SIEMENS

SIPART

Electropneumatic positioners SIPART PS2 with 4 to 20 mA/HART

Operating Instructions

6DR50..
6DR51..
6DR52..
6DR53..
6DR59..

01/2019
A5E00074631-AD

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

Introduction 1

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 Document history

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

Edition	Note
01/2019	• Changes for FW 5.02.00, HART device revision 7 • Ex "nA" (non-sparking equipment) is replaced by Ex "ec" (increased safety) • Option -Z P01 Extended diagnostics supported by pressure sensors – Parameter assignment: U.\\PRES (Page 191) – Diagnostics values: 60.PZ, 63.PZMAX und 64.N_Min (Page 215) – Online diagnostics: Error codes 17 to 19 (Page 221) Section "Installing and mounting (Page 35)" – New markings on the lever with carrier pin (Page 39) – Revised section "Setting and locking the transmission ratio (Page 47)" • Section "Pneumatic connection (Page 88)" – Revised section "Reaction to failure of auxiliary powers (Page 91)" • Section "Commissioning (Page 103)" – Revised section "Setting the friction clutch (Page 113)" • Section "Service and maintenance (Page 227)" – Section "Replacing the basic electronics" with the "Fail in Place" function has been revised and is now called "Replace basic electronics (Page 230)" – New section "Replace pneumatic block (Page 232)" and "Replace the pressure sensor module (Page 233)" • Section "Technical data (Page 237)" – Explosion protection (Page 241) restructured and contains a breakdown of the article number (Page 241) • Section "Spare parts / accessories / scope of delivery (Page 259)" extended

See also

Partial stroke test 'A.\\PST' (Page 166)

1.3 Product compatibility

The following table describes compatibility between manual edition, device revision, engineering system and associated EDD.

Manual edition	Comments	Device revision	Compatible version of device integration package	
01/2019	New device features	FW: 5.02.00 or higher Device revision 7 or higher	SIMATIC PDM V9.0	EDD: 23.00.00 or higher
			SIMATIC PDM V8.2 SP1	EDD: 23.00.00 or higher
			AMS Device Manager V12.5	EDD: 23.00.00 or higher
			SITRANS DTM V4.1	EDD: 23.00.00 or higher
			Field communicator	EDD: 23.00.00 or higher
05/2017	New device features	FW: 5.01.00 or higher Device revision 6 or higher	SIMATIC PDM V9.0	EDD: 23.00.00 or higher
			SIMATIC PDM V8.2 SP1	EDD: 23.00.00 or higher
			AMS Device Manager V12.0	EDD: 23.00.00 or higher
			SITRANS DTM V4.1	EDD: 23.00.00 or higher
			Field communicator	EDD: 23.00.00 or higher

1.4 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.

1.5 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 constitute one element of such a concept.

Customers are responsible for preventing unauthorized access to their plants, systems, machines and networks. Such systems, machines and components should only be connected to an enterprise network or the internet if and to the extent such a connection is necessary and only when appropriate security measures (e.g. firewalls and/or network segmentation) are in place.

For additional information on industrial security measures that may be implemented, please visit
https://www.siemens.com/industrialsecurity.

Siemens' products and solutions undergo continuous development to make them more secure. Siemens strongly recommends that product updates are applied as soon as they are available and that the latest product versions are used. Use of product versions that are no longer supported, and failure to apply the 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.

1.6 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 data (Page 237).

1.7 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 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.

2.2 Warning symbols on the device

Symbol	Explanation
	Consult operating instructions

2.3 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)

2.4 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.

2.5 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.

2.6 Improper modification on positioner 6DR5...6

⚠ WARNING

Improper modification on positioner 6DR5..6

Danger of explosion. The pneumatic terminal plate on the positioner 6DR5..6 is a safety-related component of the flameproof enclosure.

- Never loosen the screws ① of the pneumatic terminal plate.

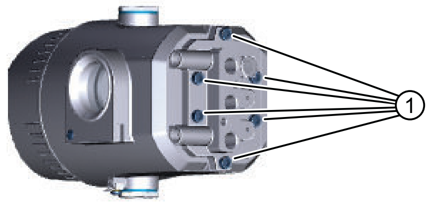


Figure 2-1 Screws of the pneumatic terminal plate on the positioner 6DR5..6

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 data (Page 237).

Description 3

3.1 Function

- The electropneumatic positioner and an actuator form a control system. 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 control system provides the setpoint w digitally to the positioner over the bus.
- The positioner works as a predictive five-point positioner, through whose output value $\pm\Delta y$ the integrated valves can be controlled by pulse length modulation.
- These input signals change pressure in the actuator chamber(s) and displace the actuator until the control deviation becomes zero.
- Using the three buttons and the display with the enclosure cover removed, operation (manual mode) and configuration (structuring, initialization, and parameter assignment) can be performed.
- By default, the basic unit has a binary input (BIN). This binary input can be individually configured and used, for example, to block the control levels.
- It has a friction clutch and a switchable gear so that the positioner can be used with different 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.

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 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:

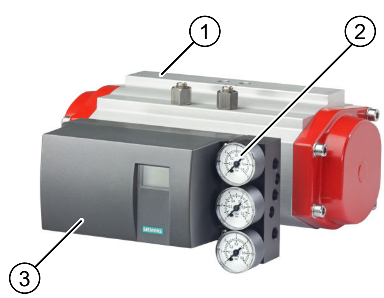
- Linear actuator
- Part-turn actuator VDI/VDE 3845

Various add-on extensions are available for linear actuators:

- IEC 60534-6-1 (NAMUR)
- Integrated mounting on ARCA, except with flameproof stainless steel enclosure (6DR5..6)
- Integrated mounting on SAMSON, not for Ex d

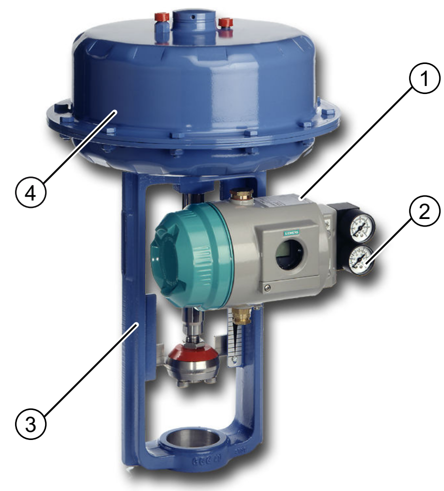
① Pressure gauge block, single-acting
② Valve
③ Yoke / actuator yoke
④ Single-acting positioner in non-flameproof aluminum enclosure
⑤ Actuator

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



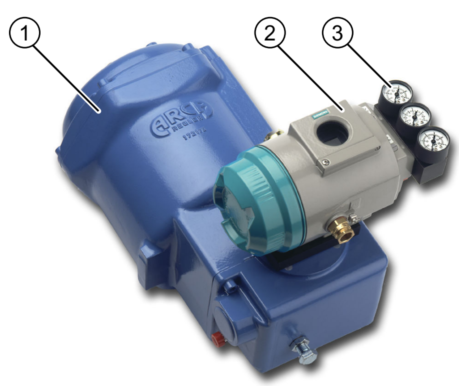
① Part-turn actuator
② Pressure gauge block, double-acting
③ Double-acting positioner in polycarbonate enclosure

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

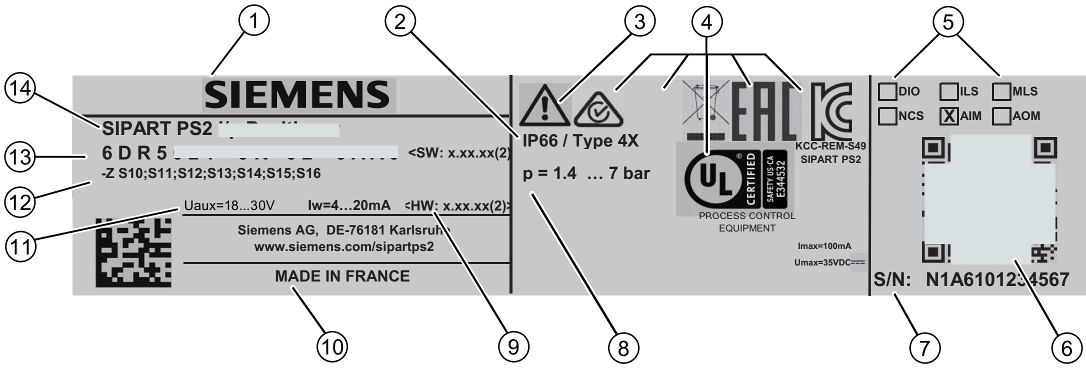


① Part-turn actuator
② Double-acting positioner in flameproof aluminum enclosure
③ Pressure gauge block, double-acting

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

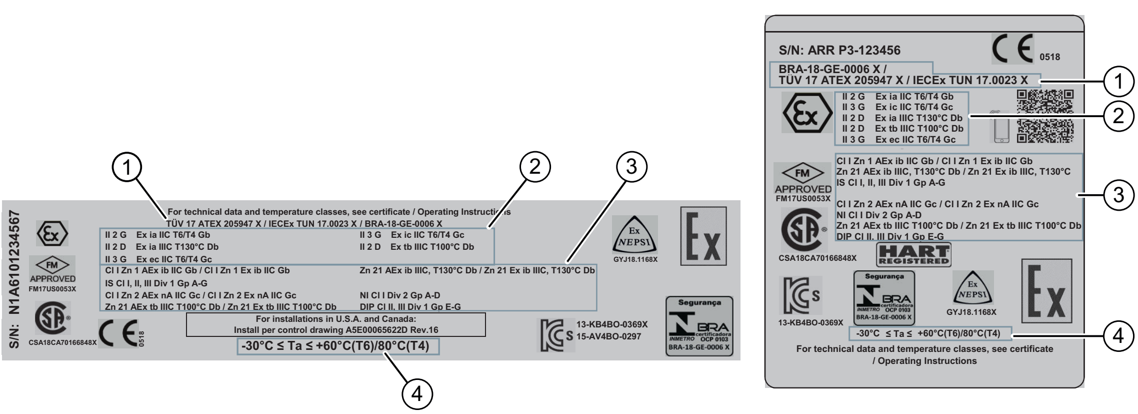
3.2.2 Nameplate layout

Example of manufacturer nameplate



①	Manufacturer	⑧	Auxiliary power (supply air 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

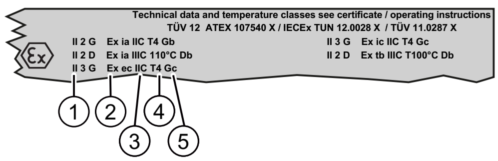
Example of explosion protection nameplate



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

3.2.3 Explanation of Ex information

Explanation of Ex information



① Category for operating range

② Type of protection

③ Group (gas, dust)

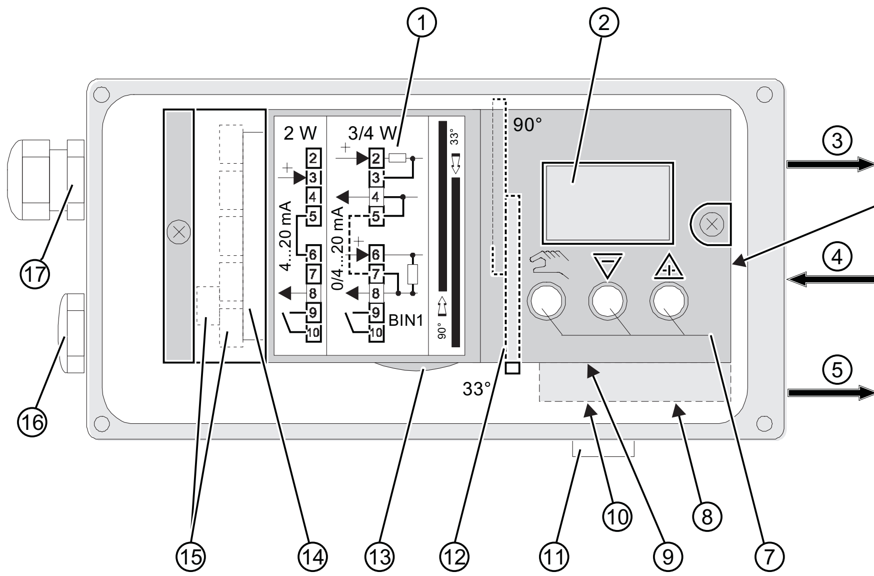
④ Maximum surface temperature (temperature class)

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	Wiring diagram on module cover	⑩	Restrictor Y1 for double-acting actuators
②	Display	⑪	Exhaust air outlet with a sound absorber
③	Output: Actuating pressure Y1	⑫	Transmission ratio selector[2)]
④	Input: Supply air PZ	⑬	Friction clutch adjustment wheel
⑤	Output: Actuating pressure Y2[1)]	⑭	Basic electronics
⑥	Purge air switch	⑮	Connecting terminals of option modules
⑦	Buttons	⑯	Blanking plug
⑧	Restrictor Y2 for double-acting actuators[1)]	⑰	Cable gland
⑨	Restrictor Y1 for single-acting actuators		

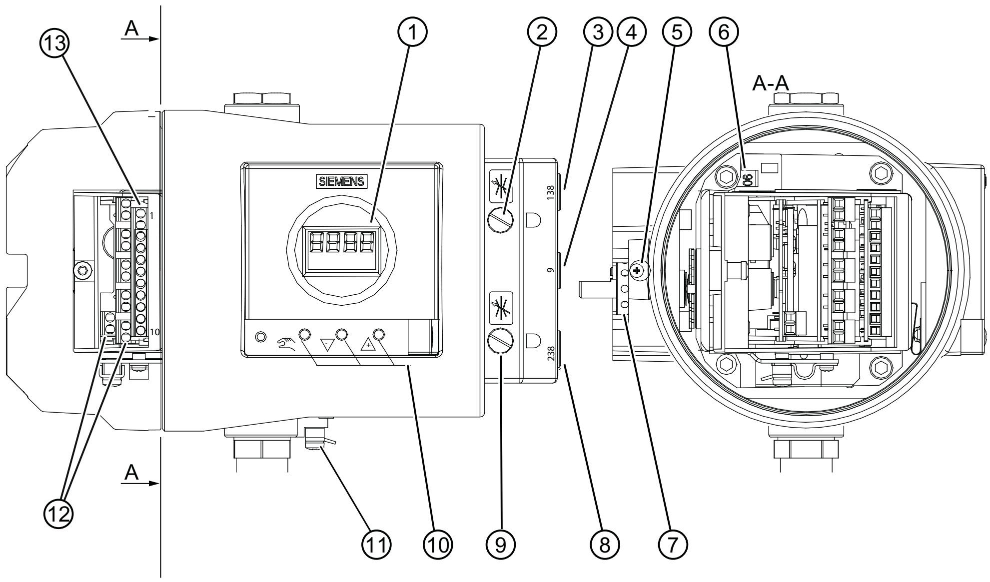
[1)] for double-acting actuators

[2)] visible when the positioner is open

Figure 3-6 View of positioner with cover open

See also

Structure of pneumatic connection (Page 89)



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

[1)] for double-acting actuators

[2)] visible when the positioner is open

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

See also

Pneumatic connection for 6DR5..5/6 (Page 90)

3.3.2 Basic electronics

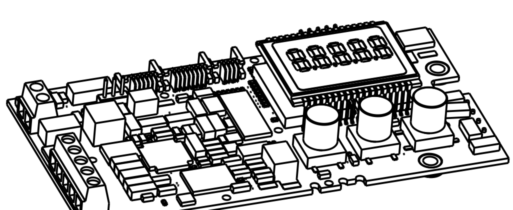


Figure 3-8 Basic electronics, schematic representation

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 Mode of operation

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 $\pm\Delta y$.

The piezo-controlled inlet or exhaust air valve is opened depending on the magnitude and direction of the control deviation (x-w). 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 case of medium control deviations, valves are controlled using pulse-length modulated pulses. This takes place in the so-called slow step zone.

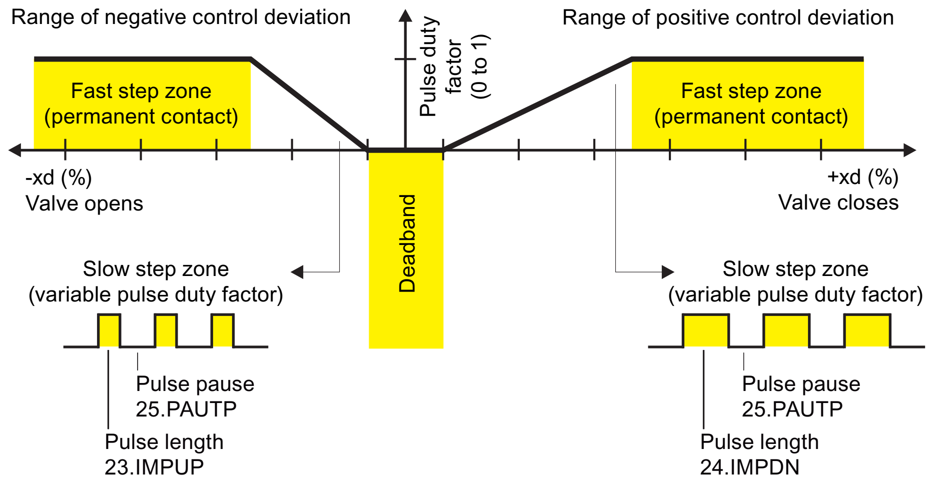


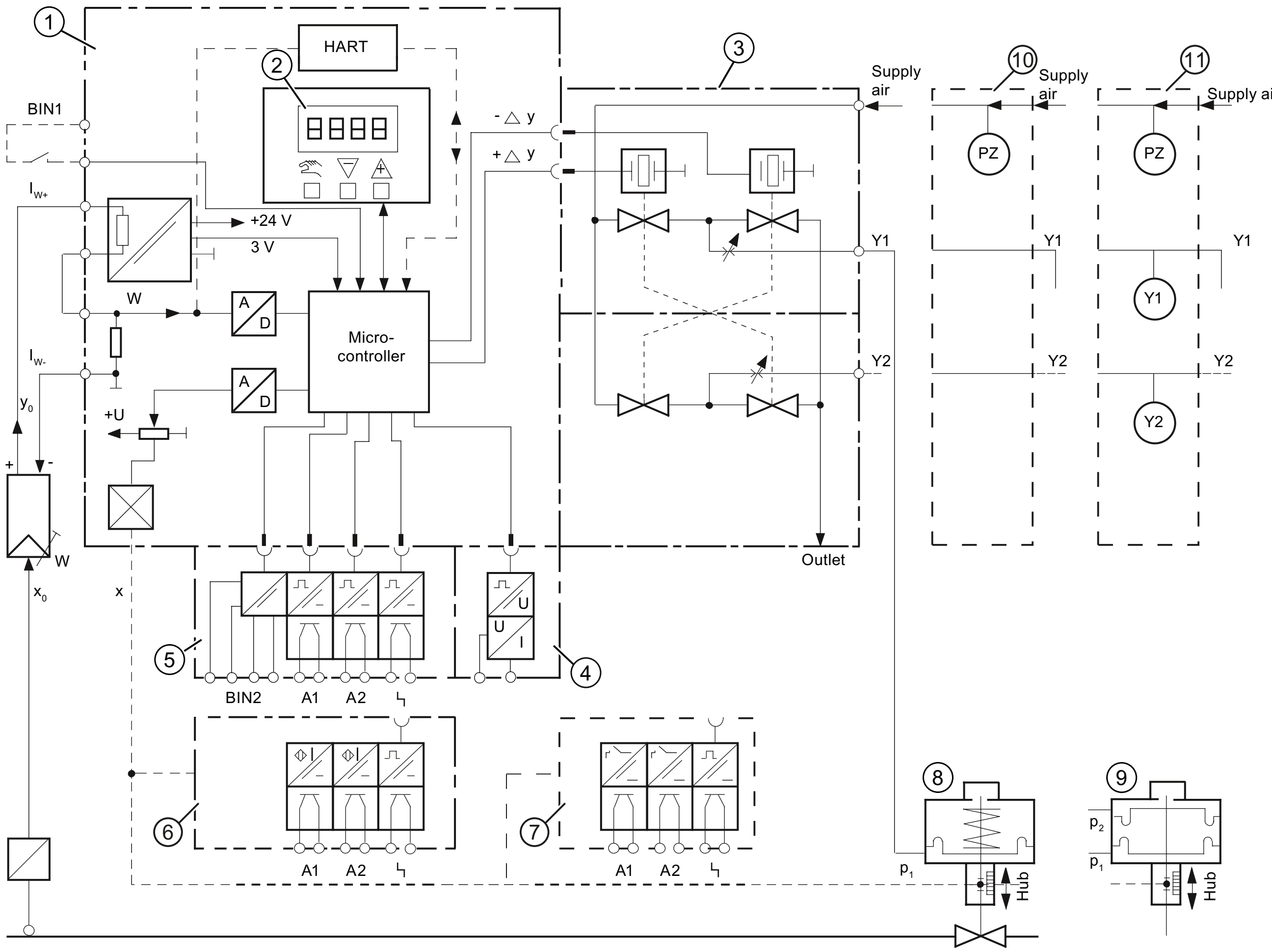
Figure 3-9 Functional principle of five-point controller

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. You can read and document these parameters using communication programs such as 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. You can use the diagnostics function for this.

3.4.1 Block circuit diagram for single-acting or double-acting actuators



① Basic electronics with microcontroller and input circuit
② Control pad with display and buttons
③ Single-acting or double-acting pneumatic block
④ Position feedback module for positioner
⑤ Alarm module for three alarm outputs and one binary input
⑥ SIA module (slot initiator alarm module)
⑦ Mechanical limit switch module
⑧ Spring-loaded pneumatic actuator (single-acting)
⑨ Pneumatic actuator (double-acting)
⑩ Pressure sensor module
⑪ Pressure gauge block

Figure 3-10 Block circuit diagram for the electropneumatic positioner, functional diagram

Note

Alarm module, SIA module and mechanical limit switch module

Alarm module ⑤, SIA module ⑥ and mechanical limit switch module ⑦ can only be alternatively used.

3.4.2 Mode of operation of the HART function

Note

Priority of operation / failure of power supply

- Operation at the positioner has priority over specifications from the HART communicator.
- Failure of the auxiliary power to the positioner also interrupts communications.

Function

The positioner is also available with built-in HART functionality. The HART protocol allows you to communicate with your device using a HART communicator, PC, or programming unit. You can do the following with your device:

- Convenient configuration
- Store configurations
- Call up diagnostic data
- Show online measured values

Communication takes place as frequency modulation on the existing signal lines for the setpoint of 4 to 20 mA.

The positioner is integrated into the following parameter assignment tools:

- HART communicator
- PDM (Process Device Manager)
- AMS (Asset Management System)

3.4.3 HART system configuration

Overview

The positioner can be used in a number of system configurations:

- Stand-alone, supplied with the required auxiliary power supply; communication with supplementary units (handheld), for example
- As part of a complex system environment, e.g. SIMATIC S7

System communication

Communication is via the HART protocol, using:

- HART Communicator (load 230 ... 1100 Ω)
- PC with HART modem, on which appropriate software is installed, e.g. SIMATIC PDM (load 230 ... 500 Ω)
- Control system which can communicate via the HART protocol, e.g. SIMATIC PCS7

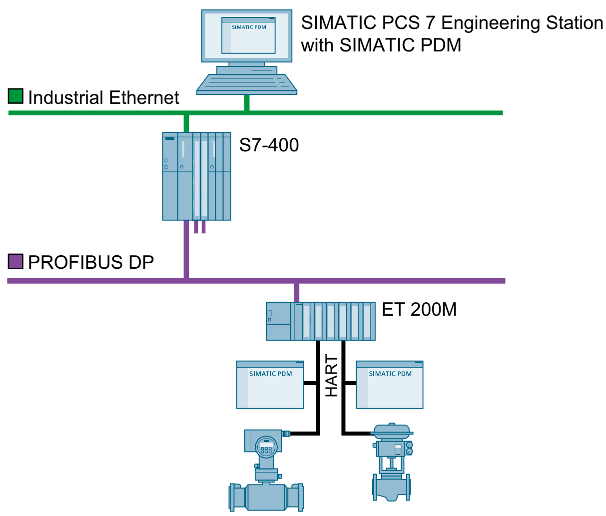


Figure 3-11 Typical system configurations

3.4.4 SIMATIC PDM

SIMATIC PDM is a software package for configuring, parameter assignment, commissioning, diagnostics and maintenance of this device and other process devices.

SIMATIC PDM offers simple monitoring of process values, alarms, and device status information.

SIMATIC PDM allows the process device data to be:

- displayed
- set
- modified
- saved
- diagnosed
- checked for plausibility
- managed
- simulated

Additional information on SIMATIC PDM can be found at www.siemens.com/simatic-pdm (www.siemens.com/simatic-pdm).

See also

Overview of the assignment of the HART variables (Page 268)

Installing and mounting

4

4.1 Basic safety instructions

4.1.1 Use in hazardous area

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

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

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

It is possible to damage the cover gasket

If the cover gasket is not positioned correctly in the groove of the base plate, it could be damaged when the cover is mounted and screwed tight.

- Therefore make sure that the gasket is seated correctly.

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 data (Page 237).

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

Please note the following 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 control valve into a completely pressureless state. Proceed as follows:
  - Depressurize the actuator chambers.
  - Switch off the supply air PZ.
  - Lock the valve in its position.
- Make sure that the valve has reached the pressureless state.
- If you interrupt the pneumatic auxiliary power to the positioner, the pressureless position may only be reached after a certain waiting time.
- When mounting, observe the following sequence imperatively to avoid injuries or mechanical damage to the positioner/mounting kit:
  - Mount the positioner mechanically.
  - Connect the electrical auxiliary power supply.
  - Connect the pneumatic auxiliary power supply.
  - 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

NOTICE

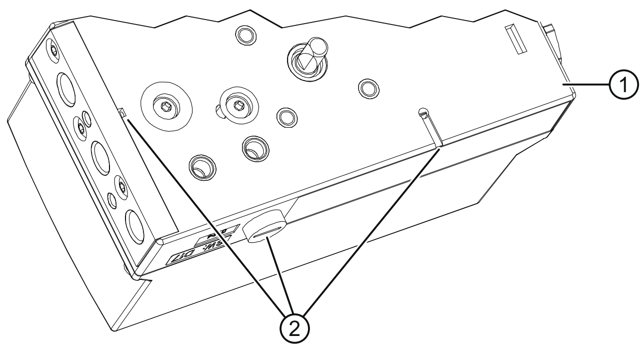
Torque with NPT screwed gland

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 238)" for the torque value.

4.1.2 Proper mounting

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

⚠ CAUTION
Loss of type of protection
Damage to device if the enclosure is open or not properly closed. The type of protection specified on the nameplate or in Technical data (Page 237) is no longer guaranteed.
• Make sure that the device is securely closed.

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 data (Page 237).

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 238)

Procedure

"Linear actuator IEC 60534 (3 to 35 mm)" mounting kit 6DR4004-8V and 6DR4004-8L			
Sr. no. *)	**Quantity**	**Name**	**Note**
①	1	NAMUR mounting bracket IEC 60534	Standardized connection point for mount with fin, column or plane surface
②	1	Pick-up bracket	Guides the pulley with the carrier pin and rotates the lever arm.
③	2	Clamping piece	Installs the pick-up bracket on the actuator spindle
④	1	Carrier pin	Installation with pulley ⑤ on lever ⑥
⑤	1	Pulley	Installation with carrier pin ④ on lever ⑥
⑥	1	Lever	For the range of stroke from 3 mm to 35 mm The lever 6DR4004–8L is additionally required for ranges of stroke > 35 mm to 130 mm (not included in the scope of delivery).
⑦	2	U–bolts	Only for actuators with columns
⑧	4	Hexagon bolt	M8x20 DIN 933–A2
⑨	2	Hexagon bolt	M8x16 DIN 933–A2
⑩	6	Spring lock washer	A8 - DIN 127–A2
⑪	6	Washer	B8.4 - DIN 125–A2
⑫	2	Washer	B6.4 - DIN 125–A2
⑬	1	Spring	VD-115E 0.70 x 11.3 x 32.7 x 3.5
⑭	1	Spring lock washer	A6 - DIN 137A–A2
⑮	1	Lock washer	3.2 - DIN 6799–A2
⑯	3	Spring lock washer	A6 - DIN 127–A2
⑰	3	Socket cap screw	M6x25 DIN 7984–A2
⑱	1	Hexagon nut	M6 - DIN 934–A4

"Linear actuator IEC 60534 (3 to 35 mm)" mounting kit 6DR4004-8V and 6DR4004-8L			
Sr. no. *)	Quantity	Name	Note
⑲	1	Square nut	M6 - DIN 557–A4
⑳	4	Hexagon nut	M8 - DIN 934–A4

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

1. Install the clamping pieces ③ on the actuator spindle.
2. Slide the pick-up bracket ② into the milled recesses of the clamping pieces ③.

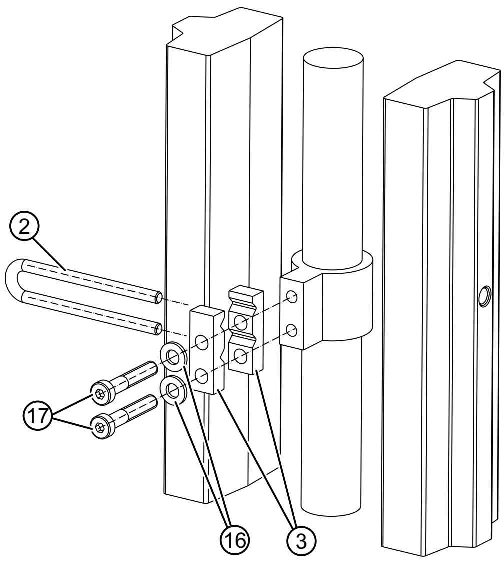


Figure 4-2 Pick-up bracket

3. Tighten the screws ⑰ so that you can still shift the pick-up bracket ②.
4. If you use a short lever, the carrier pin is already pre-mounted. If you use the long lever 6DR4004-8L, fasten the carrier pin ④ with the existing parts to the long lever.

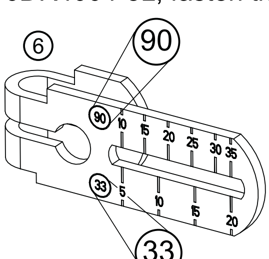


Figure 4-3 Short lever

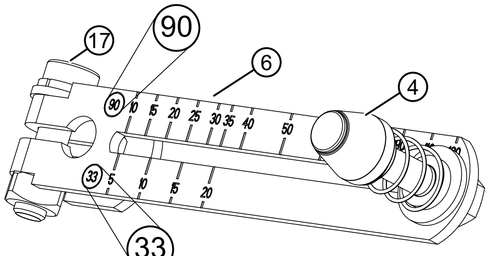


Figure 4-4 Long lever 6DR4004-8L with mounted carrier pin ④ and cylinder head screw ⑰

5. Set the stroke value. The stroke value is specified on the nameplate of the actuator. Position the pin center of the carrier pin ④ on the corresponding value of the scale. If none of the values on the lever scale matches the stroke value of the actuator, select the next higher value on the scale.
   For strokes ≥ 25 mm, select the scale (90). For strokes < 25 mm, select the scale (33).
6. Set the transmission ratio selector (Page 47) to the value of the selected scale.
7. If you need the value of actuator travel after initialization in mm: ensure that the configured stroke value matches the value of the "3.YWAY" parameter.
8. Push the pre-installed lever ⑥ up to the endstop on the positioner shaft. Fasten the lever ⑥ with socket cap screw ⑰.
9. Install the mounting bracket ① at the rear side of the positioner. Use 2 hexagon bolts ⑨, 2 spring lock washers ⑩ and 2 flat washers ⑪ for this purpose.

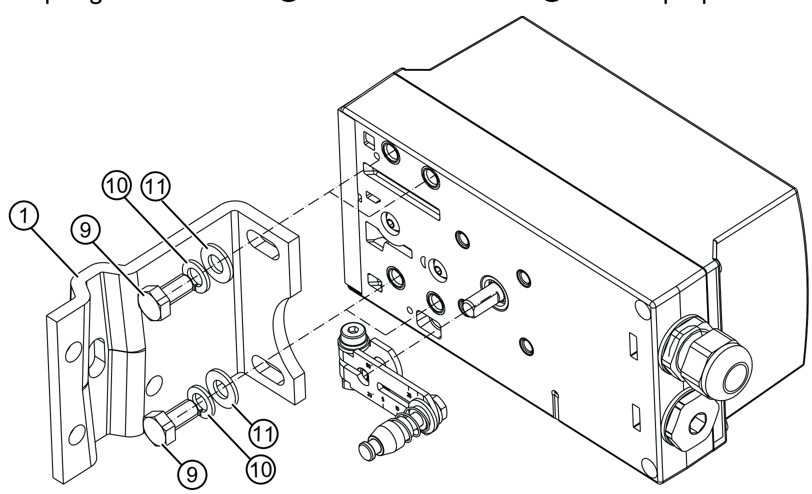


Figure 4-5 Installation with mounting bracket

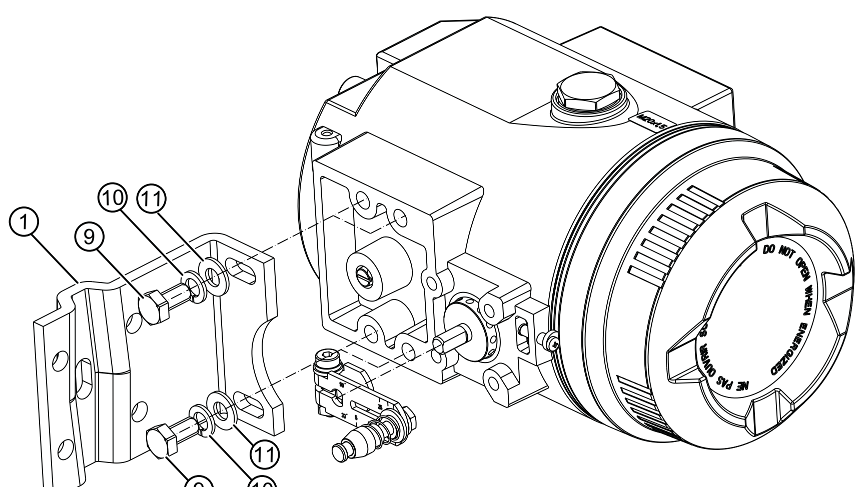
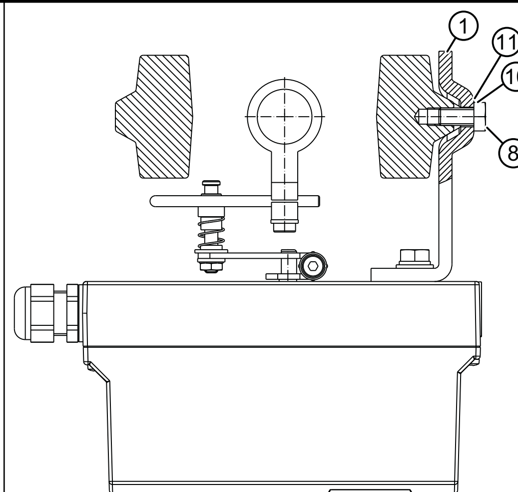
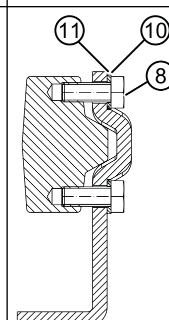
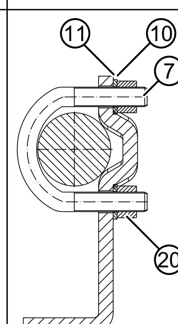


Figure 4-6 Installation with mounting bracket, flameproof enclosure

10. Select the row of holes. The selection of the row of holes depends on the yoke width of the actuator. Select the row of holes in such a way that the carrier pin ④ meshes with the pick-up bracket ② near the spindle.

11. Keep the positioner and the fastening bracket on the actuator. Ensure that the carrier pin ④ for the entire range of stroke of the actuator is guided inside the pick-up bracket ②. Ensure that the carrier pin ④ does not touch the clamping pieces ③.

12. Tighten the pick-up bracket ②.
13. Fasten the positioner on the yoke. Use the installation parts suitable for the corresponding actuator.

Actuator type	Required installation components	
Yoke with fin	• Hexagon bolt ⑧ • Washer ⑪ • Spring lock washer ⑩	
Yoke with plane surface	• Four hexagon bolts ⑧ • Washer ⑪ • Spring lock washer ⑩	
Yoke with columns	• Two U–bolts ⑦ • Four hexagon nuts ⑳ • Washer ⑪ • Spring lock washer ⑩	

Note

Height adjustment of the positioner

When you fasten the positioner on the yoke, the following applies to its height adjustment:

1. Set the height of the positioner in such a way that the horizontal lever position is near the center of the stroke.
2. Orient yourself by the lever scale of the actuator.
3. If symmetrical mounting is not possible, you must always ensure that the horizontal lever position is maintained within the range of stroke.

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. *)	Quan tity	Name	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		Mount	Actuator-specific, VDI/VDE 3845
⑦	4	Hexagon bolt	M6x12 DIN 933, torque see the section "Technical specifications > Construction (Page 238)"
⑧	4	Lock washer	S6
⑨	1	Socket cap screw	M6x16 DIN 84
⑩	1	Washer	6.4 DIN 125
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 of the description of the installation 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).

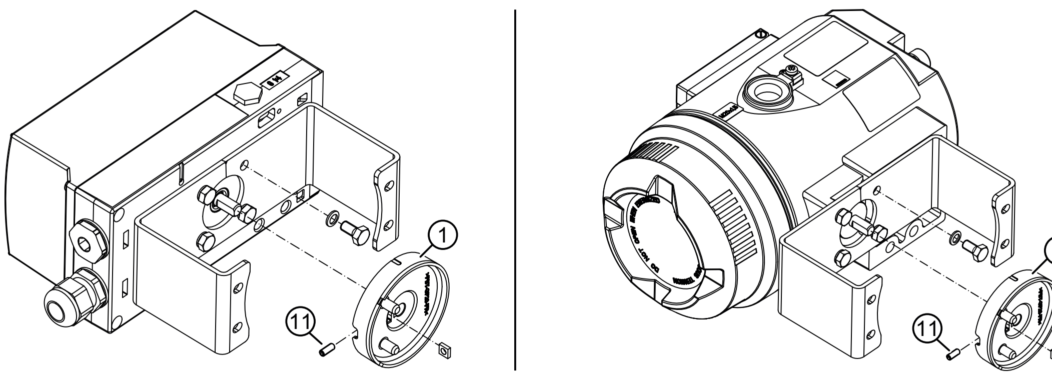


Figure 4-7 Left: Coupling wheel, right: Coupling wheel, flameproof enclosure

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

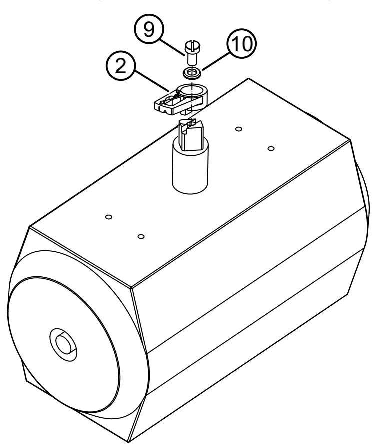


Figure 4-8 Carrier

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.

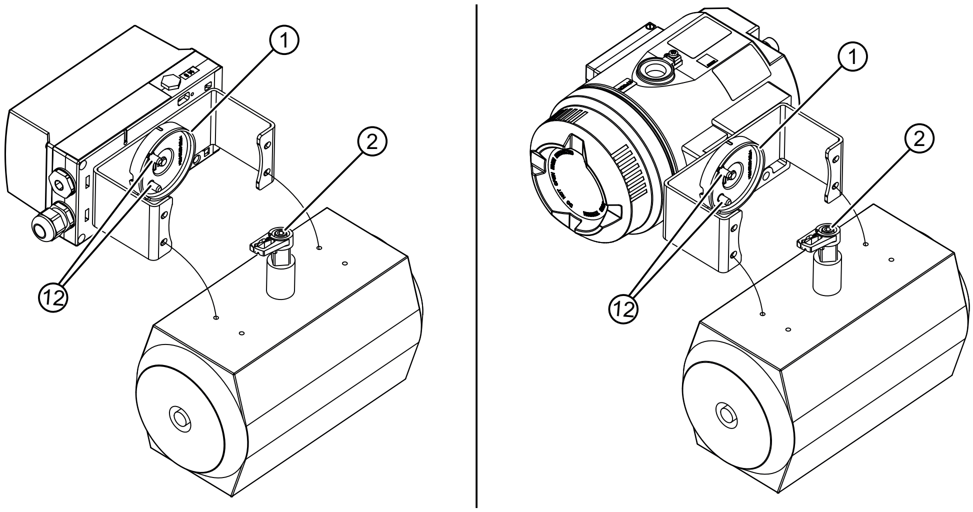


Figure 4-9 Left: Orientation of mount; right: Orientation of mount, flameproof enclosure

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.

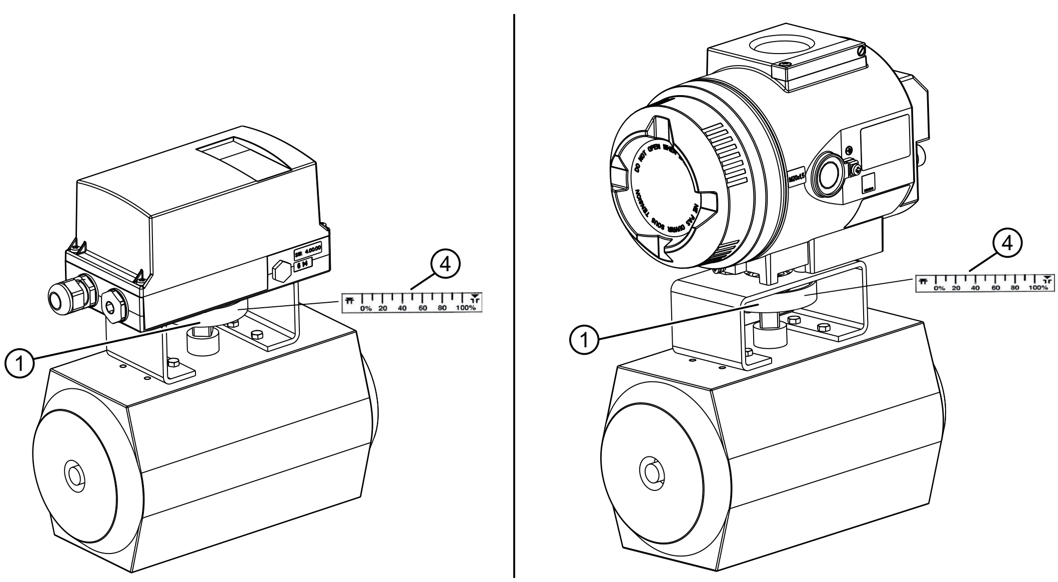
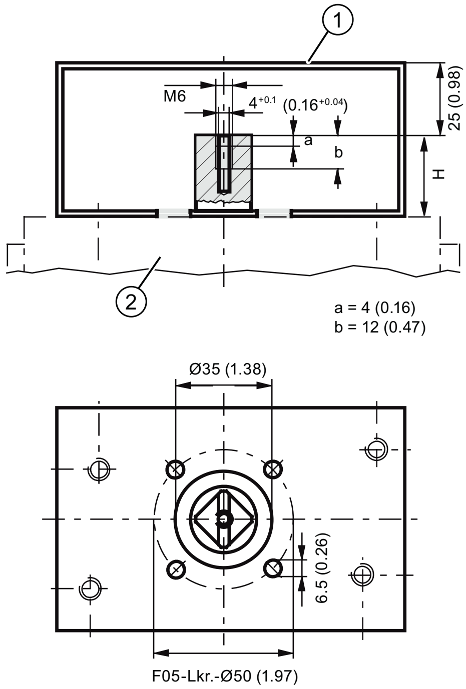


Figure 4-10 Left: Adhesive label with scale; right: Adhesive label with scale, flameproof enclosure



H = height of shaft butt

① Fixing level of positioner on mount

② Part-turn actuator

Figure 4-11 Dimensions of mount in accordance with VDI/VDE 3845 (depends on actuator)

See also

Preparing part-turn actuators for commissioning (Page 121)

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 under "Setting the friction clutch (Page 113)" in the section "Commissioning (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 registration. The hysteresis in position registration 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

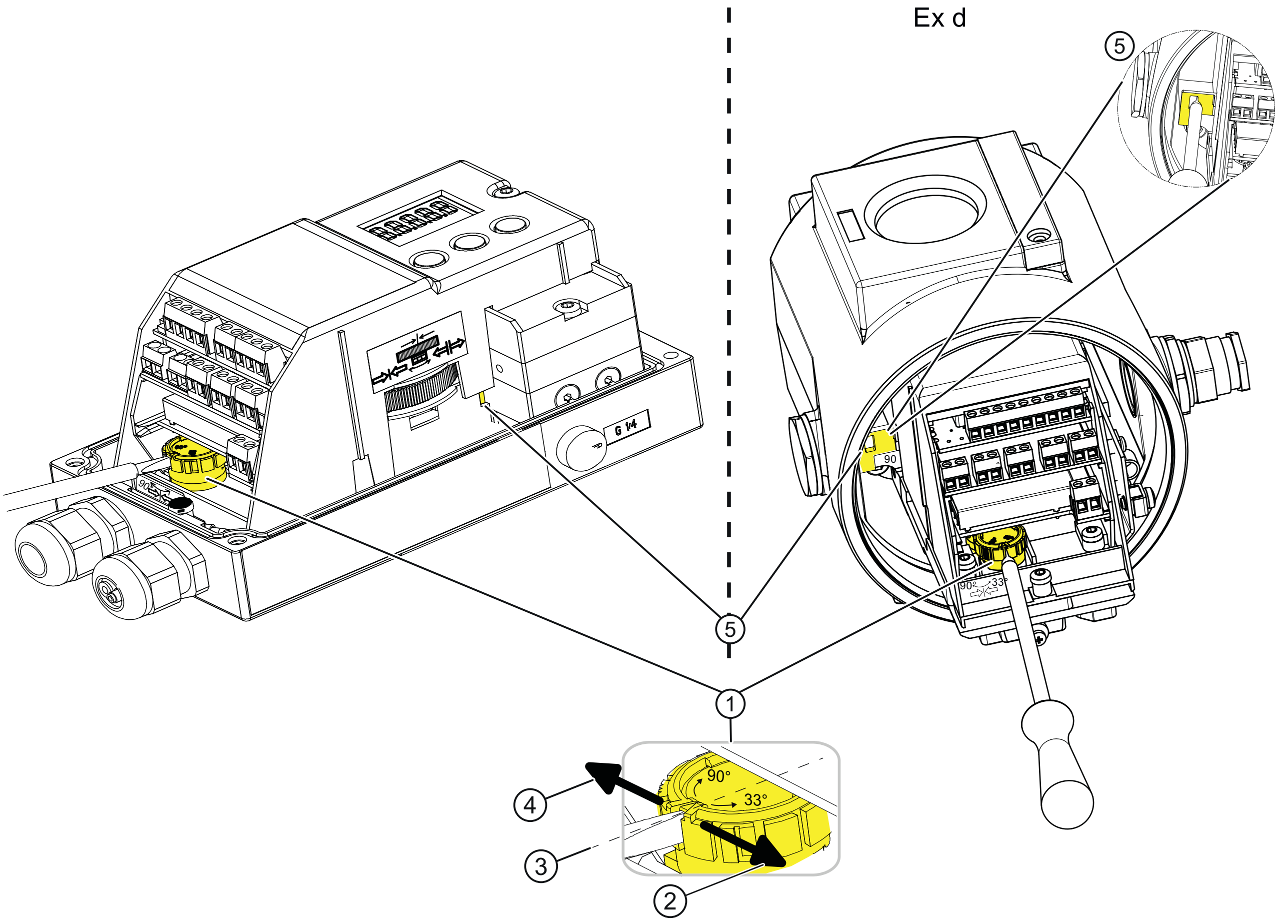
If you use the accessory part "NCS sensor for contactless position measurement" or a built-in internal NCS module, the locking and fixing measures described in this section are **not** necessary.

