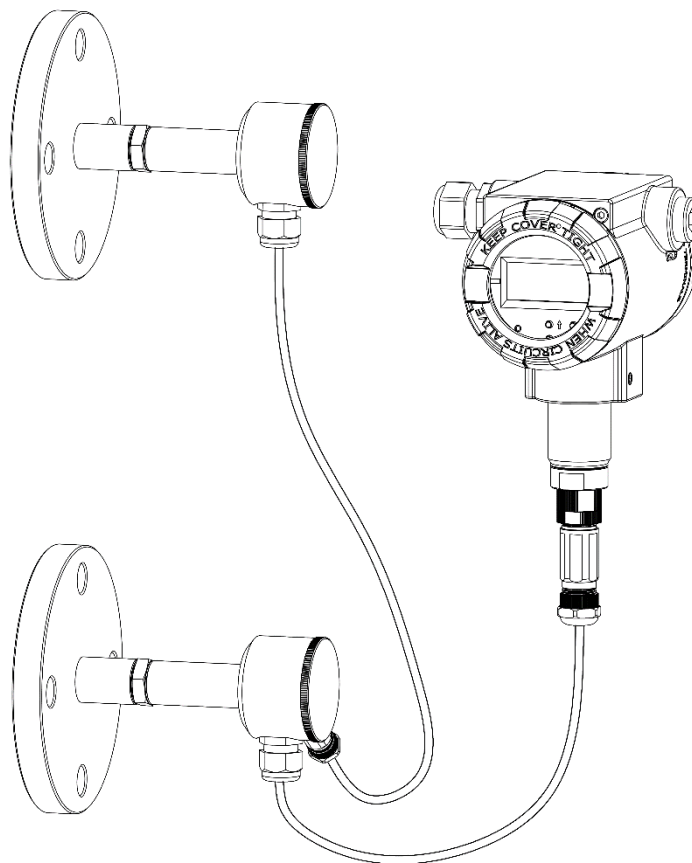








EXPLOSION-PROOF DEVICE MANUAL
SMART ELECTRONIC DIFFERENTIAL PRESSURE
TRANSMITTERS

APM-2



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 type 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 suitable technical condition of the device or use of the device other than for its intended purpose.

Installation should be carried out by qualified staff having the required authorizations to install electrical and I&C equipment. The installer is responsible for performing the installation in accordance with manual as well as with the electromagnetic compatibility and safety regulations and standards applicable to the type of installation.

All safety and protection requirements must be observed during installation, operation and inspections.

If a malfunction occurs, the device should be disconnected and handed over to the manufacturer for repair.



In order to minimize the risk of malfunction and associated risks to staff, the device is not to be installed or used in particularly unfavourable conditions, where the following hazards occur:

- possible mechanical impacts, excessive shocks and vibration;
- excessive temperature fluctuation;
- water vapour condensation, dusting, icing.



Installation of the transmitter in explosion-risk atmospheres must comply with the requirements of relevant instructions and national standards and regulations.

Changes made to the manufacturing of products may be introduced before the paper version of the manual is updated. The up-to-date manuals are available on the manufacturer's website: www.aplisens.com.

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1. INTRODUCTION

This manual is only applicable to the APM-2 series transmitters in Ex (explosion-proof), Exi (intrinsically safe), Exd and Ext (flameproof). The transmitters are identified with model ID on nameplates and also as specified in section 4. Ex information are included in the “Product Certificate”. Model ID indicates type and version of transmitter. The manual contains most important information on intrinsically safe and flameproof transmitters compliant with ATEX directive. If explosion-proof transmitters are installed, refer to this manual and also:

- User’s manual EN.IO.APM.2.

2. SAFETY

- The installation and start-up of the device and any activities related to operation shall be carried out after thorough examination of the contents of user’s manual and the instructions related thereto.
- Installation and maintenance should be carried out by qualified staff having the required authorizations to install electrical and measuring devices.
- The device shall be used according to its intended purpose in line with the permissible parameters.
- Before installing or disassembling the device, it is absolutely necessary to disconnect it from the power source.
- No repairs or alterations to the transmitter electronic system are permitted. Assessment of damages and possible repair may only be performed by the manufacturer or authorized representative.
- Do not use instruments if damaged. In case of malfunction, the device must be put out of operation.
- If the equipment is used in Ex zones, the technical requirements specified in this manual and applicable local (national) regulations must be followed.



