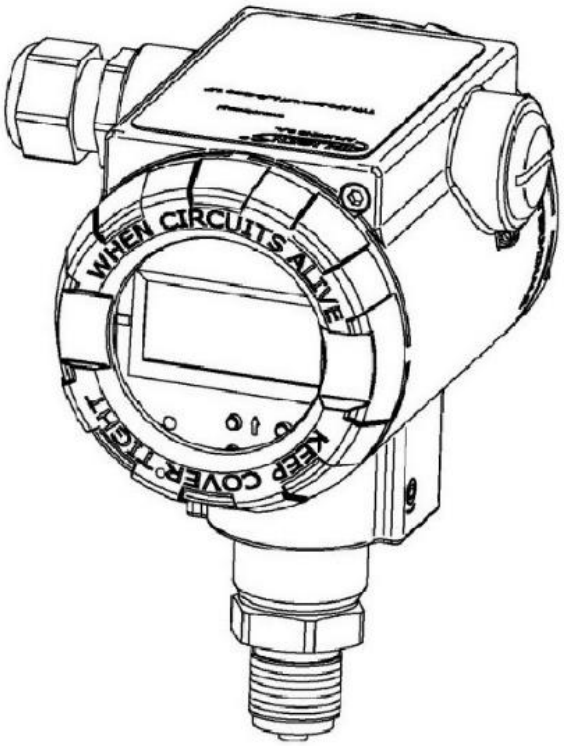
# USER'S MANUAL

# APC-2000ALW

## PRESSURE TRANSMITTERS

Version in accordance with EN 12405-1:2018 Standard (MID)

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**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 a 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.

In systems with I&C equipment, in case of leakage, there is a danger to staff due to the medium under pressure. 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.

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

## 1.1. Purpose of the document

The subject of manual are the installation and exploitation data of the **APC-2000ALW** smart pressure transmitters, used for gas conversion devices 2 type, accorded with EN 12405-1:2018 Standard, harmonized to Directive 2014/32/EU (**MID**), hereinafter referred jointly to as the transmitters. The manual applies to the intrinsically safe Exi, flameproof Exd and PED versions.

Within the scope of the MID Directive, transmitters are intended for use in volume gas converters 2 type, equipped with an electric power backup source (battery, UPS) for 1 and 2 family gas fuels in accordance with EN 437 Standard.

The Exi and Exd transmitter parameters are presented in the section ➔ 11. EXPLOSIONPROOF PARAMETERS.

Within the meaning of the Directive 2014/68/EU (PED), the transmitters are designed to category I, module A. PED marking does not apply to additional equipment of the transmitters, i.e. separators, valves, connectors, impulse tubes, etc. In the manufacturer's EU declarations of conformity, the transmitters as designed above have the CE markings. The transmitters with permissible overload of 200 bar and lower are manufactured in accordance with good engineering practice according to article 4 point 3 of Directive 2014/68/EU.

The manual contains data, tips and general recommendations for safe installation and operation of the transmitters, as well as troubleshooting in case of possible failure.

The use of the equipment in hazardous zones without appropriate approvals is forbidden.

In addition, please refer to the Technical Information:

- Technical Information contains detailed technical data, parameters and recommendations for installation and operation.

## 1.2. Trademarks

HART® is a registered trademark of FieldComm Group.
Windows® is a registered trademark of Microsoft Corporation.
Google Play® is a service registered and managed by Google® Inc.

## 1.3. Definitions and abbreviations

**Table 1.** Definitions and abbreviations

| Item no. | Abbr. | Meaning |
|---|---|---|
| 1 | **LRV** | "Lower Range Value" – the value of the set range expressed in physical units corresponding to the current of 4,000 mA, i.e. 0% of the output setpoint. Exceeding the **LRV** limit, with the MID blockade on, makes the generation of alarm signals by the transmitter, and on the main display the **undEr** inscription will be showed. |
| 2 | **URV** | "Upper Range Value" – the value of the set range expressed in physical units corresponding to the current of 20,000 mA, i.e. 100% of the output setpoint. Exceeding the **URV** limit, with the MID blockade on, makes the generation of alarm signals by the transmitter, and on the main display the **ouEr** inscription will be showed. |
| 3 | **LRL LSL** | "Lower Range Limit" or "Lower Sensor Limit" - lower limit of set range expressed in physical units. Value **(URL-LRL)** or **(USL-LSL)** is referred to as the base transmitter range. |
| 4 | **URL USL** | "Upper Range Limit" or "Upper Sensor Limit" – upper limit of set range expressed in physical units. Value **(URL-LRL)** or **(USL-LSL)** is referred to as the base transmitter range. |
| 5 | **LPL** | "Lower Processing Limit" – lower limit of digital processing of measured value. The transmitter processes a digital measurement up to 50% of the base range width below the lower limit of set range **LRL (LSL)**. |
| 6 | **UPL** | "Upper Processing Limit" – upper limit of digital processing of measured value. The transmitter processes a digital measurement up to 50% of the base range width above the upper limit of set range **URL (USL)**. |
| 7 | **LSAL** | "Lower Saturation Limit" - lower limit of the A/D transmitter processing range. The lower limit of the A/D transmitter saturation is on the pressure scale below the **LPL** point and is associated with the minimum pressure, at which the analogue-digital pressure measurement transmitter reaches the lower limit of the processing capacity. The exact determination of this pressure is not possible, however usually the pressure does not exceed the pressure corresponding to 200% of the base range width **(URL-LRL)** below the lower limit of the digital processing of measured **LPL** value. |
| 8 | **USAL** | "Upper Saturation Limit" - upper limit of the A/D transmitter processing range. The upper limit saturation point of A/D transmitter is on the pressure scale above the **UPL** point and is associated with the maximum pressure at which the analogue-digital pressure measurement transmitter reaches the upper limit of the processing capacity. The exact determination of this pressure is not possible, however usually the pressure does not exceed the pressure corresponding to 200% of the base range width **(URL-LRL)** above the upper limit of the digital processing of measured **UPL** value. |
| 9 | **AL_L** | Low current alarm. |
| 10 | **AL_H** | High current alarm. |
| 11 | **I_AL** | The alarm current set by the transmitter controller in the current loop. |

## 1.4. Transmitter set range

The figure below shows the transmitter set range and limits related to allowable set range, digital processing range and saturation limits of A/D pressure measurement transducer. As standard, values of 4 mA/20 mA currents are assigned to LRV/URV points. In order to obtain reverse characteristics, it is possible to reverse the assignment so that the LRV/URV points are assigned to 20 mA/4 mA currents.

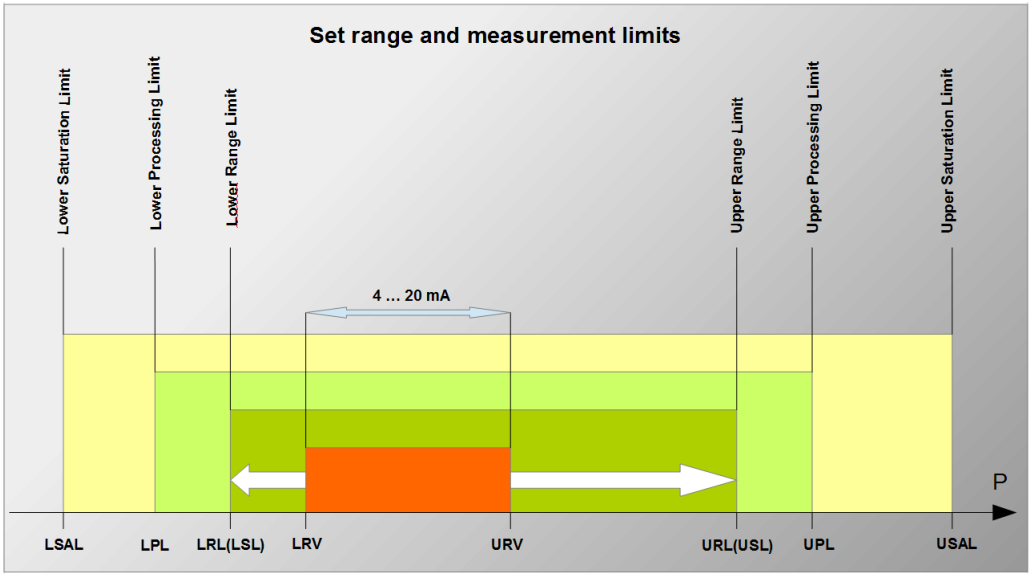



**Figure 1.** Set range and measurement limits

# 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 specified on the nameplate (➔ 5.2. Transmitter identification).

- The protection elements used by the manufacturer to ensure transmitter safety may be less effective if the device is operated in a manner not consistent with its intended purpose.
- 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.

