

SP7-20, SP7-21 and SP7-22 Smart Positioner

Installation and Maintenance Instructions



- | | |
|--------------------------------|------------------------------|
| 1. Safety information | 6. Troubleshooting |
| 2. General product information | 7. Maintenance |
| 3. Installation | 8. Approvals |
| 4. Commissioning | 9. Declaration of conformity |
| 5. Operation | |

Throughout the document SP7-2* is written where the information is relevant to all versions; the SP7-20, SP7-21 and SP7-22. Where the information is specific it will be referenced as the version appropriate.

Copyright © Spirax-Sarco Limited 2025

All rights reserved

Spirax-Sarco Limited grants the legal user of this product (or device) the right to use the Work(s) solely within the scope of the legitimate operation of the product (or device). No other right is granted under this licence. In particular and without prejudice to the generality of the foregoing, the Work(s) may not be used, sold, licensed, transferred, copied or reproduced in whole or in part or in any manner or form other than as expressly granted here without the prior written consent of Spirax-Sarco Limited.

Contents

1. Safety information	4
2. General product information	
2.1 Introduction	8
2.2 Label description	
2.3 Operating principle	
2.4 Principle of operation	10
3. Installation	11
3.1 Mechanical mounting	
3.2 Electrical connections	23
3.3 Connection on the device	30
4. Commissioning	
4.1 Commissioning the positioner	34
4.2 Recommended rotational angle range	
4.3 Operating modes	35
4.4 Standard automatic adjustment	36
4.5 Sample parameters	37
4.6 Setting the option modules	38
4.7 Setting the mechanical limit switch with proximity switches	39
4.8 Setting the mechanical limit switch with 24 V micro-switches	
5. Operation	40
5.1 Parameterisation of the device	
5.2 SP7-20 HART Parameter Overview	42
5.3 SP7-21/22 Parameter Overview	47
6. Troubleshooting	50
6.1 SP7-20 Error codes	
6.2 SP7-21/22 Error codes	52
6.3 Alarm codes	53
6.4 Message codes	54
7. Maintenance	55
8. Approvals	56
9. Declaration of conformity	57

1. Safety information

Safe operation of these products can only be guaranteed if they are properly installed, commissioned, used and maintained by qualified personnel (see Section 1.13) in compliance with the operating instructions. General installation and safety instructions for pipeline and plant construction, as well as the proper use of tools and safety equipment must also be complied with.



WARNING: The maximum process fluid temperature must be suitable for use if the unit is to be used in any potential explosive atmosphere. For the device maintenance in a potentially explosive atmosphere, we recommend the usage of tools which do not produce and/or propagate sparks.

1.1 Explosion Proof Warning

Please ensure the unit is being used and installed in conformity with local, regional, and national explosion proof regulations.



- Refer to “8. Approvals”
- Explosion proof type of cables and gaskets should be used, when explosive gases are present at the installation site.
- Power should be turned off completely when opening the product’s cover. When opening the cover, ensure that there is no power remaining in any electrical parts nearby.
- Flameproof enclosure type positioner has 2 ports for power connection. Explosion proof type wires and packing should be used. A blanking plug is required for any port that is not being used.
- For external ground terminal, ring terminal with surface area of more than 5.5 mm² should be used.
- There is risk of explosion due to static electricity charge. Static electricity charge may develop when cleaning the product with a dry cloth. It is imperative to avoid static electricity charge in the hazardous environment. A damp cloth must be used, when cleaning the surface of the product.
- To meet explosion-proof marking information and ingress protection of IP66, use certified Ex-cable glands and Ex-plugs.
- The cable entry must be equipped with a cable entry device, which must be an Ex cable entry device approved by the explosion-proof inspection agency (For NEPSI - according to the requirements of GB3836.1-2010 and GB3836.2-2010) and meet the requirements of the product explosion-proof mark, and the installation of the cable entry device Use must follow its instructions.
- The positioner is designed for use at an ambient temperature range of -40 °C up to 85 °C at maximum.
- If the positioner is used at an ambient temperature above 60 °C or below -20 °C, cable glands and cables approved for a service temperature corresponding to the maximum ambient temperature increased by 10 K or corresponding to the minimum ambient temperature shall be used.
- The dimensions of the flameproof joints are in parts other than the relevant minimum or maximum values of IEC 60079-1:2014. For information on the dimensions of the flameproof joints contact the manufacturer.
- Fasteners with a minimum property class of 10.12, A2-70 or A2-80 must be used for the closing of the flameproof enclosure.

1.2 Wiring

Every effort has been made during the design of the positioner to ensure the safety of the user, but the following precautions must be followed:

- i) Ensure correct installation. Safety may be compromised if the installation of the product is not carried out as specified in this manual.
- ii) Wiring should be carried out in accordance with IEC 60364 or equivalent.
- iii) Fuses should not be installed in the protective earth conductor. The integrity of the installation protective earth system must not be compromised by the disconnection or removal of other equipment.

1.3 Intended use

Referring to the Installation and Maintenance Instructions, product markings and Technical Information Sheet, check that the product is suitable for the intended use/application.

1.4 Access

Ensure safe access and if necessary a safe working platform (suitably guarded) before attempting to work on the product. Arrange suitable lifting gear if required.

1.5 Lighting

Ensure adequate lighting, particularly where detailed or intricate work is required.

1.6 Hazardous liquids or gases in the pipeline

Consider what is in the pipeline or what may have been in the pipeline at some previous time. Consider: flammable materials, substances hazardous to health, extremes of temperature.

1.7 Hazardous environment around the product

Consider: explosion risk areas, lack of oxygen (e.g. tanks, pits), dangerous gases, extremes of temperature, hot surfaces, fire hazard (e.g. during welding), excessive noise, moving machinery. The positioner is suitable for installation in Zone 1 or Zone 2 (Gas). The positioner shall not be used in zone 0.

1.8 The system

Consider the effect on the complete system of the work proposed. Will any proposed action (e.g. closing isolation valves, electrical isolation) put any other part of the system or any personnel at risk?

Dangers might include isolation of vents or protective devices or the rendering ineffective of controls or alarms. Ensure isolation valves are opened and closed progressively to avoid system shocks.

1.9 Pressure systems

Ensure that any pressure is isolated and safely vented to atmospheric pressure. Consider double isolation (double block and bleed) and the locking or labelling of closed valves. Do not assume that the system has depressurised even when the pressure gauge indicates zero.

1.10 Temperature

Allow time for temperature to normalise after isolation to avoid the danger of burns.

1.11 Tools and consumables

Before starting work ensure that you have suitable tools and /or consumables available. Use only genuine Spirax Sarco replacement parts.



Operators must wear ear protection when commissioning the positioner

1.12 Protective clothing

Consider whether you and /or others in the vicinity require any protective clothing to protect against the hazards of, for example, chemicals, high /low temperature, radiation, noise, falling objects, and dangers to eyes and face.

1.13 Permits to work

All work must be carried out or be supervised by a suitably competent person. Installation and operating personnel should be trained in the correct use of the product according to the Installation and Maintenance Instructions.

Where a formal 'permit to work' system is in force it must be complied with. Where there is no such system, it is recommended that a responsible person should know what work is going on and, where necessary, arrange to have an assistant whose primary responsibility is safety.

Post 'warning notices' if necessary.

1.14 Handling

Manual handling of large and/or heavy products may present a risk of injury. Lifting, pushing, pulling, carrying or supporting a load by bodily force can cause injury particularly to the back. You are advised to assess the risks taking into account the task, the individual, the load and the working environment and use the appropriate handling method depending on the circumstances of the work being done.

1.15 Residual hazards

In normal use the external surface of the product may be hot. Many products are not self-draining. Take due care when dismantling or removing the product from an installation (refer to 'Maintenance instructions').

1.16 Freezing

Provision must be made to protect products which are not self-draining against frost damage in environments where they may be exposed to temperatures below freezing point.

1.17 Returning products

Customers and stockists are reminded that under EC Health, Safety and Environment Law, when returning products to Spirax Sarco they must provide information on any hazards and the precautions to be taken due to contamination residues or mechanical damage which may present a health, safety or environmental risk. This information must be provided in writing including Health and Safety data sheets relating to any substances identified as hazardous or potentially hazardous.

Product return procedure

Please provide the following information with any equipment being returned:

1. Your name, Company name, address and telephone number, order number and invoice and return delivery address.
2. Description of equipment being returned.
3. Description of the fault.
4. If the equipment is being returned under warranty, please indicate:
 - i. Date of purchase
 - ii. Original order number
 - iii. Serial number

Please return all items to your local Spirax Sarco branch.

Please ensure all items are suitably packed for transit (preferably in the original cartons).

2. General product information

2.1 Introduction

The SP7 is an electronically configurable positioner with communication capabilities designed for mounting on pneumatic linear or rotary actuators. It features a small and compact design, a modular construction, and an excellent cost-performance ratio. Fully automatic determination of the control parameters and adaptation to the positioner allow for considerable time savings as well as optimum control behaviour. The positioner has a built-in LCD indicator with a multi-line LCD display and 4 operating buttons for commissioning, configuration, and monitoring during live operation. Alternatively, the appropriate DTM/EDD can be used via the available communication interface. The positioner supports HART5 and HART7 communication. In addition to its input for the analogue position set-point, the positioner is equipped with a digital input which can be used to activate a control system functions in the device.

2.2 Label description

- Order-Code
- Serial no.
- HW-Rev.
- SW-Rev.
- DOM
- Special Request
- Supply press.
- Input
- Output
- Safe position

Options:

- Analogue feedback output
- Digital feedback output
- Electr. limits switch
- Mech. limits switch
- Position indicator
- Approvals

Label example

ATEX/IECEx

spiralx sarco

SP7-2*



Order-Code: SP7-2-*****

Serial number: *****

HW-Rev.: *****

SW-Rev.: *****

DOM: *****

Special Request: *****

Supply press.: 0.14...0.6MPa / 20...90psi

Input: analogue 4 - 20mA

Output: ***** acting

Safe position: fail

Options:

Analogue feedback output

Digital feedback output

Electr. limits switch

Mech. limits switch

Position indicator

ATEX/IECEx

IP65

CE

Ex db IIC T6 / T5 / T4 Gb

BVS 21 ATEX E 073 X

II 2G

-40°C ≤ Ta ≤ 65°C / 80°C / 85°C

2812

IECEx BVS 21.0078X

Nach dem Abschalten 4 Minuten warten vor dem Öffnen

Please open 4 minutes after switch off of power supply

Attendez 4 minutes après avoir coupé le courant avant d'ouvrir

for parameters see operating instructions/certificate



2.3 Operating principle

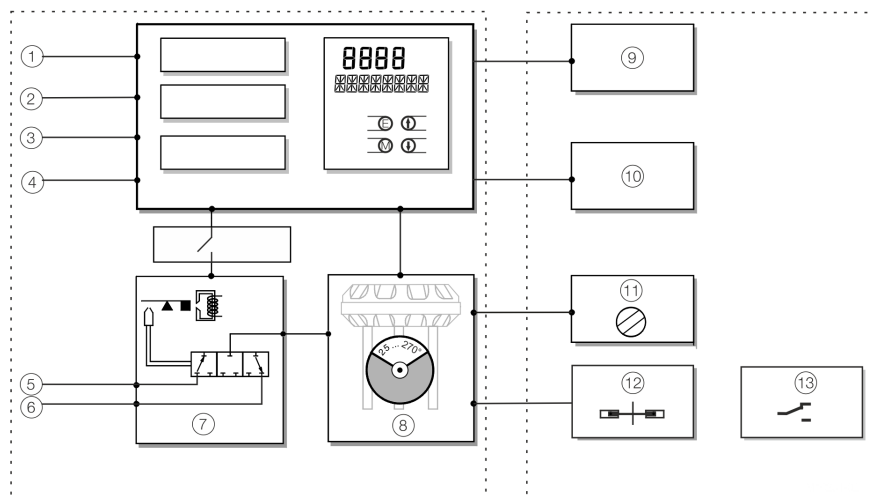


Fig. 1 Schematic diagram

Basic device

- 1 LCI plug *
- 2 Setpoint signal 4 to 20 mA/bus connection 9 to 32 Vdc
- 3 Binary input *
- 4 Binary output *
- 5 Supply air: 1.4 to 6 bar (20 to 90 psi)
- 6 Exhaust
- 7 I/P module with 3/3-way valve
- 8 Position sensor (optional up to 270 ° rotation angle)

Optional upgrades

- 9 Plug-in module analog feedback (4 to 20 mA) *
- 10 Plug-in module for digital feedback *
- 11 Installation kit for mechanical position indication
- 12 Installation kit for digital feedback with proximity switches
- 13 Installation kit for digital feedback with 24 V microswitches

* Only for devices with HART Communication.