3. COMPLETE DELIVERY CHECKLIST

The user receives the following with the transmitter:

- a) Product Certificate, which also constitutes a warranty card;
- b) Declaration of Conformity;
- c) Certificate copy (on request);
- d) EN.IX.APM.2 explosion-proof device manual;
- e) EN.IO.APM.2 user manual.

Items b), c), d), e) are available at www.aplisens.com.

4. IDENTIFICATION MARKS

Ex transmitters are delivered with a nameplate which contains data specified EN.IO.APM.2 and also the following:

- a) Designation of explosion-proof design type, certificate number;
- b) Parameter values, e.g. Ui, li, Ci, Li for Exi transmitters;
- c) Year of manufacture;
- d) „SA Version” inscription - isolated power supply for intrinsically safe transmitters with overvoltage protection in which ground isolated power supply should be used.

APLISENS[®] **CE** 1453
 APLISENS S.A. www.aplisens.pl

TYPE
 ID:.....
 → P
 → Tamb
 → U
 → I 4...20mA + HART
 Mat.
 Electrical connection:
 Ser.-No:
 Year of production:
 IP.

Designation of the type of explosion-proof structure
 designation of certificate.

Aplisens S.A. ul. Morelowa 7, 03-192 Warszawa

Figure 1. Sample transmitter nameplate.

5. TRANSMITTER DESIGN

The modular differential pressure transmitters consist of: central unit HUB two pressure transmitters PC1, PC2.

The basic central unit HUB components are: housing made of 316 (1.4401) stainless steel or aluminium, electronic module. Transmitters in aluminium, steel enclosures are allowed for II and III group.

The PC1 and PC2 transmitters consist of housing and a measuring head converting the signal from the head to the output signal. PC1 and PC2 transmitter housings are made of 316 or 304 steel and are approved for Group II and III.

6. ELECTROSTATIC HAZARDS

The paint, plastic nameplate and diaphragm seals coated with PTFE form a non-conducting layer applied on a conducting base of enclosure or diaphragm seals. Transmitters with this design in a dust-explosion zone should be installed in a place where electrostatic charging is impossible, in particular by contact with electrically charged dust falling off or blown from neighboring devices.

When performing connection and maintenance activities in the hazardous area, the possibility of electrostatic discharge should be eliminated. Do not wipe the transmitter dry.

