DTR.APT.ALW.03*(ENG)*

APLISENS

MANUFACTURE OF PRESSURE TRANSMITTERS
AND CONTROL INSTRUMENTS

USER'S MANUAL

SMART TEMPERATURE TRANSMITTER
type: **APT-2000ALW**

Edition C2

WARSAW JANUARY 2018

APLISENS S.A. 03-192 Warszawa, ul. Morelowa 7
tel. +48 22 814 07 77; fax +48 22 814 07 78
www.aplisens.pl, e-mail: aplisens@aplisens.pl

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 a type 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 suitable technical condition, 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 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 danger to staff 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 authorized by the manufacturer.

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 dangers occur:

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

Installation of intrinsic safety 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 www.aplisens.pl

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CE 1453

APT–2000ALW TEMPERATURE TRANSMITTER
Exd VERSION in accordane with ATEX directive

1. Introduction

1.1. This "Appendix Exd.ATEX" applies to transmitters of type APT-2000ALW 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 **DTR.APT.ALW.03*(ENG)*** in conjunction with **"Appendix Exd.ATEX".**

2. Use of APT–2000ALW transmitters in danger zones

2.1. The transmitters are produced in accordance with the requirements of the following standards:
EN 60079-0:2012+A11:2013, 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 T* Ga/Gb
II 1/2D Ex ia/t IIIC T* Da/Db

-40ºC ≤ Ta ≤ +45ºC/ +75ºC

KDB 10 ATEX 122X

T* - temperature class for transmitter (for gases) or a maximum surface temperature (for dust) derived in clause 5.3 and 5.4;

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 zone. The process connections may connect to a 0 zone type (see the diagram in p.5.3.3).

3. Identifying marks

Flame-proof transmitters must have a rating plate containing the information specified in paragraph 4.1 of **DTR.APT.ALW.0.3*(ENG)*** and also at least the following:

- CE mark and number of notified unit,
- „Ex" mark, Designation of explosion protection design, certificate number;
- Power supply;
- Process connection;
- Year of manufacture;
- Temperature use range.

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 numbered: DTR.APT.ALW.03*(ENG)* with Appendix Exd.ATEX.

User can find them b), c), d) at www.aplisens.pl

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. Measurements of operating temperature of transmitter.

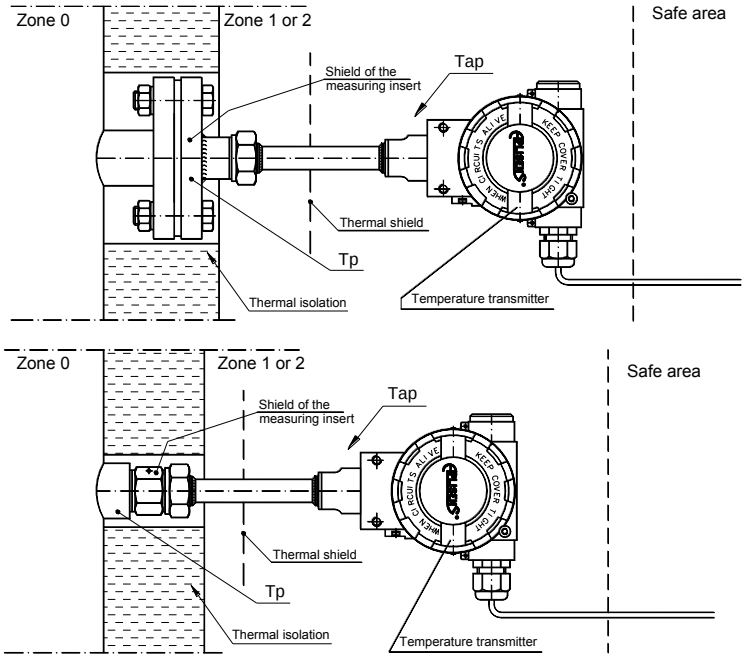
5.3.1. After installing the APT-2000ALW transmitters for the medium maximum expected temperature and expected the maximum ambient temperature measure out Tp temperature of the hottest place on the surface of transmitter and determine the temperature transmitter class or a maximum surface temperature according to p. 5.4 Appendix Exd.ATEX.

When measuring the warmed media, above ambient, is recommended to determine the temperature of the stub while is screwed into the transmitter or at the wall of the pipe or tank as shown below.

5.3.2. When medium is heated above ambient temperature it is allowed to determine the temperature class of the transmitter or the maximum surface temperature Tp through the adoption of a maximum temperature of the medium which provides the technological process. Then measurement of Tp isn't necessary.

If during the measurement of Tp for maximum temperature expected for the medium is not possible to ensure the maximum expected ambient temperature after the measurement of Tp one can estimate the potential growth in temperature Tp due to the increase of ambient temperature.

5.3.3. If the other elements of the plant have or may have a temperature higher than the highest temperature Tp on the transmitter, security conditions must be ensured in accordance with accepted principles in such cases.



5.4. Determination of the transmitter temperature class T* for gas and the maximum surface temperature:

5.4.1. Determine the temperature class of the transmitter for the gas or the maximum temperature for combustible dust depending on the temperature Tp from the formula:

$T^* \geq Tp+0,1Tp+5K$ for class T3..T6

$T^* \geq Tp+0,1Tp+10K$ for class T1, T2

5.4.2. Determine the maximum surface temperature transmitter for combustible dust from the formula:

$T^* \geq Tp+0,1Tp$

5.4.3. The following table contains the values of permissible ambient temperature depending on the temperature Tp and temperature class of the transmitter.

Tp[°C]	Temperature class and ambient temperature Ta[°C]	
Tp≤75°C	T6 and Ta=45°C T5 and Ta=75°C	
Tp>75°C	T4 and T5 T3 and T2 T1	Ta=70°C Ta=65°C Ta=60°C

Tp - transmitter temperature measured in clause 5.3

In the case of significant increase in medium temperature measurement of Tp must be executed again and again must be specified the temperature class for the gas or the maximum surface temperature combustible dust.

5.5. With regard on kind of casing material (light alloy with large aluminium content), the user is obliged to assure, and 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 intakes 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. They are at table 1 and table 2 (p.6 Appendix Exd.ATEX) at list of packing glands and plugs agreeable with production documentation and accepted by certificate station. Customer should install packing glands according to tables 1 and plugs according to tables 2 (if plugs aren't installed) or other accordance with flame-proof standards.

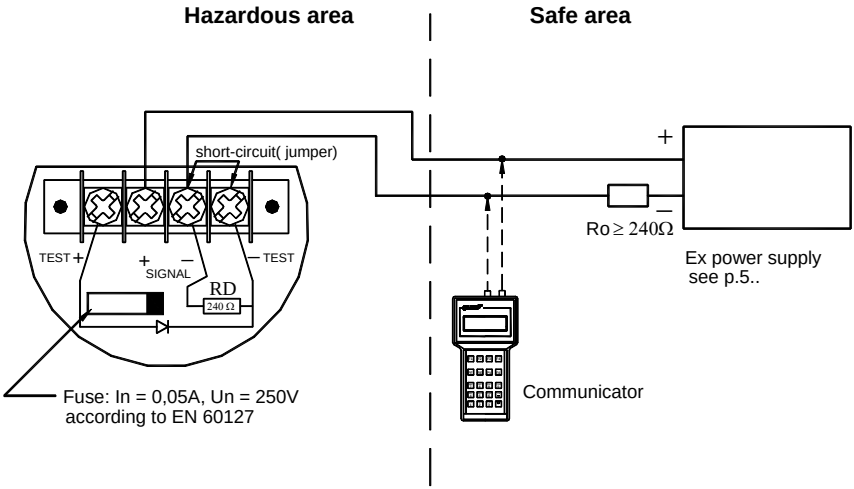
5.8. It is necessary apply a shield cable or without shield cable with round cross-section in protection from elastomer, not moisture absorbing, for example: YKSLY 2 * 1, YnTKSYekw 1 * 2 * 1, LIYCY 2 *. In case of need of use cable about different building customer should co-ordinate this with transmitter's 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: EN600079-14, EN60079-17.

5.10. During service must be made a check of the tight fastening of covers and the packing 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 80ºC, even when there is no explosion risk.

6. How to connect Exd transmitter APT-2000ALW



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

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 = 240Ω), 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 (Ro) in current loop is lover then 240Ω. Than <SIGNAL-> and <TEST-> terminals have to be open.

Blocking cover method before unscrewing and plumbing possibility is shoved at fig 8.

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.

Specific conditions of use:

- Permissible gap of flameproof joint marked L4 is less than defined in norm EN 60079-1:2007 and cannot be greater than passed value on fig. 7.
- Temperature class (T* for gases) or maximum surface temperature (T* for liquids) depends mainly on the temperature of the process (temperature of the controlled medium), and the method of installation on site. Therefore, to determine the temperature Tp hottest places on the surface of the transducer housing (practically cover the sensor) in contact with explosive atmosphere in conditions of installation on site and proceed in accordance with p.5.3 Appendix Exd.ATEX.

Table 1. Permitted packing glands.

Type of packing glands	Producer	Screw	Feature	Other marking	No of certificate	Note
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 of plug	Producer	Screw	Feature	Other marking	No of certificate	Note
	AGRO AG	M20x1.5	Exd IIC	No cat.		
475	HAWKE	M20x1.5	Exd IIC			
477	HAWKE	M20x1.5	Exd IIC			

**) for special cable only.*

II. APPENDIX Exd.IECEx

APT–2000ALW TEMPERATURE TRANSMITTER
Exd VERSION in accordance with IECEx certificate

1. Introduction

1.1. This "Appendix Exd.IECEx" applies to transmitters of type APT-2000ALW 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 of mentioned transmitters.
During installation and use of Exd transmitters, reference should be made to **DTR.APT.ALW.03*(ENG)*** in conjunction with **"Appendix Exd.IECEx".**

2. Use of APT–2000ALW transmitters in danger zones

2.1. The transmitters are produced in accordance with the requirements of the following standards: IEC 60079-0:2007-10 ed. 5, IEC 60079-1:2007-04 ed. 6, IEC 60079-11:2006 ed. 5, IEC 60079-31:2008 ed. 1, IEC 60079-26:2006 ed. 2.

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 d ia I Mb (version with enclosure 1.4401 (316))

Ex ia /d IIC T* Ga/Gb

Ex ia/t IIIC T* Da/Db

-40ºC ≤ Ta ≤ +45ºC/+75ºC

IECEx KDB 14.0002X

T* - temperature class for transmitter (for gases) or a maximum surface temperature (for dust) derived in clause 5.3 and 5.4;

2.3. Equipment protection level (EPL) and hazard areas.
Equipment protection level (EPL) Ga/Gb (Da/Db), contained within the rating, means that the transmitter may be installed within a type 1 (21) or 2 (22) danger zone. Process connections can connect to zone 0 (20) (example shown in p.5.3.3). Intrinsically safe transmitter marked Mb turn off if there is risk of an explosive atmosphere.

3. Identifying marks

Flame-proof transmitters must have a rating plate containing the information specified in paragraph 4.1 of **DTR.APT.ALW.0.3*(ENG)*** and also at least the following:

- Designation of explosion protection design, certificate number;
- Power supply;
- Process connection;
- Year of manufacture;
- Temperature use range.

4. User information

Together with the ordered transmitters, the user will receive:

a) Product Certificate;
b) Declaration of conformity (on request);
c) Copy of certificate (on request);
d) User's Manual numbered: DTR.APT.ALW.03*(ENG)* with Appendix Exd.IECEx.

User can find them b), c), d) at www.aplisens.pl

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.IECEx. 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. Measurements of operating temperature of transmitter.