Note : With optional upgrades either, the 'Installation kit for digital feedback with proximity switches' (13) or the 'Installation kit for digital feedback with 24 V microswitches' (14) can be used. In both cases though, the mechanical position indication (11) must be installed.

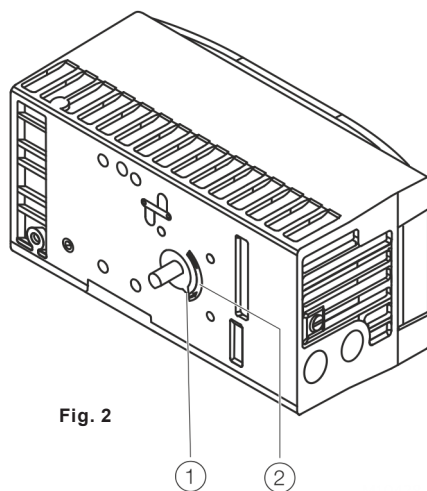
2.4 Principle of operation

The SP7-20, SP7-21, SP7-22 is an electronically configurable positioner with communication capabilities designed for mounting on pneumatic linear or rotary actuators.

Fully automatic determination of the control parameters and adaptation to the positioner allow for considerable time savings as well as optimum control behavior.

3. Installation

3.1 Mechanical mounting



Arrow (1) on the device feedback shaft (position feedback) point must move between the arrow marks (2)

3.1.1 Measuring and operating ranges of the positioner

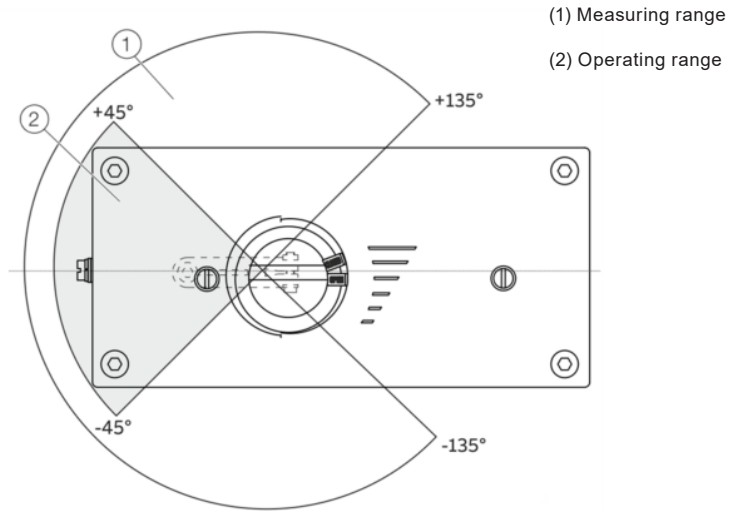


Fig. 3

Operating range for linear actuators:

The operating range for linear actuators is $\pm 45^\circ$ symmetrically to the longitudinal axis. The usable span within the operating range is at least 25° (recommended figure 40°). The usable span does not necessarily need to run symmetrically to the longitudinal axis.

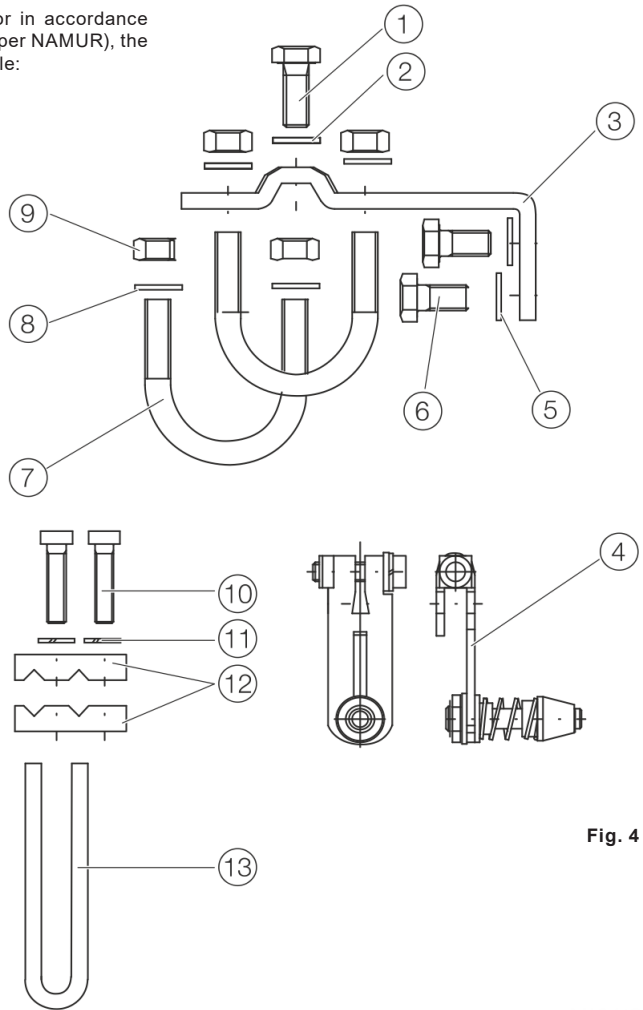
Operating range of rotary actuators:

The usable span is 90° , which must be entirely within the measuring range, but does not necessarily need to run symmetrically to the longitudinal axis.

Note: During installation make sure that the actuator travel or rotation angle for position feedback is implemented correctly.

3.1.2 Mounting on linear actuators

For mounting on a linear actuator in accordance with IEC 534 (lateral mounting as per NAMUR), the following attachment kit is available:



- | | |
|----|---|
| 1 | Screw |
| 2 | Washer |
| 3 | Mounting bracket |
| 4 | Lever with follower pin
(for mechanical stroke
10 to 35 mm
[0.39 to 1.38"]
or
20 to 100 mm
[0.79 to 3.94"]) |
| 5 | Washers |
| 6 | Screws |
| 7 | U-Bolts |
| 8 | Washers |
| 9 | Nuts |
| 10 | Screws |
| 11 | Spring washers |
| 12 | Clamp plates |
| 13 | Follower guide |

Fig. 4

Note: Items 7, 8 and 9 to be ordered separately

3.1.3 Attaching a follower guide to the actuator

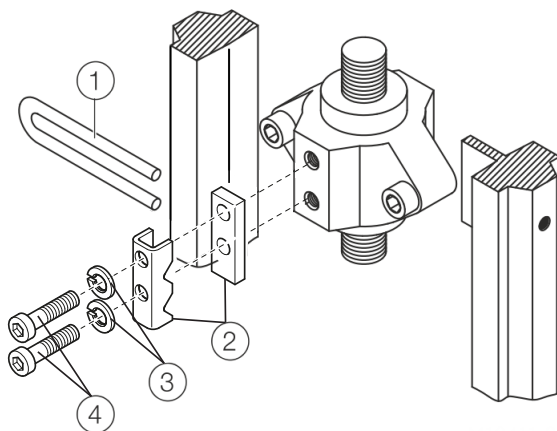


Fig. 5

1. Tighten the screws so that they are hand tight
2. Attach the follower guide (1) and clamp plates (2) with screws (4) and spring washers (3) to the actuator stem.

3.1.4 Mounting lever and bracket on the positioner

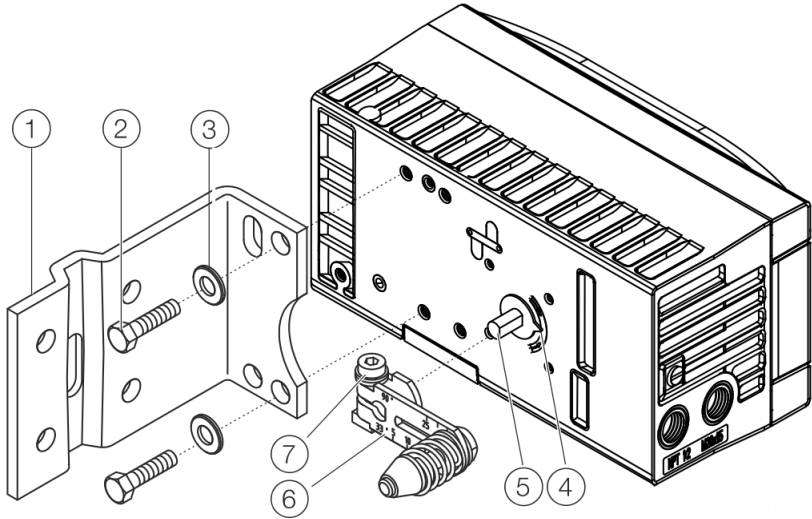


Fig. 6

Note: Positioner mounting threaded holes & bracket holes, depend on the actuator type used. Select to suit, to ensure the follower pin has free movement in the follower guide over entire valve travel.

1. Attach the lever (6) to the feedback shaft (5) of the positioner (can only be mounted in one position due to the cut shape of the feedback shaft).
2. Using the arrow marks (4), check whether the lever moves within the operating range (between the arrows).
3. Hand-tighten the screw (7) on the lever.
4. Hold the prepared positioner (with the mount bracket 1 still loose) on the actuator so that the follower pin for the lever enters the follower guide to determine which tap holes on the positioner must be used for the mount bracket.
5. Secure the mount bracket 1 with screws 2 and washers 3 using the relevant tap holes on the positioner housing.

Tighten the screws as evenly as possible to ensure subsequent linearity. Align the mount bracket in the oblong hole to ensure that the operating range is symmetrical. Set the valve mid stroke and align the lever horizontal (item 4 Fig. 6) then tighten mounting bolt (item 4 Fig. 6) (lever moves between the arrow marks Item 4 Fig. 3).

3.1.5 Mounting on a yoke

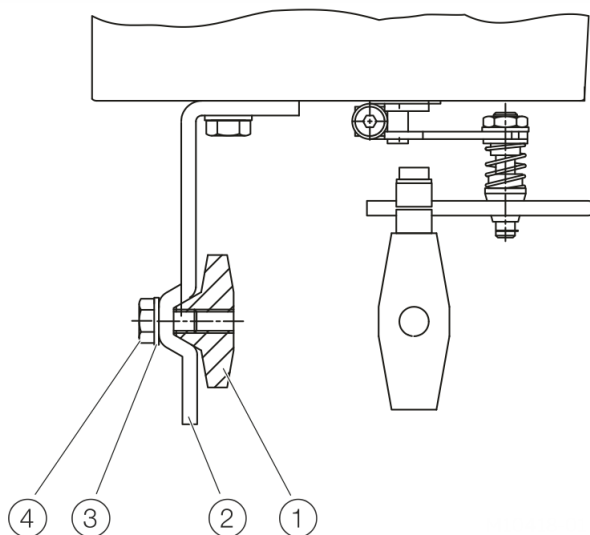


Fig. 7

1. Attach the mount bracket (2) with screw (4) and washer (3) to the yoke (1)

3.1.6 Mounting on a column

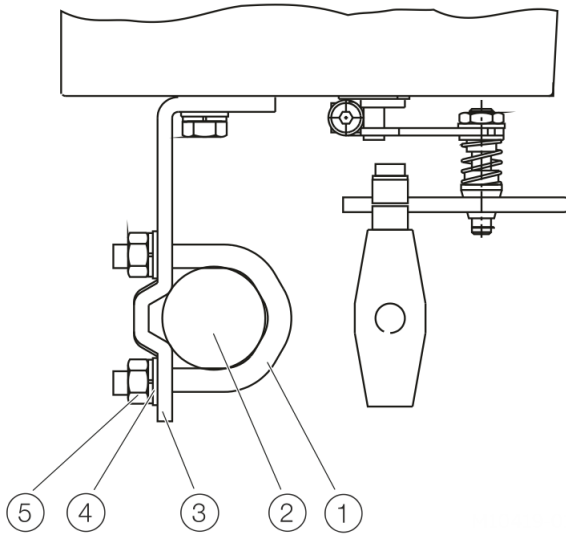


Fig. 8

1. Hold the mount bracket (3) in the proper position on the column (2).
2. Insert the U-bolts (1) from the inside of the column (2) through the holes of the mount bracket.
3. Add the washers (4) and nuts (5).
4. Tighten the nuts so that they are hand-tight.