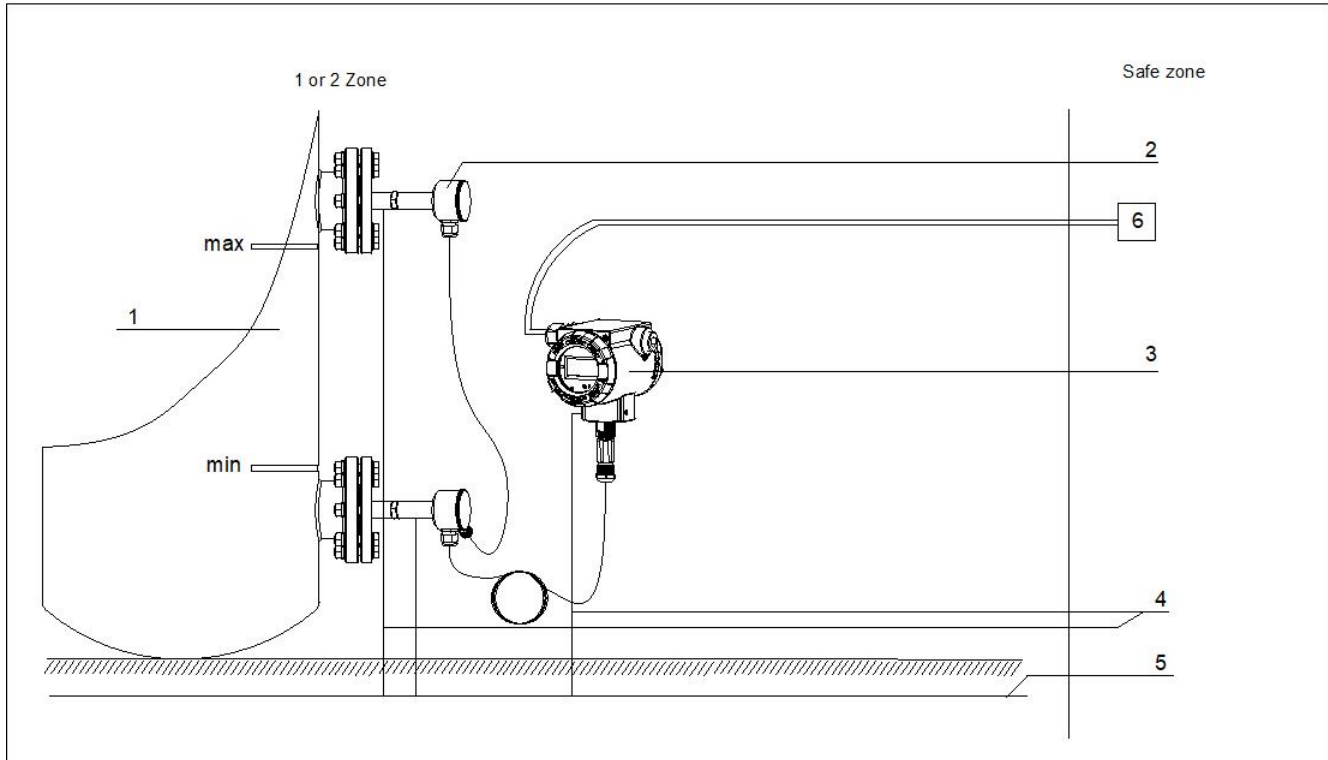
7. SPECIAL CONDITIONS OF USE

- a) In hazardous zones, transmitters with painted aluminum enclosures as well as transmitters equipped with plastic nameplate and PTFE-coated diaphragm separator components should be installed in way that prevents electrostatic charging specified in accordance with point 6.
- b) An intrinsically safe transmitter version with surge arrester, marked on the nameplate as "SA" does not meet the requirements of clause 10.3 of EN 60079-11 (500Vrms). This must be taken into account when installing the device.
- c) If the membrane separator contains titanium elements, it must be protected against mechanical impact.
- d) The circuit behind the galvanic separation in the central unit does not comply with the requirements of clause 6.3.6 of PN 60079-11:2012 for solid insulation to the housing. Potential equalisation must be applied between the transmitter central unit and transmitters PC1 and PC2.
- e) The power supply for the transmitter shall comply with overvoltage category II (or better) according to EN 60664-1.
- f) Flameproof joints are not intended to be repaired.

8. TRANSMITTER PROTECTION LEVEL (EPL) AND HAZARDOUS AREAS

Ga/Gb EPL protection level means that the transmitter can be installed in Zone 1 or 2, and transmitter process connectors of PC1, PC2 transmitters, can connect to Zone 0.

Da EPL protection level means that the transmitter and process connector can be installed in Zone 20 or 21.



1. Tank; Zone 0;
2. PC1 and PC2 transmitters;
3. Central unit;
4. Equipotential bonding conductor;
5. Equipotential bonding line;
6. Associated apparatus with appropriate approval.

Figure 2. Transmitter installation in potentially explosive areas.

8.1. INTRINSICALLY-SAFE Exi TRANSMITTERS ACCORDING TO CERTIFICATE JSHP 22 ATEX 0051X

8.2. Standards used for assessment

The transmitters are manufactured in compliance with the following standards:
 EN IEC 60079-0:2018; (IEC 60079-0:2017 ed. 7.0),
 EN 60079-11:2012; (IEC 60079-11:2011 ed. 6.0).

