Operating Instructions Edition 09/2008

Electropneumatic positioners SIPART PS2

6DR50**, 6DR51**, 6DR52**, 6DR53**

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Electropneumatic positioners SIPART PS2 with and without HART communications

Operating Instructions

6DR50** - Positioner without HART 6DR51** - Positioner with HART, not explosion-protected
6DR52** - Positioner with HART, explosion-protected
6DR53** - Positioner with HART, not explosion-protected

09/2008
A5E00074631-08

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

with a safety alert symbol, indicates that minor personal injury can result if proper precautions are not taken.

CAUTION

without a safety alert symbol, indicates that property damage can result if proper precautions are not taken.

NOTICE

indicates that an unintended result or situation can occur if the corresponding information is not taken into account.

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 device/system may only be set up and used in conjunction with this documentation. Commissioning and operation of a device/system may only be performed by **qualified personnel**. Within the context of the safety notes in this documentation qualified persons are defined as persons who are authorized to commission, ground and label devices, systems and circuits in accordance with established safety practices and standards.

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 adhered to. The information in the relevant documentation must be observed.

Trademarks

All names identified by ® are registered trademarks of the 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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Ordernumber: A5E00074631
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Introduction

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1.1 Purpose of this documentation

This programming manual contains all information that you will require to commission and use the device.

It is aimed at persons who install the device mechanically, connect it electrically, parameterize and commission it, as well as at service and maintenance engineers.

This document also contains special information and safety notes that you will require when using an SIL-certified device in safety-instrumented systems.

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 code
08 09/2008	FW from 4.00.00

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

Edition	Remark
08 09/2008	Upgrade of Zone 2/22 Revision of technical data

1.3 Further information

Information

The contents of this programming manual shall not become part of or modify any prior or existing agreement, commitment or legal relationship. All obligations on the part of Siemens AG are contained in the respective sales contract, which also contains the complete and solely applicable warranty conditions. Any statements on the device versions described in the programming manual do not create new warranties or modify the existing warranty.

The content reflects the technical status at the time of printing. We reserve the right to make technical changes in the course of further development.

Contact person worldwide

If you need more information or have particular problems that are not covered sufficiently by this programming manual, please contact your contact person. You can find your regional contact person on the Internet.

Product information on the Internet

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 specification sheet with the ordering data, the Software Device Install for SIMATIC PDM for additional installation, and the required software.

See also

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

Product information on SIPART PS2 in the Internet (http://www.siemens.com/sipartps2)

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

Environmental protection

Devices described in this programming manual can be recycled owing to the low content of noxious substances in their version. Please contact a certified waste disposal company for eco-friendly recycling and to dispose of your old devices.

General safety notes

2

2.1 General information

This device left the factory free from safety problems. In order to maintain this status and to ensure safe operation of the device, please observe the safety information and warnings contained in these instructions.

2.2 Correct usage

The device may only be used for the purposes specified in these instructions.

Insofar as they are not expressly stated in these instructions, all changes to the device are the sole responsibility of the user.

2.3 Laws and directives

Observe the test certification, provisions and laws applicable in your country during connection, assembly and operation.

For hazardous areas, these are for example:

- IEC 60079-14 (international)
- National Electrical Code (NEC - NFPA 70) (USA)
- Canadian Electrical Code (CEC) (Canada)
- EN 60079-14 (formerly VDE 0165, T1) (EU, Germany)
- The working reliability regulation (Germany)

See also

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

2.4 Measures

For the sake of safety, the following precautions must be observed:

⚠ WARNING

Type of protection "pressure-proof encapsulation"

Devices with "pressure-proof encapsulation" protection may only be opened when off circuit.

"Intrinsically safe" protection type

"Intrinsically-safe" devices lose their certification as soon as they are operated on circuits which do not correspond with the test certification valid in their country. The "ia" protection level of the device is lowered to the "ib" protection level if intrinsically safe circuits with the "ib" protection level are connected.

Protection type "limited energy" nL (zone 2)

Devices with "limited energy" may be connected and disconnected while in operation.

Protection type "non-sparking" nA (zone 2)

Devices with "non-sparking" protection may only be connected and disconnected when off circuit.

Exceptions:

Connection lines with unlimited energy as well as internal connectors may be connected or disconnected under voltage only in the following cases:

- During installation
- During maintenance
- During repairs

CAUTION

For versions 6DR5a*b-*Gc-****, where a = 0, 2, 5, 6; b = 0, 1; c = G, N, M, P, Q, the following is applicable:**

The device must be protected against power surges of over one joule.

For versions 6DR5a*b-*Gc-****, where a = 0, 2, 5, 6; b = 0; c = G, N, M, P, Q, the following is applicable:**

The maximum torque on the thread of the cable gland should not exceed 67 Nm.

⚠ CAUTION

Electrostatic Sensitive Devices (ESD)

This device contains electrostatic sensitive devices. Electrostatic sensitive devices may be destroyed by voltages that are undetectable to a human. Voltages of this kind occur as soon as a component or an assembly is touched by a person who is not grounded against static electricity. The damage to a module as a result of overvoltage cannot usually be detected immediately. It may only become apparent after a long period of operation.

Therefore, avoid electrostatic charge.

2.5 Qualified Personnel

Qualified personnel are people who are familiar with the installation, mounting, commissioning, and operation of the product. These people have the following qualifications:

- They are authorized, trained or instructed in operating and maintaining devices and systems according to the safety regulations for electrical circuits, high pressures and aggressive as well as hazardous media.
- For explosion-proof devices: 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 safety regulations.

2.6 SIL applications

The SIPART PS2 positioner, in variants 6DR501*, 6DR511*, 6DR521*, and 6DR531* (that is, with 0/4 to 20 mA excitation signal in a single-acting version), is also suitable for positioning on control valves with pneumatic drives. Control valves with pneumatic drives must satisfy the particular requirements of safety technology up to SIL 2 per IEC 61508/IEC 61511-1.

See also

Functional safety in process instrumentation (http://www.siemens.com/SIL)

Description

3

3.1 Function

- The electropneumatic positioner, in combination with the drive, forms a regulation system. The current position of the drive is detected using a servo potentiometer and is sent back as actual value x. The actual and target values are simultaneously displayed on the digital display.
- The setpoint w forms a current applied to the positioner, which in two-wire mode is also used to power the positioner. In 3- and 4-wire mode, power is supplied through a 24-V power input.
- 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 positioning signals cause pressure changes in the drive chamber(s) and thus a repositioning of the drive until the regulation deviation returns to zero.
- Using three buttons and a digital display with the housing cover removed, operation (manual mode) and configuration (structuring, initialization, and parameterization) can be performed.
- By default, the basic unit has a binary input (BE1). This binary input can be individually configured and used e.g. to block the control levels.
- To be able to use the positioner in a variety of mechanically different rotational and linear actuators, it has a friction clutch and a switchable gear.

3.2 Structure

3.2.1 Overview of structure

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

The positioner is available in the following configurations:

- SIPART PS2 without explosion protection in metal or plastic housing
- SIPART PS2 with EEx ia/ib protection in metal or plastic housing
- SIPART PS2 with EEx d protection in explosion-proof housing

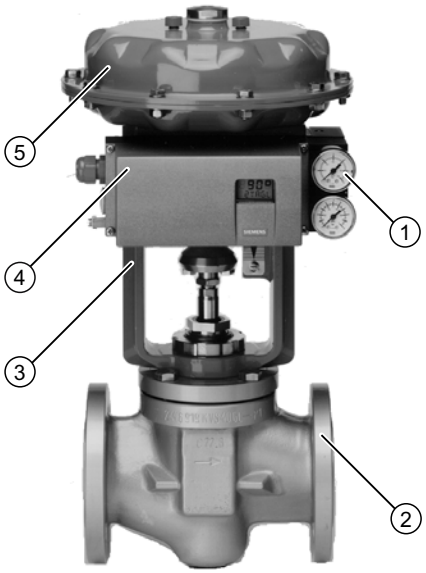
The positioner is used to adjust and regulate pneumatic drives. The positioner works electropneumatically, using compressed air as auxiliary power. The positioner can e.g. regulate valves with:

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

For linear actuators, there are various add-on extensions available:

- NAMUR or IEC 534
- Integrated addition to ARCA
- Integrated addition to SAMSON in non–explosion-proof housing

You can mount the positioner on the usual drives and operate it with the usual drives.

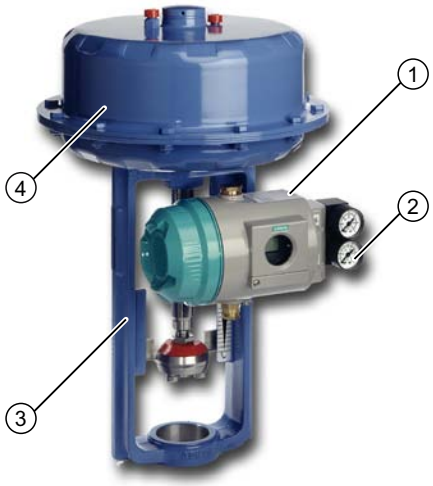


① Pressure gauge block, single-acting
② Valve
③ Yoke / actuator yoke
④ Single-acting positioner in metal enclosure
⑤ Actuator

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

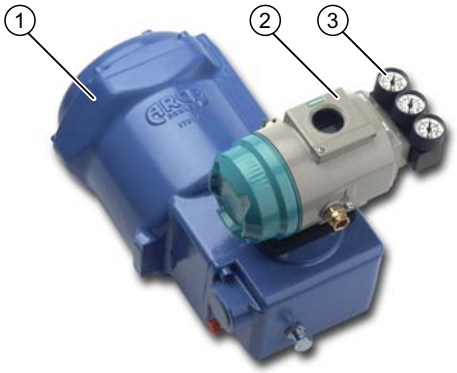
① Pressure gauge block, double-acting
② Part-turn actuator
③ Double-acting positioner in plastic enclosure

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



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

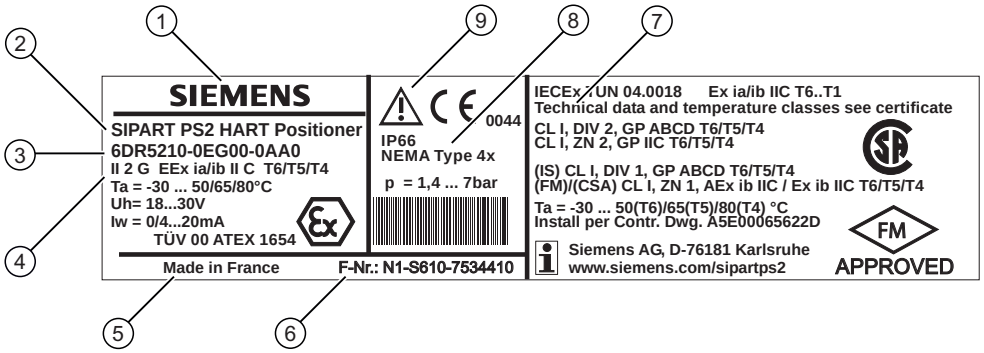
Figure 3-3 Positioner in flameproof enclosure attached to linear actuator



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

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

3.2.2 Structure of the nameplate



①	Manufacturer	⑥	Fabrication number
②	Product name	⑦	Approvals
③	Order number	⑧	Degree of protection
④	Technical data	⑨	Consult operating instructions
⑤	Place of manufacture		

Figure 3-5 Structure of the nameplate, example

3.3 Operation with natural gas

3.3.1 Safety notes for operation with natural gas

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

⚠ WARNING

Operation with natural gas

1. Only the "EEx ia" version of the positioner and optional modules with the "EEx ia" type of protection may be operated with natural gas. Positioners with other types of protection, e.g. flameproof enclosure or versions for zones 2 and 22 are not permitted.
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.
4. The mechanical limit switch module may 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.

See also

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

3.3.2 Natural gas as an actuator medium

Introduction

Normally, you operate the positioner with compressed air. Natural gas has been approved as an actuator medium for intrinsically safe positioners with the "EEx ia" type of protection.

Note

Quality of natural gas

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

Functional principle

The positioner releases the used natural gas through the exhaust air outlet E. The exhaust air outlet E is equipped with an attenuator.

As an alternative to this standard configuration, the exhaust air outlet can be replaced with a G¼ screwed fitting. You have to dismantle the attenuator for this purpose.

Maximum values for escaping natural gas

Natural gas escapes parallel to the exhaust air outlet E:

- From the enclosure vent at the bottom side of the device
- From the control air outlet near the pneumatic connections

This escaping natural gas cannot be collected and carried off. Please refer to the following table for the maximum bleeding values.

Bleeding process	Operating mode	6DR5x1x-xExxx	6DR5x2x-xExxx
		Single-acting	Double-acting
		[Nl/min]	[Nl/min]
Bleed the enclosure volume through the bottom side of the device. 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
Bleed through the control air outlet near the pneumatic connections:	Operation, typical	1.0	2.0
	Operation, max.	8.9	9.9

		6DR5x1x-xExxx	6DR5x2x-xExxx
	Error case, max.	66.2	91.0
Bleed through the exhaust air outlet E	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.

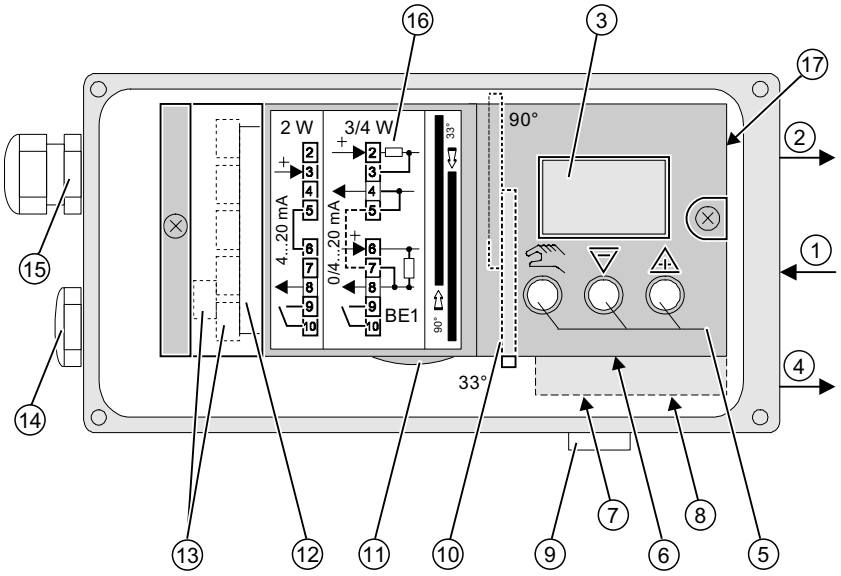
See also

Safety notes for operation with natural gas (Page 20)

Pneumatic connection on the standard controller (Page 25)

3.4 Device components

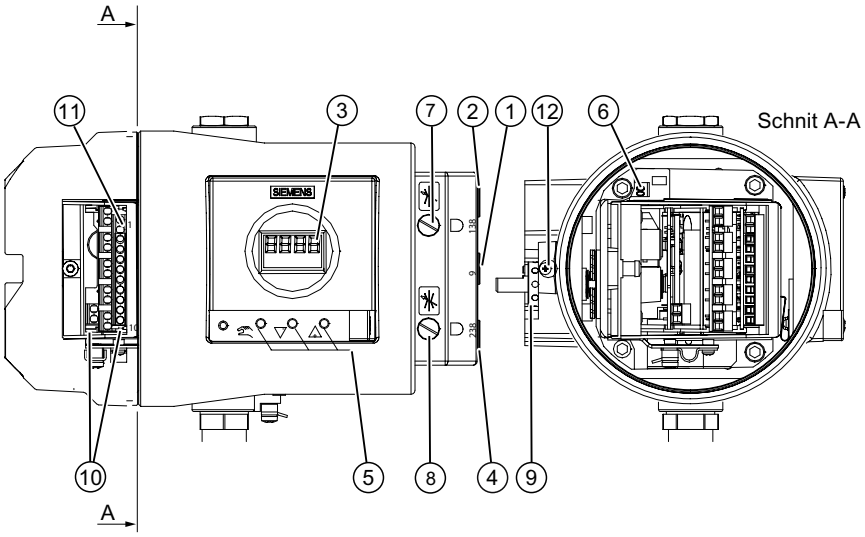
3.4.1 Overview of device components



① Input: supply air
② Output: Actuating pressure Y1
③ Digital display
④ Output: Actuating pressure Y2 [1)]
⑤ Control buttons
⑥ Restrictor
⑦ Restrictor Y1
⑧ Restrictor Y2 [1)]
⑨ Sound absorber
⑩ Transmission ratio selector
⑪ Friction clutch adjustment wheel
⑫ Motherboard
⑬ Connection terminals for optional modules
⑭ Dummy plug
⑮ Cable gland
⑯ Terminal label on cover
⑰ Purging air selector

[1)] for double-acting drives

Figure 3-6 View of basic positioner with cover open



①	Input: supply air	⑦	Restrictor Y1
②	Output: Actuating pressure Y1	⑧	Restrictor Y2 [1]
③	Digital display	⑨	Friction clutch adjustment wheel
④	Output: Actuating pressure Y2 [1]	⑩	Connection terminals for optional modules
⑤	Control buttons	⑪	Terminals standard controller
⑥	Transmission ratio selector [2]	⑫	Safety catch

[1] for double-acting drives

[2] only possible when positioner is open

Figure 3-7 View of positioner in explosion-proof housing

3.4.2 Motherboard

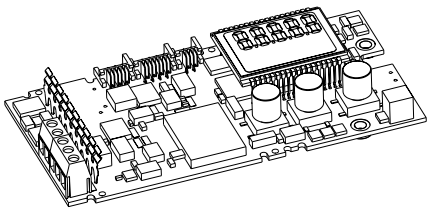


Figure 3-8 Motherboard

The motherboard contains:

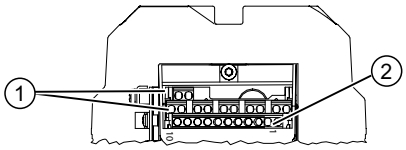
- CPU
- Memory
- Analog-to-digital converter
- Digital display

- Buttons
- Terminal strips to connect the optional module to the motherboard

3.4.3 Electrical connections

Connecting terminals of the standard controller, the I_y and the alarm optional module are provided at the left front edges, and are arranged in a staircase-shape.

The module cover protects components from being pulled out and prevents an incorrect assembly.



① Connecting terminals of optional modules
② Connecting terminals of standard controller

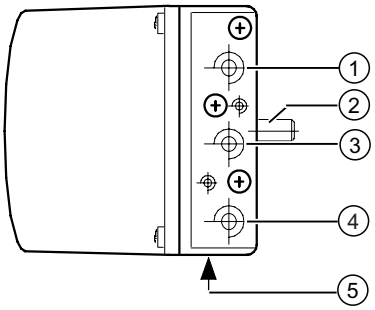
Figure 3-9 Connecting terminals of the flameproof enclosure

3.4.4 Pneumatic connections

3.4.4.1 Pneumatic connection on the standard controller

Structure

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



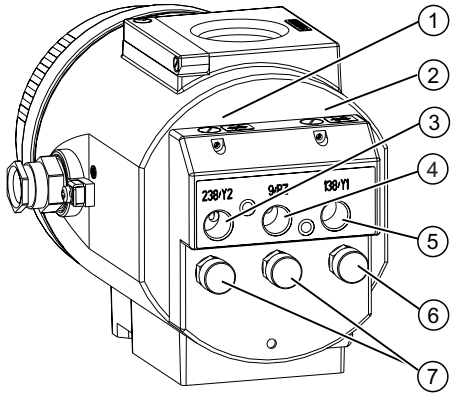
① Actuating pressure Y1 for single and double-acting actuators
② Feedback shaft
③ Supply air P_Z
④ Actuating pressure Y2 for double-acting actuators
⑤ Exhaust air outlet with an attenuator at the bottom side of the device

Figure 3-10 Pneumatic connection on the standard controller

3.4.4.2 Pneumatic connection in the flameproof enclosure

Structure

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



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

*) for double-acting actuators

Figure 3-11 Pneumatic connection in the flameproof enclosure

3.4.4.3 Pneumatic connection versions

Overview

For the integrated attachment for single-action linear actuators, the following pneumatic connections are provided at the rear side of the standard controller:

- 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.

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.

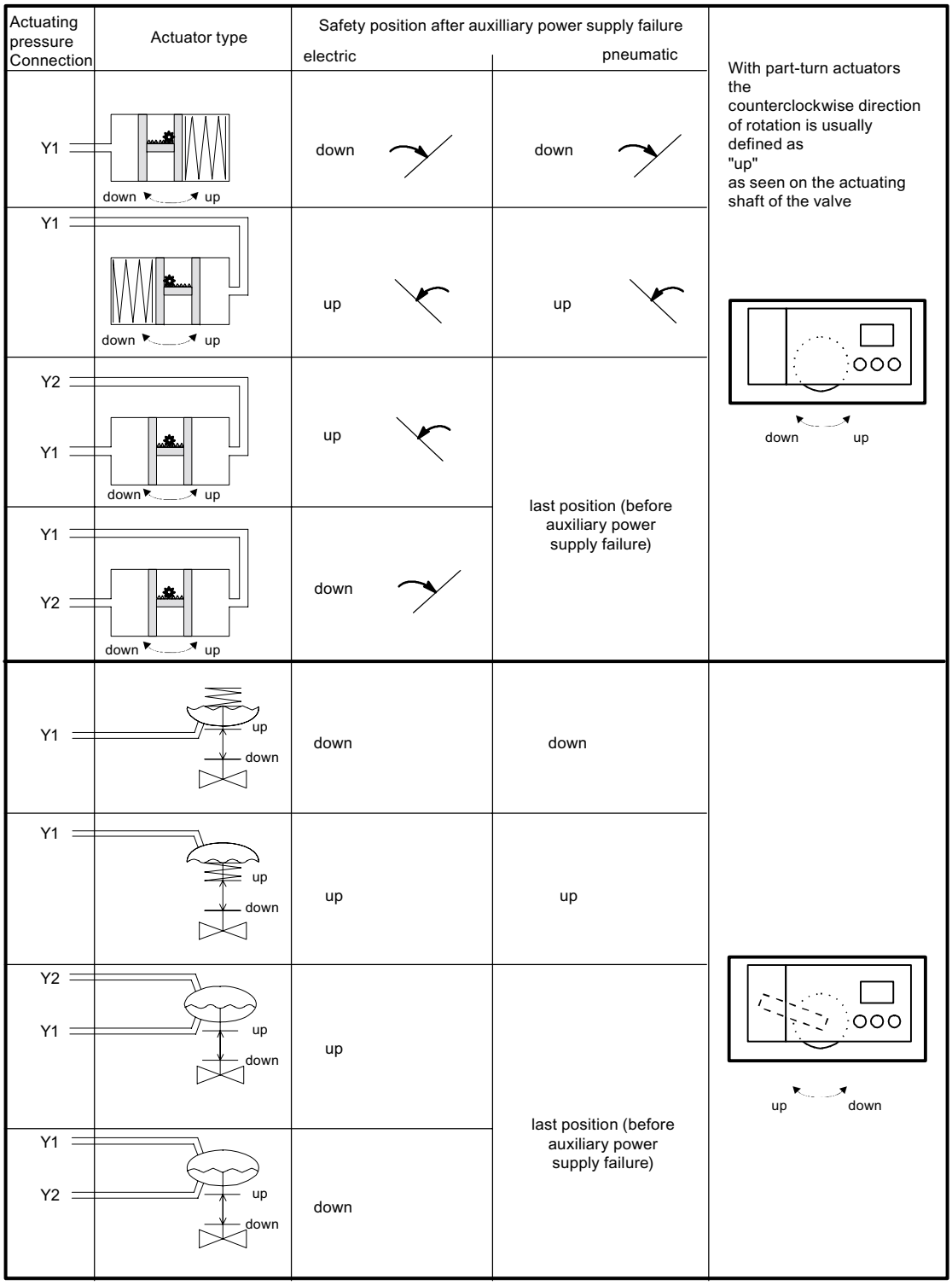


Figure 3-12 Regulating action of pneumatic connection

3.4.5 Purge air switching

Note

Equipment

Versions with flameproof enclosures are not equipped with 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.

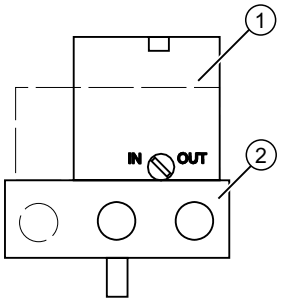


Figure 3-13 Purge air switch on the pneumatic block; view of the positioner on the pneumatic connection side when the cover is open

① Purge air switch
② Pneumatic terminal strip

3.4.6 Restrictors

Note

The exhaust air valve is always open in the de-energized state.

- Reduce the air output to achieve actuating 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.

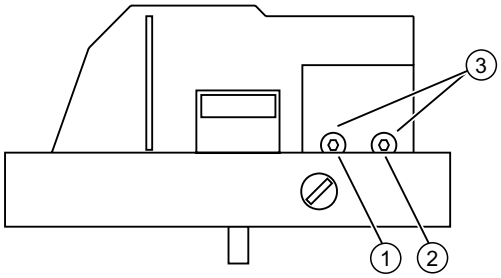


Figure 3-14 Restrictors

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

See also

Pneumatic connection in the flameproof enclosure (Page 26)
Sequence of automatic initialization (Page 114)

3.5 Mode of operation

3.5.1 Control loop

Control loop

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

- The actual value x represents the position of the drive spindle for linear actuators or the position of the drive shaft for part-turn actuators.
- The control value w represents the positioning current of a closed-loop controller or a manual control station from 0/4 to 20 mA.

The lifting or rotary movement of the actuator is transferred to a high-quality conductive plastic potentiometer using suitable attachments, feedback 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 is used to record the lifting or rotation angle directly on the actuator.

If required, the microcontroller corrects the angle error of the feedback lever bracket, compares the potentiometer voltage as an actual value x with the setpoint w that is fed through terminals 3 and 7, and calculates the controller output increment $\pm\Delta y$. Depending on the magnitude and the direction of the control deviation (x-w), the piezo advance controlled supply or exhaust air valve is opened. 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-action 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.

See also

Block circuit diagram for signal-acting or dual-acting drives (Page 33)

3.5.2 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.

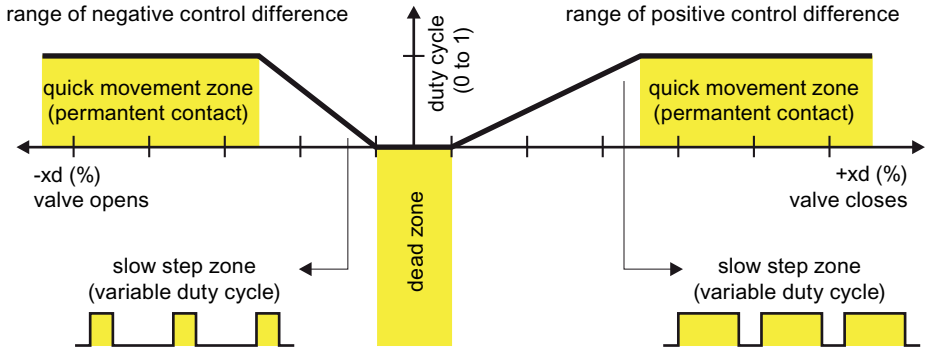


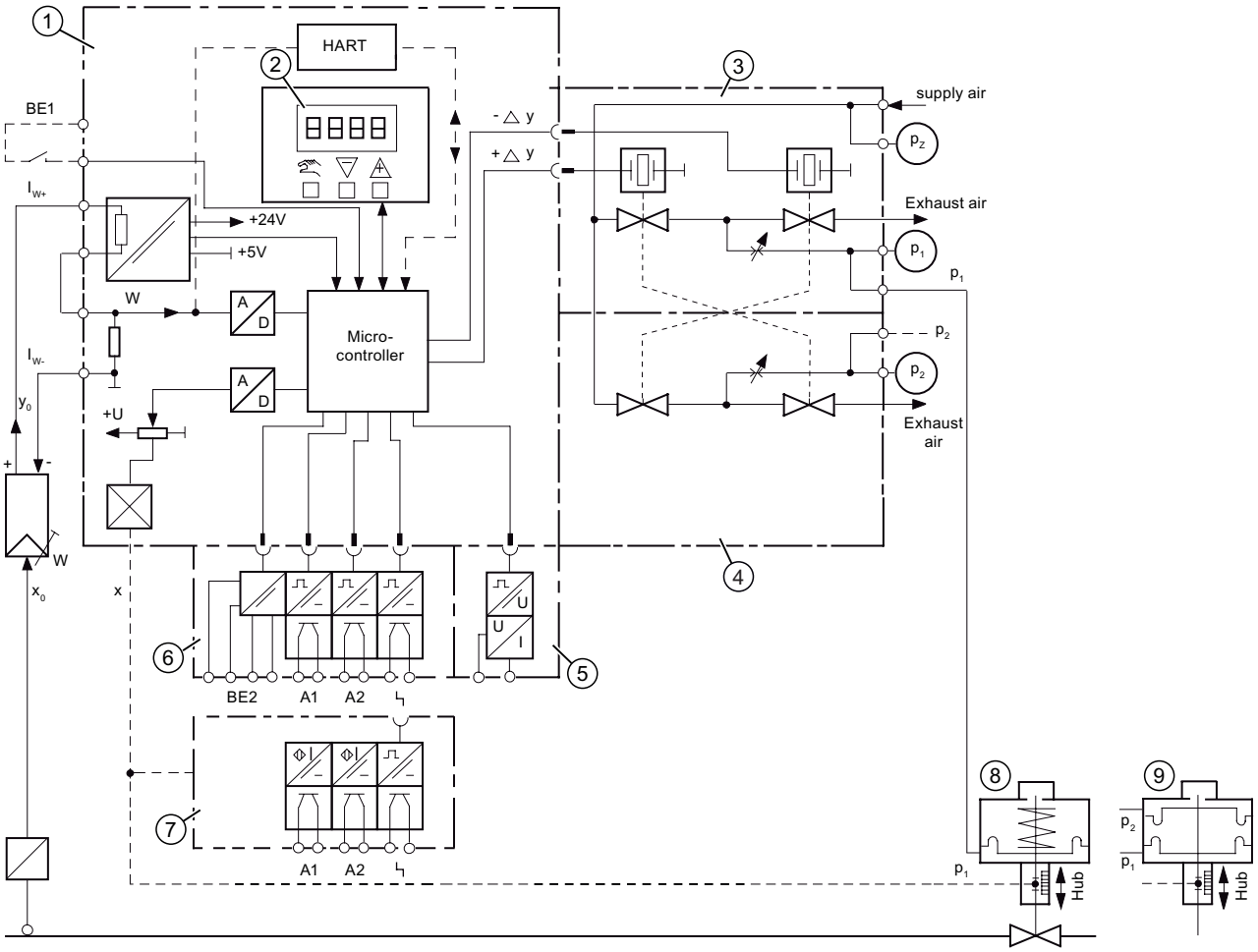
Figure 3-15 Functional principle of five-point controller

Small control deviations do not send control pulses in the zone. This takes place in the so-called adaptive dead zone. The dead zone adaptation and the continuous adaptation of minimum pulse lengths in the 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 mechanical end stops
- Actuating times
- The dead zone size

The number of fault messages, changes in direction and the stroke number are continuously determined during operation and saved after every 15 minutes. You can read and document these parameters using communication programs such as PDM and AMS. By comparing the old values with the current ones, you can draw conclusions about the wear and tear of the control valve. You can use the diagnostics function for this.

3.5.3 Block circuit diagram for signal-acting or dual-acting drives



① Basic circuit board with microcontroller and input circuit
② Control pad with digital display and buttons
③ Piezo valve unit, always installed
④ Valve unit in dual-action positioner always installed
⑤ I_y module for positioner
⑥ Alarm module for three alarm outputs and one binary input
⑦ SIA module (slot initiator alarm module)
⑧ Spring-loaded pneumatic positioning drive (single-acting)
⑨ Spring-loaded pneumatic positioning drive (dual-action)

Figure 3-16 Block circuit diagram for the electropneumatic positioner, functional diagram

Note

Alarm module and SIA module

Alarm module ⑥ and SIA module ⑦ can only be alternatively used.

3.5.4 Mode of operation of the HART function

Note

- 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 through a handheld 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 control values of 4 to 20 mA.

The positioner is integrated into the following parameterization tools:

- Handheld Communicator
- PDM (Process Device Manager)
- AMS (Asset Management System)
- Cornerstone (without diagnostic values/functions)

Mounting

4

4.1 Safety notes for installation

⚠ WARNING

Mechanical impact effect

Protect the 6DR5**0-*G***-**** version of the positioner from mechanical impact effects that are greater than 1 Joule; this ensure adherence to the IP66 degree of protection.

When installing, observe the following sequence imperatively to avoid injuries or mechanical damage to the positioner/mounting kit:

1. Mount the positioner mechanically.
2. Connect the electrical auxiliary power supply.
3. Connect the pneumatic auxiliary power supply.
4. Commission the positioner.

⚠ WARNING

Assembling the components

When assembling components, ensure that only those positioners and optional modules are combined with each other that are approved for the corresponding operating range.

This condition is particularly applicable for the safe operation of the positioner in the areas of zones 1, 2 and 22, where the atmosphere may be potentially explosive. Observe the device categories 2 and 3 of the device itself and its optional modules imperatively.

⚠ CAUTION

Humid environment/dry compressed air

Install the positioner in a humid environment such that the positioner shaft does not freeze at low ambient temperatures.

Ensure that water does not seep through an open enclosure or an open gland. Water may seep through if the positioner is not installed and connected on-site immediately and finally.

As a general rule, the positioner must be operated only with dry compressed air. Therefore, use the customary water separator. An additional dryer is required in extreme cases. The use of dryers is especially important when you operate the positioner at low ambient temperatures. Set the Purge air switch to the "OUT" position when installing on the pneumatic block, above the pneumatic connections.

4.2 Installing the linear actuator

Conditions

For linear actuators, use the "linear actuator" mounting kit or the integrated attachment.

You require different installation parts depending on the selected actuator type. Keep the suitable installation parts ready:

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

Installing the positioner

The position numbers in the text refer to the following illustrations of the assembly procedure.

1. Install the clamping pieces ③ on the actuator spindle. For this purpose, use:
   – Spring lock washers ⑯
   – Hexagon bolts ⑰
2. Slide the pick-up bracket ② into the notches of clamping pieces. Set the required length and tighten the bolts such that the pick-up bracket can still be moved.
3. Insert the pre-installed pin ④ in the lever ⑥. Install the lever with the washer ⑫ and the spring lock washer ⑭.
4. Set the stroke value. Use the value specified on the type plate of the actuator for this purpose. If none of the values on the scale matches the value on the type plate of the actuator, select the next higher scaling value. Position the pin center on the matching value on the scale. If you need the value of actuator travel after initialization in mm: ensure that the set stroke value matches the value of the "3.YWAY" parameter.
5. Install the following parts on the lever:
   – Hexagon bolt ⑰
   – Spring lock washer ⑯
   – Washer ⑫
   – Square nut ⑲
6. Push the pre-installed lever up to the end stop on the positioner shaft. Fix the lever using a hexagon bolt ⑰.

7. Install the mounting bracket ① at the rear side of the positioner. For this purpose, use:
   - Two hexagon bolts ⑨
   - Spring lock washer ⑩
   - Flat washer ⑪
8. 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 such that the carrier pin ④ meshes with the pick-up bracket ② near the spindle. Ensure that the pick-up bracket does not touch the clamping pieces.
9. Keep the positioner and the fastening bracket on the actuator. Ensure that the carrier pin ④ is guided inside the pick-up bracket ②.
10. Tighten the pick-up bracket.
11. Fasten the positioner on the yoke. Use the installation parts suitable for the corresponding actuator.

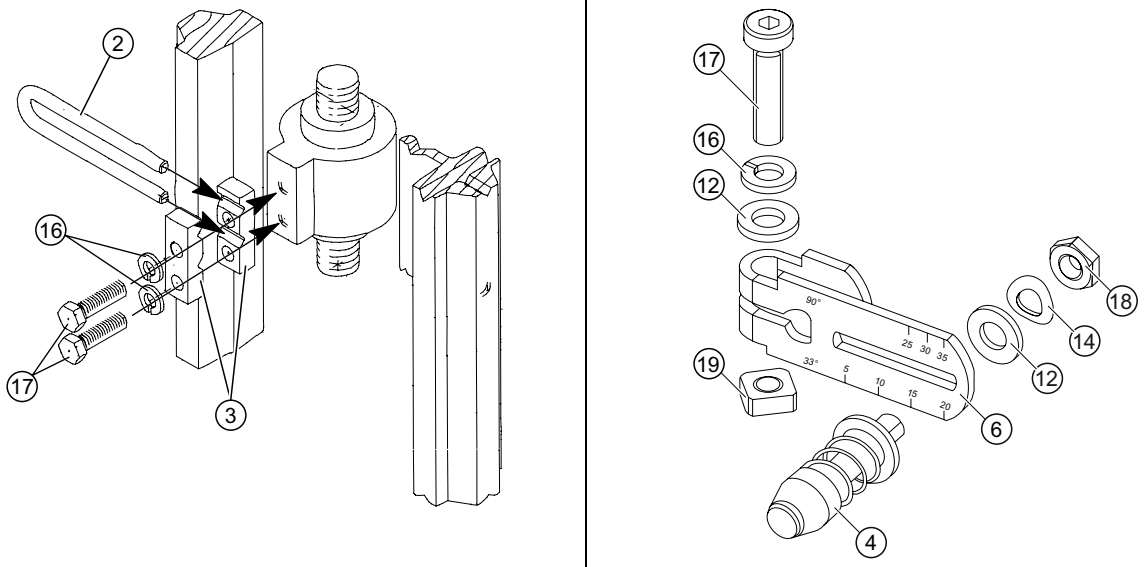
Note

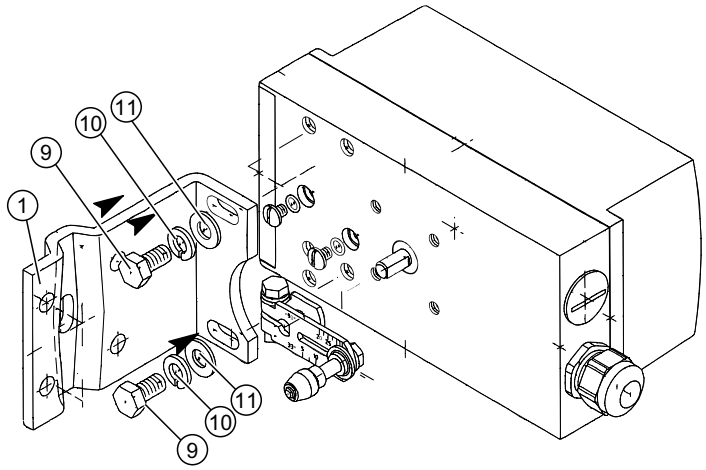
Height adjustment of the positioner

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

1. Set the height of the positioner such 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.

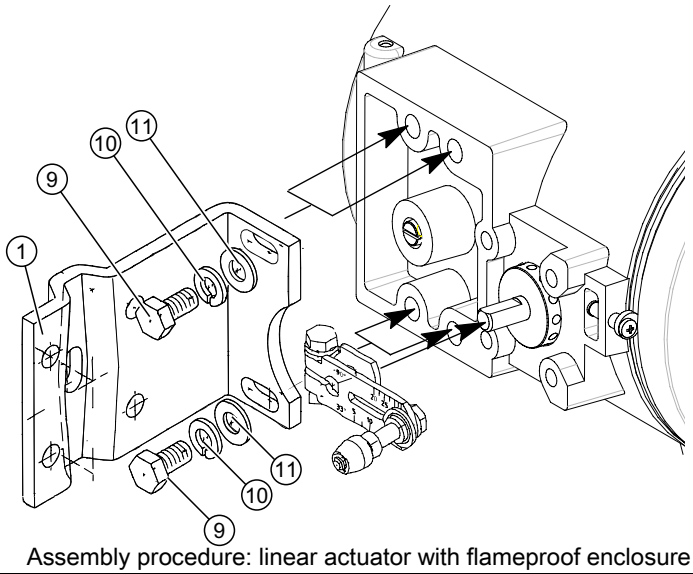
Assembly procedure: positioner with linear actuator



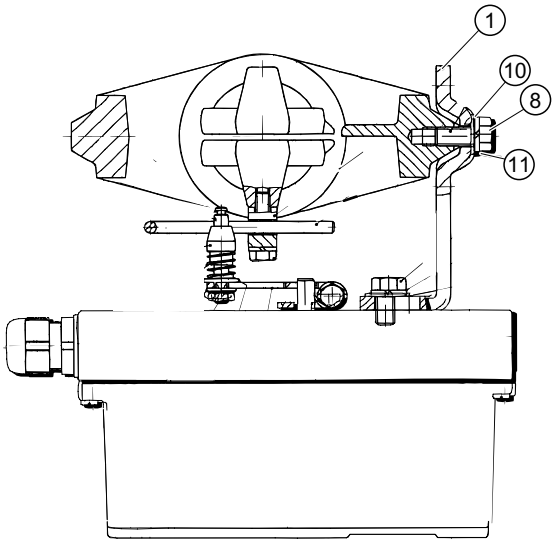


Assembly procedure: linear actuator without flameproof enclosure

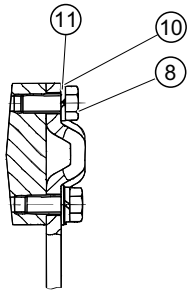
Assembly procedure: positioner with linear actuator



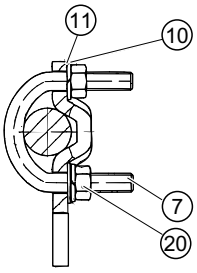
Assembly procedure: linear actuator with flameproof enclosure



Mounting on the yoke with fin



Mounting on the yoke with plane surface



Mounting on the yoke with columns

"Linear actuator IEC 534 (3 mm to 35 mm)" mounting kit 6DR4004-8V and 6DR4004-8L			
Sr. No. *)	**Quantity**	**Name**	**Note**
①	1	NAMUR mounting bracket IEC 534	Standardized connection point for mount with fin, column or plane surface
②	1	Pick-up bracket	Guide 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	NAMUR lever	For the range of stroke from 3 mm to 35 mm The 6DR4004–8L lever is additionally required for ranges of stroke > 35 mm to 130 mm (not in the scope of delivery).
⑦	2	U–bolts	Only for actuators with columns
⑧	4	Hexagon bolt	M8 x 20 DIN 933–A2
⑨	2	Hexagon bolt	M8 x 16 DIN 933–A2
⑩	6	Spring lock washer	A8 - DIN 127–A2
⑪	6	Flat washer	B8.4 - DIN 125–A2
⑫	2	Flat 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	M6 x 25 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 assembly procedure with linear actuator.