Requirement

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

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 4-12 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

Opening the device version with "flameproof enclosure" (Page 53)

Commissioning (Page 103)

4.5 Installing option modules

4.5.1 General information on installing option modules

WARNING

Use in hazardous area

Risk of explosion.

- Only use equipment that is approved for use in the intended hazardous area and labelled accordingly.
- Don't use devices that have been operated outside the conditions secified for hazardous areas. If you have used the device outside the conditions for hazardous areas permanently make all Ex markings unrecognizable on the nameplate.

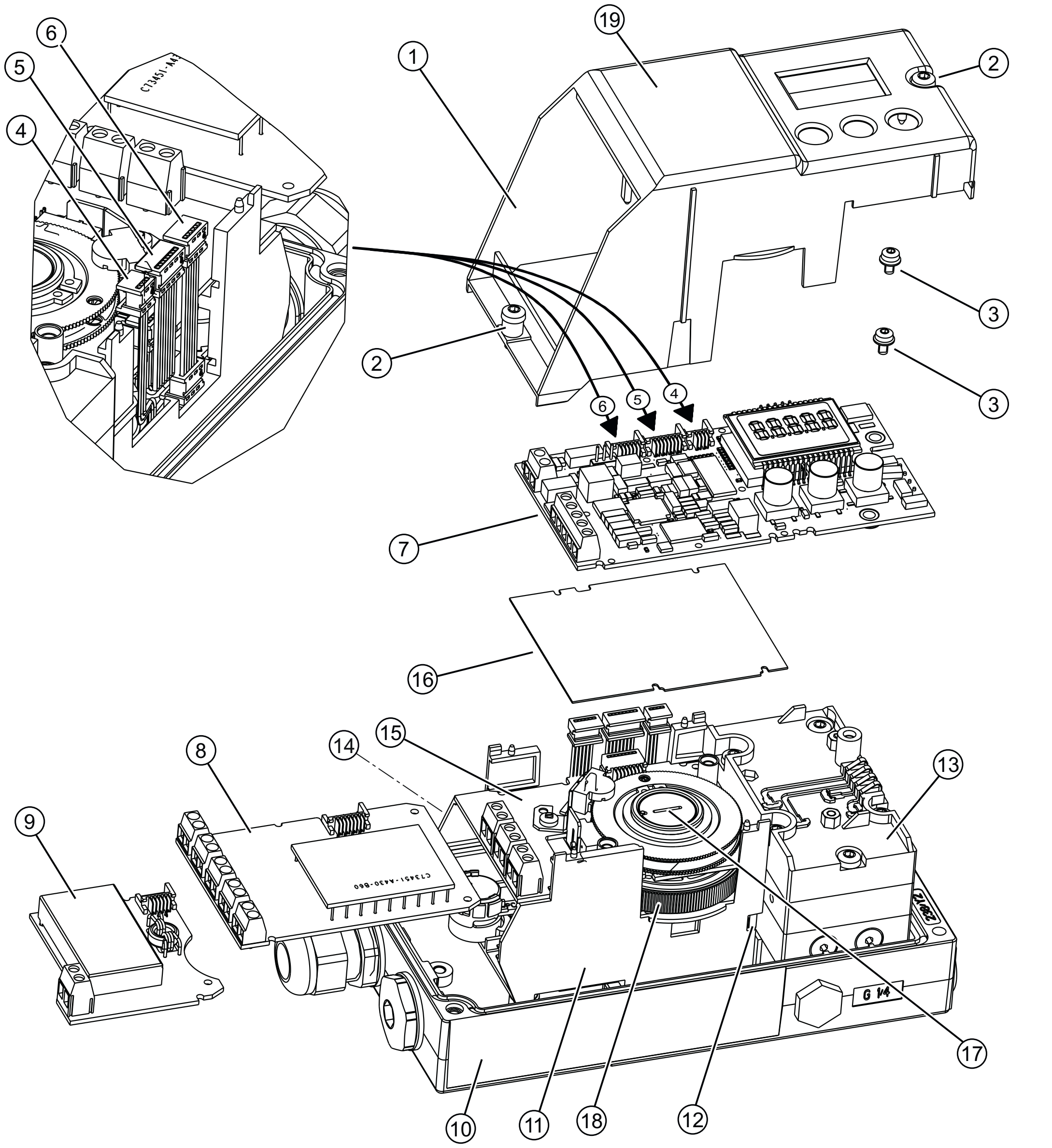
4.5.1.1 Opening the standard and and intrinsically safe version

Introduction

The following option modules are available for the positioner in the standard and intrinsically safe version:

- Position feedback module 6DR4004-6J
- Alarm module 6DR4004-6A (Page 58)
- Slit initiator alarm module (SIA) 6DR4004-6G (Page 60)
- Mechanical limit switch module 6DR4004-6K (Page 62)
- Internal NCS module (iNCS) 6DR4004-5L (Page 66)
- EMC filter module 6DR4004-6F (Page 69)

Overview screen



①	Module cover
②	Fixing screws module cover
③	Fixing screws basic electronics
④	Ribbon cable/connector for fitted potentiometer or fitted EMC filter module
⑤	Ribbon cable/connector for alarm module, SIA module or mechanical limit switch module
⑥	Ribbon cable/connector for position feedback module
⑦	Basic electronics
⑪	Adapter
⑫	Transmission ratio selector
⑬	Pneumatic block
⑭	Warning label on the side opposite the nameplate
⑮	SIA module or mechanical limit switch module
⑯	Insulating cover, yellow
⑰	Special screw

⑧	Alarm module	⑱	Friction clutch adjustment wheel
⑨	Position feedback module	⑲	Wiring diagram on module cover
⑩	Nameplate		

Figure 4-13 Installing the optional modules in the standard and intrinsically safe version

Procedure for opening the device

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

If you install an option module, proceed as described for the respective option modules. For slot initiator alarm module (SIA), mechanical limit switch module, internal non-contacting sensor module and EMC filter module, remove the basic electronics.

If you replace the basic electronics, a pneumatic block or pressure sensor module, proceed as described in the respective chapters under "Service and maintenance (Page 227)".

See also

Position feedback module 6DR4004-6J/-8J (Page 57)

4.5.1.2 Closing the standard and and intrinsically safe version

The legend numbers refer to the figure in "Opening the standard and and intrinsically safe version (Page 50)"

1. Now start with the assembly. Place on the module cover ①. Make sure that the ribbon cable is not trapped.
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 valve.

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

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

4.5.1.3 Opening the device version with "flameproof enclosure"

Introduction

The following option modules are available for the positioner in the flameproof enclosure:

- Position feedback module 6DR4004-8J (Page 57)
- Alarm module 6DR4004-8A (Page 58)
- Internal NCS module 6DR4004-5LE (Page 66)

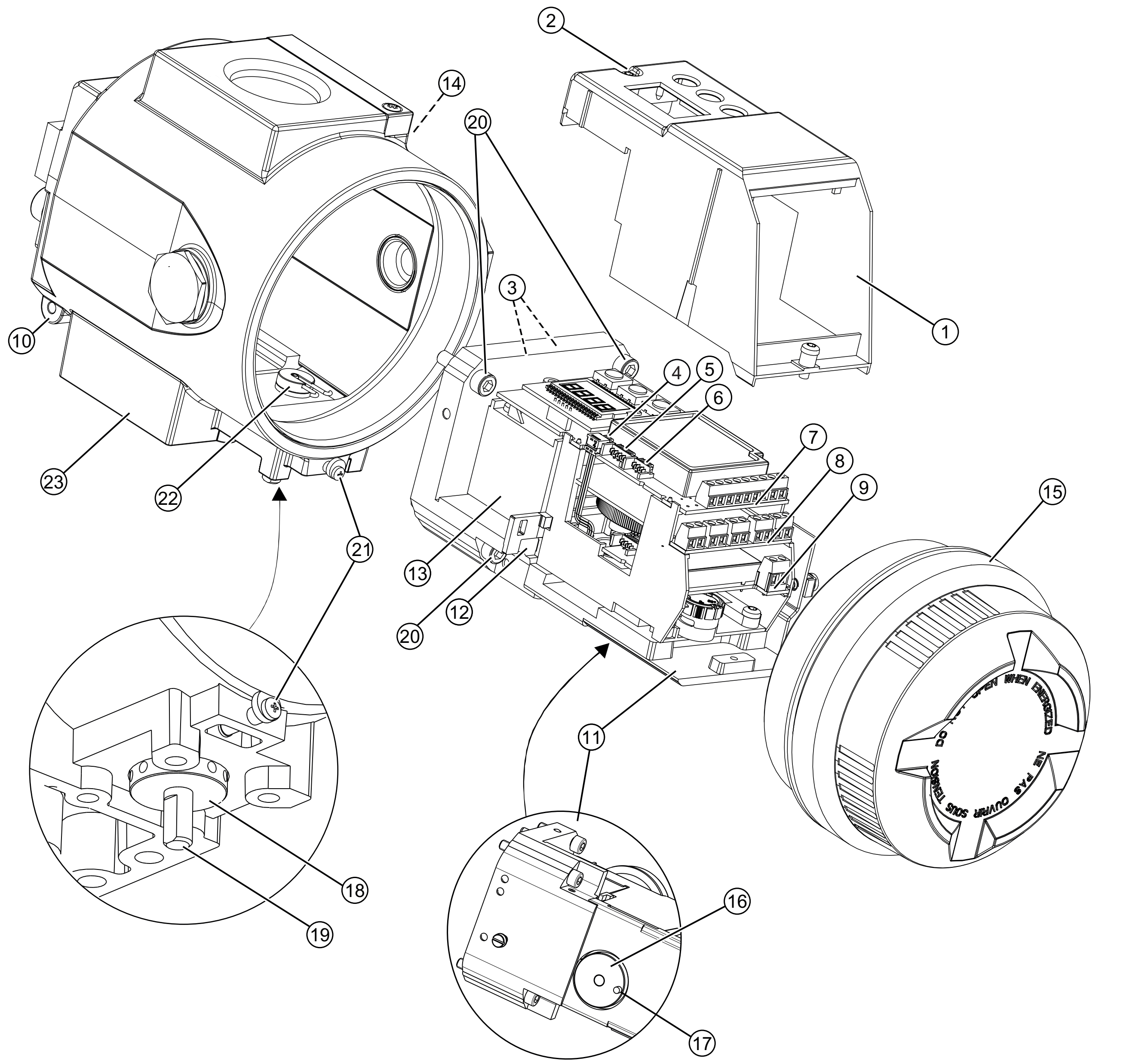
DANGER

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).

Overview screen



①	Module cover
②	Fixing screws module cover
③	Fixing screws basic electronics
④	Ribbon cable/connector for fitted potentiometer or external position detection system
⑤	Ribbon cable/connector for alarm module, SIA module or mechanical limit switch module
⑥	Ribbon cable/connector for position feedback module
⑦	Basic electronics
⑧	Alarm module
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

⑨	Position feedback module	㉑	Safety catch
⑩	Nameplate	㉒	Claw
⑪	Adapter	㉓	Enclosure
⑫	Transmission ratio selector		

Figure 4-14 Installing the optional modules in the "flameproof enclosure" version

Opening the device version with "flameproof enclosure"

1. Disconnect the power supply lines or de-energize the power supply lines.
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. Loosen 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 claw 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 install an option module, proceed as described for the respective option module. Remove the basic electronics with an internal NCS module.

If you replace the basic electronics or a pneumatic block, proceed as described in the respective chapters under "Service and maintenance (Page 227)".

4.5.1.4 Closing the device version with "flameproof enclosure"

Closing the device version with "flameproof enclosure"

1. Now start with the assembly. Place on the module cover ①. Make sure that the ribbon cable is not trapped.
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 valve.

   - In order to avoid premature wear of the valve, proceed as described here.

   ---

3. Check whether the position of the O-rings is correct before inserting the adapter into the enclosure.
   - With an enclosure made from aluminum 6DR5..5, O rings are inside the enclosure and on the back of the adapter.
   - With an enclosure made from stainless steel 6DR5..6, O-rings are inside the enclosure and on the back of the adapter.
4. Make sure no loose items in the enclosure interfere with the assembly.
5. Insert the adapter ⑪ fully into the enclosure ㉓.
   The positioner comes with a claw㉒and 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 mounting 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 lines or supply the power supply lines with voltage.

4.5.2 Position feedback module 6DR4004-6J/-8J

Function

- The optional position feedback module indicates the current position of the actuator as a two-wire signal between 4 mA and 20 mA. The position feedback module is electrically isolated from the basic device.
- 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

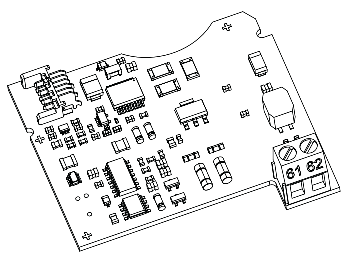


Figure 4-15 Position feedback module, schematic diagram

The position feedback module is:

- Single channel
- Potentially separated from the basic device.

Requirements

- You are familiar with the general procedure described in the section "General information on installing option modules (Page 50)".
- A supply source according to the technical data of the position feedback module (Page 250) must be available.

Procedure for installing the position feedback module

1. Open the positioner as in the description depending on the device version:
   – Opening the standard and and intrinsically safe version (Page 50)
   – Opening the device version with "flameproof enclosure" (Page 53)
2. Slide the position feedback module up to the endstop in the lower bay of the rack.
3. Connect the module to the basic electronics. For this purpose, 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 52)
   – Closing the device version with "flameproof enclosure" (Page 56)

4.5.3 Alarm module 6DR4004-6A/-8A

Function

The alarm module triggers fault messages and alarms via three binary outputs. The message function is based on the change in the signal status:

- If the signal status is "HIGH", there is no alarm message and the binary inputs are conductive.
- If the signal status is "LOW", the module reports an alarm by shutting down binary outputs using a high-resistance.
- Operational faults are signaled at a high-resistance output. Set the following parameters to activate 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

Apart from binary outputs, the alarm module has a binary input BIN2. Depending on the selected parameters, this binary input is used to block the actuator or to move it to its end position. Configure the suitable settings on parameter "BIN2".

Device features

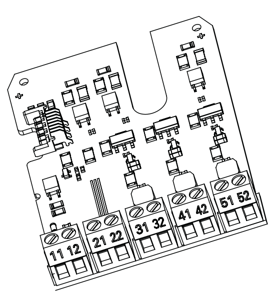


Figure 4-16 Alarm module, schematic diagram

The alarm module has the following features:

- Available in two versions.
  - Explosion-proof version for connecting 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.
- Three binary outputs. Binary inputs are potentially separated from the basic configuration and from each other.
- The binary input BIN2 has two inputs. Both inputs are implemented as logical OR combination.
  - Input 1 at terminals 11/12: Is electrically isolated, and is triggered by an active signal.
  - Input 2 at terminals 21/22: Is not electrically isolated, and is triggered by a passive NO contact.

Requirement

- You are familiar with the general procedure described in the section "General information on installing option modules (Page 50)".

Procedure for installing the alarm module

1. Open the positioner as in the description depending on the device version:
   - Opening the standard and and intrinsically safe version (Page 50)
   - Opening the device version with "flameproof enclosure" (Page 53)
2. Slide the alarm module into the rack below the basic electronics . Ensure that you slide it up to the endstop.
3. Connect the module to the basic electronics. For this purpose, 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 52)
   - Closing the device version with "flameproof enclosure" (Page 56)

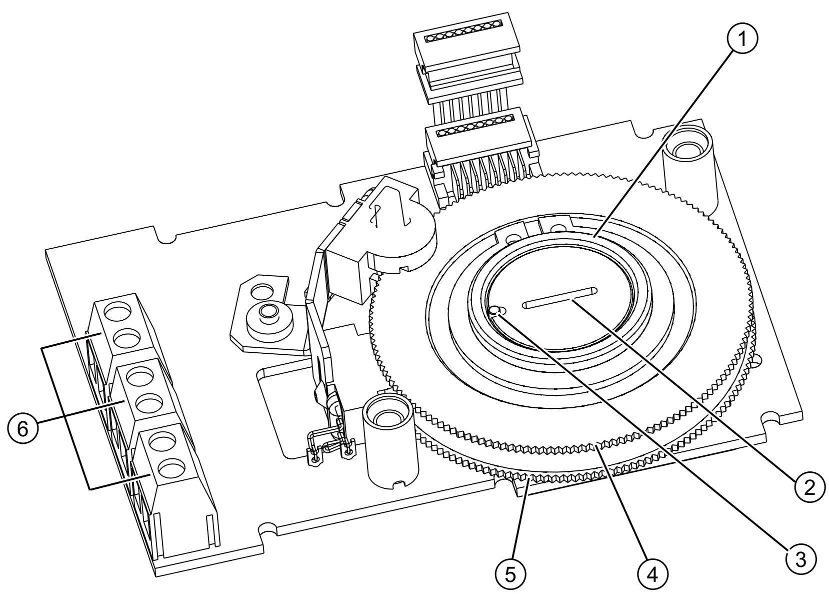
4.5.4 Slit initiator alarm module (SIA) 6DR4004 6G/-8G

Function

If the standard controller requires electrically independent limit value messages, the slotted initiator alarm module with slotted initiators is used instead of the alarm module.

- A binary output is used to display a collective fault message. Compare with the function of the alarm module. The floating binary output is implemented as an automatic fault indicating semiconductor output.
- The other two binary outputs are used to signal the two limits L1 and L2 which can be adjusted mechanically using slotted initiators. Both these binary 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 Binary outputs

Figure 4-17 SIA module, schematic diagram

The slotted initiator alarm module, SIA module for short, consists of three binary outputs ⑥.

Requirement

- You are familiar with the procedure described in the section "General information on installing option modules (Page 50)".

Procedure for installing the slot initiator alarm module

1. Open the positioner as described in section "Opening the standard and and intrinsically safe version (Page 50)".
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 SIA module from the top up to the upper printed circuit board guide of the rack.
5. Slide the module in the printed circuit board of the rack approx. 3 mm to the right.
6. Screw the special screw ② through the module 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 bearing①.
   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. Set the limits L1 and L2 as described below.
8. An insulating cover (yellow) is required over the module. This insulating cover is supplied with the module. Place the insulating cover on one side under the basic electronics seat of the rack. The recesses of the insulating cover must fit in the corresponding webs of the rack. 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 in the corresponding webs of the rack.
9. Place the basic electronics onto the four holders of the rack.
10. Tighten the two fixing screws of the basic electronics. Tighten the screws.
11. Reestablish all electrical connections between the basic electronics and the option modules.
12. Connect the basic electronics with the option modules and the potentiometer. Use the corresponding ribbon cables.
13. Put on the **supplied module cover**. Make sure that the ribbon cable is not trapped.

    Note

    Module cover

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

14. Select the labels that already exist on the standard version of the module cover from the label set provided. Affix the selected labels on the installed module cover as per the standard version.
15. Close the positioner as described in section "Closing the standard and and intrinsically safe version (Page 52)".

Procedure: Determining the switch status of the slotted 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 SIA module:
   – 41 and 42
   – 51 and 52
2. Read the switch status of slotted initiators.

Procedure: Setting the L1 and L2 limits

The consecutive numbers in the following text refer to the above image 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. Set a high-low or a low-high switchover as follows:
   – 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. Set a high-low or a low-high switchover as follows:
   – 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.

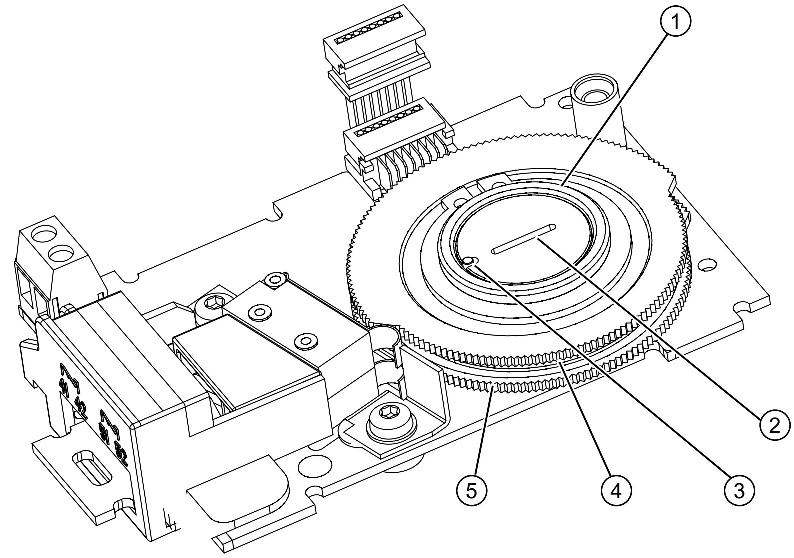
- Move the actuator to and fro while simultaneously holding the actuating disks ④ and ⑤.

4.5.5 Mechanical limit switch module 6DR4004-6K/-8K

Function

This module is 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 4-18 Limit contact module, schematic diagram

The mechanical limit switch module consists of:

- One binary output to display a collective fault message. Compare with the device features of the alarm module.
- Two switches to report two mechanically adjustable limits. Both these switches are electrically independent from the remaining electronic unit.

See also

General information on installing option modules (Page 50)

Requirement

- You are familiar with the procedure described in the section "General information on installing option modules (Page 50)".

Procedure for installing the mechanical limit switch module

1. Open the positioner as described in section "Opening the standard and and intrinsically safe version (Page 50)".
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 mechanical limit switch module from the top up to the upper printed circuit board guide of the rack.
5. Slide the module in the printed circuit board of the rack approx. 3 mm to the right.
6. Screw the special screw ② through the module 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 bearing①.

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. Set the limits L1 and L2 as described below.
8. An insulating cover (yellow) is required over the module. This insulating cover is supplied with the module. Place the insulating cover on one side under the basic electronics seat of the rack. The recesses of the insulating cover must fit in the corresponding webs of the rack. 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 in the corresponding webs of the rack.
9. Place the basic electronics onto the four holders of the rack.
10. Tighten the two fixing screws of the basic electronics. Tighten the screws.
11. Reestablish all electrical connections between the basic electronics and the option modules.
12. Connect the basic electronics with the option modules and the potentiometer. Use the corresponding ribbon cables.
13. Put on the **supplied module cover**. Make sure that the ribbon cable is not trapped.

Note

Module cover

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

14. Close the positioner as described in section "Closing the standard and and intrinsically safe version (Page 52)".

Procedure: Setting the limits L1 and L2

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. Set a high-low or a low-high switchover as follows:
   – 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. Set a high-low or a low-high switchover as follows:
   – 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.

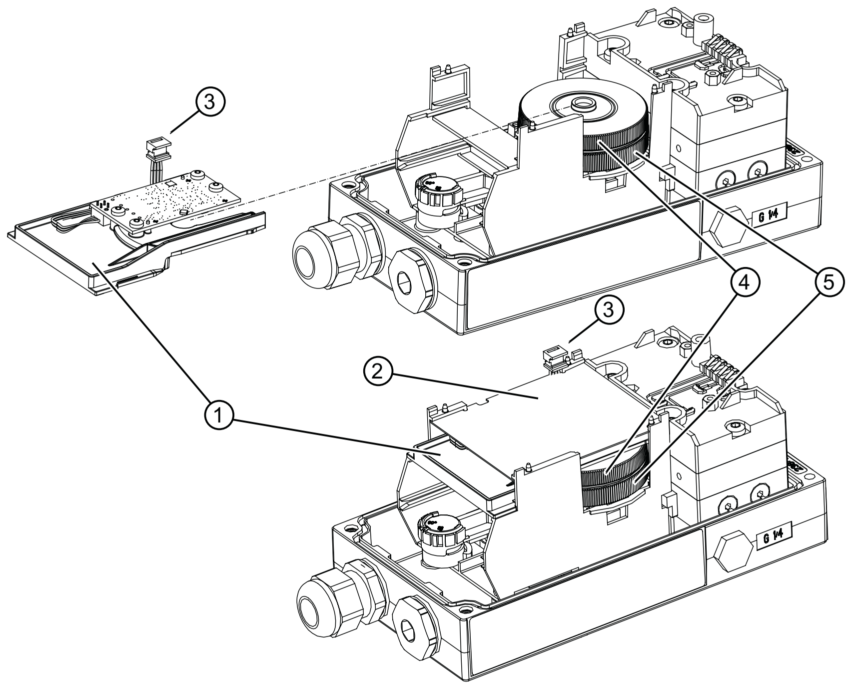
   - Move the actuator to and fro while simultaneously holding the actuating disks ④ and ⑤.

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

Function

Wear-free, contact-free position detection

Device features



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

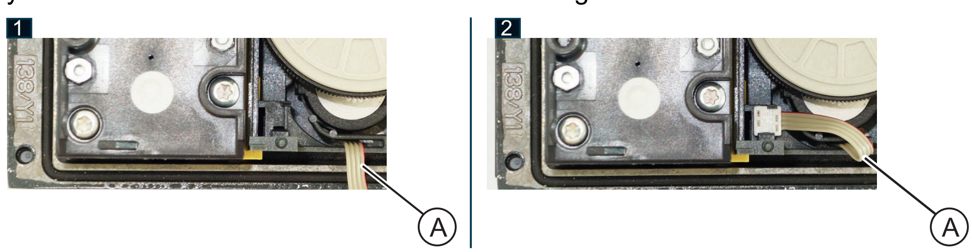
Figure 4-19 Installing the internal NCS module, schematic diagram

Requirement

- You are familiar with the general procedure described in the section "General information on installing option modules (Page 50)".
- The slot required for the internal NCS (iNCS) module in the rack is free. The following option modules use the same slot in the rack:
  - Alarm module
  - SIA module
  - Mechanical limit switch module
  - Internal NCS module
- The positioner is mounted, or is to be mounted, directly on the valve using the positioner shaft.

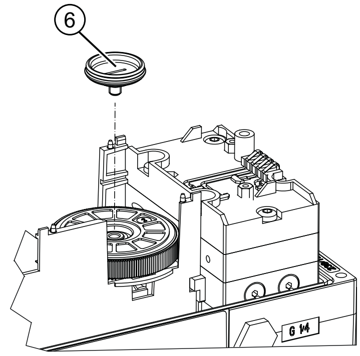
Procedure

1. Open the positioner as in the description depending on the device version:
   - Opening the standard and and intrinsically safe version (Page 50)
   - Opening the device version with "flameproof enclosure" (Page 53)
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.

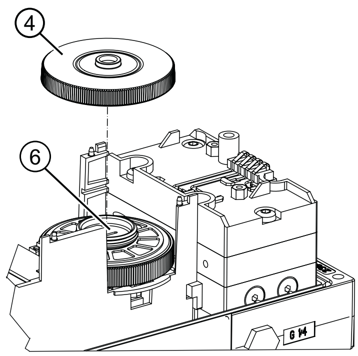


6. Screw the special screw ⑥ into the shaft of the positioner.

7. Tighten the special screw with a **torque of 2 Nm**.



8. Press the adjustment wheel of the magnet clamp 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. Position the ribbon cable ③ ofthe internal NCS module ① on the top before you slide the internal NCS module into the rack.
2. Slide the internal NCS module ① under the basic electronics into the rack 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 the insulating cover ② on one side under the basic electronics seat of the rack. The recesses of the insulating cover must fit in the corresponding webs of the rack.
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 in the corresponding webs of the rack.

Installing the basic electronics and closing the positioner

1. Place the basic electronics onto the four holders of the rack.
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 installed position feedback module: Reestablish all electrical connections between the basic electronics and the position feedback module.
5. Put on the **supplied module cover**. Make sure that the ribbon cable is not trapped.

   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 52)
   – Closing the device version with "flameproof enclosure" (Page 56)

Result

The module is installed and connected to the basic electronics of the positioner. Now configure the module with the parameter "1.YFCT (Page 145)".

See also

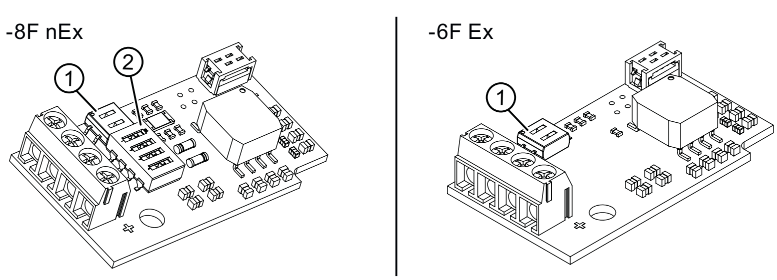
Overview of initialization parameters 1 to 5 (Page 137)

4.5.7 EMC filter module 6DR4004-6F/-8F

Function

You will require the EMC filter module if you use an external position sensor on the positioner, e.g. a potentiometer or a non-contacting sensor. The EMC filter module forms the interface between external position sensors and the basic electronics of the positioner. This module protects the positioner from electromagnetic effects.

Device features



① Switch block 1
② Switch block 2

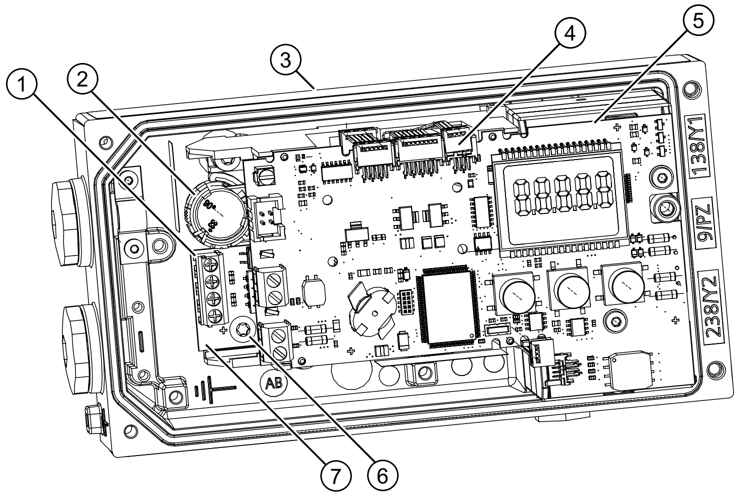
Figure 4-20 EMC filter module, schematic diagram

- EMC protection
- Connection to basic electronics
- Connection terminals for:
  - External potentiometers with 3 kΩ, 5 kΩ or 10 kΩ
  - Signals 0 to 20 mA
  - Signals 0 to 10 V

Requirement

- You are familiar with the general procedure described in the section "General information on installing option modules (Page 50)".
- You have at least one of the following modules:
  - 6DR4004-8F EMC filter module / Analog Input Module (AIM) - nEx
  - 6DR4004-6F EMC filter module / Analog Input Module (AIM) - Ex
- Any already installed optional module has been removed.
- You have one of the following external position detection systems / Position Transmitters:
  - 6DR4004-.N* NCS sensor
  - C73451-A430-D78 Polycarbonate enclosure with potentiometer
  - 6DR4004-1ES Aluminum enclosure with potentiometer
  - 6DR4004-2ES Aluminum enclosure with NCS
  - 6DR4004-3ES Aluminum enclosure with NCS and SIA module / Inductive Limit Switch (ILS)
  - 6DR4004-4ES Aluminum enclosure with NCS and Mechanic Limit Switch (MLS)

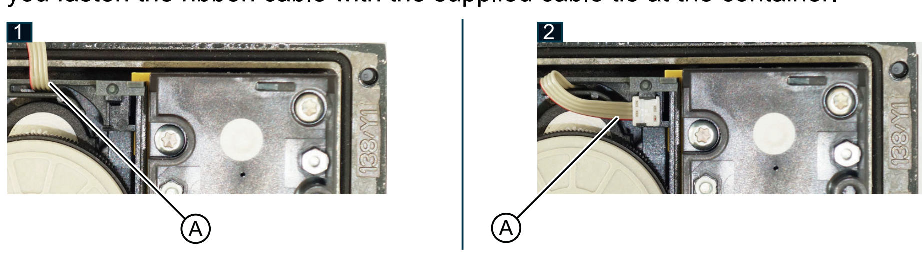
Procedure for installing the EMC filter module



①	EMC filter module terminals	⑤	Basic electronics
②	Yellow wheel for locking the position detection	⑥	Screw
③	Positioner	⑦	EMC filter module 6DR4004-6F/-8F
④	Ribbon cable connector of fitted potentiometer, or ribbon cable connector of EMC filter module		

Figure 4-21 Installation EMC filter module

1. Open the positioner as described in section "Opening the standard and and intrinsically safe version (Page 50)".
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 EMC filter module using the screw ⑥.
8. Place the basic electronics ⑤ onto the four holders of the rack.
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 EMC filter module onto the positioner basic electronics.
12. Establish all electrical connections between the basic electronics and the option modules.
13. Close the positioner as described in section "Closing the standard and and intrinsically safe version (Page 52)".

Connection 5

5.1 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

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 data (Page 237).
- 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 data (Page 237) 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 device in energized state

Risk of explosion in hazardous areas.

- Connect 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.
- Exceptions for type of protection "Increased safety ec" (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

The mechanical limit switch module 6DR4004-**6K** is approved for use for positioners with UL approval. The maximum supply voltage in this case is 30 V AC/DC.

The mechanical limit switch module 6DR4004-**8K** is not approved for use for positioners with UL approval.

If this information is ignored, the UL approval for the mechanical limit switch module for the positioner becomes invalid.

Two-wire mode

NOTICE

Connection of voltage source to current input

Device damage if a voltage source is connected to the current input I_w (terminals 6 and 7).

- Never connect the current input I_w to a low-resistance voltage source, otherwise the positioner may be destroyed.
- Always use a high-impedance power source.
- Observe the static destruction limit specified in the "Electrical data (Page 244)".

Note

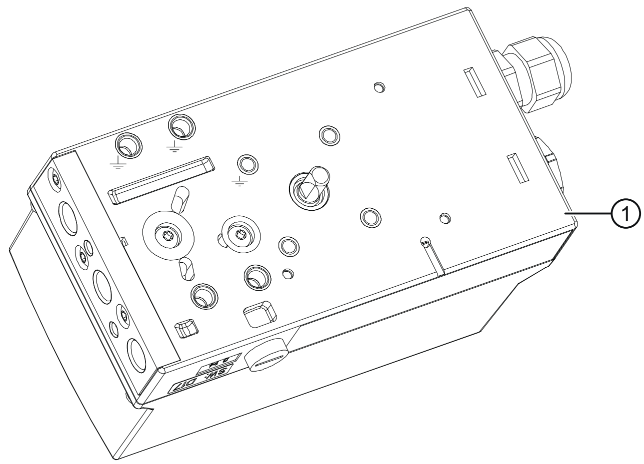
Improvement of interference immunity

- 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 244).
- 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.

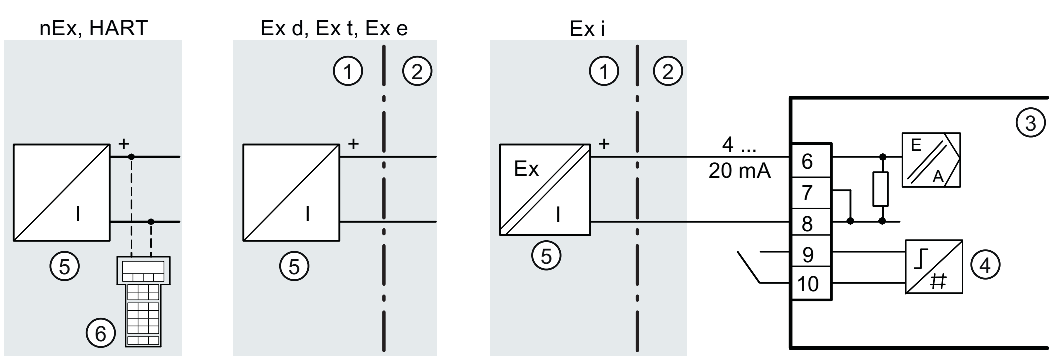


⏚ Shield

Figure 5-1 Base plate ①

5.2 Electrical wiring

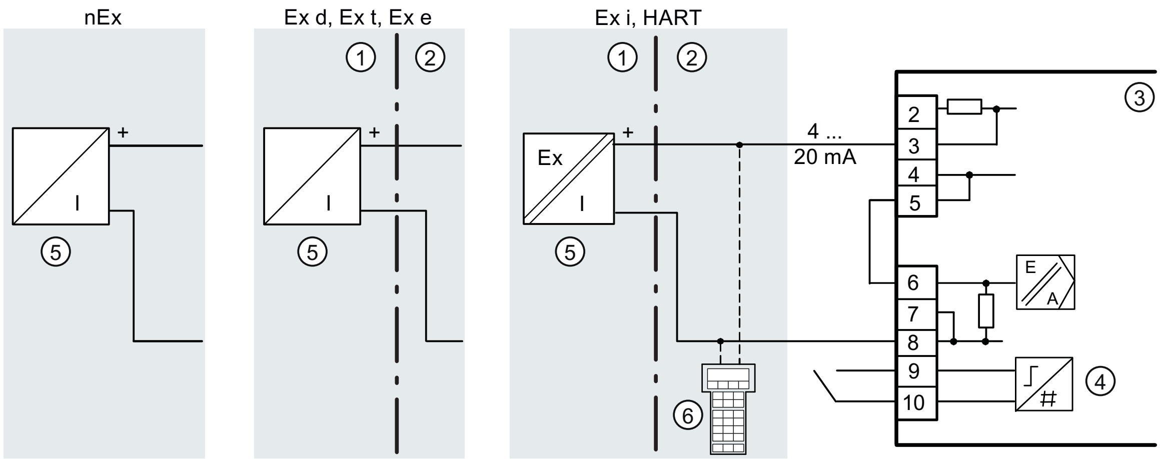
5.2.1 Connection diagram for basic electronics



① Non-hazardous area
② Hazardous area
③ Basic electronics
④ Binary input 1
⑤ Signal source
⑥ HART communicator

nEx = Non-explosion-proof device version

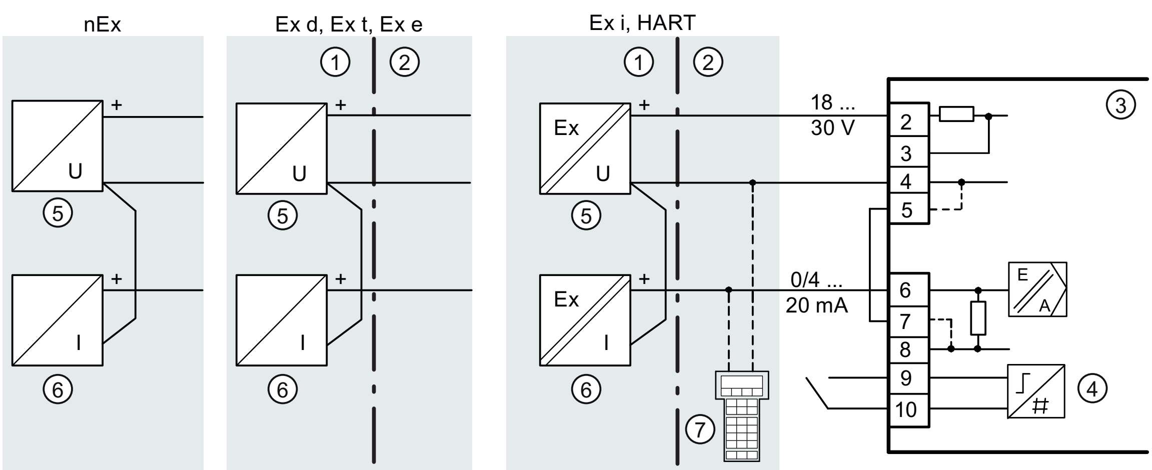
Figure 5-2 Device version 2-wire



① Non-hazardous area
② Hazardous area
③ Basic electronics
④ Binary input 1
⑤ Signal source
⑥ HART communicator

nEx = Non-explosion-proof device version

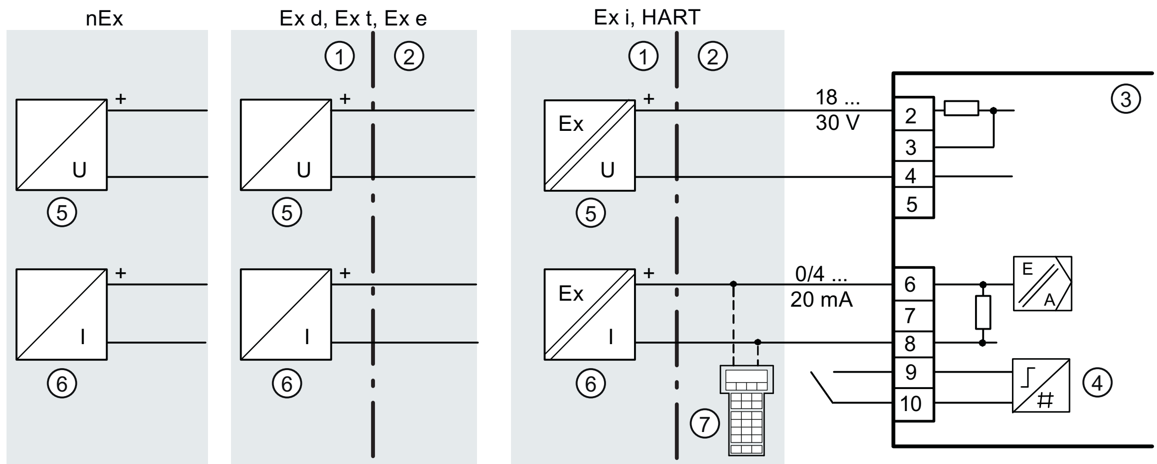
Figure 5-3 Device version 2/3/4-wire, with connection type 2-wire



① Non-hazardous area
② Hazardous area
③ Basic electronics
④ Binary input 1
⑤ Power source
⑥ Signal source
⑦ HART communicator

nEx = Non-explosion-proof device version

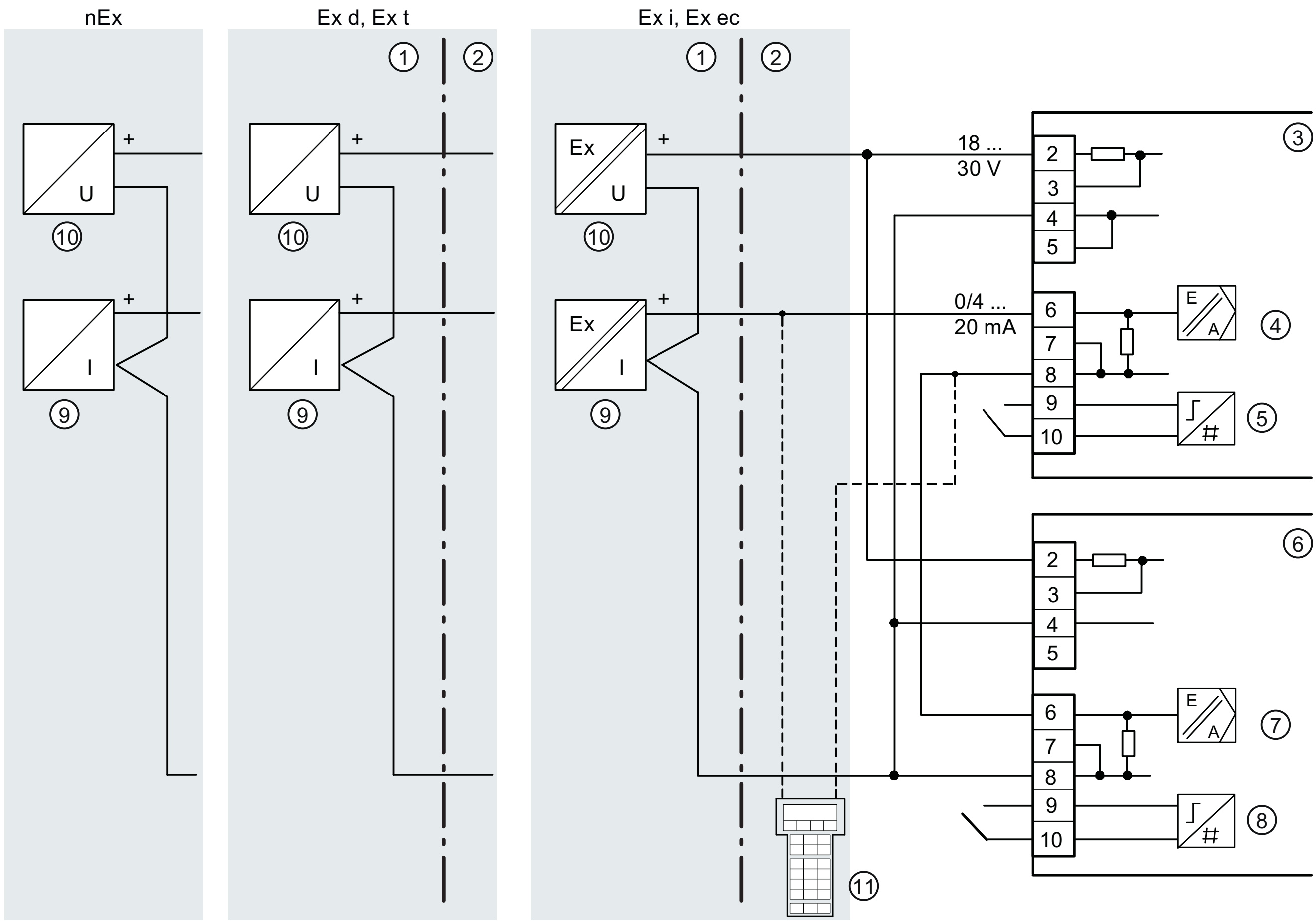
Figure 5-4 Device version 2-/3-/4-wire, with wiring type 3-wire



① Non-hazardous area
② Hazardous area
③ Basic electronics
④ Binary input 1
⑤ Power source
⑥ Signal source
⑦ HART communicator
nEx = Non-explosion-proof device version

