SIEMENS

SIPART

Electropneumatic positioners SIPART PS2 with FOUNDATION Fieldbus

Operating Instructions

6DR56..

07/2020

A5E00214569-AC

Legal information

Warning notice system

This manual contains notices you have to observe in order to ensure your personal safety, as well as to prevent damage to property. The notices referring to your personal safety are highlighted in the manual by a safety alert symbol, notices referring only to property damage have no safety alert symbol. These notices shown below are graded according to the degree of danger.

DANGER
indicates that death or severe personal injury **will** result if proper precautions are not taken.

WARNING
indicates that death or severe personal injury **may** result if proper precautions are not taken.

CAUTION
indicates that minor personal injury can result if proper precautions are not taken.

NOTICE
indicates that property damage can result if proper precautions are not taken.

If more than one degree of danger is present, the warning notice representing the highest degree of danger will be used. A notice warning of injury to persons with a safety alert symbol may also include a warning relating to property damage.

Qualified Personnel

The product/system described in this documentation may be operated only by **personnel qualified** for the specific task in accordance with the relevant documentation, in particular its warning notices and safety instructions. Qualified personnel are those who, based on their training and experience, are capable of identifying risks and avoiding potential hazards when working with these products/systems.

Proper use of Siemens products

Note the following:

WARNING
Siemens products may only be used for the applications described in the catalog and in the relevant technical documentation. If products and components from other manufacturers are used, these must be recommended or approved by Siemens. Proper transport, storage, installation, assembly, commissioning, operation and maintenance are required to ensure that the products operate safely and without any problems. The permissible ambient conditions must be complied with. The information in the relevant documentation must be observed.

Trademarks

All names identified by ® are registered trademarks of Siemens AG. The remaining trademarks in this publication may be trademarks whose use by third parties for their own purposes could violate the rights of the owner.

Disclaimer of Liability

We have reviewed the contents of this publication to ensure consistency with the hardware and software described. Since variance cannot be precluded entirely, we cannot guarantee full consistency. However, the information in this publication is reviewed regularly and any necessary corrections are included in subsequent editions.

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Table of contents

1 Introduction

1.1 Purpose of this documentation

These instructions contain all information required to commission and use the device. Read the instructions carefully prior to installation and commissioning. In order to use the device correctly, first review its principle of operation.

The instructions are aimed at persons mechanically installing the device, connecting it electronically, configuring the parameters and commissioning it, as well as service and maintenance engineers.

1.2 Scope of documentation

Article no.	Product
6DR56..	SIPART PS2 with FOUNDATION Fieldbus
6DR5...-Z D53	M12 device plug (D coding) for Analog Output Module (AOM)
6DR5...-Z D54	M12 device plug (D coding) for External Position Transmitter
6DR5...-Z D55	M12 device plug (D coding) for Digital I/O Module (DIO)
6DR5...-Z D53	M12 device plug (D coding) for Inductive Limit Switches (ILS)
6DR5...-Z D53	M12 device plug (D coding) for Mechanic Limit Switches (MLS)
6DR5...-Z F01	Fail in Place
6DR4004-6A / -8A	Alarm module / Digital I/O Module (DIO)
6DR4004-6F / -8F	EMC filter module / Analog Input Module (AIM)
6DR4004-6J / -8J	Position feedback module / Analog Output Module (AOM)
6DR4004-6G / -8G	Slot initiator alarm module / Inductive Limit Switches (ILS)
6DR4004-6K / -8K	Mechanical limit switch module / Mechanic Limit Switches (MLS)
6DR4004-5L / 5LE	Internal NCS module
6DR4004-.N	NCS sensor
6DR4004-1ES ... -4ES	Position Transmitter
6DR4004-1R / -2R / -1RN / -2RN	Pneumatic terminal strip
6DR4004-8D and TGX:16300-1556	Installation for NAMUR part-turn actuators
6DR4004-8V / -8L / -8VK / -8VL	Mounting kit for NAMUR linear actuator
6DR4004-1RJ/K/P/Q and 6DR4004-2RJ/K/P/Q	Booster

1.3 Document history

The most important changes in the documentation as compared to the respective previous edition are given in the following table.

Edition	Note
07/2020	1. Changes for FW 3.01.00 2. For ATEX approval: Ex "nA" (non-sparking equipment) is replaced by Ex "ec" (increased safety) 3. Section "Connecting pneumatically" – Revised section "Reaction to failure of auxiliary power" 4. Section "Parameterization" - '36.YCLS', '37.YCDO' and '38.YCUP' extended by "Fast closing" function 5. Section "Commissioning" – Revised section "Setting friction clutch" 6. Section "Service and maintenance" – Old section "Replacing the basic electronics with the "Fail in Place" function" has been revised and is now called "Replacing the basic electronics" – New section "Replacing the pneumatic block" 7. Section "Technical specifications" – Explosion protection restructured; contains a breakdown of the article number 8. Section "Spare parts/accessories/scope of delivery" extended 9. New appendices – External position detection – Pressure gauge block – Sealing plug / thread adapter – Booster

Edition	Note
02/2016	1. Complete editorial reworking. 2. Section "Installing and mounting": Simpler commissioning of part-turn actuators using coupling wheel with two pins. 3. Natural gas actuator 4. Section "Functional safety" 5. New parameters and values in section Parameterization – 1.YFCT - Actuator > Initialization of actuators with inverted direction of action is now possible. Linear actuator > Mounting with carrier pin on actuator stem using 'FWAY/-FWAY' parameter value is now possible. – 48.PRST - Preset > Resetting of individual parameter groups is now possible. – 49.PNEUM > Fail in place function can now be activated with appropriate pneumatic system. 6. New functions for the diagnostics parameters > section Partial stroke test 'A.\PST' – A5.RPMD and A6.RPRT > Partial stroke test is now possible in ramp mode. – A7.FLBH > Behavior after failed – PST can now be defined. 7. New functions for the diagnostics values > Diagnostics section – 7.HOURR > Resettable operating hours counter added. – 11.LEAK > Offline leakage test added. – 21.P0 and 22.P100 > Modification of upper and lower endstops now possible without initialization. – 25.PAUTP > Adjustable pulse pause added.

1.4 Product compatibility

Edition	Comments	Product compatibility	Compatibility with device integration package	
07/2020	New device features	FW: 3.01.00 or higher	SITRANS DTM V4.1	EDD: 3.00.00 or higher
		Device revision 3	AMS Device Manager V12.5	EDD: 3.00.00 or higher
			Field communicator	EDD: 3.00.00 or higher

1.5 Designated use

Use the device in accordance with the information on the nameplate and in the Technical specifications (Page 227).

1.6 Checking the consignment

1. Check the packaging and the delivered items for visible damages.
2. Report any claims for damages immediately to the shipping company.

3. Retain damaged parts for clarification.
4. Check the scope of delivery by comparing your order to the shipping documents for correctness and completeness.

> **WARNING**
>
> **Using a damaged or incomplete device**
>
> Risk of explosion in hazardous areas.
>
> - Do not use damaged or incomplete devices.

1.7 Security information

Siemens provides products and solutions with industrial security functions that support the secure operation of plants, systems, machines, and networks.

In order to protect plants, systems, machines and networks against cyber threats, it is necessary to implement – and continuously maintain – a holistic, state-of-the-art industrial security concept. Siemens' products and solutions form one element of such a concept.

Customers are responsible for preventing unauthorized access to their plants, systems, machines and networks. These systems, machines and components should only be connected to the enterprise network or the Internet if and only to the extent necessary and with appropriate security measures (firewalls and/or network segmentation) in place.

You can find more information on protective measures in the area of industrial security by visiting:
https://www.siemens.com/industrialsecurity.

Siemens' products and solutions undergo continuous development to make them more secure. Siemens strongly recommends performing product updates as soon as they are available and using only the latest product versions. Use of product versions that are no longer supported, and failure to apply latest updates may increase customer's exposure to cyber threats.

To stay informed about product updates, subscribe to the Siemens Industrial Security RSS Feed under
https://www.siemens.com/industrialsecurity.

1.8 Transportation and storage

To guarantee sufficient protection during transport and storage, observe the following:

- Keep the original packaging for subsequent transportation.
- Devices/replacement parts should be returned in their original packaging.
- If the original packaging is no longer available, ensure that all shipments are properly packaged to provide sufficient protection during transport. Siemens cannot assume liability for any costs associated with transportation damages.

NOTICE
Insufficient protection during storage The packaging only provides limited protection against moisture and infiltration. • Provide additional packaging as necessary.

Special conditions for storage and transportation of the device are listed in Technical specifications (Page 227).

1.9 Notes on warranty

The contents of this manual shall not become part of or modify any prior or existing agreement, commitment or legal relationship. The sales contract contains all obligations on the part of Siemens as well as the complete and solely applicable warranty conditions. Any statements regarding device versions described in the manual do not create new warranties or modify the existing warranty.

The content reflects the technical status at the time of publishing. Siemens reserves the right to make technical changes in the course of further development.

Safety information

2

2.1 Laws and directives - including Korea

Observe the test certification, provisions and laws applicable in your country during connection, assembly and operation. These include, for example:

- National Electrical Code (NEC - NFPA 70) (USA)
- Canadian Electrical Code (CEC) (Canada)

Further provisions for hazardous area applications are for example:

- IEC 60079-14 (international)
- EN 60079-14 (EU)
- For Korea only:
  이 기기는 업무용(A 급) 전자파 적합기기로서 판매자
  또는 사용자는 이 점을 주의하시기 바라며 가정 외의

  지역에서사용하는 것을 목적으로 합니다

2.2 Precondition for use

This device left the factory in good working condition. In order to maintain this status and to ensure safe operation of the device, observe these instructions and all the specifications relevant to safety.

Observe the information and symbols on the device. Do not remove any information or symbols from the device. Always keep the information and symbols in a completely legible state.

2.3 Warning symbols on the device

Symbol	Explanation
	Consult operating instructions

2.4 Laws and directives

Observe the safety rules, provisions and laws applicable in your country during connection, assembly and operation. These include, for example:

- National Electrical Code (NEC - NFPA 70) (USA)
- Canadian Electrical Code (CEC) (Canada)

Further provisions for hazardous area applications are for example:

- IEC 60079-14 (international)
- EN 60079-14 (EU)

See also

Certificates (http://www.siemens.com/processinstrumentation/certificates)

2.5 Conformity with European directives

The CE marking on the device shows conformity with the regulations of the following European guidelines:

Electromagnetic compatibility EMC 2014/30/EU	Directive of the European Parliament and of the Council on the harmonization of the laws of the Member States relating to electromagnetic compatibility.
Atmosphère explosible ATEX 2014/34/EU	Directive of the European Parliament and of the Council on the harmonization of the laws of the Member States relating to equipment and protective systems intended for use in potentially explosive atmospheres.
2011/65/EU RoHS	Directive of the European Parliament and of the Council on the restriction of the use of certain hazardous substances in electrical and electronic equipment

The directives applied can be found in the EU declaration of conformity for the associated device.

2.6 Improper device modifications

WARNING

Improper device modifications

Risk to personnel, system and environment can result from modifications to the device, particularly in hazardous areas.

- Only carry out modifications that are described in the instructions for the device. Failure to observe this requirement cancels the manufacturer's warranty and the product approvals.

2.7 Requirements for special applications

Due to the large number of possible applications, each detail of the described device versions for each possible scenario during commissioning, operation, maintenance or operation in systems cannot be considered in the instructions. If you need additional information not covered by these instructions, contact your local Siemens office or company representative.

Note

Operation under special ambient conditions

We highly recommend that you contact your Siemens representative or our application department before you operate the device under special ambient conditions as can be encountered in nuclear power plants or when the device is used for research and development purposes.

2.8 Use in hazardous areas

Qualified personnel for hazardous area applications

Persons who install, connect, commission, operate, and service the device in a hazardous area must have the following specific qualifications:

- They are authorized, trained or instructed in operating and maintaining devices and systems according to the safety regulations for electrical circuits, high pressures, aggressive, and hazardous media.
- They are authorized, trained, or instructed in carrying out work on electrical circuits for hazardous systems.
- They are trained or instructed in maintenance and use of appropriate safety equipment according to the pertinent safety regulations.

WARNING

Use in hazardous area

Risk of explosion.

- Only use equipment that is approved for use in the intended hazardous area and labeled accordingly.
- Do not use devices that have been operated outside the conditions specified for hazardous areas. If you have used the device outside the conditions for hazardous areas, make all Ex markings unrecognizable on the nameplate.

WARNING

Loss of safety of device with type of protection "Intrinsic safety Ex i"

If the device or its components have already been operated in non-intrinsically safe circuits or the electrical specifications have not been observed, the safety of the device is no longer ensured for use in hazardous areas. There is a risk of explosion.

- Connect the device with type of protection "Intrinsic safety" solely to an intrinsically safe circuit.
- Observe the specifications for the electrical data on the certificate and/or in Technical specifications (Page 227).

Description 3

3.1 Function

- The electropneumatic positioner and an actuator form a control loop. The current position of the actuator is recorded by a servo potentiometer and the actual value x is fed back. The setpoint and the actual value are also shown simultaneously on the display.
- The positioner works as a predictive five-point controller, whose output variable $\pm\Delta y$ is used to control the pneumatic block by pulse length modulation.
- These control signals cause pressure changes in the actuator chamber(s) and thus an adjustment of the actuator until the control deviation becomes zero.
- The three buttons and the display are used to operate (manual mode) and configure (structuring, initializing and parameter assignment) with the enclosure lid removed.
- By default, the basic unit has a digital input. This digital input is individually configured and blocks the operating levels, for example.
- The positioner has a friction clutch and a selectable gearbox. It can therefore be used on a large number of mechanical part-turn and linear actuators.
- In the case of positioners with the "Fail in Place" function, the current position of the actuator is held if the electric and/or pneumatic auxiliary power fails. Does not function in conjunction with SIL.
- Parameter "51.FSTY" must be set to "FSSP" in the case of the "Fail in Place" function if the current position is to be held when switching on again following failure of the electric auxiliary power.

3.2 Structure

3.2.1 Overview of structure

The following sections describe the mechanical and electrical structure, components, and principle functionality of the positioner.

The positioner and the FOUNDATION Fieldbus communication interface function as components in a digital process automation system. It functions as a slave and communicates with the master through the FOUNDATION Fieldbus. Apart from communication, the fieldbus also supplies electrical auxiliary power to the positioner.

The positioner is used to move and control pneumatic actuators. The positioner works electropneumatically, using compressed air as auxiliary power. The positioner is used to control valves, for example, with:

- Linear actuator
- Part-turn actuator VDI/VDE 3845

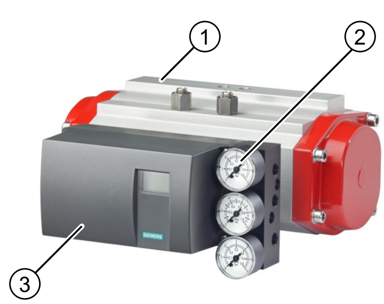
Various add-on extensions are available for linear actuators:

- IEC 60534-6-1 (NAMUR)
- Integrated mounting ARCA, except with flameproof versions
- Integrated addition to SAMSON in non-flameproof aluminum enclosure

3.2.2 Device design

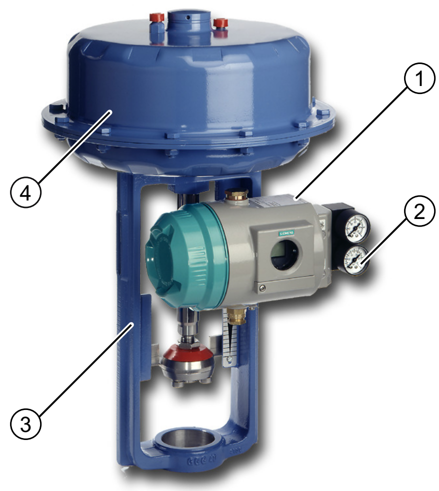
① Pressure gauge block, single-acting
② Process valve
③ Yoke / actuator yoke
④ Single-acting positioner in non-flameproof aluminum enclosure
⑤ Actuator

Figure 3-1 Positioner attached to a single-acting linear actuator



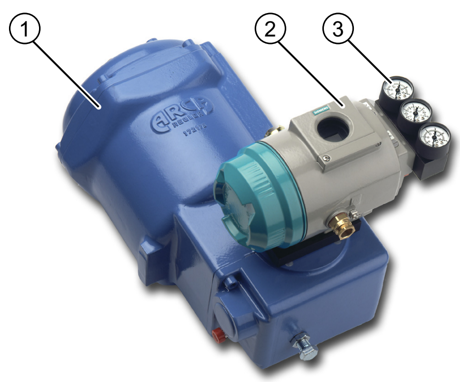
① Part-turn actuator
② Pressure gauge block, double-acting
③ Double-acting positioner in polycarbonate enclosure

Figure 3-2 Positioner attached to double-acting part-turn actuator



① Single-acting positioner in flameproof aluminum enclosure
② Pressure gauge block, single-acting
③ Yoke / actuator yoke
④ Actuator

Figure 3-3 Positioner in flameproof aluminum enclosure attached to linear actuator

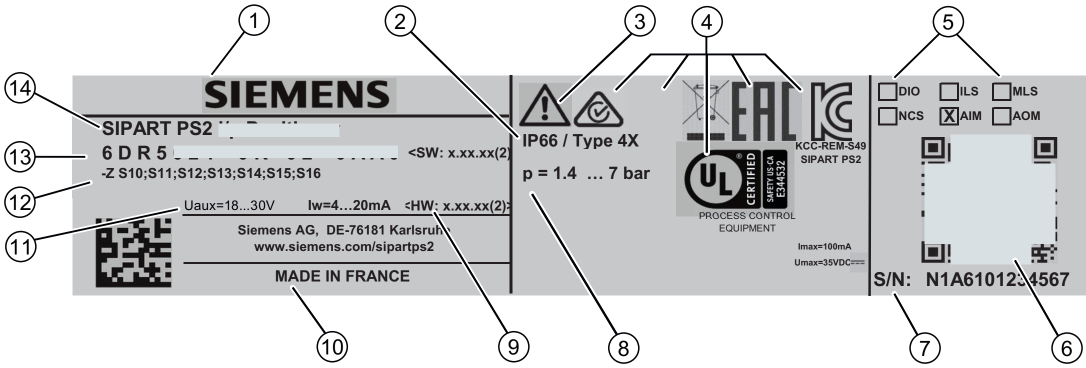


① Part-turn actuator
② Double-acting positioner in flameproof aluminum enclosure
③ Pressure gauge block, double-acting

Figure 3-4 Positioner in flameproof aluminum enclosure attached to part-turn actuator

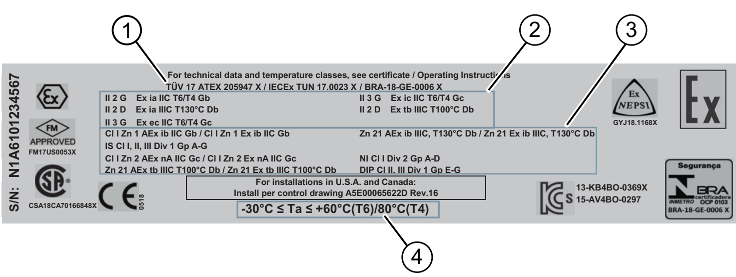
3.2.3 Nameplate layout

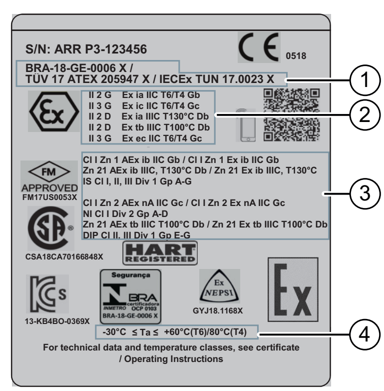
Example of manufacturer nameplate



①	Manufacturer	⑧	Supply pressure PZ
②	Degree of protection	⑨	Software version and hardware version
③	Observe the operating instructions	⑩	Country of origin
④	Conformity with country-specific directives	⑪	Supply voltage
⑤	Built-in option modules	⑫	Ordering supplement (Order code)
⑥	QR code to the mobile website with device-specific product information	⑬	Article number
⑦	Serial number	⑭	Product name

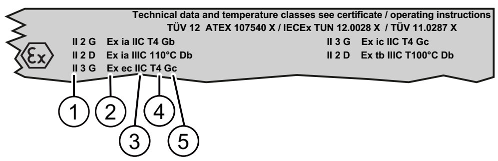
Example of explosion protection nameplate





①	Approvals	③	FM/CSA marking for hazardous area
②	ATEX/IECEx marking for hazardous area	④	Permissible ambient temperature for operation in hazardous areas

Explanation of Ex information

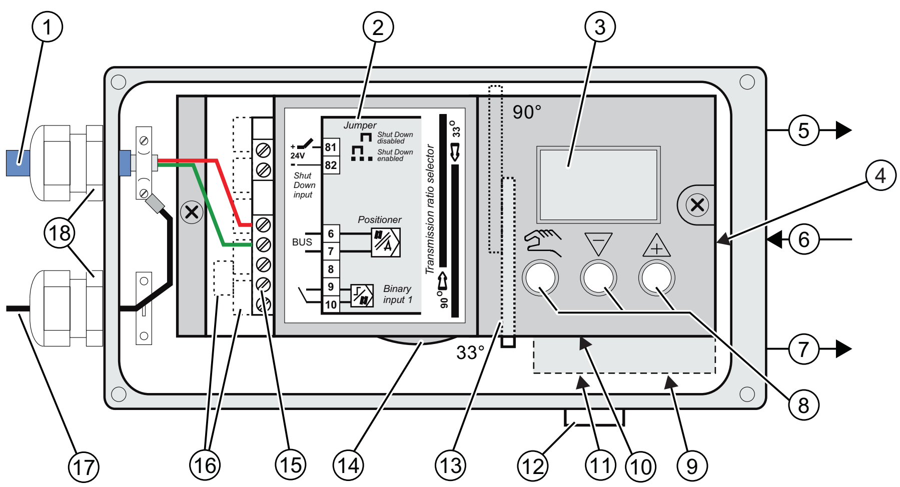


① Category for operating range
② Type of protection
③ Group (gas, dust)
④ Maximum surface temperature (temperature class)
⑤ Device protection level

Figure 3-5 Explanation of Ex information

3.3 Device components

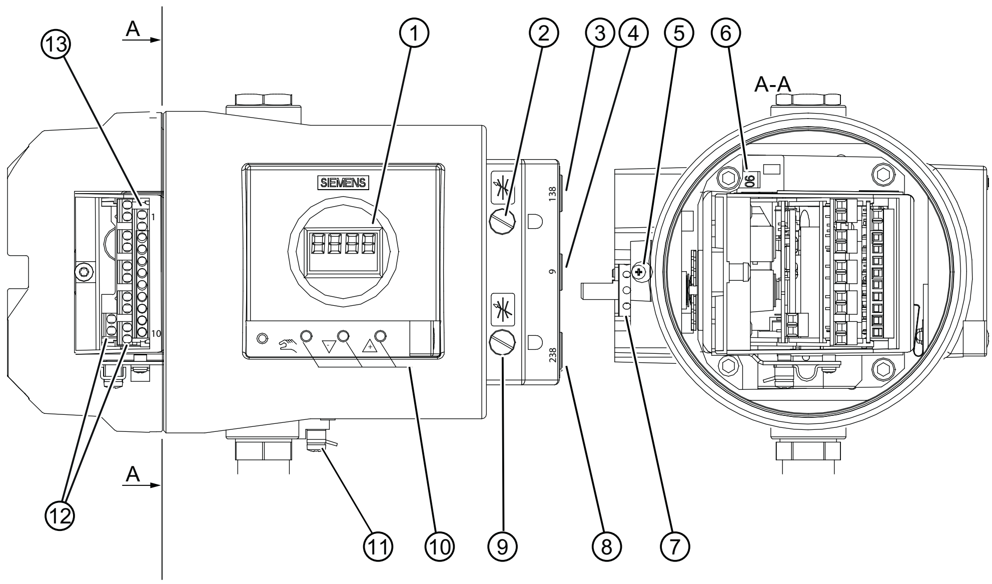
3.3.1 Overview of device components



→	Arrowhead means: Turn the device to see the corresponding view		
①	Bus cable	⑩	Restrictor Y1 for single-acting actuators
②	Wiring diagram on module cover	⑪	Restrictor Y1 for double-acting actuators
③	Display	⑫	Exhaust air outlet with a sound absorber
④	Purging air selector	⑬	Transmission ratio selector
⑤	Output: Actuating pressure Y1	⑭	Friction clutch adjustment wheel
⑥	Input: Supply pressure PZ	⑮	Basic electronics
⑦	Output: Actuating pressure Y2	⑯	Connecting terminals of option modules
⑧	Buttons	⑰	Shield connection (only with polycarbonate enclosure)
⑨	Restrictor Y2 for double-acting actuators	⑱	Cable gland

Figure 3-6 View of the positioner (cover open; polycarbonate enclosure)

3.3.2 Overview of device components (Ex)



①	Display	⑧	Output: Actuating pressure Y2[1)]
②	Restrictor Y1	⑨	Restrictor Y2[1)]
③	Output: Actuating pressure Y1	⑩	Buttons
④	Input: Supply pressure PZ	⑪	Ground terminal
⑤	Safety catch	⑫	Connecting terminals of option modules
⑥	Transmission ratio selector[2)]	⑬	Connecting terminals of basic electronics
⑦	Friction clutch adjustment wheel		

[1)] for double-acting actuators

[2)] visible when the positioner is open

Figure 3-7 View of positioner in flameproof enclosure, cover opened

3.3.3 Basic electronics

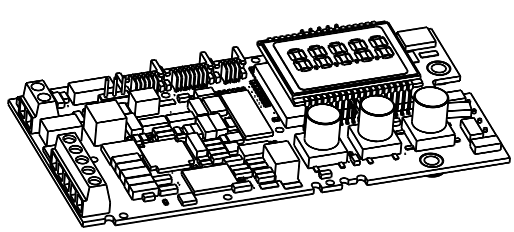


Figure 3-8 Basic electronics, schematic representation

The basic electronics contains:

- CPU
- Memory
- Analog-to-digital converter
- Display
- Buttons
- Terminal strips to connect the option module to the basic electronics

3.4 Functional principle

Control loop

The electropneumatic positioner forms a control loop with the pneumatic actuator:

- The actual value x represents the position of the actuator spindle for linear actuators or the position of the actuator shaft for part-turn actuators.
- The higher-level control loop provides the setpoint w.

The stroke or rotary movement of the actuator is transferred to a potentiometer using suitable attachments, positioner shaft and a backlash-free, switchable gear drive, and then to the analog input of the microcontroller.

The current position can also be forwarded to the positioner using an external sensor. A **N**on **C**ontacting Position **S**ensor (NCS) is used to record the stroke or rotary angle directly on the actuator.

The microcontroller:

- Corrects the angle error of the shaft pick-up if necessary.
- Compares the potentiometer voltage as actual value x with setpoint w.
- Calculates the manipulated variable increments $\pm\Delta y$.

Depending on the size and direction of the control deviation (x-w), pressurizing or depressurizing occurs via the pneumatic block. The actuator volume integrates the controller increment for the actuating pressure y which is proportional to the drive rod or the drive shaft. This controller increment changes the actuating pressure until the control deviation becomes zero.

Pneumatic actuators are available in single and double-acting versions. In a single-acting version, only one pressure chamber is ventilated and depressurized. The pressure developed works against a spring. In a double-acting version, two pressure chambers work against each other. Ventilating the volume of one chamber simultaneously depressurizes the volume of the other.

Control algorithm

The control algorithm is an adaptive, predictive five-point controller.

In case of large control deviations, the valves are controlled using permanent contact. This takes place in the so-called fast step zone.

In the case of medium-sized control deviations, the pneumatic block is controlled by pulse-length modulated pulses. This takes place in the so-called slow step zone.

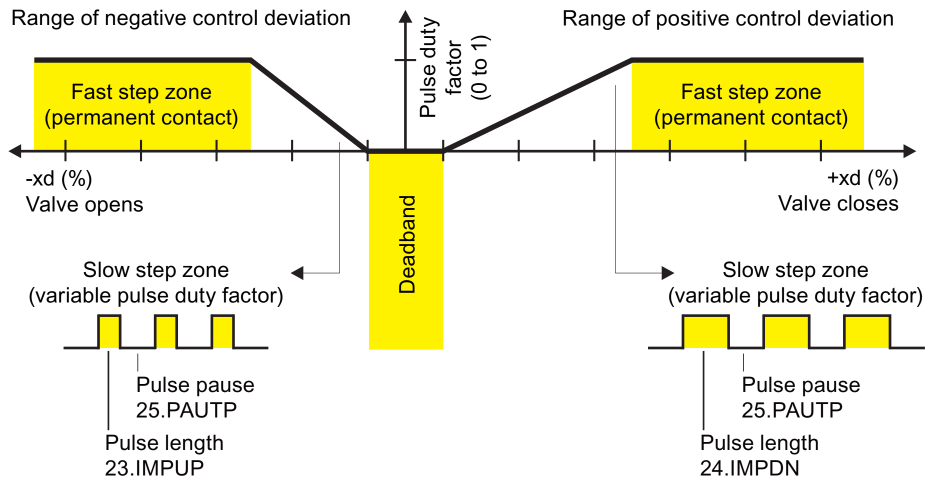


Figure 3-9 Functional principle of five-point controller

Small control deviations do not send control pulses in the zone. This takes place in the so-called adaptive deadband. The deadband adaptation and the continuous adaptation of minimum pulse lengths in "Automatic" mode ensure the best possible control accuracy with the smallest number of operating cycles. The start parameters are determined during the initialization phase and stored in the non-volatile memory. The most important start parameters are:

- The real actuator travel with end positions
- Travel times
- The deadband size

The number of fault messages, changes in direction, and the number of total strokes are continuously determined during operation and saved every 15 minutes. Document and read out these parameters via the communication software, e.g. SIMATIC PDM and AMS. By comparing the old values with the current ones, you can draw conclusions about the wear and tear of the valve. This is done using the diagnostics function.

Installing/mounting

4

4.1 Basic safety instructions

⚠ WARNING
High operating force with pneumatic actuators
Risk of injury when working on control valves due to the high operating force of the pneumatic actuator. • Please observe the corresponding safety instructions for the pneumatic actuator in use.

⚠ WARNING
Lever for position detection
Danger of crushing and shearing with mounting kits which use a lever for position detection. During commissioning and ongoing operation, severing or squeezing of limbs could occur as a result of the lever. Risk of injury when working on control valves due to the high operating force of the pneumatic actuator. • Do not reach into the range of motion of the lever following mounting of the positioner and mounting kit.

⚠ WARNING
Impermissible accessories and spare parts
Danger of explosion in areas subject to explosion hazard. • Only use original accessories or original spare parts. • Observe all relevant installation and safety instructions described in the instructions for the device or enclosed with the accessory or spare part.

⚠ WARNING
Lid gasket may be damaged
If the lid gasket is not positioned correctly in the groove of the base plate, it could be damaged when the lid is mounted and screwed tight. • Therefore, make sure that the lid gasket is seated correctly.

4.1.1 Exceeded maximum permissible operating pressure

> **WARNING**
>
> **Exceeded maximum permissible operating pressure**
>
> Risk of injury or poisoning.
>
> The maximum permissible operating pressure depends on the device version, pressure limit and temperature rating. The device can be damaged if the operating pressure is exceeded. Hot, toxic and corrosive process media could be released.
>
> Ensure that maximum permissible operating pressure of the device is not exceeded. Refer to the information on the nameplate and/or in Technical specifications (Page 227).

> **WARNING**
>
> **Electrostatic charging of nameplates**
>
> The nameplates used on the device can reach a charging capacity of 5 pF.
> - Keep the device and the cables at a distance from strong electromagnetic fields.

> **CAUTION**
>
> **Unsuitable compressed air**
>
> Device damage. As a general rule, the positioner must only be operated with dry and clean compressed air.
> - Use the customary water separators and filters. An additional dryer is required in extreme cases.
> - Use dryers, especially if you operate the positioner at low ambient temperatures.

CAUTION

Adhere to the following instructions before working on the control valve and when attaching the positioner

Danger of injury.

- Prior to working on the control valve, you must move the actuator and the process valve into a completely pressureless state. Proceed as follows:
  - Depressurize the actuator chambers.
  - Switch off the supply pressure PZ.
  - Secure the process valve.
- Make sure that the actuator has reached the pressureless state.
- If you interrupt the supply pressure PZ to the positioner, the pressureless position can only be reached after a certain waiting time.
- When mounting, adhere strictly to the following order to avoid injuries or mechanical damage to the positioner/mounting kit:
  - Mount the positioner mechanically.
  - Electric connection.
  - Connect supply pressure PZ.
  - Commission the positioner.

WARNING

Mechanical impact energy

In order to ensure the degree of protection of the housing (IP66), protect the housing versions of the positioners listed here from mechanical impact energy:

- 6DR5..3; not greater than 2 Joule
- 6DR5..0; not greater than 1 Joule
- 6DR5..1 with inspection window; not greater than 1 Joule

4.1.2 Increased sound pressure level

CAUTION

Increased sound pressure level

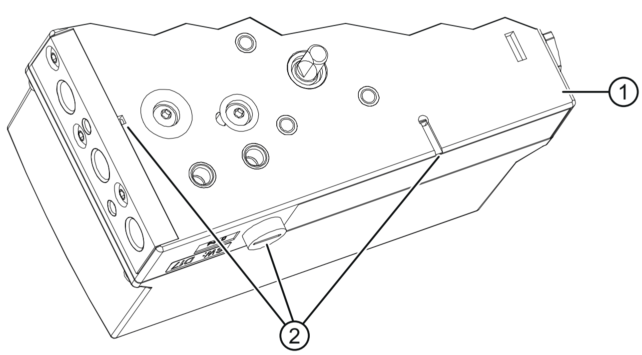
Changes to the sound absorber of the positioner or the mounting of pneumatic components or pneumatic options on the positioner can cause a sound pressure with a level of 80 dBA to be exceeded.

- Wear suitable hearing protection to protect yourself against hearing damage.

NOTICE
Torque with NPT screwed gland
Device damage. The maximum torque of the cable gland must not be exceeded. • To avoid damage to the device, the NPT adapter must be held in place while the NPT gland is screwed into the NPT adapter. Refer to the section "Technical specifications > Construction (Page 228)" for the torque value.

4.1.3 Correct assembly

NOTICE
Freezing of the exhaust air outlets
When devices of the type 6DR5..0/1/2/3 are used, the exhaust air outlets ② may freeze. The function of the device is impaired. • Do **not** install the positioner with the base plate ① pointing up.



① Base plate
② Exhaust air outlets

Figure 4-1 Exhaust air outlets, base plate

NOTICE
Incorrect mounting
The device can be damaged, destroyed, or its functionality impaired through improper mounting. • Before installing ensure there is no visible damage to the device. • Make sure that process connectors are clean, and suitable gaskets and glands are used. • Mount the device using suitable tools. Refer to the information in Technical specifications (Page 227).

4.2 Mounting to linear actuator

Requirements

There are linear actuators for standard mounting in accordance with IEC 60534 and for integrated mounting. Use the reduced mounting kit 6DR4004-8VK for actuators with integrated mounting. Integrated mounting is not possible with flameproof stainless steel enclosure (6DR5..6).

This section describes how to connect the positioner to the linear actuator according to IEC 60534. Depending on the stroke height, you will need the following mounting kit:

- 3 to 35 mm mounting kit 6DR4004-8V
- 35 to 130 mm mounting kit 6DR4004-8V and additional 6DR4004-8L

See also

Construction (Page 228)

4.3 Mounting to part-turn actuator

Requirements

You require an actuator-specific VDI/VDE 3845 mount to install the positioner on a part-turn actuator. Because of the high weight of the version in the flameproof stainless steel enclosure 6DR5..6, you should select a particularly stable mount.

Procedure

"Part-turn actuator" mounting kit 6DR4004–8D			
Sr. no. *)	**Quantity**	**Designation**	**Note**
①	1	Coupling wheel	Installation on positioner shaft
②	1	Carrier	Installing on the actuator shaft
③	1	Multiple plate	Display of the position, consisting of scale ⑤ and pointer mark ⑥
④	8	Scale	Different divisions
⑤	2	Pointer mark	Reference point for scale
⑥		Mounting console	Actuator-specific, VDI/VDE 3845
⑦	4	Hexagon bolt	M6x12 DIN 933, torque see the section "Technical specifications > Construction (Page 228)"
⑧	4	Lock washer	S6
⑨	1	Socket cap screw	M6x16 DIN 84
⑩	1	Washer	6.4 DIN 125

"Part-turn actuator" mounting kit 6DR4004–8D			
Sr. no. *)	**Quantity**	**Designation**	**Note**
⑪	1	Hex socket-head screw	For coupling wheel
	1	Machinist's wrench	For hexagon socket-head screw ⑪

*) The serial numbers refer to the images in the description of the steps below.

1. Rest the actuator-specific VDI/VDE 3845 mount ⑥ on the rear side of the positioner. Tighten the mount using the hexagon bolts ⑦ and lock washers ⑧.
2. Push the coupling wheel ① or the stainless steel coupling up to the endstop on the positioner shaft. Then retract the coupling wheel or the stainless steel coupling by approximately 1 mm. Tighten the hexagon socket-head screw ⑪ using the machinist's wrench provided. Maximum tightening torque = 1 Nm. If you are using the stainless steel coupling, omit the next step.

Note

Coupling wheel

Instead of the polycarbonate coupling wheel ①, it is possible to use a stainless steel coupling (article number TGX:16300-1556).

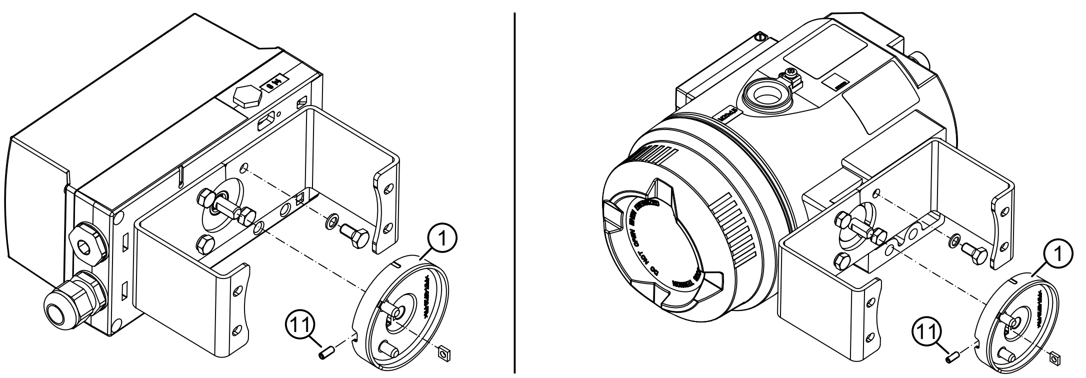


Figure 4-2 Left: Coupling wheel, right: Coupling wheel, flameproof enclosure

3. Place the carrier ② on the actuator shaft. Tighten the carrier ② using the socket cap screw ⑨ and the washer ⑩.

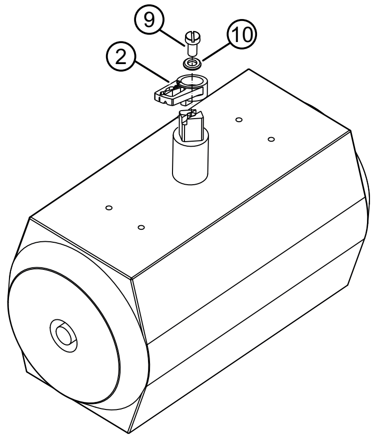


Figure 4-3 Carrier

4. Place the positioner and the mount on the actuator carefully. One of the two pins ⑫ of the coupling wheel ① must fit in the carrier ② when you do this.

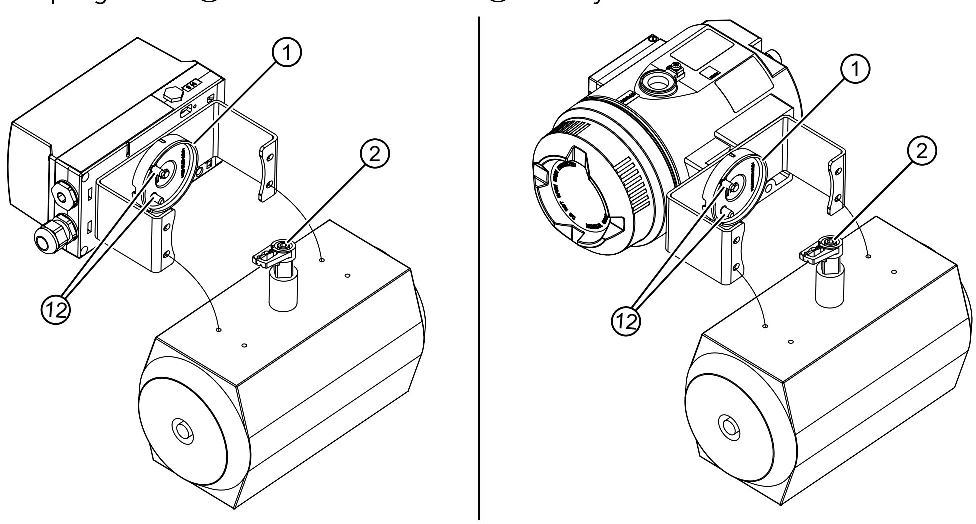


Figure 4-4 Left: Orientation of mount; right: Orientation of mount, flameproof enclosure

5. When using the stainless steel coupling (article number TGX:16300-1556): Place the positioner and the mount on the actuator carefully. Place the stainless steel coupling on the stump of the actuator's positioner shaft.
6. Align the positioner with mount at the center of the actuator.
7. Fasten the positioner with mount.
8. Initialize the positioner.

9. After commissioning, drive the positioner to the end position.
10. Stick the scale ④ with the direction of rotation or the swivel range on the coupling wheel ①. The stickers with scale are self-adhesive.

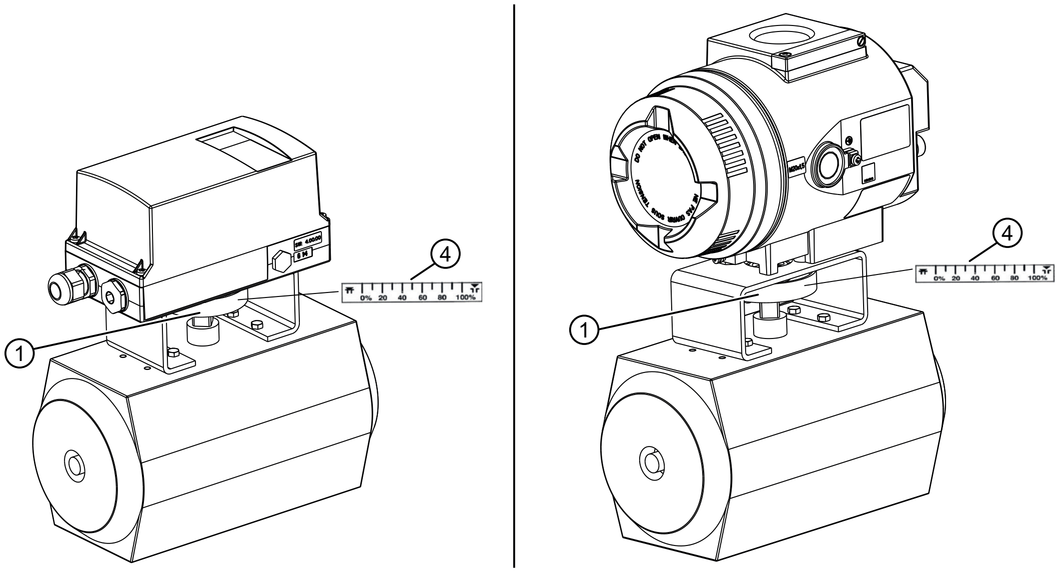
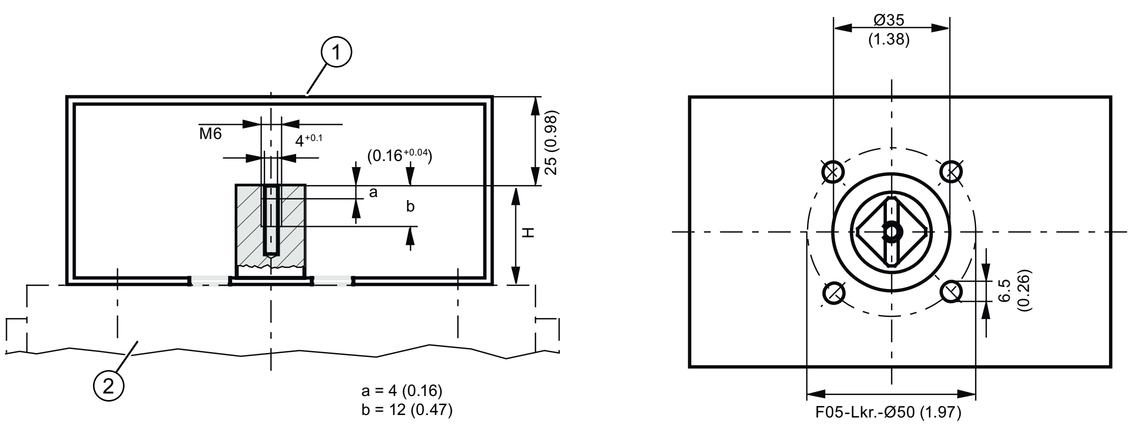


Figure 4-5 Left: Adhesive label with scale; right: Adhesive label with scale, flameproof enclosure



H = height of shaft butt

① Fixing level of positioner on mount

② Part-turn actuator

Figure 4-6 Dimensions of mount in accordance with VDI/VDE 3845 (depends on actuator)

4.4 Setting and locking the transmission ratio

Introduction

The positioner has a friction clutch and a transmission ratio selector. The positioner can therefore be used on a variety of mechanically different part-turn and linear actuators.

- The transmission ratio selector allows you to adapt the positioner to small or large strokes.
- You can then use the friction clutch to adjust the working area.

Strong acceleration forces act on control valves that are subjected to heavy mechanical loads, e.g. breakaway valves, strongly shaking or vibrating valves, as well as in case of "vapor shocks". These forces may be much higher than the specified data. This may move the transmission ratio in extreme cases. In these cases it is possible to lock the transmission ratio selector by means of the gear fixing.

When the positioner is mounted and fully operational, set the friction clutch as described in the section Setting the friction clutch (Page 103).

NOTICE
Wrong registration of the rotary or part-turn movement A different setting of the transmission ratio selector and the gear latch results in a hysteresis in position detection. The hysteresis in position detection can result in unstable control response of the higher level control loop. • Make sure the transmission ratio selector ⑤ and the gear latch ① are set to the same value, either to 33° or to 90°.

Note

Use of external NCS sensor / internal NCS module

If you use the accessory part "NCS sensor for non-contacting position detection" or a built-in internal NCS module, the locking and fixing measures described in this section are **not** necessary.

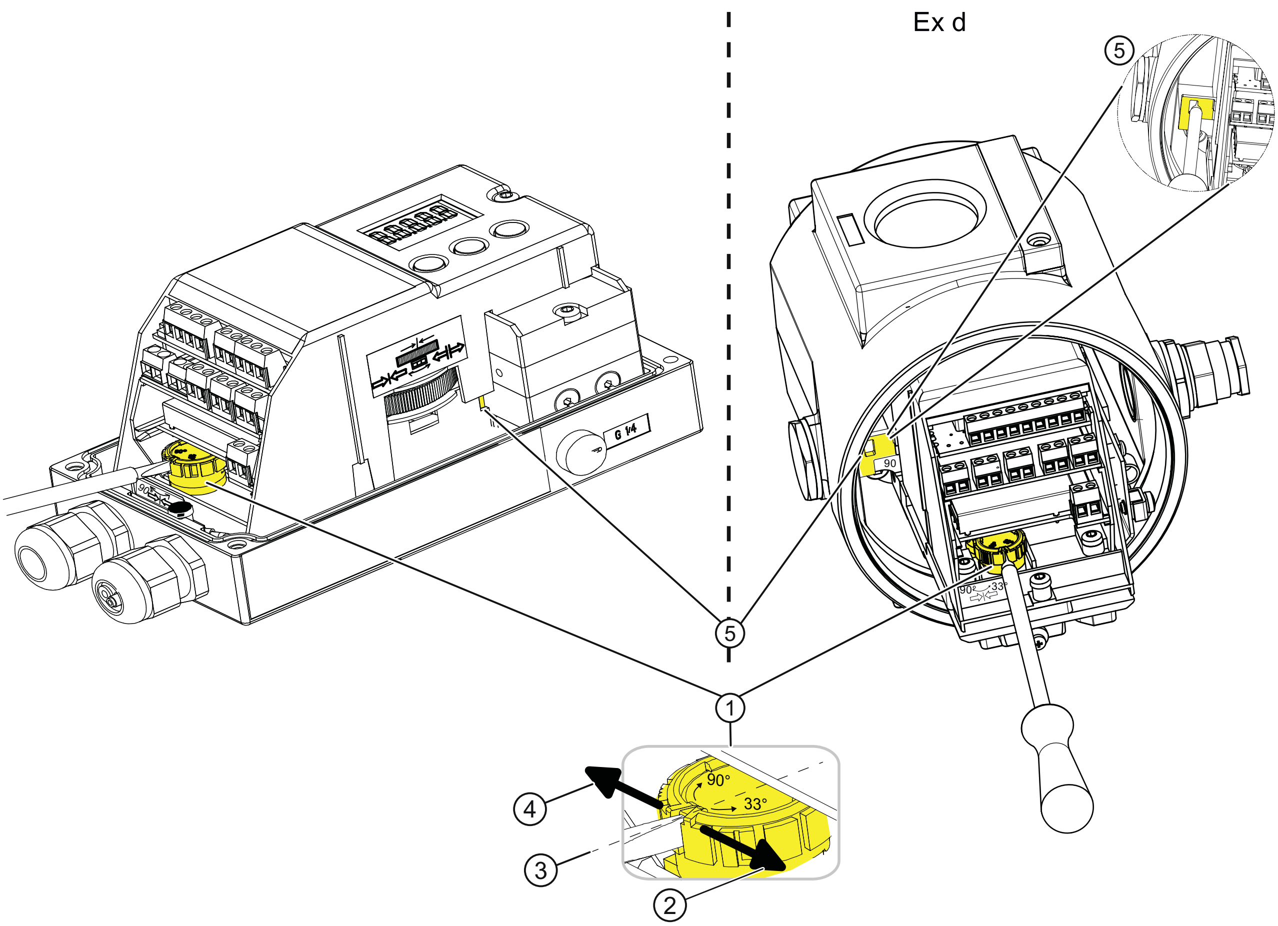
Requirement

- The positioner is mounted.
- You know whether the transmission ratio is to be set to 33° or 90°.

4.4.1 Procedure for setting and locking the transmission ratio

Procedure

On the right in the graphic the positioner is shown in the flameproof enclosure Ex d with open cover. The procedure is the same for both enclosure versions.



① Wheel for gear latch (yellow)
② Locking transmission ratio to 33°
③ Neutral position
④ Locking transmission ratio to 90°
⑤ Transmission ratio selector (yellow)

Figure 4-7 Locking the transmission ratio

1. Ensure that the wheel for the gear latch ① is in neutral position ③. The neutral position is between 33° and 90°. The setting of the transmission ratio selector ⑤ can only be changed effectively if the gear latch ① is in the neutral position ③.
2. Make sure the transmission ratio selector ⑤ is set to the same value as the gear latch ①, either to 33° or to 90°.
3. Turn the wheel for the gear latch ① until the gear latch ① perceptibly locks. Use an approx. 4 mm wide standard screwdriver.
   Turning right locks the transmission ratio to 33° ②. Turning left locks the transmission ratio to 90° ④.

The transmission ratio ② is set and locked.

See also

Overview of device components (Ex) (Page 28)

4.5 Installing option modules

4.5.1 General information on installing option modules

⚠ WARNING

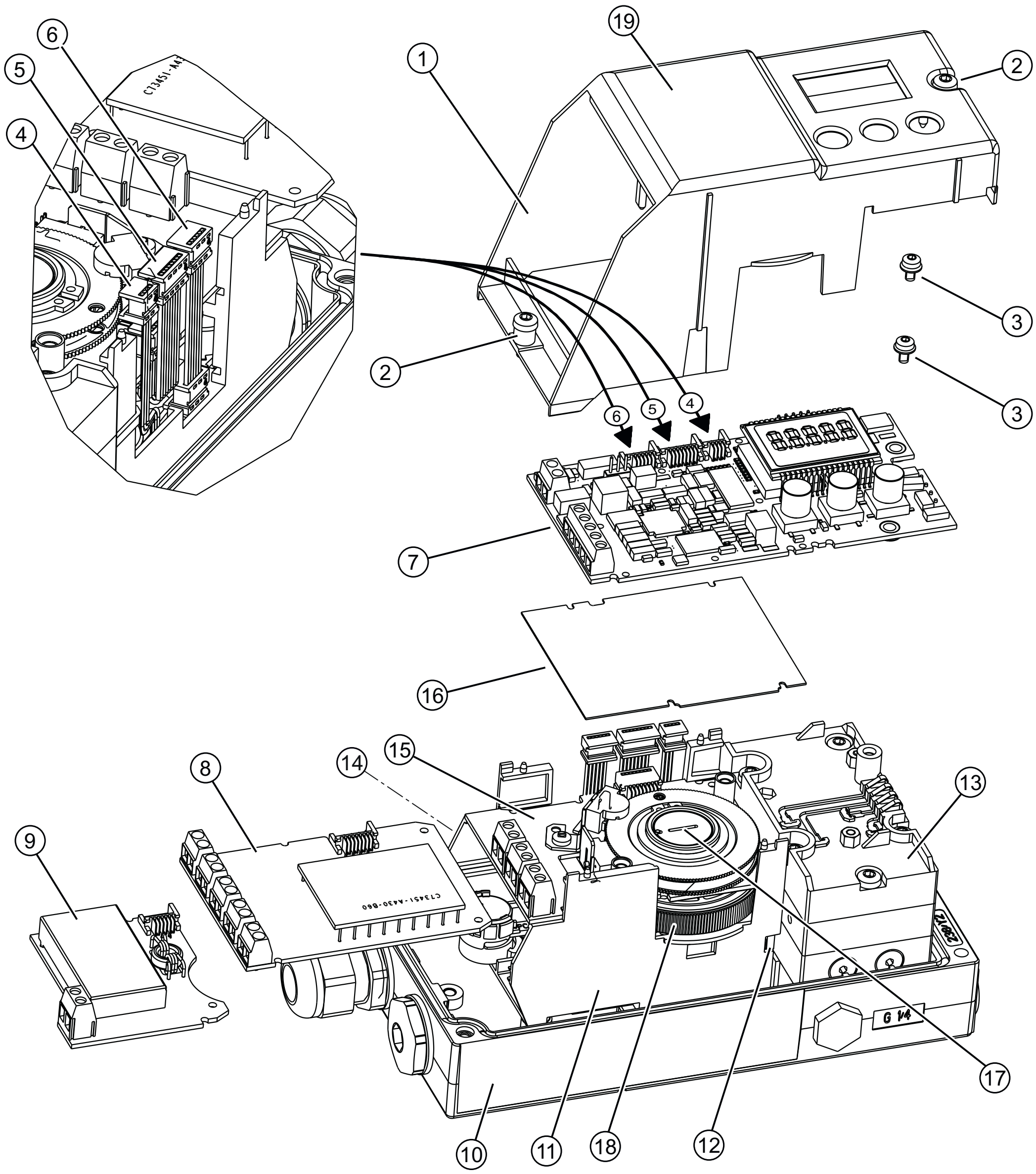
Use in hazardous areas

Risk of explosion.

- Only use equipment that is approved for use in the intended hazardous area and labelled accordingly.

4.5.1.1 Opening the standard and intrinsically safe version

Overview screen



①	Module cover	⑪	Adapter
②	Fixing screws module cover	⑫	Transmission ratio selector
③	Fixing screws basic electronics	⑬	Pneumatic block
④	Ribbon cable/connector for fitted potentiometer or fitted Analog Input Module (AIM)	⑭	Warning label on the side opposite the nameplate
⑤	Ribbon cable/connector for Digital I/O Module (DIO), Inductive Limit Switches (ILS) or Mechanic Limit Switches (MLS)	⑮	Inductive Limit Switches (ILS) or Mechanic Limit Switches (MLS)

⑥	Ribbon cable/connector for Analog Output Module (AOM)	⑯	Insulating cover, yellow
⑦	Basic electronics	⑰	Special screw
⑧	Digital I/O Module (DIO)	⑱	Friction clutch adjustment wheel
⑨	Analog Output Module (AOM)	⑲	Wiring diagram on module cover
⑩	Nameplate		

Figure 4-8 Installing the optional modules in the standard and intrinsically safe version

Procedure: Opening the positioner

1. Loosen the four fixing screws of the enclosure lid. Remove the enclosure lid.
2. Disconnect the power supply cables or de-energize the cables.
3. Disconnect all other electrical connections of the device.
4. Loosen the two fixing screws ② of the module cover ①.
5. Remove the module cover ①.

If you are installing an option module, proceed as described for the respective option modules. Remove the basic electronics for Inductive Limit Switches (ILS), Mechanic Limit Switches (MLS), the internal NCS module and Analog Input Module (AIM).

If you are replacing the basic electronics, a pneumatic block or a pressure sensor module, proceed as described in the corresponding sections under "Service and maintenance (Page 191)".

4.5.1.2 Closing the standard and and intrinsically safe version

Procedure: Closing the positioner

1. Start with the assembly. Place on the module cover ①. Make sure that no ribbon cable is pinched.
2. Turn the fixing screws ② counterclockwise until they noticeably engage in the thread pitch.
3. Carefully tighten both fixing screws ② in a clockwise direction.
   The module cover protects and locks the optional modules mechanically.

   Note

   Untimely wear

   The module cover is fastened using **self-tapping** screws, one screw for the base plate and one screw for the pneumatic block.

   - In order to avoid premature wear of the base plate and pneumatic block, proceed as described.

   ---

4. Connect the power supply cables or supply the cables with voltage.
5. Put on the enclosure lid.
6. Tighten the fixing screws of the enclosure lid.

4.5.1.3 Opening the device version with "flameproof enclosure"

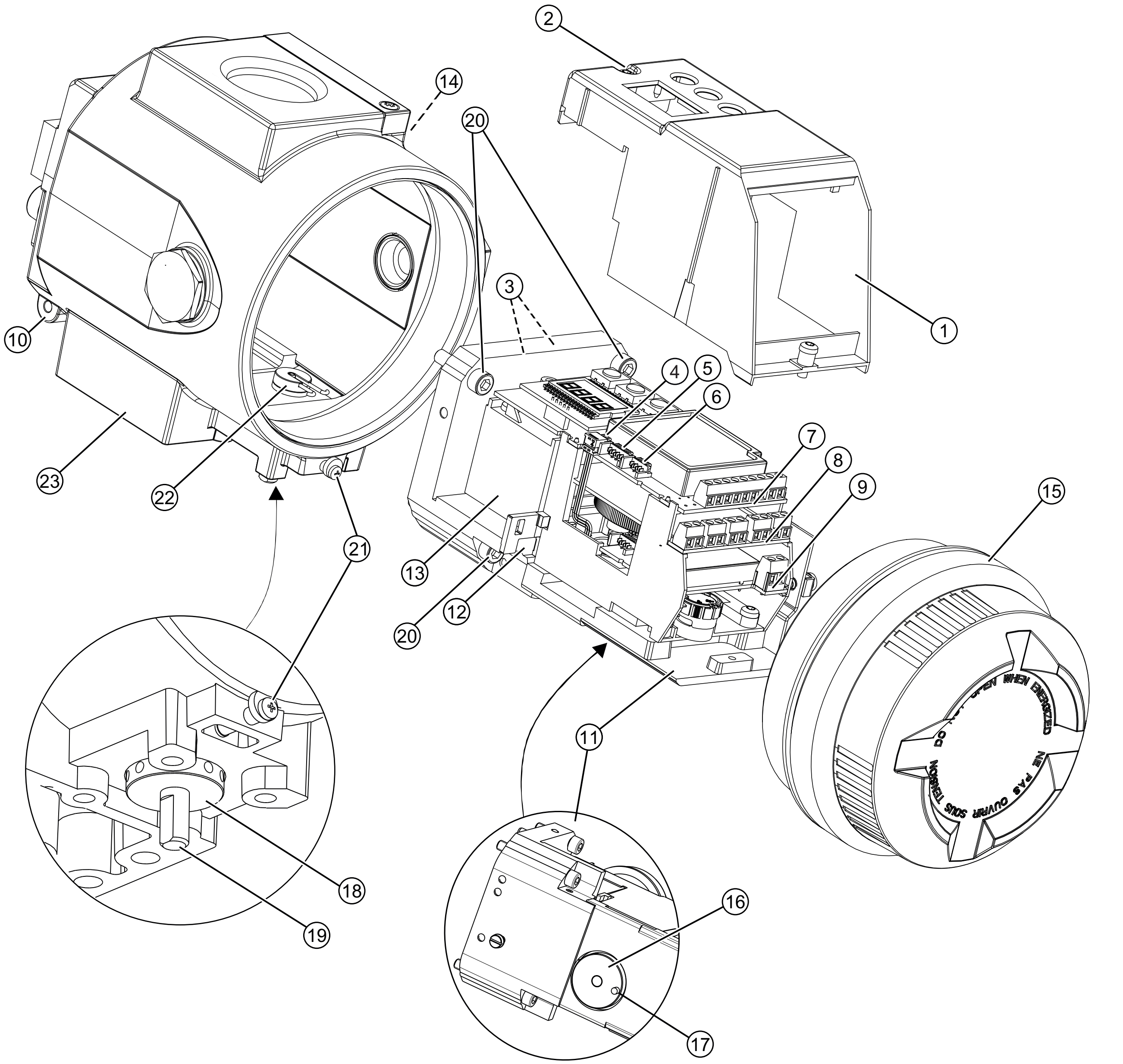
Overview screen

DANGER

Risk of explosion

Before supplying the positioner with auxiliary power in potentially hazardous areas, ensure the following:

- The installed electronic unit has been approved.
- The enclosure of the positioner is closed.
- The duct openings for electronic connections must be closed. Only use the Ex d certified cable entries or sealing plugs.
- If you use a "conduit piping system", install an ignition trap. The maximum distance between the ignition trap and the positioner enclosure is 46 cm (18 inch).



①	Module cover
②	Fixing screws module cover
③	Fixing screws basic electronics
④	Ribbon cable/connector for fitted potentiometer or Position Transmitter
⑤	Ribbon cable/connector for Digital I/O Module (DIO), Inductive Limit Switches (ILS) or Mechanic Limit Switches (MLS)
⑥	Ribbon cable/connector for Analog Output Module (AOM)
⑦	Basic electronics
⑧	Digital I/O Module (DIO)
⑨	Analog Output Module (AOM)
⑬	Pneumatic block
⑭	Warning label on the side opposite the nameplate
⑮	Screw cap
⑯	Feedback lever bracket with pin
⑰	Pin (feedback lever bracket)
⑱	Adjustment wheel for external friction clutch
⑲	Feedback shaft
⑳	Fixing screws adapter
㉑	Safety catch

⑩	Nameplate	㉒	Clip
⑪	Adapter	㉓	Enclosure
⑫	Transmission ratio selector		

Figure 4-9 Installing the optional modules in the "flameproof enclosure" version

Procedure: Opening the positioner

1. Disconnect the power supply cables or de-energize the cables.
2. Open the safety catch ㉑.
3. Unscrew the screw cap ⑮.
4. Completely dismount the positioner from the actuator.
5. Turn the feedback shaft ⑲ on the positioner until the pin (feedback lever bracket) ⑰ below the adapter ⑪ shows in the direction of removal. If you look into the enclosure below the adapter, you will see the position of the pin.
6. Screw out the four fixing screws ⑳ of the adapter ⑪.
7. Completely remove the adapter ⑪ carefully from the enclosure ㉓.
   The positioner comes with a clip ㉒ and a pin (feedback lever bracket) ⑰ which interlock and ensure backlash-free position feedback. To ensure backlash-free position feedback make sure you remove the adapter ⑪ carefully.

   NOTICE

   Displaced O-rings

   There are several O-rings between adapter ⑪ and enclosure ㉓. These O-rings may come off during removal.

   - Carefully remove the adapter. Make sure the O-rings do not get lost during removal.

8. Loosen the two fixing screws ② of the module cover ①.
9. Remove the module cover ①.

If you are installing an option module, proceed as described for the respective option module. Remove the basic electronics with an internal NCS module.

If you are replacing the basic electronics or the pneumatic block, proceed as described in the corresponding sections under "Service and maintenance (Page 191)".

4.5.1.4 Closing the device version with "flameproof enclosure"

Procedure: Closing the positioner

1. Now start with the assembly. Place on the module cover ①. Make sure that no ribbon cable is pinched.
2. Turn the fixing screws ② counterclockwise until they noticeably engage in the thread pitch. Carefully tighten both fixing screws ② in a clockwise direction.
   The module cover protects and locks the optional modules mechanically.

   Note

   Untimely wear

   The module cover is fastened using a **self-tapping** screw for the pneumatic block.

   - In order to avoid premature wear of the pneumatic block, proceed as described.

