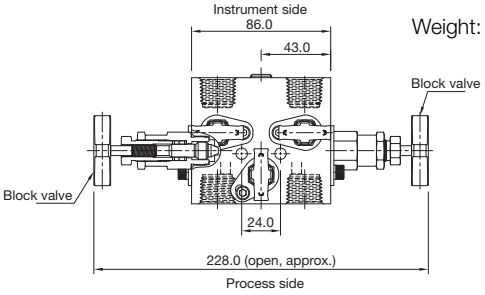


Weight: 2 kg

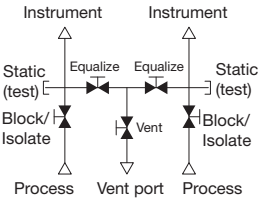


5-way Manifold valve





Weight: 2.2 kg



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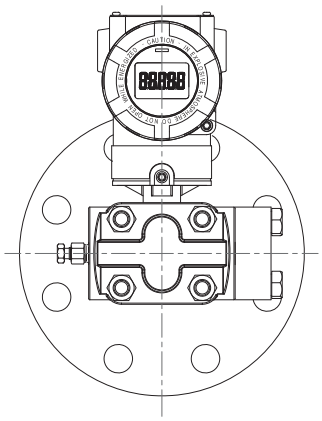
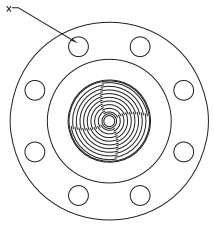
Example of PAD direct assembed with (extended) diaphragm seal

(for dimensional details, see DRM data sheet)





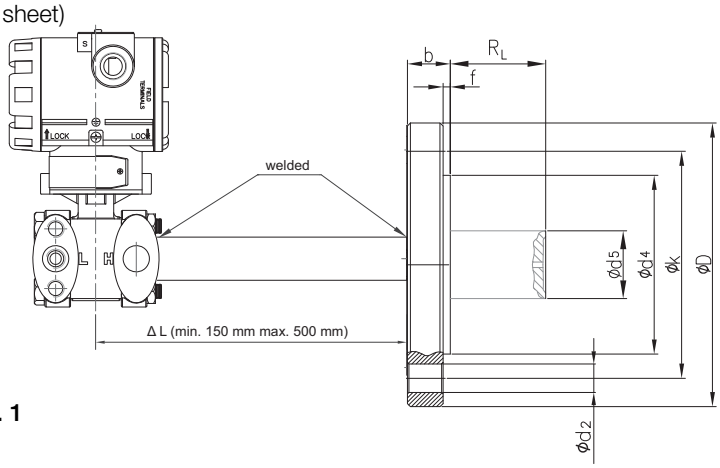


Fig. 1

Dimensions (mm): Examples for DN50 / DN 80/DN100 / 2" ANSI / 3" ANSI/4"ANSI

Flange type	D	k	d_2	b	f	d_4	X	d_5	R_L
DN50 PN16	165	125	18	18	2	102	4	48	50 mm (2")/ 100 mm (4")/ 150 mm (6")/ 200 mm (8")/ (customer specified)
DN50 PN40	165	125	18	20	2		4	48	
2" ANSI Cl. 150	152.4	120.6	19	19.1	2	92	4	48	
2" ANSI Cl. 300	165.1	127	19	22.3	2		8	48	
DN80 PN16	200	160	18	20	2	138	8	76	
DN80 PN40	200	160	18	24	2		8	76	
3" ANSI Cl. 150	190.5	152.4	19	23.9	1.6	127	4	76	
3" ANSI Cl. 300	209.5	168.3	22	28.4	1.6		8	76	
DN100 PN16	220	180	18	20	2	149	8	89	
DN100 PN40	235	190	22	24	2	149	8	89	
4" ANSI Cl. 150	228.6	190.5	19	24	1.6	157.2	8	89	
4" ANSI Cl. 300	254	200	22	32	1.6	157.2	8	89	

Example of PAD assembed with remote diaphragm seals and capillaries

(for dimensional details, see DRM data sheet)

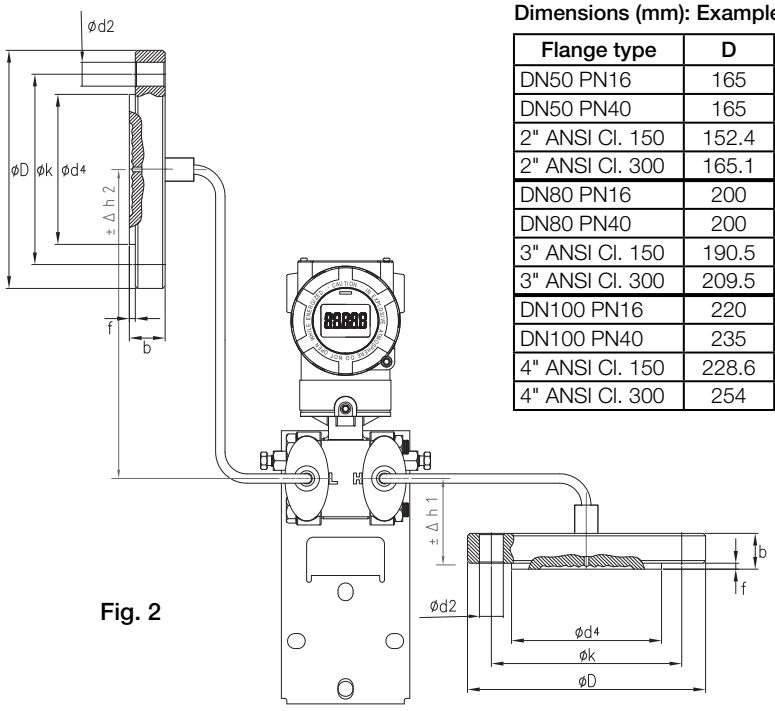
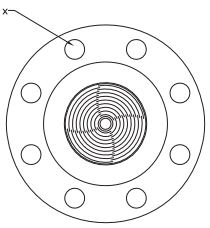


