



IO-APIS-...-IHX-...(ENG)

APLISENS

MANUFACTURER OF INDUSTRIAL MEASURING
INSTRUMENTATION AND CONTROL ELEMENTS

USER'S MANUAL

ELECTROPNEUMATIC POSITIONER
Type APIS

WARSAW FEBRUARY 2018

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Marking used

Symbol	Description
	Warning to strictly follow information included in the documentation to ensure safety and functionality of the device.
	Information particularly useful during assembly and operation of the device.
	Information particularly useful during assembly and operation of the Ex device.
	Information on procedures for used equipment

BASIC REQUIREMENTS AND OPERATIONAL SAFETY



- **The manufacturer shall not be liable for damages resulting from the incorrect installation, not maintaining in adequate condition and misuse of the positioner.**
- Assembly works and start-up should be carried out only by the qualified fitters, control engineers or trained personnel under their supervision, in accordance with applicable regulations and recommendations within the scope of control of electrical engineering.
- Incorrect installation or configuration may cause incorrect operation, leading to damage of the equipment or to an accident.
- All safety and protection requirements should be taken into consideration during installation, operation, inspections.
- The device should be disconnected in case of inoperability and sent to the manufacturer or authorized centre for repair.



Systems for intrinsically safe executions should be made with a due care and with strict observations of the standards and regulations applicable for these types of the system.

Amendments introduced in the product manufacturing documentation may be ahead of the user's paper documentation - valid user's manuals are available on the website of the manufacturer:
www.aplisens.pl

ELECTROPNEUMATIC POSITIONER

TYPE APIS-...-REx-...-IHX-...



INTRINSICALLY SAFE VERSION

1. Introduction

1.1. This “annex Exi” applies only to the intrinsically safe version of the APIS positioners with marking on the rating plates as in point 3 of the annex and information on the Ex version in the “Product certificate”.

1.2. The above-mentioned annex contains supplementary information connected with the intrinsically safe version of the positioners.

During installation and use of the positioners in the Ex version you should use **IO – APIS-...-IHX-... with the “Annex Exi”**.

2. Use of the positioners listed in point 1 in hazardous areas

2.1. The above-mentioned positioners are executed in accordance with the requirements of the standards: EN 60079-0:2012 + A11:2013, EN 60079-11:2012

2.2. The positioner can be operated in hazardous areas in accordance with the marking of explosion-proof design:



II 2G Ex ia IIC T6/T5 Gb

KDB 17 ATEX 0035

2.3. Category of the positioner and hazardous area

Category included in the marking of the 2G positioner informs that the positioner can be installed in hazardous area 1.

3. Identification marking

The intrinsically safe APIS positioner is equipped with two plates:

- a) rating plate, with information provided in point 4. IO – APIS-...-IHX-....
- b) with additional plate with the following data:
 - type of the positioner and company logo
 - CE mark and notified body number sign, mark 
 - marking of explosion-proof marking and certificate marking
 - parameters U_i, I_i, C_i, L_i, P_i
 - operating temperatures

4. Completeness of the delivery

Recipients receives the positioners in Ex version in unit package and/or bulk shipping box with documents in accordance with point 2 of the IO – APIS-...-IHX-... user's manual. Furthermore, the recipient may obtain a copy of the certificate on request (available also on the website www.aplisens.pl).

5. Allowable input and output parameters (based on the data from the annexes to KDB 17 ATEX 0035 certificate and certification documentation)

The positioners should be supplied from associated supply and measuring equipment having appropriate certificates of intrinsic safety, which parameters of outputs to hazardous areas should not exceed allowable supply parameters for the positioners as given below:

5.1. Input system, terminals 1, 2 and output system, terminals 7, 8.

a) for supply from a source with linear characteristics

$U_i=30\text{ VDC}$, $I_i=0.13\text{ A}$, $P_i=1\text{ W}$ for T5,

$U_i=30\text{ VDC}$, $I_i=0.1\text{ A}$, $P_i=0.75\text{ W}$ for T6,

- $40^\circ\text{C} \leq T_a \leq 45^\circ\text{C}$ for T6

- $40^\circ\text{C} \leq T_a \leq 80^\circ\text{C}$ for T5

b) for supply from a source with rectangular characteristics

$U_i=24\text{ VDC}$, $I_i=0.05\text{ A}$, $P_i=1.2\text{ W}$ for T5,

$U_i=24\text{ VDC}$, $I_i=0.025\text{ A}$, $P_i=0.6\text{ W}$ for T6,'

- $40^\circ\text{C} \leq T_a \leq 45^\circ\text{C}$ for T6

- $40^\circ\text{C} \leq T_a \leq 80^\circ\text{C}$ for T5

c) for supply from a source with trapezoidal characteristics

$U_i=24\text{ VDC}$, $I_i=0.1\text{ A}$, $P_i=1.2\text{ W}$, $U_o=48\text{ VDC}$ for T5

$U_i=24\text{ VDC}$, $I_i=0.05\text{ A}$, $P_i=0.6\text{ W}$, $U_o=48\text{ VDC}$ for T6

$C_i=11\text{ nF}$, $L_i=0.205\text{ mH}$

- $40^\circ\text{C} \leq T_a \leq 45^\circ\text{C}$ for T6

- $40^\circ\text{C} \leq T_a \leq 80^\circ\text{C}$ for T5

5.2. Input parameters for external position encoder, terminals 3, 4, 5

$U_o=6\text{ VDC}$, $I_o=75\text{ mA}$, $C_o=2.5\text{ uF}$

6. Connection method for the electrical APIS positioners in Ex version.

Connections of the positioner and equipment in the measuring loop of the positioner should be executed in accordance with standards applicable for intrinsic safety and explosion-proofness and conditions of use in the hazardous areas. Failure to follow the intrinsic safety rules can cause an explosion and risk to humans.

Connection methods for input and output circuit and displacement transducer are presented in point 11.4.



No repairs or other interventions in the electrical system of the positioner are allowed.

Assessment of damage and possible repair should be carried out only by the manufacturer or a company authorized by this manufacturer.

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1. INTRODUCTION

This user's manual is a document intended for users of the electropneumatic positioners, type APIS, containing technical data and guidelines necessary to familiarize with principles of operation and method of setting of the positioners. It includes also necessary guidelines concerning the installation and operation as well as procedures in case of a fault.

2. COMPLETENESS OF THE DELIVERY

Recipients receives the positioners in unit packages and/or bulk shipping boxes.

Together with the positioner the user will obtain:

- a) "Product certificate", which is used also as a warranty card,
- b) User's manual marked IO-APIS-...-IHX-...,
- c) Declaration of conformity - on request
- d) Blanking plug 1 piece

Items b), c) are also available on the website www.aplisens.pl

3. INTENDED USE

The APIS positioner is a final control element intended for control valves.

It is intended for cooperation with pneumatic membrane and piston single and double-acting actuators with linear and rotational movement. It allows quick and precise controlling of displacement of actuator piston rod using analog or digital control signal.

The positioner is controlled by a standard signal from two-wire 4..20 mA current loop or digitally in accordance with the HART 6 specification. It can be also equipped with a two-wire, current (4..20 mA) position transmitter of piston rod of the associated actuator. Current circuit of position transmitter is galvanically isolated from the input circuit of the control signal.

The positioner can cooperate both with straight and reverse acting pneumatic actuators.

The positioner can cooperate with single-acting actuators manufactured by Polna S.A., Samson, Arca Regler, Spiral-Sarco and double-acting actuators manufactured by Prema Kielce, Air Torque, Festo, Ebro Armaturen, El-O-Matic and by other manufacturers using proper mechanical coupling components.

Electronic module of the positioner allows the user to set the parameters. These parameters include among others:

- value of proportional gain,
- integral action time,
- derivative action time of internal
- limits for movement speed of actuator piston rod

4. IDENTIFICATION MARKING

Each positioner is equipped with the rating plate with the following information: CE mark, name of the manufacturer, type marking of the positioner, serial number, supply pressure, input signal, output signal, type of actuator/stroke and year of manufacture. Information on the Ex marking are additionally given for the intrinsically safe version. See the Annex ExI for the detailed identification marking.

Ordering code and types of execution acc. to point 5.3.

5. TECHNICAL DESCRIPTION

5.1. Principle of operation

The positioner is built around 16-bit microcontroller. It performs appropriate of measurements and determines value of set-point **SP** and process value **PV**.

The difference of **SP** and **PV** values is converted in accordance with the control algorithm to a control signal (Fig. 1). This signal is converted in the electropneumatic converter to the pneumatic output signal, which is measured by an optional pressure sensor. The pneumatic signal is fed to the actuator chamber causing the actuator movement in such a direction that the difference between the **SP** and **PV** values decreases.

Positioner is supplied from a standard 4...20mA current loop. For versions with optional analog position transmitter it is required to use the additional external source of supply voltage 11...36 VDC.

HART communication may require the serial connection of resistor with $250 \Omega \leq R \leq 500 \Omega$ in the line of control signal.

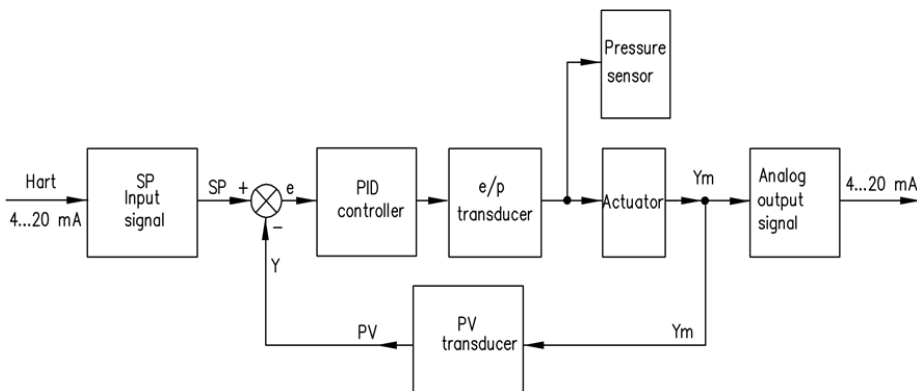


Fig. 1. Block diagram of the positioner control system

5.2. Design

APIS electropneumatic positioner consists of the following components (see Fig. 2a and 2b):

- electronic unit,
- electropneumatic transducer or transducers,
- internal or external displacement transducer for piston rod movement,
- pressure sensor (option),
- housing body*,
- cover*,
- pneumatic connections*,
- mechanical coupling unit*,
- pressure gauges.

(* units not presented in Fig. 2a and 2b)

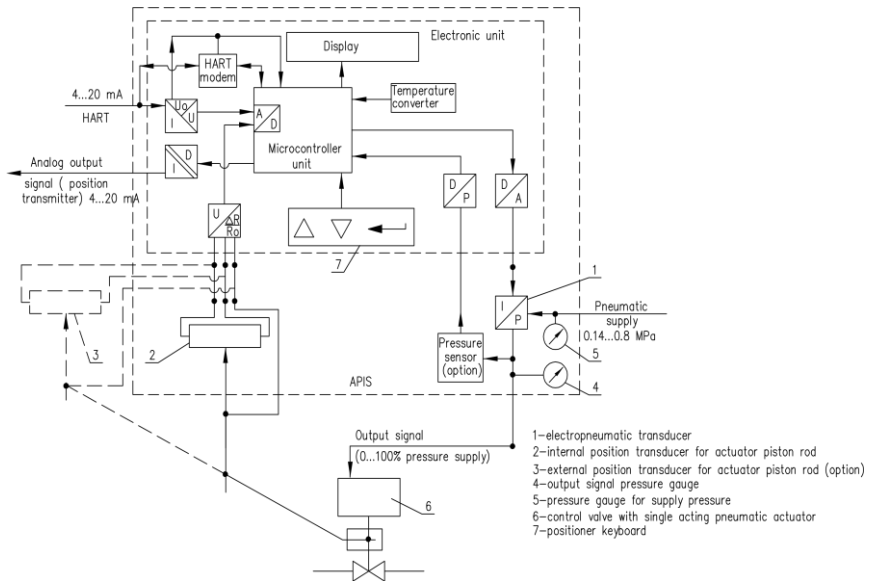


Fig. 2a. Block diagram of the APIS positioner for single-acting actuator

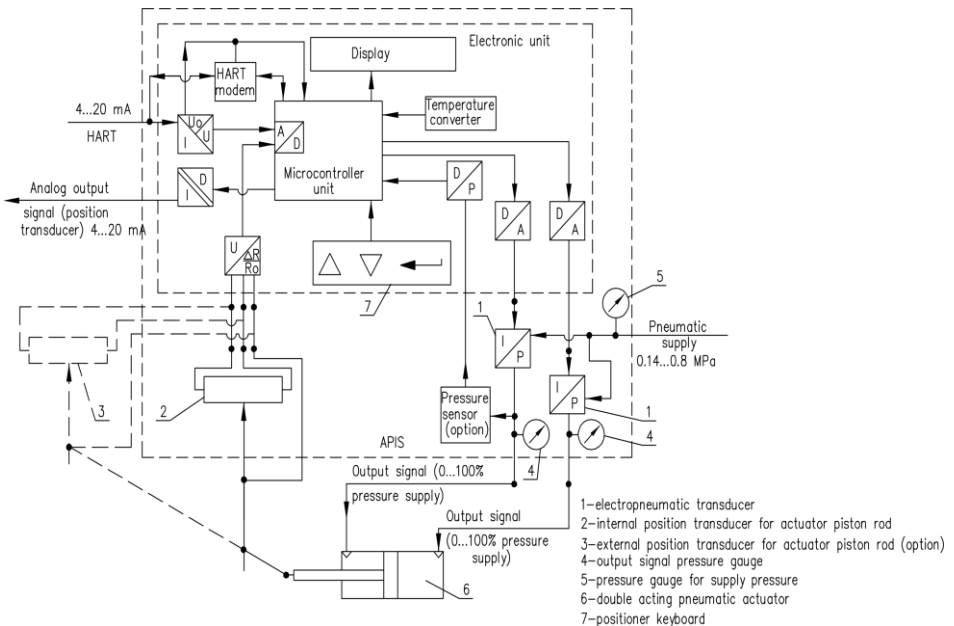


Fig. 2b. Block diagram of the APIS positioner for double-acting actuator

The electronic unit consists of:

- microcontroller,
- keyboard,
- converters: analog to digital and digital – to - analog,
- voltage-current transformer
- pressure-digital transducer,
- liquid crystal display,
- temperature transmitter,
- HART modem,
- electrical connectors.

The above-mentioned units are placed on the printed board covered with a layer of silicone and insulating varnish. The electronic unit is connected with electrical conductors with electropneumatic transducer (transducers) and a pressure sensor.

The electropneumatic converter (transducers) and pressure sensor are screwed to the body of positioner's housing. The housing body is closed with a tight cover from the side of the keyboard and electrical connectors. For APIS-XX1-..., APIS-XX2-, APIS-XX3-..., APIS-XX4-.. the displacement transducer is installed outside the housing of the positioner. The positioner housing consisting of the body and cover has an ingress protection against environmental ingress IP65, which means that it is dust-tight and splash-proof.

Glands, pneumatic connectors and pressure gauges are screwed into the housing body.

On request the positioner can be equipped with a mounting kit allowing installing it to any type of the actuator.

5.3. Dimensions of the positioner and types of executions

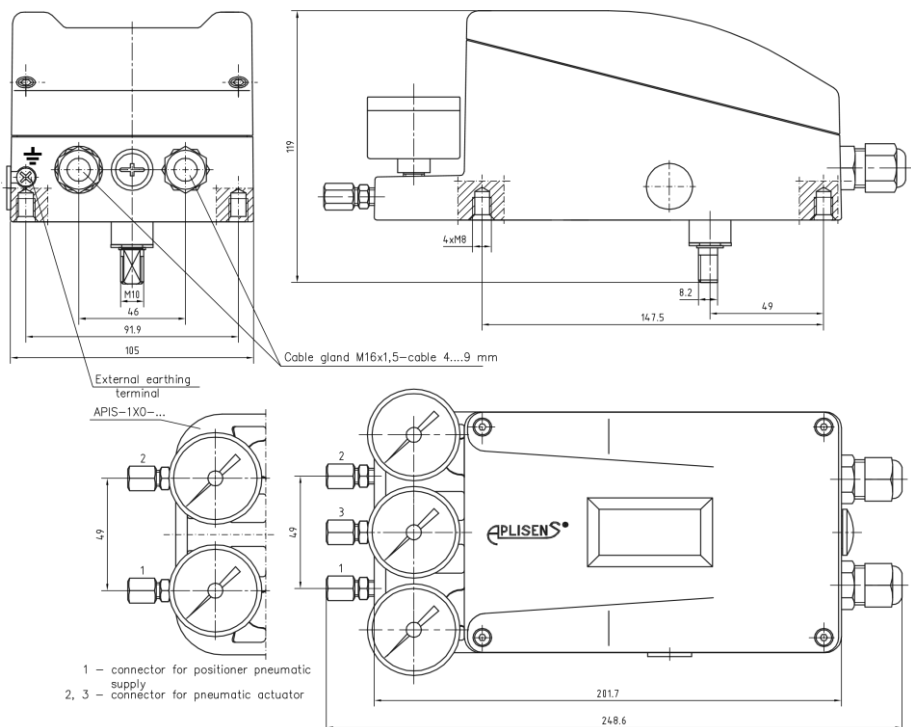


Fig.3. Dimensions of the API-XX0-... positioner

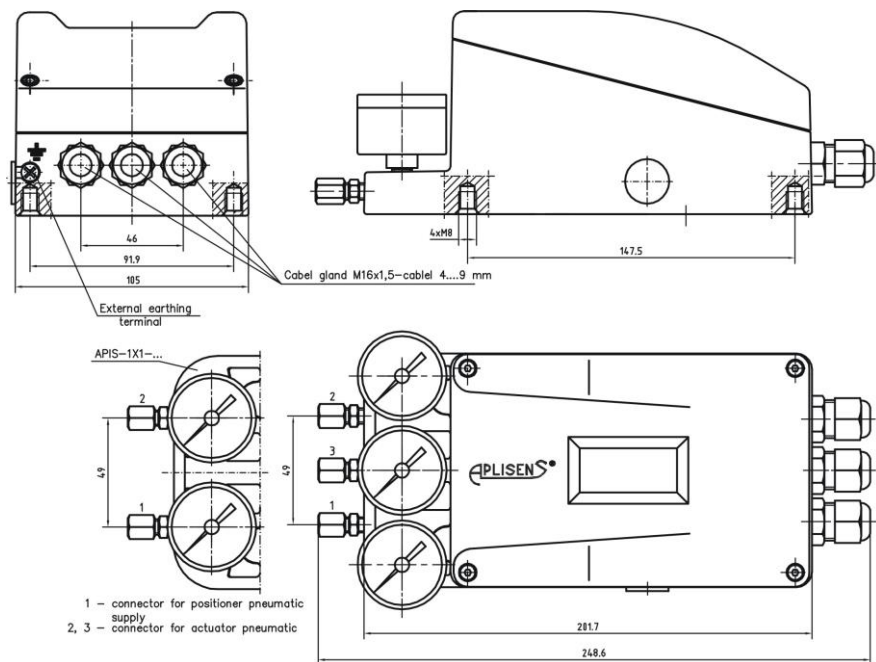


Fig.4. Dimensions of the APIS-XX1-..., APIS-XX2-..., APIS-XX3-..., APIS-XX4-... positioner

