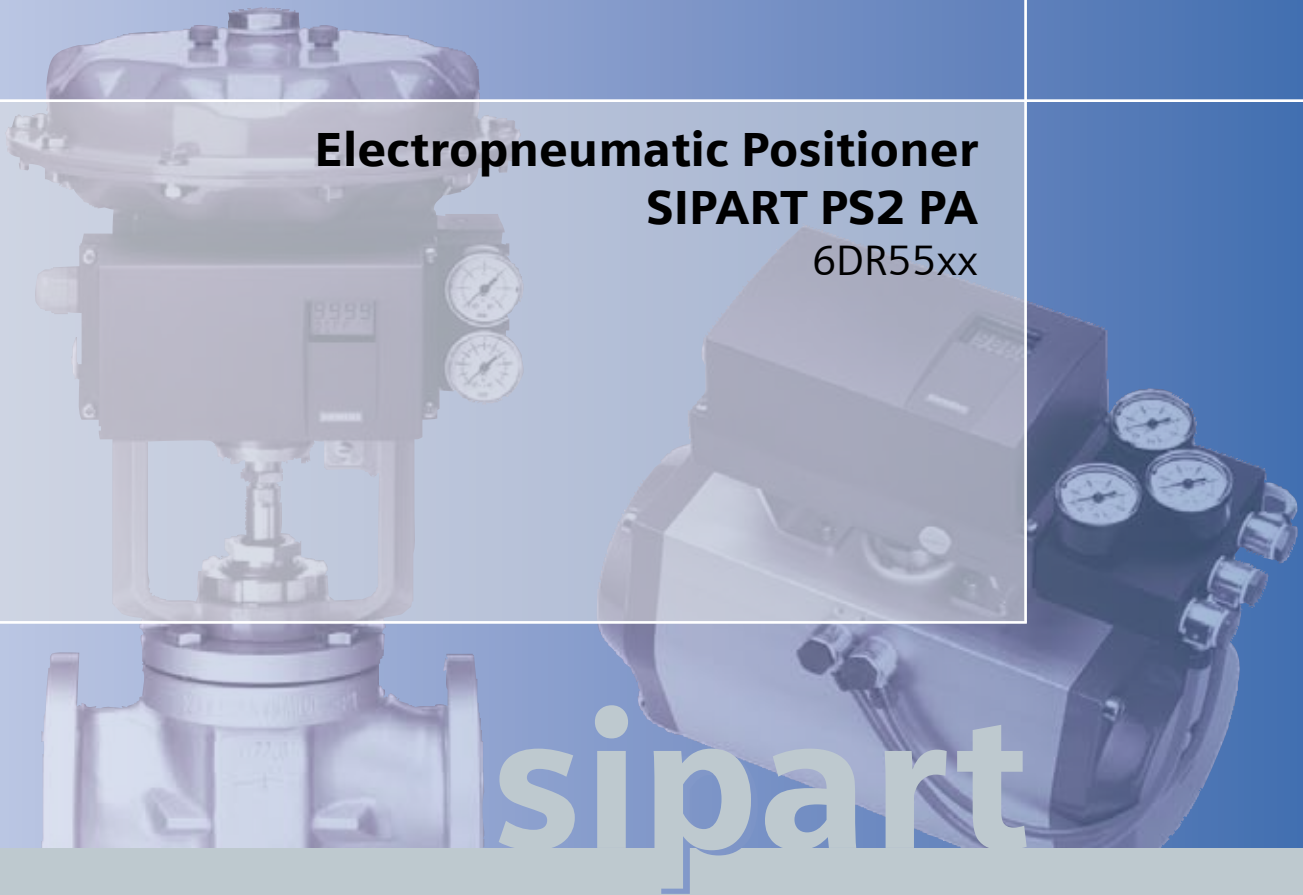


**Electropneumatic Positioner
SIPART PS2 PA
6DR55xx**



sipart

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Electropneumatic positioner SIPART PS2 with PROFIBUS communication

Operating Instructions

6DR55**

09/2007
A5E00127926-07

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Safety Guidelines

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.

Prescribed Usage

Note the following:

⚠ WARNING
This device may only be used for the applications described in the catalog or the technical description and only in connection with devices or components from other manufacturers which have been approved or recommended by Siemens. Correct, reliable operation of the product requires proper transport, storage, positioning and assembly as well as careful operation and maintenance.

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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Introduction

1.1 Purpose of this document

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 identification	System integration
07 09/2007	FW: from 5.00.00 onwards	SIMATIC PDM V6.0

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

Edition	Remark
07 09/2007	<ul style="list-style-type: none">• Additional parameters and diagnostics enhancement• Newly added contents for operating with natural gas and for functional safety• Entirely revised edition

1.3 Further information

Information

The contents of these instructions 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 contained herein 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.

Worldwide contact person

If you need more information or have particular problems which are not covered sufficiently by the operating instructions, get in touch with your contact person. You can find contact information for your local contact person in the Internet.

Product information on the Internet

The Programming Manual is an integral part of the companion CD, which may be ordered separately. In addition, the Programming Manual is available on the Internet on the Siemens homepage.

On the CD you will also find the technical data sheet containing the ordering data, the Device Install software for SIMATIC PDM for subsequent 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

2.1 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

The regulations of the test certification valid in your country are to be observed.


Electrical connection in hazardous zones with explosive atmospheres


The national directives and laws for hazardous areas valid in your country must be observed for electrical connection. For example, in Germany these are:

- Operational safety regulations
- Directive for the installation of electrical systems in hazardous areas DIN EN 60079-14 (previously VDE 0165, T1)

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: <ul style="list-style-type: none">• During installation• During maintenance• During repairs

 WARNING
Exposure to aggressive and hazardous media The device can be operated both at high pressure and with aggressive and hazardous media. Therefore, improper use of this device may lead to serious injury and or considerable damage to property. Above all, it must be noted when the device was in use and is to be exchanged.

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.
- They should be trained in first aid.

Description

3.1 Function

- The electropneumatic positioner and an actuator form a control system. The current position of the actuator is recorded by a servo potentiometer and the actual value x is fed back. The setpoint and the actual value are simultaneously shown on the digital display.
- The reference variable w is provided digitally through the PROFIBUS.
- The positioner works as a predictive, anticipatory five-point controller whose output variable $\pm\Delta y$ is used to control the integrated servo valves based on the pulse length modulation method.
- These input signals change pressure in the actuator chamber(s) and displace the actuator until the control deviation becomes zero.
- When the enclosure cover has been removed, the device can be operated and configured using three buttons and the digital display.
- The standard controller has one binary input (BE1) by default. This binary input can be configured individually, and be used to block the operating modes.
- It has a friction clutch and a switchable gear so that the positioner can be used with different mechanical part-turn and linear actuators.

3.2 Structure

3.2.1 Design overview

The mechanical and electrical assembly, the device components and functional principle of the positioner are described in the following chapter.

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

The positioner is available in the following configurations:

- SIPART PS2 PA without explosion protection in the metal or plastic enclosure
- SIPART PS2 PA with EEx ia/ib protection in the metal or plastic enclosure
- SIPART PS2 PA with EEx d protection in the flameproof enclosure

The positioner is used to move and control pneumatic actuators. The positioner works electropneumatically; compressed air is used as an auxiliary power supply. The positioner is used to control valves with:

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

Difference attachment extensions are available for linear actuators:

- NAMUR or IEC 534
- Integrated attachment to ARCA
- Integrated attachment to SAMSON in the non-flameproof enclosure

The positioner can be installed on or operated using the customary drives.

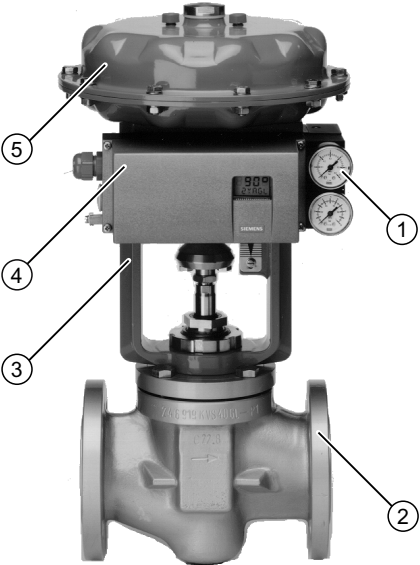


Figure 3-1 Positioner attached to a single-action linear actuator

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

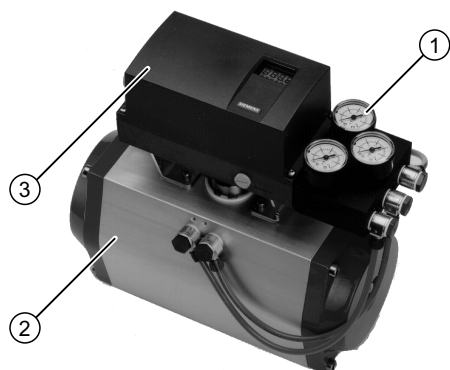


Figure 3-2 Positioner attached to dual-action part-turn actuator

- ① Pressure gauge block, dual-action.
- ② Part-turn actuator
- ③ Dual-action positioner in plastic enclosure.

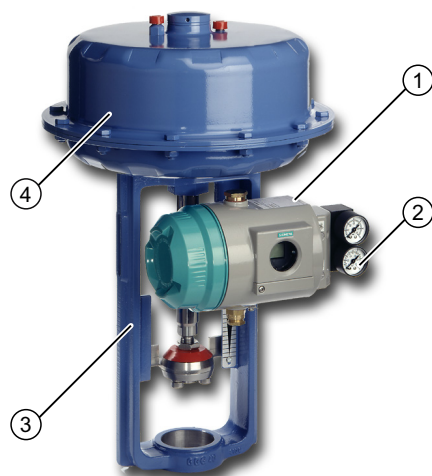


Figure 3-3 Positioner in flameproof enclosure attached to linear actuator

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

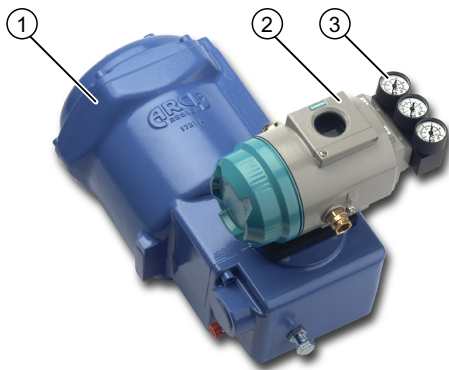
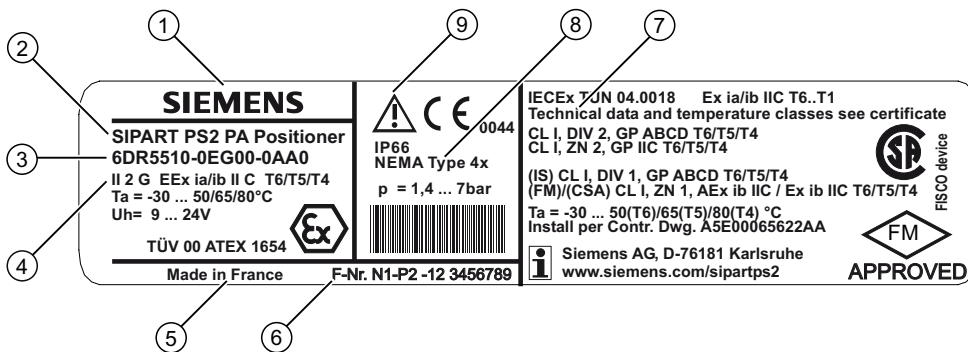


Figure 3-4 Positioner in flameproof enclosure attached to part-turn actuator

- ① Part-turn actuator
- ② Dual-action positioner in flameproof enclosure.
- ③ Pressure gauge block, dual-action.

3.2.2 Type plate structure



Type plate structure, example of the EEx ia/ib degree of protection

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

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 "Ex ia" version of the positioner and optional modules with the "Ex 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.

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 "Ex 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 G $\frac{1}{4}$ 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
		[NI/min]	[NI/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
	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 NI/min at a differential pressure of 7 bar.

3.4 Device components

3.4.1 Overview of device components

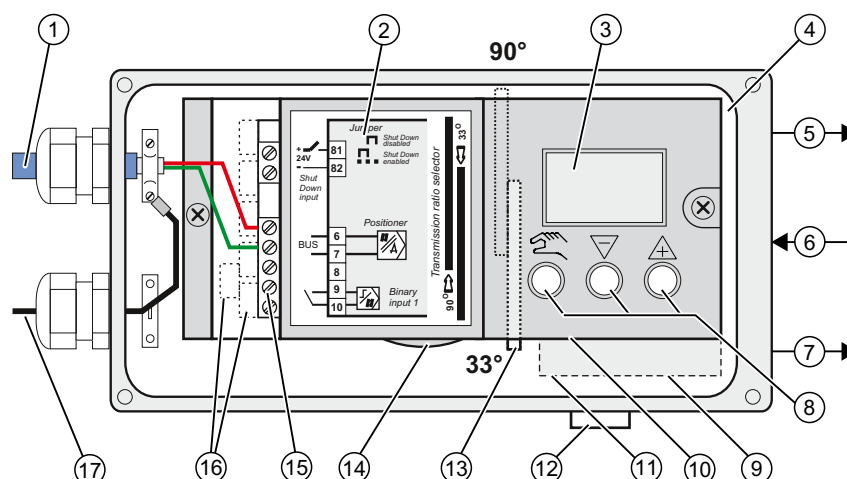


Figure 3-5 View of the positioner (cover open; plastic enclosure)

- | | | | |
|---|---|---|--|
| ① | Bus cable | ⑩ | Restrictor |
| ② | Terminal label on the cover | ⑪ | Restrictor Y1 |
| ③ | Digital display | ⑫ | Attenuator |
| ④ | Purge air switch | ⑬ | Transmission ratio selector |
| ⑤ | Output: Actuating pressure Y1 | ⑭ | Friction clutch adjustment wheel |
| ⑥ | Input: supply air | ⑮ | Motherboard |
| ⑦ | Output: Actuating pressure Y2 ¹⁾ | ⑯ | Connecting terminals of optional modules |
| ⑧ | Buttons | ⑰ | Shield support ²⁾ |
| ⑨ | Restrictor Y2 ¹⁾ | | |
- ¹⁾ for double-acting actuators
- ²⁾ Only for a plastic enclosure

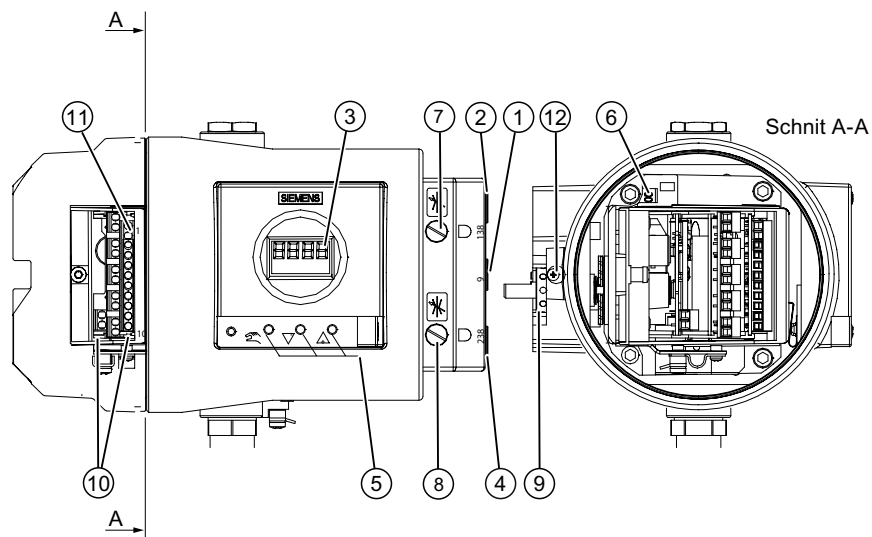


Figure 3-6 View of the positioner in the flameproof enclosure

- | | |
|---|---|
| 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 Connecting terminals of optional modules |
| ⑤ Buttons | ⑪ Connecting terminals of standard controller |
| ⑥ Transmission ratio selector ²⁾ | ⑫ Safety catch |

¹⁾ for double-acting actuators

²⁾ possible only when the positioner is open

3.4.2 Motherboard

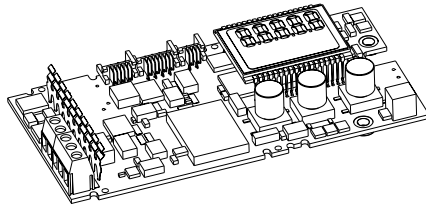


Figure 3-7 Motherboard

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.

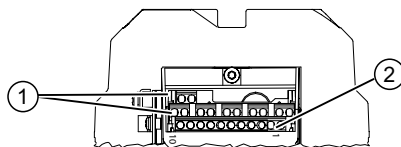


Figure 3-8 Connecting terminals of the flameproof enclosure

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

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.

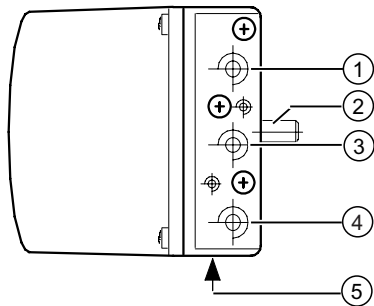


Figure 3-9 Pneumatic connection on the standard controller

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

3.4.4.2 Pneumatic connection in the flameproof enclosure

Structure

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

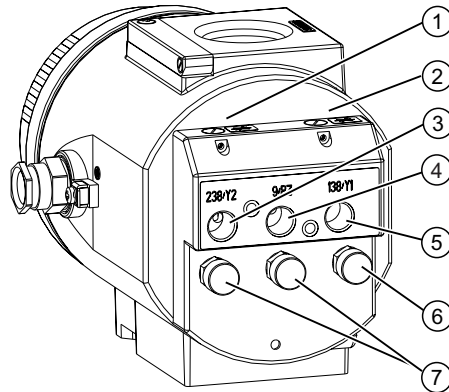


Figure 3-10 Pneumatic connection in the flameproof enclosure

- | | | | |
|---|--------------------------|---|----------------------------|
| ① | Restrictor Y2 *) | ⑤ | Actuating pressure Y1 |
| ② | Restrictor Y1 | ⑥ | Exhaust air outlet E |
| ③ | Actuating pressure Y2 *) | ⑦ | Enclosure ventilation (2x) |
| ④ | Supply air Pz | | |
- *) for double-acting actuators

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.

Description

3.4 Device components

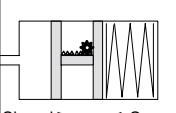


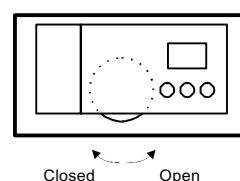
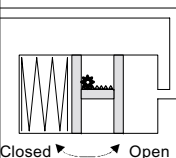


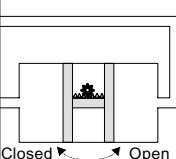

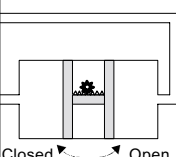

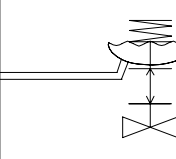
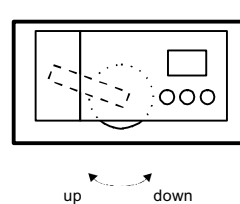
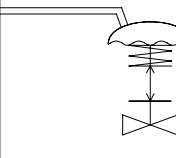
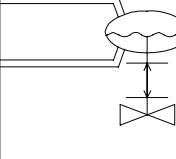
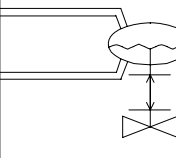
Positioning pressure Connection	Actuator type	Safety position after power failure		
		electrical	pneumatic	
Y1		Closed 	Closed 	<p>In part-turn actuators the direction of rotation counterclockwise looking onto the actuating shaft of the valve is usually defined as "Open".</p> 
Y1		Open 	Open 	
Y2		Open 	Last position (before power failure)	
Y1		Closed 		
Y1		Down	Down	
Y1		Up	Up	
Y2		Up	Last position (before power failure)	
Y1		Down		

Figure 3-11 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.

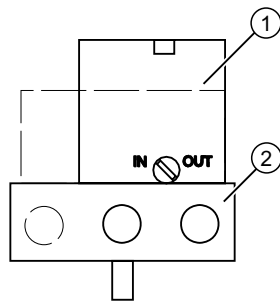


Figure 3-12 Purge air switch on the pneumatic block; view of the positioner on the pneumatic connection side when the cover is open

- 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.

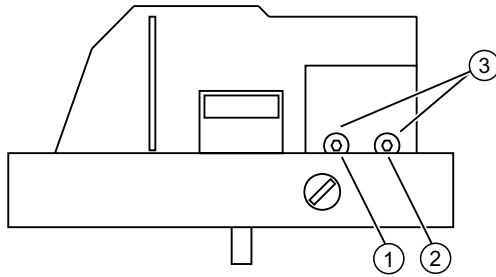


Figure 3-13 Restrictors

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

3.5 Functional principle

3.5.1 Control system

The electropneumatic positioner and an actuator form a control system. The current position of the actuator is recorded by a servo potentiometer and the actual value x is fed back. The setpoint and the actual value are simultaneously shown on the digital display.

The control system provides the setpoint digitally to the positioner through the fieldbus. The bus interface of the fieldbus version of the positioner differs from the previous versions. However, the basic functions of the positioner as well as the operation and the display are almost unchanged.

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 **Non-Contacting Position Sensor** is used to record the lifting or rotation angle directly on the actuator.

3.5.2 Microcontroller

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.

3.5.3 Pneumatic actuator

Pneumatic actuators are available in single and double-acting versions. Only one pressure chamber is ventilated and depressurized in case of a single-acting version. The pressure developed works against a spring. Two pressure chambers work against each other in case of a double-acting version. When ventilating the volume of the one, the volume of the other is depressurized.

3.5.4 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.

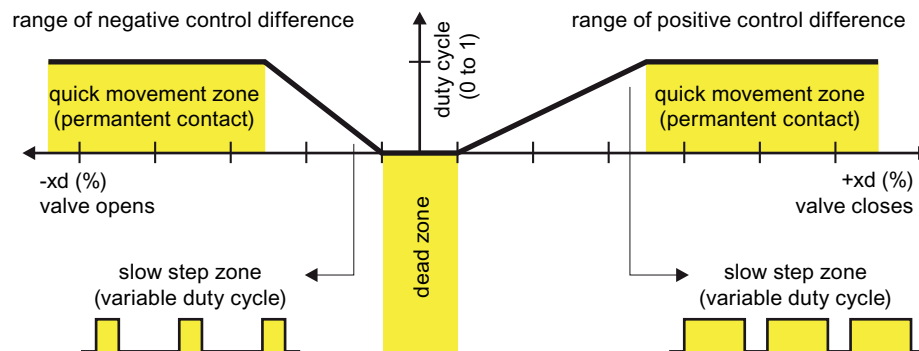


Figure 3-14 Functional principle of five-point controller

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.

3.6 PROFIBUS PA

3.6.1 Overview

The Process Field Bus (PROFIBUS) is an open communication system for automation technology and is specified in the European standard EN 50170.

PROFIBUS Process Automation (PROFIBUS PA) is a variant of PROFIBUS Decentral Peripherals (PROFIBUS DP), which is widely used in process technology.

3.6.2 Transmission technology

PROFIBUS PA uses a special transmission technology, enabling it to fulfill the requirements of process automation and process technology. This transmission technology is defined in the international standard IEC 61158-2. The low transmission rate reduces the power loss in comparison to PROFIBUS DP, enabling an intrinsically safe technology for use in hazardous zones with explosive atmospheres.

3.6.3 Bus topology

The bus topology is mainly able to be selected as desired. Therefore, line, star and tree structures, and mixed forms are possible. All types of field devices such as transmitters, actors, analysis devices, etc. can be connected to the PROFIBUS PA.

Advantages include:

- Savings on installation costs
- More extensive diagnostics, leading to increased availability of installation sections
- Automatic management of installation documentation
- Installation optimization on the fly during operation

In an automation system, there are, in general, multiple PROFIBUS PA strands connected to the fast PROFIBUS DP via coupler units. This is also connected to the process control system.

Both bus systems use the same protocol layer. This makes PROFIBUS PA a "communications-compatible" extension of the PROFIBUS DP into the field.

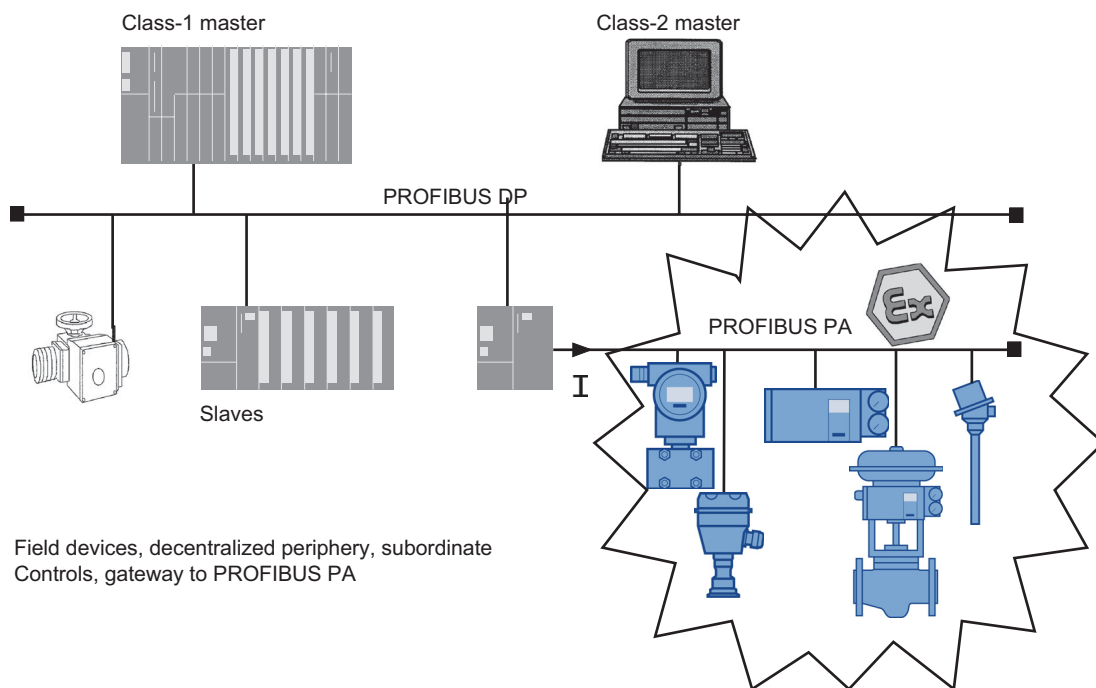


Figure 3-15 Functional principle of the PROFIBUS automation system

The figure shows a section of a typical PROFIBUS automation system. The control system consists of two masters with distributed tasks.

The class-1 master recognizes the control and regulation tasks. The class-2 master enables the operating and monitoring functions. Between the class-1 master and the field devices there is a periodic exchange of measurement and settings data. The status information from the field devices is transmitted parallel to this data, and evaluated in the class-1 master. Parameterization of the field devices or the readout of additional device information is not performed during periodic operation.

Besides periodic operation, one or more class-2 masters can access the field devices asynchronously. Using this type of communication, additional information can be retrieved from the devices or settings sent to them.

3.6.4 Properties

PROFIBUS PA enables the bidirectional communication of a bus master with field devices. At the same time, the shielded two-strand wiring provides auxiliary power to the two-wire field devices.

3.6.5 Profile

As an extension to the EN 50170 standard, the PROFIBUS user organization (PNO) defined the functionality of the individual field device types in a so-called profile description. This profile determines minimum functional requirements and optional extensions. The device-internal "Device Management" provides the configuration tool of the control system with all

necessary basic information to find profile parameters. One parameterization tool serves all profile-conforming devices, regardless of type or manufacturer.

Depending on the size of the installation (and therefore the number of field devices) and the time behavior required, you implement the system with one or more PROFIBUS PA strands. One PROFIBUS PA strand consists of the components shown in the following figure.

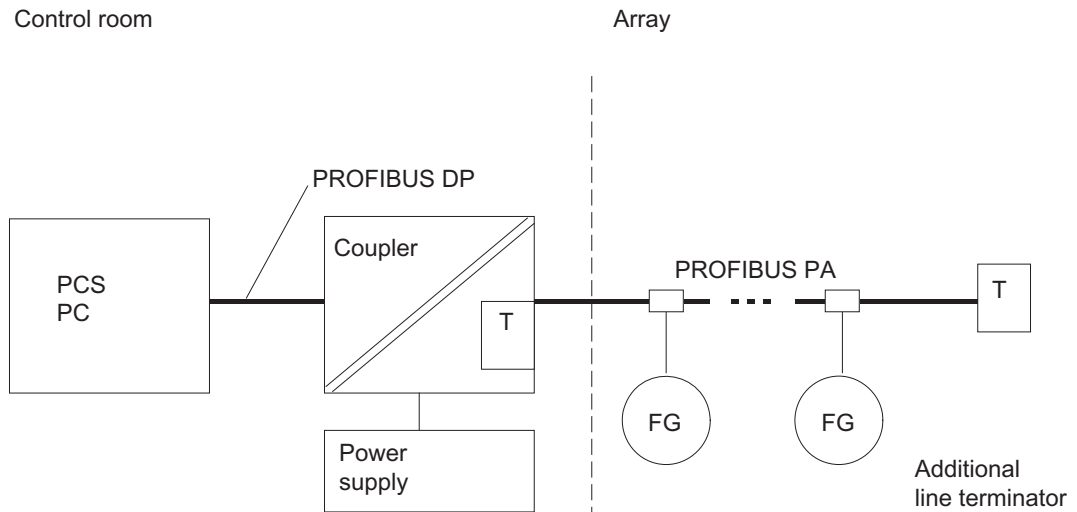


Figure 3-16 PROFIBUS PA strand

FG	Field device	PC	Personal Computer
T	Terminating resistor	PCS	Process control system

Reference

PNO PROFIBUS-PA interest group

3.6.6 Connection

Control is performed by the central process control system (PCS) or by a PC for lower-performance requirements.

In general, the following functions are combined into one coupling assembly:

- DP/PA signal transfer
- Bus power
- Bus termination

Depending on the number of the PROFIBUS PA field devices to be operated in the automation system and the time behavior required, a DP/PA coupler or a DP/PA link is used. For standard requirements, you use a DP/PA coupler; for higher requirements, a more powerful DP/PA link.

For reasons related to transmission technology, the bus is also equipped on the far end with a terminating resistance T . When using the recommended bus cable, the theoretical maximum cable length is 1900 meters. The theoretical maximum cable length is the sum of all cable segments. During planning, also take into account the voltage drop over the wires powering the field devices.

However, the power requirements of the individual nodes and the voltage drop on the cable must also be calculated during projection. The individual field devices (FD) can be connected at nearly any point in the bus system.

DP/PA couplers or DP/PA links are supplied using a safety extra-low voltage (SELV) power supply. This power supply must have sufficient reserves to bridge over temporary power failures.

The maximum number of devices which can be connected to one bus strand depends on their power consumption and the conditions of use. When operated in the safe zone, the couplers or links supply the bus with up to 400 mA.

When operated in explosive atmospheres, intrinsic safety is only guaranteed if all devices, components, etc. connected to the bus (e.g. bus terminator) fulfill the following requirements:

- They are certified as intrinsically safe equipment.
- They fulfill the requirements of the FISCO model (Fieldbus Intrinsic Safety Concept).

Power supply devices in particular (bus couplers) must be certified as so-called FISCO power supplies. Observe the safety-relevant maximum values and other specifications of the EG type test certificate.

Connect power supplies (bus couplers) which are not explosion protected and certified to intermediate EX-certified zener barriers. Observe the specifications of the EG type test certificate.

 **WARNING**

For power supply to intrinsically safe PROFIBUS, use only power supplies, DP/PA couplers, or DP/PA links certified as compliant with the FISCO model.

Switch through zener barriers if using non-EX-protected power supplies. See the requirements of the EG type test certificate.

3.6.7 Number of connectable devices

The number of devices which can be connected to a bus strand can be calculated from the sum of the maximum power consumption of the devices and the power available. By default, assume 10 mA per device. For safety reasons, plan for a power reserve. Otherwise you run the risk of a defective device overloading the bus with an increased power consumption. This can interrupt the power supply and communication with the functioning nodes. The amount of power reserved is based on the nominal power increase given by the manufacturer in case of failure.

3.6.8 Assigning the device addresses

So that the connected process devices can be distinguished from one another, each device has its own address.

Be sure that the device addresses are set before operating two or more field devices on the bus. Each address may only be given once to make sure they are unique.

Principally, the address range is from 1 to 125. The address 126 is set for the delivery state. Normally, masters in PROFIBUS systems receive lower addresses. Therefore, we recommend starting at 30 when assigning addresses to the positioners. Either use the keys on the positioner or the SIMATIC PDM software via the bus to set the addresses. In the last case, a new positioner is always connected to the bus and the new address is set via the software. The next positioner is then connected to the bus and processed the same way.

We recommend writing the set address on the field device with a wipe resistant pen.

See also

Catalog process instrumentation (<http://www.siemens.com/processinstrumentation/catalogs>)

3.7 SIMATIC PDM

SIMATIC PDM is a software package for the configuration, parameterization, commissioning, diagnostics, and servicing of the device and other process devices.


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


Using SIMATIC PDM, you can do the following with process device data:

- display
- set
- change
- compare
- check for plausibility
- administer
- simulate

Installation

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: <ol style="list-style-type: none">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.

<p>⚠ CAUTION</p> <p>Humid environment/dry compressed air</p> <p>Install the positioner in a humid environment such that the positioner shaft does not freeze at low ambient temperatures.</p> <p>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.</p> <p>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.</p>
--

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	<ul style="list-style-type: none"> • Hexagon bolt ③ • Washer ⑪ • Spring lock washer ⑩
Actuator with plane surface	<ul style="list-style-type: none"> • Four hexagon bolts ③ • Washer ⑪ • Spring lock washer ⑩
Actuator with columns	<ul style="list-style-type: none"> • Two U-bolts ⑦ • Four hexagon nuts ⑫ • 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 ⑩
 - Hexagon bolts ⑦

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 ⑮
 - Washer ⑫
 - Square nut ⑱
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.

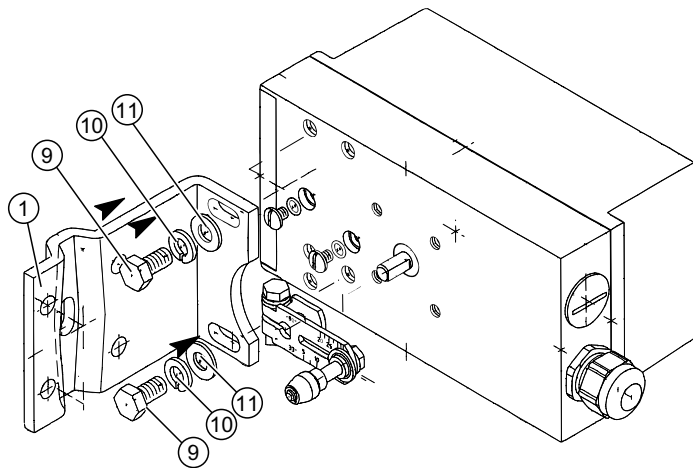
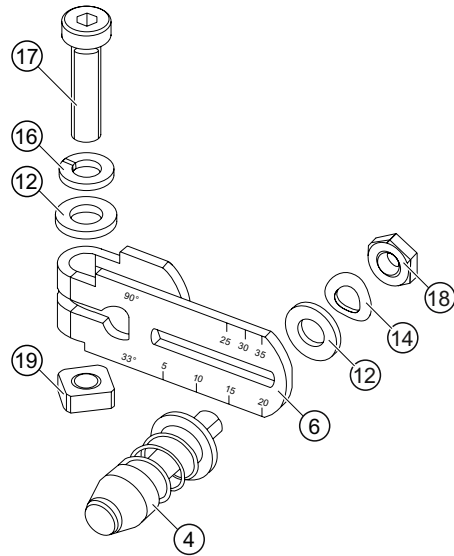
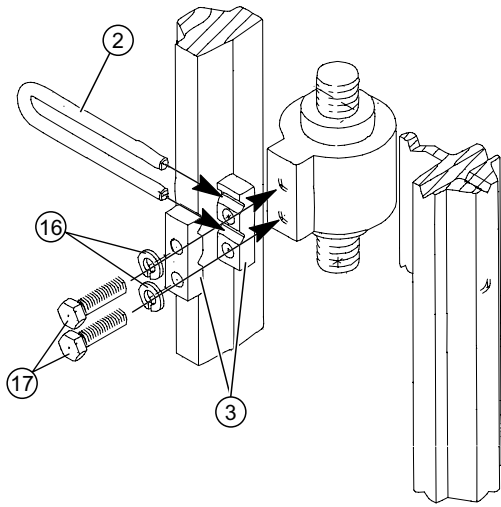
Note**Height adjustment of the positioner**

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.
-

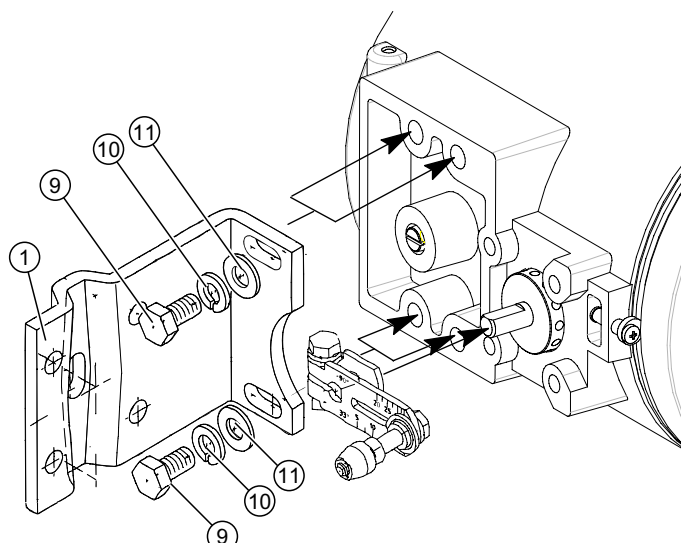
4.2 Installing the linear actuator

Assembly procedure: positioner with linear actuator

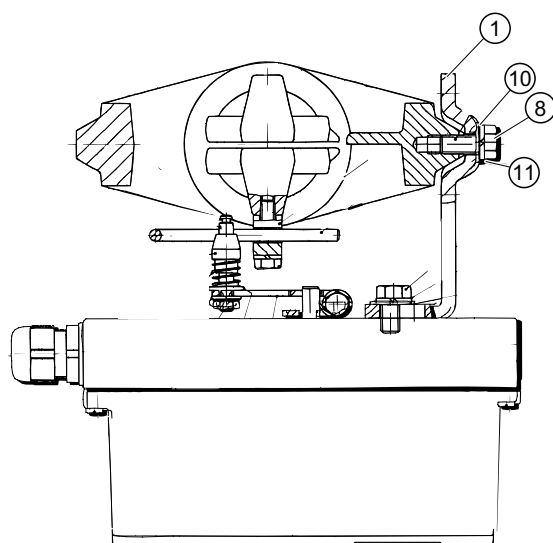


Assembly procedure: linear actuator without flameproof enclosure

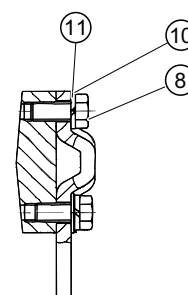
Assembly procedure: positioner with linear actuator



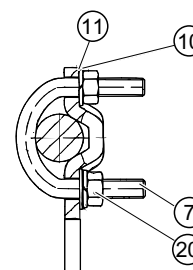
Assembly procedure: linear actuator with flameproof enclosure



Mounting on the yoke with fin



Mounting on the yoke with plane surface



Mounting on the yoke with columns

Installation

4.2 Installing the linear actuator

"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.

