

SIEMENS

SIPART PS2 FF

6DR56xx

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Manual

Electropneumatic Positioner with FOUNDATION Fieldbus for
Linear and Rotary Actuators

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Siemens AG
Bereich Automation & Drives
Geschäftsgebiet Process Instrumentation and Analytics
D-76181 Karlsruhe

We have checked the contents of this manual for agreement with the hardware and software described. Since deviations cannot be precluded entirely, we cannot guarantee full agreement. However, the data in this manual are reviewed regularly and any necessary corrections included in subsequent editions. Suggestions for improvement are welcomed.

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Patents

Manufactured under one or more of the following patents

U.S. 6,424,872 U.S. 09/598,697 PCT/US001/17022 U.S. 60/384,846 U.S. 5,909,368 U.S. 5,333,114 U.S. 5,485,400 U.S. 5,825,664 Australian Patent #638507 Canadian Patent #2,066,743 European Patent # 04905001 UK Patent # 0495001 France # 0495001 Germany # 69032954.7 Netherlands # 0495001 Japan Patent # 3137643 U.S. 6,055,633 EP1029406A2 U.S. 6,104,875 AU9680998A1

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Information for the Operator

0

Dear customer,

Please read this manual before starting work!

It contains important information and data which, when observed, ensure full availability of the equipment and save service costs. This simplifies handling of this control instrument considerably and provides accurate measuring results.

You have purchased an instrument which can be installed in various configurations:

- SIPART PS2 **without** Ex-protection in a metal or plastic housing.
- SIPART PS2 **with** EEx ia/ib-protection in a metal or plastic housing.
- SIPART PS2 EEx d in flameproof enclosure (EEx d)

This manual takes each of these possibilities into consideration. Any differences between the devices are indicated specially.

Scope of delivery, see chapter 8, page 181.

0.1 General information

The product described in this manual left the factory in a perfectly safe and tested condition. To maintain this condition and to achieve perfect and reliable operation of this product, it must only be used in the way described by the manufacturer. Successful and safe operation of this equipment is dependent on proper handling, installation, operation and maintenance.

This manual contains the information required for use as intended of the product it describes. It is addressed to technically qualified personnel specially trained or having relevant knowledge of instrumentation and control technology, hereafter called automation technology.

Familiarity with and proper technical observance of the safety notes and warnings contained in this manual are essential for safe installation and commissioning and for safety in operation and maintenance of the product described. Only qualified personnel as defined in Chapter 0.3 has the necessary specialist knowledge to interpret the general safety notes and warnings given in this document in specific cases and to take the necessary action.

The documentation supplied with the instrument is listed in Chapter 0.5.

This manual is not a permanent part of the scope of supply. For reasons of clarity, it does not contain every detail about every version of the product described and cannot take every eventuality in installation, operation, maintenance and use in systems into account. If you require further information or if problems occur that have not been dealt with in sufficient detail in this document, please request the required information from your local Siemens office or the office responsible for you.

Functionality, commissioning and operation are described in this manual.

Please pay special attention to the **Warning and Note** texts. These are separated from the remaining text by horizontal lines and specially marked with symbols (see Chapter 0.2).

0.2 Classification of Safety-Related Notices

This manual contains notices which you should observe to ensure your own personal safety, as well as to protect the product and connected equipment. These notices are highlighted in the manual by a warning triangle and are marked as follows according to the level of danger:



DANGER

indicates an imminently hazardous situation which, if not avoided, **will** result in death or serious injury.



WARNING

indicates a potentially hazardous situation which, if not avoided, **could** result in death or serious injury.

**CAUTION**

used with the safety alert symbol indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

CAUTION

used without safety alert symbol indicates a potentially hazardous situation which, if not avoided, may result in property damage.

NOTICE

used without the safety alert symbol indicates a potential situation which, if not avoided, may result in an undesirable result or state.

**NOTE**

highlights important information on the product, using the product, or part of the documentation that is of particular importance and that will be of benefit to the user.

0.3 Qualified Personnel

The result of unqualified intervention in the instrument or nonobservance of the warnings given in this manual or on product labels can be severe personal injury and/or serious material damage. Therefore only properly qualified personnel must make changes and settings in the instrument.

For the purpose of the safety information in this manual and on the product labels, qualified personnel are those who

- in the case of ex-proof equipment, are trained, instructed or authorized to perform work on electrical circuits of equipment subject to explosion hazard.
- if they are configuration personnel, are familiar with the safety concepts of automation technology
- if they are operating personnel, have been instructed in the handling of automation equipment and know the content of this manual relating to operation
- if they are commissioning and/or service personnel, are trained to repair such automation equipment and authorized to energize, de-energize, clear ground and tag circuits and equipment according to safety engineering standards.
- and instructed additionally in first aid



WARNING

The instrument must only be installed and commissioned by qualified personnel.

The instrument is designed for connection to functional and safety extra low voltage.

The instrument is designed for connection to operate voltage or safety extra-low voltage.

Electrical safety depends only on the power supply equipment.

Pneumatic actuators exert considerable positioning forces. The safety precautions of the actuator used must therefore be scrupulously observed during installation and commissioning in order to prevent injuries.

We explicitly draw your attention to the necessity of observing safety regulations regarding operation in zones subject to explosion hazard, if applicable.

The specifications of the examination certificate valid in your country must be observed. Laws and regulations valid in your country must be observed for the electrical installation in explosions hazardous areas.

In Germany these are for example:

- Working reliability regulations,
- Regulations for installing electrical equipment in hazardous areas, DIN EN 60079-14 (in the past VDE 0165, T1).

It should be checked whether the available power supply, insofar as this is required, is compliant with the power supply specified on the type plate and specified in the examination certificate valid in your country.

Take care to avoid electrostatic discharges within the hazardous area, such as can arise if a dry cloth is used to clean the positioner in the plastic housing.

Devices with the protection type "flameproof enclosure" may only be opened when the power is off.



WARNING

Devices with the protection type "intrinsically safe" lose their certification as soon as they are operated with circuits that do not conform to the specifications laid down in the EC type examination certificate valid in your country.

The successful and safe operation of this equipment is dependent upon its proper handling, installation, operation and maintenance.

0.4 Use as intended

Use as intended for the purpose of this manual means that this product must only be used for the applications described in the technical description (see also Chapter 3 of this manual).

The product described in this manual has been developed, manufactured, tested and documented observing the relevant safety standards. If the handling rules and safety information for configuration, installation, use as intended and maintenance are observed, there is normally no danger with regard to material damage or for the health of personnel. Extra low voltages that are connected must be fed in by safe isolation.

0.5 Technical Documentation

The instructions are a constituent part of the enclosed CD "sipartp ps2 POSITIONERS" (order number A5E00214567). The manual and further documentations are available on the Internet at:

www.siemens.com/sipartps2

Click on "More Info" and "-> Instructions and Manuals".

On the enclosed CD, you will find an extract of the catalog FI 01 "Field devices for process automation" with the current order data. The entire FI 01 catalog is also available at the above Web address.

If you need more information or have particular problems which are not covered sufficiently by the operating instructions, contact your local Siemens office. You will find your local Siemens office on the Internet under:

www.siemens.com/processinstrumentation

Click on "Contact" and select your closest town.

0.6 Warranty Information

We should like to point out that the content of this manual is not part of and does not modify a previous or current agreement, undertaking or legal relationship. Siemens is bound solely by the contract of sale, which also contains the complete and exclusive warranty. The contractual warranty conditions are neither extended nor restricted by this document.

0.7 Delivery Notes

The scope of delivery is listed on the dispatch papers accompanying the delivery in accordance with the valid contract of sale.

When you open the packaging please observe the information on the packaging. Check that the delivery is complete and undamaged. If possible, compare the order number on the rating plates with the ordering data.

For the scope of delivery please see Chapter 8.

0.8 Standards and Regulations

As far as possible, the harmonized European standards were used to specify and manufacture this equipment. If harmonized European standards have not been applied, the standards and regulations of the Federal Republic of Germany apply (see also Chapter 7 "Technical Data").

If this product is used outside the area of applicability of these standards and regulations, please observe the standards and regulations in force in the country where the product is operated.

1.1 General information about the positioner

The positioner is used to adjust and control pneumatic actuators. The controller operates electropneumatically with compressed air as an energy supply.

The positioner together with the FOUNDATION Fieldbus communications interface are components in a digital process automation system. The field bus is used not only for communication but also to supply the positioner with electrical power.

Purpose

For example, the positioner can be used to control valves as follows:

- with linear actuator (figure 1-1, page 15) or
- with rotary actuator VDI/VDE 3845 (figure 1-2, page 15)

Different mounting types are available for linear actuators:

- NAMUR or IEC534
- integrated mounting to ARCA
- integrated mounting to SAMSON (non-explosion-proof version)

This means the positioner can be installed and operated on all common actuator systems.

Versions

The positioner is available for the following actuators:

- double-acting and
- single-acting

For following applications:

- potentially explosive or
- not potentially explosive applications.

Housing

The electronics with display, position feedback and valve block are integrated in the housing.

The housing is available in three versions:

- Plastic housing for single- and double-acting actuators
- Metal housing for single-acting actuators
- Explosion-proof metal housing for single and double-acting actuators

Degree of protection

The device is designed with IP66/NEMA4x degree of protection.

Explosion Protection

The intrinsically safe version can be used in hazardous areas in zone 1 or zone 2.

The explosion-proof version can be used in hazardous areas in zone 1 or zone 2.

SIL applications

The positioners (version 6DR561* for single acting actuators) are also suitable for positioning on fittings with pneumatic actuators, which satisfy the special requirements for safety devices up to SIL 2 to IEC 61508 part 1–7 and IEC 61511 part 1–3. For this the SIL safety instructions in the "SIL Safety Manual (PA/FF)" order number A5E00489773 must be followed.

Options

The positioner can be expanded with various options modules (chapter 2.6, page 25). The following modules are available in:

- I_y module: Two-wire current output 4 to 20 mA for position feedback
- Alarm module: 3 digital outputs and 1 digital input
- SIA module: one digital output for fault messages, two digital outputs for limit value alarms
- Mechanical limit switch module: one binary output for the output of a group error message, two switches for signalling two limit values that can be set mechanically.

Accessories

- Manometer block: 2 or 3 manometers for single or double-acting positioners
- Connection block (NAMUR) for safety valve block
- Mounting kits for linear and rotary actuator

For decentralized installation of the positioner and position sensor:

- External position detection system
- Non-Contacting Position Sensor (NCS)

Environmental Protection

Only environmentally friendly materials have been used in the construction of the positioner.

The technical manual is printed on chlorine-free bleached paper.

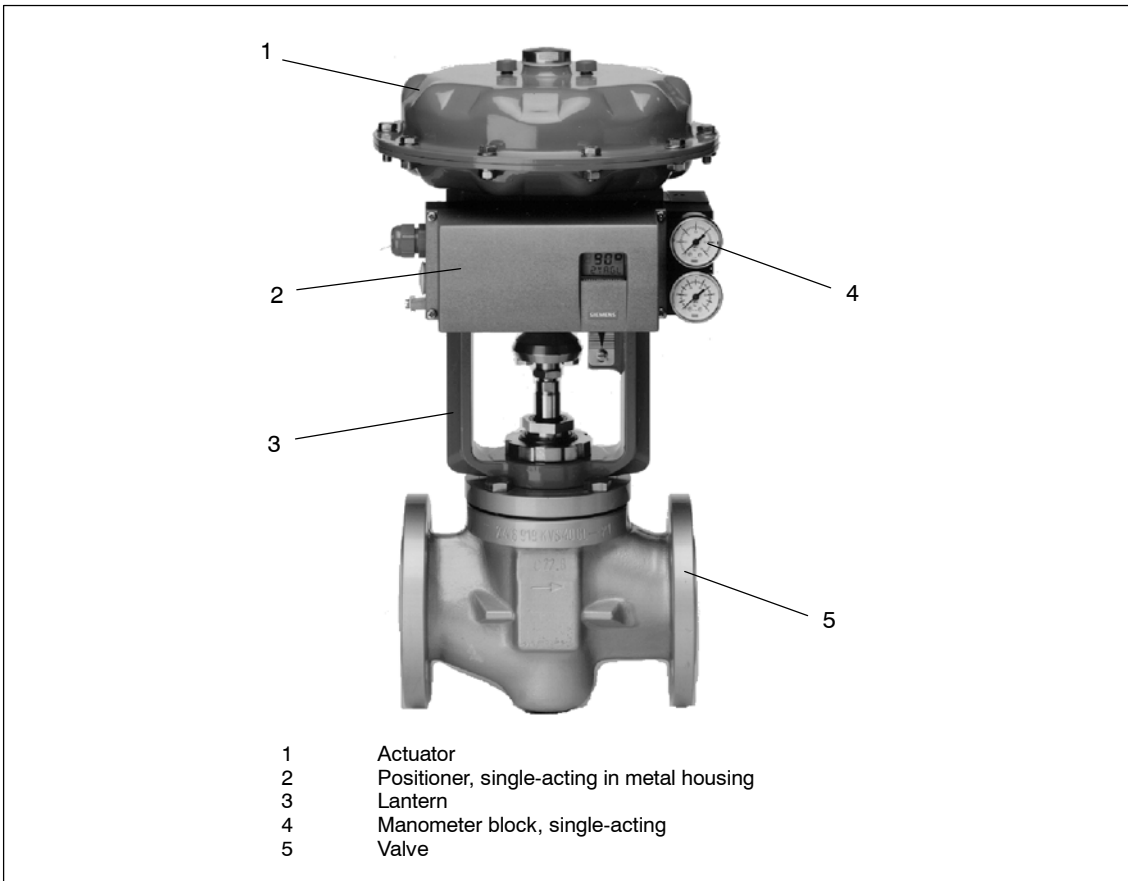


Figure 1-1 Positioner mounted on **linear actuator** (single-acting)

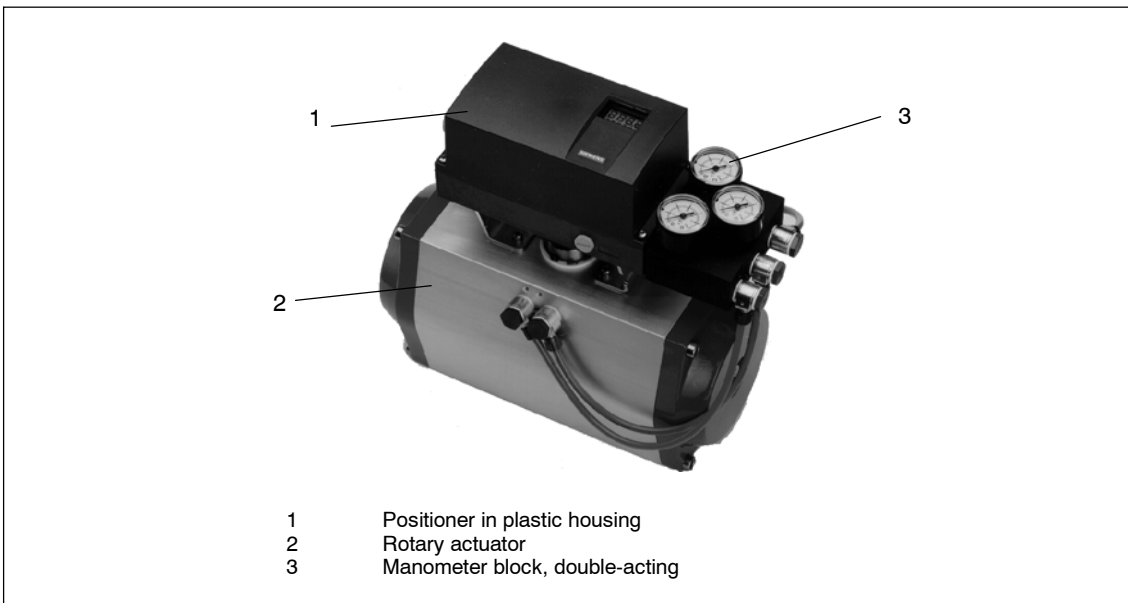


Figure 1-2 Positioner mounted on **rotary actuator** (double-acting)

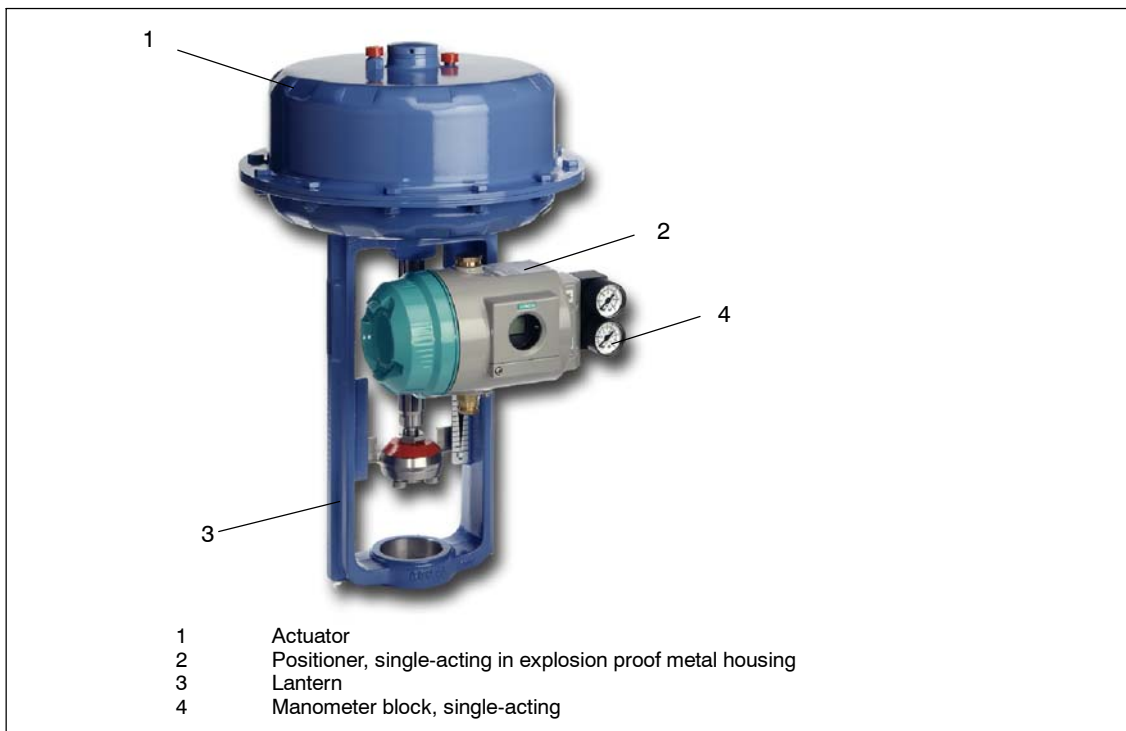


Figure 1-3 **Explosion proof** positioner mounted on **linear actuator** (single-acting)

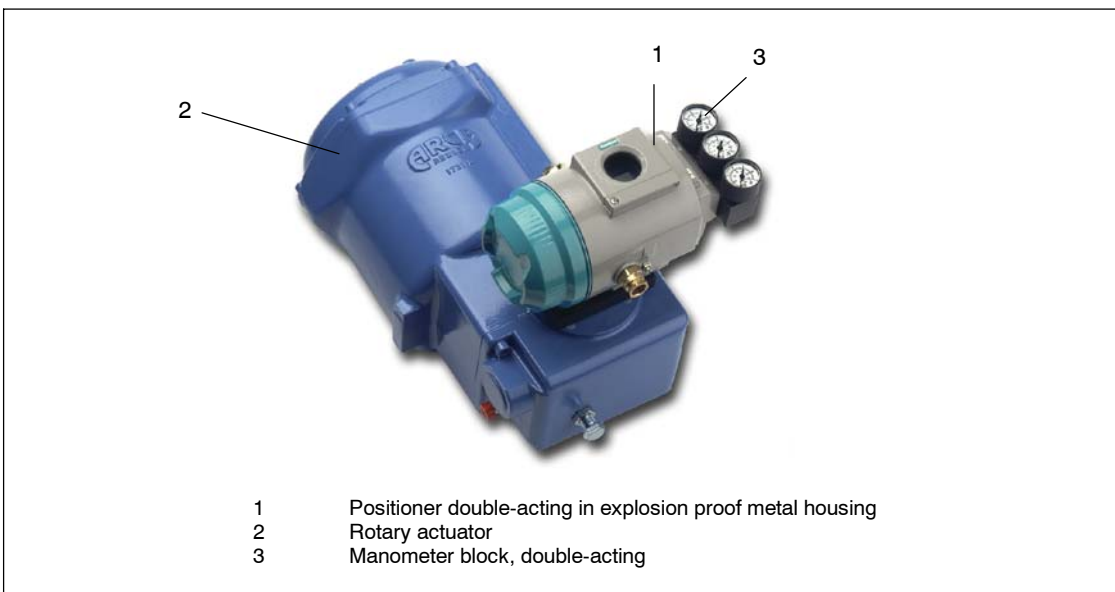


Figure 1-4 **Explosion proof** positioner mounted on **rotary actuator** (double-acting)

The following chapter describes the mechanical and electrical design, the instrument components and method of operation of the positioner.

2.1 Overview

Introduction

The electropneumatic positioner forms a control system in connection with an actuator. The current position of the positioner is detected by a servo potentiometer and fed back as actual value x . In addition a separate sensor can be fitted to the positioner for purposes of position detection. The setpoint and actual value are output simultaneously on the display.

The setpoint is set by the control system and passed to the positioner by the FOUNDATION Fieldbus digitally.

The FOUNDATION Fieldbus variant of the positioner differs from previous versions in the bus interface. The basic functions of the positioner including operation and display are virtually unchanged.

The positioner operates as a predictive five-point switch by the output variable $\pm\Delta y$ of which the integrated actuating valves are controlled with pulse length modulation.

These actuating signals cause fluctuations in pressure in the actuator chamber(s) and thus adjustment of the actuator until the control error is zero.

Operation (manual) and configuration (structuring, initialization and parameterization) is effected by three keys and a display with the housing cover removed.

A further input (Shut down) has the function of moving the actuator to a pre-set safety position (end stop).

With the I_y -option module, the current actuator position can be output as a two wire signal $I_y = 4$ to 20 mA.

In addition the actuator can be monitored for two programmable limit values which respond on exceeding or dropping below the stroke or angle of rotation.

The limit value alarms are output by the alarm option module which can monitor and report the function of the positioner and the actuator additionally through a fault message output. The value of the control difference dependent on the travel time is monitored in automatic mode. The fault signal is always set when the control error cannot be leveled after a certain time because for example the valve is blocked or the mains pressure is insufficient. The three digital outputs are implemented as semiconductor outputs and are error self-reporting, i.e. the outputs respond even when the power supply fails or the electronics are defective.

The actuator can also be blocked or driven to its final positions depending on the configuration for example by an external event via a digital input (DI2) on the alarm module.

If you require electrically independent limit value messages from the standard controller, you will have to use the SIA module with the slot initiators instead of the alarm module.

The friction clutch (9, Figure 2-2, page 19) allows you to set the working range, particularly for linear actuators, after installation. You thus do not have to ensure symmetrical mounting during the installation.

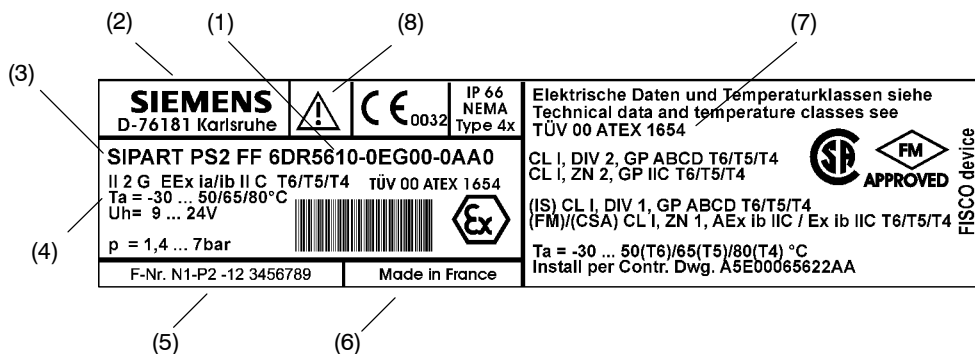
As it is not allowed to open the housing of an explosion proof version in a potentially explosive atmosphere, the shaft has an externally fitted, additional friction clutch (8, Figure 2-3, page 20).

NOTICE

for the explosion proof version:

Only adjust the outer friction clutch (8, Figure 2-3, page 20). The internal friction clutch (9, Figure 2-2, page 19) is fixed and, for the explosion proof version, must **not** be adjusted.

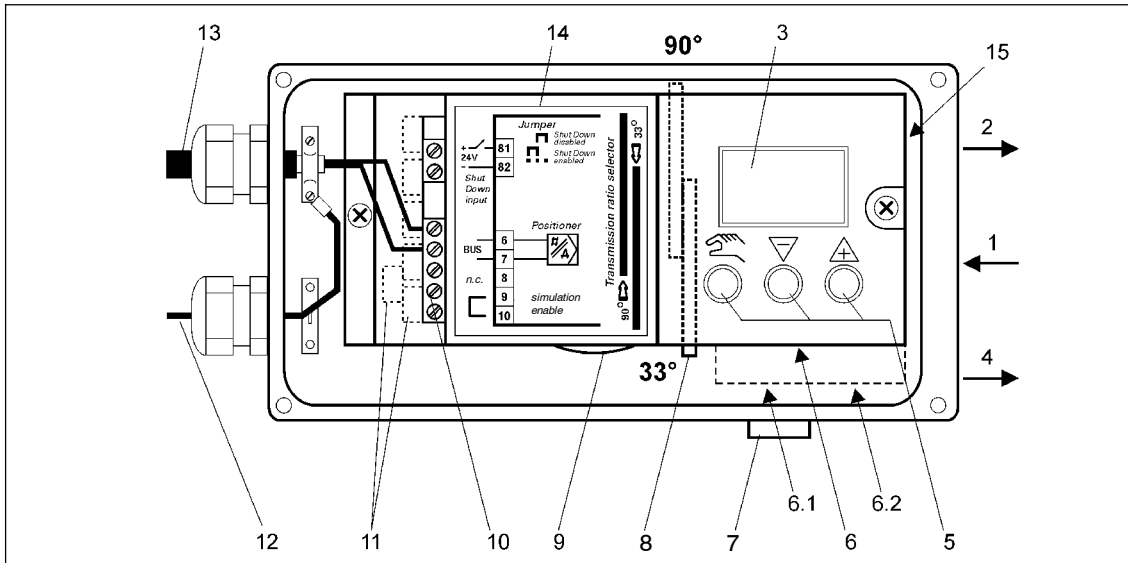
2.2 Design Rating Plate



- | | |
|--------------------|--------------------------|
| (1) Order number | (5) Serial number |
| (2) Manufacturer | (6) Place of manufacture |
| (3) Product name | (7) Protection class |
| (4) Technical data | (8) Observe manual |

Figure 2-1 Design rating plate, example with protection class EEx ia/ib

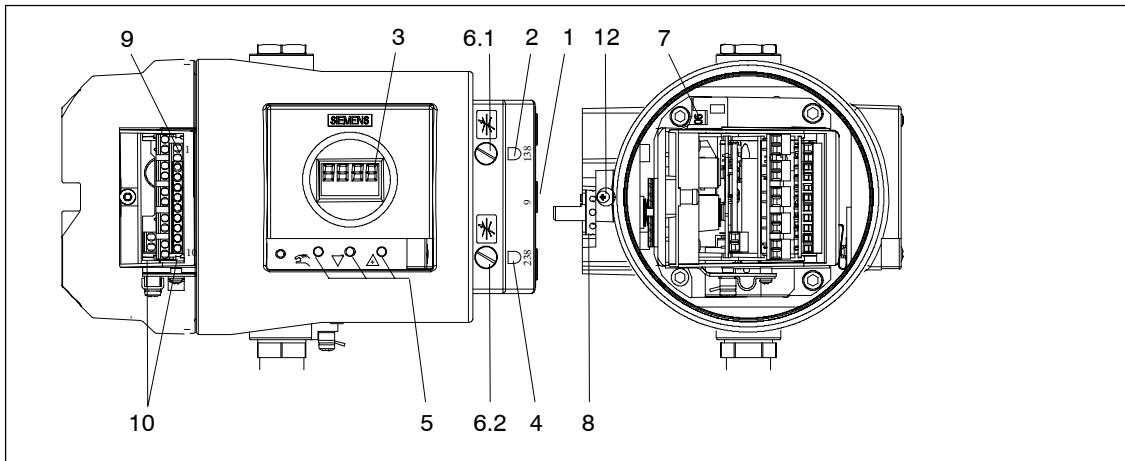
2.3 Instrument Components



- | | | | |
|-----|----------------------------------|----|---|
| 1 | Input: Supply air | 8 | Transmission ratio selector |
| 2 | Output: Actuating pressure Y1 | 9 | Adjustment wheel for friction clutch |
| 3 | Display | 10 | Motherboard |
| 4 | Output: Actuating pressure Y2 *) | 11 | Terminals options modules |
| 5 | Operating keys | 12 | Ground cable (only for plastic housing) |
| 6 | Restrictor | 13 | Bus cable |
| 6.1 | Restrictor Y1 | 14 | Terminal plate on cover |
| 6.2 | Restrictor Y2 *) | 15 | Purging air switch |
| 7 | Silencer | | |

*) in double-acting actuators

Figure 2-2 View of the positioner (cover open); plastic housing



- | | | | |
|-----|----------------------------------|----|---|
| 1 | Input: Supply air | 7 | Transmission ratio selector
(only possible with positioner open) |
| 2 | Output: Actuating pressure Y1 | 8 | Adjustment wheel for friction clutch |
| 3 | Display | 9 | Terminals standard controller |
| 4 | Output: Actuating pressure Y2 *) | 10 | Terminals options modules |
| 5 | Operating keys | 12 | Safety catch |
| 6.1 | Restrictor Y1 | | |
| 6.2 | Restrictor Y2 *) | | |

*) in double-acting actuators

Figure 2-3 View of the explosion-proof version of the positioner

2.3.1 Motherboard

The motherboard contains all the electronic elements such as the CPU, memory, A/D converter. It also contains the display and the operating keys.

In addition, the terminal strips for connecting the options modules are also on the motherboard.

2.3.2 Electrical Connections

The terminals of the standard controller, the I_y, SIA and alarm option module are arranged at the left-hand front edges and offset against each other in staircase form.

A module cover protects the modules from being pulled out and prevents incorrect installation.

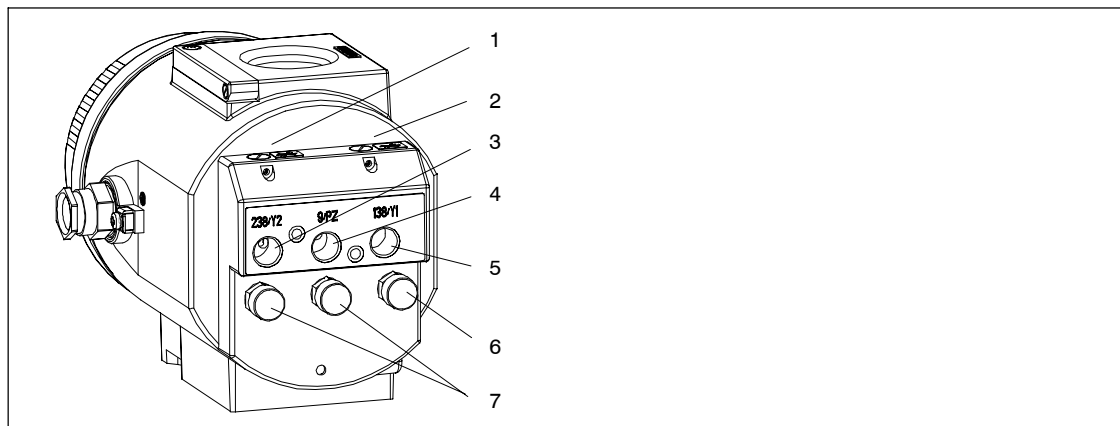
2.3.3 Pneumatic Connections

The pneumatic connections are on the right hand side of the positioner (figure 2-4 and figure 2-5).



- 1 Actuating pressure Y1 in single- and double-acting actuators
- 2 Feedback shaft
- 3 Supply air P_z
- 4 Actuating pressure Y2 in double-acting actuators
- 5 Exhaust air output E with silencer on the bottom of the instrument

Figure 2-4 Pneumatic connection in normal version



- 1 Restrictor Y2 *)
- 2 Restrictor Y1
- 3 Actuating pressure Y2 *)
- 4 Supply air PZ
- 5 Actuating pressure Y1
- 6 Exhaust air output E
- 7 Housing ventilation (2x)

*) in double-acting actuators

Figure 2-5 Pneumatic connection in explosion-proof version

In addition, there are pneumatic connections on the back of the positioner for integrated installation in single-acting linear actuators.

- Actuating pressure Y1
- Exhaust air output E (not in explosion-proof version)

In the ex-factory state, these connections are sealed by screws (see figure 3-1, page 37, figure 3-3, page 38 and figure 3-4, page 39).

The exhaust air output E can be provided for supplying dry instrument air to the tapping chamber and spring chamber to prevent corrosion.

Figure 2-6, page 22 shows the pneumatic connection variants for the different actuator types, the positioning acting and the safety position after power failure.

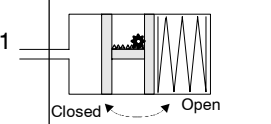


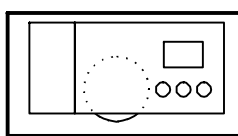
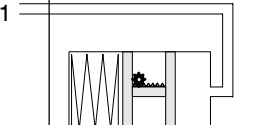


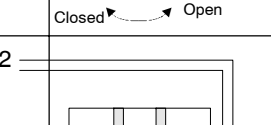

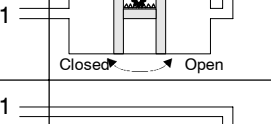

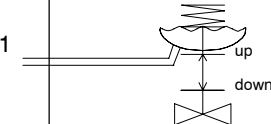
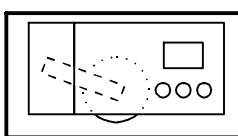
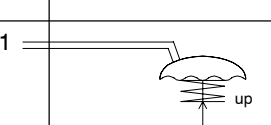
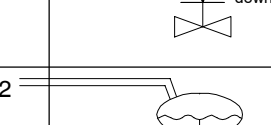

Positioning pressure Connection	Actuator type	Safety position after power failure		
		electrical	pneumatic	
Y1		Closed 	Closed 	<p>In rotary actuators the direction of rotation counterclockwise looking onto the actuating shaft of the valve is usually defined as "Open".</p>  <p>Closed Open</p>
Y1		Open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

Figure 2-6 Pneumatic connection positioning

2.3.4 Mounting Kit

The positioner can be mounted on almost all actuators with the appropriate mounting kit.

2.3.5 Purge air switching (not in the explosion-proof version)

The purge air switch is accessible above the pneumatic terminal strip with the housing open (figure 2-7). In the IN position the inside of the housing is purged with very small amounts of clean, dry instrument air. In the OUT position the purge air is fed directly to the outside air (for more information: see Chapter 3.3, page 39).

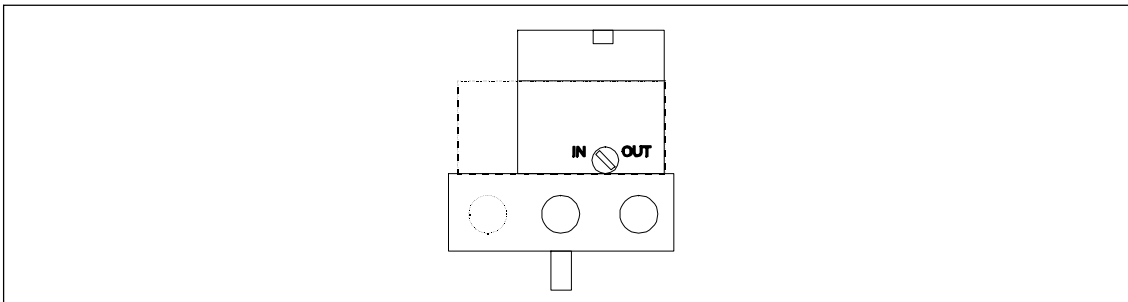


Figure 2-7 Purge air switch on the valve block, view of the positioner onto pneumatic connection side with cover open

2.3.6 Restrictors

In order to achieve travel times of > 1.5 s in small actuators, the air rate can be reduced with the restrictors Y1 and Y2 (figure 2-8, in explosion-proof version, see figure 2-5, page 21). By turning clockwise the air rate is reduced up to shutting off. To set the restrictors it is advisable to close them and then open them slowly (see initialization RUN3).

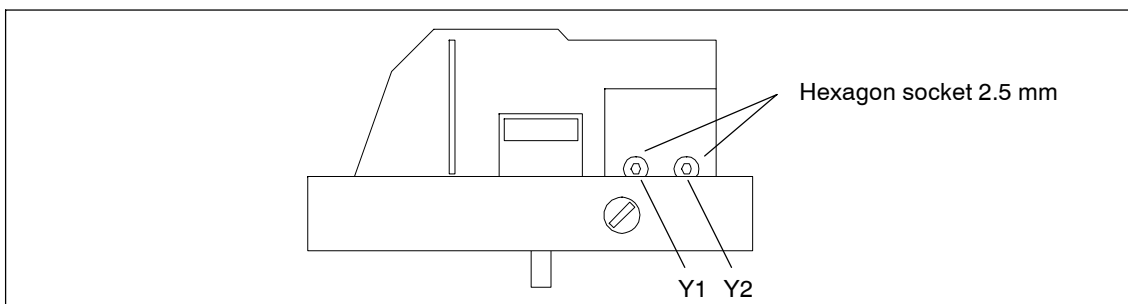


Figure 2-8 Restrictors

2.4 Method of Operation

The electropneumatic positioner forms a control circuit with the pneumatic actuator in which the actual value x is the position of the actuator bar in linear actuators or the position of the actuator shaft in rotary actuators and the command variable w is supplied digitally via the FOUNDATION Fieldbus.

The stroke or rotary movement of the actuator is transferred by the appropriate mounting accessories, the feedback shaft and a play-free switchable gearwheel to a high quality conductive plastic potentiometer and to the analog input of the microcontroller. The current position can also be measured using an external sensor. For this the stroke and the angle of rotation are sensed by a Non-Contacting Position Sensor directly on the actuator.

The positioner may correct the angle error of the stroke tap, compares the actual value x with the setpoint w and calculates the manipulated variable increments $\pm \Delta y$. Depending on the size and direction of the control error $(x-w)$ the piezo-controlled supply air or exhaust air valve is opened. The volume of the actuator integrates the positioning increments to actuating pressure y open which moves the actuator bar or actuator shaft approximately proportionally. These positioning increments change the actuating pressure until the control error becomes zero.

The pneumatic actuators are available in single and double-acting versions. Only one pressure chamber is aerated or deaerated in the single-acting version. The resulting pressure operates against a spring. In the double-acting version, two pressure chambers are counteractive. In this case the one volume is deaerated when the other volume is aerated.

The control algorithm is an adaptive predictive five-point switch (see figure 2-9, page 25). The valves are controlled with continuous contact at large control errors (fast step zone). At medium control errors the valve is controlled by pulse length modulated pulses (short step zone).

No actuating pulses are output in the small control error zone (adaptive dead zone). The dead zone adaptation and the continuous adaptation of the minimum pulse lengths in automatic operation cause the best possible control accuracy to be achieved at the lowest switching frequency. The start parameters are determined during the initialization phase and stored in a non-volatile memory. These are basically the real actuating path with the mechanical limit stops, the travel times, the size of the dead zone etc.

In addition the number of fault messages, changes in direction and the number of strokes are determined and stored every 15 minutes during operation. These parameters can be read out and documented by the communication programs such as AMS. Conclusions as to the wear on the fitting can be drawn (diagnostic function) especially by comparing the old value with the currently determined values.

**NOTE**

The exhaust air valve is always open when there is no current.

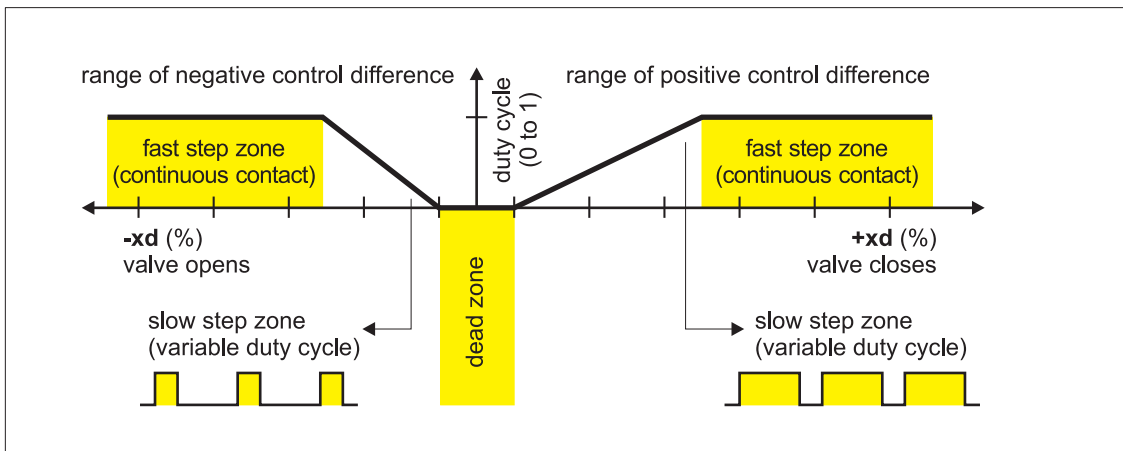


Figure 2-9 Method of operation five-point switch

2.5 State as supplied

There are no mechanical mounting accessories on the controller in the state as supplied. These must be ordered and installed according to the “operating instructions” depending on the application.

The respective connections for single or double-acting versions are prepared at the factory as ordered.

The pneumatic connections on the rear are sealed.

The input for the safety shut down is not activated.

The simulation enable jumper is not set.

2.6 Options modules

2.6.1 Installation of options modules in normal and intrinsically safe versions

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

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

Installation

The option modules are secured by a assembly covering ((1), see figure 2-10, page 27) and mechanically fixed.



NOTE

The housing must be opened to install the options modules. The degree of protection IP66 is not guaranteed as long as the positioner is open.

Opening the instrument

To open the positioner, the four screws of the housing cover must be loosened with a Phillips screwdriver.

Disconnect or isolate the power supply cables.

Remove the module cover (1). To do this, the two screws (1.1) must be removed with a screwdriver.



NOTE

To prevent premature wearing of the fixture by the self-tapping screws (1.1), the following method of mounting the module cover (1) has proven effective.

1. Turn the screws counterclockwise until you feel them snap into the thread
 2. Tighten both screws carefully in clockwise direction
-

The options modules are protected and mechanically fixed by a module cover ((1), see figure 2-10, page 27 and figure 2-11, page 29).



NOTE

The housing must be opened to install the options modules. The degree of protection IP65 is not guaranteed as long as the positioner is open.

Opening the instrument

To open the positioner, the four screws of the housing cover must be loosened with a Phillips screwdriver.

Disconnect or isolate the power supply cables.

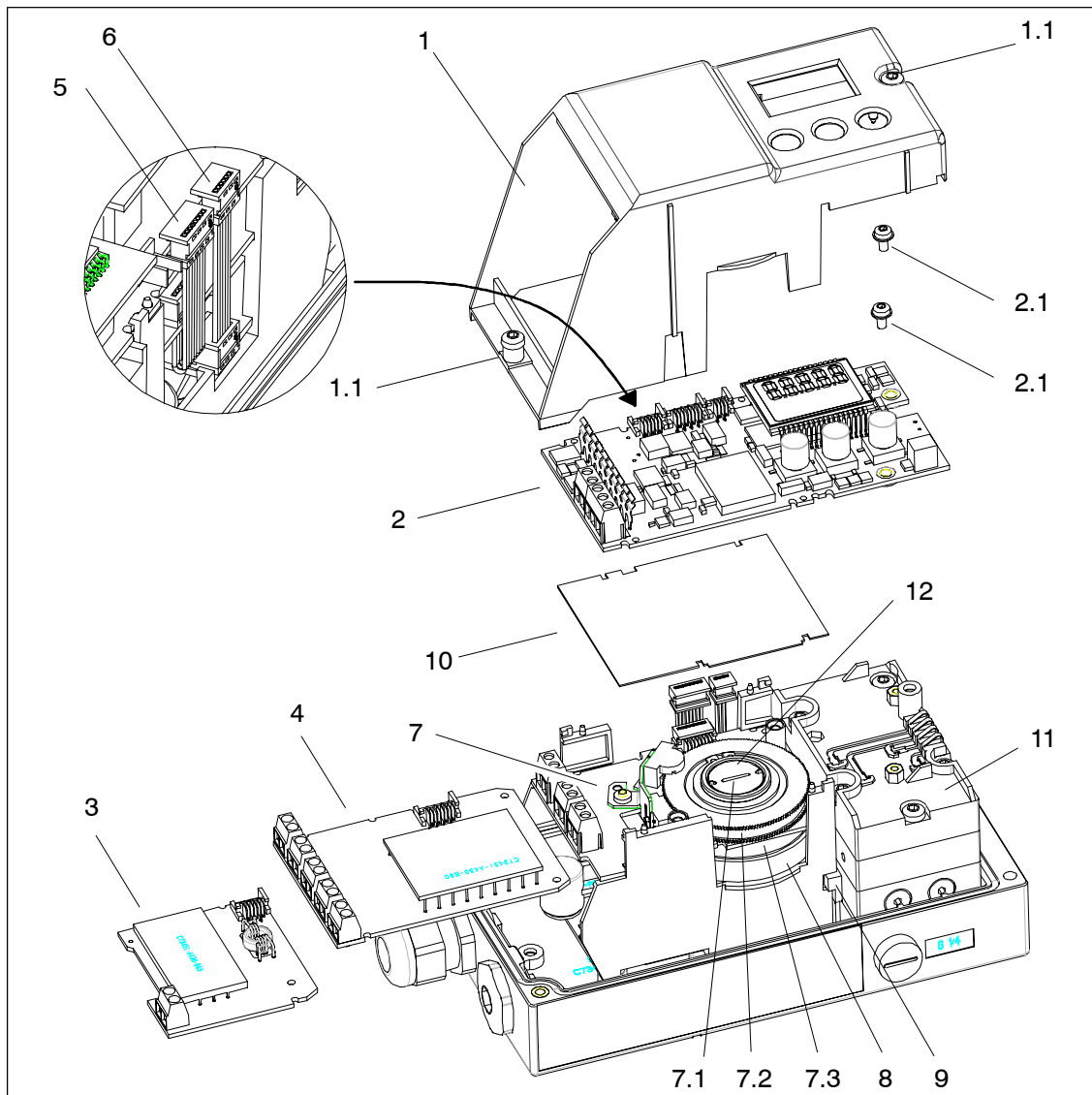
Remove the module cover (1). To do this, the two screws (1.1) must be removed with a screwdriver.



NOTE

To prevent premature wearing of the fixture by the self-tapping screws (1.1), the following method of mounting the module cover (1) has proven effective.

1. Turn the screws counterclockwise until you feel them snap into the thread
2. Tighten both screws carefully in clockwise direction



- | | | | |
|-----|--|-----|---|
| 1 | Module cover | 7 | SIA-module and mechanical limit switch module |
| 1.1 | Fixing screws | 7.1 | Special screw |
| 2 | Motherboard | 7.2 | Actuating disc for A1 (terminals 41 and 42) |
| 2.1 | Fixing screws | 7.3 | Actuating disc for A2 (terminals 51 and 52) |
| 3 | I _y -module with ribbon cable (6) | 8 | Adjusting wheel for friction clutch |
| 4 | Alarm module with ribbon cable (5) | 9 | Transmission ratio selector |
| 5 | Ribbon cable for alarm module | 10 | Insulating cover |
| 6 | Ribbon cable for I _y -module | 11 | Pneumatic block |
| | | 12 | Actuating disc bearings |

Figure 2-10 Installation of Options Modules

2.6.2 Installation of options modules in explosion proof version

The following option modules are available for the positioner in the explosion proof version:

- I_y module
- Alarm module

Installation

The options modules are protected and mechanically fixed by a module cover ((1), see figure 2-11, page 29).



NOTE

The housing must be opened to install the options modules. The degree of protection IP66/NEMA4x is not guaranteed as long as the positioner is open.



WARNING

In areas in which the atmosphere may be potentially explosive, the explosion proof positioner may only be supplied with electrical auxiliary power when the housing is closed and when built-in, approved electronics are used.

The feed-through openings for the electronic connections must be sealed with EEX-d certified cable glands or EEx-d certified plugs or an ignition lock must be mounted at a maximum distance of 46 cm (18 inches) when using the "conduit"-system.

Open the positioner

See figure 2-11, page 29. Disconnect or isolate the power supply cables first.

To open the positioner, the safety catch (12) must be opened and the screw-on cover unscrewed.

After loosening the four fixing screws (13.1) the complete rack (13) can be removed. The actuator may have to be turned so that the clutch can be easily disengaged.

