

IOM-DPC-DPR-D : APR 2018

DELTA CONTROLS

MANUFACTURE OF PRESSURE TRANSMITTERS
AND CONTROL INSTRUMENTS

USER'S MANUAL

SMART PRESSURE TRANSMITTER

type: **DPC-2000ALW**,

SMART DIFFERENTIAL PRESSURE TRANSMITTER

type: **DPR-2000ALW, DPR-2200ALW, DPR-2000GALW,**
DPR-2000ALW/L..., DPR-2200ALW/L...

SMART LEVEL PROBE

type: **DPR-2000YALW**

SMART LEVEL TRANSMITTER **DPC-2000ALW/L...**

DELTA CONTROLS LTD.

Riverside Business Park, Dogflud Way, Farnham, Surrey, GU9 7SS,

+44 (0) 1252 729140, fax 44 (0) 1252 729168

www.delta-controls.com, e-mail: sales@delta-controls.com

Symbols used

Symbol	Description
	Warning to proceed strictly in accordance with the information contained in the documentation in order to ensure the safety and full functionality of the device.
	Information particularly useful during installation and operation of the device.
	Information particularly useful during installation and operation of an Ex device.
	Information on disposal of used equipment.

BASIC REQUIREMENTS AND SAFE USE

- **The manufacturer will not be liable for damage resulting from incorrect installation, failure to maintain the device in a suitably functional condition, or use of the device other than for its intended purpose.**
- Installation should be carried out by qualified personnel having the necessary authorisation to install electrical and pressure measuring devices. The installer is responsible for performing the installation in accordance with these instructions and with the electromagnetic compatibility and safety regulations and standards applicable to the type of installation.
- The device should be configured appropriately for the purpose for which it is to be used. Incorrect configuration may cause erroneous functioning, leading to damage to the device or an accident.
- In systems with pressure transmitters there exists, in case of leakage, a risk to personnel on the side where the medium is under pressure. All safety and protection requirements must be observed during installation, operation and inspections.
- If a device is not functioning correctly, disconnect it and send it for repair to the manufacturer or to a firm authorised by the manufacturer.



In order to minimise the risk of malfunction and associated risks to personnel, the device is not to be installed or used in particularly hostile conditions, where the following risks occur:

- possibility of mechanical impacts, excessive shocks and vibration;
- excessive temperature fluctuation;
- condensation of water vapour, dust, icing.



Installation of intrinsically safe versions should be performed with particular care, in accordance with the regulations and standards applicable to that type of installation.

Changes in the production of transmitters may precede a paper updating for the user. The current user manuals are available at <http://www.delta-controls.com>

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I. APPENDIX Exd.ATEX



**DPC-2000ALW/XX PRESSURE TRANSMITTER,
DPR-2000ALW/XX, DPR-2200ALW/XX,
DIFFERENTIAL PRESSURE TRANSMITTERS,
DPR-2000YALW/XX LEVEL PROBE,**

Exd VERSION in accordance with ATEX directive

1. Introduction.

1.1. This "Appendix Exd.ATEX" applies to transmitters of types DPC-2000ALW/XX, DPR-2000ALW/XX, DPR-2200ALW/XX and DPR-2000YALW/XX in Exd versions only, marked on the rating plate as shown in p.3 and denoted Exd in the Product Certificate.

1.2. The appendix contains supplementary information relating to the Exd (flame-proof) versions compatible with ATEX directive of mentioned transmitters.

During installation and use of Exd transmitters, reference should be made to **IOM-DPCDPR-C** in conjunction with "Appendix Exd.ATEX".

2. Use of DPC..., DPR... transmitters in dangers zones.

2.1. The transmitters are produced in accordance with the requirements of the following standards:

EN 60079-0:2012, EN 60079-1:2007, EN 60079-11:2012, EN 60079-26:2007, EN 60079-31:2009.

2.2. The transmitters may operate in areas where there is a risk of explosion, in accordance with the rating of the explosion protection design:

I M2 Ex d ia I Mb

(version with enclosure 1.4401(316))

II 1/2G Ex ia/d IIC T6/T5 Ga/Gb



II 1/2D Ex ia/t IIIC T85°C/T100°C Da/Db

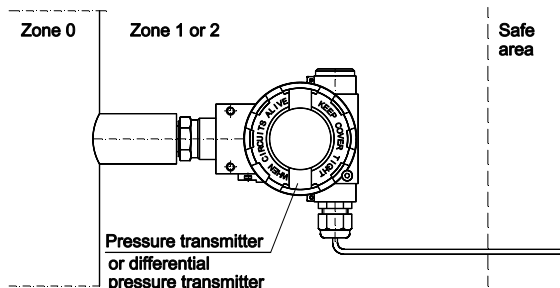
KDB 14 ATEX 0004X

marking T6 and T85 applies to range $-40^{\circ}\text{C} < T_a \leq 45^{\circ}\text{C}$

marking T5 and T100 applies to range $-40^{\circ}\text{C} < T_a \leq 75^{\circ}\text{C}$

2.3. Transmitter category and hazard areas.

The category 1/2G, contained within the rating, means that the transmitter may be installed within a type 1 or 2 hazard zones. The **DPC...**, **DPR...** process connections may connect to a 0 zone type (see the diagram below for an example).



3. Identifying marks.

Flame-proof transmitters must have a rating plate containing the information specified in p.4 of IOM-DPCDPR-C and also at least the following:

- CE mark and number of notified unit: mark;
- Designation of explosion protection design, certificate number;
- Supply voltage;
- Designation of a process connection;
- Year of manufacture;
- Temperature use range.

In place of XX letters in product rating plate will be written a pressure connection type symbols.

4. User information.

Together with the ordered transmitters, the user will receive:

- a. Product Certificate;
- b. Declaration of conformity;
- c. Copy of certificate (on request);
- d. User's Manual named: IOM-DPCDPR-C with Appendix Exd.ATEX.

Items b), c), d) are available on www.delta-controls.com

5. Power supply and exploitation of transmitters.

5.1. The transmitter connecting should be made after introduction with present instruction content.

 Electrically transmitter should be connected according to scheme at p.6 Appendix Exd.ATEX. Transmitter electrical installation should be realised with engineering standard requirements. Electrical connections of transmitters in danger zone should be made by people who have indispensable knowledge and experience in this branch. Earth clamps must be used to earth transmitters. In the event that transmitters come in contact with structural metal parts or pipes which are connected to the equipotential bonding system, transmitters do not require to be earthed.

 **5.2.** Transmitters should be supplied from DC electrical source with voltage max.45V from transformer feeders or other devices which have at least a strengthened isolation among primary and secondary windings in which don't appear voltage higher than 250V. The duty of power supply installation with above mentioned requirements rests on user.

5.3. Transmitters can be used in ambient temperatures (Ta) between $-40^{\circ}\text{C} < \text{Ta} \leq 45^{\circ}\text{C}$ for **class T6** or between $-40^{\circ}\text{C} < \text{Ta} \leq 75^{\circ}\text{C}$ for **T5**.

5.4. Transmitter sensor diaphragm should not be subject on damage during installation and exploitation. The diaphragm is made from 1.4404/1.4435 (316L) or Hastelloy thin foil and cannot be subject on medium which can entail its damage.

5.5. With regard on kind of casing material (light alloy with large aluminium content), the user is obliged to assure, that possibility of hitting casing does not step out in place of transmitter installation.

5.6. In transmitter casing are two holes to assembly of cable glands from thread M20x1.5 or 1/2 NPT.

 **5.7.** Normally transmitters are delivered without installed glands but with blank plugs (corks) in the second hole. The list of cable glands and plugs agreeable with production documentation and accepted by certificate station is specified in Table 1 and Table 2 (p.6 Appendix Exd.ATEX). Customer should install cable glands according to Tables 1 and plugs according to Tables 2 (if plugs aren't installed) or other accordance with flame-proof standards.

 **5.8.** It is necessary to apply a shield cable or without shield cable with round cross-section in protection from elastomer, not moisture absorbing, for example: YKSLY 2 * 1, YnTKSYekw 1 * 2 * 1, LIYCY 2 * In case of need use cable with different structure, customer should co-ordinate this with transmitters' manufacturer to choose intakes with cable diameter.

5.9. The general principles of connecting and the exploitation of transmitter in Exd realization should be compatible with principles and relating standards for Exd casing devices how in p.2.1 Appendix Exd.ATEX, in this including also: EN 600079-14, EN 60079-17.

 **5.10.** During service must be made a check of the tight fastening of covers and the cable glands and the fastening of the cable in the glands. The casing and supply line must be inspected for mechanical damage, and the transmitter rating plate for legibility. Periodic checks should also be made of the diaphragm, which should not carry signs of damage. During maintenance it is recommended that the threads of the covers be lubricated with non-acid vaseline.



Because of the transmitter damage possibility, the ambient temperature should not be allowed to become higher than 80°C, even when there is no explosion risk.

6. The electrical connection way of transmitter's series: DPC-2000ALW/XX, DPR-2000ALW/XX, DPR-2200ALW/XX and DPR-2000YALW/XX in Exd version.

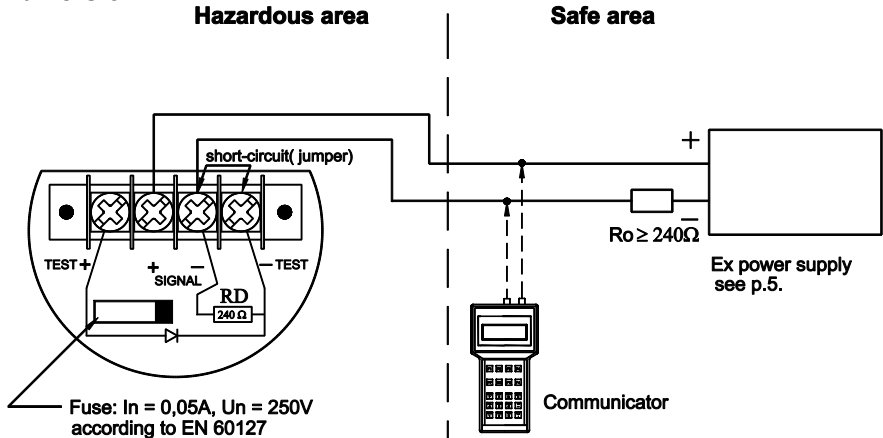


Fig. 2.

In case of transmitter calibration outside danger zone is possible communicator connecting to <SIGNAL+> and <TEST+> terminals. Transmitter is furnished in communication resistor ($R_D = 240\Omega$), closed with jumper at <SIGNAL-> and <TEST-> terminals installed by manufacturer. R_D resistor can be use then, when it is necessary to communicate with transmitter from its terminals and the load resistance (R_o) in current loop is lower then 250Ω . Than <SIGNAL-> and <TEST-> terminals have to be open.



In danger zone don't unscrew transmitter covers and don't change the display position or its back lighting.

Blocking cover method before unscrewing and plumbing possibility is showed at Fig.20.



It is not permitted to repair or otherwise interfere with the transmitter's electrical circuits in any way. Damage estimation and repair possibility may be assessed by the manufacturer or another authorized party only.

Table 1. Permitted cable glands

Type	Producer	Screw	Feature	Other marking	No of certificate	
501/423	HAWKE	M20x1.5	Exd IIC	dimension OS, O, A	Baseefa 06 ATEX 0056X	
501/421	HAWKE	M20x1.5	Exd IIC	dimension OS, O, A	Baseefa 06 ATEX 0056X	
ICG 623	HAWKE	M20x1.5	Exd IIC	dimension OS, O, A	Baseefa 06 ATEX 0058X	
501/453	HAWKE	M20x1.5	Exd IIC	dimension OS, O, A	Baseefa 06 ATEX 0056X	*
501/453/RAC	HAWKE	M20x1.5	Exd IIC	dimension OS, O, A	Baseefa 06 ATEX 0056X	*
501/453/Universal	HAWKE	M20x1.5	Exd IIC	dimension OS, O, A	Baseefa 06 ATEX 0057X	*
ICG 653	HAWKE	M20x1.5	Exd IIC	dimension OS, O, A	Baseefa 06 ATEX 0058X	*
8163/2-A2F	STAHL	M20x1.5	Exd IIC		SIRA06ATEX1188X	
A2F, A2FRC, SS2K	CMP-Products	M20x1.5	Exd IIC		SIRA06ATEX1097X	
E1FW, E1FX/Z, E2FW, E2FX/Z	CMP-Products	M20x1.5	Exd IIC		SIRA06ATEX1097X	*
T3CDS, T3CDSPB	CMP-Products	M20x1.5	Exd IIC		SIRA06ATEX1283X	*
PX2K, PXSS2K, PX2KX, PXB2KX	CMP-Products	M20x1.5	Exd IIC		SIRA06ATEX1097X	*

Table 2. Permitted plugs

Type	Producer	Screw	Feature	Other marking	No certificate	
	AGRO AG	M20x1.5	Exd IIC			
475	HAWKE	M20x1.5	Exd IIC			
477	HAWKE	M20x1.5	Exd IIC			

*) for special cable only.

Special conditions for safe use:

- Permissible gap of joint marked in documentation by L4 is smaller than this was defined in norm EN 60079-1:2007 and cannot be greater than passed value on Fig. 20.
- As the replacing elements, can be used only those specified in the descriptive documentation.

II. APPENDIX Exi.ATEX



**DPC-2000ALW/XX PRESSURE TRANSMITTER,
DPR-2000ALW/XX, DPR-2200ALW/XX, DPR-2000GALW/XX,
DPR-2000ALW/LXX, DPR-2200ALW/LXX
DIFFERENTIAL PRESSURE TRANSMITTERS,
DPR-2000YALW/XX LEVEL PROBE,
DPC-2000ALW/LXX LEVEL TRANSMITTER**

Ex VERSION in accordance with ATEX directive

1. Introduction

1.1. This "Appendix Exi.ATEX" applies to transmitters of types **DPC-2000ALW/XX, DPR-2000ALW/XX, DPR-2200ALW/XX, DPR-2000GALW/XX, DPC-2000ALW/LXX, DPR-2000ALW/LXX, DPR-2200ALW/LXX** and **DPR-2000YALW/XX** in Ex versions only, marked on the rating plate as shown in p.2.2 and denoted Ex in the Product Certificate.

1.2. The appendix contains supplementary information relating to the Ex versions compatible with ATEX directive of mentioned transmitters.

During installation and use of Ex transmitters, reference should be made to **IOM-DPCDPR-C** in conjunction with "Appendix Exi.ATEX".

2. Use of DPC..., DPR... transmitters in danger zones.

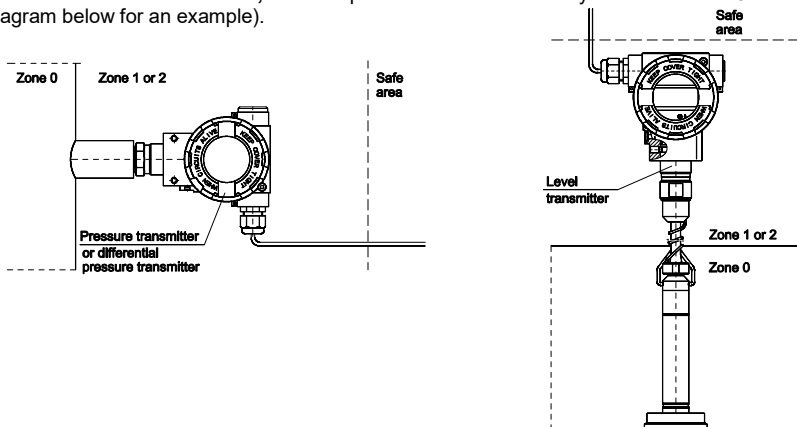
2.1. The transmitters are produced in accordance with the requirements of the following standards: EN 60079-0:2012, EN 60079-26:2007, EN 60079-11:2012, EN 50303:2000.

2.2. The transmitters may operate in areas where there is a risk of explosion, in accordance with the rating of the explosion protection design:

	II 1/2G Ex ia IIC T5/T6 Ga/Gb	(version with Teflon-shielded cable)
	II 1/2G Ex ia IIB T5/T6 Ga/Gb	
	II 1D Ex ia IIIC T105°C Da	
	I M1 Ex ia I Ma	(version with enclosure 1.4401 (316))
FTZÚ 13 ATEX 0210X		

2.3. Transmitter category and hazard areas

The category 1/2G, contained within the rating, means that the transmitter may be installed within a type 1 or 2 hazard zones. The **DPC...**, **DPR...** process connections may connect to a 0 zone type (see the diagram below for an example).



3. Identifying marks.

Intrinsically safe transmitters must have a rating plate containing the information specified in paragraph 4 of IOM-DPCDPR-C and also at least the following:

- CE mark and number of notified unit:  mark;
- Designation of explosion protection design, certificate number;
- Values of parameters such as: U_i , I_i , P_i , C_i , L_i ;
- Year of manufacture;
- Text: "Version SA" - separate power supply for transmitters with surge arresters. Power supply must be separate to earth.

4. User information.

Together with the ordered transmitters, the user will receive:

- a) Product Certificate;
- b) Declaration of conformity;
- c) Copy of certificate (on request);
- d) User's Manual named: IOM-DPCDPR-C with Appendix Exi.ATEX.

Items b), c), d) are available on www.delta-controls.com

5. Permitted input parameters (based on data from the FTZÚ 13 ATEX 0210X certificate, and certification documentation).



The transmitters should be powered via the associated power feeding and measurement devices provided with the relevant intrinsic-safe certificates. The parameters of their outputs to the danger zone should not exceed the limit power supply parameters for the below specified transmitters.

5.1. For power supply with a linear output characteristic

$U_i = 30V$ $I_i = 0.1A$ $P_i = 0.75W$ $-40^\circ C \leq T_a \leq 40^\circ C$ and T6, $-40^\circ C \leq T_a \leq 80^\circ C$ and T5

Power supply with a linear characteristic may be e.g. a typical barrier with parameters

$U_o = 28V$ $I_o = 0.093A$ $R_w = 300\Omega$.

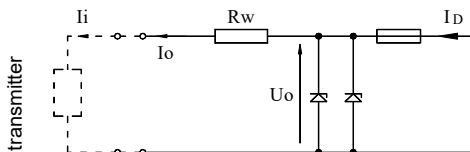


Fig.1. Power supply from a source with linear characteristic.

5.2. For power supply with a trapezoidal output characteristic

$U_i = 24V$ $I_i = 50mA$ $P_i = 0.7W$ $-40^\circ C \leq T_a \leq 80^\circ C$ and T5

Example of power supply from a source with trapezoidal characteristic (see Fig. 2).

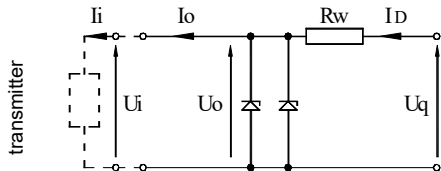


Fig. 2. Power supply from a source with trapezoidal characteristic.

If $U_o < \frac{U_q}{2}$ then parameters U_q , I_o , P_o are interrelated as follows:

$$U_q = \frac{4P_o}{I_o}, \quad R_w = \frac{U_q}{I_o}, \quad P_o = \frac{U_o(U_q - U_o)}{R_w} \quad \text{for } U_o \leq 1/2 U_q$$

5.3. For power supply with a rectangular output characteristic

$U_i = 24V$ $I_i = 25mA$ $P_i = 0.6W$ $-40^\circ C \leq T_a \leq 40^\circ C$ and T5

$U_i = 24V$ $I_i = 50mA$ $P_i = 1.2W$ $-40^\circ C \leq T_a \leq 70^\circ C$ and T5

The supply of power from a source with a rectangular characteristic means that the voltage of the Ex power supply remains constant until current limitation activates.

The protection level of power supplies with a rectangular characteristic is normally "ib".

The transmitter powered from such a supply is also an Ex device with protection level "ib".

Example of practical provision of power supply.

– use a stabilized power supply with $U_o = 24V$ with protection level „ib“ and current limited to $I_o = 25mA$.

