Installation, Operation, and Maintenance Instructions
ES-09373-1 rev AF
March 2025

Emerson TopWorx ™ PD100

Smart Valve Positioner

Safe Use - User Instructions

⚠ WARNING

To reduce risk of death, serious injury or property damage:

- Personnel installing, maintaining, or operating this equipment must be qualified, must read, understand, and follow these instructions before proceeding.
- This document must be retained for future reference.
- Please contact local Topworx representative for questions, clarifications, or comments.

NOTICE

Instructions for safe selection, installation, use, maintenance, and repair

- Do not use the positioner outside the operating range, as doing so may cause failures or even accidents with serious injuries. See Section 2 - Specifications.
- For installation in a potentially explosive atmosphere, make sure you have the positioner correctly specified for this purpose. Products for explosion hazard areas have the -EN suffix at the end of the code.
- Never touch the moving parts of the positioner when it is in operation, as the movement of the valve may cause accidents with serious injuries
- The positioner must be installed by qualified technical personnel. We warn of the risk of damage to persons and goods resulting from improper installation or configuration.

Warning Symbols Used in this Manual

This manual contains notes that must be observed for your personal safety as well as to prevent material damage.

The following symbols and explanations are listed according to their degree of danger:

⚠ DANGER

DANGER indicates a hazardous situation which, if not avoided, will result in death or serious injury.

⚠ WARNING

WARNING indicates a hazardous situation which, if not avoided, could result in death or serious injury.

⚠ CAUTION

CAUTION indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

NOTICE

NOTICE is used to address practices not related to physical injury.

Table of Contents

Section 1: Introduction

The PD100 Smart valve positioner is Type 4X and IP66 rated and designed to operate in the harshest environmental conditions. Proportional air consumption and fast response contribute to efficient operation and the device is unaffected by vibration.

The PD100 is compact and can be installed on rotary or linear actuators and is used in single or double acting actuator applications. It is powered directly by the control current loop from 4 to 20mA.

The EN version is certified as non-incendive and indicated for installation in potentially explosive atmospheres of flammable gases and vapors in Class I, Div 2 environments.

1.1 General Notes

The positioner leaves the factory with default settings and must be installed and configured following the information in this manual. In addition, special care must be taken during transport, storage, operation and maintenance according to industrial standards and in compliance with technical regulations.

This manual contains the information necessary for the proper use of the positioner. It is intended for qualified and authorized technicians who have received applicable training or have general knowledge in the field.

Knowledge and technical application of the safety instructions and warnings in this manual are of utmost importance for risk-free mounting and commissioning. This will ensure safety during operation and maintenance of the product.

This manual is not an integral part of the delivery of the positioner and is subject to change without notice. The manual is available for download on our website at www.emerson.com

For the sake of clarity, the manual does not contain all the detailed information on all versions of the product described, nor does it refer to all possible cases of installation, operation, maintenance and use in systems. If you need additional information or if problems arise that are not mentioned in this documentation, please ask our application engineering department for the necessary information.

Special attention must be paid to the warning texts. These texts are specially marked by their symbols. See Safe Use - User Instructions on page 1 for Warning symbols used in this manual.

1.2 Proper Use

The PD100 positioners are electro-pneumatic position controllers intended for positioning rotary or linear final control elements and may only be used for the applications described in the instruction manual or in its data sheet.

The positioner was developed in accordance with the current safety standards. Before field installation, make sure you have the correct positioner for your environment.

1.3 Qualified Technical Staff

Installation, configuration and maintenance of the positioner is permitted only by technicians qualified to perform this procedure in accordance with the information in the operating instructions.

The responsible technician must be familiar with the process and be able to identify risks and avoid potential dangers both during installation and during setup and maintenance of the positioner.

1.4 Exclusion of Liability

This manual contains the most relevant information for the positioner to be mounted and configured correctly.

It is the responsibility of the technician to know the safety regulations and practices applicable in your country. It is also your responsibility to read and understand the information described here.

In case of questions, the technician must contact our application engineering to answer them prior to installing/ configuring the positioner.

All mounting and configuration of the positioner must be performed by qualified personnel strictly following the guidelines contained in this manual.

Emerson TopWorx is not responsible for damages caused to persons or property resulting from incorrect installation and/or configuration.

Section 2: Specifications

Table 1 Specifications

Physical Specification	Min.	Typ.	Max.
4-20mA input Signal	3.6 mA	4-20 mA DC, Nominal	25 mA (Overcurrent Protection)
Input Voltage	12.2 VDC for analog control		35 VDC
Overcurrent Protection		Yes	
Reverse Polarity Protection		Yes	
Operation with reverse Polarity		Yes	
Voltage Drop		12.2 VDC @ 4 mA DC / 24 VDC	
Impedance - Input		470 Ω@ 20 mA / 24 VDC (external power supply)	
Impedance - Output		800 Ω @ 20mA / 24 VDC	
Linearity		0.8% of Full Scale	
Hysteresis		1.5% of Full Scale	
Repeatability		1.45% of Full Scale	
Minimum Step Response		≥0.3125% Full Scale or ≥50 µA	
Start-up		8 seconds	
Insulation Resistance		> 25 G [ohms] Approved in dielectric resistance test 500 VDC	
Operating Temperature Limits	-40 °C (-40 °F)	LCD may not be readable below -20 °C (-4 °F)	65°C (149 °F)
Output Signal		Actuator Output from 0 to 100% of the supply pressure	
Valve Action		Single, Double, Direct Action and Reverse Action	
LCD-PD100		Digital – 4 Digit Numeric	
Shaft Operating Range	60°		120°
Stroke Range Linear	10 mm		200 mm
Supply Air Pressure[1]	40 psi (2.8 bar)		116 psi (8bar)
Maximum Bearable Pressure [2]			145 psi (10 bar)

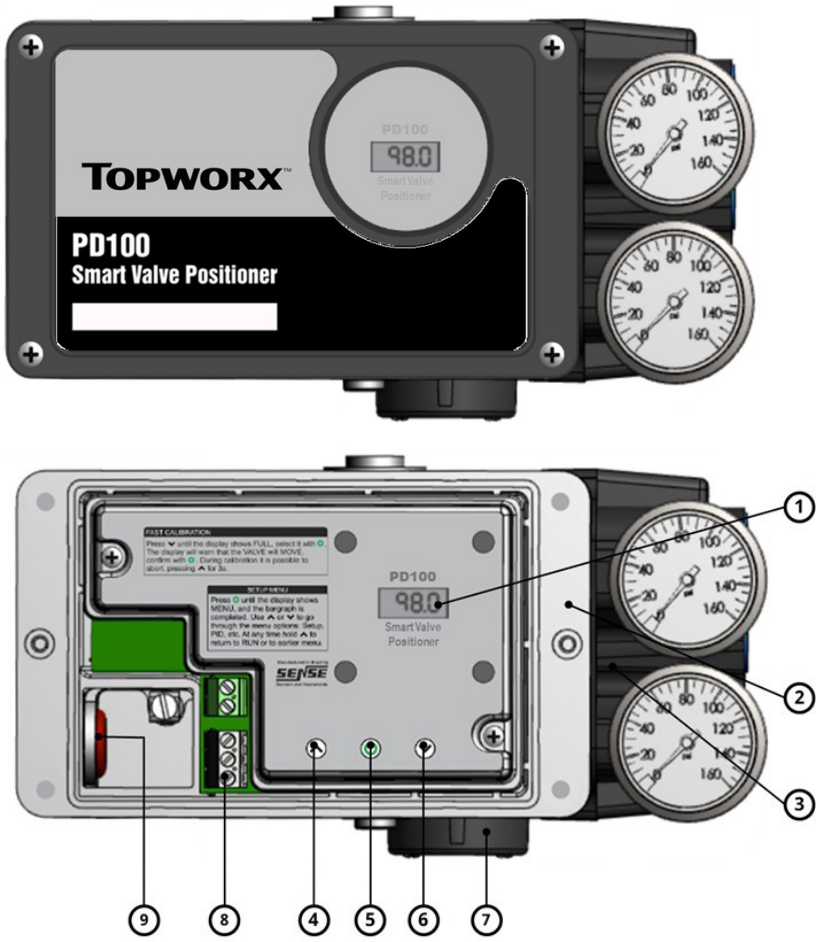
Output Position Transmitter		Nominal signal range: 4 - 20 mA Power Supply: 10 – 27 Vdc External Load Resistance: 800 Ω @ 24 Vdc Position Error: < 0.33% Temperature Error Effect: 0.01%/K °C Resolution: < 0,33% Output Type: Electrically isolated output	
Air Consumption		8.8 l/min = 0.5 N m3/h = 0,31 scfm = 18.6 scfh considering the pressure of 60 psi = 4.1 bar	
Maximum air output		311 l /min = 17.7 N m3/h = 11 scfm = 660 scfh considering the pressure of 60 psi = 4.1 bar	
Valve Flow Characteristics		Linear	
Pneumatic Connections		Supply and Output Pressure: ¼”NPT Female	
Conduit Connections		½” NPT Female	
Housing and Cover Material		FARADEX	
Display window		Polycarbonate	
Module Base Assembly		Aluminum	
Manifold		ZAMAK 5	
Elastomers		Fluoroelastomer	
Protection class		Type 4X, IP66	
Weight		2.2 Kg	

Note 1: or the maximum pressure allowed by the actuator.
Note 2: Although the positioner will resist this pressure, it is not recommended to work at this pressure as it will affect the accuracy and stability of the controller.

Section 3: Overview

See below for parts of the PD100 positioner. To access the mechanical configuration buttons and electrical terminals, you must remove the product cover.

Figure 3-1 Overview

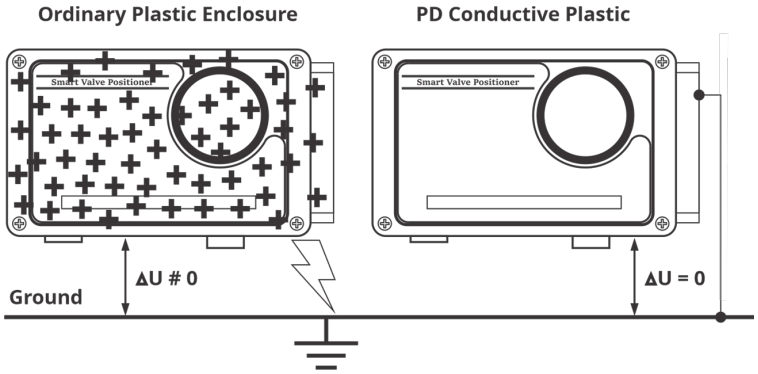


Item	Description
1	Four-Digit LCD display
2	Plate Cover
3	Manifold with Pressure Gauges
4	Mechanical UP Button
5	Mechanical ENTER Button
6	Mechanical DOWN button
7	Air Exhaust
8	Electrical Terminals (Control and Feedback Signals)
9	Cable Entry

3.1 Enclosure

Enclosure manufactured with conductive type resin. This allows the housing to be grounded to avoid the accumulation of electrostatic charges that in classified areas can cause the ignition of the explosive atmosphere. The torque specification for securing the enclosure cover is 2.5 Nm.

Figure 3-2 Enclosure



3.2 Identification Label Information

Figure 3-3 Front Label

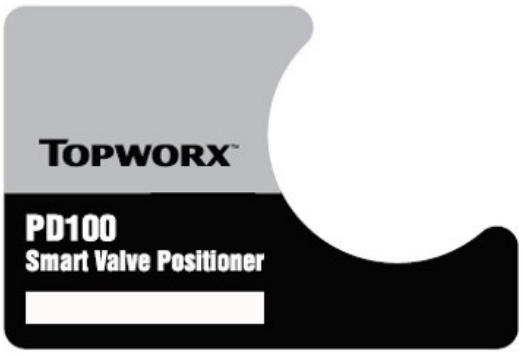


Figure 3-4 Side Label

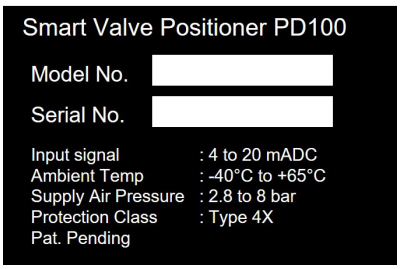
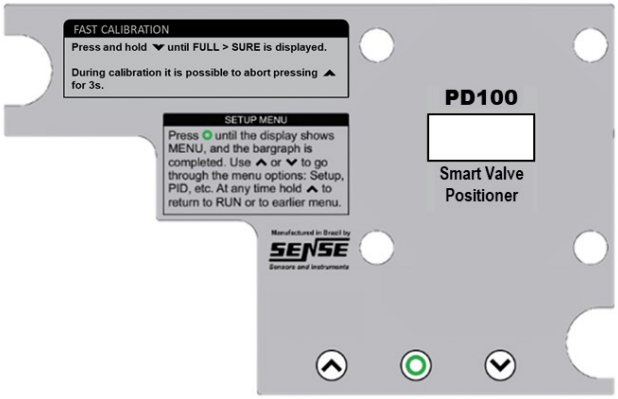


Figure 3-5 Internal Label



Front Label

This label contains the following information:

- Manufacturer ID
- Order code

Side Label

This label carries the following information:

- Model number
- Serial Number
- Operation Information

Internal Label

This label contains the following information:

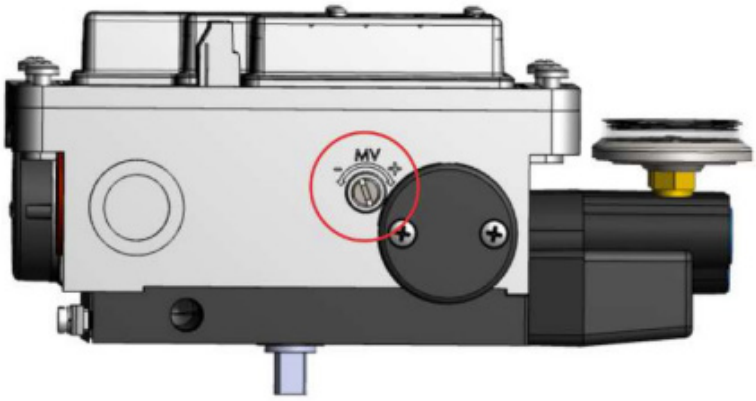
- How to perform a quick calibration
- How to enter and navigate the configuration menu

3.3 Manipulated Variable

The Manipulated Variable (MV) represents the force exerted by the electro-pneumatic system of the positioner to maintain balance at the control point. This force is the result of all the internal subsystems of the positioner.