4.3 Installing the part-turn actuator

Conditions

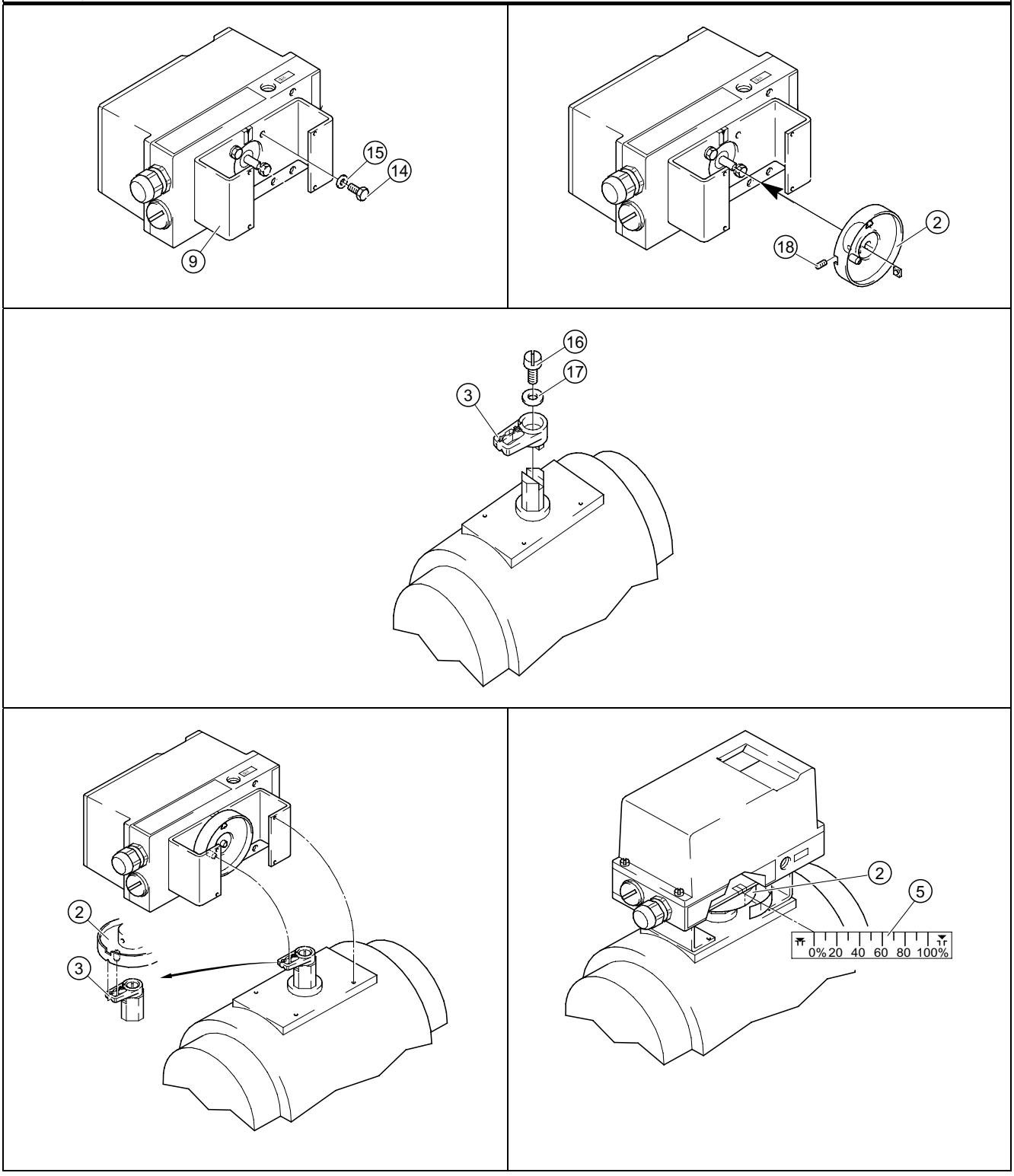
You require an actuator-specific VDI/VDE 3845 mount to install the positioner on a part-turn actuator. The mount and the bolts are included in the scope of delivery of the corresponding actuator. Ensure that the mount has a sheet metal thickness of > 4 mm and reinforcements.

Installing the part-turn actuator

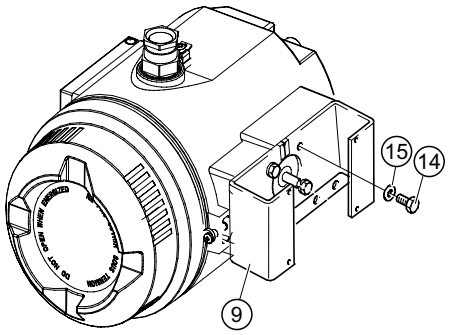
The position numbers in the text refer to the following illustrations of the assembly procedure.

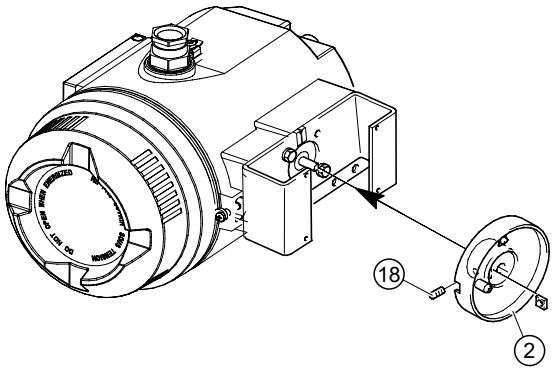
1. Rest the actuator-specific VDI/VDE 3845 mount ⑨ on the rear side of the positioner. Tighten the mount using hexagon bolts ⑭ and lock washers ⑮.
2. Stick the pointer mark ⑥ on the mount. Position the pointer mark at the center of the centering hole.
3. Push the coupling wheel up to the end stop on the positioner shaft. Then retract the coupling wheel by approximately 1 mm. Tighten the hexagon socket-head screw ⑱ using the machinist's wrench provided.
4. Place the carrier ③ on the shaft stump of the actuator. Tighten the carrier using the socket cap screw ⑯ and the washer ⑰.
5. Place the positioner and the mount on the actuator carefully. The pin of the coupling wheel must fit in the carrier while doing so.
6. Align the positioner/mount unit at the center of the actuator.
7. Tighten the positioner/mount unit.
8. Initialize the positioner.
9. After commissioning, drive the positioner to the end position.
10. Stick the scale ⑤ with the direction of rotation or the swivel range on the coupling wheel ②. The stickers with scale are self-adhesive.

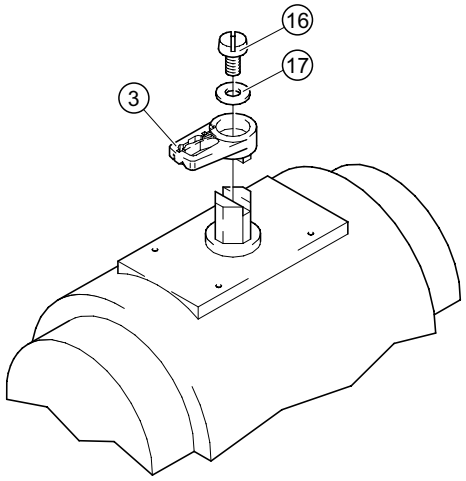
Assembly procedure for the positioner with part-turn actuator

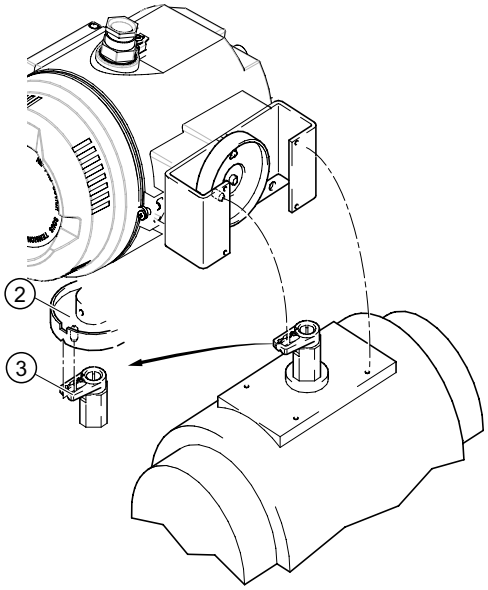


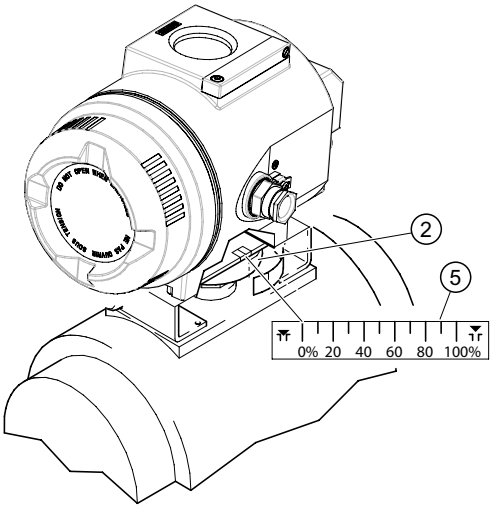
Assembly procedure for the positioner with part-turn actuator and flameproof enclosure





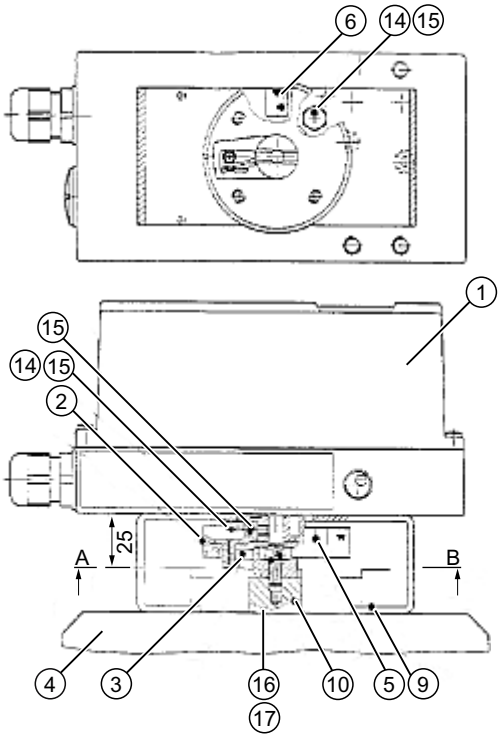






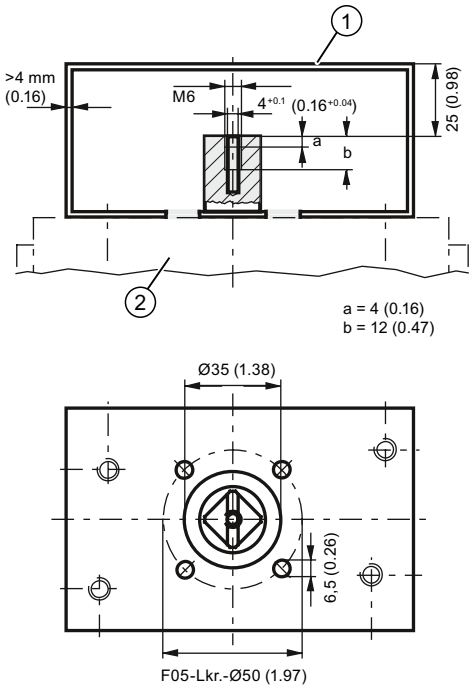
"Part-turn actuator" mounting kit 6DR4004–8D			
Sr. No. *)	**Quantity**	**Name**	**Note**
②	1	Coupling wheel	Installation on the position feedback shaft of the positioner
③	1	Carrier	Installation on the shaft stump of the actuator
④	1	Multiple plate	Display of the actuator position, consists of scale ⑤ and pointer mark ⑥
⑤	8	Scale	Different divisions
⑥	1	Pointer mark	Reference arrow for scale
⑭	4	Hexagon bolt	DIN 933 - M6 x 12
⑮	4	Lock washer	S6
⑯	1	Socket cap screw	DIN 84 - M6 x 12
⑰	1	Washer	DIN 125 - 6,4
⑱	1	Hexagon socket-head screw	Pre-installed with coupling wheel
⑲	1	Machinist's wrench	For hexagon socket-head screw ⑱

*) The serial numbers refer to the images describing the assembly procedure with part-turn actuator, with and without flameproof enclosure.



①	Positioner	⑩	Feedback shaft
②	Coupling wheel	⑭	Hexagon bolt - M6 x 12
③	Carrier	⑮	Lock washer S6
④	Part-turn actuator	⑯	Socket cap screw - M6 x 12
⑤	Scale	⑰	Washer
⑥	Pointer mark	⑱	Hexagon socket-head screw
⑨	VDI/VDE 3845 mount		

Figure 4-1 Installed positioner for part-turn actuators



① Fastening plane of positioner

② Part-turn actuator

Figure 4-2 Dimensions of mount (actuator-dependant)

See also

Preparing part-turn actuators for commissioning (Page 127)

4.4 Using the positioner in a humid environment

Introduction

CAUTION
Never clean the positioner with a high pressure cleaner since the IP66 degree of protection is not sufficient for this.

This information contains important notes for the installation and operation of the positioner in a wet environment with frequent and heavy rains and/or continuous tropical dew. The IP66 degree of protection is no longer adequate in this environment, especially when there is a risk of water freezing.

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 digital display becomes poorly legible.

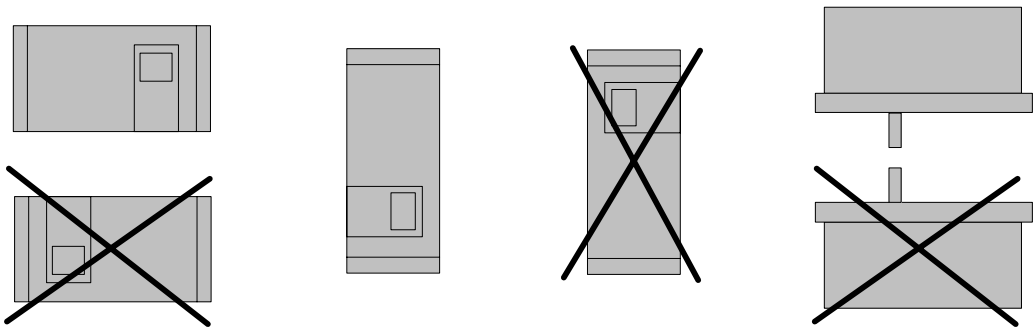


Figure 4-3 Favorable and unfavorable mounting positions

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 having 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 exposed to strong acceleration forces or vibrations

4.5.1 Notes on use

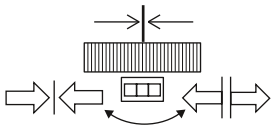
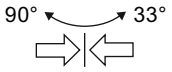
The electropneumatic positioner has a friction clutch and a switchable gear. The positioner can therefore be universally used on part-turn and linear actuators. As a result, you need not follow the zero point in case of part-turn actuators and a symmetrical mounting in case of linear actuators. The working area can be set later using the friction clutch.

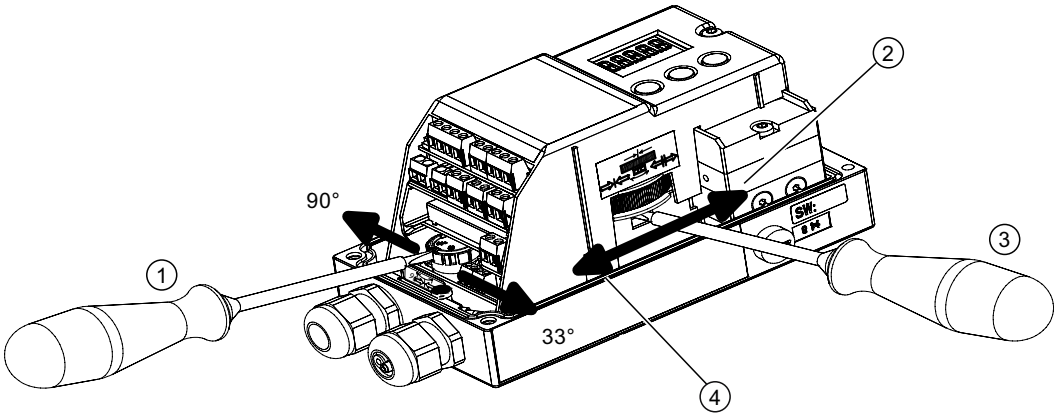
The switchable gear also allows you to adjust the positioner to small or large strokes.

Strong acceleration forces act on control valves that are subjected to heavy mechanical loads, e.g. breakaway valves, strongly shaking or vibrating valves, as well as in case of "vapor shocks". These forces may be much higher than the specified data. This may move the friction clutch in extreme cases.

The positioner is equipped with an arrester device for the friction clutch in order to counter these extreme cases. The setting of the transmission ratio selector can also be arrested. This prevents a displacement due to extreme accelerations or strong vibrations. .

These setting options are marked using additional signs and symbols.

Arrester device	
Friction clutch	**Transmission ratio selector**
	



① Arrester device
② Unplug
③ Friction clutch
④ Lock

Figure 4-4 Arrester device and lock

See also

Installing the optional modules in the "flameproof enclosure" version (Page 56)

4.5.2 Friction clutch

Procedure

NOTICE
The following is applicable for the "flameproof enclosure" version: • Move only the outer friction clutch. The inner friction clutch is fixed and may **not** be moved in case of a flameproof enclosure. • Do not open the flameproof enclosure of the positioner in explosion-prone atmospheres. An additional friction clutch is therefore provided at the outer side of the shaft. Only the outer friction clutch may be moved.

After installing the positioner and commissioning it completely, set the torque of the friction clutch as follows:

1. Insert a commercially available, approximately 4 mm wide screwdriver in the slit of the yellow wheel on the module cover.
2. Move the yellow wheel anticlockwise using the screwdriver until it noticeably engages. This intensifies the torque of the friction clutch.
3. A fixed friction clutch is characterized by an approximately 1 mm wide gap between the yellow and the black wheels.
4. In order to carry out zero balancing, e.g. after changing the actuator, first reduce the torque by rotating clockwise up to the end stop of the yellow wheel. After zero balancing, fix the friction clutch again as described above.

See also

Notes on use (Page 48)

4.5.3 Transmission ratio selector

Procedure

Lock the transmission ratio selector starting from the neutral position (condition at delivery) as follows:

1. Move the yellow wheel below the terminals using a commercially available, approximately 4 mm wide screwdriver anticlockwise or clockwise depending on the 33° or 90° position that you have selected until it noticeably engages.
2. Note that the transmission ratio selector can now be moved only after unlatching the anchorage. You must therefore bring the yellow ring back to the neutral position if you wish to move the transmission ratio selector, e.g. after changing the actuator.

See also

Notes on use (Page 48)

4.6 External position displacement sensor

⚠ WARNING

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 displacement sensor and the control 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 order number C73451-A430-D78 comprising a positioner enclosure with an integrated friction clutch, potentiometer as well as different blanking plugs and seals.
- Or a contactless explosion-proof non-contacting position Sensor (e.g.6DR4004-6N).
- A positioner
- A three-pole cable to connect components.
- An EMC filter module with the order number C73451-A430–D23 is provided in a set along with cable clamps and M20 cable glands.

The EMC filter module is always used for the control unit whenever an external position sensor is used instead of the internal position sensor. An external position sensor is, e.g. a potentiometer with a 10 kΩ resistance or a non-contacting position sensor.

Installing option modules

5

5.1 General information on installing option modules

5.1.1 Safety notes for installing the option modules

⚠ WARNING

Assembling the components

For the composition of the components it must be ensured that only positioners and option modules that are certified for the relevant operating range are combined.

This condition applies in particular to the safe operation of the positioner in the areas of zone 1, 2 and 22, in which the atmosphere can be potentially explosive. Make sure you observe the device categories 2 and 3 of the device itself as well as the ones of its option modules.

NOTICE

To observe before installation

Before you install option modules, you must open the housing of the positioner. Please note that the degree of protection IP66/NEMA 4x is not guaranteed when the housing is open.

See also

Iy module (Page 59)

Alarm unit (Page 60)

SIA unit (Page 62)

5.1.2 Installing optional modules in the standard and intrinsically safe version

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

- I_y module
- Alarm unit
- SIA unit
- Mechanical limit switch module
- EMC filter module

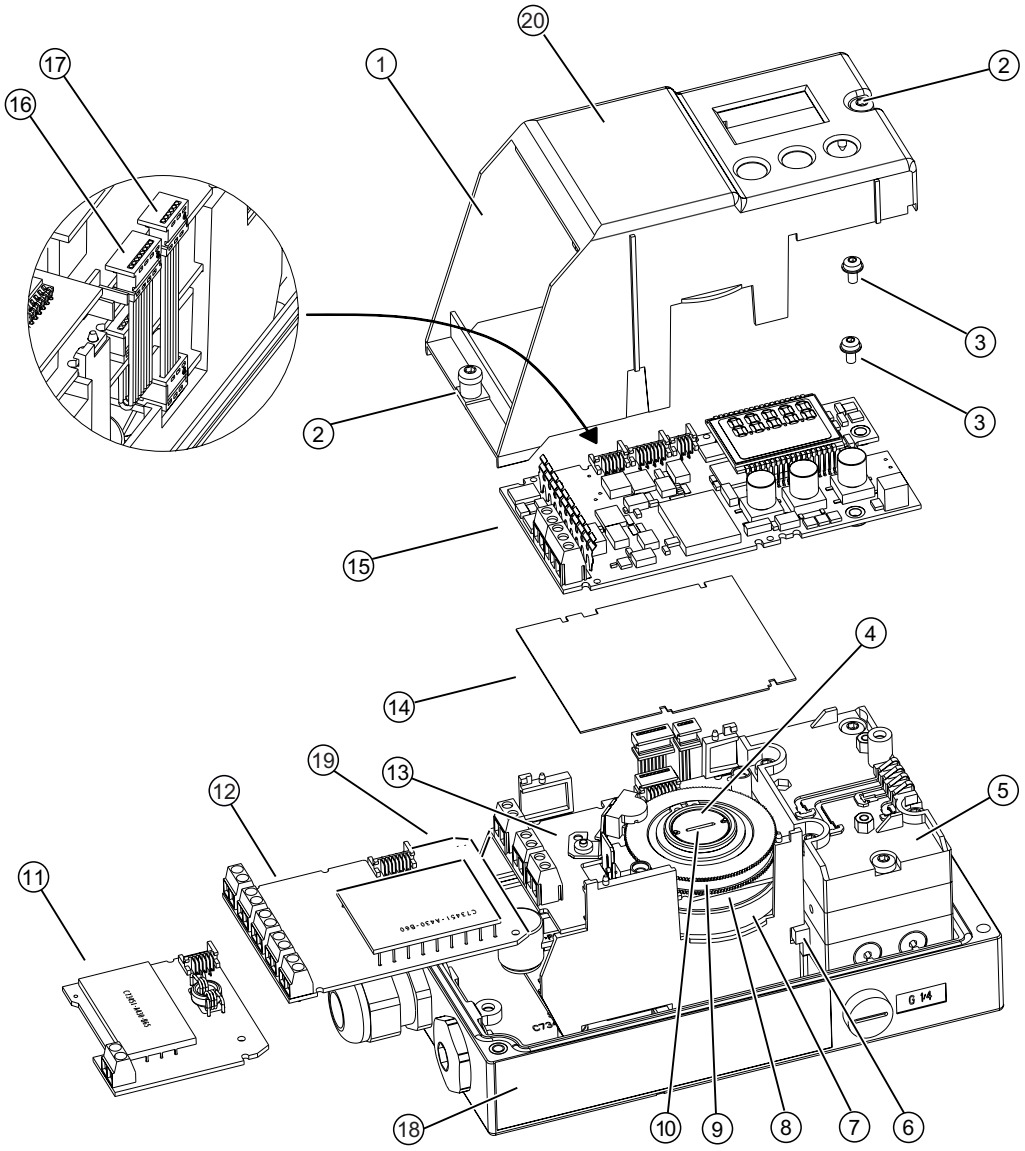
Preparations for installation

Proceed as follows for the preparations for installation:

1. Open the positioner.
2. Unlatch the four fixing screws of the enclosure cover using a Phillips screwdriver.
3. Disconnect the power supply lines or de-energize them.
4. Remove the module cover.
5. Unlatch both the screws using a screwdriver.

Overview image: installing the optional modules

The following image will help you when installing the optional modules:



① Module cover
② Fixing screws
③ Fixing screws
④ Actuating disc bearings
⑤ Pneumatic block
⑥ Transmission ratio selector
⑦ Friction clutch adjustment wheel
⑧ Actuating disc for A2, terminals 51 and 52
⑬ SIA unit or mechanical limit switch module
⑭ Insulating cover
⑮ Motherboard
⑯ Ribbon cable for alarm unit
⑰ Ribbon cable for I_y module
⑱ Nameplate

Sign set

⑲ Warning sign on the side opposite the nameplate

⑪ I_y module
⑫ Alarm unit
⑳ Wiring diagram

Figure 5-1 Installing the optional modules

See also

Iy module (Page 59)
Alarm unit (Page 60)
Installing the slotted initiator alarm unit (Page 63)
Installing the mechanical limit switch module (Page 65)
EMC filter module (Page 67)

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

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

- I_y module
- Alarm unit

Preparations for installation

⚠ DANGER

Risk of explosion

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

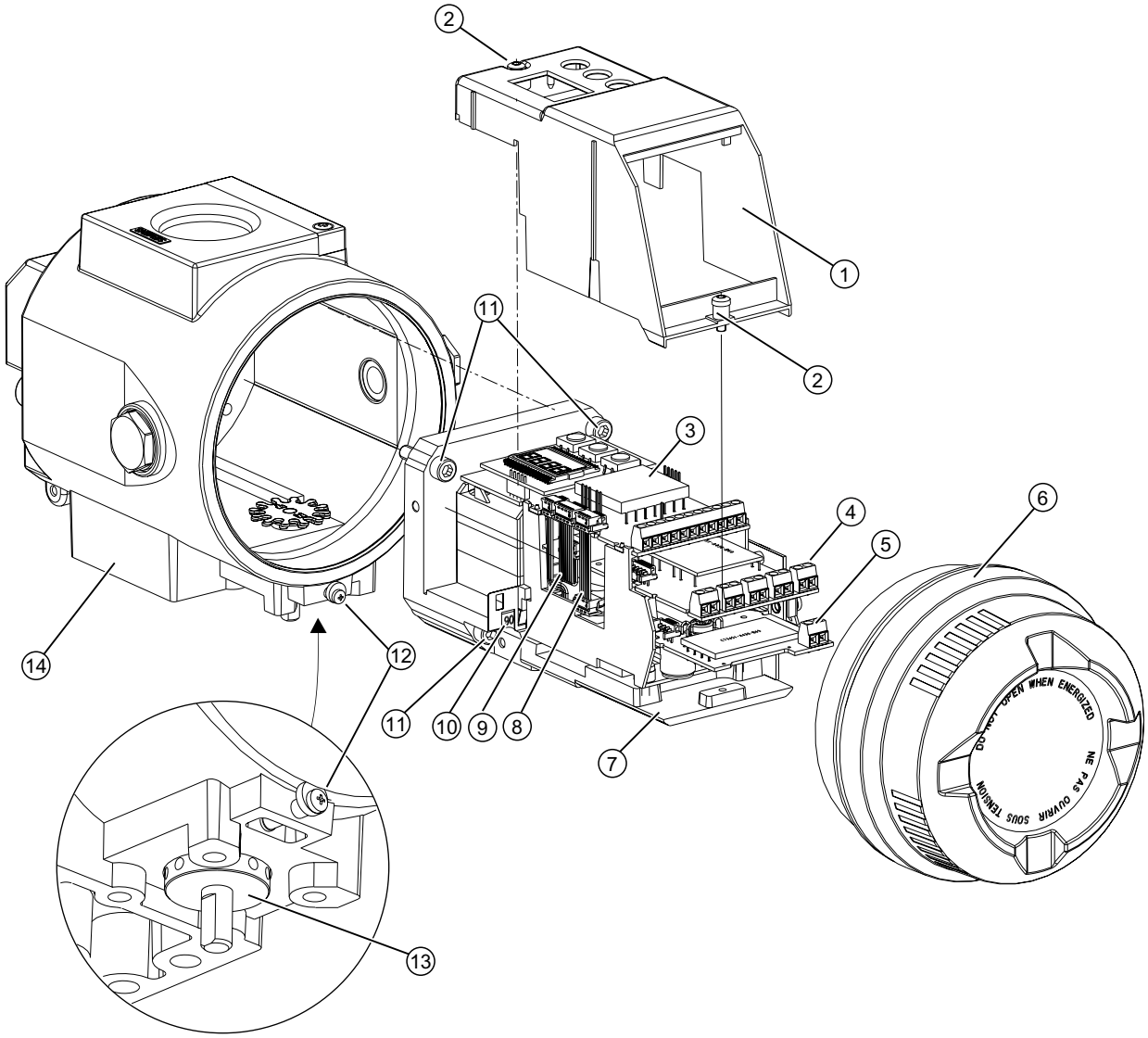
- The installed electronic unit has been approved.
- The enclosure of the positioner is closed.
- The duct openings for electronic connections must be closed. Only use the Ex d certified cable entries or sealing plugs.
- You must install an ignition trap if you use a "conduit piping system". The maximum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

The module cover ① protects and fixes the optional modules mechanically. Proceed as follows for the preparations for installation:

1. Disconnect the power supply lines or de-energize them.
2. Open the safety catch ⑫. Unscrew the screw cap ⑥.
3. Unlatch the four fixing screws ⑪.
4. Remove the entire adapter ⑦. If required, rotate the positioner until the coupling can be detached easily.
5. Unscrew the both fixing screws ② using a screwdriver.
6. Remove the module cover ①.

Overview image: installing the optional modules

The following image will help you when installing the optional modules:



①	Module cover	⑧	Ribbon cable for I_y module
②	Fixing screws	⑨	Ribbon cable for alarm unit
③	Motherboard	⑩	Transmission ratio selector
④	Alarm unit	⑪	Fixing screws
⑤	I_y module	⑫	Safety catch
⑥	Screw cap	⑬	Friction clutch adjustment wheel
⑦	Adapter	⑭	Enclosure

Figure 5-2 Installing the optional modules in a flameproof enclosure

See also

ly module (Page 59)
Alarm unit (Page 60)

5.1.4 Installing the module cover

Installing the module cover

Note

Untimely wear

The module cover is fastened using self-tapping screws. You can prevent the module cover from wearing untimely by adhering to the installation instructions.

Proceed as follows to install the module cover:

1. Turn the screws anticlockwise until they noticeably engage in the thread pitch.
2. Carefully tighten both the screws clockwise.

5.2 Iy module

Function

- The optional I_y module indicates the current actuator position as a dual line signal with I_y = 4 to 20 mA. The I_y module is potentially separated from the standard controller. Thanks to the dynamic control, this module can report the arising operational faults automatically.
- The current actuator position is indicated only after a successful initialization.

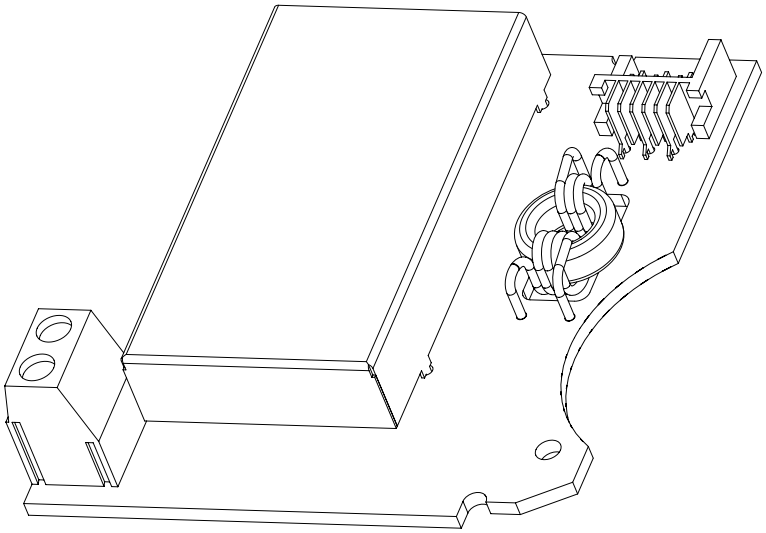


Figure 5-3 I_y module

Device features

The I_y module is:

- Single channel
- Potentially separated from the standard controller.

Installing the I_y module

Proceed as follows to install the optional I_y module:

1. Slide the I_y module up to the end stop in the lower stack of the module rack.
2. Connect the module to the motherboard. For this purpose, use the 6-pole flat ribbon cable provided.

See also

Installing optional modules in the standard and intrinsically safe version (Page 54)

Installing the optional modules in the "flameproof enclosure" version (Page 56)

Safety notes for installing the option modules (Page 53)

5.3 Alarm unit

Function

The alarm unit triggers fault messages and alarms using 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.
- Thanks to the dynamic control, this module can report the arising operational faults automatically. Set parameters 44 to 51 to activate and parameterize the output of alarms and fault messages.

Apart from binary outputs, the alarm unit has a double-acting binary input BE2. 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 43.

Device features

The alarm unit 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 standard controller and from each other.
- The binary input has dual functionality. Both inputs are implemented as logical OR combination.
  - Potentially separated for voltage level
  - Not potentially separated for floating contacts

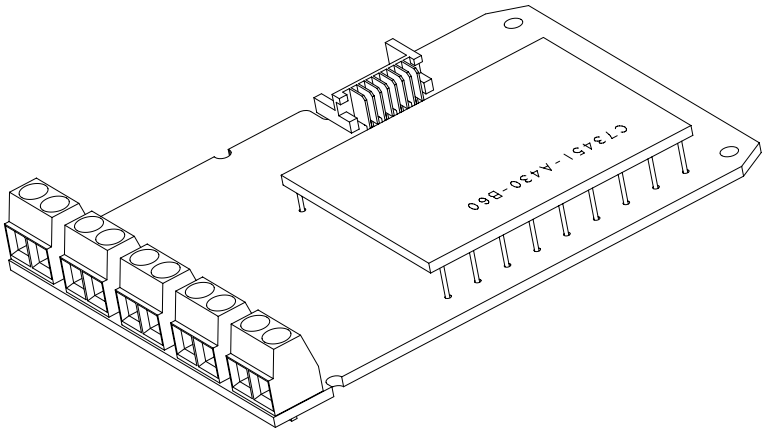


Figure 5-4 Alarm unit

Installation

Proceed as follows to install the alarm unit:

1. Slide the alarm unit below the motherboard in the module rack. Ensure that you slide it up to the end stop.
2. Connect the module to the motherboard. For this purpose, use the 8-pole flat ribbon cable provided.

See also

Safety notes for installing the option modules (Page 53)

Installing optional modules in the standard and intrinsically safe version (Page 54)

Installing the optional modules in the "flameproof enclosure" version (Page 56)

5.4 Slot initiator alarm module

5.4.1 SIA unit

Function

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

- A binary output is used to display a collective fault message. Compare with the function of the alarm unit. The floating binary output is implemented as an automatic fault indicating semiconductor output.
- The other two binary outputs are used for the message of 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

The slotted initiator alarm unit, abbreviated as SIA unit consists of three binary outputs.

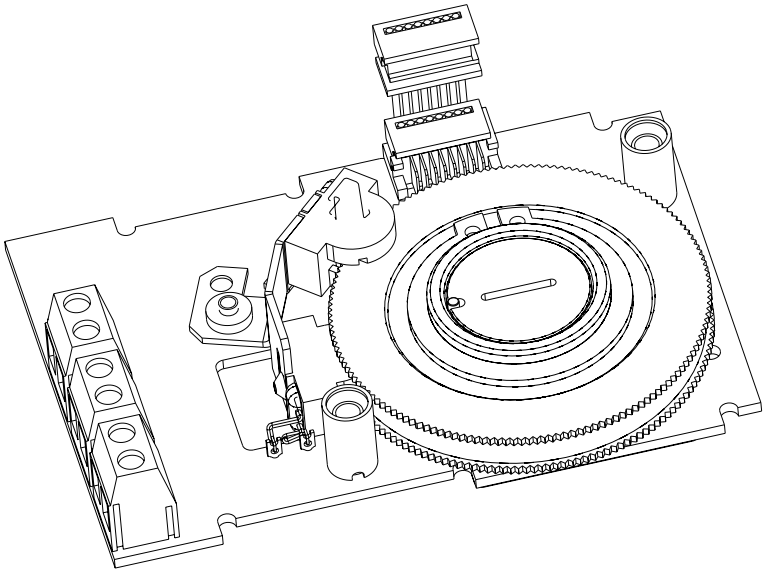


Figure 5-5 SIA unit

See also

Safety notes for installing the option modules (Page 53)

5.4.2 Installing the slotted initiator alarm unit

Installing the SIA unit

Proceed as follows to install the SIA unit:

1. Disconnect all electrical connections of the motherboard.
2. Unlatch both the fixing screws of the motherboard.
3. Disengage the motherboard by carefully bending the four brackets.
4. Insert the SIA unit from the top up to the upper printed circuit board guide of the module rack.
5. Slide the SIA unit in the printed circuit board of the module rack approximately 3 mm to the right.
6. Screw in the special screw through the SIA unit into the positioner shaft. Tighten the special screw with a **torque of 2 Nm**.

NOTICE
A pin in the actuating disc bearing is pressed. Align this pin before it touches the special screw. You must rotate the actuating disc bearing and the special screw simultaneously so that the pin is inserted into the special screw.

7. An insulating cover is provided over the SIA unit. Place the insulating cover to one side under the motherboard seat on the container wall. The recesses of the insulating cover must fit in the corresponding webs of the container wall.
8. Place the insulating cover on the SIA unit by bending the container walls carefully.
9. Engage the motherboard into the four brackets.
10. Fix the motherboard using both the fixing screws.
11. Reestablish all electrical connections between the motherboard and the optional modules. Connect the motherboard and the optional modules to the ribbon cables provided. Connect the motherboard and the potentiometer to the potentiometer cable.
12. Using both the screws, fasten the module cover provided. Do not use the standard module cover.
13. Select the signs that already exist on the standard version of the module cover from the sign set provided. Affix the selected signs on the installed module cover as per the standard version.
14. Establish all electrical connections.

See also

Installing optional modules in the standard and intrinsically safe version (Page 54)

Installing the module cover (Page 58)

5.4.3 Setting the limits of the slotted initiator alarm unit

Determining the switch status of slotted initiators

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

1. Connect the display device to the following terminals of the SIA unit:
   - 41 and 42
   - 51 and 52
2. Read the switch status of slotted initiators.

Setting the L1 and L2 limits

Proceed as follows to set the limits:

1. Move the actuator to the first desired mechanical position.
2. Adjust the upper actuating disc 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 disc 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

The actuating discs are relatively difficult to move. This design prevents their unintentional movement during operation. You can achieve an easier and finer adjustment by reducing friction temporarily. Move the actuator to and fro while simultaneously holding the actuating discs.

See also

Installing optional modules in the standard and intrinsically safe version (Page 54)

5.5 Mechanical limit switch module

5.5.1 Installing the mechanical limit switch module

⚠ WARNING

Zone 2

Use of the mechanical limit switch module in zone 2 is only approved in the "nL" type of protection.

Function

This module is used to report two limits. These limits are reported using galvanic switch contacts.

Device features

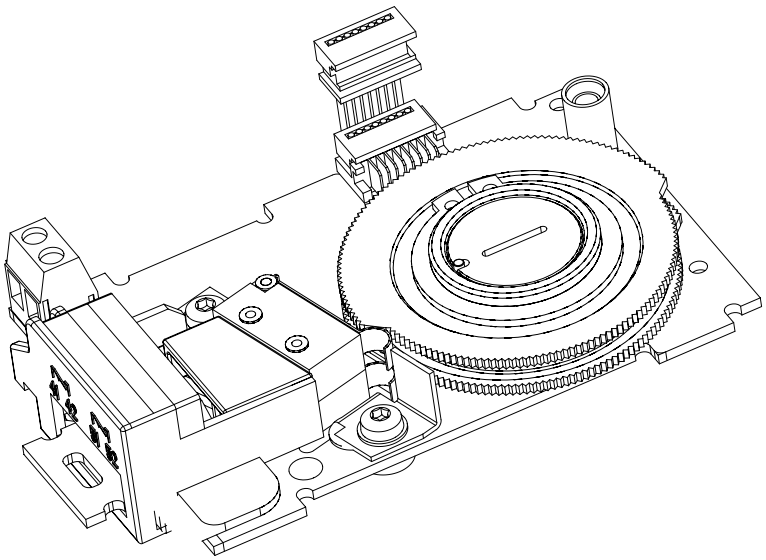


Figure 5-6 Mechanical limit switch module

The mechanical limit switch module consists of:

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

Installation

Proceed as follows to install the mechanical limit switch module:

1. Disconnect all electrical connections of the motherboard.
2. Unlatch both the fixing screws of the motherboard.
3. Disengage the motherboard by carefully bending the four brackets.
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 unit in the printed circuit board of the module rack approximately 3 mm towards right.
6. Screw in the special screw through the mechanical limit switch module into the positioner shaft. Tighten the special screw with a **torque of 2 Nm**.

NOTICE
A pin in the actuating disc bearing is pressed. Align this pin before it touches the special screw. You must rotate the actuating disc bearing and the special screw simultaneously so that the pin is inserted into the special screw.

7. An insulating cover is provided over the mechanical limit switch module. Place the insulating cover to one side under the motherboard seat on the container wall. The recesses of the insulating cover must fit in the corresponding webs of the container wall.
8. Place the insulating cover on the mechanical limit switch module by bending the container walls carefully.
9. Engage the motherboard into the four brackets.
10. Fix the motherboard using both the fixing screws.
11. Reestablish all electrical connections between the motherboard and the optional modules. Connect the motherboard and the optional modules to the ribbon cables provided. Connect the motherboard and the potentiometer to the potentiometer cable.
12. Using both the screws, fasten the module cover provided. Do not use the standard module cover.
13. Select the signs that already exist on the standard version of the module cover from the sign set provided. Affix the selected signs on the installed module cover as per the standard version.
14. Establish all electrical connections.

See also

Installing optional modules in the standard and intrinsically safe version (Page 54)

Installing the module cover (Page 58)

5.5.2 Setting the limits of the mechanical limit switch module

Setting the L1 and L2 limits

Proceed as follows to set the limits:

1. Move the actuator to the first desired mechanical position.
2. Adjust the upper actuating disc 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 disc 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

The actuating discs are relatively difficult to move. This design prevents their unintentional movement during operation. You can achieve an easier and finer adjustment by reducing friction temporarily. Move the actuator to and fro while simultaneously holding the actuating discs.

See also

Installing optional modules in the standard and intrinsically safe version (Page 54)

5.6 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 position sensor. The EMC filter module forms the interface between external position sensors and the motherboard of the positioner. This module protects the positioner from electromagnetic effects.

Device features

Device features include:

- EMC protection
- Connection to motherboard
- Connecting terminals for an external potentiometer

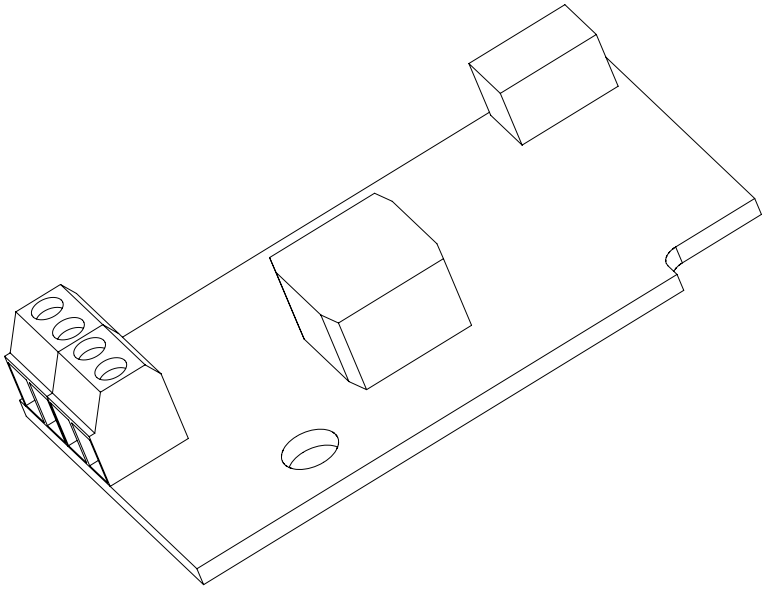


Figure 5-7 EMC module

Installation

Proceed as follows to install the EMC filter module:

1. Remove the module cover.
2. Dismantle all existing optional modules.
3. Unlatch the fixing screws of the module rack that is opposite to the blanking plugs.
4. The EMC filter module has a fastening hole. Fasten the module on the module rack using the fixing screws.
5. Lay the ribbon cable of the EMC filter module towards left through the opening of the module rack.
6. Unplug the connector of the internal potentiometer from the motherboard.
7. Connect the ribbon cable of the EMC module to the motherboard.
8. Connect the external position sensor to the terminals of the EMC module.
9. Reinstall the other optional modules in the reverse order.
10. Install the module cover.