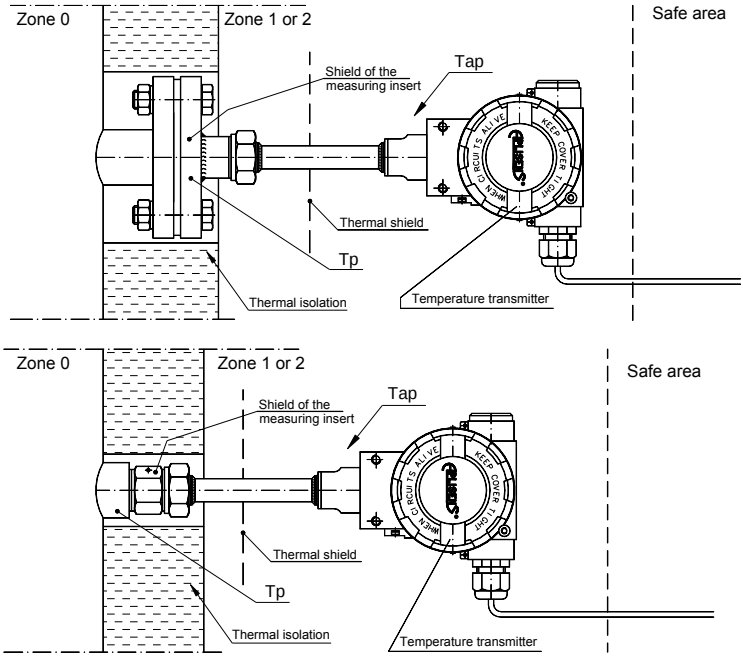
5.3.1. After installing the APT-2000ALW transmitters for the medium maximum expected temperature and expected the maximum ambient temperature measure out Tp temperature of the hottest place on the surface of transmitter and determine the temperature transmitter class or a maximum surface temperature according to p. 5.4 Appendix Exd.IECEx.

When measuring the warmed media, above ambient, is recommended to determine the temperature of the stub while is screwed into the transmitter or at the wall of the pipe or tank as shown below.

5.3.2. When medium is heated above ambient temperature it is allowed to determine the temperature class of the transmitter or the maximum surface temperature Tp through the adoption of a maximum temperature of the medium which provides the technological process. Then measurement of Tp isn't necessary.

If during the measurement of Tp for maximum temperature expected for the medium is not possible to ensure the maximum expected ambient temperature after the measurement of Tp one can estimate the potential growth in temperature Tp due to the increase of ambient temperature.

5.3.3. If the other elements of the plant have or may have a temperature higher than the highest temperature Tp on the transmitter, security conditions must be ensured in accordance with accepted principles in such cases.



5.4. Determination of the transmitter temperature class T* for gas and the maximum surface temperature:

5.4.1. Determine the temperature class of the transmitter for the gas or the maximum temperature for combustible dust depending on the temperature Tp from the formula:

$T^* \geq Tp+0.1Tp+5K$ for class T3..T6

$T^* \geq Tp+0.1Tp+10K$ for class T1, T2

5.4.2. Determine the maximum surface temperature transmitter for combustible dust from the formula:

$T^* \geq Tp+0.1Tp$

5.4.3. The following table contains the values of permissible ambient temperature depending on the temperature Tp and temperature class of the transmitter.

Tp[ºC]	Temperature class and ambient temperature Ta[ºC]	
Tp≤75ºC	T6 and Ta=45ºC T5 and Ta=75ºC	
Tp>75ºC	T4 and T5 T3 and T2 T1	Ta=70ºC Ta=65ºC Ta=60ºC

Tp - transmitter temperature measured in clause 5.3

In the case of significant increase in medium temperature measurement of Tp must be executed again and again must be specified the temperature class for the gas or the maximum surface temperature combustible dust.

5.5. With regard on kind of casing material (light alloy with large aluminium content), the user is obliged to assure, and 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 intakes 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. They are at table 1 and table 2 (p. 6 Appendix Exd.ATEX) at list of packing glands and plugs agreeable with production documentation and accepted by certificate station. Customer should install packing 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 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 of use cable about different building customer should co-ordinate this with transmitter's 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.IECEx, in this including also: IEC 600079-14, IEC 60079-17.

5.10. During service must be made a check of the tight fastening of covers and the packing 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. How to connect Exd transmitter APT-2000ALW

– According to the p.6 DTR.APT.ALW.03*(ENG)* Appendix Exd.ATEX.

Specific conditions of use:

- Permissible gap of flameproof joint marked L4 is less than defined in norm IEC 60079-1:2007 ed. 6 and cannot be greater than passed value on fig. 7.
- Temperature class (T* for gases) or maximum surface temperature (T* for liquids) depends mainly on the temperature of the process (temperature of the controlled medium), and the method of installation on site. Therefore, to determine the temperature Tp hottest places on the surface of the transducer housing (practically cover the sensor) in contact with explosive atmosphere in conditions of installation on site and proceed in accordance with p.5.3 Appendix Exd.IECEx.

III. APPENDIX Exi

CE 1453

APT–2000ALW TEMPERATURE TRANSMITTER

Exi VERSION

1. Introduction

1.1. This "Appendix Exi" applies to transmitters of type APT-2000ALW in Ex versions only, marked on the rating plate as shown in p.2 and p.3 and denoted Ex in the Product Certificate.

1.2. The appendix contains supplementary information relating to the Ex versions of these transmitters. During installation and use of Ex transmitters, reference should be made to **DTR.APT.ALW.03*(ENG)*** in conjunction with **"Appendix Exi".**

2. Use of APT–2000ALW transmitters in danger zones

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

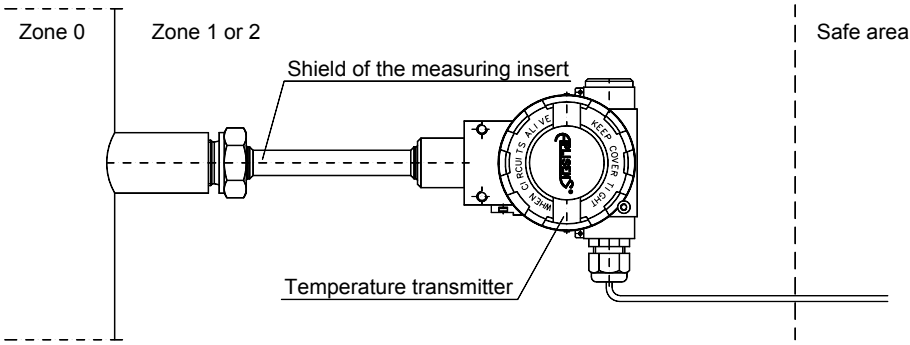
2.2. The transmitters may operate in areas where there is a risk of explosion, in accordance with the rating of the explosion protection design:

II 1/2G Ex ia IIC T4/T5/T6 Ga/Gb
I M1 Ex ia I Ma (version with enclosure 1.4401 (316))
II 1D Ex ia IIIC T105ºC Da

FTZÚ 09 ATEX 0155X

(the temperature class of transmitter depends from medium temperature)

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. Shield of the measuring insert APT-2000ALW 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 4.1 of DTR.APT.ALW.03*(ENG)* and also at least the following:

- CE mark and number of notified unit;
- „Ex" mark, designation of explosion protection design, certificate number;
- values of parameters such as. Ui, Ii, Ci, Li;
- year of manufacture.

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 numbered: DTR.APT.ALW.03*(ENG)* with Appendix Exi.

User can find them at www.aplisens.pl

5. Permitted input parameters (based on data from the FTZÚ 09 ATEX 0155X 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.

Temperature classes T4, T5, or T6 depend on the input power and maximum ambient temperature – see p. 5.1, 5.2, 5.3. The ambient temperature range is reduced to Ta = -20ºC to +60ºC if the devices is installed as group I M1 equipment.
External connections are made via integral terminals and cable glands which must be of certified type if they are mounted in hazardous areas in the presence of combustible dust.

5.1. For power supply with a linear output characteristic

Ui = 30V Ii = 0.1A Pi = 0.75W Ta ≤ 80ºC and T4; Ta ≤ 70ºC and T5; Pi = 0.5W Ta ≤ 45ºC and T6

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

Uo = 28V Io = 0.093A Rw = 300Ω.

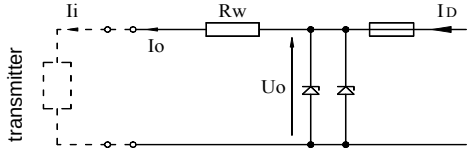


Fig.1. Power supply from a source with linear characteristic.

5.2. For power supply with a trapezial output characteristic

Ui = 24V Ii = 0.05A Pi = 0.6W Ta ≤ 80ºC and T5 and Pi = 0.5W Ta ≤ 45ºC and T6

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

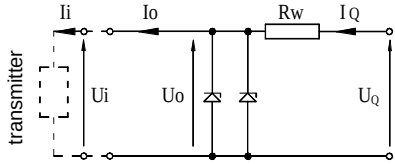


Fig. 2. Power supply from a source with trapezial characteristic.

If $U_o < \frac{U_Q}{2}$ then parameters Uq, Io, Po are interrelated as follows:

$$U_Q = \frac{4P_0}{I_0}, \quad Rw = \frac{U_Q}{I_0}, \quad P_0 = \frac{U_0(U_Q - U_0)}{Rw} \quad \text{for } U_0 \le 1/2U_Q$$

5.3. For power supply with rectangular output characteristic

Ui = 24V Ii = 0.025A Pi = 0.6W Ta ≤ 80ºC 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 Uo=24V with protection level „ib” and current limited to Io=25mA.

5.4. Input inductance and capacity: Ci = 20nF; Li = 1.1mH

5.5. Supply voltage min: 13.5VDC **

5.6. Load resistance:

- from 28V linear supply

$$Ro\ max\ [\Omega] = \frac{28V - 13.5V^{**} - (300\Omega^{*} * 0.0235A)}{0.0235A}$$ for transmitter without display back lighting

- from a source with trapezial or rectangular characteristic supply

$$Ro\ max\ [\Omega] = \frac{Usup. - 13.5V^{**}}{0.0235A}$$

**) barrier resistance;*
***) 16,5V for transmitter with display back lighting.*

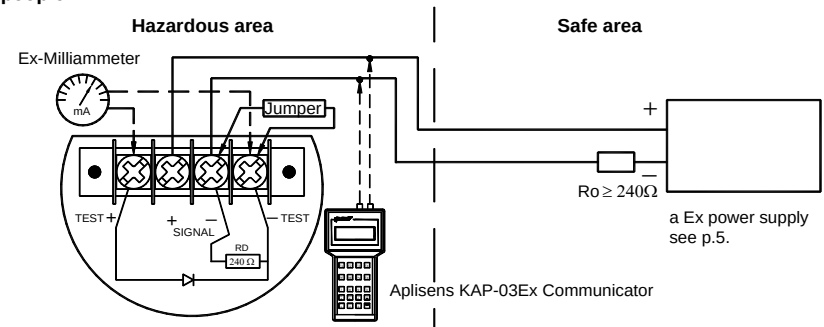
5.7. Temperature

Temperature of transmitter's surface with temperature of shield part as shown in figure at the point 2.3 can't surpass the admissible values of temperatures for temperature class of steam and gases according with standard EN 60079-0.
Simultaneously the casing temperature should not surpass max. temperature value Ta definite for conditions power supply in Certificate Exi and p.5 of Appendix Exi.

