SIEMENS

SIPART

Electropneumatic positioners
SIPART PS2 with PROFIBUS PA

Operating Instructions

Edition 10/2013

Answers for industry.

SIEMENS

SIPART

Electropneumatic positioner SIPART PS2 with PROFIBUS PA

Operating Instructions

6DR55..

10/2013

A5E00127926-09

Legal information

Warning notice system

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

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

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

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

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

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

Qualified Personnel

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

Proper use of Siemens products

Note the following:

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

Trademarks

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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.

Siemens AG
Industry Sector
Postfach 48 48
90026 NÜRNBERG
GERMANY

Order number: A5E00127926
Ⓟ 09/2013 Technical data subject to change

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Table of contents

1 Introduction

1.1 Purpose of this documentation

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

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

1.2 History

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

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

Edition	Firmware code
10/2013	From FW 5.00.05

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

<table>
<tr><th>Edition</th><th>Remark</th></tr>
<tr><td>10/2013</td><td>

- Safety information updated throughout the entire instructions.
- Chapter 3 "Description" > 3.2 "Structure (Page 19)": Nameplates revised.
- Chapter 4 "Mounting":
  - Chapters 4.2 "Mounting the linear actuator (Page 38)" and 4.3 "Mounting the part-turn actuator (Page 44)" restructured.
  - Chapter 4.5 "Position controllers subjected to fast acceleration or strong vibration (Page 49)" graphics and text supplemented.
  - Chapter 4.7.5 "Mechanical limit switch module (Page 65)" extended.
- Chapter 5 "Connect (Page 73)"
- Chapter 8 "Functional safety (Page 139)"
- Chapter 13 "Technical data (Page 269)": Restructured and content changes
- Chapter 14 "Dimension drawings (Page 289)": Some dimensions changed. New graphic in Chapter 14.4 "Positioner with flameproof enclosure 6DR5..5 (Page 292)" new graphic.
- Chapters 15.4 "Scope of delivery of external position detection system (Page 298)", 15.5 "Scope of delivery of mechanical limit switch module (Page 298)" and 15.6 "Scope of delivery EMC filter module (Page 299)" are new.

</td></tr>
</table>

See also

Certificates, approvals, explosion protection for all device versions (Page 273)

Construction (Page 271)

Option modules (Page 278)

1.3 Purpose

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

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

Operate the device according to the specifications in Chapter "Technical data (Page 269)".

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

1.4 Checking the consignment

1. Check the packaging and the device for visible damage caused by inappropriate handling during shipping.
2. Report any claims for damages immediately to the shipping company.
3. Retain damaged parts for clarification.
4. Check the scope of delivery by comparing your order to the shipping documents for correctness and completeness.

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

1.5 Transportation and storage

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

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

> **CAUTION**
>
> **Insufficient protection during storage**
>
> The packaging only provides limited protection against moisture and infiltration.
>
> - Provide additional packaging as necessary.

Special conditions for storage and transportation of the device are listed in "Technical data" (Page 269).

1.6 Product information

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

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

See also

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

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

1.7 Notes on warranty

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

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

Safety information 2

2.1 Prerequisites for safe use

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

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

2.1.1 Warning symbols on the device

Symbol	Meaning
	Consult operating instructions
	Hot surface
	Isolate the device from power using a circuit-breaker
	Protect the device from shocks (otherwise the specified degree of protection is not guaranteed)
	Protective insulation; device in protection class II

2.1.2 Laws and directives

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

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

Further provisions for hazardous area applications are for example:

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

2.1.3 Conformity with European directives

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

Electromagnetic Compatibility EMC 2004/108/EC	Directive of the European Parliament and of the Council on the approximation of the laws of the Member States relating to electromagnetic compatibility and repealing Directive 89/336/EEC.
Atmosphère explosible ATEX 94/9/EC	Directive of the European Parliament and the Council on the approximation of the laws of the Member States concerning equipment and protective systems intended for use in potentially explosive atmospheres.

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

See also

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

2.2 Improper device modifications

WARNING

Improper device modifications

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

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

2.3 Requirements for special applications

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

Note

Operation under special ambient conditions

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

2.4 Use in hazardous areas

Qualified personnel for hazardous area applications

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

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

WARNING

Unsuitable device for the hazardous area

Danger of explosion.

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

WARNING

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

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

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

Description 3

3.1 Function

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

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:

- For single-acting actuators: In Makrolon, stainless steel or aluminum enclosure, as well as flameproof aluminum enclosure
- For double-acting actuators: In Makrolon, stainless steel or aluminum enclosure, as well as flameproof aluminum enclosure

- For non-hazardous applications
- For hazardous applications in the versions
  - Intrinsic safety type of protection
  - Flameproof enclosure type of protection
  - Non-sparking type of protection
  - Dust protection by enclosure type of protection

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:

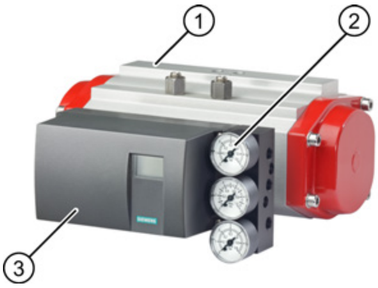
- Linear actuator
- Part-turn actuator VDI/VDE 3845

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

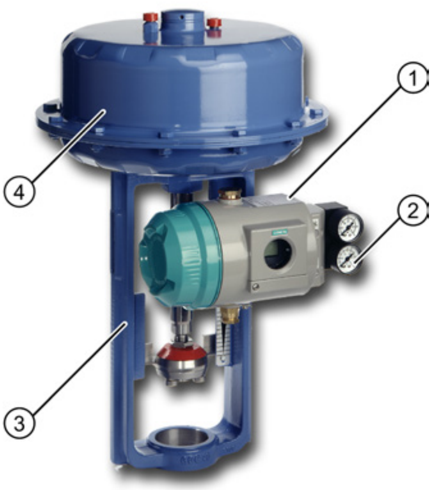
① Pressure gauge block, single-acting
② Valve
③ Yoke / actuator yoke
④ Single-acting positioner in non-flameproof aluminum enclosure
⑤ Actuator

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



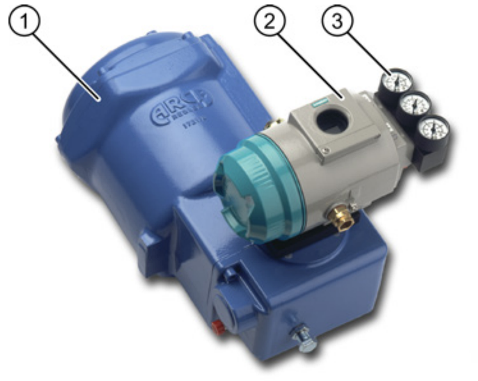
① Part-turn actuator
② Pressure gauge block, double-acting
③ Double-acting positioner in macrolon enclosure

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



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

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

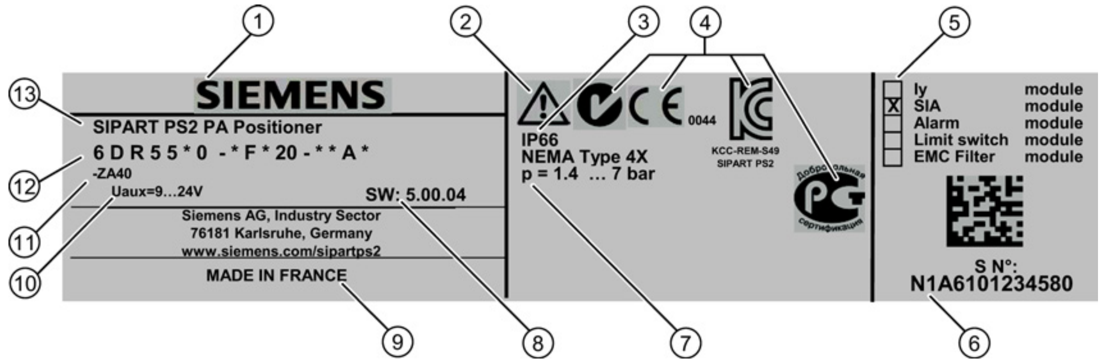


① Part-turn actuator
② Double-acting positioner in flameproof aluminum enclosure
③ Pressure gauge block, double-acting

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

3.2.2 Nameplate layout

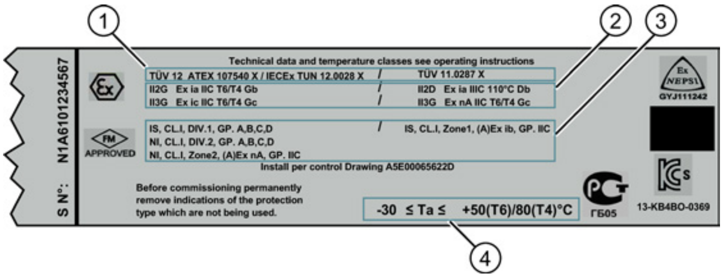
Design of the nameplate



① Manufacturer
② Consult operating instructions
③ Safety class
④ Conformity with country-specific directives
⑤ Built-in option module
⑥ Manufacturer serial number
⑦ Auxiliary power (air supply)
⑧ Software version
⑨ Place of manufacture
⑩ Auxiliary power
⑪ Ordering supplement (Order code)
⑫ Order no.
⑬ Product name

Figure 3-5 Nameplate_design, example

Layout of Ex nameplate

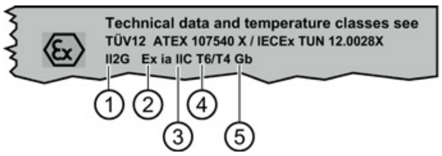


①	Approvals	③	FM/CSA marking for hazardous area
②	ATEX/IECEX marking for hazardous area	④	Permissible ambient temperature for the hazardous area of the corresponding temperature class

Figure 3-6 Layout of Ex nameplate

3.2.3 Explanation of Ex information

Explanation of Ex information

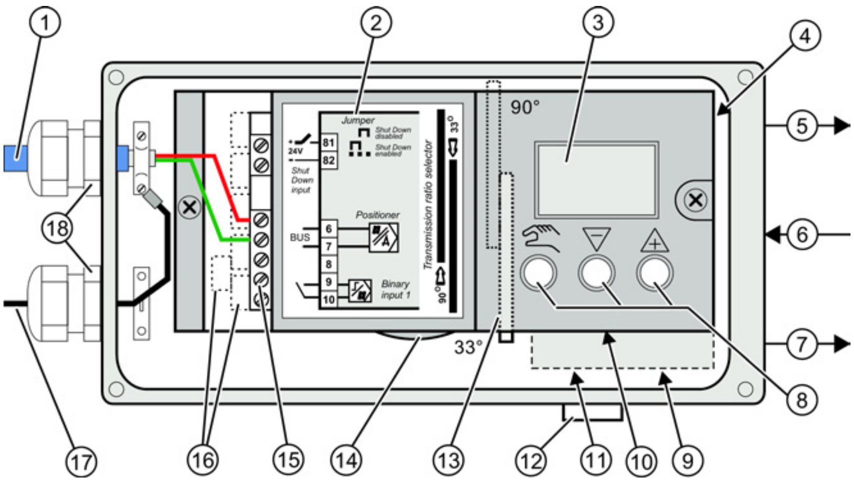


①	Category for operating range	④	Maximum surface temperature (temperature class)
②	Type of protection	⑤	Device protection level
③	Group (gas, dust)		

Figure 3-7 Explanation of Ex information

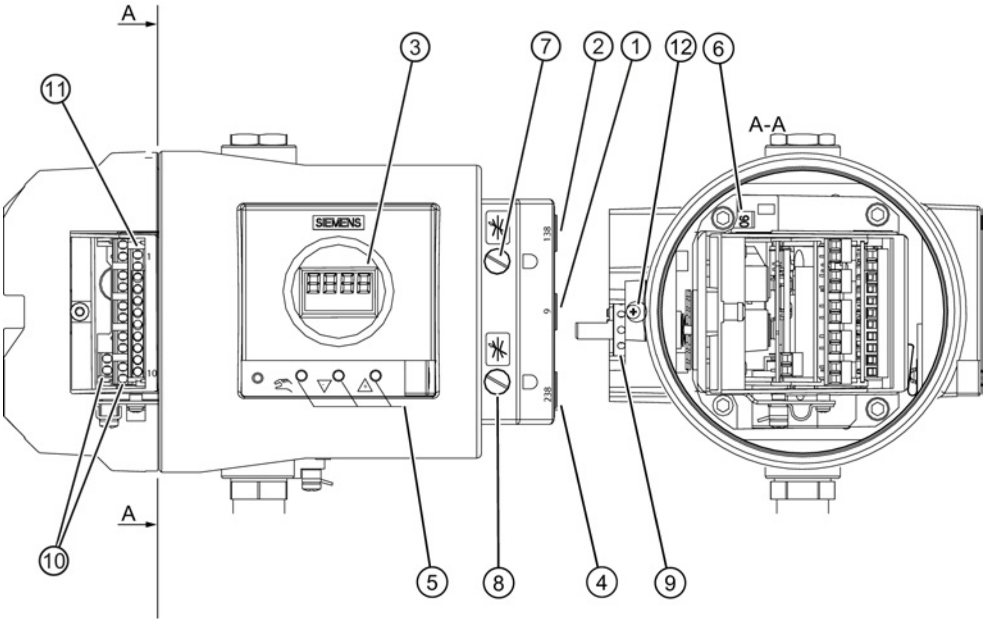
3.3 Device components

3.3.1 Overview of device components



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

Figure 3-8 View of the positioner (cover open; Makrolon enclosure)



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

[1)] for double-acting actuators

[2)] only possible when positioner is open

Figure 3-9 View of positioner in flameproof enclosure

3.3.2 Basic electronics

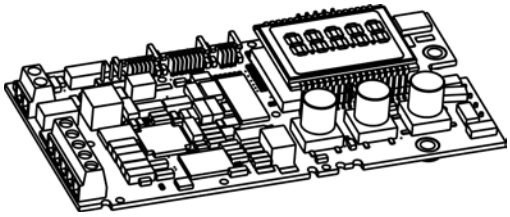


Figure 3-10 Basic electronics

The basic electronics contains:

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

3.4 Functional principle

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 shown simultaneously on the 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 potentiometer using suitable attachments, positioner axis and a backlash-free, switchable gear drive, and then to the analog input of the microcontroller. The current position can also be forwarded to the positioner using an external sensor. A **N**on-**C**ontacting Position **S**ensor (NCS) is used to record the lifting or rotation angle directly on the actuator.

The microcontroller:

- Corrects the angle error of the shaft pick-up if necessary.
- Compares the potentiometer voltage as actual value x with the setpoint w. The setpoint w is connected to terminals 6 and 7 by means of PROFIBUS communication.
- Calculates the manipulated variable increments ±Δy.

The piezo-controlled inlet or exhaust air valve is opened depending on the magnitude and direction of the control deviation (x-w). The actuator volume integrates the controller increment for the actuating pressure y which is proportional to the drive rod or the drive shaft. This controller increment change the actuating pressure until the control deviation becomes zero.

3.4.1 Pneumatic actuator

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

3.4.2 Control algorithm

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

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

In case of medium control deviations, valves are controlled using pulse-length modulated pulses. This takes place in the so-called slow step zone.

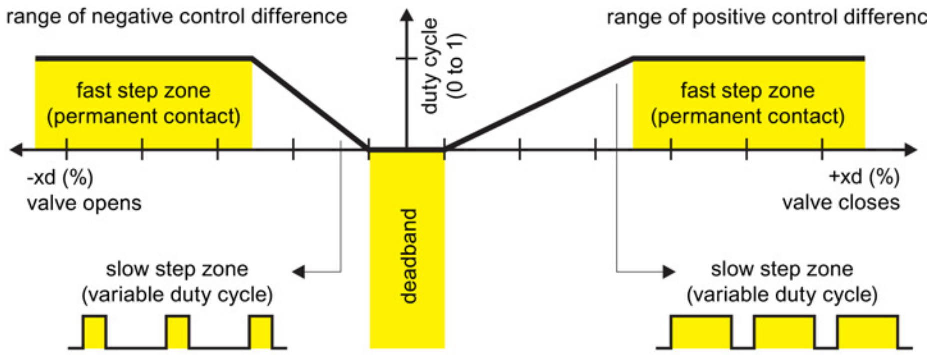


Figure 3-11 Functional principle of five-point controller

Small control deviations do not send control pulses in the zone. This takes place in the so-called adaptive deadband. The deadband adaptation and the continuous adaptation of minimum pulse lengths in 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 deadband 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.

3.4.3 PROFIBUS system configuration

Overview

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

Use with the SIMATIC PCS 7 Automation System is described below.

System communication

The Operator Station of the SIMATIC PCS 7 process control system allows easy and safe control of the process by the operating personnel using OS Multi-Clients.

The Maintenance Station assists the maintenance engineer in guaranteeing high plant availability, securing this long-term using optimization measures, and implementing the maintenance measures using a minimum of personnel, materials, energy, costs etc.

The field devices are integrated over PROFIBUS PA with:

- PA Link to the gateway between PROFIBUS PA and PROFIBUS DP
- Control system, e.g. SIMATIC PCS 7 Automation System, which communicates over PROFIBUS
- Engineering Station, SIMATIC PDM (Process Device Manager) which communicates over Industrial Ethernet

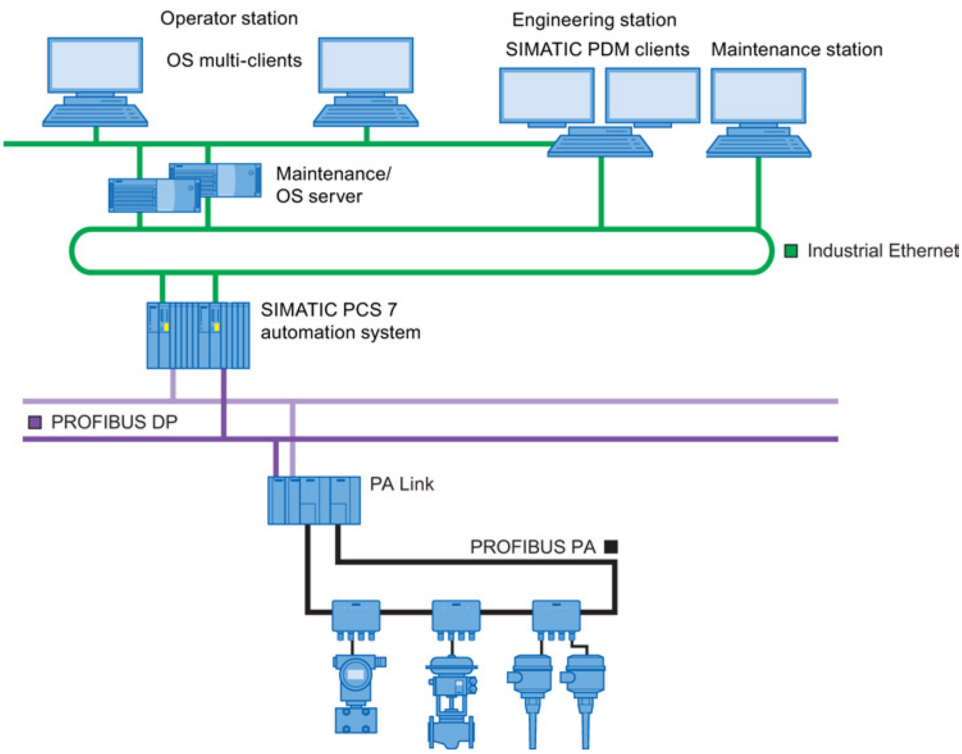


Figure 3-12 Typical system configuration

3.4.4 SIMATIC PDM

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

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

SIMATIC PDM allows the process device data to be:

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

3.5 PROFIBUS PA

3.5.1 Overview

The Process Fieldbus (PROFIBUS) is an open communications system for automation technology and is specified in the international standard IEC 61158.

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

3.5.2 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. The PROFIBUS PA and PROFIBUS DP protocols are identical.

3.5.3 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 generally multiple PROFIBUS PA lines connected to 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.

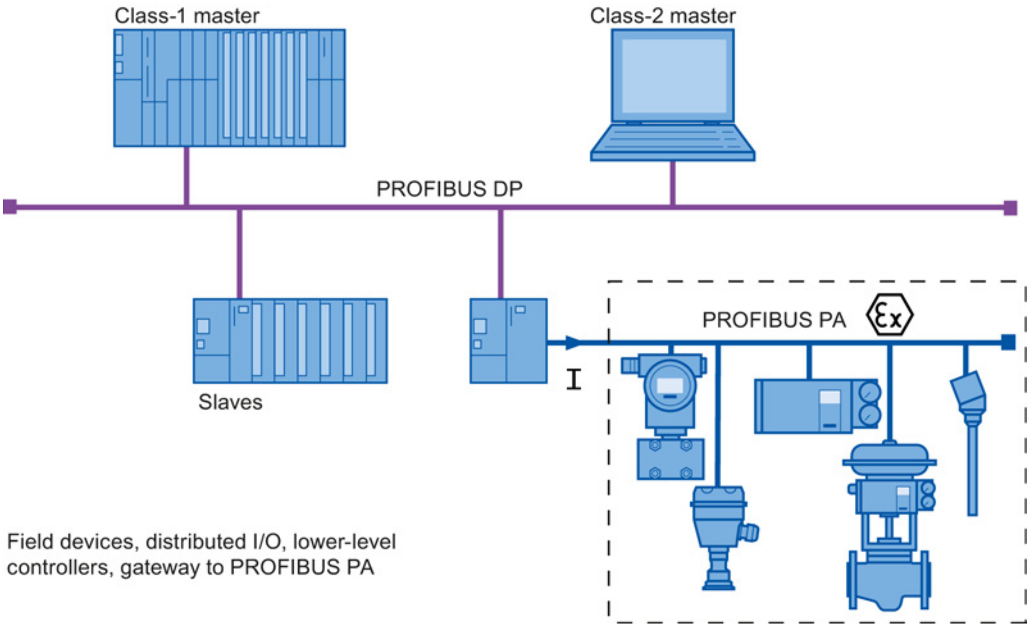


Figure 3-13 Functional principle of the PROFIBUS automation system

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. Assignment of parameters for the field devices or the reading 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.

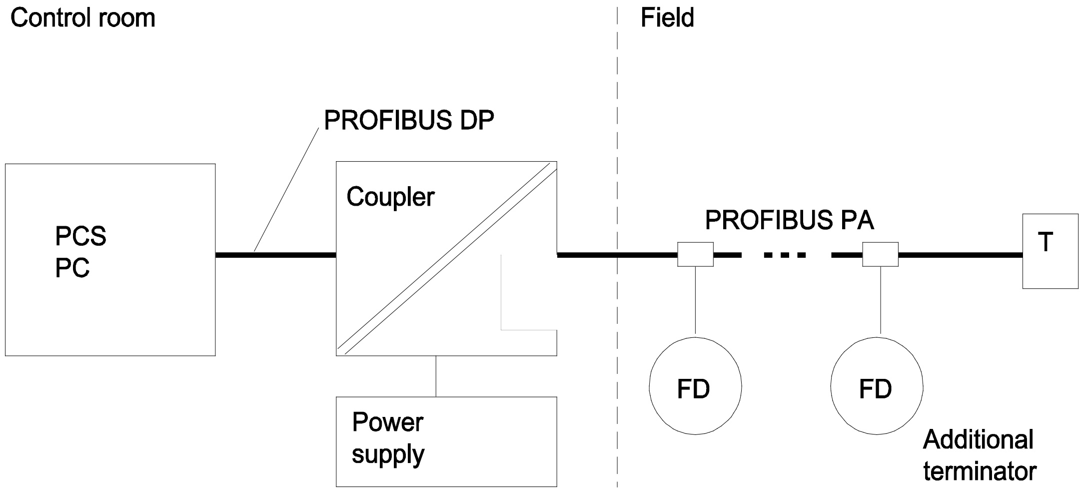
3.5.4 Properties

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

3.5.5 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 parameter assignment 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.



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

Figure 3-14 PROFIBUS PA strand

Reference

PNO PROFIBUS-PA interest group

3.5.6 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.

3.5.7 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.

3.5.8 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

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

4 Installing/mounting

4.1 Basic safety instructions

⚠ WARNING
Unsuitable device for the hazardous area Danger of explosion. • Only use equipment that is approved for use in the intended hazardous area and labelled accordingly.

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

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

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

WARNING

It is possible to damage the cover gasket

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

- Therefore make sure that the gasket is seated correctly.

WARNING

Open cable inlet or incorrect cable gland

Danger of explosion in hazardous areas.

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

See also

Construction (Page 271)

WARNING

Exceeded maximum ambient or process media temperature

Danger of explosion in hazardous areas.

Device damage.

- Make sure that the maximum permissible ambient and process media temperatures of the device are not exceeded. Refer to the information in Chapter "Technical data (Page 269)".

CAUTION

Unsuitable compressed air

Device damage. As a general rule, the positioner must only be operated with dry and clean compressed air.

- Use the customary water separators and filters. An additional dryer is required in extreme cases.
- Use dryers, especially if you operate the positioner at low ambient temperatures.

CAUTION

Please note the following before working on the control valve and when attaching the positioner

Danger of injury.

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

WARNING

Mechanical impact energy

Protect the 6DR5...0-.G...-.... version of the positioner from mechanical impact energy greater than 1 joule; this ensures adherence to the IP66 degree of protection.

NOTICE

Impact energy and torque

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.

See also

Construction (Page 271)

4.1.1 Proper mounting

NOTICE
Incorrect mounting The device can be damaged, destroyed, or its functionality impaired through improper mounting. • Before installing ensure there is no visible damage to the device. • Make sure that process connectors are clean, and suitable gaskets and glands are used. • Mount the device using suitable tools. Refer to the information in Chapter "Technical data (Page 269)", for example installation torques requirements.

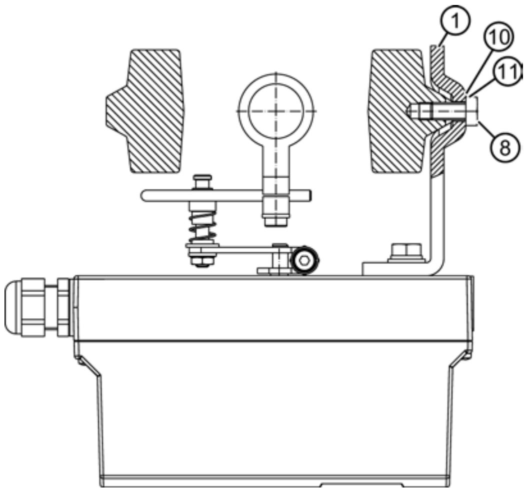
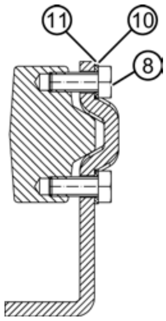
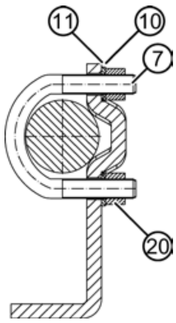
⚠ CAUTION
Loss of degree of protection Damage to device if the enclosure is open or not properly closed. The degree of protection specified on the nameplate or in Chapter "Technical data (Page 269)" is no longer guaranteed. • Make sure that the device is securely closed.

4.2 Mounting the linear actuator

Requirements

There are linear actuators for standard mounting and for integrated pneumatic mounting. Use the reduced mounting kit 6DR4004-8VK for actuators with integrated mounting.

This chapter describes how to connect the positioner to the actuator using the mounting kit 6DR4004-8V. You require different installation parts of this mounting kit depending on the selected actuator type. All installation parts listed in the following table are included in the product package of the mounting kit 6DR4004-8V. The mounting kit is suitable for a stroke of 3 to 35 mm. For a larger stroke range, you require a lever 6DR4004-8L which is to be ordered separately. Keep the suitable installation parts ready:

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

Procedure

"Linear actuator IEC 60534 (3 to 35 mm)" mounting kit 6DR4004-8V and 6DR4004-8L			
Sr. No. *)	**Quantity**	**Name**	**Note**
①	1	NAMUR mounting bracket IEC 60534	Standardized connection point for mount with fin, column or plane surface
②	1	Pick-up bracket	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	Lever	For the range of stroke from 3 mm to 35 mm The lever 6DR4004–8L is additionally required for ranges of stroke > 35 mm to 130 mm (not included in the scope of delivery).
⑦	2	U–bolts	Only for actuators with columns
⑧	4	Hexagon bolt	M8x20 DIN 933–A2
⑨	2	Hexagon bolt	M8x16 DIN 933–A2, torque see the chapter "Technical specifications > Construction (Page 271)"
⑩	6	Spring lock washer	A8 - DIN 127–A2
⑪	6	Washer	B8.4 - DIN 125–A2
⑫	2	Washer	B6.4 - DIN 125–A2
⑬	1	Spring	VD-115E 0.70 x 11.3 x 32.7 x 3.5
⑭	1	Spring lock washer	A6 - DIN 137A–A2
⑮	1	Lock washer	3.2 - DIN 6799–A2
⑯	3	Spring lock washer	A6 - DIN 127–A2
⑰	3	Socket cap screw	M6x25 DIN 7984–A2
⑱	1	Hexagon nut	M6 - DIN 934–A4
⑲	1	Square nut	M6 - DIN 557–A4
⑳	4	Hexagon nut	M8 - DIN 934–A4

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

1. Install the clamping pieces ③ on the actuator spindle. Use spring lock washers ⑯ and socket cap screws ⑰ for this purpose.
2. Slide the pick-up bracket ② into the milled recesses of the clamping pieces ③.

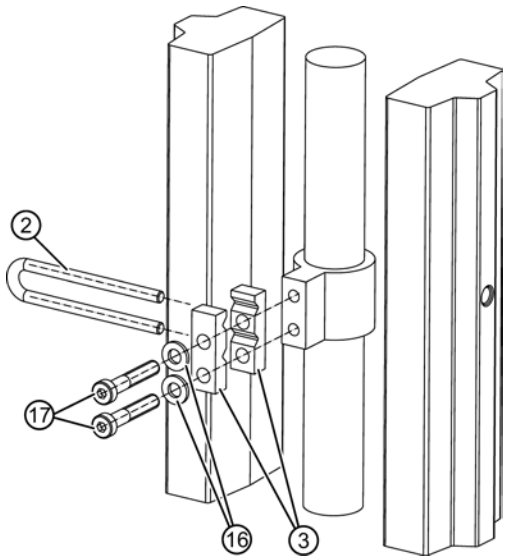


Figure 4-1 Pick-up bracket

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

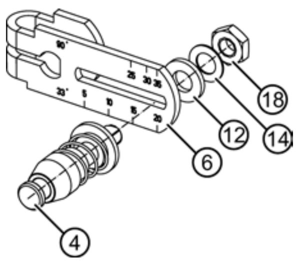


Figure 4-2 Lever with carrier pin

6. Set the stroke value. Use the value specified on the nameplate of the actuator for this purpose. If none of the values on the scale matches the value on the actuator nameplate, select the next higher scaling value. Position the pin center ④ on the matching value of the scale. If you need the value of actuator travel after initialization in mm: ensure that the configured stroke value matches the value of the "3.YWAY" parameter.

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

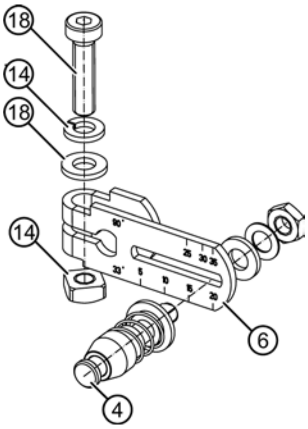


Figure 4-3 Components on the lever

8. Push the pre-installed lever ⑥ up to the end stop on the positioner shaft. Fasten the lever ⑥ using a socket cap screw ⑰.
9. Install the mounting bracket ① at the rear side of the positioner. Use 2 hexagon bolts ⑨, 2 spring lock ⑩ and 2 flat washers ⑪.

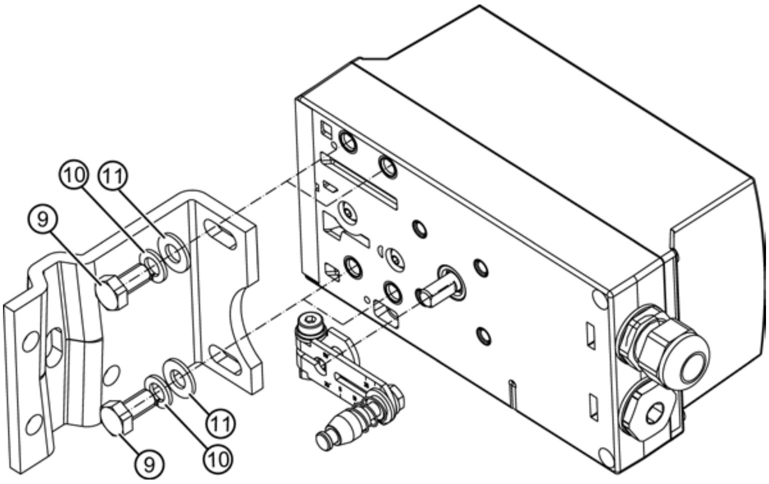


Figure 4-4 Linear actuator in **non-flameproof** enclosure

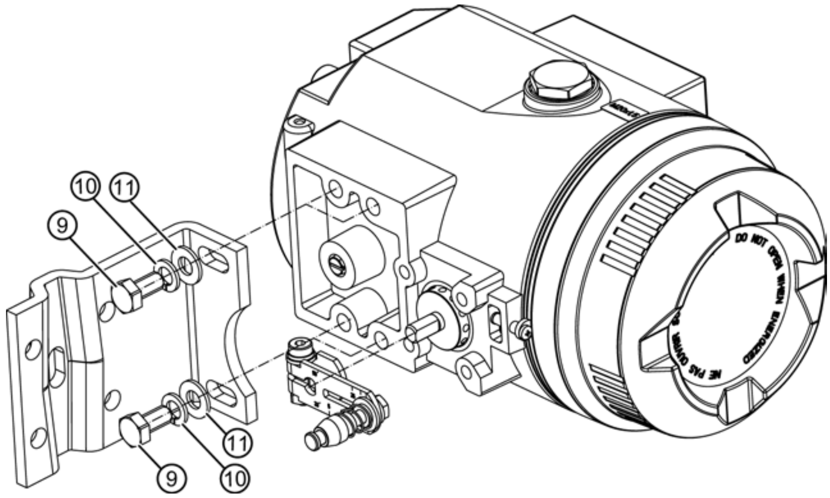


Figure 4-5 Linear actuator in **flameproof** enclosure

10. Select the row of holes. The selection of the row of holes depends on the yoke width of the actuator. Select the row of holes such that the carrier pin ④ meshes with the pick-up bracket ② near the spindle. Ensure that the pick-up bracket ②does not touch the clamping pieces③.
11. Keep the positioner and the fastening bracket on the actuator. Ensure that the carrier pin ④ is guided inside the pick-up bracket ②.
12. Tighten the pick-up bracket ② .
13. Fasten the positioner on the yoke. Use the installation parts suitable for the corresponding actuator.

Note

Height adjustment of the positioner

When you fasten the positioner on the yoke, the following applies 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.

4.3 Mounting the part-turn actuator

Requirements

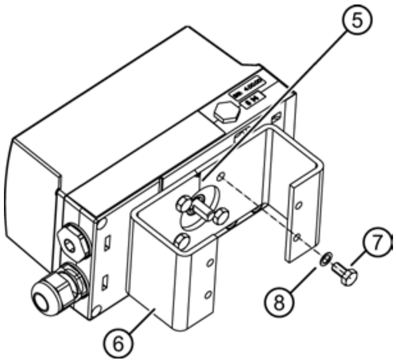
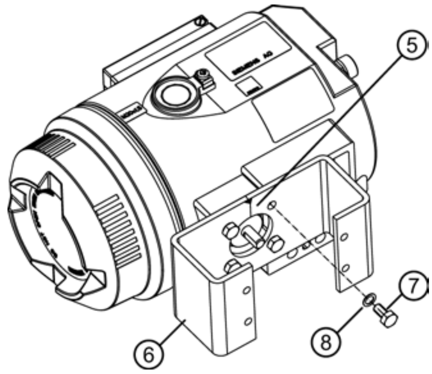
You require an actuator-specific VDI/VDE 3845 mount to install the positioner on a part-turn actuator. The mount and the bolts are included in the product package of the corresponding actuator. Ensure that the mount has a sheet metal thickness of > 4 mm and reinforcements.

