SIEMENS

SIPART

Electropneumatic positioners
SIPART PS2 with and without HART

Operating Instructions

Edition 02/2016

Answers for industry.

SIEMENS

SIPART

Electropneumatic positioners SIPART PS2 with and without HART

Operating Instructions

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

02/2016
A5E00074631-AB

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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Order number: A5E00074631
℗ 11/2015 Subject to change

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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 History

This history establishes the correlation between the current documentation and the valid firmware of the device.

The documentation of this edition is applicable for the following firmware:

Edition	Firmware identifier nameplate
02/2016	As of FW 5.00.00

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

Edition	Note
02/2016	1. Section Installing/mounting (Page 35) > Simpler commissioning of part-turn actuators using coupling wheel with two pins 2. Section Technical data (Page 243) > Expansion of permissible ambient temperature for operation at -40 °C for SIPART PS2 device version with and without HART; Order suffix -Z M40

See also

Structure (Page 21)

Positioner with flameproof enclosure (Page 265)

Tabular overview of the parameters (Page 147)

Diagnostics (Page 207)

1.3 Purpose

The electropneumatic positioner is used for the continuous control of process valves with pneumatic drives in the following industries.

- Chemicals
- Oil and gas
- Energy production
- Food and beverages
- Pulp and paper
- Water/waste water
- Pharmaceutical industry
- Offshore plants

Operate the device according to the specifications in section "Technical data (Page 243)".

For additional information, refer to the operating instructions for the device.

1.4 Checking the consignment

1. Check the packaging and the delivered items for visible damage.
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 Danger of explosion in hazardous areas. • Do not use damaged or incomplete devices.

1.5 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.

⚠ CAUTION

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 243).

1.6 Product information

The programming manual is an integral part of the CD, which is either supplied or can be ordered. The programming manual is also available on the Siemens homepage.

On the CD, you will also find the catalog extract with the ordering data, the Software Device Install for SIMATIC PDM for additional installation, and the required software.

See also

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

Contacts (http://www.siemens.com/processinstrumentation/contacts)

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

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	Meaning
	Consult operating instructions

2.3 Laws and directives

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

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

Further provisions for hazardous area applications are for example:

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

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 2004/108/EC	Directive of the European Parliament and of the Council on the approximation of the laws of the Member States relating to electromagnetic compatibility and repealing Directive 89/336/EEC.
Atmosphère explosible ATEX 94/9/EC	Directive of the European Parliament and the Council on the approximation of the laws of the Member States concerning equipment and protective systems intended for use in potentially explosive atmospheres.
LVD 2006/95/EC	Directive of the European Parliament and of the Council of the harmonisation of the laws of Member States relating to electrical equipment designed for use within certain voltage limits.

The applied standards can be found in the EC conformity declaration of the device.

2.5 Improper device modifications

⚠ WARNING

Improper device modifications

Danger 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 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.

2.7 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

Unsuitable device for the hazardous area

Danger of explosion.

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

⚠ WARNING

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

If the device has 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 danger 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 Chapter "Technical data (Page 243)".

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 ±Δy 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:

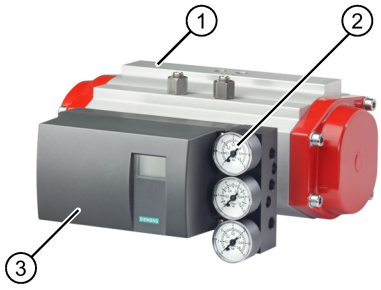
- Linear actuator
- Part-turn actuator VDI/VDE 3845

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

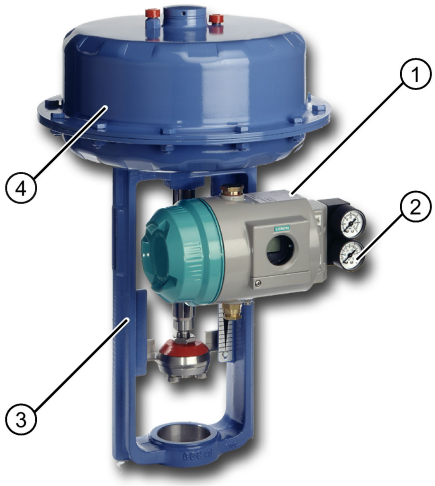
① Pressure gauge block, single-acting
② Valve
③ Yoke / actuator yoke
④ Single-acting positioner in non-flameproof aluminum enclosure
⑤ Actuator

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



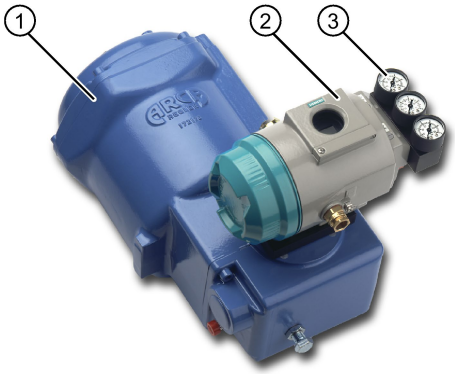
① Part-turn actuator
② Pressure gauge block, double-acting
③ Double-acting positioner in Makrolon enclosure

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

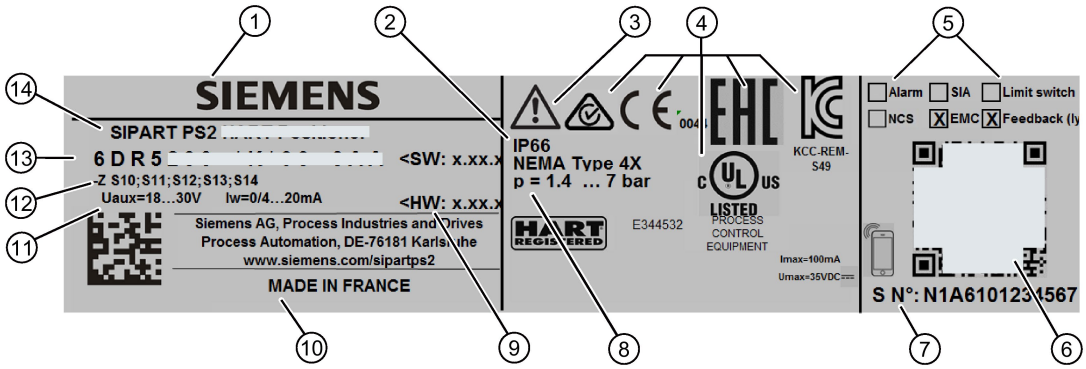


① Part-turn actuator
② Double-acting positioner in flameproof aluminum enclosure
③ Pressure gauge block, double-acting

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

3.2.2 Nameplate layout

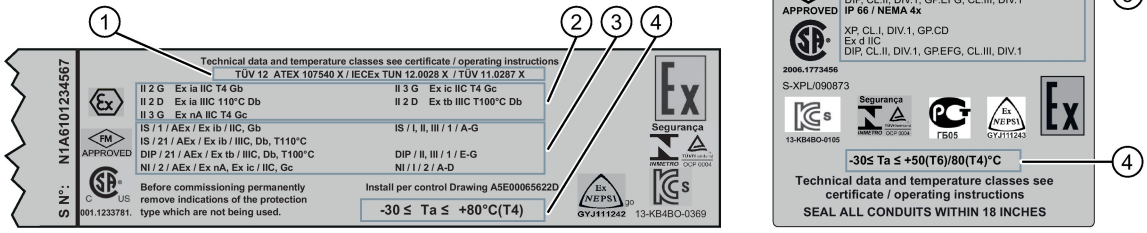
Layout of the nameplate



① Manufacturer
② Protection class
③ Consult operating instructions
④ Conformity with country-specific directives
⑤ Built-in option module
⑥ QR code to the mobile website with device-specific information on the product
⑦ Serial number
⑧ Auxiliary power (supply air PZ)
⑨ Software/hardware version
⑩ Place of manufacture
⑪ Auxiliary power
⑫ Ordering supplement (Order code)
⑬ Article number
⑭ Product name

Figure 3-5 Nameplate layout, example

Layout of Ex nameplate

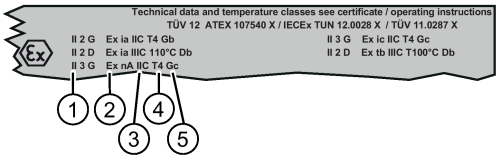


① Approvals
② ATEX/IECEx marking for hazardous area
③ FM/CSA marking for hazardous area
④ Permitted ambient temperature for the hazardous area of the corresponding temperature class

Figure 3-6 Ex nameplate layout, example

3.2.3 Explanation of Ex information

Explanation of Ex information



① Category for operating range

② Type of protection

③ Group (gas, dust)

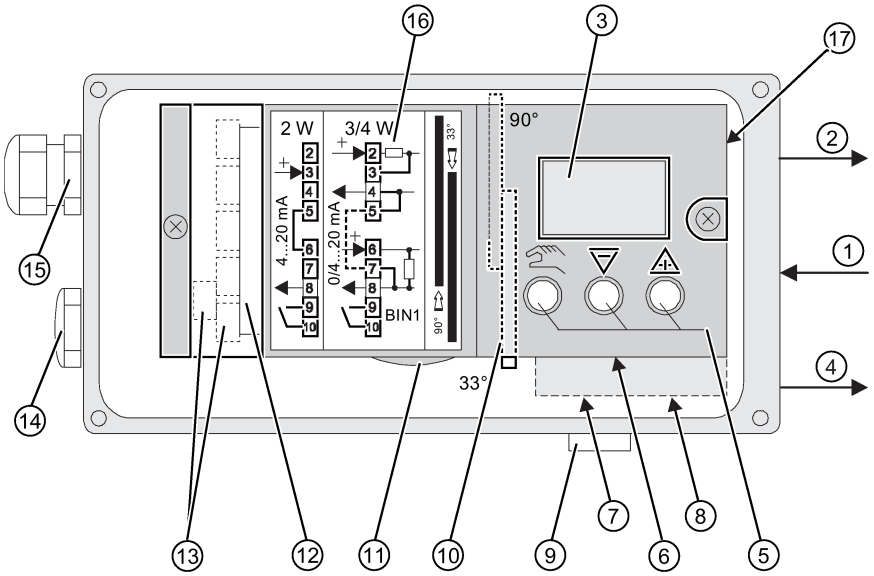
④ Maximum surface temperature (temperature class)

⑤ Device protection level

Figure 3-7 Explanation of Ex information

3.3 Device components

3.3.1 Overview of device components

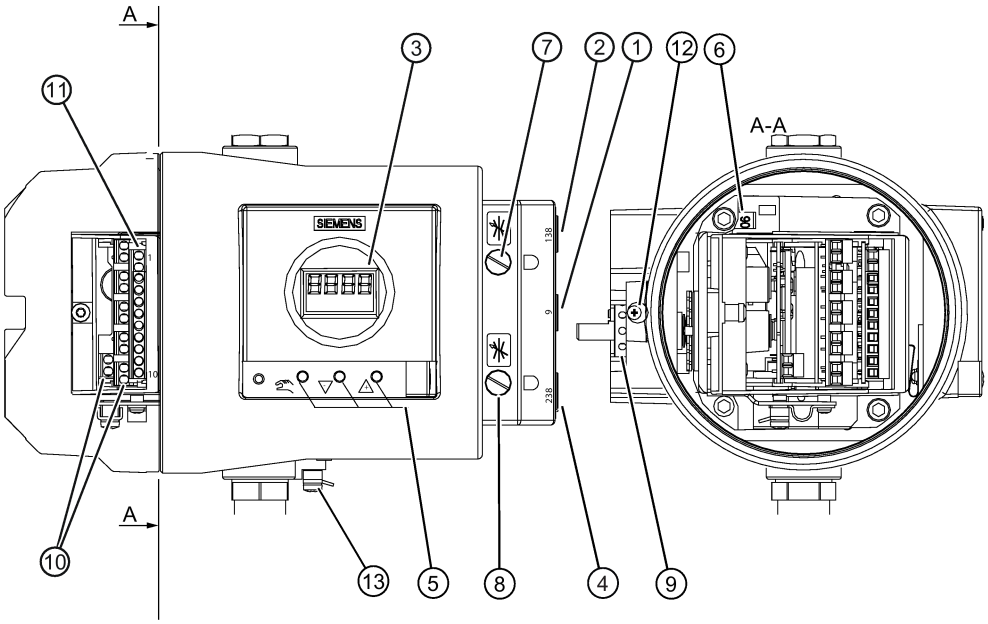


① Input: Supply air PZ
② Output: Actuating pressure Y1
③ Display
④ Output: Actuating pressure Y2 [1)]
⑤ Buttons
⑥ Restrictor Y1 for single-acting actuators
⑦ Restrictor Y1 for double-acting actuators
⑧ Restrictor Y2 for double-acting actuators
⑨ Exhaust air outlet with a sound absorber
⑩ Transmission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

[1)] for double-acting actuators

[2)] only possible when positioner is open

Figure 3-8 View of positioner with cover open



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

[1] for double-acting actuators

[2] only possible when positioner is open

Figure 3-9 View of positioner in flameproof enclosure, cover opened

3.3.2 Basic electronics

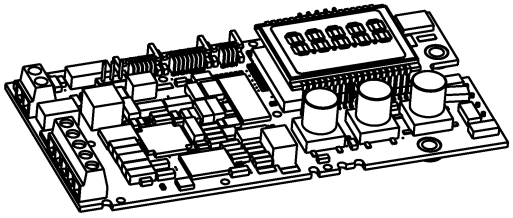


Figure 3-10 Basic electronics, schematic representation

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 change 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.

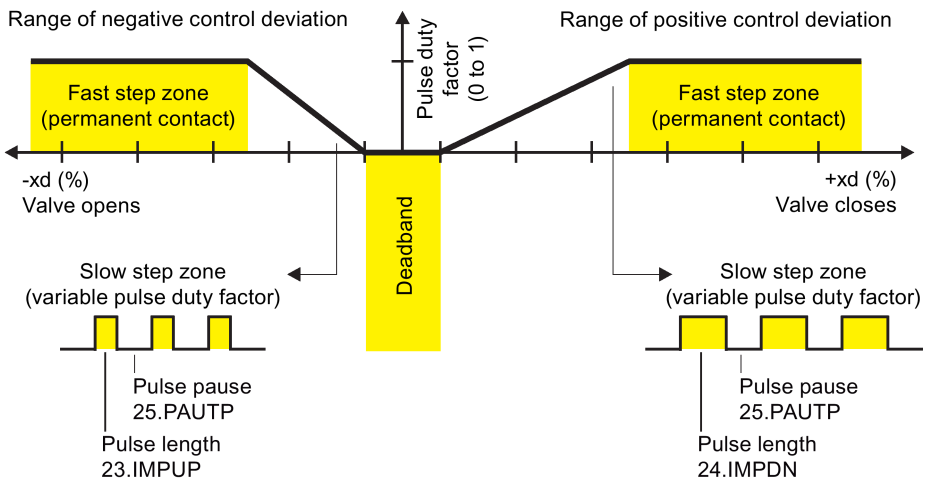


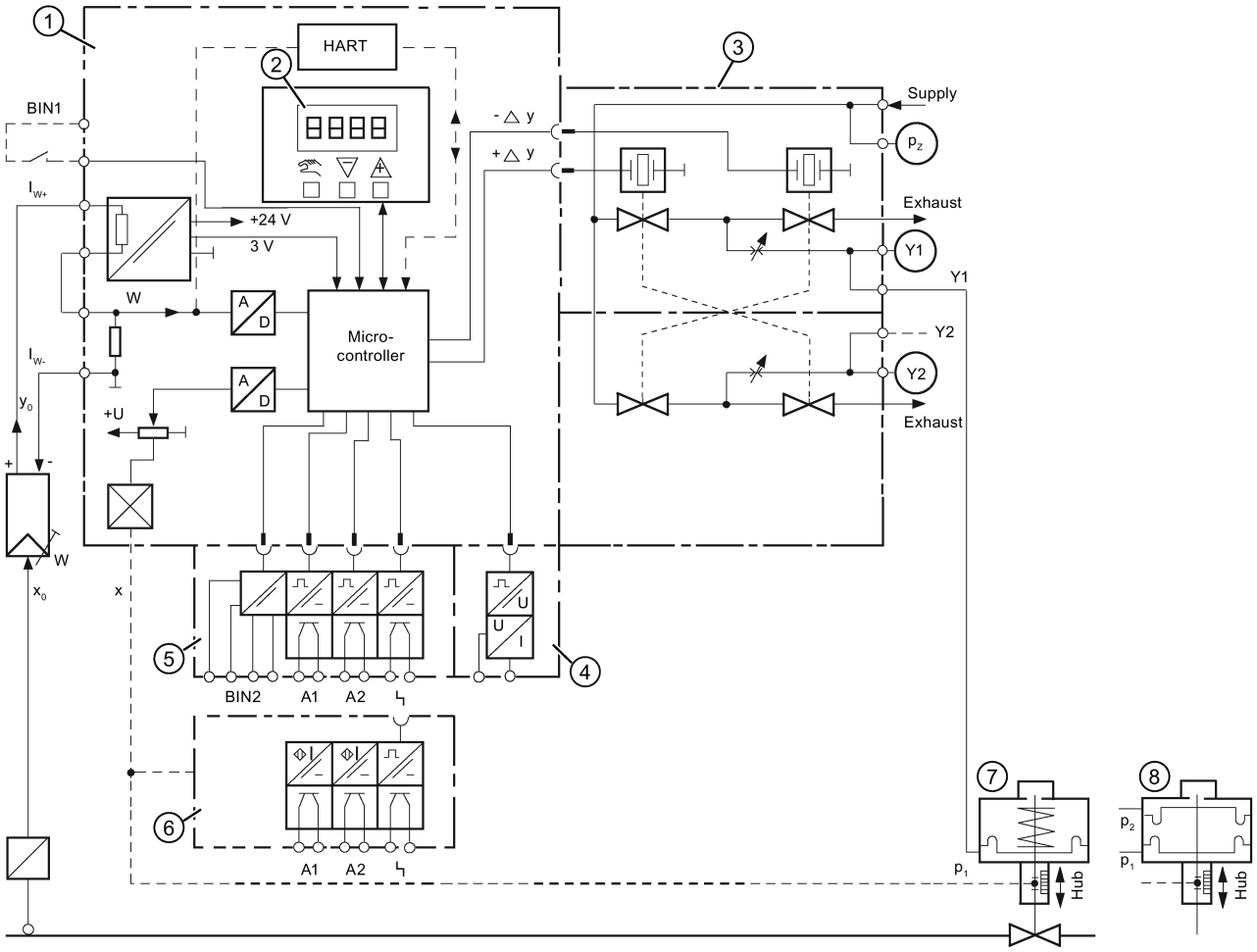
Figure 3-11 Functional principle of five-point controller

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 Spring-loaded pneumatic actuator (single-acting)
⑧ Pneumatic actuator (double-acting)

Figure 3-12 Block circuit diagram for the electropneumatic positioner, functional diagram

Note

Alarm module and SIA module

Alarm module ⑤ and SIA module ⑥ 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

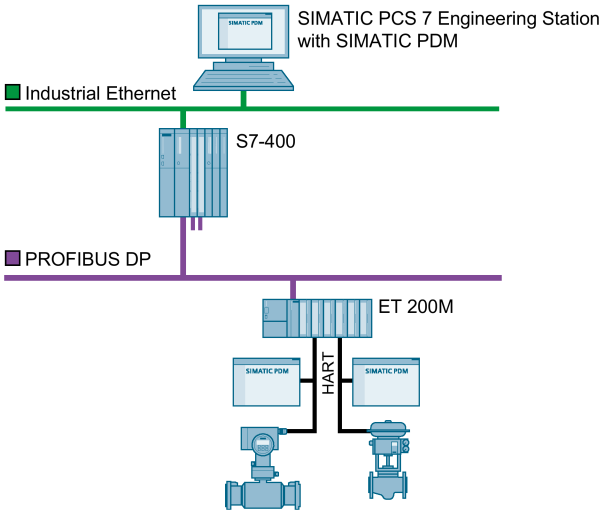


Figure 3-13 Typical system configurations

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 SIMATIC PDM instructions and manuals (https://support.industry.siemens.com/cs/products?dtp=Manual&pnid=16983&lc=en-WW).

Installing/mounting

4

4.1 Basic safety instructions

⚠ WARNING

Unsuitable device for the hazardous area

Danger of explosion.

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

⚠ WARNING

High operating force with pneumatic actuators

Risk of injury when working on control valves due to the high operating force of the pneumatic actuator.

- Please observe the corresponding safety instructions for the pneumatic actuator in use.

⚠ WARNING

Lever for position detection

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

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

⚠ WARNING

Impermissible accessories and spare parts

Danger of explosion in areas subject to explosion hazard.

- Only use original accessories or original spare parts.
- Observe all relevant installation and safety instructions described in the instructions for the device or enclosed with the accessory or spare part.

⚠ WARNING

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

Open cable inlet or incorrect cable gland

Danger of explosion in hazardous areas.

- Close the cable inlets for the electrical connections. Only use cable glands or plugs which are approved for the relevant type of protection.

⚠ WARNING

Exceeded maximum ambient or process media temperature

Danger of explosion in hazardous areas.

Device damage.

- Make sure that the maximum permissible ambient and process media temperatures of the device are not exceeded. Refer to the information in Chapter "Technical data (Page 243)".

⚠ 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 245)" for the torque value.

4.1.1 Proper mounting

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 243) for installation torque requirements.

⚠ CAUTION

Loss of degree of protection

Damage to device if the enclosure is open or not properly closed. The degree of protection specified on the nameplate or in Chapter "Technical data (Page 243)" is no longer guaranteed.

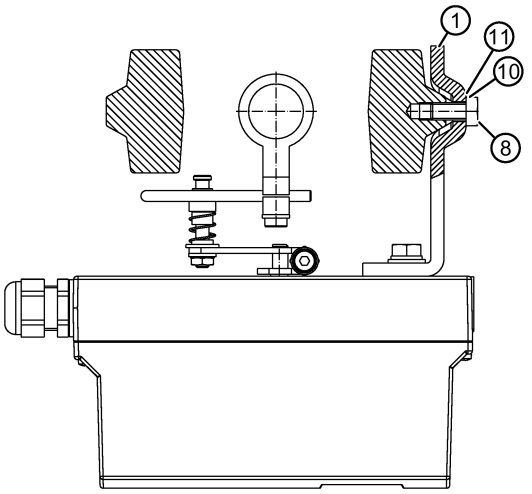
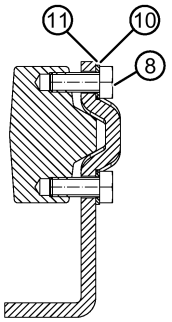
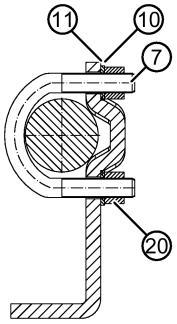
- Make sure that the device is securely closed.

4.2 Mounting the 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 actuator using the mounting kit 6DR4004-8V. You require different installation parts of this mounting kit depending on the selected actuator type. All installation parts listed in the following table are included in the product package of the mounting kit 6DR4004-8V. The mounting kit is suitable for a stroke of 3 to 35 mm. In the event of a larger range of stroke, you require the accessory "Lever for strokes greater than 35 to 130 mm", article number 6DR4004-8L, in addition to the mounting set 6DR4004-8V. Keep the suitable installation parts ready:

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	

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, torque see the section "Technical specifications > Construction (Page 245)"
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
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. Use spring lock washers ⑯ and socket cap screws ⑰ for this purpose.
2. Slide the pick-up bracket ② into the milled recesses of the clamping pieces ③.

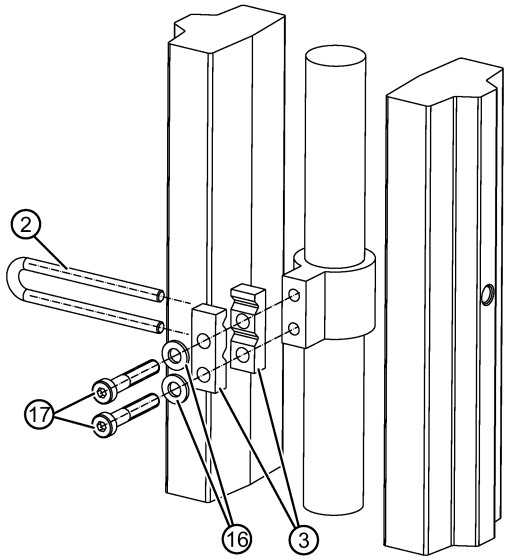


Figure 4-1 Pick-up bracket

3. Set the necessary length.
4. Tighten the screws ⑰ so that you can still shift the pick-up bracket ②.
5. Fix the pre-installed carrier pin ④ to the lever ⑥. Use the flat washer ⑫, spring lock washer ⑭ and hexagon nut ⑱ for this purpose.

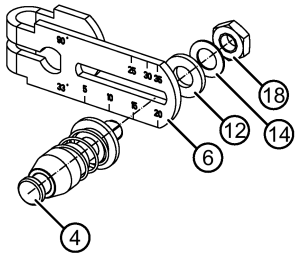


Figure 4-2 Lever with carrier pin

6. Set the stroke value. Use the stroke value specified on the nameplate of the actuator for this purpose. If none of the values on the lever scale matches the stroke value of the actuator, select the next higher value on the scale. Position the pin center ④ on the corresponding value of the scale. 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.

7. Install the following components on the lever ⑥: Socket cap screw ⑰, spring lock washer ⑯, flat washer ⑫, square nut ⑲.

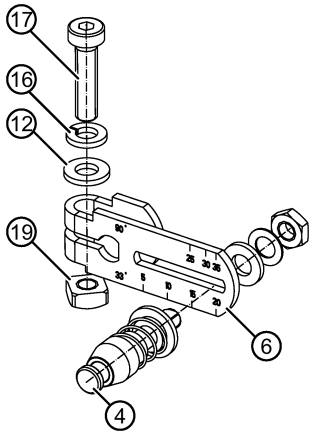


Figure 4-3 Components on the lever

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.

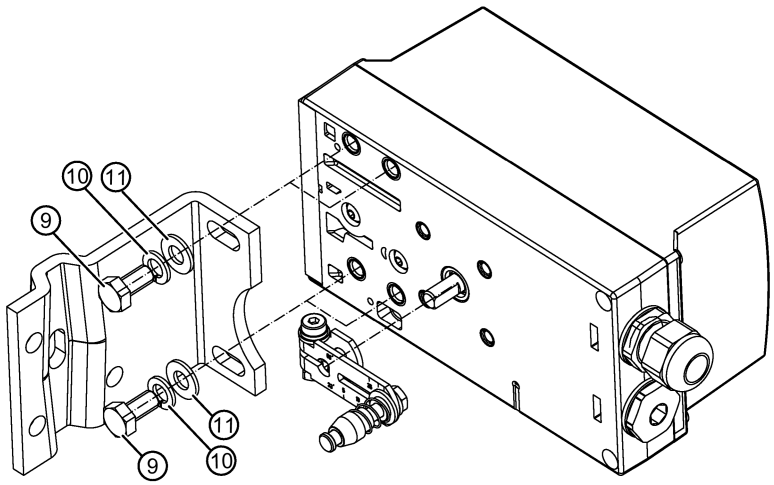


Figure 4-4 Installation with mounting bracket

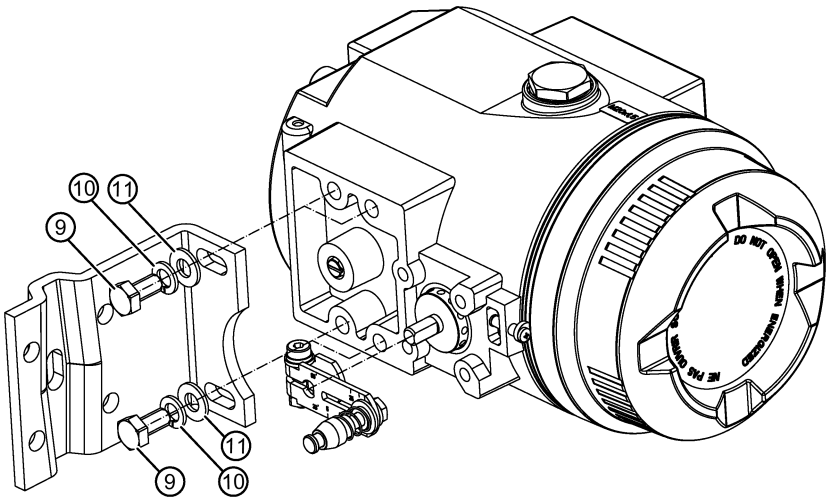


Figure 4-5 Installation with mounting bracket, flameproof enclosure

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. Ensure that the pick-up bracket ② does not touch the clamping pieces ③.
11. Keep the positioner and the fastening bracket on the actuator. Ensure that the carrier pin ④ is guided inside the pick-up bracket ②.
12. Tighten the pick-up bracket ②.
13. Fasten the positioner on the yoke. Use the installation parts suitable for the corresponding actuator.

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 the part-turn actuator

Requirements

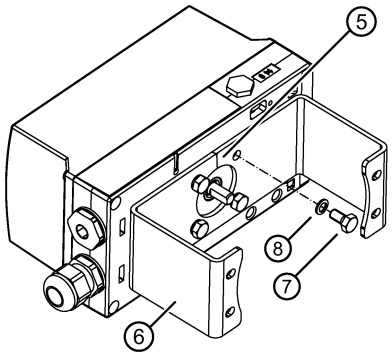
You require an actuator-specific VDI/VDE 3845 mount to install the positioner on a part-turn actuator. Because of the high weight of the version in the flameproof stainless steel enclosure 6DR5..6, you should select a particularly stable mount.

Procedure

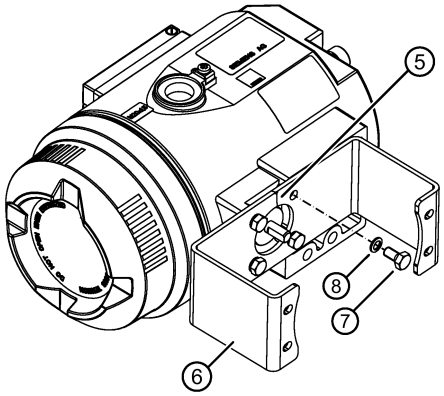
"Part-turn actuator" mounting kit 6DR4004–8D			
Sr. no. *)	**Quantity**	**Name**	**Note**
①	1	Coupling wheel	Installation on positioner shaft
②	1	Carrier	Installation on stump of actuator shaft
③	1	Multiple plate	Display of the position, consisting of scale ⑤ and pointer mark ⑥
④	8	Scale	Different divisions
⑤	2	Pointer mark	Reference arrow for scale
⑥		Mount	Actuator-specific, VDI/VDE 3845
⑦	4	Hexagon bolt	M6x12 DIN 933, torque see the section "Technical specifications > Construction (Page 245)"
⑧	4	Lock washer	S6
⑨	1	Socket cap screw	M6x16 DIN 84
⑩	1	Washer	6.4 DIN 125
⑪	1	Hexagon 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. Stick the pointer mark ⑤ on the mount. Position the pointer mark ⑤ at the center of the centering hole.