Figure 5-5 Device version 2-/3-/4-wire, with connection type 4-wire

5.2.2 Connection diagram split range

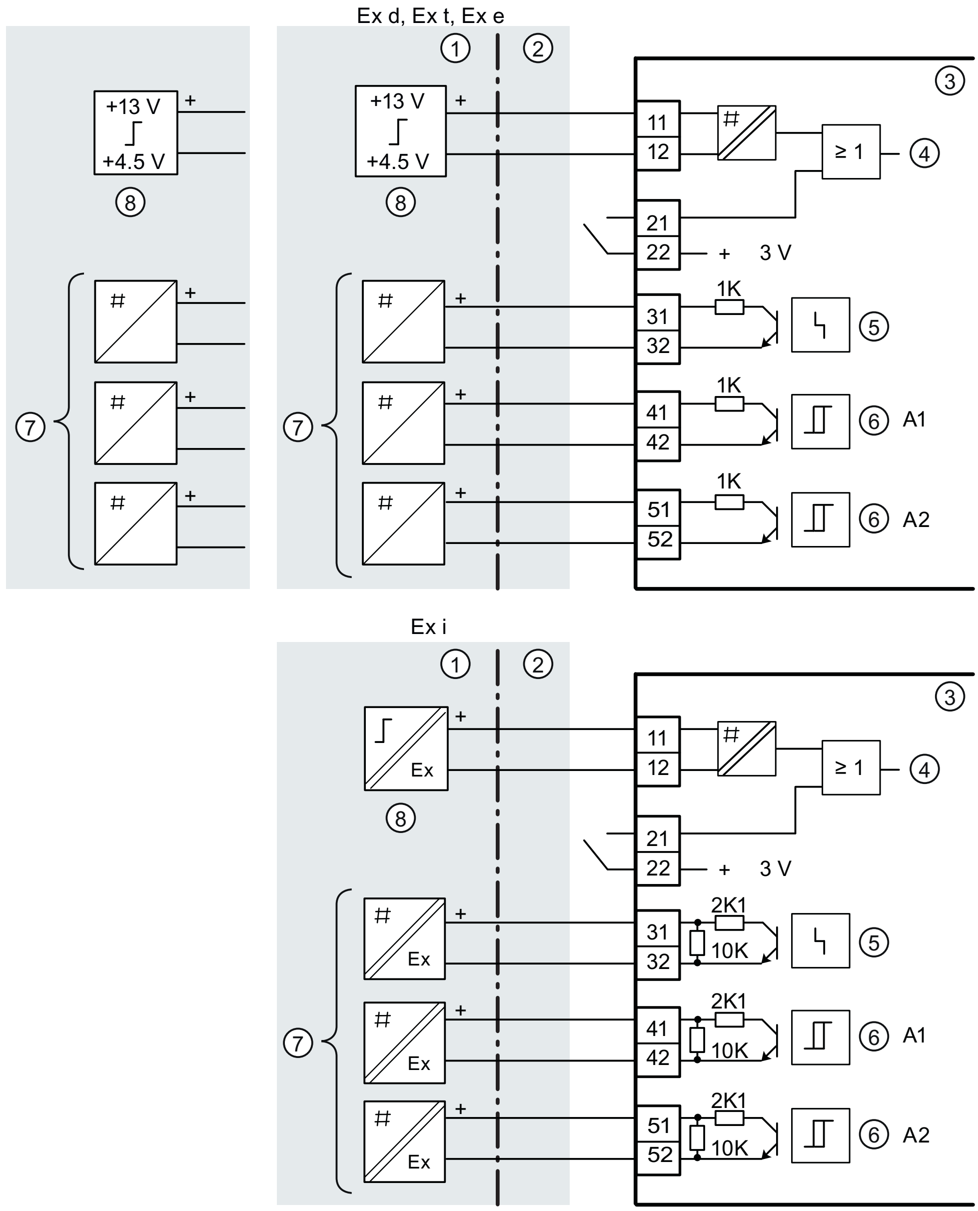


①	Non-hazardous area	⑥	Device 2
②	Hazardous area	⑦	Travel range 2
③	Device 1	⑧	Binary input 2
④	Travel range 1	⑨	Signal source
⑤	Binary input 1	⑩	Power source
	nEx = Non-explosion-proof device version	⑪	HART communicator

Figure 5-6 Series connection of two positioners, e.g. split range

5.2.3 Option modules

5.2.3.1 Alarm modules 6DR4004-6A and -8A

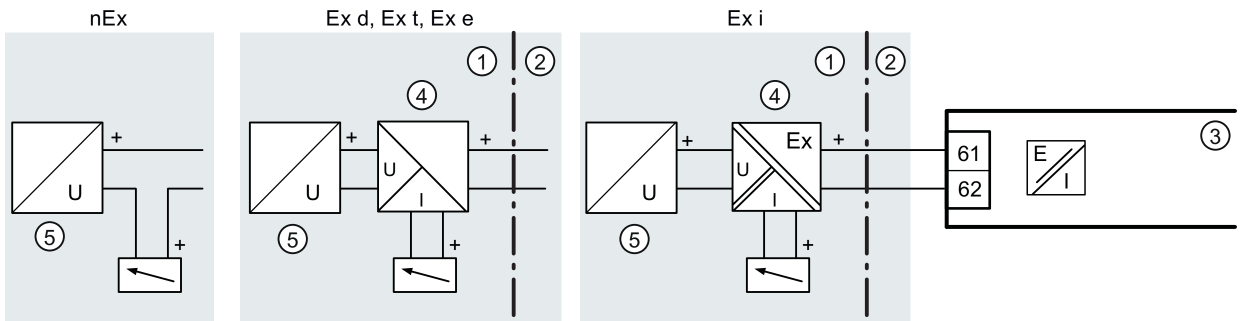


① Non-hazardous area
② Hazardous area
③ Alarm module
④ Binary input 2
⑤ Fault message
⑥ Limit
⑦ Switching amplifier
⑧ Switching output

nEx = Non-explosion-proof device version

Figure 5-7 Alarm module

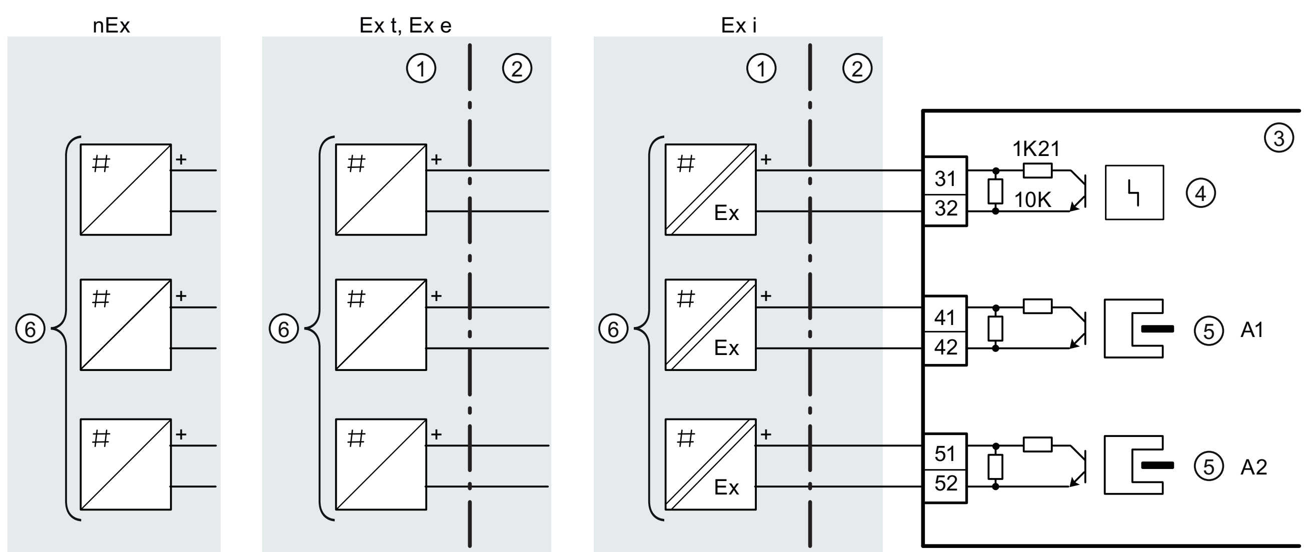
5.2.3.2 Position feedback modules 6DR4004-6J and -8J



① Non-hazardous area
② Hazardous area
③ Position feedback module
④ Feed splitter
⑤ Power source
nEx = Non-explosion-proof device version

Figure 5-8 Analog Output Module (AOM)

5.2.3.3 SIA modules 6DR4004-6G and -8G



① Non-hazardous area
② Hazardous area
③ SIA module
④ Fault message
⑤ Limit
⑥ Switching amplifier

nEx = Non-explosion-proof device version

Figure 5-9 SIA module

5.2.3.4 Mechanical limit switch modules 6DR4004-6K and -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

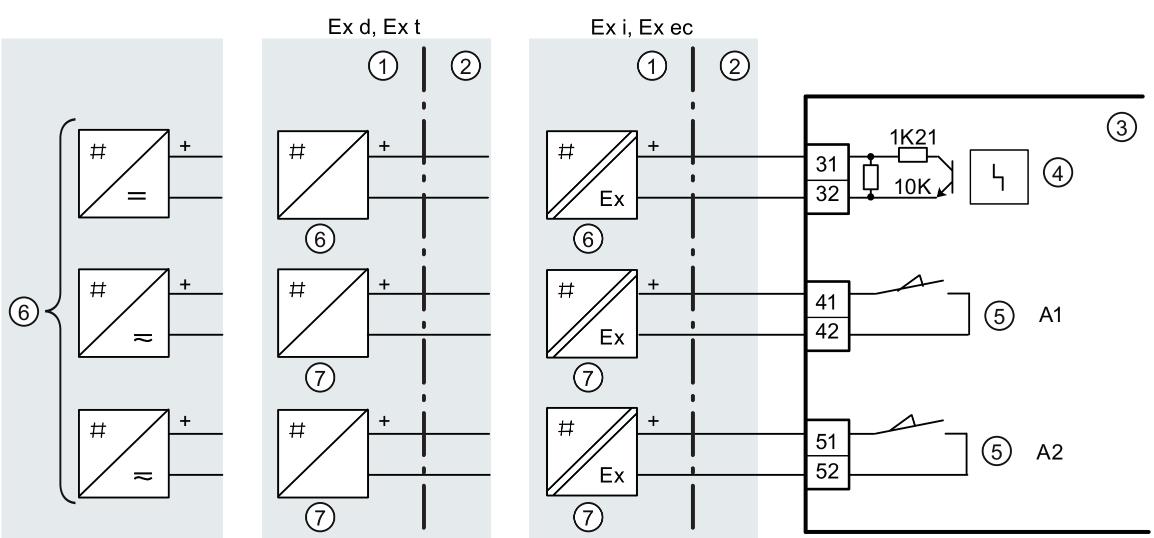
Maximum AC/DC switching voltage with UL approval E344532

The mechanical limit switch module 6DR4004-**6K** is approved for use for positioners with UL approval. The maximum supply voltage in this case is 30 V AC/DC.

The mechanical limit switch module 6DR4004-**8K** is not approved for use for positioners with UL approval.

If this information is ignored, the UL approval for the mechanical limit switch module for the positioner becomes invalid.

Connection diagram for mechanical limit switch modules 6DR4004-6K and -8K

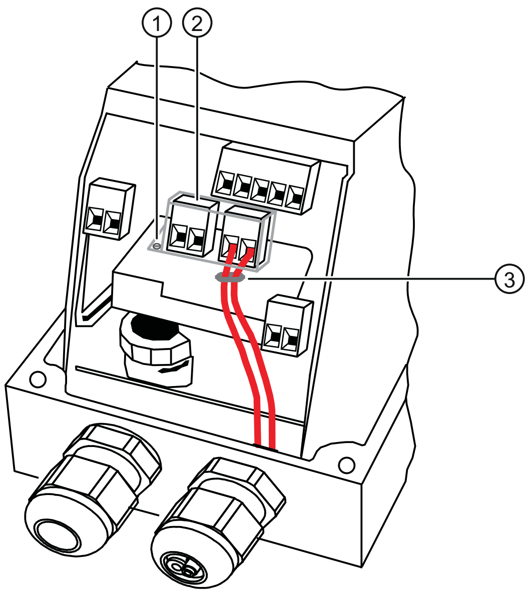


① Non-hazardous area
② Hazardous area
③ Mechanical limit switch module
④ Fault message
⑤ Limit
⑥ Switching amplifier
⑦ Switching output

Figure 5-10 Mechanical limit switch module

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.



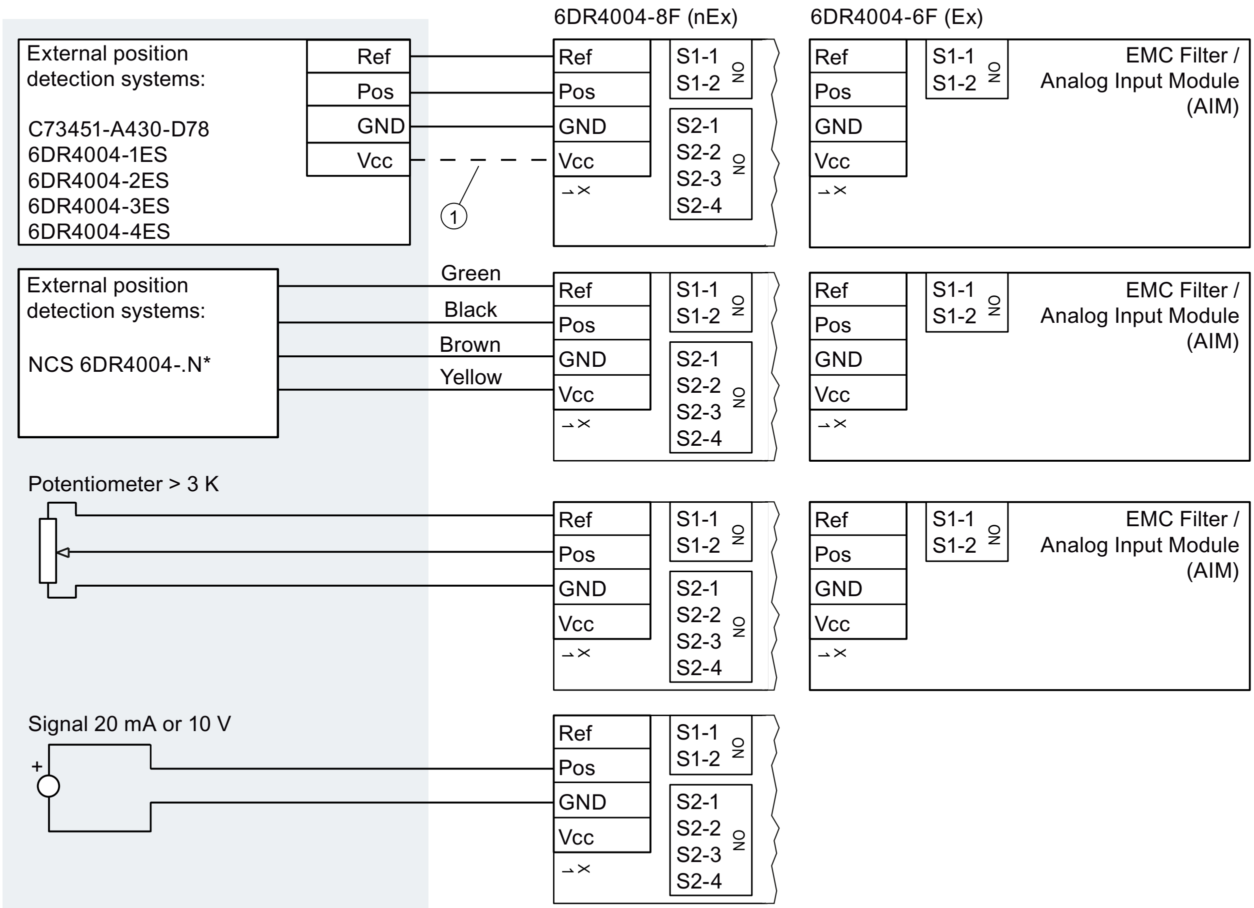
① Screw
② Cover
③ Cable tie

Figure 5-11 Connecting the cables

5.2.3.5 EMC filter module 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
C73451-A430-D78	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

Measuring range	Switch block 1			Switch block 2			
	S1-1	S1-2		S2-1	S2-2	S2-3	S2-4
20 mA	OFF	OFF		ON	OFF	ON	OFF
10 V	OFF	OFF		OFF	ON	OFF	OFF

See also

'1.YFCT' type of actuator (Page 145)

EMC filter module 6DR4004-6F/-8F (Page 69)

5.2.4 Option device version M12 connector

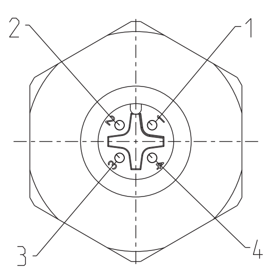
This section describes which terminal of the devices and option modules listed below is connected with the respective pole of the M12 connector.

Note

Technical specifications

Observe the specifications for the electrical data in the certificate and/or in section "Technical data (Page 237)".

View of the mating side pole pattern



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

5.2.4.1 M12 connector socket in the basic device

You have a positioner 6DR50/1..-0.**R**.. or 6DR50/1..-0.**S**. In this version of the positioner, the current input I_W 4 to 20 mA of the basic electronics is connected via the M12 connector.

Table 5-1 Assignment diagram

Current input terminal	Pole designation
6 (+)	1 - Brown
Shield support of housing	4 - Black
7 and 8 (-)	3 - Blue

5.2.4.2 M12 connector for connecting the position feedback module 6DR4004-6J / 8J (-Z D53)

You have a positioner with order suffix -Z order code D53. In this version of the positioner, the M12 connector is used to electrically connect the current output of the position feedback module.

Table 5-2 Assignment diagram

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

5.2.4.3 M12 connector for connecting the external position detection system (-Z D54)

You have a positioner with order suffix -Z order code D54. In this version of the positioner, the M12 connector is used to electrically connect the fitted EMC filter module (6DR4004-6F). Connect the external position detection system using the M12 connector.

Table 5-3 Assignment diagram

Terminal	Pole designation
POS (X1/2)	3 - Blue
VCC (X1/4)	1 - Brown
GND (X1/1)	4 - Black
VREF (X1/3)	2 - White

5.2.4.4 M12 connector for connecting the alarm module 6DR4004-6A / -8A (-Z D55)

You have a positioner with order suffix -Z order code D55. In this version of the positioner, the M12 connector is used to electrically connect the current output of the position feedback module.

Table 5-4 Assignment diagram

Alarm output terminal	Pole designation
41 (+)	1 - Brown
52 (-)	4 - Black
42 (-)	3 - Blue
51 (+)	2 - White

5.2.4.5 M12 connector for connecting the SIA module 6DR4004-6G /-8G (-Z D56)

You have a positioner with order suffix -Z order code D56. In this version of the positioner, the M12 connector is used to electrically connect the outputs of the SIA module.

Table 5-5 Assignment diagram

Alarm output terminal	Pole designation
41 (+)	1 - Brown
52 (-)	4 - Black
42 (-)	3 - Blue
51 (+)	2 - White

5.2.4.6 M12 connector for connecting the mechanical limit switch module 6DR4004-6K (-Z D57)

You have a positioner with order suffix -Z order code D57. In this version of the positioner, the M12 connector is used to electrically connect the outputs of the mechanical limit switch module.

Table 5-6 Assignment diagram

Alarm output terminal	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

Pneumatic auxiliary power

For safety reasons, the pneumatic auxiliary power supply 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, see section "Technical specifications > Pneumatic data (Page 237)".

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

See also

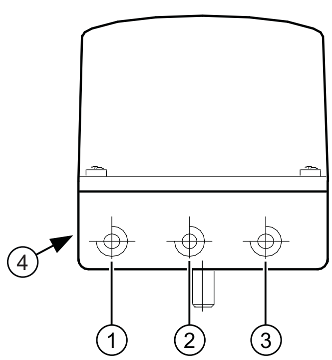
Reaction to failure of auxiliary powers (Page 91)

Changing the operating mode (Page 96)

Diagnostic value '11.LEAK - Leakage test' (Page 203)

5.3.2 Pneumatic connection for 6DR5..0/1/2/3

5.3.2.1 Structure of pneumatic connection



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

*) for double-acting actuators

Figure 5-12 Pneumatic connection, example

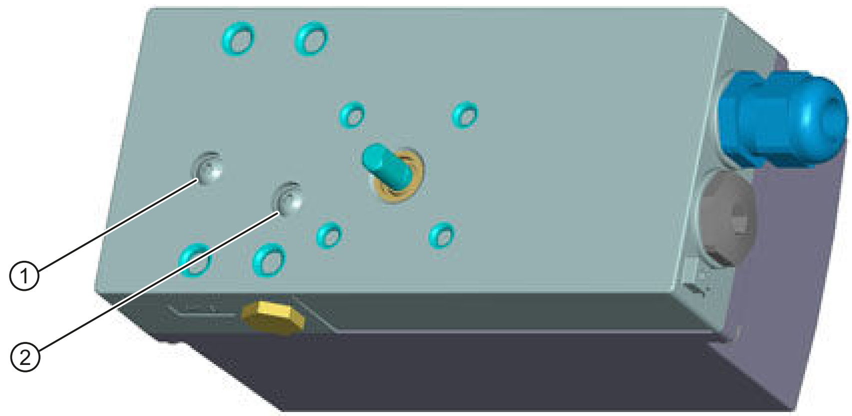
5.3.2.2 Integrated pneumatic connection

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.



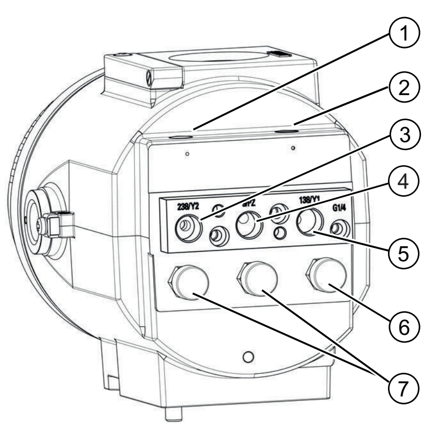
① Actuating pressure Y1
② Exhaust air outlet

Figure 5-13 Integrated pneumatic connection

5.3.3 Pneumatic connection for 6DR5..5/6

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 air PZ
⑤ Output: Actuating pressure Y1
⑦ Enclosure ventilation (2x)
⑥ Exhaust air outlet

*) for double-acting actuators

Figure 5-14 Pneumatic connection in the flameproof enclosure

5.3.4 Reaction to failure of auxiliary powers

Overview

The following overview diagram shows the pneumatic connection versions for different actuator types, regulating action and safety position after an auxiliary power supply failure.

CAUTION

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 control valve has reached the safety position. If you only interrupt the pneumatic auxiliary power supply to the positioner, the safety position may in some cases only be attained after a certain delay period.

The difference between a failure of auxiliary pneumatic power and a failure of electrical auxiliary power:

- Failure of **electrical auxiliary power** means:
  - Device version 2-wire: Failure of signal source 4 to 20 mA
  - Device version 3-wire/4-wire: Failure of power source 18 to 30 V
- Failure of **auxiliary pneumatic power** means the supply air PZ is interrupted.

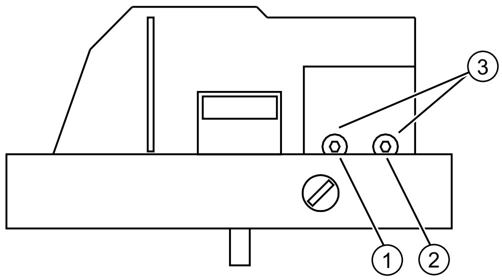
With 3-wire/4-wire device version, the position 0% is approached if the signal source 0/4 to 20 mA fails.

Actuator type	**Response to failure of auxiliary power: The actuator moves into safety position**		**Fail in place, order suffix F01**	
	Failure of electrical auxiliary power	**Failure of pneumatic auxiliary power**	**Failure of electrical auxiliary power**	**Failure of pneumatic auxiliary power**
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 5-15 Restrictors

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

See also

Pneumatic connection for 6DR5..5/6 (Page 90)

Sequence of automatic initialization (Page 107)

Operating

6

6.1 Operating elements

6.1.1 Display

Introduction

Note

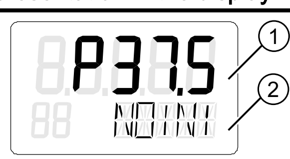
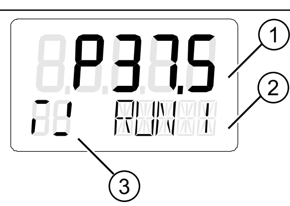
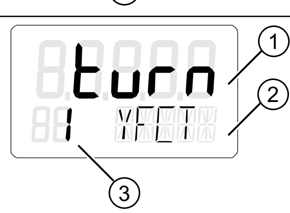
Repetition rate display

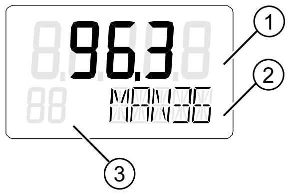
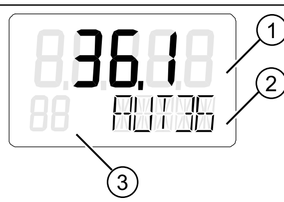
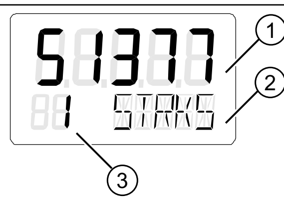
When operated in temperature ranges below -10°C, the liquid crystal display of the positioner becomes sluggish and the repetition rate display reduces considerably.

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

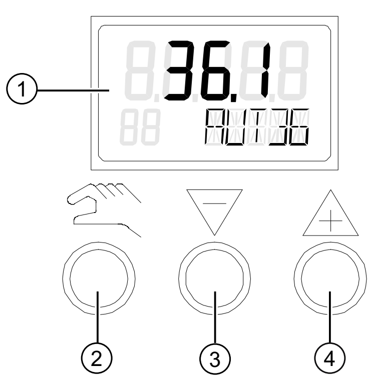
Operating mode	Representation in the display	Pos.	Legend
Manual mode (MAN)		①	Position [%]
		②	Setpoint [%]
		③	Fault message
Automatic (AUT)		①	Position [%]
		②	Setpoint [%]
		③	Fault message
Diagnostics		①	Diagnostics value
		②	Diagnostics name
		③	Diagnostics number

See also

System messages before initialization (Page 193)

Changing the operating mode (Page 96)

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 cover. The button cover can be opened after unlatching the locking screw.

  Note

  Button cover

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

You have to remove the enclosure cover 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 operating mode "Configuration".

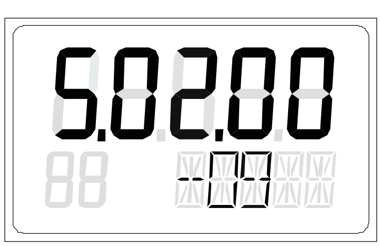


Figure 6-2 Firmware version, example

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.

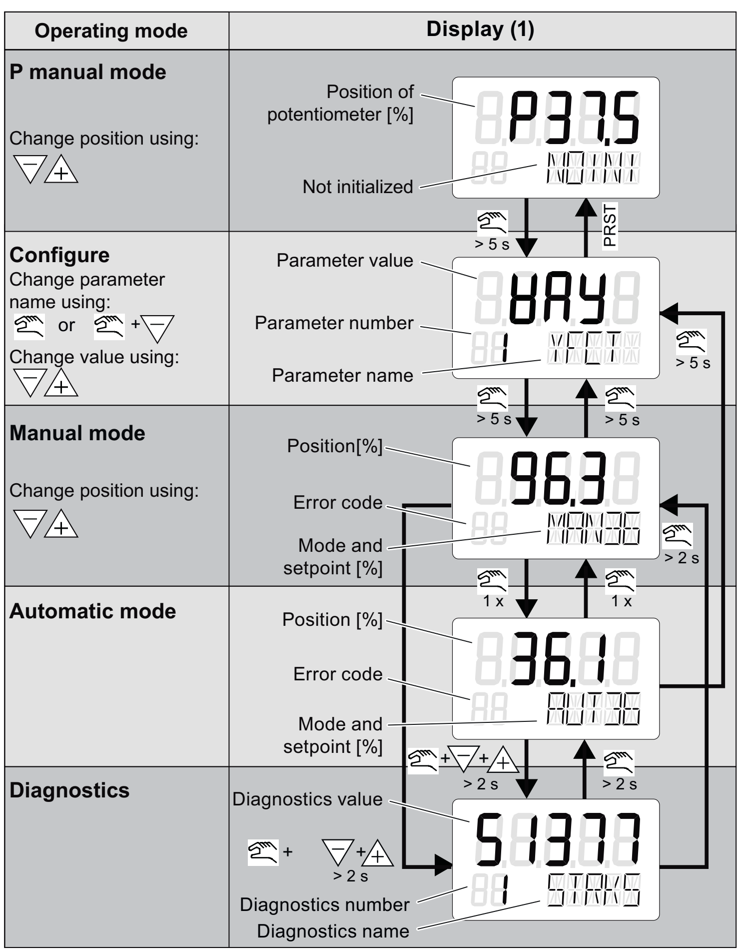


Figure 6-3 Switching between the operating modes

See also

Display (Page 93)

6.2.3 Overview of configuration

The following picture illustrates the handling of operating modes such as "Configuration" and "Initialization mode":

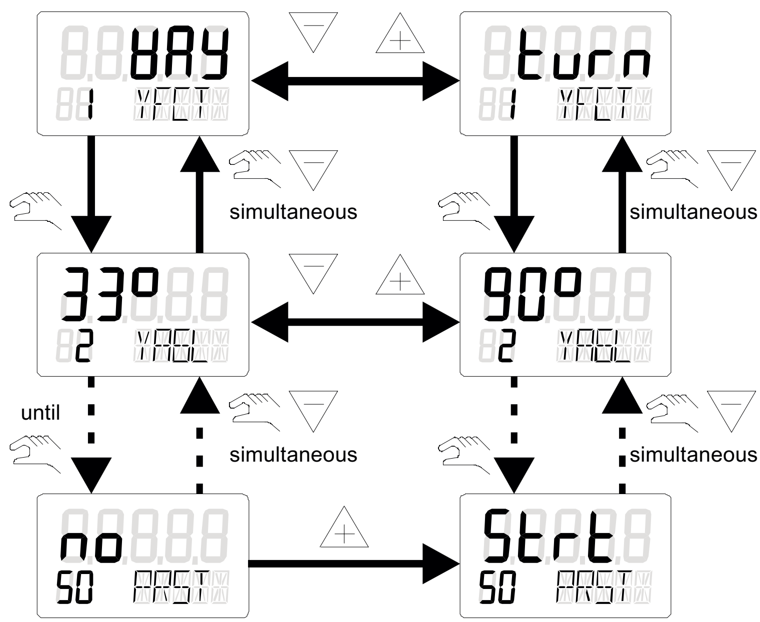


Figure 6-4 Overview of the "Configuration" operating mode

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" blinks 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 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 setting selected here is retained irrespective of the setpoint current and leakages, if any.

Note

Accelerating the actuator movement

Proceed as follows if you wish to accelerate the actuator movement:

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

Note

Failure of power supply

When the power supply is reestablished after a failure, the positioner switches to the "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. An error message is displayed if the deadband cannot be reached.

Diagnostics

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

Press the three buttons of the positioner at the same time 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.

See also

Overview (Page 105)

Overview of advanced diagnostic parameters A to U (Page 141)

Overview of diagnostics values (Page 199)

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 305)"

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 "Mode of operation (Page 28)".

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 data (Page 237). • Before commissioning take the effect on other devices in the system into account.

⚠ 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 and mounting (Page 35).

⚠ 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

Loss of type of protection

Damage to device if the enclosure is open or not properly closed. The type of protection specified on the nameplate or in Technical data (Page 237) is no longer guaranteed.

- Make sure that the device is securely closed.

⚠ 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.

⚠ 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 247)".
4. The mechanical limit switch module must not be used when operating the positioner with natural gas.
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.

You can use a suitably configured and activated binary input to protect the configured settings against accidental adjustment.

See also

Overview of operating modes (Page 96)

7.3 Sequence of automatic initialization

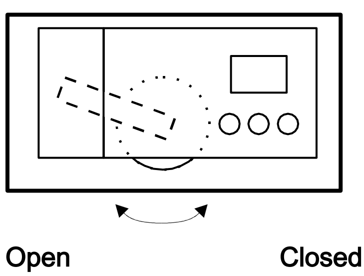
Overview

The automatic initialization takes place in the following phases:

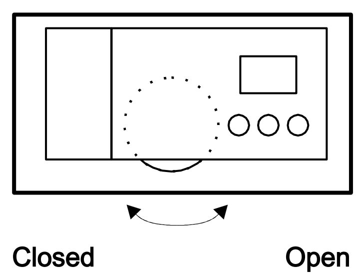
Automatic initialization phase	Description
Start	-
RUN 1	Establishing the direction of action.
RUN 2	Checking the actuator travel and trimming the lower and upper endstops.
RUN 3	Establishing and displaying the travel time (leakage test)
RUN 4	Minimization of controller increments
RUN 5	Optimization of the transient response
End	-

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

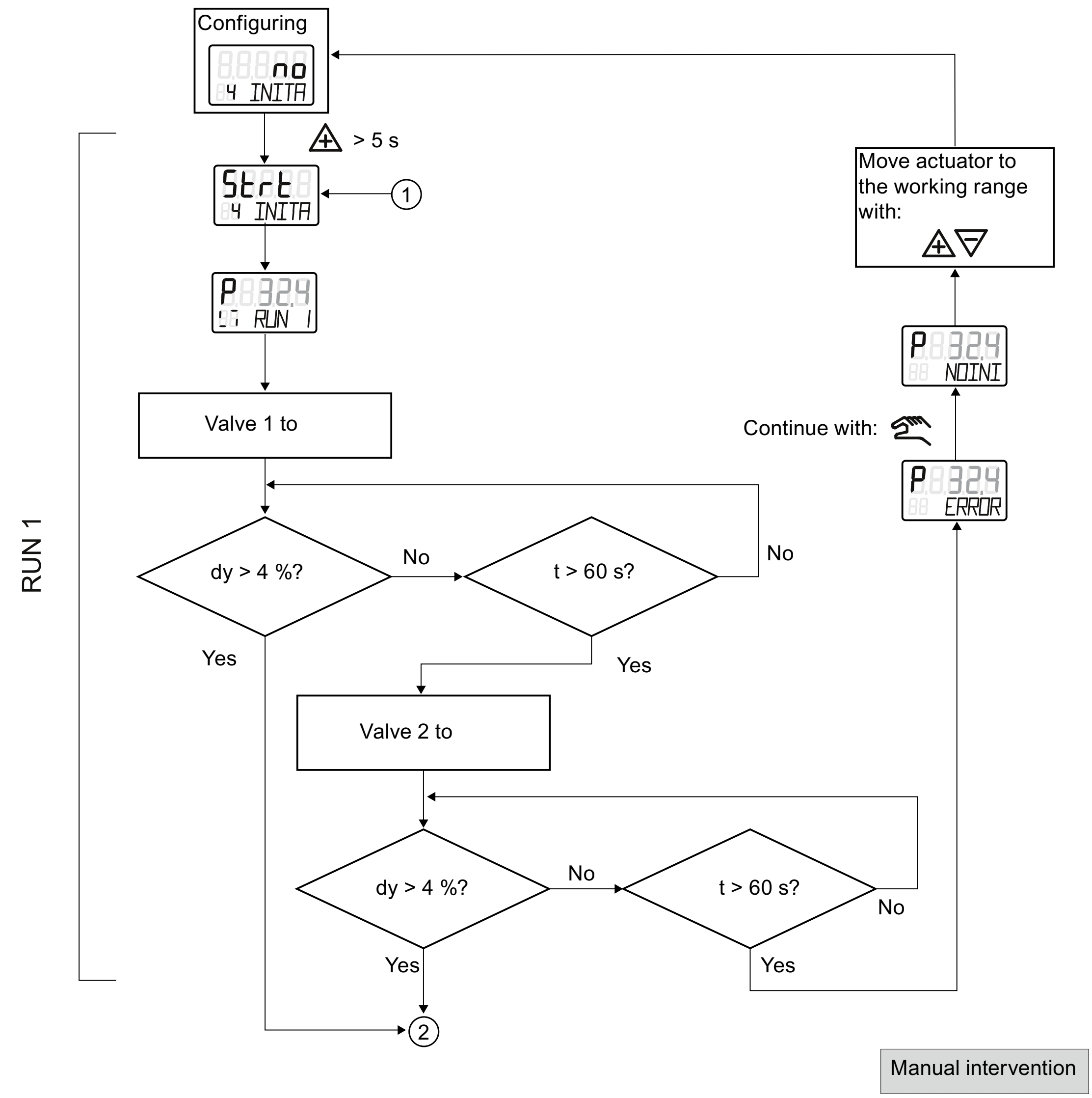
Linear actuator



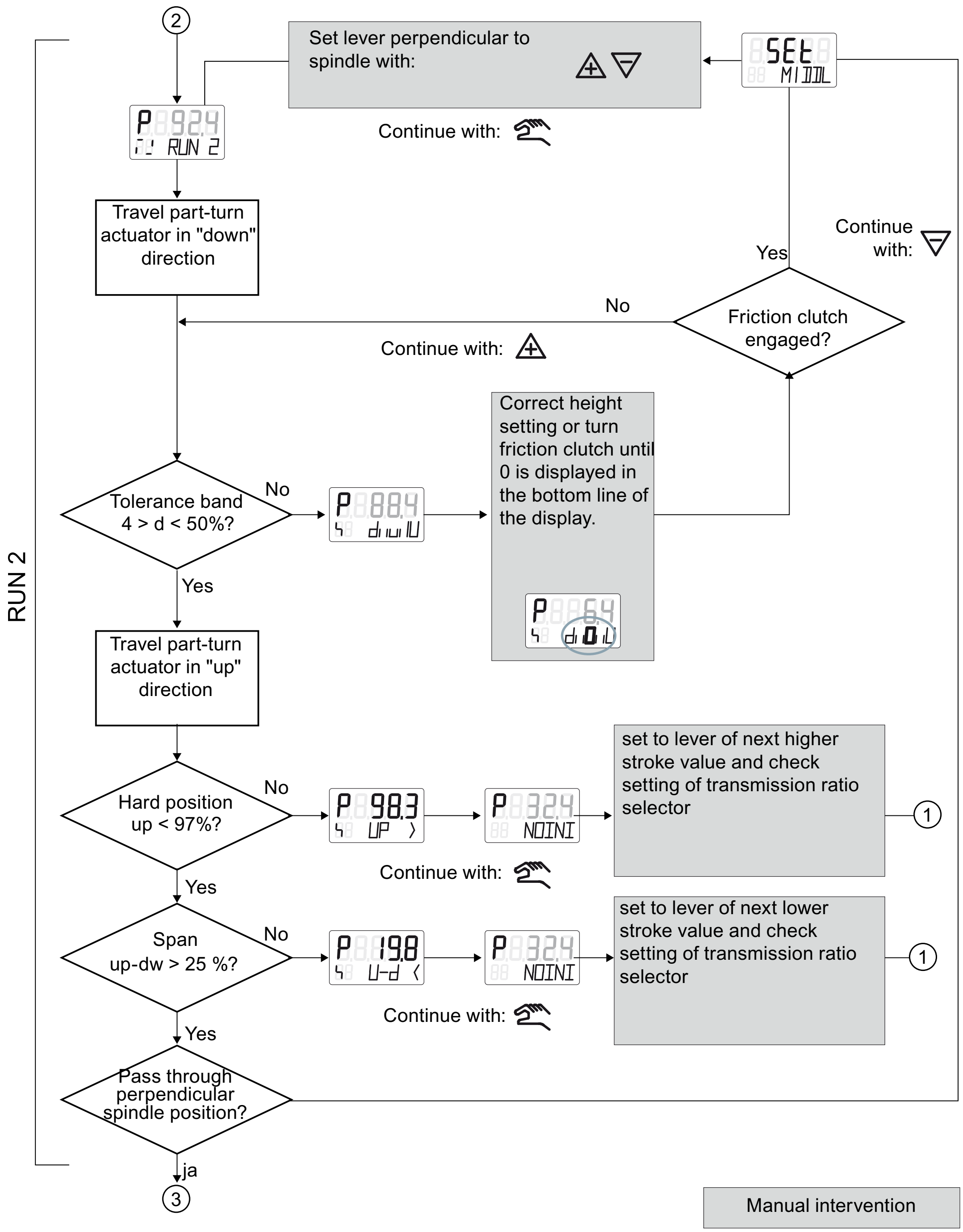
Part-turn actuator



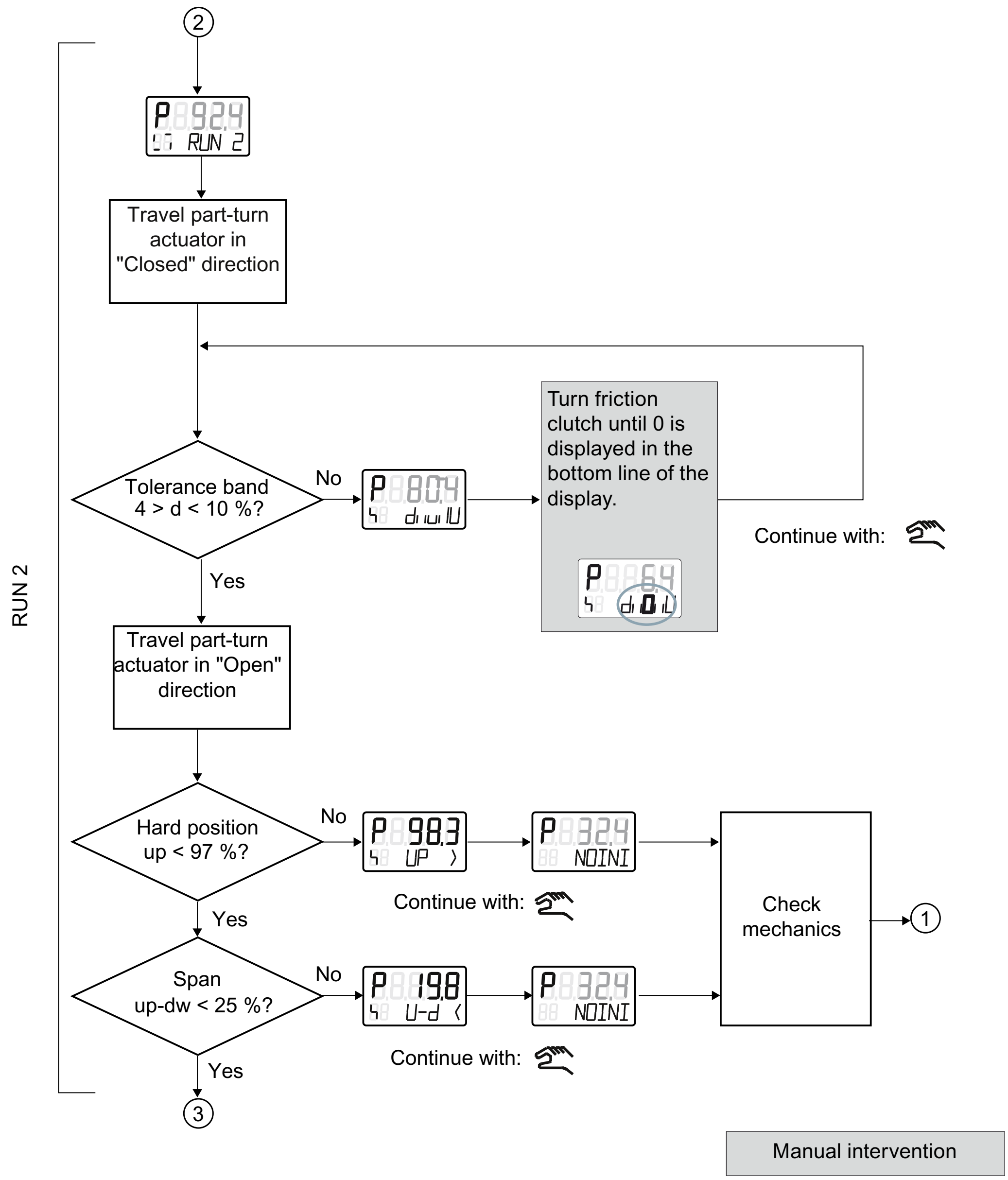
This structured chart describes the process to establish the direction of action.



This structured chart describes the process to determine the actuator travel checks. It also contains information about the sequence for trimming the lower and upper endstops.

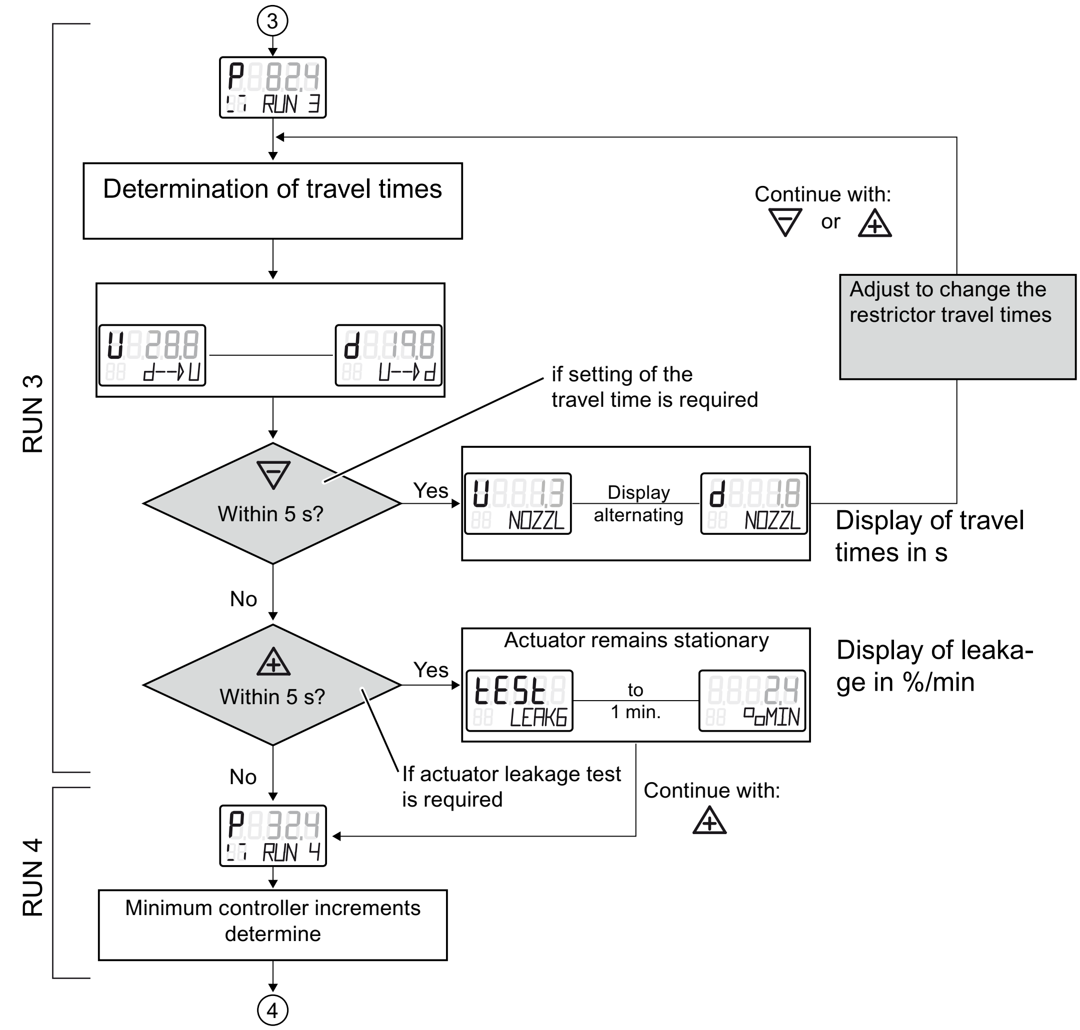


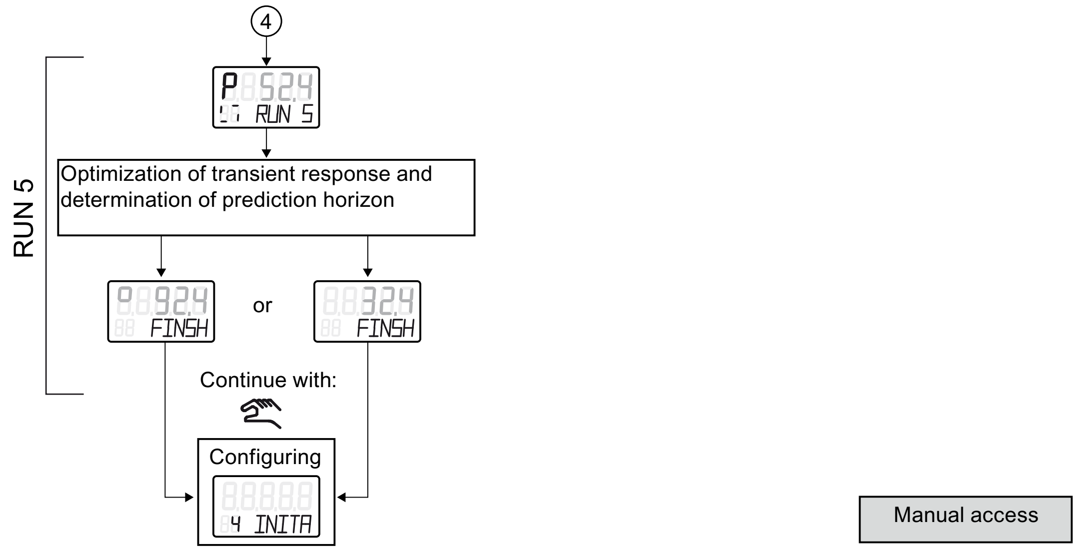
This structured chart describes the sequence for checking the actuator travel. It also contains information about the sequence for trimming the lower and upper endstops.