Fig. 2

Dimensions (mm): Examples for DN50 / DN 80/DN100 / 2" ANSI / 3" ANSI/4"ANSI

Flange type	D	k	d_2	b	f	d_4	X
DN50 PN16	165	125	18	18	2	102	4
DN50 PN40	165	125	18	20	2		4
2" ANSI Cl. 150	152.4	120.6	19	19.1	2	92	4
2" ANSI Cl. 300	165.1	127	19	22.3	2		8
DN80 PN16	200	160	18	20	2	138	8
DN80 PN40	200	160	18	24	2		8
3" ANSI Cl. 150	190.5	152.4	19	23.9	1.6	127	4
3" ANSI Cl. 300	209.5	168.3	22	28.4	1.6		8
DN100 PN16	220	180	18	20	2	149	8
DN100 PN40	235	190	22	24	2	149	8
4" ANSI Cl. 150	228.6	190.5	19	24	1.6	157.2	8
4" ANSI Cl. 300	254	200	22	32	1.6	157.2	8



Example of PAD-G remote assembled with (extended) diaphragm seal and capillary
(for dimensional details, see DRM data sheet)

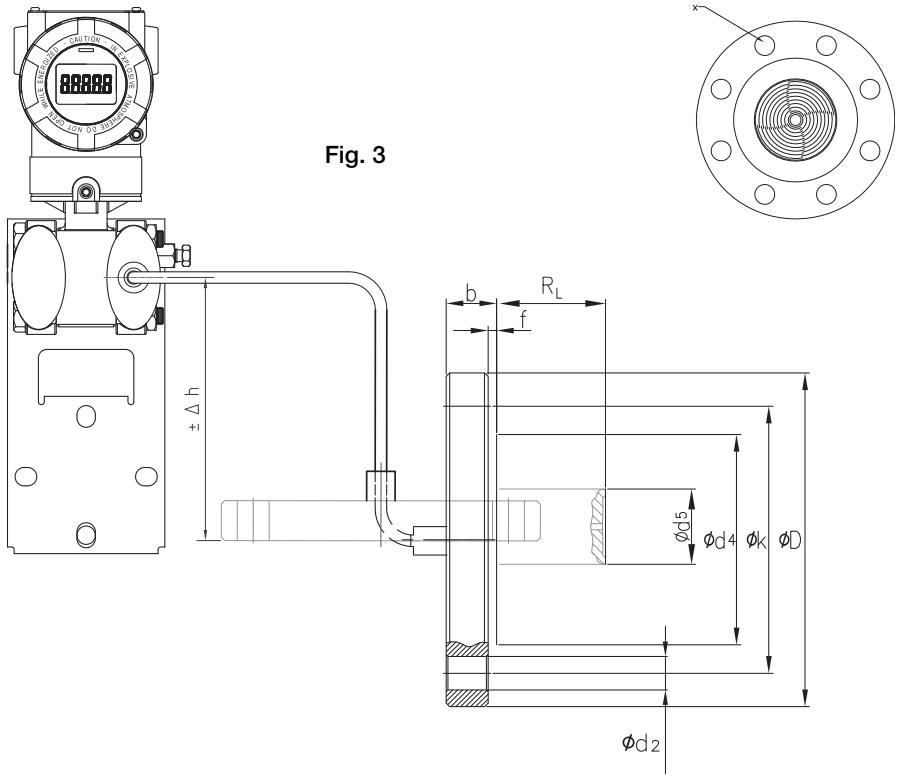


Fig. 3

Dimensions (mm): Examples for DN50 / DN80 / DN100 / 2" ANSI / 3" ANSI / 4" ANSI

Flange type	D	k	d_2	b	f	d_4	X	d_5	R_L
DN50 PN16	165	125	18	18	2	102	4	48	50 mm (2")/ 100 mm (4")/ 150 mm (6")/ 200 mm (8")/ (customer specified)
DN50 PN40	165	125	18	20	2		4	48	
2" ANSI Cl. 150	152.4	120.6	19	19.1	2	92	4	48	
2" ANSI Cl. 300	165.1	127	19	22.3	2		8	48	
DN80 PN16	200	160	18	20	2	138	8	76	
DN80 PN40	200	160	18	24	2		8	76	
3" ANSI Cl. 150	190.5	152.4	19	23.9	1.6	127	4	76	
3" ANSI Cl. 300	209.5	168.3	22	28.4	1.6		8	76	
DN100 PN16	220	180	18	20	2	149	8	89	
DN100 PN40	235	190	22	24	2	149	8	89	
4" ANSI Cl. 150	228.6	190.5	19	24	1.6	157.2	8	89	
4" ANSI Cl. 300	254	200	22	32	1.6	157.2	8	89	

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