Pointer mark



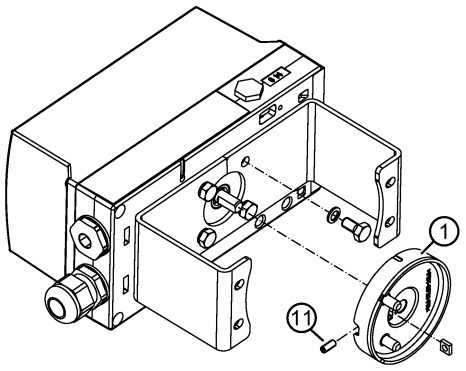
Pointer mark, flameproof enclosure

3. 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.

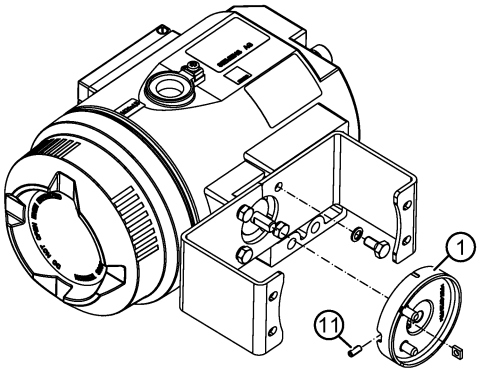
Note

Coupling wheel

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

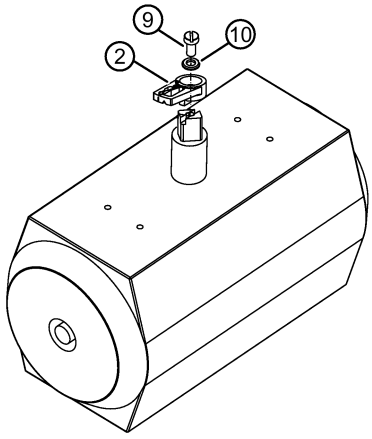


Coupling wheel



Coupling wheel, flameproof enclosure

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



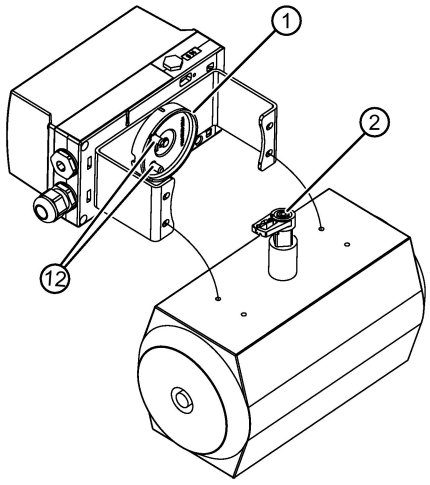
Carrier

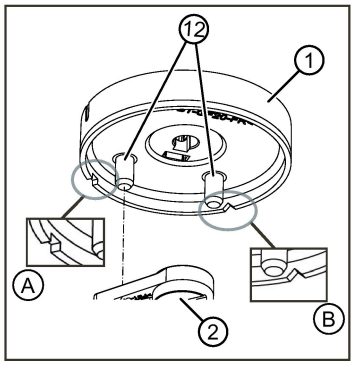
5. Place the positioner and the mount on the actuator carefully.

   One of the two pins of the coupling wheel ① must fit in the carrier ② when you do this. You need not adjust the friction clutch if you use the pins ⑫ as described below. This greatly simplifies commissioning. Each of the two pins ⑫ has a recess, see the following figures.

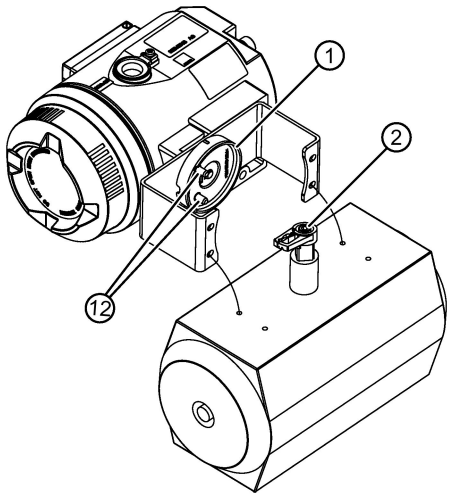
   For actuators which **close in the clockwise direction**, use the pin on which the recess has a V shape (B).

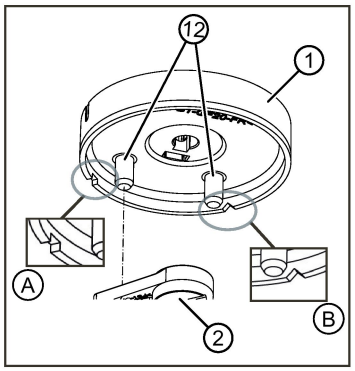
   For actuators which **open in the clockwise direction**, use the pin on which the recess has a rectangular shape (A).





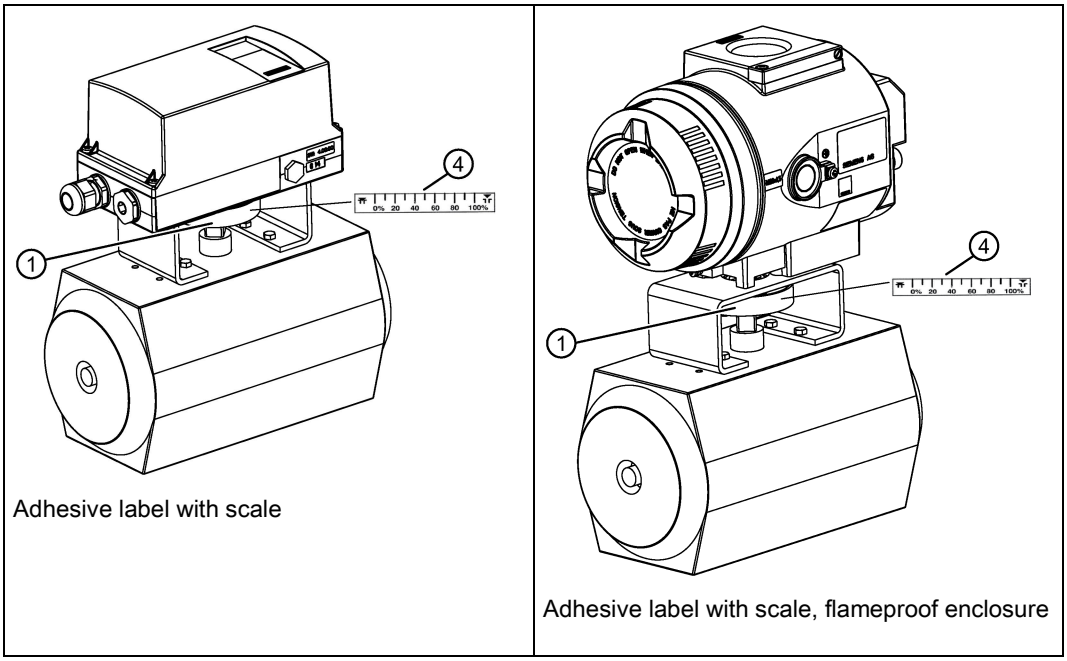
Orientation of mount

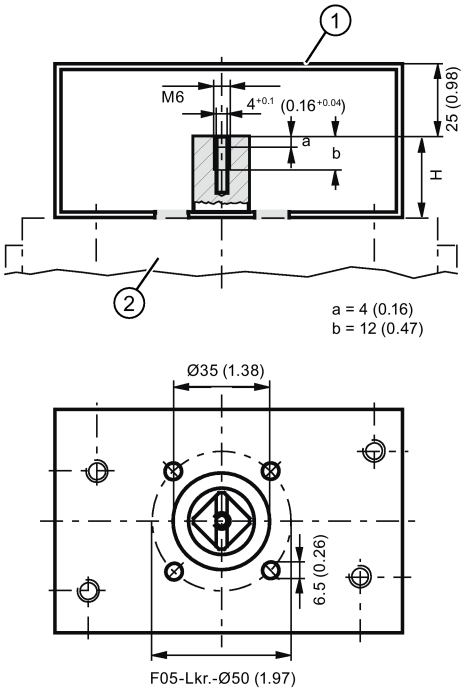




Orientation of mount, flameproof enclosure

6. 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.
7. Align the positioner/mount at the center of the actuator.
8. Tighten the positioner/mount unit.
9. Initialize the positioner.
10. After commissioning, drive the positioner to the end position.
11. 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.





H = height of shaft butt

① Fixing level of positioner on mount

② Part-turn actuator

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

See also

Preparing part-turn actuators for commissioning (Page 131)

4.4 Using the positioner in a humid environment

Introduction

The positioner enclosure provides IP66 protection with an intended installation position. It can therefore be operated in a moist or wet environment in the mounting positions shown below. Do not use other mounting positions since it would then be possible for liquids, fluff, fibers or dusts to enter the device via the exhaust openings.

Favorable and unfavorable mounting positions

Avoid the unfavorable mounting positions:

- To prevent fluids seeping through during normal operation of the device, e.g. through exhaust air openings.
- Otherwise the display becomes poorly legible.

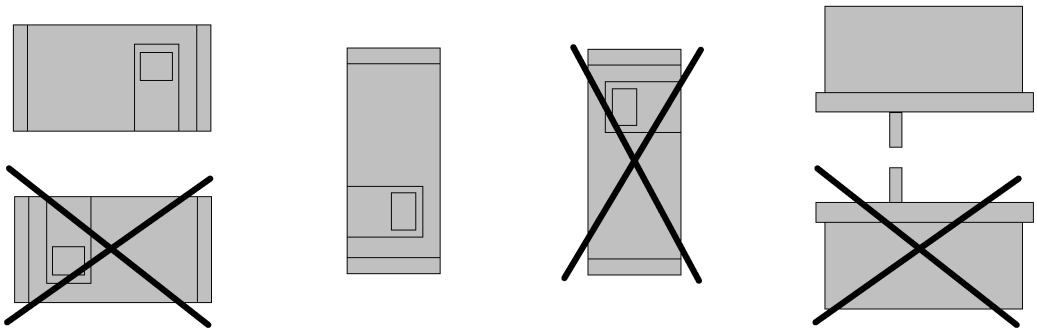


Figure 4-7 Favorable and unfavorable mounting positions

Additional measures to prevent liquids from seeping through

Take additional measures to prevent liquids from seeping through if the conditions force you to operate the positioner in an unfavorable mounting position.

Additional measures required to prevent liquids from seeping through depend on the selected mounting position. You may also require:

- Gland with sealing ring, e.g. FESTO: CK - 1 / 4-PK-6
- Approximately 20 to 30 cm plastic hose, e.g. FESTO: PUN - 8 x 1.25 SW
- Cable tie; the number and the length depend on the local conditions.

Procedure

1. Install the casing such that rain water or condensate running along the pipes can be drained before the terminal strip of the positioner.
2. Check the seals of electrical connections for perfect fitting.
3. Check the seal in the enclosure cover for damage and contaminations. Clean and/or replace if required.
4. Install the positioner such that the sintered bronze attenuator at the bottom side of the enclosure points downwards in the vertical mounting position. If this is not possible, replace the attenuator with a suitable gland with a plastic hose.

Procedure for installing the plastic hose on the gland

1. Unscrew the sintered bronze attenuator from the exhaust air opening at the bottom side of the enclosure.
2. Screw in the aforementioned gland into the exhaust air opening.
3. Install the aforementioned plastic hose into the gland and check whether it fits firmly.
4. Fasten the plastic hose with a cable tie onto the control valve such that the opening points downwards.
5. Ensure that the plastic hose does not have any kinks and the exhaust air flows out without any hindrance.

4.5 Positioners subjected to fast acceleration or strong vibration

The electropneumatic positioner has an gear latch for the friction clutch and for the transmission ratio selector.

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 cause the friction clutch to move in extreme cases.

The positioner is equipped with an gear latch for the friction clutch to counter these extreme cases. The setting of the transmission ratio selector can also be locked.

The locking procedure is illustrated and described below.

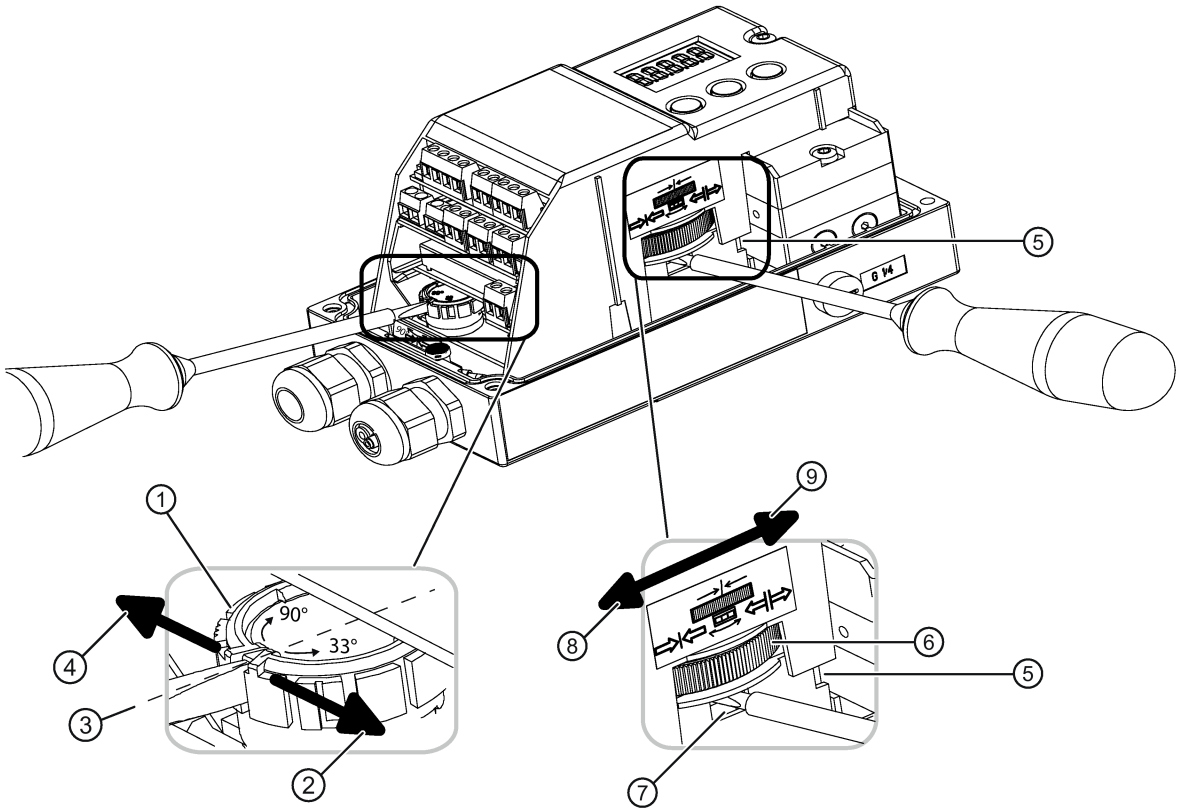
Note

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.

Overview diagram

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 behavior 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°.



① Gear latch
② Locking transmission ratio to 33°
③ Neutral position
④ Locking transmission ratio to 90°
⑤ Transmission ratio selector
⑥ Friction clutch
⑦ Friction clutch latch
⑧ Locking friction clutch
⑨ Release friction clutch

Figure 4-8 Locking friction clutch and transmission ratio

Requirements

- The positioner is mounted.
- You know whether the transmission ratio is to be set to 33° or 90°.
- The positioner has been commissioned successfully, i.e. initialization was completed with "FINISH".

Procedure

NOTICE
The following is applicable for the "flameproof enclosure" version: • A friction clutch is provided on the outside of the positioner shaft. Change the work area using this friction clutch, legend number ⑨ in "Overview of device components (Page 26)". • Do not open the flameproof enclosure of the positioner in explosion-prone atmospheres.

Fix the setting acquired by initialization as follows:

1. Make sure the gear latch ① is in neutral position ③. The neutral position is between 33° and 90°.
2. Make sure the transmission ratio selector ⑤ is in the correct position.
3. Fix the transmission ratio with the gear latch ①. Turn the gear latch ① with a standard approx. 4 mm wide screwdriver until the gear latch ① locks. Turning right locks the transmission ratio to 33°②. Turning left locks the transmission ratio to 90°④. The transmission ratio is locked.

   Note

   Changing the setting of the transmission ratio selector

   The setting of the transmission ratio selector ⑤ can only be changed effectively if the gear latch ① is in the neutral position ③.

4. To fix the friction clutch ⑥, insert a standard approx. 4 mm wide screwdriver in the friction clutch gear latch ⑦ (does not apply to device version "Flameproof enclosure").
5. Use the screwdriver to turn the friction clutch gear latch ⑦ anticlockwise until it engages. The friction clutch ⑥ is fixed (does not apply to device version "Flameproof enclosure").

4.6 External position detection

⚠ WARNING

External position detection system

Versions with flameproof enclosures may not be operated with an external position detection system.

The aforementioned measures are not adequate in some applications. For example, continuous and strong vibrations, high or too low ambient temperatures and nuclear radiation.

The position detection system and the controller unit are mounted separately for these applications. A universal component is available for this purpose. It is suitable for part-turn and linear actuators. You will require the following:

- An external position detection system with the article number C73451-A430-D78 comprising a positioner enclosure with integrated friction clutch, built-in potentiometer as well as various blanking plugs and seals.
- Or an NCS sensor for contact-free position detection 6DR4004-6N.../-8N...
- A positioner
- An EMC filter module with the article number C73451-A430–D23 is provided in a set along with cable clamps and M20 cable glands.

The EMC filter module is used for the controller unit whenever an external position detection system is used instead of the internal position sensor. An external position detection system is, for example, a potentiometer with a 10 kΩ resistance or an NCS sensor.

4.7 Installing option modules

4.7.1 General information on installing option modules

⚠ WARNING

Unsuitable device for the hazardous area

Danger of explosion.

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

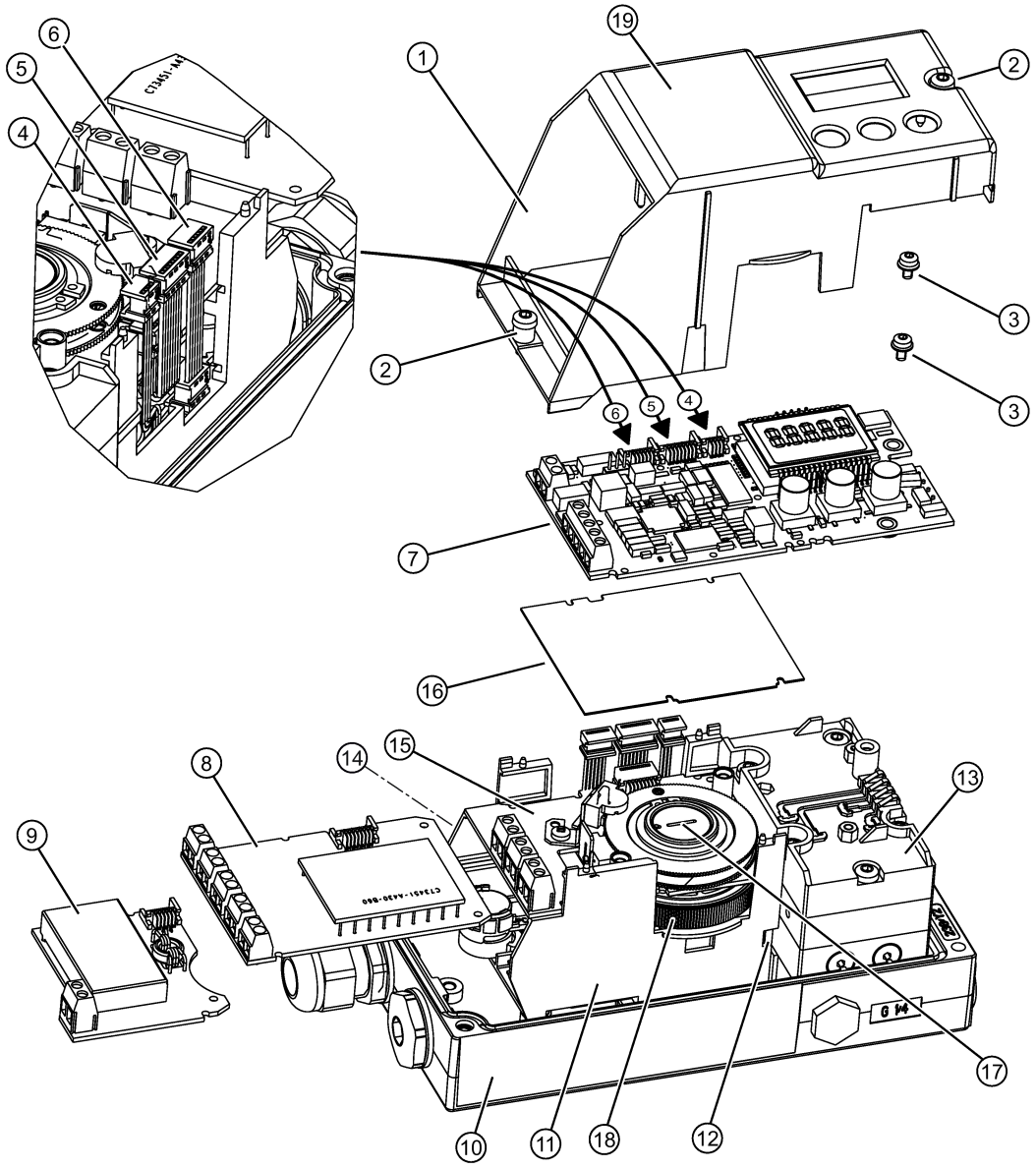
4.7.1.1 Installing optional modules in the standard and intrinsically safe version

Introduction

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

- Position feedback module
- Alarm module
- SIA module
- Mechanical limit switch module
- Internal NCS module
- EMC filter module

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
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
⑱ Friction clutch adjustment wheel

⑨ Position feedback module
⑩ Nameplate
⑲ Wiring diagram on module cover

Figure 4-9 Installing the optional modules in the standard and intrinsically safe version

General procedure for optional modules in the standard and intrinsically safe version

1. Open the positioner. Unscrew the four fixing screws of the enclosure cover.
2. Disconnect the power supply lines or de-energize them.
3. Remove the module cover ①. To do this, unscrew the two fixing screws ②.
4. Install the optional modules as described in the corresponding sections for the individual optional modules.
5. Now start with the assembly. Install the module cover ①. To this end, turn the fixing screws ② counter clockwise until they noticeably engage in the thread pitch. 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.

   - Proceed as described here in order to avoid premature wear of the base plate and valve.

   Carefully tighten both fixing screws ② in a clockwise direction.
6. Continue to assemble the positioner by executing steps 3 to 1 in reverse order.

4.7.1.2 Installing the optional modules in the "flameproof enclosure" version

Introduction

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

- Position feedback module
- Alarm module
- Internal NCS module
- EMC filter module

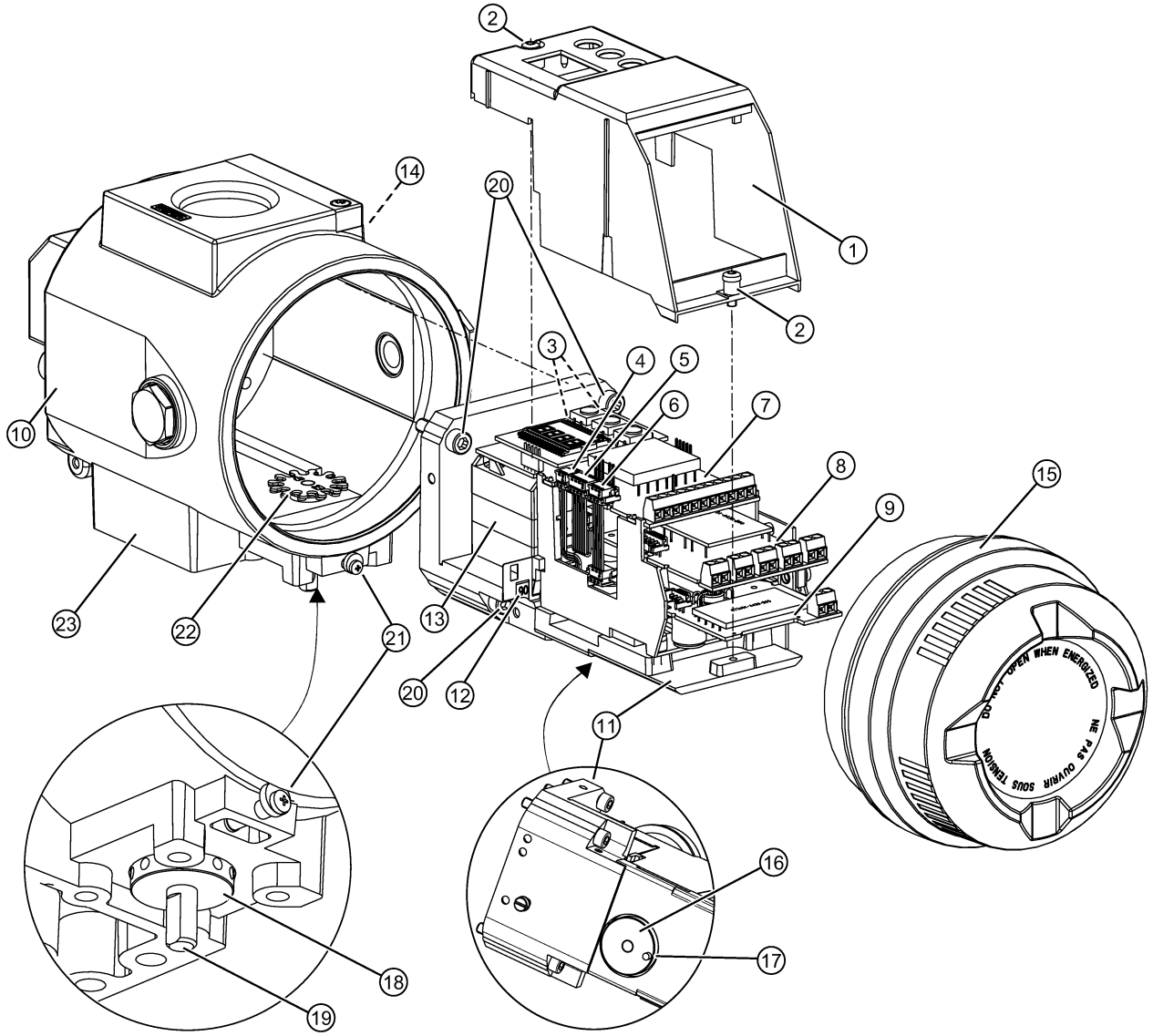
⚠ DANGER

Risk of explosion

You must fulfill the following conditions before supplying auxiliary power to the positioner in potentially hazardous areas:

- 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.
- You must install an ignition trap if you use a "conduit piping system". The maximum distance between the ignition trap and the positioner enclosure is 46 cm or 18".

Overview screen



①	Module cover	⑬	Pneumatic block
②	Fixing screws module cover	⑭	Warning label on the side opposite the nameplate
③	Fixing screws basic electronics	⑮	Screw cap
④	Ribbon cable/connector for fitted potentiometer or external position detection system	⑯	Feedback lever bracket with pin
⑤	Ribbon cable/connector for alarm module, SIA module or mechanical limit switch module	⑰	Pin (feedback lever bracket)
⑥	Ribbon cable/connector for position feedback module	⑱	Adjustment wheel for external friction clutch
⑦	Basic electronics	⑲	Feedback shaft
⑧	Alarm module	⑳	Fixing screws adapter
⑨	Position feedback module	㉑	Safety catch
⑩	Nameplate	㉒	Ring gear
⑪	Adapter	㉓	Enclosure

⑫ Transmission ratio selector

Figure 4-10 Installing the optional modules in the "flameproof enclosure" version

General procedure for optional modules in the "flameproof enclosure" version

1. Disconnect the power supply lines or de-energize them.
2. Open the safety catch ㉑.
3. Unscrew the screw cap ⑮.
4. Completely dismount the positioner from the actuator.
5. The positioner comes with a ring gear 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. To this end, turn the feedback shaft ⑲ on the positioner until the pin (feedback lever bracket) ⑯ below the adapter ⑪ shows in the direction of removal. You determine the position of the pin by looking into the enclosure below the adapter. Now, the pin can be easily removed from the ring gear ㉒.

   Note

   Damage to the ring gear

   The ring gear consists of two washers fastened staggered to each other. This offset ensures that path detection is backlash-free.

   - Do not change this offset mechanically.

6. Unlatch the four fixing screws ⑳.
7. Completely remove the adapter ⑪ from the enclosure ㉓.

   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. Remove the module cover ①. Unlatch both screws ② using a screwdriver.
9. Install the optional modules as described in the corresponding sections for the individual optional modules.

10. Now start with the assembly. Install the module cover ①. To this end, turn the screws ② counter clockwise until they noticeably engage in the thread pitch. 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.

- Proceed as described here in order to avoid premature wear of the valve.

Carefully tighten both fixing screws ② in a clockwise direction.

11. Continue to assemble the positioner by executing steps 7 to 5 in reverse order. Check whether the position of the O-rings is correct. Make sure no loose items in the enclosure interfere with the assembly.
12. Now 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, making sure to remember the previously performed steps.
13. Once you have completed all previous steps successfully, continue by performing steps 4 to 1 in reverse order.

4.7.2 Position feedback module

Function

- The optional position feedback module indicates the current position as a two-wire signal with the travel range I_y = 4 to 20 mA. The position feedback module is electrically isolated from the basic device.
- The current position is indicated only after successful initialization.
- Operational faults are signaled by a fault current of 3.6 mA.

Device features

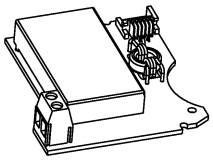


Figure 4-11 Position feedback module

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 54)".

Procedure

1. Slide the position feedback module up to the endstop in the lower bay of the rack.
2. Connect the module to the basic electronics. For this purpose, use the 6-pin flat ribbon cable provided.

4.7.3 Alarm module

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, it is used to block the actuator or to move it to its end position. Configure the suitable settings on parameter "BIN2".

Device features

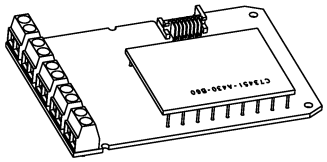


Figure 4-12 Alarm module

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.

Procedure for installing the alarm module

1. You have performed the steps described in the section General information on installing option modules (Page 54).
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. Proceed with the corresponding steps in the section General information on installing option modules (Page 54).