Procedure

"Part-turn actuator" mounting kit 6DR4004–8D			
Sr. No. *)	**Quantity**	**Name**	**Note**
①	1	Coupling wheel	Installation on positioner shaft
②	1	Carrier	Installation on stump of actuator's positioner shaft
③	1	Multiple plate	Display of the actuator position, consists of scale ⑤ and pointer mark ⑥
④	8	Scale	Different divisions
⑤	1	Pointer mark	Reference arrow for scale
⑥		Mount	Actuator-specific, VDI/VDE 3845
⑦	4	Hexagon bolt	M6x12 DIN 933, torque see the chapter "Technical specifications > Construction (Page 271)"
⑧	4	Lock washer	S6
⑨	1	Socket cap screw	M6x16 DIN 84
⑩	1	Washer	6.4 DIN 125
⑪	1	Hexagon socket-head screw	Pre-installed with coupling wheel
	1	Machinist's wrench	For hexagon socket-head screw ⑪

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

1. Rest the actuator-specific VDI/VDE 3845 mount ⑥ on the rear side of the positioner. Tighten the mount using the hexagon bolts ⑦ and lock washers ⑧.
2. Stick the pointer mark ⑤ on the mount. Position the pointer mark at the center of the centering hole.

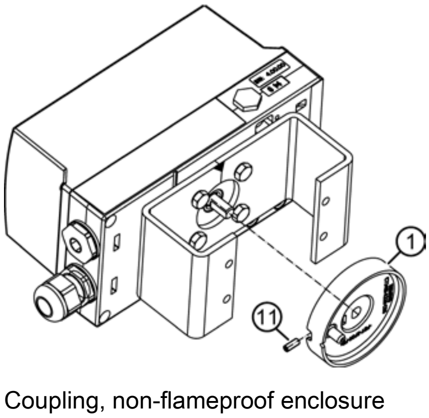
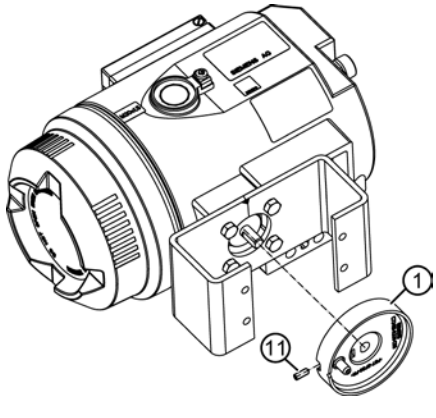
 Non-flameproof enclosure	 Flameproof enclosure

Push the coupling wheel ① or the stainless steel coupling up to the end stop on the positioner shaft. Then retract the coupling wheel or the stainless steel coupling by approximately 1 mm. Tighten the hexagon socket-head screw ⑪ using the machinist's wrench provided. If you are using the stainless steel coupling, omit the next step.

Note

Coupling wheel

Instead of the plastic coupling wheel ①, it is possible to use a stainless steel coupling (Order No. TGX: 16300-1556).

 Coupling, non-flameproof enclosure	 Coupling/clutch, flameproof enclosure

3. Place the carrier ② on the stump of the actuator's positioner shaft. Tighten the carrier ② using the socket cap screw ⑨ and the washer ⑩.

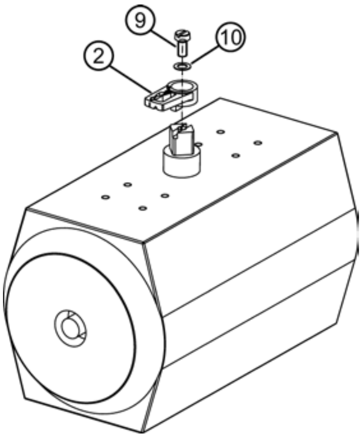
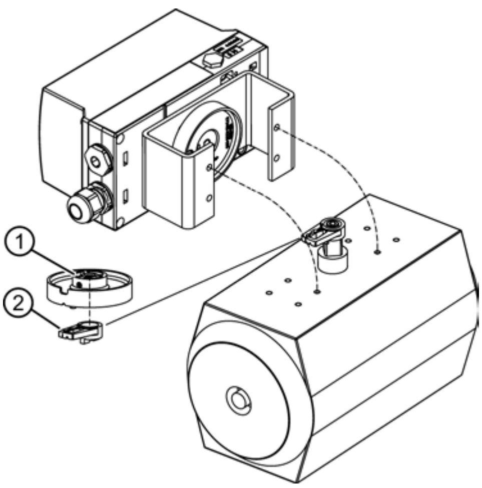
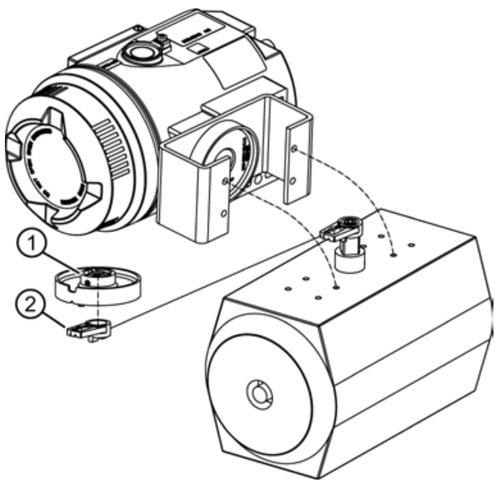


Figure 4-6 Carrier

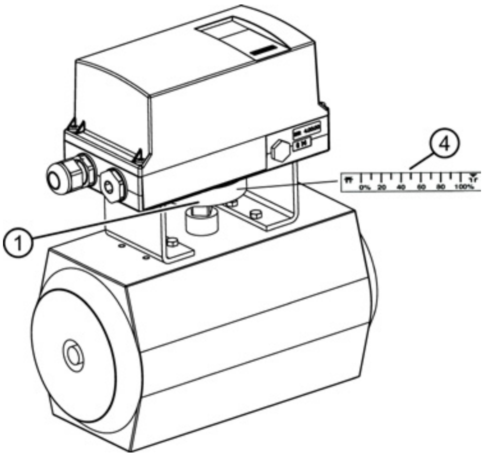
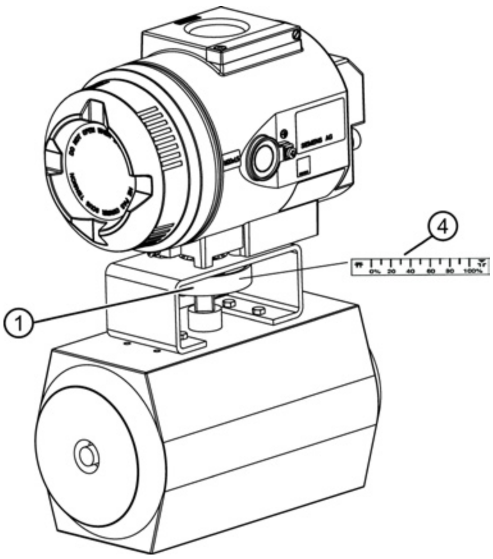
4. With the coupling wheel: Place the positioner and the mount on the actuator carefully. The pin of the coupling wheel ① must fit in the carrier ② when you do this.

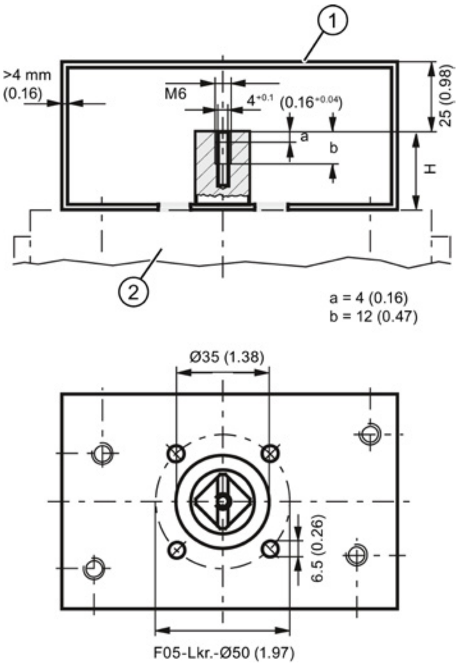
   With the stainless steel coupling: Place the positioner and the mount on the actuator carefully. Place the stainless steel coupling on the stump of the actuator's positioner shaft.

	
Actuator, non-flameproof enclosure	Actuator, flameproof enclosure

5. Align the positioner/mount unit at the center of the actuator.
6. Tighten the positioner/mount unit.
7. Initialize the positioner.

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

 Part-turn actuator in non-flameproof enclosure	 Part-turn actuator in flameproof enclosure



H = height of shaft butt

① Fixing level of positioner on mounting plate

② Part-turn actuator

Figure 4-7 Dimensions of mounting plate in accordance with VDI/VDE 3845 (depends on actuator)

See also

Preparing part-turn actuators for commissioning (Page 131)

4.4 Using the positioner in a humid environment

Introduction

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 display becomes poorly legible.

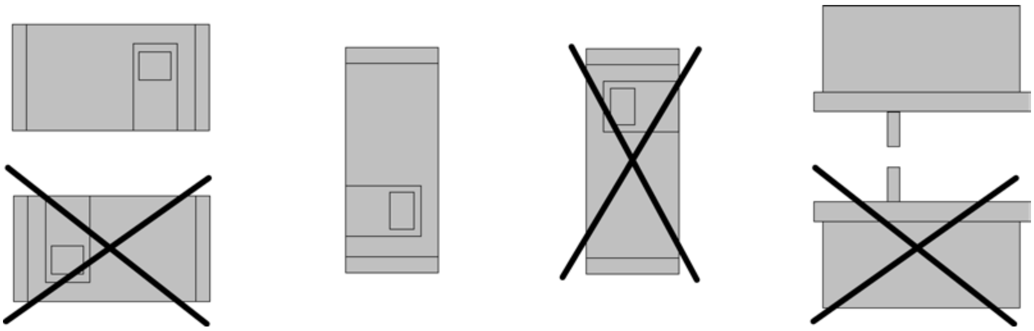


Figure 4-8 Favorable and unfavorable mounting positions

Additional measures to prevent liquids from seeping through

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

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

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

Procedure

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

Procedure for installing the plastic hose on the gland

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

4.5 Position controllers subjected to fast acceleration or strong vibration

4.5.1 Introduction locking the setting

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

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

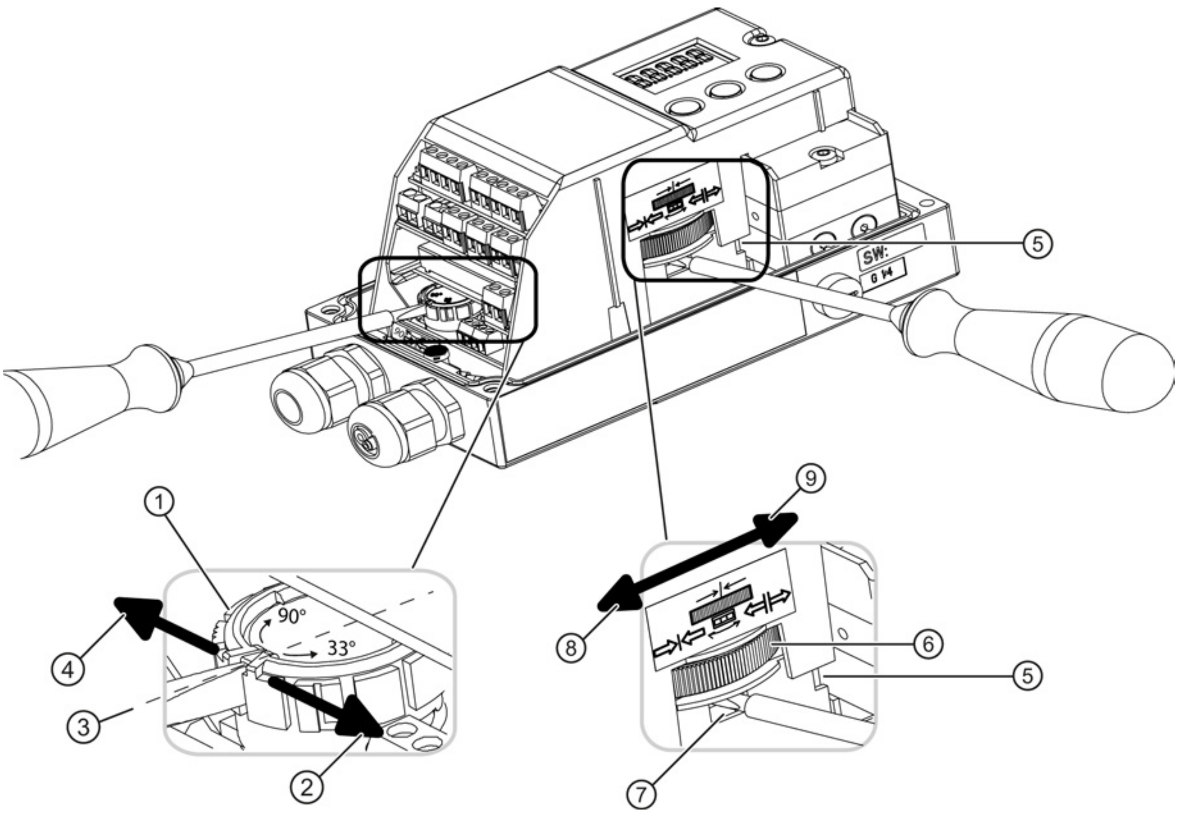
The positioner is equipped with an gear latch for the friction clutch to counter these extreme cases. The setting of the transmission ratio selector can also be locked.

The locking procedure is illustrated and described below.

4.5.2 Procedure locking the setting

Overview diagram

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



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

Figure 4-9 Locking friction clutch and transmission ratio

Requirements

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

Procedure

NOTICE
The following is applicable for the "flameproof enclosure" version: • A friction clutch is provided on the outside of the positioner axis. Change the work area using this friction clutch, legend number ⑨ in "Figure 3-9 View of positioner in flameproof enclosure (Page 25)". • Do not open the flameproof enclosure of the positioner in explosion-prone atmospheres.

Fix the setting acquired by initialization as follows:

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

Note

Changing the setting of the transmission ratio selector

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

---

4. To fix the friction clutch ⑥ insert a standard approx. 4 mm wide screwdriver in the friction clutch gear latch ⑦.
5. Use the screwdriver to turn the friction clutch gear latch ⑦ anticlockwise until it engages. The friction clutch ⑥ is locked.

4.6 External position detection

WARNING

External position detection system

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

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

The position detection system and the 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 system (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 detection system is used instead of the internal position sensor. An external position detection system is, for example, a potentiometer with a 10 kΩ resistance or a non contacting system.

4.7 Installing the optional modules

4.7.1 General information about the installation of option modules

4.7.1.1 Unsuitable device for the hazardous area

WARNING

Unsuitable device for the hazardous area

Danger of explosion.

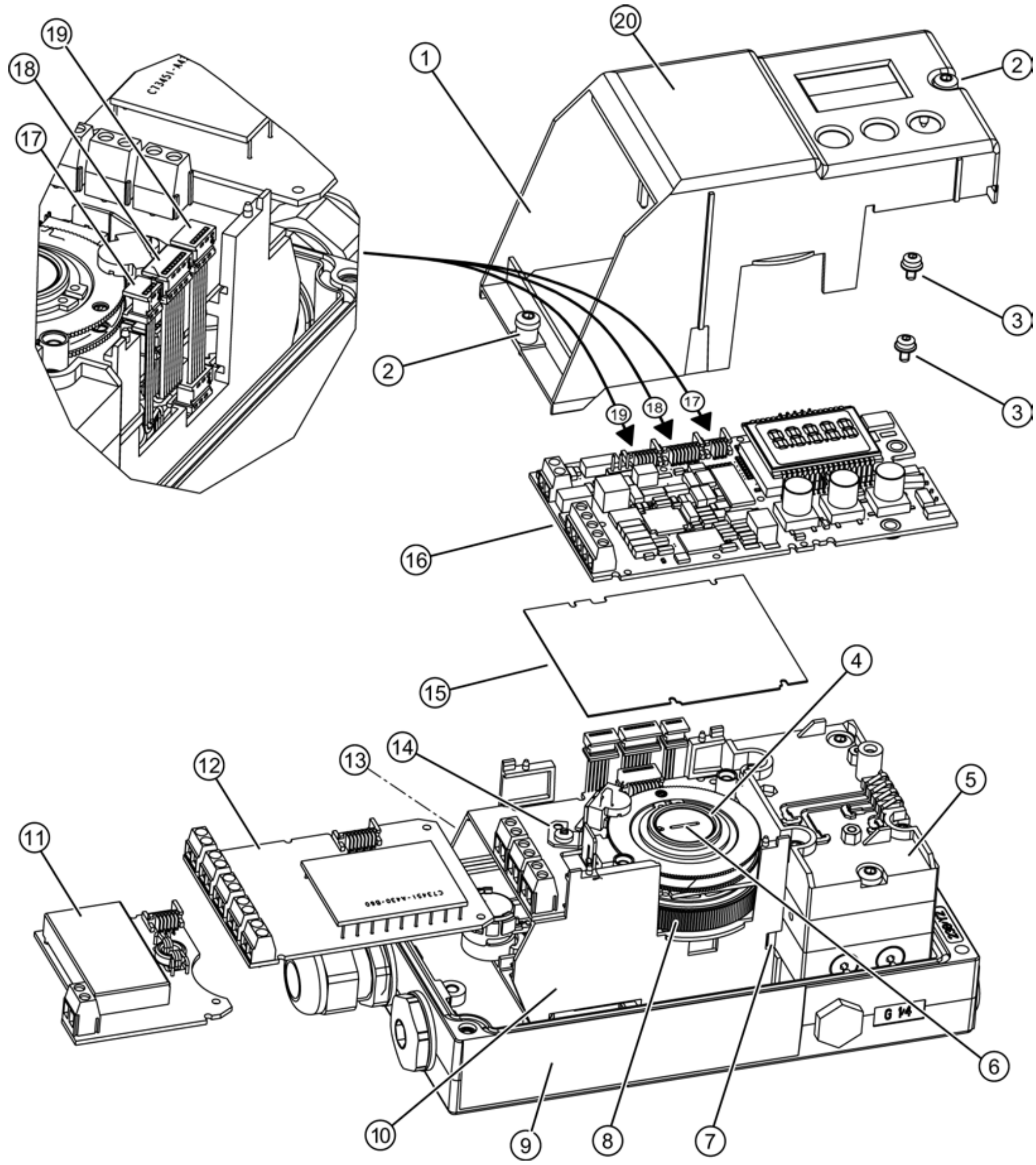
- Only use equipment that is approved for use in the intended hazardous area and labelled accordingly.

4.7.1.2 Installing optional modules in the standard and intrinsically safe version

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

- I_y module
- Alarm module
- SIA module
- Limit contact module
- EMC filter module

Overview diagram: Installing optional modules in the standard and intrinsically safe version



①	Module cover	⑪	I_y module
②	Fixing screws module cover	⑫	Alarm module
③	Fixing screws basic electronics	⑬	Warning label on the side opposite the nameplate
④	Actuating disk bearings	⑭	SIA module or limit contact module
⑤	Pneumatic block	⑮	Insulating cover
⑥	Special screw	⑯	Basic electronics
⑦	Transmission ratio selector	⑰	Ribbon cable/connector for fitted potentiometer or external position detection system

⑧	Friction clutch adjustment wheel	⑱	Ribbon cable/connector for alarm module, SIA module or limit contact module
⑨	Nameplate	⑲	Ribbon cable/connector for I_y module
⑩	Adapter	⑳	Wiring diagram

Figure 4-10 Installing the optional modules in the standard and intrinsically safe version

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

1. Open the positioner. Unscrew the four fixing screws of the enclosure cover.
2. Disconnect the power supply lines or de-energize them.
3. Remove the module cover ①. To do this, unscrew the two screws ②.
4. Install the optional modules as described in the corresponding chapters for the individual optional modules.
5. Now start with the assembly. Install the module cover①. To this end, turn the screws ② counter clockwise until they noticeably engage in the thread pitch. The module cover protects and locks the optional modules mechanically.

   Note

   Untimely wear

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

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

See also

Iy module (Page 59)

Alarm unit (Page 60)

Slotted initiator alarm unit (Page 62)

Mechanical limit switch module (Page 65)

EMC filter module (Page 69)

Label set for mechanical limit switch module (Page 67)

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

Introduction

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

- I_y module
- Alarm module
- EMC filter module

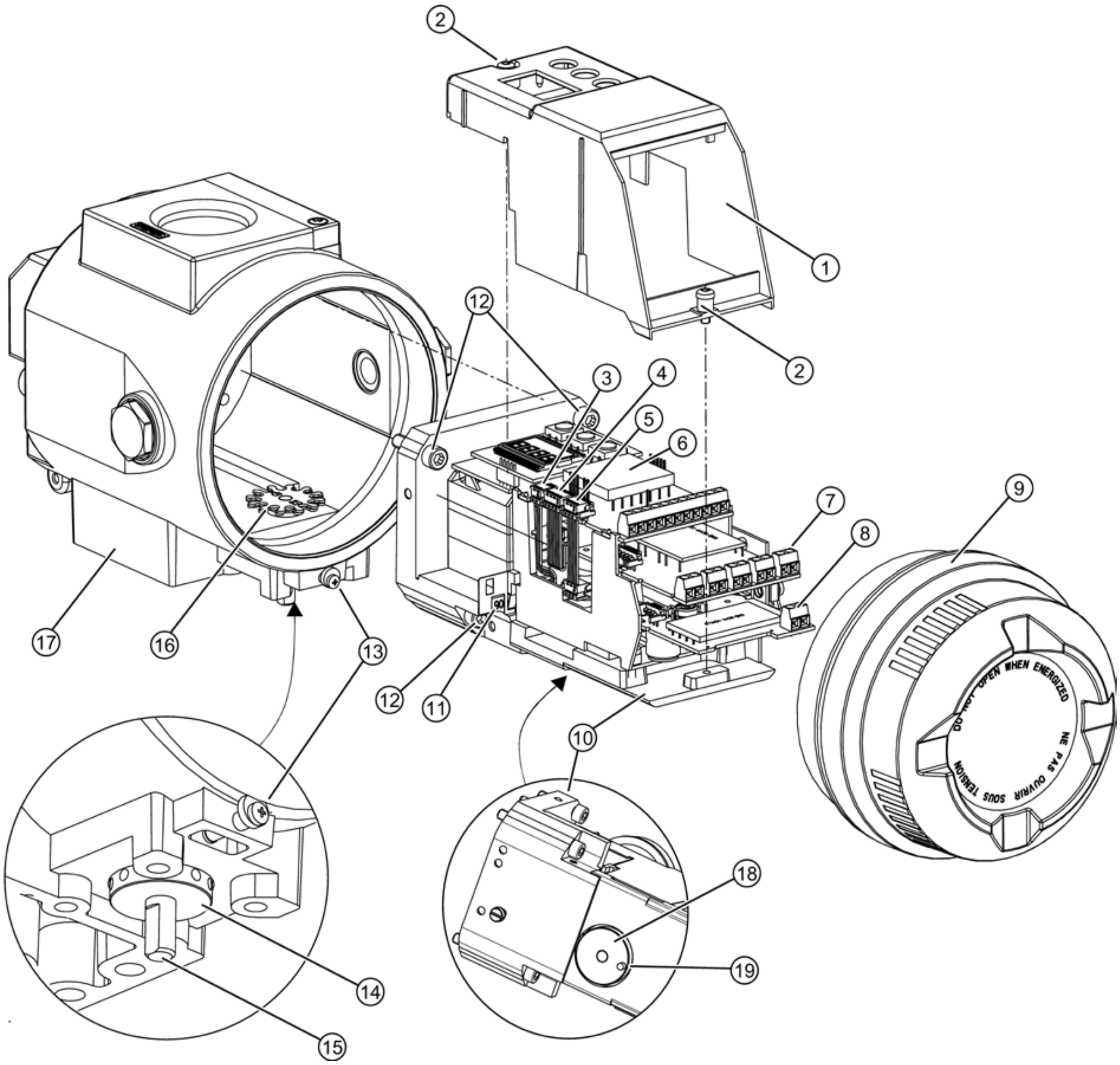
DANGER

Risk of explosion

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

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

Overview diagram: Installing the optional modules in the "flameproof enclosure" version



①	Module cover	⑪	Transmission ratio selector
②	Fixing screws module cover	⑫	Fixing screws adapter
③	Ribbon cable/connector for fitted potentiometer or external position detection system	⑬	Safety catch
④	Ribbon cable/connector for alarm module	⑭	Friction clutch adjustment wheel
⑤	Ribbon cable/connector for I_y module	⑮	Feedback shaft
⑥	Basic electronics	⑯	Ring gear
⑦	Alarm module	⑰	Enclosure
⑧	I_y module	⑱	Feedback lever bracket with pin
⑨	Screw cap	⑲	Pin (feedback lever bracket)
⑩	Adapter		

Figure 4-11 Installing the optional modules in the "flameproof enclosure" version

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

1. Disconnect the power supply lines or de-energize them.
2. Open the safety catch ⑬.
3. Unscrew the screw cap ⑨.
4. Completely dismount the positioner from the actuator.
5. The positioner comes with a ring gear ⑯ and a pin (feedback lever bracket) ⑲ which interlock and ensure backlash-free position feedback. To ensure backlash-free position feedback make sure to remove the adapter ⑩ carefully. To this end, turn the feedback shaft ⑮ at the positioner until the pin (feedback lever bracket) ⑲ below the adapter shows in the direction of removal. You determine the position of the pin by looking into the enclosure below the adapter. Now, the pin can be easily removed from the ring gear ⑯.

Note

Damage to the ring gear

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

- Do not change this offset mechanically.

6. Unlatch the four fixing screws ⑫.
7. Completely remove the adapter ⑩ from the enclosure ⑰.

NOTICE

Displaced O-rings

There are several O-rings between adapter ⑩ and enclosure ⑰. These O-rings may come off during removal.

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

8. Remove the module cover ①. Unlatch both screws ② using a screwdriver.
9. Install the optional modules as described in the corresponding chapters for the individual optional modules.
10. Now start with the assembly. Install the module cover①. To this end, turn the screws ② counter clockwise until they noticeably engage in the thread pitch. The module cover protects and locks the optional modules mechanically.

Note

Untimely wear

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

Carefully tighten both screws ② in a clockwise direction.

11. Continue to assemble the positioner by performing steps 7 to 5 in reverse order. Check whether the position of the O-rings is correct. Make sure no loose items in the enclosure interfere with the assembly.
12. Now check carefully whether the feedback shaft ⑮ can be smoothly turned by 360°.

    If you feel resistance, do **not** continue to turn but turn the feedback shaft ⑮ back again to the point of removal, making sure to remember the previously performed steps.
13. Once you have completed all previous steps successfully, continue by performing steps 4 to 1 in reverse order.

4.7.2 Iy module

Function

- The optional I_y module indicates the current actuator position as a dual line signal with I_y = 4 to 20 mA. The I_y module is potentially separated from the basic device. 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.

Device features

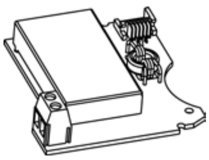


Figure 4-12 I_y module

The I_y module is:

- Single channel
- Potentially separated from the basic device.

Requirements

You are familiar with the general procedure described in the chapter "General information about the installation of option modules (Page 53)".

Procedure for installing the I_y module

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

4.7.3 Alarm unit

Function

The alarm module 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.
- Operational faults are signaled at a high-resistance output. Set the following parameters to activate and configure the output of alarms and fault messages:
  - "AFCT" - Alarm function
  - "A1" - Trigger threshold, alarm 1
  - "A2" - Trigger threshold, alarm 2
  - "FCT" - Fault message output function
  - "TIM" - Monitoring time
  - "LIM" - Trigger threshold

Apart from binary outputs, the alarm module 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 "BIN2".

Device features

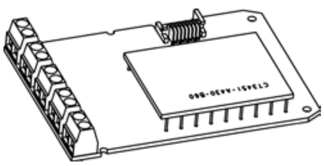


Figure 4-13 Alarm module

The alarm module has the following features:

- Available in two versions.
  - Explosion-proof version for connecting to a switching amplifier in conformity with EN 60947-5-6.
  - Non-explosion-proof version for connecting to power sources having a maximum of 35 V.
- Three binary outputs. Binary inputs are potentially separated from the basic configuration and from each other.
- The binary input has dual functionality. Both inputs are implemented as logical OR combination.
  - Potentially separated for voltage level
  - Not potentially separated for floating contacts

Requirements

You are familiar with the general procedure described in the chapter "General information about the installation of option modules (Page 53)".

Procedure for installing the alarm module

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

4.7.4 Slotted initiator alarm unit

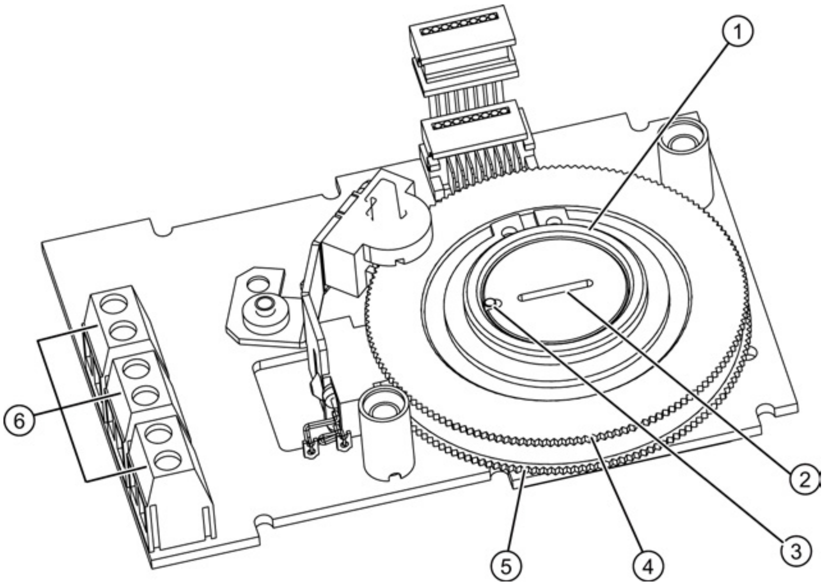
4.7.4.1 SIA module functioning and features

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 to signal the two limits L1 and L2 which can be adjusted mechanically using slotted initiators. Both these binary outputs are electrically independent from the remaining electronic unit.

Device features



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

Figure 4-14 SIA module

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

4.7.4.2 Installing the slotted initiator alarm unit

Requirements

You are familiar with the general procedure described in the chapter "Installing optional modules in the standard and intrinsically safe version (Page 53)".

Procedure for installing the slot initiator alarm module

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

Note

Pin in the actuating disk bearing

A pin ③ is pressed in the actuating disk bearing①.

1. Align the pin ③ before it touches the special screw ②.
2. Rotate the actuating disk bearing ① and the special screw ② simultaneously so that the pin ③ is inserted into the special screw ②.

---

7. Set the limits L1 and L2 as described in the chapter "Setting the limits of the slotted initiator alarm unit (Page 64)".
8. An insulating cover is provided over the SIA module. Place the insulating cover on one side under the basic electronics seat on the module cover. The recesses of the insulating cover must fit in the corresponding webs of the module cover.
9. Place the insulating cover on the SIA module by bending the module covers carefully.
10. Engage the basic electronics into the four brackets.
11. Fix the basic electronics using both the fixing screws.
12. Reestablish all electrical connections between the basic electronics and the option modules. Connect the basic electronics and the option modules to the ribbon cables provided. Connect the basic electronics and the potentiometer to the potentiometer cable.
13. Using both the screws, fasten the module cover provided. Do **not** use the standard module cover.
14. Select the labels that already exist on the standard version of the module cover from the label set provided. Affix the selected labels on the installed module cover as per the standard version.

4.7.4.3 Setting the limits of the slotted initiator alarm unit

Procedure: Determining the switch status of the slotted initiators

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

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

Procedure: Setting the L1 and L2 limits

The serial numbers in the following text refer to the image in the chapter "SIA module functioning and features (Page 62)". With linear actuators, proceed as follows to set the limits:

1. Move the actuator to the first desired mechanical position.
2. Adjust the upper actuating disk ④ manually until the output signal at terminals 41 and 42 changes. Set a high-low or a low-high switchover as follows:
   - Rotate the actuating disc ④ beyond the switching point until you reach the next switching point.
3. Move the actuator to the second desired mechanical position.
4. Adjust the lower actuating disk ⑤ manually until the output signal at terminals 51 and 52 changes. Set a high-low or a low-high switchover as follows:
   - Rotate the actuating disc ⑤ beyond the switching point until you reach the next switching point.

Note

Adjusting the actuating disk

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

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

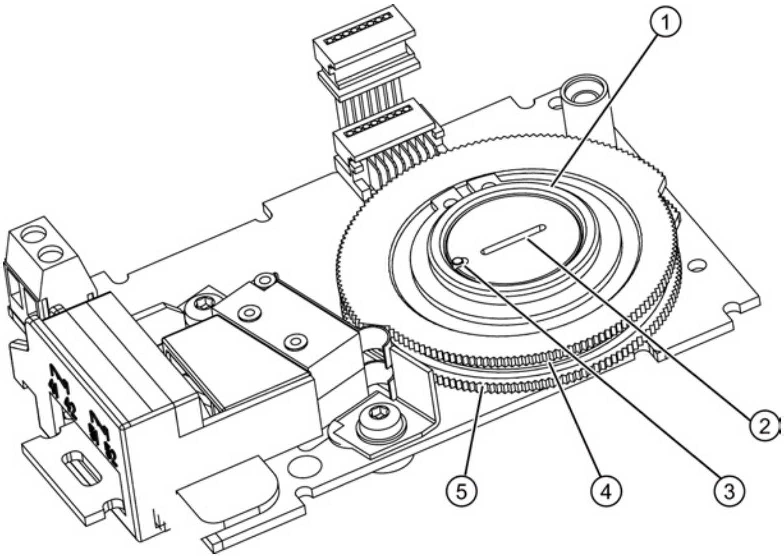
4.7.5 Mechanical limit switch module

4.7.5.1 Mechanical limit switch module - functioning and features

Function

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

Device features



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

Figure 4-15 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 module.
- Two switches to report two mechanically adjustable limits. Both these switches are electrically independent from the remaining electronic unit.

4.7.5.2 Installing the mechanical limit switch module

Requirements

You are familiar with the procedure described in the chapter "Installing optional modules in the standard and intrinsically safe version (Page 53)".

Procedure for installing the mechanical limit switch module

1. Disconnect all electrical connections of the basic electronics.
2. Loosen the two fixing screws of the basic electronics.
3. Disengage the basic electronics 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 in the printed circuit board of the module rack approximately 3 mm towards right.
6. Screw in the special screw ② through the mechanical limit switch module into the positioner shaft. Tighten the special screw ② with a **torque of 2 Nm**.

   Note

   Pin in the actuating disk bearing

   A pin ③ is pressed in the actuating disk bearing①.

   1. Align the pin ③ before it touches the special screw ②.
   2. Rotate the actuating disk bearing ① and the special screw ② simultaneously so that the pins ③ fit into the special screw ②.

7. Set the limits L1 and L2 as described in the chapter "Setting the limits of the mechanical limit switch module (Page 67)".
8. An insulating cover is provided over the mechanical limit switch module. Place the insulating cover on one side under the basic electronics seat on the walls of the rack. The recesses of the insulating cover must fit in the corresponding webs of the container wall.
9. Place the insulating cover on the mechanical limit switch module by bending the walls of the rack carefully.
10. Engage the basic electronics into the four brackets.
11. Fix the basic electronics using both the fixing screws.
12. Reestablish all electrical connections between the basic electronics and the option modules. Connect the basic electronics and the option modules to the ribbon cables provided. Connect the basic electronics and the potentiometer to the potentiometer cable.
13. Using both the screws, fasten the module cover provided. Do not use the standard module cover.

14. Select the labels that already exist on the standard version of the module cover from the label set provided. Affix the selected labels on the installed module cover as per the standard version.
15. Establish all electrical connections.

Note

Protective conductor connector

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

4.7.5.3 Setting the limits of the mechanical limit switch module

Setting the L1 and L2 limits

To set the limits proceed as follows. The serial numbers refer to the image in the chapter "Installing the mechanical limit switch module (Page 66)".

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

Note

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.