6. How to connect Ex transmitters APT-2000ALW

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



To measure the current in the transmitter without disconnecting the signalling circuit, connect a milliammeter to transmitter terminals 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 Ω.
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 Ro < 240Ω. Terminals <SIGNAL –> and <TEST –> must be opened.
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 can be assessed only by the manufacturer or another authorized party.

Specific conditions of use:

- Allowed operating temperature range specified in point 5 Appendix Exi.
- Operating temperature range is restricted in the range of Ta = -20ºC to 60ºC if the device is operating in a Group I M1.

IV. APPENDIX MID

APT-2000ALW TEMPERATURE TRANSMITTERS,
APPLICATIONS ACCORDANCE IN EN12405-1:2005+A2:2010 STANDARD
WITH RESISTANCE SENSORS PT100

1. Introduction

1.1. The "MID Appendix" applies to the series APT-2000ALW temperature transmitters applications where they are as instruments for use in/as measuring devices (MI-002 gas) in accordance with the EN 12405-1:2005 +A2:2010 standard harmonized to Measuring Instruments Directive (MID) 2014/32/UE and the OIML R140:2007 recommendations.

1.2. The appendix contains the transmitters data to realizations them to use in metrology. During the installation and exploitation of pressure transmitters in the MID version, is necessary to use the User's Manual together with MID Appendix.

2. Application

2.1. Temperature transmitters series APT-2000ALW with resistance sensors Pt100, in accordance with EN 12405-1:2005+A2:2010, are provided for use in gas volume conversion devices of type 2, equipped with a backup electrical power source (battery, UPS), for gaseous fuels first and second families according to EN 437.

2.2. Use in the danger zones

APT-2000ALW transmitters in version according to EN 12405-1:2005+A2:2010 are Intrinsically Safe (Exi) or Flameproof (Exd) and as such are made in accordance with the standards set out in Exi or Exd. ATEX Annexes. Transmitters in accordance to EN 12405-1:2005+A2:2010 can operate in hazardous areas in accordance to the designation of explosin-proof construction. Specific parameters of the Exi or Exd application, according to ATEX, with certificate numbers are given on the nameplate of the transmitter.

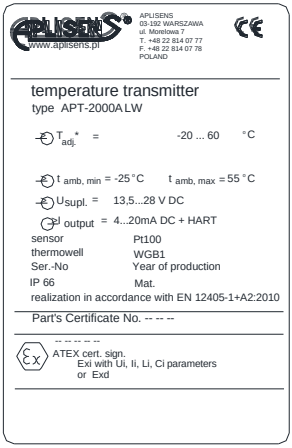
Intrinsically Safe APT-2000ALW temperature transmitters in MID version have the following input parameters: **Ci** = 30 nF, **Li** = 0,75 mH and an ambient temperature -25°C ≤ **Ta** ≤ 55°C. Other parameters are in accordance with "Exi Appendix".

Flameproof APT-2000ALW temperature transmitters in MID version have the ambient temperature -25°C ≤ **Ta** ≤ 55°C. Other parameters are in accordance with "Exd.ATEX Appendix".

During installation and use in hazardous areas in the **MID** version to be followed these parameters and other data contained in **"Exi Appendix"** or "**Exd.ATEX Appendix**" to User's Manual.

3. Product identification

APT-2000ALW transmitters made for MID applications have a rating plates on which there are at least given below information:



*) The pressure transmitters are afforded one of the measuring range:
from:
-20 …40°C
to:
-20 … 60°C

APT-2000ALW transmitters for MID applications distinguish from the other applications by information at rating plate that are made in accordance with EN 12405-1:2005+A2:2010 and is written a Number of Parts Certificate.

4. List of completeness

Together with APT-2000ALW transmitter's user receives:

a) Product Certificate which is also a warranty;
b) Declaration of Conformity (on request);
c) User's Manual;
d) Copies of certificates (on request);
e) Calibration certificate (on request).

Items: b, c, d can be found at: www.aplisens.pl

5. Technical parameters

Supply	13.5* ÷ 28 V DC *(Exi)* 13.5* ÷ 45 V DC *(Exd)*
Output signal	4÷20 mA + HART
Ambient temperature	-25° ÷ 55°C
Relative humidity	10 ÷ 98% with condensation
Case protection ingress (according to EN 60529)	IP 66

*) *Backlight setting of indicates increases the minimum supply voltage by 3V. Display backlight is switched on by the manufacturer at the order of the customer. In standard transmitters the backlight is turned off.*

For the needs of clearing, in accordance with Directive2014/32/UE, should be used one of the two metrological checked transmitter output signals: digital HART signal or loop current signal.

Ingress protection for gaseous fuels 1 and 2 family in accordance with EN 437 provides a design of transmitters and cable glands and plugs with seals of the HNBR, or TPE. Customer may purchase the transmitter with a standard cable gland or without gland. In the situation of its own cable glands and plugs you should use components dedicated to Exi zones, to ensure: temperature, resistance to fuel gas families 1 and 2 and the above degree of protection. Can be used cable glands with sealants such as TPE's for example: EX1100.20.110 AGRO.

5.1. Transmitters environmental parameters.

Products in this embodiment meets the following requirements; criteria by EN 12405-1:2005+A2:2010

5.1.1. Electromagnetic Compatibility, immunity

Electrostatic Discharge (ESD):
EN 61000-4-2
Contact: ±8 kV
Air: ±15 kV
Conducted Radio Frequency:
EN 61000-4-6
0,15… 80 MHz – 10 V, I/O
Radiated Electromagnetic Field:
EN 61000-4-3
80 … 1.000 MHz – 10 V/m
1 … 2.700 GHz – 1 V/m
Magnetic Field:
EN 61000-4-8
100 A/m – continuous
1000 A/m – short duration to 3 s
Electrical Fast Transient (Burst):
EN 61000-4-4
± 2 kV, I/O
Electrical Slow Transient (Surges):
EN 61000-4-5
±2 kV, I/O

5.1.2 Short drops in electrical supply

EN 61000-4-29
Level 1

5.1.3. Climatic Immunity

Environmental condition:
EN 60068-2-1, EN 60068-2-2, EN60068-3-1
Dry heat: T = 55°C, R_H = max 55%
Cold: T = -25°C
Damp heat, steady state:
EN 60068-2-78
T=55°C, R_H=93%, 96 h
Damp heat, cyclic:
EN 60068-2-30
(T = 22° ÷ 55°C, R_H = 80 ÷ 100%, 24 h)x2

5.1.4. Mechanical Immunity

Shock resistance:
EN 60068-2-31, level 2
Vibrations, broadband random:
EN 60068-2-64, test Fh, level 2

5.2. Connectors to gas installation

Transmitter connecting to the gas should be performed in accordance with the requirements for this installation.. WGB1 sensors of APT-2000ALW series transmitters in MID version should be screwed in thermowels which meet the user's intrinsically safe installations requirements. APT-2000ALW transmitters have connections with external thread, one of the following: M20x1.5, G1/2", or ½"NPT. Aplisens's thermowells complying with ATEX requirements are shown in Figure 6 at User's Manual.

5.3. Electrical connections the transmitter

In measuring systems according to EN 12405-1:2005+A2:2010 APT-2000ALW transmitters in MID version connecting to measuring install is 2-wire. For the connection of power and signal receiving terminals <SIGNAL+> and <SIGNAL-> of transmitter should be used with the polarization behavior < + > to <SIGNAL +>; < - > to <SIGNAL->. Terminals <TEST +> and <TEST -> of transmitter in the metrological applications are not used. The cable shield should be connected one-sidedly to grounding. Connecting the transmitter to measurement is shown in Figure 1a.

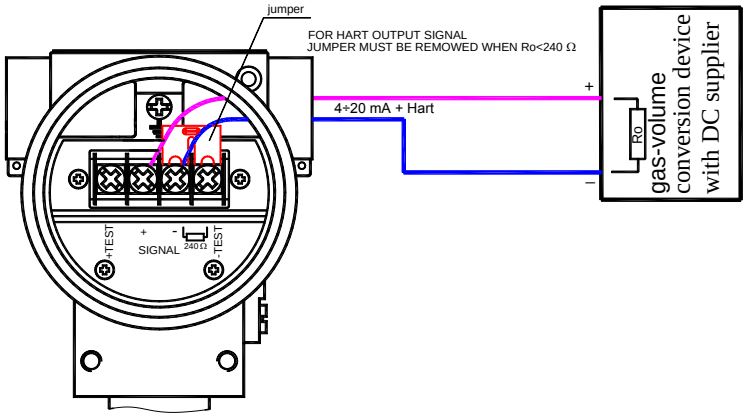


Fig.1a. APT-2000ALW for MID application.
Connecting diagram of transmitter to powering and measuring installation.

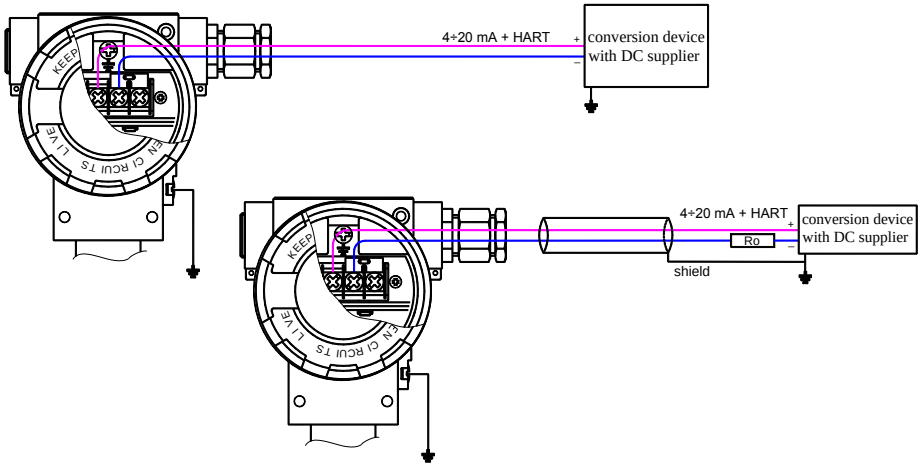


Fig. 1b. APT-2000ALW temperature transmitter for MID application.
Recommended by manufacter way of earthing to the measuring system.

For electrical connection should be use twisted pair cable; shielded or not shielded, flexible, with diameter: 5 mm ≤ ϕ ≤ 9 mm, complies with ATEX standards. Example of the type of cable is shown below.

Producer	Technokabel	*LAPPKABEL*
Type (not shielded)	IB-YSLY 2x0.75 *	ÖLFLEX® EB 2X1 (nr art. 0012440)
Type (shielded)	IB-YSLCY 2x0.75	ÖLFLEX® EB CY 2X1 (nr art. 0012650)

**) Maximum conductors cross-section: 2.5 mm.*

Grounding to the transmitter should be performed according to the gas-volume conversion device instruction manual. Thetransmitter grounding should be used external earthing terminal.

5.4. Cable entries (glands)

Transmitters in the MID version are equipped with cable entries which meet the ATEX requirements (see Appendix Exi or Exd) and the requirements of EN 12405-1:2005+A2:2010. In order to facilitate the adaptation of transmitter installation parameters for user-specific installation requirements, in agreement with the user, transmitters can be supplied without glands and plugs. Then the user has to verify and approve applied own cable inlets and plugs which will use for compliance with the requirements of ATEX, IP and EN 12405-1:2005+A2:2010.

6. Measurement ranges and metrological parameters

6.1. Measurement ranges.

Measuring range: from -20°÷ 40°C to**-20° ÷ 60°C**

Measuring range of transmitters is setting by the manufacturer. Blocking against changes in the transmitter settings can be made as follows:

- systemically, by HART System, activated by a configuration program (Raport 2) and protected by password;
- "spec MID locking" done with local buttons on the transmitter with a local menu (command MID_WP).