5.4. Input inductance and capacity

$C_i = 2.5nF$, $L_i = 18\mu H$

5.5. Supply voltage min.: 10.5VDC**5.6. Load resistance:**

- from 28V linear supply

$$R_{o \max} [\Omega] = \frac{28V - 10.5V^{**} - (300\Omega \cdot 0.0225A)}{0.0225A}$$

- from a source with trapezoidal or rectangular characteristic supply

$$R_{o \max} [\Omega] = \frac{U_{sup.} - 10.5V^{**}}{0.0225A}$$

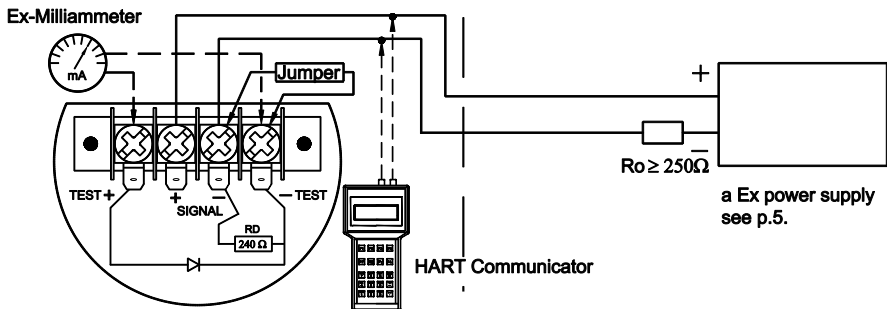
*) barrier resistance;

6. How to connect Ex transmitters DPC..., DPR... ?

The transmitter and other devices in the measuring loop should be connected in accordance with the intrinsic-safety and explosion-safety regulations and the conditions for use in dangerous areas.



Failure to observe the intrinsic-safety regulations can cause explosion and the resulting hazard to people.

Hazardous area**Safe area**

To measure the current in the transmitter without disconnecting the signalling circuit, connect a milliammeter to control sockets TEST+, TEST-.



In hazardous areas, connections to the control terminals must be made using only instruments which are permitted to be used in such areas.



The transmitter is equipped in additional communication resistor $R_D = 240\Omega$.

During normal operation terminals <SIGNAL → and <TEST → are shorted.

R_D resistor is used when you wish to communicate with the transmitter locally (from its terminals) and $R_o < 250\Omega$. Terminals <SIGNAL → and <TEST → must be opened.



If the temperature of the medium exceeds T_a , then suitable separators such as membrane separators or P-type siphon tubes must be used. Transmitter working temperature (T_p) must conform to $T_p \leq T_a$.

Special conditions for safe use:



Version of transmitter with surge arrester, marked on the plate "Version SA", does not meet the requirements of Section 10.3 of the EN 60079-11:2012 (500Vrms). This must be taken into account when installing the equipment.

Transmitter electrical installation should be realised with engineering standard requirements.



It is not allowed to repair or otherwise interfere with the transmitter's electrical circuits in any way. Damage and possible repair may be assessed only by the manufacturer or another authorized party.

III. APPENDIX Ex.IECEx

**DPC-2000ALW/XX PRESSURE TRANSMITTER,
DPR-2000ALW/XX, DPR-2200ALW/XX, DPR-2000GALW/XX,
DPR-2000ALW/LXX, DPR-2200ALW/LXX
DIFFERENTIAL PRESSURE TRANSMITTERS,
DPR-2000YALW/XX LEVEL PROBE,
DPC-2000ALW/LXX LEVEL TRANSMITTER**

Ex VERSION in accordance with IECEx certificate

2. Introduction

1.1. This “Appendix Ex.IECEx” applies to transmitters of types **DPC-2000ALW/XX, DPR-2000ALW/XX, DPR-2200ALW/XX, DPR-2000GALW/XX, DPC-2000ALW/LXX, DPR-2000ALW/LXX, DPR-2200ALW/LXX** and **DPR-2000YALW/XX** in Ex versions only, marked on the rating plate as shown in p.2.2 and denoted Ex in the Product Certificate.

1.2. The appendix contains supplementary information relating to the Ex versions compatible with requirements IECEx of mentioned transmitters.

During installation and use of Ex transmitters, reference should be made to **IOM-DPCDPR-C** in conjunction with “Appendix Ex.IECEx”.

2. Use of DPC..., DPR... transmitters in danger zones.

2.1. The transmitters are produced in accordance with the requirements of the following standards: IEC 60079-0:2011 ed. 6.0, IEC 60079-26:2006 ed. 2.0, IEC 60079-11:2011 ed.6.0.

2.2. The transmitters may operate in areas where there is a risk of explosion, in accordance with the rating of the explosion protection design:

Ex ia IIC T5/T6 Ga/Gb

Ex ia IIB T5/T6 Ga/Gb

(version with Teflon-shielded cable)

Ex ia IIIC T105°C Da

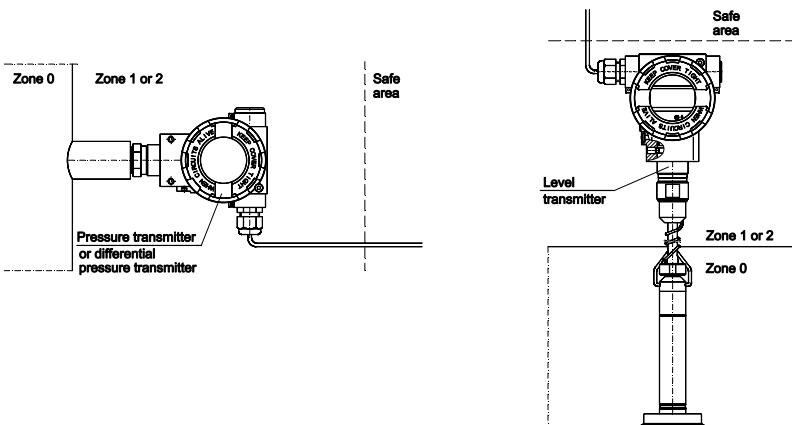
Ex ia I Ma

(version with enclosure 1.4401 (316))

IECEx FTZÚ 15.0027X

2.3. Equipment protection level (EPL) and hazard areas

Equipment protection level (EPL) Ga/Gb, contained within the rating, means that the transmitter may be installed within a type 1 or 2 hazard zones. The **DPC..., DPR...** process connections may connect to a 0 zone type (see the diagram below for an example).



3. Identifying marks.

Intrinsically safe transmitters must have a rating plate containing the information specified in paragraph 4 of IOM-DPCDPR-C and also at least the following:

- Designation of explosion protection design, certificate number;
- Values of parameters such as: U_i , I_i , P_i , C_i , L_i ;
- Year of manufacture;
- Text: "Version SA" - separate power supply for transmitters with surge arresters. Power supply must be separate to earth.

4. User information.

Together with the ordered transmitters, the user will receive:

- e) Product Certificate;
- f) Declaration of conformity;
- g) Copy of certificate (on request);
- h) User's Manual named: IOM-DPCDPR-C with Appendix Exi.IECEx.

Items b), c), d) are available on www.delta-controls.com

5. Permitted input parameters (based on data from the IECEx FTZÚ 15.0027X certificate, and certification documentation).



The transmitters should be powered via the associated power feeding and measurement devices provided with the relevant intrinsic-safe certificates. The parameters of their outputs to the danger zone should not exceed the limit power supply parameters for the below specified transmitters.

5.1. For power supply with a linear output characteristic

$U_i = 30V$ $I_i = 0.1A$ $P_i = 0.75W$ $-40^\circ C \leq T_a \leq 40^\circ C$ and T6, $-40^\circ C \leq T_a \leq 80^\circ C$ and T5

Power supply with a linear characteristic may be e.g. a typical barrier with parameters

$U_o = 28V$ $I_o = 0.093A$ $R_w = 300\Omega$.

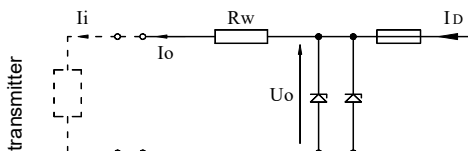


Fig. 1. Power supply from a source with linear characteristic.

5.2. For power supply with a trapezoidal output characteristic

$U_i = 24V$ $I_i = 50mA$ $P_i = 0.7W$ $-40^\circ C \leq T_a \leq 80^\circ C$ and T5

Example of power supply from a source with trapezoidal characteristic (see Fig. 2).

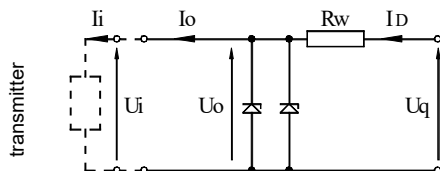


Fig. 2. Power supply from a source with trapezoidal characteristic.

If $U_o < \frac{U_q}{2}$ then parameters U_q , I_o , P_o are interrelated as follows:

$$U_q = \frac{4P_o}{I_o}, \quad R_w = \frac{U_q}{I_o}, \quad P_o = \frac{U_o(U_q - U_o)}{R_w} \quad \text{for } U_o \leq 1/2 U_q$$

5.3. For power supply with a rectangular output characteristic

$U_i = 24V$ $I_i = 25mA$ $P_i = 0.6W$ $-40^\circ C \leq T_a \leq 40^\circ C$ and T5

$U_i = 24V$ $I_i = 50mA$ $P_i = 1.2W$ $-40^\circ C \leq T_a \leq 70^\circ C$ and T5

The supply of power from a source with a rectangular characteristic means that the voltage of the Ex power supply remains constant until current limitation activates.

The protection level of power supplies with a rectangular characteristic is normally "ib".

The transmitter powered from such a supply is also an Ex device with protection level "ib".

Example of practical provision of power supply.

– use a stabilized power supply with $U_o = 24V$ with protection level „ib“ and current limited to $I_o = 25mA$.

5.4. Input inductance and capacity

$C_i = 2.5nF$, $L_i = 18\mu H$

5.5. Supply voltage min.: 10.5VDC**5.6. Load resistance:**

- from 28V linear supply

$$R_o \text{ max } [\Omega] = \frac{28V - 10.5V^{**} - (300\Omega \cdot 0.0225A)}{0.0225A}$$

- from a source with trapezoidal or rectangular characteristic supply

$$R_o \text{ max } [\Omega] = \frac{U_{sup.} - 10.5V^{**}}{0.0225A}$$

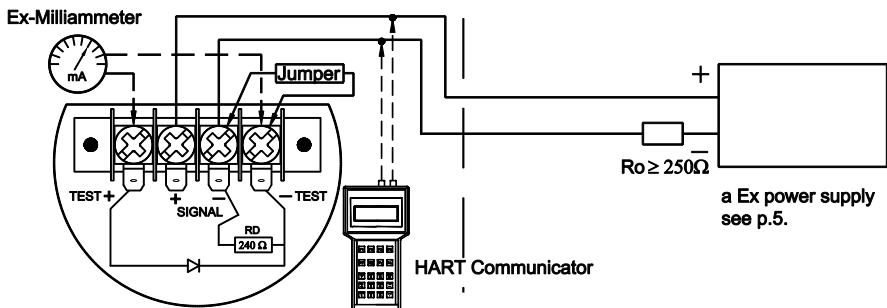
*) *barrier resistance*;

6. How to connect Ex transmitters DPC..., DPR... ?

The transmitter and other devices in the measuring loop should be connected in accordance with the intrinsic-safety and explosion-safety regulations and the conditions for use in dangerous areas.



Failure to observe the intrinsic-safety regulations can cause explosion and the resulting hazard to people.

Hazardous area**Safe area**

To measure the current in the transmitter without disconnecting the signalling circuit, connect a milliammeter to control sockets TEST+, TEST-.



In hazardous areas, connections to the control terminals must be made using only instruments which are permitted to be used in such areas.



The transmitter is equipped in additional communication resistor $R_D = 240\Omega$.

During normal operation terminals <SIGNAL → and <TEST → are shorted.

R_D resistor is used when you wish to communicate with the transmitter locally (from its terminals) and $R_o < 250\Omega$. Terminals <SIGNAL → and <TEST → must be opened.



If the temperature of the medium exceeds T_a , then suitable separators such as membrane separators or P-type siphon tubes must be used. Transmitter working temperature (T_p) must conform to $T_p \leq T_a$.

Special conditions for safe use:



Version of transmitter with surge arrester, marked on the plate "Version SA", does not meet the requirements of Section 10.3 of the IEC 60079-11 (500Vrms). This must be taken into account when installing the equipment.

Transmitter electrical installation should be realised with engineering standard requirements.



It is not allowed to repair or otherwise interfere with the transmitter's electrical circuits in any way. Damage and possible repair may be assessed only by the manufacturer or another authorized party.

IV. FEATURES, INSTALLATION AND MAINTENANCE OF TRANSMITTERS

1. INTRODUCTION

1.1. This Manual is intended for users of **DPC-2000ALW** smart pressure transmitters, **DPR-2000ALW**, **DPR-2200ALW**, **DPR-2000GALW**, **DPR-2000ALW/L**, **DPR-2200ALW/L** smart differential pressure transmitters, **DPR-2000YALW** smart level probe, **DPC-2000ALW/L** smart level transmitter and their intrinsic-safety versions, containing the data and guidelines necessary to understand the functioning of the transmitters and how to operate them. It includes essential recommendations concerning installation and use, as well as emergency procedures. The parameters and information specified for transmitters identified here as **DPC...**, **DPR...** also apply to transmitters: **DPC-2000ALW**, **DPR-2000ALW**, **DPR-2200ALW**, **DPR-2000ALW/L**, **DPR-2200ALW/L**, **DPR-2200GALW**, **DPR-2000YALW**, **DPC-2000ALW/L** and their explosion-proof versions, as well as all the variations differing by the type of the process terminals. Information on the transmitter sizes and the method of installation apply to both, all versions of transmitters.

1.2. Technical data for the diaphragm seals and for the **DPC...** and **DPR...** transmitters are contained in the catalogue cards "**DIAPHRAGM SEALS**".

1.3. The transmitters comply with the requirements of EU directives as shown on the plate and with the relevant Declaration of Conformity.

1.4. Additional data for **DPC-2000ALW**, **DPR-2000ALW**, **DPR-2200ALW**, **DPR-2000GALW** and **DPR-2000YALW** transmitters in intrinsic-safety Ex versions in accordance with ATEX directive is contained in the appendix designed to **IOM-DPCDPR-C Appendix Exi.ATEX** and in flame-proof Exd versions in the appendix designed to **IOM-DPCDPR-C Appendix Exd.ATEX**.



1.5. During installation and use of the transmitters in Exi or Exd version in accordance with ATEX directive, reference should be made to **IOM-DPCDPR-C** in conjunction with **Appendix Exi.ATEX** or **Appendix Exd.ATEX**.

1.6. During installation and use of the transmitters in Exi version in accordance with IECEx, reference should be made to **IOM-DPCDPR-C** in conjunction with **Appendix Exi.IECEx**.

2. USER MATERIALS

Transmitters are delivered in single and/or multiple packs.

Together with the transmitter are delivered:

- a) Product certificate (which is also as the warranty card);
- b) Declaration of conformity (on request);
- c) Copy of certificate (on request);
- d) User's Manual numbered: IOM-DPC-DPR-C.

Items b), c), d) are available on www.delta-controls.com

3. APPLICATIONS AND MAIN FEATURES

3.1. The **DPC...** smart pressure transmitters are designed to measure gauge pressure, vacuum pressure and absolute pressure of gases, vapours and liquids (including corrosive substances).

Differential pressure transmitters type **DPR...** are used to measure liquid levels in closed tanks, with static pressure up to 25MPa, or 32MPa for special versions and to measure differential pressure across constrictions such as filters and orifices.



3.2. The transmitters may be fitted with a range of types of process connectors, which enables them to be used in a variety of conditions such as thick or highly reactive media, high and low temperatures, etc.

3.3. **DPC...**, **DPR...** transmitters generate a 4...20mA output signal and a digital HART signal in a two-wire system (current loop). The use of smart electronics enables regulation of the zero point, the measurement range, damping, radical conversion characteristic and other functions using an Delta DKAP communicator or from a PC using a HART/RS232 or HART/USB/Bluetooth Converter and Delta "D-Soft" configuration software.

4. IDENTIFYING MARKS. ORDERING PROCEDURE

4.1. Every transmitter carries a rating plate containing at least the following information: CE mark, manufacturer name, transmitter type, serial number, pressure range, static pressure limit, output signal, power supply voltage. Version types and the method of specifying the desired product are described in the current "Information Cards" and the Catalogue.

4.2. **DPC...**, **DPR...** transmitters in Ex version or Exd version has additional markings as described in **IOM-DPCDPR-C Appendix Exi or Exd.**

5. TECHNICAL DATA.

5.1. **DPC..., DPR... Common parameters**

5.1.1. **DPC..., DPR... Electrical parameters**

Power supply voltages:

- | | | |
|---------------------|----------------|---|
| - Standard versions | 10 ÷ 55V DC, | |
| - Exi versions | 10.5 ÷ 30V DC | see Appendix Exi.ATEX or Appendix Exi.IECEx |
| - Exd versions | 13.5* ÷ 45V DC | see Appendix Exd.ATEX |

*) Backlight setting of indicates increases the minimum supply voltage for all versions by 3V.

Output signal

4÷20mA + HART rev.5.1

Communication with the transmitter to check its configuration parameters is carried out via HART transmission protocol and signal of 4÷20mA. For this purpose: DKAP-03, DKAP-03Ex communicator, HART/RS232 converter or HART/USB/Bluetooth Converter (DELTA) or another converter, PC computer and D-Soft programme can be used.

Resistance for communication (HART)

min 240Ω

Load resistance

$$R_o[\Omega] = \frac{U_{sup}[V] - 10V^*}{0.0225A}$$

The maximum length of the connection cable

1500m

Value of the minimum supply voltage transmitters in standard version should be calculated from:

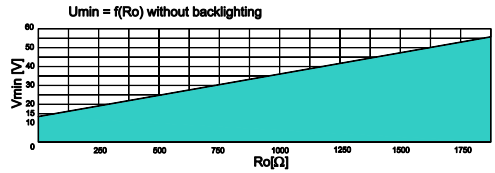
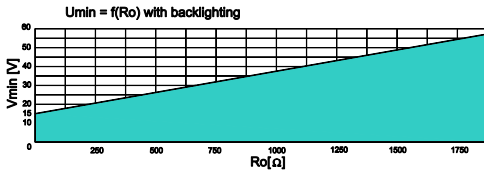


$$U_{supply \min.} = 10^* + 0.0225 \cdot R_o [V]$$

$R_o [\Omega]$ is a total resistance of the measuring line (current loop)

*) for Exi option is necessary to insert to the formulas respectively: 10.5 V.

*) for Exd option is necessary to insert to the formulas respectively: 13.5 V.



Safe working area for normal transmitter (grid) upper colour area.

Output updating time

500ms

Additional electronic damping

0...30s

5.1.2. DPC..., DPR... Construction materials

Diaphragm seal for DPC...

Stainless steel 1.4404/1.4435(316L or Hastelloy C276

Diaphragm seal for DPR...

Stainless steel 1.4404/1.4435(316L) or Hastelloy C276

Sensing module

Stainless steel 1.4404 (316L)

Liquid filling the interior the sensing module

Silicone oil, chemically inactive liquid for measurement of oxygen uses.

Connectors for DPC...

Stainless steel 1.4404 (316L) or

Hastelloy C276 only for P, GP, CM30x2

C-type vented covers and connectors for DPR...

Stainless steel 1.4404 (316L)

Electronics casing

High pressure cast of aluminium alloy, lacquered with chemical-resistant oxide enamel, colour cobalt blue (RAL 5013)

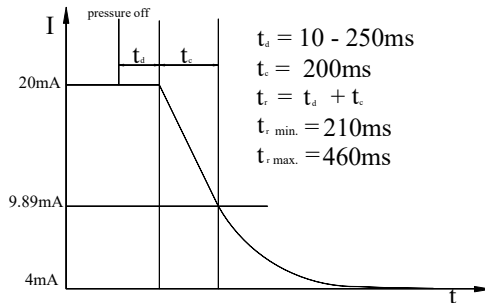
Materials for DPC... DPR... transmitters with diaphragm seals are described in Diaphragm Seals Manual.

5.1.3. Enclosure ingress protection

IP 66,67 according to EN 60529

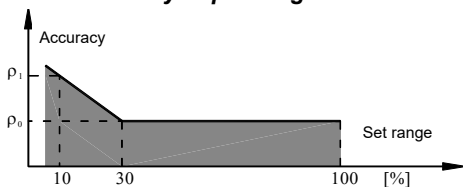
IP 65 according to EN 60529 with PD connector

5.1.4. Response time on pressure stroke.



DPC..., DPR... transmitter wit 4 – 20mA output, response time on pressure stroke t_r measuring cycle 0,5s , damping = 0.