8.3. Transmitter explosion-proofing designations according to certificate JSHP 22 ATEX 0051X

The following ATEX markings apply only to intrinsically safe transmitters:
 ATEX:



II 1/2G Ex ia IIC T5/T4/T3 Ga/Gb
 II 1D Ex ia IIIC T100°C/T135°C/ T155°C Da
 JSHP 22 ATEX 0051X



As standard, the transmitters are manufactured for explosive gas atmospheres.
 A customer can also order a transmitter for explosive dust atmospheres.

8.4. Minimum supply voltage

Table 1. Minimum supply voltage of an Exi transmitter.

Minimum supply voltage for transmitters with backlight off	Minimum supply voltage for transmitters with backlight on *)
13V	16V
*) Backlight can only be turned on at transmitter manufacturing stage.	

8.5. Load resistance

a) For a linear power supply from a barrier:

$$R_{o \max [\Omega]} = \frac{U_{zas} - 13V - (R_w * 0.02066A)}{0.02066A}$$

b) For power supply from a trapezoidal or orthogonal source.

$$R_{o \max [\Omega]} = \frac{U_{zas} - 13V}{0.02066A}$$

R_w – barrier resistance;

U_{zas} – minimum voltage of the barrier used.

9. PERMISSIBLE PARAMETERS OF Exi TRANSMITTERS.

Table 2. Permissible input parameters of an Exi transmitter.

Temperature class	Maximum surface temperature of the transmitter	Linear power supply	Trapezoidal power supply	Orthogonal power supply	
		$U_i=30V$	$U_i=24V, U_Q=48V$	$U_i=24V$	$U_i=24V$
		$I_i=0,1A$	$I_i=0,05A$	$I_i=0,025A$	$I_i=0,05A$
		$P_i=0,75W$	$P_i=0,6W$	$P_i=0,6W$	$P_i=1.2W$
		$C_i=7,5nF$	$C_i=7,5nF$	$C_i=7,5nF$	$C_i=7,5nF$
		$L_i=18\mu H$	$L_i=18\mu H$	$L_i=18\mu H$	$L_i=18\mu H$
T5	100°C	$T_a \leq 60^\circ C; T_m \leq 90^\circ C$			
T4	135°C	$T_a \leq 80^\circ C; T_m \leq 125^\circ C$			
T3	155°C	$T_a \leq 80^\circ C; T_m \leq 150^\circ C$			

T_a – ambient temperature;
 T_m – process temperature.



Supply power to transmitters from supply and measurement devices with applicable intrinsic safety certificates whose parameters of outputs to a hazard zone should not exceed the permissible transmitter power supply parameters specified above.

9.1. Linear power supply example

For example, linear power supply is provided by a typical barrier with the following parameters

$U_o = 28V; I_o = 0,1A; P_o = 0,7W; R_w = 280\Omega.$

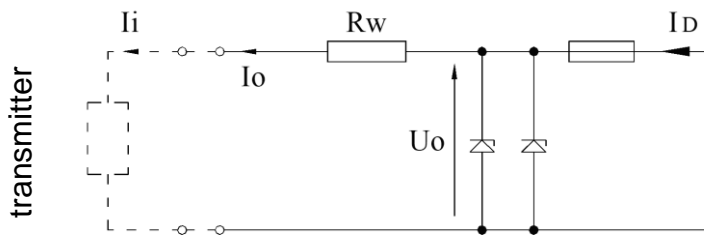


Figure 3. Principle of power supply from a linear source.

9.2. Trapezoidal power supply example

$U_o = 24V; I_o = 50mA; P_o = 0,7W$

An example of trapezoidal power supply is shown in **Figure 4**.

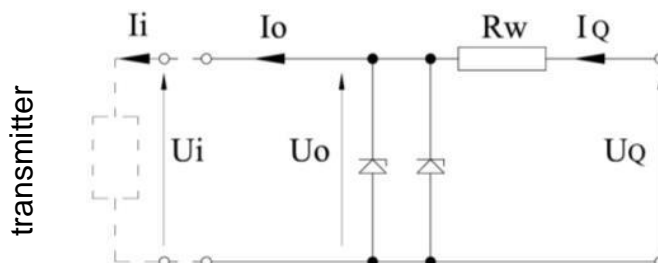


Figure 4. Principle of power supply from a trapezoidal source.