# 3. TRANSPORT AND STORAGE

## 3.1. Delivery check

After receiving the delivery of the equipment, it is necessary to:

- make sure that the packaging and its contents were not damaged during transport;
- check the completeness and correctness of the received order, and make sure no parts are missing.

## 3.2. Transport

Transport of transmitters shall be carried out with the use of covered means of transport, in original packages with diaphragm provided with protection. The packaging shall be protected against movement and direct impact of atmospheric factors.

## 3.3. Storage

Transmitters shall be stored in a factory packaging, in a room without vapours and aggressive substances, protected against mechanical impact.

Allowable range of storage temperature:
-40 ... 80 °C (-40 ... 176 °F).

# 4. GUARANTEE

General terms and conditions of guarantee are available on the manufacturer's website:
www.aplisens.com/ogolne_warunki_gwarancji

The guarantee shall be repealed if the device is used against its intended use, or failure to comply with user's manual or interference with the structure of the device.

# 5. IDENTIFICATION

## 5.1. Manufacturer's address

APLISENS S.A.
03-192 Warsaw
Morelowa 7 St.
Poland

## 5.2. Transmitter identification

The transmitter is labelled with rating plates with data as shown below:

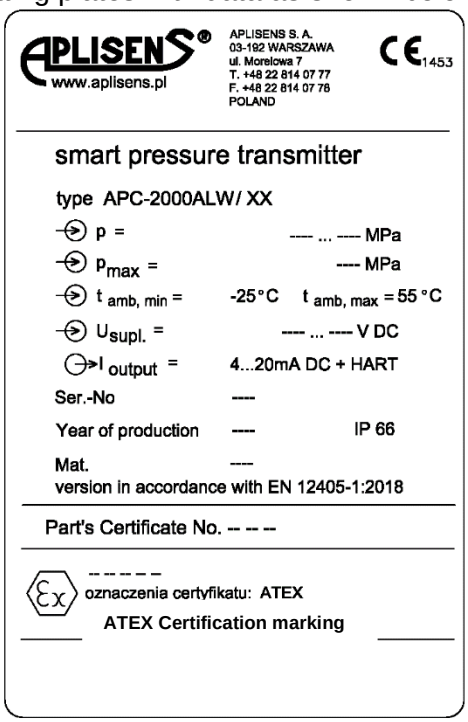



**Figure 2.** Transmitter nameplate

## 5.3. CE mark, declaration of conformity

The device has been designed to meet the highest safety standards, has been tested and has left the factory in a condition that is safe for operation. The device complies with the applicable standards and regulations listed in the EU Declaration of Conformity and has CE marking on nameplate.

# 6. INSTALLATION

## 6.1. General recommendations

In order to avoid measurement errors caused by the accumulation of condensate (in gas installations) or gas bubbles (in liquid installations) in impulse lines, assembly solutions using constructions based on available engineering knowledge should be used. For a gaseous medium, this may mean installing the transmitters above the pressure measuring point, and for liquids below this point.

### 6.1.1. Examples of transmitter installation

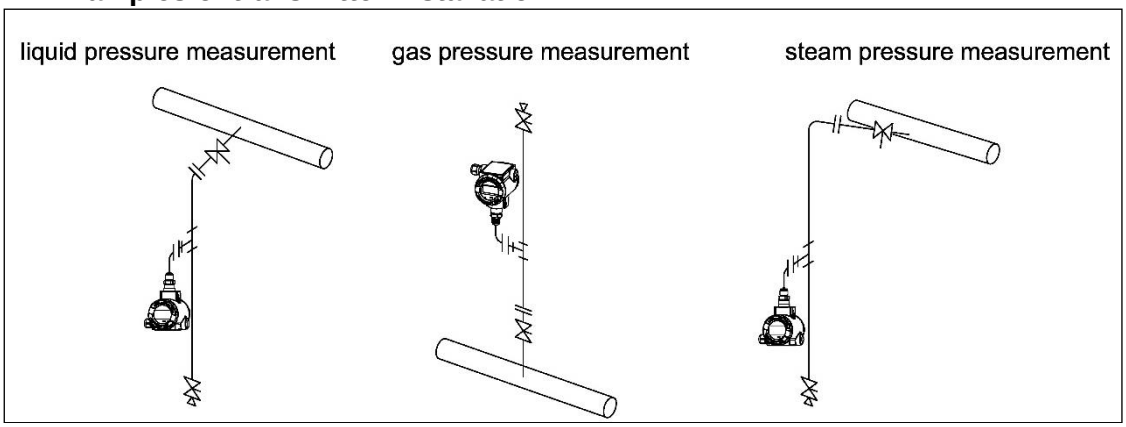



**Figure 3.** Examples of pressure transmitter installation

# 7. ELECTRICAL CONNECTION

## 7.1. Cable connection to transmitter internal terminals

All connection and installation operations shall be performed with disconnected supply voltage and other external voltages, if used.

**Failure to provide proper connection of the transmitter may result in danger.**
**Risk of electric shock and/or ignition in potentially explosive atmospheres.**

### 7.1.1. Cable connection

In order to perform correct connection of the cables, the following steps shall be performed:

- disconnect power supply of the supply & measurement cable line before connecting the transmitter cabling;
- unscrew the rear cover of the transmitter body to access the power connector;
- pull the cable through the cable gland;
- connect the transmitter according to the figure below, paying attention to the correct tightening of the bolts fixing the conductor core to the terminal;
- check the correct fixing of the HART local communication jumper;
- tighten the rear cover of the transmitter body;
- leaving a small clearance of the cable inside the body, tighten the gland nut so that the gland seal is clamped on the cable.

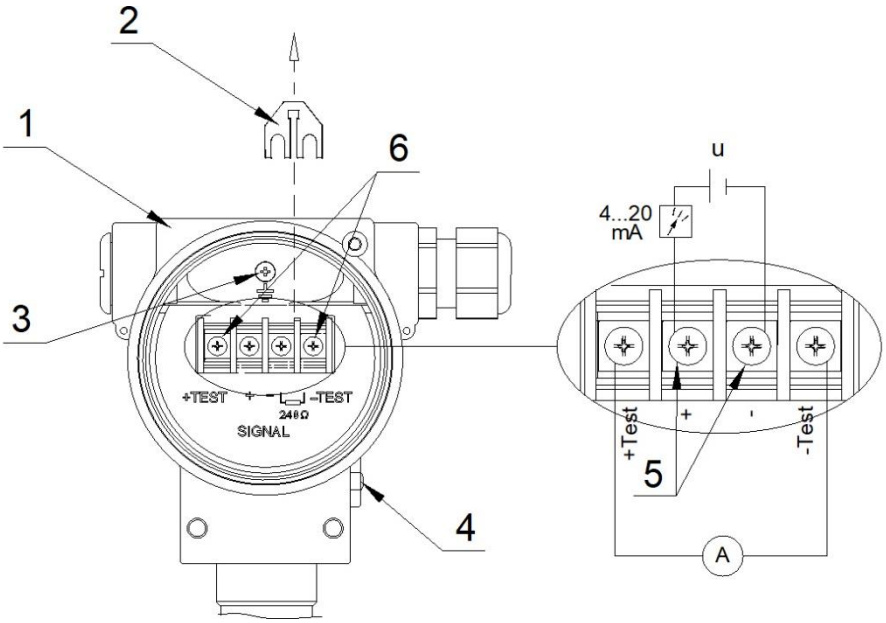



**Figure 4.** Electrical connection to transmitter

1. Housing.
2. Jumper for local HART communication.
3. Internal ground terminal.
4. External ground terminal.
5. Transmitter power terminals, 4…20 mA current loop.
6. Ammeter connection terminals for uninterruptible current measurement (optional).

In hazardous zone, do not unscrew the housing covers after connecting the Exd flameproof transmitter to the power source.

### 7.1.2. Connection of transmitter with the option of using local HART communication

The transmitter allows to use the local HART communication. To do this you can use a HART communicator or HART modem connected to a computer or a smartphone.
In order to establish the local communication, it is necessary to:

- remove HART communication jumper (item 2);
- connect the communicator or modem to electrical terminals (item 5).