5.1.5. Accuracy depending on the set range



ρ_0 – error for nominal measuring range (0...100%FSO)

ρ_1 - error for range (0...10%FSO)

$\rho_1 = 2 \times \rho_0$

5.2. DPC-2000ALW Measurement ranges and metrological parameters.

5.2.1. DPC..., Measurement ranges

N°	Nominal measuring range (FSO)	Minimum set range	Rangeability	Overpressure limit (without hysteresis)
1.	0...1000bar (0...100MPa)	10bar (1MPa)	100:1	1200bar (120MPa)
2.	0...300bar (0...30MPa)	3bar (300kPa)	100:1	450bar (45MPa)
3.	0...160bar (0...16MPa)	1,6bar (160kPa)	100:1	450bar (45MPa)
4.	0...70bar (0...7MPa)	0,7bar (70kPa)	100:1	140bar (14MPa)
5.	0...25bar (0...2,5MPa)	0,25bar (25kPa)	100:1	50bar (5MPa)
6.	0...7bar (0...0,7MPa)	0,07bar (7kPa)	100:1	14bar (1,4MPa)
7.	-1...7bar (-100...700kPa)	0,07bar (7kPa)	114:1	14bar (1,4MPa)
8.	0...2bar (0...200kPa)	100mbar (10kPa)	20:1	4bar (400kPa)
9.	0...1bar (0...100kPa)	50mbar (5kPa)	20:1	2bar (200kPa)
10.	-0,5...0,5bar (-50...50kPa)	50mbar (5kPa)	20:1	2bar (200kPa)
11.	0...0,25bar (0...25kPa)	25mbar (2,5kPa)	10:1	1bar (100kPa)
12.	-100...100mbar (-10...10kPa)	20mbar (2kPa)	10:1	1bar (100kPa)
13.	-15...70mbar* (-15...7kPa)	5mbar (0,5kPa)	17:1	0,5bar (50kPa)
14.	0...1,3bar abs (0...130kPa abs)	100mbar abs (10kPa abs)	13:1	2bar (200kPa)
15.	0...7bar abs (0...7MPa abs)	100mbar abs (10kPa abs)	70:1	14bar (1,4MPa)
16.	0...25bar abs (0...2,5MPa abs)	0,25bar abs (25kPa abs)	100:1	50bar (5MPa)
17.	0...70bar abs (0...7MPa abs)	0,7bar abs (70kPa abs)	100:1	140bar (14MPa)

* - only for transmitters without diaphragm seal.

5.2.2. DPC... Permitted environmental conditions

Operating temperature range $-40^{\circ}\text{C} \div 85^{\circ}\text{C}$



Operating temperature range for intrinsic-safe versions in accordance with Appendix Exi.ATEX or Appendix Exi.IECEx.

Operating temperature range for flame-proof versions in accordance with Appendix Exd.ATEX.

Medium temperature range

$-40^{\circ}\text{C} \div 120^{\circ}\text{C}$ – for direct measurement,
over 120°C measurement with a transmission tube or diaphragm seal using

Thermal compensation range

$-25^{\circ} \div 80^{\circ}\text{C}$, ($-40^{\circ} \div 80^{\circ}\text{C}$ for special version)

Relative humidity

max 98% with condensation

5.2.3. DPC..., Metrological parameters

Accuracy

max $\pm 0,075\%$ for the basic range (0,16% for range 14)

Long term stability

$\leq$ accuracy / 3 years (for the nominal measuring range)

or $\leq 2 \times$ accuracy / 5 years (for the nominal measuring range)

Error due to supply voltage changes

max $\pm 0,002\%(\text{FSO})/1\text{V}$

Thermal error

max $\pm 0,05\%(\text{FSO})/10^{\circ}\text{C}$

max $\pm 0,1\% \text{ FSO}/10^{\circ}\text{C}$ for n°12, 13 ranges.

Thermal error for the whole thermal compensation range

max $\pm 0,25\%(\text{FSO})$

(max $\pm 0,4\% \text{ FSO}/10^{\circ}\text{C}$ for n°12, 13 ranges.

5.2.4. DPC..., Pressure Connectors

- M-type connector with M20x1.5 thread – see Figure 6a;
- P-type connector with M20x1.5 thread – see Figure 7a;
- CM30x2-type connector with flush diaphragm – see Figure 8a;
- G1/2 -type connector with G1/2" thread – see Figure 9a;
- GP -type connector with G1/2" thread;
- CG1-type connector with G1" thread and flush diaphragm – see Figure 9e;
- RM-type connector with M20x1.5 thread and radiator;
- RP-type connector with M20x1.5 thread and radiator;
- G1/4-type connector with G1/4 thread;
- 1/2"NPT -type connector with 1/2"NPT tread;
- R1/2-type connector with R1/2 tread;
- CG1/2-type connector with G1/2 tread and flush diaphragm;
- other connection types by arrangement.

5.3. DPR-2000ALW, DPR-2000ALW/L, DPR-2200ALW, DPR-2200ALW/L Measurement ranges and metrological parameters.

5.3.1. DPR-2000ALW, DPR-2000ALW/L, Measurement ranges

N°	Nominal measuring range (FSO)	Minimum set range	Rangeability	Overpressure limit	Static pressure limit
1	0...70bar (0...7MPa)	7bar (700kPa)	10:1	250, 320bar (40bar for P-type connector)	
2	0...16bar (0...1,6MPa)	1,6bar (160kPa)	10:1		
3	0...2,5bar (0...250kPa)	0,2bar (20kPa)	12,5:1		
4	0...1bar (0...100kPa)	50mbar (5kPa)	20:1		
5	0...0,25bar (0...25kPa)	10mbar (1kPa)	25:1		
6	-0,5...0,5bar (-50...50kPa)	0,1bar (10kPa)	10:1		
7	-100...100mbar (-10...10kPa)	10mbar (1kPa)	20:1		
8	-5...70mbar (-0,5...7kPa)	4mbar (0,4kPa)	18:1		
9	-20...20mbar (-2...2kPa)	2mbar (0,2kPa)	20:1		20 bar

5.3.2. DPR-2200ALW, DPR-2200ALW/L, Measurement ranges

Nominal range (FSO)	Minimum set range	Vertical spacing of diaphragm seals.	Maximum configurable range dependent on the actual vertical spacing of diaphragm seals (m)	Static pressure limit
-160...160 mbar	0,1 mH ₂ O	≤ 1,7m	[1,6+(vertical spacing of sealsx94)]mH ₂ O	40bar
-0,5...0,5 bar	0,5 mH ₂ O	≤ 6m	[5+(vertical spacing of sealsx1,04)]mH ₂ O	40bar
-1,6...2 bar	1,5 mH ₂ O	≤ 15m	[20+(vertical spacing of sealsx1,04)]mH ₂ O	40bar
-1,6...16 bar	1bar	≤ 15m	16bar	40bar

The maximum vertical diaphragm seal spacing shown in the table applies to level measurement, ensuring that it is possible to set the zero point of the transmitter when the tank is empty.

For measurements of density or phase boundaries (in the sugar and chemical industries and in refineries) the vertical spacing of the diaphragm seals can be larger.

5.3.3. DPR... Permitted environmental conditions

Operating temperature range

-25°C ÷ 85°C

Operating temperature range for intrinsic-safe versions in accordance with Appendix Exi.ATEX or Appendix Exi.IECEx.



Operating temperature range for flame-proof versions in accordance with Appendix Exd.ATEX.

Medium temperature range

-25°C ÷ 120°C – for direct measurement,
over 120°C measurement with a transmission
tube or diaphragm seal using

Thermal compensation range

-25° ÷ 80°C

Relative humidity

max 98% with condensation

5.3.4. DPR-2000ALW, DPR-2000ALW/L, DPR-2200ALW, DPR-2200ALW/L, Metrological parameters

Accuracy	± 0,075% (FSO) for the DPR-2000ALW nominal range ± 0,01% (FSO) for the DPR-2000ALW nominal range (range n°9) ± 0,01% (FSO) for the DPR-2200ALW
Long term stability	≤ accuracy / 3 years
Error due to supply voltage changes	± 0,002%(FSO)/1V
Thermal error	± 0,05%(FSO)/10°C for range n° 1...8 ± 0,08%(FSO)/10°C for range n° 9
Thermal error for the whole thermal compensation range	± 0,3%(FSO)
Zero shift error for static pressure*	± 0,08 % (FSO)/10bar (for range n°2, 7) ± 0,01 % (FSO)/10bar (for range n°3, 4, 5, 6) ± 0,03 % (FSO)/10bar (for range n°1, 7, 8)
Cut-off on radical characteristic curve	up to 10% of flow.

**) zeroing in static pressure conditions with zero differential pressure eliminates this error*

5.3.5. DPR-2000ALW, DPR-2000ALW/L, Pressure Connectors

DPR-2000ALW, DPR-2000ALW/L – C-type connector to mount together with a valve manifold see Fig.10.

DPR-2000ALW, DPR-2000ALW/L with single direct diaphragm seal – as in the example (Fig.11) or with other diaphragm seals in accordance with “DIAPHRAGM SEALS” catalogue cards.

5.3.6. DPR-2200ALW, DPR-2200ALW/L, Pressure Connectors - diaphragm seals

see “DIAPHRAGM SEALS” catalogue cards.

5.4. DPR-2000GALW, Measurement ranges and metrological parameters.

5.4.1 DPR-2000GALW. Measurement ranges

N°	Nominal range (FSO)	Minimum set range	Overpressure limit	Static pressure limit
1	0...25mbar (0...2500Pa)	1mbar (100Pa)	1bar	350mbar
2	-2,5...2,5mbar (-250...250Pa)	0,2mbar (20Pa)	350mbar	350mbar
3	-7...7mbar (-700...700Pa)	1mbar (100Pa)	350mbar	350mbar
4	-25...25mbar (-2500...2500Pa)	5mbar (500Pa)	1bar	1bar
5	-100...100mbar (-10...10Pa)	20mbar (2kPa)	1bar	1bar

5.4.2. DPR-2000GALW Permitted environmental conditions

Operating temperature range -30°C ÷ 85°C



Operating temperature range for intrinsic-safe versions in accordance with Appendix Exi.ATEX or Appendix Exi.IECEx.

Thermal compensation range

-10° ÷ 70°C

Relative humidity

max 98% with condensation

5.4.3. DPR-2000GALW. Metrological parameters.

Nominal range	0...25mbar	-2,5...2,5mbar	-7...7mbar	-25...25mbar	-100...100mbar
Accuracy	≤ ± 0,075 %	≤ ± 0,16 %	≤ ± 0,1 %	≤ ± 0,1 %	≤ ± 0,075 %
Thermal error	± 0,1 % (FSO)/ 10°C, max ± 0,4 % (FSO) for the whole thermal compensation range				
Thermal compensation range	-10° ... 70°C				
Additional electronic damping	0...60 s				

5.4.4. DPR-2000GALW. Construction materials

M20x1.5/Ø6x1 adapter

brass

Valve manifold

1.4404 (316L)

Valve manifold adapter

1.4404 (316L)

¼ NPT connector

brass, 1.4404 (316L) or galvanized St3S carbon steel

(Other materials as given in 5.1.2 for DPR...)

5.4.5. DPR–2000GALW. Pressure Connectors

- The terminals fit adapted to $\varnothing$ 6x1 plastic tubes,
- Valve manifold adapter or ¼ NPT connector (see p. 8.3 and Fig.18).

5.5. DPR–2000YALW. Measurement ranges and metrological parameters.

5.5.1. DPR–2000YALW. Measurement ranges.

N°	1	2
Nominal range	0... – 6000 mmH ₂ O	0... – 1600 mmH ₂ O
Minimum set range	600 mmH ₂ O	160 mmH ₂ O
Static pressure limit	40 bar	

5.5.2. DPR–2000YALW Permitted environmental conditions

Operating conditions as in section 5.3.3 for DPR...

5.5.3. DPR–2000YALW. Metrological parameters.

Nominal range N°	1	2
Accuracy for basic range	± 0,16 %	± 0,2 %
Accuracy for minimum range	± 0,5 %	± 0,6 %
temperature error	0,4 % for temperatures –25°...+80°C	
Zero shift error from static pressure *	0,08 % / 10bar	0,1 % / 10bar

* zeroing in static pressure conditions with zero differential pressure eliminates this error;

Medium density range – up to 1,1 g/cm³ – (standard version)

– over 1,1 g/cm³ – (special version by arrangement with Delta)

5.6. DPC–2000ALW/L.... Measurement ranges and metrological parameters.

5.6.1. DPC–2000ALW/L....level transmitter. Measurement ranges.

N°	1	2	3
Nominal range (FSO)	0...20m H ₂ O	0...10m H ₂ O	0...2,5m H ₂ O
Minimum set range	2m H ₂ O	1m H ₂ O	0,5m H ₂ O
Possibility of zero shift	0...18m H ₂ O	0...9m H ₂ O	0...2m H ₂ O
Overpressure limit	0...200m H ₂ O	0...100m H ₂ O	0...500m H ₂ O

5.6.2. DPC–2000ALW/L....level transmitter. Permitted environmental conditions

Operating conditions as in section 5.2.2 for DPC...

5.6.3. DPC–2000ALW/L....level transmitter. Metrological parameters.

Accuracy	± 0,16% (FSO) for the DPC-2000ALW nominal range
Long term stability	≤ accuracy / 2 years
Error due to supply voltage changes	± 0,002%(FSO)/1V
Thermal error	± 0,1%(FSO)/10°C

5.6.4. DPC–2000ALW/L.... level transmitter. Pressure Connectors

- SG-25 sensor;
- SG-25S sensor;
- SG-25C sensor;
- SG-25S-tytan sensor;
- SG-16 sensor;

5.6.5. DPC–2000ALW/L.... pressure, level transmitter.

Pressure range	see p. 5.2.1
Metrological	see p. 5.2.3
Pressure connectors	see p. 5.2.5

5.7. DPC ... DPR ... Environmental parameters

5.7.1. Electromagnetic Compatibility (EMC), Immunity

Criterion according to EN 61326-1,2

Electrostatic Discharge (ESD):

EN 61000-4-2

level 3,

contact $\pm 6\text{kV}$

air $\pm 8\text{kV}$

Criterion A

Conducted Radio Frequency:

EN 61000-4-6

0,15... 80MHz, 10V

Criterion A

Radiated Electromagnetic Field:

EN 61000-4-3

80... 2 000MHz – 10V/m

... 2 700MHz – 1V/m

Criterion A

Electrical Fast Transient (Burst):

EN 61000-4-4

$\pm 1\text{kV}$

Criterion A

Electrical Slow Transient (Surge):

EN 61000-4-5

$\pm 1\text{kV}$

Criterion B

5.7.2. Electromagnetic Compatibility, emission

Criterion according to CISPR16-1, CISPR 16-2, class B

Radiated Emission:

Distance from antenna: 3m

limits quasi-peak:

0,15 ... 30MHz, 80-52dB $\mu\text{V}/\text{m}$;

30 ... 2000MHz, <54dB $\mu\text{V}/\text{m}$

Conducted Emission:

limits quasi-peak:

0,01 ... 0,150MHz, 96-50dB $\mu\text{V}/\text{m}$;

0,150 ... 0,350MHz, 60-50dB $\mu\text{V}/\text{m}$;

0,35 ... 30MHz, <50dB $\mu\text{V}/\text{m}$

5.7.3. Climatic Immunity

Temperature:

EN 60068-2-1, EN 60068-2-2

hot: T = 55°C, RH = max 55%

cold: T = -25°C,

Damp Heat Cycle:

EN 60068-2-30,

(T = 55°C, RH = min 95%, 24h)x2

Salt Mist:

5% NaCl, pH 6,5 ... 7.2 at 20°C

T = 40°C, RH = min 93%, 28 days

5.7.4. Mechanical Immunity

Shocks:

EN 60068-2-27

50g/11ms

Sinusoidal Vibrations:

EN 60068-2-6, test Fc

do 1,6mm, 2 ... 25Hz

do 4g for 25 ... 100Hz

5.7.5. Electrical Isolation

>100 M Ω @750V DC Ex

>100 M Ω @110V DC normal.

5.7.6. Insulation Strength

550V AC or 750V DC, 1min

Ex, marine

75VAC or 110V DC, 1min

normal

5.7.7. Enclosure Ingress Protection

EN 60529

IP 66,67

6. CONSTRUCTION

6.1. Principle of measurement. Electronic system construction

The electrical signal from the sensor which is proportional to the pressure is sent to a digital analog input and converted to a digital signal. The digital signal is transmitted through optoelectronic galvanic barrier to conditioning module. The main plate microcontroller reads measured values and using internal algorithms calculates the exact value of pressure and temperature. The calculated value of the process variable is displayed on the integrated LCD screen, which can be configured as needed. The digital value of the measured pressure signal is converted to an analogue 4 - 20 mA signal. A built-in modem BELL 202 and HART rev5.1 communication stack enables communication with the transmitter via a converter HART/RS232 attached to a PC and software, or via communicator. The electrical output of transmitter is equipped with a suppression filter and surge protective elements. The block circuit of transmitter is presented at Fig 1. The **DPC...**, **DPR...** transmitters monitor the work of their hardware resources and the correctness of calculations, and inform about mistakes by displaying a message on the LCD screen, and exposing the alarm current in the loop (depending on configuration). Sensor electronics is galvanically separated from the measuring line. This allows reduce a susceptibility of measurement to interference and increased safety in intrinsically safe and flameproof applications.

6.2. Enclosure of transmitters.

Enclosures of **DPC...**, **DPR ...** transmitters are made of die-cast aluminium alloy or stainless steel and consist of a body and two screwed covers (display and electrical connection), one of which is equipped with a glass window. The enclosure provides two holes on the cable entries with thread M20x1, 5 or ½ NPT (the unused hole is sealed with stopper). The housing consists of two chambers separated by an electrical culvert. Housing is equipped with ground terminals: internal and external. The basic units of transmitter are: measuring sensor, in which pressure signal is converted into electric signal, and electronic units, transforming signal from measuring sensor into unified output signal.

6.3. Main electronics plate with display

Main plate electronics with display is placed in the casing of polycarbonate. It is placed in bigger from two chambers where is possibility to change of display position by 345 with 15 ° increments to required position (in Version Exd rotation the display is possible by 180°, in ±90°) (see Fig 4). In second chamber is placed a connecting board with protective devices and EMC filter.

6.4 Measuring head

The measuring head is a measuring unit equipped with a silicon membrane sensor. The sensor is placed in a silicone oil-filled space enclosed, on one side of the culvert with the leads insulated in glass on the other side of the separating membrane which separates the sensor from the medium (**DPR...** transmitters have a two separated membranes). Measuring heads are equipped with process connectors as at Fig. 6a, 7a, 8a or other. **DPR...** transmitters measured head has two process connectors type P or C connector (Fig. 10) for assembly on manifold. Measuring head of **DPR-2000GALW** is intended to low pressures of gases with overpressure to 100kPa (or 35kPa). This transmitter in standard version (economic) is equipped in the process connectors adjusted to elastic pipes $\varnothing 6 \times 1$, and in industrial versions in adapters as Figure 18.

6.5. Separators

For pressure measurement of viscous, chemically reactive or hot process mediums, the transmitter may be additionally fitted with various types of diaphragm seal.

The diaphragm seal transmits the process pressure via an inert fluid fill between the diaphragm of the seal and the diaphragm of the transmitter. When remote diaphragm seals are fitted, the pressure between the diaphragm seal and the transmitter is via a filled capillary. The seal's construction is dependent on the process medium properties and the application operating conditions.

DPR-2000YALW smart level probe is equipped in diaphragm seal and flange to fixing on tank.

7. PLACE OF INSTALLATION

7.1. General recommendations

7.1.1. The smart pressure transmitter and differential pressure transmitter can be installed both indoors and outdoors. It is recommended that transmitters intended for outdoor use be placed in a box or under cover.

7.1.2. The place of installation should be chosen in such a way as to allow access to the device and to protect it from mechanical damage. In planning the installation of the transmitter and configuration of the impulse lines, attention should be paid to the following requirements:

- The impulse lines should be as short as possible, with a sufficiently large cross-section, and free of sharp bends, in order to prevent blockages;
- Where the medium is a gas, the transmitters should be installed above the measuring point, so that condensation flows down towards the site of the pressure measurement; where the medium is a liquid or where a protective liquid is used, the transmitters should be installed below the place where the pressure measurement is taken;
- The impulse lines should be inclined at a gradient of at least 10cm/m;
- The levels of filling liquid in the impulse lines should be equal or kept constant difference;
- The configuration of the impulse lines and the valve connection system should be chosen with regard to the measurement conditions and to requirements such as the need to reset the transmitters in position and the need for access to the impulse lines during water or gas removal and flushing.



7.1.3.  Where there is a risk of damage to the transmitter thorough impact (which can result in extreme cases with the transmitter being separated from the connecting pipework thus permitting leakage of medium), appropriate means of protection should be applied for obvious safety reasons and to avoid the possibility of sparking caused by being struck. If the transmitter cannot be suitably protected then an alternative mounting location should be sought.

7.1.4. Attention should also be paid to possible installation faults which may lead to measurement errors, such as connections which are not tight, sediment blockage in lines which are too narrow, gas bubbles in a liquid line or liquid column in a gas line etc.