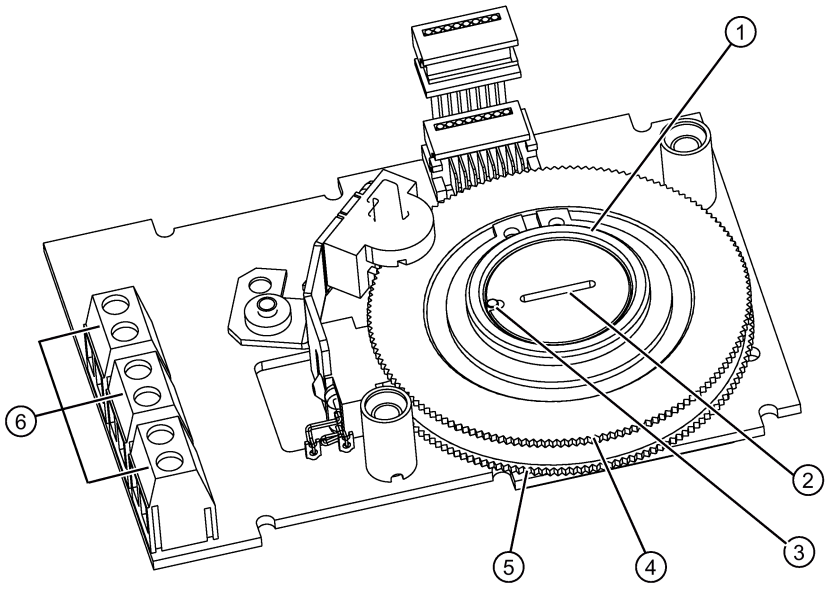
4.7.4 Slit initiator alarm module (SIA)

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 4-13 SIA module

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

Procedure for installing the slot initiator alarm module

1. You have performed the steps described in the section General information on installing option modules (Page 54).
2. Disconnect all electrical connections of the basic electronics.
3. Loosen the two fixing screws of the basic electronics.
4. Remove the basic electronics.
5. Insert the SIA module from the top up to the upper printed circuit board guide of the rack.
6. Slide the SIA module in the printed circuit board of the rack approximately 3 mm to the right.

7. Screw in the special screw ② through the SIA 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 before placing the adjustment 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 special screw ②.

---

8. Set the limits L1 and L2 as described in the section "Slit initiator alarm module (SIA) (Page 63)".
9. 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.
10. Place the basic electronics onto the four holders.
11. Fix the basic electronics using both the fixing screws.
12. Reestablish all electrical connections between the basic electronics and the option modules. Connect the basic electronics and the option modules to the ribbon cables provided. Connect the basic electronics and the potentiometer to the potentiometer cable.
13. Using both the screws, fasten the module cover provided. Do **not** use the standard module cover.
14. Select the labels that are already present 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. Proceed with the corresponding steps in the section General information on installing option modules (Page 54).

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.

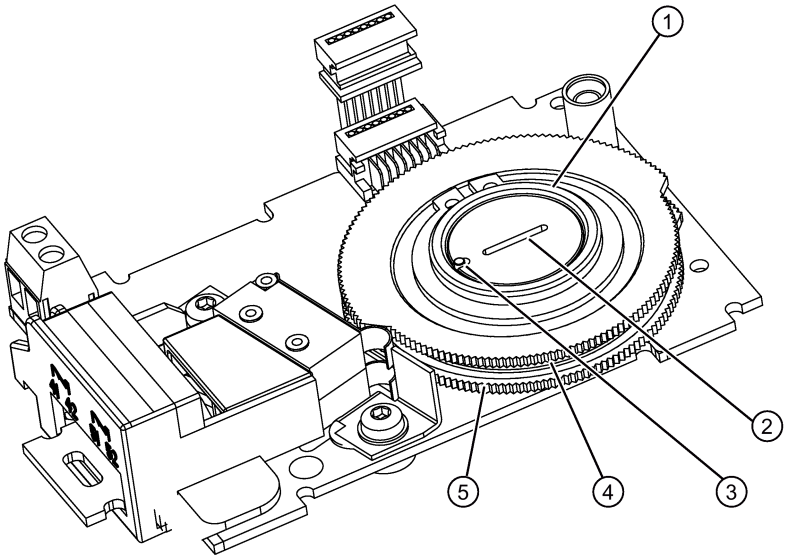
- Move the actuator to and fro while simultaneously holding the actuating disks ④ and ⑤.

4.7.5 Mechanical limit switch module

Requirement

You are familiar with the procedure described in the section "Installing optional modules in the standard and intrinsically safe version (Page 54)".

Procedure for installing the mechanical limit switch module



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

Figure 4-14 Mechanical limit switch module

1. Disconnect all electrical connections of the basic electronics.
2. Loosen the two fixing screws of the basic electronics.
3. Remove the basic electronics.
4. Insert the mechanical limit switch module from the top up to the upper printed circuit board guide of the module rack.
5. Slide the mechanical limit switch module in the printed circuit board of the module rack approximately 3 mm towards right.
6. Screw in the special screw ② through the mechanical limit switch 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 before placing the adjustment 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 special screw ②.

---

7. Set the limits L1 and L2 as described below.
8. An insulating cover is provided over the mechanical limit switch module. Place the insulating cover on one side under the basic electronics seat on the walls of the rack. The recesses of the insulating cover must fit in the corresponding webs of the container wall.

9. Place the insulating cover on the mechanical limit switch module by bending the walls of the rack carefully.
10. Place the basic electronics onto the four holders.
11. Fix the basic electronics using both the fixing screws.
12. Reestablish all electrical connections between the basic electronics and the option modules. Connect the basic electronics and the option modules to the ribbon cables provided. Connect the basic electronics and the potentiometer to the potentiometer cable.
13. Using both the screws, fasten the module cover provided. Do not use the standard module cover.
14. Select the labels that are already present 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. Establish all electrical connections.

Note

Protective conductor connector

A protective conductor connector is not required for safety reasons and therefore is not provided.

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 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.
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 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.

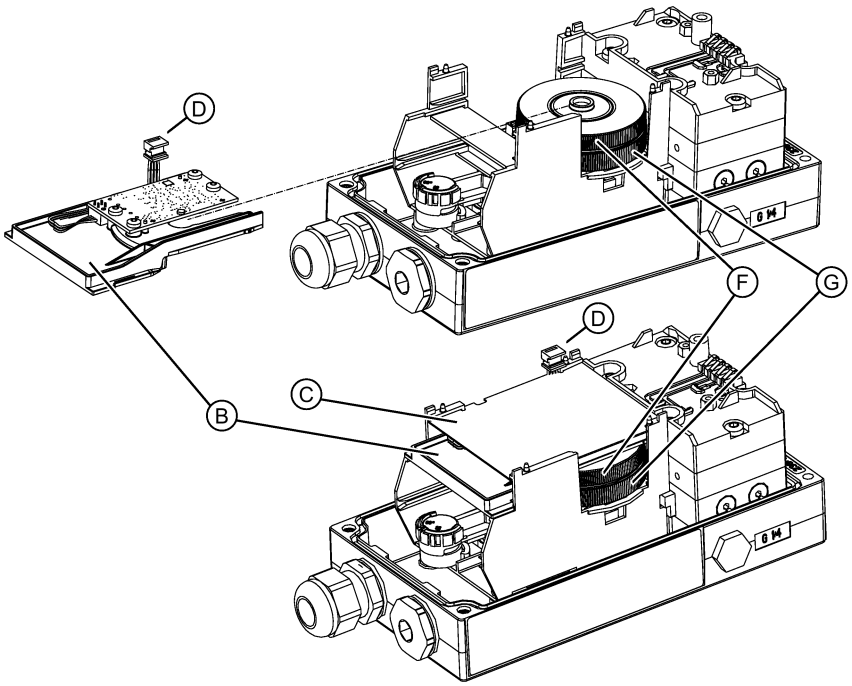
- Move the actuator to and fro while simultaneously holding the actuating disks ④ and ⑤.

4.7.6 Internal NCS module 6DR4004-5L/-5LE

Function

Wear-free, contact-free position detection

Device features



(B) Internal NCS module 6DR4004-5L.
(C) Insulating cover, yellow
(D) Ribbon cable of the internal NCS module
(F) Adjustment wheel for the magnet clamp
(G) Adjustment wheel for the friction clutch (without function)

Figure 4-15 Installing the internal NCS module

Requirement

- The slot required for the internal NCS 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.

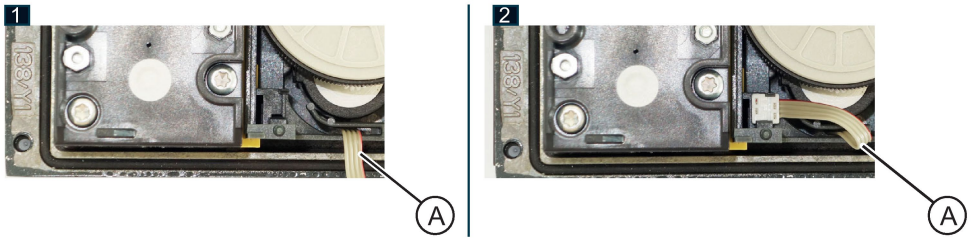
Procedure for installing the internal NCS module

1. You have performed the steps described in the section General information on installing option modules (Page 54).

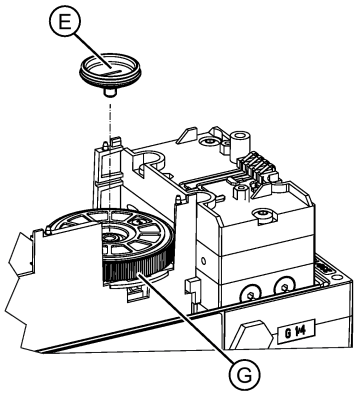
   The legend numbers refer to the indicated section. The legend letters refer to the figures in this section.

2. Unplug the ribbon cable connector ④ to the installed potentiometer from the basic electronics ⑦.
3. Remove the basic electronics ⑦ from the positioner. To do this, remove the two screws that fasten the basic electronics to the pneumatic block ⑬.
4. Insert the connector of the ribbon cable (A) into the slot as shown below.

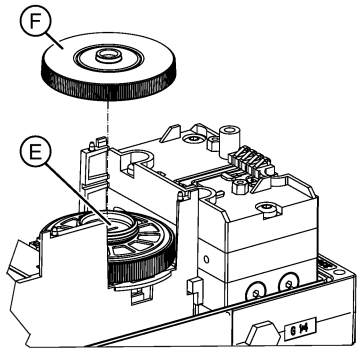
   Note: There is no space for the ribbon cable (A) in earlier versions of the positioner. Here you fasten the ribbon cable to the container using a cable tie.



5. Screw the special screw (E) into the shaft of the positioner. Tighten the special screw (E) with a torque of 2 Nm.



6. Press the adjustment wheel of the magnet clamp (F) firmly onto the special screw (E) of the friction clutch until you clearly hear it click into place.



7. Position the ribbon cable of the internal NCS module (D) upwards, as shown in the figure, before you slide the internal NCS module into the rack.
8. Slide the internal NCS module (B) under the basic electronics into the rack until you hear it click into place.
9. An insulating cover is required over the internal NCS module. This insulating cover is supplied with the internal NCS module. Place the insulating cover (C) on one side under the basic electronics seat of the rack.
10. Now position the insulating cover by pressing one end against the seat of the rack and slowly lowering the other end.
11. 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.
12. Install the basic electronics back into the positioner.
13. Insert the ribbon cable connector of the internal NCS (D) module onto the positioner basic electronics.

    Note for installed position feedback module: Reestablish all electrical connections between the basic electronics and the position feedback module.
14. Using both the screws, fasten the module cover provided. Do **not** use the standard module cover of the positioner. The provided module cover has a larger recess to accommodate the adjustment wheel of the magnet clamp (F).
15. Make sure that the ribbon cable is not trapped.
16. 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.
17. Proceed with the corresponding steps in the section General information on installing option modules (Page 54).

4.7.7 EMC filter module

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

- EMC protection
- Connection to basic electronics
- Connecting terminals for an external potentiometer

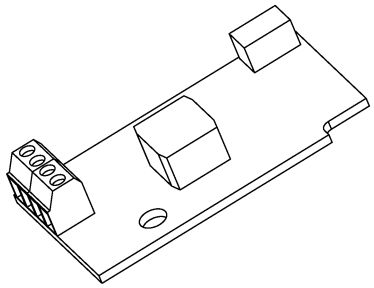


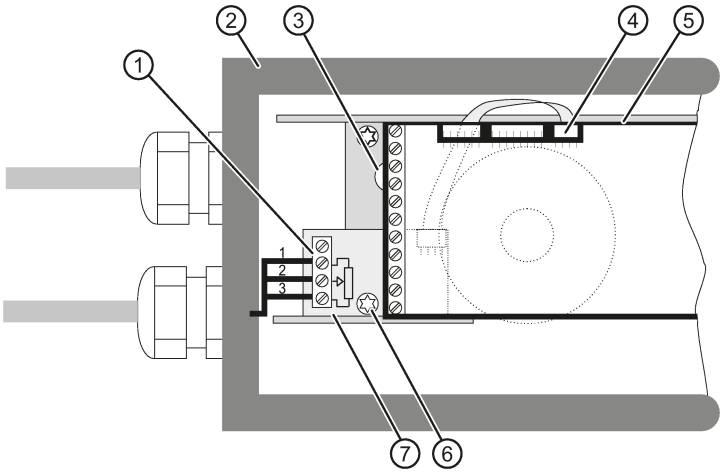
Figure 4-16 EMC filter module

Requirement

- You have an EMC filter module, article number C73451-A430-D23.
- The module cover is removed.
- Any already installed optional module has been removed.

A description of how to remove the module cover and install the optional modules is provided in the section "General information on installing option modules (Page 54)"

Procedure for installing the EMC filter module

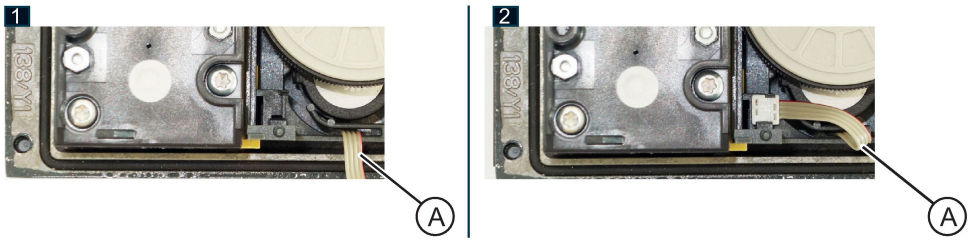


① EMC filter module terminals
② Positioner
③ Yellow wheel for locking the position detection
④ Ribbon cable connector of fitted potentiometer, or ribbon cable connector of EMC filter module
⑤ Basic electronics
⑥ Screw
⑦ EMC filter module C73451-A430-D23

Figure 4-17 Installation EMC filter module

1. You have performed the steps described in the section "General information on installing option modules (Page 54)".
2. Unplug the ribbon cable connector ④ to the fitted potentiometer from the basic electronics ⑤.
3. Remove the basic electronics ⑤ from the positioner. To this end, remove the two screws that fix the basic electronics to the pneumatic block.
4. Loosen the screw ⑥ in the connection area of the positioner.
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 with the supplied cable tie at the container.



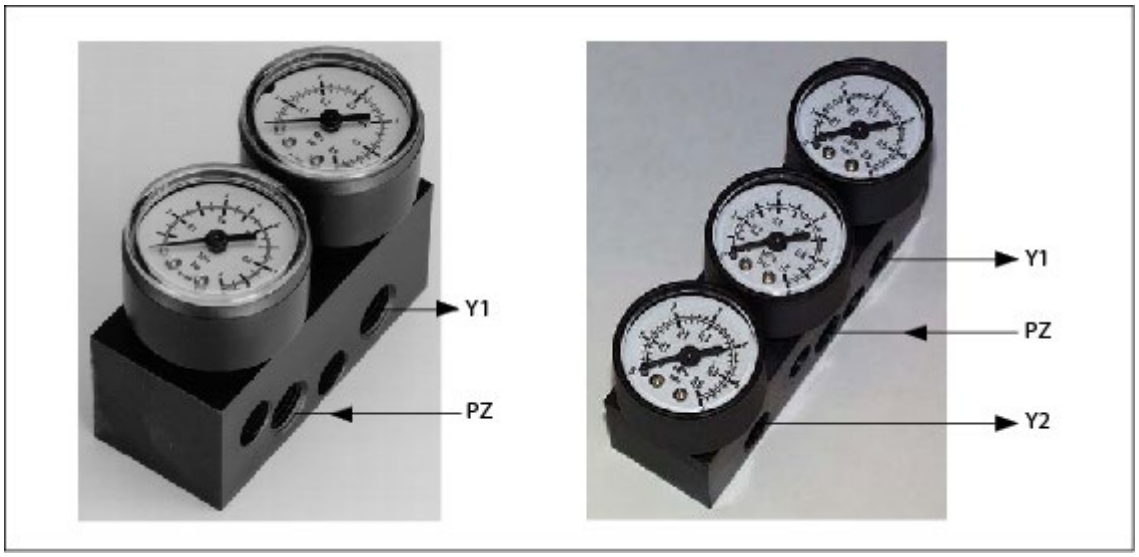
6. Secure the EMC filter module using the screw ⑥ loosened in the fourth step.
7. Fit the basic electronics ⑤ back into the positioner.
8. Insert the ribbon cable connector ④ of the EMC filter module onto the positioner basic electronics.

9. Fasten the module cover. Make sure that the ribbon cable is not trapped.
10. Proceed with the corresponding steps in the section "General information on installing option modules (Page 54)".

4.7.8 Accessories

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.

Connection 5

5.1 Basic safety instructions

⚠ WARNING

Improper power supply

Danger of explosion in hazardous areas as result of incorrect power supply, e.g. using direct current instead of alternating current.

- Connect the device in accordance with the specified power supply and signal circuits. The relevant specifications can be found in the certificates, in Chapter "Technical data (Page 243)" or on the nameplate.

⚠ 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

Unsafe extra-low voltage

Danger of explosion in hazardous areas due to voltage flashover.

- Connect the device to an extra-low voltage with safe isolation (SELV).

⚠ WARNING

Connecting device in energized state

Danger of explosion in hazardous areas.

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

Exceptions:

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

⚠ WARNING

Lack of equipotential bonding

Danger 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

Danger 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

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

- Only ground shielded cables that run into the hazardous area at one end.
- If grounding is required at both ends, use an equipotential bonding conductor.

⚠ WARNING

Unsuitable cables and/or cable glands

Danger of explosion in hazardous areas.

- Only use suitable cables and cable glands complying with the requirements specified in Chapter "Technical data (Page 243)".
- Tighten the cable glands in accordance with the torques specified in Chapter "Technical data (Page 243)".
- When replacing cable glands use only cable glands of the same type.
- After installation check that the cables are seated firmly.

⚠ WARNING

Incorrect selection of type of protection

Danger 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

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.

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 voltage source, otherwise the positioner may be destroyed.
- Always use a voltage source with a maximum output current of I = 20 mA.

Note

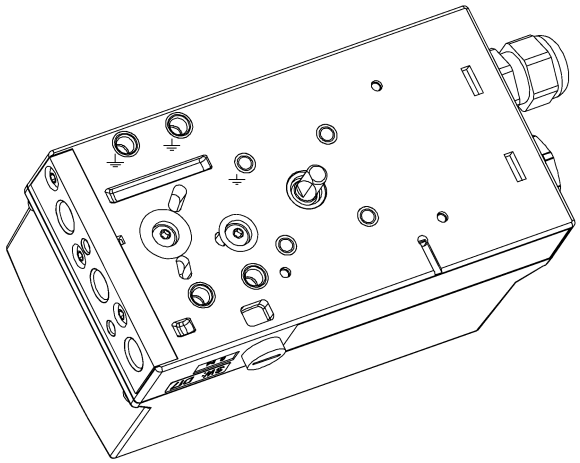
Improvement of interference immunity

- Lay signal cables separate from cables with voltages > 60 V.
- Use cables with twisted wires.
- Avoid getting too close to large electrical process cells.
- Use shielded cables to guarantee the full specification.
- Take account of the conditions for communication specified in the technical data.

Electromagnetic compatibility

The Macrolon 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.

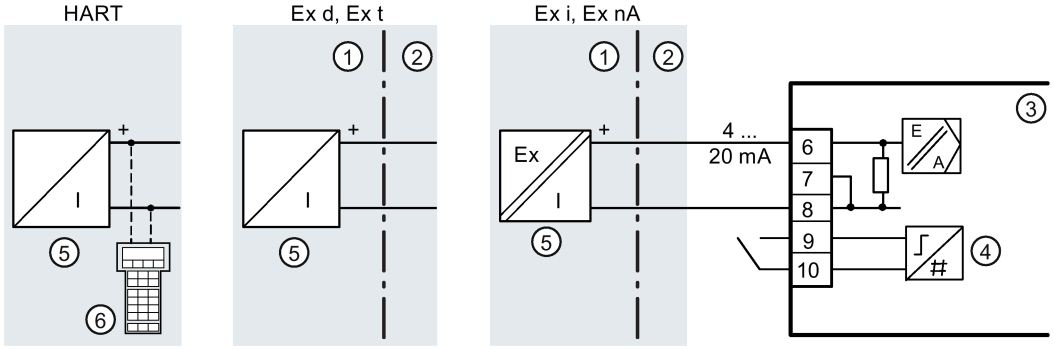
Note that this protection is effective only if you connect at least one of these bushes to the earthed control valves through electrically conductive (bare) attachments.



⏚ Shield

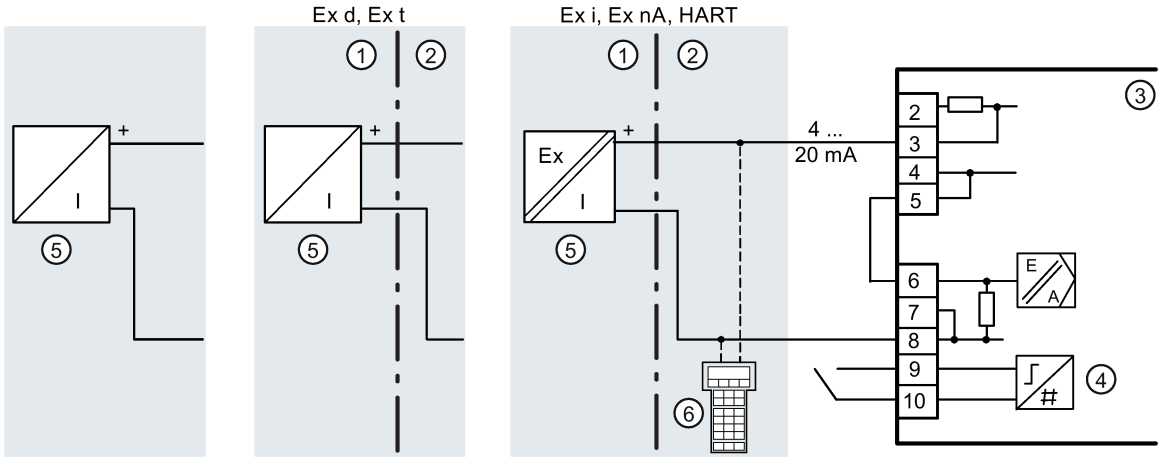
Figure 5-1 Base plate

5.2 Electrical wiring



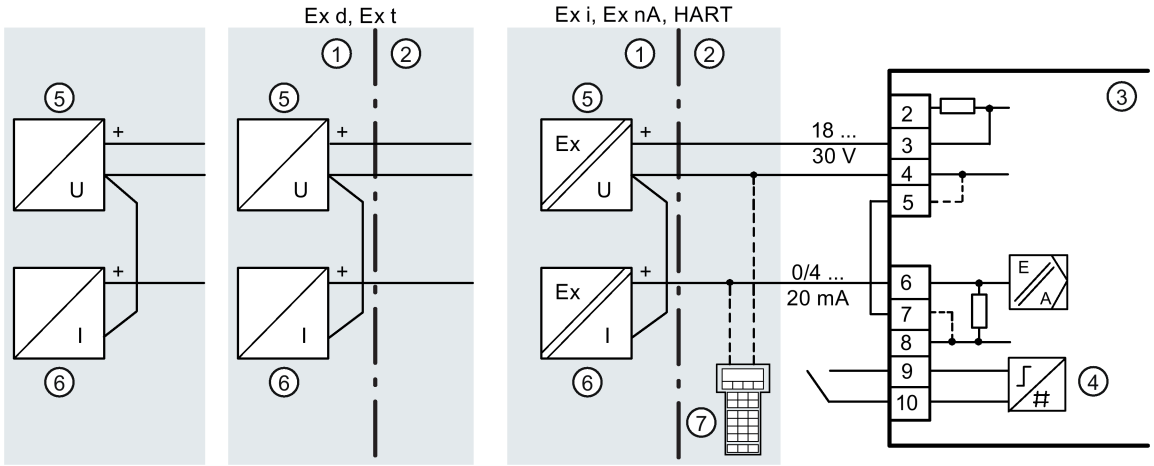
① Non-hazardous area
② Hazardous area
③ Basic electronics
④ Binary input 1
⑤ Signal source
⑥ HART communicator

Figure 5-2 Device version 2-wire



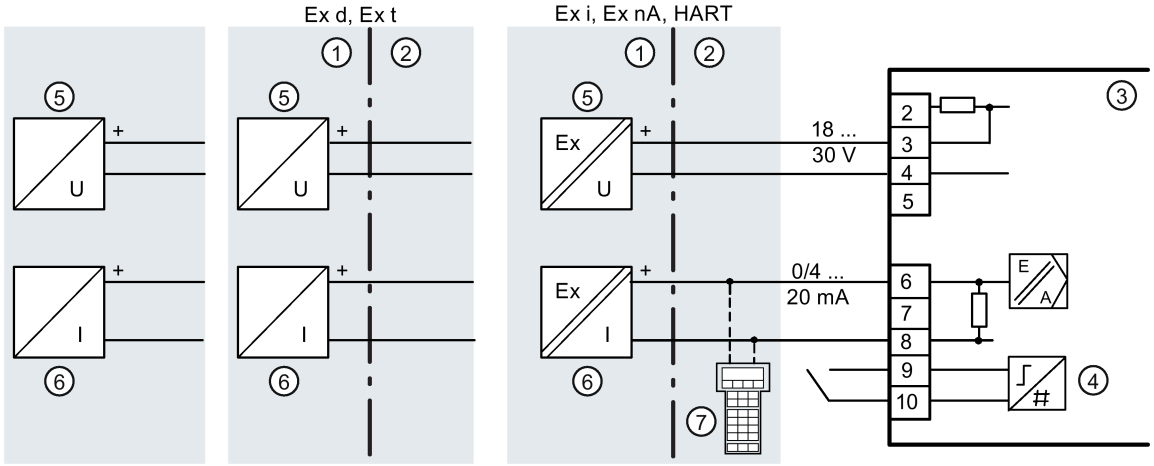
① Non-hazardous area
② Hazardous area
③ Basic electronics
④ Binary input 1
⑤ Signal source
⑥ HART communicator

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

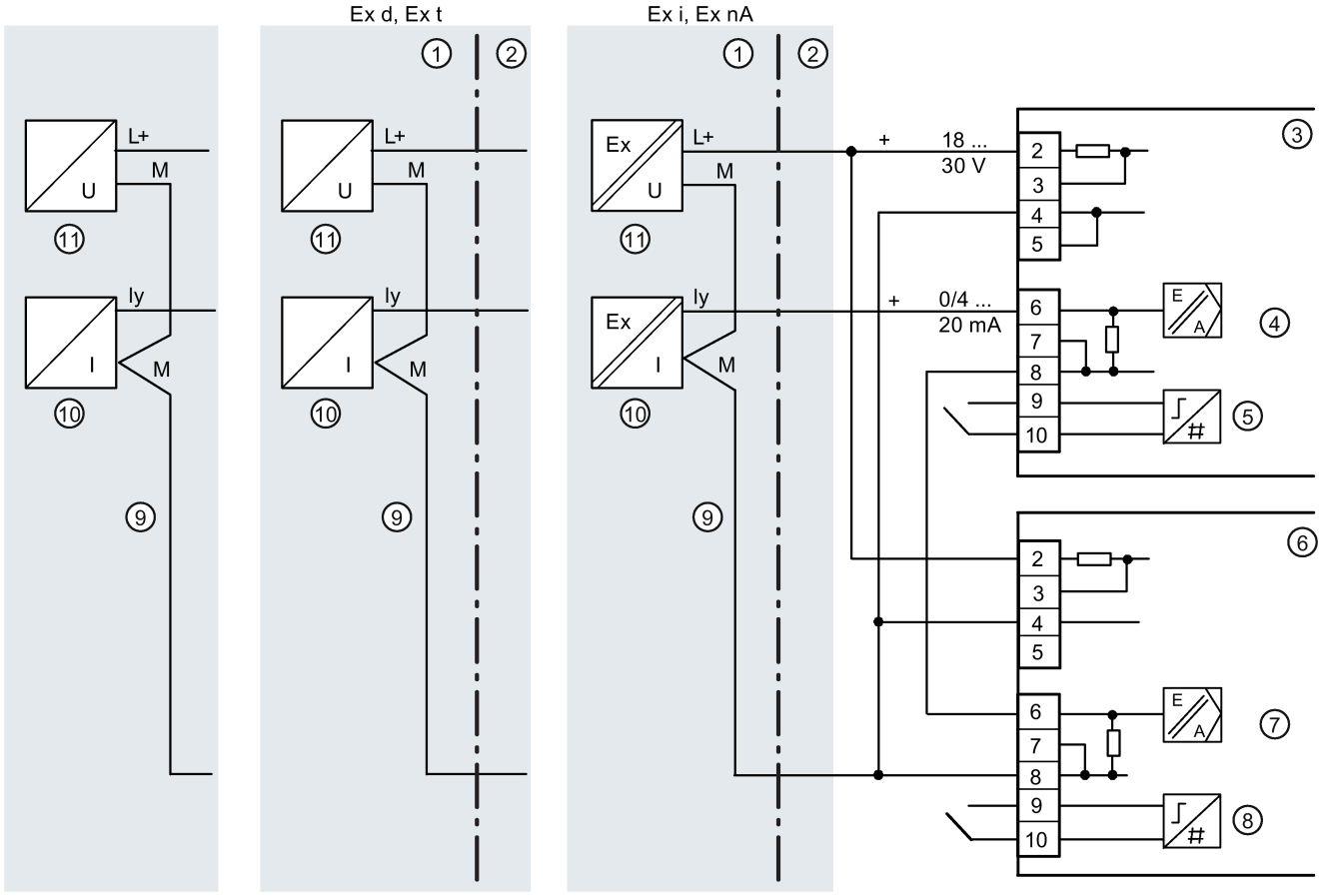
Figure 5-4 Device version 2-/3-/4-wire, with wiring type 3-wire



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

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

5.2.1 Connection diagram split range



① Non-hazardous area
② Hazardous area
③ Device 1
④ Travel range 1
⑤ Binary input 1
⑥ Device 2
⑦ Travel range 2
⑧ Binary input 2
⑨ Total travel range Iy
⑩ Signal source
⑪ Power source

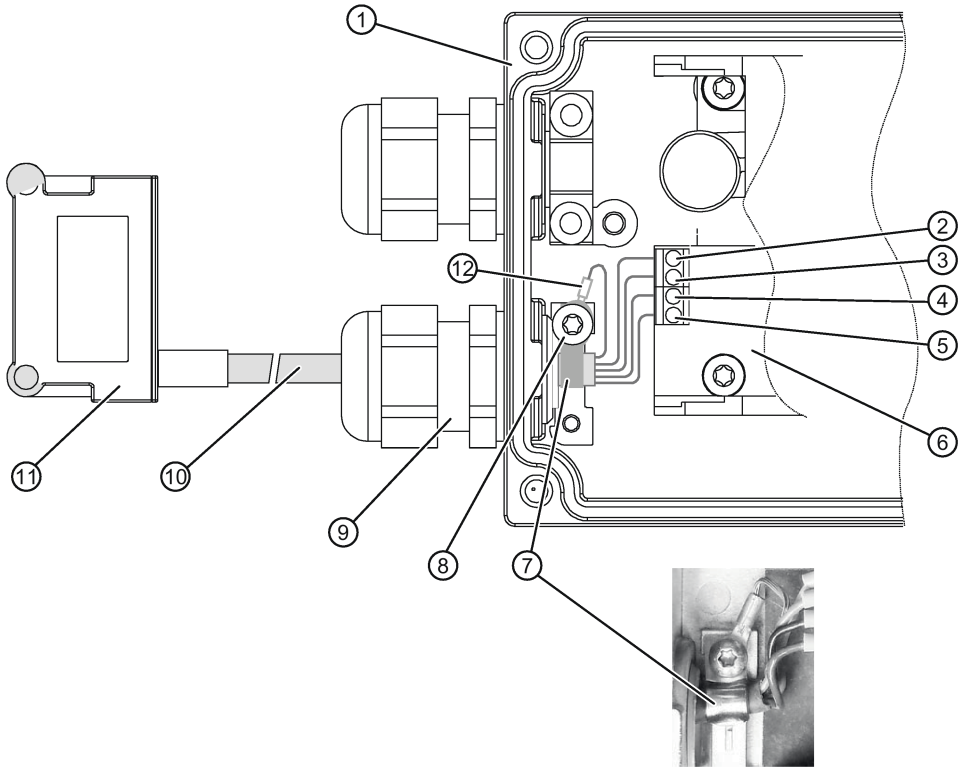
Figure 5-6 Series connection of two positioners, e.g., split range

5.2.2 Wiring NCS sensor to EMC filter module

Requirement

You need the EMC filter module, article number C73451-A430-D23, 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



①	Positioner (open state)	⑦	Cable clamp
②	Vcc: Yellow	⑧	Screw F3x8
③	Vref: Green	⑨	Cable gland
④	Vpos: Black	⑩	Four-pole NCS cable
⑤	Ground: Brown	⑪	Non Contacting Sensor (NCS)
⑥	EMC filter module C73451-A430-D23	⑫	Cable shielding lug

Figure 5-7 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 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:

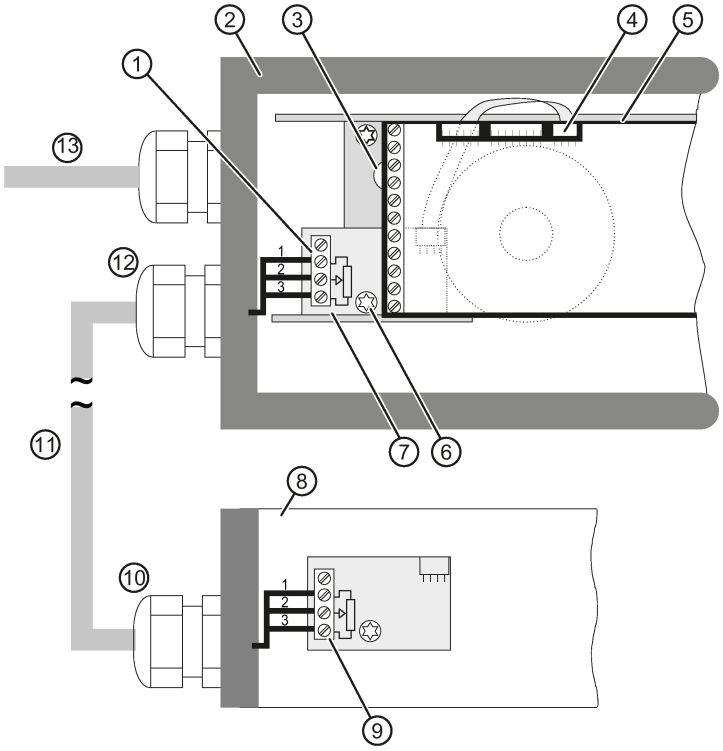
   The rear steel panel of the NCS sensor is inevitably bonded to the ground potential of the system when mounting on the console. This ground connection is only functional if there is a low-impedance connection to ground potential of the system. Ensure this state by measuring the ground resistance. If necessary, ensure proper grounding by means of an additional cable from the NCS sensor to ground potential.