Ordering code for the APIS positioner

APIS - X X X - DXX-RXX - IXX-TXX - PX - MX - WX - AX

Intended for:

- single-acting actuator1
- double-acting actuator2
- installation on actuator with internal potentiometer position encoder0
- installation outside the actuator with:
 - * external potentiometer converter position IP541⁵⁾
 - * external potentiometer converter position IP672⁵⁾
 - * external contact-free position position IP673⁴⁾⁵⁾
 - * external potentiometer converter position IP654¹⁾

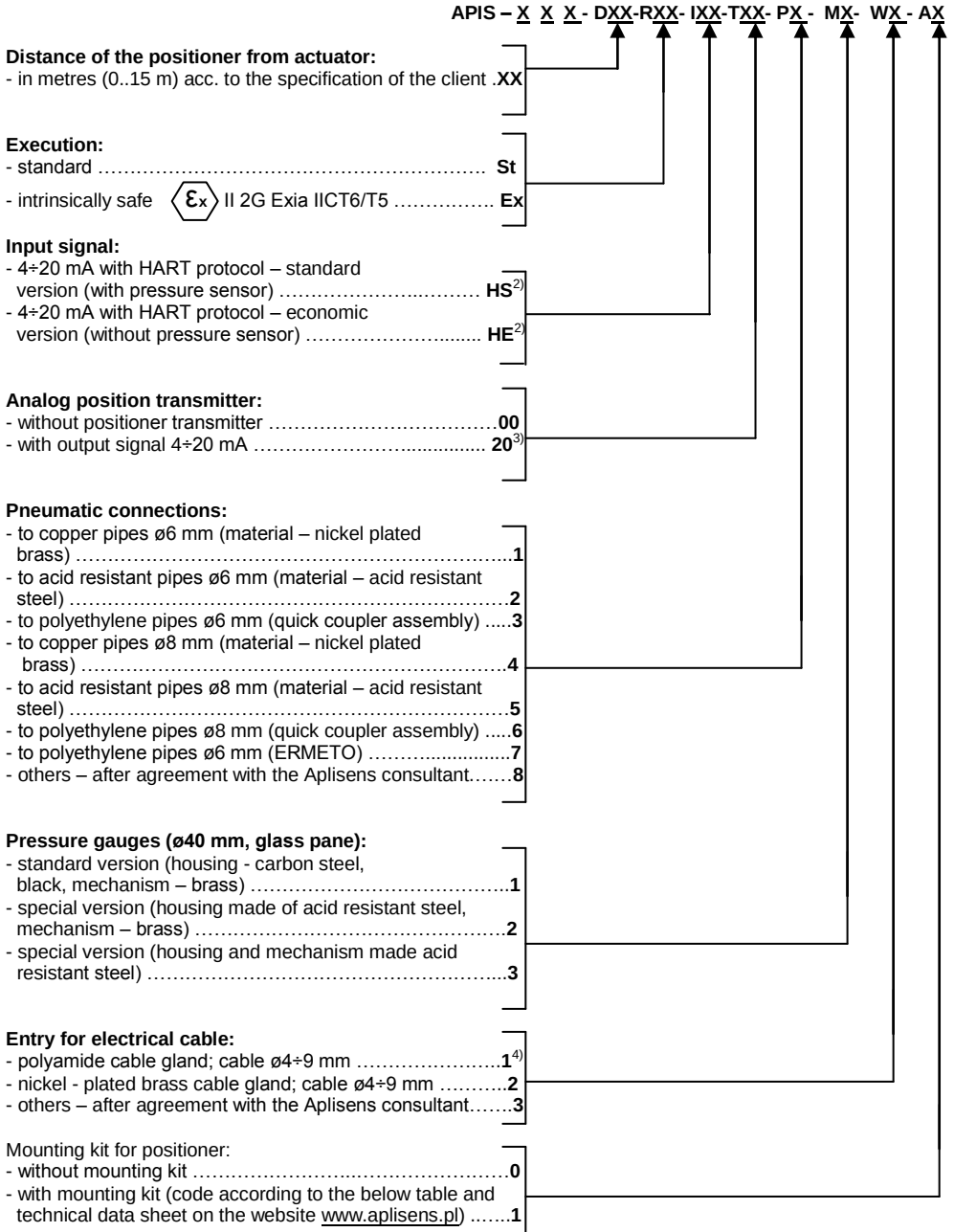


Table 1. List of mounting kits

Mounting kit APIS-A000	For positioners APIS -1X0	For installation on column cylinder type P or R manufactured by Polna S.A.
Mounting kit APIS-A001		For installation on yoke actuator type 37 or 38 manufactured by Polna S.A.
Mounting kit APIS-A002		For installation on multi-spring cylinder type P1 or R1 manufactured by Polna S.A.
Mounting kit APIS-A003		For installation on actuator with control valve equipped with a rib - according to N-EN 60534-6-1; 2001 e.g. on actuator manufactured by Samson or Arca Regler
Mounting kit APIS-A05X	For positioners APIS -1X0-... and APIS – 2X0 -...	For installation on the actuator in accordance with EN ISO 5211, DIN 3337, VDI/VDE 38450 Namur e.g.: on the actuator manufactured by Air Torque, Ebro Armature, El-O-Matic
Mounting kit APIS-AXXX	For positioners APIS -2X1-... APIS – 2X2 -..., APIS-2X3-...	For installation outside the double-acting actuator with linear movement e.g.: CNOMO series or conforming ISO 6431 manufactured by PREMA KIELCE Samson, El-O-Matic, Ebro Armature,

- 1) Applies only to versions for diaphragm single-acting actuators with linear movement and single and double-acting actuators with rotational movement.
- 2) The positioner can set reverse of analogue input signal (20÷4 mA). The reverse function of the input signal is switched on programmatically by the user.
- 3) The positioner can set reverse of analogue output signal (20÷4 mA). The reverse function of the output signal is switched on programmatically by the user.
- 4) Not available for versions with "Ex" code.
- 5) Applies only to versions intended for double-acting actuators with linear movement.

EXAMPLE OF AN ORDER

Electropneumatic positioner adapted for installation on single-acting actuator with linear movement, in standard version, with analog input signal 4÷20 mA and HART protocol, with position transmitter (4÷20 mA), with connections to copper pipes Ø8 mm (material: nickel-plated brass), with pressure gauges in standard version, with polyamide cable glands for electric cable with diameter 4÷9 mm, with a kit allowing assembling of the positioner on the actuator.

APIS-1X0-D00-RSt-IHE-T20-P4-M1-W1-A1

Mounting kit (for installation of the positioner on actuator type 37 or 38 manufactured by Polna S.A) – **APIS-A001**

6. TECHNICAL DATA

Input (control) signal (current)	analog 4÷20 mA in two - wire with HART protocol
Minimum input voltage at 20 mA	9.5 V (475 Ω)
Maximum duration of supply dip	20ms
	Ex (for intrinsically safe versions the input signal should conform the requirements acc. to the annex Exi, point 5.1)
Output signal (position transmitter)	analog 4÷20mA two - wires
Supply for position transmitter	11÷36VDC – applies to standard versions (for intrinsically safe versions acc. to the annex Exi, point 5.1)

Supply pressure	140÷800 kPa
Pneumatic output signal (controlling the actuator)	0÷100% of supply pressure
Own self consumption of air	≤ 0.035 kg/h at supply pressure 140 kPa ≤ 0.015 kg/h for supply pressure 800 kPa ≥ 3.25 kg/h at supply pressure 140 kPa ≥ 13kg/h at supply pressure 800 kPa
Air mass stream on positioner output	10÷100 mm (for single-acting actuators with linear movement) 80÷600 mm (standard version for double-acting actuators with linear movement)
Range of displacement of actuator piston rod	0÷180° (for actuators with rotational movement) linear
Operation characteristics of the actuator	normal or reverse
Positioner operating mode	normal or reverse
Mode of position transmitter	
Additional errors	
- caused by change of supply pressure	<0.05%/100kPa
- caused by change of ambient temperature	0.1%/10°C – for temperature range -30°C...+60°C 0.1%/10°C – for temperature range -40°C ÷ -30°C and +60°C...+85°C
- from vibrations in the range:	
10...60Hz, amplitude < 0.35 mm	0.25%
60...500Hz, acceleration 5g	<0.4%
Hysteresis	<0.1%
Insensitiveness threshold	IP 65 acc. to EN 60529:2003
Ingress protection of positioner enclosure	any
Working position:	1.8 kg
Mass	

7. OPERATING CONDITIONS

Positioner type APIS is intended for operation in the following conditions:

- working medium: air without dust, oil, water, contaminations aggressive agents, solids larger than 1.5 µm, relative humidity ensuring that dew point temperature is not lower than 10 °C from the ambient temperature (acc. to EN 60654-2:1999)
- ambient temperature:
 - versions with pressure gauges made of acid resistant steel: -40°C ÷ +85°C
 - versions with pressure gauges made of carbon and acid resistant steel: -25°C ÷ +60°C
- ambient air humidity <95%
- allowable vibrations acc. to EN 60654-3: 2000; class VH6
amplitude < 0.35 mm
acceleration ≤ 5g
- working position: any

8. TRANSPORT GUIDELINES

The positioner together with equipment listed in the second chapter and the mounting kit with parts specified by the employer wrapped with a bubble wrap is placed in a cardboard box used as a unit package for the product. Free space inside the box is filled with bubble wrap, which protects the positioner against the movement inside it.

During the transport, the positioners in the above-mentioned package are placed in the bulk shipping box protecting against damages and weather conditions. Ambient temperature should not exceed $-40 \div +85^{\circ}\text{C}$ during transport.

The positioner in the shipping packaging (bulk shipping box) should be protected against direct impact of precipitation.

9. INSTRUCTIONS FOR UNPACKING AND STORAGE

The recipient should check the condition of shipping packaging after receiving the consignment. Then the devices in unit packages should be taken out, unpacked and visually inspected with respect to damages. Devices should be stored in unit packages in closed rooms. Air in storage place should not contain admixtures of aggressive vapors and gases.

10. ASSEMBLY MANUAL

10.1. General recommendations

Prior to installation of the positioner on actuator it is necessary to:

- keep positioners in open packaging until their temperature is equal to the room temperature, where they are to be installed.
- check whether the intended use of the positioner and enclosed mounting kit are suitable for the actuator on which it should be installed (see technical data sheet of mounting kit of the positioner and plate on the packaging of enclosed mounting kit).

10.2. Assembly of the positioner on actuator 37 and 38 manufactured by Polna S.A. – version APIS-A1X0-... with mounting kit APIS-A001 or P1 and R1 manufactured by Polna S.A. – version APIS-1X0-... with mounting kit APIS-A002

The positioner should be installed on actuator as follows:

- a) Remove the positioner from the packaging.
- b) Install the ball-and-socket joint on setting lever of the positioner in place corresponding to stroke of the actuator and tighten M5 nut (see Fig. 5 and 6)
- c) Place the coil spring lock washer and flat washer on two M8 screws (part of mounting parts).
- d) Screw in two screws, mentioned in the point c, to body of the actuator.
- e) Insert positioner's mounting bracket between actuator body and washers located on the M8 screws (bracket has a special recess for this purpose).
- f) Lightly tighten the positioner mounting bracket to actuator.
- g) Screw the clamping ring I and III to the actuator spindle using two M6 screws.
- h) Install the M8 nut and flat and coil spring lock washer on extension arm set.
- i) Screw extension arm set into clamping ring III; then adjust its length and move whole positioner in relation to the positioner using longitudinal cut-out for fixing screws in a mounting bracket to ensure that lever set (installed later) is parallel to actuator piston rod. If the extension arm is too long it should be cut to the required length (see Fig. 5 and 6).
- j) Install the M5 nut on spindle assembly.
- k) Screw in the lever set into connector of extension arm adjusting the length in such way that after setting the position of piston rod in half (50%) of the stroke set the setting lever is placed in a horizontal position. If the lever set is too long it should be cut to the required length.

The connection of lever set with extension arm's connector, extension arm with clamping ring III and mounting bracket with actuator body should be secured by tightening firmly all screws and nuts.



After coupling the string with extension arm, the movement of the stroke corresponding to full stroke of the actuator piston rod should be visually distributed in a symmetrical way with respect to the horizontal position of this lever.

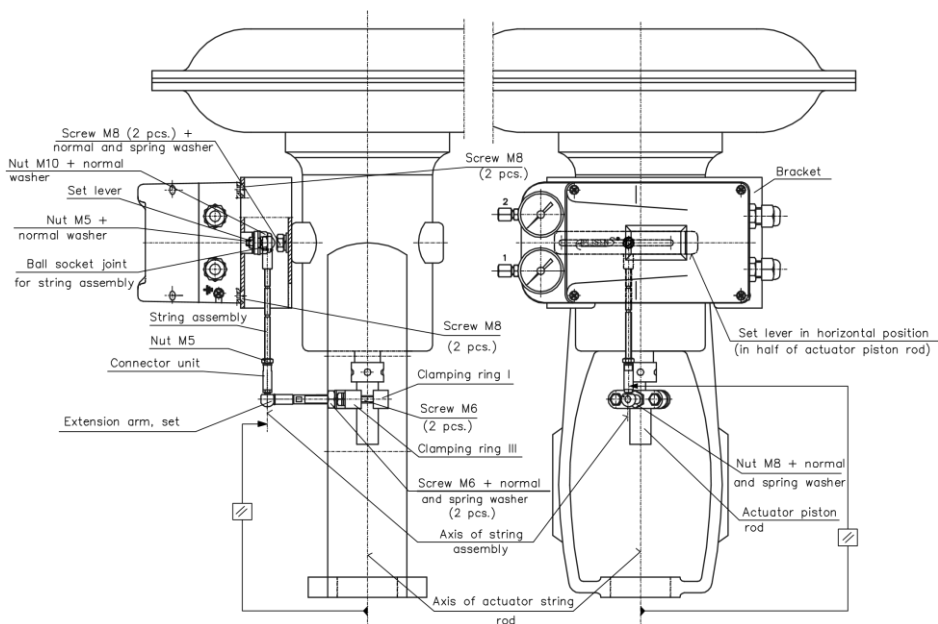


Fig. 5. Positioner APIS-1X0-... with mounting kit APIS-A001 (positioner installed on yoke actuator type 37 or 38 manufactured by Polna S.A.).

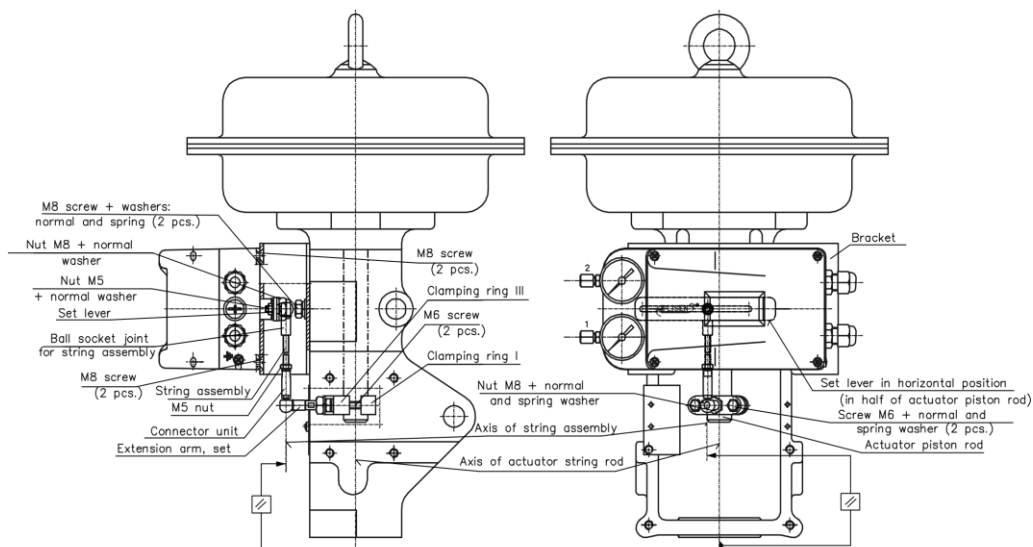


Fig. 6. Positioner APIS-1X0-...with mounting kit APIS-A002 (positioner installed on multi-spring actuator type P1 or R1 manufactured by Polna S.A.).