7.2. Low Ambient Temperature.



When the solidification point of the liquid whose pressure is being measured is higher than the ambient temperature, steps should be taken to protect the measurement apparatus from freezing effects such as medium expansion.

This is particularly important in the case open-air installations.

Protection is obtained by filling the impulse lines with a mixture of ethylene glycol and water, or another liquid whose solidification point does not exceed the ambient temperature. Thermal insulation can protect the transmitter casing and lines only from brief exposure to low temperatures. Where the temperature is very low, the transmitter and impulse lines should be heated.

7.3. High Medium Temperature.

The DPC..., DPR... transmitters may be used to measure media with temperatures of up to 120°C. To protect the sensing module from temperatures higher than 120°C, long impulse lines are used to disperse the heat and to lower the temperature of the sensing module.

Where it is not possible to use impulse lines of the required length, DPC..., DPR... transmitters with remote diaphragm seals should be used (see "DIAPHRAGM SEALS" catalogue cards).



Data as per Appendix Exi.ATEX / Appendix Exi.IECEx apply for the Ex version and Appendix Exd.ATEX apply for the Exd version.

7.4. Mechanical Vibration shocks. Corrosive Media.

7.4.1. Transmitters should correctly work with vibrations with amplitudes to 1,6 mm and accelerations to 4g. If strong vibrations are carried via the pressure line and disturb of measuring, use should be made of elastic pulse lines or transmitters with a remote diaphragm seal.

7.4.2. Transmitters should not be installed in places where the diaphragm, made of 1.4404/1.4435 (316L) steel, would be subject to corrosion by the medium being measured. If possible, transmitters with diaphragms made of Hastelloy C276 should be used, or other means of protection applied (e.g. in the form of a separating liquid) or transmitters with diaphragm seals adapted for measuring aggressive mediums according to "DIAPHRAGM SEALS" catalogue cards should be used).



8. INSTALLATION AND MECHANICAL CONNECTIONS

The **DPC...**, **DPR...** transmitters can operate in any position.

When installed on an object with a high-temperature medium, it is advantageous to mount the transmitter in a horizontal position or downwards, in such a way that the transmitter is kept away from the rising hot air.



For the small measurement ranges, the reading can be affected by the transmitter position, and by the impulse lines configuration, or the way in which they are filled with liquid. This error can be corrected using the zero-setting function.

8.1. DPC... Installation and connections

8.1.1. The **DPC...** transmitters can be mounted directly on the rigid impulse lines.

For used connectors as in Figures 5a, 6a and 7a, it is recommended that connection sockets be used as shown in Figure 6b, 7b, 8b or 8c. It is recommended that sockets labelled "Socket CG1" and "Socket CG1/2" Fig. 9 are used for CG1 and CG1/2 connections, respectively.

Besides, there are adapters for standard DIN50, (DIN40, DIN25, Clamp2", Clamp1,5", Clamp1") type connections provided for readouts carried out in aseptic conditions using transmitters with CM30x2 connection.

There are gaskets provided for every transmitter with P, CM30x2, CG1, CG1/2 and GP type connections.

The gasket material is selected based on the pressure value, temperature and the type of the medium.

8.1.2. If the pressure is applied via a flexible plastic tube, the transmitter should be mounted on a support with Red Ø6-M reduction.

The types of the impulse tubes (Fig.25) are to be selected depending on the pressure measured value and the medium temperature.

8.1.3. Tighten the transmitter in the socket with a torque suitable for the type of the gasket used and the pressure measured.

8.1.4. The **DPC...** transmitter can be installed using a universal "AL" holder allowing to mount the transmitter in any position on the support or a horizontal or vertical pipe Ø35... Ø65 (Fig. 17).

8.2. DPR... Installation and connections

8.2.1. The **DPR ...** transmitters can be mounted directly on rigid impulse lines.

To connect the transmitter basic versions, with two M20 x 1.5 connectors (P-type connector), can use (for example) straight connecting elements with C type nuts. If elastic impulse lines are used, the transmitter should be additionally fastened to a pipe, panel or supporting construction.

8.2.2. The **DPR-2000ALW**, **DPR-2000ALW/L** and **DPR-2200ALW**, **DPR-2200ALW/L** can be installed using the ø25 Fastener (Fig.12) on an ø25 pipe or on a flat surface using an angle bracket.

8.2.3. The **DPR-2000ALW**, **DPR-2000ALW/L** with connecting cover (C-type connector) (Fig.10) are designed for installation on 3-valve or 5-valve manifolds to a 2" pipe or to a flat surface using "C-2" holder (Fig.13, Fig.14).

8.3. DPR-2000GALW. Installation and connections

8.3.1. The "economy" version of the **DPR-2000GALW** transmitter can be mounted on a wall, panel or other stable construction, using a clamp with Ø9 holes (Fig.87). The transmitter is fitted with connectors which fit to an Ø6x1 elastic impulse tube. When the measuring impulse is transmitted via a metal terminal with M20 x 1.5 connector, an adapter is used between the M20 x 1.5 threads and the Ø6x1 terminal.

Transmitters should be installed in a vertical position. The way of impulse line leading should enable the vapour flowing towards the pipeline. Where there is a significant difference between the height at which the transmitter is mounted and the height of the impulse source, particularly if the measurement range is small, the reading may fluctuate depending on the temperature difference between the impulse lines. This effect can be reduced by ensuring that the impulse lines run side by side.

8.3.2. The **DPR-2000GALW** transmitter can also be fitted with an adapter (Fig.18) creating a C-type connector, designed for installation on a 3-valve or 5-valve manifold. Delta can also supply ready transmitters mounted on valves.

8.4. DPR-2000YALW. Installation and connections

The **DPR-2000YALW** level probes installed in places where liquid levels are measured in closed tanks, with access to medium from top of tank as Fig.16 and 10.2.6. Level probes should be installed in a vertical position.

8.5. DPC-2000ALW/L.... Installation and connections

DPC-2000ALW/L.... installed in places where liquid level is measurement: in wells, tanks, reservoirs, etc.

The transmitter sensor is immersed in measured medium. The sensor can be hung on the power cable by using a Delta SG handle , but especially in the case of long cables, or if are opportunities of hooking protruding elements when the cable is pulling up, it is recommended that the sensor suspended on a steel rope using the sensor lug. If the sensor would be in the flow or turbulence of medium, should be assembled in the casing pipe for example PVC made.



From sensor SG-25S remove the protective plate before it's placing into medium.

During the installation the sensor should be protected from mechanical shocks

Sensor with cable with additional Teflon shield should be hung on steel rope or on a cable (no fasten by Teflon shield).

Pressure may be transmitted to the installed device only after checking that it has a measurement range which properly corresponds to the value of the measured pressure, that gaskets have been properly selected and fitted, and the connectors have been properly screwed tight.



Attempts to undo the screws or fixing connector pipes on a transmitter under pressure may cause the medium to leak and create hazards for the personnel.

When disassembling the transmitter, it is necessary to disconnect it from the process pressure or bring the pressure to atmospheric level, and to take particular care and precautions in case of media which are highly reactive, caustic, explosive or otherwise hazardous to personnel.

If necessary, rinse out this part of the system.

Transmitters with flange diaphragm seals are to be installed on the corresponding counter flanges on the facility.



It is recommended that the user matches the screw joints material to the pressure, temperature, flange material and seal to ensure tightness of the flange joint in the expected operating conditions.

Screws complying with ISO 261 are to be used for flanges used in the **DPC...**, **DPR...** transmitters.

Additional data concerning the diaphragm seals are specified in the "**DIAPHRAGM SEALS**" catalogue cards.

9. ELECTRICAL CONNECTION

9.1. General recommendations

9.1.1. It is recommended that twisted pair cabling be used for the signal lines. If the transmitter and signal line are subject to a large amount of electromagnetic interference, then shield pair cable should be used. The signal wires should not run alongside network power supply cables or near to large electrically-powered devices.

The devices used together with the transmitters should be resistant to electromagnetic interference from the transmission line in accordance with compatibility requirements. It is also beneficial to use anti-interference filters on the primary side of the transformers, the power supplies used for the transmitters and apparatus used in conjunction with them.

9.1.2. Wet or rising damp inside transmitter can cause its damage.



When the isolation of the wires in the cable gland is ineffective (for example, when single wires are used) the opening of the gland should be carefully sealed with an elastic sealing compound to obtain IP66 protection. It is useful to form the segment of the signal wire leading to the cable gland into a protective loop to prevent condensation from running down in the direction of the gland.

9.2. Electrical connections for DPC..., DPR...

The **DPC..., DPR...** transmitters are to be connected as shown in Fig. 2a – 2d.



In **DPC..., DPR...** transmitters, a 240Ω resistor is permanently fitted in series in the transmitter's current circuit and blocked up with jumper between <SIGNAL → and <TEST → as shown in Fig.2a and 2b. When the resistance in the current loop is lower than 240Ω it is necessary to jumper disassemble to HART communication.

9.3. Protection from excess voltage

9.3.1. The transmitters may be in danger from excess voltage caused by connection faults or atmospheric electrical discharge.

Protection from excess voltage between the wires of the transmission line is provided by TVS diodes installed in all types of transmitter (see the table, column 2).

9.3.2. In order to protect against excess voltage between the transmission line and the casing or earth (not prevented by the diodes connected between the transmission wires), additional protection is provided in the form of plasma surge arresters (see the table, column 3).

Also external protective devices may be used, e.g. the UZ-2 Delta system, or others. When the transmission lines are long, it is advantageous to use one protective device near the transmitter (or inside it), and another near entry points to other devices used in conjunction with it.

Internal protection of transmitters:

1	2	3
Type of transmitter	Protection between wires (TVS diodes) – nominal voltage	Protection between wires and earth and/or casing – type of protection, nominal voltage
DPC..., DPR...	68V DC (39V DC for Exi version)	Plasma surge arresters - 230V DC (Not applicable to Exi version).

9.3.3. The voltage in the protective elements must not exceed the maximum permitted values given in columns 2 and 3 of the table. Security using surge arresters are used for Exi versions with identification on the rating plate "Version SA".



The insulation test voltages (500V AC or 750V DC) given in 5.1.1 refer to transmitters plasma surge arresters - such protection is not used in Exi versions of transmitters.

9.4. Earthing

The transmitters are fitted with internal and external earth terminals.

10. SETTING AND REGULATION

DPC..., DPR... transmitters are factory calibrated to the range stated in the order or to the basic range.

After installation, the transmitter's zero-point may move and require adjustment.

This applies particularly in cases where the measurement range is small, where the impulse lines are filled with a separating liquid or where **DPC..., DPR...** transmitters are used with remote diaphragm seals.

10.1. Transmitter Range, Basic Range. Definitions

10.1.1. The maximum range of pressure, or differential pressure, which the transmitter can measure, is called the "**basic range**" (for specifications of basic ranges see section 5.2.1, 5.3.1, 5.3.2, 5.4.1, 5.5.1).

The width of the basic range is the difference between the upper and lower limits of the basic range.

The internal characteristic conversion curve for the basic range is coded in the transmitter's memory.

This is the reference curve used when making any adjustments which affect the transmitter's output signal.

10.1.2. When the transmitter is in use the term "**set range**" is used. The set range is the range whose lower end-point corresponds to an output current of 4mA and whose upper end-point corresponds to a current of 20mA (or 20mA and 4mA respectively when the conversion curve is inverted).

The set range may cover the whole of the basic range or only a part of it.

The width of the set range is the difference between its upper and lower end-points.

The transmitter may be set to any range within the basic range of pressure values, subject to the restrictions set out in the table in section 5.2.1, 5.3.1, 5.3.2, 5.4.1, and 5.5.1.

10.2. Configuration and Calibration

10.2.1. The transmitter has features which enable metrological and identification parameters to be set and altered. The configurable metrological parameters affecting the transmitter's output current include the following:

- a) unit in which the measured pressure is expressed on the display;
- b) upper end-point of the set range;
- c) lower end-point of the set range;
- d) time constant;
- e) type of characteristic curve: linear or radical.

Parameters of an informational nature which cannot be altered include the following:

- f) upper limit of the basic range;
- g) lower limit of the basic range;
- h) minimum range.

10.2.2. Other identification parameters, not affecting the output signal, include: device address, device type code, factory identification code, factory device code, number of preambles (3÷20), UCS, TSD, program version, electronics version, flags, serial number, label tag, description tag, date tag, message, record number, sensing module number.

The process of setting the parameters listed in 10.2.1 and 10.2.2 is called **“Configuration”**.

10.2.3. It is possible to carry out a **“pressure zeroing”** procedure, for example to compensate for measurement deviation caused by a change in position during the transmitter installation.

The transmitter may also be **calibrated**, by taking readings with the input pressure controlled using a standard device. These process and zero-point adjustments are called **“Calibration”**.

10.2.4. Configuration and Calibration of the transmitter are carried out using an Delta DKAP communicator, certain HART communicators or a PC with HART/RS232 converter and Delta “D-Soft” software.

Together with the “D-Soft” configuration software there is „INTERVAL LINEARIZATION” software supplied to enable the input of 21-point nonlinear functional characteristics to the transmitter.

A description of the functions of the DKAP communicator is contained in the DKAP Communicator Operating Manual, and information on the HART/RS232 converter can be found on the HART/RS232/01 Converter information sheet.

10.2.5. TRANSMITTER CONFIGURATION WITH USING ITS BUTTONS AND LOCAL MENU

10.2.5.1. Local menu - structure. Local configuration of transmitters.

If the option of local configuration is active, operator can change transmitter set using buttons being below display. The access to buttons will get after unscrewing the display cover. Then we can also change the display position (see Fig. 4).

If the option of local configuration is active, operator can change transmitter set using buttons being below display. To enter changes at the local set mode, press one of the buttons and hold it's about 4s. If after pressing the button displays the message ERR_L16, local configuration of the transmitter is switched off. To its switching on is necessary to use DKAP 3 Calibrator or PC (see → HART command 132, 133).

The buttons are signed with symbols: [↑] [↓] [■]

After pressing by 4 seconds any of the buttons on the display will appear **“EXIT”**.

If you will confirm this message by pressing and holding button [■] by 1 sec, you will leave the local change of the MENU setting. If you do not confirm, you can move in MENU and change interesting you parameters. The time of pressing [↑] [↓] [■] has to be longer than 1s.

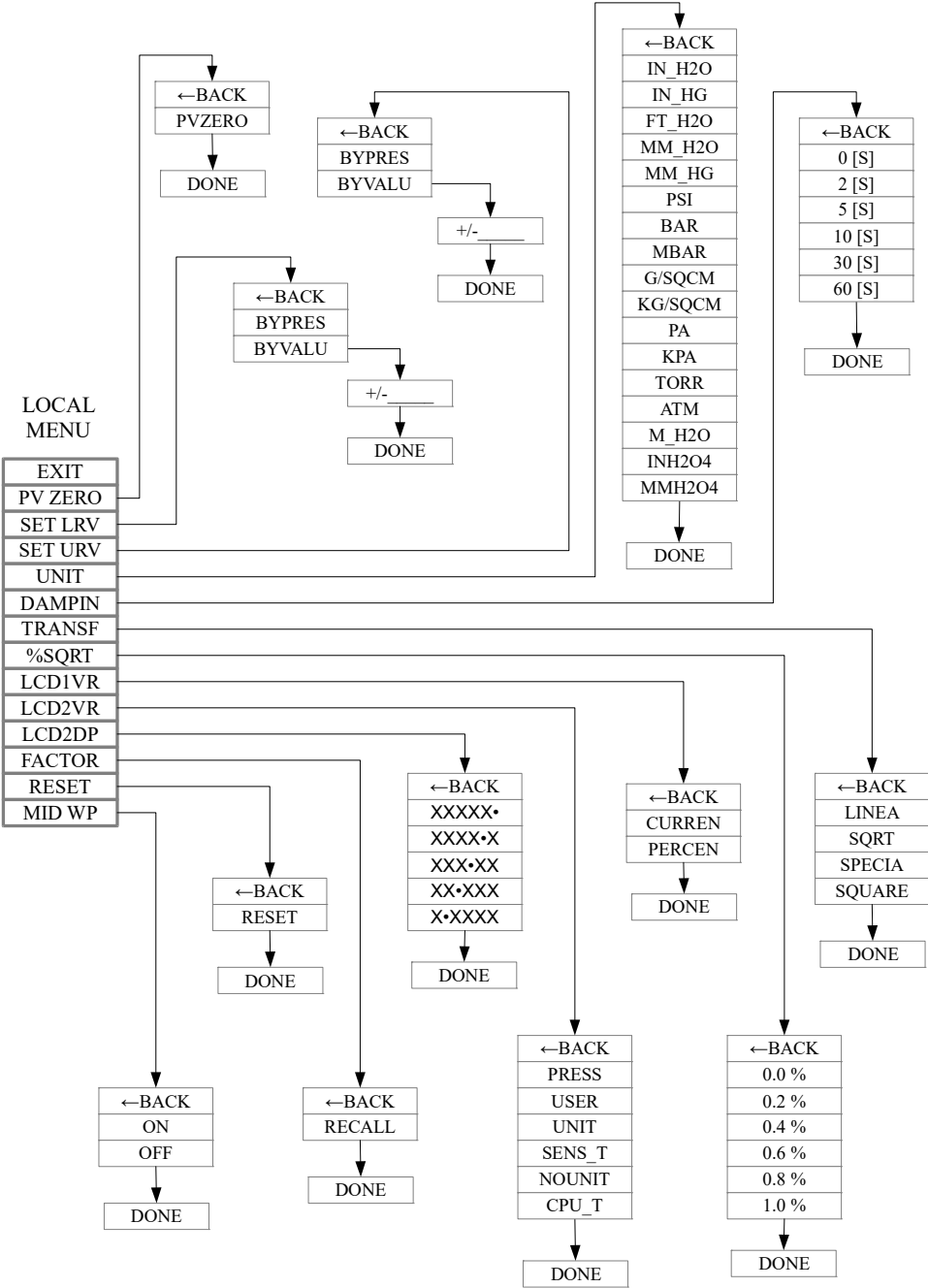
Pressing button [↑] moves up in tree's structure MENU.

Pressing button [↓] moves down in tree's structure MENU.

Pressing [■] confirms choice and leads change.

No action in the menu for more than 2 minutes will cause automatically exit from the menu and move to the display of the process variable.

Method of navigate through the commands in the menu structure **DPC...**, **DPR...** shown below.



The selected unit should be confirmed by pressing [■].

After approval the parameter transmitter will confirm the party of command by the "DONE" or report the error number. The "← BACK" cause goes up one level.

Descriptions:

Local Menu	Submenu	Notice
EXIT		return from the local Menu to the normal operation of the transmitter
PVZERO		pressure zeroing
SETLRV		setting the lower range of values set by the done pressure (no change of span)
	<i>BYPRES</i>	set across set pressure
	<i>BYVALU</i>	set across inscribing of value (after approval at display the current value will appear before the passage in edit mode)
	<i>+/- _____</i>	select and confirm sign introduced parameter. Introduce in sequence, digit after digit, 5 digital numbers with point or without point. After confirmation the last 5 digit of the parameter transmitter will confirm the party of command by the "DONE" announcement or the proper number of error will notify. The parameter will be written down in units "UNIT".
SETURV		set the upper range value by the done pressure
UNIT		menu process variable units
	<i>IN_H2O</i>	inches of water at a temperature of 68° Fahrenheit
	<i>IN_HG</i>	inches of mercury at a temperature of 68° Fahrenheit
	<i>FT_H2O</i>	foot of water a temperature of 68° Fahrenheit
	<i>MM_H2O</i>	mm of water at a temperature of 68° Fahrenheit
	<i>MM_HG</i>	mm of mercury at 0°C
	<i>MBAR</i>	millibar
	<i>G/SQCM</i>	grams per square centimetres
	<i>KG/SQCM</i>	kilogram per square centimetres, technical atmosphere
	<i>KPA</i>	kilopascal
	<i>TORR</i>	tor (mm Hg)
	<i>ATM</i>	physical atmosphere
	<i>M_H2O</i>	meter of water at 4°C
	<i>MPA</i>	Megapascal
	<i>INH2O4</i>	inch of water at a temperature of 4°C
	<i>MMH2O4</i>	mm of water at 4°C
DAMPIN		set of the solid temporary suppression of the process variable
TRANSF		set of the current output form
	<i>LINEAR</i>	linear
	<i>SQRT</i>	square root
	<i>SPECIA</i>	user's special
	<i>SQUARE</i>	square
%SQRT		square root characteristic cut-of point setting
LCD1VR		assigning a process variable to LCD1
	<i>CURREN</i>	on LCD1 will displayed current value in current loop in [mA]
	<i>PERCEN</i>	the percent value output signal will displayed on LCD1- controlling in%
LCD2VR		assigning a process variable to LCD2
	<i>PRESS</i>	the pressure value will displayed on LCD2
	<i>USER</i>	the user's units will displayed on LCD2. Scaling of the user range and record of the user units can be made using a computer or communicator, see → HART command No. 244.245.
	<i>UNIT *</i>	the current unit or user's unit alternately with process variable will displayed on LCD2
	<i>SENS_T *</i>	the current temperature of pressure sensor will displayed on LCD2
	<i>NOUNIT *</i>	the current unit or user's unit alternately with process variable will not displayed on LCD2
	<i>CPU_T *</i>	the current temperature of the transmitter CPU will displayed on LCD2 - in °C

LCD2DP		set the decimal point position on LCD2. In a situation where the value provided to display on the display LCD2 cannot be displayed properly due to the position of the decimal point, this is indicated by displaying the four flashing dots ••••. In this case, you must enter to the local menu setting and move the decimal point respectively to the right.
FACTOR		back to factory settings (removing of current and pressure calibrations)
RESET		reboot your transmitter
MID_WP **		blocking records / change the parameters associated with transmitter metrology
	ON	switch on blocking
	OFF	switch of blocking

*) for older versions of transmitters are displayed a UNIT and NO UNIT sequences, in solutions since 2011:
are SENS_T and CPU_T sequences;

**) for transmitters since 2011.

10.2.5.2. Local Menu, error reports.

During executing in Local Menu some functions, LCD2 announcement can be displayed on the screen.