See also

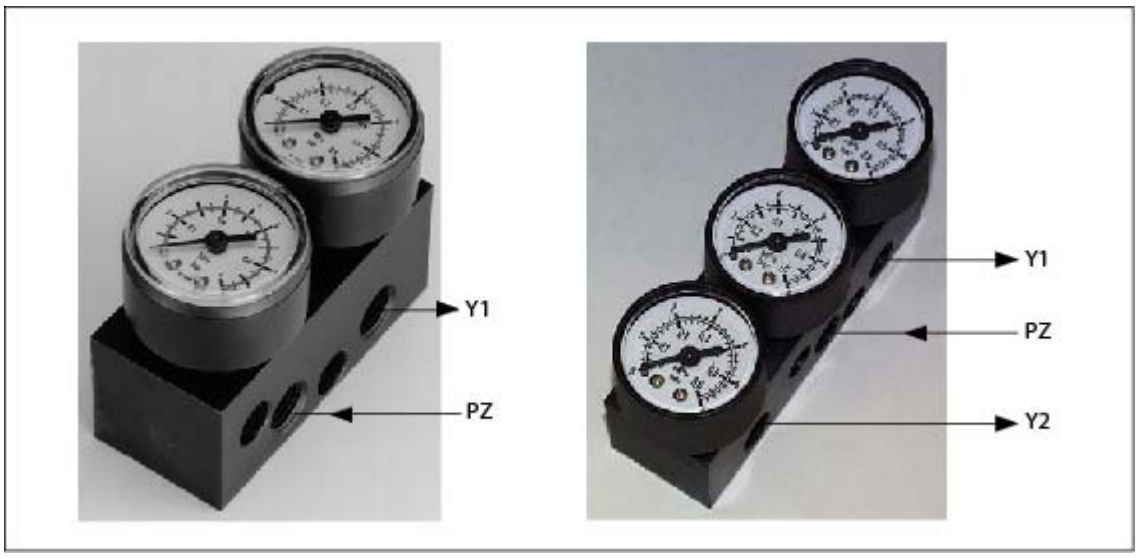
Installing the module cover (Page 58)

Installing optional modules in the standard and intrinsically safe version (Page 54)

5.7 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-action actuators. The image to the right shows the pressure gauge block for dual-action 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.

5.8 Set of signs for the non-intrinsically safe version

Warning labels

Fasten the included warning label on the side across from the type plate. There are different warning labels depending on the housing material, as described below.

Figure 5-8 Warning label for a device with a plastic enclosure

Figure 5-9 Warning label for a device with an aluminum enclosure

Figure 5-10 Warning label for a device with a stainless steel enclosure

Connection

6

6.1 Electrical connection

6.1.1 Safety notes for electrical connections

⚠ WARNING

Electrical connections in hazardous areas

Regulations in the test certificate applicable for your country must be followed.

National regulations and laws for hazardous areas applicable in your country must be followed for electrical connections. In Germany, these are, e.g.:

- Working reliability regulation
- The regulation for setting up electrical plants in hazardous areas, EN 60079-14 (previously VDE 0165, T1)
- The EC-type examination certificate

⚠ WARNING

If the intrinsically safe version is accidentally operated with a higher operating voltage, the positioner may not be used in intrinsically safe applications any longer.

When used in areas having potentially explosive atmospheres, electrical auxiliary power can be supplied to the positioners in flameproof enclosures only if the enclosure is closed and the approved electronic unit has been installed. If required, we recommend checking whether the available auxiliary power matches with the one specified on the nameplate and in the test certificate applicable for your country.

In case of flameproof enclosures, the duct openings for electronic connections must be closed with Ex d certified cable entries or Ex d certified sealing plugs, or, if using the conduit piping system, an ignition trap must be set up at a maximum distance of 46 cm (18") from the enclosure.

⚠ WARNING

Assembling the components

When assembling components, ensure that only those positioners and optional modules are combined with each other that are approved for the corresponding operating range.

This condition is particularly applicable for the safe operation of the positioner in the areas of zones 1, 2 and 22, where the atmosphere may be potentially explosive. Observe device categories 2 and 3 of the device itself and its optional modules implicitly.

⚠ WARNING

Notes on supply cable with auxiliary power

The power supply of the device must be guaranteed by safety extra-low voltage (SELV) for Ex "tD" (dust) and Ex "nA".

⚠ WARNING

Laying of cables

Connect the devices to be operated in hazardous areas according to the regulations for your country, e.g. secure laying of cables for Ex "d", "nA" and "tD".

CAUTION

The following is applicable for all intrinsically safe versions of zones 2 and 22:

The cable used for electrical connections must be suitable for temperatures that are 5°C higher than the ambient temperature.

Note

Use in zones 2 and 22

In normal operation, non-arcing resources for zones 2 and 22 may not be connected or disconnected under voltage.

However, the positioners can be connected and disconnected under voltage when installing or repairing; refer to the certificate or the manufacturer's declaration for zones 2 and 22.

Note

Installing the optional modules

Install the essential optional modules before connecting the positioner electrically.

Transmission ratio selector

Before closing the module cover of the positioner, check whether the transmission ratio selector has been set correctly.

Note

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.

Two-wire mode

Note

Never connect the current input (terminals 6 and 7) to a power source; the positioner will probably be destroyed in that case.

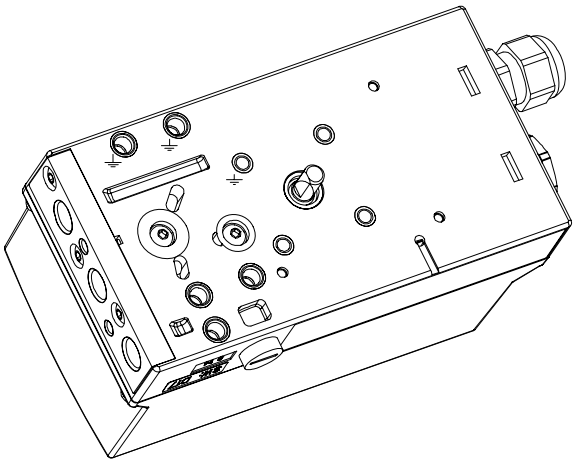
Always use a current source with a maximum output current of I = 20 mA.

To maintain auxiliary power, the input current must be I_w = 3.6 mA.

Electromagnetic compatibility

The plastic enclosure is metallized 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 6-1 Base plate

See also

Installing optional modules in the standard and intrinsically safe version (Page 54)

Test report (extract) (Page 230)

6.1.2 Connection for versions "non-intrinsically safe" or "flameproof enclosure"

6.1.2.1 Basic device

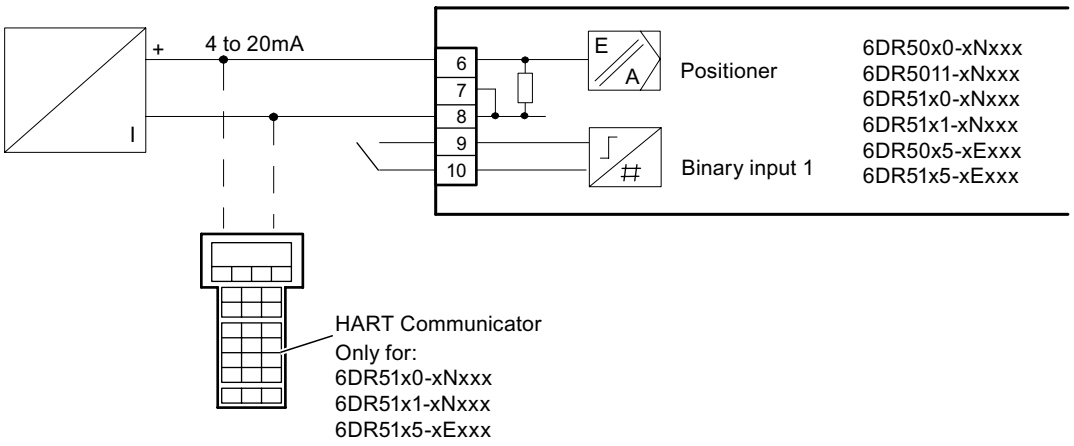


Figure 6-2 Two-wire connection

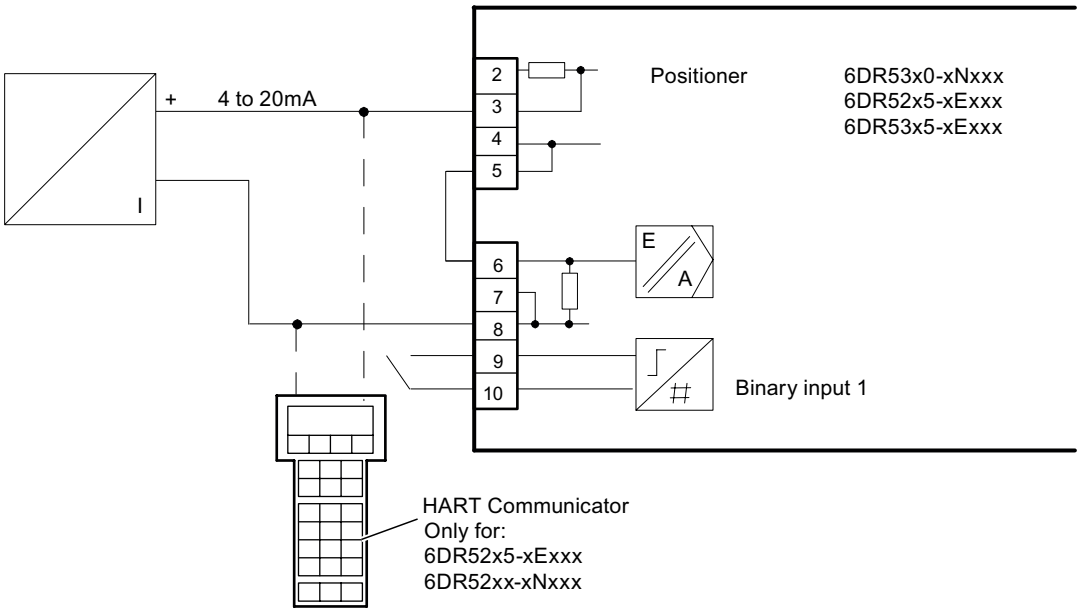


Figure 6-3 Two-wire connection for 2-, 3-, 4-wire version

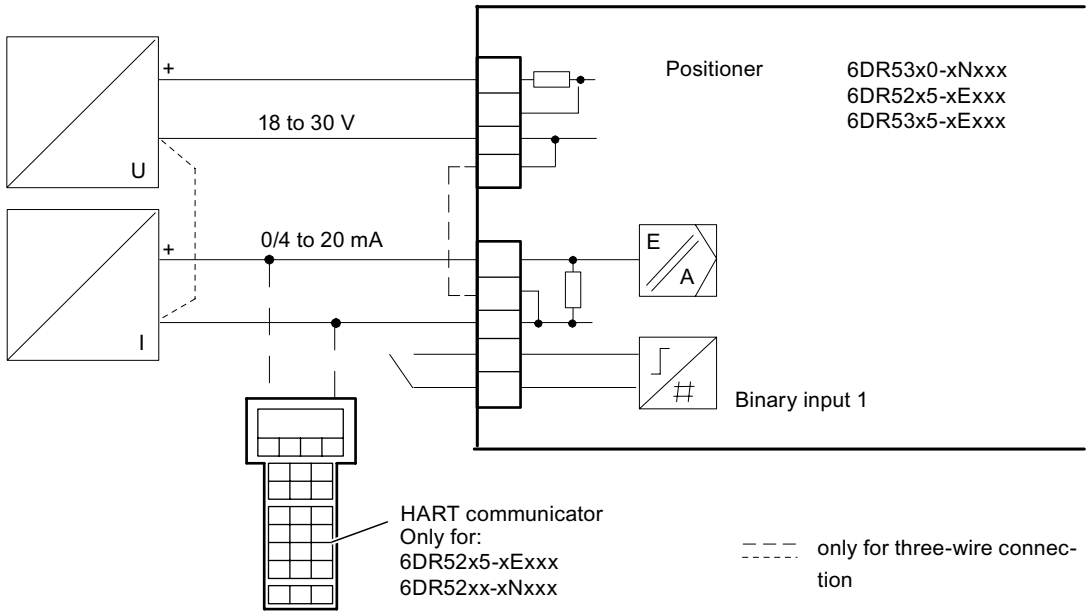


Figure 6-4 Three/four-wire connection

6.1.2.2 Current output

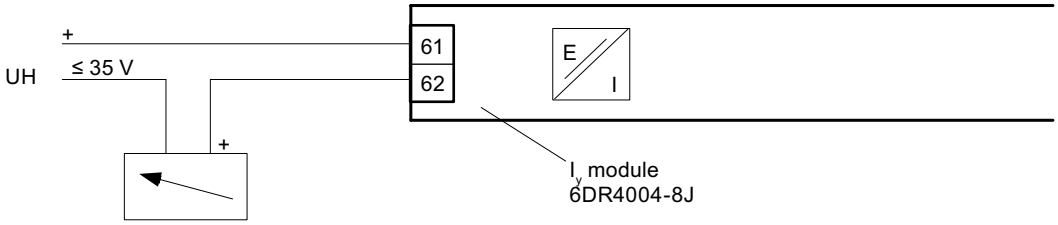


Figure 6-5 I_y module 6DR4004-8J, not Ex

6.1.2.3 Binary inputs and outputs

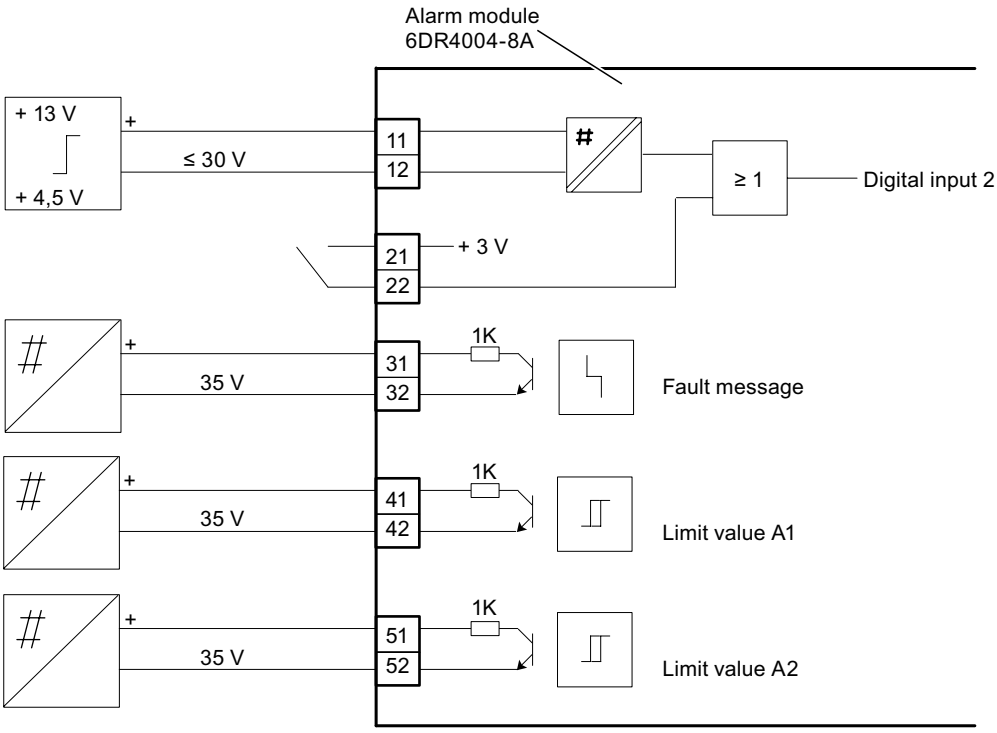


Figure 6-6 Alarm unit 6DR4004-8A, not Ex

6.1.2.4 SIA unit

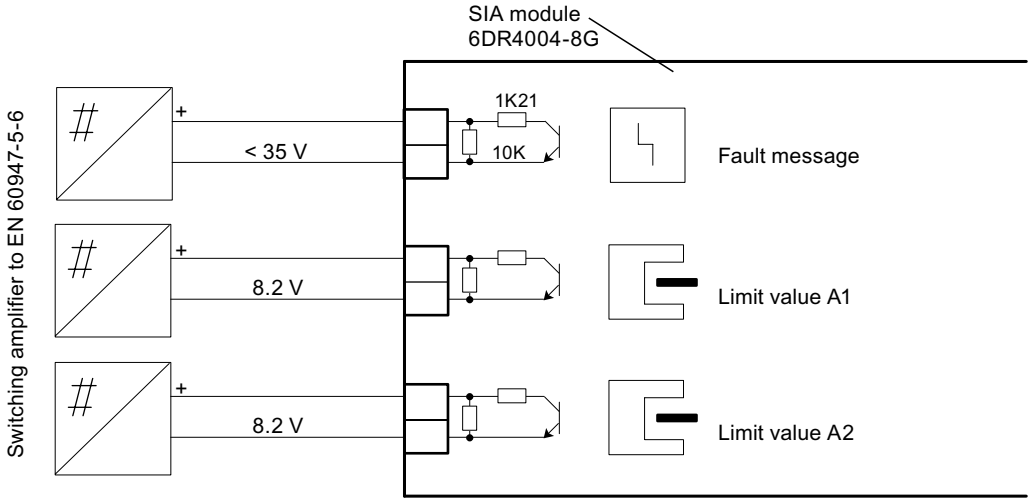


Figure 6-7 SIA unit 6DR4004-8G, not Ex

6.1.2.5 Mechanical limit switch module

Safety note for low-voltage supply

⚠ DANGER

Low-voltage supply

When you supply the module in the non-intrinsically safe version with low voltage, you must be sure to observe 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.

Safety notes for connecting the mechanical limit switch module

⚠ WARNING

Protection against mechanical influences

In order to guarantee the degree of protection IP66/NEMA 4x, you must protect the module against mechanical influences. This is achieved by selecting a suitable installation location or by installing a suitable protection device. This required protection applies to the operation of the module with the following voltages:

- > AC 16 V
- > DC 35 V, low voltage

NOTICE

Maximal values for terminals 41/42 and 51/52

The following maximum values concern only terminals 41, 42, 51, and 52:

- Maximum voltage:
  - Not Ex: AC 250 V or DC 24 V
  - Ex: 30 V DC
- Maximum current:
  - Not Ex: 4 A AC/DC
  - Ex: 100 mA DC
- Maximum performance:
  - Ex: 750 mW

No safe separation between the terminals can be guaranteed.

NOTICE

Installing/connecting

Only qualified personnel is permitted to install and connect the mechanical limit switch module.

NOTICE

To observe before connecting

Before you connect the mechanical limit switch module, observe the following conditions:

- Only qualified personnel is permitted to connect the mechanical limit switch module.
- Isolate all wires from power and make sure the device is truly isolated from power.
- Construct the cross-sectional area of the connection cables in such a way that it is appropriate for the permitted current load.
- Selected the wires on the basis of the following rule: The temperature at which the wires are permitted to be used must be 25°C above the maximum ambient temperature.
- Operate the Ex-version only in intrinsically safe circuits with approved switching amplifiers.

NOTICE

Preparing the cables or stranded wires

1. Insulate the cables in such a way that the insulation is flush with the terminal when plugging in the wires.
2. Fit ferrules to the ends of stranded wires.

Mechanical limit switch module wiring diagram, not Ex

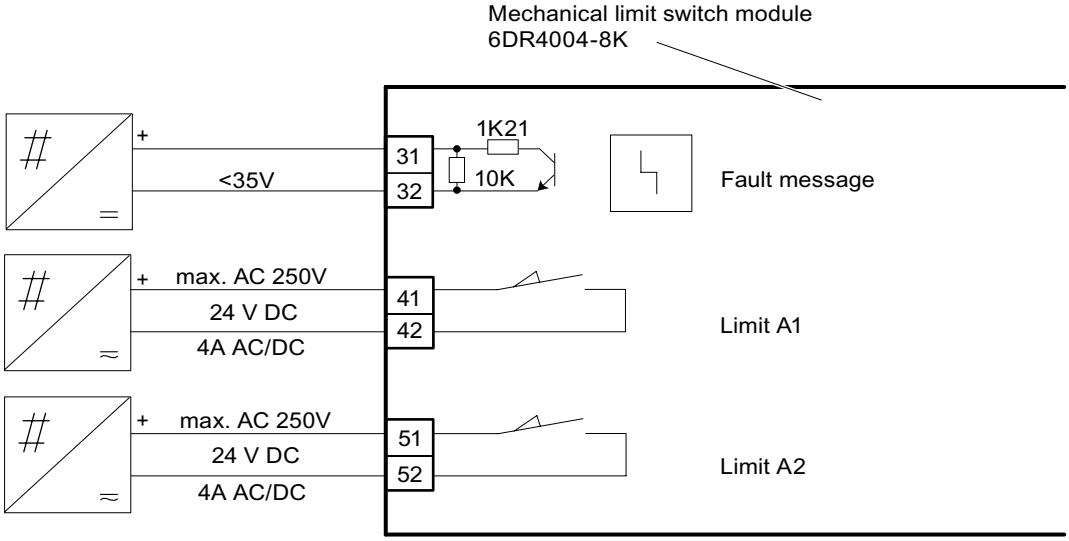


Figure 6-8 Mechanical limit switch module 6DR4004-8K, not Ex

Connecting the mechanical limit switch module

Connect the mechanical limit switch module as follows:

1. Loosen the screw ⑱ on the transparent cover ⑲.
2. Pull the transparent cover ⑲ up to the front end stop.
3. Tighten every cable in the corresponding terminal.
4. Slide the transparent cover ⑲ up to the end stop of the motherboard.

5. Tighten the screw ⑱ on the transparent cover ⑲.
6. Connect the cables of each switch to the lug of the printed circuit board in pairs. Use the provided cable tie ⑳ for this purpose.

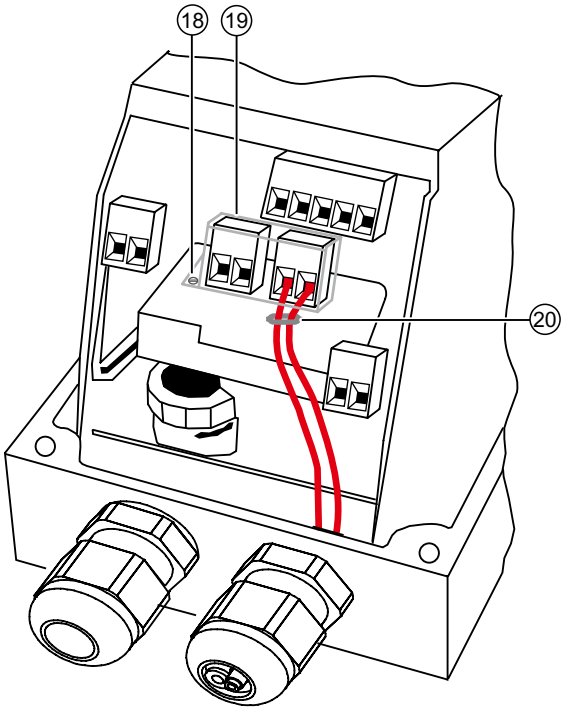


Figure 6-9 Connecting the cables

⑱ Screw
⑲ Cover
⑳ Cable tie

6.1.3 Connection for intrinsically safe type of protection

6.1.3.1 Basic device, Ex i

Note

As auxiliary power, control, and signal circuits, only certified intrinsically safe circuits may be connected.

Basic device

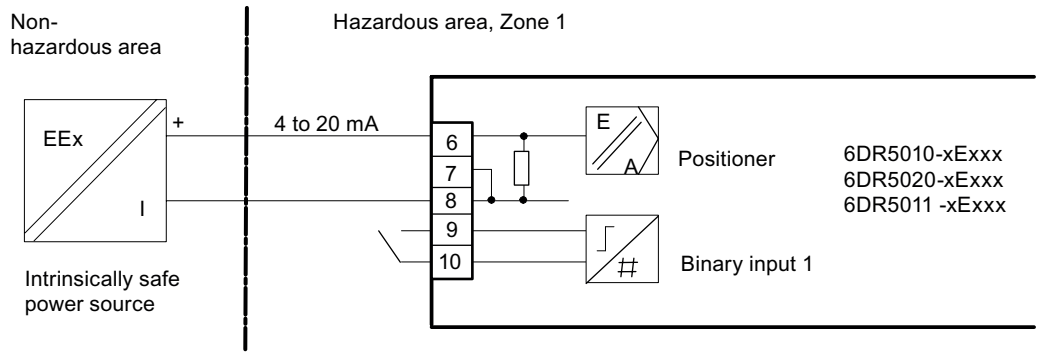


Figure 6-10 Two-wire connection, Ex i

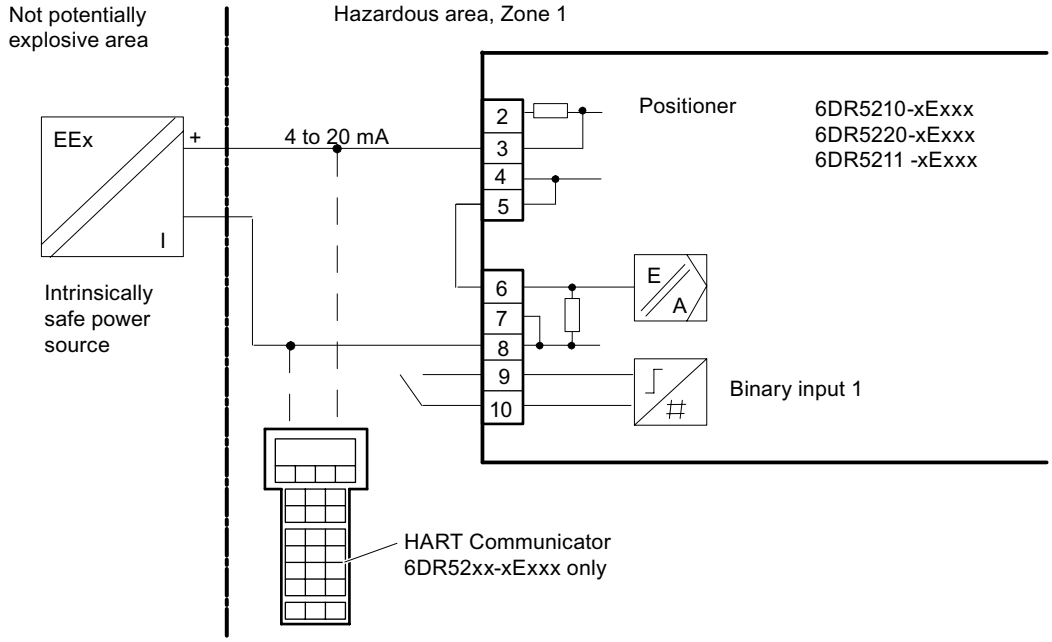


Figure 6-11 Two-wire connection, Ex i

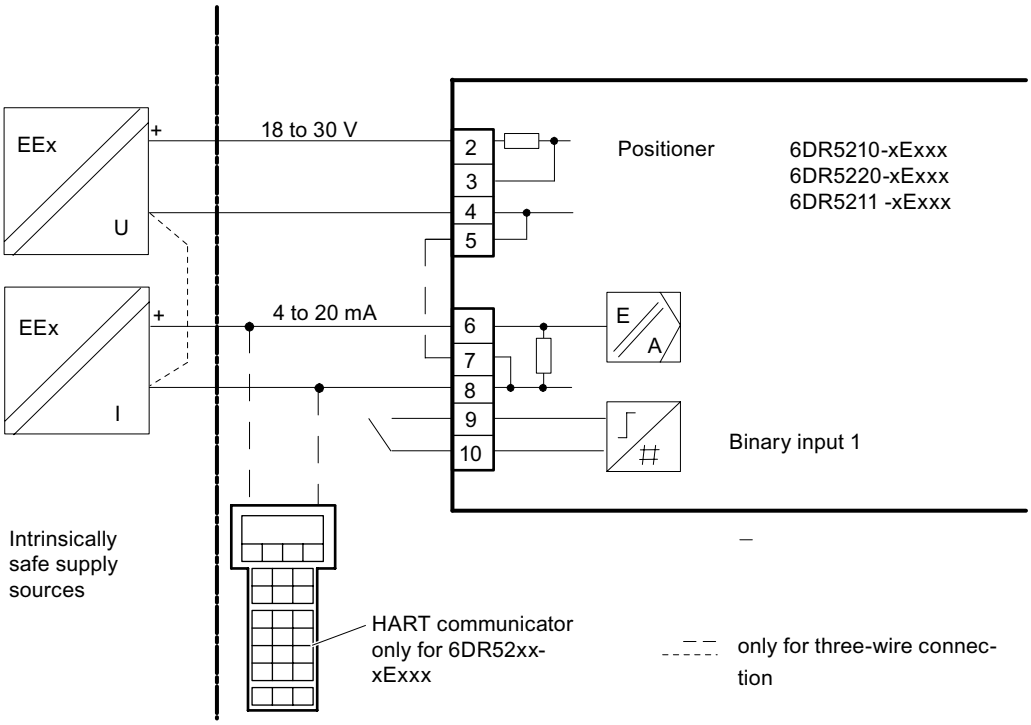


Figure 6-12 Three/four-wire connection, Ex i

6.1.3.2 Split range

Note

As auxiliary power, control, and signal circuits, only certified intrinsically safe circuits may be connected.

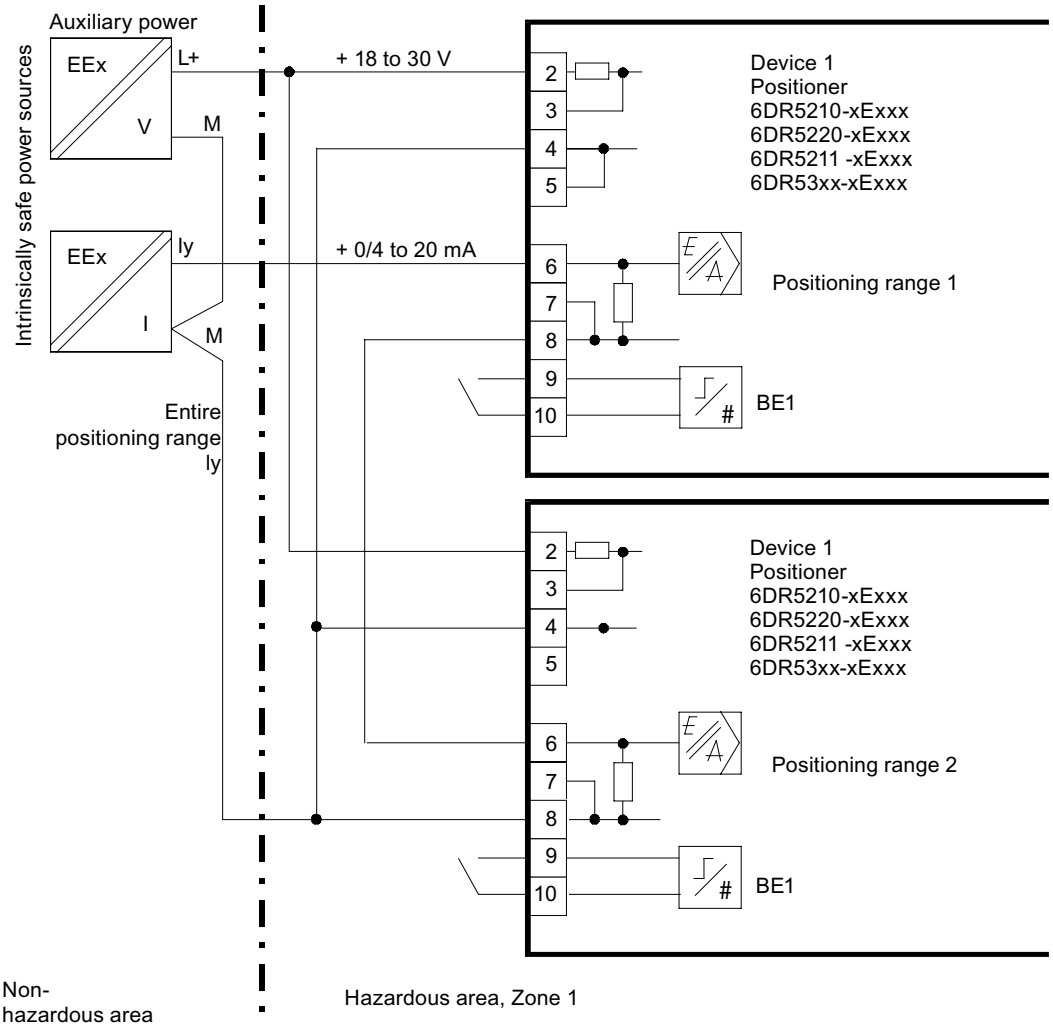


Figure 6-13 Series connection of 2 positioners, e.g. split range (auxiliary power wired separately), EEx i

6.1.3.3 Current output, Ex i

⚠ WARNING

Circuits

Only the certified circuits may be connected as auxiliary power supply, control and signal circuits.

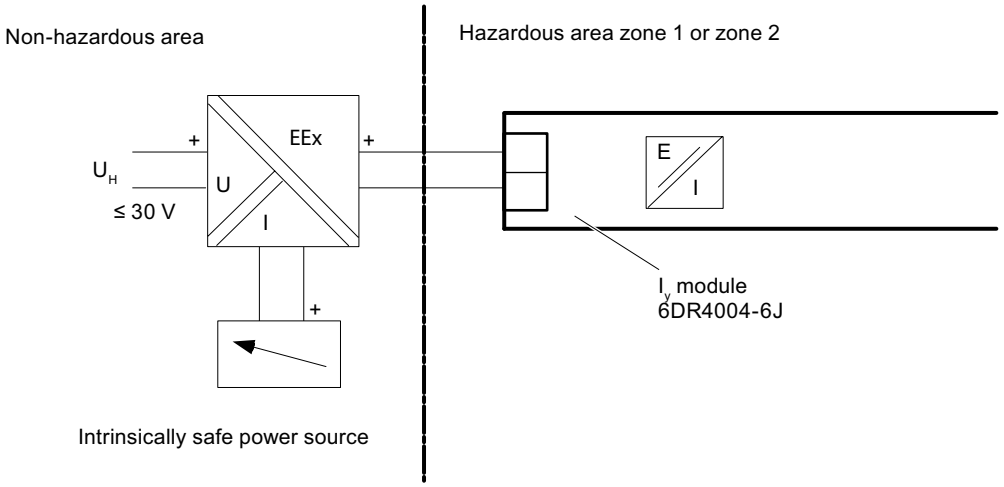


Figure 6-14 I_y module 6DR4004-6J, Ex i

6.1.3.4 Binary input and output, Ex i

⚠ WARNING

Circuits

Only the certified circuits may be connected as auxiliary power supply, control and signal circuits.

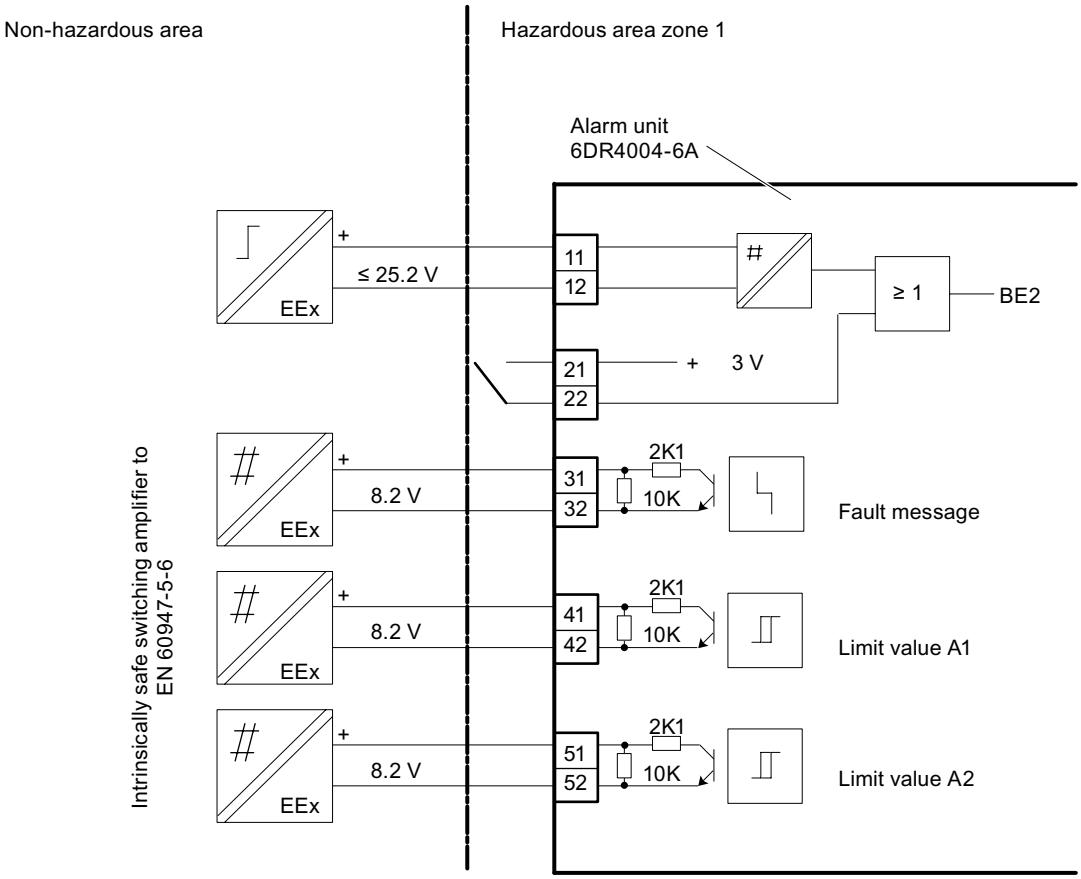


Figure 6-15 Alarm unit 6DR4004-6A, Ex i

6.1.3.5 SIA module, Ex i

⚠ WARNING

Circuits

Only the certified circuits may be connected as auxiliary power supply, control and signal circuits.

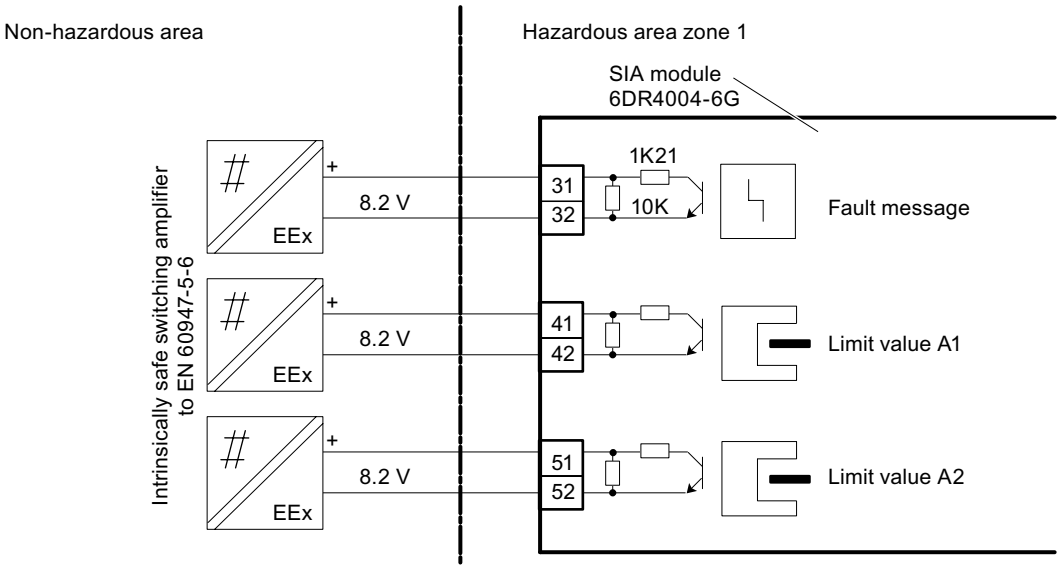


Figure 6-16 SIA module 6DR4004-6G, Ex i

6.1.3.6 Mechanical limit switch module, Ex i

Mechanical limit switch module connection diagram, Ex i

WARNING

Circuits

Only the certified circuits may be connected as auxiliary power supply, control and signal circuits.

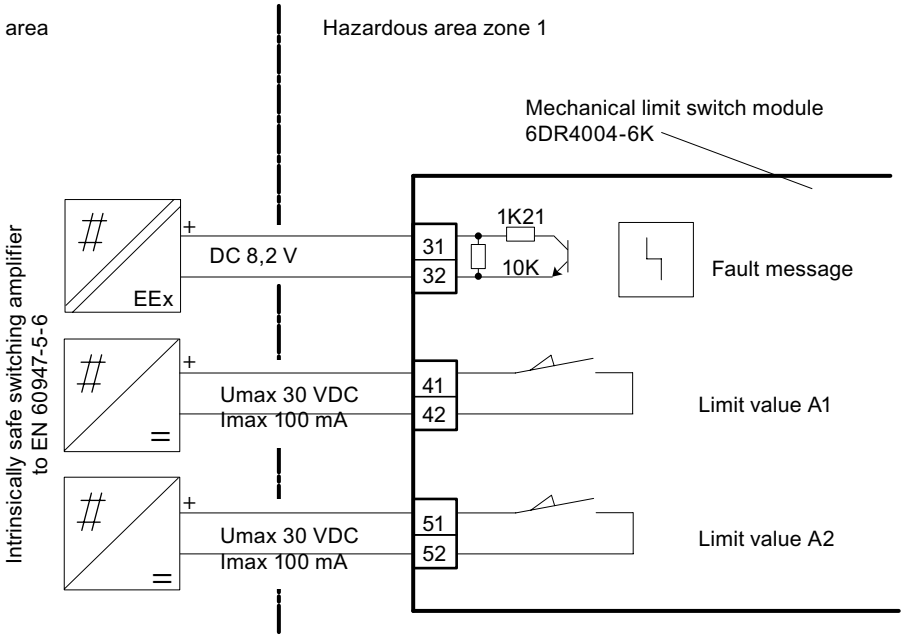


Figure 6-17 Mechanical limit switch module 6DR4004-6K, Ex i

Connecting the mechanical limit switch module

Connect the mechanical limit switch module as follows:

1. Loosen the screw ⑱ on the transparent cover ⑲.
2. Pull the transparent cover ⑲ up to the front end stop.
3. Tighten every cable in the corresponding terminal.
4. Slide the transparent cover ⑲ up to the end stop of the motherboard.

5. Tighten the screw ⑱ on the transparent cover ⑲.
6. Connect the cables of each switch to the lug of the printed circuit board in pairs. Use the provided cable tie ⑳ for this purpose.