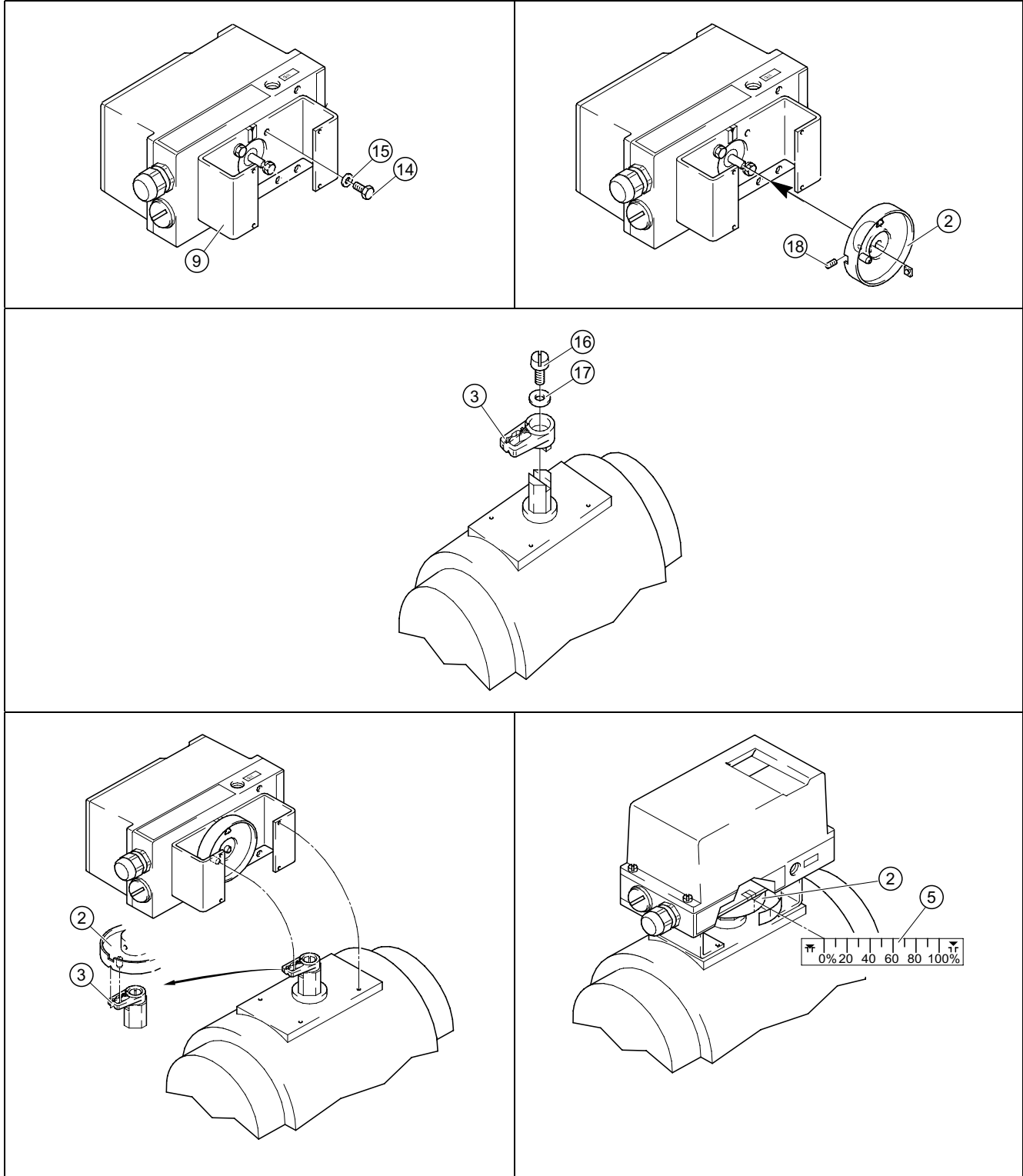
Installing the part-turn actuator

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

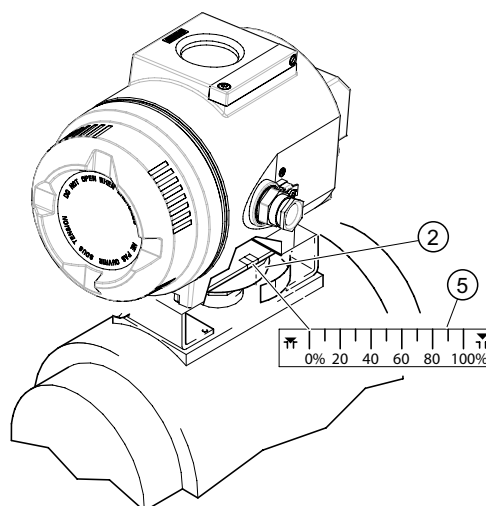
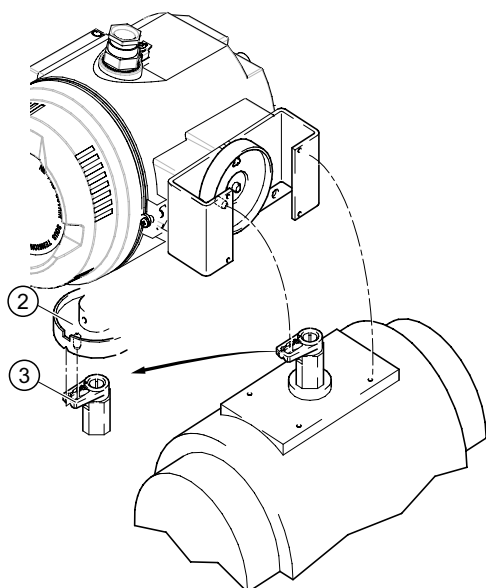
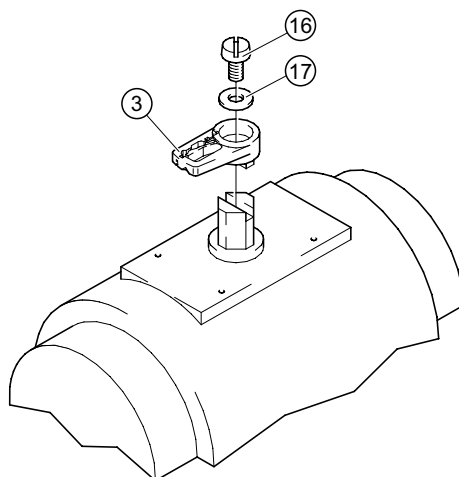
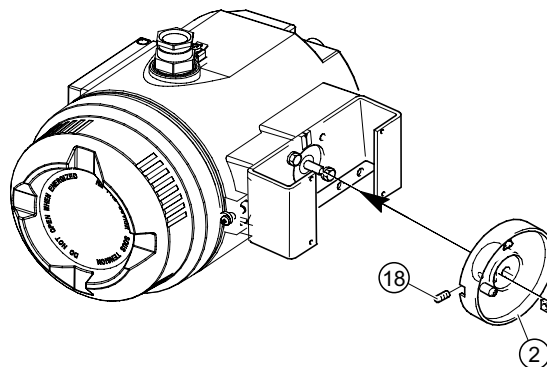
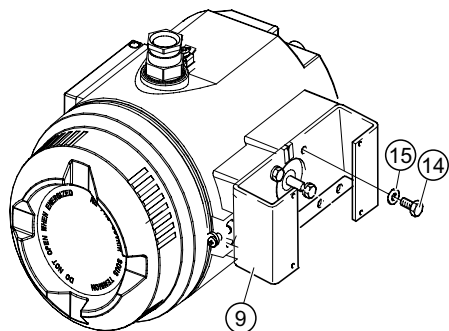
1. Rest the actuator-specific VDI/VDE 3845 mount ③ on the rear side of the positioner. Tighten the mount using hexagon bolts ⑭ and lock washers ⑮.
2. Stick the pointer mark ⑥ on the mount. Position the pointer mark at the center of the centering hole.
3. Push the coupling wheel up to the end stop on 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 ⑰ 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. Initialize the positioner.
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.

4.3 Installing the part-turn actuator

Assembly procedure for the positioner with part-turn actuator



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



Installation

4.3 Installing the part-turn actuator

"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 of the description of the assembly procedure with part-turn actuator with and without flameproof enclosure.

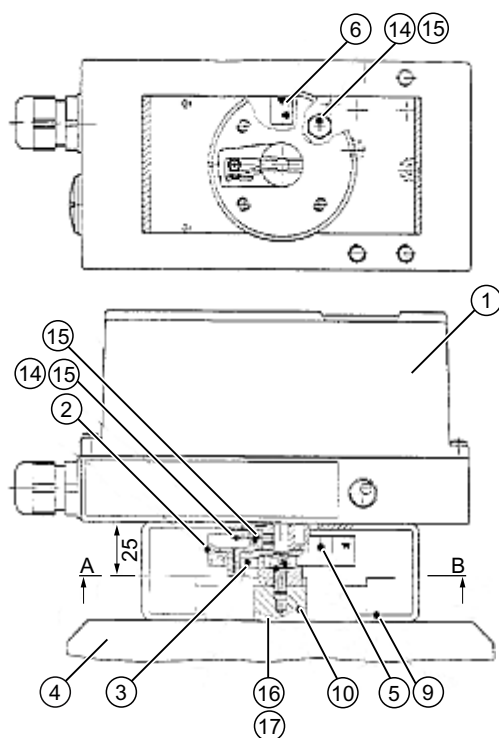


Figure 4-1 Installed positioner for part-turn actuators

- | | | | |
|---|--------------------|---|----------------------------|
| 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 | | |

4.4 Using the positioner in a humid environment

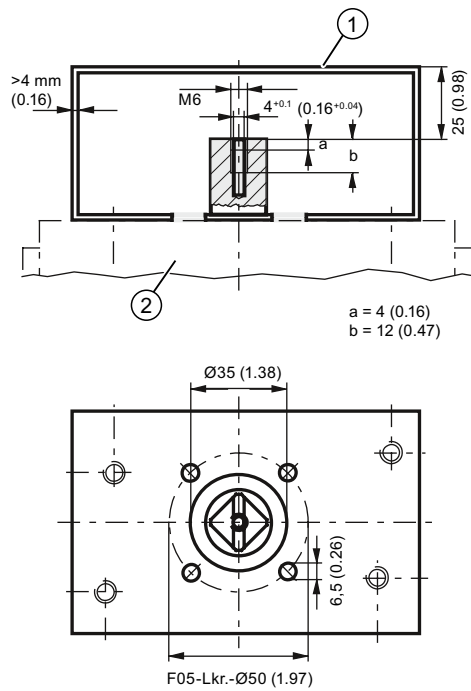


Figure 4-2 Dimensions of mount (actuator-dependant)

- ① Fastening plane of positioner
- ② Part-turn actuator

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.

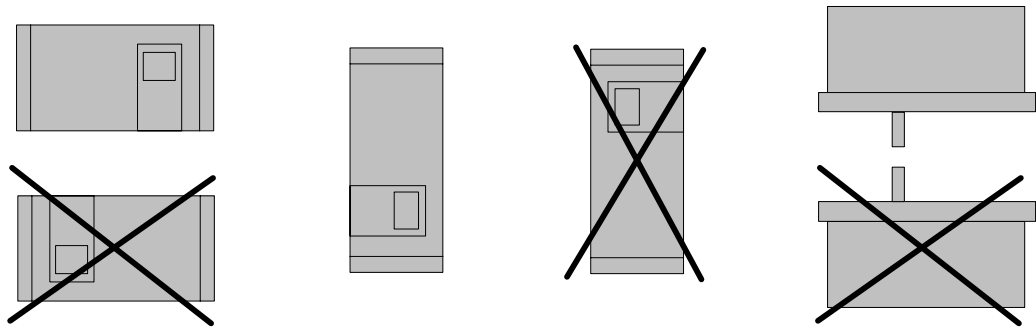


Figure 4-3 Favorable and unfavorable mounting positions

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 Notes for using positioners that are exposed to strong accelerations or vibrations

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

4.6 Setting the 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.

4.7 Switching the transmission ratio

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.

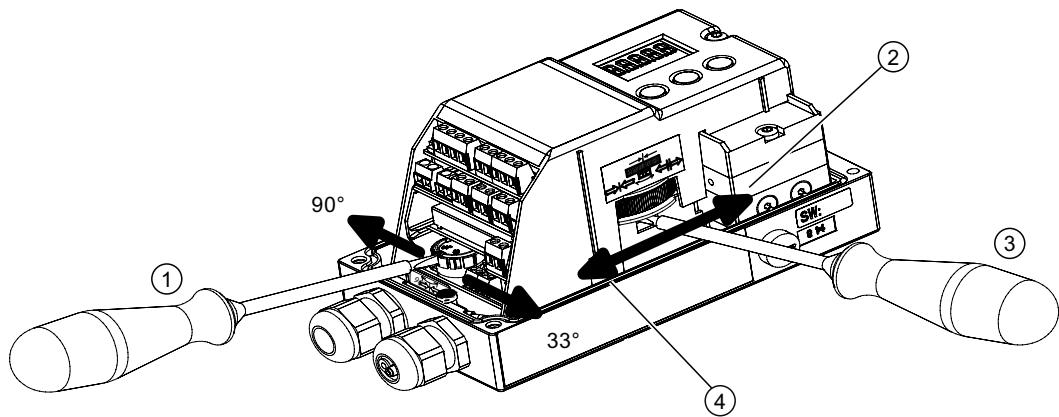


Figure 4-4 Arrester device and lock

4.8 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 external position detection system. An external position sensor is, e.g. a potentiometer with a 10 k Ω resistance or a non-contacting position sensor.

Installing the optional modules

5.1 General information about the installation of 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.
--

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:

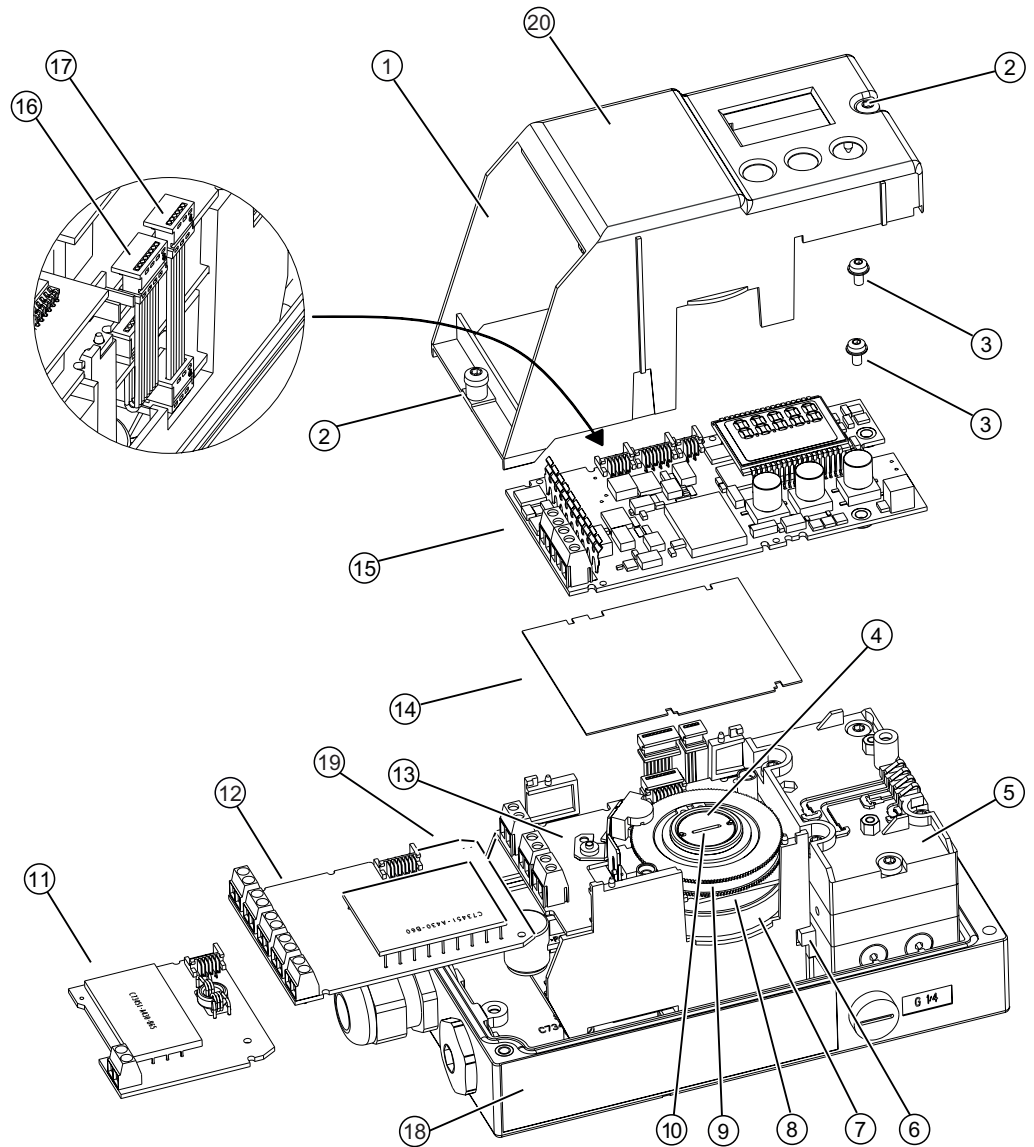


Figure 5-1 Installing the optional modules

- | | | | |
|---|-----------------------------|---|--|
| ① | Module cover | ⑬ | SIA unit or mechanical limit switch module |
| ② | Fixing screws | ⑭ | Insulating cover |
| ③ | Fixing screws | ⑮ | Motherboard |
| ④ | Actuating disc bearings | ⑯ | Ribbon cable for alarm unit |
| ⑤ | Pneumatic block | ⑰ | Ribbon cable for I _y module |
| ⑥ | Transmission ratio selector | ⑱ | Type plate |

5.1 General information about the installation of option modules

⑦	Friction clutch adjustment wheel	Sign set	
⑧	Actuating disc for A2, terminals 51 and 52	⑲	Warning sign on the side opposite to the type plate
⑩	I _y module	⑳	Wiring diagram
⑫	Alarm unit		

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 EEx d certified cable inlets 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's enclosure 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 ⑩.
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:

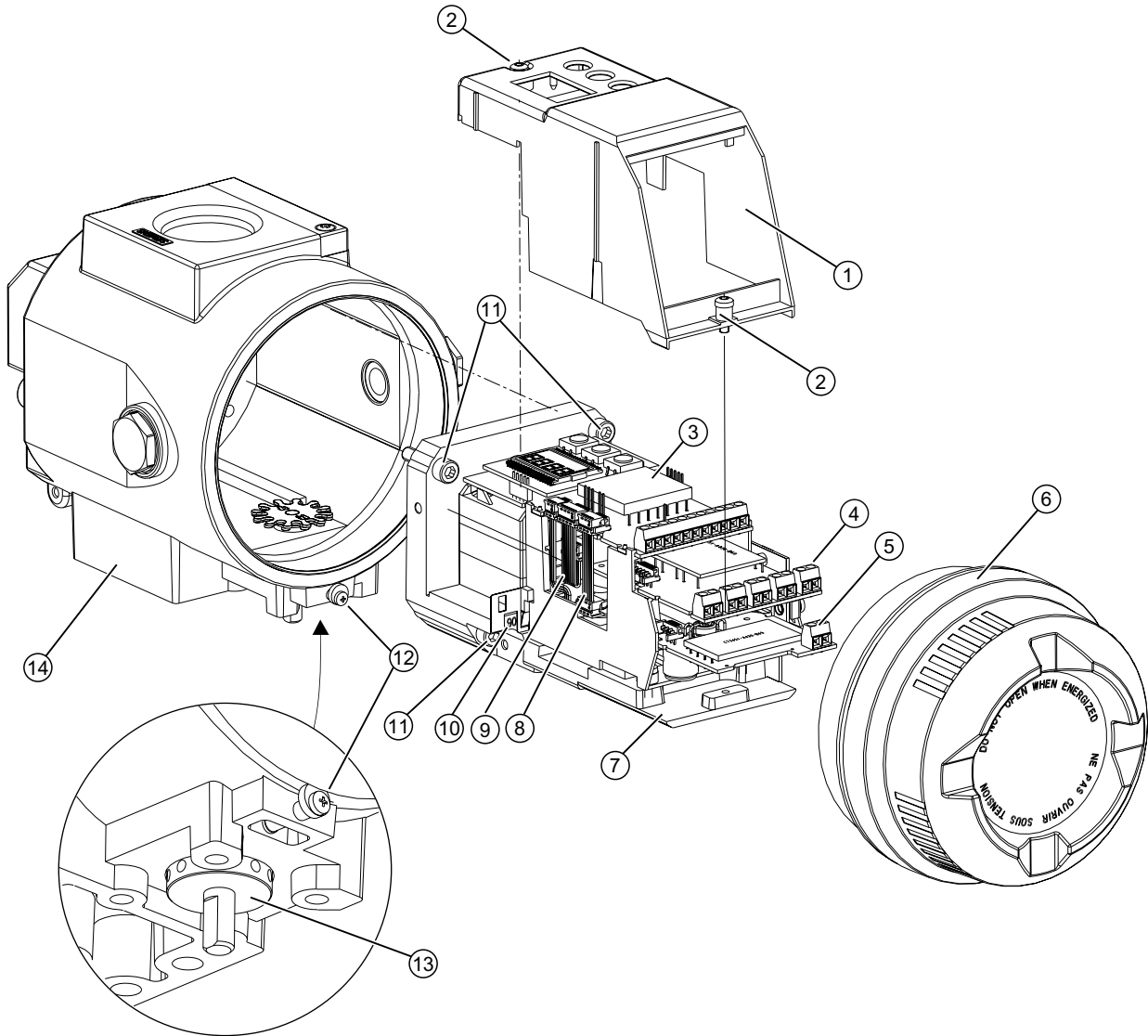


Figure 5-2 Installing the optional modules in a flameproof enclosure

- | | | | |
|---|-----------------------|---|--|
| 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 |

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.

See also

EMC filter module (Page 68)

5.2 I_y 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.

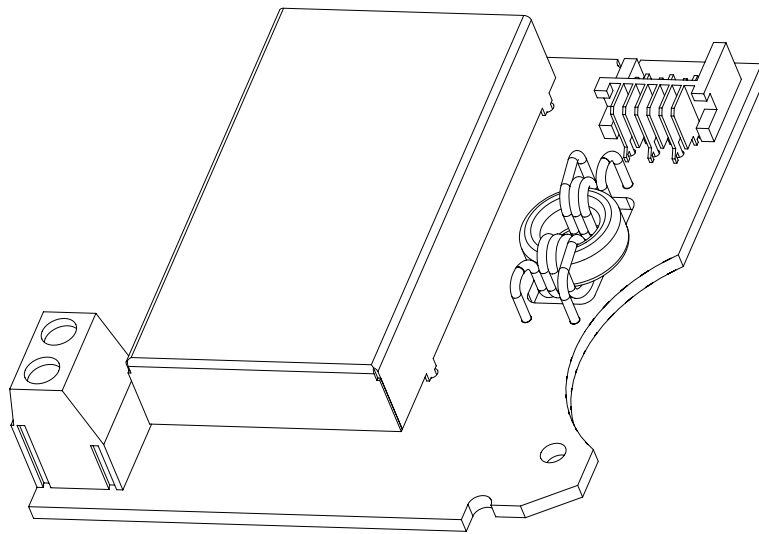


Figure 5-3 I_y module

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.

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

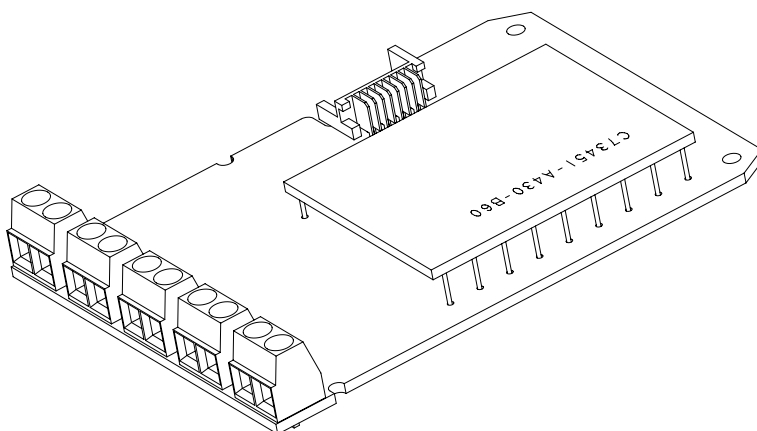


Figure 5-4 Alarm unit

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.

5.4 Slotted initiator alarm unit

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.

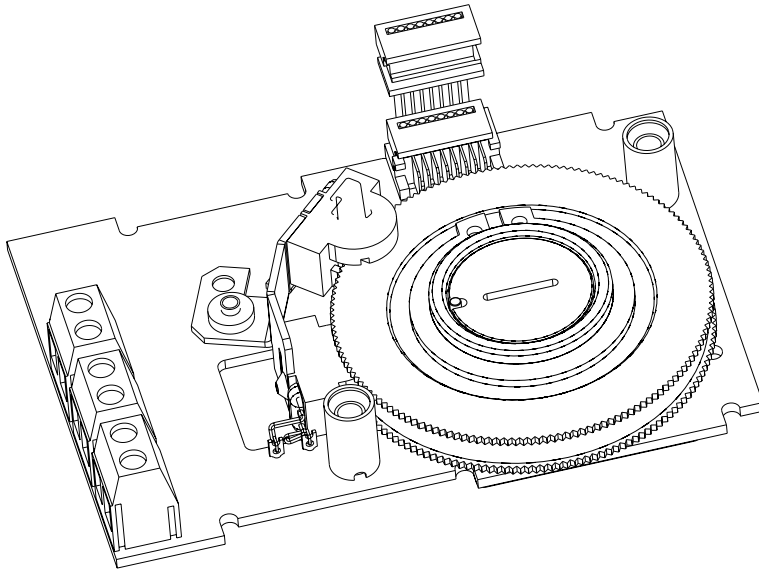


Figure 5-5 SIA unit

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.

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.

5.5 Mechanical limit switch module

5.5.1 Installing the mechanical limit switch module

 WARNING
Zones 2 and 22
The mechanical limit switch module may not be used in zones 2 and 22.

Function

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

Device features

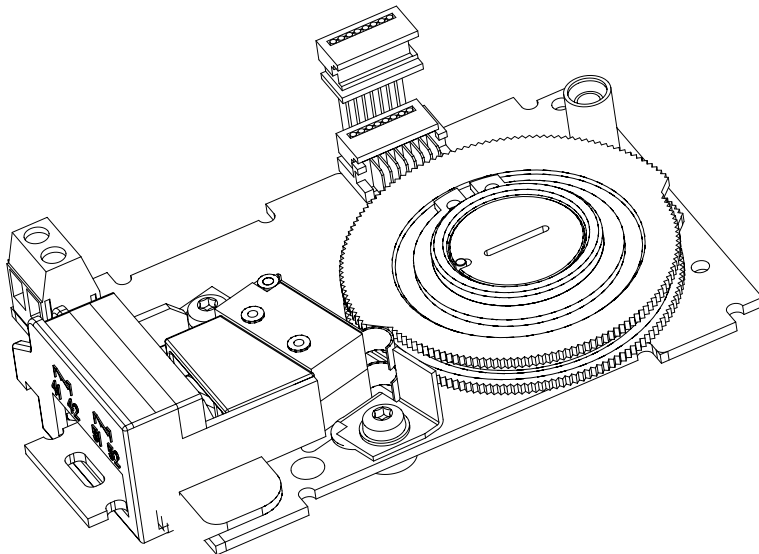


Figure 5-6 Mechanical limit switch module

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.

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.

5.6 EMC filter module

5.6.1 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

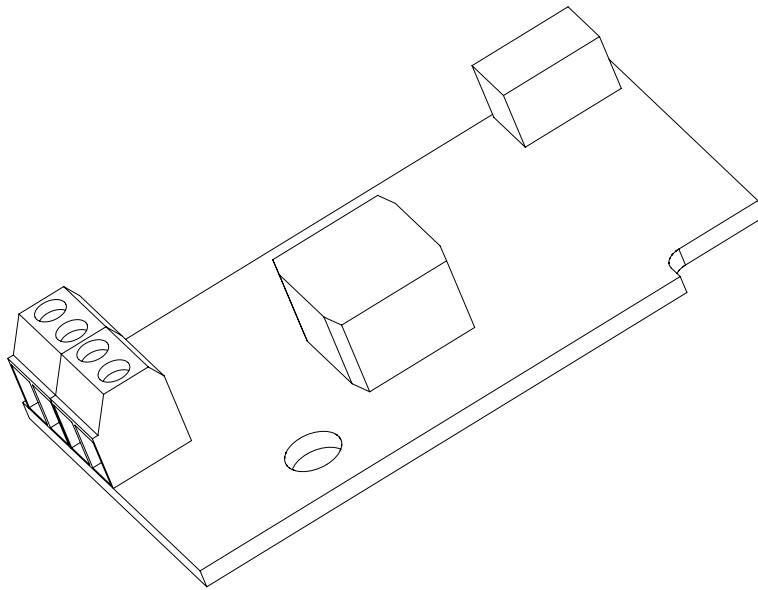


Figure 5-7 EMC module

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.

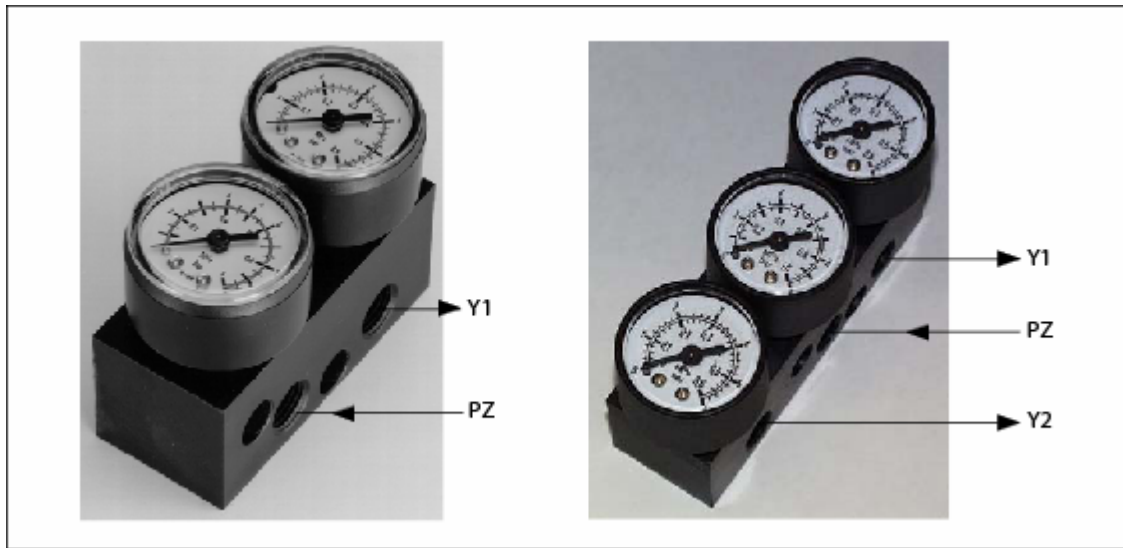
See also

Installing the module cover (Page 60)

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
- Pz 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

Connect

6.1 Connect electrically

6.1.1 Note regarding electromagnetic compatibility

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.

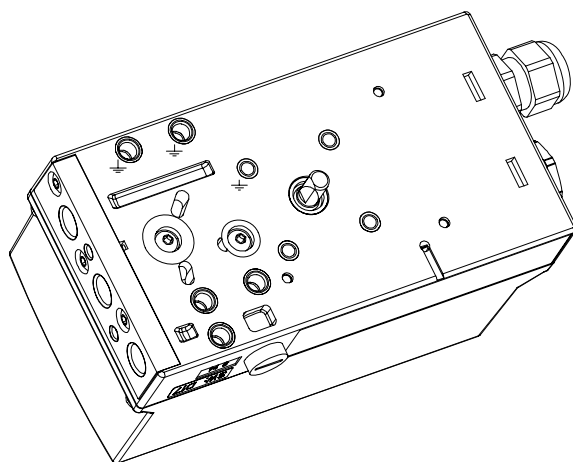






Figure 6-1 Base plate

 Shield

6.1.2 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.: <ul style="list-style-type: none">• Working reliability regulation• The regulation for erecting electrical systems in hazardous areas, DIN EN 60079-14 (earlier 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 supply matches with the one specified on the type plate and in the test certificate applicable for your country. In case of flameproof enclosures, the duct openings for electronic connections must be closed with EEx d certified cable inlets or EEx d certified sealing plugs, or, if the conduit piping system is used, an ignition trap must be provided 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.

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.

6.1.3 Interference immunity

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

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

NOTICE**Dissipation of glitch impulses/equipotential bonding**

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

Devices in the metal enclosure have a corresponding terminal on the outer side of the enclosure. This terminal must also be connected to the potential equalizing cable.

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

6.1.4 Safety shutdown

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

If this auxiliary voltage fails or is switched, the exhaust air valve is forced-opened and the actuator moves to the defined safety position so that the actuator cannot be moved using the buttons on the device and the master.

Communication with the master is still possible. The coding bridge on the motherboard is used to activate this function. It can be accessed after removing the module cover, and must be switched from the right position (as-delivered condition) to the left position.

6.1.5 Bus cable

6.1.5.1 Preparing the bus cables

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

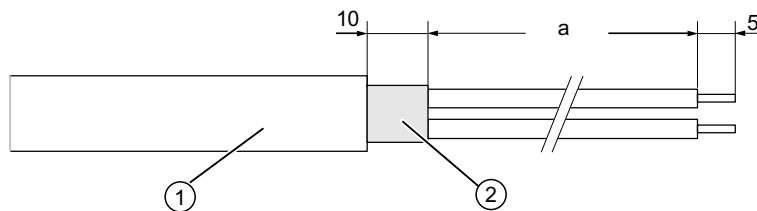


Figure 6-2 Preparing the bus cable

a	Length in [mm]:	80	Normal version of the device (without Ex and Ex i)
		120	Version with flameproof enclosure (Ex d)
①	Bus cable to be used:	6XV1 830-5AH10 or 6XV1 830-5BH10	
②	Cable shield		

6.1.5.2 Installing the bus cable

Installing the bus cable for versions without flameproof enclosures

Devices without flameproof enclosures include:

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

Proceed as follows to install the bus cable:

1. Strip the bus cable.

2. Open the enclosure of the positioner by unlatching the four cover screws.
3. Insert the prepared bus cable through the cable inlet.
4. Fasten the shield using the clamp and both the screws on the enclosure.
5. Tighten the cable inlet.
6. Connect the red and the green wires to terminals 3 and 7 of the motherboard as shown in the following picture. The polarity does not play any role here.

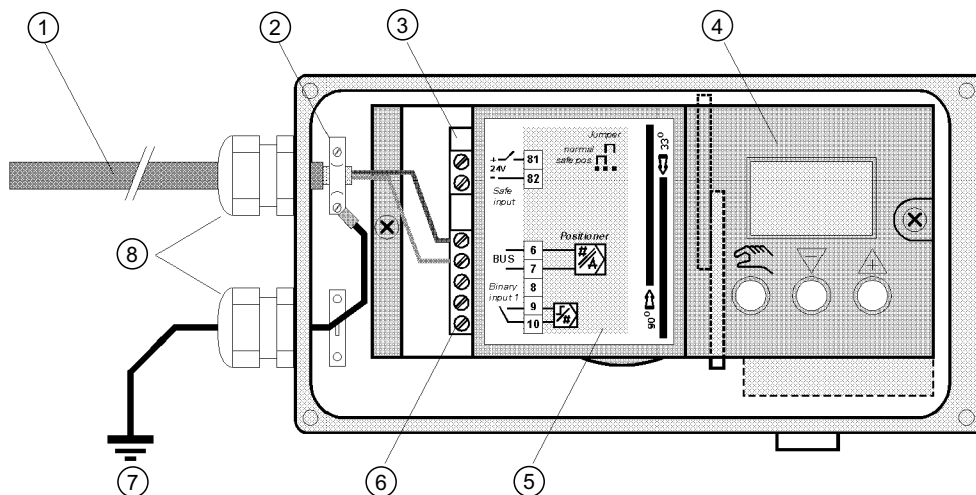


Figure 6-3 Connecting the bus cable for the positioner without a flameproof enclosure

- ① Bus cable
- ② Cable clamp
- ③ Motherboard
- ④ Module cover
- ⑤ Sign
- ⑥ Terminal strip
- ⑦ Earth potential
- ⑧ Cable glands

Installing the bus cable for versions with flameproof enclosures

Proceed as follows to install the bus cable:

1. Strip the bus cable.
2. Open the safety catch and unscrew the screw cap to open the positioner.
3. Insert the prepared bus cable through the Ex d certified cable inlet. Follow the corresponding guidelines if you are using a conduit piping system.
4. Fasten the shield on the adapter using the clamp and both the screws.
5. Tighten the Ex d certified cable inlet.