If $U_o > \frac{U_Q}{2}$, U_Q, I_o, P_o have the following relations:

$$P_o = \frac{U_Q * I_o}{4}$$

If $U_o \leq 1/2U_Q$, U_Q , I_o , P_o have the following relations:

$$P_o = \frac{U_o(U_Q - U_o)}{R_w}$$

Resistance R_w :

$$R_w = \frac{U_Q}{I_o}$$

9.3. Orthogonal power supply example

$U_o = 24V$ $I_o = 25mA$ $P_o = 0,6W$

$U_o = 24V$ $I_o = 50mA$ $P_o = 1,2W$

Orthogonal power supply means that the voltage of an intrinsically safe power adapter does not change until the current limiter is activated.

The level of protection of orthogonal power supply adapters is usually "ib". A transmitter supplied from such power adapter is usually an "ib" intrinsically safe device.

An example of power supply in practice:

A stabilized power adapter with $U_o = 24 V$, "ib" protection level and current limited to $I_o = 25 mA$.

10. CONNECTING Exi TRANSMITTERS.



Transmitter and equipment in the transmitter measurement loop must be connected in compliance with intrinsic safety and explosion proofing standards and conditions for application in risk zones. If intrinsic safety rules are not followed, explosion can occur and people can be exposed to danger.