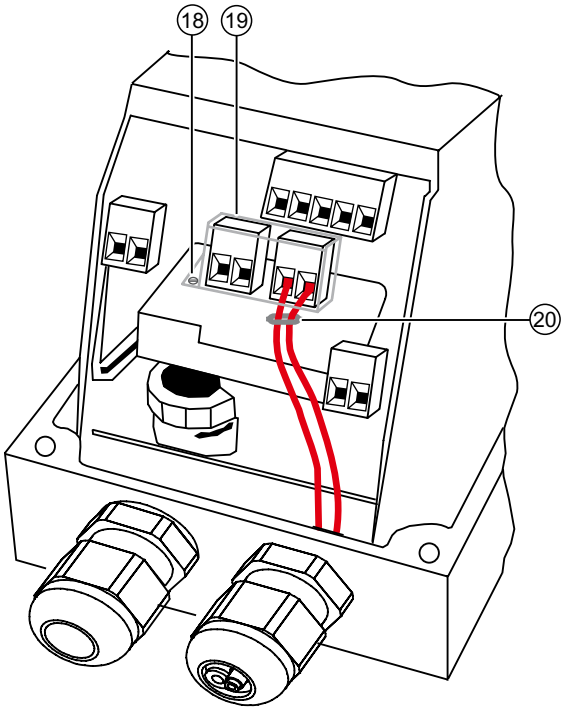


Figure 6-18 Connecting the cables

⑱ Screw
⑲ Cover
⑳ Cable tie

6.1.4 Connection for versions with type of protection "n"

6.1.4.1 Basic device, Ex n

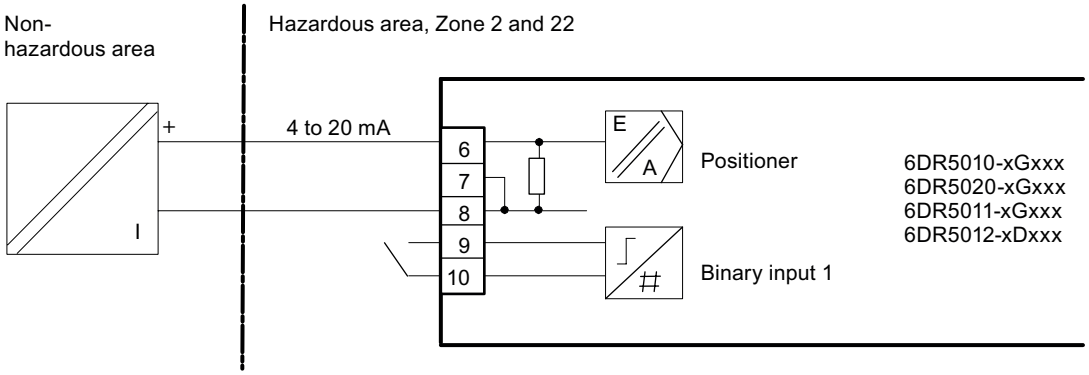


Figure 6-19 Two-wire connection, Ex n

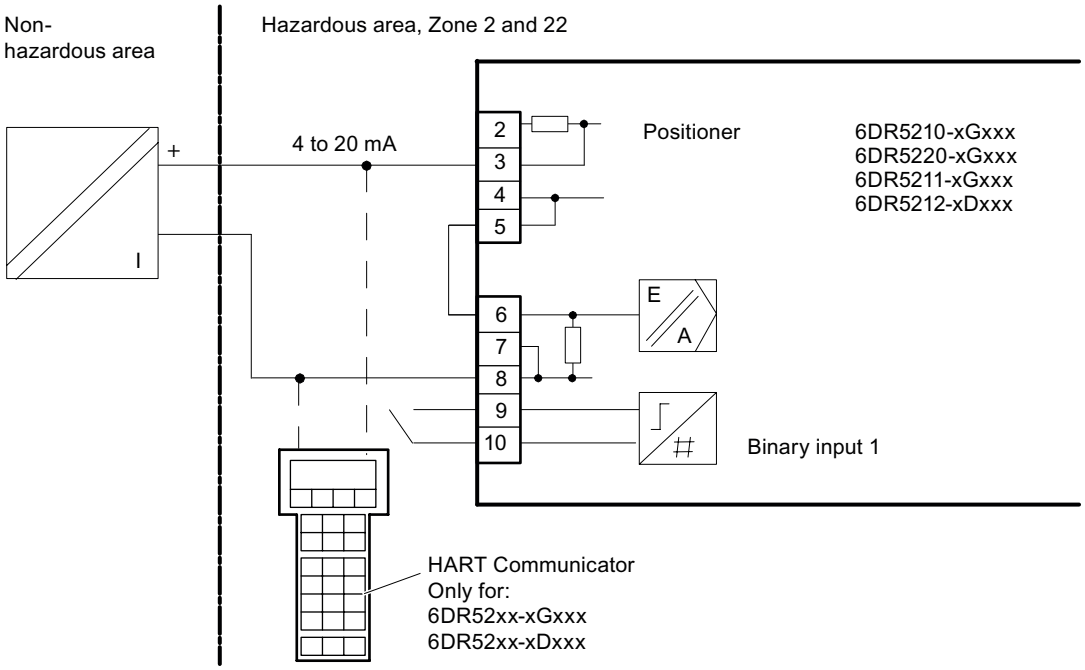


Figure 6-20 Two-wire connection, Ex n

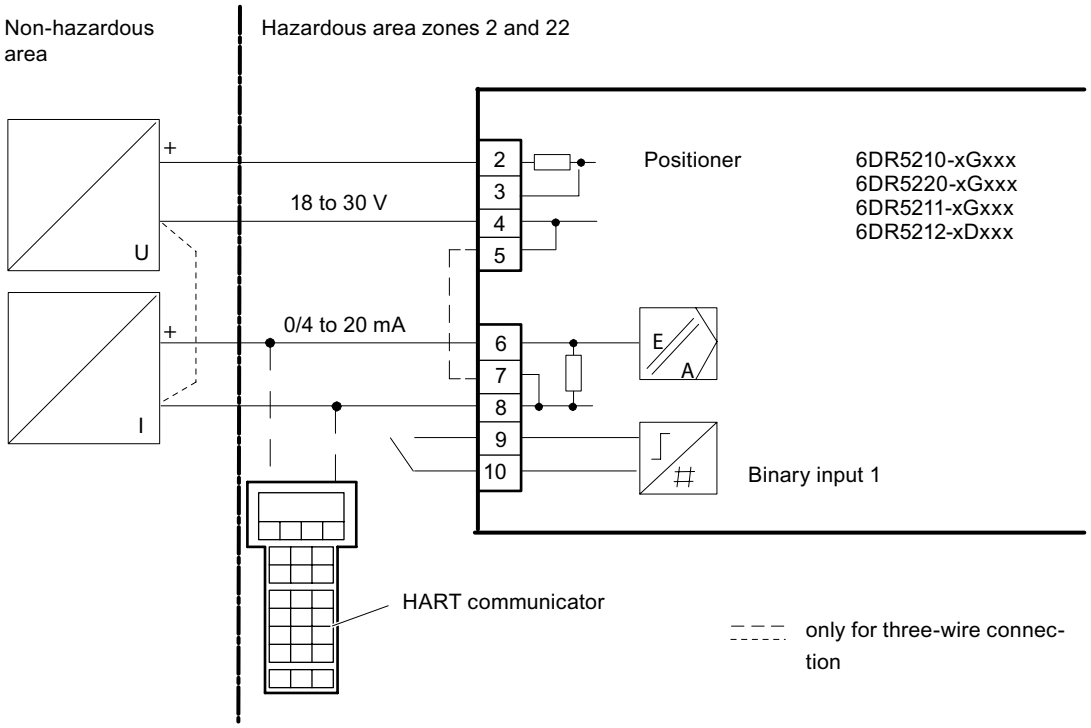


Figure 6-21 Three/four-wire connection, Ex n

6.1.4.2 Current output, Ex n

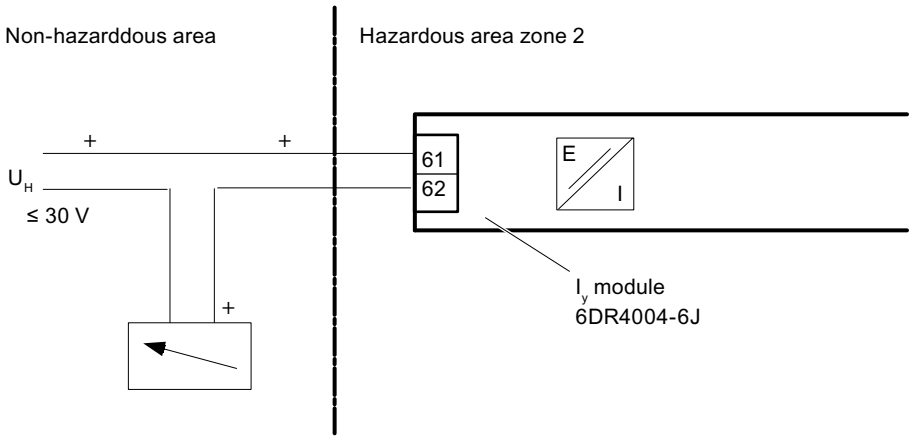


Figure 6-22 I_y module 6DR4004-6J, Ex n

6.1.4.3 Binary input and output, Ex n

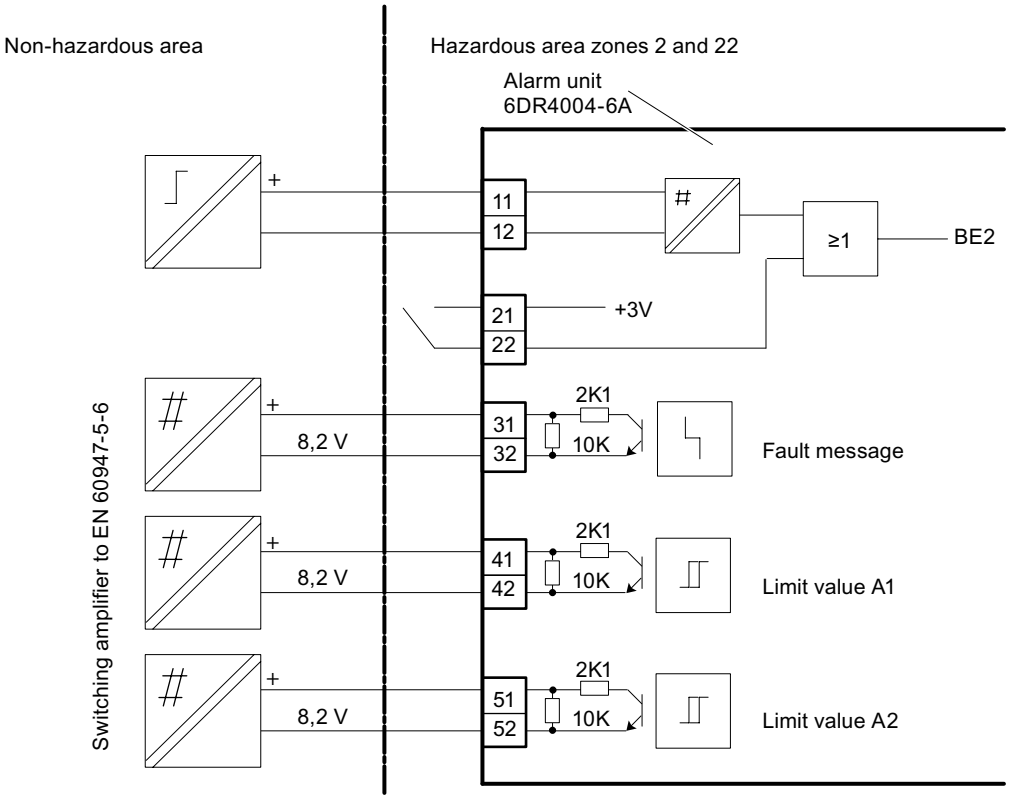


Figure 6-23 Alarm module 6DR4004-6A, Ex n

6.1.4.4 SIA module , Ex n

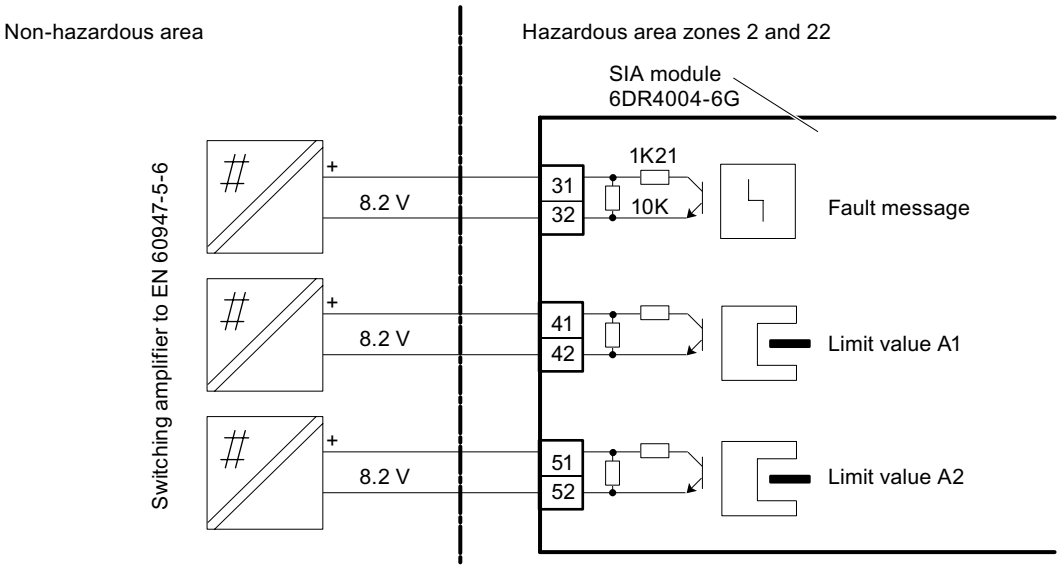


Figure 6-24 SIA module 6DR4004-6G, Ex n

6.1.4.5 Mechanical limit switch module, Ex n

Mechanical limit switch module wiring diagram, Ex n

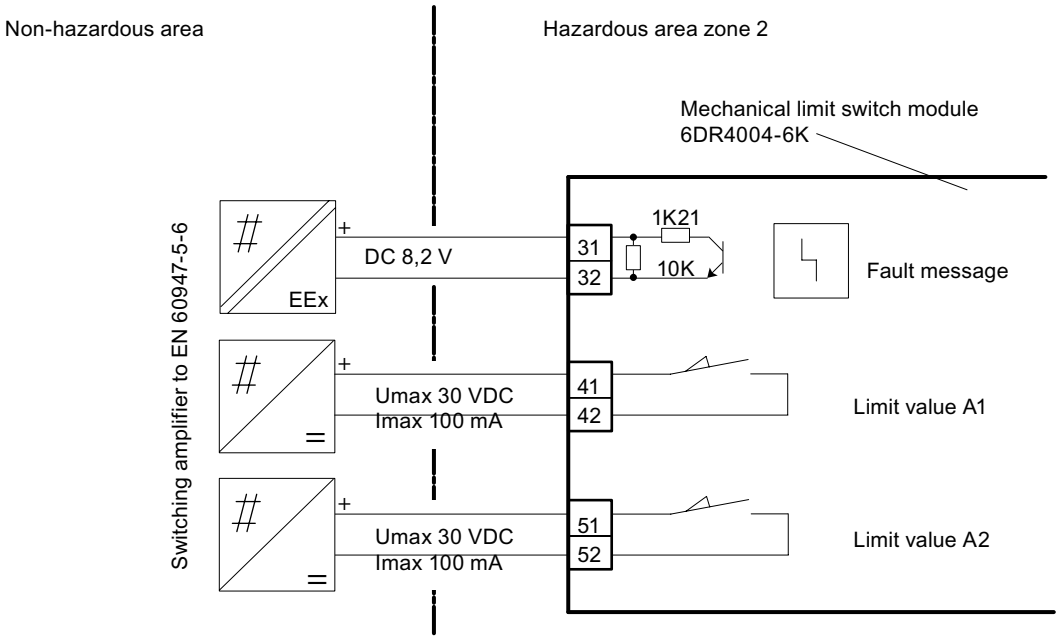


Figure 6-25 Mechanical limit switch module 6DR4004-6K, Ex n

Connecting the mechanical limit switch module

Connect the mechanical limit switch module as follows:

1. Loosen the screw ⑱ on the transparent cover ⑲.
2. Pull the transparent cover ⑲ up to the front end stop.
3. Tighten every cable in the corresponding terminal.
4. Slide the transparent cover ⑲ up to the end stop of the motherboard.

5. Tighten the screw ⑱ on the transparent cover ⑲.
6. Connect the cables of each switch to the lug of the printed circuit board in pairs. Use the provided cable tie ⑳ for this purpose.

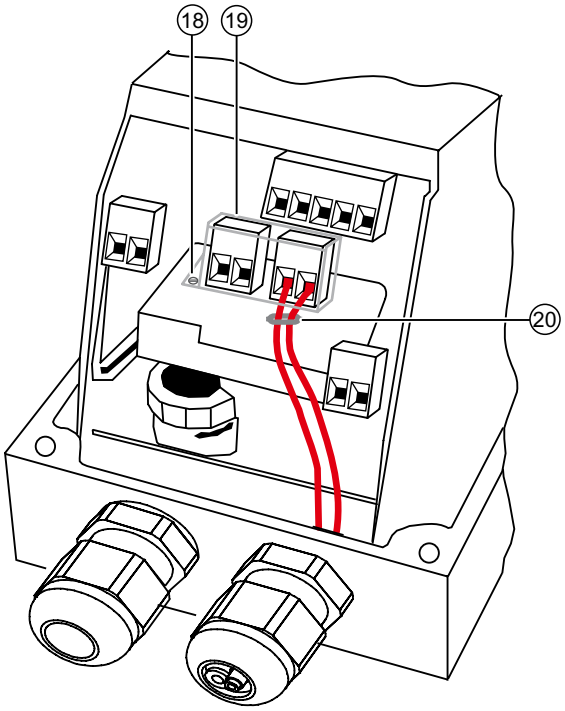


Figure 6-26 Connecting the cables

⑱ Screw
⑲ Cover
⑳ Cable tie

6.2 Pneumatic connection

⚠ WARNING

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.

NOTICE

Observe the specifications regarding the air quality.

- If required, connect the pressure gauge block for supply air and actuating pressure.
- Connect supply air to P_Z.
- Connection using female thread G1/4 DIN 45141 or 1/4" NPT:
  - P_Z supply air 1.4 to 7 bar
  - Y1: actuating pressure 1 for single and double-acting actuators
  - Y2: actuating pressure 2 for double-acting actuators
  - E: exhaust air outlet; remove the attenuator if required.
- For double-acting actuators, connect actuating pressures Y1 or Y2 depending on the desired safety position. Safety position in case of electrical auxiliary power supply failure:
  - Y1: single-acting, depressurized
  - Y1: double-acting, max. actuating pressure/supply air pressure.
  - Y2: double-acting, depressurized

Note

After installing the pneumatic connections, check the tightness of the entire control valve. Besides continuous air consumption, the positioner may try to compensate the position deviation due to leakage. This will lead to premature wear in the entire control unit.

See also

Changing the operating mode (Page 99)

Pneumatic connection in the flameproof enclosure (Page 26)

Operating

7

7.1 Operating elements

7.1.1 Digital display

Introduction

Note

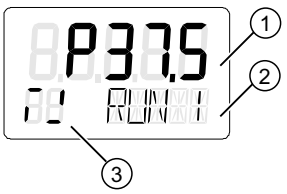
Repetition rate display

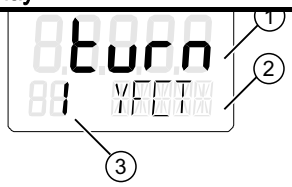
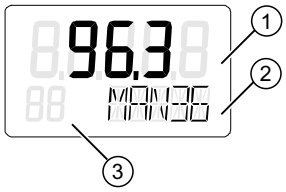
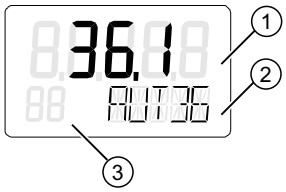
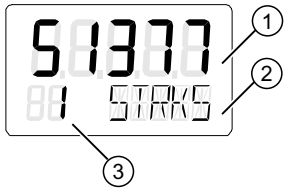
When operated in temperature ranges below -10°C, the liquid crystal display of the positioner becomes sluggish and the repetition rate display reduces considerably.

The digital 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.

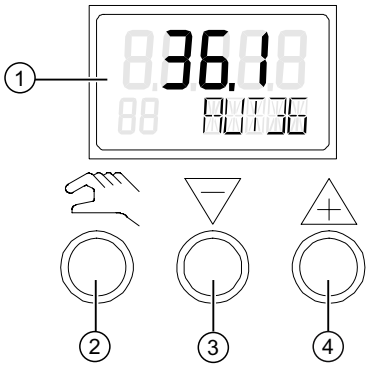
Operating mode	Representation in the digital display	Pos.	Legend
P-manual mode		①	Potentiometer setting [%]
		②	Blinking indicator for the non-initialized status.
Initialization mode		①	Potentiometer setting [%]
		②	Display of the current status of initialization or a fault message.
		③	Indicator for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

Operating mode	Representation in the digital display	Pos.	Legend
		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 179)
Changing the operating mode (Page 99)

7.1.2 Buttons



① Digital display
② Operating mode button
③ Decrement button
④ Increment button

Figure 7-1 Digital 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

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 standard controller or the "intrinsically safe" version.

Note

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

Function of buttons:

- The operating mode button is used to select the modes and to forward the parameters.
- The decrement button is used to select parameter values when configuring. You can use this button to move the actuator in the manual mode.
- The increment button is also used to select parameter values when configuring. You can use the increment button to move the actuator in the manual mode.

Note

Parameters are activated in the reverse order when the operating mode and the decrement buttons are pressed simultaneously.

7.1.3 Firmware version

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

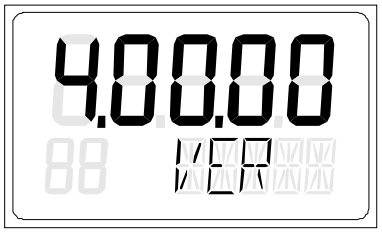


Figure 7-2 Firmware version, e.g. Version 4.00.00

7.2 Operating modes

7.2.1 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

7.2.2 Changing the operating mode

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

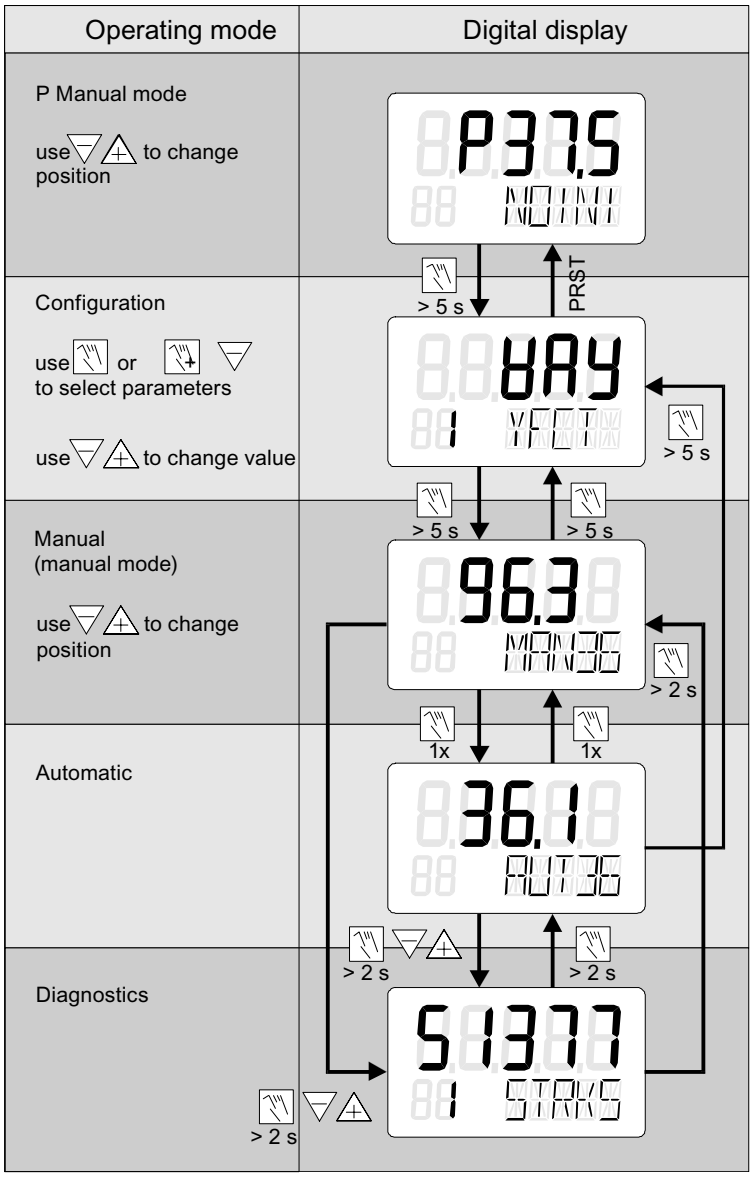


Figure 7-3 Switching between the operating modes

See also

Digital display (Page 95)

7.2.3 Overview of configuration

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

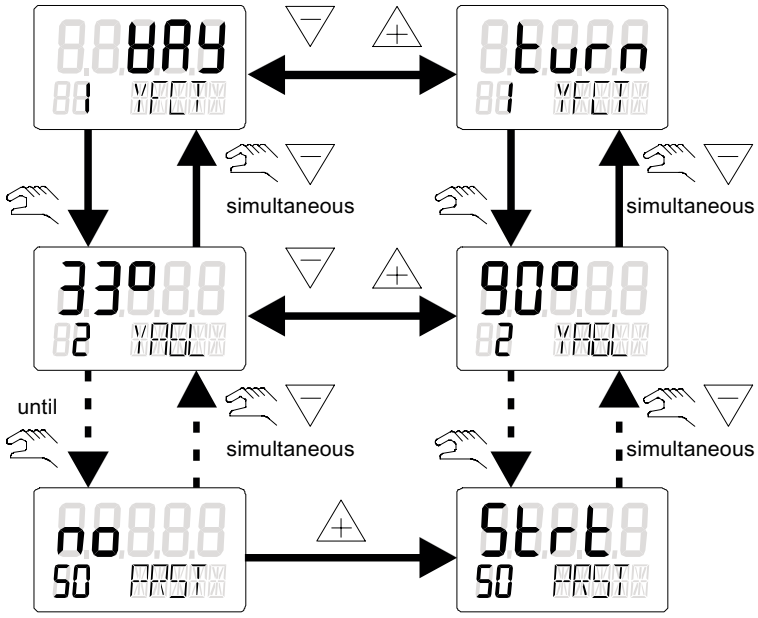


Figure 7-4 Overview of configuration

7.2.4 Description of operating modes

P-manual mode

Note

The "P-manual mode" is preset for the positioner in the as-delivered condition.

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

You can move the actuator using the ▽ decrement and △ increment buttons.

Switch to "Configuration" and "Initialization mode" to adapt the actuator as per 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 operating mode 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

If electrical auxiliary power supply fails when configuring, the positioner responds as follows until 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 the "Configuration" mode is restarted, the control in the digital display switches to the last activated parameter.

Manual mode (MAN)

You can move the actuator using the ▽ decrement and △ increment buttons in this mode. 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:

- Keep one of the two direction buttons pressed.
- 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 dead zone. A fault message is displayed if the dead zone cannot be reached.

Diagnostics

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

1. 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.:

- Stroke number
- Number of changes in direction
- Number of fault messages

Note

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

- The predefined setpoint is used as a control variable in the automatic mode.
- The last reached position is retained in the manual mode.

See also

Commissioning (Page 113)
Overview parameters A to P (Page 141)
Overview of diagnostics values (Page 185)
Meaning of diagnostics values (Page 187)

7.3 Optimizing the controller data

Note

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 case of minor overshoots.

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

The following special cases are ideal examples for a targeted data optimization:

- Small actuators with actuating times < 1 s.
- Operation with boosters.

You must change the setting of the following parameters to optimize the controller data. Proceed as follows:

1. Select the parameters in the diagnostics menu.
2. Activate the setting function. Press the increment button ⧋ or decrement button ⧊ for at least 5 seconds.
3. When you change the selected parameter, it is immediately updated. The effects on the controller results can then be tested.

22 Impulse length up / 23 Impulse length down

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

NOTICE
Controller increments • There is no movement if the values are too small. • Large controller increments also lead to large movements in case of small actuators.

26 Slow step zone up / 27 Slow step zone down

The slow step zone is an area of the control deviation. It includes the area between the fast step zone and the dead zone. The actuator is activated in the dead zone in a pulsed manner.

Even at small control deviations, the small values result in relatively large speeds of shifting. Too large speeds of shifting result in overshoots.

Large values reduce the overshoot especially in case of large changes in the setpoint. They lead to slow speeds of shifting near the corrected status.

43 Prediction up / 44 Prediction down

These parameters work similar to attenuation factors. These parameters are used to set the control dynamics. The parameter settings work as follows:

- 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 dead zone parameter from auto to a fixed value.

Functional safety

8

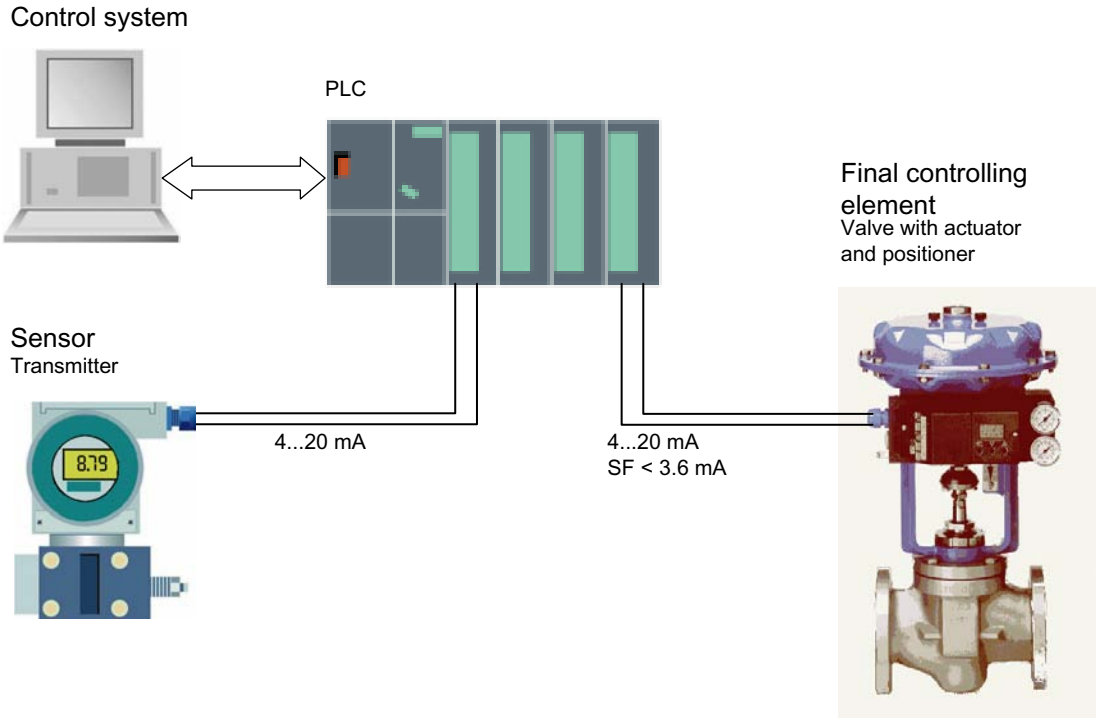
8.1 General safety notes

8.1.1 Safety-instrumented system

This chapter describes the functional safety in general and not specific to a device. The devices in the examples are selected as representative examples. The device-specific information follows in the next chapter.

Description

The sensor, logic unit/control system and final controlling element combine to form a safety-instrumented system, which executes a safety function.



S_F Failure signal

Figure 8-1 Example of a safety-instrumented system

Functioning of the system as shown in the example

The transmitter generates a process-specific analog signal. The downstream control system monitors this signal to ensure that it does not fall below or exceed a set limit value. In case of a fault, the control system generates a failure signal of < 3.6 mA or > 22 mA for the connected positioner, which switches the associated valve to the specified safety position.

See also

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

8.1.2 Safety Integrity Level (SIL)

The international standard IEC 61508 defines four discrete Safety Integrity Levels (SIL) from SIL 1 to SIL 4. Each level corresponds to the 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 three sub-systems in the following figure.

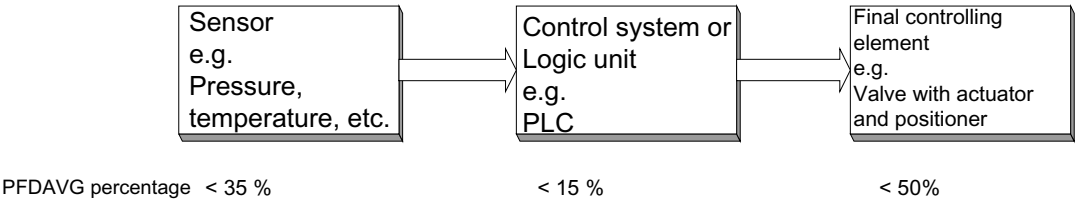


Figure 8-2 Example of PFD distribution

The following table shows the achievable Safety Integrity Level (SIL) for the entire safety-instrumented system for type B subsystems depending on the safe failure fraction (SFF) and the hardware fault tolerance (HFT). Type B subsystems include analog transmitters and shut-off valves without complex components, e.g. microprocessors (also see IEC 61508, Section 2).

SFF	HFT		
	0	1 (0) [1]	2 (1) [1]
< 60 %	Not permitted	SIL 1	SIL 2
60 to 90 %	SIL 1	SIL 2	SIL 3
90 to 99 %	SIL 2	SIL 3	SIL 4
> 99 %	SIL 3	SIL 4	SIL 4

[1] As per IEC 61511-1, Section 11.4.4

According to IEC 61511-1, Section 11.4.4, the hardware fault tolerance (HFT) can be reduced by one (values in brackets) for sensors and final controlling elements with complex components if the following conditions are applicable for the device:

- The device is proven-in-use.
- The user can configure only the process-related parameters, e.g. control range, signal direction in case of a fault, limiting values, etc.
- The configuration level of the firmware is blocked against unauthorized operation.
- The function requires SIL of less than 4.

The device fulfills these conditions.

8.2 Device-specific safety instructions

8.2.1 Range of applications for functional safety

The positioner is also suitable for controlling valves that satisfy the special requirements in terms of functional safety up to SIL 2 in accordance with IEC 61508 or IEC 61511-1. The 6DR501*, 6DR511*, 6DR521* and 6DR531* variations are available for this purpose.

These are single-acting, depressurizing positioners with an input from 4 to 20 mA for installation on pneumatic actuators with spring reset.

The positioner automatically depressurizes the valve actuator on demand or in case of faults, which thus switches the valve to the specified safety position.

These positioners meet the following requirements:

- Functional safety to SIL 2 under IEC 61508 or IEC 61511-1, from firmware version C4
- Explosion protection on 6DR5***-*E*** variations
- Electromagnetic compatibility in accordance with EN 61326/A1, Appendix A.1

See also

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

8.2.2 Safety function

Safety function on positioner

The safety function on the SIPART PS2 positioner is the depressurizing of the connected valve actuator. The built-in spring brings the valve to the required safety position. Depending on the direction of action of this spring, the valve is completely opened or closed.

This function is referred to as "tight closing" in the device documentation.

This safety function can be triggered by:

- Failure of auxiliary electrical power
- Falling below failure signal 3.6 mA at set current input (I_w).

  This also applies to failure of the pneumatic auxiliary power.

Note

Partial stroke test

If a partial stroke test is running, the safety function is only triggered if the electrical and pneumatic power supply is switched off. The safety function is not triggered by an input current less than 3.6 mA.

If the valve actuator cannot be depressurized on demand or in case of a fault, this represents a dangerous failure.

⚠ WARNING

The binding settings and conditions are listed in the sections "" Settings (Page 109) and Safety characteristics (Page 110).

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

When the safety function has been executed, safety-instrumented systems with no self-locking function should be brought to a monitored or otherwise safe status within the Mean Time To Restoration (MTTR). The MTTR is 8 hours.

The calculated Mean Time Between Failures (MTBF) for the SIPART PS2 positioner is 90 years. The MTBF for the basic electronics module is 181 years in line with SN29500.

The characteristic service life of the valve block depends on the load. On average it is approx. 200 million switching operations for each of the two pilot valves with symmetrical load. The actual number of switching operations performed can be called in the local display or via HART communication.

See also

Meaning of diagnostics values (Page 187)

Overview of diagnostics values (Page 185)

8.2.3 Settings

After assembly and commissioning, the following parameter settings should be made for the safety function:

Safety parameters

Parameter name	Function	Set parameter value	Meaning
2.YAGL	Rated angle of rotation of the feedback shaft	33° or 90° to match the setting for the transmission ratio selector	Adaptation to the mechanically set range of stroke / rotation angle
6.SCUR	Current range of setpoint	4 MA	4...20 mA
7.SDIR	Setpoint direction	riSE	Rising - for actuators with safety position down/closed (valve closed)
		FALL	Falling - for actuators with safety position up/open (valve open)
12.SFCT	Setpoint function	Everything except "FrEE"	• linear • constant percentage • inverse constant percentage
39.YCLS	Controller output tightening	do	Depressurizing - for actuators with safety position down/closed (valve closed)
		uP	Depressurizing - for actuators with safety position up/open (valve open)

Protection against configuration changes

After configuration, the SIPART PS2 positioner must be switched to automatic operation. You should then fit the housing cover so that the device is protected against unwanted and unauthorized changes/operation.

The SIPART PS2 positioner is fitted with an additional protective function to prevent configuration changes:

1. Configure the parameter 43.BIN1 = bLoc2.
2. Bridge terminals 9 and 10 of the binary input BE1.

   In this condition, the "configuration" operating level using the keys and HART communication and manual operation are blocked.

Checking the safety function

To check that the safety configuration is correct, apply a set current of 3.6 mA.

In this condition, the valve actuator must bring the valve to the intended safety position.

8.2.4 Behavior in case of faults

Repairs

Defective devices should be sent in to the repair department with details of the fault and the cause. When ordering replacement devices, please specify the serial number of the original device. The serial number can be found on the rating plate.

The address of the responsible SIEMENS repair center, contacts, spare parts lists, etc. can be found on the Internet.

See also

Services & Support (http://www.siemens.com/automation/services&support)

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

8.2.5 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 a low demand rate for the safety function (low demand mode).
- Communication with the HART protocol is only used for
  - Device configuration
  - Reading diagnostic values
  - However, it is not used for operations critical to safety. In particular, the trace function must not be activated in safety related operation.
- The safety-related parameters/settings (see "Settings" section) have been entered by local operation or HART communication and checked on the local display before commencing safety-instrumented operation.
- The positioner is blocked against unwanted and unauthorized changes/operation.
- The 4 to 20 mA input signal for the SIPART PS2 positioner is generated by a safe system that fulfills a minimum of SIL 2.
- The connected valve actuator must be single acting and switch the valve to its safe end position by spring force in the following cases:
  - Pressure failure
  - At a chamber pressure (Y1 connection) up to a third of the maximum available inlet 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.
- The MTTR after a device fault is 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 where the pressure outlet is not depressurized, or the safety position is not reached, when the input current < 3.6 mA.
- If a partial stroke test is running, the safety function is only triggered when the electrical and pneumatic power supply is switched off. The safety function is not triggered by an input current less than 3.6 mA. The partial stroke test is available as of firmware version 4.00.00.

Commissioning

9

NOTICE
• 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. • The transmission ratio selector can be set only when the positioner is open. Therefore, check this setting before closing the enclosure.

General information about commissioning

After installing the positioner on a pneumatic actuator, you must supply electric and pneumatic auxiliary power to it.

The positioner is in the "P manual mode" before initialization. At the same time, "NOINI" blinks in the lower line of the digital display.

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
  - Movement times 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 actuators with soft end stops.
- 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 98)

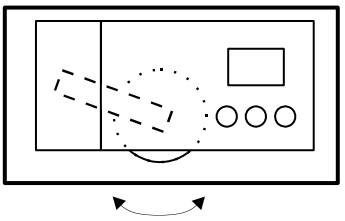
9.1 Sequence of automatic initialization

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 zero point and the stroke.
RUN3	Establishing and display of the actuating time (leak monitoring)
RUN4	Minimization of controller increments
RUN5	Optimization of the transient response
End	-

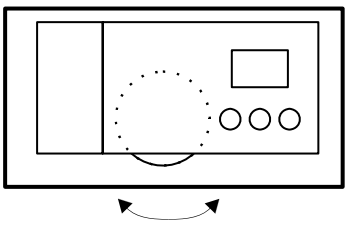
The following structured charts describe the sequence of initialization. The "Up/Down" names indicate the direction of action of actuators.