Notes:

- Adjust the height of the positioner on the yoke or column until the lever is horizontal (based on a visual check) at half stroke of the valve.
- Items 1, 4 and 5 to be ordered separately

3.1.7 Positioner linkage

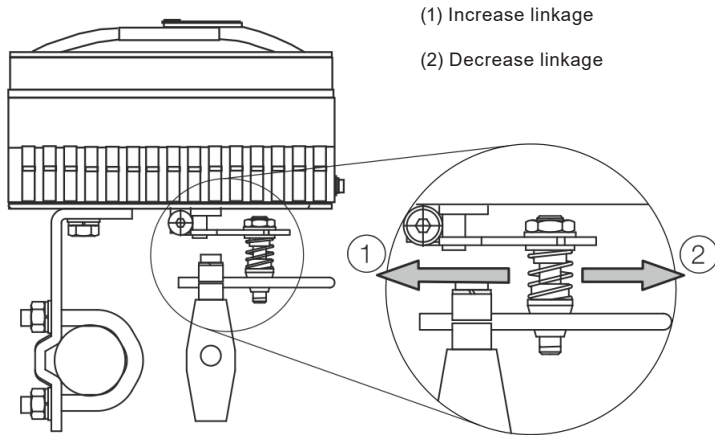


Fig. 9

The scale on the lever indicates the link points for the various stroke ranges of the valve.

Move the bolt with the follower pin in the oblong hole of the lever to adjust the stroke range of the valve to the working range for the position sensor.

Moving the link point inwards increases the rotation angle of the sensor. Moving the link point outwards reduces the rotation angle of the sensor.

Adjust the actuator stroke to make use of as large an angle of rotation as possible (symmetrical around the center position) on the position sensor.

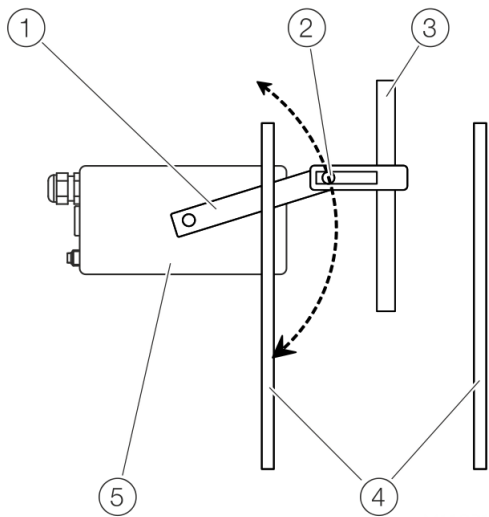
Recommended range for linear actuators:	-28 to 28 °
Minimum angle:	25 °

Note: After mounting, check whether the positioner is operating within the measuring range.

3.1.8 Position of the actuator bolt

The actuator bolt for moving the potentiometer lever can be mounted permanently on the lever itself or on the valve stem. Depending on the mounting method, when the valve moves the actuator bolt performs either a circular or a linear movement with reference to the center of rotation of the potentiometer lever. Select the chosen bolt position in the HMI menu in order to ensure optimum linearisation. The default setting is actuator bolt on lever

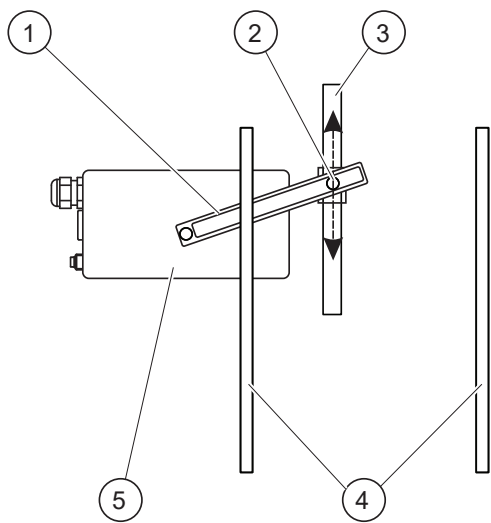
3.1.9 Actuator bolts on the lever (Rear view)



1	Potentiometer lever
2	Actuator bolts
3	Valve stem
4	Valve yoke
5	Positioner

Fig. 10

3.1.10 Actuator bolts on the Valve (Rear view)



1	Potentiometer lever
2	Actuator bolts
3	Valve stem
4	Valve yoke
5	Positioner

Fig. 11

3.1.11 Mounting on rotary actuator

For mounting on part-turn actuators in accordance with VDI/VDE 3845, the following attachment kit is available.

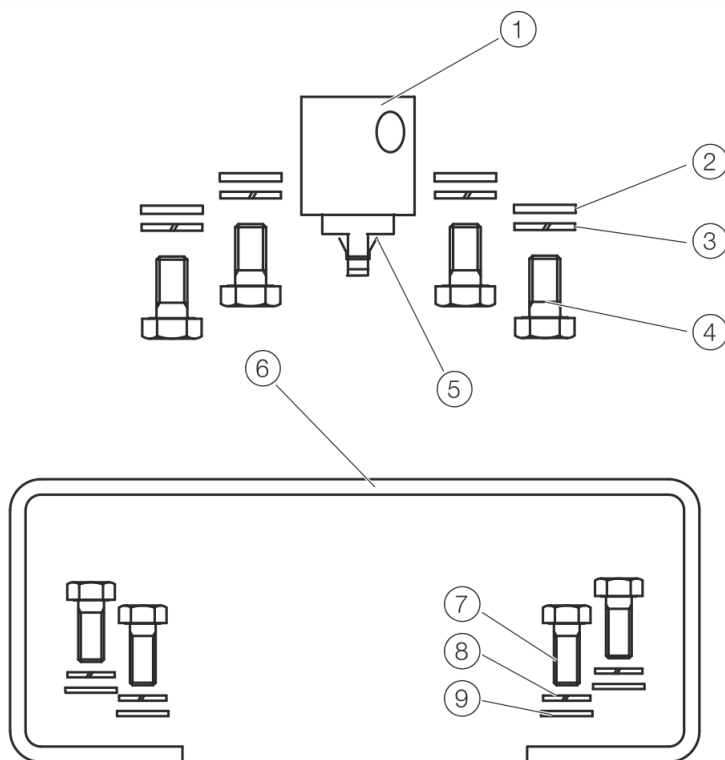


Fig. 12 Components of attachment kit

- Adapter 1 with spring (5).
- Four M6 screws each (4), spring washers (3) and washers (2) to fasten the attachment bracket (6) to the positioner
- Four M5 screws (7), Spring washers (8) and washers (9) to fasten the attachment bracket to the actuator

Required tools:

- Wrench, size 8/10
- Allen key, size 3

3.1.12 Mounting the adapter on the positioner

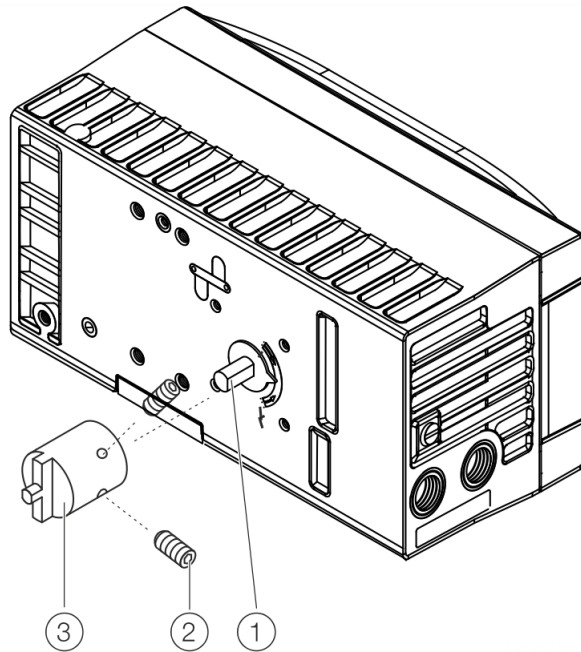


Fig. 13

1. Determine the mounting position (parallel to actuator or at 90 ° angle)
2. Calculate the rotational direction of the actuator (right or left).
3. Move the part-turn actuator into the home position.
4. Pre-adjust feedback shaft.

To make sure that the positioner runs within the operating range (refer to General on page 14), the mounting position as well as the basic position and rotation direction of the actuator must be considered when determining the adapter position on axis (1). For this purpose, the feedback shaft can be adjusted manually so that the adapter (3) can be attached in the correct position.

5. Place the adapter in the proper position on the feedback shaft and fasten with threaded pins (2). One of the threaded pins must be locked in place on the flat side of the feedback shaft.