10.3. Assembly of the positioner on actuator type P and R manufactured by Polna S.A. - version APIS-A1X0-... with mounting kit APIS-A000

The positioner should be installed on actuator as follows:

- Take the positioner out of the packaging.
- Install the driver on setting lever of the positioner in place corresponding to stroke of the actuator and tighten the M5 nut (see Fig. 7)

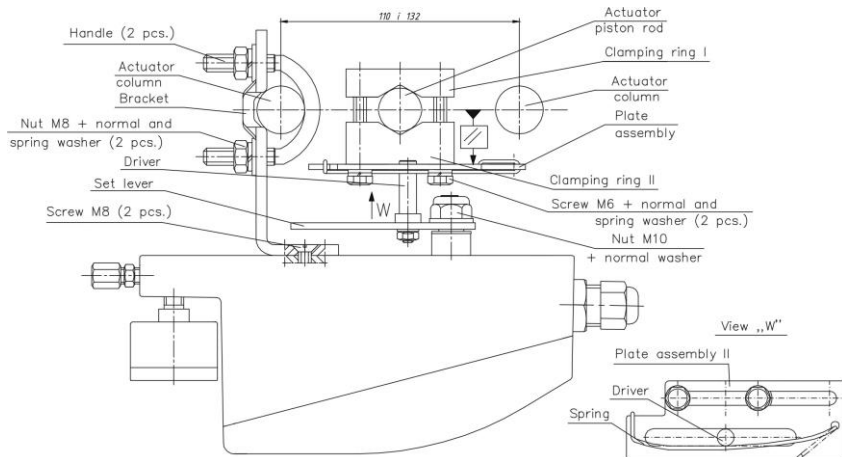


Fig. 7. Positioner APIS-1X0-... with mounting kit APIS-A000 (positioner installed on column cylinder type P or R with columns spacing 110 and 132 mm manufactured by Polna S.A.).

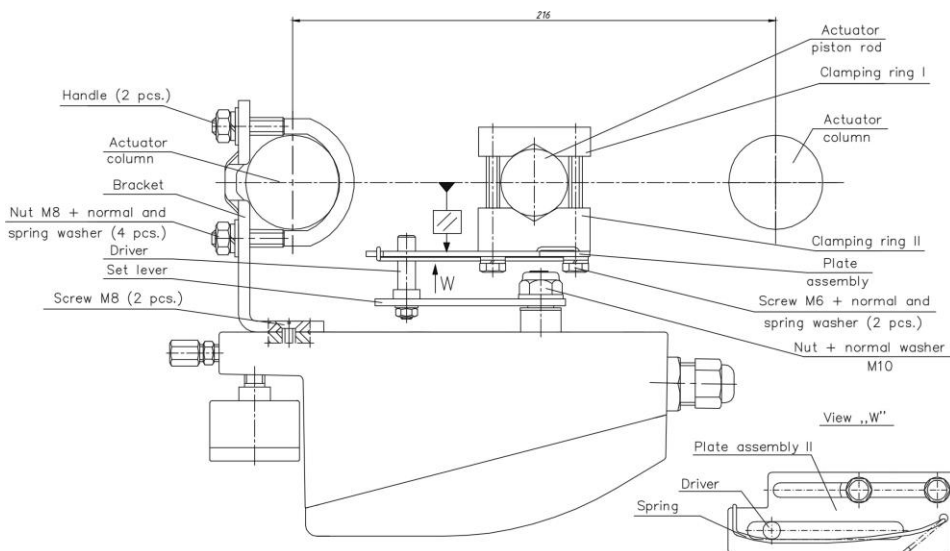


Fig. 8. Positioner APIS-1X0-... with mounting kit APIS-A000 (positioner installed on column cylinder type P or R with columns spacing 216 mm manufactured by Polna S.A.).

- c) Screw in clamping rings to actuator piston rod (clamping ring I and clamping ring II) with a plate using two M6 screws enclosed in the mounting parts



Plane of plate set should be parallel to a line connecting both axes of the column and actuator piston rod.

- d) Fix the positioner on columns using two handles - see Fig. 7 and 8, showing position of the mounting bracket taking into account the spacing of the axes of actuator columns.
 e) Connect driver with actuator piston rod by inserting it into proper cut out in a plate set - see View W in Fig. 8. The setting lever should take horizontal position (correct position of the positioner by shifting it on column of the actuator) in the 50% of stroke position.
 f) Tighten all nuts and screws firmly after the adjustment.



Driver should move smoothly in groove of the plate and without any stops. When the driver is coupled with a plate set movement of the lever corresponding to the full stroke of the actuator piston rod should be visually distributed in a symmetrical way with respect to horizontal position of this lever.

10.4. Assembly of the positioner on actuator with a control valve with a rib - compatible with PN-EN 60534-6-1:2001 e.g. on actuator manufactured by Samson or Arca Regler - version APIS-1X0-... with a mounting kit APIS-A003

The positioner should be installed on the actuator as follows:

- a) Remove the positioner from the packaging.
 b) Install the driver on the setting lever of the positioner in the place corresponding to stroke of the actuator and tighten the M5 nut (see Fig. 9)

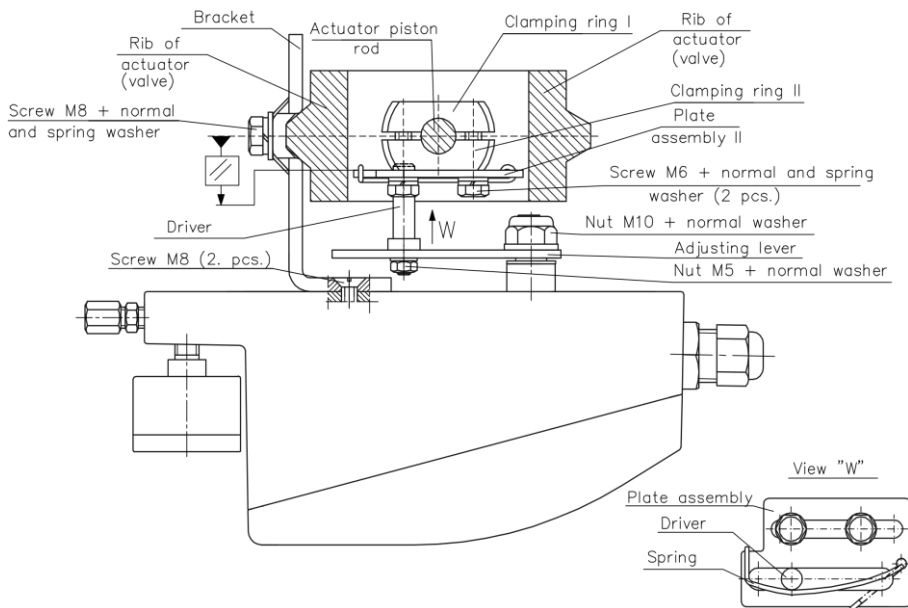


Fig. 9. Positioner APIS-1X0-... with a mounting kit APIS-A003 (positioner installed on the actuator with control valve equipped with a rib - conforming EN 60534-6-1:2001 e.g. on actuator manufactured by Samson or Arca Regler)

- c) Screw in clamping rings to actuator piston rod (clamping ring I and clamping ring II) with a plate set II using two M6 screws enclosed in the mounting parts



The plane of the plate set II should be parallel to the line connecting both axes of ribs of the actuator (valve) and actuator piston rod.

- d) Connect the driver with actuator piston rod by inserting it into proper cut out in a plate set II - see View W in Fig. 9. Visually, in approximately half (50%) of stroke the setting lever should take horizontal position (correct position of the positioner by shifting it on rib of actuator matching the given opening in the actuator mounting bracket with threaded opening of actuator ribs).
- e) Tighten the positioner bracket firmly to rib of the actuator with M8 screw enclosed in the mounting parts.
- f) Tighten the other nuts and screws firmly.



Driver in groove of the plate II should move smoothly. When the driver is coupled with the set of plate II, the movement of the lever corresponding to the full stroke of the actuator piston rod should be visually distributed in a symmetrical way with respect to the horizontal position of this lever.

10.5. Assembly of the positioner on single or double operating actuator with rotational movement conforming EN ISO 5211, DIN 3337, VDI/VDE 38450 Namur e.g. on actuator manufactured by AIR TORQUE, EBRO ARMATUREN, EL-O-MATIC - version APIS-1X0-... i APIS-2X0-... with a mounting kit APIS-A050.

The positioner should be installed on the actuator as follows:

- a) Remove the positioner from the packaging.
- b) Install the coupling connector on the positioner shaft by tightening it lightly with two M5 screws.
Pay attention to support both fixing screws on flat bevel on positioner shaft - see Fig. 10.
- c) Install the frame to the positioner body and tighten it firmly with four M6 screws - see Fig. 11.
- d) Depending on the actuator size you should set the correct height of the bracket by correct shifting of both parts on openings. Install four M6 screws and tighten it firmly with nuts after the adjustment.
- e) Check the direction of actuator shaft movement and position of screws on the coupling connector - Fig. 10.
- f) Install both brackets in this position using four M5 screws.
- g) Inspect visually whether the axis of the coupling connector matches the actuator axis and whether the bevel in the bottom part of the connector is located in cut out of the actuator shaft.
Correct the mutual position of the actuator relative to the positioner using a clearance on openings for M5 screws in angle sections.
- h) Tighten four M5 screws fixing brackets on the actuator.
- i) Move coupling connector closer to the actuator shaft and then lock it on the positioner shaft tightening two M5 screws firmly.



It is recommended to screw in two M5 screws on the coupling connector with thread locking compound e.g.: Loctite 222 or 243.

- j) Remove the clearance between frame and bracket by moving both parts towards each other. This operation should ensure the maintenance of visual parallelism of the frame tightened to the positioner in relation to a plane of the positioner from side of its shaft - see Fig. 11.
- k) Tighten firmly four M5 nuts locking the brackets with respect to the frame.

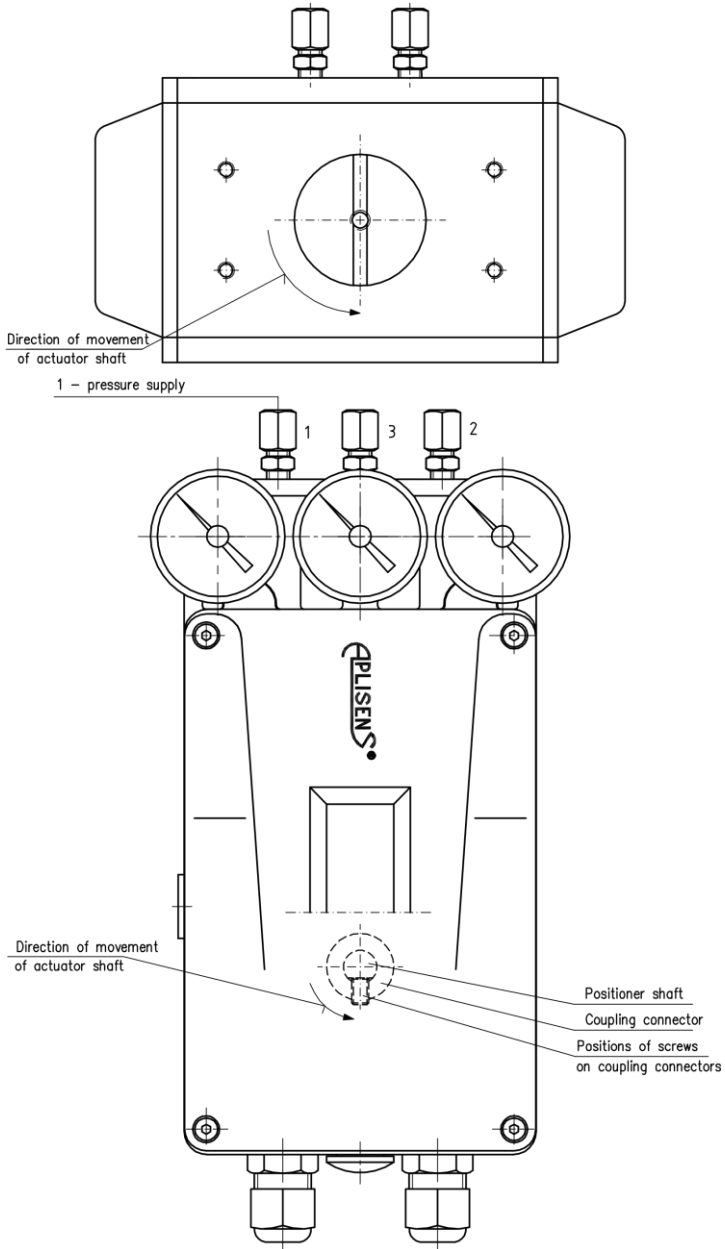


Fig. 10. Mounting position of the APIS-1X0-... and APIS-2X0-... positioner with respect to single-acting or double-acting actuator with rotational movement.

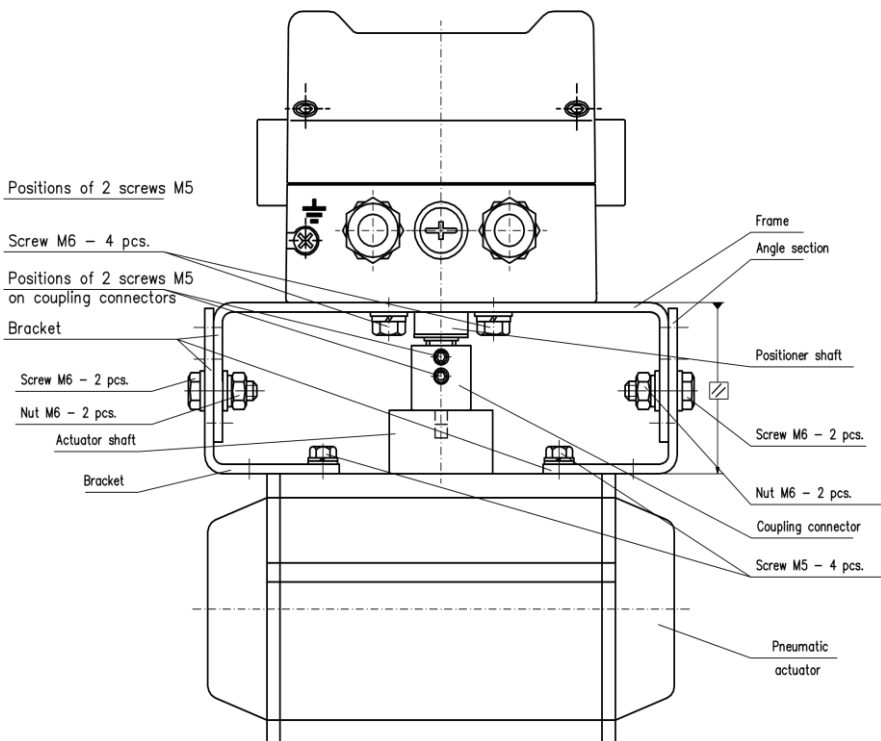


Fig. 11. Assembly of the APIS-1X0-... and APIS-2X0-... positioner with mounting kit APIS-A050 on single-acting and double-acting actuator with rotational movement.

10.6. Assembly of the positioner with double action actuator with linear movement CNOMO or or conforming the ISO 6431 e.g. actuator manufactured by PREMA Kielce, FESTO - version APIS-2X1-..., APIS-2X2-... with a mounting kit APIS-AXXX

The positioner should be installed on actuator as follows:

- Install the extension arm with a clamping ring I on piston rod by tightening firmly two M6 screws - Fig. 12.
- Install two mounting brackets fixing the position transducer on the actuator.
- Install a tip with ball-and-socket joint to the position encoder. Tighten firmly a jam nut on tip with mobile threaded spindle of the encoder.
- Connect the extension arm with a ball-and-socket joint installed on the position transducer.
Adjust the extension arm length to ensure that after the installation of the position transducer on actuator it will be possible to install a plate as shown in Fig. 12.



If the extension arm is too long it should be cut to the required length.

- Tighten the M8 nut on extension arm.
- Install position transducer using two mounting clamping rings to ensure that when the actuator piston rod is inserted its mobile spindle protrudes at least 3÷8 mm from its initial position.

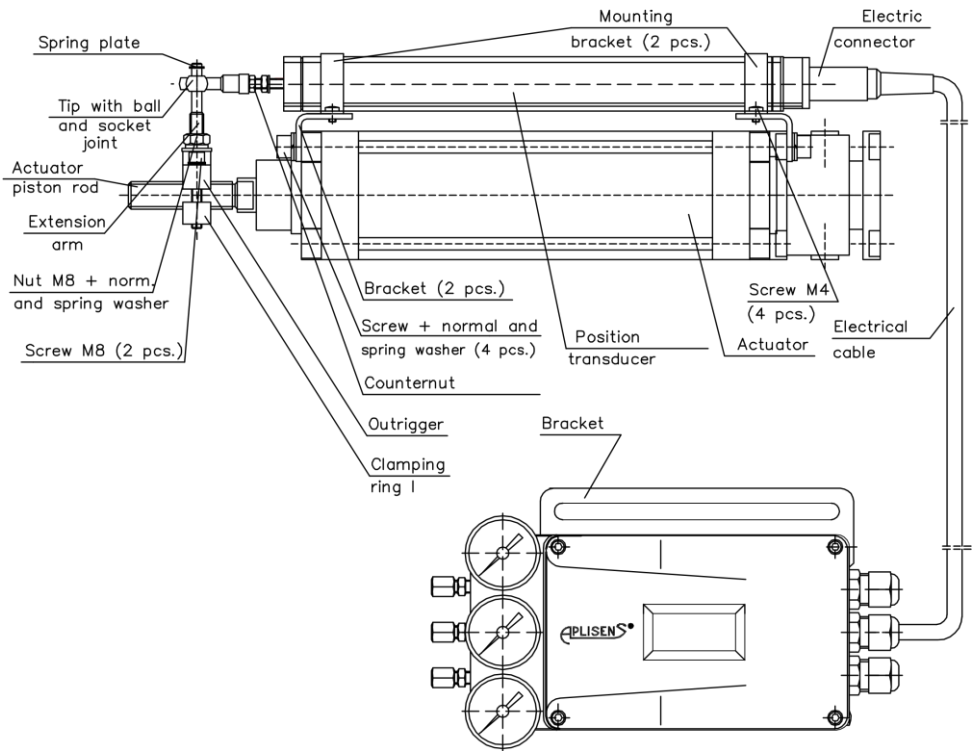


Fig. 12. Assembly of the APIS-2X1-..., APIS-2X2-... positioner with double action actuator with linear movement.