4.7.5.4 Label set for mechanical limit switch module

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

Figure 4-16 Warning label for a device with a Macrolon enclosure

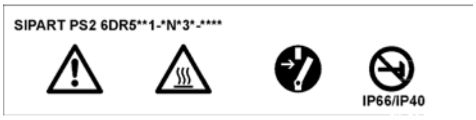


Figure 4-17 Warning label for a device with an aluminum enclosure

Figure 4-18 Warning label for a device with a stainless steel enclosure

4.7.6 EMC filter module

Requirements

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

A description of how to remove the module cover and install the optional modules is provided in the chapter "General information about the installation of option modules (Page 53)"

Note

Different cable glands

A blue and a gray cable gland are provided to distinguish between explosion-proof and not explosion-proof devices.

- Use the blue cable gland for explosion-proof devices in "intrinsically safe" protection type. Use the gray cable gland for all other designs.

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 basic electronics of the positioner. This module protects the positioner from electromagnetic effects.

Device features

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

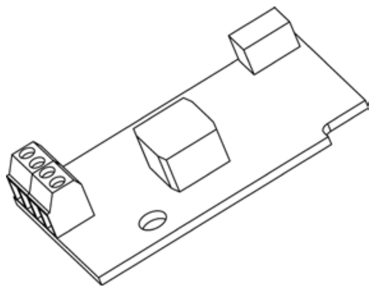
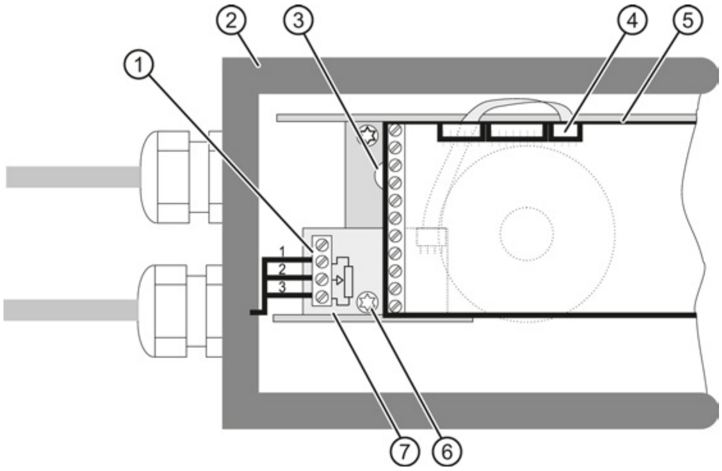


Figure 4-19 EMC filter module

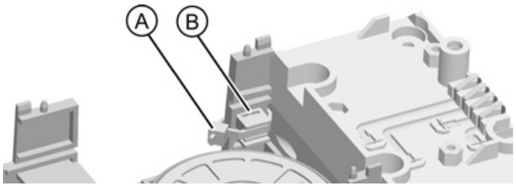
Procedure for installing the EMC filter module



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

Figure 4-20 Installation EMC filter module

1. You have performed the steps described in the chapter "General information about the installation of option modules (Page 53)".
2. Unplug the ribbon cable connector ④ to the fitted potentiometer from the basic electronics ⑤.
3. Remove the basic electronics ⑤ from the positioner. To this end, remove the two screws that fix the basic electronics to the pneumatic block.
4. Loosen the screw ⑥ in the connection area of the positioner.
5. Then secure the loose ribbon cable (B) on the container as shown in the following graphic. To do this, use the cable tie (A) supplied with the EMC filter module C73451-A430-D23



(A)	Cable tie	(B)	Ribbon cable connector

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

9. In **non-**hazardous environment:
   - Stick the supplied nameplate over the nameplate on the external position detection system.
   - Replace the blue cable gland by the supplied gray cable gland.
10. Fasten the module cover. Make sure that the ribbon cable is not trapped.
11. Proceed with the corresponding steps in the chapter "General information about the installation of option modules (Page 53)".

Refer to section "Scope of delivery of external position detection system (Page 298)", items "Nameplate for device version **without** explosion protection" and "Gray cable gland".

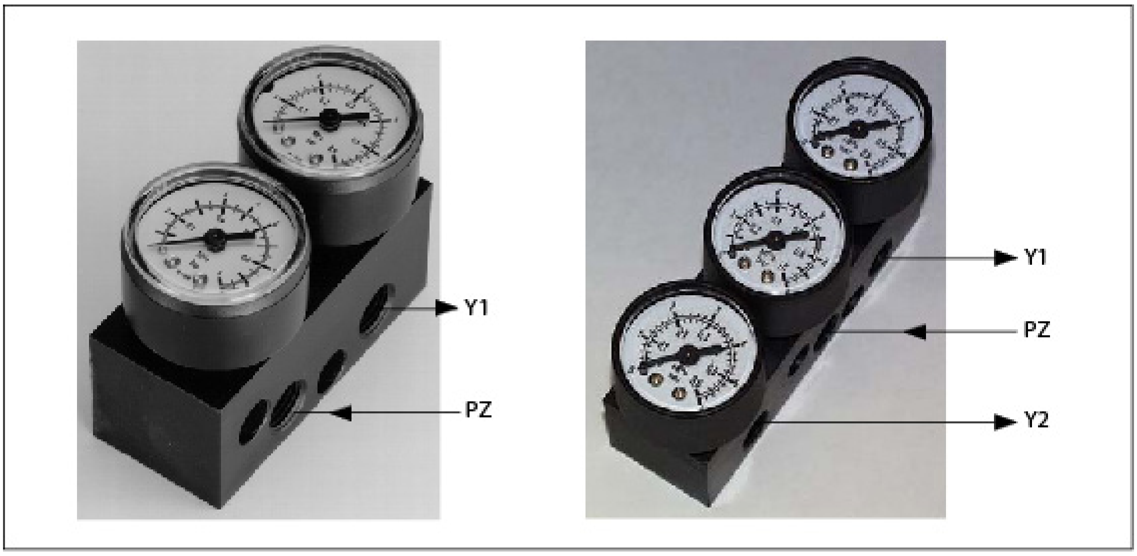
See also

Scope of delivery EMC filter module (Page 299)

4.7.7 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-acting actuators. The image to the right shows the pressure gauge block for double-acting actuators.



Y1 Actuating pressure
P_Z Supply air
Y2 Actuating pressure

Fixing the pressure gauge block

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

Connect 5

5.1 Electric

5.1.1 Basic safety instructions

WARNING

Improper power supply

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

- Connect the device in accordance with the specified power supply and signal circuits. The relevant specifications can be found in the certificates, in Chapter "Technical data (Page 269)" or on the nameplate.

WARNING

Unsafe extra-low voltage

Danger of explosion in hazardous areas due to voltage flashover.

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

WARNING

Connecting device in energized state

Danger of explosion in hazardous areas.

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

Exceptions:

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

WARNING

Lack of equipotential bonding

Danger of explosion through compensating currents or ignition currents through lack of equipotential bonding.

- Ensure that the device is potentially equalized.

Exception: It may be permissible to omit connection of the equipotential bonding for devices with type of protection "Intrinsic safety Ex i".

WARNING

Unprotected cable ends

Danger of explosion through unprotected cable ends in hazardous areas.

- Protect unused cable ends in accordance with IEC/EN 60079-14.

WARNING

Improper laying of shielded cables

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

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

WARNING

Unsuitable cables and/or cable glands

Danger of explosion in hazardous areas.

- Only use suitable cables and cable glands complying with the requirements specified in Chapter "Technical data (Page 275)".
- Tighten the cable glands in accordance with the torques specified in Chapter "Technical data (Page 271)".
- When replacing cable glands use only cable glands of the same type.
- After installation check that the cables are seated firmly.

WARNING

Incorrect selection of type of protection

Danger of explosion in areas subject to explosion hazard.

This device is approved for several types of protection.

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

NOTICE

Condensation in the device

Damage to device through formation of condensation if the temperature difference between transportation or storage and the mounting location exceeds 20 °C (68°F).

- Before taking the device into operation let the device adapt for several hours in the new environment.

NOTICE

Ambient temperature too high

Damage to cable sheath.

- At an ambient temperature ≥ 60 °C (140 °F), use heat-resistant cables suitable for an ambient temperature at least 20 °C (68 °F) higher.

Note

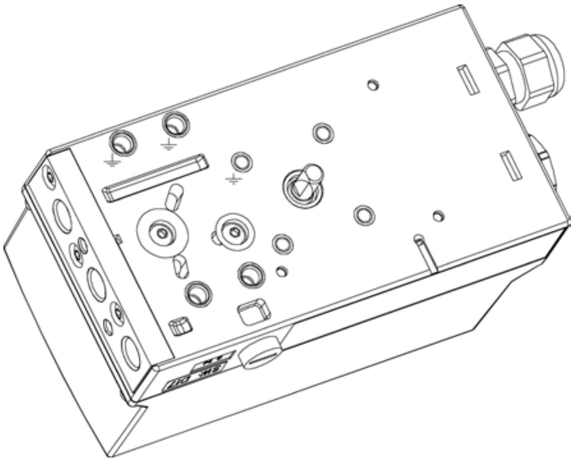
Improvement of interference immunity

- Lay signal cables separate from cables with voltages > 60 V.
- Use cables with twisted wires, except for bus cables.
- Avoid getting too close to large electrical process cells.

Electromagnetic compatibility

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

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



⏚ Shield

Figure 5-1 Base plate

5.1.1.1 Standard cable gland/torque

Note

Standard cable gland/torque

Device damage.

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

5.1.1.2 Interference immunity

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

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

Note

Dissipation of glitch impulses/equipotential bonding

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

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

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

5.1.1.3 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.

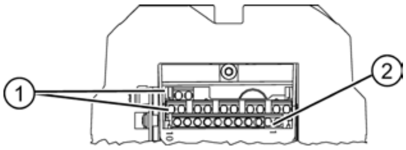
If this auxiliary voltage fails or is switched, the exhaust air valve is forced-opened and the actuator moves to the defined safety position so that the actuator cannot be moved using the buttons on the device and the master.

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

5.1.2 Electrical connections

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

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



① Connecting terminals of option modules

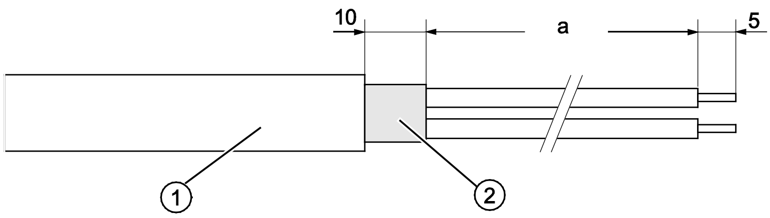
② Connecting terminals of basic device

Figure 5-2 Connecting terminals of the flameproof enclosure

5.1.3 Bus cable

5.1.3.1 Preparation of bus cable

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



a Length in [mm]

80 Normal version of the device (without Ex and Ex i)

120 Version with flameproof enclosure (Ex d)

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

② Cable shield

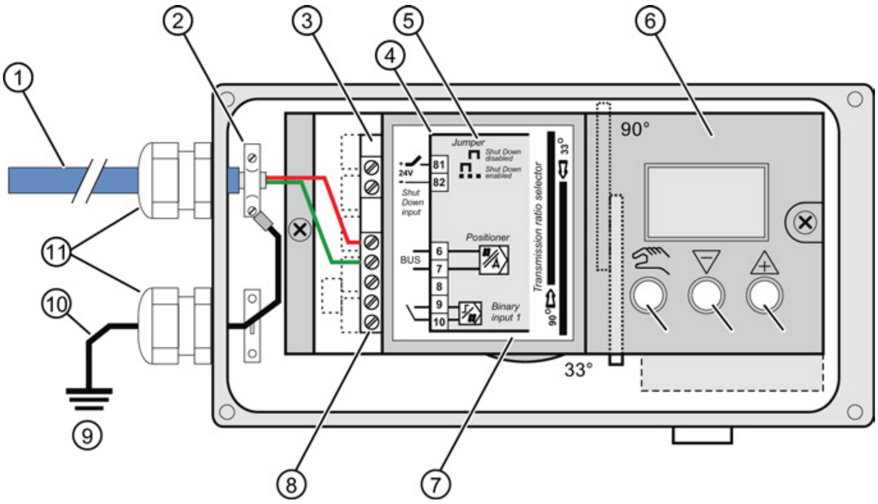
Figure 5-3 Preparation of bus cable

5.1.3.2 Bus cable for device version without flameproof enclosure

Devices without flameproof enclosure are:

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

Procedure for device versions without flameproof enclosure



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

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

1. Strip the bus cable ①.
2. Open the enclosure of the positioner by unlatching the four cover screws.
3. Insert the prepared bus cable (described in chapter "Preparation of bus cable (Page 78)") through the cable inlet.
4. Fasten the shield using the clamp ② and the two screws on the enclosure.

5. Tighten the cable inlet.
6. Connect the red and the green wires to terminals 6 and 7 of the basic electronics as shown in the following picture. The polarity does not play any role here.

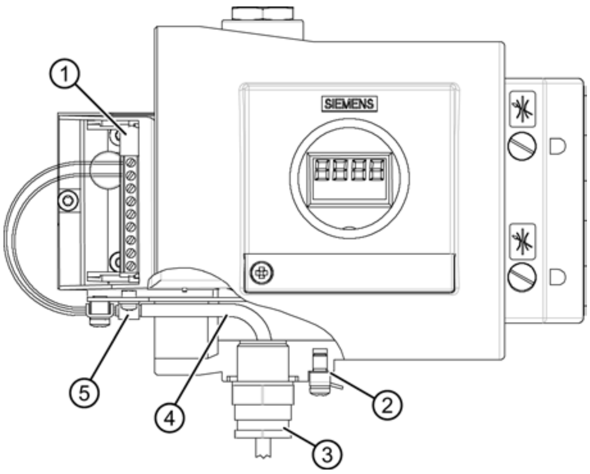
Note

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

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

5.1.3.3 Bus cable for device version with flameproof enclosure

Procedure for device versions with flameproof enclosure "Ex d"



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

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

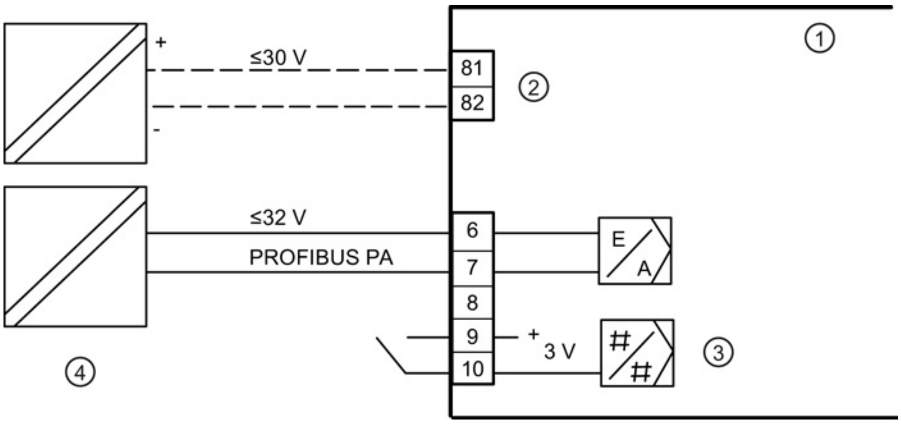
1. Strip the bus cable.
2. Open the safety catch and unscrew the screw cap to open the positioner.
3. Insert the prepared bus cable ④ (described in chapter "Preparation of bus cable (Page 78)") through the Ex d-certified cable inlet ③. Follow the corresponding guidelines if you are using a conduit piping system.
4. Fasten the shield on the adapter using the clamp ⑤ and the two screws.

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

5.1.4 Device without explosion protection/device in flameproof enclosure

5.1.4.1 Basic device without Ex protection / in flameproof enclosure "Ex d"

Connection diagram for order numbers 6DR55..-0N…; 6DR55.5-0E...

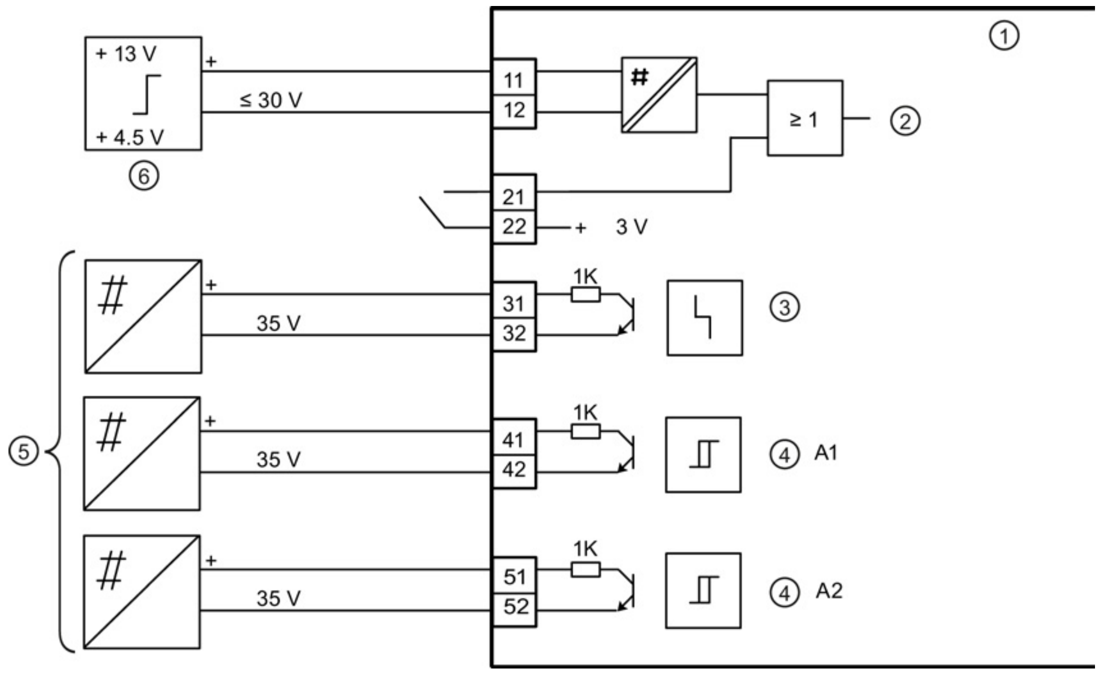


① Basic electronics
② Input: Safety shutdown
③ Binary input 1
④ Power source

Figure 5-6 Device version 2-wire PROFIBUS PA (without Ex/with Ex d)

5.1.4.2 Option modules without Ex protection / in flameproof enclosure "Ex d"

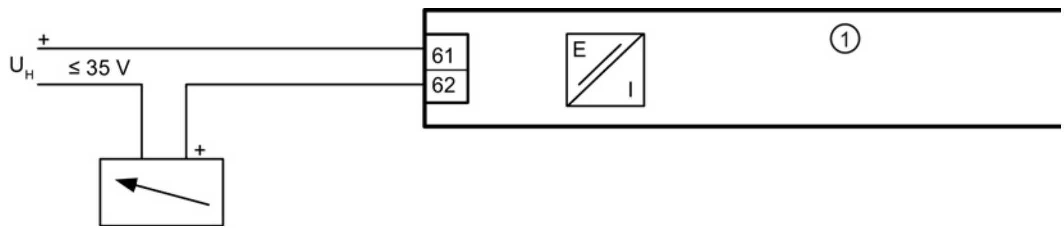
Alarm module, without Ex protection / in flameproof enclosure "Ex d"



①	Alarm module	④	Limit
②	Binary input 2	⑤	Switching amplifier
③	Fault message	⑥	Switching output

Figure 5-7 Alarm module 6DR4004-8A (without Ex/with Ex d)

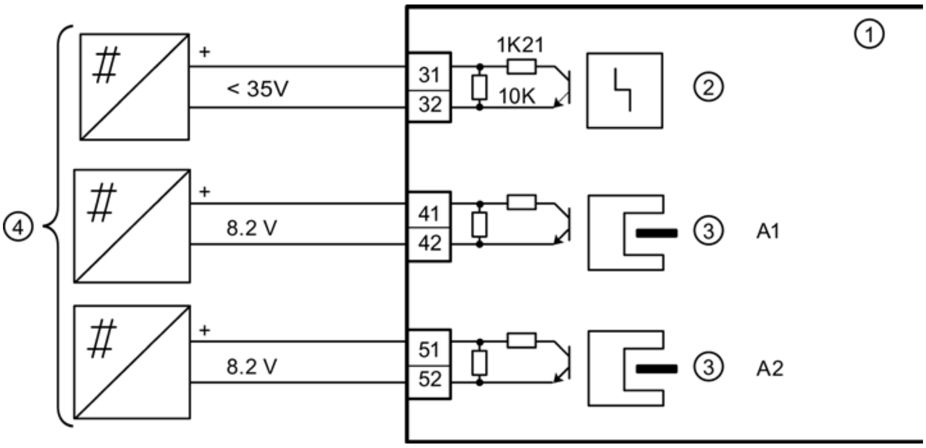
Iy module, without Ex protection / in flameproof enclosure "Ex d"



① I_y module

Figure 5-8 I_y module 6DR4004-8J, (without Ex/with Ex d)

SIA module, without Ex protection



① SIA module
② Fault message
③ Limit
④ Switching amplifier

Figure 5-9 SIA module 6DR4004-8G (without Ex)

Limit contact module, without Ex protection

DANGER

Low-voltage supply

When you supply the module in the non-intrinsically safe version with low voltage, you must be sure to observe the following safety rules before starting work on the device:

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

Note

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.

Note

To observe before connecting

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

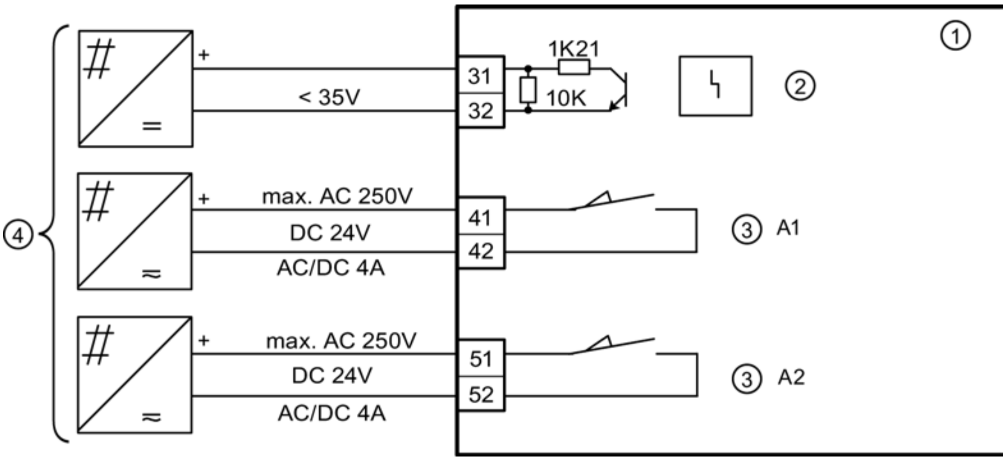
- Isolate all wires from power and make sure the device is truly isolated from power.
- Construct the cross-sectional area of the connection cables in such a way that it is appropriate for the permitted current load.

Note

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.

Connecting



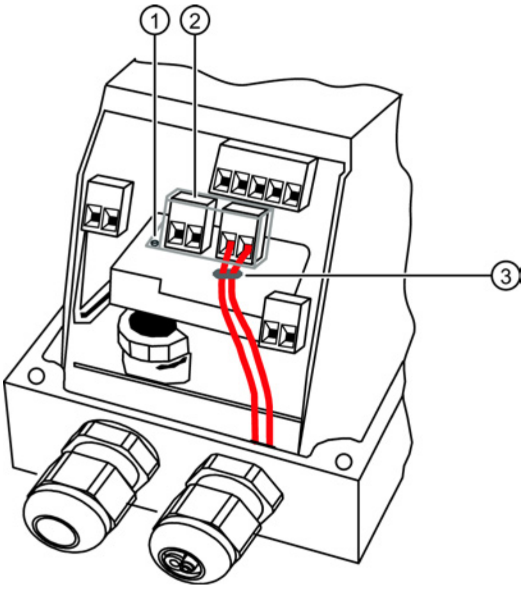
①	Mechanical limit switch module	③	Limit
②	Fault message	④	Switching amplifier

Figure 5-10 Mechanical limit switch module 6DR4004-8K (without Ex)

Procedure

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

6. Connect the cables of each switch to the lug of the printed circuit board in pairs. Use the provided cable ties ③ for this purpose.



① Screw
② Cover
③ Cable tie

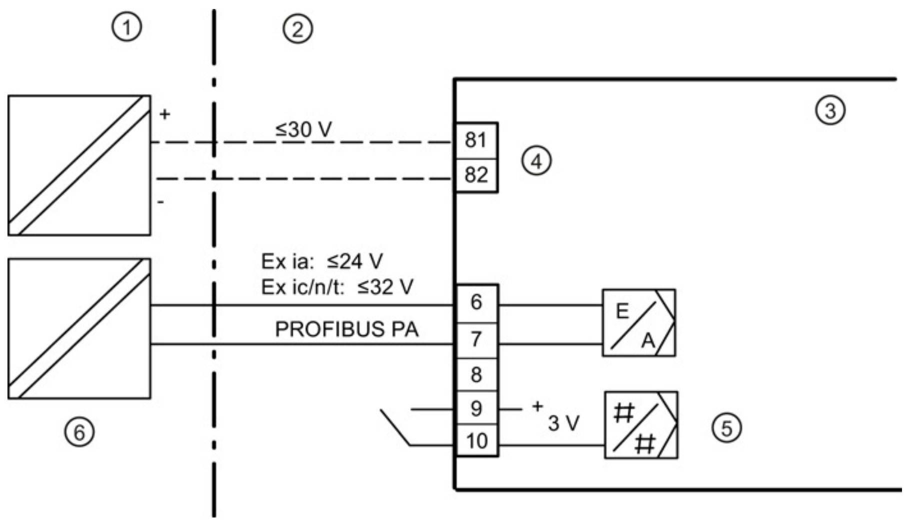
Figure 5-11 Connecting the cables

5.1.5 Device with Ex i/Ex n/Ex t type of protection

⚠ WARNING
With intrinsically device version (Ex i)
Risk of explosion in hazardous areas.
For intrinsically safe device versions only the certified circuits may be connected as auxiliary power supply, control and signal circuits.
• Make sure that the power source of the used circuits is marked as intrinsically safe.

5.1.5.1 Basic device Ex i/Ex n/Ex t

Connection diagram for order number 6DR55..-0E/D/F/G/K...

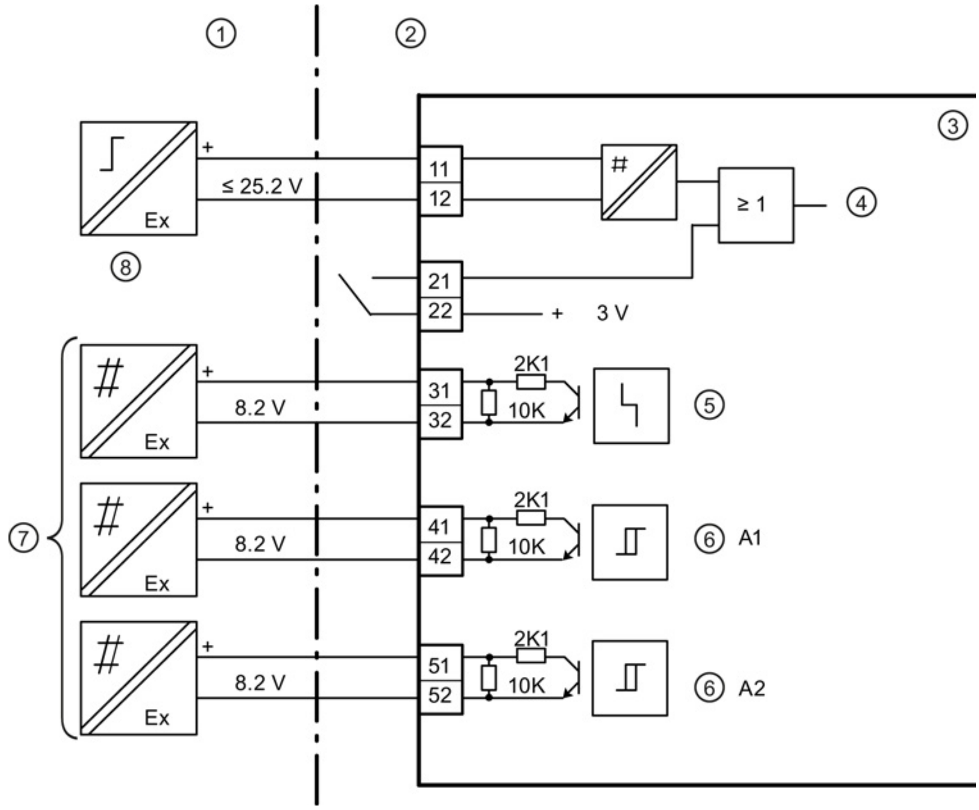


①	Non-hazardous area	④	Input: Safety shutdown
②	Potentially explosive atmosphere	⑤	Binary input 1
③	Basic electronics	⑥	Power source

Figure 5-12 Device version 2-wire with PROFIBUS PA (Ex i/Ex n/Ex t)

5.1.5.2 Option modules Ex i/Ex n/Ex t

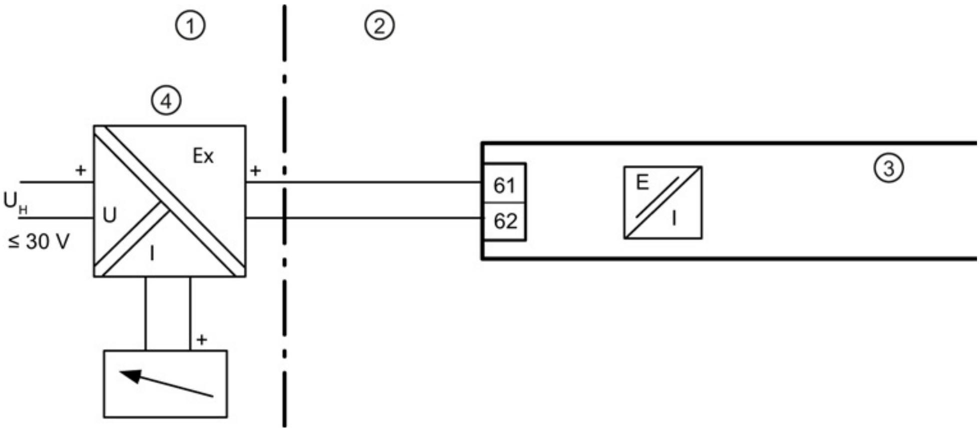
Alarm module Ex i/Ex n/Ex t



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

Figure 5-13 Alarm module 6DR4004-6A and 6DR4004-7A (Ex i/Ex n/Ex t)

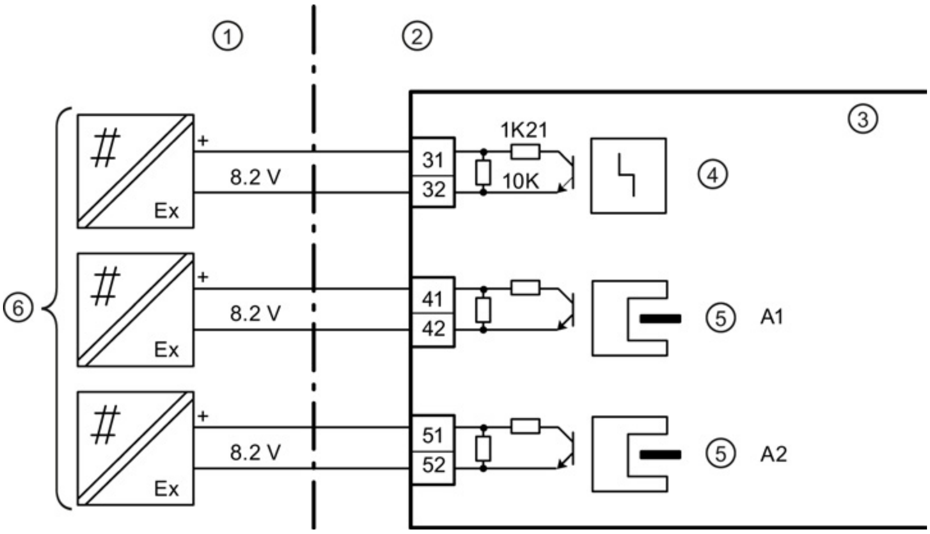
Iy module Ex i/Ex n/Ex t



①	Non-hazardous area	③	I_y module
②	Potentially explosive atmosphere	④	Feed splitter

Figure 5-14 I_y module 6DR4004-6J and 6DR4004-7J (Ex i/Ex n/Ex t)

SIA module Ex i/Ex n/Ex t

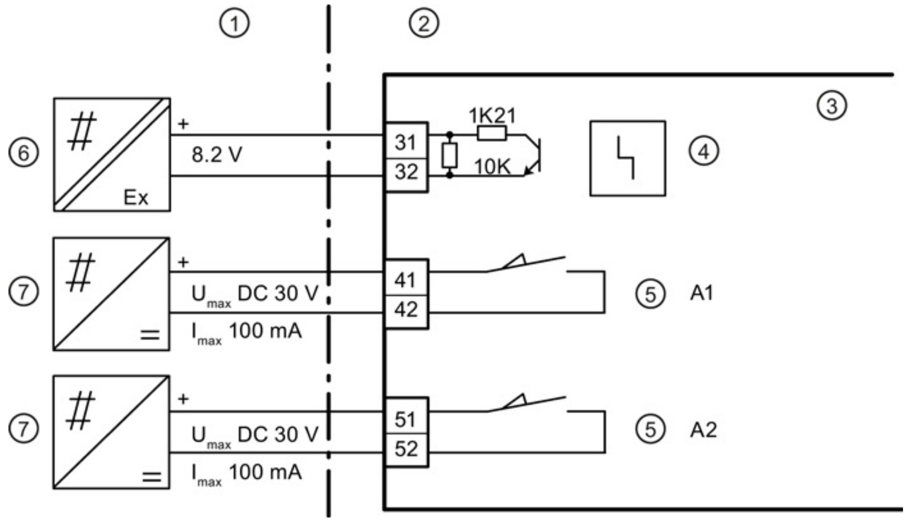


①	Non-hazardous area	④	Fault message
②	Potentially explosive atmosphere	⑤	Limit
③	SIA module	⑥	Switching amplifier

Figure 5-15 SIA module 6DR4004-6G (Ex i/Ex n/Ex t)

Limit contact module, intrinsic safety "Ex i"

Mechanical limit switch module connection diagram, Ex i



①	Non-hazardous area	⑤	Limit
②	Potentially explosive atmosphere	⑥	Isolation amplifier
③	Limit contact module	⑦	Switching amplifier/isolation amplifier
④	Fault message		

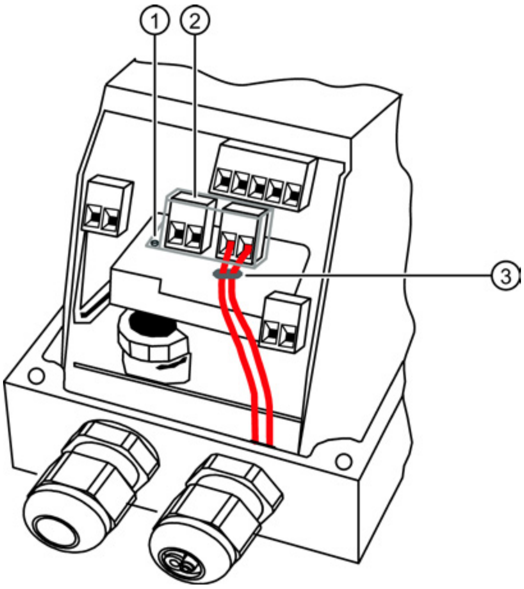
Figure 5-16 Limit contact module 6DR4004-6K (Ex i/Ex n/Ex t)

Connecting the limit contact module

Procedure

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

5. Tighten the screw ① on the transparent cover ②.
6. Connect the cables of each switch to the lug of the printed circuit board in pairs. Use the provided cable ties ③ for this purpose.