The metrological requirement in the above-mentioned ranges are met by the APT-2000ALW in MID version. The transmitters have the preset measuring range compliant with the order. The upper measurement range can be adjusted to any value range from 40°÷ 60°C by the user. It is possible when transmitter is unlocking. The adjustment range shall be changed before the transmitter installations. The measurement system shall compliant with Figure 2. The measurement system should consist of PC, HART modem and Raport 2. See point 10, appendix MID

For temperature transmitters complying to MID Parts Certificate, a manufacturer's standard "spec locking" is activated, but in agreement with the customer transmitters are not blocked and then the locking should be on by manufacturer of conversion devices.

Local buttons are protected by a screw display cover, which is sealed. When "spec MID locking" is locked can change only certain parameters of the transmitters, i.e.: HART transmitter address and the time constant, and can be made additional entries identifying the transmitter associated with its place of installation. The proceedings relating to the sealing set out in p. 8.

The temperature transmitter, as a part of the gas conversion of type 2, in accordance with the requirements of the MID Directive must be protected against unauthorized manipulation by its producer or manufacturer of the gas volume converter. Sealing of the transmitters is done by its manufacturer or, by agreement with the customer. If they not sealed then sealing should be made by manufacturer of gas volume conversion.

6.2. Measurement error (according to EN 12405-1:2005+A2:2010)
determined at absolute temperature scale (°K) in relation to the measured value:

- at the rated temperature range **(-25° ÷ 55°C)** **≤ 0.2%**
- at reference conditions **≤ 0.1%**

6.3. Long term stability / 5 years **≤ 0.2%**

6.4. Sensor thermowell version **WGB1**

6.5. Sensor length **min150 mm**

7. Electronic display

Electronic indicating device (display), built-in the APT-2000ALW transmitters, are not controlled metrologically and as such cannot be used for clearing in accordance with EN 12405-1:2005+A2:2010.

8. Protection against unauthorized manipulation

8.1. Blocking by the transmitters manufacturer. Access to the local configuration buttons and to the transmitter internal components is blocked by the sealing of the display cover and a measuring head locking screw to the housing of the transmitter. The transmitter rated plates are made of materials self-destructive during detachment, or alternative used metal rated plates have one of the screws sealed to the casing. Access “spec MID locking” protects against unauthorized interference to transmitters from a HART system. APT-2000ALW series transmitters manufacturer use a plastic seal in its MID realization. Change of the locking status is possible after removing manufacturer sealing from the display cover only. Command **MID_WP** ("ON" or "OFF") can be found in local menu.

8.2. Blocking by the gas volume conversion manufacturer. Turn on the "spec MID locking" with local buttons using local menu of transmitter (see point 9.2.4 User’s Manual, MID_WP – “ON”). Put the seals of the gas volume conversion producer on the electrical connection cover, screw of a sensor head and a label if it is metal made. Places of seals application is shown by the arrows at Fig.1c. Seal should be made in accordance with the documentation of gas volume conversions in the place/country their use.

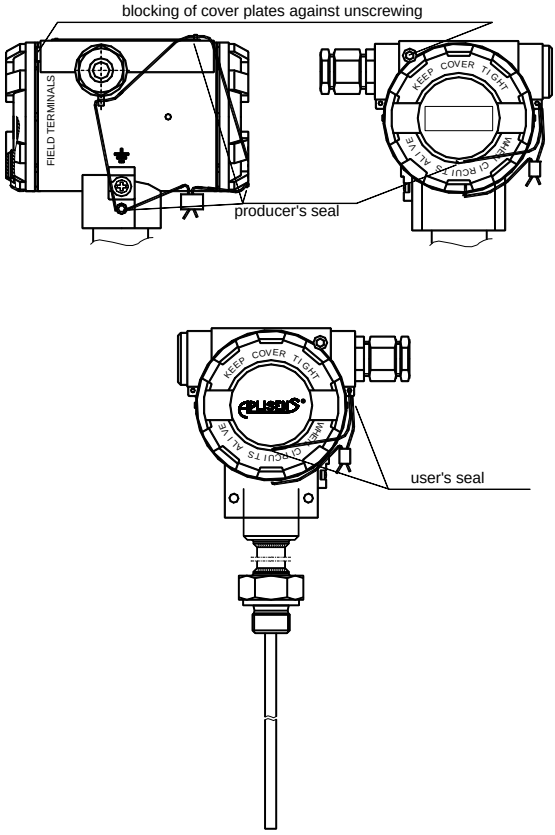


Fig 1c. APT-2000ALW in MID application. Sealed up transmitter.

9. Alarms

Temperature transmitters in MID version alarm exceeding of the limits of measuring ranges (lower and upper) by flag in the output signal HART, and information, respectively "ou E r" or "und E r" in place of the first process variable on a transmitter display. Other alarms work as at p.9.4 of User's Manual.

10. Verify of the temperature transmitter in its workplace

To verify the correct functioning of the transmitter at its workplace should be used a HART system diagnostic tool implemented to transmitter. For this purpose is need:

- converter HART / RS 232 or other for example HART/USB/ Converter;
- PC with Windows XP or higher, with at least 512 MB of RAM;
- Raport 2: Aplisens software.

A computer with a converter must be connected to the transmitter as shown in Figure 2a or 2c for the load resistance Ro < 240 Ω, see User's Manual p.16. After starting Raport 2 program read data from the transmitter. Installation parameters and current parameters of the transmitter are recorded in the tabs of the Raport 2. And so in:

- ***Identification*** tab - read the identity data of the transmitter;
- ***Basic parameters*** tab - check the measuring range, temperature unit and time constant;
- ***Process Variables*** tab - check the current parameters of the transmitter measuring;
- ***Write protection*** tab - check the setting of current lock before entries;
- ***Transmitter Status*** tab - check the current status of the transmitter, its analog and digital outputs status with the marked exceeded errors of measuring range, or errors of particular blocks of the transmitter if they would existed.

Transmitter verify in the workplace should be made by a worker who is trained in the handling of measuring electrical installations in explosive environments.

11. APT-2000ALW in MID application. Repair, calibration

Transmitters repair should be performed by the manufacturer, or the manufacturer's authorized repair shops. The procedures of handling after transmitter's repairs should be in accordance to the provisions of the country where transmitters are operating.

V. FEATURES, INSTALLATION AND MAINTENANCE OF TRANSMITTERS

1. INTRODUCTION

1.1. This Manual is intended for users of **APT-2000ALW** smart temperature transmitters in normal and 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.

Parameters and information given in the remaining part of the manual regard simultaneously all the transmitters, their intrinsically safe versions and version with various types of casings.

1.2. Additional data on **APT-2000ALW** transmitters in Ex versions is contained in the appendix designed to **DTR.APT.ALW.03*(ENG)* Appendix Exi.** During installation and use of the transmitters in Exi version reference should be made to **DTR.APT.ALW.03*(ENG)*** in conjunction with **Appendix Exi.**

1.3. Additional data on **APT-2000ALW** transmitters in Exd versions in accordance with ATEX directive is contained in the appendix designed to **DTR.APT.ALW.03*(ENG)* Appendix Exd.ATEX.** During installation and use of the transmitters in Exd version in accordance with ATEX directive reference should be made to **DTR.APT.ALW.03*(ENG)*** in conjunction with **Appendix Exd.ATEX.**

1.4. Additional data on **APT-2000ALW** transmitters in Exd versions in accordance with IECEx certificate is contained in the appendix designed to **DTR.APT.ALW.03*(ENG)* Appendix Exd.IECEx.** During installation and use of the transmitters in Exd version in accordance with IECEx certificate reference should be made to **DTR.APT.ALW.03*(ENG)*** in conjunction with **Appendix Exd.IECEx.**

1.5. Additional data on **APT-2000ALW** transmitters in MID versions is contained in the appendix designed to **DTR.APT.ALW.03*(ENG)* Appendix MID.** During installation and use of the transmitters in MID version reference should be made to **DTR.APT.ALW.03*(ENG)*** in conjunction with **Appendix MID.**

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: DTR.APT.ALW.03*(ENG).*

Items b), c), d) are available at: www.aplisens.pl

3. APPLICATIONS AND MAIN FEATURES

3.1. The **APT-2000ALW** smart temperature transmitters are designed to measure temperature in various branches of industry in normal conditions as well as in conditions of danger the explosion of gas and dust.

3.2. The **APT-2000ALW** transmitters may be equipped with various types of measuring insert casings which allows for their application in various conditions.

3.3. The **APT-2000ALW** transmitters characterized by:

a. Two-wire power supply (4…20mA current loop);
b. Digital signal processing (filtration, linearization, compensation);
c. Possibility of local configuration from display panel or remotely (HART protocol);
d. Autodiagnostic system;
e. Ambient temperature effect compensation;
f. Input/output galvanic separation.

4. IDENTIFYING MARKS

4.1. Identifying marks

Every transmitter carries a rating plate containing at least the following information:

a. Manufacturer name;
b. CE mark;
c. Transmitter type: APT-2000ALW;
d. Basic range;
e. Set range;
f. Power supply voltage;
g. Output signal;
h. Year of manufacture and serial number.

4.1.1. The **APT-2000ALW** transmitters in intrinsically safe version have additional designations, which are specified in **DTR.APT.ALW.03 Appendix Exi.**

4.1.2. The **APT-2000ALW** transmitters in Exd version in accordance with ATEX directive have additional designations, which are specified in **DTR.APT.ALW.03 Appendix Exd.ATEX.**

4.1.3. The **APT-2000ALW** transmitters in Exd version in accordance with IECEx certificate have additional designations, which are specified in **DTR.APT.ALW.03 Appendix Exd.IECEx.**

4.1.4. The **APT-2000ALW** transmitters in MID version have additional designations, which are specified in **DTR.APT.ALW.03 Appendix MID.**

5. TECHNICAL DATA

5.1. Electrical parameters

Transmitter version	Power supply	Notes
Normal	12* ÷ 55V DC	
Intrinsically safe (Exi)	13.5* ÷ 28V DC	see Appendix Exi
Flameproof (Exd)	13.5* ÷ 45V DC	see Appendix Exd
MID (Exi)	13.5* ÷ 28V DC	see Appendix MID
MID (Exd)	13.5* ÷ 45V DC	see Appendix MID

Output signal 4÷20mA + HART Rev.5.1

Communication with the transmitter to verify its configuration parameters is realized using HART transmission protocol and signal of 4÷20mA. For that, can be used the KAP-03 or KAP-03Ex communicator for temperature transmitters or Aplisens HART/USB Converter, or any other HART converter with PC computer and Aplisens program Raport2.

Resistance for communication 250÷1100Ω, min 240Ω

Load resistance $R_O[\Omega] = \frac{Usup[V]-12V^{*,**}}{0.0235A}$

Maximum length of the connection cable 1500m

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

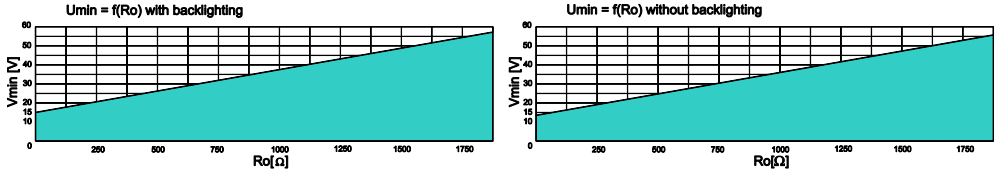
The value of transmitter minimal supply voltage in normal version can be calculated from the following formula:

Umin = 12 + 0.0235 x Ro [V] for transmitter operating without LCD display backlight (or read from the drawing below)

Umin = 15 + 0.0235 x Ro [V] for transmitter operating with LCD display backlight (or read from the drawing below)

Ro [Ω] is a total resistance of the measuring line (current loop).