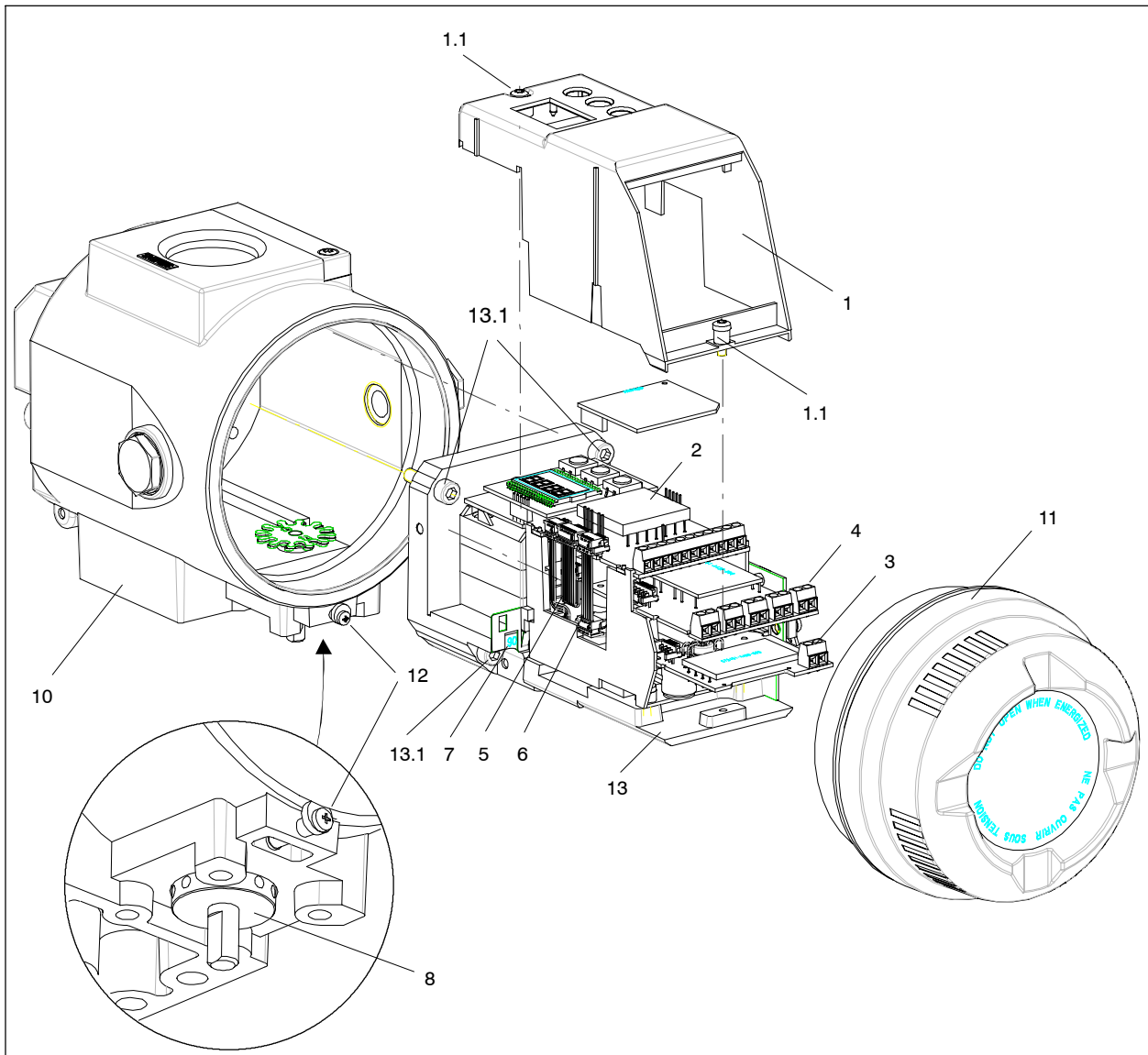
Remove the module cover (1). To do this, the two screws (1.1) must be removed with a screwdriver.



NOTE

To prevent premature wearing of the fixture by the self-tapping screw (1.1) next to the display, the following method of mounting the module cover (1) has proven effective.

1. Turn the screws counterclockwise until you feel them snap into the thread.
2. Tighten both screws carefully in clockwise direction.



- | | | | |
|-----|---|------|-------------------------------------|
| 1 | Module cover | 7 | Transmission ratio selector |
| 1.1 | Fixing screws | 8 | Adjusting wheel for friction clutch |
| 2 | PA module | 10 | Housing |
| 3 | I _y module with ribbon cable | 11 | Screw-on cover |
| 4 | Alarm module with ribbon cable | 12 | Safety catch |
| 5 | Ribbon cable for alarm module | 13 | Rack |
| 6 | Ribbon cable for I _y module | 13.1 | Fixing screws |

Figure 2-11 Installation of the options modules in the explosion-proof version

2.6.3 I_y module

Function	With the I _y -option module, the current actuator position can be output as a two wire signal I _y = 4 to 20 mA – potentially isolated from the standard controller. The dynamic control of the I _y module makes it also error self-reporting.
Installation	The I _y module (3) is pushed in to the bottom compartment of the module rack up to the stop and connected by the enclosed 6-wire ribbon cable (6) to the motherboard (see figure 2-10, page 27).

2.6.4 Alarm module

	The alarm module contains <ul style="list-style-type: none">• 3 digital outputs and• 1 digital input
Function	<p>The digital outputs serve to output fault messages and alarms. The configuration is described in chapter 4.4, page 88, with the parameters 44 to 54.</p> <p>By an external signal applied at digital input (DI2) the actuator can be blocked or driven to its limit positions for example depending on the configuration. The configuration is described in chapter 4.4, page 88, with the parameters 43.</p> <p>The alarm module is available in two versions:</p> <ul style="list-style-type: none">• explosion protected for connecting to switching amplifier EN 60947-5-6• non-explosion protected for connection to voltage sources with a maximum 35 V <p>The semiconductor outputs of the alarm module report an alarm (signal state Low) by switching off with high resistance. They are conductive in the High state (without alarm). The dynamic control makes them error self-reporting.</p> <p>The outputs are potentially isolated from the basic circuit and each other.</p> <p>The digital input is double.</p> <ul style="list-style-type: none">• one potential isolated for voltage level• one not potential isolated for floating contacts <p>These two inputs are designed as logic OR links.</p>
Installation	The alarm module (4) is pushed in underneath the motherboard into the module rack up to the stop and connected by the enclosed 8-wire ribbon cable (5) to the motherboard (see figure 2-10, page 27).

2.6.5 SIA module

The SIA module contains three digital outputs.

Function

A collected fault message (see alarm module) is output via a digital output. The floating digital output is implemented as a self error reporting semiconductor output.

The other two digital outputs are used for reporting two mechanically adjustable limit values (L1, L2) by slot initiators. The two binary outputs are electrically independent of the rest of the electronics.

Installation

(Slot Initiator Alarm module) Proceed as follows for installation:

1. Remove all the electrical connections from the motherboard (2).
2. Loosen the two fixing screws (2.1) of the motherboard.
3. Snap out the motherboard by carefully bending the four holders.
4. Insert the SIA-module (7) from above up to the top pcb rail of the container.
5. Push the SIA module in the pcb rail of the container about 3 mm to the right.
6. Screw the special screw (7.1) through the SIA module into the axle of the positioner (**Torque: 2 Nm**):

CAUTION

The pin pressed into the actuating disc bearing (12) must be adjusted to just before touching with the special screw. The actuating disc bearing and the special screw must then be turned simultaneously so that the pins slot into the special screw.

7. Place the insulating cover (10) over the SIA module underneath the surface of the motherboard at the container wall on one side. The recesses in the insulating cover must slot into the corresponding lugs on the container wall. Place the insulating cover on the SIA module by carefully bending the container walls.
8. Snap the motherboard into the four holders and screw it tight again with the two fixing screws (2.1).
9. Make all the electrical connections between the motherboard and the options with the ribbon cables provided and between the motherboard and potentiometers with the potentiometer cable.
10. Fix the enclosed module cover instead of the standard version with the two screws (1.1).

11. Select the plates which already exist on the standard version of the module cover from the set of plates enclosed. Stick the selected plates according to the standard version to the mounted module cover. In the case of the version which doesn't feature explosion protection, stick the warning sign (figure 2) onto the side of the ground plate opposite the typeplate.
12. Make the electrical connections.

Setting the two limit values:



NOTE

Connect a suitable display instrument such as the Initiator-Tester type 2/Ex made by Peperl+Fuchs to the terminals 41 and 42 or terminals 51 and 52 of the SIA module to be able to see the switching state of the slot initiators.

1. Drive the actuator to the first desired mechanical position.
2. Adjust the top actuating disc (7.2) by hand until the output signal on terminals 41 and 42 changes.
3. Drive the actuator to the second desired mechanical position.
4. Adjust the bottom actuating disc (7.3) by hand until the output signal on terminals 51 and 52 changes.



NOTE

If you turn the actuating disc beyond the switching point up to the next switching point, you can set a high-low or a low-high change.

To avoid the actuating discs being accidentally adjusted during operating, they are relatively sluggish. The following remedy might be of help if you are having trouble with the adjustment: open and close the actuator several times while holding the actuating discs. This temporarily reduces the friction. This allows an easier and finer adjustment.

2.6.6 Mechanical limit switch module

The mechanical limit switch module contains the following:

- A binary output for the output of a group error message)
- Two switches for signaling two limit values that can be set mechanically. These two switches are electrically independent from the rest of the electronic system

Installation

CAUTION

The following maximal values only refer to the clamps 41 and 42 as well as the clamps 51 and 52.

Maximal voltage (not Ex)	AC 250 V or DC 24 V
Maximal current (not Ex)	AC/DC 4 A
Maximal voltage (Ex)	DC 30 V
Maximal current (Ex)	DC 100 mA

When you supply one circuit breaker with extra-low voltage (AC < 16 V or DC < 35 V) and the other with low voltage, you ensure that the cable insulation is doubled.

When operating the switch with low voltage, you must position the low voltage circuits so that they are separated from the extra-low voltage circuits.

Follow the instructions below for installation:

1. Remove all electrical connections on the motherboard (2).
 2. Loosen carefully both fixing screws (2.1) for the motherboard.
 3. Insert the limit switch module (7) from above until it reaches the upper printed circuit board rail of the container.
 4. Snap put the motherboard (2) by carefully bending the four holders.
 5. Push the mechanical limit switch module (7) in the printed circuit board rail of the container ca. 3 mm towards the right
 6. Screw the special screw (7.1) through the mechanical limit switch module into the axle of the positioner (**torque: 2 Nm**).
-

CAUTION

The pin pressed into the actuating disc bearing (12) must be adjusted just before it touches the special screw (7.1) In order that the pin slot into the special screw, you must then turn the actuating disc bearing and the special screw simultaneously

7. Place the insulating cover (10) over the mechanical limit switch module underneath the surface of the motherboard onto the container on the wall. The recesses in the insulating cover must slot into the corresponding lugs on the container wall. Place the insulating cover on the mechanical limit switch module by carefully bending the container walls.
8. Snap the motherboard board into the four holders and screw it tight again with the two fixing screws (2.1).
9. Make sure all electrical connections between the motherboard and the options using the ribbon cables provided and between the motherboard and potentiometer using the potentiometer cable.
10. Fix the enclosed module cover (1) instead of the standard version using the two screws (1.1).



NOTE

To prevent premature wearing of the fixture by the self-tapping screws (1.1), the following method of mounting the module cover (1) has proven effective:

- Turn the screws counterclockwise until you feel them snap into the thread.
 - Tighten both screws carefully in a clockwise direction
-



NOTE

Before connecting up the limit contact module, ensure that:

- only qualified personnel connect and set the limit contact module.
 - all cables are de-energized.
 - the cables are stripped so that the insulation is flush with the terminal when plugging in the wires.
 - the ends of stranded wires have sleeves
 - the connection cables are insulated according to the permitted current load.
 - the permissible working temperature of the cables exceeds the maximal ambient temperature by minimum 25 °C.
 - the Ex-version is only allowed to be operated in intrinsically safe circuits with approved switching amplifiers.
-

Connection

1. Loosen the screw (1) on the cover (2).
2. Push the cover (2) till it reaches the front stop.
3. Screw each cable tight in the appropriate terminal.
4. Push the cover (2) till it stops at the motherboard.
5. Tighten the screw (1) of the cover (2).
6. Fix the cables of each switch in pairs on the mounting eye using the cable binders provided (3).

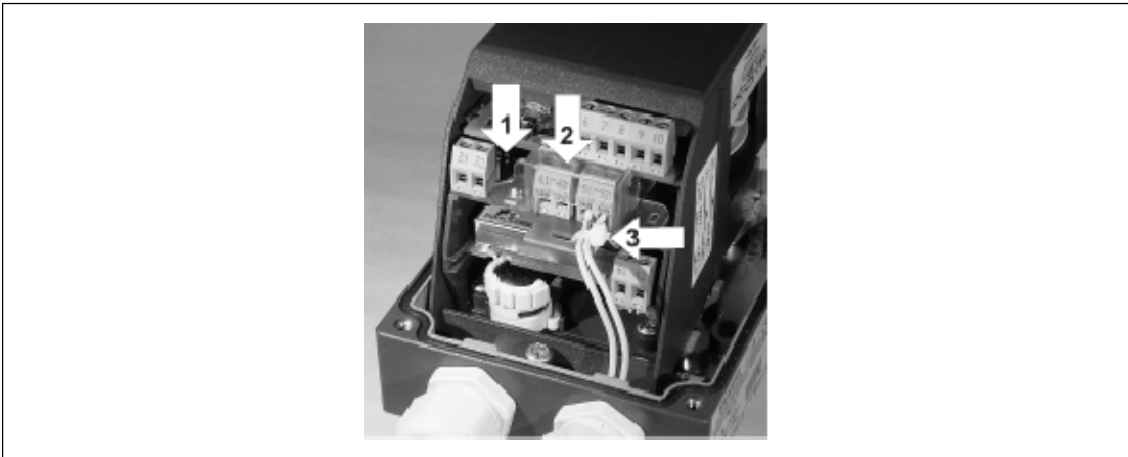


Figure 2-12 Installation of the options modules in the explosion-proof version

Setting the two limit values:

1. Drive the actuator to the first desired mechanical position.
2. Adjust the top actuating disc (7.2) by hand until the output signal on terminals 41 and 42 changes.
3. Drive the actuator to the second desired mechanical position.
4. Adjust the bottom actuating disc (7.3) by hand until the output signal on terminals 51 and 52 changes.



NOTE

To avoid the actuating discs (7.2/7.3) being accidentally adjusted during operation, they are relatively sluggish. The following remedy might be of help if you are having trouble with the adjustment: open and close the actuator several times while holding the actuating discs. This temporarily reduces the friction. This allows an easier and finer adjustment.

2.6.7 EMC filter module

The positioner can also be driven by an external position sensor (potentiometer or NCS) (see page 42 "3.3.2 Instructions for using positioners which are exposed to strong accelerations or vibrations"). An EMC filter module, order number C73451-A430-D23, is required for this.

2.6.8 Accessories

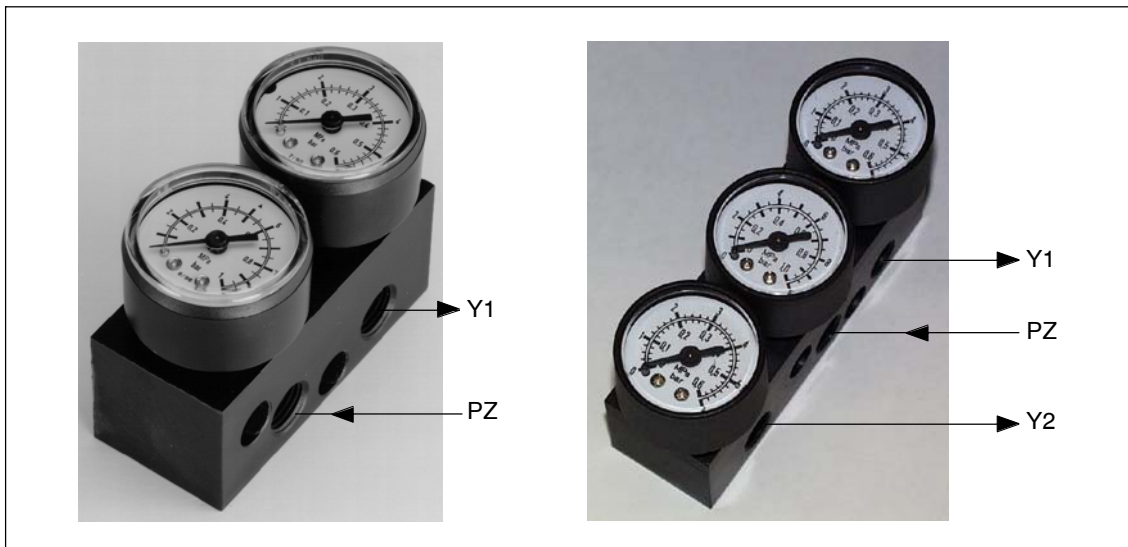


Figure 2-13 Manometer block (left for single-acting, right for double-acting actuators)

Manometer block

The manometer block for single-acting actuator contains two manometers which are screwed to the lateral pneumatic connection of the positioner with O-rings. The values for the input pressure (supply air PZ) and output pressure (actuating pressure Y1) are displayed.

The manometer block for double-acting actuators contains three manometers which are screwed to the lateral pneumatic connection of the positioner with O-rings. The values for the input pressure (supply air PZ) and output pressure (actuating pressure Y1 and Y2) are displayed.

Preparing for Operation

3

This chapter describes all the preparations necessary for operating the positioner.

3.1 Instrument identification (type key)

The order number of the positioner is printed on the rating plate and on the packaging. Compare this with the order number in chapter 8.1, page 182.

Installation of any modules required is described in chapter 2.6, page 25 of this technical manual.

3.2 Dimensional drawings

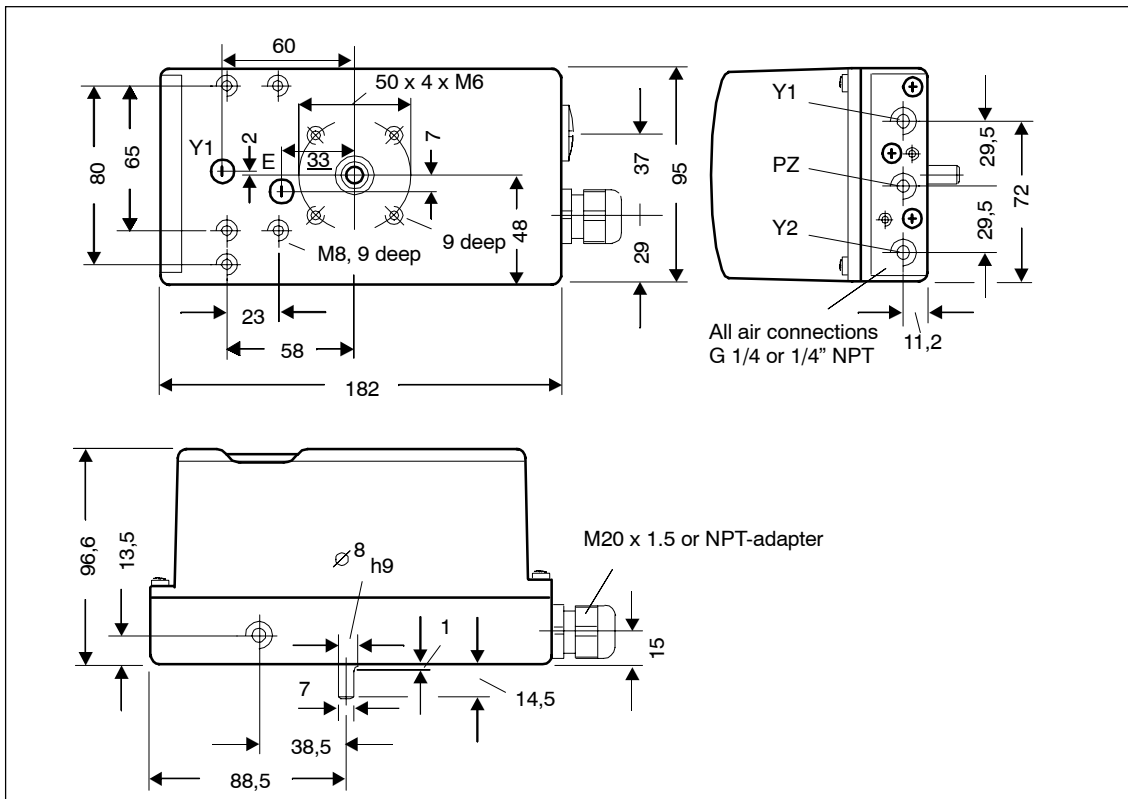


Figure 3-1 Dimensional drawing version plastic housing 6DR5xx0

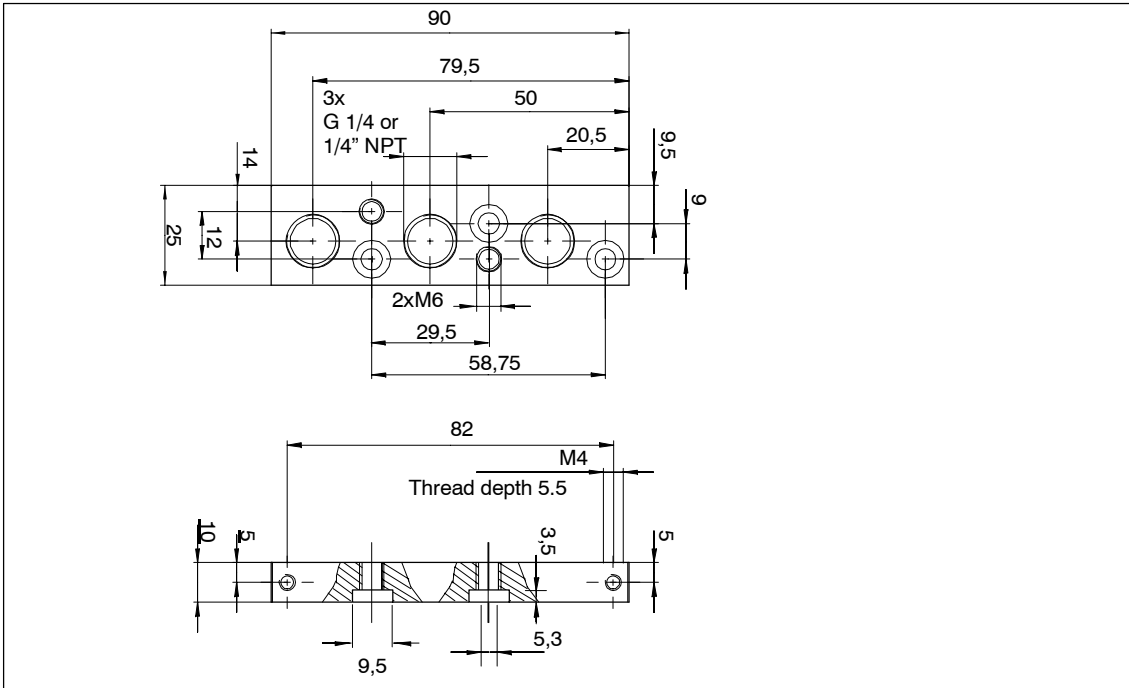


Figure 3-2 Dimensional drawing terminal strip for plastic housing

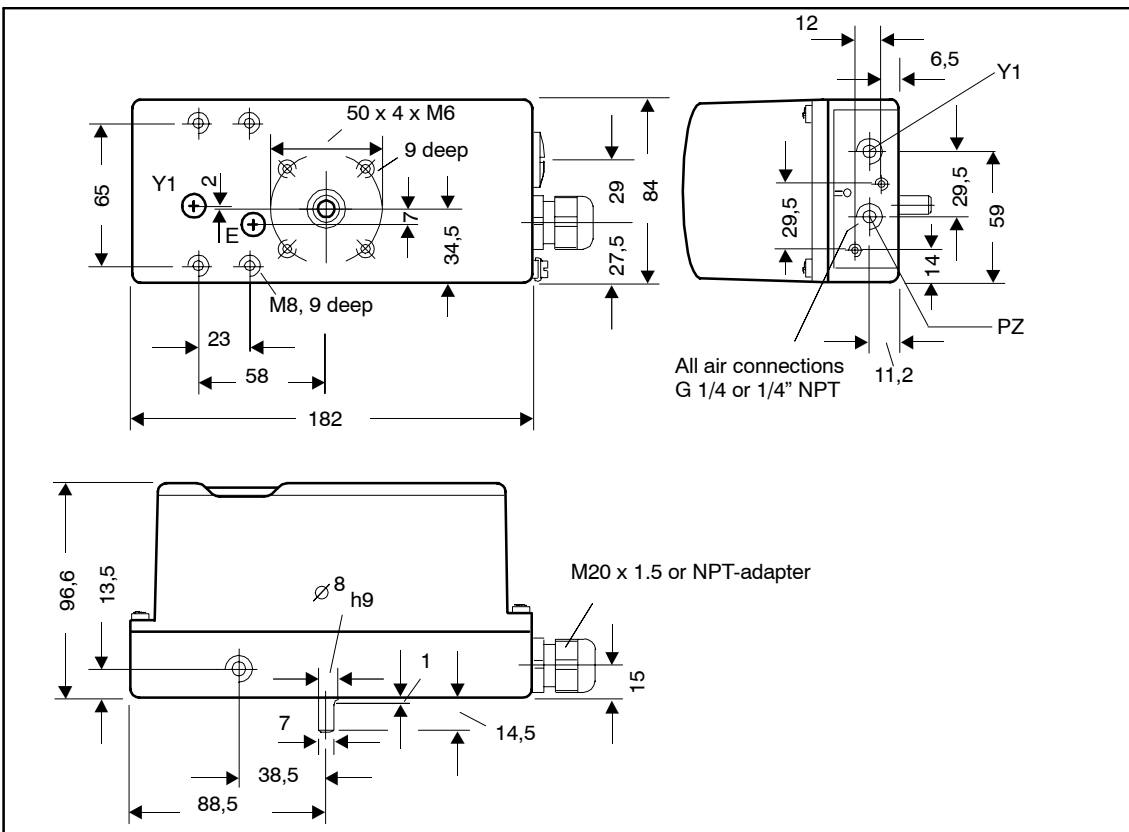


Figure 3-3 Dimensional drawing version metal housing 6DR5xx1

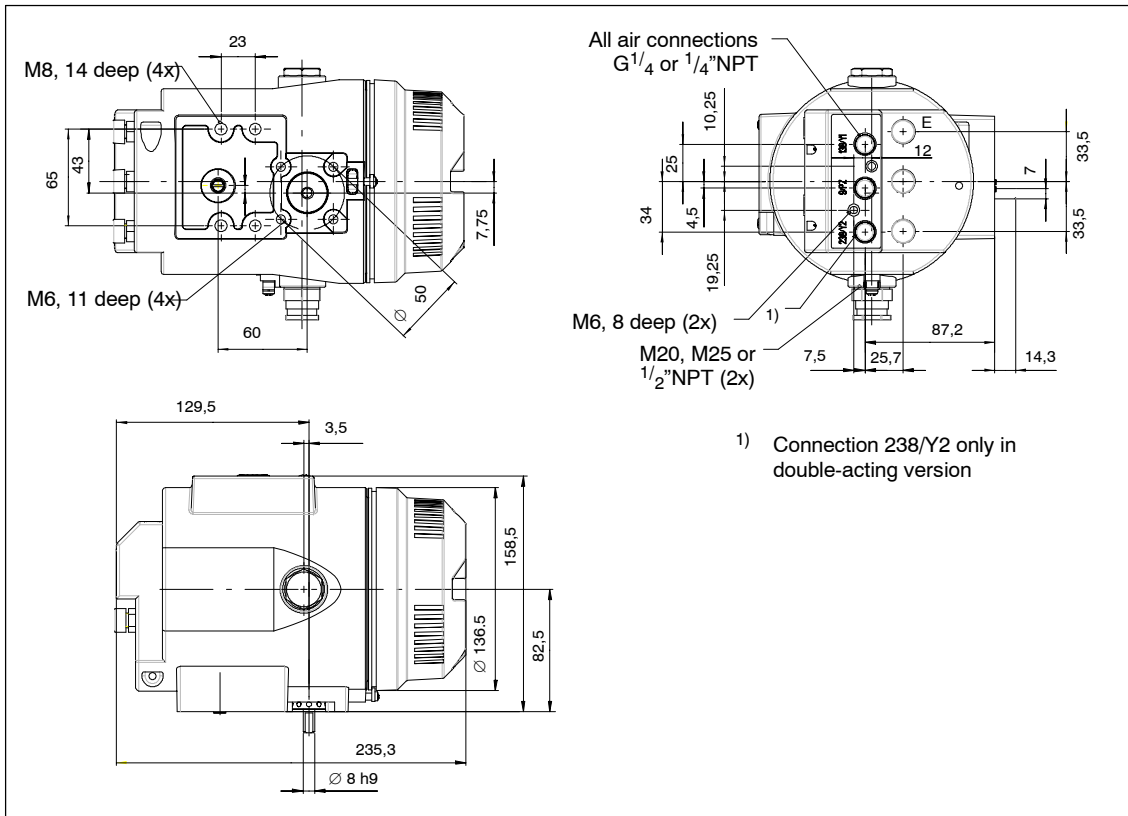


Figure 3-4 Dimensional drawing for positioner with metal housing in explosion-proof version 6DR5xx5

3.3 Assembly

General



WARNING

To avoid injury or mechanical damage to the positioner/mounting kit, the following order must be observed for assembly:

1. Mechanical fitting of positioner this chapter
2. Connection of electric power supply see chapter 3.4, p. 54
3. Connection of pneumatic power supply see chapter 3.5, p. 63
4. Put into operation see chapter 3.6, p. 64

Please also observe the warning on page 10 and 54!



NOTE

The positioner will be equipped at the factory and delivered complete with the necessary options at the customer's request. Options modules may only be retrofitted by our service technicians.

The positioner must be assembled – especially in a moist environment – in such a way as to rule out freezing of the positioner axle at low ambient temperature.

The operating keys must be covered to prevent liquid getting in.



WARNING

In the combination of components it must be ensured that only positioners and options modules are combined which are approved for the respective area of application. This applies especially for safe operation of the positioner in areas in which the atmosphere is potentially explosive (zone 1 and 2). The instrument categories (2 and 3) of the instrument itself and those of its options must be observed.

In addition, you must always make sure that no water gets into an open housing or screw-type gland. This may be the case for example when the positioner cannot be finally assembled and connected immediately.

It generally applies that the positioner may only be operated with dry compressed air. Therefore use the normal water traps. An additional drying unit may even be necessary in extreme cases. This is particularly important when operating the positioner at low ambient temperatures. Please set the purge air switch (on the valve block above the pneumatic terminals) additionally to the "OUT" position.

Use a sufficiently rugged console (e.g. plate thickness > 4 mm with reinforcements) for rotary actuators and the mounting kit "linear actuator" or integrated connection for linear actuators.

3.3.1 Instructions for using positioners in a wet environment

This information gives you important instructions for the assembly and operation of the positioner in a wet environment (frequent, heavy rain and/or prolonged tropical condensation) in which the IP65 degree of protection is no longer sufficient and especially when there is a danger that water may freeze.

To prevent water getting into the instrument in normal operation (e.g. through the exhaust air openings) or the display being poorly legible, please avoid the unfavorable installation positions illustrated in figure 3-5.

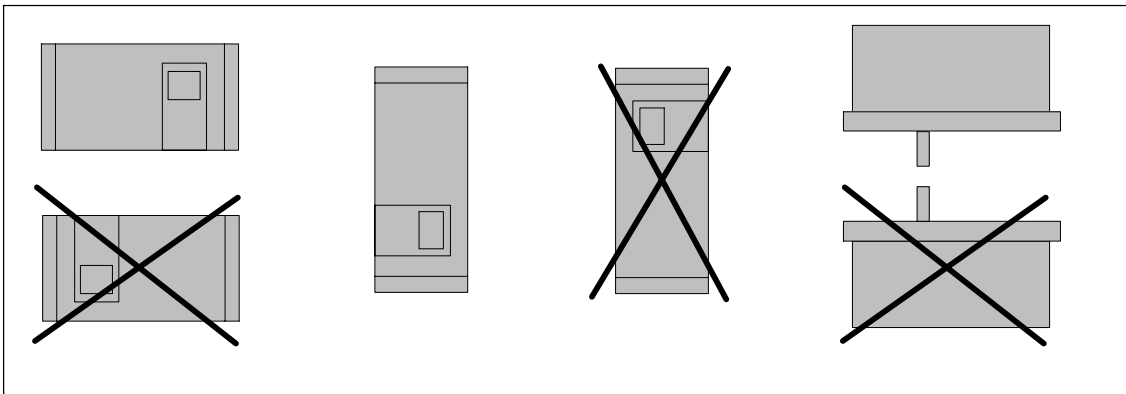


Figure 3-5 Favorable and unfavorable installation positions

If conditions oblige you to operate the positioner in a unfavorable installation position, you can take additional precautionary measures to prevent penetration by water.



NOTE

Never clean the positioner with a high pressure water jet because the IP66 degree of protection is inadequate protection for this.

The necessary additional measures to prevent penetration by water depend on the installation position chosen and you may additionally require:

- screw-type gland with sealing ring (e.g. FESTO: CK -1 / 4-PK-6)
- plastic hose approx. 20 to 30 cm (e.g. FESTO PUN- 8X1,25 SW)
- cable straps (number and length depends on local conditions)

Procedure

- Connect the pipes in such a way that rain water which runs along the pipes can drip off before it reaches the terminal strip of the positioner.
- Check the electrical connections for perfect firm contact.
- Check the seal in the housing cover for damage and contamination. Clean and replace if necessary.
- Mount the positioner if possible so that the sinter bronze silencer faces downwards on the underside of the housing (vertical installation position). If this is not possible, the silencer should be replaced by a suitable screw-type gland with a plastic hose.

Assembly of the screw-type gland with plastic hose

- Unscrew the sinter bronze silencer from the exhaust air opening on the underside of the housing.
- Screw the screw-type gland mentioned above into the exhaust air opening.
- Mount the above mentioned plastic hose on the screw-type gland and check the good fit.
- Fix the plastic hose with a cable strap to the fitting so that the opening faces downwards.
- Make sure that the hose has no kinks and the exhaust air can flow out unhindered.

3.3.2 Instructions for using positioners which are exposed to great accelerations or vibrations

NOTICE

for explosion proof versions:

Only adjust the outer friction clutch (8, Fig.2-11, page 29). The internal friction clutch (8, Fig.2-10 page 27) is fixed and, for the explosion proof version, must **not** be adjusted.

The electro-pneumatic positioner features a friction clutch and a switchable drive and is, therefore, universally applicable for part-turn and linear actuators. That's why it is not necessary to take a zero-point into consideration when implementing part-turn actuators. Similarly, there is no need to ensure that the extension is symmetrically attached when implementing linear actuators. In both cases, the work space can be adjusted afterwards via the friction clutch.

The switchable drive can be used to adjust the positioner for short or long strokes.

Large accelerating forces can occur on fittings subject to heavy mechanical wear and tear, such as openings which could break off, valves subject to heavy vibrations as well as beating blast pipes. In some cases, these forces can far exceed the specifications. In extreme cases, these forces could even cause the friction clutch to shift.

For these cases, the positioner is equipped with a position-securing device for holding the friction clutch in place. Furthermore, it is also possible to lock the transmission ratio selector into position, thus preventing it from shifting due to the influences stated above.

Both setting options are designated accordingly by icons on additional signs (see Fig. 3-6 page 43).

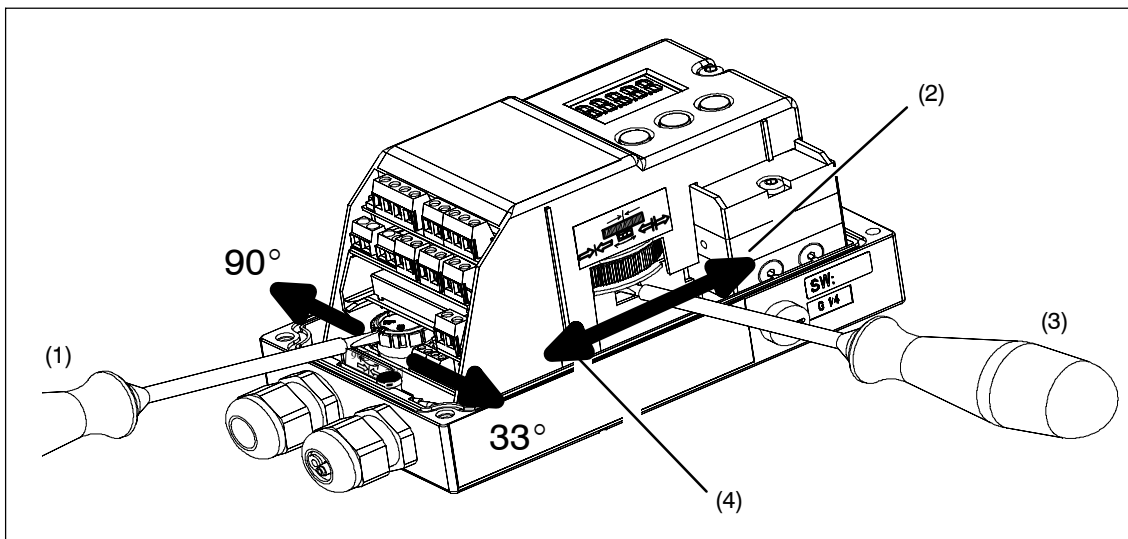
Procedure

After you have mounted the positioner and commissioned it completely, you can set the friction clutch torque as follows:

- Plug a conventional 4 mm wide screwdriver into a slot in the yellow wheel.
- Then turn the yellow wheel to the left with the screwdriver until it snaps in audibly. This increases the torque of the friction clutch.
- A fixed friction clutch is recognizable from an approx. 1 mm wide gap between the yellow and black wheel.
- If you have to make a zero point setting, e.g. after changing the drive, please reduce the torque first by turning the yellow wheel to the right stop. After the zero point setting, you can fix the friction clutch as described above.

To lock the transmission ratio selector, takt the unit as factory set and do as follows:

- Using a conventional flat headed screwdriver (approx. 4 mm wide) turn the yellow wheel underneath the clamps to the left or right according to your chosen setting (either 33° or 90°) until it snaps in audibly.
- In order to set the transmission ratio selector any locks in place must first be released. Hence the yellow wheel must first be put into the original factory set position in order to reset the transmission ratio selector if necessary, e.g. after replacing the actuator.



- (1) Transmission ratio switch interlock
- (2) Open
- (3) Friction clutch
- (4) Close

Figure 3-6 Fixing device for the slip clutch

External position detection

Applications in which the measures described above are inadequate are also conceivable. This applies for instance with continuous and heavy vibration, increased or too low ambient temperatures and in the case of nuclear radiation.

The separate attachment of position displacement sensor and controller unit can help here. A universal component is available which is suitable both for linear and part-turn actuators.

You require the following:

- The position detection system (order no. C73451-A430-D78). This consists of a SIPART PS2 housing with integrated friction clutch, built-in potentiometer and various dummy plugs and seals.
- or a Non-Contacting Position Sensor (e.g. 6DR4004-6N)
- The controller unit, any positioner version.
- The EMC filter module, this is a set together with cable clips and M-20 screw-type cable gland and has the order number C73451-A430-D23. The EMC filter module must be installed in the positioner. The installation instructions enclosed with the EMC filter module explain how to assemble the components.
- A 3-wire cable for connecting the components.

This EMC filter module always has to be used for the controller unit whenever the external position detection unit C73451-A430-D78 is to be replaced by a random drive-mounted potentiometer (resistance value 10 kOhm) or if a NCS sensor is to be installed.



WARNING

The explosion proof version may not be run together with the external position detection system.

3.3.3 Mounting kit "linear actuator" 6DR4004-8V and 6DR4004-8L

The scope of delivery of the mounting kit" linear actuator IEC 534 (3 mm to 35 mm)" are contained (ser. no. see figure 3-7, page 47):

Ser. no.	pieces	Designation	Note
1	1	NAMUR mounting kit bracket IEC534	Standardized connection for mounting console with ledge, column or plane surface
2	1	Pick-up bracket	Guides the roller with carrier pin and turns lever arm
3	2	Clamping assembly	Mounting of pick-up bracket on actuator spindle
4	1	Carrier pin	Assembly on lever (6)
6	1	Lever NAMUR	For stroke range 3 mm to 35 mm For stroke ranges > 35 mm to 130 mm (special delivery), lever 6DR4004-8L is required additionally
7	2	U bolt	Only for actuators with columns
8	4	Hexagon head screw	M8 x 20 DIN 933-A2
9	2	Hexagon head screw	M8 x 16 DIN 933-A2
10	6	Lock washer	A8 – DIN 127-A2
11	6	Flat washer	B 8,4 – DIN 125-A2
12	2	Flat washer	B 6,4 – DIN 125-A2
14	1	Spring washer	A6 – DIN 137A-A2
15	1	Lock washer	3.2 – DIN 6799-A2
16	3	Spring washer	A6 – DIN 127-A2
17	3	Socket cap screw	M6 x 25 DIN 7984-A2
18	1	Hexagon nut	M6 – DIN 934-A4
19	1	Square nut	M6 – DIN 557-A4
21	4	Hexagon nut	M8 – DIN 934-A4

3.3.4 Assembly procedure (see figure 3-7, page 47)

1. Mount clamping assembly (3) with hexagon socket cap screws (17) and lock washer (16) on the actuator spindle.
2. Insert the pick-up bracket (2) into the recesses of the clamping assembly. Set the necessary length and tighten the screws so that the pick-up bracket can still be shifted.
3. Insert the premounted pin in the lever (6) and assemble with nut (18), spring washer (14) and washer (12).
4. The value of the stroke range specified on the actuator or if this does not exist as a scaling value, the next greatest scaling value is set. The center of the pin must be in line with the scaling value. The same value can be set later under parameter 3.YWAY in commissioning to display the way in mm after initialization.
5. Assemble the hexagon socket cap screw (17), spring washer (16), washer (12) and square nut (19) on the lever.
6. Push the premounted lever onto the positioner axle up to the stop and fix with the hexagon socket cap screw (17).
7. Fit the mounting bracket (1) with two hexagon head screws (9), lock washer (10) and flat washer (11) on the rear of the positioner.

8. Selection of the row of holes depends on the width of the actuator yoke. The roll (5) should engage in the pick-up bracket (2) as close as possible to the spindle but may not touch the clamping assembly.
9. Hold the positioner with the mounting bracket on the actuator so that the pin (4) is guided within the pick-up bracket (2).
10. Tighten the pick-up bracket.
11. Position the mounting parts according to the type of actuator.
 - Actuator with ledge: Hexagon head screw (8), flat washer (11) and lock washer (10).
 - Actuator with plane surface: Four hexagon head screws (8), flat washer (11) and lock washer (10).
 - Actuator with columns: Two U bolts (7), four hexagon nuts (21) with flat washer (11) and lock washer (10).
12. Secure positioner onto the yoke using the previously positioned mounting parts.



NOTE

Set the height of the positioner so that the horizontal lever position is reached as close to the stroke center as possible. You can use the lever scale as orientation. If no symmetrical mounting is possible it must be guaranteed that the horizontal lever position is passed through within the stroke range.

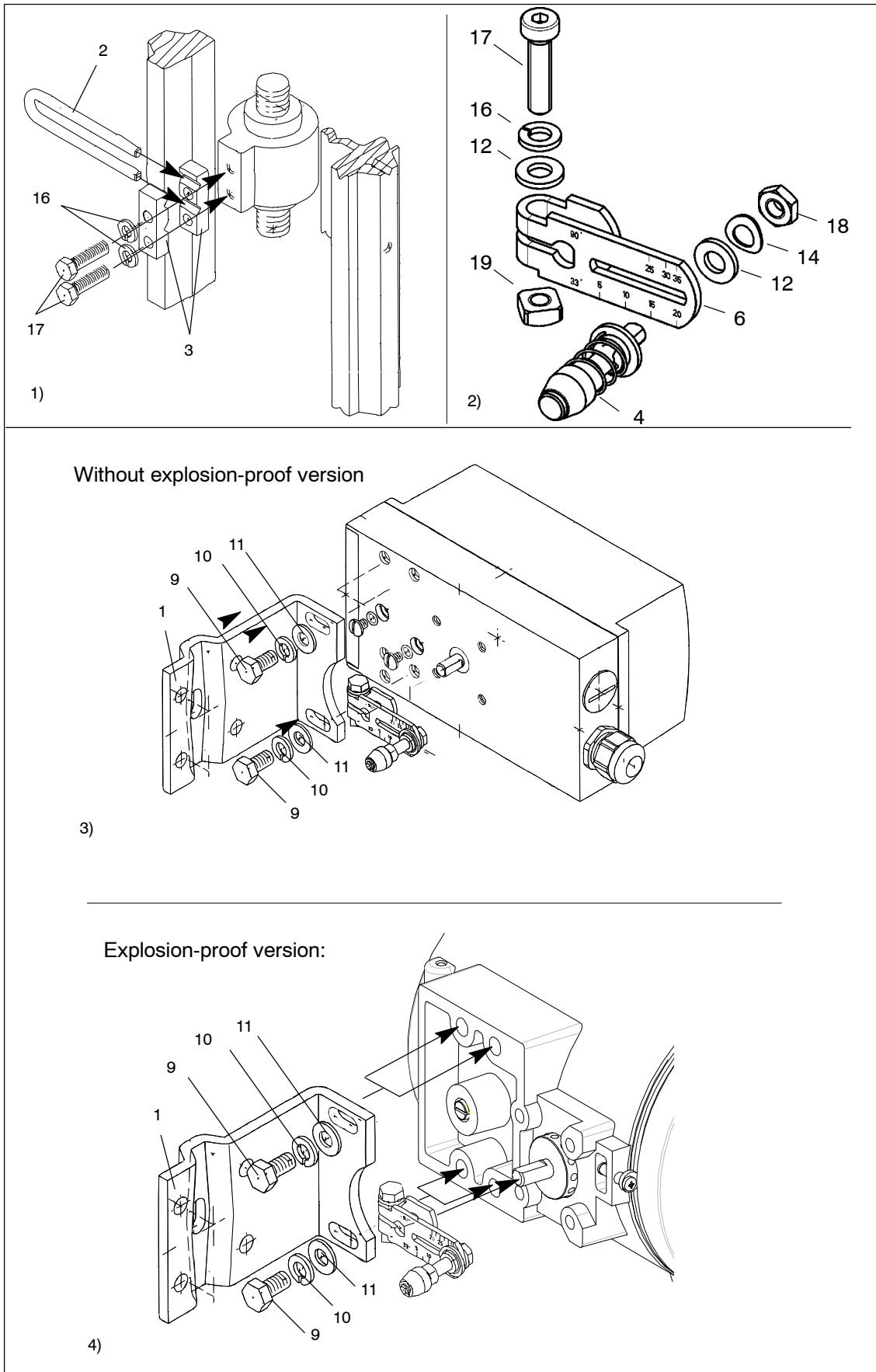


Figure 3-7 Assembly procedure (linear actuator)

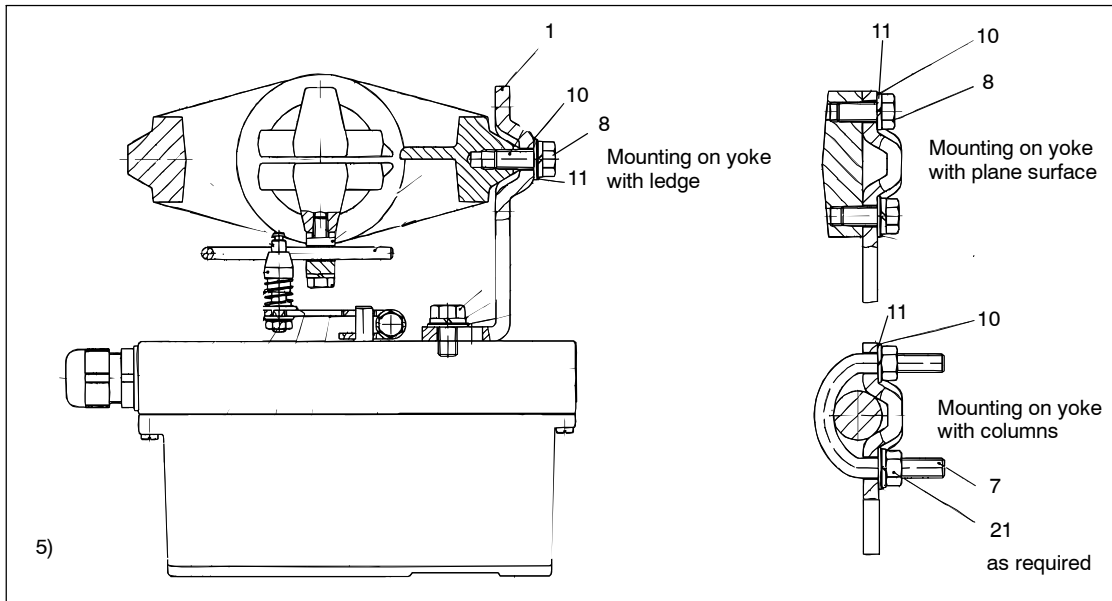


Figure 3-7 Assembly procedure (linear actuator) *continued*

3.3.5 Mounting kit "Rotary actuator" 6DR4004-8D

The *scope of delivery of the mounting kit "Rotary actuator"* contains (ser. no. see figures 3-8 and 3-9):

Ser. no.	Pieces	Designation	Note
2	1	Coupling wheel	Mounting on position feedback shaft of the SIPART PS2
3	1	Carrier	Mounting on end of actuator shaft
4	1	Multiple plate	Indication of actuator position, comprising 4.1 and 4.2
4.1	8	Scales	Different divisions
4.2	1	Pointer mark	Reference point for scale
14	4	Hexagon head screw	DIN 933 – M6 x 12
15	4	Lock washer	S6
16	1	Fillister head screw	DIN 84 – M6 x 12
17	1	Washer	DIN 125 – 6.4
18	1	Hexagon socket head screw	Premounted with coupling wheel
19	1	Allen key	For item 18

3.3.6 Assembly procedure (see figure 3-8 and figure 3-9)

1. Attach VDI/VDE 3845 mounting console ((9), actuator-specific, scope of delivery actuator manufacturer) onto rear of positioner and secure using hexagon head screws (14) and lock washers (15).
2. Adhere pointer (4.2) onto mounting console in the center of the centering hole.
3. Push the coupling wheel (2) onto positioner axle, pull back by about 1 mm and tighten the hexagon socket head screw (18) with the Allen key provided.
4. Place the carrier (3) onto the end of the actuator and secure using Fillister head screw (16) and washer (17).
5. Carefully place positioner with mounting console onto the actuator such that the pin of the coupling wheel engages in the driver.
6. Align the positioner/mounting console assembly in the center of the actuator and screw tight.
(Screws not included in delivery; they are part of the actuator mounting console!)
7. Following startup as described in Chapter 3.6, page 64: Drive the actuator to the end position and adhere scale (4.1) on the coupling wheel (2) according to direction of rotation and rotary actuator. *The scale is self-adhesive!*