The MV adjustment is found on the side of the housing, protected by a screw. This adjustment is initially set at the factory during production to balance the forces on the internal components. It should only be readjusted by a qualified technician at the factory, following maintenance or replacement of any internal component.

Figure 3-6 MV Adjustment Location



NOTICE

Avoid adjusting the MV setting, as doing so can disrupt the balance of forces within the positioner's internal subsystems. This imbalance can impair its operation, causing errors in valve positioning or even making the system unstable, potentially resulting in a loss of process control.

3.4 Scope of Supply

Check the packaging immediately after receiving the product. Make sure that the contents are undamaged and that they are in accordance with the scope of delivery and as described on the invoice. If there are any discrepancies, please contact us immediately.

The positioner is supplied in a closed package containing the following items:

- Intelligent electropneumatic positioner
- Linear or rotary actuator adaptor (as specified)

Section 4: Principle of Operation

The PD100 smart positioner is powered by the 4-20 mA loop, with the control signal. The supply air is connected to the inlet on the manifold and passes though the pneumatic spool valve that controls the valve position.

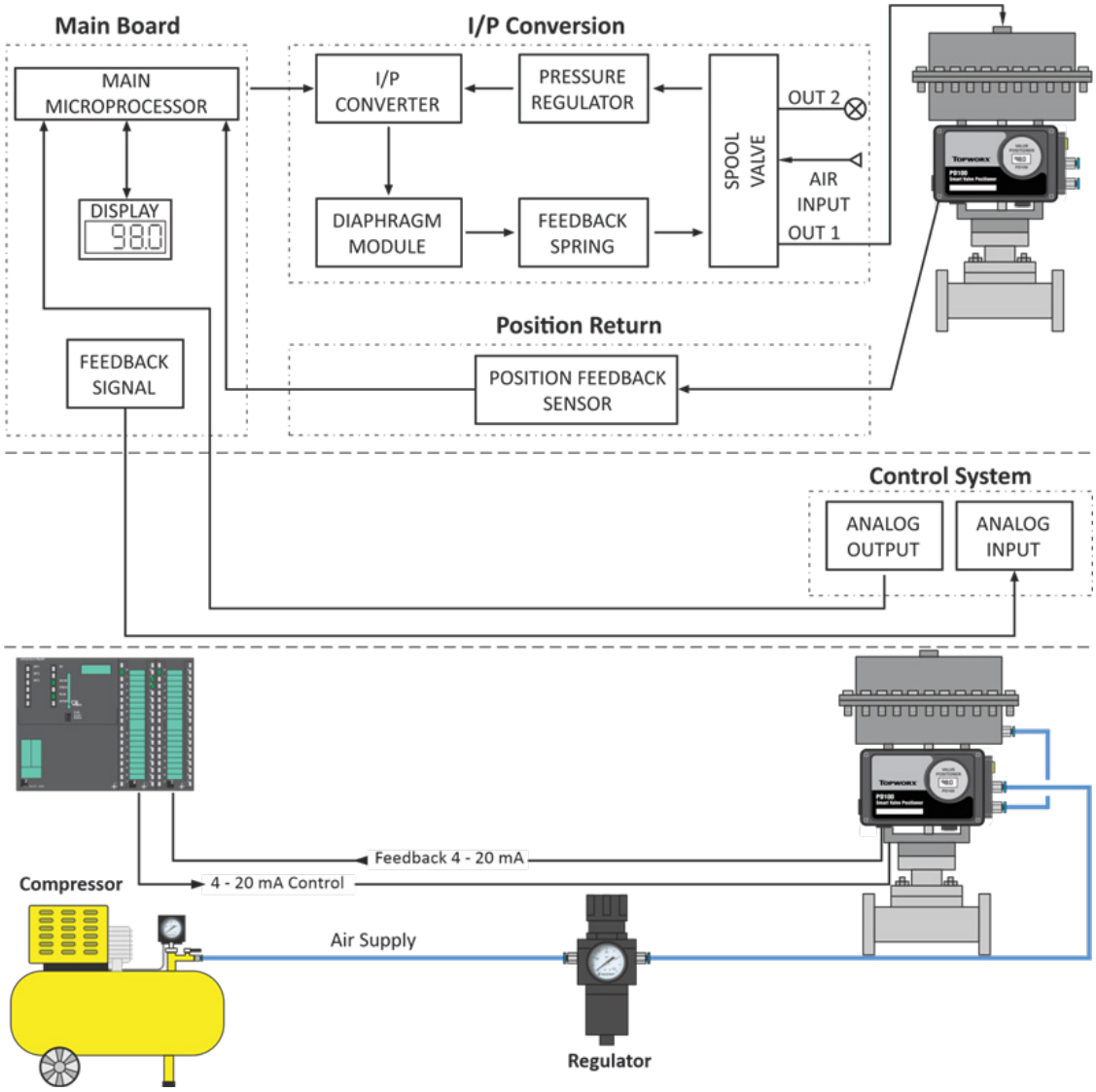
The air passes through the **Pressure Regulator** and reaches the **I / P Converter**.

The valve position is detected through the **Position Feedback Sensor** (Hall effect sensor) and transmitted to the electronic board (Main Microprocessor).

The fast microprocessor compares the control signal and the position feedback, and the difference is the input to the PID controller that will generate an appropriate signal (in frequency) to be applied to the coil of the I/P converter.

The **I / P Converter** is the nozzle / vane that generates a pressure signal to the **Diaphragm Module** that will create a dynamic force on the spring that breaks the balance of the spool valve, that then moves the valve to the new required position.The microcontroller repeats the process and when the difference between the requested position signal and the actual position feedback trends to zero, the interference of the Diaphragm Module will cease and there will be a new balance on the spool valve, and the valve will reach the new position.

Figure 4-1 Working Principle



Section 5: Mechanical Installation

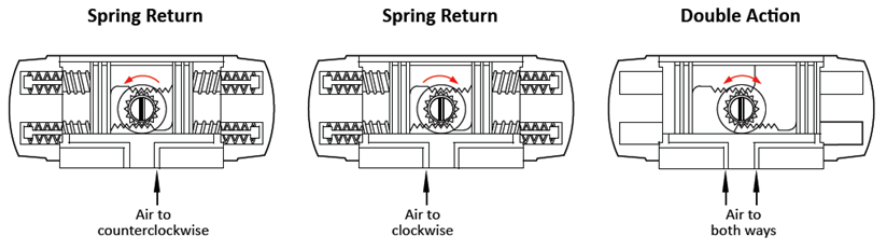
The installation of the positioner will depend on the actuator type (linear or rotary). The following shows the types of pneumatic actuators and a brief overview of their operation.

Be sure to install the air filter and regulator before the positioner. The supply pressure should be sufficient to fully open and close the valve.

5.1 What are Rotary Pneumatic Actuators?

Rotary pneumatic actuators are devices that convert the stored energy of compressed air into a rotary mechanical motion. These devices can be single-acting, where they receive air to open or close the valve and return to their original position by means of a spring, without the need for air, or double-acting, which requires compressed air to move in both directions.

Figure 5-1 Rotary Actuator Types

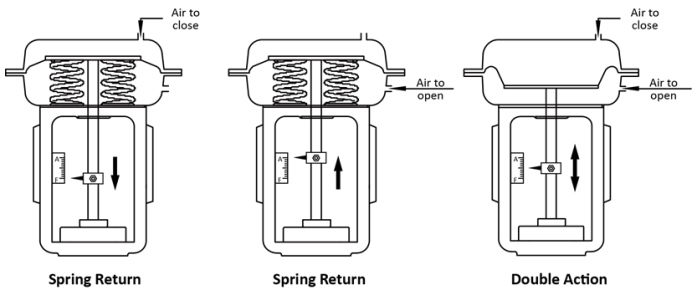


5.2 What are Pneumatic Linear Actuators?

Linear pneumatic actuators are devices that convert the stored energy of compressed air into a linear mechanical motion. This linear motion allows the valve to open or close.

Similarly, to rotary actuators, they can also be single-acting, requiring air for only one direction, or double-acting, requiring air for both directions.

Figure 5-2 Linear Actuator Types



⚠ WARNING

Observe the maximum pressure that the pneumatic actuator can withstand. Diaphragm actuators can be easily damaged by excessive pressure.

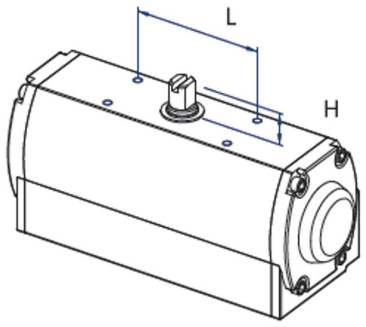
5.3 Rotary Actuator Installation

Depending upon the NAMUR mounting dimensions required, one of the existing TopWorx ISO/NAMUR quarter-turn rotary actuator VIP mounting kits, as listed below, will work with the PD Series Positioners.

For any other mounting pattern request,
please contact your Emerson representative.

Figure 5-3 Installation on a Rotary Actuator

	Mounting Hole Pattern Length (L)	
Shaft Height (H)	80 mm	130 mm
20 mm	4N20080-G41S	N/A
30 mm	4N30080-G41S	4N30130-G41S
50 mm	N/A	4N50130-G41S



NOTICE

When installing the mounting bracket on the positioner and the set on the rotary pneumatic actuator, observe the maximum torque indicated below:

Positioner on the mounting brackets (4xM6): 10 Nm (7.38 ft/lbs.).

Mounting bracket on the rotary actuator (4xM5): 10 Nm (7.38 ft/lbs.).

⚠ WARNING

Before installing the positioner, check the area classification. Never use a general-purpose positioner in a classified area with explosion risk. The positioner allows mounting to standard NAMUR rotary actuators (VDI/VDE 3835, IEC 60534-6-2). The figure below illustrates the parts of the universal rotary mounting kit.

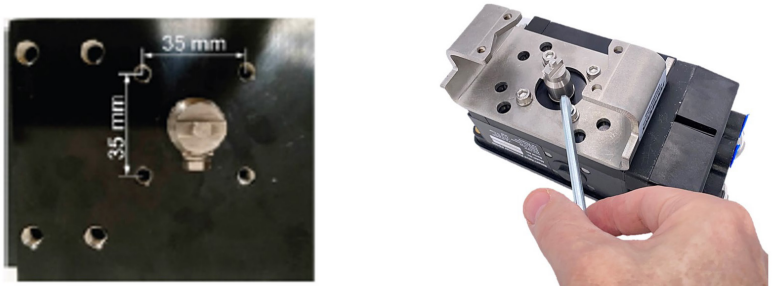
5.3.1 Mounting the Rotary NAMUR Bracket to the Actuator

1 - Mount the rotary adapter and tighten the screw with an 8 mm hex wrench.

Figure 5-4 Rotary Adaptor

2 - Mount the bracket to the positioner with four M6 x 10mm bolts with both lock washers and plain washers. The underside of the positioner has a standard 35mm x 35mm bolt pattern.

Figure 5-5 Universal Rotary Mounting Kit



⚠ WARNING

Do not touch the actuator shaft when it is running, as moving it may cause accidents with serious injuries.

⚠ CAUTION

Be careful when handling compressed air hoses, make sure the line is disconnected before connecting it to the positioner.

If actuator volume: Central chamber ≤ 0.6 liters (36 cu in.), End cap chamber ≤ 0.9 liters (53 cu in.), Displaced volume ≤ 0.3 liters (19.9 cu in.) accuracy and stability may be considerably affected.

NOTICE

The positioner can be installed at any starting angle and operates in any position, vertical or horizontal.

4 - Mount the positioner with bracket by engaging the positioner end cap on the shaft of the rotary actuator, attach the four M5x10 screws with lock washers and plain washers. Tighten the screws with an 8 mm wrench.

Figure 5-6 Fitting on the Actuator Shaft

5 - Make the pneumatic and electrical connections. See Section 6 Pneumatic Connections and item 7 Electrical Connections.

Figure 5-7 Tightening the Bracket Bolts

6 - Perform a fast calibration. See Section 8.3 - Fast Calibration.

Figure 5-8 Mounted Positioner

5.4 Linear Actuator Installation

See below the installation of the positioner on linear valves.

Figure 5-9 Installation on a Linear Actuator

⚠ DANGER

Before installing the positioner, check the area classification. Never use a General Purpose positioner in an area classified as an explosive atmosphere.

⚠ WARNING

Excess pressure can permanently damage the actuator diaphragm. Check the actuator manual for the maximum pressure supported.