This structured chart describes:

- Establishing and displaying the travel time/leakage in RUN 3
- Minimization of controller increments in RUN 4
- Optimization of the transient response in RUN 5




4
P 52.4
RUN 5
RUN 5
Optimization of transient response and determination of prediction horizon
P 92.4
FINSH
or
32.4
FINSH
Continue with:
Configuring
4 INITA
Manual access

7.4 Setting the friction clutch

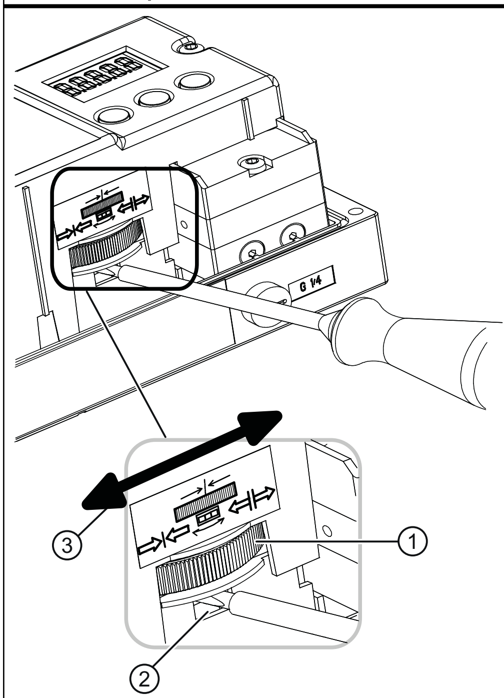
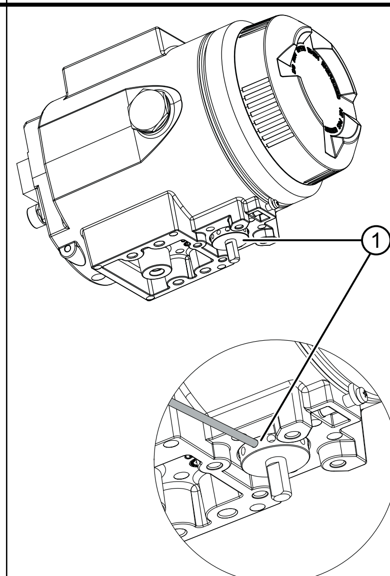
Introduction

It has a friction clutch and a switchable gear (Page 47) 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.

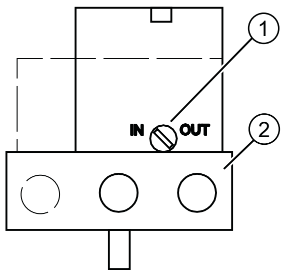
Procedure

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. With the positioner in the flameproof enclosure, the friction clutch is on the outside of the device. Attach a pin to the friction clutch ①. 2. Adjust the working area to your application by turning the adjustment wheel of the friction clutch ①. **Note:** • It is not possible to lock the friction clutch. • Do not open the screws on the friction clutch.

7.5 Purge air switching

When the enclosure is open, the purge air switch above the pneumatic terminal strip 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 Purge air switch on the pneumatic block; view of the positioner on the pneumatic connection side when the cover is open

The factory setting is the "IN" position.

7.6 Commissioning linear actuators

7.6.1 Preparing linear actuators for commissioning

Requirements

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

Setting the transmission ratio selector

Note

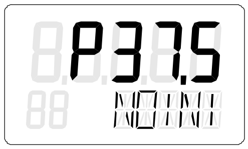
Commissioning

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

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

Connecting the positioner

1. Connect a suitable current or voltage source. 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 pneumatic auxiliary power to the positioner.

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. This means you should only adjust the adjustment wheel of the magnet clamp; see section "Internal NCS module (iNCS) 6DR4004-5L/-5LE (Page 66)". Requirement: The '1.YFCT' type of actuator (Page 145) parameter is set.

See also

Mounting to linear actuator (Page 39)

Opening the device version with "flameproof enclosure" (Page 53)

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 moving.

Initializing the linear actuator automatically

Note

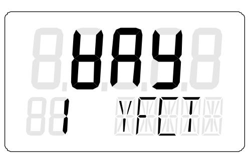
Interrupting initialization

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.

---

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

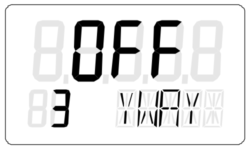


2. Call the "2.YAGL" parameter. To do this, press . The following is shown on the display depending on the setting:

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 only at the end of the initialization phase.
   - 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, press . The display shows the following:



Note

Set the "3.YWAY" parameter

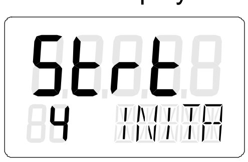
Proceed as follows to set parameter 3:

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 five initialization steps during the automatic initialization process. Displays for the initialization steps from "RUN 1" to "RUN 5" are shown in the lower line on the display. The initialization process depends on the actuator used, and takes up to 15 minutes.

7. The following display indicates that the automatic initialization is complete:

See also

Sequence of automatic initialization (Page 107)

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.

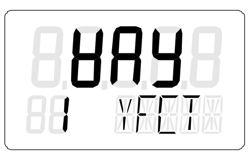
Requirements

The following requirements 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:

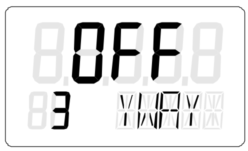


2. Call the "2.YAGL" parameter. To do this, briefly press the button. The following is shown on the display depending on the setting:

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

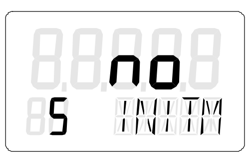
Set the "3.YWAY" parameter

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" 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

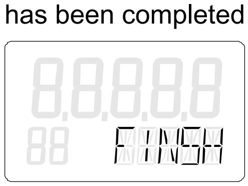
Fault message "Set Middl"

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°.

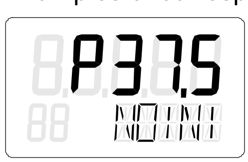
Requirements

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. Pneumatic auxiliary power is supplied to the positioner.
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

Requirements

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

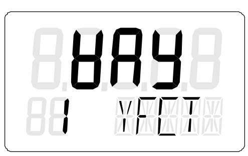
Interrupting initialization

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.

---

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:

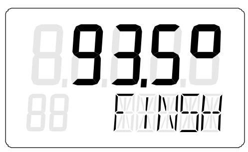
3. Call the "2.YAGL" parameter. To do this, briefly press the button. This parameter has already been set to 90° automatically. The display shows the following:

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 five initialization steps during the automatic initialization process. Displays for the initialization steps from "RUN 1" to "RUN 5" are shown in the lower line on the display. The initialization process depends on the actuator used, and takes up to 15 minutes.

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



See also

Sequence of automatic initialization (Page 107)

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.

Requirements

The following requirements 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".

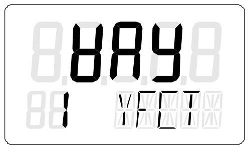
Note

Setting of the adjustment angle

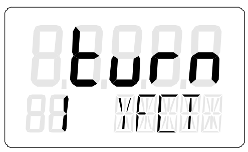
The usual adjustment angle for part-turn actuators is 90°. Accordingly set the transmission ratio selector in the positioner to 90°.

Initializing the positioner manually

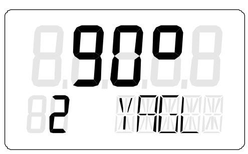
1. Switch to the "Configuration" mode. To do this, press the button for at least 5 seconds until the display shows the following:



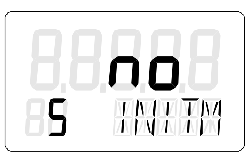
2. Set the "YFCT" parameter to "turn". To do this, press . The display shows the following:



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

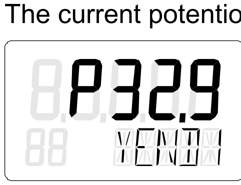


4. Call the "INITM" parameter. To do this, press the button twice. The display shows the following:



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 ongoing processes. 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 end stops
- 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 the parameter assignment tools suitable for this purpose.
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. 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 is defective, measure the actual position value with a ruler or protractor at the actuator or 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 97)".
11. Release the fixing of the actuator.

See also

Sequence of automatic initialization (Page 107)

Automatic initialization of linear actuators (Page 116)

Automatic initialization of part-turn actuators (Page 122)

Manual initialization of linear actuators (Page 118)

Manual initialization of part-turn actuators (Page 123)

8 Functional safety

8.1 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 valve actuator on demand or in case of faults, which thus switches the valve to the specified safety position.

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)

8.2 Safety function

Depressurizing of the connected actuator is the safety function for the SIPART PS2 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.

The positioner starts the depressurizing process of the connected pneumatic actuator at the latest 100 ms after the request. The progress of the depressurizing process depends on the connections and properties of the pneumatic actuator.

This safety function can be triggered by:

- With 2-wire connection: a signal source with 0 mA.
- With 3/4-wire connection: a power supply source with 0 V.

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

Disregard can result in a malfunction of the process plant or application, e.g. process pressure too high, maximum level exceeded.

The mandatory settings and conditions are listed in sections "Settings (Page 132)" and "Safety characteristics (Page 133)".

- These conditions must be met in order to fulfill the safety function.

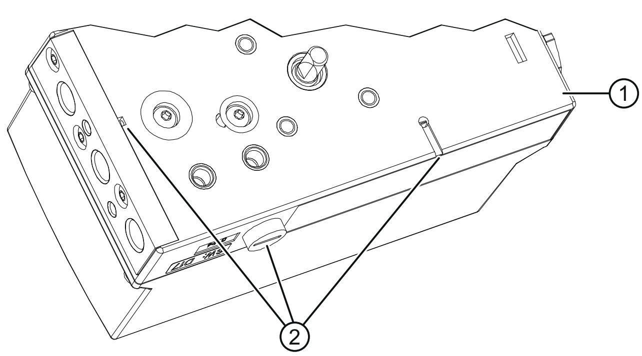
The pneumatic block of the positioner pressurizes and depressurizes the actuator. The pneumatic block contains two pilot valves. The characteristic service life of the pneumatic block depends on the load. On average it is approx. 200 million switching cycles for each of the two pilot valves with symmetrical load. The number of control procedures for the switching cycles is called in the local display or via HART communication. For more details, see Diagnostic value '42.VENT1' / '43.VENT2' (Page 212).

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 8-1 Exhaust air outlets, base plate

Safety-instrumented system in single-channel operation (SIL 2)

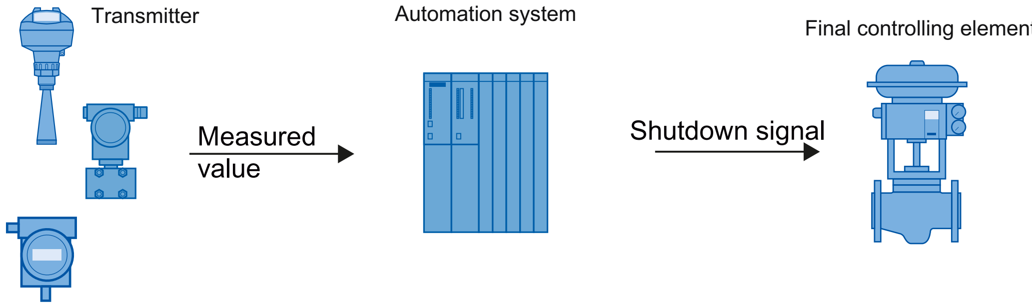


Figure 8-2 Safety-instrumented system in single-channel operation

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 exceeds the range of the high or low limit, the automation system generates a shutdown signal for the connected final controlling element, which switches the associated valve to the specified safety position.

8.3 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.

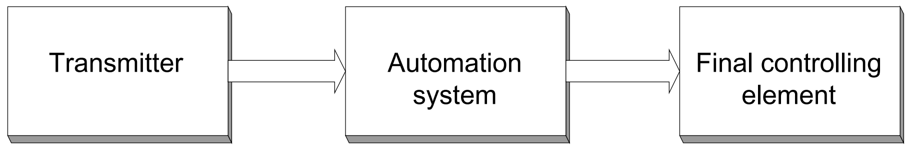
Description

The following table shows the dependency of the SIL on the "average probability of dangerous failures of a safety function of the entire safety-instrumented system" (PFD_{AVG}). The table deals with "Low demand mode", i.e. the safety function is required a maximum of once per year on average.

Table 8-1 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 failures of the entire safety-instrumented system" (PFD_{AVG}) is normally split between the following three components:



PFDAVG-Part < 35 % < 15 % < 50%

Figure 8-3 PFD distribution

The following table shows the achievable Safety Integrity Level (SIL) for the entire safety-instrumented 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 shut-off 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 (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

8.4 Settings

No special parameter settings are required for the safety function.

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

- On the positioner, switch the signal source to 0 mA or the power supply source to 0 V.
- Reduce the inlet pressure (PZ) to a third of the maximum supply pressure.
- Always carry out the validation of the safety function with positioner and valve under operating conditions.

Result

The actuator brings the valve to the specified safety position.

See also

Safety function (Page 129)

8.5 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".
- The positioner is blocked against unwanted and unauthorized changes/operation.
- The signal source with 0 mA or the power supply source with 0 V for the SIPART PS2 positioner is generated by a safe system that fulfills SIL 2 for single-channel operation.
- The connected single-acting type actuator returns the valve to the safe end position by spring force in the following scenarios:
  - With a chamber pressure (Y1 connection) up to a third of the maximum available supply air pressure (PZ 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 a failure whereby the pressure outlet is not depressurized or the safety position is not reached when the signal source is 0 mA or the power supply source is 0 V.

See also

Settings (Page 132)

8.6 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 "Settings (Page 132)"

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}).

Parameter assignment 9

9.1 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 the extended diagnostics parameters.

- Initialization parameters 1 to 5 (Page 145): Describes die parameters which are relevant for initial commissioning of the positioner on the valve. For example, you can start the automatic initialization here.
- Application parameters 6 to 52 (Page 149): Describes die parameters with which the positioner is adapted to the valve application, for example tight closing at the end stops.
- Advanced diagnostic parameters A to U (Page 166): Describes the diagnostics functions which are provided by the positioner. These include monitoring of leakages 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 198).

The following configuration schematic shows the principle of operation of the parameters. This is followed by a tabular overview of the parameters. Finally, the individual parameters and their functionality are described.

Furthermore, the positioners with HART, PA and FF communication interface in combination with a host system, e.g. SIMATIC PDM or HART communicator etc., offer the following advantages:

- Offline tests such as full stroke test, step response test, multi-step response test and valve performance test.
- Diagnostics cockpit which provides an overview of the state of positioner and valve.
- Logbook with time stamp for documentation of all events such as the violation of thresholds.
- Wizards which provide prompting through the relevant parameters during commissioning, the partial stroke test as well as the offline test.

9.2 Configuration schematic for parameter operating principle

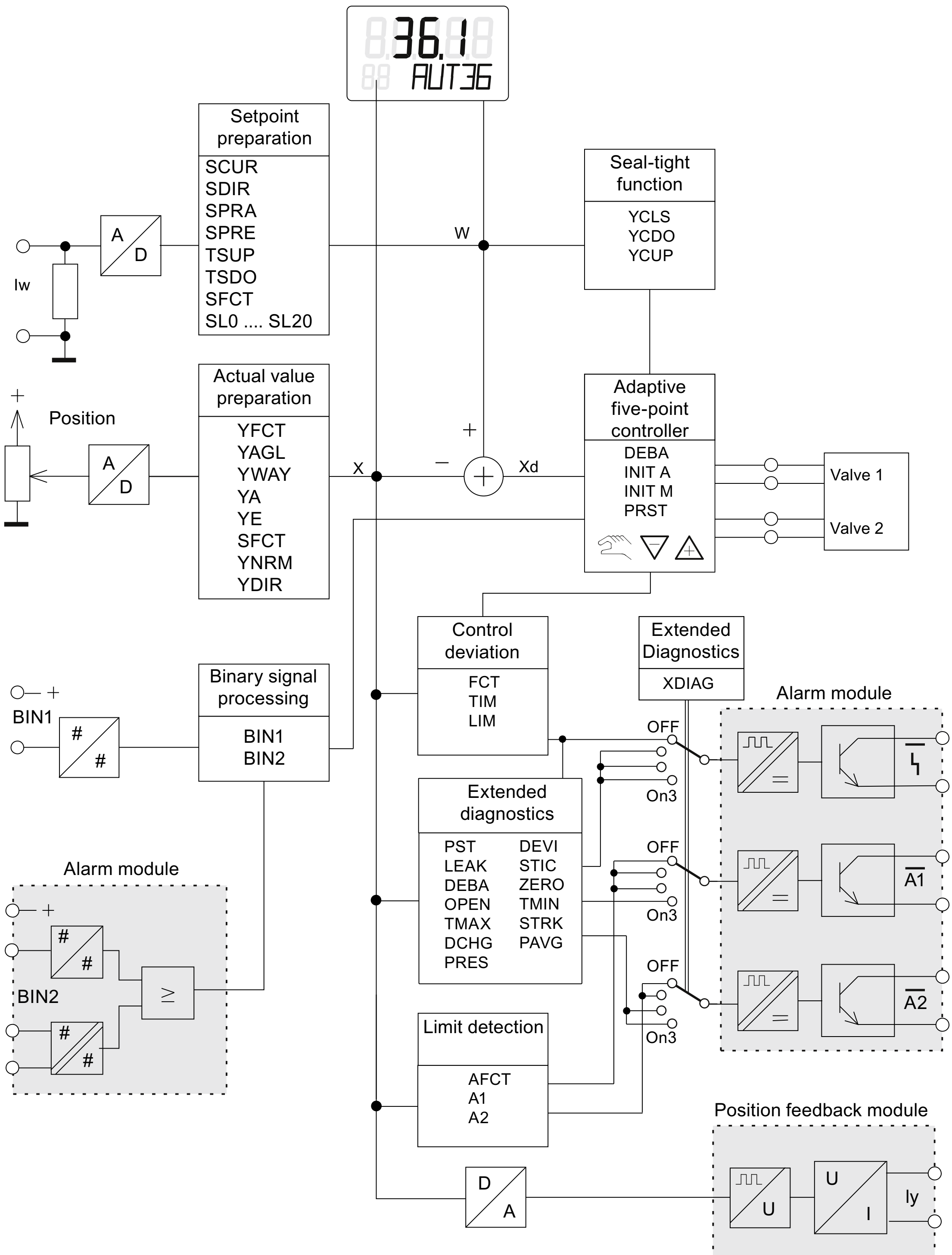


Figure 9-1 Configuration block schematic

9.3 Tabular overview of the parameters

9.3.1 Overview of initialization parameters 1 to 5

Introduction

Parameters 1 to 5 are the same for all versions of the positioner. These parameters are used to adjust the positioner to the actuator. Normally, setting these parameters is sufficient to be able to operate the positioner on an actuator.

If you want to get to know all details of the positioner, gradually try out the effects of the remaining parameters by systematic testing.

Note

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

Overview

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		

1)	Set the 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 larger scale value.

9.3.2 Overview of application parameters 6 to 52

Introduction

These parameters are used to configure the following additional functions of the positioner:

- Setpoint preparation
- Actual value preparation
- Binary signal processing
- Tight closing function
- Limit detection

Note

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

Overview

Parameter	Function		Parameter values	Unit
6.SCUR	Current range of setpoint			
		0 ... 20 mA	0 MA	
		4 ... 20 mA	**4 MA**	
7.SDIR	Setpoint direction			
		Rising	**riSE**	
		Falling	FALL	
8.SPRA	Setpoint split range start		**0.0** ... 100.0	%
9.SPRE	Setpoint split range end		0.0 ... **100.0**	%
10.TSUP	Setpoint ramp up		Auto / **0** ... 400	s
11.TSDO	Setpoint ramp down		**0** ... 400	s

Parameter	Function			Parameter values	Unit
12.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	
13.SL0 ... 33.SL20 [1)]	Setpoint turning point				
13.SL0	At	0 %		0.0 ... 100.0	%
14.SL1		5 % ...			
32.SL19		95 %			
33.SL20		100 %			
34.DEBA	Deadband of closed-loop controller			**Auto** / 0.1 ... 10.0	%
35.YA	Start of manipulated variable limit			**0.0** ... 100.0	%
36.YE	End of manipulated variable limit			0.0 ... **100.0**	%
37.YNRM	Standardization of manipulated variable				
		To mechanical travel		**MPOS**	
		To flow		FLoW	
38.YDIR	Direction of action of manipulated variable for display and position feedback				
		Rising		**riSE**	
		Falling		FALL	
39.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	
40.YCDO	Value for fast closing/tight closing Down			0.0 ... **0.5** ... 100.0	%
41.YCUP	Value for fast closing/tight closing Up			0.0 ... **99.5** ... 100.0	%

Parameter	Function		Parameter values		Unit
42.BIN1 [2)]	Function binary input 1		NO contact	NC contact	
		None	**OFF**		
		Message only	on	-on	
		Block configuration	bLoc1		
		Block configuring and manual operation	bLoc2		
		Move valve to position YE	uP	-uP	
		Move valve to position YA	doWn	-doWn	
		Block movement	StoP	-StoP	
		Partial stroke test	PSt	-PSt	
43.BIN2 [2)]	Function binary input 2		NO contact	NC contact	
		None	**OFF**		
		Message only	on	-on	
		Move valve to position YE	uP	-uP	
		Move valve to position YA	doWn	-doWn	
		Block movement	StoP	-StoP	
		Partial stroke test	PSt	-PSt	
44.AFCT [3)]	Alarm function		Normal	Inverted	
		None	OFF		
		A1 = Min, A2 = Max	Mi MA	-Mi -MA	
		A1 = Min, A2 = Min	Mi Mi	-Mi -Mi	
		A1 = Max, A2 = Max	MA MA	-MA -MA	
45.A1	Response threshold, alarm 1		0.0 ... **10.0** ... 100.0		%
46.A2	Response threshold, alarm 2		0.0 ... **90.0** ... 100.0		%
47. ϟFCT [3)]	Function for fault message output		Normal	Inverted	
		Fault	ϟ	-ϟ	
		Fault + not automatic [4)]	ϟnA	-ϟnA	
		Fault + not automatic + BIN [4)]	ϟnAb	-ϟnAb	
48. ϟTIM	Monitoring time for setting of fault message 'Control deviation'		**Auto** / 0 ... 100		s
49. ϟLIM	Response threshold of fault message 'Control deviation'		**Auto** / 0 ... 100		%

Parameter	Function	Parameter values	Unit
50.PRST	Preset		
	Reset all parameters which can be reset by 'Init', 'PArA' and 'diAg'.	**ALL**	
	Reset initialization parameters '1.YFCT' to '5.INITM'.	Init	
	Reset parameters '6.SCUR' to '49.└LIM'.	PArA	
	Reset parameters A to P of the extended diagnostics function as well as parameter '52.XDIAG'.	diAg	
51.PNEUM	Pneumatics type		
	Standard pneumatic block	**Std**	
	Fail in place pneumatic block	FIP	
	Operation with boosters	booSt	
52.XDIAG	Activation of extended diagnostics		
	Off	**OFF**	
	Single stage message	On1	
	Two stage message	On2	
	Three stage message	On3	

1) Setpoint turning points only appear when '12.SFCT = FrEE' is selected.

2) 'Normally closed' means: Operation when a switch is open or Low level
'Normally open' means: Action on switch closed or High level

3) 'Normal' means: High level, no fault message
'Inverted' means: Low level, no fault message

4) '+' means: Logical OR combination

9.3.3 Overview of advanced diagnostic parameters A to U

Introduction

These parameters are used to set the extended diagnostics functions of the positioner.

Note

Factory setting

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

Note

Display

Parameters A to U and their sub-parameters are only displayed when the extended diagnostics has been activated in parameter "52.XDIAG (Page 165)" with setting "On1", "On2" or "On3".

Overview parameter A

Parameter		Function	Parameter values	Unit
A.ߚPST		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 PST	**Auto** / HOLd / AirIn / AirOu	
	A8.INTRV	Test interval	**OFF** / 1 ... 365	Days
	A9.PSTIN	Reference stroke time for partial stroke test	**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	

Overview parameter b

Parameter		Function	Parameter values	Unit
b.ߚDEVI		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	

Overview parameter C

Parameter		Function	Parameter values	Unit
C.ߚLEAK		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	

Overview parameter d

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	

Overview parameter E

Parameter	Function	Parameter values	Unit
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.

Overview parameter F

Parameter	Function	Parameter values	Unit
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	

Overview parameter G

Parameter	Function	Parameter values	Unit
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	

Overview parameter H

Parameter	Function	Parameter values		Unit
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 ... 194	
H3.LEVL2	Threshold 2	-40 ... **-30** ... 90	-40 ... 194	
H4.LEVL3	Threshold 3	**-40** ... 90	-40 ... 194	

Overview parameter J

Parameter		Function	Parameter values		Unit
J.ϟTMAX		Monitoring of upper limit temperature with the following parameters:			
	J1.TUNIT	Temperature unit	**°C**	°F	°C/°F
	J2.LEVL1	Threshold 1	-40 ... **75** ... 90	-40 ... 194	
	J3.LEVL2	Threshold 2	-40 ... **80** ... 90	-40 ... 194	
	J4.LEVL3	Threshold 3	-40 ... **90**	-40 ... 194	

Overview parameter L

Parameter		Function	Parameter values	Unit
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	

Overview parameter O

Parameter		Function	Parameter values	Unit
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	

Overview parameter P

Parameter		Function	Parameter values	Unit
P.ϟPAVG		Monitoring of position average value with the following parameters:		
	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	%

Overview parameter U

Parameter	Function	Parameter values	Unit
U.ϟPRES	Activate pressure monitoring		
U1.PUNIT	Pressure unit	**bar** / psi / MPa	
U2.PZLIM	Low limit of the supply pressure (PZLIM)	**1.4** ...7.0	bar
		20.30 ... 101.52	psi
		0.140 ... 0.700	MPa
U3.PZHYS	Hysteresis of the low limit of the supply pressure	**0.2** ... 1.0	bar
		2.90 ... 14.50	psi
		0.020 ... 0.100	MPa
U4.PZ_FR	Error response on undershoot of the supply pressure	**cont** / HOLd	

9.4 Description of parameters

9.4.1 Initialization parameters 1 to 5

9.4.1.1 '1.YFCT' type of actuator

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

Possible settings:

Actuator with normal direction of action	Actuator with inverted direction of action
• turn	• -turn
• WAY	• -WAY
• FWAY	• -FWAY
• LWAY	• -LWAY
• ncSt	• -ncSt
• ncSL	• -ncSL
• ncSLL	• -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
  - External position detection systems 6DR4004-2ES, -3ES and -4ES
  - Internal NCS module
- 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
  - External position detection systems 6DR4004-2ES, -3ES and -4ES
  - An internal NCS module. No limitations apply to the internal NCS module.

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 downwards and the positioner shaft or magnet of the NCS sensor rotates in the **anti-clockwise** direction.

Additional information:

- The '3.YWAY' Range of stroke (Page 148) parameter is displayed only for 'WAY', '-WAY', 'ncSLL' or '-ncLL'.
- turn/-turn: The '2.YAGL' Rated angle of rotation of feedback (Page 147) 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 see section "Preparing linear actuators for commissioning (Page 114)".

Factory setting: WAY

9.4.1.2 '2.YAGL' Rated angle of rotation of feedback

Requirement: 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 ... 35 mm
- 90°: Strokes > 40 ... 130 mm

Use the mounting kit:

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

See also

Sequence of automatic initialization (Page 107)

9.4.1.3 '3.YWAY' Range of stroke

Requirement:
- 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 39).

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

See also

'1.YFCT' type of actuator (Page 145)

9.4.1.4 '4.INITA' Initialization (automatically)

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 sequence of the initialization process from "RUN 1" to "RUN 5" is output in the bottom line of the display.

Factory setting: NOINI

9.4.1.5 '5.INITM' 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

9.4.2 Application parameters 6 to 52

9.4.2.1 '6.SCUR' Current range of setpoint

Requirement:
- You have a SIPART PS2 in version "2-, 3-, 4-wire".
- Positioner is connected in accordance with the connection graphics for 2/3/4-wire systems shown in section "Electrical wiring (Page 77)".

Possible settings:
- 0 MA
- 4 MA

Purpose: This parameter is used to set the current range of the setpoint. The selection of the current range depends on the type of connection. The "0 MA" setting (0 to 20 mA) is only possible for three-wire and four-wire connections.

Factory setting: 4 MA

9.4.2.2 '7.SDIR' 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

9.4.2.3 '8.SPRA' Setpoint split range start / '9.SPRE' Setpoint split range start end

Adjustment range:	0.0 ... 100.0
Purpose:	With these two parameters in combination with parameter "'7.SDIR' Setpoint direction (Page 150)", you can limit the effective setpoint. This allows split range tasks with the following characteristic curves to be solved: • rising/falling • falling/rising • falling/falling • rising/rising
Factory setting:	With "SPRA": 0.0 With "SPRE": 100.0

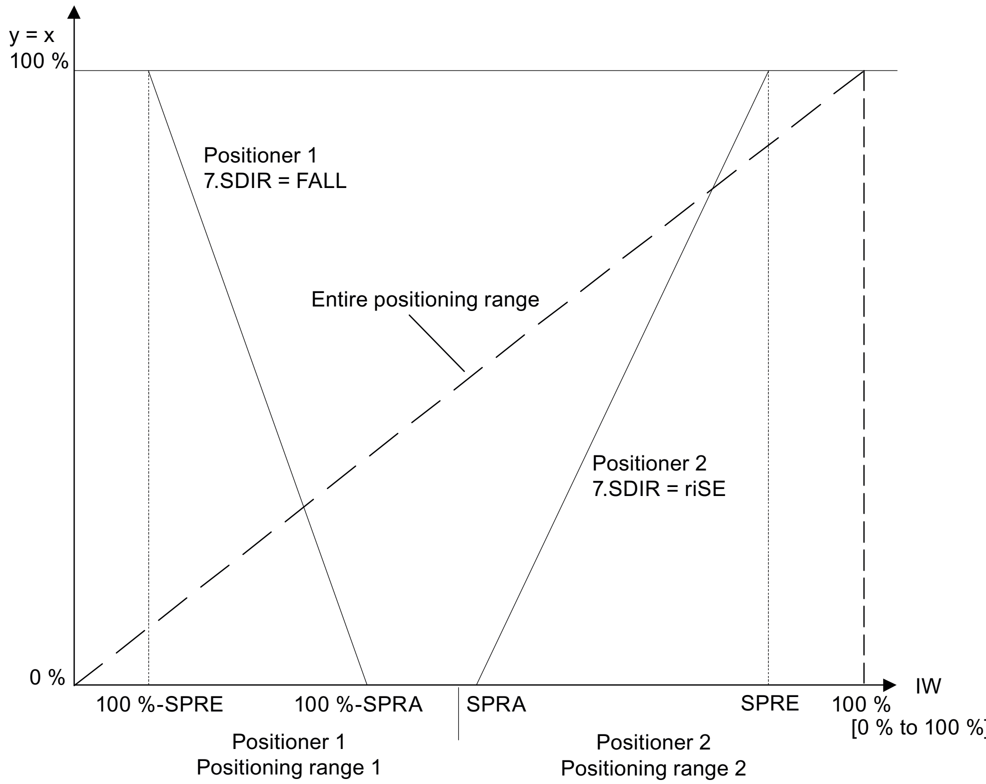


Figure 9-2 Example: Split range operation with two positioners

9.4.2.4 '10.TSUP' Setpoint ramp UP / '11.TSDO' Setpoint ramp DOWN

Possible settings:

With "TSUP"
- Auto
- 0 ... 400

With "TSDO"
- 0 ... 400

Purpose:

The setpoint ramp is effective in "Automatic" mode and limits the speed of change of the effective setpoint. This parameter is used to set the value in seconds. 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 parameter "TSUP = Auto" means 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

9.4.2.5 '12.SFCT' 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 valve characteristics. Optional flow characteristics as shown in the figure in the description of the '13.SL0' ... '33.SL20' Setpoint turning point (Page 152) parameter are simulated for linear valve characteristics.

Factory setting: Lin

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

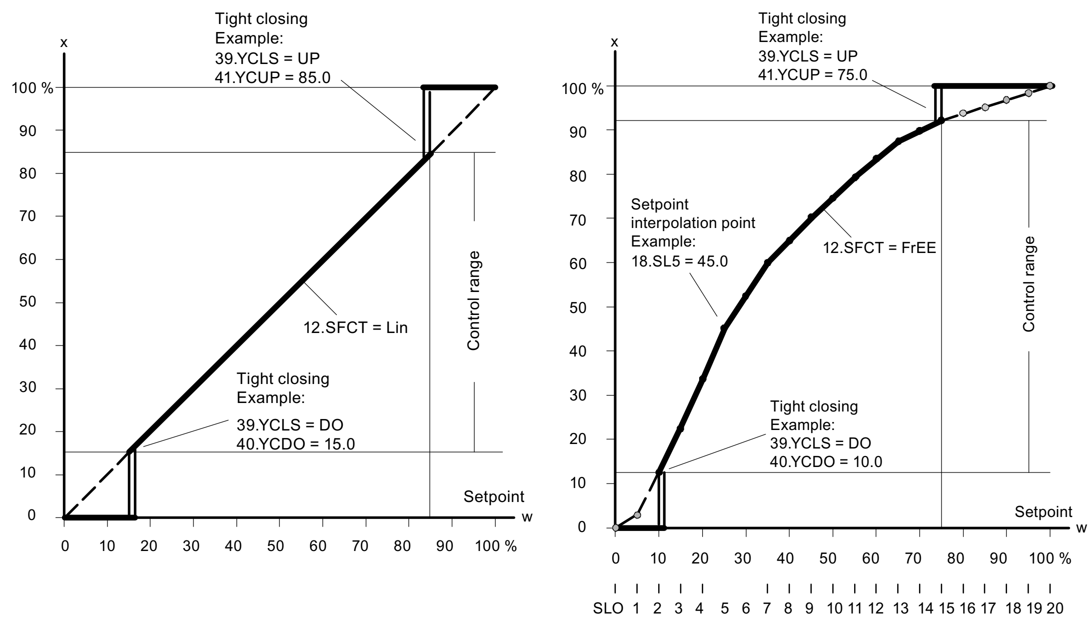
Valve characteristics		**Set with parameter value**
Linear		Lin
Equal percentage	1:25	1-25
Equal percentage	1:33	1-33
Equal percentage	1:50	1-50
Inverse equal percentage	25:1	n1-25
Inverse equal percentage	33:1	n1-33
Inverse equal percentage	50:1	n1-50
Freely adjustable		FrEE

9.4.2.6 '13.SL0' ... '33.SL20' Setpoint turning point

Adjustment 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 turning points form a polyline with 20 linear segments which models the 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 "'12.SFCT' Setpoint function (Page 152)" 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%.

9.4.2.7 '34.DEBA' 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

9.4.2.8 '35.YA' Start of manipulated variable limit / '36.YE' End of manipulated variable limit

Adjustment 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 '37.YNRM' Standardization of manipulated variable (Page 154) 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 to 20 mA). To now use the entire signal range for valve control (for example, of ball and segment valves), set the low limit of the manipulated variable (YA) to the percentage at which the medium begins to flow. To display the new start value as 0%, set '37.YNRM' Standardization of manipulated variable (Page 154) to 'FloW'.
Factory setting:	When 'YA': 0.0 When 'YE': 100.0

Note

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

9.4.2.9 '37.YNRM' Standardization of manipulated variable

Possible settings:	• MPOS • FLoW
Purpose:	Use the '35.YA' Start of manipulated variable limit / '36.YE' End of manipulated variable limit (Page 154) 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 '35.YA' Start of manipulated variable limit / '36.YE' End of manipulated variable limit (Page 154) 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 valve characteristics.

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

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

Factory setting: MPOS

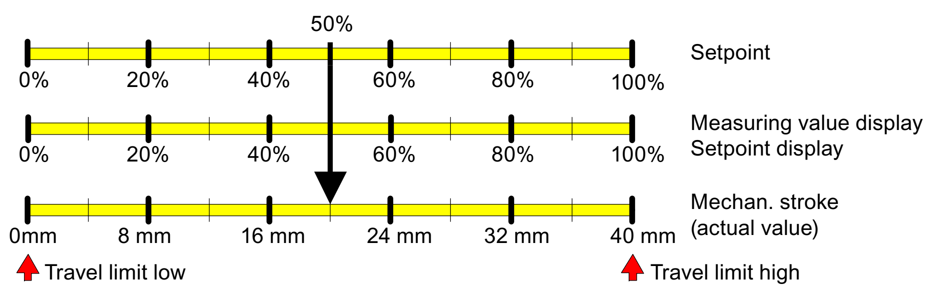


Figure 9-3 YNRM = MPOS or YNRM = FLoW; default: YA = 0 % and YE = 100 %

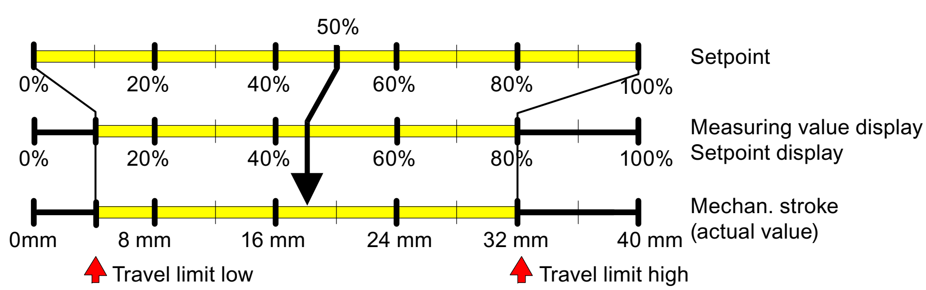


Figure 9-4 Example: YNRM = MPOS with YA = 10 % and YE = 80 %

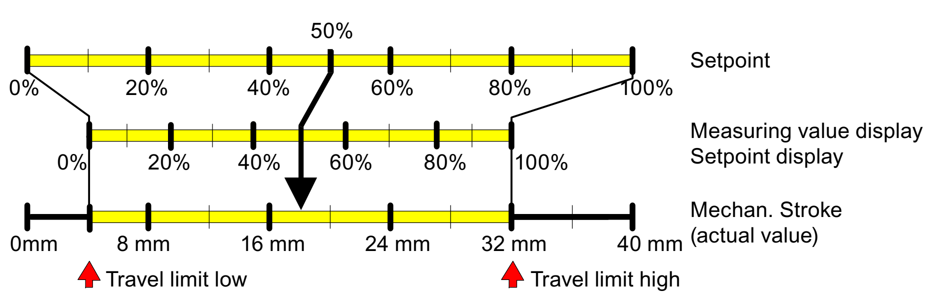


Figure 9-5 Example: YNRM = FLoW with YA = 10 % and YE = 80 %

See also

'39.YCLS' Tight closing/fast closing with manipulated variable (Page 156)

9.4.2.10 '38.YDIR' Direction 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 can be rising or falling.
Factory setting:	riSE

9.4.2.11 '39.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 mechanical end stops. If the parameter is not activated, the control valve controls to the end positions which were determined during the initialization.

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

The tight closing and fast closing functions are activated on one side or for both end positions. Parameter '39.YCLS' becomes effective if the effective setpoint:

- Is at or below the value set in the '40.YCDO' parameter.
- Is at or above the value set in the '41.YCUP' Value for tight closing/fast closing Up (Page 157) parameter.

Factory setting: no

See the figure in the description of the '37.YNRM' Standardization of manipulated variable (Page 154) parameter and the figure in the description of the '13.SL0' ... '33.SL20' Setpoint turning point (Page 152) 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.ϟ LIM' parameter. 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.

9.4.2.12 '40.YCDO' Value for tight closing/fast closing Down

Requirement:	'39.YCLS' Tight closing/fast closing with manipulated variable (Page 156) Parameter is set to 'do', 'uP do', 'Fd', 'Fu Fd', 'uP Fd' or 'Fu do'
Adjustment range:	0.0 ... 100.0
Purpose:	Use the 'YCDO' parameter 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:	0.5

Note

The value in the 'YCDO' parameter is always smaller than that in 'YCUP'. The tight closing/fast closing function has a fixed hysteresis of 1%. The 'YCDO' parameter is relative to the mechanical stops. The 'YCDO' is independent of the values set in the '7.SDIR' Setpoint direction (Page 150) and '38.YDIR' Direction of manipulated variable for display and position feedback (Page 156) parameters.

9.4.2.13 '41.YCUP' Value for tight closing/fast closing Up

Requirement:	'39.YCLS' Tight closing/fast closing with manipulated variable (Page 156) Parameter is set to 'do', 'uP do', 'Fd', 'Fu Fd', 'uP Fd' or 'Fu do'
Adjustment range:	0.0 ... 100.0
Purpose:	Use the 'YCUP' parameter 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:	99.5

Note

The value in the 'YCDO' parameter is always smaller than that in 'YCUP'. The tight closing/fast closing function has a fixed hysteresis of 1%. The 'YCUP' parameter is relative to the mechanical stops. The 'YCUP' is independent of the values set in the '7.SDIR' Setpoint direction (Page 150) and '38.YDIR' Direction of manipulated variable for display and position feedback (Page 156) parameters.

9.4.2.14 '42.BIN1' / '43.BIN2' Function binary input

Setting option

- Binary input 1

Normally open	Normally closed
OFF	OFF
on	-on
bloc1	-uP
bloc2	-doWn
uP	-StoP
doWn	-PST
StoP	
PST	

- Binary input 2

Normally open	Normally closed
OFF	OFF
on	-on
uP	-uP
doWn	-doWn
StoP	-StoP
PST	-PST

Purpose:

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

- BIN1 or BIN2 = On or -On
  Binary messages from peripherals, e.g. from pressure or temperature switches, are read over the communication interface or fed through a logical OR combination with other messages to trigger the error message output.
- BIN1 = 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.
- BIN1 = bLoc2
  If binary input 1 has been activated, the "Manual" as well as "Configuration" modes are blocked.

- BIN1 or BIN2 =
  contact uP or doWn closes, or
  contact -uP or -doWn opens
  If the binary input is activated, the actuator uses the value defined by the "'35.YA' Start of manipulated variable limit / '36.YE' End of manipulated variable limit (Page 154)" parameter for controlling in "Automatic" mode.
- BIN1 or BIN2 contact closes = StoP or -StoP contact opens
  In "Automatic" mode, the piezo valves are blocked when the binary input is activated. The actuator remains at the last position. Leakage measurements can be performed in this way without using the initialization function.
- BIN1 or BIN2 = PSt or -PSt
  Using binary inputs 1 or 2, a partial-stroke test can be triggered by actuation of your choice of a normally closed or normally open switch.
- BIN1 or BIN2 = OFF
  No function
  Special function of binary input 1: If binary input 1 is activated in "P-manual mode" by means of a jumper between terminals 9 and 10, the firmware version is displayed when the button is pressed.

If one of the above functions is activated simultaneously with the "BIN1" and "BIN2" parameters, then: "Blocking" has priority over "uP". "uP" has priority over "doWn". "doWn" has priority over "PST".

Factory setting: OFF

9.4.2.15 '44.AFCT' Alarm function

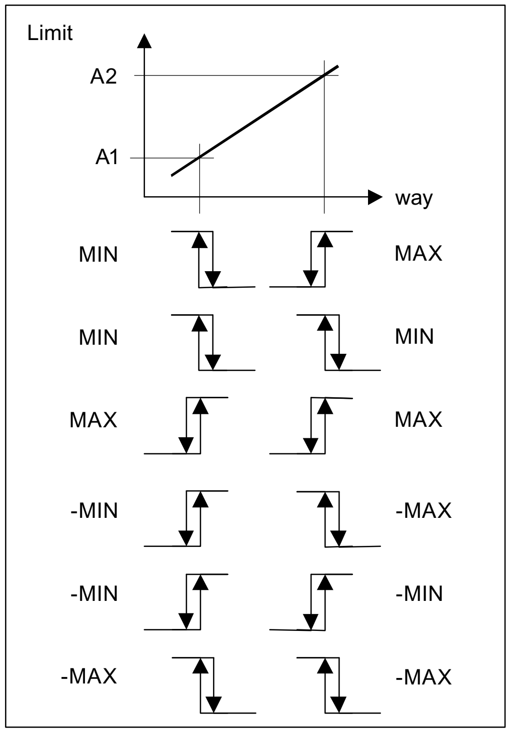
Possible settings: See representation below

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. Alarms are signaled through the alarm module. In addition, alarms can also be read via the communication interface.

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

Factory setting: OFF

Direction of action and hysteresis



	Alarm module	
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 the extended diagnostic is activated using parameter "'52.XDIAG' Activating for extended diagnostics (Page 165)" with setting "On3", then the alarms are not output through the alarm module. Alarm A1 is output with setting "On2". However, notification via the communication interface is possible at any time.

9.4.2.16 '45.A1' / '46.A2' Response threshold of alarm

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 '37.YNRM' Standardization of manipulated variable (Page 154) parameter. The MPOS scale corresponds to the mechanical travel.

Depending on the setting of the alarm function in the '44.AFCT' Alarm function (Page 159) 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

9.4.2.17 '47.\\FCT' Function for fault message output

Requirement: At least one of the following modules is fitted

- Alarm module
- Slot initiator alarm module (SIA module)
- Mechanical limit switch module

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 can also be triggered due to the following events:

- Power failure
- Processor fault
- Actuator fault
- Valve fault
- Compressed air failure
- Threshold 3 message of extended diagnostics.
  See parameter '52.XDIAG' Activating for extended diagnostics (Page 165).