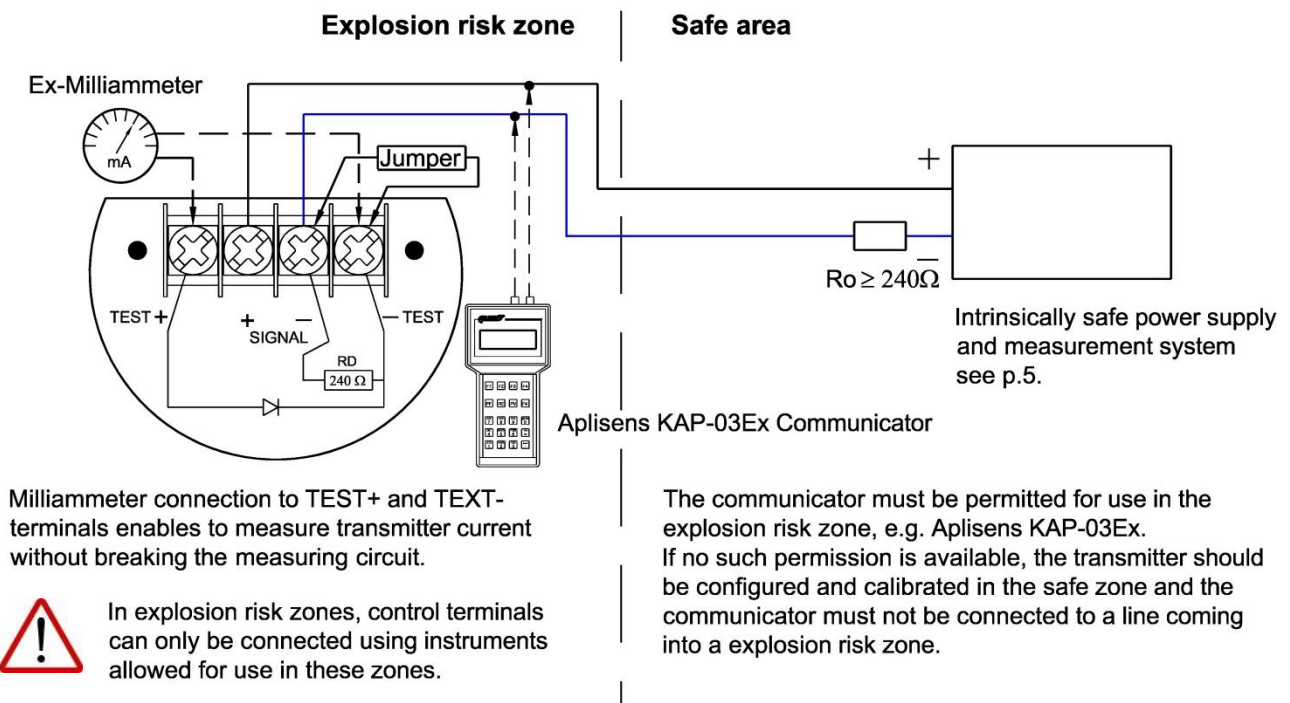


Figure 5. Connecting Exi transmitter



The central unit is equipped with an additional communication resistor $R_D=240\Omega$. <SIGNAL -> and <TEST -> terminals are short-circuited in factory. R_D resistor is used when the transmitter need to be communicated with locally (from its terminals) and a $R_o < 240 \Omega$. <SIGNAL -> and <TEST -> terminals must be open-circuited then.



The electrical system for connecting transmitters should meet installation requirements of applicable standards.



No repairs or alterations to the transmitter electrical system are permitted. Only the manufacturer or a facility authorized by the manufacturer may assess damages and repair the device.



“Version SA” transmitters should be supplied from devices equipped with galvanically isolated power supply. If galvanically isolated power supply is not possible, the transmitter or metal parts connected to it should be properly grounded, for instance with an equipotential wiring or an equipotential bonding between the transmitter and the negative pole of power supply barrier.



Electrical potential equalization must be ensured between the central unit and transmitters PC1 and PC2 remote from the central unit.

10.1. FLAMEPROOF Exd TRANSMITTERS ACCORDING TO CERTIFICATES JSHP 22 ATEX 0051X

10.2. Standards used for assessment

The transmitters are manufactured in compliance with the following standards:

EN IEC 60079-0:2018; (IEC 60079-0:2017 ed. 7.0),
 EN 60079-11:2012; (IEC 60079-11:2011 ed. 6.0.),
 EN 60079-1:2014; (IEC 60079-1:2014 ed. 7.0),
 EN 60079-31:2014; (IEC 60079-31:2013 ed. 2.0).

10.3. Transmitters explosion-proofing designations (Exd and Ext) according to certificate JSHP 22 ATEX 0051X

The following ATEX markings apply only to flameproof safe transmitters Exd and Ext:

ATEX:



II 1/2G Ex db ia IIC T5/T4/T3 Ga/Gb
 II 1D Ex ia ta IIIC T100°C/T135°C/ T155°C Da
 JSHP 22 ATEX 0051X

11. PERMISSIBLE PARAMETERS OF Exd and Ext TRANSMITTERS

11.1. Ambient temperature range and temperature classes

Table 3. Temperature classes and maximum surface temperature depending on ambient and fluid temperature.

Operating temperature range		Temperature class and maximum surface temperature
Ambient temperature	Process temperature	
$-40^{\circ}\text{C} \leq T_a \leq 75^{\circ}\text{C}$	90°C	T5/T100°C
	125°C	T4/T135°C
	150°C	T3/T155°C

11.2. Power supply, connection and operation of Exd transmitters



Connect the transmitter according to the wiring diagram (Figure 6). The transmitter electrical connections in potentially explosive zones should be made by personnel having necessary knowledge and experience in this respect. The transmitter should be properly grounded by means of a grounding terminal.



Transmitter and equipment in the transmitter measurement loop must be connected in compliance with explosion proofing standards and conditions for application in explosion risk zones. If these rules are not followed, explosion can occur and people can be exposed to danger.