5.2.3 Connecting the external position detection system to the EMC filter module

Requirement

You need the EMC filter module with article number C73451-A430-D23 for the electrical connection of an external position detection system, article number C73451-A430-D78, to the positioner.

Wiring diagram



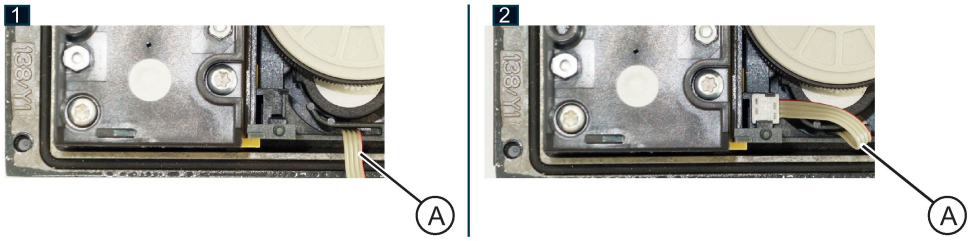
①	EMC filter module terminals	⑧	External position detection system C73451-A430-D78
②	Positioner with integral EMC filter module C73451-A430-D23	⑨	External position detection system terminals
③	Yellow wheel for locking the position detection	⑩	External position detection system cable gland
④	Ribbon cable connector of fitted potentiometer, or ribbon cable connector of EMC filter module	⑪	Cable
⑤	Basic electronics	⑫	EMC filter module cable gland
⑥	Screw	⑬	Input signal for positioner
⑦	EMC filter module C73451-A430-D23		

Figure 5-8 Connection to positioner

Preparing the positioner

1. You have performed the steps described in the section "General information on installing option modules (Page 54)".
2. Unplug the ribbon cable connector ④ to the fitted potentiometer from the basic electronics ⑤.
3. Remove the basic electronics ⑤ from the positioner. To this end, remove the two screws that fix the basic electronics to the pneumatic block.
4. Loosen screw ⑥ in the connection area of the positioner.
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 with the supplied cable tie at the container.



6. Secure the EMC filter module using the screw ⑥ loosened in the third step.
7. Fit the basic electronics ⑤ back into the positioner.
8. Insert the ribbon cable connector ④ of the EMC filter module onto the positioner basic electronics.
9. In **non**-hazardous environment:
   - Stick the supplied nameplate over the nameplate on the external position detection system ⑧.
   - Replace the blue cable gland ⑩ by the supplied gray cable gland.

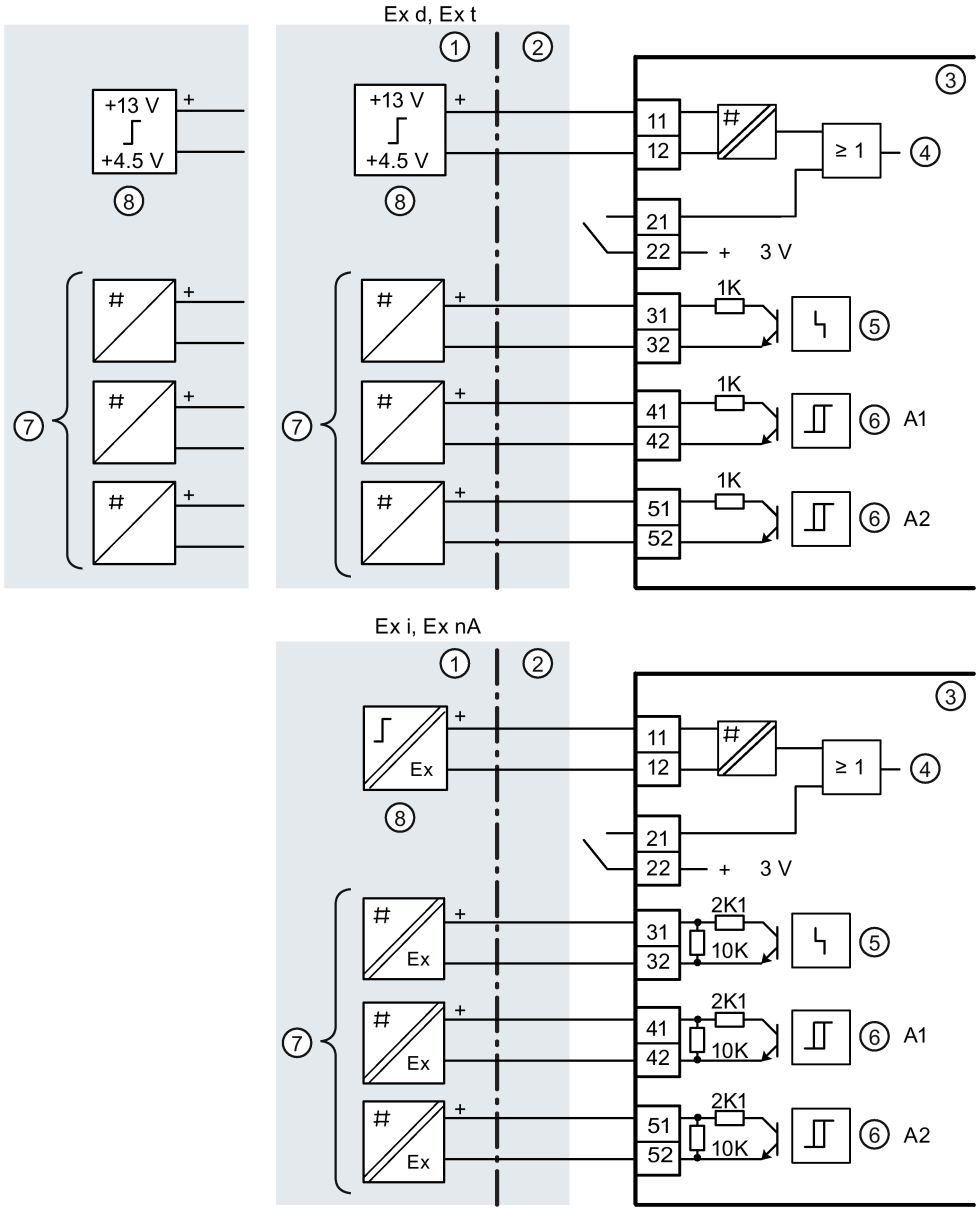
Refer to section "Scope of delivery of external position detection system (Page 270)", items "Nameplate for device version **without** explosion protection" and "Gray cable gland".

Procedure for connecting an external position detection system

1. Connect the three terminals of the external position detection system ⑨ to the three terminals of the EMC filter module ① using a cable as shown in the wiring diagram.
2. Tighten the cable glands ⑩ and ⑫.

5.2.4 Option modules

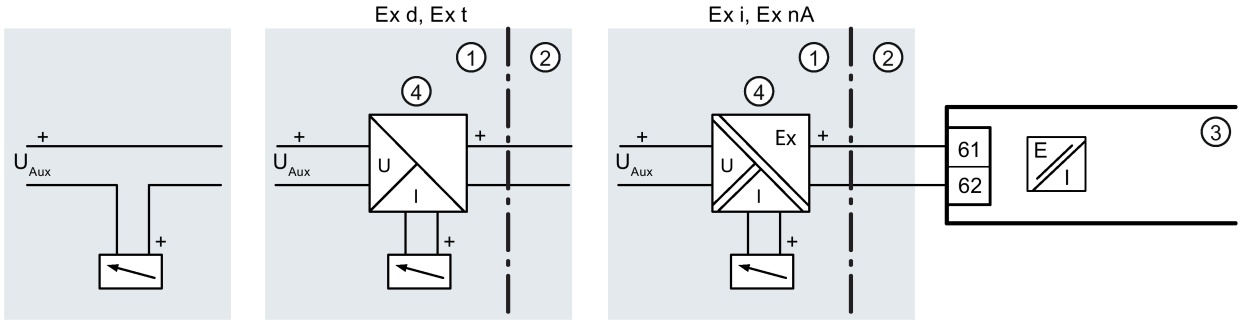
5.2.4.1 Alarm modules 6DR4004-6A and -8A



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

Figure 5-9 Alarm module

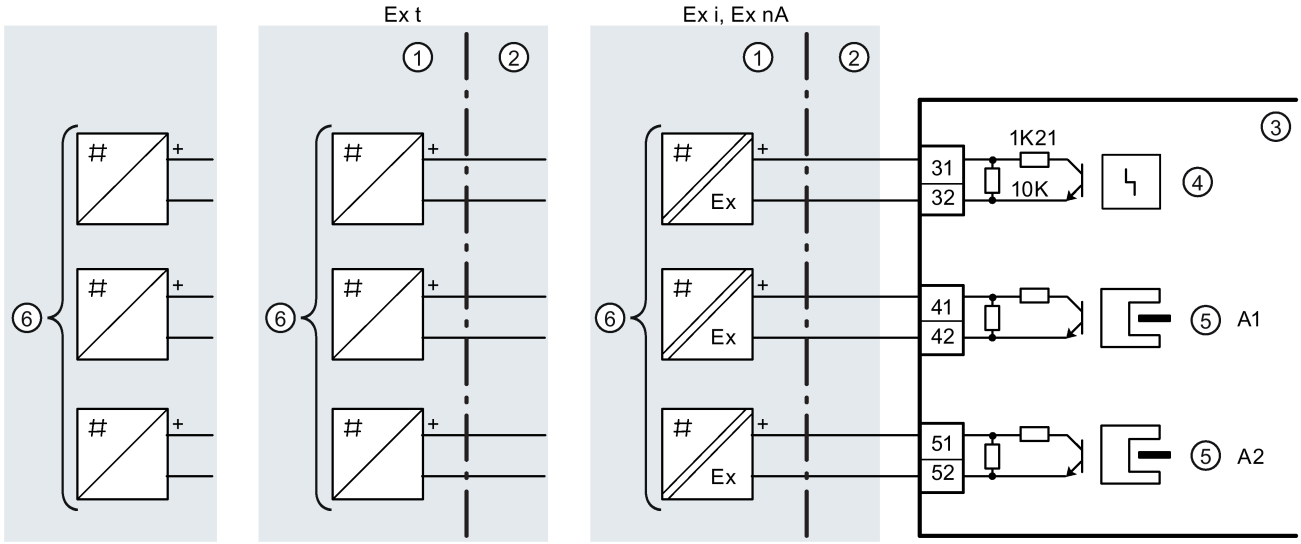
5.2.4.2 Position feedback modules 6DR4004-6J and -8J



① Non-hazardous area
② Hazardous area
③ Position feedback module
④ Feed splitter

Figure 5-10 Position feedback module

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



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

Figure 5-11 SIA module

5.2.4.4 Mechanical limit switch modules 6DR4004-6K and -8K

⚠ DANGER

Supply with hazardous voltage

When you supply the non-intrinsically safe version of the module with hazardous voltage, you must read the following safety rules before starting work on the device:

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

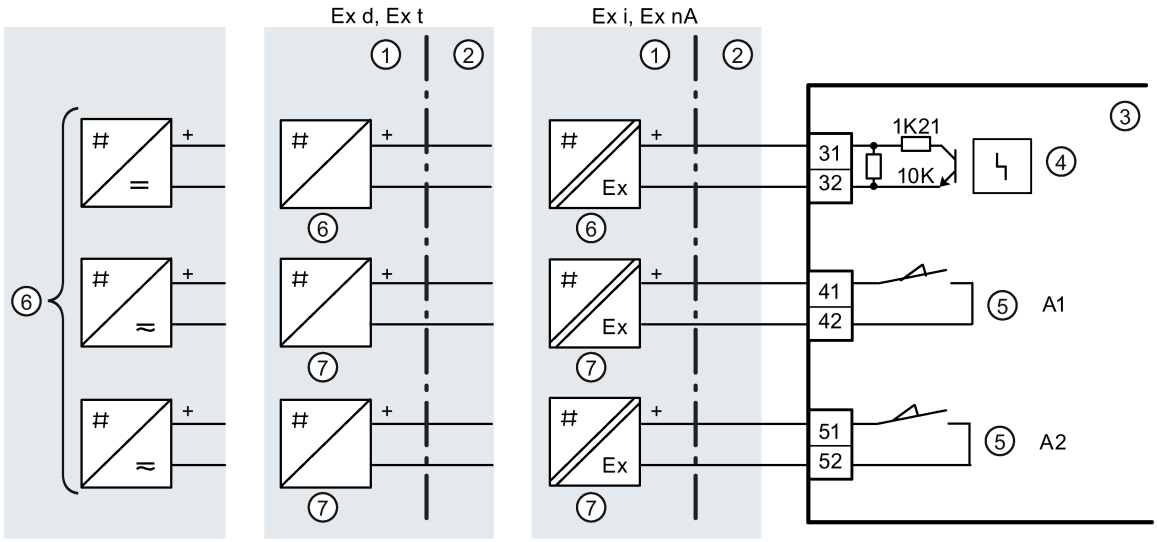
Maximum AC/DC switching voltage with UL approval E344532

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



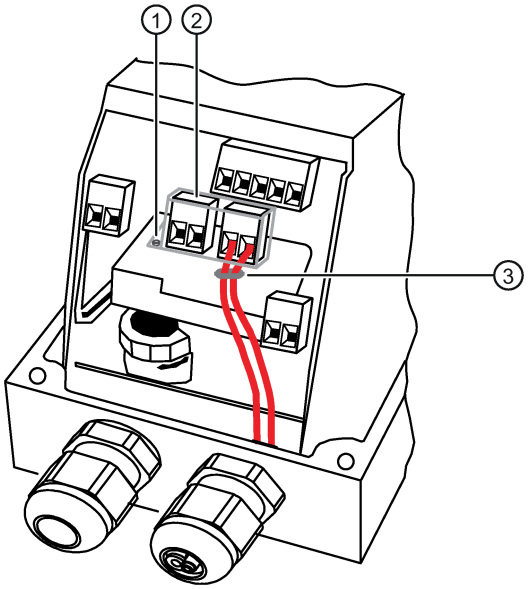
① Non-hazardous area
② Hazardous area
③ Mechanical limit switch module
④ Fault message
⑤ Limit
⑥ Switching amplifier
⑦ Switching output

Figure 5-12 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 5-13 Connecting the cables

5.2.5 Option device version M12 connector

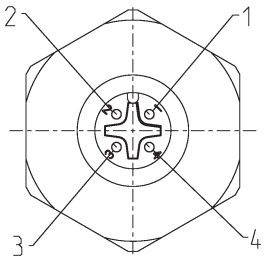
This section describes which terminal of the devices and option modules listed below is connected with the respective pole of the M12 connector.

Note

Technical specifications

Observe the specifications for the electrical data in the certificate and/or in section "Technical data (Page 243)".

View of the mating side pole pattern



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

5.2.5.1 M12 connector in the basic device

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

5.2.5.2 M12 connector for connection of the outputs of the alarm module 6DR4004-6A / -8A (-Z D55)

You have a positioner with order suffix -Z order code D55. This version of the positioner is connected via an M12 connector to the current output of the position feedback module.

Table 5- 2 Assignment diagram

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

5.2.5.3 M12 connector for connecting the outputs of 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, an M12 connector is used to electrically connect the current output of the position feedback module.

Table 5- 3 Assignment diagram

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

5.2.5.4 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 connects the external position detection system with the built-in EMC filter module (C73451-A430-D23).

Table 5- 4 Assignment diagram

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

5.2.5.5 M12 connector for connecting the outputs of 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, an M12 connector is used to electrically connect the outputs of the SIA module.

Table 5- 5 Assignment diagram

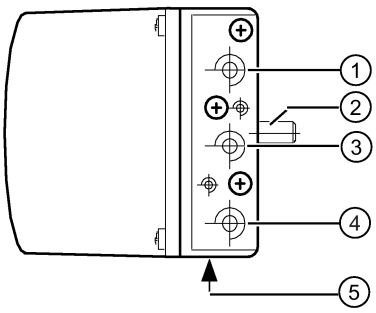
Alarm output terminal	Pole designation
41 (+)	1 - Brown
52 (-)	4 - Black
42 (-)	3 - Blue
51 (+)	2 - White

5.3 Pneumatic connection

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

Structure

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



① Actuating pressure Y1 for single and double-acting actuators
② Positioner shaft
③ Supply air PZ
④ Actuating pressure Y2 for double-acting actuators
⑤ Exhaust air outlet with a sound absorber

Figure 5-14 Pneumatic connection on the standard controller

5.3.2 Integrated pneumatic connection

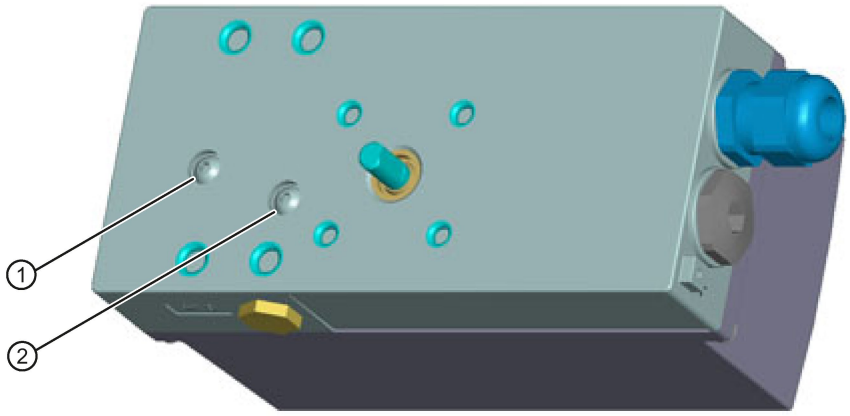
Structure

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.



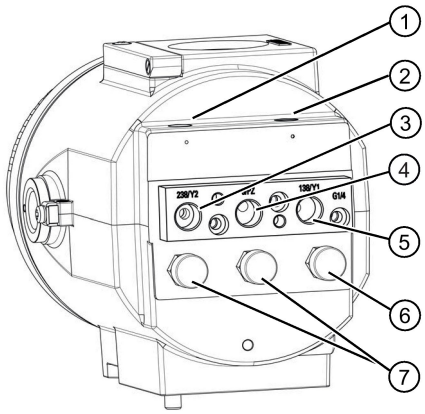
① Actuating pressure Y1
② Exhaust air outlet

Figure 5-15 Integrated pneumatic connection

5.3.3 Pneumatic connection for 6DR5..5-0E...

Structure

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



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

*) for double-acting actuators

Figure 5-16 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.

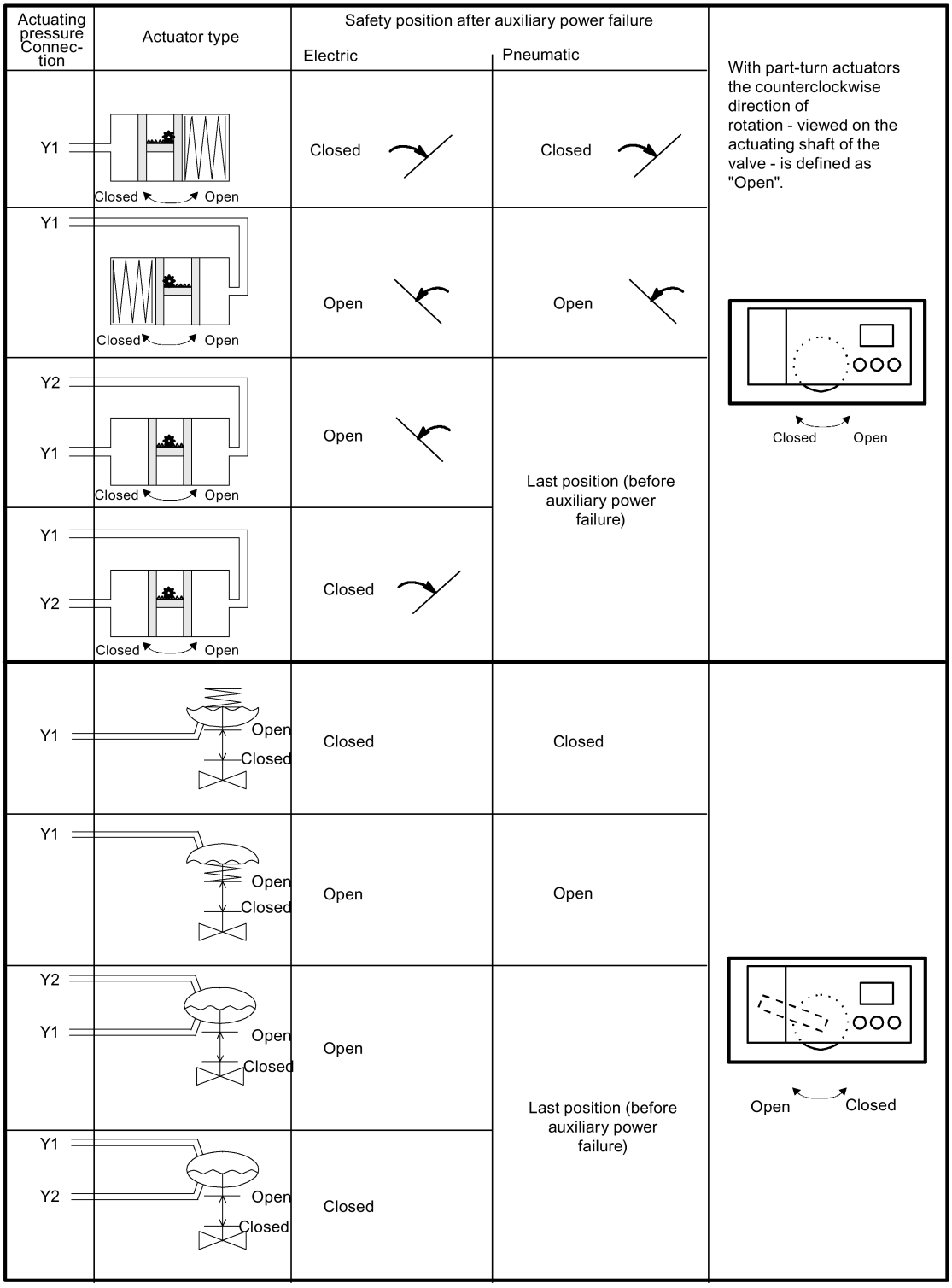


Figure 5-17 Regulating action of pneumatic connection

Overview of positioning effect for fail in place version

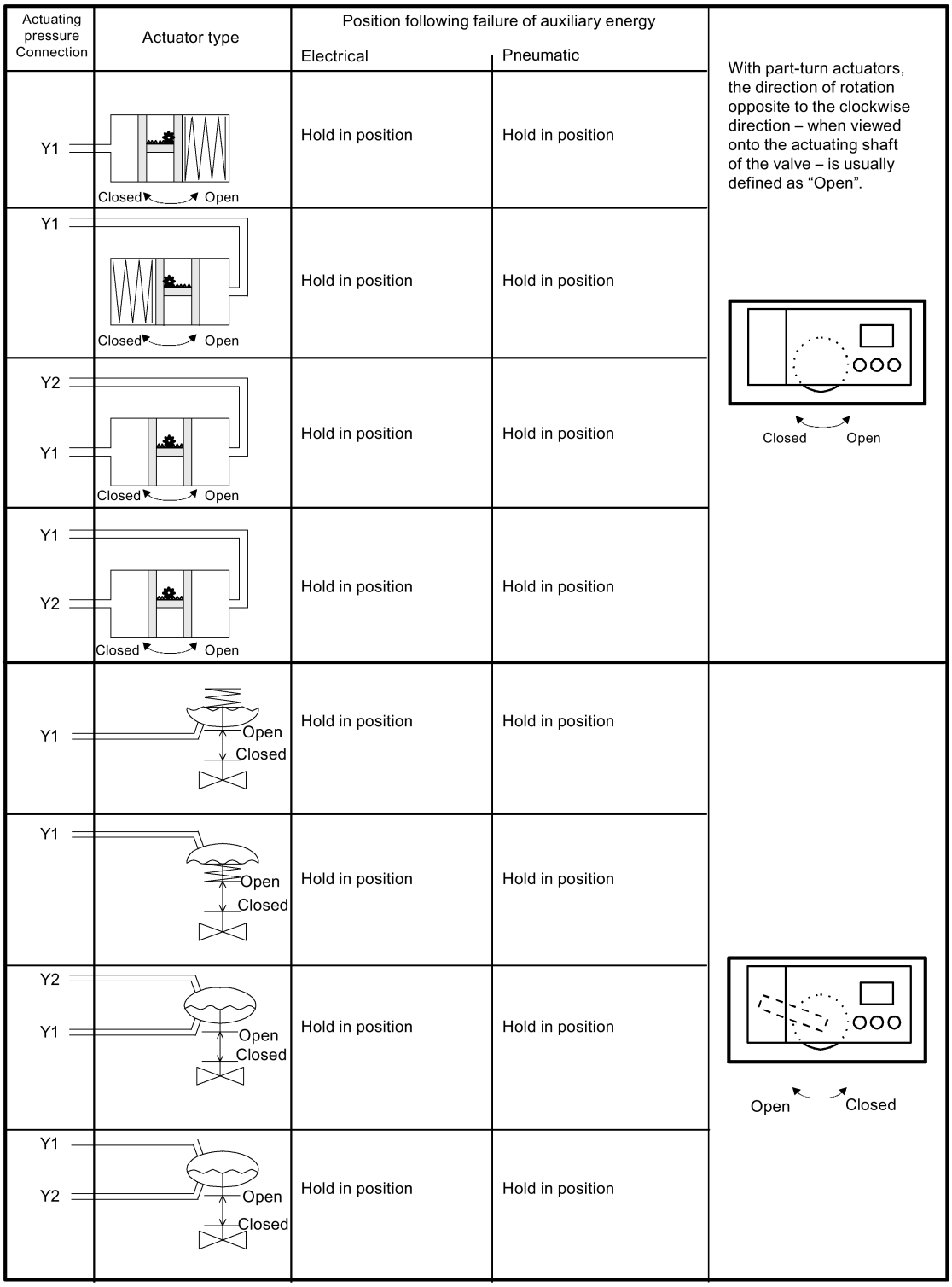


Figure 5-18 Pneumatic connections for positioning effect with fail in place version

5.3.5 Pneumatic connection

⚠ WARNING

Pneumatic auxiliary power

Owing to safety reasons, the pneumatic auxiliary power supply must be fed after installation only if the positioner is switched to the "P-manual mode" when an electrical signal is available, refer to the as-delivered condition.

Note

Specifications regarding air quality

Observe the specifications regarding the air quality, see section "Technical specifications > Pneumatic data (Page 244)".

- If required, connect the pressure gauge block for supply air and actuating pressure.
- Connection via female thread G¼ or ¼" NPT:
  - Y1: actuating pressure 1 for single and double-acting actuators
  - Y2: actuating pressure 2 for double-acting actuators
  - Exhaust air outlet with a sound absorber. Remove the sound absorber if required.
- For double-acting actuators, connect actuating pressure Y1 or Y2 depending on the desired safety setting.
- Safety position in case of electrical auxiliary power supply failure:
  - Positioner with single-acting pneumatic system: Y1 depressurized
  - Positioner with double-acting pneumatic system: Y1 pressurized (maximum actuating pressure), Y2 depressurized
  - Positioner with Fail in Place pneumatic system: Hold Y1 and Y2 (current actuating pressure)

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.