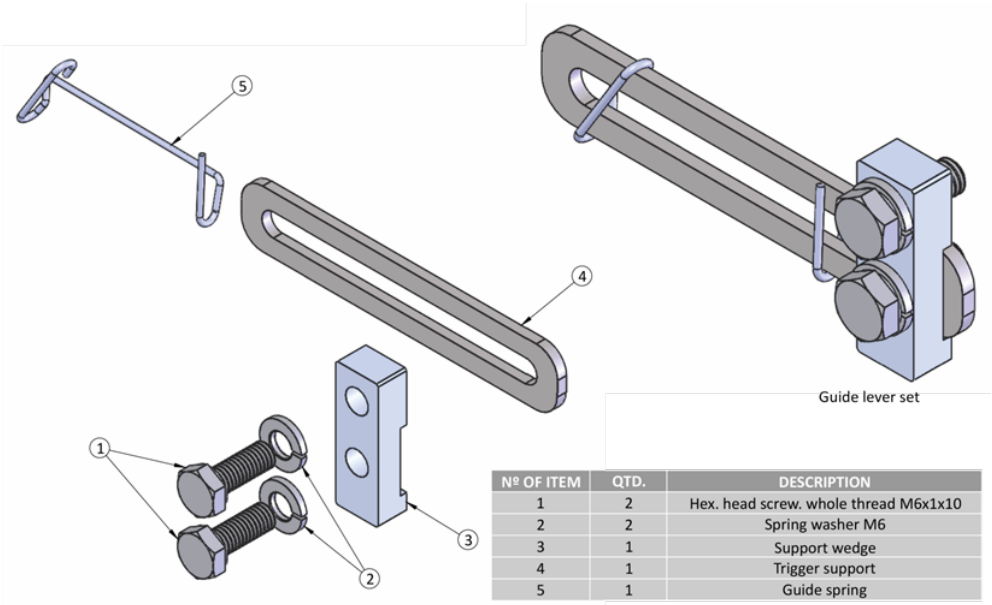
NOTICE

When installing the mounting bracket on the positioner and then setting on the linear pneumatic actuator, observe the maximum torque indicated below:

Positioner on the mounting brackets (2xM8): 15 Nm. Mounting bracket on the linear actuator (2xM8): 15 Nm.

5.4.1 Assembling the Guide Arm

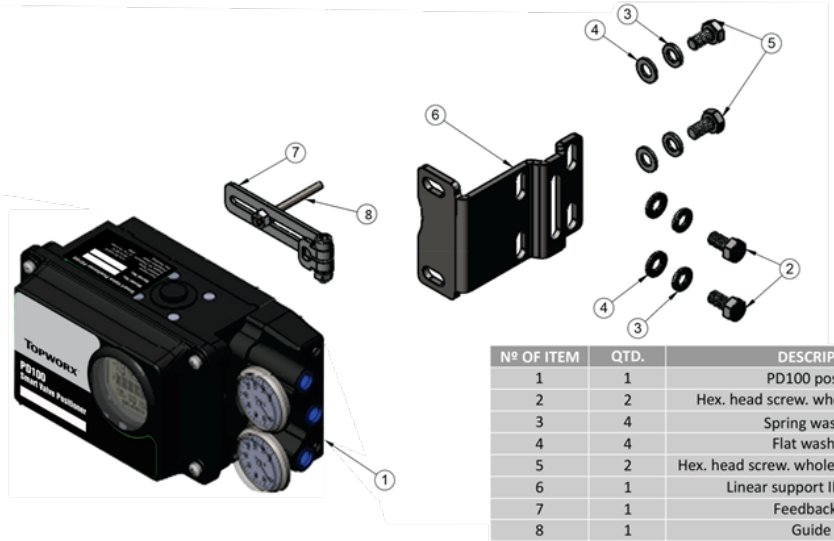
Figure 5-10 Assembling the Guide Arm



Nº OF ITEM	QTD.	DESCRIPTION
1	2	Hex. head screw. whole thread M6x1x10
2	2	Spring washer M6
3	1	Support wedge
4	1	Trigger support
5	1	Guide spring

5.4.2 Installing the Feedback Lever and Bracket

Figure 5-11 Installing the Feedback Lever and Support



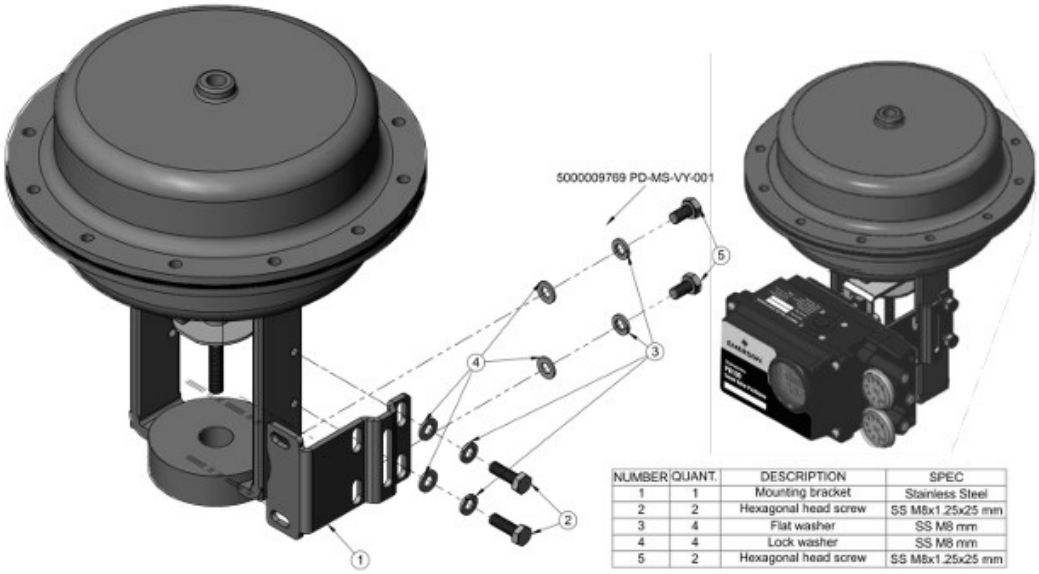
Nº OF ITEM	QTD.	DESCRIPTION
1	1	PD100 positioner
2	2	Hex. head screw. whole thread M8x25
3	4	Spring washer M8
4	4	Flat washer M8
5	2	Hex. head screw. whole thread M8x1.25x16
6	1	Linear support IEC 60534-6-1
7	1	Feedback lever
8	1	Guide pin

NOTICE

The feedback lever is graduated. Check the maximum valve travel for correct assembly of the guide pin. Refer to 5.2.6 - Feedback Lever Types.

5.4.3 Yoke Castle Mount

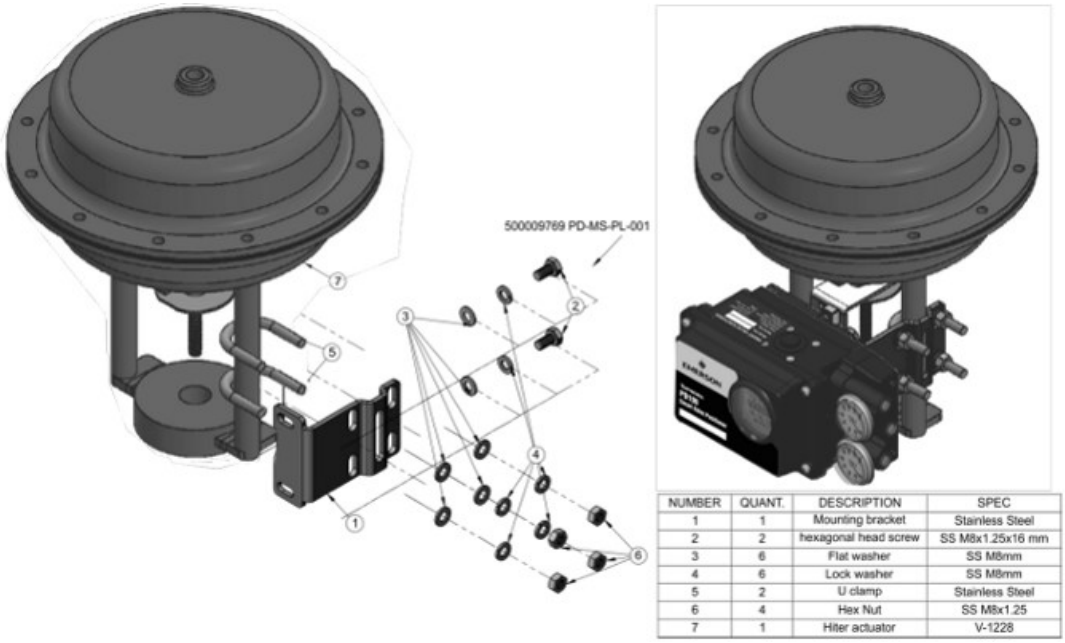
Figure 5-12 Yoke-Type Bonnet Assembly



NUMBER	QUANT.	DESCRIPTION	SPEC
1	1	Mounting bracket	Stainless Steel
2	2	Hexagonal head screw	SS M8x1.25x25 mm
3	4	Flat washer	SS M8 mm
4	4	Lock washer	SS M8 mm
5	2	Hexagonal head screw	SS M8x1.25x25 mm

5.4.4 Mounting on a Pillar Type Castle

Figure 5-13 Mounting on a Pillar-Type Castle



NUMBER	QUANT.	DESCRIPTION	SPEC
1	1	Mounting bracket	Stainless Steel
2	2	hexagonal head screw	SS M8x1.25x16 mm
3	6	Flat washer	SS M8mm
4	6	Lock washer	SS M8mm
5	2	U clamp	Stainless Steel
6	4	Hex Nut	SS M8x1.25
7	1	Hiter actuator	V-1228

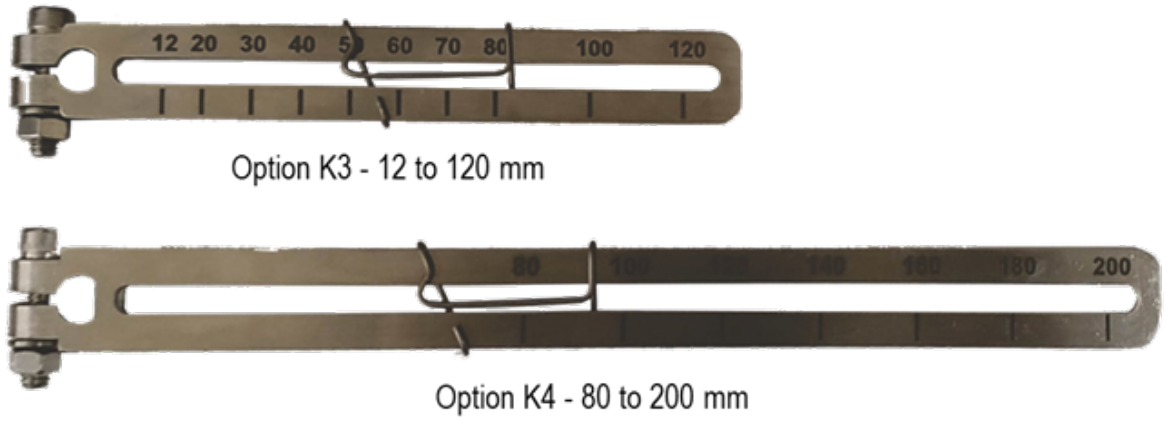
⚠ DANGER

Before installing the positioner, check the area classification. Never use a General Purpose positioner in an area classified as an explosive atmosphere.

5.4.5 Types of Feedback Lever

The feedback levers are classified by two stroke lengths (K3, and K4), which are directly linked to the minimum and maximum operating stroke.

Figure 5-14 Types of Feedback Levers



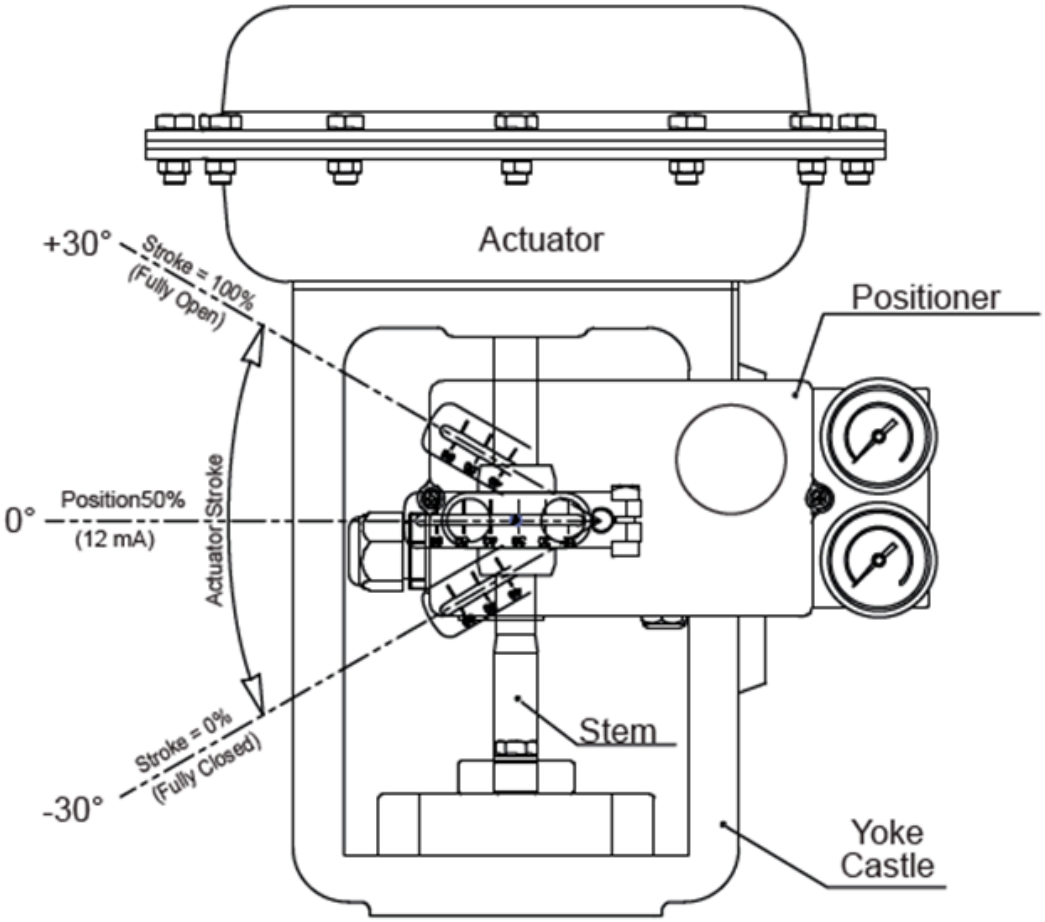
NOTICE

Check the maximum valve travel to use the correct feedback lever. For mounting the lever see: 5.4.2 Installing the Feedback Lever and Bracket.