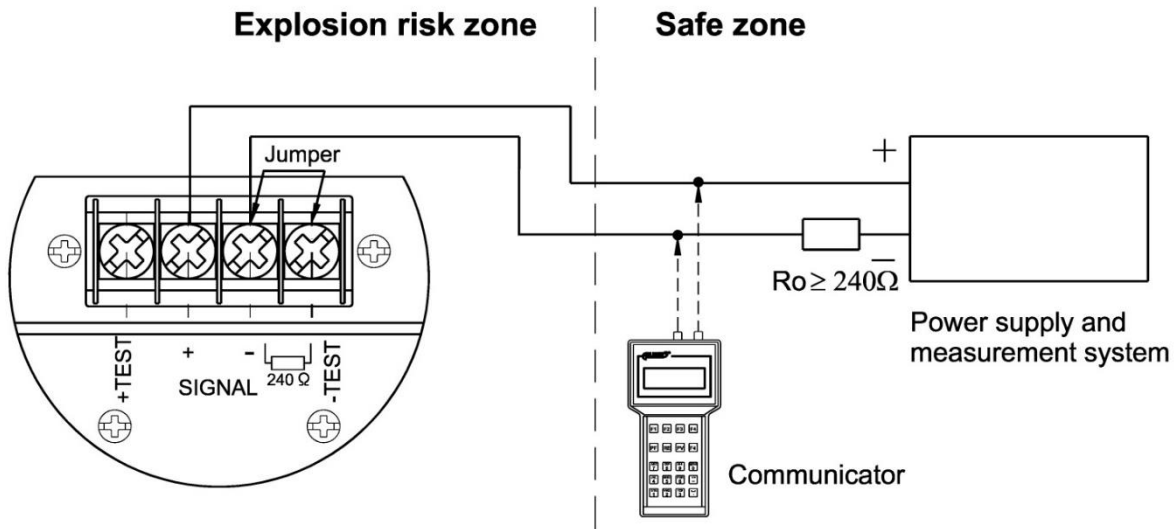


Figure 6. Connecting Exd transmitter.



The transmitter should be supplied with maximum voltage specified in the table below (24 VDC rating) from transformer power supplies or other devices providing at least enhanced isolation between primary and secondary winding in which voltages not larger than 250 VAC occur. It is responsibility of the user to provide power supply compliant with the requirements above.

Table 4. Maximum supply voltage for Exd and Ext transmitters

Maximum supply voltage
36V DC



In an explosion risk zone, do not remove the cover of supplied transmitter and do not connect to the terminals, and do not change the position of local indicator (display).

For transmitter calibration or check outside a risk zone, a communicating device can be connected to <SIGNAL +> and <TEST +> terminals.



The transmitter is equipped with a communication resistor $R_D = 240 \Omega$, which is short-circuited at <SIGNAL -> and <TEST -> terminals in factory. R_D resistor is used when the transmitter need to be communicated with locally (from its terminals) and a $R_o < 240 \Omega$. <SIGNAL -> and <TEST -> terminals must be open-circuited then.



In order to secure the side covers against loosening, unscrew the hex socket screws pressing the screw heads against the edges of the covers. The method of locking the covers against unscrewing and the possible method of sealing the transmitter are presented in the EN.IO.APM.2 user manual.



No repairs or alterations to the transmitter enclosure elements and electrical system are permitted. Flameproof joints are not designed to be repaired. Only the manufacturer or a facility authorized by the manufacturer may assess damages and repair the device.



Due to the type of enclosure material (light alloy with high aluminum content), the user is obliged to ensure that in the transmitter installation site its enclosure cannot be hit and, consequently, damaged.



In a transmitter enclosure there are two holes for installing, one for a cable entry and second for a blinding plug with M20x1.5 or 1/2 NPT thread. As standard, the transmitter is delivered to the customer without cable gland installed. After consultation with the manufacturer, the user can purchase a transmitter with a cable gland, or without a cable gland and the missing cable gland purchase separately. A transport plug is installed in the cable gland place. In such case, the transport plug should be removed and appropriate cable gland installed (**Figure 7**) before the transmitter is installed. It is responsibility of the user to install a certified cable gland compliant with the list of equivalent cable glands in **Table 5**.



As a blinding plug, an Aplisens plug supplied with the transmitter or a certified blinding plug compliant with the list of equivalent blinding plugs in **Table 6** can be used. It is allowed to install other types of certified cable entries and blinding plugs about marking Exd IIC Gb, Ex ta IIIC Da with at least IP66 protection and - 40°C...75°C temperature range.

Apply LOCTITE 577 or SWAK MS-PTS-50 on the 1/2 NPT thread of cable gland before installation.

When connecting, make sure that the cable type and diameter is suitable for the cable gland used and temperature in the installation site.