3.1.13

Screwing the attachment bracket onto the positioner

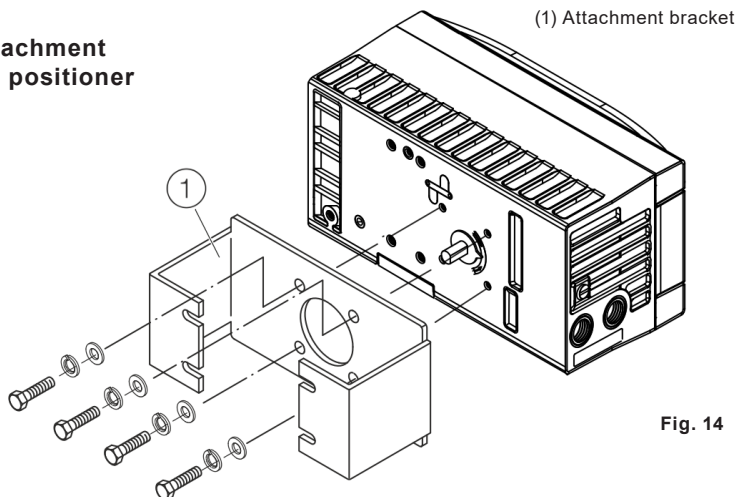


Fig. 14

3.1.14

Screwing the positioner onto the actuator

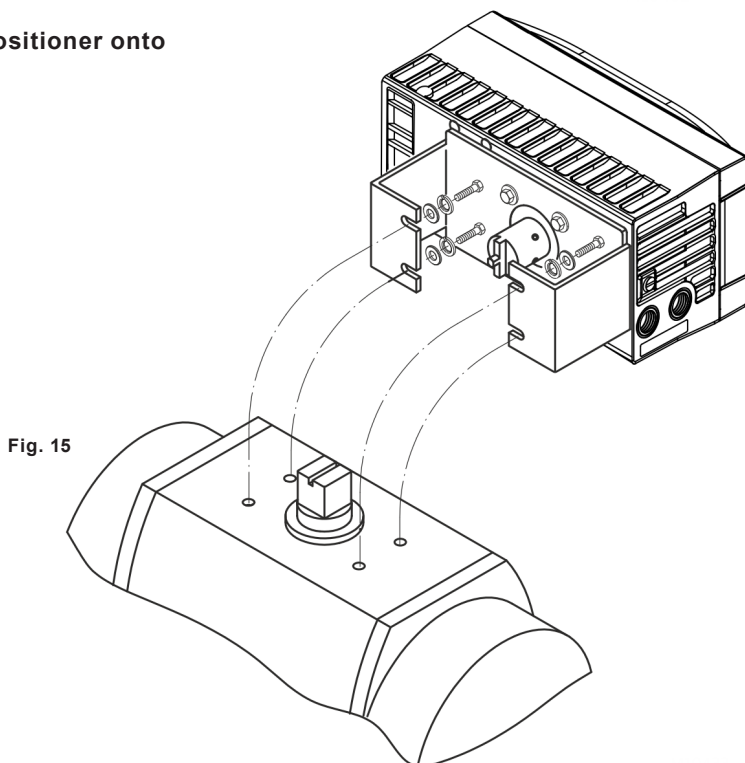


Fig. 15

3.2 Electrical connections

3.2.1 Positioner SP7-20 Electrical Connection

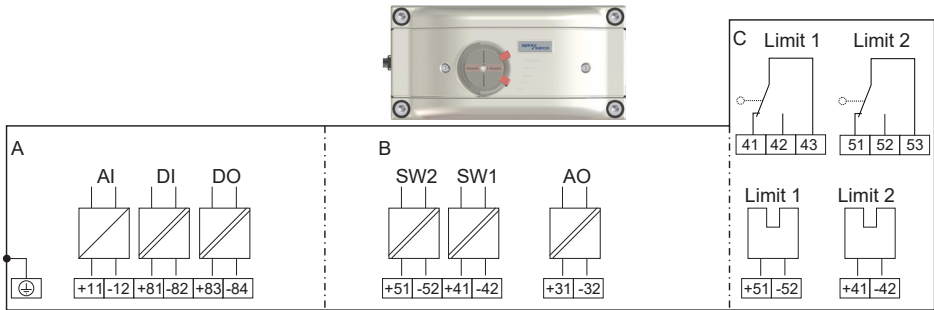


Fig. 16

A Basic device

B Options

C Options, limit switch with proximity switches or microswitches

Connections for inputs and outputs

Terminal	Function/comments
+11/-12	Analog input
+81/-82	Binary input DI
+83/-84	Binary output DO2
+51/-52	Digital feedback SW1 (Option module)
+41/-42	Digital feedback SW2 (Option module)
+31/-32	Analog feedback AO (Option module)
+51/-52	Limit switch Limit 1 with proximity switch (Option)
+41/-42	Limit switch Limit 2 with proximity switch (Option)
41/42/43	Limit switch Limit 1 with microswitch (Option)
51/52/53	Limit switch Limit 2 with microswitch (Option)

Note : The SP7-2X can be fitted either with proximity switches or microswitches as limit switches. It is not possible to combine both variants.

3.2.2 Positioner SP7-21/22 Electrical Connection

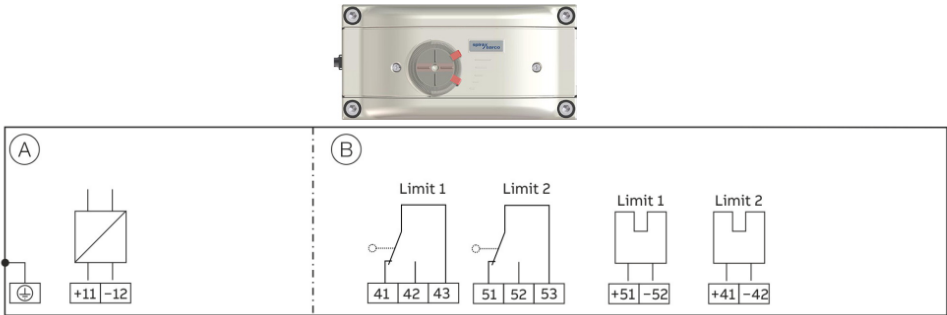


Fig. 17

- A Basic device
- B Options, digital feedback with proximity switches or microswitches

Terminal	Function/comments
+11/-12	Fieldbus, bus feed
+51/-52	Digital feedback Limit 1 with proximity switch (optional)
+41/-42	Digital feedback Limit 2 with proximity switch (optional)
41/42/43	Digital feedback Limit 1 with microswitch (optional)
51/52/53	Digital feedback Limit 2 with microswitch (optional)

Note : The SP7-20, SP7-21, SP7-22 can be fitted either with proximity switches or microswitches as limit switches. It is not possible to combine both variants.

3.2.3 Electrical data for inputs and outputs (SP7-20)

3.2.3.1 Analog input

4-20 mA or 4-20 mA HART set point signal	
Terminals	+11/-12
Nominal operating range	4 to 20 mA
Split range configuration	Selectable; 20 to 100% of nominal range
Maximum input current	50 mA
Minimum input current	3.6mA
Load	9.7 V @ 20 mA
Impedence @ 20 mA	485 Ω

3.2.3.2 Digital input

- Input configurable for the following functions:
- No function
 - Move to 0%
 - Move to 100%
 - Hold previous position
 - Block local configuration
 - Block local configuration & operation
 - Block any access (local or via PC/software)

Terminals	+81/-82
Supply voltage	12 to 30 Vdc
Input 'logic 0'	0 to 5 Vdc
Inout 'logic 1'	11 to 30 Vdc
Inout current	Maximum 4 mA

3.2.3.3 Binary output DO

Terminals	+83/-84
Supply voltage	5 to 11 Vdc (control circuit in accordance with NAMUR)
Output 'logic 0'	> 0.35 mA to < 1.2 mA
Output 'logic 1'	> 1.2 mA
Action	Configurable (logic '0' or logic '1')

3.2.3.4 Option module for analog feedback AO*

Without signal from the positioner (e.g. 'no power' or 'initializing') the output value will be > 20 mA (alarm level).

Terminals	+31/-32
Signal range	Configurable across the range 4 to 20 mA
Supply voltage	11 to 30 Vdc
Characteristic	Configurable (4 to 20 mA or 20 to 4 mA)
Deviation	< 1%

3.2.3.5 Option module for digital feedback SW1, SW2*

Two software switches for binary position feedback (position adjustable within the range of 0 to 100 %, ranges cannot overlap)

Terminals	+41/-42, +51/-52
Supply voltage	5 to 11 Vdc (control circuit in accordance with NAMUR)
Output 'logic 0'	< 1.2 mA
Output 'logic 1'	> 1.2 mA
Action	Configurable (logic '0' or logic '1')

*The analog feedback and digital feedback option have specific locations and can be used together

3.2.3.6 Option Mechanical digital feedback

Two proximity switches or two microswitches provide independent signaling of the valve actuator position. Set points are adjustable between 0 to 100%

Mechanical digital feedback with proximity switches; Limit 1, Limit 2**

Terminals	+41/-42, +51/-52	
Supply voltage	5 to 11 Vdc (control circuit in accordance with NAMUR)	
Direction of action	Metal tag in proximity	Metal tag outside proximity switch
Type SJ2-SN (NC; log 1)	< 1.2 mA	> 2.1 mA

Mechanical digital feedback with 24V microswitches; Limit 1, Limit **

Terminals	+41/-42, +51/-52
Supply voltage	maximum 24 Vac/dc
Current rating	maximum 2 A
Contact surface	10 µm Gold (Au)

**Mechanical feedback only possible with mechanical position indicator (housing type '20')

Note: Mechanical feedback only possible with either proximity switches or 24V microswitches; not both.

3.2.3.7 Electrical data for use in potentially explosive areas (Ex certified types only)

Signal circuit (+11/-12)	U _i = 30 V	C _i = 6.6 nF
	I _i = 320 mA	L _i = negligibly small
	P _i = 1.1 W	
Binary input DI (+81/-82)	U _i = 30 V	C _i = 14.5 nF
	I _i = 320 mA	L _i = negligibly small
	P _i = 1.1 W	
Binary output DO (+83/-84)	U _i = 30 V	C _i = 14.5 nF
	I _i = 320 mA	L _i = negligibly small
	P _i = 500mW	
Mechanical digital feedback (proximity switch) (Limit 1: +51/-52, Limit 2: +41/-42) Refer to Ex Certificate PTB 00 ATEX 2049 X	U _i = 16 V	C _i = 60 nF
	I _i = 25 mA	L _i = 100 µH
	P _i = 64 mW	
Digital switch feedback (software switch) (Limit 1: +51/-52, Limit 2: +41/-42)	U _i = 30 V	C _i = 3.7 nF
	I _i = 320 mA	L _i = negligibly small
	P _i = 250 mW	
Plug-in module for analog feedback (+31/-32)	U _i = 30 V	C _i = 6.6 nF
	I _i = 320 mA	L _i = negligibly small
	P _i = 1.1 W	
Local Communication Interface (LCI)	Only for connection to a programming device using ABB LCI adaptor (U _m ≤ 30 Vdc) outside hazardous area	

3.2.4 Electrical data for inputs and outputs (SP7-21)

3.2.4.1 Fieldbus communication - PROFIBUS PA

Terminals	+11/-12
Supply Voltage	9 to 32 Vdc (Power from PA Bus)
Maximum voltage	35 Vdc
Input current	10.5 mA
Current in the event of an error	15 mA (10.5 mA + 4.5 mA)

3.2.4.2 Optional Mechanical digital feedback

Two proximity switches or two microswitches provide independent signaling of the valve actuator position. Set points are adjustable between 0 to 100%

3.2.4.3 Mechanical digital feedback with proximity switches; Limit 1, Limit 2**

Terminals	+51/-52 (Limit 1), +41/-42, (Limit 2)	
Supply voltage	5 to 11 Vdc (control circuit in accordance with NAMUR)	
Direction of action	Metal tag in proximity	Metal tag outside proximity switch
Type SJ2-SN (NC; log 1)	> 2.1 mA	< 1.2 mA

3.2.4.4 Mechanical digital feedback with 24V microswitches; Limit 1, Limit2 **

Terminals	41/42/43 (Limit 1), 51/52/53 (Limit 2)
Supply voltage	maximum 24 Vac/dc
Current rating	maximum 2 A
Contact surface	10 µm Gold (Au)

**Mechanical feedback only possible with mechanical position indicator (housing type '20')

Note: Mechanical feedback only possible with either proximity switches or 24V microswitches; not both.

3.2.4.5 Electrical data for use in potentially explosive areas (Ex certified types only)

Signal circuit (+11/-12)	Ui = 24 V	Ci = < 5.0 nF
	Ii = 250 mA	Li = < 10 µH
	Pi = 1.2 W	
Mechanical digital feedback (proximity switch) (+51/-52: Limit 1, +41/-42: Limit 2)	Ui = 16 V	Ci = 60 nF
	Ii = 25 mA	Li = 100 µH
	Pi = 64 mW	
Proximity switch: Pepperl+Fuchs SJ2-SN		
Refer to Ex Certificate PTB 00 ATEX 2049 X		

3.2.5 Electrical data for inputs and outputs (SP7-22)

3.2.5.1 Fieldbus communication - Foundation Fieldbus

Terminals	+11/-12
Supply Voltage	9 to 32 Vdc (Power from Fieldbus)
Maximum voltage	35 Vdc
Input current	11.5 mA
Current in the event of an error	15 mA (11.5 mA + 3.5 mA)

3.2.5.2 Optional Mechanical digital feedback

Two proximity switches or two microswitches provide independent signaling of the valve actuator position. Set points are adjustable between 0 to 100%

3.2.5.3 Mechanical digital feedback with proximity switches; Limit 1, Limit 2**

Terminals	+51/-52 (Limit 1), +41/-42, (Limit 2)	
Supply voltage	5 to 11 Vdc (control circuit in accordance with NAMUR)	
Direction of action	Metal tag in proximity	Metal tag outside proximity switch
Type SJ2-SN (NC; log 1)	> 2.1 mA	< 1.2 mA

3.2.5.4 Mechanical digital feedback with 24V microswitches; Limit 1, Limit2 **

Terminals	41/42/43 (Limit 1), 51/52/53 (Limit 2)
Supply voltage	maximum 24 Vac/dc
Current rating	maximum 2 A
Contact surface	10 µm Gold (Au)

**Mechanical feedback only possible with mechanical position indicator (housing type '20')

Note: Mechanical feedback only possible with either proximity switches or 24V microswitches; not both.