**) *The lower power supply voltage should be taken for other versions of transmitters from the table above.*



Supply voltage dependence on current loop resistance.

Safe working area (grid) upper colour area.

Output updating time 500ms

Additional electronic damping 0...30s

List of current alarms

Alarm Type	Value of Alarm Current
NORMAL LOW	3.75 mA
NORMAL HIGH	21.6 mA
NAMUR LOW	3.6 mA
NAMUR HIGH	21.0 mA

Alarm Type	Value of Alarm Current
CUSTOM (value of alarm current is defined by user)	Value of alarm current in interval 3.6 mA ÷ 23 mA
LAST VALUE (transmitter does not update analog exit)	Alarm current value is equal to the current value in the time preceding the event which giving an alarm.

5.2. Metrological parameters

Total error of transmitter (digital value)

- Standard version
  ± (0.2 + 0.002·|t|)ºC for sensor Pt100
  ± 1.5ºC for sensor K and t ≥ 375ºC
  ± (0.004t)ºC for sensor K and t ≤ 375ºC
- KT version (with additional calibration unit sensor-transmitter)
  ± (0.05 + 0.05%·z + 0.001·|t|) ºC for sensor Pt100
  ± (0.5 + 0.05%·z)ºC for sensor K and t ≤ 375ºC
  ± (0.5+0.05%·z + 0.002·(t-375))ºC for sensor K and t >375ºC

Additional analogue output error ± 0.04%·z

where:
|t| - modulus of measured temperature in ºC;
t - the value of measured temperature in ºC;
z - the range width of transmitter in ºC.

5.3. Measurement ranges

Sensor type	*Min. measuring range*	*Nominal range*	*Calibrated range*
Pt 100	10 ºC	- 200 ... 550 ºC	0 ... 100 ºC
Ni-Cr-Ni /K/ *	10 ºC	- 40 ... 550 ºC	0 ... 300 ºC

* Recommended for measurements with strong vibrations.

5.4. Operating conditions

Ambient temperature range -40º ÷ 85ºC

Operating temperature for intrinsic-safe versions (Exi) in accordance with Appendix Exi.
Operating temperature for flame-proof versions (Exd) in accordance with Appendix Exd.ATEX or Appendix Exd.IECEx.
Operating temperature for MID versions in accordance with Appendix MID.

Relative humidity 10 ÷ 98% with condensation

Thermal compensation range -25º … 75ºC

Medium temperature range Pt100 - 200º ... 550 ºC
N-Cr-NiAl - 40º ... 550 ºC

5.4.1. Electromagnetic Compatibility (EMC), immunity

Rating according to EN 61326-1,2 for industrial applications

Electrostatic Discharge Immunity (ESD):
EN 61000-4-2; S3 level: contact ±6kV, air ±8kV; 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, 2 000 … 2 700MHz – 1V/m; criterion A

Electrical Fast Transient (Burst Immunity)
EN 61000-4-4; ± 2kV power supply port/earth, ± 1kV signal port/earth; criterion A

Electrical Slow Transient (Surge Immunity):
EN 61000-4-5; ±0.5kV (±1kV) 0,5kV differentia mode, 1kV common mode; criterion B

5.4.2. Electromagnetic Compatibility, emission:

According to CISPR16-1, CISPR 16-2, class B, distance to the antenna 3m, quasi-peak measuring:

Radiated emission: 0.15 … 30MHz, 80-52dBµV/m;
30 … 2000MHz, <54dBµV/m

Conducted emission: 0.01 … 0.150MHz, 96-50dBµV/m;
0.150 … 0,350MHz, 60-50dBµV/m;
0.35 … 30MHz, <50dBµV/m

5.4.3. Climatic immunity: dry heat, cold, humidity, salt mist:

Dry heat:
EN 60068-2-2, test B; T = 70ºC, RH = max 55%

Cold:
EN 60068-2-1, test A; T = -25ºC,

Damp heat cycle:
EN 60068-2-30, test D; (T = 55ºC, RH = min95%, 24h)x2

5.4.4. Mechanical immunity

Shocks:
EN 60068-2-27, 50g/11ms
Vibrations:
EN 60068-2-6, test Fc; up to 1,6mm for 2 … 25Hz, up to 4g for 25 … 100Hz

5.4.5. Insulation Resistance

>100 MΩ @110V transmitters with gas arresters
>100 MΩ @750V DC transmitters without gas arresters (Exi)

5.4.6. High Voltage Test

500V AC, or 750V DC, 1min, transmitters without gas arresters (Ex applications)
75V AC, or 110V DC, 1min, transmitters with gas arresters

5.4.7. Enclosure ingress protection

EN 60529 IP 66, 67

5.5. Construction materials

Electronics casing — High pressure cast of aluminium alloy, lacquered with chemical-resistant oxide enamel, colour yellow (RAL 1003), or stainless steel 1.4401 (316) – not varnished.

Shields - materials, diameters and lengths (fig.6).

Type of shield	Shield			Material of shield	Connection type
	∅[mm]	L, (L_1*) [mm]	l [mm]		
SW1	18h7	100	35	1.7335 (15HM), 1.7380 (10H2M), 1.4404 (316L)	-
		140, 200	65		
SW2	24h7	140, 200	65		-
SW1T	18h7	100	35	1.7335 (15HM), 1.7380 (10H2M), 1.4404 (316L)	Flange PN, DIN, ANSI
		140, 200	65		
SW2T	24h7	140, 200	65		Flange PN, DIN, ANSI
OG2.9	9 x 1	100, 160, 250, 400	-	1.4404 (316L)	M20x1,5, M27x2, G1/2", G3/4", ½" NPT
OG2.11	11 x 2		-		
GB1, GN1	9 x 1	100, 160, 250, 400	-	1.4404 (316L)	M20x1,5, M27x2, G1/2", G3/4", ½" NPT
WGB1**	6 x 0,5	150 ÷ 290 *	-	1.4404 (316L)	M20x1.5, G1/2, ½"NPT
G1	11 x 2	100, 160, 250, 400	-	1.4404 (316L)	M20x1,5, M27x2, G1/2", G3/4", 1/2"NPT
T1	11 x 2	100, 160, 250, 400	-	1.4404 (316L)	Flange PN, DIN, ANSI

**) L and L_1 refer to Figure 6.*

***) Transmitters with WGB1 sensors (with sliding measuring insert) should be mounted in the Aplisens (see Fig.6) or user shields that meet the design requirements of installation. Direct mounting (without shields) is dangerous for the environment; it may cause unsealing of installation and explosion.*

6. CONSTRUCTION

6.1. Measurement Principles

A signal from measuring sensor, i.e. from thermometer resistor Pt100 or thermocouple, corresponding to measured medium temperature, is delivered to the input of analogue-digital converter and converted to digital form. In digital form it is sent, through an optoelectronic galvanic barrier, to the microcontroller. The microcontroller reads measured values and, using built-in algorithms, calculates an exact value of temperature on the basis of these algorithms. Calculated value is shown on integrated LCD display, which can be configured depending on the needs (see p. 9.2.5). Digital value of measured temperature is converted to analogue signal 4...20[mA]. Built-in modem BELL 202 and implemented communication stack HART rev.5.1 allow for the communication with the converter, using PC computer and appropriate software or communicator.
The transmitter's output is fitted with a radio-noise filter and other elements protecting against ESD.
A block diagram of the transmitter is presented in Figure 1.
The **APT...** converters monitors the operation of their measuring systems and the correctness of calculations and in case when discrepancies occur they inform about an error displaying a message on LCD display and generating an alarm current in the current loop (depending on configuration).
The measuring signal of sensor has a galvanic separation from measuring line. Thanks of that construction the measurement susceptibility at interferences is reduced as well as the enlarged safety of work in the Ex and flameproof applications.

6.2. Construction

The basic units of transmitter are: sensor casing, shield with process connection, measuring sensor and electronic units, transforming signal from measuring sensor into unified output signal.

6.2.1. Transmitter casing

A casing of **APT...** transmitter is made of high-pressure casting of aluminium alloy or 1.4401 (316) steel. It consists of a body, two bolted covers (display and electrical connection), cable inlets and plug with M20x1.5 or ½ NPT thread.
Inside the casings is divided into two chambers, separated by a header. An additional header, with a ribbon cable is intended for transmitting a signal from temperature sensor to the inside of a transmitter.
The casing is equipped with internal and external earth terminals.

6.2.2. Electronic board with display

The electronic board, along with a display, is installed in a housing made of polycarbonate, in the bigger of two casing's chambers, where it is possible to rotate it by ±180°, every 90°. A connecting board with terminal strip (fig. 2a) and the elements of interference filter and protecting elements are installed in the second chamber.

6.2.3. Shields of the measuring insert

Shields of the measuring insert type GB1, GN1, G1, T1 have a welded construction (integral with the transmitter) with a wall thickness ≥ 1 mm. These shields are designed for direct mounting in mounting slots and contact with the measuring medium.

Thermowells type OG2.9, OG2.11, T1, SW1, SW2, SW1T, SW2T (Fig. 6) are an intermediate element between the medium and the sensor measuring transmitter.

7. INSTALLATION OF TRANSMITTERS

The **APT–2000ALW** transmitters can operate in any position. During the installation of temperature transmitters the casing of electronic system should be protected against exceeding of allowed temperatures. Suitable thermal covers should be used or the transmitters should be mounted in such a position so the heat from medium does not heat up the casing.

Transmitters with sensor type WGB1 should be mounted in thermowells.

When the transmitters are mounted, particularly in areas endangered by explosion, also the heat conduction of sensor metal casing and ambient temperature for ensuring proper work conditions and temperature classes should be taken into consideration.
Data specified in "Appendix Exi" are applicable for intrinsically safe versions.
Data specified in "Appendix Exd.ATEX" or "Appendix Exd.IECEx" are applicable flameproof versions.

8. ELECTRICAL CONNECTION

8.1. General recommendations

8.1.1. 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.

8.1.2. Wet or rising damp inside transmitter can cause its damage.
When the isolation of the wires in the packing 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 packing gland into a protective loop to prevent condensation from running down in the direction of the gland.

8.2. Electrical connections

The **APT...** transmitters are to be connected as shown in fig. 2a – 2d.
In **APT...** 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.

8.3. Protection from excess voltage

8.3.1. 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).

8.3.2. 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 Aplisens 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) – permitted voltage	Protection between wires and earth and/or casing – type of protection, permitted voltage
APT... (normal version, Exd version)	68V DC	Plasma surge arresters - 230V DC
APT... (Exi version)	39VDC	Not applicable

8.3.3. The voltage in the protective elements must not exceed the maximum permitted values given in the table.

The insulation test voltages (500V AC or 750V DC) given in 5.4.6 refer to transmitters plasma surge arresters - such protection is not used in Exi versions of transmitters.

8.4. Earthing

The transmitters are fitted with internal and external earth terminals.

9. SETTING AND REGULATION

9.1. Measurement ranges, Definitions

9.1.1. Nominal range

The maximum range of temperature, which the transmitter can measure, is called the **"nominal range"** (for specifications of nominal ranges see section 5.3).
The width of the nominal range is the difference between the upper and lower limits of the nominal range.
The internal characteristic conversion curve for the nominal 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.

9.1.2. Set range

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 nominal 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 nominal range of temperature values, subject to the restrictions set out in the table in section 5.3.