Linear actuator



Up **Down**

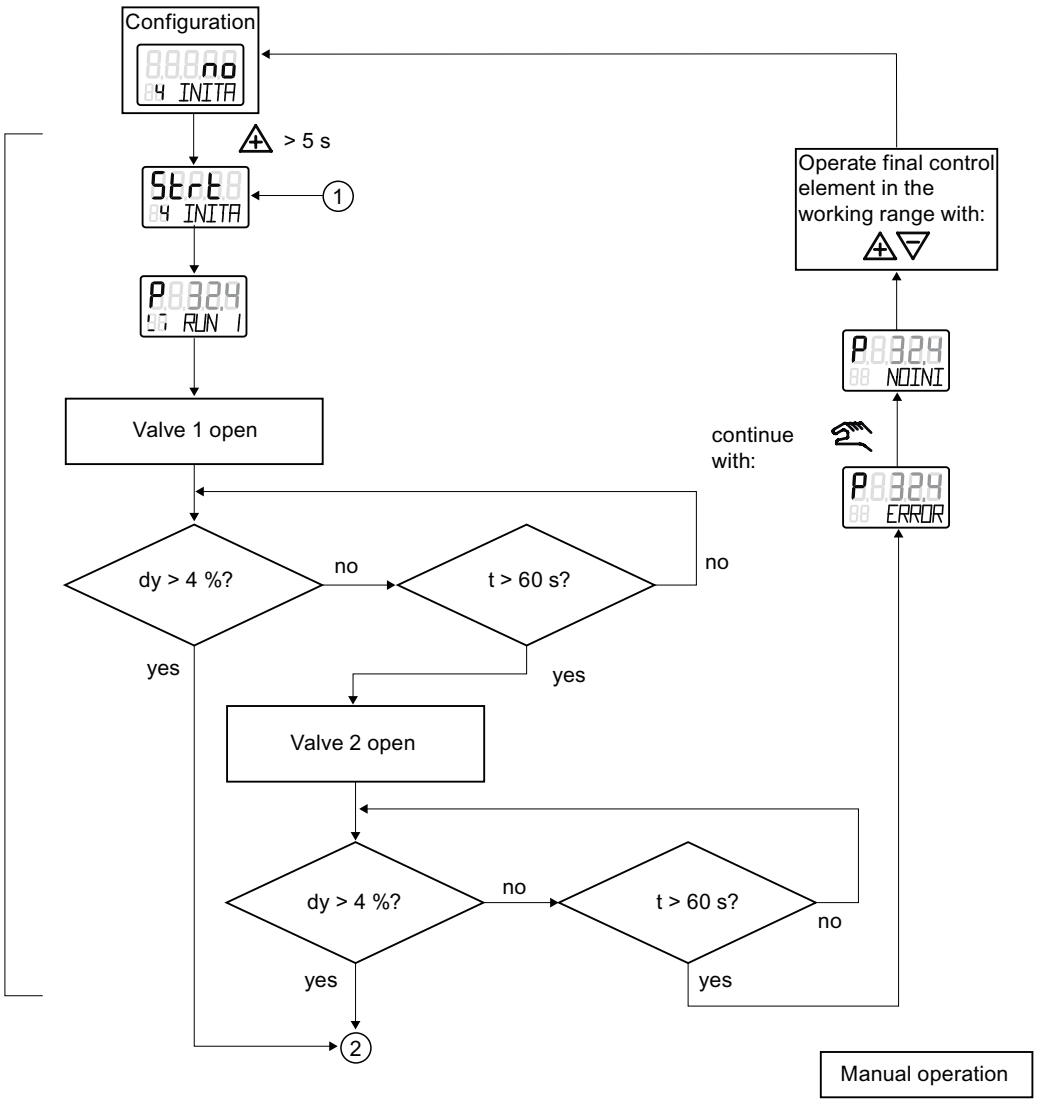
Part-turn actuator



Up **Down**

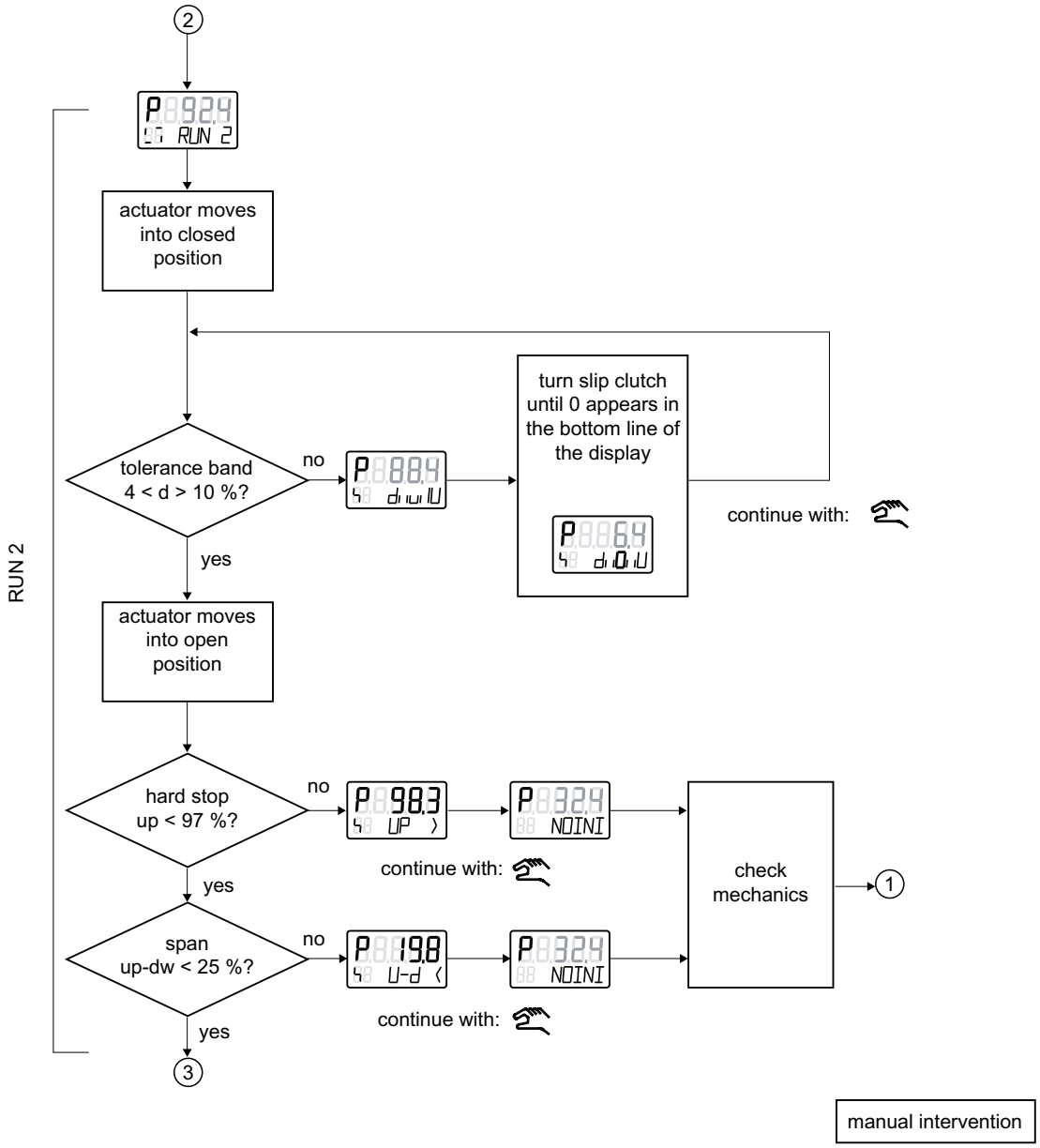
Sequence of RUN1

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



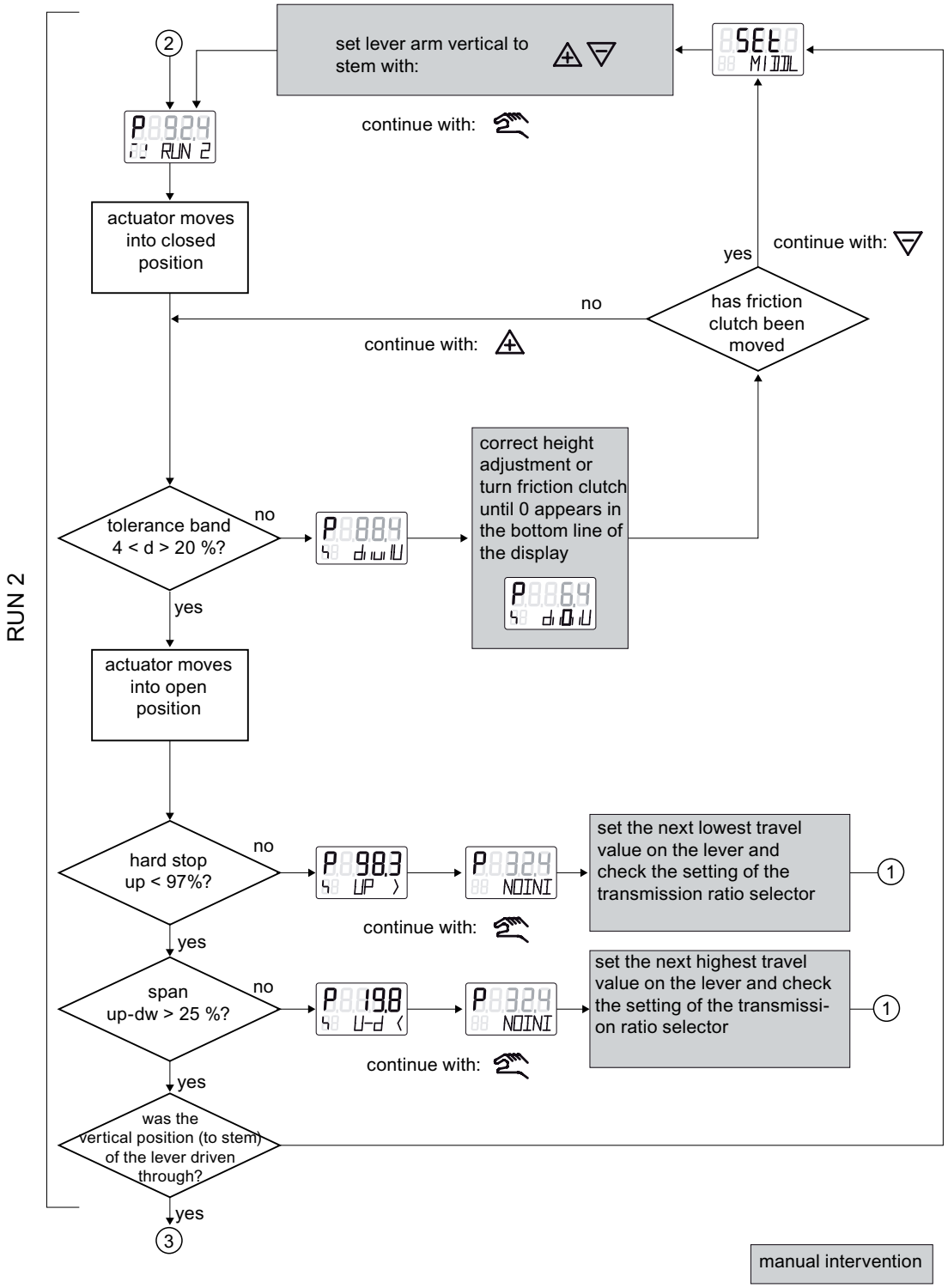
Sequence of RUN2 for part-turn actuators

This structured chart describes the sequence for checking the actuator travel. It also contains the information about the sequence for trimming the zero point and the stroke.



Sequence of RUN2 for linear actuators

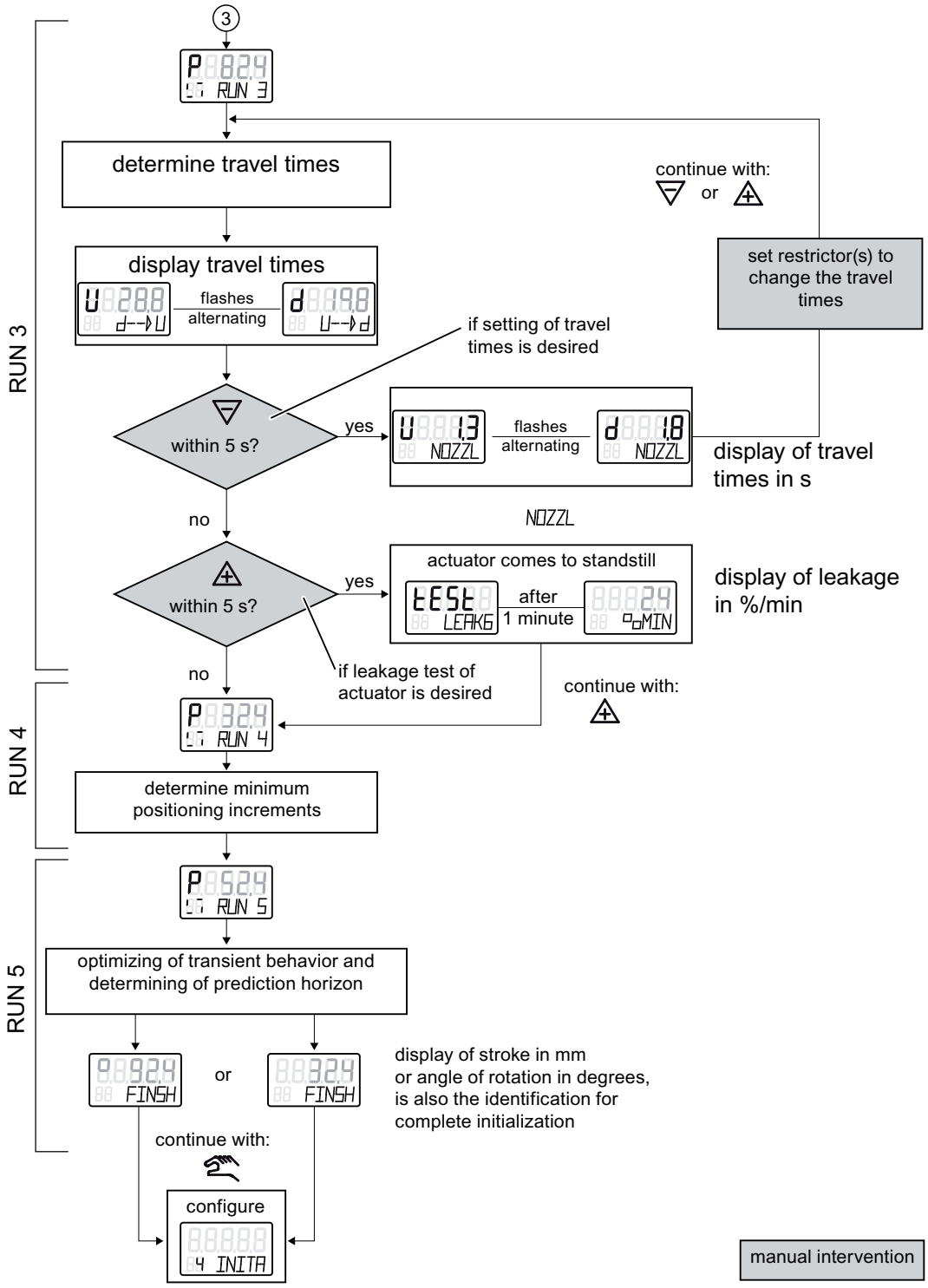
This structured chart describes the process to determine the actuator travel checks. It also contains the information about the sequence for trimming the zero point and the stroke.



Sequence of RUN3 to RUN5 for part-turn and linear actuators

This structured chart describes:

- Establishing and display of the actuating time/leak monitoring in RUN3
- Minimization of controller increments in RUN4
- Optimization of the transient response in RUN5


3
RUN 3
determine travel times
continue with:
or
display travel times
flashes
alternating
set restrictor(s) to change the travel times
if setting of travel times is desired
within 5 s?
yes
flashes
alternating
display of travel times in s
no
NOZZL
within 5 s?
yes
actuator comes to standstill
after
1 minute
display of leakage in %/min
no
if leakage test of actuator is desired
continue with:
RUN 4
determine minimum positioning increments
RUN 5
optimizing of transient behavior and determining of prediction horizon
or
display of stroke in mm
or angle of rotation in degrees,
is also the identification for
complete initialization
continue with:
configure
manual intervention

9.2 Commissioning linear actuators

9.2.1 Preparing linear actuators for commissioning

Condition

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

Setting the transmission ratio selector

Note

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

Stroke [mm]	Lever	Position of the transmission ratio selector	
		In [°]	Position
5 ... 20	Short	33	Down
25 ... 35	Short	90	Above
40 ... 130	Long	90	Above

1. Move the carrier pin on the lever. Select the scale position equal to the nominal stroke or a next-higher position.
2. Tighten the carrier pin using the M6 hexagon nut.

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.: "P12.3", and "NOINI" blinks in the lower 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 actuating range. Move the actuator to the respective end position using the ⚠ and ▽ buttons. Press both the direction buttons simultaneously to 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 the value is to "P50.0", the more accurate is the stroke travel determined by the positioner.

NOTICE
The following is applicable for the flameproof enclosure version:
The inner friction clutch is fixed. Therefore, only move the outer friction clutch.

See also

Installing the linear actuator (Page 36)

Installing optional modules in the standard and intrinsically safe version (Page 54)

Installing the optional modules in the "flameproof enclosure" version (Page 56)

External position displacement sensor (Page 51)

Transmission ratio selector (Page 50)

Overview of device components (Page 23)

9.2.2 Automatic initialization of linear actuators

Conditions

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 positioner automatically

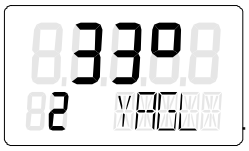
Note

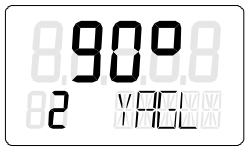
An ongoing initialization can be interrupted at any time. Press the operating mode button for this purpose. The settings configured until then are retained.

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 operating mode buttons for at least 5 seconds. The following is shown on the digital display:

2. Call the second parameter "YAGL". Press the operating mode button for a short while for this purpose. The following is shown on the digital display depending on the setting:





3. Check whether the value displayed in the "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 parameter 3 to determine the total stroke in mm. The setting of parameter 3 is optional. The digital display shows the determined total stroke only at the end of the initialization phase.
   - Press the operating mode button for a short while if you do not want any information about the total stroke in mm. You are then directed to parameter 4.
   - Call parameter 3 by pressing the operating mode button for a short while. The following is shown on the digital display:

5. Call the fourth parameter "INITA". Press the operating mode button for a short while for this purpose. The following is shown on the digital display:

6. Start the initialization process. 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 digital display. The initialization process depends on the actuator used, and takes up to 15 minutes. To start the initialization, press the increment button for at least 5 seconds until the digital display shows the following:

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

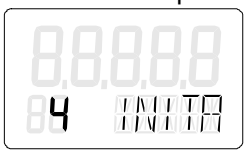
Setting parameter 3

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 to the read value. Use the increment or decrement buttons for this purpose.

Aborting the automatic initialization process

1. Press the operating mode button. The following is shown on the digital display:



2. Exit the "Configuration" mode. To do this, press the operating mode button for at least 5 seconds.
3. The software status is displayed.
4. After releasing the operating mode button, the positioner is in the "P manual mode", i.e. the positioner has not been initialized.

See also

Sequence of automatic initialization (Page 114)

9.2.3 Manual initialization of linear actuators

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

Conditions

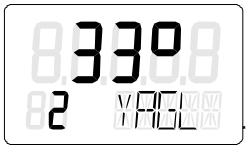
The following conditions must be fulfilled before activating the manual initialization:

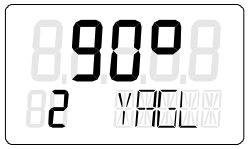
1. The positioner has been prepared for using on linear actuators.
2. The actuator spindle can be moved completely.
3. The displayed potentiometer position is within the permissible range between "P5.0" and "P95.0".

Initializing the positioner manually

1. Switch to the "Configuration" mode. To do this, press the operating mode button for at least 5 seconds. The following is shown on the digital display:

2. Call the second parameter "YAGL". Press the operating mode button for a short while for this purpose. The following is shown on the digital display depending on the setting:





3. Check whether the value displayed in the "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 parameter 3 to determine the total stroke in mm. The setting of parameter 3 is optional. The digital display shows the determined total stroke only at the end of the initialization phase.
   - Press the operating mode button for a short while if you do not want any information about the total stroke in mm. You are then directed to parameter 4.
   - Call parameter 3 by pressing the operating mode button for a short while. The following is shown on the digital display:

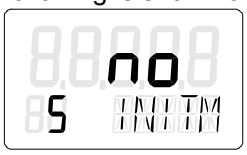
Note

Setting parameter 3

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 to the read value. Use the ⚠ increment or ▽ decrement buttons for this purpose.

5. Call the "INITM" parameter. Press the operating mode button twice for this purpose. The following is shown on the digital display:



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

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

8. Determine the end position 1 of the actuator spindle. Move the actuator spindle to the desired position by pressing the ⚠ increment or ▽ decrement buttons. Accept the current position of the actuator spindle by pressing the operating mode button. The following is shown on the digital display:

Note

"RANGE" fault message

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

- Move the friction clutch until the digital display shows "OK". Press the operating mode button again.
- Move the actuator spindle to another position using the ⚠ increment or ▽ decrement buttons.
- Abort the manual initialization process by pressing the operating mode button. Switch to the "P manual mode" and adjust the actuator travel and the position displacement sensor.

9. Determine the end position 2 of the actuator spindle. Move the actuator spindle to the desired position by pressing the ⚠ increment or ▽ decrement buttons. Accept the current position of the actuator spindle by pressing the operating mode button.

Note

"Set Middl" fault message

The lever arm is not in the horizontal position if the "Set Middl" message appears on the digital 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 by pressing the ⚠ increment or ▽ decrement buttons.
2. Press the operating mode button.

10. The initialization process is automatically resumed. Displays for the initialization steps from "RUN1" to "RUN5" are shown in the lower line on the digital display.
11. The following display indicates that the initialization has been completed successfully:

Note

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

Aborting the manual initialization process

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

9.3 Commissioning part-turn actuators

9.3.1 Preparing part-turn actuators for commissioning

NOTICE
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°.

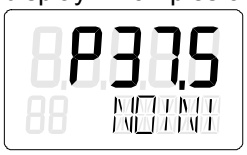
Condition

The following conditions must be fulfilled before activating the initialization:

1. You have installed the positioner for the part-turn actuators using the suitable mounting kit.
2. You have connected the actuator and the positioner to the pneumatic lines.
3. 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 digital 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 actuating range. For this purpose, move the actuator to the top and the bottom end positions alternately using the △ increment or the ▽ decrement buttons.

Note

Press the △ increment or ▽ decrement buttons additionally to reach the end position faster.

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

See also

External position displacement sensor (Page 51)

Pneumatic connection (Page 94)

Basic device (Page 74)

Transmission ratio selector (Page 50)

9.3.2 Automatic initialization of part-turn actuators

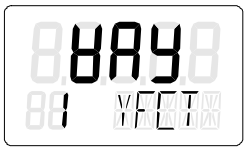
Condition

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

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

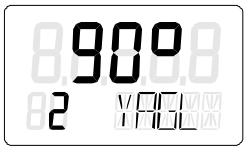
Initializing the positioner automatically

1. Switch to the "Configuration" mode. To do this, press the operating mode button for at least 5 seconds. The following is shown on the digital display:

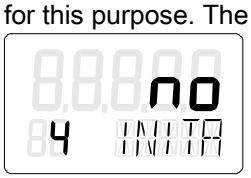


2. Change the actuator type from linear to the part-turn actuator. Change the parameter setting using the ▽ decrement button. The following is shown on the digital display:

3. Call the second parameter "YAGL". Press the operating mode button for a short while for this purpose. This parameter has already been set to 90° automatically. The following is thus shown on the digital display:



4. Call the fourth parameter "INITA". Press the operating mode button for a short while for this purpose. The following is shown on the digital display:



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

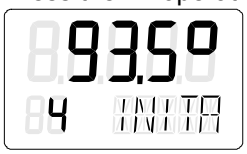
Note

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 digital 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 digital display:

Aborting the automatic initialization process

1. Press the operating mode button. The following is shown on the digital display:



2. Exit the Configuration mode. To do this, press the operating mode button for at least 5 seconds.
3. The software status is displayed.
4. After releasing the operating mode button, the positioner is in the "P manual mode", i.e. the part-turn actuator has not been initialized.

See also

Sequence of automatic initialization (Page 114)

9.3.3 Manual initialization of part-turn actuators

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

Conditions

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

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

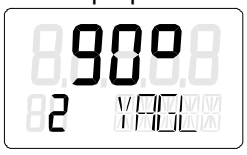
NOTICE
Setting of the adjustment angle The usual adjustment angle for part-turn actuators is 90°. Accordingly set the transmission ratio selector in the positioner to 90°.

Initializing the positioner manually

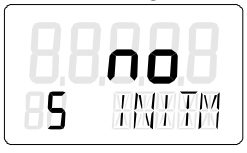
1. Switch to the "Configuration" mode. To do this, press the operating mode button for at least 5 seconds. The following is shown on the digital display:

2. Set the "YFCT" parameter to "turn". Press the decrement button for this purpose. The following is shown on the digital display:

3. Call the second parameter "YAGL". Press the operating mode button for a short while for this purpose. The following is shown on the digital display:

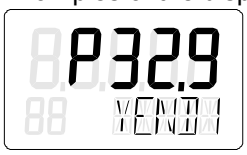


4. Call the "INITM" parameter. Press the operating mode button twice for this purpose. The following is shown on the digital display:

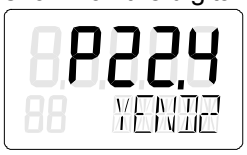


5. Start the initialization process. Press the increment button ⚠ for at least 5 seconds until the digital display shows the following:

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



7. Determine the end position 1 of the actuator.
8. Move the actuator spindle to the desired position by pressing the increment or ▽ decrement buttons.
9. Accept the current position by pressing the operating mode button. The following is shown on the digital display:



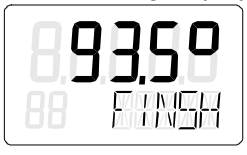
Note

RANGE fault message

- The selected end position is beyond the permissible measuring range if the "RANGE" message appears on the digital display. Correct the settings as follows: Move the friction clutch until the digital display shows "OK". Press the operating mode button again.
- Move the actuator spindle to another position using the ⚠ increment or ▽ decrement buttons.
- Abort the manual initialization process by pressing the operating mode button. Switch to the "P manual mode" and adjust the actuator travel and the position displacement sensor.

---

10. Determine the end position 2 of the actuator.
11. Move the actuator spindle to the desired position by pressing the ⚠ increment or ▽ decrement buttons.
12. Accept the current position by pressing the operating mode button.
13. The initialization process is automatically resumed. Displays for the initialization steps from "RUN1" to "RUN5" are shown in the lower line on the digital display.
14. The following display indicates that the initialization has been completed successfully:



Aborting the manual initialization process

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

See also

Overview of device components (Page 23)

Transmission ratio selector (Page 50)

9.4 Copying the initialization data when replacing a positioner

- Electropneumatic positioners can be replaced in a running system without interrupting the process.
- By copying and transferring the device and initialization data, it is possible to commission a replacement positioner without needing to initialize it.
- An electropneumatic positioner uses the communication interface to transfer data.

NOTICE
Deferred initialization Initialize the replacement 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. • Unrestricted accuracy and dynamic behavior of the positioner. • Deviation-free position of the hard end stops • Correctness of the maintenance data

Copying the initialization data

Copy the initialization data and the device parameters as follows:

1. Read in the initialization data and the device parameters of the positioner to be replaced. Use a suitable parameterization tool for this purpose.
2. Save the data in the parameterization tool.

Note

If the positioner to be replaced has already been initialized or configured using the parameterization tool, you need not read in and save the device data.

Replacing the positioner

Proceed as follows to replace a positioner in a running system:

1. Fix the actuator at its current position mechanically or pneumatically.
2. Determine the actual position value.
   - Read the actual position value on the digital display of the positioner to be replaced. Note down the read value.
   - If the electronic unit of the positioner is defective, measure the actual position value at the actuator or the valve. Note down the measured value.
3. Dismantle the positioner.
4. Attach the lever arm of the positioner to be replaced to the replacement positioner.
5. Install the replacement positioner on the control valve.
6. Set the transmission ratio selector of the replacement positioner to the same position as that of the positioner to be replaced.
7. Use the parameterization tool to transfer the saved device and initialization data to the replacement positioner.
8. If the displayed actual position value differs from the noted value, correct the deviation by moving the friction clutch.
9. The replacement positioner is ready for operation when the displayed and the noted values match.

10 Parameterizing/addressing

10.1 Parameter chapter

In this chapter, how the parameters work is explained in the form of a configuration schematic. Afterwards, there is a tabular overview of all parameters. Finally, the individual parameters and their functionality are described.

10.2 Configuration schematic for parameter operating principle

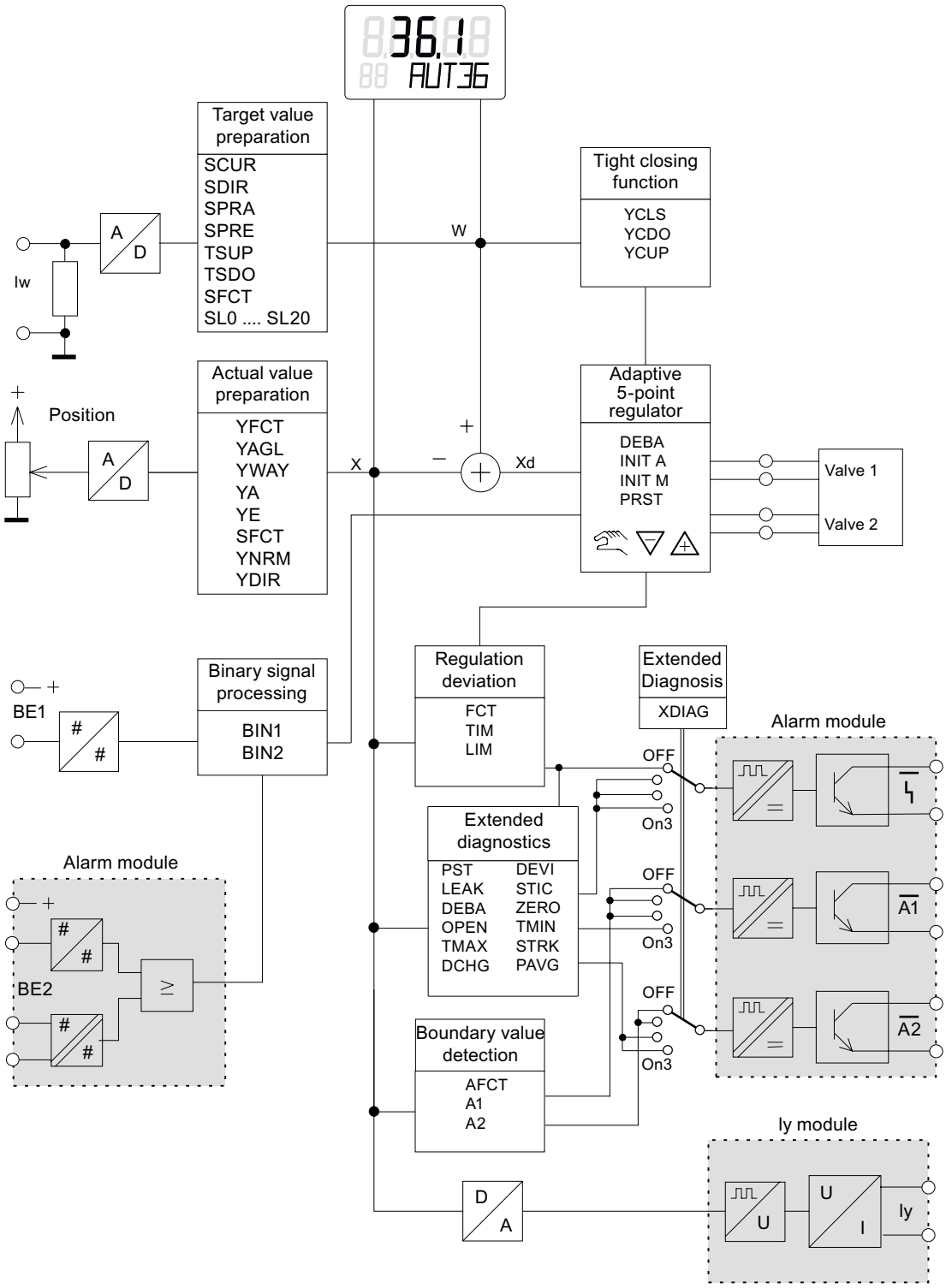


Figure 10-1 Configuration block schematic

10.3 Overview of parameters

10.3.1 Overview of parameters 1 to 5

Introduction

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

If you want to get to know the positioner in detail, 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 position actuator		
		turn (part-turn actuator)	
		WAY (linear actuator)	
		LWAY (linear actuator without sine correction)	
		ncSt (part-turn actuator with NCS)	
		-ncSt (part-turn actuator with NCS, inverse direction of action)	
		ncSL (linear actuator with NCS)	
		ncSLL (linear actuator with NCS and lever)	
2.YAGL	Nominal angle of rotation of the feedback message [1]		
		33°	Degrees
		90°	
3.YWAY[2]	Range of stroke (optional setting) [3]		
		OFF	mm
		5 | 10 | 15 | 20 (Short lever 33°)	
		25 | 30 | 35 (Short lever 90°)	
		40 | 50 | 60 | 70 | 90 | 110 | 130 (Long lever 90°)	
4.INITA	Initialization (automatic)	**NOINI** | no / ###.# | Strt	
5.INITM	Initialization (manual)	**NOINI** | no / ###.# | Strt	

1) Set the transmission ratio selector accordingly.

2) The parameter only appears for "WAY" and for "ncSLL".

3) When used the value must correspond with the set range of stroke on the actuator.
Carriers must be scaled to the actuator's stroke value,or if this is not scaled they then must be set to the next largest scaled value.

10.3.2 Overview of parameters 6 to 51

Introduction

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

- Target value preparation
- Actual value preparation
- Binary signal processing
- Tight closing function
- Boundary value detection

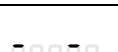
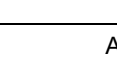
Note

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 setup				
		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 OPEN			Auto / **0** ... 400	s
11.TSDO	Setpoint ramp CLOSED			**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	

Parameter	Function			Parameter values		Unit
			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	Dead zone 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	Manipulated variable scaling					
		Mechanical		**MPOS**		
		On flow		FLOW		
38.YDIR	Manipulated variable direction of action for display and position feedback					
		Rising		**riSE**		
		Falling		FALL		
39.YCLS	Manipulated variable tight closing					
		None		**no**		
		Top only		uP		
		Bottom only		do		
		Top and bottom		uP do		
40.YCDO	Lower value for tight closing			0.0 ... **0.5** ... 100 %		%
41.YCUP	Upper value for tight closing			0.0 ... **99.5** ... 100 %		%
42.BIN1 2)	Function of BE1			Normally open	Normally closed	
		None		**OFF**		
		Message only		on	-on	
		Block configuration		bloc1		
		Block configuration and manual		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 of BE2			Normally open	Normally closed	
		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	
		without		**OFF**		

Parameter	Function		Parameter values		Unit
		A1 = Min, A2 = Max			
		A1 = Min, A2 = Min			
		A1 = Max, A2 = Max			
45.A1	Trigger threshold, alarm 1		0.0 ... 10.0 ... 100 %		%
46.A2	Trigger threshold, alarm 2		0.0 ... 90.0 ... 100 %		%
47. ↳FCT 3)	Function for fault message output		**Normal**	**Inverted**	
		Fault			
		Fault + not automatic [4]			
		Fault + not automatic + BE[4]			
48. ↳TIM	Monitoring time for setting of fault message "regulation deviation"		Auto / 0 ... 100		s
49. ↳LIM	Response threshold for fault message "regulation deviation"		Auto / 0 ... 100		%
50.PRST	Preset (factory setting) [5]				
	no	Nothing activated	no		
	Strt	Start of factory setting	Strt		
	oCAY	Display after pushing button for 5 sec	oCAY		
51.XDIAG	Activation of extended diagnostics				
		Off	OFF		
		Single-level message	On1		
		Two-level message	On2		
		Three-level message	On3		

1) Interpolation points appear only upon selection of 12.SFCT = "FrEE"

2) Normally closed means: Action on switch open or Low level
Normally closed means: Action on switch closed or High level

3) Normal means: High level without fault
Inverse means: Low level without fault

4) "+" means: Logical OR combination

5) Preset results in "NOINI"!

10.3.3 Overview parameters A to P

Introduction

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

Note

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 using parameter "XDIAG" with parameter value "On1", "On2" or "On3".

Overview parameter A

Parameter		Function	Parameter values	Unit
A.↳PST		Partial stroke test with the following parameters:		
	A1.STPOS	Starting position	0.0 ... **100.0**	%
	A2.STTOL	Starting tolerance	0.1 ... **2.0** ... 10.0	%
	A3.STEP	Step height	0.1 ... **10.0** ... 100.0	%
	A4.STEPD	Step direction	uP / **do** / uP do	
	A5.INTRV	Test interval	**OFF** / 1 ... 365	Days
	A6.PSTIN	Partial stroke test reference step time	**NOINI** / (C)##.# / Fdini / rEAL	s
	A7.FACT1	Factor 1	0.1 ... **1.5** ... 100.0	
	A8.FACT2	Factor 2	0.1 ... **3.0** ... 100.0	
	A9.FACT3	Factor 3	0.1 ... **5.0** ... 100.0	

Overview parameter b

Parameter		Function	Parameter values	Unit
b.↳DEVI		General control valve fault 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		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		Friction (slip-stick effect) 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		Dead zone monitoring with the following parameters:		
	E1.LEVEL3	Threshold	0.1 ... **2.0** ... 10.0	%

Overview parameter F

Parameter		Function	Parameter values	Unit
F.↳ZERO		Zero point monitoring with the following parameters:		
	F1.LEVEL1	Threshold 1	0.1 ... **1.0** ... 10.0	%
	F2.LEVEL2	Threshold 2	0.1 ... **2.0** ... 10.0	
	F3.LEVEL3	Threshold 3	0.1 ... **4.0** ... 10.0	

Overview parameter G

Parameter		Function	Parameter values	Unit
G.↳OPEN		Displacement of the upper stop with the following parameters:		
	G1.LEVEL1	Threshold 1	0.1 ... **1.0** ... 10.0	%
	G2.LEVEL2	Threshold 2	0.1 ... **2.0** ... 10.0	
	G3.LEVEL3	Threshold 3	0.1 ... **4.0** ... 10.0	

Overview parameter H

Parameter		Function	Parameter values		Unit
H.↳TMIN		Monitoring of the lower limit temperature with the following parameters:			
	H1.TUNIT	Temperature unit	**°C**	°F	°C/°F
	H2.LEVEL1	Threshold 1	-40 ... **-25** ... 90	-40 ... 194	
	H3.LEVEL2	Threshold 2	-40 ... **-30** ... 90	-40 ... 194	
	H4.LEVEL3	Threshold 3	**-40** ... 90	-40 ... 194	

Overview parameter J

Parameter		Function	Parameter values		Unit
J.↳TMAX		Monitoring of the upper limit temperature with the following parameters:			
	J1.TUNIT	Temperature unit	**°C**	°F	°C/°F
	J2.LEVEL1	Threshold 1	-40 ... **75** ... 90	-40 ... 194	
	J3.LEVEL2	Threshold 2	-40 ... **80** ... 90	-40 ... 194	
	J4.LEVEL3	Threshold 3	-40 ... **90**	-40 ... 194	

Overview parameter L

Parameter		Function	Parameter values	Unit
L.↳STRK		Monitoring the path integral with the following parameters:		
	L1. LIMIT	Limit for the number of changes of direction	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 changes in direction with the following parameters:		
	O1.LIMIT	Limit for the number of changes of 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		Position mean value calculation with the following parameters:		
	P1.TBASE	Time base of the mean value generation	**0.5h** / 8h / 5d / 60d / 2.5y	
	P2.STATE	State of the position mean value calculation	**IdLE** / rEF / ###.# / Strt	
	P3.LEVEL1	Threshold 1	0.1 ... **2.0** ... 100.0	%
	P4.LEVEL2	Threshold 2	0.1 ... **5.0** ... 100.0	%
	P5.LEVEL3	Threshold 3	0.1 ... **10.0** ... 100.0	%

10.4 Description of parameters

10.4.1 Description of parameters 1 through 5

10.4.1.1 Description of parameters 1 and 2

1.YFCT - actuator type

You can use this parameter to adjust the positioner as per the respective actuator and, if required, as per the position sensor used. The following parameter values are available:

- YFCT = turn

  Use this parameter value for a part-turn actuator.

  If you select "turn", the following parameter "2.YAGL" is automatically set to 90° and cannot be changed.

- YFCT = WAY (factory setting)

  Use this parameter value for a linear actuator. 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 feedback shaft. For this purpose, the positioner is set in the factory such that it displays values between "P49.0" and "P51.0" when the lever on the feedback shaft is perpendicular to the linear actuator spindle.

- YFCT = LWAY

  Use this parameter value for:

  – An external linear potentiometer on a linear actuator.

  – An external linear potentiometer on a part-turn actuator with a reverse direction of action.

- YFCT = ncSt

  Use this parameter value when you use a non-contacting position sensor on a part-turn actuator.

- YFCT = -ncSt

  Use this parameter value when you use a non-contacting position sensor on a part-turn actuator with a reverse direction of action.

- YFCT = ncSL

  Use this parameter value when you use a non-contacting position sensor on a linear actuator.

- YFCT = ncSLL

  Use this parameter value when you use a non-contacting position sensor on a linear actuator for which the position is transformed into a rotary movement using a lever.

Note

The "3.YWAY" parameter is displayed only for "WAY" and "ncSLL".

The factory setting is "WAY".

2.YAGL - angle of rotation of the feedback shaft

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 following is applicable:

- 33° for strokes ≤ 20 mm
- 90° for strokes > 20 mm

Both angles are possible when using a lever up to a stroke of 35 mm.

The long lever with a stroke greater than 35 mm is intended only for an angle of 90°. The long lever is not a part of the mounting kit 6DR4004-8V, but must be ordered separately under the order number 6DR4004-8L.

The "YFCT = turn" parameter value sets an angle of 90° automatically in case of part-turn actuators.

Note

Matching the angles

Ensure that the values set in the transmission ratio selector and the "2.YAGL" parameter match. If not, the value shown on the digital display does not match the actual position.

The factory setting is "33°".

See also

Overview of device components (Page 23)

10.4.1.2 Description of parameters 3 to 5

3.YWAY - display of the range of stroke

Use this parameter to set the value for the real range of stroke. This parameter is optional. You must set this parameter only if the determined value in mm is to be displayed at the end of the initialization process of a linear actuator.

Determine the value for the range of stroke as follows:

Fix the carrier pin on the lever at the desired position. This position on the lever has a specific scaled value, e.g. 25. Set this scaled value in the "YWAY" parameter.

If you select the "OFF" parameter value, the real stroke is not displayed after initialization.

Note

The value set in the "YWAY" parameter must match with the mechanical range of stroke. Set the carrier to the value of the actuator stroke. If the actuator stroke is not scaled, set it to the next higher scaled value.

The factory setting is "OFF".

4.INITA - automatic initialization

Use this parameter to start the automatic initialization process. Select the "Strt" parameter value. Then press the ⚠ increment button for at least five seconds. The sequence of the initialization process from "RUN1" to "RUN5" is displayed on the lower line on the digital display.

The factory setting is "NOINI".

5.INITM - manual initialization

Use this parameter to start the manual initialization process. Select the "Strt" parameter value. Then press the ⚠ increment button for at least five seconds.

Note

If the positioner has already been initialized and if the "INITA" and "INITM" values are set, it is possible to reset the positioner to the non-initialized status. For this purpose, press the ▽ decrement button for at least five seconds.

The factory setting is "NOINI".

See also

Commissioning (Page 113)

Sequence of automatic initialization (Page 114)

Manual initialization of linear actuators (Page 124)

Manual initialization of part-turn actuators (Page 130)

10.4.2 Description of parameters 6 through 51

10.4.2.1 Description of parameters 6

6.SCUR - Current range of setpoint

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

The factory setting is "4 MA".

See also

Basic device (Page 74)

Description of parameters 8 and 9 (Page 147)

10.4.2.2 Description of parameters 7

7.SDIR - Setpoint direction

This parameter is used to set the setpoint direction. The setpoint direction is used to reverse the direction of action of the setpoint. The setpoint direction is primarily used for single-acting actuators with the safety setting "up".

The factory setting is "riSE".

See also

Description of parameters 8 and 9 (Page 147)

10.4.2.3 Description of parameters 8 and 9

8.SPRA - Split range start

The factory setting is "0".

and

9.SPRE - Split range end

With these two parameters in combination with parameter "7.SDIR", 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

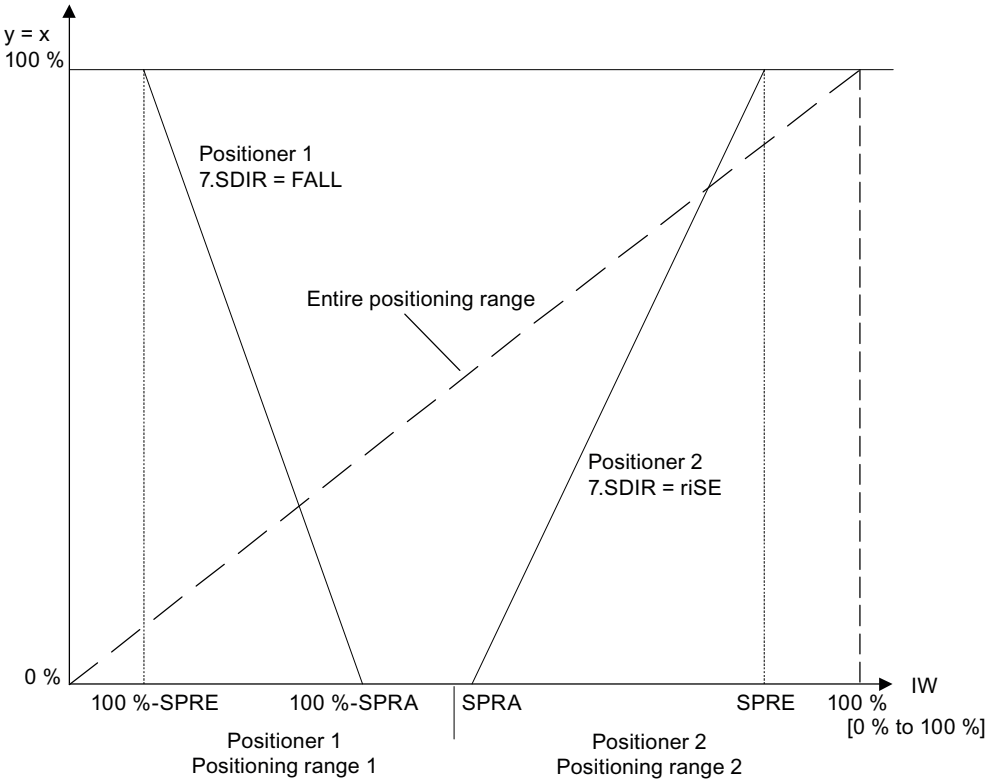


Figure 10-2 Example: Split range operation with two positioners

The factory setting is "100".

10.4.2.4 Description of parameters 10 and 11

10.TSUP - Setpoint ramp OPEN

and

11.TSDO - Setpoint ramp CLOSED

The setpoint ramp is effective in automatic mode and limits the speed of change of the effective setpoint. When switching from manual to automatic mode, the setpoint ramp is used to adjust the effective setpoint to the setpoint occupied by the positioner.