3.2.5.5 Electrical data for use in potentially explosive areas (Ex certified types only)

Signal circuit (+11/-12)	Ui = 24 V	Ci = < 5.0 nF
	Ii = 250 mA	Li = < 10 µH
	Pi = 1.2 W	
Mechanical digital feedback (proximity switch) (+51/-52: Limit 1, +41/-42: Limit 2)	Ui = 16 V	Ci = 60 nF
	Ii = 25 mA	Li = 100 µH
	Pi = 64 mW	
Proximity switch: Pepperl+Fuchs SJ2-SN		
Refer to Ex Certificate PTB 00 ATEX 2049 X		

3.3 Connection on the device

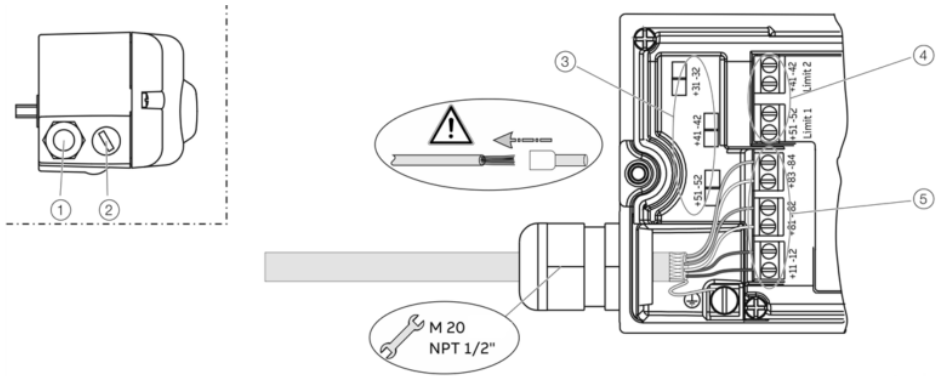


Fig. 18

- | | |
|---|--|
| 1 | Cable gland |
| 2 | Blind plug |
| 3 | Terminals for option modules |
| 4 | Terminal attachment kit for digital feedback |
| 5 | Terminals for basic unit |

2 tap holes $\frac{1}{2}$ 14 NPT or M20 $\times$ 1.5 are provided on the left side of the housing for cable entry in the housing. One of the tap holes is fitted with a cable gland, while the other tap hole has a blind plug.

Note

The connecting terminals are delivered closed and must be unscrewed before inserting the wire.

1. Strip the wires to approximately 6 mm (0.24").
2. Connect the wires to the connecting terminals in line with the connection diagram.

3.3.1 Wire cross-sectional areas

Basic device - Electrical connections

4 to 20 mA input	Screw terminals max. 2.5 mm ² (AWG14)
Options	Screw terminals max. 1.0 mm ² (AWG18)

Cross section

Rigid/flexible wires	0.14 to 2.5 mm ² (AWG26 to AWG14)
Flexible with wire end sleeve	0.25 to 2.5 mm ² (AWG23 to AWG14)
Flexible with wire end sleeve no plastic sleeve	0.25 to 1.5 mm ² (AWG23 to AWG17)
Flexible with wire end sleeve with plastic sleeve	0.14 to 0.75 mm ² (AWG26 to AWG20)

Multi-wire connection capacity (two wire with the same cross-section)

Rigid/flexible wires	0.14 to 0.75 mm ² (AWG26 to AWG20)
Flexible with wire end sleeve no plastic sleeve	0.25 to 0.75 mm ² (AWG23 to AWG20)
Flexible with wire end sleeve with plastic sleeve	0.5 to 1.5 mm ² (AWG21 to AWG17)

3.3.2 Option modules

Cross section

Rigid/flexible wires	0.14 to 1.5 mm ² (AWG26 to AWG17)
Flexible with wire end sleeve no plastic sleeve	0.25 to 1.5 mm ² (AWG23 to AWG17)
Flexible with wire end sleeve with plastic sleeve	0.25 to 1.5 mm ² (AWG23 to AWG17)

Multi-wire connection capacity (two wire with the same cross-section)

Rigid/flexible wires	0.14 to 0.75 mm ² (AWG26 to AWG20)
Flexible with wire end sleeve no plastic sleeve	0.25 to 0.5 mm ² (AWG23 to AWG22)
Flexible with wire end sleeve with plastic sleeve	0.5 to 1 mm ² (AWG21 to AWG18)

Limit switch with proximity switches or 24 V micro-switches

Rigid wire	0.14 to 1.5 mm ² (AWG26 to AWG17)
Flexible wire	0.14 to 1.0 mm ² (AWG26 to AWG18)
Flexible with wire end sleeve no plastic sleeve	0.25 to 0.5 mm ² (AWG23 to AWG22)
Flexible with wire end sleeve with plastic sleeve	0.25 to 0.5 mm ² (AWG23 to AWG22)

3.3.3 Pneumatic connections

Notes:

- The positioner must only be supplied with instrument air that is free of oil, water, and dust.
- The purity and oil content must meet the requirements of Class 3:3:3 in accordance with ISO 8573-1.

Notice

Damage to components! Contamination on the air pipe and positioner can damage components.

- Dust, splinters, and any other particles of dirt must be blown-out before the pipe is connected. Pressure above 6 bar (90 psi) can damage the positioner or actuator.
- Provisions must be made (e.g., by using a pressure reducer) to make sure that the pressure does not rise above 6 bar (90 psi)*, even in the event of a fault.

Information on double acting actuators with spring-return mechanism

On double-acting actuators with spring-return mechanism, a pressure that significantly exceeds the supply air pressure value can be generated during operation by the springs in the chamber opposite the springs.

This may damage the positioner or adversely affect control of the actuator.

To eliminate the possibility of this occurring, it is recommended to install a pressure compensation valve between the springless chamber and the supply air for these types of applications. It enables the increased pressure to be transferred back to the air inlet line.

The opening pressure of the check valve should be < 250 mbar (< 3.6 psi).

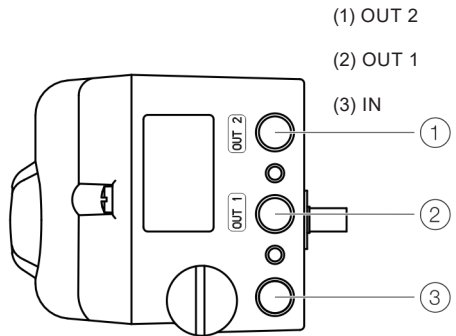


Fig. 19

Marking	Pipe connection
IN	Supply air, pressure 1.4 to 6 bar (20 to 90 psi)
OUT1	Output pressure to the actuator
OUT2	Output pressure to the actuator (2. Connection with double acting actuator)

Join the pipe connections according to the designation, observing the following points:

- All pneumatic piping connections are located on the right-hand side of the positioner. 1/4 18 NPT tap holes are provided for the pneumatic connections. The positioner is labeled according to the tap holes available.
- We recommend that you use a pipe with dimensions of 12 × 1.75 mm.
- The supply air pressure required to apply the actuating force must be adjusted in line with the output pressure in the actuator. The operating range of the positioner is between 1.4 to 6 bar (20 to 90 psi)***.

3.3.4 Pneumatic connections - Air supply

Instrument air*

Purity	Maximum particle size: 5 µm Maximum particle density: 5 mg/m ³
Oil content	Maximum concentration 1 mg/m ³
Pressure dew point	10 K below operating temperature
Supply pressure**	Standard design: 1.4 to 6 bar (20 to 90 psi)
Air consumption***	< 0.03 kg/h/0.015 scfm

* Free of oil, water and dust in accordance with DIN/ISO 8573-1. Pollution and oil content in accordance with Class 3:3:3

** Do not exceed the maximum output pressure of the actuator

*** Independent of supply pressure

4. Commissioning



Operators must wear ear protection when commissioning the positioner

Note: The electrical power supply and supply air pressure data indicated on the name plate must be complied with during commissioning.

Caution

Risk of injury due to incorrect parameter values!

Incorrect parameter values can cause the valve to move unexpectedly. This can lead to process failures and result in injuries.

- Before recommissioning a positioner that was previously in use at another location, always reset the device to its factory settings.
- Never start automatic adjustment before restoring the factory settings!

4.1 Commissioning the positioner:

1. Open the pneumatic power supply.
2. Power-up the electric power supply and feed in the set point signal 4 to 20 mA.
3. Checking mechanical mounting:
 - Press and hold MODE; in addition, press ARROW UP or ARROW DOWN until operating mode 1.3 (manual adjustment in the measuring range) is displayed. Release MODE.
 - Press ARROW UP or ARROW DOWN to move the actuator into the mechanical end position; check the end positions; rotational angle is displayed in degrees; for high-speed mode, press ARROW UP or ARROW DOWN simultaneously.

Note

For manual setup, refer to parameterization document IM-S51-07 for details.

4.2 Recommended rotational angle range

Linear actuators	-28 to 28 °
Rotary actuators	-57 to 57 °
Minimum angle	25 °

4. Perform standard automatic adjustment in accordance with Standard automatic adjustment.

Commissioning of the positioner is now complete, and the device is ready for operation.

4.3 Operating modes

Selection from the operating level

1. Press and hold down MODE.
2. Also press and release ARROW UP rapidly as often as required. The selected operating mode is displayed.
3. Release MODE.

The position is displayed in % or as a rotation angle.

Operating mode	Mode indicator	Position indicator
1.0 Control mode* with adaptation of the control parameters		
1.1 Control mode* without adaptation of the control parameters		
1.2 Manual adjustment** in the operating range. Adjust*** using ARROW UP or ARROW DOWN		
1.3 Manual adjustment** in the measuring range. Adjust*** using ARROW UP or ARROW DOWN		

* Since self-optimisation in operating mode 1.0 is subject to several factors during control operation with adaptation, incorrect adjustments could appear over an extended period.

** Positioning not active.

*** For high-speed mode, press ARROW UP and ARROW DOWN simultaneously.

4.4 Standard automatic adjustment

Note : Standard Auto Adjust does not always result in optimum control conditions.

Standard automatic adjustment for linear actuators*

1. MODE Press and hold until ADJ_LIN is displayed.
2. MODE Press and hold until the countdown ends.
3. Release MODE; this starts Auto-adjust.

Standard automatic adjustment for rotary actuators*

1. ENTER Press and hold until ADJ_ROT is displayed.
2. ENTER Press and hold until the countdown ends.
3. Release ENTER; this starts Auto-adjust.

If Auto-adjust is successful, the parameters will be stored automatically and the positioner will revert to operating mode 1.1.

If an error occurs during Auto-adjust, the process will be terminated with an error message.

Perform the following steps if an error occurs:

1. Press and hold down operating button ARROW UP or ARROW DOWN for approximately three seconds.
The unit will switch to the operating level, mode 1.3 (manual adjustment within the measuring range).
2. Check mechanical mounting in accordance with Mechanical Mounting on page 11 and repeat the standard automatic adjustment.

* The zero position is determined automatically and saved during standard automatic adjustment, counter-clockwise (CTCLOCKW) for linear actuators and clockwise (CLOCKW) for rotary actuators.

4.5 Sample parameters

Change the zero position of the LCD display from clockwise (CLOCKW) to counter-clockwise limit stop (CTCLOCKW)

Initial situation: the positioner is in bus operation on the operating level.

1. Switching to the configuration level:

- Press and hold down ARROW UP and ARROW DOWN simultaneously, additionally quickly press and release ENTER,
- Wait for the countdown to go from 3 to 0,
- Release ARROW UP and ARROW DOWN.

The following is now shown in the display:



2. Switching to parameter group 3._:

- Press and hold down MODE and ENTER simultaneously, additionally quickly press and release ARROW UP 2x,

The following is now shown in the display:



- Release MODE and ENTER .

The following is now shown in the display:



3. Selecting parameter 3.2:

- Press and hold down MODE, additionally quickly press and release ARROW UP 2x,

The following is now shown in the display:



Release MODE.

4. Changing parameter settings:

- Quickly press and release ARROW UP to select CTCLOCKW.