9.1.3. Factory range

In case when lacks information about measuring range, transmitters are setting on **"factory range".**
0 ... 100 ºC – factory range for transmitter with Pt100 sensor.
0 ... 300 ºC – factory range for transmitter with "K" thermoelement.

9.2. Configuration and Calibration

9.2.1. 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. Lower end-point of the set range;
b. Upper end-point of the set range;
c. Unit;
d. Time constant;
e. Type of characteristic curve: linear or radical;
f. Decimal index.

9.2.2. 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 9.2.1 and 9.2.2 is called **"Configuration".**

9.2.3. Remote configuration of transmitters

Configuration and Calibration of the transmitter are carried out using an APLISENS KAP communicator, APT2000 configuration software or using library EDDL software (software PC with HART/RS232 converter).
A description of the functions of the KAP communicator is contained in the KAP Communicator Operating Manual, and information on the HART/RS232 converter can be found on the HART/RS232/01 Converter information sheet.
For purposes of remote calibration a system shown on the scheme on fig. 2a ÷ 2d should be prepared.

9.2.4. 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.

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

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

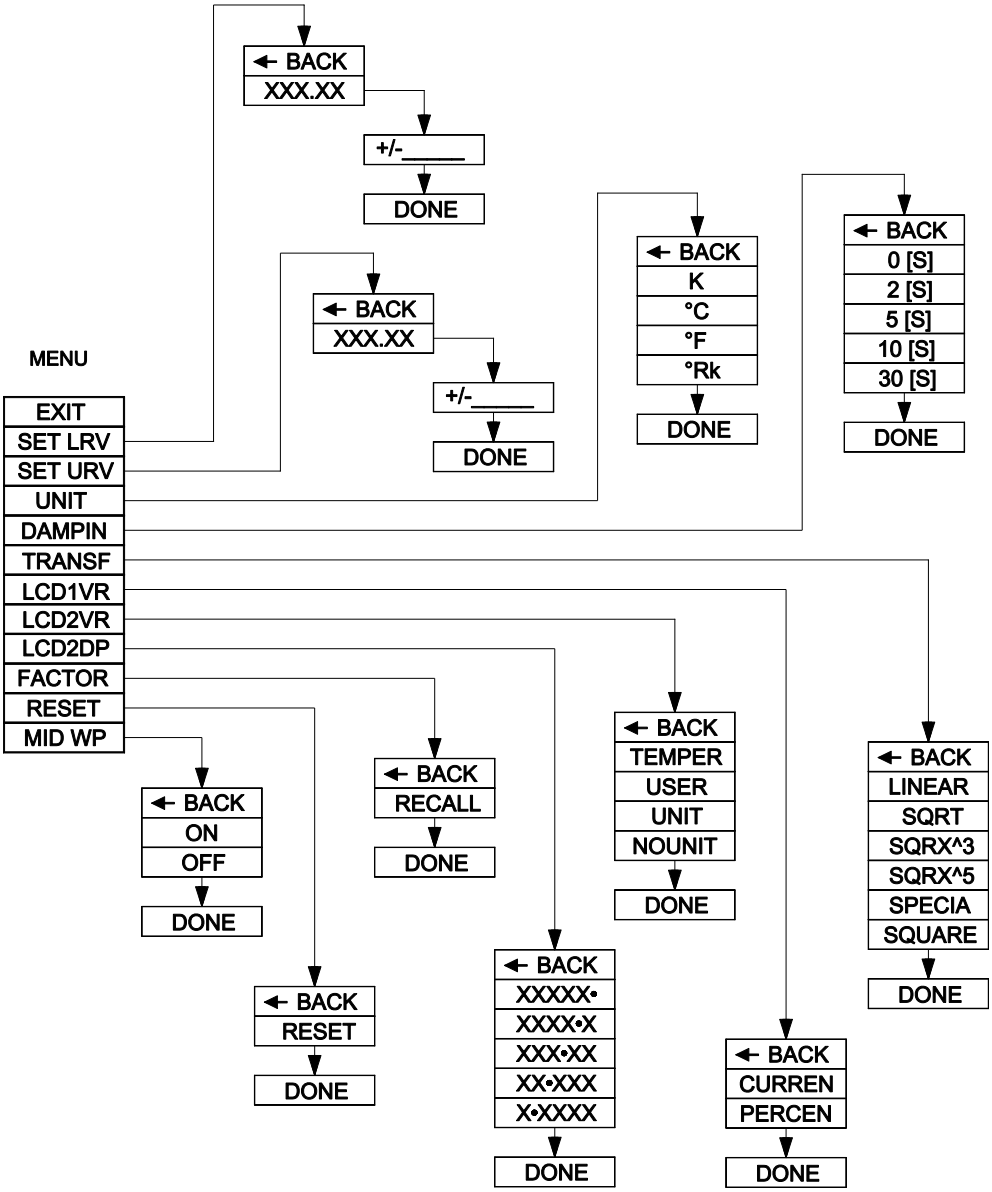
Pressing button [↓] moves down in tree's structure MENU.

Pressing [◙] confirms choice and leads change.

After pressing by 4 seconds any of buttons there will appear on display **"EXIT"**. If we will confirm this announcement across pressing button [◙], we will go out from the local change of the MENU set. If we will not confirm, we can move in MENU and change interesting us parameters using buttons [↑] [↓]. Longer pressing and holding of [↑] [↓] buttons will cause an automatic scrolling through MENU structure, with step of 0.33 s.
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 KAP 3 Calibrator or PC (see –> HART command 132, 133).

If no actions are taken in the area of MENU for a period longer than 2 min., then MENU mode will be quitted and a process variable will be displayed.

Method of navigate through the commands in the menu structure **APT...** 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" causes go up one level.

Descriptions:

Local Menu	Submenu	Notice
EXIT		Return from the local Menu to the normal operation of the transmitter
SETLRV / SETURV		The setting of the range of the set LRV beginning / the setting of the end of the set URV range
	XXX.XX	Display the current value LRV / URV
	+/-_____	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".
UNIT		Menu process variable units
DAMPIN		Set of the solid temporary suppression of the process variable
TRANSF		Set of the current output form
	LINEAR	The linear
	SQRT	The square root
	SQRX^3	The square root of x^3
	SQRX^5	The square root of x^5
	SPECIA	User's special
	SQUARE	The square
LCD1VR		Assigning a process variable to LCD1
	CURREN	On LCD1 will displayed current value in current loop in [mA]
	PERCEN	The percent value output signal will displayed on LCD1- controlling in%
LCD2VR		Assigning a process variable to LCD2
	TERMER	The temperature value will displayed on LCD2
	USER	The user's units display 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.
	UNIT	The current unit or user's unit alternately with process variable will displayed on LCD2
	NOUNIT	The current unit or user's unit alternately with process variable will not displayed on LCD2
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
RESET		Reboot your transmitter
MID_WP		Blocking records / change the parameters associated with transmitter metrology
	ON	Switch on blocking
	OFF	Switch of blocking

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 KAP -03 communicator, APT2000 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 (temperature) exceed admissible value. Zeroing or the range setting verifying is necessary.

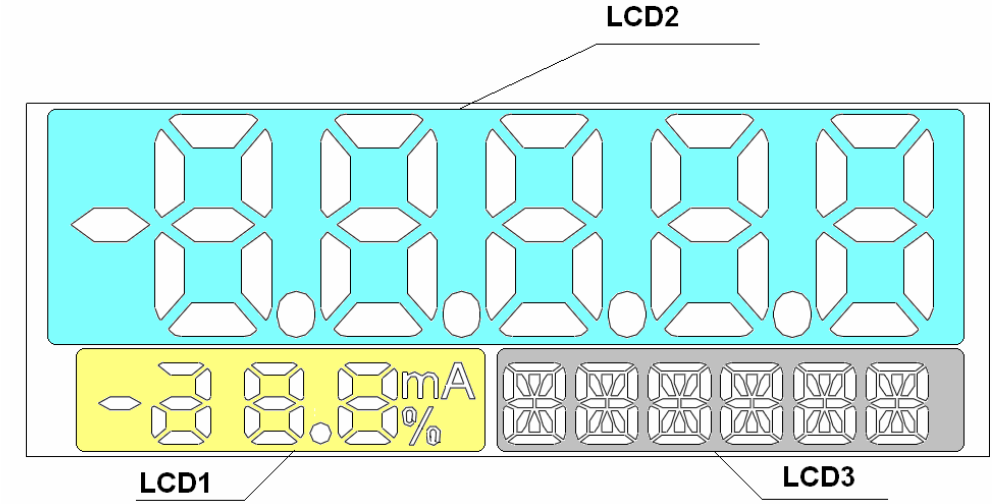
ERR_L10 [applied_process_too_low] error will ensue out when given parameter (temperature) will be too low. Zeroing or the range setting verifying is necessary.

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 [acces_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 KAP-03 communicator, APT2000 program, or software using library EDDL.

9.2.5. Setting up a local LCD display

The LCD display can be configured according to needs. 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.



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 temperature digital value display; the calibrated temperature value according to user's units display; the process variable units or user's units display; the MENU announcement and other information or warning announcement display. In the case the digital temperature value or the calibrated temperature value display, the sign "–" can be visible before displayed value. The decimal point position is possible to set in local MENU or remotely. The temperature unit or user's unit can be displayed. The transmitter makes possible rescale on the user's individual the temperature 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, switching on and switching off with jumper on electronic board. How to handle display backlight is shown in Figure 4. Figure 5 shows how to change the display position by rotation.

After configuration it is important to switch on write protection on the transmitter 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 KAP03 communicator, "APT2000 Configurator" software, as well as, in applying DD or DMT programs libraries.

9.3. Calibration

The transmitter can be calibrated with reference values of the standard operating temperature sensor transmitter to its scale (calibration input) or to current output 4 ... 20 (20 ... 4) mA - (current calibration).
The values set calibration points need not be equal to the upper and lower limit of the basic range. But they cannot exceed out up and down. The width of the calibration range shall not be less than the minimum width of the setting range. In order to achieve the best accuracy it is recommended that the calibration points were close to the beginning and end of the setting range. Calibration can be made using the KAP-03 or KAP-03Ex communicator according to the procedure described in the "User's Guide" IO.KAP-03 p.11.3 or other tools provided in clause p.9.2.3.

9.4. Alarms

Alarms signal exceeding the limits of the transmitter correct operation or non-functioning some of its components. Menu of **APT...** transmitters contains the following alarms: no sensor, sensor error, HART modem error, CRC error, flash memory CRC error, error of the oscillator, calculation error of the first process variable, the first process variable out of range, the second process variable out of range. Errors reveal themselves by issuing in the transmitter current line: high (21,6mA) or low (3,6mA) alarm, and signalling an error code on the display. Alarm current in the output transmitter line of 3,6 (low) or 21,6mA (high) can be set using the Raport 2 configuration program, or the currents alarm settings in transmitter should be agreed with the producer. Exceeding of the basic temperature range is indicated on the transmitter display by code E0256 and alarm current in the measuring line. Exceeding of the measuring ranges in MID temperature transmitters are described in MID Appendix.

10. INSPECTIONS AND SPARE PARTS

10.1. Periodic inspections

Periodic inspections should be made in accordance with the regulations to which the user is subject.
During inspection, the shield of the measuring insert should be checked for loose connections and leaks, the electrical connectors should be checked with regard to tightness and the state of the gaskets, packing glands.
Check the characteristic conversion curve by following the procedures for “Calibration” and, where appropriate, “Configuration”.

10.2. Unscheduled inspections

If the transmitters are installed in a location where they may be exposed to mechanical damage, hydraulic impulses or excess voltage, or transmitter operate abnormal – inspections should be carried out as required, check the characteristic of processing.

i 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.