Check whether maximum advance of the actuator piston rod will not cause damage of the transducer.



Make a correction of length of mobile spindle of the transducer by screwing/undoing a tip with a ball-and-socket joint from this arm and/or moving the transducer in relation to its mounting clamping rings. After these operations, the counter nut on the tip with mobile spindle of transducer and bolts fixing the transducer with clamping rings to brackets should be re-tightened.

- g) Install the spring plate on the extension arm.
- h) Install positioner e.g.: on the wall or other selected position, using a bracket and two M8 screws enclosed to the mounting kit.



Distance of the positioner from actuator is limited by length of the electrical cable connecting the positioner with position encoder

- i) Connect connector of electrical cable connected to a terminal strip of the positioner with socket of position transducer (tighten a nut located on electrical interface).
- j) Tighten firmly all screws, bolts and nuts.

10.7. Rules of installation of pneumatic hoses

The pneumatic hoses to supply pressure reducer should be as short as possible. The installed hoses should not be exposed to mechanical loads.

Avoid bends during laying. **Hoses should be blown with the air before connecting them in order to dry them and to remove the contaminations.** It is recommended to use annealed copper pipe $\varnothing$ 6x1 or $\varnothing$ 8x1. Supply pressure should be led to pneumatic connector marked with "1", while cables of output signals marked with "2" or "3" should be connected with the given chambers of the actuator.

11. USER'S MANUAL

Setting of parameters and configuration of the positioner can be carried out as follows:

- using the positioner keyboard - this method is discussed in details in section 11.3.
- using a computer with the *Raport 2* software equipped with proper help tab.

11.1. General information

11.1.1. Control buttons

Three control buttons (Fig. 13) are used for programming the positioner settings:

- Δ - Increase of parameter value or indication of previous parameter;
- ∇ - Decrease of parameter value or indication of next parameter;
- $\leftarrow$ - Confirmation of selection of set parameter.

The buttons Δ and ∇ have assigned typematic (auto - repeat) function during programming of values of the parameters. This function allows stepwise increase Δ or decrease ∇ of the value of the parameter when the given button is held for more than 0.6 s. Auto-repeat function acts of 10 times per second.

Positioner menu is presented in the Fig. 14. Buttons Δ and ∇ are used to select the given menu item.

Execution of the given function requires additional confirmation by Enter ($\leftarrow$) button.

The parameter is automatically saved and next menu item will be indicated after the setting. The choice of parameter setting sequence is arbitrary.

Parameters setting can be carried out or repeated any time of operation of the positioner.

The parameters set are saved in the positioner, nonvolatile memory.

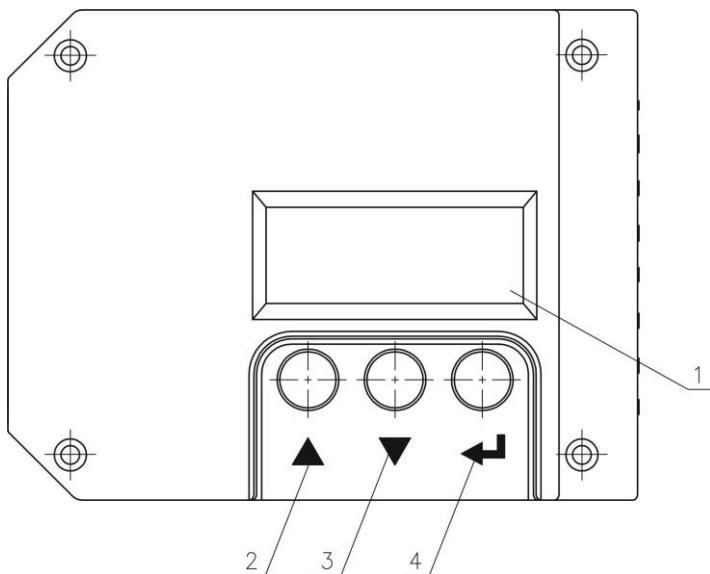


Fig. 13. Keyboard of the APIS positioner.

1. LCD display, alphanumeric;
2. Button Δ increasing the numerical value of the given parameter or return to the previous function;
3. Button ∇ decreasing numerical value of the given parameter or setting the next function;
4. Button $\leftarrow$ confirming the value of the selected parameter or confirmation of selection of the given function.

11.1.2. Positioner servicing levels

Communication of the user with microprocessor positioner APIS is carried out at three service levels (Fig. 14):

- I service level - normal operation mode
- II service level - transient mode
- III service level – configuration and parameters settings mode

The information on: displacement value **PV** of piston rod, input (control) signal (current) **SP**, internal temperature of the positioner **PT**, pressure inside the actuator chamber **PP** (option) and software version are displayed on the display in the first service level.

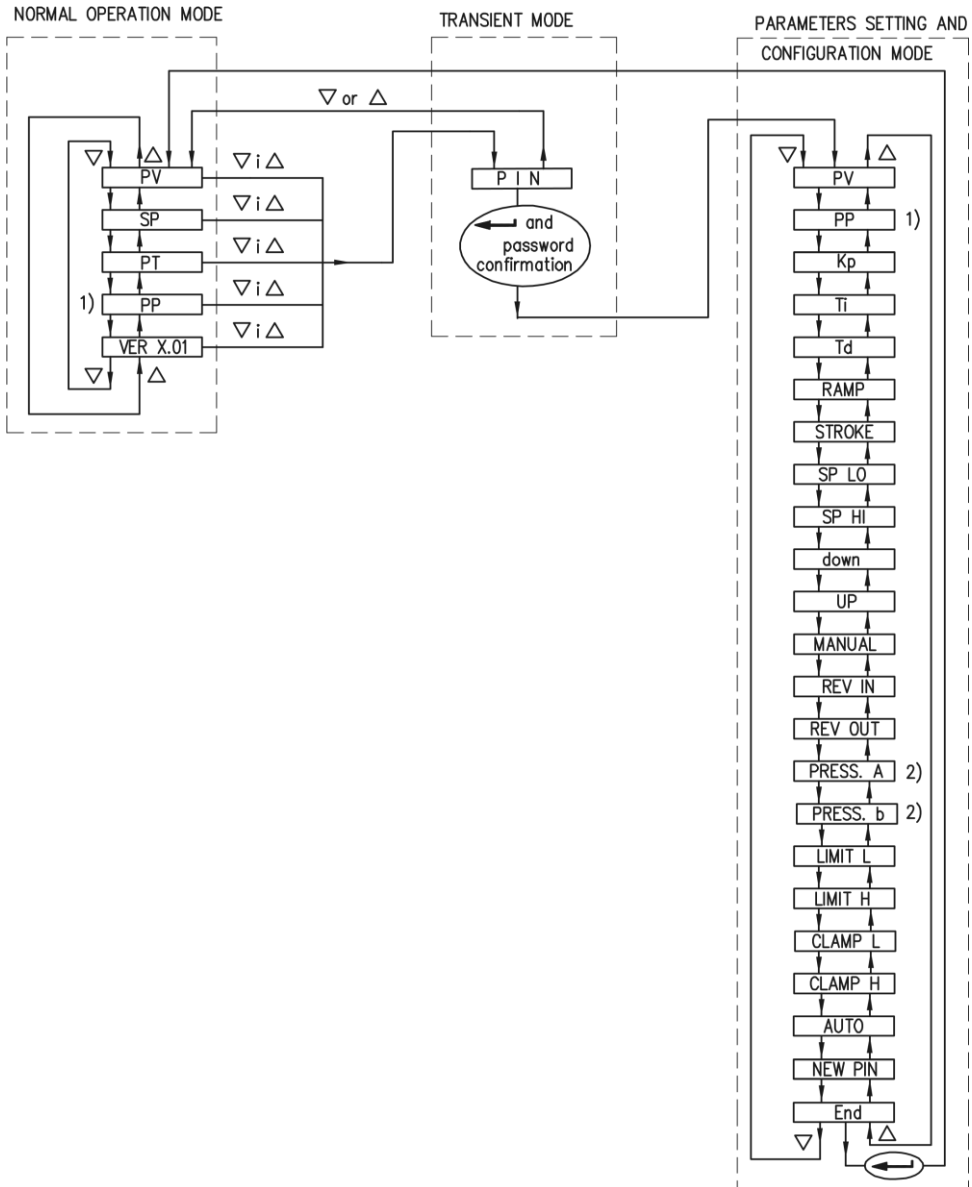


Actual internal temperature of the positioner is displayed periodically (every minute for 1 s) in the top right corner of the display (applies only for **SP** and **PV**).

Change of the item presented on the positioner display is sequential by successive pressing the button ∇

(Fig.14) in the following order: **PV, SP, PT, PP, VER X.01** or button Δ in reverse order.

The switch from the normal operation mode to the transient mode is arbitrary and takes place after pressing both buttons Δ and ∇ at the same time. **PIN** – password for advanced software and configuration functions of the positioner will appear on the display. (III service level)



1) - function available only for APIS – XXX-...-IHS-...

2) - functions available only for APIS – 2XX-...

Fig. 14. Menu of the APIS positioner functions.

Switching to the third service level - the last one, that is setting the parameters and configuration, is allowed only for authorized persons that is after entering the password during confirmation of **PIN** function using ↩ button.

11.2. Positioner functions

Launch the positioner acc. to point 11.3 before starting operation.

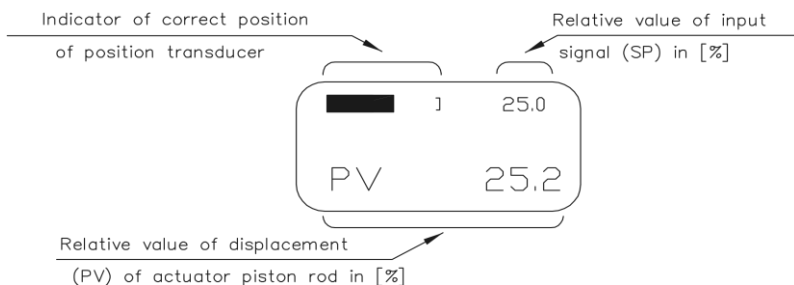
11.2.1. I (1st) service level - normal operation mode



During the normal operation mode it is possible to read the value of displacement of the actuator piston rod, the value of input signal (control) as well as the internal temperature of the positioner, pressure in the chamber of the actuator and implemented software version.

11.2.1.1. PV – readout of actual value of displacement of actuator piston rod

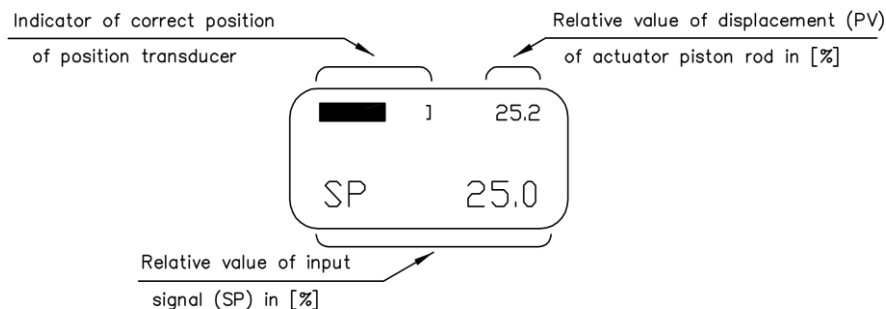
The following will appear on the display e.g.:



This information indicates that the positioner is at the I (1st) service level (normal operation mode).

11.2.1.2. SP – readout of actual value of input (control) signal (current)

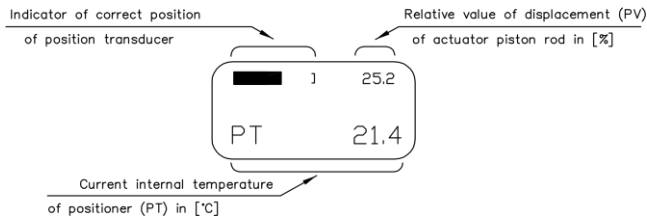
- Using button Δ or ∇ move to **SP** symbol:



Pressing the button Δ once results in the return to **PV** display mode as in sect. (11.2.1.1.). Button $\leftarrow$ remains inactive.

11.2.1.3. *PT - readout of actual internal temperature of the positioner*

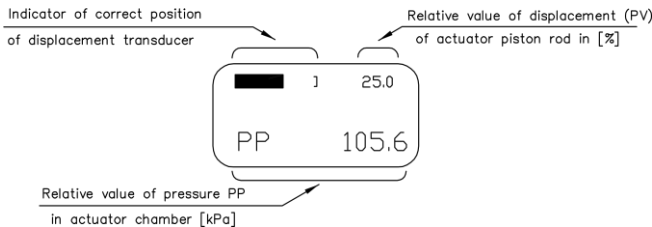
- Set the **PT** symbol using buttons Δ or ∇ :



Pressing the button Δ once results in the return to **SP** display mode as in sect. (11.2.1.2.), while successive pressing of this button results in the return to **PV** (11.2.1.1.). Button $\leftarrow$ remains inactive.

11.2.1.4. *PP - readout of actual pressure in actuator chamber*

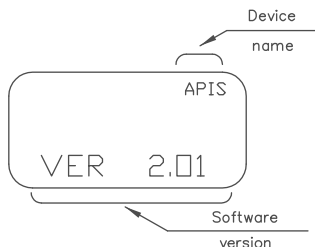
- Using buttons Δ or ∇ move to **PP** symbol:



Pressing the button Δ once results in the return to **PT** display mode as in sect. (11.2.1.3.), while successive pressing of this button results in the return to **SP**, **PV**. Button $\leftarrow$ remains inactive. Function informing about the pressure in actuator chamber is available only for versions equipped with pressure sensor APIS- XXX-...-IHS-...

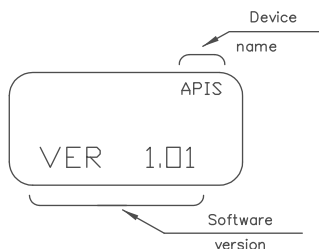
11.2.1.5. *VER X.XX – information on software version of the positioner*

- Set the **VER X.XX** symbol using buttons Δ or ∇ :



VER 2.01 indicates version for double-acting actuators (APIS-**2**XX-...), with software no. **01**.

or



VER 1.01 indicates version for single-acting actuators (APIS-**1**XX-...), with software no. **01**.

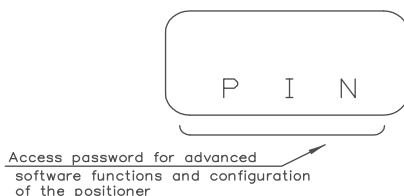


Pressing the button Δ once results in the return to **PP** display mode (11.2.1.4), while successive pressing of this button results in the return to **PT**, **SP**, **PV**. Button $\leftarrow$ remains inactive.

11.2.2. II (2nd) service level - transient mode

11.2.2.1. PIN – Access password for advanced software and configuration functions of the positioner

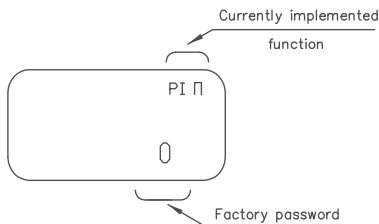
For states of the display as in sect. 11.2.1.1. or 11.2.1.2. or 11.2.1.3. 11.2.1.4. or 11.2.1.5 the user should press both buttons Δ and ∇ at the same times to switch from the first to the second service level that is from the normal operation mode to the transient operation mode. The display will show:



Such information indicates that the second service level is reached (transient mode).

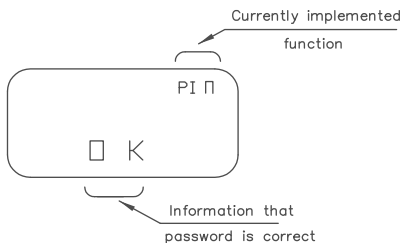
Moving in the menu in the area of the second level:

- pressing the button Δ once results in the return to the normal operation mode and displaying condition as in sect. 11.2.1.1.,
- to switch from the second service level to the third one that is to parameters setting and configuration mode:
 - o Press button $\leftarrow$; the following will appear on the display:

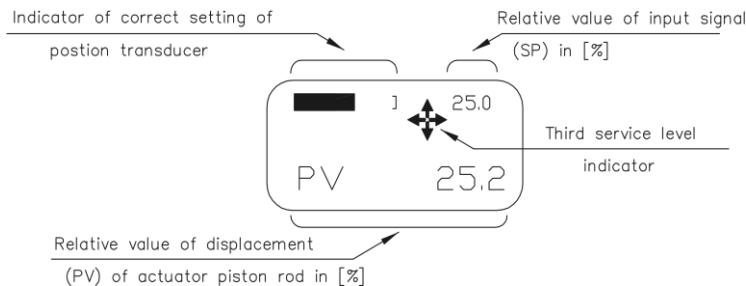


If factory password has been already changed then it should be set using buttons Δ and ∇ .

Confirm the password with a button $\leftrightarrow$; the following will appear on the display:

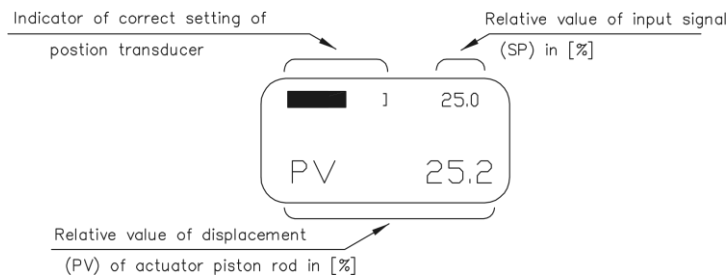


Information on the approval of the password will disappear from the positioner display. Then the following will be displayed e.g.:



If entered password is incorrect then the device will not switch to the third level and the following will appear on the display e.g.:

Then the user should re-enter the password carrying out the operations mentioned above. The number of incorrect password enterings is unlimited.