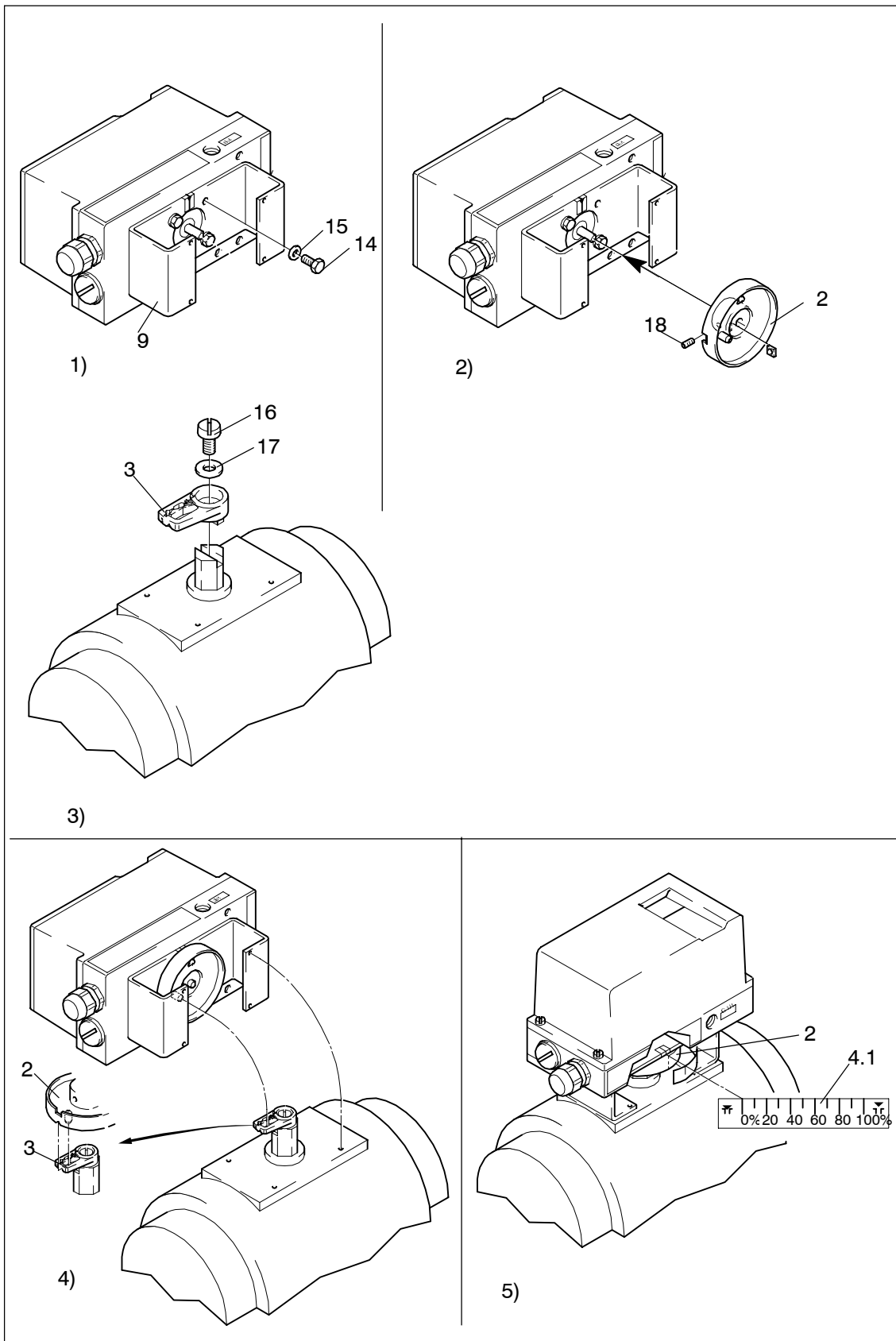


Figure 3-8 Assembly procedure (rotary actuator)

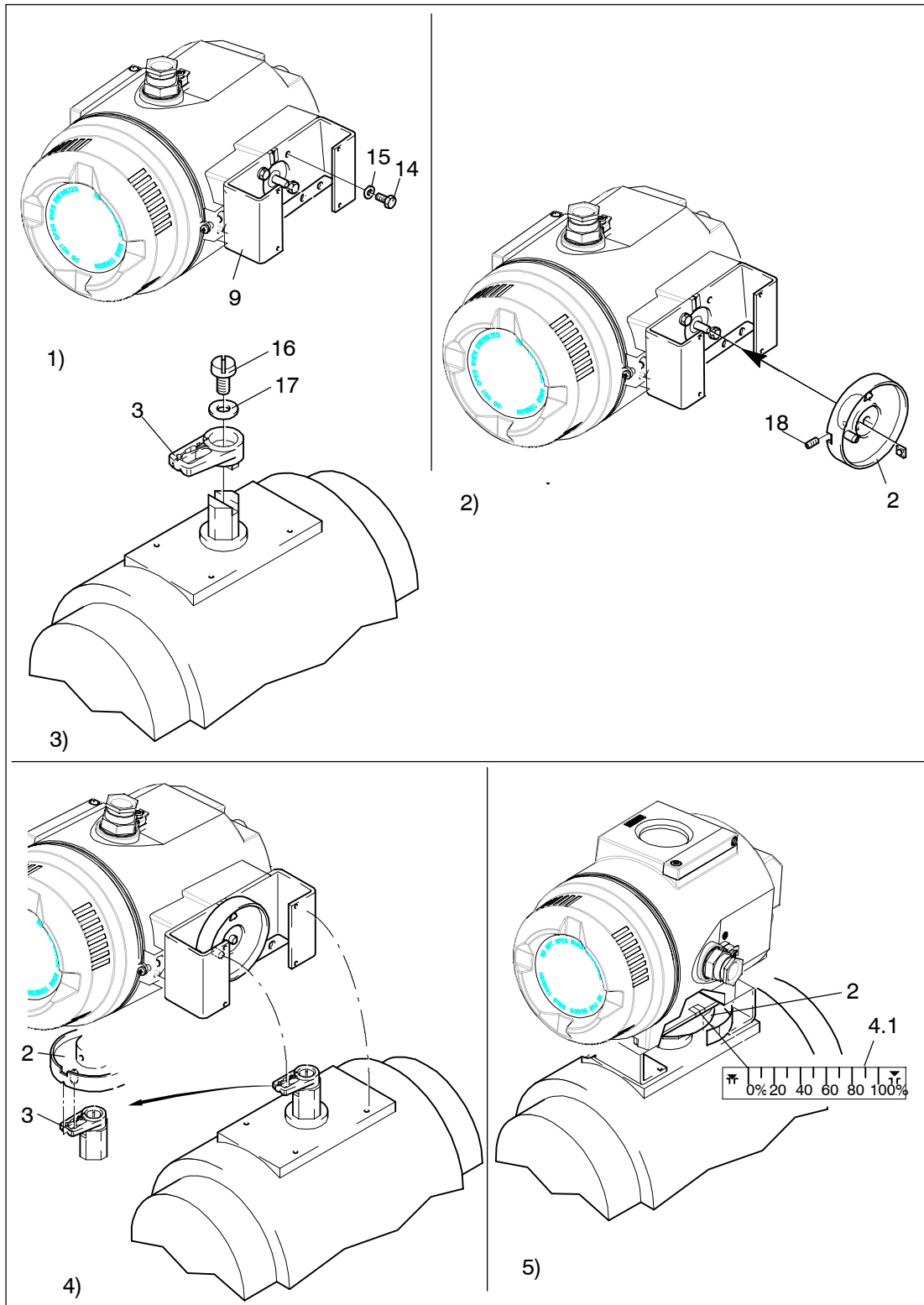
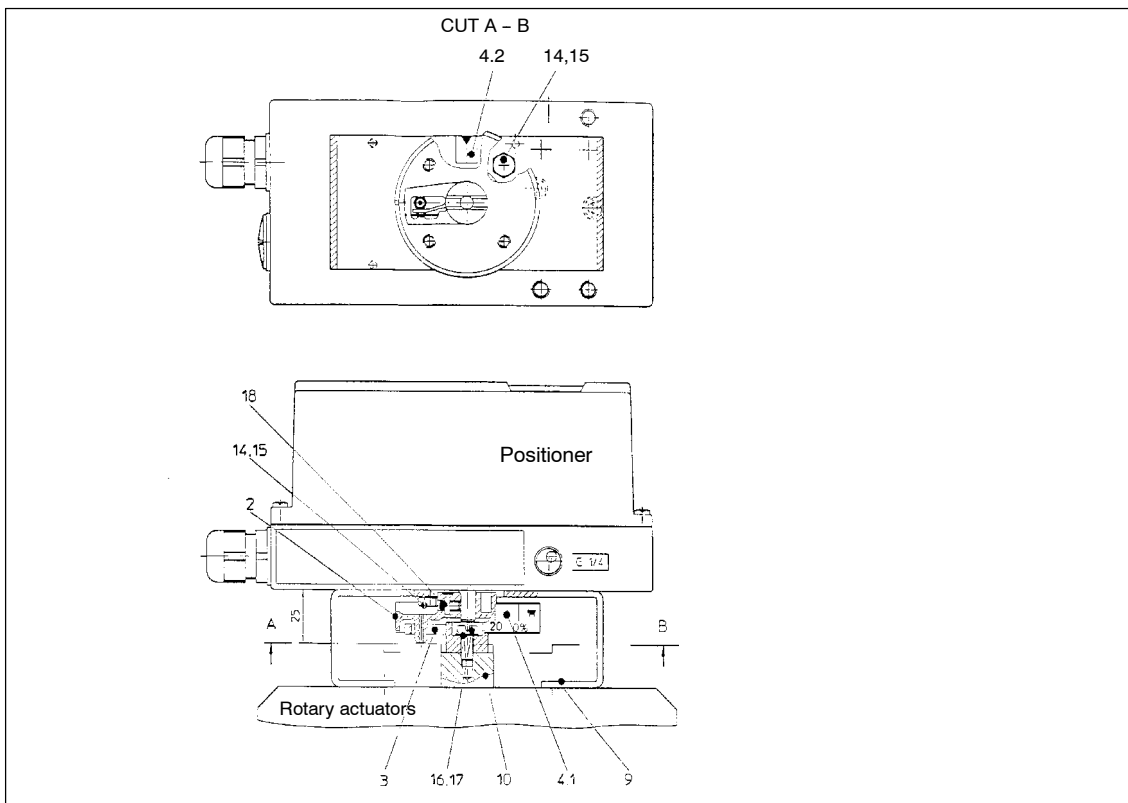


Figure 3-9 Assembly procedure for **explosion-proof version** (rotary actuator)



- | | | | |
|-----|-------------------------------|----|----------------------------|
| 2 | Clutch wheel | 10 | Feedback shaft |
| 3 | Driver | 14 | Hexagon-head screw M6 × 12 |
| 4 | Multiple-purpose plate | 15 | Retaining washer S6 |
| 4.1 | Scale | 16 | Round-head screw M6 × 12 |
| 4.2 | Pointer mark | 17 | Washer |
| 9 | VDI/VDE 3845 mounting bracket | 18 | Socket-head cap screw |

Figure 3-10 Mounted positioner for rotary actuators

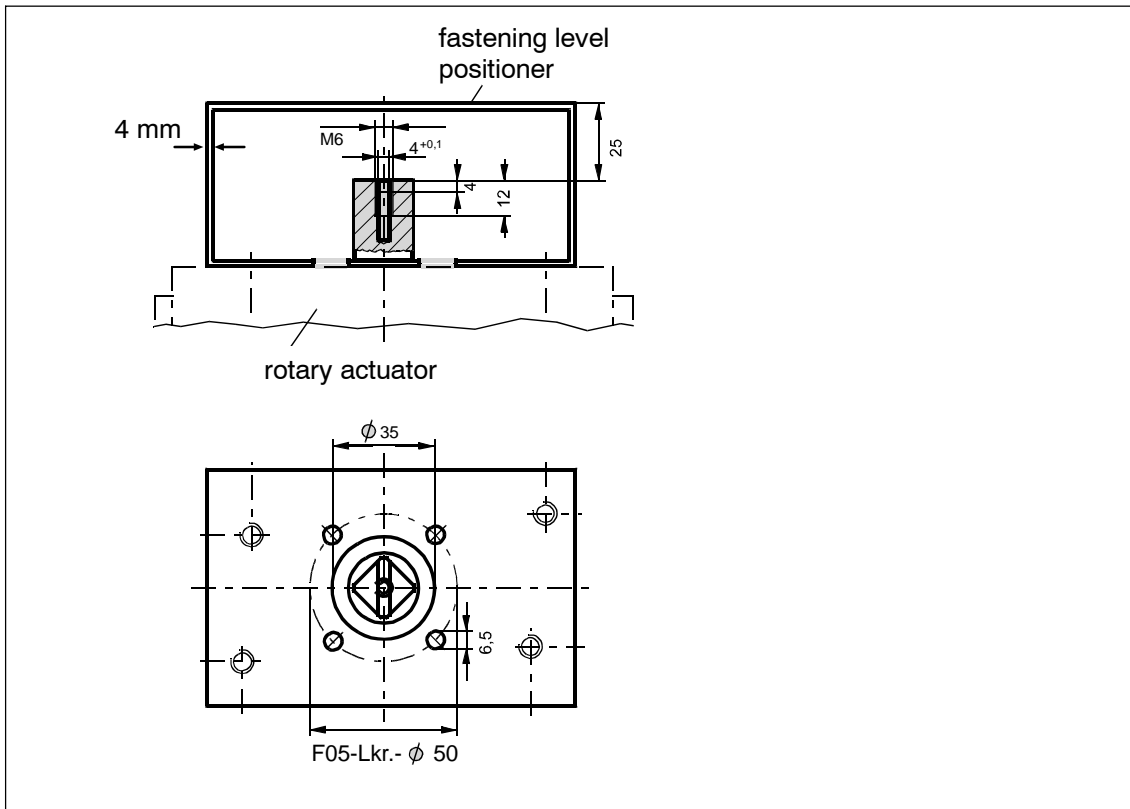


Figure 3-11 Attachment of rotary actuator, mounting console (scope of delivery actuator manufacturer), dimensions

3.4 Electrical Connection



NOTE

Any necessary options modules must be installed before electrical connection (see chapter 2.6, page 25).

N.B.: The transmission ratio selector can only be set when the positioner is open. Therefore check this setting before closing the positioner.



WARNING

The specifications of the examination certificate valid in your country must be observed. Laws and regulations valid in your country must be observed for the electrical installation in explosions hazardous areas. In Germany these are for example:

- Working reliability regulations,
- Regulations for installing electrical equipment in hazardous areas, DIN EN 60079-14 (in the past VDE 0165, T1).

It should be checked whether the available power supply, insofar as this is required, is compliant with the power supply specified on the rating plate and specified in the examination certificate valid in your country.

If the intrinsically safe version is operated with a higher operating voltage by mistake, the positioner must no longer be used for intrinsically safe application.

The explosion-proof positioner may only be supplied with electrical power in areas in which the atmosphere may be potentially explosive when the housing is closed.

The feed-through openings in the explosion-proof version for the electronic connections must be sealed with EEX-d certified cable glands or EEx-d certified plugs or an ignition lock must be mounted at a maximum distance of 46 cm (18 inches) when using the "conduit"-system.

The plastic housing is metal lined to increase the electromagnetic compatibility (EMC) against high frequency radiation. This screen is connected electrically to the threaded bushes shown in figure 3-12, page 55.

The specified noise immunity and noise emission are only ensured if the bus shield is fully effective.



CAUTION

To discharge impulses under fault conditions, the positioner must be connected via a low resistance to an equipotential bonding (ground potential). For this the positioner in plastic housing is provided with an additional cable. Connect this cable using the cable clip to the fieldbus cable shield and to the equipotential bonding.

Devices in metal housings have a corresponding terminal on the outside of the housing, which also must be connected to equipotential bonding.

Provide for suitable potential equipotential bonding between the hazardous and non-hazardous areas for applications in areas where there is a risk of explosions.

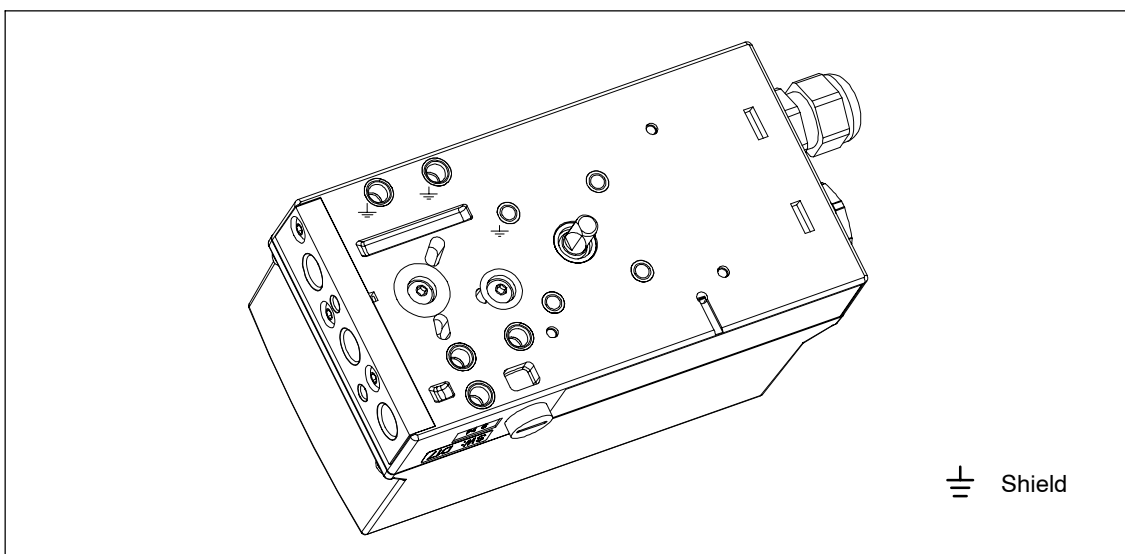


Figure 3-12 Base plate

Fitting the bus cable

Normal, intrinsically safe and zone 2 versions.

1. Isolate the bus cable as shown in figure 3-13, page 56.
2. Open the positioner housing by undoing the four cover screws.
3. Insert the prepared bus cable through the cable gland.
4. Secure the shield with the cable clip and the two screws to the housing.

Explosion-proof version

1. Isolate the bus cable as shown in figure 3-13, page 56.
2. To open the positioner, the cover catch (12) must be undone and the screw cover unscrewed.
3. Insert the prepared bus cable through the Ex-d-certified cable gland *)
4. Secure the shield with the cable clip and the two screws to the housing.

5. Tighten the cable gland.
6. Connect the red and green wires as shown in figure 3-14, page 57 to terminals 3 and 7 of the motherboard (the polarity is immaterial).

5. Tighten the Ex-d-certified cable gland. *)
6. Connect the red and green wires as shown in figure 3-16, page 58 to terminals 3 and 7 of the motherboard (the polarity is immaterial).

*) if the Conduit Tube System is being used, refer to the relevant instructions.

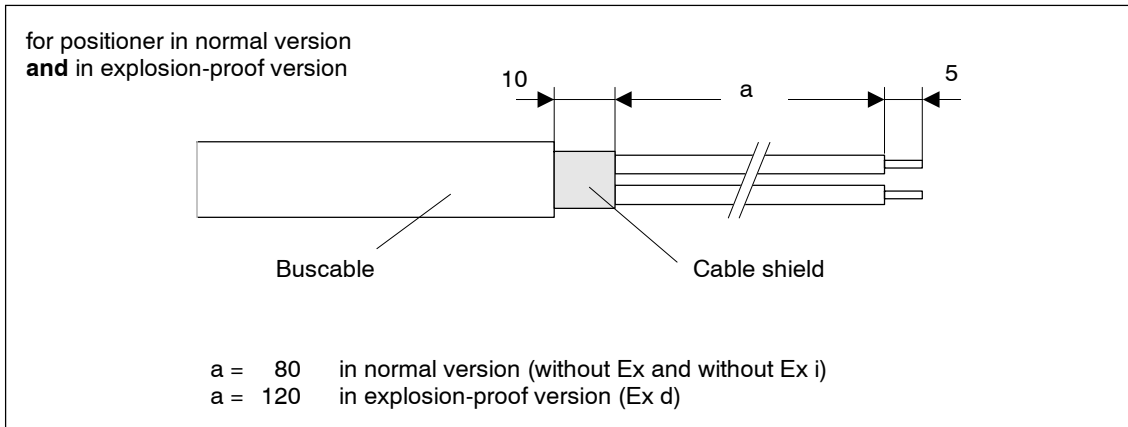


Figure 3-13 Preparation of bus cable

For error-free communication the bus must be terminated at both ends with a bus terminator. At the end nearest the control system, this is already assured by the terminator contained within the coupling or link. At the far end of the bus this must be achieved by fitting an additional terminator.

So as to avoid potential differences between individual equipment parts and thus the risk of functional impairment, a suitable potential bonding is to be provided. Information regarding dimensions and types can be found in DIN VDE 0100 parts 410 and 540.



NOTE

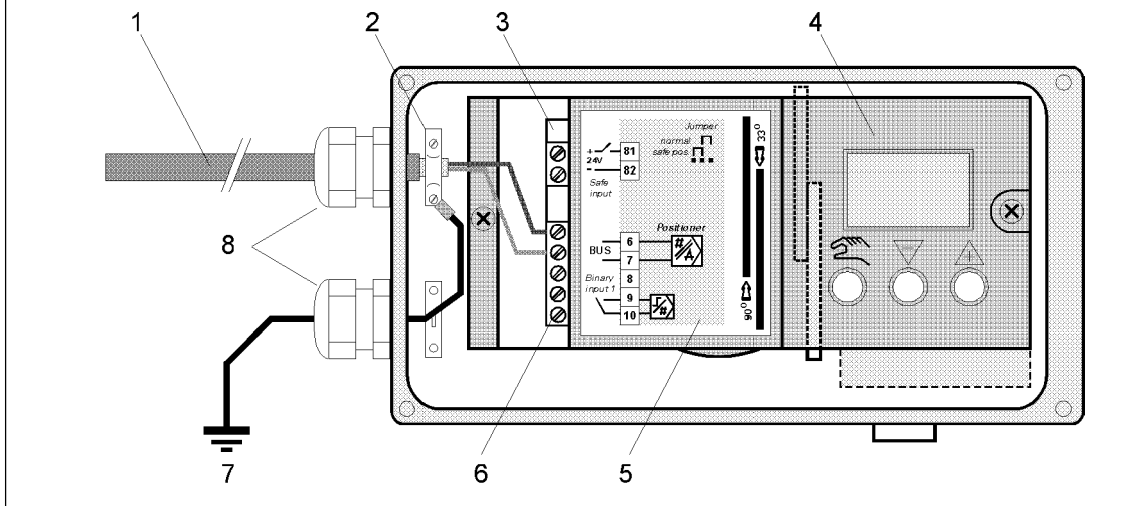
Use standard M20 x 1.5 cable gland nuts to ensure leakage (IP-protection of the housing) and for the necessary tensile strength use only cables with a cable diameter ≥ 8 mm, or for smaller diameters use a suitable sealing insert.

NOTE for use in zone 2:

Non-sparking equipment for zone 2 may not be connected or disconnected under power in normal operation.

However, during installation or repair work the positioner may be connected or disconnected even under power (see also certificate for zone 2).

for positioner in normal version:



- 1 Bus cable
- 2 Cable clip
- 3 Motherboard
- 4 Module cover
- 5 Plate
- 6 Terminal block
- 7 Ground potential
- 8 Cable glands

Figure 3-14 Bus cable connection

for positioner in explosion-proof version

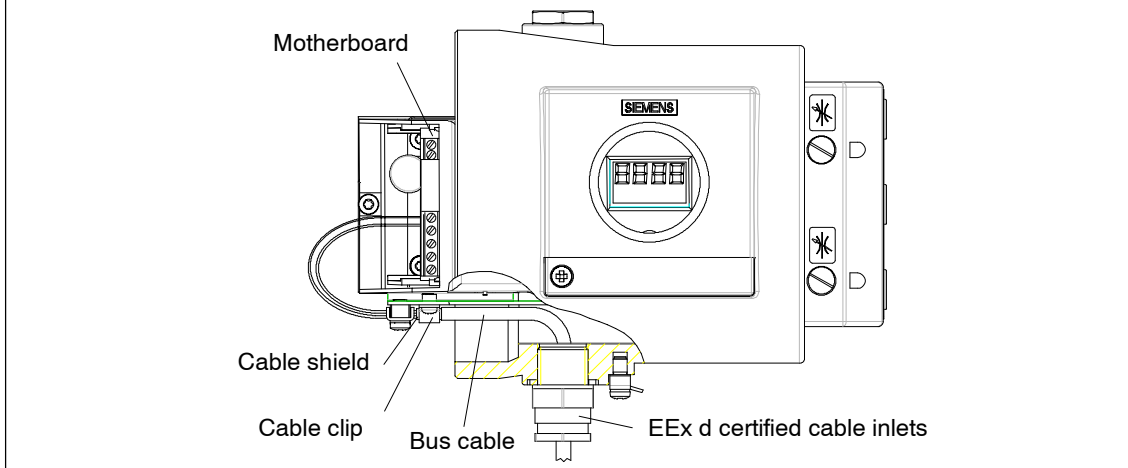


Figure 3-15 Bus cable connection for positioner in explosion-proof version

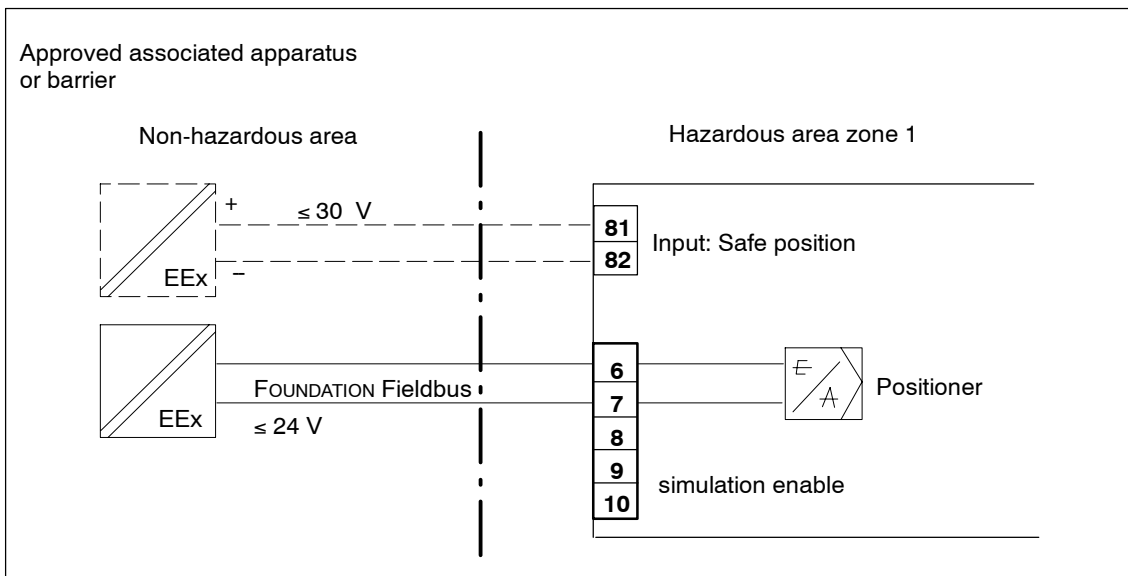


Figure 3-16 Electric connection of basic device with in intrinsically safe version

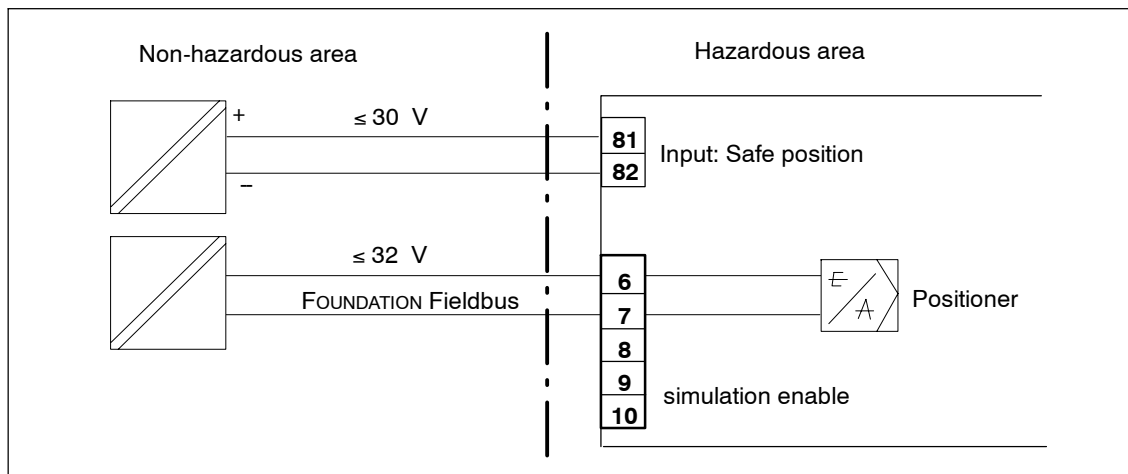


Figure 3-17 Electric connection for positioner in explosion-proof version or in type of explosion protection "n" version

Safety position

The positioner is equipped with an additional input (terminal 81 [+]) and terminal 82 [-]) for driving to the safety position. After activating this function this input must be supplied with uninterrupt +24 V, to allow normal positioning operation.

If this power supply is switched off or drops out, the air exhaust valve is automatically opened and the drive will move to the pre-arranged safety position, so that the drive cannot be activated using the keys on the control unit or by means of the master switch. Communication is still possible.

This function is activated by the coding bridge on the motherboard. This is accessible after removing the module cover and must be moved from the right position (as delivered) to the left position.

3.4.1 Connection variant: Options in positioner in non-intrinsically safe and explosion-proof version

Current output

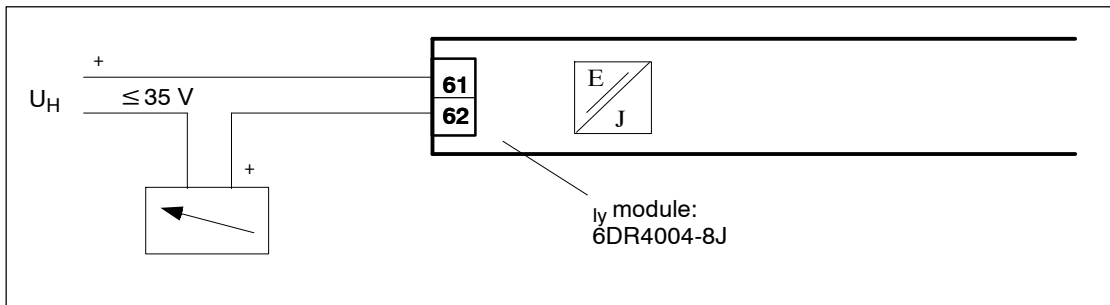


Figure 3-18 I_y module 6DR4004-8J, non Ex

Digital inputs and outputs

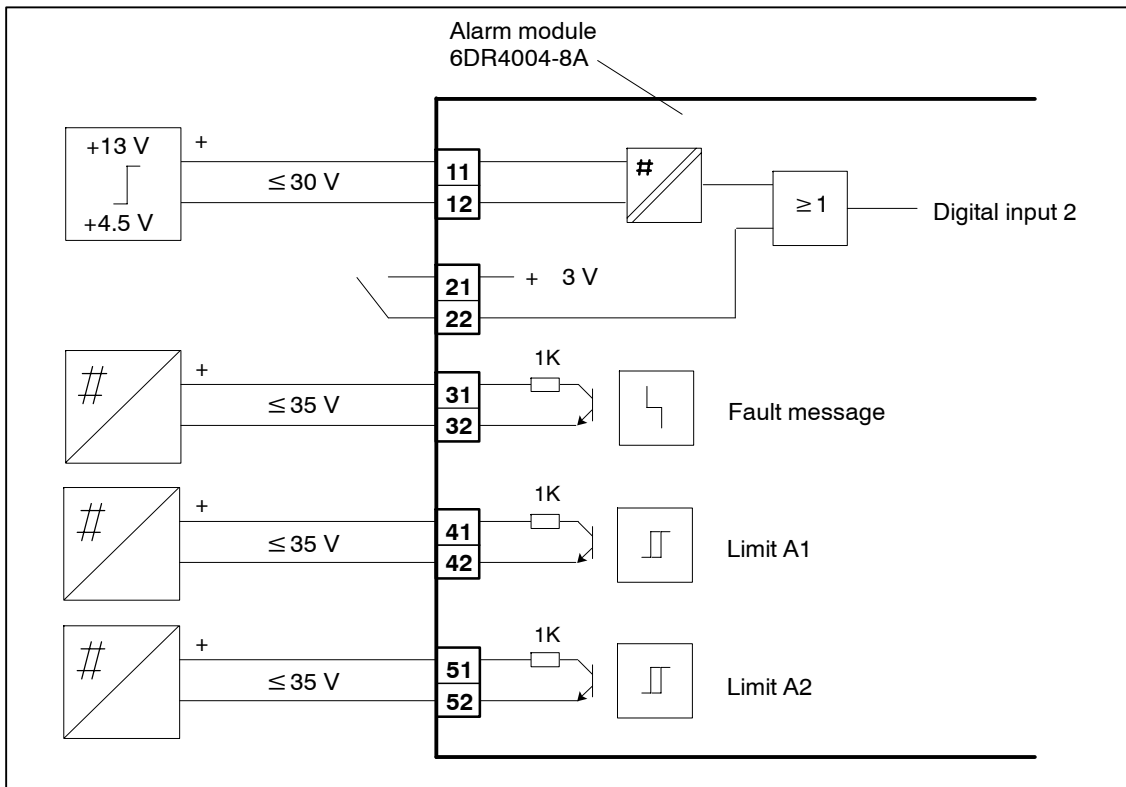


Figure 3-19 Alarm module 6DR4004-8A, non Ex

SIA module

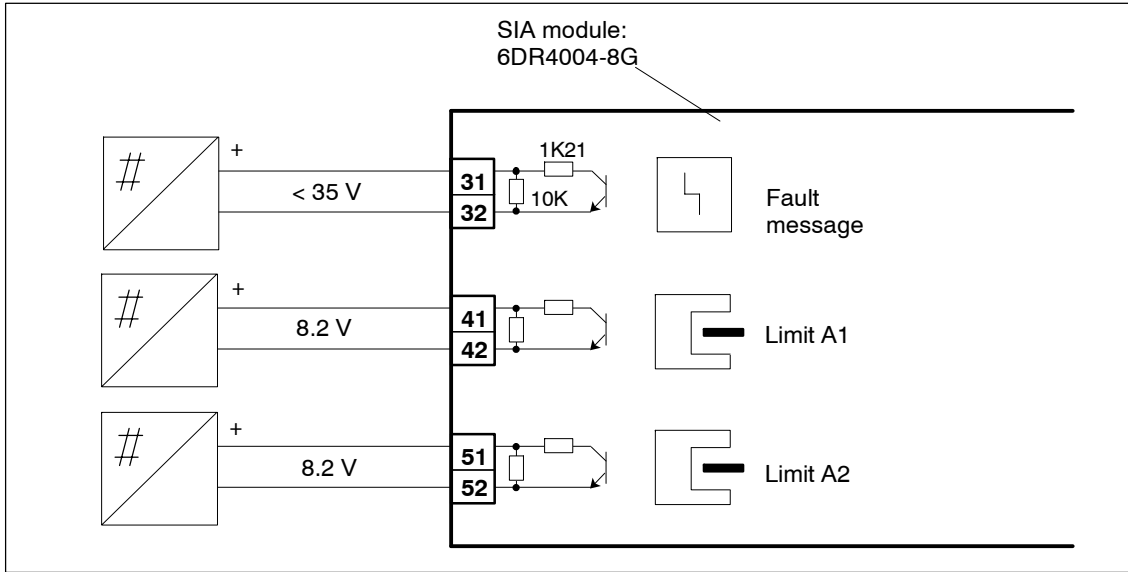


Figure 3-20 SIA module 6DR4004-8G, **non Ex**

Mechanical limit switch module

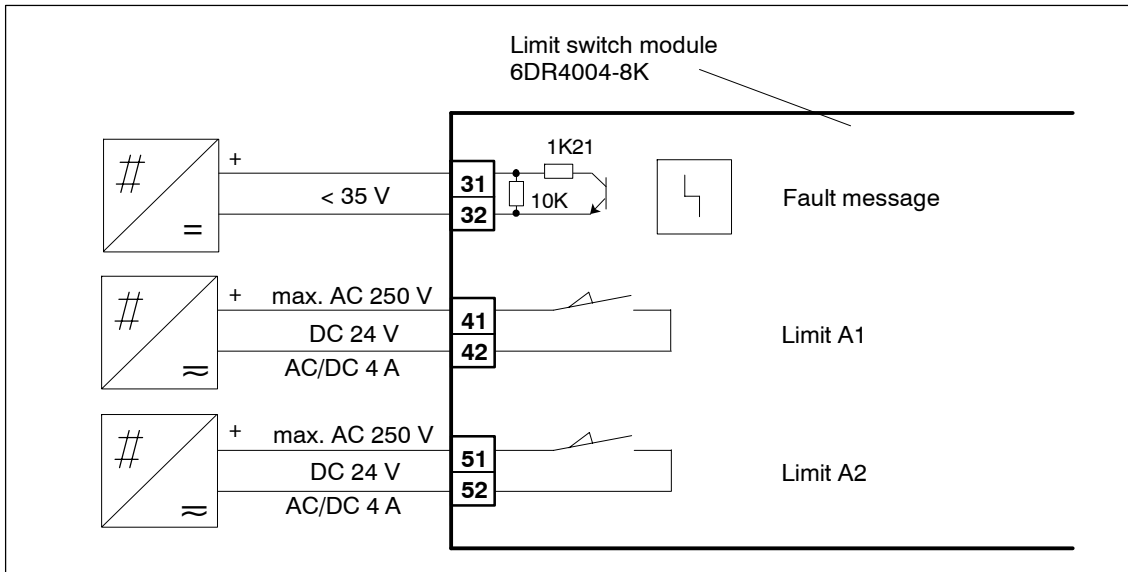


Figure 3-21 Mechanical limit switch module 6DR4004-8K, **non Ex**

3.4.2 Connection variant: Options in the positioner in intrinsically safe version

Current output

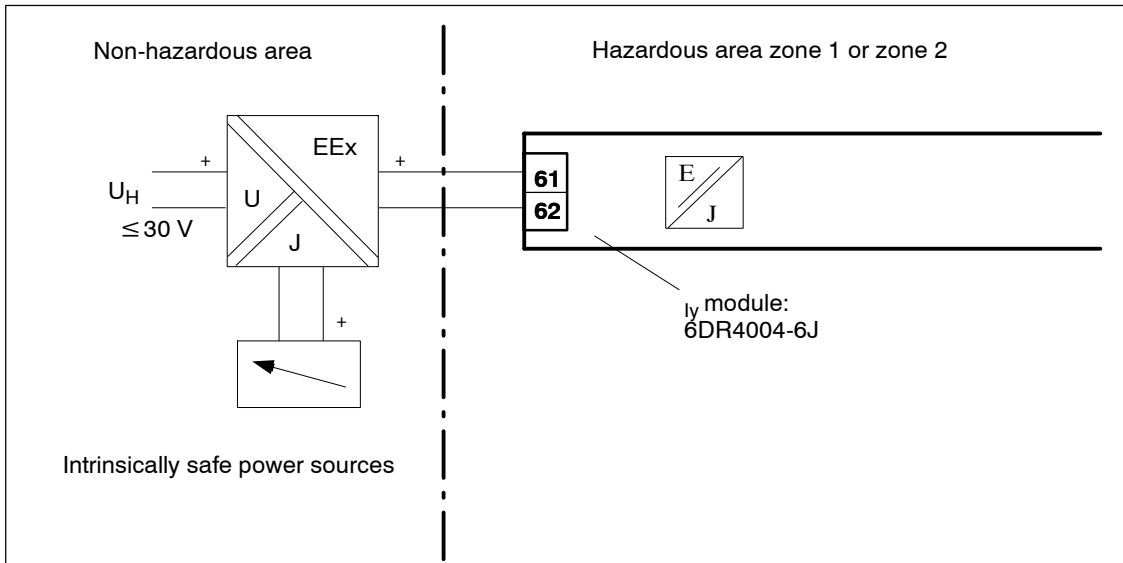


Figure 3-22 I_y module 6DR4004-6J, EEx i

Digital inputs and outputs

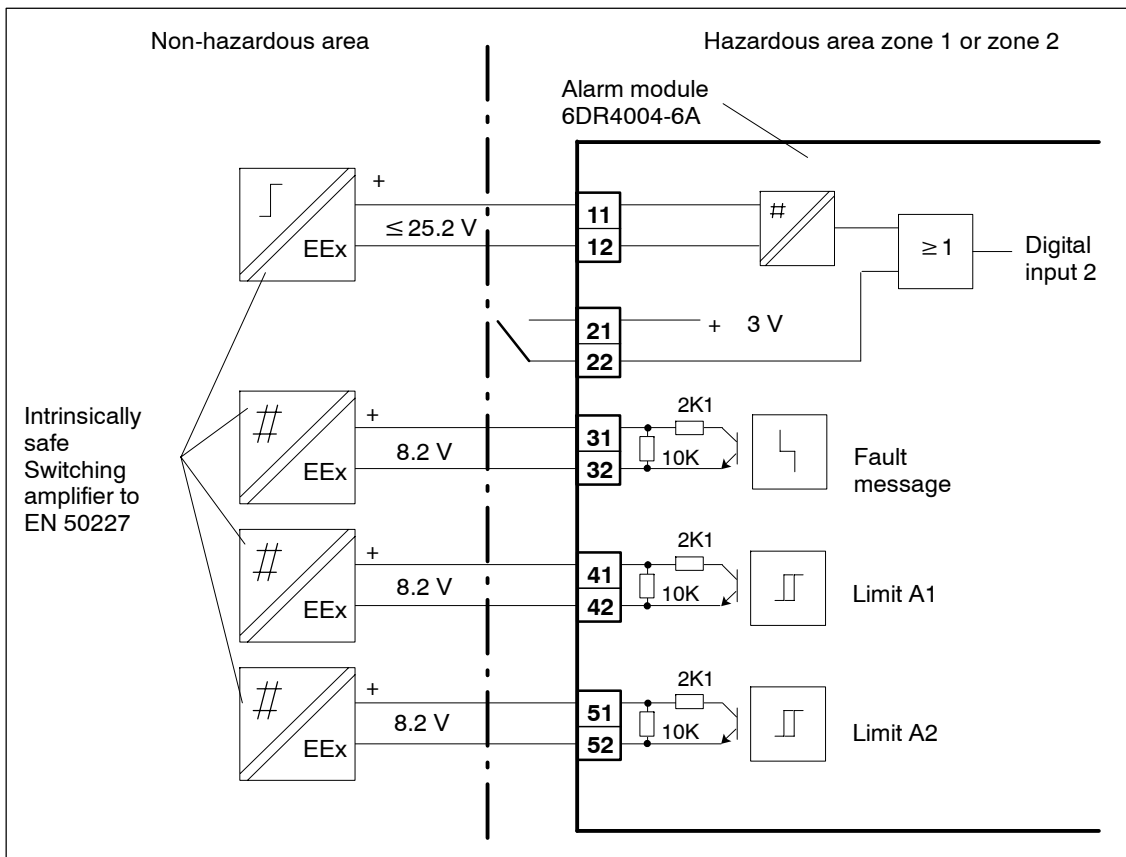


Figure 3-23 Alarm module 6DR4004-6A, EEx i

SIA module

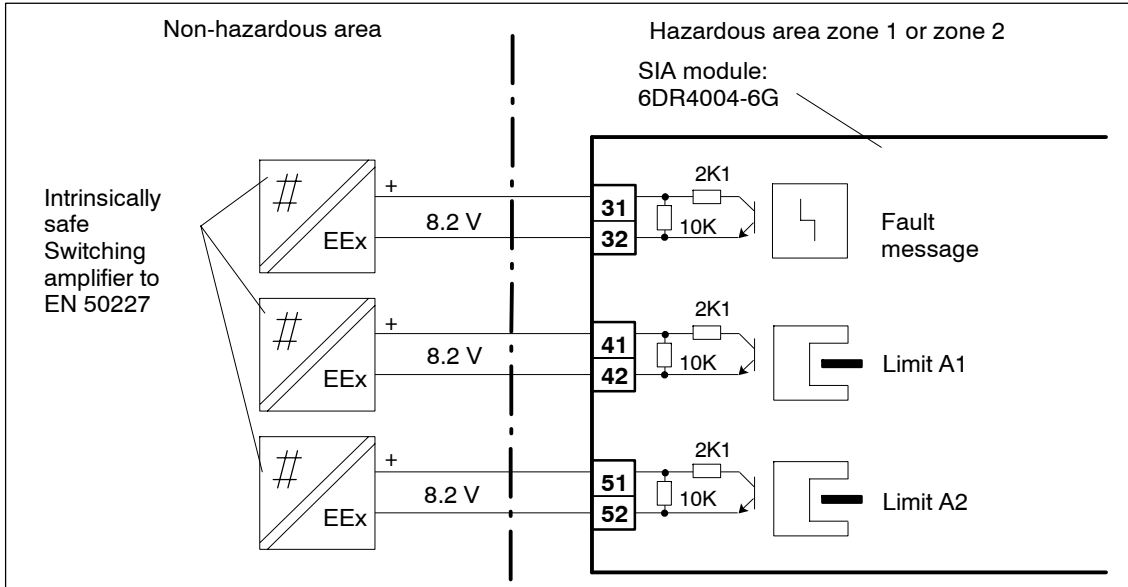


Figure 3-24 SIA module 6DR4004-8G, EEx i

Mechanical limit switch module

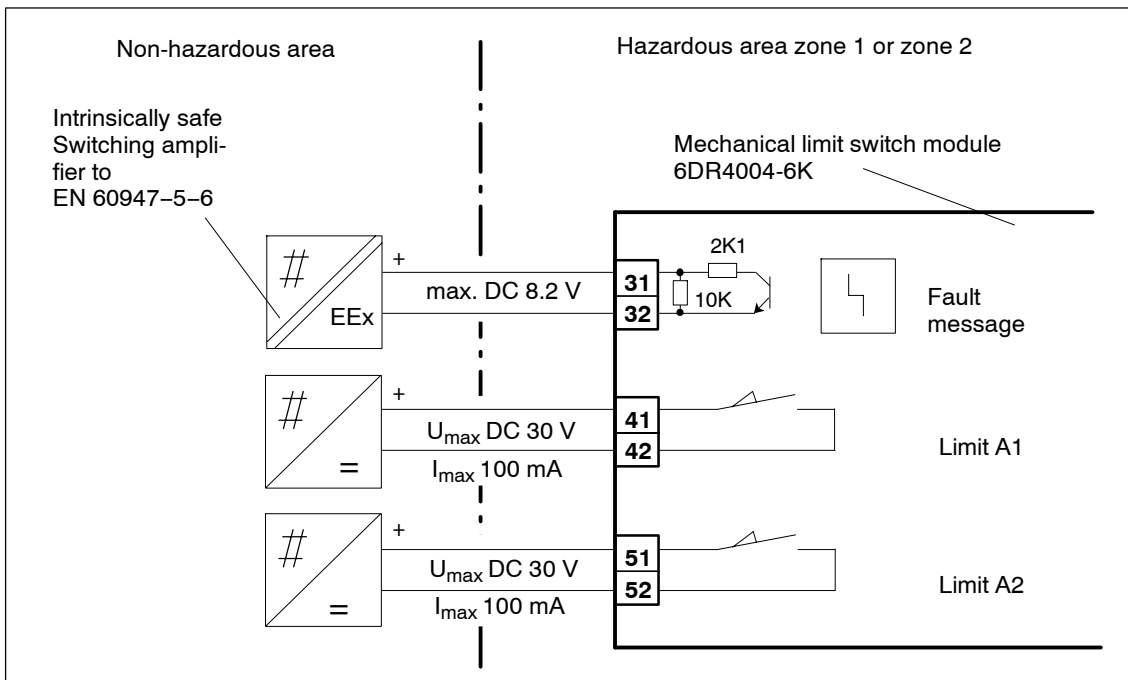


Figure 3-25 Mechanical limit switch module 6DR4004-6K, EEx i

3.5 Pneumatic Connection



WARNING

For reasons of safety, the pneumatic power may only be supplied after assembly when the positioner is switched to operating mode P manual operation with electrical signal applied (as-delivered state, see figure 4-4, page 84).



NOTE

Note the air quality! Oil-free industrial air, solid content < 30 µm, pressure dew point 20 K below the lowest ambient temperature (chapter 7 “Technical Data”, page 175).

- Connect a manometer block for supply air and actuating pressure if necessary.
- Connection by female thread G 1/4 DIN 45141 or 1/4” NPT:

P _Z	Supply air 1.4 to 7 bar
Y1	actuating pressure 1 for single- and double-acting actuators
Y2	actuating pressure 2 for double-acting actuators
E	exhaust air outlet (remove silencer if necessary)

 see figure 2-4 and 2-5, page 21.
- Safety position when the electric power supply fails:

single-acting:	Y1	deaerated
double-acting:	Y1	Max. actuating pressure (supply air pressure)
	Y2	deaerated
- Connect actuating pressure Y1 or Y2 (only in double-acting actuators) according to the desired safety position.
- Connect supply air to P_Z.



NOTE

In order for spring-loaded pneumatic actuators to be able to reliably exploit the maximum possible stroke, the supply pressure must be sufficiently greater than the maximum required final pressure of the actuator.

After installing the device, check the pneumatic connections of the entire assembly for leakage. Any leakage would cause not only continuous consumption of compressed air but also would cause the positioner to continually endeavor to compensate for the variance in position, leading in time to premature wear of the whole control mechanism.

3.6 Commissioning

Once the positioner has been fitted to a pneumatic actuator, it must be provided with electrical and pneumatic auxiliary power.

The electrical auxiliary power can be provided via a bus interface or separate power source with 15 to 30 V DC. Then you can adapt the positioner to the respective actuator by parameterizing and initializing it. Communication with a master is not necessary for this.

If the positioner has not been initialized it will be in the "P Manual Mode" operating mode (which can also if necessary be attained by "PRST") – "NOINI" will flash.

This initialization can be effected in three different ways:

- **Automatic initialization**
Initialization takes place automatically. Hereby the positioner determines the direction of action, the stem path and the angle of rotation, the adjusting times of the actuator one after the other and adapts the control parameters to the dynamic behavior of the actuator.
- **Manual initialization**
The stem travel or angle of rotation of the actuator can be set manually, the other parameters are determined as in automatic initialization. This function is useful in actuators with soft limit stops.
- **Copying initialization data (positioner exchange)**
The initialization data of a positioner can be read out and copied to another positioner. This enables a defective device to be changed without having to interrupt an ongoing process by initialization.