5.4.6 Standard Installation

The following procedure refers to standard yoke-type bonnet installation. It is important to remember that regardless of the type of yoke, the positioner must operate within the angle range of -30° to +30°, totaling 60°.

Figure 5 -15 Angles of Operation



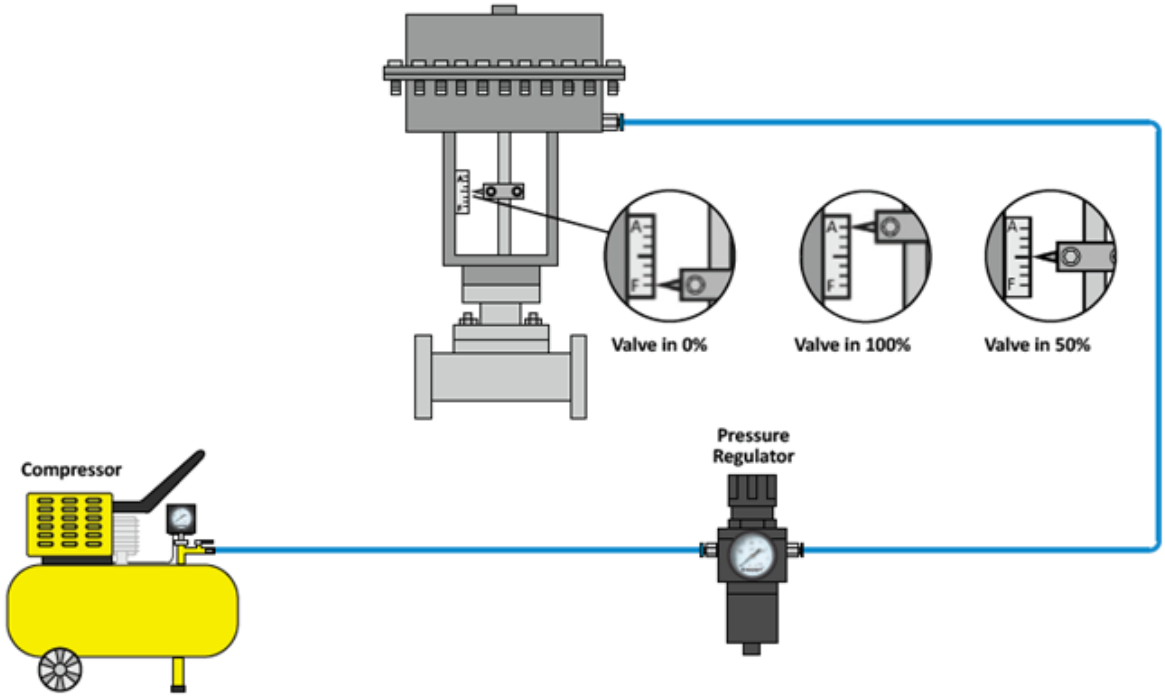
NOTICE

If the positioner operates with an angle smaller than ± 30° the accuracy and stability will be considerably affected.

1 - Perform a test by applying compressed air directly to the valve through a pressure regulating valve. To check the maximum and minimum stroke, start by applying 0% (valve closed). Slowly increase the pressure until the valve reaches 100% of its stroke.

For the positioner assembly, it is recommended to release the air through the regulator so that the valve reaches 50% of its full stroke.

Figure 5-16 Testing the Positioner's Travel and Mounting Position

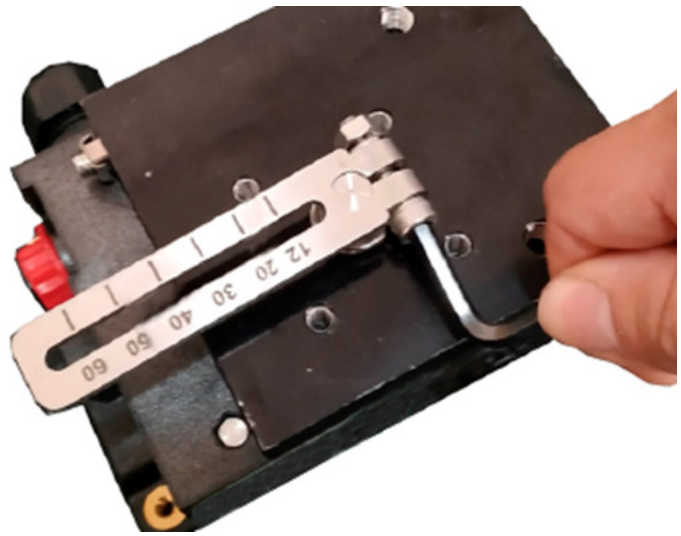


⚠ CAUTION

When handling compressed air hoses, make sure the line is disconnected before connecting it to the positioner.

2 - Install the feedback lever on the positioner shaft. Tighten the setscrew with a 5 mm hex wrench.

Figure 5-17 Installing the Feedback Lever

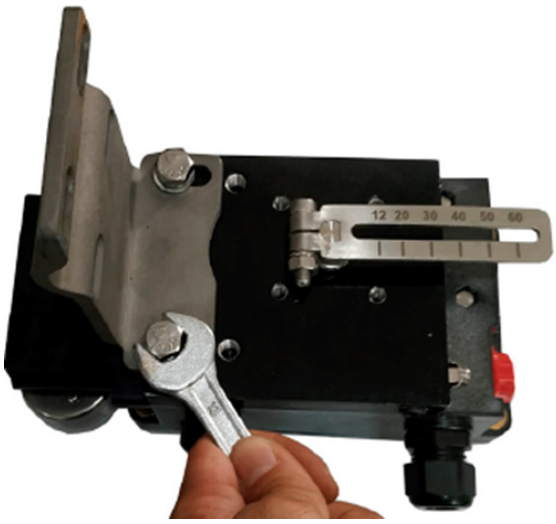


NOTICE

You can perform the assembly with the valve at 0% (fully closed) or 100% (fully open), but pay attention to the 60° operating angle range (from -30° to +30°).

3 - Install the bracket on the bottom of the positioner with the two M8 screws and the plain and spring washers. Securely tighten the screws with a 13 mm hex wrench.

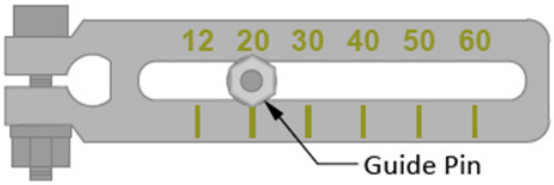
Figure 5-18 Installing the Mounting Bracket



4 - Install the guide pin in the feedback lever, observing the maximum travel of the valve. Tighten the retaining nut with a 10 mm hex wrench.

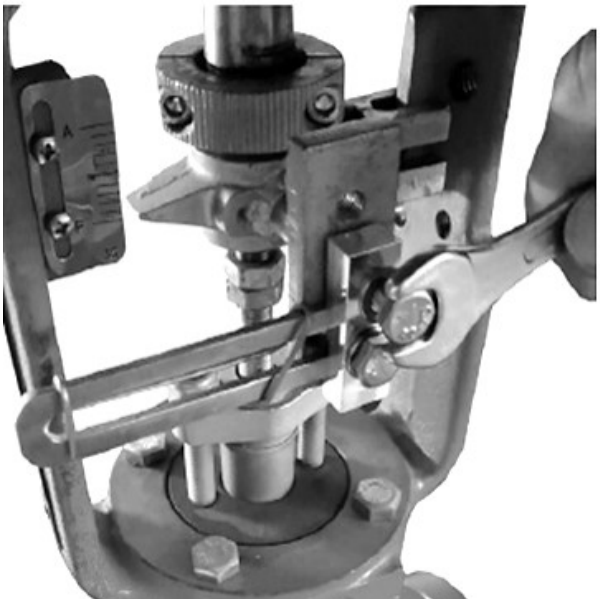
Figure 5-19 Installing the Dowel Pin

Figure 5-20: Guide Pin in the Correct Position (Valve Travel)



5 - Install the guide arm on the valve stem. Tighten the screws with a 10 mm hex wrench.

Figure 5-21 Installing the Guide Arm on the Valve Stem



6 - Install the positioner with bracket onto the valve bonnet, using M8x16 screws. The guide pin should pass through the middle of the guide arm. Do not fully tighten the screws, to allow adjustment of the feedback lever. Move the bracket up and down until the feedback lever is parallel to the guide arm.

Figure 5-22 Setting the Feedback Lever

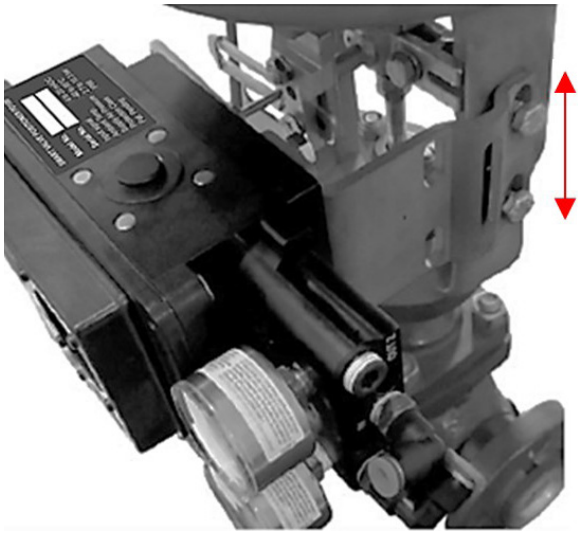
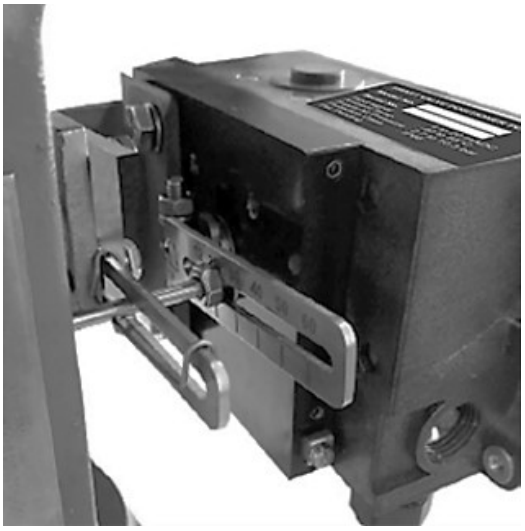


Figure 5-23 Feedback Lever and Guide Arm



7 - After adjusting the feedback lever, tighten the bracket screws firmly with a 13 mm hex wrench.

8 - Make the pneumatic and electrical connections. See Sections 6 - Pneumatic Connections and 7 - Electrical Connections.

9 - With all connections made, perform the auto-calibration process. See the item 8.3 - Fast Calibration.

⚠ WARNING

Risk of crushing and shearing with mounting kits that use a lever for position detection. During commissioning and continuous operation, cuts or compression of the limbs can occur in case of physical contact with the moving parts of the system.

The maximum pressure in the line after the regulator and before it enters the positioner MUST NOT be greater than the actuator can support (to avoid damaging it).

Section 6: Pneumatic Connections

Instrument air must be of better quality than industrial compressed air. Humidity, suspended particles, and oil can impair the instrument's operation temporarily or permanently if internal parts wear out.

⚠ WARNING

Impurities in the supply air can partially or completely damage the positioner's internal components. Before connecting the conduit, it is essential to remove dust, oil, or other impurities.

NOTICE

Before instrumentation air is connected to the positioner, we recommend that the hose be opened freely for 2 to 3 minutes to allow any contamination to escape.

⚠ WARNING

A pressure exceeding 10 bar (145 psi) may permanently damage the positioner.

Measures must be taken to ensure that even if the compressed air supply fails, the pressure does not exceed 10 bar (145 psi).

All pneumatic connections are on the right side of the positioner. Threaded holes are available for pneumatic connections. All connections are marked and their NPT standards must be observed. Connectors for pneumatic hoses are not supplied with the positioner.

See connections according to table below:

Table 6-1 Description of the Pneumatic Connections

Connection	Utilization
IN	Input pressure connection (2.8 to 8 bar)
OUT 1	Output pressure 1 (single-acting actuators)
OUT 2	Output pressure 2 (double-acting actuators)

NOTICE

The positioner's operating pressure is 2.8 to 8 bar (40 to 116 psi), but the actuator may operate with a different pressure.

Unused outputs must be plugged. Refer to 6.2 and 6.3.

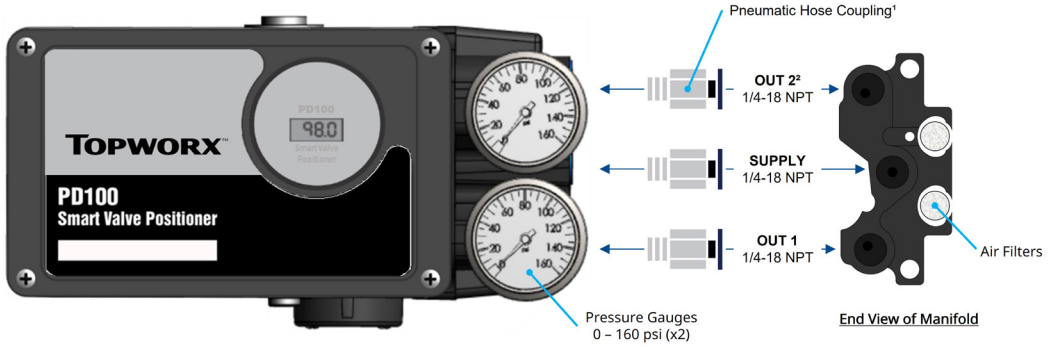
⚠ WARNING

We recommend installing a pressure regulating filter between the pneumatic line and the positioner's pressure inlet connection. High pressures may damage both the positioner and the valve actuator.