10.3. Spare parts

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

i **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.**

11. 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 an air temperature and relative humidity not exceed the limits specified in p. 5.
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.

12. GUARANTEE

Manufacturer warrants under the conditions specified in the Product Certificate which is also a guarantee card.

13. SCRAPPING, DISPOSAL

Waste or damaged transmitters should be dismantled and disposed of in accordance with Directive (2012/19/UE) on waste electrical and electronic equipment (WEEE) or returned to the manufacturer.

14. ADDITIONAL INFORMATION

The manufacturer reserves the right to make constructional and technological changes which do not lower the quality of the transmitters - not apply to devices complying with EN 12405-1+A2:2010.

15. FIGURES

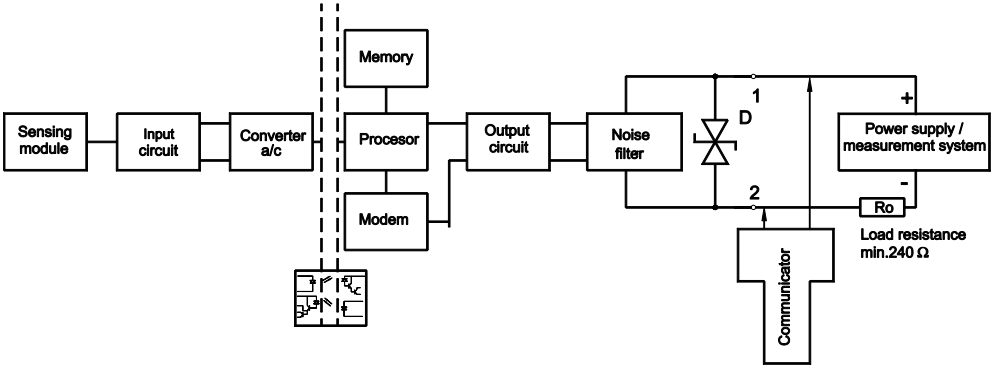


Fig.1. APT... transmitters – block diagram.

For successful communication with transmitter the resistance in measuring loop, behind connected device to communication, should be higher than 240Ω. 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).

Connection of the APT… 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 Ro from the point of connection of the communicator to the power supply source lies within the range of 240÷1100 Ω. If necessary, an additional resistance can be integrated into the line. Connect the communicator or converter as shown in Fig. 2a.

Electrical connections for APT... transmitters

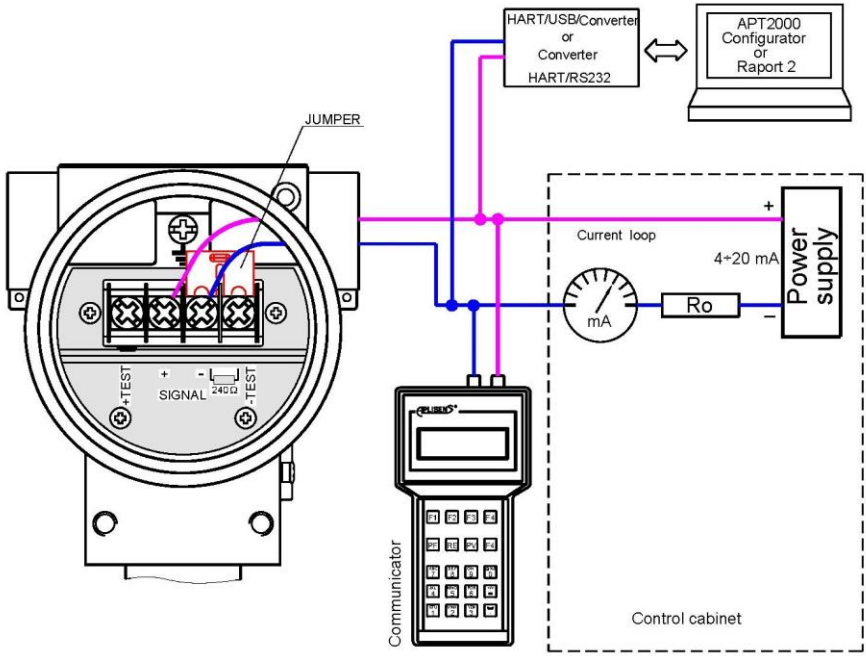


Fig.2a. The link of transmitter and communicator or converter to current line by the switch box (in case of the resistance in current loop **is higher than 240Ω**).

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 Ro from the transmitter's terminals to the power supply source lies within the range of 240÷1100 Ω. If so, connect the communicator or converter to the terminals <+> <-> as shown in Fig. 2b.

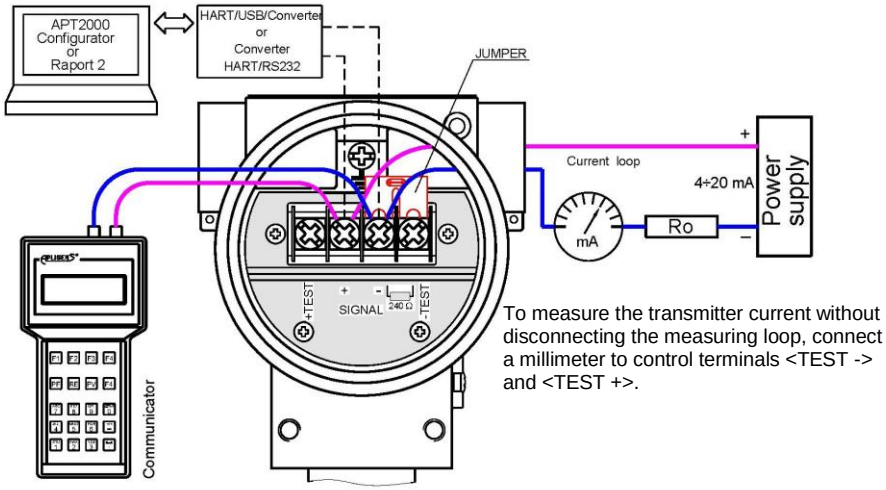


Fig.2b. The link of transmitter and communicator or converter to <SIGNAL+> <SIGNAL-> transmitter terminals in case of the resistance in current loop is **higher than 240Ω**.

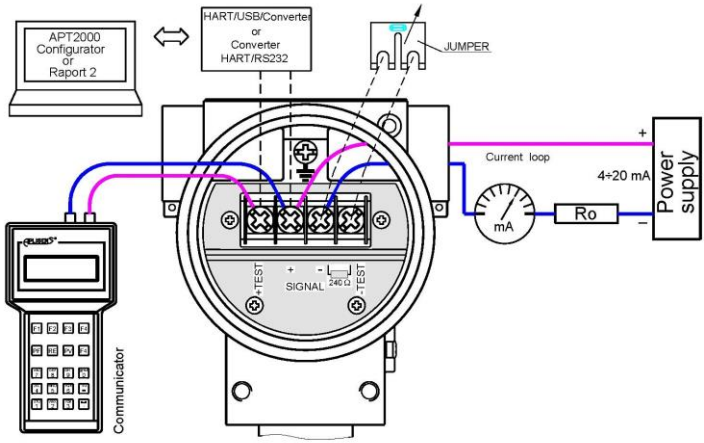


Fig.2c. The link of transmitter and communicator or converter to <SIGNAL+> <TEST+> transmitter terminals in case of the resistance in current loop is **smaller than 240Ω**.

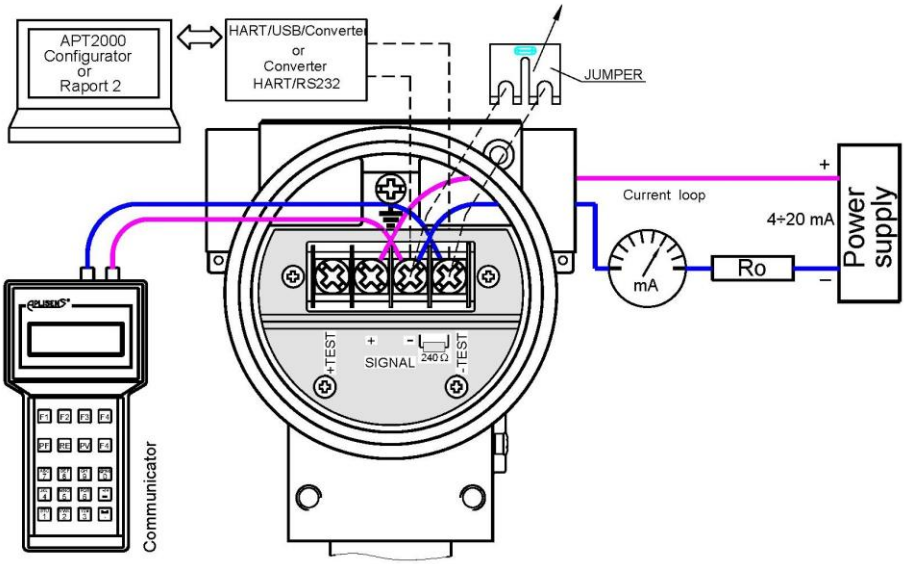


Fig.2d. The link of transmitter and communicator or converter to <TEST-> <SIGNAL-> transmitter terminals in case of the resistance in current loop is **smaller than 240Ω**.

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

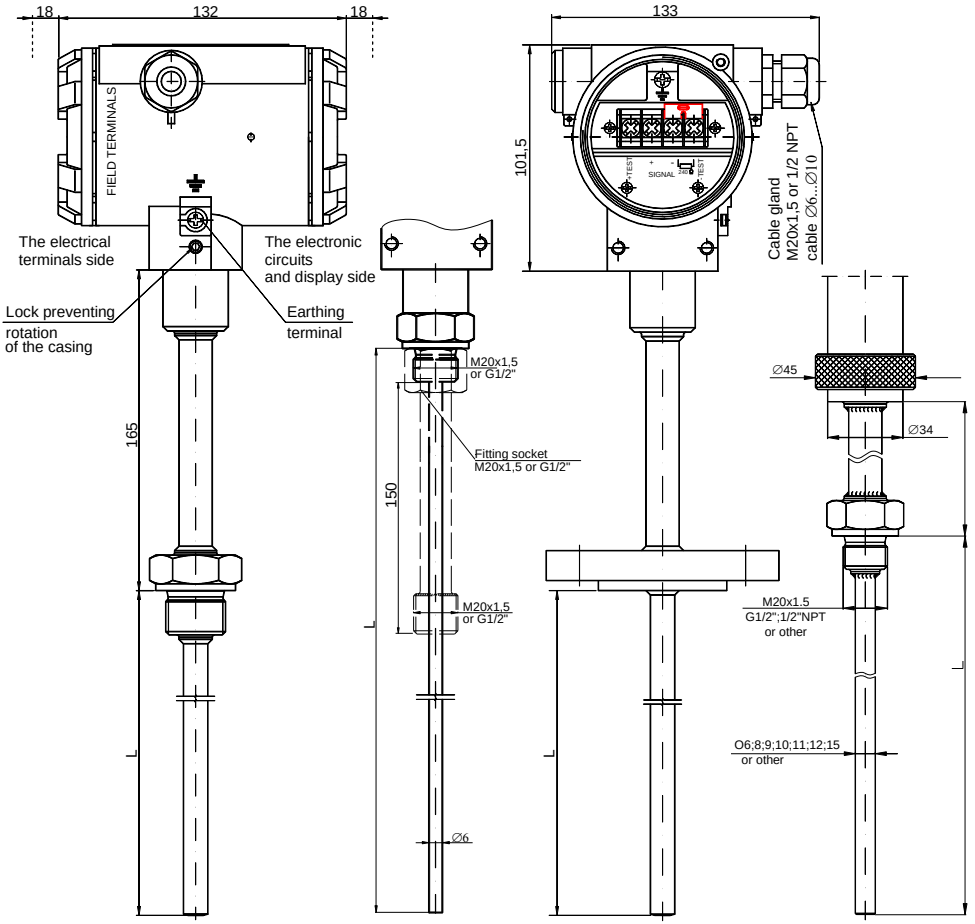


Fig.3. APT-2000ALW smart temperature transmitter.