6. Connect the red and the green wires to terminals 3 and 7 of the motherboard as shown in the following picture. The polarity does not play any role here.

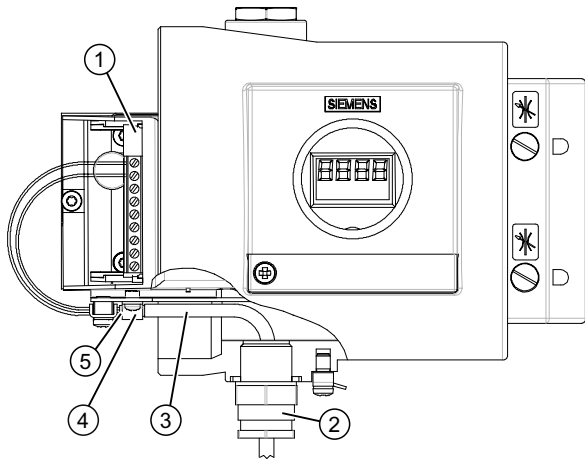


Figure 6-4 Connecting the bus cable for versions with flameproof enclosures

- ① Motherboard bus cable
- ② Ex d certified cable inlet
- ③ Bus cable
- ④ Cable clamp
- ⑤ Cable shield

6.1.6 Connections for "non-intrinsically safe" versions or versions with "flameproof enclosures"

6.1.6.1 Standard controller

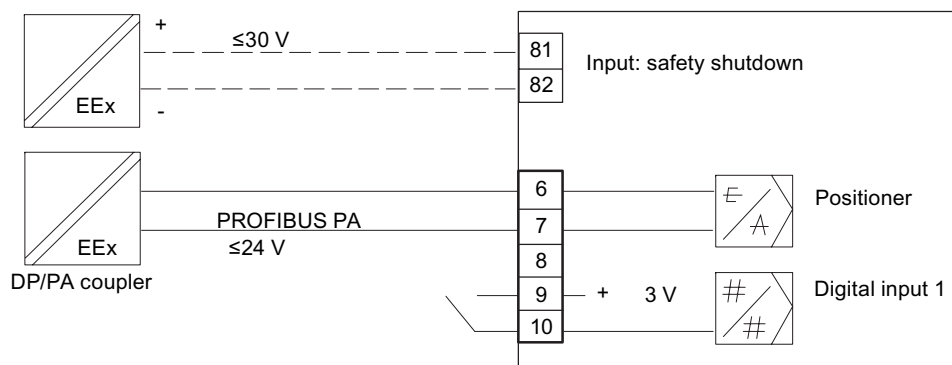


Figure 6-5 Connecting the non-intrinsically safe version of the standard controller

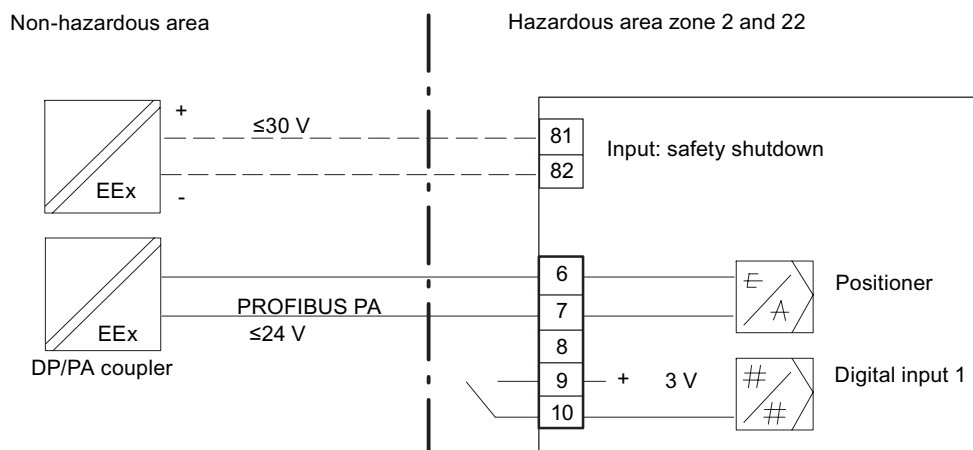


Figure 6-6 Connecting the standard controller with flameproof enclosure

6.1.6.2 Current output

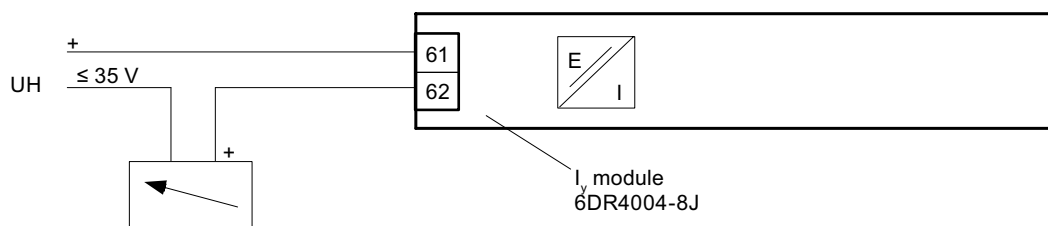


Figure 6-7 I_y module 6DR4004-8J, not Ex

6.1.6.3 Binary inputs and outputs

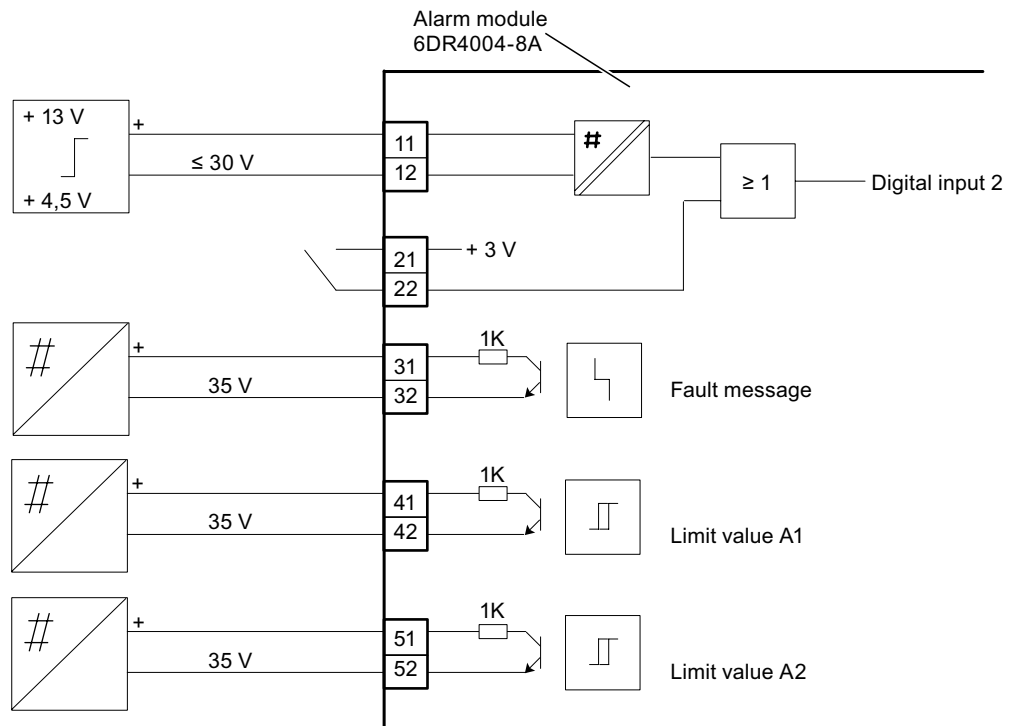


Figure 6-8 Alarm unit 6DR4004-8A, not Ex

6.1.6.4 SIA unit

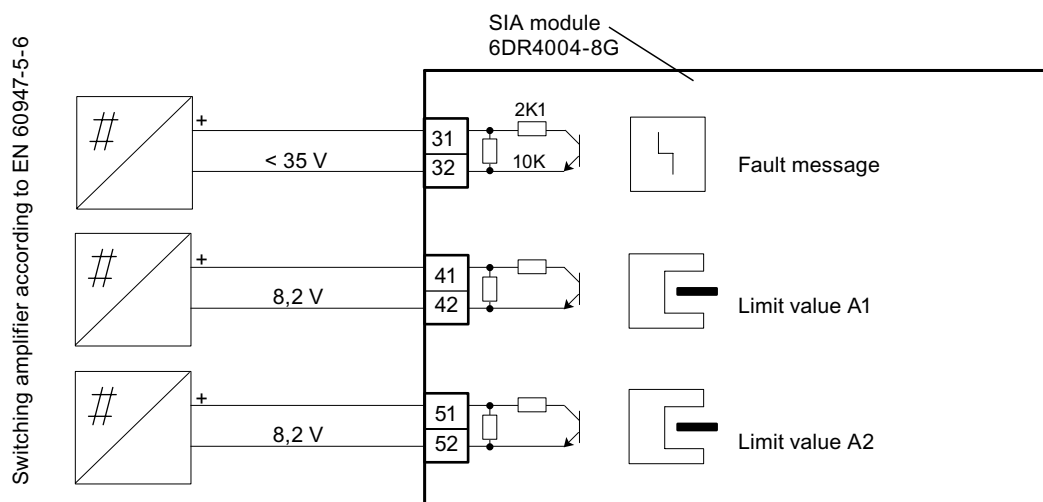




Figure 6-9 SIA unit 6DR4004-8G, not Ex

6.1.6.5 Mechanical limit switch module

Safety note for low-voltage supply

 DANGER
<p>Low-voltage supply</p> <p>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:</p> <ol style="list-style-type: none"> 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
<p>Protection against mechanical influences</p> <p>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:</p> <ul style="list-style-type: none"> • > AC 16 V • > DC 35 V, low voltage

NOTICE
<p>Maximal values for terminals 41/42 and 51/52</p> <p>The following maximum values concern only terminals 41, 42, 51, and 52:</p> <ul style="list-style-type: none"> • Maximum voltage: <ul style="list-style-type: none"> – Not Ex: AC 250 V or DC 24 V – Ex: 30 V DC • Maximum current: <ul style="list-style-type: none"> – Not Ex: 4 A AC/DC – Ex: 100 mA DC • Maximum performance: <ul style="list-style-type: none"> – Ex: 750 mW <p>No safe separation between the terminals can be guaranteed.</p>

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: <ul style="list-style-type: none">• 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 <ol style="list-style-type: none">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

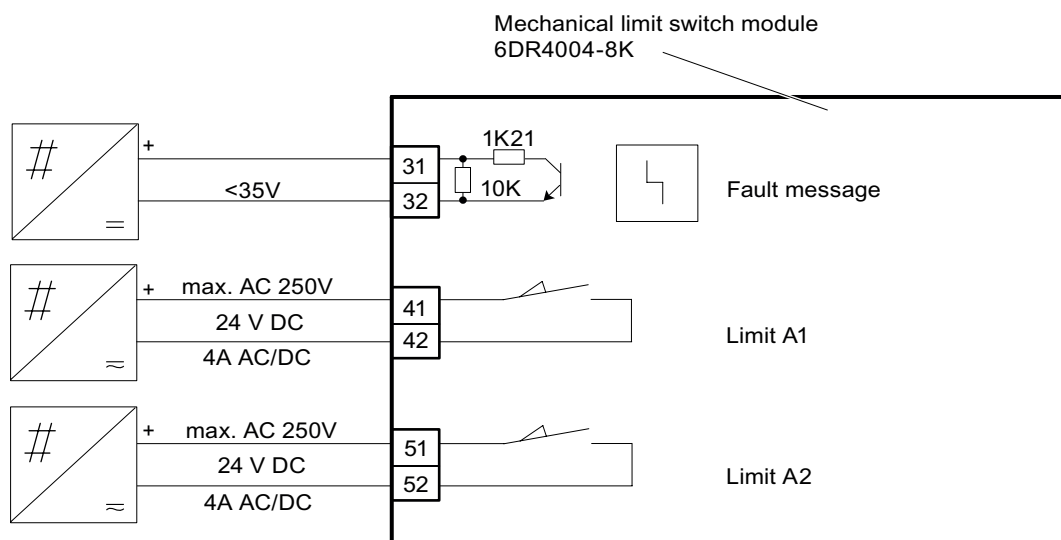


Figure 6-10 Mechanical limit switch module 6DR4004-8K, not Ex

Connecting the mechanical limit switch module

Connect

Connect the mechanical limit switch module as follows:

1. Loosen the screw ⑩ on the transparent cover ⑪.
2. Pull the transparent cover ⑪ up to the front end stop.
3. Tighten every cable in the corresponding terminal.
4. Slide the transparent cover ⑪ up to the end stop of the motherboard.
5. Tighten the screw ⑩ on the transparent cover ⑪.
6. Connect the cables of each switch to the lug of the printed circuit board in pairs. Use the provided cable tie ⑫ for this purpose.

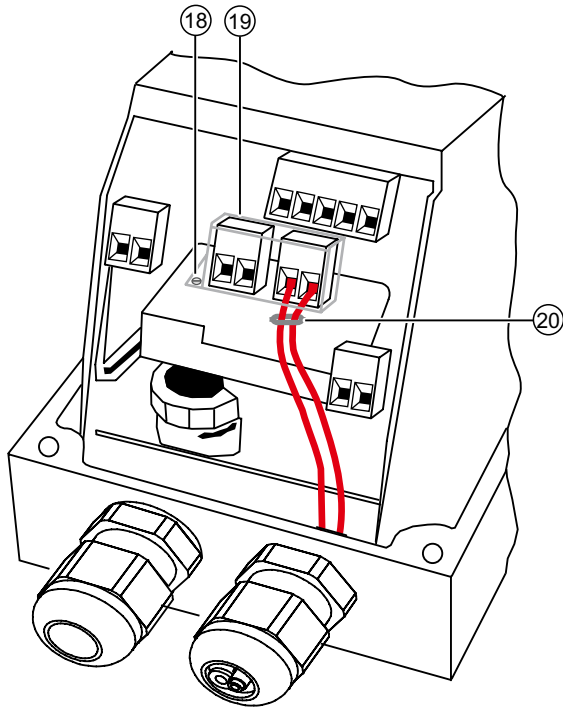



Figure 6-11 Connecting the cables

- ⑱ Screw
- ⑲ Cover
- ⑳ Cable tie

6.1.7 Connection for the "intrinsically safe" type of protection

6.1.7.1 Standard controller

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

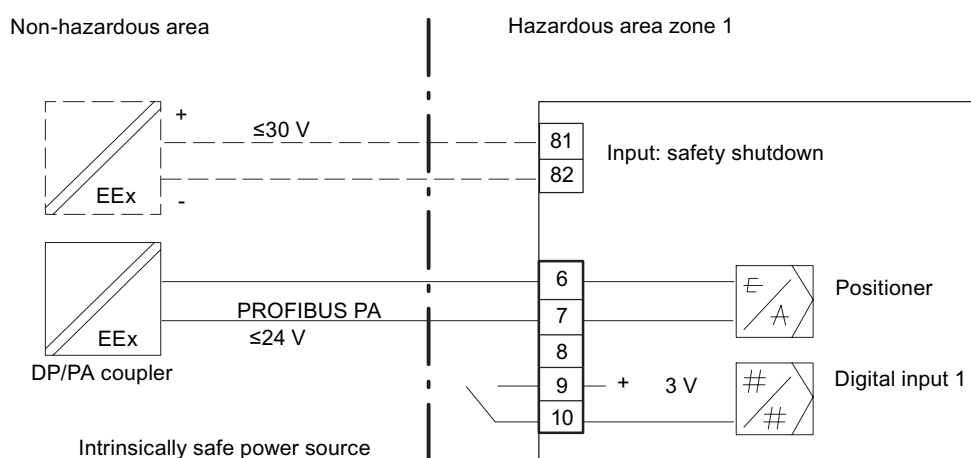


Figure 6-12 Electrical connection for the intrinsically safe version of the standard controller

6.1.7.2 Current output

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

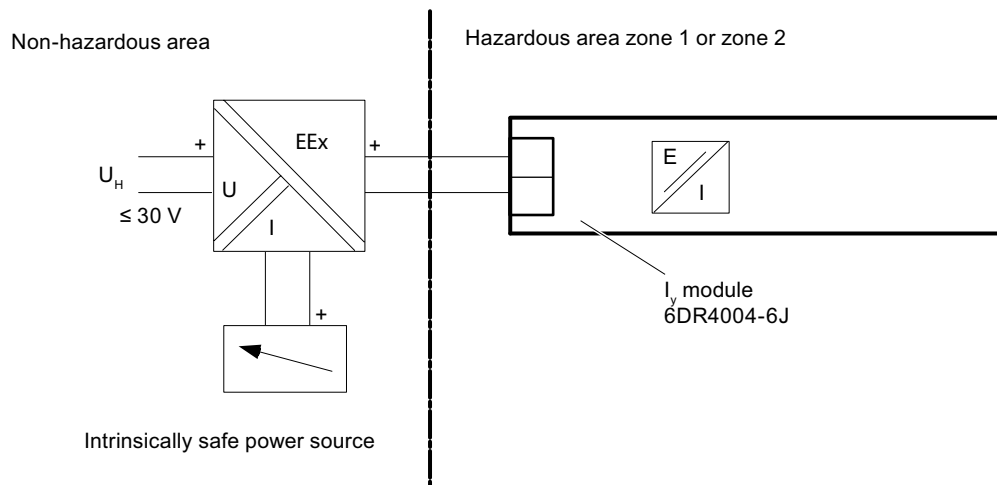


Figure 6-13 I_y module 6DR4004-6J, EEx i

6.1.7.3 Binary inputs and outputs

⚠ WARNING

Circuits

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

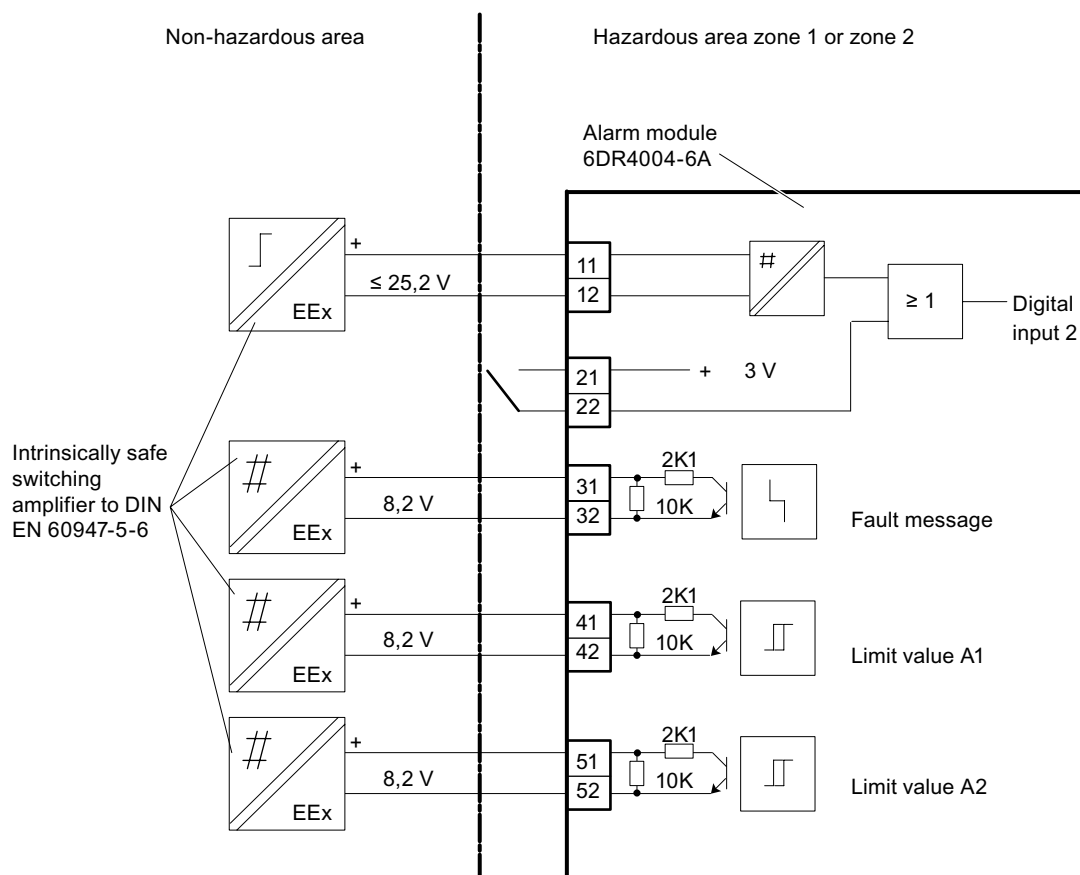


Figure 6-14 Alarm unit 6DR4004-6A, ExEx i

6.1.7.4 SIA unit

⚠ WARNING

Circuits

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

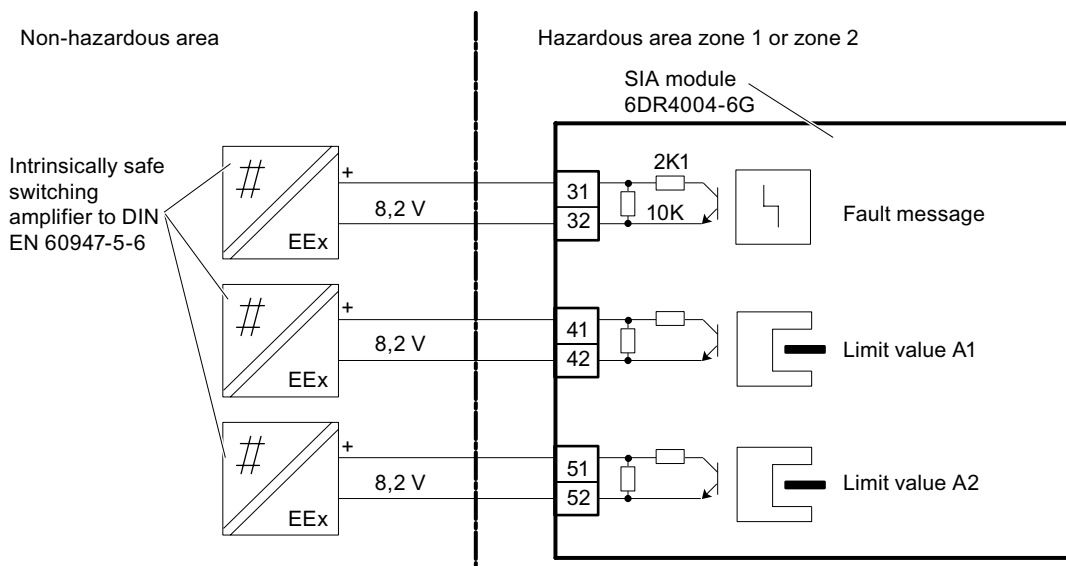


Figure 6-15 SIA unit 6DR4004-6G, EEx i

6.1.7.5 Mechanical limit switch module

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, EEx i

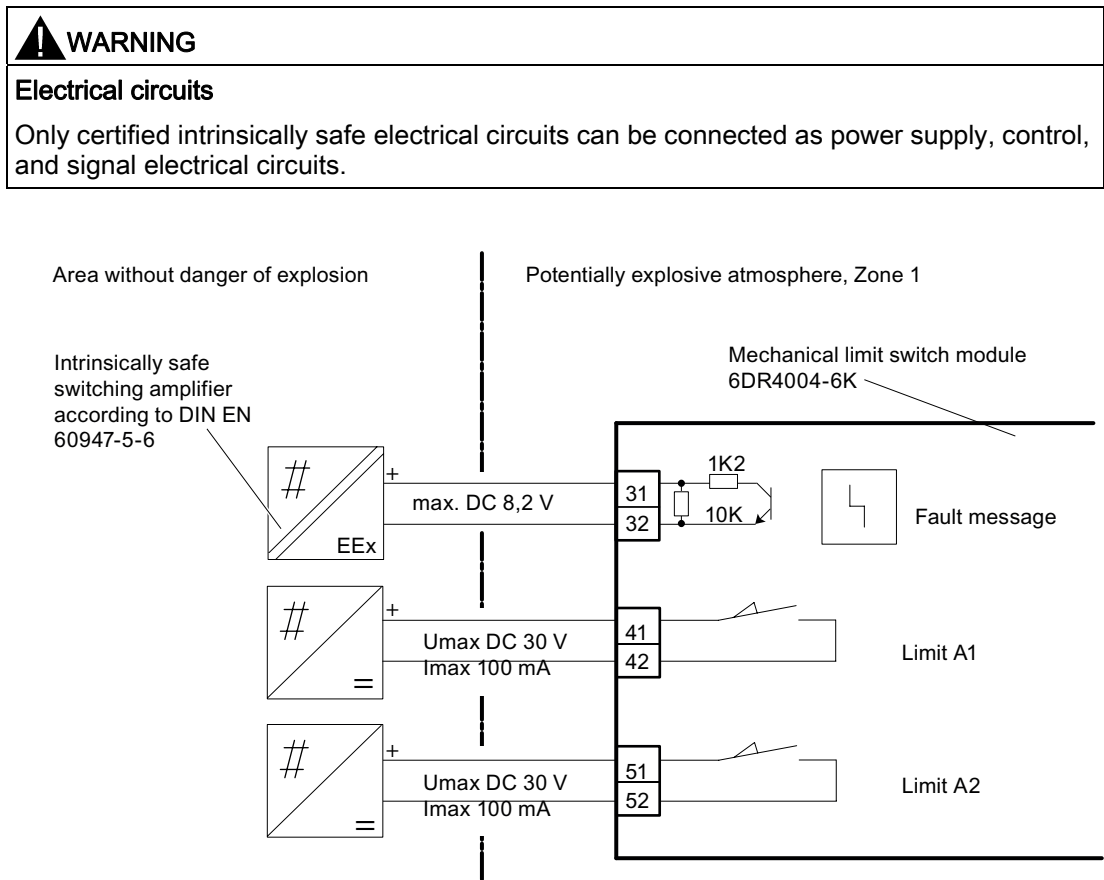


Figure 6-16 Mechanical limit switch module 6DR4004-6K, EEx i

Connecting the mechanical limit switch module

Connect

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.

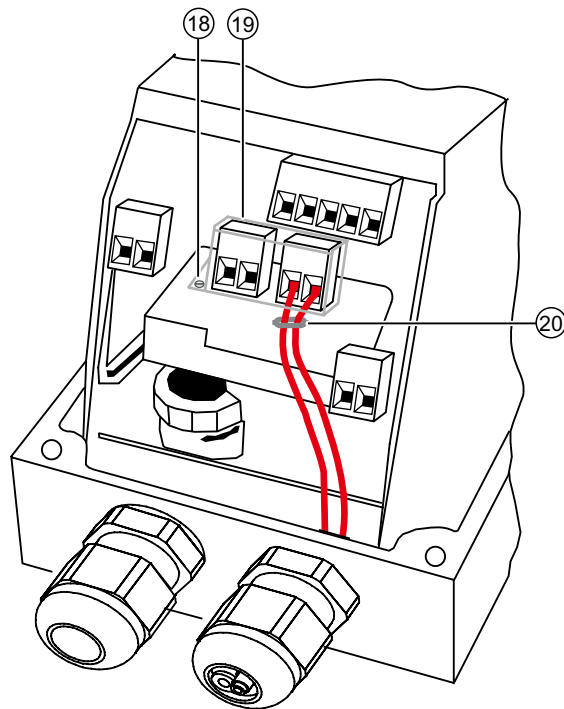


Figure 6-17 Connecting the cables

- ⑱ Screw
- ⑲ Cover
- ⑳ Cable tie

6.1.8 Connection for the "n" type of protection

6.1.8.1 Standard controller

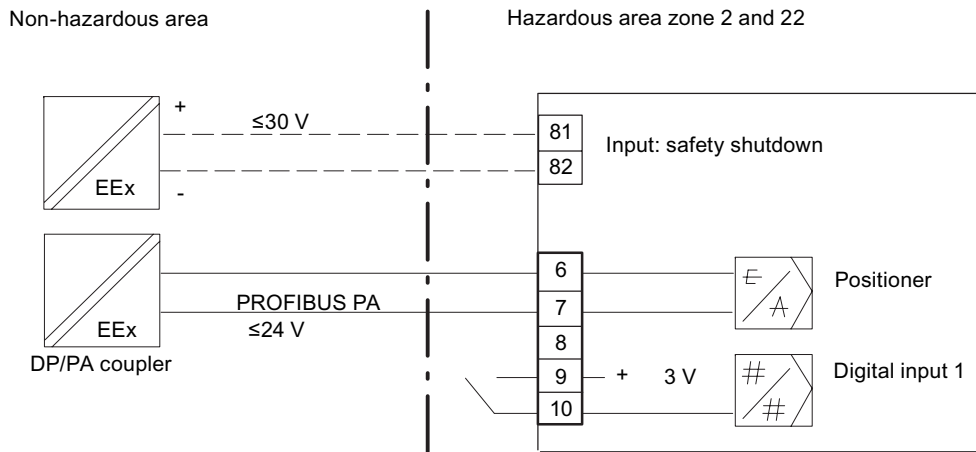


Figure 6-18 Connection of the standard controller version with the "n" type of protection

6.1.8.2 Current output

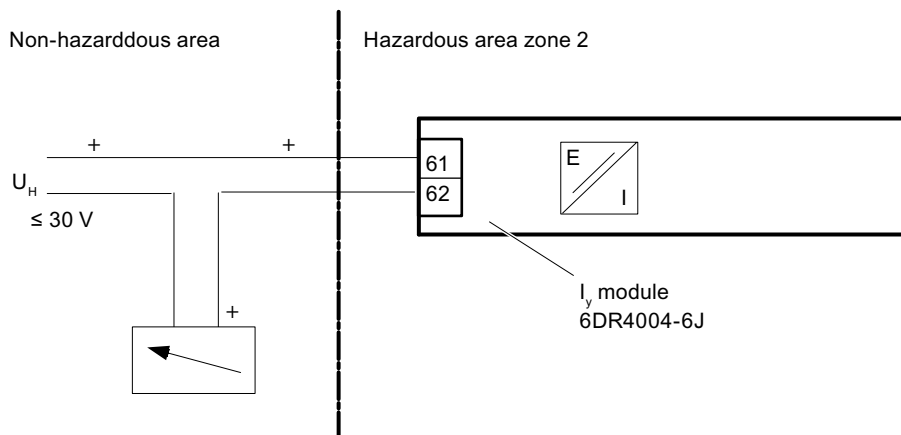


Figure 6-19 I_y module 6DR4004-6J, EEx n

6.1.8.3 Binary inputs and outputs

Binary inputs and outputs

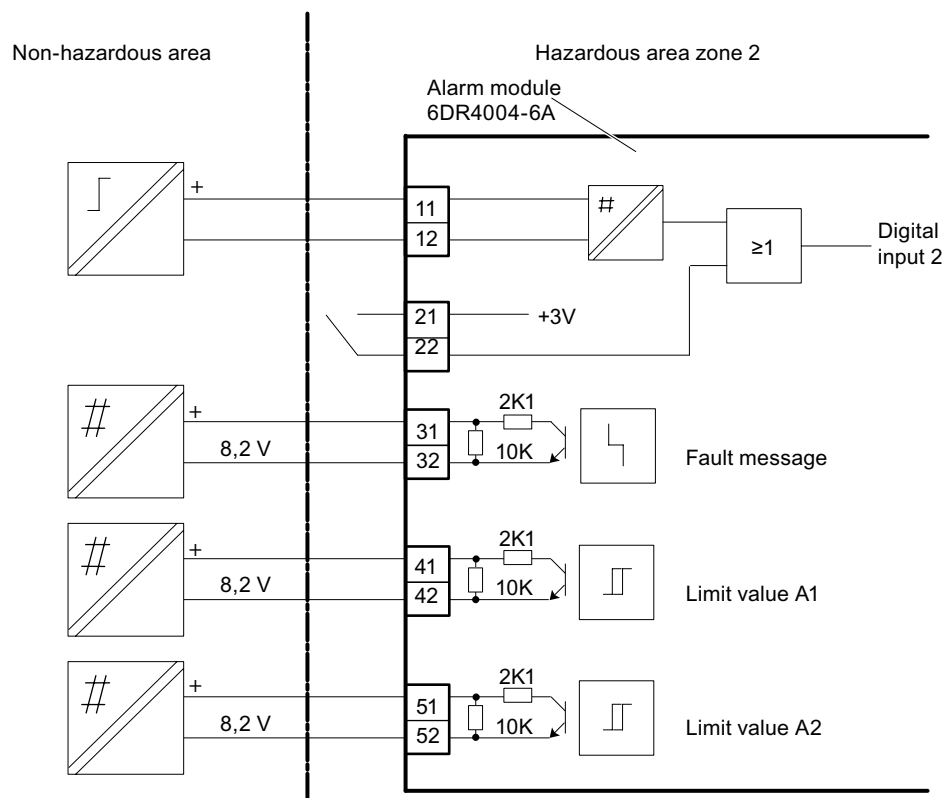


Figure 6-20 Alarm unit 6DR4004-6A, EEx n

6.1.8.4 SIA unit

SIA unit

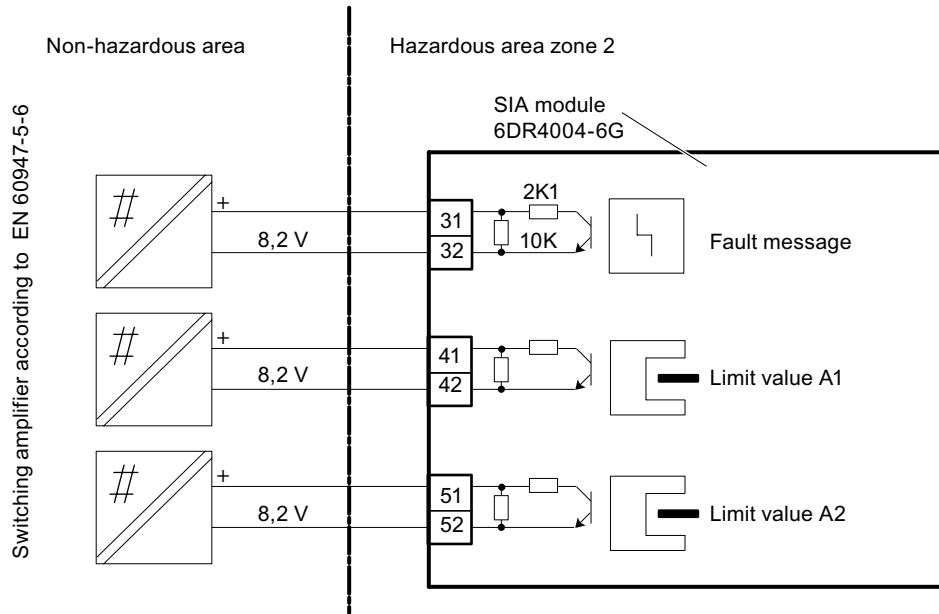



Figure 6-21 SIA unit 6DR4004-6G, EEx n

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 Pz.
- Connection using female thread G1/4 DIN 45141 or 1/4" NPT:
 - Pz 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.

Operation

7.1 Operating elements

7.1.1 Digital display

Introduction

Note


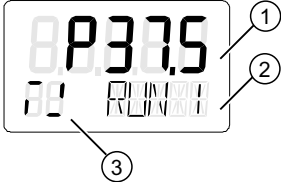
Repetition rate display

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.

Operating mode	Representation in the digital display	Pos.	Legend
Configuration	<p>The digital display shows 'turn' in the top row and 'FEET' in the bottom row. Callout 1 points to the top row, callout 2 points to the bottom row, and callout 3 points to the left side of the display.</p>	①	Parameter value
		②	Parameter name
		③	Parameter number
Manual mode (MAN)	<p>The digital display shows '96.3' in the top row and 'MAN' in the bottom row. Callout 1 points to the top row, callout 2 points to the bottom row, and callout 3 points to the left side of the display.</p>	①	Position [%]
		②	Setpoint [%]
		③	Fault message
Automatic (AUT)	<p>The digital display shows '36.1' in the top row and 'AUT' in the bottom row. Callout 1 points to the top row, callout 2 points to the bottom row, and callout 3 points to the left side of the display.</p>	①	Position [%]
		②	Setpoint [%]
		③	Fault message
Diagnostics	<p>The digital display shows '51377' in the top row and 'STARS' in the bottom row. Callout 1 points to the top row, callout 2 points to the bottom row, and callout 3 points to the left side of the display.</p>	①	Diagnostics value
		②	Diagnostics name
		③	Diagnostics number

See also

System messages before initialization (Page 217)

Changing the operating mode (Page 101)

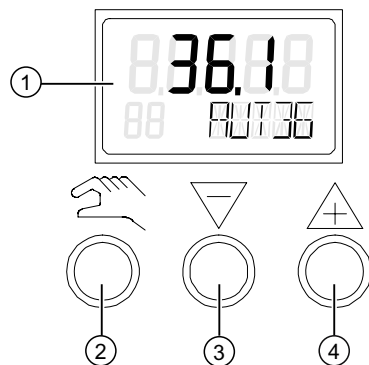


Figure 7-1 Digital display and buttons of the positioner

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

- 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.