   ---
3. Check whether the position of the O-rings is correct before inserting the adapter into the enclosure.
   – With an enclosure made from aluminum, O rings are inside the enclosure and on the rear of the adapter.
   – With an enclosure made from stainless steel, O-rings are on the rear of the adapter.
4. Make sure no loose items in the enclosure interfere with the assembly.
5. Push the adapter ⑪ fully into the enclosure ㉓.
   The positioner comes with a clip ㉒ and a pin (feedback lever bracket) ⑰ which interlock and ensure backlash-free position feedback. To ensure backlash-free position feedback, insert the adapter ⑪ carefully into the enclosure.
6. Screw in the four fixing screws ⑳ of the adapter ⑪. Tighten the screws.
   Check carefully whether the feedback shaft ⑲ can be smoothly turned by 360°. If you feel resistance, do **not** continue to turn but turn the feedback shaft ⑲ back again to the point of removal.
7. Mount the positioner on the actuator.
8. Unscrew the screw cap ⑮.
9. Close the safety catch ㉑.
10. Connect the power supply cables or supply the cables with voltage.

4.5.2 Analog Output Module (AOM) 6DR4004-6J / -8J

Function

- The Analog Output Module (AOM) indicates the current position of the actuator as a two-wire signal between 4 mA and 20 mA. The Analog Output Module (AOM) is galvanically isolated from the basic unit.
- The current position is indicated as a passive mA signal only after successful initialization.
- Operational faults are signaled by a fault current of 3.6 mA.

Device features

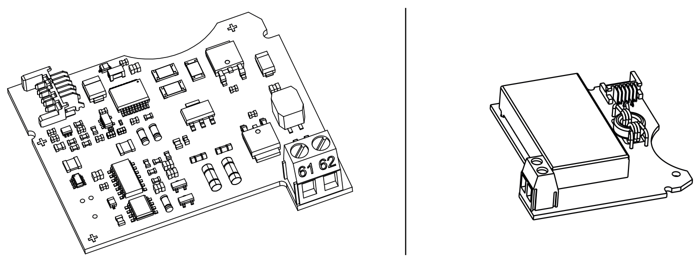


Figure 4-10 Analog Output Module (AOM) 6DR4004-6J (Ex) and 6DR4004-8J (non-Ex), schematic representation

The Analog Output Module (AOM) is:

- Single channel
- Galvanically isolated from the basic device

Requirement

A supply source corresponding to the technical specifications (Page 227) of the option module must be available.

Procedure

1. Open the positioner as in the description depending on the device version:
   – Opening the standard and intrinsically safe version (Page 42)
   – Opening the device version with "flameproof enclosure" (Page 44)
2. Slide the Analog Output Module (AOM) into the lower bay of the adapter as far as it will go.
3. Connect the Analog Output Module (AOM) to the basic electronics. To do this, use the 6-pin flat ribbon cable provided.
4. Close the positioner as in the description depending on the device version:
   – Closing the standard and and intrinsically safe version (Page 43)
   – Closing the device version with "flameproof enclosure" (Page 47)

See also

General information on installing option modules (Page 41)

4.5.3 Digital I/O Module (DIO) 6DR4004-6A / -8A

Function

The Digital I/O Module (DIO) triggers fault messages and alarms via three digital outputs.

- If there is no alarm, the digital output is conductive (not triggered).
- If there is an alarm, the digital output is deactivated (triggered).
- Set the following parameters to activate, invert and configure the output of alarms and fault messages:
  - "AFCT" - Alarm function
  - "A1" - Response threshold, alarm 1
  - "A2" - Response threshold, alarm 2
  - "FCT" - Function for fault message output
  - "TIM" - Monitoring time
  - "LIM" - Response threshold

The Digital I/O Module (DIO) also has a digital input DI2 in addition to the digital outputs. Depending on the selected parameters, this digital input is used, for example, to block the actuator or to move it to its end position. You make the corresponding settings with the "DI2" parameter.

Device features

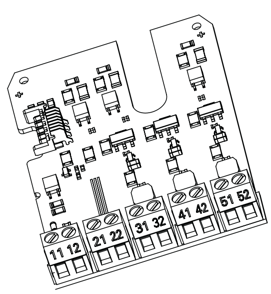


Figure 4-11 Digital I/O Module (DIO), schematic representation

The Digital I/O Module (DIO) has the following features:

- Available in two versions
  - Explosion-proof version for connection to a switching amplifier in conformity with EN 60947-5-6
  - Non-explosion-proof version for connecting to power sources having a maximum of 35 V.
- 3 digital outputs. The digital outputs are galvanically isolated from the standard controller and from each other.
- The digital input DI2 has 2 inputs. Both inputs are implemented as logical OR combination.
  - Digital input DI1 on terminal 11/12: Is electrically isolated, and is triggered by an active signal.
  - Digital input DI2 on terminal 21/22: Is not electrically isolated, and is triggered by a passive NO contact.

Procedure

1. Open the positioner as in the description depending on the device version:
   - Opening the standard and intrinsically safe version (Page 42)
   - Opening the device version with "flameproof enclosure" (Page 44)
2. Slide the Digital I/O Module (DIO) into the adapter below the basic electronics. Ensure that you slide it up to the endstop.
3. Connect the Digital I/O Module (DIO) to the basic electronics. To do this, use the 8-pin flat ribbon cable provided.
4. Close the positioner as in the description depending on the device version:
   - Closing the standard and and intrinsically safe version (Page 43)
   - Closing the device version with "flameproof enclosure" (Page 47)

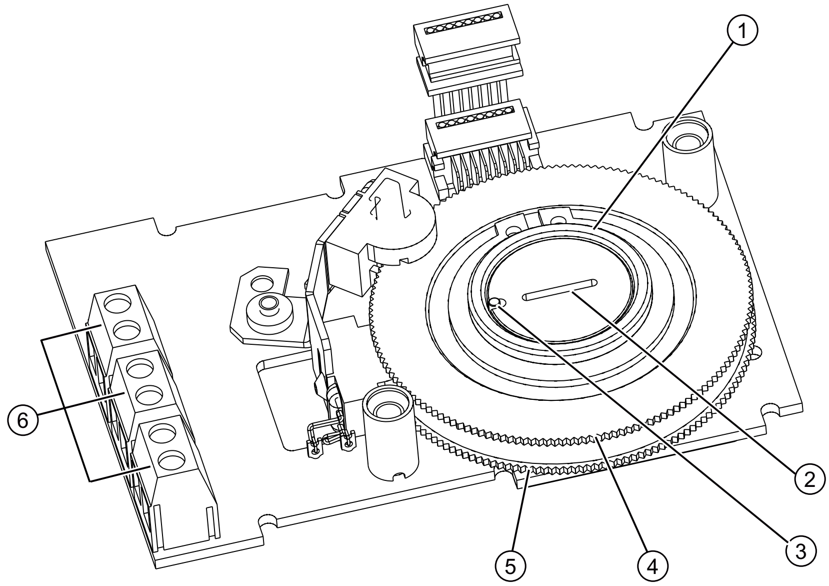
4.5.4 Inductive Limit Switches (ILS) 6DR4004 6G / -8G

Function

If the basic unit requires electrically independent limit messages, the Inductive Limit Switches (ILS) with slotted initiators is used instead of the Digital I/O Module (DIO).

- A digital output is used to display a group fault message. Compare with the function of the Digital I/O Module (DIO). The floating digital output is implemented as an automatic fault indicating semiconductor output.
- The other two digital outputs are used to signal the two limits L1 and L2 which can be adjusted mechanically using slotted initiators. These two digital outputs are electrically independent from the remaining electronic unit.

Device features



① Actuating disk bearings
② Special screw
③ Pin
④ Upper actuating disk for limit L1, terminals 41/42
⑤ Lower actuating disk for limit L2, terminals 51/52
⑥ Digital outputs

Figure 4-12 Inductive Limit Switches (ILS), schematic representation

The Inductive Limit Switches (ILS) have three digital outputs ⑥.

Procedure

1. Open the positioner as described in Opening the standard and intrinsically safe version (Page 42).
2. Remove the ribbon cable from the basic electronics.
3. Tighten the two fixing screws of the basic electronics. Remove the basic electronics.
4. Insert the Inductive Limit Switches (ILS) from the top to the upper printed circuit board guide of the adapter.
5. Slide the Inductive Limit Switches (ILS) in the printed circuit board of the adapter approx. 3 mm to the right.

6. Screw the special screw ② through the Inductive Limit Switches (ILS) into the positioner shaft. Tighten the special screw ② with a **torque of 2 Nm**.

Note

Pin in the actuating disk bearing

A pin ③ is pressed in the actuating disk bearing ①.

1. Align pin ③ with the groove of the special screw before inserting the head of the special screw ② into the actuating disk bearing ①.
2. Rotate the actuating disk bearing ① and the special screw ② simultaneously so that the pin ③ is inserted into the groove of the special screw ②.

7. An insulating cover (yellow) is required over the Inductive Limit Switches (ILS). This insulating cover is supplied with the Inductive Limit Switches (ILS). Place one end of the insulating cover under the basic electronics contact surface of the adapter. The recesses of the insulating cover must fit into the corresponding webs of the adapter. To tighten the insulating cover, bend the walls of the adapter slightly outwards.
Firmly press the other end until the insulating cover is underneath the contact surface of the basic electronics. The recesses of the insulating cover must fit into the corresponding webs of the adapter.
8. Place the basic electronics onto the four holders of the adapter.
9. Tighten the two fixing screws of the basic electronics. Tighten the screws.
10. Reestablish all electrical connections between the basic electronics and the option modules.
11. Connect the basic electronics with the option modules and the potentiometer. Use the corresponding ribbon cables.
12. Put on the **supplied module cover**. Make sure that no ribbon cable is pinched.

Note

Module cover

Do **not** use the standard module cover. The provided module cover has a larger recess.

13. Select the labels that are already available on the standard version of the module cover from the label set provided. Affix the selected labels onto the installed module cover as per the standard version.
14. Close the positioner as described in Closing the standard and and intrinsically safe version (Page 43).
15. Set the limits L1 and L2 as described in Inductive Limit Switches (ILS) 6DR4004 6G / -8G (Page 51).

Procedure: Determining the switch status of the slot-type initiators

You will require a suitable display device to determine the switch status. For example, use the initiator tester type 2 / Ex from Pepperl + Fuchs.

1. Connect the display device to the following terminals of the Inductive Limit Switches (ILS):
   – 41 and 42
   – 51 and 52
2. Read the switch status of the slot-type initiators.

Procedure: Setting the L1 and L2 limits

The consecutive numbers in the following text refer to the figure above in this section. Proceed as follows to set the limits:

1. Move the actuator to the first desired mechanical position.
2. Adjust the upper actuating disk ④ manually until the output signal at terminals 41 and 42 changes. Procedure:
   – Rotate the actuating disc ④ beyond the switching point until you reach the next switching point.
3. Move the actuator to the second desired mechanical position.
4. Adjust the lower actuating disk ⑤ manually until the output signal at terminals 51 and 52 changes. Procedure:
   – Rotate the actuating disc ⑤ beyond the switching point until you reach the next switching point.

   Note

   Adjusting the actuating disk

   The actuating disks ④ and ⑤ are relatively difficult to move. This design prevents their unintentional movement during operation. You can achieve an easier and finer adjustment by reducing stiction temporarily.

   - Move the actuator to and fro while simultaneously holding the actuating disks ④ and ⑤.

See also

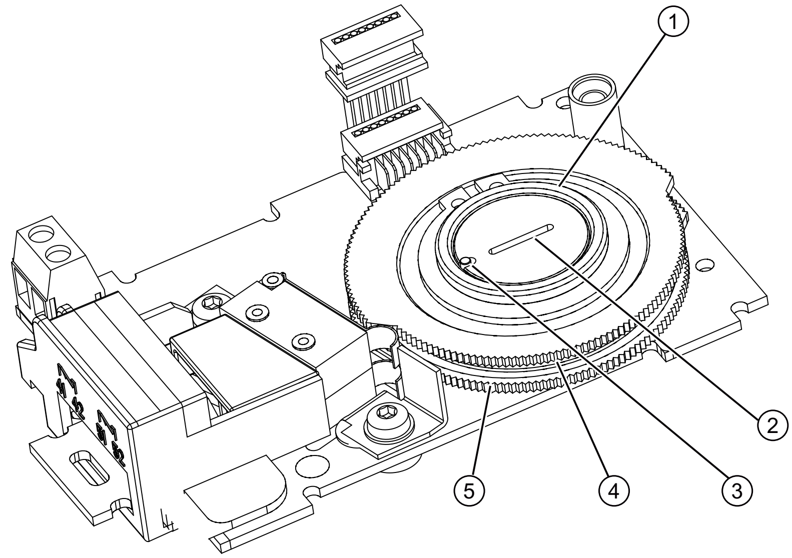
Inductive Limit Switches (ILS) 6DR4004 6G / -8G (Page 51)

4.5.5 Mechanic Limit Switches (MLS) 6DR4004-6K / -8K

Function

Mechanic Limit Switches (MLS) are used to report two limits. These limits are reported using galvanic switching contacts.

Device features



①	Actuating disk bearings	④	Upper actuating disk for limit L1, terminals 51/52
②	Special screw	⑤	Lower actuating disk for limit L2, terminals 41/42
③	Pin		

Figure 4-13 Mechanic Limit Switches (MLS), schematic representation

Mechanic Limit Switches (MLS) contain:

- One digital output to display a group fault message. Compare with the device features of the Mechanic Limit Switches (MLS).
- Two switches to report two mechanically adjustable limits. Both these switches are electrically independent from the remaining electronic unit.

Procedure

1. Open the positioner as described in Opening the standard and intrinsically safe version (Page 42).
2. Remove the ribbon cable from the basic electronics.
3. Tighten the two fixing screws of the basic electronics. Remove the basic electronics.
4. Insert the Mechanic Limit Switches (MLS) from the top to the upper printed circuit board guide of the adapter.
5. Slide the Mechanic Limit Switches (MLS) in the printed circuit board of the adapter approx. 3 mm to the right.

6. Screw the special screw ② through the Mechanic Limit Switches (MLS) into the positioner shaft. Tighten the special screw ② with a **torque of 2 Nm**.

   Note

   Pin in the actuating disk bearing

   A pin ③ is pressed in the actuating disk bearing ①.

   1. Align pin ③ with the groove of the special screw before inserting the head of the special screw ② into the actuating disk bearing ①.
   2. Rotate the actuating disk bearing ① and the special screw ② simultaneously so that the pin ③ is inserted into the groove of the special screw ②.

   ---

7. An insulating cover (yellow) is required over the Mechanic Limit Switches (MLS). This insulating cover is supplied with the Mechanic Limit Switches (MLS). Place one end of the insulating cover under the basic electronics contact surface of the adapter. The recesses of the insulating cover must fit into the corresponding webs of the adapter. To tighten the insulating cover, bend the walls of the adapter slightly outwards.
   Firmly press the other end until the insulating cover is underneath the contact surface of the basic electronics. The recesses of the insulating cover must fit into the corresponding webs of the adapter.
8. Place the basic electronics onto the four holders of the adapter.
9. Tighten the two fixing screws of the basic electronics. Tighten the screws.
10. Reestablish all electrical connections between the basic electronics and the option modules.
11. Connect the basic electronics with the option modules and the potentiometer. Use the corresponding ribbon cables.
12. Put on the **supplied module cover**. Make sure that no ribbon cable is pinched.

    Note

    Module cover

    Do **not** use the standard module cover. The provided module cover has a larger recess.

    ---

13. Close the positioner as described in Closing the standard and and intrinsically safe version (Page 43).
14. Set the limits L1 and L2 as described in Mechanic Limit Switches (MLS) 6DR4004-6K / -8K (Page 54).

Procedure: Setting the L1 and L2 limits

1. Move the actuator to the first desired mechanical position.
2. Adjust the upper actuating disk ④ manually until the output signal at terminals 51 and 52 changes. Procedure:
   – Rotate the actuating disc beyond the switching point until you reach the next switching point.

3. Move the actuator to the second desired mechanical position.
4. Adjust the lower actuating disk ⑤ manually until the output signal at terminals 41 and 42 changes. Procedure:
   - Rotate the actuating disc beyond the switching point until you reach the next switching point.

Note

Adjusting the actuating disk

The actuating disks ④ and ⑤ are relatively difficult to move. This design prevents their unintentional movement during operation. You can achieve an easier and finer adjustment by reducing stiction temporarily.

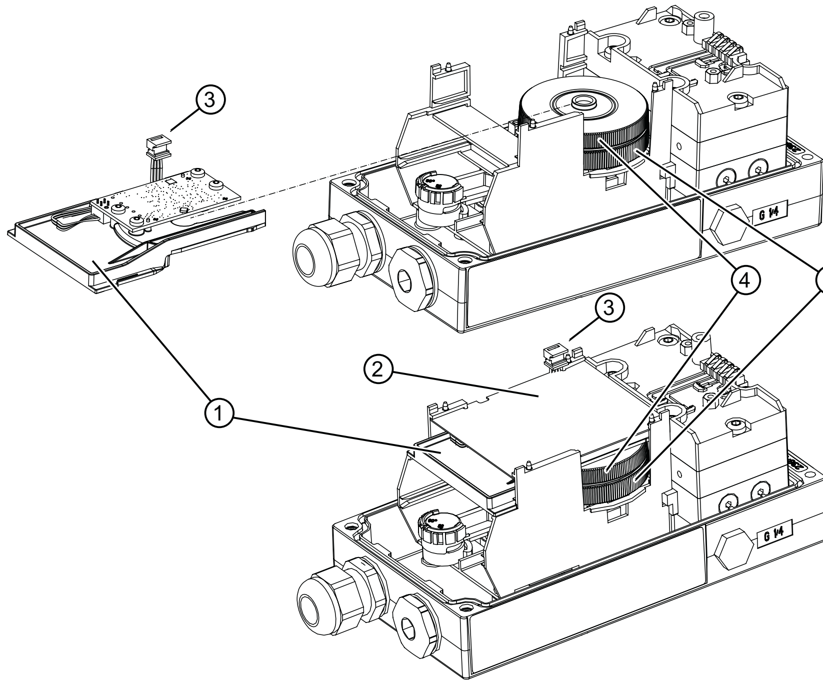
- Move the actuator to and fro while simultaneously holding the actuating disks ④ and ⑤.

4.5.6 Internal NCS module (iNCS) 6DR4004-5L / -5LE

Function

Wear-free, non-contacting position detection

Device features



①	Internal NCS module 6DR4004-5L.	④	Adjustment wheel of the magnet holder
②	Insulating cover, yellow	⑤	Adjustment wheel for the friction clutch (without function)
③	Ribbon cable of the internal NCS module		

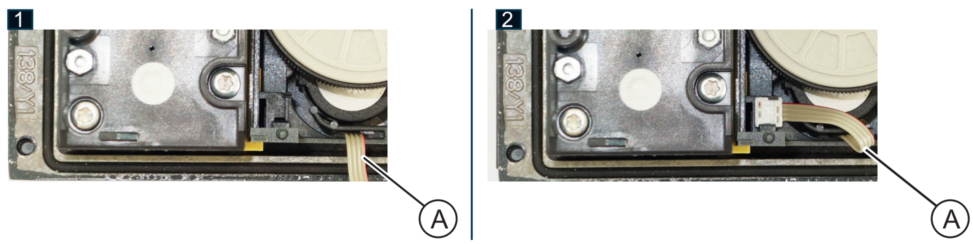
Figure 4-14 Installing the internal NCS module, schematic diagram

Requirement

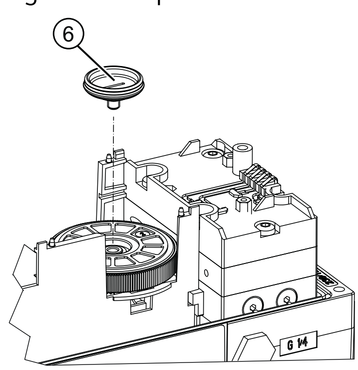
- The slot in the adapter that is needed for the internal NCS module (iNCS) is free. The following option modules use the same slot in the adapter:
  - Digital I/O Module (DIO)
  - Inductive Limit Switches (ILS)
  - Mechanic Limit Switches (MLS)
  - Internal NCS module
- The positioner is mounted, or is to be mounted, directly on the valve using the positioner shaft.

Procedure

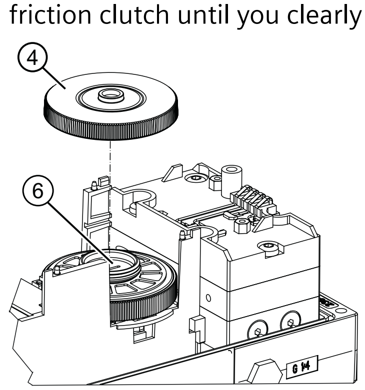
1. Open the positioner as in the description depending on the device version:
   - Opening the standard and intrinsically safe version (Page 42)
   - Opening the device version with "flameproof enclosure" (Page 44)
2. Remove the ribbon cable from the basic electronics.
3. Tighten the two fixing screws of the basic electronics.
4. Remove the basic electronics.
5. Insert the connector of the ribbon cable (A) into the slot as shown below.
   Note: There is no space for the ribbon cable (A) in earlier versions of the positioner. Here you fasten the ribbon cable to the container using a cable tie.



6. Screw the special screw ⑥ into the shaft of the positioner.
7. Tighten the special screw with a **torque of 2 Nm**.



8. Press the adjustment wheel of the magnet holder ④ firmly onto the special screw ⑥ of the friction clutch until you clearly hear it click into place.



Installing the internal NCS module

1. Route the ribbon cable ③ of the internal NCS module ① upwards before you slide the internal NCS module into the adapter.
2. Slide the internal NCS module ① under the basic electronics into the adapter until you hear it click into place.
3. An insulating cover (yellow) is required over the module. This insulating cover is supplied with the module. Place one end of the insulating cover ② under the basic electronics contact surface of the adapter. The recesses of the insulating cover must fit into the corresponding webs of the adapter.
4. To tighten the insulating cover, bend the walls of the adapter slightly outwards.
5. Firmly press the other end until the insulating cover is underneath the contact surface of the basic electronics. The recesses of the insulating cover must fit into the corresponding webs of the adapter.

Installing the basic electronics and closing the positioner

1. Place the basic electronics onto the four holders of the adapter.
2. Tighten the two fixing screws of the basic electronics.
3. Tighten the screws.
4. Insert the ribbon cable connector of the internal NCS module ① onto the positioner basic electronics.
   Note for built-in Analog Output Module (AOM): Reestablish all electrical connections between the basic electronics and the option module.
5. Put on the **supplied module cover**. Make sure that no ribbon cable is pinched.

   Note

   Module cover

   Do **not** use the standard module cover. The provided module cover has a larger recess.

6. Close the positioner as in the description depending on the device version:
   - Closing the standard and and intrinsically safe version (Page 43)
   - Closing the device version with "flameproof enclosure" (Page 47)

Result

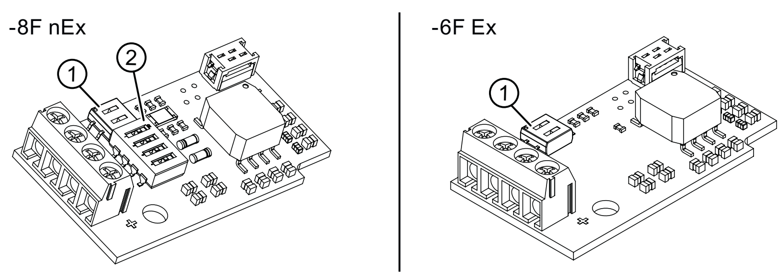
The module is installed and connected to the basic electronics of the positioner. Now configure the module with the parameter "1.YFCT (Page 125)".

4.5.7 Analog Input Module (AIM) 6DR4004-6F / -8F

Function

If you use a Position Transmitter on the positioner, you will need the Analog Input Module (AIM). The Analog Input Module (AIM) forms the interface between Position Transmitter and the basic electronics of the positioner.

Device features



① Switch block 1
② Switch block 2

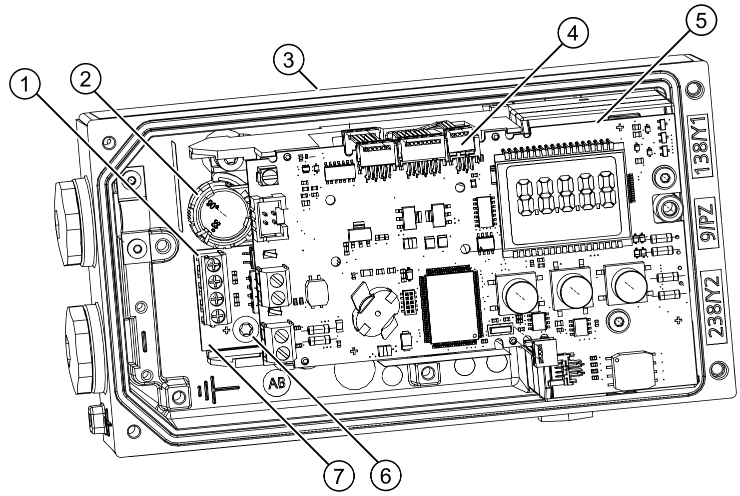
Figure 4-15 Analog Input Module (AIM), schematic representation

- Connection to basic electronics
- Connection terminals for:
  - Position Transmitter (Potentiometer) with 3 kΩ, 5 kΩ or 10 to 20 kΩ
  - Signals 0 to 20 mA
  - Signals 0 to 10 V

Requirement

- You have at least one of the following modules:
  - 6DR4004-8F Analog Input Module (AIM) - nEx
  - 6DR4004-6F Analog Input Module (AIM) - Ex
- You have opened one of the following Position Transmitters:
  - 6DR4004-6N*/-8N* NCS sensor
  - 6DR4004-1ES Position Transmitter (Potentiometer)
  - 6DR4004-2ES Position Transmitter (NCS)
  - 6DR4004-3ES Position Transmitter (NCS, ILS)
  - 6DR4004-4ES Position Transmitter (NCS, MLS)

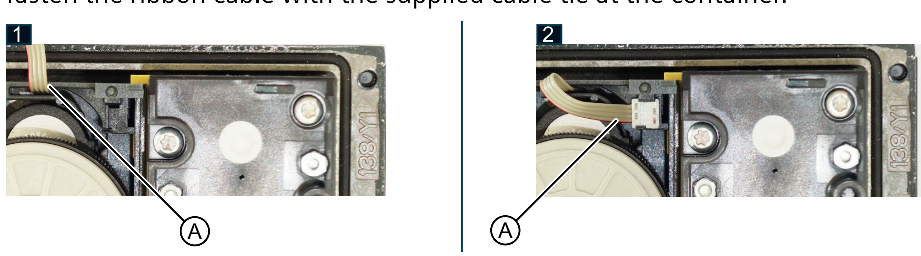
Procedure



① Terminals of the Analog Input Module (AIM)
② Yellow wheel for locking the position detection
③ Positioner
④ Ribbon cable connector of fitted potentiometer or ribbon cable connector of Analog Input Module (AIM)
⑤ Basic electronics
⑥ Screw
⑦ Analog Input Module (AIM) 6DR4004-6F/-8F

Figure 4-16 Installation of Analog Input Module (AIM)

1. Open the positioner as described in Opening the standard and intrinsically safe version (Page 42).
2. Remove the ribbon cable from the basic electronics.
3. Loosen the two fixing screws of the basic electronics ⑤.
4. Remove the basic electronics.
5. Loosen the screw ⑥ in the connection area of the positioner.
6. Insert the connector of the ribbon cable (A) into the slot as shown below.
   Note: There is no space for the ribbon cable (A) in earlier versions of the positioner. Here you fasten the ribbon cable with the supplied cable tie at the container.

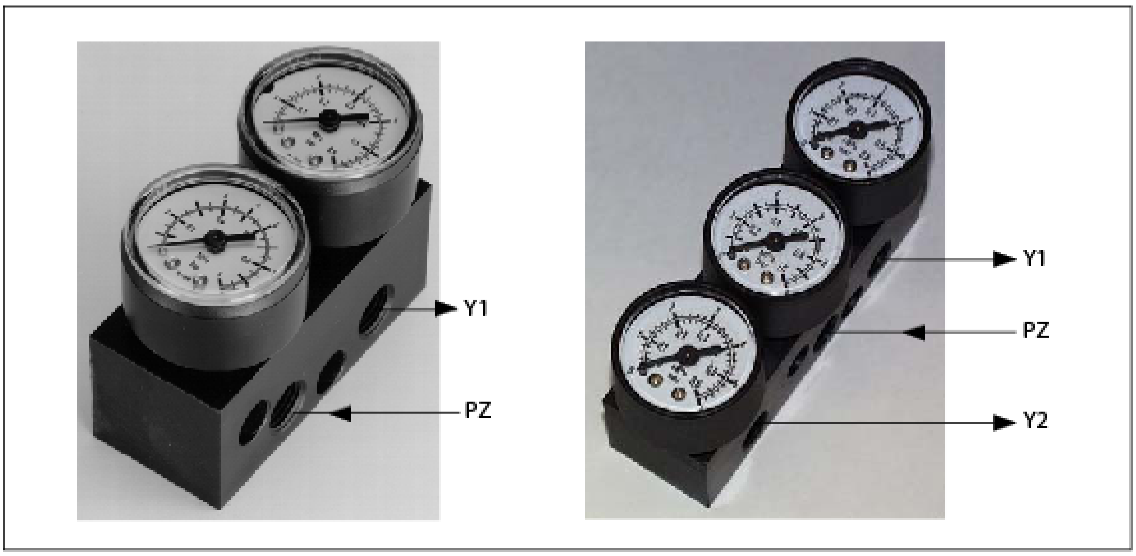


7. Secure the Analog Input Module (AIM) using the screw ⑥.
8. Place the basic electronics ⑤ onto the four holders of the adapter.
9. Screw in the two fixing screws of the basic electronics ⑤.
10. Tighten the screws.

11. Insert the ribbon cable connector ④ of the Analog Input Module (AIM) onto the basic electronics of the positioner.
12. Establish all electrical connections between the basic electronics and the option modules.
13. Close the positioner as described in Closing the standard and and intrinsically safe version (Page 43).

4.5.8 Pressure gauge block

Pressure gauge blocks that are available as accessories are illustrated below. The gauges display measured values for the actuating pressure and supply pressure. The figure to the left shows the pressure gauge block for single-acting actuators. The image to the right shows the pressure gauge block for double-acting actuators.



Y1	Actuating pressure
PZ	Supply pressure
Y2	Actuating pressure

Mounting

The pressure gauge block is fixed onto the lateral pneumatic connection of the positioner using the screws provided. Use the provided O-rings as sealing elements.

5 Connecting

5.1 Basic safety instructions

5.1.1 Lever for position detection

WARNING

Lever for position detection

Danger of crushing and shearing with mounting kits which use a lever for position detection. During commissioning and ongoing operation, severing or squeezing of limbs could occur as a result of the lever. Risk of injury when working on control valves due to the high operating force of the pneumatic actuator.

- Do not reach into the range of motion of the lever following mounting of the positioner and mounting kit.

WARNING

With intrinsically device version (Ex i)

Risk of explosion in hazardous areas.

For intrinsically safe device versions only the certified circuits may be connected as auxiliary power supply, control and signal circuits.

- Make sure that the power source of the used circuits is marked as intrinsically safe.

WARNING

Unsuitable cables, cable glands and/or plugs

Risk of explosion in hazardous areas.

- Use only cable glands/plugs that comply with the requirements for the relevant type of protection.
- Tighten the cable glands in accordance with the torques specified in Technical specifications (Page 227).
- Close unused cable inlets for the electrical connections.
- When replacing cable glands, only use cable glands of the same type.
- After installation, check that the cables are seated firmly.

NOTICE
Condensation in the device Damage to device through formation of condensation if the temperature difference between transportation or storage and the mounting location exceeds 20 °C (36 °F). • Before taking the device into operation, let the device adapt for several hours in the new environment.

NOTICE
Ambient temperature too high Damage to cable sheath. • At an ambient temperature ≥ 60 °C (140 °F), use heat-resistant cables suitable for an ambient temperature at least 20 °C (36 °F) higher.

WARNING
Improper power supply Risk of explosion in hazardous areas as result of incorrect power supply. • Connect the device in accordance with the specified power supply and signal circuits. The relevant specifications can be found in the certificates, in Technical specifications (Page 227) or on the nameplate.

WARNING
Lack of equipotential bonding Risk of explosion through compensating currents or ignition currents through lack of equipotential bonding. • Ensure that the device is potentially equalized. **Exception**: It may be permissible to omit connection of the equipotential bonding for devices with type of protection "Intrinsic safety Ex i".

WARNING
Unprotected cable ends Risk of explosion through unprotected cable ends in hazardous areas. • Protect unused cable ends in accordance with IEC/EN 60079-14.

WARNING

Improper laying of shielded cables

Risk of explosion through compensating currents between hazardous area and the non-hazardous area.

- Shielded cables that cross into hazardous areas should be grounded only at one end.
- If grounding is required at both ends, use an equipotential bonding conductor.

WARNING

Connecting or disconnecting device in energized state

Risk of explosion in hazardous areas.

- Connect or disconnect devices in hazardous areas only in a de-energized state.

Exceptions:

- Devices having the type of protection "Intrinsic safety Ex i" may also be connected in energized state in hazardous areas.

WARNING

Connecting device in energized state

Danger of explosion in hazardous areas.

- Connect devices in hazardous areas only in a de-energized state.

Exceptions:

- Circuits of limited energy may also be connected in the energized state in hazardous areas.
- Exceptions for type of protection "Non-sparking nA" (Zone 2) are regulated in the relevant certificate

WARNING

Incorrect selection of type of protection

Risk of explosion in areas subject to explosion hazard.

This device is approved for several types of protection.

1. Decide in favor of one type of protection.
2. Connect the device in accordance with the selected type of protection.
3. In order to avoid incorrect use at a later point, make the types of protection that are not used permanently unrecognizable on the nameplate.

NOTICE

Standard cable gland/torque

Device damage.

- Owing the reasons pertaining to tightness (IP enclosure rating) and the required tensile strength, only use the cables having a diameter ≥ 8 mm for standard M20x1.5 cable gland, or use a suitable seal insert in case of smaller diameters.
- In the NPT version, the positioner is delivered with a coupling. When inserting a counter piece in the coupling, ensure that the maximum permissible torque of 10 Nm is not exceeded.

CAUTION

Maximum AC/DC switching voltage with UL approval E344532

Mechanic Limit Switches (MLS) 6DR4004-**6K**/-**8K** are approved for use with positioners with UL approval. The maximum switching voltage in this case is ≤ 30 V AC/DC.

If switching voltages greater than 30 V are connected, the UL approval for the positioner becomes invalid.

5.1.2 Improvement of interference immunity

Note

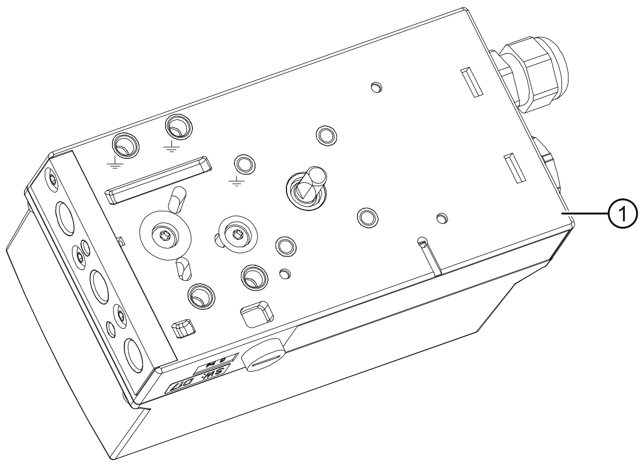
Improvement of interference immunity

- Lay signal cables separate from cables with voltages > 60 V.
- Use cables with twisted wires.
- Keep device and cables at a distance from strong electromagnetic fields.
- Take account of the conditions for communication specified in the Electrical data (Page 234).
- Use shielded cables to guarantee the full specification according to HART/PA/FF/Modbus/EIA-485/Profibus DP.

Electromagnetic compatibility

The polycarbonate enclosure is metalized from inside to increase the electromagnetic compatibility (EMC) with respect to high-frequency radiation. The shield is connected to the threaded bush shown in the following picture such that it is electrically conductive.

Note that this protection is effective only if you connect at least one of these bushes to the earthed control valves through electrically conductive (bare) attachments.



⏚ Shield

Figure 5-1 Base plate ①

5.1.3 Interference immunity

If the bus shield is fully effective, the interference immunity and the interference emission conform to the specifications. The following measures ensure that the bus shield is fully effective:

- The shields have been connected to the metallic connections of the positioner.
- The shields have been laid up to the terminal boxes, the distributor and the transceiver.

Note

Dissipation of glitch impulses/equipotential bonding

In order to dissipate glitch impulses, the positioner must be connected to an equipotential bonding cable (earth potential) using a low resistance. The positioner in the polycarbonate enclosure is therefore equipped with an additional cable. Connect the this cable to the shield of the bus cable and the equipotential bonding cable using a cable clamp.

Devices in the stainless steel or aluminum enclosure have a corresponding terminal on the outer side of the enclosure. This terminal must also be connected to the equipotential bonding cable.

For applications in hazardous areas, ensure an adequately suitable equipotential bonding between the hazardous and non-hazardous areas.

5.1.4 Safety shutdown

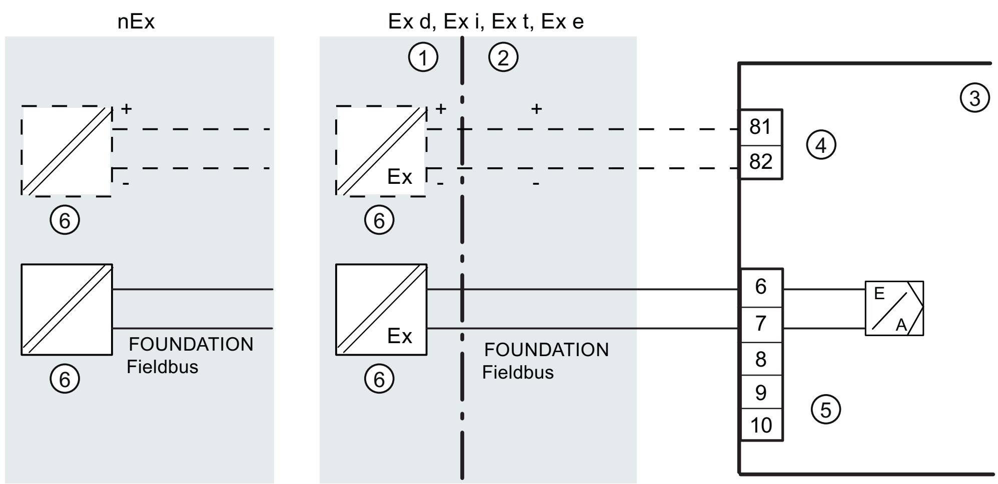
The positioner is equipped with an additional input (terminal 81 [+] and terminal 82 [-]) to approach the safety position. After activating this function, this input must be continuously supplied with +24 V in order to retain the normal control function.

If the 24-V signal is interrupted, the safety position is set as described in chapter "Basic safety instructions for the pneumatic connection (Page 81)".

Communication with the master is still possible. The "Jumper" on the basic electronics is used to activate this function. It can be accessed after removing the module cover, and must be switched from the right position (delivery state) to the left position.

5.2 Electrical wiring

5.2.1 Wiring diagram for basic electronics



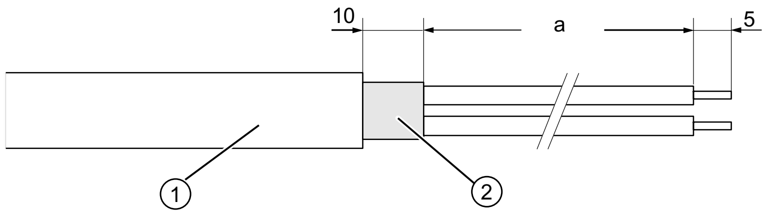
①	Non-hazardous area	④	Input: Safety shutdown
②	Hazardous area	⑤	Simulation enable
③	Basic electronics	⑥	Power source

nEx = Non-explosion-proof device version

Figure 5-2 Device version with FOUNDATION Fieldbus

5.2.2 Bus cable

The following image will help you in preparing the bus cable for the connection:



a 80 mm: Normal version of device
120 mm: Version with flameproof enclosure (6DR5..5)

① Bus cables to be used:
SIMATIC NET, PB FC Process Cable, bus cable for IEC 61158-2

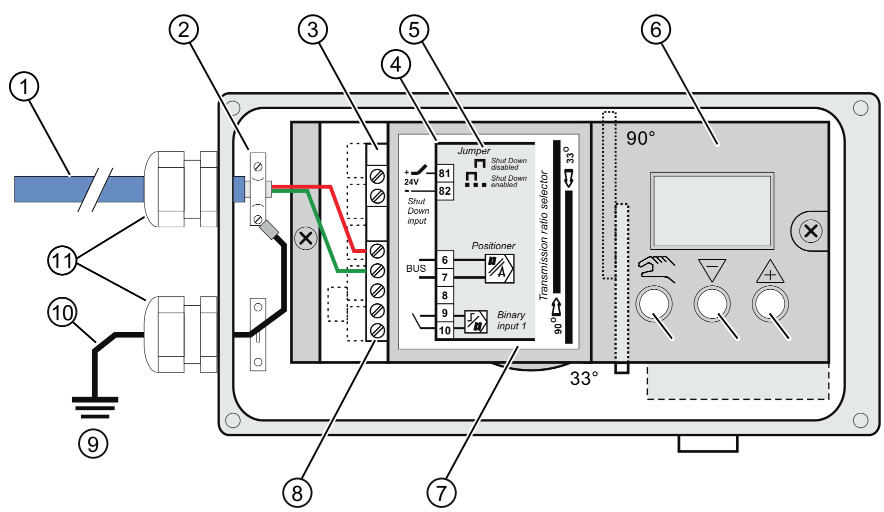
② Cable shield

Figure 5-3 Preparation of bus cable

Devices without flameproof enclosure are:

- Normal version of devices
- Intrinsically safe versions
- Versions for zones 2 and 22

Procedure for device versions without flameproof enclosure



① Bus cable
③ Basic electronics
⑤ Jumper on basic electronics
⑦ Label
⑨ Earth potential
⑪ Cable glands
② Cable clamp
④ Wiring diagram on module cover
⑥ Module cover
⑧ Terminal strip with screw-type terminals
⑩ Grounding cable

Figure 5-4 Connection of bus cable and grounding cable for device version with polycarbonate enclosure

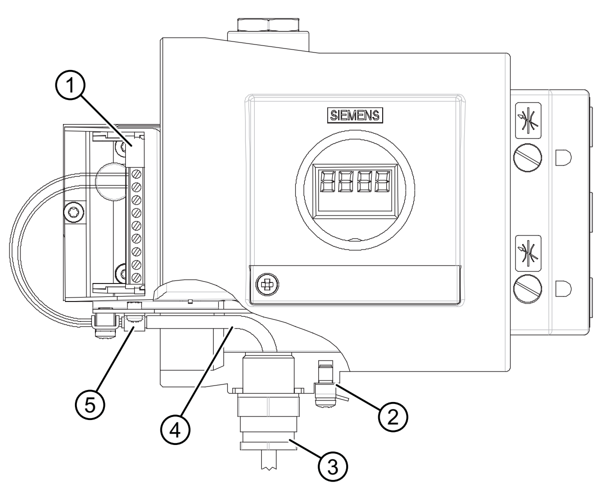
1. Strip the bus cable ①.
2. Open the enclosure of the positioner by unlatching the four cover screws.
3. Insert the prepared bus cable (described in Figure 5-3 Preparation of bus cable (Page 71)) through the cable inlet.
4. Fasten the shield using the clamp ② and the two screws on the enclosure.
5. Tighten the cable inlet.
6. Connect the red and the green wires to terminals 6 and 7 of the basic electronics as shown in the following picture. The polarity does not play any role here.

Note

Bus cable and grounding cable for device version with stainless steel/aluminum enclosure

In the case of the stainless steel or aluminum enclosure, use the grounding terminal provided on the outside of the device.

Procedure for device versions with flameproof enclosure "Ex d"



① Basic electronics bus cable
② Grounding terminal
③ Ex d certified cable inlet
④ Bus cable
⑤ Cable clamp/shield

Figure 5-5 Connection of bus cable for versions with flameproof enclosure

1. Strip the bus cable.
2. Open the safety catch and unscrew the screw cap to open the positioner.
3. Insert the prepared bus cable ④ (described in Figure 5-3 Preparation of bus cable (Page 71)) through the Ex d-certified cable inlet ③. Follow the corresponding guidelines if you are using a conduit piping system.

4. Fasten the shield on the adapter using the clamp ⑤ and the two screws.
5. Tighten the Ex d-certified cable inlet ③.
6. Connect the red and the green wires to terminals 6 and 7 of the basic electronics as shown in the following picture. The polarity does not play any role here.

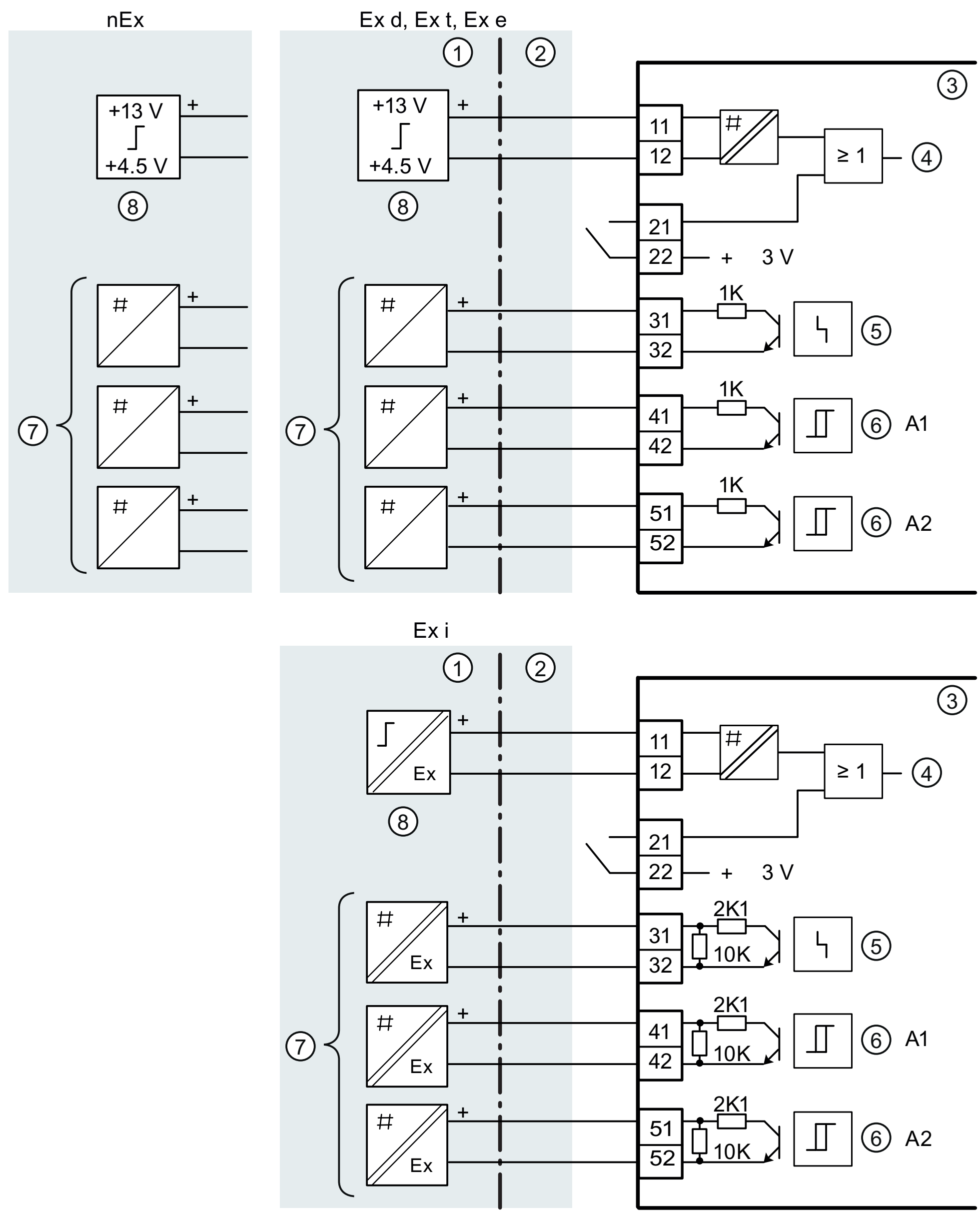
If a bus connection is not present, connect a separate power source with the following values to terminals 6/7:

- With intrinsically-safe devices: intrinsically-safe isolating power supply with 24 V DC
- With non-intrinsically-safe devices: 15 to 30 V DC

Then match the positioner to the respective actuator by configuring and initializing it. Finally set the bus address.

5.2.3 Option modules

5.2.3.1 Digital I/O Module (DIO) 6DR4004-6A / -8A

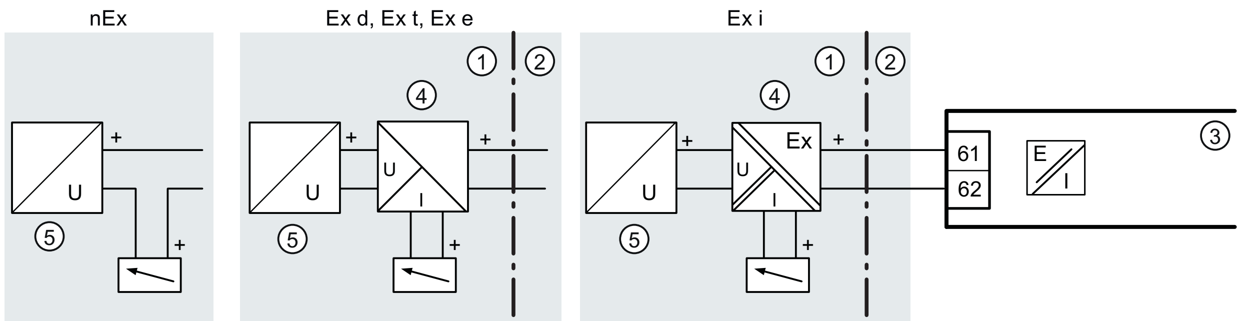


① Non-hazardous area
② Hazardous area
③ Digital I/O Module (DIO)
④ Digital input DI2
⑤ Fault message
⑥ Limit
⑦ Switching amplifier
⑧ Switching output

nEx = Non-explosion-proof device version

Figure 5-6 Digital I/O Module (DIO)

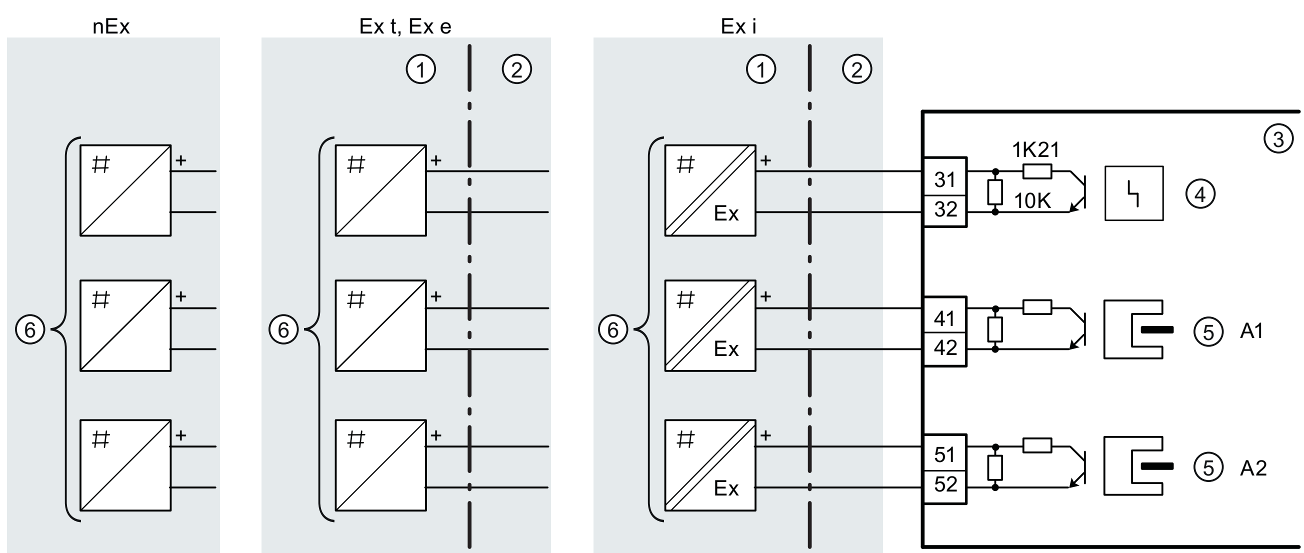
5.2.3.2 Analog Output Module (AOM) 6DR4004-6J / -8J



① Non-hazardous area
② Hazardous area
③ Analog Output Module (AOM)
④ Feed splitter
⑤ Power source
nEx = Non-explosion-proof device version

Figure 5-7 Analog Output Module (AOM)

5.2.3.3 Inductive Limit Switches (ILS) 6DR4004-6G / -8G



① Non-hazardous area
② Hazardous area
③ Inductive Limit Switches (ILS)
④ Fault message, has no function in combination with 6DR4004-3ES
⑤ Limit
⑥ Switching amplifier
nEx = Non-explosion-proof device version

Figure 5-8 Inductive Limit Switches (ILS)

5.2.3.4 Mechanical Limit Switches 6DR4004-6K / -8K

DANGER

Supply with hazardous voltage

If you connect the switching contacts of the 6DR4004-8K module to a hazardous voltage, observe the following safety rules:

1. Isolate the device from power. Use a circuit breaker positioned near the device to do this.
2. Make sure that the device cannot be switched back on inadvertently.
3. Make sure the device is truly isolated from power.

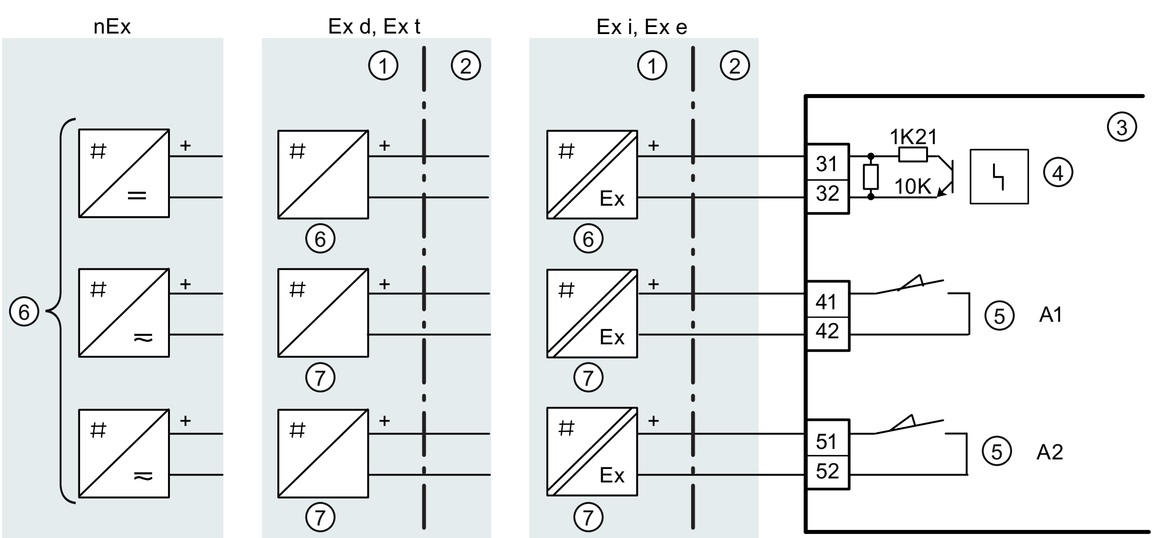
CAUTION

Maximum AC/DC switching voltage with UL approval E344532

Mechanic Limit Switches (MLS) 6DR4004-**6K**/-**8K** are approved for use with positioners with UL approval. The maximum switching voltage in this case is ≤ 30 V AC/DC.

If switching voltages greater than 30 V are connected, the UL approval for the positioner becomes invalid.

Connection diagram Mechanic Limit Switches (MLS) 6DR4004-6K and -8K



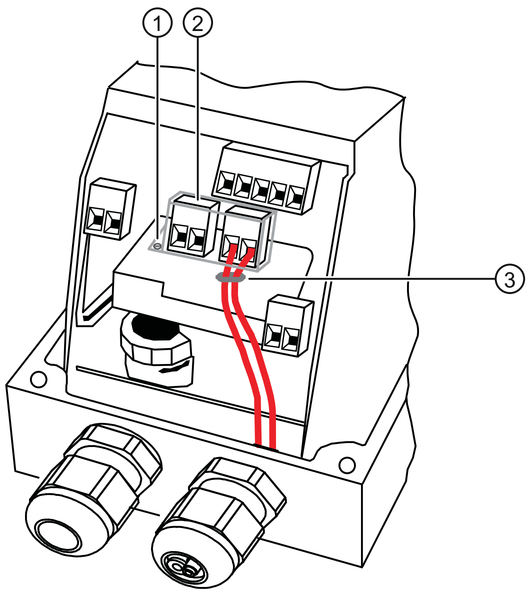
1. Non-hazardous area
2. Hazardous area
3. Mechanic Limit Switches (MLS)
4. Fault message, has no function in combination with 6DR4004-4ES
5. Limit
6. Switching amplifier
7. Switching output

nEx = Non-explosion-proof device version

Figure 5-9 Mechanic Limit Switches (MLS)

Procedure

1. Loosen the screw ① on the transparent cover ②.
2. Pull the transparent cover ② up to the front end stop.
3. Tighten every cable in the corresponding terminal.
4. Slide the transparent cover ② up to the end stop of the basic electronics.
5. Tighten the screw ① of the transparent cover ②.
6. Connect the cables of each switch to the lug of the printed circuit board in pairs. Use the provided cable ties ③ for this purpose.



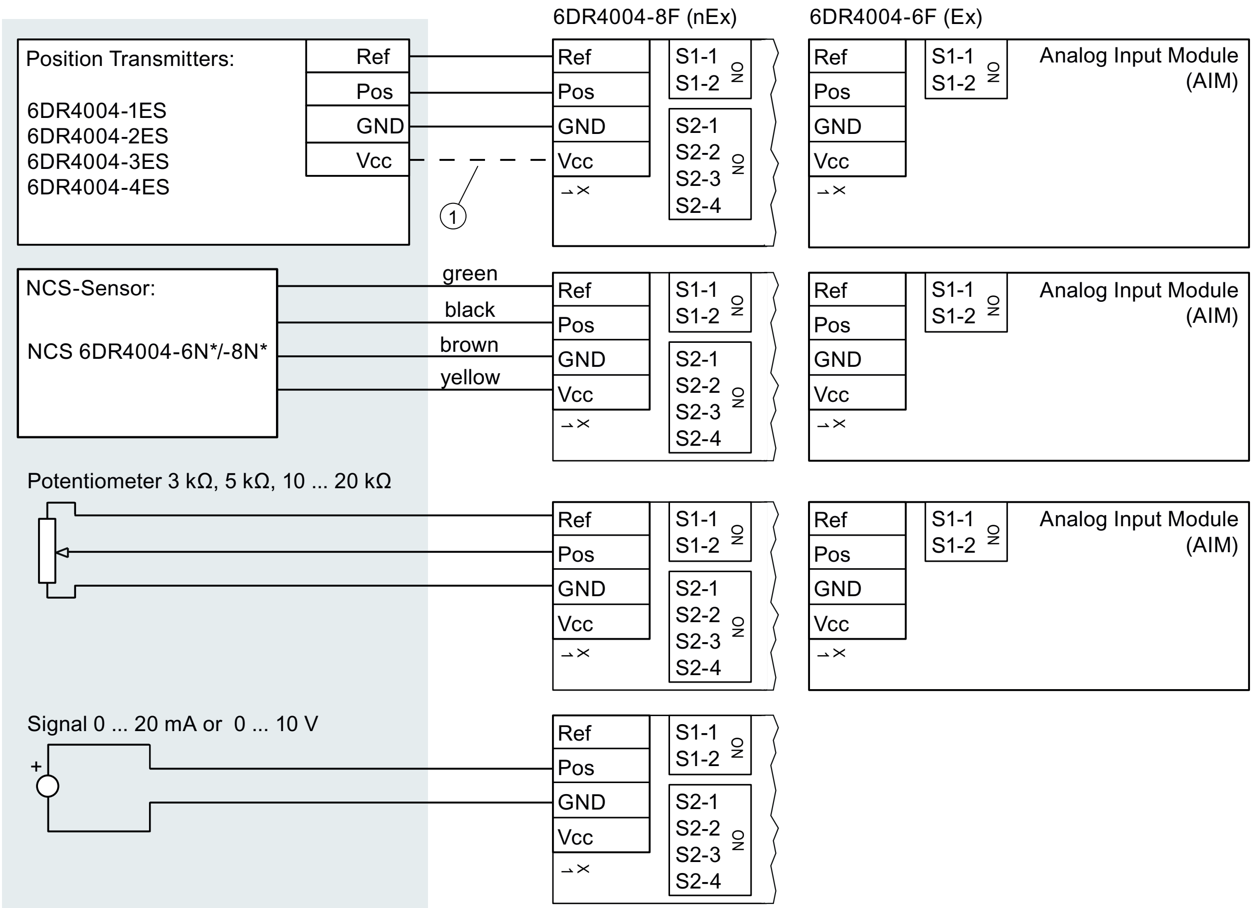
① Screw
② Cover
③ Cable tie

Figure 5-10 Connecting the cables

5.2.3.5 Analog Input Module (AIM) 6DR4004-6F / -8F

Procedure

1. Connect the external position detection as follows.



① Connection of terminal Vcc is only needed for 6DR4004-2ES, -3ES and -4ES.

2. If potentiometers or external signal sources are used, configure the switch blocks in accordance with the following table:

Measuring range	Switch block 1		Switch block 2			
	S1-1	S1-2	S2-1	S2-2	S2-3	S2-4
6DR4004-.N/P/R (NCS)	ON	OFF	ON	OFF	OFF	OFF
6DR4004-1ES/-2ES/-3ES/-4ES	ON	OFF	ON	OFF	OFF	OFF
10 ... 20 kΩ	ON	OFF	ON	OFF	OFF	OFF
5 kΩ	OFF	ON	ON	OFF	OFF	OFF
3 kΩ	OFF	OFF	ON	OFF	OFF	OFF
20 mA	OFF	OFF	ON	OFF	ON	OFF
10 V	OFF	OFF	OFF	ON	OFF	OFF

5.2.4 Optional version M12 device plug

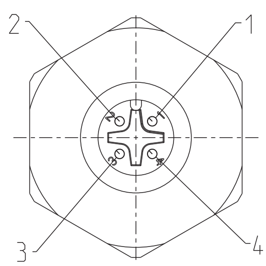
This section describes which terminal of the devices and option modules listed below is connected with the respective pole of the M12 connector.

Note

Technical specifications

Observe the specifications for the electrical data in the certificate and/or in section "Technical specifications (Page 227)".

View of the mating side pole pattern



Pole designation	Wire color of M12 basic connector socket
1	Brown
4	Black
3	Blue
2	White

5.2.4.1 In the basic unit

You have a positioner 6DR56..-0.**R**.. or 6DR56..-0.**S**.. In this case the M12 connector is connected to the bus circuit of the basic electronics.

Table 5-1 Assignment diagram

Bus circuit terminal	Pole designation
7	1 - Brown
Shield support of enclosure	4 - Black
6	3 - Blue

5.2.4.2 M12 Connector in Basic Device with Analog Output Module (AOM) 6DR4004-6J / -8J (-Z D53)

You have a positioner with order suffix -Z order code D53. In this version of the positioner, the current output of Analog Output Module (AOM) is electrically connected to the M12 connector.

Table 5-2 Assignment diagram

Current output terminal	Pole designation
61 (+)	1 - Brown
Shield support of enclosure	4 - Black
62 (-)	3 - Blue

5.2.4.3 In the basic unit with Position Transmitter (-Z D54)

You have a positioner with order suffix -Z order code D54. In this version of the positioner, the installed Analog Input Module (AIM) 6DR4004-6F/-8F is electrically connected to the M12 connector. You connect the Position Transmitter 6DR4004-1ES/-2ES using the M12 connector.

Table 5-3 Assignment diagram

Terminal	Pole designation
REF	2 - White
POS	3 - Blue
GND	4 - Black
VCC	1 - Brown

5.2.4.4 In the basic unit with Digital I/O Module (DIO) 6DR4004-6A / -8A (-Z D55)

You have a positioner with order suffix -Z order code D55. In this version of the positioner, the current output of Digital I/O Module (DIO) is electrically connected to the M12 connector.

Table 5-4 Assignment diagram

Terminal of digital outputs A1 and A2	Pole designation
41 (+)	1 - Brown
52 (-)	4 - Black
42 (-)	3 - Blue
51 (+)	2 - White

5.2.4.5 In the basic unit with Inductive Limit Switches (ILS) 6DR4004-6G /-8G (-Z D56)

You have a positioner with order suffix -Z order code D56. In this version of the positioner, the digital outputs A1 and A2 of the Inductive Limit Switches (ILS) are electrically connected to the M12 device plug.

Table 5-5 Assignment diagram

Terminal of digital outputs A1 and A2	Pole designation
41 (+)	1 - Brown
52 (-)	4 - Black
42 (-)	3 - Blue
51 (+)	2 - White

5.2.4.6 In the basic unit with Mechanic Limit Switches (MLS) 6DR4004-6K (-Z D57)

You have a positioner with order suffix -Z order code D57. In this version of the positioner, the digital outputs A1 and A2 of the Mechanic Limit Switches (MLS) are electrically connected to the M12 connector.