6.1 Manifold Types

The PD100 positioner is supplied with one type of manifold for pneumatic connection which includes two pressure gauges.

Figure 6-1 Long Manifold with Gauges



Notes
1. Pneumatic hose couplings are not supplied with the positioner.
2. The second OUT port is normally supplied plugged.
3. Air-supply pressure = 2.8 to 8 bar (40 to 116 psi)

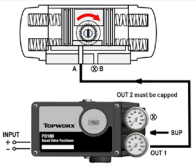
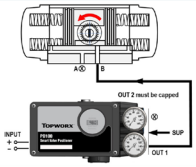
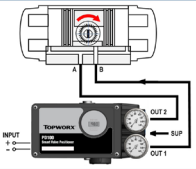
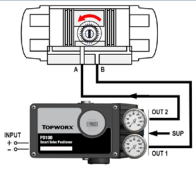
NOTICE

Pneumatic hose couplings are not supplied with the positioner.

6.2 Pneumatic Connection on Rotary Actuator

Check below the pneumatic connection for each type of rotary actuator.

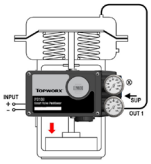
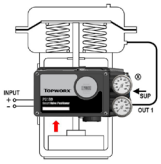
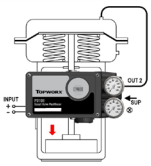
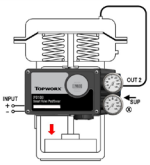
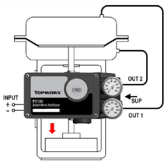
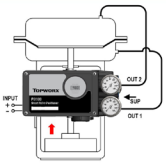
Table 6-2 Pneumatic Connections on Rotary Actuators

	Direct		Reverse	
Single	**Option 1A** As the input signal increases, the actuator shaft rotates clockwise. OUT 1 – Connected to A. OUT 2 – Capped.		**Option 1B** As the input signal increases, the actuator shaft rotates counterclockwise. OUT 1 – Connected to A. OUT 2 – Capped.	
Double	**Option 2A** As the input signal increases, the actuator shaft rotates clockwise. OUT 1 – Connected to B. OUT 2 – Connected to A.		**Option 2B** As the input signal increases, the actuator shaft rotates counterclockwise. OUT 1 – Connected to B. OUT 2 – Connected to A.	

6.3 Pneumatic Connection on Linear Actuator

Check below the pneumatic connection for each type of linear actuator.

Table 6-3 Pneumatic Connections in Linear Actuators

	Direct		Reverse	
Single	**Option 1A** As the input signal increases, the valve stem moves downwards. OUT 1 – Connect to top. OUT 2 – Capped.		**Option 1B** As the input signal increases, the valve stem moves upwards. OUT 1 – Connect to bottom. OUT 2 – Capped.	
	Option 2A As the input signal increases, the valve stem moves upwards. OUT 1 – Capped. OUT 2 – Connect to bottom.		**Option 2B** As the input signal increases, the valve stem moves downwards. OUT 1 – Capped. OUT 2 – Connect to top.	
Double	**Option 3A** As the input signal increases, the valve stem moves downwards. OUT 1 – Connect to top. OUT 2 – Connect to bottom.		**Option 3B** As the input signal increases, the valve stem moves upwards. OUT 1 – Connect to bottom. OUT 2 – Connect to top.	

NOTICE

The unused outlet must be capped.

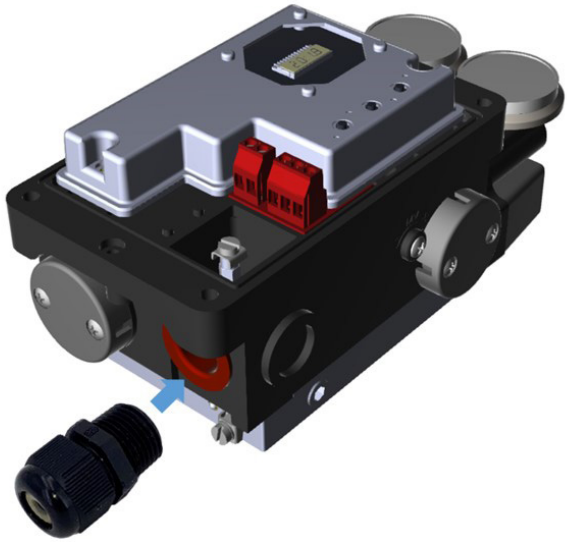
Section 7: Electrical Connections

7.1 Cable Entry

NOTICE

The cable terminals are supplied in a closed state and must be unscrewed before inserting the cables.
The positioner has one 1/2” NPT entry.

Figure 7-1 Cable Gland and Plug



⚠ DANGER

Hazardous area equipment must not operate with cable entries open.

The positioner must not operate in a hazardous area without its cover correctly installed.

1 - The cable gland should be installed as in the picture above.

2 - Turn the cover of the cable gland counterclockwise to open and insert the wires.

3 - Connect the wires to the terminals and tighten the cable gland.

NOTICE

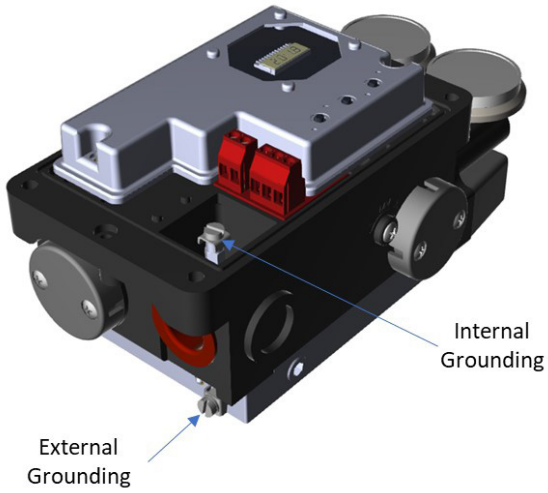
Use cables with a maximum diameter of 12 mm and a minimum diameter of 9 mm.

Be sure to de-energize the power source before connecting the cable.

7.2 Grounding

Grounding the positioner is extremely important and highly recommended. Two grounding points are provided, one internal and one external. If the cable used is shielded, it is recommended that the shield be grounded at one end only. The ungrounded end should be carefully isolated.

Figure 7-2 Grounding Screws



7.3 Electrical Connection

The PD100 is equipped with screw terminals intended for connection of the control signal and feedback signal.

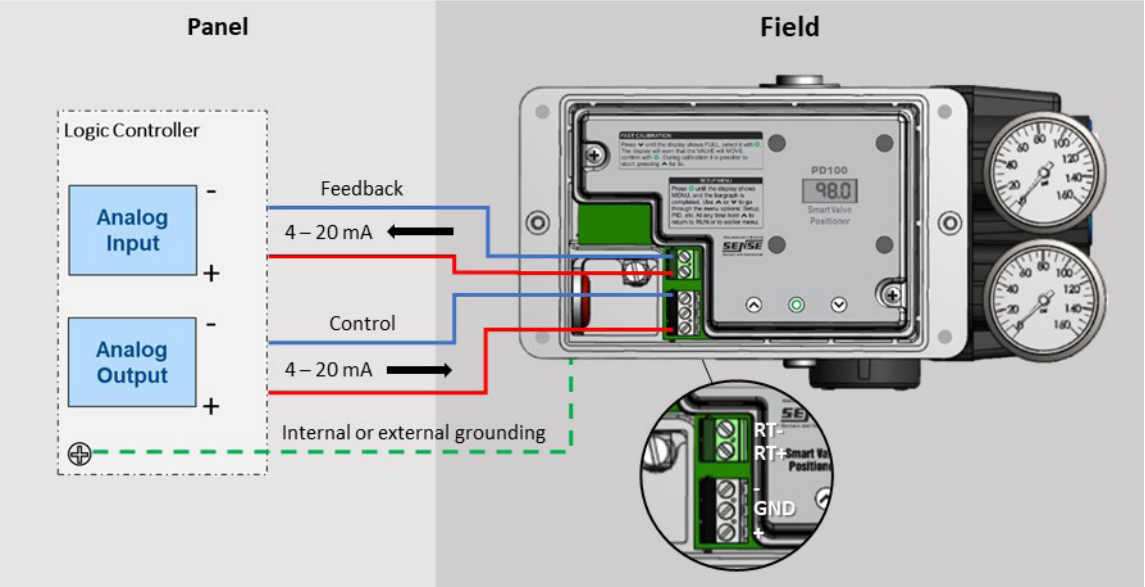
⚠ WARNING

Be sure to supply the rated voltage and current indicated in this manual (see Section 2 - Technical Specifications. Failure to do so may cause serious damage or malfunctioning of the positioner. Despite the polarity indications, reversing them does not alter the positioner's operation.
When it is necessary to open the positioner's cover in a damp place, great care must be taken. This may cause serious damage or malfunction of the electronic circuitry.

⚠ DANGER

Before installing the positioner, check the area classification. Never use a General Purpose positioner in an area classified as an explosive atmosphere.

Figure 7-3 Electrical Connection of Positioner with Feedback Connected to Active Input Card



Section 8: Configuration

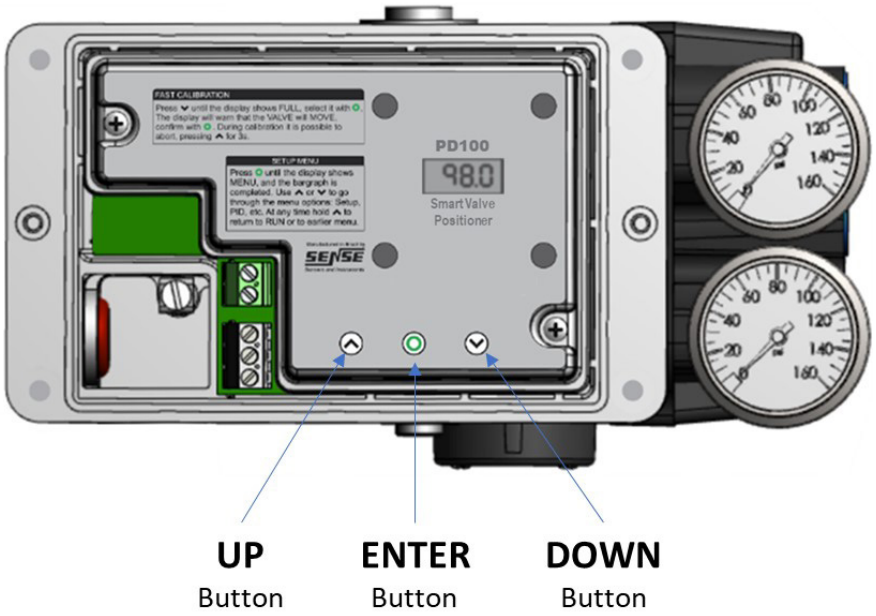
8.1 Configuration Buttons

The PD100 positioner has three mechanical buttons for configuration. To configure the positioner, you must open the cover by removing the four screws which fasten it to the positioner housing.

Figure 8-1 Positioner with Cover

Figure 8-2 Positioner without Cover

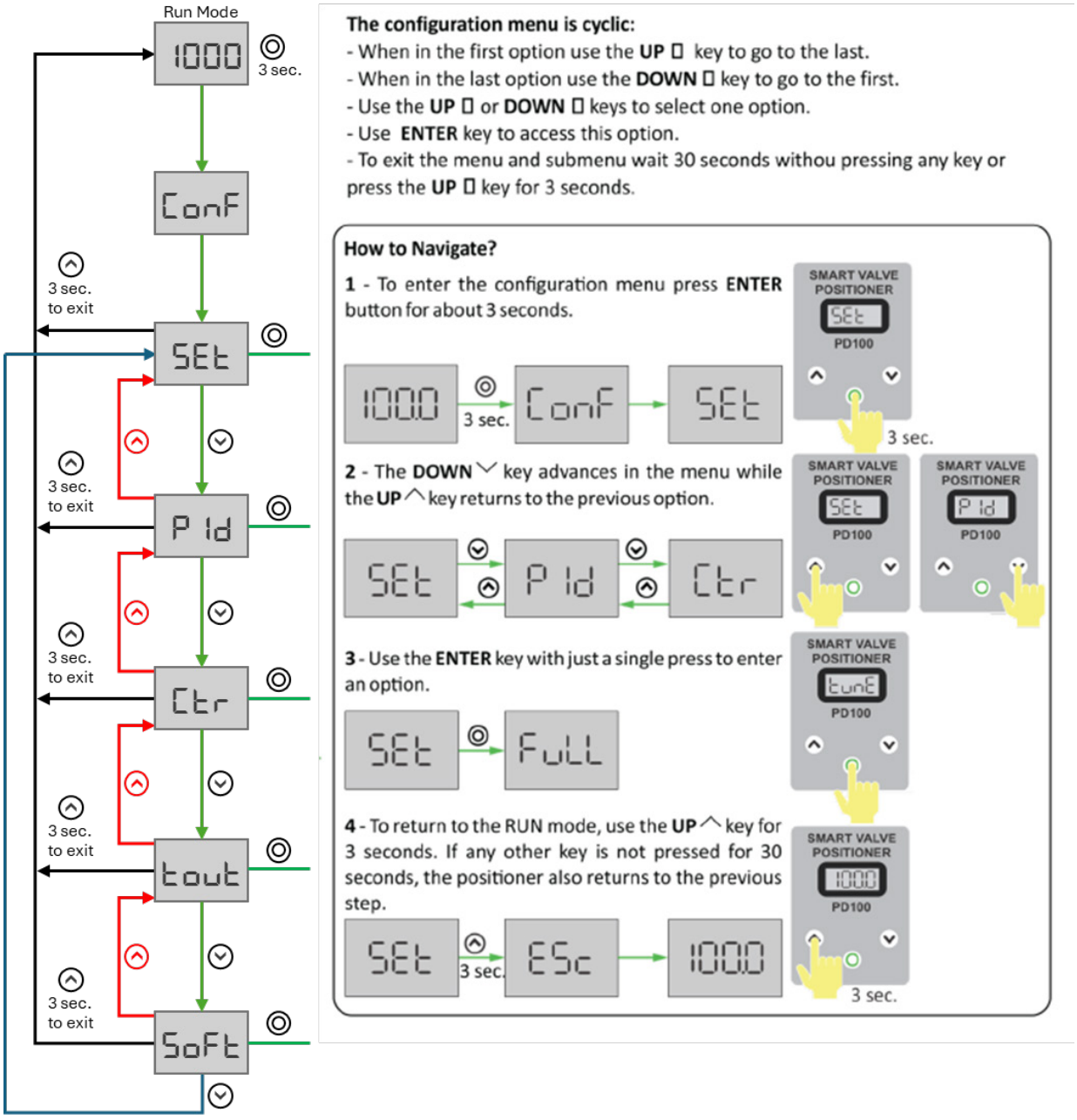
Figure 8-3 Position of Mechanical Buttons



8.2 Entering and Navigating the Configuration Menu

To enter and navigate the configuration menu via the mechanical buttons, you must remove the cover. See below how to enter and navigate in the configuration menu of the positioner.