- After installing the pneumatic connections, check the tightness of the entire control valve.

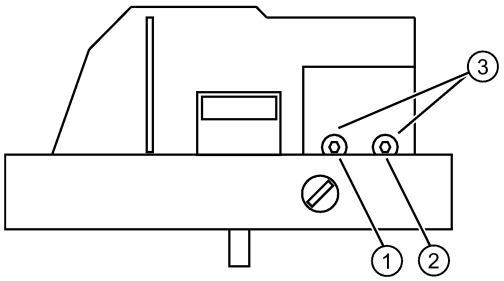
See also

Reaction to failure of auxiliary powers (Page 98)

Changing the operating mode (Page 107)

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 5-19 Restrictors

See also

Pneumatic connection for 6DR5..5-0E... (Page 97)

Sequence of automatic initialization (Page 117)

Operating

6

6.1 Operating elements

6.1.1 Display

Introduction

Note

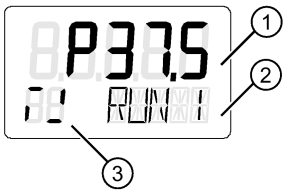
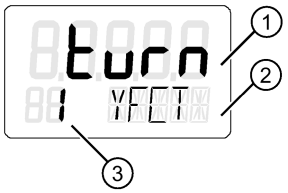
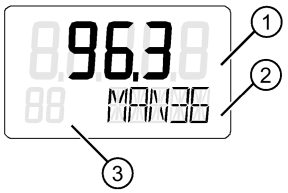
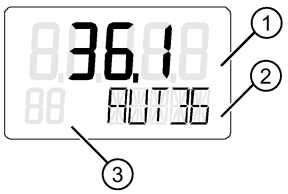
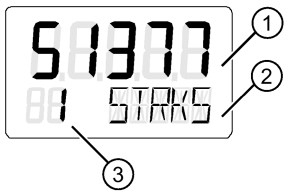
Repetition rate display

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.

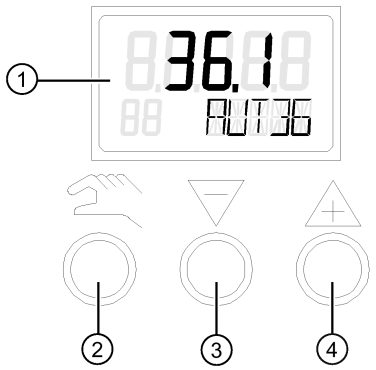
Operating mode	Representation in the display	Pos.	Legend
P manual mode		①	Potentiometer setting [%]
		②	Blinking indicator for the non-initialized status.
Initialization mode		①	Potentiometer setting [%]
		②	Display of the current status of initialization or a fault message.
		③	Indicator for ongoing initialization or a fault message.
Configuring		①	Parameter value
		②	Parameter name
		③	Parameter number
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 201)

Changing the operating mode (Page 107)

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

Note

Key cover

In positioners with flameproof enclosures, the button cover prevents liquids from seeping through. The IP66/NEMA 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/NEMA 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".

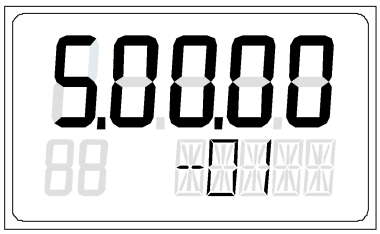


Figure 6-2 Firmware version, e.g. Version 5.00.00

6.2 Operating modes

6.2.1 Overview of operating modes

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

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

6.2.2 Changing the operating mode

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

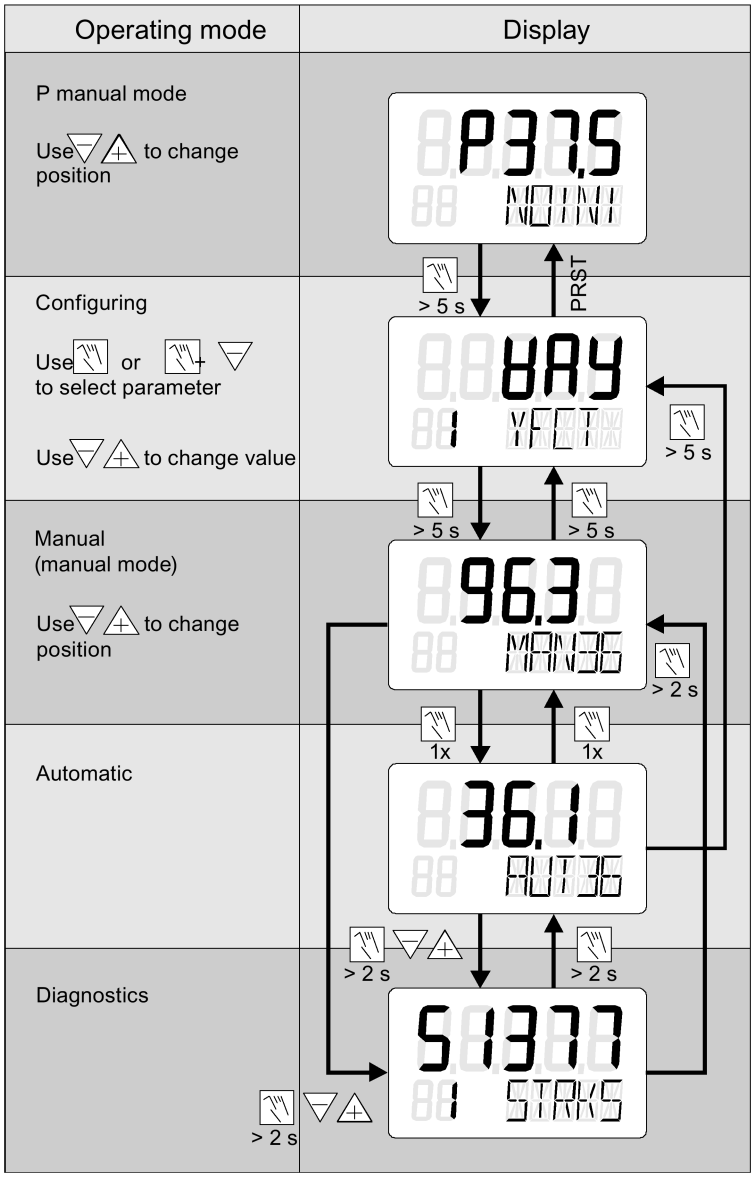


Figure 6-3 Switching between the operating modes

See also

Display (Page 103)

6.2.3 Overview of configuration

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

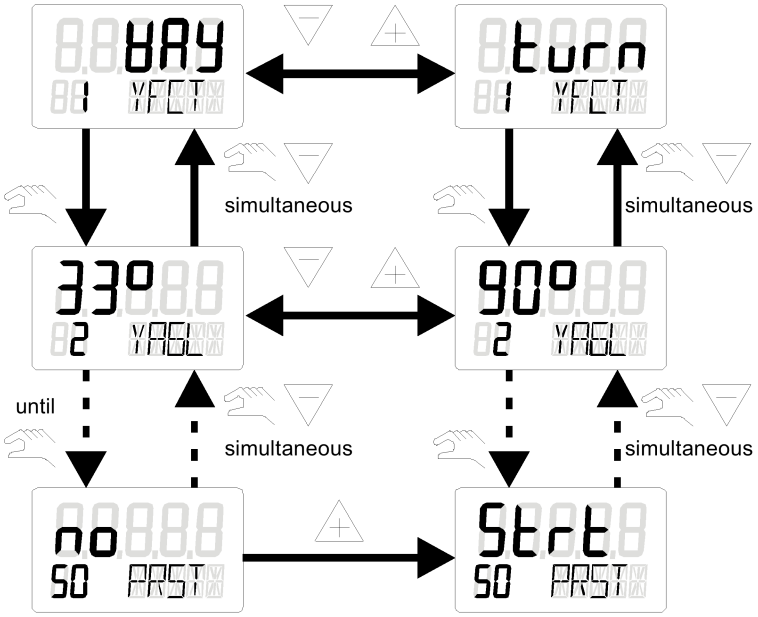


Figure 6-4 Overview of the "Configuration" operating mode

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 115)

Overview of advanced diagnostics parameters A to P (Page 151)

Overview of diagnostics values (Page 208)

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 "Operation with boosters (Page 273)"

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

Improper commissioning in hazardous areas

Device failure or danger of explosion in hazardous areas.

- Do not commission the device until it has been mounted completely and connected in accordance with the information in Chapter "Technical data (Page 243)".
- Before commissioning take the effect on other devices in the system into account.

⚠ WARNING

Loss of explosion protection

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

- Close the device as described in Chapter "Installing/mounting (Page 35)".

⚠ WARNING

Opening device in energized state

Danger of explosion in areas subject to explosion hazard.

- 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 degree of protection

Damage to device if the enclosure is open or not properly closed. The degree of protection specified on the nameplate or in Chapter "Technical data (Page 243)" 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.

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 in the servo-drive 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 252)".
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 106)

Positioners subjected to fast acceleration or strong vibration (Page 50)

7.3 Sequence of automatic initialization

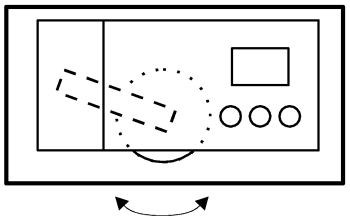
Overview

The automatic initialization takes place in the following phases:

Automatic initialization phase	Description
Start	-
RUN1	Establishing the direction of action.
RUN2	Checking the actuator travel and trimming the lower and upper endstops.
RUN3	Establishing and displaying the travel time (leakage test)
RUN4	Minimization of controller increments
RUN5	Optimization of the transient response
End	-

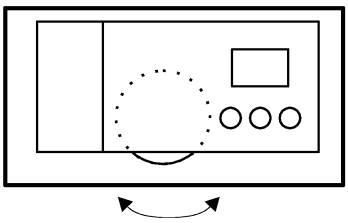
The following structured charts describe the sequence of initialization. The "Up/Down" names indicate the direction of action of actuators.

Linear actuator



Open **Closed**

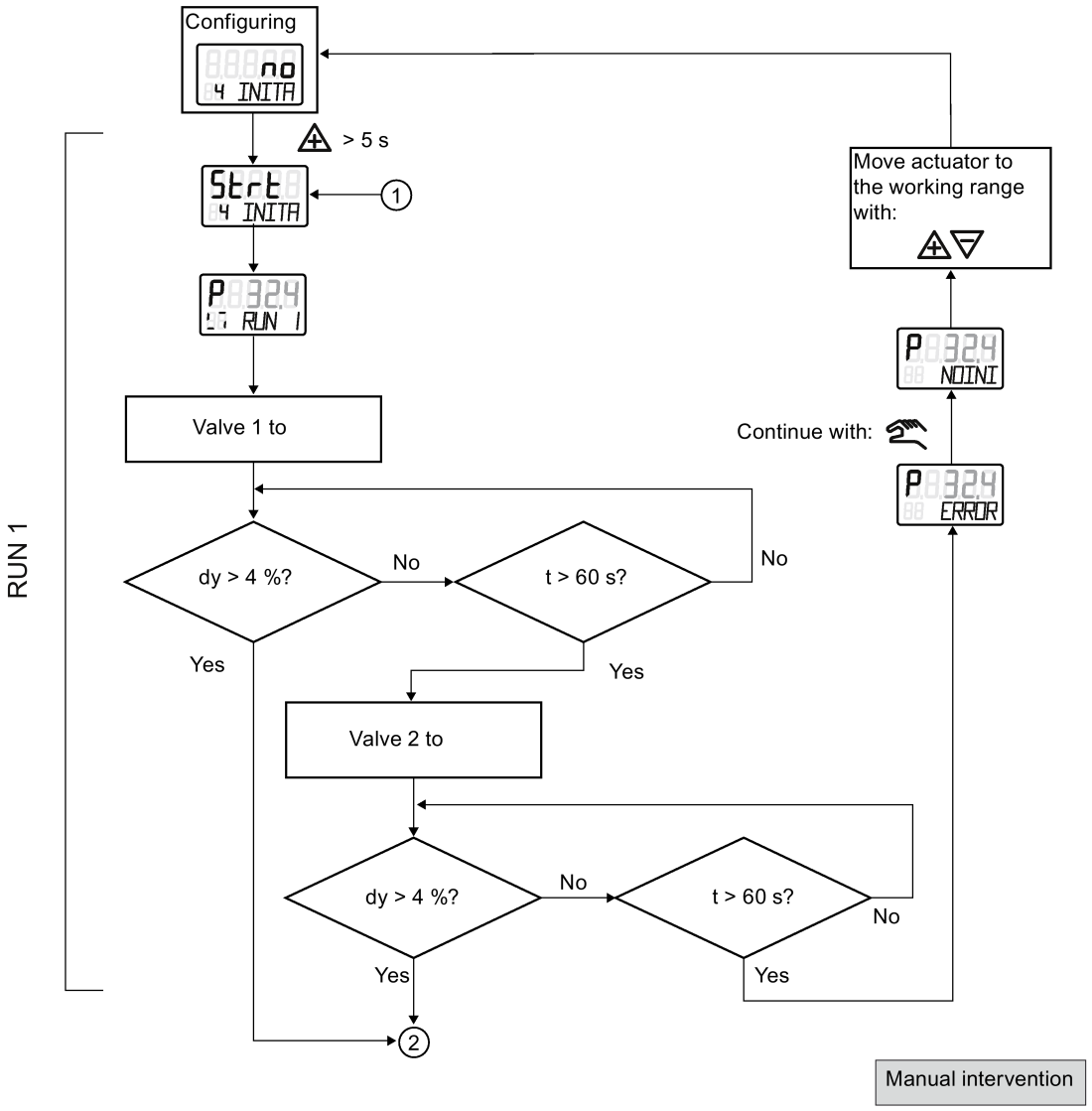
Part-turn actuator



Closed **Open**

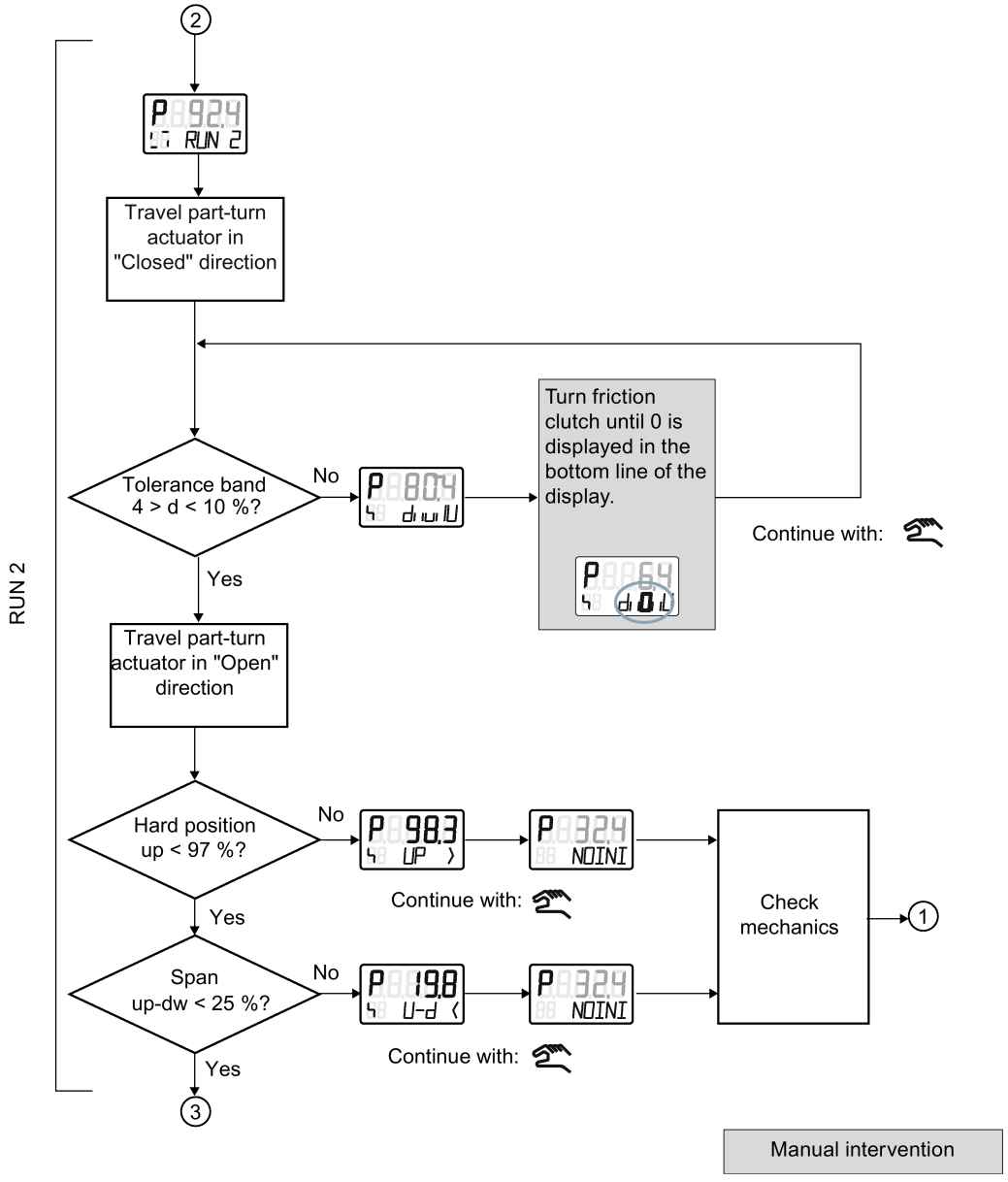
Sequence of RUN1

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



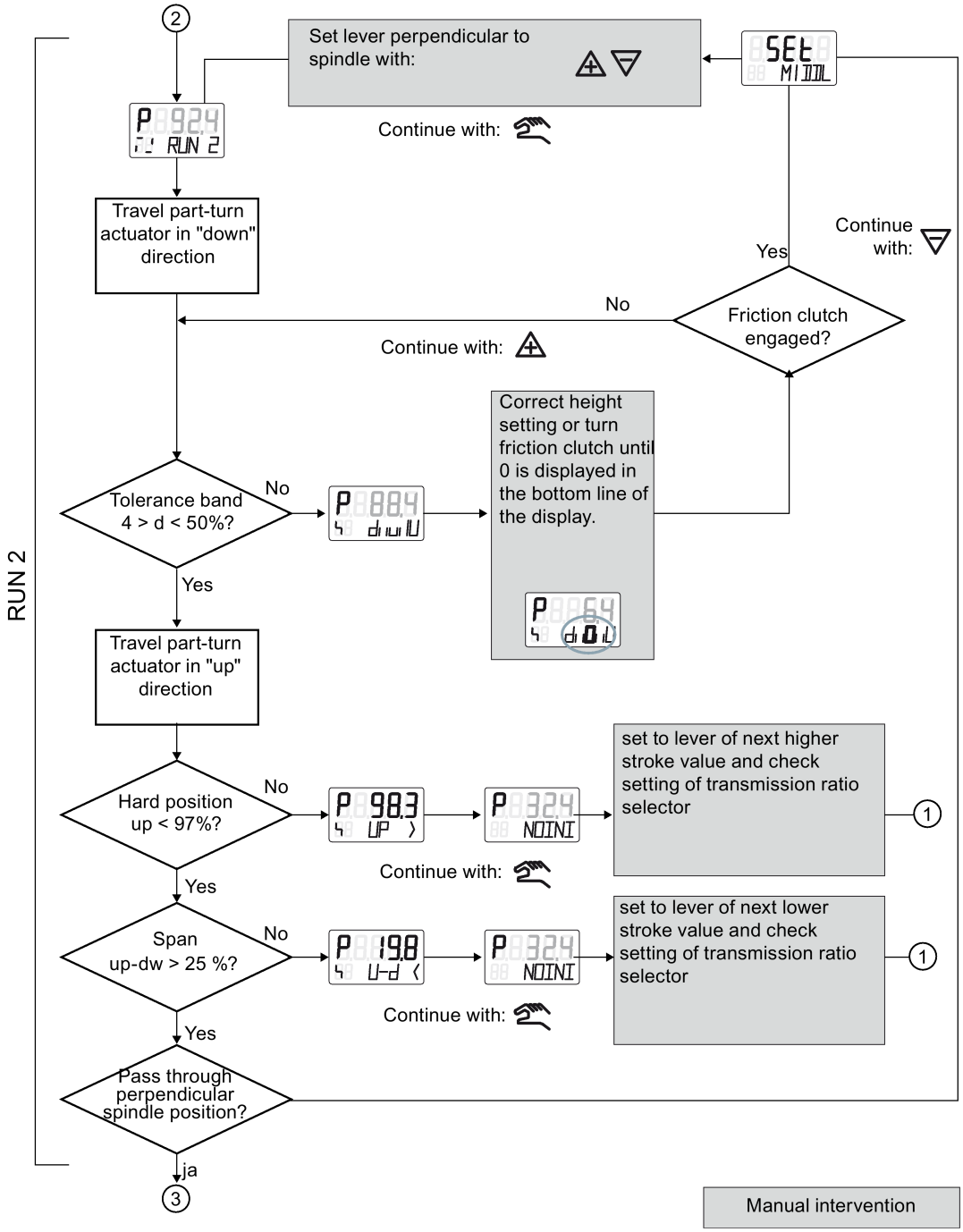
Sequence of RUN2 for part-turn actuators

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.



Sequence of RUN2 for linear actuators

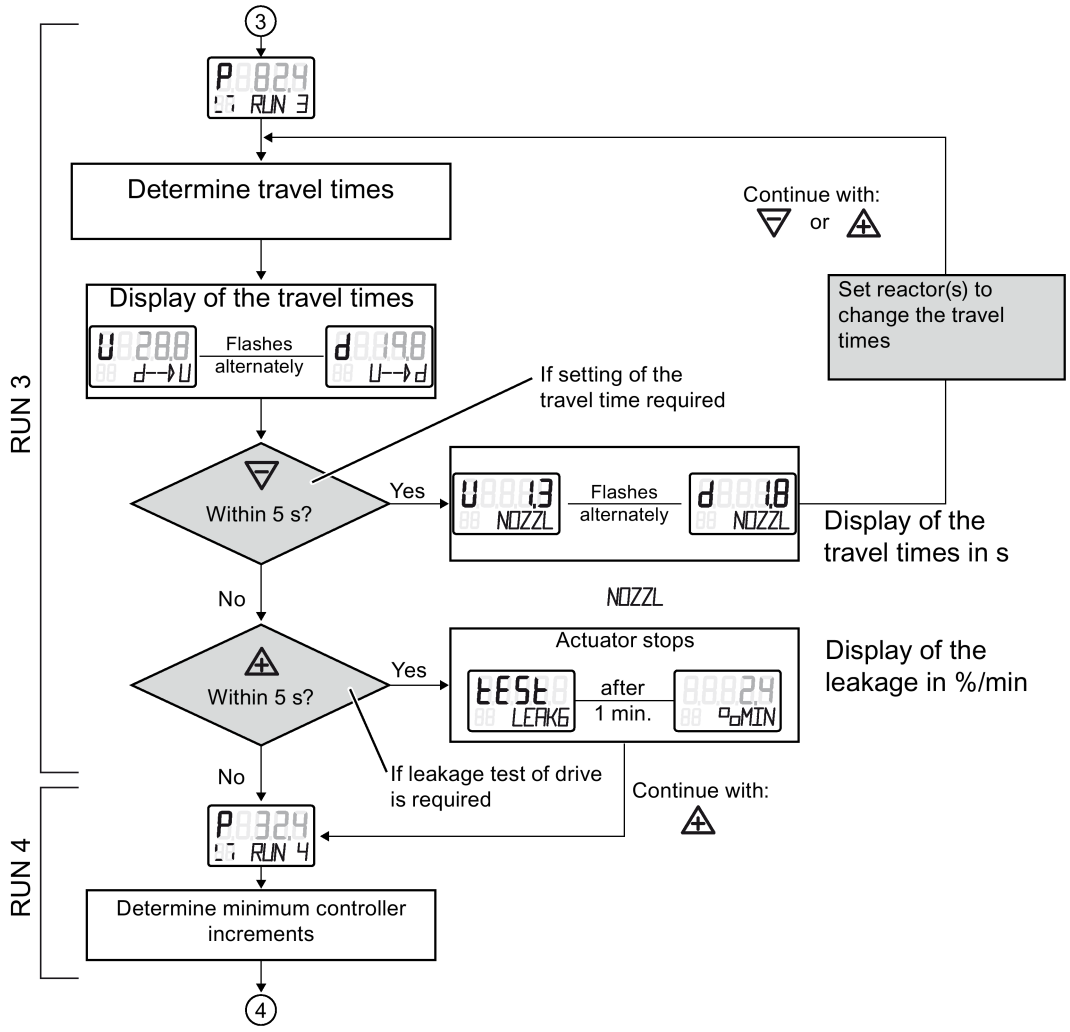
This structured chart describes the process to determine the actuator travel checks. It also contains information about the sequence for trimming the lower and upper endstops.

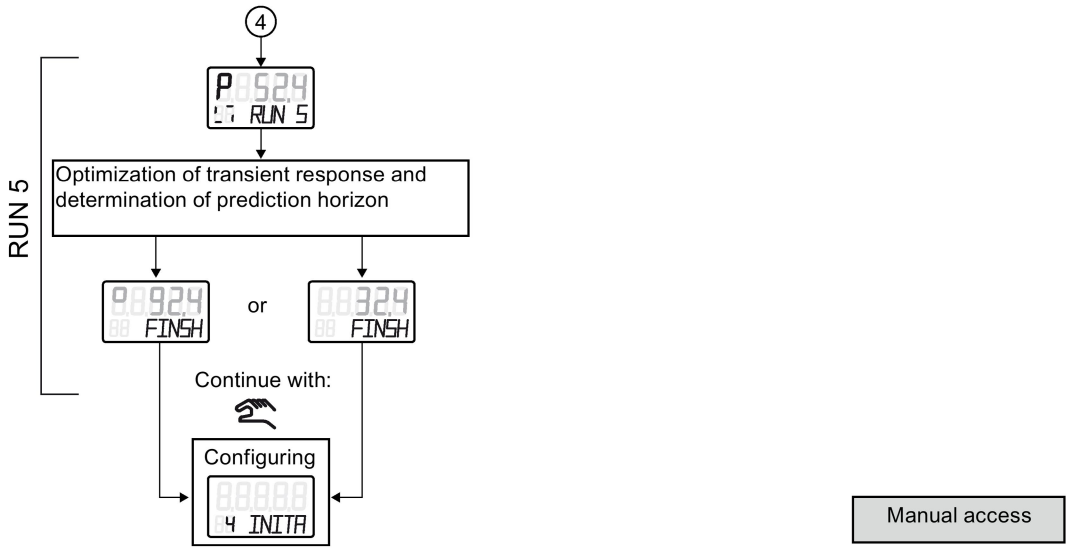


Sequence of RUN3 to RUN5

This structured chart describes:

- Establishing and displaying the travel time/leakage in RUN3
- Minimization of controller increments in RUN4
- Optimization of the transient response in RUN5

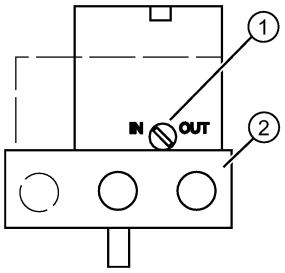




7.4 Purge air switching

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.

7.5 Commissioning linear actuators

7.5.1 Preparing linear actuators for commissioning

Requirement

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

Setting the transmission ratio selector

Note

Commissioning

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

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

Connecting the positioner

1. Connect a suitable current or voltage source. The positioner is now in the "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 achieved. The closer this value is to "P50.0", the more accurately the positioner determines the stroke travel.

   Note
   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 6DR4004-5L/-5LE (Page 69)". Requirement: The '1.YFCT' Type of actuator (Page 155) parameter is set.

See also

Mounting the linear actuator (Page 38)

Installing the optional modules in the "flameproof enclosure" version (Page 57)

External position detection (Page 53)

7.5.2 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

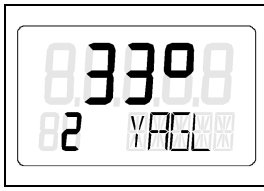
Interrupting initialization

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, press the button for at least 5 seconds. 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 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.
   - 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

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 or 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, 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.

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

Aborting the automatic initialization process

1. Press the button. The display shows the following:

   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 status is displayed.

   After releasing the button, the positioner is in "P manual mode". The positioner is not initialized.

See also

Sequence of automatic initialization (Page 117)

7.5.3 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

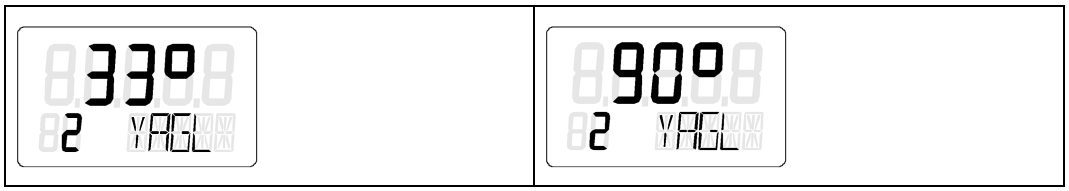
The following requirements must be fulfilled before activating manual initialization:

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:

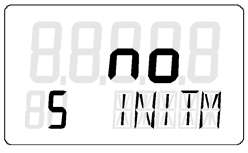
Note

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 "RUN1" to "RUN5" 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.

Aborting the manual initialization process

1. Press the button. The display shows the "5.INITM" parameter. 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 status is displayed. After releasing the button, the positioner is in "P manual mode". The positioner is not initialized.

7.6 Commissioning part-turn actuators

7.6.1 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 current or voltage source.

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.

See also

External position detection (Page 53)

7.6.2 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:

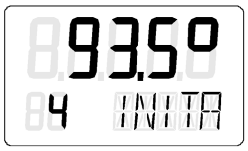
5. Start the initialization process. To do this, press the ⚠ button for at least 5 seconds until the display shows the following:

The positioner runs through five initialization steps during the automatic initialization process. Displays for the initialization steps from "RUN1" to "RUN5" 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:

Aborting the automatic initialization process

1. Press the button. The display shows the following:



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 status is displayed.

After releasing the button, the positioner is in "P manual mode". The part-turn actuator is not initialized.

See also

Sequence of automatic initialization (Page 117)

7.6.3 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 "RUN1" to "RUN5" are output in the bottom line of the display. The following display indicates that the initialization has been completed successfully:

Aborting the manual initialization process

1. Press the button. The display shows the "INITM" parameter. The positioner is in the "Configuration" mode.
2. Exit the "Configuration" mode. To do this, press the button for at least 5 seconds.
3. The software status is displayed.
4. After releasing the button, the positioner is in "P manual mode". "P manual mode" means that the positioner has not been initialized.

7.7 Device replacement

Introduction

Note

Initialization

The positioner can be replaced without having to interrupt ongoing processes. However, copying and pasting 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. Read the initialization parameters from 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 108)".
11. Release the fixing of the actuator.