Table 5-6 Assignment diagram

Terminal of digital outputs A1 and A2	Pole designation
41 (+)	1 - Brown
52 (-)	4 - Black
42 (-)	3 - Blue
51 (+)	2 - White

5.3 Pneumatic connection

5.3.1 Basic safety instructions for the pneumatic connection

WARNING

Supply pressure PZ

For safety reasons, the supply pressure PZ can be fed after installation only if the positioner is switched to "P-Manual mode" when an electrical signal is present. This operating mode is preset in the delivery state.

Note

Specifications regarding air quality

Observe the specifications regarding the air quality in section "Technical specifications > Pneumatic data (Page 227)".

Note

Leakage

Besides continuous air consumption, a leakage can cause the positioner to try to compensate the position deviation. This will result in premature wear in the entire control device.

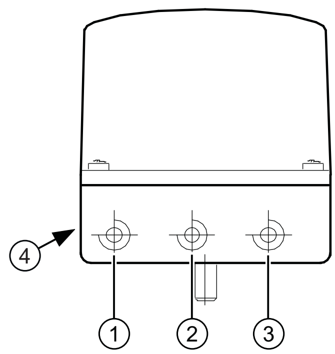
- Check offline for leakage using the "11.LEAK" diagnostic parameter.
- If there is leakage, check the pneumatic connections for leaks.

See also

Changing the operating mode (Page 90)

5.3.2 Pneumatic connection in non-flameproof enclosure

5.3.2.1 Structure of pneumatic connection



① Output: Actuating pressure Y2 *)
② Input: Supply pressure PZ
③ Output: Actuating pressure Y1
④ Exhaust air outlet with sound absorber, thread G¼

*) for double-acting actuators

Figure 5-11 Pneumatic connection, example

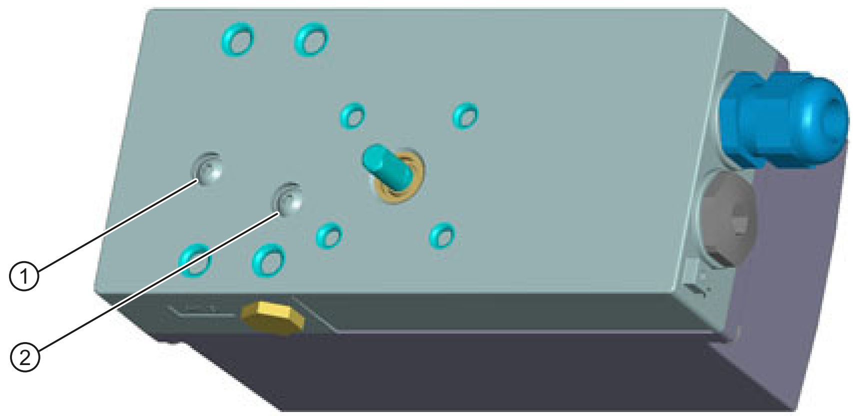
5.3.2.2 Integrated pneumatic connection

The following pneumatic connections are provided at the rear side of the basic device for the integrated attachment for single-acting linear actuators:

- Actuating pressure Y1
- Exhaust air outlet

These connections are sealed with screws when the device is delivered.

The exhaust air outlet is corrosion-resistant for the blanketing of the pick-up room and the spring chamber with dry instrument air.



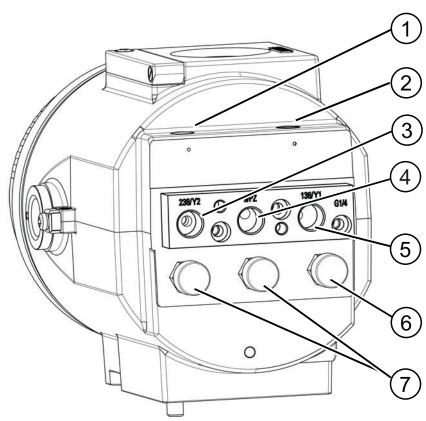
① Actuating pressure Y1
② Exhaust air outlet

Figure 5-12 Integrated pneumatic connection

5.3.3 Pneumatic connection in the flameproof enclosure

Structure

The pneumatic connections are provided on the right side of the positioner.



① Restrictor Y2 *)
② Restrictor Y1
③ Output: Actuating pressure Y2 *)
④ Input: Supply pressure PZ
⑤ Output: Actuating pressure Y1
⑦ Enclosure ventilation (2x)
⑥ Exhaust air outlet

*) for double-acting actuators

Figure 5-13 Pneumatic connection in the flameproof enclosure

5.3.4 Behavior in case of failure of the auxiliary power and/or the supply pressure PZ

Overview

> **CAUTION**
>
> **Note the following before working on the control valve**
>
> Note that, before working on the control valve, you must first move it to the safety position. Make sure that the process valve has reached the safety position. If you only interrupt the supply pressure PZ to the positioner, the safety position can in some cases only be attained after a certain delay period.

The difference between a failure of supply pressure PZ and a failure of electrical auxiliary power:

- Failure of **electrical auxiliary power** means:
  - Failure of the bus voltage
  - Failure or signal <4.5 V at input for the safety shutdown (terminals 82 and 82)
- Failure of the **supply pressure PZ**

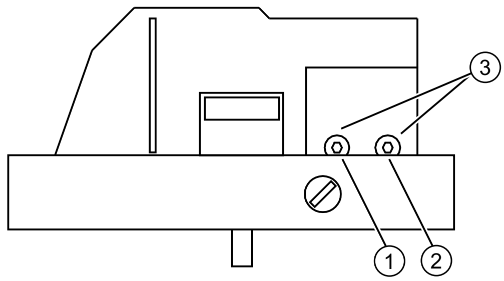
The following table shows the pneumatic connection versions for different actuator types, regulating action and safety position after failure.

Actuator type	Behavior in case of failure: The actuator moves into safety position		Fail in place, order suffix F01	
	Failure of electrical auxiliary power	**Failure of supply pressure PZ**	**Failure of electrical auxiliary power**	**Failure of supply pressure PZ**
Single-acting	Y1 = vented	Y1 = vented	Y1 = closed	Y1 = closed
Double-acting	Y1 = pressurized Y2 = vented	Y1 = closed Y2 = closed	Y1 = closed Y2 = closed	Y1 = closed Y2 = closed

5.4 Restrictors

- Reduce the air output to achieve travel times of T > 1.5 s for small actuators. Use restrictors Y1 ① and Y2 ② for this purpose.
- When turned clockwise, they reduce the air output and finally shut it off.

- In order to set the restrictors, we recommend closing them and then opening slowly.
- In case of double-acting valves, ensure that both restrictors have approximately the same setting.



① Restrictor Y1
② Restrictor Y2, only in the version for double-acting actuators *)
③ Hexagon socket-head screw 2.5 mm

Figure 5-14 Restrictors

*) Restrictor Y2 ② is not active for single-acting Fail in Place F01

Operation

6

6.1 Control elements

6.1.1 Display

Introduction

Note

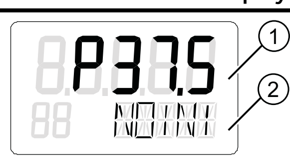
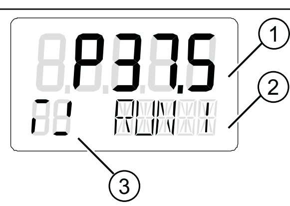
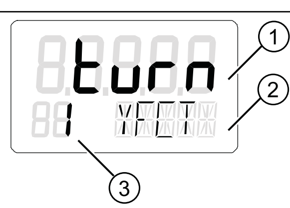
Repetition rate display

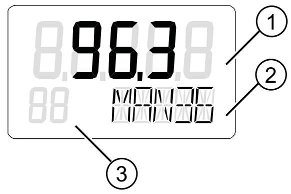
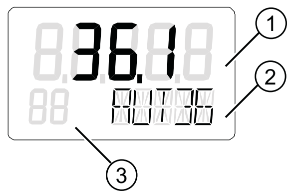
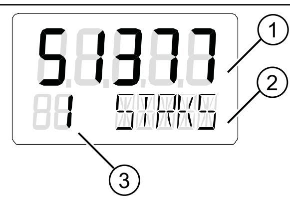
When operated in temperature ranges below -10°C, the liquid crystal display of the positioner becomes sluggish and the repetition rate display reduces considerably.

The display has two lines. These two lines are segmented differently. Each element in the upper line has 7 segments, whereas that in the lower line has 14 segments. Contents of the display depend on the selected mode.

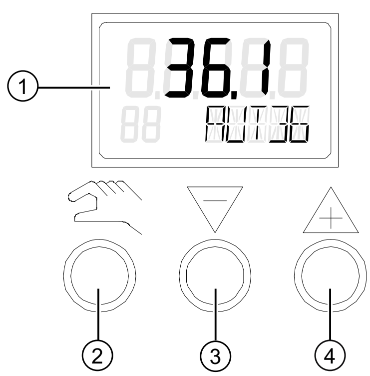
Display options as per the mode

An overview of mode-specific display options is given below.

Operating mode	Representation in the display	Pos.	Legend
P manual mode		①	Potentiometer setting [%]
		②	Blinking indicator for the non-initialized status.
Initialization mode		①	Potentiometer setting [%]
		②	Display of the current status of initialization or a fault message.
		③	Indicator for ongoing initialization or a fault message.
Configuring		①	Parameter value
		②	Parameter name
		③	Parameter number

Operating mode	Representation in the display	Pos.	Legend
Manual mode (MAN)		①	Position [%]
		②	Setpoint [%]
		③	Fault message
Automatic (AUT)		①	Position [%]
		②	Setpoint [%]
		③	Fault message
Diagnostics		①	Diagnostics value
		②	Diagnostics name
		③	Diagnostics number

6.1.2 Buttons



① Display
② Operating mode button
③ Decrement button
④ Increment button

Figure 6-1 Display and buttons of the positioner

- You can use three buttons to operate the positioner.
- The function of the buttons depends on the mode selected.
- In a positioner with a flameproof enclosure, the buttons are protected by a lid. The button lid can be opened after unlatching the locking screw.

Note

Button lid

In positioners with flameproof enclosures, the button lid prevents liquids from seeping through. The IP66 / type 4X degree of protection is not ensured when the enclosure or the button lid is open.

You have to remove the enclosure lid to operate the buttons of the basic device or the "intrinsically safe" version.

Note

Degree of protection

The IP66 / type 4X degree of protection is not ensured as long as the positioner is open.

Function of buttons:

- The button is used to select the modes and to forward the parameters.
- The ▽ button is used to select parameter values in "Configuration" mode. You can use this button to move the actuator in "Manual" mode.
- The △ button is also used to select parameter values in "Configuration" mode. You can use this button to move the actuator in "Manual" mode.

Note

Order

Parameters are activated in the reverse order when the and ▽ buttons are pressed simultaneously.

6.1.3 Firmware version

The current firmware version is displayed when you exit the configuration menu.

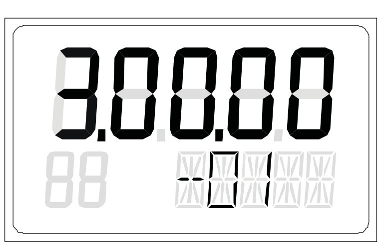


Figure 6-2 Firmware version, e.g. version 3.00.00

6.2 Operating modes

6.2.1 Overview of operating modes

You have five operating modes at your disposal to operate the positioner:

1. P-manual mode (as-delivered condition)
2. Configuration and initialization mode
3. Manual mode (MAN)
4. Automatic (AUT)
5. Diagnostics

6.2.2 Changing the operating mode

The following picture illustrates the available operating modes and switching between the operating modes.

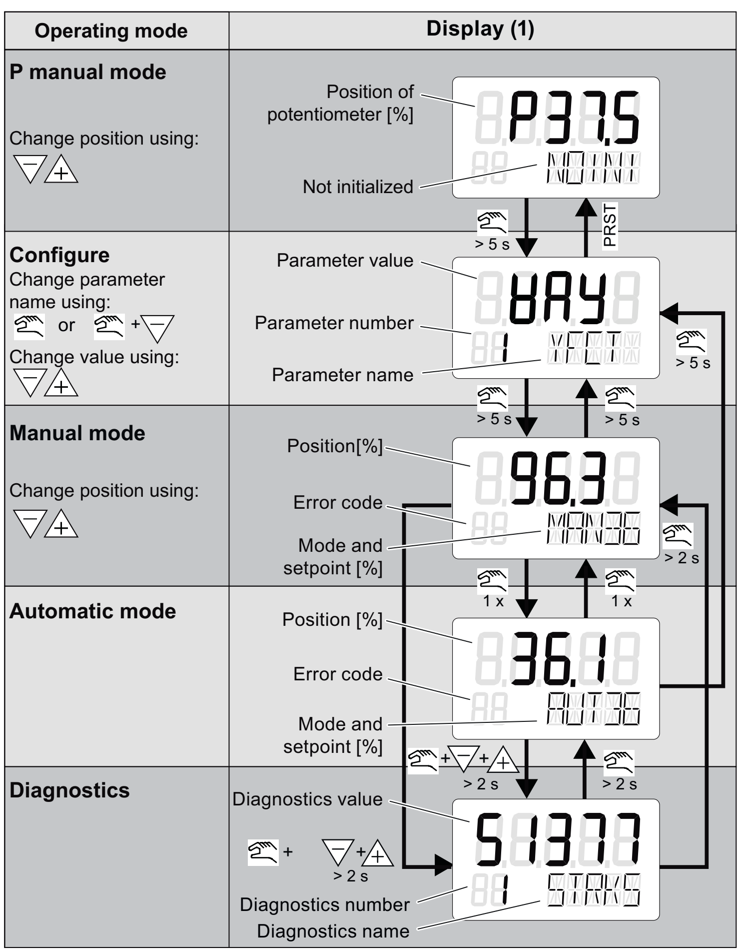


Figure 6-3 Switching between the operating modes

6.2.3 Overview of configuration

The following figure shows the operation of the configuration and initialization modes:

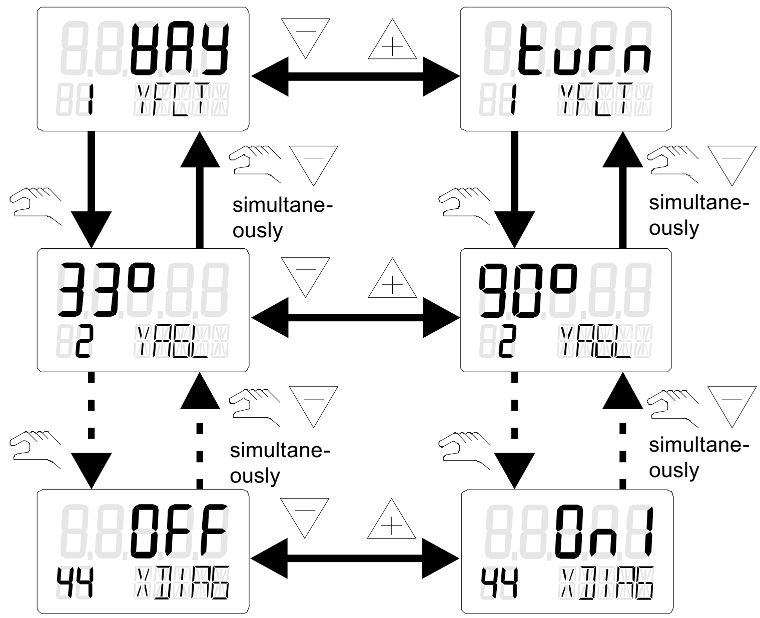


Figure 6-4 Overview of configuration

6.2.4 Description of operating modes

P manual mode

Note

Delivery state

The "P manual mode" is preset for the positioner in the delivery state.

The display of the positioner shows the current potentiometer position in the upper line. "NOINI" flashes in the second line of the display.

Move to the actuator with the ▽ or △ buttons.

Switch to "Configuration" mode to adapt the actuator to the positioner.

Alarms or position feedbacks can be triggered after initializing the positioner completely.

Configuration and initialization

To get to the "Configuration" mode, press the button for at least 5 seconds.

You can use the "Configuration" mode to adjust the positioner individually as per your actuator and start commissioning or initialization.

The positioner reports the "Configuration" mode with a configurable fault message. A position feedback or display of limits A1 and A2 is not possible.

Note

Failure of electrical auxiliary power

If electrical auxiliary power supply fails when configuring, the positioner responds as follows when the power supply is reestablished:

- The positioner switches over to the first parameter.
- Settings of the values already configured are retained.

In order to save the changed parameter values, exit the "Configuration" mode or switch to another parameter. When "Configuration" mode is restarted, the output in the display switches to the last activated parameter.

Manual mode (MAN)

In this mode, you move the actuator with or . The positioner holds the selected position irrespective of the setpoint current or any leakages that have occurred.

Note

Accelerating the actuator movement

Proceed as follows:

1. Keep one of the two direction buttons pressed.
2. Press the remaining direction button simultaneously.

Note

Power supply failure

When the power supply is reestablished after a failure, the positioner switches to "Automatic" mode.

Automatic (AUT)

Automatic is the standard mode. In this mode, the positioner compares the setpoint position with the actual position. The positioner moves the actuator until the control deviation reaches the configurable deadband. If the deadband is not reached, a fault message is output.

Diagnostics

Proceed as follows to call the "Diagnostics" mode from the "Automatic" or "Manual" modes:

Simultaneously press the 3 buttons of the positioner for at least 2 seconds.

Current operating data can be called and displayed in this mode, e.g.:

- Number of total strokes
- Number of changes in direction
- Number of fault messages

Note

Setting the mode

The "Automatic" and "Manual" modes remain set when switching to the "Diagnostics" mode. The positioner responds as per the configured mode:

- The predefined setpoint is used as the control variable in "Automatic" mode.
- The last reached position is retained in "Manual" mode.

6.2.5 Optimization of controller data

Note

Initializing

Initialize the positioner automatically before changing the parameter settings as per your specific requirements.

The positioner determines the data for control quality automatically during the initialization process.

The data determined is optimized for a short transient time in the case of minor overshoots.

The adjustment can be accelerated or the attenuation can be intensified by optimizing the data.

The following special cases are suitable for targeted data optimization:

- Small actuators with travel times < 1 s.
- Operation with boosters, described in section "Booster commissioning (Page 295)"

Procedure

1. Switch to "Diagnostics" mode.
2. Select the diagnostics parameters.
3. Press the three buttons of the positioner at the same time for at least 2 seconds.
4. Activate the setting function. Press the △ or ▽ button for at least 5 seconds.

The modified diagnostics values are effective immediately. The effects on the controller results can then be tested.

In order to optimize the controller data, change the values of the diagnostics parameters listed below.

Diagnostics parameters '23.IMPUP' Impulse length UP / '24.IMPDN' Impulse length DOWN

You can use these diagnostics parameters to determine the smallest impulse lengths for each actuating direction. The actuator is then moved with these lengths. The optimum value depends in particular on the volume of the actuator. Small values lead to small controller increments and frequent activation of the actuator. Large values are advantageous for large actuator volumes.

Note

Controller increments

- There is no movement if the values are too small.
- Large controller increments also lead to large movements with small actuators.

Diagnostics parameters '28.SSUP' Slow step zone UP / '29.SSDN' Slow step zone DOWN

The slow step zone is the area of mean control deviation. For more information on the slow step zone, refer to the section "Diagnostic value '28.SSUP - Slow step zone up' / '29.SSDN - Slow step zone down' (Page 216)".

Select small values to achieve high speeds of shifting even with small control deviations. Select large values to reduce overshoots particularly in case of large changes in the setpoint.

NOTICE

Overshoots or too low speeds of shifting

Too small values can result in overshoots.

- Enter a higher value.

Too large values result in too slow speeds of shifting near the adjusted status.

- Enter a smaller value.

Diagnostics parameters '47.PRUP' Prediction UP / '48.PRDN' Prediction DOWN

These diagnostics parameters act as attenuation factors and are used to set the control dynamics. Changes in the diagnostics values have the following results:

- Small values result in quick adjustments with overshoots.
- Large values result in slow adjustments without overshoots.

Note

Reference variable

It is advantageous to use a fixed reference variable to optimize the control data. Therefore, change the deadband of the controller in the '34.DEBA' parameter from "Auto" to a fixed value.

Commissioning 7

7.1 Basic safety instructions

WARNING

Lever for position detection

Danger of crushing and shearing with mounting kits which use a lever for position detection. During commissioning and ongoing operation, severing or squeezing of limbs could occur as a result of the lever. Risk of injury when working on control valves due to the high operating force of the pneumatic actuator.

- Do not reach into the range of motion of the lever following mounting of the positioner and mounting kit.

WARNING

Improper commissioning in hazardous areas

Device failure or risk of explosion in hazardous areas.

- Do not commission the device until it has been mounted completely and connected in accordance with the information in Technical specifications (Page 227).
- Before commissioning take the effect on other devices in the system into account.

WARNING

Commissioning and operation with pending error

If an error message appears, correct operation in the process is no longer guaranteed.

- Check the gravity of the error.
- Correct the error.
- If the error still exists:
  – Take the device out of operation.
  – Prevent renewed commissioning.

WARNING

Loss of explosion protection

Risk of explosion in hazardous areas if the device is open or not properly closed.

- Close the device as described in Installing/mounting (Page 31).

WARNING

Opening device in energized state

Risk of explosion in hazardous areas

- Only open the device in a de-energized state.
- Check prior to commissioning that the cover, cover locks, and cable inlets are assembled in accordance with the directives.

Exception: Devices having the type of protection "Intrinsic safety Ex i" may also be opened in energized state in hazardous areas.

WARNING

Water in compressed air line

Device damage and possibly loss of type of protection. The factory setting for the purging air selector is "IN". In the "IN" position, water from the compressed air line may enter the device from the pneumatics during initial commissioning.

- Before commissioning, make sure that no water is present in the compressed air line.

If you cannot be sure that there is no water in the compressed air line:

- Set the purging air selector to "OUT". In this way, you prevent water from the compressed air line from penetrating the device.
- Only set the purging air selector to "IN" again when all water has been discharged from the compressed air line.

CAUTION

Increased sound pressure level

Changes to the sound absorber of the positioner or the mounting of pneumatic components or pneumatic options on the positioner can cause a sound pressure with a level of 80 dBA to be exceeded.

- Wear suitable hearing protection to protect yourself against hearing damage.

When operating the positioner with natural gas, you must follow and adhere to the following safety notes:

WARNING

Operation with natural gas

1. Only positioners and option modules which are connected to power supplies with type of protection "Intrinsic safety, protection level [ia]" may be operated with natural gas.
2. Do not operate the positioner with natural gas in closed spaces.
3. Natural gas is continuously blown off, depending on the model. Special care must therefore be taken during maintenance activities near the positioner. Always ensure that the immediate surroundings of the positioner are adequately ventilated.
   The maximum values for ventilation are listed in section "Technical data for natural gas as actuator medium (Page 237)".
4. If you operate the positioner with natural gas, it is not permitted to use Mechanic Limit Switches (MLS).
5. Depressurize the devices operated with natural gas adequately during maintenance activities. Open the cover in an explosion-free atmosphere and depressurize the device for at least two minutes.

Note

Quality of natural gas

Only use natural gas which is clean, dry and free from additives.

7.2 Overview

Note

- During the initialization process, the operating pressure must be at least one bar more than that required to close or open the valve. However, the operating pressure should not be greater than the maximum permissible operating pressure for the actuator.

General information about commissioning

1. After installing the positioner on a pneumatic actuator, you must supply electric and pneumatic auxiliary power to it.
2. The positioner is in the "P manual mode" before initialization. At the same time, "NOINI" blinks in the lower line of the display.
3. Position feedback: You can adjust the range of position detection using the friction clutch if necessary.
4. Adjust the positioner as per the respective actuator with the help of the initialization process and by setting the parameters. If required, use the "PRST" parameter to cancel the adjustment of the positioner on the actuator. The positioner is again in the "P manual mode" after this process.

Types of initialization

You can initialize the positioner as follows:

- Automatic initialization:
  during automatic initialization, the positioner determines the following one after the other:
  – The direction of action
  – The actuator travel and angle of rotation
  – The travel time of the actuator

The positioner also adjusts the control parameters as per the dynamic response of the actuator.

- Manual initialization:
  the actuator travel and the angle of rotation of the actuator are set manually. The remaining parameters are automatically determined. This function is useful for valves which are lined, for example, with PTFE.
- Copying the initialization data when replacing a positioner:
  the initialization data of a positioner can be read and copied into another positioner. A defective device can thus be replaced without interrupting an ongoing process through initialization.

You have to define a few parameters for the positioner before initialization. Owing to the preset values, you cannot adjust further parameters for initialization.

With a suitable parameter assignment of the parameter "BIN1" and enabled digital input "DI1", you protect the configured settings against accidental adjustment.

7.3 Sequence of automatic initialization

7.3.1 Introduction

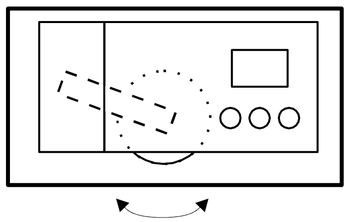
Overview

The automatic initialization takes place in the following phases:

Automatic initialization phase	Description
Start	-
RUN 1	Determination of direction of action.
RUN 2	Check of actuator travel and adjustment of lower and upper endstops.
RUN 3	Determination and display of the travel time (leakage test)
RUN 4	Minimization of controller increments
RUN 5	Optimization of the transient response
RUN 6 with option -Z P02	Recording of the Valve Signature (VS)
End	-

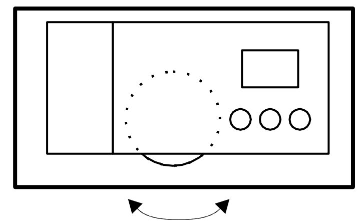
The following structured charts describe the sequence of initialization. The "Up/Down" names indicate the direction of action of actuators.

Linear actuator



Open **Closed**

Part-turn actuator



Closed **Open**

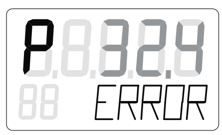
7.3.2 Step 1 – Determination of the actuator type

Part-turn actuator		
turn 1 YFCT	90° 2 YAGL	
Linear actuator		
WAY 1 YFCT	33° 2 YAGL	OFF 3 YWAY
Linear actuator - external linear potentiometer (e.g. with cylinder drives)		
LWAY 1 YFCT	90° 2 YAGL	

7.3.3 Step 2 – Start the automatic initialization.

Strt 4 INITA	Press △ > 5 s. The remaining steps run automatically.

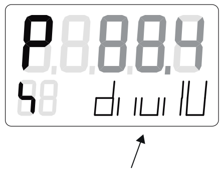
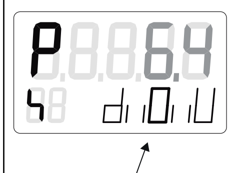
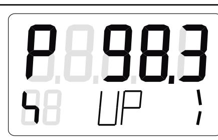
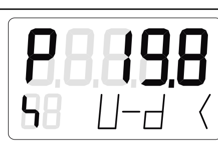
7.3.4 Step 3 – RUN 1: Determination of direction of action

	Possible messages		
	Display	Meaning	Measures
	 	Actuator does not move.	Acknowledge message with: Check restrictor(s) and open them, if necessary. Move the actuator into the working area with: Restart the initialization.

7.3.5 Step 4 – RUN 2: Determination of the travel

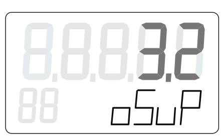
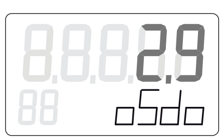
Determination of the travel. Zero point and stroke are adjusted from endstop to endstop.

	Possible messages		
	Display	Meaning	Measures

		The "**Down**" tolerance band is fallen below or exceeded.	Select the gear. Continue with: ⚠ Acknowledge message with: ☞ Check restrictor(s) and open them, if necessary. Move the actuator into the working area with: ▽⚠. Restart the initialization.
			OR: Adjustfriction clutch until the display indicates the following:  Continue with: ⚠ Or, in the case of "WAY", with: ▽
		The friction clutch was adjusted.	For linear actuator: Position the lever perpendicular to the actuator spindle with: ▽⚠ Continue with: ☞
		The "**UP**" tolerance band is exceeded.	Acknowledge message with: ☞ Set the next higher stroke value on the lever. Restart the initialization.
			For part-turn actuator, the following is additionally possible: Adjust the tolerance band with ▽⚠ until the display indicates the following:  Continue with: ☞
		The "UP-Down" span is undershot.	Acknowledge message with: ☞ Set the next lower stroke value on the lever. Restart the initialization.

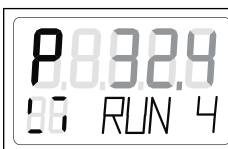
7.3.6 Step 5 – RUN 3: Determination and display of the travel time (leakage test)

<table>
<tr><td rowspan="4"></td><td colspan="2">The travel time is determined and displayed with "down" (dxx.x) and "up" (Uxx.x).
Stop with:</td></tr>
<tr><td>PNEUM</td><td></td></tr>
<tr><td>Std / FIP</td><td>Start leakage measurement with:</td></tr>
<tr><td>booSt</td><td>Display of the overshoot
down (3.2 oSuP), up (2.9 oS-do)</td></tr>
<tr><td rowspan="4"></td><td colspan="3">Possible messages</td></tr>
<tr><td>Display</td><td>Meaning</td><td>Measures</td></tr>
<tr><td>Std / FIP

</td><td>Actuator does not move.
The travel time cannot be changed.</td><td>Acknowledge message with:
Change the travel time using the restrictor screws.
Continue with:</td></tr>
<tr><td>booSt

</td><td>The overshoot is determined.</td><td>Adjust the booster bypass using the adjusting screw on the booster until the display indicates the following:

Continue with:</td></tr>
</table>

7.3.7 Step 6 – RUN 4: Minimization of controller increments

<table>
<tr><td></td><td>The minimum length of the controller increments is determined.</td></tr>
</table>

7.3.8 Step 7 – RUN 5: Optimization of the transient response

7.3.9 Step 8 – End

	Initialization was completed successfully. Travel in mm for linear actuators. Angle of rotation for part-turn actuators.

7.4 Setting the friction clutch

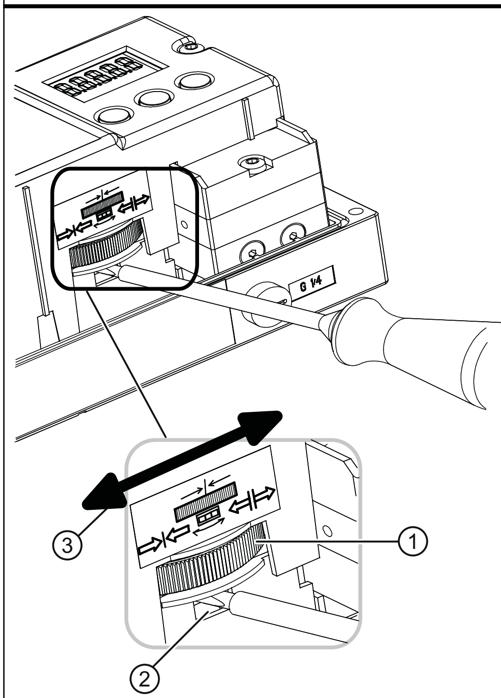
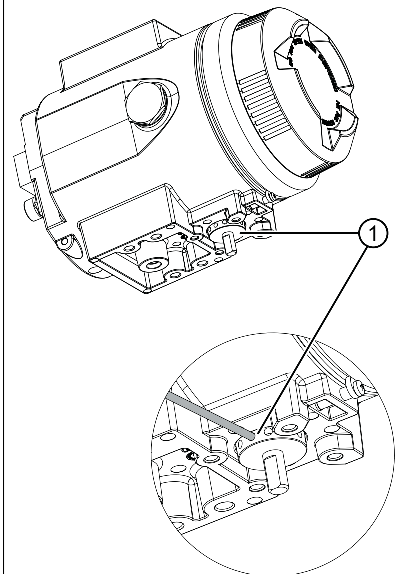
Introduction

It has a friction clutch and a switchable gear (Page 39) so that the positioner can be used with different mechanical part-turn and linear actuators. Use the friction clutch to adjust the position detection area. For positioners in non-flameproof enclosures, you also have the option of locking the friction clutch.

Requirement

- The positioner is mounted.

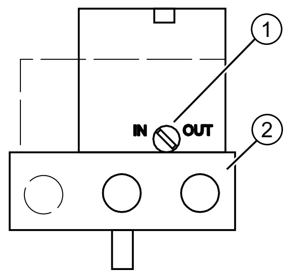
Procedure

In non-flameproof enclosure	In flameproof enclosure Ex d
	
1. Adjust the working area to your application by turning the adjustment wheel of the friction clutch (1). 2. Fasten the friction clutch. Insert a standard approx. 4 mm wide screwdriver in the friction clutch gear latch (2). 3. Use the screwdriver to turn the friction clutch gear latch (2) counterclockwise (3) until it engages. The friction clutch (1) is locked.	1. Adjust the working range by **slightly** turning the adjustment wheel of the friction clutch (1) over the hole with a pin. **CAUTION** Follow the steps below to avoid damage to your device. • The friction clutch (1) is outside the flameproof enclosure at the bottom. • Do **not** loosen the screws on the adjustment wheel of the friction clutch (1) . • Frequent twisting of the friction clutch is not provided for due to the design. • It is not necessary to lock the friction clutch.

7.5 Purge air switching

When the enclosure is open, the purging air selector above the pneumatic manifold on the pneumatic block can be accessed.

- In the IN position, the enclosure is flushed from inside with a small volume of clean and dry instrument air.
- In the OUT position, the purge air is directly directed towards outside.



① Purging air selector
② Pneumatic connections Y1, PZ and Y2

Figure 7-1 Purging air selector on the pneumatic block; view of the pneumatic connection side of the positioner with open lid

The factory setting is the "IN" position.

7.6 Commissioning linear actuators

7.6.1 Preparing linear actuators for commissioning

Requirement

You have already installed the positioner using the suitable mounting kit.

Setting the transmission ratio selector

Note

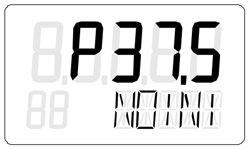
Commissioning

The setting of the transmission ratio selector is extremely important to commission the positioner.

Stroke [mm]	Position of the transmission ratio selector
5 to 20	33°
25 to 35	90°
40 to 130	90°

Connecting the positioner

1. Connect a suitable power supply. The positioner is now in "P manual mode". The current potentiometer voltage (P) in percent is shown in the upper line of the display, e.g.: 'P37.5', and 'NOINI' flashes in the bottom line:

2. Connect the actuator and the positioner to the pneumatic lines.
3. Supply the positioner with supply pressure PZ.

Setting the actuator

1. Check whether the mechanical unit can be moved freely in the entire travel range. Move the actuator to the respective end position for this purpose using the △ or ▽ button.

   Note

   End position

   By simultaneously pressing the △ and ▽ buttons, you reach the end position faster.

   ---

2. Now move the actuator to the horizontal position of the lever.
3. A value between 'P48.0' and 'P52.0' is shown on the display.
4. If a value beyond this value range is shown on the display, you must move the friction clutch. Move the friction clutch until a value between 'P48.0' and 'P52.0' is reached. The closer this value is to 'P50.0', the more accurately the positioner determines the stroke travel.

   Note

   For device versions with flameproof enclosure

   The inner friction clutch is fixed. Therefore, only move the outer friction clutch. This also applies when using an internal NCS module.

   The following applies to device versions without flameproof enclosure with internal NCS module 6DR4004-5L.:

   The inner friction clutch has no function. Therefore, only adjust the adjustment wheel of the magnet holder; see section "Internal NCS module (iNCS) 6DR4004-5L / -5LE (Page 58)".
   Requirement: The '1.YFCT' [VALVE_TYPE] Actuator type (Page 125) parameter is set.

See also

Opening the device version with "flameproof enclosure" (Page 44)

Device components (Page 27)

7.6.2 Automatic initialization of linear actuators

Requirements

The following conditions must be fulfilled before activating the automatic initialization:

1. The actuator spindle can be moved completely.
2. The actuator spindle is at a central position after travel.

Initializing the linear actuator automatically

Note

Interrupting initialization

An ongoing initialization can be interrupted at any time. To do this, press . The settings configured until then are retained.

All parameters are reset to factory settings only if you have explicitly activated the preset settings in the "PRST" parameter.

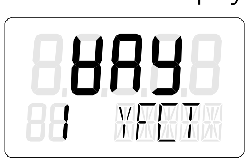
Note

Commissioning of a tight-closing valve

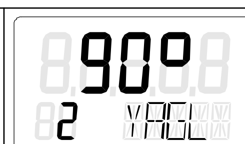
If the valve is tight-closing, set the "YCLS" parameter before commissioning. This ensures that the end positions are approached for at least 15 seconds during initialization.

---

1. Switch to the "Configuration" mode. To do this, keep the button pressed for at least 5 seconds. The display shows the following:

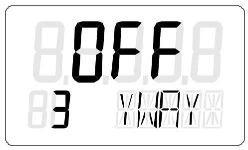


2. Call the "2.YAGL" parameter. To do this, press . The following is shown on the display depending on the setting:

3. Check whether the value displayed in the "2.YAGL" parameter matches the setting of the transmission ratio selector. If required, change the setting of the transmission ratio selector to 33° or 90°.

4. Set the "3.YWAY" parameter to determine the total stroke in mm. The setting of parameter 3 is optional. The display shows the determined total stroke at the end of the initialization phase.
   - Press the button if you do not require any information about the total stroke in mm. You then reach parameter 4.
   - Call the "3.YWAY" parameter. To do this, press . The display shows the following:

   Note

   Set the "3.YWAY" parameter

   1. On the scale of the lever, read the value marked by the carrier pin.
   2. Set the parameter with the buttons △ and ▽ to the read value.

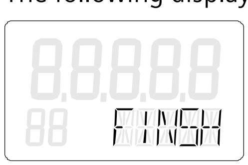
   ---
5. Call the "4.INITA" parameter. To do this, briefly press the button. The display shows the following:

6. Start the initialization process. To do this, keep the △ button pressed for at least 5 seconds until the display shows the following:

   The positioner runs through several initialization steps during the automatic initialization process. The lower line of the display indicates which initialization step is currently being run through. The initialization process depends on the actuator used, and takes up to 15 minutes.
7. The following display indicates that the initialization is complete:

7.6.3 Manual initialization of linear actuators

You can use this function to initialize the positioner without needing to move the actuator to the lower and upper endstops. The lower and upper endstops of the actuator travel are set manually. When the control parameters are optimized, the further initialization process runs automatically.

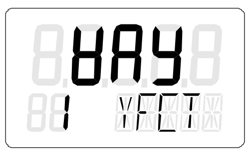
Conditions

The following conditions must be fulfilled before activating manual initialization:

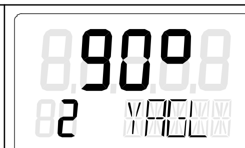
1. The positioner has been prepared for using on linear actuators.
2. The actuator spindle can be moved completely.
3. The displayed potentiometer position is within the permissible range between "P5.0" and "P95.0".

Initializing the linear actuator automatically

1. Switch to the "Configuration" mode. To do this, press the button for at least 5 seconds until the display shows the following:



2. Call the "2.YAGL" parameter. To do this, briefly press the button. The following is shown on the display depending on the setting:

3. Check whether the value displayed of the "2.YAGL" parameter matches with the setting of the transmission ratio selector. If required, change the setting of the transmission ratio selector to 33° or 90°.
4. Set the "3.YWAY" parameter to determine the total stroke in mm. The setting of the "3.YWAY" parameter is optional. The display shows the determined total stroke only at the end of the initialization phase.
   – Briefly press the button if you do not require any information about the total stroke in mm. You are then directed to parameter 4.
   – Call the "3.YWAY" parameter. To do this, briefly press the button. The display shows the following:

Note

Set the "3.YWAY" parameter

To set the "3.YWAY" parameter proceed as follows:

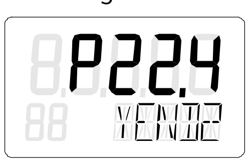
1. On the scale of the lever, read the value marked by the carrier pin.
2. Set the parameter to the read value with the △ or ▽ button.

5. Call the "5.INITM" parameter. To do this, press the button twice. The display shows the following:

6. Start the initialization process. To do this, press the button for at least 5 seconds until the display shows the following:

The current potentiometer position is output on the display after 5 seconds. Examples of the displayed potentiometer positions are given below:

7. Determine the lower endstop of the actuator spindle.
8. Move the actuator to the desired position using the or button.
9. Press the button. The current position of the actuator is applied. The display shows the following:



Note

Fault message "RANGE"

The selected end position is beyond the permissible measuring range if the "RANGE" message is output on the display. Correct the settings as follows:

1. Move the friction clutch until the display shows "OK".
2. Press the button.
3. Move the actuator to another position using the or button.
4. Abort the manual initialization process by pressing the button.
5. Then return to "P manual mode".
6. Correct the actuator travel and the position detection.

---

10. Determine the upper endstop of the actuator spindle. Move the actuator to the desired position using the or button.

11. Press the button. The current position of the actuator is applied.

Note

Fault message "Set Middl"

The lever arm is not in the horizontal position if the "Set Middl" message is output on the display. To correct the fault, set the reference point of the sine correction. Proceed as follows:

1. Move the lever arm to the horizontal position using the or button.
2. Press the button.

---

12. The initialization process is automatically resumed. Initialization steps "RUN 1" to "RUN 5" are output in the bottom line of the display. The following is displayed when the initialization has been completed successfully:

Note

Total stroke

If the "3.YWAY" parameter has been set, the display shows the total stroke in mm.

7.7 Commissioning part-turn actuators

7.7.1 Preparing part-turn actuators for commissioning

Note

Setting of the adjustment angle

The usual adjustment angle for part-turn actuators is 90°.

- Set the transmission ratio selector in the positioner to 90°.

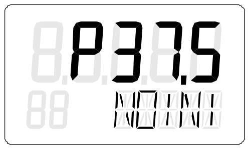
Condition

The following conditions must be fulfilled before activating the initialization:

1. You have installed the positioner for the part-turn actuators using the suitable mounting kit.
2. You have connected the actuator and the positioner to the pneumatic lines.
3. Supplying the positioner with the supply pressure PZ.
4. The positioner has been connected to a suitable power supply.

Setting the actuator

1. The positioner is in the "P manual mode". The current potentiometer voltage P in percent is shown on the upper line in the display. "NOINI" blinks in the lower line of the display. Examples of corresponding displays are given below:



2. Check whether the mechanical unit can be moved freely in the entire travel range. Move the drive to the respective end position for this purpose using the or button.

Note

End position

By simultaneously pressing the and buttons, you reach the end position faster.

3. After checking, move the actuator to a central position. This accelerates the initialization process.

7.7.2 Automatic initialization of part-turn actuators

Requirement

The following conditions must be fulfilled before activating the automatic initialization:

1. The travel range of the actuator can be passed through completely.
2. The actuator shaft is at a central position.

Initializing the part-turn actuator automatically

Note

Interrupting initialization

An ongoing initialization can be interrupted at any time. To do this, press . The settings configured until then are retained.

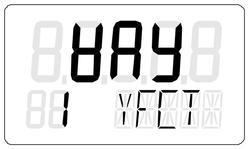
All parameters are reset to factory settings only if you have explicitly activated the preset settings in the "PRST" parameter.

Note

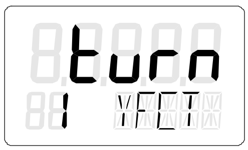
Commissioning of a tight-closing valve

If the valve is tight-closing, set the "YCLS" parameter before commissioning. This ensures that the end positions are approached for at least 15 seconds during initialization.

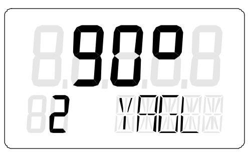
1. Switch to the "Configuration" mode. To do this, press the button for at least 5 seconds until the display shows the following:



2. Use the ▽ button to change from linear actuator to part-turn actuator until the display shows the following:



3. Call the "2.YAGL" parameter. To do this, briefly press the button. This parameter has already been set to 90° automatically. The display shows the following:



4. Call the "4.INITA" parameter. To do this, briefly press the button. The display shows the following:

5. Start the initialization process. To do this, press the △ button for at least 5 seconds until the display shows the following:

   The positioner runs through several initialization steps during the automatic initialization process. The lower line of the display indicates which initialization step is currently being run through. The initialization process depends on the actuator used, and takes up to 15 minutes.

6. The following display indicates that the initialization is complete. The total angle of rotation of the actuator is shown in the upper line of the display.

7.7.3 Manual initialization of part-turn actuators

You can use this function to initialize the positioner without needing to move the actuator to the lower and upper endstops. The lower and upper endstops of the actuator travel are set manually. When the control parameters are optimized, the further initialization process runs automatically.

Conditions

The following conditions must be fulfilled before activating manual initialization:

1. The positioner has been prepared for using on part-turn actuators.
2. The actuator can be moved completely.
3. The displayed potentiometer position is within the permissible range between "P5.0" and "P95.0".

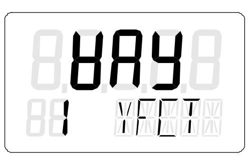
Note

Setting of the adjustment angle

The usual adjustment angle for part-turn actuators is 90°. Accordingly set the transmission ratio selector in the positioner to 90°.

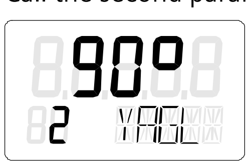
Initializing the positioner manually

1. Switch to the "Configuration" mode. To do this, press the button for at least 5 seconds until the display shows the following:

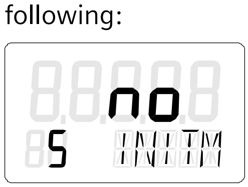


2. Set the "YFCT" parameter to "turn". To do this, press ▽. The display shows the following:

3. Call the second parameter "YAGL". To do this, press . The display shows the following:



4. Call the "INITM" parameter. To do this, press the button twice. The display shows the following:



5. Start the initialization process. Press the button for at least 5 seconds until the display shows the following:

6. The current potentiometer position is output on the display after 5 seconds:

7. Determine the lower endstop of the actuator.
8. Move the actuator to the desired position using the or button.
9. Press the button. The current position of the actuator is applied. The display shows the following:

Note

Fault message "RANGE"

The selected end position is beyond the permissible measuring range if the "RANGE" message is output on the display. Correct the settings as follows:

1. Move the friction clutch until the display shows "OK".
2. Press the button.
3. Move the actuator to another position using the or button.
4. Abort the manual initialization process by pressing the button.
5. Then return to "P manual mode".
6. Correct the actuator travel and the position detection.

---

10. Determine the upper endstop of the actuator. Move the actuator to the desired position using the or button.
11. Press the button. The current position of the actuator is applied.
12. The initialization process is automatically resumed. Initialization steps "RUN 1" to "RUN 5" are output in the bottom line of the display. The following display indicates that the initialization has been completed successfully:

7.8 Canceling initialization

1. Press the button.
   - Canceling automatic initialization: the display shows "INITA".
   - Canceling manual initialization: the display shows "INITM".

   The positioner is in the "Configuration" mode.
2. Exit the "Configuration" mode. To do this, press the button for at least 5 seconds.
   The software version is displayed.
   After releasing the button, the positioner is in "P manual mode". The positioner is not initialized.

7.9 Device replacement

Introduction

Note

Initialization

The positioner can be replaced without having to interrupt the ongoing process. However, copying and transferring of the initialization parameters only allows an approximate adjustment of the positioner to your actuator. Following initialization, the positioner initially works with the manually defined parameters.

- For this reason, an automatic or manual initialization should be carried out as soon as possible.

Note

Deferred initialization

Initialize the new positioner as soon as possible. The following properties can be ensured only after initializing:

- Optimum adjustment of the positioner as per the mechanical and dynamic properties of the actuator
- Non-deviating position of endstops
- Correctness of the maintenance data

There are two ways of replacing a positioner when the equipment is in operation, without having to interrupt the process. The two options depend on whether your positioner has communication.

First possibility - with communication

1. Read the initialization parameters from the previous positioner. Use a suitable engineering system and the associated Electronic Device Description (EDD) for this.
2. Transfer the initialization parameters read in the parameterization software under Point 1 into the new positioner.

3. Fix the actuator at its current position mechanically or pneumatically. Use the locking function of your mounting kit, if available.
4. Determine the actual position value. To do this, read the actual position value from the display of the previous positioner. Note down the read value.
5. Dismount the previous positioner from the actuator.
6. Attach the lever arm of the previous positioner to the new positioner.
7. Mount the new positioner on the actuator.
8. Set the transmission ratio selector of the new positioner to the same position as that of the previous positioner.
9. If the displayed actual position value differs from the noted value, correct the deviation by moving the friction clutch.
10. The new positioner is ready for operation when the displayed and noted values match.
11. Release the fixing of the actuator.

Second possibility - without communication

1. Fix the actuator at its current position mechanically or pneumatically. Use the locking function of your mounting kit, if available.
2. Determine the actual position value of the actuator. To do this, read the actual position value on the display of the previous positioner. Note down the read value.

Note

Electronics defect

If the positioner's electronics are defective, measure the actual position value with a ruler or protractor at the actuator or process valve. Convert the read value into %. Note down the converted value.

3. Dismount the previous positioner from the actuator.
4. Attach the lever arm of the previous positioner to the new positioner.
5. To prevent interference with the ongoing process, initialize the new positioner on an actuator with a similar stroke or swivel range. Attach the new positioner to this actuator. Initialize the new positioner.
6. Then dismount the new, initialized positioner from this actuator.
7. Mount the new, initialized positioner on the fixed actuator.
8. If the displayed actual position value differs from the noted value, correct the deviation by moving the friction clutch.
9. Use the buttons on the positioner to enter the parameters which deviate from the factory setting, such as type of actuator or tight closing.
10. Change to the measured value view using the button, see section "Description of operating modes (Page 91)".
11. Release the fixing of the actuator.

Parameter assignment 8

8.1 Introduction to parameter assignment section

A positioner is responsible for controlling a valve and for monitoring the status of a valve. The parameters described in this section are used to optimally adapt the positioner to the valve and its application.

The parameters are divided into initialization parameters, application parameters and diagnostic parameters.

- **"1.YFCT" to "5.INITM" – Initialization parameters** (Page 125)
  You use these parameters to start the automatically running initialization and adapt the positioner to the actuator. The actuator is ready for operation.
- **"6.SCUR" to "49.XDIAG" - application parameter** (Page 129)
  You use these parameters to adapt the positioner to the valve application. The following additional functions are available:
  - Setpoint preparation
  - Actual value preparation
  - Digital signals
  - Tight closing function
  - Limit detection
- **"A.PST" to "P.PAVG" - diagnostic parameter** (Page 145)
  You use these parameters to set the diagnostic functions of the positioner. These include leakage monitor as well as the Partial Stroke Test. Following activation of these functions, the positioner continuously monitors the status of the valve. If you enter thresholds in the parameters of the diagnostics functions, the positioner actively signals high or low violation of these thresholds. The current monitoring state for these thresholds is displayed as a diagnostic value. For additional details on diagnostics and diagnostic values, refer to the section Diagnostics (Page 205).

Note

Display

Diagnostic parameters and their sub-parameters are only displayed if setting "On1", "On2" or "On3" has been activated in parameter "XDIAG". The content of the diagnostic parameter is displayed if the diagnostic parameter has been activated with "On".

The positioners with an FF communication interface in combination with a host system, e.g. SIMATIC PDM, offer the following advantages:

- Offline tests such as Full Stroke Test (FST), Step Response Test (SRT), Multi Step Response Test (MSRT) and Valve Performance Test (VPT)
- Diagnostics cockpit, which provides an overview of the state of positioner and valve

- Logbook with time stamp for documentation of all events, such as violation of thresholds
- Wizards that guide you through the relevant parameters during commissioning, the Partial Stroke Test and the offline tests

8.2 Parameter overview

Factory-set parameter values are printed in **bold** in the following table.

Parameter	Function	Parameter values		Unit
1.YFCT	Type of actuator	Normal	Inverted	
	Part-turn actuator	turn	-turn	
	Linear actuator	**WAY**	-WAY	
	Linear actuator - carrier pin on actuator spindle	FWAY	-FWAY	
	Linear actuator - external linear potentiometer (e.g. with cylinder drives)	LWAY	-LWAY	
	Part-turn actuator with NCS/iNCS	ncSt	-ncSt	
	Linear actuator with NCS	ncSL	-ncSL	
	Linear actuator with NCS/iNCS and lever	ncSLL	-ncLL	
2.YAGL	Rated angle of rotation of positioner shaft [1]			
		33°		Degrees
		90°		
3.YWAY [2]	Range of stroke (optional setting) [3]			
		OFF		mm
		5 | 10 | 15 | 20 (Short lever 33°, range of stroke 5 to 20 mm)		
		25 | 30 | 35 (Short lever 90°, range of stroke 25 to 35 mm)		
		40 | 50 | 60 | 70 | 90 | 110 | 130 (Long lever 90°, range of stroke 40 to 130 mm)		
4.INITA	Initialization (automatic)	**NOINI** | no / ###.# | Strt		
5.INITM	Initialization (manual)	**NOINI** | no / ###.# | Strt		
6.SDIR	Setpoint direction			
	Rising	**riSE**		
	Falling	FALL		
7.TSUP	Setpoint ramp up	Auto / **0** ... 400		s
8.TSDO	Setpoint ramp down	0 ... 400		s

Parameter	Function		Parameter values	Unit
9.SFCT	Setpoint function			
	Linear		**Lin**	
	Equal percentage	1 : 25	1 - 25	
		1 : 33	1 - 33	
		1 : 50	1 - 50	
	Inverse equal percentage	25 : 1	n1 - 25	
		33 : 1	n1 - 33	
		50 : 1	n1 - 50	
	Freely adjustable		FrEE	
10.SL0 ... 30.SL20 [4)]	Setpoint turning point at			
10.SL0	0 %		0.0 ... 100.0	%
11.SL1	5 %			
29.SL19	95 %			
30.SL20	100 %			
31.DEBA	Deadband of closed-loop controller		**Auto** / 0.1 ... 10.0	%
32.YA	Start of the manipulated variable limit		**0.0** ... 100.0	%
33.YE	End of the manipulated variable limit		0.0 ... **100.0**	%
34.YNRM	Standardization of manipulated variable			
	To mechanical travel		**MPOS**	
	To flow		FLoW	
35.YDIR	Direction of action of manipulated variable for display and position feedback			
	Rising		**riSE**	
	Falling		FALL	
36.YCLS	Tight closing / fast closing with manipulated variable			
	None		**no**	
	Tight closing Up		uP	
	Tight closing Down		do	
	Tight closing Up and Down		up do	
	Fast closing Up		Fu	
	Fast closing Down		Fd	
	Fast closing Up and Down		Fu Fd	
	Tight closing Up and fast closing Down		uP Fd	
	Fast closing Up and tight closing Down		Fu do	
37.YCDO	Value for tight closing/fast closing Down		**0.0** ... 100.0	%
38.YCUP	Value for tight closing / fast closing Up		0.0 ... **100.0**	%

Parameter	Function	Parameter values		Unit
39.BIN1 5)	Function digital input DI1	NO contact	NC contact	
	None	OFF		
	Message only	on	-on	
	Block configuration	bloc1		
	Block configuring and manual operation	bloc2		
	Move process valve to position YE	uP	-uP	
	Move process valve to position YA	doWn	-doWn	
	Block movement	StoP	-StoP	
	Partial Stroke Test	PST	-PST	
	Simulation	**SiM**		
40.BIN2 5)	Function digital input DI2	NO contact	NC contact	
	None	**OFF**		
	Message only	on	-on	
	Move process valve to position YE	uP	-uP	
	Move process valve to position YA	doWn	-doWn	
	Block movement	StoP	-StoP	
	Partial Stroke Test	PSt	-PSt	
41.AFCT 6)	Alarm function	Normal	Inverted	
	None	**OFF**		
	A1 = Min, A2 = Max	Mi MA	n̄i n̄A	
	A1 = Min, A2 = Min	Mi Mi	n̄i n̄i	
	A1 = Max, A2 = Max	MA MA	n̄A n̄A	
42.A1	Response threshold, alarm 1	0.0 ... **10.0** ... 100 %		%
43.A2	Response threshold, alarm 2	0.0 ... **90.0** ... 100 %		%
44.ϟFCT 6)	Function of fault message output	Normal	Inverted	
	Fault	ϟ	-ϟ	
	Fault + not automatic 7)	ϟnA	-ϟnA	
	Fault + not automatic + DI 7)	ϟnAb	-ϟnAb	
45. ϟTIM	Monitoring time for setting of fault message "Control deviation"	**Auto** / 0 ... 100		
46. ϟLIM	Response threshold for fault message 'Control deviation'	**Auto** / 0 ... 100		
47.PRST	Preset			
	Reset all parameters which can be reset by 'Init', 'PArA' and 'diAg'.	**ALL**		
	Reset parameters 'YFCT' to 'INITM'.	Init		
	Reset parameters 'SDIR' to 'LIM'.	PArA		
	Reset parameters A to P of the extended diagnostics function as well as parameter '.XDIAG'.	diAg		
48.PNEUM	Pneumatics type			
	Standard pneumatic block	**Std**		
	Fail in Place pneumatic block	FIP		
	Operation with boosters	booSt		

Parameter	Function	Parameter values	Unit
49.XDIAG	Activation of extended diagnostics		
	Off	**OFF**	
	Single-stage alarm	On1	
	Two-stage alarm	On2	
	Three-stage alarm	On3	

1) Set transmission ratio selector accordingly.

2) Parameter only appears with "WAY", "-WAY", "ncSLL" and "-NCLL"

3) If used, the value on the actuator must correspond to the set range of stroke on the lever arm. Carrier must be set to the value of the actuator travel or, if this value is not scaled, to the next higher scaled value.

4) Setpoint turning points only appear when '9.SFCT = FrEE' is selected.

5) NO contact: Action when signal state is 1; NC contact: Action when signal state is 0

6) Normal: conductive, no fault; Inverted: deactivated, fault

7) '+' means: Logical OR combination

8.3 Overview of diagnostic parameters

Parameter	Function	Parameter values	Unit
A.ᔭPST	Partial Stroke Test with the following parameters:		
A1.STPOS	Start position	0.0 ... **100.0**	%
A2.STTOL	Start tolerance	0.1 ... **2.0** ... 10.0	%
A3.STRKH	Stroke height	0.1 ... **10.0** ... 100.0	%
A4.STRKD	Stroke direction	uP / **do** / uP do	
A5.RPMD	Ramp mode	**OFF** / On	
A6.RPRT	Ramp rate	0.1 ... **1.0** ... 100.0	%/s
A7.FLBH	Behavior after failed Partial Stroke Test	**Auto** / HOLd / AirIn / AirOu	
A8.INTRV	Test interval	**OFF** / 1 ... 365	Days
A9.PSTIN	Reference stroke time for PST	**NOINI** / (C)##.# / FdIni / rEAL	s
AA.FACT1	Factor 1	0.1 ... **1.5** ... 100.0	
Ab.FACT2	Factor 2	0.1 ... **3.0** ... 100.0	
AC.FACT3	Factor 3	0.1 ... **5.0** ... 100.0	
b.ᔭDEVI	Monitoring of dynamic control valve behavior with the following parameters:		
b1.TIM	Time constant	**Auto** / 1 ... 400	s
b2.LIMIT	Limit	0.1 ... **1.0** ... 100.0	%
b3.FACT1	Factor 1	0.1 ... **5.0** ... 100.0	
b4.FACT2	Factor 2	0.1 ... **10.0** ... 100.0	
b5.FACT3	Factor 3	0.1 ... **15.0** ... 100.0	
C.ᔭLEAK	Monitoring/compensation of pneumatic leakage with the following parameters:		
C1.LIMIT	Limit	0.1 ... **30.0** ... 100.0	%
C2.FACT1	Factor 1	0.1 ... **1.0** ... 100.0	
C3.FACT2	Factor 2	0.1 ... **1.5** ... 100.0	
C4.FACT3	Factor 3	0.1 ... **2.0** ... 100.0	

Parameter	Function	Parameter values		Unit
d.ϟSTIC	Monitoring of stiction (slipstick) with the following parameters:			
d1.LIMIT	Limit	0.1 ... **1.0** ... 100.0		%
d2.FACT1	Factor 1	0.1 ... **2.0** ... 100.0		
d3.FACT2	Factor 2	0.1 ... **5.0** ... 100.0		
d4.FACT3	Factor 3	0.1 ... **10.0** ... 100.0		
E.ϟDEBA	Monitoring of deadband with the following parameters:			
E1.LEVL3 *)	Threshold	0.1 ... **2.0** ... 10.0		%
*) The values are monitored in the range of '0.1' to '2.9'. Values between '3.0' and '10.0' are not monitored.				
F.ϟZERO	Monitoring of lower endstop with the following parameters:			
F1.LEVL1	Threshold 1	0.1 ... **1.0** ... 10.0		%
F2.LEVL2	Threshold 2	0.1 ... **2.0** ... 10.0		
F3.LEVL3	Threshold 3	0.1 ... **4.0** ... 10.0		
G.ϟOPEN	Monitoring of upper endstop with the following parameters:			
G1.LEVL1	Threshold 1	0.1 ... **1.0** ... 10.0		%
G2.LEVL2	Threshold 2	0.1 ... **2.0** ... 10.0		
G3.LEVL3	Threshold 3	0.1 ... **4.0** ... 10.0		
H.ϟTMIN	Monitoring of lower limit temperature with the following parameters:			
H1.TUNIT	Temperature unit	**°C**	°F	°C / °F
H2.LEVL1	Threshold 1	-40 ... **-25** ... 90	-40 ... **-13** ... 194	
H3.LEVL2	Threshold 2	-40 ... **-30** ... 90	-40 ... **-22** ... 194	
H4.LEVL3	Threshold 3	**-40** ... 90	**-40** ... 194	
J.ϟTMAX	Monitoring of upper limit temperature with the following parameters:			
J1.TUNIT	Temperature unit	**°C** / °F	°F	°C / °F
J2.LEVL1	Threshold 1	-40 ... **75** ... 90	-40 ... **167** ... 194	
H3.LEVL2	Threshold 2	-40 ... **80** ... 90	-40 ... **176** ... 194	
H4.LEVL3	Threshold 3	-40 ... **90**	-40 ... **194**	
L.ϟSTRK	Monitoring of number of total strokes with the following parameters:			
L1. LIMIT	Limit	1 ... **1E6** ... 1E8		
L2.FACT1	Factor 1	0.1 ... **1.0** ... 40.0		
L3.FACT2	Factor 2	0.1 ... **2.0** ... 40.0		
L4.FACT3	Factor 3	0.1 ... **5.0** ... 40.0		
O.ϟDCHG	Monitoring of number of changes in direction with the following parameters:			
O1.LIMIT	Limit	1 ... **1E6** ... 1E8		
O2.FACT1	Factor 1	0.1 ... **1.0** ... 40.0		
O3.FACT2	Factor 2	0.1 ... **2.0** ... 40.0		
O4.FACT3	Factor 3	0.1 ... **5.0** ... 40.0		
P.ϟPAVG	Monitoring the position average value with the following parameters:			

Parameter		Function	Parameter values	Unit
	P1.TBASE	Time basis of average value generation	**0.5h** / 8h / 5d / 60d / 2.5y	
	P2.STATE	Status of monitoring of position average value	**IdLE** / rEF / ###.# / Strt	
	P3.LEVL1	Threshold 1	0.1 ... **2.0** ... 100.0	%
	P4.LEVL2	Threshold 2	0.1 ... **5.0** ... 100.0	%
	P5.LEVL3	Threshold 3	0.1 ... **10.0** ... 100.0	%

8.4 Description of parameters

8.4.1 Parameter name

Convention

The parameter names in the following descriptions comprise two components. The name of the parameter comes first. This is followed by the name of the corresponding communication object in square parentheses.

Communication object

If you use an asset management tool, you can access all device parameters which are available as communication objects.

8.4.2 Initialization parameters 1 to 5

8.4.2.1 '1.YFCT' [VALVE_TYPE] Actuator type

Requirement: Type of actuator as well as mounting type and direction of action are known.

Possible settings:

Actuator with normal direction of action

- turn
- WAY
- FWAY
- LWAY
- ncSt
- ncSL
- ncSLL

Actuator with inverted direction of action

- -turn
- -WAY
- -FWAY
- -LWAY
- -ncSt
- -ncSL
- -ncLL

Purpose: Use this parameter to adjust the positioner to the respective actuator.

- turn/-turn: Use this setting for a part-turn actuator with a directly mounted positioner.
- WAY/-WAY: Use this setting.
  - For a linear actuator with a carrier pin mounted on the lever
  - In conjunction with devices which use an internal potentiometer
- FWAY/-FWAY: Use this setting.
  - For a linear actuator with a carrier pin mounted on the actuator spindle
  - In conjunction with devices which use an internal potentiometer
- LWAY/-LWAY: Use this setting for an external linear potentiometer on a linear actuator (e.g. with cylinder drives).
- ncSt/-ncSt: Use this setting for a part-turn actuator for:
  - An NCS sensor 6DR4004-. N.10 and -.N.40
  - A positioner 6DR5...-0..9.-....- L1A with internal NCS module
  - A positioner 6DR59* with accessory NCS module 6DR4004-5L/-5LE
  - Position Transmitter 6DR4004-2ES, -3ES and -4ES
- ncSL/-ncSL: Use this setting for an NCS sensor 6DR4004-.N.20 on a linear actuator for strokes < 14 mm (0.55 inch).
- ncSLL/-ncLL: Use this setting for a linear actuator for:
  - An NCS sensor 6DR4004-.N.30 for strokes > 14 mm (0.55 inch).
  - A positioner 6DR5...-0..9.-....- L1A with internal NCS module
  - A positioner 6DR59* with accessory NCS module 6DR4004-5L/-5LE
  - Position Transmitter 6DR4004-2ES, -3ES and -4ES

In the case of actuators with inverted direction of action, use the settings with the minus sign, e.g. -turn.