Opening of the HART jumper results in applying resistance of 240 Ω in series in line 4...20 mA. This resistance reduces voltage on transmitter supply terminals by approximately 5 V DC for maximum current that can be set by the transmitter. **To avoid the supply voltage deficit on the transmitter terminals, the HART jumper must be dismantled only for the time of performing the HART local communication.**

Connection diagram of the communicator or modem to transmitter power supply and measurement system is presented below:

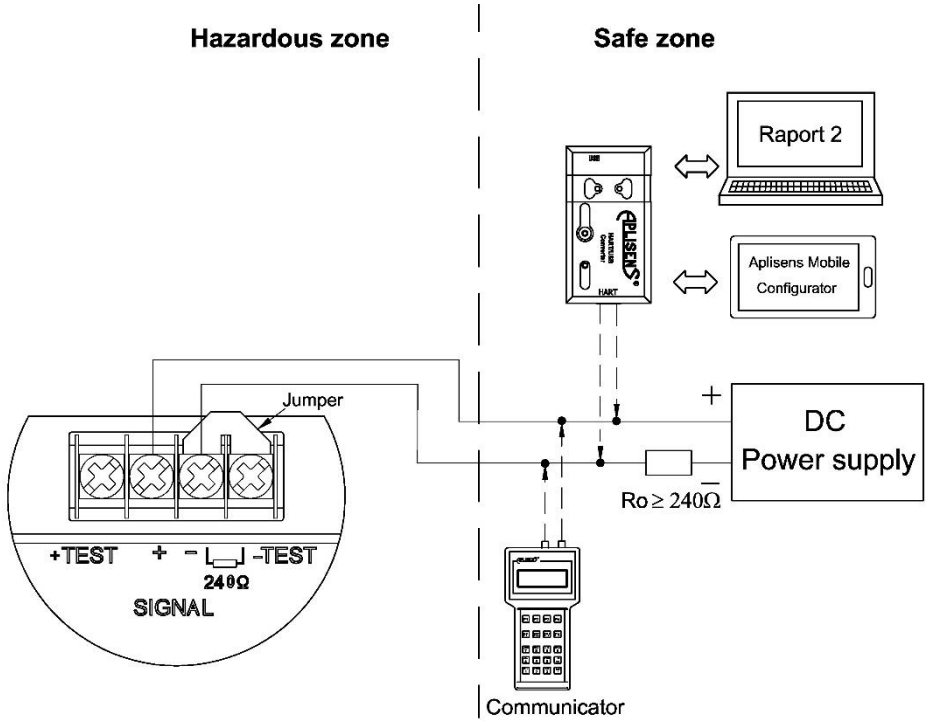



**Figure 5.** Electrical connection 4…20 mA of HART to transmitter in Exd version

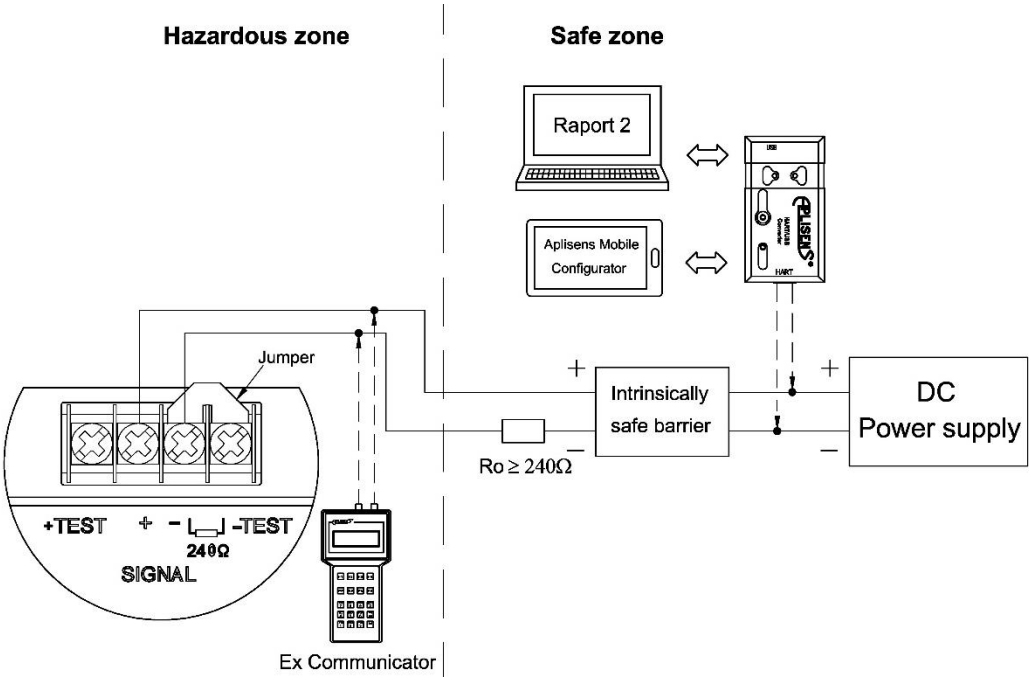



**Figure 6.** Electrical connection 4…20 mA of HART to transmitter in Exi version

It is mandatory to read section ➔ 11. EXPLOSIONPROOF PARAMETERS, containing important information related to the installation of intrinsically safe and flameproof versions of the transmitter.

The converter may also be operated using **Aplisens Mobile Configurator** installed on smartphones with Android system and connected using wireless communication.
The software is available on Google Play®:
https://play.google.com/store/apps/details?id=com.aplisens.mobile.amc.

## 7.2. Transmitter power supply

### 7.2.1. Transmitter supply voltage

**Power cables may be live.**
**There is a risk of electric shock and/or explosion.**

Installation of the transmitter in explosion-risk atmospheres must comply with national standards and regulations.
All explosion protection data is given in section ➔ 11. EXPLOSIONPROOF PARAMETERS.

**Table 2.** Permissible transmitter supply voltages

| Version | Minimum supply voltage | Maximum supply voltage |
|---|---|---|
| Exi | **13,5 V DC** | **28 V DC** |
| Exd | **13,5 V DC*** | **45 V DC** |
| * Minimum supply voltage with backlight off. Switching on the backlight increases the minimum supply voltage by 3V. The backlight is switched off by default. | | |

### 7.2.2. Uninterruptible current measurement in 4…20 mA current loop

The transmitter is capable of continuous current measurement in the current loop using an ammeter. In order to maintain the current measurement error below 0,05%, the internal resistance of the ammeter shall be less than 10 Ω.
Ammeter connection diagram – see: ➔ Figure 4. Electrical connection to transmitter.

### 7.2.3. Specifications of electrical switching terminals

Internal electrical switching terminals are suitable for conductors with the cross-section from 0,5 to 2,5 mm$^2$. The internal and external electrical ground terminal of the body is suitable for conductors with cross-section from od 0,5 to 5 mm$^2$.

### 7.2.4. Cabling specification

Aplisens S.A. recommends using two-wire screened twisted pair cable. The outer diameter of the cable shell from 5 to 9 mm is recommended.
Exemplary cable types are presented in the table below.

**Table 3.** Example of recommended types of cable

| Type | Producer | |
|---|---|---|
| | **Technokabel** | ***LAPPKABEL*** |
| **shielded** | IB-YSLY 2x0.75 | ÖLFLEX® EB 2X1 (art. No. 0012440) |
| **unshielded** | IB-YSLCY 2x0.75 | ÖLFLEX® EB CY 2X1 (art. No. 0012650) |

### 7.2.5. Resistance load in power supply line

The power line resistance, power source resistance and other additional serial resistances increase the voltage drops between the power source and the transmitter terminals. The maximum current of Exd or Exi transmitters in power supply & measurement loop under normal operation conditions is defined as I_max = 20,500 mA, in the high alarm state, the I_max current rises to at least 21,5 mA.

The maximum resistance value in the power circuit (along with the power cables resistance) is defined by the formula:

$$R_{L\_MAX} = \frac{(U - U_{min})\ [V]}{0{,}0215\ [A]}$$

where:
$R_{L\_MAX}$ – maximum power supply line resistance [Ω],
U – voltage at the supply terminals of the 4…20 mA current loop [V],
$U_{min}$ – minimum supply voltage of transmitter [V] (➔ Table 2. Permissible transmitter supply voltages).

### 7.2.6. Shielding, equipotential bonding

When using a cable in the screen, connect the screen on one side at the transmitter's power supply point.

## 7.3. Overvoltage protection

Transmitters comply with EMC standards in terms of emission and immunity for products used in industrial environments.

## 7.4. Final inspection of cabling

After completing the electrical installation of the transmitter it is necessary to check the following:

- Does the supply voltage measured at the transmitter terminals at maximum set current match the range of supply voltage specified on the transmitter nameplate?
- Is the transmitter connected according to the information given in section ➔ 7.1. Cable connection to transmitter internal terminals?
- Are all the screws tightened?
- Are the transmitter covers tightened?
- Are the cable gland and the gland plug tightened?