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 binary inputs. To do this, first set the '42.BIN1' / '43.BIN2' Function binary input (Page 158) 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 inverted direction of action.

Factory setting: ϟ

9.4.2.18 '48.\\TIM' Monitoring time for setting of fault message 'Control deviation'

Possible settings:	• Auto • 0 ... 100
Purpose:	The '48.ϟTIM' 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 '49.ϟLIM' 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 the monitoring of control deviation is turned off in the respective overflow direction for the '49.ϟ LIM' parameter. 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.

9.4.2.19 '49.\\LIM' Response threshold of fault message 'Control deviation'

Possible settings:	• Auto • 0 ... 100
Purpose:	This 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 '48.ϟTIM' and '49.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 the monitoring of control deviation is turned off in the respective overflow direction for the '49.ϟ LIM' parameter. 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.

9.4.2.20 '50.PRST' Preset

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.SCUR' Current range of setpoint (Page 149) to '49.\\LIM' Response threshold of fault message 'Control deviation' (Page 162). • diAg: Reset parameters A to P of the extended diagnostics as well as parameter '52.XDIAG' Activating for extended diagnostics (Page 165). An overview of the parameters and factory settings can be found in section Tabular overview of the parameters (Page 137). 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. Restore the factory settings if you have changed several parameters at once without being able to predict their effect and the undesired reactions which may occur as a result. To do this, use the 'ALL' setting.
Factory setting:	ALL

See also

Display of diagnostics values (Page 198)

9.4.2.21 '51.PNEUM' Pneumatics type

Requirements:	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, it 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 295).

9.4.2.22 '52.XDIAG' Activating for 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 216)). These columns ① and the error code ② are shown on the display as follows:

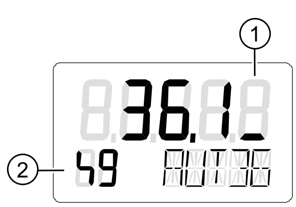


Figure 9-6 Display of a threshold 1 error message with one column (maintenance required)

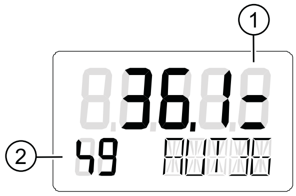


Figure 9-7 Display of a threshold 2 error message with two columns (maintenance demanded)

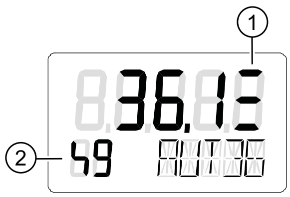


Figure 9-8 Display of a threshold 3 error message with three columns (maintenance alarm)

The factory setting is 'OFF'.

9.4.3 Advanced diagnostic parameters A to U

9.4.3.1 Partial stroke test 'A.\\PST'

A.ϟPST - Partial Stroke Test

Requirement:	The parameter "52.XDIAG (Page 165)" 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. Trigger the partial stroke test using: • Buttons on the device • A binary input • Communication • A cyclic test interval The current status of the partial stroke test is displayed in the diagnostic value "12.PST (Page 204)". Diagnostic value "13.PRPST (Page 206)" and "14.NXPST (Page 206)" provide additional information on the partial stroke test.
Factory setting:	OFF

A1.STPOS - Start position

Adjustment 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

Adjustment 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 initiated during operation only between a position of 48 and 52%.
Factory setting:	2.0

A3.STRKH - Stroke height

Adjustment 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 up and down

- 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. Control is at the ramp rate set in the "A6.RPRT" parameter.

Use ramp mode to shorten or extend the time 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

Adjustment 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 PST

Setting options:
- Auto
- HOLd
- AirIn
- AirOu

Purpose: Assign 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: Pressurize actuator with supply air PZ.
- AirOu: Depressurize actuator.

Factory setting: Auto

A8.INTRV - Test interval

Adjustment 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 - Reference stroke time for partial stroke test

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 starting position cannot be approached or the stroke target cannot be achieved, "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

Adjustment 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

Adjustment 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

Adjustment 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

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

b.ᛋDEVI - Monitoring of dynamic control valve behavior

Requirement:	The '52.XDIAG' Activating for extended diagnostics (Page 165) 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 207). 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 207). 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

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

C.ㄣLEAK - Monitoring/compensation of pneumatic leakage

Note

Accuracy of results

Please 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

Please note that monitoring with an activated '39.YCLS' Tight closing/fast closing with manipulated variable (Page 156) 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%

'40.YCDO' Value for tight closing/fast closing Down (Page 157)

and '41.YCUP' Value for tight closing/fast closing Up (Page 157)

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 203).

Requirement: The '52.XDIAG' Activating for extended diagnostics (Page 165) 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 214), Diagnostic value '58.LKPER - Period of the leakage compensation pulse' (Page 214)

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 207).

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 103)) 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 207) 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

See also

11 Monitoring/compensation of pneumatic leakage (Page 221)

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

d.ϟSTIC - Monitoring of stiction (slipstick)

Requirement: The '52.XDIAG' Activating for extended diagnostics (Page 165) parameter is set to 'On1', 'On2' or 'On3'.

Possible settings:

- OFF
- On

Purpose: Use this parameter to continuously monitor the current stiction (slipstick) of the control valve. If the parameter is activated, the positioner detects the slipstick that may occur. Sudden changes in the 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) 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 207). 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

Adjustment 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

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 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

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 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

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 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

9.4.3.5 Monitoring of deadband 'E.\\DEBA'

E.ᛚDEBA - Monitoring of deadband

Requirement:	The '52.XDIAG' Activating for extended diagnostics (Page 165) parameter is set to 'On'. The '34.DEBA' Deadband of closed-loop controller (Page 153) 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 '26.DBUP - Deadband up' / '27.DBDN - Deadband down' (Page 210). The positioner triggers a message if the current value exceeds the threshold.
Factory setting:	OFF

E1.LEVL3 - Threshold

Adjustment range:	0.1 ... 10.0
Purpose:	Use this sub-parameter to set the threshold to the deadband in percent. Set the threshold in a range from '0.1' to '2.9'. 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.

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

F.ᛋZERO - 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 '52.XDIAG' Activating for extended diagnostics (Page 165) parameter is set to 'On1', 'On2' or 'On3'. The '39.YCLS' Tight closing/fast closing with manipulated variable (Page 156) 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 '39.YCLS' Tight closing/fast closing with manipulated variable (Page 156) 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 207). The positioner triggers a message if the current value undershoots one of the three thresholds.
Factory setting:	OFF

F1.LEVL1 - threshold 1

Adjustment 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

Adjustment 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

Adjustment 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

9.4.3.7 Monitoring the upper endstop 'G.\\OPEN'

G.ꟷOPEN - 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 '52.XDIAG' Activating for extended diagnostics (Page 165) parameter is set to 'On1', 'On2' or 'On3'. The '39.YCLS' Tight closing/fast closing with manipulated variable (Page 156) 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 '39.YCLS' Tight closing/fast closing with manipulated variable (Page 156) 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 208). The positioner triggers a message if the current value exceeds one of the three thresholds.
Factory setting:	OFF

G1.LEVL1 - threshold 1

Adjustment 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

Adjustment 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

Adjustment 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

9.4.3.8 Monitoring the low limit temperature 'H.\\TMIN'

H.ϟTMIN - Monitoring the low limit temperature

Requirement:	The '52.XDIAG' Activating for extended diagnostics (Page 165) 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 low 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 211). 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

See also

'39.YCLS' Tight closing/fast closing with manipulated variable (Page 156)

9.4.3.9 Monitoring the high limit temperature 'J.\\TMAX'

J.ϟTMAX - Monitoring the upper limit temperature

Requirement:	The '52.XDIAG' Activating for extended diagnostics (Page 165) 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 high 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 211). 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

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

L.ϟSTRK - Monitoring of number of total strokes

Requirement:	The '52.XDIAG' Activating for extended diagnostics (Page 165) 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 201). 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

See also

Display of diagnostics values (Page 198)

9.4.3.11 Monitoring of number of changes in direction 'O.\\DCHG'

O.ㄣDCHG - Monitoring of number of changes in direction

Requirement:	The '52.XDIAG' Activating for extended diagnostics (Page 165) 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 201). 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

See also

Display of diagnostics values (Page 198)

9.4.3.12 Monitoring the position average value 'P.\\PAVG'

P.ᛋPAVG - Monitoring the position average value

Requirement:	The '52.XDIAG' Activating for extended diagnostics (Page 165) 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 208). 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 starting the calculation for average value of reference and expiry of the time interval, a position average over the interval period is determined and compared with the average value of reference. 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 for average value of position. If an average value of reference 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 value of reference is calculated.

When the time interval expires, the calculated average value of reference is shown on the display.

Factory setting: IdLE

Note

Current average value of position

The respective current average value of position is displayed in the Diagnostic value '20.PAVG - Average value of position' (Page 208). If no average value of position has been calculated, 'COMP' is displayed as the diagnostic 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 value of position from the average value of reference. The value is given in percent. Set the threshold in a range from '0.1' to '100.0'. The positioner triggers the threshold 1 message if the difference between the average value of position and the average value of reference 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 value of position from the average value of reference. The value is given in percent. Set the threshold in a range from '0.1' to '100.0'. The positioner triggers the threshold 2 message if the difference between the average value of position and the average value of reference 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 value of position from the average value of reference. The value is given in percent. Set the threshold in a range from '0.1' to '100.0'. The positioner triggers the threshold 3 message if the difference between the average value of position and the average value of reference exceeds threshold 3. The process to activate and display this message is described in the 'XDIAG' parameter.
Factory setting:	10.0

9.4.3.13 Pressure monitoring 'U.\\PRES'

U.ᛋPRES - Activate pressure monitoring

Requirement:	The parameter "XDIAG (Page 165)" is set to "On1", "On2" or "On3".
Possible settings:	• OFF • On
Purpose:	Activates or deactivates all pressure-based diagnostics.
Factory setting:	On

U1.PUNIT - Pressure unit

Possible settings:	bar / psi / MPa
Purpose:	Defines the pressure unit for all pressure-based diagnostic parameters.
Factory setting:	bar

U2.PZLIM - Low limit of the supply pressure (PZLIM)

Possible settings:	1.4 to 7.0 (bar) 20.30 … 101.52 psi 0.140 ... 0.700 MPa
Purpose:	Defines the minimum required supply pressure. When the value is undershot, the message "18 (Page 221)" appears on the display in "Automatic" and "Manual" modes.
Factory setting:	1.4

U3.PZHYS - Hysteresis of the low limit of the supply pressure

Possible settings:	0.2 to 1.0 (bar) 2.90 … 14.50 psi 0.020 ... 0.100 MPa
Purpose:	Defines the hysteresis of the low limit of the supply pressure (U2.PZLIM). The error message 18 (Page 221) in the "Automatic" and "Manual" modes is deleted when the value of the supply pressure PZ is "PZHYS" larger than the value assigned in "U2.PZLIM". The control becomes active again if the configured fault reaction was "HOLd".
Factory setting:	0.2

U4.PZ_FR - Error response on undershoot of the supply pressure

Possible settings:	cont / HOLd
Purpose:	Defines the behavior of the device when the limit value of the supply pressure (U2.PZLIM) is undershot. Cont = Chamber pressure is controlled via supply air PZ HOLd = Chamber pressure is maintained, corresponds to the response for Fail in Place
Factory setting:	cont

Alarm, error, and system messages 10

10.1 Output of system messages in the display

10.1.1 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 actual 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.

See also

Display (Page 93)

10.1.2 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 end 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 end position can be approached only in case of a manual initialization	1. Approach first end position using △ or ▽ button. 2. Acknowledge using button.
YEND2		X	The second end position can be approached only in case of a manual initialization	1. Approach second end position using △ or ▽ button. 2. Acknowledge using button.
RANGE		X	The end position or the measuring span is beyond the permissible measuring range only in case of a manual initialization	• Approach a different end position 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		
ᒣd___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		
ᒣUP >		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.
ᒣ90_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.
ᒣU-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		

See also

System messages before initialization (Page 193)

10.1.3 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	Bot- tom	Automatic	Manual mode	P manual mode		
n.nn.nn- nn	X 	 X				Software version	• Maintenance
Error SLnn	X 	 X				Monotony interruption of the free character-istic on the setpoint turning point n	• Correct the value

10.1.4 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	Line		Operating mode			Meaning/cause	Measure
	Up	Bot-tom	Automat-ic	Manual mode	P man-ual mode		
CPU START	X	 X				Message after application of electrical auxiliary power.	• Wait.
HW / ERROR		X				Fault in the hardware.	• Replace electronics.
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.	
AUTnn		X	X			Automatic mode (nn = setpoint)	
MANnn		X		X		Manual mode (nn = setpoint)	• Switch to automatic mode with .
oFL / 127.9	X		X	X		Display range exceeded. Possible causes: • Friction clutch or • Transmission ratio selector was moved or • Positioner was installed on a different actuator without being re-initialized.	• Offset friction clutch so that, when the actuator moves, the actual value display stays between 0.0 and 100.0, or • Switch the transmission ratio selector or • Perform factory settings (Preset) and initialization.
EXSTP		X	X			Actuator was stopped by the binary input.	
EX UP		X	X			Actuator is moved to the upper endstop by the binary input.	
EXDWN		X	X			Actuator is moved to the lower endstop by the binary input.	
EXPSt						The partial stroke test was activated, e.g. by the binary input.	
InPSt						Cyclic partial stroke test.	
FST		X	X			Full stroke test running.	
SRT		X	X			Step response test running.	
MSRT		X	X			Multi-step response test running.	
VPT		X	X			Valve performance test running.	
LEAKR		X	X			A leakage test started by communication is running.	

10.2 Diagnostics

10.2.1 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 199)".

10.2.2 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 199).

10.2.3 Overview of diagnostics values

Explanatory notes on the following table

- The "Representable diagnostics values" column shows the factory settings for the diagnostics parameters in bold type.
- 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 description	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

No.	Short description	Meaning	Representable diagnostics values	Unit	Properties
23	IMPUP	Pulse length up	**6** ... 160	ms	④
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 pilot valve 1	**0** ... 4.29E9	-	②
43	VENT2	Number of switching cycles of pilot valve 2	**0** ... 4.29E9	-	②
44	VEN1R	Number of switching cycles of pilot valve 1, resettable	**0** ... 4.29E9	-	①
45	VEN2R	Number of switching cycles of pilot 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
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

59	mA	Setpoint current	0.0 ... 20.0	mA	②
60	PZ	Supply pressure (PZ)	99.999 (bar) 999.99 (psi) 9.9999 (MPa)	-	③
63	PZMAX	Supply pressure (PZ) min/max pointer		-	①
64	N_MIN	Event counter	0 ... 99999	-	①

10.2.4 Meaning of the diagnostics values

10.2.4.1 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.

10.2.4.2 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.

10.2.4.3 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.

10.2.4.4 Diagnostic value '4.A1CNT - Number of alarms 1' / '5.A2CNT - Number of alarms 2'

Requirement: '44.AFCT' Alarm function (Page 159) parameter is activated.

Display range: 0 ... 4.29E9

Purpose: This value indicates how often the alarm has been triggered.

10.2.4.5 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.

10.2.4.6 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 202), 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 213) 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 213) and '7.HOURR'. These three parameters can be reset to enable simpler determination of the values.

10.2.4.7 Diagnostic value '8.WAY - Determined travel'

Requirement for linear actuator:	The travel is set in the '3.YWAY' Range of stroke (Page 148) parameter.
Display range:	0 ... 130
Purpose:	This value in mm or ° specifies the travel determined during the initialization.

10.2.4.8 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.

10.2.4.9 Diagnostic value '11.LEAK - Leakage test'

Requirement

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 Sequence of automatic initialization (Page 107).
- '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 '50.PRST' Preset (Page 163) > 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 198).
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.

10.2.4.10 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 stroke time measured during the last partial stroke test.

A partial stroke test can be initiated manually or a current 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 has failed.

Status messages:

The following status messages appear when you hold the button pressed:

- notoL - No Tolerance: The control valve is beyond the tolerance range to start the partial stroke test. A manual partial stroke test is not started.
- Strt - Start: A manual partial stroke test is started five seconds after pressing the button.
- StoP - Stop: The current partial stroke test is interrupted. 'WAIT' is output in the display.

Factory setting:

OFF

10.2.4.11 Diagnostic value '12.PST - Monitoring of partial stroke test' (version with pressure sensors)

The monitoring of the partial stroke test for positioners with pressure sensors is described below.

Indication on the display:

- OFF
- C-ERR
- FdIni
- notSt
- noREF
- oCAY
- SdtSt
- FdtSt

Purpose: This diagnostics parameter indicates the status of the partial stroke test.

A partial stroke test can be initiated manually or a current partial stroke test can be interrupted by pressing the ⚠ button.

Description of indications on the display:

- OFF: The function of the partial stroke test is disabled.
- C-ERR: Configuration error. Partial stroke test cannot be started. Settings in the "A1.STPOS start position" and "Ad.ENPOSend position" parameters are not plausible.
- FdIni - Failed PST Initialization: A reference abort pressure is determined with the parameter "AF.PSTRF". This test failed.
- notSt - No Test: A partial stroke test has not yet been executed.
- noREF: A reference partial stroke test has not yet been executed.
- oCAY: 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 has failed.

Status messages: The following status messages appear when you hold the ⚠ button pressed:

- notoL - No Tolerance: The control valve is beyond the tolerance range to start the partial stroke test. A manual partial stroke test is not started.
- Strt - Start: A manual partial stroke test is started five seconds after pressing the button. 'WAIT' is output in the display.
- StoP - Stop: The current partial stroke test was interrupted.

Factory setting: OFF

10.2.4.12 Diagnostic value '13.PRPST - Time since last partial stroke test' (version without pressure sensors)

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 manual 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 has failed.

10.2.4.13 Diagnostic value '13.PRPST' - Time since last partial stroke test' (version with pressure sensors)

Indication on the display:
- ###
- notSt
- noREF
- Sdtst
- FdtSt

Purpose: This diagnostics parameter shows the elapsed time in days since the last partial stroke test.

Status messages:
- notSt - No Test: A manual partial stroke test has not yet been executed.
- noREF: A reference 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 has failed.

10.2.4.14 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.

10.2.4.15 Diagnostics value '15.DEVI - Dynamic control valve behavior'

Requirement:	Monitoring of dynamic control valve behavior 'b.\\DEVI' (Page 171) 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.

10.2.4.16 Diagnostic value '16.ONLK - Pneumatic leakage'

Requirement:	Monitoring/compensation of pneumatic leakage 'C.\\LEAK' (Page 173) parameter is activated.
Display range:	0 ... 100
Purpose:	This diagnostics parameter shows the current leakage indicator.

10.2.4.17 Diagnostic value '17.STIC - Stiction (slipstick)'

Requirement:	Monitoring of stiction (slipstick) 'd.\\STIC' (Page 176) 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.

10.2.4.18 Diagnostic value '18.ZERO - Lower endstop'

Requirement:	Monitoring of lower endstop 'F.\\ZERO' (Page 179) parameter is activated. '39.YCLS' Tight closing/fast closing with manipulated variable (Page 156) 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.

10.2.4.19 Diagnostic value '19.OPEN - Upper endstop'

Requirement:	Monitoring the upper endstop 'G.\\OPEN' (Page 180) parameter is activated. '39.YCLS' Tight closing/fast closing with manipulated variable (Page 156) 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.

10.2.4.20 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.

10.2.4.21 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.
Requirement 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.

Requirement 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) may change when the process is started. These changes may result from temperature changes with the associated thermal expansion of the material. If the Monitoring of lower endstop 'F.\\ZERO' (Page 179) and Monitoring the upper endstop 'G.\\OPEN' (Page 180) 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 may 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 96)

10.2.4.22 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

See also

Mode of operation (Page 28)

Optimization of controller data (Page 99)

10.2.4.23 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

See also

Mode of operation (Page 28)

10.2.4.24 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 '34.DEBA' Deadband of closed-loop controller (Page 153) parameter or to the value automatically adapted by the device if 'DEBA' was set to 'Auto'.

10.2.4.25 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

See also

Mode of operation (Page 28)

Optimization of controller data (Page 99)

10.2.4.26 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.

10.2.4.27 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.

10.2.4.28 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

10.2.4.29 Diagnostic value '42.VENT1' / '43.VENT2'

'42.VENT1' Number of switching cycles of pilot valve 1

'43.VENT2' Number of switching cycles of pilot valve 2

Display range: 0 ... 4.29E9

Purpose: Control procedures of the pilot valves in the pneumatic block of the positioner are counted and displayed in this parameter.

Description: 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. This amounts on average to approx. 200 million switching cycles for each of the two pilot valves with symmetrical load. 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.

10.2.4.30 Diagnostic value '44.VEN1R' / '45.VEN2R'

'44.VEN1R' Number of switching cycles of pilot valve 1, resettable

'45.VEN2R' Number of switching cycles of pilot valve 2, resettable

Display range: 0 ... 4.29E9

Purpose: Control procedures of the pilot valves in the pneumatic block of the positioner 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 212) referred to the diagnostics parameters 'VEN1R' and 'VEN2R' described here.

10.2.4.31 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 202) to Diagnostic value '11.LEAK - Leakage test' (Page 203) and Diagnostic value '21.P0 - Potentiometer value of lower endstop (0%)' / '22.P100 - Potentiometer value of upper endstop (100%)' (Page 208) to Diagnostic value '28.SSUP - Slow step zone up' / '29.SSDN - Slow step zone down' (Page 211) 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.

10.2.4.32 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 99).

Factory setting: 1

10.2.4.33 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 valve or a flap 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.

10.2.4.34 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 173) is active. The sign indicates the control direction of the pulse.

Factory setting: 0

10.2.4.35 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 173) is active.

Factory setting: 0.00

10.2.4.36 Diagnostic value '59.mA - Setpoint current'

Here you can display the current setpoint in mA.

10.2.4.37 Diagnostic value '60.PZ Supply air pressure (PZ)'

Indication on the display:	##.### (bar) ###.## (psi) #.#### (MPa)
Purpose:	Shows the current supply pressure (PZ). The value refers to the pressure unit assigned in "U1.PUNIT (Page 191)". The value is only displayed if "U.\\PRES" is activated and at least one pressure sensor is connected. If the supply air PZ is switched off, the pressure value shown in the display is 0. Depending on the height at which you use the positioner, the displayed pressure value is ≠0. Press the △ button for at least 5 seconds to set the value to 0. As long as you press the △ button, "reset" is shown in the display. This calibration is only possible if the displayed pressure value is in the range -0.5 to +0.5 bar.

10.2.4.38 Diagnostic value '63.PZMAX Supply pressure (PZ) min/max pointer

Indication on the display:	##.### (bar) ###.## (psi) #.#### (MPa)
Purpose:	The supply pressure (PZ) is continuously monitored and the maximum value (min/max pointer) is displayed. The min/max pointer can be reset via HART communication.

10.2.4.39 Diagnostic value '64.N_MIN Event counter'

Display range:	0 ... 99999
Purpose:	Each new measured value of the pressure monitoring is compared with the value set in "U.PZLIM (Page 191)". The counter increases when the supply pressure is lower than the configured limit value. The counter can be reset via HART communication.

10.3 Online diagnostics

10.3.1 Overview of error codes

Overview of error codes that activate the fault message output

You can find where the error codes are output in the display under "52.XDIAG (Page 165)".

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	Compressed air failure, actuator fault, valve fault (e.g. blockade).
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	Binary input BIN1 or BIN2 active	**.ϟ FCT[1)] =ϟnAB and binary function BIN1 or BIN2 to "On"	... the binary input is no longer activated.	The contact connected to the binary 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 valve seat, deposits or foreign bodies in the valve seat, 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 valve seat, deposits or foreign bodies in the valve seat, 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: Reference stroke time for partial stroke test is exceeded.	A.ϟPST≠OFF	Case 1: ... a partial stroke test is successfully executed within the reference stroke time or the function is deactivated.	Case 1: 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. Start the partial stroke test again.	Case 2: Valve is present 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, valve fault, valve jams, increased stiction, decreased compressed air
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, 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 valve trajectory was changed so severely 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 non-plausible
17	No	Pressure sensor defective	U.ϟPRES≠OFF	... the device with functioning pressure sensors is restarted or the pressure sensors are deactivated.	
18	No	Value below supply pressure low limit	U.ϟPRES≠OFF	... the supply pressure is higher than the limit value in U2.PZLIM including the hysteresis in U3.PZHYS	Compressed air supply interrupted, compressed air tank empty, pneumatic leakage
19	No	PZ out of specification	U.ϟPRES≠OFF	... the supply pressure lies within the SIPART PS2 specification of 1.4 bar to 7.0 bar including the hysteresis in U3.PZHYS.	

1)	Refer to the corresponding parameter descriptions for additional information about parameters

10.3.2 Overview of online diagnostics

Online diagnostics means diagnostics during ongoing operation. During operation of the positioner, a few important values and parameters are continually monitored. In configuration mode, you can configure that monitoring so 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 section "Overview of error codes (Page 216)".

This section contains particular information about the following situations:

- Possible causes of the fault message.
- Events which activate the fault message output or alarm outputs.
- Settings of parameters needed for event monitoring.
- Cancelling an error message

When the fault message output is triggered in "Automatic" or "Manual" mode, the display shows which fault triggered the message. The two digits on the lower left show the corresponding error code. If multiple triggers occur at the same time, they are displayed one after the other cyclically. The device status, including all fault messages, can be called up using command "#48" over HART.

See also

'52.XDIAG' Activating for extended diagnostics (Page 165)

Advanced diagnostic parameters A to U (Page 166)

10.3.3 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, alarm outputs 1 and 2 are then used. For this purpose, set the "XDIAG" parameter as described in the following table:

Settings of XDIAG	Message due to
OFF	Extended diagnostics not activated
On1	Fault message output for threshold 3 error message (maintenance alarm, single-stage)
On2	Fault message output for threshold 3 error messages and alarm output 2 for threshold 2 error messages (maintenance demanded, two-stage)
On3	Fault message output for threshold 3 error messages and alarm output 2 for threshold 2 error messages and alarm output 1 for threshold 1 error messages (maintenance required, three-stage)

Possible settings of the 'XDIAG' parameter

10.3.4 Meaning of error codes

10.3.4.1 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.

10.3.4.2 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.

10.3.4.3 3 Binary input BIN1 or BIN2 active

If the binary input is activated, an error message is generated when the "ϟFCT" parameter (function of fault message output) and the "BIN1" parameter (function of binary input 1) are set correctly. For example, it can be a switch to monitor the packing glands, a temperature switch or a limit switch (e.g. for pressure).

Binary input 2 (in the optional alarm module) can be configured in a similar manner.

10.3.4.4 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 alarm outputs respond depending on the mode of the extended diagnostics. These two functions can be deactivated using the parameter setting "OFF" for "L.ϟSTRK".

10.3.4.5 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 alarm outputs respond depending on the mode of the extended diagnostics. These two functions can be deactivated using the parameter setting "OFF" for "O.ϟDCHG".

10.3.4.6 6 Monitoring the lower endstop / 7 Monitoring the upper endstop

If the parameter "F.ϟZERO" is set to "ON", monitoring of the lower endstop is activated. This function can be used to detect the errors in the valve seat. An overshot limit indicates the possibility of deposits or foreign bodies in the valve seat. An undershot limit indicates probable wear and tear of the valve seat or flow restrictor. Even a mechanical misalignment of the position feedback can trigger this fault message.

Monitoring is always carried out whenever the 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: '39.YCLS' Tight closing/fast closing with manipulated variable (Page 156) 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 a subsequent monitoring remains within the tolerance or a re-initialization process is executed. Even the deactivation of monitoring ("F.ϟZERO"=OFF) may trigger an error message.

This monitoring function does not deliver any utilizable results if the end stops 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.ϟOPEN" parameter is used to set the limit for this. Requirement: '39.YCLS' Tight closing/fast closing with manipulated variable (Page 156) Parameter is set to one of the following values: 'uP', 'uP do', 'Fu', 'Fu Fd', 'uP Fd', 'Fu do

10.3.4.7 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.

10.3.4.8 9 Partial stroke test

On the one hand, this fault message appears when a manual or cyclic partial stroke test is initiated and the test cannot be started since the valve is not within the starting tolerance. On the other hand, the fault message appears when one of the three thresholds of the partial stroke test that are determined from the 'A9.PSTIN' reference stroke time 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 alarm outputs depending on the mode of the advanced diagnostics.

10.3.4.9 10 Monitoring of dynamic control valve behavior

The monitoring of the operational behavior responds when the actual 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 filtered, displayed and compared with the configured thresholds that are determined from the "b2.LIMIT" limit multiplied by the factors "b3.FACT1" to "b5.FACT3".

10.3.4.10 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 173).

10.3.4.11 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.

10.3.4.12 13 Monitoring the lower limit temperature

This fault message appears when the lower limit temperature thresholds are undershot.

10.3.4.13 14 Monitoring the upper limit temperature

This fault message appears when the upper limit temperature thresholds are overshot.

10.3.4.14 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.

10.3.4.15 16 Monitoring the plausibility of values for the partial stroke test

This error message is triggered if, when starting a partial stroke test, the plausibility check of the "A1.STPOS", "A3.STRKH" and "A4.STRKD" parameters was not successful.

10.3.4.16 17 Monitoring the pressure sensors

If the pressure sensor module is activated and at least one connected pressure sensor is defective, this fault message is displayed.

10.3.4.17 18 Monitoring low limit of supply pressure (PZLIM)

If the supply pressure is below the configured low limit (PZLIM), this alarm message is displayed.

10.3.4.18 19 Monitoring PS2-specific limit values of supply pressure

If the supply pressure lies outside the SIPART PS2 specification from 1.4 to 7.0 bar, this alarm message is displayed.

10.4 Fault correction

10.4.1 Fault identification

Diagnostics guide

Fault	Corrective measures, see table				
In which mode does a fault occur?					
• Initialization	1				
• Manual and automatic modes	2	3	4	5	6
In which environment and under which boundary conditions does a fault occur?					
• Wet environment (e.g. strong rain or constant condensation)	2				
• Vibrating (oscillating) control valves	2	5			
• Impact or shock loads (e.g. vapor shocks or breakaway valves)	5				
• Moist (wet) compressed air	2				
• Dirty compressed air (contaminated with solid particles)	2	3			
When does a fault occur?					
• Regularly (reproducible)	1	2	3	4	
• Sporadically (not reproducible)	5				
• Mostly after a specific operation time	2	3	5		

See also

Remedial measures table 2 (Page 223)

Remedial measures table 3 (Page 224)

Corrective measures Table 4 (Page 225)

Remedial measures table 5 (Page 225)

10.4.2 Remedial measures table 1

Fault profile (symptoms)	Possible cause(s)	Corrective measures
• Positioner remains in "RUN 1".	• Initialization started from the end position and • The response time of a maximum of 1 minute was not observed. • Supply air PZ not connected or pressure of supply air PZ too low. • Compressed air line blocked, e.g. solenoid valve	• A waiting time of up to 1 minute is essential. • Do not start initialization from the end position. • Ensure supply air PZ. • Unlock 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. • Piezo valve does not activate.	• Check settings: see leaflet: Fig. "Device view 7" as well as parameters 2 and 3 • Check the stroke setting on the lever. See Table 2.
• Positioner remains in "RUN 3".	• Actuator travel time is too high.	• Open the restrictor completely and/or set the pressure PZ (1) to the highest permissible value. • Use a booster if required.
• Positioner remains "RUN 5", does not go up to "FINISH" (waiting time > 5 min).	• "Gap" (play) in the positioner - actuator - control valve system	• Part-turn actuator: check for the firmness of the grub screw of the coupling wheel • Linear actuator: check for the firmness of the lever on the positioning shaft. • Correct any other play between the actuator and the control valve.
	• Diagnostic value "9.TUP" or "10.TDOWN" < 1.5 s	• Set the traversing velocity to > 1.5 s using the internal restrictor.

Fault table 1

10.4.3 Remedial measures table 2

Fault profile (symptoms)	Possible cause(s)	Corrective measures
• "CPU testt" blinks on the display approximately every 2 seconds. • Piezo valve does not activate.	• Water in the pneumatic block (due to wet compressed air)	• At an early stage, this fault can be rectified with a subsequent operating using dry air, if required, in a temperature cabinet at 50 to 70°C. • 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	

Fault profile (symptoms)	Possible cause(s)	Corrective measures
• Piezo valve does not activate (a gentle click sound is not audible when the "+" or "-" buttons are pressed in the manual mode.)	• The screw between the shrouding cover and the pneumatic block has not been tightened firmly or the cover got stuck.	• Tighten the screw firmly; if required, rectify the deadlock.
	• Dirt (swarf, particles) in the pneumatic block	• Repair or a new device; clean and/or replace the built-in fine screens.
	• Deposits on the contacts between the electronic printed circuit board and the pneumatic block may develop due to abrasion owing to continuous loads resulting from strong vibrations.	• Clean all contact surfaces with spirit; if required, bend the pneumatic block contact springs.

Fault table 2

See also

Repair/Upgrading (Page 230)

10.4.4 Remedial measures table 3

Fault profile (symptoms)	Possible cause	Corrective measures
• Actuator does not move.	• Compressed air < 1.4 bar	• Set pressure of supply air PZ to > 1.4 bar.
• Piezo valve does not switch (however, a gentle clicking sound can be heard when the △ or ▽ button is pressed in "Manual" mode.)	• Restrictor valve turned off (screw at the right end stop)	• Open the restrictor screw by turning it anticlockwise, see leaflet, Fig. "Device view 6".
	• Dirt in the pneumatic block	• Repair or a new device; clean and/or replace the built-in fine screens.
• A piezo valve is switched constantly 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	• See above

Fault table 3

See also

Repair/Upgrading (Page 230)

10.4.5 Corrective measures Table 4

Fault profile (symptoms)	Possible cause(s)	Corrective measures
• In stationary automatic mode (constant setpoint) and in "Manual" mode, both piezo valves continually switch alternately, and the actuator oscillates around an average value.	• 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 throttle screws. • If a quick travel time is needed, increase the deadband (parameter "dEbA") until the oscillation stops.
• Positioner doesn't move control valve to the stop (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 mode

Error table 4

See also

Cleaning of the screens (Page 228)

10.4.6 Remedial measures table 5

Fault profile (symptoms)	Possible cause(s)	Corrective measures
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 position controller.
The device function has completely failed: No representation on the display either.	Electrical auxiliary power supply is not adequate.	• Check the electrical auxiliary power supply.
	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 the damping pads.

Fault table 5

See also

Repair/Upgrading (Page 230)

10.4.7 Corrective measures table 6

Fault profile (symptoms)	Possible cause(s)	Corrective measures
• With diagnostic value "60.PZ" (Page 215), display shows "99999". • Display shows alarm message "17 (Page 221)".	• Pressure sensor defective	Replace the pressure sensor module (Page 233)
• Display shows alarm message "18 (Page 221)". • Display shows "HOLd".	• Supply pressure undershoots the low limit (U2.PZLIM (Page 191)). • Device is set to "Hold position", when (U4.PZ_FR) "HOLd" is assigned as error response.	Increase the supply pressure until the limit (U2.PZLIM) incl. hysteresis (U3.PZHYS) is exceeded.
• Display shows alarm message "19 (Page 222)".	• Supply pressure outside the specification	Increase the supply pressure until the limit (U2.PZLIM) incl. hysteresis (U3.PZHYS) is exceeded. Lower the supply pressure until the limit (U2.PZLIM) incl. hysteresis (U3.PZHYS) is undershot.

Error table 6 Pressure sensor module

Service and maintenance 11

11.1 Basic safety instructions

WARNING
Impermissible repair of the device
• Repair must be carried out by Siemens authorized personnel only.

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.

NOTICE
Penetration of moisture into the device
Device damage.
• Make sure when carrying out cleaning and maintenance work that no moisture penetrates the inside of the device.

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.

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

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 Cleaning of the screens

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 pneumatic auxiliary power supply, they damage the screens and hamper the function of the positioner. Clean the screens as described in the following two chapters.

11.2.1 Positioners 6DR5..0, 6DR5..3 and 6DR5..5

Procedure for removal and cleaning of the screens

1. Disconnect the pneumatic auxiliary power supply.
2. Remove the pneumatic pipelines.
3. Unscrew the cover of the 6DR5..0 or 6DR5..3 enclosure.
4. Unscrew 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 cover and tighten it.
6. Connect the pneumatic pipelines again.

11.2.2 Positioners 6DR5..1, 6DR5..2 and 6DR5..6

Removal, cleaning and installation of the screens

1. Disconnect the pneumatic auxiliary power supply.
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.

11.3 Maintenance and repair work

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 Electrical data (Page 244).

11.3.1 Repair/Upgrading

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.

11.4 Replace basic electronics

Requirement

- You are familiar with the general procedure described in the section "General information on installing option modules (Page 50)".

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 air PZ and depressurize the actuator.
2. Open the positioner as in the description depending on the device version:
   - Opening the standard and and intrinsically safe version (Page 50)
   - Opening the device version with "flameproof enclosure" (Page 53)
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

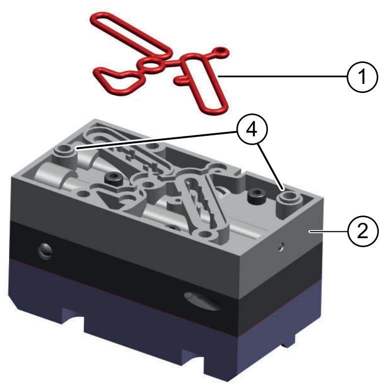
1. Tighten the two fixing screws of the basic electronics.
2. Tighten the screws.
3. Close the positioner as in the description depending on the device version:
   - Closing the standard and and intrinsically safe version (Page 52)
   - Closing the device version with "flameproof enclosure" (Page 56)
4. For a positioner with order option -Z F01 "Fail in Place", adjust the parameter "51.PNEUM (Page 163)" from "Std" to "FIP".
5. Switch on the supply air PZ again.
6. Initialize the positioner as described in section "Commissioning (Page 103)".

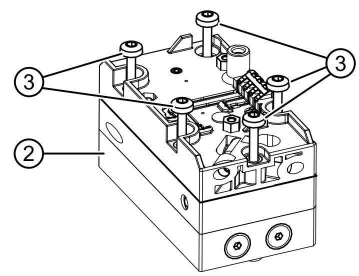
11.5 Replace pneumatic block

Requirement

- You are familiar with the general procedure described in the section "General information on installing option modules (Page 50)".

Procedure





① Cord seal
② Pneumatic block
③ Mounting screws
④ Centering elements

Figure 11-1 Pneumatic block

Removing

1. Switch off the supply air PZ and depressurize the actuator.
2. Open the positioner as in the description depending on the device version:
   – Opening the standard and and intrinsically safe version (Page 50)
   – Opening the device version with "flameproof enclosure" (Page 53)
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. Remove the fixing screws ③ of the pneumatic block ②.
   Four screws for the single-acting pneumatic block. Five screws for the double-acting pneumatic block.
7. Remove the pneumatic block ② and the cord seal ①.
8. Blow the existing dirt from 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 into the groove on the pneumatic block ② on all sides.

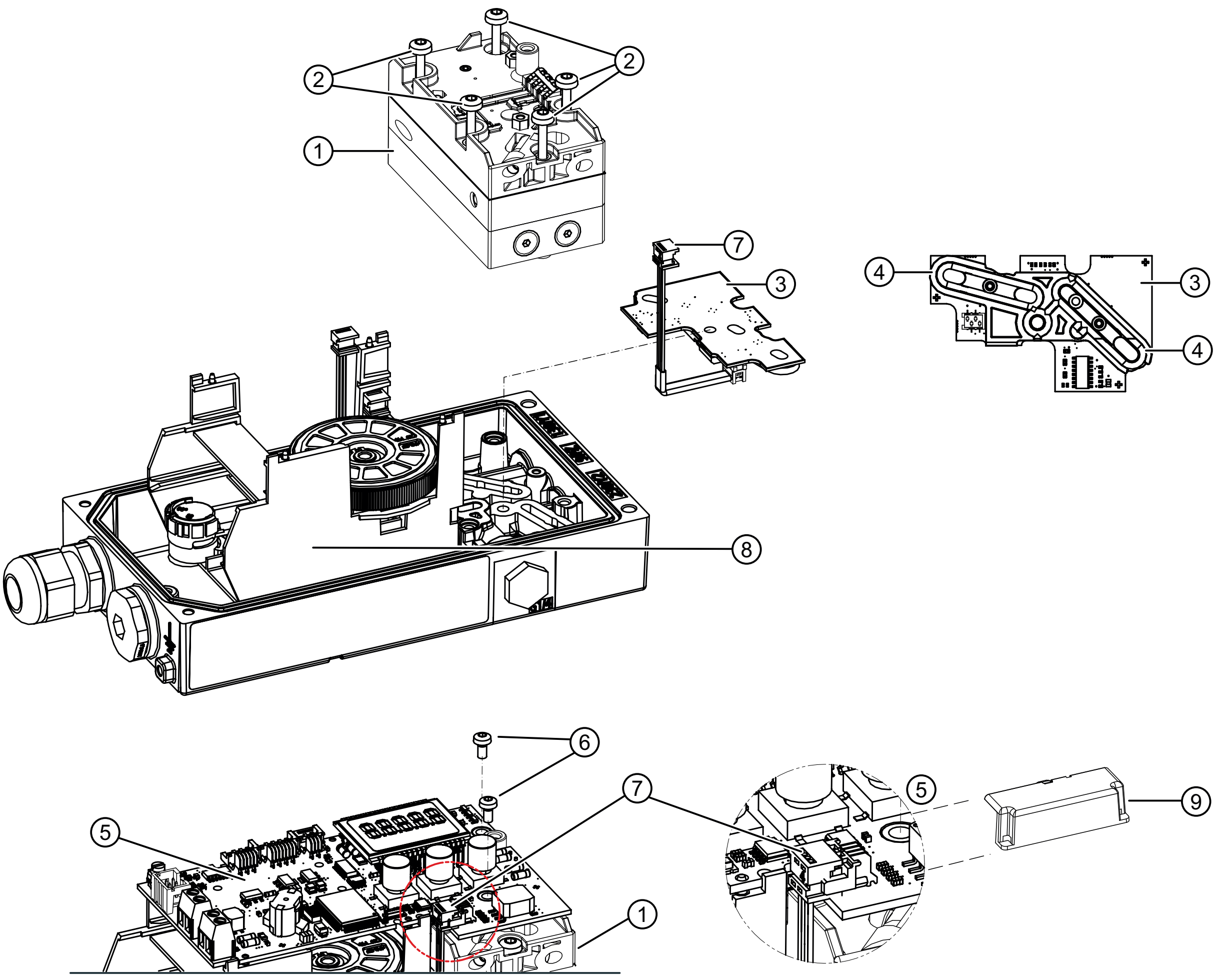
3. Place the new pneumatic block on the base plate.
   Make sure that the pneumatic block engages with the centering elements ④ on the baseplate.
4. Screw the supplied fixing screws ③ into the pneumatic block.
5. Tighten the fixing screws with a torque of 1.1 Nm.
6. Place the new basic electronics onto the four holders of the rack.
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 52)
   – Closing the device version with "flameproof enclosure" (Page 56)
10. For a positioner with order option -Z F01 "Fail in Place", adjust the parameter "51.PNEUM (Page 163)" from "Std" to "FIP".
11. Switch on the supply air PZ again.
12. Initialize the positioner as described in section "Commissioning (Page 103)".

11.6 Replace the pressure sensor module

Requirement

- You have a positioner with a built-in pressure sensor module, order suffix -Z P01.
- It is helpful if you are familiar with the procedure described in the section "Replace pneumatic block (Page 232)".

Overview screen



①	Pneumatic block	⑥	Fixing screws basic electronics
②	Mounting screws	⑦	Ribbon cable, covered with plastic cap ⑨
③	Pressure sensor module	⑧	Adapter
④	Cord seal	⑨	Plastic cap
⑤	Basic electronics		

Figure 11-2 Pressure sensor, schematic diagram

Procedure

Removing

1. Switch off the supply air PZ and depressurize the actuator.
2. Open the positioner as described in section "Opening the standard and and intrinsically safe version (Page 50)".
3. Remove the plastic cap ⑨.
4. Remove the ribbon cable ⑦ and all other ribbon cables from the basic electronics ⑤.

5. Loosen the two fixing screws ⑥ of the basic electronics.
6. Remove the basic electronics ⑤.
7. Remove the fixing screws ② of the pneumatic block ①.
   Four screws for the single-acting pneumatic block. Five screws for the double-acting pneumatic block.
8. Remove the pneumatic block ①.
   Make sure that the cord seal ④ of the pneumatic block is in the pneumatic block.
9. Blow the existing dirt from the surface on which the pneumatic block was placed.
10. Remove the pressure sensor module ③ and the cord seal ④ of the pressure sensor module.

Installation

1. Insert the new cord seal ④ into the new pressure sensor module ③.
2. Press the cord seal ④ into the groove on the pressure sensor module ③ on all sides.
3. Place the pressure sensor module ③ on the baseplate.
4. Place the pneumatic block ① on the pressure sensor module ③.
   - Make sure that the cord seal ④ of the pneumatic block is in the pneumatic block.
   - Make sure that the pneumatic block engages with the centering elements ④ on the baseplate.
5. Screw the fixing screws ② into the pneumatic block ①.
6. Tighten the fixing screws ② with a torque of 1.1 Nm.
7. Place the basic electronics ⑤ onto the four holders of the rack ⑧.
8. Screw in the two fixing screws ⑥ of the basic electronics.
9. Tighten the fixing screws ⑥.
10. Insert the ribbon cable ⑦ and all other ribbon cables onto the basic electronics ⑤.
11. Place the plastic cap ⑨.
12. Close the positioner as described in section "Closing the standard and and intrinsically safe version (Page 52)".
13. For a positioner with order option -Z F01 "Fail in Place", adjust the parameter "'51.PNEUM' Pneumatics type (Page 163)" from "Std" to "FIP".
14. Switch on the supply air PZ.
15. Initialize the positioner as described in section "Commissioning (Page 103)".

Result

The pressure sensor module is ready to use again.

See also

Closing the device version with "flameproof enclosure" (Page 56)

Parameter assignment (Page 135)

General information on installing option modules (Page 50)

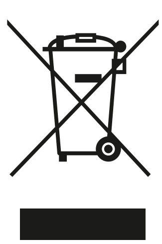
11.7 Return procedure

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/)

Technical data 12

12.1 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 [2)3)]	-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
Degree of protection [1)]	IP66 / type 4X
Mounting position	Any; pneumatic connections and exhaust air outlet not facing up in wet environment, Proper mounting (Page 38)
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 IEC/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) Max. impact energy 1 Joule for enclosure with inspection window 6DR5..0 and 6DR5..1 or max. 2 Joule for 6DR5..3

2) At ≤ -10 °C (≤ 14 °F) the display refresh rate of the indicator is limited.