Description: **Meaning of actuator with normal direction of action:**

- Part-turn actuator closes when the drive shaft, positioner shaft or magnet of the NCS sensor rotates in the **clockwise** direction.
- Linear actuator closes when the actuator spindle moves downwards and the positioner shaft or magnet of the NCS sensor rotates in the **anti-clockwise** direction.

Meaning for actuator with inverted direction of action:

- Part-turn actuator closes when the drive shaft, positioner shaft or magnet of the NCS sensor rotates in the **anti-clockwise** direction.
- Linear actuator closes when the actuator spindle moves upwards and the positioner shaft or magnet of the NCS sensor rotates **clockwise**.

Additional information:

- The '3.YWAY' [TRANSM_LENGTH] Range of stroke (Page 128) parameter is displayed only for 'WAY', '-WAY', 'ncSLL' or '-ncLL'.
- turn/-turn: The '2.YAGL' [TRANSM_ANGLE] Rated angle of rotation of positioner shaft (Page 127) parameter is automatically set to 90° and cannot be changed.
- WAY/-WAY: The positioner compensates the non-linearity. The non-linearity is caused by the transformation of the linear movement of the linear actuator into the rotary movement of the positioner shaft. For correct compensation, follow the instructions in section "Preparing linear actuators for commissioning (Page 105)".

Factory setting: WAY

8.4.2.2 '2.YAGL' [TRANSM_ANGLE] Rated angle of rotation of positioner shaft

Condition: Transmission ratio selector and the value set in the '2.YAGL' parameter match. Only then does the value shown on the display match the actual position.

Possible settings:

- 33°
- 90°

Purpose: Use this parameter for a linear actuator. For a linear actuator, set an angle of 33° or 90° depending on the range of stroke. The current setting of the actuator is then measured more accurately. The following is applicable:

- 33°: Strokes ≤ 20 mm
- 90°: Strokes 25 mm to 35 mm
- 90°: Strokes > 40 mm to 130 mm

Use the mounting kit:

- 6DR4004-8V for strokes up to 35 mm
- 6DR4004-8L for strokes greater than 35 mm up to 130 mm

'2.YAGL' can only be adjusted if '1.YFCT' is set to 'WAY'/'-WAY' or 'FWAY'/'-FWAY'.

With all other settings of '1.YFCT', an angle of 90° is automatically set for '2.YAGL'.

Factory setting: 33°

8.4.2.3 '3.YWAY' [TRANSM_LENGTH] Range of stroke

Condition:
- Positioner is mounted.
- Carrier pin is mounted on the lever in accordance with the actuator's range of stroke as described in section Mounting to linear actuator (Page 35).

Possible settings:
- OFF
- 5.0 | 10.0 | 15.0 | 20.0 | 25.0 |30.0 | 35.0 | 40.0 | 50.0 | 60.0 | 70.0 | 90.0 | 110.0 | 130.0

Purpose:
Use this parameter to display the determined stroke value in mm when initialization of a linear actuator has been completed.

If you select the 'OFF' setting, the real stroke is not displayed after initialization.

From the possible settings shown above, select the value which corresponds to the range of stroke of your actuator in mm.

If the range of stroke of the actuator does not correspond to a possible setting, use the next higher value. Use the value specified on the nameplate of the actuator for this purpose.

'3.YWAY' is only displayed if '1.YFCT' is set to 'WAY'/'-WAY' or 'ncSLL'/'-ncLL'.

Factory setting:
OFF

8.4.2.4 '4.INITA' [SELF_CALIB_COMMAND] Initialization (automatic)

Possible settings:
- NOINI
- no / ###.#
- Strt

Purpose:
Use this parameter to start the automatic initialization process.
1. Select the "Strt" setting.
2. Then press the ⊕ button for at least 5 seconds.

The lower line of the display indicates which initialization step is currently being run through.

Factory setting:
NOINI

8.4.2.5 '5.INITM' [no correspondence] Initialization (manual)

Possible settings:
- NOINI
- no / ###.#
- Strt

Purpose:
Use this parameter to start the manual initialization process.
1. Select the "Strt" setting.
2. Then press the ⊕ button for at least 5 seconds.

Description:	If the positioner has already been initialized and if the "4.INITA" and "5.INITM" values are set, it is possible to reset the positioner to the non-initialized status. To do this, press the ▽ button for at least 5 seconds.
Factory setting:	NOINI

8.4.3 Application parameters 6 to 49

8.4.3.1 '6.SDIR' [IO_OPTS] Setpoint direction

Possible settings:
- riSE
- FALL

Purpose:

This parameter is used to set the setpoint direction. The setpoint direction is used to reverse the direction of action of the setpoint.
- Rising (riSE): A higher value at the setpoint input results in opening of the valve.
- Falling (FALL): A higher value at the setpoint input results in closing of the valve.

The setpoint direction is primarily used for the split-range mode and for single-acting actuators with the safety setting 'uP'.

Factory setting: riSE

8.4.3.2 '7.TSUP' [TRAVEL_RATE_UP] Setpoint ramp up / '8.TSDO' [TRAVEL_RATE_DOWN] Setpoint ramp down

Possible settings:

With "TSUP"	With "TSDO"
• Auto	• 0 ... 400
• 0 ... 400	

Purpose:

The setpoint ramp is effective in "Automatic" mode and limits the speed of change of the effective setpoint. The parameter specifies the duration in seconds that the positioner needs to move the stroke from 0 to 100%. Example: If "TSUP" = 10 is set, the positioner needs 10 s to move the stroke from 0 to 100% and 1 s to move the stroke from 0 to 10%.

When switching over from "Manual" mode to "Automatic" mode, the setpoint ramp is used to adjust the effective setpoint to the setpoint of the positioner.

This smooth switching from "Manual" mode to "Automatic" mode prevents pressure excess in long pipelines.

The "TSUP = Auto" parameter means that the slower of the two actuating times determined during initialization is used for the setpoint ramp. Parameter value "TSDO" then has no effect.

Factory setting: 0

8.4.3.3 '9.SFCT' [CHARACT_TYPE] Setpoint function

Possible settings:
- Lin
- 1 - 25
- 1 - 33
- 1 - 50
- n1 - 25
- n1 - 33
- n1 - 50
- FrEE

Purpose: This parameter is used to linearize nonlinear process valve characteristics. Optional flow characteristics as shown in the figure in the '10.SL0' ... '30.SL20' [TAB_VALUES] Setpoint turning point (Page 130) parameter description are simulated for linear process valve characteristics.

Factory setting: Lin

Seven process valve characteristics are stored in the positioner and are selected using the 'SFCT' parameter:

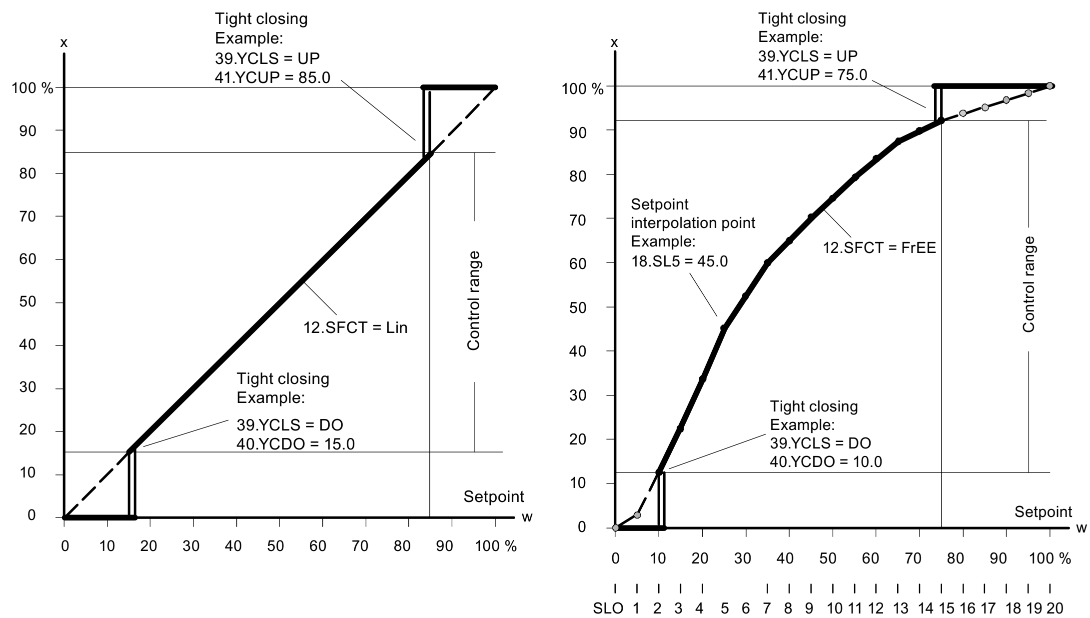
Process valve characteristic		Set with parameter value
Linear		Lin
Equal percentage	1:25	1-25
Equal percentage	1:33	1-33
Equal percentage	1:50	1-50
Inverse equal percentage	25:1	n1-25
Inverse equal percentage	33:1	n1-33
Inverse equal percentage	50:1	n1-50
Freely adjustable		FrEE

8.4.3.4 '10.SL0' ... '30.SL20' [TAB_VALUES] Setpoint turning point

Setting range: 0.0 ... 100.0

Purpose: These parameters are used to assign a flow coefficient in units of 5% to each setpoint turning point. The setpoint breakpoints form a polyline with 20 linear segments which models the process valve characteristic; see figure below.

Factory setting: "0", "5" ... "95", "100"



Setpoint characteristic curves, standardization of manipulated variables, and tight closing function

Input of the setpoint turning points is only possible if the "'9.SFCT' [CHARACT_TYPE] Setpoint function (Page 130)" parameter is set to "FrEE". You can only enter one monotone rising characteristic curve and two consecutive interpolation points must differ by at least 0.2%.

8.4.3.5 '31.DEBA' [DEADBAND] Deadband of closed-loop controller

Possible settings:
- Auto
- 0.1 ... 10.0

Purpose: This parameter is used with the "Auto" setting to adjust the deadband in automatic mode continually and adaptively to the requirements of the control loop. If a regulator oscillation is detected, then the deadband is incrementally enlarged. The reverse adaptation takes place using a time criterion.

The deadband is set using the values 0.1 to 10.0. The value is given in percent. Control oscillations can then be suppressed. The smaller the deadband, the better the control accuracy.

Factory setting: Auto

8.4.3.6 '32.YA' [TRAVEL_LIMIT_DOWN] Start of manipulated variable limit / '33.YE' [TRAVEL_LIMIT_UP] End of manipulated variable limit

Setting range:	0.0 ... 100.0	
Purpose:	These parameters are used to limit the mechanical actuator travel from stop to stop to the configured values. The value is given in percent. This allows the mechanical travel range of the actuator to be limited to the effective flow, preventing integral saturation of the controlling closed-loop controller. See the figure in the description of the '34.YNRM' [Y_NORM] Standardization of manipulated variable (Page 132) parameter. **'Dead angle' function** The dead angle is the angle range in which the process valve allows no flow. The dead angle range starts at the lower endstop of the valve, for example, and ends at the angle at which the medium begins to flow. Use this function if you want to use the entire signal range for valve control (for example, 4 mA to 20 mA). To now use the entire signal range for process valve control, set the lower manipulated variable limit (YA) to the percentage value at which the medium begins to flow. To display the new initial value as 0%, set '34.YNRM' [Y_NORM] Standardization of manipulated variable (Page 132) to 'FloW'.	
Factory setting:	When 'YA': 0.0	When 'YE': 100.0

Note

'YE' must always be set larger than 'YA'.

8.4.3.7 '34.YNRM' [Y_NORM] Standardization of manipulated variable

Possible settings:	• MPOS • FLoW
Purpose:	Use the '32.YA' [TRAVEL_LIMIT_DOWN] Start of manipulated variable limit / '33.YE' [TRAVEL_LIMIT_UP] End of manipulated variable limit (Page 132) parameters to limit the manipulated variable. This limitation causes two different scaling types 'MPOS' and 'FLoW' for the display and for the position feedback through the current output. The MPOS scale shows the mechanical positions from 0% to 100% between the upper and lower endstops of the initialization. The position is not influenced by the '32.YA' [TRAVEL_LIMIT_DOWN] Start of manipulated variable limit / '33.YE' [TRAVEL_LIMIT_UP] End of manipulated variable limit (Page 132) parameters. The 'YA' and 'YE' parameters are shown in the MPOS scale.

The FLoW scale is the standardization from 0% to 100% in the range between the 'YA' and 'YE' parameters. Over this range, the setpoint w is also always 0% to 100%. This results in a more or less flow-proportional display and position feedback. The flow-proportional display and position feedback also results from the use of process valve characteristics.

In order to calculate the control deviation, the setpoint in the display is also shown in the corresponding scale.

Below, the example of an 80-mm linear actuator is used to illustrate the dependence of the stroke on the scaling as well as on the 'YA' and 'YE' scaling parameters; see the following figure.

Factory setting: MPOS

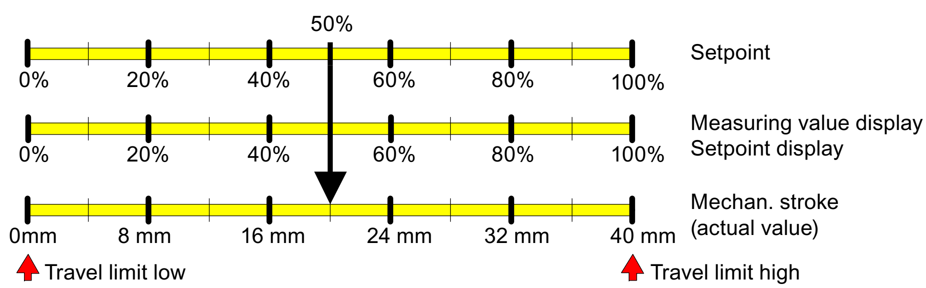


Figure 8-1 YNRM = MPOS or YNRM = FLoW; default: YA = 0 % and YE = 100 %

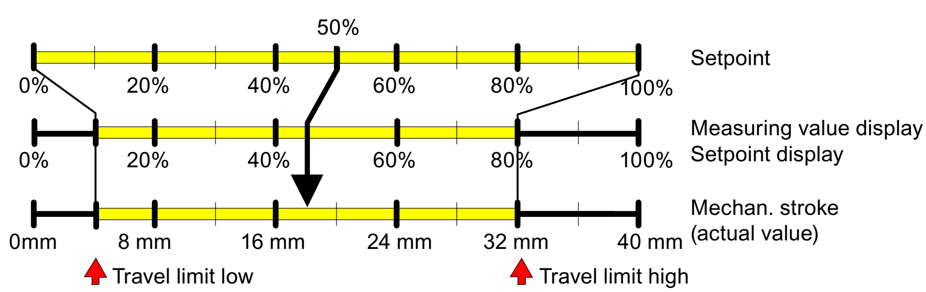


Figure 8-2 Example: YNRM = MPOS with YA = 10 % and YE = 80 %

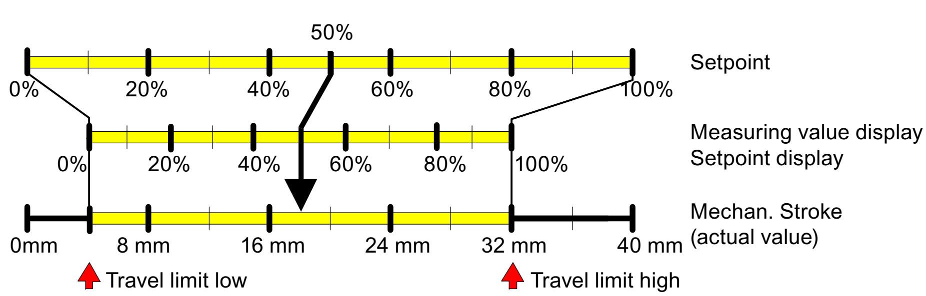


Figure 8-3 Example: YNRM = FLoW with YA = 10 % and YE = 80 %

8.4.3.8 '35.YDIR' [Y_DIR] Direction of action of manipulated variable for display and position feedback

Possible settings:	• riSE • FALL
Purpose:	This parameter is used to set the direction of action of the display and the position feedback. The direction is rising or falling.
Factory setting:	riSE

8.4.3.9 '36.YCLS' Tight closing / fast closing with manipulated variable

Possible settings:

no	None
uP	Tight closing Up
do	Tight closing Down
uP do	Tight closing Up and Down
Fu	Fast closing Up
Fd	Fast closing Down
Fu Fd	Fast closing Up and Down
uP Fd	Tight closing Up and fast closing Down
Fu do	Fast closing Up and tight closing Down

Purpose:

This parameter is used to drive the control valve to the endstops. If the parameter is not activated, the control valve controls the two endstops which were determined during the initialization.

With tight closing, the control valve requires longer to leave the endstops. With fast closing, the endstops of the control valve are left immediately.

The tight closing and fast closing functions are activated on one side or for both endstops. Parameter 'YCLS' becomes effective if the effective setpoint:

- Is at or below the value set in the "37.YCDO' [FINAL_VALUE_CUTTOFF_LO] Value for tight closing / fast closing Down (Page 135)' parameter.
- Is at or above the value set in the "38.YCUP' [FINAL_VALUE_CUTTOFF_HI] Value for tight closing / fast closing Up (Page 135)' parameter.

Factory setting: no

See the figure in the description of the '34.YNRM' [Y_NORM] Standardization of manipulated variable (Page 132) parameter and the figure in the description of the '10.SL0' ... '30.SL20' [TAB_VALUES] Setpoint turning point (Page 130) parameters.

Note

Activated tight closing/fast closing function

If the function is activated, then the monitoring of control deviation is turned off in the respective overflow direction for the "49.XDIAG' [EXT_DIAG] Activation of extended diagnostics (Page 143)' parameter. The following applies: 'YCDO: < 0 %' and 'YCUP: > 100 %'. This functionality is especially advantageous for valves with lining. For long-term monitoring of the positions of the endstops, we recommend that you activate the 'F.ᛋZERO' and 'G.ᛋOPEN' parameters.

8.4.3.10 '37.YCDO' [FINAL_VALUE_CUTTOFF_LO] Value for tight closing / fast closing Down

Requirement:	Parameter '36.YCLS (Page 134)' is set to 'do', 'uP do', 'Fd', 'Fu Fd', 'uP Fd' or 'Fu do'
Adjustment range:	0.0 ... 100.0
Purpose:	Use the parameter '37.YCDO' to set the value as of which the "Tight closing/fast closing Down" function is activated. If the effective setpoint is at or below the value set here, the actuator moves in tight closing Down or fast closing Down.
Factory setting:	0.0

Note

The value in the parameter "37.YCDO" is always smaller than that in "38.YCUP (Page 135)". The tight closing function has a fixed hysteresis of 1%. The parameter "37.YCDO" refers to the mechanical stops. "37.YCDO" is independent of the value that is set in the parameters "6.SDIR (Page 129)" and "35.YDIR (Page 134)".

8.4.3.11 '38.YCUP' [FINAL_VALUE_CUTTOFF_HI] Value for tight closing / fast closing Up

Requirement:	Parameter '36.YCLS (Page 134)' is set to 'uP', 'uP do', 'Fu', 'Fu Fd', 'uP Fd' or 'Fu do'
Adjustment range:	0.0 ... 100.0
Purpose:	Use the parameter '38.YCUP' to set the value as of which the tight closing Up or fast closing Up is activated. If the effective setpoint is at or above the value set here, the actuator moves in tight closing Up or fast closing Up.
Factory setting:	100.0

Note

The value in the parameter "37.YCDO (Page 135)" is always smaller than that in "38.YCUP". The tight closing function has a fixed hysteresis of 1%. The parameter "38.YCUP" refers to the mechanical stops. "38.YCUP" is independent of the value that is set in the parameters "6.SDIR (Page 129)" and "35.YDIR (Page 134)".

8.4.3.12 '39.BIN1' [BIN_IN1_FUNCT] Function digital input DI1 / '40.BIN2' Function digital input DI2 [BIN_IN_FUNCT]

Setting option

- Digital input DI1

NO contact	NC contact
OFF	OFF
on	-on
bloc1	
bloc2	
uP	-uP
doWn	-doWn
StoP	-StoP
PST	-PST
SiM	SiM

- Digital input DI2

NO contact	NC contact
OFF	OFF
on	-on
uP	-uP
doWn	-doWn
StoP	-StoP
PST	-PST

Purpose:

These parameters determine the function of the digital inputs. The possible functions are described below. The direction of action can be adapted to a normally closed or normally open mode.

- DI1 or DI2 = On or -On
  Digital messages from I/O devices, e.g. from pressure or temperature switches, are read out over the communication interface or result in a response from the fault message output through an OR logic operation with other messages.
- DI1 = bLoc1
  Use this parameter value to interlock the "Configuration" mode against adjustment. The lock is performed e.g. with a jumper between terminals 9 and 10.
- DI1 = bLoc2
  If the DI1 digital input has been activated, 'Manual' mode is blocked in addition to "Configuration" mode.

- DI1 or DI2 =
  Contact uP or doWn closes or
  Contact -uP or -doWn opens
  If the digital input is activated, the actuator uses the value defined by the "'32.YA' [TRAVEL_LIMIT_DOWN] Start of manipulated variable limit / '33.YE' [TRAVEL_LIMIT_UP] End of manipulated variable limit (Page 132)" parameter for controlling in 'Automatic' mode.
- DI1 or DI2 =
  Contact StoP closes or
  Contact -StoP opens
  If the digital input is activated, control of the pneumatic block is blocked in "Automatic" mode. The actuator remains at the last position. Leakage measurements can be performed in this way without using the initialization function.
- DI1 or DI2 = PSt or -PSt
  By means of digital input DI1 or DI2, a Partial Stroke Test is initiated by actuation of a normally closed or normally open contact depending on the selection.
- DI1 or DI2 = OFF
  No function
  Special function of digital input DI1: If digital input DI1 is activated in 'P-manual mode' by means of a jumper between terminals 9 and 10, the firmware version will be displayed when the button is pressed.
- DI1 = SiM
  Simulation

If one of the above-named functions is activated with the "DI1" and "DI2" parameters simultaneously, then: "Blocking" has priority over "uP". "uP" has priority over "doWn". "doWn" has priority over "PST".

Factory setting: DI1: SiM DI2: OFF

8.4.3.13 '41.AFCT' [ALARM_FUNCT] Alarm function

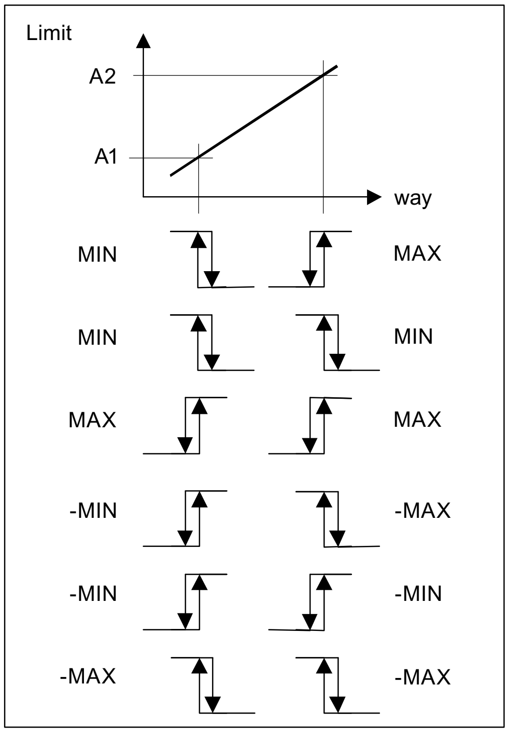
Possible settings: See corresponding representation below

Purpose: This parameter can be used to determine the value at which going above or below a given offset or angle will result in a message. The triggering of alarms (limits) is relative to the MPOS scale. The alarms are signaled via the Digital I/O Module (DIO). In addition, alarms can also be read via the communication interface.

The direction of action of the digital outputs can be adjusted from "High active" to "Low active" for the next systems.

Factory setting: OFF

Direction of action and hysteresis



	Digital I/O Module (DIO)	
Examples	A1	A2
A1 = 48	AFCT = MIN / MAX	
A2 = 52		
Way =45	**Active**	
Way =50		
Way =55		**Active**
A1 = 48	AFCT = -MIN / -MAX	
A2 = 52		
Way =45		**Active**
Way =50	Active	Active
Way =55	**Active**	
A1 = 52	AFCT = MIN / MAX	
A2 = 48		
Way =45	**Active**	
Way =50	Active	Active
Way =55		**Active**
A1 = 52	AFCT = -MIN / -MAX	
A2 = 48		
Way =45		**Active**
Way =50		
Way =55	**Active**	

Note

If extended diagnostics is activated using parameter "'49.XDIAG' [EXT_DIAG] Activation of extended diagnostics (Page 143)" with setting "On3", then the alarms are not output through the Digital I/O Module (DIO). Alarm A1 is output with setting "On2". However, notification via the communication interface is possible at any time.

8.4.3.14 '42.A1' [ALARM1] / '43.A2' [ALARM2] Response threshold of alarms

Adjustment range: 0.0 ... 100.0

Purpose: These parameters are used to specify when an alarm should be displayed. The response thresholds of the alarms (in percent) refer to the MPOS scale in the '34.YNRM' [Y_NORM] Standardization of manipulated variable (Page 132) parameter. The MPOS scale corresponds to the mechanical travel.

Depending on the setting of the alarm function in the '41.AFCT' [ALARM_FUNCT] Alarm function (Page 137) parameter, the alarm is triggered upon an upward violation (Max) or downward violation (Min) of this response threshold.

Factory setting: With 'A1': 10.0 With 'A2': 90.0

8.4.3.15 '44.\\FCT' [FAULT_FUNCT] Fault message function

Requirement: At least one of the following modules is fitted

- Digital I/O Module (DIO)
- Inductive Limit Switches (ILS)
- Mechanic Limit Switches (MLS)

Possible settings:

Normal direction of action	Inverted direction of action
• ϟ	• -ϟ
• ϟnA	• -ϟnA
• ϟnAb	• -ϟnAb

Purpose: The fault message in the form of monitoring of control deviation over time is also triggered by the following events:

- Power failure
- Processor fault
- Actuator fault
- Process valve fault
- Failure of supply pressure PZ
- Threshold 3 message of extended diagnostics
  See Parameter '49.XDIAG' [EXT_DIAG] Activation of extended diagnostics (Page 143).

The fault message cannot be switched off, but it can be suppressed (factory setting) when you exit 'Automatic' mode. Set the 'ϟFCT' parameter to 'ϟnA' to also generate a fault message here.

You also have an option to "or" the fault message with the status of the digital inputs. To do this, first set the '39.BIN1' [BIN_IN1_FUNCT] Function digital input DI1 / '40.BIN2' Function digital input DI2 [BIN_IN_FUNCT] (Page 136) parameter to 'on' or '-on'. Subsequently set the 'ϟFCT' parameter to 'ϟnAb'.

Select the '-ϟ' setting if you want the fault message to be output with inverse direction of action.

Factory setting: ϟ

8.4.3.16 '45.\\TIM' [DELAY_TIME] Monitoring time for setting of fault messages

Possible settings:
- Auto
- 0 ... 100

Purpose: The 'TIM' parameter is used to set the time in seconds within which the positioner must have reached the regulated condition. The corresponding response threshold is specified in the parameter.

When the configured time is exceeded, the fault message output is set.

Factory setting: Auto

Note

Activated tight closing/fast closing function

If the function is activated, then for the 'ϟLIM' parameter the monitoring of control deviation is turned off in the appropriate overflow direction. The following applies: 'YCDO: < 0 %' and 'YCUP: > 100 %'. This functionality is especially advantageous for valves with lining. For long-term monitoring of the end positions, we recommend that you activate the 'F.ϟZERO' and 'G.ϟ OPEN' parameters.

8.4.3.17 '46.\\LIM' [TOLERANCE_BAND] Response threshold for fault message

Possible settings:
- Auto
- 0 ... 100

Purpose: This 'ϟLIM' parameter is used to set a value for the permissible size of the control deviation to trigger a fault message. The value is given in percent.

If the 'ϟTIM' and 'ϟLIM' parameters are set to 'Auto', then the fault message is set if the slow step zone is not reached within a certain period of time. Within 5 to 95% of the actuator travel, this time is twice the initialization travel time, and ten times the initialization travel time outside of 10 to 90%.

Factory setting: Auto

Note

Activated tight closing/fast closing function

If the function is activated, then for the 'ϟLIM' parameter the monitoring of control deviation is turned off in the appropriate overflow direction. The following applies: 'YCDO: < 0 %' and 'YCUP: > 100 %'. This functionality is especially advantageous for valves with lining. For long-term monitoring of the end positions, we recommend that you activate the 'F.ϟZERO' and 'G.ϟ OPEN' parameters.

8.4.3.18 '47.PRST' Preset [no correspondence]

Possible settings:
- ALL
- Init
- PArA
- diAg

Purpose:

Use this parameter to restore the factory settings for most parameters. The following parameter groups are available:
- ALL: Reset all parameters together which can be reset by 'Init', 'PArA' and 'diAg'.
- Init: Reset initialization parameters '1.YFCT' to '5.INITM'.
- PArA: Reset application parameters '6.SDIR' [IO_OPTS] Setpoint direction (Page 129) to '46.\\LIM' [TOLERANCE_BAND] Response threshold for fault message (Page 140).
- diAg: Resetting the extended diagnostic parameters A to U as well as parameter '49.XDIAG' [EXT_DIAG] Activation of extended diagnostics (Page 143).

An overview of the parameters and factory settings can be found in section Parameter overview (Page 120).

In order to select one of the parameter groups listed above, repeatedly press the ▽ button until the desired setting is output in the display. Start the function by keeping the △ button pressed until 'oCAY' is output in the display. The values of the parameter group are now the factory settings.

Description:

If you wish to use a previously initialized positioner on a different control valve, set the parameters to the factory settings prior to a new initialization. To do this, use the 'ALL' or 'Init' setting.

Factory setting: ALL

8.4.3.19 '48.PNEUM' [PNEUMATIC_BLOCK_TYPE] Pneumatics type

Requirement:	FIP	You have a positioner with the "Fail in place" function with order suffix -Z, order code F01.
	booSt	You operate the positioner with a booster.

Possible settings:	Std	Standard pneumatic block
	FIP	Fail in Place pneumatic block
	booSt	Operation with boosters

Purpose:

Start the function by pressing the △+ button for at least 5 seconds. The display shows 'WAit' during these 5 seconds. Set the desired function after 5 seconds.

Std	Setting for a standard pneumatic block.
FIP	If you order a positioner for Fail in Place applications, the position is then equipped with a special pneumatic block. The "PNEUM" parameter is preset to "FIP". The parameter must be set to "FIP" again when the basic electronics are replaced.
booSt	Use this function if you operate the positioner with a booster. This function then shows the actuator overshoot. You can find a description of how to operate the booster under Booster (Page 291).

8.4.3.20 '49.XDIAG' [EXT_DIAG] Activation of extended diagnostics

Use this parameter to activate the extended diagnostics functions and simultaneously the online diagnostics. You also define which maintenance level is to be signaled. Maintenance levels in the order of increasing importance are maintenance required, maintenance demanded, maintenance alarm. At the factory, extended diagnostics are deactivated. 'XDIAG' parameter is set to 'OFF'. To activate extended diagnostics, there are three modes available:

- On1: Extended diagnostics is activated. Threshold 3 messages will be output via the error message output. Single stage message (maintenance alarm).
- On2: Extended diagnostics is activated. Threshold 2 messages will be activated via alarm output 2. Threshold 3 messages will also be output via the error message output. Two-stage message (maintenance demanded, maintenance alarm).
- On3: Extended diagnostics is activated. Threshold 1 messages will be activated via alarm output 1. Threshold 2 messages will be activated via alarm output 2. Threshold 3 messages will also be output via the error message output. Three-stage message (maintenance required, maintenance demanded, maintenance alarm).

Note

Activation of extended diagnostics

Please note that the parameters of extended diagnostics from 'A.\\PST' to 'U.\\PRES' will only be shown in the display following selection of one of the modes 'On1' to 'On3'.

In the factory settings, the parameters 'A.\\PST' to 'U.\\PRES' are deactivated by default. 'XDIAG' parameter is set to 'OFF'. The corresponding parameters are only displayed after you have activated the appropriate menu item with 'On'.

Note

Cancellation of messages

If a threshold is exceeded or fallen below, the positioner outputs a message in the form of an error code and a column in the display. The message is cancelled if, for example:

- The counter is reset.
- The threshold is set to a new value.
- The device is re-initialized at the upper and lower endstops.
- Monitoring is deactivated.

With extended diagnostics, the threshold of the message is displayed using columns ① in addition to the error code ② (Overview of error codes (Page 220)). These columns ① and the error code ② are shown on the display as follows:

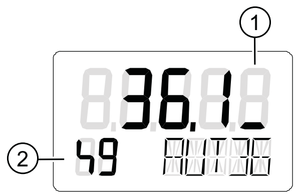


Figure 8-4 Display of a threshold 1 error message with one column (maintenance required)

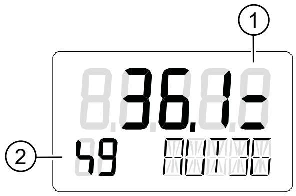


Figure 8-5 Display of a threshold 2 error message with two columns (maintenance demanded)

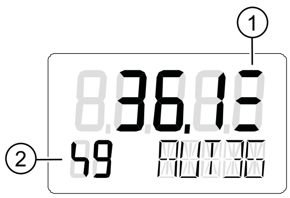


Figure 8-6 Display of a threshold 3 error message with three columns (maintenance alarm)

The factory setting is 'OFF'.

8.4.4 Extended diagnostics parameters A to P

8.4.4.1 Assigned communication objects

Overview

The communication objects assigned to parameters A to P are listed below:

Parameter	Communication object	See also
A.\\PST	Partial Stroke Test [PST_DIAG.PST_ENABLE]	Partial Stroke Test 'A.\\PST' (Page 149)
A1.STPOS	Start position [PST_DIAG.PST_START_POS]	
A2.STTOL	Start tolerance [PST_DIAG.PST_START_TOL]	
A3.STRKH	Stroke height [PST_DIAG.PST_STEP]	
A4.STRKD	Stroke direction [PST_DIAG.PST_STEP_DIR]	
A5.RPMD	Ramp mode [PST_DIAG.PST_RAMP_MODE]	
A6.RPRT	Ramp rate [PST_DIAG.PST_RAMP_RATE]	
A7.FLBH	Behavior after failed PST [PST_DIAG.PST_FAILURE_BEHAVIOR]	
A8.INTRV	Test interval [PST_DIAG.PST_INTERVAL]	
A9.PSTIN	Reference stroke time for PST [PST_DIAG.PST_REF_TIME]	
AA.FACT1	Factor 1 [PST_DIAG.PST_FACT1]	
Ab.FACT2	Factor 2 [PST_DIAG.PST_FACT2]	
AC.FACT3	Factor 3 [PST_DIAG.PST_FACT3]	

Parameter	Communication object	See also
b.ᛋDEVI	Monitoring of dynamic control valve behavior [DEVIATION_DIAG.DEVIATION_ENABLE]	Monitoring of dynamic control valve behavior 'b.\\DEVI' (Page 154)
b1.TIM	Time constant [DEVIATION_DIAG.DEVIATION_TIME]	
b2.LIMIT	Limit [DEVIATION_DIAG.DEVIATION_LIMIT]	
b3.FACT1	Factor 1 [DEVIATION_DIAG.DEVIATION_FACT1]	
b4.FACT2	Factor 2 [DEVIATION_DIAG.DEVIATION_FACT2]	
b5.FACT3	Factor 3 [DEVIATION_DIAG.DEVIATION_FACT3]	

Parameter	Communication object	See also
C.ᛋLEAK	Monitoring/compensation of pneumatic leakage [LEAKAGE_DIAG.LEAKAGE_ENABLE]	Monitoring/compensation of pneumatic leakage 'C.\\LEAK' (Page 156)
C1.LIMIT	Limit [LEAKAGE_DIAG.LEAKAGE_LIMIT]	
C2.FACT1	Factor 1 [LEAKAGE_DIAG.LEAKAGE_FACT1]	
C3.FACT2	Factor 2 [LEAKAGE_DIAG.LEAKAGE_FACT2]	
C4.FACT3	Factor 3 [LEAKAGE_DIAG.LEAKAGE_FACT3]	

Parameter	Communication object	See also
d.ᛋSTIC	Monitoring of stiction (slipstick) [SLIP_STICK_DIAG.SLIP_STICK_ENABLE]	Monitoring of stiction (slipstick) 'd.\\STIC' (Page 159)
d1.LIMIT	Limit [SLIP_STICK_DIAG.SLIP_STICK_LIMIT]	
d2.FACT1	Factor 1 [SLIP_STICK_DIAG.SLIP_STICK_FACT1]	
d3.FACT2	Factor 2 [SLIP_STICK_DIAG.SLIP_STICK_FACT2]	
d4.FACT3	Factor 3 [SLIP_STICK_DIAG.SLIP_STICK_FACT3]	

Parameter	Communication object	See also
E.ᛋDEBA	Monitoring deadband [DEBA_DIAG.DEBA_ENABLE]	Monitoring of deadband 'E.\\DEBA' (Page 160)
E1.LEVL3	Threshold [DEBA_DIAG.DEBA_LEVEL3]	

Parameter	Communication object	See also
F.ϟZERO	Monitoring the lower endstop [ZERO_DIAG.ZERO_ENABLE]	Monitoring of lower end-stop 'F.\\ZERO' (Page 161)
F1.LEVL1	Threshold 1 [ZERO_DIAG.ZERO_LEVEL1]	
F2.LEVL2	Threshold 2 [ZERO_DIAG.ZERO_LEVEL2]	
F3.LEVL3	Threshold 3 [ZERO_DIAG.ZERO_LEVEL3]	

Parameter	Communication object	See also
G.ϟOPEN	Monitoring the upper endstop [OPEN_DIAG.OPEN_ENABLE]	Monitoring of upper end-stop 'G.\\OPEN' (Page 163)
G1.LEVL1	Threshold 1 [OPEN_DIAG.OPEN_LEVEL1]	
G2.LEVL2	Threshold 2 [OPEN_DIAG.OPEN_LEVEL2]	
G3.LEVL3	Threshold 3 [OPEN_DIAG.OPEN_LEVEL3]	

Parameter	Communication object	See also
H.ϟTMIN	Monitoring the lower limit temperature [TEMP_MIN_DIAG.TEMP_MIN_ENABLE]	Monitoring the lower limit temperature 'H.\\TMIN' (Page 164)
H1.TUNIT	Temperature unit [TEMPERATURE_UNIT]	
H2.LEVL1	Threshold 1 [TEMP_MIN_DIAG.TEMP_MIN_LEVEL1]	
H3.LEVL2	Threshold 2 [TEMP_MIN_DIAG.TEMP_MIN_LEVEL2]	
H4.LEVL3	Threshold 3 [TEMP_MIN_DIAG.TEMP_MIN_LEVEL3]	

Parameter	Communication object	See also
J.ϟTMAX	Monitoring the upper limit temperature [TEMP_MAX_DIAG.TEMP_MAX_ENABLE]	Monitoring the upper limit temperature 'J.\\TMAX' (Page 166)
J1.TUNIT	Temperature unit [TEMPERATURE_UNIT]	
J2.LEVL1	Threshold 1 [TEMP_MAX_DIAG.TEMP_MAX_LEVEL1]	
J3.LEVL2	Threshold 2 [TEMP_MAX_DIAG.TEMP_MAX_LEVEL2]	
J4.LEVL3	Threshold 3 [TEMP_MAX_DIAG.TEMP_MAX_LEVEL3]	

Parameter	Communication object	See also
L.ϟSTRK	Monitoring the number of total strokes [STROKE_DIAG.STROKE_ENABLE]	Monitoring of number of total strokes 'L.\\STRK' (Page 167)
L1.LIMIT	Limit [STROKE_DIAG.STROKE_LIMIT]	
L2.FACT1	Factor 1 [STROKE_DIAG.STROKE_FACT1]	
L3.FACT2	Factor 2 [STROKE_DIAG.STROKE_FACT2]	
L4.FACT3	Factor 3 [STROKE_DIAG.STROKE_FACT3]	

Parameter	Communication object	See also
O.ϟDCHG	Monitoring the number of changes in direction [DIRCHANGE_DIAG.DIRCHANGE_ENABLE]	Monitoring of number of changes in direction 'O.\\DCHG' (Page 169)
O1.LIMIT	Limit [DIRCHANGE_DIAG.DIRCHANGE_LIMIT]	
O2.FACT1	Factor 1 [DIRCHANGE_DIAG.DIRCHANGE_FACT1]	
O3.FACT2	Factor 2 [DIRCHANGE_DIAG.DIRCHANGE_FACT2]	
O4.FACT3	Factor 3 [DIRCHANGE_DIAG.DIRCHANGE_FACT3]	

Parameter	Communication object	See also
P.ϟPAVG	Monitoring of position average value [POS_AVG_DIAG.POS_AVG_ENABLE]	Monitoring the position average value 'P.\\PAVG' (Page 170)
P1.TBASE	Time basis of average value generation [POS_AVG_DIAG.POS_AVG_TIME_BASE]	
P2.STATE	Status of monitoring position average value [POS_AVG.POS_AVG_STATUS]	
P3.LEVL1	Threshold 1 [POS_AVG_DIAG.POS_AVG_LEVEL1]	
P4.LEVL2	Threshold 2 [POS_AVG_DIAG.POS_AVG_LEVEL2]	
P5.LEVL3	Threshold 3 [POS_AVG_DIAG.POS_AVG_LEVEL3]	

8.4.4.2 Partial Stroke Test 'A.\\PST'

A.ϟPST - Partial Stroke Test

Requirement:	The parameter "52.XDIAG (Page 143)" is set to "On1", "On2" or "On3".
Possible settings:	• OFF • On
Purpose:	Use this parameter to activate and deactivate the Partial Stroke Test. To activate monitoring, assign the parameter value "On". Sub-parameters are displayed. Use this parameter to activate and deactivate the Partial Stroke Test. To activate monitoring, assign the parameter value "On". Sub-parameters are displayed. To activate monitoring, assign the parameter value "On". Sub-parameters are displayed using: • Buttons on the device • A digital input • Communication • A cyclic test interval The current status of the Partial Stroke Test is displayed in the diagnostic value "12.PST (Page 210)". Diagnostic values "13.PRPST (Page 211)" and "14.NXPST (Page 211)" provide additional information on the Partial Stroke Test.
Factory setting:	OFF

A1.STPOS - Start position

Setting range:	0.0 ... 100.0
Purpose:	Use this sub-parameter to define the start position of the Partial Stroke Test in percent. Set the start position in a range from "0.0" to "100.0". The triggering of alarms (limits) is relative to the MPOS scale. The actuator moves during the Partial Stroke Test from the start position to the target position. The target position is determined from the interaction between start position (A1.STPOS), stroke height (A3.STRKH) and stroke direction (A4.STRKD).
Factory setting:	100.0

A2.STTOL - Start tolerance

Setting range:	0.1 ... 10.0
Purpose:	Use this sub-parameter to assign the start tolerance of the Partial Stroke Test in percent. Set the start tolerance relative to the start position in a range from "0.1" to "10.0".

Example:	You have set "50.0" as start position and "2.0" as start tolerance. In this case, a Partial Stroke Test is only executed between a position of 48% and 52%.
Factory setting:	2.0

A3.STRKH - Stroke height

Setting range:	0.1 ... 100.0
Purpose:	Use this sub-parameter to assign the stroke height of the Partial Stroke Test in percent. Set the stroke height in a range from "0.1" to "100.0".
Factory setting:	10.0

A4.STRKD - Stroke direction

Possible settings:
- uP
- do
- uP do

Purpose: Use this sub-parameter to assign the stroke direction of the Partial Stroke Test.

uP: Actuator only moves upward
- The actuator moves from its start position to the upper target position.
- After reaching the upper target position, the actuator moves back to the start position.

Formula (uP): Upper target position = Start position (A1.STPOS) ± Start tolerance (A2.STTOL) + Stroke height (A3.STRKH)

do: Actuator only moves downward
- The actuator moves from its start position to the lower target position.
- After reaching the lower target position, the actuator moves back to the start position.

Formula (do): Low target position = Start position (A1.STPOS) ± Start tolerance (A2.STTOL) - Stroke height (A3.STRKH)

uP do: Actuator moves upwards and downwards
- The actuator first moves from its start position to the upper target position.
- It then moves from the upper target position to the lower target position.
- After reaching the lower target position, the actuator moves back to the start position.

Formula (uP do) Target position = Start position (A1.STPOS) ± Start tolerance (A2.STTOL) ± Stroke height (A3.STRKH)

Factory setting: do

A5.RPMD - Ramp mode

Setting options:	• OFF • On
Purpose:	Enable or disable ramp mode. • OFF: The Partial Stroke Test is executed in an uncontrolled manner. • On: The Partial Stroke Test is executed in a controlled manner. The positioner controls according to the ramp rate set in parameter "A6.RPRT". Use ramp mode to shorten or extend the duration of the Partial Stroke Test. Extend the Partial Stroke Test to give the higher-level control loop a chance to react to the Partial Stroke Test.
Factory setting:	OFF

A6.RPRT - Ramp rate

Setting range:	0.1 ... 100.0
Purpose:	Change the ramp rate to shorten or extend the duration of the Partial Stroke Test. The ramp rate refers to the total stroke of the control valve and is set in % stroke per second (%/s). Smaller values extend the duration, larger values shorten the duration of the Partial Stroke Test. Example: Setting "10.0" means that the Partial Stroke Test is run with 10% stroke per second.
Factory setting:	1.0

A7.FLBH - Behavior after failed Partial Stroke Test

Setting options:	• Auto • HOLd • AirIn • AirOu
Purpose:	Determine how the positioner is to respond if a Partial Stroke Test fails. Note: A Partial Stroke Test fails if the limit threshold assigned in "Factor 3 (AC.FACT3)" is exceeded. • Auto: Switch to "Automatic" mode. "AUT" is displayed on the device. • HOLd: Hold current position. • AirIn: Ventilate actuator with supply pressure PZ. • AirOu: Depressurize actuator.
Factory setting:	Auto

A8.INTRV - Test interval

Setting range: OFF, 1 ... 365

Purpose: Use this sub-parameter to enter the interval time for the cyclic Partial Stroke Test in days. Set the test interval in a range from 1 to 365.

Factory setting: OFF

A9.PSTIN - PST reference stroke time

Indication on the display:
- NOINI
- (C)##.#
- FdIni
- rEAL

Purpose: Status for reference stroke time in seconds

Description: Use this sub-parameter to measure the reference stroke time for the Partial Stroke Test.

The reference stroke time corresponds to the controlled movement from the start position to the target position.

If the positioner has already been initialized, the calculated average travel time of the control valve is displayed as a reference value.

- NOINI: Positioner has not yet been initialized.
- (C)##.#: An average travel time of 1.2 seconds, for example, is shown in the display as "C 1.2", whereby "C" stands for 'calculated'. The average travel time can be used as a reference stroke time. However, it merely represents a rough guideline value.
- FdIni: If the start position cannot be approached or the stroke target cannot be reached, "FdIni" is displayed. "FdIni" stands for "failed PST initialization".
- rEAL: Set the sub-parameters "A1.STPOS" to "A5.RPMD" according to your requirements. Then start measuring the reference stroke time by pressing the button for at least 5 seconds. The display shows "rEAL" during these 5 seconds.
  The device then moves to the configured start position automatically and executes the desired stroke. The current position in percent is continuously shown on the display. "inPST" for "initialize partial stroke test" appears in the lower line of the display.

Factory setting: NOINI

AA.FACT1 - Factor 1

Setting range:	0.1 ... 100.0
Purpose:	Use this sub-parameter to assign the factor to form threshold 1. Set the factor in a range from "0.1" to "100.0". The threshold is the product of the reference stroke time and "AA.FACT1". The process to determine the reference stroke time is described under "A9.PSTIN". The threshold 1 message is displayed when threshold 1 is exceeded. This message is only output if threshold 2 or 3 is not exceeded at the same time. The process to activate and display this message is described in the "XDIAG" parameter.
Factory setting:	1.5

Ab.FACT2 - Factor 2

Setting range:	0.1 ... 100.0
Purpose:	Use this sub-parameter to assign the factor to form threshold 2. Set the factor in a range from "0.1" to "100.0". The threshold is the product of the reference stroke time and "Ab.FACT2". The process to determine the reference stroke time is described under "A9.PSTIN". The threshold 2 message is displayed when threshold 2 is exceeded. This message is only output if threshold 3 is not exceeded at the same time. The process to activate and display this message is described in the "XDIAG" parameter.
Factory setting:	3.0

AC.FACT3 - Factor 3

Setting range:	0.1 ... 100.0
Purpose:	Use this sub-parameter to assign the factor to form threshold 3. Set the factor in a range from "0.1" to "100.0". The threshold is the product of the reference stroke time and "AC.FACT3". The process to determine the reference stroke time is described under "A9.PSTIN". The threshold 3 message is displayed when threshold 3 is exceeded. The process to activate and display this message is described in the "XDIAG" parameter. The positioner responds in accordance with the option set in the sub-parameter "A7.FLBH".
Factory setting:	5.0

8.4.4.3 Monitoring of dynamic control valve behavior 'b.\\DEVI'

b.ϟDEVI - Monitoring of dynamic control valve behavior

Requirement:	The '49.XDIAG' [EXT_DIAG] Activation of extended diagnostics (Page 143) parameter is set to 'On1', 'On2' or 'On3'.
Possible settings:	• OFF • On
Purpose:	This parameter allows you to monitor the dynamic control valve behavior. The actual position course is compared with the expected position course for this purpose. This comparison helps in drawing a conclusion about the correct operational response of the control valve. Monitoring is performed in three steps. To activate monitoring, set the parameter to 'On'. Sub-parameters are displayed. Appropriately set the sub-parameters. The current value is displayed in Diagnostics value '15.DEVI - Dynamic control valve behavior' (Page 212). The positioner triggers a message if the current value exceeds one of the three thresholds.
Factory setting:	OFF

b1.TIM - Time constant

Possible settings:	• Auto • 1 ... 400
Purpose:	Use this sub-parameter to define the attenuation effect of the low-pass filter. The unit is seconds. The time constant 'b1.TIM' is calculated from the travel times 'uP' and 'doWn' determined during the initialization. This time constant becomes effective when the 'b1.TIM' parameter is set to 'Auto'. If the time constant is inadequate, the setting of 'b1.TIM' can be changed manually. Set the time constant in a range from '1' to '400'. In this case: • Setting '1' indicates a very weak attenuation. • Setting '400' indicates a strong attenuation. The currently determined deviation is displayed in Diagnostics value '15.DEVI - Dynamic control valve behavior' (Page 212). The positioner triggers a message if the current value exceeds one of the three parameterizable thresholds.
Factory setting:	Auto

b2.LIMIT - Limit

Adjustment range:	0.1 ... 100.0
Purpose:	Use this sub-parameter to set a base limit in percent. The base limit defines the magnitude of the permissible deviation from the expected position course. The limit serves as a reference variable for the fault message factors. Set the base limit in a range from '0.1' to '100.0'.
Factory setting:	1.0

b3.FACT1 - Factor 1

Adjustment range:	0.1 ... 100.0
Purpose:	Use this sub-parameter to set the factor for formation of threshold 1. Set the factor in a range from '0.1' to '100.0'. The threshold is the product of 'b2.LIMIT' and 'b3.FACT1'. The threshold 1 message is displayed when threshold 1 is exceeded. This message is only output if threshold 2 or 3 is not exceeded at the same time. The process to activate and display this message is described in the 'XDIAG' parameter.
Factory setting:	5.0

b4.FACT2 - Factor 2

Adjustment range:	0.1 ... 100.0
Purpose:	Use this sub-parameter to set the factor for formation of threshold 1. Set the factor in a range from '0.1' to '100.0'. The threshold is the product of 'b2.LIMIT' and 'b4.FACT2'. The threshold 2 message is displayed when threshold 2 is exceeded. This message is only output if threshold 3 is not exceeded at the same time. The process to activate and display this message is described in the 'XDIAG' parameter.
Factory setting:	10.0

b5.FACT3 - Factor 3

Adjustment range:	0.1 ... 100.0
Purpose:	Use this sub-parameter to set the factor for formation of threshold 1. Set the factor in a range from '0.1' to '100.0'. The threshold is the product of 'b2.LIMIT' and 'b5.FACT3'. The threshold 3 message is displayed when threshold 3 is exceeded. The process to activate and display this message is described in the 'XDIAG' parameter.
Factory setting:	15.0

8.4.4.4 Monitoring/compensation of pneumatic leakage 'C.\\LEAK'

C.ᛋLEAK - Monitoring/compensation of pneumatic leakage

Note

Accuracy of results

Note that this monitoring only delivers results in the case of single-acting, spring-loaded actuators and a setpoint from 5% to 95%.

Note

Activated tight closing/fast closing function

Note that monitoring with an activated '36.YCLS' Tight closing / fast closing with manipulated variable (Page 134) function only delivers results in the case of a setpoint with the following values:

- Value for tight closing/fast closing **Down** (YCDO) +5% to
- value for tight closing/fast closing **Up** (YCUP) -5%

'37.YCDO' [FINAL_VALUE_CUTTOFF_LO] Value for tight closing / fast closing Down (Page 135)

and '38.YCUP' [FINAL_VALUE_CUTTOFF_HI] Value for tight closing / fast closing Up (Page 135)

Note

Update of the message

When the leakage has been rectified, the new status is displayed as message after some time.

- To determine the current leakage, start the online leakage test with Diagnostic value '11.LEAK - Leakage test' (Page 209).

Condition:	The '49.XDIAG' [EXT_DIAG] Activation of extended diagnostics (Page 143) parameter is set to 'On1', 'On2' or 'On3'. Operating mode 'Automatic' (AUT) is set for the leakage compensation.
Possible settings:	• OFF • On
Purpose:	This parameter is used to activate leak monitoring and leakage compensation. Leakages mainly occur in the actuator or in the pipe installation. To activate monitoring or compensation, set the parameter to 'On'. Sub-parameters are displayed. Appropriately set the sub-parameters.

The **leakage compensation** compensates the leakage in control phases with constant setpoint. The control quality is increased by reducing or preventing the typical, periodic oscillations of leaky valves. The leakage compensation compensates leakages up to 2% of the positioner's air performance.

The two following diagnostics values indicate the length and period of the current leakage compensation pulse:

Diagnostic value '57.LKPUL - Length of the leakage compensation pulse' (Page 219), Diagnostic value '58.LKPER - Period of the leakage compensation pulse' (Page 219)

The **leak monitoring** is carried out in three stages for all control phases (dynamic and static setpoints).

The current value of the monitoring is displayed in Diagnostic value '16.ONLK - Pneumatic leakage' (Page 212).

Factory setting: OFF

C1.LIMIT - Limit

Adjustment range: 0.1 ... 100.0

Purpose: Use this sub-parameter to set the limit of the leakage indicator in percent. Set the limit in a range from '0.1' to '100.0'. If no leakage exists, monitoring of the pneumatic leakage is automatically calibrated in such a way during the initialization (section Commissioning (Page 95)) that the leakage indicator remains below the value 30. A value above 30 means that a leakage exists. '30.0' is therefore an advisable setting for the parameter. After a certain time this limit can be varied slightly depending on the application.

To optimize the sensitivity of the monitoring of the pneumatic leakage to your specific application, follow these steps:

1. After initializing the positioner automatically, use a calibration device to initiate a ramp movement.
2. Conditions for the ramp movement:
   - The ramp covers the normal operating range of the valve.
   - The steepness of the ramp matches the dynamic requirements of the corresponding application.
   - The characteristic of the ramp corresponds to the characteristic of the setpoint that actually occurs.
3. During the ramp movement, the Diagnostic value '16.ONLK - Pneumatic leakage' (Page 212) provides information about the actual values. Define the limit of the leakage indicator accordingly.

The positioner triggers a message if the current value exceeds one of the three thresholds. How to set the three thresholds is described below.

Factory setting: 30.0

C2.FACT1 - Factor 1

Adjustment range:	0.1 ... 100.0
Purpose:	Use this sub-parameter to set the factor for formation of threshold 1. Set the factor in a range from '0.1' to '100.0'. The threshold is the product of 'C1.LIMIT' and 'C2.FACT1'. A leakage was detected when threshold 1 is exceeded. The control quality is not affected. The threshold 1 message is shown. This message is only output if threshold 2 or 3 is not exceeded at the same time. The process to activate and display this message is described in the 'XDIAG' parameter.
Factory setting:	1.0

C3.FACT2 - Factor 2

Adjustment range:	0.1 ... 100.0
Purpose:	Use this sub-parameter to set the factor for formation of threshold 2. Set the factor in a range from '0.1' to '100.0'. The threshold is the product of 'C1.LIMIT' and 'C3.FACT2'. A leakage was detected when threshold 2 is exceeded. The control quality is affected. Maintenance is recommended. The threshold 2 message is shown. This message is only output if threshold 3 is not exceeded at the same time. The process to activate and display this message is described in the 'XDIAG' parameter.
Factory setting:	1.5

C4.FACT3 - Factor 3

Adjustment range:	0.1 ... 100.0
Purpose:	Use this sub-parameter to set the factor for formation of threshold 3. Set the factor in a range from '0.1' to '100.0'. The threshold is the product of 'C1.LIMIT' and 'C4.FACT3'. A leakage was detected when threshold 3 is exceeded. The control quality is strongly affected. Maintenance is necessary. The threshold 3 message is shown. The process to activate and display this message is described in the 'XDIAG' parameter.
Factory setting:	2.0

8.4.4.5 Monitoring of stiction (slipstick) 'd.\\STIC'

d.ϟSTIC - Monitoring of stiction (slipstick)

Requirement:	The '49.XDIAG' [EXT_DIAG] Activation of extended diagnostics (Page 143) parameter is set to 'On1', 'On2' or 'On3'.
Possible settings:	• OFF • On
Purpose:	Use this parameter to continuously monitor the current stiction (slipstick effect) of the control valve. If the parameter is activated, the positioner detects the slipstick that can occur. Sudden changes in the process valve position, so-called slip jumps, indicate excessive stiction. Where slip jumps are detected, the filtered step height is stored as a slipstick value. If slip jumps no longer exist, the stiction (slipstick effect) is reduced slowly. Monitoring is performed in three steps. To activate monitoring, set the parameter to 'On'. Sub-parameters are displayed. Appropriately set the sub-parameters. The current value is displayed in Diagnostic value '17.STIC - Stiction (slipstick)' (Page 212). The positioner triggers a message if the current value exceeds one of the thresholds.
Factory setting:	OFF

Note

Incorrect interpretation in case of travel times below one second

If the travel times are less than one second, the positioner does not accurately differentiate between a normal movement of the actuator and a sudden change. Therefore, increase the travel time if required.

d1.LIMIT - limit for slipstick detection

Setting range:	0.1 ... 100.0
Purpose:	Use this sub-parameter to set the base limit for slipstick detection in percent. Set the base limit in a range from '0.1' to '100.0'.
Factory setting:	1.0

d2.FACT1 - Factor 1

Setting range: 0.1 ... 100.0

Purpose: Use this sub-parameter to set the factor for formation of threshold 1. Set the factor in a range from '0.1' to '100.0'. The threshold is the product of the values entered for 'd1.LIMIT' and 'd2.FACT1'.

The threshold 1 message is displayed when threshold 1 is exceeded. This message is only output if threshold 2 or 3 is not exceeded at the same time. The process to activate and display this message is described in the 'XDIAG' parameter.

Factory setting: 2.0

d3.FACT2 - Factor 2

Setting range: 0.1 ... 100.0

Purpose: Use this sub-parameter to set the factor for formation of threshold 2. Set the factor in a range from '0.1' to '100.0'. The threshold is the product of the values entered for 'd1.LIMIT' and 'd3.FACT2'.

The threshold 2 message is displayed when threshold 2 is exceeded. This message is only output if threshold 3 is not exceeded at the same time. The process to activate and display this message is described in the 'XDIAG' parameter.

Factory setting: 5.0

d4.FACT3 - Factor 3

Setting range: 0.1 ... 100.0

Purpose: Use this sub-parameter to set the factor for formation of threshold 3. Set the factor in a range from '0.1' to '100.0'. The threshold is the product of the values entered for 'd1.LIMIT' and 'd4.FACT3'.

The threshold 3 message is displayed when threshold 3 is exceeded. The process to activate and display this message is described in the 'XDIAG' parameter.

Factory setting: 10.0

8.4.4.6 Monitoring of deadband 'E.\\DEBA'

E.ϟDEBA - Monitoring of deadband

Requirement: The '49.XDIAG' [EXT_DIAG] Activation of extended diagnostics (Page 143) parameter is set to 'On'.

The '31.DEBA' [DEADBAND] Deadband of closed-loop controller (Page 131) parameter is set to 'Auto'.

Possible settings:

- OFF
- On

Purpose:	Use this parameter to continuously monitor the automatic adaptation of the deadband. Monitoring is performed in one step. To activate monitoring, set the parameter to 'On'. The sub-parameter is displayed. Appropriately set the sub-parameter. The current value is displayed in Diagnostic value '17.STIC - Stiction (slipstick)' (Page 212). The positioner triggers a message if the current value exceeds the threshold.
Factory setting:	OFF

E1.LEVL3 - Threshold

Adjustment range:	0.1 ... 3.0
Purpose:	Use this sub-parameter to set the threshold to the deadband in percent. Set the threshold in a range from '0.1' to '10.0'. The values are monitored in the range of '0.1' to '2.9'. Values between '3.0' and '10.0' are not monitored. The threshold 3 message is displayed when the current deadband exceeds the threshold during the test. The process to activate and display this message is described in the 'XDIAG' parameter.
Factory setting:	2.0

Note

Fault message display

The three-stage fault message display has not been implemented for monitoring of the deadband. The positioner triggers only threshold 3 messages depending on the setting.

8.4.4.7 Monitoring of lower endstop 'F.\\ZERO'

F.ϟZERO - Monitoring of lower endstop

Note

Fault detection

Monitoring of lower endstop not only responds to faults in the valve. If the limit thresholds of the lower endstop are exceeded due to misalignment of the position feedback, the misalignment also triggers a diagnostics message.

Requirement: The '49.XDIAG' [EXT_DIAG] Activation of extended diagnostics (Page 143) parameter is set to 'On1', 'On2' or 'On3'.

The '36.YCLS' Tight closing / fast closing with manipulated variable (Page 134) parameter is set to one of the following values: 'do', 'uP do', 'Fd', 'Fu Fd', 'uP Fd', 'Fu do'.

Possible settings:
- OFF
- On

Purpose: Use this parameter to activate continuous monitoring of the lower endstop. Monitoring is always carried out if the 'YCLS (Page 134)' parameter is set to one of the following values: 'do', 'uP do', 'Fd', 'Fu Fd', 'uP Fd', 'Fu do'

It checks whether the lower endstop has changed compared to its value during initialization. Monitoring is performed in three steps. Set the following sub-parameters appropriately. To activate monitoring, set the parameter to 'On'. Sub-parameters are displayed.

The current value is displayed in Diagnostic value '18.ZERO - Lower endstop' (Page 212). The positioner triggers a message if the current value undershoots one of the three thresholds.

Factory setting: OFF

F1.LEVL1 - threshold 1

Setting range: 0.1 ... 10.0

Purpose: Use this sub-parameter to set threshold 1 for the lower endstop in percent. Set the threshold in a range from '0.1' to '10.0'.

The positioner triggers a threshold 1 message if the difference between the lower endstop and the initialization value undershoots threshold 1. This message is only output if threshold 2 or 3 is not unsershot at the same time. The process to activate and display this message is described in the 'XDIAG' parameter.

Factory setting: 1.0

F2.LEVL2 - threshold 2

Setting range: 0.1 ... 10.0

Purpose: Use this sub-parameter to set threshold 2 for the lower endstop in percent. Set the threshold in a range from '0.1' to '10.0'.

The positioner triggers a threshold 2 message if the difference between the lower endstop and the initialization value undershoots threshold 2. This message is only output if threshold 3 is not undershot at the same time. The process to activate and display this message is described in the 'XDIAG' parameter.

Factory setting: 2.0

F3.LEVL3 - threshold 3

Setting range:	0.1 ... 10.0
Purpose:	Use this sub-parameter to set threshold 3 for the lower endstop in percent. Set the threshold in a range from '0.1' to '10.0'. The positioner triggers a threshold 3 message if the difference between the lower endstop and the initialization value undershoots threshold 3. The process to activate and display this message is described in the 'XDIAG' parameter.
Factory setting:	4.0

8.4.4.8 Monitoring of upper endstop 'G.\\OPEN'

G.ˋOPEN - Monitoring of upper endstop

Note

Fault detection

Monitoring of upper endstop not only responds to faults in the valve. If the limit thresholds of the upper endstop are exceeded due to misalignment of the position feedback, the misalignment also triggers a message.