# 8. START-UP

As standard, the transmitter is adjusted to a set range equal to the base range, unless a specific set range is provided in the order. The base range and the basic unit of the transmitter can be read out from its nameplate (➔ 5.2. Transmitter identification).

Use the transmitter within the allowable pressure limits. Risk of injury due to component breakage after exceeding the maximum permitted operating pressure.

## 8.1. Alarm configuration

Transmitters has a developed internal diagnostics, which monitors the work of their electronic circuits, process and environmental parameters.
The user has an option of enabling/disabling of the current alarms. Current alarms are disabled by default.

The figure below shows the normal operation ranges of the transmitter process output (4 … 20 mA) and the ranges of saturation and alarm currents.

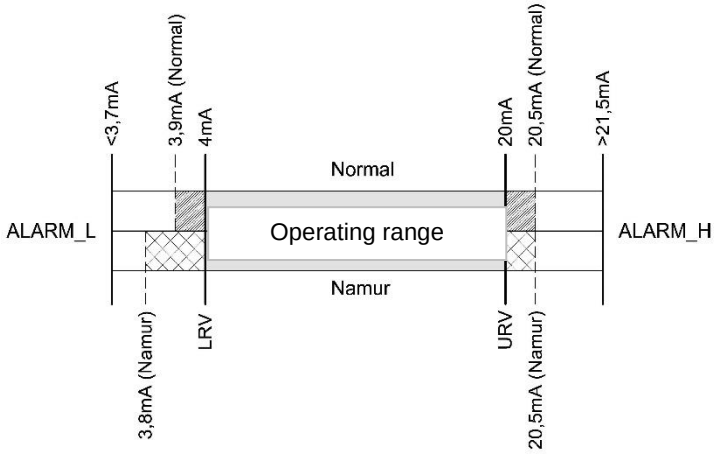



**Figure 7.** Set range current, saturation currents, alarm currents of transmitters

- 4...20 mA – set current area corresponding to setpoint 0...100% of the process output;
- 3,800 mA – - Lower saturation current for NAMUR mode;
- 3,900 mA – Lower saturation current for NORMAL mode;
- 20,500 mA – Upper saturation current for NAMUR and NORMAL mode;
- I_AL<3,700 mA – low alarm current area;
- I_AL>21,500 mA – high alarm current area.

## 8.2. Configuration of operating mode

Before starting the work with the transmitter, the following parameters must be configured:

- basic unit of transmitter;
- the beginning of the set range LRV;
- the end of the set range URV;
- damping time constant;
- NORMAL/NAMUR analogue output operation mode;
- alarm mode, high or low alarm;
- transmitter tag (TAG/LONG_TAG);
- LCD display configuration parameters;
- setting of the settings change lock password.

## 8.3. Correction of impact of transmitter mounting position on site – pressure reset

Once the transmitter is mounted in a target location, it must be reset. This operation will eliminate the possible influence of the mounting position on the indication of transmitter. In order to do so:

- in case of relative pressure transmitter without pressure supplied (vented), perform the pressure reset operation using the local MENU or HART communication;
- in case of absolute pressure transmitter the resetting is only possible with an absolute pressure calibration device.

**Once the transmitter parameters have been entered and it has been reset at the workstation, it is required to:**

- **secure the device against the possibility of making changes in the local setpoint change MENU;**
- **set your own password different from default password of "00000000". The new password may consist of any combination of 8 hexadecimal characters 0...9, A…F. Store the password in a safe place. If the password is lost, its restoration or resetting to factory settings may only be performed by the manufacturer;**
- **activate the setpoint change lock to secure the transmitter against accidental, unintentional change of parameters.**

Pressure reset can be done via local setpoint change MENU or HART communication. The remaining operations described in this section may only be performed using HART communication.

For Exd type transmitters, opening the housing cover in the hazardous zone in order to use the local setpoint change MENU is forbidden.

## 8.4. Sealing of the transmitters

The transmitters are sealed according to the regulations in the place / country of using. The manufacturer seals the side covers and the sensor as well as the nameplate, if it is made of metal. The sealing method of the transmitter by the manufacturer is shown at Fig. 8.

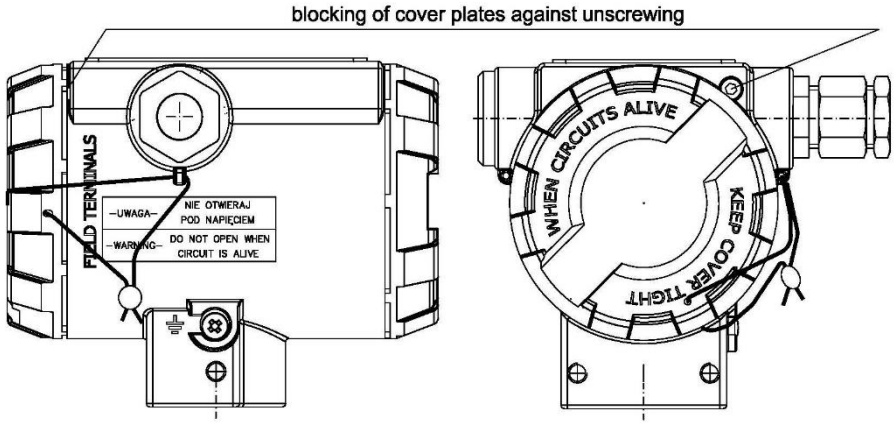



**Figure 8.** Example of the transmitter side covers sealing

Protection against changes in the settings in the transmitter can be done 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).

As a standard, the manufacturer turns on the ‘’spec lock’’ or, in agreement with the ordering party, the transmitter may be unblocked.

Local buttons, enabling the activation of the spec lock, are secured with a screw-on side cover which is sealed. With the spec lock on, it is possible to change only some of the transducer parameters, i.e. the HART address of the transducer and the time constant, and additional transducer identification entries related to its place of work can be made, e.g. TAG.

## 8.5. Pressure measurements

The transmitter version in accordance with the EN 12405-1: 2018 standard is designed to measure pressures: relative (overpressure and under pressure) and absolute pressure of gases, vapors and liquids. The metrological parameters of the transmitter are presented below.

| **Measurement ranges** | Absolute/gauge | Maximum pressure $P_{max}$ |
|---|---|---|
| **10 … 100bar (1 … 10 MPa) ***<br>.<br>**10 … 70 bar (1 … 7 MPa)**<br>**5 … 55 bar (0,5 … 5,5 MPa)** | absolute | 200 bar (20 MPa) * |
| **2 … 20 bar (0,2 … 2 MPa)** | absolute | 50 bar (5 MPa) |
| **2 … 20 bar (0,2 … 2 MPa)** | gauge | 50 bar (5 MPa) |
| **0,9 … 7 bar (0,09 … 0,7 MPa)** | absolute | 14 bar (1,4 MPa) |
| **0,9 … 7 bar (0,09 … 0,7 MPa)** | gauge | 14 bar (1,4 MPa) |

*) *The transmitter measuring range is setting by the manufacturer. For a measuring range of 10 ... 100 bar, it is possible to lower the upper limit of the range to 70 bar. A lower measuring range can be set by manufacture at the user's request, or can be changed by the user after the lock removing.*

**Maximum permissible error (according to EN 12405-1:2018)**
(calculated in relation to the measured value)

- at the rated temperature range: **(-25 ÷ 55 °C)** **≤ 0,5 %**
- at reference conditions **≤ 0,2 %**
- long-term stability / 5 years **≤ 0,5 %**

For the clearing needs, in accordance with Directive 2014/32/EU, should be used one of the two metrological checked transmitter output signals: digital HART signal rev 5.1 or analogue current signal.

**Other parameters**

| | |
|---|---|
| Medium temperature range | -40 ÷ 120 °C |
| Ambient temperature range | -25 ÷ 55 °C |
| Relative humidity | 10 ÷ 98 % with condensation |
| Error due to supply voltage changes | 0,002 %(FSO) / 1V |
| Thermal error | < ± 0,05 %(FSO) / 10°C |
| Maximum length of the connection cable | 1500 m |
| Output updating time | 150 ms |
| Dumping | 0...60 s |
| Enclosure Ingress Protection | IP 66 |

**Transmitters environmental parameters**
Products for this application meet the following requirements.
Criteria by EN 12405-1:2018

**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

*Radiated Electromagnetic Field:*
EN 61000-4-3
80 … 1 000 MHz – 10 V/m
1 … 2,700 GHz – 10 V/m

*Magnetic Field:*
EN 61000-4-8
100A/m – direct
1000A/m – for 3 s
Level 5

*Electrical Fast Transient (Burst):*
EN 61000-4-4
± 2 kV, I/O

*Electrical Slow Transient* (Surges)
EN 61000-4-5
± 2 kV

**Short drops in electrical supply**
EN 61000-4-29
Level 1

**Climatic Immunity**
The transmitters can be installed in different climatic conditions (see p.7) in environments of varying humidity, also in areas of water vapour condensation.