3) The following applies to order suffix (order code) **-Z M40**: -40 ... +80 °C (-40 ... +176°F)

12.2 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)	
• Inlet air valve (ventilate actuator) [2]	
2 bar; 0.1 KV (29 psi; 0.116 CV)	4.1 Nm³/h (18.1 USgpm)
4 bar; 0.1 KV (58 psi; 0.116 CV)	7.1 Nm³/h (31.3 USgpm)
6 bar; 0.1 KV (87 psi; 0.116 CV)	9.8 Nm³/h (43.1 USgpm)
• Exhaust valve (deaerate actuator for all versions except fail in place) [2]	
2 bar; 0.2 KV (29 psi; 0.232 CV)	8.2 Nm³/h (36.1 USgpm)
4 bar; 0.2 KV (58 psi; 0.232 CV)	13.7 Nm³/h (60.3 USgpm)
6 bar; 0.2 KV (87 psi; 0.232 CV)	19.2 Nm³/h (84.5 USgpm)
• Exhaust valve (deaerate actuator for fail in place version)	
2 bar; 0.1 KV (29 psi; 0.116 CV)	4.3 Nm³/h (19.0 USgpm)
4 bar; 0.1 KV (58 psi; 0.116 CV)	7.3 Nm³/h (32.2 USgpm)
6 bar; 0.1 KV (87 psi; 0.116 CV)	9.8 Nm³/h (43.3 USgpm)
Valve leakage	< $6 \cdot 10^{-4}$ Nm³/h (0.0026 USgpm)
Throttle ratio	Adjustable up to ∞: 1
Auxiliary power consumption in the controlled state	< $3.6 \cdot 10^{-2}$ Nm³/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 (Page 103)".

See also

Basic safety instructions (Page 103)

12.3 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°

Construction	
Mounting method	
• 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)

Construction	
Screw-in torque for metal/stainless steel glands in aluminum/stainless steel enclosure	6 Nm (4.4 ft lb)
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

12.4 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)

12.5 Explosion protection

12.5.1 Breakdown of the article numbers

Each device has a nameplate (Page 24). 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 12-1 Article number

1	2	3	4	5	6	7	-	8	9	10	11	12	-	13	14	15	16	-				
6	D	R	5	a	y	b	-	0	c	d	e	f	-	g	*	*	h	-	Z	j	j	j

Table 12-2 Enclosure and the relevant variables

Enclosure polycarbonate 6DR5 (b = 0) 	Enclosure aluminum single-acting 6DR5 (b = 1) 	Enclosure stainless steel 6DR5 (b = 2) 	Enclosure aluminum single/ double-acting 6DR5 (b = 3) 
Enclosure aluminum flameproof 6DR5 (b = 5) 		Enclosure stainless steel flameproof 6DR5 (b = 6) 	
6DR5**ayb**-	0**cdef**-	**g**..**h**-	Z **jjj**
a (version) = 0, 2, 5, 6	c (Ex protection) = E, D, F, G, K	g = 0, 2, 6, 7, 8	jjj (-Z order code) = = A20, A40, C20, D53, D54, D55, D56, D57, F01, K**, L1A, M40,R**, S**, Y** * = any character
y (actuator) = 1, 2	d (thread) = G, N, M, P, R, S	h (manometer block) = 0, 1, 2, 3, 4, 9	
b (enclosure) = 0, 1, 2, 3	e (limit monitor) = 0, 1, 2, 3, 9		
	f (option module) = 0, 1, 2, 3		

12.5.2 Protection against explosion device and option modules

Type of protection 6DR5ayb-*cdef-g*Ah-Zjjj	Ex marking ATEX/IECEx	Ex marking FM-CSA
Intrinsic safety		
• For c = E and b = 0 • C73451-A430-D78 External position detection system in the polycarbonate enclosure with potentiometer	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
Flameproof enclosure and dust protection by enclosure		
• For c = E 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
Intrinsic safety		
• For c = E and b = 1, 2, 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
Increased safety (non incendive NI)		
• For c = G and b = 1, 2, 3, 5, 6	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
Increased safety (non incendive NI) and dust protection by enclosure		
• For c = D and b = 1, 2, 3	II 2 D Ex tb IIIC T100°C Db II 3 G Ex ec IIC T6/T4 Gc	**DIP:** 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 **NI:** Cl I Zn 2 AEx nA IIC Gc Cl I Zn 2 Ex nA IIC Gc NI Cl I Div 2 Gp A-D
Intrinsic safety, increased safety (non incendive NI) and dust protection by enclosure		

Type of protection 6DR5ayb-*cdef-g*Ah-Zjjj	**Ex marking ATEX/IECEx**	**Ex marking FM-CSA**
• For c = K and b = 1, 2, 3, 5, 6 • 6DR4004-1ES External Position Transmitter (Potentiometer) • 6DR4004-2ES External Position Transmitter (NCS)	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	**IS:** 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 **NI:** Cl I Zn 2 AEx nA IIC Gc Cl I Zn 2 Ex nA IIC Gc NI Cl I Div 2 Gp A-D **DIP:** 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
Intrinsic safety and increased safety (non-incendive NI)		
• For c = F and b = 1, 2, 3, 5, 6 • 6DR4004-6N**-0-*** Non-Contacting Sensor (NCS)	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	**IS:** 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 **NI:** Cl I Zn 2 AEx nA IIC Gc Cl I Zn 2 Ex nA IIC Gc NI Cl I Div 2 Gp A-D

12.5.3 Maximal permissible ambient temperature ranges

Positioner, modules and position detection systems	*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, 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, 2 and f = 0, 2	-40 °C ≤Ta ≤ +80 °C	-40 °C ≤Ta ≤ +60 °C
Position feedback module / Analog Output Module (AOM)		

Positioner, modules and position detection systems	*Temperature class T4*	*Temperature class T6*
• Already fitted: 6DR5ayb-0cdef-g.Ah-Z ... for f = 1, 3 • Can be retrofitted 6DR4004-6J	-30 °C ≤Ta ≤ +80 °C	-
• Already fitted and can be retrofitted: 6DR5ayb-0cdef-g*Ah-Z **M40** for f = 1, 3	-40 °C ≤Ta ≤ +80 °C	-
Position detection systems		
• Non-Contacting Sensor (NCS) 6DR4004-6N**-0-***	-40 °C ≤Ta ≤ +90 °C	-40 °C ≤Ta ≤ +70 °C
• External position detection system in the polycarbonate enclosure with potentiometer C73451-A430-D78	-40 °C ≤Ta ≤ +90 °C	-40 °C ≤Ta ≤ +60 °C
• External Position Transmitter (Potentiometer) 6DR4004-1ES	-40 °C ≤Ta ≤ +90 °C	-40 °C ≤Ta ≤ +60 °C
• External Position Transmitter (NCS) 6DR4004-2ES	-40 °C ≤Ta ≤ +90 °C	-40 °C ≤Ta ≤ +50 °C

12.6 Certificates and approvals

Certificates and approvals	
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.

See also

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

12.7 Electrical data

	Basic electronics without explosion protection	Basic electronics with explosion protection Ex "db"	Basic electronics with explosion protection Ex "ia"	Basic electronics with explosion protection Ex "ic", "ec", "tb"
Current input I_W				
• Rated signal range	0/4 ... 20 mA			

	Basic electronics without explosion protection	Basic electronics with explosion protection Ex "db"	Basic electronics with explosion protection Ex "ia"	Basic electronics with explosion protection Ex "ic", "ec", "tb"
• Test voltage	840 V DC, 1 s			
• Digital input DI1 (terminals 9/10; galvanically connected to basic device)	Suitable only for floating contact; max. contact load < 5 μA with 3 V			

2-wire connection 6DR50.. and 6DR53.. Without HART 6DR51.. and 6DR52.. With HART				
Current to maintain the auxiliary power	≥ 3.6 mA			
Required load voltage U_B (corresponds to Ω at 20 mA)				
• Without HART (6DR50..)				
Typical	6.36 V (= 318 Ω)	6.36 V (= 318 Ω)	7.8 V (= 390 Ω)	7.8 V (= 390 Ω)
Max.	6.48 V (= 324 Ω)	6.48 V (= 324 Ω)	8.3 V (= 415 Ω)	8.3 V (= 415 Ω)
• Without HART (6DR53..)				
Typical	7.9 V (= 395 Ω)	-	-	-
Max.	8.4 V (= 420 Ω)	-	-	-
• With HART (6DR51..)				
Typical	6.6 V (= 330 Ω)	6.6 V (= 330 Ω)	-	-
Max.	6.72 V (= 336 Ω)	6.72 V (= 336 Ω)	-	-
• With HART (6DR52..)				
Typical	-	8.4 V (= 420 Ω)	8.4 V (= 420 Ω)	8.4 V (= 420 Ω)
Max.	-	8.8 V (= 440 Ω)	8.8 V (= 440 Ω)	8.8 V (= 440 Ω)
• Static destruction limit	± 40 mA	± 40 mA	-	-
Effective inner capacitance C_i	-	-		
• Without HART	-	-	11 nF	"ic": 11 nF
• With HART	-	-	11 nF	"ic": 11 nF
Effective inner inductance L_i	-	-		
• Without HART	-	-	209 μH	"ic": 209 μH
• With HART	-	-	312 μH	"ic": 312 μH
For connecting to circuits with the following peak values	-	-	U_i = 30 V I_i = 100 mA P_i = 1 W	"ic": U_i = 30 V I_i = 100 mA "ec"/"t": U_n ≤ 30 V I_n ≤ 100 mA

3-/4-wire connection
6DR52.. With HART, explosion-protected
6DR53.. Without HART, not explosion-protected

	Basic electronics without explosion protection	**Basic electronics with explosion protection Ex "db"**	**Basic electronics with explosion protection Ex "ia"**	**Basic electronics with explosion protection Ex "ic", "ec", "tb"**
Load voltage at 20 mA	≤ 0.2 V (= 10 Ω)	≤ 0.2 V (= 10 Ω)	≤ 1 V (= 50 Ω)	≤ 1 V (= 50 Ω)
Auxiliary power U_{Aux}	18 ... 35 V DC	18 ... 35 V DC	18 ... 30 V DC	18 ... 30 V DC
• Current consumption I_{Aux}	(U_{Aux} - 7.5 V)/2.4 kΩ [mA]			
For connecting to circuits with the following peak values	-	-	U_i = 30 V I_i = 100 mA P_i = 1 W	"ic": U_i = 30 V I_i = 100 mA "ec"/"t": U_n ≤ 30 V I_n ≤ 100 mA
Effective inner capacitance C_i	-	-	22 nF	22 nF
Effective inner inductance L_i	-	-	0.12 mH	0.12 mH
Galvanic isolation	Between U_{Aux} and I_W	Between U_{Aux} and I_W	Between U_{Aux} and I_W (2 intrinsically safe circuits)	Between U_{Aux} and I_W

12.8 Electrical data for pressure sensors

	Basic electronics without explosion protection
Basic electronics for pressure sensors 6DR51.. -Z P01 HART, non-Ex	
Current input I_W	
• Rated signal range	0/4 ... 20 mA
• Test voltage	840 V DC, 1 s
• Digital input DI1 (terminals 9/10; galvanically connected to basic device)	Suitable only for floating contact; max. contact load < 5 µA with 3 V
Current to maintain the auxiliary power	≥ 3.6 mA
Required load voltage U_B (corresponds to Ω at 20 mA)	9.4 V (= 470 Ω)
Static destruction limit	± 30 V
Effective inner capacitance C_i	-
Effective inner inductance L_i	-
For connecting to circuits with the following peak values	-

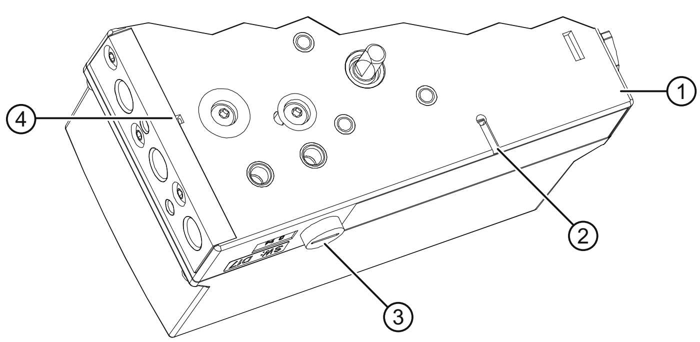
12.9 Communication (HART)

HART communication	
HART version	7
PC parameter assignment software	SIMATIC PDM; supports all device objects. The software is not included in the scope of delivery.

12.10 Technical data for natural gas as actuator medium

Introduction

Note when using an actuator with natural gas that this can escape at the exhaust air outlets.



① Base plate
② Exhaust air outlet enclosure ventilation
③ Exhaust air outlet sound absorber
④ Exhaust air outlet near the pneumatic connections

Note

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.

Enclosure ventilation ② and control air outlet ④

Enclosure ventilation and control air outlet cannot be collected and channeled off.

Please refer to the following table for the maximum ventilation values.

Maximum values for escaping natural gas

Ventilation process	Operating mode	6DR5.1.-.E... Single-acting [Nl/min]	6DR5.2.-.E... Double-acting [Nl/min]
Ventilation of the enclosure volume. Purge air switch is at "IN".	Operation, typical	0.14	0.14
	Operation, max.	0.60	0.60
	Error case, max.	60.0	60.0
Ventilation via the control air outlet near the pneumatic connections.	Operation, typical	1.0	2.0
	Operation, max.	8.9	9.9
	Error case, max.	66.2	91.0
Ventilation through the exhaust air outlet with a sound absorber.	Operation, max.	358.2 [1)]	339 [1)]
	Error case, max.		
Volume	Max. [l]	1.26	1.23

1) Depending on the actuating pressure and volume of the actuator as well as the frequency of control. The maximum flow rate is 470 Nl/min at a differential pressure of 7 bar.

See also

Proper mounting (Page 38)

12.11 Option modules

12.11.1 Alarm module

	Without explosion protection or suitable for use in the SIPART PS2 Ex d	With Ex protection Ex "ia"	With explosion protection Ex "ic", "ec", "t"
Alarm module	6DR4004-8A	6DR4004-6A	6DR4004-6A
3 binary output circuits			
• Alarm output A1: Terminals 41 and 42			
• Alarm output A2: Terminals 51 and 52			
• Fault message output: Terminals 31 and 32			
• Auxiliary voltage U_{Aux}	≤ 35 V and the current consumption is to be limited to < 25 mA	-	-
• Signal status			

	Without explosion protection or suitable for use in the SIPART PS2 Ex d	With Ex protection Ex "ia"	With explosion protection Ex "ic", "ec", "t"
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 housing, the current consumption must be restricted to 10 mA per 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"/"t": 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 binary input circuit • Binary input BI2: 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		
• Static destruction limit	± 35 V	-	-
• Connecting to circuits with the following peak values	-	U_i = DC 25.2 V	"ic": U_i = DC 25.2 V "ec"/"t": U_n ≤ DC 25.5 V
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 outputs, the BI2 input and the basic device are galvanically isolated from each other.		
Test voltage	DC 840 V, 1 s		

12.11.2 Position feedback module

	Without explosion protection or suitable for use in the SIPART PS2 Ex d	With Ex protection Ex ia (use only in temperature class T4)	With explosion protection Ex "ic", "ec", "t"
Position feedback module Direct current output for position feedback	6DR4004-8J	6DR4004-6J	6DR4004-6J
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 voltage 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"/"t": U_n ≤ DC 30 V I_n ≤ 100 mA P_n ≤ 1 W
Effective internal capacitance	-	C_i = 11 nF	C_i = 11 nF
Effective internal inductance	-	L_i = negligibly small	L_i = negligibly small
Galvanic isolation	Safe galvanic isolation from alarm option and basic device		
Test voltage	DC 840 V, 1 s		

12.11.3 SIA module

	Without Ex protection	With Ex protection Ex "ia"	With explosion protection Ex "ic", "ec", "t"
SIA module Limit encoder with slotted initiators and fault message output	6DR4004-8G	6DR4004-6G	6DR4004-6G
2 slotted initiators • Binary output (limit transmitter) A1: Terminals 41 and 42 • Binary output (limit transmitter) A2: Terminals 51 and 52			
• Connection	2 wire technology in accordance with EN 60947-5-6 (NAMUR), for switching amplifiers connected on load side		

	Without Ex protection	With Ex protection Ex "ia"	With explosion protection Ex "ic", "ec", "t"
• 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": 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 • Binary 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": 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		

12.11.4 Mechanical limit switch module

	Without Ex protection	With Ex protection Ex ia	With Ex protection Ex "ic", "t"
Mechanical limit switch module	6DR4004-8K	6DR4004-6K	6DR4004-6K
Limit encoder with mechanical switching contacts			

	Without Ex protection	With Ex protection Ex ia	With Ex protection Ex "ic", "t"
2 limit contacts • Binary output 1: Terminals 41 and 42 • Binary output 2: 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 "t": 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 • Binary 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 "t": 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	DC 3150 V, 2 s		
Rated condition height	Max. 2 000 m mean sea level Use a suitable power supply at an altitude of more than 2 000 m above sea level.	-	-

12.11.5 EMC filter module

	Without Ex protection	With Ex protection Ex "ia", "ic"	With explosion protection Ex "ec", "t"
	6DR4004-8F	**6DR4004-6F**	**6DR4004-6F**
The EMC filter module type 6DR4004-6F and -8F is required to connect contactless, external position detection, e.g. NCS module or an external position detection system with potentiometer type C73451-A430-D78 or 6DR4004-1ES to -4ES or with internal NCS module 6DR4004-2ES to -4ES. For devices with explosion protection, other types of potentiometers with a resistance value of 3 kΩ, 5 kΩ or 10 kΩ can be connected. For devices without explosion protection, signals between 0 and 20 mA or 0 and 10 V can additionally be processed.			
R-potentiometer			
• Maximum values with supply by other basic devices (6DR50/1/2/3/9)	U_{max} = 5 V	U_o = 5 V I_o = 100 mA P_o = 33 mW C_o = 1 μF L_o = 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 = 5 V I_o = 75 mA static I_o = 160 mA transient P_o = 120 mW C_o = 1 μF L_o = 1 mH	U_{max} = 5 V
Signal 20 mA			
• Nominal signal range	0 ... 20 mA		-
• Internal load R_B	200 Ω		-
• Static destruction limit	40 mA		-
Signal 10 V			
• Nominal 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		

12.11.6 Internal NCS modules 6DR4004-5L and 6DR4004-5LE

Additional modules	Without Ex protection	With Ex protection Ex "ia"	With explosion protection Ex "ic", "ec", "t"
Internal NCS module	6DR4004-5L	6DR4004-5LE	6DR4004-5LE
Linearity (after corrections made by positioner)	± 1 %	± 1 %	± 1 %
Hysteresis	± 0.2 %	± 0.2 %	± 0.2 %

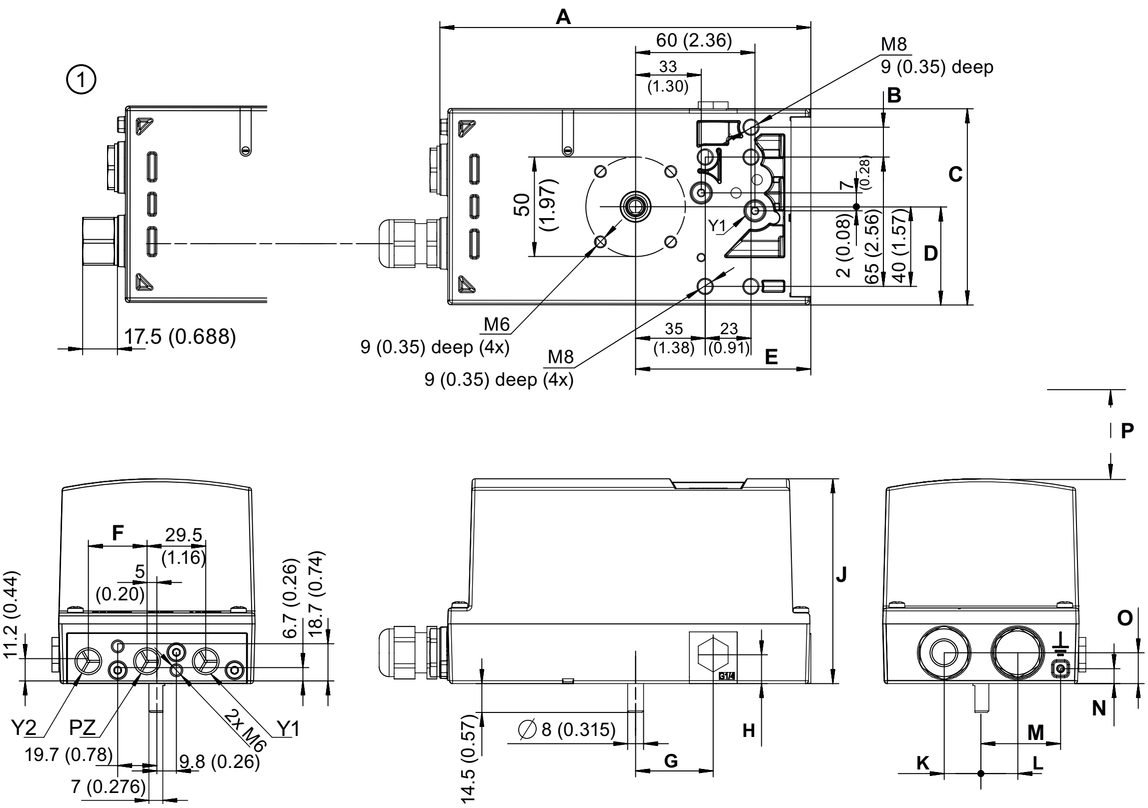
12.11.7 Other technical specifications

Technical specifications for additional option modules and accessories is available at:

- Technical specifications NCS (Page 281)
- Technical specifications of the external position detection system (Page 287)
- Sealing plug / thread adapter (Page 291)
- Positioner with remote control electronics (Page 311)

Dimension drawings 13

13.1 Positioner in non-flameproof enclosure



① M20 x 1.5 or NPT adapter

Figure 13-1 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]	

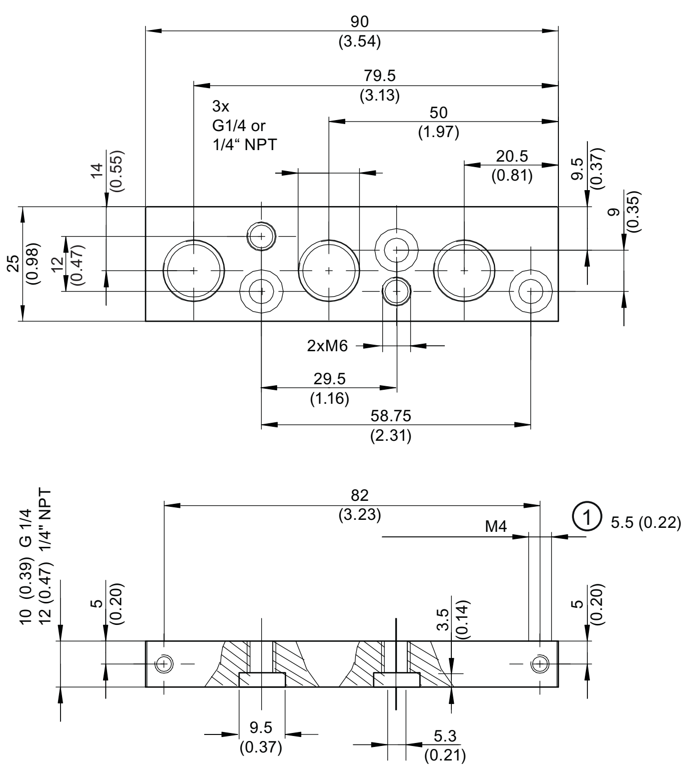
	6DR5..0		6DR5..1	6DR5..2	6DR5..3	
	G¼	1/4-18 NPT			G¼	1/4-18 NPT
M	-		26.5 [1.04]	41.5 [1.53]	40 [1.57]	
N	-		7.5	7.5	7.5	
O	14.5 [0.57]		14.5 [0.57]	14.5 [0.57]	15.5 [0.61]	
P	> 150 (5.91) Adhere to this minimum clearance for service and maintenance above the cover.					

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

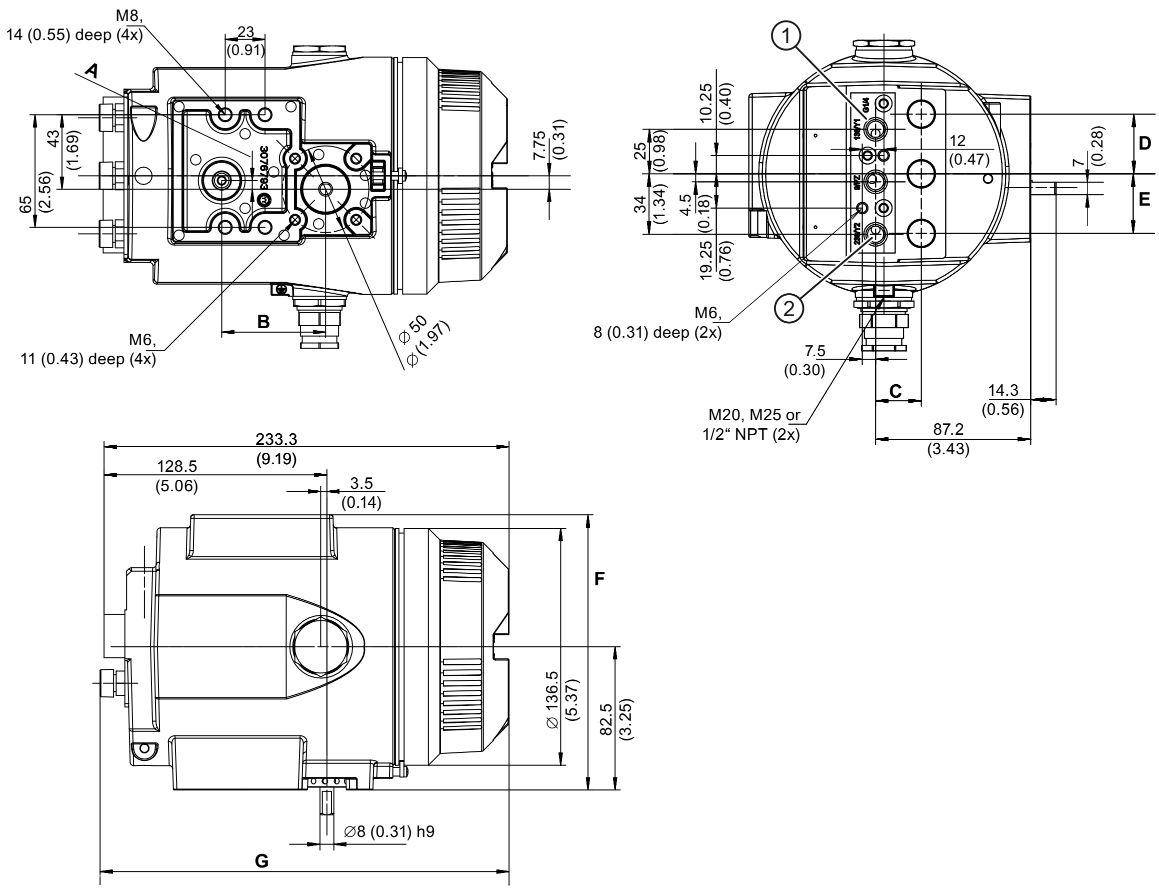
13.2 Terminal strip for enclosures 6DR5..0 and 6DR5..3



① Thread depth

Figure 13-2 Terminal strip, dimensions in mm (inch)

13.3 Positioner in flameproof enclosure



① All air connections G¼ or ¼-18 NPT

② Air connection Y2, only with double-acting version

Figure 13-3 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 14

14.1 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 data (Page 237)".

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 electronic unit 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 positioner can be equipped with different option modules. The following modules are normally available:

- Position feedback module: two-wire current output 4 to 20 mA for position feedback
- Alarm module: 3 binary outputs and 1 binary input

- SIA module: one binary output for fault messages, two binary outputs for limit monitors
- Mechanical limit switch module with two switches and one alarm output
- Internal NCS module 6DR4004-5L/-5LE

The SIA module and the mechanical limit switch module cannot be used in device versions with flameproof enclosure. For more limitations, please refer to section "Technical data (Page 237)".

Accessories

- Pressure gauge block: 2 or 3 pressure gauges for single and double-acting positioners
- Mounting flange (NAMUR) for safety pneumatic block
- Mounting kits for linear and part-turn actuators

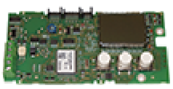
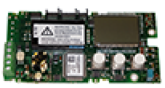
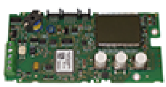
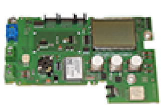
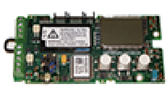
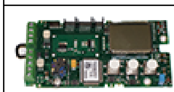
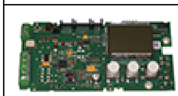
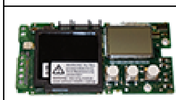
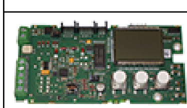
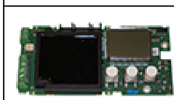
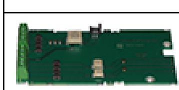
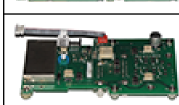
For separate mounting of positioner and position sensor

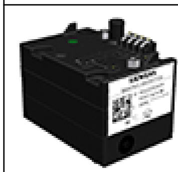
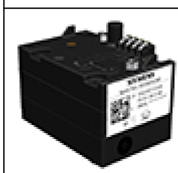
- External position detection system
- NCS sensor for contactless position detection

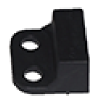
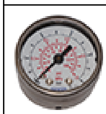
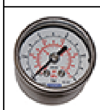
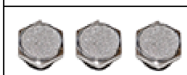
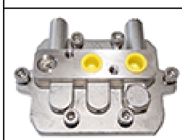
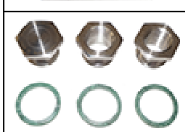
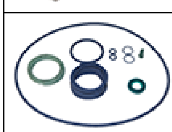
Note

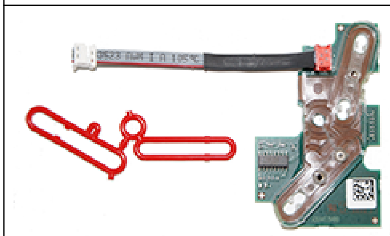
The version is identified using a special nameplate.

14.2 Spare parts

	Description	Article number	For version
	Basic electronics		
	2-wire, not Ex, without HART	A5E00082459	6DR50..-.N
	2-wire, Ex, without HART	A5E00082457	6DR50..-.D/E/F/G/K
	2-wire, not Ex, with HART	A5E00082458	6DR51..-.N
	2-wire, not Ex, with HART, extended diagnostics supported by pressure sensors	A5E45152693	6DR51..-.N* -Z P01
	2/3/4-wire, Ex, with HART	A5E00082456	6DR52..-.D/E/F/G/K
	2/3/4-wire, not Ex, without HART	A5E00102018	6DR53..-.N
	PROFIBUS PA, not Ex	A5E00141523	6DR55..-.N
	PROFIBUS PA, Ex	A5E00141550	6DR55..-.D/E/F/G/K
	FOUNDATION Fieldbus, not Ex	A5E00215467	6DR56..-.N
	FOUNDATION Fieldbus, Ex	A5E00215466	6DR56..-.D/E/F/G/K
	Interface module for positioner without basic electronics	A5E00151572	6DR5910-*
	Interface module for 19-inch slide-in module 4 ... 20 mA	A5E00151571	A5E00151560

	Description	Article number	For version
	Pneumatic block		
	Single-acting, with seal and screws	C73451-A430-D80	6DR5.1.*
	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-*

	Description	Article number	For version
	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, manometer, sound absorber			
	Magnet clamp for linear actuators	A5E00078031	6DR4004-...2*
	Magnet clamp made from anodized aluminum for rotary actuators	A5E00524070	6DR4004-...1/4*
	Manometer steel, process connection G1/8 (3 units)	A5E32527731	6DR5…-…..-…9 -R1A/-R2A 6DR4004-1P/-2P
	Manometer 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
	Pressure sensor module		
	With seal and pressure sensor at Pz	A5E45153857	6DR51.3-0N…-…..-Z P01

Note

See Catalog FI 01 "Field devices for process automation" for additives and possible modules.

14.3 Scope of delivery of mechanical limit switch module

If the mechanical limit switch module was ordered for later installation, then the following components are included in the scope of delivery:

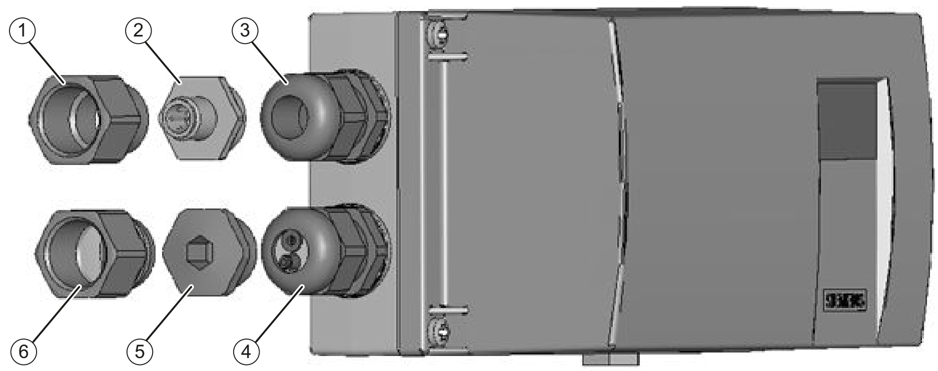
- One mechanical limit switch module with accessories
- DVD with product documentation
- One housing cover with enlarged aperture

- One insulating cover
- Two cable ties
- One set of signs; how these are to be attached depends on the version.

14.4 Scope of delivery EMC filter module

Cable glands and adapters

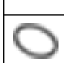
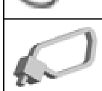
The EMC filter module is supplied with various cable glands and adapters. The following figure shows the different variants.



Connections ① to ③ for power supply		Connections ④ to ⑥ for optional modules	
①	Adapter M20 to ½-14 NPT for 6DR5..0/1/2/3-0.N/P	④	Cable gland for connection thread M20x1.5 with seal insert for 6DR55/6..0-0.G/M/R/S
②	M12 connector for device version with PROFIBUS or FOUNDATION fieldbus communication for 6DR55/6..-0.R/S	⑤	Blanking plug for device version without optional modules 6DR5...-0..00
③	Cable gland for connection thread M20x1.5 for 6DR5..0/1/2/3-0.G/M	⑥	Adapter M20 to ½-14 NPT for 6DR5..0/1/2/3-0.N/P

Figure 14-1 Positioner with the different cable glands and adapter

Scope of delivery EMC filter module

	Description
	EMC filter module 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 set for ④

	Description
	Sealing set plug for ④
	Screw for plastic
	Oval head screw M3x6

14.5 Accessories

For accessories, refer to Catalog FI 01 "Field devices for process automation", for example:

- Option modules
- NCS sensor for contactless position detection
- Mounting kits
- Operating software

14.6 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)

Appendix A

A.1 Technical support

Technical Support

If this documentation does not provide complete answers to any technical questions you may have, contact Technical Support at:

- Support request (http://www.siemens.com/automation/support-request)
- More information about our Technical Support is available at Technical support (http://www.siemens.com/automation/csi/service)

Internet Service & Support

In addition to our documentation, Siemens provides a comprehensive support solution at:

- Service&Support (http://www.siemens.com/automation/service&support)

Personal contact

If you have additional questions about the device, please contact your Siemens personal contact at:

- Partner (http://www.automation.siemens.com/partner)

To find the personal contact for your product, go to "All Products and Branches" and select "Products & Services > Industrial Automation > Process Instrumentation".

Documentation

You can find documentation on various products and systems at:

- Instructions and manuals (http://www.siemens.com/processinstrumentation/documentation)

See also

SIPART PS2 product information (http://www.siemens.com/sipartps2)

E-mail (mailto:support.automation@siemens.com)

Process instrumentation catalog (http://www.siemens.com/processinstrumentation/catalogs)

SITRANS T product information (http://www.siemens.com/sitranst)

Product information on SITRANS P in the Internet (http://www.siemens.com/sitransp)

SITRANS DA400 Product information (http://www.siemens.com/sitransda400)

Product information on SITRANS P310 on the Internet (www.siemens.com/sitransp310manuals)

A.2 QR code label

A QR code label can be found on the device. With the use of a smart phone, the QR code provides a direct link to a website with information specific to the device, such as manuals, FAQs, certificates, etc.

A.3 Overview of the assignment of the HART variables

Dynamic variables for device revision 6, as of firmware 5.02.xx HART 7

For positioners with HART communication, the variables PV, SV, TV and QV are assigned as follows:

Variable	Meaning	Physical variable
HART Primary Variable (PV)	Primary variable	W (setpoint) in %
HART Secondary Variable (SV)	1st secondary variable	X (actual value) in %
HART Tertiary Variable (TV)	2nd secondary variable	Xd (control deviation) in %
HART Quaternary Variable (QV)	3rd secondary variable	t (temperature) in °C

External position detection B

B.1 Introduction

> **WARNING**
>
> **External position detection system**
>
> Versions with flameproof enclosures may not be operated with an external position detection system 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 external position detection systems

- Article number C73451-A430-D78 made of polycarbonate or with article number 6DR4004-1ES made of aluminum consisting of:
  - Positioner enclosure
  - Integrated friction clutch
  - Integrated potentiometer
  - Various blanking plugs and seals
- An external position detection system with article number 6DR4004-2ES, 3ES or 4ES comprising:
  - Positioner enclosure
  - Internal NCS module
  - Various blanking plugs and seals
  - Integrated SIA module (6DR4004-3ES) or GWK module (6DR4004-4ES)
- NCS sensor for contactless 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

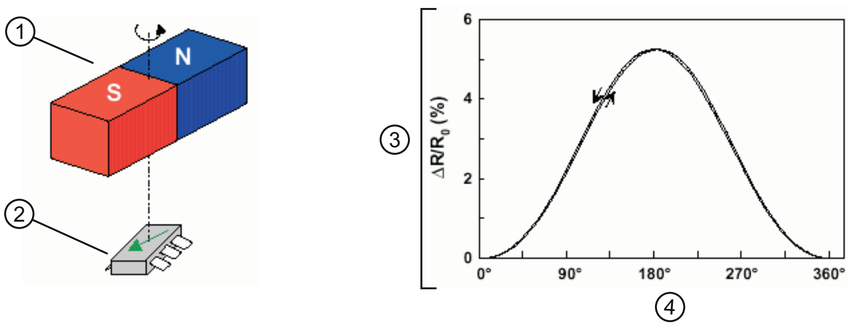
- Positioner in combination with EMC filter module 6DR5..0/1/2/3-0...2/3 or retrofitted as accessory 6DR4004-6F/-8F.
  - An EMC filter module as an accessory is provided in a set along with cable clamps and M20 cable glands.

B.2 Non-Contacting Sensor

B.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.

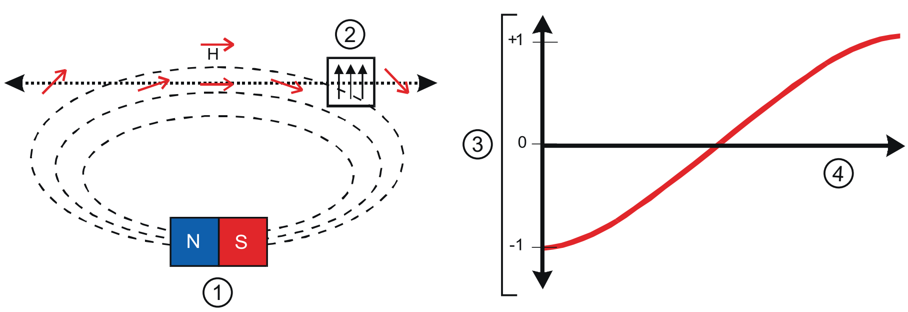


①	Magnet	③	Resistance change
②	Sensor	④	Angle

Figure B-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	③	Resistance change
②	Sensor	④	Angle

Figure B-2 Resistance change depending on the position of the magnet

Non-linearity is corrected automatically in the SIPART PS2 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.

B.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.

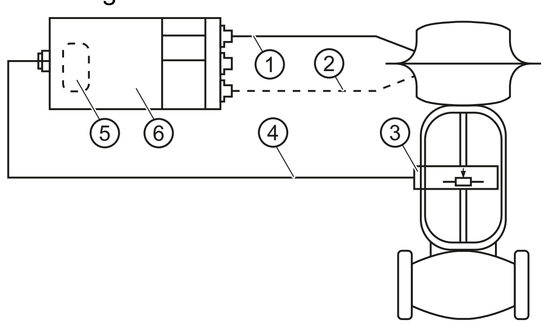
Such a separate installation is useful whenever the ambient conditions at the valve exceed the specified positioner values.

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 EMC filter module 6DR4004-6F and EMC-compatibility is ensured at the same time.

EMC filter module ordering options:

- Installed in the positioner; see Catalog FI 01
- For retrofitting in the positioner; item number 6DR4004-6F. For information on retrofitting the EMC filter module, refer to the positioner operating instructions, chapter "Installation/ Mounting".



① Pneumatic line
② Pneumatic line for double-action actuators
③ Position detection system (10 kΩ potentiometer or NCS)
④ Electrical cable
⑤ Retrofittable EMC filter module (in the positioner)
⑥ Positioner

Figure B-3 Separate installation of the NCS and positioner

B.2.2.1 Mounting on part-turn actuator

Requirements

1. An EMC filter module in 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 to VDI/VDE 3845 and mounting console to VDI/VDE 3845, or a part-turn actuator with manufacturer-specific interface.

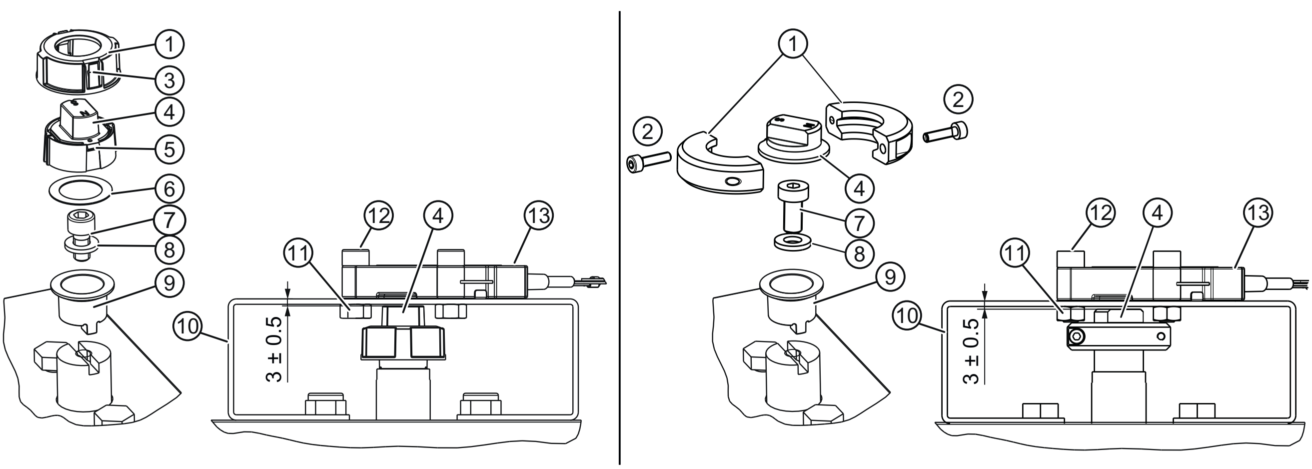
NOTICE

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 B-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 chapter "Scope of delivery of NCS for part-turn actuators (Page 283)".

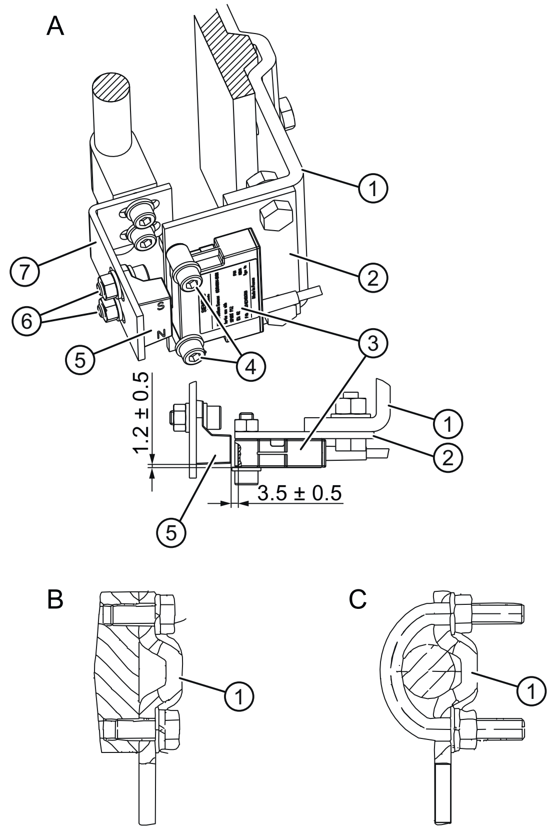
B.2.2.2 Mounting on linear actuator up to 14 mm (0.55 inch)

Requirement

1. An EMC filter module in 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.

You can find the dimensions of the NCS as well as the NCS magnet under Dimensional drawing of non-contacting sensor (Page 283).

Description



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 B-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

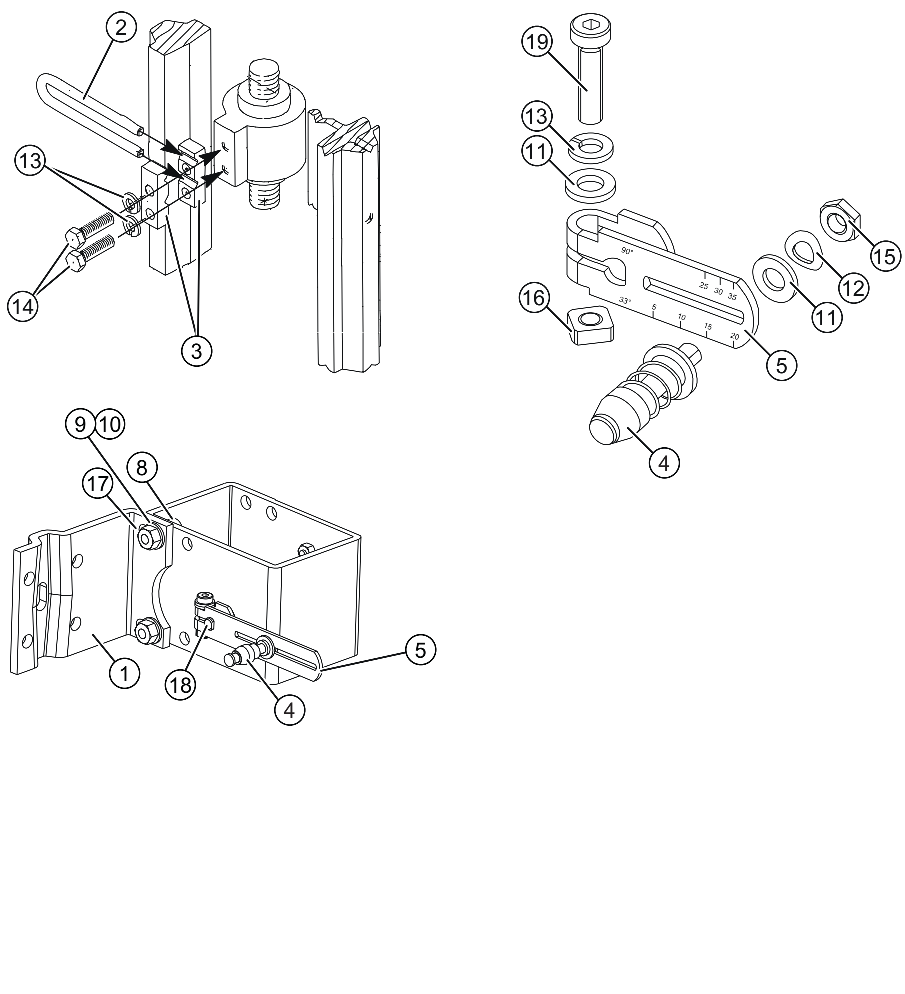
For information on the scope of delivery, refer to section "Scope of delivery of NCS for linear actuators up to 14 mm (0.55 inch) . (Page 284)".