Only a few parameters need to be set in the positioner prior to initialization. The others are defaulted so that they do not normally need to be adjusted. You will have no problems with commissioning if you observe the following points.

The possible operating modes and parameters, together with the adjustment capabilities and their effects are described in chapter 4 page 81 "Local Operation".



NOTE

N.B.: The operating pressure should be at least one bar greater than is necessary for closing/opening the valve during initialization.

N.B.: The transmission ratio selector can only be set when the positioner is open. Therefore check this setting before closing the housing.

3.6.1 Preparations for linear actuators

1. Assemble the positioner with the appropriate mounting kit (see chapter 3.3.3, page 39).



NOTE

Particularly important is the position of the transmission ratio selector (7, figure 2-2, page 19) in the positioner:

Stroke	Lever	Position of the transmission ratio selector
5 to 20 mm	short	33° (i.e. down)
25 to 35 mm	short	90° (i.e. up)
40 to 130 mm	long	90° (i.e. up)

2. Push the carrier pin (4, figure 3-7 (page 47) 2) onto the lever (6, figure 3-7, 2) to the scale position corresponding to the rated stroke or next highest position and screw the carrier pin tight with the nut (18, figure 3-7, 2).
3. Connect the actuator and the positioner with the pneumatic lines and supply pneumatic power to the positioner (figure 2-4 and 2-5, page 21).
4. Connect the positioner to the fieldbus line (figure 3-16, page 58 and figure 3-17, page 58).
5. The positioner is now in the operating mode "**P-manual operation**". The current potentiometer voltage (P) is displayed in percent in the top line of the display, e.g.: "**P12.3**", and "**NOINI**" flashes in the bottom line:



6. Check the free running of the mechanics in the whole actuating range by moving the actuator with the keys \triangle and ∇ and driving to the respective end position.



NOTE

You can move the actuator quickly by pressing the other direction key additionally whilst keeping the direction key selected first pressed.

7. Now move the actuator to the horizontal position of the lever. A value between **P48.0** and **P52.0** should be visible in the display. If this is not the case, adjust the slip clutch (8, figure 2-10, page 27) until "**P50.0**" is displayed with a horizontal lever. The more accurately you hit this value, the more exactly the positioner can determine the total stroke.

NOTICE

for the explosion proof version:

Only adjust the outer friction clutch (8, Figure 2-3, page 20). The internal friction clutch (9, Fig. 2-2 page 19) is fixed and, for the explosion proof version, must **not** be adjusted.


3.6.2 Automatic initialization of linear actuator

If you can move the actuator correctly, leave it standing in a central position and start automatic initialization:

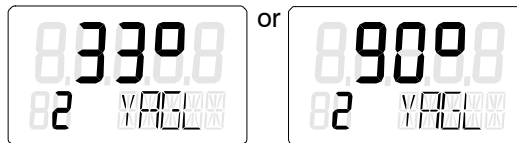
1. Press the operation mode key  for longer than 5 s. This brings you to the Configuration operating mode.

Display:



2. Switch to the second parameter by pressing the operation mode key  briefly.

Display:



NOTE

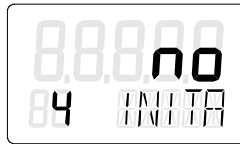
It is vital that this value corresponds to the setting of the transmission ratio selector (8, figure 2-2, page 19) (33° or 90°).


3. Switch on to the following display with the operation mode key :



You only need to set this parameter if you want to have the total stroke in mm displayed at the end of the initialization phase. To do this, select the same value in the display to which you have set the carrier pin to the scale on the lever.

4. Switch on to the following display with the operation mode key :



5. Start initialization by pressing the key  for longer than 5 s.
Display:



During the initialization phase "RUN1" to "RUN5" appear one after another in the bottom display (see also structograms figures 3-27, page 76 to figure 3-30, page 79).




NOTE


The initialization process may last up to 15 minutes depending on the actuator.

The initialization is complete when the following display appears:



The following display appears after pressing the operation mode key  briefly:



To exit the **Configuration** operating mode, press the operation mode key  for longer than 5 s. The software version is displayed after about 5 s. The instrument is in manual operation after releasing the operation mode key.



NOTE

You can abort an ongoing initialization at any time by pressing the operation mode key. Your previous settings are retained. All the parameters are reset to the factory setting only after performing a "Preset".

3.6.3 Manual initialization of linear actuator

The positioner can be initialized with this function without the actuator being driven hard against the limit stop. The start and end positions of the stem path are set manually. The other initialization steps (optimization of the control parameters) run automatically as in automatic initialization.


Manual initialization procedure in linear actuator

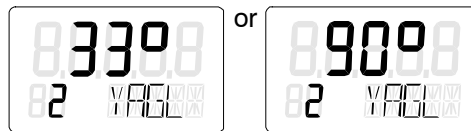
1. Make preparations as described in chapter 3.6.1, page 65 for linear actuator. In particular, make sure by manually driving the whole stem path that the displayed potentiometer setting moves in the permissible range between P5.0 and P95.0.

Press the operation mode key  for longer than 5 s. This brings you to the Configuration operating mode.

Display:



3. Switch to the second parameter by pressing the operation mode key  briefly. One of the following displays appears:




NOTE

It is vital that this value corresponds to the setting of the transmission ratio selector (33° or 90°).


4. Switch on to the following display  with the operation mode key:



You only need to set this parameter if you want to have the total stroke in mm displayed at the end of the initialization phase. To do this, select the same value in the display to which you have set the carrier pin to the scale on the lever or the next highest position in intermediate positions.

5. Switch on to the following display  by pressing the operation mode key twice:






6. Start initialization by pressing the increment key  for longer than 5 s.
Display:



7. After 5 s the display changes to:



(The display of the potentiometer setting is shown here and below as an example only).

Now move the actuator to the position which you want to define as the first of the two end positions with the increment  and decrement  key. Then press the operation mode key . This accepts the current position as end position 1 and switches on to the next position.



NOTE

If the message "RANGE" appears in the bottom line, the selected end position is outside the permissible measuring range. There are several ways to correct the error:

- Adjust the slip clutch until "OK" appears and press the operation mode key again or
- move to another end position with the increment and decrement key or
- abort initialization by pressing the operation mode key. You then have to change to P manual operation and correct the stem path and the displacement detection according to step 1.

8. If step 7 was successful, the following display appears:



Now move the actuator to the position which you want to define as the second end position with the increment Δ and decrement ∇ key. Then press the operation mode key \square . This enters the current position as end position 2.



NOTE

If the message “RANGE” appears in the bottom line, the selected end position is outside the permissible measuring range. There are several ways to correct the error:

- move to another end position with the increment and decrement key or
- abort initialization by pressing the operation mode key. You then have to change to P manual operation and correct the displacement path and the displacement detection according to step 1.

If the message “Set Middl” appears, the lever arm must be driven to horizontal position using the increment and decrement key and then the operation mode key pressed. This sets the reference point of the sine correction in linear actuators.

9. The rest of the initialization now runs automatically. “RUN1” to “RUN5” appear one after another in the bottom line of the display. The following display appears on successful completion of initialization:



The first line additionally contains the determined stroke in millimeters if the set lever length was specified with parameter 3 YWAY.

5 INITM appears in the bottom line again after pressing the operation mode key \square briefly. This brings you back to the Configuration operating mode.

To exit the Configuration mode, press the operation mode key \square for longer than 5 seconds. The software version is displayed after about 5 seconds. The instrument is in manual operation after releasing the operation mode key.

3.6.4 Preparations for rotary actuator



NOTE

Very important: Switch the transmission ratio selector in the positioner (8, figure 2-2, page 19) to position 90° (normal angle for rotary actuator).

1. Mount the positioner with the appropriate mounting kit (see chapter 3.3.5, page 48).
2. Connect the actuator and the positioner with the pneumatic lines and supply pneumatic power to the positioner (figure 2-4 and 2-5, page 21).
3. Connect the positioner to the fieldbus line (Figure 3-16, page 58 and Figure 3-17, page 58).
4. The positioner is now in the operating mode "**P-manual operation**". The current potentiometer voltage (P) is displayed in % in the top line of the display, e.g.: "**P12.3**", and "**NOINI**" flashes in the bottom line:



5. Check the free running of the mechanics in the whole actuating range by moving the actuator with the keys \triangle and ∇ and driving to the respective end position.




NOTE

You can move the actuator quickly by pressing the other direction key additionally whilst keeping the direction key selected first pressed.

3.6.5 Automatic initialization of rotary actuator

If you can move the actuator correctly through the actuating range, leave it standing in a central position and start automatic initialization:

1. Press the operation mode key  for longer than 5 s. This brings you to the Configuration operating mode.

Display



- Set the parameter with the ∇ -key to "turn"
Display:



- Switch to the second parameter by pressing the operation mode key \square briefly. This has set automatically to 90°.
Display:



- Switch on to the following display with the operation mode key \square :



- Start initialization by pressing the key \triangle for longer than 5 s.
Display:



During the initialization phase "RUN1" to "RUN5" appear one after another in the bottom display (see also structograms in figure 3-27, page 76 to figure 3-30, page 79).



NOTE

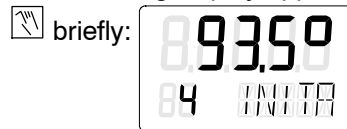
The initialization process may last up to 15 minutes depending on the actuator.


The initialization is complete when the following display appears:



The top value indicates the total angle of rotation of the actuator (example 93.5°).

The following display appears after pressing the operation mode key



To exit the **Configuration** mode, press the operation mode key  for longer than 5 s. The software version is displayed after about 5 s. The instrument is in manual operation after releasing the operation mode key.




NOTE

You can abort an ongoing initialization at any time by pressing the operation mode key. Your previous settings are retained. All the parameters are set to the factory setting only after performing a “Preset”.


3.6.6 Manual initialization of rotary actuators

The positioner can be initialized with this function without the actuator being driven hard against the limit stop. The start and end positions of the displacement path are set manually. The other initialization steps (optimization of the control parameters) run automatically as in automatic initialization.


Manual initialization procedure in rotary actuators

1. Make preparations as described in chapter 3.6.4, page 71 for rotary actuators. In particular, make sure by manually driving the whole displacement path that the displayed potentiometer setting moves in the permissible range between P5.0 and P95.0.
2. Press the operation mode key  for longer than 5 s. This brings you to the Configuration mode.
Display:



3. Set the parameter YFACT to "turn" with the decrement  key.
Display:




4. Switch to the second parameter by pressing the operation mode key  briefly.
Display:



NOTE


Make sure that the transmission ratio selector is in position 90 °!


5. Switch on to the following display by pressing the operation mode key  twice:



The following steps are identical with the steps 6) to 9) for initialization of linear actuators.

After successful initialization the determined rotary range appears in the top display.

“5.INITM” appears in the bottom line again after pressing the operation mode key  briefly. This brings you back to the Configuration operating mode.

To exit the Configuration mode, press the operation mode key  for longer than 5 seconds. The software version is displayed after about 5 seconds. The instrument is in manual operation after releasing the operation mode key.

3.6.7 Automatic initialization (structograms)

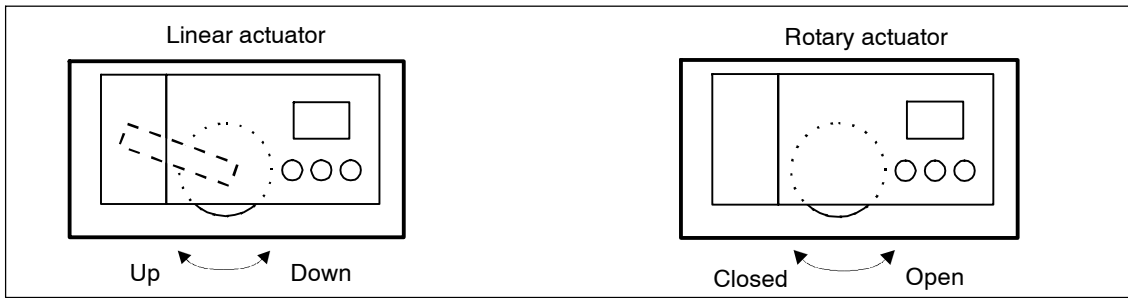


Figure 3-26 Direction of action of the actuators

The initialization procedure should be taken from the following structogram (figure 3-27 to figure 3-30). The terms Open/Closed and up/down in the structogram refer to the direction of action of the actuators as illustrated in figure 3-26.

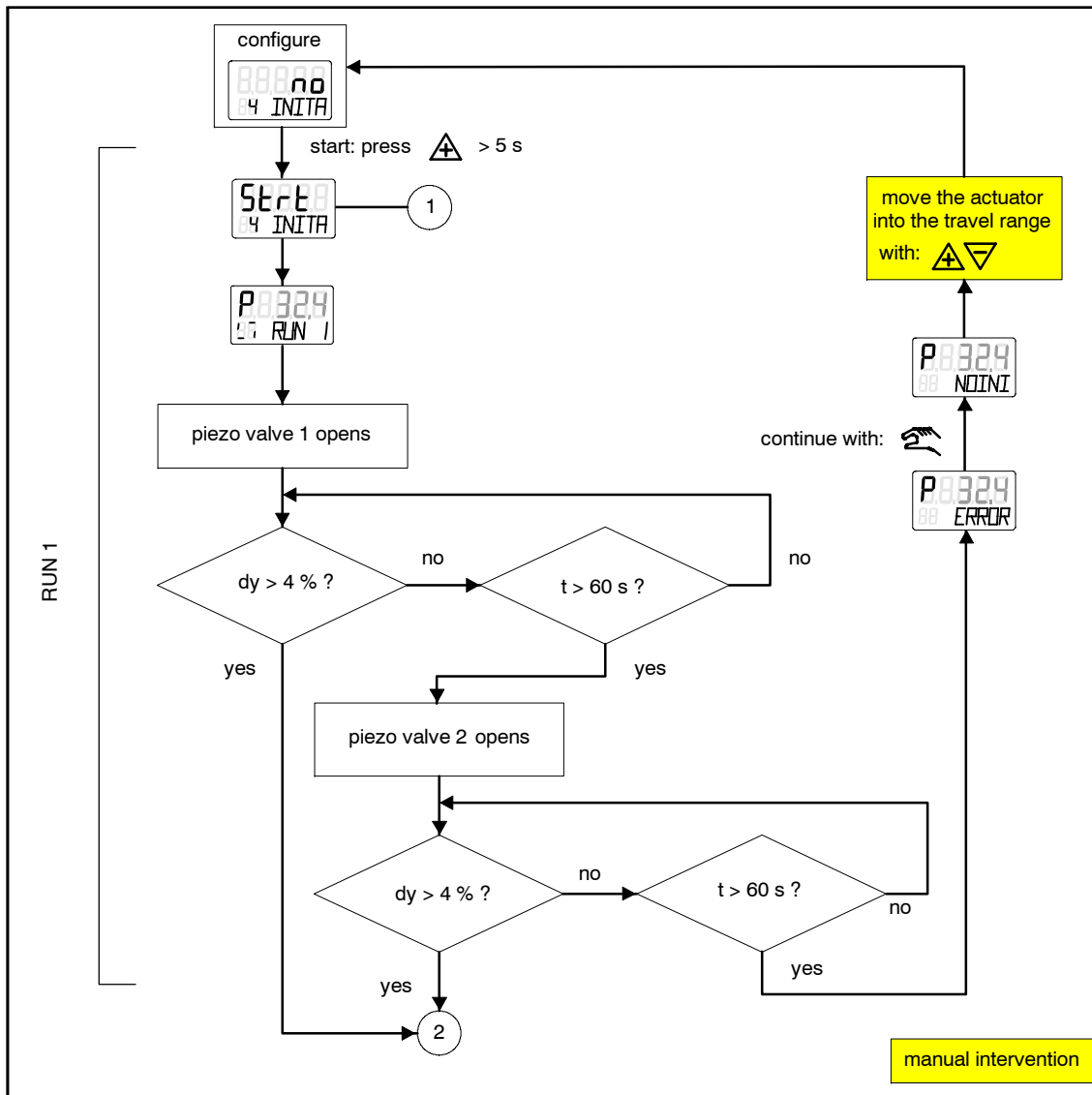


Figure 3-27 Automatic initialization, part 1

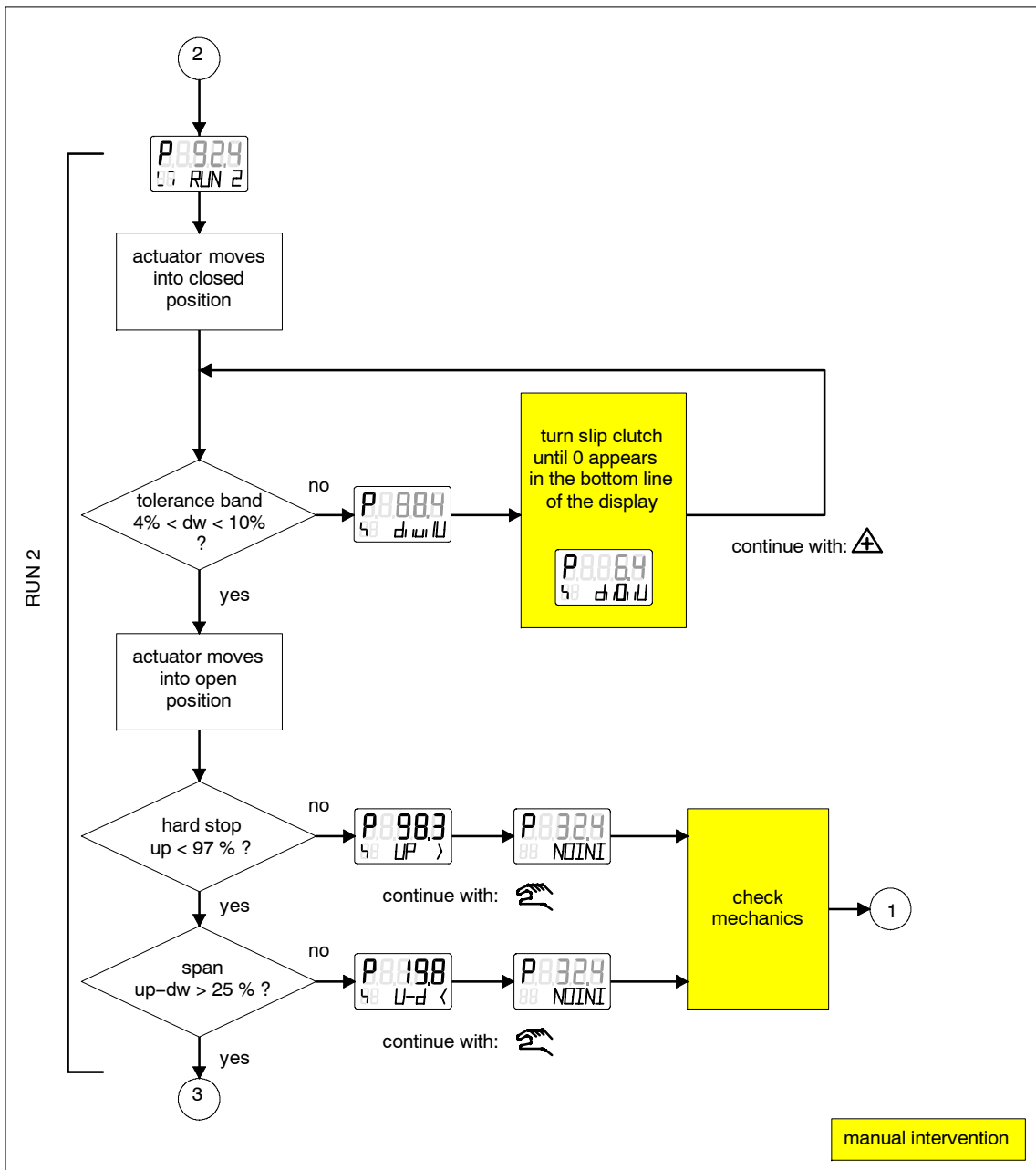


Figure 3-28 Automatic initialization, part 2 (for linear actuators)

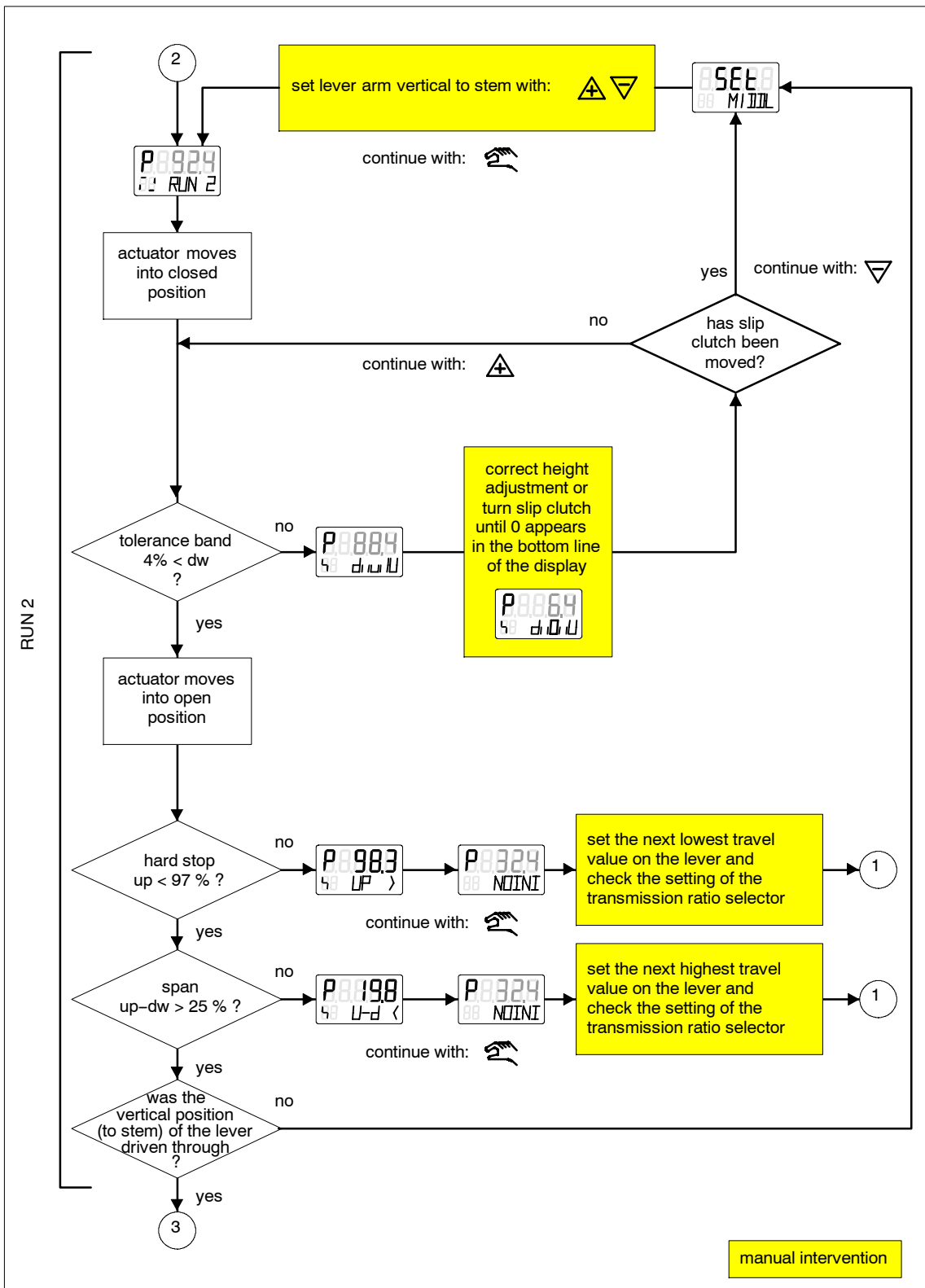


Figure 3-29 Automatic initialization part 2 (for rotary actuators)

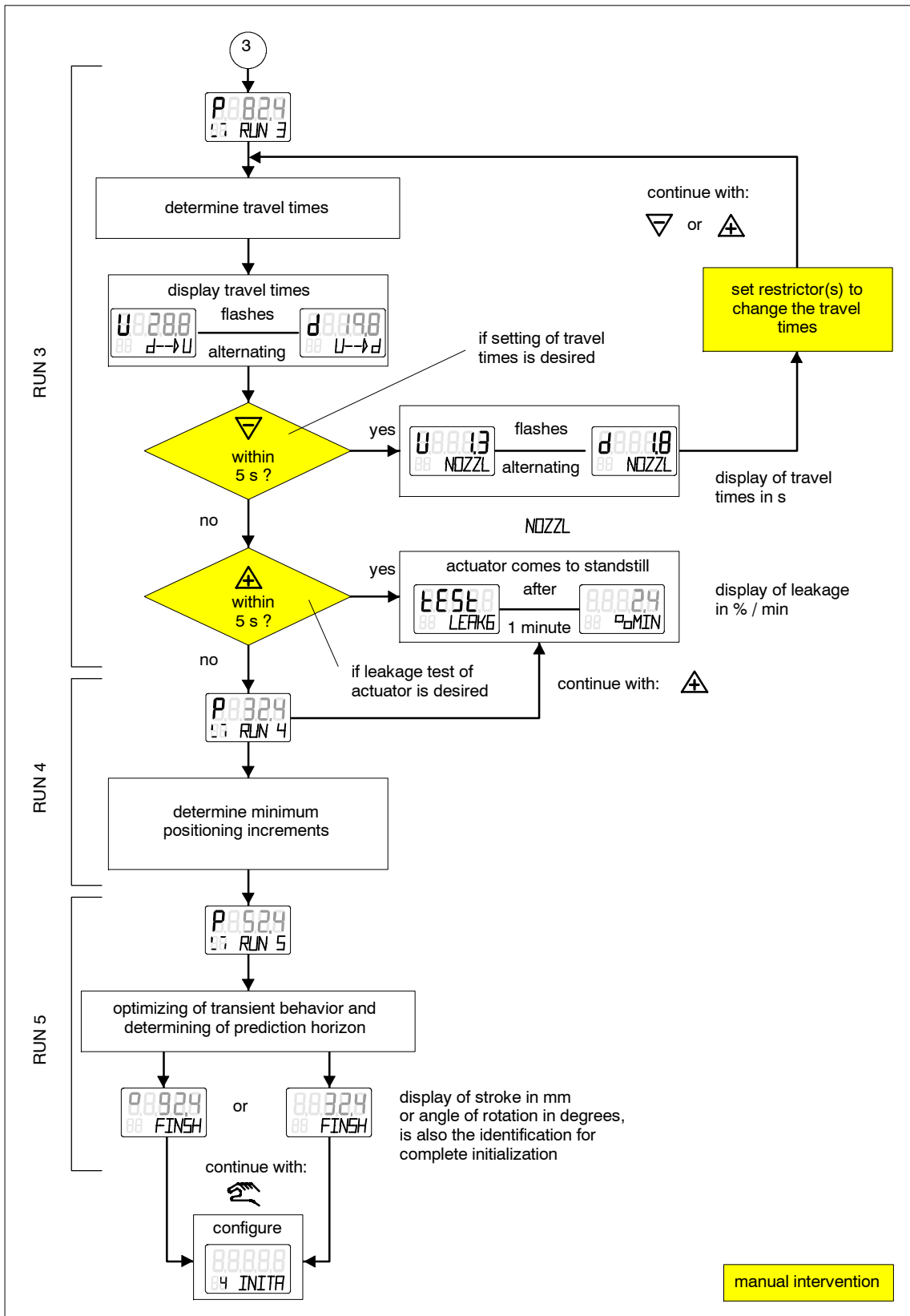


Figure 3-30 Automatic initialization, part 3

3.7 Copying initialization data (positioner exchange)

With this function you have the possibility of starting up a positioner without running the initialization routine. This allows for example a positioner to be changed on a running system in which automatic or manual initialization cannot be performed without disturbing the process.

NOTICE

Initialization (automatic or manual) should be performed as soon as possible afterwards because only then can the positioner be optimally adapted to the mechanical and dynamic properties of the actuator.

The following procedure describes how to replace a positioner when using the National Configurator. If you use a different tool step 5 may vary slightly.

1. Prerequisite is that the positioner to be replaced and all its parameters is in the project database. The replacement instrument should be online on the bus.
2. Fix the actuator in its momentary position (by mechanical or pneumatic means).
3. Read and note the current position value of the positioner to be replaced. If the electronics are defective, determine the current position by measuring on the actuator or valve.
4. Disassemble the positioner. Mount the lever arm of the positioner on the replacement instrument. Mount the replacement instrument on the valve. Move the gear switch to the same position as the defective instrument.
5. Now transfer all parameters from the projected positioner to the new positioner. With the NI Configurator this can be done by right clicking the appropriate blocks in the function block application window, choosing "Replace With ..." and selecting the new blocks. Do this also with the Transducer Block. In order to transfer the parameter INIT_VALUES (Initialisation parameters), you have to set SERVICE_UPDATE (Save/Reset) to 9 (Enable Write INIT-Values), then click "Write changes" and set SERVICE_UPDATE to 3 (Set device to state INIT). Now the positioner is initialized with the same parameters as the old one.
6. If the current position value on the display does not match the noted value of the defective positioner, set the correct value with the slip clutch.
7. The positioner is now ready to operate. The accuracy and dynamic behavior may be restricted in relation to correct initialization. The position of the hard stops and the related maintenance data may show deviations in particular. Therefore initialization must be performed at the earliest opportunity.

The following chapter describes the local operation of the positioner. The local operation allows the configuration of many parameters, the initialization of the positioner, and the manual control of the actuator and the display of many diagnostic values.

All these actions can also be performed via bus communication. But with the local operation feature you can carry out some fundamental tasks without the need of a bus interface or a configuration tool.

4.1 Display

The LC display has two lines whereby the lines have different segmentation. The elements of the top line consist of 7, those of the bottom line of 14 segments. The contents of the display depend on the selected operating mode (see chapter 4.3, page 84)



NOTE

If the positioner is operated in ranges with temperatures below $-10\text{ }^{\circ}\text{C}$ the liquid crystal display becomes sluggish and the display refresh rate is reduced considerably.

Figure 4-1 shows you the various display options.

The meaning of further display capabilities is detailed in chapter 4.6 page 108.

4.2 Input keys

The positioner is operated by three keys (figure 4-2, page 83) the function of which depends on the selected operating mode. In the explosion-proof version of the positioner the input keys are underneath a key cover which can be lifted up after loosening the cover screw.



NOTE

The input keys of the explosion-proof version must be covered to prevent liquid getting in. The IP66/NEMA4x degree of protection is not guaranteed when the housing is open or the key cover is open.

The housing cover must be removed to operate the keys in the normal and intrinsically safe versions of the positioners.

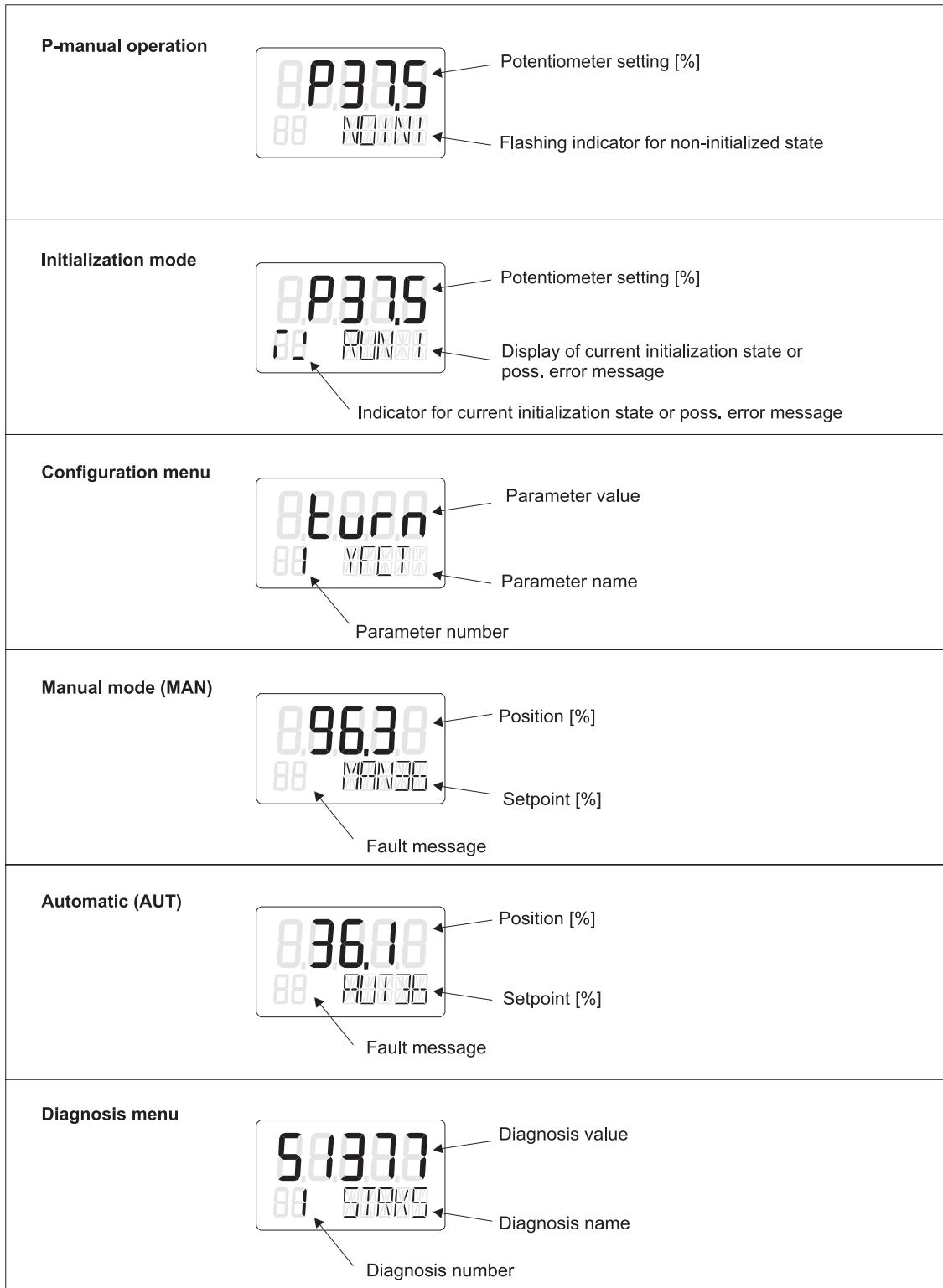
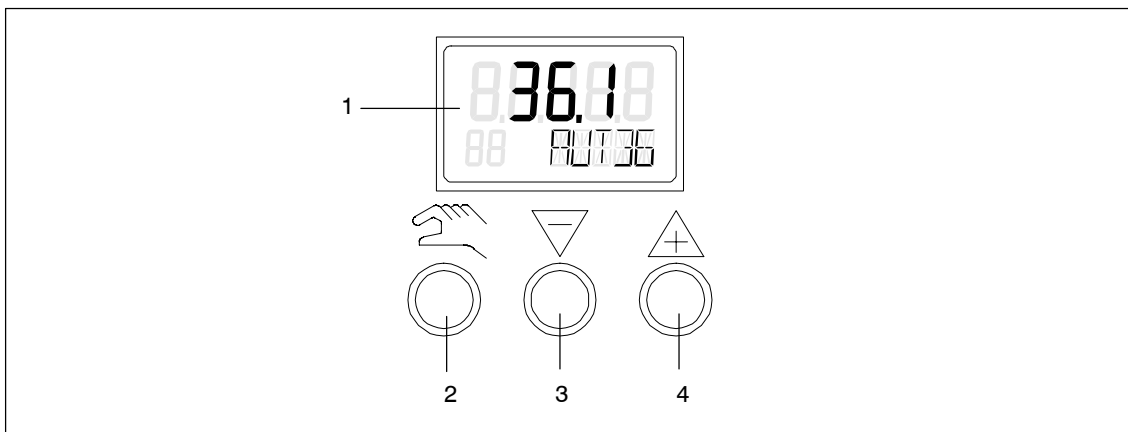


Figure 4-1 Meaning of the various display options



- 1 Display
- 2 Operation mode key
- 3 Decrement key
- 4 Increment key

Figure 4-2 Display and input keys of the positioner



Explanations of the input keys

- The operation mode key (manual key) serves to switch over the operating mode and pass on parameters.



NOTE

By pressing and holding the operation mode key and additionally pressing the decrement key, you can select the parameters in reverse order.

- The decrement key  serves to select parameter values in configuration and to move the actuator in manual operation.
- The increment key  serves to select parameter values in configuration and to move the actuator in manual operation.

Firmware version

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

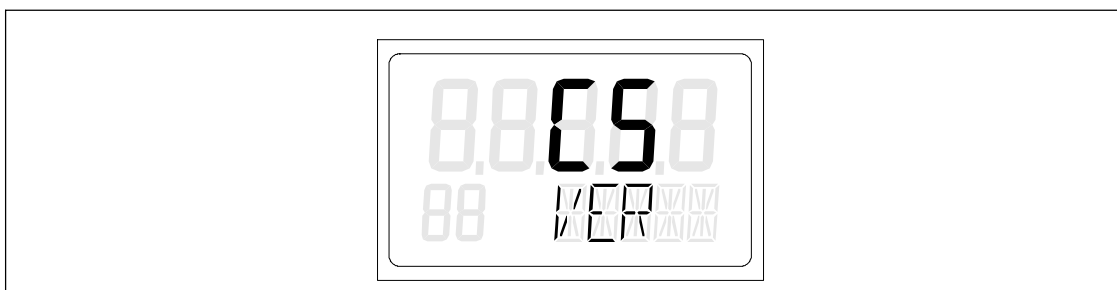


Figure 4-3 Firmware version, example: C5

4.3 Local operating modes

The positioner can be operated in five local operating modes.

1. P-manual mode (ex-factory state)
2. Configuration and initialization
3. Manual mode (MAN)
4. Automatic mode
5. Diagnostic display

Figure 4-4 gives you an overview of the possible local operating and the change between them.

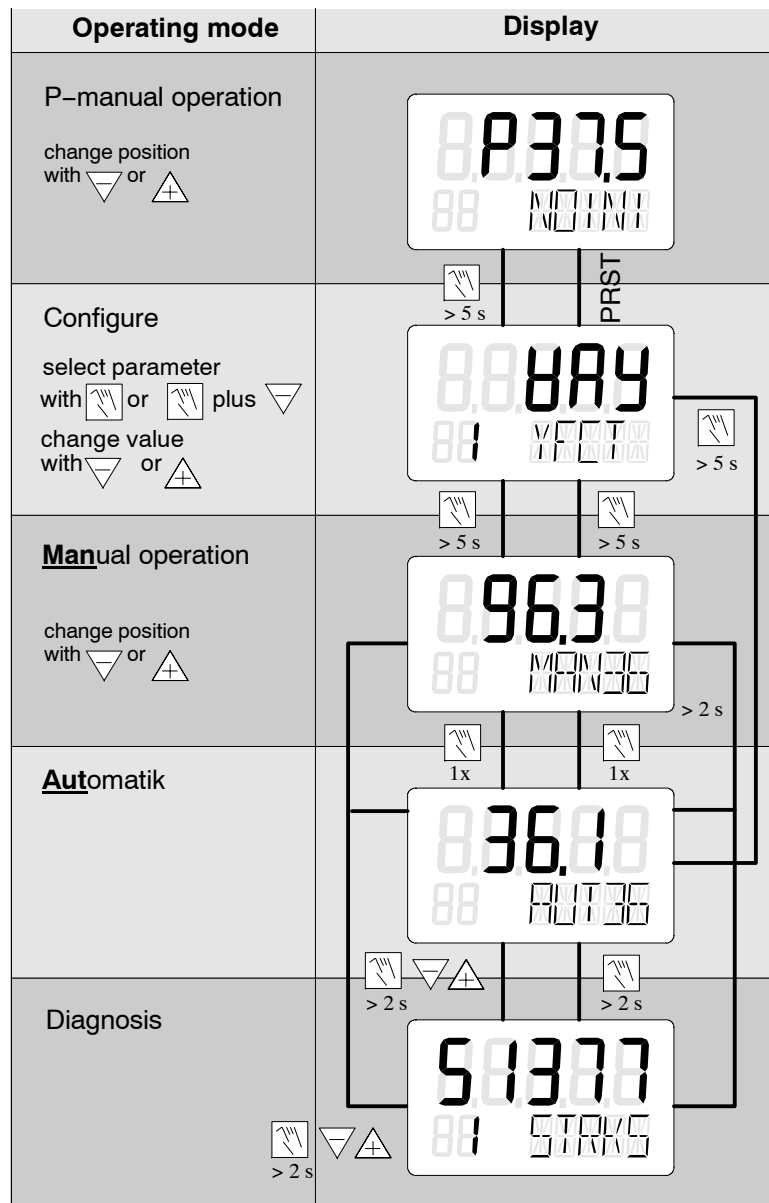


Figure 4-4 Change between the operating modes

**P-manual mode
(ex-factory state)**

The display of the positioner shows you the current potentiometer setting in the top line and "NOINI" flashes in the second line. You can move the actuator with the decrement and increment key Δ . In order to adapt the positioner to your actuator, you have to change to the Configuration menu. See also chapter 3.6, page 64 "Commissioning".

Manual and automatic mode or output of alarms and position feedback are possible after successful initialization.

**Configuration and
initialization**

To go to the Configuration menu, press the operation mode key \square for at least 5 seconds. In the Configuration menu you can adapt the positioner individually to your actuator and start initialization. Only a few parameters need to be set in the positioner prior to initialization. The others are defaulted so that they do not normally need to be adjusted. Which parameters you need to set and all other parameters are explained in chapter 4.4, page 87 Parameters.

The configuration mode can be reported by outputting a parameterizable fault message, a position feedback or output of limit values A1 and A2 is not possible in configuration mode.

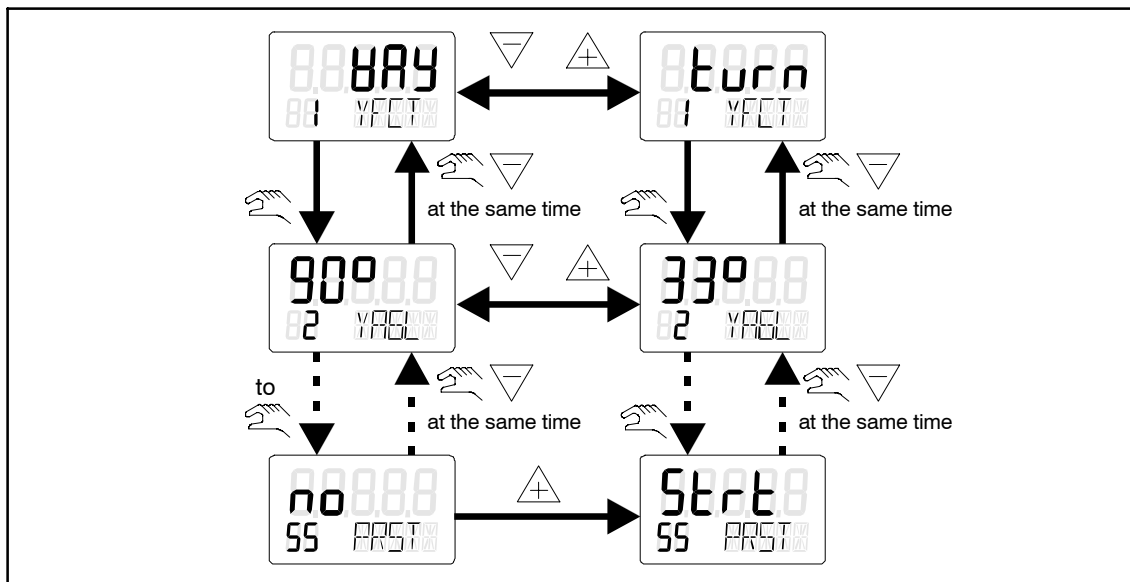


Figure 4-5 Overview: Configuration

**Manual mode
(MAN)**

In this operating mode you can move the actuator with the decrement (∇) and increment keys (Δ) and the current position is held regardless of the setpoint current and any leakages.



NOTE

You can move the actuator quickly by pressing the other direction key additionally whilst keeping the direction key selected first pressed.

The manual mode can be reported by outputting a parameterizable fault message, a position feedback or output of limit values A1 and A2 is only possible in automatic mode.



NOTE

The positioner switches over to automatic mode automatically after an electrical power failure.

Automatic mode

In automatic mode the positioner behaves according to the actual modes of the transducer block and the analog output function block as described in chapter 5.

In automatic mode the bottom line of the display shows the actual mode of the analog output function block:

Display	Mode	Meaning
OS	OOS	Out Of Service
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

The right two or three digits of the bottom line show the actual setpoint of the transducer block in percent. The left two digits show if applicable error codes as described in chapter 4.5.3 Online Diagnosis.



NOTE

Please don't mix up the local operating modes "MAN" and automatic with the function block modes MAN (display "MM") and AUTO (display "AUT").

Diagnostic display

In this operating mode you can have the current operating data (such as number of strokes, number of changes in direction, number of faults messages, etc.) displayed (see table 4-1).

From the automatic or manual mode you go to the diagnostic display by simultaneously pressing all three keys for at least two seconds.

See chapter 4.5, page 100 for further information.



NOTE

The respective operating mode (manual or automatic) of the positioner is retained when you switch to the diagnostic display, i.e. in automatic operation the specified setpoint is still used for controlling and in manual operation the position last reached is retained.

4.4 Parameters

All the parameters which are locally accessible are listed in this chapter. Figure 4-6 shows an overview of the parameters.

The parameter name is shown once in plain text and once as it appears in the display. The function of the parameter is described briefly in the "Function" column. In addition, the possible parameter values and the physical unit are shown.

Each parameter described in this chapter also accessible via fieldbus communication. The respective fieldbus name of the parameter is shown in square brackets. Almost all these parameters belong to the transducer function block (few exceptions belonging to the resource block are marked RB.parametername).

Parameter name	Display	Function	Parameter values	Unit	Factory setting	Customer setting
1. YFCT [VALVE_TYPE]	81 YFCT	Type of actuator	turn (part-turn actuator) WAY (linear actuator) LWAY (linear actuator without sine correction) ncSt (part-turn actuator with NCS) -ncSt (ditto, inv. direction of action) ncSL (linear actuator with NCS) ncSLL (lin. act. with NCS and lever)		WAY	
2. YAGL [TRANSM_ANGLE]	82 YAGL	Rated angle of rotation of feedback Set transmission ratio selector (7) appropriately (see view of device)	90° 33°	Degrees	33°	
3. YWAY [TRANSM_LENGTH]	83 YWAY	Stroke range (optional setting) When used, the value must correspond with the set of the leverage ratio on the actuator Driver pin must be set to the value of the actuator travel or, if this value is not scaled, to the next larger scale value.	OFF 5 10 15 20 (short lever 33°) 25 30 35 (short lever 90°) 40 50 60 70 90 110 130 (long lever 90°)	mm	OFF	
4. INITA [SELF_CALIBCOMMAND]	84 INITA	Initialization (automatically)	no ###.# Strt FINSH		no	
5. INITM	85 INITM	Initialization (manually)	no ###.# Strt FINSH		no	
6. TSUP [TRAVEL_RATE_UP]	86 TSUP	Setpoint ramp up	Auto 0 up to 400	s	0	
7. TSDO [TRAVEL_RATE_DOWN]	87 TSDO	Setpoint ramp down	0 up to 400	s	0	
8. SFCT [CHARACT_TYPE]	88 SFCT	Setpoint function Linear Equal-percentage 1:25, 1:33, 1:50 Inverse equal-percentage 1:25, 1:33, 1:50 Freely adjustable	Lin 1 - 25 1 - 33 1 - 50 n1 - 25 n1 - 33 n1 - 50 FrEE		Lin	
9. SL0 up to 29. SL20 [TAB_VALUES]	89 SL0 29 SL20	Setpoint turning point at 0% 5%, 10%, 15% and so on up to 100%	0.0 up to 100.0		0.0 5.0 up to 100.0	
30. DEBA [DEADBAND]	30 DEBA	Dead zone of controller	Auto 0.1 up to 10.0	%	Auto	
31. YA [TRAVEL_LIMIT_DOWN]	31 YA	Start of manipulated variable limiting	0.0 up to 100.0	%	0.0	
32. YE [TRAVEL_LIMIT_UP]	32 YE	End of manipulated variable limiting	0.0 up to 100.0	%	100.0	
33. YNRM [Y_NORM]	33 YNRM	Standardization of manipulated variable To mech. travel To flow	MPOS FLOW	%	MPOS	
34. YCDO [FINAL_VALUE_CUTOFF_LO]	34 YCDO	Value for tight closing, bottom	OFF 0.0 up to 100.0		OFF	
35. YCUP [FINAL_VALUE_CUTOFF_HI]	35 YCUP	Value for tight closing, up	OFF 0.0 up to 100.0		OFF	
36. BIN [BIN_IN_FUNCT]	36 BIN	Function of BI None Only message Block configuring Block configuring and manual Drive valve to position up Drive valve to position down Block movement	OFF NO contact on bLoc1 bLoc2 -up doWn StoP NC contact -on -up -doWn -StoP		OFF	
37. AFCT [ALARM_FUNCT]	37 AFCT	Alarm function Without A1=min. A2=max A1=min. A2=min A1=max. A2=max	OFF normal n n n n n n n n inverted n n n n n n n n		OFF	
38. A1 [ALARM1]	38 A1	Response threshold of alarm 1	0.0 up to 100.0	%	10.0	
39. A2 [ALARM2]	39 A2	Response threshold of alarm 2	0.0 up to 100.0	%	90.0	
40. 4 FCT [FAULT_FUNCT]	40 4FCT	Function of alarm output on fault Fault + not automatic Fault + not automatic + BI ("+" means logical OR operation)	normal 4 4nA 4nAb inverted -4 -4nA -4nAb		4	
41. 4 TIM [DELAY_TIME]	41 4TIM	Monitoring time for fault message "control deviation"	Auto 0 up to 100	s	Auto	
42. 4 LIM [TOLERANCE_BAND]	42 4LIM	Response threshold for fault message "control deviation"	Auto 0.0 up to 100.0	%	Auto	
43. 4 STRK [TOTAL_VALVE_TRAVEL_LIMIT]	43 4STRK	Limit for stroke integral	1 up to 1.00E9		1.00E9	
44. 4 DCHG [LIMIT_DIRECTION_CHANGE]	44 4DCHG	Limit for direction change	OFF 1 up to 1.00E9		OFF	
45. 4 ZERO [LIMIT_ZERO_POINT]	45 4ZERO	Limit for end stop monitoring, bottom	OFF 0.0 up to 100.0	%	OFF	
46. 4 OPEN [LIMIT_OPEN_VALUE]	46 4OPEN	Limit for end stop monitoring, top	OFF 0.0 up to 100.0	%	OFF	
47. 4 DEBA [LIMIT_DEADBAND]	47 4DEBA	Limit for dead zone monitoring	OFF 0.0 up to 10.0	%	OFF	
48. PRST	48 PRST	Preset (factory setting) "no" nothing activated "Strt" start of factory setting after pressing key for 5 s "oCAY" display following successful factory setting	no Strt oCAY		no	

1) Parameter appears only if "turn" or "WAY" is selected; at "turn", you cannot select 33°
2) Parameter does not appear if "turn", "LWAY" or "ncS_" has been selected with YFCT
3) Turning points only appear with selection SFCT = "FrEE"

4) NC contact means: action with opened switch or Low level
NO contact means: action with closed switch or High level
5) Normal means: High level without fault Inverted means: Low level without fault

Figure 4-6 Parameter table of the positioner

**NOTE**

In particular if the positioner has previously been operated using a different actuator, it must always be reinitialized in order to restore the factory settings. The parameter "51 PRST" is provided for this purpose.