Requirement:	The '49.XDIAG' [EXT_DIAG] Activation of extended diagnostics (Page 143) parameter is set to 'On1', 'On2' or 'On3'. The '36.YCLS' Tight closing / fast closing with manipulated variable (Page 134) parameter is set to one of the following values: 'uP', 'uP do', 'Fu', 'Fu Fd', 'uP Fd', 'Fu do'
Possible settings:	• OFF • On
Purpose:	Use this parameter to activate continuous monitoring of the upper endstop. Monitoring is always carried out if the 'YCLS (Page 134)' parameter is set to one of the following values: 'uP', 'uP do', 'Fu', 'Fu Fd', 'uP Fd', 'Fu do' It checks whether the upper endstop has changed compared to its value during initialization. Monitoring is performed in three steps. Set the following sub-parameters appropriately. To activate monitoring, set the parameter to 'On'. Sub-parameters are displayed. The value is displayed in Diagnostic value '19.OPEN - Upper endstop' (Page 213). The positioner triggers a message if the current value exceeds one of the three thresholds.
Factory setting:	OFF

G1.LEVL1 - threshold 1

Setting range:	0.1 ... 10.0
Purpose:	Use this sub-parameter to set threshold 1 for the upper endstop in percent. Set the threshold in a range from '0.1' to '10.0'. The positioner triggers a threshold 1 message if the difference between the upper endstop and the initialization value exceeds threshold 1. This message is only output if threshold 2 or 3 is not exceeded at the same time. The process to activate and display this message is described in the 'XDIAG' parameter.
Factory setting:	1.0

G2.LEVL2 - threshold 2

Setting range:	0.1 ... 10.0
Purpose:	Use this sub-parameter to set threshold 2 for the upper endstop in percent. Set the threshold in a range from '0.1' to '10.0'. The positioner triggers a threshold 2 message if the difference between the upper endstop and the initialization value exceeds threshold 2. This message is only output if threshold 3 is not exceeded at the same time. The process to activate and display this message is described in the 'XDIAG' parameter.
Factory setting:	2.0

G3.LEVL3 - threshold 3

Setting range:	0.1 ... 10.0
Purpose:	Use this sub-parameter to set threshold 3 for the upper endstop in percent. Set the threshold in a range from '0.1' to '10.0'. The positioner triggers a threshold 3 message if the difference between the upper endstop and the initialization value exceeds threshold 3. The process to activate and display this message is described in the 'XDIAG' parameter.
Factory setting:	4.0

8.4.4.9 Monitoring the lower limit temperature 'H.\\TMIN'

H.ϟTMIN - Monitoring the lower limit temperature

Requirement:	The '49.XDIAG' [EXT_DIAG] Activation of extended diagnostics (Page 143) parameter is set to 'On1', 'On2' or 'On3'.
Possible settings:	• OFF • On

Purpose:	The current temperature inside the enclosure of the field device is recorded by a sensor on the basic electronics. Use this parameter to activate continuous monitoring of the lower limit temperature inside the enclosure. Monitoring is performed in three steps. To activate monitoring, set the parameter to 'On'. Sub-parameters are displayed. Appropriately set the sub-parameters. The value is displayed in Diagnostic value '31.TMIN - Minimum temperature' / '32.TMAX - Maximum temperature' (Page 216). The positioner triggers a message if the current value undershoots one of the three thresholds.
Factory setting:	OFF

H1.TUNIT - temperature unit

Possible settings:	°C °F
Purpose:	Use this sub-parameter to set the temperature unit '°C' or '°F'. The selected temperature unit is then also applicable for all other temperature-based parameters.
Factory setting:	°C

H2.LEVL1 - threshold 1

Adjustment range:	-40.0C ... 90.0C -40.0F ... 194.0F
Purpose:	Use this sub-parameter to set the temperature for threshold 1. The positioner triggers a threshold 1 message if the current temperature inside the enclosure undershoots threshold 1. This message is only output if threshold 2 or 3 is not exceeded at the same time. The process to activate and display this message is described in the 'XDIAG' parameter.
Factory setting:	-25.0C

H3.LEVL2 - threshold 2

Adjustment range:	-40.0C ... 90.0C -40.0F ... 194.0F
Purpose:	Use this sub-parameter to set the temperature for threshold 2. The positioner triggers a threshold 2 message if the current temperature inside the enclosure undershoots threshold 2. This message is only output if threshold 3 is not exceeded at the same time. The process to activate and display this message is described in the 'XDIAG' parameter.
Factory setting:	-30.0C

H4.LEVL3 - threshold 3

Adjustment range:	-40.0C ... 90.0C -40.0F ... 194.0F
Purpose:	Use this sub-parameter to set the temperature for threshold 3. The positioner triggers a threshold 3 message if the current temperature inside the enclosure undershoots threshold 3. The process to activate and display this message is described in the 'XDIAG' parameter.
Factory setting:	-40.0C

8.4.4.10 Monitoring the upper limit temperature 'J.\\TMAX'

J.ϟTMAX - Monitoring the upper limit temperature

Requirement:	The '49.XDIAG' [EXT_DIAG] Activation of extended diagnostics (Page 143) parameter is set to 'On1', 'On2' or 'On3'.
Possible settings:	• OFF • On
Purpose:	The current temperature inside the enclosure of the field device is recorded by a sensor on the basic electronics. Use this parameter to activate continuous monitoring of the upper limit temperature inside the enclosure. Monitoring is performed in three steps. To activate monitoring, set the parameter to 'On'. Sub-parameters are displayed. Appropriately set the sub-parameters. The value is displayed in Diagnostic value '31.TMIN - Minimum temperature' / '32.TMAX - Maximum temperature' (Page 216). The positioner triggers a message if the current value exceeds one of the three thresholds.
Factory setting:	OFF

J1.TUNIT - temperature unit

Possible settings:	°C °F
Purpose:	Use this sub-parameter to set the temperature unit '°C' or '°F'. The selected temperature unit is then also applicable for all other temperature-based parameters.
Factory setting:	°C

J2.LEVL1 - threshold 1

Adjustment range:	-40.0C ... 90.0C -40.0F ... 194.0F
Purpose:	Use this sub-parameter to set the temperature for threshold 1. The positioner triggers a threshold 1 message if the current temperature inside the enclosure exceeds threshold 1. This message is only output if threshold 2 or 3 is not exceeded at the same time. The process to activate and display this message is described in the 'XDIAG' parameter.
Factory setting:	75.0C

J3.LEVL2 - threshold 2

Adjustment range:	-40.0C ... 90.0C -40.0F ... 194.0F
Purpose:	Use this sub-parameter to set the temperature for threshold 2. The positioner triggers a threshold 2 message if the current temperature inside the enclosure exceeds threshold 2. This message is only output if threshold 3 is not exceeded at the same time. The process to activate and display this message is described in the 'XDIAG' parameter.
Factory setting:	80.0C

J4.LEVL3 - threshold 3

Adjustment range:	-40.0C ... 90.0C -40.0F ... 194.0F
Purpose:	Use this sub-parameter to set the temperature for threshold 3. The positioner triggers a threshold 3 message if the current temperature inside the enclosure exceeds threshold 3. The process to activate and display this message is described in the 'XDIAG' parameter.
Factory setting:	90.0C

8.4.4.11 Monitoring of number of total strokes 'L.\\STRK'

L.ᛋSTRK - Monitoring of number of total strokes

Condition:	The '49.XDIAG' [EXT_DIAG] Activation of extended diagnostics (Page 143) parameter is set to 'On1', 'On2' or 'On3'.
Possible settings:	• OFF • On

Purpose:	Use this parameter to continuously monitor the total strokes covered by the actuator. A total stroke corresponds to the path from the lower endstop of the actuator to the upper endstop and back again, in other words twice the travel. During operation, partial strokes of the actuator are added together into total strokes. Monitoring is performed in three steps. To activate monitoring, set the parameter to 'On'. Sub-parameters are displayed. Appropriately set the sub-parameters. The current value is displayed in Diagnostic value '1.STRKS - Number of total strokes' (Page 208). The positioner triggers a message if the current value exceeds one of the three thresholds. This message is only output if threshold 2 or 3 is not exceeded at the same time.
Factory setting:	OFF

L1.LIMIT - Limit

Adjustment range:	1 ... 1.00E8
Purpose:	Use this sub-parameter to set the base limit for the number of total strokes. Set the base limit in a range from '1' to '1.00E8'.
Factory setting:	1.00E6

L2.FACT1 - Factor 1

Adjustment range:	0.1 ... 40.0
Purpose:	Use this sub-parameter to set the factor for formation of threshold 1. Set the factor in a range from '0.1' to '40.0'. The threshold is the product of 'L1.LIMIT' and 'L2.FACT1'. The threshold 1 message is displayed when threshold 1 is exceeded. This message is only output if threshold 2 or 3 is not exceeded at the same time. The process to activate and display this message is described in the 'XDIAG' parameter.
Factory setting:	1.0

L3.FACT2 - Factor 2

Adjustment range:	0.1 ... 40.0
Purpose:	Use this sub-parameter to set the factor for formation of threshold 2. Set the factor in a range from '0.1' to '40.0'. The threshold is the product of 'L1.LIMIT' and 'L3.FACT2'. The threshold 2 message is displayed when threshold 2 is exceeded. This message is only output if threshold 3 is not exceeded at the same time. The process to activate and display this message is described in the 'XDIAG' parameter.
Factory setting:	2.0

L4.FACT3 - Factor 3

Adjustment range:	0.1 ... 40.0
Purpose:	Use this sub-parameter to set the factor for formation of threshold 3. Set the factor in a range from '0.1' to '40.0'. The threshold is the product of 'L1.LIMIT' and 'L4.FACT3'. The threshold 3 message is displayed when threshold 3 is exceeded. The process to activate and display this message is described in the 'XDIAG' parameter.
Factory setting:	5.0

8.4.4.12 Monitoring of number of changes in direction 'O.\\DCHG'

O.ϟDCHG - Monitoring of number of changes in direction

Condition:	The '49.XDIAG' [EXT_DIAG] Activation of extended diagnostics (Page 143) parameter is set to 'On1', 'On2' or 'On3'.
Possible settings:	• OFF • On
Purpose:	Use this parameter to continuously monitor the number of changes in direction of the actuator beyond the deadband. Monitoring is performed in three steps. Set the following sub-parameters appropriately. To activate monitoring, set the parameter to 'On'. Sub-parameters are displayed. The current value is displayed in Diagnostic value '2.CHDIR - Number of changes in direction' (Page 208). The positioner triggers a message if the current value exceeds one of the three thresholds.
Factory setting:	OFF

O1.LIMIT - Limit

Adjustment range:	1 ... 1.00E8
Purpose:	Use this sub-parameter to set the base limit for the changes of direction of the actuator. Set the base limit in a range from '1' to '1.00E8'.
Factory setting:	1.00E6

O2.FACT1 - Factor 1

Adjustment range: 0.1 ... 40.0

Purpose: Use this sub-parameter to set the factor for formation of threshold 1. Set the factor in a range from '0.1' to '40.0'. The threshold is the product of 'O1.LIMIT' and 'O2.FACT1'.

The threshold 1 message is displayed when threshold 1 is exceeded. This message is only output if threshold 2 or 3 is not exceeded at the same time. The process to activate and display this message is described in the 'XDIAG' parameter.

Factory setting: 1.0

O3.FACT2 - Factor 2

Adjustment range: 0.1 ... 40.0

Purpose: Use this sub-parameter to set the factor for formation of threshold 2. Set the factor in a range from '0.1' to '40.0'. The threshold is the product of 'O1.LIMIT' and 'O3.FACT2'.

The threshold 2 message is displayed when threshold 2 is exceeded. This message is only output if threshold 3 is not exceeded at the same time. The process to activate and display this message is described in the 'XDIAG' parameter.

Factory setting: 2.0

O4.FACT3 - Factor 3

Adjustment range: 0.1 ... 40.0

Purpose: Use this sub-parameter to set the factor for formation of threshold 3. Set the factor in a range from '0.1' to '40.0'. The threshold is the product of 'O1.LIMIT' and 'O4.FACT3'.

The threshold 3 message is displayed when threshold 3 is exceeded. The process to activate and display this message is described in the 'XDIAG' parameter.

Factory setting: 5.0

8.4.4.13 Monitoring the position average value 'P.\\PAVG'

P.ϟPAVG - Monitoring the position average value

Requirement: The '49.XDIAG' [EXT_DIAG] Activation of extended diagnostics (Page 143) parameter is set to 'On1', 'On2' or 'On3'.

Possible settings:
- OFF
- On

Purpose: Use this parameter to activate the test to calculate and monitor the average value of position. During the test, the average values of position and reference are always compared at the end of a time interval.

The current value is displayed in Diagnostic value '20.PAVG - Average value of position' (Page 213). The positioner triggers a message if the current average value of position undershoots one of the three thresholds.

Factory setting: OFF

P1.TBASE - Time basis of average value generation

Possible settings: 0.5h / 8h / 5d / 60d / 2.5y

Purpose: Use this sub-parameter to set the time interval to calculate the average value of position. The following values are available to define the time intervals:

- 30 minutes
- 8 hours
- 5 days
- 60 days
- 2.5 years

After start of the average reference value calculation and expiration of the time interval, the average position value over the interval is calculated and compared with the average reference value. The test is then restarted.

Factory setting: 0.5h

P2.STATE - Status of monitoring position average value

Possible settings: IdLE / rEF / ###.# / Strt

Purpose: Use this sub-parameter to start the calculation of the average position value. If an average reference value has never been determined, the parameter value is 'IdLE'.

Then start the calculation by pressing the button for 5 seconds. The value in the display changes from 'IdLE' to 'rEF'. The average reference value is calculated.

When the time interval expires, the calculated average reference value is shown on the display.

Factory setting: IdLE

Note

Current average position value

The current average position value in each case is displayed in the Diagnostic value '20.PAVG - Average value of position' (Page 213). If no average position value has been calculated, 'COMP' is displayed as the diagnostics value.

P3.LEVL1 - threshold 1

Possible settings:	0.1 ... 100.0
Purpose:	Use this sub-parameter to set threshold 1 for the maximum deviation of the current average position value from the average reference value. The value is given in percent. Set the threshold in a range from '0.1' to '100.0'. The positioner outputs the threshold 1 message if the difference between the average position value and the average reference value exceeds threshold 1. This message is only output if threshold 2 or 3 is not exceeded at the same time. The process to activate and display this message is described in the 'XDIAG' parameter.
Factory setting:	2.0

P4.LEVL2 - Threshold 2

Possible settings:	0.1 ... 100.0
Purpose:	Use this sub-parameter to set threshold 2 for the maximum deviation of the current average position value from the average reference value. The value is given in percent. Set the threshold in a range from '0.1' to '100.0'. The positioner outputs the threshold 2 message if the difference between the average position value and the average reference value exceeds threshold 2. This message is only output if threshold 3 is not exceeded at the same time. The process to activate and display this message is described in the 'XDIAG' parameter.
Factory setting:	5.0

P5.LEVL3 - Threshold 3

Possible settings:	0.1 ... 100.0
Purpose:	Use this sub-parameter to set threshold 3 for the maximum deviation of the current average position value from the average reference value. The value is given in percent. Set the threshold in a range from '0.1' to '100.0'. The positioner outputs the threshold 3 message if the difference between the average position value and the average reference value exceeds threshold 3. The process to activate and display this message is described in the 'XDIAG' parameter.
Factory setting:	10.0

Functional safety 9

9.1 Range of applications for functional safety

The positioner is suitable for use on valves that satisfy the special requirements in terms of functional safety up to SIL 2 in accordance with IEC 61508 or IEC 61511. The 6DR5.1.-0....-....-Z C20 versions are available for this.

These are single-acting positioners for mounting on pneumatic actuators with spring return.

The positioner automatically depressurizes the actuator on demand or in case of faults. The actuator brings the process valve to the specified safety position in this way.

This positioner meets the following requirement:

- Functional safety up to SIL 2 in accordance with IEC 61508 or IEC 61511 for safe venting

See also

Functional safety in process instrumentation (http://www.siemens.com/SIL)

9.2 Safety function

Safety function on positioner

Depressurizing of the connected actuator is the safety function for the positioner. The built-in spring brings the valve to the required safety position. Depending on the direction of action of this spring, the valve is completely opened or closed.

This safety function can be triggered by:

- The signal at the input for the safety shutdown (terminals 81 and 82) is < 4.5 V.
  This function is also referred to as "safety shutdown" in the device documentation.
- Failure of the auxiliary power supply via the bus connection.

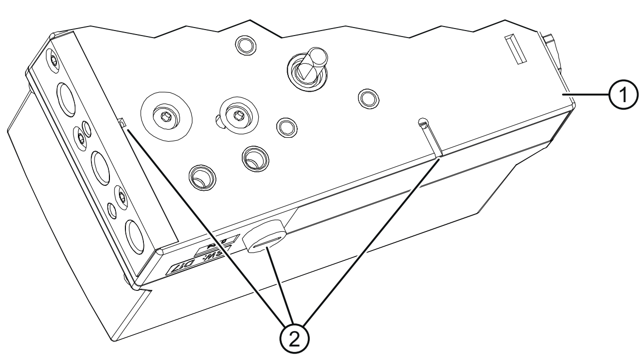
The safety function is not affected by other device functions, particularly the microcontroller, software and communication interface. With respect to this safety function, the positioner must therefore be considered as a type A subsystem in accordance with EN 61508-2.

Situations in which it is not possible to depressurize the actuator on demand or in the case of a fault represent a dangerous failure.

⚠ WARNING
Disregarding conditions for fulfilling the safety function
Disregarding conditions can result in a malfunction of the process system or application, for example, process pressure too high, maximum level exceeded.
The mandatory settings and conditions are listed in sections Setup (Page 178) and Safety characteristics (Page 179).
• These conditions must be met in order to fulfill the safety function.

The pneumatic block of the positioner pressurizes and depressurizes the actuator. The pneumatic block contains two pilot valves. The characteristic service life of the pneumatic block depends on the load. On average it is approx. 200 million switching cycles for each of the two pilot valves with symmetrical load. The number of control procedures for the switching cycles is called in the local display or via the communication function. For more details, see Diagnostic value '42.VENT1' / '43.VENT2' (Page 217).

NOTICE
Freezing of the exhaust air outlets
When devices of the type 6DR5..0/1/2/3 are used, the exhaust air outlets ② may freeze. The function of the device is impaired.
• Do **not** install the positioner with the base plate ① pointing up.



① Base plate
② Exhaust air outlets

Figure 9-1 Exhaust air outlets, base plate

Safety-instrumented system in single-channel operation (SIL 2)

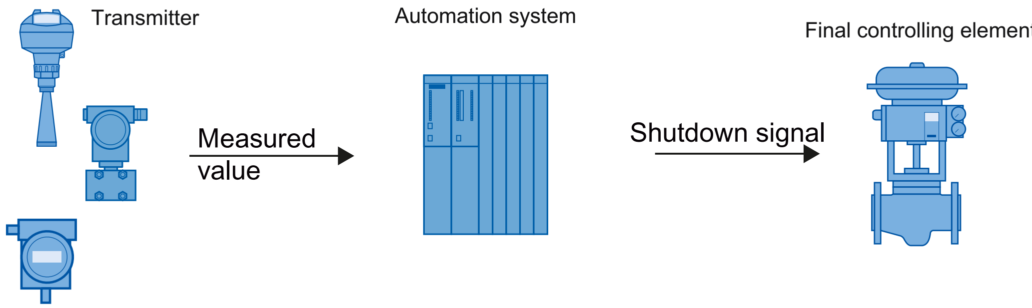


Figure 9-2 Safety-instrumented system in single-channel operation

The combination of transmitter, automation system and final controlling element forms a safety-instrumented system that performs a safety function.

The transmitter generates a process-related measured value that is transferred to the automation system. The automation system monitors this measured value. If the measured value violates the high or low limit, the automation system generates a shutdown signal for the connected final controlling element, which switches the corresponding process valve to the specified safety position.

9.3 Safety Integrity Level (SIL)

The international standard IEC 61508 defines four discrete Safety Integrity Levels (SIL) from SIL 1 to SIL 4. Each level corresponds to a range of probability for failure of a safety function.

Description

The following table shows the dependency of the SIL on the "average probability of dangerous failure of a safety function of the entire safety-instrumented system" (PFD_{AVG}). "Low demand mode" is examined. The safety function is required a maximum of once per year on average.

Table 9-1 Safety Integrity Level

SIL	Interval
4	$10^{-5} \leq PFD_{AVG} < 10^{-4}$
3	$10^{-4} \leq PFD_{AVG} < 10^{-3}$
2	$10^{-3} \leq PFD_{AVG} < 10^{-2}$
1	$10^{-2} \leq PFD_{AVG} < 10^{-1}$

The "average probability of dangerous failure of the entire safety-related system" (PFD_{AVG}) is normally split between the following three components:

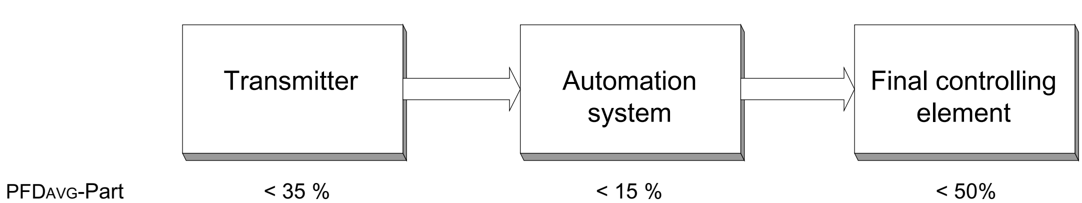


Figure 9-3 PFD distribution

The following table shows the achievable Safety Integrity Level (SIL) for the entire safety-related system for type A devices depending on the safe failure fraction (SFF) and the hardware fault tolerance (HFT).

- Type A devices include analog transmitters and solenoid valves **without** complex components, e.g. microprocessors (see also IEC 61508, Section 2).
- The specific values for your device are listed in the manufacturer's declaration of the device (SIL Declaration of Conformity, Functional Safety according to IEC 61508 and IEC 61511): Certificates (http://www.siemens.com/processinstrumentation/certificates).

SFF	**HFT for type A devices**		
	0	**1**	**2**
< 60%	SIL 1	SIL 2	SIL 3
60 to 90%	SIL 2	SIL 3	SIL 4
90 to 99%	SIL 3	SIL 4	SIL 4
> 99%	SIL 3	SIL 4	SIL 4

9.4 Setup

WARNING

Safety function: Positioning "Jumper" on the basic electronics

The safety function is not activated in the delivered state; the "Jumper" is in the "Normal" position. "Normal" means: Without safety function, no depressurizing of the connected actuator. To activate the safety function, proceed as follows:

- Insert the "Jumper" in the left position facing the terminals. This corresponds to the position "Shut Down enabled" on the wiring diagram present on the module cover, see "Figure 3-6 View of the positioner (cover open; polycarbonate enclosure) (Page 27)".

Or

- Remove the "Jumper" from the basic electronics.

Special parameter settings are not necessary.

Protection against configuration changes

You should attach the housing cover so that the device is protected against unwanted and unauthorized changes/operation.

Checking the safety function

Prerequisite for checking the safety function

- Positioner is in operation.
- The actuator belonging to the positioner is **not** in the safety position.

Procedure

1. In order to test the safety shutdown, apply a LOW level, i.e. a voltage of maximum 4.5 V, to the input for the safety shutdown.
2. Verify that the valve returns to the safety position.
3. In order to test the response of the actuator, apply a HIGH level, i.e. a voltage >13 V, to the input for the safety shutdown.
4. Set the setpoint to 50% using a local operation (manual operation) or bus communication.
5. Reduce the supply pressure (PZ) to a third of the maximum supply pressure.
6. Verify that the valve returns to the safety position.
7. Check the filters in the pneumatic connections for contamination and clean them if necessary.

See also

Overview of device components (Page 27)

Safety function (Page 175)

9.5 Safety characteristics

The safety characteristics necessary for use of the system are listed in the SIL declaration of conformity. These values apply under the following conditions:

- The positioner is only used in applications with low demand rate for the "Low demand mode".
- "Jumper" on the basic electronic system was plugged into the left position facing the terminals at position "Shut Down enabled" or removed completely.
- The positioner is blocked against unwanted and unauthorized changes/operation.
- The shut-off signal for the positioner is generated at the input for the safety shutdown (terminals 81 and 82) by a safe system which meets at least SIL 2. The LOW level has a maximum of 4.5 V at the input terminals.
- The connected actuator must be singe-acting and return the valve to the safe end position by spring force in the following scenario:
  – At a chamber pressure (Y1 connection) up to a third of the maximum available intake pressure (P_z connection)
- The air outlet does not contain any additional cross-sectional contractions leading to an increased dynamic pressure. In particular, a silencer is only allowed if icing or other contamination is ruled out.

- The restrictor in the Y1 circuit may not be completely closed during operation.
- The auxiliary pneumatic power is free of oil, water and dirt in line with: DIN/ISO 8573-1, maximum class 3
- The average temperature viewed over a long period is 40 °C.
- Fault rates are calculated on the basis of a mean time to repair (MTTR) of 8 hours.
- In case of a fault, the pneumatic outlet of the positioner is depressurized. A spring in the pneumatic actuator must move the valve to the pre-defined, safe end position.
- A dangerous failure of the positioner is when the pressure outlet is not depressurized, or the safety position is not reached, with a LOW level of maximum 4.5 V at the input for the safety shutdown.

See also

Setup (Page 178)

9.6 Maintenance/check

Interval

We recommend that the functioning of the positioner is checked at regular intervals of one year.

Checking the safety function

Check the safety function as detailed in chapter "Setup (Page 178)"

Checking safety

Verify the safety function of the entire safety circuit on a regular basis in accordance with IEC 61508/61511. The test intervals are determined in the course of calculations for each safety circuit of a system (PFD_{AVG}).

Fieldbus communication 10

10.1 Overview

10.1.1 Block structure

In accordance with the FOUNDATION Fieldbus specification, the positioner is designed as a Basic-Field-Device with Link Master function. It consists of four blocks:

- Resource Block
- 1 Analog Output Function Block
- 1 Analog Output Transducer Block
- 1 PID Function Block

Function blocks

The following image provides an overview of the two function blocks and of the Transducer Block with the associated inputs and outputs. The Link Master function is not shown.

The Resource Block is not shown since it has neither inputs nor outputs.

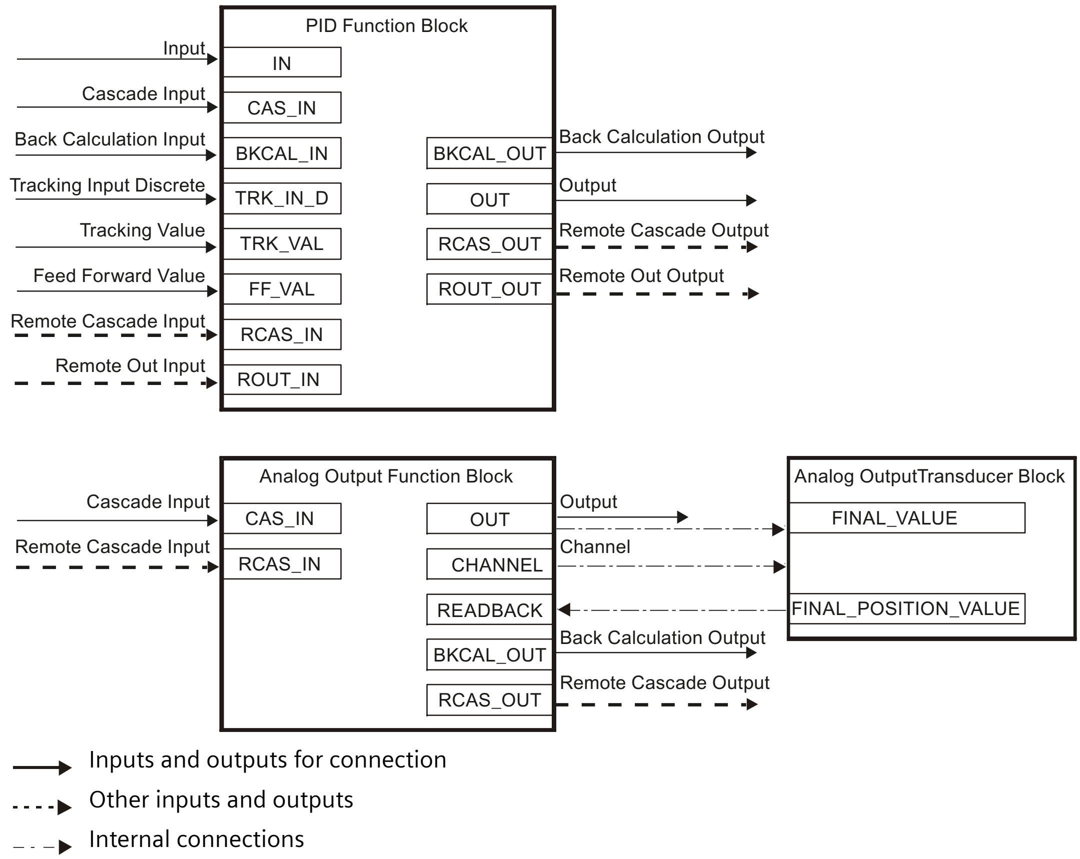


Figure 10-1 Overview of the function blocks

10.1.2 Addressing

Node address

In order to function correctly, the fieldbus device must have a unique node address and a physical device identifier for the fieldbus.

The node address must be unique within the link (segment), while the physical device identifier must be unique within the entire network.

The positioner is provided with a unique physical device identifier in the factory. The device identifier is a concatenation of the SIPART PS2 FF string and part of the serial number. The node address is set to "22".

During device configuration, you must set the node address to a value that is unique within the link.

If the positioner detects another device with the same node address, it automatically sets one of the temporary standard addresses between "248" and "251". This avoids address conflicts.

10.1.3 Configuring

Requirements

You require the following software or files in order to configure the positioner:

- Device Description
- Capability file for the Offline configuration
- Configuration tool such as the National Instruments NIFBUS-Configurator or the tool integrated in your control system.

Device Description

The Device Description (DD) contains all information available at the fieldbus interface in a machine-readable format. The Device Description contains:

- Notes concerning the display of information on the screen
- Notes concerning the arrangement of parameters in hierarchical menus
- Methods for execution of action sequences. These methods help you during the individual configuration steps
- Detailed help texts concerning the meaning and possible settings for the individual parameters.

Host computers and configuration tools use the Device Description in order to provide a user-friendly configuration interface.

Information concerning installation of the Device Description can be found in the manuals of your respective configuration tool or control system.

The Device Description consists of two files:

Files of the Device Description:

DD binary:	0301.ff5
Symbol information:	0301.sy5

Capability file

The **Capability** file contains all information required for the **Offline** configuration.

Information concerning installation of the **Capability** file can be found in the manuals of your respective configuration tool or control system.

Capability file	**030101.cff**

10.2 Resource block (RB2)

The resource block contains data specific to the hardware associated with this block. They include:

- Device type with change index
- Manufacturer's number
- Serial number
- Resource status

All data is designed as "integrated", and therefore there are no connections whatsoever to this block. Since the data cannot be processed as in a function block, there is no flowchart.

Note

Operating mode of resource block

The resource block must be in automatic mode so that the function blocks contained in the device can be executed.

10.3 Analog output function block (AO)

Functional principle

The Analog Output Block processes the setpoint SP and sends this to the Analog Output Channel of the transducer block. The source of the setpoint SP depends on the current operating mode of the block. Possible sources are:

Operating mode	Source
AUTO	Parameter SP
CAS mode	Input CAS_IN
RCAS mode	Value RCAS_IN

In manual mode (MAN), the output OUT can be set directly to the desired value.

The actual position of the valve (FINAL_POSITION_VALUE parameter) is received by the transducer block and scaled in order to obtain the actual process value PV.

PV or SP can be used in order to supply the Back Calculation Output BKCAL_OUT and RCAS_OUT.

The block supports cascade initialization so that the subsequent control blocks can be switched smoothly from manual to automatic mode.

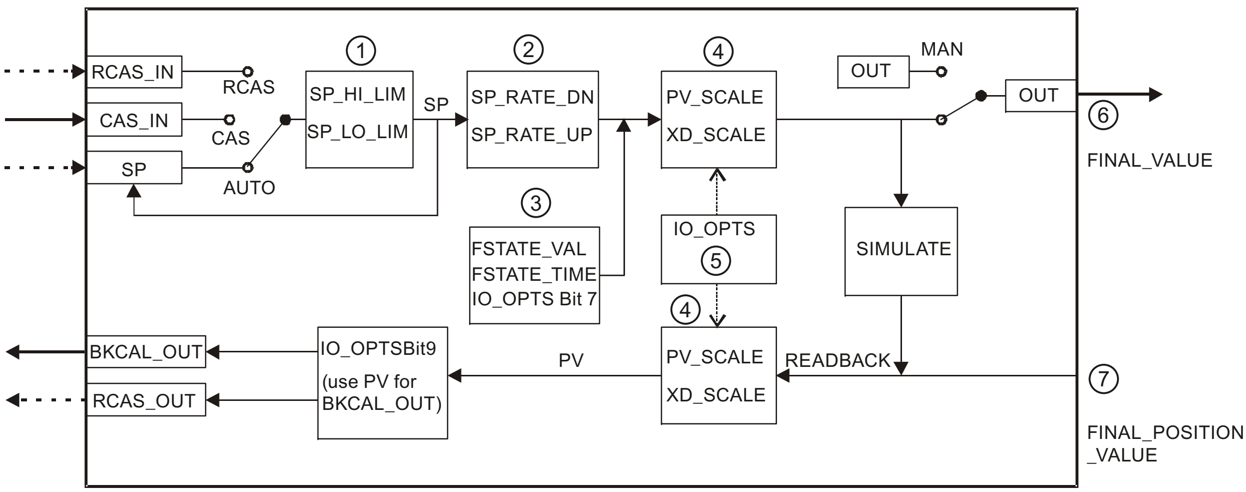
The analog output has an error status response which reacts if the transfer with the subsequent block fails. See the FSTATE_TIME, FSTATE_VAL and IO_OPTS parameters.

Simulation is possible with the SIMULATE parameter. A prerequisite for this function is a properly parameterized digital input DI1. With active simulation, Transducer Block is ignored: READBACKvalue and status originate from SIMULATE_VALUE and SIMULATE_STATUS.

The execution time of the analog output block is 60 ms, with a minimum time of 60 ms.

Flowchart

The following image provides a summary of the functions of the function block Analog Output (AO):



⟶	Inputs and outputs for connection
- - - -▶	Other inputs and outputs
PV	Process value
SP	Setpoint
①	Setpoint limitation
②	Manipulated variable limits
③	Error status control
④	Scaling
⑤	Increment to close.
⑥	To the transducer block
⑦	From the transducer block

Figure 10-2 Flowchart of function block Analog Output (AO)

10.4 Analog output transducer block (AOTB)

Functional principle

The Analog Output Transducer Block is the interface to the physical hardware. This block separates the Analog Output Function Block from the hardware components of the positioner.

The "FINAL_VALUE" parameter of the Analog Output Transducer Block is supplied from the output "OUT" of the analog output. For this purpose, the "CHANNEL" parameter of the analog output must be set to "1".

The "FINAL_VALUE" parameter can be converted either as standard or according to user-defined characteristics and set to a manipulated variable limit. The result is used as setpoint for the servo controller which compares it with the actual position and generates the corresponding control signals for the piezo-valve unit.

The value of the actual position is derived from the signal of the position sensor and processed by a scaling and correction block. The value is subsequently calculated back by the inverse characteristic in order to serve as the position readback for the analog output ("FINAL_POSITION_VALUE").

Several parameters are used to configure the diagnostics and monitoring functions of the SIPART PS2 FF.

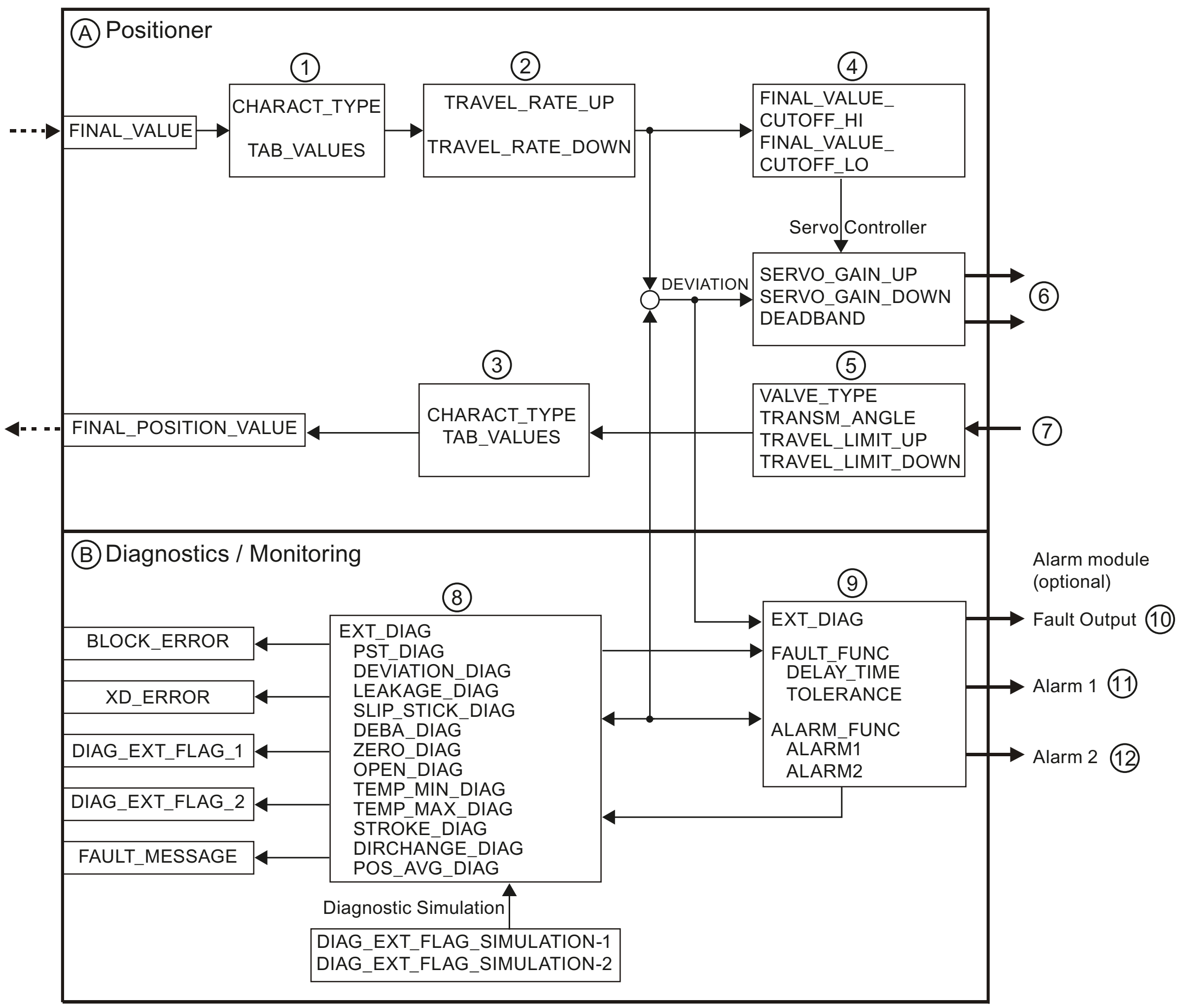
Operating modes

The transducer block can be operated in Automatic and Out of Service modes.

It is only possible to set the transducer block to "Automatic" following initialization of the positioner. It is possible in this mode to directly enter the FINAL_VALUE for test purposes. A requirement is that the Analog Output Function Block is set to Out of Service) mode.

Local operating modes may have priority over the selected operating mode of the block.

Flowchart



→	Inputs and outputs for connection
- - - →	Inputs and outputs from/to the AO block
Ⓐ	Positioner
Ⓑ	Diagnostics / monitoring
①	Characteristic curve
②	Setpoint ramp
③	Characteristic curve (inverse)
④	Tight closing function
⑤	Scaling, correction
⑥	To the piezo valve unit
⑦	From the position sensor
⑧	Extended diagnostic functions
⑨	Binary output functions
⑩	(Maintenance alarm)

⑪ (Maintenance required)

⑫ (Maintenance request)

Figure 10-3 Flowchart of the Analog Output Transducer Blocks

10.5 PID function block

Functional principle

The PID function block implements a PID control algorithm. The execution time of the PID block is 80 ms. The source of the setpoint SP depends on the selected operating mode of the block. Possible sources are:

Operating mode	Source
AUTO	Parameter SP
CAS mode	Input CAS_IN
RCAS mode	Value RCAS_IN

In manual mode (MAN), the output OUT can be set directly to the desired value.

The process value to be controlled is connected to the input IN. This value passes through a filter with the time constant PV_FTIME.

A BYPASS switch is available to the operator for the case that the control option "Bypass enable" applies.

"Bypass" is used with secondary cascade controls with a poor PV. The "Bypass enable" option is necessary because not all cascade control modes are stable when BYPASS is enabled.

The BYPASS parameter can only be set in manual (Man) or out of service (O/S) modes. When BYPASS is set, the SP value (in percent of the range) is passed directly to the target output, and the OUT value is used for the BKCAL_OUT parameter.

If the mode is changed to "CAS", you must initialize the OUT value of the block for the "OPEN" direction. If you use a block in "CAS" mode, you must initialize the actual value (PV) for the "OPEN" direction when leaving the Bypass option. The initialization must be carried out independent of selection of the "Use PV for BKCAL_OUT" Option.

Controller constants

Controller constants for the P, I, and D factors are:

- GAIN (dimensionless number)
- RESET (time constant expressed in seconds)
- RATE (time constant expressed in seconds)

A number of existing controllers are regulated by the inverse values of some or all of these time constants, e.g. proportional band and repetitions per minute.

If the RESET constant is set to "infinity", the integral component of the PID has no effect during normal operation. However, the integral component of the PID is still used internally to enable bumpless switchover from manual mode to automatic mode. The working point is adapted accordingly in automatic mode.

If RESET if set to "0 s", the integral component is set to zero. This results in a fixed working point.

The differential component defined by RATE is smoothed by a first order filter. This reduces the effects of the process noise. Without limitation by the cycle time, the time constant of the filter is 0.2*RATE.

Control option "Direct action"

Note

Changing the setting of "Direct action"

Triggering of a positive or negative readback is possible depending on the setting. Therefore only change the setting of "Direct action" following careful checking. Never make changes to the selected setting during automatic mode.

If the actual value PV exceeds the setpoint SV, the setting of this control option results in an increase in the output value. A positive feedback is possible.

If the actual value PV exceeds the setpoint SV with the control option not set, the output value decreases. A negative feedback is possible.

The control option "Direct action" is additionally used to calculate the limit status for BKCAL_OUT.

Output

The output supports the feedforward algorithm. The input FF_VAL applies an external value which responds proportional to certain faults in the control loop. The value is converted by the values of the FF_SCALE parameter into a percentage of the output span.

This converted value is multiplied by the FF_GAIN parameter and added to the setpoint output of the PID algorithm.

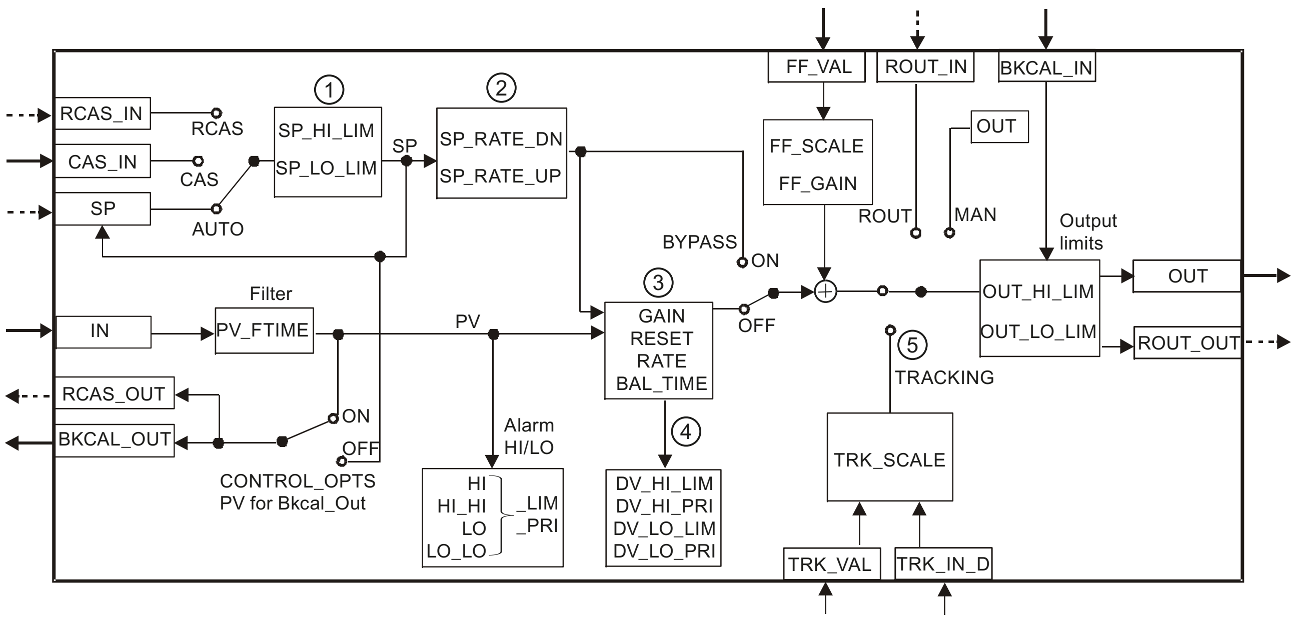
If FF_VAL has a status Bad, the last usable value is applied in order to prevent jumps in the output. If FF_VAL returns to a good status, the block adapts its integral component in order to hold the previous output value.

The output supports the track algorithm.

The following values can be set as options for BKCAL_OUT:

- Setpoint SP following limiting
- Actual value

Flowchart



Inputs and outputs for connection

Other inputs and outputs

PV Process value

SP Setpoint

① Setpoint limitation

② Manipulated variable limits

③ PLC

④ Deviation alarm

⑤ Tracking active if Track Enable = applicable, TRK_IN_D = applicable, and status of TRK_VAL and TRK_IN_D = good

Figure 10-4 Flowchart of PID function block

Service and maintenance 11

11.1 Electrostatic charge

⚠ WARNING
Electrostatic charge
Risk of explosion in hazardous areas if electrostatic charges develop, for example, when cleaning plastic surfaces with a dry cloth.
• Prevent electrostatic charging in hazardous areas.

11.2 Basic safety instructions

11.2.1 Maintenance

The device is maintenance-free. However, a periodic inspection according to pertinent directives and regulations must be carried out.

An inspection can include, for example, check of:

- Ambient conditions
- Seal integrity of the process connections, cable entries, and cover
- Reliability of power supply, lightning protection, and grounds

⚠ WARNING
Dust layers above 5 mm
Risk of explosion in hazardous areas.
Device may overheat due to dust build up.
• Remove dust layers in excess of 5 mm.

⚠ CAUTION
Releasing button lock
Improper modification of parameters could influence process safety.
• Make sure that only authorized personnel may cancel the button locking of devices for safety-related applications.

NOTICE
Penetration of moisture into the device
Damage to device. • Make sure when carrying out cleaning and maintenance work that no moisture penetrates the inside of the device.

11.3 Cleaning

The positioner is maintenance-free to a large extent. Screens are installed in the pneumatic connections of the positioners to protect them from rough dirt particles. If there are dirt particles in the supply air (PZ), they damage the screens and hamper the function of the positioner. Clean the screens as described in the following two chapters.

11.3.1 Cleaning the enclosure

Cleaning the enclosure

- Clean the outside of the enclosure with the inscriptions and the display window using a cloth moistened with water or a mild detergent.
- Do not use any aggressive cleansing agents or solvents, e.g. acetone. Plastic parts or the painted surface could be damaged. The inscriptions could become unreadable.

⚠ WARNING
Electrostatic charge
Danger of explosion in hazardous areas if electrostatic charges develop, for example, when cleaning plastic surfaces with a dry cloth. • Prevent electrostatic charging in hazardous areas.

11.3.2 Positioners 6DR5..0, 6DR5..3 and 6DR5..5

Procedure for removal and cleaning of the screens

1. Switch off the supply pressure PZ.
2. Remove the pneumatic pipelines.
3. Unscrew the lid of the 6DR5..0 or 6DR5..3 enclosure.
4. Remove the three screws on the pneumatic terminal strip.

5. Remove the screens and O-rings behind the terminal strip.
6. Clean the screens, e.g. using compressed air.

Procedure for installation of the screens

CAUTION

Damage to the polycarbonate enclosure 6DR5..0

- The enclosure is damaged due to screwing in the self-tapping screws improperly.
- Ensure that the available thread pitches are used.
- Turn the screws anticlockwise until they engage noticeably in the thread pitch.
- Tighten the self-tapping screws only after they have engaged.

1. Insert the screens into the recesses of the enclosure.
2. Place the O-rings on the screens.
3. Insert the pneumatic terminal strip.
4. Tighten the three screws. Note: With the polycarbonate enclosure, the screws are self-tapping.
5. Place the lid on and tighten it.
6. Connect the pneumatic pipelines again.

11.3.3 Positioners 6DR5..1, 6DR5..2 and 6DR5..6

Removal, cleaning and installation of the screens

1. Switch off the supply pressure PZ.
2. Remove the pneumatic connecting cables.
3. Remove the metal screen from the bores carefully.
4. Clean the metal screens, e.g. using compressed air.
5. Insert the screens.
6. Connect the pneumatic pipelines again.

11.4 Maintenance and repair work

Send defective devices to the repairs department, together with information on the malfunction and the cause of the malfunction. When ordering replacement devices, please provide the serial number of the original device. You can find the serial number on the nameplate.

WARNING
Impermissible repair of the device • Repair must be carried out by Siemens authorized personnel only.

WARNING
Maintenance during continued operation in a hazardous area There is a risk of explosion when carrying out repairs and maintenance on the device in a hazardous area. • Isolate the device from power. - or - • Ensure that the atmosphere is explosion-free (hot work permit).

WARNING
Impermissible accessories and spare parts Risk of explosion in areas subject to explosion hazard. • Only use original accessories or original spare parts. • Observe all relevant installation and safety instructions described in the instructions for the device or enclosed with the accessory or spare part.

WARNING
Improper connection after maintenance Risk of explosion in areas subject to explosion hazard. • Connect the device correctly after maintenance. • Close the device after maintenance work. Refer to Connecting (Page 65).

11.5 Replacing the basic electronics

Condition

- You are familiar with the general procedure described in the section "General information on installing option modules (Page 41)".

Procedure

Note

Possible movement of the actuator

While replacing the basic electronics, the actuator can unintentionally vent itself.

- Observe the procedure described below.

Removing

1. Switch off the supply pressure PZ and depressurize the actuator.
2. Open the positioner as in the description depending on the device version:
   - Opening the standard and intrinsically safe version (Page 42)
   - Opening the device version with "flameproof enclosure" (Page 44)
3. Remove the ribbon cable from the basic electronics.
4. Tighten the two fixing screws of the basic electronics.
5. Remove the basic electronics.
6. Place the new basic electronics onto the four holders of the rack.

Installation

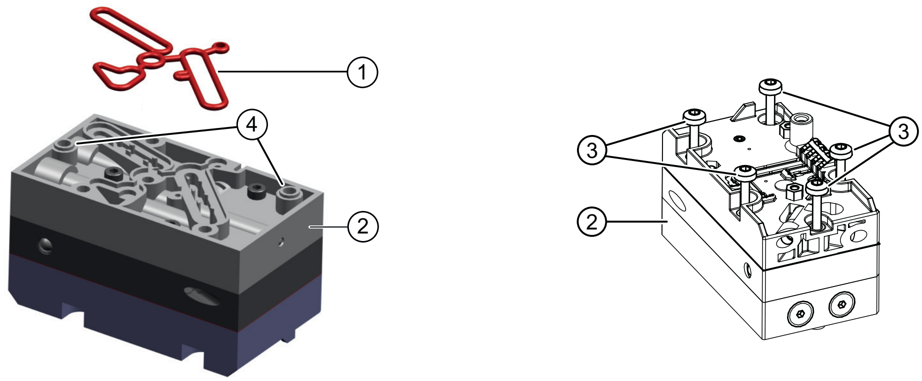
1. Tighten the two fixing screws of the basic electronics.
2. Tighten the screws.
3. Close the positioner as in the description depending on the device version:
   - Closing the standard and and intrinsically safe version (Page 43)
   - Closing the device version with "flameproof enclosure" (Page 47)
4. For a positioner with order option -Z F01 "Fail in Place", adjust the parameter "PNEUM (Page 141)" from "Std" to "FIP".
5. Switch on the supply pressure PZ.
6. Initialize the positioner as described in section "Commissioning (Page 95)".

11.6 Replacing the pneumatic block

Requirement

- You are familiar with the general procedure described in the section "General information on installing option modules (Page 41)".

Procedure



1 Cord seal

2 Pneumatic block

3 Mounting screws

4 Centering elements

Figure 11-1 Pneumatic block

Removing

1. Switch off the supply pressure PZ and depressurize the actuator.
2. Open the positioner as in the description depending on the device version:
   - Opening the standard and intrinsically safe version (Page 42)
   - Opening the device version with "flameproof enclosure" (Page 44)
3. Remove the ribbon cable from the basic electronics.
4. Tighten the two fixing screws of the basic electronics.
5. Remove the basic electronics.
6. Unscrew the fixing screws 3 of the pneumatic block 2.
   4 screws for single-acting pneumatic block. 5 screws for double-acting pneumatic block.
7. Remove the pneumatic block 2 and the cord seal 1.
8. Blow any dirt off the surface on which the pneumatic block was placed.

Installation

1. Insert the new cord seal 1 into the new pneumatic block 2.
2. Press the cord seal 1 evenly into the groove on the pneumatic block 2.
3. Place the new pneumatic block on the base plate.
   Make sure that the pneumatic block engages with the centering elements 4 on the base plate.
4. Screw the supplied fixing screws 3 into the pneumatic block.
5. Tighten the fixing screws with a torque of 1.1 Nm.
6. Place the basic electronics onto the four holders of the adapter.
7. Tighten the two fixing screws of the basic electronics.
8. Tighten the fixing screws.

9. Close the positioner as in the description depending on the device version:
   – Closing the standard and and intrinsically safe version (Page 43)
   – Closing the device version with "flameproof enclosure" (Page 47)
10. For a positioner with order option -Z F01 "Fail in Place", adjust the parameter '48.PNEUM' [PNEUMATIC_BLOCK_TYPE] Pneumatics type (Page 141) from "Std" to "FIP".
11. Switch on the supply pressure PZ.
12. Initialize the positioner as described in section "Commissioning (Page 95)".

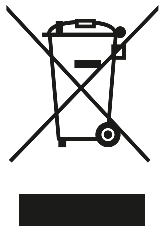
11.7 Return procedure

Enclose the bill of lading, return document and decontamination certificate in a clear plastic pouch and attach it firmly to the outside of the packaging.

Required forms

- Delivery note
- Return document (http://www.siemens.com/processinstrumentation/returngoodsnote) with the following information:
  – Product (item description)
  – Number of returned devices/replacement parts
  – Reason for returning the item(s)
- Decontamination declaration (http://www.siemens.com/sc/declarationofdecontamination)
  With this declaration you warrant "that the device/replacement part has been carefully cleaned and is free of residues. The device/replacement part does not pose a hazard for humans and the environment."
  If the returned device/replacement part has come into contact with poisonous, corrosive, flammable or water-contaminating substances, you must thoroughly clean and decontaminate the device/replacement part before returning it in order to ensure that all hollow areas are free from hazardous substances. Check the item after it has been cleaned.
  Any devices/replacement parts returned without a decontamination declaration will be cleaned at your expense before further processing.

11.8 Disposal



Devices described in this manual should be recycled. They may not be disposed of in the municipal waste disposal services according to the Directive 2012/19/EC on waste electronic and electrical equipment (WEEE).

Devices can be returned to the supplier within the EC, or to a locally approved disposal service for eco-friendly recycling. Observe the specific regulations valid in your country.

Further information about devices containing batteries can be found at:
Information on battery/product return (WEEE) (https://support.industry.siemens.com/cs/document/109479891/)

Diagnostics and troubleshooting

12

12.1 Output of system messages in the display

12.1.1 System messages before initialization

Remarks about the tables:

nn	Stands for variable numeric values
ϟ	Error symbol
/	(slash): the texts on the left and right of the slash flash alternately

Messages before initialization (first commissioning)

Message	Line		Meaning / cause	Measure
	Up	Down		
CPU **Start**	X 	 X	Message after application of electrical auxiliary power	• Maintenance
Pnnn.n	X		Potentiometer voltage of a non-initialized positioner (P-manual mode) (actual position value in % of the measuring range).	• Check whether the complete travel can be covered using the △ and ▽ buttons and that "P---" is never displayed. • Execute the initialization process.
P---	X		Measuring range was exceeded, the potentiometer is in the inactive zone, the transmission ratio selector or the effective lever arm are not adjusted as per the actuator travel.	• Switch the transmission ratio selector to 90°, especially in the case of part-turn actuators. • Adjust the effective lever length of linear actuators as per the measuring range.
NOINI		X	Positioner is not initialized.	• Start initialization.

12.1.2 System messages during initialization

Remarks about the tables:

nn	Stands for variable numeric values
ϟ	Error symbol
/	(slash): the texts on the left and right of the slash flash alternately

Messages during initialization

Message	Line		Meaning/cause	Measure
	Up	Down		
P---	X		Measuring range was exceeded, the potentiometer is in the inactive zone, the transmission ratio selectors or the effective lever arm are not adjusted as per the actuator travel	• Switch the transmission ratio selector to 90°, especially in the case of part-turn actuators. • Adjust the effective lever length of linear actuators as per the measuring range.
RUN 1		X	Initialization was started, part 1 is active (the direction of action is determined)	• Wait.
RUN 2		X	Initialization part 2 is active (actuator travel check and determination of stops)	• Wait.
RUN 3		X	Initialization part 3 is active (determination and display of travel times)	• Wait.
RUN 4		X	Initialization part 4 is active (determination of the minimum controller increment length)	• Wait.
RUN 5		X	Initialization part 5 is active (optimization of the transient response)	• Wait until "FINSH" is displayed. Initialization was completed successfully.
YEND1		X	The first position of the stop can be approached only in case of a manual initialization	1. Approach first position of the stop with the button or . 2. Acknowledge using button.
YEND2		X	The second position of the stop can be approached only in case of a manual initialization	1. Approach second position of the stop with the button or . 2. Acknowledge using button.
RANGE		X	The position of the stop or the measuring span is beyond the permissible measuring range only in case of a manual initialization	• Approach a different position of the stop using or button and acknowledge using button. • Move the friction clutch until "ok" is displayed, and then acknowledge with the button. • Terminate the initialization process using the button, switch to the P-manual mode, and correct the actuator travel and the position displacement sensor.
ok		x	The permissible measuring range of end positions is achieved only in case of a manual initialization	• Use the button to acknowledge; the remaining steps ("RUN 1" to "FINSH") run automatically.
RUN 1 / ERROR		X	Error in "RUN 1", no movement e.g. due to the lack of compressed air	Possible causes: • Insufficient supply of compressed air. • Restrictor(s) blocked. • Actuator does not move freely. Measures: 1. Eliminate possible causes. 2. Restart initialization.

Message	Line		Meaning/cause	Measure
	Up	Down		
ϟd___U		X	Bar graph display of the zero point is outside the tolerance range	1. Set between "P 4.0" and "P 9.9" (>0<) using friction clutch. 2. Continue using △ or ▽ button.
SEt	X		Friction clutch was moved; "P 50.0" not displayed when the lever is horizontal	1. In the case of linear actuators, use the △ or ▽ button to bring the lever perpendicular to the spindle. 2. Briefly acknowledge using ☐ button (initialization is continued).
MIDDL		X		
ϟUP >		X	"UP" tolerance range was exceeded or the inactive zone of the potentiometer was covered.	1. Increase the effective lever length of the linear actuators or switch the transmission ratio selector to 90°. 2. Briefly acknowledge using ☐ button. 3. Restart initialization.
ϟ90_95		X	Possible only in case of part-turn actuators: actuator travel is not in the range between 90 and 95%	1. Use the △ or ▽ button to move it in the range between 90 and 95%. 2. Briefly acknowledge using ☐ button.
ϟU-d>		X	"Up-Down" measuring span was undershot	1. Decrease the effective lever length of the linear actuators or switch the transmission ratio selector to 33°. 2. Briefly acknowledge using ☐ button. 3. Restart initialization.
U nn.n	X		Display of the "Up" travel time	• Wait until initialization continues in RUN 4. • To change the travel time, interrupt the initialization process using the ▽ button. • Activate the leakage test using the △ button.
D->U		X		
D nn.n	X		Display of the "Down" travel time	• Wait until initialization continues in RUN 4. • To change the travel time, interrupt the initialization process using the ▽ button. • Activate the leakage test using the △ button.
U->d		X		
NOZZL		X	Actuator stops (the initialization process was interrupted using the "-" button when the actuation speed display was active)	1. The travel time can be changed by adjusting the restrictor(s). 2. Redetermine the positioning speed using the ▽ button. 3. Continue using △ button.
TESt	X		Leakage test active (the "+" button was pressed when the actuation speed display was active)	• Wait for one minute.
LEAKG		X		
nn.n	X		Value and unit of the result after the leakage test	• Rectify the leakage if the value is too large. • Continue using △ button.
%/MIN		X		

Message	Line		Meaning/cause	Measure
	Up	Down		
nn.n	X		Initialization completed successfully with the display of actuator travel or the actuator angle	1. Briefly acknowledge using button. 2. Leave configuration level with a long press on the button.
FINISH		X		

12.1.3 System messages when exiting the Configuration mode

Remarks about the tables:

nn	Stands for variable numeric values
ϟ	Error symbol
/	(slash): the texts on the left and right of the slash flash alternately

Messages when exiting the configuration mode:

Message	Line		Operating mode			Meaning / cause	Measure
	Up	Bottom	Automatic	Manual mode	P manual mode		
n.nn.nn-nn	X	X				Software version	• Maintenance
Error SLnn	X	X				Monotony interruption of the free characteristic on the setpoint turning point n	• Correct the value

12.1.4 System messages during operation

Remarks about the tables:

nn	Stands for variable numeric values
ϟ	Error symbol
/	(slash): the texts on the left and right of the slash flash alternately

Messages during operation:

Message	Display line		Operating mode			Meaning/cause	Measure
	Top	Bottom	Automatic	Manual mode	P manual mode		
CPU **START**	X	 X				Message after application of electrical auxiliary power.	• Wait.
NOINI		X			X	Positioner is not initialized.	• Start initialization.
nnn.n	X		X	X		Actual position [in %] for initialized positioner. Flashing decimal point shows communication with a class 2 master.	
MANnn				X		Manual mode (nn = setpoint)	• Switch to automatic mode using operating mode button.
OS nn		X	X			The AO function block is currently out of service (O/S).	• Set the desired mode of the AO function block. • If the AO remains out of service (O/S), check whether the resource block is currently in automatic mode.
IMN nn		X	X			The AO function block is currently in the "Initialization manual" mode (Iman). AO cannot access the transducer block.	• Set the transducer block to the desired mode "AUTO".
MM nn		X	X			The AO function block is currently in manual mode.	• You obtain the setpoint for the transducer block by entering a value in the AO parameter "OUT".
LO nn		X	X			The AO function block is currently in "Local override" mode (LO). The device is possibly in a fault state.	• Check whether communication from the block is configured for the "OPEN" direction. • Check whether the resource block is in the fault state.
AUT nn		X	X			The AO function block is currently in automatic mode.	• If you have expected CAS, check whether CAS_IN is linked to a block for the "OPEN" direction and has a good state.
CASnn		X	X			The AO function block is currently in cascade mode (Cas).	
RCS nn		X	X			The AO function block is currently in remote cascade mode (RCas).	

Message	Display line		Operating mode			Meaning/cause	Measure
	Top	Bottom	Automatic	Manual mode	P manual mode		
oFL / 127.9	X		X	X		Display range exceeded. Possible causes:	
						• Friction clutch was maladjusted or:	• Adjust friction clutch such that the actual value display remains within "0.0" to "100.0" when moving the actuator or:
						• Transmission ratio selector was maladjusted or:	• Set transmission ratio selector correctly, or:
						• Positioner was installed on a different actuator without being re-initialized.	• Perform factory settings (Preset) and initialization.
EXSTP		X	X			Actuator was stopped by the digital input.	
EX UP		X	X			Actuator is moved to the upper endstop by the digital input.	
EXDWN		X	X			Actuator is moved to the lower endstop by the digital input.	
EXPSt						Partial Stroke Test was activated, e.g. by the digital input.	
InPSt		X	X			Cyclic Partial Stroke Test	
FST		X	X			Full Stroke Test is running.	
SRT		X	X			Step Response Test is running.	
MSRT		X	X			Multi Step Response Test is running.	
VPT		X	X			Valve Performance Test is running.	
LEAKR		X	X			A leakage test started by communication is running.	

12.2 Diagnostics

12.2.1 Display of diagnostics values

Structure of the diagnostics display

The display in "Diagnostics" mode has a structure similar to that in "Configuration" mode:

- The upper line shows the value of the diagnostics variable.
- The lower line shows the number and the abbreviation of the displayed variable.

Some diagnostics value can be greater than 99999. In such a case, the display switches over to the exponential view. Example: The value "1234567" is shown as "1.23E6".

General procedure

1. Press all three buttons at the same time for at least 2 seconds. You are now in the diagnostics display.
2. Use the button to select the next diagnostics value.
3. Press the button for at least 2 seconds in order to exit the diagnostics display.

How to show the diagnostics values in reverse order

Press the and buttons simultaneously.

How to set values to zero

Specific values can be set to zero by pressing the button for at least 5 seconds. The diagnostics values which can be reset are listed in the table in section "Overview of diagnostics values (Page 206)".

12.2.2 Saving the diagnostics values

The diagnostic values are written into a non-volatile memory every 15 minutes so that, in the event of a power failure, only the diagnostic values of the previous 15 minutes are lost. The values in the resettable parameters can be set to zero.

To do this, press the button for at least 5 seconds.