See also

Sequence of automatic initialization (Page 117)

Automatic initialization of linear actuators (Page 125)

Automatic initialization of part-turn actuators (Page 132)

Manual initialization of linear actuators (Page 127)

Manual initialization of part-turn actuators (Page 134)

Functional safety

8

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 142)" and "Safety characteristics (Page 142)".

- 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 222).

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

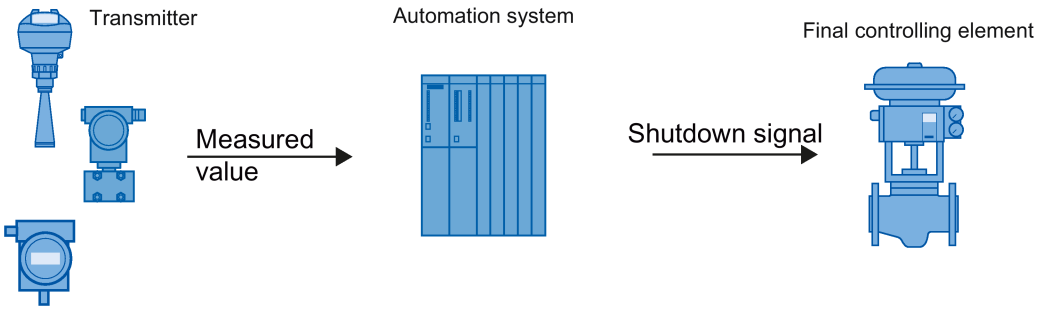


Figure 8-1 Safety-instrumented system in single-channel operation

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. Every level corresponds to a probability range for the failure of a safety function.

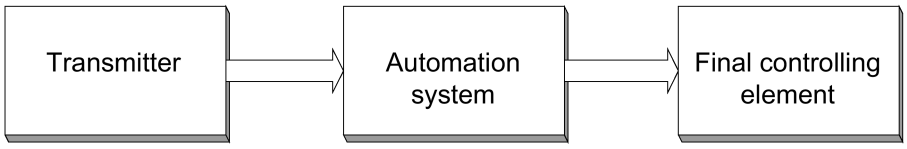
Description

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:



PFD_{AVG}-Part < 35 % < 15 % < 50%

Figure 8-2 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 139)

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 2
- 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 142)

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 142)"

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 155): 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 159): Describes die parameters with which the positioner is adapted to the valve application, for example tight closing at the end stops.
- Extended diagnostics parameters A to P (Page 176): 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 207).

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

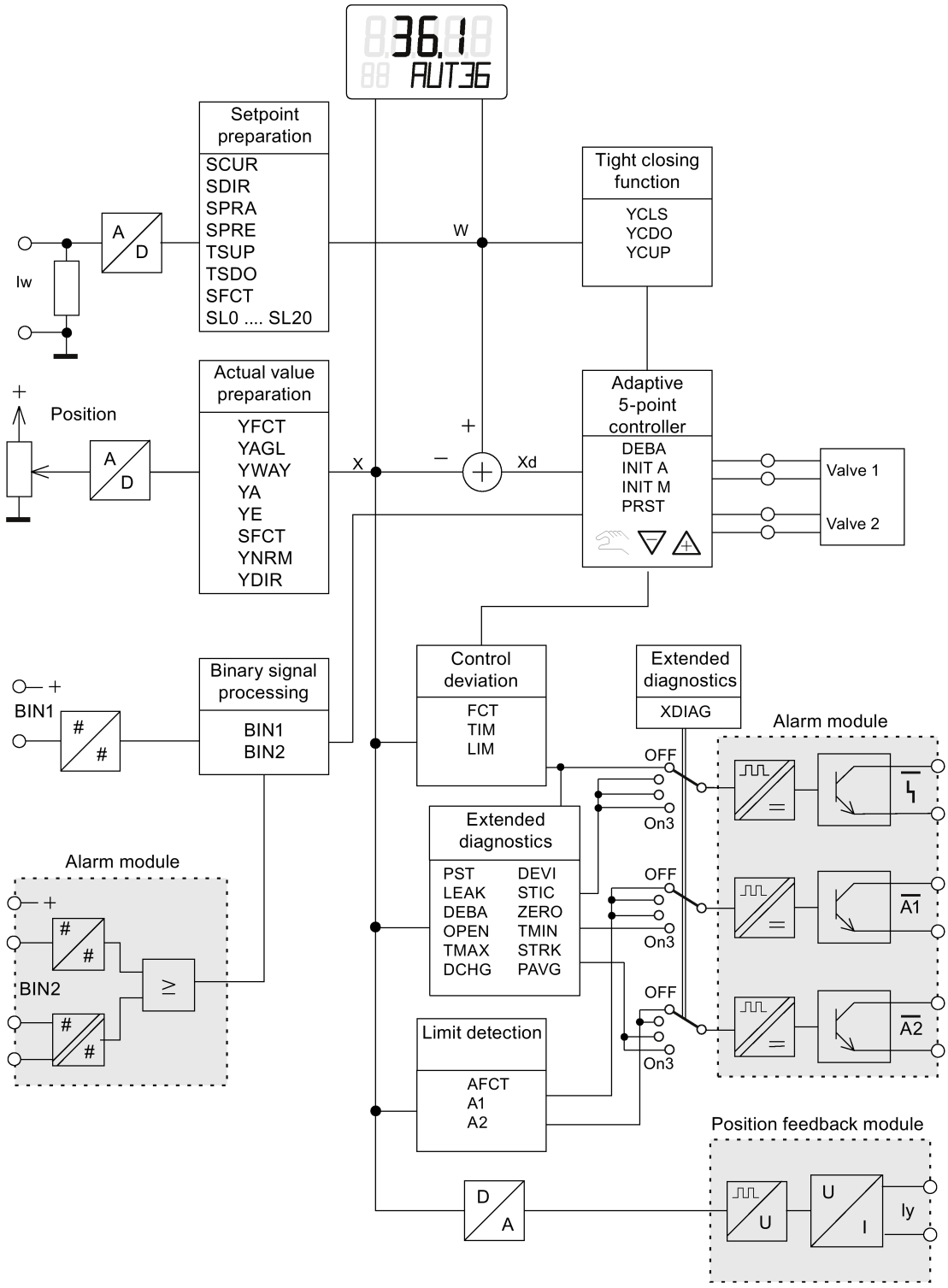


Figure 9-1 Configuration block schematic

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	LWAY	-LWAY	
	Part-turn actuator with NCS	ncSt	-ncSt	
	Linear actuator with NCS	ncSL	-ncSL	
	Linear actuator with NCS 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
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 the manipulated variable limit			**0.0** ... 100.0	%
36.YE	End of the manipulated variable limit			0.0 ... **100.0**	%
37.YNRM	Standardization of manipulated variable				
		To mechanical travel		**MPOS**	
		On flow		FLoW	
38.YDIR	Direction of action of manipulated variable for display and position feedback				
		Rising		**riSE**	
		Falling		FALL	
39.YCLS	Tight closing manipulated variables				
		None		**no**	
		Up only		uP	
		Down only		do	
		Up and down		uP do	
40.YCDO	Low value for tight closing			0.0 ... **0.5** ... 100.0	%

Parameter	Function		Parameter values		Unit
41.YCUP	Upper value for tight closing		0.0 ... **99.5** ... 100.0		%
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	MinMA	-MinMA	
		A1 = Min, A2 = Min	MinMin	-MinMin	
		A1 = Max, A2 = Max	MAMA	-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. ↳ FCT[3)]	Function for fault message output		Normal	Inverted	
		Fault	F	-F	
		Fault + not automatic [4)]	FnA	-FnA	
		Fault + not automatic + BIN[4)]	FnAb	-FnAb	
48. ↳ TIM	Monitoring time for setting of fault message 'Control deviation'		**Auto** / 0 ... 100		s
49. ↳ LIM	Response threshold of fault message 'Control deviation'		**Auto** / 0 ... 100		%
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		

Parameter	Function		Parameter values	Unit
		Reset parameters A to P of the extended diagnostics function as well as parameter '52.XDIAG'.	diAg	
51.PNEUM	Fail in Place			
		Standard pneumatic block	**Std**	
		Fail in Place pneumatic block	FIP	
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 diagnostics parameters A to P

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 P and their sub-parameters are only displayed when the extended diagnostics has been activated in parameter "'52.XDIAG' Activating for extended diagnostics (Page 174)" with setting "On1", "On2" or "On3".

Overview parameter A

Parameter		Function	Parameter values	Unit
A.┗PST		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.┗DEVI		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.┗LEAK		Monitoring 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.┗ STIC		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.┗ DEBA		Monitoring of deadband with the following parameters:		
	E1.LEVL3	Threshold	0.1 ... **2.0** ... 2.9	%

Overview parameter F

Parameter		Function	Parameter values	Unit
F.┗ ZERO		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.┗ OPEN		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.┗ TMIN		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.┗TMAX		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.┗STRK		Monitoring of number of total strokes with the following parameters:		
	L1. LIMIT	Limit for number of total strokes	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.┗DCHG		Monitoring the number of changes in direction with the following parameters:		
	O1.LIMIT	Limit for number of changes in direction	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.┗PAVG		Monitoring the 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	%

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 • turn • WAY • FWAY • LWAY • ncSt • ncSL • ncSLL Actuator with inverted direction of action • -turn • -WAY • -FWAY • -LWAY • -ncSt • -ncSL • -ncLL
Purpose:	Use this parameter to adjust the positioner to the respective actuator. • turn/-turn: Use this setting for a part-turn actuator with a directly mounted positioner. • WAY/-WAY: Use this setting for a linear actuator with a carrier pin mounted on the lever. • FWAY/-FWAY: Use this setting for a linear actuator with a carrier pin mounted on the actuator spindle. • LWAY/-LWAY: Use this setting for an external linear potentiometer on a linear actuator. • ncSt/-ncSt: Use this setting for an NCS sensor (6DR4004-.N.10 and -.N.40) on a part-time actuator. • 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 an NCS sensor (6DR4004-.N.30) on a linear actuator for strokes > 14 mm (0.55 inch) and for 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 rotates 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 rotates downwards and the positioner shaft or magnet of the NCS sensor rotates in the clockwise direction.

Additional information:

- The '3.YWAY' Range of stroke (Page 157) parameter is displayed only for 'WAY', '-WAY', 'ncSLL' or '-ncLL'.
- turn/-turn: The '2.YAGL' Rated angle of rotation of feedback (Page 156) parameter is automatically set to 90° and cannot be changed.
- WAY/-WAY: The positioner compensates the non-linearity caused due to the transformation of the linear movement of the linear actuator into the rotary movement of the positioner shaft. For this purpose, the positioner is set in the factory in such a way that it displays a value between 'P49.0' and 'P51.0' when the lever on the positioner shaft is perpendicular to the linear actuator spindle.

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 117)

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 the linear actuator (Page 38), Figure 4-2 Lever with carrier pin (Page 41).

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 155)

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 "RUN1" to "RUN5" 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 81)".
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 end

Adjustment range: 0.0 ... 100.0

Purpose: With these two parameters in combination with parameter "'7.SDIR' Setpoint direction (Page 159)", 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

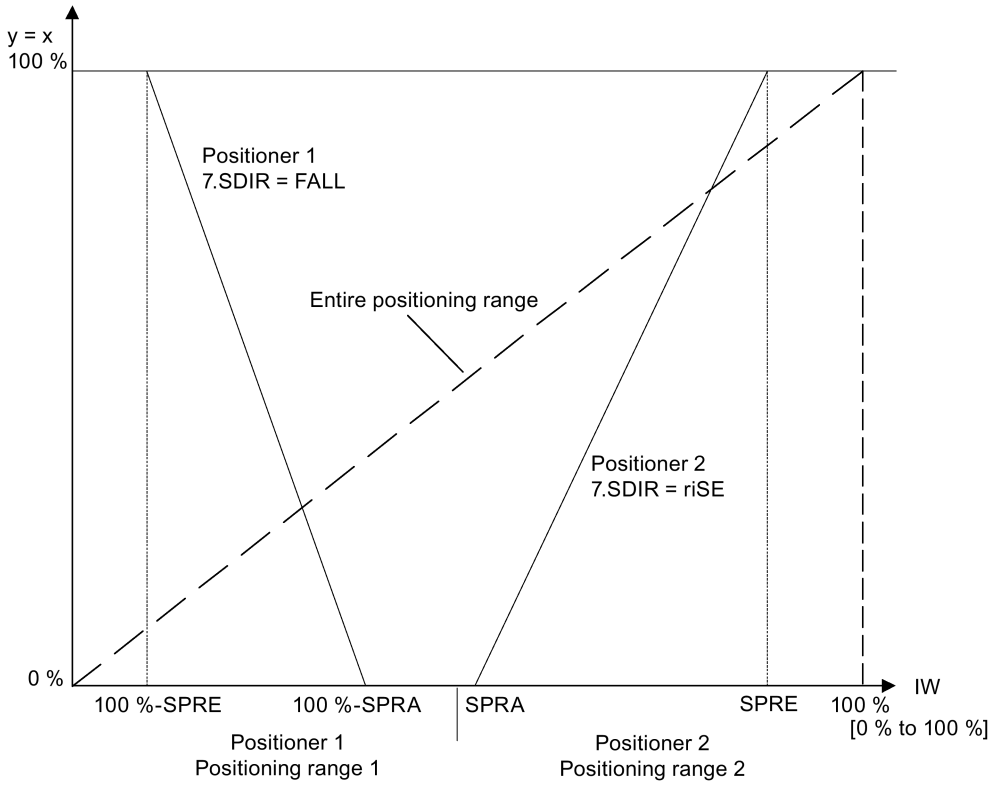


Figure 9-2 Example: Split range operation with two positioners

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 162)" 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

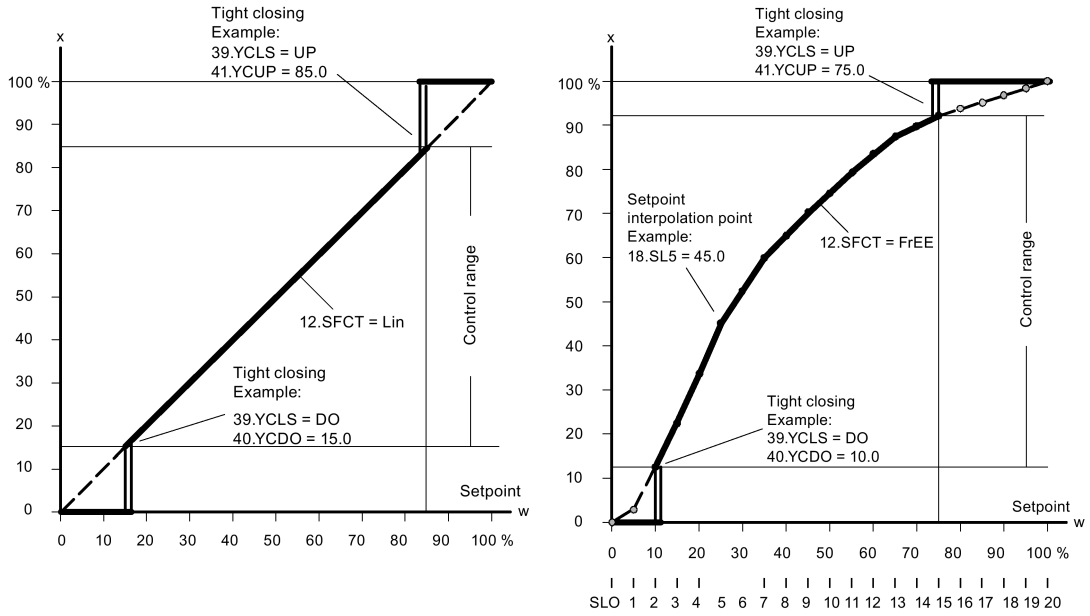
Valve characteristics		Set with parameter value
Inverse equal percentage	50:1	n1-50
Freely adjustable		FrEE

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 161)" 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 164) parameter.	
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 163) 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 163) 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 'IY'. The flow-proportional display and position feedback 'IY' also result when using 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

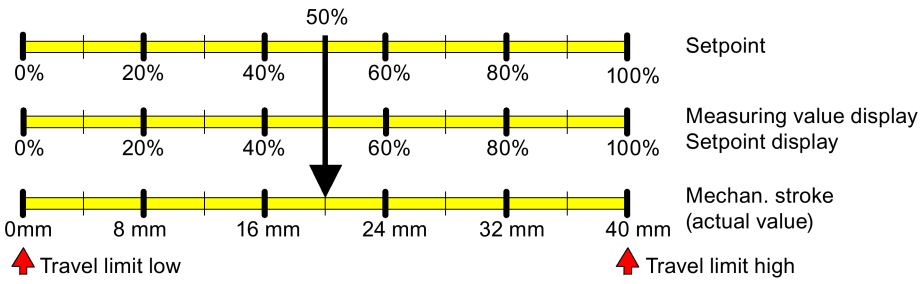


Figure 9-3 YNRM = MPOS or YNRM = FLoW; default: YA = 0 % and YE = 100 %

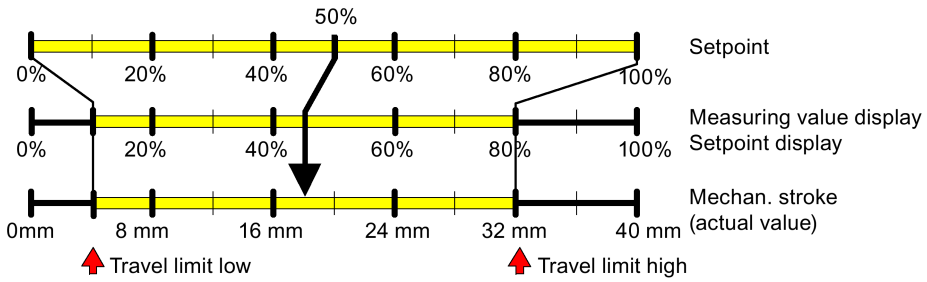


Figure 9-4 Example: YNRM = MPOS with YA = 10 % and YE = 80 %

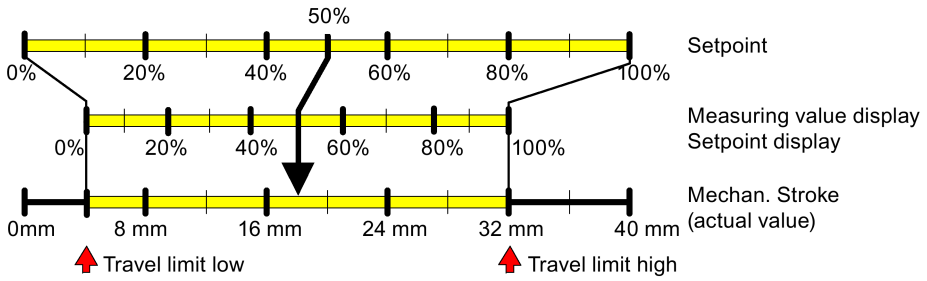


Figure 9-5 Example: YNRM = FLoW with YA = 10 % and YE = 80 %

See also

'39.YCLS' Tight closing with manipulated variable (Page 166)

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 I_Y. The direction can be rising or falling.

Factory setting: riSE

9.4.2.11 '39.YCLS' Tight closing with manipulated variable

Possible settings:
- no
- uP
- do
- uP do

Purpose: This parameter is used to move the valve into its seat with the maximum force of the actuator (permanent contact of the piezo valves). The tight closing function is activated on one side or for both end positions. Parameter "39.YCLS" becomes effective when the effective setpoint is at or below parameter "40.YCDO" or at or above parameter "41.YCUP".

Factory setting: no

See the figure in the description of the "'37.YNRM' Standardization of manipulated variable (Page 164)" parameter and the figure in the description of the "'13.SL0' ... '33.SL20' Setpoint turning point (Page 162)" parameter.

Note

Activated tight closing function

If the tight closing function is activated, and if parameter "49.↳ is LIM", monitoring of the control deviation in the respective overflow direction is switched off. In this case, parameter "YCDO: < 0%" and parameter "YCUP: > 100%". This functionality is especially advantageous for valves with soft seats. For long-term monitoring of the end stop positions, we recommend that you activate the "F.↳ ZERO" and "G. ↳ OPEN" parameters.

9.4.2.12 '40.YCDO' Lower value for tight closing / '41.YCUP' Upper value for tight closing

Adjustment range: 0.0 ... 100.0

Purpose: These parameters are used to set the values for "Lower value for tight closing " (YCDO) and "Upper value for tight closing" (YCUP) in %.

Factory setting: With "YCDO": 0.5 With "YCUP": 99.5

Note

The value in the "YCDO" parameter is always smaller than that in "YCUP". The tight closing function has a fixed hysteresis of 1%. The "YCDO" and "YCUP" parameters are relative to the mechanical stops. The "YCDO" and "YCUP" parameters are independent of the values set in the "'7.SDIR' Setpoint direction (Page 159)" and "'38.YDIR' Direction of manipulated variable for display and position feedback (Page 165)" parameters.

9.4.2.13 '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 163)" 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 will be displayed when the mode button is pressed.

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

Factory setting: OFF

9.4.2.14 '44.AFCT' Alarm function

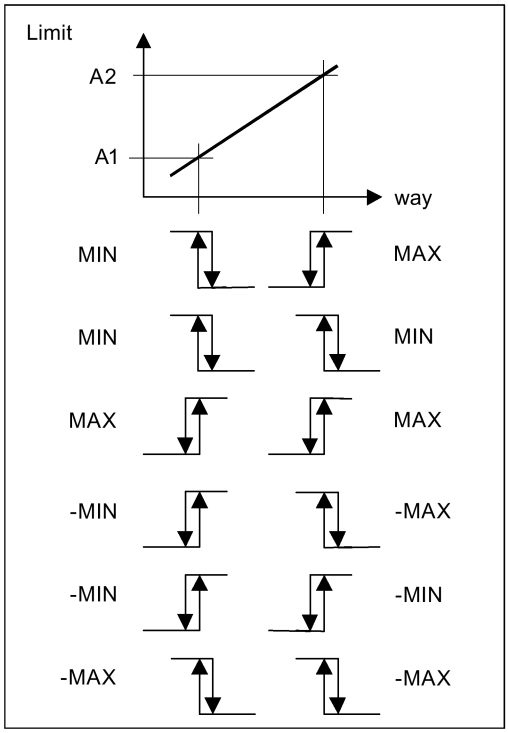
Possible settings: See representation below

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 A2 = 52	AFCT = MIN / MAX	
Way =45	**Active**	
Way =50		
Way =55		**Active**
A1 = 48 A2 = 52	AFCT = -MIN / -MAX	
Way =45		**Active**
Way =50	Active	Active
Way =55	**Active**	
A1 = 52 A2 = 48	AFCT = MIN / MAX	
Way =45	**Active**	
Way =50	Active	Active
Way =55		**Active**
A1 = 52 A2 = 48	AFCT = -MIN / -MAX	
Way =45		**Active**
Way =50		
Way =55	**Active**	

Note

If the extended diagnostic is activated using parameter "'52.XDIAG' Activating for extended diagnostics (Page 174)" 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.

9.4.2.15 '45.A1' / '46.A2' Response threshold of alarms

Adjustment range:	0.0 ... 100.0	
Purpose:	These parameters are used to specify when an alarm should be displayed. The response thresholds of the alarms (in percent) refer to the MPOS scale in the "'37.YNRM' Standardization of manipulated variable (Page 164)" parameter. The MPOS scale corresponds to the mechanical travel. Depending on the setting of the alarm function in the "'44.AFCT' Alarm function (Page 168)" 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

9.4.2.16 '47.\\FCT' Function fault message

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 • ┐ • ┐nA • ┐nAb Inverted direction of action • -┐ • -┐nA • -┐nAb
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 174). The fault message cannot be switched off, but it can be suppressed (factory setting) when you exit 'Automatic' mode. Set the '┐FCT' parameter to '┐nA' 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 167) parameter to 'on' or '-on'. Subsequently set the '┐FCT' parameter to '┐nAb'. Select the '-┐' setting if you want the fault message to be output with inverted direction of action.
Factory setting:	┐

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

Possible settings:	• Auto • 0 ... 100
Purpose:	The '48.┐TIM' parameter is used to set the time in seconds within which the positioner must have reached the regulated condition. The corresponding response threshold is specified in the '49.┐LIM' parameter. When the configured time is exceeded, the fault message output is set.
Factory setting:	Auto

Note

Activated tight closing function

If the tight closing function is activated, then for the '49.↳ LIM' parameter the monitoring of control deviation is turned off in the appropriate overflow direction. Then 'YCDO: < 0 %' and 'YCUP: > 100 %'. This functionality is especially advantageous for valves with lining. For long-term monitoring of the endstop positions, we recommend activating the 'F.↳ ZERO' and 'G.↳ OPEN' parameters.

9.4.2.18 '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.↳TIM' and '49.↳LIM' 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 function

If the tight closing function is activated, then for the '49.↳ LIM' parameter the monitoring of control deviation is turned off in the appropriate overflow direction. Then 'YCDO: < 0 %' and 'YCUP: > 100 %'. This functionality is especially advantageous for valves with lining. For long-term monitoring of the end stop positions, we recommend activating the 'F.↳ZERO' and 'G. ↳ OPEN' parameters.

9.4.2.19 '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 159) to '49.\\LIM' Response threshold of fault message 'Control deviation' (Page 172).
- diAg: Reset parameters A to P of the extended diagnostics as well as parameter '52.XDIAG' Activating for extended diagnostics (Page 174).

An overview of the parameters and factory settings can be found in section Tabular overview of the parameters (Page 147).

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 207)

9.4.2.20 '51.PNEUM' Fail in place

Requirement:	You have a positioner with the "Fail in Place" function, article number with order code -Z F01.
Possible settings:	• Std • FIP
Purpose:	You only require this parameter for servicing if the basic electronics has been replaced. 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 if the basic electronics is replaced.

9.4.2.21 '52.XDIAG' Activating for extended diagnostics

Use this parameter to activate the extended diagnostics and simultaneously the online diagnostics. 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 required).
- 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 demand).
- 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 alarm).

Note

Activation of extended diagnostics

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

In the factory settings, the 'A.\\PST' to 'P.\\PAVG' parameters 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. These columns ① are shown on the display as follows:

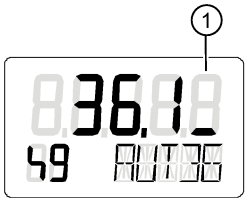


Figure 9-6 Display of a threshold 1 message (maintenance required)

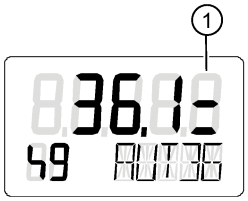


Figure 9-7 Display of a threshold 2 message (maintenance demand)

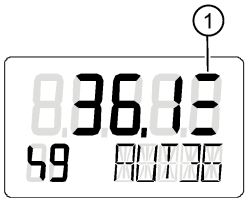


Figure 9-8 Display of a threshold 3 message (maintenance alarm)

The factory setting is 'OFF'.

See also

Partial stroke test 'A.\\PST' (Page 176)

Monitoring the position average value 'P.\\PAVG' (Page 197)

Overview of error codes (Page 226)

9.4.3 Extended diagnostics parameters A to P

9.4.3.1 Partial stroke test 'A.\\PST'

A.↳PST - Partial Stroke Test

Requirement:	The '52.XDIAG' Activating for extended diagnostics (Page 174) parameter 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, set the parameter to '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 displayed in Diagnostic value '12.PST - Monitoring of partial stroke test' (Page 214). Diagnostic value '13.PRPST' - Time since last partial stroke test' (Page 215) and Diagnostic value '14.NXPST - Time until next partial stroke test' (Page 215) provide further 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 define 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 a start position and '2.0' as a 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 define 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 set 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):	Lower 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: Specify how the positioner is to respond if a partial stroke test fails. Note: A partial stroke test fails if the limit threshold set 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', where '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: 'FdInI' is displayed if the start position cannot be approached or the stroke target cannot be reached. '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 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 reference stroke time and 'AA.FACT1'. Determining the reference stroke time is described under 'A9.PSTIN'.

The threshold 1 message is displayed when threshold 1 is exceeded. 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 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 reference stroke time and 'Ab.FACT2'. Determining the reference stroke time is described under 'A9.PSTIN'.