The error displaying evidences about no realization of command of Local Menu.

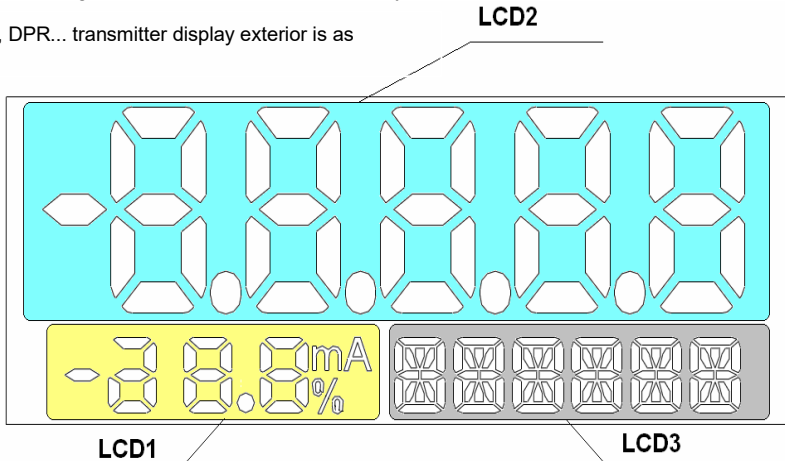
The shortened description of errors announcements is showed below.

ERR_L07	[in_write_protected_mode]. Error will ensue out when we try to change setting in Local Menu, but transmitter is protected before recording. To make the change of setting with Local Menu using, transmitter has to have the included service of Local Menu as well as switched off protection before record. These parameters modification is possible by using DKAP -03 communicator, "D-Soft" program or software using library EDDL. default setting: Local Menu service switched on protection before record switched off
ERR_L09	[applied_process_too_high]. Error will ensue out when given parameter (pressure) exceed admissible value. Zeroing or the range setting verifying is necessary.
ERR_L10	[applied_process_too_low]. Error will ensue out when given parameter (pressure) will be too low. Zeroing or the range setting verifying is necessary.
ERR_L14	[span_too_small]. Error will ensue out when in result of setting range executing change the width of the range will be smaller than admissible.
ERR_L16	[access_restricted]. Error will ensue out when the service of Local Menu is switched off, and the user tries to call out the Menu Local service. You should switch on the service of Local Menu with the DKAP-03 communicator, "D-Soft" program, or software using library EDDL. Warning! ERR_L16 announcement can be displayed as well by zeroing attempt of the absolute transmitter.
WNG_L14	[WARNING! New Lower Range Value Pushed !] Error will ensue out when the end of range set (the URV) change will cause the change of the range set beginning (LRV).

10.2.6. View local LCD display

Changes of the display options in local MENU are possible using buttons or remote way using communicator, or the PC software. If it is necessary the display switching off is also possible. The display switching of function is possible with using communicator or PC software only.

The DPC..., DPR... transmitter display exterior is as below.



There 3 main displays are visible:

- **LCD1** – the current or guidance percent preset range display. In accordance with display configuration the current value in 4-20 mA current loop, or percent guidance preset range is possible to display.
- **LCD2** – the measured pressure digital value display; the calibrated pressure value according to user's unit's display; the process variable units, or user's units, or pressure sensor or CPU temperature; the MENU announcement and other information or warning announcement display. In the case the digital pressure value or the calibrated pressure value display, the sign „-“, can be visible before displayed value. The decimal point position is possible to set in local MENU or remotely. The pressure unit or user's unit can be displayed. The transmitter makes possible rescale on the user's individual the pressure value. To make this is necessary with using communicator or PC software write the corresponding to beginning and to end values of setting range as well as write the own unit name. After activating user's mode the rescale value will be visible on display.
- **LCD3** – information display. During normal operation is designed for continuous display of the base unit or the user units. In case of errors in the transmitter's work, it displays an error number. In manual mode, the local change settings menu displays options of selecting the setting. It also displays errors related to the implementation of commands in the local menu of the settings change.

Display backlighting - Local display is equipped in backlight. In Version Exd it is possible to switching on and switching off display backlighting via jumper on electronic board as required. How to handle display backlight is shown in Figure 5. Figure 4 shows how to change the display position by rotation.

Warning!



Exceeding the basic transmitter measuring range over 50% range in the up or down is indicated by "o V E r" or "u n d e r" in the display LCD2. Such situation is encountered most often when overloaded a difference pressure transmitter, created when the large static pressure compared to the pressure range will blockage or a leak in one of the capillaries.



After configuration it is important to protect the transducers using command HART [247]. During work transmitter should be safe prior to entries. This prevents accidental or intentional changes configurational data. The protection function is accessible in DKAP03 communicator, "D-Soft" software, as well as, in applying DD or DMT programs libraries.

10.2.7. Remote configuration

Remote configuration is possible with DKAP-XX communicator or PC software. Measuring circuit should be in accordance with the Fig. 2.

10.2.8. Configuration of the DPR-2200ALW transmitters to measure the level, density of liquid and phase boundary

To simplify the mathematical operations we introduce the density coefficient of the medium X_p .

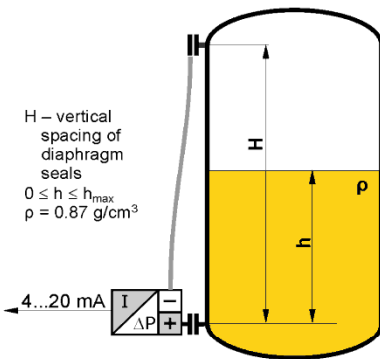
$$X_p = \frac{\rho_{\text{medium}} [\text{g/cm}^3]}{\rho_{\text{water at 4}^\circ\text{C}} [\text{g/cm}^3]}$$

Since the density of water at 4°C is 1 g/cm³, the density coefficient X_p is numerically equal to the density of the medium expressed in g/cm³. To determine the hydrostatic pressure of a column of liquid in mm H₂O, it is sufficient to multiply the height of the column h [mm] by the density coefficient of the liquid X_p . Since it is easy to determine the hydrostatic pressure in mm H₂O and the transmitter can be configured in those units, in the descriptions of measurement methods given below we will make use of pressures expressed in mm H₂O and the density coefficient X_p .

Configuration of the DPR-2200ALW transmitters to measure the level of liquid in a tank.

The measurement task:

To convert a variation in the level of a liquid with density $\rho = 0.87 \text{ g/cm}^3$ between 0 and h_{max} to a variation in the output signal from 4 to 20 mA.



1. Install the transmitter in its working position on an empty tank.
2. Make the electrical connections of the transmitter, providing for the ability to use HART communication.
3. Connect the KAP-01 communicator, identify the transmitter and select the "configuration" function.

4. On the configuration menu select the "Reranging" procedure.
5. On the "Reranging" menu:
 - a) change the units of measurement to mm H₂O at 4°C;
 - b) enter the values for the start ($X_p \times h_{\text{min}}$ [mm]) and end ($X_p \times h_{\text{max}}$ [mm]) of the measurement range, namely 0 and $(0.87 h_{\text{max}}$ [mm]) respectively;
 - c) to compensate for the hydrostatic pressure of the manometric fluid, the start of the measurement range should be set using regulated pressure; when subject to the action of only the manometric fluid (empty tank) the transmitter will shift the start and end-points of the range, compensating for the value of that pressure.

When the transmitter has been configured in this way it is ready to be used to carry out the given measurement task.

If it is not possible to empty the tank to configure the transmitter, the hydrostatic pressure of the manometric fluid should be calculated by multiplying the vertical spacing of the diaphragm seals by the density coefficient of the oil in the capillaries. This pressure should be taken into account when entering the values for the start and end of the range:

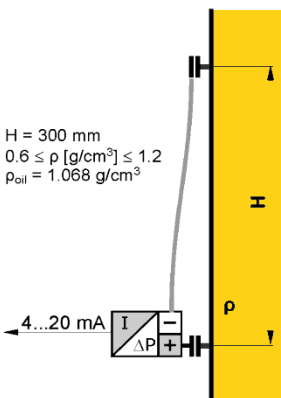
$$\text{Start [mm H}_2\text{O]} = -H [\text{mm}] \times X_{p_{\text{oil}}}$$

$$\begin{aligned} \text{End [mm H}_2\text{O]} &= \\ &= h_{\text{max}} [\text{mm}] \times X_{p_{\text{measured liquid}}} - H [\text{mm}] \times X_{p_{\text{oil}}} \end{aligned}$$

$$\rho_{\text{oil}} \text{ for DC-550 oil is equal to } 1.068 \text{ g/cm}^3$$

$$\rho_{\text{oil}} \text{ for AK-20 oil is equal to } 0.945 \text{ g/cm}^3$$

Configuration of the DPR-2200ALW transmitters to measure density of liquids.



The measurement task:

To convert a variation in liquid density from $\rho_{\text{min}} = 0.6 \text{ g/cm}^3$ to $\rho_{\text{max}} = 1.2 \text{ g/cm}^3$ to a variation in the output signal from 4 to 20 mA, with the vertical spacing of the diaphragm seals equal to $H = 3000 \text{ mm}$. The sealing system is filled with DC-550 oil with density $\rho_{\text{oil}} = 1.068 \text{ g/cm}^3$.

1. Calculate the value of the start of the range as follows:
 $H_{[\text{mm}]} \times (X_{p_{\text{min}}} - X_{p_{\text{oil}}}) =$
 $= 3000 \times (0.6 - 1.068) = -1404 [\text{mm H}_2\text{O}]$
2. Calculate the value of the end of the range as follows:
 $H_{[\text{mm}]} \times (X_{p_{\text{max}}} - X_{p_{\text{oil}}}) =$
 $= 3000 \times (1.2 - 1.068) = 396 [\text{mm H}_2\text{O}]$
3. Set the zero point of the transmitter with the diaphragm seals positioned at the same level.
4. Install the transmitter in its working position.
5. Make the electrical connections to the transmitter, providing for the possibility of using HART communication.

6. Connect the KAF communicator, identify the transmitter and select the "configuration" function.
7. On the configuration menu select "Reranging" procedure.
8. On the "Reranging" menu:
 - a) change the measurement units to mm H₂O at 4°C;
 - b) enter the calculated values for the start (-1404) and end (396) of the range.

When the transmitter has been configured in this way it is ready to be used to carry out the given measurement task.

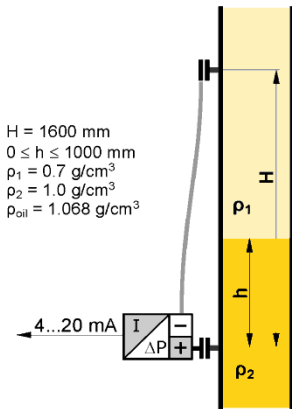
Note: If it is possible to fill the space between the seals with a liquid whose density corresponds to the start of the measurement range, the start of the range of the transmitter can be set using regulated pressure.

Measurement of phase boundary

The height of the phase boundary of liquids of different densities is determined by measuring the average density of the medium between the seals.

Example:

Calculate the measurement range start and end points for an DPR-2200 transmitter configured to measure phase boundary height in the range 0–1000 mm between liquids of density $\rho_1 = 0.7 \text{ g/cm}^3$ and $\rho_2 = 1.0 \text{ g/cm}^3$, where the vertical spacing of the seals $H = 1600 \text{ mm}$. The sealing system uses DC-550 oil with a density of 1.068 g/cm^3 .



To determine the start of the measurement range, calculate the pressure difference at the transmitter when the tank is filled with the lighter liquid only:

$$1600 [\text{mm}] \times (0.7 - 1.068) = -588.8 [\text{mm H}_2\text{O}]$$

To determine the end-point of the range, add the increase in pressure resulting from the appearance of a 1 metre column of the heavier liquid:

$$-588.8 [\text{mm H}_2\text{O}] + (1.0 - 0.7) \times 1000 [\text{mm}] = -288.8 [\text{mm H}_2\text{O}]$$

Additional remarks

The settings of the transmitter can be adjusted with reference to laboratory results from density measurements carried out on samples of the liquid being measured. This is most often necessary when the measurement takes place in a pipeline segment where the flow velocity of the measured liquid reaches several m/s.

Increasing the vertical spacing of the diaphragm seals widens the range and often improves measurement accuracy.

In planning the spacing of the diaphragm seals, ensure that the pressure difference at the transmitter lies within the basic range.

The maximum vertical spacing of the diaphragm seals (H) depends on the transmitter's basic range and the boundary values for the density of the measured liquid ($\rho_{\min}, \rho_{\max}$).

If $\rho_{\min} < \rho_{\text{oil}} < \rho_{\max}$, the seal spacing H should satisfy the following conditions:

$$H [\text{mm}] \leq \frac{\text{lower boundary of range [mm H}_2\text{O}]}{X\rho_{\min} - X\rho_{\text{oil}}}$$

$$H [\text{mm}] \leq \frac{\text{upper boundary of range [mm H}_2\text{O}]}{X\rho_{\max} - X\rho_{\text{oil}}}$$

Example:

Determine the maximum vertical spacing of the seals for the DPR-2200 / -10...10 kPa transmitter when measuring the density of liquid between 0.6 and 1.2 g/cm^3 . The sealing system uses AK-20 silicone oil with a density of 0.945 g/cm^3 .

The lower boundary of the range of the transmitter is $-10 \text{ kPa} = -1020 \text{ mm H}_2\text{O}$

$$H [\text{mm}] \leq \frac{-1020}{0.6 - 0.945} \Rightarrow H [\text{mm}] \leq \frac{-1020}{-0.345} \Rightarrow$$

$$H [\text{mm}] \leq 2957$$

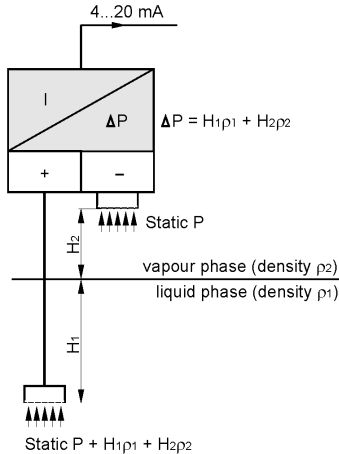
The upper boundary of the range of the transmitter is $+10 \text{ kPa} = 1020 \text{ mm H}_2\text{O}$

$$H [\text{mm}] \leq \frac{1020}{1.2 - 0.945} \Rightarrow H [\text{mm}] \leq \frac{1020}{0.255} \Rightarrow$$

$$H [\text{mm}] \leq 4000$$

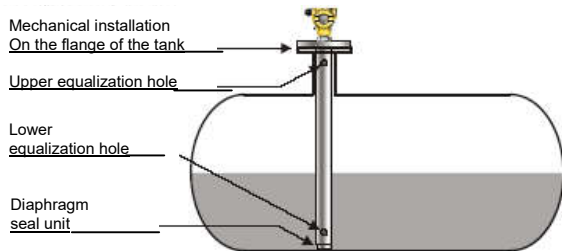
In the example, both conditions are satisfied when the spacing of the seals is not more than 2957 mm.

10.2.9. Configuration of the DPR-2200YALW smart level probes



Principles of operation

Measurement is carried out using an APR-2000 differential pressure transmitter, enabling compensation for static pressure in the tank. The value processed is just the hydrostatic pressure of the medium measured at the level of the diaphragm of the lower seal. This pressure is the sum of the hydrostatic pressures of the liquid and vapour phases of the medium. In most practical measurement situations the density of the vapour phase is negligibly small, and therefore the measured hydrostatic pressure relates only to the height of the liquid phase column and can be taken as representing the level of the surface of the liquid phase. For media where the density of the vapour phase is significant (e.g. propane) the level found by the method described can be treated as the theoretical level of the liquid level obtained by adding the actual liquid phase to the condensed vapour phase.



Configuration example

To convert a rise in the level of liquid with density 0.87 from 0 to 3200 mm to a current change from 4 to 20 mA.

1. Install the transmitter in working position, place the seal at the appropriate height (tank empty).
2. Calculate the width of the measurement range in mm H₂O (4°C): $3200 \text{ mm} \times 0.87 \text{ g/cm}^3 = 2784 \text{ mm H}_2\text{O}$.
3. Using the communicator, set the transmitter to use the units **mm H₂O at 4°C**.
4. To determine the start of the measurement range, read off via the communicator the hydrostatic pressure produced by the manometric fluid in the capillary (e.g. **-4250 mm H₂O**).
5. To determine the end-point of the measurement range, add the value **-4250 mm H₂O** and the width of the measurement range **-4250 mm H₂O + 2784 mm H₂O = -1466 mm H₂O**.
6. Using the communicator enter the calculated start (**-4250 mm H₂O**) and end-point (**-1466 mm H₂O**) of the measurement range and send as a block to the transmitter. After receiving these parameters the transmitter will perform measurements as required.

10.2.10. Configuration of the DPR- 2000ALW transmitters for the flow measurements with the orifice plate.

Orifice flow meters are based on the square root output signal from the differential pressure transmitters.

To archive this function you should:

- Install the DPR-2000 ALW transmitter to the flow measurement workstation with orifice;
- Make the transmitter zeroing at the workstation; remotely using computer and Delta D-Soft software or locally with transmitter buttons according to p. 10.2.5 of the Manual;
- Set the square root output transmitter signal and the cutoff point [in % FS]; remotely using computer and Delta D-Soft software according with p. 10.2.4 or locally with transmitter buttons (up to 1% only) according to p. 10.2.5 of the Manual.

For transmitters with software from 1.9 version, the cutoff point setting means, that, when the pressure is increasing from 0 to set cutoff point (n%FS), the output signal is zero (4mA), but in the setting cutoff point and above its, the transmitter output signal passes to the square root output for the current transmitter output, and to the linear output for the HART transmitter output. If the pressure on orifice falls below the n%FS setting minus 0.2% (hysteresis), the output transmitter signal will switch to zero (4mA). The cutoff operation algorithm on the analog output signal example is shown at the below figure.

Description:

I [mA] – analog output signal; loop current [4-20 mA] or A [%];

n% - cutoff point at square root output transmitter signal;

PV or Z [%] - axis of the process variable in user unit or in percent of the set range;

LRV – Lower Range Value; the lower value of the pressure set range (corresponds to the 4 mA current output signal);

URV – Upper Range Value; the upper value of the pressure set range (corresponds to the 20 mA current output signal).

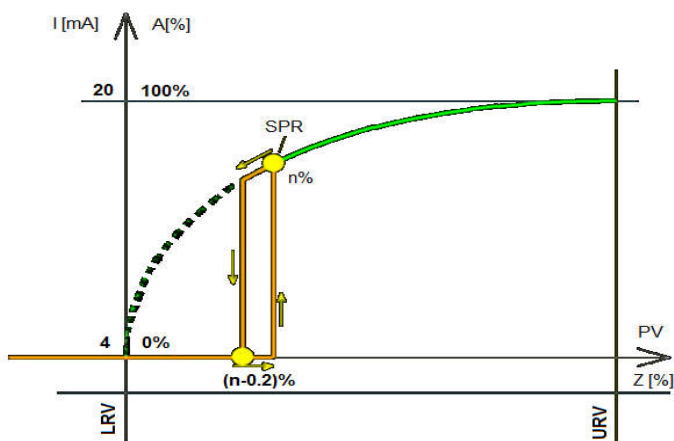


Fig. DPR-2000ALW transmitter analog output signal with setting cutoff point in $n\%$.