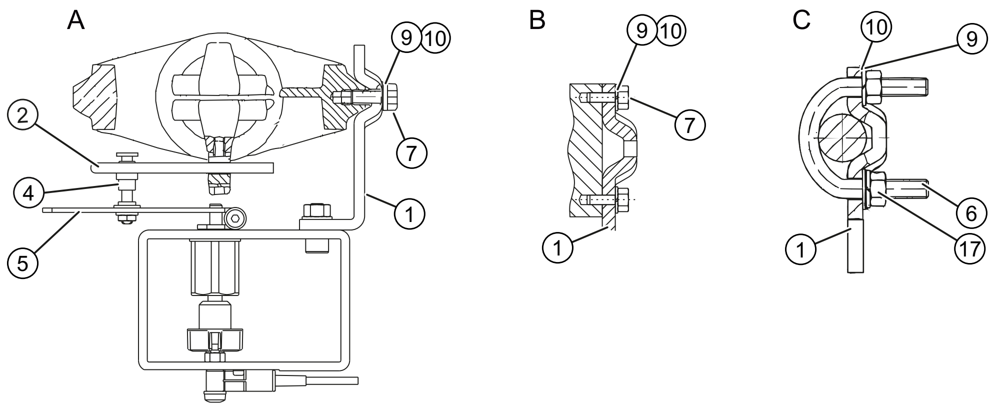
B.2.2.3 Mounting on linear actuator > 14 mm (0.55 inch)

Prerequisites

1. An EMC filter module in 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





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	Dog 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 B-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 mechanical stop.
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.

Reference

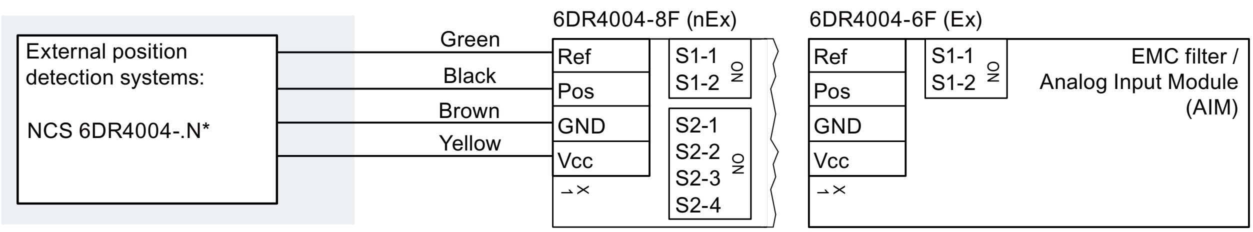
For information on the scope of delivery, refer to section "Scope of delivery of NCS for linear actuators > 14 mm (0.55 inch) . (Page 285)"

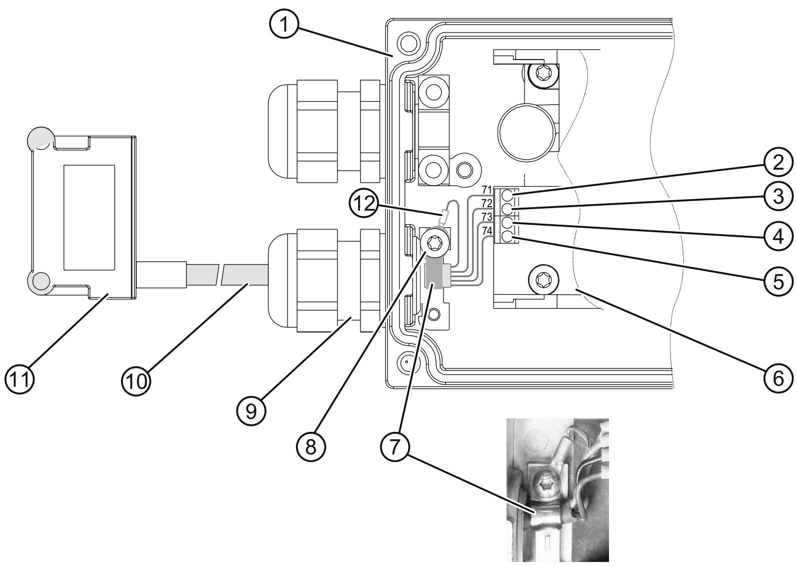
B.2.3 Connecting NCS to EMC filter module

Requirement

You need the EMC filter module, article number 6DR4004-6F or -8F for the electrical connection of the accessory part "NCS sensor for contactless position measurement" to the positioner. The positioner supplies auxiliary power to the NCS sensor via the EMC filter module.

Wiring diagram





Positioner (open state)
② Terminal Ref: Green
③ Terminal Pos: Black
④ Terminal GND: Brown
⑤ Terminal Vcc: Yellow
⑥ EMC filter module
⑦ Cable clamp
⑧ Screw F3x8
⑨ Cable gland
⑩ Four-pole NCS cable
⑪ Non Contacting Sensor (NCS)
⑫ Cable shielding lug

Figure B-7 Example of connecting the NCS to the EMC filter module

Procedure

The NCS sensor is equipped with a shielded four-pole cable. Wire this cable to the positioner as follows:

1. Feed the four-pole 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. Terminate the four-pole NCS cable ⑩ in the EMC module of the positioner in accordance with the wiring diagram.
4. Place the cable clamp ⑦ onto the outer insulation of the four-pole 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 state by measuring the ground resistance. If necessary, ensure proper grounding by means of an additional cable from the NCS sensor to ground potential.

B.2.4 Commissioning of NCS

B.2.4.1 Prerequisites / default settings

1. Supply electrical and pneumatic auxiliary power to the SIPART PS2 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 SIPART PS2 positioner has already been initialized, carry out a reset. Carry out the reset of parameter group "Init" in the '50.PRST' Preset (Page 163) parameter.
3. Preset for part-turn actuators:
   While the valve or flaps are closed, align the North pole of the magnet with the cable; "N" in position ⑦ in "Figure B-4 Mounting on part-turn actuator with magnet holder made of glass fiber reinforced polyester (left figure) or anodized aluminum (right figure) (Page 272)".
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.

B.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".

B.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".

B.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".

B.2.5 Technical specifications NCS

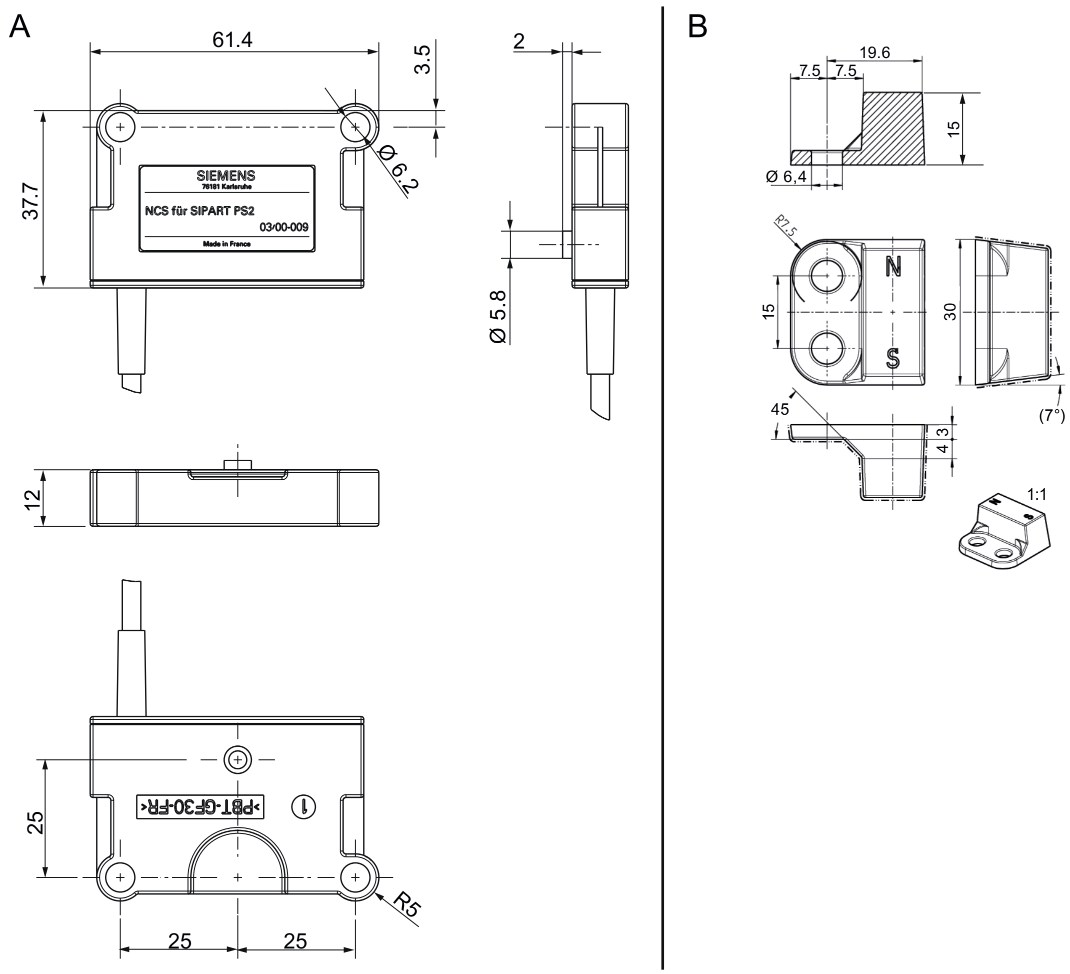
Additional modules	Without Ex protection	With Ex protection Ex "ia"	With explosion protection Ex "ic", "ec"
Travel range			
• Linear actuator 6DR4004-6/8N.20	3 to 14 mm (0.12 to 0.55")		
• Linear actuator 6DR4004-6/8N.30	10 to 130 mm (0.39 to 5.12"); up to 200 mm (7.87") on request		
• Part-turn actuator	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

B.2.6 Dimensional drawing of non-contacting sensor



A NCS B Magnet

Figure B-8 Dimensional drawing of the NCS and magnet

B.2.7 NCS sensor scope of delivery

B.2.7.1 Scope of delivery of NCS for part-turn actuators

Part-turn actuator 6DR4004-.N.10	Part-turn actuator 6DR4004-.N.40		
Quantity	**Quantity**	**Name**	**Note**
1	1	Magnet clamp	
5	5	Washer	6
2	2	Hex socket head screw	M6x12

Part-turn actuator 6DR4004-.N. 10	Part-turn actuator 6DR4004-.N. 40		
1	-	Plastic washer	
1	1	Magnet	
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 polycarbonate 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

See also

Mounting the NCS (Page 271)

B.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

See also

Mounting the NCS (Page 271)

B.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; refer to the 'Accessories' section in Catalog FI 01
1	DVD	with documentation

See also

Mounting the NCS (Page 271)

B.3 External position detection system

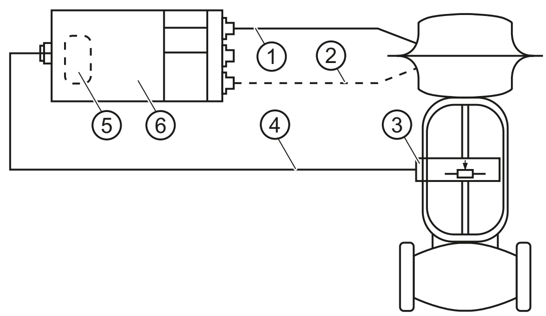
B.3.1 Principle of operation of external position detection systems

The external position detection systems essentially consist 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 270)". 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 external position detection system is secured to a console on rotary actuators and to a mounting bracket on linear actuators, section "Mounting to linear actuator (Page 39)".

Auxiliary power is supplied to the external position detection system via the EMC filter module, and EMC is ensured at the same time.



① Pneumatic line
② Pneumatic line for double-action actuators
③ External position detection system
④ Electrical cable
⑤ EMC filter module (fitted in the positioner or retrofittable)
⑥ Positioner

Figure B-9 External position detection system and positioner

B.3.2 Mounting the external position detection systems

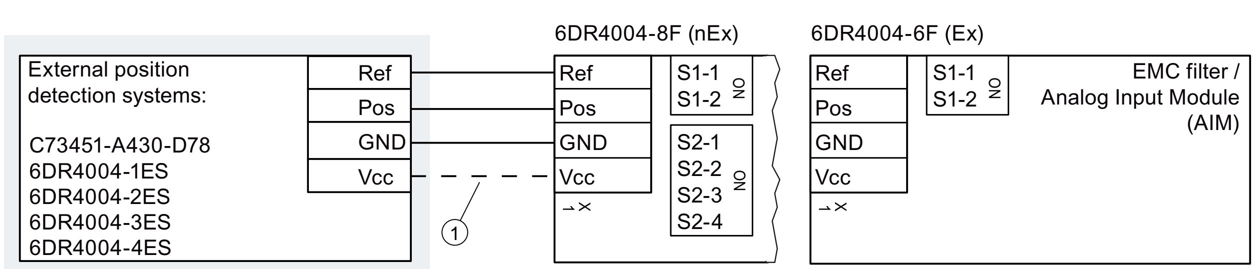
Mounting of an external position detection system corresponds to the mounting of the positioner in a non-flameproof enclosure. Proceed as described in Section "Installing and mounting (Page 35)". The connection of the module is described in section "EMC filter module 6DR4004-6F/-8F (Page 85)".

B.3.3 Connecting the external position detection system to the EMC filter module

Requirement

You have an external position detection system.

Wiring diagram



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

B.3.4 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
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.

See also

Construction (Page 238)

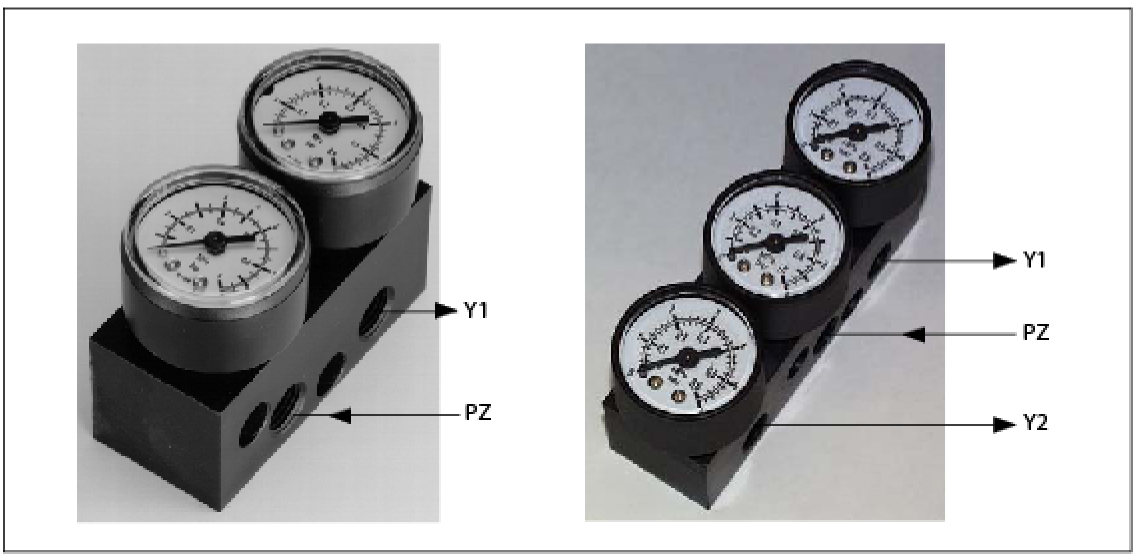
Construction	
Material body	
• C73451-A430-D78	Glass-fiber reinforced polycarbonate (PC)
• 6DR4004-1ES	Aluminum
Weight	
• Enclosure C73451-A430-D78	Approx. 0.9 kg (1.98 lb)
• Enclosure 6DR4004-1ES	Approx. 1.6 kg (3.53 lb)
Torque for cable gland nut made of plastic	See Construction (Page 238)

Pressure gauge block

C

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 air. The image 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
P_Z	Supply air
Y2	Actuating pressure

Fixing the pressure gauge block

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.

Sealing plug / thread adapter

D

D.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.

D.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 292)", 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 for accessory part (Page 293)").

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

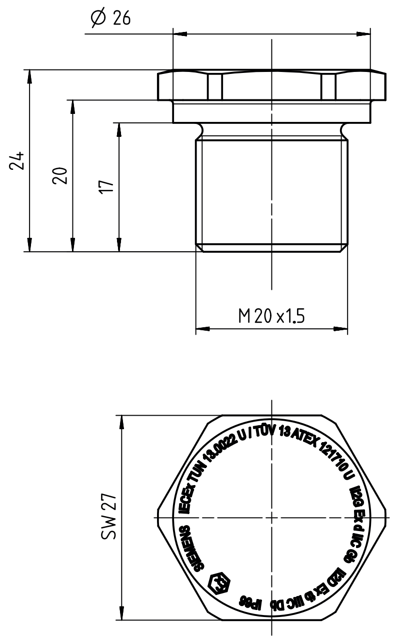
Changes in the ambient conditions can loosen the component.

- As part of the recommended maintenance intervals: Check the compression fitting for tight fit and tighten, if necessary.

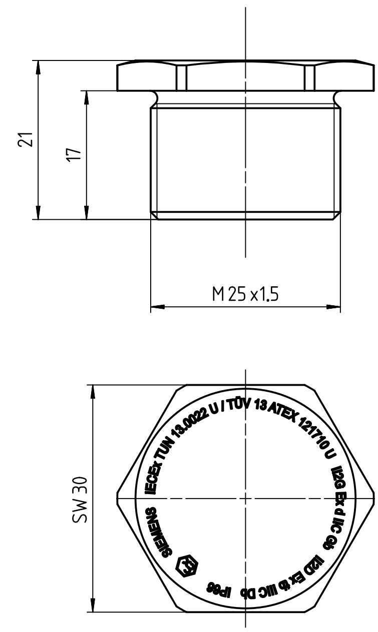
D.3 Technical specifications of accessory part

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

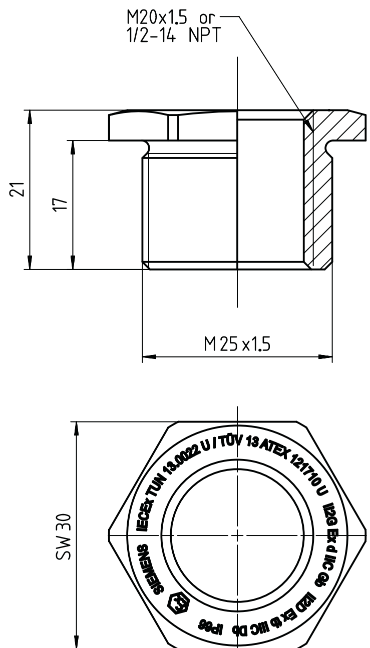
D.4 Dimensional drawings for accessory part

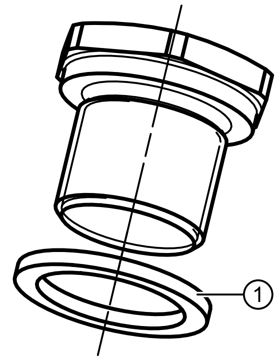


Sealing plug Ex d, M20 x 1.5, dimensions in mm



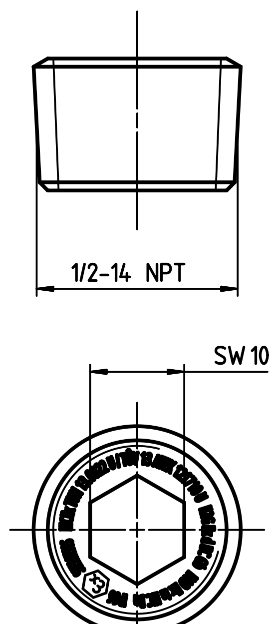
Sealing plug Ex d, M25 x 1.5, dimensions in mm





① Sealing ring: Use for dust protection "Ex t" type of protection.

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



Sealing plug Ex d ½ -14 NPT

Booster

E

> **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.

E.1 Booster introduction

In order to shorten the travel times, use a booster between the positioner and actuator. The booster increases the air performance.

With single-acting positioners, use of the boosters 6DR4004-1RJ, -1RK, -1RP or -1RQ, you connect to the air output Y1.

With double-acting positioners, use two of the boosters 6DR4004-2RJ, -2RK, -2RP or -2RQ which you connect to the air outputs Y1 and Y2.

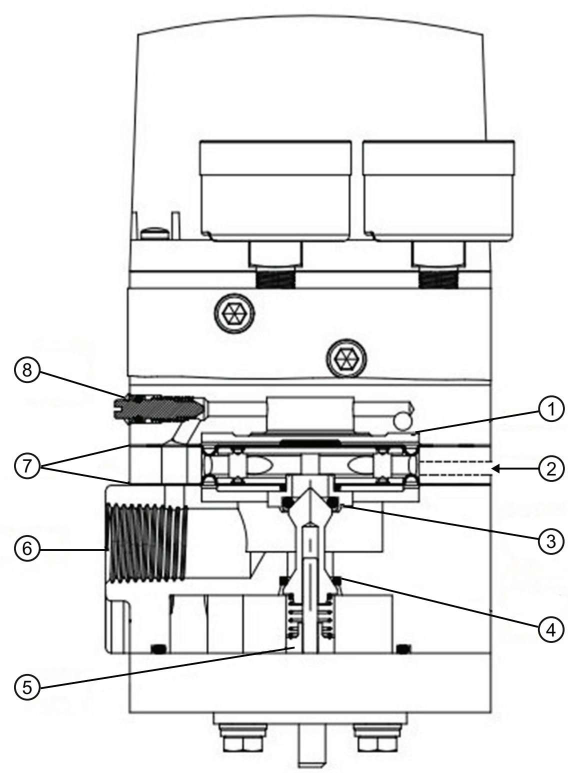
Note

SIPART PS2 double-acting

The booster changes the double-acting SIPART PS2-operation in the event of the loss of supply air. The Integral Volume Booster or external Volume Booster is used to depressurize the output pressure; the valve position cannot be determined in the event of loss of supply air. The Integral Volume Booster does not have any effect on the operation of the positioner in the event of the failure of the control signal or power supply. You can find more detailed information on this in the SIPART PS2 manual.

E.2 Operating principle of booster

The input pressure from the positioner which acts on the effective surface of the upper diaphragm, produces a force which counteracts the force of the outlet pressure acting on the lower diaphragm at a ratio of 1:1. A change of the inlet pressure results in a difference so that balance has to be restored by a pilot valve. This increase presses the diaphragm module down, opens the pilot valve and releases supply air to the outlet until balance is restored. A decrease, on the other hand, ensures that the diaphragm module is raised, which opens the outlet air seat and lowers the outlet pressure such that it corresponds to the inlet pressure. These devices have a stabilizing bypass needle valve, so that the inlet pressure can directly go to the output in the event of small or gradual changes at the input. As the booster has a bypass, there is no loss of accuracy and if the needle valve is set properly, the persistence stability can be retained. The suitable setting of the needle valve depends on the size of the actuator. The larger the actuator, the more the needle valve can be closed and its stability retained.



①	Input	⑤	Supply pressure
②	Exhaust air outlet	⑥	Output
③	Outlet air seat	⑦	Diaphragm
④	Supply air seat	⑧	Bypass valve

E.3 Mounting booster, without flameproof enclosure

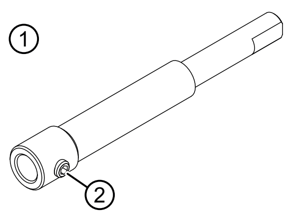
Requirements

1. You are familiar with the safety instructions in section "Installing and mounting (Page 35)".
2. You have one of the following boosters:
   – With single-acting positioners, booster with the article number 6DR4004-1RJ or -1RK
   – With double-acting positioners booster with the article number 6DR4004-2RJ or -2RK

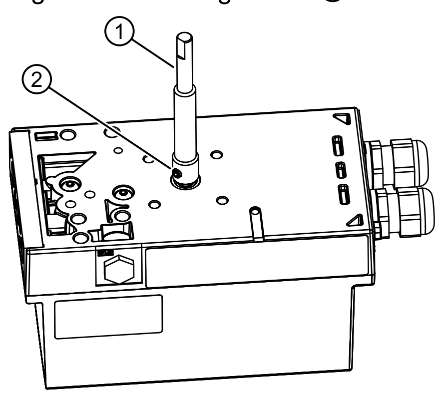
A. Mount extension shaft and booster

Using the example of a single-acting positioner

1. Remove the extension shaft ① from the booster mounting kit.

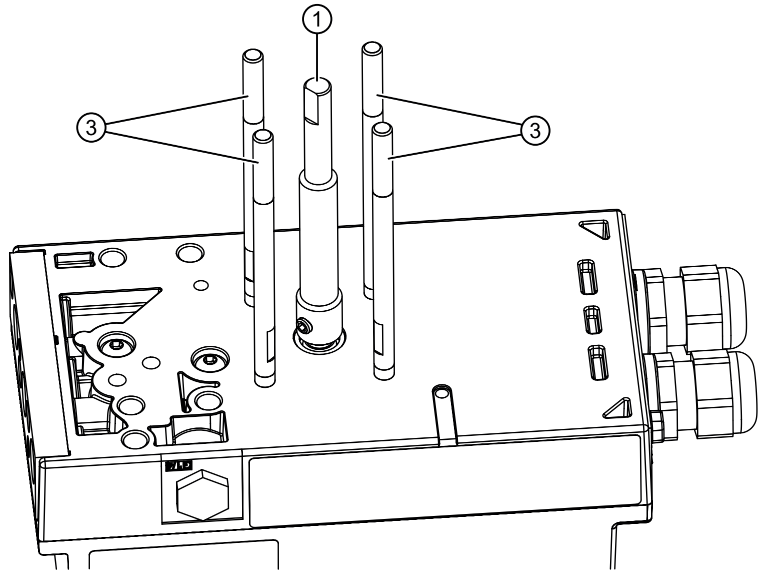


2. Lower the extension shaft ① completely into the positioner.
3. Tighten the locking screw ② at the flat end of the positioner shaft.

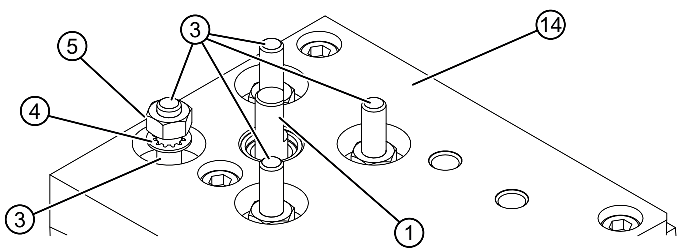


4. Check that the extension shaft ① sits properly.
5. Screw the 4 threaded bolts ③ with the short end of the thread into the positioner.

6. Tighten the threaded bolts ③ around the extension shaft ①.



7. Insert the booster ⑭ via the threaded bolts ③.



8. Fasten the booster ⑭ to the 4 threaded bolts ③ with the lock washers ④ and nuts ⑤. The extension shaft ① can still be rotated manually.

Note

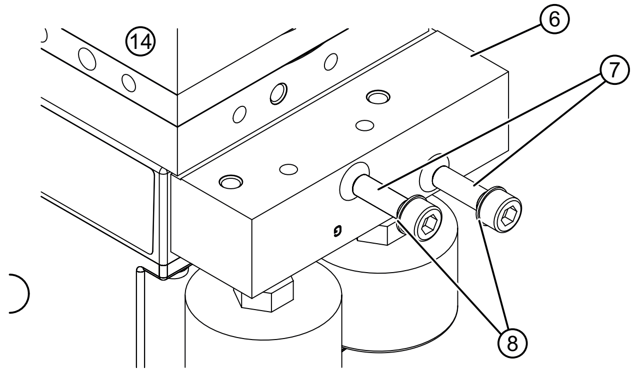
If the extension shaft ① is no longer rotatable

1. Loosen the nuts ⑤.
2. Bring the booster ⑭ in position by turning the extension shaft ①.
3. Tighten the nuts ⑤ again.

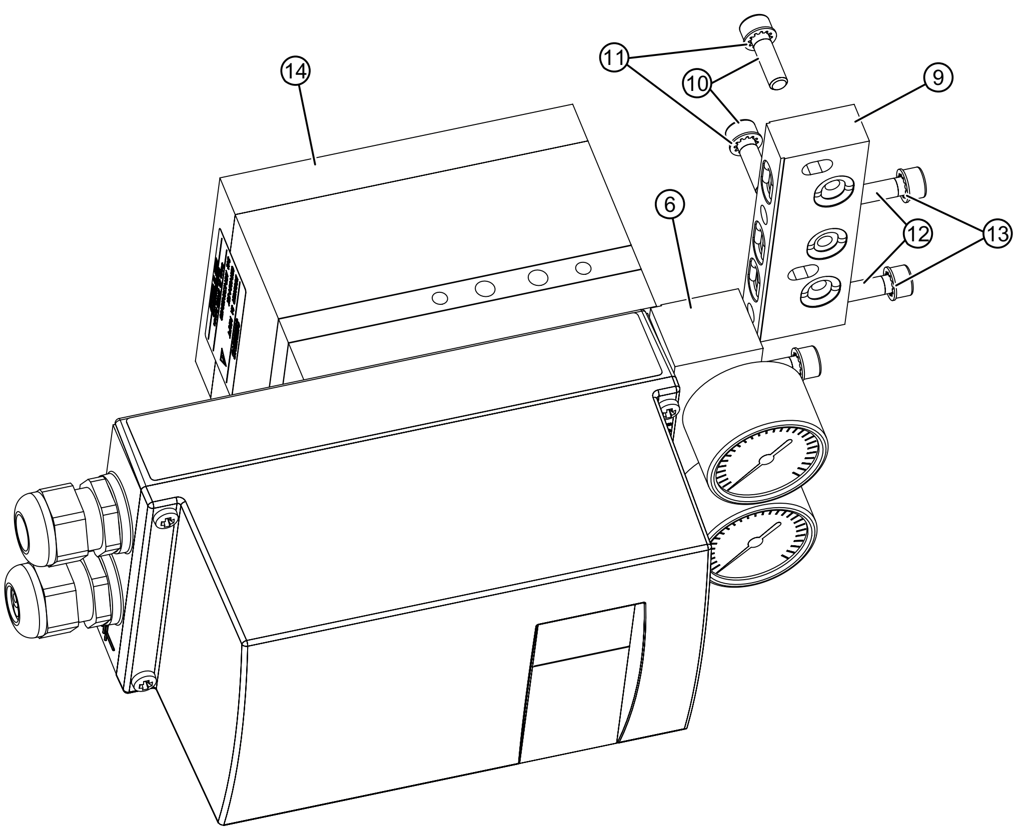
B. Mounting the manometer and connection block

Using the example of a single-acting positioner

1. Fasten the manometer block ⑥ to the positioner with two screws ⑦ and lock washers ⑧.



2. Check whether the O-rings are in the manometer block. There are two O-rings in the single-acting version. There are three O rings with the double-acting version.
3. Apply light pressure to the lock washers ⑧. **The screws are tightened later.**
4. Fasten the connection block ⑨ to the booster with 2 screws ⑫ and 2 lock washers ⑬.

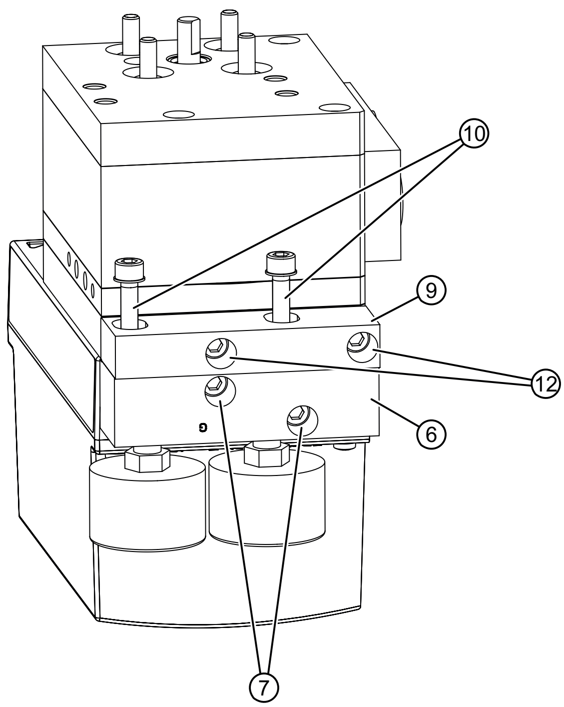


5. Fasten the connection block ⑨ to the manometer block ⑥ with 2 screws ⑩ and 2 lock washers ⑪.

6. Check whether the O-rings are in the manometer block. There are two O-rings in the single-acting version. There are three O-rings with the double-acting version.
7. Apply light pressure to the lock washers ⑬. **The screws are tightened later.**

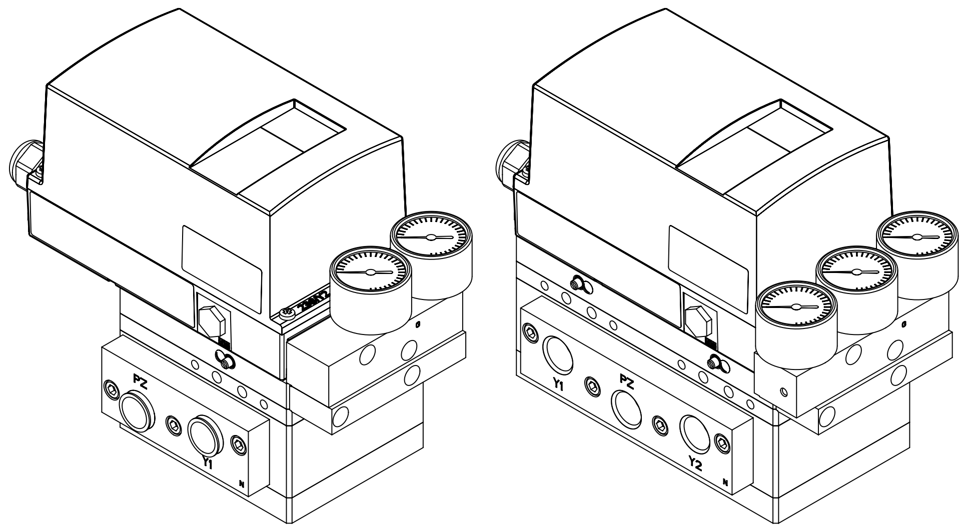
C. Tighten screws

Tighten the screws in the following sequence:



1. Screws ⑦ which are used to fasten the manometer 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 manometer ⑥.
4. Mount the positioner on the actuator as described in:
   – Mounting to linear actuator (Page 39)
   – Mounting to part-turn actuator (Page 44)
5. Use the existing interfaces on the booster.

Result



Left:	Single-acting positioner with mounted booster	Right:	Double-acting positioner with mounted booster

E.4 Booster mounting, flameproof enclosure

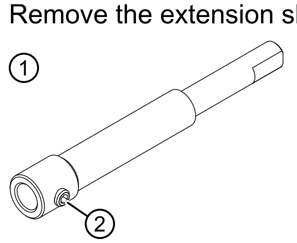
Requirements

1. You are familiar with the safety instructions in section "Installing and mounting (Page 35)".
2. You have one of the following boosters:
   – With single-acting positioners, booster with the article number 6DR4004-1RJ or -1RK
   – With double-acting positioners booster with the article number 6DR4004-2RJ or -2RK

A. Mount extension shaft and booster

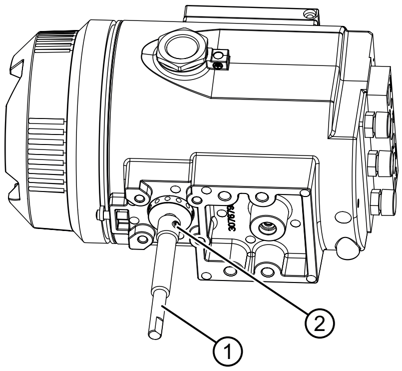
Using the example of a single-acting positioner in a flameproof enclosure (Ex d)

1. Remove the extension shaft ① from the booster mounting kit.

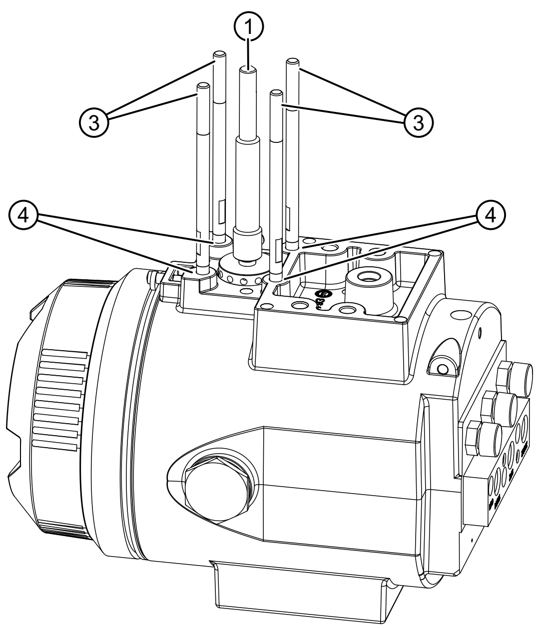


2. Lower the extension shaft ① completely into the positioner.

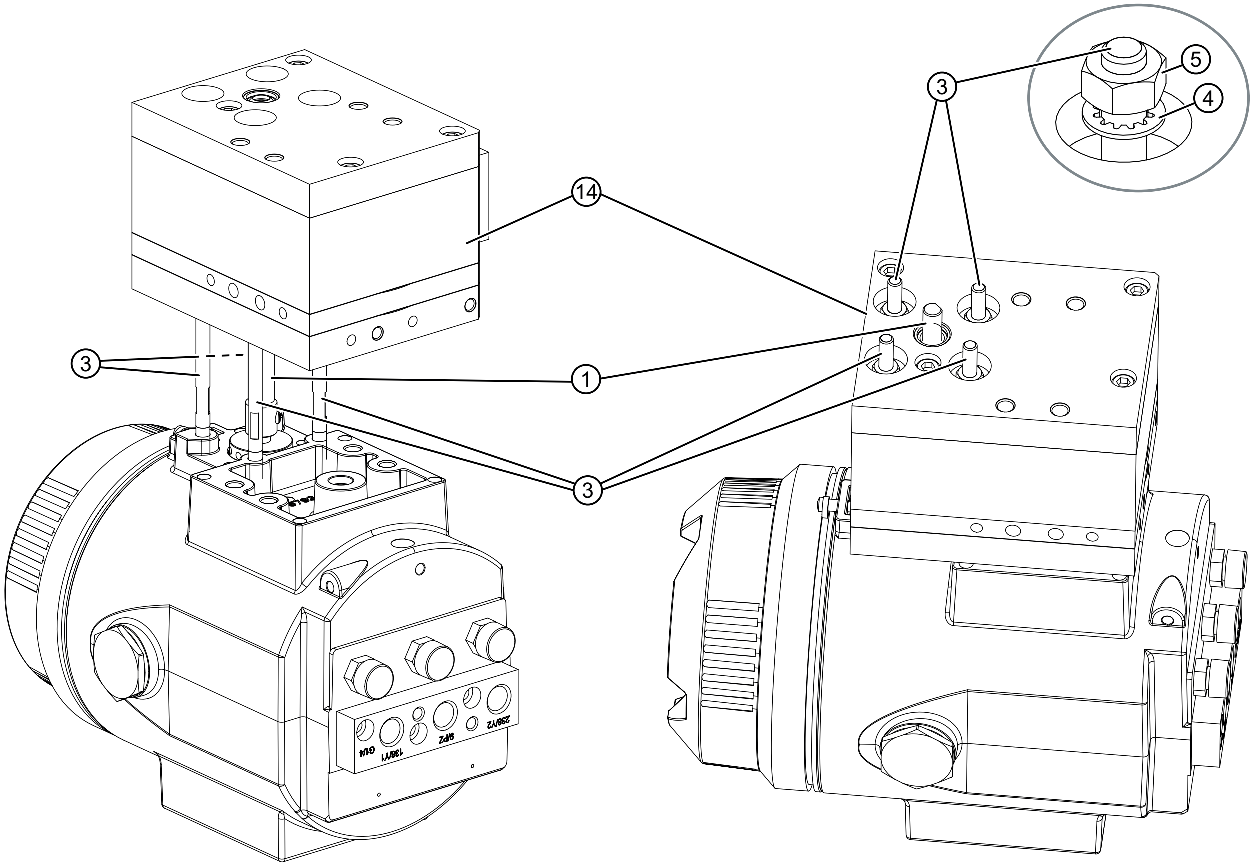
3. Tighten the locking screw ② at the flat end of the positioner shaft.



4. Check that the extension shaft sits properly.
5. Screw the 4 threaded bolts ③ into the 4 holes ④.
6. Turn the threaded bolts ③ at least 5 to max. 9 full revolutions into the hole ④.



7. Insert the booster ⑭ via the threaded bolts ③.



8. Fasten the booster ⑭ to the 4 threaded bolts ③ with the lock washers ④ and nuts ⑤. The extension shaft ① can still be rotated manually.

Note

If the extension shaft ① is no longer rotatable

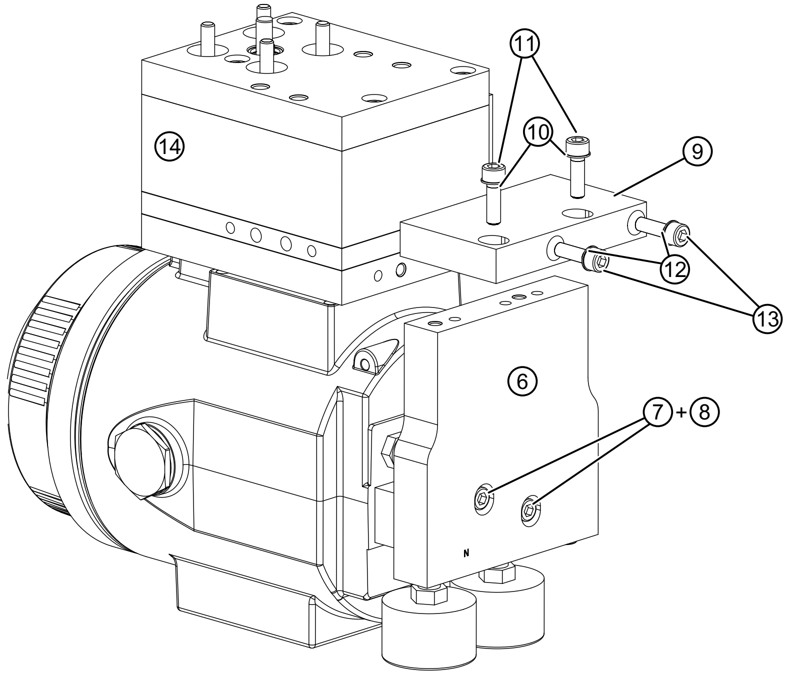
1. Loosen the nuts ⑤.
2. Bring the booster ⑭ in position by turning the extension shaft ①.
3. Tighten the nuts ⑤ again.

B. Mounting the manometer and connection block

Using the example of a single-acting positioner in a flameproof enclosure (Ex d)

1. Fasten the manometer block ⑥ to the positioner with two screws ⑦ and lock washers ⑧.
2. Check whether the O-rings are in the manometer block. There are two O-rings in the single-acting version. There are three O rings with the double-acting version.

3. Apply light pressure to the lock washers ⑧. **The screws are tightened later.**



4. Fasten the connection block ⑨ to the booster with 2 screws ⑫ and 2 lock washers ⑬.
5. Fasten the connection block ⑨ to the manometer block ⑥ with 2 screws ⑩ and 2 lock washers ⑪.
6. Check whether the O-rings are in the manometer block. There are two O-rings in the single-acting version. There are three O-rings with the double-acting version.
7. Apply light pressure to the lock washers ⑬. **The screws are tightened later.**

C. Tighten screws

Tighten the screws in the following sequence:

1. Screws ⑦ which are used to fasten the manometer 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 manometer ⑥.
4. Mount the positioner on the actuator as described in:
   – Mounting to linear actuator (Page 39)
   – Mounting to part-turn actuator (Page 44)
5. Use the existing interfaces on the booster.

Result

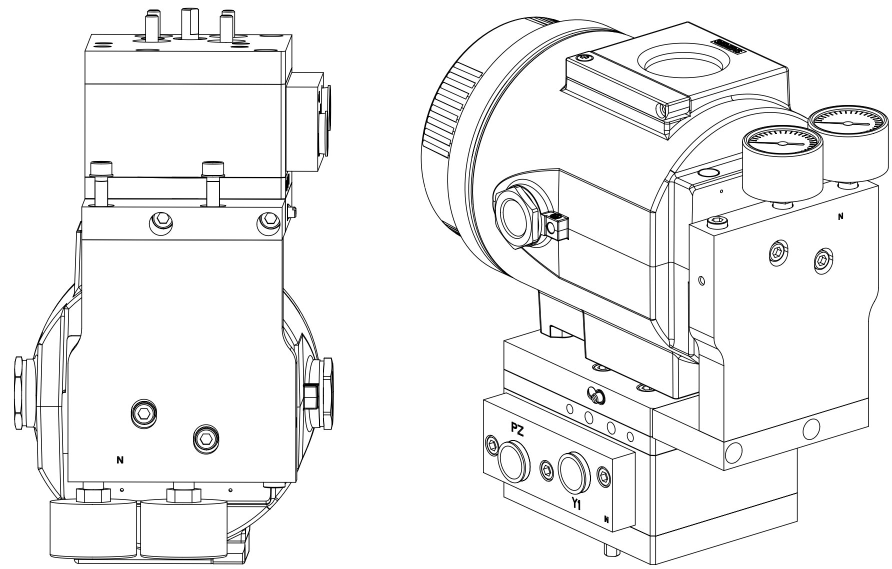


Figure E-1 Ex d: Booster mounted

See also

Mounting to linear actuator (Page 39)

Mounting to part-turn actuator (Page 44)

Basic safety instructions (Page 35)

E.5 Booster commissioning

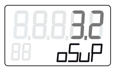
Requirements

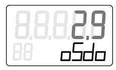
1. You operate the positioner with a booster.
2. '51.PNEUM' Pneumatics type (Page 163) parameter is set to 'booSt'.

Procedure for booster commissioning

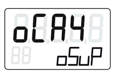
1. Check whether the restrictor(s) on the positioner are completely open. With a new positioner, the restrictors are factory-set to open. The position of the restrictors is shown in the figure in section Device components (Page 26).
2. Set '34.DEBA' Deadband of closed-loop controller (Page 153) to the largest value permissible for your process. The largest value is usually 0.5.
3. Start the automatic initialization process as described under Commissioning (Page 103).

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. Observe the description of your booster.
   If 'oCAY' is shown on the display, the overshoot is less than 3%.

   Adjustment of the booster is sufficient. If you do not achieve the message 'oCAY' (<3% overshoot), try instead to achieve as small a value as possible. Observe the travel time in the process.

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 99).