1.YFCT
[VALVE_TYPE]

Type of actuator

This is to match the positioner with the respective actuator and where necessary to the position sensor being used. The following adjustment capabilities are provided:

- YFCT = turn

This adjustment is necessary for the rotary actuator.

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

- YFCT = WAY (Factory setting)

This is necessary for a linear actuator. This allows the positioner to compensate for the non-linearity that arises due to the conversion of the linear movement of the linear actuator into the rotary movement of the feedback shaft. For this the positioner is factory set so that it shows between "P 49.0 and P 51.0" when the arm on the feedback shaft is vertical to the linear actuator spindle.

- YFCT = LWAY

This must be adjusted, if an external linear potentiometer is to be connected to a linear actuator.

TIP: use this adjustment also for rotary actuators with reverse direction of control action.

- YFCT = ncSt

Use this when an NCS is fitted to a rotary actuator.

- YFCT = -ncSt

This must be set when an NCS is used with a rotary actuator with reverse direction of control action.

- YFCT = ncSL

This must be adjusted if an NCS is to be connected to a linear actuator with the position measured directly (linear) from the NCS.

- YFCT = ncSLL

This must be adjusted if an NCS is to be connected to a linear actuator with the position converted by an arm into a rotary movement.



NOTE

After "LWAY, ncSt, -ncSt or ncSL" have been adjusted, the parameter "3. YWAY" will not be displayed.

**2.YAGL
[TRANSM_ANGLE]**

Rated angle of rotation of the feedback shaft

In rotary actuators, an angle of 90° is preset automatically by 1.YFCT = turn (see above). In linear actuators (1.YFCT = WAY) a value of 33° or 90° can be selected depending on the stroke range:

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

When using the lever up to 35 mm, both angles of rotation (33° and 90°) are possible.

The long lever (> 35 mm stroke) is only designed for an angle of rotation setting of 90°. It is not part of the mounting kit set 6DR4004-8V but must be ordered separately under order number 6DR4004-8L.



NOTE

The setting of the transmission ratio selector on the positioner (see figure 2-2, page 19 and figure 2-3, page 20) **must** correspond to the angle value selected under "2.YAGL".

**3.YWAY
[TRANSM_
LENGTH]**

Lever arm transmission



NOTE

The use of this parameter is optional. You only need to set this parameter if you want to have the way in mm displayed at the end of the initialization.

Selection of the lever arm range: serves to display the real stroke after initialization.

This parameter is only relevant for linear actuator. If the parameter value "oFF" is selected here, the real stroke is not displayed after initialization.



NOTE

The specification "YWAY" must match the mechanical lever arm transmission. The carrier must be set to the value of the actuator stroke, if this is not scaled to the next highest scaled value.

4.INITA
[SELF_CALIB_
COMMAND]

Automatic initialization (see chapter 3.6, page 64)

By selecting "Strt" and pressing the increment key \triangle for at least 5 seconds, automatic initialization is started. The initialization process is displayed by "RUN 1" to "RUN 5" (see figure 3-27, page 76 to figure 3-30, page 79).

5.INITM
[no correspon-
dence]

Manual initialization

By selecting "Strt" and pressing the increment key \triangle for at least 5 seconds, manual initialization is started. The manual initialization process is described in chapter 3.6.3, page 68 and chapter 3.6.6, page 74.



NOTE

If the positioner has already been initialized, for INITA and INITM it is possible to transfer it to its non-initialized state without changing the remaining parameters by pressing the decrement key ∇ for five seconds.

6.TSUP
[TRAVEL_
RATE_UP]

Setpoint ramp UP

and

7.TSDO
[TRAVEL_
RATE_DOWN]

Setpoint ramp DOWN

The setpoint ramp is effective in automatic operation and limits the speed of alteration of the active setpoint. When switching over from manual operation to automatic the active setpoint is adjusted to the setpoint on the positioner with the setpoint ramp.

This bumpless manual/automatic switchover avoids excessive pressure increases on long pipelines.

In the position TSUP = Auto the slower of the two travel times determined during initialization is used for the setpoint ramp. TSDO is then ineffective.

8.SFCT
[CHARACT_TYPE]

Setpoint function (see figure 4-7, page 92)

Non-linear valve characteristics can be linearized with this function and any flow characteristics simulated in linear valve characteristics.

Six valve characteristics are stored in the positioner

- linear (8.SFCT = Lin, factory setting)
- equal percentage 1 : 25 (8.SFCT = 1 : 25)
- equal percentage 1 : 33 (8.SFCT = 1 : 33)
- equal percentage 1 : 50 (8.SFCT = 1 : 50)
- inverse equal percentage 25 : 1 (8.SFCT = n1 : 25)
- inverse equal percentage 33 : 1 (8.SFCT = n1 : 33)
- inverse equal percentage 50 : 1 (8.SFCT = n1 - : 50)
- freely adjustable (8.SFCT = FrEE)

9.SLO to 29.SL20
[TAB_VALUES]

Setpoint turning point/characterization

A flow parameter can be assigned to the respective setpoint turning point at an interval of 5%. These points lead to a polygon chain with 20 straight lines which therefore represents a projection of the valve characteristic.

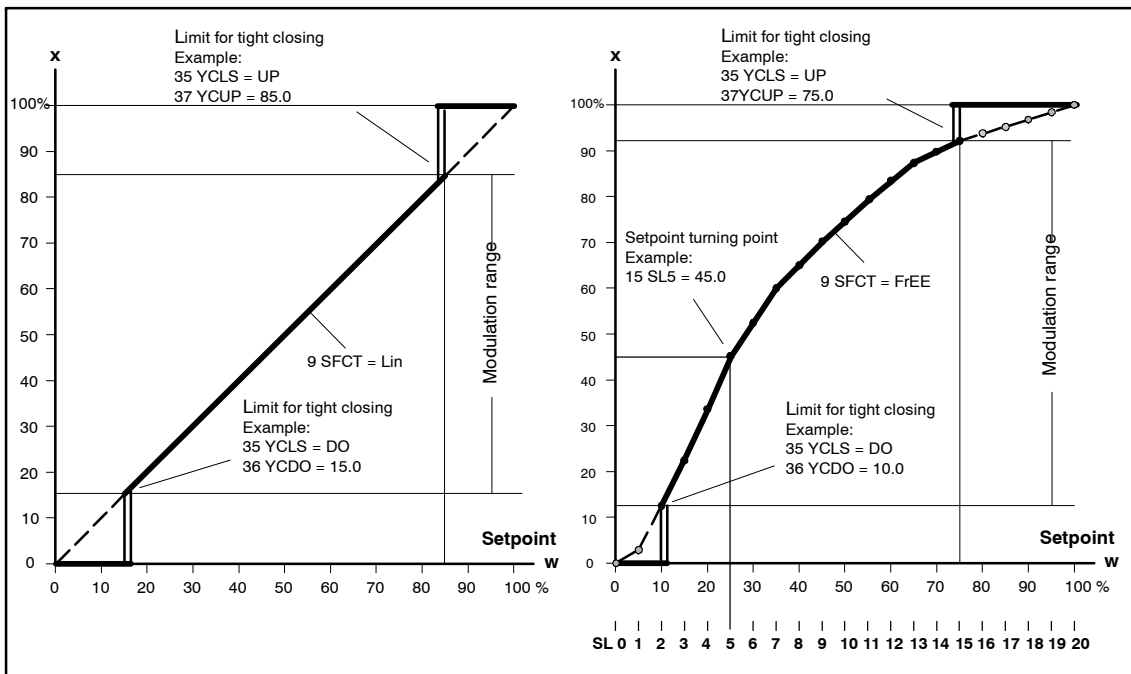


Figure 4-7 Setpoint characteristic, manipulated variable standardization and tight closing function

The setpoint turning point can only be input if 8.SFCT is set to “FREE”. You may only enter a strictly monotonous characteristic, and two consecutive vertex values must differ by at least 0.2 %.

30.DEBA
[DEADBAND]

Deadband of the controller

At dEbA = AUto the deadband in automatic operation is adapted continuously to the requirements of the control circuit. The deadband is gradually increased on detecting a control oscillation. The reverse adaptation takes place by a time criterion.

In the other discrete settings the fixed value is used for the deadband.

31.YA
[TRAVEL_
LIMIT_DOWN]

Manipulated variable limiting start (see figure 4-7, pg. 92 and 4-8, pg. 94)

and

32.YE
[TRAVEL_
LIMIT_UP]

Manipulated variable limiting end (see figure 4-7, pg. 92 and 4-8, pg. 94)

With the parameters “YA” and “YE” the mechanical actuating distance (from stop to stop) is limited to the set values. In this way the mechanical setting range of the actuator can be limited to the active flow and the integral saturation of the commanding controller avoided.



NOTE

YE must always be set to greater than YA.

33.YNRM
[Y_NORM]

Manipulated variable feedback standardization (see figure 4-7, pg. 92 and 4-8, pg. 94)

With limiting of the manipulated variable (by “31.YA” and “32.YE”) two different scalings are produced for the display and the position feedback via the current output (MPOS or FLOW).

The MPOS scaling shows the mechanical position (0 to 100%) between the hard stops of the initialization. This is not affected by the parameters “31.YA” and “32.YE”. The parameters “31.YA” and “32.YE” are displayed in the MPOS-scale.

The FLOW-scale is the standardization (0 to 100%) to the range between “31.YA” and “32.YE”. The setpoint w (0 to 100%) is always referred to this range. This gives (also by using valve characteristics) a quasi-flow-proportional display and position feedback Iy.

The setpoint is also shown in the appropriate scale on the display.

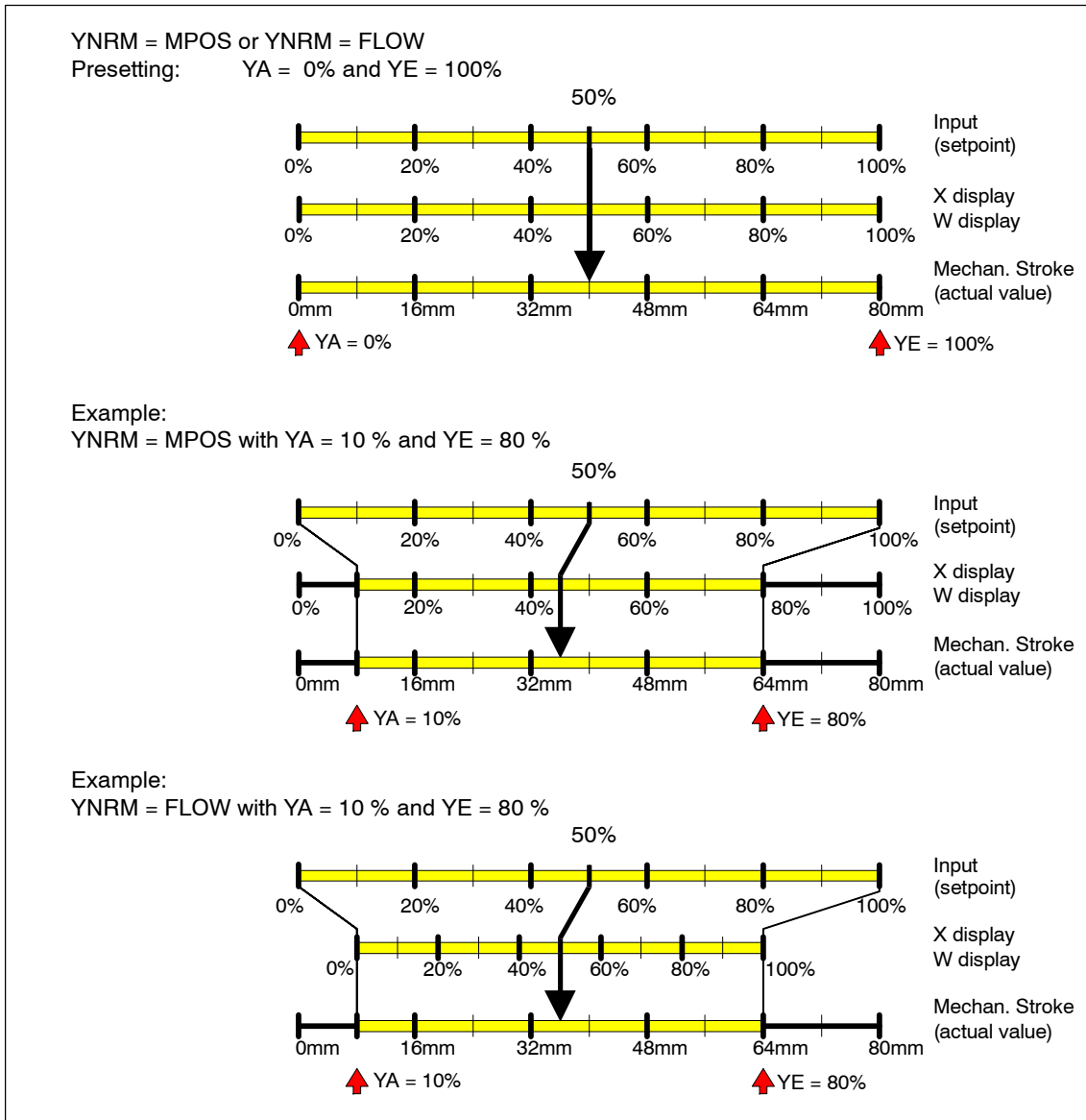


Figure 4-8 Dependence of the stroke on standardization and on YA and YE in the example of an 80 mm linear actuator

34.YCDO
[FINAL_VALUE_
CUTOFF_LO]

Value for tight closing, bottom

35.YCUP
[FINAL_VALUE_
CUTOFF_HI]

Value for tight closing, up

With this function the valve can be driven to the seat with the maximum actuating force of the actuator (continuous contact of the piezo-valves). The tight closing function can be activated on one side or for both limit positions. It becomes active when the setpoint is below YCDO or above YCUP (figure 4-7, page 92). "off" disables this function.

**NOTE**

YCDO must always be set to less than YCUP.

The tight closing function has a fixed hysteresis of 1 %.

36.BIN
[BIN_IN_FUNCT]

Function of the binary input (on optional alarm module)

This parameter can be set individually depending on the purpose. The direction of action can be adapted to an NCC or an NOC.

- BIN = on or –on

Digital messages of the periphery (e.g. pressure or temperature switches) can be read out via the communication interface or lead to responding of the fault message output by OR linking with other messages.

- BIN = bLoc1

The Configuration operating mode is locked to prevent it being adjusted (e.g. by a wire jumper between terminals 21 and 22).

- BIN = bLoc2

If the binary input has been activated, manual operation is also locked in addition to the Configuration operating mode.

- BIN = uP or doWn (contact closes) or –uP or –doWn (contact opens).

When the binary input is activated, the actuator drive controls the actuator in automatic mode through the values held in YA and YE.

- BIN (contact closes) = StoP or –StoP (contact opens).

With activated binary input the piezo-valves are blocked in automatic mode and the actuator remains in the last position. Leakage messages can then be executed without initialization function.

- BIN = oFF (factory setting)

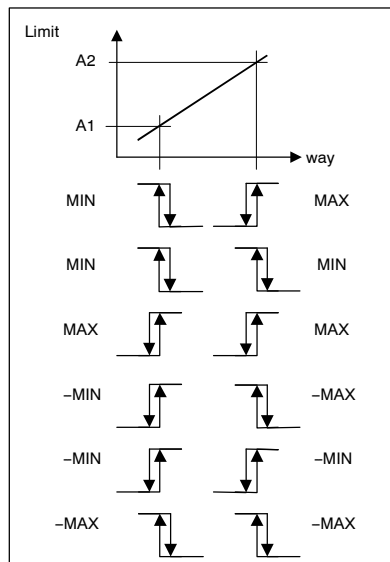
no function

37.AFCT
[ALARM_FUNC1]

Alarm function

There are 6 setting capabilities available:

1. Min Max
2. Min Min
3. Max Max
4. -Min -Max (inverted reporting)
5. -Min -Min (inverted reporting)
6. -Max -Max (inverted reporting)



Please note:

- the direction of control action shown on the alarm module is reversed.
- the direction of control action is also reversed if A1 is set to greater than A2.
- the hysteresis of the limit value is 1% as standard.
- in the factory setting "OFF" the output of both alarms A1 and A2 is deactivated.

38.A1
[ALARM1]
39.A2
[ALARM2]

Response threshold alarm 1
 and
 Response threshold alarm 2

The alarm thresholds are related to the mechanical path (MPOS-scale).

40. \downarrow FCT [FAULT_FUNC]

Function of the fault message output

If fault messages are used as a monitor for control non-conformities over a period of time, they will be triggered in addition by the following events also:

- Power failure
- Processor fault
- Actuator fault
- Valve fault
- Compressed air failure
- Responses of the limit values 43 to 57

Note that the fault message cannot be switched off, however it can be suppressed (factory setting), if the actuator is set to "non-automatic mode". If it is wished to generate fault messages here also, the parameter FCT must be set to " \downarrow nA".

In addition there is also the facility to "alternate" the fault message using the status of the binary inputs. For this, set the parameter FCT to " \downarrow nAb".

Select the setting " \downarrow " if the fault message is to be sent inverted on the alarm module or SIA module.

41. \downarrow TIM [DELAY_TIME]

Monitoring time for setting the fault messages

The set value(s) serves as a specification for the time within which the positioner must have reached the controlled state. The corresponding response threshold is specified with "42. \downarrow LIM".

The fault message output is set on exceeding the set time.



NOTE

If the control function to close tightly is activated, for parameter "42. \downarrow LIM" the monitoring of the control deviation in each overrun direction (YCDO: < 0 %, YCUP: > 100 %) is disabled. This function is particularly useful for valves with a soft seating. For long term monitoring of the end-stop positions, we recommend activating the parameters "45. \downarrow ZERO" and "46. \downarrow OPEN".

For more information on fault messages, see chapter 4.5.3 Online-Diagnosis, page 105.

42. \downarrow LIM [TOLERANCE_BAND]

Response threshold of the fault message

Here a value (%) can be set for the permissible variable of control error for releasing the fault message.

If the parameters "41. \downarrow TIM" and "42. \downarrow LIM" are both set to "Auto" (factory setting), the fault message is set if the slow step zone is not reached within a certain time. This time is 2 times the initialization travel time within 5 to 95% of the actuating path and 10 times this time outside 10 to 90% of the actuating path.

43. \downarrow STRK [TOTAL_VALVE_ TRAVEL_LIM] SIPART PS2 FF Manual A5E00214569-02

Limit value for monitoring the travel integral (number of strokes)

A limit value for the way integral can be set here. If the way integral exceeds the limit value, the fault message output (optional) is activated.

This function enables a preventive maintenance of the fitting, see also chapter 4.5 “Diagnostics”, page 100.

This monitoring function can not be deactivated.

**44. 4DCHG
[LIMIT_DIREC-
TION_CHANGE]**

Limit value for monitoring the change of direction

A limit value for the direction changes counter can be set here. If this counter exceeds the limit value, the fault message output is activated.

This function enables a preventive maintenance of the fitting, see also chapter 4.5 “Diagnostics”, page 100.

This monitoring function can be deactivated with the OFF setting (factory setting).

**45. 4ZERO
[LIMIT_ZERO_
POINT]**

Tolerance value for monitoring the bottom hard stop

With this value a limit value (in percent related to the total mechanical distance) can be preset for the monitoring of the bottom hard stop. If this tolerance value is exceeded or dropped below of, the fault message output (optional) is activated.

This function detects when the bottom stop has changed by more than the specified tolerance related to its initialization value. Monitoring takes place when the valve is in tight closing bottom. Activation of the tight closing bottom function (parameter “35.YCLS”) is therefore a prerequisite.

The fault message remains activated until either a subsequent monitoring remains within the tolerance or a new initialization is performed.

This monitoring function can be deactivated with the OFF setting (factory setting). See also chapter 4.5 “Diagnostics”, page 100.

**46. 4OPEN
[LIMIT_OPEN_
VALUE]**

Tolerance value for monitoring the top hard stop

With this value a limit value (in percent related to the total mechanical distance) can be preset for the monitoring of the top hard stop. If this tolerance value is exceeded or dropped below of, the fault message output (optional) is activated.

This function detects when the top stop has changed by more than the specified tolerance related to its initialization value. Monitoring takes place when the valve is in tight closing top. Activation of the tight closing top function is therefore a prerequisite.

The fault message remains activated until either a subsequent monitoring remains within the tolerance or a new initialization is performed.

This monitoring function can be deactivated with the OFF setting (factory setting).

**NOTE**

But the monitors of the bottom and top hard stop do not only react to valve errors. An erroneous displacement of the position feedback is also detected as an error if the tolerance values are exceeded as a result.

**47. 4 DEBA
[LIMIT_DEAD-
BAND]**

Limit value for monitoring the dead zone adaptation

The automatic adaptation of the dead zone can be monitored with this value (%). If the dead zone exceeds the set value, the fault message output is activated.

Prerequisite for this function is the setting of the parameter "30.DEBA" = Auto. This monitoring function can be deactivated with the OFF setting (factory setting).

**48.PRST
[no correspon-
dence]**

Preset

By pressing the increment key for at least 5 seconds all parameters accessible by local operation are reset to their default value. The initialization is also reset so that the positioner is in P-manual mode (ex-factory state). The positioner has to be initialized again before it can resume normal operation. You should use PRST if the positioner previously has been operated at a different actuator.

**NOTE**



This function is not identical with the fieldbus parameter RESTART with defaults. The latter clears all parameters of all blocks, PRST only the locally visible transducer block parameters.


4.5 Diagnosis

4.5.1 Diagnostic display

You go to the diagnostic display from automatic or manual operation by simultaneously pressing all three keys for at least two seconds.

The diagnostic display has a similar structure to in the "Configuration" operating mode. The top line shows the value of the diagnostic variable, the bottom line the number and abbreviation of the displayed variable.

The respective next diagnostic value can be selected with the operation mode key . By pressing and holding the operation mode key and additionally pressing the decrement key  you can select the diagnostic values in reverse order.

Certain values can be set to zero by pressing the increment key  for at least 5 seconds. This is noted in the last column in the table.

Some diagnostic values may be greater than 99999. In this case the display switches to exponential display. Example: the value 1234567 is displayed as 1.23E6.

No.	Abbreviation	Meaning	Displayable values	Unit	Rest poss.
0	The Device Tag as defined in Parameter RB.DESCRIPTOR is displayed in the bottom line				
1	STRKS	Number of Strokes	0 to 4.29E9	–	x
2	CHDIR	C hanges of D irection	0 to 4.29E9	–	x
3	HCNT	Fault C ounter	0 to 4.29E9	–	x
4	A1CNT	A larm 1 Counter	0 to 4.29E9	–	x
5	A2CNT	A larm 2 Counter	0 to 4.29E9	–	x
6	HOURS	Operating H ours	0 to 4.29E9	Hours	
7	WAY	Determined actuating path (W ay)	0 to 130	mm or °	
8	TUP	Travel T ime U p	0 to 1000	s	
9	TDOWN	Travel T ime D own	0 to 1000	s	
10	LEAK	L eakage	0.0 to 100.0	%/min	
11	P0	P otentiometer value below stop (0 %)	0.0 to 100.0	%	
12	P100	P otentiometer value bottom stop (100 %)	0.0 to 100.0	%	
13	IMPUP	I mpulse Length U p	2 to 100	ms	
14	IMPDN	I mpulse Length D own	2 to 100	ms	
15	DBUP	D ead B and U p	0.1 to 100.0	%	
16	DBDN	D ead B and D own	0.1 to 100.0	%	
17	SSUP	S low S tep Z one U p	0.1 to 100.0	%	
18	SSDN	S low S tep Z one D own	0.1 to 100.0	%	
19	TEMP	Current t emperature	–40 to 85	°C	
20	TMIN	M inimum temperature ("drag pointer")	–40 to 85	°C	
21	TMAX	M aximum temperature ("drag pointer")	–40 to 85	°C	
22	T1	Number of operating hours in T emperature range 1	0 to 4.29E9	Hours	
23	T2	Number of operating hours in T emperature range 2	0 to 4.29E9	Hours	
24	T3	Number of operating hours in T emperature range 3	0 to 4.29E9	Hours	
25	T4	Number of operating hours in T emperature range 4	0 to 4.29E9	Hours	
26	T5	Number of operating hours in T emperature range 5	0 to 4.29E9	Hours	
27	T6	Number of operating hours in T emperature range 6	0 to 4.29E9	Hours	
28	T7	Number of operating hours in T emperature range 7	0 to 4.29E9	Hours	
29	T8	Number of operating hours in T emperature range 8	0 to 4.29E9	Hours	
30	T9	Number of operating hours in T emperature range 9	0 to 4.29E9	Hours	

No.	Abbreviation	Meaning	Displayable values	Unit	Rest poss.
31	VENT1	Number of cycles pre-control valve 1	0 to 4.29E9	–	
32	VENT2	Number of cycles pre-control valve 2	0 to 4.29E9	–	
33	STORE	Store current values as "last maintenance" (press increment key for 5 s) (Store)	–	–	
34	PRUP	Prediction up	1 to 40	–	
35	PRDP	Prediction down	1 to 40	–	
36	WT00	Number of operating hours in distance class WT00	0 to 4.29E9	Hours	x
37	WT05	Number of operating hours in distance class WT05	0 to 4.29E9	Hours	x
38	WT10	Number of operating hours in distance class WT10	0 to 4.29E9	Hours	x
39	WT30	Number of operating hours in distance class WT30	0 to 4.29E9	Hours	x
40	WT50	Number of operating hours in distance class WT50	0 to 4.29E9	Hours	x
41	WT70	Number of operating hours in distance class WT70	0 to 4.29E9	Hours	x
42	WT90	Number of operating hours in distance class WT90	0 to 4.29E9	Hours	x
43	WT95	Number of operating hours in distance class WT95	0 to 4.29E9	Hours	x

Table 4-1 Overview diagnostic values

4.5.2 Meaning of the diagnostic values

The respective fieldbus names are shown in square brackets. All parameters belong to the transducer block except those starting with RB.xxx).

0 [RB.DESRIPTOR]

Device Tag

The contents of the resource block parameter DESCRIPTOR (a 32 byte visible string) is displayed in the bottom line. You can use it e.g. for displaying the device tag.

If the string is longer than five characters, it can be scrolled with the decrement key and the increment key.

1 STRKS [TOTAL_VALVE_TRAVEL]

Number of strokes (Total valve travel)

The actuator movements during operation are totalized and can be read here as number of strokes. Unit: 100% strokes, i.e. the distance between 0 to 100 % and backwards. The value is written every 15 minutes in a non-volatile memory. It can be reset to zero with the increment key \triangle .

2 CHDIR [NUMBER_DIRECTION_CHANGE]

Number of direction changes

Every change in direction is detected by the controller and added to the number of changes of direction.

The value is written every quarter of an hour in a non-volatile memory. It can be reset to zero with the increment key \triangle .

3 CNT [NUMBER_ALARMS]

Fault counter

Every fault is noted in the controller and added to the number of fault messages. The counter can be reset to zero with the increment key \triangle .

<p>4 A1CNT [NUMBER_ ALARMS_1]</p>	<p>Alarm counter 1 and</p>
<p>5 A2CNT [NUMBER_ ALARMS_2]</p>	<p>Alarm counter 2</p> <p>Responses of alarm 1 and alarm 2 are counted with these two counters. The prerequisite is the activation of the alarms with the parameter "37.AFCT". The counters can be reset to zero with the increment key \triangle.</p>
<p>6 HOURS [RB.HOURS]</p>	<p>Operating hours</p> <p>The operating hours counter is incremented every hour when the positioner is supplied with electrical power.</p>
<p>7 WAY [RATED_TRAVEL]</p>	<p>Determined actuating way</p> <p>This value indicates the actuating way determined during initialization according to the display at the end of an initialization. Prerequisite in linear actuator: Specification of the lever arm with the parameter "3.YWAY".</p>
<p>8 TUP [TRAVEL_ RATE_UP]</p>	<p>Travel time up and</p>
<p>9 TDOWN [TRAVEL_RATE_ DOWN]</p>	<p>travel time down</p> <p>These values show the travel times which have been determined during initialization. The unit is seconds.</p>
<p>10 LEAK [LEAKAGE]</p>	<p>Leakage</p> <p>The value of the leakage measurement in %/min. can be read off here. This measurement may take place during the initialisation phase or here in this diagnostic menu.</p>
<p>11 P0 [ZERO_POINT_P0]</p>	<p>Potentiometer value bottom stop and</p>
<p>12 P100 [END_VALUE_ P100]</p>	<p>Potentiometer value top stop</p> <p>These two values indicate the measured values of displacement measurement (potentiometer) at the bottom and top hard stops as determined in automatic initialization. In manual initialization the values of the manually reached limit positions are indicated here.</p>
<p>13 IMPUP [PULS_LENGTH_ UP]</p>	<p>Impulse length up and</p>
<p>14 IMPDN [PULS_LENGTH_ UP]</p>	<p>Impulse length down</p> <p>During initialization the smallest impulse lengths are determined with which a movement of the actuator can be achieved. They are determined and displayed here for the "Up"-direction and the "Down"-direction.</p>

These two parameter can be tuned for special applications (see chapter 4.7 page 112).

15 DBUP

Dead zone up
and

**16 DBDN
[DEADBAND]**

Dead zone down

Here the dead zone of the controller is displayed in "Up"-direction or in "Down"-direction. The values correspond either to the manually set value of the parameter "30.DEBA" or the value adapted automatically by the instrument when "DEBA" has been set to "Auto".

17 SSUP**[SERVO_GAIN_UP]**

Short step zone up
and

18 SSDN**[SERVO_GAIN_DOWN]**

Short step zone down

The short step zone is the range of the controller in which pulse-shaped control signals are output. The impulse length here is proportional to the control error. If the control error is outside the short step zone, the valves are controlled in continuous contact.

These two parameter can be tuned for special applications (see chapter 4.7 page 112).

**NOTE**

The corresponding fieldbus parameters are inverted ($SSUP = 1/SERVO_GAIN_UP$).

19 TEMP**[TEMPERATURE]**

Current temperature

Current temperature in the positioner housing. The sensor is on the electronics board.

The temperature display can be switched between °C and °F by pressing the decrement key.

20 TMIN**[MIN_TEMPERATURE]**

Minimum temperature (drag pointer)
and

21 TMAX**[MAX_TEMPERATURE]**

Maximum temperature (drag pointer)

The minimum and maximum temperature inside the housing is determined and stored continuously in a kind of drag pointer and can only be reset in the factory.

**22 T1 to
30 T9
[RB_TEMPERA-
TURE_HOURS]**

Number of operating hours in temperature range T1 to T9

Statistics how long operation takes place in which temperature ranges is kept in the instrument. To do this, the measured temperature over one hour respectively is averaged and incremented in the counter which is assigned to the corresponding temperature range every hour. This enables you to draw conclusions about the past operating conditions and thus the whole fitting.

The temperature ranges are divided up as follows:

	T1	T2	T3	T4	T5	T6	T7	T8	T9
Temperature range [°C]	≥ -30	≥ -30 < -15	≥ -15 < 0	≥ 0 < 15	≥ 15 < 30	≥ 30 < 45	≥ 45 < 60	≥ 60 < 75	≥ 75
[°F]	< -22	≥ -22 < 5	≥ 5 < 32	≥ 32 < 59	≥ 59 < 86	≥ 86 < 113	≥ 113 < 140	≥ 140 < 167	≥ 167

**31 VENT1
[NUMBER_CY-
CLES_VALVE_1]**

Number of cycles pre-control valve 1
and

**32 VENT2
[NUMBER_CY-
CLES_VALVE_2]**

Number of cycles pre-control valve 2

These two counters add up the control processes of the pre-control valves.

**33 STORE
[no correspon-
dence]**

Store maintenance data

A store function is triggered by pressing the increment key Δ for at least 5 seconds. Here the diagnostic data 7 to 17 are stored in a non-volatile memory as "Data of the last maintenance". These diagnostic data are selected values, the changes of which can provide information on the mechanical wear of the valve.

Normally this function is operated via bus communication, transducer block method "Maintenance Info Save/Reset" → "safe maintenance info". Data is stored in the object PREV_CALIB_VALUES.

**34 PRUP
35 PRDN
[INIT_VALUES_
INIT_PREDIC-
TION_UP and
INIT_PREDIC-
TION_DOWN]**

Prediction up

Prediction down

see chapter 4.7, page 112.



NOTE

All diagnostic values are updated every 15 minutes to a non-volatile memory, so that in the event of a loss of electrical power only the events of at most the last 15 minutes will be lost.

4.5.3 Online-Diagnosis

Some important variables and parameters are monitored continuously during operation. In the "Configuration" operating mode you can configure this monitoring so that the fault message output is activated when a certain event such as exceeding a limit value occurs.

The following table shows which events can activate the fault message output, how the parameters must be set for this event to be monitored, when the fault message disappears again and where the possible causes of the fault lie.

In automatic and manual operation response of the fault message output on the display shows which is the fault message trigger. The two digits at the bottom left indicate the corresponding error code. If several triggers occur at the same time, these are displayed cyclically.

Error code	Event	Parameter setting	Fault message disappears when ...	Possible causes
41	Remaining control error	always active	... the control error has disappeared again	Compressed air missing, actuator fault, valve fault (e.g. blockade).
42	Instrument not in automatic mode	40.4 FCT= 4nA or = 4nAB	... the instrument is brought into automatic mode	The instrument is configured or is in manual operation.
43	Digital input DI1 or DI2 active	40.4 FCT= 4nAB and digital function BIN to "on"	... the digital input is no longer activated	The contact connected to the binary input has become active (e.g. stuffing box monitoring, excess pressure, temperature switch).
44	Limit value Number of strokes exceeded	43.4 STRK≠OFF	... the stroke counter is reset or the limit value increased	The total distance traveled by the actuator exceeded the set limit value.
45	Limit value change of direction exceeded	44.4 DCHG≠OFF	... the change of direction counter is reset or the limit value increased	The number of changes of direction exceeded the set limit value.
46	Limit value bottom hard stop exceeded	45.4 ZERO≠OFF 34.YCDO or 35.YCUP /= OFF	... the deviation of the stop disappears or the instrument is re-initialized	Wear of the valve seat, deposits or foreign bodies in the valve seat, mechanical maladjustment, slip clutch maladjusted.
47	Limit value top hard stop exceeded	46.4 OPEN≠OFF 34.YCDO or 35.YCUP /= OFF	... the deviation of the stop disappears or the instrument is re-initialized	Wear of the valve seat, deposits or foreign bodies in the valve seat, mechanical maladjustment, slip clutch maladjusted.
48	Limit value dead zone adaptation exceeded	47.4 DEBA≠OFF 30.DEBA=Auto	... the limit value has dropped below again	Increased stuffing box friction, mechanical backlash of the position feedback

Table 4-2 Events which can activate the fault message output

See also parameter FAULT_MESSAGE of the transducer block. There each error is bit coded.

Explanations of column “Error codes”:

1 Monitoring of control error

In automatic mode the error between setpoint and actual value is monitored continuously. The fault message is activated with unchanged control error according to the setting of the parameters 41.4TIM, monitoring time for setting the fault messages and 42.4LIM, response threshold of the fault message. As soon as the control error drops back below the response threshold, the fault message is reset.

2 Monitoring automatic operation

A fault message is generated when the instrument is not in the automatic mode at the appropriate parameter setting “40.4FCT”. In this way the control system can be warned for example when the instrument has been switched to manual operation or Configuration on site.

3 Binary input active

A fault message is generated when the digital input is activated at the the corresponding setting of the parameter “40.4FCT”, function of the fault message output and the parameter “36.BIN”, function digital input. This may be a switch for stuffing box monitoring, a temperature switch or a limit value switch for example.

4 Monitoring of number of strokes

5 Monitoring of number of changes of direction

The two values number of strokes and number of changes of direction are compared continuously with the limit values which are specified with the parameters “43.4STRK” and “44.4DCHG”. The fault message output responds when exceeded. Both functions can be deactivated with the parameter setting “OFF”.

6 Monitoring of the bottom hard stop (valve seat)

7 Monitoring of the top hard stop

Monitoring of the bottom hard stop is activated when the parameter “45.4ZERO” has a value \neq OFF. Errors of the valve seat can be detected with this function for example. Exceeding of the limit value may hint at deposits or foreign bodies in the valve seat. Exceeding the limit value may be caused by wear of the valve seat. Mechanical maladjustment of the position feedback may also trigger this error message.

Monitoring takes place every time the valve is in tight closing bottom position. The current position is compared with the one determined during initialization as a bottom end stop. Activation of the tight closing bottom function (parameter “34.YCDO”) is therefore a prerequisite.

Example: 3% is set as a value. Normally the setting 0% is adopted when closed. If a value $>3\%$ or $<-3\%$ is determined instead, a fault is reported.

The fault message remains activated until either a subsequent monitoring remains within the tolerance or a new initialization is performed. The deactivation of the monitoring ("45.4ZERO"=OFF) also clears any existing fault message.

This monitoring function supplies no useful results when the stops have not been determined automatically in initialization but the limits set manually (manual initialization"5.INITM").

An appropriate diagnosis is made for the top hard stop. The limit value for this is set with the parameter 46.4OPEN. Activation of the tight closing top function (parameter "35.YCUP") is therefore a prerequisite.

8 Monitoring of the dead zone adaptation

If the dead zone increases unproportionally in operation in automatic adaptation of the dead zone (parameter 30.DEBA = Auto) this points to an error in the system (e.g. a marked increase in stuffing box friction, play in the displacement detection, leakage). Therefore a limit value can be specified for this value ("47.4DEBA", limit value for dead zone monitoring) which activates the fault message output when it is exceeded.

4.6 Meanings of the display texts

Notes on the tables:

nn	stands for variable numerical values
⚡	Fault symbol
/	(slash): the texts to the left and right of the slash flash alternately
AO	Analog output

Reports before initializing (first commissioning):

	Upper line	Lower line	Meaning/Cause	Actions
CPU START	x	x	Report after connecting the electrical auxiliary power	<ul style="list-style-type: none"> Wait
P nnn.n	x		Potentiometer voltage for non-initialized positioner (P manual mode) (Setting actual value in % of measurement range)	<ul style="list-style-type: none"> Check using the "+" and "-" keys whether the overall actuator travel can be traversed without ever "P----" being displayed Perform initialization
P----	x		Measurement range exceeded, potentiometer is in the inactive zone, transmission ratio selector or effective lever arm are not matched to the actuator travel	<ul style="list-style-type: none"> Set leverage ratio switch to 90 degrees, in particular for rotary actuators Match effective arm length for thrust drives to measurement range
NOINI		x	Positioner not initialized	<ul style="list-style-type: none"> Start initialization

Messages during initialization:

	Upper line	Lower line	Meaning/Cause	Actions
P---	x		See above	See above
RUN 1		x	Initialization started, part 1 active (direction of control action being determined)	<ul style="list-style-type: none"> Wait
RUN 2		x	Initialization part 2 active (actuator travel check and determination of the end stops)	<ul style="list-style-type: none"> Wait
RUN 3		x	Initialization part 3 active (determination and display of positioning times)	<ul style="list-style-type: none"> Wait
RUN 4		x	Initialization part 4 active (determination the minimum positioning increment length)	<ul style="list-style-type: none"> Wait
RUN 5		x	Initialization part 5 active (optimization of the behavior on transients)	<ul style="list-style-type: none"> Wait until "FINSH" is displayed (initialization completed successfully) Press "operating mode" key briefly to acknowledge or longer to quit configuration mode
YEND1		x	<u>only during manual initialization</u> first end position can be moved to	<ul style="list-style-type: none"> Move to first end position using the "+" or "-" key Press "operating mode" key to acknowledge

	Upper line	Lower line	Meaning/Cause	Actions
YEND2			<u>only during manual initialization</u> second end position can be moved to	<ul style="list-style-type: none"> Move to second end position using the "+" or "-" key Press "operating mode" key to acknowledge
RANGE		x	<u>only during manual initialization</u> End position or measurement span are outwith the permitted measurement range	<ul style="list-style-type: none"> Using "+" and "-" keys move to the other end position and press "operating mode" key to acknowledge, or Adjust slip clutch until "ok" is displayed and press "operating mode" key to acknowledge or Interrupt initialization by pressing the "operating mode" key, switch to P manual mode and correct the actuator travel and position sensing
ok			<u>only during manual initialization</u> permitted measurement range for end positions reached	<ul style="list-style-type: none"> Press "operating mode" key to acknowledge, the remaining steps ("RUN1" to "FINSH") will run through automatically
RUN 1/ ERROR		x	Fault in RUN 1 no movement e.g. no compressed air	<ul style="list-style-type: none"> Ensure compressed air is sufficient Open any choke(s) Re-start initialization
↳ d__U		x	Bar display of the zero point Zero point is outwith the tolerance range	<ul style="list-style-type: none"> With slip clutch set to "P 4.0" to "P 9.9" (>0<) Continue using the "+" or "-" key
SEt MIDL	x	x	Slip clutch misaligned; "P 50.0" no displayed when arm horizontal	<ul style="list-style-type: none"> For thrust drives, use the "+" and "-" keys to bring the arm to the correct angle on the spindle Press "operating mode" key briefly to acknowledge (initialization will resume)
↳ UP >		x	"UP" – tolerance range exceeded or inactive zone of potentiometer entered	<ul style="list-style-type: none"> Increase effective arm length with linear actuators or set leverage ratio switch to 90 degrees Press "operating mode" key briefly to acknowledge Re-start initialization
↳ 90_95		x	Only applies to rotary drives: Actuator travel is not within range 90 to 95%	<ul style="list-style-type: none"> Use the "+" and "-" keys to move into the range of 90 to 95% Press "operating mode" key briefly to acknowledge
↳ U-d>		x	Measurement span "Up-Down" is insufficient	<ul style="list-style-type: none"> Reduce effective arm length for thrust drives or set leverage ratio switch to 33 degrees Press "operating mode" key briefly to acknowledge Re-start initialization
U nn.n D->U	x	x	Display the positioning time "Up"	<ul style="list-style-type: none"> Wait, or To change the positioning time interrupt initialization with the "-" key, or Activate the leakage test with the "+" key
d nn.n U->d	x	x	Display the positioning time "Down"	<ul style="list-style-type: none"> Wait, or To change the positioning time interrupt initialization with the "-" key, or Activate the leakage test with the "+" key
NOZZL		x	Actuator stationary (initialization interrupted with the "-" key during actuation speed display)	<ul style="list-style-type: none"> Positioning time can be adjusted by varying the choke(s) Use the "-" key to repeat the determination of the positioning speed Continue using the "+" key
TESt LEAG	x	x	Leakage test active initialization interrupted with the "+" key during actuation speed display)	<ul style="list-style-type: none"> Wait 1 minute Continue with the "+" key

	Upper line	Lower line	Meaning/Cause	Actions
nn.n oMIN	x	x	Value and units of results of the leakage test	<ul style="list-style-type: none"> Remove leakage if value is too high. Continue with the "+" key
nn.n FINSH	x	x	Initialization completed successfully, with display of the actuator travel or positioning angle as appropriate	<ul style="list-style-type: none"> Press "operating mode" key briefly to acknowledge or longer to quit configuration mode

Reports on leaving "configuration" operating mode:

	Upper line	Lower line	Local operating mode			Meaning/Cause	Actions
			Auto-matic	Manual mode	P manual mode		
An VER	x	x				Software version	<ul style="list-style-type: none"> Wait
Error SLnn	x	x				Monotonicity transgression of the free characteristic line at support point "n"	<ul style="list-style-type: none"> Correct value

Reports during operation:

	Upper line	Lower line	Local operating mode			Meaning/Cause	Actions
			Auto-matic	Manual mode	P manual mode		
CPU START	x	x				Message after applying auxiliary electrical power	<ul style="list-style-type: none"> Wait
NOINI		x			x	Positioner not initialized	<ul style="list-style-type: none"> Start initialization
nnn.n	x		x	x		Setting actual value [in %] for initialized positioners. Flashing decimal point indicates communication with a class 2 master	
MAN nn		x		x		Positioner is in local operation mode "Manual"	<ul style="list-style-type: none"> In this mode you can move the actuator with the decrement and increment keys Press operation mode key to enter automatic mode
OS nn		x	x			Actual mode of AO function block is Out of Service (O/S)	<ul style="list-style-type: none"> Set target mode of AO function block to the desired mode If AO remains in O/S, check if resource block is in actual mode AUTO
IMN nn		x	x			Actual mode of AO function block is Initialization Manual (IMan). AO has no access to transducer block	<ul style="list-style-type: none"> Set the transducer block to target mode AUTO

	Upper line	Lower line	Auto- matic	Manual mode	P manual mode	Meaning/Cause	Actions
MM nn		x	x			Actual mode of AO function block is Manual	<ul style="list-style-type: none"> The setpoint for the transducer block is given by writing a value to AO parameter OUT
LO nn		x	x			Actual mode of AO function block is Local Override (LO). Device might be in Fault State	<ul style="list-style-type: none"> Check if communication from the upstream block is established Check if resource block is in Faultstate
AUT nn		x	x			Actual mode of AO function block is Automatic (Auto)	<ul style="list-style-type: none"> If you expected CADS, check if CAS_IN is linked to an upstream block and has a good status
CASnn		x	x			Actual mode of AO function block is Cascade (Cas)	
RCS nn		x	x			Actual mode of AO function block is Remote Cascade (RCas)	
oFL / 127.9	x		x	x		Display range exceeded. Possible causes: <ul style="list-style-type: none"> Slip clutch or Transmission ratio selector switch changed or Positioner installed without reinitialization, having previously been fitted to another drive 	<ul style="list-style-type: none"> Adjust slip clutch so that when moving the drive the actual value display remains within 0.0 to 100.0 or Change transmission selector switch or Carry out factory setting (preset) and initialization
EXSTP		x	x			Actuator stopped by binary input	
EX UP		x	x			Actuator moved by binary input to upper stop	
EXDWN		x	x			Actuator moved by binary input to lower stop	

4.7 Optimization of the control data

The data automatically determined during initialization for control quality are optimized for short duration commands with small overshoots. In special cases (e.g. extremely small and specially quick actuators or when operating with boosters) it can however occur that these data need to be revised to achieve quick responses or heavy damping. The following six parameters are available for this purpose:

- 13 Pulse length up** This determines for any sense of actuation the smallest drive movement pulse length. The optimum value is dependent particularly on the volume of the drive. Small values will lead to small actuation increments and frequent control drive activations. Note that if the value is too small no movement will result. If drive volumes are large, then it is better to use larger actuation increments. Note also that large actuation increments will still lead to large movements for small drives.
- 14 Pulse length down**

17 Short step zone up

18 Short step zone down

The short step zone is the range in which the control deviation is between the fast step zone and the deadband. In this zone the drive is activated in pulses.

If the value is small, even small changes of setpoint will evoke relatively large positioning speeds and can thus lead to overshoots. If the value is large, the overshoots will be reduced, particularly on large changes of setpoint but will lead to slow positioning speeds, particularly as the target setpoint is approached closely.

34 Prediction up

35 Prediction down

These parameters operate on the damping factor and have the effect of adjusting the control dynamics.

If the value is small, responses will be quick but possibly with overshoots. If the value is large, response will be slow but without overshoots.

It is recommended that first an automatic initialization is performed and only thereafter that the positioner parameters are matched to any special requirements.

TIP: So as to have a fixed reference value, it is advantageous for special control optimization to set a fixed value for the dead zone (parameter DEBA) instead of "Auto".

The above parameters are usually selected from the diagnostics menu and activated for general adjustment by pressing the increment or decrement key. Any adjustment to a parameter will be immediately effective. This means the effect of the new values on the control results can be immediately tested.

On leaving the diagnostic menu the activation of the parameter for adjustment will be deactivated again.