① Screw
② Cover
③ Cable tie

Figure 5-17 Connecting the cables

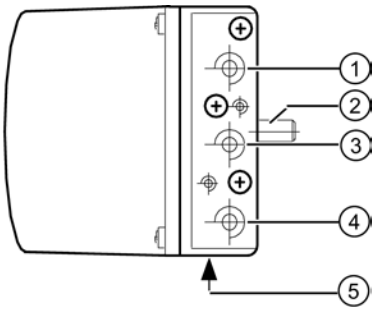
5.2 Pneumatic

5.2.1 Pneumatic connections

5.2.1.1 Pneumatic connection on the standard controller

Structure

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



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

Figure 5-18 Pneumatic connection on the standard controller

5.2.1.2 Integrated pneumatic connection

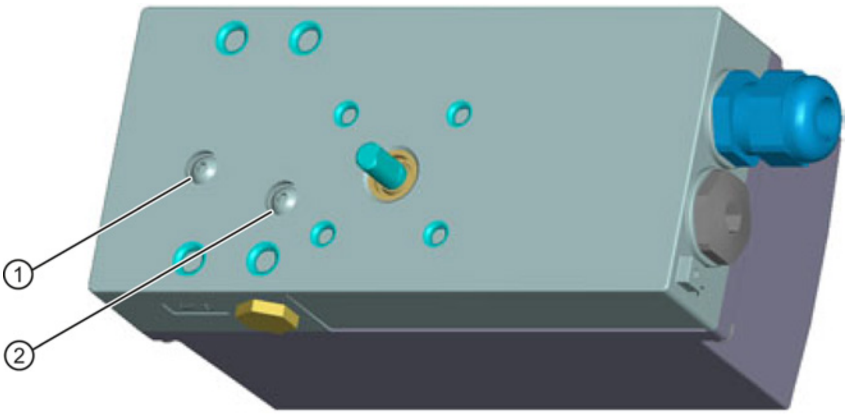
Structure

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

- Actuating pressure Y1
- Exhaust air outlet

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

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



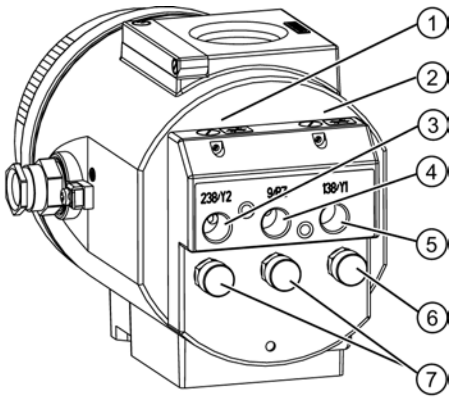
① Actuating pressure Y1
② Exhaust air outlet

Figure 5-19 Integrated pneumatic connection

5.2.1.3 Pneumatic connection in the flameproof enclosure

Structure

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



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

*) for double-acting actuators

Figure 5-20 Pneumatic connection in the flameproof enclosure

5.2.1.4 Pneumatic connection versions

Overview

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

- Actuating pressure Y1
- Exhaust air outlet

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

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

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

CAUTION

Before working on the control valve

Note that before working on the control valve, you must first move it to the safety position. Make sure that the control valve has reached the safety position. If you only interrupt the pneumatic auxiliary power supply to the positioner, the safety position may in some cases only be attained after a certain delay period.

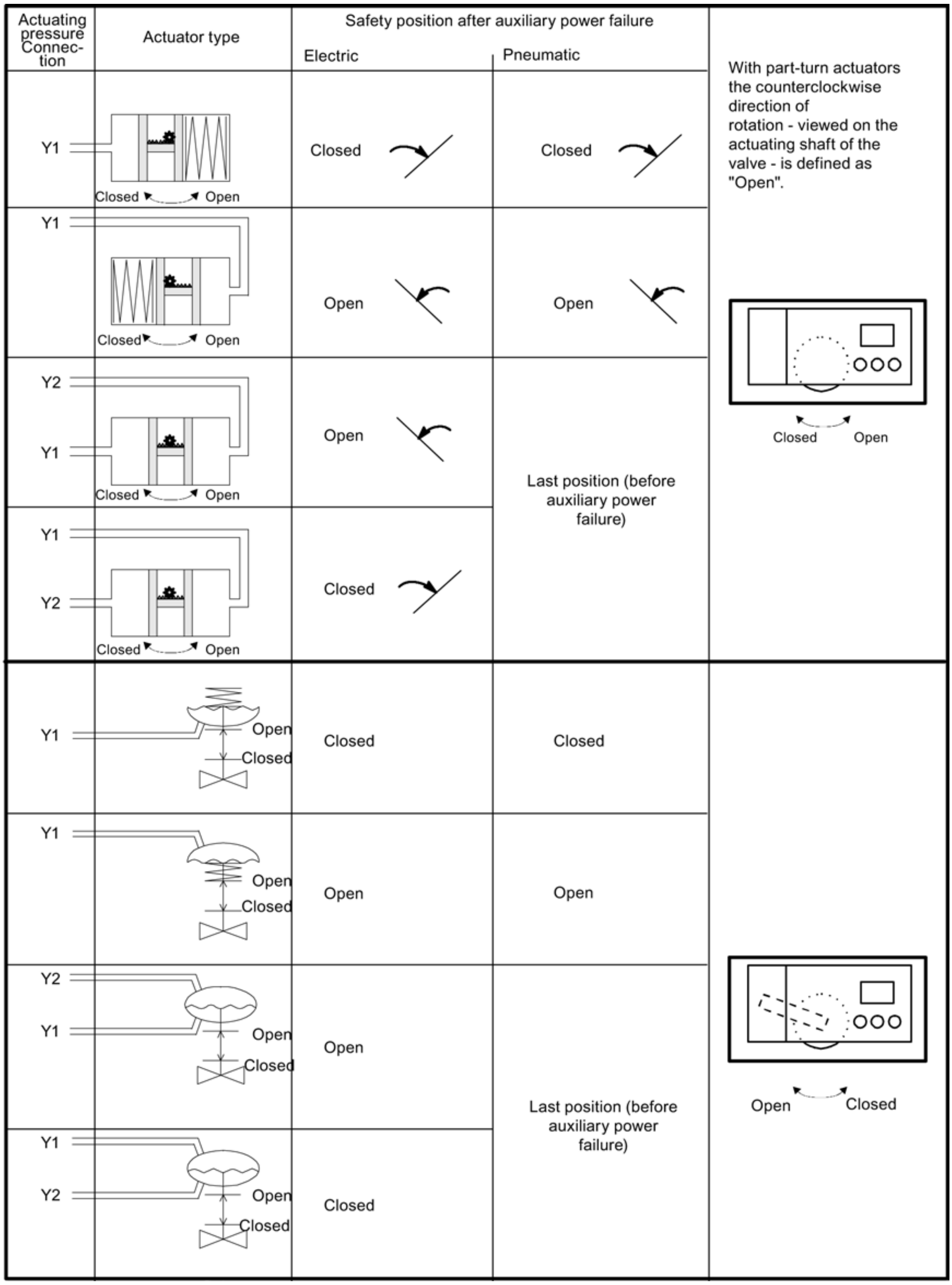


Figure 5-21 Regulating action of pneumatic connection

5.2.2 Pneumatic connection

WARNING

Pneumatic auxiliary power

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

Note

Specifications regarding air quality

Observe the specifications regarding the air quality, see section "Pneumatic data (Page 270)".

- If required, connect the pressure gauge block for supply air and actuating pressure.
- Connection via female thread G¼ or ¼" NPT:
  - Y1: actuating pressure 1 for single and double-acting actuators
  - Y2: actuating pressure 2 for double-acting actuators
  - Exhaust air outlet with a sound absorber at the bottom of the device. Remove the sound absorber if required.
  - P_Z: Supply air 1.4 to 7 bar
- 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, maximum actuating pressure
  - Y2: double-acting, depressurized

Note

Leakage

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.

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

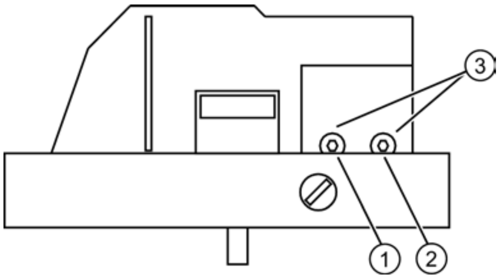
See also

Pneumatic connection versions (Page 95)

Changing the operating mode (Page 104)

5.3 Restrictors

- 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.



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

Figure 5-22 Restrictors

See also

Pneumatic connection in the flameproof enclosure (Page 94)

Sequence of automatic initialization (Page 115)

Operation 6

6.1 Operating elements

6.1.1 Display

Introduction

Note

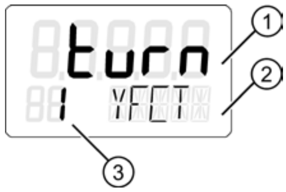
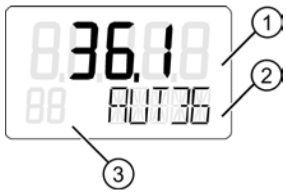
Repetition rate display

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

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

Display options as per the mode

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

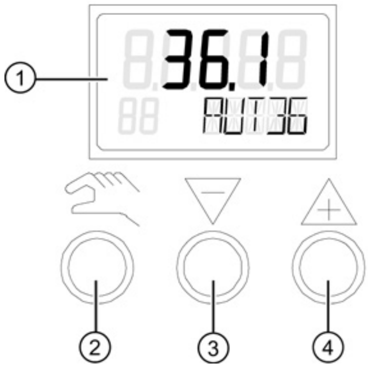
Operating mode	Representation in the display	Pos.	Legend
P manual mode		①	Potentiometer setting [%]
		②	Blinking indicator for the non-initialized status.
Initialization mode		①	Potentiometer setting [%]
		②	Display of the current status of initialization or a fault message.
		③	Indicator for ongoing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

See also

System messages before initialization (Page 233)

Changing the operating mode (Page 104)

6.1.2 Buttons



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

Figure 6-1 Display and buttons of the positioner

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

Note

Key cover

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

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

Note

Degree of protection

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

Function of buttons:

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

Note

Order

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

6.1.3 Firmware version

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

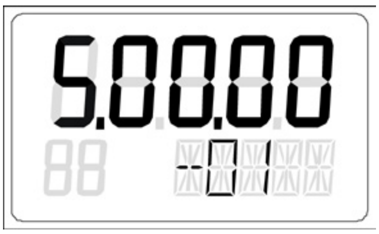


Figure 6-2 Firmware version, e.g. Version 5.00.00

6.2 Operating modes

6.2.1 Overview of operating modes

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

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

6.2.2 Changing the operating mode

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

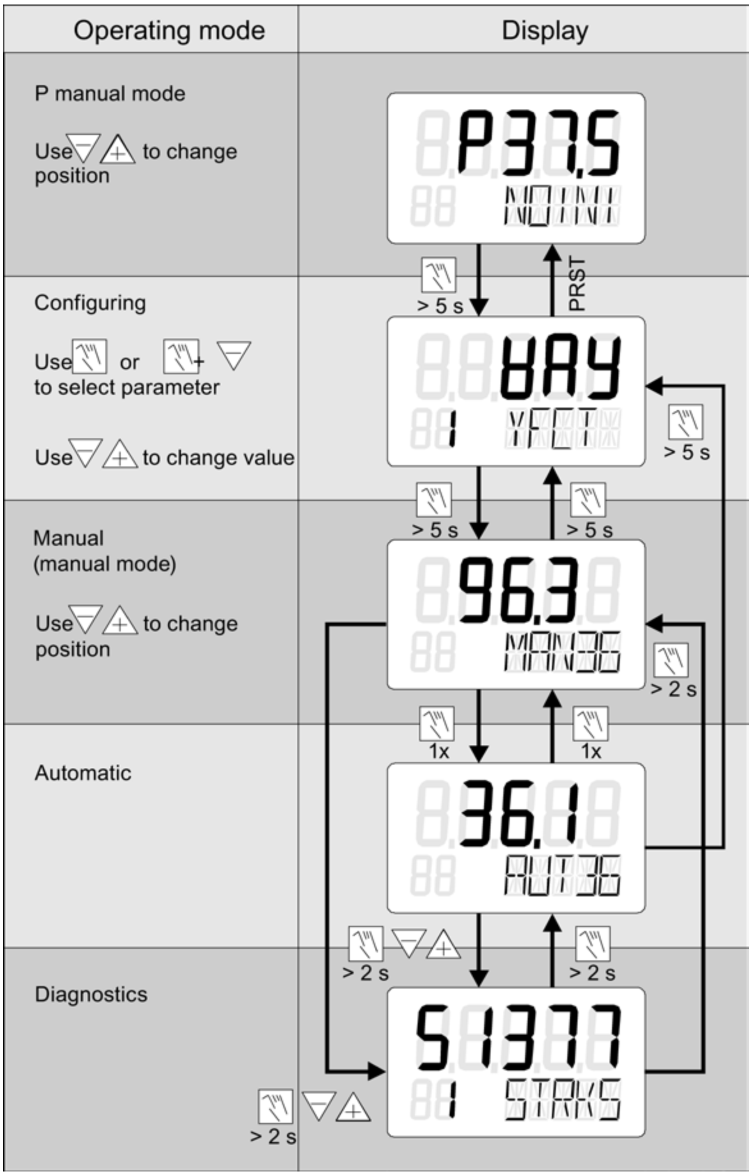


Figure 6-3 Switching between the operating modes

See also

Display (Page 99)

6.2.3 Overview of configuration

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

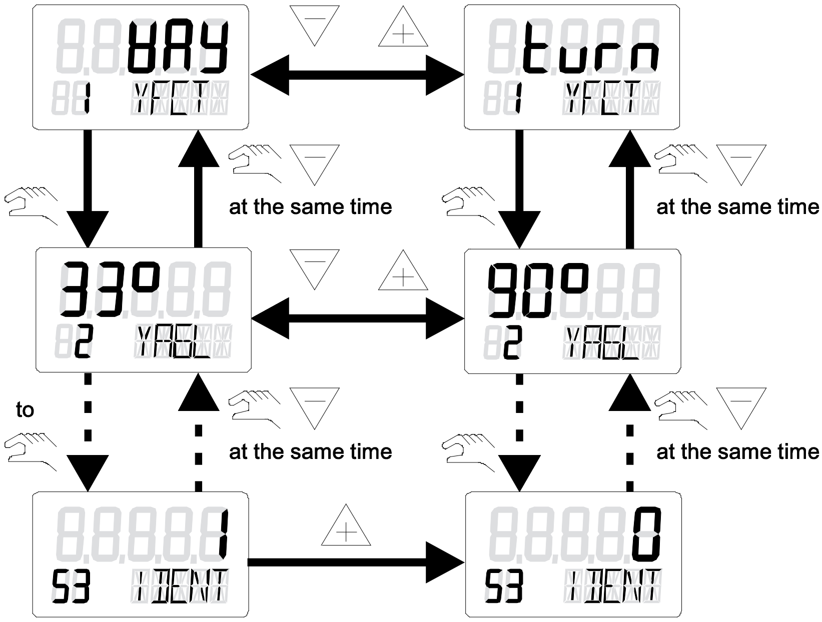


Figure 6-4 Overview of the "Configuration" operating mode

6.2.4 Description of operating modes

P manual mode

Note

Delivery state

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

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

Move to the actuator with the ▽ or △ buttons.

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

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

Configuration and initialization

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

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

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

Note

Failure of electrical auxiliary power

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

Manual mode (MAN)

In this mode, you move the actuator with ▽ or △. The setting selected here is retained irrespective of the setpoint current and leakages, if any.

Note

Accelerating the actuator movement

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

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

Note

Failure of power supply

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

Automatic (AUT)

Automatic is the standard mode. In this mode, the positioner compares the setpoint position with the actual position. The positioner moves the actuator until the control deviation reaches the configurable deadband. A fault message is displayed if the deadband cannot be reached.

Display	Mode	Meaning
OS	OOS	out of service; reaction: last position is retained.
IMN	IMAN	initialization manual mode
LO	LO	local override
MM	MAN	manual mode
AUT	AUTO	automatic mode
CAS	CAS	cascade mode
RCS	RCAS	remote cascade

Diagnostics

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

Press the three buttons of the positioner at the same time for at least 2 seconds.

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

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

Note

Setting the mode

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

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

See also

Commissioning (Page 111)

Description of parameters A to P (Page 172)

Overview of diagnostics values (Page 242)

Meaning of the diagnostics values (Page 244)

6.3 Optimizing the controller data

Note

Initializing

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

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

The data determined is optimized for a short transient time in 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, described in section "Operation with boosters (Page 301)"

Procedure

1. Select the parameters in the diagnostics menu. Press the three buttons of the positioner at the same time for at least 2 seconds.
2. Activate the setting function. Press the △ or ▽ button for at least 5 seconds.
3. When you change the selected parameter, it is immediately updated. The effects on the controller results can then be tested.

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

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.

Note

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 the area of mean control deviation. For more information on the slow step zone, refer to the chapter "Control algorithm (Page 27)".

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

NOTICE

Overshoots or too low speeds of shifting

Too small values can result in overshoots.

- Enter a higher value.

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

- Enter a smaller value.

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 have the following results:

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

Note

Reference variable

It is advantageous to use a fixed reference variable to optimize the control data. Therefore, change the deadband parameter from auto to a fixed value.

7 Commissioning

7.1 Basic safety instructions

WARNING

Improper commissioning in hazardous areas

Device failure or danger of explosion in hazardous areas.

- Do not commission the device until it has been mounted completely and connected in accordance with the information in Chapter "Technical data (Page 269)".
- Before commissioning take the effect on other devices in the system into account.

WARNING

Loss of explosion protection

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

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

WARNING

Opening device in energized state

Danger of explosion in areas subject to explosion hazard.

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

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

WARNING

Water in compressed air line

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

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

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

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

CAUTION

Loss of degree of protection

Damage to device if the enclosure is open or not properly closed. The degree of protection specified on the nameplate or in Chapter "Technical data (Page 269)" is no longer guaranteed.

- Make sure that the device is securely closed.

WARNING

Commissioning and operation with pending error

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

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

7.1.1 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 option 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.

   The maximum values for ventilation are listed in section "Technical data for natural gas as actuator medium (Page 277)".
4. The limit contact 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.

Note

Quality of natural gas

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

7.2 Overview

Note

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

Adjust the positioner as per the respective actuator with the help of the initialization process and by setting the parameters. If required, use the "PRST" parameter to cancel the adjustment of the positioner on the actuator. The positioner is again in the "P manual mode" after this process.

Types of initialization

You can initialize the positioner as follows:

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

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

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

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

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

See also

Overview of operating modes (Page 103)

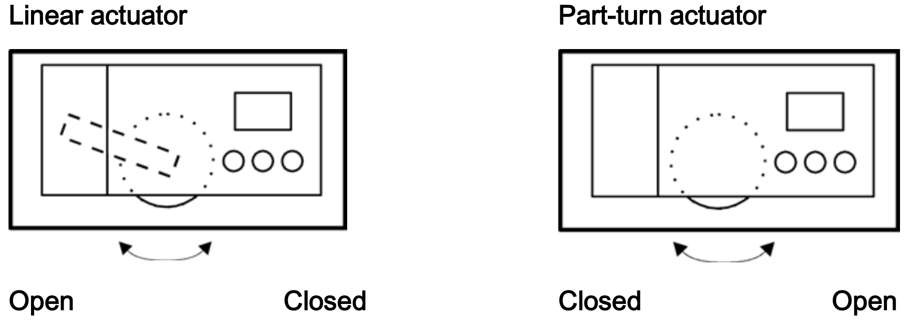
7.3 Sequence of automatic initialization

Overview

The automatic initialization takes place in the following phases:

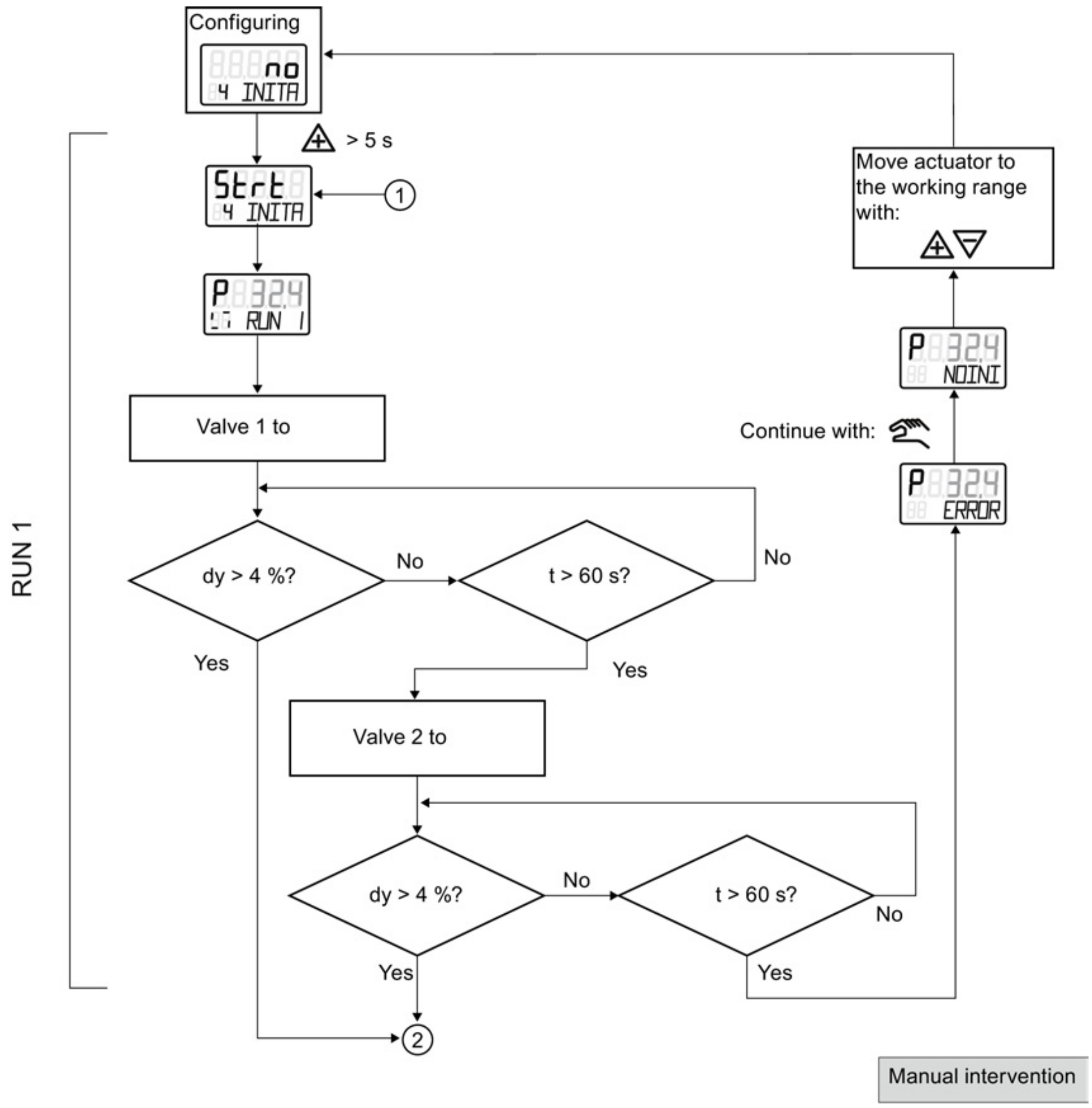
Automatic initialization phase	Description
Start	-
RUN1	Establishing the direction of action.
RUN2	Checking the actuator travel and trimming the zero point and the stroke.
RUN3	Establishing and display of the actuating time (leak monitoring)
RUN4	Minimization of controller increments
RUN5	Optimization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



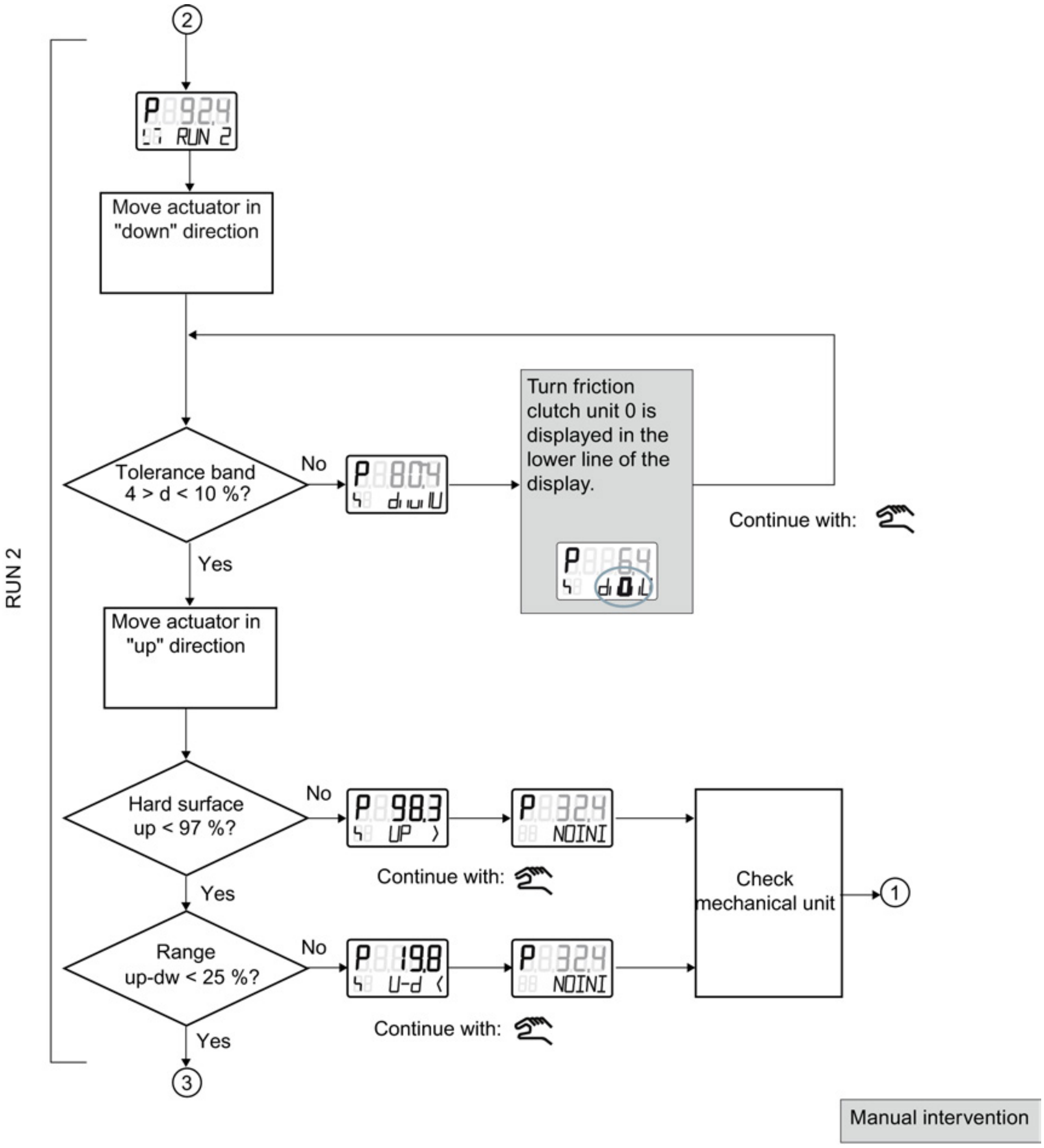
Sequence of RUN1

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



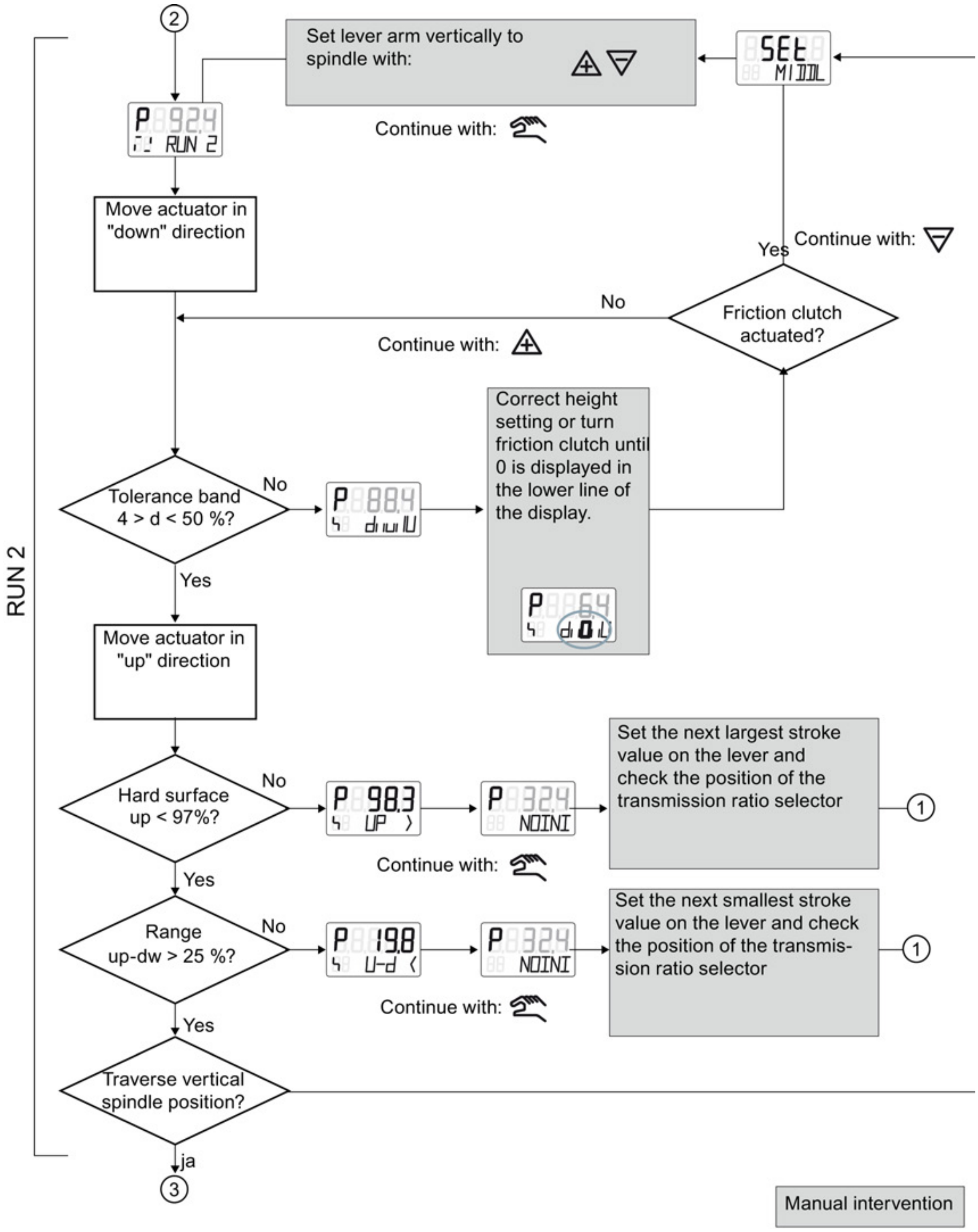
Sequence of RUN2 for part-turn actuators

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

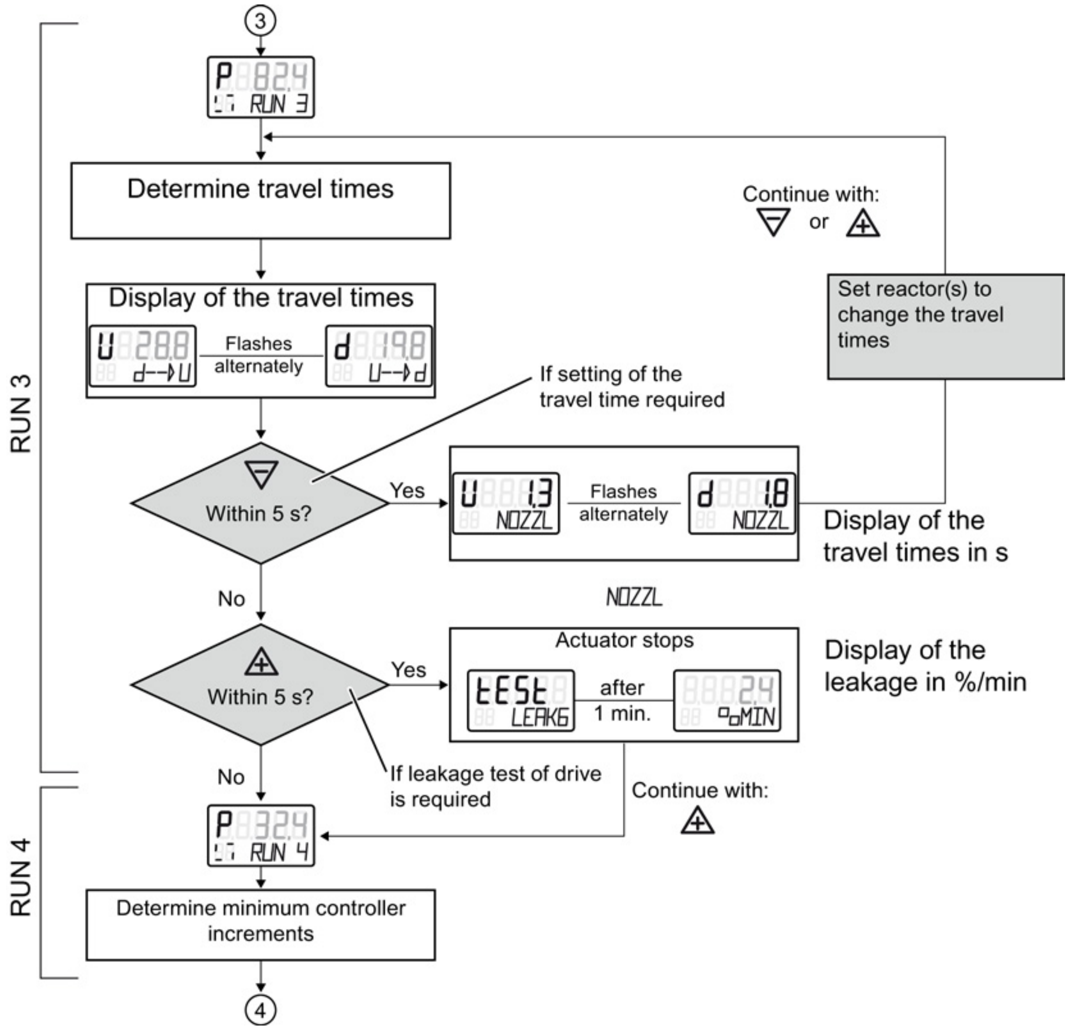
This structured chart describes the process to determine the actuator travel checks. It also contains the information about the sequence for trimming the zero point and the stroke.

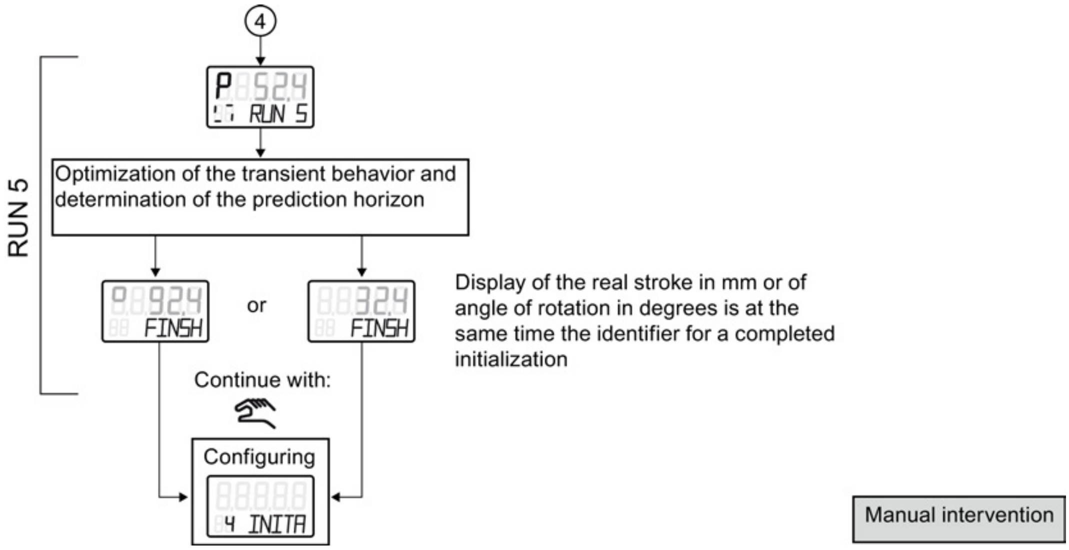


Sequence of RUN3 to RUN5

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

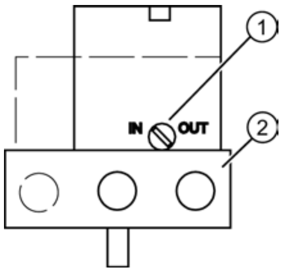



RUN 5
P 52.4
RUN 5
Optimization of the transient behavior and determination of the prediction horizon
92.4
FINSH
or
32.4
FINSH
Display of the real stroke in mm or of angle of rotation in degrees is at the same time the identifier for a completed initialization
Continue with:
Configuring
4 INITA
Manual intervention

7.4 Purge air switching

When the enclosure is open, the purge air switch above the pneumatic terminal strip on the pneumatic block can be accessed.