*Environment temperature:*
EN 60068-2-1, EN 60068-2-2,
EN 60068-3-1
hot: T = 55 °C, $R_H$ = max 55 %
cold: T = -25 °C

*Humid Permanent Heat:*
EN 60068-2-78
T=55 °C, $R_H$=93 %, 96 h

*Damp Heat Cycle:*
EN 60068-2-30
(T = 22 ÷ 55 °C, $R_H$ = 80 ÷ 100 %, 24h)x2

**Mechanical Immunity**

*Shocks:*
EN 60068-2-31, Level 2

*Vibrations in a wide band:*
EN 60068-2-64, test Fh, Level 2

## 9. OPERATION

The IP 66 degree of the housing protection for applications with gaseous fuels from 1 and 2 families in accordance with EN 437 Standard is ensured by the transmitter housing design as well as cable entries and plugs with HNBR or NBR seals. When you intend to use own cable inlets and plugs, you should use components dedicated to Ex zones, guaranteeing compliance with the requirements regarding: ambient temperatures, resistance to gaseous fuels, families 1 and 2 and IP degree.

The transmitter gives the possibility of rotating the housing – to do this, loosen the screw (item 1), position the transmitter housing (item 2) as required, tighten the screw (item 1). The transmitter body can be rotated max. by 330°. It is also possible to adjust the position of the display to the mounting position of the body. The module can be rotated ±180° with 90° step. To do this, tighten the cover screw (item 5), unscrew the front cover (item 3) and two display screws (item 6), then use them to pull the module out. Rotate the taken out module and insert it back into the lower housing of the display electronics assembly, then tighten the display screws and cover.

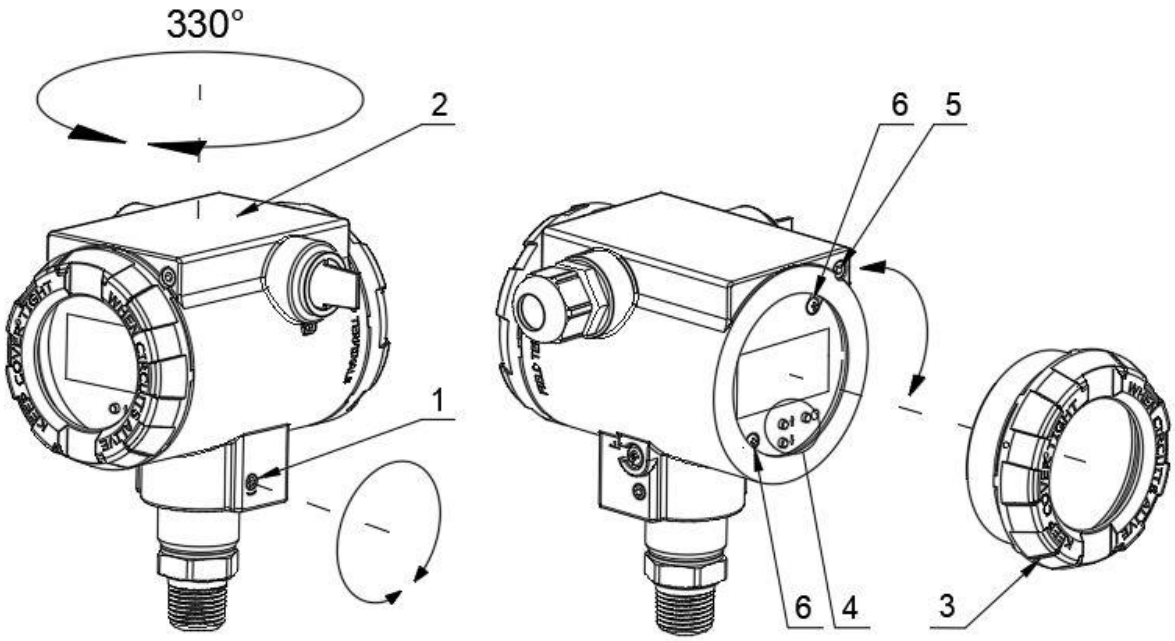



**Figure 9.** Rotation of the housing, change of display position and access to buttons

1. Screw blocking transmitter rotation.
2. Transmitter housing.
3. Front cover.
4. Buttons.
5. Screw blocking front cover unscrewing.
6. Display screws.

In hazardous zone, do not unscrew the housing covers after connecting the Exd flame-proof transmitter to the power source.

## 9.1. Local LCD display

The LCD has three primary information fields identified in the figure below as LCD1, LCD2, LCD3.

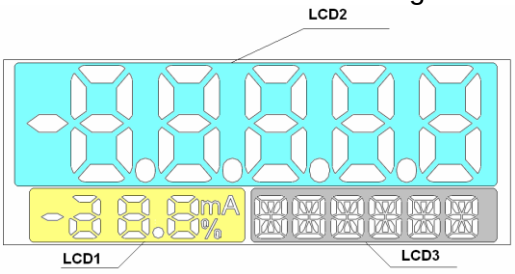



**Figure 10.** Display information fields

**LCD1 field:**
**[mA]** – value (milliamperes) of process current in line 4...20 mA, proportional to the measured pressure.
**[%]** – value (percentage) of the setpoint $\mathrm{U(t)}$ of current controller in current loop 4...20 mA. This value is the ratio of the process current $\mathrm{Ip(t)}$ to the current range width according to the following formula:

$$\%U(t) = \frac{Ip(t) - 4\,[mA]}{16\,[mA]} \cdot 100[\%]$$

**LCD2 field**:
The LCD2 field is used mainly to display floating point decimal values in a unit displayed on LCD3. In some cases, other messages may be displayed:

- **ERROR** in case of some operating errors or failure diagnosed in the transmitter, error/failure number **Exxxx** will appear on LCD2, the **ERROR** message will be displayed on LCD3. The image will blink to attract the operator's attention. The transmitter will set the current output to alarm status.
- **undEr** if the limit below LRV of the set range in MID mode is exceeded by the process, the LCD1 display of transmitter will show the message **undEr** (under). The image will blink to attract the operator's attention. The transmitter will set the current output to alarm status.
- **ouEr** if the limit above URV of the set range in MID mode is exceeded by the process, the LCD1 display of transmitter will show the message **ouEr** (over). The image will blink to draw the operator's attention.
- ● ● ● ● when the set position of comma (point) on LCD2 does not allow for the correct display of the process variable, four dots ● ● ● ● will appear on LCD. The image will blink to attract the operator's attention. In this situation, change the decimal point position in the local setpoint change MENU or via HART communication.

**LCD3 field:**
**Abbreviations of physical units of pressures and levels and their description:**

| | |
|---|---|
| **INH2O** | inches of water column with temperature of 0°C |
| **INHG** | inches of mercury column with temperature of 0°C |
| **FTH2O** | feet of water column with temperature of 20°C (68°F) |
| **MMH2O** | millimeters of water column with temperature of 20°C (68°F) |
| **MMHG** | millimeters of mercury column with temperature of 0°C |
| **PSI** | pounds per square inch |
| **BAR** | bars |
| **MBAR** | millibars |
| **GSQCM** | grams per square centimeter |
| **KGSQCM** | kilograms per square centimeter |
| **PA** | pascals |
| **KPA** | kilopascals |
| **TORR** | torrs |
| **ATM** | atmosphere |
| **MH2O4** | metres of water column with temperature of 4°C |
| **MPA** | megapascals |
| **INH2O4** | inches of water column with temperature of 4°C |
| **MMH2O4** | millimeters of water column with temperature of 4°C |
| **NOUNIT** | the shortcut displayed when a unit not implemented in the transmitter is configured via HART communication |

**Abbreviations of temperature measurement point name:**

**SENS °C** temperature of pressure sensor measurement structure in degrees Celsius.
**CPU °C** temperature of the main CPU structure in degrees Celsius.