The device configuration example:

Transmitter configuration parameters

- Basic range 0...100 kPa
- Set range 0...50 kPa
- Cutoff 5% of the set range

Assemble the measuring system in accordance with Figure 2 and run D-Soft:

- Set the zero of the transmitter – tab page: Basic Commands → Zeroing;
- Set the width of the set range the transmitter to a value of 0 ... 50 kPa - tab page: Common Parameters → Lower Range Value and Upper Range Value
- Set the square root output signal of transmitter – tab page: Common Parameters → Transfer Function;
- Enter 5 in the parameter area inflection point – tab page: Common Parameters → Start point rad;
- Save the data to the transmitter (button: Write Parameters).

The cutoff function will be implemented to 5% of set range with pressure increase and to 4.8% of set range with a pressure decrease

10.3. Alarms.

Alarms signal exceeding the limits of the transmitter correct operation or non-functioning some of its components. Menu of **DPC...**, **DPR...** transmitters contains the following alarms: HART modem error, ADC error (error of A /D converter), EEPROM error, error of the oscillator, DS33 error (check the correctness of floating point calculations). Errors reveal themselves by issuing in the transmitter current line: 22mA (high alarm) or 3,6mA (low alarm), and signalling an error code on the display. Alarm current in the output transmitter line of 3,6 (low) or 22mA (high) can be set using the D-Soft configuration program, or the currents alarm settings in transmitter should be agreed with the producer. Exceeding of the basic pressure range of over 50% is indicated on the transmitter display by code E0256 and alarm current in the measuring line.

11. INSPECTIONS AND SPARE PARTS.

11.1. Periodic service

Periodic inspections should be made in accordance with the regulations to which the user is subject. During inspection, the pressure connectors should be checked for loose connections and leaks, the electrical connectors should be checked with regard to tightness and the state of the gaskets, cable glands, and the diaphragm seals should be checked for tarnishing and corrosion.

Check the characteristic conversion curve by following the procedures for "Calibration" and, where appropriate, "Configuration".

11.2. Other services

If the transmitters are installed in a location where they may be exposed to mechanical damage, excess pressure, hydraulic impulses or excess voltage, or the diaphragm may be in danger from sedimentation, crystallization or erosion, inspections should be carried out as required.

 Where it is found that the signal in the transmission line is absent or its value is incorrect, a check should be made on the line and its terminal connections.

Check whether the values of the supply voltage and load resistance are correct.

If a communicator is connected to the power supply line of the transmitter, a fault in the line may be indicated by the message "No response" or "Check connection".

If the line is in order, check the operation of the transmitter.

11.3. Cleaning the Diaphragm Seal, Overloading Damage

11.3.1. Sediment and dirt which have formed on the diaphragm in the course of operation must not be removed by mechanical means, as this may damage both the diaphragm and the transmitter itself.

The only permitted method is the dissolving of sediment.

11.3.2. Sometimes transmitters malfunction due to damage caused by overloading, e.g. in case of:



- **Application of excessive pressure;**
- **Freezing or solidification of the medium;**
- **Action of a hard object, such as a screwdriver, on the diaphragm.**

Usually in such cases the symptoms are such that the output current falls below 4mA or rises above 20mA, and the transmitter fails to respond to input pressure.

11.4. Spare parts.

Parts of the transmitter which may be subject to wear or damage and require replacement: cover gasket.

 **Other listed parts, due to the specific features and requirements of explosion-protected devices, may be replaced only by the manufacturer or by a firm authorized by the manufacturer.**

12. PACKING, STORAGE AND TRANSPORT.

The transmitters should be packed singly or in sets, in such a way as to protect them from damage during transportation.

The transmitters should be stored in multiple packs under cover, in a place free of vapours and reactive substances, with temperature and humidity not exceed the limits specified in p. 5.2.2 for DPC... or p. 5.3.3 and 5.4.2 for DPR....

Transmitters with uncovered diaphragm or seal connectors, stored without packaging, should have covers to prevent damage to the diaphragm.

During transportation, the transmitters should be packed and secured so as to prevent them from shifting.

Any means of transport may be used, provided direct atmospheric effects are eliminated.

13. GUARANTEE.

The manufacturer guarantees the proper operation of the transmitters for a period of 24 months from the date of purchase and servicing provided under the guarantee and following the guarantee period. In the case of special versions, the guarantee period shall be agreed by the manufacturer and the user, but shall not be less than 12 months.

14. SCRAPPING, DISPOSAL.

Waste or damaged transmitters should be dismantled and disposed of in accordance with Directive (2002/96/EC) on waste electrical and electronic equipment (WEEE) or returned to the manufacturer.

15. ADDITIONAL INFORMATION.

The manufacturer reserves the right to make constructional and technological changes which do not lower the quality of the transmitters.

15.1. Related documents.

- IO.DKAP-03.02 – Communicator User's Manual.
- IO.D-SOFT – "D-Soft" software and HART/RS232 converter User's Manual.
- DTR.HB.01 – HART/USB/Bluetooth converter User's Manual.
- „INTERVAL LINEARIZATION" software.

16. FIGURES.

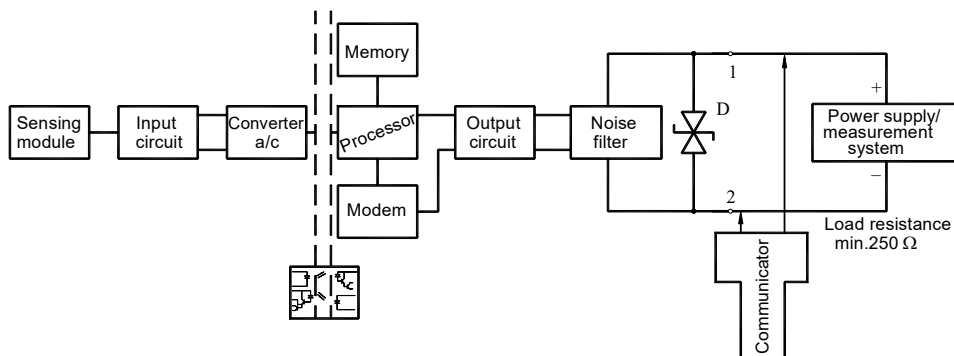


Fig. 1. DPC..., DPR... transmitters – block diagram.

Communicator or converter electrical connections to transmitter measuring lines.



For successful communication with transmitter the resistance in measuring loop, behind connected device to communication, should be higher than 250Ω. If necessary install the additional resistor in the line. The communicator or converter connecting ways to the measuring loop are presented at diagrams. During increasing of resistance in the measure loop at making the good transmission, is necessary to make sure that the tension falls at sum resistances in the loop don't lower minimum tension at transmitter terminals. (see p.5.1.1)

Connection of the DPC..., DPR... transmitter

Connect as shown in Fig. 2a. If it is necessary to enable communication with the transmitter, a communicator or converter can also be connected.

Optional connection configurations to communication devices are shown below.

Communicator or converter connection near to a switch box

In order to enable communication with a transmitter at a distant location via connection near to a switch box, make sure that the resistance R_o from the point of connection of the communicator to the power supply source lies within the range of $250 \pm 1100 \Omega$. If necessary, an additional resistance can be integrated into the line. Connect the communicator or converter as shown in Fig. 2a.

Fig. 2. Electrical connections for DPC..., DPR... transmitters:

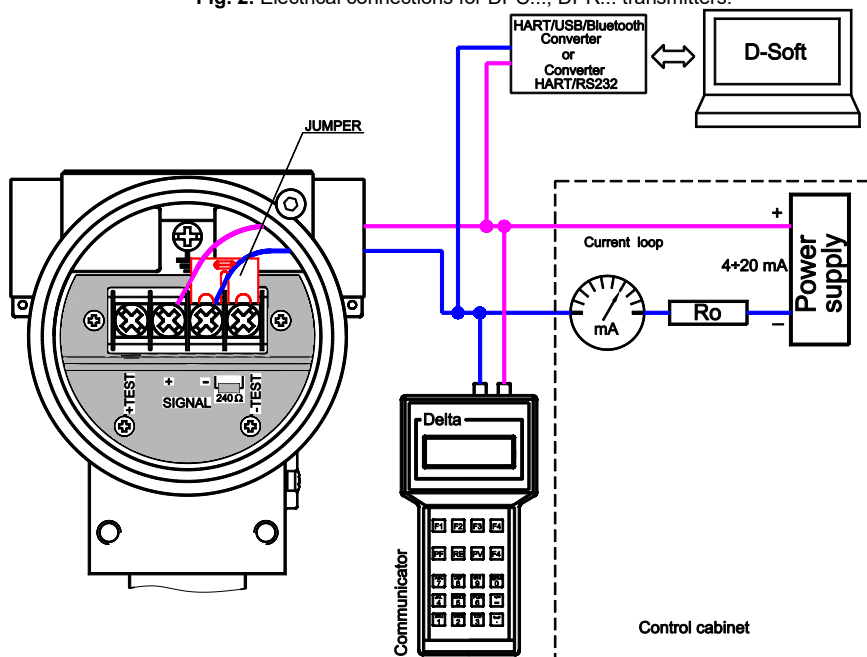


Fig.2a. The link of transmitter and communicator or converter to current line by the switch box (in case of the resistance in current loop is higher than 250Ω).

Communicator or converter connection to the transmitter's terminals

In order to enable local communication by connecting a communicator or converter to the transmitter's terminals, make sure that the resistance R_o from the transmitter's terminals to the power supply source lies within the range of $250 \div 1100 \Omega$. If so, connect the communicator or converter to the terminals <+> <-> as shown in Fig. 2b.

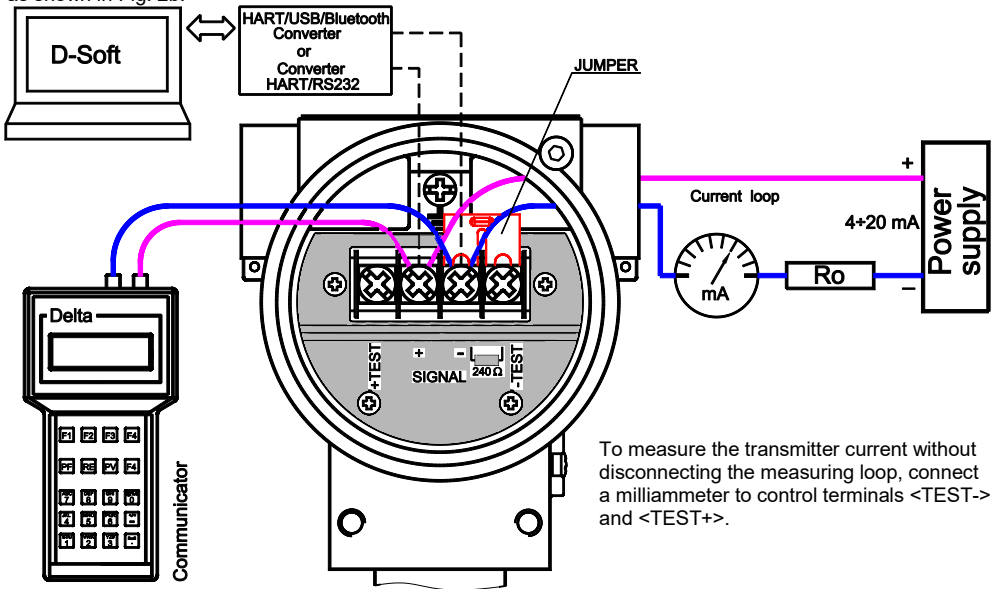


Fig.2b. The link of transmitter and communicator or converter to <SIGNAL+> <SIGNAL-> transmitter terminals in case of the resistance in current loop is **higher than 250Ω**.

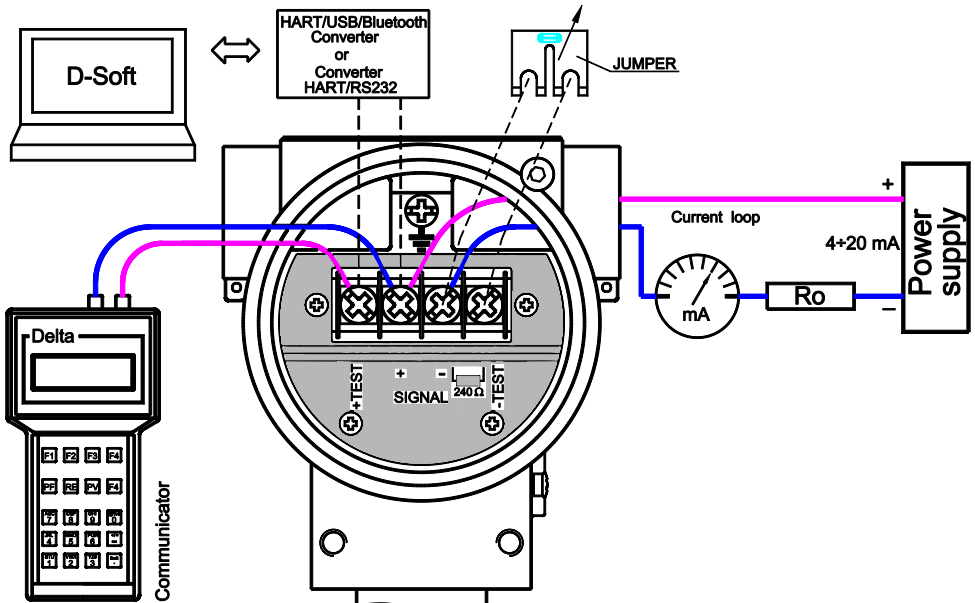


Fig.2c. The link of transmitter and communicator or converter to <SIGNAL+> <TEST+> transmitter terminals in case of the resistance in current loop is **smaller than 250Ω**.

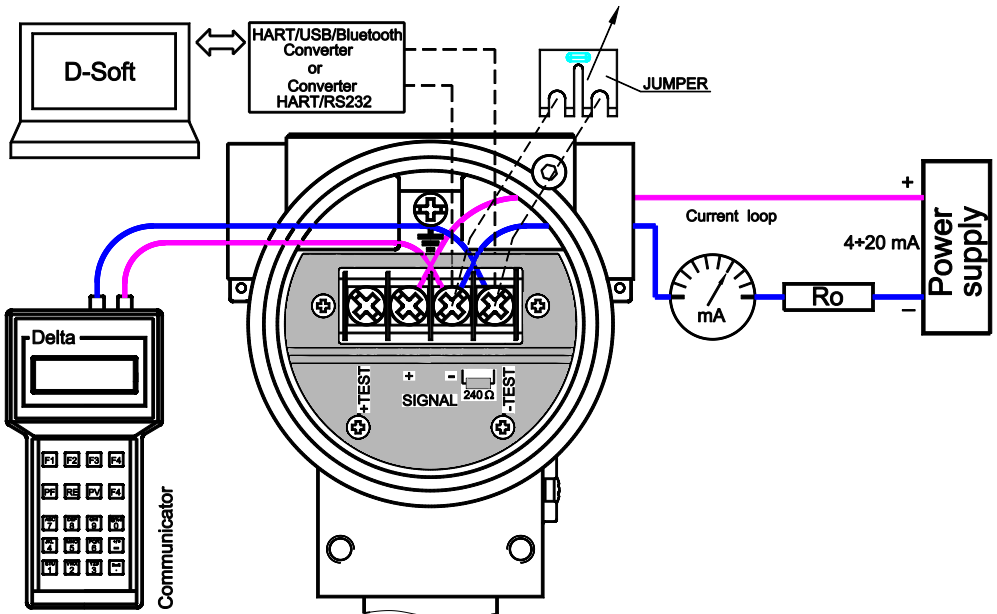


Fig.2d. The link of transmitter and communicator or converter to <SIGNAL+> <SIGNAL-> transmitter terminals in case of the resistance in current loop **is smaller than 250Ω**.



If R_o in current loop is lower than 250Ω is necessary to connect 240Ω resistor to current loop by remove jumper from <SIGNAL-> and <TEST-> terminals. After communication jumper should came back at its place.

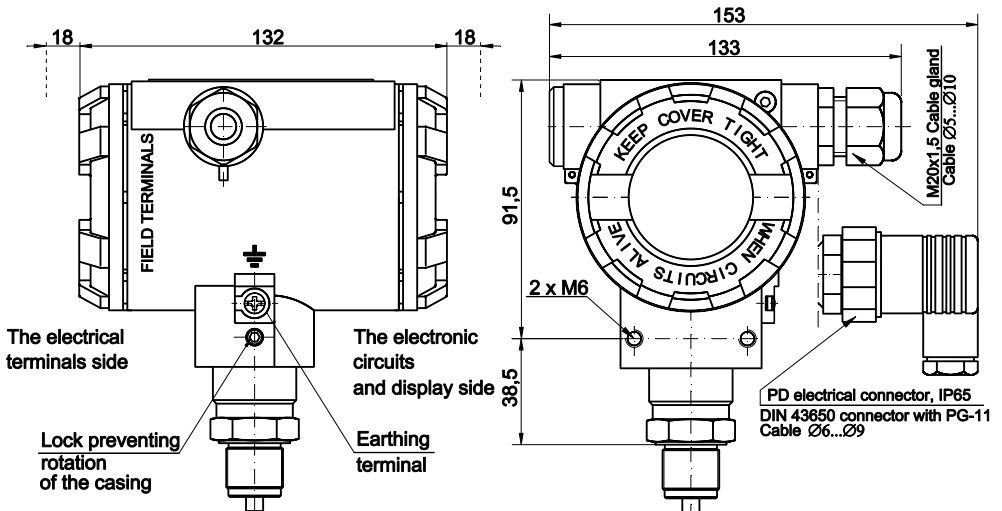


Fig. 3. DPC-2000ALW smart pressure transmitter.

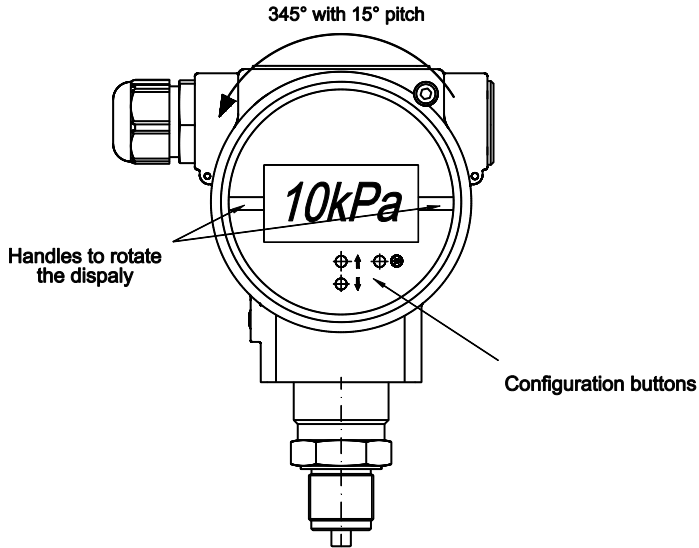


Fig. 4. DPC..., DPR.... display rotation possibility, configuration buttons.

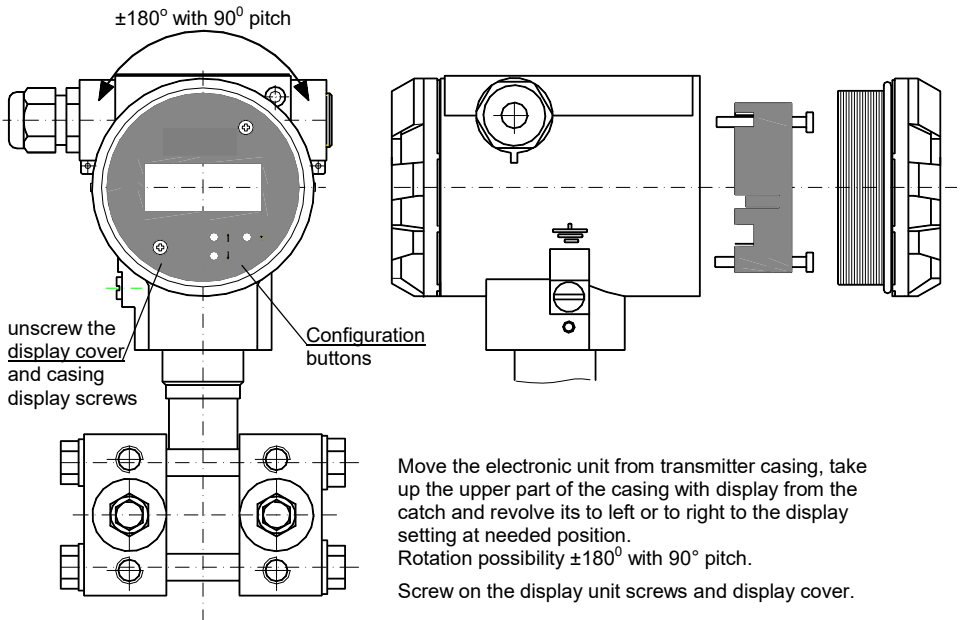


Fig. 4a. Version Exd for DPC..., DPR.... display rotation possibility, configuration buttons.