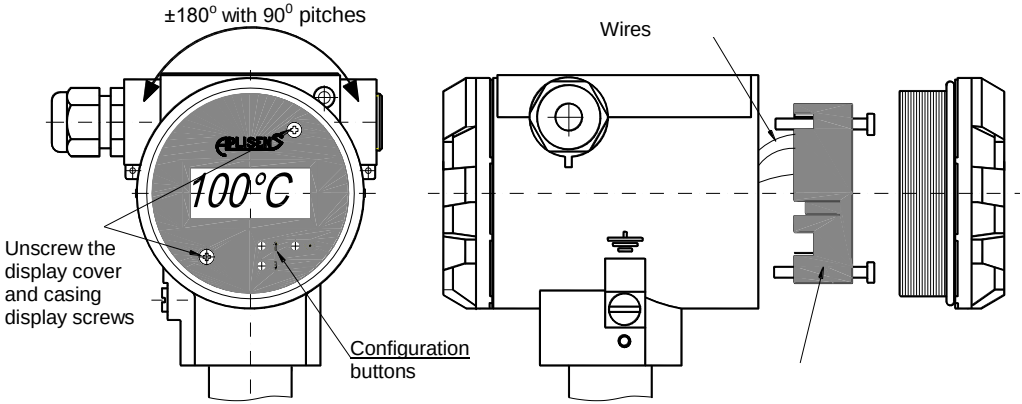


Fig.4. APT... display rotation possibility, configuration buttons.

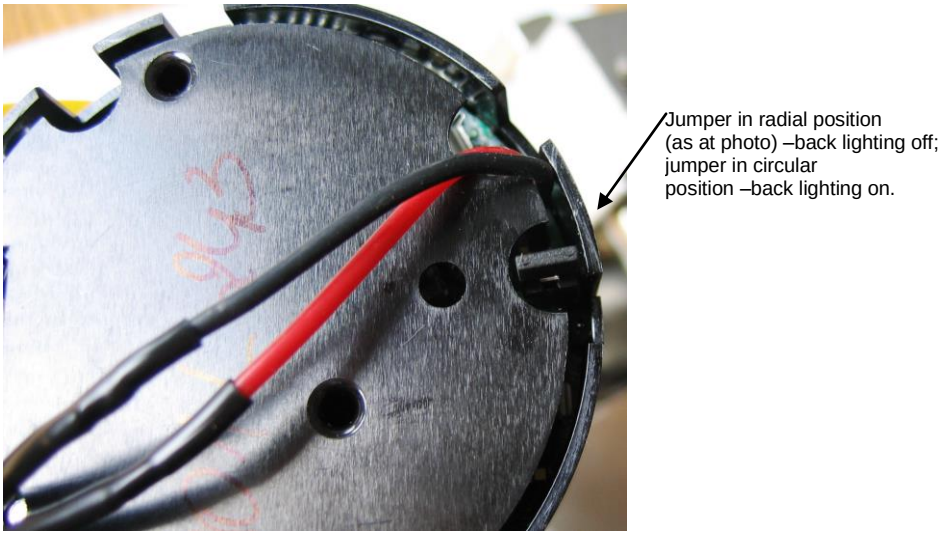


Fig.5. Back lighting jumper view at transmitter electric board (unit display back side).

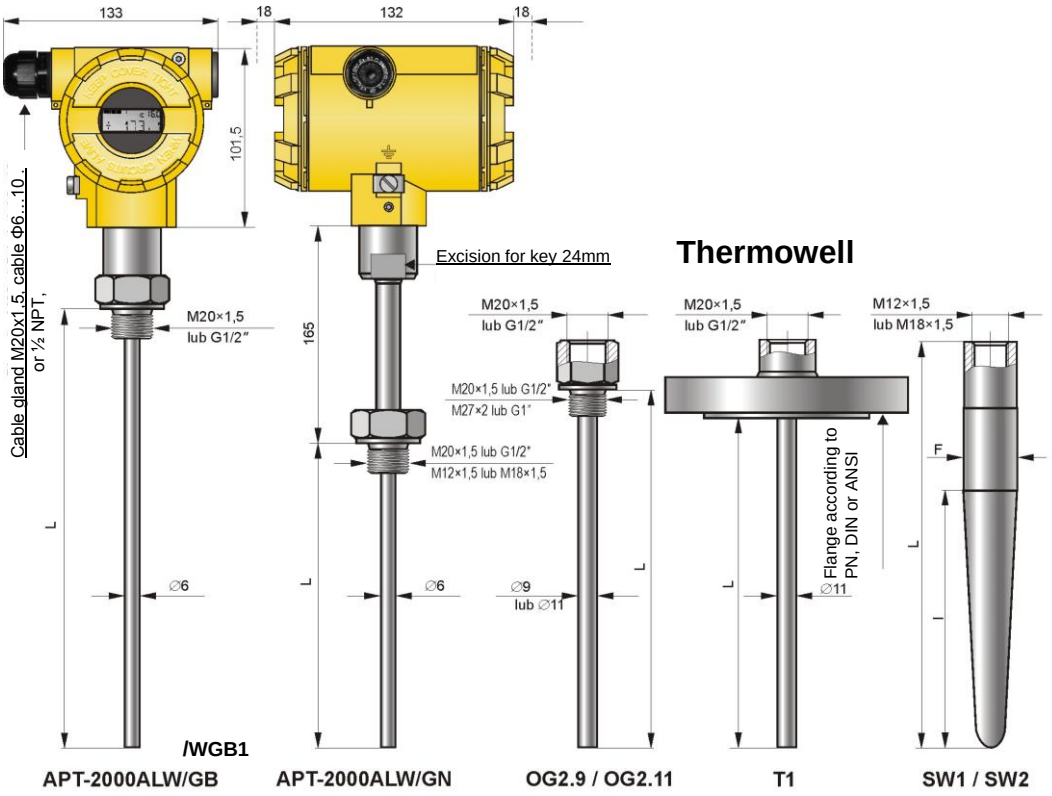
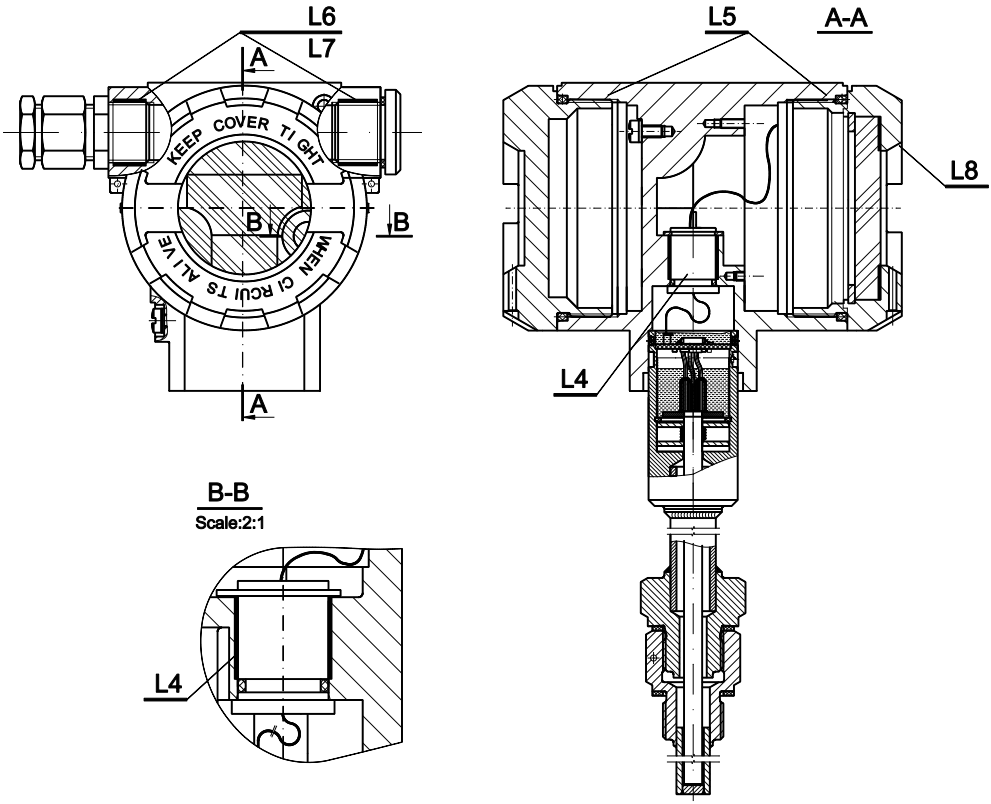


Fig.6. The types of shields of measuring insert.



MINIMUM WIDTH OF JOINT AND MAXIMUM GAP FOR GROUP IIC ENCLOSURES						
Nr	width of joint (min. real) L [mm]	diameter D [mm]	diameter d [mm]	D-d [mm]	quantity of joint	minimum according to PN-EN 60079-1:2008
L4	13,3	$Ø15^{+0,027}$	$Ø15^{-0,040}_{-0,070}$	0,097	2	width of joint min.12,5
L5	12	M72x1,5	M72x1,5		2	min.5 threads engaged(8)
L6	9	M20x1,5	M20x1,5		2	min.5 threads engaged(6)
L7	12,7	1/2NPT	1/2NPT		2	min.6 threads engaged
L8	10				1	cemented joints width of joint min.10

Fig.7. The explosion - proof joints of APT-2000ALW transmitter.

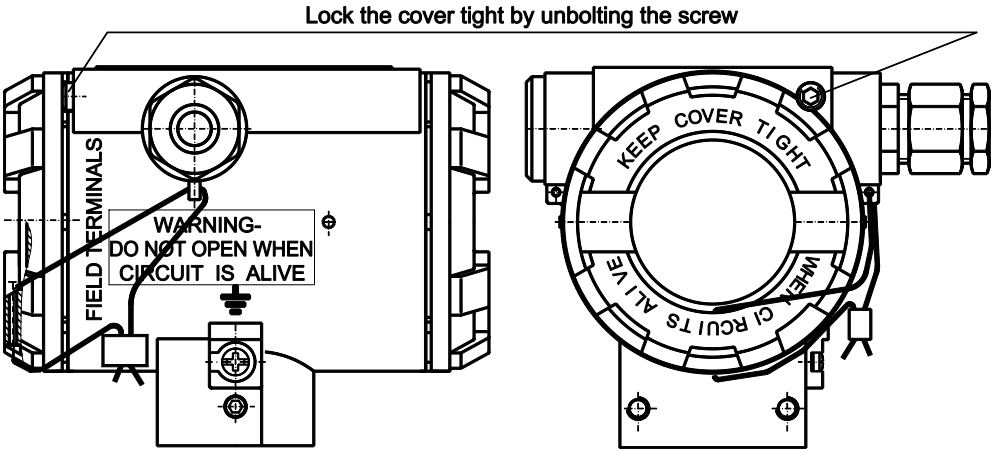


Fig.8. How to lead the casing of APT-2000ALW transmitter.

The method of sealing transmitters compatible with EN 12405-1 + A2:2010 is given in fig. 1c Appendix MID.