This smooth switching from manual to automatic mode prevents pressure excess in long pipelines.

The parameter value "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.

The factory setting is "0".

10.4.2.5 Description of parameters 12

12.SFCT - Setpoint function

This parameter is used to linearize nonlinear valve characteristics. For linear valve characteristics, arbitrary flow characteristics are formed.

See figure in Description of parameters 13 through 33 (Page 150).

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

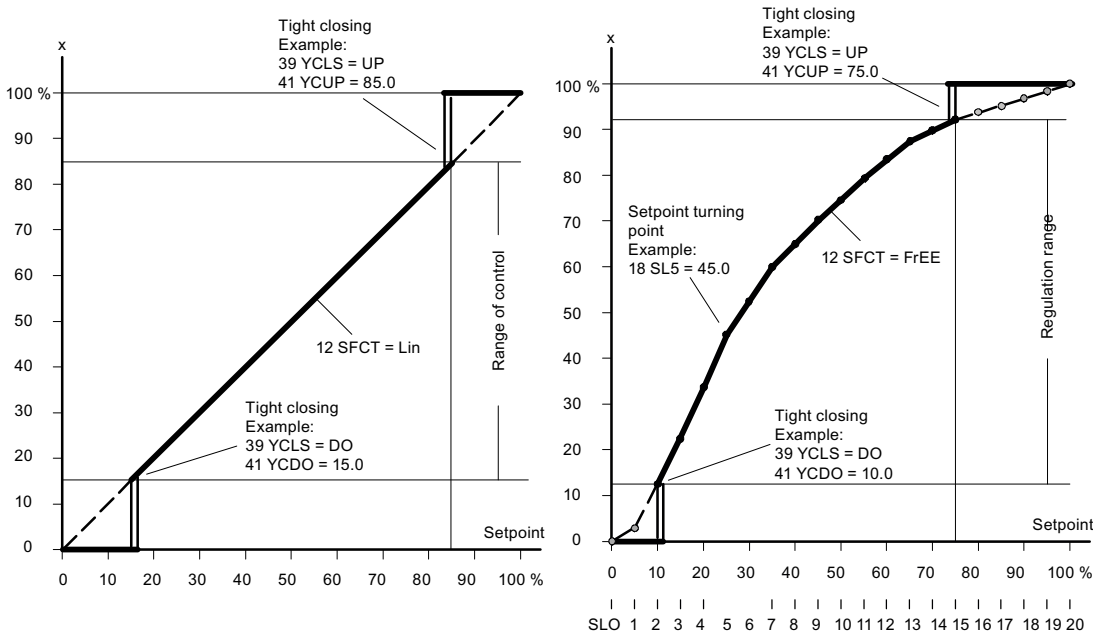
Valve characteristics		Set with parameter value
Linear		Lin
Equal percentage	1:25	1-25
Equal percentage	1:33	1-33
Equal percentage	1:50	1-50
Inverse equal percentage	25:1	n1-25
Inverse equal percentage	33:1	n1-33
Inverse equal percentage	50:1	n1-50
Freely adjustable		FrEE

The factory setting is "Lin".

10.4.2.6 Description of parameters 13 through 33

13.SL0 bis 33.SL20 - Setpoint interpolation points

These parameters are used to assign each setpoint interpolation point a flow metric in units of 5%. The setpoint interpolation points form a polygonal curve with 20 linear segments, which models the valve characteristic:



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

Input of the setpoint interpolation points is only possible for setting "12.SFCT = FrEE". You may only enter a monotonically rising characteristic and two consecutive interpolation points must differ by at least 0.2%.

Factory settings are "0", "5" ... "95", "100".

See also

Description of parameters 12 (Page 149)

10.4.2.7 Description of parameters 34

34.DEBA - Dead zone of closed-loop controller

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

In the other discrete settings, the fixed value for the dead zone is edited.

The factory setting is "Auto".

10.4.2.8 Description of parameters 35 and 36

35.YA - Start of the manipulated variable limit

The factory setting is "0".

and

36.YE - End of the manipulated variable limit

These parameters are used to limit the mechanical actuator travel from stop to stop to the configured values. This allows the mechanical positioning range of the actuator to be limited to the effective flow, preventing integral saturation of the controlling closed-loop controller.

See figure in Description of parameters 37 (Page 151).

Note

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

The factory setting is "100".

10.4.2.9 Description of parameters 37

YNRM - Normalization of manipulated variable

Using the "YA" and "YE" parameters, you can limit the manipulated variable. This limitation causes two different scaling types, MPOS or FLOW, for the digital display and for the position feedback through the current output. See the figure below.

The MPOS scaling type shows the mechanical position from 0 to 100% between the hard stops of the initialization. The position is not influenced by the "YA" or "YE" parameters. The parameters "YA" and "YE" are shown in the MPOS scale.

The FLOW scale is a scaling from 0 to 100% over 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 "I_Y". The flow-proportional display and position feedback "I_Y" also results from the use of valve characteristics.

In order to calculate the regulation difference, the setpoint in the digital display is also shown to 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 the parameters "YA" and "YE".

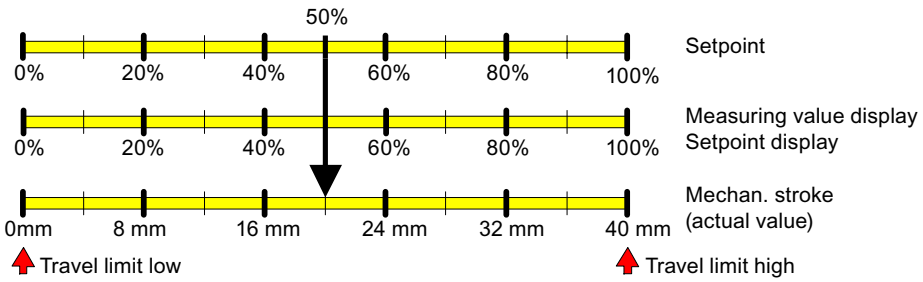


Figure 10-3 YNRM = MPOS or YNRM = FLOW; default: YA = 0 % and YE = 100 %

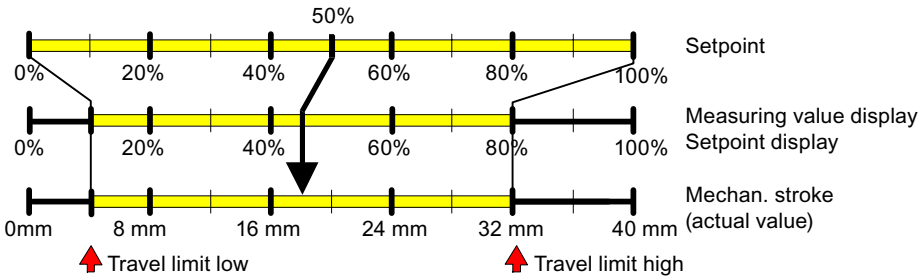


Figure 10-4 Example: YNRM = MPOS with YA = 10 % and YE = 80 %

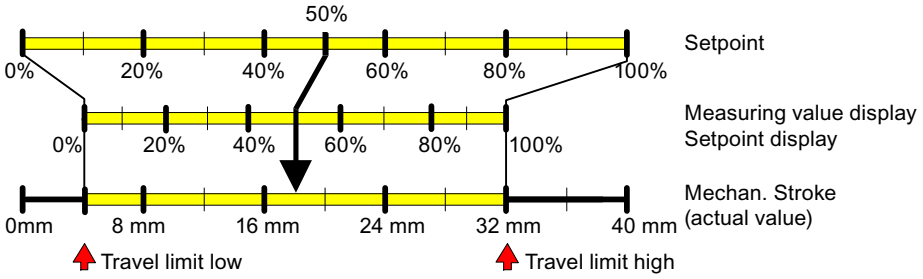


Figure 10-5 Example: YNRM = FLOW with YA = 10 % and YE = 80 %

The factory setting is "MPOS".

See also

Description of parameters 35 and 36 (Page 151)
Description of parameters 39 (Page 153)

10.4.2.10 Description of parameters 38

38.YDIR - Direction of manipulated variable for display

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.

The factory setting is "riSE".

10.4.2.11 Description of parameters 39

39.YCLS - Manipulated variable tight closing

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. The parameter "39.YCLS" becomes effective if the effective setpoint is below the parameter "40.YCDO" or above the parameter "41.YCUP".

See figure in Description of parameters 37 (Page 151) and figure in Description of parameters 13 through 33 (Page 150).

Note

Activated tight closing function

If the tight closing function is activated, then for parameter "49.ϟ LIM" the monitoring of regulation deviation is turned off in the appropriate overflow direction. Here, "YCDO: < 0 %" and "YCUP: > 100 %" apply. This functionality is especially advantageous for valves with soft seats. For a long-term monitoring of the end stop positions, we recommend activating the parameters "F.ϟZERO" and G. ϟ OPEN".

The factory setting is "no".

10.4.2.12 Description of parameters 40 and 41

40.YCDO - Lower value for tight closing

The factory setting is "0.5".

and

41.YCUP - Value for "tight closing above"

This parameter is used to set the value for "Tight closing below" and "Tight closing above".

Note

The value in the "40.YCDO" parameter must always be less than that in "41.YCUP". The tight closing function has a fixed hysteresis of 1%. The parameters "40.YCDO" and "41.YCUP" are relative to the mechanical stops. Both parameters are independent of the values set in the "7.SDIR" and "38.YDIR" parameters.

The factory setting is "99.5".

10.4.2.13 Description of parameters 42 and 43

42.BIN1 - Function binary input 1

and

43.BIN2 - Function binary input 2

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, can be read over the communication interface or fed through a logical OR combination with other messages to trigger the fault message output.

- BIN1 = bLoc1

  With this parameter value, you can lock the "configuration" operation mode against reconfiguration. The lock is performed e.g. with a jumper between terminals 9 and 10.

- BIN1 = bLoc2

  If binary input 1 is activated, then manual mode is also blocked in additional to the configuration operation mode.

- BIN1 or BIN2 = uP or doWn Contact closes or -uP or -doWn Contact opens.

  If the binary input is activated in automatic mode, the actuator regulates to the value specified by the parameters "35.YA" and "36.YE".

- BIN1 or BIN2 Contact closes = StoP or -StoP Contact opens.

  If the binary input is activated in automatic mode, the piezo valves are blocked. 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 (factory setting)

  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, then when the mode button is pushed the firmware version will be displayed.

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

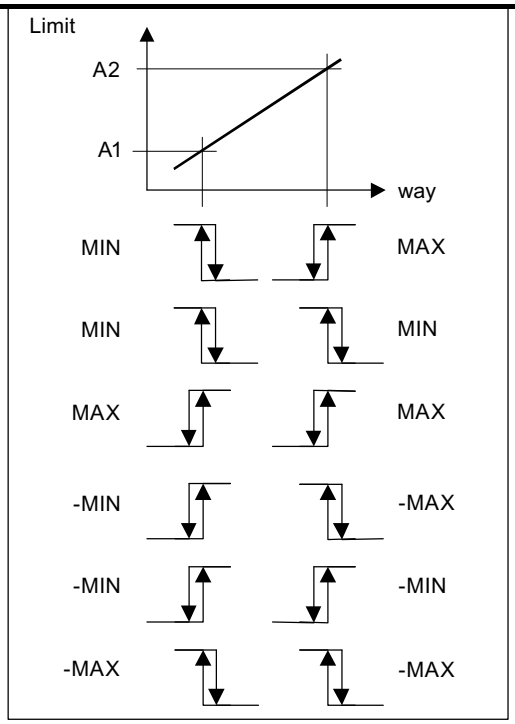
10.4.2.14 Description of parameters 44

44.AFCT - Alarm function

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 out over the HART communicator (optional).

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

Direction of action and hysteresis			
		Alarm module	
	Examples	A1	A2
	A1 = 48	AFCT = MIN / MAX	
	A2 = 52		
	Way =45	**Active**	
	Way =50		
	Way =55		**Active**
	A1 = 48	AFCT = -MIN / -MAX	
	A2 = 52		
	Way =45		**Active**
	Way =50	Active	Active
	Way =55	**Active**	
	A1 = 52	AFCT = MIN / MAX	
	A2 = 48		
	Way =45	**Active**	
	Way =50	Active	Active
	Way =55		**Active**

Direction of action and hysteresis			
	A1 = 52	AFCT = -MIN / -MAX	
	A2 = 48		
	Way =45		**Active**
	Way =50		
	Way =55	**Active**	

Note

If the extended diagnostic is activated using parameter "51.XDIAG" with setting "On2" or "On3", then the alarms will not be output through the alarm module. Notification through HART communication is possible at any time, however.

See also

Description of parameters 51 (Page 159)

10.4.2.15 Description of parameters 45 and 46

45.A1 - Trigger threshold, alarm 1

and

46.A2 - Trigger threshold, alarm 2

These parameters are used to specify when an alarm should be displayed. The response thresholds of the alarms "45.A1" and "46.A2" are relative to the MPOS scale, which corresponds to the mechanical way.

10.4.2.16 Description of parameters 47

47.ϟFCT - Fault message function

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 error message in advanced diagnostics

  See Description of parameters 51 (Page 159), 51.XDIAG activation of advanced diagnostics.

Note that the fault message cannot be switched off. It can however be suppressed (factory setting) when you switch over to "No automatic mode". If you want to generate a fault message here too, you must the parameter "47.ϟFCT" to "ϟnA".

You also have an option to "or" the fault message with the status of the binary inputs. To do this, set the "47.ϟFCT" parameter to "ϟnAb".

Select the setting "-ϟ" if you want to output the fault message inverted to the alarm or SIA unit.

The factory setting is "ϟ".

10.4.2.17 Description of parameters 48

48.ϮTIM - Monitoring time for setting of fault messages

This parameter is used to set the time in seconds within which the positioner must have reached the regulated condition. The corresponding response threshold is specified in the "49.ϟLIM" parameter.

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

Note

Activated tight closing function

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

10.4.2.18 Description of parameters 49

49.↳LIM - Response threshold of fault message

This parameter is used to set a value for the permissible size of the regulation deviation to trigger a fault message. The value is given in percent.

If the parameters "48.↳TIM" and "49.↳LIM" are set to "Auto", then the fault message is set if the slow motion zone is not reached within a certain period of time. The setting "Auto" is the factory setting. Within 5 to 95% of the actuator travel, this time is twice the initialization set time, and ten times the initialization set time outside of 10 to 90%.

Note

Activated tight closing function

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

10.4.2.19 Description of parameters 50

50.PRST - Preset

These parameters are used to restore the factory settings and reset initialization. To do this, press the increment button ⚠ for at least five seconds.

In particular when the positioner was already used previously on a different actuator, you must always restore factory settings before a fresh initialization. Only in this way can you start from known starting conditions. The parameter "PRST" is available for this purpose.

It is recommended to restore factory settings when you have changed many parameters at once but cannot predict their effect, and there are then undesired reactions.

Note

If you have activated the "Preset" parameter value for the factory setting, then you must reinitialize the positioner. All previously configured maintenance parameters will be deleted.

10.4.2.20 Description of parameters 51

51.XDIAG - Activation of extended diagnostics

This parameter is used to activate extended diagnostics. At the factory, extended diagnostics are deactivated. Parameter "51.XDIAG" is set to "OFF". To activate extended diagnostics, there are three modes available:

- On1: Extended diagnostics are activated. Threshold-3 fault messages will be output over the fault message output.
- On2: Extended diagnostics are activated. Threshold-2 fault messages will be activated using alarm output 2. Threshold-3 fault messages will also be output over the fault message output.
- On3: Extended diagnostics are activated. Threshold-1 fault messages will be activated using alarm output 1. Threshold-2 fault messages will be activated using alarm output 2. Threshold-3 fault messages will also be output over the fault message output.

Note

Please note that only after selection of one of the modes "On1" to "On3" will the parameters of extended diagnostics be shown on the digital display, from "A.ϟPST" to "P.ϟPAVG".

In the factory settings, parameters "A.ϟPST" through"P.ϟPST" are deactivated by default. Parameter "51.XDIAG" is set to "OFF". The corresponding parameters are only displayed after you activate the appropriate menu item with "On".

In advanced diagnosis, the threshold of the fault message is displayed using columns in addition to the error code. These columns are shown on the digital display as follows:

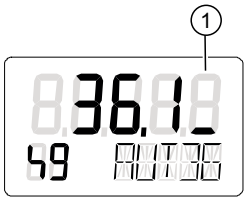


Figure 10-6 Display of a threshold 1 error message

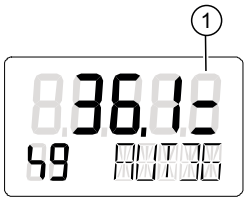


Figure 10-7 Display of a threshold 2 error message

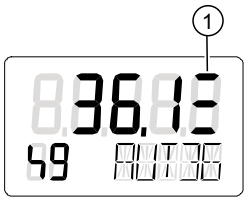


Figure 10-8 Display of a threshold 3 error message

The factory setting is "OFF".

10.4.3 Description of parameters A through P

10.4.3.1 Description of parameter A

A.ϟPST - partial stroke test

Use this parameter to activate the partial stroke test for cyclic or manual test of up/down and servo solenoid valves. Set the "On" parameter value to activate the test. Sub-parameters are displayed. If the sub-parameters are set to the desired parameter values, initiate the partial stroke test using:

- Buttons on the device
- A binary input
- Communication
- A cyclic test interval

Sub-parameters are described below.

The factory setting is "OFF".

A1.STPOS - start position

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 factory setting is "100.0".

A2.STTOL - start tolerance

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 "100.0".

Example: You have set 50% as a start position and 2% as a start tolerance. In this case, a partial stroke test is initiated during operation only between a current position of 48 and 52%.

The factory setting is "2.0".

A3.STEP - step height

Use this sub-parameter to define the step height of the partial stroke test in percent. Set the step height in a range from "0.1" to "100.0".

The factory setting is "10.0".

A4.STEPD - step direction

Use this sub-parameter to set the step direction of the partial stroke test. The following parameter values are available:

- "uP" for up
- "do" for down
- "uP do" for up and down

If you select the "uP" parameter value, it leads to the following:

- The actuator moves from the start position to the target position in a controlled manner.
- After reaching the target position, the actuator moves back to the start position in a controlled manner.

The target position is determined from the start position **plus** the step height.

The same procedure in the reverse order is applicable for the "do" parameter value.

If you select the "uP do" parameter value, it leads to the following:

- The actuator first moves from its start position to the upper target position in a controlled manner.
- Then the actuator moves from the upper target position to the lower target position in a controlled manner.
- After reaching the lower target position, the actuator moves back to the start position in a controlled manner.

The upper target position is determined from the start position **plus** the step height. The lower target position is determined from the start position **minus** the step height.

The factory setting is "do".

A5.INTRV - test interval

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".

The factory setting is "OFF".

A6.PSTIN - partial stroke test reference step time (PSTIN = partial stroke test initialization)

Use this sub-parameter to measure the reference step time for the partial stroke test. The unit is seconds. The reference step time corresponds to the controlled movement from the start position to the target position.

The positioner must be initialized in order to measure a reference step time. If the positioner is not yet initialized, the digital display shows "NOINI". If the positioner has already been initialized, the calculated average actuating time of the control valve is displayed as a reference value.

Example: An average actuating time of 1.2 seconds is shown in the digital display as "C 1.2", where "C" stands for "calculated". The average actuating time can be used as a reference step time. However, it merely represents a rough standard value.

Set the sub-parameters "A1" to "A5" as per your requirements. Then start measuring the reference step time by pressing the ⚠ increment button for at least five seconds. The digital display shows "rEAL" during these five seconds.

The device then moves to the set start position automatically and executes the desired jump. The current position in percent is continuously shown on the digital display. "inPST" for "initialize partial stroke test" appears in the lower line of the digital display. When the test is completed, the measured reference step time in seconds is shown on the digital display. "Fdini" is displayed if the start position cannot be approached or the step target cannot be achieved. "Fdini" stands for "failed PST initialization".

The factory setting is "NOINI".

A7.FACT1 - factor 1

Use this sub-parameter to set the factor for the formation of limit threshold 1. Set the factor in a range from "0.1" to "100.0". The limit threshold is the product of the reference step time and "A7.FACT1". The process to determine the reference step time is described under "A6.PSTIN".

The threshold 1 fault message is displayed when the limit threshold 1 exceeds. The process to activate and display this fault message is described in the "XDIAG" parameter.

The factory setting is "1.5".

A8.FACT2 - factor 2

Use this sub-parameter to set the factor for the formation of limit threshold 2. Set the factor in a range from "0.1" to "100.0". The limit threshold is the product of the reference step time and "A8.FACT2". The process to determine the reference step time is described under "A6.PSTIN".

The threshold 2 fault message is displayed when the limit threshold 2 exceeds. The process to activate and display this fault message is described in the "XDIAG" parameter.

The factory setting is "3.0".

A9.FACT3 - factor 3

Use this sub-parameter to set the factor for the formation of limit threshold 3. Set the factor in a range from "0.1" to "100.0". The limit threshold is the product of the reference step time and "A9.FACT32". The process to determine the reference step time is described under "A6.PSTIN".

The threshold 3 fault message is displayed when the limit threshold 3 exceeds. The process to activate and display this fault message is described in the "XDIAG" parameter.

If the time threshold exceeds, the control signal of the actuator is simultaneously cancelled to prevent a sticky or rusty valve, if any, from breaking off and overshooting.

The partial stroke test is then interrupted temporarily, a threshold 3 fault message is reported, and the actuator is moved back to its start position.

The factory setting is "5.0".

10.4.3.2 Description of parameter b

b.↳DEVI - general control valve fault

Use this parameter to activate the general control valve fault test for dynamic monitoring of the control valve response. 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. Set the "On" parameter value to activate the test. Sub-parameters are displayed. Sub-parameters are described below.

The current value is displayed in the "14 DEVI" diagnostics parameter. The positioner triggers a fault message if the current value exceeds one of the three configurable limit thresholds.

The factory setting is "OFF".

b1.TIM - time constant of the low-pass filter

Use this sub-parameter to define the attenuation effect of the low-pass filter. The unit is seconds. This sub-parameter is set to "Auto" if the device is initialized automatically. The "b1.TIM" time constant is determined from the initialization parameters such as "uP" and "doWn" actuating times.

If the time constant is not adequate, 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 too weak an attenuation.
- Setting "400" indicates too strong an attenuation.

The current value is displayed in the "14 DEVI" diagnostics parameter. The positioner triggers a fault message if the current value exceeds one of the three configurable limit thresholds.

The factory setting is "Auto".

b2.LIMIT - limit of the general control valve fault

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".

The factory setting is "1.0".

b3.FACT1 - factor 1

Use this sub-parameter to set the factor for the formation of limit threshold 1. Set the factor in a range from "0.1" to "100.0". The limit threshold is the product of "b2.LIMIT" and "b3.FACT1".

The threshold 1 fault message is displayed when the limit threshold 1 is exceeded. The process to activate and display this fault message is described in the "XDIAG" parameter.

The factory setting is "5.0".

b4.FACT2 - factor 2

Use this sub-parameter to set the factor for the formation of limit threshold 2. Set the factor in a range from "0.1" to "100.0". The limit threshold is the product of "b2.LIMIT" and "b4.FACT2".

The threshold 2 fault message is displayed when the limit threshold 2 is exceeded. The process to activate and display this fault message is described in the "XDIAG" parameter.

The factory setting is "10.0".

b5.FACT3 - factor 3

Use this sub-parameter to set the factor for the formation of limit threshold 3. Set the factor in a range from "0.1" to "100.0". The limit threshold is the product of "b2.LIMIT" and "b5.FACT3".

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

The factory setting is "15.0".

10.4.3.3 Description of parameter C

C.↳LEAK - pneumatic leakages

Use this parameter to activate the pneumatic leakage test. This test can be used to determine possible pneumatic leakages. Depending on the direction, changes in the position and the internal manipulated variable used for it are continuously recorded and filtered for this purpose. The filter result is used to form an indicator, which allows drawing a conclusion about a possible leakage.

NOTICE
Accuracy of results Note that this test delivers unambiguous results only in the case of single-acting, spring-loaded actuators.

Set the "On" parameter value to activate the test. Sub-parameters are displayed. Sub-parameters are described below.

The current value is displayed in the "15 ONLK" diagnostics parameter. The positioner triggers a fault message if the current value exceeds one of the three configurable limit thresholds.

The factory setting is "OFF".

C1.LIMIT - limit of the leakage indicator

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". There is no leakage if the limit is less than "30.0".

Utilize the complete sensitivity of the leakage detection as follows:

1. After initializing the positioner automatically, use a calibration device to initiate a ramp movement.
2. Conditions for the ramp movement:
   – The ramp must cover the normal operating range of the valve.
   – The steepness of the ramp must match the dynamic requirements of the corresponding application.
3. During the ramp movement, the "15 ONLK" diagnostics parameter provides information about the actual values. Define the limit of the leakage indicator accordingly.

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

The factory setting is "30.0".

C2.FACT1 - factor 1

Use this sub-parameter to set the factor for the formation of limit threshold 1. Set the factor in a range from "0.1" to "100.0". The limit threshold is the product of "C1.LIMIT" and "C2.FACT1".

The threshold 1 fault message is displayed when the limit threshold 1 exceeds. The process to activate and display this fault message is described in the "XDIAG" parameter.

The factory setting is "1.0".

C3.FACT2 - factor 2

Use this sub-parameter to set the factor for the formation of limit threshold 2. Set the factor in a range from "0.1" to "100.0". The limit threshold is the product of "C1.LIMIT" and "C3.FACT2".

The threshold 2 fault message is displayed when the limit threshold 2 exceeds. The process to activate and display this fault message is described in the "XDIAG" parameter.

The factory setting is "1.5".

C4.FACT3 - factor 3

Use this sub-parameter to set the factor for the formation of limit threshold 3. Set the factor in a range from "0.1" to "100.0". The limit threshold is the product of "C1.LIMIT" and "C4.FACT3".

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

The factory setting is "2.0".

10.4.3.4 Description of parameter d

d.↳STIC - static friction/slipstick effect

Use this parameter to continuously monitor the current static friction of the final controlling element (slipstick). If the parameter is activated, the positioner detects the slipstick effects

that may occur. Reverse changes in the valve position, the so-called slip jumps, let the positioner close at too large a static friction. If slip jumps are detected, the filtered step height is saved as a slipstick value. If slip jumps no longer exist, the slipstick value is reduced slowly.

Set the parameter value to "On" to activate the test. Sub-parameters are displayed. Sub-parameters are described below.

The current value is displayed in the "16 STIC" diagnostics parameter. The positioner triggers a fault message if the current value exceeds a limit threshold.

Note

Incorrect interpretation in case of actuating times below one second

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

The factory setting is "OFF".

d1.LIMIT - limit for slipstick detection

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".

The factory setting is "1.0".

d2.FACT1 - factor 1

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

The threshold 1 fault message is displayed when the limit threshold 1 exceeds. The process to activate and display this fault message is described in the "XDIAG" parameter.

The factory setting is "2.0".

d3.FACT2 - factor 2

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

The threshold 2 fault message is displayed when the limit threshold 2 is exceeded. The process to activate and display this fault message is described in the "XDIAG" parameter.

The factory setting is "5.0".

d4.FACT3 - factor 3

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

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

The factory setting is "10.0".

10.4.3.5 Description of parameter E

E.↳DEBA - dead zone monitoring

Use this parameter to activate the "dead zone monitoring" test. This test can be used to monitor the automatic adjustment of dead zones continuously.

Configure the following settings to activate the test:

1. Ensure that the "31.DEBA" parameter has been set to "Auto".
2. Set the "E.↳DEBA" parameter to "On". The sub-menu to set the threshold value is displayed. The test is activated.
3. Change the parameter in the sub-menu if required. The setting option is described below.

The positioner triggers a fault message if the current dead zone exceeds the configured limit threshold during the test.

The factory setting is "OFF".

E1.LEVL3 - threshold for monitoring the dead zone adjustment

Use this sub-parameter to set the factor limit threshold to monitor the dead zone adjustment. Set the threshold in a range from "0.1" to "10.0".

The threshold 3 fault message is displayed when the current dead zone exceeds the threshold limit during the test. The process to activate and display this fault message is described in the "XDIAG" parameter.

Note

Fault message display

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

The factory setting is "2.0".

10.4.3.6 Description of parameter F

F.↳ZERO - zero point displacement

Note

Fault detection

The monitoring unit for the zero point displacement responds to the fault in the valve. If the limit thresholds of the zero point displacement are exceeded due to misalignment of the position feedback, the misalignment also triggers a diagnostics message.

Use this parameter to activate the test to monitor the zero point displacement. The test is executed whenever the valve is in the "down tight closing" position. The test checks whether the value of the lower end stop has changed with respect to its value at the time of initialization (zero point P0).

Configure the following settings to activate the test:

1. Ensure that the parameter "YCLS" manipulated variable tight closing parameter is set to values "do" or "uP do".
2. Set the "F.↳ZERO" parameter to "On". Sub-parameters to set the test parameters are displayed. The test is activated.
3. Set the suitable parameter values in sub-parameters. The setting options available in sub-parameters are described below.

The current zero point displacement is displayed in the "17 ZERO" diagnostics parameter. The positioner triggers a fault message if the current value undershoots a threshold.

If the value undershoots a threshold, the fault message is saved in a power fail-safe manner until:

- No fault occurs during a repeat test.
- The device is re-initialized.
- The "F.↳ZERO" parameter is deactivated.

The factory setting is "OFF".

F1.LEVL1 - threshold 1

Use this sub-parameter to set a threshold in percent. Use threshold 1 to monitor the lower hard end stop. Set the threshold in a range from "0.1" to "10.0".

The positioner triggers a fault message if the difference between the lower hard end stop and the initialization value undershoots threshold 1. The process to activate and display this fault message is described in the "XDIAG" parameter.

The factory setting is "1.0".

F2.LEVL2 - threshold 2

Use this sub-parameter to set a threshold in percent. Use threshold 2 to monitor the lower hard end stop. Set the threshold in a range from "0.1" to "10.0".

The positioner triggers a fault message if the difference between the lower hard end stop and the initialization value undershoots threshold 2. The process to activate and display this fault message is described in the "XDIAG" parameter.

The factory setting is "2.0".

F3.LEVL3 - threshold 3

Use this sub-parameter to set a threshold in percent. Use threshold 3 to monitor the lower hard end stop. Set the threshold in a range from "0.1" to "10.0".

The positioner triggers a fault message if the difference between the lower hard end stop and the initialization value undershoots threshold 3. The process to activate and display this fault message is described in the "XDIAG" parameter.

The factory setting is "4.0".

10.4.3.7 Description of parameter G

G.↳OPEN - displacement of upper end stop

Note

Fault detection

The monitoring unit for the displacement of the upper end stops does not only respond to the fault in the valve. If the limit thresholds of the displacement of the upper end stop are exceeded due to the misalignment of position feedback, the misalignment also triggers a diagnostics message.

Use this parameter to activate the test to monitor the displacement of the upper end stop. The test is executed whenever the valve is in the "up tight closing" position. The test checks whether the value of the upper hard end stop has changed with respect to its value at the time of initialization (end stop P100).

Configure the following settings to activate the test:

1. Ensure that the parameter "YCLS" manipulated variable tight closing parameter is set to values "uP" or "do uP".
2. Set the "G.↳OPEN" parameter to "On". Sub-parameters to set the test parameters are displayed. The test is activated.
3. Set the suitable parameter values in sub-parameters. The setting options available in sub-parameters are described below.

The current displacement of the upper end stop is displayed in the "18 OPEN" diagnostics parameter. The positioner triggers a fault message if the current value exceeds a threshold.

If the value exceeds a threshold, the fault message is saved in a power fail-safe manner until:

- No fault occurs during a repeat test.
- The device is re-initialized.
- The "G.↳OPEN" parameter is deactivated.

The factory setting is "OFF".

G1.LEVL1 - threshold 1

Use this sub-parameter to set a threshold in percent. Use threshold 1 to monitor the upper hard end stop. Set the threshold in a range from "0.1" to "10.0".

The positioner triggers a fault message if the difference between the upper hard end stop and the initialization value exceeds threshold 1. The process to activate and display this fault message is described in the "XDIAG" parameter.

The factory setting is "1.0".

G2.LEVL2 - threshold 2

Use this sub-parameter to set a threshold in percent. Use threshold 2 to monitor the upper hard end stop. Set the threshold in a range from "0.1" to "10.0".

The positioner triggers a fault message if the difference between the upper hard end stop and the initialization value exceeds threshold 2. The process to activate and display this fault message is described in the "XDIAG" parameter.

The factory setting is "2.0".

G3.LEVL3 - threshold 3

Use this sub-parameter to set a threshold in percent. Use threshold 3 to monitor the upper hard end stop. Set the threshold in a range from "0.1" to "10.0".

The positioner triggers a fault message if the difference between the upper hard end stop and the initialization value exceeds threshold 3. The process to activate and display this fault message is described in the "XDIAG" parameter.

The factory setting is "4.0".

10.4.3.8 Description of parameter H

H.ϟTMIN - monitoring the lower limit temperature

Use this parameter to activate the test to continuously monitor the lower limit temperature inside the enclosure. The current temperature in the enclosure is recorded by a sensor on the electronic printed circuit board. The limit temperature is monitored in three stages.

Configure the following settings to activate the test:

1. Set the "H.ϟTMIN" parameter to "On". Sub-parameters to set the test parameters are displayed. The test is activated.
2. Set the suitable parameter values in sub-parameters. The setting options available in sub-parameters are described below.

The positioner triggers a fault message if the lower limit temperature undershoots a threshold during the test.

The factory setting is "OFF".

H1.TUNIT - temperature unit

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.

The factory setting is "°C".

H2.LEVL1 - threshold 1

Use this sub-parameter to set a threshold in "°C" or "°F". Use threshold 1 to monitor the lower limit temperature. Set the threshold in a range from "-40.0C" to "90.0C" or "-40.0F" to "194.0F".

The positioner triggers a fault message if the current temperature inside the enclosure undershoots threshold 1. The process to activate and display this fault message is described in the "XDIAG" parameter.

The factory setting is "-25.0C".

H3.LEVL2 - threshold 2

Use this sub-parameter to set a threshold in "°C" or "°F". Use threshold 2 to monitor the lower limit temperature. Set the threshold in a range from "-40.0C" to "90.0C" or "-40.0F" to "194.0F".

The positioner triggers a fault message if the current temperature inside the enclosure undershoots threshold 2. The process to activate and display this fault message is described in the "XDIAG" parameter.

The factory setting is "-30.0C".

H4.LEVL3 - threshold 3

Use this sub-parameter to set a threshold in "°C" or "°F". Use threshold 3 to monitor the lower limit temperature. Set the threshold in a range from "-40.0C" to "90.0C" or "-40.0F" to "194.0F".

The positioner triggers a fault message if the current temperature inside the enclosure undershoots threshold 3. The process to activate and display this fault message is described in the "XDIAG" parameter.

The factory setting is "-40.0C".

10.4.3.9 Description of parameter J

J.↳TMAX - monitoring the upper limit temperature

Use this parameter to activate the test to continuously monitor the upper limit temperature inside the enclosure. The current temperature in the enclosure is recorded by a sensor on the electronic printed circuit board. The limit temperature is monitored in three stages.

Configure the following settings to activate the test:

1. Set the "J.ϟTMAX" parameter to "On". Sub-parameters to set the test parameters are displayed. The test is activated.
2. Set the suitable parameter values in sub-parameters. The setting options available in sub-parameters are described below.

The positioner generates a fault message if the upper limit temperature exceeds a threshold during the test.

The factory setting is "OFF".

J1.TUNIT - temperature unit

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.

The factory setting is "°C".

J2.LEVL1 - threshold 1

Use this sub-parameter to set a threshold in "°C" or "°F". Use threshold 1 to monitor the upper limit temperature. Set the threshold in a range from "-40.0C" to "90.0C" or "-40.0F" to "194.0F".

The positioner triggers a fault message if the current temperature inside the enclosure exceeds threshold 1. The process to activate and display this fault message is described in the "XDIAG" parameter.

The factory setting is "75.0C".

J3.LEVL2 - threshold 2

Use this sub-parameter to set a threshold in "°C" or "°F". Use threshold 2 to monitor the upper limit temperature. Set the threshold in a range from "-40.0C" to "90.0C" or "-40.0F" to "194.0F".

The positioner triggers a fault message if the current temperature inside the enclosure exceeds threshold 2. The process to activate and display this fault message is described in the "XDIAG" parameter.

The factory setting is "80.0C".

J4.LEVL3 - threshold 3

Use this sub-parameter to set a threshold in "°C" or "°F". Use threshold 3 to monitor the upper limit temperature. Set the threshold in a range from "-40.0C" to "90.0C" or "-40.0F" to "194.0F".

The positioner triggers a fault message if the current temperature inside the enclosure exceeds threshold 3. The process to activate and display this fault message is described in the "XDIAG" parameter.

The factory setting is "90.0C".

10.4.3.10 Description of parameter L

L.↳STRK - monitoring the path integral

Use this parameter to monitor the entire path covered by the final controlling element continuously.

Configure the following settings to activate the test:

1. Set the "L.↳STRK" parameter to "On". Sub-parameters to set the test parameters are displayed. The test is activated.
2. Set the suitable parameter values in sub-parameters. The setting options available in sub-parameters are described below.

The following is applicable for the version with PROFIBUS communication: This test determines the actuator movements in 100% strokes. In this case, a 100% stroke is equal to twice the complete path, e.g. from ON→OFF and OFF→ON.

The following is applicable for the standard version and the version with FOUNDATION fieldbus communication: This test determines the actuator movements in 100% strokes. In this case, a 100% stroke is equal to the complete path, e.g. from ON→OFF or OFF→ON.

The current value is displayed in the "1 STRKS" diagnostics parameter. The positioner triggers a fault message if the current value exceeds a limit threshold.

The factory setting is "OFF".

L1.LIMIT - limit for the number of strokes

Use this sub-parameter to set the base limit for the number of strokes. Set the base limit in a range from "1" to "1.00E8".

The factory setting is "1.00E6".

L2.FACT1 - factor 1

Use this sub-parameter to set the factor for the formation of limit threshold 1. Set the factor in a range from "0.1" to "40.0". The limit threshold is the product of "L1.LIMIT" and "L2.FACT1".

The threshold 1 fault message is displayed when the limit threshold 1 exceeds. The process to activate and display this fault message is described in the "XDIAG" parameter.

The factory setting is "1.0".

L3.FACT2 - factor 2

Use this sub-parameter to set the factor for the formation of limit threshold 2. Set the factor in a range from "0.1" to "40.0". The limit threshold is the product of "L1.LIMIT" and "L3.FACT2".

The threshold 2 fault message is displayed when the limit threshold 2 exceeds. The process to activate and display this fault message is described in the "XDIAG" parameter.

The factory setting is "2.0".

L4.FACT3 - factor 3

Use this sub-parameter to set the factor for the formation of limit threshold 3. Set the factor in a range from "0.1" to "40.0". The limit threshold is the product of "L1.LIMIT" and "L4.FACT3".

The threshold 3 fault message is displayed when the limit threshold 3 exceeds. The process to activate and display this fault message is described in the "XDIAG" parameter.

The factory setting is "5.0".

See also

Display of diagnostics values (Page 184)

10.4.3.11 Description of parameter O

O.↳DCHG - monitoring the change of direction

Use this parameter to continuously monitor the number of changes of direction of the actuator caused in the dead zone.

Configure the following settings to activate the test:

1. Set the "O.↳DCHG" parameter to "On". Sub-parameters to set the test parameters are displayed. The test is activated.
2. Set the suitable parameter values in sub-parameters. The setting options available in sub-parameters are described below.

The current value is displayed in the "2 CHDIR" diagnostics parameter. The positioner triggers a fault message if the current value exceeds a limit threshold.

The factory setting is "OFF".

O1.LIMIT - limit for the change of direction

Use this sub-parameter to set the base limit for the number of changes of direction of the actuator. Set the base limit in a range from "1" to "1.00E8".

The factory setting is "1.00E6".

O2.FACT1 - factor 1

Use this sub-parameter to set the factor for the formation of limit threshold 1. Set the factor in a range from "0.1" to "40.0". The limit threshold is the product of "O1.LIMIT" and "O2.FACT1".

The threshold 1 fault message is displayed when the limit threshold 1 exceeds. The process to activate and display this fault message is described in the "XDIAG" parameter.

The factory setting is "1.0".

O3.FACT2 - factor 2

Use this sub-parameter to set the factor for the formation of limit threshold 2. Set the factor in a range from "0.1" to "40.0". The limit threshold is the product of "O1.LIMIT" and "O3.FACT2".

The threshold 2 fault message is displayed when the limit threshold 2 exceeds. The process to activate and display this fault message is described in the "XDIAG" parameter.

The factory setting is "2.0".

O4.FACT3 - factor 3

Use this sub-parameter to set the factor for the formation of limit threshold 3. Set the factor in a range from "0.1" to "40.0". The limit threshold is the product of "O1.LIMIT" and "O4.FACT3".

The threshold 3 fault message is displayed when the limit threshold 3 exceeds. The process to activate and display this fault message is described in the "XDIAG" parameter.

The factory setting is "5.0".

See also

Display of diagnostics values (Page 184)

10.4.3.12 Description of parameter P

P.┘PAVG - calculation of position average

Use this parameter to activate the test to calculate and monitor the position average.

Configure the following settings to activate the test:

1. Set the "P.┘PAVG" parameter to "On". Sub-parameters to set the test parameters are displayed. The test is activated.
2. Set the suitable parameter values in sub-parameters. The setting options available in sub-parameters are described below.

During the test, the position and reference average values are always compared at the end of a time interval. The positioner triggers a fault message if the current position average exceeds a threshold.

The factory setting is "OFF".

P1.TBASE - time base for averaging

Use this sub-parameter to set the time interval to calculate the position average.

The following values are available to define the time intervals:

- 30 minutes
- 8 hours
- 5 days

- 60 days
- 2.5 years

After starting the reference average calculation and the expiry of the time interval, a position average over the interval period is determined and compared with the reference average. The test is then restarted.

The factory setting is "0.5 h".

P2.STATE - status of the position average calculation

Use this sub-parameter to start the calculation of the position average. If a reference average has never been determined yet, the parameter value is "IdLE".

Then start the calculation by pressing the ⚠ increment button for five seconds. The value in the digital display changes from "IdLE" to "rEF". The reference average is calculated.

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

Note

The respective current position average is displayed in the "19 PAVG" diagnostics parameter. If no position average has been calculated, "COMP" is displayed in the "19 PAVG" diagnostics parameter.

The factory setting is "IdLE".

P3.LEVL1 - threshold 1

Use this sub-parameter to set threshold 1 for the maximum deviation of the current position average from the reference average. Set the threshold in a range from "0.1" to "100.0".

The positioner triggers a fault message if the difference between the position average and the reference average exceeds threshold 1. The process to activate and display this fault message is described in the "XDIAG" parameter.

The factory setting is "2.0".

P4.LEVL2 - threshold 2

Use this sub-parameter to set threshold 2 for the maximum deviation of the current position average from the reference average. Set the threshold in a range from "0.1" to "100.0".

The positioner triggers a fault message if the difference between the position average and the reference average exceeds threshold 2. The process to activate and display this fault message is described in the "XDIAG" parameter.

The factory setting is "5.0".

P5.LEVL3 - threshold 3

Use this sub-parameter to set threshold 3 for the maximum deviation of the current position average from the reference average. Set the threshold in a range from "0.1" to "100.0".

The positioner triggers a fault message if the difference between the position average and the reference average exceeds threshold 3. The process to activate and display this fault message is described in the "XDIAG" parameter.

The factory setting is "10.0".