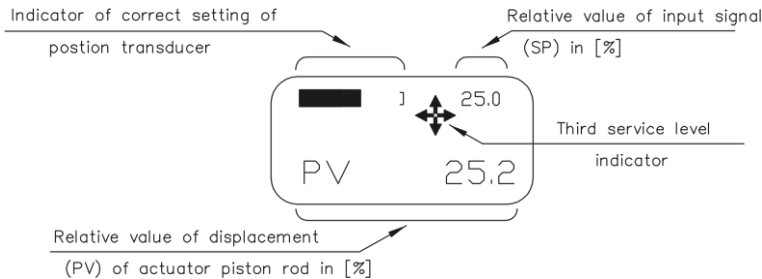
Change of the password is possible exclusively in the third service level by means of function

NEW PIN . Please refer to procedure described in sect. 11.2.3.22. User should use Δ and ∇ buttons for this purpose.

11.2.3. III (3rd) service level – configuration and parameters settings mode

11.2.3.1. PV – readout of actual value of displacement of actuator piston rod

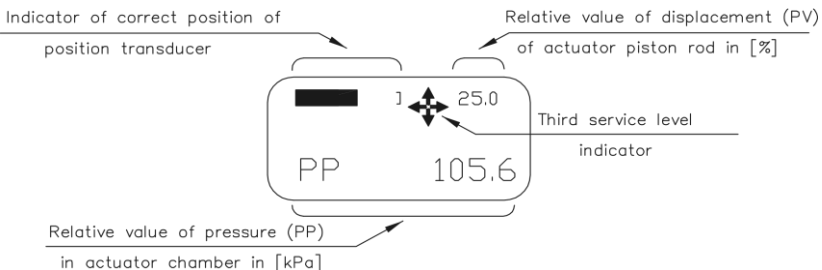
The following will appear on the display after entering the correct password as in sect. 11.2.2.1:



This function is used to preview the value of piston rod displacement during parameters settings and configuration process at the third service level.

11.2.3.2. PP - readout of actual pressure in actuator chamber

- Set the **PP** symbol using buttons Δ or ∇ :

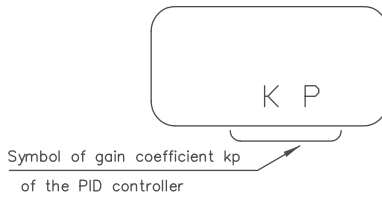


This function is used to preview value of pressure in actuator chamber during parameters settings and configuration process at the third service level.

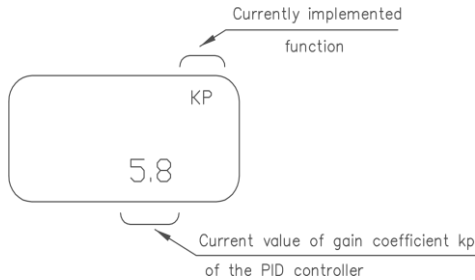
This function is available only for versions with pressure sensor (APIS- XXX-...-IHS-...).

11.2.3.3. KP – gain coefficient k_p of the PID controller

- Set the **KP** symbol using Δ or ∇ buttons:



- Press the button $\leftarrow$; the following will appear on the display:

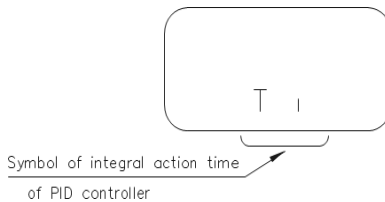


- The user should change the value of gain coefficient by pressing and/or holding the button Δ , or ∇ .



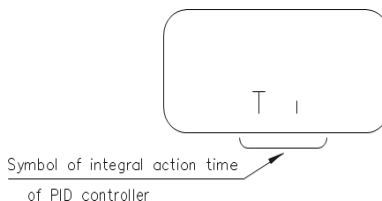
Gain coefficient **Ti** has a high impact on the stable operation of the positioner and it is determined automatically during the implementation of the **AUTO** function – see sect. 11.2.3.21.

- Confirm the set value **kp** with the button $\leftarrow$; the following will appear on the display:

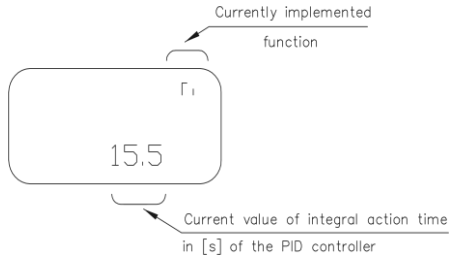


11.2.3.4. T_i – integral action time of the PID controller

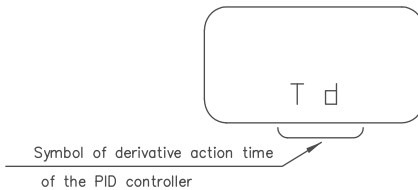
- Set the **Ti** symbol using buttons Δ or ∇ :



- Press the button $\leftarrow$; the following will appear on the display:



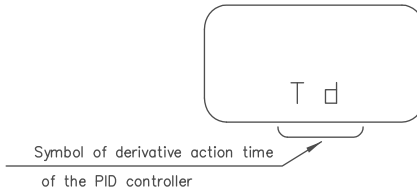
- The user should change the value of integral action time by pressing and/or holding the button Δ , or ∇ .
- Confirm the set value **Ti** using the button $\leftarrow$; the following will appear on the display:



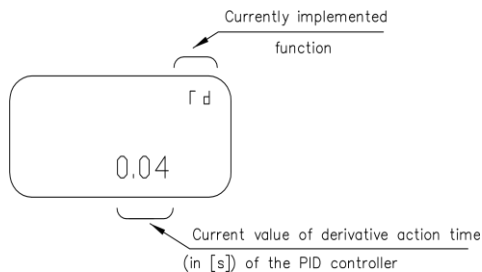
Integral action time **Ti** is determined automatically during implementation of the **AUTO** function – see sect. 11.2.3.21.

11.2.3.5. *Td* – derivative action time of the PID controller

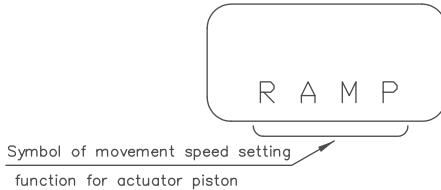
- Set the **Td** symbol using buttons Δ or ∇ :



- Press the button $\leftarrow$; the following will appear on the display:



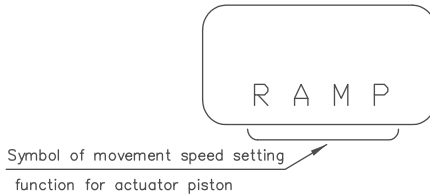
- The user should change the value of derivative action time of the controller by pressing and/or holding the button Δ , or ∇ .
- Confirm the set value **Td** with button $\leftarrow$; the following will appear on the display:



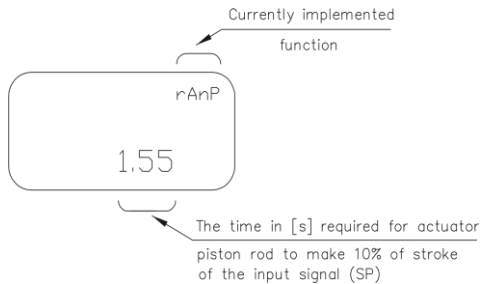
Derivative action time **Td** is determined automatically during the implementation of the **AUTO** function – see sect. 11.2.3.21.

11.2.3.6. **RAMP** – movement speed of actuator piston rod

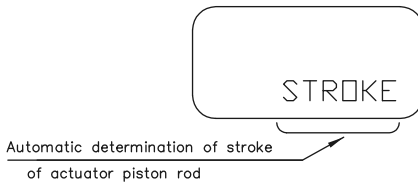
- Set the **RAMP** symbol using buttons Δ or ∇ :



- Press the button $\leftarrow$; the following will appear on the display:



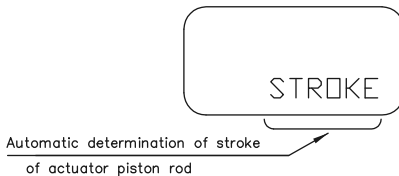
- The user should set the required value of the **RAMP** coefficient by pressing and/or holding the button Δ or ∇ .
- Confirm the set value **RAMP** using the button $\leftarrow$; the following will appear on the display:



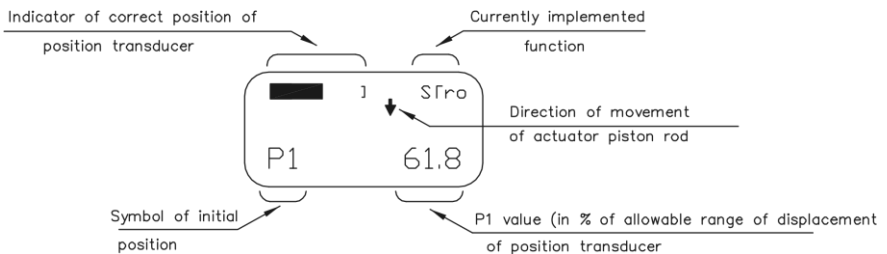
Speed of movement of actuator piston rod **RAMP** is determined automatically during implementation of the **AUTO** function – see sect. 11.2.3.21.

11.2.3.7. **STROKE** – automatic determination of stroke of movement of piston rod of the actuator

- Set the **STROKE** function using buttons Δ or ∇



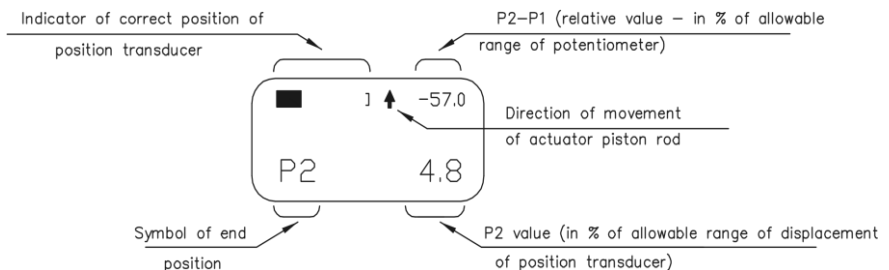
- Press the button $\leftarrow$; the following will appear on the display



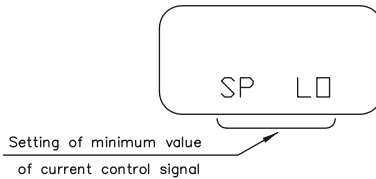
Then determination of the range of movement of piston rod of the actuator in automatic mode will start. This process lasts from several to several dozens of seconds.



Actuator piston rod is ejected (inserted) during implementation of this operation and the following will appear on the display:



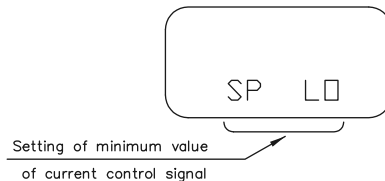
The following text will be displayed on the positioner display when automatic determination of movement stroke for the actuator piston rod is completed.



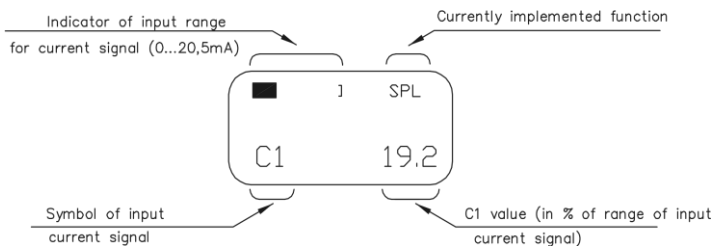
The range of movement of actuator piston rod is determined automatically during the implementation of the **AUTO** function – see sect. 11.2.3.21.

11.2.3.8. *SP LO – setting of minimum value of current control signal*

- Set the **SP LO** function using buttons Δ or ∇ :



- Press the button $\leftarrow$; the following will appear on the display:

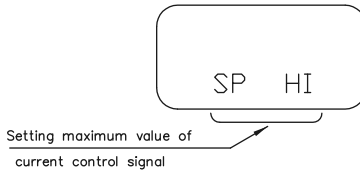


- Set the required value of minimum current signal (usually 4.000 mA) from the current DC source to the terminals 1 and 2 (see Fig. 16).



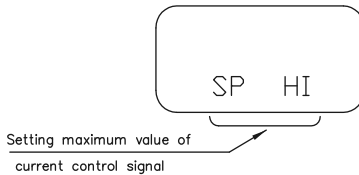
Change of the value of minimum current signal is visible on the display of the positioner in the bottom row at the LCD display. The positioners are delivered from the factory with minimum value of current control signal set to (4.000 mA).

- Press the button $\leftarrow$; the following will appear on the display:

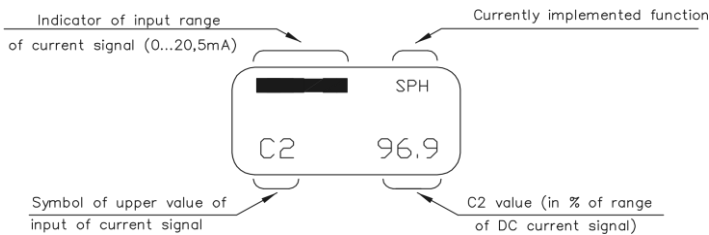


11.2.3.9. *SP HI – setting the maximum value of current control signal*

- Set the **SP HI** function using buttons Δ or ∇ :



- Press the button $\leftarrow$; the following will appear on the display:

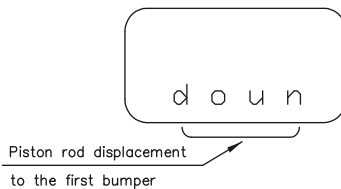


- Set the required value of maximum current signal (usually 20.000 mA) from the DC current source to the terminals 1 and 2 (see fig. 16).



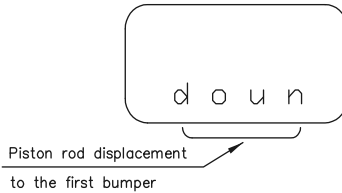
Change in the value of maximum current signal is visible on the display of the positioner in the bottom row at LCD display. The positioners are delivered from the factory with minimum value of current control signal set to (20.000 mA).

- Confirm the new **SP HI** value with the button $\leftarrow$; the following will appear on the display:

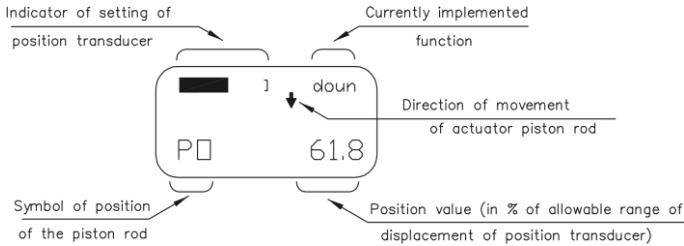


11.2.3.10. *DOWN – displacement of actuator piston rod to the first bumper*

- Set the **doun** function using buttons Δ or ∇ :

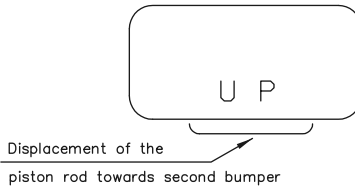


- Press the button ; the following will appear on the display:



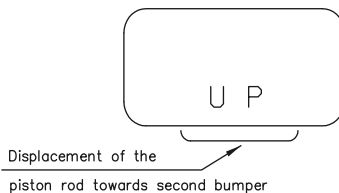
doun command results in unloading of chamber of the pneumatic actuator and causes the movement of the piston rod to the first bumper which is called conventionally as **doun**. When this position is reached – the actuator piston rod remains there until the operator executes other command.

- Press the button ; the following will appear on the display:

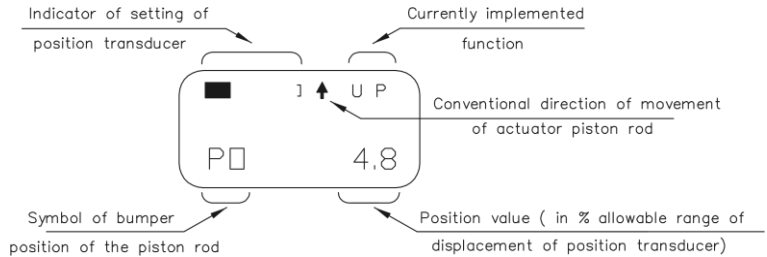


Ending of **doun** command results in restarting of the positioner in on-line control mode, that is in normal automatic operation mode of the actuator.

11.2.3.11. **UP** – displacement of the actuator piston rod to the second bumper

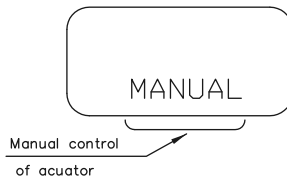


- Set the **UP** function using buttons or .
- Press the button ; the following will appear on the display:



UP command results in loading the chamber of the pneumatic actuator and causes the movement of the piston rod to the second bumper position called conventionally as **UP**. When this position is reached - actuator piston rod remains there until the operator executes other command.

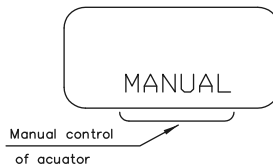
- Press the button $\leftarrow$; the following will appear on the display:



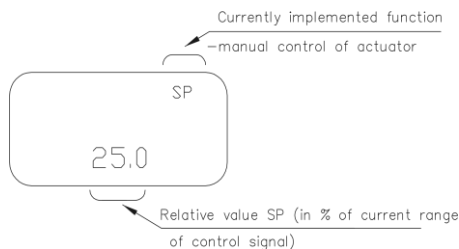
Ending of **UP** command results in restarting the positioner in on-line control mode, that is in normal operation mode of the positioner.