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



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

Figure 7-1 Purge air switch on the pneumatic block; view of the positioner on the pneumatic connection side when the cover is open

The factory setting is the "IN" position.

7.5 Commissioning the linear actuators

7.5.1 Preparing linear actuators for commissioning

Requirements

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

Setting the transmission ratio selector

Note

Commissioning

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

Stroke [mm]	Lever	Position of the transmission ratio selector	
		In [°]	Position
5 ... 20	Short	33	Down
15 ... 35	Short	90	Up
30 ... 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 drive to the respective end position for this purpose using the △ or ▽ button.

   Note

   End position

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

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

   Note

   The following is applicable for the flameproof enclosure version:

   The inner friction clutch is fixed. Therefore, only move the outer friction clutch.

See also

Device components (Page 24)

Installing the optional modules (Page 53)

7.5.2 Automatic initialization of linear actuators

Requirements

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

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

Initializing the linear actuator automatically

Note

Interrupting initialization

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

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

---

1. Switch to the "Configuration" mode. To do this, press the button for at least 5 seconds.

   The display shows the following:

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

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

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

Note

Set the "3.YWAY" parameter

Proceed as follows to set parameter 3:

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

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

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

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

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

Aborting the automatic initialization process

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

   The positioner is in the "Configuration" mode.

2. Exit the "Configuration" mode. To do this, press the button for at least 5 seconds.

   The software status is displayed.

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

7.5.3 Manual initialization of linear actuators

You can use this function to initialize the positioner without needing to move the actuator to the 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.

Requirements

The following requirements must be fulfilled before activating manual initialization:

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

Initializing the linear actuator automatically

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

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

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

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

Note

Set the "3.YWAY" parameter

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

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

---

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

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

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

7. Determine the end position 1 of the actuator spindle.
8. Move the actuator to the desired position using the or button.

9. Press the button. The current position of the actuator is applied. The display shows the following:

Note

Fault message "RANGE"

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

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

10. Determine the end position 2 of the actuator spindle. Move the actuator to the desired position using the or button.
11. Press the button. The current position of the actuator is applied.

Note

Fault message "Set Middl"

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

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

12. The initialization process is automatically resumed. Initialization steps "RUN1" to "RUN5" are output in the bottom line of the display. The following is displayed when the initialization has been completed successfully:

Note

Total stroke

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

Aborting the manual initialization process

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

7.6 Commissioning the part-turn actuators

7.6.1 Preparing part-turn actuators for commissioning

Note

Setting of the adjustment angle

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

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

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 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. Move the drive to the respective end position for this purpose using the △ or ▽ button.

   Note

   End position

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

   ---

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

See also

Device components (Page 24)

Installing the optional modules (Page 53)

7.6.2 Automatic initialization of part-turn actuators

Requirements

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

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

Initializing the part-turn actuator automatically

Note

Interrupting initialization

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

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

---

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

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

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

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

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

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

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

Aborting the automatic initialization process

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

   The positioner is in the "Configuration" mode.

2. Exit the "Configuration" mode. To do this, press the button for at least 5 seconds.

   The software status is displayed.

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

See also

Sequence of automatic initialization (Page 115)

7.6.3 Manual initialization of part-turn actuators

You can use this function to initialize the positioner without needing to move the actuator to the 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.

Requirements

The following requirements must be fulfilled before activating manual initialization:

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

Note

Setting of the adjustment angle

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

Initializing the positioner manually

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

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

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

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

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

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

7. Determine the end position 1 of the actuator.
8. Move the actuator to the desired position using the or button.
9. Press the button. The current position of the actuator is applied. The display shows the following:

Note

Fault message "RANGE"

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

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

---

10. Determine the end position 2 of the actuator. Move the actuator to the desired position using the or button.

11. Press the button. The current position of the actuator is applied.
12. The initialization process is automatically resumed. Initialization steps "RUN1" to "RUN5" are output in the bottom line of the display. The following display indicates that the initialization has been completed successfully:

Aborting the manual initialization process

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

7.7 Device replacement

Introduction

Note

Initialization

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

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

Note

Deferred initialization

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

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

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

First possibility - with communication

1. Read the initialization parameters from the previous positioner. Use the parameter assignment tools suitable for this purpose.
2. Read the initialization parameters from Point 1 into the new positioner.
3. Fix the actuator at its current position mechanically or pneumatically. Use the locking function of your mounting kit, if available.
4. Determine the actual position value. To do this, read the actual position value from the display of the previous positioner. Note down the read value.
5. Dismount the previous positioner from the actuator.
6. Attach the lever arm of the previous positioner to the new positioner.
7. Mount the new positioner on the actuator.
8. Set the transmission ratio selector of the new positioner to the same position as that of the previous positioner.
9. If the displayed actual position value differs from the noted value, correct the deviation by moving the friction clutch.

10. The new positioner is ready for operation when the displayed and noted values match.
11. Release the fixing of the actuator.

Second possibility - without communication

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

Note

Electronics defect

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

---

3. Dismount the previous positioner from the actuator.
4. Attach the lever arm of the previous positioner to the new positioner.
5. To prevent interference with the ongoing process, initialize the new positioner on an actuator with a similar stroke or swivel range. Attach the new positioner to this actuator. Initialize the new positioner.
6. Then dismount the new, initialized positioner from this actuator.
7. Mount the new, initialized positioner on the fixed actuator.
8. If the displayed actual position value differs from the noted value, correct the deviation by moving the friction clutch.
9. Use the buttons on the positioner to enter the parameters which deviate from the factory setting, such as type of actuator or tight closing.
10. Change to the measured value view using the mode button (manual button), see section "Description of operating modes (Page 105)".
11. Release the fixing of the actuator.

Functional safety 8

8.1 Range of applications for functional safety

The positioner is suitable for use on valves that satisfy the special requirements in terms of functional safety up to SIL 2 in accordance with IEC 61508 or IEC 61511. The 6DR5.1.-0....-....-Z C20 versions are available for this.

These are single-acting positioners for mounting on pneumatic actuators with spring return.

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

This positioner meets the following requirement:

- Functional safety up to SIL 2 in accordance with IEC 61508 or IEC 61511 for safe venting

See also

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

8.2 Safety function

Safety function on positioner

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

This safety function can be triggered by:

- The signal at the input for the safety shutdown (terminals 81 and 82) is < 4.5 V.
  This function is also referred to as "safety shutdown" in the device documentation.
- Failure of the auxiliary power supply via the bus connection.

The safety function is not effected by other device functions, particularly the microcontroller, software and communication interface. With respect to this safety function, the positioner must therefore be considered as a type A subsystem in accordance with EN 61508-2.

Situations in which it is not possible to depressurize the actuator on demand or in the case of a fault represent a dangerous failure.

WARNING

Disregarding conditions for fulfilling the safety function

Disregarding conditions can result in a malfunction of the process system or application, for example, process pressure too high, maximum level exceeded.

The mandatory settings and conditions are listed in chapters "Settings (Page 142)" and "Safety characteristics (Page 143)".

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

The pneumatic block of the positioner pressurizes and depressurizes the actuator. The pneumatic block contains two pilot valves. The characteristic service life of the pneumatic block depends on the load. On average it is approx. 200 million switching operations for each of the two pilot valves with symmetrical load. The number of control procedures for the switching operations is called in the local display or via HART communication. Refer to the diagnostics parameters "40 VENT1" and "41 VENT2" under the following "see also" link.

See also

Meaning of the diagnostics values (Page 244)

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

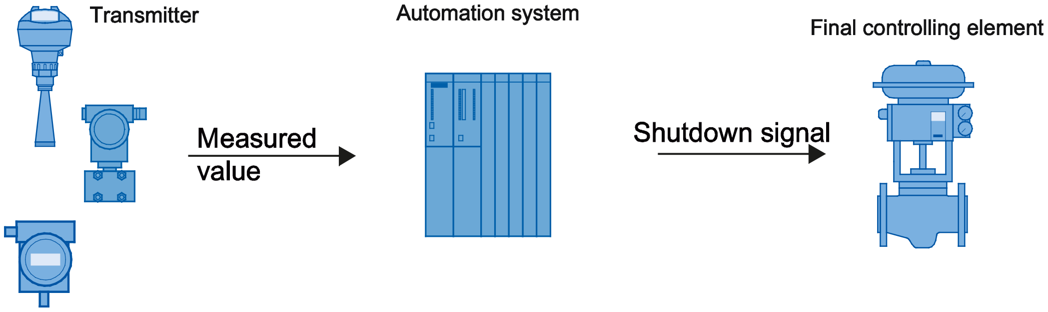


Figure 8-1 Safety-instrumented system in single-channel operation

The combination of transmitter, automation system and final controlling element forms a safety-instrumented system that performs a safety function.

The transmitter generates a process-related measured value that is transferred to the automation system. The automation system monitors this measured value. If the measured value exceeds the range of the high or low limit, the automation system generates a shutdown signal for the connected final controlling element, which switches the associated valve to the specified safety position.

8.3 Safety Integrity Level (SIL)

The international standard IEC 61508 defines four discrete Safety Integrity Levels (SIL) from SIL 1 to SIL 4. Every level corresponds to a probability range for the failure of a safety function.

Description

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

Table 8- 1 Safety Integrity Level

SIL	**Interval**
4	$10^{-5} \leq PFD_{AVG} < 10^{-4}$
3	$10^{-4} \leq PFD_{AVG} < 10^{-3}$
2	$10^{-3} \leq PFD_{AVG} < 10^{-2}$
1	$10^{-2} \leq PFD_{AVG} < 10^{-1}$

The "average probability of dangerous failures of the entire safety-instrumented system" (PFD_{AVG}) is normally split between the following three components:

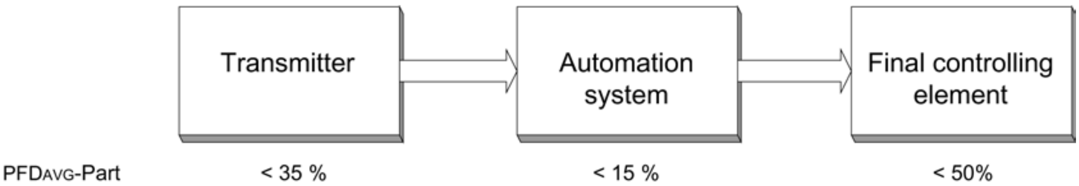


Figure 8-2 PFD distribution

The following table shows the achievable Safety Integrity Level (SIL) for the entire safety-instrumented system for type A devices depending on the safe failure fraction (SFF) and the hardware fault tolerance (HFT).

- Type A devices include analog transmitters and shut-off valves **without** complex components, e.g. microprocessors (see also IEC 61508, Section 2).
- The specific values for your device are listed in the manufacturer's declaration (Declaration of Conformity, Functional Safety according to IEC 61508 and IEC 61511): Certificates (http://www.siemens.com/processinstrumentation/certificates).

SFF	**HFT for type A devices**		
	0	**1**	**2**
< 60 %	SIL 1	SIL 2	SIL 3
60 to 90 %	SIL 2	SIL 3	SIL 4
90 to 99 %	SIL 3	SIL 4	SIL 4
> 99 %	SIL 3	SIL 4	SIL 4

8.4 Settings

WARNING

Safety function: Positioning "Jumper" on the basic electronics

The safety function is not activated in the delivered state; the "Jumper" is in the "Normal" position. "Normal" means: Without safety function, no depressurizing of the connected actuator. To activate the safety function, proceed as follows:

- Insert the "Jumper" in the left position facing the terminals. This corresponds to the position "Shut Down enabled" on the wiring diagram present on the module cover, see "Auto-Hotspot".

Or

- Remove the "Jumper" from the basic electronics.

Special parameter settings are not necessary.

Protection against configuration changes

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

Checking the safety function

Prerequisite for checking the safety function

- Positioner is in operation.
- The actuator belonging to the positioner is **not** in the safety position.

Procedure

1. In order to test the safety shutdown, apply a LOW level, i.e. a voltage of maximum 4.5 V, to the input for the safety shutdown.
2. Verify that the valve returns to the safety position.
3. In order to test the response of the actuator, apply a HIGH level, i.e. a voltage >13 V, to the input for the safety shutdown.
4. Set the setpoint to 50% using a local operation (manual operation) or bus communication.
5. Reduce the intake pressure (P_z) to a third of the maximum supply pressure.
6. Verify that the valve returns to the safety position.
7. Check the filters in the pneumatic connections for contamination and clean them if necessary.

8.5 Safety characteristics

The safety characteristics necessary for use of the system are listed in the SIL declaration of conformity. These values apply under the following conditions:

- The positioner is only used in applications with low demand rate for the "Low demand mode".
- "Jumper" on the basic electronic system was plugged into the left position facing the terminals at position "Shut Down enabled" or removed completely.
- The positioner is blocked against unwanted and unauthorized changes/operation.
- The shut-off signal for the positioner is generated at the input for the safety shutdown (terminals 81 and 82) by a safe system which meets at least SIL 2. The LOW level has a maximum of 4.5 V at the input terminals.
- The connected actuator must be singe-acting and return the valve to the safe end position by spring force in the following scenario:
  - At a chamber pressure (Y1 connection) up to a third of the maximum available intake pressure (P_z connection)
- The air outlet does not contain any additional cross-sectional contractions leading to an increased dynamic pressure. In particular, a silencer is only allowed if icing or other contamination is ruled out.
- The restrictor in the Y1 circuit may not be completely closed during operation.
- The auxiliary pneumatic power is free of oil, water and dirt in line with:

  DIN/ISO 8573-1, maximum class 2
- The average temperature viewed over a long period is 40 °C.
- Fault rates are calculated on the basis of a mean time to repair (MTTR) of 8 hours.
- In case of a fault, the pneumatic outlet of the positioner is depressurized. A spring in the pneumatic actuator must move the valve to the pre-defined, safe end position.
- A dangerous failure of the positioner is when the pressure outlet is not depressurized, or the safety position is not reached, with a LOW level of maximum 4.5 V at the input for the safety shutdown.

9 Parameter assignment/Addressing

9.1 Overview of the parameters

9.1.1 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

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Note

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

Overview

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

[1] Set the transmission ratio selector accordingly.

[2] The parameter only appears for "WAY" and for "ncSLL".

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

See also

Commissioning (Page 111)

9.1.2 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	
			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 manipulated variables				
		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**	%

Overview of the positioner parameters 6 to 53					
Parameter	**Function**		**Parameter values**		**Unit**
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	
40.AFCT 3)	Alarm function		**Normal**	**Inverted**	
		none	**OFF**		
		A1 = Min, A2 = Max	MI MA	-MI -MA	
		A1 = Min, A2 = Min	MI MI	-MI -MI	
		A1 = Max, A2 = Max	MA MA	-MA -MA	
41.A1	Response threshold alarm 1		0.0 ... **10.0** ... 100		%
42.A2	Response threshold alarm 2		0.0 ... **90.0** ... 100		%
43. ϟFCT 3)	Fault message output function		**Normal**	**Inverted**	
		Fault	ϟ	-ϟ	
		Fault + not automatic 4)	ϟnA	-ϟnA	
		Fault + not automatic + BE4)	ϟnAb	-ϟnAb	
44. ϟTIM	Monitoring period for setting the fault message "Control deviation"		**Auto** / 0 ... 100		s

Overview of the positioner parameters 6 to 53				
Parameter	**Function**		**Parameter values**	**Unit**
45. ϟLIM	Response threshold of the fault message "Control deviation"		**Auto** / 0 ... 100	%
46. ϟSTRK	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 advanced 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**	
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" means: Operation when a switch is open or Low level
"Normally open" means: Operation when a switch is closed or High level

3) "Normal" means: High level, no fault message
"Inverse" means: Low level, no fault message

4) "+" means: OR logic combination

5) Preset effects "NOINI"!

9.1.3 Overview parameters A to P

Introduction

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

Note

Factory setting

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

Note

Display

Parameters A to P and their sub-parameters are only displayed when the extended diagnostics has been activated using parameter "XDIAG" with parameter value "On1", "On2" or "On3".

Overview parameter A

Parameter	Function	Parameter values	Unit
A.ϟPST	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	Stroke magnitude	0.1 ... **10.0** ... 100.0	%
A4.STEPD	Stroke direction	uP / **do** / uP do	
A5.INTRV	Test interval	**OFF** / 1 ... 365	Days
A6.PSTIN	Reference stroke time for partial stroke test	**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.ϟDEVI	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.ϟLEAK	Pneumatic leakage with the following parameters:		
C1.LIMIT	Limit	0.1 ... **30.0** ... 100.0	%
C2.FACT1	Factor 1	0.1 ... **1.0** ... 100.0	
C3.FACT2	Factor 2	0.1 ... **1.5** ... 100.0	
C4.FACT3	Factor 3	0.1 ... **2.0** ... 100.0	

Overview parameter d

Parameter	Function	Parameter values	Unit
d.ϟSTIC	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.ϟDEBA	Deadband monitoring with the following parameters:		
E1.LEVL3	Threshold	0.1 ... **2.0** ... 10.0	%

Overview parameter F

Parameter	Function	Parameter values	Unit
F.ϟZERO	Zero point monitoring with the following parameters:		
F1.LEVL1	Threshold 1	0.1 ... **1.0** ... 10.0	%
F2.LEVL2	Threshold 2	0.1 ... **2.0** ... 10.0	
F3.LEVL3	Threshold 3	0.1 ... **4.0** ... 10.0	

Overview parameter G

Parameter	Function	Parameter values	Unit
G.ϟOPEN	Displacement of the upper stop with the following parameters:		
G1.LEVL1	Threshold 1	0.1 ... **1.0** ... 10.0	%
G2.LEVL2	Threshold 2	0.1 ... **2.0** ... 10.0	
G3.LEVL3	Threshold 3	0.1 ... **4.0** ... 10.0	

Overview parameter H

Parameter	Function	Parameter values		Unit
H.ϟTMIN	Monitoring of the lower limit temperature with the following parameters:			
H1.TUNIT	Temperature unit	**°C**	°F	°C/°F
H2.LEVL1	Threshold 1	-40 ... **-25** ... 90	-40 ... 194	
H3.LEVL2	Threshold 2	-40 ... **-30** ... 90	-40 ... 194	
H4.LEVL3	Threshold 3	**-40** ... 90	-40 ... 194	

Overview parameter J

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

Overview parameter L

Parameter	Function	Parameter values	Unit
L.ϟSTRK	Monitoring the path integral with the following parameters:		
L1. LIMIT	Limit for the number of changes of direction	1 ... **1E6** ... 1E8	
L2.FACT1	Factor 1	0.1 ... **1.0** ... 40.0	
L3.FACT2	Factor 2	0.1 ... **2.0** ... 40.0	
L4.FACT3	Factor 3	0.1 ... **5.0** ... 40.0	

Overview parameter O

Parameter	Function	Parameter values	Unit
O.ϟDCHG	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.ϟPAVG	Position mean value calculation with the following parameters:		
P1.TBASE	Time base of the mean value generation	**0.5h** / 8h / 5d / 60d / 2.5y	
P2.STATE	State of the position mean value calculation	**IdLE** / rEF / ###.# / Strt	
P3.LEVL1	Threshold 1	0.1 ... **2.0** ... 100.0	%
P4.LEVL2	Threshold 2	0.1 ... **5.0** ... 100.0	%
P5.LEVL3	Threshold 3	0.1 ... **10.0** ... 100.0	%

9.2 Description of parameters

9.2.1 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.

  The subsequent 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 positioner 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 positioner 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 sensor on a part-turn actuator.

- YFCT = -ncSt

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

- YFCT = ncSL

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

- YFCT = ncSLL

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

  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 m
- 90° for strokes > 20 m

Both angles are possible if the lever up to 35 mm stroke is used. The long lever with a stroke greater than 35 mm is intended for an angle of 90°. The long lever is not part of the mounting kit 6DR4004-8V. Order the long lever separately using order number 6DR4004-8L.

The "YFCT = turn" parameter value sets an angle of 90° automatically for 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 display does not match the actual position.

The factory setting is "33°".

9.2.1.1 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 button for at least 5 seconds. The sequence of the initialization process from "RUN1" to "RUN5" is output in the bottom line of the display.

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 △ button for at least 5 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. To do this, press the ▽ button for at least 5 seconds.

The factory setting is "NOINI".

9.2.2 Description of parameters 6 to 53

9.2.2.1 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".

See also

Description of parameters 7 and 8 (Page 157)

9.2.2.2 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".

9.2.2.3 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. Refer to the pictures you can find in chapter "Description of parameters 10 to 30 (Page 159)".

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

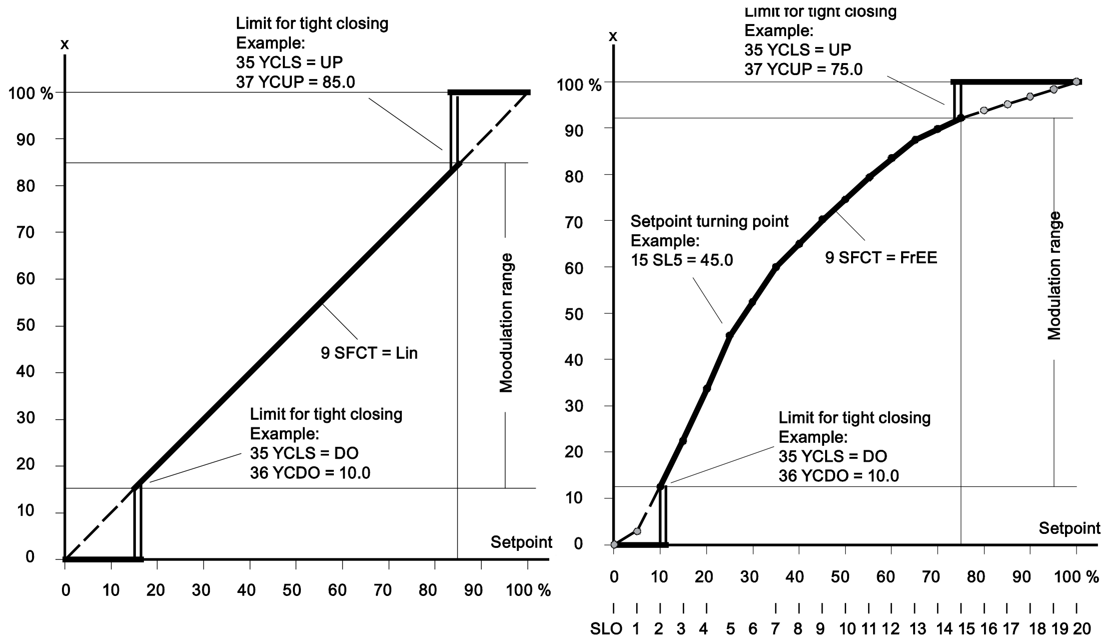
Valve characteristic curve		Setting with parameter value
Linear		Lin
Equal percentage	1:25	1-25
Equal percentage	1:33	1-33
Equal percentage	1:50	1-50
Inverse equal percentage	25:1	n1-25
Inverse equal percentage	33:1	n1-33
Inverse equal percentage	50:1	n1-50
Freely adjustable		FrEE

The factory setting is "Lin".

9.2.2.4 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 158)

9.2.2.5 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".

9.2.2.6 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".

9.2.2.7 Description of parameter 34

YNRM - Normalization of manipulated variable

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

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

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

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

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

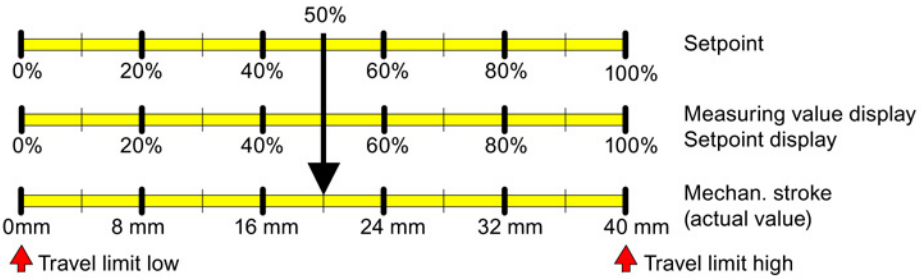


Figure 9-1 YNRM = MPOS or YNRM = FLOW; default: YA = 0 % and YE = 100 %

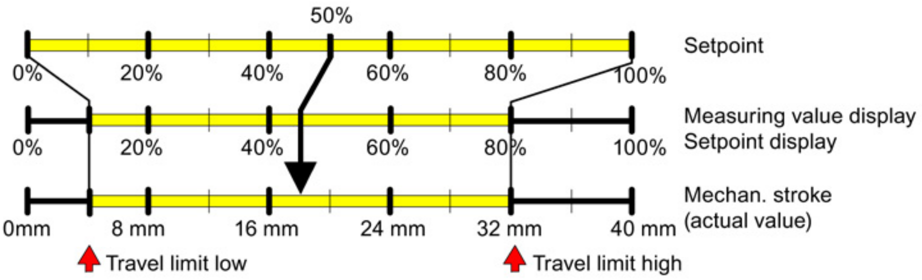


Figure 9-2 Example: YNRM = MPOS with YA = 10 % and YE = 80 %

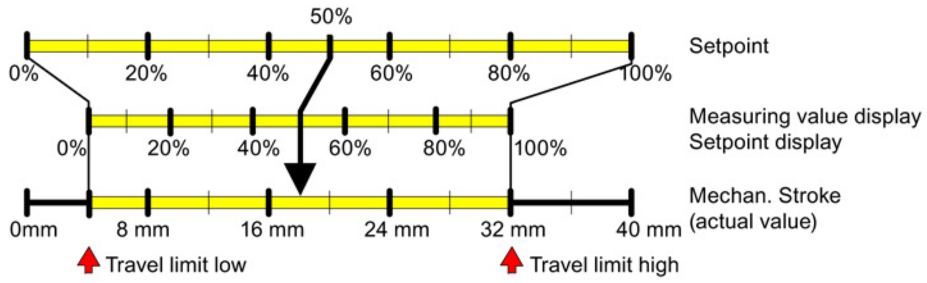


Figure 9-3 Example: YNRM = FLOW with YA = 10 % and YE = 80 %

The factory setting is "MPOS".

See also

Description of parameters 32 and 33 (Page 160)

Description of parameter 35 (Page 162)

9.2.2.8 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 at or below "36.YCDO" or at or above "37.YCUP". See the picture in chapter "Description of parameters 10 to 30 (Page 159)".

Note

Activated tight closing function

If the tight closing function is activated, then for parameter "45.ᛋLIM" the monitoring of regulation deviation is turned off in the appropriate overflow direction. "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.ᛋZERO" and "G.ᛋOPEN" parameters.

The factory setting is "no".

9.2.2.9 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 162)

9.2.2.10 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".

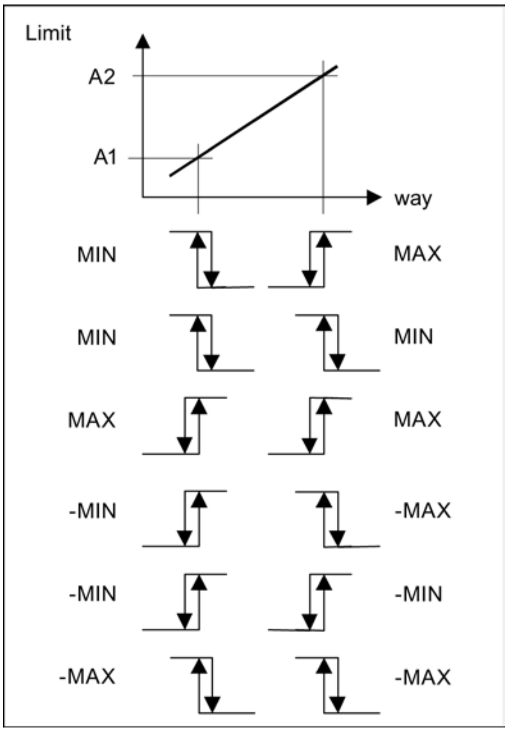
9.2.2.11 Description of parameter 40

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**	
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 48 (Page 169)

9.2.2.12 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".

9.2.2.13 Description of parameter 43

43.ϟFCT - 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
- Compressed air failure
- Threshold 3 error message of advanced diagnostics.

  See Description of parameter 48 (Page 169) , 48.XDIAG - Activating advanced diagnostics.

Note that the fault message cannot be switched off. It can however be suppressed (factory setting) when you switch over to "No automatic mode". If you also want to generate a fault message here, you will need to 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 "-ϟ" setting if you want the fault message output inverted on the alarm or SIA module.

The factory setting is "ϟ".

9.2.2.14 Description of parameter 44

44.ϟTIM - 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.ϟLIM" 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.ϟLIM" 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.ϟZERO" and "G.ϟOPEN" parameters.

The factory setting is "Auto".

9.2.2.15 Description of parameter 45

45.ϟLIM - 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.ϟTIM" and "45.ϟLIM" 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.ϟLIM" 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.ϟZERO" and "G.ϟOPEN" parameters.

The factory setting is "Auto".

9.2.2.16 Description of parameter 46

46.ϟSTRK - 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" and was applied for compatibility reasons.

If the configured limit is exceeded, the bit "CB_TOT_VALVE_TRAV" is set in the profile parameter "CHECK_BACK".

This function enables preventive maintenance of the control valve.

Note

Path integral

The path integral can also be monitored by the advanced diagnostics. Refer to chapter "Description of parameter 48 (Page 169).XDIAG - activation of advanced diagnostics" and chapter "Description of parameter L (Page 186) .STRK - monitoring the path integral".

The factory setting is "1E9".

9.2.2.17 Description of parameter 47

47.PRST - Preset

Use this parameter to restore the factory settings. To do this, press the △ button for at least 5 seconds.

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

We recommend that you restore factory settings when you have changed many parameters at once without being able to predict their effect and undesired reactions have occurred as a result.

Not all parameters are set to the factory setting if "no" is shown on the display. All parameters are set to the factory setting if "oCAY" is shown on the display.

Note

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

9.2.2.18 Description of parameter 48

48.XDIAG - activation of advanced diagnostics

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

- On1: Advanced diagnostics is activated. Threshold 3 error messages are output via the fault message output.
- On2: advanced diagnostics is activated. The threshold 2 error messages are activated via alarm output 2. Threshold 3 error messages are also output via the fault message output.
- On3: advanced diagnostics is activated. Threshold 1 error messages are activated via alarm output 1. Threshold 2 error messages are activated via alarm output 2. Threshold 3 error messages are also output via the fault message output.

Note

Activation of advanced diagnostics

Please note that the parameters of advanced diagnostics from "A.ϟPST" to "P.ϟPAVG" will only be shown on the display after one of the modes "On1" to "On3" has been selected.

In the factory settings, parameters "A.ϟPST" to "P.ϟPST" are deactivated by default. Parameter "48.XDIAG" is set to "OFF". The corresponding parameters are only displayed after you activate the appropriate 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 display as follows:

Figure 9-4 Display of a threshold 1 fault message

Figure 9-5 Display of a threshold 2 fault message

Figure 9-6 Display of a threshold 3 fault message

The factory setting is "OFF".

See also

Description of parameter A (Page 172)

XDIAG parameter (Page 253)

9.2.2.19 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 configured safety setpoint. This value also becomes effective following failure of the auxiliary power supply.
- FSSP:
  the actuator is controlled using the last effective setpoint.
- FSAC:
  the positioner responds in the same way as when the auxiliary power supply fails, see Figure 5-21 Regulating action of pneumatic connection (Page 96).

The factory setting is "FSAC".

See also

Pneumatic connection versions (Page 95)

9.2.2.20 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".

9.2.2.21 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 157)

9.2.2.22 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".

9.2.2.23 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 206)

9.2.3 Description of parameters A to P

9.2.3.1 Description of parameter A

A.ϟPST - partial stroke test

Use this parameter to activate the partial stroke test for cyclic or manual testing of open/closed and control 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 - starting position

Use this sub-parameter to define the starting position of the partial stroke test in percent. To this end, set the starting position within a range from "0.0" to "100.0".

The factory setting is "100.0".

A2.STTOL - starting tolerance

Use this sub-parameter to define the starting tolerance of the partial stroke test in percent. Set the starting tolerance relative to the starting position in a range from "0.1" to "10.0".

Example: You have set 50% as a starting position and 2% as a starting 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 - stroke magnitude

Use this sub-parameter to define the stroke magnitude of the partial stroke test in percent. To this end, set the stroke magnitude within a range from "0.1" to "100.0".

The factory setting is "10.0".

A4.STEPD - stroke direction

Use this sub-parameter to set the stroke 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 starting position to the target position without control.
- After reaching the target position, the actuator moves back to the starting position in a controlled manner.

The target position is determined from the starting position **plus** the stroke magnitude.

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 starting position to the upper target position without control.
- Then, the actuator moves from the upper target position to the lower target position without control.
- After reaching the lower target position, the actuator moves back to the starting position in a controlled manner.

The upper target position is determined from the starting position **plus** the stroke magnitude. The lower target position is determined from the starting position **minus** the stroke magnitude.

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 stroke time (PSTIN = partial stroke test initialization)

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

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

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

Set the sub-parameters "A1" to "A5" as per your requirements. Then start measuring the reference stroke time by pressing the △ button for at least 5 seconds. The display shows "rEAL" during these 5 seconds.

The device then moves to the configured starting position automatically and executes the desired stroke. The current position in percent is continuously shown on the display. "inPST" for "initialize partial stroke test" appears in the lower line of the display. When the test is completed, the measured reference stroke time in seconds is shown. "Fdini" is displayed if the starting position cannot be approached or the stroke 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 stroke time and "A7.FACT1". The process to determine the reference stroke time is described under "A6.PSTIN".

The threshold 1 error message is displayed when the limit threshold 1 is exceeded. The procedure to activate and display this error 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 stroke time and "A8.FACT2". The process to determine the reference stroke time is described under "A6.PSTIN".

The threshold 2 error message is displayed when the limit threshold 2 is exceeded. The procedure to activate and display this error 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 stroke time and "A9.FACT3". The process to determine the reference stroke time is described under "A6.PSTIN".

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

If the time threshold is exceeded, 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 error message is reported, and the actuator is moved back to its starting position.

The factory setting is "5.0".

See also

Description of parameter 48 (Page 169)

9.2.3.2 Description of parameter b

b.ϟDEVI - 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".

9.2.3.3 Description of parameter C

C.ϟLEAK - pneumatic leakage

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.

Note

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". If no leakage exists, the leakage detection is automatically calibrated in such a way during the initialization (see chapter "Commissioning (Page 111)") that the leakage indicator remains below the value 30. If a value above 30 is displayed, this means that a leakage exists. "30.0" is therefore an advisable setting for the parameter. After a certain time this limit can be varied slightly depending on the application. To optimize the sensitivity of the leakage detection to your specific application, follow these steps:

1. After initializing the positioner automatically, use a calibration device to initiate a ramp movement.
2. Conditions for the ramp movement:
   - The ramp covers the normal operating range of the valve.
   - The steepness of the ramp matches the dynamic requirements of the corresponding application.
   - The characteristic of the ramp corresponds to the characteristic of the setpoint that actually occurs.
3. During the ramp movement, the "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 error message is displayed when the limit threshold 1 is exceeded. The procedure 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 error message is displayed when the limit threshold 2 is exceeded. The procedure 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 error message is displayed when the limit threshold 3 is exceeded. The procedure to activate and display this fault message is described in the "XDIAG" parameter.

The factory setting is "2.0".

9.2.3.4 Description of parameter d

d.ϟSTIC - 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. Sudden changes in the valve position, so-called slip jumps, indicate excessive friction. If slip jumps are detected, the filtered stroke magnitude 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 an error 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 error message is displayed when the limit threshold 1 is exceeded. The process to activate and display this error 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 error message is displayed when the limit threshold 2 is exceeded. The process to activate and display this error 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 error message is displayed when the limit threshold 3 is exceeded. The process to activate and display this error message is described in the "XDIAG" parameter.

The factory setting is "10.0".

9.2.3.5 Description of parameter E

E.ϟDEBA - deadband monitoring

Use this parameter to activate the "deadband monitoring" test. This test can be used to monitor the automatic adjustment of deadbands continuously.