11 Alarm, error, and system messages

11.1 Representation of system messages in the digital display

11.1.1 System messages before initialization

Remarks about the tables:

nn	stands for variable numeric values
↳	Error symbol
/	(Slash): texts to the left and the right of the slash blink alternately

Messages before initialization (first commissioning)

Message	Line		Meaning / cause	Measure
	Up	Down		
CPUStart	X	X	Message after connecting the electrical auxiliary power supply	• Wait
Pnnn.n	X		Potentiometer voltage of a non-initialized positioner (P-manual mode) (actual position value in % of the measuring range)	• Check whether the entire actuator travel can be covered using the "+" and "-" buttons and "P---" is never displayed • Execute the initialization process
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 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 the initialization process

See also

Digital display (Page 95)

11.1.2 System messages during initialization

Remarks about the tables:

nn	stands for variable numeric values
↳	Error symbol
/	(Slash): texts to the left and the right of the slash blink 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 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 end stops)	• Wait
RUN3		X	Initialization part 3 is active (determination and display of actuating 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 completed successfully) • Acknowledge by pressing the operating mode button slightly and exit the configuration level by pressing it longer
YEND1		X	The first end position can be approached only in case of a manual initialization	• Approach the first end position using the "+" or "-" button • Acknowledge using the operating mode button
YEND2		X	The second end position can be approached only in case of a manual initialization	• Approach the second end position using the "+" or "-" button • Acknowledge using the operating mode button
RANGE		X	The end position or the measuring span is beyond the permissible range only in case of a manual initialization	• Approach another end position using the "+" and "-" buttons and acknowledge with the operating mode button, or • Move the friction clutch until "ok" is displayed, and then acknowledge with the operating mode button, or • Terminate the initialization process by pressing the operating mode button, switch to the P-manual mode and correct the actuator travel and the position displacement sensor

	Line			
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	• Provide adequate compressed air • Open the restrictor(s) • Restart the initialization process
┗d___U		X	Bar graph display of the zero point; zero point is beyond the tolerance range	• Set between "P 4.0" and "P .9" (>0<) using a friction clutch • Continue with the "+" or "-" button
SEt	X		Friction clutch was moved; "P 50.0" not displayed when the lever is horizontal	• In case of linear actuators, use the "+" and "-" buttons to bring the lever perpendicular to the spindle • Press the operating mode button slightly to acknowledge (the initialization process is continued)
MIDDL		X		
┗UP >		X	"UP" tolerance range was exceeded or the inactive zone of the potentiometer was covered	• Increase the effective lever length of the linear actuators or switch the transmission ratio selector to 90° • Press the operating mode button slightly to acknowledge • Restart the initialization process
┗90_95		X	Possible only in case of part-turn actuators: actuator travel is not in the range between 90 and 95%	• Use the "+" and "-" buttons to move it in the range between 90 and 95% • Press the operating mode button slightly to acknowledge
┗U-d>		X	"Up-Down" measuring span was undershot	• Decrease the effective lever length of the linear actuators or switch the transmission ratio selector to 33° • Press the operating mode button slightly to acknowledge • Restart the initialization process
U nn.n	X		Display of the "Up" actuating time	• Wait, or • To change the actuating time, interrupt the initialization process with the "-" button, or • Activate the leakage test with the "+" button
D->U		X		
D nn.n	X		Display of the "Down" actuating time	• Wait, or • To change the actuating time, interrupt the initialization process with the "-" button, or • Activate the leakage test with the "+" button
U->d		X		
NOZZL		X	Actuator stops (the initialization process was interrupted using the "-" button when the actuation speed display was active)	• The actuating time can be changed by adjusting the restrictor(s) • Redetermine the speed of shifting using the "-" button • Continue with the "+" button
TESt	X		Leakage test active (the "+" button was	• Wait for 1 minute

	Line			
LEAKG		X	pressed when the actuation speed display was active)	
nn.n	X		Value and unit of the result after the leakage test	• Rectify the leakage if the value is too large • Continue with the "+" button
%/MIN		X		
nn.n	X		Initialization completed successfully with the display of actuator travel or the actuator angle	• Acknowledge by pressing the operating mode button slightly and exit the configuration level by pressing it longer
FINISH		X		

See also

System messages before initialization (Page 179)

11.1.3 System messages when exiting the Configuration mode

Remarks about the tables:

nn	stands for variable numeric values
↳	Error symbol
/	(slash): the text to the left and right of the slash blink interchangeably.

Messages when exiting the configuration mode:

Message	Goals		Operating mode			Meaning / Cause	Measure
	Up	Down	Automatic	Manual mode	P Manual mode		
n.nn.nnVER	X	X				Software version	• Wait
ErrorSLnn	X	X				Monotony interruption of the free characteristic on the setpoint turning point n	• Correct value

11.1.4 System messages during operation

Remarks on the tables:

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

Messages during operation:

Message	Line		Mode			Meaning / cause	Measure
	Above	Below	Automatic	Manual	P-manual		
CPUSTART	X	X				Message after application of electrical auxiliary power	• Maintenance
HW / ERROR		X				Fault in the hardware	• Replace electronics
NOINI		X			X	Positioner is not initialized	• Start initialization
nnn.n	X		X	X		Actual position [in %] for initialized positioner. Flashing decimal point shows communication with a class-2 master	
AUTnn		X	X			Automatic mode (nn = setpoint)	
MANnn				X		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 disturbed or • Positioner was installed on a different actuator without being reinitialized	• 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 with the binary input	
EX UP		X	X			Actuator is moved to the upper stop with binary input	
EXDWN		X	X			Actuator is moved to the lower stop with binary input	

	Line		Mode				
EXTPSt						Partial-Stroke-Test was activated, e.g. through binary input	
InPSt						Cyclic Partial-Stroke-Test	
HTCNF		X	X	X	X	HART configuration running	

11.2 Diagnosis

11.2.1 Display of diagnostics values

Structure of the diagnosis display

The diagnostics display has similar structure to that of the "Configuration" mode:

- The upper line shows the value of the diagnosis 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 diagnosis display.
2. Use the operating mode button to select the next diagnosis value.

How to show the diagnosis values in reverse order

Press the operating mode button together with the decrement button.

How to set values to zero

Specific values can be set to zero by pressing the increment button for at least 5 seconds.

See also

Description of parameter L (Page 173)

Description of parameter O (Page 174)

11.2.2 Overview of diagnostics values

Explanation about the table

The following table provides an overview of values that can be displayed. The third column contains the German meaning and the corresponding English term used to derive the abbreviation if it is not self-explanatory. The last column contains "X" if the value can be set to zero.

Overview of diagnostics values

No.	Abbreviation	Meaning	Values that can be displayed	Unit	Reset possible
1	STRKS	Stroke number (Strokes)	0 ... 4.29E9	-	X
2	CHDIR	Changes of direction (Changes of Direction)	0 ... 4.29E9	-	X
3	↳CNT	Number of fault messages (↳Counter)	0 ... 4.29E9	-	X
4	A1CNT	Number of alarms 1 (Alarm 1 Counter)	0 ... 4.29E9	-	X
5	A2CNT	Number of alarms 2 (Alarm 2 Counter)	0 ... 4.29E9	-	X
6	HOURS	Operating hours (Hours)	0 ... 4.29E9	Hours	-
7	WAY	Determined actuator travel (Way)	0 ... 130	mm or °	-
8	TUP	Actuating time up (Travel Time Up)	0 ... 1000	s	-
9	TDOWN	Actuating time down (Travel Time Down)	0 ... 1000	s	-
10	LEAK	Leakage (Leakage)	P 0.0 ... 100.0	%	-
11	PST	Monitoring of the partial stroke test	OFF / ###.#, fdini, notSt, SdtSt, fdtSt, notd, Strt	s for ###.#	-
12	PRPST	Time since the last Partial-Stroke-Test	###, notSt, Sdtst, fdtSt	Days	-
13	NXPST	Time until the next Partial-Stroke-Test	###, notSt, SdtSt, fdtSt	Days	-
14	DEVI	General control valve fault	OFF, 0.0 ... 100.0	%	-
15	ONLK	Pneumatic leakage	OFF, 0.0 ... 100.0	-	-
16	STIC	Static friction/Slipstick effect	OFF, 0.0 ... 100.0	%	-
17	ZERO	Zero point displacement	OFF, 0.0 .. 100.0	%	-
18	OPEN	Displacement of upper end stop	OFF, 0.0 ... 100.0	%	-
19	PAVG	Position average	0.0 ... 100.0	%	-
20	P0	Potentiometer value of lower end stop (0%)	0.0 ... 100.0	%	-
21	P100	Potentiometer value of upper end stop (100%)	0.0 ... 100.0	%	-
22	IMPUP	Impulse length up (Impuls Length Up)	6 ... 160	ms	-
23	IMPDN	Impulse length down (Impuls Length Down)	6 ... 160	ms	-
24	DBUP	Dead zone up (Dead Band Up)	0.1 ... 10.0	%	-
25	DBDN	Dead zone down (Dead Band Down)	0.1 ... 10.0	%	-
26	SSUP	Slow step zone up (Short Step Zone Up)	0.1 ... 100.0	%	-
27	SSDN	Slow step zone down (Short Step Zone Down)	0.1 ... 100.0	%	-

No.	Abbreviation	Meaning	Values that can be displayed	Unit	Reset possible
28	TEMP	Current temperature	-40 ... 85	°C	-
29	TMIN	Minimum temperature ("min/max pointer")	-40 ... 85	°C	-
30	TMAX	Maximum temperature ("min/max pointer")	-40 ... 85	°C	-
31	T1	Number of operating hours in temperature range 1	0 ... 4.29E9	Hours	-
32	T2	Number of operating hours in temperature range 2	0 ... 4.29E9	Hours	-
33	T3	Number of operating hours in temperature range 3	0 ... 4.29E9	Hours	-
34	T4	Number of operating hours in temperature range 4	0 ... 4.29E9	Hours	-
35	T5	Number of operating hours in temperature range 5	0 ... 4.29E9	Hours	-
36	T6	Number of operating hours in temperature range 6	0 ... 4.29E9	Hours	-
37	T7	Number of operating hours in temperature range 7	0 ... 4.29E9	Hours	-
38	T8	Number of operating hours in temperature range 8	0 ... 4.29E9	Hours	-
39	T9	Number of operating hours in temperature range 9	0 ... 4.29E9	Hours	-
40	VENT1	Number of switching cycles of pilot valve 1	0 ... 4.29E9	-	-
41	VENT2	Number of switching cycles of pilot valve 2	0 ... 4.29E9	-	-
42	STORE	Save the current value as "last maintenance" (press the increment button for 5 s) (Store)	-	-	-
43	PRUP	Prediction up	1 ... 40	-	-
44	PRDN	Prediction down	1 ... 40	-	-
45	WT00	Number of operating hours in the actuating range WT00	0 ... 4.29E9	Hours	X
46	WT05	Number of operating hours in the actuating range WT05	0 ... 4.29E9	Hours	X
47	WT10	Number of operating hours in the actuating range WT10	0 ... 4.29E9	Hours	X
48	WT30	Number of operating hours in the actuating range WT30	0 ... 4.29E9	Hours	X
49	WT50	Number of operating hours in the actuating range WT50	0 ... 4.29E9	Hours	X
50	WT70	Number of operating hours in the actuating range WT70	0 ... 4.29E9	Hours	X
51	WT90	Number of operating hours in the actuating range WT90	0 ... 4.29E9	Hours	X
52	WT95	Number of operating hours in the actuating range WT95	0 ... 4.29E9	Hours	X

Diagnostic value 53

No.	Abbreviation	Meaning	Values that can be displayed	Unit	Reset possible
53	mA	Setpoint current	0.0 to 20.0	mA	--

11.2.3 Meaning of diagnostics values

1 STRKS - stroke number

The movements of the actuator in operation are summed up and can be read here as the stroke number. Unit: 100% strokes, i.e. the path between 0 and 100% and back. The value is written in a non-volatile memory every 15 minutes. The non-volatile memory can be set to zero using the ⚠ increment button.

2 CHDIR - number of changes of direction

Every change of direction of the actuator caused in the dead zone is noted in the closed-loop controller and added to the number of changes of direction.

The value is written in a non-volatile memory every 15 minutes. The non-volatile memory can be set to zero using the ⚠ increment button.

3 CNT - number of fault messages

Every fault is noted in the closed-loop controller and added to the number of fault messages. The counter can be set to zero using the ⚠ increment button.

4 A1CNT - number of alarms 1

and

5 A2CNT - number of alarms 2

The response of alarms 1 and 2 is counted using these two counters. Activation of alarms using the "AFCT" parameter is a condition for this. The counters can be set to zero using the ⚠ increment button.

6 HOURS - operating hours

The runtime meter is incremented every hour as soon as electric auxiliary power is supplied to the positioner.

7 WAY - determined actuator travel

This value indicates the actuator travel determined during the initialization process as per the display at the end of an initialization process. Conditions for lift actuators: Specification of the lever arm using the "YWAY" parameter.

8 TUP - actuating time up

9 TDOWN - actuating time down

These values indicate the actuating times determined during the initialization process. The unit is seconds.

10 LEAK - leakage

If a leakage measurement was initiated during the initialization process, the leakage value in %/min can be read here.

11 PST - monitoring of the Partial-Stroke test

The measured step time of the last partial stroke test is displayed here. A partial stroke test can be initiated manually or a current partial stroke test can be interrupted by pressing the increment button ⚠.

The following statuses are shown on the digital display:

- OFF

  The partial stroke test function is deactivated in the configuration menu.

- FdIni - Failed PST Initialization

  The reference step time measurement of the partial stroke test has failed.

- notSt - No Test

  A manual partial stroke test was not yet executed.

- ###.# (measured step 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.

The following status messages appear when you press the increment button ⚠:

- 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.

12 PRPST - time since the last partial stroke test

The time in days elapsed since the last partial stroke test is displayed here. In addition, the following status messages can be displayed:

- notSt - No Test

  A manual partial stroke test was not yet executed.

- SdtSt - Stopped Test

  The last Partial-Stroke-Test was interrupted.

- FdtSt - Failed Test

  The last partial stroke test has failed.

13 NXPST - time until the next partial stroke test

The time in days until the next partial stroke test is displayed here. The conditions are that the partial stroke test is activated in the configuration menu and a test interval is set. If one of the above-mentioned conditions is not met, "OFF" is shown on the digital display.

14 DEVI - general control valve fault

This value provides information about the present dynamically determined deviation from the model response. If the underlying function is deactivated in the configuration menu, "OFF" is displayed.

15 ONLK - pneumatic leakage

The current leakage indicator is displayed here. If the leakage detection is deactivated in the configuration menu, "OFF" is displayed.

16 STIC - static friction/slipstick effect

The filtered value of the step height based on static friction is displayed here in percent. If the function is deactivated in the configuration menu, "OFF" is displayed.

17 ZERO - zero point displacement

Display of the current displacement of the lower hard end stop with respect to its initialization value. The activation of the "down tight closing function" is a condition to determine this. Activate using the "YCLS" parameter in the configuration menu. If the underlying function is deactivated in the configuration menu, "OFF" is displayed.

18 OPEN - displacement of upper end stop

Display of the current displacement of the upper hard end stop with respect to its initialization value. The activation of the "up tight closing function" is a condition to determine this. Activate using the "YCLS" parameter in the configuration menu. If the underlying function is deactivated in the configuration menu, "OFF" is displayed.

19 PAVG - position average

The last calculated comparison average is displayed here. The following status messages are also available:

- 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.

20 P0 - potentiometer value of the lower end stop

21 P100 - potentiometer value of the upper end stop

Both these values indicate the measured values of the position displacement sensor (potentiometer) on the lower or upper hard end stop, as they were determined during automatic initialization. The values of manually approached end positions are applicable for manual initialization.

22 IMPUP - impulse length up

This parameter can be set for special applications.

23 IMPDN - impulse length down

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.

This parameter can be set for special applications.

24 DBUP - dead zone up

25 DBDN - dead zone down

The dead zones of the closed-loop controller in the "Up" and "Down" directions are displayed here. The values correspond to either the manually set value of the "DEBA" parameter or the automatically adapted value by the device if DEBA" was set to "Auto".

26 SSUP - slow step zone up

This parameter can be set for special applications.

27 SSDN - slow step zone down

The slow step zone is the zone of the closed-loop controller in which control signals are issued in a pulsed manner. 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.

28 TEMP - current temperature

Current temperature in the positioner enclosure. The sensor is provided on the electronic printed circuit board.

The temperature display can be toggled between °C and °F by pressing the decrement button.

29 TMIN - minimum temperature ("min/max pointer")

30 TMAX - maximum temperature ("min/max pointer")

The minimum and maximum temperatures inside the enclosure are continuously determined and saved using a min/max pointer. They can be reset only in the factory.

31 T1 ... 39 T9 - number of operating hours in temperature ranges T1 to T9

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

40 VENT1 - number of switching cycles of pilot valve 1

41 VENT2 - number of switching cycles of pilot valve 2

Both these counters sum up the control processes of pilot valves and are used to assess the switching frequency.

42 STORE - save maintenance data

A save function can be initiated by pressing the ⚠ increment button for at least 5 seconds. The diagnostics data 7 to 10 and 20 to 27 is 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 "Device-> Save maintenance info". The data of the last maintenance data can be compared with the current data using the PDM.

43 PRUP - prediction up

and

44 PRDN - prediction down

Also see Optimizing the controller data (Page 103)

45 WT00 bis 52 WT95 - number of operating hours in the actuating ranges WT00 to WT95

When the positioner is in the automatic mode, statistics regarding the duration for which a valve or a flap operated in a particular section of the actuating range are continuously maintained. The entire actuating 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 actuating 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.

The actuating range is divided as follows:

Actuating range	WT00	WT05	WT10	WT30	WT50	WT70	WT90	WT95
Actuating range section [%]	-	≥ 5	≥ 10	≥ 30	≥ 50	≥ 70	≥ 90	≥ 95
	< 5	< 10	< 30	< 50	< 70	< 90	< 95	-

Division of actuating range

You can simultaneously set the eight runtime meters to zero. To do this, press the ⚠ increment button for at least five seconds.

TIP: Since the actuating ranges are provided at the end of the diagnostics menu, press the ▽ decrement button repeatedly along with the operating mode button. This will help you in accessing the diagnostics numbers faster.

Note

All diagnostics values are updated in the non-volatile memory every 15 minutes so that, in case of a power failure, only the values of the previous 15 minutes may be lost.

See also

Description of parameters 13 through 33 (Page 150)

11.2.4 Meaning of diagnostic value 53

53 mA - setpoint current

Here, you can display the current setpoint in mA.

Note

All diagnostic value are updated every 15 minutes to a non-volatile memory, so that in case of a power failure only the values from the last quarter hour will be lost.

11.3 Online diagnostics

11.3.1 Overview of online diagnostics

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 Chapter Overview of error codes (Page 194).

This chapter 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 a fault message

In automatic and manual mode, when the fault message output triggers the digital display shows what 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

Overview of error codes (Page 194)

Description of parameters 51 (Page 159)

11.3.2 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

11.3.3 Overview of error codes

Overview of error codes that activate the fault message output

Error code	Three-stage	Event	Parameter setting	Fault message disappears when	Possible causes
↳1	No	Remaining control deviation	Always active	... the control deviation disappears again.	Compressed air failure, actuator fault, valve fault (e.g. blockade).
↳2	No	Device not in the automatic mode	**.↳FCT[1)] =↳nA or = ↳nAB	... the device is switched to the automatic mode.	The device has been configured or is in the manual mode
↳3	No	Binary input BE1 or BE2 active	**.↳ FCT[1)] =↳nAB and binary function BIN1 or BIN2 on "On"	... the binary input is no longer active.	The contact connected to the binary input was active (e.g. packing gland monitoring, overpressure, temperature switch).
↳4	Yes	The limit of stroke number 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 set thresholds.
↳5	Yes	Limit of changes of 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 set thresholds.
↳6	Yes	Limit of the lower hard end stop exceeded	F.↳ZERO≠OFF **.YCLS = do or up do	... the deviation of the end stop 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	Limit of the upper hard end stop exceeded	G.↳OPEN≠OFF **.YCLS[1)] = do or up do	... the deviation of the end stop 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.

Error code	Three-stage	Event	Parameter setting	Fault message disappears when	Possible causes
↳8	No	Limit of dead zone adjustment exceeded	E.↳DEBA≠OFF **.DEBA[1] = Auto	... the limit is undershot again	Increased packing gland friction, mechanical gap in the position feedback.
↳9	Yes	Partial-Stroke-Test exceeds the reference step time	A.↳PST≠OFF	... a Partial-Stroke-Test is successfully executed within the reference step time or the function is deactivated.	Valve jams or has rusted, increased friction
10	Yes	General control valve fault	b.↳DEVI≠OFF	... the position is again in a narrow corridor between the reference variable and the model, or the function is deactivated.	Actuator fault, valve fault, valve jams, increased friction, decreased compressed air
11	Yes	Pneumatic leakage	C.↳LEAK≠OFF	... the leakage drops below the set thresholds, or the function is deactivated.	Pneumatic leakage
12	Yes	Static friction/ Slipstick effect occurs	d.↳STIC≠OFF	... Slipjumps can no longer be detected, or the function is deactivated.	Increased static friction, valve no longer moves smoothly, but with jerks
13	Yes	Temperature undershot	H.↳TMIN≠OFF	... the lower temperature thresholds are no longer undershot.	Ambient temperature too low
14	Yes	Temperature overshot	J.↳TMAX≠OFF	... the upper thresholds are no longer overshot.	Ambient temperature too high
15	Yes	Position average deviates from the reference value	P.↳PAVG≠OFF	... the position average 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 position average was calculated.

[1] Refer to the corresponding parameter descriptions for additional information about parameters.

See also

Overview of parameters 1 to 5 (Page 137)
Overview of parameters 6 to 51 (Page 138)

11.3.4 Meaning of error codes

1 Monitoring of control deviation

The deviation between the setpoint and the actual value is continuously monitored in the automatic mode. The fault message for the remaining control deviation is activated depending on the setting of the "ϟTIM" parameter, monitoring time for setting the fault messages and "ϟLIM" and the response threshold. The fault message is cancelled as soon as the control deviation drops below the response threshold.

2 Automatic mode monitoring

If the "ϟFCT" parameter is set correctly and the fault message output is functioning properly, a fault message is generated when the device is not in the automatic mode. A warning can thus be sent to the control system when the device was switched to manual or configuration mode on-site.

3 Binary input BE1 or BE2 active

If the "ϟFCT" and the "BIN1" parameters are set correctly and the fault message output and binary input 1 are functioning properly, a fault message is generated when the binary input is activated. 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 unit) can be configured in a similar manner.

4 Monitoring of the stroke number

5 Monitoring of the number of changes of direction

Both the values, namely the stroke number and the number of changes of direction are constantly compared with the thresholds that are determined from the parameters "L1.LIMIT" to "L4.FACT3" and "O1.LIMIT" to "O4.FACT3". If the thresholds are exceeded, the fault message output or the alarm outputs respond depending on the mode of the advanced diagnostics. Both these functions can be deactivated using the parameter setting "OFF" for "L.ϟSTRK" and "O.ϟDCHG".

6 Monitoring of the lower hard end stop (valve seat)

7 Monitoring of the upper hard end stop

Monitoring of the lower hard end stop is activated when the value of the parameter "F.ϟZERO" is set to "ON". 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 end stop

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.ꞱZERO"=OFF) may trigger a fault 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").

A similar diagnostics is carried out for the upper hard end stop. The "G.ꞱOPEN" parameter is used to set the limit for this. The activation of "up tight closing" ("YCLS" parameter) is therefore the condition.

8 Monitoring of dead zone adjustment

If the dead zone 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 dead zone monitoring). A fault message output is activated when this value is exceeded.

9 Partial stroke test exceeds the reference step time

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 start tolerance. On the other hand, this fault message appears when one of the three thresholds of the partial stroke test that are determined from the "A6.PSTIN" reference step time multiplied by factors "A7.FACT1" to "A9.FACT3" is violated. The degree of the fault message is shown in the number of columns on the digital display. The degree of the fault message is simultaneously displayed using the fault message output or alarm outputs depending on the mode of the advanced diagnostics.

10 General control valve fault

The monitoring of the operational response responds when the actual valve position shifts from a narrow corridor between the reference variable and the expected position course. In this case, the deviation between the expected and actual position course is filtered, displayed and compared with the set thresholds that are determined from the "b2.LIMIT" limit multiplied by the factors "b3.FACT1" to "b5.FACT3".

11 Pneumatic leakage

This fault message appears when the leakage indicator exceeds the set 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").

12 Static friction/slipstick effect is too large

If the static friction of the control valve increases during operation or more Slipjumps are detected, it may exceed the corresponding limits and lead to this fault message.

13 Temperature undershot

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

14 Temperature overshot

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

15 Monitoring of the position average

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 set thresholds.

See also

Description of parameter C (Page 164)

11.4 Fault correction

11.4.1 Fault identification

Diagnostics guide

Fault	See fault 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 1 (Page 200)
Remedial measures table 2 (Page 201)
Remedial measures table 3 (Page 201)
Corrective measures Table 4 (Page 202)
Remedial measures table 5 (Page 203)

11.4.2 Remedial measures table 1

Fault profile (symptoms)	Possible cause(s)	Remedial 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. • Network pressure not connected or it is too low.	• A waiting time of up to 1 minute is essential. • Do not start initialization from the end position. • Provide the network pressure.
• 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: "Device view (7)" picture as well as parameters 2 and 3 • Check the stroke setting on the lever. See table 2
• Positioner remains in "RUN 3".	• Actuator actuating 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. • Remove any play between the actuator and the control valve.

Fault table 1

See also

Service and maintenance (Page 205)

11.4.3 Remedial measures table 2

Fault profile (symptoms)	Possible cause(s)	Remedial measures
• "CPU test" blinks on the digital display approximately every two 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[1)]
• 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

[1)] More information is given under the also-see link.

See also

Service and maintenance (Page 205)

11.4.4 Remedial measures table 3

Fault profile (symptoms)	Possible cause	Remedial measures
• Actuator does not move.	• Compressed air < 1.4 bar	• Set the supply air pressure to > 1.4 bar.
• Piezo valve does not activate (a gentle click sound is however audible when the "+" or "-" buttons are pressed in the manual mode.)	• Restrictor valve turned off (screw at the right end stop)	• Open the restrictor screw by turning it anticlockwise, see leaflet, "Device view (6)".
	• Dirt in the pneumatic block	• Repair[1)] or a new device; clean and/or replace the built-in fine screens.

Fault profile (symptoms)	Possible cause	Remedial measures
• A piezo valve activates constantly in the stationary automatic mode (constant setpoint) and the 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[1)] or a new device
	• Dirt in the pneumatic block, see above	• See above

Fault table 3

[1)] More information is given under the also-see link.

See also

Service and maintenance (Page 205)

11.4.5 Corrective measures Table 4

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 a mean value.	• Sticking friction of the packing gland from the control valve or actuator too large	• Reduce friction or increase dead zone 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 actuating times using throttle screws. • If a quick actuating time is needed, increase the dead zone (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

Service and maintenance (Page 205)

11.4.6 Remedial measures table 5

Fault profile (symptoms)	Possible cause(s)	Remedial 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 positioner.
• The device function has completely failed: no view even on the digital display.	• 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[1)] • For prevention: Install the positioner on the damping pads.

Fault table 5

[1)] More information is given under the also-see link.

See also

Service and maintenance (Page 205)

Service and maintenance 12

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.

12.1 Positioner in the metal enclosure and in the flameproof enclosure

Dismantling and installation

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.

12.2 Positioner in the plastic enclosure

⚠ DANGER

Risk of explosion due to electrostatic charge

Electrostatic charges develop when cleaning the positioner in the plastic enclosure with a dry cloth.

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

Dismantling

1. Disconnect the pneumatic power supply.
2. Remove the lines.
3. Unscrew the cover.
4. Unscrew the three self-tapping 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.

Installation

CAUTION

Damage to the 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 plastic enclosure.
2. Place the O-rings on the screens.
3. Fit the pneumatic terminal strip on both studs so that it fits flushly.
4. Screw-on the three self-tapping screws.
5. Place the cover and tighten it.
6. Reconnect the pipelines and feed the pneumatic power supply.

12.3 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.

The address of the relevant service station, contact details, replacement parts lists, etc. is available on the Internet under:

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

See also

Structure of the nameplate (Page 20)

Technical data

13

13.1 General technical data

General data	
Range of stroke (linear actuator)	3 ... 130 mm (0.12 ... 5.12") (angle of rotation of the feedback shaft 16 to 90°)
Angle of rotation (part-turn actuator)	30 ... 100°
Installation	
• On the linear actuator	using the mounting kit 6DR4004-8V and, if required, an additional lever arm 6DR4004-8L on the actuators as per IEC 534-6 (NAMUR) with a fin, columns, or a plane surface.
• On the part-turn actuator	Using the mounting kit 6DR4004-8D on the actuators with fastening plane as per VDI/VDE 3845 and DIN 3337: The required mount must be provided on the actuator-side; shaft with groove, and M6 female thread.
Control unit	
• Five-point controller	Adaptive
• Dead zone	
dEbA = auto	Adaptive or can be preset
dEbA = 0.1 ... 10 %	Adaptive or can be preset
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)
Cycle time	
• 20 mA/HART device	20 ms
• PA device	60 ms
• FF device	60 ms (min. loop time)
Binary input BE1 (clamp 9/10; galvanically connected with basic device)	Only usable for a dry contact; max. contact load <5 mA at 3 V
Degree of protection [1])	IP66 according to EN 60529 / NEMA 4X
mounting position	Any; in wet environment, pneumatic connections and outlet opening not upward
CE symbol	Conformity in regards to EMC guideline 89/336 EEC in agreement with the following norms
EMC requirements	EN 61326/A1 App. A.1 and NAMUR NE21 August 98
Material	

General data	
• Enclosure	
6D5**0-*** (plastic)	Glass fiber reinforced macrolon
6DR5**1-*** (metal)	GD AlSi12
6DR5**2-*** (stainless steel)	Austenitic stainless steel mat. no. 1.4581
6DR5**5-*** (metal, pressure resistant)	GK AlSi12
• Pressure gauge block	Aluminum AlMgSi, anodized
Vibration resistance	
• Harmonic vibrations (sine) according to DIN EN 60062-2-6/05.96	3.5 mm (0.14"), 2 ... 27 Hz, 3 cycles/axes
	98.1 m/s² (321.84 ft/s²), 27 to 300 Hz, 3 cycles/axes
• Bump (half-sine) according to DIN EN 60068-2-29/03.95	150 m/s² (492 ft/s²), 6 ms, 1000 shocks/axle
• Noise (controlled digitally) according to DIN EN 60068-2-64/08.95	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
Weight, basic device	
• Plastic enclosure	Approximately 0.9 kg (1.98 lb)
• Metal enclosure, aluminum	Approximately 1.3 kg (2.87 lb)
• Metal enclosure, stainless steel	Approximately 3.9 kg (8.6 lb)
• Metal housing, Ex d version	Approximately 5.2 kg (11.46 lb)
Dimensions	See dimensional drawing
Climate class	According to DIN EN 60721-3-4
• Storage [2])	1K5, but -40 ... +80°C (1K5, but -40 ... +176°F)
• Shipping [2])	2K4, but -40 ... +80°C (2K4, but -40 ... +176°F)
• Operation [3])	4K3, but -30 ... +80°C (4K3, but -22 ... +176°F)

[1]) Impact energy max. 1 joule for plastic/aluminum enclosure.

[2]) Be sure that the valves have been flushed out enough with the dry medium when commissioning is at a temperature of ≤ 0°C (≤ 32 F).

[3]) When the temperature is ≤ -10°C (≤ 14°F) limited repetition rate of the LCD display. When using I_y modul, only T4 is permissible.

Certificates and approvals	
Classification according to pressure equipment directive (PED 97/23/EC)	For fluid group 1 gases; fulfills requirements in article 3, paragraph 3 (good engineering practice SEP)

Pneumatic data	
Auxiliary power (air supply)	
• Pressure	1,4 ... 7 bar (20.3 ... 101.5 psi): sufficiently greater than max. drive pressure (actuating pressure)
Air quality in accordance with 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	
• Air supply valve (vent drive) [4])	
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)
• Air exhaust valve (depressurize drive) [4])	
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)
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)
Versions	
• In the plastic enclosure	Single-acting and double-acting
• In the aluminum enclosure	Single-acting
• In the flameproof encapsulated housing	Single-acting and double-acting
• In the stainless steel enclosure	Single-acting and double-acting
[4]) When using device version Ex d (6DR5..5-...) values are reduced by approximately 20%.	

All the programming manuals mentioned are on the CD-ROM and are available on the internet.

13.2 Technical data for device version with and without HART

	Basic device without explosion protection	Basic device with Ex d explosion protection (flameproof enclosure)	Basic device with Ex ia/ib explosion protection	Basic device with Ex n/dust explosion protection
Protection against explosion in accordance with ATEX	without	Ex d II 2 G Ex d II C T6	Ex ia/ib II 2 G Ex ia/ib II C T6	Ex n II 3 G Ex nA nL [nL] IIC T6 Dust: II 3 D Ex tD A22 IP66 T100°C
Installation point		Zone 1	Zone 1	Zone 2/22
Permissible ambient temp. for operation At ≤ -10 °C (+14°F) limited display repetition of LC display. (the following applies for basic devices with explosion protection Ex ia/ib and Ex n: When using I_y module, only T4 permitted)	-30...+80 °C (22...+176°F)	T4: -30...+80 °C (-22...+176 °F) T5: -30...+65 °C (-22...+149 °F) T6: -30...+50 °C (-22...+122 °F)		

Electrical data				
	Basic device without explosion protection	**Basic device with Ex d explosion protection (flameproof enclosure)**	**Basic device with Ex ia/ib explosion protection**	**Basic device with Ex n/dust explosion protection)**
Input				
2-wire connection (terminals 6/8)				
Nominal signal range	4...20 mA	4...20 mA	4...20 mA	4...20 mA
Current to maintain auxiliary power	≥ 3.6 mA	≥ 3.6 mA	≥ 3.6 mA	≥ 3.6 mA
load voltage U_B required (corresponds to Ω at 20 mA)				
• Without HART (6DR50..)				
typ.	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..)				
typ.	7.9 V (= 395 Ω)	-	-	-
max.	8.4 V (= 420 Ω)	-	-	-
• With HART (6DR51..)				
typ.	6.6 V (= 330 Ω)	6.6 V (= 330 Ω)	-	-
max.	6.72 V (= 336 Ω)	6.72 V (= 336 Ω)	-	-

Electrical data				
	Basic device without explosion protection	**Basic device with Ex d explosion protection (flameproof enclosure)**	**Basic device with Ex ia/ib explosion protection**	**Basic device with Ex n/dust explosion protection)**
• With HART (6DR52..)				
typ.		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	-	-
Internal capacitance C_i				
• Without HART	-	-	22 nF	22 nF (at "nL")
• With HART	-	-	7 nF	7 nF (at "nL")
Internal inductance L_i				
• Without HART	-	-	0.12 mH	0.12 mH (at "nL")
• With HART	-	-	0.24 mH	0.24 mH (at "nL")
For connecting to circuits with the following peak values	-	-	Intrinsically safe U_n = 30 VDC I_i = 100 mA P_i = 1 W	At "nA" and "tD": U_n = 30 VDC I_n = 100 mA At "nL": U_n = 30 VDC I_i = 100 mA
3-/4-wire connection (terminals 2/4 and 6/8) (6DR52.. and 6DR53..)				
• Auxiliary power U_H	18 to 35 VDC	18 to 35 VDC	18 to 30 VDC	18 to 30 VDC
• Current consumption I_H	(V_H - 7.5 V)/2.4 kΩ [mA]	(V_H - 7.5 V)/2.4 kΩ [mA]	(V_H - 7.5 V)/2.4 kΩ [mA]	(V_H - 7.5 V)/2.4 kΩ [mA]
• Internal capacitance C_i	-	-	22 nF	22 nF (at "nL")
• Internal inductance L_i	-	-	0.12 mH	0.12 mH (at "nL")
• For connecting to circuits with the following peak values	-	-	Intrinsically safe U_n = 30 VDC I_i = 100 mA P_i = 1 W	At "nA" and "tD": U_n = 30 VDC I_n = 100 mA At "nL": U_i = 30 VDC I_i = 100 mA
Current input I_W				
Nominal signal range	0/4 ... 20 mA	0/4 ... 20 mA	0/4 ... 20 mA	0/4 ... 20 mA
Load voltage at 20 mA	≤ 0.2 V (= 10 Ω)	≤ 0.2 V (= 10 Ω)	≤ 1 V (= 50 Ω)	≤ 1 V (= 50 Ω)
Internal capacitance C_i	-	-	22 nF	22 nF (at "nL")
Internal inductance L_i	-	-	0.12 mH	0.12 mH (at "nL")
For connecting to circuits with the following peak values	-	-	Intrinsically safe U_n = 30 VDC I_i = 100 mA P_i = 1 W	At "nA" and "tD": U_n = 30 VDC I_n = 100 mA At "nL": U_i = 30 VDC I_i = 100 mA

Electrical data				
	Basic device without explosion protection	**Basic device with Ex d explosion protection (flameproof enclosure)**	**Basic device with Ex ia/ib explosion protection**	**Basic device with Ex n/dust explosion protection)**
Electrical isolation	between V_H and I_W	between V_H and I_W	between U_H and I_W (2 intrinsically safe circuits)	between V_H and I_W
Test voltage	840 VDC (1 s)	840 VDC (1 s)	840 VDC (1 s)	840 VDC (1 s)

Connections				
	Basic device without explosion protection	**Basic device with Ex d explosion protection (flameproof enclosure)**	**Basic device with Ex ia/ib explosion protection**	**Basic device with Ex n/dust explosion protection)**
• Electrical	Screw terminals 2.5 AWG28-12 Cable penetration M20x1.5 or ½-14 NPT	Screw terminals 2.5 AWG28-12 Ex d certified cable penetration M20x1.5, ½-14 NPT or M25x1.5	Screw terminals 2.5 AWG28-12 Cable penetration M20x1.5 or ½-14 NPT	Screw terminals 2.5 AWG28-12 Cable penetration M20x1.5 or ½-14 NPT
• Pneumatic	Female thread G¼ DIN 45141 or ¼-18 NPT	Female thread G1/4 DIN 45141 or ¼-18 NPT	Female thread G1/4 DIN 45141 or ¼-18 NPT	Female thread G¼ DIN 45141 or ¼-18 NPT
External position sensor (potentiometer or NCS, optional) with the following peak values				
• V_o	-	-	5 V	5 V
• I_o (static)	-	-	75 mA	75 mA
• I_s (temporary)	-	-	160 mA	-
• P_o	-	-	120 mW	120 mW
Highest permitted external capacity C_o	-	-	1 µF	1 µF
Highest permitted external inductance L_o	-	-	1 mH	1 mH

13.3 Technical data of optional modules

Additional module	Without explosion protection	With Ex ia/ib explosion protection	With Ex n/dust explosion protection
Explosion protection in accordance with ATEX	-	II 2G Ex ia/ib II C T4/T5/T6 [1])	Ex n II 3 G Ex nA nL [nL] IIC T6 Dust II 3 D Ex tD A22 IP66 T100°C
Installation point	-	Zone 1	Zone 2/22
Permissible ambient temperature for operation (For devices with explosion protection: only in combination with the 6DR5***-*E*** basic device; only T4 is permitted for use with the I_y module.)	-30 ... +80°C (-22 ... +176°F)	T4: -30 ... +80°C (-22 ... +176°F) [1] T5: -30 ... +65°C (-22 ... +149°F) [1] T6: -30 ... +50°C (-22 ... +122°F) [1]	

[1]) only in combination with the 6DR5***-*E*** standard controller; only T4 is permitted for use with the I_y module.