The threshold 2 message is displayed when threshold 2 is exceeded. 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 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 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 - Behavior after failed PST'.
Factory setting:	5.0

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

b.ᒪ DEVI - Monitoring of dynamic control valve behavior

Requirement:	The '52.XDIAG' Activating for extended diagnostics (Page 174) 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 Diagnostic value '15.DEVI - General control valve fault' (Page 215). The positioner triggers a message if the current value exceeds one of the three thresholds.
Factory setting:	OFF

b1.TIM - Time constant of low-pass filter

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 Diagnostic value '15.DEVI - General control valve fault' (Page 215). The positioner triggers a message if the current value exceeds one of the three parameterizable thresholds.
Factory setting:	Auto

b2.LIMIT - Limit for dynamic control valve behavior

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 pneumatic leakage 'C.\\LEAK'

C.↳LEAK - Monitoring 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 function

Please note that this monitoring only delivers results in the case of an activated tight closing function and a setpoint with the following values:

Lower value for tight closing (YCDO) +5 % up to upper value for tight closing (YCUP) -5 %

Requirement:	The '52.XDIAG' Activating for extended diagnostics (Page 174) parameter is set to 'On1', 'On2' or 'On3'.
Possible settings:	• OFF • On
Purpose:	Use this parameter to detect leakages in the actuator or in the pipe installation. 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 '16.ONLK - Pneumatic leakage' (Page 216). The positioner triggers a message if the current value exceeds one of the three thresholds.
Factory setting:	OFF

C1.LIMIT - Limit for leakage indicator

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 (see section Commissioning (Page 113)) that the leakage indicator remains below the value 30. If a value above 30 is displayed, this 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 216) 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'. The threshold 1 message is displayed when threshold 1 is exceeded. 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'. The threshold 2 message is displayed when threshold 2 is exceeded. 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'. 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:	2.0

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

d.ᒐ STIC - Monitoring the stiction (slipstick)

Requirement:	The '52.XDIAG' Activating for extended diagnostics (Page 174) 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 216). 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. 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. 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 the deadband 'E.\\DEBA'

E.↳DEBA - Monitoring the deadband

Requirement:	The '52.XDIAG' Activating for extended diagnostics (Page 174) parameter is set to 'On1', 'On2' or 'On3'. The '34.DEBA' Deadband of closed-loop controller (Page 163) 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 three steps. 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 220). The positioner triggers a message if the current value exceeds the threshold.
Factory setting:	OFF

E1.LEVL3 - Deadband threshold

Adjustment range:	0.1 ... 2.9
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 threshold 3 fault message is displayed when the current deadband exceeds the threshold during the test. The procedure to activate and display this error message is described in the 'XDIAG' parameter.
Factory setting:	2.0

Note

Fault message display

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

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

F.↳ZERO - Monitoring the lower endstop

Note

Fault detection

Monitoring the 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 174) parameter is set to 'On1', 'On2' or 'On3'. The '39.YCLS' Tight closing with manipulated variable (Page 166) parameter is set to 'do' or 'uP do'.
Possible settings:	• OFF • On

Purpose:	Use this parameter to activate continuous monitoring of the lower endstop. The monitoring is executed whenever the valve is in the 'Lower tight closing' position. 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 216). 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 message if the difference between the lower endstop and the initialization value undershoots threshold 1. 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 message if the difference between the lower endstop and the initialization value undershoots threshold 2. 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 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.↳OPEN - Monitoring the upper endstop

Note

Fault detection

Monitoring the 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 174) parameter is set to 'On1', 'On2' or 'On3'. The '39.YCLS' Tight closing with manipulated variable (Page 166) parameter is set to 'uP' or 'uP do'.
Possible settings:	• OFF • On
Purpose:	Use this parameter to activate continuous monitoring of the upper endstop. The monitoring is executed whenever the valve is in the 'Upper tight closing' position. 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 216). 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 message if the difference between the upper endstop and the initialization value overshoots threshold 1. 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 message if the difference between the upper endstop and the initialization value overshoots threshold 2. 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 message if the difference between the upper endstop and the initialization value overshoots 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.↳TMIN - Monitoring the low limit temperature

Requirement:	The '52.XDIAG' Activating for extended diagnostics (Page 174) 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 221). 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 message if the current temperature inside the enclosure undershoots threshold 1. 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 message if the current temperature inside the enclosure undershoots threshold 2. 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 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 with manipulated variable (Page 166)

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

J.↳TMAX - Monitoring the upper limit temperature

Requirement:	The '52.XDIAG' Activating for extended diagnostics (Page 174) 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 221). 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 message if the current temperature inside the enclosure overshoots threshold 1. 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 message if the current temperature inside the enclosure overshoots threshold 2. 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 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:	90.0C

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

L.↳STRK - Monitoring the number of total strokes

Requirement:	The '52.XDIAG' Activating for extended diagnostics (Page 174) 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 211). 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 for number of total strokes

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. 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 1. 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 1 message is displayed when threshold 1 is exceeded. 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 1. 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 1 message is displayed when threshold 1 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 207)

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

O.↳DCHG - Monitoring the number of changes in direction

Requirement:	The '52.XDIAG' Activating for extended diagnostics (Page 174) 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 211). The positioner triggers a message if the current value exceeds one of the three thresholds.
Factory setting:	OFF

O1.LIMIT - Limit for number of changes in direction

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. 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 1. 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 1 message is displayed when threshold 1 is exceeded. 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 1. 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 1 message is displayed when threshold 1 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 207)

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

P.↳PAVG - Monitoring the position average value

Requirement:	The '52.XDIAG' Activating for extended diagnostics (Page 174) 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 217). 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 217). 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 a message if the difference between the average value of position and the average value of reference exceeds threshold 1. The procedure 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 an error message if the difference between the average value of position and the average value of reference exceeds threshold 2. The process to activate and display this message is described in the 'XDIAG' parameter. The factory setting is '5.0'.
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 a message if the difference between the average value of position and the average value of reference exceeds threshold 3. The procedure to activate and display this message is described in the 'XDIAG' parameter.
Factory setting:	10.0

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
↳	Error symbol
/	(slash): the texts on the left and right of the slash flash alternately

Messages before initialization (first commissioning)

Message	Line		Meaning / cause	Measure
	Up	Down		
CPU Start	X	X	Message after application of electrical auxiliary power	• Maintenance
Pnnn.n	X		Potentiometer voltage of a non-initialized positioner (P-manual mode) (actual position value in % of the measuring range).	• Check whether the complete travel can be covered using the ⧋ and ⧊ buttons and that "P---" is never displayed. • Execute the initialization process.
P---	X		Measuring range was exceeded, the potentiometer is in the inactive zone, the transmission ratio selector or the effective lever arm are not adjusted as per the actuator travel.	• Switch the transmission ratio selector to 90°, especially in the case of part-turn actuators. • Adjust the effective lever length of linear actuators as per the measuring range.
NOINI		X	Positioner is not initialized.	• Start initialization.

See also

Display (Page 103)

10.1.2 System messages during initialization

Remarks about the tables:

nn	Stands for variable numeric values
↳	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.
RUN1		X	Initialization was started, part 1 is active (the direction of action is determined)	• Wait.
RUN2		X	Initialization part 2 is active (actuator travel check and determination of endstops)	• Wait.
RUN3		X	Initialization part 3 is active (determination and display of travel times)	• Wait.
RUN4		X	Initialization part 4 is active (determination of the minimum controller increment length)	• Wait.
RUN5		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 ⧊ key. 2. Acknowledge using ⏎ key.
YEND2		X	The second end position can be approached only in case of a manual initialization	1. Approach second end position using ⧋ or ⧊ key. 2. Acknowledge using ⏎ key.
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 ⧊ key and acknowledge using ⏎ key. • Move the friction clutch until "ok" is displayed, and then acknowledge with the ⏎ key. • Terminate the initialization process using the ⏎ key, switch to the P-manual mode, and correct the actuator travel and the position displacement sensor.

Message	Line		Meaning/cause	Measure
	Up	Down		
ok		x	The permissible measuring range of end positions is achieved only in case of a manual initialization	• Acknowledge with the operating mode button; the remaining steps ("RUN1" to "FINSH") execute automatically.
RUN1 / ERROR		X	Error in "RUN1", 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.
↳ d___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 ⧊ key.
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 ⧊ key to bring the lever perpendicular to the spindle. 2. Briefly acknowledge using key (initialization is continued).
MIDDL		X		
↳ UP >		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 key. 3. Restart initialization.
↳ 90_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 ⧊ key to move it in the range between 90 and 95%. 2. Briefly acknowledge using key.
↳ U-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 key. 3. Restart initialization.
U nn.n	X		Display of the "Up" travel time	• Wait until initialization continues in RUN4. • To change the travel time, interrupt the initialization process using the ⧊ key. • Activate the leakage test using the ⧋ key.
D->U		X		
D nn.n	X		Display of the "Down" travel time	• Wait until initialization continues in

Message	Line		Meaning/cause	Measure
	Up	Down		
U->d		X		RUN4. • To change the travel time, interrupt the initialization process using the ▽ key. • Activate the leakage test using the △ key.
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 ▽ key. 3. Continue using △ key.
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 △ key.
%/MIN		X		
nn.n	X		Initialization completed successfully with the display of actuator travel or the actuator angle	1. Briefly acknowledge using ⏎ key. 2. Leave configuration level by long pressing of ⏎ key.
FINISH		X		

See also

System messages before initialization (Page 201)

10.1.3 System messages when exiting the Configuration mode

Remarks about the tables:

nn Stands for variable numeric values
↳ Error symbol
/ (slash): the texts on the left and right of the slash flash alternately

Messages when exiting the configuration mode:

Message	Line		Operating mode			Meaning / cause	Measure
	Up	Bottom	Automatic	Manual mode	P manual mode		
n.nn.nn-nn	X	X				Software version	• Maintenance
Error SLnn	X	X				Monotony interruption of the free characteristic on the setpoint turning point n	• Correct the value

10.1.4 System messages during operation

Remarks about the tables:

nn Stands for variable numeric values
↳ 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	Bottom	Automatic	Manual mode	P manual 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)	

Message	Line		Operating mode			Meaning/cause	Measure
	Up	Bottom	Automatic	Manual mode	P manual mode		
MANnn		X		X		Manual mode (nn = setpoint)	• Switch to automatic mode with mode button.
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 • 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 208)".

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 208).

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.	Abbreviation	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	↳ CNT	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 actuator 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 the partial stroke test	**OFF** / ###.#, FdInI, notSt, SdtSt, fdtSt, notoL, Strt, StoP	s for ###.#	③
13	PRPST	Time since the last partial stroke test	###, **notSt**, Sdtst, fdtSt	Days	②
14	NXPST	Time until the next partial stroke test	**OFF** / ###	Days	②
15	DEVI	Dynamic control valve behavior	**OFF** / 0.0 ... 100.0	%	②
16	ONLK	Pneumatic leakage	**OFF** / 0.0 ... 100.0	-	②
17	STIC	Stiction (slipstick)	**OFF** / 0.0 ... 100.0	%	②

No.	Abbreviation	Meaning	Representable diagnostics values	Unit	Properties
18	ZERO	Lower endstop	**OFF** / 0.0 .. 100.0	%	②
19	OPEN	Upper endstop	**OFF** / 0.0 ... 100.0	%	②
20	PAVG	Average value of position	**OFF**, IdLE, rEF, COMP 0.0 ... 100.0	%	②
21	P0	Potentiometer value of lower endstop (0%)	**0.0** ... 100.0	%	③
22	P100	Potentiometer value of upper endstop (100%)	**0.0** ... 100.0	%	③
23	IMPUP	Impulse length up	**6** ... 160	ms	④
24	IMPDN	Impulse length down	**6** ... 160	ms	④
25	PAUTP	Pulse interval	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

No.	Abbreviation	Meaning	Representable diagnostics values	Unit	Properties
46	STORE	Save the current values as 'last maintenance' (press ⏃ key 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	mA	Setpoint current	0.0 ... 20.0	mA	②

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.↳CNT' 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 168) 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 211), 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 222) 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 222) 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 157) 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 RUN3 in section Sequence of automatic initialization (Page 117).
- '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 173) > 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. *Recommendation:* Set value to approx. 50. The actuator is in the center position.
2. In 'Diagnostics' mode, go to the '11.LEAK' diagnostic value as described in section Display of diagnostics values (Page 207).
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 starting position', 'A3.STRKH stroke height' and 'A4.STRKD direction of stroke' parameters are not plausible.
- FdInI - Failed PST Initialization: The reference stroke time measurement of the partial stroke test has failed.
- notSt - No Test: A manual 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 '13.PRPST' - Time since last partial stroke test'

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

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

Status messages:
- notSt - No Test: A 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.

10.2.4.12 Diagnostic value '14.NXPST - Time until next partial stroke test'

Requirement:
- The partial stroke test is activated in 'Configuration' mode.
- The test interval is set in the 'A8.INTRV' parameter.

Indication on the display:
- OFF
- ###

Purpose: This diagnostics parameter shows the time in days until the next partial stroke test. If one of the above-mentioned conditions is not met, 'OFF' is shown on the display.

10.2.4.13 Diagnostic value '15.DEVI - General control valve fault'

Requirement: Monitoring of dynamic control valve behavior 'b.\\DEVI' (Page 181) parameter is activated.

Display range:
- OFF
- 0.0 ... 100.0

Purpose: This value in percent provides information about the current dynamically determined deviation from the model response. If the underlying function is deactivated, 'OFF' is displayed.

See also

Partial stroke test 'A.\\PST' (Page 176)

10.2.4.14 Diagnostic value '16.ONLK - Pneumatic leakage'

Requirement:	Monitoring pneumatic leakage 'C.\\LEAK' (Page 183) parameter is activated.
Display range:	• OFF • 0 ... 100
Purpose:	This diagnostics parameter shows the current leakage indicator. If the leakage detection is deactivated, 'OFF' is displayed.

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

Requirement:	Monitoring the stiction (slipstick) 'd.\\STIC' (Page 185) parameter is activated.
Display range:	• OFF • 0.0 ... 100.0
Purpose:	This diagnostics parameter shows the filtered value of the slip jumps in percent resulting from the stiction.

10.2.4.16 Diagnostic value '18.ZERO - Lower endstop'

Requirement:	Monitoring the lower endstop 'F.\\ZERO' (Page 188) parameter is activated. '39.YCLS' Tight closing with manipulated variable (Page 166) parameter is set to 'do' or 'uP do'.
Display range:	• OFF • 0.0 ... 100.0
Purpose:	Indication of how many percent the lower endstop has changed compared to its value during initialization. If the underlying function is deactivated, 'OFF' is displayed.

10.2.4.17 Diagnostic value '19.OPEN - Upper endstop'

Requirement:	Monitoring the upper endstop 'G.\\OPEN' (Page 190) parameter is activated. '39.YCLS' Tight closing with manipulated variable (Page 166) parameter is set to 'uP' or 'uP do'.
Display range:	• OFF • 0.0 ... 100.0
Purpose:	An indication of the current shift of the upper endstop compared to its initialization value. If the underlying function is deactivated, 'OFF' is displayed.

10.2.4.18 Diagnostic value '20.PAVG - Average value of position'

Indication on the display:
- OFF
- IdLE
- rEF
- COMP

Purpose: This value shows the last calculated comparison average. Meaning of the displays:
- OFF: The underlying function is deactivated in the configuration menu.
- IdLE : Inactive. The function has not been started yet.
- rEF: The reference average is calculated. The function was started, and the reference interval is in progress at the moment.
- COMP: The comparison average is calculated. The function was started, and the comparison interval is in progress at the moment.

10.2.4.19 Diagnostic value '21.P0 - Potentiometer value of lower endstop (0%)' / '22.P100 - Potentiometer value of upper endstop (100%)'

Display range:	• NO • 0.0 ... 100.0 'NO': Changing the low or upper endstop is not possible in the current state of the control valve. Initialize the positioner again.
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 the lower endstop 'F.\\ZERO' (Page 188) and Monitoring the upper endstop 'G.\\OPEN' (Page 190) 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 ▽ keys.
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 107)

10.2.4.20 Diagnostic value '23.IMPUP - Impulse length UP' / '24.IMPDN - Impulse 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 110)

10.2.4.21 Diagnostic value '25.PAUTP - Pulse interval'

Display range:	2 ... 320
Purpose:	This value is not changed during an initialization process. Display in ms. For applications with high stiction (slipstick), adjusting this parameter improves the control quality. This parameter can be set for special applications.
Factory setting:	28

See also

Mode of operation (Page 28)

10.2.4.22 Diagnostic value '26.DBUP - Deadband UP' / '27.DBDN - Deadband DOWN'

Display range:	0.1 ... 10.0
Purpose 1	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 163) parameter or to the value automatically adapted by the device if 'DEBA' was set to 'Auto'.

10.2.4.23 Diagnostic value '28.SSUP - Slow step zone UP' / '29.SSDN - Slow step zone DOWN'

Display range:	0.1 ... 100.0
Purpose:	The slow step zone is the zone of the closed-loop controller in which control signals are issued in a pulsed manner. Display is in percent. The impulse length is thus proportional to the control deviation. If the control deviation is beyond the slow step zone, the valves are controlled using permanent contact. This parameter can be set for special applications.
Factory setting:	10.0

See also

Mode of operation (Page 28)

Optimization of controller data (Page 110)

10.2.4.24 Diagnostic value '30.TEMP - Current temperature'

Display range: °C: -50 ... 100
°F: -58 ... 212

Purpose: Current temperature in the positioner enclosure. The sensor is present on the basic electronics. In order to switch over the temperature display between °C and °F, press the ⚠ button.

10.2.4.25 Diagnostic value '31.TMIN - Minimum temperature' / '32.TMAX - Maximum temperature'

Display range: °C: -50 ... 100
°F: -58 ... 212

Purpose: The minimum and maximum temperatures within the enclosure are constantly determined and saved as with a slave 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.

10.2.4.26 Diagnostic value '33.T1' ... '41.T9' - Number of operating hours in the temperature range 1 to 9

Display range: 0 ... 4.29E9

Purpose: Statistics about the duration of operation in different temperature ranges is maintained in the device. An average of the measured temperature is taken every hour and the counter assigned to the corresponding temperature range is incremented. This helps in drawing conclusions about the past operating conditions of the device and the entire control valve.

The temperature ranges are classified as follows:

	T1	T2	T3	T4	T5	T6	T7	T8	T9
Temperature range [°C]	-	≥ -30	≥ -15	≥ 0	≥ 15	≥ 30	≥ 45	≥ 60	≥ 75
	≤ -30	< -15	< 0	< 15	< 30	< 45	< 60	< 75	-

Operating hours in temperature ranges T1 to T2

10.2.4.27 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.

10.2.4.28 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 222) referred to the diagnostics parameters 'VEN1R' and 'VEN2R' described here.

10.2.4.29 Diagnostic value '46.STORE - Save maintenance data'

Purpose: The minimum and maximum temperatures within the enclosure are constantly determined and saved as with a slave pointer. This value can only be reset in the factory. In order to switch over the temperature display between °C and °F, press the ⚠ key 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 212) to Diagnostic value '11.LEAK - Leakage test' (Page 212) and Diagnostic value '21.P0 - Potentiometer value of lower endstop (0%)' / '22.P100 - Potentiometer value of upper endstop (100%)' (Page 218) to Diagnostic value '28.SSUP - Slow step zone UP' / '29.SSDN - Slow step zone DOWN' (Page 220) 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.

10.2.4.30 Diagnostic value '47.PRUP - Prediction UP' / '48.PRDN - Prediction DOWN'

Display range: 1 ... 40

Purpose: This value specifies the prediction of the controller for the up (PRUP) and down (PRDN) movements.

For more information, refer also to the section Optimization of controller data (Page 110).

Factory setting: 1

10.2.4.31 Diagnostic value '49.WT00' ... '56.WT95' - Number of operating hours in the travel range WT00 to WT95

Display range: 0 ... 4.29E9

Purpose: When the positioner is in "Automatic" mode, statistics are continuously maintained regarding the duration for which a 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 ▽ key several times along with the key. This will help you to access the desired diagnostics parameters faster.

10.2.4.32 Diagnostic value '57.mA - Setpoint current'

Here you can display the current setpoint in mA.

10.3 Online diagnostics

10.3.1 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 226)".

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 174)
Extended diagnostics parameters A to P (Page 176)

10.3.2 Overview of error codes

Overview of error codes that activate the fault message output

Error code	Three-stage	Event	Parameter setting	Error message disappears when	Possible causes
↳ 1	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).
↳ 2	No	Device not in "Automatic" mode	**.↳ FCT[1)] =↳ nA or = ↳ nAB	... the device is changed to "Automatic" mode.	The device has been configured or is in the manual mode
↳ 3	No	Binary input BIN1 or BIN2 active	**.↳ FCT[1)] =↳ nAB 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).
↳ 4	Yes	Limit for number of total strokes exceeded	L.↳ STRK≠OFF	... the stroke counter is reset or the thresholds are increased	The total path covered by the actuator exceeds one of the configured thresholds.
↳ 5	Yes	Limit for number of changes in direction exceeded	O.↳ DCHG≠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.
↳ 6	Yes	Lower endstop limit exceeded	F.↳ ZERO≠OFF **.YCLS = do or up do	... the deviation of the endstop disappears or the device is re-initialized.	Wear and tear of the valve seat, deposits or foreign bodies in the valve seat, mechanical misalignment, friction clutch moved.
↳ 7	Yes	Upper endstop limit exceeded	G.↳ OPEN≠OFF **.YCLS[1)] = do or up do	... the deviation of the endstop disappears or the device is re-initialized.	Wear and tear of the valve seat, deposits or foreign bodies in the valve seat, mechanical misalignment, friction clutch moved.
↳ 8	No	Deadband limit exceeded	E.↳ DEBA≠OFF **.DEBA[1)] = Auto	... the limit is undershot again	Increased packing gland friction, mechanical gap in the position feedback.
↳ 9	Yes	Case 1: Reference stroke time for partial stroke test is exceeded.	A.↳ PST≠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.

Error code	Three-stage	Event	Parameter setting	Error message disappears when	Possible causes
10	Yes	Deviation from expected dynamic control valve behavior	b. ↳ DEVI≠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	Pneumatic leakage limit exceeded	C. ↳ LEAK≠OFF	... the leakage drops below the configured thresholds, or the function is deactivated.	Pneumatic leakage
12	Yes	Stiction limit (slip-stick) exceeded	d. ↳ STIC≠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. ↳ TMIN≠OFF	... the low temperature thresholds are no longer undershot.	Ambient temperature too low
14	Yes	Temperature overshot	J. ↳ TMAX≠OFF	... the high thresholds are no longer overshot.	Ambient temperature too high
15	Yes	Position average deviates from the reference value	P. ↳ PAVG≠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. ↳ PST≠OFF	the parameter values entered in A1.STPOS, A3.STRKH and A4.STRKD are plausible.	Parameters for partial stroke test are non-plausible

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

See also

Overview of application parameters 6 to 52 (Page 148)

10.3.3 XDIAG parameter

You can use the advance diagnostics parameters to display fault 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	Advanced diagnostics not activated
On 1	Fault message output for threshold 3 fault messages (one-stage)
On 2	Fault message output for threshold 3 fault messages and alarm output 2 for threshold 2 fault messages (two-stage)
On 3	Fault message output for threshold 3 fault messages and alarm output 2 for threshold 2 fault messages and alarm output 1 for threshold 1 fault messages (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 "↳ TIM" - monitoring time for setting the fault messages - and "↳ LIM" - 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 '↳ FCT' 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 "↳ FCT" 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.↳STRK".

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.↳DCHG".

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

If the parameter "F.↳ZERO" 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 "down tight closing" position. The current position is compared with the position that was determined as the lower endstop at the time of initialization. The activation of "down tight closing" ("YCLS" parameter) is therefore the condition.

Example: A value of 3% is set. The position is normally adopted for "down tight closing". 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.↳ZERO"=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.↳OPEN" parameter is used to set the limit for this. The activation of "up tight closing" ("YCLS" parameter) is therefore the condition.

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 the pneumatic leakage

This fault message appears when the leakage indicator exceeds the configured thresholds. Keep in mind that the complete sensitivity of this function can be used only if a ramp movement was initiated after initialization to set the leakage indicator (see explanations for "C1.LIMIT").

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.

10.4 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
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 (contaminated with solid particles) compressed air	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 233)
Remedial measures table 3 (Page 234)
Corrective measures Table 4 (Page 235)
Remedial measures table 5 (Page 236)

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.	• A waiting time of up to 1 minute is essential. • Do not start initialization from the end position. • Ensure supply air PZ.
• 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.

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	
• 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 241)

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 241)

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 238)

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 241)

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

Impermissible accessories and spare parts

Danger of explosion in areas subject to explosion hazard.

- Only use original accessories or original spare parts.
- Observe all relevant installation and safety instructions described in the instructions for the device or enclosed with the accessory or spare part.

⚠ WARNING

Improper connection after maintenance

Danger of explosion in areas subject to explosion hazard.

- Connect the device correctly after maintenance.
- Close the device after maintenance work.

Refer to Chapter "Electrical data (Page 250)".

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 key lock

Improper modification of parameters could influence process safety.

- Make sure that only authorized personnel may cancel the key locking of devices for safety-related applications.

⚠ WARNING

Electrostatic charge

Danger of explosion in hazardous areas if electrostatic charges develop, for example, when cleaning plastic surfaces with a dry cloth.

- Prevent electrostatic charging in hazardous areas.

⚠ WARNING

Dust layers above 5 mm

Danger of explosion in hazardous areas. Device may overheat due to dust build up.

- Remove dust layers in excess of 5 mm.

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.

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 with Makrolon enclosure 6DR5..0, aluminum enclosure 6DR5..3, and flameproof aluminum enclosure 6DR5..5

⚠ DANGER

Risk of explosion due to electrostatic charge

Electrostatic charges develop when cleaning the positioner in the Makrolon enclosure with a dry cloth, for example.

It is imperative you avoid electrostatic charges in the hazardous environment.

Procedure for removal and cleaning of the screens

1. Disconnect the pneumatic auxiliary power supply.
2. Remove the lines.
3. Unscrew the cover of the Makrolon enclosure 6DR5..0 or aluminum enclosure 6DR5..3.
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 Makrolon enclosure

- 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 Makrolon enclosure, the screws are self-tapping.
5. Place the cover and tighten it.
6. Reconnect the pipelines and feed the pneumatic power supply.

11.2.2 Positioners with stainless steel enclosure 6DR5..2, flameproof stainless steel enclosure 6DR5..6, and narrow aluminum enclosure 6DR5..1

Removal, cleaning and installation of the screens

1. Disconnect the pneumatic auxiliary power supply.
2. Remove the pipelines.
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 pipelines again.
7. Feed the pneumatic auxiliary power supply.

11.3 Replacing the basic electronics with the "Fail in Place" function

Requirement

You have a positioner with the "Fail in place" function, order suffix -Z F01.

Replacing the basic electronics with the "Fail in Place" function

When replacing the basic electronics for positioning controllers with the function "Fail in Place", order suffix -Z F01, the parameters for the pneumatic type have to be set. The procedure is described here.

Note

Possible movement of the actuator

While replacing the basic electronics, the actuator can unintentionally vent itself.

- Observe the procedure described below.

1. Switch off the supply air PZ.
2. Remove the enclosure cover of the positioner.
3. Replace the basic electronics as described in section "General information on installing option modules (Page 54)".
4. Set the "'51.PNEUM' Fail in place (Page 174)" parameter from "Std" to "FIP".
5. Install the enclosure cover.
6. Switch on the supply air PZ again.
7. Initialize the positioner as described in section "Commissioning (Page 113)"

11.4 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.

See also

Technical support (Page 274)

11.5 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.

The forms can be found on the Internet as well as in the documentation which comes with the device.

11.6 Disposal

Devices identified by this symbol may not be disposed of in the municipal waste disposal services under observance of the Directive 2002/96/EC on waste electronic and electrical equipment (WEEE).

They can be returned to the supplier within the EC or to a locally approved disposal service. Observe the specific regulations valid in your country.

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 to IEC/EN 60529 / NEMA 4X
Mounting position	Any; in wet environment, pneumatic connections and outlet opening not upward
Vibration resistance	
• Harmonic oscillations (sine) according to EN 60068-2-6/10.2008	3.5 mm (0.14"), 2 ... 27 Hz, 3 cycles/axle
	98.1 m/s² (321.84 ft/s²), 27 ... 300 Hz, 3 cycles/axle
• Bumping (half-sine) according to EN 60068-2-27/02.2010	150 m/s² (492 ft/s²), 6 ms, 1000 shocks/axle
• 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/axle
• 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. When using position feedback module, only T4 is permissible.

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 (CO2), nitrogen (N), noble gases or cleaned natural gas
• Pressure [1]	1.4 ... 7 bar (20.3 to 101.5 psi)
Air quality to ISO 8573-1	
• Solid particulate size and density	Class 2
• Pressure dew point	Class 2 (min. 20 K (36°F) below ambient temperature)
• Oil content	Class 2
Unrestricted flow (DIN 1945)	
• Inlet air valve (ventilate actuator) [2]	
2 bar (29 psi)	4.1 Nm³/h (18.1 USgpm)
4 bar (58 psi)	7.1 Nm³/h (31.3 USgpm)
6 bar (87 psi)	9.8 Nm³/h (43.1 USgpm)
• Exhaust valve (deaerate actuator for all versions except fail in place) [2]	
2 bar (29 psi)	8.2 Nm³/h (36.1 USgpm)
4 bar (58 psi)	13.7 Nm³/h (60.3 USgpm)
6 bar (87 psi)	19.2 Nm³/h (84.5 USgpm)
• Exhaust valve (deaerate actuator for fail in place version)	
2 bar (29 psi)	4.3 Nm³/h (19.0 USgpm)
4 bar (58 psi)	7.3 Nm³/h (32.2 USgpm)
6 bar (87 psi)	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

[1] The following applies to fail in place: 3 ... 7 bar (43.5 to 101.5 psi)

[2] When using device versions Ex d (6DR5..5-... and 6DR5..6-...), values are reduced by approximately 20%.

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 ... 100°
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 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	Approximately 0.9 kg (1.98 lb)
• 6DR5..1 aluminum enclosure, narrow	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	Approx. 5.2 kg (11.46 lb)
• 6DR5..6 stainless steel enclosure, flameproof	Approx. 8.4 kg (18.5 lb)
Material	
• Enclosure	
6DR5..0 Makrolon	Glass-fiber reinforced polycarbonate (PC)
6DR5..1 aluminum, narrow	GD AlSi12
6DR5..2 stainless steel	Austenitic stainless steel 316 Cb, mat. No. 1.4581
6DR5..3 aluminum	GD AlSi12
6DR5..5 aluminum, flameproof	GK AlSi12
6DR5..6 stainless steel enclosure, flameproof	Austenitic stainless steel 316 L, mat. No. 1.4409 or 316 Ti, mat. No. 1.4571
• Pressure gauge block	Aluminum AlMgSi, anodized or stainless steel 316
Versions	
• In Makrolon enclosure 6DR5..0	Single-acting and double-acting
• In aluminum enclosure 6DR5..1	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	

Construction	
• 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)
• Gland pneumatic ¼" 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 Makrolon enclosure	6 Nm (4.4 ft lb)
Screw-in torque for metal/stainless steel glands in aluminum/stainless steel enclosure	6 Nm (4.4 ft lb)
Screw-in torque for NPT adapter made of metal/stainless steel in Makrolon 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)
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: M20x1.5 or ½-14 NPT With explosion protection Ex d: Ex d certified M20x1.5, ½-14 NPT or M25x1.5
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 Certificates, approvals, explosion protection

Certificates and approvals	
Classification according to pressure equipment directive (PED 97/23/EC)	For fluid group 1 gases; fulfills requirements according to article 3, paragraph 3 (good engineering practice SEP)
CE conformity	The applicable directives and applied standards with their revision levels can be found in the EC declaration of conformity on the Internet.