Configure the following settings to activate the test:

1. Ensure that the "34.DEBA" parameter is set to "Auto".
2. Set the "E.ϟDEBA" 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 deadband exceeds the configured limit threshold during the test.

The factory setting is "OFF".

E1.LEVL3 - threshold for monitoring the deadband adjustment

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

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

Note

Fault message display

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

The factory setting is "2.0".

9.2.3.6 Description of parameter F

F.ϟZERO - zero point displacement

Note

Fault detection

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

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

Configure the following settings to activate the test:

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

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

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

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

The factory setting is "OFF".

F1.LEVL1 - threshold 1

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

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

The factory setting is "1.0".

F2.LEVL2 - threshold 2

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

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

The factory setting is "2.0".

F3.LEVL3 - threshold 3

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

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

The factory setting is "4.0".

9.2.3.7 Description of parameter G

G.ϟOPEN - 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.ϟOPEN" 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.ϟOPEN" 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".

9.2.3.8 Description of parameter H

H.ϟTMIN - monitoring the lower limit temperature

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

Configure the following settings to activate the test:

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

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

The factory setting is "OFF".

H1.TUNIT - temperature unit

Use this sub-parameter to set the temperature unit "°C" or "°F". The selected temperature unit is then also applicable for all other temperature-based parameters.

The factory setting is "°C".

H2.LEVL1 - threshold 1

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

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

The factory setting is "-25.0C".

H3.LEVL2 - threshold 2

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

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

The factory setting is "-30.0C".

H4.LEVL3 - threshold 3

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

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

The factory setting is "-40.0C".

9.2.3.9 Description of parameter J

J.ϟTMAX - monitoring the upper limit temperature

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

Configure the following settings to activate the test:

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

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

The factory setting is "OFF".

J1.TUNIT - temperature unit

Use this sub-parameter to set the temperature unit "°C" or "°F". The selected temperature unit is then also applicable for all other temperature-based parameters.

The factory setting is "°C".

J2.LEVL1 - threshold 1

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

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

The factory setting is "75.0C".

J3.LEVL2 - threshold 2

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

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

The factory setting is "80.0C".

J4.LEVL3 - threshold 3

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

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

The factory setting is "90.0C".

9.2.3.10 Description of parameter L

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

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

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

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

The factory setting is "OFF".

L1.LIMIT - limit for the number of strokes

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

The factory setting is "1.00E6".

L2.FACT1 - factor 1

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

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

The factory setting is "1.0".

L3.FACT2 - factor 2

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

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

The factory setting is "2.0".

L4.FACT3 - factor 3

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

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

The factory setting is "5.0".

See also

Display of diagnostics values (Page 241)

9.2.3.11 Description of parameter O

O.ϟDCHG - monitoring the change of direction

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

Configure the following settings to activate the test:

1. Set the "O.ϟDCHG" 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 error message is displayed when the limit threshold 1 is exceeded. The procedure to activate and display this error 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 error message is displayed when the limit threshold 2 is exceeded. The procedure to activate and display this error 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 error message is displayed when the limit threshold 3 is exceeded. The procedure to activate and display this error message is described in the "XDIAG" parameter.

The factory setting is "5.0".

See also

Display of diagnostics values (Page 241)

9.2.3.12 Description of parameter P

P.ϟPAVG - 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.ϟPAVG" 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 an error 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, the parameter value is "IdLE".

Then start the calculation by pressing the △ button for 5 seconds. The value in the display changes from "IdLE" to "rEF". The reference average is calculated.

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

Note

Current position average

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 an error message if the difference between the position average and the reference average exceeds threshold 1. The procedure to activate and display this error 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 an error message if the difference between the position average and the reference average exceeds threshold 2. The procedure to activate and display this error 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 an error message if the difference between the position average and the reference average exceeds threshold 3. The procedure to activate and display this error message is described in the "XDIAG" parameter.

The factory setting is "10.0".

Functions/operations using PROFIBUS PA 10

10.1 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.

10.2 Acyclic data transfer

10.2.1 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.

10.2.2 "Device" menu

10.2.2.1 Communication path

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

10.2.2.2 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 10-1 Load into devices

10.2.2.3 Load into PG/PC

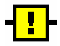
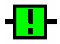
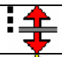
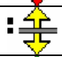
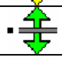
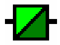
Use this sub-menu to read the parameters from the positioner. These parameters are then displayed using SIMATIC PDM. This function can also be called using the following icon.

Figure 10-2 Load into PG/PC

10.2.2.4 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

10.2.2.5 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.

10.2.2.6 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.

Make 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. To do this, you need only set priority over the cyclic master beforehand.

Make 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, "Good" as the quality and "OK" as the status.
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 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

Depressurize

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

Make 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 display of the positioner.

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

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

Note

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

10.2.2.7 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.

10.2.2.8 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.

10.2.2.9 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.

10.2.2.10 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.

10.2.2.11 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.

10.2.2.12 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.

10.2.2.13 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.

10.2.2.14 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.

10.2.2.15 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.

10.2.3 "View" menu

10.2.3.1 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.

10.2.3.2 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.

10.2.3.3 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" tan 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.

10.2.3.4 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.

10.2.3.5 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.

10.2.3.6 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.

10.2.3.7 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.

10.3 Cyclic data transfer

10.3.1 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.

10.3.2 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.

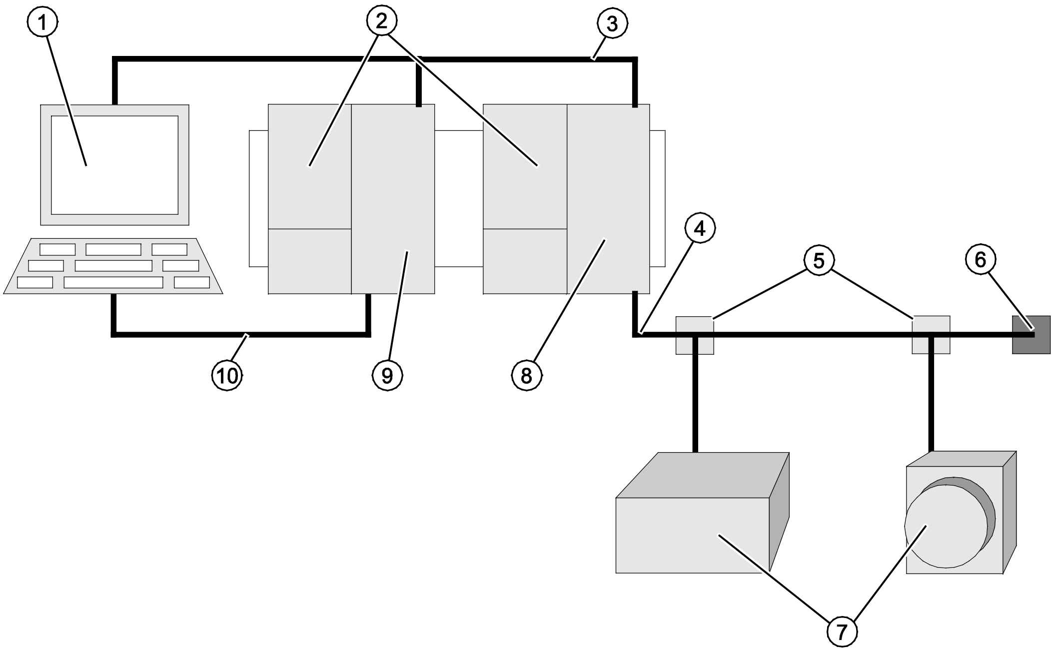


Figure 10-3 Example of a small PROFIBUS DP/PA system

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.

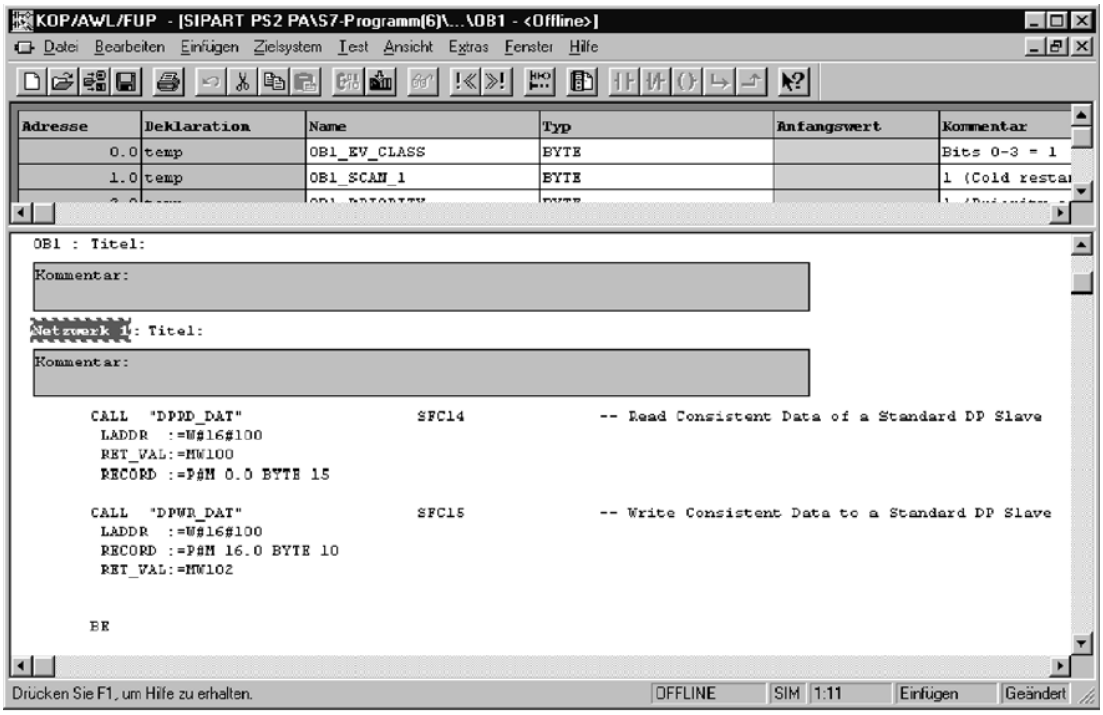


Figure 10-4 STEP 7 sample program

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

10.3.3 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				
Setpoint	Setpoint	SP	Input	5	Value/Status
Readback	Readback	RB	Output	5	Value/Status
Position discrete	Position discrete	POS_D	Output	2	Value/Status
Checkback	Checkback	CB	Output	3	Value
Remote Cascade Input	Remote Cascade Input	RCAS_IN	Input	5	Value/Status
Remote Cascade Output	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.
	3	Emergency operation active	The device is in the manual mode. Representation on the 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.

10.3.3.1 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

10.3.3.2 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 (DDLM_Slave_Diag)

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

10.3.4 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.

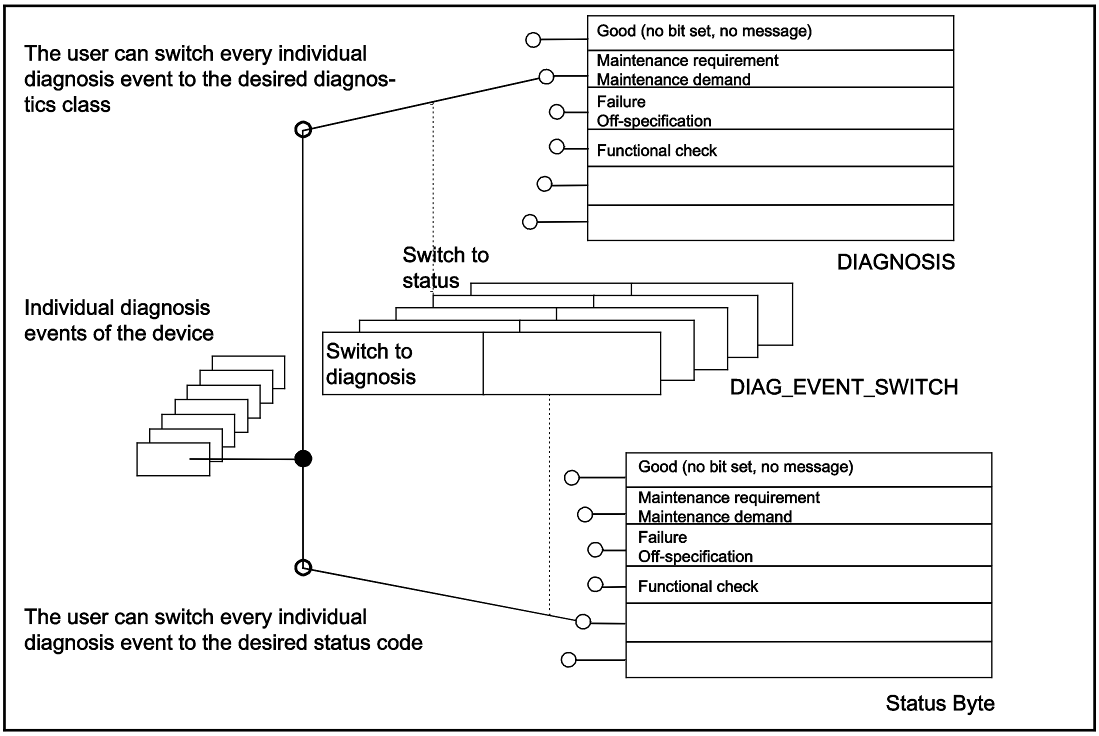


Figure 10-5 Routing of a diagnostics event

Note

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.

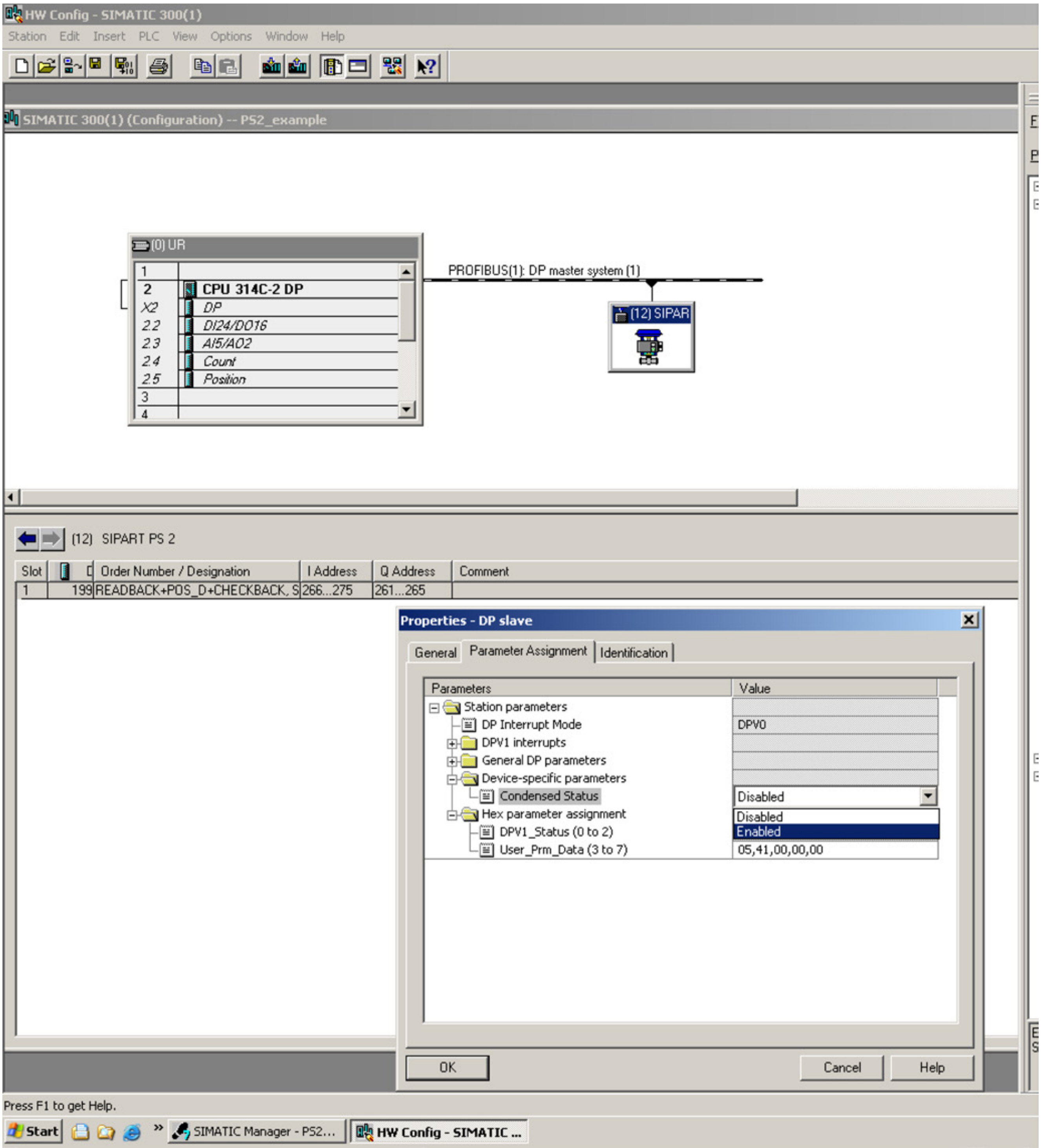


Figure 10-6 Activating the condensed status for the device parameterization - with an example of HW configuration with SIMATIC S7

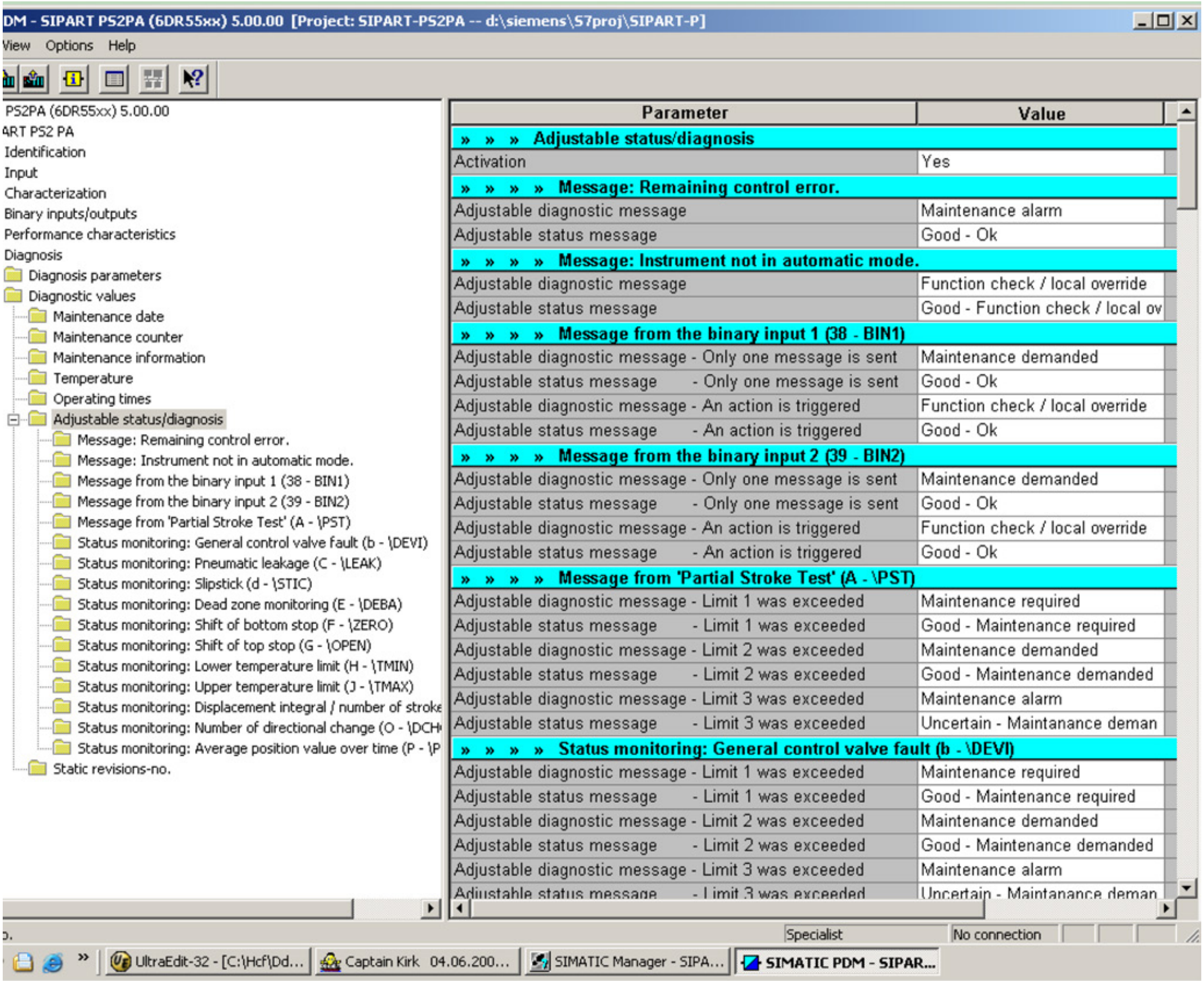


Figure 10-7 Activating the condensed status for the device parameterization - with an example of SIMATIC PDM

10.3.4.1 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. SIMATIC PDM was used to trigger a warm restart. The internal watchdog has responded.	Check the cabling and the supply unit.
	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.

Byte	Bit	Name and meaning	Cause	Measure
	6	DIA_CHARACT 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.	-

10.3.4.2 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	DIA_WARMSTART Warm restart executed (goes to "0" after 10 s)	To determine the cause, check in DIAGNOSTICS_EXTENSION and DIAGNOSTICS_EXTENSION_2 which diagnostics event has triggered the message.	Check the cabling and the supply unit.	-

Byte	Bit	Name and meaning	Cause	Measure	Group
	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	-	-	-
	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	-	-	-

Byte	Bit	Name and meaning	Cause	Measure	Group
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.	-	-

10.3.4.3 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.

10.3.4.4 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
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

10.3.4.5 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

10.3.4.6 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

Byte	Bit	No.	Diagnostics events	Hard-coded effect of a diagnostics event	
				Quality status code	DIAGNOSTICS bit
	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
	7	56	Static friction (limit 2)	Good, maintenance required	DIA_MAINTENANCE
1	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

Byte	Bit	No.	Diagnostics events	Hard-coded effect of a diagnostics event	
				Quality status code	DIAGNOSTICS bit
	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
	7	64	Limit 1 for path integral (100% strokes) exceeded	Good, maintenance required	DIA_MAINTENANCE
2	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
	7	72	Limit 3 for position average exceeded	Good, maintenance required	DIA_MAINTENANCE
3	0	73	PST reference time exceeded (limit 1)	Good, maintenance required	DIA_MAINTENANCE
	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	-	-

10.3.4.7 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 lever 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_DEMANDED	M, F, P
	3	4	Action triggered by binary input 1	Good, Ok	DIA_FUNCTION_CHECK	M, F, P
	4	5	Binary 2 is active (only message)	Good, Ok	DIA_MAINTENANCE_DEMANDED	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

Byte	Bit	No.	Diagnostics events	Effect of the event[1)]		Group
				Quality status code	DIAGNOSTICS bit	
	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_DEMANDED	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_DEMANDED	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_DEMANDED	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_DEMANDED	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

Byte	Bit	No.	Diagnostics events	Effect of the event[1)]		
				Quality status code	DIAGNOSTICS bit	Group
	5	62	Upper end stop monitoring (limit 2)	Good, maintenance demand	DIA_MAINTENANCE_DEMANDED	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_DEMANDED	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_DEMANDED	M12
	4	69	Limit 3 for changes of direction exceeded	Uncertain, maintenance demand	DIA_MAINTENANCE_ALARM	M
	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_DEMANDED	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_DEMANDED	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

Byte	Bit	No.	Diagnostics events	Effect of the event[1)]		
				Quality status code	DIAGNOSTICS bit	Group
	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 11

11.1 Representation of system messages on the display

11.1.1 System messages before initialization

Remarks about the tables:

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

Messages before initialization (first commissioning)

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

See also

Display (Page 99)

11.1.2 System messages during initialization

Remarks about the tables:

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

Messages during initialization

Message	Line		Meaning / cause	Remedy
	Up	Down		
P--	X		Measuring range was exceeded, the potentiometer is in the inactive zone, the transmission ratio selectors or the effective lever arm are not adjusted as per the actuator travel	• Switch the transmission ratio selector to 90° especially in case of part-turn actuators • Adjust the effective lever length of linear actuators as per the measuring range
RUN1		X	Initialization was started, part 1 is active (the direction of action is determined)	• Maintenance
RUN2		X	Initialization part 2 is active (actuator travel check and determination of end stops)	• Maintenance
RUN3		X	Initialization part 3 is active (determination and display of travel times)	• Maintenance
RUN4		X	Initialization part 4 is active (determination of the minimum controller increment length)	• Maintenance
RUN5		X	Initialization part 5 is active (optimization of the transient response)	• Wait until "FINSH" is displayed (initialization completed successfully) • Acknowledge by pressing the operating mode button briefly and exit the configuration level by pressing it longer
YEND1		X	The first end position can be approached only in case of a manual initialization	• Approach the first end position using the "+" or "-" button • Acknowledge using the operating mode button
YEND2		X	The second end position can be approached only in case of a manual initialization	• Approach the second end position using the "+" or "-" button • Acknowledge using the operating mode button
RANGE		X	The end position or the measuring span is beyond the permissible measuring range only in case of a manual initialization	• Approach another end position using the "+" and "-" buttons and acknowledge with the operating mode button, or • Move the friction clutch until "ok" is displayed, and then acknowledge with the operating mode button, or • Terminate the initialization process by pressing the operating mode button, switch to the P-manual mode and correct the actuator travel and the position displacement sensor
ok		x	The permissible measuring range of end positions is achieved only in case of a manual initialization	• Acknowledge with the operating mode button; the remaining steps ("RUN1" to "FINSH") execute automatically

Message	Line		Meaning / cause	Remedy
	Up	Down		
RUN1 / ERROR		X	Error in "RUN1", no movement e.g. due to the lack of compressed air	• Provide adequate compressed air • Open the restrictor(s) • Restart the initialization process
ϟd___U		X	Bar graph display of the zero point; zero point is beyond the tolerance range	• Set between "P 4.0" and "P .9" (>0<) using a friction clutch • Continue with the "+" or "-" button
SEt	X		Friction clutch was moved; "P 50.0" not displayed when the lever is horizontal	• In case of linear actuators, use the "+" and "-" buttons to bring the lever perpendicular to the spindle • Press the operating mode button slightly to acknowledge (the initialization process is continued)
MIDDL		X		
ϟUP >		X	"UP" tolerance range was exceeded or the inactive zone of the potentiometer was covered	• Increase the effective lever length of the linear actuators or switch the transmission ratio selector to 90° • Press the operating mode button slightly to acknowledge • Restart the initialization process
ϟ90_95		X	Possible only in case of part-turn actuators: actuator travel is not in the range between 90 and 95%	• Use the "+" and "-" buttons to move it in the range between 90 and 95% • Press the operating mode button slightly to acknowledge
ϟU-d>		X	"Up-Down" measuring span was undershot	• Decrease the effective lever length of the linear actuators or switch the transmission ratio selector to 33° • Press the operating mode button slightly to acknowledge • Restart the initialization process
U nn.n	X		Display of the "Up" travel time	• Wait, or • To change the travel 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" travel time	• Wait, or • To change the travel time, interrupt the initialization process with the "-" button, or • Activate the leakage test with the "+" button
U->d		X		

Message	Line		Meaning / cause	Remedy
	Up	Down		
NOZZL		X	Actuator stops (the initialization process was interrupted using the "-" button when the actuation speed display was active)	• The travel 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)	• Wait for 1 minute • Continue with the "+" button
LEAKG		X		
nn.n	X		Value and unit of the result after the leakage test	• Rectify the leakage if the value is too large • Continue with the "+" button
%/MIN		X		
nn.n	X		Initialization completed successfully with the display of actuator travel or the actuator angle	• Acknowledge by pressing the operating mode button briefly and exit the configuration level by pressing it longer
FINISH		X		

See also

System messages before initialization (Page 233)

11.1.3 System messages when exiting the Configuration mode

Remarks about the tables:

nn stands for variable numeric values

ϟ Error symbol

/ (slash): the text to the left and right of the slash blink interchangeably.

Messages when exiting the configuration mode:

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

11.1.4 System messages during operation

Remarks about the tables:

nn	stands for variable numeric values
ϟ	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		
CPUSTART	X	X				Message after connecting the electrical auxiliary power supply	• Wait
HW / ERROR		X				Error in the hardware	• Replace the electronic unit
NOINI		X			X	Positioner is not initialized	• 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: • No communication connection with the master • Target mode is at "MA" • Master sends a wrong status	• 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

Message	Line		Operating mode			Meaning / cause	Measure
	Up	Down	Automatic	Manual mode	P-manual mode		
MM nn		X	X			Positioner is in the "manual mode"	• Set the target mode with class 2 master to "Automatic" • Send the "0x80" status (good)
MAnn				X		Manual mode (nn = setpoint)	• Switch to the automatic mode using the operating mode button
LO nn		X	X			Positioner is in the "local override mode"	• 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"	• Set the target mode with class 2 master to "Automatic" • Send the "0x80" status (good)
oFL / 127.9						Display range was exceeded. Possible causes:	
						• Friction clutch or • Transmission ratio selector were moved or • The positioner was attached to another actuator without re-initializing it	• 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	

Message	Line		Operating mode			Meaning / cause	Measure
	Up	Down	Automatic	Manual mode	P-manual mode		
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	

11.2 Diagnostics

11.2.1 Display of diagnostics values

Structure of the diagnostics display

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

- The upper line shows the value of the diagnostics variable.
- The lower line shows the number and the abbreviation of the displayed variable.

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

General procedure

1. Press all three buttons at the same time for at least 2 seconds. You are now in the diagnostics display.
2. Use the button to select the next diagnostics value.
3. Press the button for at least 2 seconds in order to exit the diagnostics display.

How to show the diagnostics values in reverse order

Press the and buttons simultaneously.

How to set values to zero

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

See also

System messages before initialization (Page 233)

Description of parameters 10 to 30 (Page 159)

11.2.2 Overview of diagnostics values

Explanation about the table

The following table provides an overview of values that can be displayed. 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	Number of strokes	0 ... 4.29E9	-	X
2	CHDIR	Number of changes of direction	0 ... 4.29E9	-	X
3	ϟCNT	Number of fault messages	0 ... 4.29E9	-	X
4	A1CNT	Number of alarms 1	0 ... 4.29E9	-	X
5	A2CNT	Number of alarms 2	0 ... 4.29E9	-	X
6	HOURS	Operating hours	0 ... 4.29E9	Hours	-
7	WAY	Determined actuator travel	0 ... 130	mm or °	-
8	TUP	Travel time up	0 ... 1000	s	-
9	TDOWN	Travel time down	0 ... 1000	s	-
10	LEAK	Leakage	P 0.0 ... 100.0	%	-
11	PST	Monitoring of the partial stroke test	OFF / ###.#, fdini, notSt, SdtSt, fdtSt, notd, Strt, StoP	s for ###.#	-
12	PRPST	time since the last partial stroke test	###, notSt, Sdtst, fdtSt	Days	-
13	NXPST	time until the next partial stroke test	OFF / ###	Days	-
14	DEVI	General control valve fault	OFF, 0.0 ... 100.0	%	-
15	ONLK	Pneumatic leakage	OFF, 0.0 ... 100.0	-	-
16	STIC	Stiction	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	6 ... 160	ms	-
23	IMPDN	impulse length down	6 ... 160	ms	-
24	DBUP	deadband up	0.1 ... 10.0	%	-
25	DBDN	deadband down	0.1 ... 10.0	%	-
26	SSUP	slow step zone up	0.1 ... 100.0	%	-
27	SSDN	slow step zone down	0.1 ... 100.0	%	-
28	TEMP	Current temperature	-50 ... 100 -58 ... 212	° C ° F	- -
29	TMIN	Minimum temperature ("min/max pointer")	-50 ... 100 -58 ... 212	° C °F	-

No.	Abbreviation	Meaning	Values that can be displayed	Unit	Reset possible
30	TMAX	Maximum temperature ("min/max pointer")	-50 ... 100 -58 ... 212	° C ° F	-
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	Counter for pilot valve 1	0 ... 4.29E9	-	-
41	VENT2	Counter for pilot valve 2	0 ... 4.29E9	-	-
42	STORE	Save the current values as "last maintenance" (press the increment button for 5 s)	-	-	-
43	PRUP	Prediction up	1 ... 40	-	-
44	PRDN	Prediction down	1 ... 40	-	-
45	WT00	Number of operating hours in the actuating range WT00	0 ... 4.29E9	Hours	X
46	WT05	Number of operating hours in the actuating range WT05	0 ... 4.29E9	Hours	X
47	WT10	Number of operating hours in the actuating range WT10	0 ... 4.29E9	Hours	X
48	WT30	Number of operating hours in the actuating range WT30	0 ... 4.29E9	Hours	X
49	WT50	Number of operating hours in the actuating range WT50	0 ... 4.29E9	Hours	X
50	WT70	Number of operating hours in the actuating range WT70	0 ... 4.29E9	Hours	X
51	WT90	Number of operating hours in the actuating range WT90	0 ... 4.29E9	Hours	X
52	WT95	Number of operating hours in the actuating range WT95	0 ... 4.29E9	Hours	X

11.2.3 Meaning of the diagnostics values

1 STRKS - Number of strokes

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

2 CHDIR - number of changes of direction

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

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

4 A1CNT - Number of alarms 1 and
5 A2CNT - Number of alarms 2

These two counters indicate how often alarms 1 and 2 have been triggered. Activation of alarms using the "AFCT" parameter is a requirement for this. The counters can be set to zero using the 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. Requirement for linear actuators: Specification of the lever arm using the "YWAY" parameter.

8 TUP - Response time open and
9 TDOWN - Response time closed

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 in this parameter.

11 PST - monitoring of the Partial-Stroke test

This parameter indicates the stroke time measured during the last partial stroke test. A partial stroke test can be initiated manually or a current partial stroke test can be interrupted by pressing the △+ button.

The following states are output in the display:

- OFF

  The partial stroke test function is deactivated in the configuration menu.
- FdIni - Failed PST Initialization

  The reference stroke time measurement of the partial stroke test has failed.
- notSt - No Test

  A manual partial stroke test has not yet been executed.
- ###.# (measured stroke time in seconds)

  The last partial stroke test was successfully executed.
- SdtSt - Stopped Test

  The last partial stroke test was interrupted.
- FdtSt - Failed Test

  The last partial stroke test has failed.

The following status messages appear when you press the △+ button:

- notoL - No Tolerance

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

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

  The current partial stroke test is interrupted.

12 PRPST - time since the last partial stroke test

This parameter shows the elapsed time in days since the last partial stroke test. In addition, the following status messages can be displayed:

- notSt - No Test

  A manual partial stroke test has not yet been executed.
- SdtSt - Stopped Test

  The last Partial-Stroke-Test was interrupted.
- FdtSt - Failed Test

  The last partial stroke test has failed.

13 NXPST - time until the next partial stroke test

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

This parameter shows the current leakage indicator. If the leakage detection is deactivated in the configuration menu, "OFF" is displayed.

16 STIC - static friction/slipstick effect

This parameter shows the filtered value of the stroke magnitude in percent resulting from the static friction. 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

This value shows the last calculated comparison average. 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 bottom end stop and 21 P100 - Potentiometer value of top 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 - Deadband open and 25 DBDN - Deadband closed

This parameter shows the deadbands of the controller in the "Open" and "Closed" directions. The values correspond either to the manually configured value of the "DEBA" parameter or to the value automatically adapted 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.

In order to switch over the temperature display between °C and °F, press the ▽ button.

29 TMIN - Minimum temperature (slave pointer) and
30 TMAX - Maximum temperature (slave 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 - Counter for pilot valve 1 and
41 VENT2 - Counter for pilot valve 2

Control procedures of the pilot valves in the pneumatic block of the positioner are counted and displayed in these two parameters.

The pneumatic block of the positioner pressurizes and depressurizes the actuator. The pneumatic block contains two pilot valves. The characteristic service life of the pneumatic block depends on the load. On average it is approx. 200 million switching operations for each of the two pilot valves with symmetrical load. The number of control procedures for the switching operations serves to assess the switching frequency of the pneumatic block.

Counting procedure for single-acting actuators:

- Pressurize => 40 VENT1
- Depressurize => 41 VENT2

Counting procedure for double-acting actuators:

- Pressurize (Y2) / Depressurize (Y1) => 40 VENT1
- Depressurize (Y1) / Pressurize (Y2) => 41 VENT2

42 STORE - save maintenance data

Press the ⚠ button for at least 5 seconds in order to exit the save function. The diagnostics data 7 to 10 and 20 to 27 is saved in the non-volatile memory as "data of last maintenance". This diagnostics data contains selected values whose changes can give information about mechanical wear and tear of the valve.