4.8 Troubleshooting

Diagnostics indicator

	see	Table			
In which operating mode did the fault occur?					
• Initialization	4-3				
• Manual mode and automatic mode	4-4	4-5	4-6	4-7	
Under which circumstances and conditions did the fault occur?					
• Wet environment (e.g. heavy rain or constant condensation)	4-4				
• Vibrating fittings	4-4	4-7			
• Under impact or shock (e.g. steam jets or breakaway flaps)	5				
• Damp (wet) compressed air	4-4				
• Dirty (contaminated with solid particles) compressed air	4-4	4-5			
When does the fault occur?					
• Constantly (reproducibly)	4-3	4-4	4-5	4-6	
• Sporadically (not reproducible)	4-7				
• Usually after a certain operating period	4-4	4-5	4-7		

Fault description (symptoms)	Possible cause(s)	Corrective actions
<ul style="list-style-type: none"> Positioner comes to a halt in RUN 1 	<ul style="list-style-type: none"> Initialization started from the final stop and Reaction time of max. 1 min. not waited Network pressure not connected or too low 	<ul style="list-style-type: none"> Up to 1 min. waiting time required Do not start initialization from an end stop Confirm network pressure
<ul style="list-style-type: none"> Positioner comes to a halt in RUN 2 	<ul style="list-style-type: none"> Transmission ratio selector and parameter 2 (YAGL) and true stroke did not correlate Stroke on the lever incorrectly set Piezo valve(s) do not switch (see Table 4-4) 	<ul style="list-style-type: none"> Check settings: See leaflet: Figure Device view (7) and parameters 2 and 3 Check stroke setting on the lever see Table 4-4
<ul style="list-style-type: none"> Positioner comes to a halt in RUN 3 	<ul style="list-style-type: none"> Actuator positioning time too long 	<ul style="list-style-type: none"> Open restrictor fully and/or set pressure PZ(1) to the highest permissible value Use booster if necessary
<ul style="list-style-type: none"> Positioner comes to a halt in RUN 5, does not reach FINISH (waiting time > 5 min) 	<ul style="list-style-type: none"> Play in the positioner, actuator, fittings system 	<ul style="list-style-type: none"> Linear actuator: Check seating of the stud screw of the coupling wheel Rotary actuator: Check seating of the lever on the positioner shaft Correct any other play between the actuator and the fittings

Table 4-3

Fault description (symptoms)	Possible cause(s)	Corrective actions
<ul style="list-style-type: none"> CPU test blinks in the display of the SIPART PS2 (ca. every 2 secs) Piezo valve(s) do not switch 	<ul style="list-style-type: none"> Water in the valve manifold (from wet compressed air) 	<ul style="list-style-type: none"> At the early stages the fault can be corrected by subsequent operation with dry air (when necessary, in a temperature cupboard at 50 to 70 °C) Otherwise: send back to repair center (see page 174)
<ul style="list-style-type: none"> Actuator cannot be moved in manual or automatic mode, or only in one direction 	<ul style="list-style-type: none"> Dampness in the valve manifold 	<ul style="list-style-type: none"> Otherwise: send back to repair center (see page 174)
<ul style="list-style-type: none"> Piezo valve(s) do not switch (no soft clicking can be heard when the + or – keys are pressed in manual mode) 	<ul style="list-style-type: none"> Screw between cover hood and the valve manifold is not tight or the hood is jammed 	<ul style="list-style-type: none"> Tighten screw, or release cause of jamming when necessary
	<ul style="list-style-type: none"> Dirt (swarf, particles) in the valve manifold 	<ul style="list-style-type: none"> Send back to repair center (see page 174)
	<ul style="list-style-type: none"> Deposits on the contact(s) between the electronics board and the valve manifold can occur from abrasion through continuous stresses from strong vibrations 	<ul style="list-style-type: none"> Clean all contact surfaces with alcohol: when necessary bend the valve manifold contact springs back into place

Table 4-4

Fault description (symptoms)	Possible cause(s)	Corrective actions
<ul style="list-style-type: none"> Actuator does not move 	<ul style="list-style-type: none"> Compressed air < 1.4 bar 	<ul style="list-style-type: none"> Set inlet air pressure to > 1.4 bar
<ul style="list-style-type: none"> Piezo valve(s) do not switch (although a soft clicking can be heard when the + or – keys are pressed in manual mode) 	<ul style="list-style-type: none"> Restrictor(s) closed down (screw(s) at the right end stop) 	<ul style="list-style-type: none"> Open restrictor screw(s) (see leaflet, Figure “View of device (6)”) by turning to the left
	<ul style="list-style-type: none"> Dirt in the valve manifold 	<ul style="list-style-type: none"> Send back to repair center (see page 174) or new device with integrated fine filter which can be replaced and cleaned
<ul style="list-style-type: none"> One piezo valve constantly switches in stationary automatic mode (constant set-point) and in manual mode 	<ul style="list-style-type: none"> Pneumatic leak in the positioner, actuator system, start leak test in RUN 3 (Initialization) !!! 	<ul style="list-style-type: none"> Fix leak in the actuator and/or supply line If the actuator and supply line are intact: Send back to repair center (see page 174)
	<ul style="list-style-type: none"> Dirt in the valve manifold (see above) 	<ul style="list-style-type: none"> See above

Table 4-5

Fault description (symptoms)	Possible cause(s)	Corrective actions
<ul style="list-style-type: none"> The two piezo valves constantly switch alternately in stationary automatic mode (constant setpoint), actuator oscillates around a middle point 	<ul style="list-style-type: none"> Static friction on the packing glands of the fittings or actuator too high 	<ul style="list-style-type: none"> Reduce static friction or increase dead zone of the positioner (parameter dEbA) until the oscillating movements stop.
	<ul style="list-style-type: none"> Play in the positioner, actuator, fittings system 	<ul style="list-style-type: none"> Rotary actuator: Check seating of the stub screw of the coupling wheel Linear actuator: Check seating of the lever on the positioner shaft Correct any other play between the actuator and fittings
	<ul style="list-style-type: none"> Actuator too fast 	<ul style="list-style-type: none"> Increase positioning times by means of restrictor screws If fast positioning times are required, increase dead zone (parameter dEbA) until the oscillating movements stop.

Table 4-6

Fault description (symptoms)	Possible cause(s)	Corrective actions
<ul style="list-style-type: none"> Zero point shifts sporadically (> 3 %) 	<ul style="list-style-type: none"> Such high accelerations have occurred through impact or shock that the friction clutch has shifted (e.g. through steam jets in the steam pipelines) 	<ul style="list-style-type: none"> Shut off the cause of the shocks Reinitialize the positioner Upgrade at the repair center (see below): mount reinforced friction clutch (order number C73451-A430-D14)
<ul style="list-style-type: none"> Device function breaks down totally: no display 	<ul style="list-style-type: none"> Insufficient electrical supply <p>With very high continuous stresses by vibrations, the following can occur:</p> <ul style="list-style-type: none"> Screws of the electrical terminals can loosen The electrical terminals and/or electronic modules can be shaken loose 	<ul style="list-style-type: none"> Check electrical supply Tighten screws and secure with sealing varnish Send back to repair center (see below) Prevention: Mount the positioner on rubber metal

Table 4-7

Fieldbus Communication

5.1 Overview

5.1.1 Block Structure

The positioner SIPART PS2 FF is implemented as a Basic Field Device according to FOUNDATION fieldbus specifications. It comprises four blocks

- Resource Block
- Analog output function block
- Analog output transducer block
- PID function block

Figure 5-1 shows an overview over the two function blocks and the transducer block with their in- and outputs. The resource block is not shown, as it has neither inputs nor outputs.

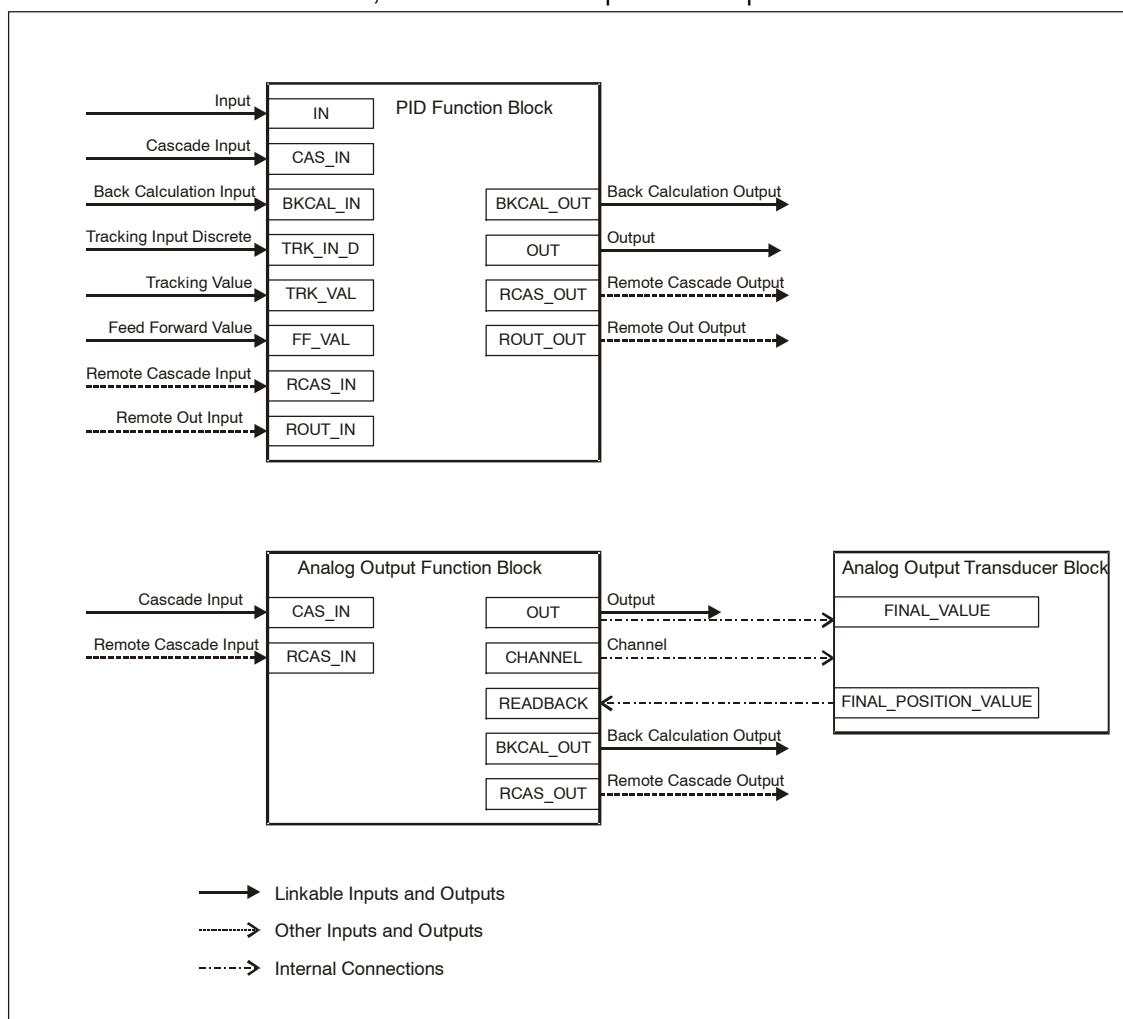


Figure 5-1 Overview Function Blocks

5.1.2 Addressing

Every fieldbus device must have a unique node address and physical device tag for the fieldbus to operate properly. The node address must be unique within the link (segment), the physical device tag must be unique within the whole network.

When a SIPART PS2 FF leaves the factory, it has a unique physical device tag, which is a concatenation of the string "SIPART PS2 FF" and part of the serial number. The node address is set to the value 22.

When configuring the device, the node address must be set to a value which is unique within the link. To avoid address conflicts, the SIPART PS2 FF sets its address automatically to one of the temporary default addresses of 248 to 251, if it detects another device with the same node address.

5.1.3 Configuration

For the configuration of the SIPART PS2 FF you need

- the Device Description
- the capability file (for offline configuration)
- a configuration tool such as National Instruments NIFBUS-Configurator or the tool integrated in your control system

The Device Description (DD) describes in machine-readable format all the information available at the fieldbus interface. It also contains information how to display information to the user and how to arrange the parameters in hierarchical menus. Another element of the DD is a number of so-called methods, which carry out sequences of actions to make some configuration steps easier. Extensive help texts are also included in the DD to describe the meaning and handling of the various parameters.

Hosts and configuration tools can use the information contained in the DD to generate a user friendly configuration surface.

The DD consists of two files:

- 0101.ffo (DD binary)
- 0101.sym (Symbol information)

The capability file (010101.cff) contains all information necessary for offline configuration.

Please refer to the manual of your configuration tool or control system how to install the files.



NOTE

Many of the parameters can be set directly via the three keys and the local display. This way you can perform certain tasks such as the initialization without the need of a fieldbus interface and configuration tool. You only need to supply the device with electrical and pneumatic power. See also chapter 4, page 81 Local Operation.

5.2 Resource Block (RB2)

5.2.1 Overview

The Resource block contains data that is specific to the hardware that is associated with the resource. This includes the device type and revision, manufacturer ID, serial number, and resource state. All data is modeled as Contained, so there are no links to this block. The data is not processed in the way that a function block processes data, so there is no function schematic.



NOTE

The resource block must be in automatic mode for any function blocks in the device to execute.

5.2.2 Parameter description

The Resource Block contains all standard parameters as specified in [FF-891-1.5] and some manufacturer specific parameters. These include additional static information about the device and several counters for operating time. For detailed information see the following table.

Resource Block		
Label/Name/Handling	Index (rel.)	Description/Format
ACK_OPTION Acknowledge Option Read & Write	38	Selection of whether alarms associated with the block will be automatically acknowledged. Bit Clear: Auto acknowledge disabled Bit Set: Auto acknowledge enabled Bit 0: Write has been disabled Bit 7: Block Alarm Data format: Bit-String with 16 Bits (2 Byte) Default value: 0
ALARM_SUM (Record) Alarm Summary	37	The current alert status, unacknowledged states, unreported states, and disabled states of the alarms associated with the block, coded in 4 bitstrings. Data format: Record with 4 Parameters (8 Byte)
1. CURRENT Current Read only	37.1	The active status of each alarm. Meaning of the bits see ACK_OPTION Data format: Bit-String with 16 Bits (2 Byte)
2. UNACKNOWLEDGED Unacknowledged Read only	37.2	The unacknowledged state of each alarm. Meaning of the bits see ACK_OPTION Data format: Bit-String with 16 Bits (2 Byte)
3. UNREPORTED Unreported Read only	37.3	The unreported status of each alarm. Meaning of the bits see ACK_OPTION Data format: Bit-String with 16 Bits (2 Byte)

Resource Block		
Label/Name/Handling	Index (rel.)	Description/Format
4. DISABLED Disabled Read & Write	37.4	The disabled state of each alarm. Meaning of the bits see ACK_OPTION Data format: Bit-String with 16 Bits (2 Byte)
ALERT_KEY Alert Key Read & Write	4	The identification number of the plant unit. This information may be used in the host for sorting alarms, etc. Data format: Unsigned8 Value range: 1 255 Default value: 0
BLOCK_ALM (Record) Block Alarm	36	The block alarm is used for all configuration, hardware, connection failure or system problems in the block. The cause of the alert is entered in the subcode field. The first alert to become active will set the Active status in the Status attribute. As soon as the Unreported status is cleared by the alert reporting task, another block alert may be reported without clearing the Activestatus, if the subcode has changed. Data format: Record with 5 Parameters (13 Byte)
1. UNACKNOWLEDGED Unacknowledged Read & Write	36.1	A discrete enumeration which is set to Unacknowledged when an alarm occurs, and set to Acknowledged by a write from a human interface device or other entity which can acknowledge that the alarm/event has been noticed. 0: Uninitialized 1: Acknowledged 2: Unacknowledged Data format: Unsigned8
2. ALARM_STATE Alarm State Read only	36.2	A discrete enumeration which gives an indication of whether the alert is active and whether it has been reported. 0: Uninitialized 1: Alarm not active and reported 2: Alarm not active and not reported 3: Alarm active and reported 4: Alarm active and not reported Data format: Unsigned8
3. TIME_STAMP Time Stamp Read only	36.3	The time when evaluation of the block was started and a change in alarm/event state was detected that is unreported. The time stamp value will be maintained constant until alert confirmation has been received – even if another change of state occurs. Data format: Time-Value (8 Byte)
4. SUB_CODE Subcode Read only	36.4	An enumeration specifying the cause of the alert to be reported. Values see BLOCK_ERROR Data format: Unsigned16
5. VALUE Value Read only	36.5	The value of the associated parameter at the time the alert was detected. Data format: Unsigned8

Resource Block		
Label/Name/Handling	Index (rel.)	Description/Format
BLOCK_ERR Block Error Read only	6	This parameter reflects the error status associated with the hardware or software components associated with a block. It is a bit string, so that multiple errors may be shown. The following bits are supported: Bit 3: Simulation Active. The simulation jumper is set, simulation can be activated. Bit 9: Memory Failure. A ROM checksum error has been detected. Bit 10: Lost Static Data. A checksum error within the FF static data has been detected. Bit 11: Lost NV Data. A checksum error within application data has been detected. Bit 15: Out Of Service. Actual mode is out-of-service. Data format: Bit-String with 16 Bits (2 Byte)
CALIBRATION_DATE (Record) Calibration 1. CAL_DATE Calibration Date Read only 2. CAL_WHO Calibration Executor Read only	53	Date of Calibration in factory. Data format: Record with 2 Parameters (32 Byte)
	53.1	Date of last device calibration, stored in the field device. Data format: Visible String (10 Byte)
	53.2	Name of the person who did the calibration. Data format: Visible String (22 Byte)
CLR_FSTATE Clear Fault State Read & Write	30	Writing a Clear to this parameter will clear the device fault state. 0: Uninitialized 1: Off (Normal operating position) 2: Clear (Block faultstate conditions will be cleared) Data format: Unsigned8 Default value: 1 { Off (Normal operating position) }
CONFIRM_TIME Confirm Time Read & Write	33	The minimum time between retries of alert reports. Data format: Unsigned32 Default value: 640000 (20000 ms)
CYCLE_SEL Cycle Selection Read & Write	20	Used to select the block execution method for this resource. Bit 0: Scheduled Bit 1: Block Execution Bit 2: Manuf Specific Data format: Bit-String with 16 Bits (2 Byte) Default value: 0xC000 (Scheduled Block Execution)
CYCLE_TYPE Cycle Type Read only	19	Identifies the block execution methods available for this resource. Bit 0: Scheduled Bit 1: Block Execution Bit 2: Manuf Specific Data format: Bit-String with 16 Bits (2 Byte) Default value: 0xC000 (Scheduled Block Execution)

Resource Block		
Label/Name/Handling	Index (rel.)	Description/Format
DD_RESOURCE DD Resource Read only	9	String identifying the tag of the resource which contains the Device Description for this resource. Data format: Visible String (32 Byte)
DD_REV DD Revision Read only	13	Revision of the DD associated with the resource – used by an interface device to locate the DD file for the resource. Data format: Unsigned8
DESCRIPTOR Descriptor Read & Write	44	The descriptive text can be used freely and is saved in the field device. It is displayed in the bottom line of the LC display in the diagnostic menu, number 0. You can use it e.g. for displaying the device tag to unambiguously identify the device in the field. Data format: Visible String (32 Byte)
DEV_REV Device Revision Read only	12	Revision number associated with the resource – used by an interface device to locate the DD file for the resource. Data format: Unsigned8
DEV_TYPE Device Type Read only	11	Model number associated with the resource – used by interface devices to locate the DD file for the resource. Data format: Unsigned16
DEVICE_CERTIFICATION Device Certification Read only	47	Certifications of the device. Data format: Visible String (32 Byte)
DEVICE_ID Device ID Read only	46	String that identifies the Device Type Data format: Visible String (16 Byte) Default value: SIPART PS2 FF
DEVICE_INSTAL_DATE Device Installation Date Read & Write	48	The date (ASCII coded) on which the device was installed in the system can be entered in this parameter (e.g. 12.01.2001) Data format: Visible String (32 Byte)
DEVICE_MESSAGE Device Message Read & Write	45	The message text can be used freely and is saved in the field device. The use is free there is no recommended application. Data format: Visible String (32 Byte)
DEVICE_SER_NUM Serial Number Read only	49	The serial number of the device. Data format: Visible String (22 Byte)
FAULT_STATE Fault State Read only	28	Condition set by loss of communication to an output block, failure promoted to an output block or a physical contact. When faultstate condition is set, then output function blocks will perform their FSTATE actions. 0: Uninitialized 1: Clear (Normal operating position) 2: Active (Faultstate is active) Data format: Unsigned8

Resource Block		
Label/Name/Handling	Index (rel.)	Description/Format
FEATURES Features Read only	17	Used to show supported resource block options. Bit 0: Unicode Bit 4: Hard Write Lock Bit 1: Reports Bit 5: Out Readback Bit 2: Faultstate Bit 6: Direct Write Bit 3: Soft Write Lock Data format: Bit–String with 16 Bits (2 Byte) Default value: 0x7400 (Reports Faultstate Soft Write Lock Out Readback)
FEATURE_SEL Feature Selection Read & Write	18	Used to select resource block options (see FEATURES) Data format: Bit–String with 16 Bits (2 Byte) Default value: 0x7400 (Reports Faultstate Soft Write Lock Out Readback)
FREE_SPACE Free Space Read only	24	Percent of memory available for further configuration. Zero in a preconfigured device. Data format: Float–Value (4 Byte) Value range: 0.0 % ... 100.0 % Not supported, set to 0%
FREE_TIME Free Time Read only	25	Percent of the block processing time that is free to process additional blocks. Data format: Float–Value (4 Byte) Value range: 0.0 % ... 100.0 % Not supported, set to 0%
GRANT_DENY (Record) Grant Deny 1. GRANT Grant Read & Write 2. DENY Deny Read & Write	14	Options for controlling access of host computers and local control panels to operating, tuning, and alarm parameters of the block. Data format: Record with 2 Parameters (2 Byte) 14.1 Depending on the philosophy of the plant, the operator or a higher level device (HLD), or a local operator’s panel (LOP) in the case of Local, may turn on an item of the Grant attribute – Program, Tuning, Alarm, or Local. Bit 0: Program Bit 2: Alarm Bit 1: Tune Bit 3: Local Data format: Bit–String with 8 Bits (1 Byte) Default value: 0x00 14.2 The Denied attribute is provided for use by a monitoring application in an interface device and may not be changed by an operator. Bit 0: Program Denied Bit 2: Alarm Denied Bit 1: Tune Denied Bit 3: Local Data format: Bit–String with 8 Bits (1 Byte) Default value: 0x00
HARD_TYPES Hard Types Read only	15	The types of hardware available as channel numbers. Bit 0: Scalar Input Bit 2: Discrete Input Bit 1: Scalar Output Bit 3: Discrete Output Data format: Bit–String with 16 Bits (2 Byte) Default value: 0x0004 (Scalar Output)

Resource Block		
Label/Name/Handling	Index (rel.)	Description/Format
HARDWARE_REVISION Hardware Revision Read only	42	The revision state of the hardware (electronics) of the field device. Data format: Visible String (16 Byte)
HOURS Number of Operating Hours (HOURS) Read only	51	The operating hours counter is incremented hourly as soon as the positioner is supplied with auxiliary power. The value is written to non-volatile memory every 15 minutes. Data format: Unsigned32
ITK_VER ITK Version Read only	41	Major revision number of the interoperability test case used to register this device. Data format: Unsigned16 Default value: 4
LIM_NOTIFY Limit Notify Read & Write	32	Maximum number of unconfirmed alert notify messages allowed. Data format: Unsigned8 Value range: 0 ... MAX_NOTIFY Default value: 8
MANUFAC_ID Manufacturer Id Read only	10	Manufacturer identification number – used by an interface device to locate the DD file for the resource. Data format: Unsigned32 Default value: 0x00534147 (Siemens)
MAX_NOTIFY Max Notify Read only	31	Maximum number of unconfirmed alert notify messages possible. Data format: Unsigned8 Default value: 8
MEMORY_SIZE Memory Size Read only	22	Available configuration memory in the empty resource. Not supported by SIPART PS2 FF. Data format: Unsigned16 Default value: 0 KBytes
MIN_CYCLE_T Minimum Cycle Time Read only	21	Time duration of the shortest cycle interval of which the resource is capable. Data format: Unsigned32 Default value: 1600 (50 ms)
MODE_BLK (Record) Block Mode 1. TARGET Target Read & Write 2. ACTUAL Actual Read only	5 5.1 5.2	The actual, target, permitted, and normal modes of the block. Data format: Record with 4 Parameters (4 Byte) This is the mode requested by the operator. Target Mode is limited to the values allowed by the permitted mode parameter. Bit 3: Auto (Automatic Mode) Bit 7: O/S (Out Of Service) Data format: Bit-String with 8 Bits (1 Byte) This is the current mode of the block, which may differ from the target based on operating conditions. Its value is calculated as part of block execution. Bit 3: Auto (Automatic Mode) Bit 7: O/S (Out Of Service) Data format: Bit-String with 8 Bits (1 Byte)

Resource Block		
Label/Name/Handling	Index (rel.)	Description/Format
3. PERMITTED Permitted Read & Write	5.3	Defines the modes which are allowed for an instance of the block. The permitted mode is configured based on application requirement. Bit 3: Auto (Automatic Mode) Bit 7: O/S (Out Of Service) Data format: Bit-String with 8 Bits (1 Byte) Default value: 0x11 (Auto O/S)
4. NORMAL Normal Read & Write	5.4	This is the mode which the block should be set to during normal operating conditions. Bit 3: Auto (Automatic Mode) Data format: Bit-String with 8 Bits (1 Byte) Default value: 0x10 (Auto)
NV_CYCLE_T Nonvolatile Cycle Time Read only	23	Interval between writing copies of NV parameters to non-volatile memory. Zero means never. Data format: Unsigned32
PRODUCT_CODE Product Type (Order Number) Read only	50	The product type (order number) of the field device corresponds to the as-delivered state of the device and was stored by manufacturer of this field device. Data format: Visible String (32 Byte)
RESTART Restart Read & Write	16	Allows a manual restart to be initiated. Several degrees of restart are possible. 0: Uninitialized 3: Restart with defaults 1: Run 4: Restart processor Data format: Unsigned8 Default value: 1 (Run)
RS_STATE Resource State Read only	7	State of the function block application state machine. 0: Uninitialized 4: Online 1: Start/Restart 5: Standby 2: Initialization 6: Failure 3: Online Linking Data format: Unsigned8
SET_FSTATE Set Fault State Read & Write	29	Allows the faultstate condition to be manually initiated by selecting Set. 0: Uninitialized 1: OFF (Normal operating condition) 2: SET (Activate Faultstate) Data format: Unsigned8 Default value: 1 { OFF (Normal operating condition) }
SHED_RCAS Shed Remote Cascade Read & Write	26	Time duration at which to give up on computer writes to function block RCas locations. Data format: Unsigned32 Default value: 640000 (20 sec)
SHED_ROUT Shed Remote Out Read & Write	27	Time duration at which to give up on computer writes to function block ROut locations. Data format: Unsigned32 Default value: 640000 (20 sec)

Resource Block		
Label/Name/Handling	Index (rel.)	Description/Format
SOFTWARE_REVISION Software Revision Read only	43	The revision state of the software or firmware of the field device. Data format: Visible String (16 Byte)
ST_REV Static Revision Read only	1	The revision level of the static data associated with the function block. The revision value will be incremented each time a static parameter value in the block is changed. Data format: Unsigned16
STRATEGY Strategy Read & Write	3	The strategy field can be used to identify grouping of blocks. This data is not checked or processed by the block. Data format: Unsigned16 Default value: 0
TAG_DESC Tag Description Read & Write	2	The user description of the intended application of the block Data format: Octet-String (32 Byte)
TEMPERATURE_HOURS (Record)	52	Operating hours in temperature range T1 to T9. The value is written to non-volatile memory every 15 minutes. Data format: Record with 9 Parameters (36 Byte)
1. TEMPERATURE_HOURS_T1 Temperature Range T1 Read only	52.1	Operating hours in temperature range < -30°C (< -22°F) Data format: Unsigned32
2. TEMPERATURE_HOURS_T2	52.2	-30°C - -15°C (-22°F - 5°F)
3. TEMPERATURE_HOURS_T3	52.3	-15°C - 0°C (5°F - 32°F)
4. TEMPERATURE_HOURS_T4	52.4	0°C - 15°C (32°F - 59°F)
5. TEMPERATURE_HOURS_T5	52.5	15°C - 30°C (59°F - 86°F)
6. TEMPERATURE_HOURS_T6	52.6	30°C - 45°C (86°F - 113°F)
7. TEMPERATURE_HOURS_T7	52.7	45°C - 60°C (113°F - 140°F)
8. TEMPERATURE_HOURS_T8	52.8	60°C - 75°C (140°F - 167°F)
9. TEMPERATURE_HOURS_T9	52.9	>75°C (>167°F)
TEST_RW (Record) Test Read Write Read & Write	8	Read/write test parameter – used only for conformance testing. Data format: Record with 15 Parameters (112 Byte)
UPDATE_EVT (Record) Update Event	35	This alert is generated by any change to the static data. Data format: Record with 5 Parameters (14 Byte)

Resource Block		
Label/Name/Handling	Index (rel.)	Description/Format
1. UNACKNOWLEDGED Unacknowledged Read only	35.1	A discrete enumeration which is set to Unacknowledged when an update occurs, and set to Acknowledged by a write from a human interface device or other entity which can acknowledge that the alarm has been noticed. 0: Uninitialized 1: Acknowledged 2: Unacknowledged Data format: Unsigned8
2. UPDATE_STATE Update State Read only	35.2	A discrete enumeration which gives an indication of whether the alert has been reported. 0: Uninitialized 1: Reported 2: Not Reported Data format: Unsigned8
3. TIME_STAMP Time Stamp Read only	35.3	The time when evaluation of the block was started and a change in alarm/event state was detected that is unreported. The time stamp value will be maintained constant until alert confirmation has been received – even if another change of state occurs. Data format: Time-Value (8 Byte)
4. STATIC_REVISION Static Rev Read only	35.4	The static revision of the block whose static parameter was changed and is being reported. It is possible for the present value of static revision to be greater than this because static can be changed at any time. Data format: Unsigned16
5. RELATIVE_INDEX Relative Index Read only	35.5	The OD index of the static parameter whose change caused this alert, minus the FB starting index. If the update event was caused by a write to multiple parameters at the same time, then this attribute will be zero. Data format: Unsigned16
WRITE_ALM (Record) Write Alarm	40	This alert is generated if the write lock parameter is cleared. Data format: Record with 5 Parameters (13 Byte)
1. UNACKNOWLEDGED	40.1	See BLOCK_ALM
2. ALARM_STATE	40.2	
3. TIME_STAMP	40.3	
4. SUB_CODE	40.4	
5. VALUE Discrete Value Read only	40.5	The value of the associated parameter at the time the alert was detected. 0: Discrete state 0 (Uninitialized) 1: Discrete state 1 (Not Locked) 2: Discrete state 2 (Locked) Data format: Unsigned8

Resource Block		
Label/Name/Handling	Index (rel.)	Description/Format
WRITE_LOCK Write Lock Read & Write	34	If set, no writes from anywhere are allowed, except to clear WRITE_LOCK. Block inputs will continue to be updated. 0: Uninitialized 1: Not Locked (Writes to Parameters are allowed) 2: Locked (Writes to Parameters are not allowed) Data format: Unsigned8 Default value: 1 (Not Locked)
WRITE_PRI Write Priority Read & Write	39	Priority of the alarm generated by clearing the write lock. Data format: Unsigned8 Value range: 0 15 Default value: 0

5.2.3 Device Description

The Device Description is based on the standard device description for resource block 2. Manufacturer specific parameters, hierarchical parameter menus and two method have been added. The methods allows to restart the processor or to reset all configuration data to default.

5.3 Analog Output Function Block (AO)

5.3.1 Overview

The AO block processes the setpoint SP and sends it to the analog output channel of the transducer block. The source of SP depends on the actual block mode and can be the parameter SP itself (in mode AUTO), the input CAS_IN (in mode CAS) or the value of RCAS_IN (in mode RCAS). In mode MAN the output OUT can be set directly to the desired value.

The actual position of the valve (parameter FINAL_POSITION_VALUE) is received from the transducer block and scaled to get the actual process value PV. Either PV or SP can be used to feed the back calculation output BKCAL_OUT and RCAS_OUT.

The block supports cascade initialization to allow upstream control blocks to switch bumplessly from manual to automatic mode.

The AO has a faultstate behavior to react if the communication with the upstream block fails. See parameters FSTATE_TIME, FSTATE_VAL and IO_OPTS.

Simulation is possible with the parameter SIMULATE. The simulation enable jumper has to be set for this function. When simulation is active, the transducer block is ignored and the READBACK value and status are taken from SIMULATE_VALUE and SIMULATE_STATUS.

The execution time of the AO is 50 ms with a minimum period time of 60 ms.

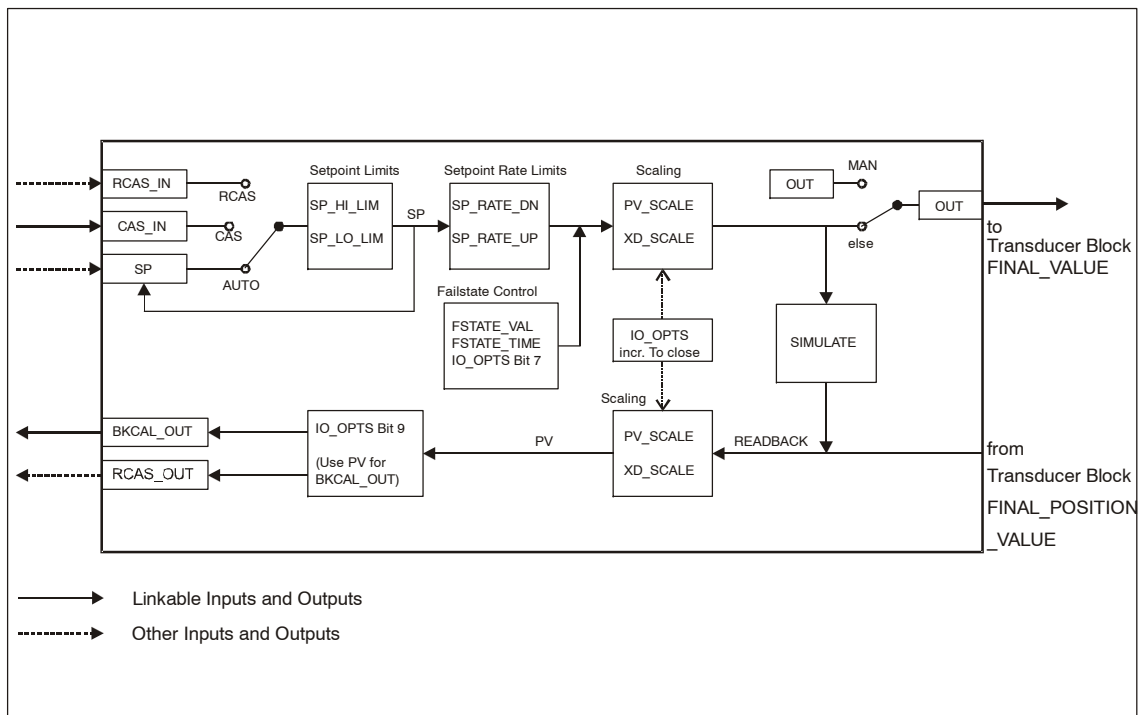


Figure 5-2 Function schematic of AO function block

5.3.2 Parameter description

The AO block contains all standard parameters as specified in [FF-891-1.5]. There are no additional manufacturer specific parameters.

Analog Output (AO) Block		
Label/Name/Handling	Index (rel.)	Description/Format
ALERT_KEY Alert Key Read & Write	4	The identification number of the plant unit. This information may be used in the host for sorting alarms, etc. Data format: Unsigned8 Value range: 1 ... 255 Default value: 0x00
BKCAL_OU (Record) Back Calculation Output 1. STATUS 2. VALUE	25 25.1 25.2	The output value and status provided to an upstream block for output tracking when the loop is broken or limited, as determined by the status bits. This information is used to provide bumpless transfer to closed loop control and to prevent windup under limited conditions when that becomes possible. See PID-Block → BKCAL_IN
BLOCK_ALM (Record) Block Alarm 1. UNACKNOWLEDGED 2. ALARM_STATE 3. TIME_STAMP 4. SUB_CODE 5. VALUE	30 30.1 30.2 30.3 30.4 30.5	See Resource Block
BLOCK_ERR Block Error Read only	6	This parameter reflects the error status associated with the hardware or software components associated with a block. It is a bit string, so that multiple errors may be shown. Bit 1: Block Configuration Bit 4: Local Override Bit 7: Input Failure Bit 8: Output Failure Bit 5: Out Of Service Data format: Bit-String with 16 Bits (2 Byte)
CAS_IN (Record) Cascade Input 1. STATUS 2. VALUE	17 17.1 17.2	This parameter is the remote setpoint value, which must come from another Fieldbus block, or a DCS block through a defined link. See PID-Block → BKCAL_IN

Analog Output (AO) Block		
Label/Name/Handling	Index (rel.)	Description/Format
CHANNEL Channel Read & Write	22	The number of the logical hardware channel that is connected to this I/O block. This information defines the transducer to be used going to or from the physical world. Must be set to 1 for SIPART PS2 FF. Data format: Unsigned16 Value range: 0x0001 0x7FFF Default value: 0x0001
FSTATE_TIME Fault State Time Read & Write	23	The time in seconds from detection of failure of the output block remote setpoint to the output action of the block output if the condition still exists. Data format: Float-Value (4 Byte) Value range: 0.0 Sec ... 100.0 Sec Default value: 0.0 Sec
FSTATE_VAL Fault State Value Read & Write	24	The preset analog SP value to use when failure occurs. This value will be used if the I/O option Faultstate to value is selected. Data format: Float-Value (4 Byte) Default value: 0.0
GRANT_DENY (Record) Grant Deny 1. GRANT 2. DENY	13 13.1 13.2	Options for controlling access of host computers and local control panels to operating, tuning, and alarm parameters of the block. See Resource Block
IO_OPTS I/O Options Read & Write	14	Option which the user may select to alter input and output block processing. Bit 1: SP tracks PV if Man Bit 3: SP tracks PV if LO Bit 4: SP tracks RCas or Cas if LO or Man Bit 5: Increase to close Bit 6: Faultstate Type Bit 7: Faultstate restart Bit 8: Target to Man Bit 9: PV for BKCal_Out see chapter 5.3.3, page 136 for details Data format: Bit-String with 16 Bits (2 Byte) Default value: 0x0000
MODE_BLK (Record) Block Mode	5	The actual, target, permitted, and normal modes of the block. Data format: Record with 4 Parameters (4 Byte)
1. TARGET Target Read & Write	5.1	This is the mode requested by the operator. Only one mode from those allowed by the permitted mode parameter may be requested. Bit 1: RCas (Remote Cascade) Bit 2: Cas (Cascade Mode) Bit 3: Auto (Automatic Mode) Bit 4: Man (Manual Mode) Bit 7: O/S (Out Of Service) Data format: Bit-String with 8 Bits (1 Byte)

Analog Output (AO) Block		
Label/Name/Handling	Index (rel.)	Description/Format
2. ACTUAL Actual Read only	5.2	This is the current mode of the block, which may differ from the target based on operating conditions. Its value is calculated as part of block execution. Bit 1: RCas (Remote Cascade) Bit 2: Cas (Cascade Mode) Bit 3: Auto (Automatic Mode) Bit 4: Man (Manual Mode) Bit 5: LO (Local Override) Bit 6: IMan (Initializ. Man.) Bit 7: O/S (Out Of Service) Data format: Bit-String with 8 Bits (1 Byte)
3. PERMITTED Permitted Read & Write	5.3	Defines the modes which are allowed for an instance of the block. The permitted mode is configured based on application requirement. Bit 1: RCas (Remote Cascade) Bit 2: Cas (Cascade Mode) Bit 3: Auto (Automatic Mode) Bit 4: Man (Manual Mode) Bit 7: O/S (Out Of Service) Data format: Bit-String with 8 Bits (1 Byte). Default value: 0x79 (Rcas Cas Auto Man O/S)
4. NORMAL Normal Read & Write	5.4	This is the mode which the block should be set to during normal operating conditions. Bit 1: RCas (Remote Cascade) Bit 2: Cas (Cascade Mode) Bit 3: Auto (Automatic Mode) Bit 4: Man (Manual Mode) Bit 7: O/S (Out Of Service) Data format: Bit-String with 8 Bits (1 Byte) Default value: 0x30 (Cas Auto)
OUT (Record) Output 1. STATUS Read only 2. VALUE Read & Write	9 9.1 9.2	The primary analog value calculated as a result of executing the function block. This parameter is linked to FINAL_VALUE in the transducer block. See PID-Block → BKCAL_IN
PV (Record) Process Value Read only 1. STATUS 2. VALUE	7 7.1 7.2	Either the primary analog value for use in executing the function, or a process value associated with it. May also be calculated from the READBACK value of an AO block. The PV_SCALE is used for this value. See PID-Block → BKCAL_IN

Analog Output (AO) Block		
Label/Name/Handling	Index (rel.)	Description/Format
PV_SCALE (Record) Process Value Scale 1. EU_100 2. EU_0 3. UNITS_INDEX 4. DECIMAL	11 11.1 11.2 11.3 11.4	The high and low scale values, engineering units code, and number of digits to the right of the decimal point to be used in displaying the PV parameter and parameters which have the same scaling as PV. See PID-Block → FF_SCALE
RCAS_IN (Record) Remote Cascade Input 1. STATUS 2. VALUE	26 26.1 26.2	Target setpoint and status provided by a supervisory Host to a analog control or output block. See PID-Block → BKCAL_IN
RCAS_OUT (Record) Remote Cascade Output Read only 1. STATUS 2. VALUE	28 28.1 28.2	Block setpoint and status after ramping – provided to a supervisory Host for back calculation and to allow action to be taken under limiting conditions or mode change. See PID-Block → BKCAL_IN
READBACK (Record) Readback 1. VALUE Value Read only 2. STATUS QUALITY Status SUBSTATUS Read only LIMITS	16 16.1 16.2	This indicates the readback of the actual continuous valve or other actuator position, in transducer units. The READBACK is linked to the FINAL_POSITION_VALUE of the transducer block. Data format: Record with 2 Parameters (5 Byte) A numerical quantity received by the block parameter from another block parameter to which this block is linked. Or a default or user entered value if the parameter has not been linked. The XD_SCALE is used for this value. Data format: Float-Value (4 Byte) See PID-Block → BKCAL_IN
SHED_OPT Shed Options Read & Write	27	Defines action to be taken on remote control device timeout. 0: Uninitialized 1: Normal Shed_Normal Return 2: Normal Shed_No Return 3: Shed To Auto_Normal Return 4: Shed To Auto_No Return 5: Shed To Manual_Normal Return 6: Shed To Manual_No Return 7: Shed To Retained Target_Normal Return 8: Shed To Retained Target_No Return Data format: Unsigned8 Default value: 0 (Uninitialized)

Analog Output (AO) Block		
Label/Name/Handling	Index (rel.)	Description/Format
SIMULATE (Record) Simulate	10	Allows the transducer analog input or output to the block to be manually supplied when simulate is enabled. When simulate is disabled, the simulate value and status track the actual value and status. Data format: Record with 5 Parameters (11 Byte)
1. SIMULATE_STATUS Simulate Status Read & Write	10.1	Used for the transducer status when simulation is enabled. QUALITY: SUBSTATUS: LIMITS: Status-Structure see: PID-Block → BKCAL_IN Data format: Unsigned8 Default value: 0 (Bad: Non Specific: Not Limited)
2. SIMULATE_VALUE Simulate Value Read & Write	10.2	Used for the transducer value when simulation is enabled. Data format: Float-Value (4 Byte) Default value: 0.0
3. TRANSDUCER_STATUS Transducer Status Read only	10.3	Status of value supplied by the transducer. QUALITY: SUBSTATUS: LIMITS: Status-Structure see: PID-Block → BKCAL_IN Data format: Unsigned8 Default value: 0 (Bad: Non Specific: Not Limited)
4. TRANSDUCER_VALUE Transducer Value Read only	10.4	Current value supplied by the transducer. Data format: Float-Value (4 Byte) Default value: 0.0
5. ENABLE_DISABLE Simulate En/Disable Read & Write	10.5	Enable/disable simulation. 0: Uninitialized 1: Disabled 2: Active Data format: Unsigned8 Default value: 1 (Disabled)
SP (Record) Setpoint	8	The analog setpoint of this block. Data format: Record with 2 Parameters (5 Byte) See PID-Block → BKCAL_IN
1. STATUS Status Read & Write	8.1	QUALITY SUBSTATUS LIMITS
2. VALUE Value Read only	8.2	A numerical quantity received by the block parameter from another block parameter to which this block is linked. Or a default or user entered value if the parameter has not been linked. The PV_SCALE is used for this value. Data format: Float-Value (4 Byte)

Analog Output (AO) Block		
Label/Name/Handling	Index (rel.)	Description/Format
SP_HI_LIM Setpoint High Limit Read & Write	20	The setpoint high limit is the highest setpoint operator entry that can be used for the block. Data format: Float-Value (4 Byte) Default value: 100.0
SP_LO_LIM Setpoint Low Limit Read & Write	21	The setpoint low limit is the lowest setpoint operator entry that can be used for the block. Data format: Float-Value (4 Byte) Default value: 0.0
SP_RATE_DN Setpoint Rate Down Read & Write	18	Ramp rate at which downward setpoint changes are acted on in Auto mode, in PV units per second. If the ramp rate is set to zero or the block is in a mode other than Auto, then the setpoint will be used immediately. If the setpoint changes are to be independent from loop time use TRAVEL_RATE_DOWN in the transducer block. Data format: Float-Value (4 Byte) Value range: ≥ 0.0 [PV/Sec] Default value: 1.#INF (Not active)
SP_RATE_UP Setpoint Rate Up Read & Write	19	Ramp rate at which upward setpoint changes are acted on in Auto mode, in PV units per second. If the ramp rate is set to zero or the block is in a mode other than Auto, then the setpoint will be used immediately. If the setpoint changes are to be independent from loop time use TRAVEL_RATE_UP in the transducer block. Data format: Float-Value (4 Byte) Value range: ≥ 0.0 [PV/Sec] Default value: 1.#INF (Not active)
ST_REV Static Revision Read only	1	The revision level of the static data associated with the function block. The revision value will be incremented each time a static parameter value in the block is changed. Data format: Unsigned16
STATUS_OPTS Status Options Read & Write	15	Options which the user may select in the block processing of status. Bit 4: Propagate Fault Backward Data format: Bit-String with 16 Bits (2 Byte) Default value: 0x0000
STRATEGY Strategy Read & Write	3	The strategy field can be used to identify grouping of blocks. This data is not checked or processed by the block. Data format: Unsigned16 Default value: 0x0000
TAG_DESC Tag Description Read & Write	2	The user description of the intended application of the block. Data format: Octet-String (32 Byte)

Analog Output (AO) Block		
Label/Name/Handling	Index (rel.)	Description/Format
UPDATE_EVT (Record) Update Event	29	This alert is generated by any change to the static data.
1. UNACKNOWLEDGED	29.1	See Resource Block
2. UPDATE_STATE	29.2	
3. TIME_STAMP	29.3	
4. STATIC_REVISION	29.4	
5. RELATIVE_INDEX	29.5	
XD_SCALE (Record) Transducer Scale	12	The high and low scale values, engineering units code, and number of digits to the right of the decimal point used with the value obtained from the transducer for a specified channel.
1. EU_100	12.1	Because FINAL_VALUE_RANGE in the transducer block is fixed to 0.0 and 100.0 use these values for XD_SCALE for proper operation. See PID-Block → FF_SCALE
2. EU_0	12.2	
3. UNITS_INDEX	12.3	
4. DECIMAL	12.4	

5.3.3 Options

The effect of the option bits of the parameters IO_OPTS, STATUS_OPTS and SHED_OPT are described in the following sections.

IO_OPTS

Options which the user may select to alter output block processing.

SP-PV Track in Man

Permits the setpoint to track the process variable when the target mode of the block is Man.

SP-PV Track in LO

Permits the setpoint to track the process variable when the actual mode of the block is LO or IMAN.

SP Track retained target

Permits the setpoint to track the RCas or Cas parameter based on the retained target mode when the actual mode of the block is LO or Man. When SP-PV track options are enabled, then SP Track retained target will have precedence in the selection of the value to track when the actual mode is Man and LO.

Increase to close

Indicates whether the output value should be inverted before it is communicated to the I/O channel.

Fault State to value

The output action to take when fault occurs. (0: freeze, 1: go to preset value)

Use Fault State value on restart

Use the value of `FSTATE_VAL(_D)` if the device is restarted, otherwise use the non-volatile value. This does not act like Fault State, just uses the value.

Target to Man if Fault State activated

Set the target mode to Man, thus losing the original target, if Fault State is activated. This latches an output block into the manual mode.

Use PV for BKCAL_OUT

The `BKCAL_OUT` value is normally the working SP. This option changes it to the PV.

STATUS_OPTS

Options which the user may select in the block processing of status.

Propagate Fault Backward

If the status from the actuator is Bad, Device failure or Fault State Active or Local Override is active, propagate this as Bad, Device Failure or Good Cascade, Fault State Active or Local Override to `BKCAL_OUT` respectively without generating an alarm. The use of these sub-status in `BKCAL_OUT` is determined by this option. Through this option, the user may determine whether alarming (sending of an alert) will be done by the block or propagated upstream for alarming.

SHED_OPT

Defines action to be taken on remote control device timeout.

- 0 = Undefined – Invalid
- 1 = Normal shed, normal return – Actual mode changes to the next lowest priority non-remote mode permitted but returns to the target remote mode when the remote computer completes the initialization handshake.
- 2 = Normal shed, no return – Target mode changes to the next lowest priority non-remote mode permitted. The target remote mode is lost, so there is no return to it.
- 3 = Shed to Auto, normal return
- 4 = Shed to Auto, no return – Target mode changes to Auto on detection of a shed condition.
- 5 = Shed to Manual, normal return
- 6 = Shed to Manual, no return – Target mode changes to Man on detection of a shed condition. When the target mode is set to Manual, the Retained bits will be set to zero (0).
- 7 = Shed to Retained target, normal return
- 8 = Shed to Retained target, no return (change target to retained target)

5.3.4 Device Description

The device description is based on the standard device description for analog output function blocks. An additional hierarchical parameter menu has been added.

5.4 Analog Output Transducer Block (AOTB)

5.4.1 Overview

The transducer block is the interface to the physical hardware. It decouples the AO function block from the hardware details of the positioner.

The FINAL_VALUE of the AOTB is feed by the output OUT of the AO (note that AO parameter CHANNEL must be set to 1). The FINAL_VALUE can be converted by standard or user defined characteristics and can be rate limited. The result is used as setpoint to the servo controller, which compares it with the actual position and generates the appropriate control signals for the piezo valve unit. The actual position value is derived from the signal of a position sensor, processed by a scaling and correction block. The value is then back-calculated by the inverted characteristic to serve as position readback to the AO (FINAL_POSITION_VALUE).

Several parameters serve to configure the diagnosis and monitoring features of the SIPART PS2 FF.

The transducer block supports modes Automatic and Out of Service. It can only be switches to Automatic after the positioner has been initialized (see chapter 3.6, page 64 Comissioning).

In Automatic mode the setpoint FINAL_VALUE can be directly written for test purpose, if the AO function block is set to Out of Service.

Local operation modes can have priority over the block actual mode, see chapter 4.3, page 84 for details.