The diagnostic values which can be reset can be found in the table in section Overview of diagnostics values (Page 206).

12.2.3 Overview of diagnostics values

Explanatory notes on the following table

- The "Representable diagnostics values" column shows the factory-set diagnostics values for the diagnostics parameters in **bold**.
- The "Properties" column shows the properties of the diagnostics parameters:
  - ① Diagnostics value can be read and reset
  - ② Diagnostics value can be read but **not** reset
  - ③ Diagnostics value can be read but **not** reset. A function can be executed.
  - ④ Diagnostics value can be read, manually reset, and manually changed

Overview of diagnostics values

No.	Short designation	Meaning	Representable diagnostics values	Unit	Properties
1	STRKS	Number of total strokes	**0** ... 4.29E9	-	①
2	CHDIR	Number of changes in direction	**0** ... 4.29E9	-	①
3	ϟCNT	Number of fault messages	**0** ... 4.29E9	-	①
4	A1CNT	Number of alarms 1	**0** ... 4.29E9	-	①
5	A2CNT	Number of alarms 2	**0** ... 4.29E9	-	①
6	HOURS	Number of operating hours	**0** ... 4.29E9	Hours	②
7	HOURR	Resettable operating hours counter	**0** ... 4.29E9		①
8	WAY	Determined travel	**0** ... 130	mm or °	②
9	TUP	Travel time up	**0.0** / 0 ... 1000	s	②
10	TDOWN	Travel time down	**0.0** / 0 ... 1000	s	②
11	LEAK	Leakage test	- / 0.0 ... 100.0	%/minute	③
12	PST	Monitoring of Partial Stroke Test	**OFF** / ###.#, FdIni, notSt, SdtSt, fdtSt, notoL, Strt, StoP	s for ###.#	③
13	PRPST	Time since last Partial Stroke Test	###, **notSt**, Sdtst, fdtSt	Days	②
14	NXPST	Time until next Partial Stroke Test	**OFF** / ###	Days	②
15	DEVI	Dynamic control valve behavior	0.0 ... 100.0	%	②
16	ONLK	Pneumatic leakage	0.0 ... 100.0	-	②
17	STIC	Stiction (slipstick)	0.0 ... 100.0	%	②
18	ZERO	Lower endstop	0.0 ... 100.0	%	②
19	OPEN	Upper endstop	0.0 ... 100.0	%	②
20	PAVG	Average value of position	**OFF**, IdLE, rEF, COMP 0.0 ... 100.0	%	②
21	P0	Potentiometer value of lower endstop (0%)	**0.0** ... 100.0	%	③
22	P100	Potentiometer value of upper endstop (100%)	**0.0** ... 100.0	%	③
23	IMPUP	Pulse length up	**6** ... 160	ms	④

No.	Short designation	Meaning	Representable diagnostics values	Unit	Properties
24	IMPDN	Pulse length down	**6** ... 160	ms	④
25	PAUTP	Pulse pause	2 ... **28** ... 320	ms	④
26	DBUP	Deadband up	**0.1** ... 10.0	%	②
27	DBDN	Deadband down	**0.1** ... 10.0	%	②
28	SSUP	Slow step zone up	0.1 ... **10.0** ... 100.0	%	④
29	SSDN	Slow step zone down	0.1 ... **10.0** ... 100.0	%	④
30	TEMP	Current temperature	-50 ... 100 -58 ... 212	°C °F	②
31	TMIN	Minimum temperature (min/max pointer)	-50 ... 100 -58 ... 212	°C °F	②
32	TMAX	Maximum temperature (min/max pointer)	-50 ... 100 -58 ... 212	°C °F	②
33	T1	Number of operating hours in temperature range 1	**0** ... 4.29E9	Hours	②
34	T2	Number of operating hours in temperature range 2	**0** ... 4.29E9	Hours	②
35	T3	Number of operating hours in temperature range 3	**0** ... 4.29E9	Hours	②
36	T4	Number of operating hours in temperature range 4	**0** ... 4.29E9	Hours	②
37	T5	Number of operating hours in temperature range 5	**0** ... 4.29E9	Hours	②
38	T6	Number of operating hours in temperature range 6	**0** ... 4.29E9	Hours	②
39	T7	Number of operating hours in temperature range 7	**0** ... 4.29E9	Hours	②
40	T8	Number of operating hours in temperature range 8	**0** ... 4.29E9	Hours	②
41	T9	Number of operating hours in temperature range 9	**0** ... 4.29E9	Hours	②
42	VENT1	Number of switching cycles of pneumatic block, valve 1	**0** ... 4.29E9	-	②
43	VENT2	Number of switching cycles of pneumatic block, valve 2	**0** ... 4.29E9	-	②
44	VEN1R	Number of switching cycles of pneumatic block, valve 1, resettable	**0** ... 4.29E9	-	①
45	VEN2R	Number of switching cycles of pneumatic block, valve 2, resettable	**0** ... 4.29E9	-	①
46	STORE	Save the current values as 'last maintenance' (press button for 5 seconds)	-	-	③
47	PRUP	Prediction up	**1** ... 40	-	④
48	PRDN	Prediction down	**1** ... 40	-	④
49	WT00	Number of operating hours in the travel range WT00	**0** ... 4.29E9	Hours	①
50	WT05	Number of operating hours in the travel range WT05	**0** ... 4.29E9	Hours	①
51	WT10	Number of operating hours in the travel range WT10	**0** ... 4.29E9	Hours	①
52	WT30	Number of operating hours in the travel range WT30	**0** ... 4.29E9	Hours	①
53	WT50	Number of operating hours in the travel range WT50	**0** ... 4.29E9	Hours	①
54	WT70	Number of operating hours in the travel range WT70	**0** ... 4.29E9	Hours	①
55	WT90	Number of operating hours in the travel range WT90	**0** ... 4.29E9	Hours	①
56	WT95	Number of operating hours in the travel range WT95	**0** ... 4.29E9	Hours	①

No.	Short designation	Meaning	Representable diagnostics values	Unit	Properties
57	LKPUL	Length of the leakage compensation pulse	-256 ... **0** ... 254	ms	②
58	LKPER	Period of the leakage compensation pulse	**0.00** ... 600.00	s	②

12.2.4 Meaning of the diagnostics values

12.2.4.1 Diagnostic value '1.STRKS - Number of total strokes'

Display range: 0 ... 4.29E9

Purpose: In operation, the movements of the actuator are summed up and displayed in this diagnostics parameter as the number of strokes. Unit: 100% strokes, i.e. the path between 0% and 100% and back.

12.2.4.2 Diagnostic value '2.CHDIR - Number of changes in direction'

Display range: 0 ... 4.29E9

Purpose: Every change in direction of the actuator is noted in the controller and added to the number of changes in direction.

12.2.4.3 Diagnostic value '3.\\CNT - Number of fault messages'

Display range: 0 ... 4.29E9

Purpose: Every fault is noted in the closed-loop controller with '3.ϟCNT' and added to the number of fault messages.

12.2.4.4 Diagnostic value '4.A1CNT - Number of alarms 1' / '5.A2CNT - Number of alarms 2'

Requirement: '44.\\FCT' [FAULT_FUNCT] Fault message function (Page 139) parameter is activated.

Display range: 0 ... 4.29E9

Purpose: This value indicates how often the alarm has been triggered.

12.2.4.5 Diagnostic value '6.HOURS - Number of operating hours'

Display range: 0 ... 4.29E9

Purpose: The runtime meter is incremented every hour as soon as electric auxiliary power is supplied to the positioner.

12.2.4.6 Diagnostic value '7.HOURR - Resettable operating hours counter'

Display range:	0 ... 4.29E9
Purpose:	The runtime meter is incremented every hour as soon as electric auxiliary power is supplied to the positioner. In contrast to Diagnostic value '6.HOURS - Number of operating hours' (Page 208), this value can be reset.
Description:	In order to minimize the control valve wear resulting from a poor control quality, it makes sense to optimize the positioner's parameters. You can recognize optimum parameter settings when the values of the Diagnostic value '44.VEN1R' / '45.VEN2R' (Page 217) are low. Low values mean that the switching frequency of the positioner pneumatics is also low. In order to carry out a comparison with various parameter settings, determine the number of switching cycles per hour. To do this, use the values of the Diagnostic value '44.VEN1R' / '45.VEN2R' (Page 217) and '7.HOURR'. These three parameters can be reset to enable simpler determination of the values.

12.2.4.7 Diagnostic value '8.WAY - Determined travel'

Condition for linear actuator:	The travel is set in the '3.YWAY' [TRANSM_LENGTH] Range of stroke (Page 128) parameter.
Display range:	0 ... 130
Purpose:	This value in mm or ° specifies the travel determined during the initialization.

12.2.4.8 Diagnostic value '9.TUP - Travel time up' / '10.TDOWN - Travel time down'

Display range:	0 ... 1000
Purpose:	This value indicates the current UP or DOWN travel time in seconds determined during the initialization.

12.2.4.9 Diagnostic value '11.LEAK - Leakage test'

Condition	The positioner is initialized and in manual mode (MAN).
Display range:	• - • 0.0 ... 100.0

Purpose:

You can use this diagnostics parameter to read the last test result or start an offline leakage test with which you can detect leakages in the actuator or in the pipe installation. Display is percent stroke per minute referred to the total stroke. A test result originates from one of the following options:

- Function '11.LEAK' has already been carried out.
- Leakage test was already carried out during initialization, see procedure of RUN 3 in section Step 5 – RUN 3: Determination and display of the travel time (leakage test) (Page 102).
- 'Offline leakage test' function was already executed by a HOST system.

"-" in the display can have the following causes:

- A leakage test has not yet been carried out.
- Resetting to the factory settings was carried out using the '47.PRST' Preset [no correspondence] (Page 141) > ALL parameter.
- Positioner is not initialized.

How to start the test

1. Move the actuator to the position at which you wish to start the test.
2. In 'Diagnostics' mode, go to the '11.LEAK' diagnostic value as described in section Display of diagnostics values (Page 205).
3. Start the function by pressing the button for at least 5 seconds.

Description:

'Strt' is output in the display. The function is started after 5 seconds. 'tESt' and the current position of the actuator (actual value) are then displayed alternately for one minute.

After one minute, the display shows the difference in the actuator position before and after the test. This means: the actuator position has changed by the displayed value in one minute.

12.2.4.10 Diagnostic value '12.PST - Monitoring of Partial Stroke Test'

Indication on the display:

- OFF
- C-ERR
- FdIni
- notSt
- ###.#
- SdtSt
- FdtSt

Purpose:

This diagnostics parameter indicates the measured stroke time of the last Partial Stroke Test.

A Partial Stroke Test can be initiated manually or an active Partial Stroke Test can be interrupted by pressing the button.

Description of indications on the display:	• OFF: The Partial Stroke Test function is deactivated. • C-ERR: Configuration error. Partial Stroke Test cannot be started. Settings in the 'A1.STPOS start position', 'A3.STRKH stroke height' and 'A4.STRKD stroke direction' are not plausible. • FdIni - Failed PST Initialization: The reference stroke time measurement of the Partial Stroke Test has failed. • notSt - No Test: A Partial Stroke Test has not yet been executed. • ###.#: Corresponds to the measured stroke time in seconds. The last Partial Stroke Test was successfully executed. • SdtSt - Stopped Test: The last Partial Stroke Test was interrupted. • FdtSt - Failed Test: The last Partial Stroke Test failed.
Status messages:	The following status messages appear when you hold the △ button pressed: • notoL - No Tolerance: The valve is outside the tolerance range for start of the Partial Stroke Test. No manual Partial Stroke Test will be started. • Strt - Start: A manual Partial Stroke Test is started after the button is pressed for five seconds. • WAIt - Wait: The Partial Stroke Test is being executed.
Factory setting:	OFF

12.2.4.11 Diagnostic value '13.PRPST' - Time since last Partial Stroke Test'

Indication on the display:	• ### • notSt • Sdtst • FdtSt
Purpose:	This diagnostics parameter shows the elapsed time in days since the last Partial Stroke Test.
Status messages:	• notSt - No Test: A Partial Stroke Test has not yet been executed. • SdtSt - Stopped Test: The last Partial Stroke Test was interrupted. • FdtSt - Failed Test: The last Partial Stroke Test failed

12.2.4.12 Diagnostic value '14.NXPST - Time until next Partial Stroke Test'

Requirement:	• The Partial Stroke Test is activated in 'Configuration' mode. • The test interval is set in the 'A8.INTRV' parameter.
Indication on the display:	• OFF • ###
Purpose:	This diagnostics parameter shows the time in days until the next Partial Stroke Test. If one of the above-mentioned conditions is not met, 'OFF' is shown on the display.

12.2.4.13 Diagnostics value '15.DEVI - Dynamic control valve behavior'

Requirement:	Monitoring of dynamic control valve behavior 'b.\\DEVI' (Page 154) parameter is activated.
Display range:	0.0 ... 100.0
Purpose:	This value in percent provides information about the current dynamically determined deviation from the model response.

12.2.4.14 Diagnostic value '16.ONLK - Pneumatic leakage'

Requirement:	Monitoring/compensation of pneumatic leakage 'C.\\LEAK' (Page 156) parameter is activated.
Display range:	0 ... 100
Purpose:	This diagnostics parameter shows the current leakage indicator.

12.2.4.15 Diagnostic value '17.STIC - Stiction (slipstick)'

Requirement:	Monitoring of stiction (slipstick) 'd.\\STIC' (Page 159) parameter is activated.
Display range:	0.0 ... 100.0
Purpose:	This diagnostics parameter shows the filtered value of the slip jumps in percent resulting from the stiction.

12.2.4.16 Diagnostic value '18.ZERO - Lower endstop'

Requirement:	Monitoring of lower endstop 'F.\\ZERO' (Page 161) parameter is activated. '36.YCLS' Tight closing / fast closing with manipulated variable (Page 134) Parameter is set to one of the following values: 'do', 'uP do', 'Fd', 'Fu Fd', 'uP Fd', 'Fu do'
Display range:	0.0 ... 100.0
Purpose:	Indication of how many percent the lower endstop has changed compared to its value during initialization.

12.2.4.17 Diagnostic value '19.OPEN - Upper endstop'

Requirement:	Monitoring of upper endstop 'G.\\OPEN' (Page 163) parameter is activated. '36.YCLS' Tight closing / fast closing with manipulated variable (Page 134) parameter is set to one of the following values: 'uP', 'uP do', 'Fu', 'Fu Fd', 'uP Fd', 'Fu do'
Display range:	0.0 ... 100.0
Purpose:	An indication of the current shift of the upper endstop compared to its initialization value.

12.2.4.18 Diagnostic value '20.PAVG - Average value of position'

Indication on the display:
- OFF
- IdLE
- rEF
- COMP

Purpose: This value shows the last calculated comparison average. Meaning of the displays:
- OFF: The underlying function is deactivated in the configuration menu.
- IdLE : Inactive. The function has not been started yet.
- rEF: The reference average is calculated. The function was started, and the reference interval is in progress at the moment.
- COMP: The comparison average is calculated. The function was started, and the comparison interval is in progress at the moment.

12.2.4.19 Diagnostic value '21.P0 - Potentiometer value of lower endstop (0%)' / '22.P100 - Potentiometer value of upper endstop (100%)'

Display range:
- NO
- 0.0 ... 100.0

'NO': Changing the low or upper endstop is not possible in the current state of the control valve. Initialize the positioner again.

Condition 1 - read values: The positioner is initialized.

Purpose 1

Read values

You can use the P0 and P100 parameters to read the values for the lower endstop (0%) and the upper endstop (100%) of the position measurement as determined during the automatic initialization. The values of manually approached end positions are applicable for manual initialization.

Condition 2 - change values

- The positioner is initialized and in manual mode (MAN) or automatic mode (AUT).
- The current position of the actuator is within the range -10% to +10% of the lower endstop (P0).
- The current position of the actuator is within the range 90% to 110% of the upper endstop (P100).

Purpose 2:

Change values

You can use these two parameters to change the lower endstop (P0) and the upper endstop (P100).

Since initialization is not usually carried out under process conditions, the values for the lower endstop (P0) and the upper endstop (P100) can change when the process is started. These changes can result from temperature changes with the associated thermal expansion of the material. If the Monitoring of lower endstop 'F.\\ZERO' (Page 161) and Monitoring of upper endstop 'G.\\OPEN' (Page 163) parameters are active, the thresholds set in these two parameters can be exceeded as a result of thermal expansion. An error message is output in the display.

The process-dependent thermal expansion might represent the normal state in your application. You do not wish to receive an error message as a result of this thermal expansion. Therefore reset the 'P0' and/or 'P100' parameters after the process-dependent thermal expansion has had its complete effect on the control valve. The procedure is described in the following.

Description:

Procedure for manual mode (MAN)

1. Move the actuator to the desired position of the lower endstop (upper endstop) using the △ and ▽ buttons.
2. Switch to diagnostics mode.
3. Go to diagnostic value 21.P0 (22.P100).
4. Apply the setting by pressing the △ button for at least 5 seconds. After 5 seconds, '0.0' (with 22.P100: '100.0') is displayed. Result: The lower endstop (upper endstop) now corresponds to the current position of the actuator.
5. Switch to manual mode (MAN). Result: Values for the upper endstop (lower endstop) have changed.

Procedure for automatic mode (AUT)

1. Check in the display whether the current position of the actuator is at the desired position of the lower endstop (upper endstop).
2. Switch to diagnostics mode.
3. Go to diagnostic value 21.P0 (22.P100).
4. Apply the setting by pressing the △ button for at least 5 seconds. After 5 seconds, '0.0' (with 22.P100: '100.0') is displayed. Result: The lower endstop (upper endstop) now corresponds to the current position of the actuator.
5. Switch to automatic mode (AUT).

See also

Changing the operating mode (Page 90)

12.2.4.20 Diagnostic value '23.IMPUP - Pulse length up' / '24.IMPDN - Pulse length down'

Display range:	6 ... 160
Purpose:	The smallest impulse lengths that can be used to move the actuator are determined during the initialization process. They are separately determined for the 'Up' and 'Down' directions and displayed here. Display in ms. In the case of special applications you can additionally set the smallest impulse lengths in these two parameters.
Factory setting:	6

12.2.4.21 Diagnostic value '25.PAUTP - Pulse interval'

Display range:	2 ... 320
Purpose:	This value is not changed during an initialization process. Display in ms. For applications with high stiction (slipstick), adjusting this parameter improves the control quality. This parameter can be set for special applications.
Factory setting:	28

12.2.4.22 Diagnostic value '26.DBUP - Deadband up' / '27.DBDN - Deadband down'

Display range:	0.1 ... 10.0
Purpose:	In this parameter, you can read the deadbands of the controller in the 'Up' and 'Down' directions. Display in percent. The values correspond either to the manually configured value of the '31.DEBA' [DEADBAND] Deadband of closed-loop controller (Page 131) parameter or to the value automatically adapted by the device if 'DEBA' was set to 'Auto'.

12.2.4.23 Diagnostic value '28.SSUP - Slow step zone up' / '29.SSDN - Slow step zone down'

Display range:	0.1 ... 100.0
Purpose:	The slow step zone is the zone of the closed-loop controller in which control signals are issued in a pulsed manner. Display is in percent. The impulse length is thus proportional to the control deviation. If the control deviation is beyond the slow step zone, the valves are controlled using permanent contact. This parameter can be set for special applications.
Factory setting:	10.0

12.2.4.24 Diagnostic value '30.TEMP - Current temperature'

Display range:	°C: -50 ... 100 °F: -58 ... 212
Purpose:	Current temperature in the positioner enclosure. The sensor is present on the basic electronics. In order to switch over the temperature display between °C and °F, press the △ button.

12.2.4.25 Diagnostic value '31.TMIN - Minimum temperature' / '32.TMAX - Maximum temperature'

Display range:	°C: -50 ... 100 °F: -58 ... 212
Purpose:	The minimum and maximum temperatures within the enclosure are constantly determined and saved as with a min/max pointer. This value can only be reset in the factory. In order to switch over the temperature display between °C and °F, press the △ button.

12.2.4.26 Diagnostic value '33.T1' ... '41.T9' - Number of operating hours in the temperature range 1 to 9

Display range:	0 ... 4.29E9
Purpose:	Statistics about the duration of operation in different temperature ranges is maintained in the device. An average of the measured temperature is taken every hour and the counter assigned to the corresponding temperature range is incremented. This helps in drawing conclusions about the past operating conditions of the device and the entire control valve. The temperature ranges are classified as follows:

	T1	T2	T3	T4	T5	T6	T7	T8	T9
Temperature range [°C]	-	≥ -30	≥ -15	≥ 0	≥ 15	≥ 30	≥ 45	≥ 60	≥ 75
	≤ -30	< -15	< 0	< 15	< 30	< 45	< 60	< 75	-

Operating hours in temperature ranges T1 to T2

12.2.4.27 Diagnostic value '42.VENT1' / '43.VENT2'

'42.VENT1' number of switching cycles pneumatic block, valve 1

'43.VENT2' number of switching cycles pneumatic block, valve 2

Display range: 0 ... 4.29E9

Purpose: Control procedures of the pneumatic block are summarized and displayed in this parameter.

Description: The pneumatic block of the positioner pressurizes and depressurizes the actuator. The characteristic service life of the pneumatic block depends on the load. The average service life is approx. 200 million switching cycles. The number of control procedures for the switching cycles serves to assess the switching frequency of the pneumatic block.

Counting procedure for single-acting actuators:

- Pressurize => 42.VENT1
- Depressurize => 43.VENT2

Counting procedure for double-acting actuators:

- Pressurize (Y2) / Depressurize (Y1) => 42.VENT1
- Depressurize (Y1) / Pressurize (Y2) => 43.VENT2

The value is written hourly into a nonvolatile memory.

12.2.4.28 Diagnostic value '44.VEN1R' / '45.VEN2R'

'44.VEN1R' number of switching cycles pneumatic block, valve 1, resettable

'45.VEN2R' number of switching cycles pneumatic block, valve 2, resettable

Display range: 0 ... 4.29E9

Purpose: Control procedures of the pneumatic block are counted since the last time this parameter was reset, and displayed here.

Description: Corresponds to the description for Diagnostic value '42.VENT1' / '43.VENT2' (Page 217) referred to the diagnostics parameters 'VEN1R' and 'VEN2R' described here.

12.2.4.29 Diagnostic value '46.STORE - Save maintenance data'

Purpose:	The minimum and maximum temperatures within the enclosure are constantly determined and saved as with a min/max pointer. This value can only be reset in the factory. In order to switch over the temperature display between °C and °F, press the button for at least 5 seconds in order to initiate a save function. The values of the diagnostics parameters Diagnostic value '8.WAY - Determined travel' (Page 209) to Diagnostic value '11.LEAK - Leakage test' (Page 209) and Diagnostic value '21.P0 - Potentiometer value of lower endstop (0%)' / '22.P100 - Potentiometer value of upper endstop (100%)' (Page 213) to Diagnostic value '28.SSUP - Slow step zone up' / '29.SSDN - Slow step zone down' (Page 216) are saved in the non-volatile memory as 'data of last maintenance'. This diagnostics data contains selected values whose changes can give information about mechanical wear and tear of the valve. This function is normally operated through the PDM, menu command 'Diagnostics-> Save maintenance information'. The data of the last maintenance operation can be compared with the current data using SIMATIC PDM.

12.2.4.30 Diagnostic value '47.PRUP - Prediction up' / '48.PRDN - Prediction down'

Display range:	1 ... 40
Purpose:	This value specifies the prediction of the controller for the up (PRUP) and down (PRDN) movements. For more information, refer also to the section Optimization of controller data (Page 93).
Factory setting:	1

12.2.4.31 Diagnostic value '49.WT00' ... '56.WT95' - Number of operating hours in the travel range WT00 to WT95

Display range:	0 ... 4.29E9
Purpose:	When the positioner is in "Automatic" mode, statistics are continuously maintained regarding the duration for which a process valve is operated in a particular section of the travel range. The entire travel range is divided into 8 sections from 0 to 100 %. The positioner records the current position continuously and increments the runtime meter assigned to the corresponding travel range every hour. This helps in drawing conclusions about the past operating conditions and especially in assessing the control properties of the control loop and the entire control valve.

Travel range	WT00	WT05	WT10	WT30	WT50	WT70	WT90	WT95
Travel range section [%]	-	≥ 5	≥ 10	≥ 30	≥ 50	≥ 70	≥ 90	≥ 95
	< 5	< 10	< 30	< 50	< 70	< 90	< 95	-

Division of travel ranges

You can simultaneously set the eight operating hours counters to zero.

TIP: Since the travel ranges are provided at the end of the diagnostics parameters, press the ▽ button several times along with the button. This will help you to access the desired diagnostics parameters faster.

12.2.4.32 Diagnostic value '57.LKPUL - Length of the leakage compensation pulse'

Display range: -256 ... **0** ... 254

Purpose: This value in milliseconds indicates the length of a compensation pulse when Monitoring/compensation of pneumatic leakage 'C.\\LEAK' (Page 156) is active. The sign indicates the control direction of the pulse.

Factory setting: 0

12.2.4.33 Diagnostic value '58.LKPER - Period of the leakage compensation pulse'

Display range: **0.00** ... 600.00

Purpose: This value in seconds indicates the period of the leakage compensation pulses when Monitoring/compensation of pneumatic leakage 'C.\\LEAK' (Page 156) is active.

Factory setting: 0.00

12.3 Online diagnostics

12.3.1 Overview of online diagnostics

Online diagnostics means diagnostics during ongoing operation. A few important variables and parameters are continuously monitored during the operation of the positioner. In "Configuration" mode, you can configure this monitoring in such a way that the fault message output will be activated if, for instance, a limit is exceeded.

Information about what events can activate the fault message output can be found in the table in chapter "Overview of error codes (Page 220)".

This chapter contains information about the following situations in particular:

- Possible causes of the fault message.
- Events which activate the fault message output or alarm outputs.
- Setting of parameters needed for event monitoring.
- Canceling a fault message

When the fault message output is triggered in automatic or manual mode, the display shows which fault triggered the message. Both digits at bottom-left indicate the corresponding error code. If multiple triggers occur at the same time, they are displayed one after the other cyclically.

12.3.2 Overview of error codes

Overview of error codes that activate the fault message output

Error code	Three-stage	Event	Parameter setting	Error message disappears when	Possible causes
ϟ1	No	Control deviation: Actual value response has exceeded values for TIM and LIM	Always active	... the actual value response falls below the value for LIM	Supply pressure PZ missing, actuator fault, process valve fault (e.g. blockage).
ϟ2	No	Device not in "Automatic" mode	**.ϟFCT[1)] =ϟnA or = ϟnAB	... the device is changed to "Automatic" mode.	The device has been configured or is in the manual mode
ϟ3	No	Digital input BIN1 or BIN2 active	**.ϟ FCT[1)] =ϟnAB and digital function BIN1 or BIN2 set to "On"	... the digital input is no longer activated.	The contact connected to the digital input was active (e.g. packing gland monitoring, overpressure, temperature switch).
ϟ4	Yes	Limit for number of total strokes exceeded	L.ϟSTRK≠OFF	... the stroke counter is reset or the thresholds are increased	The total path covered by the actuator exceeds one of the configured thresholds.
ϟ5	Yes	Limit for number of changes in direction exceeded	O.ϟDCHG≠OFF	... the counter for changes of direction is reset or the thresholds are increased.	The number of changes of direction exceeds one of the configured thresholds.
ϟ6	Yes	Lower endstop limit exceeded	F.ϟZERO≠OFF **.YCLS = do or up do	... the deviation of the endstop disappears or the device is reinitialized.	Wear and tear of the process valve, deposits or foreign bodies in the process valve, mechanical misalignment, friction clutch moved.
ϟ7	Yes	Upper endstop limit exceeded	G.ϟOPEN≠OFF **.YCLS[1)] = do or up do	... the deviation of the endstop disappears or the device is reinitialized.	Wear and tear of the process valve, deposits or foreign bodies in the process valve, mechanical misalignment, friction clutch moved.
ϟ8	No	Deadband limit exceeded	E.ϟDEBA≠OFF **.DEBA[1)] = Auto	... the limit is undershot again	Increased packing gland friction, mechanical gap in the position feedback.

Error code	Three-stage	Event	Parameter setting	Error message disappears when	Possible causes
ϟ9	Yes	Case 1: Partial Stroke Test exceeds reference stroke time.	A.ϟPST≠OFF	Case 1: ... a Partial Stroke Test is successfully executed within the reference stroke time or the function is deactivated.	Case 1: Process valve is stuck or rusted. Increased stiction.
		Case 2: Start position outside the start tolerance		Case 2: Move the actuator into the range of the PST start tolerance. Or increase the PST start tolerance until the actuator (PST start position) is within the PST start tolerance. Restart the Partial Stroke Test.	Case 2: Valve is in the safety position.
10	Yes	Deviation from expected dynamic control valve behavior	b.ϟDEVI≠OFF	... the position is again in a narrow corridor between the setpoint and the model, or the function is deactivated.	Actuator fault, process valve fault, process valve jams, increased stiction, decreased supply pressure PZ
11	Yes	Valve leakage	C.ϟLEAK≠OFF	... the valve leakage has been remedied or the function is deactivated.	Pneumatic leakage
12	Yes	Stiction limit (slipstick) exceeded	d.ϟSTIC≠OFF	... Slipjumps can no longer be detected, or the function is deactivated.	Increased stiction, process valve no longer moves smoothly but in jerky motion.
13	Yes	Temperature undershot	H.ϟTMIN≠OFF	... the low temperature thresholds are no longer undershot.	Ambient temperature too low
14	Yes	Temperature overshot	J.ϟTMAX≠OFF	... the high thresholds are no longer overshot.	Ambient temperature too high
15	Yes	Position average deviates from the reference value	P.ϟPAVG≠OFF	... the average position value calculated after a comparison interval is again within the thresholds for the reference value, or the function is deactivated.	In the last comparison interval, the process valve characteristic was changed so significantly that a deviating average value of position was calculated.
16	No	Partial Stroke Test is to be carried out with non-plausible parameter values	A.ϟPST≠OFF	the parameter values entered in A1.STPOS, A3.STRKH and A4.STRKD are plausible.	Parameters for Partial Stroke Test are not plausible

[1] You can find additional information on the parameter in the corresponding parameter descriptions

12.3.3 XDIAG parameter

You can use the extended diagnostics parameters to display error messages in one, two or three stages. In addition to the fault message output, the digital outputs A1 and A2 are then used. For this purpose, set the "XDIAG" parameter as described in the following table:

XDIAG settings	Message due to
OFF	Extended diagnostics not activated
On1	Fault message output for threshold 3 error message (maintenance alarm, single-stage)

XDIAG settings	Message due to
On2	Fault message output for threshold 3 error messages and digital output A2 for threshold 2 error messages (maintenance demanded, two-stage)
On3	Fault message output for threshold 3 error messages, digital output A2 for threshold 2 error messages and digital output A1 for threshold 1 error messages (maintenance required, three-stage)

Possible parameter setting 'XDIAG'

12.3.4 Meaning of error codes

12.3.4.1 1 Remaining control deviation

The deviation between the setpoint and the actual value is continuously monitored in "Automatic" mode. The fault message for a remaining control deviation is activated depending on the setting of the application parameters "ϟTIM" - monitoring time for setting the fault messages - and "ϟLIM" - response threshold for the fault message. The fault message is cancelled as soon as the control deviation drops below the response threshold. This monitoring function is always active.

12.3.4.2 2 Device not in "Automatic" mode

When the device is not in automatic mode, an error message is generated if the 'ϟFCT' parameter (function of fault message output) is set correctly. A warning is then sent to the control system if the device was switched to manual or configuration mode on-site.

12.3.4.3 3 digital input BIN1 or BIN2 active

If the digital input is activated and the 'ϟFCT' and 'DI1' parameters are set accordingly, a fault message is generated. A fault message can be generated, for example, by a switch to monitor the packing glands, a temperature switch, or a limit switch (e.g. for pressure).

Configure the digital input DI2 on the Digital I/O Module (DIO) in the same way.

12.3.4.4 4 Monitoring the number of total strokes

The diagnostics value "1 STRKS" is constantly compared with the thresholds that are determined from the "L1.LIMIT" to "L4.FACT3" parameters. If the thresholds are exceeded, the fault message output or the digital outputs A1 and A2 respond, depending on the operating mode of the extended diagnostics . These two functions can be deactivated using the parameter setting "OFF" for "L.ϟSTRK".

12.3.4.5 5 Monitoring the number of changes in direction

The diagnostics value "2 CHDIR" is constantly compared with the thresholds that are determined from the "O1.LIMIT" to "O4.FACT3" parameters. If the thresholds are exceeded, the fault message output or the digital outputs A1 and A2 respond, depending on the operating mode of the extended diagnostics . These two functions can be deactivated using the parameter setting "OFF" for "O.ᛋDCHG".

12.3.4.6 6 Monitoring the lower endstop / 7 Monitoring the upper endstop

If the parameter "F.ᛋZERO" is set to "ON", monitoring of the lower endstop is activated. This function can be used to detect the errors in the process valve. If the limit is exceeded, this indicates the presence of deposits or foreign bodies in the process valve. If the limit is fallen below, this indicates wear of the process valve. A mechanical misalignment of the position feedback also triggers this fault message.

Monitoring is always carried out whenever the process valve is in the "tight closing/fast closing Down" position. The current position is compared with the position that was determined as the lower endstop at the time of initialization. Requirement: '36.YCLS' Tight closing / fast closing with manipulated variable (Page 134) parameter is set to one of the following values: 'do', 'uP do', 'Fd', 'Fu Fd'.

Example: A value of 3% is set. The position is normally adopted for "tight closing/fast closing Down". A fault is reported if a value > 3% or < -3% is determined instead.

The fault message remains activated until either subsequent monitoring remains within the tolerance or a re-initialization process is executed. Even the deactivation of monitoring ("F.ᛋ ZERO"=OFF) may trigger an error message.

This monitoring function does not deliver any utilizable results if the endstops were not determined automatically at the time of initialization, but the limits were set manually (manual initialization, "5.INITM").

Similar diagnostics is carried out for the upper endstop. The "G.ᛋOPEN" parameter is used to set the limit for this. Requirement: '36.YCLS' Tight closing / fast closing with manipulated variable (Page 134) parameter is set to one of the following values: 'uP', 'uP do', 'Fu', 'Fu Fd', 'uP Fd', 'Fu do'.

12.3.4.7 8 Monitoring deadband

If the deadband increases disproportionately when adjusting it automatically ("DEBA"=Auto parameter), it indicates an error in the system (e.g. severely increased packing gland friction, play in the position displacement sensor, leakage). A limit can therefore be entered for this value ("E1.LEVL3", threshold for deadband monitoring). An error message output is activated when this value is exceeded.

12.3.4.8 9 Partial Stroke Test

This fault message appears when a manual or cyclic Partial Stroke Test is initiated and the test cannot be started because the process valve is not within the starting tolerance. The fault message also appears when one of the three thresholds of the Partial Stroke Test, which result from reference stroke time 'A9.PSTIN' multiplied by factors 'AA.FACT1', 'Ab.FACT2' and 'AC.FACT3', is violated. The severity of the fault message is shown by the number of bars on the display. The severity of the fault message is simultaneously displayed using the fault message output or digital outputs A1 and A2 depending on the mode of extended diagnostics.

12.3.4.9 10 Monitoring of dynamic control valve behavior

The monitoring of the operational behavior responds when the actual process valve position shifts from a narrow corridor between the setpoint and the expected position course. In this case, the deviation between the expected and actual position course is output filtered. The deviation is compared with the configured thresholds that are determined from the "b2.LIMIT" limit multiplied by the factors "b3.FACT1" to "b5.FACT3".

12.3.4.10 11 Monitoring/compensation of pneumatic leakage

This fault message appears if a leakage is present. For additional information, see Monitoring/ compensation of pneumatic leakage 'C.\\LEAK' (Page 156).

12.3.4.11 12 Monitoring of stiction (slipstick)

If the stiction of the control valve increases during operation or if an increasing number of Slipjumps is detected, "d1.LIMIT" could be exceeded and result in this fault message.

12.3.4.12 13 Monitoring the lower limit temperature

This fault message appears when the lower limit temperature thresholds are undershot.

12.3.4.13 14 Monitoring the upper limit temperature

This fault message appears when the upper limit temperature thresholds are overshot.

12.3.4.14 15 Monitoring the position average value

This fault message appears when a position value calculated after the expiry of a comparison interval deviates from the reference value by more than the configured thresholds.

12.3.4.15 16 Monitoring the plausibility of values for the Partial Stroke Test

If, at the start of a Partial Stroke Test, the plausibility check of the "A1.STPOS", "A3.STRKH" and "A4.STRKD" parameters was not successful, this fault message is displayed.

12.4 Fault and remedy

Fault profile (symptoms)	Possible cause(s)	Remedy
Positioner remains in "RUN 1".	• Initialization started from the end position • The response time of a maximum of 1 minute was not observed • Supply pressure PZ not connected or supply pressure PZ too low. • Compressed air line blocked, e.g. solenoid valve	• A waiting time of up to 1 minute is required • Do not start initialization from the end position. • Ensure supply pressure PZ. • Free up blocked lines
Positioner remains in "RUN 2".	• Transmission ratio selector and parameter 2 • "YAGL" and the real stroke do not match. • Incorrectly set stroke on the lever • Pneumatic block does not switch.	• Check settings: Parameters 2 and 3 • Check the stroke setting on the lever
Positioner remains in "RUN 3".	• Actuator travel time is too high	• Open the restrictor completely and/or set supply pressure PZ to the highest permissible value. • Use a booster if required.
Positioner remains in "RUN 5", does not go to "FINISH" (waiting time > 5 min.).	• "Gap" (play) in the positioner - actuator - control valve system	• Part-turn actuator: Check for firm seating of set screw on coupling wheel • Linear actuator: Check for firm seating of lever on positioner shaft. • Correct any other play between the actuator and the control valve.
	• Diagnostic value "9.TUP" or "10.TDOWN" < 1.5 s	• Adjust the travel speed to > 1.5 s with the internal restrictors.
"CPU test" flashes on the local display approximately every 2 seconds. Pneumatic block does not switch.	• Water in the pneumatic block (due to wet compressed air)	• At an early stage, this fault can be rectified with subsequent operation using dry air, in a temperature cabinet at 50 to 70 °C if required. • Otherwise: Repair
In the manual and automatic modes, the actuator cannot be moved or can be moved only in one direction.	• Moisture in the pneumatic block	
Pneumatic block does not switch. A gentle click sound is also not audible when the △ or ▽ buttons are pressed in manual mode.	• The screw between the cover and the pneumatic block has not been tightened firmly or the cover is jammed.	• Tighten the screw firmly; if required, rectify the deadlock.
	• Dirt (swarf, particles) in the pneumatic block	• Repair or a new device; built-in fine screen, can also be replaced and cleaned.
	• Deposits on contacts between the electronics board and the pneumatic block can develop due to abrasion resulting from continuous strong vibration loads.	• Clean all contact surfaces with spirit; bend the pneumatic block contact springs slightly if required.

Fault profile (symptoms)	Possible cause(s)	Remedy
Actuator does not move.	• Compressed air < 1.4 bar	• Set supply pressure PZ to > 1.4 bar.
Pneumatic block does not switch (however, a gentle clicking sound can be heard when the $\triangle$ or ∇ button is pressed in "Manual" mode.)	• Restrictors on the pneumatic block are closed (screw at the right end-stop)	• Open the restrictor screw by turning it to the left.
	• Dirt in the pneumatic block	• Repair or a new device; built-in fine screen, can also be replaced and cleaned.
The pneumatic block continually switches in stationary automatic mode (constant setpoint) and in "Manual" mode.	• Pneumatic leakage in the positioner - actuator system; start the leakage test in "RUN 3" (initialization).	• Rectify leakage in the actuator and/or feed line. • In case of an intact actuator and tight feed line: Repair or new device
	• Dirt in the pneumatic block	• Repair or a new device; built-in fine screen, can also be replaced and cleaned.
The pneumatic block continually switches and the actuator oscillates around a mean value in stationary automatic mode (constant setpoint) and in "Manual" mode.	• Stiction of the packing gland from the control valve or actuator too large	• Reduce stiction or increase deadband of positioner (parameter "dEbA") until the oscillation stops.
	• Looseness (play) in the positioner/actuator/control valve system	• Part-turn actuator: Check for firm seating of set screw on coupling wheel. • Linear actuator: Check for firm seating of lever on positioner shaft. • Correct any other play between the actuator and the control valve.
	• Actuator too fast	• Increase travel times using restrictor screws. • If a quick travel time is needed, increase the deadband (parameter "dEbA") until the oscillation stops.
Positioner does not move control valve to the endstop (at 20 mA).	• Supply pressure too low. Load on the feeding controller or system output is too low.	• Increase supply pressure, insert ballast converter • Select 3-/4-wire operation.
Zero point displaces sporadically (> 3%).	Impact or shock loads result in accelerations so high that the friction clutch moves, e.g. due to "vapor shocks" in vapor lines.	• Rectify the causes for shock loads. • Re-initialize the positioner.
The device function has completely failed: No representation on the display either.	Electrical auxiliary power is not adequate.	• Check the electrical auxiliary power.
	In case of very high continuous loads due to vibrations (oscillations): • Screws of the electrical connecting terminals may be loosened. • Electrical connecting terminals and/or electronic components may be knocked out.	• Tighten the screws firmly and secure using sealing wax. • Repair • For prevention: Install the positioner on damping pads.

13 Technical specifications

13.1 Rated conditions

Rated conditions	
Ambient conditions	For use indoors and outdoors.
Ambient temperature	In hazardous areas, observe the maximum permissible ambient temperature corresponding to the temperature class.
• Permissible ambient temperature for operation [1)]	-30 ... +80 °C (-22 ... +176 °F)
• Height	2000 m above sea level. At altitudes greater than 2000 m above sea level, use a suitable power supply.
• Relative humidity	0 ... 100%
Degree of pollution	2
Overvoltage category	II
Type of protection [2)]	IP66 / type 4X to UL 50E
Mounting position	Any; pneumatic connections and exhaust opening not facing up in wet environment, Installing/mounting (Page 31)
Vibration resistance	
• Harmonic oscillations (sine) according to EN 60068-2-6/10.2008	3.5 mm (0.14"), 2 ... 27 Hz, 3 cycles/axis
	98.1 m/s² (321.84 ft/s²), 27 ... 300 Hz, 3 cycles/axis
• Bumping (half-sine) according to EN 60068-2-27/02.2010	150 m/s² (492 ft/s²), 6 ms, 1000 shocks/axis
• Noise (digitally controlled) according to EN 60068-2-64/04.2009	10 ... 200 Hz; 1 (m/s²)²/Hz (3.28 (ft/s²)²/Hz)
	200 ... 500 Hz; 0.3 (m/s²)²/Hz (0.98 (ft/s²)²/Hz)
	4 hours/axis
• Recommended range of continuous operation of the entire control valve	≤ 30 m/s² (98.4 ft/s²) without resonance peak
Climate class	According to DIN EN 60721-3
• Storage	1K5, but -40 ... +80°C (1K5, but -40 ... +176°F)
• Transport	2K4, but -40 ... +80°C (2K4, but -40 ... +176°F)

1) At ≤ -10 °C (≤ 14 °F), the refresh rate of the display is limited.

2) Max. impact energy 1 Joule for enclosure with inspection window 6DR5..0 and 6DR5..1 or max. 2 Joule for 6DR5..3

13.2 Pneumatic data

Pneumatic data	
Auxiliary power (air supply)	Compressed air, carbon dioxide (CO_2), nitrogen (N), noble gases or cleaned natural gas
• Pressure [1)]	1.4 ... 7 bar (20.3 ... 101.5 psi)

Pneumatic data	
Air quality to ISO 8573-1	
• Solid particulate size and density	Class 3
• Pressure dew point	Class 3 (min. 20 K (36 °F) below ambient temperature)
• Oil content	Class 3
Unrestricted flow (DIN 1945)	
• Pressurize actuator 2)	
2 bar; 0.1 KV (29 psi; 0.116 CV)	4.1 Nm^3/h (18.1 USgpm)
4 bar; 0.1 KV (58 psi; 0.116 CV)	7.1 Nm^3/h (31.3 USgpm)
6 bar; 0.1 KV (87 psi; 0.116 CV)	9.8 Nm^3/h (43.1 USgpm)
• Depressurize actuator for all versions except fail in place 2)	
2 bar; 0.2 KV (29 psi; 0.232 CV)	8.2 Nm^3/h (36.1 USgpm)
4 bar; 0.2 KV (58 psi; 0.232 CV)	13.7 Nm^3/h (60.3 USgpm)
6 bar; 0.2 KV (87 psi; 0.232 CV)	19.2 Nm^3/h (84.5 USgpm)
• Depressurize actuator for fail in place version	
2 bar; 0.1 KV (29 psi; 0.116 CV)	4.3 Nm^3/h (19.0 USgpm)
4 bar; 0.1 KV (58 psi; 0.116 CV)	7.3 Nm^3/h (32.2 USgpm)
6 bar; 0.1 KV (87 psi; 0.116 CV)	9.8 Nm^3/h (43.3 USgpm)
Valve leakage	$< 6 \cdot 10^{-4}$ Nm^3/h (0.0026 USgpm)
Throttle ratio	Adjustable up to ∞: 1
Auxiliary power consumption in the controlled state	$< 3.6 \cdot 10^{-2}$ Nm^3/h (0.158 USgpm)
Sound pressure level	$L_{A\,eq} < 75$ dB $L_{A\,max} < 80$ dB
Sound pressure with installed booster 3)	$L_{Aeq} < 95.2$ dB $L_{A\,max} < 98.5$ dB

1) The following applies to fail in place double acting: 3 ... 7 bar (43.5 ... 101.5 psi)

2) When using device versions Ex d (6DR5..5-... and 6DR5..6-...), values are reduced by approximately 20%.

3) Read the warning notice "Increased sound pressure level".

See also

Basic safety instructions (Page 95)

13.3 Construction

Construction	
How does it work?	
• Range of stroke (linear actuator)	3 ... 130 mm (0.12 ... 5.12") (angle of rotation of the positioner shaft 16 ... 90°)
• Angle of rotation (part-turn actuator)	30 to 100°
Mounting method	

Construction	
• On the linear actuator	Using mounting kit 6DR4004-8V and, where necessary, an additional lever arm 6DR4004-8L on actuators according to IEC 60534-6-1 (NAMUR) with a fin, columns, or a plane surface.
• On the part-turn actuator	Using mounting kit 6DR4004-8D or TGX:16300-1556 on actuators with mounting plane according to VDI/VDE 3845 and IEC 60534-6-2: The required mount must be provided on the actuator-side.
Weight, positioner without option modules or accessories	
• 6DR5..0 Glass-fiber reinforced polycarbonate enclosure	Approx. 0.9 kg (1.98 lb)
• 6DR5.11 aluminum enclosure, only single-acting	Approx. 1.3 kg (2.86 lb)
• 6DR5..2 stainless steel enclosure	Approx. 3.9 kg (8.6 lb)
• 6DR5..3 aluminum enclosure	Approx. 1.6 kg (3.53 lb)
• 6DR5..5 aluminum enclosure, flameproof, rugged	Approx. 5.2 kg (11.46 lb)
• 6DR5..6 stainless steel enclosure, flameproof, rugged	Approx. 8.4 kg (18.5 lb)
Material	
• Enclosure	
6DR5..0 polycarbonate	Glass-fiber reinforced polycarbonate (PC)
6DR5.11 aluminum, only single-acting	GD AlSi12
6DR5..2 stainless steel	Austenitic stainless steel 316Cb, mat. No. 1.4581
6DR5..3 aluminum	GD AlSi12
6DR5..5 aluminum, flameproof, rugged	GK AlSi12
6DR5..6 stainless steel enclosure, flameproof, rugged	Austenitic stainless steel 316L, mat. No. 1.4409
• Pressure gauge block	Aluminum AlMgSi, anodized or stainless steel 316
Versions	
• In the polycarbonate enclosure 6DR5..0	Single-acting and double-acting
• In aluminum enclosure 6DR5.11	Single-acting
• In aluminum enclosures 6DR5..3 and 6DR5..5	Single-acting and double-acting
• In stainless steel enclosures 6DR5..2 and 6DR5..6	Single-acting and double-acting
Torques	
• Part-turn actuator fixing screws DIN 933 M6x12-A2	5 Nm (3.7 ft lb)
• Linear actuator fixing screws DIN 933 M8x16-A2	12 Nm (8.9 ft lb)
• Gland pneumatic G¼	15 Nm (11.1 ft lb)
• Pneumatic gland 1/4-18 NPT	
Without sealant	12 Nm (8.9 ft lb)
With sealant	6 Nm (4.4 ft lb)
• Cable glands	
Screw-in torque for plastic gland in all enclosures	4 Nm (3 ft lb)
Screw-in torque for cable gland made of metal/stainless steel in polycarbonate enclosure	6 Nm (4.4 ft lb)
Screw-in torque for metal/stainless steel glands in aluminum/stainless steel enclosure	6 Nm (4.4 ft lb)

Construction	
Screw-in torque for NPT adapter made of metal/stainless steel in polycarbonate enclosure	8 Nm (5.9 ft lb)
Screw-in torque for NPT adapter made of metal/stainless steel in aluminum/stainless steel enclosure	15 Nm (11.1 ft lb)
Screw-in torque for NPT gland in the NPT adapter NOTE: To avoid damage to the device, the NPT adapter must be held in place while the NPT gland is screwed into the NPT adapter.	68 Nm (50 ft lb)
Tightening torque for union nut made of plastic	2.5 Nm (1.8 ft lb)
Tightening torque for union nut made of metal/stainless steel	4 Nm (3 ft lb)
• Pressure gauge block fixing screws	6 Nm (4.4 ft lb)
Manometer	
• Degree of protection	
Manometer made of plastic	IP31
Manometer, steel	IP44
Manometer made of stainless steel 316	IP54
• Vibration resistance	In accordance with DIN EN 837-1
Connections, electrical	
• Screw terminals	2.5 mm^2 AWG30-14
• Cable gland	
Without Ex protection as well as with Ex i	M20 x 1.5 or 1/2-14 NPT
With explosion protection Ex d	Ex d-certified M20 x 1.5; 1/2-14 NPT or M25 x 1.5
Connections, pneumatic	Female thread G¼ or ¼-18 NPT

13.4 Controller

Controller	
Control unit	
• Five-point controller	Adaptive
• Dead zone	
dEbA = auto	Adaptive
dEbA = 0.1 ... 10 %	Can be set as fixed value
Analog-to-digital converter	
• Scanning time	10 ms
• Resolution	≤ 0,05 %
• Transmission error	≤ 0,2 %
• Temperature influence	≤ 0.1 %/10 K (≤ 0.1 %/18 °F)

13.5 Certificates and approvals

13.5.1 Breakdown of the article numbers

Each device has a nameplate. This nameplate shows a specific article number for the device. Lower-case letters are used and explained in the tables below for the variable digits in the article number. Each variable that is used stands for a different order version. You will find the order data in the FI 01 catalog on the Internet.

Table 13-1 Article number

1	2	3	4	5	6	7	-	8	9	10	11	12	-	13	14	15	16	-				
6	D	R	5	a	*	b	-	0	c	d	e	f	-	g	*	*	h	-	Z	j	j	j

Table 13-2 Enclosure in explosion-proof version and the relevant variables

<table>
<tr><td>Enclosure polycarbonate 6DR5 (b = 0)
</td><td>Enclosure aluminum single-acting 6DR5 (b = 1)
</td><td>Enclosure stainless steel 6DR5 (b = 2)
</td><td>Enclosure aluminum single/double-acting 6DR5 (b = 3)
</td></tr>
<tr><td colspan="2">Enclosure aluminum flameproof 6DR5 (b = 5)
</td><td colspan="2">Enclosure stainless steel flameproof 6DR5 (b = 6)
</td></tr>
</table>

6DR5a*b-0cdef-gh-Zjjj**	**If enclosure b =**	**If type of protection c =**	**If order code Z =**
Electronics: a =			
• 0, 2, 5, 6	0, 1, 2, 3	D, E, G, F, K	-
• 0, 1, 2, 3, 5, 6	5, 6	E	-
• 0, 2, 5, 6	5, 6	E	K50
• 0, 2, 5, 6	5, 6	G, F, K	-
• 1	3	D, E, G, F, K	P01...P02

6DR5a*b-0cdef-g**h-Zjjj	If enclosure b =	If type of protection c =	If order code Z =
Enclosure version b =			
0, 1, 2, 3, 5, 6			
Type of protection c =			
D, E, F, G, K			
Connection thread d =			
• G, N, M, P, R, S	0, 1, 2, 3		
• G, N, M, P, Q	5, 6		
Limit monitor e =			
0, 1, 2, 3, 9			
Option modules f =			
0, 1, 2, 3			
Customer-specific design g =			
0, 3, 7			
Pneumatic accessories h =			
0, 1, 2, 3, 4, 9R**			
Order code Z = jjj			
A**, C**, D53...D57, F**, K50, L1A, M40, P01...P02, R**, S**, Y**			

13.5.2 Basic unit and optional modules

Type of protection 6DR5ayb-*cdef-g*Ah-Zjjj	Ex marking Ex ATEX 205947X IECEx TUN 17.0023X	Ex marking FM 17US0053X CSA 18CA70166848X
For c = D, • a = 0, 2, 5, 6 and b = 1, 2, 3 • a = 1 and b = 3	II 2 D Ex tb IIIC T100°C Db II 3 G Ex ec IIC T6/T4 Gc	Zn 21 AEx tb IIIC T100°C Db Zn 21 Ex tb IIIC T100°C Db DIP Cl II, III Div 1 Gp E-G Cl I Zn 2 AEx nA IIC Gc Cl I Zn 2 Ex nA IIC Gc NI Cl I Div 2 Gp A-D
For c = E, • a = 0, 2, 5, 6 and b = 0	II 2 G Ex ia IIC T6/T4 Gb II 3 G Ex ic IIC T6/T4 Gc	Cl I Zn 1 AEx ib IIC Gb Cl I Zn 1 Ex ib IIC Gb IS Cl I Div 1 Gp A-D
For c = E, • a = 0, 2, 5, 6 and b = 1, 2, 3 • a = 1 and b = 3	II 2 G Ex ia IIC T6/T4 Gb II 3 G Ex ic IIC T6/T4 Gc II 2 D Ex ia IIIC T130°C Db	Cl I Zn 1 AEx ib IIC Gb Cl I Zn 1 Ex ib IIC Gb Zn 21 AEx ib IIIC, T130°C Db Zn 21 Ex ib IIIC, T130°C Db IS Cl I, II, III Div 1 Gp A-G

Type of protection 6DR5ayb-*cdef-g*Ah-Zjjj	Ex marking Ⓔx ATEX 205947X IECEx TUN 17.0023X	Ex marking FM 17US0053X CSA 18CA70166848X
For c = E, • a = 0, 1, 2, 3, 5, 6 and b = 5, 6	II 2 G Ex db IIC T6/T4 Gb II 2 D Ex tb IIIC T100°C Db	**FM** Cl I Zn 1 AEx db IIC Gb XP Cl I Div 1 Gp A-D **CSA** Cl I Zn 1 Ex db IIC Gb XP Cl I Div 1 Gp C-D **FM + CSA** Zn 21 AEx tb IIIC T100°C Db Zn 21 Ex tb IIIC T100°C Db DIP Cl II, III Div 1 Gp E-G
For c = F, • a = 0, 2, 5, 6 and b = 1, 2, 3, 5, 6 • a = 1 and b = 3 Non Contacting Sensor (NCS) • 6DR4004-6N	II 2 G Ex ia IIC T6/T4 Gb II 3 G Ex ic IIC T6/T4 Gc II 2 D Ex ia IIIC T130°C Db II 3 G Ex ec IIC T6/T4 Gc	Cl I Zn 1 AEx ib IIC Gb Cl I Zn 1 Ex ib IIC Gb Zn 21 AEx ib IIIC T130°C Db Zn 21 Ex ib IIIC T130°C Db IS Cl I, II, III Div 1 Gp A-G Cl I Zn 2 AEx nA IIC Gc Cl I Zn 2 Ex nA IIC Gc NI Cl I Div 2 Gp A-D
For c = G, • a = 0, 2, 5, 6 and b = 1, 2, 3, 5, 6 • a = 1 and b = 3	II 3 G Ex ec IIC T6/T4 Gc	Cl I Zn 2 AEx nA IIC Gc Cl I Zn 2 Ex nA IIC Gc NI Cl I Div 2 Gp A-D
For c = K and b = 1, 2, 3, 5, 6 • a = 0, 2, 5, 6 and b = 1, 2, 3, 5, 6 • a = 1 and b = 3 Position Transmitter: • 6DR4004-1ES • 6DR4004-2ES • 6DR4004-3ES • 6DR4004-4ES	II 2 G Ex ia IIC T6/T4 Gb II 3 G Ex ic IIC T6/T4 Gc II 2 D Ex ia IIIC T130°C Db II 2 D Ex tb IIIC T100°C Db II 3 G Ex ec IIC T6/T4 Gc	Cl I Zn 1 AEx ib IIC Gb Cl I Zn 1 Ex ib IIC Gb Zn 21 AEx ib IIIC, T130°C Db Zn 21 Ex ib IIIC, T130°C Db IS Cl I, II, III Div 1 Gp A-G Cl I Zn 2 AEx nA IIC Gc Cl I Zn 2 Ex nA IIC Gc NI Cl I Div 2 Gp A-D Zn 21 AEx tb IIIC T100°C Db Zn 21 Ex tb IIIC T100°C Db DIP Cl II, III Div 1 Gp E-G

13.5.3 Maximal permissible ambient temperature ranges

Positioner and option modules	*Temperature class T4*	*Temperature class T6*
Positioner		
• 6DR5ayb-0cdef-g*Ah-Z jjj	-30 °C ≤Ta ≤ +80 °C	-30 °C ≤Ta ≤ +50 °C
• 6DR5ayb-0cdef-g*Ah-Z **M40**	-40 °C ≤Ta ≤ +80 °C	-40 °C ≤Ta ≤ +50 °C
• 6DR5ayb-0cdef-g*Ah-Z jjj for a = 0, 1, 2 and f = 0, 2	-30 °C ≤Ta ≤ +80 °C	-30 °C ≤Ta ≤ +60 °C
• 6DR5**a**yb-0cd**ef**-g*Ah-Z **M40** for a = 0, 1, 2 and f = 0, 2	-40 °C ≤Ta ≤ +80 °C	-40 °C ≤Ta ≤ +60 °C

Positioner and option modules	*Temperature class T4*	*Temperature class T6*
Option modules		
• Non-Contacting Sensor (NCS) 6DR4004-6N	-40 °C ≤Ta ≤ +90 °C	-40 °C ≤Ta ≤ +70 °C
• Position Transmitter (Potentiometer) 6DR4004-1ES	-40 °C ≤Ta ≤ +90 °C	-40 °C ≤Ta ≤ +60 °C
• Position Transmitter (NCS) 6DR4004-2ES	-40 °C ≤Ta ≤ +90 °C	-40 °C ≤Ta ≤ +50 °C
• Position Transmitter (NCS, ILS) 6DR4004-3ES		
• Position Transmitter (NCS, MLS) 6DR4004-4ES		

13.6 Certificates, approvals, explosion protection for external position displacement system

Classification according to pressure equipment directive (PED 2014/68/EU)	For fluid group 1 gases; fulfills requirements according to article 4, paragraph 3 (good engineering practice SEP)
CE conformity	The applicable directives and applied standards with their revision levels can be found in the EU declaration of conformity on the Internet.
UL conformity	You can find the appropriate "Standard(s) for Safety", including the relevant versions, in the UL-CERTIFICATE OF COMPLIANCE on the Internet under Certificate.

13.7 Electrical data

Note

Pressure sensor module

The following electrical data also apply to electronics with pressure sensor module.

	Basic device without explosion protection	Basic device with explosion protection Ex "db"	Basic device with explosion protection Ex "ia", Ex "db ia"	Basic device with explosion protection Ex "ic", "ec", "tb"
Auxiliary power supply bus circuit (terminals 6 and 7)	Bus-powered			
Bus voltage	9 ... 32 V	9 ... 32 V	9 ... 24 V	9 ... 32 V
For connecting to circuits with the following peak values				

	Basic device without explosion protection	**Basic device with explosion protection Ex "db"**	**Basic device with explosion protection Ex "ia", Ex "db ia"**	**Basic device with explosion protection Ex "ic", "ec", "tb"**
• Bus connector with FISCO supply unit	-	-	$U_i \leq 17.5$ V $I_i \leq 380$ mA $P_i \leq 5.32$ W	"ic": $U_i \leq 17.5$ V $I_i \leq 570$ mA "ec"/"tb": $U_n \leq 32$ V
• Bus connector with barrier			$U_i \leq 24$ V $I_i \leq 250$ mA $P_i \leq 1.2$ W	"ic": $U_i \leq 32$ V "ec"/"tb": $U_n \leq 30$ V $I_n \leq 100$ mA
Effective inner capacitance C_i	-	-	Negligible	Negligible
Effective inner inductance L_i	-	-	8 μH	"ic": 8 μH
Current consumption	11.5 mA ± 10 %			
Additional fault current	0 mA			

Safety shutdown can be activated using "Jumper" (terminals 81 and 82)	Electrically isolated from bus circuit and digital input			
• Input resistance	> 20 kΩ			
• Signal status "0" (shutdown active)	0 ... 4.5 V or unused			
• Signal status "1" (shutdown not active)	13 ... 30 V			
• For connecting to power source with the following peak values	-	-	$U_i \leq 30$ V $I_i \leq 100$ mA $P_i \leq 1$ W	"ic": $U_i \leq 30$ V $I_i \leq 100$ mA "ec"/"tb": $U_n \leq 30$ V $I_n \leq 100$ mA
• Effective internal capacitance and inductance	-	-	Negligible	Negligible

Digital input DI1 (terminals 9 and 10) electrically connected to the bus circuit	Jumpered or connection to switch contact. Suitable only for floating contact; max. contact load < 5 μA with 3 V

Galvanic isolation	
• For basic device without explosion protection and for basic device with Ex "db"	Galvanic isolation between the basic device and the input for safety shutdown and the outputs of option modules.
• For basic device Ex "ia"	The basic device, the input for safety shutdown, and the outputs of option modules are individual intrinsically safe circuits.

	Basic device without explosion protection	Basic device with explosion protection Ex "db"	Basic device with explosion protection Ex "ia", Ex "db ia"	Basic device with explosion protection Ex "ic", "ec", "tb"
• For basic device Ex "ic", "ec", "tb"	Galvanic isolation between the basic device and the input for safety shutdown and the outputs of option modules.			
Test voltage	DC 840 V, 1 s			

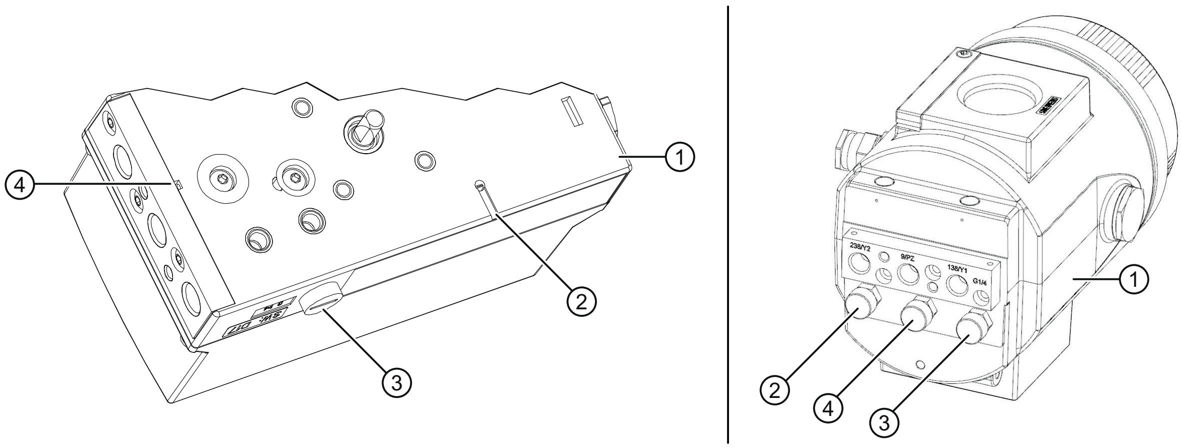
13.8 Communication

FOUNDATION Fieldbus communication	
Communications group and class	According to technical specification of the Fieldbus Foundation for H1 communication
Function blocks / functions	Group 3, class 31PS (Publisher Subscriber) 1 Resource Block (RB2) 1 Analog Output Function Block (AO) 1 PID Function Block (PID) 1 Transducer Block (Standard Advanced Positioner Valve) Link Active Schedular (LAS) function
Execution times of the blocks	AO: 30 ms PID: 40 ms
Physical layer profile	123, 511
FF registration	Tested with ITK 6.0
Device address	22 (when delivered)

13.9 Technical data for natural gas as actuator medium

Introduction

For operation with natural gas, note that used natural gas escapes at the exhaust air outlets.



①	Base plate	③	Exhaust air outlet sound absorber
②	Exhaust air outlet enclosure ventilation	④	Exhaust air outlet near the pneumatic connections

Note

The following applies for exhaust air outlet with sound absorber ③:

The positioner is supplied as standard with a sound absorber. To provide an outlet for the exhaust air, replace the sound absorber by a G¼ pipe coupling.

The following applies for enclosure ventilation ② and control air outlet ④:

1. With the "flameproof enclosure" device version in an aluminum enclosure with order suffix -Z K50 "Operation with natural gas", you can completely collect and discharge the escaping natural gas.
2. In all other device versions, the escaping natural gas is released into the environment.