7.1.2 Firmware version

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

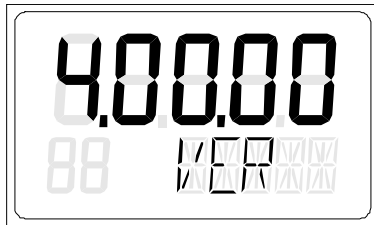


Figure 7-2 Firmware version, e.g. Version 4.00.00

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.

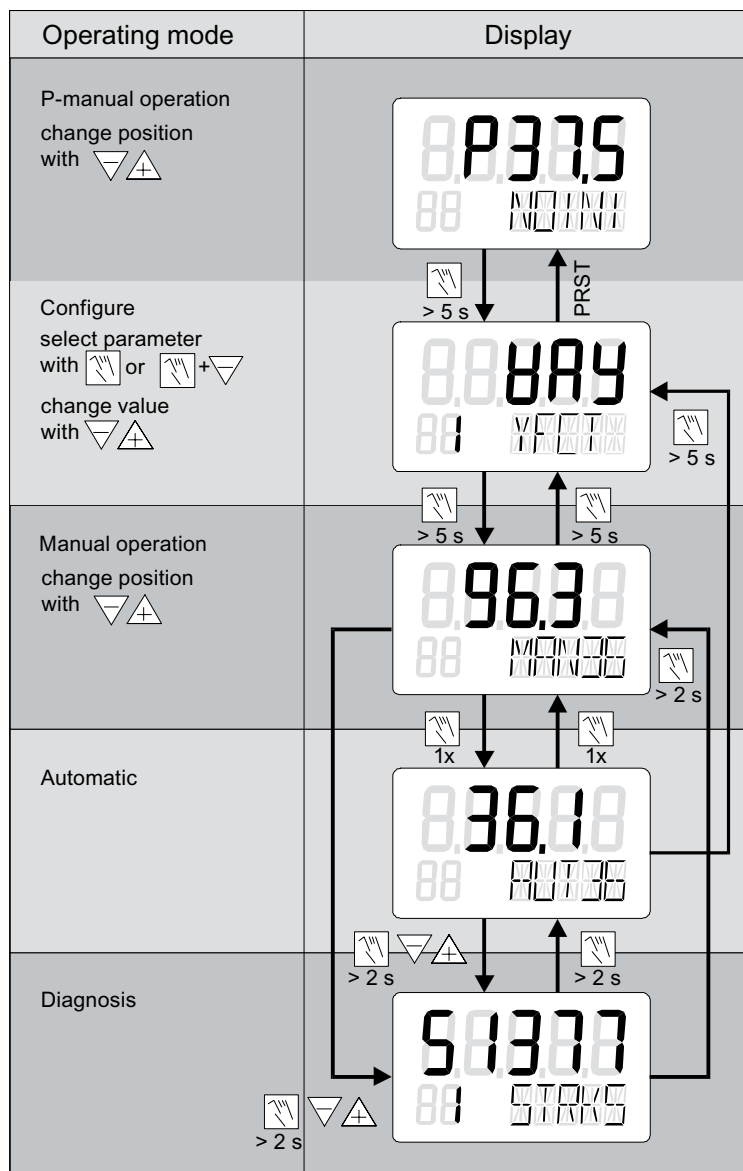



Figure 7-3 Switching between the operating modes

See also

Digital display (Page 97)

Configuration and initialization

You can access the "Configuration" mode by pressing 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.
-

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

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 all three buttons of the positioner.
2. Keep these buttons pressed for more than 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.
-

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. Keep the \triangle increment or ∇ decrement button pressed for more than 5 s.
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

8.1 General safety notes

8.1.1 Safety-instrumented system

Definition: Safety-instrumented system

A safety-instrumented system 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.

Example:

A safety-instrumented system is made up of a pressure transmitter, a limit signal sensor and a control valve.

Definition: Safety function

A defined function executed by a safety-instrumented system with the objective of achieving or maintaining a safe system status taking into account a defined dangerous occurrence.

Example:

Limit pressure monitoring

Definition: Dangerous failure

Failure with the potential to bring the safety-instrumented system into a dangerous or non-functional status.

Description

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

Note

This document deals with the SIPART PS2 positioner exclusively as part of a safety function.

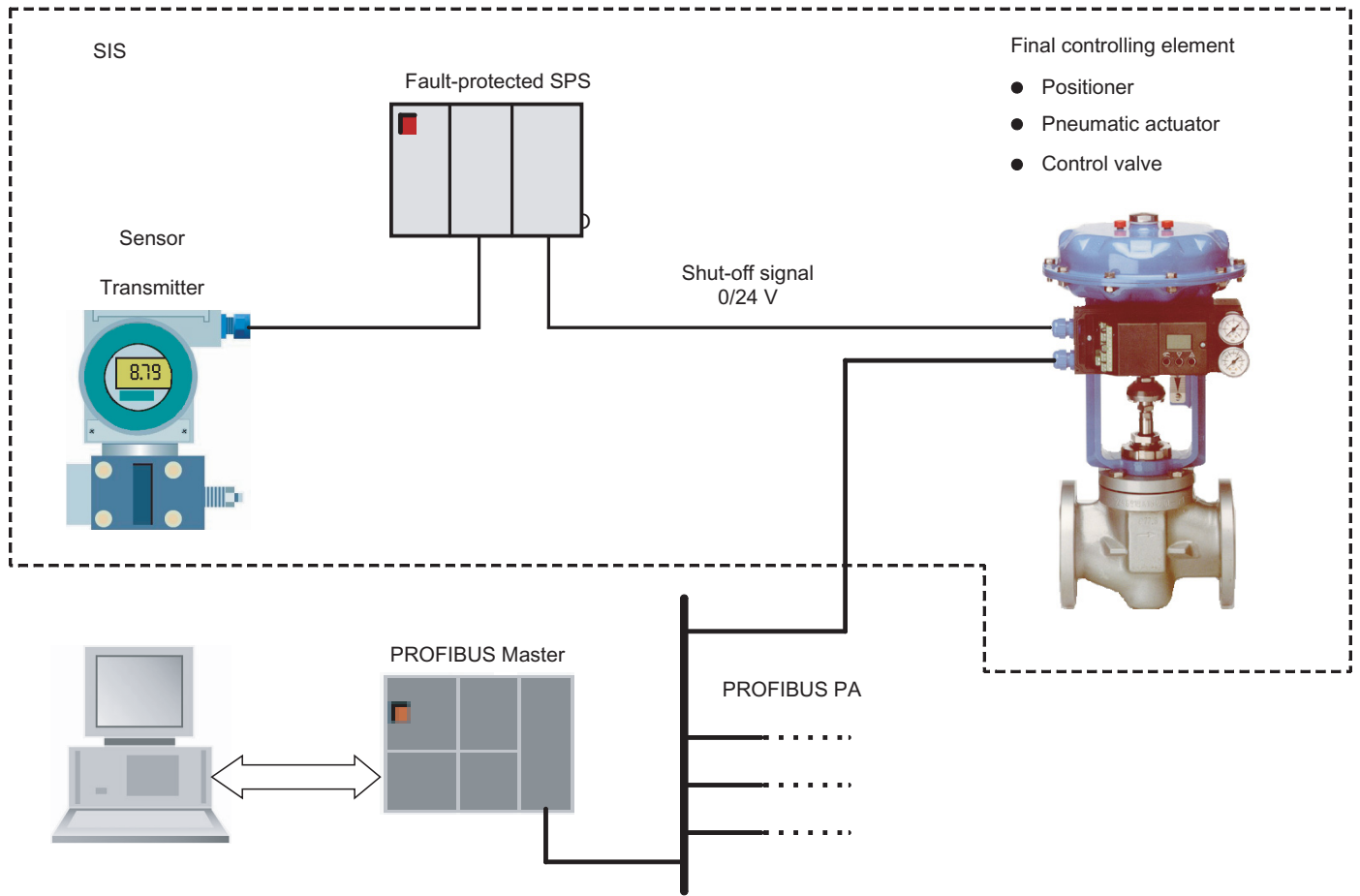


Figure 8-1 Example of a safety-instrumented system (SIS)

Function

The transmitter generates a process-specific measured value. The programmable controls (SPS) monitors this value in case it exceeds a preset limit value. If a fault occurs, the SPS generates a shut-off signal for the connected positioner. The positioner switches the corresponding valve to the specified safety position. The communication with the positioner via PROFIBUS PA or FOUNDATION field bus remains unrestricted, i.e. position and status signals are still possible.

SFF	HFT (for type A sub-systems)		
	0	1	2
< 60%	SIL 1	SIL 2	SIL 3
60 to 90%	SIL 2	SIL 3	SIL 4
90 to 99%	SIL 3	SIL 4	SIL 4
> 99%	SIL 3	SIL 4	SIL 4

8.2 Device-specific safety notes

8.2.1 Application range for functional safety

The SIPART PS2 positioner is also suitable for control valves that satisfy the special requirements in terms of function safety to SIL 2 in accordance with IEC 61508 or IEC 61511-1. The device versions SIPART PS2 PA (6DR551*) and SIPART PS2 FF (6DR561*) are available for applications with PROFIBUS PA and for the FOUNDATION field bus respectively.

These are single-acting, depressurizing positioners for installation on pneumatic actuators with spring return.

The positioner depressurizes the valve actuator when faults occur or on demand by means of the separate input for the safety shutdown. The valve actuator thus switches the valve to the specified safety position. Except for the valve control, all other device functions including position and status signals and the communication via PROFIBUS PA or FOUNDATION field bus remain unrestricted.

These positioners meet the following requirements:

- Functional safety to SIL 2 in accordance with IEC 61508 and IEC 61511-1 regarding the safety shutdown
- Explosion protection on 6DR5***-*E*** variations
- Electromagnetic compatibility in accordance with EN 61326/A1, Appendix A.1

8.2.2 Safety function

Safety function on positioner

Depressurizing the connected valve actuator can be referred to as a safety function on the positioner SIPART PS2 PA and SIPART PS2 FF. The built-in spring brings the valve into the required safety position - this is known as tight closing. Depending on the direction of action of this spring, the valve is completely opened or closed.


The safety function is triggered if the following occurs:

- The signal at the input for the safety shutdown (terminals 81 and 82) is less than 4.5 V. This function is likewise referred to as "safety shutdown" in the device documentation.

- The electrical auxiliary power supply from the PROFIBUS PA or the FOUNDATION fieldbus connection fails
- Failure of auxiliary pneumatic power

The safety function is not effected by other device functions, particularly the microcontroller, software and communication interface. The positioners SIPART PS2 PA and SIPART PS2 FF must therefore be considered as a type A subsystem as per EN 61508-2 as far as this safety function is concerned.

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 "Settings" and "Safety characteristics" sections.
These conditions must be met in order to fulfill 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 state within the Mean Time To Restoration (MTTR). The MTTR is 8 hours.

The calculated Mean Time Between Failures (MTBF) for the positioners SIPART PS2 PA and SIPART PS2 FF is 73 years. The MTBF for the basic electronics module is 187 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 recalled in the local display or by means of the PROFIBUS PA or the FOUNDATION fieldbus communication. See diagnostics parameters "40.VENT1" and "41.VENT2" under the following also-see link for this purpose.

See also

Meaning of diagnostics values (Page 225)

8.2.3 Settings

The coding bridge on the basic electronic system must be plugged without fail on to the left position facing the terminals ("safe pos.") or removed completely for the safety function to work properly.

Special parameter settings are not necessary.

Protection against configuration changes

You should attach the housing cover so that the device is protected against unwanted and unauthorized changes/operation.

Checking the safety function

To check the safety function, proceed as follows:

- Set the setpoint to 50% either by using the local operation from the "Manual" mode or PROFIBUS PA or the FOUNDATION fieldbus communication.
- Apply a LOW signal, i.e. a voltage less than 4.5 V, at the input for the safety shutdown
- Check whether the valve moves to the specified safety position

See also

Connect electrically (Page 73)

8.2.4 Behavior in case of faults

Fault

The procedure in case of faults is described in the "Fault correction" chapter. See the following also-see link for this purpose.

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 type plate.

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

See also

Fault identification (Page 236)

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

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

8.2.5 Maintenance/Checking

Checking the function

We recommend that the functioning of the positioner is checked at regular intervals of one year.

Checking safety

You should regularly check the safety function of the entire safety circuit in line with IEC 61508/61511. The testing intervals are determined during the calculation for each individual safety circuit in a system (PFD_{AVG}).

The following tests are particularly relevant for the SIPART PS2 PA and SIPART PS2 FF positioners and are to be carried out:

1. Inspection of the safety shutdown
 - Apply a LOW signal, i.e. a voltage less than 4.5 V, at the input for the safety shutdown
 - Check whether the valve moves to the safety position.
2. Inspection of the actuator behavior
 - Apply a HIGH signal, i.e. a voltage more than 13 V, at the input for the safety shutdown
 - Set the nominal value to 50% either by using the local operation (manual operation), the PROFIBUS PA or the FOUNDATION field bus communication
 - Reduce the inlet pressure (P_2) to a third of the maximum supply pressure
 - Check whether the valve moves to the safety position.
3. Check the filters in the pneumatic connections for contamination and clean them if necessary.

8.2.6 Safety characteristics

The safety characteristics necessary for using the system are listed in the SIL declaration of conformity (see "Appendix A"). 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).
- The coding bridge on the basic electronic system was plugged on to the left position facing the terminals ("safe pos.") or removed completely.
- The positioner is blocked against unwanted and unauthorized changes/operation.
- The shut-off signal for the SIPART PS2 PA and SIPART PS2 FF positioners is generated at the input for the safety shutdown (terminals 81 and 82) by a safe system which meets at least SIL2. The LOW level has a maximum of 4.5 V at the input terminals.

- 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 drive must move the valve to the pre-defined, safe end position.
- A dangerous failure of the positioner is when the pressure outlet is not depressurized, or the safety position is not reached, when the LOW signal is less than 4.5 V at the input for the safety shutdown.

Commissioning

9.1 Overview

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.

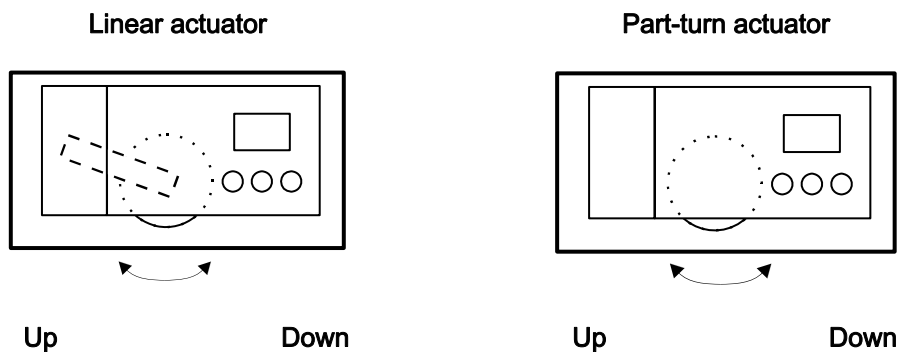
You can use a suitably configured and activated binary input to protect the configured settings against accidental adjustment.

9.2 Sequence of automatic initialization

The automatic initialization takes place in the following phases:

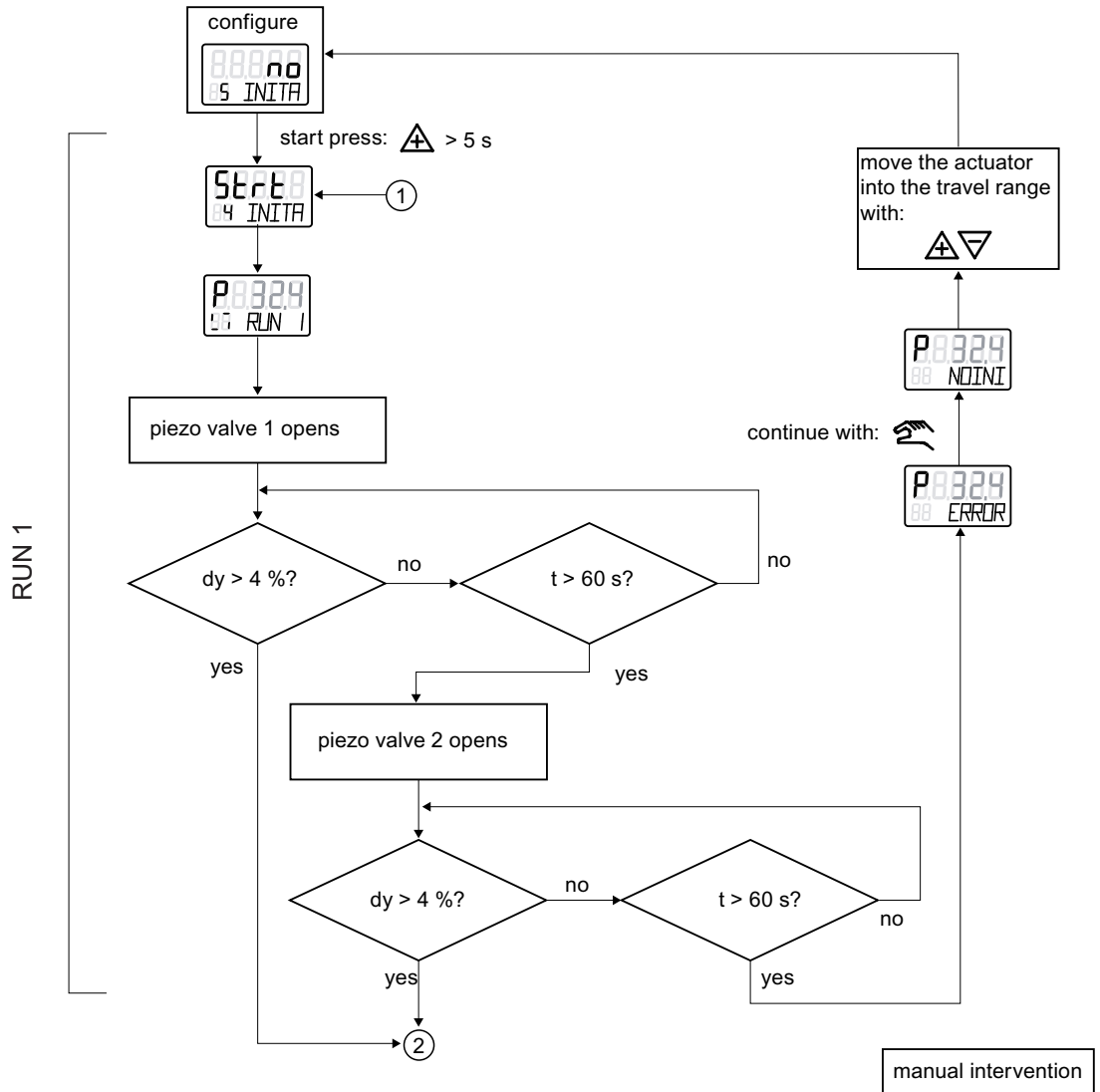
Automatic initialization phase	Description
Start	-
RUN1	Establishing the direction of action.
RUN2	Checking the actuator travel and trimming the zero point and the stroke.
RUN3	Establishing and display of the actuating time (leak monitoring)
RUN4	Minimization of controller increments
RUN5	Optimization 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.



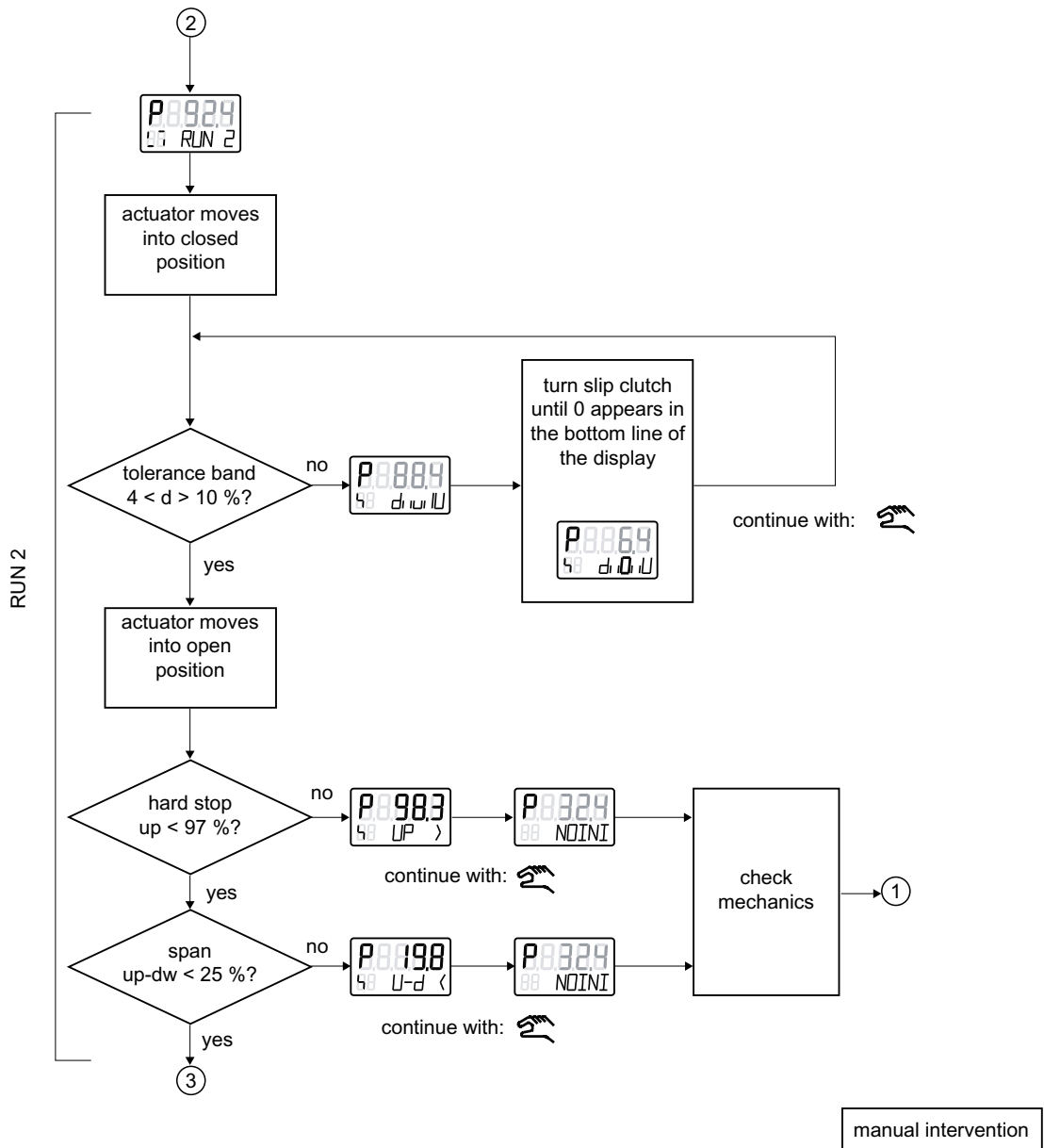
Sequence of RUN1

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



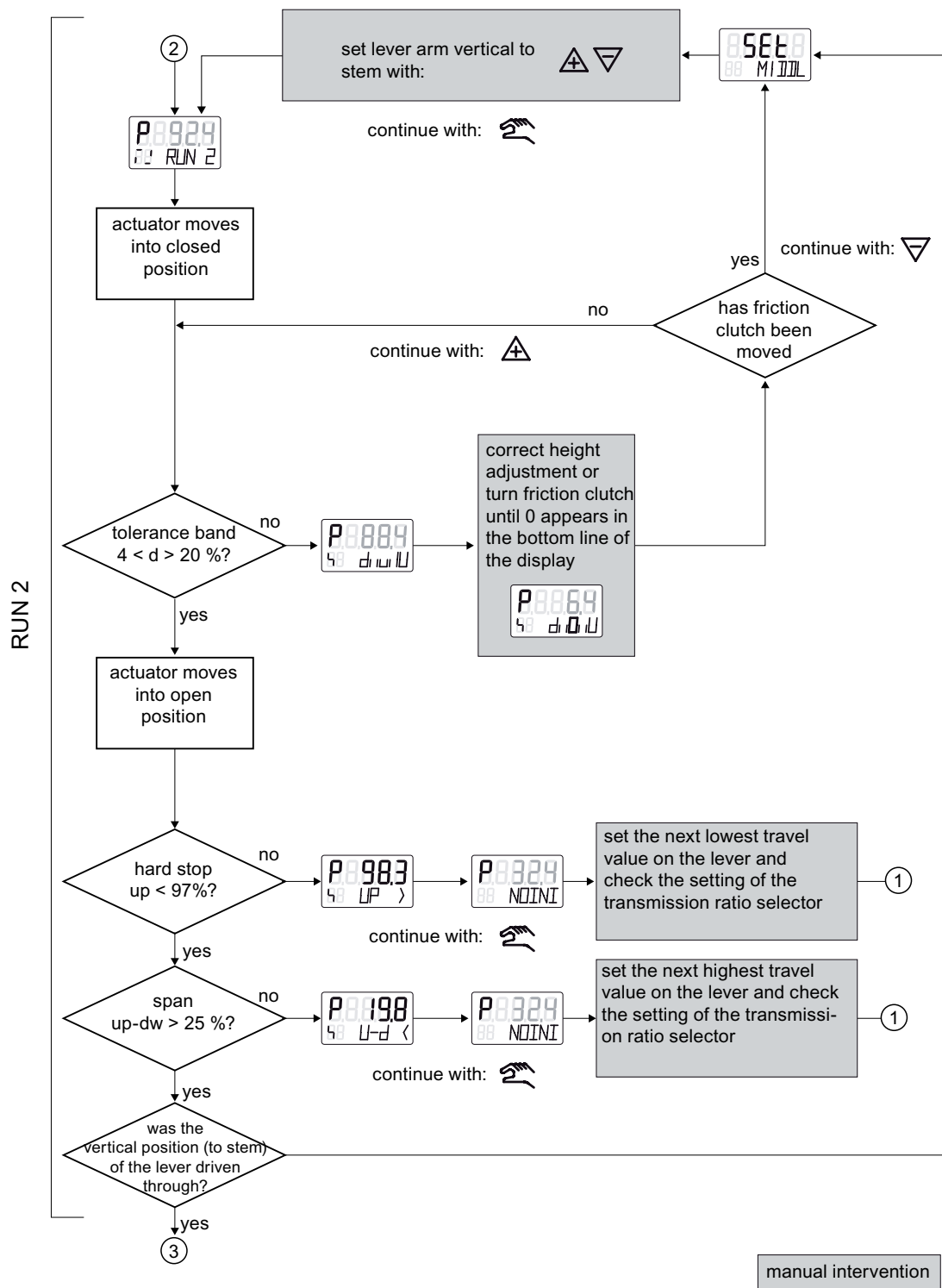
Sequence of RUN2 for part-turn actuators

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

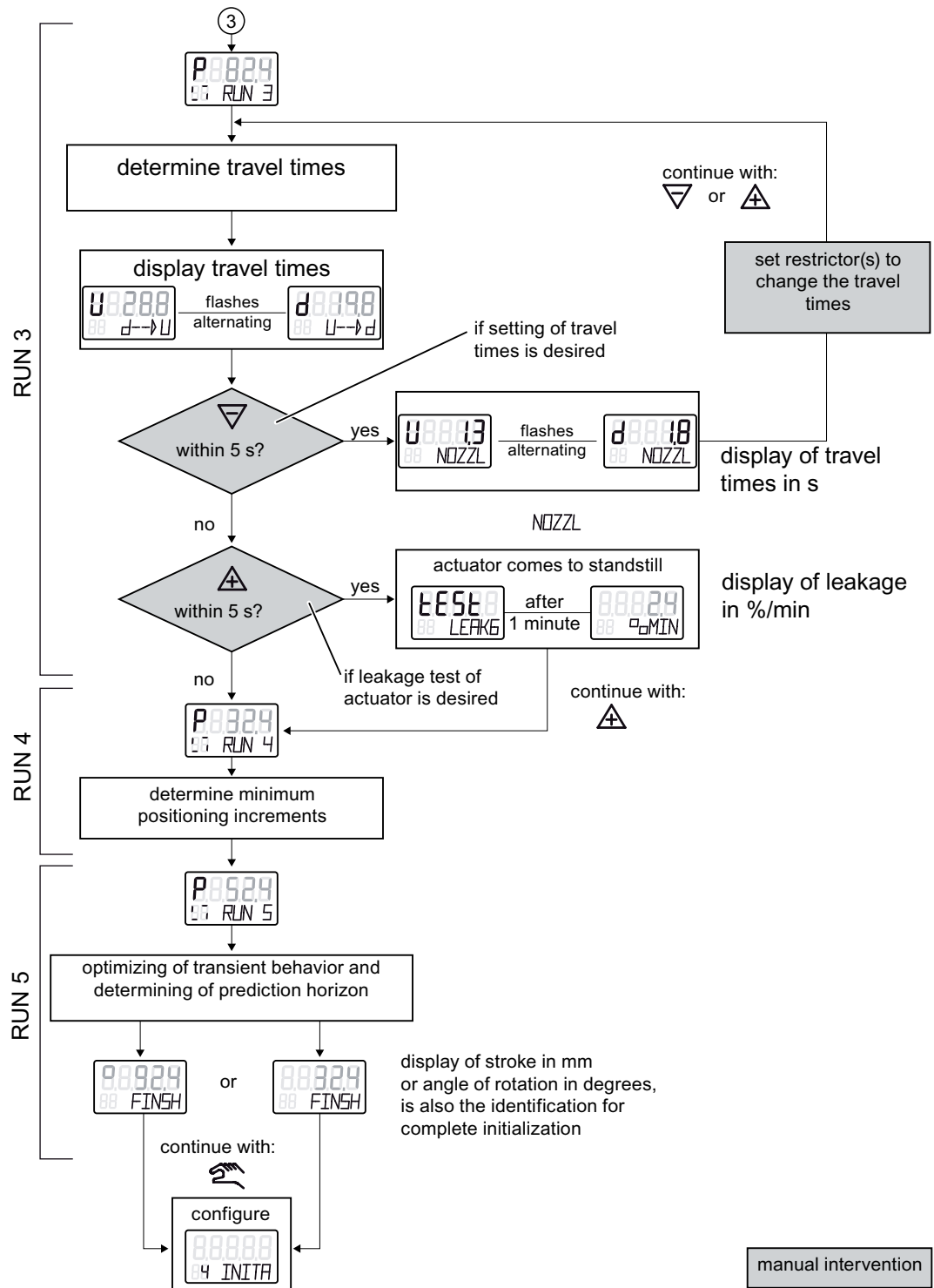
This structured chart describes the process to determine the actuator travel checks. It also contains the information about the sequence for trimming the zero point and the stroke.



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



9.3 Commissioning the linear actuators

9.3.1 Preparing linear actuators for commissioning

Condition

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

Setting the transmission ratio selector

Note

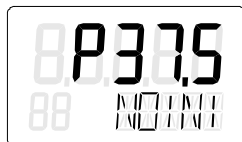
The setting of the transmission ratio selector is extremely important to commission the positioner.

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

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 \triangle 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.

9.3.2 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

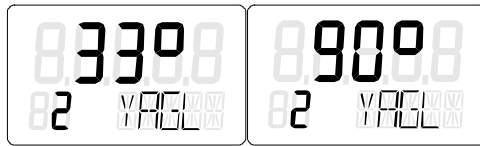
An ongoing initialization can be interrupted at any time. Press the  operating mode button for this purpose. The settings configured until then are retained.



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

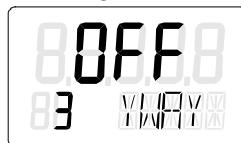
1. Switch to the "Configuration" mode. Keep the operating modes buttons pressed for more than 5 s for this purpose. The following is shown on the digital display:




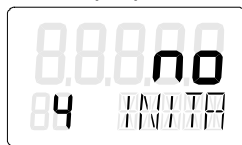
2. Call the second parameter "YAGL". Press the  operating mode button for a short while for this purpose. The following is shown on the digital display depending on the setting:




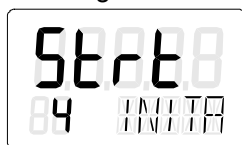
3. Check whether the value displayed in the "YAGL" parameter matches the setting of the transmission ratio selector. If required, change the setting of the transmission ratio selector to 33° or 90°.
4. Set parameter 3 to determine the total stroke in mm. The setting of parameter 3 is optional. The digital 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. In order to start the initialization process, keep the  increment button pressed for more than 5 s until the following is shown on the digital display:



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



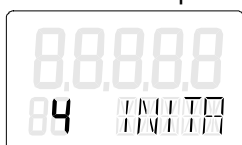
Setting parameter 3



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 \triangle 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. Keep the  operating modes button pressed for more than 5 s.
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.

9.3.3 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:

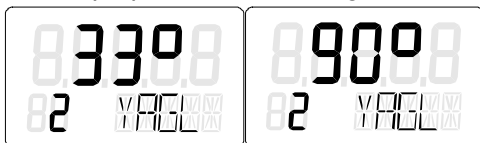
1. The positioner has been prepared for using on linear actuators.
2. The actuator spindle can be moved completely.
3. The displayed potentiometer position is within the permissible range between "P5.0" and "P95.0".



Initializing the positioner manually

1. Switch to the "Configuration" mode. Keep the  operating modes button pressed for more than 5 s. 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. Keep the increment button pressed for more than 5 s until the following is shown on the digital display:



7. The current potentiometer position is shown on the digital display after 5 s. 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 \triangle increment or ∇ decrement buttons. Accept the current position of the actuator spindle by pressing the \square 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 \square operating mode button again.
- Move the actuator spindle to another position using the \triangle increment or ∇ decrement buttons.
- Abort the manual initialization process by pressing the \square 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 \triangle increment or ∇ decrement buttons. Accept the current position of the actuator spindle by pressing the \square 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 \triangle increment or ∇ decrement buttons.
2. Press the \square 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. Keep the  operating modes button pressed for more than 5 s.
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.

9.4 Commissioning the part-turn actuators

9.4.1 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 Δ 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.

9.4.2 Automatic initialization of part-turn actuators

Condition

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

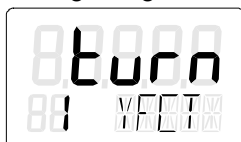
1. The actuating range of the actuator can be passed through completely.
2. The actuator shaft is at a central position.

Initializing the positioner automatically

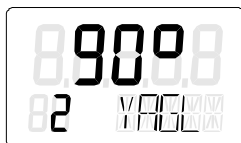
1. Switch to the "Configuration" mode. Keep the operating modes buttons pressed for more than 5 s for this purpose. The following is shown on the digital display:



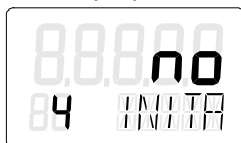
2. Change the actuator type from linear to the part-turn actuator. Change the parameter setting using the ∇ decrement button. The following is shown on the digital display:




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



5. Start the initialization process. Keep the  button pressed for more than 5 s until the following is shown on the digital display:



Note

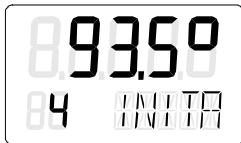
The positioner runs through five initialization steps during the automatic initialization process. Displays for the initialization steps from "RUN1" to "RUN5" are shown in the lower line on the digital display. The initialization process depends on the actuator used, and takes up to 15 minutes.



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. Keep the  operating modes button pressed for more than 5 s.
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.

9.4.3 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.

- The displayed potentiometer position is within the permissible range between "P5.0" and "P95.0".


NOTICE**Setting of the adjustment angle**

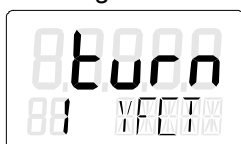
The usual adjustment angle for part-turn actuators is 90°. Accordingly set the transmission ratio selector in the positioner to 90°.


Initializing the positioner manually

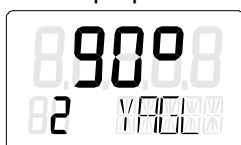
- Switch to the "Configuration" mode. Keep the  operating modes button pressed for more than 5 s. The following is shown on the digital display:



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




- 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:



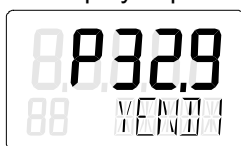
- Call the "INITM" parameter. Press the  operating mode button twice for this purpose. The following is shown on the digital display:



- Start the initialization process. Keep the  increment button pressed for more than 5 s until the following is shown on the digital display:



- The current potentiometer position is shown on the digital display after 5 s. 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 \square 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 \triangle increment or ∇ decrement buttons.
 - Abort the manual initialization process by pressing the \square 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 \triangle increment or ∇ decrement buttons.
12. Accept the current position by pressing the \square 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 \square operating mode button. The digital display shows the "INITM" parameter. The positioner is in the "Configuration" mode.
2. Exit the "Configuration" mode. Keep the \square operating modes button pressed for more than 5 s.
3. The software status is displayed.
4. After releasing the \square operating mode button, the positioner is in the "P manual mode", i.e. the positioner has not been initialized.

9.5 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.

9.5 Copying the initialization data when replacing a positioner

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.

Parameter assignment/Addressing

10.1 Overview of the parameters

10.1.1 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°	

10.1 Overview of the parameters

Parameter	Function	Parameter values	Unit
3.YWAY ²⁾	Range of stroke (optional setting) ³⁾		mm
	OFF		
	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.

10.1.2 Overview of parameters 6 to 53

Note

The following table contains the parameters required to operate the positioner. Factory-set parameter values are printed in bold.