Figure 8-4 Entering the Menu



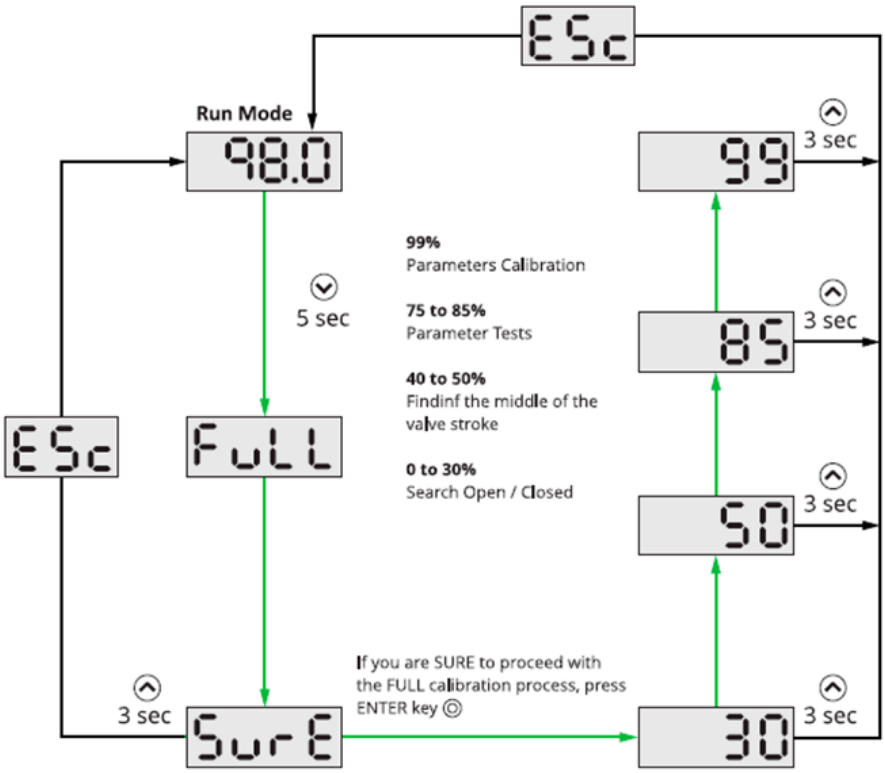
8.3 Fast Calibration

When executing fast calibration, the positioner performs a complete calibration, obtaining all valve parameters. For example: the opening and closing positions and the PID values. To perform a fast calibration, follow the steps below:

1 - Press the DOWN button until “Sure” appears in the display.

2 - Use the ENTER button to confirm the calibration.

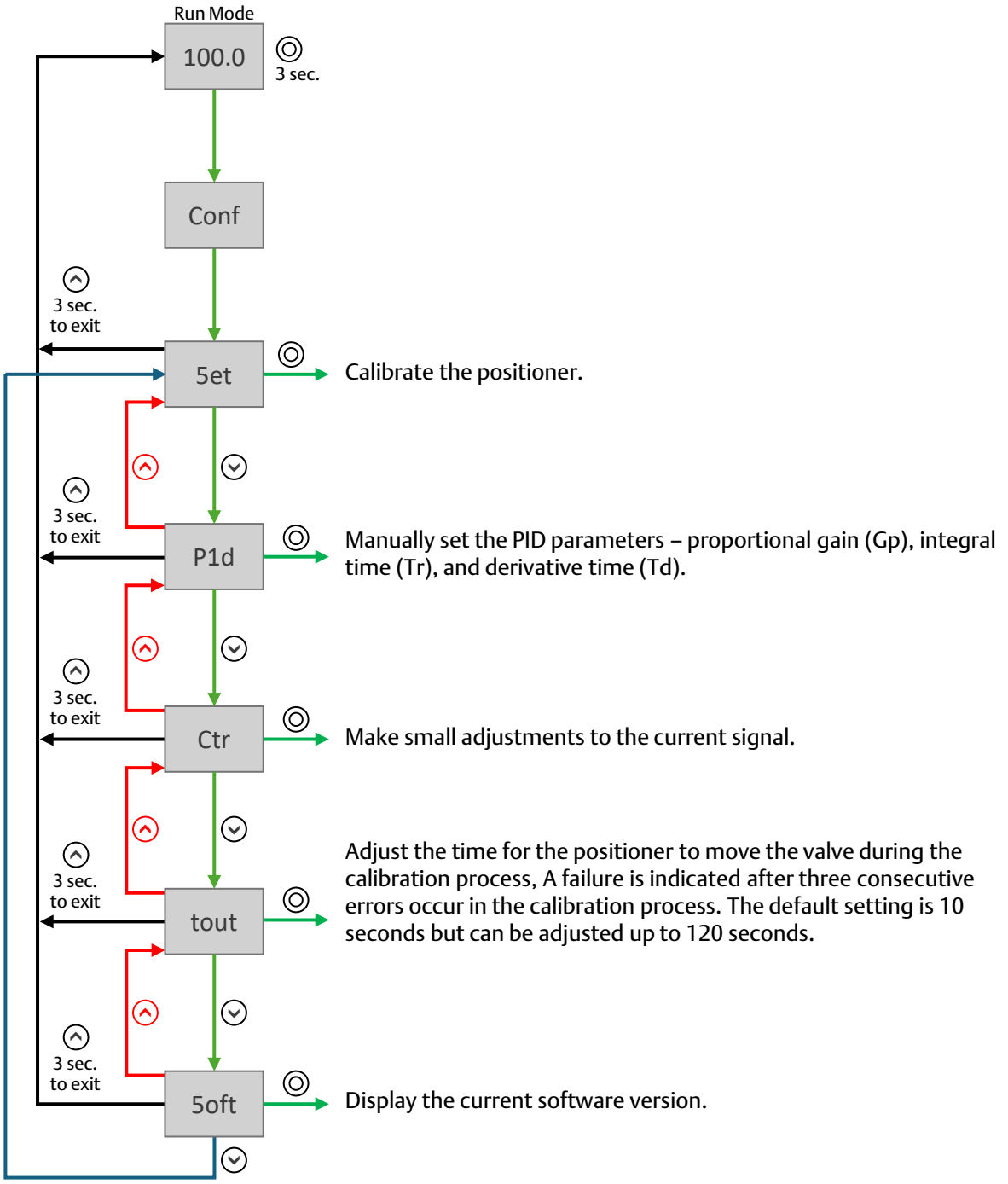
Figure 8-5 Fast Calibration



8.4 Configuration Menu

The PD100's configuration menu has four functions that can be configured using the mechanical buttons.

Figure 8-6 Configuration Menu



8.4.1 Setup Menu

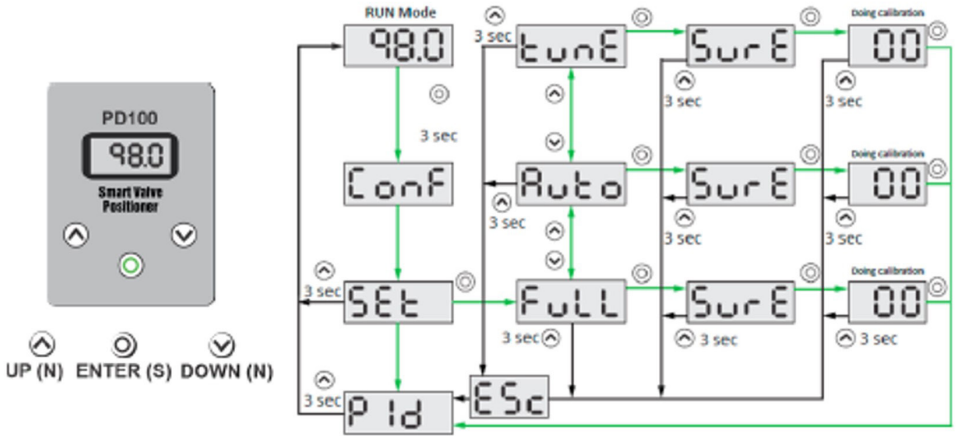
In this function you can perform the 3 modes of positioner calibration:

1 - FULL: Recognizes the open and closed points and adjusts the best parameters for the PID.
Note: Recommended use for the first calibration.

2 - AUTO: Learns the open and closed points (0% and 100%).
Note: Recommended use in a process change or after maintenance.

3 - TUNE: Automatically calculates the PID parameters (Kp, Tr and Td).
NOTE: Recommended use in a process changeover.

Figure 8-7 Setup Menu



Accessing the Setup Menu

- Press the ENTER button for 3 seconds to enter the menu.
- The first option is the SET menu.
- Use the ENTER button to select this function.
- Use the UP or DOWN buttons to navigate to the item you wish to set.
- Use the ENTER button for the calibration procedure you want to perform.
- To continue with the selected calibration procedure, confirm with the ENTER button.
- If you want to exit without performing the calibration, use the UP button for 3 seconds and return to the main menu.

NOTE: You can exit the calibration process at any time by pressing the UP button for 3 seconds. The message ESC will appear in the display.

8.4.2 PID Menu

Proportional, integral and derivative control (PID control or simply PID) is a process control technique. It unites proportional, integral and derivative actions so that an error signal is minimized by the proportional action, zeroed by the integral action and obtained with an anticipative speed by the derivative action. PID control is the most widely used in industrial automation and can act in four ways:

- Proportional control (P)

- Proportional and integral control (PI)

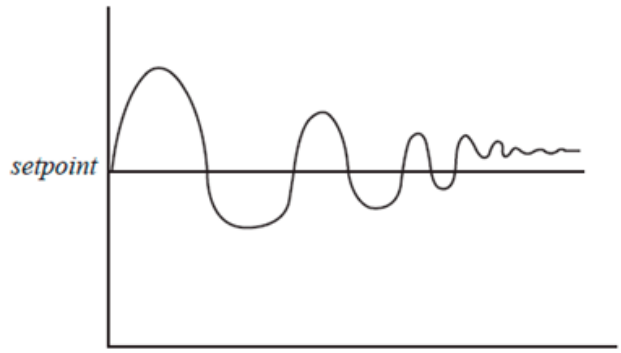
- Proportional and derivative control (PD)

- Proportional Integral and Derivative control (PID)

Proportional Control

- Proportional control always works on top of the system error, that is, it will generate an output according to the error and not as a function of time.
- The gain (Kp) is the variable that the proportional controller uses for control. A value that is too low for Kp will result in slow control, while a value that is too high will result in the system oscillating around the setpoint.
- As can be seen from the adjacent graph, the proportional action does not eliminate the error, which is called offset.
- This residual error consists of the steady state and can be changed by adjusting the gain (Kp).

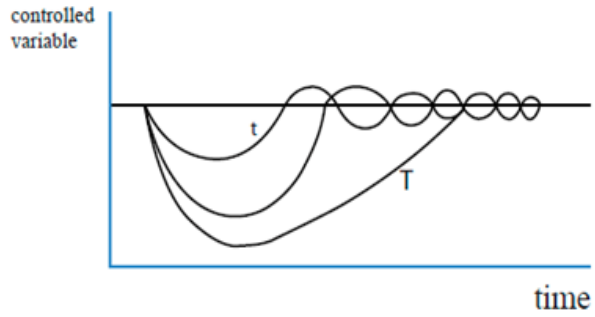
Figure 8-8 Proportional Control Chart



Integral Control

- In integral action the correction speed is proportional to the error, that is, in integral action the control variable is time (Tr).
- Because this action provides a relatively slow correction speed when used alone, in practice it is always accompanied by proportional action (PI control).
- The PI control eliminates the offset that the proportional control presents, and it has a faster response than the integral alone.
- A too small value of Tr will lead to large oscillations that will take longer to stabilize.
- A too high value of Tr will result in a very slow and inefficient integration.

Figure 8-9 PI Control Chart



Derivative Control

The derivative action like the integral action works with time (Td) and is also used in conjunction with the proportional action (PD control).