Maximum values for escaping natural gas

- The quantity of escaping natural gas is negligible during regulated operation.
- If a control error occurs, a maximum of 30 Nl/min of natural gas will escape at the enclosure vent ② and a maximum of 89 Nl/min at the control air outlet ④.

13.10 Option modules

13.10.1 Digital I/O Module (DIO) 6DR4004-6A / -8A

	Without explosion protection or suitable for use in Ex "db" version	With explosion protection Ex "ia", "db ia"	With explosion protection Ex "ic", "ec", "tb"
	6DR4004-8A	**6DR4004-6A**	**6DR4004-6A**
3 digital output current circuits • Digital output A1: Terminals 41 and 42 • Digital output A2: Terminals 51 and 52 • Fault message output: Terminals 31 and 32			
• Auxiliary power supply U_{Aux}	≤ 35 V and the current consumption is to be limited to < 25 mA	-	-
• Signal status			
High (not addressed)	Conductive, R = 1 kΩ, +3/-1 % *)	≥ 2.1 mA	≥ 2.1 mA
Low *) (addressed)	Deactivated, I_R < 60 µA	≤ 1.2 mA	≤ 1.2 mA
*) The status is also Low if the basic device is faulty or without a auxiliary power.	*) When using in the flameproof enclosure, the current consumption must be restricted to 10 mA per digital output.	Switching threshold for supply according to EN 60947-5-6: U_{Aux} = 8.2 V, R_i = 1 kΩ	Switching threshold for supply according to EN 60947-5-6: U_{Aux} = 8.2 V, R_i = 1 kΩ
• For connecting to circuits with the following peak values	-	U_i ≤ 15 V DC I_i ≤ 25 mA P_i ≤ 64 mW	"ic": U_i ≤ 15 V DC I_i ≤ 25 mA "ec"/"tb": U_n ≤ 15 V DC
Effective internal capacitance	-	C_i ≤ 5.2 nF	C_i ≤ 5.2 nF
Effective internal inductance	-	L_i = negligibly small	L_i = negligibly small

1 digital input current circuit • Digital input DI2: Terminals 11 and 12, terminals 21 and 22 (jumper)	
• Galvanically connected with the basic device	
Signal status 0	Floating contact, open
Signal status 1	Floating contact, closed
Contact load	3 V, 5 µA
• Electrically isolated from the basic device	
Signal status 0	≤ 4.5 V or open
Signal status 1	≥ 13 V
Internal resistance	≥ 25 kΩ

	Without explosion protection or suitable for use in Ex "db" version	With explosion protection Ex "ia", "db ia"	With explosion protection Ex "ic", "ec", "tb"
	6DR4004-8A	**6DR4004-6A**	**6DR4004-6A**
• Static destruction limit	± 35 V	-	-
• Connecting to circuits with the following peak values	-	U_i ≤ 25.2 V DC	"ic": U_i ≤ 25.2 V DC "ec"/"tb": U_n ≤ 25.2 V DC
Effective internal capacitance	-	C_i = negligibly small	C_i = negligibly small
Effective internal inductance	-	L_i = negligibly small	L_i = negligibly small
Galvanic isolation	The three digital outputs, the DI1 digital input and the basic device are galvanically isolated from each other.		
Test voltage	DC 840 V, 1 s		

13.10.2 Analog Output Module (AOM) 6DR4004-6J / -8J

	Without explosion protection or suitable for use in Ex d version	With explosion protection Ex "ia", "db ia"	With explosion protection Ex "ic", "ec", "tb"
	6DR4004-8J	**6DR4004-6J**	**6DR4004-6J**
Direct current output for position feedback			
1 current output, terminals 61 and 62	2-wire connection		
• Rated signal range	4 ... 20 mA, short-circuit proof		
• Dynamic range	3.6 ... 20.5 mA		
• Auxiliary power supply U_{Aux}	+12 ... +35 V	+12 ... +30 V	+12 ... +30 V
• External load R_B [kΩ]	≤ (U_{Aux} [V] - 12 V)/I [mA]		
• Transmission error	≤ 0.3%		
• Temperature influence	≤ 0.1%/10 K (≤ 0.1%/18 °F)		
• Resolution	≤ 0.1%		
• Residual ripple	≤ 1 %		
• For connecting to circuits with the following peak values	-	U_i ≤ DC 30 V I_i ≤ 100 mA P_i ≤ 1 W	"ic": U_i ≤ DC 30 V I_i ≤ 100 mA "ec"/"tb": U_n ≤ DC 30 V I_n ≤ 100 mA P_n ≤ 1 W
Effective internal capacitance	-	C_i ≤ 2 nF	C_i ≤ 2 nF
Effective internal inductance	-	L_i ≤ 3 μH	L_i ≤ 3 μH
Galvanic isolation	Electrically isolated from the alarm option and safely isolated from the basic device		
Test voltage	DC 840 V, 1 s		

13.10.3 Inductive Limit Switches (ILS) 6DR4004-6G / -8G

	Without explosion protection	With explosion protection Ex "ia", "db ia"	With explosion protection Ex "ic", "ec", "tb"
	6DR4004-8G	**6DR4004-6G**	**6DR4004-6G**
Limit encoder with slotted initiators and fault message output			
2 slotted initiators • Digital output (limit monitor) A1: Terminals 41 and 42 • Digital output (limit monitor) A2: Terminals 51 and 52			
• Connection	2-wire technology in accordance with EN 60947-5-6 (NAMUR), for switching amplifiers connected on load side		
• Signal state High (not triggered)	> 2.1 mA		
• Signal state Low (triggered)	< 1.2 mA		
• 2 slotted initiators	Type SJ2-SN		
• Function	NC contact (NC, normally closed)		
• Connecting to circuits with the following peak values	Rated voltage 8 V, power consumption: ≥ 3 mA (limit not activated), ≤ 1 mA (limit activated)	U_i ≤ DC 15 V I_i ≤ 25 mA P_i ≤ 64 mW	"ic": U_i ≤ DC 15 V I_i ≤ 25 mA "ec"/"tb": U_n ≤ DC 15 V P_n ≤ 64 mW
Effective internal capacitance	-	C_i ≤ 161 nF	C_i ≤ 161 nF
Effective internal inductance	-	L_i ≤ 120 μH	L_i ≤ 120 μH
1 fault message output • Digital output: Terminals 31 and 32			
• Connection	At switching amplifier in accordance with EN 60947-5-6: (NAMUR), U_{Aux} = 8.2 V, R_i = 1 kΩ).		
• Signal state High (not triggered)	R = 1.1 kΩ	> 2.1 mA	> 2.1 mA
• Signal state Low (triggered)	R = 10 kΩ	< 1.2 mA	< 1.2 mA
• Auxiliary power U_{Aux}	U_{Aux} ≤ DC 35 V I ≤ 20 mA	-	-
• Connecting to circuits with the following peak values	-	U_i ≤ DC 15 V I_i ≤ 25 mA P_i ≤ 64 mW	"ic": U_i ≤ DC 15 V I_i ≤ 25 mA "ec"/"tb": U_n ≤ DC 15 V P_n ≤ 64 mW
Effective internal capacitance	-	C_i ≤ 5.2 nF	C_i ≤ 5.2 nF
Effective internal inductance	-	L_i = negligibly small	L_i = negligibly small
Galvanic isolation	The 3 outputs are galvanically isolated from the basic device.		
Test voltage	DC 840 V, 1 s		

13.10.4 Mechanic Limit Switches (MLS) 6DR4004-6K / -8K

	Without explosion protection	With explosion protection Ex "ia", "db ia"	With explosion protection Ex "ic", "tb"
	6DR4004-8K	**6DR4004-6K**	**6DR4004-6K**
Limit encoder with mechanical switching contacts			
2 limit contacts • Digital output DO1: Terminals 41 and 42 • Digital output DO2: Terminals 51 and 52			
• Max. switching current AC/DC	4 A	-	-
• For connecting to circuits with the following peak values	-	U_i ≤= 30 V I_i ≤ 100 mA P_i ≤ 750 mW	"ic": U_i ≤ 30 V I_i ≤ 100 mA "tb": U_n ≤ 30 V I_n ≤ 100 mA
Effective internal capacitance	-	C_i = negligibly small	C_i = negligibly small
Effective internal inductance	-	L_i = negligibly small	L_i = negligibly small
• Max. switching voltage AC/DC	250 V/24 V	DC 30 V	DC 30 V
1 fault message output • Digital output: Terminals 31 and 32			
• Connection	On switching amplifier according to EN 60947-5-6: (NAMUR), U_{Aux} = 8.2 V, Ri = 1 kΩ).		
• Signal state High (not triggered)	R = 1.1 kΩ	> 2.1 mA	> 2.1 mA
• Signal state Low (triggered)	R = 10 kΩ	< 1.2 mA	< 1.2 mA
• Auxiliary power	U_{Aux} ≤ DC 35 V I ≤ 20 mA	-	-
• Connecting to circuits with the following peak values	-	U_i ≤ 15 V I_i ≤ 25 mA P_i ≤ 64 mW	"ic" : U_i ≤ 15 V I_i ≤ 25 mA "tb": U_n ≤ 15 V I_n ≤ 25 mA
Effective internal capacitance	-	C_i ≤ 5.2 nF	C_i ≤ 5.2 nF
Effective internal inductance	-	L_i = negligibly small	L_i = negligibly small
Galvanic isolation	The 3 outputs are galvanically isolated from the basic device		
Test voltage	3150 V DC, 2 s		
Rated condition height	Max. 2 000 m above sea level. At altitudes greater than 2 000 m above sea level, use a suitable power supply.	-	-

13.10.5 Analog Input Module (AIM) 6DR4004-6F / -8F

	Without explosion protection	With explosion protection Ex "ia", "db ia", "ic"	With explosion protection Ex "ec", "tb"
	6DR4004-8F	**6DR4004-6F**	**6DR4004-6F**
The Analog Input Module (AIM) 6DR4004-6F and -8F is required to connect a Non-Contacting Sensor (NCS) or Position Transmitter 6DR4004-1ES to -4ES.			
For devices without explosion protection, other types of potentiometers with resistance values between 3 and 20 KΩ can be connected.			
R-potentiometer			
• Peak values when supplied by other basic devices (6DR50/1/2/3/9)	U_{max} = 5 V	$U_o \leq 5$ V $I_o \leq 100$ mA $P_o \leq 33$ mW $C_o \leq 1$ μF $L_o \leq 1$ mH	U_{max} = 5 V
• Maximum values when powered by the base unit with PA (6DR55) or FF communication (6DR56)	U_{max} = 5 V	$U_o \leq 5$ V $I_o \leq 75$ mA static $I_o \leq 160$ mA transient $P_o \leq 120$ mW $C_o \leq 1$ μF $L_o \leq 1$ mH	U_{max} = 5 V
Signal 20 mA			
• Rated signal range	0 ... 20 mA	-	
• Internal load R_B	200 Ω	-	
• Static destruction limit	40 mA	-	
Signal 10 V			
• Rated signal range	0 ... 10 V	-	
• Internal resistance R_i	25 kΩ	-	
• Static destruction limit	20 V	-	
Supply and signal power circuits	Galvanically connected with the basic device		

13.10.6 Internal NCS module 6DR4004-5L / 6DR4004-5LE

Additional modules	Without explosion protection	With explosion protection Ex "ia", "db ia"	With explosion protection Ex "ic", "ec", "tb"
	6DR4004-5L	**6DR4004-5LE**	**6DR4004-5LE**
Linearity (after corrections made by positioner)	± 1 %		
Hysteresis	± 0.2 %		
For connecting to circuits with the following peak values	-	$U_i \leq 5$ V $I_i \leq 160$ mA $P_i \leq 120$ mW	$U_i \leq 5$ V

Additional modules	Without explosion protection	With explosion protection Ex "ia", "db ia"	With explosion protection Ex "ic", "ec", "tb"
	6DR4004-5L	**6DR4004-5LE**	**6DR4004-5LE**
Effective internal capacitance	-	C_i = 110 nF + 110 nF per meter of connecting cable	
Effective internal inductance	-	L_i = 270 µH + 6.53 µH per meter of connecting cable	

13.10.7 External NCS sensors 6DR4004-6N/8N and 6DR4004-2ES

Additional modules	Without Ex protection	With Ex protection Ex "ia"	With explosion protection Ex "ic", "ec"
Travel range			
• Linear actuator 6DR4004-6/8N.20	3 to 14 mm (0.12 to 0.55")		
• Linear actuator 6DR4004-6/8N.30	10 to 130 mm (0.39 to 5.12"); up to 200 mm (7.87") on request		
• Part-turn actuator	30 to 100°		
Linearity (after corrections made by positioner)	± 1 %		
Hysteresis	± 0.2 %		
Temperature influence (range: rotation angle 120° or stroke 14 mm)	≤ 0.1 %/10 K (≤ 0.1 %/18 °F) for -20 to +90 °C (-4 to +194 °F) ≤ 0.2%/10 K (≤ 0.2%/18 °F) for -40 to -20 °C (-40 to -4 °F)		
Climate class	According to IEC/EN 60721-3		
• Storage	1K5, but -40 to +90 °C (-40 to +194 °F)		
• Transport	2K4, but -40 to +90 °C (-40 to +194 °F)		
Vibration resistance			
• Harmonic oscillations (sine) according to IEC 60068-2-6	3.5 mm (0.14"), 2 to 27 Hz, 3 cycles/axis 98.1 m/s² (321.84 ft/s²), 27 to 300 Hz, 3 cycles/axis		
• Bumping according to IEC 60068-2-29	300 m/s²(984 ft/s²), 6 ms, 4000 shocks/axis		
Torque for cable gland nut made of	Plastic	Metal	Stainless steel
	2.5 Nm (1.8 ft lb)	4.2 Nm (3.1 ft lb)	4.2 Nm (3.1 ft lb)
Torque of hexagon socket-head screw M6x12 (shaft end or mounting bracket)	4 Nm (3 ft lb)		
Torque of hexagon socket head screw M6x25 (mounting console or mounting plate)	4 Nm (3 ft lb)		
Torque of hexagon socket head screw M3x12 (clamping ring)	1 Nm (0.7 ft lb)		
Degree of protection	IP68 / type 4X		
For connecting to circuits with the following peak values	-	U_i = 5 V I_i = 160 mA P_i = 120 mW	U_i = 5 V

Additional modules	Without Ex protection	With Ex protection Ex "ia"	With explosion protection Ex "ic", "ec"
Effective internal capacitance	-	C_i = [1]	C_i = [1]
Effective internal inductance	-	L_i = [2]	L_i = [2]

[1] C_i = 110 nF + 110 nF per meter of connecting cable

[2] L_i = 270 μH + 6.53 μH per meter of connecting cable

13.10.8 External position detection

13.10.8.1 Rated conditions and electrical data for external position detection system

Rated conditions	
Ambient temperature	In hazardous areas, observe the maximum permissible ambient temperature corresponding to the temperature class.
• Permissible ambient temperature for operation	-40 ... +90 °C (-40 ... +194 °F)
Degree of protection [1]	
Climate class	According to IEC/EN 60721-3
• Storage	1K5, but -40 ... +90 °C (1K5, but -40 ... +194 °F)
• Transport	2K4, but -40 ... +90 °C (2K4, but -40 ... +194 °F)
• Operation	4K3, but -40 ... +90 °C (4K3, but -40 ... +194 °F)

Electrical data	
For connecting to circuits with the following peak values	U_i = 5 V C_i = 10 nF L_i = 240 μH

13.10.8.2 External NCS sensors 6DR4004-6N / -8N

	Without explosion protection	With explosion protection Ex "ia", "db ia", "ic"	With explosion protection Ex "ec"
	6DR4004-8N	**6DR4004-6N**	**6DR4004-6N**
Travel range			
• Linear actuator 6DR4004-6/-8N.20	3 to 14 mm (0.12 to 0.55")		
• Linear actuator 6DR4004-6/-8N.30	10 to 130 mm (0.39 to 5.12"); up to 200 mm (7.87") on request		
• Part-turn actuator	30 to 100°		
Linearity (after corrections made by positioner)	± 1 %		
Hysteresis	± 0.2 %		

	Without explosion protection	With explosion protection Ex "ia", "db ia", "ic"	With explosion protection Ex "ec"
	6DR4004-8N	**6DR4004-6N**	**6DR4004-6N**
Temperature influence (range: rotation angle 120° or stroke 14 mm)	≤ 0.1 %/10 K (≤ 0.1 %/18 °F) for -20 to +90 °C (-4 to +194 °F) ≤ 0.2%/10 K (≤ 0.2%/18 °F) for -40 to -20 °C (-40 to -4 °F)		
Climate class	According to IEC/EN 60721-3		
• Storage	1K5, but -40 to +90 °C (-40 to +194 °F)		
• Transport	2K4, but -40 to +90 °C (-40 to +194 °F)		
Vibration resistance			
• Harmonic oscillations (sine) according to IEC 60068-2-6	3.5 mm (0.14"), 2 to 27 Hz, 3 cycles/axis 98.1 m/s² (321.84 ft/s²), 27 to 300 Hz, 3 cycles/axis		
• Bumping according to IEC 60068-2-29	300 m/s²(984 ft/s²), 6 ms, 4000 shocks/axis		
Torque for cable gland nut made of	Plastic	Metal	
	2.5 Nm (1.8 ft lb)	4.2 Nm (3.1 ft lb)	
Torque of hexagon socket-head screw M6x12 (shaft end or mounting bracket)	4 Nm (3 ft lb)		
Torque of hexagon socket head screw M6x25 (mounting console or mounting plate)	4 Nm (3 ft lb)		
Torque of hexagon socket head screw M3x12 (clamping ring)	1 Nm (0.7 ft lb)		
Degree of protection	IP68 according to IEC/EN 60529; Type 4X according to UL 50E		
For connecting to circuits with the following peak values	-	$U_i \leq 5$ V $I_i \leq 160$ mA $P_i \leq 120$ mW	$U_i \leq 5$ V
Effective internal capacitance	-	C_i = 110 nF + 110 nF per meter of connecting cable	
Effective internal inductance	-	L_i = 270 μH + 6.53 μH per meter of connecting cable	

13.10.8.3 Position Transmitter (Potentiometer) 6DR4004-1ES

Additional modules	With explosion protection Ex "ia", "db ia", "ic"	With explosion protection Ex "ec", "tb"
Degree of protection	IP66 according to IEC/EN 60529; Type 4X according to UL 50E	
For connecting to circuits with the following peak values	$U_i \leq 5$ V	$U_i \leq 5$ V
Effective internal capacitance	$C_i \leq 10$ nF	-
Effective internal inductance	$L_i \leq 240$ μH	-

13.10.8.4 Position Transmitter (NCS) 6DR4004-2ES

	Without explosion protection	With explosion protection Ex "ia", "db ia", "ic"	With explosion protection Ex "ec", "tb"
Travel range			
• Linear actuator	3 to 14 mm (0.12 to 0.55") 10 to 130 mm (0.39 to 5.12"); up to 200 mm (7.87") on request		
• Part-turn actuator	30 to 100°		
Linearity (after corrections made by positioner)	± 1 %		
Hysteresis	± 0.2 %		
Temperature influence (range: rotation angle 120° or stroke 14 mm)	≤ 0.1 %/10 K (≤ 0.1 %/18 °F) for -20 to +90 °C (-4 to +194 °F) ≤ 0.2%/10 K (≤ 0.2%/18 °F) for -40 to -20 °C (-40 to -4 °F)		
Climate class	According to IEC/EN 60721-3		
• Storage	1K5, but -40 to +90 °C (-40 to +194 °F)		
• Transport	2K4, but -40 to +90 °C (-40 to +194 °F)		
Vibration resistance			
• Harmonic oscillations (sine) according to IEC 60068-2-6	3.5 mm (0.14"), 2 to 27 Hz, 3 cycles/axis 98.1 m/s² (321.84 ft/s²), 27 to 300 Hz, 3 cycles/axis		
• Bumping according to IEC 60068-2-29	300 m/s²(984 ft/s²), 6 ms, 4000 shocks/axis		
Torque for cable gland nut made of	Plastic	Metal	
	2.5 Nm (1.8 ft lb)	4.2 Nm (3.1 ft lb)	
Torque of hexagon socket-head screw M6x12 (shaft end or mounting bracket)	4 Nm (3 ft lb)		
Torque of hexagon socket head screw M6x25 (mounting console or mounting plate)	4 Nm (3 ft lb)		
Torque of hexagon socket head screw M3x12 (clamping ring)	1 Nm (0.7 ft lb)		
Degree of protection provided by enclosure	IP66 according to IEC/EN 60529; Type 4X according to UL 50E		
For connecting to circuits with the following peak values	-	U_i ≤ 5 V I_i ≤ 160 mA P_i ≤ 120 mW	U_i ≤ 5 V
Effective internal capacitance	-	C_i = 110 nF + 110 nF per meter of connecting cable	
Effective internal inductance	-	L_i = 270 µH + 6.53 µH per meter of connecting cable	

13.10.8.5 Position Transmitter (NCS, ILS) 6DR4004-3ES

	Without explosion protection	With explosion protection Ex "ia", "db ia", "ic"	With explosion protection Ex "ec", "tb"
Degree of protection provided by enclosure	IP66 according to IEC/EN 60529; type 4X according to UL 50E		
NCS module (NCS)	**6DR4004-5L**	**6DR4004-5LE**	**6DR4004-5LE**
• For connecting to circuits with the following peak values	-	$U_i \leq 5$ V $I_i \leq 160$ mA $P_i \leq 120$ mW	$U_i \leq 5$ V $I_i \leq 160$ mA
• Effective internal capacitance	-	$C_i = 110$ nF + 690 pF/m Connecting cable	-
• Effective internal inductance	-	$L_i = 270$ µH + 6,53 µH/m Connecting cable	-
Inductive Limit Switches (ILS)	**6DR4004-8G**	**6DR4004-6G**	**6DR4004-6G**
2 slotted initiators			
• Digital output (slot-type initiators) A1: Terminals 41 and 42			
• Digital output (slot-type initiators) A2: Terminals 51 and 52			
• Connection	2-wire system according to EN 60947-5-6 (NAMUR), for switching amplifier connected on load side		
• Signal state High (not triggered)	> 2.1 mA		
• Signal state Low (triggered)	< 1.2 mA		
• 2 slotted initiators	Type SJ2-SN		
• Function	NC (normally closed)		
• Connecting to circuits with the following peak values	Rated voltage 8 V, power consumption: ≥ 3 mA (limit not activated), ≤ 1 mA (limit activated)	$U_i \leq$ DC 15 V $I_i \leq 25$ mA $P_i \leq 64$ mW	$U_n \leq$ DC 15 V $I_n \leq 25$ mA
Effective internal capacitance	-	$C_i \leq 161$ nF	-
Effective internal inductance	-	$L_i \leq 120$ µH	-
1 fault message output			
• Digital output: Terminals 31 and 32			
• Connection	At switching amplifier in accordance with EN 60947-5-6: (NAMUR), $U_{Aux} = 8.2$ V, $R_i = 1$ kΩ)		
• Signal state High (not triggered)	R = 1.1 kΩ	> 2.1 mA	> 2.1 mA
• Signal state Low (triggered)	R = 10 kΩ	< 1.2 mA	< 1.2 mA
• Auxiliary power U_{Aux}	$U_{Aux} \leq$ DC 35 V I ≤ 20 mA	-	-
• Connecting to circuits with the following peak values	-	$U_i \leq$ DC 15 V $I_i \leq 25$ mA $P_i \leq 64$ mW	$U_i \leq 15$ V $I_i \leq 25$ mA
Effective internal capacitance	-	$C_i = 5.2$ nF	-
Effective internal inductance	-	L_i = negligibly small	L_i = negligibly small

	Without explosion protection	With explosion protection Ex "ia", "db ia", "ic"	With explosion protection Ex "ec", "tb"
Galvanic isolation	The 3 digital outputs are galvanically isolated from the basic unit.		
Test voltage	DC 840 V, 1 s		

13.10.8.6 Position Transmitter (NCS, MLS) 6DR4004-4ES

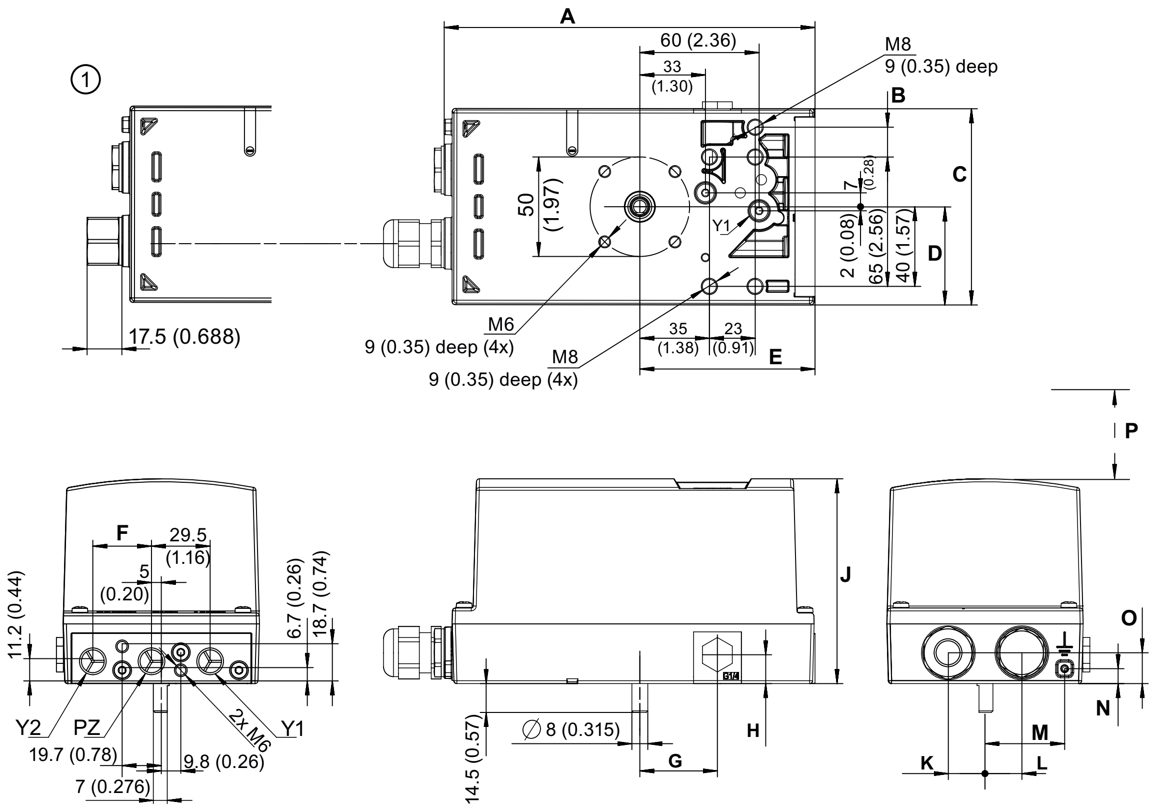
	Without explosion protection	With explosion protection Ex "ia", "db ia", "ic"	With explosion protection Ex "ec", "tb"
Degree of protection provided by enclosure	IP66 according to IEC/EN 60529; type 4X according to UL 50E		
NCS module (NCS)	**6DR4004-5L**	**6DR4004-5LE**	**6DR4004-5LE**
• For connecting to circuits with the following peak values		$U_i \leq 5$ V $I_i \leq 160$ mA $P_i \leq 120$ mW	$U_i \leq 5$ V $I_i \leq 160$ mA
• Effective internal capacitance		C_i = 110 nF + 690 pF/m Connecting cable	-
• Effective internal inductance		L_i = 270 µH + 6,53 µH/m Connecting cable	-
Mechanic Limit Switches (MLS)	**6DR4004-8K**	**6DR4004-6K**	**6DR4004-6K**
2 limit contacts			
• Digital output (switching contact) A1: Terminals 41 and 42			
• Digital output (switching contact) A2: Terminals 51 and 52			
• Max. switching current AC/DC	4 A	-	-
• For connecting to circuits with the following peak values	-	$U_i \leq 30$ V $I_i \leq 100$ mA $P_i \leq 750$ mW	$U_n \leq 30$ V $I_n \leq 100$ mA
Effective internal capacitance	-	C_i = negligibly small	-
Effective internal inductance	-	L_i = negligibly small	-
• Max. switching voltage AC/DC	250 V/24 V	DC 30 V	DC 30 V
1 fault message output			
• Digital output: Terminals 31 and 32			
• Connection	On switching amplifier according to EN 60947-5-6: (NAMUR), U_{Aux} = 8.2 V, Ri = 1 kΩ)		
• Signal state High (not triggered)	R = 1.1 kΩ	> 2.1 mA	> 2.1 mA
• Signal state Low (triggered)	R = 10 kΩ	< 1.2 mA	< 1.2 mA
• Auxiliary power	$U_{Aux} \leq$ DC 35 V $I \leq 20$ mA	-	-
• Connecting to circuits with the following peak values	-	$U_i \leq 15$ V $I_i \leq 25$ mA $P_i \leq 64$ mW	$U_n \leq 15$ V $I_n \leq 25$ mA
Effective internal capacitance	-	Ci = 5.2 nF	Ci = 5.2 nF
Effective internal inductance	-	L_i = negligibly small	
Galvanic isolation	The 3 digital outputs are galvanically isolated from the basic unit		

	Without explosion protection	With explosion protection Ex "ia", "db ia", "ic"	With explosion protection Ex "ec", "tb"
Test voltage		3150 V DC, 2 s	
Rated condition height	Max. 2 000 m above sea level. Use a suitable power supply at an altitude of more than 2 000 m above sea level.	-	-

Dimension drawings

14

14.1 Positioner in non-flameproof enclosure



① M20 x 1.5 or NPT adapter

Figure 14-1 Dimension drawing, dimensions in mm (inch)

	6DR5..0		6DR5..1	6DR5..2	6DR5..3	
	G¼	1/4-18 NPT			G¼	1/4-18 NPT
A	184.5 [7.26]	186.5 [7.34]	185 [7.28]	186.5 [7.34]	186.5 [7.34]	188.5 [7.42]
B	-	-	-	-	15 [0.59]	
C	95 [3.74]		84 [3.31]	99 [3.90]	98.6 [3.88]	
D	47.5 [1.87]		49.5 [1.95]	49.5 [1.95]	49.3 [1.94]	
E	88.5 [3.48]		88.8 [3.50]	88.5 [3.48]	88.8 [3.50]	
F*)	29.5 [1.16]		-	29.5 [1.16]	29.5 [1.16]	
G	39 [1.54]		44 [1.73]	39 [1.54]	39 [1.54]	
H	14.5 [0.57]		16 [0.63]	16 [0.63]	14.5 [0.57]	
J	96.6 [3.80]		96.6 [3.80]	98.5 [3.88]	103 [4.06]	
K	18.5 [0.73]		22 [0.87]	18.5 [0.73]	18.5 [0.73]	
L	18.5 [0.73]		7 [0.23]	18.5 [0.73]	18.5 [0.73]	

	6DR5..0		6DR5..1	6DR5..2	6DR5..3	
	G¼	1/4-18 NPT			G¼	1/4-18 NPT
M	-		26.5 [1.04]	41.5 [1.53]	40 [1.57]	
N	-		7.5	7.5	7.5	
O	14.5 [0.57]		14.5 [0.57]	14.5 [0.57]	15.5 [0.61]	
P	> 150 (5.91) Adhere to this minimum clearance P for service and maintenance above the lid.					

Dimensions in mm [inch]

*) Dimensions only apply to double-acting actuators.

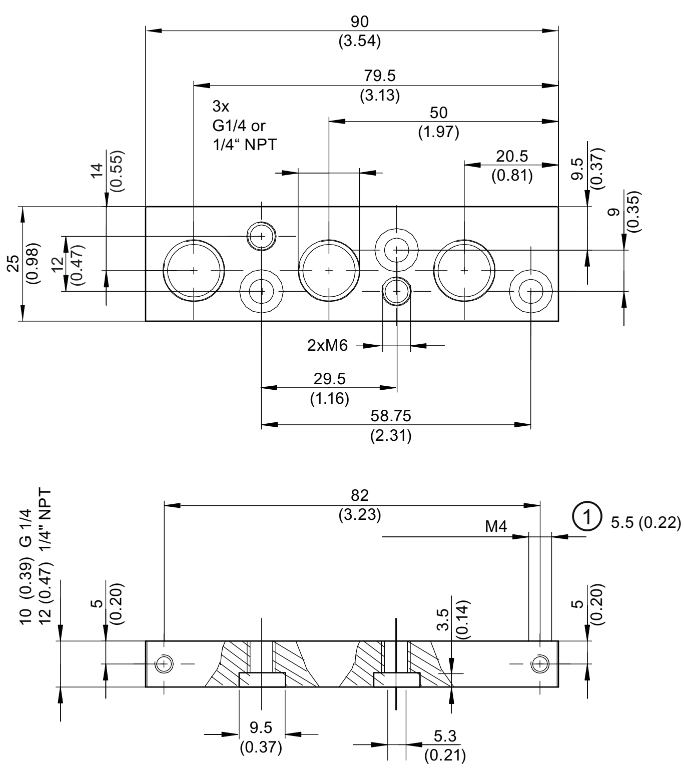
6DR5..0 Polycarbonate enclosure; dimensions with pneumatic connection G¼ or 1/4-18 NPT

6DR5..1 Aluminum enclosure, single-acting

6DR5..2 Stainless steel enclosure, without inspection window

6DR5..3 Aluminum enclosure, single/double-acting; dimensions with pneumatic connection G¼ or 1/4-18 NPT

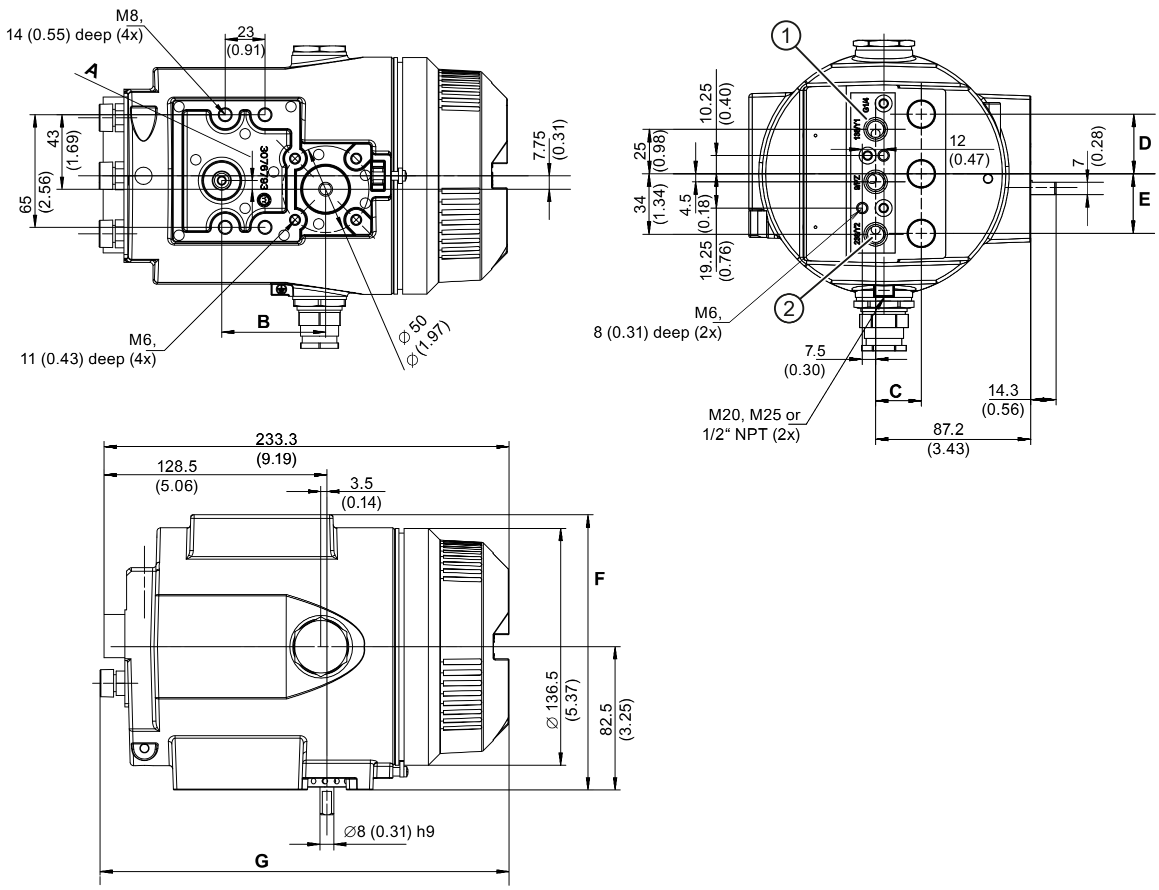
14.2 Terminal strip for positioner with Makrolon enclosure



① Thread depth

Figure 14-2 Terminal strip, dimensions in mm (inch)

14.3 Positioner in flameproof enclosure



① All air connections G¼ or ¼-18 NPT

② Air connection Y2, only with double-acting version

Figure 14-3 Dimensions of positioner in flameproof enclosure

	6DR5..5	6DR5..6
A	5 [0.2]	-
B	60 (2.36)	-
C	25.7 (1.01)	21.7 (0.85)
D	33.5 (1.32)	25 [0.99]
E	33.5 (1.32)	-
F	158.5 [6.24]	160 [6.3]
G	235.3 [9.26]	227.6 [8.96]

Dimensions in mm [inch]

6DR5..5 Aluminum enclosure, flameproof; dimensions with pneumatic connection G¼ or 1/4-18 NPT

6DR5..6 Stainless steel enclosure, flameproof

Spare parts/accessories/scope of delivery 15

15.1 Overview

⚠ WARNING
Assembling the components When assembling components, ensure that only those positioners and option modules are combined with each other that are approved for the corresponding operating range. These conditions particularly apply to safe operation of the positioner in hazardous areas. Observe the applicable certificates and approvals or the "Technical specifications (Page 227)".

Basic version

The positioner can be delivered for:

- Double-acting actuators
- Single-acting actuators

The positioner and its option modules are delivered as separate units and with different versions for the operation in:

- Hazardous environments and atmospheres
- Non-hazardous environments and atmospheres

Enclosure

The electronics with display, the position feedback and the pneumatic block are integrated in the enclosure.

The enclosure is available in the following versions:

- Polycarbonate enclosure for single-acting and double-acting actuators
- Aluminum enclosure for single-acting or double-acting actuators
- Stainless steel enclosure for single and double-acting actuators
- Flameproof enclosure for single and double-acting actuators

Options

The following option modules are available for the positioner:

- Analog Output Module (AOM) 6DR4004-6J / -8J: 2-wire current output 4 to 20 mA for position feedback
- Digital I/O Module (DIO) 6DR4004-6A / -8A: 3 digital outputs and 1 digital input

- Inductive Limit Switches (ILS) 6DR4004-6G / -8G: 1 digital output for fault signals, 2 digital outputs for limit monitors
- Mechanic Limit Switches (MLS) 6DR4004-6K / -8K: 1 digital output for fault signals, 2 digital outputs for limit monitors
- Internal NCS module 6DR4004-5L/-5LE

The Inductive Limit Switches (ILS) and Mechanic Limit Switches (MLS) cannot be used in device versions with flameproof enclosure. Additional restrictions in section "Technical specifications (Page 227)".

Accessories

- Pressure gauge block: 2 or 3 pressure gauges for single and double-acting positioners
- Mounting kits for linear and part-turn actuators

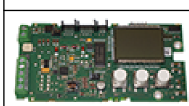
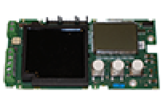
For separate mounting of positioner and position sensor

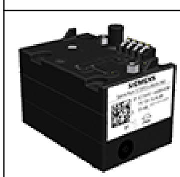
- Position Transmitter
- NCS sensor for non-contacting position detection

Note

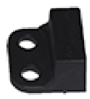
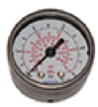
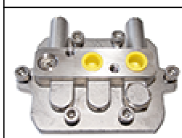
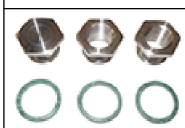
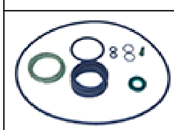
The version is identified using a special nameplate.

15.2 Spare parts

	Description	Article number	For version
	Basic electronics		
	FOUNDATION Fieldbus, not Ex	A5E00215467	6DR56..-.N
	FOUNDATION Fieldbus, Ex	A5E00215466	6DR56..-.D/E/F/G/K

	Description	Article number	For version
	Pneumatic block		
	Single-acting, with seal and screws	C73451-A430-D80	6DR5.1.*

	Description	Article number	For version
	Double-acting, with seal and screws	C73451-A430-D81	6DR5.2.*
	Fail in place, with seal and screws	A5E34409029	6DR5* -Z F01
	Single-acting for temperature range extension -40 °C ... 80 °C, with seal and screws	A5E35377156	6DR5.1.* -Z M40
	Double-acting for temperature range extension -40 °C ... 80 °C, with seal and screws	A5E35377157	6DR5.2.* -Z M40
	Optimized for small actuators with seal and screws	A5E43291389	6DR5.1.* -Z K10
Enclosure cover without Ex d			
	Made from polycarbonate, with inspection window, single and double-acting, with cover seal and screws	C73451-A430-D82	6DR5..0-.N/E C73451-A430-D78
	Made from aluminum, with inspection window, single-acting, with cover seal and screws	C73451-A430-D83	6DR5.11-.N/E/F/G
	Made from aluminum, without inspection window, single-acting, with cover seal and screws	A5E00065819	6DR5.11-.D/K*
	Made from aluminum, with inspection window, single and double-acting, with cover seal and screws	A5E39637097	6DR5..3-*
	Made from aluminum, without inspection window, single and double-acting, with cover seal and screws	A5E39636806	6DR5..3-*- -Z M40 6DR4004-1/2/3/4ES
Magnet clamp, pressure gauge, sound absorber			

	Description	Article number	For version
	Magnet clamp for linear actuators	A5E00078031	6DR4004-...2*
	Magnet clamp made from anodized aluminum for part-turn actuators	A5E00524070	6DR4004-...1/4*
	Pressure gauge steel, process connection G1/8 (3 units)	A5E32527731	6DR5...-.....-...9 -R1A/-R2A 6DR4004-1P/-2P
	Pressure gauge stainless steel, process connection G1/8 (3 units)	A5E32527735	6DR5...-.....-...9 -R1C/-R2C 6DR4004-1QP/-2Q
	Stainless steel sound absorber (3 units)	A5E32527711	6DR5..0/1/2/3/6-*
Spare parts for flameproof enclosure Ex d			
	Pneumatic connection board 1/4-18 NPT with seals and screws	A5E37056680	6DR5..6-..N/M/S*
	Pneumatic connection board G1/4 with seals and screws	A5E37056681	6DR5..6-..G/P/R/Q*
	Sealing plugs M25 and thread adapter M25 on M20 with seals	A5E37056682	6DR5..5/6-..G/M/Q*
	Sealing plugs M25 and thread adapter M25 on 1/2-14 NPT with seals	A5E37056685	6DR5..5/6-..N/P/Q*
	Enclosure cover with seal	A5E37056687	6DR5..6*
	Sealing set with seals for cover, button cover, pneumatic connection board, valve for enclosure ventilation and shaft sealing ring	A5E37056923	6DR5..6*

	Description	Article number	For version
Small part set			
	With cover seal, pneumatic terminal strips with **G thread**, air filter, O rings for pneumatic connections, screws, sound absorber, metal cable gland	A5E33519995	6DR5..0/3
	With cover seal, pneumatic terminal strips with **NPT thread**, air filter, O-rings for pneumatic connections, screws, sound absorber, metal cable gland and metal **NPT adapter**	A5E33519994	6DR5..0/3

Note

See Catalog FI 01 "Field devices for process automation" for additives and possible modules.

15.3 Scope of delivery Mechanic Limit Switches (MLS)

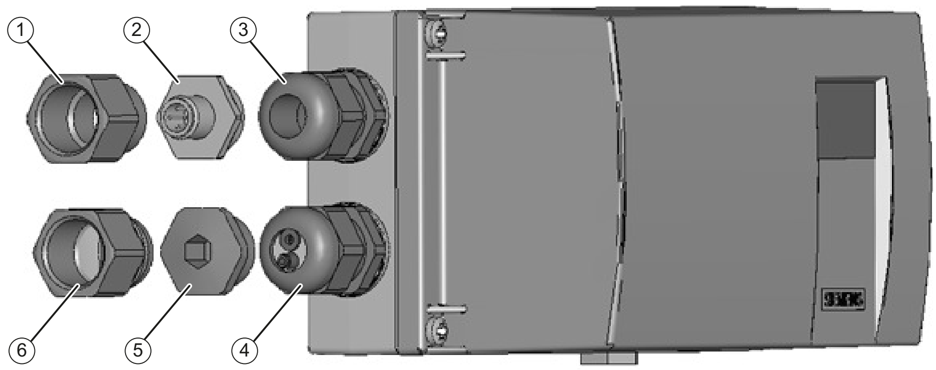
If the Mechanic Limit Switches (MLS) were ordered for later installation, then the following components are included in the scope of delivery:

- Mechanic Limit Switches (MLS) with accessories
- One housing cover with enlarged aperture
- One insulating cover
- Two cable ties
- One set of signs; how these are to be attached depends on the version.

15.4 Scope of delivery Analog Input Module (AIM)

Cable glands and adapters

The Analog Input Module (AIM) is supplied with various cable glands and adapters.



Connections ① to ③ for power supply

① Adapter M20 to ½-14 NPT for 6DR5..0/1/2/3-0.N/P

② M12 connector for device version with PROFIBUS communication or Fieldbus FOUNDATION for 6DR55/6..-0.R/S

③ Cable gland for connection thread M20x1.5 for 6DR5..0/1/2/3-0.G/M

Connections ④ to ⑥ for optional modules

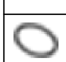
④ Cable gland for connection thread M20x1.5 with seal insert for 6DR55/6..0-0.G/M/R/S

⑤ Blanking plug for device version without optional modules 6DR5...-0..00

⑥ Adapter M20 to ½-14 NPT for 6DR5..0/1/2/3-0.N/P

Figure 15-1 Positioner with the different cable glands and adapter

Scope of delivery Analog Input Module (AIM)

	Description
	Analog Input Module (AIM) C73451-A430-L8
	Sealing ring for ⑥
	Cable tie
⑥	Adapter M20 to ½-14 NPT
④	Cable gland for connection thread, gray
④	Cable gland for connection thread, blue
	Sealing element for ④
	Sealing element plug for ④
	Screw for plastic
	Oval head screw M3x6

15.5 Accessories

For accessories, refer to Catalog FI 01 "Field devices for process automation", for example:

- Option modules
- NCS sensor for non-contacting position detection
- Mounting kits
- Operating software

15.6 Order data

In order to ensure that the ordering data you are using is not outdated, the latest ordering data is always available on the Internet:

Process instrumentation catalog (http://www.siemens.com/processinstrumentation/catalogs)

Product documentation and support 16

16.1 Product documentation

Process instrumentation product documentation is available in the following formats:

- Certificates (http://www.siemens.com/processinstrumentation/certificates)
- Downloads (firmware, EDDs, software) (http://www.siemens.com/processinstrumentation/downloads)
- Catalog and catalog sheets (http://www.siemens.com/processinstrumentation/catalogs)
- Manuals (http://www.siemens.com/processinstrumentation/documentation)
  You have the option to show, open, save, or configure the manual.
  - "Display": Open the manual in HTML5 format
  - "Configure": Register and configure the documentation specific to your plant
  - "Download": Open or save the manual in PDF format
  - "Download as html5, only PC": Open or save the manual in the HTML5 view on your PC

You can also find manuals with the Mobile app at Industry Online Support (https://support.industry.siemens.com/cs/ww/de/sc/2067). Download the app to your mobile device and scan the device QR code.

Product documentation by serial number

Using the PIA Life Cycle Portal, you can access the serial number-specific product information including technical specifications, spare parts, calibration data, or factory certificates.

Entering a serial number

1. Open the PIA Life Cycle Portal (ttps://www.pia-portal.automation.siemens.com).
2. Select the desired language.
3. Enter the serial number of your device. The product documentation relevant for your device is displayed and can be downloaded.

To display factory certificates, if available, log in to the PIA Life Cycle Portal using your login or register.

Scanning a QR code

1. Scan the QR code on your device with a mobile device.
2. Click "PIA Portal".

To display factory certificates, if available, log in to the PIA Life Cycle Portal using your login or register.

16.2 Technical support

Technical support

If this documentation does not completely answer your technical questions, you can enter a Support Request (http://www.siemens.com/automation/support-request).

Additional information on our technical support can be found at Technical Support (http://www.siemens.com/automation/csi/service).

Service & support on the Internet

In addition to our technical support, Siemens offers comprehensive online services at Service & Support (http://www.siemens.com/automation/serviceandsupport).

Contact

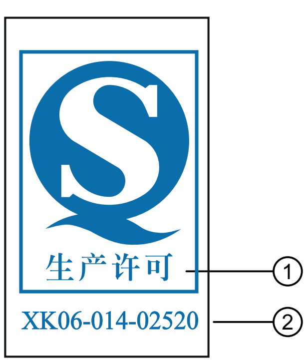
If you have further questions about the device, contact your local Siemens representative at Personal Contact (http://www.automation.siemens.com/partner).

To find the contact for your product, go to "all products and branches" and select "Products & Services > Industrial automation > Process instrumentation".

Contact address for business unit:
Siemens AG
Digital Industries
Process Automation
Östliche Rheinbrückenstr. 50
76187 Karlsruhe, Germany

16.3 Chinese production license for explosion proof electrical products

防爆电气产品生产许可证标志



① 生产许可
② 生产许可证书编号

External position detection A

A.1 Introduction to external position detection

> **WARNING**
>
> **Position Transmitter**
>
> Device versions with flameproof enclosures may only be operated with a Position Transmitter with the same type of protection.

In some cases it makes sense to mount the position detection and the controller unit separately. A separate mounting the case, for example, with continuous and strong vibrations, high or too low ambient temperatures and nuclear radiation. A universal component is available for this purpose. It is suitable for part-turn and linear actuators. You will require the following:

One of the following Position Transmitters

- Position Transmitter with Article No. 6DR4004-2ES, 3ES or 4ES
- NCS sensor for non-contacting position detection 6DR4004-6N/-8N
- Potentiometers with 3 kΩ, 5 kΩ or 10 kΩ
- Position sensor with a signal range from 0 to 20 mA
- Position sensor with a signal range from 0 to 10 V

And a positioner

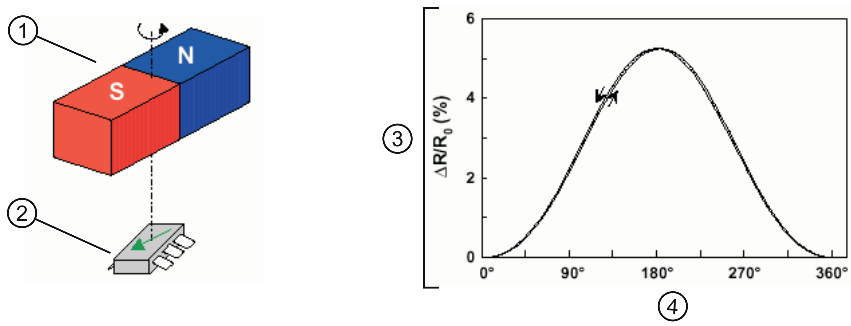
- Positioner in combination with Analog Input Module (AIM) 6DR5..0/1/2/3-0...2/3 or retrofitted as accessory 6DR4004-6F/-8F
  - An Analog Input Module (AIM) as an accessory is provided in a set along with cable clamps and M20 cable glands.

A.2 Non-Contacting Sensor

A.2.1 Principle of operation of NCS

The NCS contains a magnetic field sensor. This sensor changes its electrical resistance in response to the immediate presence of a permanent magnet. The sensor has a high signal-to-noise ratio to external magnetic fields due to the measurement method used.

The following figure shows the mode of operation with a rotating magnet.

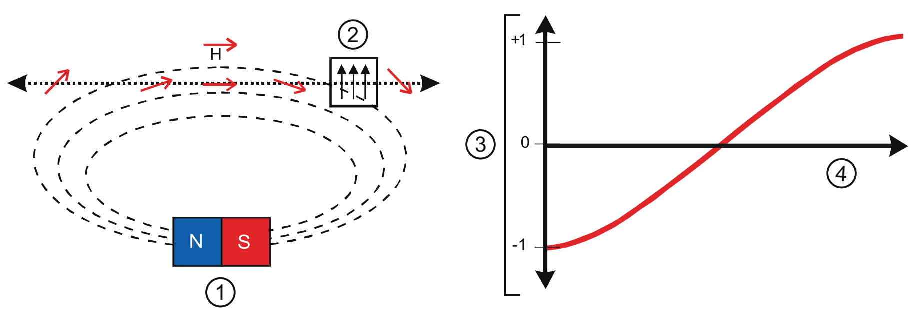


① Magnet
② Sensor
③ Resistance change
④ Angle

Figure A-1 Relative resistance change depending on the angle of the magnet

The figure shows that a circular movement of the magnet generates a sinusoidal change of the resistance. The mechanical stops of the fitting ensure that only one part (quadrant) of the sinusoidal curve is used at any one time. The principle-related non-linearity of the curve is corrected by means of software based on a curve that is stored in the positioner.

A linear movement of the magnet in the sensor range also generates a resistance change that is used to identify the position. The following figure highlights the principle:



① Magnet
② Sensor
③ Resistance change
④ Angle

Figure A-2 Resistance change depending on the position of the magnet

Non-linearity is corrected automatically in the positioner by software.

The great advantage of this principle is the absence of wear. Moreover, vibration, dampness and temperature only have a minor impact on the measurement result.

A.2.2 Mounting the NCS

Function

The positioner facilitates the separate installation of the position detection system. The stroke or rotary angle is measured directly at the actuator by means of a non-contacting sensor. It is therefore possible to install the controller unit at some distance away, e.g. on a mounting pipe or similar. The positioner is connected to the position detection system by means of an electrical cable.

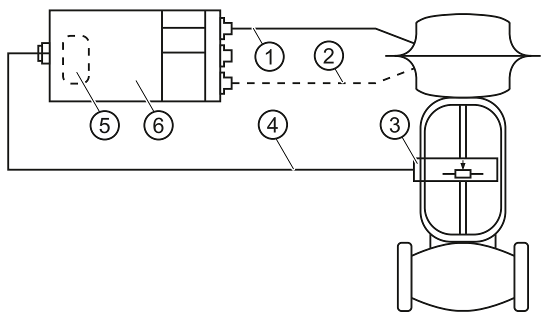
Such a separate installation is useful whenever the ambient conditions at the valve exceed the specified positioner values.

The NCS consists of a molded sensor for fixed installation and a magnet. The magnet is mounted to the spindle on linear actuators, or to the stub shaft on part-turn actuators. The sensor housing is mounted onto the console on part-turn actuators and to the bracket on linear actuators. The bracket can be a NAMUR type, or any other mounting bracket.

Auxiliary power is supplied to the NCS via the Analog Input Module (AIM) 6DR4004-6F and EMC compatibility is ensured at the same time.

You have the following options:

- To order the Analog Input Module (AIM) already installed in the positioner, Catalog FI 01
- To retrofit the Analog Input Module (AIM) in the positioner; article number 6DR4004-6F. For information on retrofitting the Analog Input Module (AIM), refer to the Installing/mounting (Page 31) section of the positioner operating instructions.



① Pneumatic line
② Pneumatic line for double-action actuators
③ Position detection system (10 kΩ potentiometer or NCS)
④ Electrical cable
⑤ Retrofittable Analog Input Module (AIM) (in the positioner)
⑥ Positioner

Figure A-3 Separate installation of the NCS and positioner

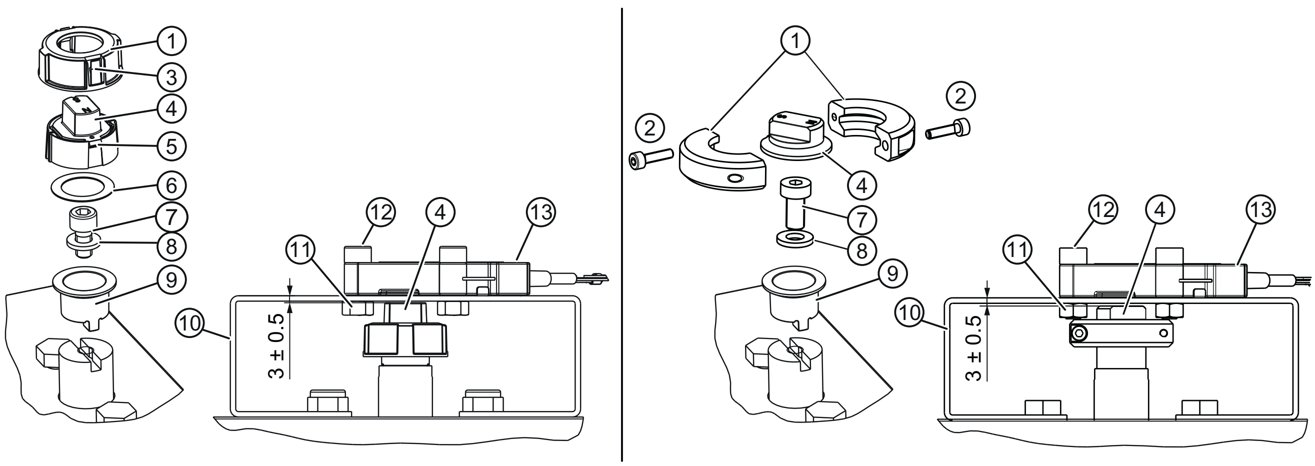
A.2.2.1 Mounting on part-turn actuator

Requirement

1. An Analog Input Module (AIM) built into the positioner
2. A non-contacting sensor for part-turn actuators 6DR4004-.N.10 or 6DR4004-.N.40
3. A part-turn actuator with interface acc. to VDI/VDE 3845 and mounting console acc. to VDI/VDE 3845, or
   A part-turn actuator with manufacturer-specific interface

NOTICE
Incorrect mounting
A clearance of 3 mm must be maintained between the magnet and the mounting console in order to ensure correct measurement of the actuator position. The values transferred may be incorrect if this clearance is not given. • Maintain a clearance of 3 mm between the top edge of the magnet ④ and the top edge of the mounting console ⑩.

Description



①	Tensioning ring	⑧	Washer
②	Hex socket head screw size M3x12	⑨	Clamping table
③	Spring element	⑩	Mounting console
④	Magnet	⑪	Hexagon nut
⑤	Hooks	⑫	Hex socket head screw size M6x25
⑥	Plastic washer	⑬	Non Contacting Sensor (NCS)
⑦	Hex socket head screw size M6x12		

Figure A-4 Mounting on part-turn actuator with magnet holder made of glass fiber reinforced polyester (left figure) or anodized aluminum (right figure)

Procedure for the part-turn actuator to VDI/VDE 3845

1. Slide the clamping table ⑨ onto the stub shaft of the part-turn actuator.
2. Mount the clamping table ⑨ to the stub shaft using a hex socket head screw ⑦ and washer ⑧.

3. Depending on the material of the magnet holder, proceed as follows:

Magnet holder made of glass fiber reinforced polyester	Magnet holder made of anodized aluminum
1. Insert the plastic washer ⑥ into the magnet ④. 2. Fix the magnet ④ onto the clamping table ⑨. The magnet ④ can now be rotated easily on the clamping table ⑨. 3. Slide the tensioning ring ① over the magnet ④. Make sure that the spring elements ③ and the hook ⑤ on the magnet ④ are lined up above one another and that they engage. You will now have more resistance when turning the tensioning ring ① and magnet ④.	1. Place the magnet ④ onto the clamping table ⑨. 2. Secure the magnet ④ to the clamping table⑨ by connecting the two parts of the tensioning ring ① to the two hex socket head screws ②. The magnet ④ can now be rotated easily on the clamping table ⑨. 3. Then tighten the two hex socket head screws ②. The magnet ④ can then no longer be rotated on the clamping table ⑨.

4. Screw the NCS ⑬ onto the mounting console ⑩ using the hexagon socket-head screw ⑫, hex nut ⑪ and the washer ⑧.
5. Once the NCS ⑬ is mounted, the clearance of 3 mm between the top edge of the magnet ④ and the top edge of the mounting console ⑩ is set automatically.

Procedure for part-turn actuators with manufacturer-specific interface

1. Steps 1 to 4 as above
2. Set a clearance of 3 mm between the top edge of the magnet ④ and the top edge of the mounting console ⑩. Extend the stub shaft accordingly, or insert washers underneath the NCS housing ⑬.

Reference

For information on the scope of delivery, refer to section "NCS sensor scope of delivery (Page 279)".

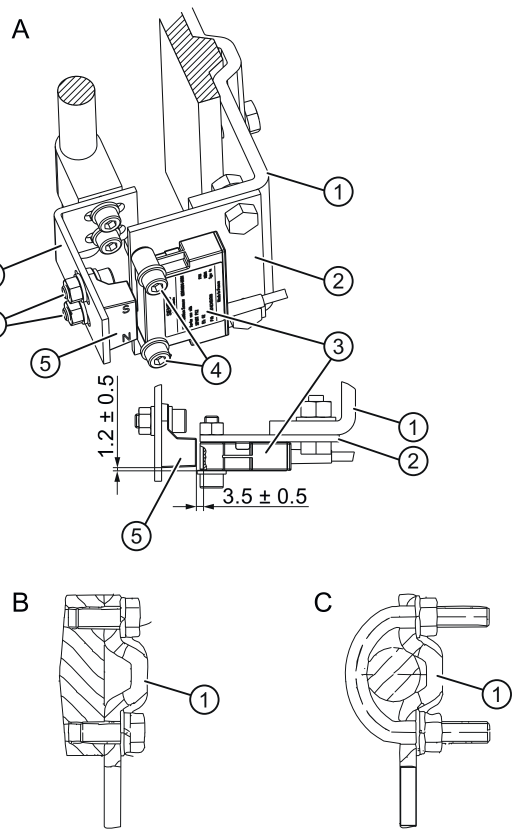
A.2.2.2 Mounting on linear actuator up to 14 mm (0.55 inch)

Requirement

1. An Analog Input Module (AIM) built into the positioner.
2. An NCS for linear actuators up to 14 mm (0.55 inch) 6DR4004-.N.20.
3. A linear actuator with interface to NAMUR. This installation must be carried out individually. Only a NAMUR mounting bracket can be used as mounting base. The following figure shows the assembly with NAMUR mounting bracket. Or:
A linear actuator without interface to NAMUR and individual mounting solution.

Description

The dimensions of magnet and NCS can be found under Dimensional drawing of non-contacting sensor (Page 279).



Dimensions in mm

A	Mounting on a yoke with fin	③	Non Contacting Sensor (NCS)
B	Mounting on a yoke with plane surface	④	Hex socket head screw M6x25
C	Mounting on a yoke with columns	⑤	Magnet
①	NAMUR mounting bracket IEC 60534 - not included in the scope of delivery	⑥	Hex socket head screw M6x12
②	Assembly panel for Non Contacting Sensor (NCS) - individual solution; not included in the scope of delivery	⑦	Mounting bracket for the magnet - individual solution; not included in the scope of delivery

Figure A-5 Example of the assembly on a linear actuator with a stroke up to 14 mm (0.55 inch)

Procedure

1. Produce the mounting panel ② and mounting bracket ⑦ individually.
2. Align the sensor to the center of the stroke. Observe the dimensions specified in the figure.

Reference

For information on the scope of delivery, refer to section "NCS sensor scope of delivery (Page 279)".

See also

Scope of delivery of NCS for linear actuators up to 14 mm (0.55 inch) . (Page 280)

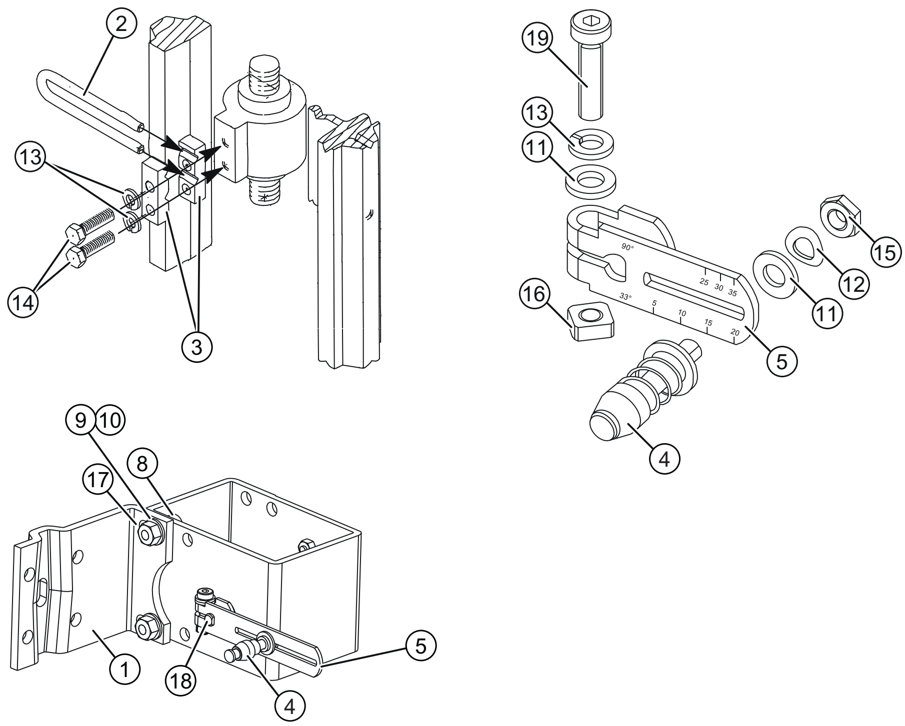
A.2.2.3 Mounting on linear actuator > 14 mm (0.55 inch)

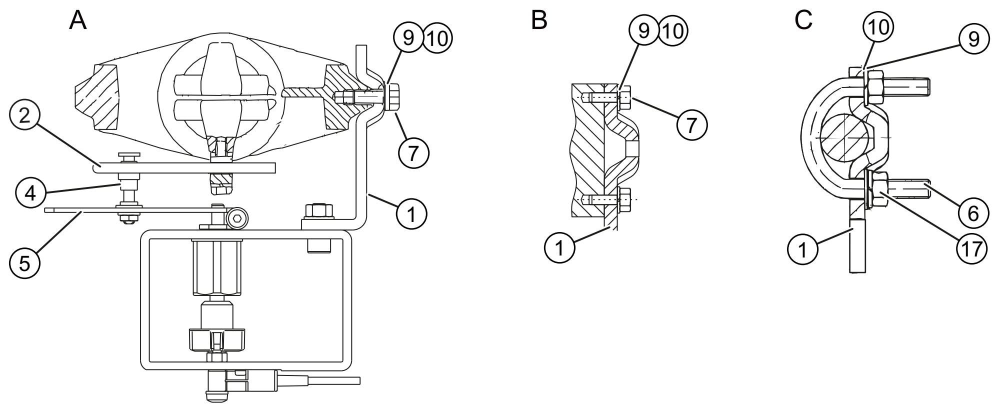
Requirement

1. An Analog Input Module (AIM) built into the positioner.
2. An NCS for linear actuators > 14 mm (0.55 inch) 6DR4004-.N.30.
3. Linear actuator with interface to NAMUR
   Item no. based on the respective stroke range: 6DR4004-8V or 6DR4004-8V + 6DR4004-8L.
   or
   linear actuator without interface to NAMUR and individual mounting solution. Item No. 6DR4004-8VK or 6DR4004-8VL can be used as individual assembly solution, depending on the stroke range.