5. Switching to parameter 3.3 (Return to operating level) and saving the new settings:

- Press and hold down MODE, additionally quickly press and release ARROW UP 2×,
The following is now shown in the display:



- Release MODE,
- Quickly press and release ARROW UP to select NV_SAVE,
- Press ENTER and hold down until the countdown goes from 3 to 0.

The new parameter setting is saved and the positioner automatically returns to the operating level. It continues in the operating mode that was active prior to the configuration level being called up.

4.6 Setting the option modules

Setting the mechanical position indication

1. Loosen the screws for the housing cover and remove it.
2. Rotate the position indicator on the shaft to the desired position.
3. Attach the housing cover and screw it onto the housing. Tighten the screws so that they are hand-tight.
4. Attach the symbol label to mark the minimum and maximum valve positions on the housing cover.

Note: The labels are located on the inside of the housing cover.

4.7 Setting the mechanical limit switch with proximity switches

1. Loosen the screws for the housing cover and remove it.

Caution - Risk of injury!

The device includes slot sensors with sharp edges.

- Adjust the metal tags using a screwdriver only!
2. Set the upper and lower switching points for binary feedback as follows:
 - Select the 'Manual Adjustment' operating mode and move the final control element by hand into the lower switching position.
 - Using a screwdriver, adjust the metal tag of proximity switch 1 (lower contact) on the axis until contact is made, i. e., just before it is inserted in the proximity switch. The slot sensor enters proximity switch 1 when the feedback shaft is rotated clockwise (as viewed from the front).
 - Move the final control element by hand into the upper switching position.
 - Using a screwdriver, adjust the metal tag of proximity switch 2 (upper contact) on the axis until contact is made, i. e., just before it is inserted in the proximity switch. The slot sensor enters proximity switch 2 when the feedback shaft is rotated counter-clockwise (as viewed from the front).
 3. Attach the housing cover and screw it onto the housing.
 4. Tighten the screws so that they are hand-tight.

4.8 Setting the mechanical limit switch with 24 V micro-switches

1. Loosen the screws for the housing cover and remove it.
2. Select the 'Manual Adjustment' operating mode and move the final control element by hand into the desired switching position for contact 1.
3. Set maximum contact (1, lower washer).
Fasten the upper washer with the special adjustment retainer and rotate the lower washer manually.
4. Select the 'Manual Adjustment' operating mode and move the final control element by hand into the desired switching position for contact 2.
5. Set minimum contact (2, upper washer);
Fasten the lower washer with the special adjustment retainer and rotate the upper washer manually.
6. Connect the microswitch.
7. Attach the housing cover and screw it on to the housing.
8. Tighten the screws so that they are hand-tight.

5. Operation

5.1 Parameterisation of the device

5.1.1 Menu navigation

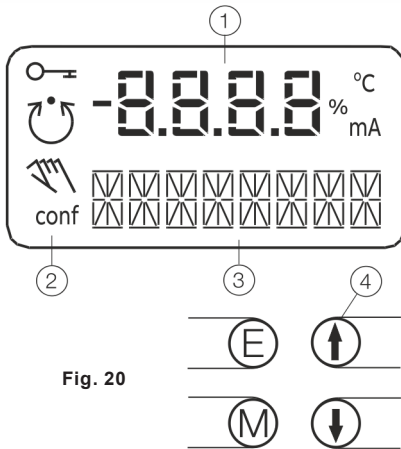


Fig. 20

1	Value display with unit
2	Symbol display
3	Designator display
4	Operating buttons for menu navigation

5.1.2 Value display with unit

This 7-segment display with four digits indicates parameter values or parameter reference numbers. For values, the physical unit (°C, %, mA) is also displayed.

5.1.3 Current state display

This 14-segment display with eight digits indicates the designators of the parameters with their status, of the parameter groups, and of the operating modes.

Symbol	Description
	Operation or access is restricted.
	Control loop is active. The symbol is displayed when the positioner is in operating mode 1.0 CTRL_ADP (adaptive control) or 1.1 CTRL_FIX (fixed control) at operating level. On the configuration level there are test functions for which the controller will be active as well. The control loop symbol will also be displayed when these functions are active.
	Manual adjustment. The symbol is displayed when the positioner is in operating mode 1.2 MANUAL (manual adjustment within the stroke range) or 1.3 MAN_SENS (manual adjustment within the measuring range) at operating level. At configuration level, manual adjustment is active when setting the valve range limits (parameter group 6 MIN_VR (min. of valve range) and 6 MAX_VR (max. of valve range)). The symbol will also be displayed when these parameters are being set.
conf	The configuration icon indicates that the positioner is at the configuration level. The control operation is inactive.

The four operating buttons ENTER, MODE, ARROW UP and ARROW DOWN are pressed individually or in certain combinations according to the function desired.

5.1.4 Operating button functions

Control button	Meaning
ENTER	• Acknowledge message • Start an action • Save in the non-volatile memory
MODE	• Choose operating mode (operating level) • Select parameter group or parameter (configuration level)
↑	UP direction button
↓	DOWN direction button
Press and hold all four buttons for 5 s	Reset

5.1.5 Menu levels

The positioner has two operating levels.

Operating level	On the operating level the positioner operates in one of four possible operating modes (two for automatic control and two for manual mode). Parameters cannot be changed or saved on this level.
Configuration level	On this level most of the parameters of the positioner can be changed locally. The PC is required to change the limit values for the movement counter, the travel counter, and the user-defined characteristic curve. On the configuration level the active operating mode is deactivated. The I/P module is in neutral position. The control operation is inactive

5.2 SP7-20 HART Parameter Overview

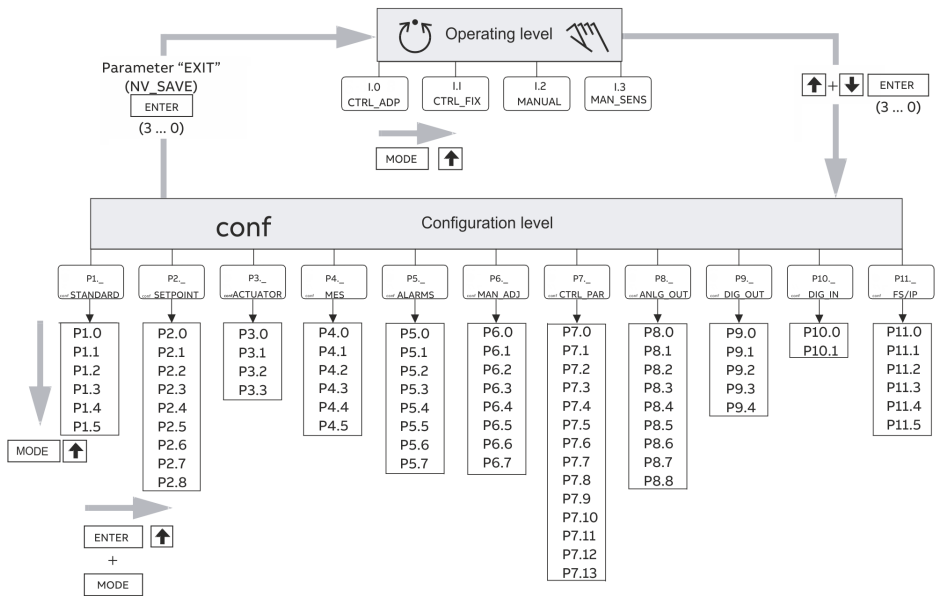


Fig. 21

5.2.1 SP7-20 Parameter description HART

Parameter	Display	Function		Possible parameter setting	Unit	Factory setting
P1._	STANDARD					
P1.0	ACTUATOR	Actuator type	Actuator type	LINEAR, ROTARY	---	LINEAR
P1.1	AUTO_ADJ	Automatic adjustment	Autoadjust	Function	---	---
P1.2	ADJ_MODE	Auto adjust mode	Automatic adjustment mode	FULL, STROKE, CTRL_PAR, ZERO_POS, LOCKED		FULL
P1.3	TEST	Test	Test	Function	---	INACTIVE
P1.4	FIND_DEV	Find device	Find device	DISABLE, ONE TIME, CONTINUOUS	---	DISABLE
P1.5	EXIT	Return	Return to operating level	Function	---	NV_SAVE
P2._	SETPOINT					
P2.0	MIN_RGE	Min setpoint range	Min. setpoint range	4.0 to 18.4	mA	4.0
P2.1	MAX_RGE	Max setpoint range	Max. setpoint range	20.0 to 5.6	mA	20.0
P2.2	CHARACT	Charact. curve	Characteristic curve	LINEAR, 1:25, 1:50, 25:1, 50:1, USERD	---	LINEAR
P2.3	ACTION	Valve action	Direction of action	DIRECT, REVERSE	---	DIRECT
P2.4	SHUT_CLS	Shut-off value 0%	Shut-off value 0 %	OFF, 0.1 to 45.0	%	1.0
P2.5	SHUT_OPN	Shut off value 100%	Shut-off value 100%	55.0 to 100.0, OFF	%	OFF
P2.6	RAMP UP	Set point ramp, up	Setpoint ramp (up)	OFF, 0 to 200	---	OFF
P2.7	RAMP DN	Set point ramp, down	Setpoint ramp (down)	OFF, 0 to 200	---	OFF
P2.8	EXIT	Return	Return to operating level	Function	---	NV_SAVE
P3._	ACTUATOR					
P3.0	MIN_RGE	Min. of stroke range	Operating range, min.	0.0 to 90.0	%	0.0
P3.1	MAX_RGE	Max. of stroke range	Operating range, max.	100.0 to 10.0	%	100
P3.2	ZERO_POS	Zero position	Zero position	CLOCKWISE, CTCLOCKWISE	---	CTCLOCKWISE
P3.3	EXIT	Return	Return to operating level	Function	---	NV_SAVE

5.2.1 SP7-20 Parameter description HART (continued)

Parameter	Display	Function		Possible parameter setting	Unit	Factory setting
P4._	MESSAGES					
P4.0	TIME_OUT	Control time out	Dead band time limit	OFF, to 200	---	OFF
P4.1	POS_SW1	Position switch 1	Switching point SW1	0.0 to 100.0	%	0.0
P4.2	POS_SW2	Position switch 2	Switching point SW2	0.0 to 100.0	%	100.0
P4.3	SW1_ACTV	Switchpoint 1 enable	Active direction SW1	FALL_BEL, EXCEED	---	FALL_BEL
P4.4	SW2_ACTV	Switchpoint 2 enable	Active direction SW2	FALL_BEL, EXCEED	---	EXCEED
P4.5	EXIT	Return	Return to operating level	Function	---	NV_SAVE
P5._	ALARMS					
P5.0	LEAKAGE	Leakage detection	Leakage to actuator	ACTIVE, INACTIVE	---	INACTIVE
P5.1	SP_RGE	Setpoint rng monitor	Outside the setpoint range	ACTIVE, INACTIVE	---	INACTIVE
P5.2	SENS_RGE	Sens. range monitor	Operating range exceeded	ACTIVE, INACTIVE	---	INACTIVE
P5.3	CTRLER	Controller monitor	Controller inactive	ACTIVE, INACTIVE	---	INACTIVE
P5.4	TIME_OUT	Control time out	Dead band time limit	ACTIVE, INACTIVE	---	INACTIVE
P5.5	STRK_CTR	Stroke counter	Movement counter	ACTIVE, INACTIVE	---	INACTIVE
P5.6	TRAVEL	Travel counter	Travel counter	ACTIVE, INACTIVE	---	INACTIVE
P5.7	EXIT	Return	Return to operating level	Function	---	NV_SAVE
P6._	MAN_ADJ					
P6.0	MIN_VR	Min. valve range	Operating range, min.	0.0 to 100.0	%	0
P6.1	MAX_VR	Max. valve range	Operating range, max.	0.0 to 100.0	%	100
P6.2	ACTUATOR	Actuator type	Actuator type	LINEAR, ROTARY	---	LINEAR
P6.3	SPRNG_Y2	Spring action (Y2)	Spring action (Y2)	CLOCKWISE, CTCLOCKWISE	---	CTCLOCKWISE
P6.4	DANG_DN	Dead angle close	Dead angle 0 %	0.0 to 45.0	%	0.0
P6.5	DANG_UP	Dead angle open	Dead angle 100%	55.0 to 100.0	%	100.0
P6.6	BOLT_POS	Bolt position	Actuator position	LEVER, STEM	---	LEVER
P6.7	EXIT	Return	Return to operating level	Function	---	NV_SAVE