See also

Sequence of automatic initialization (Page 107)

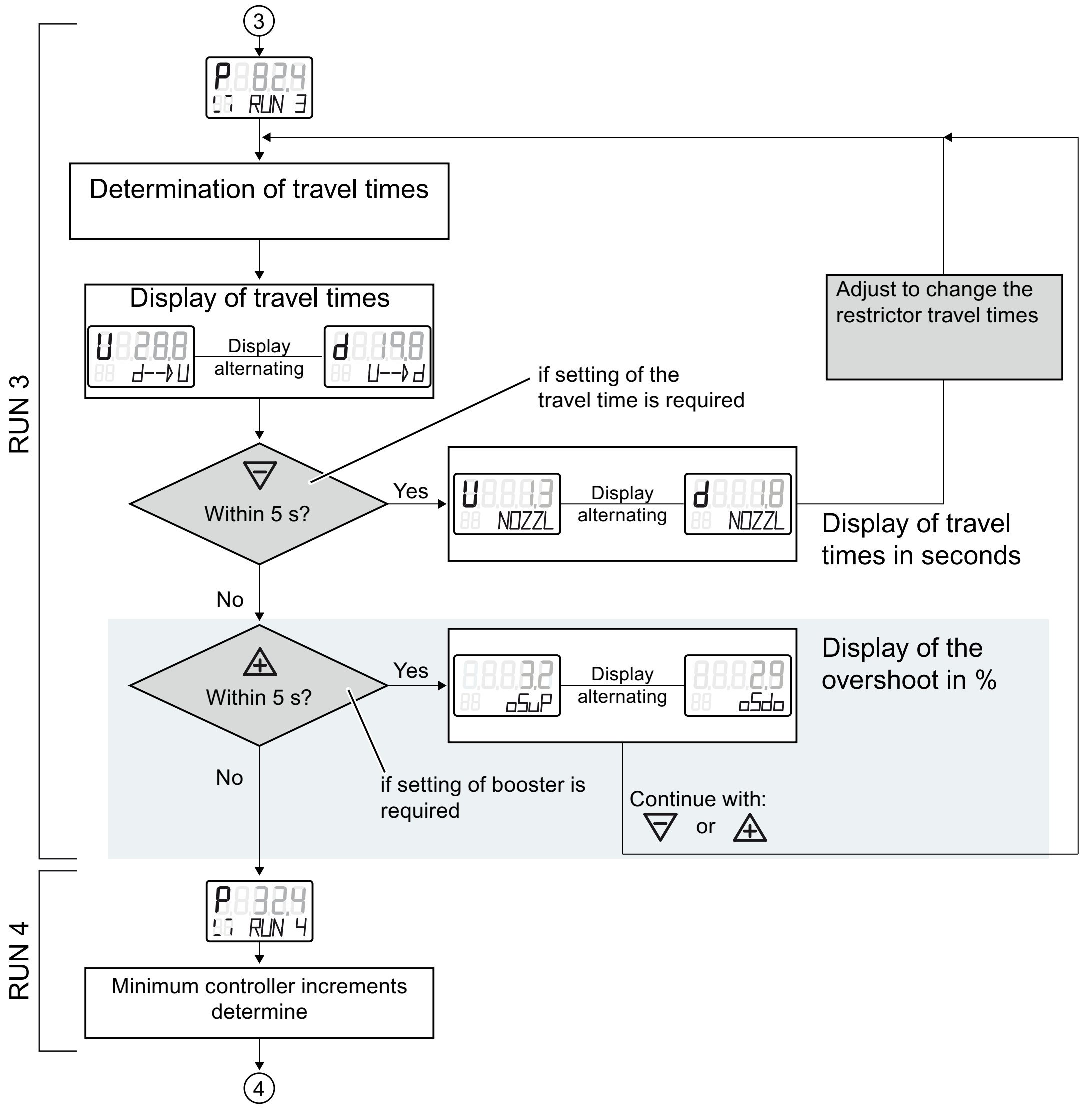


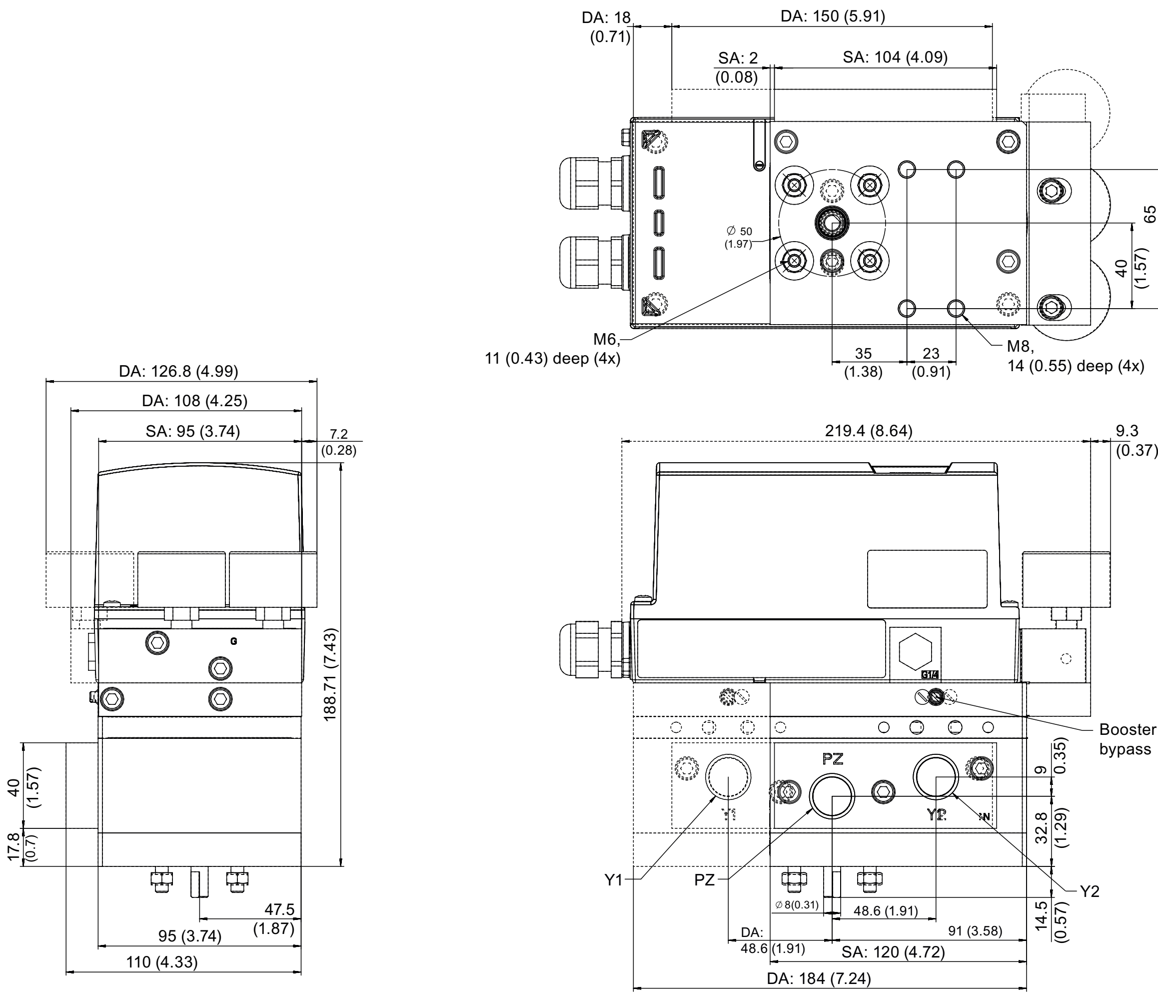
Figure E-2 RUN 3 and 4 (booster)

See also

Commissioning (Page 103)

E.6 Booster dimension drawings

E.6.1 For positioners in non-flameproof enclosure

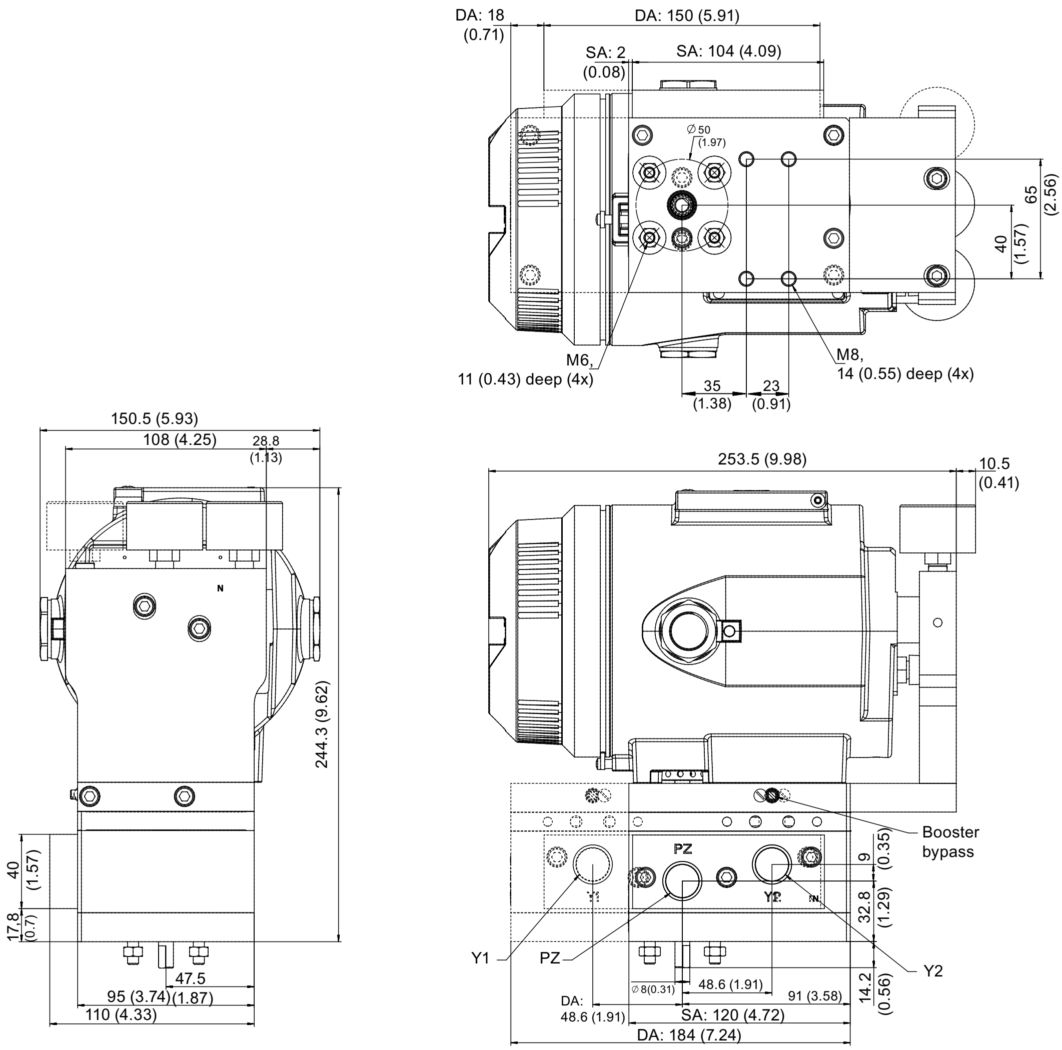


SA Single-acting

DA Double-acting

Figure E-3 Dimension drawings booster mounted on positioner, dimensions in mm (inch)

E.6.2 For positioners in flameproof enclosure



SA	Single-acting
DA	Double-acting

Figure E-4 Dimension drawings booster mounted on positioner in a flameproof enclosure, dimensions in mm (inch)

E.7 Technical specifications of booster

Booster	
Vibration resistance	
• Harmonic oscillations	According to ISA-S75.13
• Bumping (half-sine) according to EN 60068-2-27/02.2010	150 m/s² (492 ft/s²), 6 ms, 1000 shocks/axis
Climate class	According to IEC/EN 60721-3

Booster	
• Storage	1K5, but -40 ... +80°C (1K5, but -40 ... +176°F)
• Transport	2K4, but -40 ... +80°C (2K4, but -40 ... +176°F)
Weight booster, single-acting	
• Booster, single-acting, polycarbonate, with positioner	4.0 kg (8.8 lb)
• Booster, single-acting, polycarbonate, installation kit only	2.9 kg (6.5 lb)
• Booster, single-acting with flameproof enclosure, with positioner	7.9 kg (17.4 lb)
• Booster, single-acting with flameproof enclosure, installation kit only	3.3 kg (7.3 lb)
Weight booster, double-acting	
• Polycarbonate enclosure, with positioner	5.3 kg (11.7 lb)
• Polycarbonate enclosure, installation kit only	4.3 kg (9.4 lb)
• Enclosure with flameproof enclosure, with positioner	9.3 kg (20.5 lb)
• Enclosure with flameproof enclosure, installation kit only	4.7 kg (10.4 lb)
Connections	
• Pneumatic	1/2-14 NPT or G½
• Manometer	1/4-18 NPT or G½
Auxiliary power (air supply)	Compressed air, carbon dioxide (CO2), nitrogen (N), noble gases or cleaned natural gas
• Pressure	1.4 ... 7 bar (20.3 ... 101.5 psi)
• Supply air	According to ISO 8573-1
• Air consumption	1.2 x 10^{-2} Nm^3/h (0.007SCFM)
Manometer	Thread 1/4-18 NPT or G½ with stainless steel enclosure MPa, bar, psi Degree of protection IP66
Flow capacity	Cv 2.0

Positioner with remote control electronics F

F.1 Introduction to remote control electronics

In some cases it is advisable to use the positioner separately from the control electronics. The option of separating the control electronics of the positioner is available for this purpose. The positioner is in a different location than the control electronics. This remote control electronics of the positioner allows the valves to be controlled in radiation contaminated environment, as all highly integrated electronic components are located in the area that is protected from radiation. Highly integrated electronic components are, for example, memory blocks and microprocessor blocks.

For the above described deployment you required the two following components:

- Component 1 consisting of the control electronics in the form of a 19" slide-in module. The 19" slide-in module is installed in the control cabinet and is available in the following two versions:
  - Slide-in module as 4 to 20 mA with 2-wire connection, article number A5E00151560
- Component 2 consisting of the positioner without control electronics. The positioner with control electronics is mounted on the valve.
  - Positioner without control electronics with position detection system and pneumatic unit, mounted on the valve, article number 6DR5910-0NG00-0AA0.
    Positioner without basic electronics 6DR5910 (Page 318)

Components 1 and 2 are connected electrically to each other. The components are described below.

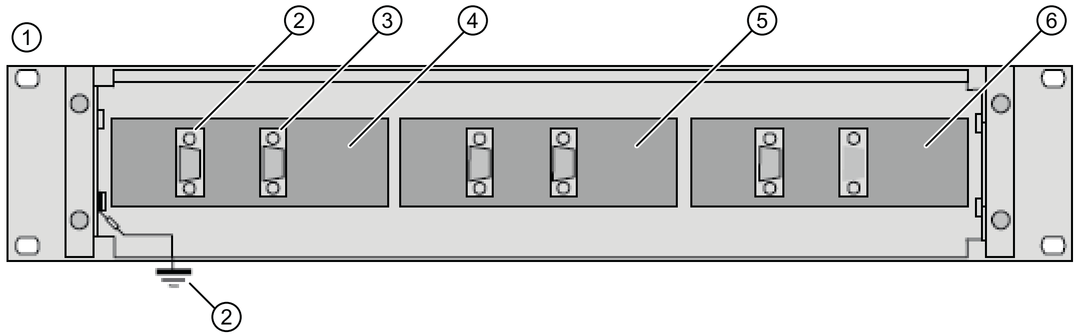
F.2 19" slide-in module

F.2.1 Description of 19" slide-in module 4 to 20 mA

Description

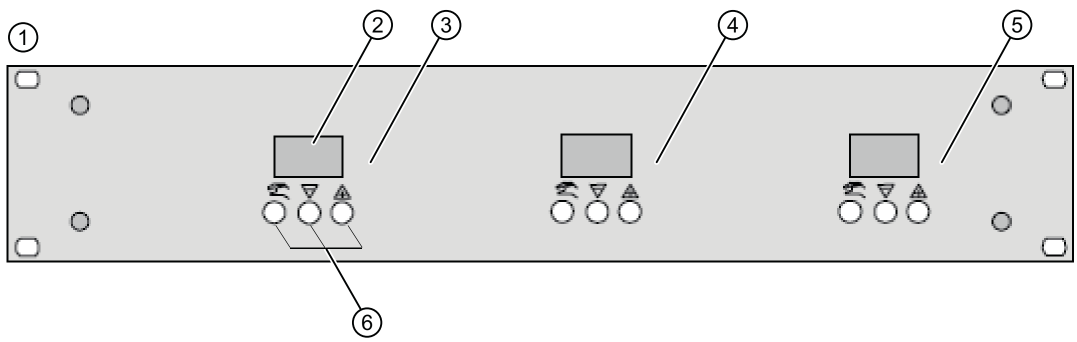
This component is a control electronics in the 19" slide-in module in 4 to 20 mA version. Commissioning is only possible in conjunction with a positioner component 6DR5910. The 19" slide-in module has three channels and controls up to three valves.

The control electronics supplies the current position of the valve in the form of a current of 4 to 20 mA, which corresponds to the position feedback.



①	19" slide-in module 4 to 20 mA	④	Channel 3
②	Sub-D 15-pin socket connector for cable to the valve	⑤	Channel 2
③	Sub-D male connector 9-pin for cable to the control system	⑥	Channel 1

Figure F-1 Device view of 19" slide-in module 4 to 20 mA, rear view



①	19" slide-in module 4 to 20 mA	④	Channel 2
③	Channel 1	⑤	Channel 3
②	Display	⑥	Input keys

Figure F-2 Device view of 19" slide-in module 4 to 20 mA, front view

F.2.2 Connecting the 19" slide-in module 4 to 20 mA

F.2.2.1 Grounding concept of 19" slide-in module 4 to 20 mA

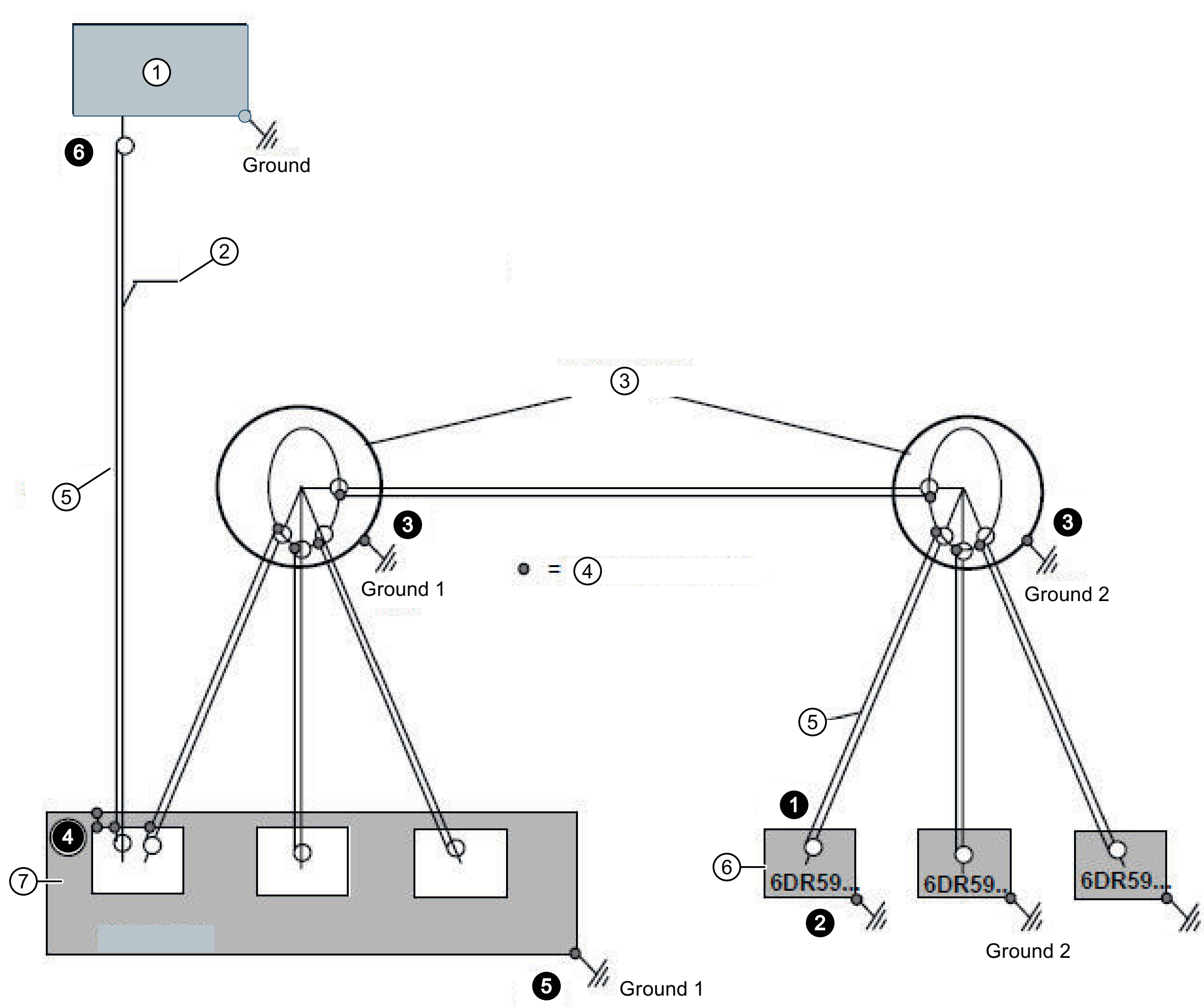
NOTICE
Interference To dissipate interference pulses the positioner components must be connected to an equipotential bonding cable (ground potential) using a low resistance. • Connect the positioner 6DR5910 according to the grounding concept described below.

Note

Properties of the cable

To avoid interference, the cable between 19" slide-in module, positioners 6DR59.. and field distributors should have the following signal pairs (twisted pair):

- Discharge - / Discharge +
- Supply - / Supply +
- GND / POS
- V_REF GND



①	Control system	⑤	Shield
②	3 x 1 cable to the control system	⑥	Positioner 6DR5910
③	Field distributor	⑦	19" slide-in module
④	Connection point		

Ground

Figure F-3 Grounding concept of 19" slide-in module 4 to 20 mA version

Notes on the individual connection points:

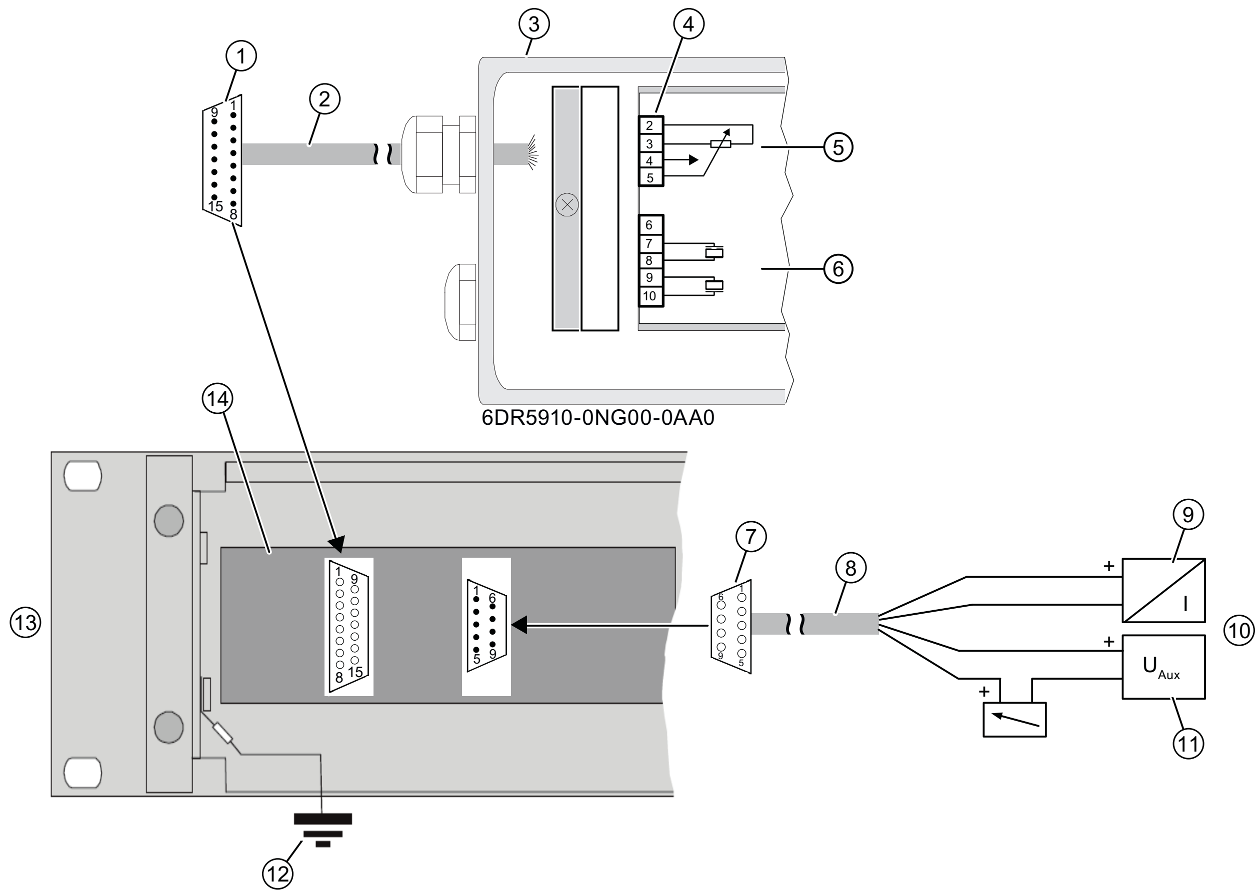
1. The cable shield is not connected to the positioner 6DR5910.
2. The positioner 6DR5910 is connected via the mechanical assembly to Ground 2 , see Installing and mounting (Page 35). Section Basic safety instructions (Page 73) describes how to ground the enclosure.
3. Each field distributor is grounded. The cable shields in the field distributor are not grounded. The cable shields are interconnected.
4. The cable shields on the 19" slide-in module are connected to the field distributor.
5. The 19" slide-in module is connected to Ground 1.
6. The cable shields on the control system are not connected to ground.

F.2.2.2 Electrical connection of 19" slide-in module 4 to 20 mA

Requirement

You have read sections Connection (Page 73) and Grounding concept of 19" slide-in module 4 to 20 mA (Page 312).

Connecting



①	D-SUB male connector 15-pin	⑧	Cable to control system
②	Cable to the positioner 6DR5910	⑨	Signal source
③	Positioner 6DR59..	⑩	Control system
④	Connecting terminals, positioner	⑪	Power source
⑤	Signal cables for potentiometer	⑫	Earth potential
⑥	Signal cables for pneumatic block	⑬	Control electronics in the 19" slide-in module 4 to 20 mA
⑦	D-SUB female connector 9-pin	⑭	Channel 1 of 3

Figure F-4 Connecting basic electronics to power supply

Procedure

Observe the safety instructions for connection in section Basic safety instructions (Page 73).

1. Strip 5 mm of the cable shield on the cable ②.
2. Open the positioner 6DR5910. Unscrew the four fixing screws of the enclosure cover.
3. Insert the prepared cable ② through the cable entry of the positioner.
4. Tighten the cable entry.

5. Connect the wires of the cable ② to the connecting terminals ④ and to the SUB-D male connector ⑦ according to the following table:

Connecting terminals ④ / ⑤	Assignment	Assignment, male connector ①		Connecting terminals ④ / ⑥	Assignment	Assignment, male connector ①
2	GND	7		6	Not assigned	-
3	Vref	6		7	Discharge +	2
4	Vcc	-		8	Discharge -	1
5	Vpos	5		9	Supply +	15
				10	Supply -	14

6. Connect the positioner 6DR5910 ③ with the 19" slide-in module ⑬ using the SUB-D female connector ⑦.
7. Connect the wires of the cable ⑧ to the signal source ⑨ and the power source ⑪ as well as the SUB-D female connector ⑦ according to the following table:

Assignment of female connector ⑦ for ⑪		Assignment of female connector ⑦ for ⑪	
1	Signal source +	6	-
2	Signal source -	7	-
3	-	8	Signal source +
4	-	9	Signal source -
5	-		

8. Connect the 19" slide-in module ⑬ with the control system ⑩ using the SUB-D female connector ⑦.

F.2.3 Technical specifications of 19" slide-in module 4 to 20 mA

You can find the valid technical specifications for the positioner Technical data (Page 237). The technical specifications valid for the 19" slide-in module 4 to 20 mA are set out below.

Rated conditions	
Degree of protection	
• Front	IP40 acc. to DIN EN 60529
• Back page	IP20 acc. to DIN EN 60529
Mounting position	Any
Vibration resistance	
• Harmonic oscillations (sine wave) according to DIN EN 60082-2-6/05.96	3.5 mm (0.14"), 5 ... 8.4 Hz, 4 cycles/axle 10 m/s² (33 ft/s²), 8.4 ... 500 Hz, 4 cycles/axle
• Oscillations (sinusoidal) according to DIN EN 60068-2-6/04.96	KWU DD 7080.9/93 KTA 3503 from 11.86
• Shock (half-sine) according to DIN EN 60068-2-27/02.2010	150 m/s² (492 ft/s²), 11 ms, 6 shocks/axle

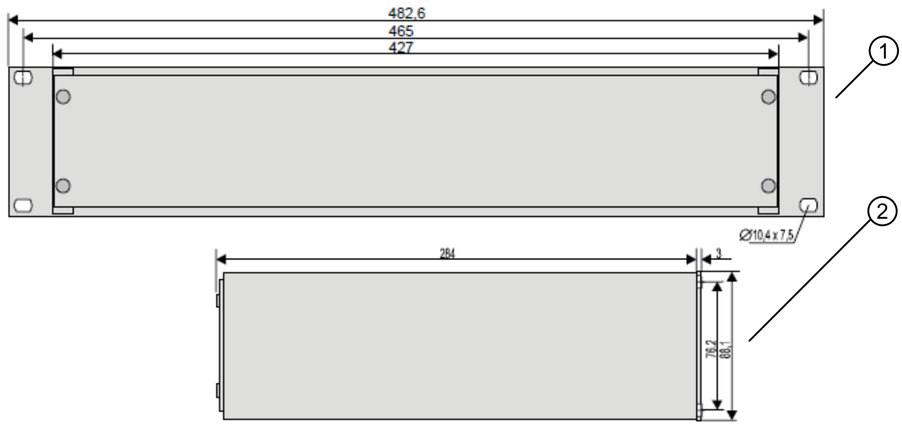
Construction	
Weight	Approx. 1.8 kg
Material body	19" slide-in module, 2HM, aluminum
Number of channels, basic electronics:	3
Climate class	According to IEC/EN 60721-3
• Storage	-25°C to 80°C, 75% at 25°C, without condensation
• Transport	-25°C to 80°C, 75% at 25°C, without condensation
• Operation	0°C to 50°C, 75% at 25°C, without condensation

Electrical data	
Electrical connection	9-pin Sub-D plug 15-pin Sub-D female connector
Current input I_W	
• Rated signal range	4 to 20 mA
• Current to maintain the auxiliary power	≥ 3.6 mA
2-wire connection	
• Current to maintain the auxiliary power	≥ 3.6 mA
• Required load voltage U_B (corresponds to Ω at 20 mA)	6.4 V (= 320 Ω)
• Static destruction limit	± 40 mA

Technical specifications for the controller unit is available at Controller (Page 240).
Technical specifications for the position feedback module is available at Position feedback module (Page 250).

Cable data (minimum requirements)	
Cable length	≤ 130 m
Capacity wire / wire	≤ 150 nF/km
Capacity wire / shield	≤ 200 nF/km
Inductance	≤ 1 mH/km
Copper resistance	≤ 100 Ω/km
Insulation conductance	≥ 0.5 x 10^7 S/km
Ambient temperature	-30 ... +80 °C
Number of poles	
• Cable to the control system (min/max)	4 or 9
• Cable to the positioner 6DR5910	8 or 15
Connection	
• Cable to the control system (min/max)	9-pin Sub-D female connector
• Cable to the positioner 6DR5910	15-pin Sub-D male connector

F.2.4 Dimensional drawing of 19" slide-in module 4 to 20 mA



① Rear view ② Side view

Figure F-5 19" slide-in module 4 to 20 mA, dimensions in mm

The dimensions of the positioner without basic electronics 6DR5910 correspond to the dimensions 6DR5..0. You can find these dimensions in the Positioner in non-flameproof enclosure (Page 255) section.

F.2.5 Scope of delivery of remote control electronics

Description	Article number
19" slide-in module as 4 to 20 mA version, aluminum, 3 channels, non-Ex	A5E00151560
SIPART PS2 without basic electronics, single-acting, polycarbonate enclosure, non-Ex	6DR5910-...

See also

Spare parts (Page 261)

F.3 Positioner without basic electronics 6DR5910

This component is a positioner without basic electronics (6DR5910). Commissioning is only possible in conjunction with a basic electronics component in the form of a 19" slide-in module. The positioner without basic electronics is available in the device version in polycarbonate enclosure, single-acting.

The following section describes how you mount, connect and commission the positioner without basic electronics.

Installing/mounting

Mounting of this positioner without basic electronics corresponds to the mounting of the positioner in non-flameproof enclosure. Proceed as described in Section "Installing and mounting (Page 35)".

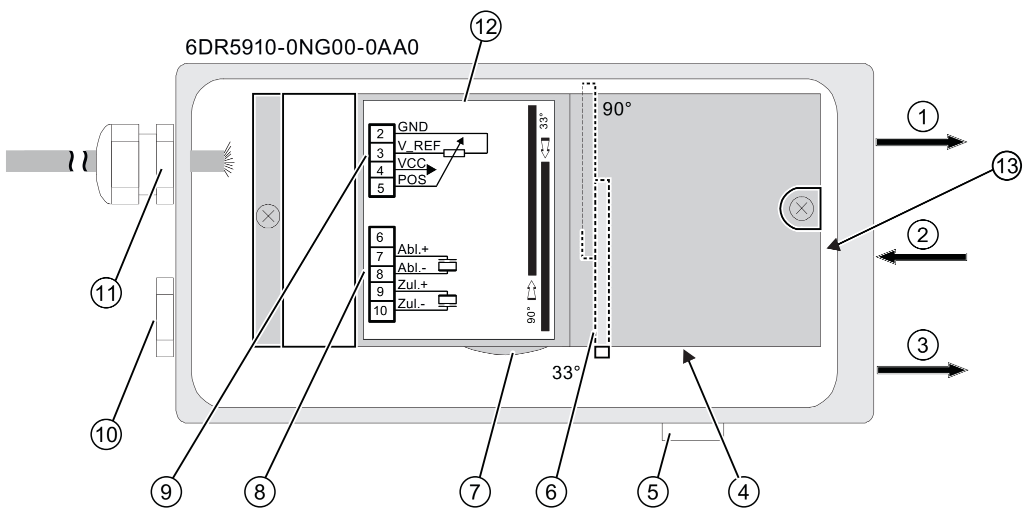
Connecting

Connect the positioner as described in Section "Positioner without basic electronics 6DR5910 (Page 318)". Please also observe Basic safety instructions (Page 73) for connection.

Commissioning

Commission the positioner as described in Section "Commissioning (Page 103)".

Device view of positioner 6DR5910



① Output: Actuating pressure Y1
② Input: Supply air PZ
③ *Output: Actuating pressure Y2 (not for 6DR59..)*
④ Restrictor Y1
⑤ Exhaust air outlet with a sound absorber
⑥ Transmission ratio selector
⑦ Friction clutch adjustment wheel
⑧ Connecting terminals of valve
⑨ Connecting terminals of potentiometer
⑩ Blanking plug
⑪ Cable gland
⑫ Wiring diagram on module cover
⑬ Purge air switch

Abbreviations G

G.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 contactless 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.
SIA	Slit initiator alarm module	Option module of the positioner
VDE	Verband der Elektrotechnik, Elektronik und Informationstechnik e. V.	Industrial and professional association
VDI	Verein Deutscher Ingenieure e. V.	Technical/scientific association

G.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

Abbreviation	Full term in English	Meaning
PFD_{AVG}	Average Probability of Dangerous Failure on Demand	Average probability of dangerous failures of a safety function on demand
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

Actuator

Converter that converts electric signals into mechanical or other non-electric variables.

Actuator chamber

For pneumatic actuators which consist of two pressure chambers in double-acting versions and of a pressure chamber and a spring chamber in single-acting versions.

Analog

A signal type which represents data using continuously varying, measurable and physical quantities, e.g. current or voltage. Opposite to digital. The range between 4 and 20 mA is often used to transfer analog signals.

Analog-to-digital converter

An analog-to-digital converter is an interface between the analog environment and the digitally working computers. Only then can the computers be used for measurement and control tasks.

Analog-to-digital converters convert analog input signals to digital signals. Analog measurement data is thus converted into digital information. On the other hand, a digital-to-analog converter coverts digital information into analog signals.

Asset Management Solution (AMS)

Software package by Emerson Process. The AMS Device Manager, which is somewhat similar to the PDM, is the most significant part of the package.

ATEX

ATEX is the abbreviation of the French term "Atmosphère explosible". ATEX stands for the two directives of the European Community in the field of explosion protection: the ATEX product directive 2014/34/EU and the ATEX operation directive 1999/92/EC.

Auxiliary voltage

Auxiliary voltage is an electric supply or reference voltage that is required by some electric circuits in addition to the standard supply. The auxiliary voltage can, for example, be specially stabilized, have a particular level or polarity and/or other properties which are important for the correct functioning of switch components. Auxiliary voltage is used, for example, with four-wire systems.

Chamber

A largely or completely enclosed cavity in a machine or apparatus.

Conduit piping system

A piping system for the American market, wherein the electric and pneumatic lines are protected by a casing.

Configuring

See parameter assignment.

Control fitting

A valve consisting of an actuator + control valve + positioner.

Cornerstone

Management software for process instrumentation.

Decrement

From the Latin word decrementare, decrease. Decrement is the defined amount of change when decreasing a variable gradually. IT term that refers to a step-by-step decrease in a numeric value.→Increment.

Degree of protection

The degree of protection of a device indicates the extent of protection. The extent of protection includes the safety of persons against coming in contact with live or rotating parts, and the protection of electric resources against the penetration of water, foreign bodies and dust. The degrees of protection of electric machines are indicated by an abbreviation comprising two letters and two numbers (e.g. IP55). The degree of protection is coded using the IP code. The degrees of protection are standardized in DIN EN 60529.

Device category 1

Category 1 devices must be procured such that they ensure an extremely high degree of safety. Devices in this category must ensure an extremely high degree of safety even for faults that occur rarely. Even if two faults occur in the device, it should not lead to ignition. Devices in this category are suitable for use in zone 0 or 20.

Device category 2

Category 2 devices must be procured such that they ensure a high degree of safety. Devices in this category must ensure the required degree of safety in case of frequent faults or ones that can be normally expected, e.g. defects in the device, and avoid ignition sources. Devices in this category are suitable for use in zone 1 or 21.

Device category 3

Category 3 devices must be procured such that they ensure a normal degree of safety. Devices in this category must ensure the required degree of safety in case of frequent faults or ones that can be normally expected, e.g. defects in the device, and avoid ignition sources. Devices in this category are suitable for use in zone 2 or 22.

Digital

Representation of a variable in the form of characters or numbers. The functional course of an originally changeable analog variable is simulated in predefined stages. Predefined values are assigned to these stages. Opposite to "analog".

EEPROM

EEPROM (Electrically Erasable Programmable Read-Only Memory; literally: elektrisch löschbarer, programmierbarer Nur-Lese-Speicher in German) is a non-volatile electronic memory. EEPROMs are often used when individual data bytes change over long time periods and need to be saved in a manner protected against power failure, e.g. configuration data or operating hours counters.

Electromagnetic compatibility

Definition as per the EMC law: EMC is the capability of a device to operate satisfactorily in an electromagnetic environment without itself emitting electromagnetic signals which interfere with other devices in that environment.

Ex d

"Flameproof enclosure" type of protection. When the potentially explosive mixtures enter the enclosure of a resource and an ignition source exists in the enclosure. The transfer of the explosion inside the enclosure to the surrounding space must be ruled out.

- d: flameproof enclosure

Ex ia / Ex ib / Ex ic

If potentially explosive mixtures enter the enclosure of a resource, it should not lead to ignition. Demarcation of energy and increased temperatures.

Ex n

Equipment containing energy-limiting, non-sparking contacts as well as circuits whose contacts are supplied with limited energy.

Ex t

Dust ignition protection with "t" enclosure. Dust ignition protection where the electric equipment has an enclosure providing protection against dust ingress and a measure for limiting the surface temperature.

Factory Mutual

Industrial property insurer and certification agency in the USA. FM Global is one of the largest industrial insurers in the world who are specialized in the field of technically-supported property insurance. It offers services like product research, testing and certification.

Failure that causes a dangerous situation

Failure with the potential to switch a safety-instrumented system to a hazardous or non-functioning safety status.

Firmware

Firmware (FW) is software that is embedded on a chip in electronic devices – in contrast to software which is saved on hard disks, CD-ROMs or other media. These days, firmware is mostly stored in a flash memory or an EEPROM. Firmware is software in the hardware, and is thus an intermediate between software and hardware. Firmware is normally model-specific. This means that it does not function on other device models and is delivered by the manufacturing company. The corresponding devices cannot function without the firmware. The firmware mostly contains elementary functions to control the device, as well as input and output routines.

Frequency shift keying

ENGLISH: Frequency shift keying (FSK)

Frequency shift keying is a simple modulation format in which digital values 0 and 1 are represented by two different frequencies.

GSD file

The file that describes the properties of a PROFIBUS DP slave or a PROFINET IO device.

The GSD file is a database file for PROFIBUS devices. The device manufacturer provides the corresponding GSD file containing the description of device properties. The information in the file can be read using Engineering Tools.

HART

HART (Highway Addressable Remote Transducer) is a standardized and widely used communication system for configuring industrial fieldbuses. This communication system enables digital communication of multiple participants (field devices) using a common data bus. HART implements the widely used 4/20 mA standard to transfer analog sensor signals. Existing cables of the old system can be used directly and both systems can be operated simultaneously. HART specifies several protocol levels in the OSI model. HART enables transfer of process and diagnostics information and control signals between field devices and the higher-level control system. Standardized parameter sets can be used for manufacturer-independent operation of all HART devices.

HART communication

HART devices use the 4 to 20 mA lines for data exchange, and communicate with each other using the HART protocol. The process enables bidirectional data exchange even in hazardous environments. With HART communication, digital data from an FSK modem is modulated to the analog 4 to 20 mA signals. As a result, additional information such as measuring and/or device data can be transmitted without influencing the analog signals. The FSK modem required for this is installed in the field device or HART communicator. In the case of an operator station, the connection is made externally via the serial interface. A point-to-point connection is used between the field and HMI device. In this case, a HART HMI device is connected to exactly one HART field device. However, further devices can be integrated using a multiplexer.

HART communicator

For parameter assignment with the HART Communicator, the connection is made directly to the 2-wire cable. For parameter assignment with a laptop or a PC, a HART modem is connected in between.

Increment

From the Latin word incrementare, increase. Increment is the defined amount of change when increasing a variable gradually. IT term that refers to a step-by-step increase in a numeric value.→Decrement.

Initialization

Setting the most important basic parameters. Requirement for commissioning the positioner.

IP code

The abbreviation IP stands for International Protection as per DIN. In English-speaking countries, IP stands for Ingress Protection.

Microcontroller

Microcontrollers (also µController, µC, MCU) are single-chip computer systems in which almost all components such as master processor, program memory, working memory and input/output interfaces are included in a single chip.

NAMUR

Standardization association for measurement and control in chemical industries. NAMUR is an association of users of process control technology. The members are mainly companies from German-speaking countries. The association was formed in Leverkusen in 1949.

NEMA

National Electrical Manufacturers Association. NEMA is a standardization institute in the USA. NEMA was formed in 1926 with the merge of Associated Manufacturers of Electrical Supplies and the Electric Power Club.

Parameter assignment

Individual parameter settings are specifically changed to adjust the positioner as per the actuator or other requirements. Parameter assignment is carried out after the complete commissioning of the positioner.

Piezoelectric effect

Name of a physical phenomenon. Due to mechanical compression loads on a crystal, an electric potential develops on specific crystal surfaces. In a reverse case, applying an electric field to specific crystal surfaces leads to crystal deformation.

Potentially explosive atmosphere

Mixture of air, combustible gases, fluff, fibers or dusts.

Pressure chamber

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

Process Device Manager

PDM is a Siemens software package for configuration, parameter assignment, commissioning and maintenance of network configurations and field devices. Part of SIMATIC STEP 7. Used for configuration and diagnostics.

Protection level

- ia: Protection level. Electric equipment operating fault-free, and with existence of two countable errors.
- ib: Protection level. Electric equipment operating fault-free, and with existence of one countable error.
- ic: Protection level. Electrical equipment is not able to cause an ignition when operating fault-free.

Protocols

Protocols contain information about data formats, time sequences and error handling when exchanging data between computers.

A protocol is a convention about establishing, monitoring and terminating a connection. Different protocols are required for a data connection. Protocols can be assigned to every layer of the reference model. Transport protocols are used for the lower four layers of the reference model and higher protocols are used for control, data provision and application.

Safety function

Defined function executed by a safety-instrumented system with the objective of attaining or maintaining a safe status of the system by taking a defined hazardous incident into account.

Example: limit pressure monitoring

Safety-instrumented system

A safety-instrumented system (SIS) executes safety functions that are required to attain or maintain the safe status in a system. It consists of sensors, logic unit/control system and final controlling elements.

Example: a safety-instrumented system consists of a pressure transmitter, a limit signal indicator and a servo valve.

Sensor

Converter that converts mechanical or other non-electric variables into electric signals.

SIL

The international standard IEC 61508 defines four discrete safety integrity levels (SIL) from SIL 1 to SIL 4. Every level indicates a probability range for the failure of the safety function. The higher the SIL of the safety-instrumented system, the higher the probability that the required safety function works. The achievable SIL is determined by the following safety-instrumented characteristics:

- Average probability of dangerous failures of a safety function on demand (PFDAVG)
- Hardware fault tolerance (HFT)
- Safe failure fraction (SFF)

SIMATIC software

Programs for process automation (e.g. PCS 7, WinCC, WinAC, PDM, STEP 7).

Type 4X

according to UL 50E. This standard contains additional requirements relating to the design and performance of enclosures which are to be used indoors and outdoors.

Zone 0

Area in which potentially explosive atmospheres build up often, regularly or over long durations during the normal operation of a device.

Zone 1

Area in which potentially explosive atmospheres build up occasionally during the normal operation of a device.

Zone 2

Area in which a potentially explosive atmosphere normally never builds up or builds up only for a short while during the normal operation of a device.

Zone 20

Zone 20 is an area in which a potentially explosive atmosphere in the form of a cloud of combustible dust in air is present continuously, over a long period, or frequently.

Zone 21

Zone 21 is an area in which a potentially explosive atmosphere in the form of a cloud of combustible dust in air can be occasionally produced during normal operation.

Zone 22

Zone 22 is an area in which a potentially explosive gaseous atmosphere in the form of a cloud of combustible dust in air never develops or develops only for a short while during normal operation.

Index

G

H

I

L

M

N

T

V

W

Y