Overview of parameters 6 to 53

Overview of the positioner parameters 6 to 53				
Parameter	Function	Parameter values	Unit	
6.SDIR	Setpoint direction			
	Ascending	riSE		
	Decreasing	FALL		
7.TSUP	Setpoint ramp OPEN	Auto / 0 ... 400	s	
8.TSDO	Setpoint ramp CLOSED	0 ... 400	s	
9.SFCT	Setpoint function			
	Linear	Lin		
	Equal percentage	1 : 25		1 - 25
		1 : 33		1 - 33
		1 : 50		1 - 50
Inverse equal percentage	25 : 1	n1 - 25		

Overview of the positioner parameters 6 to 53					
Parameter	Function		Parameter values		Unit
			33 : 1	n1 - 33	
			50 : 1	n1 - 50	
		Freely adjustable		FrEE	
10.SL0 ... 30.SL20 ¹⁾	Setpoint turning points with free characteristic				
10.SL0	at	0%		0 ... 100.0	%
11.SL1 ...		5% ...			
29.SL19		95%			
30.SL20		100%			
31.DEBA	Controller dead zone		Auto / 0.1 ... 10.0		%
32.YA	Beginning of manipulated variable limiting		0.0 ... 100.0		%
33.YE	End of manipulated variable limiting		0.0 ... 100.0		%
34.YNRM	Standardization of manipulated variable				
		To mechanical travel		MPOS	
		At flow		FLOW	
35.YCLS	Tight closing with manipulated variable				
		None		no	
		Above only		uP	
		Below only		do	
		Above and below		uP do	
36.YCDO	Value for tight closing below		0.0 ... 100		%
37.YCUP	Value for tight closing above		0.0 ... 100		%
38.BIN1 ²⁾	Function of the BE1		Normally open contact	Normally closed contact	
		None	OFF		
		Message only	on	-on	
		Block configuring	bloc1		
		Block configuring and manual operation	bloc2		
		Move valve to position YE	uP	-uP	
		Move valve to position YA	doWn	-doWn	
		Block movement	StoP	-StoP	
		Partial stroke test	PST	-PST	
39.BIN2 ²⁾	Function of the BE2		Normally open contact	Normally closed contact	
		None	OFF		
		Message only	on	-on	
		Move valve to position YE	uP	-uP	
		Move valve to position YA	doWn	-doWn	
		Block movement	StoP	-StoP	
		Partial-Stroke-Test	PST	-PST	

10.1 Overview of the parameters

Overview of the positioner parameters 6 to 53					
Parameter	Function		Parameter values		Unit
40.AFCT ³⁾	Alarm function		Normal	Inverted	
		none	OFF		
		A1 = Min, A2 = Max	0000A	0000A	
		A1 = Min, A2 = Min	0000B	0000B	
		A1 = Max, A2 = Max	0A00A	0A00A	
41.A1	Response threshold alarm 1		0.0 ... 10.0 ... 100		%
42.A2	Response threshold alarm 2		0.0 ... 90.0 ... 100		%
43. 4FCT ³⁾	Fault message output function		Normal	Inverted	
		Fault	05000	05000	
		Fault + non automatic ⁴⁾	050A0	050A0	
		Fault + non automatic BE ⁴⁾	050AB	050AB	
44. 4TIM	Monitoring period for setting the fault message "Control deviation"		Auto / 0 ... 100		s
45. 4LIM	Response threshold of the fault message "Control deviation"		Auto / 0 ... 100		%
46. 4STRK	Limit for path integral		0 ... 1.00E9		
47.PRST	Preset (factory setting) ⁵⁾				
	no	Nothing activated	no		
	Strt	Start of the factory setting	Strt		
	oCAY	Display after the button has been pressed for 5 seconds	oCAY		
48.XDIAG	Activation of the extended diagnostics				
		Off	OFF		
		Single stage message	On1		
		Two stage message	On2		
		Three stage message	On3		
49.FSTY	Safety setting.				
		Parameterized safety setpoint	FSVL		
		Last setpoint	FSSP		
		Open vent valve	FSAC		
50.FSTI	Monitoring period for setting the safety setting		0 ... 100		s
51.FSVL	Safety setpoint		0.0 ... 100.0		%
52.STNR	Station number		0 ... 126		

Overview of the positioner parameters 6 to 53			
Parameter	Function	Parameter values	Unit
53.IDENT	Device operating mode (ID No.)		
	Independent of manufacturer	0	
	Full functionality	1	

- 1) Setpoint turning points only appear when "9.SFCT = FrEE" is selected.
- 2) Normally closed Operation when a switch is open or Low level contact means:
Normally open contact Operation when a switch is closed or High level means:
- 3) Normal means: High level: no fault message
Inverse means: Low level: no fault message
- 4) "+" means: OR logic combination
- 5) Preset effects "NOINI!"

10.1.3 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.4PST	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	

10.1 Overview of the parameters

Parameter	Function	Parameter values	Unit
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	

10.2 Description of parameters

Parameter	Function	Parameter values	Unit
L4.FACT3	Factor 3	0.1 ... 5.0 ... 40.0	

Overview parameter O

Parameter	Function	Parameter values	Unit
O.4DCHG	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.4PAVG	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	ldLE / 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	%

10.2 Description of parameters

10.2.1 Description of parameters 1 to 5

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°".

10.2.1.1 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 \triangle 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 \triangle 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".

10.2.2 Description of parameters 6 to 53

10.2.2.1 Description of parameter 6

6.SDIR - setpoint direction

Use this parameter to set the setpoint direction. The setpoint direction is used to reverse the direction of action of the setpoint. The setpoint direction is mainly used for single-acting actuators with the "uP" safety position.

The factory setting is "riSE".

10.2.2.2 Description of parameters 7 and 8

7.TSUP - setpoint ramp up

and

8.TSDO - setpoint ramp down

The setpoint ramp is effective in the automatic mode and restricts the modification speed of the effective setpoint. When switching over from the manual to the automatic mode, the setpoint ramp is used to adjust the effective setpoint to the setpoint of the positioner.

The shock-free switchover from the manual to the automatic mode prevents excessive increase in pressure in long pipelines.

Two actuating times are determined during the initialization process. In the "TSUP = Auto" position, the slower of the two actuating times is used for the setpoint ramp. The "TSDO" parameter then has no effect.

The factory setting is "0".

10.2.2.3 Description of parameter 9

9.SFCT - setpoint function

Use this parameter to linearize the non-linear valve characteristic curves. Any flow characteristics can be simulated in case of linear valve characteristic curves. For this purpose, see the pictures below the also-see link.

Seven valve characteristic curves are stored in the positioner and are set using the "SFCT" parameter:

Valve characteristic curve		Setting with parameter value
Linear		Lin
Equal percentage	1:25	1-25
Equal percentage	1:33	1-33
Equal percentage	1:50	1-50

10.2 Description of parameters

Valve characteristic curve		Setting with parameter value
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".

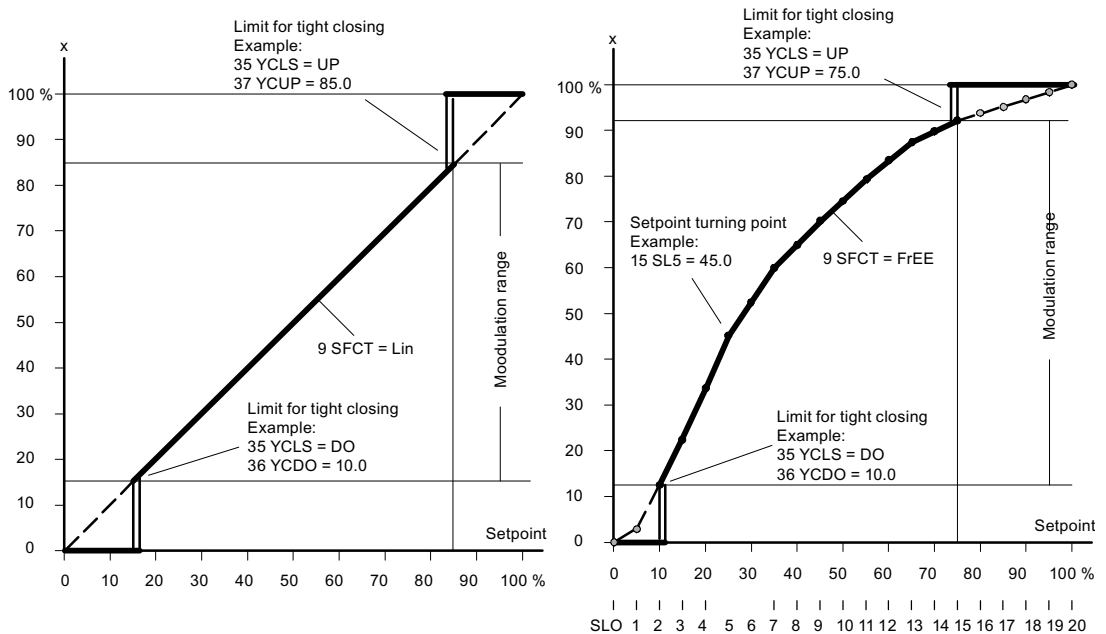
See also

Description of parameters 10 to 30 (Page 146)

10.2.2.4 Description of parameters 10 to 30

10.SL0 to 30.SL20 - setpoint support points

Use these parameters to allocate a characteristic flow value at a distance of 5% to the corresponding setpoint support point. These points lead to a polyline with 20 linear sections which form a valve characteristic line:



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

Setpoint support points can be entered only for "9.SFCT = FrEE". You may only enter a monotonously rising characteristic curve, and two successive support values must differ by at least 0.2%.

The factory setting is "0", "5" ... "95", "100".

See also

Description of parameter 9 (Page 145)

10.2.2.5 Description of parameter 31

31.DEBA - dead zone of the controller

In the automatic mode, use this parameter and the "Auto" parameter value to adjust the dead zone continuously as per the requirements of the control loop in an adaptive manner. If a control deviation is detected, the dead zone is increased stepwise. A time criterion is used for the reverse adaptation.

The fixed set value is used for the dead zones in other discrete settings.

The factory setting is "Auto".

10.2.2.6 Description of parameters 32 and 33

32.YA - start of the manipulated variable limit

The factory setting is "0".

and

33.YE - end of the manipulated variable limit

Use these parameters to limit the mechanical actuator travel between the end stops to the set values. This helps in limiting the mechanical actuating range of the actuator to the effective flow rate and in preventing the integral saturation of the guiding controller. For this purpose, see the picture below the also-see link.

Note

Setting

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

The factory setting is "100".

See also

Description of parameter 34 (Page 148)

10.2.2.7 Description of parameter 34

34.YNRM - standardization of manipulated variable

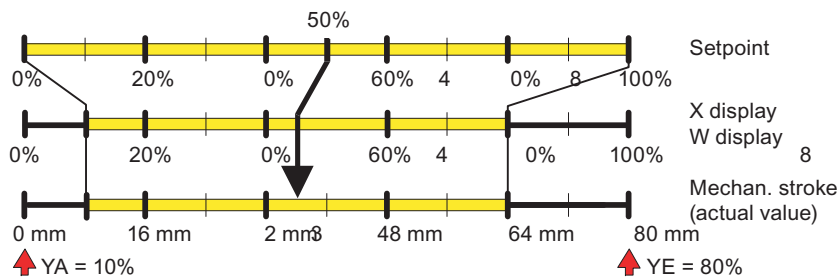
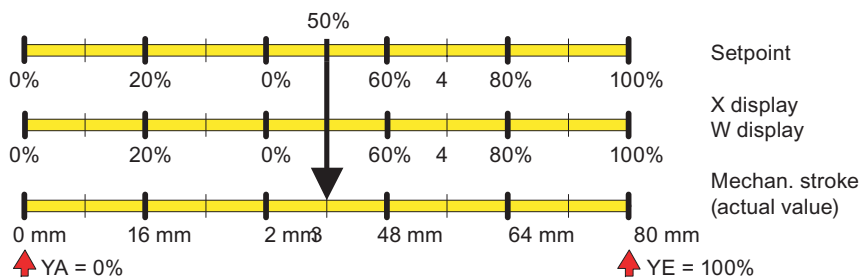
Use the "YA" and "YE" parameters to restrict the manipulated variable. This restriction results in two different scales, MPOS and FLOW, for the digital display and the position feedback through the current output. See the following picture for this purpose.

The MPOS scale shows the mechanical positions from 0 to 100% between the hard end stops of the initialization. The position is not affected by the "YA" and "YE" parameters. The "YA" and "YE" parameters are displayed in the MPOS scale.

The FLOW scale is the standardization from 0 to 100% in the range between the "YA" and "YE" parameters. The setpoint w from 0 to 100% is always referred to in this range. This results in a display that is more or less proportional to the flow rate and a position feedback "I_v". The flow rate-proportional display and position feedback "I_v" are also obtained when the valve characteristic lines are used.

The setpoint in the digital display is also shown in the corresponding scale to calculate the control difference.

The dependency of the stroke on standardization and on the "YA" and "YE" parameters is shown below with an example of a 80 mm linear actuator:



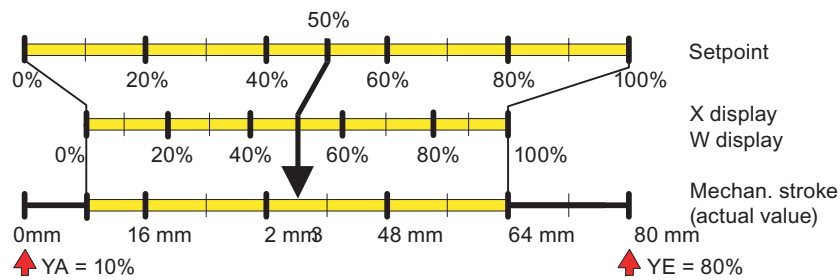


Figure 10-1 Dependency of the stroke on standardization and on "YA" and "YE"

The factory setting is "MPOS".

See also

Description of parameters 32 and 33 (Page 147)

Description of parameter 40 (Page 151)

Description of parameters 41 and 42 (Page 153)

10.2.2.8 Description of parameter 35

35.YCLS - tight closing manipulated variables

Use this parameter to move the valve using the maximum torque of the actuator (permanent contact of piezo valves) into the seat. The tight closing function can be activated on one side or for both end positions. "35.YCLS" becomes effective when the effective setpoint is below "36.YCDO" or above "37.YCUP". For this purpose, see the picture below the also-see link.

Note

Activated tight closing function

If the tight closing function is activated, the monitoring of control deviation in the corresponding overrun direction is switched off for the "45.4LIM" parameter. "YCDO: < 0 %" and "YCUP: > 100 %" are applicable in such a case. This function is mainly advantageous for the valves with soft seats. In order to monitor the end positions for a long time, we recommend activating the "F.4ZERO" and "G.4OPEN" parameters.

The factory setting is "no".

See also

Description of parameters 10 to 30 (Page 146)

10.2.2.9 Description of parameters 36 and 37

36.YCDO - value "down tight closing"

The factory setting is "0".

and

37.YCUP- value "up tight closing"

Note

"36.YCDO" must always be set greater than "37.YCUP". The tight closing function has a fixed hysteresis of 1%. "36.YCDO" and "37.YCUP" refer to mechanical end stops. Mechanical end stops are independent of the setting of "6.SDIR".

The factory setting is "100".

See also

Description of parameter 35 (Page 149)

10.2.2.10 Description of parameters 38 and 39

38.BIN1 - function binary input 1

and

39.BIN2 - function binary input 2

Use these parameters to determine the function of binary inputs. The possible functions are described below. The direction of action can be adjusted as per a normally open contact or a normally closed contact.

- BIN1 or BIN2 = on or -on

Binary messages of peripherals (e.g. pressure or temperature switch) can be read through the communication interface, or they lead to the response of the fault message output through a logical OR combination with other messages.

- BIN1 = bLoc1

Use this parameter value to interlock the "Configuration" mode against adjustment. For example, a wire jumper between terminals 9 and 10 is used for interlocking.

- BIN1 = bLoc2

If binary input 1 has been activated, the "Manual" as well as "Configuration" modes are blocked.

- BIN1 or BIN2 = uP and doWn (contact closed) or -uP and -doWn (contact open).

If the binary input is activated, the actuator uses the value defined by "YA" and "YE" for controlling in the "Automatic" mode.

- BIN1 or BIN2 (contact closed) = StoP or -StoP (contact open).

In "Automatic" operating mode the piezo valves are blocked when the binary input is activated. The actuator remains in the last position. Leakage measurements can then be taken without the initialization function.

- BIN1 or BIN2 = PSt or -PSt

Binary inputs 1 or 2 can be used to initiate a partial stroke test by pressing either a normally closed or a normally open contact depending on the choice.

- BIN1 or BIN2 = OFF (factory setting)

No function

The following is applicable if one of the aforementioned functions has been activated simultaneously using the "BIN1" and "BIN2" parameters: "Blocking" has priority over "uP" and "uP" has priority over "doWn".

The factory setting is "OFF".

10.2.2.11 Description of parameter 40

40.AFCT - alarm function

Six setting options are available:

1. Min Max
2. Min Min
3. Max Max
4. -Min -Max (inverting message)
5. -Min -Min (inverting message)
6. -Max -Max (inverting message)

Direction of action and hysteresis			
			Alarm unit
	Examples:	A1	A2
	A1 = 48	AFCT = MIN / MAX	
	A2 = 52		
	Path = 45	Active	
	Path = 50		
	Path = 55		Active
	A1 = 48	AFCT = -MIN / -MAX	
	A2 = 52		
	Path = 45		Active
	Path = 50	Active	Active
	Path = 55	Active	

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

Note that:

- Both limits can be evaluated separately in the control system only for settings 1 or 4 since both the limits, A1 and A2 are connected to each other through a logical OR combination in the "READBACK" and "POS_D" status messages.
- The response of both limits cannot be detected in the "READBACK" and "POS_D" status reports if the positioner is in the manual mode.
- The direction of action shown reverses for an alarm unit.
- The direction of action also reverses when the setting of the response threshold of alarms in the "41.A1" parameter is greater than that in the "42.A2" parameter.
- The hysteresis of the limit is 1% by default.
- In the factory setting "OFF", the output of both alarms "41.A1" and "42.A2" is deactivated.

The factory setting is "OFF".

See also

Description of parameter 34 (Page 148)

10.2.2.12 Description of parameters 41 and 42

41.A1 - response threshold of alarm 1

The factory setting is "10.0".
and

42.A2 - response threshold of alarm 2

Use these parameters to set the alarm thresholds that are used to trigger an alarm. The response thresholds of the "41.A1" and "42.A2" alarms refer to the MPOS scale that corresponds to the mechanical path.

The factory setting is "90.0".

See also

Description of parameter 34 (Page 148)

10.2.2.13 Description of parameter 43

43.4FCT - function of the fault message output

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
- Pressure failure
- Response of limits

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 wish to generate a fault message here, set the "43.FCT" parameter to "nA".

You also have an option to connect the fault message with the status of binary inputs using a logical OR combination. For this purpose, set the "32.FCT" parameter to "nAb".

Select the "-" setting if you wish to forward the fault message to the alarm or SIA unit in an inverted format.

The factory setting is "4".

10.2.2.14 Description of parameter 44

44.TIM - monitoring time to set the fault messages

Use this parameter to set the value in seconds before which the positioner must attain the corrected status. The corresponding response threshold is defined using the "45.4LIM" parameter.

The fault message output is set when the set time is exceeded.

Note

Activated tight closing function

If the tight closing function is activated, the monitoring of control deviation in the corresponding overrun direction is switched off for the "45.4LIM" parameter. "YCDO: < 0 %" and "YCUP: > 100 %" are applicable in such a case. This function is mainly advantageous for the valves with soft seats. In order to monitor the end positions for a long time, we recommend activating the "F.4ZERO" and "G.4OPEN" parameters.

The factory setting is "Auto".

10.2.2.15 Description of parameter 45

45.4LIM - response threshold of fault message

Use this parameter to set a value for the permissible extent of the control deviation to trigger a fault message. The value is specified in percent.

If the "44.4TIM" and "45.4LIM" parameters have been set to "Auto", the fault message is set when the slow step zone is not reached within a specific time. The "Auto" setting is the factory setting. Within 5 to 95% of the actuator travel, this time is two times the initialization time, and outside 10 to 90% it is ten times the initialization time.

Note

Activated tight closing function

If the tight closing function is activated, the monitoring of control deviation in the corresponding overrun direction is switched off for the "45.4LIM" parameter. "YCDO: < 0 %" and "YCUP: > 100 %" are applicable in such a case. This function is mainly advantageous for the valves with soft seats. In order to monitor the end positions for a long time, we recommend activating the "F.4ZERO" and "G.4OPEN" parameters.

The factory setting is "Auto".

10.2.2.16 Description of parameter 46

46.STRK - limit for monitoring the path integral (number of strokes)

Use this parameter to set the limit for the path integral. This parameter corresponds to the profile parameter "TOTAL_VALVE_TRAVEL_LIMIT".

NOTICE
Limit overshoot A fault message is not triggered if the set limit is exceeded. Only the "CB_TOT_VALVE_TRAV" bit in the "CHECK_BACK" parameter is set.

The fault message is activated if the path integral exceeds the limit.

This function enables preventive maintenance of the control valve.

Note**Path integral**

Use the "L" parameter in the advanced diagnostics to monitor the path integral along with the diagnostics messages.

The factory setting is "1E9".

10.2.2.17 Description of parameter 47

47.PRST - Preset

Use this parameter to reset the factory setting. Press the Δ increment button for at least 5 seconds. Not all parameters are set to the factory setting if "no" is shown on the digital display. All parameters are set to the factory setting if "oCAY" is shown on the digital display.

Note

After a "Preset", the positioner must be re-initialized. All maintenance parameters determined until now are deleted.

10.2.2.18 Description of parameter 48

48.XDIAG - activation of advanced diagnostics

Advanced diagnostics is deactivated by default. The "48.XDIAG" parameter is thus set to "OFF". Three operating modes are available to activate advanced diagnostics:

- On1: advanced diagnostics is activated and the threshold 3 fault messages are triggered through the fault message output.
- On2: advanced diagnostics is activated. The threshold 2 fault messages are triggered through alarm output 2 and the threshold 3 fault messages are additionally triggered through the fault message output.
- On3: advanced diagnostics is activated. The threshold 1 fault messages are triggered through alarm output 1, the threshold 2 fault messages through alarm output 2 and the threshold 3 fault messages are additionally triggered through the fault message output.

Note

Note that you have to select one of the operating modes from "On1" to "On3" to enable the menu items of advanced diagnostics from "A.4PST" to "P.4PAVG" in the digital display.

The factory setting is "OFF", which deactivates the parameters of menu items A to P by default. The corresponding parameters are displayed only after you activate the corresponding menu item with "On".

In advanced diagnostics, 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:

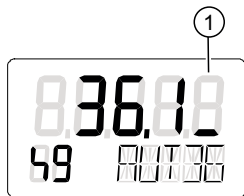


Figure 10-2 Display of a threshold 1 fault message

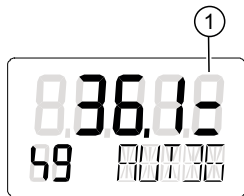


Figure 10-3 Display of a threshold 2 fault message

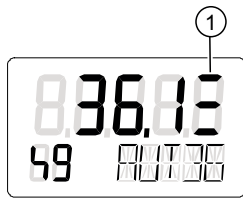


Figure 10-4 Display of a threshold 3 fault message

The factory setting is "OFF".

See also

Description of parameter A (Page 159)

XDIAG parameter (Page 231)

10.2.2.19 Description of parameter 49

49.FSTY - safety position

Use this parameter to move the actuator to a defined safety position when communication fails. Three settings are available:

- FSVL:
the actuator is controlled using the parameterized safety setpoint. This value also becomes effective after a power failure.
- FSSP:
the actuator is controlled using the last effective setpoint.
- FSAC:
the exhaust air valve is opened. The single-acting actuator moves to the end position due to its spring force.

The factory setting is "FSAC".

10.2.2.20 Description of parameter 50

50.FSTI - monitoring time to set the safety position

If communication fails, the positioner switches to the safety position after the set value expires.

The factory setting is "0".

10.2.2.21 Description of parameter 51

51.FSVL - safety setpoint

Default value of the safety position.

Note that the "FSVL" safety setpoint of 0% always refers to the mechanical position in which the actuator is depressurized. The mechanical position is especially important if you have set the "6.SDIR" parameter to "FALL" and expect 100% mechanical position at 0% setpoint default. The "6.SDIR = FALL" setting corresponds a declining characteristic curve of the setpoint.

The factory setting is "0.0".

See also

Description of parameter 6 (Page 145)

10.2.2.22 Description of parameter 52

52.STNR - station number

A separate station number must be set on each device in order to address the devices on the bus separately.

The factory setting is "126".

10.2.2.23 Description of parameter 53

53.IDENT - device operating mode

The positioner identifies two device operating modes with respect to the response to the DP master of class 1:

- [0] profile-compliant:
can be replaced with positioners of other manufacturers complying with PROFIBUS PA profile 3.0.
- [1] profile-compliant with extensions:
complete functional range of the positioner (condition at delivery).

Note

A specific GSD file is allocated to every device operating mode.

If the configuration of your PROFIBUS PA path does not match the set device operating mode, the device cannot accept the cyclic data exchange. The station number and the device operating mode cannot be modified during ongoing communication with a master of class 1.

A successfully established connection with a cyclic master can be detected when the positioner responds to the setpoint of the master.

A blinking decimal point in the upper line of the positioner display indicates communication with an acyclic master.

The factory setting is "1".

See also

Cyclic data transfer (Page 192)

10.2.3 Description of parameters A to P

10.2.3.1 Description of parameter A

A.4PST - 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 Δ 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.FACT3". 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".

See also

Description of parameter 48 (Page 156)

10.2.3.2 Description of parameter b

b.1 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".

10.2.3.3 Description of parameter C

C.4LEAK - 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".

10.2.3.4 Description of parameter d

d.4 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".

10.2.3.5 Description of parameter E

E.4 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.4 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".

10.2.3.6 Description of parameter F

F.½ZERO - 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.½ZERO" 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.½ZERO" 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".

10.2.3.7 Description of parameter G

G.4OPEN - 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.4OPEN" 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.4OPEN" 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".

10.2.3.8 Description of parameter H

H.4TMIN - 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.4TMIN" 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".

10.2.3.9 Description of parameter J

J.4.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.4.TMAX" 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".

10.2.3.10 Description of parameter L

L.4STRK - 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.4STRK" 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".

10.2.3.11 Description of parameter O

O.1DCHG - 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.1DCHG" 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".

10.2.3.12 Description of parameter P

P.4PAVG - 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.4PAVG" 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 Δ 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".

Functions/operations using PROFIBUS PA

11.1 System integration

A control system (master) uses acyclic and cyclic data transfer to operate and monitor the positioner. You must set an address of the positioner in advance so that it can communicate with the master as a slave.

The PROFIBUS address is set to 126 in the as-delivered condition. You set the PROFIBUS address on the device or use a configuration tool like SIMATIC PDM to set the address through the bus.

11.2 Acyclic data transfer

11.2.1 Acyclic data transfer using SIMATIC PDM

SIMATIC PDM

The acyclic data transfer is mainly used to transfer parameters during commissioning and maintenance, for batch processes or to display other measured variables that do not participate in the cyclic transmission of useful data.

The data is transferred between a class 2 master and a field device using the so-called C2 connections. The device supports up to four C2 connections, so the multiple class 2 masters can access the same positioner simultaneously.

SIMATIC PDM is preferably used for the acyclic data transfer. It is a software package for project planning, parameterization, commissioning, diagnostics and maintenance of the positioner and other field devices.

SIMATIC PDM enables access to process values, alarms, status and diagnostics information of the device. You can use SIMATIC PDM to execute the following functions for field devices:

- Display
- Set
- Change
- Compare
- Check for plausibility
- Manage and simulate

Procedure for acyclic data transfer:

We recommend the following general procedure:

1. First read the current settings from the device using the "Load into PG/PC" menu item.
2. Check the current settings.
3. Configure the necessary settings.
4. Load the parameter settings into the device using the "Load into devices" menu item.
5. Save the settings in the PDM as well.

The menu bar of SIMATIC PDM contains the "File", "Device", "View", "Extras" and "Help" menus. The "Device" and "View" menus, which also contain other sub-menus, are described below in detail.

11.2.2 "Device" menu

11.2.2.1 Communication path

Call this sub-menu to display the communication path. It normally deals with a PROFIBUS DP.

11.2.2.2 Load into devices

Use this sub-menu to load the parameters from the offline display of SIMATIC PDM into the corresponding device. This function can also be called using the following icon.



Figure 11-1 Load into devices

11.2.2.3 Load into PG/PC

Use this sub-menu to read the parameters from the positioner. These parameters are then displayed using SIMATIC PDM. This function can also be called using the following icon.
















Figure 11-2 Load into PG/PC

11.2.2.4 Update diagnostics status

Use this sub-menu to update the diagnostics status in SIMATIC PDM that is visualized using symbols. Symbols are shown before the device name.

The following table contains the symbols and the corresponding diagnostics status represented by these symbols:

Meaning	Symbols	Priority
Out of service		Highest
Manual mode		
Simulation or substitute value		
Maintenance requirement		
Maintenance demand		
Maintenance requirement		
Configuration error		
Configuration warning		
Configuration changed		
Erroneous process value		
Process value uncertain		
Process value out of tolerance		
Normal operation		Lowest

11.2.2.5 Set address

Use this sub-menu to allocate a new address to the positioner. Note that, this is possible only if the slave is not yet integrated into the cyclic service.

11.2.2.6 Operation

Target modes

The following target modes (operating modes) are possible:

- Automatic
- Manual
- Out of service (OS)

Note that the target modes refer to the operating modes of function blocks of the PROFIBUS PA block model, and should not be mistaken for with the "Automatic" and "Manual" operating modes of the positioner.

The above target modes are effective when the positioner is in the automatic mode (AUT). If the positioner is in the manual mode (MAN), they are effective only after an on-site switchover to the automatic mode (AUT).

These target modes are saved in the positioner in the power failure-safe manner.

Automatic mode

As long as the positioner is not integrated into the cyclic service as a slave, SIMATIC PDM can be used to send a setpoint to it in a cyclic manner.

Configure the following settings:

1. Go to the "Operating mode" tab.
2. Set the target mode to "Automatic".
3. Enter a value between 0 and 100% for the desired setpoint, quality as "Good" and the status as "OK".
4. Transfer these settings to the positioner.

The positioner is controlled using the desired setpoint until a cyclic master starts communication with a slave or you switch over the positioner to the "Manual" mode on-site.

Note

Note that the positioner responds with the "Poor" quality and the "Constant value" status after sending the data.

If you exit this target mode and no other master sends a setpoint to the positioner, it is controlled using the configured fail-safe value after the set monitoring time expires.

Manual mode

You can use SIMATIC PDM to send a setpoint to the positioner even when cyclic communication is active. You must have priority over the cyclic master.

Configure the following settings:

1. Go to the "Operating mode" tab.
2. Set the target mode to "Manual".
3. Enter a value between 0 and 100% as a starting value, quality as "Good" and the status as "OK".
4. Transfer these settings to the positioner.

The positioner is now controlled using the desired starting value and reports this manual mode through "MM" on the digital display.

Note that the starting value entered in the manual mode is directly written in the starting block of the positioner without scaling.

You can switch the positioner to the manual mode on-site and move the actuator using buttons. The setpoint is tracked as per the current actual value. The manual mode and the current position are retained after switching back to the automatic mode.

After a power failure, the positioner is controlled in the manual mode depending on the direction of action of the actuator using the value set in the "YA" or "YE" parameters.

Note

You must set the target mode to "Automatic" to reactivate the setpoints of the cyclic master.

Out of service (O/S)

You can use SIMATIC PDM to put the positioner out of service irrespective of the cyclic communication.

 **CAUTION**

In order to prevent physical injuries and material damage, you must keep in mind that the actuator is depressurized when it is put out of service.

Configure the following settings:

1. Go to the "Operating mode" tab.
2. Set the target mode to "Out of service (O/S)".
3. Transfer these settings to the positioner.

The successful transmission is reported by "OS--" on the digital display of the positioner.

You can switch the positioner to the manual mode on-site and move the actuator using buttons even in this target mode. "MAN--" is then shown on the digital display.

The "Out of service (O/S)" mode is retained after switching back to the automatic mode. The actuator is depressurized after a power failure.

Note

You must set the target mode to "Automatic" to reactivate the setpoints of the cyclic master.

11.2.2.7 Simulation

Tab

Use this sub-menu to access the "Simulation" online menu that is split into the following four tabs:

- Simulation of actual value
- Simulation of device status
- Simulation of device diagnostics 1
- Simulation of device diagnostics 2

Simulation of actual value

You can activate the actual value simulation in this tab and also define the actual value to be simulated and its quality and status. The following feedback values are available:

- Setpoint
- Actual value
- Setpoint deviation
- Checkback bits in the checkback field.

Changes become effective as soon as the Transfer button is pressed.

Simulation of device status

You can activate the simulation of device status in this tab and can then select the diagnostics messages to be simulated. It concerns the content of the "DIAGNOSTICS physical block parameters" that generates different diagnostics messages depending on whether the condensed status has been activated or deactivated. Changes become effective as soon as the Transfer button is pressed.

Simulation of device diagnostics 1

You can activate the simulation of device diagnostics in this tab. It is applicable for device diagnostics 1 and 2.

You can then select the desired diagnostics events in the simulation of device diagnostics 1, and use device diagnostics 1 and message text to obtain the feedback indicating that the corresponding event has been triggered in the device. Changes become effective as soon as the Transfer button is pressed.

Simulation of device diagnostics 2

You can activate the simulation of device diagnostics in this tab. It is applicable for device diagnostics 2 and 1. You can then select the desired diagnostics events in the simulation of device diagnostics 2, and use device diagnostics 2 and message text to obtain the feedback indicating that the corresponding event has been triggered in the device. Changes become effective as soon as the Transfer button is pressed.

11.2.2.8 Partial stroke test (PST)

Availability

This menu item is available only if the advanced diagnostics has been activated in the parameter list in advance. You can then activate and parameterize the partial stroke test.

Functions

Use the Partial stroke test button to access the functions of the partial stroke test:

- Start the partial stroke test.
- Stop the partial stroke test.
- Initialize the partial stroke test.

Changes become effective as soon as the Transfer button is pressed.

11.2.2.9 PST trace characteristic

Availability

This menu item is available only if the advanced diagnostics has been activated in the parameter list in advance. Use this menu item to call the following sub-menus:

- Read in the trace data
- Save the trace data
- PST trace characteristic

Read in the trace data

When executing a partial stroke test, the temporal course of the actual value is scanned in the background and saved in the RAM of the positioner with a maximum of 1000 data points. Use this menu item to read in the saved data in the PDM. The end of the reading process is displayed in the PDM status bar.

Save the trace data

Use this menu item to save the currently read in temporal course of the partial stroke test in the PDM as a reference in the PDM.

PST trace characteristic

Use this to call the characteristic display of the actual value course during the partial stroke test. If you have already saved the trace data once, the saved and the currently read in courses are displayed simultaneously.

11.2.2.10 Status monitoring

Availability

This menu item is available only if the advanced diagnosis has been activated in the parameter list in advance. You can then activate and parameterize the following diagnostic functions:

- General control valve fault
- Pneumatic leakage

- Static friction/slipstick
- Dead zone monitoring
- Lower end stop
- Upper end stop
- Lower limit temperature
- Upper limit temperature
- Path integral/number of strokes
- Change of direction
- Temporal position average

Changes become effective as soon as the Transfer button is pressed.

11.2.2.11 Initialization parameters

Use

Not only you can display the initialization parameters in this menu, but also change them specifically. Allow only specialists to change the initialization parameters.


You also need this function if you need to replace the electronic unit. However you cannot initialize at the moment.

11.2.2.12 Initialization

Use

With SIMATIC PDM, you have the option to initialize the positioner for the first time.

First initialization

 WARNING
You are not located on-site. In order to prevent personal injuries and material damage, take in-house precautionary measures before starting the initialization process.

Note

Also ensure that you always start the initialization process from the acyclic master even if the positioner is in the automatic mode and contains setpoints of a cyclic master.

If required, you can interrupt the ongoing initialization by pressing the "Stop initialization" button. You can also press the operating mode button or disconnect the power supply to interrupt the initialization process on the device.

Proceed as follows to initialize the positioner using SIMATIC PDM for the first time:

1. For this purpose, go to the "Device" menu and then to the "Initialization" sub-menu. A window containing an overview of initialization-relevant device parameters, checkback, device status, diagnostics and initialization status then opens.
2. Press the "Start initialization" button. A warning is then displayed. Follow this warning without fail to prevent personal injuries and damage to the system.
3. Acknowledge the warning.

The initialization process starts once you acknowledge the warning. You can monitor the progress in the "Status (initialization)" field in the open window of the initialization menu. As soon as the initialization is completed successfully, the positioner continues working in the operating mode from which the initialization process was started. If a fault message appears, an on-site correction is required.

11.2.2.13 Reset PDM parameters

Use

Use this menu item to open a dialog box to reset all PDM parameters to their factory settings (default values).

PDM parameters are reset when you press the "OK" button. You can then transfer the parameters to the PDM memory using "File->Save".

Select "Device->Load into devices" to transfer the reset parameters to the positioner as well.

11.2.2.14 Reset the field device

Reset the positioner to the as-delivered condition

If the positioner has been moved such that it can no longer perform its control task, you can use the "Reset" function to restore the as-delivered condition. This function resets all parameters to their factory settings except for the PROFIBUS address.

The reset action is indicated by the "Restart executed" diagnostics message. You must then reset all parameters and execute the initialization process.

Warm restart

Use the warm restart to exit the positioner, shut it down and restart. The communication is interrupted and restored while doing so.

This warm restart is indicated by the "Warm restart executed" diagnostics message. If no measured value result is available, the automation or control system reads in the "Uncertain, initial value, constant value" status.

Reset the PROFIBUS address to 126

If no device in your system has the preset address 126, you can add your positioner to the PROFIBUS path during the ongoing operation of the automation or control system. You must then change the address of the newly integrated device to another value.

If you remove a positioner from the PROFIBUS path, you must reset its address to 126 using this function, so that you can re-integrate a positioner in this or another system depending on the requirement.