SP7-20, SP7-21 and SP7-22 Smart Positioner

5.2.1 SP7-20 Parameter description HART (continued)

Parameter	Display	Function		Possible parameter setting	Unit	Factory setting
P7._	CTRL_PAR					
P7.0	KP UP	KP value, up	KP value (up)	0.1 to 120.0	---	5.0
P7.1	KP DN	KP value, down	KP value (down)	0.1 to 120.0	---	5.0
P7.2	TV UP	TV value, up	TV value (up)	10 to 450	---	200
P7.3	TV DN	TV value, down	TV value (down)	10 to 450	---	200
P7.4	Y-OFS UP	Y offset, up	Y offset (up)	0.0 to 100.0	%	48.0
P7.5	Y-OFS DN	Y offset, down	Y offset (down)	0.0 to 100.0	%	48.0
P7.6	TOL_BAND	Tolerance band (zone)	Tolerance band (zone)	0.3 to 10.0	%	1.5
P7.7	DEADBAND	Deadband	Dead band	0.10 to 10.00	%	12:10 AM
P7.8	DB_APPR	Deadband Approach	Dead-band approach	SLOW, MEDIUM, FAST		
P7.9	TEST	Test	Test	Function	---	INACTIVE
P7.10	DB_CALC	Deadband calculat.	Dead-band determination	ON, OFF	---	ON
P7.11	LEAK_SEN	Leakage sensivity	Leakage sensitivity	1 to 7200	S	30
P7.12	CLOSE_UP	Pos. time out	Position monitoring	0.0 to 100.0	%	30.0
P7.13	EXIT	Return	Return to operating level	Function	---	NV_SAVE
P8._	ANLG_OUT					
P8.0	MIN_RGE	Min. range	Min. current range	4.0 to 18.4	mA	4.0
P8.1	MAX_RGE	Max. range	Max. current range	20.0 to 5.7	mA	20.0
P8.2	ACTION	Action	Direction of action of characteristic curve	DIRECT, REVERSE	---	DIRECT
P8.3	ALARM	Alarm current	Alarm message	HIGH_CUR, LOW_CUR	---	HIGH_CUR
P8.4	RB_CHAR	Readback character.	Converted characters	DIRECT, RECALC		DIRECT
P8.5	TEST	Test	Test	Function	---	NONE
P8.6	ALR_ENAB	Alarm function enabled	Alarm via analog output	ON, OFF	---	ON
P8.7	CLIPPING	Current signal	Actuator position	LEVER, STEM	---	LEVER
Signal clipping range	Extension of signal output to 3.8 to 20.5 mA	4.0 to 20.0; 3.8 to 20.5 mA	mA	4.0 bis 20.5	---	NV_SAVE
P8.8	EXIT	Return	Return to operating level	Function	---	---

5.2.1 SP7-20 Parameter description HART (continued)

Parameter	Display	Function		Possible parameter setting	Unit	Factory setting
P9._	DIG_OUT					
P9.0	ALRM_LOG	Alarm logic	Alarm output logic	ACTIVE_HI, ACTIVE_LO	---	ACTIVE_HI
P9.1	SW1_LOG	Switchpoint 1 logic	Logic SW1	ACTIVE_HI, ACTIVE_LO	---	ACTIVE_HI
P9.2	SW2_LOG	Switchpoint 2 logic	Logic SW2	ACTIVE_HI, ACTIVE_LO	---	ACTIVE_HI
P9.3	TEST	Test	Test	Function	---	NONE
P9.4	EXIT	Return	Return to operating level	Function	---	NV_SAVE
P10._	DIG_IN					
P10.0	FUNCTION	Function select	Function selection	NONE, POS_0 %, POS_100 %, POS_HOLD	---	NONE
P10.1	EXIT	Return	Return to operating level	Function	---	---
P11._	FS/IP					
P11.0	FAIL_POS	Save position	Safe position	ACTIVE, INACTIVE	---	INACTIVE
P11.1	FACT_SET	Factory setting	Factory setting	Function	---	START
P11.2	IP-TYP	I/P module type	Type of I/P module	NO_F_POS,F_SAFE_1,F_SAFE_2,	S	30
P11.3*	IP_COMP	IP compensation	IP compensation	ON, OFF	---	ON
P11.4	HART_REV	HART revision	HART revision	5; 7	---	5
P11.5	EXIT	Return	Return to operating level	Function	---	NV_SAVE

*Activation by Spirax Sarco Service only

Note

For detailed information on the parameterization of the device, consult the associated configuration and parameterization instructions.

5.3 SP7-21/22 Parameter Overview

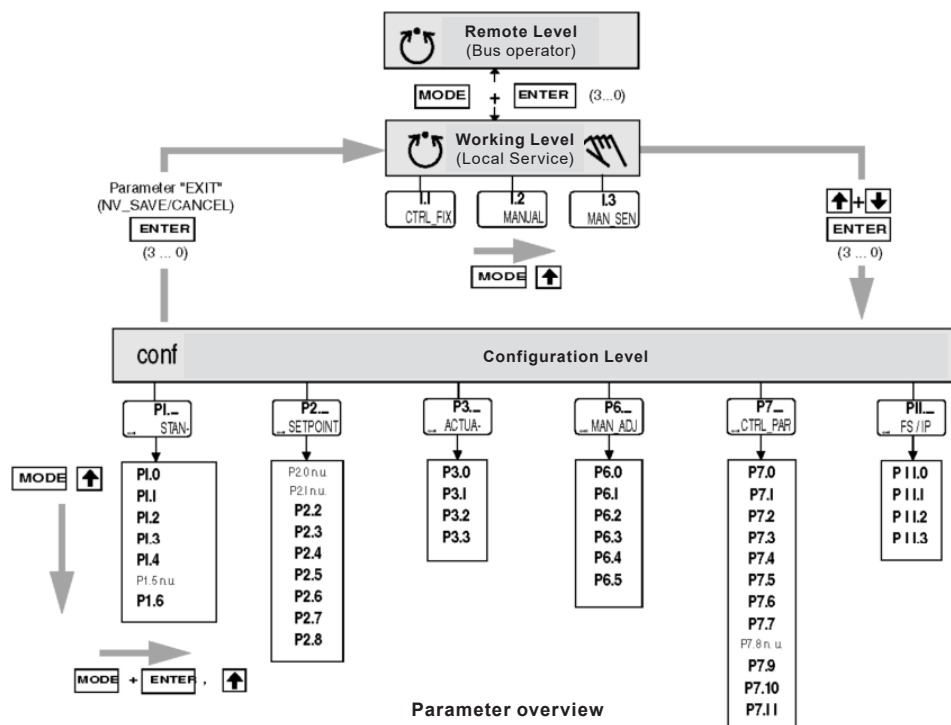


Fig. 22

5.3.1 SP7-21/22 Parameter description

Parameter	Display	Function		Possible parameter setting	Unit	Factory setting
P1._	STANDARD					
P1.0	ACTUATOR	Actuator type	Actuator type	LINEAR, ROTARY	---	LINEAR
P1.1	AUTO_ADJ	Automatic adjustment	Autoadjust	Function	---	---
P1.2	TOL_BAND	Tolerance band	Tolerance band	0.30 bis 10.00	%	0.30
P1.3	DEADBAND	DEAD BAND	Dead band	0.10 bis 10.00	%	0.10
P1.4	TEST	Test	Test	function	---	---
P1.5*	ADRESS	Bus address		1 bis 126	---	126
P1.6	EXIT	Return	Return to operating level	Function	---	---
P2._	SETPOINT					
P2.0					---	---
P2.1					---	---
P2.2	CHARACT	Charact. curve	Characteristic curve	LINEAR, 1:25, 1:50, 25:1, 50:1, USERD	---	LINEAR
P2.3	ACTION	Valve action	Direction of action	DIRECT, REVERSE	---	DIRECT
P2.4	SHUT_CLS	Shut-off value 0%	Shut-off value 0 %	OFF, 0.1 to 45.0	%	1.0
P2.5	RAMP_UP	Set point ramp, up	Setpoint ramp (up)	0.1 to 999.9	Sec	OFF
P2.6	RAMP DN	Set point ramp, down	Setpoint ramp (down)	0.1 to 999.9	Sec	OFF
P2.7	SHUT_OPN	Shut off value 100%	Shut-off value 100%	OFF, 80.0 to 100	%	OFF
P2.8	EXIT	Return	Return to operating level	Function	---	---
P3._	ACTUATOR					
P3.0	MIN_RGE	Min. of stroke range	Operating range, min.	0.0 to 100.00	%	0.0
P3.1	MAX_RGE	Max. of stroke range	Operating range, max.	0.0 to 100.00	%	100
P3.2	ZERO_POS	Zero position	Zero position	CLOCKWISE, CTCLOCKWISE	---	CTCLOCKWISE
P3.3	EXIT	Return	Return to operating level	Function	---	NV_SAVE
P4._, P5._						
P6._	MAN_ADJ					
P6.0	MIN_VR	Min. valve range	Operating range, min.	0.0 to 100.0	%	0
P6.1	MAX_VR	Max. valve range	Operating range, max.	0.0 to 100.0	%	100
P6.2	ACTUATOR	Actuator type	Actuator type	LINEAR, ROTARY	---	LINEAR
P6.3	SPRNG_Y2	Spring action (Y2)	Spring action (Y2)	CLOCKWISE, CTCLOCKWISE	---	CTCLOCKWISE

SP7-20, SP7-21 and SP7-22 Smart Positioner

5.3.2 SP7-21/22 Parameter overview

Parameter	Display	Function		Possible parameter setting	Unit	Factory setting
P6.4	ADJ_MODE	Auto adjust mode	Dead angle 0 %	FULL, STROKE, CTRL_PAR, ZERO_POS, LOCKED	---	FULL
P6.5	EXIT	Return	Return to operating level	Function	---	NV_SAVE
P7._	CTRL_PAR					
P7.0	KP UP	KP value, up	KP value (up)	0.1 to 120.0	---	1.0
P7.1	KP DN	KP value, down	KP value (down)	0.1 to 120.0	---	1.0
P7.2	TV UP	TV value, up	TV value (up)	10 to 450	msec	100
P7.3	TV DN	TV value, down	TV value (down)	10 to 450	msec	100
P7.4	GOPULSUP	Go pulse up	---	0 to 200	msec	0
P7.5	GOPULSDOWN	Go pulse, down		0 to 200	msec	0
P7.6	Y-OFSUP	Y offset up	Y offset up	Y-Min to 100.0	%	40.0
P7.7	Y-OFSDN	Y offset down	Y offset down	Y-Min to 100.0	%	40.0
P7.8					---	---
P7.9	TOL_BAND	tolerance band (zone)	Tolerance band (zone)	0.3 to 10.0	%	0.8
P7.10	TEST	Test	Test	Function	---	INACTIVE
P7.11	EXIT	Return	Return to operating level	Function	---	NV_SAVE
P8._, P9._, P10._						
P11._	FS/IP					
P11.0	FAIL_POS	Safe position	Safe position	ACTIVE, INACTIVE	---	INACTIVE
P11.1	FACT_SET	Factory setting	Factory setting	Function	---	---
P11.2	IP-TYP	I/P module type	Type of I/P module	NO_F_POS, F_SAFE_1, F_SAFE_2, F_FREEZE1, F_FREEZE2	---	NO_F_POS
P11.3	EXIT	Return	Return to operating level	Function	---	---

*Activation by Spirax Sarco Service only

Note: For detailed information on the parameterization of the device, consult the associated configuration and parameterization instructions.