11.2.3.12. **MANUAL** – manual control mode for the actuator

- Set the **MANUAL** function using buttons Δ or ∇ :



- Press the button $\leftarrow$; the following will appear on the display:

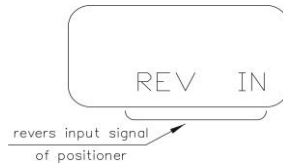


- Change the position of the actuator piston rod by pressing or holding the button Δ or ∇ .



The actuator piston rod stops moving when the button Δ or ∇ is released. When position specified by the operator is reached – the actuator piston rod remains there until the operator executes another command. Adjustment functions of the positioner are active during the implementation of the **MANUAL** command.

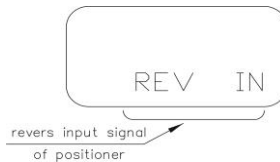
- Press the button $\leftarrow$; the following will appear on the display:



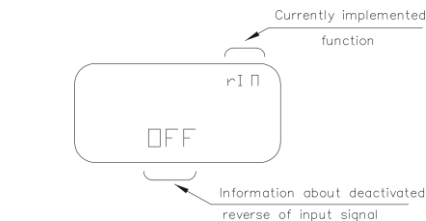
Ending the **MANUAL** command results in the return to control in the automatic operation mode with the external control signal **SP**.

11.2.3.13. REV IN – reverse of the input signal

- Set the **REV IN** function using buttons Δ or ∇ :

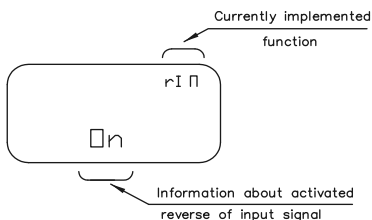


- Press the button $\leftarrow$; the following will appear on the display:

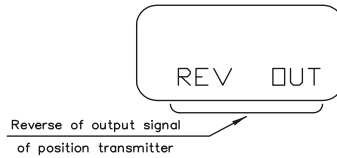


If the user does not intend to activate the reverse of the input signal, then he/she should press the button $\leftarrow$.

If the user intends to activate the reverse of the input signal, then he/she should press the button ∇ or Δ once; then the following will appear on the display:



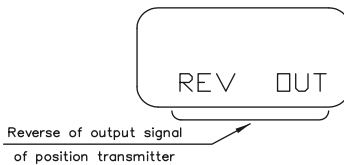
- Confirm the activation of the reverse of the input signal with the button  ; then the following will appear on the display:



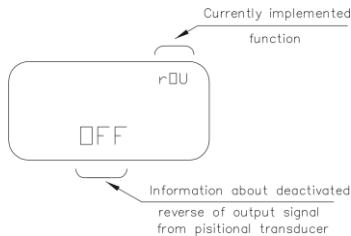
By default (factory) function of reverse of input signal is deactivated (**OFF**) .

11.2.3.14. **REV OUT** – reverse of the output signal from the position transmitter

- Set the **REV OUT** function using buttons  or .

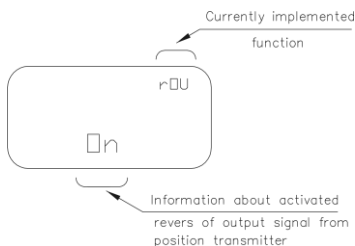


- Press the button  ; the following will appear on the display:



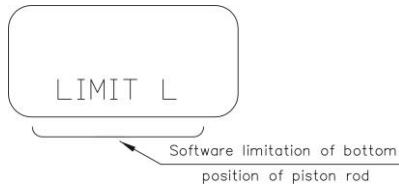
If the user does not intend to activate the reverse of the output signal from the position transmitter, then he/she should press the button .

If the user intends to activate the reverse of the output signal from the position transmitter then he/she should press the button  or  once; then the following will appear on the display:

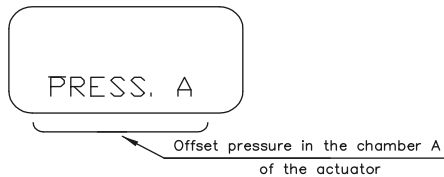


- Confirm the activation of the reverse of the output signal from the position transmitter with the button  ; then the following will appear on the display:

- for executions APIS-1XX-...:



- for executions APIS-2XX-...:



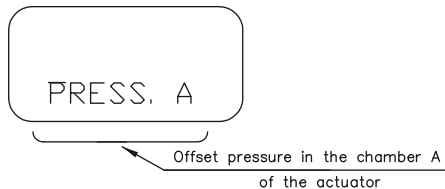
The function of the reverse of the output signal from position transmitter is factory deactivated (**OFF**) for both versions.

11.2.3.15. *PRESS. A – offset pressure of chamber A of the actuator*

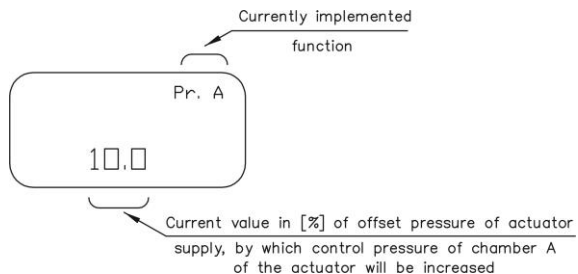


This function is not available for **APIS-1XX-...** executions. Drawing facilitating identification of chamber A of the actuator is presented in the Fig. 15.

- Set the **PRESS. A** function using buttons  or 



- Press the button  ; the following will appear on the display:



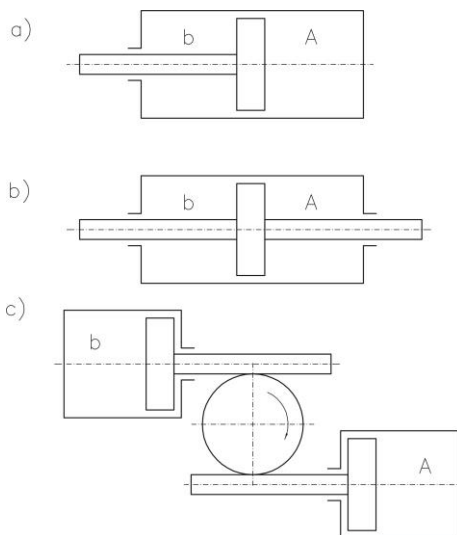
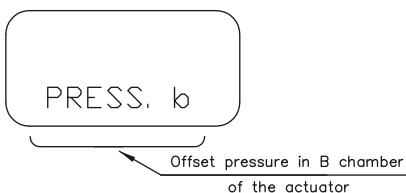


Fig. 15. Identification of support chambers of double-acting actuators

- a) with linear movement with single-acting piston rod
- b) with linear movement with double-acting piston rod
- c) with rotational movement

- Observe the pressure on a pressure gauge connected to connector “3” of the positioner while pressing and/or holding button Δ or ∇ . The value of this pressure should fall into the range 30 - 70 % of the supply pressure of the positioner.
- Confirm the set value **Pr. A** pressing the button $\leftarrow$; the following will appear on the display:



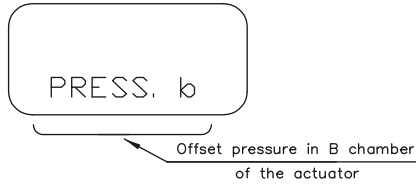
Offset pressure of chamber A of the actuator **PRESS. A** is determined automatically during the implementation of the **AUTO** function – see sect. 11.2.3.21.

11.2.3.16. **PRESS. b.** – offset pressure of chamber b of the actuator

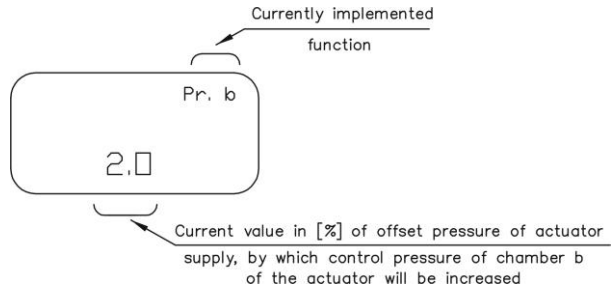


This function is not available for **APIS-1XX-....** executions. Drawing facilitating identification of chamber b of the actuator is presented on the Fig. 15.

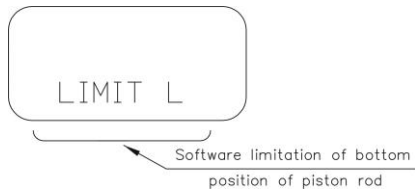
- Set the **PRESS. b** function using buttons Δ or ∇



- Press the button $\leftarrow$; the following will appear on the display:



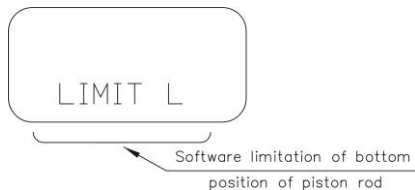
- Observe the pressure on a pressure gauge connected to the connector "2" of the positioner while pressing and/or holding button Δ or ∇ . The value of this pressure should fall into the range 30 - 70 % of the supply pressure of the positioner.
- Confirm the set value **Pr. b** with the button $\leftarrow$; the following will appear on the display:



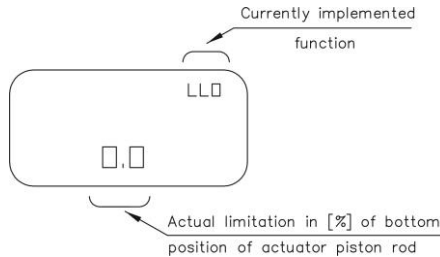
Supporting pressure of chamber b of the actuator **PRESS.b** is determined automatically during the implementation of the function **AUTO** – see sect. 11.2.3.21.

11.2.3.17. **LIMIT L – software limitation of the bottom position of piston rod**

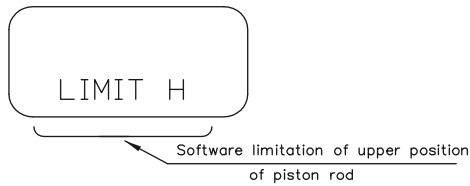
- Set the **LIMIT L** function using buttons Δ or ∇ :



- Press the button $\leftarrow$; the following will appear on the display:



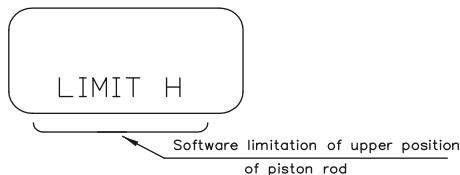
- Enter the required value in [%] of the lower limit of the actuator piston movement limitation range by pressing and/or holding Δ or ∇ button.
- Confirm the set value **LLO** with the button $\leftarrow$; the following will appear on the display:



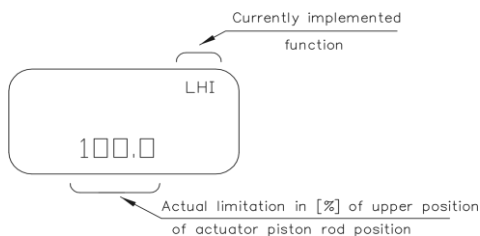
By default, the limitation of the bottom range of position of piston rod of the actuator is set to 0%.

11.2.3.18. **LIMIT H** – software limitation for upper range of position of actuator piston rod

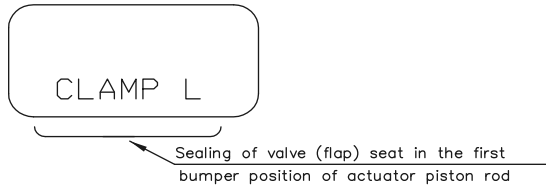
- Set the **LIMIT H** function using buttons Δ or ∇ :



- Press the button $\leftarrow$; the following will appear on the display:



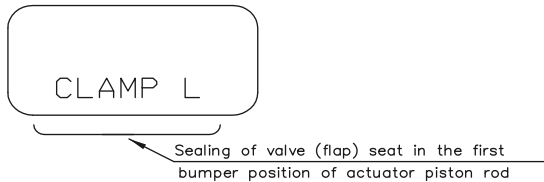
- Enter the required value in [%] of the upper limit of the actuator piston position by pressing and/or holding Δ or ∇ button.
- Confirm the set value **LHI** with the button $\leftarrow$; the following will appear on the display:



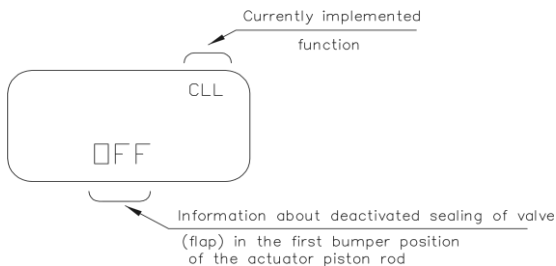
By default limitation for upper range of position of actuator piston rod is set to 100%.

11.2.3.19. CLAMP L - clamping of valve (flap) seat in the first bumper position of the actuator piston rod

- Set the **CLAMP L** function using buttons Δ or ∇ :

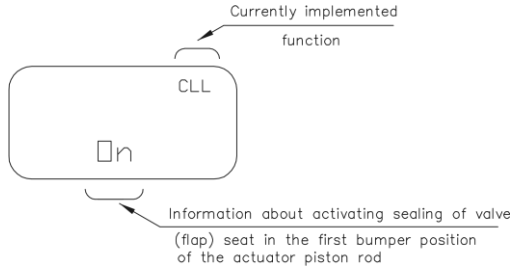


- Press the button $\leftarrow$; the following will appear on the display:

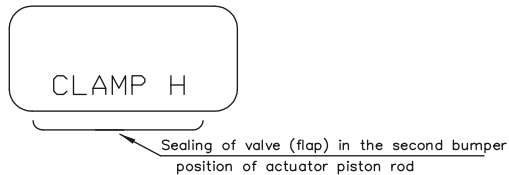


If the user does not intend to activate valve (flap) clamping function in the first bumper position of the actuator piston rod then he/she should press the button $\leftarrow$.

If the user intends to activate valve (flap) clamping function in the first bumper position of the actuator piston rod then he/she should press the button ∇ or Δ once; then the following will appear on the display:



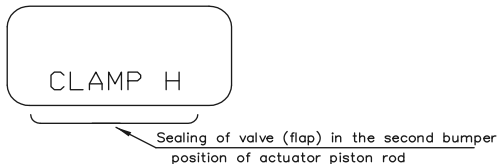
- Confirm the activation of valve (flap) seat clamping function in the first bumper position of actuator piston rod by pressing the button ; the following will appear on the display:



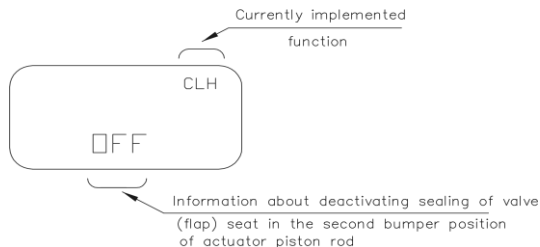
Clamping of valve (flap) seat in the first bumper position of the actuator piston rod is factory set as switched off (OFF)

11.2.3.20. CLAMP H - clamping of valve (flap) seat in the second bumper position of the actuator piston rod

- Set the **CLAMP H** function using buttons or .

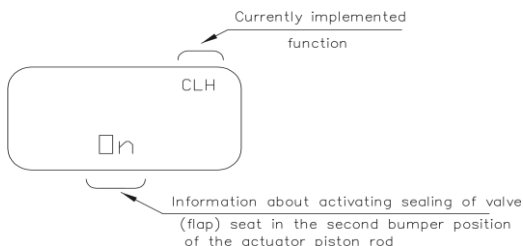


- Press the button ; the following will appear on the display:

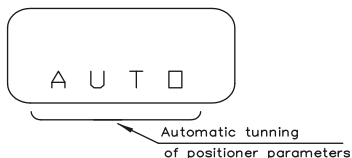


If the user does not intend to activate the valve (flap) clamping function in the second bumper position of the actuator piston rod then he/she should press the button .

If the user intends to activate the valve (flap) clamping function in the second bumper position of the actuator piston rod then he/she should press the button ▽ or Δ once; then the following will appear on the display:



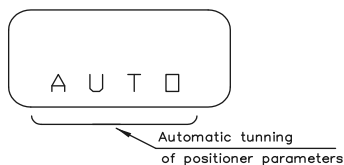
- Confirm the activation of valve (flap) seat clamping function in the second bumper position of actuator piston rod by pressing the button ↵ ; the following will appear on the display:



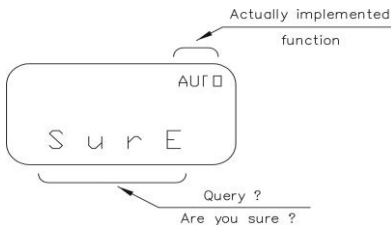
Clamping of valve (flap) seat in the second extreme position of the actuator piston rod is factory set as switched off (**OFF**)

11.2.3.21. ***AUTO – automatic tuning of settings of the positioner***

- Set the **AUTO** function using buttons Δ or ▽



- Press the button ↵ ; the following will appear on the display:



If the automatic tuning function for the positioner should be skipped, then the user should press the button ▽ or Δ , which results in the exit from the AUTO function.

- Press the button ↵ :
Automatic tuning procedure for positioner will start.



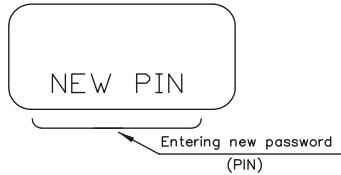
Because of several movements (in/out) of the actuator piston rod during performing of the **AUTO** function, the user should be particularly careful.



Selection of control pressures for actuator chambers (**PRESS. A** and **PRESS. b**) applies only to **APIS-2XX-....**

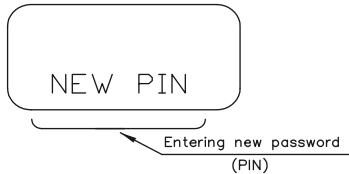
Duration of the function **AUTO** depends on volume of actuator chambers and changes from 30 sec. to several minutes.