Description

You can find the dimensions in the dimension drawing in the section "Figure A-9 Dimension drawing NCS module > 14 mm (0.55 inch) (Page 281)".





A	Mounting on a yoke with fin	⑨	Spring washer A8
B	Mounting on a yoke with plane surface	⑩	Washer B 8.4
C	Mounting on a yoke with columns	⑪	Washer B 6.4
①	NAMUR mounting bracket IEC 60534	⑫	Spring lock washer
②	Pick-up bracket	⑬	Spring washer A6
③	Clamping piece	⑭	Hexagonal screw size M6x25
④	Carrier pin	⑮	Hexagonal nut M6
⑤	Lever	⑯	Square-head nut M6
⑥	U bracket	⑰	Hexagonal nut M8
⑦	Hexagonal screw size M8x20	⑱	Shaft
⑧	Hexagonal screw size M8x16	⑲	Hex socket head screw size M6x25

Figure A-6 Mounting instructions for linear actuators with a stroke > 14 mm (0.55 inch)

Procedure

1. Mount the clamping pieces ③ to the actuator spindle using the hexagonal screw ⑭ and spring washers ⑬.
2. Slide the pick-up bracket ② into the milled recesses of the clamping pieces.
3. Set the necessary length.
4. Tighten the screws so that you can still shift the pick-up bracket ②.
5. Set the center of the pin ④ to the stroke range value specified on the actuator, or to the next higher scaling value of the lever ⑤. The actuating distance in mm will be displayed on successful initialization if you set the same value at parameter "3.YWAY" when commissioning the system.
6. Slide the lever ⑤ onto the shaft ⑱ up to the endstop.
7. Secure the lever ⑤ using the hex socket head screw ⑲.

8. Mount the bracket ① to the NCS mounting kit using:
   - Two hexagonal screws ⑧
   - Spring washer ⑨
   - Washer ⑩
   - Hexagonal nut ⑰

   The selection of the row of holes depends on the yoke width of the actuator. Make sure that the dog pin ④ engages in the pick-up bracket ② as close as possible to the spindle over the complete stroke range. The dog pin must not touch the clamping pieces.
9. Place the NCS assembly kit with the mounting bracket ① onto the actuator. Ensure that the dog pin ④ is guided inside the pick-up bracket ②.
10. Tighten the pick-up bracket ② .
11. Prepare the assembly parts for the relevant actuator type for installation:
    - For mounting on yoke with fin: hexagonal screw ⑦, washer ⑩ and spring washer ⑨.
    - For mounting on a yoke with plane surface: Four hexagonal screw ⑦ with washer ⑩ and spring washer ⑨.
    - For actuator with columns: Two U brackets ⑥, four hexagonal screw ⑰ with washer ⑩ and spring washer ⑨.
12. Mount the NCS assembly kit to the yoke using the assembly parts that you prepared.

Note

Observe the height

Adjust the height of the NCS assembly kit so that the lever position is in line horizontally with the stroke center. Use the lever scale on the actuator for orientation. If a symmetrical assembly is not possible, you must always ensure that the lever is in horizontal position within the range of the stroke.

See also

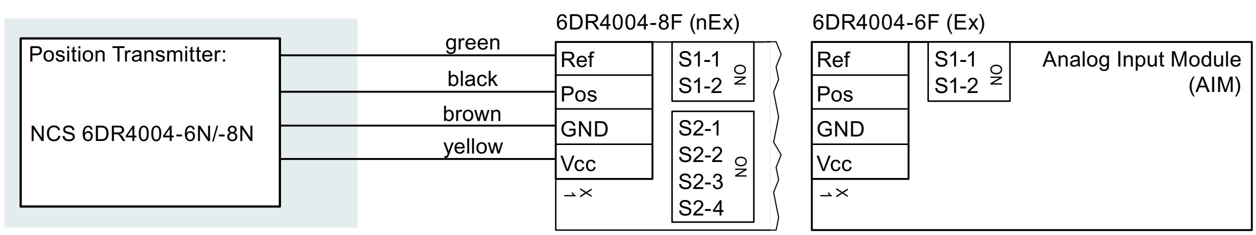
Scope of delivery of NCS for linear actuators > 14 mm (0.55 inch) . (Page 280)

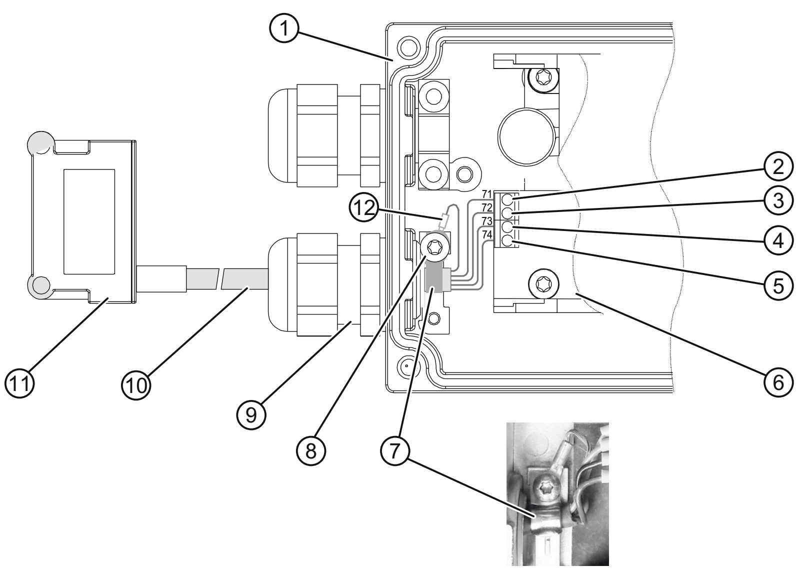
A.2.3 Connecting NCS to EMC filter module

Requirement

You need the Analog Input Module (AIM), article number 6DR4004-6F or -8F, for the electrical connection of the accessory part "NCS sensor for non-contacting position measurement" to the positioner. The positioner supplies auxiliary power to the NCS sensor via the option module.

Wiring diagram





Positioner (open state)
② Terminal Ref: Green
③ Terminal Pos: Black
④ Terminal GND: Brown
⑤ Terminal Vcc: Yellow
⑥ Analog Input Module (AIM)
⑦ Cable clamp
⑧ Screw F3x8
⑨ Cable gland
⑩ Four-pole NCS cable
⑪ Non Contacting Sensor (NCS)
⑫ Cable shielding lug

Figure A-7 Example of connecting the NCS to the Analog Input Module (AIM)

Procedure

The NCS sensor is equipped with a shielded 4-pin cable. Connect this 4-pin cable to the positioner as follows:

1. Feed the 4-pin NCS cable ⑩ through the union nut and the cable gland. Note: The type of cable gland depends on the positioner version.
2. Tighten the cable gland ⑨.
3. Connect the 4-pin NCS cable ⑩ to the Analog Input Module (AIM) of the positioner in accordance with the wiring diagram.
4. Place the cable clamp ⑦ onto the outer insulation of the 4-pin NCS cable ⑩.
5. Use the screw ⑧ to bond the cable shielding lug ⑫ and the cable clamp ⑦ to the ground terminal of the positioner.
6. Grounding:
   The rear steel panel of the NCS sensor is inevitably bonded to the ground potential of the system when mounting on the console. This ground connection is only functional if there is a low-impedance connection to ground potential of the system. Ensure this connection by measuring the resistance. If necessary, ensure proper grounding by means of an additional cable from the NCS sensor to ground potential.

A.2.4 Commissioning of NCS

A.2.4.1 Prerequisites / default settings

1. Supply electrical and pneumatic auxiliary power to the positioner. The top row of the display shows the current sensor voltage (0 to 100%), while the "NOINI" info flashes in the bottom row. The pneumatic actuator does not move.
2. If the positioner has already been initialized, perform a reset. Carry out the reset of parameter group "Init" in the '48.PNEUM' [PNEUMATIC_BLOCK_TYPE] Pneumatics type (Page 141) parameter.
3. Preset for part-turn actuators:
   While the process valve is closed, align the magnet so that the north pole is in the direction of the cable; "N" in position ⑦ in "Figure A-4 Mounting on part-turn actuator with magnet holder made of glass fiber reinforced polyester (left figure) or anodized aluminum (right figure) (Page 268)".
4. Monitor the display of the positioner while adjusting the actuator to its mechanical stops by means of △ and ▽ at the positioner. Verify that the displayed values never exceed the range from P2.0 to P98.0.

   Note

   This condition cannot be met with slipping flaps or linear actuators that exceed the mechanical actuation limits.

A.2.4.2 Initialization of part-turn actuators

Procedure

1. For part-turn actuators operating in standard control direction, set parameter "1.YFCT" to "ncSt", or to "-ncSt" in case of inverse control direction.
2. Launch initialization as usual with "INITA".

A.2.4.3 Initializing linear actuators with a stroke range up to 14 mm (0.55 inch)

Requirements

1. Set the "1.YFCT" parameter of the positioner to "ncSL" or - with inverse control direction - to "-ncSL".
2. Launch initialization as usual with "INITA".

A.2.4.4 Initializing linear actuators with a stroke range > 14 mm (0.55 inch)

Note

Parameter values "ncSLL" and "-ncLL" are only available for devices of the 6DR5... series and only with the firmware version > C4. Set the value to 90° on devices of the 6DR5... series with firmware version < C5 (YAGL). This setting is also necessary for devices of the 6DR4... series. Resultant non-linearity can be corrected by means of the programmable characteristic by setting the parameter value from "SFCT" to "FrEE" and adapting the interpolation points.

Requirements

1. Set the "1.YFCT" parameter of the positioner to "ncSLL" or - with inverse control direction - to "-ncLL".
2. Launch initialization as usual with "INITA".

A.2.5 Technical specifications NCS

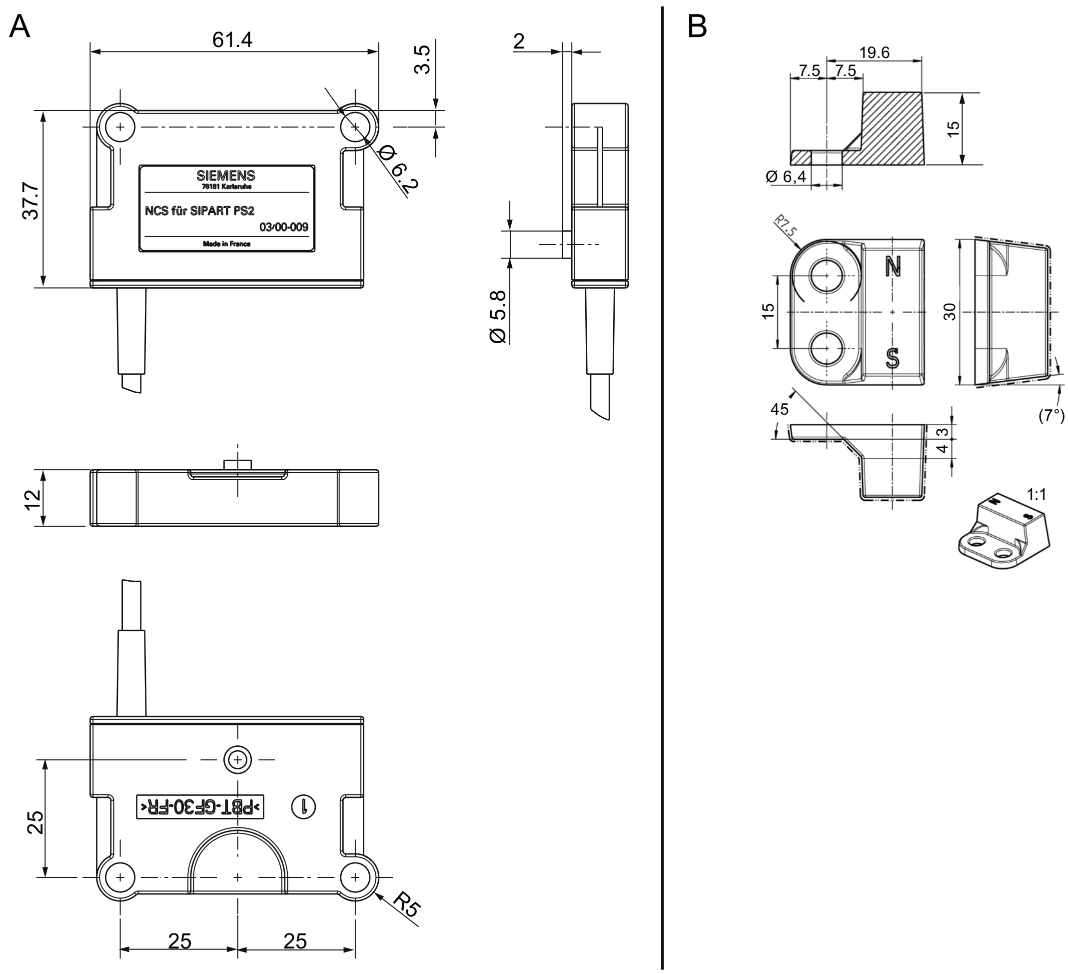
Additional modules	Without Ex protection	With Ex protection Ex "ia"	With explosion protection Ex "ic", "ec"
Travel range			
• Linear actuator 6DR4004-6/8N.20	3 to 14 mm (0.12 to 0.55")		
• Linear actuator 6DR4004-6/8N.30	10 to 130 mm (0.39 to 5.12"); up to 200 mm (7.87") on request		
• Part-turn actuator	30 to 100°		

Additional modules	Without Ex protection	With Ex protection Ex "ia"	With explosion protection Ex "ic", "ec"
Linearity (after corrections made by positioner)	± 1 %		
Hysteresis	± 0.2 %		
Temperature influence (range: rotation angle 120° or stroke 14 mm)	≤ 0.1 %/10 K (≤ 0.1 %/18 °F) for -20 to +90 °C (-4 to +194 °F) ≤ 0.2%/10 K (≤ 0.2%/18 °F) for -40 to -20 °C (-40 to -4 °F)		
Climate class	According to IEC/EN 60721-3		
• Storage	1K5, but -40 to +90 °C (-40 to +194 °F)		
• Transport	2K4, but -40 to +90 °C (-40 to +194 °F)		
Vibration resistance			
• Harmonic oscillations (sine) according to IEC 60068-2-6	3.5 mm (0.14"), 2 to 27 Hz, 3 cycles/axis 98.1 m/s² (321.84 ft/s²), 27 to 300 Hz, 3 cycles/axis		
• Bumping according to IEC 60068-2-29	300 m/s²(984 ft/s²), 6 ms, 4000 shocks/axis		
Torque for cable gland nut made of	Plastic	Metal	Stainless steel
	2.5 Nm (1.8 ft lb)	4.2 Nm (3.1 ft lb)	4.2 Nm (3.1 ft lb)
Torque of hexagon socket-head screw M6x12 (shaft end or mounting bracket)	4 Nm (3 ft lb)		
Torque of hexagon socket head screw M6x25 (mounting console or mounting plate)	4 Nm (3 ft lb)		
Torque of hexagon socket head screw M3x12 (clamping ring)	1 Nm (0.7 ft lb)		
Degree of protection	IP68 / type 4X		
For connecting to circuits with the following peak values	-	U_i = 5 V I_i = 160 mA P_i = 120 mW	U_i = 5 V
Effective internal capacitance	-	C_i = 1)	C_i = 1)
Effective internal inductance	-	L_i = 2)	L_i = 2)

1) C_i = 110 nF + 110 nF per meter of connecting cable

2) L_i = 270 µH + 6.53 µH per meter of connecting cable

A.2.6 Dimensional drawing of non-contacting sensor



A NCS B Magnet

Figure A-8 Dimensional drawing of the NCS and magnet

A.2.7 NCS sensor scope of delivery

A.2.7.1 Scope of delivery of NCS for part-turn actuators

6DR4004-.N.10	6DR4004-.N.40		
Quantity	**Quantity**	**Name**	**Note**
1	1	Magnet holder	
5	5	Washer	6
2	2	Hex socket head screw	M6x12
1	-	Plastic washer	
1	1	Magnet	

6DR4004-.N.10	6DR4004-.N.40		
1	2	Tensioning ring	
4	4	Hexagon nut	M6
2	2	Hex socket head screw	M6x25
-	2	Hex socket head screw	M3x12
1	1	Non-contacting sensor	Cable lengths as ordered
1	1	Self-tapping screw for polycar-bonate enclosure	F3x8
1	1	Sealing	For cable bushings
1	1	Plugs	For closing the sealing insert
1	1	Cable clamp	
1	1	DVD	with documentation

A.2.7.2 Scope of delivery of NCS for linear actuators up to 14 mm (0.55 inch) .

Linear actuator with a stroke range up to 14 mm (0.55 inch) 6DR4004-.N.20		
Quantity	**Designation**	**Notes**
1	Magnet	
5	Washer	6
2	Hex socket head screw	M6x12
4	Hexagon nut	M6
2	Hex socket head screw	M6x25
1	Non-contacting sensor	Cable lengths as ordered
1	Screw	F3x8
1	Sealing	For cable bushings
1	Plugs	For closing the sealing insert
1	Cable clamp	
1	DVD	with documentation

A.2.7.3 Scope of delivery of NCS for linear actuators > 14 mm (0.55 inch) .

Linear actuator > 14 mm (0.55 inch) 6DR4004-.N.30		
Quantity	**Designation**	**Notes**
1	NCS assembly kit, completely assembled	Mounting by means of assembly kit for NAMUR linear actuators Mounting kit available on separate order, see 'Accessories' in Catalog FI 01.

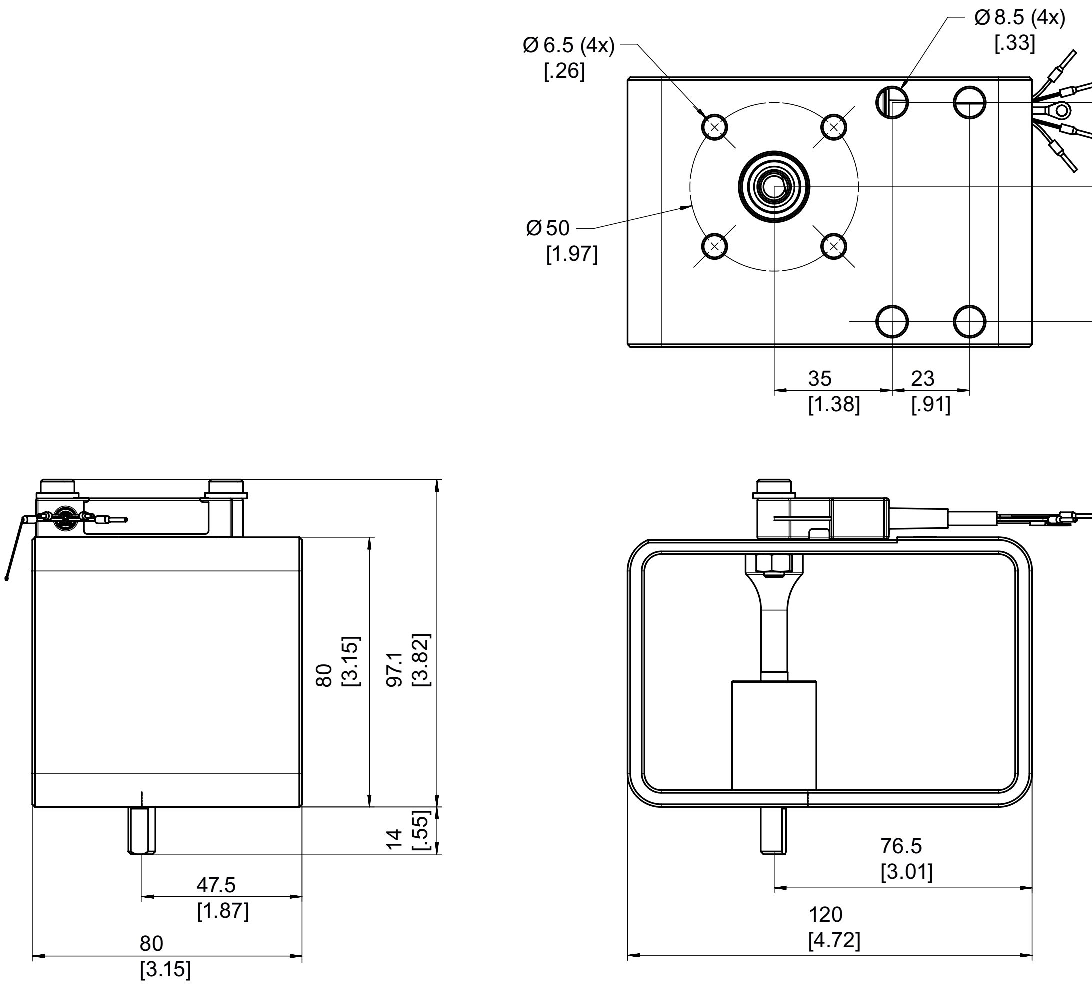


Figure A-9 Dimension drawing NCS module > 14 mm (0.55 inch)

A.3 External position detection system

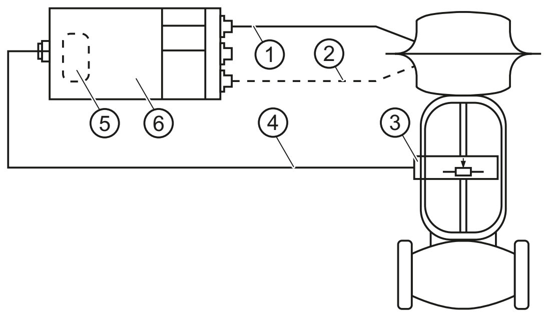
A.3.1 Principle of operation of external position detection system

The Position Transmitter essentially consists of an enclosure and an internal position detection system. The position is recorded by a potentiometer or an internal NCS module, section "Principle of operation of NCS (Page 265)". The controller unit is separated from the positioner.

Such a separate installation is useful whenever the ambient conditions at the valve exceed the specified positioner values.

The Position Transmitter is secured to a console with part-turn actuators and to a mounting bracket with linear actuators, section "Mounting to linear actuator (Page 35)".

Auxiliary power is supplied to the Position Transmitter via the Analog Input Module (AIM) and EMC compatibility is ensured at the same time.



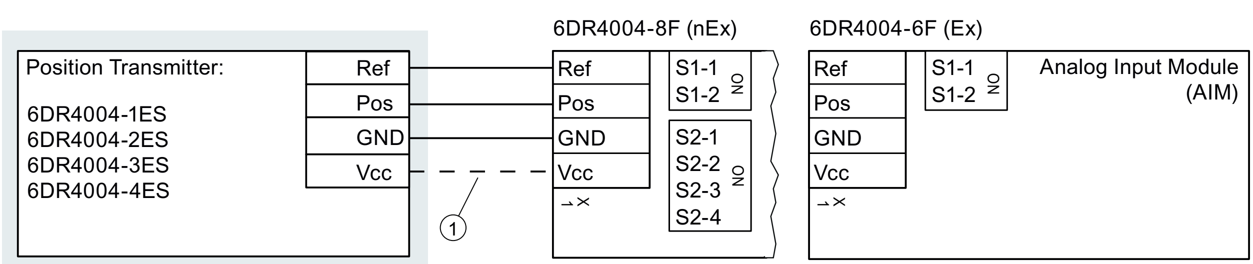
1 Pneumatic line
2 Pneumatic line for double-action actuators
3 Position Transmitter
4 Electrical cable
5 Analog Input Module (AIM) (fitted in the positioner or retrofittable)
6 Positioner

Figure A-10 Position Transmitter and positioner

Mounting of the Position Transmitter corresponds to the mounting of the positioner in a non-flameproof enclosure. Proceed as described in Section "Installing and mounting (Page 31)". The connection of the Analog Input Module (AIM) is described in the section "Analog Input Module (AIM) 6DR4004-6F / -8F (Page 61)".

A.3.2 Connecting to Analog Input Module (AIM)

Wiring diagram



1 Connection of terminal Vcc is only needed for 6DR4004-2ES, -3ES and -4ES.

A.3.3 Technical specifications of the external position detection system

Rated conditions	
Ambient temperature	In hazardous areas, observe the maximum permissible ambient temperature corresponding to the temperature class.
• Permissible ambient temperature for operation	-40 ... +90 °C (-40 ... +194 °F)
Degree of protection 1)	IP66 / Type 4X to UL 50E

Rated conditions	
Climate class	According to IEC/EN 60721-3
• Storage	1K5, but -40 ... +90 °C (1K5, but -40 ... +194 °F)
• Transport	2K4, but -40 ... +90 °C (2K4, but -40 ... +194 °F)
• Operation	4K3, but -40 ... +90 °C (4K3, but -40 ... +194 °F)

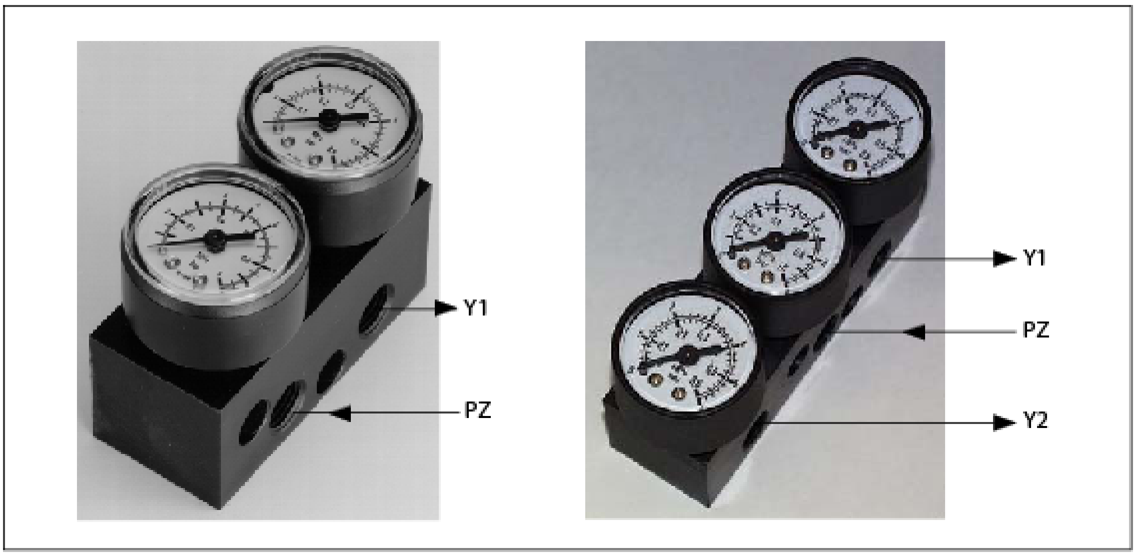
[1]) Impact energy max. 1 joule.

Construction	
Material body	Aluminum
Weight, housing	Approx. 1.6 kg (3.53 lb)
Torque for cable gland nut made of plastic	See Construction (Page 228)

Pressure gauge blocks 17

17.1 Pressure gauge block

Pressure gauge blocks that are available as accessories are illustrated below. The gauges display measured values for the actuating pressure and supply pressure. The figure to the left shows the pressure gauge block for single-acting actuators. The image to the right shows the pressure gauge block for double-acting actuators.

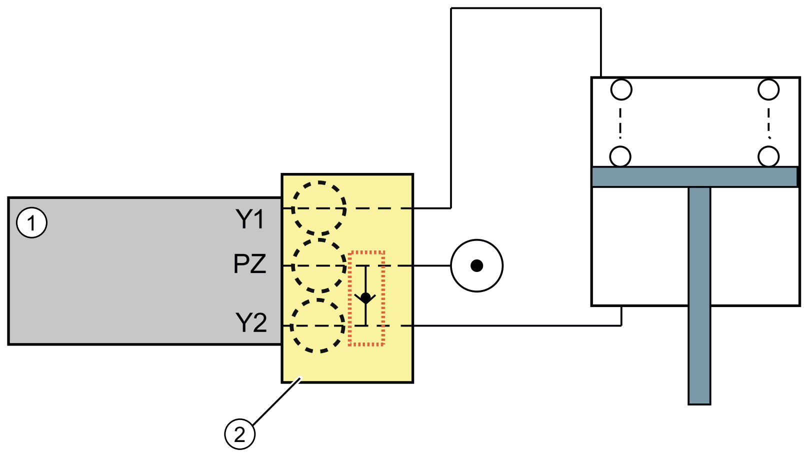


Y1	Actuating pressure
PZ	Supply pressure
Y2	Actuating pressure

Mounting

The pressure gauge block is fixed onto the lateral pneumatic connection of the positioner using the screws provided. Use the provided O-rings as sealing elements.

17.2 Venting gauge block



①	Positioner	Y1	Actuating pressure
②	Venting gauge block	PZ	Supply pressure
		Y2	Actuating pressure

Figure 17-1 Mode of operation of venting gauge block

Sealing plug / thread adapter

A

A.1 Intended use of accessory part

The sealing plug and the thread adapter (components) can be used for installation in electrical equipment of flameproof" "Ex d" type of protection of groups IIA, IIB, IIC as well as dust protection by enclosure "Ex t" type of protection.

A.2 Safety instructions for accessory part

WARNING

Incorrect assembly

- The component can be damaged or destroyed or its functionality impaired through incorrect assembly.
  - Mount the component using a suitable tool. Refer to the information in Chapter "Technical specifications of accessory part (Page 288)", for example, torques for installation.
- For "Explosion-proof Ex d" type of protection: To ensure an engagement depth of 8 mm, the enclosure must have a wall thickness of at least 10 mm.

Improper modifications

Danger to personnel, system and environment can result from modifications and repairs of the component, particularly in hazardous areas.

- Any modification which deviates from the delivery state is not permitted.

Loss of enclosure type of protection

IP protection is not guaranteed without sealant.

- Use a suitable thread sealant.
- If you are using the component in type of protection dust protection by enclosure "Ex t", use the supplied sealing ring (①, figure in Chapter "Dimensional drawings of accessory part (Page 289)").

Unsuitable fluids in the environment

Danger of injury or damage to device.

Aggressive media in the environment can damage the sealing ring. Type of protection and device protection may no longer be guaranteed.

- Make sure that the sealing material is suitable for the area of use.

Note

Loss of type of protection

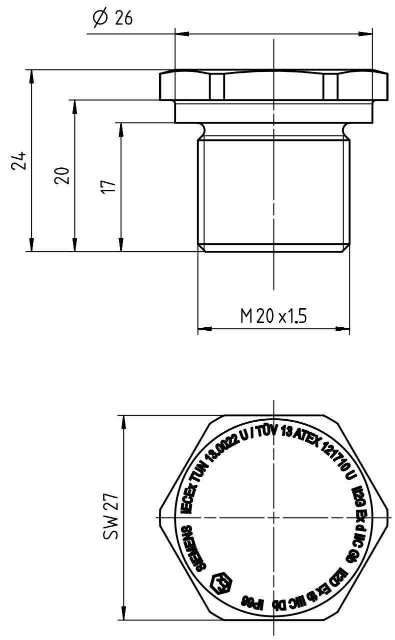
Changes in the ambient conditions can loosen the component.

- As part of the recommended maintenance intervals: Check the compression fitting for tight fit and tighten, if necessary.

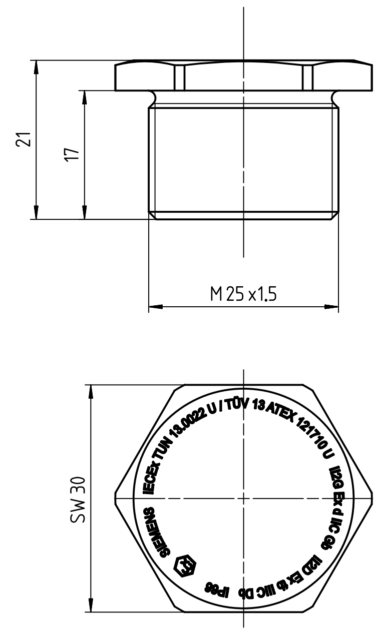
A.3 Technical specifications of accessory part

Technical specifications sealing plug and thread adapter	
Sealing plug suitable for types of protection	Explosion-proof enclosure "d" of groups IIA, IIB, IIC Dust protection by enclosure "t"
Standard compliance	The components meet Directive 94/9. They meet the requirements of standards IEC/EN 60079-0; IEC/EN 60079-1; IEC/EN 60079-31.
Explosion protection	
• Gas explosion protection	II2G Ex d IIC
• Dust explosion protection	II1D Ex t IIIC
Certificates	IECEx TUN 13.0022 U TÜV 13 ATEX 121710 U
Material for sealing plug / thread adapter	Stainless steel
Material for seal	Vulcanized fiber or Victor Reinz AFM 30
Ambient temperature range	-40 ... +100 °C (-40 ... +212 °F)
For "Ex d" type of protection: Required wall thickness for tappings	10 mm
Torque	
• For thread size M20 x 1.5	65 Nm
• For thread size M25 x 1.5	95 Nm
• For thread size ½-14 NPT	65 Nm
Width A/F for thread size M20 x 1.5	27
Width A/F for thread size M25 x 1.5	30
Key size for thread size ½-14 NPT	10

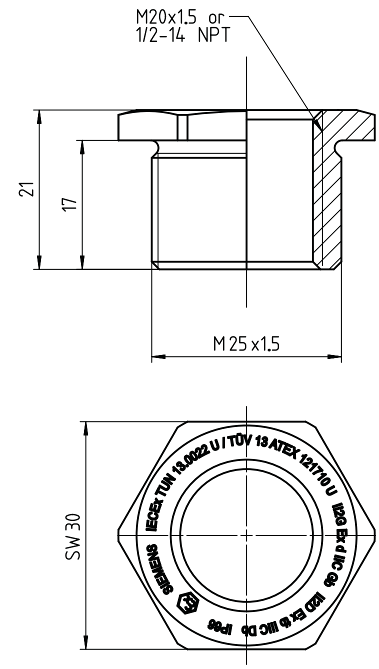
A.4 Dimensional drawings of accessory part



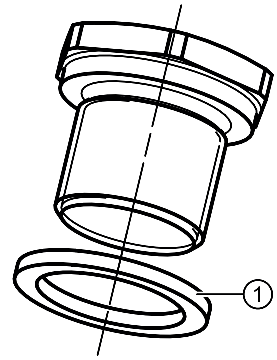
Sealing plug Ex d, M20 x 1.5, dimensions in mm



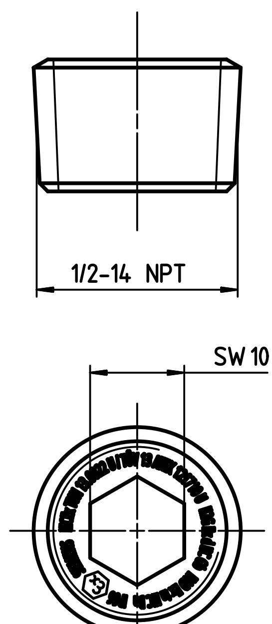
Sealing plug Ex d, M25 x 1.5, dimensions in mm



Thread adapter Ex d, M25 x 1.5 on M20 x 1.5 and M25 x 1.5 on ½-14 NPT, dimensions in mm



① Sealing ring: Use for dust protection "Ex t" type of protection.



Sealing plug Ex d ½ -14 NPT

Booster B

B.1 Increased sound pressure level

CAUTION

Increased sound pressure level

Changes to the sound absorber of the positioner or the mounting of pneumatic components or pneumatic options on the positioner can cause a sound pressure with a level of 80 dBA to be exceeded.

- Wear suitable hearing protection to protect yourself against hearing damage.

B.2 Booster introduction

In order to shorten the travel times, use a booster between the positioner and actuator.

Note

Positioner with booster, double-acting

If the supply pressure PZ fails, the booster changes the failure behavior of the positioner. The position of the valve is random.

The booster has no effect in the event of an electrical power failure.

B.3 Mounting a booster

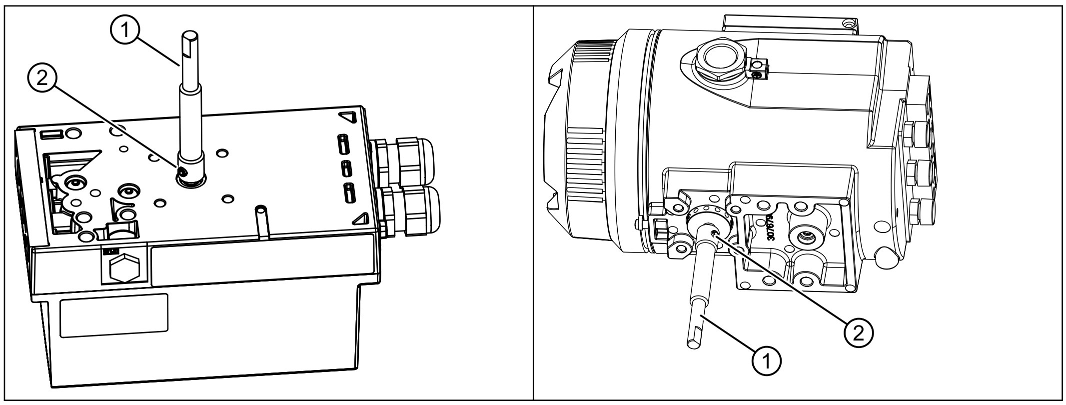
Requirement

1. You are familiar with the safety instructions in section "Installing and mounting".
2. You have one of the following boosters:
   – With single-acting positioners, booster with the article numbers 6DR4004-1RJ, -1RK, -1RP or -1RQ
   – With double-acting positioners, booster with the article numbers 6DR4004-2RJ, -2RK, -2RP or -2RQ

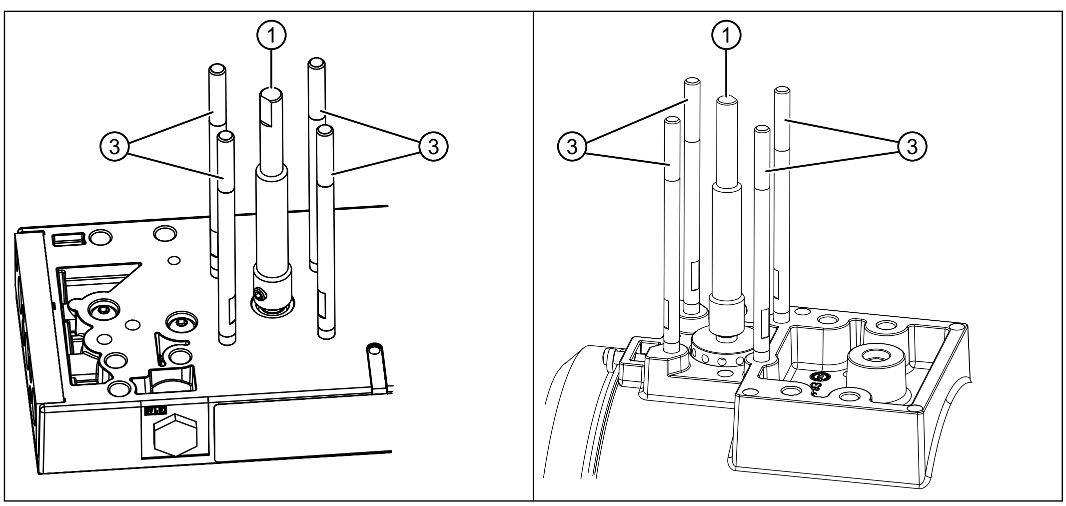
A. Mount extension shaft and booster

Using the example of a single-acting positioner. The figure on the right shows the devices in a flameproof enclosure.

1. Plug the extension shaft ① onto the shaft of the positioner.
2. Tighten the locking screw ② at the flat end of the positioner shaft.

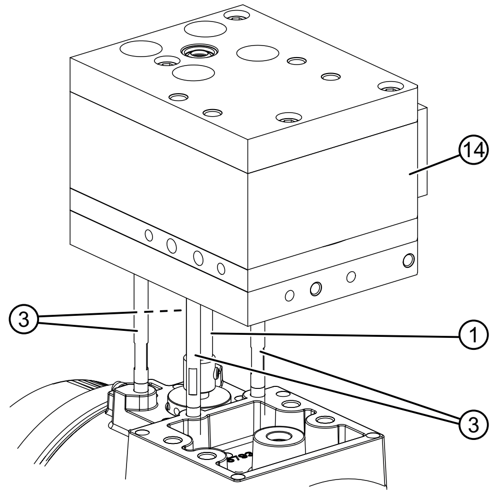


3. Check that the extension shaft ① sits properly.
4. Turn the short threaded end of the threaded bolts ③ into the positioner up to the endstop.

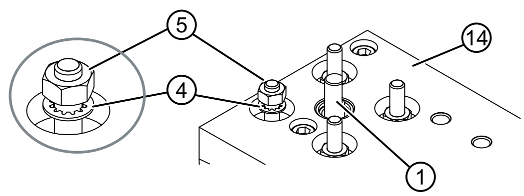


5. Tighten the threaded bolts ③ lightly using an open-ended wrench.

6. Insert the booster ⑭ via the threaded bolts ③.

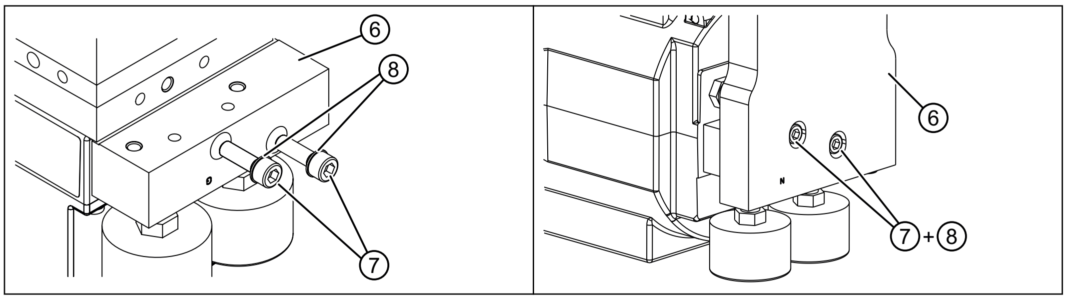


7. Fasten the booster ⑭ with the lock washers ④ and nuts ⑤. When tightening, make sure that the shaft ① can be turned easily.

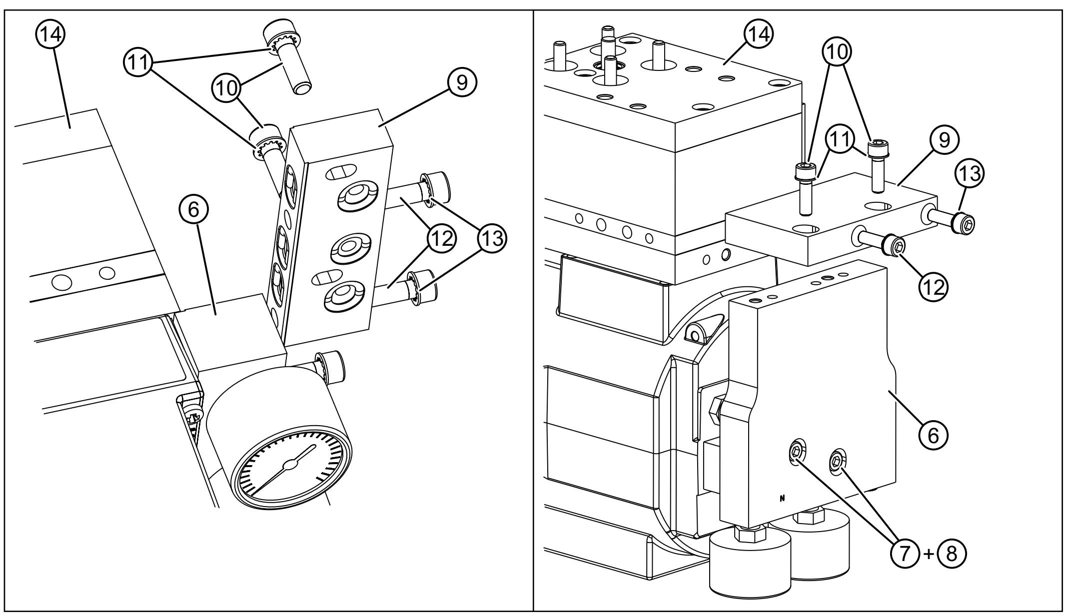


B. Mounting the pressure gauge and connection block

1. Check whether the O-rings are in the pressure gauge block. There are two O-rings in the single-acting version. There are three O rings in the double-acting version.
2. Fasten the **pressure gauge block** ⑥ with the screws ⑦ and lock washers ⑧. Position the screws, do **not** tighten them.

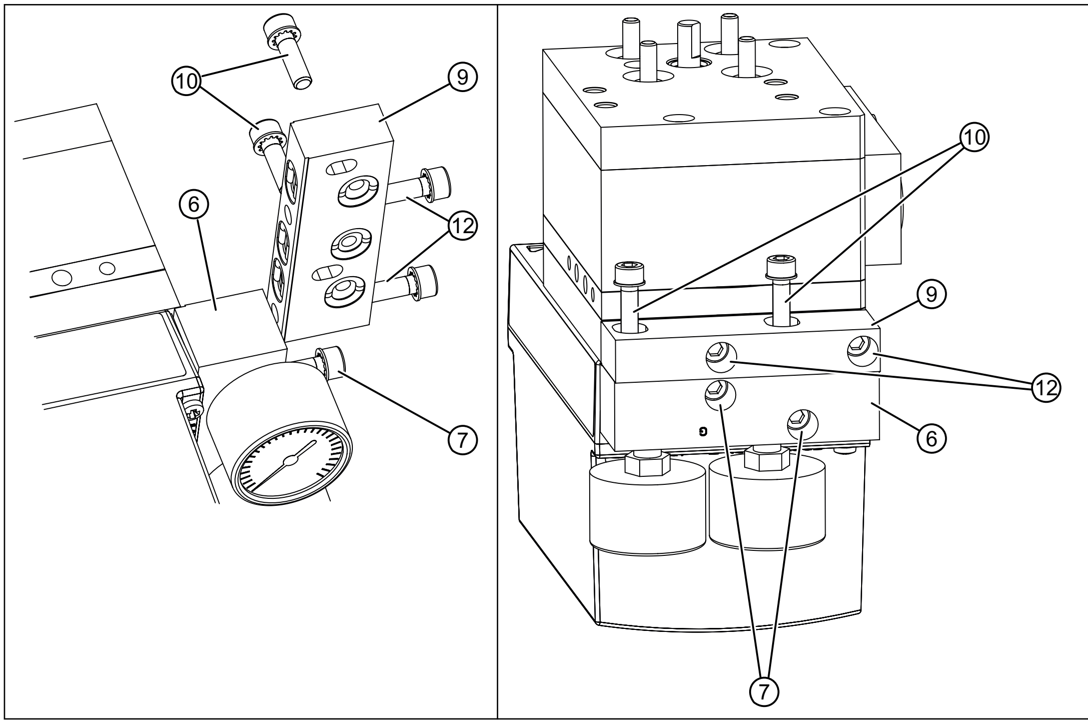


3. Fasten the connection block ⑨ with the screws ⑩, ⑫ and lock washers ⑪, ⑬. Position the screws, do **not** tighten them.



C. Tightening screws

Tighten the screws in the following order.



1. Screws ⑦ which are used to fasten the pressure gauge block ⑥ to the positioner
2. Screws ⑫ which are used to fasten the connection block ⑨ to the booster
3. Screws ⑩ which are used to fasten the connection block ⑨ to the pressure gauge block ⑥
4. Mount the positioner on the actuator as described in:
   - Mounting to linear actuator (Page 35)
   - Mounting to part-turn actuator (Page 35)
5. Use the existing interfaces on the booster.

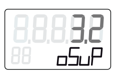
B.4 Booster commissioning

Requirement

1. You operate the positioner with a booster.
2. '48.PNEUM' [PNEUMATIC_BLOCK_TYPE] Pneumatics type (Page 141) parameter is set to 'booSt'.

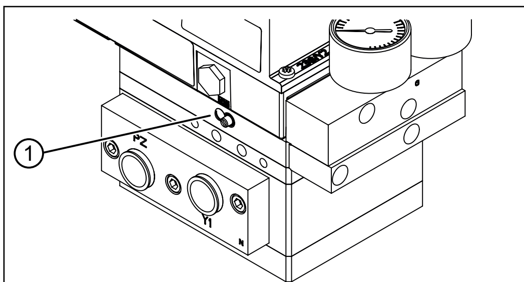
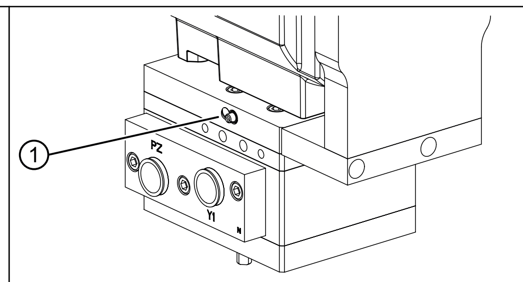
Procedure for commissioning the booster

1. Check whether the restrictor(s) on the positioner are completely open. With a new positioner, the restrictors are factory-set to open. The position of the restrictors is shown in the figure in section Device components (Page 27).
2. Set '31.DEBA' [DEADBAND] Deadband of closed-loop controller (Page 131) to the largest value permissible for your process. The largest value is usually 0.5.
3. Start the automatic initialization process as described under Commissioning (Page 95).
4. With RUN 3, the initialization is stopped for five seconds. During these five seconds, start the function for setting the booster using the △ button.
   A cycle is started which continuously determines the overshoots. The values 'oSuP' and 'oSdo' are shown alternately in the display. 'oSuP' and 'oSdo' represent the values of the overshoot in % of the total stroke.

5. During the automatic initialization, adjust the booster bypass using the adjustment screw on the booster. For single-acting actuators, there is one adjustment screw; there are two adjustment screws for double-acting actuators.

	
① Booster bypass on single-acting positioner	① Booster bypass on single-acting positioner in flameproof enclosure

   If 'oCAY' is shown on the display, the overshoot is less than 3%.

6. Press the △ or ▽ button. The positioner again runs through the initialization step RUN 3, starting with determination of the travel times. The following figure schematically shows the RUN 3 sequence for the booster.
7. 'FINISH' is shown on the display when the initialization has been completed.

If the process value on the display does not remain stable or if a constant manipulated variable cannot be achieved for a constant setpoint, further optimization of the controller data is necessary. This is described in section Optimization of controller data (Page 93).

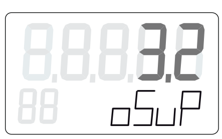
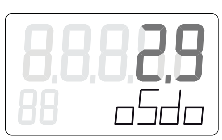
See also

Sequence of automatic initialization (Page 98)

B.5 RUN 3: Determination and display of the travel time (leakage test)

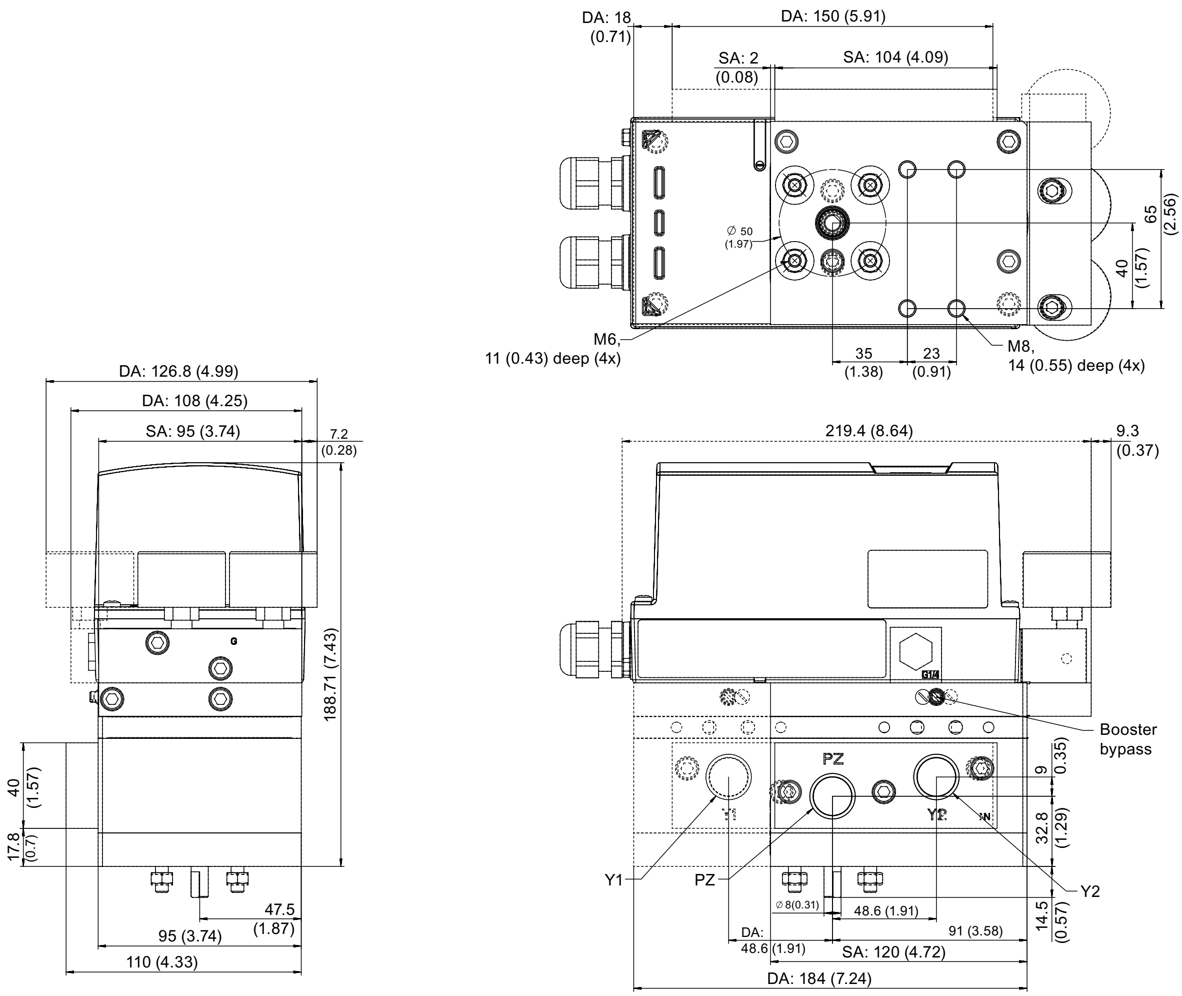
	The travel time is determined and displayed with "down" (dxx.x) and "up" (Uxx.x). Stop with: ▽	
	PNEUM	
	Std / FIP	Start leakage measurement with: △
	booSt	Display of the overshoot down (3.2 oSuP), up (2.9 oS-do)△

Possible messages

Display	Meaning	Measures
Std / FIP  	Actuator does not move. The travel time cannot be changed.	Acknowledge message with: Change the travel time using the restrictor screws. Continue with:▽△
booSt  	The overshoot is determined.	Adjust the booster bypass using the adjusting screw on the booster until the display indicates the following:  Continue with: ▽△

B.6 Booster dimension drawings

B.6.1 For positioners in non-flameproof enclosure

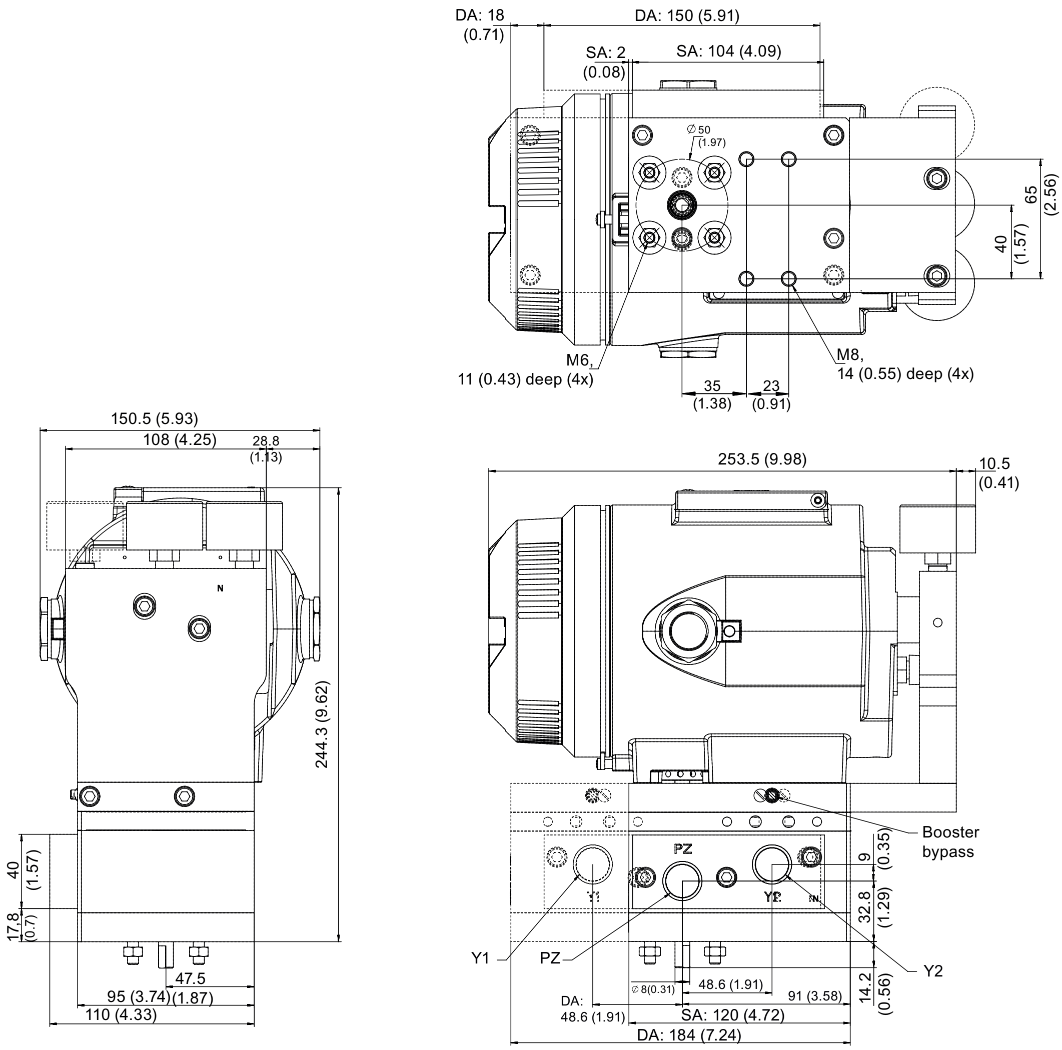


SA Single-acting

DA Double-acting

Figure B-1 Dimension drawings booster mounted on positioner, dimensions in mm (inch)

B.6.2 For positioners in flameproof enclosure



SA Single-acting

DA Double-acting

Figure B-2 Dimension drawings booster mounted on positioner in a flameproof enclosure, dimensions in mm (inch)

B.7 Technical specifications of booster

Booster	
Weight booster, single-acting	
• BOOSTER KIT for 6DR5.10 and 6DR5.13	2.9 kg (6.5 lb)
• BOOSTER KIT for 6DR5.15	3.3 kg (7.3 lb)
Weight booster, double-acting	

Booster	
• BOOSTER KIT for 6DR5.20 and 6DR5.23	4.3 kg (9.4 lb)
• BOOSTER KIT for 6DR5.25	4.7 kg (10.4 lb)
Connections, pneumatic	1/2-14 NPT or G½
Air consumption	1.2×10^{-2} Nm^3/h
Pressure gauge	Made of steel IP44. Scaling MPa, bar, psi
Flow capacity	Cv 2.0

Abbreviations

C

C.1 Abbreviations for positioners

Abbreviation	Long form	Meaning
A/D	Analog-to-digital converter	-
AC	Alternating current	Alternating current
AI	Analog Input	-
AMS	Asset Management Solutions	Communication software from Emerson Process comparable with SIMATIC PDM
AO	Analog Output	-
AUT	Automatic	Operating mode
ATEX	Atmosphère explosible	Product and operation directive of European Commission for explosion protection.
CENELEC	Comité Européen de Normalisation Electrotechnique	Standards organization, responsible for European standardization in the field of electrical engineering.
CPU	Central Processing Unit	Master processor
CSA	Canadian Standard Association	Canadian standards organization
DC	Direct current	Direct current
DI	Digital Input	-
DIN	Deutsche Industrie Norm	-
DO	Digital Output	-
DTM	Device Type Manager	-
EDD	Electronic Device Description	-
Ex	Explosion protection	-
EMC	Electromagnetic compatibility	-
FDT	Field Device Tool	-
FF	FOUNDATION Fieldbus	Fieldbus of the Fieldbus Foundation
FM	Factory Mutual	American testing agency/insurance company
FW	Firmware	Device-specific software
GSD	Device master data	-
HART®	Highway Addressable Remote Transducer	Communication system for the development of industrial field busses.
IEC	International Electrotechnical Commission	International standards organization for standards in electrical engineering and electronics.
IP	International Protection Ingress Protection	International degrees of protection (long form as per DIN) Seepage protection (long form as used in US)
ISO	International Organization for Standardization	
LC	Liquid Crystal	Liquid crystal
MAN	Manual	Operating mode

Abbreviation	Long form	Meaning
NAMUR	Standards working group for measurement and control technology in the chemicals industry	Association of users in process conductor technology
µC	Microcontroller	One-Chip computer system
NCS	Non-Contacting Sensor	Sensor for non-contacting position detection
NEMA	National Electrical Manufacturers Association	US standards institution National Electrical Manufacturers Association
NPT	National Pipe Thread Taper	Pipe threading for self-sealing threads as per ANSI B.1.20.1
OPOS interface®	Open Positioner Interface	Standard interface for the connection between a positioner and a pneumatic linear or part-turn actuator
PA	Process Automation	Process automation
PDM	Process Device Manager	Siemens communication software / Engineering tool
PROFIBUS	Process Field Bus	Fieldbus
RSS feed	Rich Site Summary Feed	Shows changes in regular intervals to web sites you are subscribed to.
VDE	Verband der Elektrotechnik, Elektronik und Informationstechnik e. V.	Industrial and professional association
VDI	Verein Deutscher Ingenieure e. V.	Technical/scientific association

C.2 Abbreviations for functional safety

Abbreviation	Full term in English	Meaning
FIT	Failure in Time	Frequency of failure Number of faults within 10^9 hours
HFT	Hardware Fault Tolerance	Hardware fault tolerance: Capability of a function unit to continue executing a required function in the presence of faults or deviations.
MooN	"M out of N" voting	Classification and description of the safety-instrumented system in terms of redundancy and the selection procedures used. A safety-instrumented system or part that consists of "N" independent channels. The channels are connected to each other in such a way that "M" channels are in each case sufficient for the device to perform the safety instrumented function. Example: Pressure measurement: 1oo2 architecture. A safety-instrumented system decides that a specified pressure limit has been exceeded if one out of two pressure sensors reaches this limit. In a 1oo1 architecture, there is only one pressure sensor.
MTBF	Mean Time Between Failures	Average period between two failures
MTTR	Mean Time To Restoration	Average period between the occurrence of a fault in a device or system and restoration of functionality
PFD	Probability of Dangerous Failure on Demand	Probability of dangerous failures of a safety function on demand
PFD_{AVG}	Average Probability of Dangerous Failure on Demand	Average probability of dangerous failures of a safety function on demand

Abbreviation	Full term in English	Meaning
SFF	Safe Failure Fraction	Proportion of safe failures: Proportion of failures without the potential to bring the safety-instrumented system into a dangerous or non-permissible functional status.
SIL	Safety Integrity Level	The international standard IEC 61508 defines four discrete Safety Integrity Levels (SIL 1 to SIL 4). Each level corresponds to a range of probability for failure of a safety function. The higher the Safety Integrity Level of the safety-instrumented system, the lower the probability that it will not execute the required safety functions.
SIS	Safety Instrumented System	A safety-instrumented system (SIS) executes the safety functions that are required to achieve or maintain a safe status in a system. It consists of sensors, logic unit/control system and final controlling elements.

Glossary

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