This function is normally operated through the PDM, menu command "Device-> Save maintenance info". The data of the last maintenance operation can be compared with the current data using SIMATIC PDM.

43 PRUP - Prediction open and
44 PRDN - Prediction closed

Refer to chapter "Optimizing the controller data (Page 108)"

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 operating hours counters to zero. To do this, press the ⚠ button for at least 5 seconds.

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

Note

Updating of the diagnostics values

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 139)

11.3 Online diagnostics

11.3.1 Overview of online diagnostics

Online diagnostics means diagnostics during ongoing operation. A few important variables and parameters are continuously monitored during the operation of the positioner. In "Configuration" mode, you can configure this monitoring in such a way that the fault message output will be activated if, for instance, a limit is exceeded.

Information about what events can activate the fault message output can be found in the table in chapter "Overview of error codes (Page 251)".

This chapter contains information about the following situations in particular:

- Possible causes of the fault message.
- Events which activate the fault message output or alarm outputs.
- Setting of parameters needed for event monitoring.
- Canceling a fault message

When the fault message output is triggered in automatic or manual mode, the display shows which fault triggered the message. Both digits at bottom-left indicate the corresponding error code. If multiple triggers occur at the same time, they are displayed one after the other cyclically.

See also

Description of parameter 48 (Page 169)

11.3.2 Overview of error codes

Overview of error codes that activate the fault message output

Error code	Three-stage	Event	Parameter setting	Error message disappears when	Possible causes
ϟ1	No	Remaining control deviation	Always active	... the control deviation disappears again.	Compressed air failure, actuator fault, valve fault (e.g. blockade).
ϟ2	No	Device not in the automatic mode	**.ϟFCT[1)] =ϟnA or = ϟnAB	... the device is switched to the automatic mode.	The device has been configured or is in the manual mode
ϟ3	No	Binary input BE1 or BE2 active	**.ϟ FCT[1)] =ϟnAB 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).

Error code	Three-stage	Event	Parameter setting	Error message disappears when	Possible causes
ϟ4	Yes	The limit of stroke number exceeded	L.ϟSTRK≠OFF	... the stroke counter is reset or the thresholds are increased	The total path covered by the actuator exceeds one of the configured thresholds.
ϟ5	Yes	Limit of changes of direction exceeded	O.ϟDCHG≠OFF	... the counter for changes of direction is reset or the thresholds are increased.	The number of changes of direction exceeds one of the configured thresholds.
ϟ6	Yes	Limit of the lower hard end stop exceeded	F.ϟZERO≠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.
ϟ7	Yes	Limit of the upper hard end stop exceeded	G.ϟOPEN≠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.
ϟ8	No	Limit of deadband adjustment exceeded	E.ϟDEBA≠OFF **.DEBA[1)] = Auto	... the limit is undershot again	Increased packing gland friction, mechanical gap in the position feedback.
ϟ9	Yes	Partial-Stroke-Test exceeds reference stroke time	A.ϟPST≠OFF	... a Partial-Stroke-Test is successfully executed within the reference stroke time or the function is deactivated.	Valve jams or has rusted, increased friction
10	Yes	General control valve fault	b.ϟDEVI≠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.ϟLEAK≠OFF	... the leakage drops below the configured thresholds, or the function is deactivated.	Pneumatic leakage
12	Yes	Static friction/ Slipstick effect occurs	d.ϟSTIC≠OFF	... Slipjumps can no longer be detected, or the function is deactivated.	Increased static friction, valve no longer moves smoothly, but with jerks
13	Yes	Temperature undershot	H.ϟTMIN≠OFF	... the lower temperature thresholds are no longer undershot.	Ambient temperature too low
14	Yes	Temperature overshot	J.ϟTMAX≠OFF	... the upper thresholds are no longer overshot.	Ambient temperature too high
15	Yes	Position average deviates from the reference value	P.ϟPAVG≠OFF	... the position average calculated after a comparison interval is again within the thresholds for the reference value, or the function is deactivated.	In the last comparison interval, the valve trajectory was changed so severely that a deviating position average was calculated.

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

See also

Description of parameters (Page 155)

11.3.3 XDIAG parameter

You can use the advance diagnostics parameters to display fault messages in one, two or three stages. In addition to the fault message output, alarm outputs 1 and 2 are then used. For this purpose, set the "XDIAG" parameter as described in the following table:

Settings of XDIAG	Message due to
OFF	Advanced diagnostics not activated
On 1	Fault message output for threshold 3 fault messages (one-stage)
On 2	Fault message output for threshold 3 fault messages and alarm output 2 for threshold 2 fault messages (two-stage)
On 3	Fault message output for threshold 3 fault messages and alarm output 2 for threshold 2 fault messages and alarm output 1 for threshold 1 fault messages (three-stage)

Possible settings of the "XDIAG" parameter

See also

Description of parameter 48 (Page 169)

11.3.4 Meaning of error codes

1 Monitoring of control deviation

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

2 Automatic mode monitoring

When the device is not in automatic mode, a fault message is generated if the "ЧFCT" parameter (function of fault message output) is set correctly. A warning is then sent to the control system if the device was switched to manual or configuration mode on-site.

3 Binary input BE1 or BE2 active

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

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

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 extended diagnostics. Both these functions can be deactivated using the parameter setting "OFF" for "L.ϟSTRK" and "O.ϟDCHG".

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

7 Monitoring of the upper hard end stop

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

Monitoring is always carried out whenever the valve is in the "down tight closing" position. The current position is compared with the position that was determined as the lower 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.ϟ 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.ϟOPEN" parameter is used to set the limit for this. The activation of "up tight closing" ("YCLS" parameter) is therefore the condition.

8 Monitoring of deadband adjustment

If the deadband increases disproportionately when adjusting it automatically ("DEBA"=Auto parameter), it indicates an error in the system (e.g. severely increased packing gland friction, play in the position displacement sensor, leakage). A limit can therefore be entered for this value ("E1.LEVL3", threshold for deadband monitoring). A fault message output is activated when this value is exceeded.

9 Partial stroke test exceeds the reference stroke 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 starting 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 stroke 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 display. The degree of the fault message is simultaneously displayed using the fault message output or alarm outputs depending on the mode of the extended 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 configured 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 configured thresholds. Keep in mind that the complete sensitivity of this function can be used only if a ramp movement was initiated after initialization to set the leakage indicator (see explanations for "C1.LIMIT").

12 Static friction/slipstick effect is too large

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

13 Temperature undershot

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

14 Temperature overshot

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

15 Monitoring of the position average

This fault message appears when a position value calculated after the expiry of a comparison interval deviates from the reference value by more than the configured thresholds.

See also

Description of parameter C (Page 177)

11.4 Fault correction

11.4.1 Fault identification

Diagnostics guide

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

11.4.2 Remedial measures table 1

Fault profile (symptoms)	Possible cause(s)	Remedial measures
• Positioner remains in "RUN 1".	• Initialization started from the end position and • The response time of a maximum of 1 minute was not observed. • Network pressure not connected or it is too low.	• A waiting time of up to 1 minute is essential. • Do not start initialization from the end position. • Provide the network pressure.
• Positioner remains in "RUN 2".	• Transmission ratio selector and parameter 2 • "YAGL" and the real stroke do not match. • Incorrectly set stroke on the lever. • Piezo valve does not activate.	• Check settings: see leaflet: "Device view (7)" picture as well as parameters 2 and 3 • Check the stroke setting on the lever. See table 2
• Positioner remains in "RUN 3".	• Actuator actuating time is too high.	• Open the restrictor completely and/or set the pressure PZ (1) to the highest permissible value. • Use a booster if required.
• Positioner remains "RUN 5", does not go up to "FINISH" (waiting time > 5 min).	• "Gap" (play) in the positioner - actuator - control valve system	• Part-turn actuator: check for the firmness of the grub screw of the coupling wheel • Linear actuator: check for the firmness of the lever on the positioning shaft. • Remove any play between the actuator and the control valve.

Fault table 1

11.4.3 Remedial measures table 2

Fault profile (symptoms)	Possible cause(s)	Remedial measures
• "CPU testt" blinks on the display approximately every 2 seconds. • Piezo valve does not activate.	• Water in the pneumatic block (due to wet compressed air)	• At an early stage, this fault can be rectified with a subsequent operating using dry air, if required, in a temperature cabinet at 50 to 70°C. • Otherwise: Repair
• In the manual and automatic modes, the actuator cannot be moved or can be moved only in one direction.	• Moisture in the pneumatic block	
• Piezo valve does not activate (a gentle click sound is not audible when the "+" or "-" buttons are pressed in the manual mode.)	• The screw between the shrouding cover and the pneumatic block has not been tightened firmly or the cover got stuck.	• Tighten the screw firmly; if required, rectify the deadlock.
	• Dirt (swarf, particles) in the pneumatic block	• Repair or a new device; clean and/or replace the built-in fine screens.
	• Deposits on the contacts between the electronic printed circuit board and the pneumatic block may develop due to abrasion owing to continuous loads resulting from strong vibrations.	• Clean all contact surfaces with spirit; if required, bend the pneumatic block contact springs.

Fault table 2

See also

Repair/Upgrading (Page 266)

11.4.4 Remedial measures table 3

Fault profile (symptoms)	Possible cause	Remedial measures
• Actuator does not move.	• Compressed air < 1.4 bar	• Set the supply air pressure to > 1.4 bar.
• Piezo valve does not activate (a gentle click sound is however audible when the "+" or "-" buttons are pressed in the manual mode.)	• Restrictor valve turned off (screw at the right end stop)	• Open the restrictor screw by turning it anticlockwise, see leaflet, "Device view (6)".
	• Dirt in the pneumatic block	• Repair or a new device; clean and/or replace the built-in fine screens.
• A piezo valve activates constantly in the stationary automatic mode (constant setpoint) and the manual mode.	• Pneumatic leakage in the positioner - actuator system; start the leakage test in "RUN 3" (initialization).	• Rectify leakage in the actuator and/or feed line. • In case of an intact actuator and tight feed line: Repair or new device
	• Dirt in the pneumatic block, see above	• See above

Fault table 3

See also

Repair/Upgrading (Page 266)

11.4.5 Remedial measures table 4

Symptoms	Possible cause(s)	Remedial measures
• In stationary automatic mode (constant setpoint) and in manual mode, both piezo valves continually switch alternately, and the actuator oscillates around a mean value.	• Sticking friction of the packing gland from the control valve or actuator too large	• Reduce friction or increase dead zone of positioner (parameter "dEbA") until the oscillation stops.
	• Looseness (play) in the positioner/actuator/control valve system	• Part-turn actuator: Check for firm seating of set screw on coupling wheel. • Linear actuator: Check for firm seating of lever on positioner shaft. • Correct any other play between the actuator and the control valve.
	• Actuator too fast	• Increase actuating times using throttle screws. • If a quick actuating time is needed, increase the dead zone (parameter "dEbA") until the oscillation stops.
• Positioner doesn't move control valve to the stop (at 20 mA).	• Supply pressure too low. Load on the feeding controller or system output is too low.	• Increase supply pressure, insert ballast converter • Select 3/4-wire mode

Error table 4

11.4.6 Remedial measures table 5

Fault profile (symptoms)	Possible cause(s)	Remedial measures
• Zero point displaces sporadically (> 3%).	• Impact or shock loads result in accelerations so high that the friction clutch moves, e.g. due to "vapor shocks" in vapor lines.	• Rectify the causes for shock loads. • Re-initialize the position controller.
• The device function has completely failed: No representation on the display either.	• Electrical auxiliary power supply is not adequate.	• Check the electrical auxiliary power supply.
	• In case of very high continuous loads due to vibrations (oscillations): • Screws of the electrical connecting terminals may be loosened. • Electrical connecting terminals and/or electronic components may be knocked out.	• Tighten the screws firmly and secure using sealing wax. • Repair • For prevention: Install the positioner on the damping pads.

Fault table 5

See also

Repair/Upgrading (Page 266)

12 Service and maintenance

12.1 Basic safety instructions

WARNING

Impermissible repair of the device

- Repair must be carried out by Siemens authorized personnel only.

WARNING

Impermissible accessories and spare parts

Danger of explosion in areas subject to explosion hazard.

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

WARNING

Improper connection after maintenance

Danger of explosion in areas subject to explosion hazard.

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

Refer to Chapter "Connect (Page 73)".

NOTICE

Penetration of moisture into the device

Device damage.

- Make sure when carrying out cleaning and maintenance work that no moisture penetrates the inside of the device.

CAUTION

Releasing key lock

Improper modification of parameters could influence process safety.

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

WARNING

Electrostatic charge

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

- Prevent electrostatic charging in hazardous areas.

WARNING

Dust layers above 5 mm

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

- Remove any dust layers in excess of 5 mm.

Cleaning the enclosure

- Clean the outside of the enclosure and the display window using a cloth moistened with water or a mild detergent.
- Do not use aggressive cleaning agents or solvents. Plastic components or painted surfaces could be damaged.

12.2 Cleaning of the screens

The positioner is maintenance-free to a large extent. Screens are installed in the pneumatic connections of the positioners to protect them from rough dirt particles. If there are dirt particles in the pneumatic auxiliary power supply, they damage the screens and hamper the function of the positioner. Clean the screens as described in the following two chapters.

12.2.1 Positioner in macrolon enclosure

DANGER

Risk of explosion due to electrostatic charge

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

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

Removal and cleaning of the screens

1. Disconnect the pneumatic auxiliary 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 of the screens

CAUTION

Damage to the enclosure

- The enclosure is damaged due to screwing in the self-tapping screws improperly.
- Ensure that the available thread pitches are used.
- Turn the screws anticlockwise until they engage noticeably in the thread pitch.
- Tighten the self-tapping screws only after they have engaged.

1. Insert the screens into the recesses of the macrolon enclosure.
2. Place the O-rings on the screens.
3. Fit the pneumatic terminal strip on both studs so that it fits flushly.
4. Screw-on the three self-tapping screws.

5. Place the cover and tighten it.
6. Reconnect the pipelines and feed the pneumatic power supply.

12.2.2 Positioner in stainless steel, aluminum and flameproof aluminum enclosure

Removal, cleaning and installation of the screens

1. Disconnect the pneumatic auxiliary power supply.
2. Remove the pipelines.
3. Remove the metal screen from the bores carefully.
4. Clean the metal screens, e.g. using compressed air.
5. Insert the screens.
6. Connect the pipelines again.
7. Feed the pneumatic auxiliary power supply.

12.3 Repair/Upgrading

Send defective devices to the repairs department, together with information on the malfunction and the cause of the malfunction. When ordering replacement devices, please provide the serial number of the original device. You can find the serial number on the nameplate.

See also

Nameplate layout (Page 22)

12.4 Return procedure

Enclose the bill of lading, return document and decontamination certificate in a clear plastic pouch and attach it firmly to the outside of the packaging.

Required forms

- Delivery note
- Return document (http://www.siemens.com/processinstrumentation/returngoodsnote)

  with the following information:
  - Product (item description)
  - Number of returned devices/replacement parts
  - Reason for returning the item(s)
- Decontamination declaration (http://www.siemens.com/sc/declarationofdecontamination)

  With this declaration you warrant "that the device/replacement part has been carefully cleaned and is free of residues. The device/replacement part does not pose a hazard for humans and the environment."

  If the returned device/replacement part has come into contact with poisonous, corrosive, flammable or water-contaminating substances, you must thoroughly clean and decontaminate the device/replacement part before returning it in order to ensure that all hollow areas are free from hazardous substances. Check the item after it has been cleaned.

  Any devices/replacement parts returned without a decontamination declaration will be cleaned at your expense before further processing.

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

Technical data 13

13.1 Rated conditions

Rated conditions	
Ambient temperature	In hazardous areas, observe the maximum permissible ambient temperature corresponding to the temperature class.
• Permissible ambient temperature for operation	-30 ... +80 °C (-22 ... +176°F)
Degree of protection [1]	IP66 to EN 60529/NEMA 4X
Mounting position	Any; in wet environment, pneumatic connections and outlet opening not upward
Vibration resistance	
• Harmonic oscillations (sine) according to EN 60068-2-6/10.2008	3.5 mm (0.14"), 2 ... 27 Hz, 3 cycles/axle
	98.1 m/s² (321.84 ft/s²), 27 ... 300 Hz, 3 cycles/axle
• Bumping (half-sine) according to EN 60068-2-27/02.2010	150 m/s² (492 ft/s²), 6 ms, 1000 shocks/axle
• Noise (digitally controlled) according to EN 60068-2-64/04.2009	10 ... 200 Hz; 1 (m/s²)²/Hz (3.28 (ft/s²)²/Hz)
	200 ... 500 Hz; 0.3 (m/s²)²/Hz (0.98 (ft/s²)²/Hz)
	4 hours/axle
• Recommended range of continuous operation of the entire control valve	≤ 30 m/s² (98.4 ft/s²) without resonance peak
Climate class	According to DIN EN 60721-3-4
• Storage	1K5, but -40 ... +80°C (1K5, but -40 ... +176°F)
• Transport	2K4, but -40 ... +80°C (2K4, but -40 ... +176°F)
• Operation [2]	4K3, but -30 to +80 °C (4K3, but -22 to +176 °F) [3]

1) Max. impact energy 1 Joule for enclosure with inspection window 6DR5..0 and 6DR5..1.

2) At ≤ -10 °C (≤ 14 °F), the display refresh rate is limited. In the case of use with I_y module, only T4 is permissible.

3) -20 to +80 °C (-4 to +176 °F) for 6DR55..-0G ..., 6DR56..-0G ..., 6DR55..-0D ... and 6DR56..-0D...

13.2 Pneumatic data

Pneumatic data	
Auxiliary power (air supply)	Compressed air, carbon dioxide (CO_2), nitrogen (N), noble gases or cleaned natural gas
• Pressure	1,4 ... 7 bar (20.3 ... 101.5 psi)
Air quality to ISO 8573-1	
• Solid particulate size and density	Class 2
• Pressure dew point	Class 2 (min. 20 K (36°F) below ambient temperature)
• Oil content	Class 2
Unrestricted flow (DIN 1945)	
• Inlet air valve (ventilate actuator) [1)]	
2 bar (29 psi)	4.1 Nm³/h (18.1 USgpm)
4 bar (58 psi)	7.1 Nm³/h (31.3 USgpm)
6 bar (87 psi)	9.8 Nm³/h (43.1 USgpm)
• Air exhaust valve (depressurize drive) [1)]	
2 bar (29 psi)	8.2 Nm³/h (36.1 USgpm)
4 bar (58 psi)	13.7 Nm³/h (60.3 USgpm)
6 bar (87 psi)	19.2 Nm³/h (84.5 USgpm)
Valve leakage	$< 6 \cdot 10^{-4}$ Nm³/h (0.0026 USgpm)
Throttle ratio	Adjustable up to ∞: 1
Auxiliary power consumption in the controlled state	$< 3{,}6 \cdot 10^{-2}$ Nm³/h (0.158 USgpm)

1) When using device version Ex d (6DR5..5-...), values are reduced by approximately 20%.

13.3 Construction

Construction	
How does it work?	
• Range of stroke (linear actuator)	3 ... 130 mm (0.12 ... 5.12") (angle of positioner shaft 16 ... 90°)
• Angle of rotation (part-turn actuator)	30 ... 100°
Mounting method	
• On the linear actuator	Using mounting kit 6DR4004-8V and, where necessary, an additional lever arm 6DR4004-8L on actuators according to IEC 60534-6-1 (NAMUR) with rib, bars or flat face.
• On the part-turn actuator	Using mounting kit 6DR4004-8D on actuators with mounting plane according to VDI/VDE 3845 and IEC 60534-6-2: The required mount must be provided on the actuator-side.
Weight, basic device	
• Glass-fiber reinforced polycarbonate housing	Approx. 0.9 kg (1.98 lb)
• Aluminum enclosure	Approx. 1.3 kg (2.86 lb)
• Stainless steel enclosure	Approx. 3.9 kg (8.6 lb)
• Flameproof aluminum enclosure	Approx. 5.2 kg (11.46 lb)
Material	
• Enclosure	
6DR5..0-... (Makrolon)	Glass-fiber reinforced polycarbonate (PC)
6DR5..1-... (aluminum)	GD AlSi12
6DR5..2-... (stainless steel)	Austenitic stainless steel mat. No. 1.4581
6DR5..5-... (aluminum, flameproof)	GK AlSi12
• Pressure gauge block	Aluminum AlMgSi, anodized
Versions	
• In Makrolon enclosure	Single-acting and double-acting
• In the aluminum enclosure	Single-acting
• In flameproof aluminum enclosure	Single-acting and double-acting
• In the stainless steel enclosure	Single-acting and double-acting
Torques	
• Part-turn actuator fixing screws DIN 933 M6x12-A2	5 Nm (3.7 ft lb)
• Linear actuator fixing screws DIN 933 M8x16-A2	12 Nm (8.9 ft lb)

Construction	
• Gland pneumatic G¼	15 Nm (11.1 ft lb)
• Gland pneumatic ¼ NPT	
Without sealant	12 Nm (8.9 ft lb)
With sealant	6 Nm (4.4 ft lb)
• Cable glands	
Screw-in torque for plastic gland in all enclosures	4 Nm (3 ft lb)
Screw-in torque for cable gland made of metal/stainless steel in Makrolon enclosure	6 Nm (4.4 ft lb)
Screw-in torque for metal/stainless steel glands in aluminum/stainless steel enclosure	6 Nm (4.4 ft lb)
Screw-in torque for NPT adapter made of metal/stainless steel in Makrolon enclosure	8 Nm (5.9 ft lb)
Screw-in torque for NPT adapter made of metal/stainless steel in aluminum/stainless steel enclosure	15 Nm (11.1 ft lb)
Screw-in torque for NPT gland in the NPT adapter NOTE: To avoid damage to the device, the NPT adapter must be held in place while the NPT gland is screwed into in the NPT adapter.	68 Nm (50.2 ft lb)
Tightening torque for union nut made of plastic	2.5 Nm (1.8 ft lb)
Tightening torque for union nut made of metal/stainless steel	4 Nm (3 ft lb)
Manometer	
• Degree of protection	
Manometer made of plastic	IP31
Manometer, steel	IP44
Manometer made of stainless steel 316	IP54
• Vibration resistance	In accordance with DIN EN 837-1

13.4 Controller

Controller	
Control unit	
• Five-point controller	Adaptive
• Dead zone	
dEbA = auto	Adaptive or can be preset
dEbA = 0.1 ... 10 %	Adaptive or can be preset
Analog-to-digital converter	
• Scanning time	10 ms
• Resolution	≤ 0.05 %
• Transmission error	≤ 0.2 %
• Temperature influence	≤ 0.1 %/10 K (≤ 0.1 %/18 °F)
Cycle time	
• 20 mA/HART device	20 ms
• PA device	60 ms
• FF device	60 ms (min. loop time)

13.5 Certificates, approvals, explosion protection for all device versions

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

Explosion protection	**Ex markings**	
Explosion protection in accordance with	**ATEX/IECEx**	**FM/CSA**
Flameproof enclosure "d"	Zone 1: ⟨Ex⟩ II 2 G Ex d IIC T6/T4 Gb	FM: XP, Class I, Division 1, ABCD XP, Class I, Zone 1, AEx d, IIC,T6/T4 CSA: Class I, Division 1, Groups CD Class II/III, Division 1, Groups EFG
Intrinsic safety "ia"	Zone 1: ⟨Ex⟩ II 2 G Ex ia IIC T6/T4 Gb ⟨Ex⟩ II 2 D Ex ia IIIC 110°C Db	FM: IS, Class I, Division 1, ABCD Class I, Zone 1, AEx ib, IIC,T6/T4 CSA: Class I, Division 1, ABCD Class I, Zone 1, Ex ib, IIC
Intrinsic safety "ic"	Zone 2: ⟨Ex⟩ II 3 G Ex ic IIC T6/T4 Gc	-
Non-sparking "nA"	Zone 2: ⟨Ex⟩ II 3 G Ex nA IIC T6/T4 Gc	FM: NI, Class I, Division 2, ABCD NI, Class I, Zone 2, IIC,T6/T4 CSA: Class I, Division 2, ABCD Class I, Zone 2, IIC
Dust, protection by enclosure "t"	Zone 22: ⟨Ex⟩ II 3 D Ex tb IIIC T100°C Dc IP66	CSA: Class II, Division 1
Permissible ambient temperature		
• For operation with or without HART [1)]	Zones 1, 2 and 22 T4: -30 ... +80 °C (-22 ... +176 °F) T6: -30 ... +50 °C (-22 ... +122 °F)	
• For operation with PROFIBUS PA or with FOUNDATION Fieldbus [1)]	Zones 1, 2 and 22 T4: -20 ... +75 °C (-4 ... +103 °F) T6: -20 ... +50 °C (-4 ... +122 °F)	

1) At ≤ -10 °C (+14 °F), the display refresh rate of the display is limited. For basic devices with explosion protection: When using Iy module, only T4 is permissible.

13.6 Electrical specifications

	Basic device without explosion protection	Basic device with explosion protection Ex d	Basic device with explosion protection Ex "ia"	Basic device with explosion protection Ex "ic", "nA", "t"
Auxiliary power supply bus circuit (terminals 6 and 7)	Bus-powered			
Bus voltage	9 ... 32 V	9 ... 32 V	9 ... 24 V	9 ... 32 V
For connecting to circuits with the following peak values				
• Bus connector with FISCO supply unit	-	-	U_i = 17.5 V DC I_i = 380 mA P_i = 5.32 W	"ic": U_i = 17.5 VDC I_i = 570 mA "nA"/"t": U_n ≤ DC 32 V
• Bus connector with barrier			U_i = DC 24 V I_i = 250 mA P_i = 1.2 W	"ic": U_i = DC 32 V "nA"/"t": U_n ≤ DC 32 V
Effective inner capacitance C_i	-	-	Negligible	Negligible
Effective inner inductance L_i	-	-	8 μH	"ic": 8 μH
Current consumption	11.5 mA ± 10 %			
Additional fault current	0 mA			
Safety shutdown can be activated using "Jumper" (terminals 81 and 82)	Electrically isolated from bus circuit and binary input			
• Input resistance	> 20 kΩ			
• Signal status "0" (shutdown active)	0 ... 4.5 V or no switch			
• Signal status "1" (shutdown inactive)	13 ... 30 V			
• For connecting to power source with the following peak values	-	-	U_i = DC 30 V Ii = 100 mA P_i = 1 W	"nA": U_n ≤ DC 30 V I_n ≤ 100 mA "ic": U_i = DC 30 V I_i = 100 mA
• Effective internal capacitance and inductance	-	-	Negligible	Negligible

	Basic device without explosion protection	Basic device with explosion protection Ex d	Basic device with explosion protection Ex "ia"	Basic device with explosion protection Ex "ic", "nA", "t"
Binary input BE1 (terminals 9 and 10) electrically connected to the bus circuit	Jumpered or connection to switch contact. Suitable only for floating contact; max. contact load < 5 µA with 3 V			

Galvanic isolation	
• For basic device without Ex protection and for basic device with Ex d	Galvanic isolation between the basic device and the input for safety shutdown and the outputs of option modules.
• For basic device Ex "ia"	The basic device, the input for safety shutdown, and the outputs of option modules are individual intrinsically safe circuits.
• For basic device Ex "ic", "nA", "t"	Galvanic isolation between the basic device and the input for safety shutdown and the outputs of option modules.
Test voltage	DC 840 V, 1 s

	Basic device without explosion protection	Basic device with explosion protection Ex d	Basic device with explosion protection Ex "ia"	Basic device with explosion protection Ex "ic", "nA", "t"
Connections, electrical				
• Screw terminals	2.5 AWG28-12			
• Cable gland	M20x1.5 or ½-14 NPT	Ex d certified M20x1.5; ½-14 NPT or M25x1.5	M20x1.5 or ½-14 NPT	M20x1.5 or ½-14 NPT
Connections, pneumatic	Female thread G¼ or ¼-18 NPT			

13.7 Technical data for natural gas as actuator medium

Introduction

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

- At the exhaust air outlet with a sound absorber at the bottom of the device.
- At the enclosure ventilation at the bottom of the device.
- At the control air outlet near the pneumatic connections.

Note

Exhaust air outlet with a sound absorber at the bottom of the device

The positioner is delivered as standard with a sound absorber at the bottom of the device. To provide an outlet for the exhaust air, replace the sound absorber by a G¼ pipe coupling.

Enclosure ventilation and control air outlet

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

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

Maximum values for escaping natural gas

Bleeding process	Operating mode	6DR5.1.-.E... Single-acting [Nl/min]	6DR5.2.-.E... Double-acting [Nl/min]
Ventilation of enclosure volume via bottom of 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
Ventilation via the exhaust air outlet with a sound absorber at the bottom of the device	Operation, max.	358.2[1)]	339[1),]
	Error case, max.		
Volume	Max. [l]	1.26	1.23

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

See also

Safety notes for operation with natural gas (Page 113)

Pneumatic connection on the standard controller (Page 92)

13.8 Option modules

13.8.1 Alarm module

	Without Ex protection/ with Ex protection Ex d	With Ex protection Ex "ia"	With Ex protection Ex "ic", "nA", "t"
Alarm module	6DR4004-8A	6DR4004-6A	6DR4004-6A
3 binary output circuits • Alarm output A1: Terminals 41 and 42 • Alarm output A2: Terminals 51 and 52 • Fault message output: Terminals 31 and 32			
• Auxiliary voltage U_H	≤ 35 V	-	-
• Signal status			
High (not addressed)	Conductive, R = 1 kΩ, +3/-1 % *)	≥ 2.1 mA	≥ 2.1 mA
Low *) (addressed)	Deactivated, I_R < 60 µA	≤ 1.2 mA	≤ 1.2 mA
*) The status is also Low if the basic device is faulty or without a auxiliary power.	*) When using in the flameproof housing, the current consumption must be restricted to 10 mA per output.	Switching thresholds for supply as per EN 60947-5-6: U_H = 8.2 V, R_i = 1 kΩ	Switching thresholds for supply as per EN 60947-5-6: U_H = 8.2 V, R_i = 1 kΩ
• For connecting to circuits with the following peak values	-	U_i = DC 15.5 V I_i = 25 mA P_i = 64 mW	"ic": U_i = DC 15.5 V I_i = 25 mA "nA"/"t": U_n ≤ DC 15.5 V
Effective internal capacitance	-	C_i = 5.2 nF	C_i = 5.2 nF
Effective internal inductance	-	L_i = negligibly small	L_i = negligibly small

1 binary input circuit • Binary input BE2: Terminals 11 and 12, terminals 21 and 22 (jumper)	
• Galvanically connected with the basic device	
Signal status 0	Floating contact, open
Signal status 1	Floating contact, closed

	Without Ex protection/ with Ex protection Ex d	With Ex protection Ex "ia"	With Ex protection Ex "ic", "nA", "t"
Contact load	3 V, 5 μA		
• Electrically isolated from the basic device			
Signal status 0	≤ 4.5 V or open		
Signal status 1	≥ 13 V		
Internal resistance	≥ 25 kΩ		
• Static destruction limit	± 35 V	-	-
• Connecting to circuits with the following peak values	-	U_i = DC 25.2 V	"ic": U_i = DC 25.2 V "n"/"t": U_n ≤ DC 25.5 V
Effective internal capacitance	-	C_i = negligibly small	C_i = negligibly small
Effective internal inductance	-	L_i = negligibly small	L_i = negligibly small
Galvanic isolation	The three outputs, the BE2 input and the basic device are galvanically isolated from each other.		
Test voltage	DC 840 V, 1 s		

13.8.2 Iy module

	Without Ex protection/ with Ex protection Ex d	**With Ex protection Ex ia** (only in temperature class T4)	**With Ex protection Ex "ic", "nA", "t"**
I_y module Direct current output for position feedback	6DR4004-8J	6DR4004-6J	6DR4004-6J
1 current output, terminals 61 and 62			
	2-wire connection		
Rated signal range	4 ... 20 mA, short-circuit proof		
Dynamic range	3.6 ... 20.5 mA		
Auxiliary voltage U_H	+12 ... +35 V	+12 ... +30 V	+12 ... +30 V
External load R_B [kΩ]	≤ (U_H [V] - 12 V)/i [mA]		
Transmission error	≤ 0.3%		
Temperature influence	≤ 0.1%/10 K (≤ 0.1%/18 °F)		
Resolution	≤ 0.1%		
Residual ripple	≤ 1 %		
For connecting to circuits with the following peak values		U_i = DC 30 V I_i = 100 mA P_i = 1 W	"ic": U_i = DC 30 V I_i = 100 mA "nA"/"t": U_n ≤ DC 30 V I_n ≤ 100 mA P_n ≤ 1 W
Effective internal capacitance	-	C_i = 11 nF	C_i = 11 nF
Effective internal inductance	-	L_i = negligibly small	L_i = negligibly small
Galvanic isolation	Safe galvanic isolation from alarm option and basic device		
Test voltage	DC 840 V, 1 s		

13.8.3 SIA module

	Without Ex protection	With Ex protection Ex "ia"	With Ex protection Ex "ic", "nA", "t"
SIA module Limit encoder with slotted initiators and fault message output	6DR4004-8G	6DR4004-6G	6DR4004-6G
2 slotted initiators • Binary output (limit transmitter) A1: Terminals 41 and 42 • Binary output (limit transmitter) A2: Terminals 51 and 52			
	2-wire connection		
• Connection	2 wire technology in accordance with EN 60947-5-6 (NAMUR), for switching amplifiers connected on load side		
• Signal state Low (triggered)	< 1.2 mA		
• 2 slotted initiators	Type SJ2-SN		
• Function	NC contact (NC, normally closed)		
• Connecting to circuits with the following peak values	Nominal voltage 8 V; current consumption: ≥ 3 mA (limit not activated), ≤ 1 mA (limit activated)	U_i = DC 15 V I_i = 25 mA P_i = 64 mW	"ic": U_i = DC 15 V I_i = 25 mA "nA": U_n ≤ DC 15 V P_n ≤ 64 mW
Effective internal capacitance	-	C_i = 41 nF	C_i = 41 nF
Effective internal inductance	-	L_i = 100 μH	L_i = 100 μH
1 fault message output • Binary output: Terminals 31 and 32			
• Connection	At switching amplifier in accordance with EN 60947-5-6: (NAMUR), U_H = 8.2 V, R_i = 1 kΩ).		
• Signal state High (not triggered)	R = 1.1 kΩ	> 2.1 mA	> 2.1 mA
• Signal state Low (triggered)	R = 10 kΩ	< 1.2 mA	< 1.2 mA
• Auxiliary power supply U_H	U_H ≤ DC 35 V I ≤ 20 mA	-	-
• Connecting to circuits with the following peak values	-	U_i = DC 15 V I_i = 25 mA P_i = 64 mW	"ic": U_i = DC 15 V I_i = 25 mA "nA": U_n ≤ DC 15 V P_n ≤ 64 mW
Effective internal capacitance	-	C_i = 5.2 nF	C_i = 5.2 nF
Effective internal inductance	-	L_i = negligibly small	L_i = negligibly small
Galvanic isolation	The 3 outputs are galvanically isolated from the basic device.		
Test voltage	DC 840 V, 1 s		

13.8.4 Limit value contact module

	Without Ex protection	With Ex protection Ex ia	With Ex protection Ex "ic", "nA", "t"
Mechanical limit switch module	6DR4004-8K	6DR4004-6K	6DR4004-6K
Limit encoder with mechanical switching contacts			
2 limit contacts • 1 binary output: Terminals 41 and 42 • 2 binary output: Terminals 51 and 52			
• Max. switching current AC/DC	4 A	-	-
• For connecting to circuits with the following peak values	-	U_i = DC 30 V I_i = 100 mA P_i = 750 mW	"ic": U_i = 30 V DC I_i = 100 mA "nA": Un ≤ 15 V DC
Effective internal capacitance	-	C_i = negligibly small	C_i = negligibly small
Effective internal inductance	-	L_i = negligibly small	L_i = negligibly small
• Max. switching voltage AC/DC	250 V/24 V	DC 30 V	DC 30 V

1 fault message output • Binary output: Terminals 31 and 32			
• Connection	At switching amplifier in accordance with EN 60947-5-6: (NAMUR), U_H = 8.2 V, R_i = 1 kΩ).		-
• Signal state High (not triggered)	R = 1.1 kΩ	> 2.1 mA	> 2.1 mA
• Signal state Low (triggered)	R = 10 kΩ	< 1.2 mA	< 1.2 mA
• Auxiliary power	U_H ≤ DC 35 V I ≤ 20 mA	-	-
• Connecting to circuits with the following peak values	-	U_i = 15 V I_i = 25 mA P_i = 64 mW	"ic": U_i = 15 V I_i = 25 mA
Effective internal capacitance	-	C_i = 5.2 nF	C_i = 5.2 nF
Effective internal inductance	-	L_i = negligibly small	L_i = negligibly small
Galvanic isolation	The 3 outputs are galvanically isolated from the basic device		
Test voltage	DC 3150 V, 2 s		
Rated condition height	Max. 2 000 m mean sea level Use a suitable power supply at an altitude of more than 2 000 m (6,562 ft.) above sea level.	-	-

13.8.5 EMC filter module

	Without Ex protection	With Ex protection Ex ia	With Ex protection Ex "ic", "nA", "t"
EMC filter module type C73451-A430-L8 is required for NCS sensor or an external potentiometer. External position sensor (potentiometer or NCS; option) with the following maximum values			
Resistance of the external potentiometer	10 kΩ		
Maximum values when powered by the PROFIBUS basic device	-	U_o = 5 V I_o = 75 mA static I_o = 160 mA short-term P_o = 120 mW	U_o = 5 V I_o = 75 mA P_o = 120 mW
Maximum values when powered by other basic devices	-	U_o = 5 V I_o = 100 mA P_o = 33 mW C_o = 1 μF L_o = 1 mH	U_o = 5 V I_o = 75 mA P_o = 120 mW C_o = 1 μF L_o = 1 mH
Galvanic isolation	Galvanically connected with the basic device		
Test voltage	DC 840 V, 1 s		

13.8.6 Non-contacting position sensor

Additional modules	Without Ex protection		With Ex protection Ex "ia"	With Ex protection Ex "ic", "nA"
Actuating range				
• Linear actuator 6DR4004-.N.20	3 to 14 mm (0.12 ... 0.55")			
• Linear actuator 6DR4004-.N.30	10 ... 130 mm (0.39 ... 5.12"); up to 200 mm (7.87") on request			
• Part-turn actuator	30 ... 100°			
Linearity (after corrections made by positioner)	± 1 %			
Hysteresis	± 0.2%			
Temperature influence (range: rotation angle 120° or stroke 14 mm)	≤ 0.1%/10 K (≤ 0.1%/18 °F) for -20 to 90 °C (-4 to 194 °F) ≤ 0.2%/10 K (≤ 0.2%/18 °F) for -40 to -20 °C (-40 to -4 °F)			
Climate class	According to DIN EN 60721-3-4			
• Storage	1K5, but -40 to +90 °C (1K5, but -40 to +176 °F)			
• Transport	2K4, but -40 to +90 °C (2K4, but -40 to +176 °F)			
Vibration resistance				
• Harmonic oscillations (sine wave) according to IEC 60068-2-6	3.5 mm (0.14"), 2 ... 27 Hz, 3 cycles/axis 98.1 m/s² (321.84 ft/s²), 27 ... 300 Hz, 3 cycles/axis			
• Permanent shocks according to IEC 60068-2-29	300 m/s²(984 ft/s²), 6 ms, 4000 shocks/axis			
Torque for cable gland nut made of	Plastic	Metal	Stainless steel	
	2.5 Nm (1.8 ft lb)	4.2 Nm (3.1 ft lb)	4.2 Nm (3.1 ft lb)	
Housing protection type	IP68 according to EN 60529; NEMA 4X / Encl. Type 4X			
For connecting to circuits with the following peak values	-		U_i = 5 V I_i = 160 mA P_i = 120 mW	U_i = 5 V
Effective internal capacitance	-		C_i = 180 nF	C_i = 180 nF
Effective internal inductance	-		L_i = 922 µH	L_i = 922 µH

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

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

13.8.7 External position sensing system

13.8.7.1 Operating conditions for all device versions

Ambient temperature	In hazardous areas, observe the maximum permissible ambient temperature corresponding to the temperature class.
• Permissible ambient temperature for operation	-40 ... +90 °C (-40 ... +194°F)
Degree of protection [1)]	IP66 according to EN 60529 / NEMA 4X
Climate class	According to DIN EN 60721-3-4
• Storage	1K5, but -40 ... +90 °C (1K5, but -40 ... +194 °F)
• Transport	2K4, but -40 ... +90 °C (2K4, but -40 ... +194 °F)
• Operation	4K3, but -40 ... +90 °C (4K3, but -40 ... +194 °F)

[1]) Impact energy max. 1 joule.