The address cannot be reset if a cyclic master is already communicating with the positioner.

Reset message

You can use the "Reset message" tab to reset the messages regarding the checkback, device status and unfiltered device diagnostics 1 in the PDM. Since it concerns an online menu, messages that have been reset in the PDM may be set again in the next cycle as the corresponding events still exist in the device.

11.2.2.15 Write lock

Use

After completing the commissioning, you can set the write lock to prevent undesired changes through an acyclic master.

You can however change the parameters of the positioner on-site as before.

Activate the write lock

1. Call the "Write lock" sub-menu.
2. Enter "ON" in the "Write lock" sub-menu in the positioner.

If you still try to write, the PDM displays the "Connection terminated" message.

Note

If "Hardware protection" equal to "ON" is displayed in this mask, the binary input 1 in the positioner has been parameterized at "bLoc1" or "bLoc2" and activated. Writing through the PDM is this blocked.

11.2.3 "View" menu

11.2.3.1 Measured value display

"Measured value" tab

This tab contains:

- Bar graph displays of actual value and setpoint.
- Further information about the quality of values.
- Information about the valve position.
- Information about setpoint deviation.
- Information about checkback.

"Output" tab

The "Output" tab contains:

- A bar graph display of the output value
- Information about the quality of the output value
- Information about checkback.

11.2.3.2 Characteristic

Characteristic (setpoint/actual value)

In this online menu, the actual value and setpoint are displayed as bar graphs and a characteristic curve over time.

Characteristic (characteristic curve)

Device characteristic curves are displayed in this characteristic if it has been set to "free (user-defined)".

If tight closing is active, the tight closing limits are also displayed irrespective of the setting of the characteristic curve.

11.2.3.3 Device status

Available tabs

In this online menu, information about the device status is processed in the following four tabs:

- General
- Profile
- Status/Messages
- Device diagnostics

"General" tab

The "General" tab contains information about the unique identification of the device, e.g. TAG or the device serial number.

"Profile" tab

The "Profile" tab contains profile-relevant information, e.g. profile revision or revision numbers of blocks.

"Status/Messages" tab

The "Status/Messages" tab contains an overview of the device status (DIAGNOSTICS physical block parameter), the checkback (CHECK_BACK analog output block parameter) and the limit status. As far as the limit status is concerned, all three-stage diagnostics events are handled by a collective message. This means that, if any threshold of a diagnostics event has exceeded, a corresponding limit status message is displayed here.

You will also obtain information about the statuses of:

- "Fault message output"
- "Alarm output 1"
- "Alarm output 2"
- "Binary input 1"
- "Binary input 2".

"Device diagnostics" tab

Diagnostics events of the devices are displayed in the "Device diagnostics 1" "Device diagnostics 2" fields of the "Device diagnostics" tab. It also contains information about the communication, the quality and the status of the actual value as well as a message text. The message text contains notes regarding the currently active diagnostics event.

11.2.3.4 Maintenance information

Available tabs

The maintenance information is processed in the following six tabs:

- "Current maintenance information" tab
- "Maintenance information (last maintenance)" tab
- "Maintenance counter" tab
- "Operating temperature" tab
- "Operating times" tab
- "Static revision numbers" counter

Use

The "Maintenance information (current)" tab contains an overview of the values determined by the positioner during the last initialization process. Use the "Save maintenance information (last maintenance)" button to transfer the current values to the memory of the positioner. You can use these values in the "Maintenance information (last maintenance)" tab as the reference values for comparison at the time of a subsequent re-initialization of the device. When saving the current values, you will be prompted to enter the maintenance date. Use the "Reset maintenance information" button to reset the maintenance date to 01.01.2000. This date indicates the positioner that no maintenance has been carried out as yet.

The saved values are then hidden in the next "Maintenance information (last maintenance)" tab.

The "Maintenance counter" contains an overview of the number of:

- Strokes,
- Changes of direction
- Fault messages
- Alarms
- switching cycles of piezo valves.

Press the "Reset maintenance counter" button to access a selection menu to reset all maintenance counters at one go or individually.

The "Operating temperature" tab displays the minimum, current and maximum temperatures in the pointer instruments.

The "Operating times" tab contains the number of operating hours of the positioner and the time elapsed since the last initialization.

The "Static revision numbers" tab gives an overview of the status of the revision numbers of PROFIBUS blocks. Revision numbers of a block are incremented whenever a parameter in the corresponding block is changed.

11.2.3.5 Trend characteristic

Versions

Use this menu item to access the following trend characteristics:

- Actual value
- Control deviation
- Leakage
- Static friction
- Lower end stop
- Upper end stop
- Temperature
- Dead zone

Use

The temporal course of the corresponding measured variable over the selected interval is shown in a trend characteristic. The trend characteristic gives an overview of the previous development of the measured value and can be used as the basis to estimate the future course. If adequate measured values are available, trends over the last 30 minutes, eight hours, five days, two months and 30 months can always be processed.

11.2.3.6 Histograms

Versions

Use this menu item to access the following histograms:

- Position
- Control deviation
- Temperature

Use

A class division over the entire measuring range of a variable is included in a histogram. The time spent by the measured variable within different classes is also displayed. You can use the position histogram to assess whether a servo solenoid valve has been designed practically and whether it was essentially in the expected operating point during its use so far.

11.2.3.7 Adjusting the view of SIMATIC PDM

Function bar

With this you can show or hide the function bar containing the color icons in the top margin of SIMATIC PDM.

Status bar

With this you can show or hide the status bar in the lower margin of SIMATIC PDM. Note that, important information is sometimes displayed in the status bar, e.g. end of data upload for the PST trace characteristic.

Update

Use this menu item to update the view in the open working window. After every entry in the table, the values of all parameters dependent on the changed parameter are automatically updated; however, their visibility is not updated.

The visibility of all parameters in the table is updated by clicking this menu line or by pressing the F5 function key. You can use the menu item Extras > Settings > Table to define whether this update should be executed immediately after changing any value. In addition, the diagnostics status in the PDM that is visualized using symbols before the device name is updated.

11.3 Cyclic data transfer

11.3.1 Cyclic data transfer

The cyclic data transfer is used to transfer the useful data relevant for the process automation between the class 1 master (control or automation system) and the positioner.

11.3.2 Configuration

Configuring with the GSD

Information about input and output ranges as well as the consistency of the cyclically transferred data is defined in the GSD file that is used by the device to check the configuration telegram and to declare it as valid if required.

The useful data to be transferred in the cyclic operation is determined during the projecting planning. The data volume to be transferred can thus be optimized. The GSD files of all common devices are already stored in the Siemens control systems. GSD files can be imported later. You can download the GSD files from:

www.siemens.de/sipartps2

Under "More Info", click on "→ Downloads".

Configuring the useful data

The useful data made available to the control system or the controller through PROFIBUS depends on the selected desired configuration.

Note

Configuration tool

In case of STEP 7, the configuration tool used is HW config.

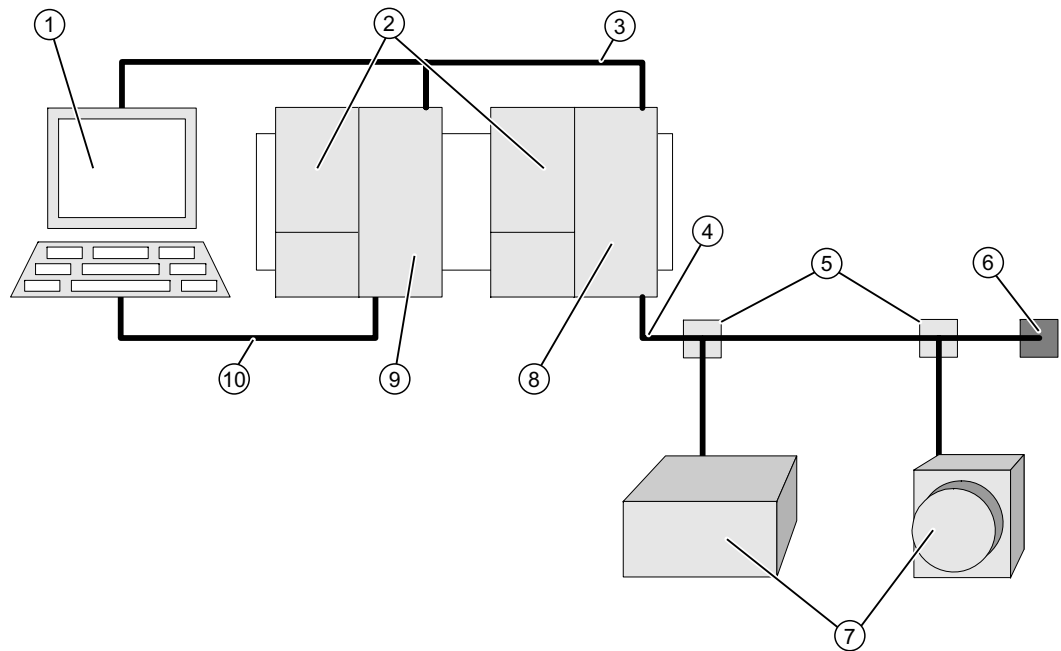


Figure 11-3 Example of a small PROFIBUS DP/PA system

- | | | | |
|---|---------------------------|---|---|
| ① | PC or PG (master class 2) | ⑦ | PA devices |
| ② | Power supply | ⑧ | DP/PA coupler/link |
| ③ | PROFIBUS DP | ⑨ | CPU SIMATIC S7 (master class 1) |
| ④ | PROFIBUS PA | ⑩ | MPI cable (required for commissioning and monitoring) |
| ⑤ | Splitter | | |
| ⑥ | Bus terminator | | |

A small STEP 7 program that establishes cyclic exchange with the positioner using PROFIBUS PA (positioner) is given below.

11.3 Cyclic data transfer

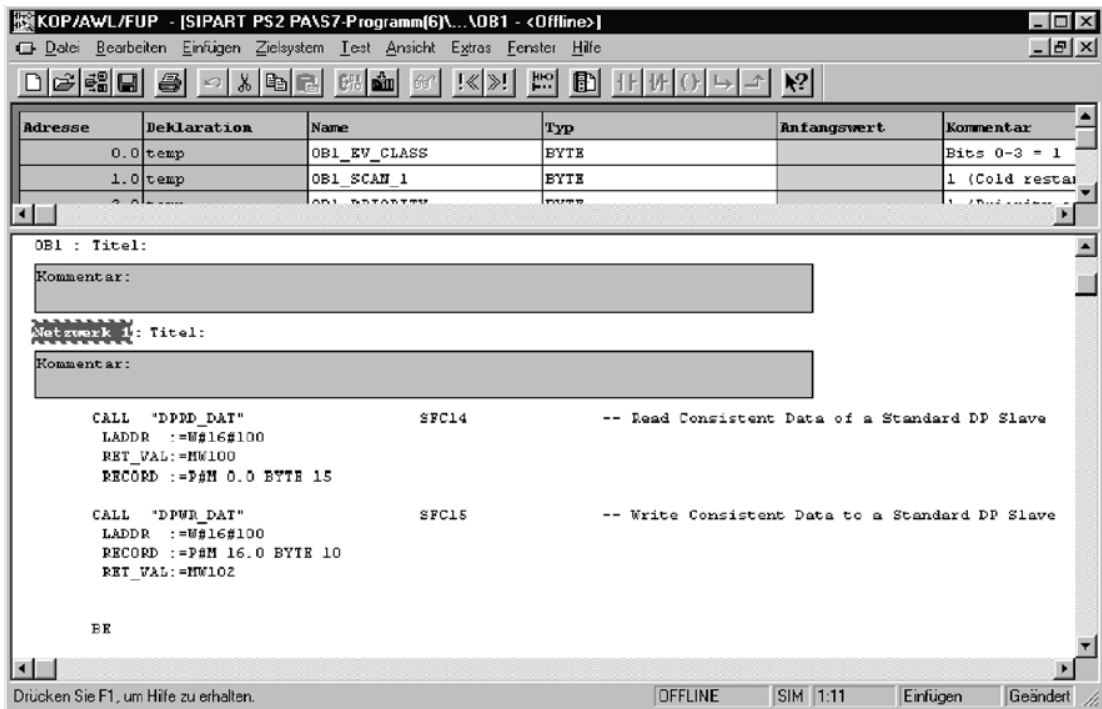


Figure 11-4 STEP 7 sample program

In this example, all data in the input and output directions supported by the device are transferred. The selected peripheral starting address is 256 (W#16#100).

Note

Only the older SIMATIC CPUs require the SFC14 and SFC16 modules for consistent reading and writing.

Legend of the sample program			
Byte	Function	Composition	Number of bytes
Byte 15	Input data	READBACK	5
		RCAS_OUT	5
		CHECKBACK	3
		POS_D	2
Byte 10	Output data	SP	5
		RCAS_IN	5

11.3.3 Useful data through PROFIBUS

Cyclic useful data

The positioner can exchange a combination of the following cyclic useful data through PROFIBUS:

Name		Abbreviation	Direction from the positioner's point of view	Length in byte	Comprising:
German	English				
Sollwert	Setpoint	SP	Input	5	Value/Status
Istwert		RB	Output	5	Value/Status
	Position discrete	POS_D	Output	2	Value/Status
Aktorzustand	Checkback	CB	Output	3	Value
Fernkaskade Eingang	Remote Cascade Input	RCAS_IN	Input	5	Value/Status
Fernkaskade Ausgang	Remote Cascade Output	RCAS_OUT	Output	5	Value/Status

Setpoint

The setpoint is divided into a floating point value (4 bytes) and the corresponding status (1 byte, see further below).

Actual value

The actual value indicates the valve position. The actual value is divided into a floating point value (4 bytes) and the corresponding status (1 byte).

Position discrete

The discrete valve position is displayed as a value (1 byte) having the following meaning:

0 = not initialized

1 = valve closed

2 = valve open

3 = valve in the intermediate position: Even this value has a status (1 byte).

Checkback

The checkback is displayed in 3 bytes in a bit-coded format:

	Bit	Meaning of "1"	Remarks
0	0	Device in the fail safe position	The position is determined by the "49.FSTY" parameter.
	1	Request for on-site operation	Reports that a button has been pressed.
	2	The device is operated on-site.	The device is parameterized on-site, e.g. using the "1.YFCT" parameter or is not initialized.

11.3 Cyclic data transfer

	Bit	Meaning of "1"	Remarks
	3	Emergency operation active	The device is in the manual mode. Representation in the digital display: MAN or P
	4	Deviation of the movement direction	Not required for the positioner.
	5	End stop reached (valve completely open)	Not required for the positioner.
	6	End stop reached (valve completely closed)	Not required for the positioner.
	7	Run time overshoot	The device could not be adjusted. Monitoring time and threshold in the "44.TIM" and "45.LIM" parameters exceeded, e.g. due to the lack of compressed air
1	0	The valve is opened.	The "Ventilate actuator" command issued
	1	The valve is closed.	The "Depressurize actuator" command issued
	2	Parameters were changed.	Set temporarily after switching back from the "Configuration" mode if one or more parameters were changed.
	3	Simulation mode	The simulation mode was released. Master class 2 can overwrite the current actual value, e.g., to test the response of limits in the control system.
	4	Not occupied in profile 3.	-
	5	Fault in the closed-loop control.	Not required for the positioner.
	6	Closed-loop control inactive	Not required for the positioner.
	7	Self-monitoring active	Not required for the positioner.
2	0	Path integral exceeded	Set if the set limit for the path integral has exceeded
	1	Additional input active	Binary 1 was activated.
	2	Additional input active	Binary 2 was activated.

Remote cascade input

The remote cascade input is used as a setpoint in the remote cascade mode (actual mode = remote cascade). The remote cascade input comprises the floating point value (4 bytes) and the status (1 byte).

Remote cascade output

This output delivers the current setpoint in the AUTO and Remote cascade modes. The status is specially used for the transfer from AUTO to Remote cascade.

In combination with the input variable parameter (primary value scale), not only you can define the setpoints as a percentage of the valve position, but also in terms of physical variables such as cubic meter per day or liter per minute. Even the actual values are adjusted as per this scale.

11.3.3.1 Possible combinations of the useful data

Useful data and position in the address room

You can select a combination of values for the communication of cyclic useful data between the master and the positioner:

SP

Setpoint:

Output (master view)		
Starting address	0	SP - floating point number
	1	
	2	
	3	
	4	SP - status

RCAS_OUT, RCAS_IN

Remote cascade output, remote cascade input:

Input (master view)		
Starting address	0	RCAS_OUT - floating point number
	1	
	2	
	3	
	4	RCAS_OUT - status

Output (master view)		
Starting address	0	RCAS_IN - floating point number
	1	
	2	
	3	
	4	RCAS_IN - status

READBACK, POS_D, SP

Actual value, discrete position, setpoint:

Input (master view)		
Starting address	0	READBACK - floating point number
	1	
	2	
	3	
	4	READBACK - status
	5	POS_D
	6	POS_D - status

Output (master view)		
Starting address	0	SP - floating point number
	1	
	2	
	3	
	4	SP - status

Checkback, SP

Checkback, setpoint:

Input (master view)		
Starting address	0	CHECKBACK
	1	
	2	

Output (master view)		
Starting address	0	SP - floating point number
	1	
	2	
	3	
	4	SP - status

READBACK, CHECKBACK, POS_D, SP

Actual value, discrete position, checkback, setpoint:

Input (master view)		
Starting address	0	READBACK - floating point number
	1	
	2	
	3	
	4	READBACK - status
	5	POS_D
	6	POS_D - status
	7	CHECKBACK
	8	
9		

Output (master view)		
Starting address	0	SP - floating point number
	1	
	2	
	3	
	4	SP - status

RCAS_OUT, CHECKBACK, RCAS_IN

Remote cascade output, checkback, remote cascade input:

Input (master view)		
Starting address	0	READBACK - floating point number
	1	
	2	
	3	
	4	READBACK - status
	5	POS_D
6	POS_D - status	

Output (master view)		
Starting address	0	RCAS_IN - floating point number
	1	
	2	
	3	
4	RCAS_IN - status	

READBACK, RCAS_OUT, POS_D, CHECKBACK, SP, RCAS_IN

Actual value, remote cascade output, discrete position, checkback, setpoint, remote cascade input:

Input (master view)		
Starting address	0	READBACK - floating point number
	1	
	2	
	3	
	4	READBACK - status
	5	RCAS_OUT - floating point number
	6	
	7	
	8	
	9	RCAS_OUT - status
	10	POS_D
	11	POS_D - status
	12	CHECKBACK
	13	
14		

Output (master view)		
Starting address	0	SP - floating point number
	1	
	2	
	3	
	4	SP - status
	5	RCAS_IN - floating point number
	6	
	7	
	8	
9	RCAS_IN - status	

11.3.3.2 Diagnostics

Function

The positioner can report active information about its device status. These diagnoses are important information that can be used by an automation system to initiate remedial measures.

Standard mechanisms of PROFIBUS-DP are used to transfer the diagnostics information and report it actively to the class 1 master. PROFIBUS-DP has a protocol to transfer the information that has higher priority than the useful data to the class 1 master.

The contents of the "Device status" parameter from the physical block are reported along with the information whether a status change (event received/event sent) has occurred.

Diagnostics as per PROFIBUS DP (DDLMSlaveDiag)

The positioner delivers the diagnostics data in the following format:

Input (master view)			
Starting address	0	Station_status_1	
	1	Station_status_2	
	2	Station_status_3	Standard DP - diagnostics
	3	Diag_Master_Add	
	4	Ident_Number	
	5	Ident_Number	
	6	Header	
	7	Status_Type	Status coding as per DP/V1
	8	Slot_Number	
	9	Specifier	
	10	Diagnostics (0)	Diagnostics object of the physical block
	11	Diagnostics (1)	
	12	Diagnostics (2)	
	13	Diagnostics (3)	

Specifier

The following specifiers are available:

- 1: Incoming event
- 2: Outgoing event

11.3.4 Adjustable status (condensed status)

Diagnostics messages are generated in the DIAGNOSTICS physical block parameter depending on the diagnostics events in the device. At the same time, the statuses of three PowerTags (FEEDBACK_VALUE, READBACK and POS_D) that are sent to the master by the SIPART PS2 PA positioner are affected.

In the device, there is now an option to use diagnostics messages and predefined status messages that are permanently associated with the triggering diagnostics events. The condensed status must be deactivated for this purpose.

If the condensed status is activated, the diagnostics messages in a specific frame can be allocated to a smaller number of collective diagnostics messages and selectable status messages. This "routing" of diagnostics events is shown in the following picture.

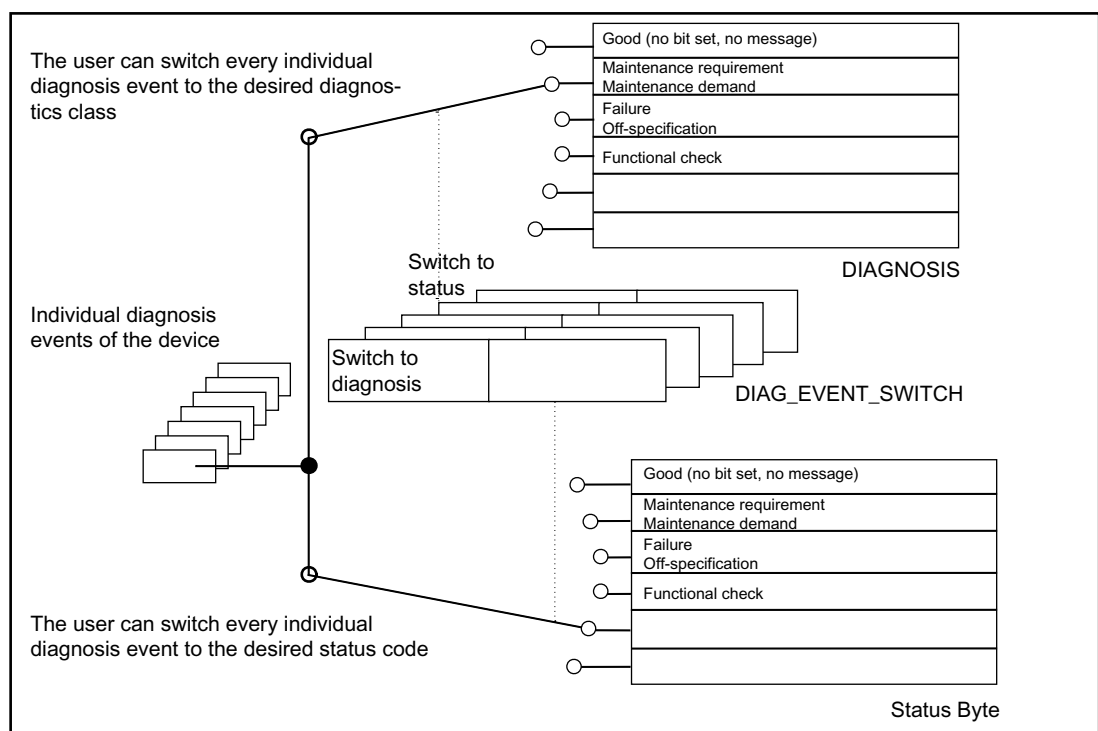


Figure 11-5 Routing of a diagnostics event

NOTICE

Please note that the condensed status cannot be changed using the SIMATIC PDM when the device is in a cyclic operation with a master class 1.

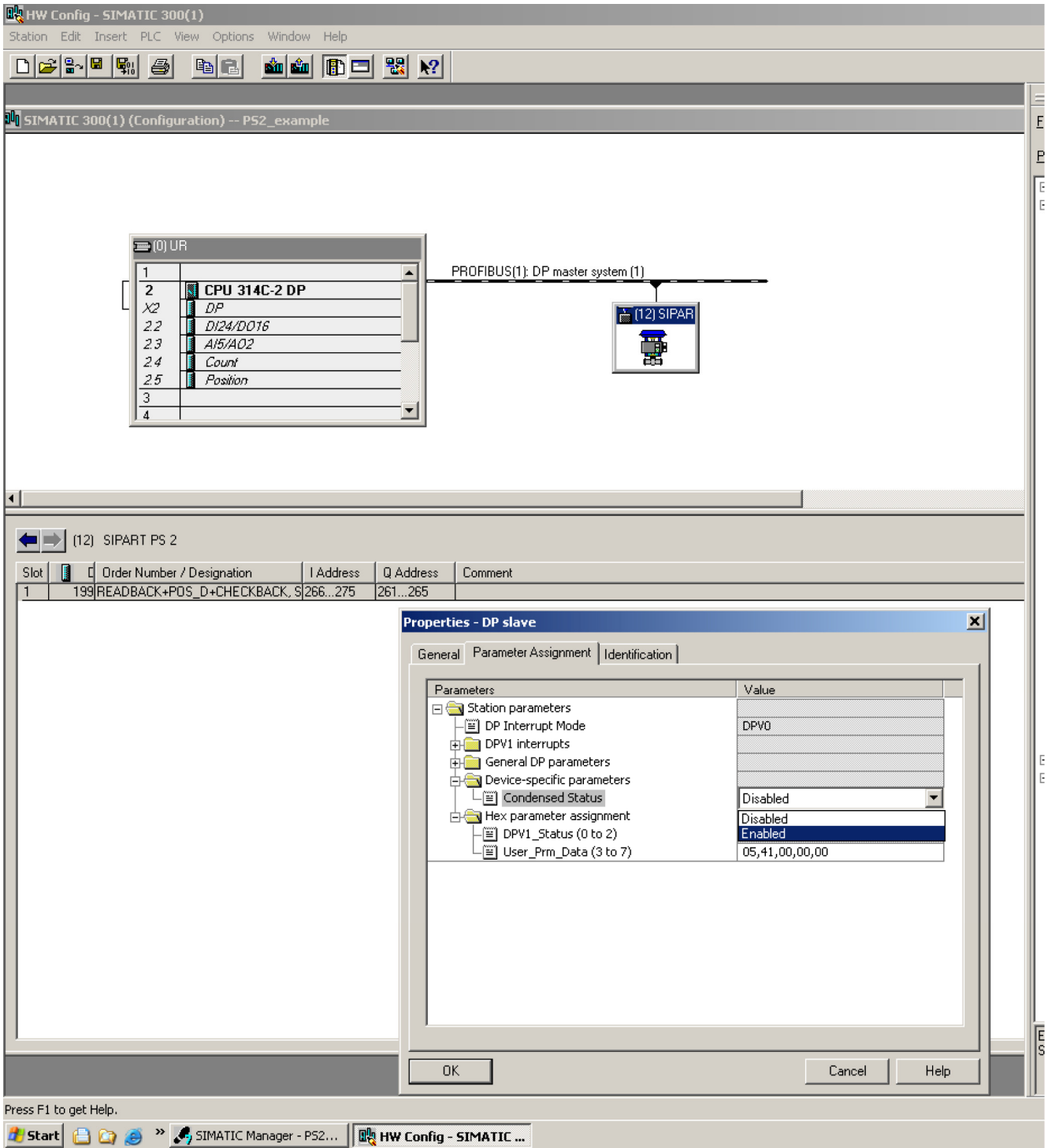


Figure 11-6 Activating the condensed status for the device parameterization - with an example of HW configuration with SIMATIC S7

11.3 Cyclic data transfer

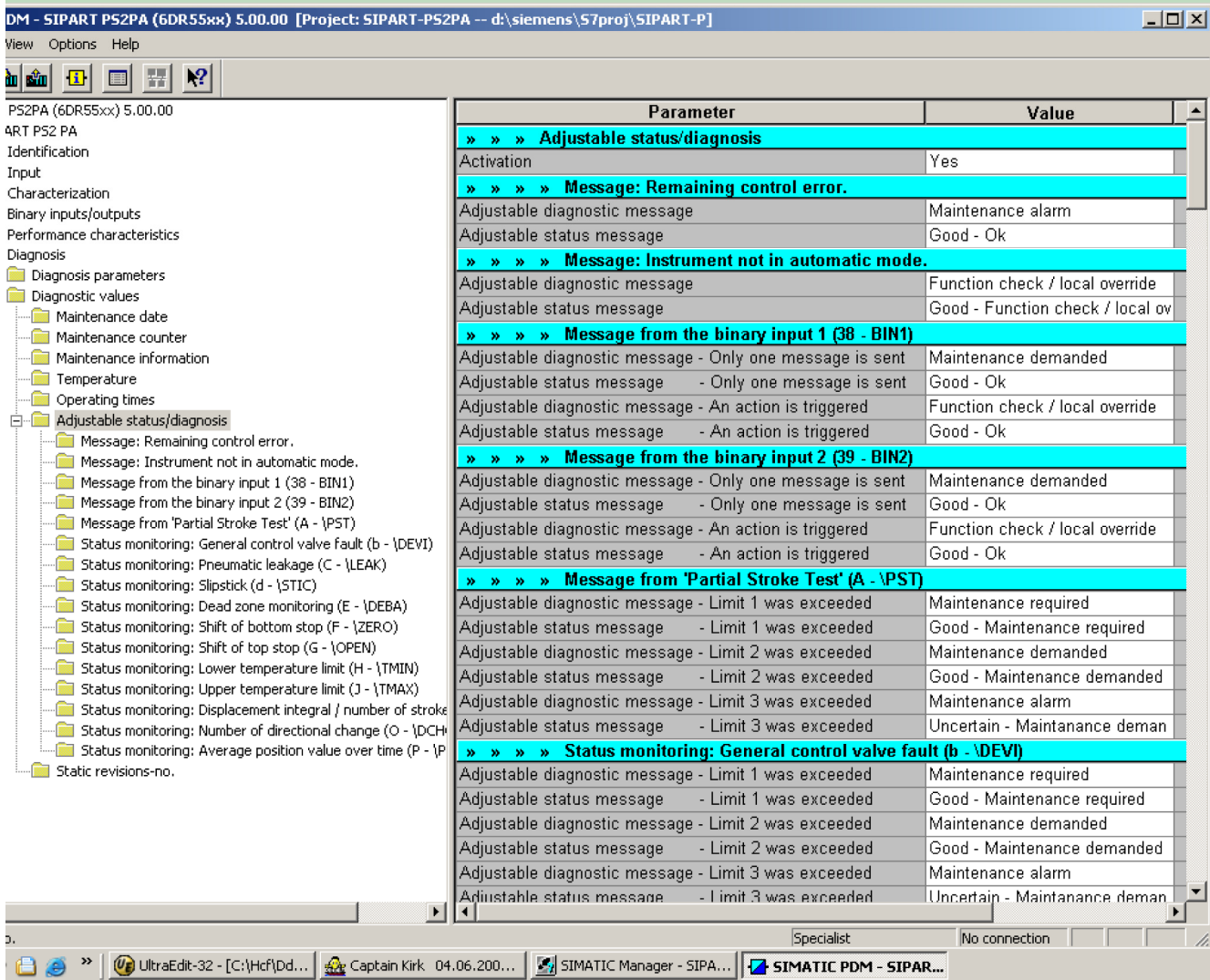


Figure 11-7 Activating the condensed status for the device parameterization - with an example of SIMATIC PDM

11.3.4.1 Diagnostics messages in case of deactivated condensed status

The diagnostics messages of the DIAGNOSTICS physical block parameter in case of the deactivated condensed status are shown in the following table:

Byte	Bit	Name and meaning	Cause	Measure
0	0 ... 2	Not used	-	-
	3	DIA_TEMP_ELECTR Electronic unit temperature too high	The temperature measured at the device electronic unit has exceeded one or more set thresholds.	Check why the temperature is beyond the specified range.
	4	DIA_MEM_CHKSUM Memory error	During operation, the memory is constantly checked for the checksum and write/read errors. This message is generated in case of an error.	Replace the electronic unit.
	5	Not used	-	-
	6	DIA_NOT_INIT Device not initialized	The initialization process required for the device functioning has not yet been carried out successfully.	Carry out the device initialization process.
	7	DIA_INIT_ERR Error in initialization	Values obtained during the initialization process cannot be used.	Carry out the device initialization process again. Check the relevant parameter settings.
1	0	DIA_ZERO_ERR Lower end stop beyond the tolerance	The lower end stop is beyond the set tolerance.	Check the valve. Flow restrictors and/or the seat ring are probably worn out.
	1	DIA_SUPPLY Error in the compressed air supply	A run time overshoot was detected. In all probability, the energy (compressed air) is not available.	Establish the compressed air supply and check the feed lines.
	2	Not used	-	-
	3	DIA_WARMSTART Warm restart executed (goes to "0" after 10 s)	Power was fed to the device.	Check the cabling and the supply unit.
			SIMATIC PDM was used to trigger a warm restart.	
			The internal watchdog has responded.	
4	DIA_COLDSTART Restart executed (goes to "0" after 10 s)	The device was reset to factory settings.	-	
5	DIA_MAINTENANCE Maintenance required	To determine the cause, check in DIAGNOSTICS_EXTENSION and DIAGNOSTICS_EXTENSION_2 which diagnostics event has triggered the message.	Depends on the triggering diagnostics event.	

11.3 Cyclic data transfer

Byte	Bit	Name and meaning	Cause	Measure
	6	DIA_CHARACTER Characteristic curve invalid	The parameterized characteristic curve does not have the required monotony, number of support points, or the x values are not arranged in 5% distances. The original characteristic curve is used further.	Modify the configuration data (change the GSD) such that it is consistent with the identification number set in the device.
	7	IDENT_NUMBER_VIOLATION Identification number changed	You have changed the PROFIBUS identification number parameter during the active cyclic operation. The device reports the identification number violation and displays a failure warning. In case of a warm restart, the device no longer participates in the cyclic transfer of useful data without changing the system configuration.	Modify the configuration data (change the GSD) such that it is consistent with the identification number set in the device.
2	0 ... 7	Reserved	-	-
3	0 ... 6	Reserved	-	-
	7	EXTENSION_AVAILABLE Extension available	Further information about the triggering diagnostics event is available in DIAGNOSTICS_EXTENSION and DIAGNOSTICS_EXTENSION_2.	-

11.3.4.2 Diagnostics messages in case of activated condensed status

Thematic classification

Collective diagnostics messages of the DIAGNOSTICS physical block parameter when the condensed status is activated are given below. The Group column contains a thematic classification of diagnostics messages. The same meaning is also used for status messages:

Maintenance:

- M1 MAINTENANCE REQUIRED
- M12 MAINTENANCE REQUIRED,
MAINTENANCE DEMAND
- M MAINTENANCE REQUIRED,
MAINTENANCE DEMAND,
MAINTENANCE ALARM

Process-dependant:

P PROCESS RELATED

Functional check:

F FUNCTION CHECK

Collective diagnostics messages

Collective diagnostics messages in the case of the activated condensed status are shown in the following table:

Byte	Bit	Name and meaning	Cause	Measure	Group
0	0 ... 7	Reserved	Power was fed to the device.	-	-
			Or: SIMATIC PDM was used to trigger a warm restart,		
			Or: The internal watchdog has responded.		
1	0 ... 2	Reserved	The device was reset to factory settings.	-	-
			3		
	4	DIA_COLDSTART Restart executed (goes to "0" after 10 s)	-	-	-
	5	DIA_MAINTENANCE Maintenance required	You have changed the PROFIBUS identification number parameter during the active cyclic operation. The device reports the identification number violation and displays a failure warning. In case of a warm restart, the device will no longer participate in the cyclic transfer of useful data without changing the system configuration.	Depends on the triggering diagnostics event.	M1, M12, M
	6	Reserved	-	-	-

11.3 Cyclic data transfer

Byte	Bit	Name and meaning	Cause	Measure	Group
	7	IDENT_NUMBER_VIOLATION Identification number changed	To determine the cause, check in DIAGNOSTICS_EXTENSION and DIAGNOSTICS_EXTENSION_2 which diagnostics event has triggered the message.	Modify the configuration data (change the GSD) such that it is consistent with the identification number set in the device.	-
2	0	DIA_MAINTENANCE_ALARM Maintenance alarm	To determine the cause, check in DIAGNOSTICS_EXTENSION and DIAGNOSTICS_EXTENSION_2 which diagnostics event has triggered the message.	Depends on the triggering diagnostics event.	M
	1	DIA_MAINTENANCE_DEMANDED Maintenance demand	To determine the cause, check in DIAGNOSTICS_EXTENSION and DIAGNOSTICS_EXTENSION_2 which diagnostics event has triggered the message.	Depends on the triggering diagnostics event.	M12, M
	2	DIA_FUNCTION_CHECK Functional check	The device is in the on-site operation or FEEDBACK_VALUE is simulated	-	F
	3	DIA_INV_PRO_COND Invalid process conditions	To determine the cause, check in DIAGNOSTICS_EXTENSION and DIAGNOSTICS_EXTENSION_2 which diagnostics event has triggered the message.	Depends on the triggering diagnostics event.	P
	4 ... 7	Reserved	-	-	-
3	0 ... 6	Reserved	-	-	-
	7	EXTENSION_AVAILABLE Extension available	Further information about the triggering diagnostics event is available in DIAGNOSTICS_EXTENSION and DIAGNOSTICS_EXTENSION_2.	-	-

11.3.4.3 Definition of the status

Status byte

The status is used to provide information about the quality of the input and output values. This information is classified into four stages. Quality stages such as "Bad", "Uncertain", "Good" and "Good (cascade)" are accompanied with further information. In this case, it deals with the sub-status and the limit bits. The status byte has the following structure:

Status byte structure							
7	6	5	4	3	2	1	0
Quality		Sub-status				Limit bits	

Quality	00	Bad
	01	Uncertain
	10	Good
	11	Good (cascade)

Limit bits	00	Good
	01	Lower limit reached
	10	Upper limit reached
	11	Value is constant.

The meaning of the sub-status depends on whether the condensed status is activated or not. The sub-status is therefore specified separately for both the cases.