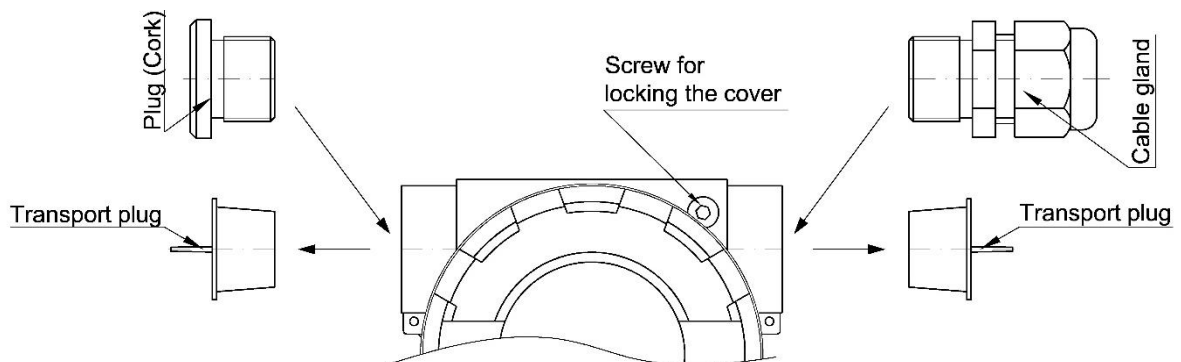


Figure 7. Installation of cable entries and blinding plugs

Table 5. List of equivalent cable entries

Cable entry type	Manufacturer	Thread	Designation	IP	Certificate no.
A2F, A2FRC	CMP-Products	M20x1.5 (1/2" NPT)	Exd IIC Gb Exta IIIC Da	67	CML 18ATEX1321X
SS2K	CMP-Products	M20x1.5 (1/2" NPT)	Exd IIC Gb Exta IIIC Da	67	CML 18ATEX1321X
E1FW, E2FW	CMP-Products	M20x1.5 (1/2" NPT)	Exd IIC Gb Exta IIIC Da	67	CML 18ATEX1324X
PX2K, PXSS2K, PX2KX	CMP-Products	M20x1.5 (1/2" NPT)	Exdb IIC Gb Exta IIIC Da	67	CML18ATEX1325X

Table 6. List of equivalent blinding plugs

Plug type	Manufacturer	Thread	Designation	IP	Certificate no.
747, 757 i 767	CMP-Products	M20x1.5 (1/2" NPT)	Exd IIC Gb Exta IIIC Da Exd I Mb	67	CML 18ATEX1320X



Use a shielded or unshielded, non-reinforced cable with compact structure and circular cross-section in an non-hygroscopic sheath made of an elastomer, e.g. YKSLY 2*1, YnTKSYekw 1*2*1, LIYCY 2*1. If a cable of different design has to be used, it should be agreed on with the transmitter manufacturer in order to choose a suitable cable gland or individually purchase a cable gland suited to the cable used. The list of equivalent cable entries is given above (**Table 5**). The cables should be protected from damage by routing them in cable trays, jacket tubes, cable ladders, by using fixed mounts, etc.



When periodic inspections are performed, the covers tightness, cable entry and cable fixing in the cable entry should be checked. Visually check the enclosure and cable for mechanical damage, and the nameplate for legibility. The sensor diaphragm should be also included to periodic inspections. There shouldn't be a signs of damage. During maintenance it is recommended to apply acid-free petroleum jelly on threads connection.

The connecting and operating general rules for an Exd transmitters should be compliant with the rules and standards applicable to devices in a flameproof enclosure:



EN 60079-14 – Electrical devices in explosive atmospheres. Part 14: Electrical installations in risk areas (other than mines).

EN 60079-17 – Electrical devices in explosive atmospheres. Part 17: Electrical installations inspection and maintenance in risk areas (other than mines).



Due to possible damage, the transmitter should be protected from heating above 80°C also when explosion hazard does not occur.

12. ADDITIONAL INFORMATION

12.1. Additional information

The manufacturer reserves the right to introduce structural and technological changes to the device, which does not deteriorate its performance.

12.2. History of revisions

Revision No	Document revision	Description of changes
-	01.A.001/2022.09	Initial document version. Prepared by DKD, DCF.