## Abbreviations displayed during configuration via local MENU and their descriptions:

| | |
|---|---|
| **<-BACK** | Return to one level above in local MENU. |
| **EXIT** | Going out of the local MENU. |
| **UNIT** | Pressure and level unit selection menu. |
| **SENS_T** | Option of measuring the temperature of pressure sensor measurement structure. |
| **CPU_T** | Option of measuring the main CPU structure temperature. |
| **DAMPIN** | Menu of selecting damping time constant of process variable. |
| **TRANSF** | Menu of selecting the current output linearization function. |
| **%SQRT** | Menu of selecting the deadband percentage of the root characteristics of the current output linearization. |
| **PVZERO** | Pressure transmitter resetting menu and option. |
| **SETURV** | URV setting menu (upper pressure of the set range). |
| **SETLRV** | LRV setting menu (lower pressure of the set range). |
| **BYPRES** | Option of setting the range according to pressure. |
| **BYVALU** | Option of setting the set range by entering a value. |
| **RESET** | Transmitter hot restart software menu. |
| **LCD1VR** | Menu for selection of the type of measurement displayed on LCD1. |
| **LCD2VR** | Menu for selection of the type of measurement displayed on LCD2. |
| **LCD2DP** | Menu for selecting position of comma/decimal point. |
| **FACTOR** | Return to factory values menu. |
| **RECALL** | Option of return to factory settings. Factory pressure calibrations, zero setpoints of pressure and current will be restored. |
| **LINEAR** | Option of linear function of current output setpoint linearization. |
| **SQRT** | Option of root function of current output setpoint linearization. |
| **SPECIA** | Option of the user's special characteristics of current output setpoint linearization. |
| **SQUARE** | Option of square function of current output setpoint linearization. |
| **CURREN** | Option of selecting the display of set current on LCD1. |
| **PERCEN** | Option of selecting the display of set percentage on LCD1. |
| **PRESS** | Option of selecting the display of pressure on LCD2. |
| **USER** | Option of selecting user's units and scaling to be displayed on LCD3. |
| **MID_WP** | MID mode setting menu. In this mode, the option of changing the setpoints related to the transmitter metrology is disabled. Additionally for Exd versions, exceeding of LRV and URV limits results in displaying under or ouer message, blinking of the display and setting of the process output to the current alarm mode I_AL<3,600 ma. For standard or Exi transmitters, the exceeding of LRV and URV limits results in displaying the under or ouer message, blinking of the display and setting of the process output to the current alarm mode depending on the configuration I_AL<3,650 ma or I_AL>21,500 ma. |
| **ON** | MID mode activation option. |
| **OFF** | MID mode deactivation option. |
| **X.XXXX** | Option of selecting position of comma/decimal point. |
| **XX.XXX** | Option of selecting position of comma/decimal point. |
| **XXX.XX** | Option of selecting position of comma/decimal point. |
| **XXXX.X** | Option of selecting position of comma/decimal point. |
| **XXXXX.** | Option of selecting position of comma/decimal point. |
| **0 [S]** | Option of selecting damping time constant. |
| **2 [S]** | Option of selecting damping time constant. |
| **5 [S]** | Option of selecting damping time constant. |
| **10 [S]** | Option of selecting damping time constant. |
| **30 [S]** | Option of selecting damping time constant. |
| **60 [S]** | Option of selecting damping time constant. The 60-second damping constant is only available from the local keypad; the configuration via HART in revision 5 does not allow a damping value greater than 30 seconds. Other damping values are possible to be set via HART communication. |
| **0.0 %** | Option of selecting root characteristics deadband point. |
| **0.2 %** | Option of selecting root characteristics deadband point. |
| **0.4 %** | Option of selecting root characteristics deadband point. |
| **0.6 %** | Option of selecting root characteristics deadband point. |
| **0.8 %** | Option of selecting root characteristics deadband point. |
| **1.0 %** | Option of selecting root characteristics deadband point. |
| | Other deadband values are possible to be set via HART communication. |
| **DONE** | Message about the acceptance and implementation of the set-point change. |

**Abbreviations of local configuration errors and description of abbreviations:**

| | |
|---|---|
| **ER_L07** | Message displayed on LCD3. It is displayed if a user tries to change the setpoint in the transmitter protected against entry (change of setpoints) or in active MID mode. |
| **ER_L09** | Message displayed on LCD3. It is displayed if:<br>– a user tries to change the set range by set pressure which is not within the allowable upper URL pressure.<br>– A user tries to pressure reset when the pressure exceeds the allowable upper limit. |
| **ER_L10** | Message displayed on LCD3. It is displayed if:<br>– a user tries to change the set range by set pressure which is not within the allowable lower LRL pressure.<br>– A user tries to pressure reset when the pressure exceeds the allowable lower limit. |
| **ER_L14** | Message displayed on LCD3. It is displayed if:<br>– the adopted URV value through the set pressure or entry of a value cannot be accepted because it causes a reduction of the set pressure range set below the allowable limit. |
| **ER_L16** | Message displayed on LCD3. It is displayed if:<br>– a user tried to perform an operation that is disabled or unavailable. It may be caused by:<br>– attempting to access the local setpoint change MENU when the access to the local MENU is disabled;<br>– attempting to pressure reset in the absolute pressure measurement transmitter. |
| **WG_L14** | The message will appear if the assumed LRV value through the set pressure or entry of a value causes a decrease of the current set range. Entry of LRV automatically results in the transmitter's attempt to set URV in such a way that the current width of the set range is maintained. If this is not possible due to exceeded URL, the transmitter automatically adopts the URV=URL value and a new LRV value. Since the set range width and URV deviate from previous values, a message is displayed. |

**ASCII characters displayed on LCD3 in user's unit:**

– using HART communication, the user can configure its own 6-character unit displayed on LCD3. It is possible to display ASCII characters from the range (32…96 dec) or (20…60 hex), i.e.:

**!"#$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`**

## 9.2. Local buttons

Local buttons are used to enable the configuration mode of some transmitter parameters and to navigate through MENU and accept MENU options. The MENU can be accessed by pressing and holding any of the buttons for at least 4 seconds. After this time, the LCD3 field of the local display will show an **EXIT** message. This signals entering into the MENU navigation mode.

## 9.3. Local configuration of setpoints

Transmitter enables local configuration of some of the most common setpoints via local buttons and local LCD display.

## 9.4. Navigation in local setpoints MENU

The MENU can be accessed by pressing and holding any of the buttons for at least 4 seconds. After this time, the LCD3 field of the local display will show an **EXIT** message. This signals entering into the local configuration MENU. By pressing the buttons with arrows [↑] [↓] for at least 1 second you can move up or down in MENU.

## 9.5. Acceptance of local setpoints

The button marked with symbol [●] is used to accept the selection. The acceptance of setpoint change is confirmed by a **DONE** message displayed on LCD3. After changing the setpoint, the transmitter leaves the local configuration change MENU. If no selection is made in the MENU mode, after 2 minutes the transmitter automatically returns to display of standard messages. The MENU can also be left by selecting and accepting the **EXIT** option.

## 9.6. Structure of local setpoints MENU

Press and hold any of 3 buttons for 4 seconds.

When navigating in the area of the active local MENU, holding the button required to trigger the action is minimum 1 second. Continuous pressing of the ↑ or ↓ button results in scrolling of the MENU positions every 1 second. If the local MENU remains inactive for more than 2 minutes, after this time the transmitter will automatically leave the MENU mode and will display the process variable.