11.3.4.4 Sub-status for deactivated condensed status

Bit								Name profile	German name
7	6	5	4	3	2	1	0		
0	0	0	0	0	0	x	x	Bad, non specific	Schlecht
0	0	0	0	0	1	x	x	Bad, configuration error	Schlecht, Konfigurationsfehler
0	0	0	0	1	0	x	x	Bad, not connected	Schlecht, keine Verbindung
0	0	0	0	1	1	x	x	Bad, device failure	Schlecht, Gerätefehler
0	0	0	1	0	0	x	x	Bad, sensor failure	Schlecht, Sensorfehler
0	0	0	1	1	1	x	x	Bad, out of service	Schlecht, Außer Betrieb
0	1	0	0	0	0	x	x	Uncertain, non specific	Unsicher
0	1	0	1	0	0	x	x	Uncertain, sensor conversion not accurate	Unsicher, Wert ungenau
0	1	0	1	1	1	x	x	Uncertain, configuration error	Unsicher, Konfigurationsfehler
0	1	1	0	0	0	x	x	Uncertain, simulated value	Unsicher, Simulationswert
1	0	0	0	0	0	x	x	Good, ok	Gut, Ok
1	0	0	0	0	1	x	x	Good, update event	Gut, Aktiver Blockalarm

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Bit								Name profile	German name
7	6	5	4	3	2	1	0		
1	0	1	0	0	1	x	x	Good, maintenance required	Gut, Instandhaltungsbedarf
1	1	0	0	0	0	x	x	Good (Cascade), ok	Gut (Kaskade), Ok
1	1	0	0	0	1	x	x	Good (Cascade), initialisation acknowledged	Gut (Kaskade), Initialisierung bestätigt
1	1	0	0	1	0	x	x	Good (Cascade), initialisation request	Gut (Kaskade), Initialisierung angefordert
1	1	0	0	1	1	x	x	Good (Cascade), not invited	Gut (Kaskade), Nicht eingeladen
1	1	0	1	1	0	x	x	Good (Cascade), local override	Gut (Kaskade), Vor-Ort-Bedienung
1	1	1	0	0	0	x	x	Good (Cascade), initiate fail safe	Gut (Kaskade), Sicherheitsstellung anfahren

11.3.4.5 Sub-status for activated condensed status

Bits								Name		Group
7	6	5	4	3	2	1	0	Profile	German	
0	0	1	0	0	1	x	x	Bad, maintenance alarm	Schlecht, Instandhaltungsalarm	M
0	0	1	0	1	0	x	x	Bad, process related, no maintenance	Schlecht, Prozess-Störung, kein Wartungsbedarf	P
0	0	1	1	1	1	x	x	Bad, function check /local override; value not usable	Schlecht, Funktion überprüfen / Handbetrieb	F
0	1	1	0	1	0	x	x	Uncertain, maintenance demand	Uncertain, maintenance demand	M
0	1	1	1	1	0	x	x	Uncertain, process related, no maintenance	Unsicher, Prozess-Störung, kein Wartungsbedarf	P
1	0	0	0	0	0	x	x	Good, ok	Gut, Ok	-
1	0	1	0	0	1	x	x	Good, maintenance required	Gut, Instandhaltungsbedarf	M1, M12, M
1	0	1	0	1	0	x	x	Good, maintenance demand	Good, maintenance requirement	M12, M
1	0	1	1	1	1	x	x	Good, function check	Gut, Funktion überprüfen / Handbetrieb	F

11.3.4.6 List of diagnostics events with status and diagnostics message for deactivated condensed status

A list of diagnostics events with status and diagnostics message for deactivated condensed status is given in the following table. DIAGNOSTICS_EXTENSION and DIAGNOSTICS_EXTENSION_2 are physical block parameters.

DIAGNOSTICS_EXTENSION physical block parameter

Byte	Bit	No.	Diagnostics events	Hard-coded effect of a diagnostics event	
				Quality status code	DIAGNOSTICS bit
0	0	1	Run time error of the actuator	Bad, maintenance requirement	DIA_SUPPLY
	1	2	The device is not in the "Automatic mode"	Uncertain, simulation value	None
	2	3	Binary 1 is active (only message)	Good, maintenance required	DIA_MAINTENANCE
	3	4	Action triggered by binary input 1	Uncertain, simulation value	None
	4	5	Binary 2 is active (only message)	Good, maintenance required	DIA_MAINTENANCE
	5	6	Action triggered by binary input 2	Uncertain, simulation value	None
		7 ... 21	Reserved	-	-
2	5	22	Limit for alarm A1 exceeded	Good, maintenance required	DIA_MAINTENANCE
	6	23	Limit for alarm A2 exceeded	Good, maintenance required	DIA_MAINTENANCE
	7	24	Error in the device electronic unit	Bad, device error	DIA_MEM_CHKSUM
3	0	25	The device is not yet ready for operation (not initialized)	Bad, configuration error	DIA_NOT_INIT
	1	26	The device is not yet ready for operation (initialization error)	Bad, configuration error	DIA_INIT_ERR
	3	27	Reserved	-	-
	3	28	Reserved	-	-
	4	29	Device in the Manual mode (FB in the Manual mode)	Depends on the set status	None
	5	30	Device in the Simulation mode (FEEDBACK is simulated)	Depends on the simulated status	None
	6	31	Device in the TRACE mode	-	None
	7	32	Diagnostics simulation (diagnostics events are simulated)	Depends on the simulated diagnostics event	Depends on the simulated diagnostics event
	33 ... 48	Reserved	-	-	

DIAGNOSTICS_EXTENSION_2 physical block parameter

Byte	Bit	No.	Diagnostics events	Hard-coded effect of a diagnostics event	
				Quality status code	DIAGNOSTICS bit
0	0	49	General control valve fault (limit 1)	Good, maintenance required	DIA_MAINTENANCE
	1	50	General control valve fault (limit 2)	Good, maintenance required	DIA_MAINTENANCE
	2	51	General control valve fault (limit 3)	Good, maintenance required	DIA_MAINTENANCE
	3	52	Pneumatic leakage (limit 1)	Good, maintenance required	DIA_MAINTENANCE
	4	53	Pneumatic leakage (limit 2)	Good, maintenance required	DIA_MAINTENANCE
	5	54	Pneumatic leakage (limit 3)	Good, maintenance required	DIA_MAINTENANCE
	6	55	Static friction (limit 1)	Good, maintenance required	DIA_MAINTENANCE
1	7	56	Static friction (limit 2)	Good, maintenance required	DIA_MAINTENANCE
	0	57	Static friction (limit 3)	Good, maintenance required	DIA_MAINTENANCE
	1	58	Lower end stop monitoring (limit 1)	Good, maintenance required	DIA_ZERO_ERR
	2	59	Lower end stop monitoring (limit 2)	Good, maintenance required	DIA_ZERO_ERR
	3	60	Lower end stop monitoring (limit 3)	Good, maintenance required	DIA_ZERO_ERR
	4	61	Upper end stop monitoring (limit 1)	Good, maintenance required	DIA_ZERO_ERR
	5	62	Upper end stop monitoring (limit 2)	Good, maintenance required	DIA_MAINTENANCE
	6	63	Upper end stop monitoring (limit 3)	Good, maintenance required	DIA_MAINTENANCE
2	7	64	Limit 1 for path integral (100% strokes) exceeded	Good, maintenance required	DIA_MAINTENANCE
	0	65	Limit 2 for path integral (100% strokes) exceeded	Good, maintenance required	DIA_MAINTENANCE
	1	66	Limit 3 for path integral (100% strokes) exceeded	Good, maintenance required	DIA_MAINTENANCE
	2	67	Limit 1 for changes of direction exceeded	Good, maintenance required	DIA_MAINTENANCE
	3	68	Limit 2 for changes of direction exceeded	Good, maintenance required	DIA_MAINTENANCE
	4	69	Limit 3 for changes of direction exceeded	Good, maintenance required	DIA_MAINTENANCE
	5	70	Limit 1 for position average exceeded	Good, maintenance required	DIA_MAINTENANCE
	6	71	Limit 2 for position average exceeded	Good, maintenance required	DIA_MAINTENANCE
3	7	72	Limit 3 for position average exceeded	Good, maintenance required	DIA_MAINTENANCE
	0	73	PST reference time exceeded (limit 1)	Good, maintenance required	DIA_MAINTENANCE

				Hard-coded effect of a diagnostics event	
	1	74	PST reference time exceeded (limit 2)	Good, maintenance required	DIA_MAINTENANCE
	2	75	PST reference time exceeded (limit 3)	Good, maintenance required	DIA_MAINTENANCE
		76 ... 80	Reserved	-	-
4	0	81	Permissible device temperature exceeded (limit 1)	Good, maintenance required	DIA_TEMP_ELECTR
	1	82	Permissible device temperature exceeded (limit 2)	Good, maintenance required	DIA_TEMP_ELECTR
	2	83	Permissible device temperature exceeded (limit 3)	Good, maintenance required	DIA_TEMP_ELECTR
	3	84	Permissible device temperature undershot (limit 1)	Good, maintenance required	DIA_TEMP_ELECTR
	4	85	Permissible device temperature undershot (limit 2)	Good, maintenance required	DIA_TEMP_ELECTR
	5	86	Permissible device temperature undershot (limit 3)	Good, maintenance required	DIA_TEMP_ELECTR
	6	87	Limit for dead zone monitoring exceeded	Good, maintenance required	DIA_TEMP_ELECTR
			88 ... 96	Reserved	-

11.3.4.7 List of diagnostics events with status and diagnostics message for activated condensed status

A list of diagnostics events with status and diagnostics message for activated condensed status is given in the following table. DIAGNOSTICS_EXTENSION and DIAGNOSTICS_EXTENSION_2 are physical block parameters.

Different status and diagnostics messages can be allocated to individual diagnostics events as per the following tables. The frame in which an allocation is possible is defined by the group in the selection column. The following principle is used: in case of three-stage diagnostics events of the MAINTENANCE group, the effect of the higher level events can be downgraded, but that of the lower level events cannot be upgraded.

DIAGNOSTICS_EXTENSION physical block parameter

Byte	Bit	No.	Diagnostics events	Effect of the event ¹⁾		Group
				Quality status code	DIAGNOSTICS bit	
0	0	1	Run time error of the actuator	Good, Ok	DIA_MAINTENANCE_ALARM	M
	1	2	The device is not in the "Automatic mode"	Good, check function / manual mode	DIA_FUNCTION_CHECK	F
	2	3	Binary 1 is active (only message)	Good, Ok	DIA_MAINTENANCE_DEMAND	M, F, P
	3	4	Action triggered by binary input 1	Good, Ok	DIA_FUNCTION_CHECK	M, F, P

11.3 Cyclic data transfer

			Effect of the event ¹⁾			
	4	5	Binary 2 is active (only message)	Good, Ok	DIA_MAINTENANCE_DEMAND	M, F, P
	5	6	Action triggered by binary input 2	Good, Ok	DIA_FUNCTION_CHECK	M, F, P
		7 ... 21	Reserved	-	-	-
2	5	22	Limit for alarm A1 exceeded	Good, maintenance requirement	DIA_MAINTENANCE	None, hard-coded
	6	23	Limit for alarm A2 exceeded	Good, maintenance requirement	DIA_MAINTENANCE	None, hard-coded
	7	24	Error in the device electronic unit	Bad, maintenance requirement	DIA_MAINTENANCE_ALARM	None, hard-coded
3	0	25	The device is not yet ready for operation (not initialized)	Bad, maintenance requirement	DIA_MAINTENANCE_ALARM	None, hard-coded
	1	26	The device is not yet ready for operation (initialization error)	Bad, maintenance requirement	DIA_MAINTENANCE_ALARM	None, hard-coded
	3	27	Reserved	-	-	-
	3	28	Reserved	-	-	-
	4	29	Device in the Manual mode (FB in the Manual mode)	-	DIA_FUNCTION_CHECK	None, hard-coded
	5	30	Device in the Simulation mode (FEEDBACK is simulated)	Depends on the simulated status	DIA_FUNCTION_CHECK	None, hard-coded
	6	31	Device in the TRACE mode	-	DIA_FUNCTION_CHECK	None, hard-coded
	7	32	Diagnostics simulation (diagnostics events are simulated)	Depends on the simulated diagnostics event	Depends on the simulated diagnostics event	-
		33 ... 48	Reserved	-	-	-

¹⁾ Effects of the event can be set using the DIAG_EVENT_SWITCH or DIAG_EVENT_SWITCH_2 parameters (default settings in this case)

DIAGNOSTICS_EXTENSION_2 physical block parameter

Byte	Bit	No.	Diagnostics events	Effect of the event ¹⁾		
				Quality status code	DIAGNOSTICS bit	Group
0	0	49	General control valve fault (limit 1)	Good, maintenance requirement	DIA_MAINTENANCE	M1
	1	50	General control valve fault (limit 2)	Good, maintenance requirement	DIA_MAINTENANCE_DEMAND	M12
	2	51	General control valve fault (limit 3)	Uncertain, maintenance demand	DIA_MAINTENANCE_ALARM	M
	3	52	Pneumatic leakage (limit 1)	Good, maintenance requirement	DIA_MAINTENANCE	M1
	4	53	Pneumatic leakage (limit 2)	Good, maintenance demand	DIA_MAINTENANCE_DEMAND	M12
	5	54	Pneumatic leakage (limit 3)	Uncertain, maintenance demand	DIA_MAINTENANCE_ALARM	M
	6	55	Static friction (limit 1)	Good, maintenance requirement	DIA_MAINTENANCE	M1
	7	56	Static friction (limit 2)	Good, maintenance demand	DIA_MAINTENANCE_DEMAND	M12
1	0	57	Static friction (limit 3)	Uncertain, maintenance demand	DIA_MAINTENANCE_ALARM	M
	1	58	Lower end stop monitoring (limit 1)	Good, maintenance requirement	DIA_MAINTENANCE	M1
	2	59	Lower end stop monitoring (limit 2)	Good, maintenance demand	DIA_MAINTENANCE_DEMAND	M12
	3	60	Lower end stop monitoring (limit 3)	Uncertain, maintenance demand	DIA_MAINTENANCE_ALARM	M
	4	61	Upper end stop monitoring (limit 1)	Good, maintenance requirement	DIA_MAINTENANCE	M1
	5	62	Upper end stop monitoring (limit 2)	Good, maintenance demand	DIA_MAINTENANCE_DEMAND	M12
	6	63	Upper end stop monitoring (limit 3)	Uncertain, maintenance demand	DIA_MAINTENANCE_ALARM	M
	7	64	Limit 1 for path integral (100% strokes) exceeded	Good, maintenance requirement	DIA_MAINTENANCE	M1
2	0	65	Limit 2 for path integral (100% strokes) exceeded	Good, maintenance demand	DIA_MAINTENANCE_DEMAND	M12
	1	66	Limit 3 for path integral (100% strokes) exceeded	Uncertain, maintenance demand	DIA_MAINTENANCE_ALARM	M
	2	67	Limit 1 for changes in direction exceeded	Good, maintenance requirement	DIA_MAINTENANCE	M1
	3	68	Limit 2 for changes of direction exceeded	Good, maintenance demand	DIA_MAINTENANCE_DEMAND	M12
	4	69	Limit 3 for changes of direction exceeded	Uncertain, maintenance demand	DIA_MAINTENANCE_ALARM	M

11.3 Cyclic data transfer

			Effect of the event ¹⁾			
	5	70	Limit 1 for position average exceeded	Good, maintenance requirement	DIA_MAINTENANCE	M1, P
	6	71	Limit 2 for position average exceeded	Good, maintenance demand	DIA_MAINTENANCE_DEMAND ED	M12, P
	7	72	Limit 3 for position average exceeded	Uncertain, maintenance demand	DIA_MAINTENANCE_ALARM	M, P
3	0	73	PST reference time exceeded (limit 1)	Good, maintenance requirement	DIA_MAINTENANCE	M1
	1	74	PST reference time exceeded (limit 2)	Good, maintenance demand	DIA_MAINTENANCE_DEMAND ED	M12
	2	75	PST reference time exceeded (limit 3)	Uncertain, maintenance demand	DIA_MAINTENANCE_ALARM	M
		76 ... 80	Reserved	-	-	-
4	0	81	Permissible device temperature exceeded (limit 1)	Uncertain, process fault, no maintenance required	DIA_INV_PRO_COND	M1, P
	1	82	Permissible device temperature exceeded (limit 2)	Uncertain, process fault, no maintenance required	DIA_INV_PRO_COND	M12, P
	2	83	Permissible device temperature exceeded (limit 3)	Uncertain, process fault, no maintenance required	DIA_INV_PRO_COND	M, P
	3	84	Permissible device temperature undershot (limit 1)	Uncertain, process fault, no maintenance required	DIA_INV_PRO_COND	M1, P
	4	85	Permissible device temperature undershot (limit 2)	Uncertain, process fault, no maintenance required	DIA_INV_PRO_COND	M12, P
	5	86	Permissible device temperature undershot (limit 3)	Uncertain, process fault, no maintenance required	DIA_INV_PRO_COND	M, P
	6	87	Limit for dead zone monitoring exceeded	Uncertain, maintenance demand	DIA_MAINTENANCE_ALARM	M
		88 ... 96	Reserved	-	-	-

1) Effects of the event can be set using the DIAG_EVENT_SWITCH or DIAG_EVENT_SWITCH_2 parameters (default settings in this case)

Alarm, fault and system messages

12.1 Representation of system messages on the digital display

12.1.1 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	<ul style="list-style-type: none"> • Wait
Pnnn.n	X		Potentiometer voltage of a non-initialized positioner (P-manual mode) (actual position value in % of the measuring range)	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • Start the initialization process

See also

Digital display (Page 97)

12.1.2 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	<ul style="list-style-type: none"> • 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)	<ul style="list-style-type: none"> • Wait
RUN2		X	Initialization part 2 is active (actuator travel check and determination of end stops)	<ul style="list-style-type: none"> • Wait
RUN3		X	Initialization part 3 is active (determination and display of actuating times)	<ul style="list-style-type: none"> • Wait
RUN4		X	Initialization part 4 is active (determination of the minimum controller increment length)	<ul style="list-style-type: none"> • Wait
RUN5		X	Initialization part 5 is active (optimization of the transient response)	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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

12.1 Representation of system messages on the digital display

		Line		
ok		x	The permissible measuring range of end positions is achieved only in case of a manual initialization	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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%	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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)	<ul style="list-style-type: none"> 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 pressed when the actuation speed display was active)	<ul style="list-style-type: none"> Wait for 1 minute Continue with the "+" button
LEAKG		X		

12.1 Representation of system messages on the digital display

		Line		
nn.n	X		Value and unit of the result after the leakage test	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> Acknowledge by pressing the operating mode button slightly and exit the configuration level by pressing it longer
FINISH		X		

12.1.3 System messages when exiting the Configuration mode

Remarks about the tables:

- nn stands for variable numeric values
- ₄ 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.nnV ER	X					Software version	<ul style="list-style-type: none"> Wait
ErrorSLn n	X					Monotony interruption of the free characteristic on the setpoint turning point n	<ul style="list-style-type: none"> Correct value

12.1.4 System messages during operation

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 operation:

Message	Line		Operating mode			Meaning / cause	Measure
	Up	Down	Automatic	Manual mode	P-manual mode		
CPUSTA RT	X					Message after connecting the electrical auxiliary power supply	<ul style="list-style-type: none"> • Wait
HW / ERROR		X				Error in the hardware	<ul style="list-style-type: none"> • Replace the electronic unit
NOINI		X			X	Positioner is not initialized	<ul style="list-style-type: none"> • Start the initialization process
nnn.n	X		X	X		Actual position value [in %] of the initialized positioner. Blinking decimal point indicates communication with a class 2 master	
AUnn		X	X			Automatic mode (nn = setpoint)	
FS --		X	X			Failsafe (the exhaust air valve is opened). Possible causes: <ul style="list-style-type: none"> • No communication connection with the master • Target mode is at "MA" • Master sends a wrong status 	<ul style="list-style-type: none"> • Correct the station address • Set the target mode with class 2 master to "Automatic" • Send the "0x80" status (good)
FS nn		X	X			Controlled using the configured failsafe position (Cause: see above)	See above
MM nn		X	X			Positioner is in the "manual mode"	<ul style="list-style-type: none"> • Set the target mode with class 2 master to "Automatic" • Send the "0x80" status (good)

12.1 Representation of system messages on the digital display

	Line		Operating mode			
				X		
MAnn				X	Manual mode (nn = setpoint)	<ul style="list-style-type: none"> Switch to the automatic mode using the operating mode button
LO nn		X	X		Positioner is in the "local override mode"	<ul style="list-style-type: none"> Set the target mode with class 2 master to "Automatic" Send the "0x80" status (good)
OS --	X		X	X	Positioner is in the "out of service mode"	<ul style="list-style-type: none"> Set the target mode with class 2 master to "Automatic" Send the "0x80" status (good)
oFL / 127.9					Display range was exceeded. Possible causes:	<ul style="list-style-type: none"> Move the friction clutch such that the actual value display remains within 0.0 to 100.0 when moving the actuator or Adjust the transmission ratio selector or Set the factory setting (preset) and execute the initialization process
EXSTP		X	X		Actuator was stopped using a binary input	
EX UP		X	X		Actuator is moved to the upper end stop using a binary input	
EXDWN		X	X		Actuator is moved to the lower end stop using a binary input	
EXTPSt					The partial stroke test was activated, e.g. using a binary input	
inPSt					Cyclic partial stroke test	



12.2 Diagnostics


12.2.1 Display of diagnostics values

You can access the diagnostics display from the automatic or manual mode by pressing all three buttons simultaneously for at least two seconds.

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 diagnostics display has similar structure to that of the "Configuration" mode: The upper line shown the value of the diagnostics variable and the lower line shows the number and the abbreviation of the displayed variable.

Use the  operating mode button to select the respective next diagnostics value. In order to select the diagnostics values in the reverse order, keep the operating mode button pressed and press the  decrement button as well.

Specific values can be set to zero by pressing the  increment button for at least five seconds. This is mentioned in the last column of the table.

Some diagnostics value can be greater than 99999. In such a case, the display switches over to the exponential view. Example: 1234567 is displayed as 1.23E6.

12.2.2 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	HCNT	Number of fault messages (H 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	-

12.2 Diagnostics

No.	Abbreviation	Meaning	Values that can be displayed	Unit	Reset possible
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)	2 ... 160	ms	-
23	IMPDN	Impulse length down (Impuls Length Down)	2 ... 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	%	-
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

No.	Abbreviation	Meaning	Values that can be displayed	Unit	Reset possible
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

12.2.3 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. It can be set to zero using the \triangle 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. It can be set to zero using the \triangle 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 \triangle 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 \triangle 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 larger 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 partial stroke test reference step time measurement has failed.
- notSt - No Test
A Partial-Stroke-Test was not executed yet.
- ###.# (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 the larger button is pressed:

- notoL - No Tolerance

The control valve is beyond the tolerance range to start the partial stroke test. A manual partial stroke test is not started.

- Strt - Start

A manual partial stroke test is started five seconds after pressing the button.

- StoP - Stop

The current partial stroke test is interrupted.

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 two 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 Δ increment button for at least 5 seconds. The diagnostics data 7 to 18 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 item "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 104)

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 Δ 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 \square 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

Safety function (Page 110)

12.3 Online diagnostics

12.3.1 Overview of online diagnostics

A few important variables and parameters are continuously monitored during the operation of the positioner. In the "Configuration" mode, you can configure this monitoring such that the fault message output is activated when a specific event such as exceeding a threshold occurs.

The following table shows which events can activate the fault message output, how the parameters must be set to monitor this event, when does the fault message disappear and what are the probable causes for a fault.

In the automatic and manual modes, the initiator of a fault message is shown on the digital display when responding to the fault message output. Both digits at bottom-left indicate the corresponding error code. If there are more initiators at a time, they are displayed cyclically one after the other.

12.3.2 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

See also

Description of parameter 48 (Page 156)

12.3.3 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
h1	No	Remaining control deviation	Always active	... the control deviation disappears again.	Compressed air failure, actuator fault, valve fault (e.g. blockade).
h2	No	Device not in the automatic mode	**hFCT ¹⁾ =hnA or =hnAB	... the device is switched to the automatic mode.	The device has been configured or is in the manual mode
h3	No	Binary input BE1 or BE2 active	**hFCT ¹⁾ =hnAB 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).
h4	Yes	The limit of stroke number exceeded	LhSTRK≠OFF	... the stroke counter is reset or the thresholds are increased	The total path covered by the actuator exceeds one of the set thresholds.
h5	Yes	Limit of changes of direction exceeded	O.hDCHG≠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.
h6	Yes	Limit of the lower hard end stop exceeded	F.hZERO≠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.
h7	Yes	Limit of the upper hard end stop exceeded	G.hOPEN≠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.
h8	No	Limit of dead zone adjustment exceeded	E.hDEBA≠OFF **.DEBA ¹⁾ = Auto	... the limit is undershot again	Increased packing gland friction, mechanical gap in the position feedback.
h9	Yes	Partial-Stroke-Test exceeds the reference step time	A.hPST≠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.hDEVI≠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.hLEAK≠OFF	... the leakage drops below the set thresholds, or the function is deactivated.	Pneumatic leakage
12	Yes	Static friction/Slipstick effect occurs	d.hSTIC≠OFF	... Slipjumps can no longer be detected, or the function is deactivated.	Increased static friction, valve no longer moves smoothly, but with jerks

Error code	Three-stage	Event	Parameter setting	Fault message disappears when	Possible causes
13	Yes	Temperature undershot	H.4TMIN#OFF	... the lower temperature thresholds are no longer undershot.	Ambient temperature too low
14	Yes	Temperature overshoot	J.4TMAX#OFF	... the upper thresholds are no longer overshoot.	Ambient temperature too high
15	Yes	Position average deviates from the reference value	P.4PAVG#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.

12.3.4 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 "4TIM" parameter, monitoring time for setting the fault messages and "4LIM" 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 "4FCT" 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 "4FCT" 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.↵STRK" and "O.↵DCHG".

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

7 Monitoring of the upper hard end stop

The monitoring of the lower hard end stop is activated when the value of the "F.↵ZERO" parameter is "OFF". This function can be used to detect the errors in the valve seat. An overshoot limit indicates the possibility of deposits or foreign bodies in the valve seat. An undershoot 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.↵ZERO"=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.↵OPEN" 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 overshoot

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

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.

12.4 Fault correction

12.4.1 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

Behavior in case of faults (Page 112)

12.4.2 Remedial measures table 1

Fault profile (symptoms)	Possible cause(s)	Remedial measures
<ul style="list-style-type: none"> Positioner remains in "RUN 1". 	<ul style="list-style-type: none"> 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. 	<ul style="list-style-type: none"> A waiting time of up to 1 minute is essential. Do not start initialization from the end position. Provide the network pressure.
<ul style="list-style-type: none"> Positioner remains in "RUN 2". 	<ul style="list-style-type: none"> 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. 	<ul style="list-style-type: none"> 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

Fault profile (symptoms)	Possible cause(s)	Remedial measures
<ul style="list-style-type: none"> Positioner remains in "RUN 3". 	<ul style="list-style-type: none"> Actuator actuating time is too high. 	<ul style="list-style-type: none"> Open the restrictor completely and/or set the pressure PZ (1) to the highest permissible value. Use a booster if required.
<ul style="list-style-type: none"> Positioner remains "RUN 5", does not go up to "FINISH" (waiting time > 5 min). 	<ul style="list-style-type: none"> "Gap" (play) in the positioner - actuator - control valve system 	<ul style="list-style-type: none"> 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

12.4.3 Remedial measures table 2

Fault profile (symptoms)	Possible cause(s)	Remedial measures
<ul style="list-style-type: none"> "CPU test" blinks on the digital display approximately every two seconds. Piezo valve does not activate. 	<ul style="list-style-type: none"> Water in the pneumatic block (due to wet compressed air) 	<ul style="list-style-type: none"> 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: repair¹⁾
<ul style="list-style-type: none"> In the manual and automatic modes, the actuator cannot be moved or can be moved only in one direction. 	<ul style="list-style-type: none"> Moisture in the pneumatic block 	
<ul style="list-style-type: none"> Piezo valve does not activate (a gentle click sound is not audible when the "+" or "-" buttons are pressed in the manual mode.) 	<ul style="list-style-type: none"> The screw between the shrouding cover and the pneumatic block has not been tightened firmly or the cover got stuck. 	<ul style="list-style-type: none"> Tighten the screw firmly; if required, rectify the deadlock.
	<ul style="list-style-type: none"> Dirt (swarf, particles) in the pneumatic block 	<ul style="list-style-type: none"> Repair or a new device; clean and/or replace the built-in fine screens.
	<ul style="list-style-type: none"> 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. 	<ul style="list-style-type: none"> 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.

12.4.4 Remedial measures table 3

Fault profile (symptoms)	Possible cause	Remedial measures
<ul style="list-style-type: none"> Actuator does not move. 	<ul style="list-style-type: none"> Compressed air < 1.4 bar 	<ul style="list-style-type: none"> Set the supply air pressure to > 1.4 bar.
<ul style="list-style-type: none"> Piezo valve does not activate (a gentle click sound is however audible when the "+" or "-" buttons are pressed in the manual mode.) 	<ul style="list-style-type: none"> Restrictor valve turned off (screw at the right end stop) 	<ul style="list-style-type: none"> Open the restrictor screw by turning it anticlockwise, see leaflet, "Device view (6)".
	<ul style="list-style-type: none"> Dirt in the pneumatic block 	<ul style="list-style-type: none"> Repair¹⁾ or a new device; clean and/or replace the built-in fine screens.
<ul style="list-style-type: none"> A piezo valve activates constantly in the stationary automatic mode (constant setpoint) and the manual mode. 	<ul style="list-style-type: none"> Pneumatic leakage in the positioner - actuator system; start the leakage test in "RUN 3" (initialization). 	<ul style="list-style-type: none"> Rectify leakage in the actuator and/or feed line. In case of an intact actuator and tight feed line: repair¹⁾ or a new device
	<ul style="list-style-type: none"> Dirt in the pneumatic block, see above 	<ul style="list-style-type: none"> See above

Fault table 3

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

12.4.5 Remedial measures table 4

Fault profile (symptoms)	Possible cause(s)	Remedial measures
<ul style="list-style-type: none"> In the stationary automatic mode (constant setpoint) and in the manual mode, both piezo valves are continuously activated alternately and the actuator oscillates to a mean value. 	<ul style="list-style-type: none"> Static friction of the packing gland of the control valve and the actuator is too high 	<ul style="list-style-type: none"> Reduce the static friction or increase the dead zone of SIPART PS2 ("dEbA" parameter) until the oscillatory movement stops.
	<ul style="list-style-type: none"> Gap (play) in the positioner - actuator - control valve system 	<ul style="list-style-type: none"> 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.
	<ul style="list-style-type: none"> Actuator is too fast 	<ul style="list-style-type: none"> Increase the actuating times using the restrictor screws. If a fast actuating time is required, increase the dead zone ("dEBA" parameter) until the oscillatory movement stops.

Fault table 4

12.4.6 Remedial measures table 5

Fault profile (symptoms)	Possible cause(s)	Remedial measures
<ul style="list-style-type: none"> Zero point displaces sporadically (> 3%). 	<ul style="list-style-type: none"> Impact or shock loads result in accelerations so high that the friction clutch moves, e.g. due to "vapor shocks" in vapor lines. 	<ul style="list-style-type: none"> Rectify the causes for shock loads. Re-initialize the positioner.
<ul style="list-style-type: none"> The device function has completely failed: no view even on the digital display. 	<ul style="list-style-type: none"> Electrical auxiliary power supply is not adequate. 	<ul style="list-style-type: none"> Check the electrical auxiliary power supply.
	<ul style="list-style-type: none"> 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. 	<ul style="list-style-type: none"> Tighten the screws firmly and secure using sealing wax. Repair¹⁾ For prevention: Install the positioner on the damping pads.

Fault table 5

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

Service and maintenance

13.1 Service and maintenance


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.

13.2 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.


13.3 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 <ul style="list-style-type: none">• 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.

Technical data

14.1 General technical data

SIPART PS2 (all versions)

General data	
Range of stroke (linear actuator)	3 ... 130 mm (0.12 ... 5.12") (angle of rotation of the feedback shaft 16 ... 90°)
Angle of rotation (part-turn actuator)	30 ... 100°
Installation	
<ul style="list-style-type: none"> 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
<ul style="list-style-type: none"> 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	
<ul style="list-style-type: none"> Five-point controller 	Adaptive
<ul style="list-style-type: none"> Dead zone 	
dEbA = auto	Adaptive or can be preset
dEbA = 0.1 ... 10 %	Adaptive or can be preset
Analog-to-digital converter	
<ul style="list-style-type: none"> Scanning time 	10 ms
<ul style="list-style-type: none"> Resolution 	≤ 0,05 %
<ul style="list-style-type: none"> Transmission error 	≤ 0,2 %
<ul style="list-style-type: none"> Temperature influence 	≤ 0.1 %/10 K (≤ 0.1 %/18 °F)
Cycle time	
<ul style="list-style-type: none"> 20 mA/HART device 	20 ms
<ul style="list-style-type: none"> PA device 	60 ms
<ul style="list-style-type: none"> 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

Technical data

14.1 General technical data

General data	
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	
<ul style="list-style-type: none"> Enclosure 	
6D5**0-*** (plastic)	Glass fiber reinforced macrolon
6DR5**1-*** (metal)	GD AISi12
6DR5**2-*** (stainless steel)	Austenitic stainless steel mat. no. 1.4581
6DR5**5-*** (metal, pressure resistant)	GK AISi12
<ul style="list-style-type: none"> Pressure gauge block 	
	Aluminum AlMgSi, anodized
Vibration resistance	
<ul style="list-style-type: none"> Harmonic vibrations (sine) according to DIN EN 60062-2-6/05.96 	
	3.5 mm (0.14"), 2 ... 27 Hz, 3 cycles/axle
	98.1 m/s ² (321.84 ft/s ²), 27 ... 300 Hz, 3 cycles/axle
<ul style="list-style-type: none"> Bump (half-sine) according to DIN EN 60068-2-29/03.95 	
	150 m/s ² (492 ft/s ²), 6 ms, 1000 shocks/axle
<ul style="list-style-type: none"> Noise (controlled digitally) according to DIN EN 60068-2-64/08.95 	
	10 ... 200 Hz; 1 (m/s ²) ² /Hz (3.28 (ft/s ²) ² /Hz)
	200 ... 500 Hz; 0.3 (m/s ²) ² /Hz (0.98 (ft/s ²) ² /Hz)
	4 hours/axle
<ul style="list-style-type: none"> Recommended range of continuous operation of the entire control valve 	
	≤ 30 m/s ² (98.4 ft/s ²) without resonance peak
Weight, basic device	
<ul style="list-style-type: none"> Plastic enclosure 	
	Approx. 0.9 kg (1.98 lb)
<ul style="list-style-type: none"> Metal enclosure, aluminum 	
	Approx. 1.3 kg (2.87 lb)
<ul style="list-style-type: none"> Metal enclosure, stainless steel 	
	Approx. 3.9 kg (8.6 lb)
<ul style="list-style-type: none"> Metal enclosure, EEx d version 	
	Approx. 5.2 kg (11.46 lb)
Dimensions	
	See dimensional drawing
Climate class	
<ul style="list-style-type: none"> Storage ²⁾ 	
	1K5, but -40 ... +80°C (1K5, but -40 ... +176°F)
<ul style="list-style-type: none"> Shipping ²⁾ 	
	2K4, but -40 ... +80°C (2K4, but -40 ... +176°F)
<ul style="list-style-type: none"> Operation ³⁾ 	
	4K3, but -30 ... +80°C (4K3, but -22 ... +176°F)
<p>1) Impact energy max. 1 joule for plastic/aluminum enclosure.</p> <p>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).</p> <p>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.</p>	

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)
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Pneumatic data

Auxiliary power (air supply)

• Pressure	1,4 ... 7 bar (20.3 ... 101.5 psi): sufficiently greater than max. drive pressure (actuating pressure)
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Air quality according to ISO 8573-1

• Solid particulate size and density	Class 2
• Pressure dew point	Class 2 (min. 20 K (36°F) below ambient temperature)
• Oil content	Class 2

Unrestricted flow

• Air supply valve (vent drive) ⁴⁾

2 bar (29 psi)	4.1 Nm ³ /h (18.1 USgpm)
4 bar (58 psi)	7.1 Nm ³ /h (31.3 USgpm)
6 bar (87 psi)	9.8 Nm ³ /h (43.1 USgpm)

• Air exhaust valve (depressurize drive) ⁴⁾

2 bar (29 psi)	8.2 Nm ³ /h (36.1 USgpm)
4 bar (58 psi)	13.7 Nm ³ /h (60.3 USgpm)
6 bar (87 psi)	19.2 Nm ³ /h (84.5 USgpm)

Valve leakage	< 6·10 ⁻⁴ Nm ³ /h (0.0026 USgpm)
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Throttle ratio	adjustable up to ∞: 1
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Auxiliary power consumption in the controlled state	< 3,6·10 ⁻² Nm ³ /h (0.158 USgpm)
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Versions

• In the plastic enclosure	Single-acting and double-acting
• In the aluminum enclosure	Single-acting
• In the pressure-resistant encapsulated enclosure	Single-acting and double-acting
• In the stainless steel enclosure	Single-acting and double-acting

⁴⁾ When using version EEx d (6DR5..5-...) values are reduced by approx. 20%.