Jumper in radial position
(as at photo) –back lighting
off; jumper in circular

Fig. 5. Back lighting jumper view at transmitter electric board (unit display back side) (for version Exd).

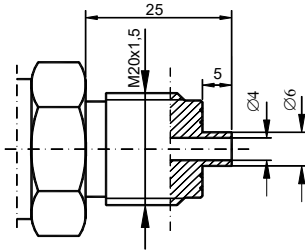


Fig. 6a. M-type connector
with M20x1.5 thread

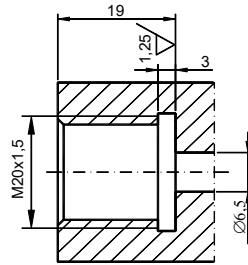


Fig. 6b. Socket for M-type connector

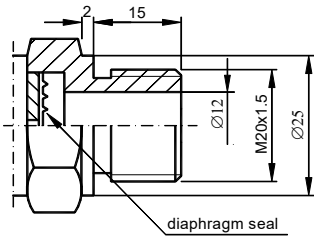


Fig. 7a. P-type connector
with M20x1.5 thread

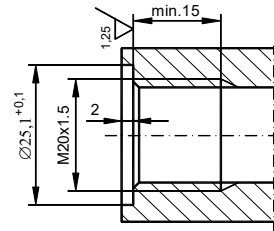


Fig. 7b. Socket for P-type connector

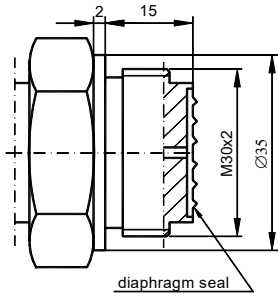


Fig. 8a. CM30x2-type connector
with flush diaphragm
with M30x2 thread,

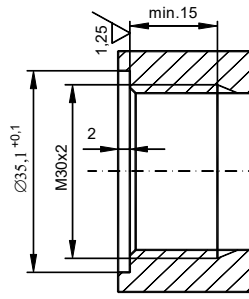


Fig. 8b. Socket for
CM30x2-type
connector.

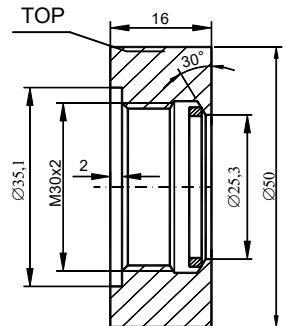


Fig. 8c. Socket for
CM30x2-type connector
Sealing: teflon

Order code Socket CM30x2

i

The ring in Fig. 8c has to be welded in place with the word TOP upwards.

Fig. 6. M-type connector with M20x1.5 thread.

Fig. 7. P-type connector with M20x1.5 thread.

Fig. 8. CM30x2-type connector with flush diaphragm with M30x2 thread.

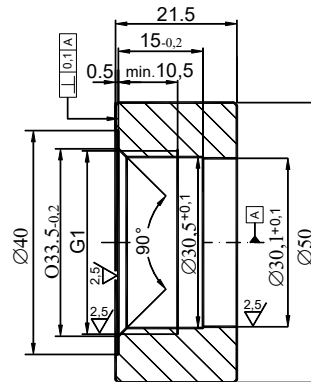
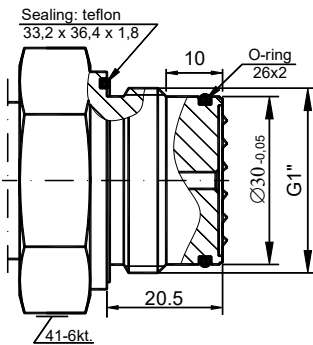
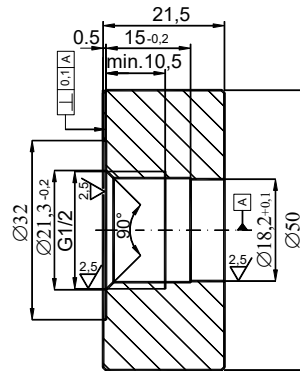
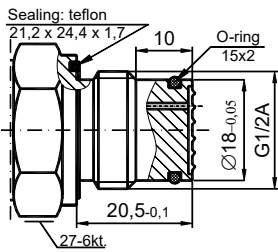
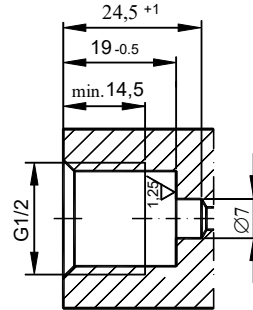
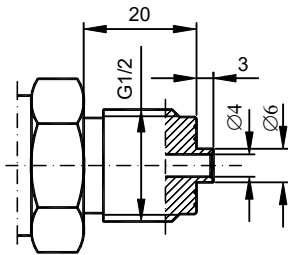


Fig.9e. CG1-type connector
with flush diaphragm
with G1" thread,

Fig.9f. Socket for
CG1 - type connector
Order code Socket CG1

Fig. 9. Process connections G1/2" and G1".

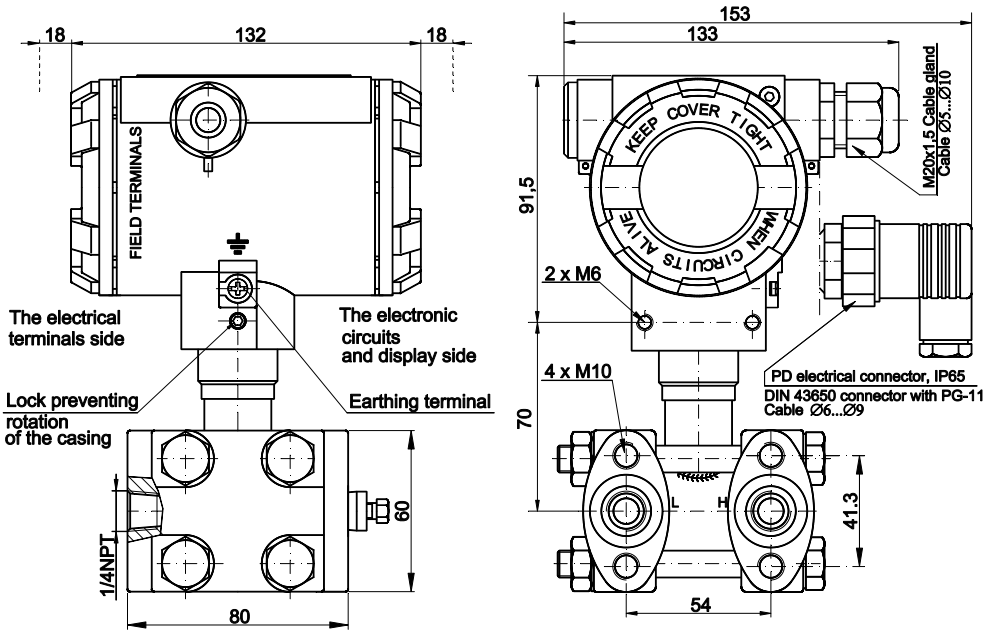


Fig. 10. DPR-2000ALW differential pressure transmitter with C type vented covers.

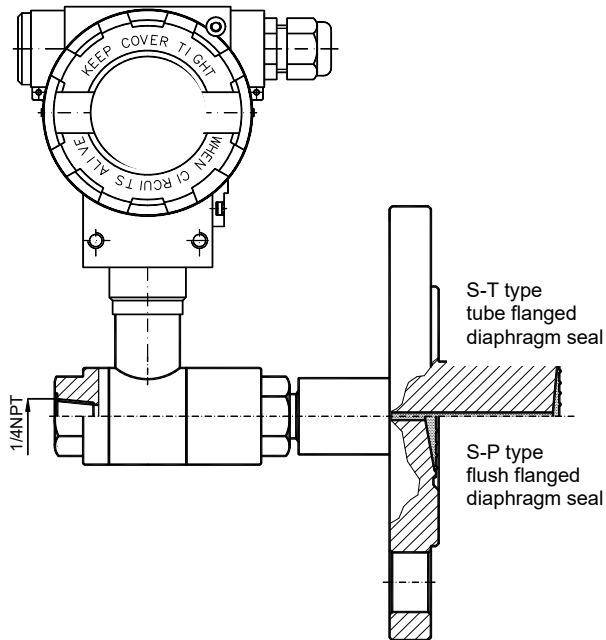
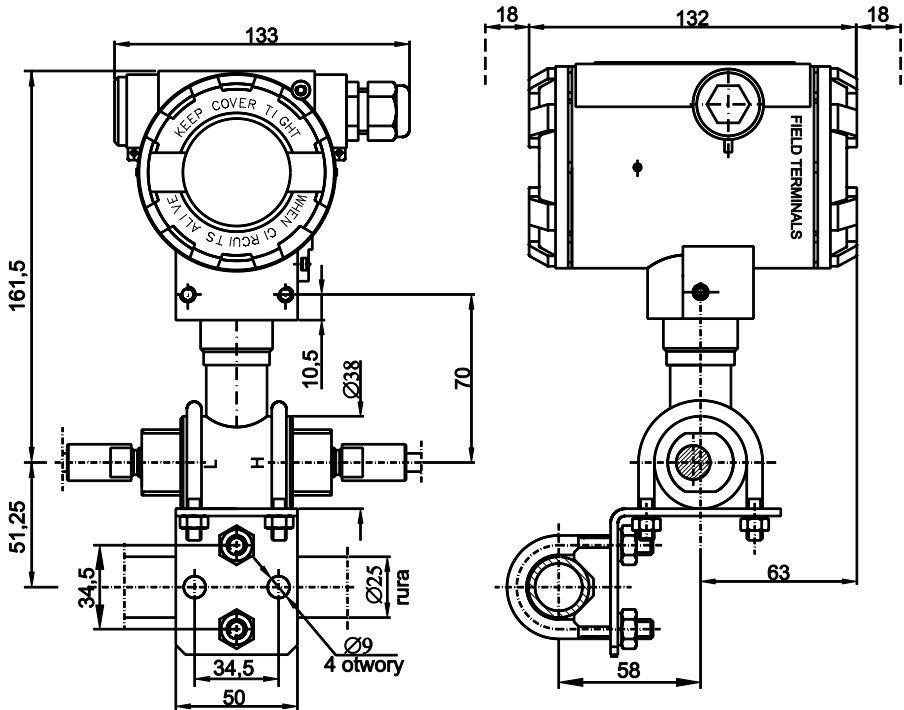


Fig. 11. DPR-2000ALW differential pressure transmitter with a single direct diaphragm seal (example).



Assembly Kit ("Mounting bracket $\varnothing 25$ " made by DELTA) for fitting differential pressure transmitters with P-type connector on a $\varnothing 25$ pipe see catalogue cards "Fitting accessories".

Fig. 12. Example: how to install the DPR-2200ALW transmitters with remote diaphragm.

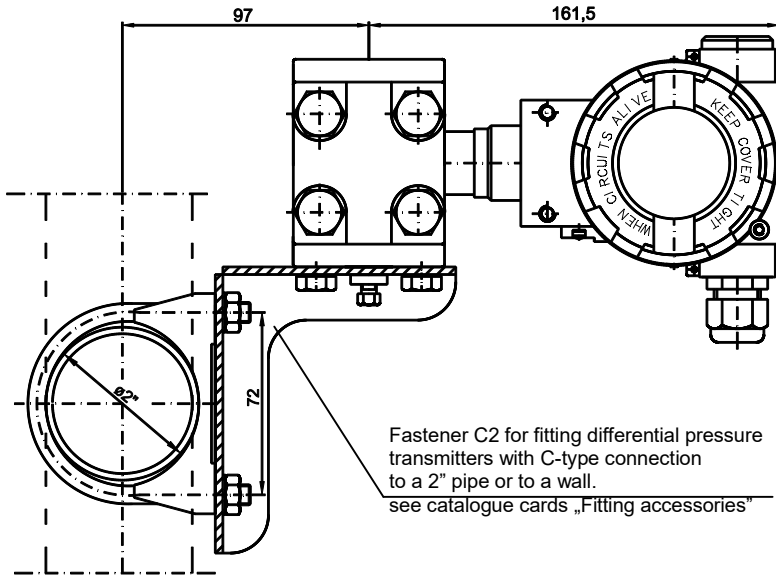


Fig. 13. Example: how to install the DPR-2000ALW transmitter on a vertical or horizontal pipe.

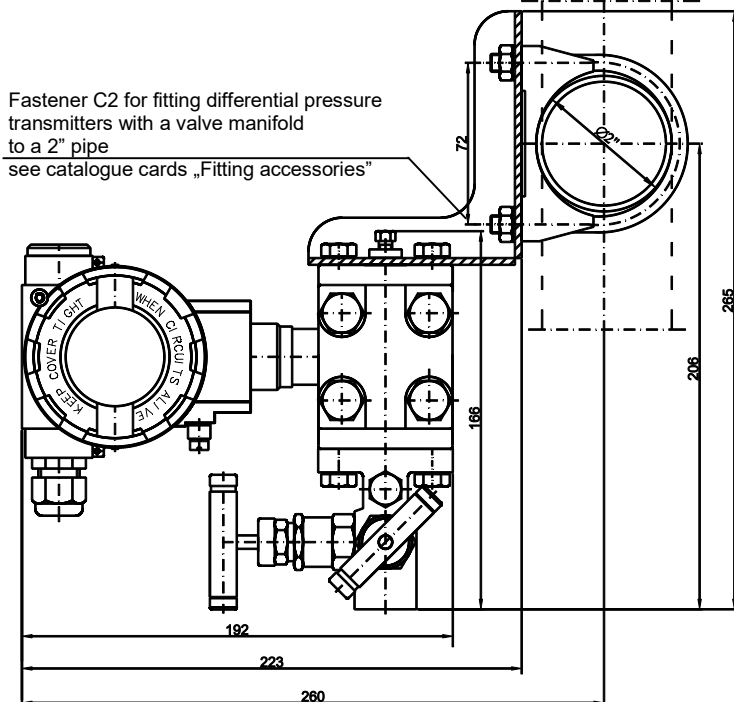


Fig. 14. Example: how to install the DPR-2000ALW transmitter with a valve manifold to a 2" pipe.

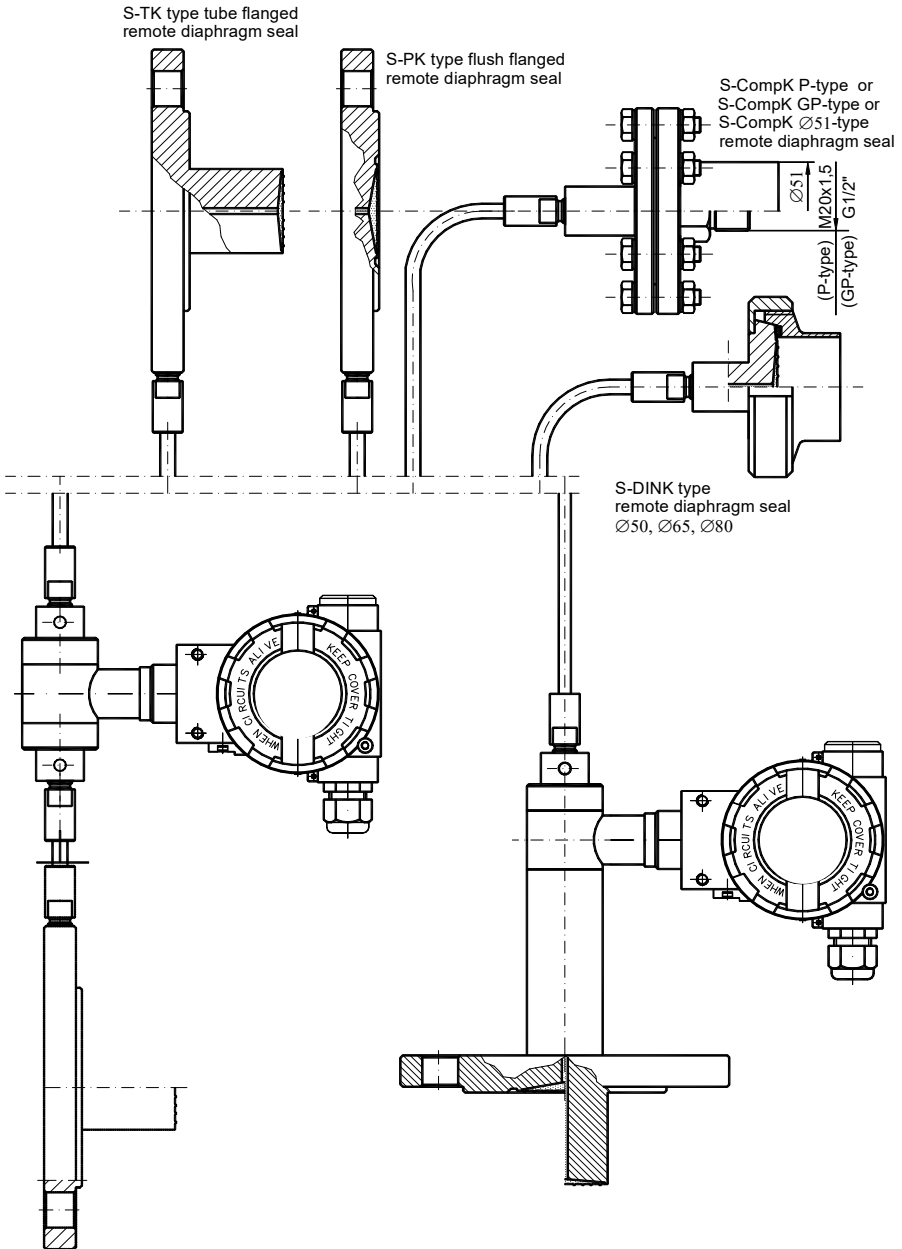


Fig. 15. DPR-2200ALW differential pressure transmitter with two remote diaphragm seals (examples).

Fig. 16. DPR-2200ALW differential pressure transmitter with direct and remote diaphragm seal (examples).

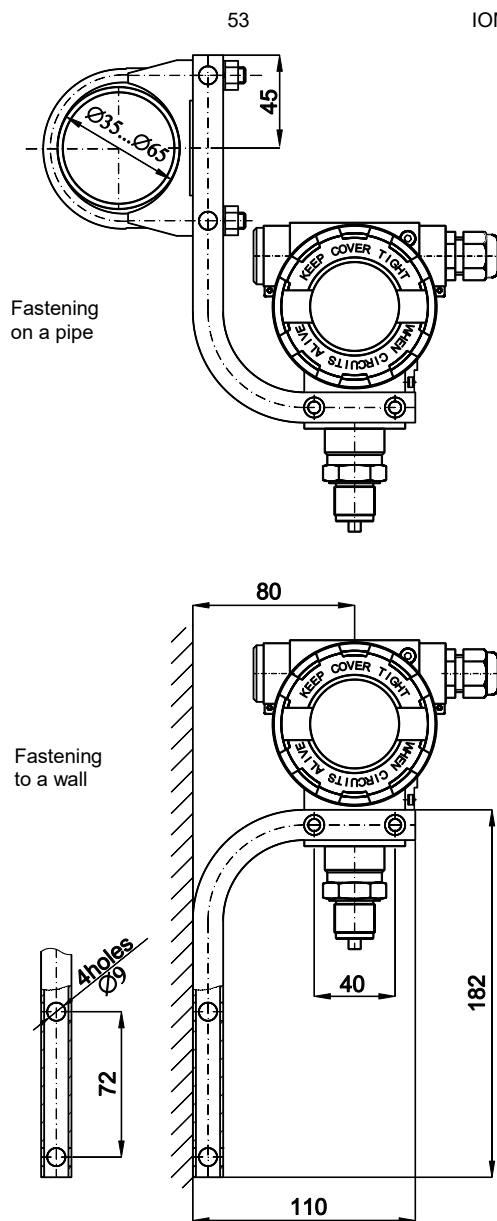


Fig. 17. Example: how to install the DPC..., DPR... transmitter.

Fig. a.