Alarm unit	6DR4004-8A	6DR4004-6A	6DR4004-6A
Binary alarm outputs A1, A2 and fault message output			
Signal state High (not activated)	Conductive, R = 1 kΩ, +3/-1 %*	≥ 2.1 mA	≥ 2.1 mA
Signal state Low* (activated)	Deactivated, I_R < 60 µA	≤ 1.2 mA	≤ 1.2 mA
(* The status is also Low if the standard controller has faults or electrical auxiliary power is not supplied)	(* When using in the flameproof enclosure, 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)
Internal capacitance C_i	-	5.2 nF	5.2 nF (at "nL")
Internal inductance L_i	-	Negligible	Negligible
Auxiliary voltage U_H	≤ 35 V	-	-
Connecting to circuits with the following peak values		Intrinsically safe switching amplifier EN 60947-5-6 U_i = DC 15.5 V I_i = 25 mA P_i = 64 mW	At "nA" and "tD": U_H = DC 15.5 V At "nL": U_i = DC 15.5 V I_i = 25 mA
Binary input BE2			
• Galvanically connected with the standard controller			
Signal status 0	Dry contact, open	Dry contact, open	Dry contact, open
Signal status 1	Dry contact, closed	Dry contact, closed	Dry contact, closed
Contact load	3 V, 5 µA	3 V, 5 µA	3 V, 5 µA
• Galvanically isolated from the standard controller			

Additional module	**Without explosion protection**	**With Ex ia/ib explosion protection**	**With Ex n/dust explosion protection**
Signal status 0	≤ 4.5 V or open	≤ 4.5 V or open	≤ 4.5 V or open
Signal status 1	≥ 13 V	≥ 13 V	≥ 13 V
Internal resistance	> 25 kΩ	> 25 kΩ	> 25 kΩ
Static destruction limit	± 35 V	-	-
Internal inductance and capacitance	-	Negligible	Negligible
Connecting to circuits with the following peak values	-	Intrinsically safe U_i ≤ 25.2 V	At "nA" and "tD": U_n = 25.2 VDC At "nL": U_i = 25.2 VDC
Electrical isolation	The three outputs, the BE2 input and the standard controller are galvanically isolated from each other.		
Test voltage	840 VDC, 1 s	840 VDC, 1 s	840 VDC, 1 s
SIA module	6DR4004-8G	6DR4004-6G	6DR4004-6G
Limit value encoder with slot initiators	2-wire connection	2-wire connection	2-wire connection
• Connection	2 wire technology in accordance with EN 60947-5-6 (NAMUR), for switching amplifiers to be switched down		
• Signal state Low (activated)	< 1.2 mA	< 1.2 mA	< 1.2 mA
• 2 slotted initiators	Type SJ2-SN	Type SJ2-SN	Type SJ2-SN
• Function	NC, normally closed	NC, normally closed	NC, normally closed
• Internal capacitance C_i	-	41 nF	41 nF (at "nL")
• Internal inductance L_i	-	100 µH	100 µH (at "nL")
• Connecting to circuits with the following peak values	Nominal voltage 8 V; current consumption: ≥ 3 mA (limit not responded), ≤ 1 mA (limit responded)	Intrinsically safe switching amplifier EN 60947-5-6 U_i = 15.5 VDC I_i = 25 mA P_i = 64 mW	At "nA" and "tD": U_n = 15.5 VDC P_n = 64 mW At "nL": U_i = 15.5 VDC I_i = 25 mA
Fault message output			
• 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 activated)	R = 1.1 kΩ	≥ 2.1 mA	≥ 2.1 mA
• Signal state Low (activated)	R = 10 kΩ	< 1.2 mA	< 1.2 mA
• Internal capacitance C_i	-	≤ 5.2 nF	≤ 5.2 nF
• Internal inductance L_i	-	Negligible	Negligible
• Auxiliary power U_H	U_H ≤ 35 VDC I ≤ 20 mA	-	-
• Connecting to circuits with the following peak values	-	Intrinsically safe switching amplifier EN 60947-5-6 U_i = 15.5 VDC I_i = 25 mA P_i = 64 mW	At "nA" and "tD": U_n = 15.5 VDC At "nL": U_i = DC 15.5 V I_i = 25 mA

Additional module	**Without explosion protection**	**With Ex ia/ib explosion protection**	**With Ex n/dust explosion protection**
Electrical isolation	The three outputs are galvanically isolated from the basic device.		
Test voltage	840 VDC, 1 s	840 VDC, 1 s	840 VDC, 1 s
Mechanical limit switch module	6DR4004-8K	6DR4004-6K	6DR4004-6K
Limit value encoder with mechanical switch contacts			
• Max. switching step AC/DC	4 A	Connecting to intrinsically safe circuits with the following peak values: U_i = 30 V I_i = 100 mA P_i = 750 mW	Connecting to intrinsically safe circuits with the following peak values: At "nL": U_i = 30 V I_i = 100 mA
• Max. switching step AC/DC	250 V/24 V	30 VDC	30 VDC
• Internal capacitance C_i	-	Negligible	Negligible
• Internal inductance L_i	-	Negligible	Negligible
Fault message output			
• 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 activated)	R = 1.1 kΩ	≥ 2.1 mA	≥ 2.1 mA
• Signal state Low (activated)	R = 10 kΩ	< 1.2 mA	< 1.2 mA
• Internal capacitance C_i	-	≤ 5.2 nF	-
• Internal inductance L_i	-	Negligible	-
• Auxiliary power	U_H ≤ 35 VDC I ≤ 20 mA	-	-
• Connecting to circuits with the following peak values	-	Intrinsically safe switching amplifier EN 60947-5-6 U_i = 15.5 VDC I_i = 25 mA P_i = 64 mW	At "nA" and "tD": U_n = 15.5 VDC At "nL": U_i = DC 15.5 V I_i = 25 mA

Electrical isolation	The three outputs are galvanically isolated from the standard controller		
Test voltage	3150 VDC, 2 s	3150 VDC, 2 s	3150 VDC, 2 s
I_y Module	6DR4004-8J	6DR4004-6J	6DR4004-6J
Direct current for position feedback	2-wire connection	2-wire connection	2-wire connection
Nominal signal area i	4 ... 20 mA, short-circuit proof	4 ... 20 mA, short-circuit proof	4 ... 20 mA, short-circuit proof
Dynamic range	3,6 ... 20.5 mA	3,6 ... 20.5 mA	3,6 ... 20.5 mA
Auxiliary voltage U_H	+12 ... +35 V	+12 ... +30 V	+12 ... +30 V
External loads R_B [kΩ]	≤ (U_H [V] - 12 V)/i [mA]	≤ (U_H [V] - 12 V)/i [mA]	≤ (U_H [V] - 12 V)/i [mA]
Transmission error	≤ 0,3 %	≤ 0,3 %	≤ 0,3 %

Additional module	Without explosion protection	With Ex ia/ib explosion protection	With Ex n/dust explosion protection
Temperature influence	≤ 0.1 %/10 K (≤ 0.1 %/18 °F)	≤ 0.1%/10 K (≤ 0.1%/18 °F)	≤ 0.1 %/10 K (≤ 0.1 %/18 °F)
Resolution	≤ 0,1 %	≤ 0,1 %	≤ 0,1 %
Residual ripple	≤ 1 %	≤ 1 %	≤ 1 %
Internal capacitance C_i	-	11 nF	11 nF (at "nL")
Internal inductance L_i	-	Negligible	Negligible
For connecting to circuits with the following peak values		Intrinsically safe U_i = 30 VDC I_i = 100 mA P_i = 1 W (only T4)	At "nA" and "tD": U_n = 30 VDC I_n = 100 mA P_n = 1 W (only T4) At "nL": U_i = 30 VDC I_i = 100 mA
Electrical isolation	Electrically isolated from the basic device	Electrically isolated from the basic device	Electrically isolated from the basic device
Test voltage	840 VDC, 1 s	840 VDC, 1 s	840 VDC, 1 s

NCS sensor (not for Ex d device version)			
Actuating range			
• Linear actuator	3 ... 130 mm (0.12 ... 5.12"), up to 200 mm (7.87") on request	3 ... 130 mm (0.12 ... 5.12"), up to 200 mm (7.87") on request	3 ... 130 mm (0.12 ... 5.12"), up to 200 mm (7.87") on request
• Part-turn actuator	30° ... 100°	30° ... 100°	30° ... 100°
Linearity (after corrections made by positioner)			
• Linear actuator	± 1 %	± 1 %	± 1 %
• Part-turn actuator	± 1 %	± 1 %	± 1 %
Hysteresis	± 0,2 %	± 0,2 %	± 0,2 %
Regular operation temperature	-40 °C ... +85 °C (-40 °F ... +185 °F), extended temperature range on request	-40 °C ... +85 °C (-40 °F ... +185 °F), extended temperature range on request	-40 °C ... +85 °C (-40 °F ... +185 °F), extended temperature range on request
Housing protection type	IP68/NEMA 4X	IP68/NEMA 4X	IP68/NEMA 4X
Internal capacitance C_i	-	10 nF	10 nF (at "nL")
Internal inductance L_i	-	240 µH	240 µH (at "nL")
For connecting to circuits with the following peak values		Intrinsically safe U_i = 5 VDC	At "nL": U_i = 5 VDC

Dimension drawings

14

14.1 Positioner with plastic enclosure 6DR5**0

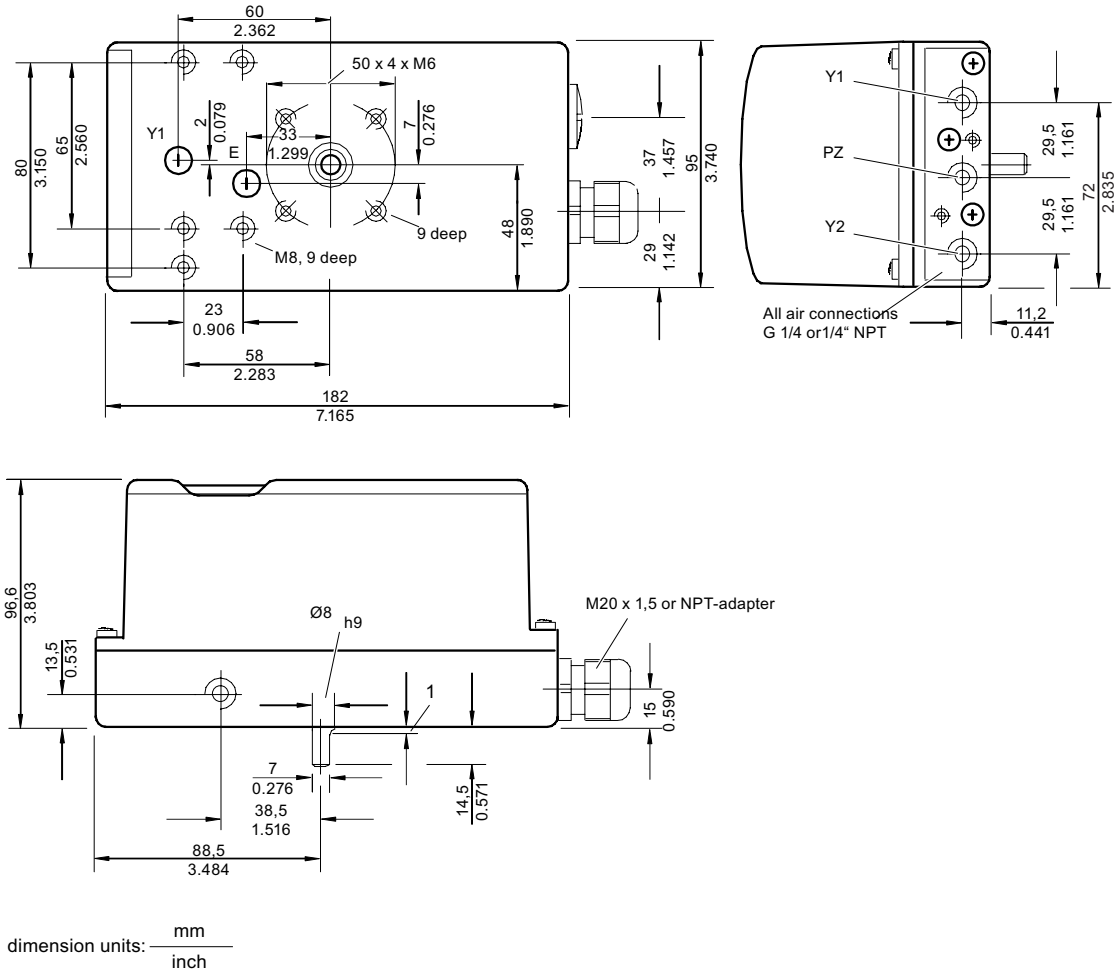


Figure 14-1 Dimensions of plastic enclosure version

14.2 Terminal strip for positioner with plastic enclosure

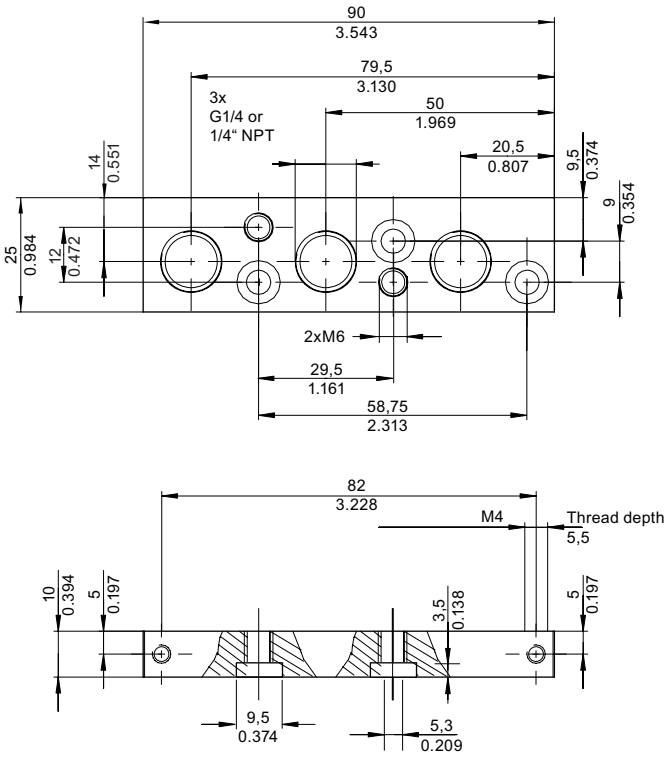


Figure 14-2 Dimensions of plastic enclosure terminal strip

14.3 Positioner with metal housing 6DR5**1

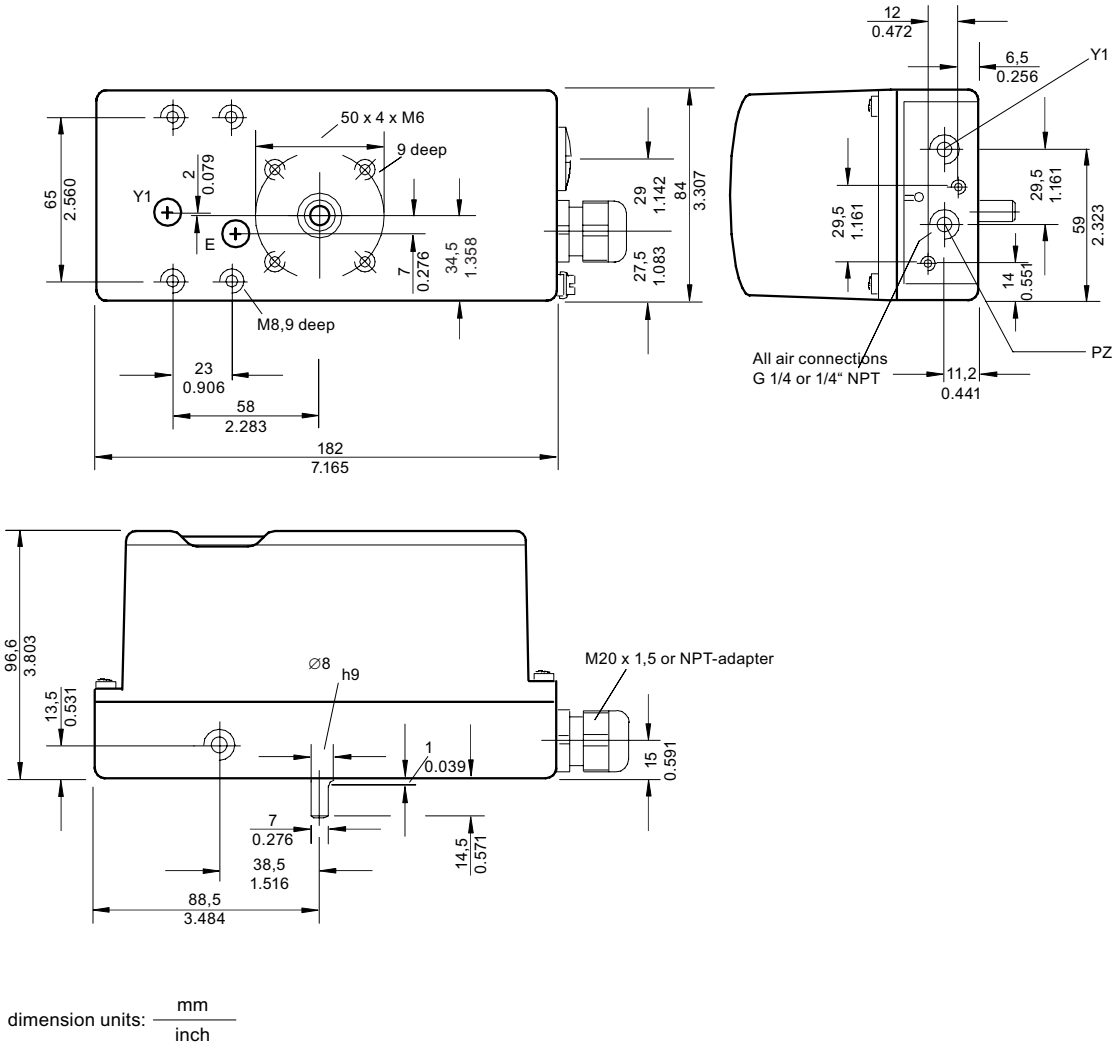
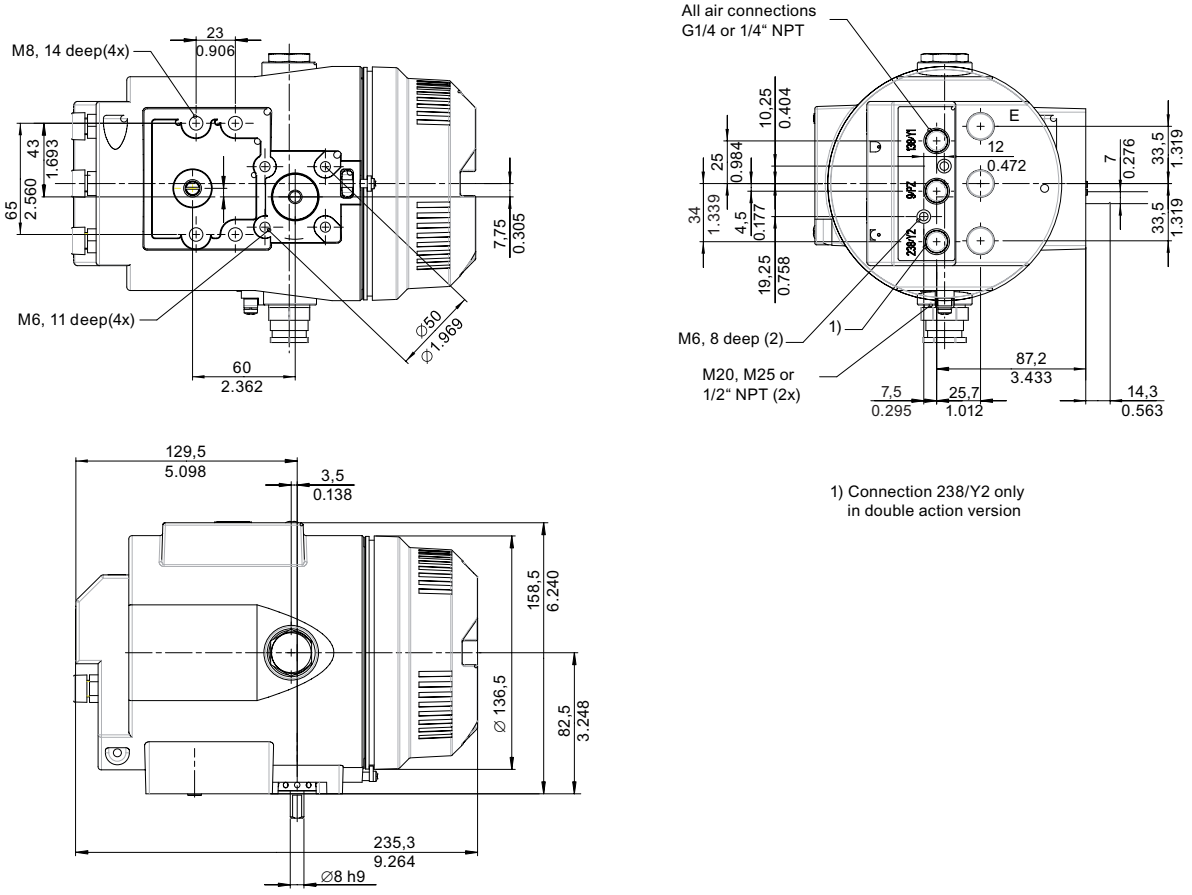


Figure 14-3 Dimensions of metal housing version

14.4 Positioner with flameproof metal housing 6DR5**5



dimension units: mm / inch

Figure 14-4 Dimensions of device version with flameproof metal housing

Scope of delivery/spare parts/accessories 15

15.1 Overview

⚠ WARNING

Assembling the components

When assembling components, ensure that only those positioners and optional modules are combined with each other that are approved for the corresponding operating range. This condition is particularly applicable for the safe operation of the positioner in the areas where the atmosphere may be potentially explosive (zones 1 and 2). Observe the device categories (2 and 3) of the device itself and its options implicitly.

Version

The positioner can be delivered for:

- Double-acting actuators
- Single action actuators

The positioner and its optional 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 the digital display, position feedback and the pneumatic block are integrated into the enclosure.

The enclosure is available in three versions:

- Plastic enclosure for single and double-acting actuators
- Metal enclosure for single action actuators
- Flameproof enclosure for single and double-acting actuators

Options

The positioner can be equipped with different optional modules. The following modules are normally available:

- I_y module: two-wire current output 4 to 20 mA for position feedback
- Alarm unit: 3 binary outputs and 1 binary input
- SIA unit: one binary output for fault messages, two binary outputs for limit monitors
- Mechanical limit switch module with two switches and one alarm output.
  The mechanical limit switch module cannot be used in versions with flameproof enclosures. Likewise, its use is zones 2 or 22 is not permitted

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

Non-contacting position sensor (NCS)

Note

The version is identified using a special type plate.

15.2 Scope of delivery of basic unit

Version	Housing	Valve	Explosion protection	Order numbers
SIPART PS2 2L without HART	Plastic housing	Single-acting	Not Ex	6DR5010-*N***-0AA0
	Plastic housing	Double-acting	Not Ex	6DR5020-*N***-0AA0
	Metal housing	Single-acting	Not Ex	6DR5011-*N***-0AA0
SIPART PS2 2L without HART	Plastic housing	Single-acting	CENELEC/FM	6DR5010-*E***-0AA0
	Plastic housing	Double-acting	CENELEC/FM	6DR5020-*E***-0AA0
	Metal housing	Single-acting	CENELEC/FM	6DR5011-*E***-0AA0
	Explosion-proof housing	Single-acting	CENELEC/FM	6DR5015-*E***-0AA0
	Explosion-proof housing	Double-acting	CENELEC/FM	6DR5025-*E***-0AA0
SIPART PS2 2L with HART	Plastic housing	Single-acting	Not Ex	6DR5110-*N***-0AA0
	Plastic housing	Double-acting	Not Ex	6DR5120-*N***-0AA0
	Metal housing	Single-acting	Not Ex	6DR5111-*N***-0AA0
SIPART PS2 4L without HART	Plastic housing	Single-acting	Not Ex	6DR5310-*N***-0AA0
	Plastic housing	Double-acting	Not Ex	6DR5320-*N***-0AA0
	Metal housing	Single-acting	Not Ex	6DR5311-*N***-0AA0
SIPART PS2 4L with HART	Plastic housing	Single-acting	CENELEC/FM	6DR5210-*E***-0AA0
	Plastic housing	Double-acting	CENELEC/FM	6DR5220-*E***-0AA0
	Metal housing	Single-acting	CENELEC/FM	6DR5211-*E***-0AA0
	Explosion-proof housing	Single-acting	CENELEC/FM	6DR5215-*E***-0AA0
	Explosion-proof housing	Double-acting	CENELEC/FM	6DR5225-*E***-0AA0

2L: corresponds to two-wire mode

4L: corresponds to four-wire mode

-*: stands for subvariants

15.3 Optional modules

Option	Order number
I_y module without explosion protection	6DR4004-8J
I_y module with PTB [1] explosion protection	6DR4004-6J
I_y module with FM [2] explosion protection	6DR4004-7J
Alarm unit without explosion protection	6DR4004-8A
Alarm unit with PTB [1] explosion protection	6DR4004-6A
Alarm unit with FM [2] explosion protection	6DR4004-7A
SIA unit without explosion protection	6DR4004-8G
SIA unit with CENELEC and FM [1] [2] explosion protection	6DR4004-6G
Mechanical limit switch module without explosion protection	6DR4004-8K
Mechanical limit switch module with CENELEC and FM [1] [2] [3] explosion protection	6DR4004-6K

[1] EC-type examination certificates

[2] Approval Reports by Factory Mutual System

[3] In preparation

15.4 Spare parts

	Description	Order number	For version
	Plastic cover with 4 screws and circumferential sealing ring.	C73451-A430-D82	6DR4*** 6DR5***
	Metal cover with 4 screws and circumferential sealing ring.	C73451-A430-D83	6DR4*** 6DR5***
	Motherboard, 2-wire, not Ex, without HART	A5E00082459	6DR50**-*N 6DR40**-*N [1)]
	Motherboard, 2-wire, Ex, without HART	A5E00082457	6DR50**-*E
	Motherboard, 2-wire, not Ex, with HART	A5E00082458	6DR51**-*N 6DR40**-*N [1)]
	Motherboard, 2/3/4-wire Ex, with HART	A5E00082456	6DR52**
	Motherboard, 2/3/4-wire, not Ex, without HART	A5E00102018	6DR53**-*N 6DR40**-*N [1)]
	Motherboard, PROFIBUS PA, not Ex	A5E00141523	6DR55**-*N 6DR41**-*N
	Motherboard, PROFIBUS PA, Ex	A5E00141550	6DR55**-*E 6DR41**-*E
	Motherboard, FOUNDATION fieldbus, not Ex	A5E00215467	6DR56**
	Motherboard, FOUNDATION fieldbus, Ex	A5E00215466	6DR56**
	Pneumatic block, single action, with seal and screws.	C73451-A430-D80	6DR4*** 6DR5***
	Pneumatic block, dual action, with seal and screws.	C73451-A430-D81	6DR4*** 6DR5***
	Potentiometer (complete)	C73451-A430-D84	6DR4*** 6DR5***

[1]) 6DR40** can be used after refining either the two-wire input or the three/four-wire input.

Note

See catalog FI01 "Field device for process automation" for additives and possible modules.

15.5 Scope of delivery of small part sets

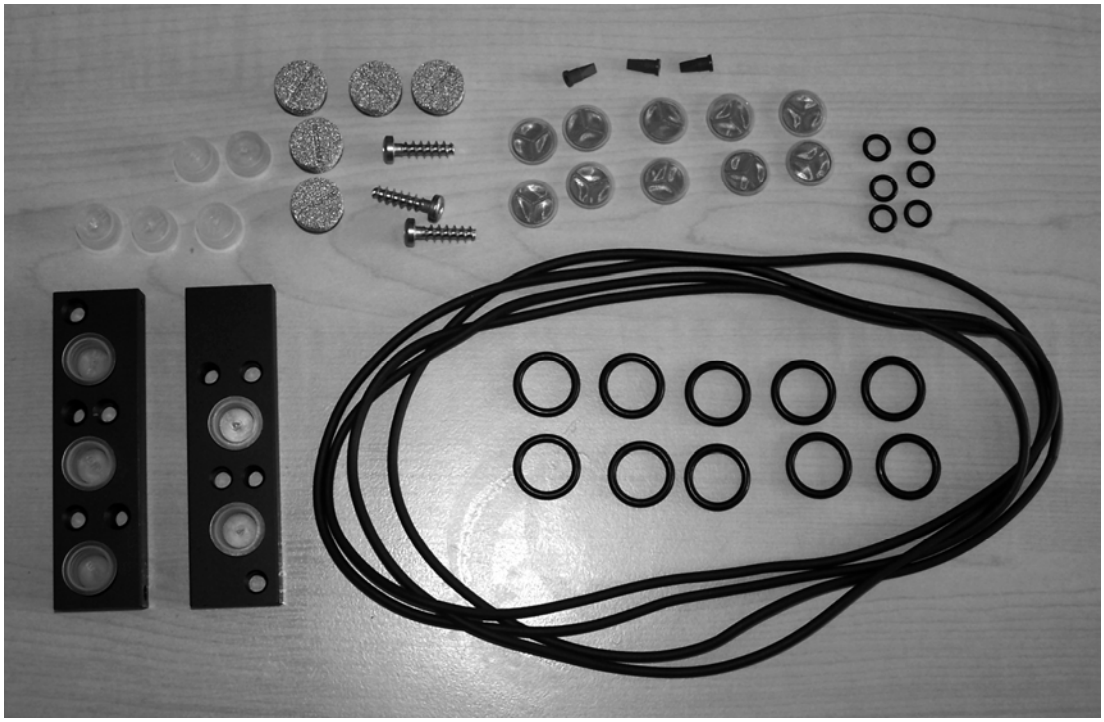
Small part set 1

The small part set 1 with the order number **C73451-A430-D85** contains the following items:

Position	Quantity [unit]
Clamping piece	2
Pick-up bracket	1
Screw DIN 7984 M6x25-A2	2
Spring lock washer DIN 127 B6-SN06031	2
Screw SN 62217 G4x45-/16WN1452-TX-ST	5
Screw SN 62217 G4x14-combi-Torx-TX-ST	5
Screw SN 62217 G5x18-WN1452-T20-A2	3
Screw SN 62217 H5x8-WN1451-TX-A2	2
Screw DIN 7964 M4x16x6-A4-70-F	4
Cable gland MET 20-GR	3
Cable gland MET 20-BL	3
Blind plug M20 SW	3
Slide switch	1
Leaf spring	1
Sign, printed	1

Small part set 2

The small part set 2 with the order number **C73451-A430-D86** contains the following items:



Position	Quantity [unit]
Terminal strip C73451-A430-C21	1
Terminal strip C73451-A430-C22	1
Screen, molded	10
O-ring 14-P431ANBR75 (black)	10
O-ring 5.5-P431ANBR75 (black)	6
Screw SN 62217 G5x18-WN1452-T20-A2	3
Attenuator	5
Lip non-return valve	3
Plug 12 PE	10
Seal	3
Installation instructions	1
Sign, printed	1

15.6 Accessories

Accessories	Order number
Mounting kit for linear actuator IEC 534 - 6 including a lever for 3 ... 35 mm actuator travel	6DR4004-8V
Additional lever for actuator travel > 35 to 130 mm	6DR4004-8L
Mounting kit for part-turn actuators VDI/VDE 3845	6DR4004-8D
Magnetic pneumatic block for SAMSON actuator (integrated attachment)	6DR4004-1C
Pressure gauge block, single-acting	6DR4004-1M
Pressure gauge block, double-acting	6DR4004-2M
Magnetic valve block, single-acting (NAMUR)	6DR4004-1B
Mounting kit for SAMSON actuator (integrated attachment)	6DR4004-8S
Non-contacting position sensor: • Not explosion-proof • Explosion-proof • Cable length 6 m • For part-turn actuators • For linear actuators up to 14 mm	6DR4004-*N**0 6DR4004-8N 6DR4004-6N 6DR4004-*NN 6DR4004-*N*10 6DR4004-*N*20
EMC filter module	C73451-A430-D23
External position detection system	C73451-A430-D78
SIMATIC PDM operation software	On request

Appendix

A

A.1 Certificate

The certificates can be found on the enclosed CD and on the Internet under:

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

A.2 Literature/catalogs/standards

Bibliography and catalogs

No.	Title	Publisher	Order number
/1/	SIMATIC NET, Ind. communication for automation and drives catalog, IK PI, 2007	Siemens AG	E86060-K6710-A101-B5
/2/	Field devices for process automation catalog, FI 01, 2007	Siemens AG	E86060-K6201-A101-A8
/3/	SIMATIC PCS 7 process control system catalog, ST PCS 7, March 2007	Siemens AG	E86060-K4678-A111-B2

Standards

No.	Standard	Description
/1/	IEC 61508 Part 1-7	Functional safety of the following systems: • Safety-instrumented • Electric • Electronic • Programmable Target group: Manufacturers and suppliers of devices
/2/	IEC 61511 Part 1-3	Functional safety - safety-instrumented systems for the processing industry Target group: Planners, installers and users

A.3 Test report (extract)

FMEDA and Proven-in-use Assessment

Project:
Electro-pneumatic Positioner SIPART PS2 –
single acting shut-down module

Customer:
SIEMENS AG, A&D PI TQ2
Karlsruhe
Germany

Contract No.: SIEMENS 04/12-06
Report No.: SIEMENS 04/12-06 R004
Version V1, Revision R1.0, April 2005
Stephan Aschenbrenner

Management summary

This report summarizes the results of the hardware assessment with proven-in-use consideration according to IEC 61508 / IEC 61511 carried out on the Electro-pneumatic Positioner SIPART PS2 with software version C4 and C5. Table 1 gives an overview of the different configurations that belong to the considered Electro-pneumatic Positioner SIPART PS2.

The hardware assessment consists of a Failure Modes, Effects and Diagnostics Analysis (FMEDA). A FMEDA is one of the steps taken to achieve functional safety assessment of a device per IEC 61508. From the FMEDA, failure rates are determined and consequently the Safe Failure Fraction (SFF) is calculated for the device. For full assessment purposes all requirements of IEC 61508 must be considered.

Table 1: Configuration ov erv ie w

[Conf 1]	6DR501*_*E***_****	2-wire Ex (L250) without HART; single-acting
[Conf 2]	6DR501*_*N***_****	2-wire standard (L350) without HART; single-acting
	6DR511*_*****_****	2-wire standard (L300) with HART; single-acting
[Conf 3]	6DR521*_*****_****	2-, 3-, 4-wire Ex (L200) with HART; single-acting
[Conf 4]	6DR531*_*****_****	2-, 3-, 4-wire standard (L220) without HART; single-acting

For safety applications only the 4..20 mA control input with the corresponding pressure output was considered to work as a single-acting shut-down module ("tight closing bottom"). All other possible input and output variants or electronics are not covered by this report.

The failure rates of the electronic components used in this analysis are the basic failure rates from the Siemens standard SN 29500.

SIEMENS AG, A&D PI TQ2 and exida.com together did a quantitative analysis of the mechanical parts of the Electro-pneumatic Positioner SIPART PS2 to calculate the mechanical failure rates using different failure rate databases ([N6], [N7], [N8] and exid a 's experienced-based data compilation) for the different mechanical components (see [D32] and [R6]). The results of the quantitative analysis are included in the calculations described in sections 5.2 to 5.5.

According to table 2 of IEC 61508-1 the average PFD for systems operating in low demand mode has to be $\geq 10^{-3}$ to $< 10^{-2}$ for SIL 2 safety functions. A generally accepted distribution of PFD_{AVG} values of a SIF over the sensor part, logic solver part, and final element part assumes that 50% of the total SIF PFD_{AVG} value is caused by the final element. However, as the Electro-pneumatic Positioner SIPART PS2 is only one part of the final element it should not claim more than 20% of the range. For a SIL 2 application the total PFD_{AVG} value of the SIF should be smaller than 1,00E-02, hence the maximum allowable PFD_{AVG} value for the positioner would then be 2,00E-03.

The Electro-pneumatic Positioner SIPART PS2 is considered to be a Type B[1] component with a hardware fault tolerance of 0.

Type B components with a SFF of 60% to < 90% must have a hardware fault tolerance of 1 according to table 3 of IEC 61508-2 for SIL 2 (sub-) systems.

[1] Type B component: "Complex" component (using micro controllers or programmable logic); for details see 7.4.3.1.3 of IEC 61508-2.

As the Electro-pneumatic Positioner SIPART PS2 is supposed to be a proven-in-use device, an assessment of the hardware with additional proven-in-use demonstration for the device and its software was carried out. The proven-in-use investigation was based on field return data collected and analyzed by SIEMENS AG, A&D PI TQ2. This data cannot cover the process connection. The proven-in-use justification for the process connection still needs to be done by the end-user.

According to the requirements of IEC 61511-1 First Edition 2003-01 section 11.4.4 and the assessment described in section 5.1 the Type B Electro-pneumatic Positioner SIPART PS2 with a hardware fault tolerance of 0 and a SFF of 60% to < 90% are considered to be suitable for use in SIL 2 safety functions The decision on the usage of proven-in-use devices, however, is always with the end-user.

The following tables show how the above stated requirements are fulfilled for the worst case configuration listed in Table 1.

Table 2: Summary for SIPART PS2 as single-acting shutdow n module – Failure rates

Failure categor y	Failure rates (in FIT)
Fail Safe Detected	0
Fail Safe Undetected	919
Fail Dangerous Detected	4
Fail Dangerous Undetected	182
No Effect	93
Annunciation Undetected	1
Not part	76
MTBF = MTTF + MTTR	90 years

Table 3: Summary for SIPART PS2 as single-acting shutdow n module – IEC 61508 failure rates

λ_{sd}	λ_{su}	λ_{dd}	λ_{du}	SFF	DC_S	DC_D
0 FIT	1013 FIT	4 FIT	182 FIT	84%	0%	2%

Table 4: Summary for SIPART PS2 as single-acting shutdow n module – PF D_{AVG} values

T[Proof] = 1 y ear	T[Proof] = 5 y ears	T[Proof] = 10 y ears
PF D_{AVG} = 7,94E-0 4	PF D_{AVG} = 3,96E-0 3	PF D_{AVG} = 7,91E-0 3

The boxes marked in yellow (▭) mean that the calculated PFD_{AVG} values are within the allowed range for SIL 2 according to table 2 of IEC 61508-1 but do not fulfill the requirement to not claim more than 20% of this range, i.e. to be better than or equal to 2,00E-03. The boxes marked in green (▭) mean that the calculated PFD_{AVG} values are within the allowed range for SIL 2 according to table 2 of IEC 61508-1 and table 3.1 of ANSI/ISA–84.01–1996 and do fulfill the requirement to not claim more than 20% of this range, i.e. to be better than or equal to 2,00E-03.

The assessment has shown that the Electro-pneumatic Positioner SIPART PS2 when used as a single-acting shut-down module ("tight closing bottom") has a PF D_{AVG} within the allowed range for SIL 2 according to table 2 of IEC 61508-1 and table 3.1 of ANSI/ISA–84.01–1996 and a Safe Failure Fraction (SFF) of more than 84%. Based on the verification of "proven-in-use" according to IEC 61508 and its direct relationship to "prior-use" of IEC 61511-1 it can be used as a single device for SIL2 Safety Functions in terms of IEC 61511-1 First Edition 2003-01.

The failure rates listed above do not include failures resulting from incorrect use of the Electro-pneumatic Positioner SIPART PS2, in particular humidity entering through incompletely closed housings or inadequate cable feeding through the inlets.

The listed failure rates are valid for operating stress conditions typical of an industrial field environment similar to IEC 60654-1 class Dx (outdoor location) with an average temperature over a long period of time of 40ºC. For a higher average temperature of 60°C, the failure rates should be multiplied with an experience based factor of 2,5. A similar multiplier should be used if frequent temperature fluctuation must be assumed.

A user of the Electro-pneumatic Positioner SIPART PS2 can utilize these failure rates in a probabilistic model of a safety instrumented function (SIF) to determine suitability in part for safety instrumented system (SIS) usage in a particular safety integrity level (SIL). A full table of failure rates for different operating conditions is presented in section 5.2 to 5.5 along with all assumptions.

It is important to realize that the “no effect” failures and the “annunciation” failures are included in the “safe undetected” failure category according to IEC 61508. Note that these failures on its own will not affect system reliability or safety, and should not be included in spurious trip calculations.

Abbreviations

B

Abbreviation	Long form	Meaning
A/D	Analog-to-digital converter	-
AC	Alternating current	Alternating current
AMS	Asset Management Solutions	Communication software by Emerson Process comparable with the PDM
AUT	Automatic	Operating mode
ATEX	Atmosphère explosible	Product and operation directive of European Commission for explosion protection.
BE	Binary input	-
CENELEC	Comité Européen de Normalisation Electrotechnique	European committee for electrotechnical standardization
CPU	Central processing unit	Master processor
DC	Direct current	Direct current
EEx	European explosion protection	-
EMC	Electromagnetic compatibility	-
FM	Factory Mutual	American testing agency/insurance company
FF	FOUNDATION fieldbus	Fieldbus of the Fieldbus Foundation
FW	Firmware	Device-specific software
GSD	Device master data	-
HART®	Highway Addressable Remote Transducer	Communication system for erecting industrial fieldbuses.
IP	International Protection Ingress Protection	International degrees of protection (long form as per DIN) Ingress protection (long form used in the USA)
LC	Liquid crystal	Liquid crystal
MAN	Manual	Operating mode
NAMUR	Standardization association for measurement and control in chemical industries	Association of the users of process control systems
µC	Microcontroller	Single-chip computer system
NCS	Non-contacting position sensor	Non-contacting position sensor
NEMA	National Electrical Manufacturers Association	American standardization institute National electrical manufacturers association
NPT	National taper pipe	Pipe thread for self-tapping threads as per ANSI B.1.20.1
PA	Process automation	Process automation
PDM	Process device manager	Siemens communication software / engineering tool
PROFIBUS	Process field bus	Fieldbus
PTB	Physikalisch Technische Bundesanstalt	-
SIA	Slotted initiator alarm unit	-

Abbreviation	Long form	Meaning
SIL	Safety integrity level	Safety requirement level as per IEC 61508/IEC 61511
VDE	Verband der Elektrotechnik, Elektronik und Informationstechnik e.V.	Industrial and professional association
VDI	Verein Deutscher Ingenieure e.V.	Technical-scientific association

Abbreviation	Full term in English	Meaning
FIT	Failure in Time	Frequency of failure Number of faults withing 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 Failure on Demand	Probability of dangerous failures of a safety function on demand
PFD_{AVG}	Average Probability of Failure on Demand	Average probability of dangerous failures of a safety function on demand
SFF	Safe Failure Fraction	Proportion of safe failures: Proportion of failures without the potential to bring the safety-instrumented system into a dangerous or non-permissible functional status.
SIL	Safety Integrity Level	The international standard IEC 61508 defines four discrete Safety Integrity Levels (SIL 1 to SIL 4). Each level corresponds to a range of probability for failure of a safety function. The higher the Safety Integrity Level of the safety-instrumented system, the lower the probability that it will not execute the required safety functions.
SIS	Safety Instrumented System	A safety-instrumented system (SIS) executes the safety functions that are required to achieve or maintain a safe status in a system. It consists of a sensor, logic unit/control system and final controlling element.
TI	Test Interval	Testing interval of the protective function

Glossary

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 a part of the package. The SIPART PS2 (HART) and SIPART PS2 FF are integrated into the AMS Device Manager, i.e. AMS can be used to communicate with these devices, especially for the configuration purpose.

ATEX

ATEX is the abbreviation of the French term "Atmosphère explosible". ATEX stands for both the directives of the European Community for 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 many electric circuits in addition to the standard supply. The auxiliary voltage can be extremely stabilized, have a specific level or polarity and/or other properties having decisive significance for the correct functioning of parts in the circuit.

Conduit piping system

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

Configuration

See parameterization.

Cornerstone

Management software for process instrumentation.

Dangerous failure

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

Decrement

From the Latin word decrementare, decrease. Decrement is the defined amount of change when decreasing a variable(s) gradually. In informatics, it is referred to as the stepwise 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.

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 the ones that are normally expected, e.g. defects in the device, and prevent the ignition sources. Devices in this category are suitable for use in zone 1.

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 the ones that are normally expected, e.g. defects in the device, and prevent the ignition sources. Devices in this category are suitable for use in zone 2.

Digital

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

EEPROM

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

EEx ia/ib protection

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

- ia: intrinsic safety, as per special requirements compliant with EN 50020
- ib: intrinsic safety, as per EN 50020

EEx-d protection

Type of protection for versions with flameproof enclosures. 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

Electromagnetic compatibility

Definition as per the EMC law: EMC is the capability of a device to work satisfactorily in the electromagnetic environment without causing electromagnetic interferences that are unacceptable for other devices present in this environment.

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.

Fieldbus

A fieldbus is an industrial communication system used to connect a number of field devices with a control device. Field devices include measuring sensors, final controlling elements and actuators.

Final controlling element

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

Firmware

Firmware (FW) is the software embedded in a chip in electronic devices. It is not like software that is stored on hard disks, CD-ROMs or other mediums. These days, the firmware is mostly stored in a flash memory or an EEPROM. Firmware is software in the hardware, and is thus an intermediate between the software and the 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.

Foundation fieldbus

Syndicate of manufacturers of measurement and control systems. The syndicate develops the open fieldbus specifications of the FOUNDATION fieldbus.

FOUNDATION fieldbus

Fieldbus to connect sensors and final controlling elements in hazardous areas as per IEC 61158-2. The FOUNDATION fieldbus uses a common 2-wire cable for data communication and power supply. Data communication and power supply. The FOUNDATION fieldbus uses bus types such as High Speed Ethernet and Foundation H1.

Frequency shifting process

The frequency shifting process 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 erecting 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 superordinated control system. Standardized parameter sets can be used for manufacturer-independent operation of all HART devices.

HART communicator

Connection with a two-wire line is directly established for the parameterization with the HART communicator. For the parameterization 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(s) gradually. In informatics, it is referred to as the stepwise increase in a numeric value.→Decrement.

Initialization

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

IP code

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

Microcontroller

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

Motherboard

All electronic elements of the positioner are installed on the motherboard.

NAMUR

Standardization association for measurement and control in chemical industries. NAMUR is an association of users of process control technology. The members are mainly the 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 merger of Associated Manufacturers of Electrical Supplies and the Electric Power Club.

NEMA 4

An enclosure standard of the National Electrical Manufacturers Association. The 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 like NEMA 4. Additional protection of the enclosure from corrosion.

Parameterization

During parameterization, individual parameter settings are specifically changed to adjust the positioner as per the actuator or other requirements. Parameterization 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 gaseous atmosphere

Mixture of air, combustible gases, vapors or mist.

Process device manager

PDM is a Siemens software package for project planning, parameterization, commissioning and maintenance of network configuration and field devices. Part of SIMATIC Step7. Used for the configuration and diagnostics of SIPART PS2.

PROFIBUS

PROFIBUS stands for process fieldbus. PROFIBUS is a manufacturer-independent standard to network the field devices (e.g. PLCs, actuators, final controlling elements and sensors). PROFIBUS is compatible with protocols such as DP (decentralized peripherals), FMS (fieldbus message specification) and PA (process automation).

PROFIBUS PA

PA is an abbreviation of process automation. PROFIBUS PA is used in process engineering. This fieldbus is used to control the measuring devices using a process control system. This version of PROFIBUS is suitable for hazardous areas of zones 0 and 1. Only a weak current flows through an intrinsically safe circuit in the bus cables, and hence sparks are not generated even in case of a fault.

PA enhances PROFIBUS DP with an intrinsically safe transmission technique compliant with the international standard IEC 61158-2.

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 mode 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

Program for process automation (e.g. PCS7, WinCC, WinAC, PDM).

Zero point shutdown

The zero point shutdown guarantees a tight closing of the valve if an input signal is < 2% of the maximum value. The coil current is then set to zero. The zero point shutdown must normally be deactivated to set the minimum coil current

Zone 0

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

Zone 1

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

Zone 2

Area in which potentially explosive gaseous atmospheres normally never build up or build up for a short while during the normal operation of a device.

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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