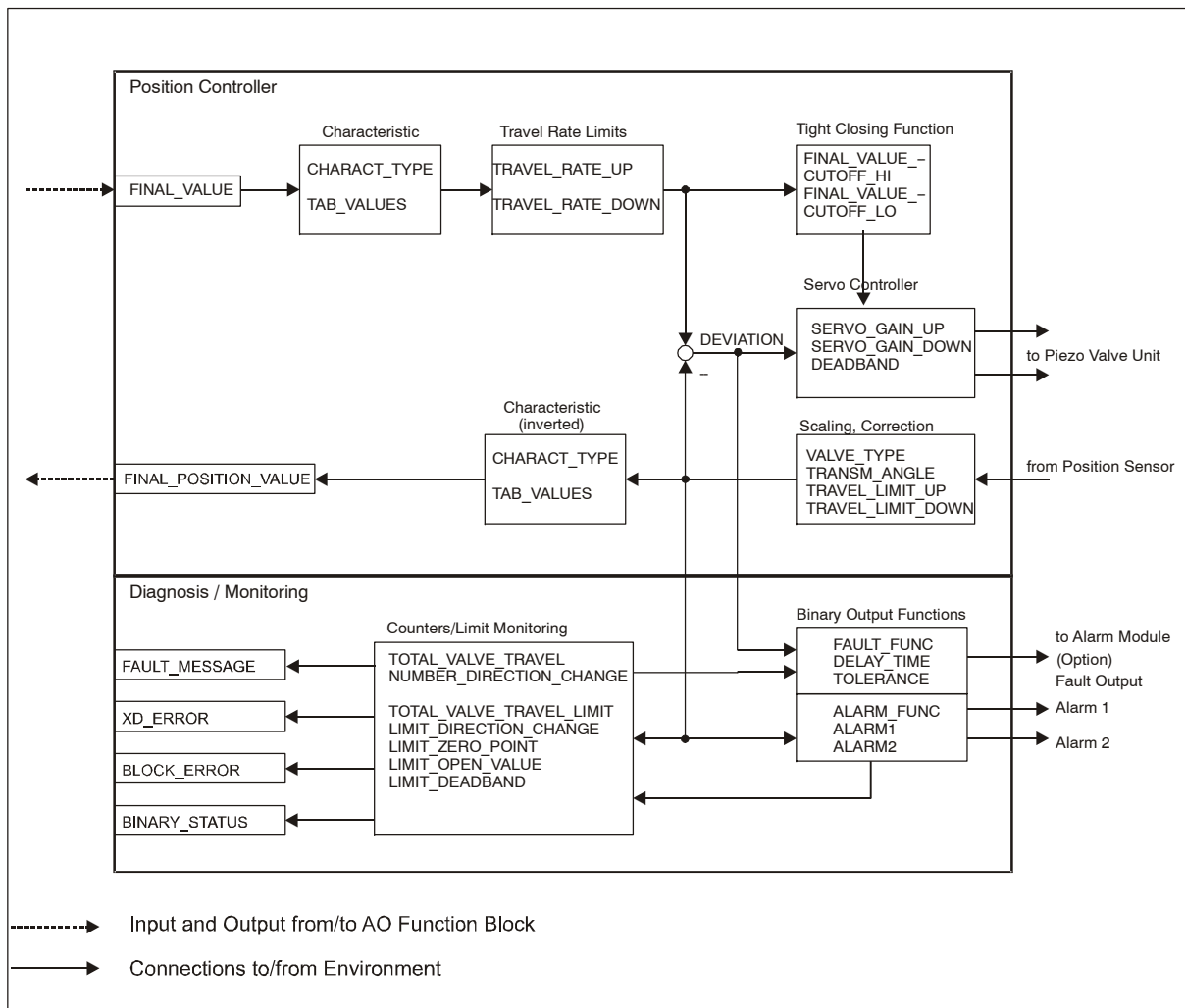


Figure 5-3 Function schematic of Analog Output transducer block

5.4.2 Parameter description

The transducer block contains all parameters as defined in the preliminary specification [FF-903 PS 3.0] for a standard advanced positioner valve. There are many additional manufacturer specific parameters to allow a perfect adaptation to all kind of actuators and valves and provide many useful information about the armature and the process.

Transducer Block		
Label/Name/Handling	Index (rel.)	Description/Format
ACT_FAIL_ACTION Actuator Fail Action Read & Write	21	Specifies the action the actuator takes in case of failure. The value is only informative and has no influence on the behaviour of the positioner. Possible values: 0: Undefined 3: Hold last value 1: Self-Closing 4: Maximum value 2: Self-Opening 5: Minimum value 255: Indeterminate Data format: Unsigned8 Default value: 255 (Indeterminate)
ACT_MAN_ID Actuator Manufacturer Id Read & Write	22	The actuator manufacturer's identification number as defined by the Fieldbus Foundation. Data format: Unsigned32
ACT_MODEL_NUM Actuator Model Number Read & Write	23	The actuator model number. Data format: Visible String (32 Byte)
ACT_SN Actuator Serial Number Read & Write	24	The actuator serial number. Data format: Visible String (32 Byte)
ACT_STROKE_TIME_DOWN Min. travel time from 'OPEN' to 'CLOSE' Read only	55	This time, measured during initialization, is the minimum time, which the actuator needs to run through the rated stroke/rated angle from 'OPEN' to 'CLOSE' direction. Data format: Float-Value (4 Byte)
ACT_STROKE_TIME_UP Min. travel time from 'CLOSE' to 'OPEN' Read only	56	This time, measured during initialization, is the minimum travel time, which the actuator needs to run through the rated stroke/rated angle from 'CLOSE' to 'OPEN' direction. Data format: Float-Value (4 Byte)

Transducer Block		
Label/Name/Handling	Index (rel.)	Description/Format
ALARM_FUNC Alarm function (AFCT) Read & Write	47	The positioner can report the exceeding (Max.) or dropping below (Min) of a specified stroke or angle of rotation. The response of the alarms is related to the mechanical position (see TRAVEL_LIMIT_DOWN, TRAVEL_LIMIT_UP and Y_NORM). The alarms are reported by the alarm module (option) and by BINARY_STATUS. The direction of action of the alarm can be set to High active (e.g. 'Alarm 1: Min, Alarm 2: Max') or Low active (e.g. 'Alarm 1: /Min, Alarm 2: /Max'). 0: Off, Without function. 1: MI: MA (Alarm 1: Min, Alarm 2: Max) 2: MI: MI (Alarm 1: Min, Alarm 2: Min) 3: MA: MA (Alarm 1: Max, Alarm 2: Max) 4: /MI:/MA (Alarm 1: /Min, Alarm 2: /Max) inverted 5: /MI:/MI (Alarm 1: /Min, Alarm 2: /Min) inverted 6: /MA:/MA (Alarm 1: /Max, Alarm 2: /Max) inverted Data format: Unsigned8 Default value: 0 (Off, Without function)
ALARM1 Response threshold of alarm 1 (A1) Read & Write	48	The response threshold (0 to 100%) for Alarm 1 is related to the mechanical way (see TRAVEL_LIMIT_DOWN, TRAVEL_LIMIT_UP and Y_NORM). Note, if the alarm is outside TRAVEL_LIMIT_DOWN / UP, the alarm can only occur, when FINAL_VALUE_CUTOFF_HI / LO is activated. Depending on the parameterization of the alarm function (ALARM_FUNC), the Alarm is activated on exceeding (Max) or dropping below (Min) this response threshold. Data format: Float-Value (4 Byte) Value range: 0.0 % 100.0 % Default value: 10.0 %
ALARM2 Response threshold of alarm 2 (A2) Read & Write	49	See ALARM1. Data format: Float-Value (4 Byte) Value range: 0.0 % 100.0 % Default value: 90.0 %
ALERT_KEY Alert Key Read & Write	4	The identification number of the plant unit. This information may be used in the host for sorting alarms, etc. Data format: Unsigned8 Value range: 1 255 Default value: 0

Transducer Block		
Label/Name/Handling	Index (rel.)	Description/Format
BIN_IN_FUNCT Function of binary input (BIN) Read & Write	46	The function of the binary input (BIN) can be set individually according to the purpose. These functions can only be used with the option Alarm Module. The direction of action can be adapted to an NCC or an NOC. * + or High means: Action at high level at binary input (switch contact is closed). * – or Low means: Action at low level at the binary input (switch contact is opened). 0: OFF 1: –ON / only message (Low) 2: +ON / only message (High) 3: BLOC1 / block configuration mode 4: BLOC2 / block configuration and manual mode 5: +UP / drive valve to 'UP' position (High) 6: +DOWN / drive valve to 'DOWN' position (High) 7: +STOP / Block movement (High) 8: –UP / drive valve to 'UP' position (Low) 9: –DOWN / drive valve to 'DOWN' position (Low) 10: –STOP / Block movement (Low) Data format: Unsigned8 Default value: 0 (OFF)
BINARY_STATUS State of the binary signals Read only	51	Status information of the binary signals. Bit 0: Simulate input Bit 3: Alarm output 2 Bit 1: Binary input Bit 4: Fault output Bit 2: Alarm output 1 Data format: Bit-String with 8 Bits (1 Byte)
BLOCK_ALM (Record) 1. UNACKNOWLEDGED 2. ALARM_STATE 3. TIME_STAMP 4. SUB_CODE 5. VALUE	8 8.1 8.2 8.3 8.4 8.5	See Resource Block
BLOCK_ERR Block Error Read only	6	This parameter reflects the error status associated with the hardware or software components associated with a block. It is a bit string, so that multiple errors may be shown. The following bits are supported: Bit 0: Other. See XD_ERROR for more information. Bit 1: Block Configuration. The user defined characteristic has violated the monotonic condition (See TAB_VALUES). Bit 8: Output Failure. The deviation of the positioner has exceeded the limit. Bit 13: Device Needs Maintenance Now. Limits, e.g. strokes, direction change, etc., has exceeded. Bit 15: Out Of Service. Actual mode is out-of-service Data format: Bit-String with 16 Bits (2 Byte)

Transducer Block		
Label/Name/Handling	Index (rel.)	Description/Format
CHARACT_TYPE Setpoint function (SFCT) Read & Write	36	Non-linear valve characteristics can be linearized with this function and any flow characteristics simulated in linear valve characteristics. The 'LINEAR' setting means that the linearization is switched off. The entry of individual setpoint vertex points (Free) can be changed by TAB_VALUES. 0: Linear 1: Equal percentage 1:25 2: Equal percentage 1:33 3: Equal percentage 1:50 4: Equal percentage inverse 25:1 (n1:25) 5: Equal percentage inverse 33:1 (n1:33) 6: Equal percentage inverse 50:1 (n1:50) 7: Free (user defined) Data format: Unsigned8 Default value: 0 (Linear)
COLLECTION_DIRECTORY Collection Directory / Characteristics Read only	12	A directory that specifies the number, starting indices, and DD Item IDs of the data collections in each transducer within a transducer block. Data format: Unsigned32
DEADBAND Dead zone of controller (DEBA) Read & Write	38	The dead zone can be entered as a percentage of the way in this parameter. The way corresponds to the output signal range (start value and end value). The dead zone is constantly adapted to the requirements of the control circuit in the 'AUTO' mode (value = -120.0). The initial value is used. Data format: Float-Value (4 Byte) Value range: -120.0 %, 0.1 % 10.0 % Default value: -120.0 % (Auto)
DELAY_TIME Delay time for fault message (\TIM) Read & Write	41	The monitoring time for setting the fault messages (in seconds) can be set in this parameter. The initial value is valid in the 'AUTO' mode (value = -120.0). The position controller must have reached the controlled state within the set time. The corresponding response threshold can be entered by TOLERANCE_BAND. The fault message output is activated on exceeding the set time. Data format: Float-Value (4 Byte) Value range: -120.0, 0.0 sec 100.0 sec Default value: -120.0 (Auto)
DEVIATION Setpoint deviation Read only	53	Deviation between 'setpoint' and 'readback' in % of the travel span (span between OPEN and CLOSED). See also Fig 5-3. Data format: Float-Value (4 Byte)
DEVICE_CONFIG_DATE Configuration date Read & Write	77	The date of the last configuration can be entered in ASCII code in this parameter (e.g. 12.01.2001) Data format: Visible String (16 Byte)

Transducer Block		
Label/Name/Handling	Index (rel.)	Description/Format
END_VALUE_P100 End value P100(current) Read only	80	This value indicates the way measured value (value of the potentiometer voltage in %) at the top hard stop as it was determined in automatic initialization. In manual initialization the value of the manually reached upper limit position is indicated here. Data format: Float-Value (4 Byte)
FAULT_FUNCT Function fault output (\FCT) Read & Write	43	The fault message output on the optional alarm module serves as a group message for different controller faults. This fault message output can also signal when the position controller is not in automatic mode or the binary input (BIN_IN_FUNCT) is activated. The fault message is also reported by BIN_STATUS. <ul style="list-style-type: none"> • Normal means: High level without fault. • Inverted means: Low level without fault. • The character '+' means a logic OR operation. 0: \ Fault 1: \nA (Fault + not automatic) 2: \nAb (Fault + not automatic + binary input) 3: -\ (Fault / inverted) 4: -\nA (Fault + not automatic / inverted) 5: -\nAb (Fault + not automatic + BI / inverted) Data format: Unsigned8 Default value: 0 (\ Fault)
FAULT_MESSAGE State of fault messages Read only	52	The FAULT_MESSAGE shows different controller faults: Bit 0: System deviation Bit 1: No automatic Bit 2: Binary input Bit 3: TOTOL_VALVE_TRAVEL_LIM exceeded Bit 4: LIM_DIRECTION_CHANGE exceeded Bit 5: LIM_ZERO_POINT exceeded Bit 6: LIM_OPEN_VALUE exceeded Bit 7: LIM_DEADBAND exceeded Data format: Bit-String with 16 Bits (2 Byte)
FINAL_POSITION_VALUE (Record) Final Position Value 1. STATUS QUALITY Status SUBSTA- TUS Read & Write LIMITS	17 17.1	The actual valve position and status, linked to the READBACK in the AO block. Data format: Record with 2 Parameters (5 Byte) The status of the value. This additional, valuable information will be passed along with each transmission of a data value in the form of a status attribute. Status can be: Bad / Out of Service / Not limited, when the block is in mode O/S. Good (Cascade) / Local Override / Not limited, when local key switches are used to move the valve. Good (Cascade) / Non-specific / Not limited, in normal operation. See PID-Block → BKCAL_IN Data format: Unsigned8

Transducer Block		
Label/Name/Handling	Index (rel.)	Description/Format
2. VALUE Value Read & Write	17.2	The actual valve position, calculated backward from the position sensor. A programmed linearization characteristics (CHARACT_TYPE) and travel limits (TRAVEL_LIMIT_DOWN / UP) are taken into account. Normally, the range is from 0 to 100%. If FINAL_VALUE_CUTOFF_HI /LO are used, the range can exceed. Data format: Float-Value (4 Byte)
FINAL_VALUE (Record) Final Value	13	The proposed valve position and status, linked to the OUT of the AO block. If the AO is in mode O/S this value can be written directly. Data format: Record with 2 Parameters (5 Byte)
1. STATUS QUALITY Status SUBSTA- TUS Read & Write LIMITS	13.1	The status has to be Good (Cascade) / Non-specific, that the transducer block will accept the value. See PID-Block → BKCAL_IN
2. VALUE Value Read & Write	13.2	The proposed valve position. A programmed linearization characteristics (CHARACT_TYPE) and travel limits (TRAVEL_LIMIT_DOWN / UP) are taken into account. The range is from 0 to 100%. Data format: Float-Value (4 Byte)
FINAL_VALUE_ CUTOFF_HI Final Value Hi Cutoff Read & Write	15	If the FINAL_VALUE is more positive than this value, the valve is forced to full opened. Data format: Float-Value (4 Byte) Value range: 0.0 100.0 Default value: 1.#INF (Not active)
FINAL_VALUE_ CUTOFF_LO Final Value Lo Cutoff Read & Write	16	If the FINAL_VALUE is more negative than this value, the valve is forced to full closed. Data format: Float-Value (4 Byte) Value range: 0.0 100.0 Default value: -1.#INF (Not active)
FINAL_VALUE_RANGE (Record) Final Value Range	14	The High and Low range limit values, the engineering units code and the number of digits to the right of the decimal point to be used to display the Final Value. Data format: Record with 4 Parameters (11 Byte)
1. EU_100 EU at 100% Read & Write	14.1	The engineering unit value which represents the upper end of range of the associated block parameter. Data format: Float-Value (4 Byte) Value range: Only 100.0 % possible Default value: 100.0
2. EU_0 EU at 0% Read & Write	14.2	The engineering unit value which represents the lower end of range of the associated block parameter. Data format: Float- Value (4 Byte) Value range: Only 0.0 % possible Default value: 0.0

Transducer Block		
Label/Name/Handling	Index (rel.)	Description/Format
3. UNITS_INDEX Units Index Read & Write	14.3	Device Description units code index for the engineering unit descriptor for the associated block value. Data format: Unsigned16 Value range: Only % possible Default value: % (1342)
4. DECIMAL Decimal Read & Write	14.4	The number of digits to the right of the decimal point which should be used by an interface device in displaying the specified parameter. Data format: Unsigned8 Default value: 1
INIT_VALUES (Record) Initialization parameters	85	The initialization data of a positioner can be read out and transmitted to another positioner. Therefore it is possible to exchange a defective device without interrupting the running process by an initialization. After downloading the INIT_VALUES to a not-initialization device, the initialization state must be set to INIT by SERVICE_UPDATE. For correct operation of the positioner execute SELF_CALIB_COMMAND as soon as possible. Data format: Record with 17 Parameters (28 Byte)
1. INIT_SLIP_CLUTCH_ADJ_FLAG Slip clutch adjustment flag Read & Write	85.1	This flag indicates whether the slip clutch has been adjusted. Data format: Unsigned8
2. INIT_SAFTY_POSITION_FLAG Safety position flag Read & Write	85.2	This flag indicates the direction of the safety position. Data format: Unsigned8
3. INIT_PULS_LENGTH_UP Pulse length 'UP' Read & Write	85.3	This value indicates the current pulse length for the up direction (in ms). This is the smallest pulse length with which movement of the actuator in the up direction can be achieved. Data format: Unsigned8
4. INIT_PULS_LENGTH_DOWN Pulse length 'DOWN' Read & Write	85.4	This value indicates the current pulse length for the down direction (in ms). This is the smallest pulse length with which movement of the actuator in the down direction can be achieved. Data format: Unsigned8
5. INIT_ACT_TIME_UP Actuating time 'UP' Read & Write	85.5	This value indicates the current upward actuating time (in seconds). Data format: Unsigned16
6. INIT_ACT_TIME_DOWN Actuating time 'DOWN' Read & Write	85.6	This value indicates the current downward actuating time (in seconds). Data format: Unsigned16

Transducer Block		
Label/Name/Handling	Index (rel.)	Description/Format
7. INIT_SERVO_GAIN_DOWN Short step zone 'DOWN' Read & Write	85.7	This value indicates the current short step zone of the positioner for the down direction. The short step zone is the range of the positioner in which pulse-type control signals are output. The pulse length is proportional to the system deviation. If the system deviation is outside the short step zone, the valves are controlled with maintained contact. Data format: Signed16
8. INIT_SERVO_GAIN_UP Short step zone 'UP' Read & Write	85.8	This value indicates the current short step zone of the positioner for the up direction. The short step zone is the range of the positioner in which pulse-type control signals are output. The pulse length is proportional to the system deviation. If the system deviation is outside the short step zone, the valves are controlled with maintained contact. Data format: Signed16
9. INIT_REF_VALUE_HORIZ_LEVER Reference value for horizontal lever Read & Write	85.9	This is the reference value for correction in the case of linear actuators. Data format: Signed16
10. INIT_ZERO_POINT_P0 Zero point P0 Read & Write	85.10	This is the current position detection value (potentiometer voltage in %) at the lower stop. Data format: Unsigned16
11. INIT_END_VALUE_P100 End stop P100 Read & Write	85.11	This is the current position detection value (potentiometer voltage in %) at the upper stop. Data format: Signed16
12. INIT_PREDICTION_UP Prediction 'UP' Read & Write	85.12	This value specifies the prediction horizon of the positioner for the upward movement. Data format: Signed16
13. INIT_PREDICTION_DOWN Prediction 'DOWN' Read & Write	85.13	This value specifies the prediction horizon of the positioner for the downward movement. Data format: Signed16
14. INIT_DEAD_ZONE_ADAPT_TIME Dead zone adaptation time Read & Write	85.14	This value indicates the adaptation time for the dead zone. Data format: Unsigned16
15. INIT_RATED_TRAVEL Real travel Read & Write	85.15	This value indicates the current real travel (in mm or °). It corresponds to the display at the end of initialization. Prerequisite in the case of linear actuators: The lever is specified with the TRANSM_LENGTH parameter. Data format: Unsigned16

Transducer Block		
Label/Name/Handling	Index (rel.)	Description/Format
16. INIT_ROTARY_ACT_END_FLAG Rotary actuator end stop flag Read & Write	85.16	This flag indicates whether the end stop of the rotary actuator has been reached. Data format: Unsigned8
17. INIT_INTERPULSE_PERIODE_LEN Interpulse period length Read & Write	85.17	This value indicates the min. interpulse period length. Data format: Unsigned8
LEAKAGE Leakage(current) Read only	83	This value indicates the current leakage (in %/min) if leakage measurement was specified during initialization. Data format: Float-Value (4 Byte)
LIMIT_DEADBAND Limit for dead zone monitoring (DEBA) Read & Write	66	The automatic adaptation of the dead zone can be monitored with this value (in percent). Monitoring needs setting the parameter 'DEADBAND' to -120.0 (AUTO). If the dead zone exceeds the set value, the fault message output is activated. This monitoring function can be deactivated with the 'OFF' setting (value = -120.0). Data format: Float-Value (4 Byte) Value range: 0.1 % 10.0 % Default value: -120.0 % (OFF)
LIMIT_DIRECTION_CHANGE Limit for direction changes (DCHG) Read & Write	63	A limit value for the direction change counter can be set here. If this counter exceeds the limit value, the fault message output is activated. This monitoring function can be deactivated with the 'OFF' setting (value = 0). Data format: Unsigned32 Value range: 1 1000000000 Default value: 0 (OFF)
LIMIT_OPEN_VALUE Limit for end stop monitoring, top (OPEN) Read & Write	65	A limit value (in percent related to the total mechanical way) for the monitoring of the upper hard stop can be set here. This function detects when the top stop has changed by more than the set tolerance value related to its initialization value. Detecting needs to activate FINAL_VALUE_CUTOFF_HI. If this tolerance value is exceeded or dropped below of, the fault message output is activated. This monitoring function can be deactivated with the 'OFF' setting (value = -120.0). Data format: Float-Variable (4 Byte) Value range: 0.0 % 100.0 % Default value: -120.0 % (OFF)
LIMIT_ZERO_POINT Limit for end stop monitoring, bottom (ZERO) Read & Write	64	A limit value (in percent related to the total mechanical way) for the monitoring of the lower hard stop can be set here. This function detects when the bottom stop has changed by more than the set tolerance value related to its initialization value. Detecting needs to activate FINAL_VALUE_CUTOFF_LO. If this tolerance value is exceeded or dropped below of, the fault message output is activated. This monitoring function can be deactivated with the 'OFF' setting (value = -120.0). Data format: Float-Variable (4 Byte) Value range: 0.0 % 100.0 % Default value: -120.0 % (OFF)

Transducer Block		
Label/Name/Handling	Index (rel.)	Description/Format
MAINTENANCE_DATE Maintenance date Read & Write	78	The date on which the valve was last serviced can be entered in ASCII code in this parameter (e.g. 12.01.2001) Data format: Visible String (16 Byte)
MAX_TEMPERATURE Maximum temperature / TMAX Read only	59	This value indicates the maximum temperature inside the housing. The value is written to non-volatile memory every 15 minutes in the form of a drag pointer. The maximum temperature can be displayed in °C or °F depending on the TEMPERATURE_UNIT setting. Data format: Float-Value (4 Byte)
MIN_TEMPERATURE Minimum temperature / TMIN Read only	60	This value indicates the minimum temperature inside the housing. The value is written to non-volatile memory every 15 minutes in the form of a drag pointer. The minimum temperature can be displayed in °C or °F depending on the TEMPERATURE setting. Data format: Float-Value (4 Byte)
MODE_BLK (Record) Block Mode	5	The actual, target, permitted, and normal modes of the block. Data format: Record with 4 Parameters (4 Byte)
1. TARGET Target Read & Write	5.1	This is the mode requested by the operator. Target Mode is limited to the values allowed by the permitted mode parameter. Bit 3: Auto (Automatic Mode) Bit 7: O/S (Out Of Service) Data format: Bit-String with 8 Bits (1 Byte)
2. ACTUAL Actual Read only	5.2	This is the current mode of the block, which may differ from the target based on operating conditions. Its value is calculated as part of block execution. Bit 3: Auto (Automatic Mode) Bit 7: O/S (Out Of Service) Data format: Bit-String with 8 Bits (1 Byte)
3. PERMITTED Permitted Read & Write	5.3	Defines the modes which are allowed for an instance of the block. The permitted mode is configured based on application requirement. Bit 3: Auto (Automatic Mode) Bit 7: O/S (Out Of Service) Data format: Bit-String with 8 Bits (1 Byte) Default value: 0x11 (Auto O/S)
4. NORMAL Normal Read & Write	5.4	This is the mode which the block should be set to during normal operating conditions. Bit 3: Auto (Automatic Mode) Data format: Bit-String with 8 Bits (1 Byte) Default value: 0x10 (Auto)
NUMBER_ALARMS Number of alarms (\CNT} Read only	67	All faults during operation are totalized and can be read here as 'Number of fault messages'. The value is written to non-volatile memory every 15 minutes and can be reset to zero with the parameter SERVICE_UPDATE. Data format: Unsigned32 Value range: 0 1,000,000,000

Transducer Block		
Label/Name/Handling	Index (rel.)	Description/Format
NUMBER_ALARMS_1 Number of alarm 1 (A1CNT) Read only	68	Every response of Alarm 1 is totalized in operation and can be read here as 'Number of Alarm 1'. The prerequisite for this is that this alarm is activated with the parameter ALARM_FUNCT. The value is written to non-volatile memory every 15 minutes and can be reset to zero with the parameter SERVICE_UPDATE. Data format: Unsigned32 Value range: 0 1,000,000,000
NUMBER_ALARMS_2 Number of alarm 2 (A2CNT) Read only	69	Every response of Alarm 2 is totalized in operation and can be read here as 'Number of Alarm 2'. The prerequisite for this is that this alarm is activated with the parameter ALARM_FUNCT. The value is written to non-volatile memory every 15 minutes and can be reset to zero with the parameter SERVICE_UPDATE. Data format: Unsigned32 Value range: 0 1,000,000,000
NUMBER_CYCLES_VALVE_1 Number of cycles valve 1 (VENT 1) Read only	70	This counter counts the control cycles of pilot valve 1. The value is written to non-volatile memory every 15 minutes. Data format: Unsigned32 Value range: 0 1,000,000,000
NUMBER_CYCLES_VALVE_2 Number of cycles valve 2 (VENT 2) Read only	71	This counter counts the control cycles of pilot valve 2. The value is written to non-volatile memory every 15 minutes. Data format: Unsigned32 Value range: 0 1,000,000,000
NUMBER_DIRECTION_CHANGE Number of direction changes (CHDIR) Read only	72	During operation, all changes in direction are totaled and can be read here as 'Number of changes in direction'. The value is written to non-volatile memory every 15 minutes and can be reset to zero with the parameter SERVICE_UPDATE. Data format: Unsigned32 Value range: 0 1,000,000,000
PREV_CALIB_VALUES (Record) Calibration information	84	Information of the last calibration can be stored in this parameter by SERVICE_UPDATE. Data format: Record with 11 Parameters (44 Byte)
1. PREV_ZERO_POINT_P0 Zero point P0(old) Read only	84.1	This is the position detection value (potentiometer voltage in %) measured at the lower limit, as determined at the last service. Data format: Float-Value (4 Byte)
2. PREV_END_VALUE_P100 End value P100(old) Read only	84.2	This is the position detection value (potentiometer voltage in %) measured at the upper limit, as determined at the last service. Data format: Float-Value (4 Byte)
3. PREV_ACT_TIME_UP Actuating time 'UP'(old) Read only	84.3	This value indicates the upward actuating time (in seconds) determined during the last service. Data format: Float-Value (4 Byte)
4. PREV_ACT_TIME_DOWN Actuating time 'DOWN'(old) Read only	84.4	This value indicates the downward actuating time (in seconds) determined during the last service. Data format: Float-Value (4 Byte)

Transducer Block		
Label/Name/Handling	Index (rel.)	Description/Format
5. PREV_PULSE_LENGTH_UP Pulse length 'UP'(old) Read only	84.5	This value indicates the current pulse length for the up direction (in ms) determined during the last service. This is the shortest pulse length with which movement of the actuator in the up direction can be achieved. Data format: Float-Value (4 Byte)
6. PREV_PULSE_LENGTH_DOWN Pulse length 'DOWN'(old) Read only	84.6	This value indicates the current pulse length for the down direction (in ms) determined during the last service. This is the shortest pulse length with which movement of the actuator in the down direction can be achieved. Data format: Float-Value (4 Byte)
7. PREV_DEADBAND Dead zone(old) Read only	84.7	This value indicates the dead zone of the positioner in % determined during the last service. Data format: Float-Value (4 Byte)
8. PREV_SERVO_GAIN_DOWN Servo gain 'DOWN'(old) Read only	84.8	Gain value of the servo controller 'DOWN'. Data format: Float-Value (4 Byte)
9. PREV_SERVO_GAIN_UP Servo gain 'UP'(old) Read only	84.9	Gain value of the servo controller 'UP'. Data format: Float-Value (4 Byte)
10. PREV_RATED_TRAVEL Real positioning travel(old) Read only	84.10	This value indicates the real positioning travel (in mm or °) determined during the last service. Data format: Float-Value (4 Byte)
11. PREV_LEAKAGE Leakage(old) Read only	84.11	This value indicates the leakage (in %/min) determined during the last maintenance. Data format: Float-Value (4 Byte)
PULS_LENGTH_DOWN Pulse length 'DOWN'(current) Read only	82	This value indicates the current pulse length for the down direction (in ms) determined during initialization. This is the shortest pulse length with which movement of the actuator in the down direction can be achieved. Data format: Float-Value (4 Byte)
PULS_LENGTH_UP Pulse length 'UP'(current) Read only	81	This value indicates the current pulse length for the up direction (in ms) determined during initialization. This is the shortest pulse length with which movement of the actuator in the up direction can be achieved. Data format: Float-Value (4 Byte)
RATED_TRAVEL Real positioning travel / WAY(current) Read only	54	This value indicates the current real positioning travel (in mm or °) determined during initialization. This value corresponds to the display at the end of initialization. Prerequisite for stroke actuators: The lever must be specified with the TRANSM_LENGTH parameter. Data format: Float-Value (4 Byte) Value range: 0.0 999.9

Transducer Block		
Label/Name/Handling	Index (rel.)	Description/Format
SELF_CALIB_COMMAND Initialization command Read & Write	44	Initiation of the device-specific (manufacturer specific) initialization-procedure. 0x00: No function 0x02: Start initialization 0xF0: Stop initialization Data format: Unsigned8 Default value: 0 (No function)
SELF_CALIB_STATUS Initialization status Read only	45	Status of the device-specific (manufacturer specific) initialization. 0x00: Device not initialized 0x01: Initialization: RUN 1 0x02: Initialization: RUN 2 0x03: Initialization: RUN 3 0x04: Initialization: RUN 4 0x05: Initialization: RUN 5 0xF1: Error in RUN 1 0xF2: Error in RUN 2 0xFE: Initialization OK Data format: Unsigned8
SERVICE_UPDATE Save/Reset Write only	76	Allows you to save the current values as last service or to reset the values of the last service to zero. Also, some read only counter can be reset. For 'Set device to state INIT' see INIT_VALUES. 0: No function 1: Save (last service) 2: Reset (last service) 3: Set device to state INIT 4: Reset counter: Number of 100% strokes (STRKS) 5: Reset counter: Number of dir. changes (CHDIR) 6: Reset counter: Number of alarms (\CNT) 7: Reset counter: Number of alarm 1 (A1CNT) 8: Reset counter: Number of alarm 2 (A2CNT) Data format: Unsigned16 Default value: 0 (No function)
SERVO_GAIN_DOWN Servo gain 'DOWN' Read & Write	18	Gain value of the servo controller 'DOWN'. Data format: Float-Value (4 Byte) Value range: 1.0 1000.0 Default value: 1.0
SERVO_GAIN_UP Servo gain 'UP' Read & Write	19	Gain value of the servo controller 'UP'. Data format: Float-Value (4 Byte) Value range: 1.0 1000.0
SERVO_RATE Servo Rate Read & Write	20	The servo PID rate value (Not used) Data format: Float-Value (4 Byte) Not supported, set to 1.0

Transducer Block		
Label/Name/Handling	Index (rel.)	Description/Format
ST_REV Static Revision Read only	1	The revision level of the static data associated with the function block. The revision value will be incremented each time a static parameter value in the block is changed. Data format: Unsigned16
STRATEGY Strategy Read & Write	3	The strategy field can be used to identify grouping of blocks. This data is not checked or processed by the block. Data format: Unsigned16 Default value: 0x0000
TAB_VALUES (Record) Characterization	37	At a distance of 5% a flow parameter can be assigned to the respective setpoint coordinate whereby two consecutive coordinates must differ by at least 0.2%. These points lead to a polygon train with 20 straight line sections for projecting the valve characteristic. Attention: The characteristic must be monotonously rising. Data format: Record with 21 Parameters (84 Byte)
1. TAB_VALUE0 Setpoint turning point at 0% (SL0) Read & Write	37.1	The characteristic value at 0% setpoint. Data format: Float-Value (4 Byte) Value range: 0.0 % 100.0 % Default value: 0.0 %
2. TAB_VALUE1 Setpoint turning point at 5% (SL1) Read & Write	37.2	The characteristic value at 5% setpoint. Data format: Float-Value (4 Byte) Value range: 0.0 % 100.0 % Default value: 5.0 %
3. TAB_VALUE3 to	37.4	The characteristic value at 10% to 90% setpoint. Data format: Float-Value (4 Byte)
19. TAB_VALUE18	37.19	Value range: 0.0 % 100.0 % Default value: 10.0 % to 90.0 %
20. TAB_VALUE19 Setpoint turning point at 95% (SL19) Read & Write	37.20	The characteristic value at 95% setpoint. Data format: Float-Value (4 Byte) Value range: 0.0 % 100.0 % Default value: 95.0 %
21. TAB_VALUE20 Setpoint turning point at 100% (SL20) Read & Write	37.21	The characteristic value at 100% setpoint. Data format: Float-Value (4 Byte) Value range: 0.0 % 100.0 % Default value: 100.0 %
TAG_DESC Tag Description Read & Write	2	The user description of the intended application of the block. Data format: Octet-String (32 Byte)
TEMPERATURE Current temperature / TEMP Read only	57	This value indicates the current temperature inside the housing. This temperature can be measured and displayed in °C or °F depending on the TEMPERATURE_UNIT. Data format: Float-Value (4 Byte)

Transducer Block		
Label/Name/Handling	Index (rel.)	Description/Format
TEMPERATURE_UNIT Dimension temperature Read & Write	58	The temperature can be measured and displayed in °C or °F. 1001: °C 1002: °F Data format: Unsigned16 Default value: °C (1001)
TEST_ACTIVATE Activate test function Write only	73	Used by manufacturer, do not change. Data format: Unsigned8
TEST_FUNCTION (Record) Select test function	74	Used by manufacturer, do not change. Data format: Record with 3 Parameters (32 Byte)
TEST_READ Read test result Read only	75	Used by manufacturer. Data format: Octet-String (32 Byte)
TOLERANCE_BAND Response threshold for fault message (\LIM) Read & Write	42	In this parameter a value (%) can be set for the permissible variable of control error for releasing the fault message. The initial value is valid in the 'AUTO' mode. After parameterization 'TOLERANCE_BAND = AUTO' (value = -120.0) and 'DELAY_TIME = AUTO' (value = -120.0) the fault message is set when the slow step zone has not been reached within the valid time (within 5 to 95% of the way 2 times and outside 10 to 90% 10 times the initialization time). Data format: Float-Value (4 Byte) Value range: 0.0 % 100.0 % Default value: -120.0 (Auto)
TOTAL_VALVE_TRAVEL Number of 100% strokes (STRKS) Read only	61	The movements of the actuator are totalized during operation (unit: 100% strokes) and can be read here as number of strokes. The value is written to non-volatile memory every 15 minutes and can be reset to zero with the parameter SERVICE_UPDATE. Data format: Unsigned32 Value range: 0 1,000,000,000
TOTAL_VALVE_TRAVEL_LIM Limit for stroke integral / 100% strokes (\STRK) Read & Write	62	A limit value for the movements of the actuator (unit: 100% strokes) can be set here. If the TOTAL_VALVE_TRAVEL exceeds this limit value, the fault message output is activated. This monitoring function can be deactivated with the 'Off' setting (value = 0). Data format: Unsigned32 Value range: 1 1,000,000,000 Default value: 0 (OFF)
TRANSDUCER_DIRECTORY Transducer Directory Entry/ Characteristics Read only	9	A directory that specifies the number and starting indices of the data collections in the transducer block. Data format: Unsigned16 Default value: 0x0000

Transducer Block		
Label/Name/Handling	Index (rel.)	Description/Format
TRANSDUCER_TYPE Transducer Type Read only	10	Identifies the transducer that follows. 100: Standard Pressure with Calibration 101: Standard Temperature with Calibration 102: Standard Dual Temperature with Calibration 103: Standard Radar Level with Calibration 104: Standard Flow with Calibration 105: Standard Basic Positioner Valve 106: Standard Advanced Positioner Valve 107: Standard Discrete Valve 65535: Other Data format: Unsigned16 Default value: 106 (Standard Advanced Positioner Valve)
TRANSM_ANGLE Rated angle of rotation of feedback (YAGL) Read & Write	32	Rated angle of rotation of feedback. In linear actuator (VALVE_TYPE = WAY) a value of 33° or 90° can be selected depending on the stroke range: * 33° for strokes <= 20mm. * 90° for strokes >= 25mm. Important: The setting of the gear transmission switch on the control regulator must match the selected angle value. 0: 90° 1: 33° Data format: Unsigned8 Default value: 1 (33°)
TRANSM_LENGTH Lever arm transmission/stroke range (YWAY) Read & Write	33	Lever arm transmission. This parameter serves to display the real stroke after initialization. The parameter need only be set when a determined way (VALVE_TYPE = WAY) is to be displayed in mm at the end of initialization of a linear actuator. If this parameter has been set to 'Off', the real stroke is not displayed after initialization. 0: Off 1: 5mm / short lever 33° 8: 40mm / long lever 90° 2: 10mm / short lever 33° 9: 50mm / long lever 90° 3: 15mm / short lever 33° 10: 60mm / long lever 90° 4: 20mm / short lever 33° 11: 70mm / long lever 90° 5: 25mm / short lever 90° 12: 90mm / long lever 90° 6: 30mm / short lever 90° 13: 110mm / long lever 90° 7: 35mm / short lever 90° 14: 130mm / long lever 90° Data format: Unsigned8 Default value: 0 (OFF)

Transducer Block		
Label/Name/Handling	Index (rel.)	Description/Format
TRAVEL_LIMIT_DOWN Start of manipulated variable limiting (YA) Read & Write	39	With the parameters TRAVEL_LIMIT_DOWN and TRAVEL_LIMIT_UP the mechanical travel (from stop to stop) is limited to the set values. In this way the mechanical travel range of the actuator can be limited to the active flow and the integral saturation of the commanding controller avoided. Data format: Float-Value (4 Byte) Value range: 0.0 % 100.0 % Default value: 0.0 %
TRAVEL_LIMIT_UP End of manipulated variable limiting (YE) Read & Write	40	See TRAVEL_LIMIT_DOWN. Data format: Float-Value (4 Byte) Value range: 0.0 % 100.0 % Default value: 100.0 %
TRAVEL_RATE_DOWN Setpoint ramp 'DOWN' (TSDO) Read & Write	34	See TRAVEL_RATE_UP. Data format: Float-Value (4 Byte) Value range: 0 sec 400 sec Default value: 0 (max. speed down)
TRAVEL_RATE_UP Setpoint ramp 'UP' (TSUP) Read & Write	35	The setpoint ramp is effective in automatic operation and limits the speed of alteration of the active setpoint. When switching over from automatic operation to manual operation , the time can be specified with TRAVEL_RATE_UP / TRAVEL_RATE_DOWN in which the active setpoint is to be adapted to the setpoint applied to the device in the upward / downward movement. But movement cannot be faster than shown in ACT_STROKE_TIME_UP / ACT_STROKE_TIME_DOWN. In the position 'TSUP = AUTO' (value = -120) the slower of the two travel times determined during initialization is used for the setpoint ramp. The parameter 'TSDO' is then ineffective. Data format: Float-Value (4 Byte) Value range: 0 sec 400 sec. / -120 = Auto Default value: 0 (max. speed up)
UPDATE_EVT (Record) 1. UNACKNOWLEDGED 2. UPDATE_STATE 3. TIME_STAMP 4. STATIC_REVISION 5. RELATIVE_INDEX	7 7.1 7.2 7.3 7.4 7.5	See Resource Block
VALVE_MAN_ID Valve Manufacturer Id Read & Write	25	The valve manufacturer's identification number as defined by the Fieldbus Foundation. Data format: Unsigned32
VALVE_MODEL_NUM Valve Model Number Read & Write	26	The valve model number. Data format: Visible String (32 Byte)
VALVE_SN Valve Serial Number Read & Write	27	The valve serial number. Data format: Visible String (32 Byte).

Transducer Block		
Label/Name/Handling	Index (rel.)	Description/Format
VALVE_TYPE Type of actuator (YFCT) Read & Write	28	You can choose between a linear or rotary actuator with different position sensors. 1: WAY (linear actuator with rotary potentiometer) 2: TURN (rotary actuator with rotary potentiometer) 240: LWAY (linear actuator with thrust potentiometer) 241: NCST (rotary actuator with NC-sensor) 242: -NCST (rotary actuator with NC-sensor 'inverse') 243: NCSL (linear actuator with NC-sensor) 244: NCSLL (linear actuator with NC-sensor/lever) Data format: Unsigned8 Default value: 1 { WAY (linear actuator) }
XD_CAL_DATE Transducer Calibration Date Read & Write	30	The date of the last positioner calibration. Data format: Time of Day (7 Byte)
XD_CAL_LOC Transducer Calibration Location Read & Write	29	The physical location at which the last positioner calibration was performed. Data format: Visible String (32 Byte)
XD_CAL_WHO Transducer Calibration Who Read & Write	31	The name of the person responsible for the last positioner calibration. Data format: Visible String (32 Byte)
XD_ERROR Transducer Error Read only	11	One of the transducer error codes defined in the FF Transducer Specifications in section 4.8 Block Alarm Subcodes. 17: General error 18: Calibration error 19: Configuration error Data format: Unsigned8
Y_NORM Feedback normalization (YNRM) Read & Write	50	Two different scalings are produced for the display and the position feedback with the limiting of the manipulated variable by YA and YE. * The 'MPOS scaling' shows the mechanical position (from 0 to 100%) between the hard stops of the initialization. This is not influenced by the parameters YA and YE. * The 'FLOW scaling is in the range from 0 to 100%. The FINAL_POSITION_VALUE is displayed. 0: MPOS (to mech. travel) 1: FLOW (to flow) Data format: Unsigned8 Default value: 0 { MPOS (to mech. travel) }
ZERO_POINT_PO Zero point P0(current) Read only	79	This is the position detection value (potentiometer voltage in %) measured at the lower limit, as determined at automatic installation. In the case of manual initialization, the value of the lower end position approached manually appears here. Data format: Float-Value (4 Byte)

5.4.3 Device Description

The device description contains a description of all parameters, a hierarchical parameter menu and a collection of methods.

5.5 PID Function Block (PID)

5.5.1 Overview

The PID function block implements a PID control algorithm. The source of setpoint SP depends on the actual block mode and can be the parameter SP itself (in mode AUTO), the input CAS_IN (in mode CAS) or the value of RCAS_IN (in mode RCAS). In mode MAN the output OUT can be set directly to the desired value.

The Process Value to be controlled is connected to the IN input. This value is passed through a filter whose time constant is PV_FTIME.

There is a switch for BYPASS, which is available to the operator if the Bypass Enable control option is true. Bypass is used in secondary cascade controllers that have a bad PV. The Bypass Enable option is necessary because not all cascade control schemes will be stable if BYPASS is true. BYPASS can only be changed when the block mode is Man or O/S. While it is set, the value of SP, in percent of range, is passed directly to the target output, and the value of OUT is used for BKCAL_OUT. When the mode is changed to Cas, the upstream block is requested to initialize to the value of OUT. When a block is in Cas mode, then on the transition out of bypass, the upstream block is requested to initialize to the PV value, regardless of the "Use PV for BKCAL_OUT" option.

GAIN, RESET, and RATE are the tuning constants for the P, I, and D terms, respectively. Gain is a dimensionless number. RESET and RATE are time constants expressed in seconds. There are existing controllers that are tuned by the inverse value of some or all of them, such as proportional band and repeats per minute. The human interface to these parameters should be able to display the user's preference.

If RESET is set to infinity, the integral part of the PID has no effect during normal operation. But it is still used internally to allow bumpless switching from Manual to Automatic mode by adjusting the working point accordingly. If RESET is set to 0s, the integral part is set to zero, thus giving a fixed working point.

The derivative part defined by RATE is smoothed by a first order filter to reduce the effect of process noise. The time constant of this filter is $0.2 \cdot \text{RATE}$, if its not limited by the loop time.

The Direct Acting control option, if true, causes the output to increase when the PV exceeds the SP. If false, the output will decrease when the PV exceeds the SP. It will make the difference between positive and negative feedback, so it must be set properly, and never changed while in an automatic mode. The setting of the option must also be used in calculating the limit state for BKCAL_OUT.

The output supports the feed forward algorithm. The FF_VAL input brings in an external value which is proportional to some disturbance in the control loop. The value is converted to percent of output span using the values of parameter FF_SCALE. This value is multiplied by the FF_GAIN and added to the target output of the PID algorithm. If the status of FF_VAL is Bad, the last usable value will be used, because this prevents bumping the output. When the status returns to good, the block will adjust its integral term to maintain the previous output.

The output supports the track algorithm.

There is an option to use either the SP value after limiting or the PV value for the BKCAL_OUT value.

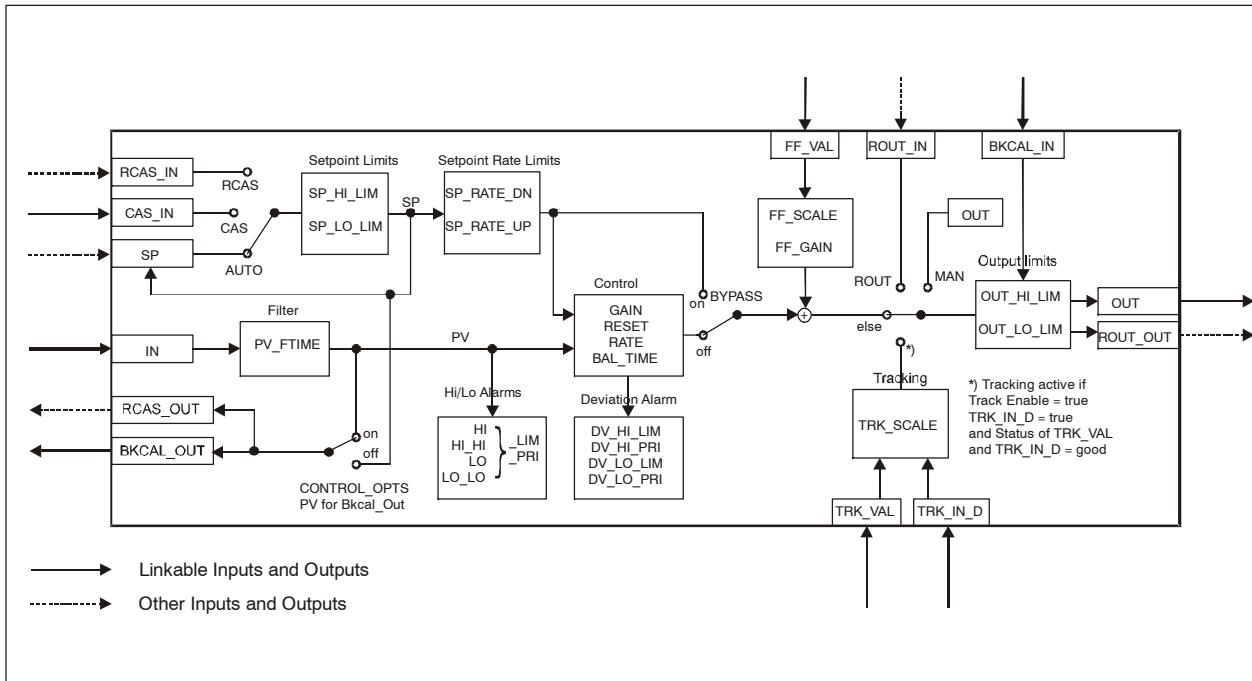


Figure 5-4 Overview Function Blocks

5.5.2 Parameter description

The PID block contains all standard parameters as specified in [FF-891-1.5]. There are no additional manufacturer specific parameters.