13.8.7.2 Constructional design for all device versions

How does it work?	
• Range of stroke (linear actuator)	3 ... 130 mm (0.12 ... 5.12") (angle of rotation of the positioner axis 16 to 90°)
• Angle of rotation (part-turn actuator)	30 ... 100°
Mounting method	
• 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 60534-6-1 (NAMUR) with a fin, columns, or a plane surface.
• On the part-turn actuator	Using the mounting kit 6DR4004-8D on the actuators with fastening plane as per VDI/VDE 3845 and IEC 60534-6-2: The required mount must be provided on the actuator-side.
Material	
• Enclosure	Makrolon® glass-fiber reinforced polycarbonate (PC)
Weight, basic device	Approximately 0.9 kg (1.98 lb)
Torque for plastic cable gland nut	2.5 Nm

13.8.7.3 Certificates, approvals, explosion protection for all device versions

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

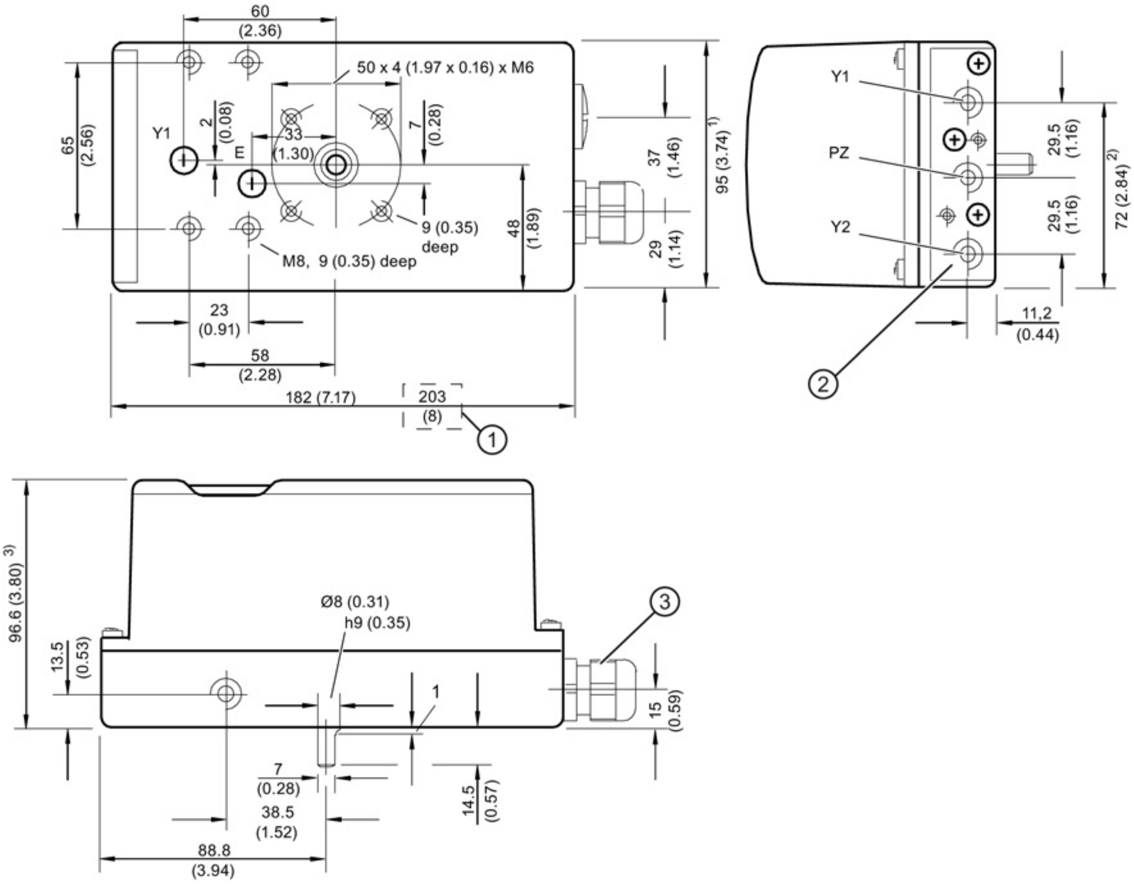
Certificates and approvals	
CE conformity	The applicable directives and standards applied with their revision levels can be found in the EC declaration of conformity on the Internet.

Explosion protection	**Ex markings**
Explosion protection in accordance with	**ATEX**
Intrinsic safety "ia"	Zone 1: Ⓔx II 2 G Ex ia IIC T6/T4 Gb Zone 21: Ⓔx II 2 D Ex ia IIIC 110°C Db

Explosion protection	Ex markings
Intrinsic safety "ic"	Zone 2: II 3 G Ex ic IIC T6/T4 Gc
Non-sparking "nA"	Zone 2: II 3 G Ex nA IIC T6/T4 Gc
Permissible ambient temperature	T4: -40 ... +90 °C (-40 ... +194 °F) T6: -40 ... +60 °C (-40 ... +140 °F)

Dimension drawings 14

14.1 Positioner with Makrolon enclosure 6DR5..0 and stainless steel enclosure 6DR5..2



① Dimension for electrical connection ½-14 NPT due to adapter: 203 mm (8 inch)

② All air connections G¼ or ¼ NPT

③ M20 x 1.5 or NPT adapter

Dimensions of stainless steel version (see superscript footnotes in the graphic)

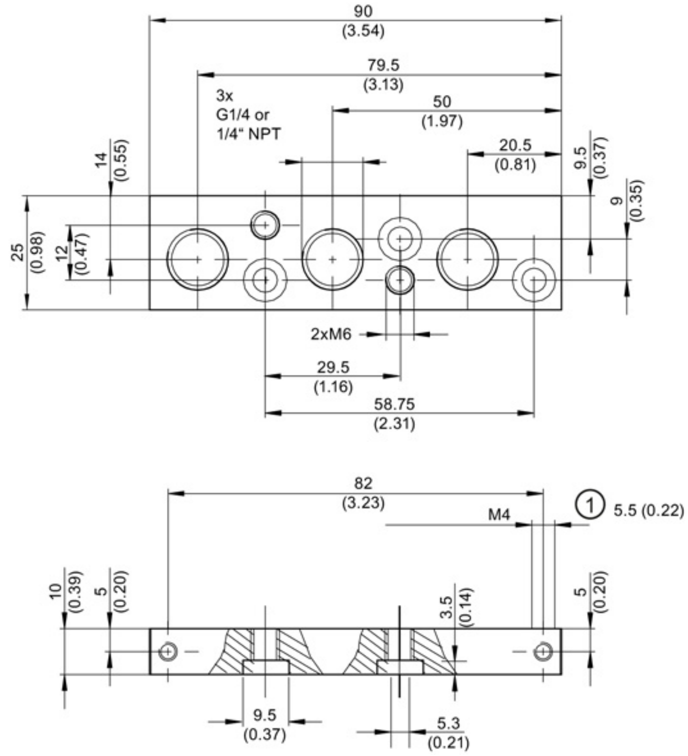
1) 99 mm (3.89 inch)

2) 74 mm (2.91 inch)

3) 98 mm (3.86 inch)

Figure 14-1 Macrolon enclosure version, dimensions in mm (inch)

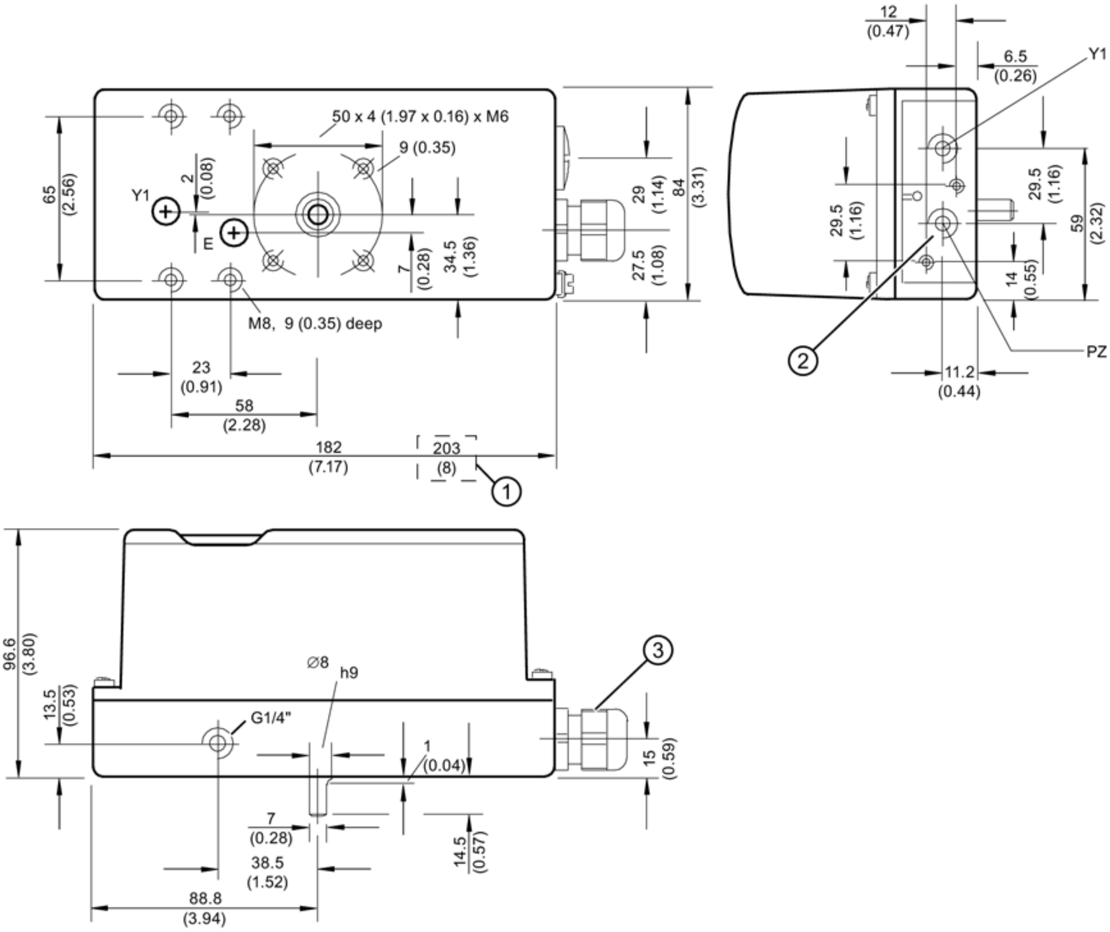
14.2 Terminal strip for positioner with Macrolon enclosure



① Thread depth

Figure 14-2 Terminal strip for positioner with Macrolon enclosure, dimensions in mm (inch)

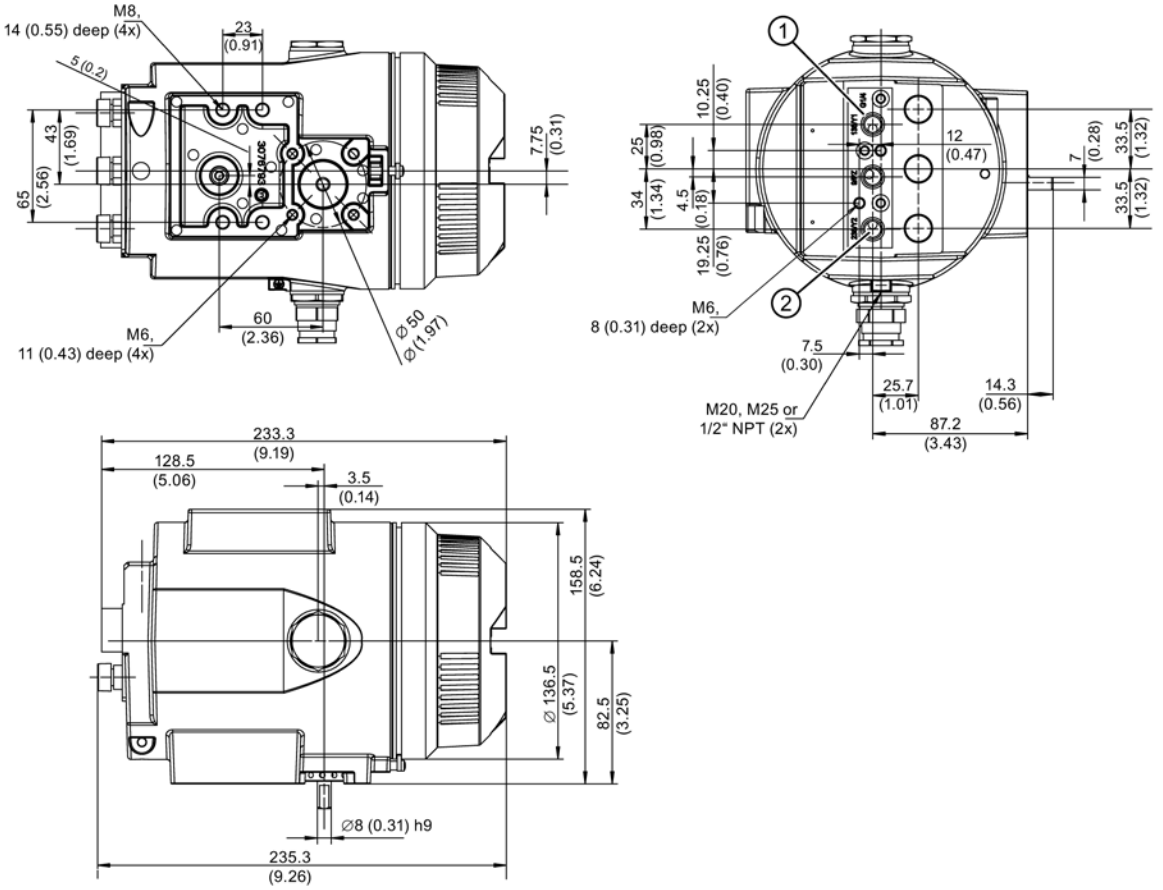
14.3 Positioner with aluminum enclosure 6DR5..1



① Dimension for electrical connection ½-14 NPT due to adapter: 203 mm (8 inch)
② All air connections G¼ or ¼ NPT
③ M20 x 1.5 or NPT adapter

Figure 14-3 Aluminum enclosure version, dimensions in mm (inch)

14.4 Positioner with flameproof enclosure 6DR5..5



① All air connections G¼ or ¼ NPT

② Air connection Y2, only with double-acting version

Figure 14-4 Version with flameproof enclosure, dimensions in mm (inch)

Spare parts/accessories/scope of delivery 15

15.1 Overview

> **WARNING**
>
> **Assembling the components**
>
> When assembling components, ensure that only those positioners and option modules are combined with each other that are approved for the corresponding operating range.
>
> This condition particularly applies to safe operation of the positioner in Zones 1, 2 and 22. It is imperative to observe categories 2 and 3 of the device itself and of its option modules.

Basic version

The positioner can be delivered for:

- Double-acting actuators
- Single-acting actuators

The positioner and its option modules are delivered as separate units and with different versions for the operation in:

- Hazardous environments and atmospheres
- Non-hazardous environments and atmospheres

Enclosure

The electronic unit with display, the position feedback, and the pneumatic block are integrated in the enclosure.

The enclosure is available in the following versions:

- Makrolon enclosure for single and double-acting actuators
- Aluminum enclosure for single-acting actuators
- Stainless steel enclosure for single and double-actuators
- Flameproof enclosure for single and double-acting actuators

Options

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

- I_y module: two-wire current output 4 to 20 mA for position feedback
- Alarm module: 3 binary outputs and 1 binary input
- SIA module: one binary output for fault messages, two binary outputs for limit monitors
- Mechanical limit switch module with two switches and one alarm output.
  The mechanical limit switch module cannot be used in device versions with flameproof enclosure. 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

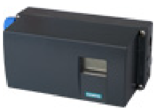
For separate mounting of positioner and position sensor

- External position sensing system
- Non contacting sensor (NCS)

Note

The version is identified using a special nameplate.

15.2 Spare parts

	Description	Order no.	For version
	Plastic cover with 4 screws and circumferential sealing ring	C73451-A430-D82	6DR5...
	Aluminum cover with 4 screws and circumferential sealing ring	C73451-A430-D83	6DR5...
	Basic electronics, 2-wire, not Ex, without HART	A5E00082459	6DR50..-.N
	Basic electronics 2-wire, Ex, without HART	A5E00082457	6DR50..-.E
	Basic electronics, 2-wire, not Ex, with HART	A5E00082458	6DR51..-.N
	Basic electronics, 2/3/4-wire, Ex, with HART	A5E00082456	6DR52..
	Basic electronics, 2/3/4-wire, not Ex, without HART	A5E00102018	6DR53..-.N
	Basic electronics, PROFIBUS PA, not Ex	A5E00141523	6DR55..-.N
	Basic electronics, PROFIBUS PA, Ex	A5E00141550	6DR55..-.E
	Basic electronics, FOUNDATION fieldbus, not Ex	A5E00215467	6DR56..
	Basic electronics, FOUNDATION fieldbus, Ex	A5E00215466	6DR56..
	Pneumatic block, single-acting, with seal and screws	C73451-A430-D80	6DR5...
	Pneumatic block, double-acting, with seal and screws	C73451-A430-D81	6DR5...
	Potentiometer (complete)	C73451-A430-D84	6DR5...
	Magnet holder made of fiberglass reinforced polyester including magnet for non contacting position detection for part-turn actuators	A5E00078030	6DR4004-.N.10
	Magnet holder made of anodized aluminum including magnet for non contacting position detection for part-turn actuators	A5E00524070	6DR4004-.N.40

Note

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

15.3 Scope of delivery of small part sets

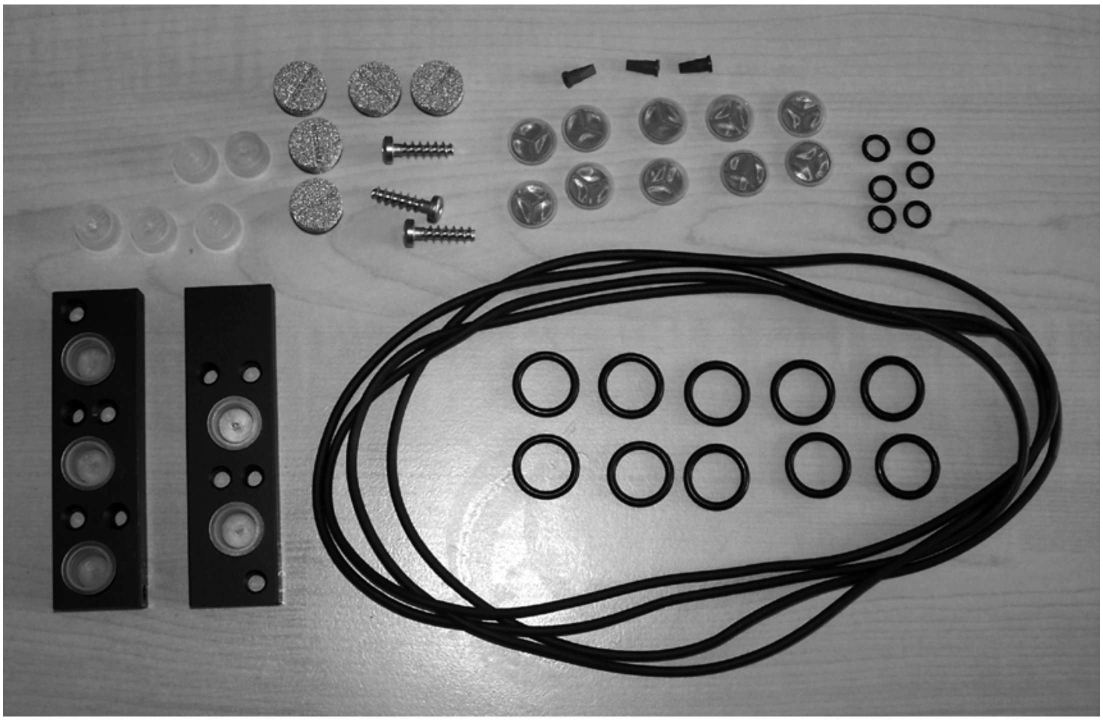
Small part set 1

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

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

Small part set 2

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



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

15.4 Scope of delivery of external position detection system

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

15.5 Scope of delivery of mechanical limit switch module

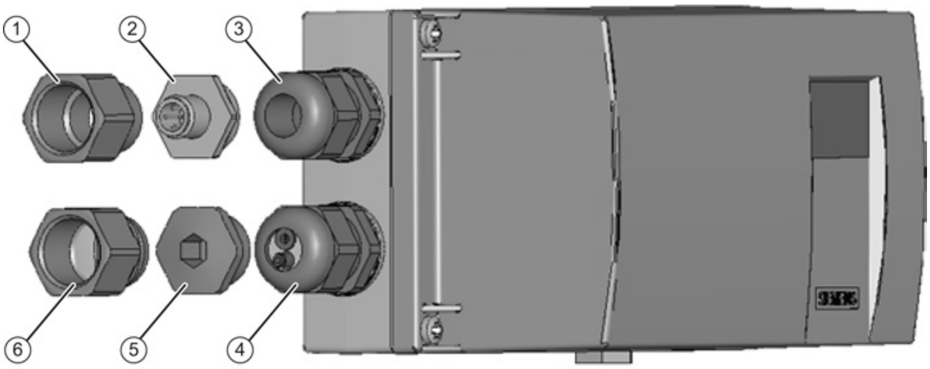
If the mechanical limit switch module was ordered for later installation, then the following components are included in the scope of delivery:

- One mechanical limit switch module with accessories
- DVD with product documentation
- One housing cover with enlarged aperture
- One insulating cover
- Two cable ties
- One set of signs; how these are to be attached depends on the version.

15.6 Scope of delivery EMC filter module

Cable glands and adapters

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



Connections ① to ③ for power supply

① Adapter M20 ½-14 NPT for macrolon enclosure
- 6DR5..0-0.N../ -0.P..

② M12 connector for device version with PROFIBUS communication (optional)
- 6DR55..-0.R../ -0.R..

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

Connections ④ to ⑥ for optional modules

④ Cable gland for connection thread M20x1.5 with seal insert
- 6DR5...-0...1/ -0...2/ -0...3

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

⑥ Adapter M20 ½-14 NPT for macrolon enclosure with connection thread and cover
- 6DR5..0-0.N../ -0.P..

Figure 15-1 Positioner with the different cable glands and adapter

Scope of delivery EMC filter module

Legend numbers refer to the graphic

	Description
	EMC filter module C73451-A430-L8
	Seal ring
	Cable tie l = 200 mm
①	Adapter M20 ½-14 NPT for macrolon enclosure
②	M12 connector for device version with PROFIBUS communication
③	Cable gland for connection thread M20x1.5
④	Cable gland for connection thread M20x1.5 with seal insert
⑤	Dummy plug for device version without optional modules
⑥	Adapter M20 ½-14 NPT for macrolon enclosure with connection thread and cover
	Adhesive label 9x37 ws

15.7 Accessories

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

- Option modules
- Non-contacting position sensor (NCS)
- Mounting kits
- Operating software

Appendix A

A.1 Operation with boosters

Introduction

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

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

NOTICE
Avoid pressure variations Make sure that the booster does not result in pressure variations in the supply air P_z on the positioner.

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

Procedure

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

If the process value on the display does not remain stable or if a constant manipulated variable cannot be achieved for a constant setpoint, further optimization of the controller data is necessary. This is described in section Optimizing the controller data (Page 108).

See also

Sequence of automatic initialization (Page 115)

A.2 Certificates

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

A.3 Literature and catalogs

Table A- 1

No.	Title	Publisher	Order no.
/1/	PNO guidelines PROFIBUS PA	PNO Technologiefabrik Haid-und-Neu-Str. 7 D-76131 Karlsruhe	2.091
/2/	Catalog ST 70 **SIMATIC** Products for Totally Integrated Automation	Siemens AG	E86060-K4670-A111-B1
/3/	Catalog ST 70 N**SIMATIC News** Products for Totally Integrated Automation	Siemens AG	E86060-K4670-A151-A3
/4/	Catalog ST 80 **SIMATIC HMI** operation and observation products	Siemens AG	E86060-K4680-A101-B4
/5/	Catalog IK PI **Industrial Communication**	Siemens AG	Internet address: IK PI Catalog (http://www.automation.siemens.com/net/html_76/support/printkatalog.htm) E86060-K6710-A101-B5

See also

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

A.4 Technical support

Technical Support

You can contact Technical Support for all IA and DT products:

- Via the Internet using the **Support Request:**
  Support request (http://www.siemens.com/automation/support-request)
- E-mail (mailto:support.automation@siemens.com)
- **Phone:** +49 (0) 911 895 7 222
- **Fax:** +49 (0) 911 895 7 223

Further information about our technical support is available on the Internet at
Technical support (http://www.siemens.com/automation/csi/service)

Industry Online Support

In addition to our documentation, we offer a comprehensive knowledge base on the Internet at:

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

There you will find:

- The latest product information, FAQs, downloads, tips and tricks.
- Our newsletter with the latest information about our products.
- A Knowledge Manager to find the right documents for you.
- Our bulletin board, where users and specialists share their knowledge worldwide.
- Your local contact partner for Industry Automation and Drives Technologies in our partner database.
- Information about field service, repairs, spare parts and lots more under "Services."

Additional Support

Please contact your local Siemens representative and offices if you have any questions about the products described in this manual and do not find the right answers.

Find your contact partner at:

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

Documentation for various products and systems is available at:

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

See also

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

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

Abbreviations B

B.1 Abbreviations for PS2 positioners

Abbreviation	Long form	Meaning
A/D	Analog-to-digital converter	-
AC	Alternating current	Alternating current
AMS	Asset Management Solutions	Communication software from Emerson Process comparable with the PDM
AUT	Automatic	Operating mode
ATEX	Atmosphère explosible	Product and operation directive of European Commission for explosion protection.
CENELEC	Comité Européen de Normalisation Electrotechnique	European committee for electrotechnical standardization
CPU	Central processing unit	Master processor
DC	Direct current	Direct current
DI	Digital Input	Digital input
DIN	Deutsche Industrie Norm	-
DO	Digital Output	Digital output
DTM	Device Type Manager	-
EDD	Electronic Device Description	-
Ex	Explosion protection	-
EMC	Electromagnetic compatibility	-
FDT	Field Device Tool	-
FF	FOUNDATION Fieldbus	Fieldbus of the Fieldbus Foundation
FM	Factory Mutual	American testing agency/insurance company
FW	Firmware	Device-specific software
GSD	Device master data	-
HART®	Highway Addressable Remote Transducer	Communication system for the development of industrial field busses.
IP	International Protection Ingress Protection	International protection types (long form as per DIN) Seepage protection (long form as used in US)
LC	Liquid crystal	Liquid crystal
MAN	Manual	Operating mode
NAMUR	Standards working group for measurement and control technology in the chemicals industry	Association of users in process conductor technology
µC	Microcontroller	One-Chip computer system
NCS	Non-Contacting Position Sensor	No-contact position sensor
NEMA	National Electrical Manufacturers Association	US standards institution National Electrical Manufacturers Association

Abbreviation	Long form	Meaning
NPT	National Pipe Thread Taper	Pipe threading for self-sealing threads as per ANSI B.1.20.1
OPOS interface®	Open Positioner Interface	Standard interface for the connection between a positioner and a pneumatic linear or part-turn actuator
PA	Process Automation	Process automation
PDM	Process Device Manager	Siemens communication software / Engineering tool
PROFIBUS	Process Field Bus	Fieldbus
PTB	Physical Technical Federal Institution	-
SIA	Slit 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
FIT	Failure in Time	Frequency of failure Number of faults within 10^9 hours
HFT	Hardware Fault Tolerance	Hardware fault tolerance: Capability of a function unit to continue executing a required function in the presence of faults or deviations.
MooN	"M out of N" voting	Classification and description of the safety-instrumented system in terms of redundancy and the selection procedures used. A safety-instrumented system or part that consists of "N" independent channels. The channels are connected to each other in such a way that "M" channels are in each case sufficient for the device to perform the safety instrumented function. Example: Pressure measurement: 1oo2 architecture. A safety-instrumented system decides that a specified pressure limit has been exceeded if one out of two pressure sensors reaches this limit. In a 1oo1 architecture, there is only one pressure sensor.
MTBF	Mean Time Between Failures	Average period between two failures
MTTR	Mean Time To Restoration	Average period between the occurrence of a fault in a device or system and restoration of functionality
PFD	Probability of Dangerous Failure on Demand	Probability of dangerous failures of a safety function on demand
PFD_{AVG}	Average Probability of Dangerous Failure on Demand	Average probability of dangerous failures of a safety function on demand
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.

Abbreviation	Full term in English	Meaning
SIL	Safety Integrity Level	The international standard IEC 61508 defines four discrete Safety Integrity Levels (SIL 1 to SIL 4). Each level corresponds to a range of probability for failure of a safety function. The higher the Safety Integrity Level of the safety-instrumented system, the lower the probability that it will not execute the required safety functions.
SIS	Safety Instrumented System	A safety-instrumented system (SIS) executes the safety functions that are required to achieve or maintain a safe status in a system. It consists of sensors, logic unit/control system and final controlling elements.

Glossary

Analog

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

Analog-to-digital converter

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

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

Asset Management Solution (AMS)

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

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. Auxiliary voltage is used, for example, with four-wire systems.

Conduit piping system

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

Configuring

See parameter assignment.

Cornerstone

Management software for process instrumentation.

Decrement

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

Degree of protection

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

Device category 1

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

Device category 2

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

Device category 3

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

Digital

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

EEPROM

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

Electromagnetic compatibility

Definition as per the EMC law: EMC is the capability of a device to work satisfactorily in the electromagnetic environment without causing electromagnetic interferences that are unacceptable for other devices present in this environment.

Ex 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

Ex 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

Factory Mutual

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

Failure that causes a dangerous situation

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

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.

Fieldbus Foundation

Syndicate of manufacturers of measurement and control systems. The syndicate develops the open fieldbus specifications of the FOUNDATION Fieldbus.

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

Fieldbus to connect sensors and final control elements in hazardous areas in accordance with 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

ENGLISH: Frequency shift keying (FSK)

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 parameter assignment with the HART communicator. For the parameter assignment with a laptop or a PC, a HART modem is connected in between.

Increment

From the Latin word incrementare, increase. Increment is the defined amount of change when increasing a variable(s) gradually. In informatics, it is referred to as the stepwise increase in a numeric value.→Decrement.

Initialization

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

IP code

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

Microcontroller

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

NAMUR

Standardization association for measurement and control in chemical industries. NAMUR is an association of users of process control technology. The members are mainly 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.

Parameter assignment

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

Piezoelectric effect

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

Potentially explosive gaseous atmosphere

Mixture of air, combustible gases, vapors, mists or dusts.

Process device manager

PDM is a Siemens software package for project planning, parameter assignment, commissioning and maintenance of network configuration and field devices. Part of SIMATIC Step7. Is used for configuration and diagnostics.

PROFIBUS

PROFIBUS stands for process fieldbus. PROFIBUS is a vendor-independent standard for networking field devices (e.g. PLCs, actuators, final control elements, and sensors). PROFIBUS is compatible with protocols such as DP (decentralized peripherals), FMS (fieldbus message specification) and PA (process automation).

PROFIBUS PA

PA is an abbreviation of process automation. PROFIBUS PA is used in process engineering. This fieldbus is used to control the measuring devices using a process control system. This version of PROFIBUS is suitable for hazardous areas of zones 0 and 1. Only a weak current flows through an intrinsically safe circuit in the bus cables, and hence sparks are not generated even in case of a fault.

PA enhances PROFIBUS DP with an intrinsically safe transmission technique compliant with the international standard IEC 61158-2.

Protocols

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

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

Safety function

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

Example: limit pressure monitoring

Safety-instrumented system

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

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

Sensor

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

SIL

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

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

SIMATIC software

Programs for process automation (e.g. PCS7, WinCC, WinAC, PDM, Step7).

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 a potentially explosive gaseous atmosphere normally never builds up or builds up only for a short while during 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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Industry Sector
Postfach 48 48
90026 NÜRNBERG
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