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

14.2 Technical data of SIPART PS2 PA

	Standard controller without explosion protection	Standard controller with EEx d explosion protection (flameproof enclosure)	Standard controller with EEx ia/ib explosion protection	Standard controller with EEx n explosion protection
Explosion protection as per EN 50014, EN 50020 and EN 50021	Without	EEx d II 2 G EEx d II C T4/T5/T6	EEx ia/ib II 2 G EEx ia/ib II C T6	EEx n II 3 G EEx nA L [L] II C T6/T5/T4 X
Installation point		Zone 1	Zone 1	Zone 2
Permissible ambient temperature for operation	-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)		T4: -20 ... +75°C T5: -20 ... +65°C T6: -20 ... +50°C
Restricted display refresh rate of the LCD at 10°C (+14°F). (For standard controllers with explosion protection: only T4 is permitted when using with the I _y module)				

Electrical data

	Standard controller without explosion protection	Standard controller with EEx d explosion protection (flameproof enclosure)	Standard controller with EEx ia/ib explosion protection	Standard controller with EEx n explosion protection
Input				
Auxiliary power supply (terminals 6/7)	Bus-powered	Bus-powered	Bus-powered	Bus-powered
Bus voltage	9 ... 32 V	9 ... 32 V	9 ... 24 V	9 ... 32 V
<ul style="list-style-type: none"> Bus connection with a FISCO supply unit, ia or ib group IIC or IIB 				
Max. supply voltage U _o	-	-	17.5 V	-
Max. short circuit current I _o	-	-	380 mA	-
Max. power P _o	-	-	5.32 W	-
<ul style="list-style-type: none"> Bus connection with a barrier, ia or ib group IIC or IIB 				
Max. supply voltage U _o	-	-	24 V	-
Max. short circuit current I _o	-	-	250 mA	-
Max. power P _o	-	-	1,2 W	-
Current consumption	10.5 mA ± 10%	10.5 mA ± 10%	10.5 mA ± 10%	10.5 mA ± 10%

Electrical data				
	Standard controller without explosion protection	Standard controller with EEx d explosion protection (flameproof enclosure)	Standard controller with EEx ia/ib explosion protection	Standard controller with EEx n explosion protection
Fault current	0 mA	0 mA	0 mA	0 mA
Effective internal inductance	-	-	$L_i \leq 8 \mu\text{H}$	-
Effective internal capacitance	-	-	Negligible	-
Connection	-	-	Certified intrinsically safe circuit	-
Safety shutdown with coding bridge can be activated (terminals 81/82; galvanically isolated from the standard controller)				
• Input resistance	> 20 k Ω	> 20 k Ω	> 20 k Ω	> 20 k Ω
• Signal status "0" (shutdown active)	0 ... 4.5 V or unconnected	0 ... 4.5 V or unconnected	0 ... 4.5 V or unconnected	0 ... 4.5 V or unconnected
• Signal status "1" (shutdown inactive)	13 ... 30 V	13 ... 30 V	13 ... 30 V	13 ... 30 V
• Effective internal capacitance C_i	-	-	Negligible	-
• Effective internal inductance L_i	-	-	Negligible	-
• For connecting to a power source with	-	-	Intrinsically safe	-
Maximum supply voltage U_i	-	-	< 30 V	< 30 V
Maximum short circuit current I_i	-	-	< 100 mA	< 100 mA
Maximum power P_i	-	-	< 1 W	-
Electrical isolation	Between the standard controller and the input for safety shutdown and the outputs of optional modules	Between the standard controller and the input for safety shutdown and the outputs of optional modules	The standard controller, the input for safety shutdown and the outputs of optional modules are individual intrinsically safe circuits.	Between the standard controller and the input for safety shutdown and the outputs of optional modules
Test voltage	840 V DC, 1 s	840 V DC, 1 s	840 V DC, 1 s	840 V DC, 1 s

Communication				
	Standard controller without explosion protection	Standard controller with EEx d explosion protection (flameproof enclosure)	Standard controller with EEx ia/ib explosion protection	Standard controller with EEx n explosion protection
	Layers 1 + 2 as per PROFIBUS PA, transmission technique as per IEC 1158-2; slave function layer 7 (protocol layer) as per PROFIBUS DP, standard EN 50170 with the extended PROFIBUS functionality (all data is acyclic, manipulated variables, feedbacks and statuses are additionally cyclic)			
C2 connections	Four connections with the master class 2 are supported; automatic connection termination 60 s after interruption in communication			
Device profile	PROFIBUS PA profile B, version 3.0; over 150 objects			
Response time for a master telegram	Typically, 10 ms			
Device address	126 (in the as-delivered condition)			
PC parameterization software	SIMATIC PDM; supports all device objects. The software is not included in the scope of delivery.			

Connections				
	Standard controller without explosion protection	Standard controller with EEx d explosion protection (flameproof enclosure)	Standard controller with EEx ia/ib explosion protection	Standard controller with EEx n explosion protection
<ul style="list-style-type: none"> Electric 	Screw terminals 2.5 AWG28-12 Cable inlet M20x1.5 or ½-14 NPT	Screw terminals 2.5 AWG28-12 EEx d certified cable inlet M20x1.5, ½-14 NPT or M25x1.5	Screw terminals 2.5 AWG28-12 Cable inlet M20x1.5 or ½-14 NPT	Screw terminals 2.5 AWG28-12 Cable inlet M20x1.5 or ½-14 NPT
<ul style="list-style-type: none"> Pneumatic 	Female thread G¼ DIN 45141 or ¼-18 NPT	Female thread G¼ DIN 45141 or ¼-18 NPT	Female thread G¼ DIN 45141 or ¼-18 NPT	Female thread G¼ DIN 45141 or ¼-18 NPT
External position sensor (potentiometer or NSC; optional)				
<ul style="list-style-type: none"> U_o 	-	-	< 5 V	< 5 V
<ul style="list-style-type: none"> I_o 	-	-	< 75 mA	< 5 mA
<ul style="list-style-type: none"> I_s 	-	-	< 160 mA	< 160 mA
<ul style="list-style-type: none"> P_o 	-	-	< 120 mW	< 120 mW
Maximum permissible external capacitance C _o	-	-	< 1 µF	< 1 µF
Maximum permissible external inductance L _o	-	-	< 1 mH	< 1 mH

14.3 Technical data of optional modules

Optional modules

	Without explosion protection (also EEx d)	With EEx ia/ib explosion protection	With EEx n explosion protection
Explosion protection as per EN 50014 and EN 50020 and EN 50021	-	II 2G EEx ia/ib II C T4/T5/T6 ¹⁾	II 3G EEx nA L [L] II C T6
Installation point	-	Zone 1	Zone 2
Permissible ambient temperature for operation (For devices with explosion protection: only in combination with the 6DR5***_*E*** standard controller; 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	Without explosion protection (also EEx d)	With EEx ia/ib explosion protection	With EEx n explosion protection
	6DR4004-8A (without explosion protection)	6DR4004-6A (with explosion protection)	6DR4004-6A (with explosion protection)
Binary alarm outputs A1, A2 and fault message output			
Signal status High (not responded); signal status Low* (responded)	Conductive, R = 1 kΩ, +3/-1%* blocked, IR < 60 μA	≥ 2.1 mA ≤ 1.2 mA	≥ 2.1 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	-
Internal inductance L _i	-	Negligible	-
Auxiliary voltage U _H	≤ 35 V	-	-
Connection to circuits with		Intrinsically safe switching amplifier EN 60947-5-6 U _o ≤ 15.5 V DC I _k ≤ 25 mA P ≤ 64 mW	U _i ≤ 15.5 V DC
Binary input BE2			

Technical data

14.3 Technical data of optional modules

Alarm unit	Without explosion protection (also EEx d)	With EEx ia/ib explosion protection	With EEx n explosion protection
<ul style="list-style-type: none"> 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 μ A	3 V, 5 μ A	3 V, 5 μ A
<ul style="list-style-type: none"> Galvanically isolated from the standard controller 			
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 k Ω	> 25 k Ω	> 25 k Ω
Static destruction limit	± 35 V	-	-
Internal inductance and capacitance	-	Negligible	-
Connection to circuits	-	Intrinsically safe U_i ≤ 25.2 V	$U_i \leq 25.2$ V DC
Electrical isolation	The three outputs, the BE2 input and the standard controller are galvanically isolated from each other.		
Test voltage	840 V DC, 1 s	840 V DC, 1 s	840 V DC, 1 s
SIA unit (not for the EEx d version)	Without explosion protection (also EEx d)	With EEx ia/ib explosion protection	With EEx n explosion protection
	6DR4004-8G (without explosion protection)	6DR4004-6G (with explosion protection)	6DR4004-6G (with explosion protection)
Limit indicator with slotted initiators and fault message output	2-wire connection	2-wire connection	2-wire connection
Explosion protection	Without	II 2 G EEx ia/ib IIC T6	II 3 G EEx nA L [L] IIC T6
Connection	2-wire technique as per EN60947-5-6 (NAMUR), for switching amplifier to be connected downstream		
2 slotted initiators	Type SJ2-SN	Type SJ2-SN	Type SJ2-SN
Function	NC, normally closed	NC, normally closed	NC, normally closed
Connection to circuits with	Nominal voltage 8 V; current consumption: ≥ 3 mA (limit not responded), ≤ 1 mA (limit responded)	Intrinsically safe switching amplifier EN60947-5-6 $U_i \leq 15.5$ V DC $I_k \leq 25$ mA $P_i \leq 64$ mW	$U_i \leq 15.5$ V DC $P_i \leq 64$ mW
Internal capacitance	-	≤ 41 nF	-
Internal inductance	-	< 100 mH	-
Electrical isolation	The three outputs are galvanically isolated from the standard controller		
Test voltage	840 V DC, 1 s	840 V DC, 1 s	840 V DC, 1 s
Fault message output	See alarm unit	See alarm unit	See alarm unit

Mechanical limit switch module (not for EEx d version)	Without explosion protection	With EEx ia/ib explosion protection
	6DR4004-8K	6DR4004-6K
Limit indicator with mechanical switch contacts and fault message output		
Explosion protection	Without	II 2 G EEx ia/ib IIC T6
Max switching current AC/DC	4 A	Connection to intrinsically safe circuits: $U_o \leq 30 \text{ V}$ $I_k \leq 100 \text{ mA}$, $P_i \leq 750 \text{ mW}$
Max switching voltage AC/DC	250 V/24 V	DC 30 V
Internal capacitance C_i	-	Negligible
Internal inductance L_i	-	Negligible
Electrical isolation	The three outputs are galvanically isolated from the standard controller	
Test voltage	3150 V DC, 2 s	3150 V DC, 2 s
Fault message output	See alarm unit	See alarm unit

I_y module	Without explosion protection (also EEx d)	With EEx ia/ib explosion protection	With EEx n explosion protection
	6DR4004-8J (without explosion protection)	6DR4004-6J	6DR4004-6J
Direct current output for position feedback	2-wire connection	2-wire connection	2-wire connection
Nominal signal range i	4 ... 20 mA, short circuit resistant	4 ... 20 mA, short circuit resistant	4 ... 20 mA, short circuit resistant
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 load R_B [k Ω]	$(U_H [\text{V}] - 12 \text{ V}) / i$ [mA]	$(U_H [\text{V}] - 12 \text{ V}) / i$ [mA]	$(U_H [\text{V}] - 12 \text{ V}) / i$ [mA]
Transmission fault	$\leq 0.3\%$	$\leq 0,3 \%$	$\leq 0.3\%$
Temperature effect	$\leq 0.1\%/10 \text{ K}$ ($\leq 0.1\%/18^\circ\text{F}$)	$\leq 0.1\%/10 \text{ K}$ ($\leq 0.1\%/18^\circ\text{F}$)	$\leq 0.1\%/10 \text{ K}$ ($\leq 0.1\%/18^\circ\text{F}$)
Resolution	$\leq 0,1 \%$	$\leq 0,1 \%$	$\leq 0.1\%$
Residual ripple	$\leq 1 \%$	$\leq 1 \%$	$\leq 1 \%$
Internal capacitance C_i	-	$\leq 11 \text{ nF}$	-
Internal inductance L_i	-	Negligible	-
For connecting to circuits with		Intrinsically safe: $U_i \leq 30 \text{ V DC}$ $I_k \leq 100 \text{ mA}$ $P_i \leq 1 \text{ W (only T4)}$	$U_i \leq 30 \text{ V DC}$ $I_k \leq 100 \text{ mA}$ $P_i \leq 1 \text{ W (only T4)}$
Electrical isolation	Galvanically isolated from the standard controller	Galvanically isolated from the standard controller	Galvanically isolated from the standard controller
Test voltage	840 V DC, 1 s	840 V DC, 1 s	840 V DC, 1 s

Technical data

14.3 Technical data of optional modules

Non-contacting position sensor (not for EEx d version)	Without explosion protection (also EEx d)	With EEx ia/ib explosion protection	With EEx n explosion protection
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 (as per correction through SIPART PS2)			
• Linear actuator	± 1%	± 1%	± 1%
• Part-turn actuator	± 1%	± 1%	± 1%
Hysteresis	± 0.2%	± 0.2%	± 0.2%
Continuous operating 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
IP-ingress protecting	IP68/NEMA 4X	IP68/NEMA 4X	IP68/NEMA 4X

Dimension drawings

15.1 Dimension drawings

Positioner with plastic enclosure 6DR5xx0

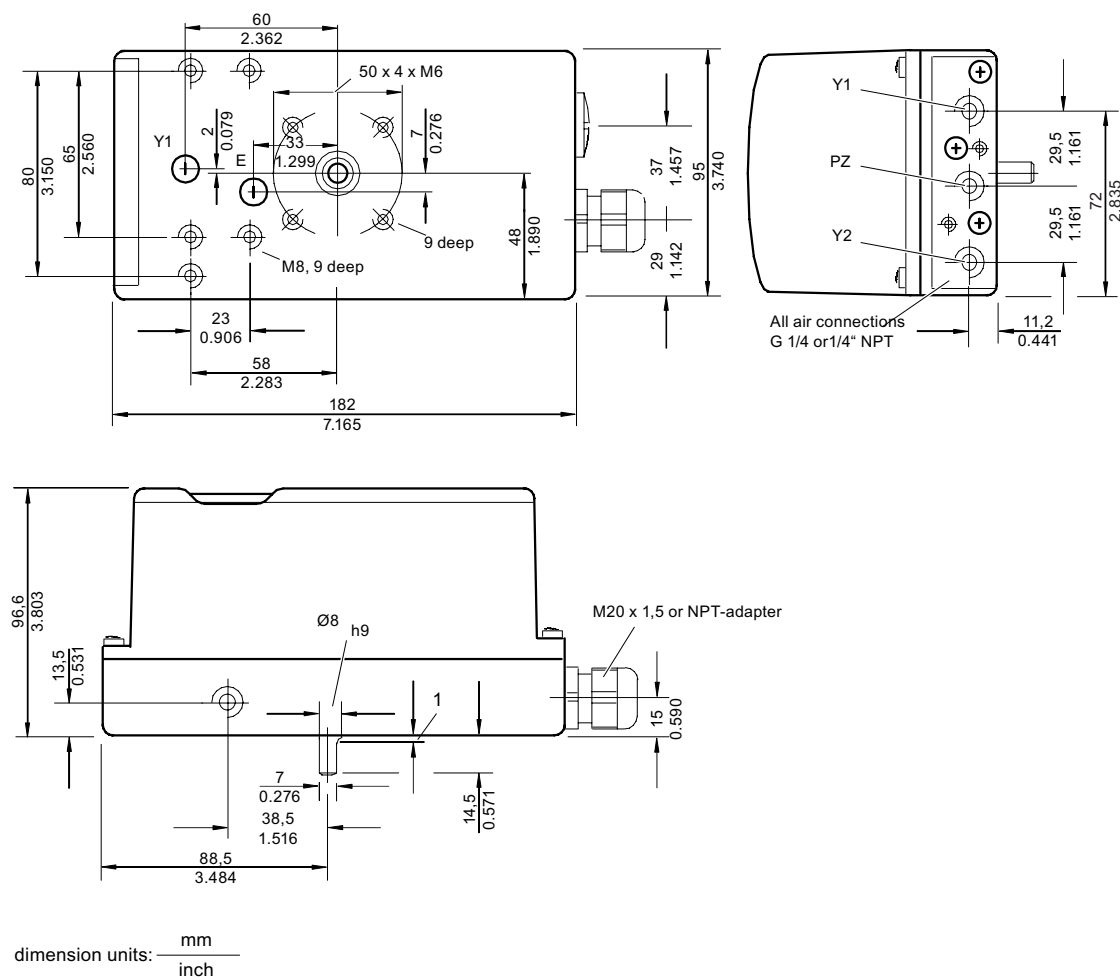
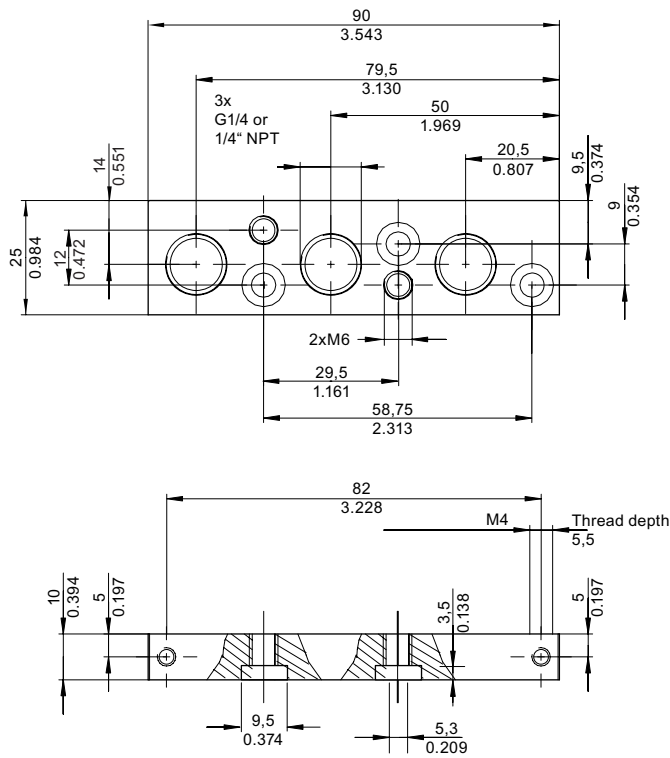


Figure 15-1 Dimensions of the plastic enclosure 6DR5xx0 version

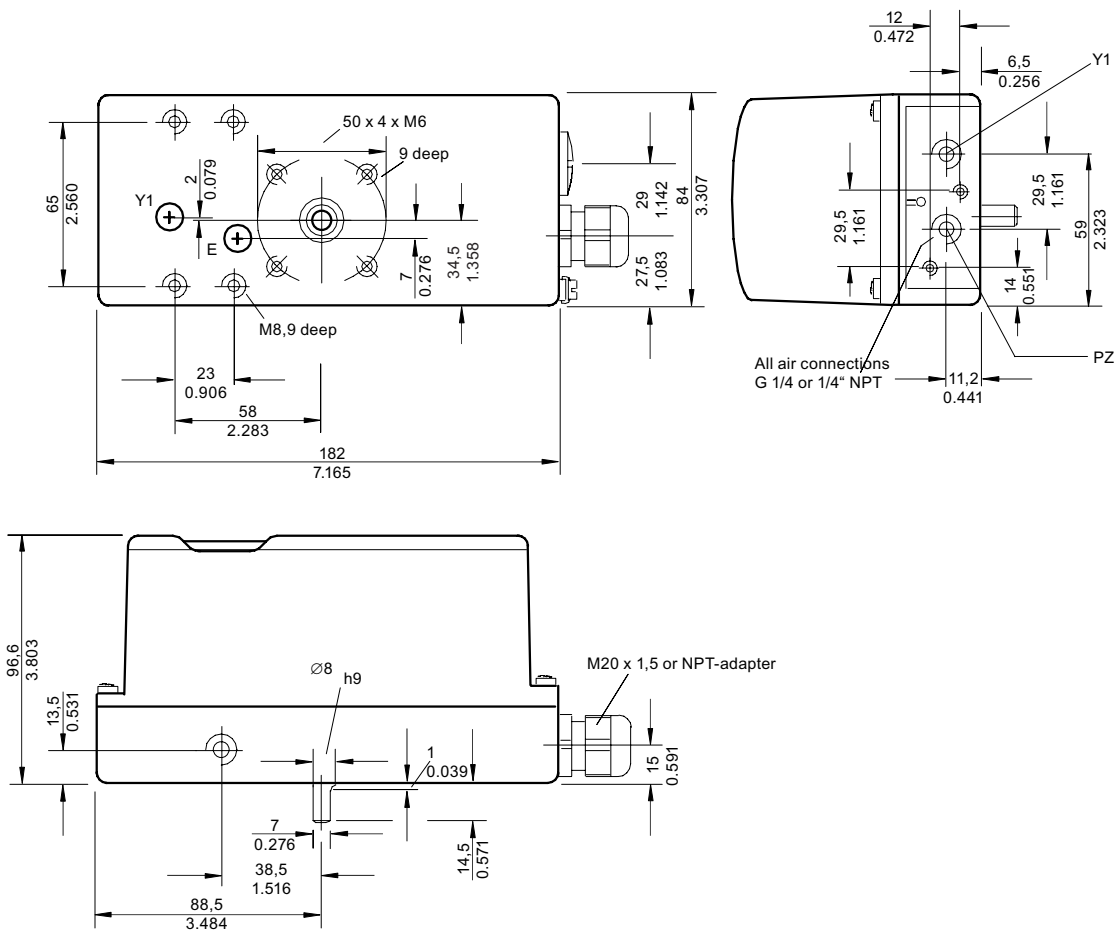
Terminal strip for positioner with plastic enclosure



dimension units: $\frac{\text{mm}}{\text{inch}}$

Figure 15-2 Dimensions of terminal strip and plastic enclosure

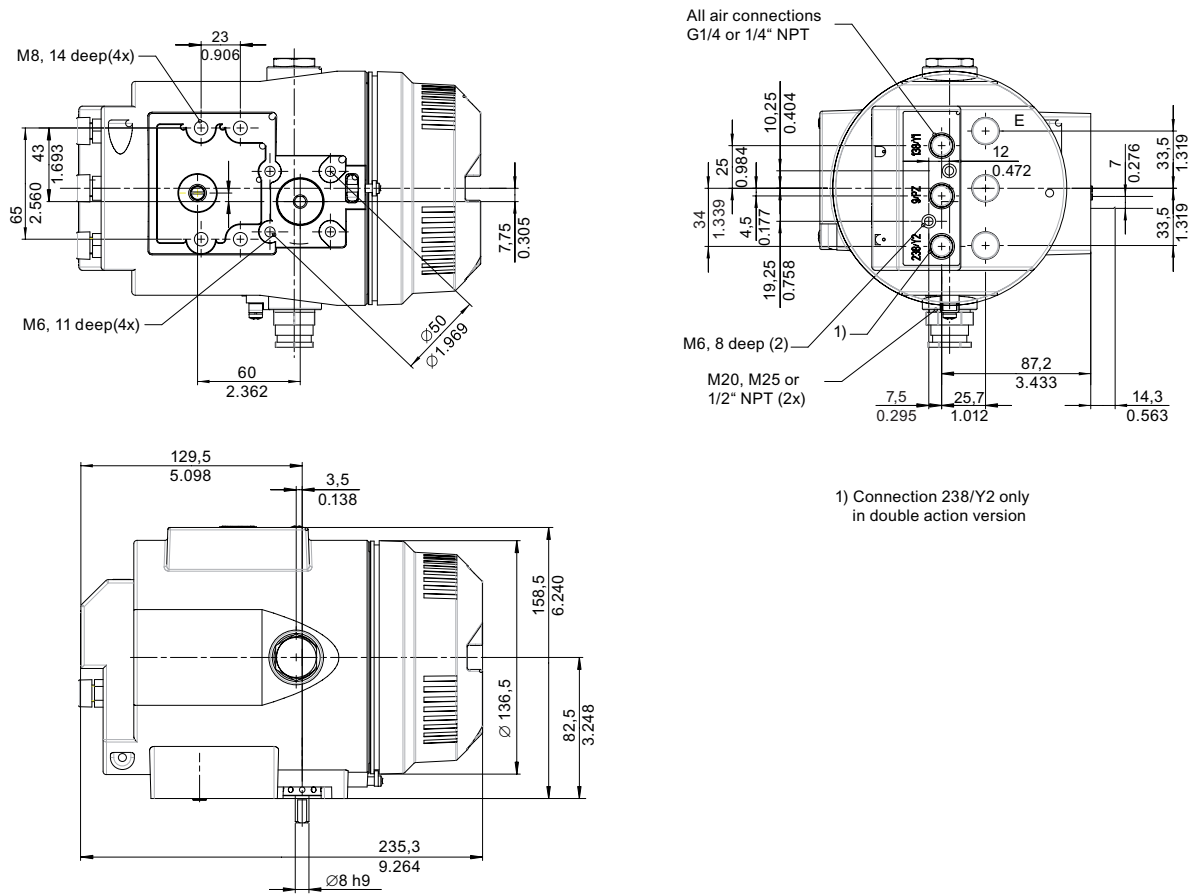
Positioner with metal enclosure 6DR5xx1



dimension units: $\frac{\text{mm}}{\text{inch}}$

Figure 15-3 Dimensions of the metal enclosure 6DR5xx1 version

Positioner with flameproof metal enclosure 6DR5xx1



dimension units: $\frac{\text{mm}}{\text{inch}}$

Figure 15-4 Dimensions of the positioner with the flameproof metal enclosure 6DR5xx5

Scope of delivery/spare parts/accessories

16.1 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 in 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.

16.2 Standard controller

The following table shows the type range of different standard controllers:

		Standard controller						
Equipment	6DR5	*	*	*	- 0	*	*	
Electronics		Δ	Δ	Δ		Δ	Δ	
PS2 2L: 2 wire, without HART		0						
PS2 2L: 2 wire, with HART		1						
PS2 4L: 2, 3, 4 wire, without HART		2						
PS2 4L: 2, 3, 4 wire, with HART		3						
PS2 wire PROFIBUS PA		5						
PS2 wire FOUNDATION fieldbus		6						
Drive								
Single-acting			1					
double-acting			2					
Enclosure								
Plastic				0				
Aluminum ¹⁾				1				
Stainless steel ²⁾				2				
Aluminum, pressure resistant ³⁾				5				
Protection against explosion								
Without						N		
With protection against explosion EEx ia/ib						E		
With protection against explosion EEx d ⁴⁾						E		
With protection against explosion EEx n ^{5) 7)}						G		
With protection against explosion EEx n/dust ^{5) 8)}						D		
Connection thread		Electric		Pneumatic				
M20x1.5		M20x1.5		G¼				G N M P Q R S V
½-14 NPT		M20x1.5		¼-18 NPT				
M20x1.5		½-14 NPT		¼-18 NPT				
½-14 NPT		M25x1.5 ³⁾		G¼				
M25x1.5 ³⁾		M12 ⁶⁾		G¼ ³⁾				
M12 ⁶⁾		M12 ⁶⁾		G¼ ⁶⁾				
M12 ⁶⁾		M20x1.5		¼-18 NPT ⁶⁾				
M20x1.5				VDI/VDE 3847				

- 1) Aluminum enclosure only for single-acting drives
- 2) Stainless steel enclosure, not for: EEx d version
- 3) Only for EEx d pressure-resistant enclosure, not CSA. Without cable gland
- 4) CENELEC/FM/CSA
- 5) CENELEC
 - With PROFIBUS connector
 - Not for EEx d
 - With FM/CSA approval
 - EEx ia/ib (CENELEC) upon request
- 7) Enclosure with window
- 8) Enclosure without window

16.3 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

16.4 Spare parts

Spare parts: Positioner SIPART PS2			
	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	66DR4*** 6DR5***
	Motherboard, 2-wire, not EEx, without HART	A5E00082459	6DR50**-*N 6DR40**-*N*)
	Motherboard, 2-wire, EEx, without HART	A5E00082457	6DR50**-*E
	Motherboard, 2-wire, not EEx, with HART	A5E00082458	6DR51**-*N 6DR40**-*N *)
	Motherboard, 2/3/4-wire, EEx, with HART	A5E00082456	6DR52**
	Motherboard, 2/3/4-wire, not EEx, without HART	A5E00102018	6DR53**-*N 6DR40**-*N *)
	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***

16.4 Spare parts

Spare parts: Positioner SIPART PS2			
	Description	Order number	For version
	Potentiometer (complete)	C73451-A430-D84	6DR4*** 6DR5***

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

Note

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

16.5 Scope of delivery of small part sets

Small part set 1

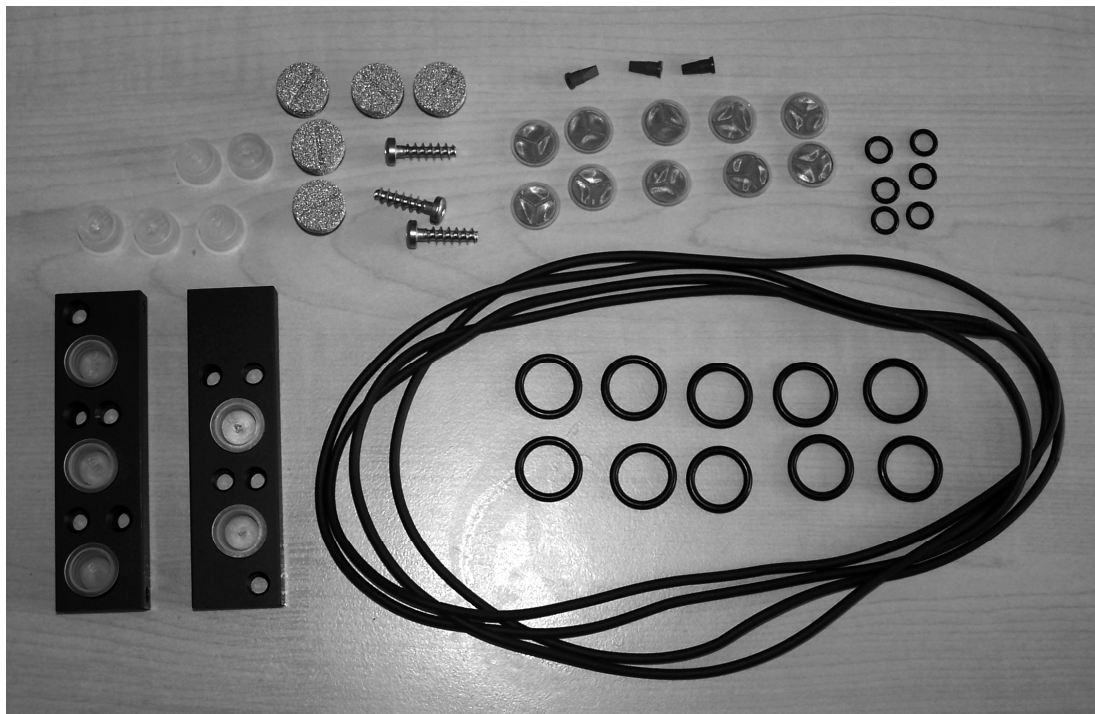
The small part set 1 with the order number **C73451-A430-D85** contains the following items:



Position	Quantity [unit]
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

Small part set 2

The small part set 2 with the order number **C73451-A430-D86** 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

16.6 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: <ul style="list-style-type: none"> • 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.1 Bibliography/catalogs/standards

A.1.1 Bibliography/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: <ul style="list-style-type: none"> • 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.2 SIL declaration of conformity

SIEMENS

SIL Declaration of Conformity

Functional Safety According to IEC 61508 und IEC 61511

Siemens AG
Automation & Drives
Process Instrumentation and Analytics
Östliche Rheinbrückenstr. 50
76187 Karlsruhe, Germany

Product: **Electropneumatic Positioner SIPART PS2 PA / FF**
single acting, with PROFIBUS PA / FOUNDATION Fieldbus

Ordering Nr.: 6DR551* / 6DR561*

We as manufacturer declare that the above Positioners SIPART PS2 PA / FF are suitable for use in safety instrumented systems according to IEC 61508 / 61511.

Safety function: Safety shutdown (depressurizing the output) via separate digital input.

The appropriate SIL Safety Manual must be observed.

The failure rates were calculated via FMEDA (Failure Modes, Effects and Diagnostic Analysis) according to IEC 61508. The calculation was carried out by exida.com.


The proven-in-use was verified according to IEC 61508 / 61511 and evaluated by exida.com.

Safety Related Characteristics:


Device Type		A
SIL	Safety Integrity Level (single mode)	2
HFT	Hardware Failure Tolerance	0
PFD_{AVG}	Average Probability of Failure on Demand	6,7 * 10⁻⁴
λ_{sd}	Safe detected Failure Rate	0 FIT
λ_{su}	Safe undetected Failure Rate	1010 FIT
λ_{dd}	Dangerous detected Failure Rate	13 FIT
λ_{du}	Dangerous undetected Failure Rate	152 FIT
SFF	Safe Failure Fraction	87%

These characteristics are valid for low demand operation mode within an 1oo1 architecture. (Guidance to calculation according to IEC 61508-6, annex B).
The PFD_{AVG} value is valid under the assumption of mean time to repair MTTR = 8h and proof test interval T1 = 8760h

Karlsruhe, 19.08.2005
Siemens AG



Dr. Schmidt, General Manager Instrumentation



Schradi, Segment Manager Positioner

No. A5E00481296D - 01

A.3 Test report



FMEDA and Proven-in-use Assessment

Project:

Electro-pneumatic Positioner SIPART PS2 PA / FF
single acting shut-down module using shut-down input (terminal 81/82)

Customer:

SIEMENS AG, A&D PI TQ2
Karlsruhe
Germany

Contract No.: SIEMENS 05/01-04
Report No.: SIEMENS 05/01-04 R014
Version V1, Revision R1.0, August 2005
Stephan Aschenbrenner

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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 PA / FF. Table 1 gives an overview of the different configurations that belong to the considered Electro-pneumatic Positioner SIPART PS2 PA / FF.

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 overview

[Conf 1]	6DR551*_*E***_****	PROFIBUS PA EEx; single-acting
[Conf 2]	6DR551*_*N***_****	PROFIBUS PA Standard; single-acting
[Conf 3]	6DR561*_*E***_****	FF EEx; single-acting
[Conf 4]	6DR561*_*N***_****	FF Standard; single-acting

For safety applications only the shut-down input (terminal 81/82) with the corresponding pressure output was considered to work as a single-acting shut-down module ("tight closing"). 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 *exida's* experienced-based data compilation) for the different mechanical components (see [D17] and [R3]). The results of the quantitative analysis are included in the calculations described in sections 5.2 and 5.3.

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 PA / FF 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 PA / FF when using the shut-down input (terminal 81/82) for the safety function is considered to be a Type A¹ component with a hardware fault tolerance of 0.

For Type A components the SFF has to be between 60% and 90% for SIL 2 (sub-) systems with a hardware fault tolerance of 0 according to table 2 of IEC 61508-2.

¹ Type A component: "Non-complex" component (all failure modes are well defined); for details see 7.4.3.1.2 of IEC 61508-2.



As the Electro-pneumatic Positioner SIPART PS2 PA / FF 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 A Electro-pneumatic Positioner SIPART PS2 PA / FF when using the shut-down input (terminal 81/82) for the safety function, with a hardware fault tolerance of 0 and a SFF of 60% to < 90% is 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 – Failure rates

Failure category	Failure rates (in FIT)
Fail Safe Detected	0
Fail Safe Undetected	940
Fail Dangerous Detected	13
Fail Dangerous Undetected	152
No Effect	70
Not part	397
MTBF = MTTF + MTTR	73 years

Table 3: Summary – IEC 61508 failure rates

λ_{sd}	λ_{su}	λ_{dd}	λ_{du}	SFF	DC _S	DC _D
0 FIT	1010 FIT	13 FIT	152 FIT	87%	0%	7%

Table 4: Summary – PFD_{AVG} values

T[Proof] = 1 year	T[Proof] = 5 years	T[Proof] = 10 years
PFD _{AVG} = 6,65E-04	PFD _{AVG} = 3,32E-03	PFD _{AVG} = 6,63E-03

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 PA / FF when used as a single-acting shut-down module ("tight closing") has a PFD_{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 86% when using the shut-down input (terminal 81/82) for the safety function.

The Electro-pneumatic Positioner SIPART PS2 PA / FF has been developed without considering IEC 61508, however, and so IEC 61511-1 First Edition 2003-01 section 11.4.4 is used as a basis for arguing that proven-in-use shows the unlikelihood of systematic failures for the mechanical / pneumatic components.

The failure rates listed above do not include failures resulting from incorrect use of the Electro-pneumatic Positioner SIPART PS2 PA / FF, 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 40°C. 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 PA / FF 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 is presented in sections 5.2 and 5.3 along with all assumptions.

It is important to realize that the "no effect" 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.

The failure rates are valid for the useful life of the Electro-pneumatic Positioner SIPART PS2 PA / FF, which is estimated to be 10 years (see Appendix 3).

Abbreviations

B.1 List of abbreviations

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

Abbreviations

B.1 List of abbreviations

Abbreviation	Long form	Meaning
PDM	Process device manager	Siemens communication software / engineering tool
PROFIBUS	Process field bus	Fieldbus
PTB	Physikalisch Technische Bundesanstalt	-
SIA	Slotted initiator alarm unit	-
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
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.
MTBF	Mean Time Between Failures	Average period between two failures
MTTR	Mean Time To Repair	Average period between the occurrence of a fault in a device or system and the repair
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.
FIT	Failure in Time	Frequency of failure Number of faults within 10 ⁹ hours
TI	Test Interval	Testing interval of the protective function

Abbreviation	Full term in English	Meaning
MooN	"M out of N" voting	<p>Classification and description of the safety-instrumented system in terms of redundancy and the selection procedures used.</p> <p>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.</p> <p>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.</p>

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 converts 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.

Dangerous failure

Failure with the potential to bring the safety-instrumented system into a dangerous or non-functional 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 3.

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 löschtbarer, 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 μ Controller, μ C, 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 function

A defined function executed by a safety-instrumented system with the objective of achieving or maintaining a safe system status taking into account a defined dangerous occurrence.

Example:

Limit pressure monitoring

Safety Integrity Level

→ *SIL*

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.

Safety-instrumented system

A safety-instrumented system 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.

Example:

A safety-instrumented system is made up of a pressure transmitter, a limit signal sensor and a control 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 (PFD_{AVG})
- Hardware fault tolerance (HFT)
- Safe failure fraction (SFF)

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. The higher the SIL of the safety-instrumented system, the higher probability that the required safety function will work.

The achievable SIL is determined by the following safety characteristics:

- Average probability of dangerous failure of a safety function in case of demand (PFD_{AVG})
- Hardware fault tolerance (HFT)
- Safe failure fractions (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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