Ending of the automatic tuning algorithm of parameters of the positioner is signaled by the text on the display:

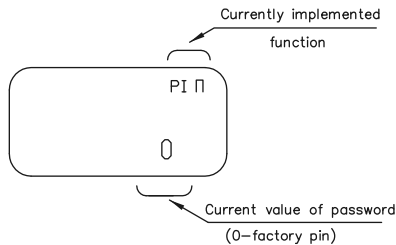


11.2.3.22. NEW PIN – entering a new numerical password (PIN)

- Set the **NEW PIN** function using buttons Δ or ∇



- Press the button $\leftarrow$; the following will appear on the display:

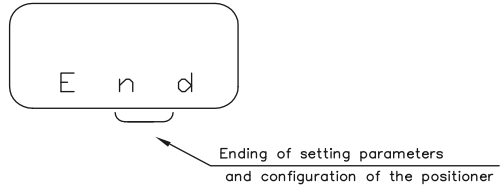


- The numerical values of new password (according to the wish of the user) should be set by pressing and/or holding the button Δ , or ∇ .



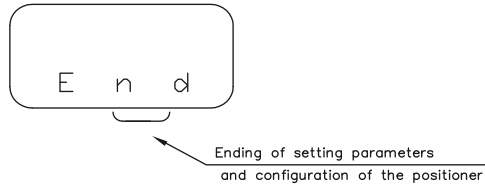
Factory set value for **PIN** - **0**. Maximum number of characters - 4.

Press the button $\leftarrow$ after entering the new PIN; the following will appear on the display:

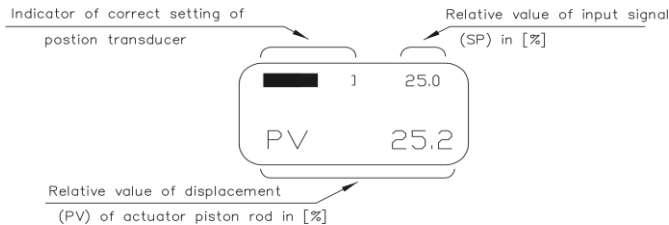


11.2.3.23. **END** – the end of settings of the parameters and configuration of the positioner

- Set the **END** function using buttons Δ or ∇

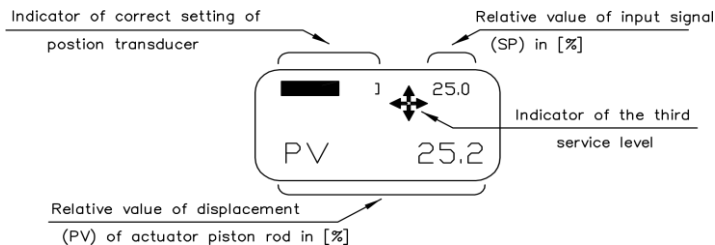


The user should press the button $\leftarrow$ to finish entering parameters and configuration of the positioner; then the following will appear on the display e.g.:



This information indicates the 1st service level (normal operation mode) of the positioner.

The user should press the button ∇ to continue setting the parameters and configuration of the positioner ; then the following will appear on the display e.g.:



The above information indicates that we are at the top of the third service level.

11.3. Starting positioner - actuator assembly



Do not rub plastic components of the positioner in hazardous areas during works related to the positioner due to the possibility of accumulation of static charges.

- a) Positioner APIS-100-... installed on the actuator acc. to point 10.2...10.4. should be connected with the measuring system acc. to the diagram presented in Fig. 16.

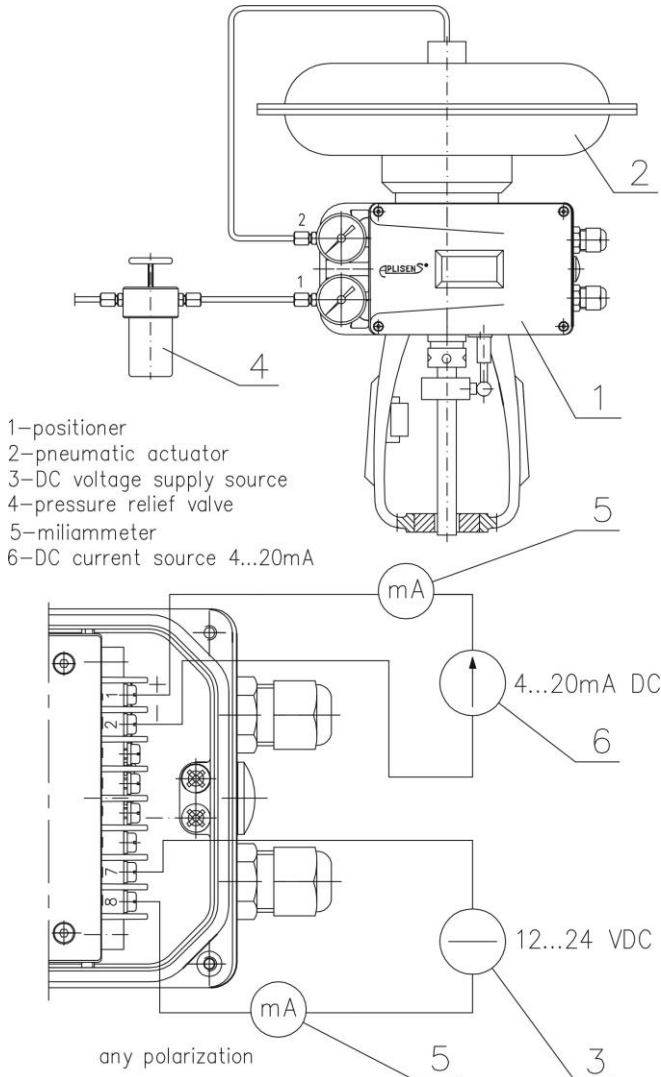


Fig. 16. Diagram of measuring circuit for starting APIS-1X0-... positioner (single-acting membrane actuator)

- Positioner APIS-1X0-... and APIS-2X0-... installed on the actuator acc. to sect. 10.5. should be connected acc. to the diagram presented in Fig. 17.

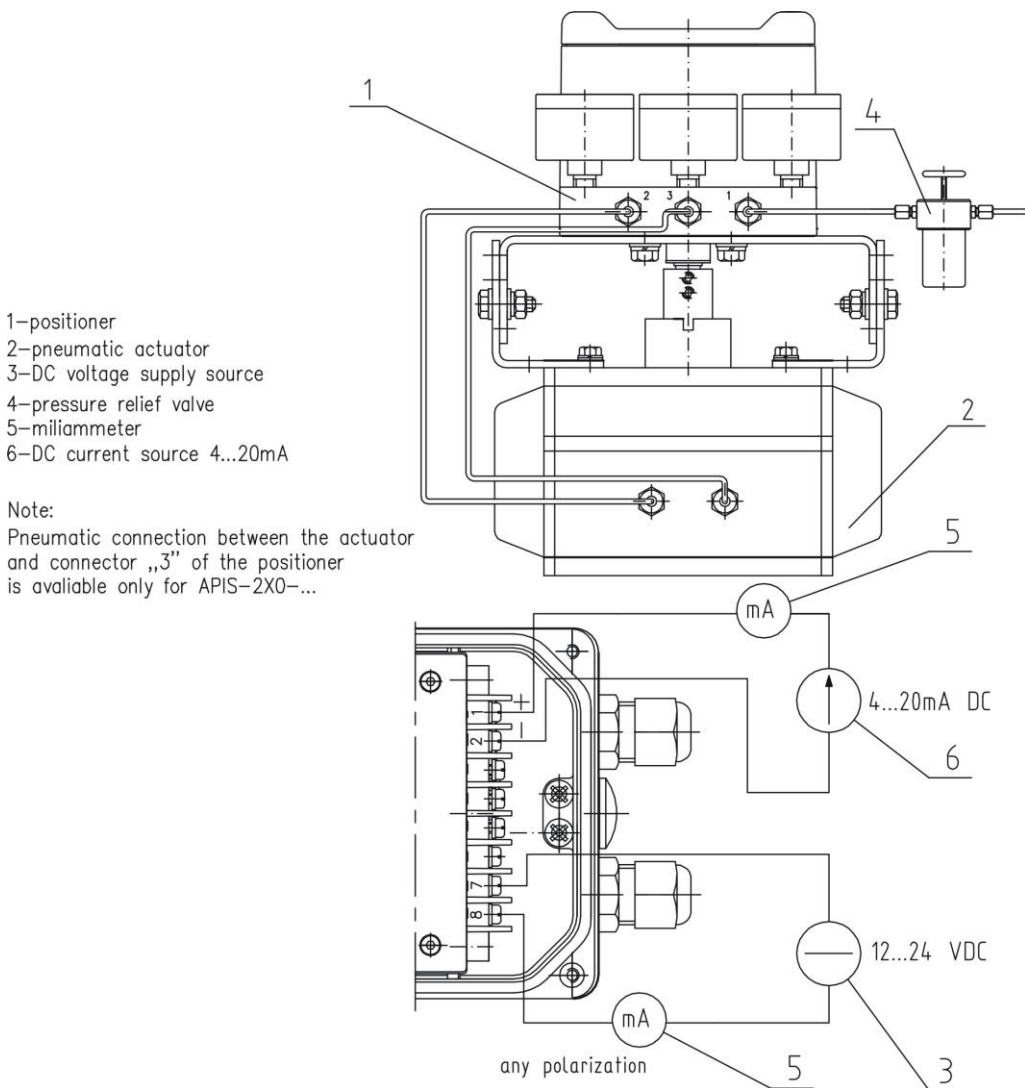


Fig. 17. Diagram of wiring for launching APIS-1X0-... and APIS-2X0-... positioners single/double-acting rotary actuator)

- Positioner APIS-2X1-... and APIS-2X2-... installed on the actuator acc. to sect. 10.6. should be wired acc. to the diagram presented in Fig. 18.

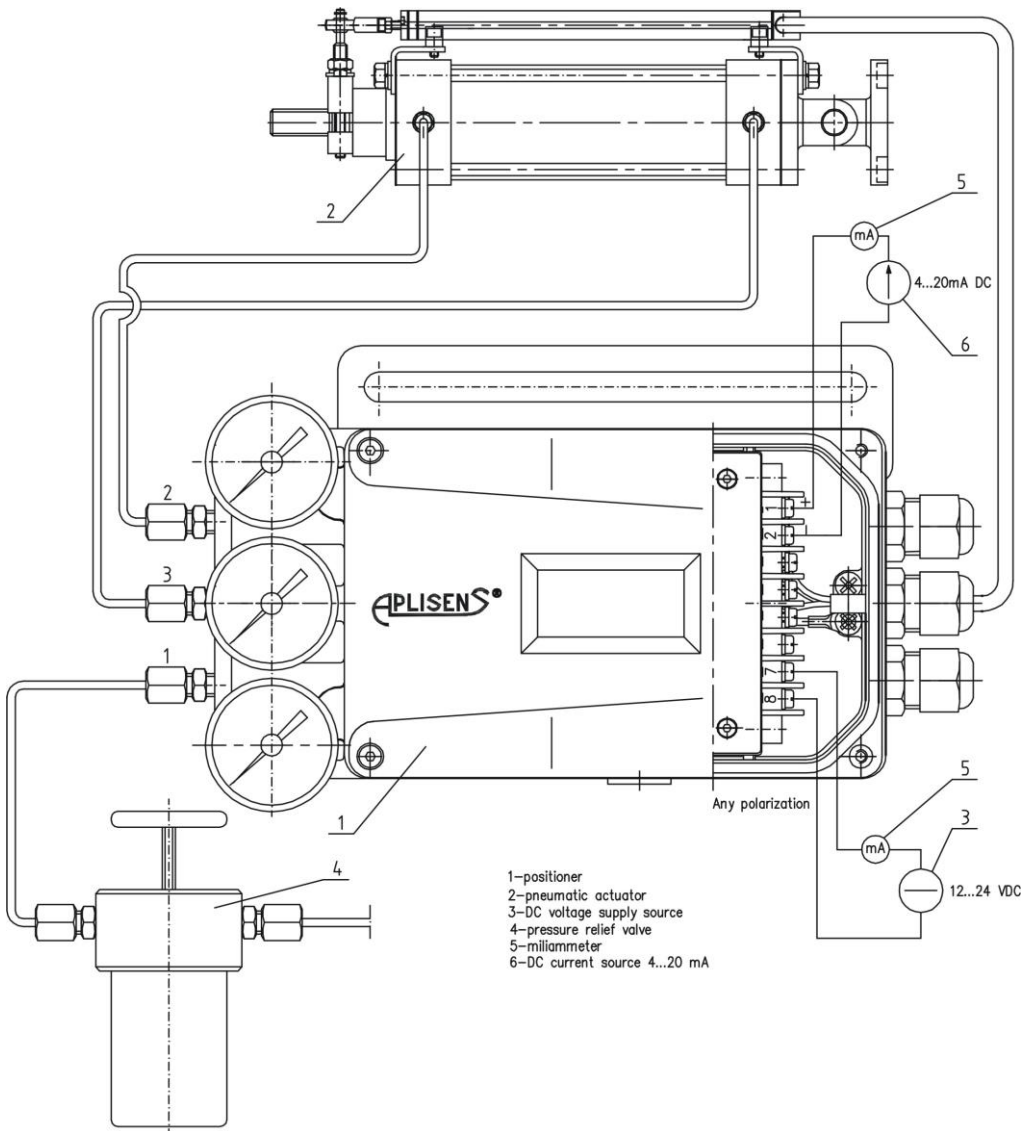
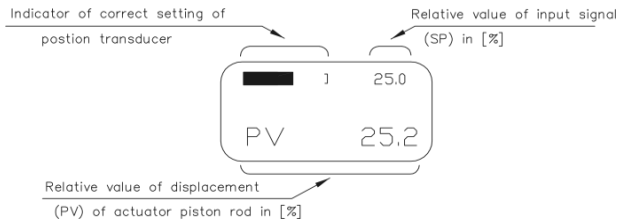


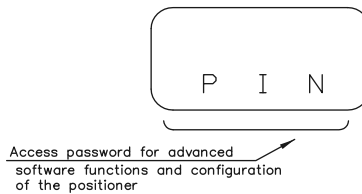
Fig. 18. Diagram of wiring circuit for launching APIS-2X1-... and APIS-2X2-... positioner (linear double-acting actuator)

b) Apply input signal with value 8 ± 0.5 mA from the DC current source. The following will appear on the display e.g.

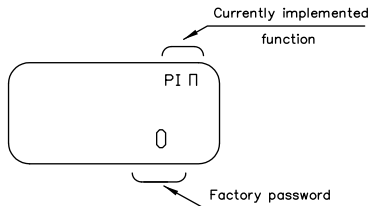


This information indicates that the positioner is at the I (1st) service level (normal operation mode).

- c) Set the supply pressure for an actuator to e.g. 140 kPa using the pressure controller.
- d) Then switch to the second service level. For this purpose, press the buttons Δ and ∇ at the same time. The display will show:

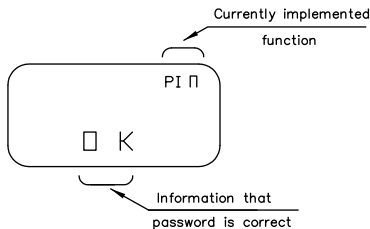


- o Press the button $\leftarrow$; the following will appear on the display:

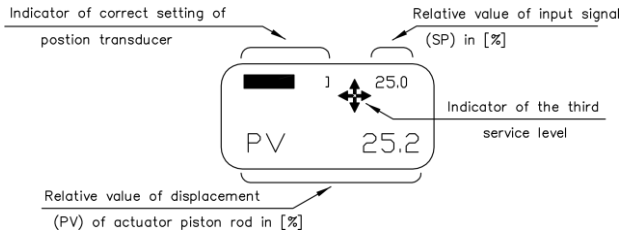


If the factory password has been already changed then it should be set using buttons Δ and ∇ .

- o Confirm the password with a button $\leftarrow$; the following will appear on the display:

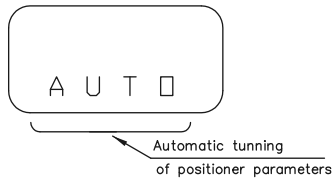


Above texts will disappear from the positioner display after approx. 1 s. Then the following will be displayed e.g.:

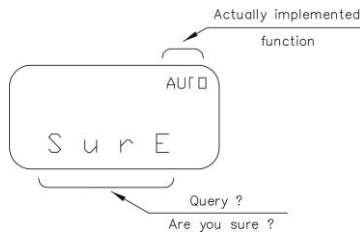


The above information indicates that we are at the third service level of the positioner (parameters setting and configuration mode).

- the user should move to the following text on the display by pressing and/or holding the button Δ , or ∇ :



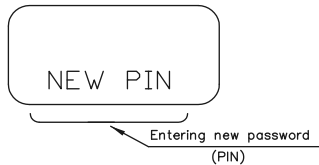
- Press the button $\leftarrow$; the following will appear on the display:



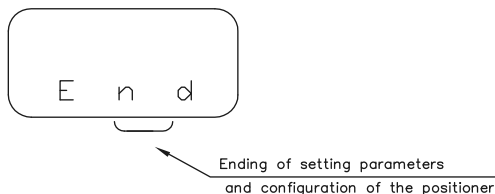
- Press the button $\leftarrow$:

Wait for ending the operation of the automatic tuning of for the positioner.