This control is very efficient with respect to correction because it starts the correction immediately as soon as the error starts (as the derivation of constant is always zero).

As in PI control this control also suffers effects for very high or very low values for time (Td).

When we have large times, we will have more stability in the system with low-speed response.

And when the time is small, there are many oscillations and falls in the stability of the loop.

The PD control has the same peculiarity of proportional control, which is to have an offset, even though the derivative action improves the stability of the system.

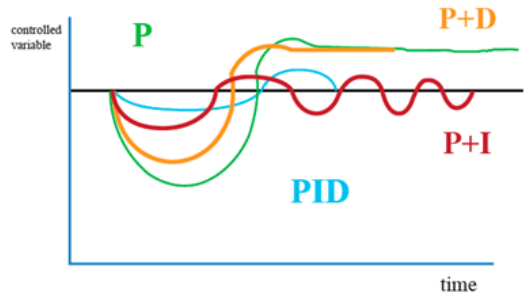
Graphically the PD control is like PI control differing only by leaving an offset.

PID Control

- PID control uses proportional, integral, and derivative actions together.
- As it joins all the control actions, it makes the error correction faster and more assertive by eliminating the offset left by the proportional and derivative actions.

See the actions in graphical form in the picture below.

Figure 8-10 PID Control Chart



PID Tuning Methods

The positioner automatically adjusts the PID parameters in the calibration process, but you can change the values for proportional gain (Kp), integral time (Tr) and derivative time (Td) manually. To this end, there are a few methods for adjusting the parameters (tuning).

Borderline Sensitivity Method

This method will work on the closed loop setting. It will first reduce the effect of the integral and derivative actions to a minimum. Only then will it start with the gain (Kp) and increase it until the controlled variable oscillates with the amplitude that is constant making small perturbations in the system.

The most common adjustment is the one that reaches a quarter of the previous amplitude. This method can be used in many processes.

Reaction Curve Method

This method is widely used in first order systems since it is less complex. It will present an S-shaped curve through the two constants delay (L) and time (T), through the K-coordinate.

Trial and Error Method

This is one of the most used methods because it is simple. It consists in modifying the control actions and observing the effects on the process (as the name suggests).

However, to be able to work with this system, it is important to have knowledge of both the process and its algorithm.

It cannot be used for open loops because it can generate instability when the gains are too low or too high.

Another disadvantage that can occur with this method is that depending on the amount of adjustment, it will take a lot of time to tune. Depending on the conditions, this could impair the process.

Ziegler and Nichols Method

Ziegler and Nichols suggested a process tuning rule to get a given performance specification, such a method took their names. It is suitable for complex plants in which the mathematical modulus is not easily obtained, or when the plant model is unknown.

A few rules for PID tuning are presented. These rules are based on his experiments which works on steps and gain. They provide an estimate of the parameters of integral time, derivative time, and proportional gain.

Sometimes this signal can generate a very large step response. In that case you will need to do some finer tuning to get the desired adjustment.

Auto Tuning Method

This method is an improvement of the Ziegler and Nichols method. The proportional gain, derivation, and integration variables are calculated automatically. The data for the calculations is usually obtained from the reaction curve, causing a step-shaped disturbance.

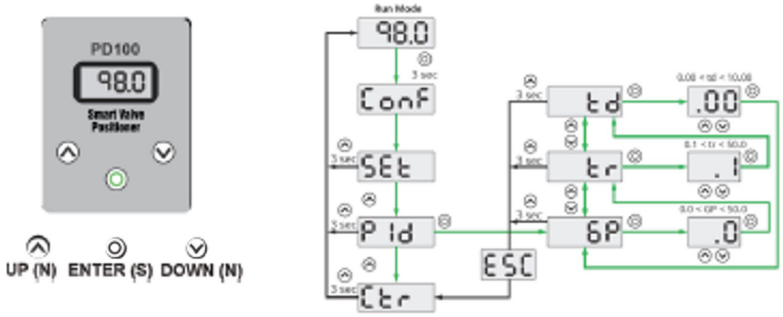
NOTICE

The PD100 firmware is the result of years of experience in controller tuning and, in conjunction with the auto-calibration routines, provides a very close to optimal set of parameters, but the product also allows the instrumentalist to make a final adjustment of the parameters (Kp, Tr and Td), which can add from experience of the valve / actuator and the controlled process.

The intention of describing PID control in this manual is only for a basic notion of control, if you want to know more about it, please look for specific literature on process control.

1 - GP: Allows you to adjust the proportional gain of the PID control with values between 0 to 50.
2 - TR: Allows you to adjust the integral time of PID control with values between 0.1 to 50 (s).
3 - TD: Allows you to adjust the derivative time of PID control with values between 0 to 10 (s).

Figure 8-11 PID Menu



Accessing the PID Menu

- Press ENTER button for 3 seconds to enter the menu.
- Use the DOWN button to move to the PID option. The UP button returns to the previous option.
- Press ENTER button to select the option.
- Use the UP or DOWN buttons to select an option.
- Press ENTER button to select the option.
- Use the UP or DOWN buttons to increase or decrease the value. Hold down to increase or decrease rapidly.
- When the value is ready, store it with the ENTER button and return to the KP, Td, and Tr setting to set the other if desired.
- If you enter KP, Tr, or Td and want to exit, wait 30 seconds without pressing any buttons and return to the PID options.
- If you want to exit the PID menu, use the UP button for 3 sec and return to the main menu.

⚠ WARNING

If you change any value, it will be implemented immediately, which can cause process instability and lead to incorrect valve positioning.

NOTICE

If the user changes the PID control parameters incorrectly and does not remember the previously calculated values, simply perform the TUNE procedure again.

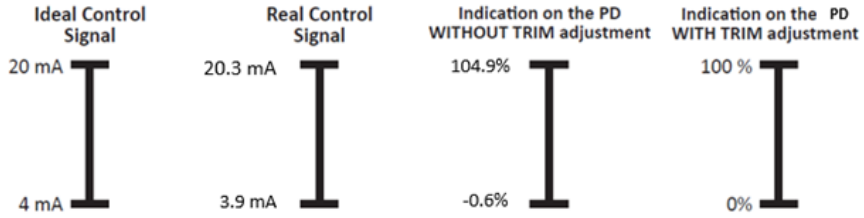
8.4.3 CTR Menu

It allows you to correct for a small variation in the 4-20 mA signal. See the example below:

4: Define the inlet current as 0% dated valve.

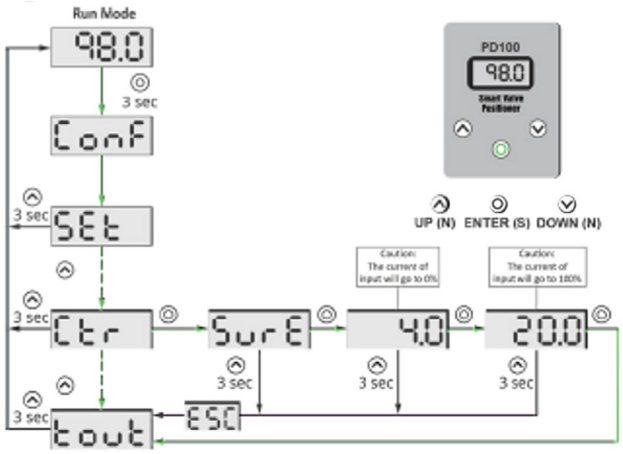
20: Define the inlet current as 100% dated valve.

Figure 8-12 Example of CTR Adjustment



To make the adjustment, follow the procedure below:

Figure 8-13 CTR Menu



Accessing the CRT Menu

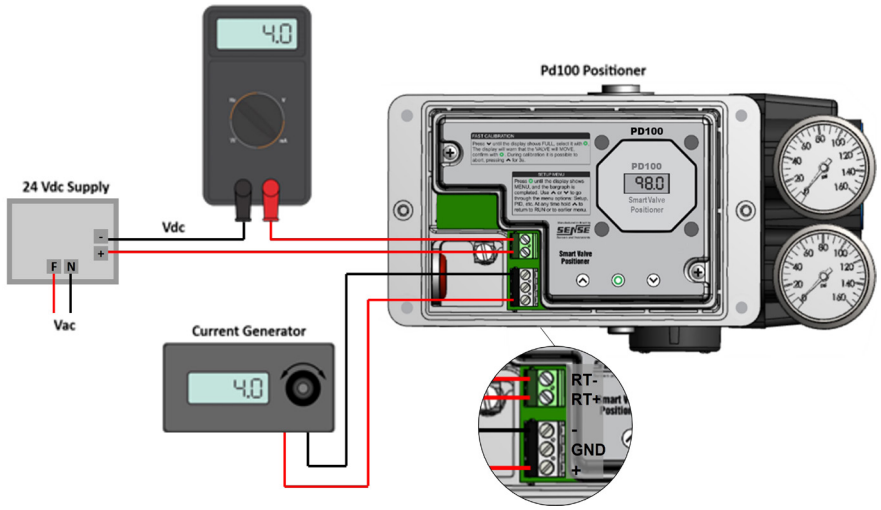
- Press ENTER button for 3 seconds to enter the menu.
- Use the DOWN button to move to the CTR option. The UP button returns to the previous option.
- Use the ENTER button to select the option.
- Set the control signal to 4 mA, then confirm the 4 mA point with the ENTER button.
- Set the control signal to 20 mA, then confirm the 20 mA point also with the ENTER button.
- If you wish to exit the CTR menu without making changes, DO NOT use ENTER button, use the UP button for 3 seconds and return to the main menu.

Testing the Feedback Output

The feedback signal is automatically obtained in the positioner calibration process. You can measure this signal to check possible differences between the control and feedback signals before putting the positioner into operation.

To test the signal, connect a 4 to 20 mA current generator to the H + and H - terminals. Connect a 24 V DC voltage source in series with a current-rated multimeter to terminals RT+ and RT-.

Figure 8-14 Connection of Feedback Test

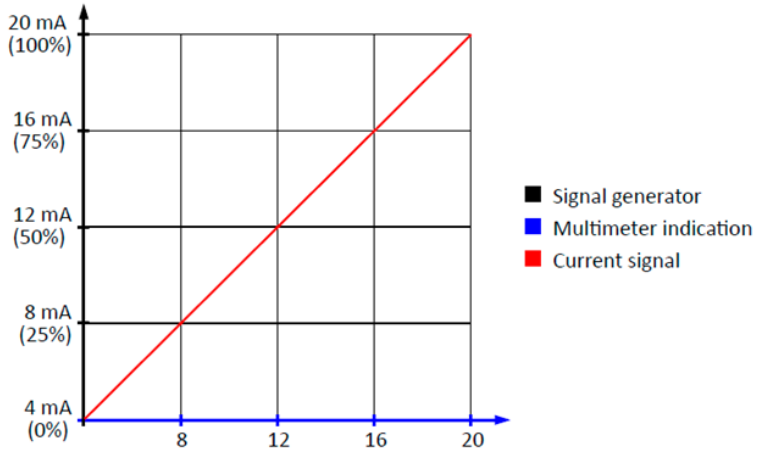


Set the current generator to 4 mA and gradually increase by checking the output signal (feedback) on the multimeter.

See the graph below for 4 to 20 mA current values.

The output signal must be the same as the current generator, if there is a difference, perform the TRIM adjustment procedure indicated in the previous item.

Figure 8-15 Feedback signal Graph



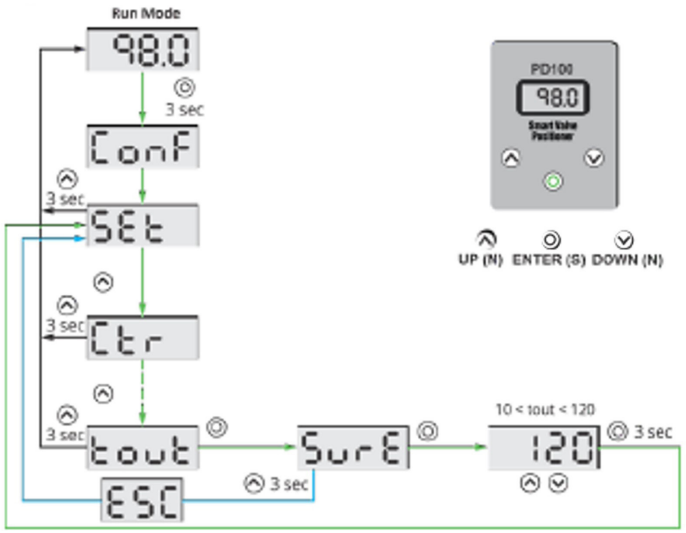
8.4.4 T OUT Menu

It is the time set in the menu for the positioner to move the valve during the calibration process.

A failure is indicated after three consecutive errors occur in the calibration process.

Tout is factory programmed for 10 seconds, but can be adjusted from 10 to 120 seconds.

Figure 8-16 TIMEOUT Menu



Accessing the T OUT Menu

- Press ENTER button for 3 seconds to enter the menu.
- Use the DOWN button to move to the T OUT option. The UP button returns to the previous option.
- Use the ENTER button to select the option. The display shows SURE.
- To continue, use the ENTER button.
- Use the ENTER button to select the digit, and the UP or DOWN buttons to change the digit.
- When the value is ready, confirm with the ENTER button for 3 seconds.
- If you want to exit without any change, use the UP button for 3 seconds and return to the main menu.

NOTICE

Large valves and actuators may require longer T OUT time, because it takes longer to move the valve.

Calibration Failure Alarm - Tout Alert

A failure is indicated if the valve does not respond within the time set in the menu. Three consecutive failures must occur for the positioner to indicate an alarm.