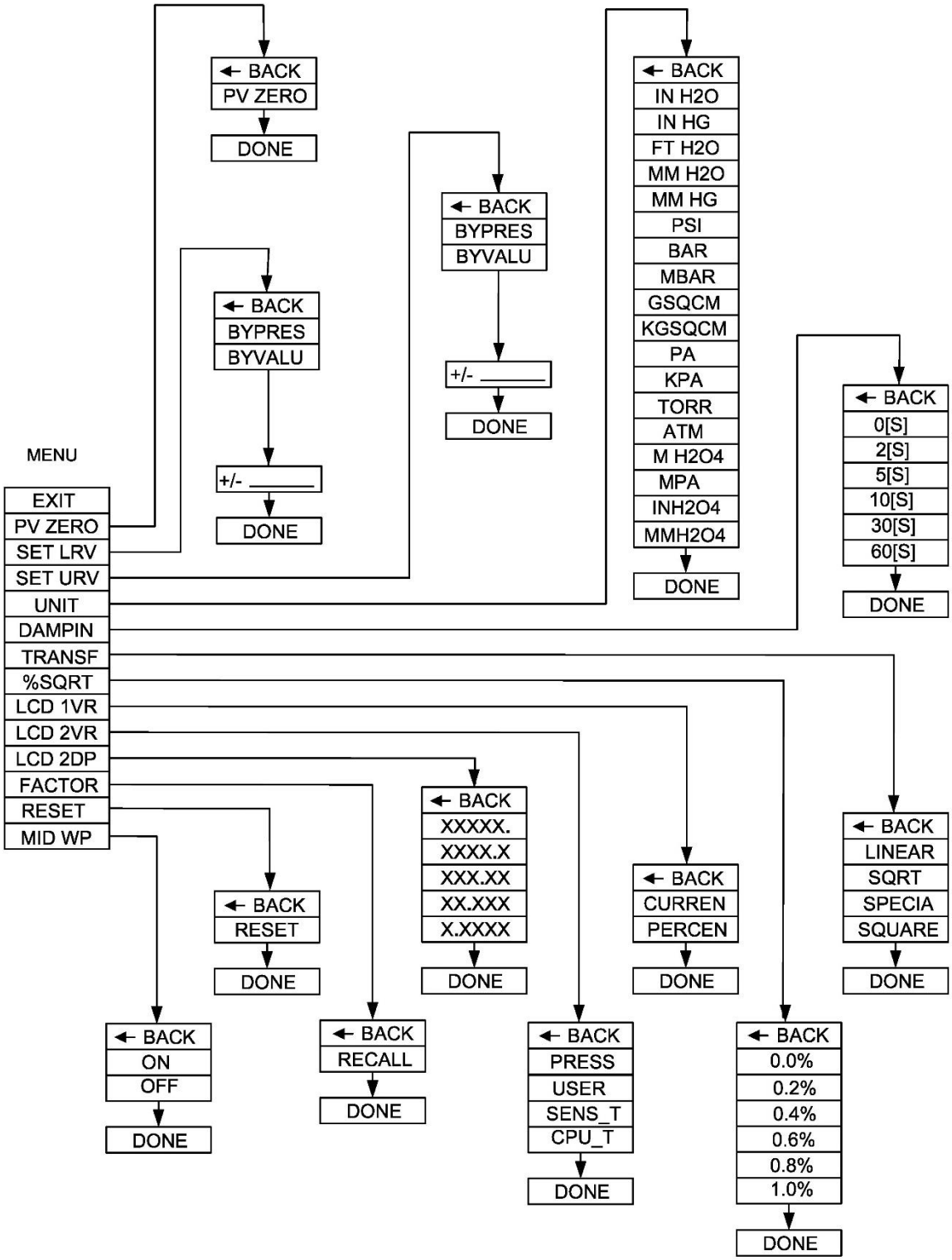



**Figure 11.** Local menu structure of transmitter

### 9.7. Remote configuration of setpoints (HART)

The transmitter allows to read out and configure the parameters via HART communication using 4...20 mA loop as a physical layer for FSK BELL 202 modulation.

#### 9.7.1. Compatible devices

The following devices may be used to communicate with the transmitter:

- Aplisens S.A. KAP-03, KAP-03Ex communicator;
- communicators from other companies, including those using DDL and DTM libraries;
- PC computers equipped with HART modem (e.g. HART/USB converter by Aplisens S.A.) with Windows 7 or Windows 10 operating system with installed Raport 2;
- PC computers equipped with HART modem using software from other companies, accepting DDL and DTM libraries;
- smartphones with Android system, using a converter providing wireless communication (e.g. HART/USB converter by Aplisens S.A.) using Aplisens Mobile Configurator. The software is available on Google Play under the link: https://play.google.com/store/apps/details?id=com.aplisens.mobile.amc.

#### 9.7.2. Compatible configuration software

- Raport 2 Aplisens under control of Windows 7 or Windows 10;
- Aplisens Mobile Configurator under control of the Android system;
- every software from other companies accepting DDL and DTM libraries.

#### 9.7.3. Local HART communication

The transmitter allows to use the local HART communication. To do this you can use a HART communicator unit or modem interoperating with a computer or a smartphone.
In order to establish communication, it is necessary to:

- remove the HART communication jumper (see: ➔ Figure 4. Electrical connection to transmitter, item 2);
- connect the communicator or modem to terminals (➔ 7.1.2. Connection of transmitter with the option of using local HART communication).

## 10. MAINTENANCE

### 10.1. Periodic inspections

Periodic inspections shall be carried out in accordance with applicable standards. During the inspection, the condition of the pressure (absence of loosened elements and leaks) and electrical (check of connections reliability and condition of gaskets and glands) connectors, condition of separating diaphragms (tarnish, corrosion) and stability of fixing of the housing and mounting bracket (if used) shall be checked. Check the processing characteristics by performing the operations specific for the CALIBRATION and possibly CONFIGURATION procedure.

### 10.2. Non-periodic inspections

If the transmitter at the installation site has been exposed to mechanical damage, pressure overload, hydraulic pulses, overvoltage, deposits, medium crystallization, undercutting of the diaphragm, or incorrect operation of the transmitter is detected, the device should be inspected. Check the condition of the diaphragm, clean it, check the electrical functionality of the transmitter and the processing characteristics.

If there is no signal in the transmission line or its value is improper, check the supply line, connection status on terminal blocks, connectors, etc. Check if the supply voltage and load resistance are correct.

### 10.3. Cleaning/washing

To remove impurities from the external surfaces of the transmitter wipe it with a cloth dampened in water.

#### 10.3.1. Diaphragm cleaning

The only possible method of cleaning the transmitter diaphragms is to dissolve the sludge produced.

Do not remove deposits and impurities from the transmitter diaphragms, which are formed during operation, mechanically using tools, since the diaphragms and the transmitter can be damaged.

### 10.4. Spare parts

Parts of the transmitter that may be worn or damaged and thus replaced: cover seals.

**Other parts in the case of ATEX, PED type of transmitter may be replaced only by the manufacturer or an authorized representative.**

### 10.5. Repair

Faulty or non-operational transmitter shall be provided to the manufacturer.

### 10.6. Returns

In the following cases, the transmitter should be returned directly to the manufacturer:

- need for repair;
- need for factory calibration;
- replacement of improperly selected/shipped transmitter.

## 11. EXPLOSIONPROOF PARAMETERS

### 11.1. Transmitters with Exd protection

Transmitters are made in accordance with the requirements of the following standards:
EN IEC 60079-0-2018-09, EN 60079-1:2014-12, EN 60079-11:2012, EN 60079-31:2014-10, EN 60079-26:2015-04.

### 11.2. Transmitter explosion-proof marking

Transmitters can operate in potentially explosive areas, in accordance with the assigned marking (feature) of explosion-proof construction:

**II 1/2 G Ex ia/db IIC T6/T5 Ga/Gb**
**KDB 08 ATEX 224X**

The T6 notations refer to -25 °C < Ta < 45 °C temperature range
The T5 notations refer to -25 °C < Ta < 55 °C temperature range

### 11.3. Category transmitter and hazard zones

1/2G transmitter category means that transmitter can be installed in 1 or 2 hazard zone and the transmitter process connection can be connecting to 0 zone. Example on the figure 12.

### 11.4. Power and operation

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.

Transmitters should be supplied from DC electrical source with voltage max.55 V DC (nominal 24 V DC) 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 250 V AC. The duty of power supply installation with above mentioned requirements rests on user.

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

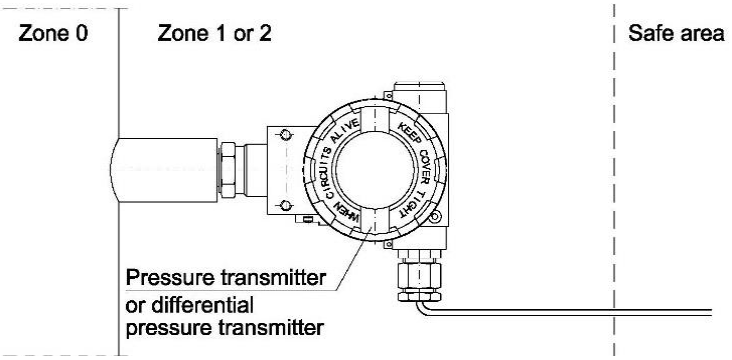



**Figure 12.** Mounting transmitter in zones

## 11.5. List of cable glands and plug replacements

As standard, the transmitters in Exd version are delivered without a cable glands, with blanking plugs approved by the certification process. Used cable glands and blanking plugs must comply with the transmitter documentation approved by the validation process.
The installer is responsible for installing the cable glands and blanking plugs in accordance with the transmitter documentation. The list of cable entries and plugs are given in the tables below.