PID Block		
Label/Name/Handling	Index (rel.)	Description/Format
ACK_OPTION Acknowledge Option Read & Write	46	Selection of whether alarms associated with the block will be automatically acknowledged. Bit Clear: Auto acknowledge disabled Bit Set: Auto acknowledge enabled Bit 0: Write has been disabled Bit 1: High High Alarm Bit 2: High Alarm Bit 3: Low Low Alarm Bit 4: Low Alarm Bit 5: Deviation High Alarm Bit 6: Deviation Low Alarm Bit 7: Block Alarm Data format: Bit-String with 16 Bits (2 Byte) Default value: 0
ALARM_HYS Alarm Hysteresis Read & Write	47	Amount the PV must return within the alarm limits before the alarm condition clears. Alarm hysteresis expressed as a percent of the span of the PV. Data format: Float-Value (4 Byte) Value range: 0.0 % 50.0 % Default value: 0.5 %
ALARM_SUM (Record) 1. CURRENT 2. UNACKNOWLEDGED 3. UNREPORTED 4. DISABLED	45 45.1 45.2 45.3 45.4	See Resource Block
ALERT_KEY Alert Key Read & Write	4	The identification number of the plant unit. This information may be used in the host for sorting alarms, etc. Data format: Unsigned8 Value range: 1 255 Default value: 0
BAL_TIME Balance Time Read & Write	25	This specifies the time for the internal working value of bias or ratio to return to the operator set bias or ratio, in seconds. In the PID block, it may be used to specify the time constant at which the integral term will move to obtain balance when the output is limited and the mode is Auto, Cas, or RCas. Data format: Float-Value (4 Byte) Value range: ≥ 0.0 Sec Default value: 0.0 Sec

PID Block		
Label/Name/Handling	Index (rel.)	Description/Format
BKCAL_HYS Back Calculation Hysteresis Read & Write	30	The amount that the block output must change away from its output limit before the limit status is turned off, expressed as a percent of the span of the output. Data format: Float-Value (4 Byte) Value range: 0.0 % 50.0 % Default value: 0.5 %
BKCAL_IN (Record) Back Calculation Input	27	The value and status used for backwards tracking of the output, provided by a link to a downstream block's back calculation output parameter. Data format: Record with 2 Parameters (5 Byte)
1. STATUS QUALITY Status SUBSTATUS LIMITS Read & Write	27.1	This additional, valuable information will be passed along with each transmission of a data value in the form of a status attribute. Bit 7, 6 QUALITY Bit 5, 4, 3, 2 SUBSTATUS Bit 1, 0 LIMITS See FF-890 FS 1.5 Data format: Unsigned8
2. VALUE Value Read & Write	27.2	A numerical quantity received by the block parameter from another block parameter to which this block is linked. Or a default or user entered value if the parameter has not been linked. Data format: Float-Value (4 Byte)
BKCAL_OUT (Record) Back Calculation Output	31	The output value and status provided to an upstream block for output tracking when the loop is broken or limited, as determined by the status bits.
1. STATUS 2. VALUE	31.1 31.2	This information is used to provide bumpless transfer to closed loop control and to prevent windup under limited conditions when that becomes possible. See PID-Block → BKCAL_IN
BLOCK_ALM (Record) 1. UNACKNOWLEDGED 2. ALARM_STATE 3. TIME_STAMP 4. SUB_CODE 5. VALUE	44 44.1 44.2 44.3 44.4 44.5	See Resource Block
BYPASS Bypass Read & Write	17	The normal control algorithm may be bypassed through this parameter. When bypass is set, the setpoint value (in percent) will be directly transferred to the output. To prevent a bump on transfer to/from bypass, the setpoint will automatically be initialized to the output value or process variable, respectively, and the path broken flag will be set for one execution. 0: Uninitialized 1: Off 2: On Data format: Unsigned8 Default value: 0 (Uninitialized)

PID Block		
Label/Name/Handling	Index (rel.)	Description/Format
BLOCK_ERR Block Error Read only	6	This parameter reflects the error status associated with the hardware or software components associated with a block. It is a bit string, so that multiple errors may be shown. Bit 1: Block Configuration Bit 15: Out Of Service Data format: Bit-String with 16 Bits (2 Byte)
CAS_IN (Record) Cascade Input 1. STATUS 2. VALUE	18 18.1 18.2	This parameter is the remote setpoint value, which must come from another Fieldbus block, or a DCS block through a defined link. See PID-Block → BKCAL_IN
CONTROL_OPTS Control Options Read & Write	13	Options which the user may select to alter the calculations done in a control block. Bit 0: Bypass Enable Bit 1: Setpoint-Process variable Track Man Bit 2: Setpoint-Process variable Track Rout Bit 3: Setpoint-Process variable Track LO-IMan Bit 4: Setpoint Track retain Bit 5: Direct acting Bit 7: Track enable Bit 8: Track in manual Bit 9: Process variable for BKCal_Out Bit 12: Restrict Setpoint to limits in Cas and RCas Bit 13: No output limits in Man Data format: Bit-String with 16 Bits (2 Byte) Default value: 0
DV_HI_ALM (Record) Deviation High Alarm 1. UNACKNOWLEDGED 2. ALARM_STATE 3. TIME_STAMP 4. SUB_CODE 5. VALUE	64 64.1 64.2 64.3 64.4 64.5	The status and time stamp associated with the high deviation alarm. See Resource Block
DV_HI_LIM Deviation High Limit Read & Write	57	The setting of the high deviation alarm limit in engineering units. Data format: Float-Value (4 Byte) Default value: 1.#INF (Not active)
DV_HI_PRI Deviation High Priority Read & Write	56	Priority of the high deviation alarm. Data format: Unsigned8 Value range: 0 15 Default value: 0

PID Block		
Label/Name/Handling	Index (rel.)	Description/Format
DV_LO_ALM (Record) Deviation Low Alarm 1. UNACKNOWLEDGED 2. ALARM_STATE 3. TIME_STAMP 4. SUB_CODE 5. VALUE	65 65.1 65.2 65.3 65.4 65.5	The status and time stamp associated with the low deviation alarm. See Resource Block
DV_LO_LIM Deviation Low Limit Read & Write	59	Setting of the low deviation alarm limit in engineering units. Data format: Float-Value (4 Byte) Default value: -1.#INF (Not active)
DV_LO_PRI Deviation Low Priority Read & Write	58	Priority of the low deviation alarm. Data format: Unsigned8 Value range: 0 15 Default value: 0
FF_GAIN Feed Forward Gain Read & Write	42	The gain that the feed forward input is multiplied by before it is added to the calculated control output. Data format: Float-Value (4 Byte) Default value: 0.0
FF_SCALE (Record) Feed Forward Scale 1. EU_100 EU at 100% Read & Write 2. EU_0 EU at 0% Read & Write 3. UNITS_INDEX Units Index Read & Write 4. DECIMAL Decimal Read & Write	41 41.1 41.2 41.3 41.4	The feed forward input high and low scale values, engineering units code, and number of digits to the right of the decimal point. Data format: Record with 4 Parameters (11 Byte) The engineering unit value which represents the upper end of range of the associated block parameter. Data format: Float-Value (4 Byte) Default value: 100.0 % The engineering unit value which represents the lower end of range of the associated block parameter. Data format: Float-Value (4 Byte) Default value: 0.0 % Device Description units code index for the engineering unit descriptor for the associated block value. Data format: Unsigned16 Default value: 0 The number of digits to the right of the decimal point which should be used by an interface device in displaying the specified parameter. Data format: Unsigned8 Default value: 0
FF_VAL (Record) Feed Forward Value 1. STATUS 2. VALUE	40 40.1 40.2	The feed forward value and status. See PID-Block → BKCAL_IN
GAIN Gain Read & Write	23	Dimensionless value used by the block algorithm in calculating the block output. Data format: Float-Value (4 Byte) Default value: 0.0

PID Block		
Label/Name/Handling	Index (rel.)	Description/Format
GRANT_DENY (Record) Grant Deny 1. GRANT 2. DENY	12	Options for controlling access of host computers and local control panels to operating, tuning, and alarm parameters of the block. See Resource Block
HI_ALM (Record) High Alarm 1. UNACKNOWLEDGED 2. ALARM_STATE 3. TIME_STAMP 4. SUB_CODE 5. VALUE	61 61.1 61.2 61.3 61.4 61.5	The status for high alarm and its associated time stamp. See Resource Block
HI_HI_ALM (Record) High High Alarm 1. UNACKNOWLEDGED 2. ALARM_STATE 3. TIME_STAMP 4. SUB_CODE 5. VALUE	60 60.1 60.2 60.3 60.4 60.5	The status for high high alarm and its associated time stamp. See Resource Block
HI_HI_LIM High High Limit Read & Write	49	The setting for high high alarm in engineering units. Data format: Float-Value (4 Byte) Default value: 1.#INF (Not active)
HI_HI_PRI High High Priority Read & Write	48	Priority of the high high alarm. Data format: Unsigned8 Value range: 0 15 Default value: 0
HI_LIM High Limit Read & Write	51	The setting for high alarm in engineering units. Data format: Float-Value (4 Byte) Default value: 1.#INF (Not active)
HI_PRI High Priority Read & Write	50	Priority of the high alarm. Data format: Unsigned8 Value range: 0 15 Default value: 0
IN (Record) Input 1. STATUS 2. VALUE	15 15.1 15.2	Primary input value of the block, required for blocks that filter the input to get the PV. See PID-Block → BKCAL_IN
LO_ALM (Record) Low Alarm 1. UNACKNOWLEDGED 2. ALARM_STATE 3. TIME_STAMP 4. SUB_CODE 5. VALUE	62 62.1 62.2 62.3 62.4 62.5	The status of the low alarm and its associated time stamp. See Resource Block

PID Block		
Label/Name/Handling	Index (rel.)	Description/Format
LO_LIM Low Limit Read & Write	53	The setting for the low alarm in engineering units. Data format: Float-Value (4 Byte) Default value: -1.#INF (Not active)
LO_LO_ALM (Record) Low Low Alarm 1. UNACKKNOWLEDGED 2. ALARM_STATE 3. TIME_STAMP 4. SUB_CODE 5. VALUE	63 63.1 63.2 63.3 63.4 63.5	The status of the low low alarm and its associated time stamp. See Resource Block
LO_LO_LIM Low Low Limit Read & Write	55	The setting of the low low alarm in engineering units. Data format: Float-Value (4 Byte) Default value: -1.#INF (Not active)
LO_LO_PRI Low Low Priority Read & Write	54	Priority of the low low alarm. Data format: Unsigned8 Value range: 0 15 Default value: 0
LO_PRI Low Priority Read & Write	52	Priority of the low alarm. Data format: Unsigned8 Value range: 0 15 Default value: 0
MODE_BLK (Record) Block Mode	5	The actual, target, permitted, and normal modes of the block. Data format: Record with 4 Parameters (4 Byte)
1. TARGET Target Read & Write	5.1	This is the mode requested by the operator. Only one mode from those allowed by the permitted mode parameter may be requested. Bit 0: ROut (Remote Ouput) Bit 1: RCas (Remote Cascade) Bit 2: Cas (Cascade Mode) Bit 3: Auto (Automatic Mode) Bit 4: Man (Manual Mode) Bit 7: O/S (Out Of Service) Data format: Bit-String with 8 Bits (1 Byte)
2.ACTUAL Actual Read only	5.2	This is the current mode of the block, which may differ from the target based on operating conditions. Its value is calculated as part of block execution. Bit 0: ROut (Remote Ouput) Bit 1: RCas (Remote Cascade) Bit 2: Cas (Cascade Mode) Bit 3: Auto (Automatic Mode) Bit 4: Man (Manual Mode) Bit 5: LO (Local Override) Bit 6: IMan (Initializ. Man.) Bit 7: O/S (Out Of Service) Data format: Bit-String with 8 Bits (1 Byte)

PID Block		
Label/Name/Handling	Index (rel.)	Description/Format
3. PERMITTED Permitted Read & Write	5.3	Defines the modes which are allowed for an instance of the block. The permitted mode is configured based on application requirement. Bit 0: ROut (Remote Output) Bit 1: RCas (Remote Cascade) Bit 2: Cas (Cascade Mode) Bit 3: Auto (Automatic Mode) Bit 4: Man (Manual Mode) Bit 7: O/S (Out Of Service) Data format: Bit-String with 8 Bits (1 Byte). Default value: 0xF9 (ROut RCas Cas Auto Man O/S)
4. NORMAL Normal Read & Write	5.4	This is the mode which the block should be set to during normal operating conditions. Bit 0: ROut (Remote Output) Bit 1: RCas (Remote Cascade) Bit 2: Cas (Cascade Mode) Bit 3: Auto (Automatic Mode) Bit 4: Man (Manual Mode) Bit 7: O/S (Out Of Service) Data format: Bit-String with 8 Bits (1 Byte) Default value: 0x10 (Auto)
OUT (Record) Output	9	The primary analog value calculated as a result of executing the function block.
1. STATUS	9.1	See PID-Block → BKCAL_IN
2. VALUE	9.2	
OUT_HI_LIM Output High Limit Read & Write	28	Limits the maximum output value for modes other than Manual. Data format: Float-Value (4 Byte) Default value: 100.0
OUT_LO_LIM Output Low Limit Read & Write	29	Limits the minimum output value for modes other than Manual. Data format: Float-Value (4 Byte) Default value: 0.0
OUT_SCALE (Record) Output Scale	11	The high and low scale values, engineering units code, and number of digits to the right of the decimal point to be used in displaying the OUT parameter and parameters which have the same scaling as OUT.
1. EU_100	11.1	
2. EU_0	11.2	See PID-Block → FF_SCALE
3. UNITS_INDEX	11.3	
4. DECIMAL	11.4	
PV (Record) Process Value Read only	7	Either the primary analog value for use in executing the function, or a process value associated with it. May also be calculated from the READBACK value of an AO block.
1. STATUS	7.1	
2. VALUE	7.2	See PID-Block → BKCAL_IN

PID Block		
Label/Name/Handling	Index (rel.)	Description/Format
PV_FTME Process Value Filter Time Read & Write	16	Time constant of a single exponential filter for the PV, in sec. Data format: Float-Value (4 Byte) Value range: ≥ 0.0 Sec Default value: 0.0 Sec
PV_SCALE (Record) Process Value Scale 1. EU_100 2. EU_0 3. UNITS_INDEX 4. DECIMAL	10 10.1 10.2 10.3 10.4	The high and low scale values, engineering units code, and number of digits to the right of the decimal point to be used in displaying the PV parameter and parameters which have the same scaling as PV. See PID-Block \rightarrow FF_SCALE
RATE Rate Read & Write	26	Defines the derivative time constant, in seconds. Data format: Float-Value (4 Byte) Default value: 0.0
RCAS_IN (Record) Remote Cascade Input 1. STATUS 2. VALUE	32 32.1 32.2	Target setpoint and status provided by a supervisory Host to a analog control or output block. See PID-Block \rightarrow BKCAL_IN
RCAS_OUT (Record) Remote Cascade Output 1. STATUS 2. VALUE	35 35.1 35.2	Block setpoint and status after ramping – provided to a supervisory Host for back calculation and to allow action to be taken under limiting conditions or mode change. See PID-Block \rightarrow BKCAL_IN
RESET Reset Read & Write	24	The integral time constant, in seconds per repeat. Data format: Float-Value (4 Byte) Default value: 1.#INF Sec
ROUT_IN (Record) Remote Out Input 1. STATUS 2. VALUE	33 33.1 33.2	Target output and status provided by a Host to the control block for use as the output (ROut mode) See PID-Block \rightarrow BKCAL_IN
ROUT_OUT (Record) Remote Out Output 1. STATUS 2. VALUE	36 36.1 36.2	Block output and status – provided to a Host for back calculation in ROut mode and to allow action to be taken under limited conditions or mode change. See PID-Block \rightarrow BKCAL_IN
SHED_OPT Shed Options Read & Write	34	Defines action to be taken on remote control device timeout. 0: Uninitialized 1: Normal Shed_Normal Return 2: Normal Shed_No Return 3: Shed To Auto_Normal Return 4: Shed To Auto_No Return 5: Shed To Manual_Normal Return 6: Shed To Manual_No Return 7: Shed To Retained Target_Normal Return 8: Shed To Retained Target_No Return Data format: Unsigned8 Default value: 0 (Uninitialized)

PID Block		
Label/Name/Handling	Index (rel.)	Description/Format
SP (Record) Setpoint 1. STATUS 2. VALUE	8 8.1 8.2	The analog setpoint of this block. See PID-Block → BKCAL_IN
SP_HI_LIM Setpoint High Limit Read & Write	21	The setpoint high limit is the highest setpoint operator entry that can be used for the block. Data format: Float-Value (4 Byte) Default value: 100.0
SP_LO_LIM Setpoint Low Limit Read & Write	22	The setpoint low limit is the lowest setpoint operator entry that can be used for the block. Data format: Float-Value (4 Byte) Default value: 0.0
SP_RATE_DN Setpoint Rate Down Read & Write	19	Ramp rate at which downward setpoint changes are acted on in Auto mode, in PV units per second. If the ramp rate is set to zero or the block is in a mode other than Auto, then the setpoint will be used immediately. Data format: Float-Value (4 Byte) Value range: ≥ 0.0 [PV/Sec] Default value: 1.#INF (Not active)
SP_RATE_UP Setpoint Rate Up Read & Write	20	Ramp rate at which upward setpoint changes are acted on in Auto mode, in PV units per second. If the ramp rate is set to zero or the block is in a mode other than Auto, then the setpoint will be used immediately. Data format: Float-Value (4 Byte) Value range: ≥ 0.0 [PV/Sec] Default value: 1.#INF (Not active)
ST_REV Static Revision Read only	1	The revision level of the static data associated with the function block. The revision value will be incremented each time a static parameter value in the block is changed. Data format: Unsigned16
STATUS_OPTS Status Options Read & Write	14	Options which the user may select in the block processing of status. Bit 0: Initiate Fault State if Bad IN Bit 1: Initiate Fault State if Bad CAS_IN Bit 2: Uncertain as Good Bit 5: Target to Man if Bad IN Bit 9: Target to next permitted mode if BAD CAS_IN Data format: Bit-String with 16 Bits (2 Byte) Default value: 0
STRATEGY Strategy Read & Write	3	The strategy field can be used to identify grouping of blocks. This data is not checked or processed by the block. Data format: Unsigned16 Default value: 0x0000
TAG_DESC Tag Description Read & Write	2	The user description of the intended application of the block. Data format: Octet-String (32 Byte)

PID Block		
Label/Name/Handling	Index (rel.)	Description/Format
TRK_IN_D (Record) Tracking Input Discrete 1. VALUE Value Read & Write 2. STATUS QUALITY Status SUBSTATUS Read & Write LIMITS	38 38.1 38.2	This discrete input is used to initiate external tracking of the block output to the value specified by TRK_VAL. Data format: Record with 2 Parameters (2 Byte) A numerical quantity received by the block parameter from another block parameter to which this block is linked. Or a default or user entered value if the parameter has not been linked. 0 Discrete state 0 (False/Off/Close) 1 Discrete state 1 (True/On/Open) Data format: Unsigned8 This additional, valuable information will be passed along with each transmission of a data value in the form of a status attribute. See PID-Block → BKCAL_IN
TRK_SCALE (Record) Tracking Scale 1. EU_100 2. EU_0 3. UNITS_INDEX 4. DECIMAL	37 37.1 37.2 37.3 37.4	The high and low scale values, engineering units code, and number of digits to the right of the decimal point associated with TRK_VAL. See PID-Block → FF_SCALE
TRK_VAL (Record) Tracking Value 1. STATUS 2. VALUE	39 39.1 39.2	This input is used as the track value when external tracking is enabled by TRK_IN_D. See PID-Block → BKCAL_IN
UPDATE_EVT (Record) Update Event 1. UNACKNOWLEDGED 2. UPDATE_STATE 3. TIME_STAMP 4. STATIC_REVISION 5. RELATIVE_INDEX	43 43.1 43.2 43.3 43.4 43.5	This alert is generated by any change to the static data. See Resource Block

5.5.3 Options

The effect of the option bits of the parameters CONTROL_OPTS, STATUS_OPTS and SHED_OPT are described in the following sections.

CONTROL_OPTS

These are options the user may select to alter the calculation done in the PID block.

Bypass Enable

This parameter, if true, allows BYPASS to be set. Some control algorithm applications cannot provide closed loop control if bypassed.

SP–PV Track in Man

Permits the setpoint to track the process variable when the target mode of the block is Man.

SP–PV Track in ROut

Permits the setpoint to track the process variable when the actual mode of the block is ROut.

SP–PV Track in LO or IMan

Permits the setpoint to track the process variable when the actual mode of the block is LO or IMan.

SP Track retained target

Permits the setpoint to track the RCas or Cas parameter based on the retained target mode when the actual mode of the block is IMan, LO, Man, or ROut. When SP–PV track options are enabled, then SP Track retained target will have precedence in the selection of the value to track when the actual mode is Man, IMan, Rout, and LO.

Direct Acting

Defines the relationship between a change in PV and corresponding change in output. When Direct is selected, an increase in PV results in an increase in the output.

Track Enable

This enables the external tracking function. If true, the value in TRK_VAL will replace the value of OUT if TRK_IN_D becomes true and the target mode is not Man.

Track in Manual

This enables TRK_VAL to replace the value of OUT when the target mode is Man and TRK_IN_D is true. The actual mode will then be LO.

Use PV for BKCAL_OUT

The BKCAL_OUT and RCAS_OUT values are normally the working SP. If this option is enabled, then the PV value will be used after the cascade is closed.

Obey SP limits if Cas or RCas

Normally the setpoint will not be restricted to the setpoint limits except when entered by a human interface device. However, if this option is selected, the setpoint will be restricted to the setpoint absolute limits in the Cas and RCas modes.

No OUT limits in Manual

Do not apply OUT_HI_LIM or OUT_LO_LIM when target and actual modes are Man. Trust the operator to do the right thing.

STATUS_OPTS

Options which the user may select in the block processing of status.

IFS if BAD IN

Set Initiate Fault State status in the OUT parameter if the status of the IN parameter is BAD.

IFS if BAD CAS_IN

Set Initiate Fault State status in the OUT parameter if the status of the CAS_IN parameter is BAD.

Use Uncertain as Good

If the status of the IN parameter is Uncertain, treat it as Good. Otherwise, treat it as BAD.

Target to Manual if BAD IN

Set the target mode to Man if the status of the IN parameter is BAD. This latches a PID block into the Man state if the input ever goes bad.

Set the output status of an input or calculation block to uncertain if the actual mode of the block is Man. Target to Next Permitted Mode if BAD

CAS_IN

Set the target mode to next permitted mode if the target mode is CAS and the status of CAS_IN is BAD. This latches a control block into the next permitted mode if the CAS_IN is being used in control and the status goes bad.

SHED_OPTS

Defines action to be taken on remote control device timeout.

- 0 = Undefined – Invalid
- 1 = Normal shed, normal return – Actual mode changes to the next lowest priority non-remote mode permitted but returns to the target remote mode when the remote computer completes the initialization handshake.
- 2 = Normal shed, no return – Target mode changes to the next lowest priority non-remote mode permitted. The target remote mode is lost, so there is no return to it.
- 3 = Shed to Auto, normal return
- 4 = Shed to Auto, no return – Target mode changes to Auto on detection of a shed condition.
- 5 = Shed to Manual, normal return
- 6 = Shed to Manual, no return – Target mode changes to Man on detection of a shed condition. When the target mode is set to Manual, the Retained bits will be set to zero (0).
- 7 = Shed to Retained target, normal return
- 8 = Shed to Retained target, no return
(change target to retained target)

5.5.4 Device Description

The device description is based on the standard device description for PID function blocks. An additional hierarchical parameter menu has been added.

The positioner is largely maintenance-free. The positioners are fitted with filters in the pneumatic connections as protection against coarse particles of dirt. This dirt will be deposited under pressure on to the filter and the filters may clog and impair the function of the positioner. In this case the filters can be cleaned as follows.

Positioner in metal housing and explosion-proof version

1. Switch off the pneumatic power supply and remove the pipes.
2. Remove the metal filters carefully from the holes and clean (e.g. with compressed air).
3. Insert the filters.
4. Re-connect the pipes and supply pneumatic energy.

Positioner in plastic housing

Removal

1. Switch off the pneumatic power supply and remove the pipes.
2. Unscrew the cover
3. Remove the three screws from the pneumatic connector strip.
4. Remove the filters and O-rings behind the connector strip.
5. Clean the filters (e.g. with compressed air).

Installation

6. First insert the filters in the recesses in the plastic housing and then place the O-rings on the filters.
7. Align the pneumatic connector strip on the two lugs and screw tight with the three self-tapping screws.

Important:

Make sure that the same thread is used. To do this turn the screws counterclockwise until they snap into the thread audibly. Only then should you tighten the screws.

8. Replace the cover and screw it tight.
9. Re-connect the pipes and supply pneumatic energy.



DANGER

Electrostatic charging must be prevented in hazardous areas. These could be caused by example when cleaning the positioner in plastic housing with a dry cloth.

Repair/Upgrade

Faulty equipment should be sent to the repair department with details of the fault and its origin. When ordering replacement equipment, please specify the serial number of the original equipment. You will find the serial number on the type plate.

Address of the responsible repair location, your contact, lists of spare parts etc. can all be found on the Internet, under:

www.siemens.com/automation/services&support or
www.automation.siemens.com/partner

Technical Data

7

(see following pages)

Technical specifications

SIPART PS2 (all versions)

General data

Travel range (linear actuators)	3 ... 130 mm (0.12 ... 5.12 inch) (angle of feedback shaft 16 ... 90°)
Angle of rotation (part-turn actuators)	30 ... 100°
Installation	
• On linear actuators	Using attachment set 6DR4004-8V and where necessary with an additional lever arm 6DR4004-8L on actuators according to IEC 534-6 (NAMUR) with ribs, bars or flat face
• On part-turn actuators	Using attachment set 6DR4004-8D on actuators with mounting plane according to VDI/VDE 3845 and DIN 3337: The required mounting console has to be provided on the actuator side; shaft with groove and female thread M6
Controller	
• Five-point switch	Self-adjusting
• Dead zone - dEbA = Auto	Self-adjusting or can be set as fixed value
- dEbA = 0.1 ... 10%	Self-adjusting or can be set as fixed value
A/D converter	
• Scan time	10 ms
• Resolution	≤ 0.05%
• Transmission error	≤ 0.2%
• Temperature effect	≤ 0.1%/10 K (≤ 0.1%/18 °F)
Cycle time	
• 20 mA/HART device	20 ms
• PA device	60 ms
• FF device	60 ms (min. loop time)
Binary input BE1 (terminals 9/10; electrically connected to the basic device)	Suitable only for floating contact; max. contact load < 5 mA with 3 V device)
Degree of protection ¹⁾	IP66 to EN 60 529/NEMA 4x
Mounting position	Any; pneumatic connections and exhaust opening not facing up in wet environment
CE marking	Conformity as regards EMC Directive 89/336 EC in accordance with the following standards
EMC requirements	EN 61326/A1 Appendix A.1 and NAMUR NE21 August 98
Material	
• Housing	
- 6DR5..0-... (plastic)	Glass-fiber-reinforced Macrolon
- 6DR5..1-... (metal)	GD AISi12
- 6DR5..2-... (stainless steel)	Austenitic stainless steel mat. No. 1.4581
- 6DR5..5-... (metal, pressure-proof)	GK AISi12
• Pressure gauge block	Aluminium AlMgSi, anodized
Vibration resistance	
• Harmonic oscillations (sine-wave) according to DIN EN 60062-2-6/05.96	3.5 mm (0.14 inch), 2 ... 27 Hz 3 cycles/axis 98.1 m/s ² (321.84 ft/s ²), 27 ... 300 Hz, 3 cycles/axis

• Bumping (half-sine) to DIN EN 60068-2-29/03.95	150 m/s ² (492 ft/s ²), 6 ms, 1000 shocks/axis
• Noise (digitally controlled) to DIN EN 60068-2-64/08.95	10 ... 200 Hz; 1 (m/s ²) ² /Hz (3.28 (ft/s ²) ² /Hz) 200 ... 500 Hz; 0.3 (m/s ²) ² /Hz (0.98 (ft/s ²) ² /Hz) 4 hours/axis
• Recommended continuous duty range of the complete fitting	≤ 30 m/s ² (≤ 98.4 ft/s ²) without resonance sharpness
Weight, basic device	
• Plastic casing	Approx. 0.9 kg (0.90 kg)
• Metal casing, aluminium	Approx. 1.3 kg (1.30 kg)
• Metal casing, stainless steel	Approx. 3.9 kg (3.90 kg)
• Metal casing EEx d version	Approx. 5.2 kg (11.46 lb)
Dimensions	See Dimensional drawings
Climate class 4	To DIN EN 60721-3-4
• Storage ²⁾	1K5, but -40 ... +80 °C (1K5, but -40 ... +176 °F)
• Transport ²⁾	2K4, but -40 ... +80 °C (2K4, but -40 ... +176 °F)
• Operation ³⁾	4K3, but -30 ... +80 °C (4K3, but -22 ... +176 °F)

Certificate and approvals

Classification according to pressure equipment directive (DRGL 97/23/EC)	For gases of fluid group 1, complies with requirements of article 3, paragraph 3 (sound engineering practice SEP)
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Pneumatic data

Power supply (inlet air)	
• Pressure	1.4 ... 7 bar (20.3 ... 101.5 psi): Sufficiently greater than max. drive pressure (actuating pressure)
Air quality to ISO 8573-1	
• Solid particle size and density	Class 2
• Pressure dew point	Class 2 (min. 20 K (36 °F) below ambient temperature)
• Oil content	Class 2
Unthrottled flow	
• Inlet air valve (ventilate actuator) ⁴⁾	
- 2 bar (29 psi)	4.1 Nm ³ /h (18.1 USgpm)
- 4 bar (58 psi)	7.1 Nm ³ /h (31.3 USgpm)
- 6 bar (87 psi)	9.8 Nm ³ /h (43.1 USgpm)
• Outlet air valve (ventilate actuator) ⁴⁾	
- 2 bar (29 psi)	8.2 Nm ³ /h (36.1 USgpm)
- 4 bar (58 psi)	13.7 Nm ³ /h (60.3 USgpm)
- 6 bar (87 psi)	19.2 Nm ³ /h (84.5 USgpm)
Valve leakage	< 6 · 10 ⁻⁴ Nm ³ /h (0.0026 USgpm)
Throttle ratio	Adjustable up to ∞ : 1
Power consumption in the controlled state	< 3.6 · 10 ⁻² Nm ³ /h (0.158 USgpm)
Types of actuators	
• In plastic casing	Single-action and double-action
• In aluminium casing	Single-action
• In flameproof casing	Single-action and double-action
• In stainless steel casing	Single-action and double-action

1) Impact energy max. 1 Joule for plastic/aluminium casing.
 2) During commissioning at ≤ 0 °C (≤ 32 °F) make sure that the valves are flushed long enough with the dry medium.
 3) At ≤ -10 °C (14 °F) the display refresh rate of the LCD is limited. Only T4 is permissible when using I_y module.
 4) With EEx d version (6DR5..5-...) the values are reduced by approx. 20%

Technical specifications

SIPART PS2 FF	Basic device without Ex protection	Basic device with EEx d protection, flameproof casing	Basic device with EEx ia/ib protection
Explosion protection to EN 50014, EN 50020 and EN 50021	Without	EEx d II 2 G EEx d II C T4/T5/T6	EEx ia/ib II 2 G EEx ia/ib II C T6
Mounting location		Zone 1 or zone 2	Zone 1
Permissible ambient temperature for operation	-30 ... +80 °C (-22 ... +176 °F)	T4: -30 ... +80 °C (-22 ... +176 °F)	
At ≤ -10 °C (+14 °F) the display refresh rate of the LCD is limited.		T5: -30 ... +65 °C (-22 ... +149 °F)	
(for basic devices with Ex protection the following applies: Only T4 is permissible when using I _y module.)		T6: -30 ... +50 °C (-22 ... +122 °F)	

Electrical data

Input			
Power supply (terminals 6/7)	Bus-supplied	Bus-supplied	Bus-supplied
Bus voltage	9 ... 32 V	9 ... 32 V	9 ... 24 V
<ul style="list-style-type: none"> • Bus connection with FISCO supply unit, ia or ib group IIC or IIB - Max. supply voltage U_o - Max. short-circuit current I_o - Max. power P_o • Bus connection with barrier, ia or ib group IIC or IIB - Max. supply voltage U_o - Max. short-circuit current I_o - Max. power P_o 	—	—	17.5 V 380 mA 5.32 W
Electrical data			
Current consumption	10.5 mA ± 10%	10.5 mA ± 10%	10.5 mA ± 10%
Fault current	0 mA	0 mA	0 mA
Effective internal inductance	—	—	L _i ≤ 8 µH
Effective internal capacitance	—	—	Negligible
Connection	—	—	Certified intrinsically safe circuit
Safety shutdown can be activated with coding bridge (terminals 81/82; electrically isolated from the basic device)			
<ul style="list-style-type: none"> • Input resistance • Signal status "0" (shutdown active) • Signal status "1" (shutdown not active) • Effective Internal capacitance C_i • Effective internal inductance L_i • For connection to power supply with - Max. supply voltage U_i - Maximum short-circuit current I_i - Maximum power P_i 	> 20 kΩ 0 ... 4.5 V or unused 13 ... 30 V — — —	> 20 kΩ 0 ... 4.5 V or unused 13 ... 30 V — — —	> 20 kΩ 0 ... 4.5 V or unused 13 ... 30 V Negligible Negligible Intrinsically safe < 30 V <100 mA < 1 W
Electrical isolation	Between basic device and the input for safety shutdown, as well as the outputs of the option modules	Between basic device and the input for safety shutdown, as well as the outputs of the option modules	The basic device and the input to the safety shutdown, as well as the outputs of the option modules, are individual, intrinsically-safe circuits
Test voltage	840 V DC, 1 s	840 V DC, 1 s	840 V DC, 1 s

SIPART PS2 FF	Basic device without Ex protection	Basic device with EEx d protection, flameproof casing	Basic device with EEx ia/ib protection
Communication			
Communications group and class	According to technical specification of the Fieldbus Foundation for H1 communication		
Function blocks	Group 3, Class 31PS (publisher, subscriber) 1 resource block (RB2) 1 analog output function block (AO) 1 PID function block (PID) 1 transducer block (standard advanced positioner valve)		
Execution times of the blocks	AO: 50 ms PID: 80 ms		
Physical layer profile	123, 511		
FF registration	Tested with ITK 4.6		
Connections			
Electric	Screw terminals 2.5 AWG28-12 Cable gland M20 x 1.5 or ½-14 NPT	Screw terminals 2.5 AWG28-12 EEx d certified cable gland M20 x 1.5, ½-14 NPT or M25 x 1.5	Screw terminals 2.5 AWG28-12 Cable gland M20 x 1.5 or ½-14 NPT
Pneumatic	Female thread G¼ DIN 45 141 (¼-18 NPT)	Female thread G¼ DIN 45 141 (¼-18 NPT)	Female thread G¼ DIN 45 141 (¼-18 NPT)
External position sensor (potentiometer or NCS; as option)			
• U _o	–	–	< 5 V
• I _o	–	–	<75 mA
• I _s	–	–	<160 mA
• P _o	–	–	<120 mW
Maximum permissible external capacitance C _o	–	–	< 1 mF
Maximum permissible external inductance L _o	–	–	< 1 mH

Technical specifications

Option modules	Without Ex protection (EEx d also)	With Ex protection EEx ia/ib	With Ex protection EEx n
Ex protection to EN 50014, EN 50020 and EN 50021	–	II 2G EEx ia/ib II C T4/T5/T6	II 3G EEx nA L [L] II C T6
Mounting location	–	Zone 1	Zone 2
Permissible ambient temperature for operation (For devices with Ex protection: Only in conjunction with the basic device 6DR5...-E.... Only T4 is permissible when using I _y module)	-30 ... +80 °C (-22 ... +176 °F)	T4: -30 ... +80 °C (-22 ... +176 °F) ¹⁾ T5: -30 ... +65 °C (-22 ... +149 °F) ¹⁾ T6: -30 ... +50 °C (-22 ... +122 °F) ¹⁾	
Alarm module	6DR4004-8A (without Ex protection)	6DR4004-6A (with Ex protection)	6DR4004-6A (with Ex protection)
Binary alarm outputs A1, A2 and alarm output			
Signal status High (not responded)	Active, R = 1 kΩ, +3/-1%*	≥ 2.1 mA	≥ 2.1 mA
Signal status Low* (responded) (* Low is also the status when the basic device is faulty or has not electric power supply)	Disabled, I _R < 60 μA (* When used in the flameproof casing the current consumption is limited to 10 mA per output.)	≤ 1.2 mA (Switching threshold with supply to EN 60947-5-6: U _H = 8.2 V, R _i = 1kΩ)	≤ 1.2 mA (Switching threshold with supply to EN 60947-5-6: U _H = 8.2 V, R _i = 1kΩ)
Internal capacitance C _i	–	≤ 5.2 nF	–
Internal inductance L _i	–	Negligible	–
Power supply U _H	≤ 35 V	–	–
Connection to power circuits with	–	intrinsically safe switching amplifier EN 60947-5-6 U _o ≤ 15.5 V DC I _k ≤ 25 mA, P ≤ 64 mW	U _i ≤ 15.5 V DC
Binary input BE2			
• Electrically connected to the basic device			
- Signal status 0	Floating contact, open	Floating contact, open	Floating contact, open
- Signal status 1	Floating contact, closed	Floating contact, closed	Floating contact, closed
- Contact load	3 V, 5 μA	3 V, 5 μA	3 V, 5 μA
• Electrically isolated from the basic device			
- Signal status 0	≤ 4.5 V or open	≤ 4.5 V or open	≤ 4.5 V or open
- Signal status 1	≥ 13 V	≥ 13 V	≥ 13 V
- Natural resistance	≥ 25 kΩ	≥ 25 kΩ	≥ 25 kΩ
Static destruction limit	± 35 V	–	–
Internal inductance and capacitance	–	Negligible	–
Connection to power circuits	–	Intrinsically safe U _i ≤ 25.2 V	U _i ≤ 25.2 V DC
Electrical isolation	The 3 outputs, the input BE2 and	the basic device are electrically isolated from each other	
Test voltage	840 V DC, 1 s	840 V DC, 1 s	840 V DC, 1 s
SIA module (not for EEx d version)	6DR4004-8G (without Ex protection)	6DR4004-6G (with Ex protection)	6DR4004-6G (with Ex protection)
Limit transmitter with slot-type initiators and alarm output	2-wire connection		
Ex protection	Without	II 2 G EEx ia/ib IIC T6	II 3 G EEx nA L [L] IIC T6
Connection	2-wire system to EN 60947-5-6 (NAMUR), for switching amplifier to		be connected on load side
2 slot-type initiators	Type SJ2-SN	Type SJ2-SN	Type SJ2-SN
Function	NC (normally closed)	NC (normally closed)	NC (normally closed)
Connection to power circuits with	nominal voltage 8 V Current consumption: ≥ 3 mA (limit value not responded) ≤ 1 mA (limit value responded)	Intrinsically safe switching amplifier EN 60947-5-6 U _i ≤ 15.5 V DC I _i ≤ 25 mA, P _i ≤ 64 mW	U _i ≤ 15.5 V DC P _i ≤ 64 mW
Internal capacitance	–	≤ 41 nF	–
Internal inductance	–	≤ 100 mH	–
Electrical isolation		The 3 outputs are electrically isolated from the	basic device
Test voltage	840 V DC, 1 s	840 V DC, 1 s	840 V DC, 1 s
Alarm output	See Alarm module	See Alarm module	See Alarm module

1) Only in conjunction with the basic device 6DR5...-E..... With I_y module only T4 permitted.

Accessory modules	Without Ex protection (EEx d also)	With Ex protection EEx ia/ib	With Ex protection EEx n
Limit value contact module Limit transmitter with mechanical ground contact and alarm output Ex protection Max. switching current AC/DC Max. switching voltage AC/DC Internal capacitance C_i Internal inductance L_i Electrical isolation Test voltage Alarm module	6DR4004-8K without 4 A 250 V / 24 V – – 3150 V DC, 2 s See Alarm module	6DR4004-6K II 2 G EEx ia/ib IIC T6 Connection to intrinsically safe power circuits: $U_o \leq 30$ V $I_k \leq 100$ mA, $P_i \leq 750$ mW 30 V DC Negligible Negligible 3150 V DC, 2 s See Alarm module	6DR4004-6K II 3 G EEx nA L [L] IIC T6 Connection to intrinsically safe power circuits: $U_o \leq 30$ V $I_k \leq 100$ mA, $P_i \leq 750$ mW 30 V DC – – 3150 V DC, 2 s See Alarm module
The 3 outputs are electrically isolated from the basic device			
I_y module DC output for position feedback Nominal signal range i Total operating range Power supply U_H External load R_B [kW] Transmission error Temperature effect Resolution Residual ripple Internal capacitance C_i Internal inductance L_i For connection to power circuits with Electrical isolation Test voltage	6DR4004-8J (without Ex protection) 2-wire connection 4 ... 20 mA, short-circuit-proof 3.6 ... 20.5 mA +12 ... +35 V $\leq (U_H [V] - 12 V) / i$ [mA] $\leq 0.3\%$ $\leq 0.1\%/10$ K ($\leq 0.1\%/18$ °F) $\leq 0.1\%$ $\leq 1\%$ – – Electrically isolated from the basic device 840 V DC, 1 s	6DR4004-6J (with Ex protection) 2-wire connection 4 ... 20 mA, short-circuit-proof 3.6 ... 20.5 mA +12 ... +30 V $\leq (U_H [V] - 12 V) / i$ [mA] $\leq 0.3\%$ $\leq 0.1\%/10$ K ($\leq 0.1\%/18$ °F) $\leq 0.1\%$ $\leq 1\%$ ≤ 11 nF Negligible Intrinsically safe: $U_i \leq 30$ V DC $I_i \leq 100$ mA; $P_i \leq 1$ W (only T4) Electrically isolated from the basic device 840 V DC, 1 s	6DR4004-6J (with Ex protection) 2-wire connection 4 ... 20 mA, short-circuit-proof 3.6 ... 20.5 mA +12 ... +30 V $\leq (U_H [V] - 12 V) / i$ [mA] $\leq 0.3\%$ $\leq 0.1\%/10$ K ($\leq 0.1\%/18$ °F) $\leq 0.1\%$ $\leq 1\%$ – $U_i \leq 30$ V DC $I_i \leq 100$ mA; $P_i \leq 1$ W (only T4) Electrically isolated from the basic device 840 V DC, 1 s
NCS sensor (not for EEx d version) Position range • Linear actuator • Part-turn actuator Linearity (after correction by SIPART PS2) • Linear actuator • Part-turn actuator Hysteresis Continuous working temperature Degree of protection of casing	 3 ... 130 mm (0.12 ... 5.12 inch), to 200 mm (7.87 inch) on request 30° ... 100° $\pm 1\%$ $\pm 1\%$ $\pm 0.2\%$ -40 ... +85 °C (-40 ... +185 °F), extended temperature range on request IP68/NEMA 4X	 3 ... 130 mm (0.12 ... 5.12 inch), to 200 mm (7.87 inch) on request 30° ... 100° $\pm 1\%$ $\pm 1\%$ $\pm 0.2\%$ -40 ... +85 °C (-40 ... +185 °F), extended temperature range on request IP68/NEMA 4X	 3 ... 130 mm (0.12 ... 5.12 inch), to 200 mm (7.87 inch) on request 30° ... 100° $\pm 1\%$ $\pm 1\%$ $\pm 0.2\%$ -40 ... +85 °C (-40 ... +185 °F), extended temperature range on request IP68/NEMA 4X

Scope of Delivery

8

The positioner and its options modules are delivered as separate units and in different versions. positioners and options modules for operation in hazardous areas and non-hazardous areas are available. These versions are identified respectively by a special rating plate.



WARNING

In the combination of components it must be ensured that only positioners and options modules are combined which are approved for the respective area of application. This applies especially for safe operation of the positioner in areas in which the atmosphere is potentially explosive (zone 1 and 2). The instrument categories (2 and 3) of the instrument itself and those of its options must be observed.

8.1 Ordering Data

Selection and ordering data	Order No.	Selection and ordering data	Order No.
Electropneumatic positioner SIPART PS2, PS2 PA and PS2 FF	6 DR 5 - 0 - A	Electropneumatic positioner SIPART PS2, PS2 PA and PS2 FF	6 DR 5 - 0 - A
Version		Customer-specific design	
2-wire		Without	0
• Without HART (4 to 20 mA)	0	Brief instructions	
• With HART, not explosion-protected (except EEx d)	1	German/English	A
2-, 3-, 4-wire		French/Spanish/Italian	B
• With HART, explosion-protected	2	Mounted pressure gauge block	
• Without HART, not explosion-protected	3	Without	0
PROFIBUS PA connection	5	Single-action G $\frac{1}{4}$	1
FOUNDATION Fieldbus connection (not EEx n)	6	Double-action G $\frac{1}{4}$	2
		Single-action $\frac{1}{4}$ -18 NPT	3
		Double-action $\frac{1}{4}$ -18 NPT	4
For actuator		Further designs	
Single-action	1	Add "-Z" to Order No. and specify Order Code.	
Double-action	2	Version with stainless steel sound absorbers	A40
Casing		not for EEx d version; standard with stainless steel enclosures	
Plastic	0	Customized preset bus address (max. 126) and/or software tag No.	Y25
Aluminum; only single-action	1	for PROFIBUS PA and FOUNDATION Fieldbus version, for plastic enclosures, for metal enclosures on request.	
Stainless steel; not for EEx d version; not FM/CSA and not EEx n	2		
Aluminum; EEx d housing (flameproof) ¹⁾ , not CSA	5		
Explosion protection			
Without			
With explosion protection EEx ia/ib or EEx d (CENELEC/FM/CSA)			
With explosion protection EEx n (CENELEC)			
Connection thread electrical/pneumatic			
M20 x 1.5 / G $\frac{1}{4}$			
$\frac{1}{2}$ -14 NPT / $\frac{1}{4}$ -18 NPT			
M20 x 1.5 / $\frac{1}{4}$ -18 NPT			
$\frac{1}{2}$ -14 NPT / G $\frac{1}{4}$			
M25 x 1.5 / G $\frac{1}{4}$ (only EEx d version) ¹⁾			
With PROFIBUS plug M12 / G $\frac{1}{4}$ ²⁾			
With PROFIBUS plug M12 / $\frac{1}{4}$ -18 NPT ²⁾			
M20 x 1.5 / VDI/VDE 3847			
Limit monitor			
Installed, incl. 2nd cable gland ³⁾			
Without			
Alarm module; electronic (6DR4004-.A)	0		
SIA module; slot-type initiators (6DR4004-.G); not for EEx d version)	1		
Limit value contact module (mechanical switching contacts (6DR4004-.K); not for EEx d version)	2		
	3		
Optional modules			
Installed, incl. 2nd cable gland ³⁾			
Without			
ly module for position feedback signal (4 ... 20 mA) (6DR4004-.J)	0		
EMC filter module for external position sensor (C73451-A430-D23), (not for EEx d version)	1		
ly module and EMC filter module for external position sensor, not for EEx d version	2		
	3		

▶ Available ex stock

1) EEx d version without cable gland.

2) Not for EEx d, FM/CSA approval, EEx ia/ib (CENELEC) on request

8.2 Scope of delivery of options

Option	Bestellnummer
I _y module without explosion protection	6DR4004-8J
I _y module with explosion protection PTB ¹⁾ I _y module with explosion protection FM ²⁾	6DR4004-6J 6DR4004-7J
Alarm module without explosion protection	6DR4004-8A
Alarm module with explosion protection PTB ¹⁾ Alarm module with explosion protection FM ²⁾	6DR4004-6A 6DR4004-7A
SIA module without explosion protection	6DR4004-8G
SIA module with explosion protection CENELEC and FM ¹⁾²⁾	6DR4004-6G
Mechanical limit switch module without explosion protection	6DR4004-8K
Mechanical limit switch module with explosion protection CENELEC and FM ¹⁾²⁾³⁾	6DR4004-6K

1) EC-type examination certificates

2) Approval Reports of Factory Mutual System

3) In preparation

8.3 Scope of delivery of accessories

Accessories	Order number
Mounting kit set linear actuators IEC 534 – 6 including lever arm for 3 to 35 mm way	6DR4004-8V
Additional lever for > 35 to 130 mm way	6DR4004-8L
Mounting kit rotary actuators VDI/VDE 3845	6DR4004-8D
Solenoid valve block for SAMSON actuator (integrated mounting)	6DR4004-1C
Manometer block single-acting	6DR4004-1M
Manometer block double-acting	6DR4004-2M
Solenoid valve block single-acting (NAMUR)	6DR4004-1B
Mounting set for SAMSON actuator (integrated mounting)	6DR4004-8S
NCS-Sensor non-explosion-proof explosion-proof cable length 6 m for rotary actuator for linear actuator up to 14 mm	6DR4004- _ N _ _ 0 6DR4004-8N 6DR4004-6N 6DR4004- _ NN 6DR4004- _ N _ 10 6DR4004- _ N _ 20
EMC filter module	C73451-A430-D23
External position detection system	C73451-A430-D78

8.4 List of Spare Parts

Spare parts list: SIPART PS2 positioner			
	Description	Order No.	for version
	Cover (plastic enclosure) with screws (4 pcs) and seal	C73451-A430-D82	6DR4 ___ 6DR5 ___
	Cover (metal enclosure) with screws (4 pcs) and seal	C73451-A430-D83	6DR4 ___ 6DR5 ___
	Motherboard, two-wire without HART, without explosion protection	A5E00082459	6DR50 __ - _ N 6DR40 __ - _ N *)
	Motherboard, two-wire without HART, with explosion protection	A5E00082457	6DR50 __ - _ E
	Motherboard, two-wire HART, without explosion protection	A5E00082458	6DR51 __ - _ N 6DR40 __ - _ N *)
	Motherboard, two-,three-,four-wire HART, with explosion protection	A5E00082456	6DR52 __
	Motherboard Two-,three-,four-wire without HART, without expl. protect.	A5E00102018	6DR53 __ - _ N 6DR40 __ - _ N *)
	Motherboard PROFIBUS PA, without explosion protection	A5E00141523	6DR55 __ - _ N. 6DR41 __ - _ N
	Motherboard PROFIBUS PA, with explosion protection	A5E00141550	6DR55 __ - _ E 6DR41 __ - _ E
	Motherboard FIELDBUS Foundation, without explosion proof	A5E00215467	6DR56 __
	Motherboard FIELDBUS Foundation, with explosion protection	A5E00215466	6DR56 __
	Pneumatic block (Valve single acting incl. seals and screws)	C73451-A430-D80	6DR4 ___ 6DR5 ___
	Pneumatic block (Valve double acting incl. seals and screws)	C73451-A430-D81	6DR4 ___ 6DR5 ___
	Potentiometer (complete)	C73451-A430-D84	6DR4 ___ 6DR5 ___

*) 6DR40.. can be used after having clarified whether application with two-wire or three-wire/four-wire input

Note: For accessories and option modules see Catalog FI 01 "Field Instruments for Process Automation"

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10.1 Literature and catalogs

No.	Title	Issued by	Order number
[1]	Field Instruments for Process Automation Catalog FI01	Siemens AG	E86060-D4001-A110-B9-7600
[FF-890 FS 1.5]	Function Block Application Process Part 1, Revision FS 1.5	Fieldbus Foundation	
[FF-891 FS 1.5]	Function Block Application Process Part 2, Revision FS 1.5	Fieldbus Foundation	
[FF-903 PS 3.0]	Transducer Block Application Process Part 2, Revision PS 3.0	Fieldbus Foundation	

10.2 Certificates

The certificates are enclosed as a collection of loose leaves in the operating instructions or on CD.