See also

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

Explosion protection

Explosion protection	**Ex markings**	
Explosion protection in accordance with	ATEX/IECEx	FM/CSA
Flameproof enclosure encapsulation "d", "XP" 6DR5..5/6	II 2 G Ex d IIC T6/T4 Gb	FM: XP, Class I, Division 1, GP.ABCD CSA: XP, Class I, Division 1, GP.CD FM/CSA: XP, Class I, Zone 1, AEx d, IIC, T6/T4
Intrinsic safety "i", "IS"		
• 6DR5..0/1/2/3	II 2 G Ex ia IIC T6/T4 Gb II 3 G Ex ic IIC T6/T4 Gc	IS / I, II / 1 / A-D IS / 1 / AEx / Ex ib / IIC, Gb
• 6DR5..1/2/3	II 2 D Ex ia IIIC T110°C Db	IS / III / 1 / E-G IS / 21 / AEx / Ex ib / IIIC, Db, T110°C
Non-sparking "nA", "NI"	II 3 G Ex nA IIC T6/T4 Gc	NI / I / 2 / A-D NI / 2 / AEx / Ex nA, Ex ic / IIC, Gc
Dust, protection by means of enclosure "t", "DIP" • 6DR5..**1**-.D/K... • 6DR5..**2**-.D/K... • 6DR5..**3**-.D/K... • 6DR5..**6**-.E...	II 2 D Ex tb IIIC T100°C Db	DIP / II, III / 1 / E-G DIP / 21 / AEx / Ex tb / IIIC, Db, T100°C

Breakdown of the article numbers for assignment of the maximum permissible ambient temperature ranges

6DR5ayb-	**0cdef-**	**g..h-**	**Z jjj**
a = 0, 2, 5, 6	c = E, G, D, F, K	g = 0, 2, 6, 7, 8	A20, A40, C20, D53, D54, D55, D56, F01, K**, L1A, M40, R**, S**, Y** * = any character
y = 1, 2	d = G, N, M, P, R, S	h = 0, 1, 2, 3, 4, 9	
b = 0, 1, 2, 3	e = 0, 1, 2, 3		
	f = 0, 1, 2, 3		

Maximum permissible ambient temperature ranges with types of protection Ex ia, Ex ic and Ex nA

Explosion protection in accordance with	ATEX/IECEx	FM/CSA
• 6DR5ayb-0cdef-g.Ah-Z ...		T4: -30 ≤ T_a ≤ +80 °C (-22 ≤ T_a ≤ +176 °F) T6: -30 ≤ T_a ≤ +50 °C (-22 ≤ T_a ≤ +122 °F)
• 6DR5ayb-0cdef-g.Ah-Z **M40**		T4: -40 ≤ T_a ≤ +80 °C (-40 ≤ T_a ≤ +176 °F) T6: -40 ≤ T_a ≤ +50 °C (-40 ≤ T_a ≤ +122 °F)
Position feedback module (already fitted or can be retrofitted)		

Explosion protection in accordance with	ATEX/IECEx	FM/CSA
• Already fitted: 6DR5ayb-0cdef-g.Ah-Z ... with the data (f = 1 or 3) • Can be retrofitted 6DR4004-6J		T4: -30 ≤ T_a ≤ +80 °C (-22 ≤ T_a ≤ +176 °F)
• Already fitted and can be retrofitted: 6DR5ayb-0cdef-g.Ah-Z **M40** with the data (f = 1 or 3)		T4: -40 ≤ T_a ≤ +80 °C (-40 ≤ T_a ≤ +176 °F)
Option modules		
• Non contacting sensor (NCS) 6DR4004-6N..-0-...	T4: -40 ≤ T_a ≤ +90 °C (-40 ≤ T_a ≤ +194 °F) T6: -40 ≤ T_a ≤ +70 °C (-40 ≤ T_a ≤ +158 °F)	T4: -40 ≤ T_a ≤ +85 °C (-40 ≤ T_a ≤ +185 °F) T6: -40 ≤ T_a ≤ +70 °C (-40 ≤ T_a ≤ +158 °F)
• External position detection system C73451-A430-D78	T4: -40 ≤ T_a ≤ +90 °C (-40 ≤ T_a ≤ +194 °F) T6: -40 ≤ T_a ≤ +60 °C (-40 ≤ T_a ≤ +140 °F)	T4: -40 ≤ T_a ≤ +85 °C (-40 ≤ T_a ≤ +185 °F) T6: -40 ≤ T_a ≤ +60 °C (-40 ≤ T_a ≤ +140 °F)

Maximum permissible ambient temperature ranges with type of protection Ex t

Explosion protection in accordance with	ATEX/IECEx	FM/CSA
• 6DR5ayb-0cdef-g.Ah-Z ... with the data (c = D or K)		-30 ≤ T_a ≤ +80 °C (-22 ≤ T_a ≤ +176 °F)
• 6DR5ayb-0cdef-g.Ah-Z **M40** with the data (c= D or K)		-40 ≤ Ta ≤ +80 °C (-40 ≤ Ta ≤ +176 °F)

12.6 Electrical data

	Basic electronics without explosion protection	Basic electronics with explosion protection Ex d	Basic electronics with explosion protection Ex "ia"	Basic electronics with explosion protection Ex "ic", "nA", "t"
Current input I_W				
• Rated signal range		0/4 ... 20 mA		
• Test voltage		840 V DC, 1 s		
• Binary input BIN1 (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	-	-	207 µH	"ic": 207 µH
• With HART	-	-	310 µH	"ic": 310 µH

	Basic electronics without explosion protection	Basic electronics with explosion protection Ex d	Basic electronics with explosion protection Ex "ia"	Basic electronics with explosion protection Ex "ic", "nA", "t"
For connecting to circuits with the following peak values	-	-	Ui = 30 V I_i = 100 mA P_i = 1 W	"ic": U_i = 30 V I_i = 100 mA "nA"/"t": U_n ≤ 30 V I_n ≤ 100 mA

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

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_H	18 ... 35 V DC	18 ... 35 V DC	18 ... 30 V DC	18 ... 30 V DC
• Current consumption I_H	(U_H - 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 "nA"/"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_H and I_W	Between U_H and I_W	Between U_H and I_W (2 intrinsically safe circuits)	Between U_H and I_W

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.

12.7 Technical data for natural gas as actuator medium

Introduction

Note when using an actuator with natural gas that this can escape at the following points:

- At the exhaust air outlet with sound absorber.
- At the enclosure vent.
- At the control air outlet near the pneumatic connections.

Note

Exhaust air outlet with a sound absorber

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 and control air outlet

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...	6DR5.2.-.E...
		Single-acting	Double-acting
		[Nl/min]	[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

Pneumatic connection for 6DR5..0/1/2/3 (Page 96)

12.8 Option modules

12.8.1 Alarm module

	Without explosion protection or suitable for use in the SIPART PS2 Ex d	With Ex protection Ex "ia"	With Ex protection Ex "ic", "nA", "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_H	≤ 35 V	-	-
• Signal status			
High (not addressed)	Conductive, R = 1 kΩ, +3/-1 % *)	≥ 2.1 mA	≥ 2.1 mA
Low *) (addressed)	Deactivated, I_R < 60 µA	≤ 1.2 mA	≤ 1.2 mA
*) The status is also Low if the basic device is faulty or without a auxiliary power.	*) When using in the flameproof housing, the current consumption must be restricted to 10 mA per output.	Switching thresholds for supply as per EN 60947-5-6: U_H = 8.2 V, R_i = 1 kΩ	Switching thresholds for supply as per EN 60947-5-6: U_H = 8.2 V, R_i = 1 kΩ
• For connecting to circuits with the following peak values	-	U_i = 15 VDC I_i = 25 mA P_i = 64 mW	"ic": U_i = 15 VDC I_i = 25 mA "nA"/"t": U_n ≤ 15 VDC
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

	Without explosion protection or suitable for use in the SIPART PS2 Ex d	With Ex protection Ex "ia"	With Ex protection Ex "ic", "nA", "t"
• 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 "nA"/"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		

12.8.2 Position feedback module

	Without explosion protection or suitable for use in the SIPART PS2 Ex d	With Ex protection Ex ia (only in temperature class T4)	With Ex protection Ex "ic", "nA", "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_H	+12 ... +35 V	+12 ... +30 V	+12 ... +30 V
External load R_B [kΩ]	≤ (U_H [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 %		

	Without explosion protection or suitable for use in the SIPART PS2 Ex d	**With Ex protection Ex ia** (only in temperature class T4)	**With Ex protection Ex "ic", "nA", "t"**
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 "nA"/"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		

12.8.3 SIA module

	Without Ex protection	**With Ex protection Ex "ia"**	**With Ex protection Ex "ic", "nA", "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		
• 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	Nominal voltage 8 V; current 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 "nA": U_n ≤ DC 15 V P_n ≤ 64 mW
Effective internal capacitance	-	C_i = 41 nF	C_i = 41 nF
Effective internal inductance	-	L_i = 100 µH	L_i = 100 µH

	Without Ex protection	With Ex protection Ex "ia"	With Ex protection Ex "ic", "nA", "t"
1 fault message output • Binary output: Terminals 31 and 32			
• Connection	At switching amplifier in accordance with EN 60947-5-6: (NAMUR), U_H = 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_H	U_H ≤ 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 "nA": 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		

12.8.4 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			
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

	Without Ex protection	With Ex protection Ex ia	With Ex protection Ex "ic", "t"
• 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), UH = 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_H ≤ 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.	-	-

12.8.5 EMC filter module

	Without Ex protection	With Ex protection Ex ia	With Ex protection Ex "ic", "nA", "t"
EMC filter module type C73451-A430-D23 is required for NCS sensor or an external potentiometer. External position sensor (potentiometer or NCS; option) with the following maximum values			
Resistance of the external potentiometer		10 kΩ	
Maximum values when powered by the PROFIBUS basic device	-	U_o = 5 V I_o = 75 mA static I_o = 160 mA short-term P_o = 120 mW	U_o = 5 V I_o = 75 mA P_o = 120 mW
Maximum values when powered by other basic devices	-	U_o = 5 V I_o = 100 mA P_o = 33 mW C_o = 1 µF L_o = 1 mH	U_o = 5 V I_o = 75 mA P_o = 120 mW C_o = 1 µF L_o = 1 mH
Galvanic isolation		Galvanically connected with the basic device	

12.8.6 NCS 6DR4004-.N.20 and 6DR4004-.N.30

Additional modules	Without Ex protection	With Ex protection Ex "ia"	With Ex protection Ex "ic", "nA"
Travel range			
• Linear actuator 6DR4004-.N.20		3 to 14 mm (0.12 to 0.55")	
• Linear actuator 6DR4004-.N.30		10 to 130 mm (0.39 to 5.12"); up to 200 mm (7.87") on request	
• Part-turn actuator		30 to 100°	
Linearity (after corrections made by positioner)		± 1 %	
Hysteresis		± 0.2 %	
Temperature influence (range: rotation angle 120° or stroke 14 mm)		≤ 0.1 %/10 K (≤ 0.1 %/18 °F) for -20 to +90 °C (-4 to +194 °F) ≤ 0.2%/10 K (≤ 0.2%/18 °F) for -40 to -20 °C (-40 to -4 °F)	
Climate class		According to IEC/EN 60721-3	
• Storage		1K5, but -40 to +90 °C (-40 to +194 °F)	
• Transport		2K4, but -40 to +90 °C (-40 to +194 °F)	
Vibration resistance			
• Harmonic oscillations (sine) according to IEC 60068-2-6		3.5 mm (0.14"), 2 to 27 Hz, 3 cycles/axis 98.1 m/s² (321.84 ft/s²), 27 to 300 Hz, 3 cycles/axis	
• Bumping according to IEC 60068-2-29		300 m/s²(984 ft/s²), 6 ms, 4000 shocks/axis	
Torque for cable gland nut made of	Plastic	Metal	Stainless steel
	2.5 Nm (1.8 ft lb)	4.2 Nm (3.1 ft lb)	4.2 Nm (3.1 ft lb)

Additional modules	Without Ex protection	With Ex protection Ex "ia"	With Ex protection Ex "ic", "nA"
Housing protection type	IP68 according to IEC/EN 60529; NEMA 4X / Encl. 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 = 180 nF	C_i = 180 nF
Effective internal inductance	-	L_i = 922 µH	L_i = 922 µH

Certificates and approvals	
CE conformity	The applicable directives and applied standards with their revision levels can be found in the EC declaration of conformity on the Internet.

Explosion protection Types of protection	Ex markings	
	ATEX/IECEx	FM/CSA
• Intrinsic safety "ia"	Zone 1: ⟨Ex⟩ II 2 G Ex ia IIC T6/T4 Gb	IS, Class I, Divison 1, ABCD IS, Class I, Zone 1, AEx ib, IIC
• Intrinsic safety "ic"	Zone 2: ⟨Ex⟩ II 3 G Ex ic IIC T6/T4 Gc	-
• Non-sparking "nA"	Zone 2: ⟨Ex⟩ II 3 G Ex nA IIC T6/T4 Gc	NI, Class I, Divison 2, ABCD NI, Class I, Zone 2, AEx nA, IIC
Perm. ambient temperature	T4: -40 ... +90 °C (-40 ... +194 °F) T6: -40 ... +70 °C (-40 ... +158 °F)	T4: -40 ... +85 °C (-40 ... +185 °F) T6: -40 ... +70 °C (-40 ... +158 °F)

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

Additional modules	Without Ex protection	With Ex protection Ex "ia"	With Ex protection Ex "ic", "nA" ,"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 %

12.8.8 External position detection system

12.8.8.1 Rated conditions for external position detection system

Ambient temperature	**In hazardous areas, observe the maximum permissible ambient temperature corresponding to the temperature class.**
• Perm. ambient temperature for operation	-40 ... +90 °C (-40 ... +194 °F)
Degree of protection [1)]	IP66 to IEC/EN 60529 / NEMA 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.

12.8.8.2 Construction for external position detection system

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 to 90°)
• Angle of rotation (part-turn actuator)	30 ... 100°
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 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.
Material	
• Enclosure	Makrolon® glass-fiber reinforced polycarbonate (PC)
Weight, basic device	Approximately 0.9 kg (1.98 lb)
Torque for cable gland nut made of plastic	2.5 Nm

12.8.8.3 Certificates, approvals, explosion protection for external position detection system

Electrical data	
For connecting to circuits with the following peak values	U_i = 5 V I_i = 100 mA P_i = 160 mW C_i = negligibly small L_i = negligibly small

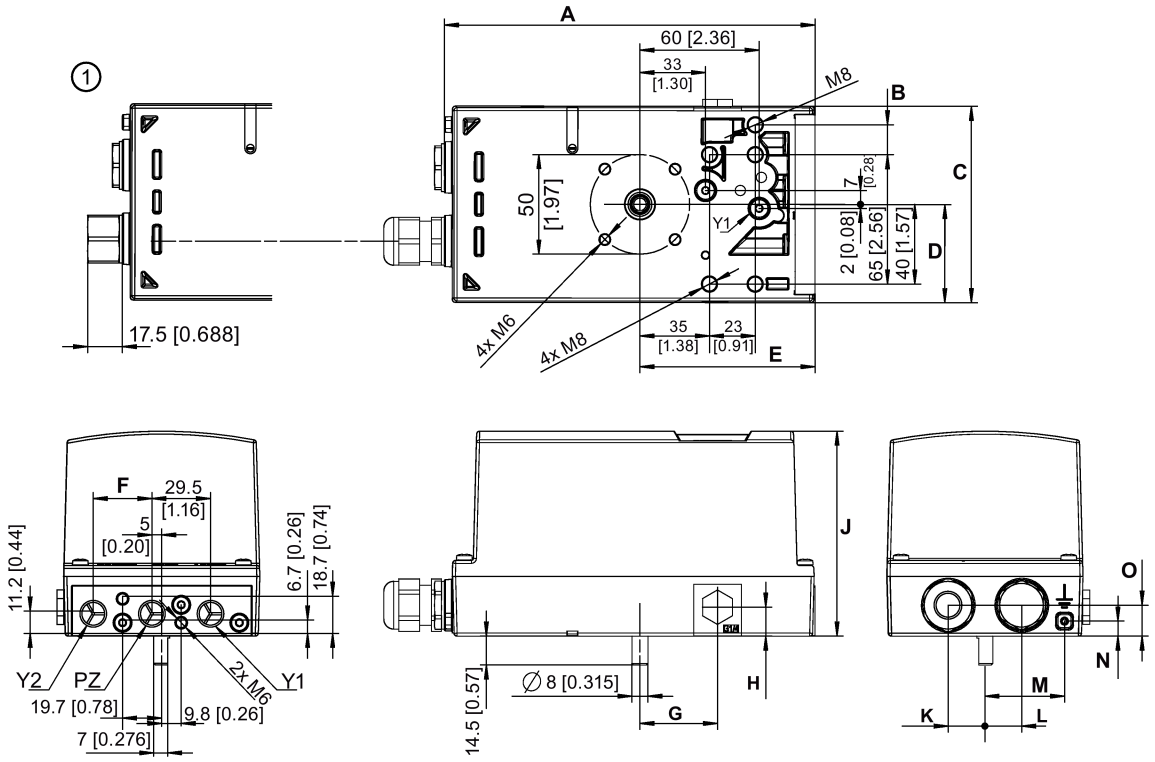
Certificates and approvals	
CE conformity	The applicable directives and applied standards with their revision levels can be found in the EC declaration of conformity on the Internet.

Explosion protection	**Ex markings**
Explosion protection in accordance with	**ATEX**
Intrinsic safety "ia"	Zone 1: II 2 G Ex ia IIC T6/T4 Gb Zone 21: II 2 D Ex ia IIIC T110°C Db
Intrinsic safety "ic"	Zone 2: II 3 G Ex ic IIC T6/T4 Gc
Non-sparking "nA"	Zone 2: II 3 G Ex nA IIC T6/T4 Gc
Permissible ambient temperature	T4: -40 ... +90 °C (-40 ... +194 °F) T6: -40 ... +60 °C (-40 ... +140 °F)

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 / 6DR64..	
	G¼	¼-NPT			G¼	¼-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	48 [1.89]		34.5 [1.36]	49.5 [1.95]	48.6 [1.91]	
E	88.5 [3.48]		90.5 [3.56]	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]	

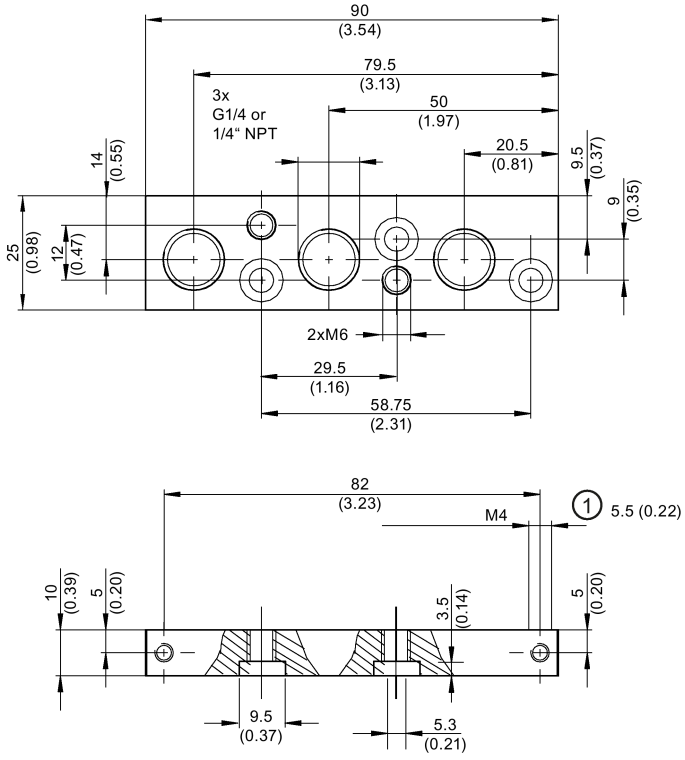
	6DR5..0		6DR5..1	6DR5..2	6DR5..3 / 6DR64..	
	G¼	¼-NPT			G¼	¼-NPT
L	18.5 [0.73]		7 [0.23]	18.5 [0.73]	18.5 [0.73]	
M	-		26.5	41.5	40	
N	-		7.5	7.5	7.5	
O	14.5 [0.57]		14.5 [0.57]	14.5 [0.57]	15.5 [0.61]	

Dimensions in mm [inch]

*) Dimension does not apply to double-acting actuators

6DR5..0 Makrolon enclosure; dimensions with pneumatic connection G¼ or ¼-NPT
6DR5..1 Aluminum enclosure, narrow, only single-action
6DR5..2 Stainless steel enclosure, without inspection window
6DR5..3 Aluminum enclosure; dimensions with pneumatic connection G¼ or ¼-NPT
6DR64.. SITRANS VP160; dimensions with pneumatic connection G¼ or ¼-NPT

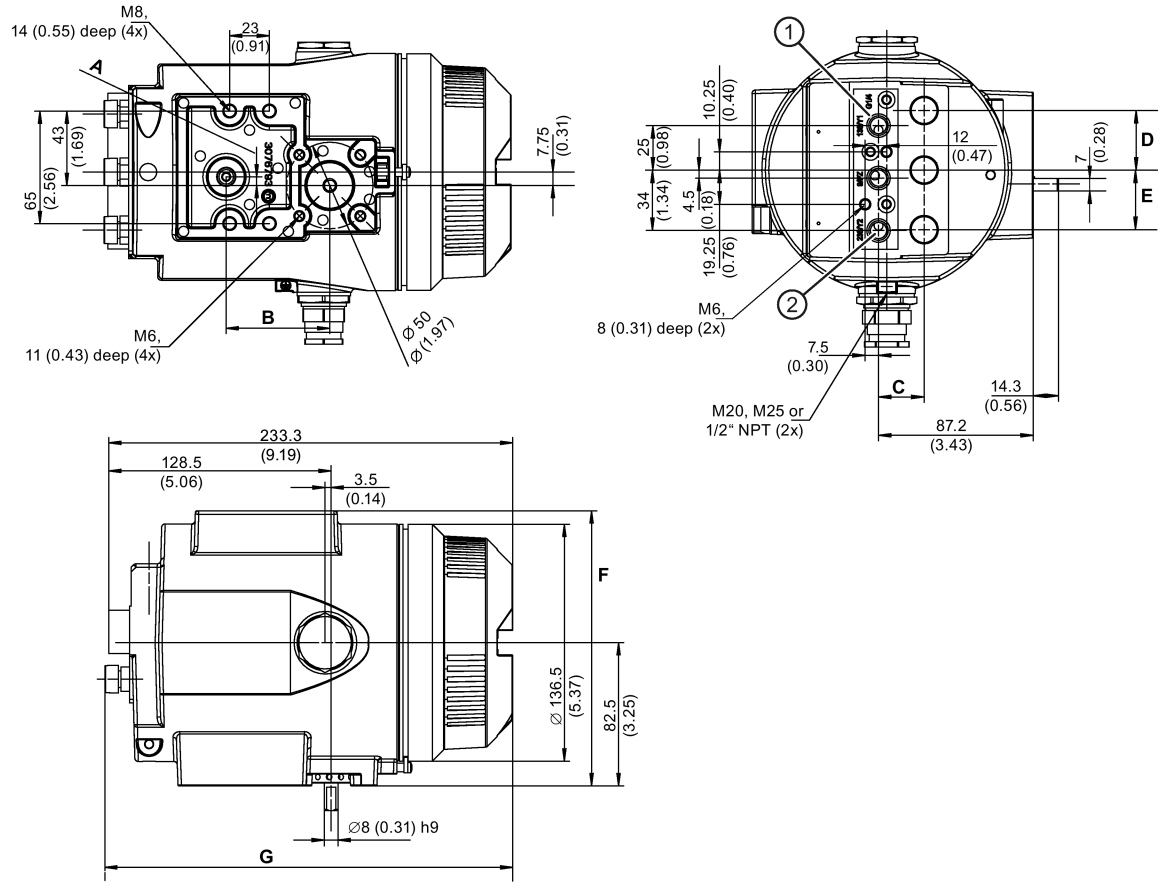
13.2 Terminal strip for positioners with Macrolon enclosure 6DR5..0 and aluminum enclosure 6DR5..3



① Thread depth

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

13.3 Positioner with flameproof enclosure



① All air connections G¼ or ¼" 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 ¼-NPT

6DR5..6 Stainless steel enclosure, flameproof

Spare parts / accessories / scope of delivery 14

14.1 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)

14.2 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 243)".

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:

- Makrolon enclosure for single 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 243)".

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.

14.3 Spare parts

	Description	Order No.	For version
	Basic electronics, 2-wire, not Ex, without HART	A5E00082459	6DR50..-.N
	Basic electronics 2-wire, Ex, without HART	A5E00082457	6DR50..-.D/E/F/G/K
	Basic electronics, 2-wire, not Ex, with HART	A5E00082458	6DR51..-.N
	Basic electronics, 2/3/4-wire, Ex, with HART	A5E00082456	6DR52..-.D/E/F/G/K
	Basic electronics, 2/3/4-wire, not Ex, without HART	A5E00102018	6DR53..-.N
	Basic electronics, PROFIBUS PA, not Ex	A5E00141523	6DR55..-.N
	Basic electronics, PROFIBUS PA, Ex	A5E00141550	6DR55..-.D/E/F/G/K
	Basic electronics, FOUNDATION Fieldbus, not Ex	A5E00215467	6DR56..-.N
	Basic electronics, FOUNDATION Fieldbus, Ex	A5E00215466	6DR56.-.D/E/F/G/K
	Pneumatic block, single-acting, with seal and screws	C73451-A430-D80	6DR5...
	Pneumatic block, double-acting, with seal and screws	C73451-A430-D81	6DR5...
	Valve manifold for Fail in Place, with seal, cover panel and screws	A5E34409029	-Z F01
	Potentiometer (complete)	C73451-A430-D84	6DR5...
	Magnet holder made of fiberglass reinforced polyester including magnet for non-contacting position detection for part-turn actuators	A5E00078030	6DR4004-.N.10
	Magnet holder made of anodized aluminum including magnet for non-contacting position detection for part-turn actuators	A5E00524070	6DR4004-.N.40
	Stainless steel sound absorber, 3 units	A5E32527711	6DR5..0; 6DR5..1; 6DR5..2; 6DR5..3
	Manometer 0 to 10 bar, metal, G1/8, 3 units	A5E32527731	6DR5...
	Manometer 0 to 10 bar, stainless steel, G1/8, 3 units	A5E32527735	6DR5...

Note

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

14.4 Scope of delivery of external position detection system

Scope of delivery of external position detection system C73451-A430-D78	
Quan-tity	**Designation**
1	DVD with the complete documentation for all variants and accessories
1	External position detection system
1	Gray cable gland
1	Sealing set 2x5 mm for cable gland
1	Plug for sealing set
1	Nameplate for device version **without** explosion protection

14.5 Scope of delivery of mechanical limit switch module

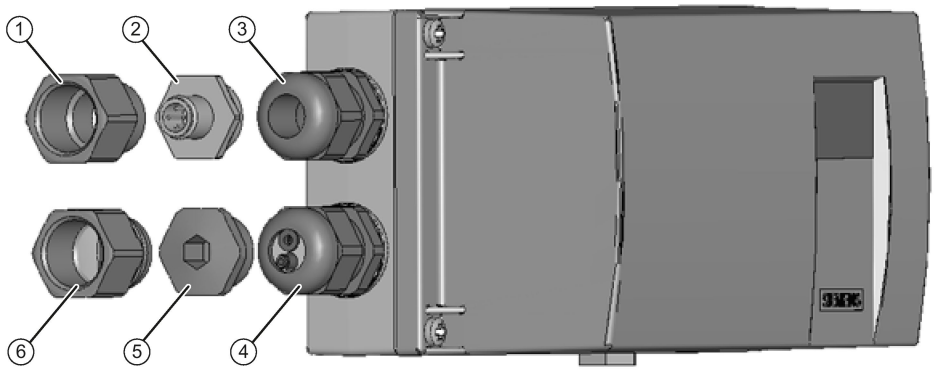
If the mechanical limit switch module was ordered for later installation, then the following components are included in the scope of delivery:

- 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.

14.6 Scope of delivery EMC filter module

Cable glands and adapters

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



Connections ① to ③ for power supply

① Adapter M20 to ½-14 NPT for
- 6DR5..0/1/2/3-0.N/P

② M12 connector for device version with PROFIBUS or FOUNDATION fieldbus communication
- 6DR55..-0.R/S
- 6DR56..-0.R/S

③ Cable gland for connection thread M20x1.5 for
- 6DR5..0/1/2/3-0.G/M

Connections ④ to ⑥ for optional modules

④ Cable gland for connection thread M20x1.5 with seal insert
- 6DR55..0-0.G/M/R/S
- 6DR56..0-0.G/M/R/S

⑤ Dummy plug for device version without optional modules
- 6DR5...-0..00

⑥ Adapter M20 to ½-14 NPT for
- 6DR5..0/1/2/3-0.N/P

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

Scope of delivery EMC filter module

Legend numbers refer to the graphic

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

14.7 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

Appendix A

A.1 Operation with boosters

Introduction

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

With single-acting positioners you require a booster which must be connected to the air output Y1. With double-acting positioners you require two boosters which must be connected to the air output Y1 and to Y2.

NOTICE
Avoid pressure variations Ensure pressure variations do not occur in the supply air PZ on the positioner due to the booster.

NOTICE
Note when selecting the boosters: • Only boosters may be used which do not have a continuous air consumption in the setpoint input. • The boosters must not have a follow-up time. A stable operating state will not be reached if these two points are not observed. All process components involved are subject to faster wear.

Procedure

1. Reduce the air performance. To do this, use the restrictors on the positioner.
2. Set the deadband "DEBA" to the largest value permissible for your process.
3. Start the initialization process.
4. If necessary, adjust the travel times during the initialization process.

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 110)".

See also

Sequence of automatic initialization (Page 117)

A.2 Certificates

The certificates can be found on the DVD supplied and on the Internet at: Certificates (http://www.siemens.com/processinstrumentation/certificates)

A.3 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) where you will find support news, support documents including EDDs and software, and also support from experts.

Additional Support

If you have additional questions about the device, please contact your local Siemens representative.

Find your local contact partner at:

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

Documentation for various products and systems is available at:

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

See also

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

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

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

Abbreviations

B

B.1 Abbreviations for positioners

Abbreviation	Long form	Meaning
A/D	Analog-to-digital converter	-
AC	Alternating current	Alternating current
AMS	Asset Management Solutions	Communication software from Emerson Process comparable with the PDM
AUT	Automatic	Operating mode
ATEX	Atmosphère explosible	Product and operation directive of European Commission for explosion protection.
CENELEC	Comité Européen de Normalisation Electrotechnique	European committee for electrotechnical standardization
CPU	Central processing unit	Master processor
CSA	Canadian Standard Association	-
DC	Direct current	Direct current
DI	Digital Input	Digital input
DIN	Deutsche Industrie Norm	-
DO	Digital Output	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.
IP	International Protection Ingress Protection	International protection types (long form as per DIN) Seepage protection (long form as used in US)
LC	Liquid crystal	Liquid crystal
MAN	Manual	Operating mode
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

Abbreviation	Long form	Meaning
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
SIA	Slit initiator alarm module	-
VDE	Verband der Elektrotechnik, Elektronik und Informationstechnik e. V.	Industrial and professional association
VDI	Verein Deutscher Ingenieure e. V.	Technical/scientific association

B.2 Abbreviations for functional safety

Abbreviation	Full term in English	Meaning
FIT	Failure in Time	Frequency of failure Number of faults within 10^9 hours
HFT	Hardware Fault Tolerance	Hardware fault tolerance: Capability of a function unit to continue executing a required function in the presence of faults or deviations.
MooN	"M out of N" voting	Classification and description of the safety-instrumented system in terms of redundancy and the selection procedures used. A safety-instrumented system or part that consists of "N" independent channels. The channels are connected to each other in such a way that "M" channels are in each case sufficient for the device to perform the safety instrumented function. Example: Pressure measurement: 1oo2 architecture. A safety-instrumented system decides that a specified pressure limit has been exceeded if one out of two pressure sensors reaches this limit. In a 1oo1 architecture, there is only one pressure sensor.
MTBF	Mean Time Between Failures	Average period between two failures
MTTR	Mean Time To Restoration	Average period between the occurrence of a fault in a device or system and restoration of functionality
PFD	Probability of Dangerous Failure on Demand	Probability of dangerous failures of a safety function on demand
PFD_{AVG}	Average Probability of Dangerous Failure on Demand	Average probability of dangerous failures of a safety function on demand

Abbreviation	Full term in English	Meaning
SFF	Safe Failure Fraction	Proportion of safe failures: Proportion of failures without the potential to bring the safety-instrumented system into a dangerous or non-permissible functional status.
SIL	Safety Integrity Level	The international standard IEC 61508 defines four discrete Safety Integrity Levels (SIL 1 to SIL 4). Each level corresponds to a range of probability for failure of a safety function. The higher the Safety Integrity Level of the safety-instrumented system, the lower the probability that it will not execute the required safety functions.
SIS	Safety Instrumented System	A safety-instrumented system (SIS) executes the safety functions that are required to achieve or maintain a safe status in a system. It consists of sensors, logic unit/control system and final controlling elements.

Glossary

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 94/9/EC 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) is a non-volatile electronic memory chip. 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

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.

Makrolon

Glass-fiber reinforced polycarbonate (PC).

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.

NEMA 4

An enclosure standard of the National Electrical Manufacturers Association. NEMA 4-compliant devices are suitable for use in indoor and outdoor applications. Protection is provided against dust particles, rain as well as spray and splash water.

NEMA 4x

The same protection as NEMA 4. Additional protection of the enclosure from corrosion.

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).

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.

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