**Table 4.** List of cable glands

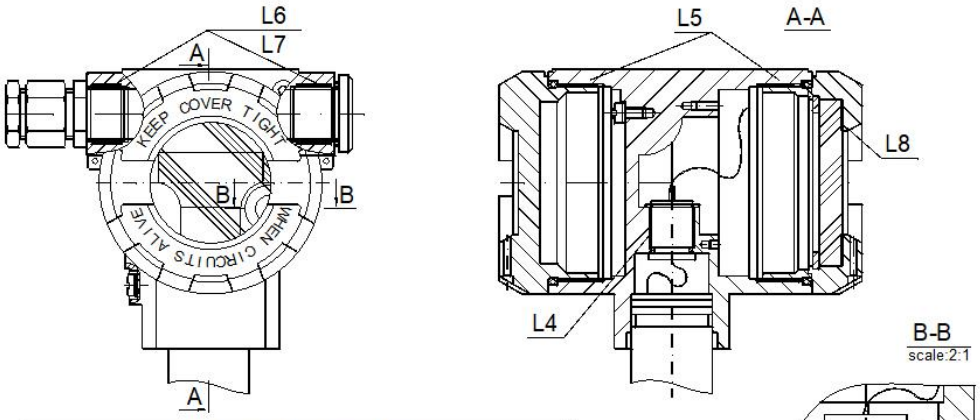
| Type | Producer | Screw | Feature | IP | Certificate No. |
|---|---|---|---|---|---|
| 501/423 | Hawke International | M20x1.5 (1/2" NPT) | Exd IIC Gb Extb IIIC Db | 67 | CML 19ATEX1167X |
| 501/421 | Hawke International | M20x1.5 (1/2" NPT) | Exd IIC Gb Extb IIIC Db | 67 | CML 19ATEX1167X |
| ICG 623 | Hawke International | M20x1.5 (1/2" NPT) | Exd IIC Gb Extb IIIC Db | 67 | Baseefa 06ATEX0058X |
| 501/453/RAC | Hawke International | M20x1.5 (1/2" NPT) | Exd IIC Gb Extb IIIC Db | 67 | CML 19ATEX1167X |
| 501/453/Universal | Hawke International | M20x1.5 (1/2" NPT) | Exd IIC Gb Extb IIIC Db | 67 | CML 18ATEX1268X |
| ICG/653/Universal | Hawke International | M20x1.5 (1/2" NPT) | Exdb IIC Gb Extb IIIC Db | 67 | CML 18ATEX1268X |
| ICG/653/Universal/L | Hawke International | M20x1.5 (1/2" NPT) | Exd IIC Gb Extb IIIC Db | 67 | CML 18ATEX1268X |
| 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 Exd I Mb | 67 | CML 18ATEX1324X |
| PX2K, PXSS2K, PX2KX | CMP-Products | M20x1.5 (1/2" NPT) | Exdb IIC Gb Exta IIIC Da Exdb I Mb | 67 | CML18ATEX1325X |

**Table 5.** List of blank plug replacements

| Blanking plug type | Producer | Screw | Feature | IP | Certyfikate No. |
|---|---|---|---|---|---|
| 475 | Hawke International | M20x1.5 (1/2" NPT) | Exd IIC Gb Extb IIIC Da Exd I Mb | 67 | Baseefa 10ATEX0262X |
| 477 | Hawke International | M20x1.5 (1/2" NPT) | Exd IIC Gb Extb IIIC Da Exd I Mb | 67 | Baseefa 10ATEX0262X |
| 747, 757, 767 | CMP-Products | M20x1.5 (1/2" NPT) | Exd IIC Gb Exta IIIC Da Exd I Mb | 67 | CML 18ATEX1320X |

During the installation, the M20x1.5 thread of cable glands, should be sealed with LOCTITE243 adhesive. For cable glands with ½ "NPT tread the LOCTITE 577 or SWAK MS-PTS-50 sealant should be used.
Special conditions of use:

- only specified parts in the approved documentation may be used as replacements for the housing;
- some clearances of the flameproof joints are smaller, and the lengths are longer than required in Table 3, EN 600793-13; see figure below.




EXPLOSIONPROOF ROADS FOR GROUP IIC.

| N° | Minimum length of slot L mm | diameter D mm | diameter d mm | D-d mm | quantity of joint | minimum according to EN 60079-1 |
|---|---|---|---|---|---|---|
| L4 | 13,2 | ⌀15$^{+0,027}$ | ⌀15$^{-0,040}_{-0,070}$ | 0,097 | 2 | length of slot 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 length of joint min.10 |

**Figure 13.** Flameproof joints

## 11.6. Transmitters with Exi protection

Transmitters are made in accordance with the requirements of the following standards:
EN IEC 60079-0: 2018, EN 60079-11: 2012, EN 50303: 2000.

## 11.7. Transmitter explosion-proof marking

Transmitters can work in potentially explosive atmospheres in accordance with the marking of the type of explosion-proof structure:

**II 1/2G Ex ia IIC T4/T5 Ga/Gb**
**FTZÚ 08 ATEX0020X**

## 11.8. Transmitter category and hazard zones

The 1/2G transmitter category in the marking indicates that transmitter can be installed in the 1 or 2 hazard zone. Transmitter process connections can be connect to 0 zone. Example on the figure 12.

## 11.9. Ui, Ii, Pi supply parameters and temperature classes

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

Supply with linear output characteristics:

| | | | |
|---|---|---|---|
| Ui = 28 V | Ii = 0,1 A | Pi = 0,7 W | -25 °C ≤ Ta ≤ 55 °C & T5 |
| Ui = 30 V | Ii = 0,1 A | Pi = 0,75 W | -25 °C ≤ Ta ≤ 80 °C & T5 |

An example of a supply with a linear characteristic is a typical barrier with parameters:
Uo = 28 V Io = 0.093 A Rw = 300 Ω.

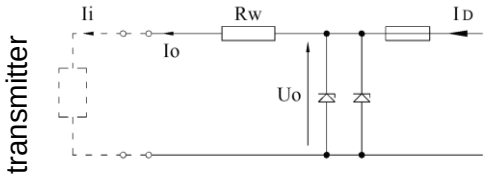



**Figure 14.** The principle of feeding from a source with a linear characteristic

Supply with a trapezoidal output characteristics:

| | | | |
|---|---|---|---|
| Ui = 24V | Ii = 50 mA | Pi = 0,7W | -25 °C ≤ Ta ≤ 80 °C & T5 |

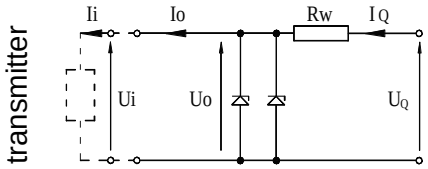



**Figure 15.** The principle of feeding from a source with a trapezoidal characteristic

If $U_O > 0{,}5U_Q$, then $U_Q$, $I_O$, $P_O$ have the following relations:

$$P_O = \frac{U_Q \cdot I_O}{4}$$

If $U_O \leq 0{,}5U_Q$, then $U_Q$, $I_O$, $P_O$ have the following relations:

$$P_O = \frac{U_O(U_Q - U_O)}{R_W}$$

Resistance $R_W$:

$$R_W = \frac{U_Q}{I_O}$$

For power supply with a rectangular output characteristic:

| | | | |
|---|---|---|---|
| Ui = 24 V | Ii = 25 mA | Pi = 0,6 W | -25 °C ≤ Ta ≤ 55 °C i T5 |
| Ui = 24 V | Ii = 50 mA | Pi = 1,2 W | -25 °C ≤ Ta ≤ 55 °C i T4 |

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 a such supply is also, an Ex device, with “ib” protection level.

Example of practical provision of power supply:
stabilized power supply with Uo = 24 V, protection level "ib", and current limited to Io = 25 mA.

### 11.10. Ci, Li parameters and operating temperature range

Input inductance and capacity:

Ci = 30 nF, Li = 0,75 mH

Transmitters operating temperature range:

-25 °C ≤ Ta ≤ 55 °C

## 12. SCRAPPING, DISPOSAL

Worn or damaged devices shall be scrapped in accordance with WEEE Directive (2012/19/EU) on waste electrical and electronic equipment or returned to the manufacturer.

## 13. HISTORY OF REVISIONS

| Revision No. | Document revision | Description of changes |
|---|---|---|
| - | 01.A.001/2022.10 | Initial document version. Prepared by DBFD. |
| 1 | 01.A.002/2022.11 | Addition of the measuring range. Prepared by DBFD. |