Tout Alert can occur in three cases during the calibration process:

1 - Lack of initial movement:
Let's assume that Tout was set to 10 seconds, and for some reason during the self calibration process the actuator does not move its axis, example: lack of air, wrong pneumatic connection, stuck valve, etc.
When you start the calibration procedure, the Tout time starts counting with the display indicating 0%, and from this moment on we have the following steps:

A - Display showing 0% - At this point, the positioner will send a command for the actuator to move to the rest position and wait 10 seconds (Tout set) then it logs internal fault 1, as there was no movement.

B - Now the display changes to 5% - and the positioner sends a new command for the actuator to go to position A (example: Open), and after 10 seconds it accumulates internal fault 2, since there was no movement.

C - Then the display shows 10% - and the positioner sends a new command for the actuator to move to position B (example: Closed).

D - Tout Alert is triggered generating an initial lack of movement fault. Note that only after internal faults 1, 2, and 3 is the Tout Alert generated. Notice that it took 30s after the start of the auto calibration routine, or 3 times the Tout set in the menu, for the Tout Alert to be generated.

If in this case the Tout set was 120 seconds, the lack of initial movement alarm would only be generated after 360 seconds.

2 - Actuator pressurization delay condition:
Imagine the case of an actuator that takes 100 seconds to fully open, and starts its movement only from 90 seconds after the start of pressurization of its chamber.
In this case if the Tout is kept at 10 seconds, the display will indicate the steps 0%, then 5% and 10% and after the initial 30 seconds the Tout Alert will be generated, because the actuator has not had time to start the movement of its axis, due to lack of pressurization of the chamber.
In situations where this failure condition occurs, it is necessary that the user "reset" Tout to a minimum value of 100 seconds.

3 - Failure in the learning cycles of the open and closed points:

Imagine the condition where Tout is set to 10 seconds and that the set (positioner/actuator) was able to perform the 1st cycle of learning the open and closed points, but when starting the second or third cycle, a failure of lack of compressed air occurs. In this case, the Tout Alert will only be generated at the end of the self-calibration process of the Open and Close positions.

A - Display showing 0% - At this point the positioner will send a command for the actuator to go to the rest position and wait 10 seconds (Tout set), action successfully performed within the 10-second interval.

B - Now the display changes to 5% - and the positioner will send a new command for the actuator to go to position A (example: Open), action successfully accomplished within the 10-second interval.

C - Then the display changes to 10% - and the positioner sends a new command for the actuator to go to position B (example: Open), action successfully accomplished within 10 seconds.

D - The display changes to 15% - and the positioner sends a new command for the actuator to go to position A (example: Open), and after the 10 seconds elapsed, internal fault 1 occurs - because there was no movement.

E - Then the display changes to 20% - and the positioner sends a new command for the actuator to go to position A (example: Open), and after the 10 seconds elapsed internal fault 2 occurs - because there was no movement.

F - The display now shows 25% - and the positioner sends a new command for the actuator to go to position A (example: Open), and after the 10 seconds elapsed internal fault 3 occurs - because there was no movement.

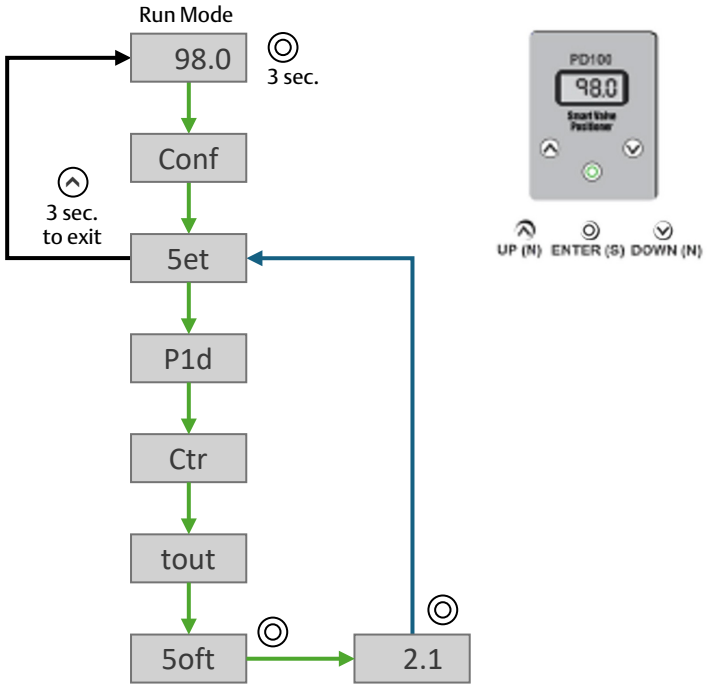
G - The display now shows 30% - and the positioner sends a new command for the actuator to go to position A (example: Open), and after the 10 seconds internal fault 4 occurs - because there was no movement.

H - Tout Alert is activated, but note that it now took 70 seconds for the alert to be generated, i.e. 7 times the Tout set in the menu, because the first 3 steps of the 1st learning cycle were successful and the positioner only registered the problem in the 2nd cycle and confirmed the lack of movement in the 3rd cycle.

8.4.5 SOFT Menu

The SOFT function displays the current loaded software version for the device. The current version is also displayed briefly when the positioner is first powered up or when restarted after a disruption in power.

Figure 8-17 Software Version Menu



Section 9: Certifications

Non-Incendive:

USL/CNL Class I, Division 2, Group ABCD; Class II, Division 2, Group FG; Class III

T4, T135°C - UL File E125326

UL 23ATEX3093X / IECEx UL 23.0074X

Ⓔx II 2 D Ex tb IIIC T85°C Db; -40°C ≤ Tamb ≤ +65°C

General Purpose:

USL/CNL General Purpose

UL File E359150

Environmental Ratings: Type 4X, IP66

Operating and Ambient temperature ratings vary depending on materials of construction. Reference certificate for specific markings available.

Conformance to Directives: ATEX 2014/34/EU, EMC 2014/30/EU, LVD 2014/35/EU

Conformance to International Standards:

- UL 121201 - Nonincendive Electrical Equipment for Use in Class I and II, Division 2 and Class III, Divisions 1 and 2 Hazardous (Classified) Locations.
- CSA C22.2 No. 213-17 - Nonincendive Electrical Equipment for Use in Class I and II, Division 2 and Class III, Divisions 1 and 2 Hazardous (Classified) Locations.
- UL 50E - Enclosures for Electrical Equipment, Environmental Considerations.
- CSA C22.2 No. 94.2:20 - Enclosures for Electrical Equipment, Environmental Considerations.
- IEC 60079-0 Ed. 7 - Explosive atmospheres - Part 0: Equipment - General requirements.
- IEC 60079-31 Ed. 2 - Explosive atmospheres - Part 31: Equipment dust ignition protection by enclosure “t”.
- IEC 61514-2, IEC 61000-4-3, and complementary test - Immunity to Radiated Electromagnetic Fields.
- IEC 61000-4-4 and IEC 61514-2, clause 5.5.2 - BURST Fast Transients.
- According to IEC 61326-1 and IEC 61326-2-3, Table 2, acceptance criteria B.
- IEC 61000-4-8 and IEC 61514-2, clause 5.5.2 - Magnetic Fields.
- IEC 61000-4-2 e IEC 61514-2, item 5.5.2 - Electrostatic Discharge.
- IEC 61000-4-6 - Immunity to conducted disturbances, induced by radiofrequency fields.
- IEC 61000-4-5 - Surge Immunity Test - PD100: input 4 to 20mA:1 kV - Line to ground. Feedback 4 to 20mA: 1kV Line to Line.

Pending:

- REACH/RoHS Compliant

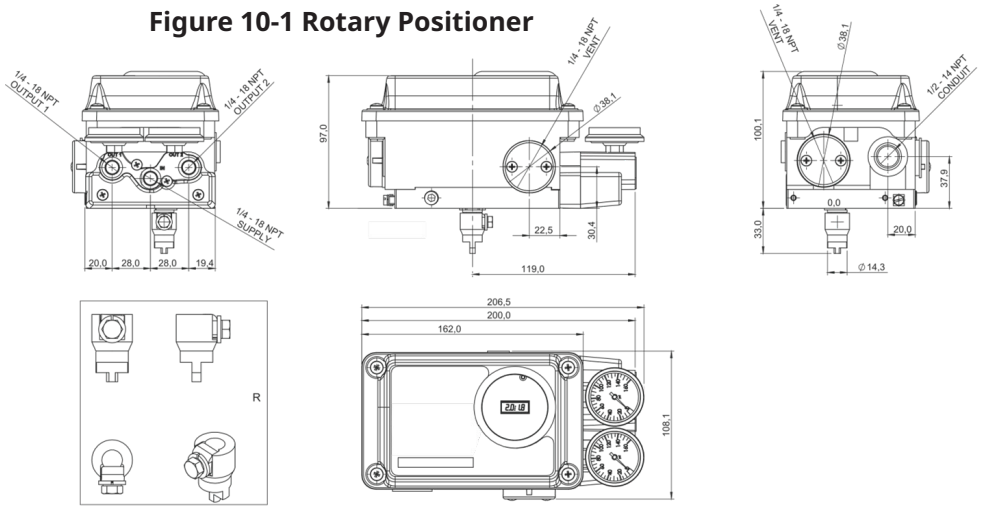
Specific Conditions of Use:

- Clean with a damp cloth before touching or servicing to avoid electrostatic discharge. See installation instructions for further guidance.
- Equipment has only been evaluated for low risk of mechanical impact. Equipment shall only be installed in areas where the risk for mechanical impact is low.

Section 10: Mechanical Dimensions

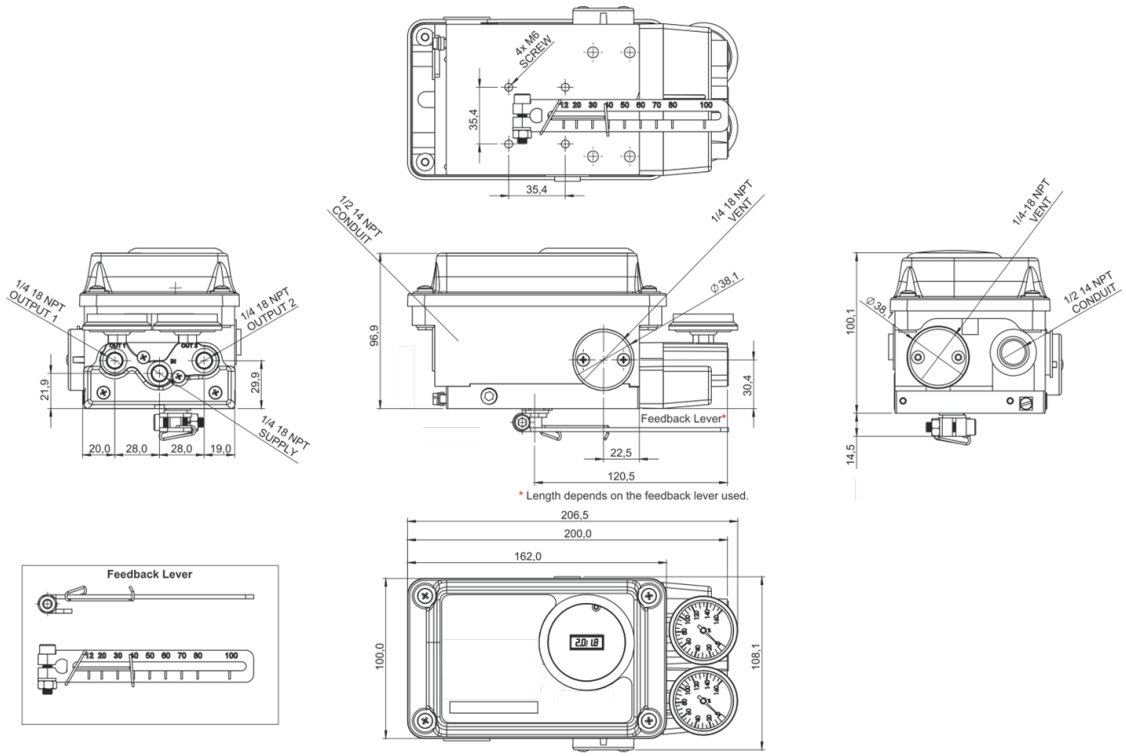
10.1 Positioner Dimensions

Figure 10-1 Rotary Positioner



Mounting Torque:
Positioner in the mounting bracket (4xM6): 10 Nm
Mounting bracket on the rotary actuator (4XM5): 10 Nm

Figure 10-2 Linear Positioner



Mounting Torque:
Positioner in the mounting bracket (2xM8): 15 Nm
Mounting bracket on the rotary actuator (2XM8): 15 Nm

Section 11: How to Specify

PD100-CFNGXX0000-XX

PD100-C (4-20 mA) - F (4-20 mA position transmitter) - N (One input conduit 1/2” NPT / Manifold 1/4” NPT standard) - G (Long manifold with two PSI manometers) - XX (RN [Rotating NAMUR adapter], K3 [Linear with 12 to 120mm feedback lever), and K4 (Linear with 80 to 200mm feedback lever]) – 00, - 00, – EN (Non-Incendive)

Example: PD100 - C F N G RN 00 00 - EN

Model
- **PD100** Smart Valve Positioner

Input & Communication
- **C** 4-20mA

Feedback Output
- **F** Isolated position feedback transimitter 4-20mA

Electric and Pneumatic Connections
- **N** Single conduit entry 1/2" NPT / Pneumatic manifold with 1/4" NPT

Pneumatic Manifold
- **G** ZAMAC Manifold with two pressure gauges

Type of Actuator Adaptor
- **RN** Rotary NAMUR adaptor
- **K3** Linear feedback lever 12-120mm
- **K4** Linear feedback lever 80-200mm

Actuator Mounting Brackets
- **00** No mounting bracket included

Other Options
- **00** No other options

Area Classification
- **EN** Non Incendive

Regional Certs
- **Blank** No regional certs

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