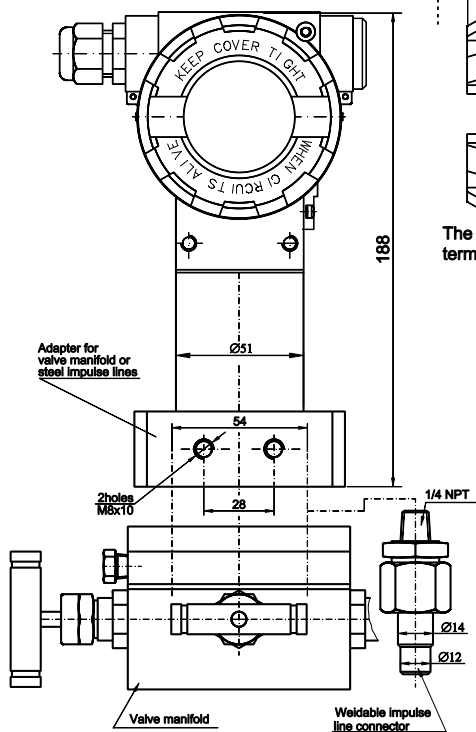


Fig. b.

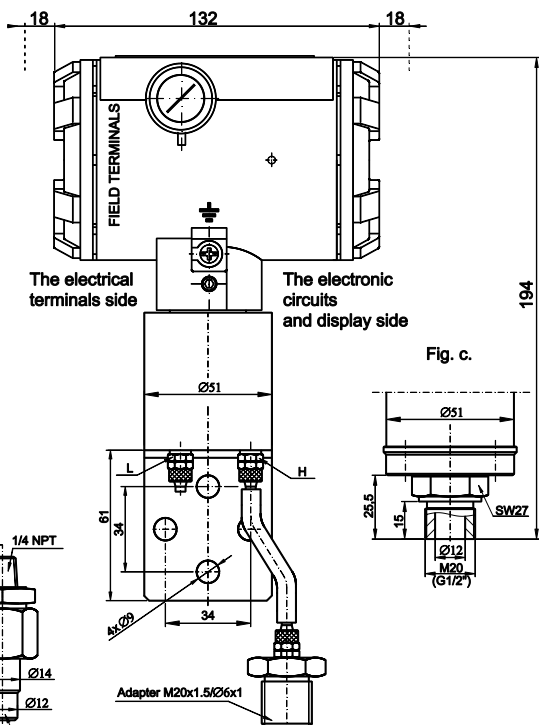


Fig. c.

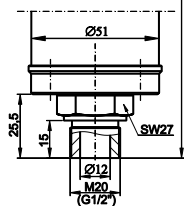


Fig. 18. DPR-2000GALW smart differential pressure transmitter for low ranges.

- DPR-2000GALW transmitter – industrial version with C type process connector to mount together with a valve manifold or weldable impulse line connectors.
- DPR-2000GALW transmitter – economical version with PCV type process connector.
- DPR-2000GALW transmitter – with GP or P type process connector (G1/2" or M20x1,5 thread).

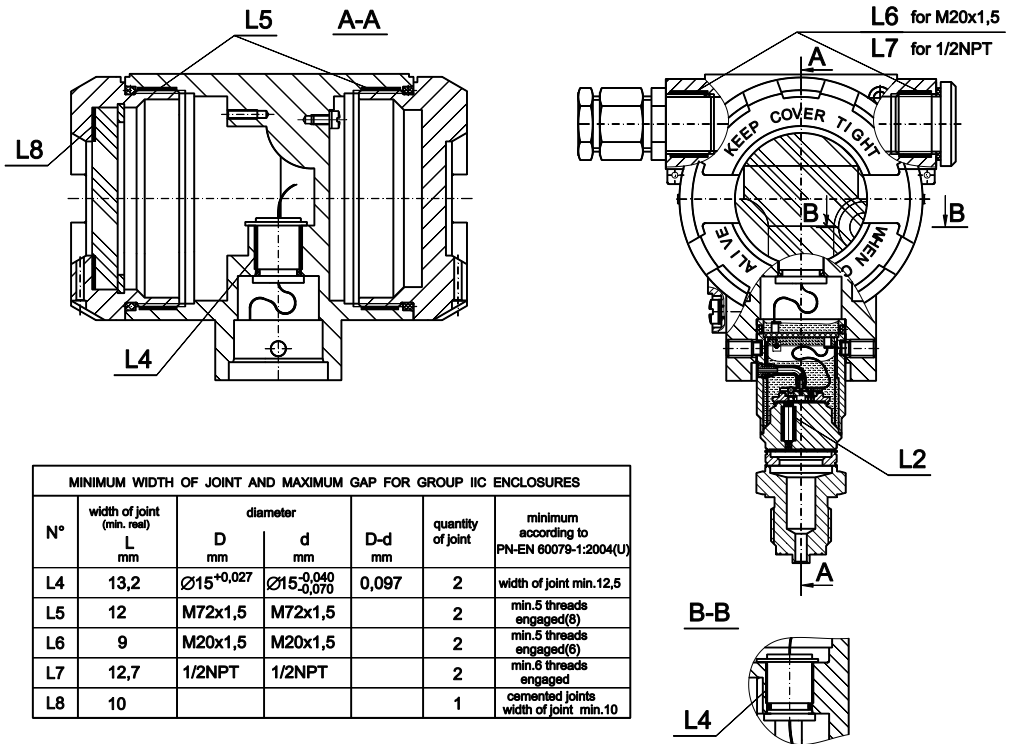


Fig. 20. The explosion - proof joints of DPC..., DPR... transmitters.

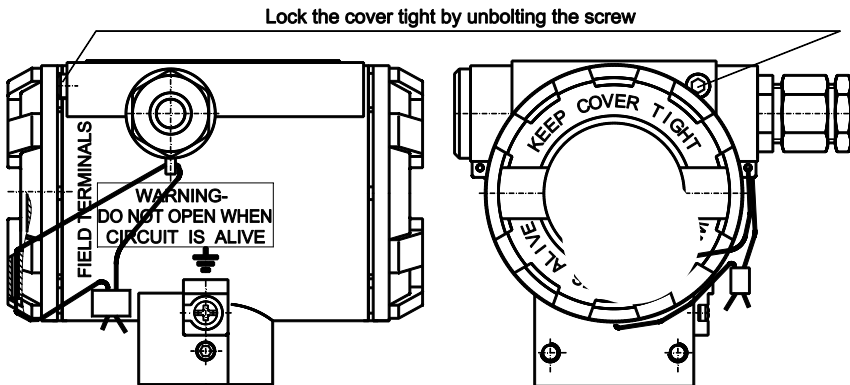


Fig. 21. How to lead the casing of DPC..., DPR... transmitters.

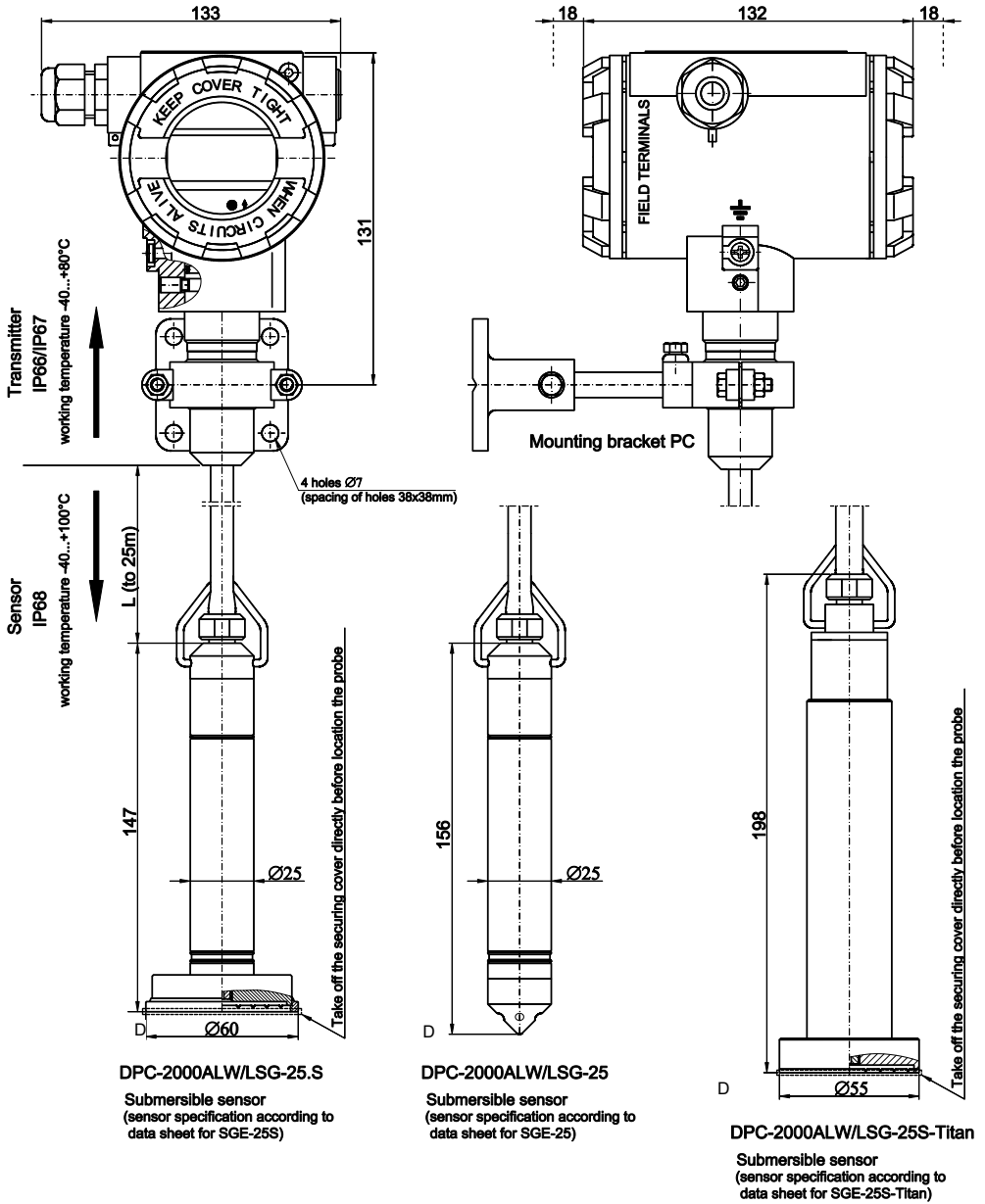
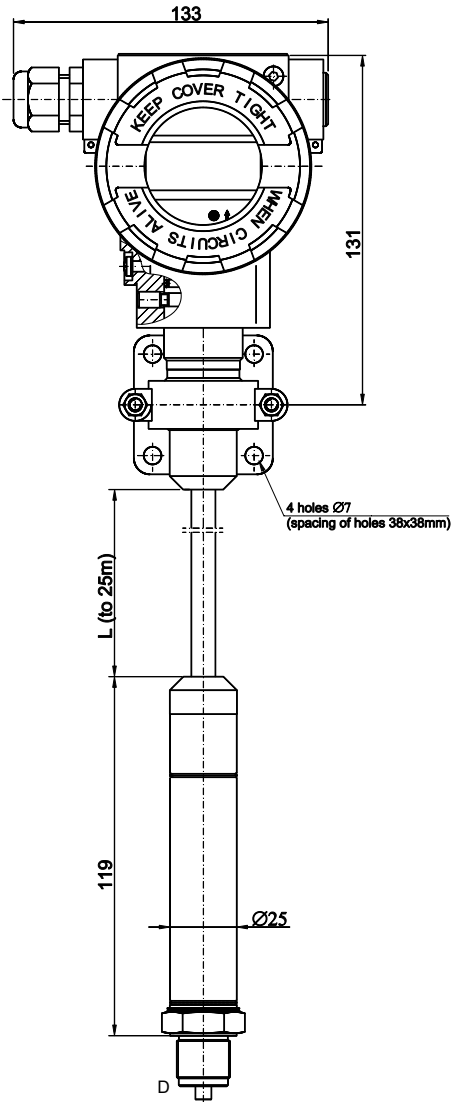
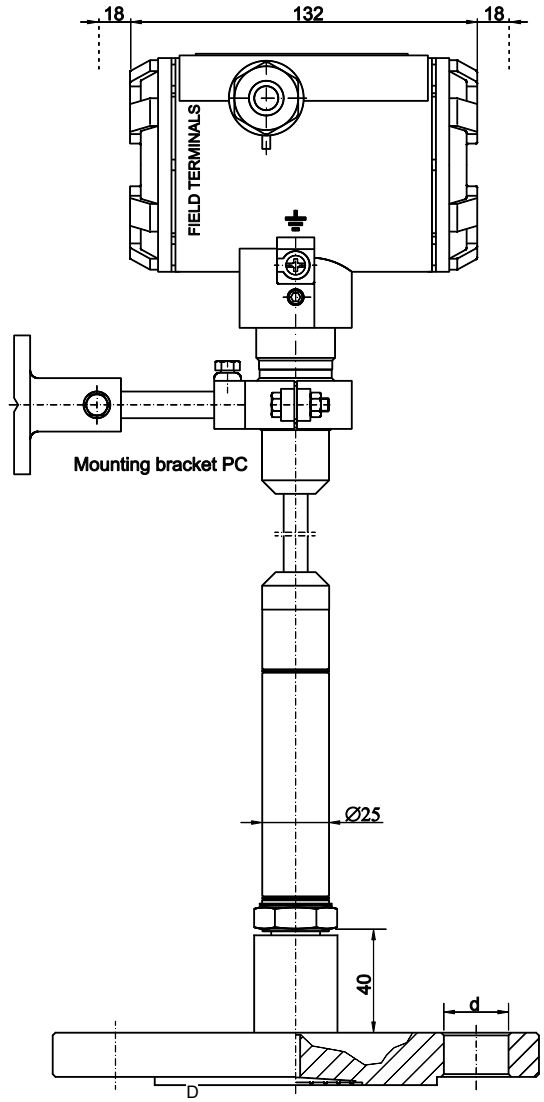


Fig. 22. DPC-2000ALW/LSG... smart level transmitters.



DPC-2000ALW/LM

Transmitter with M type sensor



DPC-2000ALW/LSP

Transmitter with SP type diaphragm seal

Fig. 23. DPC-2000ALW/LM & DPC-2000ALW/LSP smart pressure or level transmitters.

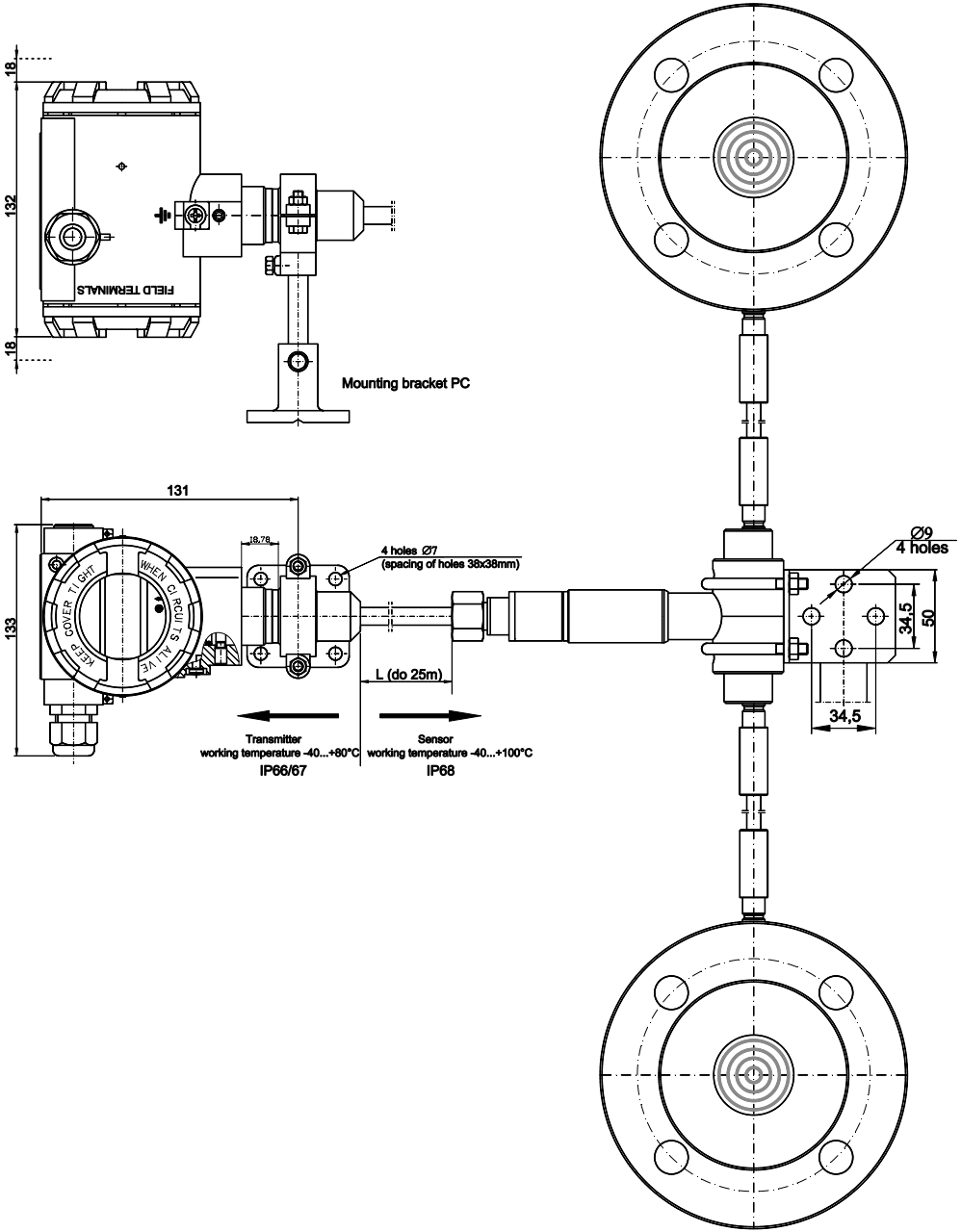


Fig. 24. An example of the differential pressure transmitter DPR-2200ALW/L.

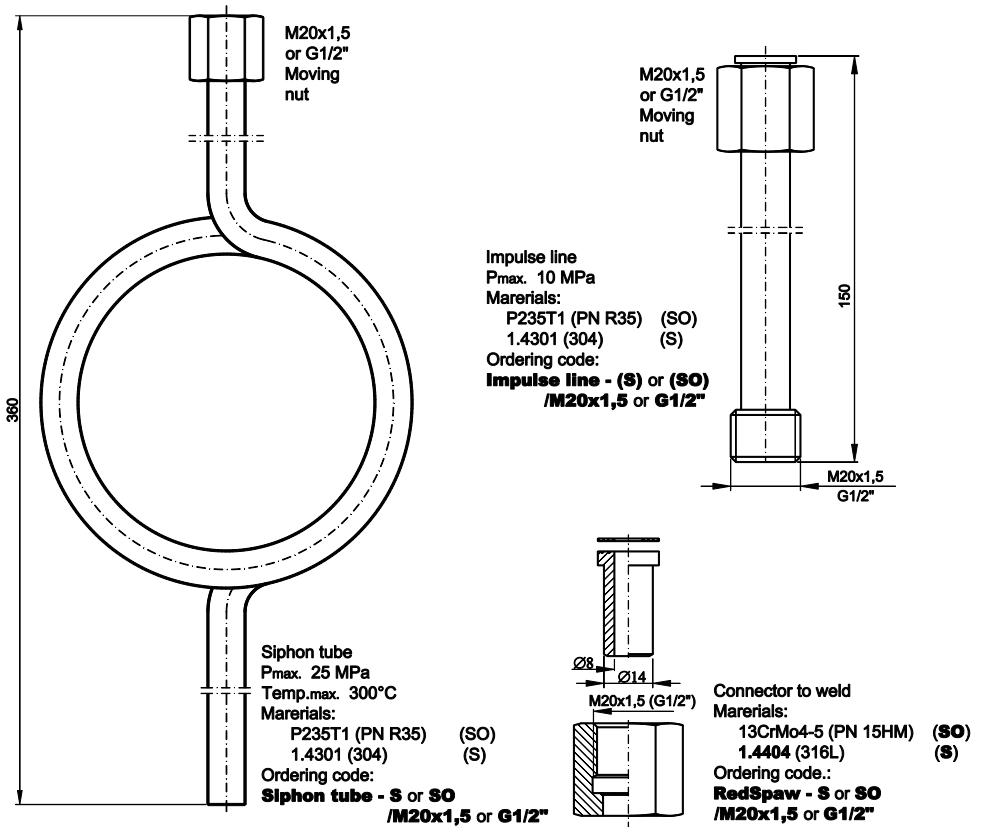


Fig. 25. Additional equipment for fitting of pressure transmitters.