6. Troubleshooting

6.1 SP7-20 Error codes

Error code	Possible cause	Impact	Troubleshooting
ERROR 10	The supply voltage was interrupted for at least 20 ms. (This error is displayed after resetting the device to indicate the reason for the reset.)	-	Check the power source and the wiring.
ERROR 11	The supply voltage has fallen below the minimum voltage.	The actuator is moved to the safe position. After approx. 5 seconds, the positioner is automatically reset and starts up again with the message ERROR 10. If a local communication interface (LCI) is plugged in, the device will enter the operating mode LCI supply.	Check the power source and the wiring.
ERROR 12	The position is outside the measuring range. Possible reason is a malfunction in the position sensor.	In control mode: • The actuator is moved to the safe position. On the configuration level: • The output is set to neutral until a button is pressed. After approx. 5 seconds the positioner is automatically reset in control mode and on the configuration level.	Check the mounting.
ERROR 13	Invalid input current. This display indicates when the setpoint signal is overridden. The actuator is moved to the safe position.	-	Check the power source and the wiring.
ERROR 20	No access possible to the data in the EEPROM.	The actuator is moved to the safe position. After approx. 5 seconds, the positioner is automatically reset. Attempts are made to restore the data. This compensates for intermittent errors in the communication environment with the EEPROM.	If there is still no access to the EEPROM data after resetting the device, load the factory settings. If the error still persists, the device must be returned for repair to the manufacturer.
ERROR 21	Error while processing the measured values, pointing to an error in the working data (RAM).	The actuator is moved to the safe position. After approx. 5 seconds, the positioner is automatically reset and the RAM is reinitialised.	If the error persists even after the positioner has been reset, the device will need to be returned to the manufacturer for repair.

6.1 SP7-20 Error codes (continued)

Error code	Possible cause	Impact	Troubleshooting
ERROR 21	Error while processing the measured values, pointing to an error in the working data (RAM).	The actuator is moved to the safe position. After approx. 5 seconds, the positioner is automatically reset and the RAM is reinitialized.	If the error persists even after the positioner has been reset, the device will need to be returned to the manufacturer for repair.
ERROR 22	Error during the table processing, pointing to an error in the working data (RAM).	The actuator is moved to the safe position. After approx. 5 seconds, the positioner is automatically reset and the RAM is reinitialized.	If the error persists even after the positioner has been reset, the device will need to be returned to the manufacturer for repair.
ERROR 23	Error when verifying the checksum of the configuration data (RAM).	The actuator is moved to the safe position. After approx. 5 seconds, the positioner is automatically reset and the RAM is reinitialized.	If the error persists even after the positioner has been reset, the device will need to be returned to the manufacturer for repair.
ERROR 24	Error in the processor function registers (RAM).	The actuator is moved to the safe position. After approx. 5 seconds, the positioner is automatically reset and the RAM is reinitialized.	If the error persists even after the positioner has been reset, the device will need to be returned to the manufacturer for repair.
ERROR 50 to 99	Internal error.	The actuator is moved to the safe position. After approx. 5 seconds, the positioner is automatically reset.	If the error can be reproduced and occurs in the same position after resetting, the device must be returned for repair to the manufacturer.

6.2 SP7-21/22 Error codes

Error code	Possible cause	Impact	Troubleshooting
NV_ERROR	Defective memory chip	Device does not boot up.	Return the device for repair.
TIMEOUT	Automatic adjustment function lasts too long.	Automatic adjustment function is aborted.	Increase the supply pressure or use boosters.
OUTOFRNG	Mounting conditions not correct. Position outside sensor range.	Autoadjust function is aborted.	Check mounting conditions.
CALC_ERR	1 Inconsistent data, e.g., low value > than high value, or incorrect configuration. 2 Data cannot be saved locally, as PROFIBUS saves data in the background.	1 Automatic adjustment is aborted. 2 Saving is not possible.	1 Correct values or load factory settings. 2 Try again at a later point.
NO_F_POS	The device is not in the safe position.	-	Move the device to the safe position.
ERROR	Alarm message (can only be read out using the DTM). • Temperature alarm • Automatic adjustment has failed • Zero point has shifted • Device reset • Maintenance required • Motion counter limit value up-scaled • Travel counter limit value up-scaled • Limit switch 1 up-scaled • Limit switch 2 up-scaled • Position outside operating range • Position outside sensor range • Invalid set point • Local operating mode requested • Local operating mode active • Simulation active • Controller deactivated.	See DTM online help	See DTM online help
NO_COMM	No PROFIBUS communication	No PROFIBUS communication	Check bus address and status bit (128)
SENS_ERR	Position sensor defective	Device moves to safety position	Return the device for repair
MEM_ERR	Defective memory chip	Device does not boot up	Return the device for repair.

6.3 Alarm codes

Error code	Possible cause	Impact	Troubleshooting
ALARM 1	Leakage between positioner and actuator	Depending on how well the leakage can be compensated, small control actions are required at regular intervals.	Check the piping.
ALARM 2	The setpoint current is outside the permissible range, i.e. it is < 3.8 mA or > 20.5 mA.	-	Check the power source.
ALARM 3	Alarm of the zero monitor. The zero position has shifted by more than 4 %.	- In control mode, a position outside the valve range can only be reached by moving to the limit stops, as the setpoint is limited from 0 to 100 %	Correct the mounting.
ALARM 4	Controlling is inactive, because the device does not operate in control mode or the binary input is active.	The controller does not follow the setpoint.	Switch to control mode or switch off the binary input.
ALARM 5	Positioning timed out. The settling time needed exceeds the configured stroke time.	None, or adaptive control is performed (in adaptive mode).	Ensure that •the actuator is not blocked. •the supply air pressure is adequately high. •the specified time limit is higher than 1.5 times the longest stroke time of the actuator. If adaption cannot run uninterruptedly for an actuator, adaption should be switched on until the alarm does not occur anymore during controlling actions.
ALARM 6	The defined limit value for the stroke counter has been exceeded.	-	Reset the counter (only possible via a connected PC with suitable software).
ALARM 7	The specified limit value for the travel counter has been exceeded.	-	Reset the counter (only possible via a connected PC with suitable software).

6.4 Message codes

Message codes	Message description
BREAK	Action stopped by operator.
CALC_ERR	Error during plausibility check.
COMPLETE	Action completed, acknowledgment required.
EEPR_ERR	Memory error, data could not be saved.
FAIL_POS	Safe position is active, action cannot be executed.
NO_F_POS	Safe position required, but not active.
NO_SCALE	Valve range limits have not yet been determined; therefore, partial Auto Adjust cannot be run.
NV_SAVE	Data is saved in the non-volatile memory.
OUTOFRNG	Measuring range is exceeded, Auto Adjust was automatically stopped.
LOAD	Data (factory settings) are being loaded.
RNG_ERR	Less than 10 % of the measuring range is used.
RUN	Action running.
SIMUL	Simulation has been started externally from a PC via HART protocol; switch outputs, alarm output and analog position feedback are no longer influenced by the process.
SPR_ERR	Actual spring action is different from the adjusted one.
TIMEOUT	Time-out; parameter could not be determined within two minutes; Auto-adjust was automatically stopped.

7. Maintenance

Spares available:

A filter spares kit is available for the SP7 smart positioners: Part Number 3440580.

8. Approvals

ATEX

Rating: ATEX II 2G Ex db IIC T6/T5/T4 Gb

Certification number: BVS 21 ATEX E 073 X

Ambient temperature: $-40 \sim 65\text{ °C}/80\text{ °C}/85\text{ °C}$ ($-40 \sim 149\text{ °F}/176\text{ °F}/185\text{ °F}$) .

IECEX

Rating: IECEX Ex db IIC T6/T5/T4 Gb

Certification number: IECEX BVS 21.0078X

Ambient temperature: $-40 \sim 65\text{ °C}/80\text{ °C}/85\text{ °C}$ ($-40 \sim 149\text{ °F}/176\text{ °F}/185\text{ °F}$) .

CCC/NEPSI

Rating: NEPSI Ex db IIC T4/T5/T6 Gb

Certification number: GYJ22.1768X

Ambient temperature: $-40 \sim 85\text{ °C}/80\text{ °C}/65\text{ °C}$

UKEX

Rating: UKEx Ex db IIC T6/T5/T4 Gb

Certification number: EMA22UKEX0002X

Ambient temperature: $-40 \sim 65\text{ °C}/80\text{ °C}/85\text{ °C}$

INMETRO

Rating: INMETRO Ex db IIC T6...T4 Gb

Certification number: TÜV 25.1036 X

Ambient temperature:

T6: $-40\text{ °C} \leq T_{\text{amb}} \leq 65\text{ °C}$;

T5: $-40\text{ °C} \leq T_{\text{amb}} \leq 80\text{ °C}$;

T4: $-40\text{ °C} \leq T_{\text{amb}} \leq 85\text{ °C}$

9. Declaration of conformity

spiraxsarco.com



DECLARATION OF CONFORMITY

Apparatus model/Product: **Smart Positioner**
SP7-20
SP7-21
SP7-22

Name and address of the manufacturer or his authorised representative: **Spirax Sarco Ltd,**
Runnings Road
Cheltenham
GL51 9NQ
United Kingdom

This declaration of conformity is issued under the sole responsibility of the manufacturer.

The object of the declaration described above is in conformity with the relevant statutory requirements of:

SI 2016 No.1091 * The Electromagnetic Compatibility Regulations 2016

SI 2016 No.1107 * The Equipment and Protective Systems Intended for Use in Potentially Explosive Atmospheres Regulations 2016

(*As amended by EU Exit Regulations)

References to the relevant designated standards used or references to the other technical specifications in relation to which conformity is declared:

SI 2016 No.1091 * EN 61326-1:2013

SI 2016 No.1107 * EN IEC 60079-0:2018
EN 60079-1:2014

Where applicable, the approved body:

Approved Body	number	Performed	Certificate
Element Materials Technology Warwick Ltd.	0891	Issue of Quality Assurance Notification	EMA21UKQAN0002
Element Materials Technology Warwick Ltd.	0891	Issue of UK Type examination certificate	EMA22UKEX0002X

Additional information:

Ex coding:  II 2G Ex db IIC T6/T5/T4 Gb
T6: -40°C ≤ Ta ≤ 65°C; T5: -40°C ≤ Ta ≤ 80°C; T4: -40°C ≤ Ta ≤ 85°C

Signed for and on behalf of: **Spirax Sarco Ltd,**

(signature): 

(name, function): **Neil Morris**
Compliance Manager
Steam Business Development Engineering
(place and date of issue): **Cheltenham**

23 September 2022

EU DECLARATION OF CONFORMITY

Apparatus model/Product: **Smart Positioners**
SP7-20
SP7-21
SP7-22

Name and address of the manufacturer or his
authorised representative: **Spirax Sarco Ltd,**
Runnings Road
Cheltenham
GL51 9NQ
United Kingdom

This declaration of conformity is issued under the sole responsibility of the manufacturer.

The object of the declaration described above is in conformity with the relevant Union harmonisation legislation:

2014/30/EU EMC Directive
2014/34/EU ATEX Directive

References to the relevant harmonised standards used or references to the other technical specifications in relation to which conformity is declared:

EMC Directive EN 61326-1:2013
ATEX Directive EN IEC 60079-0:2018
EN 60079-1:2014

Where applicable, the notified body:

<i>Notified Body</i>	<i>number</i>	<i>Performed</i>	<i>Certificate</i>
Element Materials Technology Rotterdam B.V. Voorerf 18, 4824 GN Breda Netherlands	2812	Issue of Quality Assurance Notification	TRAC13QAN0002
DEKRA Testing and Certification GmbH, Handwerkstraße 15, 70565 Stuttgart, Germany	0158	Issue of EC Type examination certificate	BVS 21 ATEX E 073 X

Additional information:

ATEX coding:  II 2G Ex db IIC T6/T5/T4 Gb
-40°C ≤ Ta ≤ 65°C / 80°C / 85°C

Signed for and on behalf of: Spirax Sarco Ltd,

(signature):



(name, function): M Sadler
Steam Business Development Engineering
Product Integrity & Compliance Manager

(place and date of issue): Cheltenham
2021-11-01