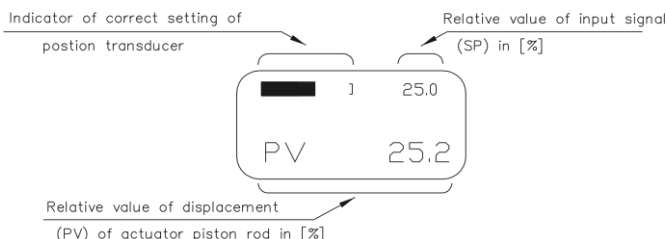
After completion of automatic tuning of positioner parameters, the following will appear:



- Press the button ∇ once; the following will appear on the display:

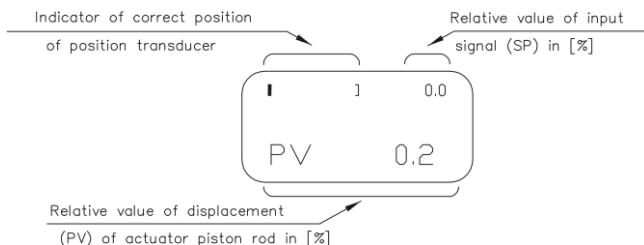


- Press the button ; the following will appear on the display:



The above information indicates that we are at the first service level of the positioner.

e) Current programming device item 6 – e.g.: Fig. 16 decrease input signal to 4 ± 0.01 mA; The following will appear on the display e.g.:



Relative value of displacement of actuator piston rod on the display should be equal to $0 \pm 0.4\%$.

f) Check operation of the positioner by changing input signal in the range 4...20 mA. It should include smoothness of operation and lack of stops and vibrations. If this condition is not fulfilled then the user should adequately correct the parameters of the PID controller that is parameters **k_p , T_i , T_d** , and additionally **RAMP** parameter.

11.4. Electrical connections of the positioner

Commissioning of the positioner with actuator and control valve is carried out by applying the given input (control) signal from the system controller and applying suitable supply pressure.

Pneumatic wiring diagram of the positioner is presented in the Fig. 16...18, and electrical wiring diagram in the Fig. 19 (depending on version of the positioner).



Unused electrical gland during normal operation should be replaced with blanking component (plug) enclosed to the positioner.

11.4.1. Electrical wiring diagram of positioner for the executions with build-in (internal) displacement transducer applies for executions APIS-XXX-...

Example of connection of a communicator for communication using HART transmission

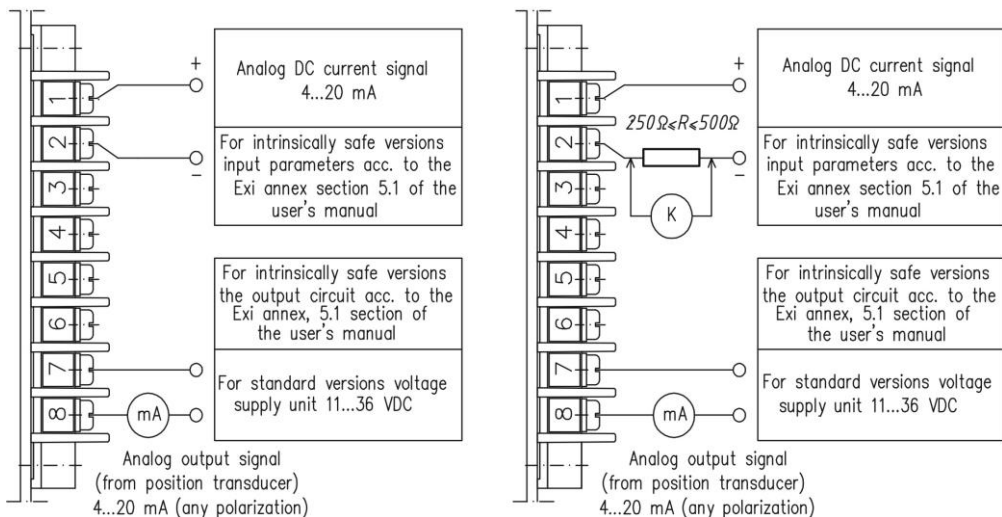


Fig. 19a. Electrical wiring diagram of the positioner's version with build-in displacement (position) transducer

11.4.2 Electrical wiring connections of the positioner for execution with external displacement transducer (applies for executions APIS-XX1-...)

In case of executions of positioner with external position transducer it is strongly recommended to carry out the electrical connections accordingly to the following rules:

- The only one terminal of the shield of the cable of the displacement transducer must be connected with terminal #2 of the positioner as in Figures 19 b,c,d,e;
- If the shield of the cable of potentiometer is connected galvanically to potentiometer's case (Fig. 19c) then the potentiometers case should not be grounded (in order to disrupt current loop).
- If the second terminal of the shield of the cable is separated from potentiometer's case (Fig.19b) then it is recommended to connect positioner's and potentiometer's cases by means of external wire.

In remaining cases (Fig.19d,e) the electrical connection between both cases is ensured by the common grounding.

example of connection of a communicator for communication using HART transmission

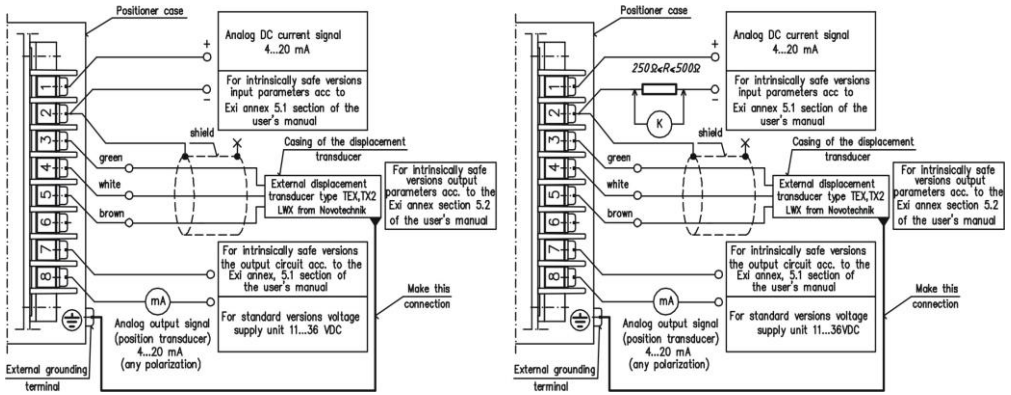


Fig. 19b Wiring position for executions with an external displacement transducer if:

- The shield of the potentiometer cable is disconnected from the case of the potentiometer;
- The displacement transducer and positioner are galvanically isolated. Please note that in this case is necessary to connect both cases by means of an external wire

Example of connection of a communicator for communication using HART transmission

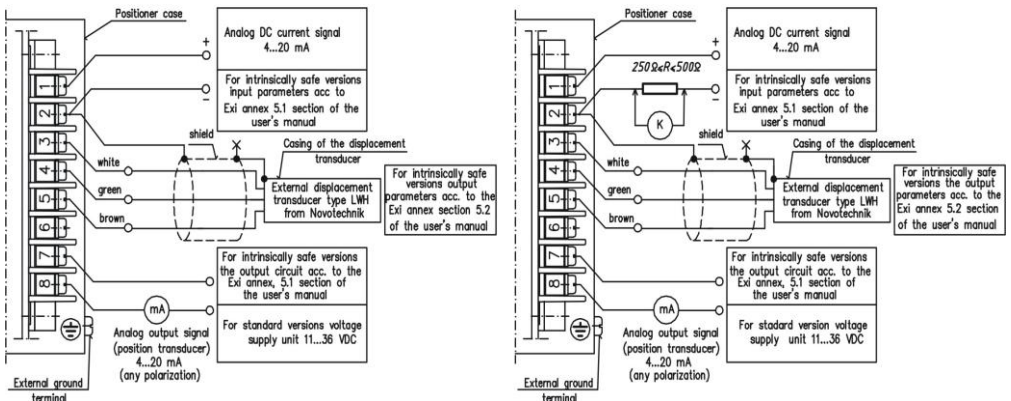


Fig.19c Wiring of positioner for the executions with an external displacement transducer if:

- The shield of the potentiometer cable is galvanically connected with the case of potentiometer;
- The potentiometer and positioner cases are electrically separated

Example of connection of a communicator for communication using HART transmission

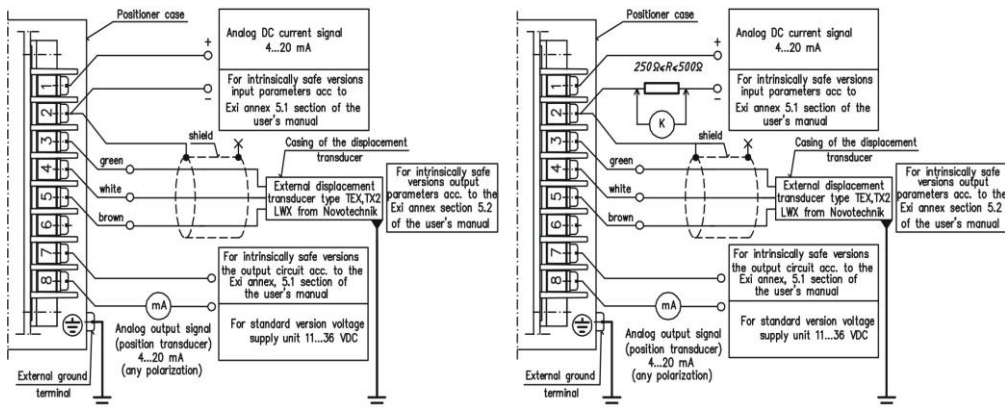


Fig.19d Wiring of positioner for the executions with an external displacement transducer if:

- The shield of the potentiometer cable is galvanically disconnected with the case of potentiometer;
- The potentiometer and positioner cases are electrically separated

Example of connection of a communicator for communication using HART transmission

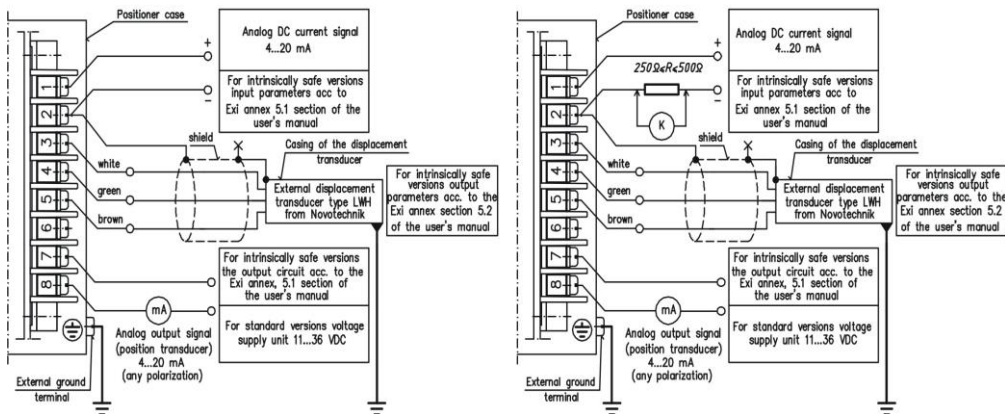


Fig. 19e Wiring diagram of the positioner for executions with an external displacement transducer if:

- The shield of the cable is galvanically connected with the case of potentiometer;
- The potentiometer and positioner cases are electrically connected and grounded

11.5. Operation

Correctly installed positioner and set for operation does not require any servicing during operation except the periodic maintenance. The condition for correct operation is proper preparation of supply air in accordance with the requirement given in the section 7.

11.6. Disassembly of the positioner

If it is necessary to dismount the positioner:

- a) Reduce the supply pressure to zero;
- b) Shutdown the current input signal (control);
- c) Disconnect electrical conductors of the input signal and pneumatic conductors of supply pressure and output from the positioner, secure pneumatic tips of the positioner against the contamination
- d) Undo fixing screws and remove the positioner with support from the actuator or structural component, on which the positioner was installed (applies to APIS-1X0-... with mounting kit APIS-A001 and APIS-A002)
- e) Disassemble from the actuator:
 - extension arm set with clamping rings (applies to APIS-1X0-... with mounting kit APIS-A001 and APIS-A002)
 - board set with clamping rings (applies to APIS-1X0-... with mounting kit APIS-A000 and APIS-A003)
 - support (applies to APIS-1X0-... and APIS-2X0-... with mounting kit APIS-A050)
 - two supports, linear displacement transducer, extension arm and clamping ring (applies to APIS-2X1-... version with mounting kit APIS-2X1-AXXX).
- f) Components disassembled in point e) should be fixed to the positioner in a way preventing loosening them further storage and possible packaging of the positioner for shipment should conform the requirements given in chapter 8 and 9.

12. MAINTENANCE

Check tightness of the pneumatic hoses every six months or more often and tighten nuts on the connectors. Detected leaks should be immediately eliminated. The user should maintain periodic inspections of filtering equipment located in the supply line of the positioner to ensure adequate cleanness of working medium.

13. DAMAGES AND REPAIRS

Table 2 Troubleshooting

No.	Damage	Causes of damage	Removal method
1	Incorrect indications of the supply pressure gauge	Supply reducer damaged or shutdown Defective pressure gauge	Damage outside the positioner Replace pressure gauge
2	Incorrect indications of the output pressure gauge	Defective pressure gauge	Replace pressure gauge
3	No indications on the positioner display	Source of input signal damaged or shutdown Input signal cables damaged. Input signal below 3.2 mA	Damage outside the positioner. Replace cables. Damage outside the positioner

4	The positioner does not respond to changes of input signal Output pressure equal to zero	Damaged connection or no connection between electropneumatic converter or displacement transducer and electronic controller. Leak between body of the positioner and input chamber of actuator or electropneumatic converter.	Replace damaged connector or connect correctly. Remove leaks
5	Actuator does not respond to changes of output pressure from the positioner	Cable connecting positioner with actuator damaged or crushed. Actuator or valve seized,	Replace the cable. Damage outside the positioner
6	Unstable operation of the actuator (vibrations of actuator piston rod)	Too high gain coefficient k_p value, too low value of integral action time T_i , leaky actuator	Decrease gain coefficient k_p of the controller (see sec. 11.2.3.6), increase integral action time of the controller (see sec. 11.2.3.7) Damage outside the positioner Increase value PRESS A (see sec. 11.2.3.18), PRESS b (see sec. 11.2.3.19).
7.	Too slow displacement of the actuator piston rod	Too high value of time constant RAMP of actuator piston rod. Too high pressure in chamber A or b or both chambers of the actuator	Decrease value of time constant RAMP of actuator piston rod (see point 11.2.3.9) Decrease value PRESS A (see sec. 11.2.3.18), PRESS b (see sec. 11.2.3.19)
8.	Too quick displacement of the actuator piston rod	Too low value of time constant RAMP of actuator piston rod. Too low pressure in chamber A or b or both chambers of the actuator.	Increase value of time constant RAMP of actuator piston rod (see sec. 11.2.3.9) Increase value PRESS A (see sec. 11.2.3.18), PRESS b (see sec. 11.2.3.19)



All repairs should be carried out by the manufacturer or authorized service. The manufacturer shall not be responsible for safety and correct operation of the product in case of repairs carried out by the third parties.

14. SPARE PARTS

Table 3 List of spare parts

Item No. acc. to the Fig. 20.	Part name	Drawing no. (Ordering code)	Notes
1	Electropneumatic converter	APIS-H001-100	Applies to APIS-XXX-...-RSt-... versions
2	Electronic unit	APIS-B121-110	Applies to: APIS-1X0-...-RSt-...
		APIS-B121-100	Applies to: APIS-2X0-...-RSt-...
		APIS-B122-210	Applies to: APIS-1X4-...-RSt-...
		APIS-B122-200	Applies to: APIS-2X1-...-RSt-... and APIS-2X2-...-RSt-...
		APIS-B121-300	Applies to: APIS-2X3-...-RSt-...

3	Pressure gauge - housing made of steel, black, glass pane	M40T-2,5-NPT1/8"; 0-1MPa	Applies to: APIS-XXX-...-RSt-...-M1-...
4	Pressure gauge - housing made of acid resistant steel, glass pane	M40T-2,5-NPT1/8"; 0-1MPa	Applies to: APIS-XXX-...-RSt-...-M2-...
5	Pressure gauge made of acid resistant steel, glass pane	RCh 40-3rm, rear central connector, range 0...1 MPa.	Applies to: APIS-XXX-...-RSt-...-M3...
6	Sealing	APIS-H001-200	Applies to APIS-XXX-...-RSt-... versions
7	Linear displacement converter	APIS-H002-...	Not visible on Fig. 20, applies to APIS-2X1-...-RSt-... Please provide stroke and diameter of actuator piston rod during ordering
8	Sealing	ON 145x3	Applies to APIS-XXX-...-RSt-... versions

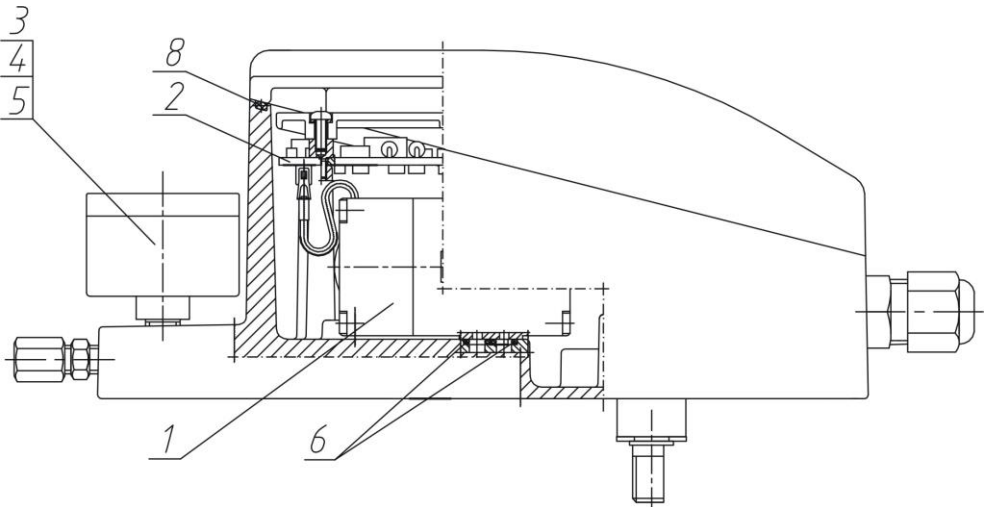


Fig. 20. Positioner type APIS. Location of the spare parts.

